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Oral papers

1 INFERRING CHANGES IN LAND USE IN GREAT BRITAIN FROM THE COUNTRYSIDE SURVEY DATASETS.

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Land use is an event that has both temporal and spatial qualities. It is relatively straightforward to record the spatial aspects, i.e. the land cover, but the temporal part is much more demanding. Collecting information on use and changes in land use is time consuming and often requires one-to-one interviews with farmers and land managers. Response rates may be disappointing and resultant information can be variable in quality. Alternative means of gathering such information are worth exploring.

Fortunately, there is a close relationship between land cover and land use. The primary purpose of the Countryside Surveys of 1978, 1984, 1990 and 1998 has been to make estimates of the national and regional stock of land cover, landscape features, vegetation, soils and freshwater biota, and changes in these over time. However, as part of the data collection, information is recorded which allows inferences to be made about the use to which different recorded land parcels are being put at the time of survey. Some land use data are recorded routinely as part of the survey protocol (eg livestock type, woodland use, building type), other data give good evidence for certain land uses to be in operation (eg certain habitats present, dominant tree species, presence of grouse butts) and some data infer something about the quality of land usage (eg gappiness of hedges, dominance of certain grass species, age of tree species). The potential of the CS database to quantify land use, as a driver of change, has not been fully explored until now.

This paper describes a re-examination of the land in the 569 1 km CS sample squares throughout Great Britain to produce estimates of the area of land under different land uses, with additional information on the sub-types of land use and the quality or intensity of land management. Change in these metrics is computed over time and results are compared generally with independent sources of land use information (such as the MAFF June Returns, the Farm Business Survey and other, targeted surveys). It is concluded that the Countryside Surveys are able to detect change in some land uses but others are difficult to validate using external data due to differences in definitions, methodology and timing of surveys.

2 APPLICATION OF INTERNET TECHNOLOGIES TO ENVIRONMENTAL MONITORING AND EDUCATION AT THE LOCAL LEVEL IN IWATE PREFECTURE, JAPAN

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IEN, launched in September 1998, explores the local dimensions of environmental sustainability through the application of new information and communication technologies (ICTs). It is a collaborative project based on a partnership between UNU/IAS, Iwate Prefectural Government and Nippon Telegraph and Telephone Corporation (NTT). IEN combines six basic elements – environmental monitoring, information system development, environmental education, research, capacity building and institutional networking. An information system has been developed which includes real-time sensors placed in the environment to monitor air (NO2, CO2 and SPM) and water quality (ten different indicators), linked to databases located at two NTT research facilities in Japan, seamlessly connected via the Internet.

As part of this project, a number of activities have been implemented to promote local innovation in monitoring environmental change and in support of environmental education. Key achievements include the use of the Internet to support compulsory education with the online monitoring of Acid Rain levels.

Local teachers have been closely involved in the development of new teaching for environmental education using the Internet. For instance, they developed a sub-project that involved 200 schools in the monitoring of the Cherry Blossom across the prefecture. In addition, one teacher went diving on the local coastline and gave a real-time/interactive lesson to children in 5 local schools. Another gave a real-time environmental lesson using multipoint videoconferencing which linked three schools with experts from local environmental installations. These and other aspects of the project will be examined in the paper which will focus on the social implications of the Internet as a tool for environmental monitoring, information dissemination and public participation

In order to better appreciate local environmental attitudes of young children and their views of the role of various information media, a survey was undertaken of the environmental attitudes of 1,000 high school students with the results disseminated online. Moreover, in June/August 2000, students from three local schools were given the opportunity to remotely observe via the Internet the nesting of the Black-tailed Gull in a national conservation area. More recently, in September 2000, with cooperation from Iwate Prefectural University, preparatory work began on the development of demonstration modules for a web-based Virtual University on the theme of the environmental change.

This environmental monitoring project has significant social implications for the locality and elsewhere. It has been extensively reported in the local press and on national television. In line with the goals of Agenda 21, the project seeks to strengthen local capacities and environmental decision-making while at the same time providing local stakeholders with access to relevant, reliable, and useful environmental information in a cost-effective manner. The project uses ICTs to build new links between local institutions and the wider community, as well as to promote environmental education and awareness. Through this action-oriented project, the United Nations University is developing a model for "networked digital environmental governance" that can be replicated in other parts of the world.

A project website is available at: http://www.ias.unu.edu/ecology

3 DECADAL-SCALE CHANGE IN LAKE ECOSYSTEMS

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Lake ecosystems have been increasingly disturbed and polluted by human activity over the last two centuries. Consequently, the importance of conserving aquatic ecosystems by managing water resources in a sustainable way is widely recognised.
In developing a strategy for the sustainable use of lakes it is crucial that we understand how lakes vary through time on different time-scales, past, present and future. Such understanding requires a combination of methods using data from monitoring programmes, from palaeoecological reconstruction and from dynamic modelling.
In this presentation we illustrate our approach using data from the UK acid waters monitoring network. In particular we demonstrate the role of the monitoring programme not only for its own sake but also as the basis for verifying output from models used both for reconstructing (transfer functions) and predicting ecological change.

4 REVIEW OF BACKGROUND WATER QUALITY IN LATVIA FROM THE ICP-WATERS OBSERVATION RESULTS, 1946-1998

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The International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes (ICP-Water) is one among the five ICPs established within the Convention on Long-Range Transboundary Air Pollution that cover freshwaters, forests, crops, materials and integrated monitoring.

The present review provides the systemised and generalised observation results obtained from the national background water quality network involved in the International ICP-Waters Programme aimed at:
determining of pollutants in different compartments of the environment;
detecting of the impact of pollutants on ecosystems and their components;
predicting of the changes in the environment taking into consideration quality of pollutants transmitted and climate change dynamics.
During the last ten years, international emission reduction measures in Europe have resulted in a decrease in atmospheric sulphur deposition of up to 50%. Nitrogen deposition has remained nearly constant. To relate these developments to the changes in the surface water chemistry and biology, the ICP-Waters database was used in the assessments of trends in surface waters.
The present material, including assessment of background water quality, is also intended for assessing the anthropogenic impact on water bodies located in different geographical regions of Latvia.
The background water quality network of Latvia covers water bodies the least exposed to the anthropogenic impact that are located in the 3 major regions, Kurzeme, Zemgale and Vidzeme. There are 5 ICP-Waters sites in Latvia: 3 rivers (Tulija, L.Jugla and Barta), 1 bog stream (Zvirbuli) and 1 lake (Burtnieku).

The following principles are basic to the characterisation of water quality:
the comparison of the statistical data obtained for the variables (nutrients, pH, oxygen, salt composition, heavy metals, hydrobiology) measured within four 10-year periods: i) 1946-1968, a longer period because of few observation data; ii) 1969-1978; iii) 1979-1988; iv) 1989-1998;
establishing of interseasonal variability and the correlation with the hydrological characteristics and chemistry of the precipitation.
the comparison of the statistical data with the water quality standards in action (Table 4), with more "tough" standards being used for salmonid waters.
establishing of long-term dynamics in pollutant discharge and a comparison analysis of the dicharge with water courses under strong anthropogenic impact.
Analysis of long-term hydrochemical, hydrobiological and hydrological measurement results show that the ICP-Waters rivers are water objects of good quality, yet Ptot shows concentrations non-compliant with the good water quality requirements in action in Latvia.
Water quality dynamics bears evidences of:
decreasing pH and oxygen concentration in the stream Zvirbuli;
decreasing sulphate concentration since the late 1980-ies;
increased sulphate and nitrate concentrations in the 1950-ies until the late 1980- ies when the downward tendency was evident;
decreased phosphate concentrations since the end of the1970-ies;
Pollutant run-off calculations show generally higher pollution load (t/km2) on the ICP-Waters sites than on ICP-IM sites, yet it is lower than in the principal rivers of the basins.
Nitrate and phosphate concentration measurements available for the period 1946-1958 (minimum for the whole period under observation) may be used as the background concentrations in the assessments of the share of the anthropogenic impact on small catchments.

5 DETECTING ENVIRONMENTAL CHANGE: BENEFITS AND IMPLICATIONS FOR SOCIETY – POLITICAL PERSPECTIVES

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6 CAN PUBLIC POLICY KEEP UP WITH SCIENTIFIC PROGRESS? THE CASE OF ACIDIFICATION POLICY IN NORTHERN SWEDEN?

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The multi-investigator project “Episodic Acidification in Northern Sweden” has sought to better understand, separate and quantify natural and anthropogenic driving mechanisms of episodic pH decline in Northern Sweden. This is a region with relatively low anthropogenic acid deposition rate the last decade (2-4 kg SO42--S ha-1yr-1)1 specify when?? after 1995??) but where streams commonly have low pH values (< pH 5.0) during runoff periods, especially spring flood.
The project was initiated in 1996 since there has been a considerable concern that government subsidized liming in the region during to keep the pH of spring flood above 6 in the region had no method for assessing the natural pH decline during spring flood in TOC rich waters. is not appropriate due to the TOC-rich waters where natural acidity is, at least partly, responsible for the low pH and buffering capacity.
Within the framework of this project over 25 episodes have been sampled for stream water chemistry during spring flood runoff. Of these episodes close monitoring of fish physiological stress and mortality have been carried out in eight of these sites. The most important factors driving the pH decline were DTOC increase in combination with ANC dilution. The results suggest that the current geographic extent of major anthropogenic impacts on episodic acidification in Northern Sweden is limited. The physiological response in brown trout (Salmo trutta) exposed to low pH and high inorganic aluminium in these TOC-rich streams was found to be lower than previously observed in fish from low TOC streams. Brown trout (Salmo trutta???) were also found to manage more exposure to low pH and high inorganic Al in these TOC-rich streams than has been found for fish in low-TOC streams.However, even a marginal anthropogenic contribution of acidity superimposed on the natural pH dynamic was shown to cause acute toxicity in brown trout.toxic levels of acidity. in very acid sensitive streams.

Keywords: Episodic acidification, natural acidity, anthropogenic acidification, Dissolved organic carbon (DOC), Brown trout, acute toxicity, Northern Sweden

7 MONITORING OF ECOSYSTEM FUNCTION ALONG GEOGRAPHICALLY DEFINED TRANSECTS: LONGITUDINAL AND MERIDIONAL TRANSECTS IN NORTH-CENTRAL EUROPE

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Ecosystem response to climate change was evaluated by measuring pine litter production and decomposition on two transects in Europe: on 1500 km W-E transect along 52oN parallel and 1000 km N-S, meridional transect (25oE, 50oN).
The applied monitoring system makes the following theoretical assumptions:
- first, where the distribution of sites was concerned, it was assumed that their placement along the climatic transect “simulates” the treating of the studied ecosystem type by different climates. For, if the research concerns a group of very similar ecosystems distributed along a well-defined climatic gradient, it is as if one ecosystem was moved through the different climates occurring on the transect (or as if the climate in which the studied ecosystem functions has changed). Such assumptions bring us close to an answer to questions regarding the way in which these ecosystems react to climate change. In this way we avoid “two obvious and fundamental weaknesses” of ecosystems studies discussed by Parry (1995): “Firstly we have inaccurate information on their present-day sensitivity to climatic variability... and secondly most impact models treat the predicted climatic anomalies as sudden changes in the climate rather than as a gradual change in the mean over perhaps s everal decades”,
- second, when it came to the two ecosystem processes identified for measurement, i.e. litter fall and its decomposition, it was assumed that those provide and acceptable index of the overall balance of organic matter being produced and mineralised at the time in the ecosystem. The fall of dying parts of plants to the forest floor is a measure of ABVG production, in particular the production of green parts, and the subject literature shows that organic fall is – in our climatic zone – proportional to total organic matter production in a forest ecosystem (O’Neil & DeAngelis 1981). The rate of decomposition of litter, i.e. the process by which organic residues break down to replenish the pool of biogenic compounds in the soil, may be regarded as a measure of the rate at which matter cycles in the ecosystem.
The results of first years monitoring on two transects show distinct response of pine ecosystems to change of temperature means (N-S transect) and change of continentality (W-E transect). The rate of

change differs for two ecosystem processes; the indexes of change per temperature unit and geographical distance are calculated.

8 PUBLIC UNDERSTANDING OF ENVIRONMENTAL CHANGE

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One key feature of environmental research over the last decade has been an increasingly productive dialogue between social and natural scientists about questions of knowledge and uncertainty, risk and responsibility. Environmental scientists, working from an 'environment first' perspective have been able to produce more systematic and reliable evidence of the impact of human activities on biophysical systems from local to global scales. With more certain science feeding down through policy communities and public fora, it is widely believed that it will be possible to influence and redirect the economic, social and cultural drivers of environmental change. The basis for this belief is an assumption that objective information, disseminated effectively, will lead to action by institutions and individuals. However, there is mounting evidence to suggest that the 'top-down' communicative model is not working, despite the plethora of information and the many different media through which it is accessible.

Evidence from environmental social science allows analysis of this problem. First, there is a history of longitudinal studies monitoring public opinion about environmental issues. Whereas environmental monitoring is progressive and deepens understandings of system characteristics, 'opinion monitoring' reveals a cyclical process in which expressed public concerns about specific environmental 'problems' rise and fall in line with intensity of media coverage. Furthermore, whilst individuals will express strong intentions to change aspects of their behaviour 'for the sake of the environment', few will actually do so. As President Bush's recent announcement on US withdrawal from Kyoto, and the new energy-friendly policies being put in place indicate, the commitments of governments can fall as well as rise. Second, research which draws on intensive work with small samples of ordinary people reveals that the word 'environment' does not have a common or agreed meaning. Meanings vary widely between individuals, across different social groups and through time. 'Environment' is a synthetic 'macro-category' in cultural terms, and this raises significant problems for communication strategies which take their warrant from environmental science. The critical issue becomes one of working with the grain of lay knowledges and understandings, in highly specific geographical contexts. Finally, there is considerable anxiety within scientific and policy making networks about growing public mistrust and scepticism in the legitimacy of science. The development of new and innovative forms of environmental decision-making represents a serious commitment to bring local people into dialogue with experts to share their knowledges and engage in joint action to progress the development of environmental science and management.

9 SO FROM THAT SPRING … DISCOMFORT SWELLS: MONITORING CHANGE IN HYDROLOGICAL SYSTEMS

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Water resource management can be considered effective when it allows an adequate supply of water that is sustainable over many years, maintains water quality at levels that meet legal requirements and other societal objectives, and allows sustainable economic development over the short and longer term. Yet all too often we make major management decisions with scarcely any adequate indication of the changing state of the environment or of its response to our collective impact. Monitoring is the process by which we keep the behaviour of the environment in view; it provides essential information on how systems are changing and how fast, and allows us to adjust what we are doing to get the best out of the system.

A river basin (or catchment) is a complex dynamical system, composed of a number of state variables related to one another by a series of transfer functions, and subjected to inputs to produce outputs. Changes in inputs produce changes in output, with differences between input and output governing the rate of change of the state variables. In the short term, time invariant constants, or parameters, govern the behaviour of the system but in the long term, even these too may be time variant, introducing

further complexity. Human impact, direct or indirect, can affect catchment systems in a whole variety of ways and over many timescales.
This paper will investigate the changing condition of catchment systems over time, with coverage of both quantity and quality issues. As well as considering changes in internal state variables, outputs from the system will be also be examined; UNEP and others have argued recently for an integrated approach to the hydrological environment emphasising links between river and coastal systems. The detailed content of the paper will reflect the author's own experience in researching sediment and nutrient transport in a variety of river basins. The emphasis will be on detecting long-term variation in catchment behaviour in response to changing climate and land use. Some reference will be made to river restoration schemes in order to counterbalance the inevitable discussion of environmental degradation. Particular reference will be made to the work of the UK's Environmental Change Network with which the author is closely associated.

10 MARINE ECOSYSTEM RESPONSE TO ARCTIC CLIMATE CHANGE: TRACING OCEAN-ATMOSPHERE REGIME SHIFT SIGNALS TO BENTHIC COMMUNITIES

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Past empirical evidence and current models indicate that climate regime shifts occur in the Arctic at 5- to 7- year intervals. These large-scale phenomena are accompanied by variations in physical characteristics such as sea ice extent and formation/melting rates, water temperatures, and river-runoff -- processes that can strongly affect Arctic marginal seas and the ecological dynamics of organisms. Little is known about the specific bio-physical links that relate atmospheric forcing to marine ecosystems or the inter-regional pattern of ecosystem responses. Using a comparative approach with historical data from the Bering and Barents Seas, we examine the spatial and temporal patterns of benthic community structure in relation to past decadal-scale climatic variability. We link variations in benthic communities to specific Arctic climatic phenomena via physical variables directly influencing the ecological processes of the benthos. Comparing community responses in two important marginal seas on opposite sides of the Arctic basin (Bering/Chukchi and Barents Seas) allows inferences as to the possible trajectories of ecosystem shifts in response to climate change and whether benthic ecosystem responses associated are general (i.e. large-scale, circumpolar Arctic) or region-specific.

11 URBAN AND REGIONAL SUSTAINABILITY: ANALYSIS OF LAND USE CHANGE INDICATORS

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European urban areas are rich in culture and history, with magnificent centres characterised by ancient buildings and monuments, and are the expression of the European societies and of their diversity. However, from an environmental point of view, they are not different from any other urban area in the world. Their development is threatening the ecological equilibrium of whole regions, and is in some way affecting the global environment. In particular, the density of urban settlements in Europe further exacerbates typical problems: as cities expand, they tend to merge with neighbouring towns, forming

continuous urban agglomerations. The resulting problems are closely connected to economic and cultural factors, so that the environmental effects can be assessed only with interdisciplinary integrated approaches.
Fast land use dynamics need to be monitored in order to enable city managers to establish local programmes, and regional and national decision-makers to shape sectoral policies for sustainable development. Supranational bodies, like the European Commission, have the role to drive towards a common strategy the efforts carried out at different levels in the various countries.
The European Commission is carrying out an analysis of selected European cities, measuring the changes in the land use that have occurred during the past forty-fifty years. Earth Observation tools, like satellite imagery, and Geographic Information Systems (GIS) are at the basis of this methodology that, among others products, generates standard territorial indicators for assessing past and present situations.
We present the results of a comparative analysis carried out, so far, for 25 European urban areas. We quantify the changes in the artificial land use, but also the depletion of natural and agricultural areas. We try to establish links between the diverse evolution of the transport network and the position of commercial areas in different cities, etc.
These data are indeed a valuable source of information for local planners and decision-makers. However, the real innovation in this approach is the multi-temporal dimension and the possibility to develop standard indicators for different areas within Europe. The European Environment Agency and the European Commission's DG Environment are already making use of this approach for formulating working strategies.

Keywords: Europe; land use; remote sensing; urban dynamics; indicators; urban sustainability; spatial approach; sustainable urban development.

12 THE IMPACTS OF HUMAN ACTIVITIES ON ATMOSPHERIC COMPOSITION

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The impact of human activities on atmospheric composition during the 20th century has been unprecedented during the recent historical record. Understanding has grown rapidly concerning the trace gas composition of the atmosphere and the impact of human activities upon it. The concentrations of all the major greenhouse gases peaked during the 1990s. Regional scale deposition of the acidfying and eutrophying agents has begun to decline in some areas but they are still set to increase in some others in the future. Tropospheric ozone will continue to pose a threat in the future because of increasing global background levels upon which regional scale pollution episodes are superimposed.

We have only recently begun to quantify the magnitudes of these human-induced forcings. We have yet to complete the task of identifying the responses of the physical environment to these forcings. The changes in our physical environment will in turn induce biological responses from ecosystems with attendant changes in the exchange of trace gases between the ecosystems and the atmosphere. It is too early to say yet whether the trace gas responses induced will exert an amplifying or a dampening effect on the human-induced forcings.

13 LONG-TERM ECOLOGICAL AND HYDROLOGICAL RESEARCH INTO TROPICAL RAIN FOREST ENVIRONMENTAL CHANGE IN SOUTHEAST ASIA

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Long-term ecological studies focus around the relatively straightforward notion that certain processes, such as succession, the natural frequency distributions of climate regimes, or disturbances exemplified by treefalls and fires, are long-term processes and must be studied as such (Risser, 1991).
Although the need for long-term studies is well documented, few institutionalised, comprehensive long-term investigations exist in the humid tropics. Apart from some detailed ecological work at tropical field stations and research centres, such as La Selva, Panama and Los Banos, Philippines, and

the excellent catchment studies in Puerto Rico operated by the US Geological Survey as part of the long-term ecological research in the United States (Larsen and Torres-Sánchez, 1998), relatively little long term monitoring has been undertaken, particularly in areas of marked disturbance by human activity.

Studies of hydrology and earth surface processes in undisturbed forests have seldom been maintained for long enough to understand the effects of extremes of exceptional rainfall or drought. have provided many insights into the role of extreme events, especially hurricanes, in producing landsliding and high sediment yields. Forest disturbance and recovery require long-term monitoring, alongside undisturbed control areas, to understand the way in which systems respond and opportunities for modification of the hydrological cycle and carbon budget emerge. 15 years of hydrological investigations at Danum Valley, Sabah, Malaysian Borneo have demonstrated the persistence of the influence of disturbance by selective logging, despite forest recovery.

Extreme events dominate the water flows and sediment transport by rivers, triggering landslides and initiating channel changes. In disturbed areas, landsliding and erosion during extreme events is much more pronounced than in natural forests, delaying forest recovery in small unstable areas.

However, runoff regimes remain modified, with the deposition from extreme events contributing to channel changes that affect downstream flood frequencies. El Nino years see flows in natural forest streams severely reduced and inevitably affect forest regeneration. Their impact on low flows from disturbed areas differs little from that in natural areas, but the reduction in forest cover gives local communities the impression that their environment has become drier. Rainfall statistics do not bear this out.

Long term hydrological research relating the impacts of land use change to variations in natural processes in undisturbed areas helps to unravel the different impacts of local socio-economic and global atmospheric drivers of environmental change.

14 REGIONAL MONITORING OF LONG-TERM CHANGE IN RANGELANDS: AN EXAMPLE FROM EASTERN AUSTRALIA

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A statewide Rangelands Assessment Program (RAP) commenced in New South Wales, Australia in 1990 in order to assess the health and trend of semi-arid and arid rangelands. More than 350 fixed sites were established on grazing properties in seven main vegetation communities, and measurements made of plant composition, landscape health, erosion and management activities on an annually.

Multi-variate analyses of the Hard Red range type sites using non-metric multi-dimensional scaling (NMDS) and principle coordinate analyses (PCOORD) were undertaken to determine the degree to which sites changed between 1990 and 1997 in relation to their complement of plant species. Ordination of site-times indicated major changes in sites between 1990-1993 and 1994-1998, which was attributed to a change in the seasonality of rainfall.

The degree of movement of sites over time using NMDS and PCOORD was generally poorly correlated with physical and biotic data (bare soil, plant and shrub cover, plant biomass, distance to water, stocking rate etc). Rangeland change, as measured by the degree to which sites moved over time, was poorly correlated with crude assessments of rangeland condition made by field officers, but assessments by experienced officers resulted in better correlations. Analysis of these data highlight the difficulty of separating management-induced changes from environmental change and the problems of managing large multi-temporal, multi-spatial datasets.

15 EVIDENCE FOR WIDESPREAD INCREASES IN THE DISSOLVED ORGANIC CARBON CONCENTRATIONS OF UK UPLAND WATERS

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The United Kingdom Acid Waters Monitoring Network (AWMN) was set up in 1988 to provide regular and consistent chemical and biological monitoring of 24 lakes and streams in acid-sensitive

regions of Scotland, England, Wales and Northern Ireland. Between 1988 and 2000, recovery from acidification has been observed only at a minority of sites within the AWMN.
However, concentrations of dissolved organic carbon (DOC) appear to have increased strongly at sites throughout the UK over the same period; an analysis of trends using the Seasonal Kendall Test indicates that DOC has risen significantly ($p < 0.05$) at 20 out of 22 monitored sites. Estimated annual increases range from 6 to 61 mmol/l/yr, and at some sites annual mean DOC concentrations have more than doubled since 1988. These rising trends have occurred across a wide range of deposition, soils, topography, land-use and geographical location, suggesting that DOC increases in upland waters over the last twelve years may have been a UK-wide phenomenon. Longer-term data further suggest that DOC has been rising since at least the early 1980s.
Whilst the processes driving increases in DOC remain unclear, a number of potential mechanisms, linked both to reductions in acid deposition and to climatic changes, are considered, and their likely applicability assessed. The potential environmental impacts, both beneficial and detrimental, of rising DOC are discussed, including the role of organic acids in delaying recovery from acidification; effects of DOC on the toxicity of acid waters; and the impact of an associated rise in water colour on light penetration in surface waters. The significance of increased water colour for drinking water supply is also considered.

16 RECOVERY FROM ACIDIFICATION OF FINNISH LAKES: REGIONAL PATTERNS AND RELATIONS TO EMISSION REDUCTION POLICY

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Due to the implementation of successful emission reduction measures, emissions of SO2, NOx and NH3 in Europe have declined by 39%, 16%, and 18 % respectively, between years 1988 and 1996. High costs are associated with the implementation of European air pollution reduction policy (some 45 billion Euro/year in the EU-countries), and it is therefore essential that scientific evidence is available for assessing the ecosystem benefits of these large investments. The large emission reductions have resulted in decline in the deposition of acidifying compounds and consequent recovery also of acidified Finnish lakes. Acid sensitive headwater lakes (n=163) throughout Finland have been monitored during autumn overturn between 1987-98. Statistically significant decline in sulphate concentrations is detected in 60 to 80% of the lakes, depending on the region. Median slope estimates are from -1.1 µeq L-1 yr-1 in northern Finland to -3.3 µeq L-1 yr-1 in southern parts. Gran alkalinity slope medians range from 1.4 to1.8 µeq L-1 yr-1. In order to further increase the policy relevance of these results we extend the evaluation of this data set in two ways:
1) By comparing slope estimates of S and N compounds and base cations in the lake waters to those in deposition, using data from selected sites of a national deposition monitoring network. In addition, the potential for future decreases in S and N deposition at the lakes by the year 2010 is estimated using a deposition model, assuming emission reductions in Europe according to the new 1999 Gothenburg emission reduction protocol of the UN/ECE Convention on Long-Range Transboundary Air Pollution and the EU-directive on national emission ceilings;
2) By estimating the number of Finnish lakes for which the observed acidification recovery pattern can be assumed to be representative. These lake population estimates are derived by using data for both lake water chemistry and catchment characteristics of the subjectively chosen acidification monitoring lakes and a statistically based national lake survey of 873 lakes conducted in 1995. A set of statistical techniques, including cluster analyses-mixture models, is used.

17 AGRICULTURE OR URBAN? – PHOSPHORUS ENRICHMENT OF LOUGH NEAGH IN THE 20TH CENTURY: LINKING RIVER AND LAKE MONITORING TO THE PALAEOLIMNOLOGICAL RECORD

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Lough Neagh is large eutrophic lake in Northern Ireland. Grassland agriculture dominates the landscape, but there is also a large urban population living in the catchment. In the early 1970s, two major palaeological investigations on sediment cores from the lake, one on the diatom record (Batterbee) and the other on the chironomid record (Carter), demonstrated that the lake had been markedly less enriched in the 19th century.

The chronology of enrichment in the 20th century was not entirely consistent between the two studies as the chironomid accumulation record, suggested a much larger increase in lake productivity post-1950 than was evident from the increase in diatom accumulation which showed little change over this period. Batterbee explicitly linked the 20th century enrichment of the lake to increased urban phosphorus (P) inputs, reflecting the development of urban sewerage systems, urban population growth and the introduction of P based detergents.

Regular monitoring of the lake from 1974 to 1999 has documented an increase in lake P concentrations. Due to silica limitation, diatom production has not responded to increasing lake P and although, the relative proportions of the two dominant diatom species have fluctuated from year to year, the diatom population structure has been quite stable over the long term. Lake P has increased despite: 1) Controls on P discharges (post 1980) from major sewage treatment works (post 1980). 2) A 50% reduction (post 1985) in the per capita use of P in household detergents and 3) A reduction in point source farm pollution since 1987.

Regular river monitoring and the development of a methodology to quantify P loadings to the lake, have identified a steady increase in the diffuse soluble molybdate reactive P loading from, almost certainly, agricultural sources over the period of monitoring (1974 to 1999). In the light of this experience, this paper examines the contention that agriculture has been the primary source of P enrichment in Lough Neagh in the 20th century. The impacts on lake P from urban sources since 1900, estimated from census statistics, detergent usage and sewerage connectivity, are compared with the chironomid and diatom accumulation rates in the sediments. The agricultural P economy is examined in context of intensification in agriculture production and increases in animal numbers.

It is argued that although intensification, which was largely confined to period 1940 to 1980, contributed to higher P loads, an important underlying factor has been the increase in soil P that has occurred in the catchment. This increase is a direct result of a phosphorus surplus that has been a feature of agriculture throughout the 20th century. The surplus, in turn, reflects imports of P fertilisers and the increasing reliance on imported foodstuffs for intensive animal production.

18 GLOBAL INITIATIVES TO DETECT CHANGE

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Abstract. Development of overall strategies for observations of the Earth system has received considerable attention in recent years. Most attention has been paid to space-based observations but of comparable importance is the wide variety of *in situ* observations made at the surface of the Earth and in its atmosphere and oceans. The *in situ* data are essential for the success of global observations and these combined efforts are critical because they represent the fundamental ability to provide the data essential for sound policy formation and planning. Neither of the two basic approaches can accomplish what is needed by itself. The global observing systems represented by GTOS (Global Terrestrial Observing System), GOOS (Global Ocean Observing System and GCOS (Global Climate Observing System) are examples of these activities, but equally important are national and regional efforts to link their initiatives. The national and regional activities of the International Long Term Ecological Research Network (ILTER), and newly proposed TIMEforGTOS (Toward Integrated Monitoring in Europe for the Global Terrestrial Observing System) and a European Long Term Socio-Environmental Research Network (EU-LTSERNET) are further evidence of this need. A recent workshop under the US-EU Scientific and Technical Co-operation Agreement also stressed the need for a network of Observatories between the US and Europe. These activities are the basis of a rich set of lessons that can be used to characterize the successes and failures of these different activities and make recommendations for future efforts. The presentation will provide an overview of the values of the combination of space-based and *in situ* approaches, the need to scale observations across the approaches represented, identify challenges to the *in situ* observational system ranging from management and lack of standards to funding, and show how "demonstration" projects are key to improving the capabilities of the global observing systems.

19 DETECTING CLIMATE CHANGE

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20 INDUSTRIAL TRANSFORMATIONS AND SYSTEM INNOVATIONS

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The problem of human-induced climate change is probably the greatest environmental challenge to face humanity in the next 50 years. Whilst its causes are without doubt the fossil-fuel-using profligacy of the world's richer countries over the last 100 years (especially in North America and Western Europe), solutions have to be considered at a global level; though the scale and nature of these solutions will have to depend on the stage of industrialisation of the country in question. Whatever the Factor changes and rates of convergence that are necessary to achieve both sustainability and economic equity in the face of climate change, there is no doubt that the solutions lie in combinations of good housekeeping with regard to energy use and, of course, technological innovation. However, such technological solutions are not likely to be sufficient on their own and their transfer to developing countries has continued to prove difficult. They have to be combined with social innovations, in lifestyles and the ways humans fulfil their needs. These technological and social innovations can be considered together in the concept of Industrial Transformation. This paper outlines the rationale for a new international research plan as part of the International Human Dimensions Project's(IHDP) Industrial Transformation Programme - to provide the basis for an understanding of the types of technological and social change that is required.

Industrial Transformation research seeks to understand complex society-environment interactions, identify (potential) driving forces for change, and explore development trajectories that have a significantly smaller burden on the environment on a global scale. Changes in production and consumption systems, including the incentive structures and related institutional settings, are the central object of study. Industrial Transformation research is based on the assumption that important changes in production and consumption systems will be required in order to meet the needs and aspirations of a growing world population while using environmental resources in a sustainable manner.

From a social sciences perspective, the global environmental issues can be seen as problems directly related to society through the ways in which the human needs and preferences are met in the following four domains: energy, food, land and water. These domains could also be grouped as nutrition (food and water), habitation (energy, housing, working), health (human and eco-system) and communication and transport (people, resources and materials). Each of these domains draws on and impacts environmental systems and resources. So far, research has mainly looked at specific aspects of these four domains. The historic focus on production and production efficiency in the field of energy and food is an illustration. It is increasingly recognised that a better understanding of consumption processes and what drives production and consumption changes is equally important.

Systems in the framework of Industrial Transformation Research are defined as a chain of interrelated economic activities aimed at providing a specific need for society (e.g. energy and food). Such systems include: the actors (government, producers and consumers), the flow of goods and/or services they deal with (including the metabolism along the chain) and the overall physical and institutional setting in which they operate. System changes in the past have occurred as a result of scientific and technological developments that through their progressive adoption came to replace existing systems (for example, the steam engine and a later stage information technology). System changes have also occurred as a result of technical and institutional innovation inspired by societal problems (for example the green revolution driven by the concern about food shortages). Usually system changes are

driven by a combination of societal concerns and economic/technological opportunities. System change comes about when such concerns and opportunities are mutually reinforcing.
Overall it is concluded that systems change as compared to end-of-pipe measures is something that is about longer time scales in the order of 10 to 25 years as well as being about larger geographic scales. Transformation may well start at the local level triggered by local initiatives. To survive in the end as a new way of meeting primary needs and preferences it is likely to be accepted and adopted at larger geographical scales.
The paper illustrates the systems and innovations approach by examining the Food Consumption and Production System.

21 THE MONITORING OF BRITISH BREEDING BIRDS: A SUCCESS STORY FOR CONSERVATION SCIENCE?

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For almost four decades the British Trust for Ornithology has monitored populations of the commoner 35-50% of species of British breeding birds. The monitoring involves surveillance of numbers, breeding output and survival rates across the whole of the United Kingdom. A formal alert system allows serious declines to be identified and brought to the attention not only of conservationists and those responsible for countryside policy but also the general public.

Demographic modelling, the gathering of ancillary information and linked research programmes allow the causes of declines to be identified.

The paper will present details of the operation of the programme, illustrated by examples.

The system has resulted in the widespread declines in farmland birds that occurred in the last quarter of the 20th century being brought to the attention of conservation scientists, campaigners, policy-makers, politicians and the public. From this (and from the associated understanding of the causes of the declines) have stemmed policies aimed at reducing the problems and a commitment by government to halt the declines.

The success of the programme rests on scientifically rigorous design and analysis, on a partnership between volunteer birdwatchers (who do most of the fieldwork) and professional ecologists (responsible for design and analysis), and on effective interaction between scientists and policy makers.

22 CARBON - NITROGEN INTERACTIONS IN FOREST ECOSYSTEMS – A KEY TO DETECT AND PREDICT RESPONSES TO ENVIRONMENTAL CHANGE

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Abstract. In terrestrial ecosystems the largest pools of carbon (C) and nitrogen (N) are bound in soil organic matter. The fate of deposition N in forests is to large extent regulated by C availability in this soil pool. Then again C sequestration in plants and soil may be stimulated by N deposition. This interdependence of the C and N cycles is the basis for a new project on 'Carbon – Nitrogen inTERactions in forest ecosystems' (CNTER). In this project we will use data from several hundred study and monitoring sites, and results from long-term nitrogen addition and labelling experiments to gain new insights in C and N interactions in forest soils. Using the European monitoring data we will identify and validate key parameters and empirical relationships (indicators and transfer functions) relevant to C and N that signify changes in forest ecosystem functioning or environmental impacts. Data and process insights will be used to improve and validate dynamic models for prediction in time and space. Also impacts from forest management options will be evaluated to provide guidance for forest management to optimise environmental benefits. The major ecosystem impacts considered in the project are (1) changes in forest soil carbon storage, and (2) changes in nitrate concentrations in forest waters.

The data sources are the European monitoring networks under UN-ECE: ICP Forest Level II (plot-scale) and the ICP Integrated Monitoring (catchment-scale) as well as literature compilations of element budgets (link to presentation by Dise et al.) and decomposition studies in forests. Also a number of regional and national surveys are available to the project. The experiments are continuations of the European NITREX experiments and similar experiments in N. America.

Based on analyses of parts of the datasets we found some promising results:
Strong relationships between nitrate leaching (or soil water concentrations) and the C/N ratio of the forest floor, whereas there were no relations to mineral soil C/N ratios.
A quantitative separation of N-limited and N-saturated forest ecosystems by their flux and concentration characteristics.
By combining knowledge on the fate of N from experiments and N budgets from monitoring an upper estimate of C-sequestration in forest soils in Europe was calculated as well as a preliminary spatial image of C-sequestration in Europe.
In the paper we will show our first results from CNTER refining and validating the empirical relationships and calculations. Further we will discuss the value of having a combination of monitoring programs and ecosystem manipulation experiments.

23 QUANTIFYING THE EFFECTS OF FORESTRY PRACTICES ON THE RECOVERY OF UPLAND STREAMS FROM ACIDIFICATION

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During the early 1970,s when the UK emissions of SO2 were at their peak, numerous investigations were instigated to assess the impact of commercial forestry practices on surface water acidification and its ecological consequences (eg, Harriman et al, 1982). By intercepting greater quantities if acidic pollutants, the loading of sulphur (S) and nitrogen (N) compounds to upland catchments was shown to increase as a function of forest age and cover in each catchment. With the significant decline in S deposition during the past two decades concerns were raised that recovery may be delayed in forested catchments due to the grreater pool of accumulated S and slower release rates.
In this paper we present long-term data for a series of acidified upland streams in central Scotland which characterise the chemical responses associated with forest growth, clearfelling and subsequent planting during a period of significant reduction in S deposition. The pattern of S deposition in the area shows a non linear decline with the largest S reduction recorded in the early 1980's, followed by a slow decline in the following decade and thereafter declining at a greater rate in recent years.
For all streams, sulphate concentration showed a significant and more linear decline than for deposition. The greatest decline was in the felled catchment which showed a near 50% greater decline than catchments with moorland or young, developing forests. A similar pattern was found for chloride concentrations which reflected the reduced interception of sea-salt aerosols following clearfelling.
Alkalinity and pH increased more in the felled catchment than in moorland or young forest catchments while the largest reduction in labile aluminium was observed in the felled catchment.
The pattern of nitrate change was more complex especially in the felled catchment where large increases in nitrate concentration after the felling were followed by significant reductions during the last five years as the young plantation becomes established. In aggrading forest (25yr) catchment nitrate concentrations initially declined then increased during the early 1990's followed by another fall during the past five years.

Over the 25 year sampling period Dissolved Organic Carbon (DOC) increased significantly at both forest and moorland sites which may explain the increase in UV-absorbance and the concentration of organically complexed forms of aluminium.
The implications for forest management are discussed in the context of long-term changes in Critical Load exceedance and biological recovery.

Reference: Harriman R. & Morrison B.R.S. (1982) Ecology of streams draining forested and non-forested catchments in an area of central Scotland subject to acid precipitation.
Hydrobiologia 88, 251-263

24 RESPONSES OF APHIDS TO TEMPERATURE CHANGE

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Aphids are one of the insect groups most sensitive to changes in temperature because of their very short generation times and low developmental thresholds. A long term monitoring network using 12.2 metre tall suction traps was established in the UK in 1964. Sixteen traps are now operated in the UK. Similar traps are operated throughout Europe and co-ordinated through the EU Thematic Network `EXAMINE'. This paper deals only with results from the UK but the wider network will increase the scope of such analyses in future. Aphid abundance and migration phenology are influenced by winter temperature. More aphids are trapped in spring and early summer after mild than after severe winters, and migrations are advanced in time with increases in winter temperature. Relationships are strongest for aphids which pass the winter largely in the active stage, as opposed to the egg stage, at the location concerned; active stages are considerably less tolerant of low temperature than are eggs, but can develop and reproduce in warm spells during the winter. Over the 36 years of trap operation in the UK, trends towards earlier migrations, that are compatible with the expected impacts of climate change, are detectable. Life-cycle type itself can be influenced by winter temperature. Some aphids have clones which produce winter eggs as well as clones which do not. In these cases the proportion of aphids flying in autumn that are from clones that do not produce eggs increases with the temperature of the previous winter. These empirical relationships between aphid and temperature data occur despite effects of other meteorological variables and other global change drivers on the aphids and on other trophic levels with which they interact. It is concluded that the pest potential of aphids is likely to increase as winter temperature increases in the UK.

25 IS AUSTRALIA SUSTAINABLE? AGRICULTURE, LAND USE CHANGE AND IMPACTS ON WATER QUALITY: SCIENCE AND SOCIETY IN A POST-MODERN WORLD.

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In Australia the introduction of western agricultural techniques to an ancient, arid and fragile landscape has wrought havoc with soils, river health and water quality. Habitat fragmentation and replacement of the native Australian bush by western agriculture has totally altered the hydrological balance and the ecology of the landscape. Large areas of the Australian wheat and sheep zones are now threatened by dryland salinity, much unique biodiversity is threatened and landscape failure is rife. Overall the present mix of land use on the continent is not sustainable and business as usual is not an option.

Water quality is proving to be an effective and sensitive monitoring tool for detecting and monitoring anthropogenic changes to a number of landscape processes. Changes in soil chemistry are rapidly reflected in declining water quality. There is also growing evidence of global change through long term changes in rainfall and stream flow patterns in parts of the continent. The situation is complicated by strong inter-annual climate variability, drought interspersed with flooding rains, linked to ENSO events in the southern hemisphere. Simultaneously rivers are dammed and flows are regulated to provide water for irrigation. All in all water quality is poor and large areas of the landscape are threatened by permanent sterilisation by salt.

Much research is being centred on catchment science and landscape ecology at unprecedented scales with restoration of the natural landscape function a priority. Strong linkages between land use and water quality are providing essential data for monitoring both landscape degradation and attempts at restoration. If water quality and hydrological balances are to be restored, the original ecological function of the Australian landscape must be replaced by productive forms of vegetation and agriculture that mimics, as far as possible, the diverse functions of the native bush. This goes to the heart of what we know about landscape function and the relationship between biodiversity and ecosystem function. It seems that “catchment physiology” is the best way to relate anthropogenic change to water quality and hydrology, and that a non-equilibrium view of community structure and function is the most adequate for predictive purposes.

Even though ecological science can contribute to the solution to some of these problems, these are "wicked problems" that are not amenable to simple solutions even if we knew what to do. These are highly complex problems of massive spatial extent, involving science, economics, politics and society in a very complex and charged mixture. The "balkanisation" of society, with regional interests overriding national and state interests, with local community groups demanding control of decision making and with a major economic and social disjunction between the cities and regional Australia, have all led to a totally new environment in which to try to do science and to deliver solutions. Science, as a modernist project, is frequently out of its depth in this post-modern world.

Agricultural management of degraded lands is essential. We must have sustainable rural communities in order to deliver sustainable land management. Ecological and agricultural science must deliver understanding and offer solutions in an environment where farmers "cannot be green if they are in the red" and in which there is a much lack of trust between social groups and institutions. At present we have few viable options to offer. Even if we did, how does science engage a fragmented and marginalised rural community? In such a variable climate, even if landscape restoration were successful, performance monitoring using hydrology and water quality would also be a major challenge

Added to this problem is the growing realisation that agriculture is only one (small) part of a rural economy increasingly dependent on different values – on tourism and on other life-style choices. In this environment ensuring productive farm enterprises together with effective natural resource management and the preservation and conservation of rural lands is a highly charged and complex set of issues.

The Prime Minister of Australia has recently announced a AUS$1.4B National Action Plan for Salinity and Water Quality to be delivered across most of the Australian wheat and sheep zone through 21 regional catchment committees over a seven year period. CSIRO has been intimately involved with the development of this new policy and the interaction has been challenging. This is a major attempt to mix science and monitoring of anthropogenic change with landscape restoration based on social and economic forces. Whether or not it succeeds, it must rank as one of the boldest attempts yet to reverse the effects of two hundred years of anthropogenic change at continental scales. It is sure to teach us much about the origins of landscape failure, the best methods of detecting and monitoring global and regional anthropogenic change, and the most effective ways to deliver solutions that are ecologically sustainable as well as socially and economically viable.

26 RESPONSE TO CLIMATE CHANGE BY MARINE ORGANISMS: A CENTURY OF RESEARCH IN THE WESTERN ENGLISH CHANNEL.

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The Plymouth Laboratory of the Marine Biological Association (MBA) possesses more than 100 years of records that assess changes in marine species and communities in the Western English Channel and along the coasts of Cornwall, Devon, Dorset and Somerset. Recording began in 1888 when the laboratory was opened, and was greatly expanded after 1919 with funding from the U.K. Government Development Commission. Quantitative time series exist for plankton, sea temperature and salinity from 1903 to 1987. Demersal fishes were assayed at intervals from 1913 to 1984, and surveys of intertidal invertebrate abundances were begun in the 1930s. Other series of shorter length, carried out from the 1920s to the 1980s, measured dissolved nutrients, phytoplankton production and infaunal benthos.

Over the last century the records show marked changes in the marine ecosystem linked to fluctuations in climate. . In more recent times, other factors such as commercial fishing and eutrophication need to be taken into account as having influences on the marine ecosystem. For the area studied, eutrophication of coastal waters can be largely discounted as a cause of change, but fishing intensity is more important. Even low fishing intensity has been connected to reduced populations of cartilaginous fish such as skate and spurdog. High fishing intensity combined with climate change in the 1930s was responsible for loss of an important herring fishery off Plymouth, where herring were replaced by the warm water fish pilchard. Previously, off the southwest of Britain, historical records going back to the 15th century show that herring and pilchard abundance alternated in response to climate, but the change in the 1930s appears to be irreversible.

Particularly marked changes have been recorded in plankton and fish populations. A period of warming from 1920 to the late 1950s saw replacement of cold water species of invertebrates and fish by warmer water species. This change reversed after 1962 when sea temperatures declined for nearly twenty years. After 1980 the ecosystem gradually reverted to the warmer water type, as strongly shown in the last two years of the 20th century. These changes are not linked to the primary productivity of the ecosystem, as once supposed, but are more subtly connected to temperature change and its influence on ocean currents, possibly through competition between species.

Comparable changes occurred in invertebrate communities of the intertidal zone. Fluctuations in easily quantified indicator organisms such as barnacles and limpets provide an index to overall ecosystem change which could be cheaply utilized for future monitoring.

The MBA records are currently under statistical analysis and some parts of the series discontinued in the 1980s have been resumed. We are actively seeking funding to restore the complete series and continue monitoring into the 21st century.

27 CHANGES OF PHENOLOGICAL PHASES IN EUROPE FROM 1982 - 1998: NOAA/AVHRR NDVI DATA COMPARED TO DATA OF THE INTERNATIONAL PHENOLOGICAL GARDENS

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Remote sensing data like the Normalized Difference Vegetation Index (NDVI) observed from a space platform will be used to study the green-vegetation dynamics of several land cover types. Detecting the real start, maximum and the end of the growing period and the changes during the last decades in Europe is one aim of the investigation. Specially in Central Europe, where land coverage is highly variable and large connected areas with the same vegetation type are rare, it is important to combine ground and space observations. The International Phenological Gardens (IPG) provide a unique network of ground stations for Europe. During the last four decades genetically identical clones of trees and shrubs were observed under various climatic influences at single sites. On the other hand, satellite data show a good spatial spread but have in general a limited temporal resolution due to cloud coverage. As a result, it is often difficult to determine the actual days of onset of the different phenological events. To provide important 'ground truth' to the interpretation of remote sensing data the calculated trends of the different observed phases of the IPG stations will be compared with trends of a new available NOAA/AVHRR maximum NDVI land data set, produced by the NASA/GSFC, with a resolution of 8×8 km and a temporal frequency of 15 days from 1982 to 1998. We will discuss the beginning of spring and autumn and the length of the growing season in both data sets in Northern, Central and Southern Europe.

28 HUMAN IMPACT STUDIES IN SW NETHERLANDS BY MEANS OF MACROBENTHOS MONITORING: LIMITATIONS AND SOLUTIONS

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Because of their sessile character and relatively long life-span, benthos integrate environmental fluctuations and influences at a particular place over a relatively long time span. It makes benthos a suitable indicator for changes in environmental quality.

The aim of the long-term monitoring studies on benthos at NIOO-CEMO is to obtain insight in the natural development of estuarine and coastal areas and the anthropogenic influences in those areas in order to saveguard natural resources and to allow optimal use of a system's potentials.
As most monitoring programma's, this kind of continuous long-term assessments is perfect to detect slow and small deviations from a standard or norm: year-to-year changes may not be significant but longer series of data may reveal trends.

Since most of these monitoring studies depend in the Netherlands on restricted funding by governmental agencies, two major problems arise in the present-day evaluation and use of the monitoring data.

The first problem is that the basic data sets (on species, numbers, biomass) are stored by the funding governmental agencies, yet remarkably, hardly processed and used for further analyses. Because of such, the benefit of moitoring-programmes has been strongly debated: the projects were costly, yet did not yield a proper end-product for the end-users (managers and the public in large).
Modern analyses (e.g. ordination, correspondence analysis) and communication (web-page structured) techniques, allow us nowadays to analyse and visualise monitoring data in a limited time and at (relatively) limited costs. A first visualisation of a long-term (10-year) data-set showed dramatic changes in the macrobenthos species composition of the brackish lake Grevelingen without having been noticed before by the managers. Therefore, it is proposed to adjust the handling and processing of monitoring data in order to fullfil more the needs of managers and the public in large.

The second problem is that coastal managers nowadays ask frequently for causal relationships related to changes in environmental quality, and thus a different type of monitoring is desirable.
Information is needed on temporal and spatial distribution and dynamics of benthic populations, and moreover environmental variables have to determined. A first analysis of an available extensive database on macrobenthos monitoring shows that less then 10 % of the data can be connected to other databases with relevant environmental data.
In connection with fundamental research the relation with many more environmental variables is determined. From this it became clear that beside grain size of sediments, information on shear stress, carbon and chlorophyll content of sediments is of importance to evaluate changes in benthos.
Accordingly adjustment of strategic monitoring projects is proposed.

29 MONITORING GLOBAL WARMING WITH LICHENS

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Environmental monitoring involves observations and assessment of the changes in ecosystems and their components caused by anthropogenic influence. An ideal monitoring system makes it possible to quantify contemporary state of the environment and its changes. At background level (far from pollutant emission sources) terrestrial ecosystems are mainly affected by such anthropogenic factors as slow air pollution and global climate change. The methodology to detect trends in background air pollution by epiphytic lichens has been elaborated at the end of 70th. We have accomplished lichen monitoring survey in 28 nature reserves of USSR/Russia since then.

Climate change due to the greenhouse effect appears to be one of the most serious global threats expected in the foreseeable future (Houghton et al., 1996). The important effects of global climate change on biota are changes in bioproductivity, biodiversity, and community structure, replacement of some species by other ones. To meet the nowadays challenge, a system to monitor climate change with lichens should be elaborated as well. The major objective of this study is to determine how the response of lichens on influence of global warming can be detected and measured.

Ramon Nature Reserve (RNR) in the Central Negev Highlands, Israel has been selected for lichen monitoring to indicate background levels anticipated global climate change. There are sharp altitudinal gradients of annual precipitation and temperature in the area. These gradients are an important reasons why the RNR lies at the junction of two biogeographical and floristic zones, the Irano-Turanian and Saharo-Arabian zones. Ecosystems of such frontier areas are more sensitive to an exogenetic impacts than inland ecosystems. Epilithic lichens are suggested as biological monitors of the local consequences of anticipated global warming for RNR. The proposed methodology of such monitoring consists of a sampling scheme, including lichen measurement along transects on flat calcareous rocks, and construction of a trend detection index (TDI) which provides maximum ability to detect global climate trends in comparison with other linear indices. Coefficients to construct TDI, as well as traditional quantitative characteristics and sensitivity to climate change of 22 lichen species have been estimated in a study of lichens along an altitudinal gradient from 500 to 1000 m a.s.l. in RNR. The gradient study demonstrated that the TDI index is performed better than such traditional integrated

quantitative characteristics of community as overall cover, number of species, and Shannon-Wiener index of biodiversity. Optimization of the system to monitor climate change with epilithic lichens is made. Measuring a hundred transects in fifty plots (two transect per plot scheme) allows one to detect a climate-driven change in the epilithic lichen community corresponding to a 0.8 oC shift in annual mean temperature. Such resolution appears sufficient in view of global warming of 2.5 oC considered by the Intergovernmental Panel on Climate Change as a realistic prediction for the end of the 21nd century.

This system is based on the same methodological principles as the system of air pollution monitoring. Suggestion how monitor simultaneous influence of global warming and atmospheric pollution with lichens is made.

30 THE FUTURE OF REMOTE SENSING TECHNOLOGIES IN DETECTING ENVIRONMENTAL CHANGE

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Abstract: Land cover and land use change are two of the most critical environmental issues that we should be concerned with today. Not only are land uses and land cover changing very rapidly, but they are also the main components of a host of other issues such as food security, climate change, water management, and biodiversity. Therefore, if we monitor land use change, and combine the resultant data with other data about particular ecosystem services, we can develop new ways to measure and detect environmental change on a global scale.

Keeping track of global land use change with the purpose of maintaining environmental goods and services is particularly complex. In order to accomplish this task we need to know what the indicators of land use change are and how to measure them. In addition, we need to understand the capacity for monitoring and what the actual capabilities are for keeping track of land use change in developed and developing countries. Historically, most developed countries have conducted monitoring of certain ecosystems' land use in order to keep track of the goods provided from the ecosystems that have value in the market place. For example, forests have been monitored for decades to follow the trends of timber production and availability, agricultural lands have also been monitored to measure food production. Developing countries, on the other hand, rarely conduct systematic, regular monitoring because they do not have the resources and it is simply too expensive.

Today, we are not merely concerned with marketable goods and services like timber and food, but are also interested in monitoring other ecosystem goods and services such as carbon storage, habitat, nutrient cycling, and water quality and quantity. The monitoring systems that exist today to measure marketable goods need to be expanded and new technologies need to be developed and incorporated into a land cover monitoring system in order to begin to monitor these ecosystem services on a global scale. The question then becomes what else needs to be done institutionally and scientifically so that new technologies can be used most effectively.

Most data on land cover and land use change such as remote sensing data remain in the research domain and are expensive to access and analyze. Research costs have gone down in recent years and there has also been a broader dissemination of techniques to analyze the data. However, institutions outside the governments in the developed world are typically not able to afford the steep capital costs of modern monitoring systems. It therefore becomes the responsibility of developed countries to strengthen commitments to these countries and civil society and to provide long term support mechanisms for data access and analysis. In order to effectively monitor the new goods and services, baseline and time series data need to be established and to do more complex analyses, remote sensing data about changes in land cover will need to be integrated with other measurable data about the system in question.

31 POSSIBLE INTERACTIONS BETWEEN CLIMATE CHANGE AND IMMIGRATION, RECRUITMENT AND EMIGRATION IN THE EUROPEAN EEL, ANGUILLA ANGUILLA (L.)

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The European eel is a panmictic species that is believed to breed in the Sargasso Sea in the western Atlantic. Leptocephalus larvae migrate across the Atlantic using oceanic current systems, before metamorphosing into glass eels that use selective tidal-stream transport at critical temperatures to enter freshwaters throughout Europe. Recruitment to inland stocks is then particularly dependent on temperature-induced migration of pigmented glass eels (elvers) and older immature fish. Growth rates are sensitive to mean temperature and lengths of growth seasons. Sexual differentiation may be influenced by relative population density and biomass, with males tending to dominate at higher values. Males then mature as silver eels and emigrate to sea earlier and at a smaller size than females. All life stages but the leptocephalus are exploited commercially.
These life-history characteristics mean that recruitment and eel stocks are likely to be sensitive to medium and long-term large-scale trends in climate change – and that recruitment and migration patterns could be useful indicators of such trends. There is strong evidence for major declines in glass eel recruitment since the late 1970s-early 1980s and these have impacted some commercial fisheries. Anthropogenic causes have been proposed (e.g. over-fishing, pollution and loss of habitat) but evidence will be reviewed that imply that climate changes have played a much more significant role. Evidence of oceanic factors comes from correlations between immigration, recruitment and condition factors and changes in current systems in the N. Atlantic, e.g. as indicated by the position of the north wall of the Gulf Stream/N. Atlantic Current. Such widespread changes can also be related to declines in recruitment of the N. American eel (Anguilla rostrata) to N. America. North Atlantic Oscillations and environmental changes in the entrance to the Baltic and in the North Sea are also implicated in differential impacts in some fisheries, especially in Scandinavia and in southern North Sea rivers. Long term environmental cycles may be linked to commercial fishery trends, with increases in catches circa 1870-1880 and during 1955-1975 but with low catches between 1910-1935 and following peaks in the late 1970s-early1980s. Possible impacts of changes in average temperatures and lengths of growth seasons on freshwater immigration, life stages and emigration will be reviewed. Future possibilities for catch-independent monitoring of migration, growth and recruitment will be discussed - and how information gained could enhance our understanding of climate change and its biological impacts on eels and related aquatic communities, both in the deep N. Atlantic, on the Continental Shelf and in freshwaters.

32 OVERVIEW OF THE MAGIC MODEL APPLICATIONS IN 1985-2000

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A variety of biogeochemical models were developed to analyze long-term effects of air pollution during the last two decades. MAGIC (Modeling of Acidification of Groundwater in Catchments; Cosby et al. 1985, Water Resour. Res. 21: 51) is probably the most successful process oriented model at least with respect to the amount of applications and publications. Several versions of the model are available, the latest one is 7.07 (Cosby 2000, NIVA Oslo). The model uses a lumped representation of biogeochemical processes because simulating the catchment runoff chemistry may not require detailed knowledge of the spatial distribution of the parameters within the catchment. MAGIC can be applied for a maximum of 140 years "hindcast" before the calibration year, and for the same time span for the future forecast. The model typically simulates annual mean composition of soil water and stream water (pH, Ca2+, Mg2+, Na+, K+, Aln+, H+, NH4+, NO3-, SO42-, Cl-, F-, organic acid anions) and the soil chemistry (exchangeable Ca2+, Mg2+, Na+, K+ and adsorbed SO42-).

The objective of this paper is to review and synthesize the extensive results of 150 published MAGIC applications during the last sixteen years (86 of which were published in international peer-reviewed journals in English). MAGIC was used extensively in northwestern Europe, 38% of papers were about Scandinavia and 29% about the United Kingdom. Continental western Europe had 14% of the published applications, and North America 15%. Other regions are clearly under-represented in this respect (Asia 2%, Southern America and Eastern Europe both approximately 1%). We have registered 113 MAGIC papers with individual site applications (usually in catchment scale, especially in the UK and Norway), 39 papers with regional applications (e.g. in southern Norway, in the Adirondack Mountains, New York and in Wales) and only 3 papers with laboratory applications. MAGIC was applied using one soil layer in 111 cases. Two soil compartments, one on top of the other, were used in 30 cases. Monthly or seasonal time step was used only 4 times. Linked applications with hydrological (4) and mixing models (3) and especially with biological models (5), e.g. for evaluation of chemical impacts on fish are particularly valuable. For model confirmation, comparisons to computer simulations from other dynamic geochemical models were performed many times (most often with the SAFE and SMART models). Thirteen applications compared MAGIC simulations with diatom-based reconstructions of lake water chemistry history. Generally, validation of long-term dynamic models is problematic because of the lack of real long-term measurements. Simulations of experimental manipulations with known fluxes is therefore helpful in this respect (e.g. RAIN Project in Norway, Gårdsjön Roof in Sweden). MAGIC's long-term hindcasts and future predictions of acidification and recovery of terrestrial and aquatic ecosystems have been an important source of information for policy-makers.

33 ENVIRONMENTAL AND LAND USE AND LAND COVER CHANGE MONITORING IN THE COASTAL BELT OF INDIA: STUDY BASED ON REMOTE SENSING AND GIS TOOLS

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Of the ten bio-geographic zones of India, the coastal zone is very significant as it stretches to over 7500 km. There are 9 maritime states inhabited by about 100 million people of who are directly dependent on the coastal resources. More than 170 million population concentrated in the 100 km coastal belt. In the recent past to prepare coastal zone management plans, it was realised that the data on environmental parameters, land use and land cover changes along the coastal belt and the adjacent watershed and river basins are very important. The changes in coastal land use and land cover are having more influence on coastal environments, biodiversity, coastal ocean resources, etc. Additionally the biotic pressure on the coastal belt is more and many protected areas along the coastal ocean are facing severe environmental problems. The Department of Ocean Development has funded to carry out various national programmes such as Marine Remote Sensing Satellite Information Service (MARSIS), Coastal Zone Information System (CZIS), Critical Habitats Information System (CHIS) under the coordination/guidance of National Remote Sensing Agency (NRSA) and Space Applications Centre (SAC) since 1990. Both remote sensing data and GIS tools were extensively in these studies. This paper has been prepared based on the experience gained from the above programmes.

Under the coastal zone mapping and monitoring programme, the land use and land cover (LUCC), brackishwater sites, mangrove and coral reef areas were mapped using multidate data of Landsat MSS, TM and IRS series. Spatial data on 1:250,000 scale were generated using MSS and IRS LISS-I sensor data and for the site-specific studies detailed scale maps i.e. 1:50,000 and 1:25,000 are prepared. The other biophysical information especially on geomorphology and shoreline changes was also derived from the interpretation of remote sensing data. Using GIS tool, the database has been created for selective "hot spot" areas along the coastal India. The non-spatial data on socio-economic, coastal water quality and biological parameters were also incorporated in the GIS database in the relevant spatial layers in order to analyse the database to assess the biotic and abiotic pressures on the coastal zone. Based on the interpretation of satellite data and GIS database analysis it was observed that the following biotic and abiotic driving forces are mainly responsible for coastal environmental change in the country.

Changes in coastal land use due to population pressure and migration of population from upland to coast due to drought are the main driving forces for resource depletion and environmental degradation.
Changes in land use along the adjacent watershed are the main sources for coastal pollution.
Changes in coastal land cover especially the mangrove forests are mainly due to human activities like illegal felling, aquaculture, agriculture, grazing, etc.
Certain parts of the coast experience the environmental degradation due to abiotic factors like shoreline and coastal configuration changes. Especially the estuaries and creeks in the Southeast part of India are witnessed with the development sand spit formation and closing of these mouthpart leads to changes in water and soil quality in these areas.
The driving forces for coastal environmental degradation is vary from the mainland coast to island coast.
The impact of coastal tourism is very limited.

The time series analysis were carried out to quantitatively estimate the changes in land use and land cover along the coast using multidate satellite data in conjunction with historical data. Attempts are made to fill the data gaps for coastal LUCC modeling. Especially the high-resolution sensor data like IRS LISS-III and PAN data provides more information on coastal ecosystem status, degradation and re-growth areas and infrastructure details along the coast. The spatial data generated from remote sensing imagery are playing a vital role in implementation of coastal regulation zone and also for long-term environmental monitoring in the country. The spatial information derived from satellite data are validated by ground truth and more field information added to make them more self-explanatory. More end user utilisation workshops and awareness programmes were conducted based on the outputs derived from the analysis of satellite data and GIS database. Community based conservation and management works have been initiated in few areas along the east coast of India where the remote sensing and GIS provides vital information on environmental parameters and also the influence of various driving forces. Also the utilisation of remote sensing and GIS outputs were demonstrated to social scientists and the wider public. Recently the short-courses on ICZM for key decision-makers are initiated with funding support from DFID and British Council India. Various management issues concerning the coastal environmental degradation are being taught and discussed in the short-course programmes. This paper highlights the present scenario in India especially in the area of coastal environmental issues and the applications of remote sensing and GIS tools.

34 DETECTING ENVIRONMENTAL CHANGE IN EUROPEAN WATERS

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The European Environment Agency (EEA) delivers timely, targeted, relevant and reliable information to policy-makers and the public for the development, implementation and assessment of sound environmental policies in the European Union and other member countries totalling around 31.

Crucial to successful environmental policy and management is the detection, analysis and responses to the slow-moving, underlying, driving forces and pressures that create the current and future state of the environment.

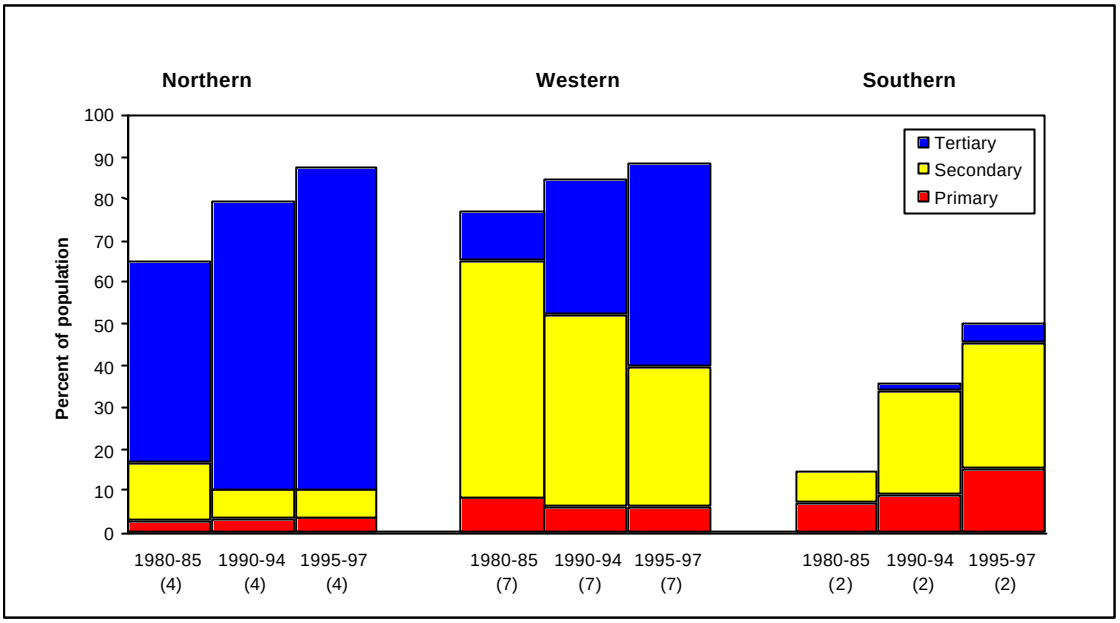
This paper describes the sources of nutrient pollution (nitrogen and phosphorus), the measures that have been taken to reduce them (largely through the Urban Waste Water Treatment Directive (91/271/EEC)) and assesses how effective these measures have been. The Directive came into force in 1991 but there have been considerable delays by Member States to fully or partly transpose the Directive into their national laws and develop implementation plans.

Measures have been most effective for major point sources such as urban waste water and industrial effluents, and where nutrient use has been restricted or banned e.g. phosphate in detergents.

Over the last 17 years, marked changes have occurred in the proportion of the population connected to waste water treatment as well as in the waste water treatment technology involved. (Figure 1). The percentage of the population connected to tertiary treatment has increased since 1980 in all European regions. In Northern countries such as Finland and Sweden, the majority of the population was connected to sewers with waste water treatment early in the 1980s, while in many of the other countries a marked increase in the population connected to sewers has occurred over the last 10-17 years. In

Austria and Spain, the proportion of the population connected to sewers and waste water treatment has more than doubled over the last 17 years. In Spain, however, only around 50 % of the population had their waste water treated in treatment plants by 1995, some of the waste water to sewers was discharged untreated.

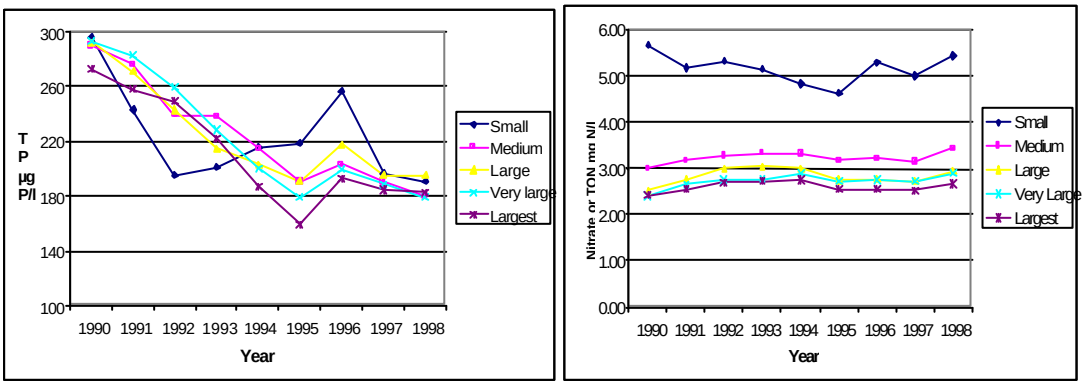
Figure 1 Changes in waste water treatment in regions of Europe between 1980/85, 1990/94 and 1995/97.



Notes: Only countries with data from all periods included, the number of countries in parentheses.
Northern: Iceland, Norway, Sweden, Finland.
Western: Austria, Ireland, United Kingdom, Luxembourg, Netherlands, Germany, Denmark.
Southern: Greece, Spain.
Missing data from: Liechtenstein, Belgium, Italy, France, Portugal.
Source: OECD/Eurostat

Efficient control of diffuse sources such as nitrate run-off from agriculture has rarely been achieved. Fertiliser use and nutrient loads from manure have fallen since the 1980s mainly because of reforms to the Common Agricultural Policy. Implementation of the Nitrates Directive has been unsatisfactory in most Member States and the Commission has begun legal action against them.

Figure 2 Trends in annual average total phosphorus (left graph) and nitrate or total oxidised nitrogen (right graph) in different sized European rivers, 1980-1998



It can be seen from Figure 2 that concentrations of phosphorus have been decreasing in European rivers since the 1990s reflecting the general improvements in waste water treatment over this period. However the rate of decrease appears to have slowed in more recent years. Since 1990, nitrate (or total oxidised nitrogen) concentrations in European rivers have remained more or less unchanged.

The Directive requires a 70 to 80 % reduction in total nitrogen loads being discharged into sensitive areas from large agglomerations. There was no available information as to whether this is generally being achieved. Experience in Finland, with high levels of tertiary treatment and large reductions in phosphorus load, indicates that this might be difficult as only a 30 % reduction in total nitrogen has been possible. Even though point source discharges from urban waste water treatment works may not be the main source of nitrate in many catchments, the reduction of nitrate concentrations and loads may require more efficient removal of nitrogen from sewage.

All EU countries except Sweden expect to increase their sewage sludge production between 1991/92 (when the Directive came into force) and 2005 when all sewage treatment measures required by the Directive are due to be operational. Comparison of the proportion of types of sewage treatment in EU countries in the early 1990s with the predicted sewage sludge production by 2005 shows that the biggest increase in sludge production is expected in those countries with the lowest proportion of sewage treatment in 1990. For example, Ireland is expected to increase it s sewage sludge production 3 fold compared to 1991 production. In contrast those countries with a high proportion of their population connected to sewage treatment before the implementation of the Directive only expect a relatively small increase in sewage sludge production by 2005, e.g. Denmark and Germany. Overall in the EU there is expected to be a 2.4 fold increase in sludge production between 1991 and 2005.

Once produced, sewage sludge needs to be disposed of in environmentally acceptable ways, for example through agricultural use, landfilling or incineration. In the terms of agricultural use there is a Directive (86/278/EEC) which ensures that heavy metals arising from the sludge do not accumulate in the soil at levels that exceed specified limits. The incorrect application of sewage sludge onto agricultural land can in itself lead to the pollution of surface waters through run off during rainfall, for example.

Clearly there is a continuing need to be vigilant and when fully implemented, EUROWATERNET (the data and information gathering network of the EEA), will provide the necessary data and information. This is increasingly being focused on the development of indicators for the pressures, state and impacts on the environment. Indicators and analysis of the effectiveness of the Directives against the costs of the measures will also be needed.

35 WHICH FACTORS ARE RESPONSIBLE FOR THE CHANGING LICHEN COMMUNITIES IN W. LONDON?

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Lichens are valuable indicators of air quality largely owing to theirdifferential ability to accumulate S and other pollutants including metalparticulates and their varied dose-effect response. However, synergisticeffects of low levels of SO2 air pollution, N and particulate emissions onlichen communities have not previously been investigated. This study seeks,through an integrated approach, to identify factors responsible for thechanging lichen communities at Burnham Beeches NNR, where a 7-yearmonitoring programme in response to possible dust emissions from adjacentquarrying has been undertaken. Fixed point photographic monitoring ofParmelion communities on Quercus, was carried out along transects ofsuspected gradients of dust pollution, has identified a rapid turn-over ofthalli of the dominant macrolichen Parmelia sulcata, development of the'nitrophilous' Xanthorion and loss of 'acidophilous' species. Selectedsamples of Parmelia sulcata, widely employed as a biomonitor of metaldeposition throughout Europe, were examined using SEM and energy dispersiveelectron probe microanalysis to analyse for surface particles. Thesignificance of S, N and particulate contaminants as possible factorsresponsible for the changing lichen assemblages is assessed by correlatinglichen biodiversity, radial growth measurements of P. sulcata and lichenvitality with physicochemical data from nearest pollution monitoringstations. Spatial and temporal variation in the elemental contents ofvarious stages of the life-cycle of P. sulcata were analysed by ICP-MS (Li,Be, Bo, Ti, V, Co, Ni, Zn, Ga, Ge, As, Se, Rb, Sr, Mo, Ru, Cd, S, Sb, Te,Cs, Ba, W, Tl, Pb, Bi, Th, U) and ICP-AES (P, S, Sn, Hg, Zn, Mn, Fe, Cr,Mg, Nb, Cu, Yb, Zr, Sc, Y, Ca, Al, Sr, Na, Li, K) and its sulphur andnitrogen isotopic composition compared with the bark substrate and withreference to historical NHM collections dating back to 1750. Data wasanalyzed by numerical classification and by applying multivariatestatistical techniques. Comparisons are made with other investigationscarried out on this

species in other areas in Europe. In the absence ofreliable instrumental data for all elements in the survey area it is as yetimpossible to establish a quantitative relation between the concentrationof metals within thalli and deposition rates and to identify specificsources of emission. Never-the-less, our results clearly demonstrate thevalue of an integrated approach to lichen monitoring and corroborate theirvalue as sensitive indicators of the effects of changing air quality on theenvironment.

36 THE CREATION OF USABLE KNOWLEDGE FOR THE DETECTION OF ENVIRONMENTAL CHANGE

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Given the cumulative and expansionary impact of Homo sapiens upon the earth¹s ecosystems, the 21st century bodes significant environmental change at multiple scales. Few habitats and organisms are immune from our reach and thrust. And from cave painting to ancient calendars to interstellar remote sensing, our species has been driven*by the arts, sciences, gods and commerce*to monitor the human environment. We mark our territory, and record our markings for future generations.

The conference objectives include achieving new understandings and refined methods of detecting environmental change, and the application of monitored data to improved policy and decision-making. These are worthy yet difficult goals, as environmental and social policy is driven by a wide range of inputs*of which science (and scientific information) is not always (if hardly) preeminent. To have substantive benefits and significant implications for society, monitoring activities and resulting data must be converted to *usable knowledge¹. Usable knowledge is a particular form and delivery of scientific information increasingly practiced within the environmental and social sciences. The purpose of this paper is to describe the importance and creation of usable knowledge for the detection of environmental change.

A brief primer on the inter-relationship of biological and social systems is presented. The human ecosystem as an organizing concept is described, and its relevance to detecting social trends and environmental change is highlighted. The importances of models, maps and measures are stressed. The characteristics of *usable knowledge¹ are presented as unique and necessary criteria for effective environmental monitoring in the 21st century. Examples of models, maps and monitoring measures*both poorly executed and extraordinarly effective*are presented for critique. Recommendations for increasing the likelihood that monitoring will create usable knowledge are suggested, derived from the author¹s experience, current literature on the adoption and diffusion of innovations, and various conference contributions.

And, given the Faustian nature of modern science, information systems, and environmental policy-making, a brief collection of grim warnings and harsh cautions regarding the consequences of ineffective efforts looms appropriate.

37 THE IMPORTANCE OF LONG TERM MONITORING FOR DETECTING CHANGES IN FOREST ECOSYSTEMS: THE SOLLING PROJECT

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For more than 30 years monitoring of indicators related to various functions of forest ecosystems have been conducted at spruce and beech stands at Solling, Germany. Today the monitoring sites are part of different monitoring programs like the European Intensive Monitoring of Forest Ecosystems (ICP Forest Level II) and the Soil Protection Program of Lower Saxony, Germany. The paper demonstrates the findings, which can be conducted from similar monitoring programs and emphazises the value of long term monitoring programs.
The major findings of the monitoring program are related to acidification induced by atmospheric deposition, eutrophication by nitrogen deposition and effects of climatic change and elevated CO2.
The effects of changing emission rates on deposition are clearly detectable at Solling. Sulfur deposition at Solling increased until about 1975 and decreased by more than 70 % since then. Ca deposition as a

measure of input of basic substances decreased since the beginning of the monitoring. Nitrogen deposition increased until the end of the 70th and decreased slightly since then, but is still well above the demand for forest growth. Deposition of acids decreased drastically as a consequence of changing deposition rates of sulfur, nitrogen and basic substances.
The sulfur content of soil solution shows a delayed response to decreasing deposition. Sulfur concentrations decreased only by about 50 %. Simultaneously, contents of Ca and Al in soil solution decreased. Nitrate concentrations show strong fluctuations, although a trend cannot be detected. The Ca/Al ratio as indicator for Al stress for tree roots is below the critical value of 1.0 within the whole rooted mineral soil indicating actual stress.
Input-output budgets show that forest utilization at the spruce stand cannot be maintained in a sustainable manner without depletion of the nutrient pools. The actual Mg budget is negative even with no biomass use. For the beech stand, sustainibility can be achieved at a higher level of biomass utilization because of a better nutrient availability due to deeper rooting.
As a consequence of negative nutrient budgets, the pools of exchangeable nutrient cations decreased drastically during the last 30 years. Actual base saturation is only about 3 % indicating a reduced elasticity of the system. Simultaneously, the carbon storage in the organic layer has doubled indicating an important role of forest ecosystems for carbon sequestration.
The time series show the dynamic and complex behaviour of forest ecosystems. Changing environmental conditions are reflected by alterations of the ecosystems. Reduced deposition resulted not yet in improved soil conditions. For the recovery of the ecosystems, one has to expect a very long time span. The monitoring data from the Solling sites have been proved an important tool for testing scientific hypotheses and for the evaluation of forest management practises. For polici makers, the verification of the efficiency of environmental legislation has been important.

38 MEASURING ENVIRONMENTAL CHANGES AT THE SCOTTISH ENVIRONMENTAL CHANGE NETWORK (ECN) SITES: WHAT HAVE WE LEARNED FROM THE FIRST TEN YEARS?

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Data from the three Scottish ECN sites at Glensaugh, Sourhope and Cairngorms (formerly Mharcaidh) reveal differential temporal and spatial responses. The use of additional monitoring equipment and the contribution that improved methods for determining and describing environmental changes can make to the understanding of these complex systems are demonstrated.

Not all three sites have shown similar responses to drivers of change such as, for example, national or international modifications in the pollution climate driven by S abatement policies. While all sites show changes in the amount of S in the rainfall inputs these have not been transferred directly into responses in soil and surface water SO4-S concentrations. This is likely to be due to a site-specific soil property altering S reactions within the soil, which may control the rate of recovery. For some sites there are parallel temporal responses for SO4-S concentrations in both soil and surface waters, whereas others show only partial responses in some soil waters but not yet into surface waters. The application of improved methods of trend analysis to hydrochemical data and the incorporation of some soil properties have led to a better understanding of site specific recoveries.

While S deposition has declined, there are concerns about the current levels of N deposition and its impact on the environment. Changes in forms of N, particularly NO3-N, in response to an increased loading are more difficult to determine and interpret. Data from all sites illustrate the expected strong seasonal patterns in NO3-N concentrations in soil waters and surface waters. Disturbances to these trends caused by climatic factors, such as drought or elevated temperatures, have been identified. Trend analysis separates out the seasonal pattern from the influences of flow (or volume) and any long-term trend, and can determine any changes in either amplitude or phase that could indicate that these systems could be moving towards N saturation. Information from new instrumentation, such as soil water probes, has contributed to an improved understanding of site responses to the more extreme climatic events that result in changes in N chemistries. These episodic changes need to be described before any long-term trends in concentrations can be established.

Additional non-ECN data from Glensaugh using a series of sampling sites within a single catchment will be used to examine scaling issues and responses to land use. Possible ways of using integrated data sets, such as inputs, vegetation and soil properties, soil and surface waters, to improve the interpretation of site and network responses will be discussed.

39 A MARINE ENVIRONMENTAL REAL-TIME OBSERVATIONAL SYSTEM FOR THE UK

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The shelf-seas are the most biologically productive regions of the oceans but also those under most immediate threat through over-fishing, pollution and eutrophication. A range of international (Oslo and Paris Commission) and European (eg Nitrates Directive) policy drivers determine the legislative framework for which the UK developed a National Marine Monitoring Programme (NMMP) under the auspices of the Marine Pollution Monitoring Management Group. During the previous decade monitoring of the offshore and coastal seas around England and Wales has been carried out employing research vessels during annual winter and summer surveys. Although providing good spatial coverage sampling frequency is unable to resolve temporal variability adequately for current and future purposes. Against this background, the Centre for Environment Fisheries and Aquaculture Sciences (CEFAS) has developed a suite of automated in situ instrumentation capable of deployment at a mooring (Smart Buoy) for monitoring a range of physico-chemical and environmental variables including phytoplankton.

A network of 3 buoys in the southern North Sea has formed the basis of long-term and automated observational system with the potential for expansion to a 10 buoy network. In addition, the buoy network will be integrated with the Continuous Plankton Recorder survey carried out by SAHFOS (Sir Alister Hardy Foundation for Ocean Science) an established long term (>50 year) plankton monitoring programme. This integrated programme will provide information on the plankton, one of the most sensitive indicators of environmental change, together with the key environmental control variables at a wide range of time (minutes – years) and space (metres to 100's km).

The key components of the automated monitoring system will be briefly described and results obtained from the current programme presented and discussed in relation to anthropogenic nutrient inputs to the North Sea. The strengths of this approach will be assessed by comparison with other environmental monitoring programmes operating in the North Sea. Early results confirm the value of moorings as an important measurement strategy in marine monitoring. The full seasonal cycle of the key environmental variables can be measured in sufficient detail to resolve important episodic events such as storms and algal blooms. The future development of the programme will be outlined including the potential for addition of other measurements (eg contaminants) and the linkage to models.

40 THE STATE OF LAKES IN FINNISH EUROWATERNET

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Eurowaternet is supposed to cover all European countries, with the overall objective to obtain timely, quantitative and comparable information on the status of inland waters so that key environmental problems associated with Europe's inland waters can be defined, quantified and monitored. Finland launched the Eurowaternet of lakes and rivers at the beginning of year 2000. This network was designed according the guidelines of European Environment Agency and was based on national, regional and local monitoring.

The paper presents the concentrations of nutrients and chlorophyll a, and transparency of 253 Finnish lake sites in the Eurowaternet during four periods: 1981–1985, 1986–1990, 1991–1995 and 1996–2000. Lakes were grouped to different types by their loading background: (i) reference sites, (ii) point loading (impact) sites and (iii) agricultural sites. Moreover, (iv) lakes <100 km2 with typical water quality in

the catchment comprised the fourth (representative sites) and (v) lake deep sites in large lakes (size >100 km2) the fifth group. These two last groups included lakes in natural condition or partly loaded by point sources (municipalities and industry) or non-point sources (agriculture or forestry). However, the sampling sites of these lakes were selected to the Eurowaternet from areas not directly affected by loading, such as the pelagic area of the main basin of the lake. Concentration levels of and differences in water quality between these lake groups were compared.

Phosphorus is the major growth controlling nutrient in Finnish freshwaters. Annual mean concentrations of total P during 1981–2000 were (i) 9 µg l-1 (range <2–69 µg l-1) in reference lakes, (ii) 40 µg l-1 (4–1470 µg l-1) in lakes affected by point loading, (iii) 77 µg l-1 (14–390 µg l-1) in lakes affected by agriculture, (iv) 22 µg l-1 (<2–240 µg l-1) in representative lakes, and (v) 16 µg l-1 (2–260 µg l-1) in large lakes. The comparison to reference lakes revealed major impact of human activities on total P – and consequently on chlorophyll a and transparency – in all other groups. Temporal changes and regional differences in water quality will be discussed in more detail.

41 PEOPLE'S PERCEPTION OF THE CHANGING ENVIRONMENTAL SCENARIO IN THE SIKKIM HIMALAYA: A MICRO-LEVEL ANTHROPOLOGICAL STUDY

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The present study makes an attempt to investigate into some of the important environmental issues as perceived by a cross-section of Sikkimese people. The approach of the paper remains anthropological and hence based on the sociocultural perspectives. The study is purported to examine the changes that occurred through the recent decades as perceived by the people in some of the environmental characteristics of the State in the midst of ongoing developmental agenda. The environmental issues such as biodiversity status, land use pattern, soil erosion and degradation, water quality and quantity, air and water pollution and the like have been considered in the study. Further, perceived seriousness of such environmental issues, sources of environmental concerns, role of environment in economic sustainability have also been assessed in relation to sociocultural, age and sex factors.

The study utilises both quantitative and qualitative data, following anthropological methodology, collected from study participants inhabiting different districts of the tiny eastern Himalayan Indian State of Sikkim having variable age, sex, socioeconomic status, educational status and activity pattern. Data from governmental and non-governmental organisations dealing with environmental issues of the State were also gathered in order to reveal perceived institutional understanding on the concerned issues.

The findings of the study reveal that people in general perceive fast changes in the environmental situation of the State as measured by the selected characteristics indicating current/future environmental problem/degradation and ascribe these changes to be originating from interplay of demographic, socioeconomic and political forces. The implications of the findings in terms of sociocultural and developmental aspects of this Himalayan State are discussed.

42 ENVIRONMENTAL MONITORING: TRANSLATING SCIENCE INTO POLICY

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In this paper, I propose to take a deliberately anthropocentric approach to environmental change. In particular I wish to address the role of public decisions in managing change and the knowledge needed to support them. Implicit in this is the aim of limiting the scale and rate of environmental change to levels that humanity and its societies can sustain.

Environmental change has been, of course, a constant throughout the history of the earth, on a wide range of temporal and geographical scales. Two main factors are behind it. Firstly, the earth system

itself it highly dynamic and, over geological time, oceans, continents and the atmosphere have formed and reformed. There have been changes in their chemical composition and in the life they support. Large-scale physical properties, of which the earth's surface temperature is a notable example, have varied continually. Secondly, occasional catastrophic events such as meteor impacts have caused widespread destruction of ecosystems with the consequent loss of the species dependant on them. These rare but dramatic events are widely suspected to be the cause of the mass extinctions seen in the fossil record.

Throughout most of the period since life emerged, the environmental conditions on the earth have remained within narrow limits. Catastrophes apart, change has been at a pace that enabled most forms of life to adapt to new conditions. We now see a great diversity of life occupying the full range of habitats on earth, even the most extreme.

Now a new factor is emerging in environmental change. The Intergovernmental Panel on Climate Change concludes in its recent scientific assessment that there is now persuasive evidence of climate change and that recent changes can only be explained if human activity is taken into account. The reconstructed record of surface temperature over the last millennium shows a rise over the last 100 years with temperatures in recent decades rising above the upper limits of the range in the long-term record. An attribution of the observed warming to its possible causes suggests a strong human signal due to the increasing levels of the main greenhouse gas, CO2 in the atmosphere.

Despite this emerging and strengthening consensus within the scientific communities involved, it has proved hard to reach agreement on the nature and scale of action required. Estimates, however, are that considerable reductions in the rates of emission of greenhouse gases will be required and that these are expected to have considerable implications for economies worldwide. The recent challenge to the principal international agreement on limiting climate change, the Kyoto Protocol, has illustrated the fragility of political will when such powerful economic interests are at stake.

At this global scale and despite the strength of the evidence it is difficult to find a satisfactory public decision on the way forward. However even at a local scale, where problems are more immediate, there are challenges in managing environmental change, particularly when a treasured human activity is a major factor. For example, it will be difficult to manage the changes in our fragile upland ecosystems as increasing levels of nitrogen deposition, much of which comes from road transport, promote the growth of invasive plant species.

In both cases, global and local, the scientific evidence of change and its causes is an important component of the decision process and the policies that emerge from them, but it is not sufficient in itself. To see why this might be so, we have to consider how policy questions are framed, how decisions are made, and they way in which both are changing.

One of the major trends in environmental policy over the last years has been that it is increasingly integrated and increasingly seen in a larger context. Integration at one level has meant joining up related issues, so that separate measures on, for example, acid rain, environmental eutrophication and photochemical air pollution to become a unified air pollution policy. At another level, it has meant that environmental considerations have become part of a sustainable development framework. Furthermore, policy is increasingly expected to be clear about the outcomes it will produce, rather than focussing simply on outputs. It has to address river quality rather than simply discharge standards.

During the same period, environmental governance has also changed. The new principle of subsidiarity aims to ensure that decisions are taken at the most appropriate level. It is reasonable that decisions on global climate change should be taken at international level, whereas decisions, for example on waste disposal, are more appropriately taken locally. As public decisions in general become increasingly subject to challenge, environmental decisions are becoming more open to scrutiny from a wide range of constituents, including different publics. There is also a loss of confidence in scientific descriptions of environmental issues, for example in the cases of genetically modified organisms or BSE.

The practical consequences of these trends for the production of evidence and the use of evidence in policy are considerable. In the past, the main thrust of the environmental sciences has been to improve understanding of trends and mechanisms. Models of the "pressure-state-response" kind are typical of this approach. Increasingly, though, the role of environmental science will be to inform a hard-fought debate about the evidence and its relevance to public decisions. In the face of increasing costs of action,

evidence for change will face a stringent test and will need to be robust. Issues of uncertainty and intrinsic variability will have to be tackled explicitly, for example by through a framework of risk analysis.

Monitoring regimes will increasingly be required to track high level indicators to determine trends in what are inevitable aggregate properties of the environment, such as "quality". These are likely to have at least a degree of subjectivity. Sustainable development indicators, for example, depend on views about sustainability that may themselves be contested.

The challenge will be to retain as much objectivity in the development of the scientific knowledge base for environmental policy as possible, whilst responding to the need for science to answer public questions in a public arena. This will mean at the least a new openness about areas of uncertainty or judgement. It could even require a fundamental reassessment of the way in which scientific descriptions of environmental change are constructed and communicated.

43 ON "THE OCEAN-ATMOSPHERE COUPLING - FUTURE OF ENVIRONMENTAL MONITORING"

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Ocean circulation studies are advancing rapidly due to increased scientific understanding, improved numerical models, expanded use of numerical models, increased horizontal and temporal model resolution (10 to 1 km and 1 to 0.1 hour or finer) and vertical resolution (15 to 30 or more depths). Increased long time-series observations at fixed points, deployment of more Lagangian drifters, new observing technologies (e.g.; coastal HF radars, towed sensor packages, high resolution profilers for velocity, temperature, salinity and turbulence variables) have added a new dimension to the studies. Better integration of modelling and observing systems and improved atmospheric forcing information due to increased deployment of moored buoys and meteorological stations with nested-grid, mesoscale atmospheric models in both research and real-time forecast modes have greatly helped the process of monitoring and understanding.

The paper addresses the key trends to focus on realistic regional simulations and hindcasts. More efforts needed in the direction of model data comparisons are dealt with for validation, verification, evaluation and skill assessment. The requirement still exist for knowing how accurate the atmospheric forcing need to be estimated to achieve a specified level of accuracy in circulation estimation. Accuracy pertains not only to the amplitude and variance of air-sea transfers but also the spatial and temporal scales delineating the space-time structure of weather systems, etc. Due to nonlinearities, even less is known about amplitude accuracy requirements.

In conclusion, attention is drawn to drag law sensitivity and, in particular, fetch limited drag laws and explicit wave field information needed to be incorporated. Wind stress are needed over the full range of wind speeds, especially for storm conditions associated with tropical and extra-tropical cyclones crossing and paralleling coastlines.
A number of initiatives are proposed to be addressed on a global scale coordinating the initiatives of the Global Ocean Observing Systems (GOOS), and the Global Ocean Ecosystem Dynamics (GLOBEC) programmes. This envisages a comprehensive and integrated operational observation system that will provide data needed for oceanic and atmospheric forecasting, and management to address the needs of global environmental change research. Quality control of measurement when a suite of instruments is deployed on one location is a major issue and inter-calibration between instruments is a greater problem needing wider attention of the global environmental change community is highlighted.

44 INDICATORS FOR DETECTING THE IMPACTS OF CLIMATE CHANGE ON SPECIES AND ECOSYSTEMS

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Although there is broad agreement that climate change is happening, there are still major uncertainties concerning the rate and regional consequences of this change and how it might impact on ecosystems. In this paper we explore the kinds of indicators that may be useful for the early detection of climate change impacts on species, communities and ecosystems (particularly in relation to impacts on biodiversity). Indicators that can be applied across a broad range of ecosystems and can enable the early detection of impacts may have a key role to play in moulding public attitudes to climate change and in guiding the adaptive response of society as a whole. But are such indicators feasible?

Current ecological theory predicts a range of potential ecosystem responses to long-term climate change. We will briefly review these and then examine the power with which standard approaches to the measurement of ecosystem structure and function may be able to detect such changes. These measures include:

Changes in the distribution and abundance of rare, indicator or characteristic species
Changes in key or keystone species.
Increases the distribution and abundance of alien species.
Community responses: changes in species composition.
Community responses: shifts in the balance of functional types.
Whole community responses: e.g. species diversity indices.
Emergent/ecosystem properties: e.g. decomposition, NPP, NEP, biogeochemical cycling.

We will use examples from published studies and new results from an established monitoring programme in the UK (the Environmental Change Network (ECN)) to illustrate the role of long-term integrated monitoring in this early detection process. The ECN (www.ecn.ac.uk) collects data from a network of 54 terrestrial and freshwater sites on a range of taxa (including plants, birds, beetles, butterflies, moths, phytoplankton, zooplankton, and freshwater invertebrates) together with measurements of the main drivers of change (climate, land management, atmospheric chemistry and precipitation chemistry). These data enable the effects of climate on different taxa to be distinguished from other, possibly confounding, environmental changes.

Finally, we will discuss what kind of observation networks are required in order to provide the data necessary for the kinds of indicators we have presented. Data from site based monitoring programmes are a necessary part of the detection process, but they are not sufficient. We will also discuss the benefits of a broader approach using data from sites, sample surveys, volunteer networks and remote sensing.

45 WHY DO HUMANS OVER-POLLUTE? - AN ECONOMIST'S PERSPECTIVE

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There is an imperative need to extend environmental monitoring to embrace the underlying causes of human behaviour that gives rise to environmental degradation. As currently advocated, the 'pressure-state-response' model is wholly inadequate for this purpose, confining analysis to the proximate causes of degradation and ignoring the reasons why those proximate causes exist. Two very broad categorisations of fundamental causes are provided, the first emphasising the absolute level of consumption of goods and services, and the second emphasising the scope and need to increase the productivity of resource use without sacrificing overall consumption. In either case, the monitoring needs involve looking at how the consumption of goods translates into consumption of materials and energy. On the 'over-consumption' model motivations for consumption need to be described and analysed. On the 'resource productivity' model indicators of productivity are required along with the scope for improving the efficiency of resource use. The paper focuses on the second model since it seems politically more feasible and because even advocates of the over-consumption approach espouse

many features of the resource productivity approach. It is argued that the fundamental causes of environmental degradation include rapid rates of population change and its association with land-use conversion, primarily from forest land to agriculture, and a general failure of economic systems to signal true levels of scarcity of natural resources. This 'economic failure' comprises the absence of markets for 'open access' resources, and is accompanied by a parallel failure of governments to intervene efficiently in economic activity. While other factors are present (and not discussed in this paper) this combination of economic and government failure is pervasive and of major significance in resource degradation. As far as environmental information systems are concerned, there is a need to expand their focus to include efforts to identify and analyse the fundamental causes of degradation, causes that lie in the mis-design of political and economic systems.

46 ECOSYSTEM MONITORING OF SOUTHERN OCEAN VARIABILITY

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In order to understand the causes and consequences of long-term change in marine ecosystems it is essential to characterise natural variability over a range of scales and trophic levels. Integrated land and ship-based research conducted by the British Antarctic Survey at the sub-Antarctic island of South Georgia provides a mechanism by which to examine variability at an ecosystem level. Since the late 1970's a programme of annual monitoring of population size, adult condition, breeding success, mass at independence and population demographics has been conducted on 3 species of albatross, 2 species of penguin and 1 species of seal. Throughout this period indices of performance have revealed large inter-annual variability, particularly in association with the abundance of Antarctic krill Euphausia superba, the keystone prey species in the Antarctic foodweb. Simultaneous ship-based determination of variability in the abundance and distribution of Antarctic krill have revealed a clear relationship between its contribution to the diet to the reproductive output of predators. The non-linearity of the relationship between prey abundance and predator indices and the frequency of negative responses of predators suggest that they are operating close to the limit of prey availability. There is also evidence for a long-term change in the importance of krill in the diet of at least one penguin species in which the population has shown a dramatic decline over the past decade. Elucidating to what extent these changes reflect local versus regional effects is crucial to detecting large-scale environmental change.

47 SEDIMENTARY EVIDENCE FOR CHANGES IN THE POLLUTION STATUS OF LAKES IN THE JIANGSU REGION OF EASTERN CHINA.

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In China, anthropogenic impact from changes in water quality, land-use and atmospheric deposition vary both spatially and temporally. There is a gradient across the country from the populous lowlands in the east, where considerable long-term impact on water bodies has resulted from centuries of agricultural and aquacultural practices superimposed by more recent, rapid industrial growth, to the mountainous west where many areas remain minimally impacted and any anthropogenic effects are restricted to long-range transport of atmospheric pollutants and changes in climate. Currently, however, there is little information on temporal trends in atmospheric deposition.

The importance of water resources in China cannot be overestimated and therefore determining the extent, rate and direction of change in water quality is a national priority. In the absence of long-term monitoring programmes, lake sediments remain the only way whereby this information can be retrospectively determined at the necessary temporal scale to ascertain whether the causes of any detriment in quality are as a result of natural changes, or due to agricultural or industrial impacts.

In 1998 a collaborative project, jointly funded by the Royal Society in London and the Chinese Academy of Sciences, was initiated to use lake sediments from three regions of China to determine the extent to which impacts to freshwaters have changed through time and the causes of these changes. The three areas were selected on an east-west transect along the Yangtse River. This paper discusses the results from the first of these areas, the lowland Jiangsu region in eastern China, and focusses on those aspects of the study dealing with the identification of changes to the pollution status of the lakes.
Lake sediment cores were taken from three sites in October 1998; Tai Hu, Cheng Hu and Ge Hu. Analyses included radiometric dating using 210Pb and 137Cs, geochemistry of major and trace elements, environmental magnetics, nitrogen and phosphorus measurements and spheroidal carbonaceous fly-ash particle (SCP) analysis. Non-pollutant analyses, used to aid interpretation of the pollutant signal included lithostratigraphy, grain-size and microfabric properties.
With respect to atmospheric pollution, SCP profiles fom Tai Hu showed rapid increases in concentration in the 1940s and 1950s, peaks in the mid-1980s to 1990s and a decline towards the sediment surface. Similarly, strong trace metal enrichment was observed for Cd, Cu, Pb and Zn. Concentrations increased simultaneously with the SCP profile, and then whilst Cd and Pb plateaued, Cu continued to increase to the surface. The magnetic records also showed that the recent record was dominated by pollution derived particles. Tai Hu has therefore been increasingly contaminated over the last 40 - 50 years probably due to the rapid development of the nearby cities Shanghai, Suzhou, Wuxi and Changzhou as well as many local industries. Nitrogen and phosphorus data show a continuous increase over the period covered by the cores suggesting increased eutrophication as well. In Cheng Hu and Ge Hu, atmospheric contamination is also observed via the SCP record, although enrichment in trace metals is less clear than in Tai Hu. However, at both Ge Hu and Cheng Hu nitrogen and phosphorus increase over the period of the cores.

48 MONITORING THE CHANGES IN BIODIVERSITY IN OMAYED BIOSPHERE RESERVE (OBR) USING MULTIDATE SATELLITE IMAGERY

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The Mediterranean coast of Egypt forms the edge of great arid desert belt which extends through a great part of Africa, but it has an increased rainfall owing to its proximity to the Mediterranean sea. It is characterized by a distinct variety of landforms ranging from snow-white coastal sand dunes to clay/loam salt marshes and rocky ridges with skeletal shallow soils. El-Omayed biosphere reserve is a part of the western Mediterranean desert of Egypt.
The main features of the various physiographic units lead to the distinction of three major physiographic systems which are; a coastal system , ridges and depressions and inland plateau system. According to UNESCO, Man and Biosphere (MAB) Program, the Omayed Biosphere Reserve is divided into core zone (2 core zones in Omayed), buffer zone, and transition zone. The three zones cover a total area of about 700 km2 . The declaration of OBR provided a stimulus to conservation movement in Egypt.
In 1983, the law 102 was issued, that provided the legal framework for the establishment and management of nature reserves, national parks, and similar reserves throughout Egypt. This law explicitly prohibits any action that would endanger living species or destroy landscapes within the protection area. There are many development projects in the area that have affected the biodiversity in the Omayed Biosphere Reserve. All economic development takes place within natural ecosystems, which may or may not have been modified by man. Development brings about very varying degrees of modification, but always remains subject to ecological limitations which operate within natural systems; these limiting factors must be taken into consideration if the development is to succeed.
Habitat loss has also been observed in OBR, subsequently extinction of species were encountered. This would call for assessing the changes in biodiversity in OBR to formulate the appropriate biodiversity strategies that meet the conservation goals of the BR. The objectives of this paper is the assessment of the Biodiversity change in Omayed Biosphere reserve using multidate SPOT satellite imagery, and identification of keystone species of different habitats in the area for restoring their environments. In the present study, environmental changes were assessed by comparing spot imagery of 1987, 1993 and 1999. New boundary definition of the OBR are suggested , which include less affected areas and representative biodiversity for better conservation actions.

49 BRIDGING THE GAP : DEVELOPING A NATIONAL ENVIRONMENTAL MONITORING STRATEGY TO MOVE FROM BEST AVAILABLE INFORMATION TO BEST NEEDED INFORMATION

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This paper will address the question of how environmental monitoring programmes might be better targeted to meet the priority information needs of policy-makers and environmental managers. It will draw upon experience gained in a recent review of national environmental monitoring programmes in England and Wales and related projects being carried out at a pan-European level. The overall conclusion is that there is a significant gap between the information available and that which is needed for framing, implementing and evaluating effective environmental policies. There are several reasons for this, but a fundamental problem is inadequate communication between information users and providers.

The review process has resulted in several initiatives being taken forward. It is recognised that in an economic climate where resources for long-term monitoring programmes will inevitably be constrained, gaps will have to be bridged by re-focussing effort away from low priority and redundant activity to high priority work. Emphasis is therefore currently being placed in improving the efficiency of monitoring networks and the streamlining of data flows. Issues that are being pursued as a consequence of this review include:

elimination of monitoring activity which produces redundant information, particularly in statutory programmes;
obtaining better information value from existing data sets;
improving integration of monitoring programmes across different issues and environmental media;
the use of modelling techniques to improve the targeting of long-term monitoring programmes and to fill information gaps;
development of new environmental surveillance technologies to improve, in particular, the spatial dimension to environmental information; and
exploring other ways of acquiring priority information such as 'volunteer' monitoring.

There are undoubtedly all sorts of opportunities to optimise the efficiency of monitoring and reporting processes. But, the effectiveness of these programmes can only be improved if they are addressing the right questions in the first place. A consensus is needed on what are the priority policy-related questions of today (and what they are likely to be for tomorrow). The policy-makers themselves need to take a central role in this debate and not leave it to the data providers to second-guess their requirements. This is essential if we are to move from a position of trying to make the best use of available, but inadequate information, to generating information that is actually needed.

Recent developments in environmental and sustainable development indicators have already begun to focus and improve the dialogue between the information user and information provider communities. Much of this work has centred so far on presenting basic trends in the state of the environment and the pressures placed upon it. More emphasis is now needed on bringing together social, economic and environmental information to improve our understanding of what is happening within different sectors and the driving forces behind environmental change to help policy-makers focus on appropriate responses.

50 AN EARTH SYSTEM OBSERVATION NETWORK: GLOBAL CHANGE AND GLOBAL CHALLENGES

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The reasons to monitor the environment at local and regional scales seem obvious, and there are many examples where long-term observational data have pointed to an environmental problem which has then been ameliorated. But why monitor the environment at the global scale? Three aspects of the contemporary global environment strongly suggest that we develop a comprehensive, coherent global observation system, and we do so as a matter of urgency. First, the global environment is a

manifestation of the Earth's physical, chemical and biological components acting together as a single system at the global scale. Second, the role of biological and ecological processes in controlling the functioning of the Earth System is far more important than we thought a decade ago. Third, human activities are having a profound and accelerating influence on the functioning of the Earth System, perhaps even threatening the stability of the global environment on which human welfare depends. The evidence is mounting that the impacts of these human activities are now beginning to reverberate through the Earth System, triggering an increasing number of changes in the environment. An Earth System observation network – a type of early warning system for systemic planetary change – is now urgently needed to identify, describe and monitor such changes. The challenges to develop such a system are many – consistency, flexibility, continuity, longevity, institutional - but they must be met if human societies are to have a chance to understand and respond to the accelerating changes now affecting the global environment.

51 PAST AND FUTURE CLIMATE MEASUREMENT

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Even the most sophisticated climate models are not yet able to predict what the real-world climate will do, for many natural influences cannot be modelled with any certainty. This makes it essential that we measure precisely what the climate actually does in reality.

However, all environmental measurements from the past, and most measurements being made today, originate from simple, manual instruments developed a century or more ago, with all their manifest shortcomings, including low accuracy and their need for operators (Strangeways 2000). A typical consequence of this is that the datasets that the Intergovernmental Panel on Climate Change (IPCC) has had to work with, in an attempt to estimate how global temperatures might have changed over the last 150 years, are far from perfect, and much work has been required to "homogenise" the measurements, to reduce their many errors. The same difficulties occur with all of the other climate variables, and over the oceans we have virtually no measurements whatsoever of precipitation, evaporation, or radiation.

With the recent development of intelligent data loggers, able to record, automatically, measurements made by precision electronic sensors and to telemeter them from anywhere on Earth, the environment can now be measured to much higher accuracy, with complete geographical coverage - should we choose to make the necessary investment. This conference is an encouraging sign that the scientific community now recognises the importance of better data collection. But the potential of these new techniques will only be realised if the instruments are of suitable quality, competently operated, correctly sited, and well maintained.

The WMO recently introduced its Global Climate Observing System (GCOS) to co-ordinate data from the existing mix of national and international instrument networks. However, the GCOS does not introduce any new instruments of its own, relying on existing networks over which it has no control, its success resting entirely in the hands of the individual network operators, whose skill, commitment and permanence vary greatly. The GCOS does not go nearly far enough.

If we wish to obtain a reliable dataset of climate variables in the future, it will be necessary to install a new, world-wide network of precision automatic instruments, dedicated to the task of climate monitoring, to a standard design throughout the world, independent of national networks, managed and inspected by an international team of experts, measuring selected variables at key sites, the sites being chosen for their scientific and geographical suitability, rather than by historic chance, the availability of operators and the dictates of shipping lanes, as with the existing network. While Remote Sensing will certainly figure in this, ground-based measurements will be the key. This talk outlines possible future strategies for better long-term, surface-based climate monitoring and examines the shortcomings of past and present techniques.

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52 ENVIRONMENTAL REPORTING AND DISCLOSURE IN SIX INDUSTRIAL SECTORS

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The paper is based upon reported results of a survey of environmental reporting and disclosure practices in UK companies in six industrial sectors. The sectors are automotive, banking, electronics, energy, food and drink and water.

Many of the early empirical studies about environmental disclosure and reporting were concerned with simple "yes", "no" questions as to whether or not companies disclosed environmental information. This led to other studies that attempted to quantify the amount of disclosure by considering the number of pages, lines or words that were devoted to such disclosures. As time passed the research became increasingly concerned with the type of disclosures and, most recently, with extensions into environmental auditing.

The purpose of the paper is to extend these findings and to go beyond just an examination of whether or not environmental information is disclosed and the nature of such disclosures. Whilst these remain important questions, it is also important to determine how companies make such disclosures and who they believe are the audiences for such disclosures. This is an issue that is addressed. Furthermore, frequent criticism has been levelled in the past at those companies producing environmental reports, in particular, about the confusion they exhibit over their intended audiences. Information that is released to attempt to satisfy environmental groups and campaigners ought to be different to that released for the eyes of potential investors or shareholders. Therefore, we also consider the intended audiences of such information and the feedback gained from such audiences.

The paper also considers who influences the nature of environmental disclosures and which groups, if any, companies consult when making such disclosures. This concerns the issue of the groups or organisations, if any, from which companies seek guidance about what to report and how to go about reporting environmental information. Furthermore, this is related to the types of people or groups from whom companies receive requests for environmental information. Such requests ought to enable them to form an opinion about new and existing audiences that emerge as increasing interest is developed about companies' attitudes to sustainability and sustainable development.

The paper also examines the attitudes of the respondents, mainly environmental officers and health and safety officers, to various aspects concerned with environmental reporting including whether or not it should be made mandatory and how it may develop in the forthcoming years.

Sectoral results are reported and considerable differences exist. However, the totality of the findings does not paint a rosy future for environmental reporting and disclosure in the future.

53 DETECTING CHANGE IN DIVERSE SPECIES ASSEMBLAGES: LONG-TERM MONITORING OF THE GREAT BARRIER REEF

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Coral reefs have famously diverse assemblages of fishes and benthic organisms. For the last nine years, the Australian Institute of Marine Science has run an extensive monitoring program which aims to track regional changes in status of coral reefs over most of the Great Barrier Reef World Heritage Area. The abundances of nearly 200 species of fishes and more than 70 categories of benthic organism are recorded at sites on 48 reefs in annual visits. A technique of non-parametric MANOVA is being applied to assess change in the diverse assemblages. This technique can accommodate the hierarchical sampling design and provides probability values based on randomization.

54 INTEGRATING SEDIMENTARY AND DOCUMENTARY HISTORIES IN AUSTRALIA: APPROACHES AND CHALLENGES

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Detecting instrumental data trends in highly variable Australian environments is problematic, a situation worsened by the paucity of long term observations (particularly those focussed on the biota). An understanding of environmental change and variability may therefore be obtained by systematically relating palaeoecological data to detailed documentary information. Importantly, where palaeoenvironmental records are compared to comprehensive historical data, the key processes driving ecological change may be identified, thereby informing both monitoring and management decision making. This paper outlines a critical approach to the integrated use of palaeoecological data (notably pollen and diatoms as indicators of vegetation and water quality, respectively) in combination with comprehensive documentary data to examine the nature of human influence on the Australian landscape.

Imposition of settled agriculture on a continent until recently occupied solely by hunter-gatherers, combined with often systematic record keeping by early non-indigenous inhabitants, makes the task of identifying land use impacts more straightforward. However, there are still considerable methodological challenges to integrating palaeoenvironmental and documentary data related to both the nature of environmental change and the way in which it is recorded.

Factors such as documented climate shifts and purported intensification of indigenous occupation leading up to, and during, initial European contact serve to confound simple explanations about land use impacts. Intra-and inter-sample timing different to that of forcing mechanisms may blur understanding, particularly where system variability (e.g. fire and flood periodicity) is important. Additionally, the contrasting life cycles of indicator organisms means variability is expressed differently for different groups. Taxa with short life spans (e.g. diatoms) may survive only in one alternate state, resulting in core assemblages without analogue in the environment. By contrast, the longer life span of terrestrial plants means that variability may competitively advantage taxa with wide tolerances.

Informative descriptive relationships can be drawn between core data and documentary sources and these can be rigorously evaluated using regression-based techniques. A major limitation to their application is dating accuracy, particularly in the case of 210Pb analyses. More reliable understanding is derived where chronologies are "tied" to independent dating markers (e.g. appearance of crop pollen). A complementary technique, requiring less precise chronology, is examination of historical changes in "control" and "impact" sites (for example burnt v. unburnt catchments). Examples of these approaches, which utilise very precise historical information, are provided.

Despite these and other methodological challenges, our evidence of water quality and vegetation response to European impact indicates that in some cases variability has been amplified (for example more extreme fires). By contrast, in a number of systems, agricultural land use results in initially high levels of disturbance (which shift ecosystems to a new state), followed by the imposition of unnatural level of stability. Genuine restoration measures would therefore focus on re-establishment of natural variability regimes.

55 CANADA'S ECOLOGICAL MONITORING AND ASSESSMENT NETWORK: SCIENCE-BASED AND POLICY-RELEVANT

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Ecological monitoring and its associated research programs have often provided answers to environmental management issues. Ecological monitoring provides decision-makers with reliable information as they grapple with maintaining a healthy economy, in the face of changing environmental conditions. The Ecological Monitoring and Assessment Network (EMAN) is a national ecological monitoring network consisting of about 100 case study sites across the country characterized by long-term multi-disciplinary environmental work that is conducted by a multitude of agencies; a variety of less comprehensive yet more extensive monitoring sites; a network of core monitoring variables of ecosystem change; and geo-referenced environmental observations. EMAN's focus is the fostering of a scientifically-sound, policy-relevant ecosystem monitoring and research network based on stabilizing a network of case-study sites operated by a variety of partners; and developing a number of cooperative dispersed monitoring initiatives. This network delivers unique and needed goods and services: an efficient and cost-effective early warning system of ecosystem changes; and cross-disciplinary and cross-jurisdictional assessments of ecosystem status, trends and processes. An Early Warning System is needed to detect, describe and report on changes in Canadian ecosystems at a national or ecozone scale providing: a national perspective on Canadian ecosystems affected by the multitude of stresses on the environment; an early warning system that identifies new ecosystem changes as they emerge; consistent nation-wide
information related to the success of, or need for, controls and other resource management initiatives; sound recommendations for appropriate follow-up initiatives in research, focused studies or assessment; and ongoing information on the appropriateness of existing priorities.
Assessments of Ecosystem Status, Trends and Processes are needed to: demonstrate the utility of partnerships in meeting departmental, other federal government department, partner and national objectives related to ecosystem understanding, trends and management; improve partnership monitoring, data-base management, metadata, interpretation and communication
initiatives; cooperate in the interpretation and assessment of observations and subsequent communications; and provide a unique input to State of the Environment Reporting. These two pillars ensure that Environment Canada and partner organizations are provided with timely information that allows for increasingly adaptive policies and priorities; and that Canadians are informed of changes and trends occurring in Canadian ecosystems and as a
result are better able to make decisions related to environmental conservation and sustainability.

(Note: this paper was also presented as a poster paper)

56 THE PALEOLIMNOLOGICAL RECORD OF ECOSYSTEM RESPONSE TO HUMAN IMPACT ON LAKE VICTORIA, EAST AFRICA

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Lake Victoria, the largest tropical lake ecosystem in the world, has in recent decades become affected by severe eutrophication and probable extinction of more than half of its 500 species of endemic haplochromine cichlid fishes. Continuing destabilisation of food-web structure and nutrient dynamics in Lake Victoria has serious long-term consequences for the basic functioning of this unique large-lake ecosystem, and may threaten social welfare in the riparian countries by its impact on fisheries and water quality. However, balanced evaluation of the relative impacts of fish introductions, increased

nutrient inputs, and other recent disturbances on ecosystem functions in the context of natural long-term ecosystem variability and the history of land use in the Lake Victoria basin has been hampered by a lack of systematic monitoring data from before the recent upheavals. Here we present paleolimnological data from the offshore sediment record of Lake Victoria which show that the onset and evolution of eutrophication over the past century has paralleled human population growth and agricultural activity in the region, and that the dominance shift from diatom algae to bloom-forming cyanobacteria during the mid-1980s was triggered by the seasonal depletion of the lake's dissolved-Si reservoir which resulted after 50 years of excess diatom growth and burial. Eutrophication-induced hypolimnetic anoxia started in the early 1960s; seasonal persistence of deep-water anoxia since the late 1970s, which forced demersal haplochromine fishes to remain in shallower waters, may have been the proximate cause of intensified Nile perch predation which led to the early 1980s collapse of indigenous fisheries. Our data potentially explain why significant impact of Nile perch on indigenous fish stocks started only 20 years after its introduction to Lake Victoria, and suggest that increased algal production was an indirect cause rather than a consequence of changes in fish community structure. Restoration of the Lake Victoria ecosystem is primarily contingent upon improved land-use practices in its watershed.

57 THE EFFECTS OF THE EL NIÑO SOUTHERN OSCILLATION ON THE FISHERY AND RECRUITMENT OF *MUGIL PLATANUS* IN SOUTHERN BRAZIL

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In southern Brazil, cold (La Niña) and warm (El Niño) episodes of the El Niño Southern Oscillation (ENSO) phenomenon cause drought and high rainfall, respectively. The extreme rainfall associated with El Niño affect estuarine salinity and thereby exerts a strong influence on juvenile recruitment and adult reproductive migration dynamics of catadrome mullet (Mugil platanus) in the Patos Lagoon estuary (32o S). In this paper we describe the influence of occasional episodes of ENSO on the fishery, reproduction and juvenile recruitment of this species in the Patos Lagoon estuary and southern Brazil. The data set was composed M. platanus fisheries statistics in southern Brazil (1945 to the present) and the relative abundance and temporal distribution of young-of-the-year in the Patos Lagoon estuary (1979 to date) in conjunction with environmental factors (rainfall, salinity, temperature).

Mugil platanus occurs only from Rio de Janeiro (Brazil) to Argentina and is important to the artisanal fishery, with about 6000 metric tons caught annually. More than 95% of the total catch is harvested in the estuaries and coastal waters of southern Brazil (Rio Grande do Sul and Santa Catarina). In the Patos Lagoon, large mono-specific schools of adults are abundant during the late summer and fall. During April and May, the maturing adults start their reproductive migration out of the estuary and north after a sudden drop of temperature of 5º C to about 19º (both air and water). This also coincides with the peak on the commercial catches of mullets along the southern Brazilian coast, which start during April and May in Rio Grande do Sul and gradually move northward to São Paulo in June and July. The formation of large schools before adults reproductive migration out of Patos Lagoon only occurs on years of summers of high salinity and low precipitation.

Spawning occurs in off-shore waters between northern Rio Grande do Sul and northern Santa Catarina. Eggs and larvae drift towards the surf zone and after early juveniles reach approx. 20 mm TL they migrate to the bottom and begin to feed on benthic organism, specially diatoms, and a large quantity of mineral particles. At 25 mm TL mineral particles represents 18% of dry weight and 45% at 55 mm TL. The high specify weight at those size help them to recruit passively to estuaries by the bottom net upstream estuarine circulation. Recruitment at the Patos Lagoon occurs year-round with peak abundance during winter and spring. Ours data suggest that the increased fresh water discharge associated with El Niño event in 1997-1998 did not allow an abundant entrance of M. platanus juveniles into the estuary.

58 LONG-TERM LAKE RESEARCH IN THE BOHEMIAN FOREST (CENTRAL EUROPE)

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We present an overview of long-term investigation of eight glacial lakes in the Bohemian Forest (BF, Böhmerwald, Šumava). This Central European mountain range of sensitive crystalline bedrock has been exposed to heavy air pollution from both local and remote emission sources since many decades ago. Owing to 130-year occasional hydrobiological research we are able to document significant changes in plankton composition and fish. These changes in biota were running in parallel with the changes in lake water chemistry. Available trends in sulphate and nitrate concentrations, as well as palaeolimnological records document the timing of acidification progress and reversal from acidification. Atmospheric acidification of the BF lakes started >100 years ago but the first signs of acidification derived changes of lake water composition were observed in the early 1960s. Lake water acidification peaked in the early 1980s. However, distinct status of catchment vegetation, bedrock and soil composition, and nutrient loading yielded different response of the BF lakes to acid deposition and their composition varied in a wide range (the 1984 status: pH, 4.2–5.5; SO42–, NO3–, and total Al concentrations of 26–93, 38–86, and 4–39 µmol l–1, respectively). Due to acidification, extinction of fish and crustacean species occurred in most of the BF lakes and, therefore, both autotrophic and heterotrophic microorganisms became the dominant plankton components there. Reversal of lake chemistry from acidification has occurred since the late 1980s and led to a pronounced improvement of water composition (the 1997–1999 status: pH, 4.5–5.7; SO42–, NO3–, and total Al concentrations of 22–58, 16–62, and 7–20 µmol l–1, respectively). Yet the only unequivocal sign of biological recovery has been observed in Èerné Lake where a cladoceran species, Ceriodaphnia quadrangula has recently reached its pre-acidification abundance.

At present, the BF catchment–lake ecosystems represent a valuable Central European environment documenting the rapidly changing World: (1) They are sensitive indicators of environmental changes. (2) Being situated in the vicinity of pronounced emission centres of S and N compounds, they are valuable sensors of both acidification and recovery processes. (3) Differences in the lake chemistry and biota enable to study biological processes and biodiversity within a gradient of various limiting conditions like pH, Al concentration, nutrient status or food webs. (4) Whole ecosystem studies involving atmospheric deposition, soil, water and sediment compositions enable to investigate present and historical status of nutrient availability for both terrestrial and aquatic biota and to predict their future development.

59 INTEGRATING BIODIVERSITY AND GLOBAL CHANGE: THE INTERNATIONAL BIODIVERSITY OBSERVATION YEAR

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A solid science-based knowledge of the linkages between biological diversity and the functioning and sustainability of ecological, physical and social systems is urgently needed for informed environmental decisions. In recent decades disciplinary research has dramatically improved knowledge of the individual components of biodiversity and its importance to the Earth system.
Rapid expansion and diversification of biodiversity research has occurred as technological advances have enabled investigations at genetic to landscape scales and in previously inaccessible habitats. Thus, biodiversity research has become an important component of applied research to monitor and manage the Earth's natural resources. However, these developments have occurred along traditional reductionist lines of scientific inquiry, so that much of the research and findings are compartmentalized by discipline (e.g., taxonomy, ecology, biogeophysics), by taxonomic group (e.g., microbes, amphibians, C3 grasses), by habitat (e.g., freshwater, marine or terrestrial) and by biome (e.g., wet tropics, arid grasslands). As scientists have increased their knowledge, and as they investigate means to model and detect environmental change, they have realized the need to integrate and cross the interfaces of disciplines in order to: (i) capitalize on new techniques and technologies such as

informatics, molecular technologies and remote sensing and (ii) consider the interactions of biological diversity with physical and social systems.

Until recently there has been no forum for scientists to gather to integrate the many facets of biodiversity research. Integration of the global biodiversity sciences has been a primary focus of the DIVERSITAS-International Biodiversity Observation Year 2001-2002 (IBOY). This effort has brought together biodiversity researchers involved in local studies and those involved in large-scale, international research networks that cross multiple disciplines, habitats, organisms, temporal and spatial scales, technologies and nations. They also work to increase communication from scientists to the public, through many venues, including film and press media. The ultimate goal of IBOY is to be a pulse of activity in which to increase holistic understanding of biodiversity and its influence on the functioning and stability of the Earth System, through integration of the disparate components of biodiversity research. Amalgamating research on, and knowledge of the many facets of biodiversity will yield more complete detection of environmental change that considers the feedbacks within and across anthropogenic and natural systems. Drawing together the researchers across disciplines will also identify how integrated research can address environmental challenges, impacting the direction of future research.

60 EFFECTIVE USES OF ENVIRONMENTAL MONITORING DATA: WATERWATCH – KAITIAKI WAI A WATER QUALITY MONITORING PROGRAMME FOR NEW ZEALAND SCHOOLS AND COMMUNITIES

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In many countries there are examples of water quality monitoring studies being undertaken by schools and communities. Several questions are prompted by the fact that these programmes have increased in number over the last ten years at a time when there has been growing interest in 'state of the environment reporting' and recognition of the relevance of long-term monitoring of environmental change. Can the information collected by school water quality monitoring programmes contribute to regional and national long-term monitoring programmes (of waterways, lakes, estuaries and coasts) - or State of the Environment reporting at both national and international levels? Should monitoring the State of the Environment be part of the curriculum? Should part of the curriculum deal explicitly with monitoring environmental change? Children are the future adults in society. Could school programmes contribute to a national picture of water quality?

The establishment of a Waterwatch programme at Lincoln University, New Zealand, in 1998 has proved to be very popular with schools. The experience and information from this venture together with collaborative work with other water quality monitoring programmes in schools in other parts of the country help to provide some answers to the above questions.

The data collected by schools and communities can provide useful information for long term monitoring provided that there is quality control in the methods used. Waterwatch uses US EPA approved methods and the need for quality control must be provided by the Waterwatch staff or trained teachers. The water quality monitoring is adaptable to a wide range of ages and can fit within school curriculum in a variety of subjects. Monitoring allows schools to make spatial and/or temporal comparisons between sites and at different times of year. Ideally this type of activity should be incorporated as part of the school curriculum. Education and training are relevant to and enhance societal attitudes to environment, particularly in stewardship towards the environment. Opportunities exist to detect change as a community group, going beyond the classroom into the wider community thereby raising awareness of water quality issues.

If the results of all these activities can be co-ordinated regionally and nationally, they will contribute to a national picture of water quality that, in turn, could contribute to State of the Environment reporting. Costs are involved in this co-ordinating role to train teachers, maintain equipment and ensure quality control. At present our Waterwatch kits are loaned to schools free of charge because New Zealand schools are unable to meet these costs.

61 PARTICIPATORY MONITORING AND ENVIRONMENTAL PLANNING IN URBAN AREAS.

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This paper will report on a research project that investigates the level of participation in urban environmental monitoring in the UK and analyses the extent to which it contributes to local authority planning. The roles played by actors and institutions are analysed in terms of their contribution to both regulatory monitoring (statutory duty) and voluntary environmental monitoring in the West Midlands local authorities areas. The research uses a case study approach to investigating monitoring activities in four environmental theme areas: the shallow sub-surface; atmospheric dynamics and chemistry; hydrological balances; and urban biodiversity. The paper examines pathways of information exchange within the monitoring community in terms of policy networks, and how these activities contribute to environmental policy and local authority development planning.

Local authorities of the West Midlands are used as the case study area where the relationships between statutory and non-statutory bodies, experts and non-experts, individuals and groups in local level environmental monitoring are investigated through face-to-face interviews. These were designed to gain an understanding of the procedures undertaken in monitoring and of the involvement of non-statutory groups and their contribution to local authority planning. Similar interviews were carried out with these non-statutory organisations which are made up of voluntary groups and independent research groups (consultancies and universities) involved in monitoring in the West Midlands local authority areas. The extent and nature of participation in terms of data collection and evaluation of information in the four theme areas will be described.

Results of the survey will be presented through diagrammatic representations of the links between the statutory and non-statutory organisations. These will be repeated for the four themes and will show that involvement in urban biodiversity monitoring is high since large numbers of independent voluntary groups are active in this field. These groups have collected a significant amount of the data used by both local and regulatory authorities and their involvement in data analysis and presentation is also high compared with the other theme areas. Participation by non-statutory bodies in monitoring of water quality and atmospheric quality is less active, and there is very little non-statutory involvement in soil quality monitoring. This is due to a lack of interest in these theme areas or a deficit of technical expertise and equipment.

The context for this study is provided by the UK's Natural Environment Research Council (NERC) URGENT Programme (Urban Regeneration and the Environment) currently being co-ordinated by the Centre for Hydrology and Ecology (CEH). This programme aims to integrate urban ecological and environmental research across the geological, terrestrial and freshwater and atmospheric sciences. It works in partnership with city authorities, industry, regulatory bodies and research institutions to stimulate regeneration of the urban environment.

(Note: this paper was also presented as a poster paper)

62 UNCERTAINTY AND MODAL DOMINANCE IN THE MODELLING AND PREDICTION OF ENVIRONMENTAL CHANGE

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The environment is a large and complex system and it is not surprising that environmental simulation models are often similarly complex. But such large (and often deterministic) models suffer from problems of severe over-parameterisation, so that their statistical identification and estimation from limited observational data is fraught with many difficulties. This leads to considerable parametric uncertainty and the need to evaluate the consequences of this uncertainty, particularly when the model is used as a vehicle in either detecting environmental change, or predicting environmental variables over long periods into the future. Another, rather different, approach is to statistically identify reduced

order, 'dominant mode' models directly from the available environmental time series. This approach can by-pass some of the over-parameterisation problems by ensuring that the model is well identified from the data and so well parameterised (parsimonious). Of course, these methods are not mutually exclusive and this paper will argue that the science of environmental change detection and prediction should exploit them both within a wider dynamic systems context.

The paper will first discuss briefly the results of a study that investigated the problems of over-parameterisation, modal dominance and uncertainty in global carbon cycle models (e.g. Young et al, 1996; Parkinson and Young, 1998; Shackley et al, 1999). These results suggest that the Data-Based Mechanistic (DBM) approach to environmental modelling (e.g. Young, 1998 and the prior references therein), which exploits powerful methods of optimal recursive estimation (e.g. Young, 1999 and the prior references therein), negates some of the difficulties associated with the use of large deterministic models. As a result, it is not only useful in its own right but can also help in drawing attention to some of the potential problems associated with the modelling and use of large simulation models. Because of its inherent recursive nature, this approach also provides a vehicle for 'data assimilation'; one that is particularly well suited to the statistical detection of change in the environmental time series.

The efficacy of this DBM approach to environmental modelling will be illustrated by a number of practical environmental examples. These will include the investigation of changes in water quality in the River Elbe following the unification of Germany; modelling and prediction of Central England temperatures from 1659-2000; modelling the relationship between greenhouse-gas changes and global average temperature over the period 1850-1995; and of the modelling of air temperature variations in the Antarctic over the period 1956-1996. The latter example also considers a possible stochastic, dynamic relationship between the ENSO index and the air temperature that suggests the possibility of interesting long-term feedback effects.

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Poster papers

1 SOCIO-ECONOMIC IMPACTS OF THE ENVIRONMENT DEGRADATION IN THE COASTAL ZONE OF CÔTE D'IVOIRE.

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The coastline of Côte d'Ivoire encompasses a variety of coastal habitats including lagoons, estuaries, mangroves, swamps and humid zones. These critical habitats providing spawning grounds for numerous fish, molluscs, birds and manatees and other life forms are now endergoing rapid destruction as a result of intense human activities such as agriculture, industry, mining, urbanization and tourism. This has resulted in deforestation and critical habitat destruction and loss of biodiversity, pollution of water bodies, over-exploitation of natural resources and increase rate of coastal erosion in the coastal zone. The degradation of the coastal environment have several socio-economic implications. The loss of income as result of decrease touristic activities, low fisheries potential. Unemployment and impoverishment have favorised the migration of the coastal rural population toward the big cities. The contamination of surface and ground waters by toxic substances and microbes and also the invasion of coastal waters by aquatic plants (weeds and water hyacinth) have increased the public health hazard. Concerning the traditional and cultural aspect there has been a loss of the coastal rural population identity and culture.

2 CHANGES IN SOLUTE DYNAMICS OF UPLAND BLANKET PEAT AT THE MOOR HOUSE – UPPER TEESDALE ENVIRONMENTAL CHANGE NETWORK SITE.

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Moor House – Upper Teesdale National Nature Reserve, in the north Pennine uplands, has been an ECN site since the network was established in 1992. Precipitation, soil solution and drainage water are collected using ECN protocols from an area of the site dominated by blanket peat. Blanket peat covers more than 14,000 km2 of Britain, but despite this there have been no other long term studies of solute concentrations in such ecosystems. Solutes are important because changes in their concentration drive changes in the biota being monitored by ECN.

Precipitation is collected weekly from a funnel gauge. Input fluxes of most solutes are higher than the UK average, because of the high annual rainfall of 2 m. Annual input of NO3-N averages 4.0 kg ha-1 and NH4-N averages 4.8 kg ha-1. In common with other sites SO42- in precipitation is declining.

Soil solution is collected from blanket peat using quartz/Teflon suction lysimeters, with six at 10 cm where pH averages 4.1 and at six 50 cm where pH averages 4.5. Low concentrations of NO3- and NH4+ at 10 cm indicate that the N in rainfall is utilised by the vegetation, while high concentrations of dissolved organic N indicate that N in the soil is derived from the decomposition of plant material. Following the exceptionally dry summer of 1995 solute chemistry at 10 cm changed rapidly as a result of the formation of SO42+, when a fall in the water table exposed a large volume of the peat to aeration. This caused an increase in acidity at 10 cm equivalent to fall of 0.7 pH units. Similar but smaller peaks were detected following the summers of 1994 and 1999. The dry summer of 1995 also resulted in increased concentration of NO3- in soil solution which persisted until autumn 1998.

Drainage water is sampled weekly at five locations ranging in size from a seasonally flowing Sphagnum flush to the Trout Beck which has a catchment of 11.5 km2. Discharge at the time of sampling strongly influences solute concentrations in the streams but the peaks in SO42- and NO3- associated with the drought conditions were detected in the streams. Snow has a detectable influence on stream concentrations with preferential release of SO42- and NO3- from the snow. A single sampling of 74 peat dominated streams on the site during a period of low flow demonstrated significant correlations between the form of N and the type of vegetation in the catchment.

Important changes have been detected in soil and stream solute concentrations and drought is a more significant driver of change than temperature or atmospheric deposition. If dry summers become common then solute concentrations will rise, particularly if the tail of one peak is superimposed on the

following peak. As terrestrial vegetation depends upon soil solution as the principal source of nutrients and aquatic organisms are very responsive to water quality, an understanding of solute dynamics is essential to understanding change in plant and animal populations.

3 OBJECT MODEL FOR TEMPORAL CHANGES IN GEOGRAPHICAL INFORMATION SYSTEMS

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Current GIS approach of representing changes of geographical phenomena does not provide the ability to examine the complexities within the changes, in order to allow the integration of changes for different themes (e.g. transportation, infrastructure, population etc). This has become a major problem because a change in one theme may have adverse effect on the others, thereby risking the work of urban planners. This situation is exacerbated by the fact that no adequate data models are available which could efficiently represent detailed changes, showing the pattern of relationship among the themes, the cause of changes and result of the changes over time.

Existing GIS database models cannot represent effectively the history of geographical phenomenon and the current approach of representing changes such as snapshots cannot show the detailed complexities within the changes. The ability to examine the continuity of change of geographical phenomena has been given some attention in the past decade. The conceptual and practical problems of representing typical models within a database have made it difficult to successfully implement them.

The aim of this research is to develop an object-oriented GIS model that will represent detailed changes of geographical objects and track the evolution of objects. The detailed changes include spatial, thematic, temporal, events and processes that are involved in the changes. Those have been addressed, but not implemented, by a number of works on GIS. The major problem that needs addressing and is regarded as the main contribution of this work is related to object tracking and evolution. Object tracking and evolution includes not only attributes changes to homogenous objects, but also major changes that lead to transforming/destroying existing objects and creating new ones. This will allow the pattern of changes of geographical phenomena to be examined by tracking the evolution of geographical objects.

This research is addressing the deficiencies in two existing GIS models which are related to this work. The first model, triad model represents the spatial, thematic and temporal but fails to represent events and processes connected to the changes. The second model, the event-oriented model, though represents the events (or processes) related to the changes, it stores the changes as attributes of the object. This model is limited to temporal stable (static) changes and can not be applied to the evolution of dynamic geographical phenomena or changes that involves several objects sharing common properties and temporal relationships. Moreover, the model does not take into account the evolution (e.g. splitting, transformation etc) of a specific object which can involve more than changes to its attributes. Both models are not able to tackle for instance the following situations:
When an object such as a park is disappearing to make way to new objects such as a number of roads and new buildings.
An agriculture piece of land becomes an industrial lot or village becomes a city.
In this work the construction of a new approach which overcomes these deficiencies is presented. The approach also take into account all associations and relationships between objects which would be reflected in the object oriented database such as inheritance. For example a road can be regarded a base class from which other classes can be derived such as motorways, streets, dual roads etc which might reflect the evolution of objects in non-homogenous ways.

4 "VALUATION OF ECOLOGICAL FUNCTIONS AND BENEFITS: A CASE STUDY OF WETLAND ECOSYSTEMS ALONG THE YAMUNA RIVER CORRIDORS OF DELHI REGION"

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The estimation of economic values of the ecological functions of any ecosystem makes decisions of resource utilization and allocation more meaningful and efficient. Economic estimates of natural resources help in comparing various options available to the decision makers for the management of a given natural resource. Wetland ecosystems present in the corridors of a river passing through a city provides benefits not only to the human society but also to the associated dependent ecosystems. These wetlands areas present in the midst of an urban society are greatly influenced by anthropogenic factors. Twenty five kilometers strecth of the river Yamuna extending from Wazirabad to Okhla in the corridor of Delhi is perhaps the most threatened riverine ecosystem in the world because of the anthropogenic pressures on the riparian habitat particularly in the floodplain areas. These areas of floodplains of Yamuna river have been continuously been confronted by the encroachments and conversions for various purposes i.e. for urban development and agricultural activities putting threat to the very existence of this wetland.

In the current paper first, the area of floodplain has been identified. On the basis of soil, vegetation and hydrogeomorphic criteria three types of wetland ecosystem have been demarcated in the Yamuna river corridor. The extent of these wetlands types have been mapped out by field surveys of the respective areas. During the winter season the area of marshyland and seasonal pools have been identified as 3100 ha, 110 ha abd 40 ha respectively. The areas of these wetlands ecosystems change seasonally therefore it is necessary to map their extent in various seasons. Their extent also varies in between seasons depending upon the change in land use brought about by anthropogenic pressures. Yamuna river corridor being in Delhi city which has ever increasing population, the rate of conversion of natural areas to alternative uses is high. Wetlands consist of characteristic assemblages of species, which interact with each other and the environment. These interactions within and between the biotic and abiotic compnents of wetland ecosystems leads to the flow of ecological funcitons which provide direct economic benefits whereas others provide indirect support and protection to an economic activity. Wetland ecosystems of the Yamuna river corridor were assesed for six funcitons based upon the prelimniary observations . These are hydrological functions, biological productivity ,sediment trapping/stabilization, habitat for flora and fauna and nutrient storage.

Since the economic valuation of ecological functions of wetland help in developing a sustainable conservation strategy for floodplain area and they provide the rationale for investible funds for this purpose, an attempt has been made in this paper to evaluate the economic value of these ecological functions and for this purpose different direct and indirect benefits arising out of ecological funcitons of the wetlands of Yamuna River in the corridor of Delhi e.g. water supply, fisheries, low input sustainable agriculture, fodder, utilizable plant species, fuelwood and recreation/ tourism benefits etc. have been quantified and estimated.

A great care has been taken in the selection of valuation techniques for these functions. For direct tangible benefits (e.g agriculture, fisheries, water supply, fuelwood and fodder etc.) market based techniques have been preferred. For indirect benefits (e.g recreation and water supply through water recharging etc.) indirect market based techniques have been adopted. For biodiversity (birds and other plant species) constructed market method, (contingent valuation method) have been applied. Finally the cost of development (Foregone preservation benefits arising out of ecological functions) has been estimated for this floodplain area.

5 CHANGES IN THE CONCENTRATION AND TRANSPORT OF ORGANIC CARBON FROM SWEDISH RIVERS OVER THIRTY YEARS.

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This investigation reports changes in the concentration and transport of organic carbon in 43 Swedish rivers, together draining 84 % of the Swedish land area between the years 1965 and 1997.

Water chemistry data were obtained from the Swedish Environmental Protection Agency's national surface water quality monitoring program. Mean daily discharge measurements for the period were obtained from the Swedish Meteorological and Hydrological Institute. Permanganate number was used to measure organic carbon before 1987 after which year TOC was analyzed.

Considerable temporal variations were found during the period in rivers all over Sweden. In some rivers mean annual concentrations varied by more than 100 % between years. No clear temporal trend was detected and both concentrations and transport was related to variations in runoff.

6 INFLUENCE OF DEFICIENCY AND ABUNDANCE OF NUTRIENT ELEMENTS ON BEHAVIOR OF RADIOSTRONTIUM IN SOIL-PLANT SYSTEM

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Regulation of the fission products migration intensity in the soil-plant system by introducing into soil separate nutrient elements often leads to contradictory results. The reasons of such situation may be of insufficient evaluation of regulation mechanism of ion transportation by plants, which depend on concentration of salts in soil solution [Epshtain at all., 1976] and interrelation of macro- and microelements in nutrient substrate [G. Rinkis at all., 1989].
On the basis of the literature data, it was grounded the expediency of evaluation not only for the interactions, such as radionuclide / stable analog, but also the influence on behavior of fission products in soil-plant system N, P,K, Ca, Mg, Fe, Mn, Cu, Zn, Co, Mo and B.
To confirm this supposition, the experiments were conducted with Lettuce (sort Berlinsky) on highly cleared quartz sand and serozem soil. In inert substrate Rinkis medium [1972] was used as nutrient.
Decreasing of strontium-90 accumulation on mass/unit in Lettuce, was observed on relatively small lack (1,5–2 times) of nitrogen, magnesium, iron, copper, boric, and abundance of phosphorus, potassium, calcium, copper, zinc and cobalt. Increasing of radionuclides uptake in plants was observed by small abundance of nitrogen and insufficiency of phosphorus and calcium.
By strong insufficiency or abundance (10 or more times) of the substance one of the macro- or microelements in nutrition, a considerable increase of strontium-90 quantity on weight/unit in Lettuce was discovered.
More over, determining in Lettuce N, P, K, Ca, Mg, Fe, Mn, Cu, Zn, Co, Mo and B demonstrated that in dependence upon concentration of nutrient substance between individual elements, synergism, antagonism and mutual transition form synergism to antagonism can be exhibited.
Similar change in accumulation of radiostrontium in dependence on concentration of individual macro- and microelements was observed on serozem soil.
Thus, generalizing obtained results, the following conclusion can be made: uptake of strontium-90 in plants from inert substrate is being in dependence upon the concentration of separate macro- and microelements. Insufficiency or abundance not only of calcium but any other nutrient elements can considerably modify intensity of radiostrontium migration in soil-plant system.
The obtained results possibly will be also useful for evaluation radionuclide sizes of accumulation by plants, by combined contamination of soils with radionuclides, and heavy metals

7 SYSTEMATIC STUDY OF TENDENCIES OF DEVELOPMENT OF THE MOUNTAIN LANDSCAPES WITH USEING OF REMOTE SENSING TECHNIQUES.

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Intensification of anthropogenic load on environmental, excessive and irrational utilization of the natural resources lead to deep structural transformation of modern landscapes. The detection of direction of changes of natural territorial complexes in future has given a need to organization of constant ecological monitoring. Importance of aerospace monitoring, especially in mountain regions, which is difficult of access for surface researches, has been highered in connection with necessity in

information providing for ecological programs. The period of restoration in disturbed and natural systems is large enough in these regions. Multilevel aerospace photos (ASP) taking place at different times owing to its high resolution, large survey and optical generalization allow to regular observation of environmental change, to reveal a dominant exogenic and anthropogenic processes, to determine a direction and character of changes in relatively unstable mountain landscapes, to register every change at the appointed time and to forecast tendencies of its subsequent development.
Remote sensing techniques oppose to isolated, strictly specialized consideration of present problems of environmental and favour the integration in modern geography. This aspect has given a need in elaboration or perfection of methods of complex landscape-geomorphological (geographical) interpretation of ASP.
In the light of aforesaid the new complex methods of indication landscape-geomorphological interpretation of ASP of mountain territories with large dynamics of processes of endo- and exogenic reliefforming and landscapeforming have been worked out by us. Eastern part of the Major Caucasus has been selected as a model region for approbation of proposed methods. Various scale, black-white and colours ASP in the period of time from 1970 to 2000 years have been interpreted accordingly.
The comparative analysis of materials of the complex landscape-geomorphological interpretation of ASP of the eastern part of the Major Caucasus has been allowed to follow the dynamics of development of modern mountain landscapes, to study the character and degree of anthropogenic influence, to determine the after-effects of human activity.
As a result of complex aerospace monitoring in environmental the original map-scheme has been compiled. Interpretation of materials of ASP has been allowed to distinguish within the researched region following types of landscape: nival-subnival, high mountain meadow, mountain forest, mountain meadow-shrub, mountain steppe, semidesert and, conformably, types of morphosculptures: glacial, periglacial, humid, arid (zonal) and gravity, water-erosion, water-accumulative (azonal). Some main typical peculiarities of interpretation of its spatial, altitudional and internal differentiation have been exposed.
On the basis of remote sensing materials it has been also determined those unstable natural systems of the eastern part of the Major Caucasus change, transform and sometimes degrade completely under anthropogenic influence. Critical mass of negative changes, which don, t self-reestablish, accumulates. In this conditions new natural-anthropogenic systems form. Its development depends on natural appropriates, on the one hand, and anthropogenic influence, on the other hand. Therefore, in future for information providing with optimization of ecological situation within the given region it is necessary to perfect the system of monitoring in environmental on the basis of remote sensing.

8 ECOSYSTEMS CHANGING IN RUSSIA IN THE CONTEXT OF THE LAND TRANSFORMATION IN ADJACENT COUNTRIES.

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The paper is aimed at valuation of the contribution of Russia in occurrence and decision of ecological problems and problems of sustainable development in Eurasia region. A valuation of ecosystems' disturbance degree in Russia and adjacent countries due to economic activity is given on the basis of the joint analysis of statistical data on the environmental state and taking into consideration the reasons for distinctions in indicators. A structure of broken and non broken lands in Russia and adjacent territories is also analyzed in the paper. The degree of anthropogenically changed lands for different purposes is considered as an environmental change detector. Special emphasis was put on the role of the boreal forests in global ecological situation. One the important factor for the natural ecosystems disturbance is a population density and settling, so data on these parameters for Russia and neighboring countries are given in the context of discussed problem. Mentioned analysis has allowed to reveal regions of disturbance in terms of global scale and the regions of stabilization, able to become centers for sustainable development.

9 IMPLICATONS OF WETLANDS DETERIORATION IN THE BONABERI DISTRICT OF DOUALA IN CAMMEROON

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Located to the northwest of Douala Central, Bonaberi has grown into the largest district of the Douala metropolitan area. Characterised by massive urban-industrial development over a predominantly coastal wetland area, Bonaberi remain influenced by the expansive lagoon system and the Atlantic ocean to its north and south respectively.
Evolved with the Holocene Alluvial landscape of pronounced hydrologic and edaphic variability, its wetlands display extensive estuarine, deltaic, and coastal sediments, where tidal rather than flood regimes occur and where brackish rather than freshwater prevail. Wetlands of the Bonaberi district therefore constitute an interface between terrestrial and aquatic ecosystems describing coastal low-lying areas. Its geomorphic setting display old barrier beaches, coastal sandy plains, barrier islands, intricate network of creeks and lagoon inlets and an imposing lagoon complex. It is thus a zone of fragile geomorphic configuration where firm land is scarce, but ironically under high competition for utilisation.
This has witnessed haphazard encroachment of multiple land uses over the Bonaberi wetlands in the face of urban-industrial development, constituting the most intense process of deterioration. These are in form of increased housing structure, heavy industrial development, excavation for construction materials, road construction as well as agricultural activities.
A major finding is the poor land reclamation practices which has further increased wetlands deterioration in the Bonaberi district with serious environmental and social consequences . The paper discusses these consequences which include impaired water quality, inundation, flooding, sewage disposal, groundwater depletion, subsidence etc. with the goal for management strategies.

10 URBANISATION AND NOISE POLLUTION IN METROPOLITAN LAGOS: LEGISLATION AND ENFORCEMENT.

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Noise is any undersirable sound that is harmful to a person. Constant noise above 85 decibels could damage or cause permanent deafness when it affects the ear drum.
It causes stress, fatigue and irritability; it can wear a person down physically and emotionally.
Prolonged exposure can affect ones personality and provoke hostility.

Modernity has created many avenues that generates noise in our daily lives. Some of these are rapid and uncontrolled urbanization, industrialization, transportation and poor institutional arrangement.

While the developed economies have constantly explored ways and means to control the menace of noise pollution in their cities, the emerging economies are still involved in acts and practices that promote noise pollution with blantat disregard to Health.

Noise pollution is the most wide spread hazard plaguing metropolitan Lagos today. People with certain background cannot live in some parts of Lagos because of the noise level in such areas.
A recent publication by an environmental active group, Human Environment Organisation. (HEO), ranks Lagos as one of the noisest cities in the world.

Measurements carried out within the metropolis by the author, indicates that the sources of noise vary from area to area.
The measurement also reveals that the noise level is higher in densely populated areas of the metropolis than less congested areas, though they may fall in the same income category.

In 1986, the Federal Government of Nigeria, through the Federal Environmental Protection Agency (FEPA) a body empowered to implement environmental laws enacted some laws and published standard of noise level for the metropolis in line with WHO standard.

Despite this, Noise pollution is increasing daily. FEPA does not have the will and capability to implement the set laws.So far, nobody has been prosecuted.

This poster shall highlight the spatial spread of Noise by zoning the metropolis along income levels according to the zoning formular earlier used by the Lagos State government in 1997. with the aim to identify:

•The different sources of noise pollution in each zone.
•The views of residents and how it affects them.
•The laws and FEPA's effort at implementing them.
.
*It shall draw the relationship between congestion and Noise level in the metropolis.
*It shall highlight the correlation between land use landuse and Noise pollution level.

The poster shall have pictoral illustrations, graphs and tables.

11 OZONE CHARACTERISTICS IN BIOMASS BURNING REGIONS OF EAST GODAVARI DISTRICT, INDIA – A STUDY FROM SATELLITE DATA AND GROUND BASED MEASURMENTS

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Emissions from the biomass burning represent a major source of important trace gases and significantly impact the photochemistry of atmosphere, especially in the tropics. Two and three dimensional simulations of global troposphere involving the photochemical oxidant cycle as well as the emissions of CO, CH4 and NOx from the fossil fuel combustion, biomass burning and natural processes, suggest that fossil fuel combustion and biomass burning has changed the troposphere from one that was slightly ozone destroying in pre-industrial times to the present one that is net ozone producing. When compared to the other trace gases, the more important is the modification imposed on the lower atmosphere by the concentration of gases such as CO and O3 which show large increases during the dry season in tropics. Thus studies relating to trace gases in general and Ozone in particular gain imp ortance in the context of increasing biomass burning activities in the tropical regions. In the present study, an attempt has been made to study the temporal variations in ozone concentrations over a period of time over the biomass burning regions corresponding to East Godavari District, Andhra Pradesh, obtained from Total Ozone Mapping Spectrometer Earth Probe (TOMS) TOMS/EP data and ground based columnar ozone measurements obtained from the MICROTOPS II Sunphotometer. The Total Ozone Mapping Spectrometer, launched in July 1996 onboard an Earth Probe satellite (TOMS/EP) of NASA, provides data of global distribution of earth's atmospheric ozone. Ozone concentrations over the study area, has been studied from 1998 to 2000 for monthly and seasonal variations from TOMS data and has been correlated with the sporadic measurements conducted from ground based studies thorough MICROTOPS II Sunphotometer for total columnar ozone. Analysis of the results suggests that, the averaged total columnar ozone concentrations showed a clear seasonal variation with minima in the December month and maxima in the month of May. Ozone concentrations during the dry season viz., from 1998 to 2000 showed a regular increasing trend for all the three years. The dry period in the study area strongly corresponds to biomass burning period and the regular increasing trend in Ozone concentrations suggests increase in the intensity of biomass burning activities. The sunphotometer ozone values obtained for 8 days during November 1999 viz., 10,11,12,13,14,15,16,and 17th and May 2000 for 4, 5, 7, 8, and 9th dates and corresponding ozone values derived from TOMS/EPS data for the similar dates suggested correlation coefficient of about 0.76 for the period of May and 0.87 for the period of November. Further in the study, the measurement details with respect to surface ozone during the peak burning events are also discussed.

12 MODELING ANTHROPOGENIC FACTORS AND FOREST REHABILITATION ZONES USING REMOTE SENSING AND GIS – A CASE STUDY FROM PARTS OF TROPICAL DECIDUOUS FORESTS OF INDIA

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The continuous impact of anthropogenic activities on the selected ecosystems is reducing the quantity of natural habitats, such as forests and its structural diversity resulting in multiple ecological impacts. Forests forms one of the most important natural renewable resources which are fast decreasing due to increasing deforestation and urbanization.

In the present study, an attempt has been made to study the forestry related aspects, viz,. mainly the factors that are directly leading to deforestation, urbanization and also the methods for forest rehabilitation. IRS P4 OCM multi-spectral satellite data of pertaining to Rampa Agency of tropical deciduous forests of India of 17th January 2000 has been taken to obtain details with respect to various land use/land cover features.

A detailed methodology has been framed combining the spatial data inputs and the socioeconomic data for studying afforestation, area prone to urbanization and in totality forest rehabilitation. Land Use / Land cover estimates have been obtained from IRS-P4 OCM data. NDVI and Aridity Index are taken as a main source of data in the spatial form for biophysical parameters in addition to topographic data with respect to different provinces for altitude and slope. A detailed socio-economic database has been created to study the impact of different factors on the surrounding forest ecosystem.
Detailed analysis from the results from GIS modeling, suggested that of the total 66 villages in seven provinces of the study area, 20 villages are found to be highly prone to deforestation. Urbanization studied as a function of dynamics between the rural-urban fringe through GIS suggested that of the seven provinces, two provinces, viz., Rajavommangi and Gangavaram are highly prone to urbanization. The database of Socio-economic, biophysical and Geographical/environmental used for analysis for modeling afforestation activities and the results suggested that Addateegala province is highly suitable for afforestation.

Use of Remote sensing and GIS in conjunction with socio-economic and bio-physical data for forest rehabilitation suggested that for focus on net forestation area with a focus on erosion conditions, provinces of Ganagavaram and Rampachodavaram should be given higher priority when compared to other provinces.

13 GEOPHYSICAL AND GEOCHRONOLOGICAL ASSESSMENT OF CHANGES IN COASTAL DUNES.

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This work presents a unique combination of two techniques for the study of coastal dune formation and their behaviour in past history. Ground penetrating radar (GPR) surveys provide insight into the internal structure and sub-surface stratigraphy of coastal dunes, whilst optically stimulated luminescence (OSL) dating provides an absolute chronology based on sampling of the dunes. The surveys were based at a 357 Ha dune field on the southwest coast of the Isle of Angelsey, N.Wales, a site with documented historical evidence of past dune activity. The dunes form a plume of sand moving from the shore towards their terminus at a lake 3km to the northeast.

GPR is a non-invasive geophysical tool for imaging the internal structure of coastal dunes, which is used to interpret their past behaviour and evolution. GPR surveys at Aberffraw reveal sets of landward and seaward dipping reflectors, interpreted as accretionary foresets representing progradation on the foreslope or rearslope of the dune – periods of active dune building and migration. Similarly, troughs with cut and fill structures may be interpreted as erosion, representing periods of dune erosion and reworking. The identification of different packages of sand within the dunes and interdune areas allows the construction of a relative chronology based upon their superposition and the cross-cutting relationships of erosion surfaces between units.

Packages of sand identified on GPR profiles have been sampled for OSL dating. OSL is a dating technique for quartz based on the sediments last exposure to light. Its application to dunes allows the absolute dating of sand packages within the stratigraphy, their last exposure to light representing their point of burial by successive sand units, or their exposure through erosion and then re-burial. The OSL date therefore provides a calendar age for past dune activity. A number of cased boreholes were placed based on the stratigraphy identified by the GPR, and samples taken. The quartz grains were dated using a single aliquot regenerative dose protocol.

The OSL dating provides ages for various parts of the stratigraphy from 1320 to 1760 AD, and 1480 to 1680 AD. The older age can be related to documented historical evidence of major storms at Aberffraw in 1331 AD, which inundated land used at the time for agricultural purposes. The sub-700 year old OSL dates also provide an accurate chronology for a period which typically produces a wide range of calibrated radiocarbon ages. The evidence for past activity of coastal dunes has implications for management of the site which is a SSSI. The results indicate that the dunes should be allowed to migrate inland, and stabilisation is not appropiate at this location where habitat management has to be adapted to accommodate change.

14 3 - DIMENSIONAL ALPHA STABLE MODEL OF CONTAMINATION OF THE ROUNDABOUT ENVIRONMENT

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The development is devoted to the description of methods of creation an alpha stable model of contamination of the roundabout environment. For model are very important of internal distribution parameters of a various sort of discontinuities till an observed data random cuts of the various forms. Such measurements are carried out during an intersection of the polluted objects a way by planes, satellites, ships, at drilling etc. Formal aspects of method converge to two procedures. First of them the methodology is interlined with 3-D kriging, and second is interlined with problems of a local estimation of parameters of the characteristic function in alpha stable distribution. The main requirement of model is keeping equality between allocations of empirical data and their estimations.
During research the output is made, that kriging of estimation obtained from N of independent input data, distributed on alpha stable distribution, also have alpha stable distribution. This output puts alpha stable distribution in a special position in relation to the majority till now of used allocations, for which the dispersion average tends to zero, so itself this average tends somewhat to a stationary value peer to expectation of the initial random variables.
The approbation of a method is made on the basis of the permeability data , which is characterized from a major dispersion from 0.75 on 23 000. To treat these data by reference resources practically it is impossible. Obtained 3-D of a figure are extremely realistic and in this schedule are useful at interpretation of outcomes Ecological measurements in various stratums of an atmosphere, ocean, contamination of a surface of the Earth etc.

15 DEVELOPMENT OF A CORE SET OF ENVIRONMENTAL INDICATORS FOR SOUTH AFRICA

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The South African National Environmental Indicators Programme was initiated by the national Department of Environmental Affairs & Tourism, for the year 2001.
The programme aims to address the need for a coordinated approach to reporting on progress towards the objectives of Agenda 21 in South Africa, as well as providing a basis for continued and strengthened State of the Environment Reporting at national and sub-national levels.

The process is designed to involve a wide range of stakeholders (users of the information and people in a position to implement recommendations and effect change for enhanced environmental management).
It will raise public awareness of environment and development issues and provide a national integrated system of monitoring and reporting on environmental trends and conditions, as well as reporting on the effectiveness of environmental management practices in the public and private sectors.

The project involves a review and evaluation of existing indicator sets (and their design processes) developed elsewhere in the world, against certain criteria for relevance to the South African situation, as a precursor to developing alternative, more appropriate indicators where necessary.
A review of national and international policies will set the parameters for establishing priority issues to be reported on, as well as the national or international objectives, and interim targets, for each issue.

A reporting framework will be established, and an information management system will be designed to coordinate and manage the data required to support the indicators. Finally an implementation strategy will be developed to ensure the long-term sustainability of the project.

This poster outlines our proposed approach (on which we would appreciate comments) and our preliminary findings on indicator development processes, both internationally and in a uniquely South African context.

16 LAKE LEVEL AND PRECIPITATION CHANGES IN MONGOLIA

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Analyzed seasonal and long-term variation of some greet lake's levels, such as Khuvsgul, Uvs, Khirgas, Boon-tsagaan and Buir, located in different geographical regions: -mountain, steppe and Gobi Desert arid regions of Mongolia.
In generally, there are more than 3500 lakes in Mongolia. Total water resources of all lakes calculated about 500 cub.km, from which 380.7 cub.km belongs to Khuvsgul lake.

Availability of level recording data is quite limited and in largest lakes started since 1960s. Monitoring results shows that, seasonal and long-term variation of lakes level changes are closely related with the precipitation changes in the basin and main rivers discharges. About 70 % of annual precipitation is falling during July and August, consequently during this time lakes levels are slightly increasing.

Calculated long-term accumulative precipitation changes using the recorded data, in order to determine main humidity variation of the region.
Humidity changes in arid and semi-arid basins more clearly determined, because environmental condition of such regions more sensitive to climatic changes, specially to annual precipitation amount.
For example, in the Gobi Desert region dry period was about 18 years, beginning from 1970s to the end of 1980s.
During this period level of closed salty lakes (Boon-tsagaan, Orog, Ulaan etc.) as well as river runoff dropped dramatically and some lakes were dried up completely.
After that, started humid periods and increased lake levels. During this period, for instance, Uvs lake level is increased about 1.5 m.
Its surface area was increased about 42 sq.km since 1992 and covering some former roads and summer housing places.

Similar condition is observed in Khuvsgul and Khirgas lakes. Discussed possible reasons and relationships of largest lakes level changes, precipitation and river discharges and their long-term trends.

17 METHODS FOR TESTING AND PREDICTING SPECIES' FITNESS UNDER CLIMATE CHANGE SCENARIOS

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Methods have been developed for scoring species' attributes related to life history and habitat selection and which can then be statistically tested for 'suitedness' under particular environmental conditions. Increased summer drought and wetter than average winters are some of the expected climatic conditions modelled under the UKCIPmedium-high to medium-low climate change scenarios. Where these combinations of conditions have occurred recently, such as in 1995, attributes of 'successful' species (in terms of population change) can be compared to 'disadvantaged' species to see which of these attributes accord fitness.

Combinations of attributes can be used to predict which species might benefit or decline under certain climate change scenarios. Data from the UK Environmental Change Network have been used to test the method and to predict species' population changes under future climatic conditions.

18 RIVERINE INPUT OF ENVIRONMENTAL CONTAMINANTS IN THE HOOGHLY MATLAH ESTUARINE COMPLEX, EAST COAST OF INDIA

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Ecological hazards arising from urban and industrial sources have necessitated the evaluation of levels of toxic trace metals in water and sediment.
In view of the relative paucity of information, the present work is undertaken with the primary objective of obtaining the base-line data.
The study area comprises complex interplay of the Hooghly Matlah river system and its numerous tributaries and carrying about suspended sediment load of 520x 106 tones/year. The climate is humid (up to 96%), tropical and the seasons are pronounced with four month duration; Premonsoon (March to June), Monsoon (July to October), and Postmonsoon (November to February).
Considerable degradation in the estuarine health was recorded during the last couple of years due to extensive fishing, tourism, agriculture and industrial activities. Multifarious industries are situated on the banks of the dominant Hooghly river, namely paper, textile, chemicals, pharmaceuticals, plastic, shellac, leather, pesticides etc.
The heavy metals, pesticides from industrial effluents and sewage water contaminate
river basin and also coastal environment.

The present study envisages monitoring of environmental contaminants in water and sediment at three stations located in the eastern flank of Sagar Island (between 210 37 and 210 52 N and 880 03 and 880 11 E) , the larg est delta in the Hooghly- Matlah estuarine complex from April 1997 to March 1999 with seasonal variations. The mud-flat study area is scattered with mangrove vegetation. Towards the lower intertidal zone the sand-mud ratio increases and ultimately the flat becomes sandy in the lowest intertidal zone. The slope is gradual to feebly terraced.
The parameter studied were pH, BOD, COD, TDS, TSS, Hg, As, Se, Cu, Fe, Ni, Co, Cr, Cd, Pb, Zn, Mn, NO3-1, SO4-2 , PO4-3 in surfacial water and heavy metals in
sediments.
Substantial increase in the contaminants were observed during monsoon may be due to run off from industrial effluents and agricultural fields.
Comparison with previous studies in this coastal area is difficult due to paucity of published data. The sources of pollution are from natural as well as anthropogenic influences, such as fishing, tourism, agricultural and sewage disposal.

19 ENVIRONMENTAL CHANGE ASSESSMENT OF ISFAHAN ZAYANDEHRUD DAM

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Zayandehrud is the longest river (140 Km) in IRAN. It emerges from Dimeh Spring continuing to Isfahan city and ends to Gavkhoni wetland. This river received a lot of attention due to locating in semi-arid area and also plenty of uses for agricultural, Industrial and public services.
Zayandehrud dam was constructed in 110 km of western Isfahan and consists of main dam, water power and adjustable dam.
The method used for analysis is based on Wooden and Rau matrix. In this method subactivties of Zayandehrud dam project are classified into two steps (instruct
ion and operation) and effect of each one on the environmental parameters such as climate, soil, noise, water etc. were assessed.
In this study the magnitude of an interaction was described by the assignment of a numerical value from one to three, with representing a large magnitude and one small magnitude. Depend on positive or negative effect the magnitude value was positive or negative respectively.
The scale of importance ranged from one to five, with five representing a very important interaction and one, an interaction of relatively low importance.
Summation of the number of rows and columns designated as having interaction can offer insight into impact assignment and interpretation.
Based on this methodology total value of +62 was obtained which indicate the positive effect of Zayandehrud dam on the environment.

20 SWEDISH ENVIRONMENTAL QUALITY CRITERIA: WHAT CAN THREE DECADES OF DEBATE TELL US ABOUT THE IMPLEMENTATION OF A GOOD IDEA

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In 1999 the Swedish Environmental Protection Agency (SEPA) adopted a system of for Environmental Quality Assessment Criteria (EQC). The idea behind EQC is that a simple uniform assessment system will facilitate the contribution of environmental monitoring data to decision-making at local, regional and national levels. There are great hopes that these EQC's will support flexible, goal based environmental management in Sweden, and also serve as the foundation for Sweden's work with the European Union's new Water Framework Directive.

Despite the great hopes for EQC, it took SEPA over 20 years to officially accept the concept of environmental quality criteria, after EQC were initially mooted, and rejected, in 1969. It then took another decade to produce the full set of EQC. The presentation seeks insight into the challenges that must be faced in implementing EQC in Sweden (and similar systems in other countries) by understanding of the roots of the enduring resistance to the adoption of EQC. With an example of how EQC is applied in a region we demonstrate that many of the issues concerning the application of EQC today have been debated during the past three decades.

There are two primary reasons why it took so long to officially accept EQC. First, there was a scientific concern that the complexity of the environment is not suited to the generalisations entailed by EQC, even if those generalisations are deemed useful for non-experts. The second set of reasons is administrative in nature, and arises from disagreement about the best way to protect the environment. While one camp within the SEPA supported EQC, another camp saw EQC as being a hinder to progress, with a potential for abuse. This group advocated best available technology (BAT) as the most effective way to control pollution.

Part of the explanation for the eventual acceptance of EQC can be found in the changing quality of the environment. The initial embrace of BAT was in part due to the polluted state of the surface waters during the 1970s. This meant there was little difficulty in deciding what needed to be done in the way of water management. By the 1990's, though, the status of the environment had improved significantly,

and means were needed both to set priorities and track gradual changes in the environment to follow up achievement of management objectives.
Scientifically, the tension between scientific detail, and simplification remains. Three decades of research have not resolved, and often deepened the complexities of environmental assessment. But a concerted effort to reach a consensus contributed to the acceptance of EQC by much of the scientific community in Sweden.

In the coming years, It will be interesting to see whether EQC will be embraced by environmental managers at different levels in Sweden. Of particular concern will be whether managers will be content with the simple generalisations provided by EQC, or whether those initial generalisations will lead to a better awareness among decision-makers of the scientific details which should be further investigated.

Keywords: Environmental Assessment, Sweden, Freshwater Ecosystems, Decision Support ToolsDOES Episodic acidification in Northern Sweden: Causes and effects of acid deposition during spring flood

21 ACIDIFICATION POLICY FOLLOW RESEARCH IN NORTHERN SWEDEN? EXAMPLES FROM A DECADE OF SCIENTIFIC PROGRESS

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The multi-investigator project “Episodic Acidification in Northern Sweden” has sought to better understand, separate and quantify natural and anthropogenic driving mechanisms of episodic pH decline in Northern Sweden. This is a region with relatively low anthropogenic acid deposition rate the last decade (2-4 kg SO42--S ha-1yr-1)1 specify when?? after 1995??) but where streams commonly have low pH values (< pH 5.0) during runoff periods, especially spring flood.
The project was initiated in 1996 since there has been a considerable concern that government subsidized liming in the region during to keep the pH of spring flood above 6 in the region had no method for assessing the natural pH decline during spring flood in TOC rich waters. is not appropriate due to the TOC-rich waters where natural acidity is, at least partly, responsible for the low pH and buffering capacity.
Within the framework of this project over 25 episodes have been sampled for stream water chemistry during spring flood runoff. Of these episodes close monitoring of fish physiological stress and mortality have been carried out in eight of these sites.
The most important factors driving the pH decline were DTOC increase in combination with ANC dilution. The results suggest that the current geographic extent of major anthropogenic impacts on episodic acidification in Northem Sweden is limited. The physiological response in brown trout (Salmo trutta) exposed to low pH and high inorganic aluminium in these TOC-rich streams was found to be lower than previously observed in fish from low TOC streams. Brown trout (Salmo trutta???) were also found to manage more exposure to low pH and high inorganic Al in these TOC-rich streams than has been found for fish in low-TOC streams.However, even a marginal anthropogenic contribution of acidity superimposed on the natural pH dynamic was shown to cause acute toxicity in brown trout.toxic levels of acidity. in very acid sensitive streams.
Keywords: Episodic acidification, natural acidity, anthropogenic acidification, Dissolved organic carbon (DOC), Brown trout, acute toxicity, Northern Sweden

22 MONITORING THE SPREAD AND IMPACT OF THE NEW ZEALAND FLATWORM ON WILDLIFE AND AGRICULTURE IN THE BRITISH ISLES

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The New Zealand flatworm, which is an obligate predator of earthworms, was first officially recorded from the British Isles in the early 1960s although there are verbal records suggesting it was present in Northern Ireland and Scotland just after the Second World War.
Initially it was considered a curiosity but field observations in the late 1980s in Northern Ireland indicated that it was responsible for the reduction of earthworm populations to below detectable levels. Surveys in the 1990s showed how the flatworm had spread in since 1965 to be distributed throughout most of Scotland while in Northern Ireland a survey suggested that the majority of farms could now be infested.

Although there is on going work to monitor the population dynamics and seasonal fluctuations of the flatworm in Scotland, England and Northern Ireland there is, at present, no programme to monitor the flatworms impact on either the wellbeing of the soil or wildlife. Observations in an area of the west of Scotland has suggested that moles may be indirectly adversely affected by the flatworms eating the earthworms available to moles. However recent field observations in Northern Ireland and Scotland have shown that while earthworm populations may be significantly reduced by flatworms considerable populations of earthworms may continue to survive possibly because the soil has in some places become too waterlogged for the survival of the flatworm.

Earthworms are know to have a beneficial impact on a number of soil processes including nutrient turnover, aeration and the maintenance of soil structure as well as being a major source of food for a number of wild animals and plants. It is assumed that any reduction in earthworm populations due to the introduction of the New Zealand flatworm will have a harmful impact on the soil ecosystem but this has yet to be proved. The problem for the future is to be able to quantitatively assess the possible impact of the New Zealand and this will only be achieved by long term monitoring of earthworm populations and the soil processes and animals that rely on earthworms

23 ENVIRONMENTAL CHANGE MONITORING AND DISEASE SURVEILLANCE IN RESPONSE TO GLOBAL WARMING, RISING SEA LEVEL, AND CHOLERA IN LATIN AMERICAN COASTAL REGIONS.

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This paper argues the hypothesis that cholera endemicity in coastal areas of Latin America is likely to be enhanced by global warming and rising sea level.
It also proposes territories that should receive priority when it comes to monitoring environmental changes, surveillance of cholera outbreaks, and investing in both, safe water supply facilities and adequate excreta-disposal systems.
The seventh pandemics of cholera seems to have become endemic in Latin America, particularly in low-lying coastal areas, where incidence rates have been much higher than in the interior, mountainous regions.
The incidence rate in coastal states of Brazil has been 18.9 times higher than in the interior states (95 % confidence interval = 16.7 – 21.3), 3.18 times higher in coastal provinces of Ecuador (95 % C.I. = 3.01 – 3.38), and 2.39 times higher in coastal administrative regions of Peru (95 % C.I. = 2.34 – 2.45). A similar pattern has been observed in Colombia, Mexico, and Guatemala.
Higher water temperature resulting from global warming would favour survival of mesophilic Vibrio cholerae serogroup O1 in freshwater, brackish, and seawater environments. Rising sea level would threaten both surface and underground freshwater bodies that are currently used for drinking and irrigation. Higher salinity in brackish estuarine waters would also favour survival and growth of V. cholerae in coastal areas.
Moreover, warmer waters would improve conditions for green and blue-green algae multiplication, since they require temperatures ranging from 25 through 35 ºC for optimal growth. Other factors, such

as eutrophication and lost of wetlands to development may also favour blooms of phytoplankton and, consequently, the growth of zooplankton populations feeding on phytoplankton.
Therefore, the enhanced availability of phytoplankton and zooplankton species in aquatic environments may favour V. cholerae survival during inter-epidemic periods in areas where cholera is endemic. Floods could also damage sanitation and water distribution systems.
These changes could increase both, primary and secondary transmission of the disease. Monitoring stations should be set up in coastal areas to systematically measure long-term changes in sea level and water parameters, particularly salinity, temperature, nutrients, as well as biotic components (V. cholerae in the water column or in association with plankton, fish, molluscs, and crustaceans).
The changes in the frequency and density of V. cholerae should be measured, by using both, standard cultivation techniques and more sophisticated detection methods (e.g. epifluorescence, immunology, and molecular biology). Sites of monitoring stations in Mexico should prioritise the Gulf Coast (particularly the states of Tabasco, Campeche, and Veracruz), the Caribbean coast in Colombia (with emphasis placed in the Departments of Antioquia, Guajira, and Magdalena), and the Pacific coast in Peru (mainly in El Callao port). Poor communities living in coastal areas should receive priorities when it comes to investing in both, safe water supply facilities and adequate excreta-disposal systems.

Key words: cholera, global warming, Latin America.

24 SPATIAL VARIABILITY IN FOREST HUMUS LAYERS AS INDICATOR OF POLLUTION EFFECTS.

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Spatial heterogeneity is a conspicuous characteristic of soils. We found a striking gradient in the magnitude of small scale variability in humus layers of forest sites along a gradient of long-range air pollution in South Sweden. pH and microbial respiration showed much less variation in western sites with high pollution level than in cleaner eastern sites.
The extent of variation was closely correlated to pollution level. This evoked
the idea of using variability within sites as sensitive indicator of environmental stress. By contrast, mean levels of sites showed no geographic gradient, at least not for pH, leaving variation as the only indicator.
Analysed by bounded variograms we also found autocorrelation in pH and respiration in eastern sites, which was absent in western sites.
It appears that spatial structures had disintegrated along with diminished variation under the influence of pollution.

Our measurements were made on samples taken 2 dm apart along 20m transects in humus layers. pH and respiration at standard temperature and moisture content were chosen for their general information value and easy performance on large numbers of samples.

Although the investigated forests and soils were of similar type, other factors than pollution should be considered. E g, there is substantially higher precipitation on the western end of the South Swedish gradient and geology differs somewhat. However, investigations in a recipient area around a metal smelter in Northern Sweden confirm the idea of pollution effects on variability. In this area with a very large point source for metal emissions, pollution is a factor of singular importance.
Nevertheless, similar patterns of variation and structure as in Southern Sweden were found in relation to pollution levels.

High spatial variability and distinct spatial structures in humus layers due to natural influence of trees by litter production and root growth are characteristics of healthy ecosystems. A variable and yet predictable environment is essential for living organisms and a prerequisite for niche separation. The mechanisms causing disappearance of variability and structure are not clear, but influence of pollution heterogeneously intercepted in tree canopies superimposed on natural spatial patterns could cause the deterioration. This point in combination with need for more sensitive indicators is strong motive to investigate spatial variability in forest soils at various pollution levels. There is also need for basic knowledge on mechanisms involved and consequences for life conditions of soil organisms.

25 COASTAL DUNE ACTIVITY: THE ACTIONS AND REACTIONS OF MEDIEVAL MAN

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It has been suggested that a decline in medieval agriculture and resulting famines were due to climate change, while other historians prefer socio-economic explanations. Dating of coastal dune sands in north Wales indicates phases of sand movement and stabilisation from the fourteenth century to the present day that provide an independent record of physical environmental change. The movement of sand dunes is usually triggered by a loss of vegetation cover, or a change in climate such as an increase in storms which blow sand inland. The consequence of sand movement is a loss of agricultural land and in extreme cases the inundation and abandonment of towns and villages such as Kenfig in south Wales. We suggest that human activities and climate change combined to initiate sand movement at Newborough Warren on the Island of Anglesey in north Wales in the fourteenth century. During the construction of Beaumaris Castle in the 1290's the local inhabitants were evicted and moved to Newborough Warren.
Around 40 years later, in 1331, a great storm initiated extensive dune sand movement. It is likely that increased population pressure with associated agriculture and grazing destabilised the coastal dune system allowing sand to be blown inland. Contemporary reports also indicate increased storm activity in eastern England and south Wales around the same period with sand mobilisation at Kenfig. We suggest that while sand movement was driven by storms, human activity had helped to establish suitable conditions for sand mobilisation. Historic records also document medieval environmental management practices introduced to reduce sand movement.
These included restrictions on harvesting marram grass, restrictions on collecting vegetation for fodder and controls on livestock stocking.

The documentary evidence demonstrates a clear understanding of the importance of vegetation cover in controlling sand movement and provides early examples of environmental legislation.

26 FARMLAND BIRD POPULATIONS: AN ANALYSIS OF SKYLARK (*ALAUDA ARVENSIS*) AND YELLOWHAMMER (*EMBERIZA CITRINELLA*) REGISTRATIONS DATA IN RELATION TO AGRICULTURAL LAND USE AND BEETLE POPULATIONS.

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Population changes/activity levels during the breeding season in two farmland bird species (skylark and yellowhammer) were studied over an eight year period, at ADAS Drayton - a lowland mixed farm in south Warwickshire - using registrations data from annual Common Birds Censuses, undertaken as part of the UK Environmental Change Network (ECN) project.

National populations of both species have declined in recent years and this study, as well as determining whether similar declines occurred at Drayton, also attempted to determine the effects of cropping and the management of non-cropped areas on bird activity. Carabid beetle (Carabidae) activity in field margins was also monitored each year (within the ECN project), and the numbers of beetles captured annually were compared with skylark and yellowhammer registrations, to examine any possible correlations between these groups.

The number of breeding territories of skylarks declined steadily over the period of the study. The number of registrations per hectare, however, did not differ significantly between years but did indicate major differences in the attraction of various crops to skylarks. Rotational set-aside, where vegetation was allowed to naturally regenerate, was very attractive in comparison with other crops. The lowest numbers of registrations were recorded on intensively managed grass fields.

The results generally agree with findings from other studies, and suggest that the sparser vegetation present in rotational set-aside allows skylarks to forage and nest successfully, whereas the denser, more disturbed intensively managed grassland does not. The invertebrate diet of these birds is also likely to

be present in greater amounts on set-aside land. The correlation between Carabid beetle numbers trapped in field boundaries and skylark registrations was poor, probably reflecting the fact that skylarks forage in open field habitats.

Yellowhammer populations were affected by the management of cropped and uncropped areas of farmland. Comparisons of various cropping combinations occurring each side of a field boundary indicated a positive effect for rotational set-aside and a negative effect for intensively managed grassland. Although the type of hedge forming the boundary, in terms of its density, did not affect the number of registrations significantly, the presence of a ditch and an unmanaged grassy area more than 1.5 metres wide adjacent to the crop did result in significantly higher numbers of registrations. Yellowhammer population declines occurred when Carabid beetle numbers in field margins fell, indicating that these beetles may be a good indicator of prey availability for yellowhammers, and that uncropped field margins are an important habitat for foraging yellowhammers.
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27 MONITORING COASTAL SACS USING REMOTE SENSING

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The 1992 EC Habitats Directive contributes to the conservation of biodiversity by requiring Member States to maintain or restore habitats and species at a favourable conservation status. Sites have been designated as Special Areas of Conservation (SACs) and together with Special Protection Areas for Birds (SPAs), they will make up a network of sites in Europe called Natura 2000.

A key component in the successful management of such sites is the ability to assess the status of the site in question. Associated with this is the ability to determine whether the extent of either the site, or discrete habitats within the site, are changing with time. Such information is crucial in being able to respond to the many pressures that may act upon such ecosystems. In addition, the adoption of the techniques presented allows the detection of change brought about by the direct influence of man, such as the managed retreat of sea defences.

Remote sensing offers the opportunity to monitor these habitats at regional and national scales. Though traditional ground based studies can be highly accurate over small areas, scaling this information up may be problematic. Remote sensing does not provide the level of detail of ground based methods, but it can cover large areas relatively quickly and cheaply and may be used to monitor inaccessible areas.

Limitations in the accuracy and precision of remote sensing have previously restricted its usefulness for operationally monitoring land cover change. However, recent advances in methods used to classify and georeference imagery have greatly improved both the thematic and positional accuracy of the informational extraction.

The ability of remote sensing to detect environmental boundaries has also improved, particularly with the use of fuzzy classification techniques. These methods enable boundaries to be identified even when there are gradual spatial gradients between land cover types. Accurately distinguishing boundaries increases the ability of remote sensing to detect movement of these boundaries and therefore monitor environmental change

This study used data gathered with the Compact Airborne Spectrographic Imager (CASI) and Light Detection and Ranging (LIDAR) to provide fifteen band multispectral data and highly accurate elevation data respectively. A variety of classification methods were tested in order to optimise accuracy and the ability to monitor change within coastal habitats.

Previous studies of intertidal vegetation have shown that species distribution is partially a function of position within the tidal cycle. Use of LIDAR to provide elevation increases the potential of remotely sensed data to discriminate between intertidal species.

Results are presented that show how discrimination between intertidal land cover types is modified by the use of LIDAR data in conjunction with multispectral CASI imagery. In addition, the ability of remotely sensed data to define the boundaries between land cover classes in coastal habitats and the

implications of these results on the use of remote sensing for detecting environmental change are discussed.

28 THE POTENTIAL OF U.K. LOWLAND RESERVOIRS FOR THE DEVELOPMENT OF DIATOM-NUTRIENT PALAEOLIMNOLOGICAL INFERENCE MODELS

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To date, palaeolimnological research has focused on many different types of water body (e.g. shallow lowland lakes; crater lakes; deep natural lakes). However, despite their wide distribution across many regions of the world, reservoirs have been relatively little exploited as natural archives of recent environmental change. It is clear that reservoirs present an array of possible problems e.g. the short history of many reservoirs; poor fossil preservation and complex sedimentation patterns. However, reservoirs are of major economic and landscape importance for water supply and recreation and often possess detailed historical records of water chemistry and lake biota which are important for the validation of inference models.

This poster presents results from the modern sampling stage in the development of a U.K. lowland reservoir diatom-based palaeolimnological inference model for the evaluation of lake eutrophication. Monitored seasonal water chemistry data over a 12 month period, along with surface-sediment diatom assemblages from selected reservoirs are presented, and relationships between diatom species and environmental variables (particularly nutrients) explored.

The majority of diatom-based palaeolimnological inference models have utilised both planktonic and periphytic taxa. However, inclusion of non-planktonic taxa in diatom training sets can add error to inference models, especially if they do not respond directly to epilimnetic conditions The plankton is the dominant diatom habitat in most reservoirs and since these taxa respond directly to epilimnetic conditions, the potential for creating a planktonic diatom transfer function alongside the traditional approach is explored. Initial results from the examination of seasonal plankton samples in selected reservoirs are also presented and their potential for the development of inference models discussed.

29 IMPACTS OF CLIMATE CHANGE ON NATURAL AND SEMI-NATURAL VEGETATION IN IRELAND

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As this century progresses the European climate is likely to be warmer, with drier summers, wetter winters and more variable patterns of rainfall and temperature. The major cause of climatic change is the increasing concentration of CO2 in the atmosphere. Before the Industrial Revolution, the atmospheric CO2 concentration was about 270 (mol mol-1 and it is predicted that it will rise to 530 (mol mol-1 in 2050 and will exceed 700 (mol mol-1 by 2100. As atmospheric CO2 is used directly by vegetation in photosynthesis increasing concentrations might be expected to have a direct impact by increasing biomass production.

Numerous studies in recent years have attempted to predict both indirect and direct consequences of elevated CO2 on natural ecosystems. It is probable that CO2 enrichment will affect the productivity and physiological functioning of natural ecosystems in ways that are more difficult to assess than for agricultural cropping systems and forests. A major complexity arises from the large number of plant species which may interact in the primary production system. The different species can show marked differences in their responses to increasing CO2 concentrations. This may result in major alterations in the community structure of natural ecosystems in the future with possible shifts in ecosystem boundaries. Changes in plant community structure and productivity under elevated CO2 are important

because of the potential for modifying biological diversity and because there may be long-term feedbacks on ecosystem function including the storage of carbon, particularly in soils.

This study has reviewed data on the impacts of climate change (CO2, trace gases, temperature, rainfall) on the complete range of natural and semi-natural habitats of Ireland and their associated species. Five broad habitat types have been identified – grasslands, wetlands, uplands, terrestrial coasts and native woodlands. Impacts of climate change on each habitat category are being assessed through analysis of 'whole ecosystem' studies both in Ireland and abroad. Preliminary results will be presented.

30 INDICATORS OF CLIMATE CHANGE IN THE UK

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A set of 34 indicators of climate change in the UK were identified for the Department of Environment and Regions, covering the climate itself, socio-economic and environmental factors. The criteria used to select most indicators were that: (i) they were key climate variables that were expected to change in future, or they were factors which were sensitive to climate, (ii) they had historic time series which could be used to establish correlations with climate, (iii) they were available from sources which will provide reliable data at low cost in the future, and (iv) they were readily understood by the non-specialist.
Both a book 'Indicators of Climate Change in the UK' and the website http://www.nbu.ac.uk/iccuk/ were published in June 1999. The indicators have been updated on the website annually to display recent trends. Some trends are as follows:
The decade 1991-1999 was 0.57 ºC warmer than the 1961-1990 average. In none of the 97/8, 09/9 and 99/00 winters were there more than two days with mean temperatures below zero in Central England.
Scotland experienced exceptionally wet winters in 97/8 and 98/9, with about 20 % more rainfall than the long-term average, especially in the northwest. This high rainfall was associated with strong westerly airflows (high values of the North Atlantic Oscillation) and high river flows in the northwest..
Oak trees in Surrey leafed out in late March to early April in 1997, 1998 and 1999, 1-2 weeks earlier than the long-term average. Also, insects emerged relatively early and birds began breeding behaviour early.
Many suggestions have been received to improve the indicator list, which are currently under consideration.
Cannell MGR, Palutikof JP, Sparks TH. 1999 Indicators of climate change in the UK. Free from: DETR, PO Box 236, Wetherby, W Yorks, UK.

31 THE ECOLOGY AND WILDLIFE RESOURCES OF THE LUKANGA SWAMP REGION OF THE KAFUE RIVER BASIN: ZAMBIA

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The Lukanga swamp is 2,600Km2, and it is located in the central part of the country within the Kafue River Basin .The area is significant for the conservation of fisheries and wildlife as well as for agriculture and water resources. The paper discusses the observations of an ecological study carried between 1997 and 1998 to determine the status and distribution of wildlife species. There are six main habitat types, but most significant are the Munga vegetation, Termitaria grasslands, Reed bed and the permanent swamp. Seasonal transects were established in various habitat types using a canoe, motor vehicle and walking on foot to identify the presence of wildlife species.
Whereas the region is severely disturbed through human settlements and agricultural activities, at least 129 species of mammals and 290 species of birds have since been recorded. The sitatunga (Tragelaphus spekei) and Red Lechwe (Kobus leche) and Hippopotamus (Amphibius hippopotamus) were commonly observed among mammals, while common birds included white Backed Duck (Thalassornis leuconotus), spurwinged goose (Plectropterus gambensis) and wattled crane (Grus carunculatus). The study recommendations include the introduction of adequate conservation measures in the area and the promotion of the Community Based Resource Management. Unless drastic steps are taken, wildlife resources will continue to be severely degraded.

32 ENVIRONMENTAL CHANGE DUE TO AQUA CULTURE: LESSION FROM INDIAN EXPERIENCE

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INTRODUCTION

Aquaculture has emerged as one of the more promising industries in the world with considerable growth potential and expected to contribute around the global fishery harvest by the year 2000AD .The aquaculture industry has multidimentions in perspective growth. Aquaculture is a tool for utilizing the water more economically and optimally for increasing the productivity of both, land and water. The world scenario indicates the total fish production of 100, million tones by the year 2000. Even if India ventures to contribute 5% of the world fish production by that period, the aqua food would remain the scare commodity for the 500 Million population which is ever increasing.

The countries in the Asia -Pacific regions have vast and varied aquaculture resources such as dams, reservoirs, ponds, Lake Tanks, rice fields and lagoons. These are main sources of the water supply for urban development in the urban region. Oftnly the water from these sources is used accordingly to the national priority for domestic , industrial and the agricultural purpose . Hence it is necessary to develop the water use plan for environmental management by optimizing the available resources. Waste water reuse from aquaculture industry for urban agriculture become essential to avoid the high cost transfers from irrigation schemes.

PRESENTATION OF THE PROJECT

The availability of water of appropriate quality is important for all systems of aquaculture but the quantity is particularly important for land based systems .The research project was carried out in Jalgaon District of Maharashtra state in India on quality and quantity of water required for aquaculture and reuse of waste water from aquaculture. During this research study the average removal of turbidity was achieved between 60 to 70 % by providing the silting tank at the inlet and the outlet of the ponds . Various aeration methods have been adopted for treating the wastewater for reuse and conjunctive use . The bubbling aeration method was found most suitable for maintaining the oxygen level and pH of the water for acceptable limits .The waste water contain the valuable nutrients and sludge from the aquaculture ponds suitable for using as supplement s to the fertilizers along with the irrigation water. Research shows that the yields of groundnut were increased 35 % by application of the wastewater along the irrigation water.

DISCUSSION ON THE RESULTS

For optimum utilization of water resources, wastewater treatment from aquaculture ponds is essential for increasing the productivity of the water and land.
Developing of salinity is a challenge to the performance of the aquafarming.
Lack of drainage facility and poor water management are main causes of salt accumulation The feasibility of conjunctive use approach depend on operating a pond water effluent over the range of water levels. The conjunctive use of wastewater can prove to be a promising technology in drought prone and water short region s, particularly in urban regions.

CONCLUSIONS

The wastewater from aquaculture ponds should be treated properly so as to minimize the adverse impacts on the environment. The reuse of waste water should be done for socioeconomic development of the urban and co- urban areas .The need based and allocation - specific recommendation should be taken up for the time bound implementation for integrated urban development. An aquaculture economy should be fully established abd it's advantage and sustainability vis a vis other sectors and sub sectors should be prorogated for it's ready acceptanceby people and targated population groups in urban and peri-urban areas for socioeconomic development.

33 THE SWISS LONG-TERM FOREST ECOSYSTEM RESEARCH (LWF)

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Since 1994, the Swiss Government is undertaking multi-disciplinary, long-term studies through its "Long-term Forest Ecosystem Research Project", a monitoring platform open to research modules. The Swiss Long-term Forest Ecosystem Research (LWF) was established in 1994 under the Forest Observations Programme (now called Forest Monitoring in Switzerland). It is one of four programmes designed to provide basic information about forest dynamics in Switzerland, primarily in relation to the sustainable management of the forest resource.
The mission of the LWF is to improve the understanding of forest ecosystem processes through the long-term study of 15 to 20 selected forest plots in Switzerland. A particular emphasis is the possible effects of air pollution and climate change on forest ecosystem processes. The Swiss LWF aims to obtain a deeper understanding of the processes that take place in the forest ecosystem and the cause-effect relationships involved. Detailed investigations should yield information about how the influences of modern society, e.g. changed patterns of forest use, pollution and anticipated climate change, affect the forest. It should become apparent which processes harm the forest in both the short- and the long-term.
The Swiss LWF is divided into two main components: long-term continuous monitoring of ecosystem processes, and short-term (1–4 years) research projects. The main aims of the programme are:
To monitor the state of ecosystems and provide an explanation of changes in terms of causal environmental factors in order to provide a scientific basis for emission controls and other environmental policies.
To develop and validate models for the simulation of ecosystem responses and to use these (a) in concert with survey data to make regional assessments, (b) to undertake ecological risk analyses in relation to actual or predicted changes in environmental stresses.

34 PREDICTING ALTITUDINAL SHIFTS IN LAND USE IN THE HIGHLANDS OF SCOTLAND ASSOCIATED WITH CLIMATE CHANGE

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Scotland is situated in a maritime, mid-latitude zone between polar, tropical, maritime and continental air masses and thus has a climate characterised by high temporal variability. The interaction of weather systems with the varied topography characteristic of the Highland region results in orographic effects adding significant spatial variability, even over relatively short distances. Here relatively modest increases in altitude result in a rapid deterioration in climatic and environmental conditions. In effect this compresses a relatively broad range of climatic zones, representative of a wider latitudinal range, into a small area. Consequently, amid general concern that climatic changes will severely impact mountain regions, there is particular concern that marginal maritime upland regions such as the Scottish Highlands are particularly sensitive to the impact of such changes.
With respect to lowland areas, upland regions are characterised by lower air and soil temperatures; lower incident solar radiation and higher wind speed and precipitation inputs. In the Highlands of Scotland observations over recent decades show a trend in intensification of observed mean winter precipitation. These observed changes have been attributed to more active westerlies caused by a shift towards a more progressive zonal circulation associated with a highly positive phase of the North Atlantic Oscillation (NAO) index.
Some Global Climate Model (GCM) scenarios have broadly paralleled these observed climatic trends for the region. However, it is well documented that even high resolution GCM's do not adequately simulate climate patterns in regions of complex topography. The temporal variability of the Highland climate merely exacerbates these weaknesses of GCM's and makes it difficult to disaggregate long-term trends from noise in the data. These difficulties are further compounded by spatial and temporal gaps in the meteorological record in large tracts of the region which make it difficult to construct a robust baseline climatology.
Here we present a methodology aimed at overcoming these challenges and hence obtaining realistic regional assessments of climate change for the Highlands of Scotland and other analogous regions.

The steep lapse rates associated with maritime upland areas, allied to the orographic enhancement of precipitation profoundly influence the altitudinal regulation on flora growth. We will focus on the possible upslope changes in temperature and precipitation regimes associated with various climate change scenarios, since these are likely to be the most significant drivers of future shifts in land use. The initial methodology will involve deriving regression models of lapse rate change under varying seasonal and synoptic conditions for the observed climate in areas of the region in which there is adequate data coverage. These models will be primed with outputs from various GCMs to assess lapse rate changes for a range of scenarios. Model outputs will then be integrated with existing data within a GIS to assess altitudinal shifts in land use under the range of GCM scenarios considered.

35 CLIMATE VARIATIONS, GLACIER MASS BALANCE AND MELTWATER DISCHARGE FROM ALPINE BASINS

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Meltwater discharge from four glacierised basins in the upper Rhône catchment, Swiss Alps, from 1922 and dates thereafter to 2000, has been monitored together with air temperature and precipitation at several meteorological stations throughout a range of elevations in and around the basins. May through September mean air temperature generally increased from the late 1920s through 1940s, followed by cooling to the late 1970s, and general increase to the 1990s reflecting the overall pattern for the Alps. The range of quinquennial mean T5-9 was wide, extending from 10.3ºC centred on 1979 to 12.2ºC (1990-1994).
Annual total discharge of the more highly (60+ %) glacierised basins between May and September (Q5-9) was in the range –39.1% through +38.9% of the period mean, with a coefficient of variation of 0.19.
Year-to-year variation of Q5-9 broadly followed that of T5-9, more strongly in more glacierised basins, association between Q5-9 and T5-9 represented by correlation coefficients greater than 0.9 in the most highly glacierised basin.
However, precipitation in both winter and summer interacts with energy input and tends to reduce discharge from glacierised basins, such that glacier mass balance is more positive/less negative following winters with heavy snowfall.
Some of the largest annual Q5-9 resulted from thermally-produced runoff being augmented by substantial rainfall in the months June through October, often in warmer years having substantial peak rainfall-induced runoff events. Such events are more pronounced, higher maxima reached more rapidly, in basins with lower percentage ice-cover.
Should the current warm phase continue, decreasing glacier mass will reduce glacier cover, and hence move runoff responses towards those associated with less glacierised basins, that is to higher storm peaks and more year to year variability of flow.

36 LONG-TERM SPATIO-TEMPORAL VARIATION IN ABUNDANCE OF THE GARDEN TIGER MOTH (*ARCTIA CAJA*) DURING A POPULATION DECLINE.

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The garden tiger moth (Arctia caja) is a well-known and attractive moth that was once regarded as common in the UK. It is polyphagous and overwinters as small larvae. Over the past 35 years numbers of garden tiger moth have declined severely. We examined this decline using almost 2700 trap-years of data collected at 407 Rothamsted Insect Survey light-traps from all over Great Britain, spanning 1968-98. The annual collated index, commonly used to assess relative changes in lepidopteran abundance, confirms this long-term trend.
However, our examination of the geometric mean abundance across occupied sites has revealed a somewhat different pattern. The annual geometric mean fluctuated around approximately 4.2 individuals/year until 1983, and then fell suddenly to approximately 3.0 individuals/year and continued oscillating near that new, lower level thereafter. In contrast, the proportion of sampled sites occupied (incidence) remained high at approximately 0.60 until 1987-88, when it fell to 0.46 and continued to

decline. Thus, garden tiger moth density fell across Great Britain initially in 1983, but the moths did not begin disappearing from individual sites until several years later. Populations may have hovered near some threshold level with local extinctions lagging behind local declines in abundance.
Since 1989, the garden tiger moth has remained at low densities and low incidence. The general trend over time has been for the species to become more restricted to the north and west and almost completely absent from the Southeast.
Multiple regression analysis using monthly mean values from the Central England data set suggest garden tiger moth abundance is adversely affected by warm wet winters and warm springs. However, the sudden collapse in abundance between 1983 and 1984 is more likely associated with an extreme meteorological event.
The sudden drop in abundance and the four to five year lag before the accompanying decrease in incidence underscore the value of long-term monitoring in determining changes in abundance and distribution, even of species considered to be widespread and common.

37 MONITORING – THE NEGLECTED KEY TO IMPROVING ENVIRONMENTAL MANAGEMENT

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In Australia monitoring of the environment is in sharp decline. The cause of the decline appears to be the lack of promise of visible benefits before the next election. Monitoring of meteorological and climatological variables in general has declined at a slow but steady rate for about 30 years, but observation of some of the very topical, current public interest issues, such as greenhouse gases and tropospheric ozone has increased.
However on the driest inhabited continent on earth the monitoring of water resources, using the widest possible definition, has declined dramatically. This is in spite of a clear demonstration that in 1990 monitoring provided financial benefits to the community of at least nine times the total cost of all monitoring activities. The Murray-Darling basin has had a "cap" on irrigation for the last 6 years, meaning that water usage permitted in 1995 may continue but no additional water is allowed for irrigation.
This blanket approach has slowed the increase of water usage, but sadly it has not been accompanied by any increased effort to establish the magnitude and distribution of the resource. Monitoring on some of the major tributaries of the basin, which has a total area of more than 106 km2, has been so poor that the margin of error in estimating such a simple parameter as the mean annual flow is large, much larger than the total amount of flow assumed to remain after all licensed demands have been met.
The basin coordination agency's latest annual report states that flow data used to oversee compliance with water use agreements for the last 7 years will be adjusted when more detailed investigations provide improved estimates of flows! Will allocated water consumed during the last 7 years be adjusted retrospectively? As public awareness of the need for environmental flows is increasing and as salinity levels inexorably rise there is a need for a large increase in monitoring - not just of flow rates but of salinity and aquatic species and their populations to allow development of understanding of the basin. Salinity abatement programs developed at huge cost have had no measurable effect on river salinity - but we do not monitor the phenomena closely enough to be sure of why, or to provide a sound basis for development of feasible alternative strategies.
No matter how much clever research is focussed on these environmental resources, without large monitoring programs to provide a factual data base, very little understanding of the myriad processes which determine the state of the aquatic environment can be gained. A large increase in investment in collecting and archiving environmental data is needed. However since any funding increase is likely to be small a large effort is also needed to develop more effective, less costly methods of data collection and archiving.

38 MOBILITY OF TOXIC ELEMENTS IN GOLD MINE POLLUTED LAND – COLUMN SOIL LEACHING AND COMPUTER MODELING

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The ecological significance of heavy metals follows from their general toxicity and the fact that they are non-biodegradable. Metals released into ecosystems tend to accumulate in sediments, plants and animals through various physical and chemical processes. They are thus more or less permanently incorporated into the ecosystem.

South African, and specially Gauteng, is very rich in heavy metal ores. A variety of metal mines, smelters and other production units contribute to metal pollution. Climatic seasonal changes, specific for this part of the world, also affects metals speciation, transport and fate in the environment. A very high concentration of some anions (specially sulphates) also affects metals transport.

The determination of heavy metals and major anions mobility can give information for the long-term conservation and management of natural waters as well as monitoring of wastewaters.

Some problems and results of a mobility study of heavy metals and environmentally important anions in South African (Gauteng) gold mine tailings dumps are presented.

In this paper, sequential column leaching experiments are used as an alternative rapid screening approach to element mobility assessment. In these experiments, field-moist material is treated with an extracting solution to assess the effects of acidification on element mobility in mine tailings. The main advantage of sequential column leaching experiments is that they give quick information on current element mobility in conditions closely simulating field conditions to compare with common unrepresentative air-dried, sieved samples used for sequential extractions.

Layers with different concentrations of heavy minerals from the tailings dump were sampled and packed into columns. The design of columns allows extracting leachates from different levels. The extracting solutions used were artificial rainwater and acid main drainage water.
Metals were determined in the leachates by atomic absorption spectrometry and principle anions by izotacophoresis.

The use of column leaching experiments with mathematical modelling can provide information on realistic contaminated soil remediation.

The chemical analytical data from tailings leaching and physico-chemical data from field measurements (including pH, conductivity, redox potential, temperature) are used for computer modelling of element mobility. The MINTEQA2 and JESS computer software are utilized. Models are developed, which predict the distribution and mobility of metals and anions. The form and concentration of chemical species predicted from the models are compared with analytical results obtained during dry (winter) and wet (summer) seasons.

Heavy minerals from the tailings were separated and identified by means of microprobe analysis. Concentration profiles and tailings permeability versus heavy mineral content within samples are also presented and discussed.

39 LONG-TERM CLIMATIC CHANGES AT THE ALLT A'MHARCAIDH, SCOTLAND: 1986-2000

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Research into British mountain weather has previously tended to concentrate on the change in conditions with altitude, with relatively few studies of localised weather patterns at individual sites. Since the manned observatory on the summit of Ben Nevis was closed in 1904 few reliable, routine weather observations in mountainous areas of Scotland have been undertaken.

To address this problem three automatic weather stations (AWS) were set up in the late 1970s and 80s, two in the Cairngorms and one at Balquiddher, Central Scotland. The AWS was erected in the Allt a'Mharcaidh catchment in the Cairngorms in 1986 at an altitude of approximately 600m. It was originally installed to provide continuous climatic data for the Surface Water Acidification Programme, and has since supported a range of research at this site.

It takes readings of solar radiation, net radiation, wet humidity, air temperature, rain, wind strength and wind direction every ten seconds which are then averaged and recorded at hourly intervals. As well as allowing a detailed analysis of the localised patterns experienced within this catchment, continuous sampling at this site also ensures that episodic events are closely monitored. This has been particularly useful for hydrologists and environmental modellers working within the catchment, as processes occurring under extreme conditions often have a significant impact on catchment hydrological, chemical and biological dynamics.

The Allt a'Mharcaidh catchment experiences sub-arctic conditions with temperatures ranging from –9.4oC to 28.0oC and mean annual precipitation in the order of 1100mm, 30% of which can be expected to fall as snow during the winter (October to March). Snow cover in the Cairngorm mountains is often more extensive than anywhere else in Britain, which has an obvious influence on the regional water balance.

Analysis of the dataset suggests both temperature and rainfall have experienced small but significant increases since 1986 and a marked shift in the wind direction was experienced within the catchment after 1993. The findings suggest a change in the dominant air masses affecting the region.

Prior to 1993 south easterly winds (c. 140 degrees) dominated which in general come from polar continental air masses bringing cold, dry air to North West Europe. Recently, however the winds appear to have become more westerly (c. 200 degrees) possibly reflecting an increasing influence of tropical maritime air masses which are generally associated with warmer and wetter weather.

This shift towards milder weather may have in turn been responsible for the reduced snow cover observed in recent years and the associated economic problems experienced by the local ski resort. In 1994/95 the five main Scottish skiing centres (Cairngorm, Glenshee, Nevis Range, Lecht and Glencoe) had a combined total of c. 700,000 lift passes sold. This has reduced steadily over the years to c. 370,000 in 1996/7 influenced by a number of factors including snow cover and frequency of storms.

40 NUMERICAL SIMULATION OF TWO-DIMENSIONAL UNSTEADY FLOW AND SEDIMENT MOVEMENT IN KARKHAEH RIVER

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In this abstract a procedure for numerical simulation of two-dimensional unsteady flow and sediment movement in Kharkheh river course is developed. Here is assumed that same sediment particle can move either in suspension or as bedload. Governing equations for water and sediment movement are derived in curvilinear coordinates and then depth averaged. Sediment & water equations are solved in an implicit as a coupled manner. Sediment -transport and bed-evolution processes influence the flow field through changes in direction coefficient and bed elevation. At final a field investigation for verification of model was done and results show that they are in good agreement. In bed reach for computational points, eroded volume is calculated and flow pattern is presented. Result shows that this model for Kharkheh river has a good agreement.

41 FLUX-RESPONSE RELATIONSHIPS – A TOOL FOR THE ASSESSMENT OF OZONE-INDUCED YIELD LOSS IN AGRICULTURAL CROPS

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The Critical Levels for ozone in Europe established some years ago are based on the ozone exposure of plants during daylight hours. This AOT40 concept found the basis of the level I approach, used to describe the negative effects of ground-level ozone on plants. To be able to correctly estimate the yield loss in crops caused by ozone, it is necessary to take into account the biological and climatic factors of vital importance for the actual uptake, flux, of ozone into the plant. This so-called level II approach, must take into consideration not only the ozone levels, but also the species stomatal conductance depending on genetic, phenological and climatic factors as well as the climatic factors affecting the transportation of ozone to the plants.

Studies on the ozone sensitivity of several agricultural crops and natural plants accomplished at Östad säteri, 40 km north-east of Göteborg, Sweden, have produced a large database consisting of biological and climate data from 13 years of experiments. This database offers the opportunity to construct a general model for the assessment of ozone-induced yield loss in agricultural crops. Stomatal conductance measurements on potato, what and timothy are used to construct flux-response relationships.

The constructed flux-response relationships will be combined with climate and ozone data from different parts of the Nordic countries in order to estimate the ozone uptake and yield loss due to ozone, in these areas.

The database of stomatal conductance, ozone concentrations and climate will also be used to test if there exist general relationships between growth rate, ozone sensitivity and stomatal conductance of species.

42 MODELLING OF PREFERENTIAL PATHWAYS FOR CONTAMIANTS' MOBILITY UNDERGROUND AND DISPERSION OF LEACHATE IN FREE SURFACE CHANNELS

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Fluid flow through preferential pathways in porous media is inherent to many engineering and environmental transport processes, for example, crossflow filtration, contaminants' mobility in soil and groundwater zones etc. The impact of this flow on the overall transport behaviour depends on many distinguishing features such as the dimension of the pathways, its behaviour in combination with the surroundings and, the characteristics of the adjacent porous material, e.g., the permeability. The fluid flow within the preferential paths behaves as free viscous flow while, in its neighbourhood, it is porous flow. If the permeability of the porous media is relatively high so that the interface between the preferential pathways and the nearby porous medium forces a transition from free to porous flow, or vice versa, the whole domain must be viewed as a combination of adjacent flow fields rather than a continuous single domain as traditionally hypothesised. The combination of this flow with the convection and dispersion of leachate into free surface water channels which may border porous domains has also great impact in the environment and hence should also be considered.

This paper presents a methodology of combining three dimensional (3D) zones of preferential pathways, permeable soil domain and free flow channels. The continuum approach for calculating the average macroscopic flow properties in the permeable medium has been used. The preferential flow is modelled by the Navier-Stokes equations while the Darcy's equation has been used for the porous domain. For rivers where the leachate may end up, appropriate hydrodynamical equations are used. In the absence of a universally accepted interfacial boundary condition between porous and free flow

regimes, the Darcy-slip formulation has been adopted for calculating the jump in the relevant flow variables. The mathematical formulation is based on the finite volume method and non-dimensional forms of governing equations. Results presented in this paper represent physical transport of the contaminants. It is envisaged that the developed model would make predictions of water quality in the surface and sub-surface zones more accurate and realistic.

43 HEGADISP: A SIMULATOR OF HEAVY GAS DISPERSION MODELLING FOR QUANTIFYING RISKS DUE TO INSTANTANEOUS GROUND LEVEL RELEASE OF CHLORINE

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Recent technological progress has reached the stage where there is a proliferation of industries associated with most centres of population. Frequently these industries use chemicals on a large scale, sometimes with the bulk storage of many thousands of tons of dangerous materials. One aspect which is causing growing concern is the hazards arising from accidental rupture of these plants containing heavy gas, or vapour, which is highly flammable or toxic (e.g., liquefied petroleum gas (LPG), chlorine or hydrogen fluoride). Knowledge of how such materials are dispersed in the atmosphere is important from the safety aspect of plant design and siting, but more importantly, for contingency plans concerning the evacuation of people in danger. The behaviour of these dense gases or vapours is simulated based on semi-empirical models.

In the present study, a simulator (HEGADISP: HEavy GAs DISPersion) was developed based on a heavy gas model with an aim of quantifying risks owing to an accidental release of chlorine, and development of a disaster management plan in the future. The heavy gas model is most suitable for instantaneous release of dense toxic material. The governing equations in the model for gravitational slumping, air entrainment in the cloud at the edges and sides were solved analytically and then used in the simulator. Effect of surface roughness was included; while, cloud heating, statistical variation of concentration about a mean and a possible two-phase flow of pollutants were ignored. The most attractive feature of the model is the ease of computational effort and at the same time providing quick and reasonable estimates of hazards, which can then be used, for emergency preparedness.

Simulator performance was evaluated which indicated a good agreement with the reported values. The simulator was then utilised for a study on a hypothetical accidental release of chlorine. Plume concentration as a function of distance and time, safe downwind distance and time intervals based on different threshold concentration were predicted. The results, for example, yielded a conservative estimate of ground level concentration (GLC) of 0.124, which is higher than IDLH (Immediately Dangerous to Life and Health concentration) value, at 2 km after a time interval of 25 minutes for a 35 ton-release. Similarly, safe IDLH distance and the time interval for a 75 ton-release were 5.8 km and 65 minutes, respectively. A decreasing trend of GLC was observed for 'high turbulence' due to proper mixing of toxic cloud. Polar isopleths based on actual average wind velocities in the area were generated to examine the simultaneous effects of wind direction along with velocity on air quality. The probabilities of percentage deaths of, or injuries to, a given population were found by a probit analysis; and, area of lethal dosage was determined in order to estimate the percentage of population affected based on population density.

44 DETERMINISTIC MODELLING OF THE TOTAL ENVIRONMENT

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Though the natural world is far from being deterministic where one physical or chemical condition leads uniquely to another, the deterministic models have been very useful in engineering description of

the environmental transport processes. The random (statistical) nature of the environmental parameter can be said to result from variety of factors. For example, pollutant concentration in air can vary due to changing weather conditions or other factors such as humidity, ambient temperature etc. Similarly, in the surface and sub-surface transport processes, the water quality may fluctuate within a range due to microbial growth and reactions. The deterministic models cannot predict such variability, as it is most suitable for calculating mean values. Nevertheless, they have been particularly useful in identifying the risks and hazards owing to degraded environmental quality (what-if analysis). Deterministic models of the environmental flow processes are based on the physical laws of conservation of mass, momentum and energy. They are represented in terms of non-linear partial differential equations, which usually require a numerical scheme for solution. These models allows the transport processes to be expressed with great accuracy but also demand a great deal of understanding about the phenomena. This realisation comes from the fact that the primary source of erroneous results is external logic (model assumptions) rather than the internal arguments in the mathematical formulations. Furthermore, to solve the model equations, special techniques need to be employed based on the desired tasks and model assumptions.

The present paper has been motivated by mainly two broad aims. Firstly, to demonstrate the utility of deterministic methods for modelling complex environmental transport processes. For this purpose, modelling cases of flow phenomena in all three components of the total environment, i.e., air, surface water and sub-surface are illustrated. The first example studies dispersion of a heavy gas in air. The dense chemical is released in air instantaneously at the ground level due to a catastrophic rupture of a storage tank. The second example studies solute convection and dispersion phenomenon in an estuary as a typical case of flow in surface water. The third example is given for the pollutant mobility in land and groundwater zone.

The second objective of the paper is to demonstrate the utility of specific solution techniques in specific cases. For the heavy gas dispersion modelling, analytical methods have been adopted, while, for the other two cases, numerical techniques such as, finite element and finite volume method, respectively, are used. The use of a particular method for each case is justified in the paper.

45 MORE THAN A DECADE OF BIOTIC AND CHEMICAL WATER QUALITY ASSESSMENT IN FLANDERS.

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Since 1989 the Flemish Environmental Agency (VMM) runs a biological monitoring network consisting of 1,300 different sites at which the Belgian Biotic Index (BBI) based on the presence of aquatic macroinvertebrates as water quality indicators is assessed. Also since 1989 the VMM runs a parallel physico-chemical monitoring network consisting of more than 1,600 sites ranging from canals and navigable rivers to municipal water courses.
The basic variables measured are: temperature, dissolved oxygen concentrations, chemical oxygen demand, nitrogen (NH4-N, NO2-N, NO3-N), phosphate, total phosphorus, chloride, conductivity and pH. For a selected number of sites the following variables are added: Biochemical Oxygen Demand, Kjeldahl-nitrogen, sulphates and suspended matter. The annual sampling frequency ranges from 8 to 12. The data show a general amelioration of the water quality, especially for waterbodies of previous very low quality (2-4). However, a high number of good quality waters (7 or higher) showed a deterioration. Some points show fluctuations. The analysis of the data show that the present-day norms for chemical water quality are too high to reach and maintain a high biotic quality.

46 THE USE OF REGIONAL DATA IN ASSESSING FOREST ECOSYSTEM RESPONSES TO ATMOSPHERIC POLLUTION

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Intensive research centered on a single site or a small number of sites is valuable to precisely identify those components of terrestrial ecosystems that may respond most rapidly to changes in environmental drivers such as air pollution. Advantages of such research include the control (to a certain extent) of extraneous variables, the precise measurement of responses, and the ability to manipulate the variable(s) in question. Laboratory and field manipulation studies are, however, limited in one important way: time. They are biased toward short-term responses whereas long-term changes, arguably more important, may never occur within the usual funding lifetime of a research project.
Empirical analysis of simple ecosystem parameters from regional data, on the other hand, can consider many more sites, but less intensively than experimental studies. General patters in response variables revealed in surveys can support hypotheses developed through experimental manipulations, and may be useful to identify simple parameters for regional assessment of risk. In addition, analysis of a large database may reveal patterns in variables that are not changed in manipulation experiments, perhaps because they respond slowly to changes in the environment, or because they are well 'buffered' against such changes. However, inferences drawn from regional data must assume space to be a surrogate for time, and are often hampered by lack of control over extraneous factors. The causes for observed patterns are therefore often open to interpretation.
Advantages and disadvantages of regional data will be examined using the IFEF (Indicators of Forest Ecosystem Functioning) database as an example. IFEF is a compilation of several previous databases and now numbers over 200 forested sites in Europe. The large amount of data has revealed European-wide patterns in N leaching, Al leaching and Mg leaching in runoff or leachate from forests which can be related to meaningful environmental drivers. Empirical analysis of IFEF data has supported the results of manipulation experiments such as NITREX (Nitrogen Saturation Experiments), but in addition has identified significant statistical relationships between N deposition and 'slow-response' soil parameters that did not change over the duration of the NITREX treatments.

47 MONITORING URBAN AREAS USING SATELLITE REMOTE SENSING

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Urban areas, whilst the smallest class of global land use are of huge importance to global change research, as it is in these areas where the activities which drive produce much of the greenhouse gas emissions.

This paper examines some of the most recent developments in mapping urban areas from satellite imagery. Amongst these are night-time light imagery which lends a completely different perspective to urban mapping as it detects street lighting, and evidence of other anthropogenic activity such as gas flaring, and biomass burning. Night-time light imagery will be shown to correlate with other parameters such as Gross Domestic Product, Carbon Dioxide, and also population. In less developed areas, this technique may not be so applicable, so radar interferometry may be used to detect urban area by temporally correlating two images to identify the coherent urban areas. This can be useful for areas which have high degrees of cloud cover. In addition to this, modelling surface anisotropy can also highlight urban areas due to the shadow casting property of buildings. This is closely related to the albedo, a crucial parameter in land-atmosphere interactions.

The need to reliably detect and monitor urban development are manifold. Urban areas are both a cause of global change as well as the location of around half of the World's population. Examples will be shown of detecting urbanisation using different remote sensing techniques.

48 THE USE OF BIOLOGICAL INDICATORS TO DETECT CLIMATE CHANGE IN IRELAND.

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Climate change is widely recognised as a serious threat to the world's environment. Climate is influenced by changes in the concentration of greenhouse gases of which CO2 has the largest concentration in the atmosphere. Since the industrial revolution (1750) anthropogenic increases in greenhouse gases, in particular CO2 has lead to enhanced global warming. European annual air temperatures have increased by 0.3ºC to 0.6ºC since 1990 with further increases being predicted by climate models. The potential consequences include increases in sea level, more frequent and intense storms, floods and droughts and changes in biota and food productivity. It is likely that biological organisms will respond to these changes.

We are currently compiling a list of biological indicators which will be sufficiently sensitive to be used to detect climate change in Ireland. The main components of climate change that will be followed are temperature and rainfall. The compiled list of indicators encompasses a wide range of observations in order to catch all possible information. It is anticipated that future study will allow refinement of the list as more information becomes available. The main function of an indicator is to communicate information and therefore, an indicator consists of a value derived from a measurement or series which provides information about the state of the climate. The criteria for establishing indicators include, their sensitivity to changes in climate, their variation over time and their ease of access and interpretation.

The list of potential indicators is divided into a number of categories including agriculture, health, insects and birds, phenology, paleoecology, economic, greenhouse gases, fish, tourism and plant distribution. The problems associated with this kind of study will be discussed, in particular, the availability of long-term data sets and the fact that coverage is highly variable both temporally and geographically.

The purpose of this poster is to present some of the potential biological indicators of climate change in Ireland and to address their future application in long-term monitoring programmes.

49 MONITORING ENVIRONMENTAL CHANGE DRIVERS ASSOCIATED WITH URBANISATION

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The twentieth century was marked by rapid urbanisation, changing the world from a predominantly rural society of subsistence peoples to a predominatly urbanised world with global supply chains and interdependence of regions, ecosystems and societies. Urban communities depend mainly upon food, energy and materials sources outside the areas occupied by cities and towns. This dependence on other ecosystems creates an indirect land use and land cover change which greatly exceeds the change of land from rural uses to urban occupation. Sourcing construction materials close to urban areas drives food production further away from urban markets, adding to the energy and transport infrastructure demands for food transportation. Superimposed on the immediate demands for food and shelter for survival in cities is the consumption of luxury goods ranging from out-of-season foods in supermarkets, including cherries from Chile and beetroots from Saudi Arabia in the UK, to exotic imports to decorate homes or add prestige to the entrances of corporate headquarter buildings. Such luxury goods consumption is expanding exponentially with the growth of both the per capita spending power of the established urban European and North American middle class and the expansion of the Asian and Latin American urban middle class.

Monitoring this urban driven change in land use and land cover involves establishing patterns of materials flows, accounting for hidden flows and tracing their impacts back to parcels of land. Only by such an audit trail can the responsibilities and causes of environmental changes be properly identified. The links between consumption in one part of the world and environmental change in another need to be understood. To begin to assess the extent to which international material transfers or externally driven changes in agricultural production systems influence land use and land cover change in individual countries, urban expansion, aggregate and building materials use, agricultural production and commodity trading in Asian, African and Latin American countries were compared with those of

European and North American countries. Despite a clear dominance of the countries of the "north" in per capita CO2 emissions, Asian countries have the highest per capita cement production, reflecting their rapid development of urban infrastructure in the 1990s. Many African and Asian countries have seen great changes in their agricultural export trade which have impact on local patterns of land use. Monitoring such changes contributes greatly to the understanding of the drivers of environmental change.

50 THE PURE WATER OF MONGOLIA

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Central Asia includes North regions of China, Mongolia, Tuva, South and West of Siberia. The differenr unique water ecosystems are situated on this wide territory. The lake Baikal takes the particular place among them. It is the deepest fresh water reservoir on our planet, and it contains 1/5 of the worlt water volume, to say more it is the richest relict and endemic species's fauna and flora in the North Asia.UNESCO declared it as the World Heritage Site.

Why we need to investigate the ecological situation in mongolia? There are some reasons for it.
Mongolia is situated in the heart of Asia.Ecological situation of the lake Baikal depends on the further development of the ecological situation in Mongolia.For example,rivers of the North Mongolia supply Baikal with more than a half of its' waters.In a word, clean waters of rivers of Mongolia means - clean water of Baikal.
The water samples taken from rivers Tuul, Khara, Ero,Orhon were analysed with the help of HRGC/HRMS methods.The most typical organic substances distinguished in the freshwater are oilproducts, polycyclic aromatic hydrocarbons, fatty acids, phthalic ethers etc...Priority toxic organic compounds were not detected.The levels of pollution with these substances were defined and compared with maximum allowable concentration for fishery basin of Russia.

51 VARIATION OF INTEGRATED ALBEDO AND SURFACE ENERGY BALANCE OVER TWO HIMALAYAN RANGES – A COMPARISON

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Three years of solar radiation and snow-met data of seasonal snow cover over two ranges of Himalayas viz. the Pirpanjal range and the Great Himalayan range has been analyzed beginning from January till mid March. It is found that the average integrated albedo over Patsio, a research station in the Great Himalayan range, is higher than that over Dhundi, a station over the Pirpanjal range. This is due to the topographical difference in the two areas as well as due to the difference in types of snow found in general in this areas. It is shown that by analyzing the variation of albedo over a period of time it is possible to qualitatively predict the beginning of the ablation season in the two places. A simple model has been used to calculate the surface energy budget of the two places on hourly basis. It is found that in both the places the net radiation is the dominant energy source responsible for the ablation of the snow cover. The turbulent energy fluxes are small compared to the radiative fluxes. The calculation shows that over Patsio the latent heat flux is dominant over the sensible heat flux while over Dhundi it is the reverse, the latent heat flux being negligible. This in turn imply that over the high altitudes of the Great Himalayan ranges where semi polar conditions prevail, sublimation to some extent is responsible for loss of the snow cover while over the Pirpanjal range, where alpine conditions prevail, heat is transferred to the snow from air resulting in melting of the snow cover. During the period considered the increase in net surface energy budget over Dhundi had occurred much earlier than that over Patsio suggesting that melting starts in the former region much ahead than in the later region, a fact which is borne out by field observations. Also the large magnitude of the energy budget over the former compared to the later area suggest that the rate of melt produced at Dhundi is much larger than that at Patsio. The authors feel that this differences are primarily due to the large differences in the geographical location of the two areas including altitude, and surrounding topography. The authors also feel that the year to year variation in the quantities studied can be correlated to certain specific events of that times such as average temperatures and snow fall events.

52 GROUNDWATER BASELINES AND INDICATORS OF ENVIRONMENTAL CHANGE

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Groundwater resources provide around a third of the drinking water in England and Wales, and in Europe around 70% of drinking water is abstracted from aquifers. Groundwater also interacts with rivers, lakes, estuaries, and wetlands, by way of springs, baseflow and seepages.
Groundwater quality is under threat from agriculture, industries the urban infrastructure and population sources. Deteriorating water quality due to contaminating activities may render part or all of the groundwater resource unsuitable for use. It is important in this context to be able to define the natural baseline quality since without this any definition of pollution cannot be made. Groundwater quality in its own right also constitutes an important indicator of environmental change which may be used together with other geoindicators and ecosystem indicators (Berger and Iams 1997). In this paper progress on defining baseline groundwater quality in England and Wales is described and the main indicators proposed for detection of anthropogenic change above baseline.

Results are given from two aquifers – the Chalk and the Triassic sandstone – which illustrate well the spatial variability in baseline due to geological conditions and especially to time-dependent geochemical changes along flow lines. Water-rock interactions may give rise to elevated concentrations of potentially harmful elements eg Al, As, Be, Cr, F, Ni, Se, or their complexes under acidic conditions or, under changing redox conditions. Thus natural variations in the natural baseline need to be ascertained for each aquifer system to define thresholds that indicate pollution by man. Trends in water quality since the development of the aquifer are also used as a means of defining external inputs. Residence times in the aquifer are determined primarily using radioisotopes. The stable isotope composition of water or palaeoclimatic indicators such as noble gases or chloride (Cl) may also provide indirect evidence of residence time (Bath and Edmunds 1978; Andrews et al 1995). The identification (or absence) of marker species related to activities of the industrial era, such as total organic carbon (TOC), tritium (3H), freons (CFCs) - and certain micro-organic pollutants may provide evidence of a recent component in the groundwater.
The quality status of groundwater is an important marker of environmnetal impacts. Groundwaters are well-buffered systems and inert tracers are best used to detect overall change. Changes in quality may be recognised by a number of simple key indicators which include Cl, NO3 and TOC. Monitoring of these three mobile but inert indicators on a regular basis will detect important changes in both natural as well as contaminant sources; additional compounds may then be needed to attribute these sources. The current results provide a basis for formulating strategy, policy and guidance in connection with existing regulations for groundwater and environmental protection and the emerging European (Water Framework Directive) legislation.

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53 THE INFLUENCE OF LITHOLOGY, CLIMATE AND HUMAN IMPACT ON HOLOCENE RIVER SEDIMENT GEOCHEMISTRY: THE YORKSHIRE OUSE BASIN, UK

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The weathering of rocks at the Earth's surface and conveyance of weathering products by rivers is controlled by both chemical and physical parameters which are in turn intrinsically linked to temperature, precipitation, vegetative cover, relief, lithology and tectonic processes. Anthropogenic activity, however, also has been shown to play a major role in the denudation of rocks and soils, primarily through processes associated with agricultural activity (e.g., deep ploughing, removal of

vegetative cover) and deforestation. Although much work has been carried out recently to elucidate the links between silicate weathering and river geochemistry, little attention has been paid to the role of anthropogenic activities in these processes. Furthermore, these studies have focused mainly on contemporary processes and environments, despite the fact that anthropogenic activities have increasingly been impacting on the environment during the Holocene.
The Yorkshire Ouse basin of northern England provides an ideal case study area for elucidating long-term river catchment chemical and sediment storage histories because the Holocene fluvial sedimentation history is, by UK standards, well understood. The objectives of this paper are to (1) examine spatial and temporal variations in Holocene chemical storage in the Yorkshire Ouse basin, and (2) link these variations to changes in sediment sources, climate and anthropogenic activity, to develop a more complete understanding of the effects of these factors on river sediment geochemistry. This work forms part of the UK Natural Environmental Research Council's (NERC) Land-Ocean Interaction Study (LOIS) community research programme.
The research has shown that floodplain alluvium in the Yorkshire Ouse basin records spatial and temporal changes in sediment and geochemical storage throughout the Holocene. A major change in sediment provenance from local Pleistocene and Holocene sands and gravels to silts to clays derived from the upland, Carboniferous lithology-underlain part of the basin, began at c. 3700-3380 cal. BC, and continuing to c. 400-300 cal. BC. These changes are strongly dependent on both climatic and anthropogenic factors (land-use, mining, industrial activity), and are reflected in the geochemical composition of the alluvial sediments. This work has shown that the geochemistry of river sediments depends on a complex interplay of climatic, lithological (source material) and anthropogenic factors. When using river sediments to yield chemical weathering and atmospheric CO2 information, these factors, as well as the (temporary) geochemical storage in channel and floodplain sediments, must be taken into account.

54 MONITORING CLIMATE CHANGE IMPACTS ON SITES DESIGNATED FOR NATURE CONSERVATION PURPOSES

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The UK Conservation Agencies are statutorily obliged to protect natural features throughout their range. Site designation (e.g. Sites of Special Scientific Interest and European sites in the Natura 2000 network) is a principal mechanism for safeguarding threatened habitats and species. A common standards procedure for the monitoring of nature conservation across Britain, Site Condition Monitoring, was implemented on 1 April 1999. This assesses the effectiveness of measures prescribed for the protection of natural features by monitoring the condition of the notified interests within the sites on a six-yearly cycle.

This paper outlines how Scottish Natural Heritage, the statutory Conservation Agency in Scotland, is progressing towards monitoring the most threatened habitats and species under a changing climate using the designated site network. Whereas the Site Condition Monitoring methodology includes changes in distribution, extent, abundance and characteristic species, the frequency of monitoring may be too coarse to provide a practical warning of the direction, rate and degree of natural heritage responses to climate change.

Effort is therefore being targeted on key species within sensitive ecosystems, including those at the limits of their distributional ranges. Recording annually means that a small sample of the total number of designated sites within Scotland are to be monitored. A further approach being explored is a simplified method of collecting phenological data using diagrammatic keys.

55 DETECTING ENVIRONMENTAL TRENDS AND DIFFERENCES IN TRENDS: WHERE DO WE START, AND WHERE DO WE END?

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In studying environmental change, the main aim is to detect trends that are likely to continue over many years. Tests for trend are therefore usually based on the assumption of a monotonic increase or decrease. However, year-to-year variations in weather patterns can result in long-term cycles and this means that artificial trends may be detected if short time series are used. Smoothing techniques provide a means of visually examining changes in the data without making any assumptions about the nature of the change. This form of graphical presentation is most informative when there is some reference point in time with respect to which we wish to draw comparisons. Such reference points arise naturally if we are looking at changes since some particular event, such as an industrial accident or a change in management practice. However, when this is not the case, it is common practice to draw comparison with estimated values at the start of a time series of observations, or to compare past values with the most recently estimated value. Unfortunately, these extremities are exactly the points in the time series at which the underlying trend is estimated with least precision.

We will discuss the impact that the choice of time reference point has on comparisons of trends in water quality data using data from pairs of streams in the Scottish uplands. Whilst the overall statistical evidence for differences in trends does not depend on the choice of reference point, the choice has a big impact on the visual impression of these differences.

56 DYNAMICS OF ADAPTATION TO TYPHOONS AMONG COCONUT FARMING COMMUNITIES IN THE PHILIPPINES

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The Philippines is one among the most environmentally threatened countries in Southeast Asia Its geography accounts for its vulnerability to natural hazards such as earthquakes, volcanic eruptions and more regularly, typhoons. An average of 20 out of 36 tropical cyclones that develop over the northwest Pacific basin, hit the country every year. As such, management of agricultural systems in typhoon prone areas becomes extremely difficult.
In areas frequented by typhoons, coconut is the dominant crop being cultivated. Farmers, despite the risks, continue to depend on coconut farms. Notwithstanding the low productivity and ultimately low profitability of coconut, it stands to be a significant crop that brings farmers modest, (nee low) income and food on the table. It is also this marginal situation that led to assumption that coconut farmers in these areas are among the poorest of the poor. Hence, coconut farmers in this region are one among the major targets of poverty alleviation programs of civic organizations and the government.
However, it is the consensus among development workers t that development of agriculture in typhoon prone areas is hinged on an adequate understanding of the dynamics of the adaptation process among farming communities in these areas. It is within this context that this study was conducted. This study examines the nature of coconut farming in typhoon prone areas, how they evolved over time, and the extent to which they are affected by typhoons.
The study also looks into the varied coping mechanisms that coconut farmers have adapted to changing nature of typhoons over the year and respective losses, and attempts to understand the way farmers make decision under conditions of great uncertainties. The study uses a mix of research techniques such as a sample survey of communities in 2 typhoon regions in the country, oral history and coconut genetic resource inventory for a period of 6 months.
Findings from this study provide the Philippine Coconut Authority a development framework for an integrated program for strengthening the capacity of coconut -based communities in typhoon prone areas for improved productivity and food security.

Keywords: adaptation, typhoons, coconut, coping mechanisms, Philippines

57 STUDY OF TRITIUM CONCENTRATION IN OBJECTS OF THE ENVIRONMENT AT THE RFNC-VNIITF-ADJACENT TERRITORY

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Consideration is given to the impact of tritium releases from industrial buildings at RFNC-VNIITF on the Environment on industrial sites, the sanitary protection zone, and the zone of Institute supervision.
Study of soil samples from the closed administrative territory of Snezhinsk and the neighborhood shows their contamination by tritium oxide to be nonuniform. The area with the soil contaminated by tritium oxide in the amount of (30.0-84.5) Bq/kg covers the territory up to 10 km from the center of the industrial site to the south. The rest directions are subject to small changes and tritium oxide concentration in the soil sampled in these directions is 4.8 ÷25.1 Bq/kg.

The amount of tritium oxide in the soil of industrial sites ranges from 14.8 Bq/kg to 177.6 Bq/kg with the average of 59.2 Bq/kg.
Concentration of tritium oxide in the ground air of the industrial site was determined to range from 17.4.10-4 Bq/l to 288.6. 10-4 Bq/l, with an average of 61.8.10-4 Bq/l.
Industrial discharges and tritium releases from industrial sites partially get in rivers and lakes in the neighborhood of the Institute. Investigation in five lakes demonstrated that tritium content in water is not more than its admissible concentration for drinkable water (7.7.103 Bq/l) and, in drinkable water lakes (lakes Sinara, Itkul', Sungul'), remains 50-80 times less than admissible concentrations.
In order to study tritium content in atmospheric precipitation, 126 snow samples were taken in checkpoints at the territory adjacent to RFNC-VNIITF. Amount of tritium oxide in snow samples from industrial sites ranged from 50 to 1246 Bq/l; in Snezhinsk and its neighborhood this amount was 55÷176 Bq/l.

In 1996 potatoes, vegetables, fish, eggs, meat, milk, etc. were sampled to monitor tritium concentration in foodstuffs for citizens of Snezhinsk. Totally, 33 foodstuffs were tested.
Experimental data showed tritium contamination of the environmental objects in the closed administrative territory of Snezhinsk to be relatively low. Tritium discharges and releases have insignificant impact on the ecological situation, in general.

58 URBAN EXPANSION AND LOSS OF AGRICULTURAL LAND. A STUDY IN INDIAN CONTEXT USING REMOTE SENSING AND G.I.S. TECHNIQUES.

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During the last few decades the population of the world has increased tremendously. This increase was more pronounced among the developing and under-developed countries. This results in high pressure on the land. This alarming population growth has resulted in rapid urbanization and urban expansion because rural areas are unable to provide employment for opportunities resulting in mass migration to urban areas. This urban expansion is encroaching upon fertile agricultural land.
The present study makes an attempt to draw factual use of land on the map to show precise locational insight about the use of land, further to eliminate misuse in terms of the physical, economic, social and cultural factors. Further it also estimate the loss of agricultural land and resultant loss of agricultural products, which has been incurred by expansion of urban centres. The case study was done on Indian city, where agriculture is still the main occupation of countries 70 percent population. But with rapidly growing population any shortage of agricultural products have far reaching implications both politically and socially. Saharanpur city was chosen as the study area which is one of the class I city situated in the most populous state of Uttar Pradesh (India). The initial development of Saharanpur city is due to its well-developed agricultural hinterland. But in the last few years, several industries have come up and city is now shedding its agrarian character by adopting secondary and tertiary economic activities.
The study is based on remotely sensed data and processed in G.I.S. environment using IL WIS software. The result clearly points towards substantial loss of good quality agricultural land due to

expansion of Saharanpur city. Interestingly non-built up development of the city has caused maximum loss.

59 CHANGES IN THE SEASONAL TIMING OF LIFE CYCLE EVENTS OF EASTERN CANADA FROM 1900 TO 1920

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From 1900 to 1923, an influential inspector of schools in Nova Scotia, Dr. A.H. MacKay, recruited a number of knowledgeable teachers around the province to use their students to observe 100 natural occurrences each year, and report them in a standardized way. This is the science of phenology - the study of the seasonal timing of life cycle events. These observations included the appearance of blooming wildflowers, cultivated plants, migratory birds, mammals, amphibians plus the freezing of lakes and rivers, appearance of frost and snow, number and severity of thunderstorms, hurricanes, etc. In addition, the timing of human agricultural practices was also recorded, including calving, seeding, potato planting, and haying. Tracking the timing of naturally occurring events helps show trends in the effects on biota and human activities as a result of climate change and weather variability. Analysis has shown that earlier Springs can be linked to El Nino events, and a trend has been observed towards earlier plant development over the last 40 years in the Edmonton, Alberta area - a trend that matches trends in warmer January to June temperatures in Western Canada. Some plant and animal life cycle events integrate the effects of various climate factors and can be used to detect subtle trends against the noisy background of normal weather variability. Many centuries of plant phenology records from Europe show us that plants and animals are sensitive weather instruments: they can be used for recording climate variables (heat, precipitation, wind) and for forecasting the best time for planting, harvesting, treating for pests, avoiding pollen or planning your holidays. Knowing valuable seasonality information such as the timing of spring flowering helps decision-making for farmers and foresters, that is, to correctly time operations such as planting, fertilizing, crop protection (integrated pest management) and to predict harvest timing. It also is useful in wildlife management (e.g.. the survival of deer fawns is greater in years with early spring arrival); human health (pollen-warnings for allergy-sufferers), and tourism (best times to photograph flowers or animals, or to go fly-fishing). Our hope is to have schools and communities track changes in this seasonality as a measure of climate change. MacKay was an acclaimed botanist whose lichen collection and publications are part of the Nova Scotia Museum resources. The records from his environmental observation project are also part of the Nova Scotia Museum collection, and are a valuable source of data. With over 1500 Nova Scotian schools participating, MacKay filled 20 thick volumes with meticulous records of the natural environment (6 are summary volumes). In 1998, these records were digitized, put into a database, and are now available to the public through a Website. This paper will examine the 20 years of MacKay data identifying trends in phenology and human activity, and its possible messages for climate change in eastern Canada.

60 MAJOR ROAD CHANGES IN CANADA 1915-1995: IMPLICATIONS FOR ECOSYSTEMS, BIODIVERSITY AND PROTECTED AREAS

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Roads are important indicators of environmental change as forested lands are cleared and wetlands are drained to make the roads. Roads also open up areas to further human development leading to declining wildlife habitat and increased introduction of invasive wildlife species. This study examines changes in the major roads of Canada every decade from 1915 to 1995. The authors began with a digitized 1995 road map of Canada and hard copy road maps from the archives for 1985, 1975, 1965, 1955, 1945, 1935, 1925 and 1915. Using a geographic information system, roads not present on the 1985 map were removed from the 1995 digitized map. This was repeated for every ten year interval map. The authors will present maps to illustrate the dramatic changes in roads in Canada over the past century, and focus on some protected areas of southern Ontario to detail the implications of these road developments to ecosystems, biodiversity and protected areas.

61 DESIGN CONCEPTS ADOPTED IN LONG-TERM FOREST ECOSYSTEM MONITORING PROGRAMS IN EUROPE – PROBLEMS FOR THE FUTURE?

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It is widely acknowledged that environmental issues such as climatic change, biodiversity loss and air pollution needs long-term and integrated monitoring programs. Once these two attributes are met, than the success of the program is often taken for granted. This belief is reflected by the relatively poor attention paid to the development of robust design concepts underlying some of the most important and expensive ecosystem monitoring programs in Europe. Unfortunately, it is not enough to have a long-term commitment for integrated monitoring to ensure the success of the program, and many other factors or design issues needs attention. Besides the firm conviction that long-term integrated monitoring is an indispensable tool to understand status and changes of ecosystems, this paper will concentrate on three other major design issues: the choice of measurements, indicators and indices of ecosystem status and changes (structural vs. functional indicators; priorities among measurements), the sampling design (the selection of the sites where establish the measurements; preferential, model based, design based) and the sampling tactic (the selection of where locate the measurements within the site). For an effective program, all the above issues must have clear links with the program objectives, and must be considered carefully as they will have a strong influence on the value of the future results.
While it is easy to find a generic consensus about the importance of these issues, at the same time there is evidence that they are often neglected in the practice of international ecosystem monitoring programs. This is reflected by the blanket adoption of the most common indicators of e.g. tree condition, the blanket adoption of similar plot sizes throughout Europe, the frequent misuse of the term "representative" (which has a definite statistical meaning) to indicate samples, data, sites and results thought to be either "characteristics" or "typical" of a given environmental resources. Poor consideration of the issues related to the design of the monitoring programs can have a strong impact on the monitoring results, with the potential of serious consequences when the monitoring results will be used for the implementation of environmental policies.

62 THE SOCIAL-HYGIENIC MONITORING AT THE BELARUS ARE THE MAIN DETECTING ENVIRONMENTAL AND HEALTH CHANGES FOR POLICY

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The Concept of the National Strategy of Sustainable Development of Belarus considers the protection and improvement of the public health as one of the main purpose. Now we prepare own National Environmental Health Action Plan in conformity Declaration of the Third Ministerial Conference on Envirionmental and Health, London, 1999. According to the Law of the Republic of Belarus "About Sanitary-Epidemical Well-being Population" the Ministry of the Health are responsible for the Social-Hygienic Monitoring (SHM). For this purpose Belarus has 148 the Hygiene & Epidemiology Centers in our cities, where the environment quality and population health is observed and supervised.

Regional Centers have Social-Hygienic Monitoring Department, which have all data collected and analyzed for the State Annual Report About Sanitary-Epidemical Situation at Belarus. This Report for the state management is the global final official document with objective information about sanitary-epidemical situation in regions, conditions and factors of population health formation, accepted and necessary actions on a population health protection. The SHM information base have data about:
the natural-climatic factors;
the industry, agriculture, transport, trade, economic development;
the cities and settlements development, their municipal accomplishment and population household service level;
the life style and the population incomes, the population housing condition;
the structure and food quality, food raw material, food products and drinking water safety for a health;
the sources of emission pollution;
the air, surface and underground waters quality and radiation safety;
the children training and education condition;
the working conditions (work place hazard);
the demographic situation and the morbidity (including infectious and professional);
the population medical maintenance.

The Hygiene&Epidemiology Centers accumulate all information and environmental pollution and social-economic factors connection are establish for prophylactic. The database formation source are existing from the state authority and management, ministries, departments and others information banks, as well as international organizations. It is the main problems among the National priorities.

63 THE APPLICATION OF DIATOM BASED PALAEOLIMNOLOGY IN THE ACQUISITION OF MODERN AUTECOLOGICAL DATA.

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The ecological reconstruction of palaeolimnological records is usually based upon information derived from modern data sets. Due to the short lived nature of most ecological research programs, these modern data sets are typically generated over a 1 – 2 year monitoring period. In terms of defining accurate autecological information for individual taxa, this brief temporal snapshot obviously has important ramifications, and these are outlined.

An often overlooked source of autecological information is the fossil records themselves. This paper looks at one record in particular, Lake Cullulleraine in south east Australia, and examines the possibilities for the generation of diatom autecological information. Essential criteria to facilitate this derivation of autecological data include a well dated chronological sequence with ideally a constant sedimentation rate, well defined changes in the fossilised diatom assemblage, and a well documented local and regional catchment history. Sites in Australia are favourably suited to the last criterion due to the continent's relatively short record of non – indigenous settlement.

The diatom fossil record from Lake Cullulleraine, when combined with the known catchment history, provides an important insight into the ecological requirement of several common taxa, including Aulacoseira subborealis, Aulacoseira granulata, Staurosira construens forma venter, and Tabularia fasciculata.

64 HARMONISATION OF METHODOLOGIES AT A NATIONAL LEVEL: THE HUNGARIAN BIODIVERSITY MONITORING SYSTEM

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A complex programme for long-term nature-conservation-targeted biodiversity monitoring in Hungary has been elaborated by a large group of experts during 1995-97, the design of the Hungarian

Biodiversity Monitoring System (HBMS) was initiated and organised by the Authority for Nature Conservation of the Ministry for Environment.
The priorities during the selection of entities of HBMS were as follows:
monitoring of endangered and protected natural values
observation of elements with a diagnostic value in assessing the general state of the biota and communities
study of the direct and indirect effects of human-induced changes, and changes of the environment

To monitor the habitat patterns of Hungary 124 quadrates of 5X5 km have been selected for habitat mapping. This network serves as the background of community and species population monitoring.

The proposed programme of HBMS was described in a series of 10 volumes (I. Information management, II. Description and definition of Hungarian habitats and the National Habitat Classification System, III. Plant communities, IV. Plant species, V. Crustaceans, Dragonflies and Orthopteroid insects, VI. Coleoptera, VII. Lepidoptera, VIII. Amphibians and Reptiles, IX. Birds, Mammals and the monitoring of genetic diversity , printed in Hungarian in 1997).

The National Biodiversity Service (NBS) was established in 1997. The Central Coordination Unit provides the management of the system, and responsible for the administrative and professional co-ordination of the NBS. The Unit is responsible for the realisation of the programme of the HBMS, for standardising procedures, for the co-ordination of the data collection and management at a national, regional and local level. An independent Scientific Advisory Committee of highly respected experts advise and give professional control of the monitoring activities of HBMS. At each national park directorate, altogether 9, a regional co-ordinator is responsible for organising the data collection according to the agreed protocols.

In 1998 the Central Coordination Unit elaborated monitoring projects, which synthesises the tasks of HBMS. In priority order the projects are as follows:
monitoring of protected and threatened plant and animal populations
monitoring of biocoenosis of surface waters and wetlands
monitoring of habitats of Hungary
monitoring invasive plant and animal species populations
monitoring the selected sites of the proposed Hungarian Forest Reserve Network
regional monitoring of the biota of the Kis-Balaton wetland
regional monitoring of the Szigetköz wetland area
monitoring of salt-effected habitats
monitoring of dry grasslands
monitoring of secondary hay meadows

The protocols developed for specific components of the projects provide detailed description of sampling methodologies, frequency, examined attributes, proposed data analysis, the plan of costs. Some examples of protocols will be presented in the poster.

65 TIME TRENDS IN SOIL WATER CHEMISTRY OF SWEDISH FORESTED REFERENCE SITES.

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The decline in acid deposition during the last several decades has caused recovery in surface waters in many regions in northern Europe. The recovery, however, is slow and it will probably take decades or centuries before a pre-industrial state will be reached. While the surface waters are recovering, there are indications that forest soils continue to acidify. The improvement of the acid status of the surface water would then only be a temporal effect of the decrease in acid anions. As soon as the sulphur deposition has stabilised at a constant level, the recovery would stop and the pH could even continue to decrease. This would mean that the critical level for acidification has not yet been reached and further restrictions in sulphur emissions have to be undertaken. An important factor for the future acid status of the environment is whether the soil pool of exchangeable base cations is continuing to decrease, despite the decrease in acid deposition. Another important question is whether the soils are retaining or leaching sulphate.

Changes in soil pools are, however, not easy to detect. Soil chemistry has a high degree of spatial variability and repeated sampling of soil may not be possible at monitoring sites since sampling is destructive. An indirect measurement of the soil chemistry is to sample soil solution chemistry, assuming equilibrium between soil water and the soil matrix. Soil water concentrations are sensitive indicators of changes of soil chemistry, since the soil pools are large and small changes in the pools causes large changes in the soil solution chemistry. Sampling of soil water can be done regularly with suction lysimeters. Time series of soil water can, however, only be done for a limited number of locations at a site. Although a reasonable number of lysimeters cannot provide an estimate of a mean value for the soil water chemistry of a site, the change in time may be satisfactorily described. This assumes that the soil water chemistry at the different locations vary in the same way over time, although the mean concentrations are different. To find out whether lysimeter data can be used for detecting time trends in soil chemistry, we have calculated time trends of lysimeter data from three sites between 1985 and 1996. The sites are Berg, on the south-west cost, Tiveden, in central south Sweden and Reivo in northern Sweden, thus representing different climate and deposition levels. Lysimeters were installed at the E- B and C- horizons with 3-7 replicates at each level. The trend tests were done with Seasonal-Kendal combined for all lysimeters at each level and site. The covariance of the lysimeters at each level was analysed with an estimation of replicates needed to detect trends at a certain slope.

66 TIME SERIES OF LONG-TERM ANNUAL FLUXES IN THE STREAMWATER OF NINE SELECTED FOREST CATCHMENTS OF THE SWEDISH ENVIRONMENTAL MONITORING PROGRAM (PMK)

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The rate of acidification recovery is of great concern in Sweden, since the anti-pollution strategy is designed to stop the spread of surface water acidification, but does not directly consider the need for recovery in areas that are already anthropogenically acidified.
The Swedish national small catchment-monitoring program PMK **Error! Bookmark not defined.**, which comprised fifteen intensively monitored catchments across Sweden between 1986 and 1994, is a valuable resource for achieving a regionally nuanced understanding of the prospects for recovery. The Swedish small catchment monitoring was reduced to four catchments in 1993. These catchments became part of the Inter-governmental Cooperative Program for Integrated Monitoring (ICP IM) under the auspices of the UN ECE.., The Swedish University of Agricultural Sciences Dept. of Environmental Assessment, however, has continued runoff chemistry monitoring at the original PMK sites.
The objective of this paper is to assess long-term trends of the time series of chemical fluxes from the nine selected catchments of the PMK network. The following catchments were analyzed in this study (from north to south): SE5 (Ammarnäs), SE3 (Reivo), SE8 (Sandnäset), SE10 (Tandövala), SE11 (Tresticklan), SE1A (Tiveden-Lommabäcken Nedre), SE1B (Tiveden-Bråtängsbäcken), SE2 (Berg), SE13 (Tostarp). The northernmost catchments (SE5, SE3 and SE8) are rather unaffected by acid deposition whereas SE10, SE11, SE1A, SE1B and SE2 are chronically acidified. The southernmost SE13 has a high deposition, but is well buffered due to highly weatherable soils.
We used linear regression for estimating the slopes and Kendalls tau for testing the significance of the trends of the annual streamwater fluxes. We found an obvious response to the declining deposition in negative trends for SO4 in eight of the nine sites with statistically significant changes at six sites. This was followed by decreases in the H+ transport in seven of the sites with three significant trends. Even the transport of non marine base cations (BC) decreased during the studied period at eight of the sites. The southernmost site SE13 diverges from the others in having increasing transports of all substances, due to a significant increase in runoff. For the other sites there was no trend in runoff volume. The changes in BC depended mostly on Ca and Mg. These can be derived from both soil ion exchange and mineral weathering. Non-marine Na, which mainly originates from weathering, was stable during the period. This implies a constant weathering rate and a decreasing leaching of exchangeable BC. Although the results show an improvement of the water quality, the changes are very small. The decreases in H+ for example, correspond to increases of c. 0.01 pH units for the acidified sites at SE10, SE11, SE1 and SE2. Further, the improved water quality may be a temporary effect of the decrease of total soluble ion concentration, which changes the equilibrium between adsorbed and dissolved ions in the soil. This temporary improvement might well hide a continuing soil acidification. Further

knowledge of the within catchment processes are needed in order to estimate levels for sulfur emissions where the soil can start to recover from acidification, and not only stagnate at the present acidified state.

67 SHORT TERM CLIMATIC EFFECTS ON THE SULPHATE BUDGET OF A LOWLAND LAKE: LOUGH NEAGH, 1988-1999.

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Lough Neagh drains a largely lowland catchment of 4450 km2 in north-east Ireland. The predominant catchment land-use is grassland. Regular monitoring for sulphate (SO4) and other major ions has been undertaken since 1988 on the Lough Neagh (14 day sampling), the six major inflowing rivers (weekly sampling) and from the single outflow from the lake (weekly sampling).
Data from this monitoring have been used to calculate catchment exports of SO4 to Lough Neagh and a SO4 mass balance for the lake. In addition, catchment inputs of SO4 from precipitation have been estimated from three rainfall monitoring stations which are located close to the periphery of the lake catchment. Neither rainfall inputs or catchment exports of SO4 showed any linear trend with time. Catchment exports exceeded rainfall inputs by a factor of 3. Agricultural inputs of SO4 cannot account for this difference and inputs of sulphur via fertiliser are minimal in relation to exports of sulphur in agricultural product. The catchments therefore act as net exporters of SO4, in contrast to catchment retention or gaseous losses evident from catchment mass balances for nitrogen, phosphorus and potassium. Mean catchment export rates of SO4 for the six inflowing river catchments were in the range 31 to 43 kg S ha-1 yr-1).
After the dry summers of 1989 and 1995 there were marked peaks in SO4 concentrations in the rivers in the autumn, particularly from the two catchments where the pedology was not dominated by basaltic soils. In this respect SO4 resembled nitrate in rivers, although the peaks in SO4 concentrations preceded those for nitrate and were less persistent in the following winters. Mass balances of SO4 for Lough Neagh showed a close agreement between inputs and exports, suggesting that the lake was a minor sink for SO4 (c 2% of inputs). The quantities of SO4 retained by the lake were however consistent with values from other lakes.

68 EFFECTS OF THE EL NIÑO SOUTHERN OSCILLATION ON THE SHALLOW-WATER FISH ASSEMBLAGE OF THE PATOS LAGOON ESTUARY (BRAZIL)

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The latest El Niño event in 1997-1998 was, by some measures, the strongest on record, with major climatic impacts felt around the world. In southern Brazil, El Niño episodes cause excess of rainfall, which directly affects the stream flow variability in major rivers of the region. The greater river discharge disrupts the salinity, temperature and water circulation patterns in estuaries and coastal waters. Southern Brazil has a very important productive fishing area, and several species from this region utilize the shallow waters of the Patos Lagoon estuary as important nursery grounds. Thus, it is important to understand the extent to which 1997-1998 El Niño events affect the recruitment and abundance patterns of juvenile fishes that utilize this ecosystem. The aim of this study is to describe the recruitment patterns, species composition and diversity of the fish assemblage in shallow waters of the Patos Lagoon estuary before, during and after the 1997-1998 El Niño event, based in a 4-year monthly collected data set.
One Survey stations was located in a coastal marine area adjacent to Patos Lagoon, and four other stations were located inside the estuary. Fish were sampled using a 9-m beach seine (13 mm bar mesh in the wings and 0.5 mm in the center 3 m section) that was pulled to cover an area of about 60 m2. Five hauls of equal length were made monthly at each station from August 1996 to November 1998. Specimens were identified, counted and the total length (TL) was measured to the nearest millimeter

(mm). Each month, air and water temperature, water transparency (Secchi disk) and salinity were measured at each station. Also, precipitation and the number of days with rain were recorded.
Variation in the abundance (catch per unit effort, CPUE) of fishes between seasons and locations was analyzed by ANOVA. In order to assess recruitment patterns of the dominant species, CPUE and size (total length, TL) were analyzed graphically by plotting CPUE by size class. Relationships between fish assemblage and the environmental variables at five sampling stations were analyzed with canonical correspondence analysis (CCA). The species richness component was calculated by rarefaction, whereas equitability by the E4 Hill ratio. The Shannon index, rarefaction richness and Hill's equitability were compared graphically and with ANOVA to assess the statistical significance of patterns.
The extreme rainfall caused by the 1997-1998 El Niño phenomenon affected the fish assemblage of the Patos Lagoon estuary in many ecological aspects. Recruitment of dominant species patterns was negatively altered, whereas freshwater fishes ranged their distribution to the estuary leading to higher species richness. Assemblage shifts occurring during El Niño were not long ranging. Instead, the assemblage returned to pre-El Niño conditions almost immediately after the El Niño period.

69 MONITORING VEGETATION CHANGE IN THE UPLANDS: A TOOL FOR EVALUATING MANAGEMENT STRATEGIES AND PRIORITIES

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Over the past 50 years there has been a significant decline in the amount and quality of upland heather moor in the UK. More recently, the importance of this habitat for rare and declining species, and its contribution to biodiversity, has increasingly been recognised. The decline of heather moor has been variously attributed to inappropriate grazing and burning regimes, atmospheric pollution and drainage, and with the onset of climate change, further change may be expected.

To counteract this decline, a number of agri-environment schemes, such as the Environmentally Sensitive Areas Scheme, have been introduced that focus on maintaining and enhancing heather (Calluna vulgaris) on upland moor by reducing the density of livestock (primarily sheep). Monitoring of these schemes over a 5-10 year period has highlighted considerable variation in the vegetation response arising from factors such as soil condition, deep peat vs mineral soils, plant age, occurrence of competitive species and the distribution of grazing animals. Faced with these different factors, determining the rate and direction of vegetation change under different management regimes is a challenging and imprecise science.

In this paper, we present a modelling tool that integrates both environmental and management factors to determine their effect on the rate and direction of upland vegetation change. The model links small-scale ecological processes of interspecific competition and spatial heterogeneity to larger-scale processes of herbivore preference and grazing intensity, to determine the rate of species change in different plant assemblages. By characterising the variety of assemblages present on a moor, this approach can be used to predict the rate of vegetation change across a whole moor. Outputs from the model have been tested against field experiments conducted at the plot (0.18 ha) and whole-moor (50 ha) scales. Results are presented to indicate the use of the model in the evaluation of different management strategies and the establishment of appropriate timescales for vegetation monitoring on upland moor.

70 LINKING ECOLOGICAL PROCESSES TO LARGE-SCALE VEGETATION DYNAMICS

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A particular challenge to ecologists is to determine how processes that operate at one scale affect the dynamics of systems operating at a larger scale. For example, the extent to which interspecific

competition between individuals is important in structuring species assemblages at the community scale. Until recently, the use of cellular automata to investigate scaling issues has been difficult, requiring either a significant increase in model complexity and computational demand or the extraction of aggregate functions to capture the behaviour of the system at one scale and enable it to be incorporated at another.

In this paper, we present an individual-based cellular automaton model, investigating the effects of interspecific competition and spatial heterogeneity at the local level, and a coupled map lattice model, investigating large-scale vegetation dynamics at the field level. The models are linked by three aggregate functions that enable the properties emerging from the small-scale competition model to be incorporated into the vegetation dynamics model. These functions emerge firstly, from the observation that the spatial distribution of a species can be quantified by its perimeter to area ratio, where the perimeter is defined by the population of individuals located at the interfaces of patches of different species, and secondly from the observation that the perimeter to area ratio is a good predictor of the probability of species persistence. Preliminary results from the large-scale model suggest that small-scale spatial heterogeneity can act to enhance species persistence at the large-scale, particularly where the vegetation is fragmented. The results have implications for the management of fragmented habitats and suggest a role for diversity in enabling species persistence.

71 REVERSING THE DECLINE IN HEATHER ON UPLAND MOOR: CURRENT APPROACHES & FUTURE NEEDS

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Agriculture is a key driver of habitat change in upland Britain. The loss of dwarf shrub species, notably heather (Calluna vulgaris), and their replacement by competitive grasses, such as purple moor grass (Molinia caerulea) and mat grass (Nardus stricta), has important consequences for both the economics and conservation of upland moor.

Vegetation change has been variously attributed to inappropriate grazing and burning regimes, increased atmospheric pollution and climate change. Current conservation policies tend to focus on reducing the level of grazing stock in order to reverse change and the decline of heather in particular. The reduction of grazing pressure is the principal approach adopted by agri-environment schemes, such as ESAs and CSS, to maintain and enhance the biodiversity of upland areas.

In this paper, we review the effectiveness of this approach using data from a 10 year research programme, quantifying the responses of key moorland species and communities to a reduction in grazing pressure, and reviewing these data in relation to those from the ESA monitoring programme in the uplands of England and Wales. The data highlight differences in the rate of response of each species reflecting both geographical differences in species growth and vigour, the spatial distribution of species and biological differences in species' response to factors such as N deposition. This variability emphasises the requirement for reliable tools that integrate the effects of different environmental drivers and enable regional variation in species responses to be considered during the formulation of policy on the management of the biodiversity of the uplands. The data also indicate that the choice of indicator species and the scale at which vegetation is monitored, influences the sensitivity of the monitoring programme to detect significant changes in the biological system.

In the second part of the paper we introduce a model to assess the effects of both environmental and anthropogenic change on upland vegetation. The model operates at scales appropriate to the management of whole moors and herds of livestock and links ecological processes of plant competition and succession to large-scale dynamics of vegetation change. We demonstrate how such a tool can assist in the establishment of priorities for management and restoration of upland moor and in determining appropriate timetables for monitoring that take account of variation in species response to different environmental drivers.

72 HUMAN DIMENSION AND ENVIRONMENTAL CHANGE OF A METROPOLITAN CITY USING REMOTE SENSING TECHNIQUES

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To study and analyse the human dimension and land use/land cover change, the land use forms the basis of city structure. Intensive growth of population have posed the problem of the availability of land to meet the requirement for various uses. This type of situation is more prevalent in metropolitan areas because of migration. The environmental degradation starts due to mismatch of population growth versus infrastructure development. As per population projections of UN, population of India is estimated to be 1442 millions by 2025, at the rate of 3% decadal growth to total population, and urban population will be around 37% to total population.

Hyderabad, a mega city, capital of Andhra Pradesh state is one of the information technology hubs. As per the 1991 census total population of Metropolitan area was around 4.66 million (fig.2). As per the analysis of the urban sprawl, increase in built up area is estimated to be around 3% per annum whereas population increase was about 5% (fig-3 & 4). The population dynamics with in the built-up area shows density is below 100 persons / hectare (fig.5). As per the natural growth of population and general development trend it is expected again the city will attain above 100 persons per hectare by 2011.

A rough estimate of population for 1999 as per the flexible gross density city norm worked out to be around 5.46 millions where as conventional projection estimate is about 6.7 millions. The gap clearly states the over crowding of population in core area of the city. The land use change out side the Municipal Corporation of Hyderabad (MCH) between 1992-99 shows lot off development in the residential sector close proximity to main city (fig.6). This development formed the basis for notification of nine municipalities out side MCH. In these municipalities, F.A.R is given more compared to MCH to encourage vertical compact development. The compact development always saves infrastructure cost at the same time it supports mass transit system. Estimated population in the extend areas as per the density norm 150 persons/hectare works out to be 2.28 millions where as projection is about 2.26 millions and this shows slight over crowding. The infrastructure in these areas is very poor and most of the areas are not served by drinking water network hence ground water is being exploit tied and it has to be regulated. The present availability of water is 680 MLD and future estimated requirement taking medium growth, will be around 2322 MLD.

The housing of excess population indicates an environmental degradation. Physical environment closely concerned with the state of city-infrastructure and land use. An efficient drainage and solid waste disposal system is essential for public health. Suitable industrial location and effluent treatment can alone keep the air and water pollution levels within tolerable limits. The suspended Particulate Matter (SPM) in air will remain within safe limits if the road surface are clean, well paved. Heap of garbage scattered here and there contribute to more SPM Matter carrying all kinds of bacteria and virus. Some of the most harmful gases in the air are mainly contributed by automobile exhaust. The built-up area is about 29% and rest of the area found to be agriculture and other non-urban uses. The land use reveals major change from agriculture to urban uses. Due to urban expansion some of the water bodies are converted to residential areas. Protection of lakes water bodies has assumed great importance for recharge of ground water recycling, for various urban uses, development of recreational and picnic spots for maintaining ecological balance. The study clearly brings out utility of remote sensing in land use/land cover change and various urban systems viz., water supply, solid waste, public utilities, transport network etc., which are required to improve the environmental conditions with respect to human dimension.

Key words : human dimension, population, environment, ecology, development

73 IDENTIFYING PATTERNS OF CHANGE IN LAKES SAMPLED AT INFREQUENT INTERVALS

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The Environmental Change Network protocols for monitoring lakes recommends that samples be collected at fortnightly intervals but some sites are only visited four times a year.
Samples of water and plankton have, however, been collected from two ECN sites (Windermere and Esthwaite Water) at fortnightly intervals for several decades using methods that have remained essentially the same over the years. Here we use these data as 'reference' time-series from which to derive simple predictive models which can then be used to predict seasonal, inter-annual and long-term patterns of change. Sampling the reference time-series at monthly, bi-monthly and quarterly intervals and re-estimating the model parameters allows the information lost from reduced sampling effort to be quantified. The time-series selected include one physical, one chemical and two biological variables from each lake and the window of observation extends from January 1966 to December 1997. During this period both lakes were exposed to short-term variations in the weather and long-term changes in the flux of nutrients from the surrounding catchments.

74 THE RESPONSE OF NITROGEN CYCLING IN SOILS TO NITROGEN DEPOSITION FROM THE ATMOSPHERE: INDICES OF NITROGEN SATURATION

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The study of the impacts of nitrogen (N) deposition on the N cycle is compromised by the complexity of the processes involved. Isotopic pool dilution techniques using 15N offer the chance to obtain a much clearer understanding of the N cycle based on measured gross rates of N transformations. In the context of environmental impact, the ratio of gross nitrification to gross immobilisation (N:I) can be used to describe the extent to which a soil is over-producing nitrate relative to the ability of the microbial community in the soil to use that nitrate; the greater the ratio the more likely a soil to lose N by leaching or denitrification (Goulding et al., 1998). We measured gross N transformations and N pools, including the N:I index, in a series of soils with a range of land uses in the UK and in New Zealand. The sites experienced a range of N depositions from almost zero at some 'pristine' sites in New Zealand to >>50 kg N ha-1 yr-1 in the south-east of the UK. Gross N fluxes – ammonification, nitrification, immobilisation - and N pools - ammonium, nitrate - were measured as described by Willison et al. (1998).

Gross rates of N cycling were very rapid where sufficient carbon (C) was available, but the source(s) of this C are uncertain. There were strong interactions of N pools and transformations with soil properties and N deposition. Our measurements show that additions of N in atmospheric deposition can disrupt the soil N cycle, in particular stimulating nitrification. As deposition increases, efficient internal cycling with an N:I ratio of <<1, a small mineral N pool and minimal losses changes to a saturated system with N:I >1 and a large mineral N pool that is more prone to N loss. Knott Wood, 15 ha of 300-year old deciduous woodland at Rothamsted, receives well over 50 kg N ha-1 yr-1 and appears to be N-saturated, emitting 0.73 kg N2O ha-1 yr-1, a rate comparable with arable land receiving > 200 kg N fertiliser ha-1 yr-1. The paper will discuss the likely causes of these observations and the implications for both assessing and predicting the impacts of N deposition on ecosystems.

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75 A CONCEPT FOR BIOGEOCHEMICAL MONITORING IN CONIFEROUS FORESTS

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Abstract. Areal representation of sampling is a problem in monitoring of element cycling in forests. Monitoring of throughfall/litterfall fluxes, soil water chemistry and soil moisture is based on point sampling and sampling can not be performed at the same point without mutual disturbance of the samples/results. This is especially a problem in coniferous forest where different radial patterns of water and element input around tree trunks cause steep gradients over short distances. Further, it is difficult to relate results from point sampling/measurements of fluxes to determinations of crown conditions or tree growth other than on the areal mean. Good areal representation requires a large number of point samples and generates numerous expensive chemical analyses. This paper discusses the problems in monitoring element fluxes and budgets. A sampling concept based on small subplots is presented. This concept i) provide an areal representation and a measure of variability between subplots, ii) use minimal displacement (1m) of sampling at different levels (throughfall, soil water, etc.), iii) provide a possibility to relate variability in element fluxes/soil conditions to the variability in tree conditions within the site, and iv) is cost effective.

76 BIOGEOCHEMISTRY IN TWO AMMONIA AFFECTED FORESTS IN DENMARK

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Abstract. In a national survey focussed on agricultural impacts on freshwaters dormant season soil solution nitrate concentrations were measured 1986-92. The survey was based on a systematic grid including also forest soils. Some 10% of these forest soils had high nitrate concentration (>10 mg N/l) indicating nitrogen saturation. From this group two sites with mature coniferous stands (Picea abies and Abies alba) where chosen for further study of element cycling in 1996. Throughfall and litterfall fluxes, soil water chemistry, foliage chemistry and soil characteristics were measured in 1996-1999.

The sites were situated within areas dominated by intensive agricultural activity. Throughfall supplied >40 kg N/ha/yr with c. 70% being ammonium. Often throughfall pH was 6-7 even though bulk precipitation pH was below 5. Nitrogen concentrations in needles were 1.7% in Picea and 1.5% in Abies. Concentrations of K and P were low and below critical values relative to nitrogen. Nitrate concentrations in soil water varied between 10 and 30 mg N/l at both sites over the whole monitoring period 1986-92, 96-99. The paper will discuss the effect of nitrogen input on element cycling and the future nutrient supply in the stands. Data on the effect of clear felling/ windthrow on nitrate leaching at such nitrogen-saturated sites will be presented as well.

77 EVALUATING THE IMPACT OF CLIMATE CHANGE AND DAMMING ACTIVITIES ON THE SEDIMENTARY BUDGET OF THE SEBOU RIVER AND THE ESTUARINE ZONE (MOROCCO).

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The Sebou catchment area covers around 40 000 km2 and contains a population of about 5 million people. It is funnel shaped and runs from the Atlantic coast between two mountain ranges, i.e. the Rif

to the North and the Middle Atlas range to the South. These two ranges differ in terms of their hypsometry, size and lithological composition, thus explaining the differences in rainfall distributions and flow regimes in the northern and southern parts of the Sebou basin.
Moreover, hydroclimatic patterns for the 1940-1979 period, as defined by annual discharge rates, indicated an alternation of short dry periods and long humid periods (lasting 3 to 9 years). The basin was affected by a long dry period that began in 1980 when water resources were not sufficient to meet needs during this period. The discharge versus rainfall curve plotted for this period confirms the marked discrepancy. This situation could be explained by the extensive use of surface waters during the dry period and the construction of hydroelectric dams on Sebou River and tributaries. The natural vulnerability of the area has been magnified. by the magnitude and extent of socio-economic activities, impacts and interventions that increase since the 1973s.
It is important therefore to know that construction of the large dams, supplemented by changes in rainfall regimes, has led to sharp reduction of water inflow and sediment discharge. It is estimated that the increasing degree of environmental pressure has reduced the water discharge of Sebou River by about 70% and the sediment flux of nearly 95%.
As result of these intensified pressures, water and sediment discharges led to a decline in the estuarine zone. In this case, with the decrease of the fluvial competence, the Sebou estuarine zone will become the site of enhanced siltation and the defensive structures could induce important modifications in the natural evolution of the coast.

78 THINKING OF TECHNIQUES TO PROTECT ECO-ENVIRONMENT OF THE FOUNTAINHEAD OF THE YELLOW RIVER IN MADOU COUNTRY

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1.Grassland deterioration aggravates eco-environment of the fountainhead area. The first country at the fountainhead area is Maduo. Its elevation is above 4,200m. There many streams and small lakes in this area. The climate is cold and draught. There is no absolute frostless term. The precipitation is about 300mm.The grassland type is alpine meadow. In recent years, grassland in this area has been deteriorating, and desertification aggravated. The deteriorated grassland area was about 1.07¢ª104km2, which was 46.55% of the total grassland area in 1986. But in 1998, the figure changed to 1.61¢ª104km2 and 70% respectively. Because the vegetation has been destroyed, water reservation has decreased, glacier has shrunk back, many streams have disappeared and lakes are getting smaller and smaller.
2.The capacity of livestock is low, and the death rate of adult livestock products have declined. The survival rate of young livestock is low, and the death rate of adult livestock is high. The capacity of livestock was 0.61hm2/sheep in whole Guoluo prefecture and 1.00hm2/sheep in Maduo in 1990. The figure changed to 0.95hm2 and 3.67hm2 respectively in 1996. The productivity (meet)of available grassland was 3.06kg/hm2 in whole Guoluo prefecture and 0.97hm2 in Maduo in 1996. The survival rate of young livestock was 72.79% (yak and horse) and 77.04% (Tibetan sheep and goat) in whole Guoluo prefecture , comparatively, 52.08% and 11.04% in Maduo. The death rate of adult livestock was 11.04% (yak and horse) and 5.63% (Tibetan sheep and goat) in whole Guoluo prefecture and in Maduo was 20.46% and 21.25%, and Maduo is in the first place.
3.Thinking of techniques to protect eco-environment of the area. At present, Chinese government are making great efforts to the eco-environment protection of the fountainhead area of the Yellow River. I think Qinghai province government should cooperate with central government in getting international aids and taking practical measures. Meanwhile, Herdsmen in the country should be exempted from taxing. Grass Planting should be continued. Herdsmans settlements and livestock shed construction should be speeded up. Fence construction should be according to local condition. Some places must be fenced off for vegetation recovering. To attain this goal, the effective method is to strengthen rear ability. The total livestock number should limited to present level (280,000). The proportion of female livestock should be increased for seasonal animal husbandry. Feed should be used to supplement the shortage of grass. So the state government and provincial government must provide amount of fund for the country. Strive for fund supporting from other provinces at the Yellow River valley. There are 210,000 livestock in Yellow River country, Heihe country, Zhaling Lake country and Huashixia country. In this area, 20kg fine feed should be supplemented for per livestock. Add other countrys need.5000tons fine feed needed every year. It is estimated the total unpaid fund is about 7,750,000yuan (RMB). I believe the eco-system balance will be recovered in 10 to 15 years. And from a long viewpoint, this is worthwhile.

Key words the Fountainhead of the Yellow River, Eco-environment protection, Thinking of techniques

79 THE ENVIRONMENTAL CHANGE NETWORK AND THE USE OF THE LONG-TERM EXPERIMENTS AT ROTHAMSTED.

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Rothamsted Experimental Farm is one of the main terrestrial sites in the UK Environmental Change Network (ECN). It was established as an ECN site in 1992 and has been collecting data using the majority of the core protocols since this time.

The collection of data is based on the farm as a whole to facilitate the use of as many of the long-term experiments and data sets already in existence, some going back over 150 years. One of the monitoring sites has been the Broadbalk Continuous Winter Wheat experiment; this was started in 1843 and has been sown with wheat every year to the present. The main focus of the ECN is the Park Grass hay experiment. This was started in 1856 and has had cuts taken twice a year, one for hay in June/July and again in October when a green cut is taken. The addition of a range of fertilisers and lime to the plots on these experiments has created unique conditions for amongst other things, studying changes in the carbon content of the soils on Broadbalk and the changes in the botanical composition on the Park Grass experiment.

Atmospheric inputs are calculated from an extensive run of precipitation samples collected over 100 years, with additional weather data for rainfall, temperature and through flow of lysimeters. These data, linked with an archive of regular herbage and soil samples, gives one of the best indications of long-term changes to a grassland site in the world.

Park Grass is the more important experiment for use for environmental monitoring as it shows the effects of atmospheric deposition of acidity and nitrogen on the species composition of the plots. Goulding et al. (1998) showed changes in the number of plant species from around 50 on an unfertilised plot in 1856 to around 30 species at the present time because of increased atmospheric acid input. Other changes on plots with fertiliser applied as ammonium sulphate show an even more dramatic effect of acidification with numbers down to 2 or 3 species. When a very acidic plot was split in 1950 and lime applied on a regular basis (every three to four years) the species numbers are seen to be recovering but are still low (around 12 different species). This demonstrates how amelioration of the soil takes a considerable time. In addition, the confounding aspects of atmospheric inputs of nitrogen, calculated at around 30 to 40 kg ha-1 yr-1, can slow this process.

The ECN is helping to continue this monitoring work on the long-term experiments at Rothamsted and with the addition monitoring protocols building up a more complete picture of the effects of environmental change on these eco-systems.

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80 A MODEL TO DESCRIBE THE EFFECTS OF INCREASED NITROGEN INPUTS TO DECIDUOUS WOODLAND AND THE CHANGES IN GROUND COVER SPECIES.

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A model of the impacts of nitrogen deposition has been developed using long-term data sets of soil analysis and vegetation surveys, going back 100 years, on an area of naturally regenerated woodland at IACR Rothamsted, Geescroft Wilderness, which was fenced off in 1882. Long runs of precipitation data collected over the last 100 years and dry deposition measurements since 1986 have provided a good indication of the changes in atmospheric inputs of nitrogen to this semi-natural eco-system, and are used to drive the model.

Most data and surveys of temperate deciduous woodland have concentrated on the tree species, this model looks specifically to explain, simulate and predict changes in the ground cover species.

The model uses the nitrogen and carbon cycling basis of the Rothamsted Sundial model to simulated the movement of the nitrogen in the soil. The effects on the ground vegetation have been calculated using visual surveys of the site and values from the literature.
The model uses the 'big leaf' idea to incorporate the effects of changes in the weather on the up take and availability of atmospheric nitrogen. This creates the opportunity to use the model in a predictive way to see the effects of different climate change scenarios on the ground cover vegetation changes.
The model is now being used to simulate the effects and changes on another area of deciduous woodland on the Rothamsted farm, Knott Wood. Measurements have been made over the last two years on the nitrogen content of the ground cover and visual surveys of any changes in ground cover species diversity.

81 IMPACTS OF ELEVATED CO2 AND TEMPERATURE ON A SEMI-NATURAL GRASSLAND IN NORTH WALES.

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We are studying the impacts of future climatic changes, and the interaction with management, on grasslands. In 1998 monoliths were extracted from a semi-natural grassland on Anglesey, North Wales, transferred to the Climate Change Solardomes at CEH Bangor (Rafarel et al., 1995), and exposed to two CO2 concentrations (ambient and ambient + 235 ppmv) and two temperatures (ambient and ambient + 3 oC) in a factorial design experiment. Within each dome a sub-treatment of two cutting frequencies has been applied - two and six times per year.

Above-ground productivity was either the same or higher at low compared with high cutting frequency, but significant interactions between cutting frequency, [CO2] and temperature were observed. In the first year, above-ground productivity of monoliths that were cut six times per year was stimulated by elevated temperature (20%) and [CO2] (22%) in an additive manner (39%). In the second year, productivity was stimulated even more by elevated temperature and [CO2], compared with the first year, but in a less than additive manner. However, the magnitude of stimulation of yield by enhanced temperature and [CO2] was dependent on season.

A higher cutting frequency resulted in a reduction in allocation of dry weight into flowers and dead material. Monoliths that were cut six times per year allocated a higher fraction of their annual yield into flowers at elevated compared with ambient [CO2], especially in the first year. On the other hand, monoliths that were cut twice per year allocated a lower fraction of their annual yield into flowers at elevated compared with ambient temperature. Exposure to elevated [CO2] or temperature did not affect the fraction of dead material present in the monoliths in the first year. Meanwhile, in the second year there was an effect of both elevated [CO2] and temperature on the fraction of dead material, which was dependent on cutting frequency. There was an increase in the fraction of Dicotyledoneae in response to both elevated [CO2] and temperature at the high cutting frequency, but the opposite trends were observed at the low cutting frequency. Neither elevated [CO2] nor elevated temperature did affect the leaf area index and specific leaf area at the low cutting frequency. On the other hand, at the high cutting frequency for some seasons, elevated [CO2] reduced the specific leaf area and both elevated [CO2] and temperature enhanced leaf area index.

It can be concluded that the impacts of climate change on semi-improved natural grasslands are primarily dependent on management practice (i.e. cutting frequency), and vary with season and duration of exposure. We will continue this research in order to determine the impact of climate change on semi-natural grasslands in the long term. This study clearly shows that grassland management can be directed towards practices that could mitigate the effects of climate change.

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82 THE RELATIONSHIP BETWEEN PH, ALUMINIUM SPECIES AND DISSOLVED ORGANIC CARBON IN SCOTTISH FRESHWATERS: LONG-TERM TRENDS AND IMPLICATIONS FOR BROWN TROUT SURVIVAL

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It has long been recognised that the presence of ionic forms of labile aluminium (Al-L) in fresh waters is potentially toxic to fish. Reports of elevated stream concentrations of Al-L (>10µgl-1) in upland catchment have usually been linked to freshwater acidification caused by atmospheric deposition of acidic pollutants. As catchment soils become more acid, Al-L is leached into the soil solution and thereafter into streams and lakes where significant concentrations are found once the pH falls to pH 5.5 or below.
Not all catchment can provide sufficient Al buffering to slow down the decline in pH, therefore it is not unusual to find a negative correlation between acidity (H+) and Al-L concentration.
One of the main confounding factors in predicting fishery responses to freshwater acidification is the transformation of Al-L into relatively non-toxic, organically complexed forms of alu minium (Al-NL), a process which appears to depend on the extend of dissolved organic carbon (DOC) leaching.
Recent studies (Roy&Campbell, 1997) suggest that DOC may play an additional protective role in directly reducing the toxicity of Al-L as well as increasing Al complexation.
Trend analysis of Scottish freshwater has revealed a significant decline in Al-L concentrations in the past two decades whilst DOC concentrations have increased over a similar period.

In this paper we evaluate the relationships between pH and Al-L in streams exhibiting a range of DOC concentrations and compare these data with DOC / Al-NL relationships in streams of varying pH.
Using logistic regression, the probability of occurrence of brown trout at different pH and Al-L concentrations will be derived and possible implications for survival of different life stages will be discussed.

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83 EXAMINE (EXPLOITATION OF APHID MONITORING IN EUROPE); AN EU THEMATIC NETWORK FOR THE STUDY OF GLOBAL CHANGE IMPACTS ON APHIDS.

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www.iacr.bbsrc.ac.uk/examine/

Aphids are the insect group most sensitive to climate change because of their very short generation times and rapid potential growth rates. A network of suction traps, 12.2 metres tall, has been established in 15 countries to monitor these insects. The combined system will provide the most comprehensive database for any terrestrial invertebrate group anywhere in the world and will be a unique resource for studies on the impacts of global change. An SQL SERVER database is being developed which will comprise daily records of approximately 20 major pest species of aphid at all 73 sites throughout Europe for all years of trap operation. Over 1000 site-years of data are available. The database will be interfaced to the NT IIS (Internet Information Server) via ASP (Active Server Page). Participants will then be able to access the database via the World Wide Web and be able to put queries, obtain formatted files, plot graphs, maps etc. and punch in data. Data on climate, pollutant concentrations and land use will be accessed and general linear models will be used to examine relationships between these and the aphid data. Where significant relationships are found, these will be extrapolated to show the likely impact on the aphid variables of environmental conditions expected up to fifty years hence. The project will produce a lasting infrastructure for validating predictions of the

impacts of global change on European agroecosystems. Details of the project can be found www.iacr.bbsrc.ac.uk/examine/

84 TADPOLES AS BIOINDICATORS OF AQUATIC HEALTH: ASSESSING THE MINING INDUSTRY'S IMPACT ON WATER QUALITY

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South Africa is renowned for its vast wealth in mineral resources, typified by extensive gold deposits and mining activities on the Witwatersrand region. In contrast to this mineral wealth, water resources are limited and vulnerable to past and present environmental impacts from the mining industry. In South Africa the historical lack of use ecological indicators for monitoring water quality, is presently being addressed. Acid deposition and associated metal toxicity from mines and industry are believed to be one of the factors affecting amphibian development and abundance. Over the past decade there have been dramatic worldwide declines in amphibian populations and increased occurrences of malformations.
The purpose of our study was to determine the effect of acute and chronic exposure to a range of pH and metals (Zn, Cu, Cd and Pb) on the growth and development of Xenopus laevis (African clawed frog) embryos and tadpoles, in order to establish a biomonitoring technique that can be applied to water quality testing. The method relates development (survivorship, body length and malformations) of eggs and tadpoles to a range of pH and metal concentrations comparable to that found in mine drainage water on the Witwatersrand, South Africa. Cleaving embryos were initially exposed to various concentrations of Zn, Cu, Cd and Cd, and then to various pH levels all over a period of eight days. The bioaccumulation of the individual metals was measured by means of atomic absorption spectrophotometry.

Cadmium and Zn (< 0.5 ppm and < 1 ppm respectively) had no effect on egg hatching, but caused significant increased mortality and malformations during the tadpoles later development ($p < 0.05$). However, Cu and Pb (< 0.5 ppm and <1 ppm respectively) reduced the hatching success of the embryos. We found a significant trend of reduced growth rate with increasing metal concentrations ($p < 0.05$). Similarly, increased metal concentrations caused increased malformations ($p < 0.05$). The next step is to determine the additive, antagonistic or synergistic nature of the metals to the tadpoles by combining metals and pH.

This method is similar to FETAX, however the outcomes and protocol are different due to a number of constraint, such as animal ethics. We argue that this method of biomonitoring mine pollutants with the use of X. laevis as a bioindicator is a suitable low cost and ecological more correct alternative to currently used chemical and physical analysis in a third world country.

85 OVERTOPPING AND FLOODING: FUTURE THREATS TO LOW LYING ATOLL ISLAND COUNTRIES: A CASE STUDY IN SOUTH TARAWA, REPUBLIC OF KIRIBATI

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The South Pacific Applied Geoscience Commission is an independent professional intergovernmental organization serving 18 member countries in the South Pacific in applying geosciences to the management and sustainable development of their non-living resources. Among its membership, several countries are located at low-lying coral atoll, with the maximum elevations of 3-5 m above mean sea level and is undoubtedly, under threats of overtopping and flooding by future sea-level rise, hatched by the global climate change. These countries include Cook Islands, Kiribati, Nauru, Marshall Islands and Vanuatu.

Tarawa, the capital of Republic of Kiribati, inundated by hearsay that it will be sank when sea level rise in the future after the topic of global climate change has attracted the attention of scientific communities, is a triangular low lying coral atoll located in the western Pacific at 1(30' N and 173(00'

E. There is a series of islets on the east and south sides of the Tarawa Lagoon which have mostly been linked by artificial causeways. The capital has a high density population and is threatened by different hazards, both natural and man-made, such as increasing pollution from solid and liquid wastes (especially increase in level of fecal coliform bacteria), in-appropriate coastal structures, change of directions of prevailing winds and waves, and threat of sea level rise. Some of these have already lead to degradation of the lagoon, change of sediment pattern, coastal erosion and damage to coastal eco-systems of Tarawa. Among these, the future overtopping and flooding caused by sea-level rise will be the most dangerous threat, which will directly damage infrastructures, erode and flood valuable and scarce land and contaminate ground water with seawater.

A quantitative assessment of the effects of overtopping and flooding caused by future sea level rise based IPCC projection scenarios was conducted. The beach profile and land elevation data were collected in August 1999 around Bairiki, Bikenibeu and Bonriki. These three important districts have high population densities, high level of national development and concentration of infrastructure in the south Tarawa. Together with historical airphoto coverage, analysis of this information with those from a number of long - term beach monitoring stations show that:

Under sea level condition of IPCC best guess scenario of 0.3 m above present sea level during a 14-year storm event which coincides with a spring tide, 15 to 17% of top coast will be overtopped and 11.5-14.3% of land area will be flooded;

Under sea level condition of IPCC medium guess scenario of 0.5 m above present sea level during a 14-year storm event which coincides with a spring tide, 33-38% of top coast will be overtopped and 28-30 % of land area will be flooded;

Under sea level condition of IPCC high guess scenario of 0.95 m above present sea level during a 14-year storm event which coincides with a spring tide, the whole islands will be over washed.

86 A NEW APPROACH TO DETECTING LICHEN RESPONSE TO CHANGING AIR POLLUTION

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As measures are taken to reduce emissions of air pollutants, there is a need to improve our understanding of the processes of biological recovery. Bradford University on behalf of the British Lichenological Society manages the large and nationally important database on the distribution of lichens in the British Isles. The distribution of vascular plants, bryophytes and lichens has been traditionally recorded and displayed, as in this database, as presence/absence data on a 10 km x 10 km grid square basis, or hectad. This presents particular problems, one of these being that it is not possible to know whether the absence of a species from a particular hectad is a genuine absence, or due to the hectad never having been visited by lichenologists or due to the species concerned being overlooked. In order to overcome this problem, the potential distribution of each species of lichen has been generated from the relationship of all known records of that species to over 24 environmental variables, including climatic, edaphic, geological, topographic and land use types. The patterns of new records that have occurred over the last 20 years within this potential distribution are compared to the deposition fields of sulphur and nitrogen. This paper presents the results of the analysis of how the distribution patterns of nearly 200 different species of lichen are responding to the falling concentrations of SO2 and changing patterns of nitrogen deposition in Britain.

87 MONITORING IN THE ARCTIC: SCANNET

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The Arctic has been subject to recent climate change with some areas warming but others cooling. Long-term projections indicate that the region will experience the largest climate change in the World, with forest forecast to replace almost 50% of tundra by 2100.

Responses of terrestrial ecosystems will be modified by enhanced CO2 , UVB and atmospheric deposition and land use change.

New monitoring activities are being proposed, but what changes have already been detected through long-term observations and experiments at existing field sites? Existing sites in the European Arctic are sparse, but widely distributed over a variety of environmental conditions, that cover strong N to S and oceanic to continental gradients. Data from some sites go back 50 years with observations on climate, hydrology, birds, mammals and vegetation. Whilst individual information has been used to determine changes in particular variables, most of the data are not documented, are inaccessible, and lack common format.

Thus valuable long-term information from observations and experiments is underused both within sites and in comparisons across the region.

A new EC project, SCANNET, has been initiated to establish a distributed network of 10 terrestrial sites in the North Atlantic region to address questions of variation in system sensitivity and response to environmental change. The overall aims are to:

Establish a network of field sites which can enhance comparable information on environmental change in a region which is particularly sensitive and where information is hard to obtain.
Generate an accessible database and focal points for contact and interaction with major organisations requiring information on change.

Provide a field based community with the capacity to respond to proposals for future monitoring and is capable of rapid and integrated response to needs for comparative observations when short-term events or emergencies occur. Generate knowledgeable advice for improved detection and interpretation of environmental change and on interaction with local communities

Search, documentation and collation of information will lay the foundation for later analytical and synthesis efforts and will be focussed by 5 science-based questions:

Wherein the European Arctic are ecosystems and natural resources most susceptible to change?
How are these changes related to local and regional environmental conditions and hat are the most important drivers of change at these sites?
What are the consequences of environmental change for stakeholders?
How is our understanding of environmental change constrained by methodology, technology, perception and policy?
How does the focus on specific questions lead to the establishment of a network of sites and improved co-ordination of observation of change?

88 THE EFFECT OF CLIMATE CHANGE ON THE CONCENTRATION OF DISSOLVED ORGANIC MATTER IN A TEMPERATE STREAM (MALSE, SOUTH BOHEMIA).

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Long-term increase of dissolved organic matter (DOM) concentrations has been detected in European streams at many localities during the last decades. Increase in temperature, recovery from acidification and/or changes of hydrological conditions were suggested as explanatory variables for this increase. The purpose of this paper is to analyse the long-term and seasonal variability of DOM in the Malse, a fifth-order stream in South Bohemia, during the period from 1961 to 1999, and to predict its changes expected in the 2050's due to global climate warming.
The Malse catchment (14°40' E/48°58' N, area - 495 km2, mean/maximum/minimum altitudes - 695/1072/420 m above sea level) is situated in an upland area with the bedrock formed by weathered paragneiss, diorite and granite. Most soils in the catchment are acid brown soils and mountainous podzols. About 32% of the catchment is used as arable land, 19% as meadows, 43% for forestry and

2% are urbanised areas. The typical seasonal pattern of runoff is dominated by maximum discharges after snowmelt in March and April followed by a gradual decrease until November.
Simulations of discharge using the Sacramento Soil Moisture Accounting Model (SAC-SMA) for the period of 1961-1999 showed an important increase in the proportion of surface and interflow runoff during the summer months (up to 32%) coinciding with the highest precipitation period. Baseflow was especially dominant during winter (84 to 90%). Average monthly DOM concentrations showed a significant correlation with temperature and with the surface plus interflow portion of the discharge. A multiple regression linear model of DOM was calculated with these two parameters explaining 66% of DOM variability.
During the period from 1961 to 1999, increasing trends were detected in the Malse catchment for temperature (+0.026 °C per year; P>0.99) and for DOM (+0.3% per year; P>0.99). Neither total annual discharge or any of runoff components showed significant long term trends, however, average discharge in the summer period (June to August) decreased (-1.5% per year; P>0.95). Precipitation amounts remained without any significant change during the period under study.
A stochastic weather generator was used to produce 39-year series of daily data on temperature and precipitation with statistical parameters either identical with the observed data in the Malse catchment or changed according to a General Circulation Model (ECHAM4) based climate change scenario for the 2050's (CO_2 increased by about 66%). Hydrological response in the Malse was then calculated with the SAC-SMA model. The changed $2\times CO_2$ conditions resulted in an increase of mean annual temperature by 3.1 °C but no changes in mean annual precipitation (the annual cycle was changed). Concurrently, average discharge in the Malse decreased by 6%.This occurred due to an approximately 12% decrease in discharges during spring and summer, which was partly compensated by a 4% increase in autumn and winter. Surface and interflow components of the runoff decreased by less than 1% in comparison with the average conditions in 1961-1999. These changes of climatic and hydrological conditions resulted in a 5% increase of DOM concentration, as calculated with the above mentioned regression model.

89 LAND USE INFLUENCES ON ACIDIFICATION AND RECOVERY OF FRESHWATERS IN GALLOWAY, SOUTH-WEST SCOTLAND

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The long term response of surface waters to changes in sulphur (S) deposition, and afforestation was investigated for three upland river systems in the Galloway region of south-west Scotland. From 1984 to 1999 these rivers exhibited a statistically significant decline in non-marine sulphate (nmSO4) concentrations in response to reduced acid deposition. This reduction in $nmSO_4$ was however, insufficient to induce a pH recovery from 1984 to 1999. A statistically significant increase in river pH was observed between 1956-1970 (0.05 yr^{-1}) when subsidised agricultural lime payments were at a maximum. In 1976, this subsidy ceased and concurrently surface waters have progressively acidified. In addition, climatic change was found to influence long-term trends in pH. Mean annual pH measurements were greatest during a dry period between 1969 and 1973 when annual total discharge was low. Thereafter pH gradually declined in response to higher rainfall and increased annual total discharge. Overall surface water draining the afforested catchments of the Rivers Cree and Bladnoch are more acid than those draining the moorland catchment of the Luce. These results indicate that in afforested catchments, current reductions in S emissions have not led to an observed improvement in the acid status of surface waters. Forestry therefore represents a confounding factor with regard to chemical recovery from acidification in this region.

Keywords: Acidification, afforestation, deposition, rivers, lochs, non-marine sulphate, pH.

90 CHANGES IN PRECIPITATION, SURFACE RUNOFF AND GROUNDWATER ACIDITY, OVER THE LAST TWENTY YEARS, FOR THE TILLINGBOURNE CATCHMENT (SOUTHERN ENGLAND).

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Measurements of acid deposition and stream- and ground- water chemistry, made in 1979-1982 and 1999-2001, are compared for a small, acid-sensitive catchment in Southeast England. The catchment is forested and is located on acidic cretaceous sandstone with a low permeability clay substratum. The soils are predominantly podzol and gley, with some peat.
Mean volume-weighted concentrations in precipitation, indicate that SO42- has declined by 61%, H+ by 75%, both NO3- and NH4+ by 37% and Cl- by 26%. The changes in wet deposition are greater; sulphate deposition declined by 69%, non-marine SO42- by 73%, H+ deposition by 75%, NO3- and NH4+ by 50% and Cl- by 41%. Sulphate deposition in throughfall, used as a surrogate for total deposition, has declined by 82% and non-marine SO42- by 86%. Some of these changes are due to alterations in the tree cover and location of the collectors. Surface water was sampled at the same locations in the catchment during the two periods. At the catchment exit, mean pH increased, from 3.93 to 4.21, and SO42- declined from 20.2 to 16.7 mgl-1 (18%). The decrease in SO42- is much less than the reduction in deposition, suggesting that the predicted recovery is being delayed by release of sulphur from the soil. In contrast, NO3- concentrations in the catchment waters increased from 0.22 to 0.52 mg N l-1 (133%) despite the reduction in N deposition. NH4+ concentrations were low during both study periods.
At present, the catchment is showing signs of recovery from acidification. However, the recovery process in streamwater is probably being delayed by desorption of soil S and the increasing N saturation, despite decreases in both S and N deposition. Further data collection is required to elucidate these findings.

91 A HIERARCHICAL MODELLING APPROACH TO COMBINING ENVIRONMENTAL DATA AT DIFFERENT SCALES

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Long-transported air pollution in Europe is monitored by a combination of a highly complex mathematical model and a limited number of measurement stations.
The model takes emission estimates from all countries and uses observed weather patterns to predict deposition on a 150km square grid covering the whole of the continent. These can be regarded as spatial averages, with some spatially correlated model error. The measurement stations give point estimates, with some uncorrelated measurement error. Some simple analyses show that the model values are not good predictors of the point values, although they are correlated.

The model therefore has the advantage that it can predict at any location, while the measurements are assumed to be more accurate at a very limited number of locations.We combine these two sources of data by assuming both are observations of an underlying true process. This enables us to estimate both the bias in the model and the magnitude of the errors in both sources of data, and thus provide better estimates of the true depostion, along with a realistic measure of uncertainty.

92 A 70-YEAR UPLAND RECORD OF CLIMATE CHANGE IN THE UK

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Most long-term meteorological records in the UK are confined to the lowlands. Climate change in the UK uplands is important because their peaty soils are key carbon stores, they contain internationally important ecological habitats and are source areas for water supply. The temperature record for Moor

House meteorological station, north Pennines, UK, at 556 m altitude provides a rare long-term framework for analysing past temperature in an upland location in Britain. Earlier examination of these data suggested that there was no evidence in the uplands for the recent warming which has been identified in lowland Britain.
This paper shows that, in line with lowland records, there has been a long-term warming trend in the north Pennine uplands over the past seven decades. Indeed recent annual warming at Moor House has been greater than experienced at the nearby Durham station at an altitude some 450 m lower suggesting localised changes to lapse rates. Most of the annual warming is concentrated during winter months. Winters have warmed significantly by 1.5-2.0oC while no significant temperature changes have been recorded during summers. Milder winters could be crucial in upland areas because where temperatures are close to freezing for much of the winter slight warming may result in changes to frost frequency. The occurrence of frost is a key biological and geomorphological control and an important indicator of climate change.
This paper demonstrates that the mean number of days with air frost has significantly reduced at Moor House by 24 % over the last 10 years in the context of the 70-year record. This has been accompanied by a decrease in the number of days when the temperature is both above and below freezing (geomorphologically active days) and by a reduction in the number of days with snow cover. Mean annual minimum temperatures have increased significantly but mean maxima have not. The result is a decrease in the average diurnal temperature range and in the mean seasonal temperature range.

93 NITROGEN APPLICATION FOR FOOD PRODUCTION AND ITS EFFECT ON ENVIRONMENT IN BANGLADESH

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Nitrogen in various chemical forms plays a major role in large number of environment issues. Some atmospheric nitrogen combines with oxygen to form nitrogen oxide, which is hazardous to environment. Bangladesh cannot avoid the use of chemical fertilizers as the demand for food for the ever-growing population is very high. The present annual production of food grain is about 46 million tonnes for 128 million people. The target for achieving food grain production by 2020 AD is 66 million tonnes to feed about 170 million people. A rapid increase in agricultural production is possible only by increasing the application of chemical fertilizers. Over 470 thousand tonnes of nitrogen is used for crop production annually in Bangladesh, but there is still a great shortage of nitrogen to meet the requirement of crops; hence, the gap between demand and supply is very high. With the modernization in technology and the liberalized economy and market system, the demand for processed food items is increasing; therefore, the application of nitrogen in food industry will also be increased in the early future. Thus, the application of nitrogen for various purposes is increasing without its adverse effect on the environment being realised. It is essential to optimize the seriousness of population growth on economy and environment. The consumption patterns, existing within society must be based on the clear understanding of the carrying capacity of the land. Therefore, an attempt has been made to present the status of application of nitrogen in crop production and food preservation in Bangladesh. A future demand for nitrogen for these activities has been highlighted. The effect of nitrogen on the environment and measures to overcome it are suggested in this manuscript.

94 CLIMATE CHANGE AND CONSERVATION POLICY: FROM WILDLIFE GARDENING TO THE KING CANUTE APPROACH.

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This paper is based on the work undertaken as part of a DETR/MAFF funded project reviewing the implications of climate change for UK habitat and species conservation. The work reviewed the current state of knowledge on the potential impacts of climate change on BAP broad and priority habitats and the species associated with them. It identified 4 key habitat types that may be considered most susceptible to climate change based either on the change in climate and rise in sea level or on the human response to climate change. The work also considered the range of UK and international commitments that we are subscribed to at present and how action to meet these commitments would be

affected by climate change impacts. The work concluded that climate change should be explicitly considered within the formulation of conservation policy and practice. Climate change could have a significant effect on the ability of the UK to meet its conservation commitments over the next 50 years. The report recommended that:
Conservation objectives within the wider countryside could also be achieved by directly supporting the protection of designated areas; for example through encouraging the use of Countryside Stewardship schemes to provide buffer zones around protected areas and to create stepping-stones for species and habitats to colonise new sites and establish in new locations.
Discussion within the EU institutions on the interpretation and implementation of EC nature conservation legislation in the light of climate change potentially affecting UK's ability to meet or to sustain current obligations;
Refocusing and, where necessary, periodic re-assessment of the priorities for conservation in the light of climate change impacts. This will allow for improvements in the understanding of species and habitat responses and updated scenarios of climate change. These priorities will need to be forward looking and to anticipate species and habitat responses to climate change;
Barriers to change will need to be overcome in order to make changes to conservation practice and policy. These include vested interests from land owners and conservation bodies as well as public opinion and awareness on the need for conservation and why this may not mean preservation of existing habitats and species in situ

In addition the work raised a number of fundamental questions for nature conservation that will be discussed in this paper:
What are the ultimate objectives of conservation and how should these be adjusted in light of climate change impacts?
How far should conservation policy go to protect a species or habitat within the UK and at what stage should conservation priorities move away from a species or habitat that can no longer be maintained?
At what spatial scale should conservation success be judged, e.g. at the site level, at the regional level, the national level, the international level etc?

This paper will discuss these issues and consider some of the implications of different responses to the questions.

95 STRATEGIC ENVIRONMENTAL ASSESMENT IN ALGERIA; STATUS AND CHALLENGES.

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Any operation of space planning or management requires to draw-up a balance of land-use state.Land may be more or less transformed or damaged by man, it is then ecessary to explain the reasons that lead to the environment's deterioration(physical and human
reasons).From the quality of the diagnosis depends the quality of the measures vocated for space planning, management, rehabilitation. From this basis the algerian overnment noticed that space planning and environment have to work together in a same ministry, as it is in many countries.

While opting for this form, Algeria has operated a kind of level establishement. Creating a ministry of space planningand environment, may constitutesa real turnning point in this field and announces a new era for the Algerian ecology.
If we stick to the commonly use definition,the space planning is:"the organisation of the space in such a way to improve the population living conditionds,to develop the economic activities and to put in value the natural resources by avoiding at the same time, disturbing the natural ecosystems". The spase planning is also regarded as, one of the action fields where should win over the sciences of development and environmental protection.

Keywords:Space planning - Environment – Ministry

96 BIOMARE: IMPLEMENTATION AND NETWORKING OF LARGE-SCALE LONG-TERM MARINE BIODIVERSITY RESEARCH IN EUROPE.

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Consensus has grown that concertation and co-ordination at European scale is urgently required to implement long-term and large-scale marine biodiversity research and to plan the adequate use of the European research infrastructure. Many research questions cannot be addressed at local scales and require cooperation and the establishment of a committed network of scientists and institutes. There is no agreed common methodology for many aspects of biodiversity research; this needs careful preparation.

The BIOMARE concerted action aims at establishing the infrastructure and conditions required for marine biodiversity research at European scale. The objectives of the Concerted Action are to achieve a European consensus on the selection and implementation of:
- 1) a network of Reference Sites as the basis for long-term and large-scale marine biodiversity research in Europe,
- 2) internationally agreed standardised and normalised measures and indicators for (the degree of) biodiversity,
- 3) facilities for capacity building, dissemination and networking of marine biodiversity research, by a) workshops, b) improving training and mobility, c) an internet web-site including an overview of ongoing research programs and existing infrastructure for marine biodiversity research in Europe, d) a database on, reviewed and evaluated, available data, aiming at employing data for socio-economic questions such as the impact of fisheries or tourism.

To implement the objectives a series of evaluations, recommendations, regional meetings and joint workshops is foreseen. The Concerted Action started in November 2000.
The first results on the selection of reference sites and putative indicators of marine biodiversity in Europe will be demonstrated.

97 SPATIAL INTERPRETATION OF AMBIENT AIR QUALITY FOR THE TERRITORY OF THE CZECH REPUBLIC

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A new method for spatial interpretation and visualisation of measured air quality data developed and introduced in 1998 (Hunová, 1998) is used for ambient air quality assessment in the Czech Republic. The data from country wide air quality monitoring network is collated into the least possible number of factors describing the overall air quality in 1996-1999. The factors identified as “ambient air pollution”, “ground-level ozone” and “wet atmospheric deposition” represent three different aspects of ambient air quality and their impact on receptors´ evaluation.
The “ambient air pollution” factor contains the information on concentrations of sulphur dioxide (SO2), nitrogen oxides (NOx) including nitrogen oxide (NO) and nitrogen dioxide (NO2), carbon oxide (CO), suspended particles, measured either as TSP (suspended particles without fraction resolution) or PM10 fraction (defined as particulate matter which passes through a size-selective inlet with a 50 % efficiency cut-off at 10 µm aerodynamic diameter), and selected heavy metals – lead (Pb), cadmium (Cd) and arsenic (As) in TSP.
The “ground-level ozone” factor includes the information on concentrations of that part of the tropospheric ozone formed as a secondary pollutant through photochemical reactions from precursors which are NOx and Volatile Organic Compounds (VOC).
The “wet atmospheric deposition” includes the information on wet deposition of SO42-, NO3-, H+, NH4+, Pb and Cd linked to episodes of so called vertical precipitation, rain and snow.
The “ambient air pollution” factor describes the ambient air quality mainly from the direct impact on human health point of view, the “ground-level ozone” factor from the impact on ecosystem point of view and the “wet atmospheric deposition” factor from the impact on soils and ecosystem point of view.

The results are presented in colored maps produced in Arc/View system classifying the Czech Republic territory into 5 category scale as to relative ambient air quality. The air quality picture differs for the respective factors within one calendar year considerably. The temporal changes within each factor in period 1996-1999 are evident.
This method enables comparison of different areas as to ambient air quality in relative terms and has practical consequences in decision making and public information. It can be used as a supporting tool for determining which area or areas should be given the priority in providing financial means for environmental protection.

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98 CHANGES IN THE PHYSICAL ENVIRONMENT IN AN AREA WITH SEMI-ARID APPEARANCE IN RESPONSE TO THE MANAGEMENT OF THE VEGETATION ENVIRONMENT

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This paper has presented the analysis of data on the changes of physical environment of a driven system pertaining to a selected area of the Barind Tract, NW Bangladesh. The physical environment of the study area has already been driven into semi-arid appearance through the destruction of vegetation environment since long time. Since 1990, the vegetation environment of the area has been started to be managed through the increase of community plantation and cropping intensity. One of the objectives of this management was to reduce the aridity in the area. At the beginning of this management (1990), the area has very poor coverage of community vegetation (2.6%-3%), low intensity of cropping (129% out of 300%), no vegetation coverage in forest scale, very low coverage of surface water (2.7%) and poor level of ground water table (10 to 22 meters in dry season). The agricultural management was based on ground water irrigation. However, due to poor level of water resources in the area, this management practices have hypothetically induced duel excitations in the system: increase of vegetation coverage and deterioration of water balance. The responses of these excitations have been studied in this paper with the ultimate objective of examining the sustainability of the management practices. The variables studied are rainfall, air temperature and humidity, ground water level, irrigation extent, cropping intensity, existence of water, vegetation and soil (exposed) and a thermal state indicator (to monitor the state of droughtiness). Information on the last three variables has been extracted from Landsat TM images. The variables have been studied during the time frame 1990-1999, when ground water was increasingly being abstracted starting at 1990. The most exciting fact revealed in this study is that, in one side, a noticeable increase of annual rainfall has been observed, which may be attributed to the increase of vegetation. On the other side, decrease of the ground water level due to irrigation activities has increased dry season droughtiness in the area. These induced changes (increase of both rainfall and droughtiness) were obviously occurred within the hysteresis limit of the relevant physical system and can not be continued out side this limit, when, they would tend to damp each other. Since water resources in the area are very limited, its excessive use may make the existing water-imbalance critical to the degree to damp the vegetation existing cycle. This study, therefore, suggests to continuously monitor the responses of the physical environment to the management practices to find out the safe limit of water-use, so that an optimum scale of the sustainable management practices can be set up.

99 MONITORING ENVIRONMENTAL CHANGE IN LAKE BAIKAL, SOUTH EASTERN SIBERIA.

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Lake Baikal is a key site in reconstructing and monitoring climate change and global pollutant levels in continental Eurasia. Since 1991, an interdisciplinary team of scientists from Russia and Europe has been investigating the interaction between physical, chemical and biological processes in the waters of Lake Baikal and it's recent sediments. Our studies have concentrated on trying to overlap the time scales of present-day lake monitoring programmes with time scales that ought to be detected in the sediment records. Realising the value of this record is fundamental to the successful reconstruction of past climate conditions, especially with regard to how sediments are formed in a water column that is over 1.5 km deep.

Diatoms are the main biological indicators in the sediments, so understanding how the endemic planktonic species have adapted to the unusual physical conditions in Lake Baikal is important, not least because the unique character of Baikal precludes the use of proxies or transfer functions from other lakes. However, the disadvantages are far outweighed by the advantages, because growth of the endemic diatom species is largely controlled by physical factors, which is important in their potential use as past climate indicators. Furthermore, one other advantage of Lake Baikal is that it has one of the longest continuous records of ice conditions dating back some 250 years. This record covers the period when major population shifts have been found in the dominant diatoms in palaeoecological studies (Mackay et al. 1998). These population shifts have been related to climate rather than anthropogenic drivers. For example, the success of one species, Aulacoseira baicalensis, can be linked to conditions prevailing under the ice and following ice break up, when mixing in the upper layers can reach several hundred metres depth. Also, field studies have been combined with laboratory experiments, and the growth rate responses of the main species have been established over gradients of two key environmental factors, light and temperature. The results show that temperature preferences need to be related to the extent of areas available during the initiation of growth rather than times of peak biomass. Linking the results to events in the lake has been helped by the inclusion of satellite information on snow cover in winter and surface-water temperatures in summer. Spatial studies in the last 3 years have looked at the relative timing of events along the lake, which is effectively a 650 km long climate gradient, with freezing starting in the north in December but up to a month later in the south. Similarly, melting usually begins in early May in the south but not until early June in the north. One spin-off from establishing the natural variation in the lake is that threats due to more recent human disturbance can be effectively evaluated.

100 RECONSTRUCTION OF RIVERFLOW IN THE SWEDISH BOREAL ZONE.

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A dendrohydrological method was used to study long term changes in riverflow and flood frequencies in the Swedish boreal zone.

Trees were selected in a gradient from the channel margin to a reference area not affected by riverflow. The latewood and earlywood were measured and the series of ring-widths were standardised using standard procedures.

Daily riverflow data was obtained from the Swedish Meteorological and Hydrological Institute. The mean discharge during the period 15 May -15 July showed the best correlation with tree-ring chronologies. The spring floods occur within this period and it represents more than 50% of the yearly discharge.

The result shows that dendrohydrology has a great potential for reconstructing riverflows and detecting climatic changes, even in the boreal zone where water is not the principal limiting factor.

101 ENVIRONMENTAL MONITORING AT AN UPLAND ENVIRONMENTAL CHANGE NETWORK SITE

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The Moor House-Upper Teesdale National Nature Reserve covers an area of 74km2 in the Northern Pennines, one of England's most remote areas. It is the highest and one of the largest NNRs reserves in England and a UNESCO Biosphere reserve which is managed by English Nature. The altitude of the reserve ranges from 290m to 850m and habitats are very diverse, from mountain tops and blanket peat to woodlands and meadows. Upper Teesdale is especially renowned for its rare arctic-alpine flora.
Environmental monitoring at Moor House started with meteorological measurements in the 1930s and has since involved a large number of universities and institutes. From 1952 till 1979 a field station at the site made very intensive vegetation studies possible. Other topics researched include land use and climate change effects on biodiversity. The existing long-term data records on climate, soils, hydrology, atmospheric pollution and ecology are very valuable for research into climate change and its effects.
In 1992, Moor House-Upper Teesdale became a terrestrial site of the Environmental Change Network (ECN) which monitors long-term environmental change in the UK. ECN is now a network of 12 terrestrial and 42 freshwater sites covering a diverse range of habitats. Measurements on a set of key chemical, physical and biological variables are carried out in accordance with protocols and include meteorology, precipitation and soils as well as vertebrates, invertebrates and vegetation. In 1997 the Trout Beck, one of the main streams at Moor House, became the first ECN freshwater site located within a terrestrial site. Freshwater measurements cover stream water chemistry and discharge, phytoplankton, invertebrates and macrophytes. The ECN site at Moor House-Upper Teesdale is sponsored by the Natural Environmental Research Council and English Nature.
Routine ECN monitoring is undertaken at 550 m altitude where soils are dominated by blanket peat. Although birds, moths, butterflies and bats occur here in low numbers some are species that are adapted to the extreme conditions and not recorded at lowland sites. Other species are on the edge of their range at this altitude which makes them very responsive to environmental change. Some measurements are repeated at 350 m altitude where higher numbers of species and individuals are found.
Since ECN monitoring began at Moor House-Upper Teesdale, more than 100 research projects have been undertaken at the site, including 24 PhD and 18 MSc studies. ECN data are stored centrally and consist of a unique set of long-term data which in the future will be important in interpreting environmental change and its impacts on flora and fauna.

102 CLOVER AS A TOOL FOR BIOINDICATION OF PHYTOTOXIC OZONE. – 10 YEARS OF EXPERIENCE FROM SOUTHERN SWEDEN

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The International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation) is part of the activities of the Working Group on Effects under the Convention on Long-Range Transboundary Air Pollution (CLRTAP) which covers the UN/ECE (United Nations Economic Commission for Europe) region of Europe and North America.
The ICP Vegetation started using clover as a bioindicator in 1991. Both subterranean (*Trifolium subterraneum*) and white clover (*Trifolium repens*) have been used with partly different experimental designs. One of the experimental aims for the ICP-Vegetation was to determine visible injury in response to phytotoxic ozone concentrations, and to determine whether or not the biomass was reduced, by this pollutant.
In addition, our research group in Sweden have made several supplementary studies of clover as a bioindicator for phytotoxic ozone.
In order to relate ozone concentrations to an impact in terms of visible injury or growth, the influence of a number of factors has to be considered. Our studies have e.g. covered the influence of phytotoxic ozone concentration, day or night ozone exposure, leaf conductance, the importance of leaf age, different species and varieties of clover with varying ages, weather conditions and EDU as an ozone protective substance.
Results that will be presented include:
The leaf conductance differed between cultivars of white clover, an ozone sensitive cultivar had a higher leaf conductance compared to an unsensitive cultivar.

Night time ozone exposure of subterranean clover was found to have small effects. Furthermore night time exposure did not increase the visible injury of subterranean clover which was also exposed to ozone during the day.
Three clover species, subterranean clover, white clover and red clover *(Trifolium pratense*), were tested due to ozone sensitivity. Subterranean clover was the most sensitive and red clover the least sensitive.
Ozone sensitivity variation among cultivars of white and red clover of different ages.
Experiments with subterranean clover showed that older leaves were more sensitive to phytotoxic ozone than younger leaves and that a peak of ozone sensitivity appears to be within a certain physiological age of the leaf.
A shorter period with higher ozone concentrations produced more ozone injury on subterranean clover than a longer period with lower ozone concentrations, although the two periods had the same number of ppb-hours (AOT20).
A comparison of different ozone exposure indicies to explain observed visible injury and biomass loss in subterraneum and white clover
A flux effect relationship for clover
As a conclusion – a number of important points for the future use of clover as a bioindicator for phytotoxic ozone are rised.

103 PIGMENT ANALYSIS AS A TOOL TO DETECT IMPACT OZONE AND DROUGHT STRESS ON NORWAY SPRUCE

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The impact of tropospheric ozone on the vegetation has become a major concern in Europe during the last two decades. However, the impact on forest trees has been difficult to establish. There is a high demand for methods that can be used to detect the impact of groundlevel ozone on forest trees, e.g. within the UN-ECE initiative ICP Forest.
The formation of free radicals inside the leaf/needle is a phenomenon that is likely to be shared with several other stresses. Thus, a main problem will be to demonstrate the specificity of the diagnosis system for ozone. Consequently, the impact of ozone on the diagnosis system should always be compared with the impact of other important stresses such as e.g. drought stress.
The Göteborg Ozone-Spruce project was initiated in 1991 with the aim to quantify the effects of ozone on growth, carbon allocation and water balance of Norway spruce. Norway spruce saplings (three years old at the start of the experiment) were exposed to ozone, alone or in combination with drought stress, in open-top chambers from 1992 until 1995. The ozone treatments were charcoal filtered air and non-filtered air with extra ozone, added to correspond to 1.5 times the ozone concentration in the ambient air. The drought stress treatment lasted 7-8 weeks in late summer each year, starting in 1993.
Current-year needles from the uppermost whorl were sampled four times during the experimental period, three times at the end of the drought periods 1993, 1994 and 1995, respectively, and once beore the start of the drought period 1995. The needles were analysed for the carotenoids participating in the xanthophyll cycle, as well as several other carotenoids, alpha- and beta caroten and chlorophyll a and b.
The impact of the drought stress on the pigment components of the xanthophyll cycle, as well as for several other pigments, was evident for the 1993 and 1994 drought periods. These effects were considerably reduced during the last drought period 1995 and the reasons for that are not clear.
The impact of ozone on the pigment composition was much more subtle and difficult to demonstrate statistically.
The preliminary conclusion from this study is that the pigment composition of Norway spruce needles is difficult to use as a diagnostic tool for ozone impact.

104 SOUTH AFRICA'S TOOLS FOR ENVIRONMENTAL AND SUSTAINABLE DEVELOPMENT

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The 1986 Declaration of the Right to Development by the United Nations (UN) made the Right to Development, part of the international law with people as the central subjects of the right. It is an inalienable universal human right. The UN's General Assemble Resolution 34/46 of 1979, states that "…the right to development is a human right and the equality of opportunity for development is as much a prerogative of nations as of individual within nations"

The South African Constitution does not explicitly mention a right to development, it however recognises and protects the right to human dignity, equality, democracy, equity and justice. The preamble to the Constitution gives a mandate to elected representatives to, inter alia, improve the quality of life for all citizens.

The White Paper on Population Development of April 1998 regards sustainable development as the central theme and organising principle of the population development policy.

The preamble to National Environmental Management Act (NEMA) states that everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

prevent pollution and ecological degradation;

promote conservation;

secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Section 24 of the Constitution also protects the rights of everyone to an environment that is not harmful to their health or well being.

The presentation will focus on aspects of the law that have a direct bearing on industries such as the polluter pays principle as implied in Section 28 of NEMA and Section 19 of the National Water Act.

Reference will also be made of other laws and policies which protect the environment, inter alia, National Water Act (NWA) no 36 of 1998, Atmospheric Pollution Prevention Act (APPA) no 45 of 1965, Environmental Conservation Act (ECA) no 73 of 1989. South Africa's commitment to environmental justice globally through its Neighbour Law will also be discussed.

105 CRITICAL LOADS AND LEVELS OF NOX AND SO2 POLLUTANTS AT URBAN CONSTRUCTION MATERIALS IN BANGKOK

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Ambient air quality monitoring in Bangkok, Thailand, is carrying out at 18 automated ambient air quality monitoring stations. The previous acid deposition monitoring included a joint Thai-Swedish project, within the framework of the IGAC/DEBITS project; precipitation has been collected for chemical analysis on a daily basis since mid-1991 at two sites in Thailand. The samples are generally slightly acidic which can be explained as an imbalance between acidifying components in modest to low concentration and neutralizing components in somewhat lower concentration. In addition to the monitoring plan for Acid Deposition Monitoring Network in East Asia (EANET), the Air Quality and Noise Management Division of the Pollution Control Department, Ministry of Science, Technology and Environment set the monitoring network in Bangkok area from June 1998-October 1999. Both of wet and dry depositions are sampling.
Objectives of our study are to estimate NOx emissions and NOx depositions in Bangkok; to study and assess the NOx contribution to acid deposition in Bangkok and to evaluate the SO2/NOx impacts on materials.
For estimating NOx emissions, the following identified sources of NOx emissions in Bangkok area are studying, mobile sources, industrial sources and households. To estimate the contribution of NOx to acidity and its effects, the ratio [NOx]:[SO2] is analyzed and Critical Levels and Critical Load are

calculating. To assess NOx impact on materials, the method of Mapping Acceptable Levels/Loads for Effects on Materials (CCE, 1996) is applied. The structural metals (weathering steel, zinc, aluminum, copper, and bronze) and stone materials (marble and sandstone) with nominal surface area of 10x10 cm, are located in different sites in Bangkok area to monitor structural changes upon the influence of acidity from both sulfur and nitrogen acid-forming air compounds.
This research will be done within 2 years (2000-2002) and in 2001 we will report the first set of data with estimating CL(NOx) and their exceedances in Bangkok area.

106 THE SUCCESSION RATE OF PHYTOPLANKTON IN THE POWER PLANT COOLING- RESERVOIR IN SIBERIA

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The phytoplankton and chlorophyll content are investigated in Belovo Reservoir on the Inya River (Kemerovo region). It is a small (surface area 13 km 2) and shallow (average depth 4.4 m) cooling reservoir of coal-fired power plant. Indices for succession rate of phytoplankton were calculated from the few formulas (Lewis, 1978; Stephenson, 1980; Willams, 1975) due to the data on year-round sampling (101 Samples) nearby water intake site of electric power station. . The least values for seasonal dynamics of indices (up to 0.03 day-1) were registered for flood water period. Just after this period in the course of spring-summer algae complex development succession rate index increased up to 0.22. In June-September succession intensity reached its maximum (up to 0.5). Subdominant species in phytoplankton increased in importance with occasional decrease in Melosira granulata dominant number in summer. Succession rate index didn't exceed 0.20 at the beginning of fall and didn't fall below 0.17 up to the end of November due to fall algae species development on the heated parts of reservoir. The mentioned index decreased during freeze-up period and was 0.15 in December-January but reached 0.21 day-1 due to outbreaks in cold-resistant algae species development. In February-March stabilisation of spring species complex was observed on warm sites and succession rate index fell up to 0.15 day-1. Annual dynamics of succession rate indices reflect the key events in phytoplankton life in Belovo reservoir as a result of dominated complexes change and main phases of hydrological cycle that is typical for limnetic systems of moderate latitudes. Statistically reliable relation of succession rate indices with temporal temperature gradient indicate that water temperature fluctuations in the reservoir effect greatly on phytoplankton communities tolerance in time. Correlation coefficients for succession rate indices with phytoplankton properties (rate of biomass change and Shannon species diversity index) and temporal temperature gradient testified that a strong and statistically reliable relation among succession rate indices, absolute value of change rate for species diversity index and water temperature gradient existed. Effect of water temperature fluctuation on phytoplankton communities stability in winter-spring and fall-winter periods is most pronounced. Consideration of research results of primary production in June-August as well as "a" chlorophyll in phytoplankton in June-Jule showed that maximum succession rate was noted concurrently with fluctuations of primary productions intensity and chlorophyll content. Quantitative characteristics of intensity of phytoplankton succession in Belovo reservoir were obtained first for heated reservoirs. That's why comparison of our results is possible to perform only with data on lakes. Sensitivity of succession rate index to instability of structural and functional features of phytoplankton caused by abiotic factors fluctuations was demonstrated for Lanao Lake, Phillipines (Lewis, 1978). The phytoplankton dynamics in small eutrophic Cross-Mir Lake, mid England (Reynolds, 1981) shows that frequency and amplitude of index value fluctuations for tropical lake in fall and especially in winter are higher than for lakes situated in moderate latitudes. The conclusion that succession acceleration under change in hydrological features on seasons and its decrease-under any influence absence followed from comparison of index for North American Taho, Klir, Castle lakes and arctic pond with tropical lake Victoria (Williams, 1975). Fluctuations of succession rate index in Belovo reservoir are distinguished by higher amplitude than in Lanao Lake. However, compared to Cross-Mir Lake greater succession rate values were obtained for heated Belovo reservoir. The establishment of the heterogeneity of aquatic communities structure on the basis of succession rate indices is the element of empirical statistical description model as the means of obtaining quantitative ecological forecast as well as paleoecological reconstruction.

107 GROUNDWATER RESOURCES AND THEIR APPROPRIATE ECONOMIC IMPLEMENTATION

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The North - Western part of Bulgaria is mainly characterized by the shortage of the surface sustainable drinkable water quantity, so the residents have been rested into the dead-lock situation since 1980 year. This fact mainly concerns the Mezdra town municipality, which totally depends on the water consumption of the Vratsa town, supplied from the " Stetchanska Bara" hydrocenter. The surrounded vulnerable karst regions might dispose a sufficient water quantity, but their quality is threaten by activities of the closely disposed big Chemical Industrial Enterprise "CHIMCO'' - (Nitrogen-fertilizer producer). The karst native source (springs) possesses nitrite and ammonia contents, exceeded the maximum admissible levels according to the BDS 2823-83). Unless, the provided attempts to approve groundwater quality: (adding the liquid chlorine from bottles of 40 kg to the water at a rate of 0.5-l mg/l and an experimental dilution of the waters with those of another sources), the essential effects have not been achieved .To meet the mentioned problem, in this concrete region, (presented as an local disturbed Environmental one), the following summarized long-term data are completed:
The collected Imission data from the Vratsa`s " Hygiene Epidemiological Inspectorate -HEI ". On these basis, the mathematical model describing the pollutants behavior can be applied because of the potential of the inorganic nitrogen contamination by an airway transport of N- Emissions from "CHIMCO'' Enterprise and respectively with the following precipitations. This is appear to be a real reason for the groundwater quality deterioration owing to the prevailing wind direction;
The investigated data about already built industrial waste landfill deposits into the karst area - the Vratsa`s " Hygiene Epidemiological Inspectorate -HEI ";
The data concerning the real conditions of sewage system and waste toxic chemical outflow into the Dabnic river, collected by the Mezdra`s Water Supply & Sewerage Company (VIK);
The data clarifying the part of the artificially cultivated agricultural lands by the"CHIMCO'' products {fertilizers -(NH4)2CO3 } and their consecutive disintegration .
Although collected and correspondingly treated data, as well as, up to now undertaken attempts to remove the exceeding contents of nitrite and ammonia (with the practically applicable technical and economical means), this vital problem for the Mezdra `s citizens still remains as an open one.

108 URBAN COASTAL COMMUNITY DYNAMICS DURING THE CRISIS IN INDONESIA

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The paper attempts to observe the value of behavioural management of coastal community of urban-rural areas in relation to the crisis impacts. First, the crisis has hard-hit most urban areas in Southeast Asian Region, including Indonesia. Since mid –1997, Indonesia has experienced a significant turmoil in the economy due to the crisis. Most major urban areas were badly influenced. The development of economic sectors was mostly collapsed. As a consequence, the unemployment problems occur. Second, because of the limitation access to economic development, the Government took a consideration to boost a rescue programme, i.e . Social Safety Net (SSN) programme.
Third, the urban coastal community was the most vulnerable group that was severely affected by the crisis. When the economic condition has reduced, they hardly found the job. Most of them, in fact, were job-loosers and laid-off workers. They could not find any better alternative way to get access to employment, but the coastal resources. Fourth, some attempted to find resources along the coast that can be utilised for income earnings. Because of their limitations of knowledge in utilising the coastal resources, the activities related to the social life-style might damage the coastal environment. Meanwhilst, the SSN programme was launched to public, but the coastal urban community still could not get easily access to the programme. Finally, there would be some room for environmental scholars

and behavioural scientists to contribute their capacity to empower and assist the coastal community to get access to employment.

109 BIOREGIONAL APPROACHES: OVERCOMING THE CRISIS IN INDONESIA

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The paper attempts to discover the value of bioregional management in regional areas in relation to the crisis impacts. First, the crisis has hard-hit most rural-urban areas in Southeast Asian Region, including Indonesia. Since mid –1997, Indonesia has experienced a significant turmoil in the economy due to the crisis. Most major dynamic areas were badly influenced. The management of resource exploitation would be disordered. Second, because of the severe impacts on regional economic development, the Govemment of Indonesia took a consideration to boost a rescue programme, i.e. Social Safety Net (SSN) programme. At the same time, regulation on decentralization has been released and this may generate community's aspirations to regional development processes.
Third, the considerations of bioregional approaches allow medium and long-term management for maintaining and monitoring regional resources in terms of biogeophysical and non-physical systems. Finally, there would be some room for bioregional scholars and behavioural scientists to contribute their capacity to empower and assist the community to get access to regional development and maintain the environment, especially in the developing nations like Indonesia and other.

Key words:
Bioregional system, Decentralization, Community, Regulation, Resources, Regional Development, Monitoring

110 ANALYSIS OF CHOSEN CASES OF HIGH DAILY RAINFALL IN SLOWIŃSKI NATIONAL PARK (POLAND)

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The current paper surveys daily rainfall at the local station of Climatology Department (Adam Mickiewicz University in Poznañ) located on the Mierzeja Lebska (the Leba Barrier) measured in July and August of the decade 1990 – 1999 as well as synoptic maps of the territory of Europe from days marked by rainfall higher than 30 mm.
Having analyzed the data there were distinguished a few synoptic situations over Europe at which high rainfall occurs on the area of Slowiñski National Park. Development of several chosen situations were illustrated with images from METEOSAT satellite.
In July and August of the analyzed period of 10 years there were seven days with rainfall higher than 30 mm:

26 August 1993	–	47.8mm
8 July 1996	-	48.0 mm
28 July 1998	-	36.0mm
25 August 1998	-	33.1mm
12 August 1999	-	35.3mm
13 August 1999	-	46.1mm
15 August 1999	-	36.6mm

On the days with high rainfall the synoptic situations were created by the center of a low moving along with atmospheric fronts from southwest to northeast directly over Westem and Central Europe. While the center of a low remained over Poland there was higher pressure with local centers of lows and highs over Western and Southern Europe. The rainfall to occur at that time in Slowiñski National Park was connected with rain clouds of the low level (Nimbostratus) present on the northern side of the moving low. On 8 July 1996 and 28 July 1998 the rainfall occurred in the mass of atlantic air, whereas on 25 August 1998 in the mass of arctic air. The synoptic situation on 28 July 1998, which is an example of such a situation, was illustrated with satellite images. The images from the range of water vapor absorption show high humidity of the air (bright color) coming over Poland from the

Mediteranean. Infrared images reveal gradual movement east of the cloud layer connected with the system of low pressure. Their bright color suggests low temperature of the peaks of the clouds, which in turn implies the high level of their occurrence. The visible range images show a coherent layer of clouds over the eastern part of the Pobrzeze Slowiñskie.
High rainfall also occurred as the center of a low moves from southwest to southeast over the Southern Baltic Sea. Poland was then under the influence of atmospheric fronts connected with low pressure systems. The rainfalls were initiated in the Nimbostratus clouds related with the moving cyclonic system. Such situation was observed on 12 and 15 August 1999. Infrared satellite images from 15 August show a fast moving clouded atmospheric front over Poland, which precedes a mass of cold polar-sea air. The visible range picture reveals a layer of clouds over the eastern part of Pobrzeze Slowiñskie.
High rainfall also occurred from storm clouds (Cumulonimbus). A storm may appear inside a homogenous air mass (intra-mass storms) or on the front of a fast moving cold atmospheric front (front storms).
Intra-mass storms occur in periods of nice cloudless weather over Poland connected with the influence of high pressure, in periods of unstable balance of air masses and lack of atmospheric fronts. Convectional clouds begin to emerge around noon as the intensity of sunshine is the highest and they stop developing by sunset. At night they tend to disappear. Such situation occurred on 26 August 1993.
13 August 1999 was marked by high rainfall connected with the occurrence of frontal storms. Cold atmospheric front preceding masses of arctic air moved over Poland from the area of the Southern Baltic Sea. Storms took place directly on the front at night between midnight and 2 a.m. and lasted with short intervals till around noon. Satellite images show remarkable cloudiness ranging over the Southern Baltic Sea and Northern Poland. The image from the range of water vapor absorption reveals accumulation of humidity in the air over the area Northern Poland.

111 ANNUAL INCREMENT OF TREE BRANCHES IN LENGTH AS A VARIABLE TO MONITOR

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The acute environmental pressures may cause different adverse changes in tree status. For instance, peaks in air pollution lead to an increase in defoliation of trees and discoloration of leaves/needles. However, such type of damage takes place on the local to regional scale only. If one consider influences of factors of subcontinental to global scale (increase in concentration of carbon dioxide, nitrogen and sulphur oxides, in atmospheric deposition of acidifying compounds, in surface flux of solar ultraviolet-B radiation, changes in global climate), neither peak pressures nor subsequent acute damage to plant can be found. Trees respond to the moderate alterations in a state of the environment in different way.
One of the most universal characteristics of such responses is a change in tree growth. Annual increments in total biomass and stem biomass as well as radial stem increment are often employed in quantifying these responses. However, some limitations of their use in large-scale monitoring systems exist. Measurements of tree biomass increment are very time and labour demanding, and, therefore, cannot be recommended for systematic measurements at a continental or global network. Radial stem increments are very efficient in characterising past status of the environment. Methodologies for either measurements or data analysis are available. However, in some species tree rings are not distinguishable. Even if they are, the nearest past (last decade) typically cannot be reliably characterised with this method, since increment borer heavily damages the last tree rings that negatively affects detecting the current trends. This was the main reason for us to attempt to develop for this particular case (i. e. for detection trends occurring over last 5-20 years) a different monitoring methodology. We decided to employ measurements of annual increments of tree branches in length.

Such increments for past 5 to 20 years are reliably distinguishable in some tree species. Pine (Pinus sylvestris) and birch (Betula pendula) typical of Europe are among them. We undertook the test measurements of annual increments of the first order branches in pines in 2000 for methodological purposes. Territory of Kandalakshskiy biosphere reserve adjacent to the White sea (North of European Russia) was chosen for the measurements. Since pines grow there practically at the northern limit of their area, growth rates are typically very low. Therefore, one can distinguish and measure even 20 to 30 past annual segments of stem and branches of rather small trees, namely, of 1 to 2 meters that is very convenient for observers. The proposed measurement methodology, results of the above

mentioned test measurements and their analysis against interannual variations of climate will be presented in this paper.

The proposed monitoring method could be named "horpexometry" (from the Greek word " ορπηξ " that means " a twig " constituting the annual increment of a branch in length).

112 DETECTION OF CLIMATE-CHANGE EFFECTS ON VECTOR-BORNE DISEASE: CURRENT EVIDENCE AND FUTURE PROSPECTS.

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It is often suggested that one of the most important societal consequences of climate change may be an increase in the geographic distribution and transmission intensity of vector-borne disease. We present the results of a comprehensive review of published studies on climate-driven changes in vector-borne disease from throughout the world. While some studies are suggestive of an effect, they do not generally meet the high standards of evidence already available for non-health ecological systems. On balance, we do not yet have clear and unequivocal evidence of a general pattern of climate change-driven increase in vector-borne disease transmission.

The lack of clear evidence is partly a function of the relatively small amount of global warming that has occurred so far. More importantly, it may be because most studies rely on data collected by public health services, with objectives that often conflict with the detection of climate effects. Monitoring of changes in disease incidence or vector abundance over time is usually for the purpose of directing public health interventions. If implemented, these may obscure climate effects. The most vulnerable regions (i.e. where climate change effects are least likely to be obscured by control interventions) are often the places where monitoring infrastructure is weakest. Whereas detection of changes in distribution require standardised monitoring of the extremes of distribution, vector monitoring is more likely to be concentrated on areas of greatest transmission intensity: often towards the centre of the climatically suitable range. The effects of confounding variables, such as local changes in public health infrastructure land use, are seldom measured.

Early detection of climate change effects could be facilitated by careful selection of indicators, following criteria already described for non-health outcomes. Selected indicators should show high climate sensitivity, high vulnerability (i.e. little intentional or unintentional adaptation to climate change effects), and low numbers of plausible alternative explanations. We suggest a preliminary stratification of possible indicators for climate change effects on vector-borne disease. Of the candidate variables, almost all are highly climate sensitive: however, they vary significantly in terms of vulnerability, and plausibility of alternative explanations. Among the most suitable are the length of activity seasons and altitude distribution of vectors in pristine environments. Among the least suitable are changes in the incidence of controllable diseases, transmitted in and around houses. Results from non-health indicators suggest that monitoring of the most suitable indicators could be expected to demonstrate unequivocal effects of climate change within about two decades (assuming similar rates of climate change to those observed in recent years).

The information requirements for early detection differ from those for estimation of the magnitude of climate change effects on the burden of vector-borne disease. It may be easier to achieve the latter objective through measurement of the effects of geographic or short-term climate variation (and other influences) on vector bionomics and infection rates, and human disease. These data can then be used to build quantitative models of climate-health relationships, which may be applied to longer term trends.

113 RECENT FLOODING PATTERN SHIFTS OBSERVED THROUGH CHANGES IN SURFACE WATER CONDUCTIVITY IN THE OKAVANGO ALLUVIAL FAN, BOTSWANA.

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The Okavango alluvial fan, located in the northern part of Botswana, receives rainfall water from the Angolan Highlands. After passing through Namibia, the Okavango River spreads into numerous channels and floodplains, creating the Okavango fan with an expansion of more than 12.000 km2. The annual flood event sustains the rich ecosystem of this wetland contrasting with the surrounding dry Kalahari belt of Southern Africa. Currently, the fan is sustained through two main streams, the Jao/Boro in the central part and Nqoga/Santantadibe in the eastern extension. However, early visitors (1850) describe the western area, sustained by the Taoghe River, as being wetter than the eastern extension of the Delta. This indicates a gradual flow shift through the last 150 years, the reasons for which are geomorphological and probably tectonic. For hydrological modelling and wetland management, it is imperative to know whether the increase in inflow to the eastern extension is ongoing, leaving the western part with steadily decreasing amounts of incoming water, or whether the trend is reversed and surface water is returning to the western extensions. Evapo-transpiration is the major factor in the water balance of the Okavango Delta and as a consequence only 3% of inflow leaves as surface outflow. For analysing flow shift patterns, temporal trends in electrical conductivity along the two main distributaries were compared. Over a distance of approximately 300 km the conductivity values increase by more than a factor of ten. For the study, available data on electrical conductivity of surface water, collected during various research campaigns in the past 3 decades, were compiled. First results indicate that although the readings for the last 30 years are fairly stable, the east-shifting trend may be in the process of being reversed.

114 ACIDIFICATION AND RECOVERY MODELING IN FOUR SWEDISH CATCHMENTS WITH DIFFERING ATMOSPHERIC DEPOSITION (BERG-TRESTICKLAN-TIVEDEN-VINDELN)

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Computer simulation of chemical changes subsequent to acid atmospheric deposition declines with dynamic models is a valuable approach for assessing forest ecosystems recovery potential. The dynamic model MAGIC (Modeling of Acidification of Groundwater in Catchments; version 5.01,Cosby 1991) uses a lumped representation of biogeochemical processes because understanding the catchment runoff and soil chemistry may not require detailed knowledge of the spatial distribution of the parameters within a catchment.
MAGIC will be applied to four forest catchments (Berg (SE02), in south-western Sweden; Trestic klan (SE11) and Tiveden (SE01A) in central Sweden; and Vindeln-Svartberget (SE06) in northern Sweden). The selected catchments are part of the old national catchment-monitoring program (PMK; Aastrup et al. 1996, Report 4524, Swedish EPA Stockholm; http://info1.ma.slu.se/ IM/ Background.html). The objective of the modeling is to estimate the recovery prospects for forested areas that have experienced different atmospheric acidic deposition, given two scenarios of future atmospheric deposition. The issue of sensitivity of the MAGIC model predictions to the key assumptions of the parameterization will be explored as well. The existence of considerable ancillary data at the four catchments, including more than a decade of deposition and runoff data definitely contribute to the value of such sensitivity analysis.
MAGIC has previously been applied only to the first study catchment (Berg). The 93 ha catchment (57o05'N, 12o46' E; 75-165 m.a.s.l.) is situated on the rainy western slope of Sweden's southern highland and represents a region of high susceptibility to acid deposition. Almost two thirds of the catchment is covered by century-old mixed forest. Anthropogenic atmospheric deposition was the dominant factor causing a decline of streamwater pH and especially soil base saturation in the examined historical period 1846-1986. Results showed a large decline of soil base saturation from an

estimated 51% in 1846 to 25% measured in the calibration year 1986. Streamwater pH decreased from 5.3 in 1846 to 4.6 in 1986.
Two future scenarios were modeled for 1999-2020 at Berg. 1) Implementation of the Gothenburg Protocol for further significant declines in the atmospheric deposition of SO42- and NO3- and a small decline of NH4+ for the target year 2010. 2) The business as usual scenario where the future deposition was held constant at average of 1995–1997 levels. Both simulations showed very limited prospects for recovery with respect to soil base saturation and streamwater pH. The key difference between the two scenarios was that soil acidification was reversed at Gothenburg Protocol scenario, while it continued in the business as usual scenario.

115 A LAKE AND ITS WATERSHED - THE LAST 50 YEARS OF COEXISTENCE

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Lake Mikolajskie is a dimictic, eutrophic lake situated in the southern part of the Great Masurian Lakes system in Poland. The lake has a long-term record of various limnological studies and its bibliography exceeds 300 original research papers. From its north-eastern part the lake is surrounded by Mikolajki - a small town, which during the last 50 years has evolved from a small fishermen's settlement to an important tourist resort with numerous hotels, pensions, marinas etc. Except tourist influence the lake is also affected by agriculture, which has recently undergone significant changes due to the general political transformations in Poland.
The relative importance of man-made factors contributing to the lake eutrophication varied during the last five decades. Point nutrient sources (partly treated domestic sewage) were of primary importance earlier while dispersed sources chiefly affect lake functioning in the recent years. This paper is aimed at confronting temporally varying man-made factors and the watershed impact (population, tourism, animal stock, mineral fertilizers, surface runoff, commercial fishery) with in-lake indices usually regarded indicative of the trophic status (Secchi disc depth, chlorophyll, nutrient concentrations, macrophyte abundance and diversity).

116 CONNECTING SCIENCE AND POLICY? A CASE STUDY OF THE USE OF AUSTRALIA: STATE OF THE ENVIRONMENT 1996

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Over the last three decades, State of the Environment Reporting has come to be regarded as an essential tool for connecting science and policymaking. The first national State of the Environment Report was prepared in Japan in 1969 and State of the Environment Reports have been prepared in over a hundred nations since then. However, until now the effectiveness of State of the Environment Reporting as a means of communicating environmental information to policy makers has not been examined. Given the international effort going towards detecting environmental change, it is worth examining the process of how the reports about environmental change are being used.

This paper discusses some of the findings of a transdisciplinary research project into the preparation and use of Australia: State of the Environment 1996. The empirical evidence shows that this report was used of Commonwealth government politicians and policy makers in a number of ways, in particular to legitimate existing policies. However, no evidence was found that Australia: State of the Environment 1996 was used in government decision making. The report was not used to change government policies, priorities or budgetary allocations. The paper looks at why the report was not used and makes some suggestions about how environmental information can be prepared so that it is able to be used to change policy.
Drawing on work in the sociology of scientific knowledge and environmental communication, this paper suggests that State of the Environment Reports need to be reconceptualised in order to be effective forms of communication. State of the Environment Reports, and environmental information in general, needs to be designed to meet the needs of its users. The case of Australia: State of the Environment 1996 illustrates that it is unlikely that a single report will meet the needs of both

government decision makers and the public. Having decided who will be the users of the environmental information, we should seek to engage them in conversation in order to be able to meet their information needs. This paper suggests some strategies for good conversations with information users based on the work of the Communication Research Institute of Australia. Without engaging the users, we won't know what they want to know or if we have met their needs. This is particularly pertinent in the area of environmental information where we want people to be able to take action as a result of reading the information. Without engaging the users, there is the danger that State of the Environment Reporting will simply be a procedural innovation, with only symbolic use.

117 COMPARATIVE STUDY OF AFFORESTATION AND SUPPORTING STRUCTURES TO CONTROL AVALANCHES

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Afforestation and supporting structures are the two reliable methods for controlling formation zone of the avalanche. Afforestation is effective and environment friendly method to control avalanche. There are other advantages to adopt this method like reducing pollution and increasing the strength of soil. Comparative study has involved layout of trees and supporting structures and their comparative cost and quantities. It has been found that forest act like supporting structures to anchor the snow on the formation area and the possibility to come the avalanche has been reduced. This study has also found out that afforestaion should be one of the alternate methods of all the control measures applying in the different zones of avalanche path. Jammu - Srinagar national highway (NH-1A) is the only tarmac all weather road connecting Kashmir with the rest part of the country. However it is severely effected by 15 major avalanche sites in a stretch of 40 km between Banihal (Km180) and Quazigund (km 220). The highway passes through different zones of the avalanche sites and so different types of avalanche control measures has been proposed under the avalanche control schemes. The avalanche sites D-7, D-8, D-10, D-12 and D-14 have been selected for formation zone control structures and other sites are proposed to be controlled by middle zone and run out control measures like snow gallery, diversion dam, catch dam and mound on the basis of intensity and type of avalanche, terrain, economic aspects etc. It is found that about 73 to 84 snow bridges or snow nets (4m in length) per hectare are required depending upon slope, deposition of snow and topographical conditions of the site. There are rare threes and forest in the avalanche area and so frequency and chances of avalanches are high. However installing supporting structures they have helped to grow forest or trees in lower portion of avalanche and after a period they act like supporting structures and help to other trees to grow. This paper deals with the comparative study and optimization of afforestaion and the supporting structures to control avalanches.

118 EPISODIC PH DECLINE DURING SPRING FLOOD: AN OPERATIONAL MODEL FOR SEPARATING NATURAL ACIDITY FROM ANTHROPOGENIC ACIDIFICATION

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Spring flood is a defining feature of the boreal ecosystem. The dramatic hydrochemical changes occasioned by snowmelt profoundly effect aquatic biodiversity. Spring flood is also the period most susceptible to anthropogenic acidification. An operational model has been developed to quantitatively separate the anthropogenic from the natural contribution to pH decline during high flow events, primarily spring flood. The key assumptions in this model are:
that baseflow ANC has not been affected by anthropogenic acidification, (or that this can be corrected for)
that the amount and character of contemporary DOC is similar to that of the natural, pre-industrial state
Natural dilution of ANC during hydrological episodes can be quantified by reference to a dilution index (e.g. base cation).

The limited data requirements for the model of 10-15 stream water samples before and during spring flood render the model suitable for widespread use in environmental monitoring programs. This makes it possible to distinguish trends of human impact as well as natural pH decline in space and time.

Keywords: Episodic acidification, Natural acidity, Anthropogenic acidification, Episode model, Northern Sweden

119 PH DECLINE DURING FALL EPISODES IN NORTHERN SWEDEN FOLLOWING A SUMMER DROUGHT

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Episodic pH decline associated with four fall runoff events in Northern Sweden preceded by an extensive summer drought where found to be more dependent on TOC and existing sulfate in the catchment than was the situation in spring flood when the sulfur content of precipitation was a much more important factoron the sulfate content in deposition driving the eventswas the situation in spring flood when the sulfur content of precipitation was a much more important factor. By using a dilution model to quantify driving mechanisms of the episodic pH decline the sources of the 1.1 to 1.8 pH unit drop were calculated. Despite a relatively large influence of sulfate were TOC, which increased by 200 to 250% during peak flow, the most important driving mechanism of the pH decline. The export of sulfate during the episodes following one of the lowest ground water levels during the 1990's wehere four to twelve times higher than what was expected from sulfate deposition only. In the sites where past and present anthropogenic deposition was believed to be the main source of sulfate it contributed less than 0.3 pH units. In catchments where natural sources of sulfate are known to be present sulfate contributed up to 0.6 pH units. The large export of sulfate was probably due to oxidation ofof natural sulfate bearing minerals in the soil and/or previously deposited sulfate driven by the low ground water level preceding the episodesThe situation in Northern Sweden did not figure prominently in the intense period of research during the 1980's that laid the basis for much of the acidification related policies in Europe and Sweden that are now in effect. Northern Sweden, however, has some of the lowest critical loads for acid deposition in Europe. The region has also been the focus of intensive liming activity since 1990. During the last decade much has been learned about the acidification status of that large area of Europe characterized by relatively low acid deposition loadings, but intense episodes of pH decline during spring flood. Most notable has been the discovery of a direct proportionality between the amount of sulfur deposited in the snow and the anthropogenic contribution to ANC decline during the subsequent spring flood. This paper compares the developments of acidification policy during the last decade with the scientific developments of relevance to the region. Considerable discrepancies are noted in both national and international policies. Therefore there are opportunities to update policies to better reflect the state of knowledge in 2000, as opposed to 1990 when many current policies were formulated.

Keywords: public policy, northern Sweden, episodic acidification, nnatural acidity, sulfate budget, Dissolved organic carbon (DOC)

120 PREDICTING EPISODIC ACIDIFICATION IN THE DEVELOPMENT AND RECOVERY OF CHRONIC ACIDIFICATION

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Dynamic acidification models, such as the MAGIC model, together with soil chemistry and deposition information can be used to understand and predict past and future acidification trends. The time resolution in model output is sufficient to understand the general trend in the acidification in a region.

But since the biota in surface waters are not primarily controlled by the annual runoff chemistry but rather by the maximum toxicity occurring during episodes a model predicting the development and recovery from episodic acidification has been developed.
By combining the Magic model with an episode model developed within the framework of the project "Episodic Acidification in Northern Sweden" a greater resolution in the development of stream water acidification of the heavily acidified Lysina catchment in the Czech Republic was achieved. Prior to large scale S-emissions in central Europe the spring flood was driven entirely by natural processes. As time progressed and the deposition load increased both baseflow and spring flood became progressively more acidic and toxic (due largely to higher monomeric aluminum levels). Following a 70% reduction in S-emissions in the region, since the fall of the iron curtain, the severity of spring flood episodes are becoming less severe although base flow has not recovered to the same extent.

Keywords: Episodic acidification, Recovery prediction, Anthropogenic deposition, Czech republic

121 SEVERITY OF EPISODIC ACIDIFICATION IN NORTHERN SWEDEN: CHANGES CAUSED BY DECLINE IN SO42- DEPOSITION

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Spring flood is the most sensitive period in boreal ecosystems to acid deposition since as much as half of the year's precipitation melts and enters the soil in the space of a few weeks. A recent finding in the project "Episodic Acidification in Northern Sweden" has been a consistent relationship between the S content of snow and the anthropogenic component of Acid Neutralization Capacity (ANC) decline during spring flood.

This relationship in combination with the national atmospheric deposition monitoring data and 1216 geographically representative lakes from Northern Sweden facilitates a regional prediction of the severity of anthropogenic episodic acidification during spring flood under different S-deposition loadslakes toof lakes in .

The deposition load in Northern Sweden has decreased by 50% from the winter of 1984/85 to the winter of 1997/98. This has in turn led to a 65% decrease in the areal extent of anthropogenically affected areas during spring flood in the region during the same period. The results suggest a rapid positive responds to declining winter S-deposition load which will have a large impact on the remediation strategy for Northern Sweden.

The rapidity of the response to reductions in S emissions should also influence the acidification remediation strategy for Northern Sweden where state subsidized liming is focussed on spring flood.

Keywords: Episodic acidification, Regionalisation, Anthropogenic deposition, Northern Sweden

122 PLANT COMMUNITY DIVERSITY AND BIOMASS ON ALPINE MEADOW IN THE REGION OF AN HIGH ELEVATION ON QINGZANG PLATEAU

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Based on data from 42 plots in Jianshe township Dari county, the species richness, evenness, species diversity and biomass of plant communities on Alpine meadow in the region of an high elevation (from 4036m to 4280m) were discussed. It was showed that the species diversity index basically decreased along with the increase of elevation. The species richness, evenness, species diversity indices and biomass of Black Beach were lowest among communities, and those of Carex, Kobresia and shrub

meadow were higher. Along with the increase of elevation, the changes of grass and shrub biomass were complicated, but the forb biomass basically decreased.

Key words: Alpine meadow; species diversity; Qingzang plateau

123 USING ENVIRONMENTAL AND GROWTH CHARACTERISTICS OF PLANTS TO DETECT LONG-TERM CHANGES IN RESPONSE TO ATMOSPHERIC POLLUTION: SOME EXAMPLES FROM BRITISH BEECHWOODS.

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Where historical data on plant communities exists but long-term monitoring data are absent, habitat responses to perturbations such as atmospheric inputs of acidic and nitrogenous pollutants may be detected by comparing the environmental requirements (as characterised by Ellenberg et al 1991; Hill et al 1999) and plant functional types (as characterised by Grime et al, 1988) of the current flora with those of past surveys. By using species Ellenberg ratings for nitrogen and acidity it is possible to detect pollution-driven changes in plant community, whilst analyses with Ellenberg's ratings for light and moisture and Grime's CSR classification of functional types can indicate where change is caused by other factors such as management. This poster presents the results of investigations into changes in the ground flora of beechwoods in both the Cotswolds and the Chilterns regions of southern Britain.

In the Chilterns study, the relative frequencies of ground flora species found in a survey of 48 woods conducted in 1989 were compared with those from a 46 wood survey by A.S. Watt in the 1920s and 1930s (Watt 1934). Significant increases in nitrophilic species were detected on acid sites, whilst acid-loving species increased on sites with alkaline soils.

In the Cotswolds study, detailed surveys of the ground flora of two beech woods were made in 1998 and the results compared with those of a similar survey of the early 1960s (Barkham 1968). Whilst changes in frequency of individual species over the 30+ year period were inconsistent, at a plot level there were clear indications of an increase in nitrophilic species.

The advantages and disadvantages of this approach to detecting and monitoring long-term changes in vegetation are discussed, as well as the need to reproduce original sampling methodologies.

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124 LINKING SATELLITE, CENSUS AND SURVEY DATA TO STUDY LAND-USE/LAND-COVER CHANGE IN NORTHEAST CHINA

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Advances in remote sensing technology undoubtedly rank among the most significant contributions to the study of environmental topics in recent decades. The ability to use orbiting platforms to measure

the magnitude, pace, and pattern of land-use/land-cover change has particularly relevant to the study of the Northeast China, a region that has experienced one of higher rates of deforestation.
High-resolution satellite data provide a firm empirical base for measuring the amount and the spatial configuration of forest clearing, but they do not themselves explain the causes of deforestation. It is well understood that, beyond the need for refined measurement, explanation and projections of land-use/land-cover change depend critically on the ability to model the social determinants of deforestation. When the concern is for large regions, such as the Northeast China, population and agriculture censuses are virtually the only source of region wide data on the socioeconomic and demographic characteristics of the population. These considerations suggest the prospect of modeling the causes of deforestation by using data set that links the estimates of land-use/land-cover change derived by the satellite images to the social indicators generated by the various censuses.

Key words: Land use, Land cover change, Deforestation, Remote Sensing

125 LONG-TERM MODELING OF ACIDIFICATION AND RECOVERY IN AN UPLAND CATCHMENT OF THE WESTERN ORE MOUNTAINS, SE-GERMANY

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The upper part of the Western Ore Mountains, Germany is almost completely covered by man-made spruce (Picea abies) forest ecosystems. While the production of timber is the main interest of the foresters, the water suppliers are using these areas as infiltration areas for drinking water reservoirs, which supply water to the cities of southern Saxony. One of the major problems in the water supply is the acidic character of the surface waters. Since the 1950s an increasing acidification of the tributaries to the reservoirs was observed. The reasons for the acidification are the natural properties of the granitic catchments with podzolic and peaty soils on the one hand and the anthropogenic spruce monocultures on the other hand. Another major factor is the elevated atmospheric deposition of acidifying substances within the so called “Black Triangle” region (e.g. sulfate-S 20 kg ha yr-1, nitrate-N 8.2 kg ha yr-1, ammonia-N 8.5 kg ha yr-1, protons 1.61 kg ha yr-1 in the water year 1997). As a redevelopment measure the investigated area was limed subsequently in 1986, 1987, 1991, and 1992 by 3.5 t and in 1994,1996,1998, and 2000 by 4.5 t of dolomitic limestone per ha.
The aim of our contribution is to predict the future development of the surface water quality using the dynamic geochemical model MAGIC (Cosby, 1991, NIVA, Oslo). It is a lumped parameter model with simplifying process-oriented approach, and was often used in modeling in the catchment scale. We focused our modeling on the liming activities and their impact on stream water quality at the Grosse Pyra catchment (5.4 km2) since the end of the 1980s. In the scope of our investigations a special attention has been paid to the acidification related compounds as sulfate, nitrate, base cations, aluminum and pH. The MAGIC model was able to reproduce the annual measured streamwater chemistry for the period 1994 – 1999 at Grosse Pyra. Furthermore, the older data fitted reasonably the simulated data for pH, aluminum, sulfate and sum of base cations. Under the given future deposition (stable from 1999) and liming scenario (liming until 2006) there will be a steep increase in pH up to 5.0 until the end of liming activities. From then the pH will decrease again down to approx. 4.6 in 2020. This result suggests (i) there is a strong dependence of the soil reaction on the liming activities due to the shallow soils with low CEC and (ii) the increase in base saturation due to the liming is only temporal. Streamwater aluminum shows extremely high simulated values (252 (mol L-1) and pH was 4.1 in 1987 when the liming starts. The Al-concentrations remain high in the liming period 1994 – 1999 (33 – 66 (mol L-1). For sulfate there is a steady strong decrease until 2002, after 2002 the sulfate concentrations will decline only slightly according to our scenario. For the sum of base cations we observe a liming dependent situation. The long-term recovery of stream water will be only partly affected by terrestrial liming. Part of the improvement of water quality is due to the massive atmospheric deposition reductions in the “Black Triangle” region which occurred in the 1990’s.

126 THE NATIONAL SOIL INVENTORY: MONITORING CHANGE ACROSS ENGLAND AND WALES 1980 - 1995

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The National Soil Inventory (NSI) of England and Wales was originally carried out c. 1980, based on sampling and inspection of the soil at the intersects of an orthogonal 5 km grid. This yielded 6271 points, of which 5691 were sampled, the rest being urban, water, farm buildings etc. Each location was recorded to an accuracy of 10 m, the landscape described and the soil profile described to 80 cm. The soil was sampled to a depth of 15 cm (less if rock intervened), at 4 m intervals on a 20 m x 20 m grid centred on the 5 km grid point (Loveland, 1990). These 25 sub-samples were bulked for determination of pH, organic carbon, particle size distribution, plant nutrients P, K, Mg, aqua regia extractable Al, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, P, Pb, Sr, Zn, and NH4-EDTA extractable Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn (McGrath & Loveland, 1992).
By the mid-1990s concerns had been expressed that soils were degrading due to loss of organic matter, acidification, build up of heavy metals etc. There was also discussion of long-term, country-wide soil monitoring. Therefore, 900 of the arable NSI sites and 780 of the permanent grass sites were resampled between 1994 and 1996. The sample numbers were based on the need to detect a change of 0.2% in the mean organic carbon content of the soils under those land uses. Other land uses were not re-sampled. pH, organic carbon and aqua regia extractable elements were determined in the new samples.
Less than 3% of sites had changed land use. Under both land uses, mean pH had increased, possibly due to better targetting of liming advice - especially on grassland. Increases above pH≥7 in arable soils might reflect deeper ploughing into more calcareous subsoils. This is consistent with increases in the size and power of tillage machinery between the samplings. Mean organic carbon contents have declined in all soils, more so in the permanent grass soils and organic soils under arable cultivation in Eastern England. Aqua regia Cd, Cu, Co, Cr, Pb and Zn have decreased under both land uses, whilst Ni increased under permanent grass only, although the concentrations have changed little in absolute terms. Total P has decreased, but available P and K have increased. Available Mg has increased in permanent grassland soils - possibly due to the increased use of magnesian limestone for correcting acidity - but shows no significant change under arable cultivation. These summary findings conceal a wealth of detail which will be explored further during the presentation.

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127 ESTIMATION OF PHYTOSANITARY CHANGES OF FOREST STAND STATE WITHIN THE CHORNOBYL NPP EXCLUSION ZONE ON MULTIBAND SPACE SURVEY

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For recent 3-4 years the most stressed situation has arised in the Chornobyl NPP Exclusion Zone (EZ) concerning common pine forest stands injured with pests (in general silkworm (Dendrolimus pini L.). So large reproduction for 1997-1998 has provoked the considerable weakening and in some cases death of the whole forest stands of the State Specialised Complex Forest Enterprise “Chornobyllis”.
Accumulation of the considerable forest stand volumes as a result of pest injury increased a probability of fire emergence that complicates the ecological and radiological conditions within the EZ and out of it introducing area recontamination by air transfer of combustion products. During the forest fires radionuclide concentration may increase more than 5 times even at the distance of 5-6 km from the burning site and direct near fire front they reach the critical values. Forest fires are the main factor that intensifies migration processes. Thus after the top fire 60-80% of radiocesium pass into the mineral part of soil, while this value is 20-40% under the common conditions.
In order to control forest stand state within the EZ the Centre for Aerospace Research of the Earth has conducted complex remote sensing study of observed area wood stand for 1998-2000. The central,

southern, northern and western parts of the Zone and adjacent plots at the overall area of about 1400 km2 are studied. The research has based on multiband digital space images with SPOT high spatial resolution (20 m per pixel). They are used to analyse vegetation canopy features relative to absorbed, reflected and transmitted light energy at its interaction with the plants. Reflectance spectra over different ranges have various information on principle about physiological plant state (chlorophyll content, leaf structure, water content in plant, etc.) and plant growth condition (moisture level and thropotop of root ambient soil layer, groundwater table, toxicant pollution, etc.).
Thus as a result of study:
Analysis of spectral brightness for various types of plant groups in the right-bank Pripyat River of the EZ were made using SPOT multiband space image (14.07.1998) for 260 test-sites and ERDAS Imagine software.
Integral signatures for 25 natural object classes are formed and signature assessment for the classifying on maximum likelihood method is carried out.
Plant groups classification of the Zone are carried out for the area about 1400 km2.
Phytosanitary state for the EZ forest stands are estimated in the right-bank Pripyat River.
Area differentiation of forest stands in considered territories according to fire risk level are conducted.
Proposed variation of classification allows to distinguish in detail pine and deciduous forests, long-fallow land vegetation. Pine forest stands are well identified as 15-30 years old forests and older 30 years ones. Particularly it's necessary to distinguish pine forest stands injured with pine silkworm and pine fungus (Fomitopsis annosa (Fr.) Bond et Sing (Fomes annosum). They cover the considerable areas (86 km2, and 31.3 km2, respectively). Pine forest stands are identified well (mainly the western and northern parts of studied area, which influenced by hydrological routine change, submergence of the territory. Their area is 71 km2.
As far as the deciduous forests it is defined the stands with dominant black alder and birch forests. For the fallow lands it has distinguished the natural and artificial afforestation with pine and birch at the age up to 15 years, orchards and acacia plantings. Vegetation on fallow lands and in the flood plains are distinguished worse among themselves, as well as sites of fire and fallow lands.
Using reflectance spectra analysis and normalised difference vegetation index the scheme for phytosanitary state of plant groups together with the pattern of natural risk fire for the central part of the Zone are designed. Phytosanitary scheme distinguishes the pine stands injured with pine silkworm at the maximum, mean, and low damage levels (9.5 km2, 29.9 km2, 46.6 km2, respectively). Pine stands injured with silkworm caterpillar consist of some individual plots located mainly in the central part of the EZ. Field test has validated these findings.
Thus, one of the important results of this study is a detailed pattern of spatial distribution for healthy and hurt forest stands within the Zone that permit to estimate dynamics of the suitable changes and plan the well-grounded forest-technical works and phytosanitary measures within their boundaries.

128 USING OF OIL POLLUTION LANDS

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Industrial development in XX century has increased an antropogen press to environment. And it is impossible to delete year by year assimilated demerits and amissions in environmental protect by some recommendations. Therefore it is necessary to co-ordinate the forces of government and public bodies, scientific organisations for prevention of negative phenomenon, which complicated through ecological situation. Apsheron peninsula has got one of more from point of ecological issue breached landscape.
This is more important (both natural and economical)region where is disposing of oil extracting and oil remaking industries, chemical industry and etc. For analysing of both ecological and biological, either geographical and chemical, and also landscape peculiarities of Apsheron lands were making the local and laboratory examinations of oil pollution influence's to main environment components (soil, plants).
In selected samples (specimen) of soil and plants have defined agrochemical, geochemical and biochemical dates. Used to spectrum analyse method identified the presence of some chemical elements such as Cu, Pb, Ni, Co, Cr, Mo, Ba. In result of our research were marked the levels, types and capacities (powers) of oil pollution, were revealed the common conformities of chemical elements' migration and concentration in system of "soil-plant". Author suggests have to use the experience scheme, where will carry out the biological re-cultivation with taking into consideration the pollution levels and types. This approach will be more efficiency for restoration of exploring landscape.

129 OIL CONTAMINATION ON APSHERON PENINSULA (AZERBAIJAN) WITH REGARDS OF LAND-RECLAMATION.

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One of the most ecologically disturbed landscapes in Azerbaijan is Apsheron peninsula. Some parts of the Apsheron were heavily contaminated. Due to exploitation of oil fields with erroneous method accompanied by spilling out oil and gas, chemical matters spread on the surface. Elementary demands of environmental protection have never been met.

The main aim of our investigation is to carry out complex study on the Apsheron peninsula landscapes polluted with oil wastes. We also want to determine the qualitative characteristics of vegetable crops cultivated on re-cultivated landscapes. Some of the basic problems requiring scientific solution are restoration and amelioration of the contaminated landscapes as well as their consequent rational utilization for the needs of agriculture.

We have carried out field and laboratory investigations concerning influence of oil pollution on geo-chemical and biological components of the landscapes. As a result of the research we have determined that the polluted landscapes are capable to self-restoration and self-purification. If degree of pollution is within 6%-10%, the contaminated agro-landscapes are capable to grow "chemically pure" agricultural production. The change in biochemical composition of vegetables mainly depends on degree of pollution, type of contaminants, time duration of contamination. The study indicated that if the pollution degree in soils within 10 - 30% these contaminated soils might be considered as organically fertile.

In field experiments we studied oil pollution influence on vegetables that are widely growing on the Apsheron such as tomatoes and eggplants. Ash of burned vegetable and their leaves contained chemical elements Cu, Zn, Pb, Cr, Ni, Mo, Co. The investigation shows that average content of chemical elements depends on degree of contamination. Among considered elements there is more Cu, Zn, Mo in plants than in soil due to biological accumulation of these elements in the plants. Elements of Pb, Cr, Co have not been found in vegetables. The latter indicates that the studied vegetables can be used for agricultural purposes.

130 APPLICATION OF ENVIRONMENTAL AUDIT AS A TOOL IN IMPROVING ENVIRONMENTAL PERFORMANCE OF AGRICULTURAL FARMS IN THE PHILIPPINES

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Environmental audit refers to the systematic examination of the environmental performance of any business activities and their interaction into and with the surrounding environment. It involves the process of complete and in-depth review of current and past regulatory and pollution control practices affecting a facility, operation, or activity. It evaluates the effects of any activities on the neighboring community, landscape, ecology, and the public's perception of the operation in the local area and in the global environment. In agriculture, environmental audit is a methodological examination of farm production, farm inputs, practices, and farm site to verify whether or to what extent they conform to specified environmental audit criteria.
In the Philippines, intensification of agricultural production using modern technologies to sustain increasing demands aggravates environmental problems. Environmental audit of agricultural

production can be used to address these environmental concerns. This paper aims to evaluate the environmental performance of agricultural production in the Philippines using the environmental rating of Environmental Farm Plan developed and used in Ontario, Canada. To do this, tomato farms located in San Francisco, Nagcarlan, Laguna, Philippines was chosen as the study site. The study determined the impacts of tomato production on soil, vegetation and farmer's health, farmer's knowledge, perception and attitudes towards environmental protection, human health hazard associated with tomato farming practices, and safety of tomatoes to consumers.
This study also tested the applicability of the environmental rating of the environmental farm plan in small-scale tomato farms in the Philippines. Results of this study showed that agricultural production in the Philippines aggravates environmental problems in terms air pollution, soil degradation, contamination of water, loss of genetic diversity, and deterioration of farmer's health, thus, needs serious attention.

131 PACIFIC ISLANDS AT RISK: MONITORING AND ASSESSMENT OF THE VULNERABILITY OF FORESHORE DEVELOPMENT TO CLIMATE CHANGE AND SEA-LEVEL RISE

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The south Pacific Ocean includes twelve small island states which are inhabited along narrow coastal strips and used for various socio-economic activities, ranging from port development to marine aggregate extraction. Many of these islands are Holocene coral atolls, have elevations from 1-5m above mean sea level, and are generally flat. This makes these islands entirely coastal, in terms of systems interaction and relative relief. As a result of their location and small land area, between 0.0028 to 14.81% of their EEZ, many Pacific countries are exposed to regional weather phenomena, like cyclones, which wreck havoc along these atoll island, causing destruction of property and infrastructure. These also cause flooding, coastal erosion and, loss of life. Natural hazards, like cyclones, in Pacific Island Countries are several orders of magnitude larger than the size of individual island systems, and consequently, are capable of engulfing entire island states. In the South Pacific, up to 17 cyclones with wind speeds > 120 kph, and up to 4 cyclones, with wind speeds > 185 kph, affected the region between 1958-1994. Between 1990-present, 63 cyclones affected the region, causing 6,046 deaths, affecting over 406,000 people and with damage costs in excess of US $807 Million.

However, modification of coastlines for human habitation and extensive foreshore developments, make coastal communities more exposed to the sea and vulnerable to coastal erosion, increasing the risk to coastal communities. These risks are compounded with the possible threat of sea-level rise, projected by IPCC to rise by 20-86 cm in 2100, and in these low islands, can exacerbate coastal erosion and property damage. Consequently, coastal communities are vulnerable and face the possible threat to their very existence. These natural events and human occupation of fragile coastal areas cause loss of scarce land, an invaluable resource in these small, non-market oriented developing economies. With Pacific countries having an average poverty rate of 15%; GNP/capita between US $2,210 to £ $760; GNP from less than US $96 - $1,748 Million and external debt (as a % of GNP) as high as 56%, loss of land and damage to infrastructure can seriously impair national and regional economic development. With annual population growth as high as 4.2%, Pacific island countries are therefore confronted with having to look towards development of appropriate coastal adaptation strategies for protecting coastal communities against the possible threat of sea level rise. For Pacific atoll communities, retreat (based on IPCC's definition) is not possible, while accommodation is limited. Therefore, protection and sound planning (for accommodation) are essential, for addressing the possible threats to sea level rise. To that end, development of ICZM or Island System Management plans are essential for Pacific atoll environments.

This paper examines aspects of south Pacific island systems, foreshore development and coastal problems, in relation to sea-level rise. These are discussed in context of coastal vulnerability, and within the framework of development of coastal adaptation technologies to sea level rise, with examples from Fiji, Nauru, the Federated States of Micronesia and Kiribati.

132 IMPACTS OF EXPERIMENTAL MANIPULATION OF CLIMATE ON GRASSLAND PLANTS AND INVERTEBRATES: IMPLICATIONS FOR MONITORING.

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In 1993, we began research into the impacts of climate change on invertebrates and plants and the interactions between them. Field manipulations of local climate have been employed at two sites, Wytham, Oxfordshire, UK and Buxton, Derbyshire, UK, to model the impacts of climate change on these grassland ecosystems.
Manipulations of local climate represent predictions of climate change models for the UK. These include winter warming of 3°C during November to April, a complete summer drought (extreme event) during the months of July and August and a supplementation of summer rainfall from June to September. These simulations were applied singly, or in combination, to address two scenarios, warmer winters with increased or decreased summer rainfall. Manipulations began in early 1994 after a year of pre-treatment assessment. Plants and invertebrates were monitored regularly for seven years. The vegetation was monitored by recording plant species composition, relative abundance and structure (architecture). In addition to monitoring the abundance and general composition (order/family) of the invertebrates, key groups were identified to species for special study, as potential indicators of climate change. To date, we have identified over 300 species and have data of the abundance of over 60,000 specimens (over 65% have been identified to species). This work aims to provide a means of predicting how grasslands will be affected by climate change through establishing the mechanisms behind observed and predicted changes.
Generally, warmer winters may lead to spring droughts, which are exacerbated by dry summers. At Wytham, water is the key to the responses of the ecosystem: grasses dominate with increased rainfall, while deep-rooted forbs ("weeds") persist under drought. At Buxton, there was little change in the vegetation. Invertebrate responses are, predictably, complex, showing both direct and indirect (host-plant mediated) responses to climate manipulation. Invertebrates track changes in the vegetation, except under drought, where plant nutritional quality is more important and insect populations show an increase instead of the predicted decline. The timing of insect activity is modified, as is the size of their populations – in the extreme, leading to insect outbreaks.
This research has added to our knowledge of how these important ecosystems will respond to climate change. The data enables prediction of the magnitude and direction of change that grassland ecosystems will experience under climate change and tests whether indicator groups/species used in monitoring programmes are responding to imposed climate change. Although complex, the data suggests that indicators may not be that specific, e.g. generally all insect herbivores have responded in a similar fashion to summer drought.

133 URBAN AND REGIONAL GROWTH MODELLING AS A TOOL FOR SUSTAINABLE LAND USE MANAGEMENT

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This paper describes and demonstrates an urban and regional growth model that is being used as part of the European Commission's MOLAND (Monitoring Land Cover / Use Dynamics) Project, as a spatial planning tool for assessing the likely impact of current and proposed spatial plans and policies, on future land use development in the European Union (EU). Under the MOLAND Project, detailed GIS databases of land use types and transport networks have been created for around forty study areas throughout Europe, at a mapping scale of 1:25,000. The MOLAND databases are typically for four dates (early 1950s, late 1960s, 1980s, late 1990s) over the last fifty years, or for two dates (mid 1980s, late 1990s) in the case of larger areas. For each study area the reference database (late 1990s) is created by interpretation of satellite imagery mainly from the IRS (Indian Remote Sensing) satellite (resolution of 5.7x5.7 metres), while the three historical databases are created from available data (aerial photographs, military satellite images, etc.) for these dates. MOLAND adopts the CORINE land cover legend, with a more detailed fourth level added for artificial surfaces. Spatial analysis is applied

to the MOLAND databases and associated socio-economic data, in order to compute various types of indicators of urban and regional development. The urban and regional growth model that is used in MOLAND, which is based on spatial dynamics systems called "cellular automata", can be applied to any geographical area of interest. The model takes as input five distinct types of digital maps: actual land use types present in the area; inherent suitability of the area for different land uses; zoning status (i.e. legal constraints) of the area for different land uses; accessibility of the area to the transport network; socio-economic characteristics (e.g. population, income, production, employment) of the area. The land use maps are derived from the MOLAND databases, described above. The suitability maps are created by an overlay analysis of physical, environmental and institutional factors. The zoning maps are derived from existing planning maps (e.g. master plans, zoning plans, designated areas, protected areas, historic sites, natural reserves, land ownership). The accessibility maps are computed from the MOLAND land use and transport network databases, based on the importance of access to transport networks for the various land uses. The output from the model is maps showing the predicted development of land use, over the next twenty years. By modifying the input data, the model can be used to explore, in a realistic way, alternative future scenarios of land use development. The model is currently being calibrated for MOLAND's Europe-wide network of cities and regions, using the land use and transport databases, and ancillary data acquired from the local authorities. A new version of the model also incorporates socio-economic information, and simulates the interactions between cities and their surrounding regions. This "macro-model" is being tested on MOLAND study areas where extensive regional changes in land use are likely to occur, due to major economic and infrastructural developments (e.g. the Dresden-Prague transport corridor).

134 CLIMATE AS A DRIVER FOR ECOSYSTEM CHANGES: RESULTS OF AN INTEGRATED MAPPING ASSESSMENT

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Integrated Mapping Assessment, involves collecting maps of the country, superimposing them over one another-typically on a computer screen-and then analyzing and interpreting any spatial correlation. The maps are produced at various scales, from local to global, although the initial focus of the study has been on regions of Ontario, where a plethora of detailed, high-quality maps are already available. Using regional maps is also an important part of the project's goal of bringing national issues-such as climate change-to a level that municipal decision-makers can understand and take action on. Results of an Integrated Mapping Assessment of southern Ontario show that available heat is a powerful trigger in the natural world, and a major influence on land use. Maps of land use that are combined with those of available heat (expressed in corn heat units (CHUs) and growing degree days) are used to show that the location, intensity and profitability of agriculture are affected by climate. For example, CHUs over 2800 and 3200, respectively, have been historically linked to the disappearance of wetlands and woodlots in southern Ontario. This suggests that, particularly
in rural areas, the degree or two of warming that is expected to take place over the next several years due to climate change will eliminate many natural habitats by making them more suitable to human economic activities-such as farming. Integrated mapping has also shown a clear connection between biodiversity and the climate of Canada. Results of our
study, which used international biodiversity protocols, revealed a link between climate and the diversity and growth of forest species-a factor that could affect conservation practices in the future. Although a warmer landscape for southern Ontario can support greater biodiversity, increases in species may come primarily from exotic or non-native species, similar to the invasions of zebra mussels and purple loosestrife.

135 SMART BUOY – A NEW DATA BUOY FOR MARINE ENVIRONMENTAL MONITORING

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Effective monitoring of the marine environment requires observations to be carried out at a range of time and space scales in order to resolve all the relevant scales of variability at which change may occur. Reliance on ship based surveys alone results in good spatial coverage at the expense of temporal resolution. As a result the efforts to detect environmental change are compromised and the possibilities of linking responses of the ecosystem to drivers of change diminished. In order to address these shortcomings the Centre for Environment Fisheries and Aquaculture Sciences (CEFAS) has developed an array of automated in situ instrumentation that can be deployed for extended periods at a mooring (Smart Buoy). These systems provide high frequency (sub-hourly) measurements of range of biological and environmental variables that provide a key element of an effective monitoring system.

Currently, Smart Buoy is configured to meet the needs of the National Marine Monitoring Programme (NMMP) through monitoring of plant nutrient concentrations and the response of the ecosystem in terms of phytoplankton growth and species composition. Additional physical measurements are also made to ensure that a full interpretation of the time-series is possible. Summary data are returned in real-time via satellite telemetry with full data sets recovered during servicing of the buoy. Data are published on the internet to give rapid access to other collaborators and the public.

A typical mooring configuration will be described and time-series obtained from recent deployments in the southern North Sea presented. Plans for the development of mulit-buoy network and its integration with established monitoring programmes will be outlined. Technology development currently underway at CEFAS for the next generation of Smart Buoys will be briefly described in relation to the perceived future needs of the UK for marine monitoring.

136 GEOCHEMICAL CONTROLS ON HEAVY METAL ACCUMULATION IN THAMES ESTUARY EELS

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Estuaries are important environments for the fisheries industry, but often are zones of high heavy metal discharge. The major sinks of metals in estuaries are sediment, water and biota. The sediments themselves are not in stasis and are subject to many physical, chemical and biological processes which can release the metals into pore waters and the overlying water column from which they are absorbed by the inhabitants of the estuary. Knowledge of the concentrations, forms and stabilities of metals in estuarine water and sediment is therefore critical in developing an understanding of the geochemical controls on metal accumulation in estuarine biota such as eels.
The eel fishery in the UK Thames Estuary was banned in 1987 due to reported elevated Pb levels within eel muscle tissue. The European Eel (Anguilla anguilla) which inhabits the Thames is particularly susceptible to uptake of heavy metals from sediment as it feeds on epi- and shallow infauna within bottom sediment, and semi-hibernates in holes and sheltered parts of the riverbed during winter months. Although the Thames does not support large amounts of heavy industry along its banks, it does accommodate considerable light industry ranging from heavy to light shipping traffic, manufacturing, oil refineries and sewage works. These, combined with urban runoff from the Greater London area, constitute a variety of diffuse and point sources of metal pollution into the Thames River which are available to the European Eel.
Surprisingly little historical heavy metal data for Thames water and sediment exists in the literature. Initial data obtained for this study suggest that Thames sediment exhibits elevated levels of some heavy metals (e.g., Pb up to 710 mg/kg, Ni up to 412 mg/kg, Zn up to 2800 mg/kg, Cu up to 1100 mg/kg), and that these elevated concentrations are commonly found in sediment in the vicinity of road bridges and moorings. Data on metal concentrations in eel tissue (gill, axial muscle tissue and liver) and metal speciation in Thames sediment and water will also be presented, and this data will be used to predict the stability of metal sinks within the estuary with reference to metal bioavailability to the European Eel.

137 DETECTING ENVIRONMENTAL SUSTAINABILITY OF LAND TRANSFER IN SOUTH AFRICA: THE CASE OF GALLAWATER IN THE EASTERN CAPE

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South Africa's history is essentially one of land dispossession. The combination of land dispossession and population resettlement into marginal lands has not only reduced the quality of life of the majority of African but lead to environmental degradation. There are gross inequalities not only in the quantity of the land available in white and black farming areas but also in its quality. The South African post-apartheid government has since 1994 embarked on a land reform programme based on land redistribution, land restitution and land tenure reform programmes. The challenge facing land reform in South Africa is the integration of environmental impact assessment to any type of land reform programme. Based on empirical evidence from Gallawater, one of land resettlement in the Eastern Cape, this paper argues that in many instances the focus is on transferring land to beneficiaries without consideration of environmental impact of land reform and changes in land use patterns. This may lead to environmental degradation, and worseningpoverty and recreation of conditions that exist in the formerbantustans. In Gallawater there is a real threat of an acceleratedenvironmental degradation because population resettlement programme andland use planning did not include impact assessment of land transfer andchanges in land use patterns. Putting land under a different type oftenure and different land use without due consideration of environmentalsustainability may accelerate land degradation and poverty. The papersuggests that important benefits and insights can be gained in theapplication of environmental impact assessment prior to land transferand that environmental impact assessment should be an integral part ofland use planning in any type of land reform programme.

138 AMELIORATION STRATEGIES FOR IMPOVERISHED SOILS DUE TO LAND USE MALPRACTICES.

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The problem of land use in Nigeria shows that agricultural activities accounts for more than 70%. Closely related to this is the interraction effects of weather, climate and disturbed vegetation. Consequently, current land use problems and its associated soil impoverishment in the Nigerian savanna and forest ecological zones were determined under two boundary conditions that will aid proferred land use technologies.

Quantitative data from modelling of climate change and natural disasters in Nigeria will increase the efficiency of soil productivity and development activities and arrest resource degradation due to lands use intensification.

139 IDENTIFICATION OF REGIONAL SCALE TEMPORAL VARIATION ON THE UK ACID WATERS MONITORING NETWORK ALLOWS THE ELUCIDATION OF KEY DRIVERS IN UPLAND FRESHWATERS

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Spatially consistent patterns of temporal variation have been observed in several components of water chemistry and aquatic biology measured over wide areas of the UK uplands on the over the period 1988-2000. Quantification of these regional scale signals across the United Kingdom Acid Waters Monitoring Network (UKAWMN) has demonstrated the dominance of regional drivers on these systems. Here we present examples of anthropogenic influence on common variation (non-marine

sulphate), and meteorological influences linked to the state of the North Atlantic Oscillation (nitrate and Cl concentrations). Common patterns of variation in species assemblages of epilithic diatoms and macroinvertebrates are also presented and possible causes are proposed. The UKAWMN dataset demonstrates the power of protocol governed parallel monitoring in the elucidation of environmental processes.

140 HOW FREQUENTLY SHOULD VEGETATION BE MONITORED?

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Vegetation is clearly influenced by climate, but it is often assumed to change relatively slowly in response to changes in climate and tends to be recorded at intervals of several years or more. Is this justified? Is it possible that species composition can change year-to-year in response to fluctuations in the weather?

Changes in species presence or absence in permanently marked plots were recorded yearly in a wide range of different vegetation types at Environmental Change Network (ECN) sites throughout the British Isles. Differences between different vegetation types and different plant types were investigated and trends compared with changing meteorological conditions.

Some vegetation types, such as moorland, proved to be very stable in composition. Others did however show substantial differences between years. In particular, fertile, disturbed grasslands, (mainly those which have been agriculturally improved) proved particularly variable. In this case most of the changes could be related to a severe drought in the summer of 1995 and reduced soil water contents in the subsequent two years. Annual, ruderal (weed) species were able to colonise gaps that opened in the sward in 1995 and were slowly excluded by more competitive species as soil water levels recovered.

This work shows that it is important to record some vegetation types on an annual basis to distinguish long-term trends from short-term fluctuations and to improve our understanding of the ecological impacts of extreme weather conditions.

141 PERSPECTIVES ON THE IMPACTS OF AIR POLLUTION AND LOCAL CLIMATE CHANGE: AGRICULTURE IN URBAN AND PERI-URBAN AREAS --A STUDY OF TWO INDIAN STATES

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Farmer's perspectives on air pollution and agriculture in urban and peri-urban areas were the subject of a research project recently conducted in India. The field research was carried out in 14 villages in Varanasi (Uttar Pradesh State) and 13 villages in Faridabad (Haryana State), between August 1998 and January 2000. Participatory research methods were used in the project and around 1200 women and men were interacted with.

The villages selected experience a range of different types of air pollution resulting from both urbanization and industrialisation. The field studies show that polluted air from industrial areas usually consists of a mixture of pollutants, which can adversely affect agriculture in many complex ways. Air pollution has a major impact on the productivity and efficiency of both people and nature. It poses a serious health hazard leading to higher levels of morbidity, premature mortality, chronic bronchitis and other respiratory infections.

Faridabad is a green revolution belt of India. Air pollution at Faridabad is linked to industrial estates in the near-by towns of Ballavgarh and Faridabad and is factory-related and vehicle-related. The

industrial belts of these two towns are close to the village and smoke and other pollutants from the factories pollute the air and settle on crops thus affecting yields. The incidence of air pollution has risen considerably over the last 20 years, which has led to smoke and dust hanging in the air, which affects crop production. In one village it was reported that factory fumes are particularly bad in winter months when deposits fall on the wheat crops. The size of wheat grain is reduced, which affects its market price. Pollution from local factories such as thermocol, plastic, brick kiln and cement factories has affected the health of humans, crops and animals. The smoke from burnt industrial waste is intense every fortnight and visible on the leaves of the vegetation and also causes problems for livestock.

Amongst other constraints, the farmers in Faridabad described weather/climate-related constraints as a problem-cluster much beyond their control. During May to July, hot winds can damage creeper vegetable plants such as cucumber, melon and bottle gourd. Sudden hailstorms affected crops and damaged them with maximum damage occurring in their infant stage of growth. The farmers also described how un-seasonal and heavy rains accelerated growth of weeds amongst crops such as wheat, jowar and bajra at diferent stages of growth. Excess rains also damaged standing crops and lightning damaged vulnerable mustard flower. It was reported that a late monsoon resulted in up to 25 per cent crop damage while excess rains could cause as much as 40-50 per cent crop damage.

In contrast to the Faridabad villages, the farmers at Varanasi were more able to relate the direct impact of air pollution with their health problems. The researchers observed that the incidence of pest, insects and weeds is noticed more in the villages where dependence on farming and/or horticulture is great and which are situated in a ozone-polluting zone.

Based on field research, the study derives some important lessons in policy-making such as public awareness raising on air pollution and local climate change and also suggests intiating policy interventions for mitigating impacts of air pollution.

142 FLOOD MITIGATION STRATEGIES OF THE BULOZI FLOOD PLAIN, WESTERN PROVINCE, ZAMBIA.

Allan David **Mulando**

Disasters, by definition are events that appear suddenly and with little warning. They are usually short lived, with extreme events bringing death, injury and destruction of buildings and communications. Their aftermath can be as damaging as their physical effects through destruction of sanitation and water supplies, destruction of housing and breakdown of transport for food, temporary shelter and emergency services.

Since floods are one of the natural disasters which endanger both life and property, it becomes vital to know its extents and where the hazards exists. Flood disasters manifest natural processes on a larger scale and information provided by Remote Sensing is a most appropriate input to analysis of actual events and investigations of potential risks. An analytical and qualitative image processing and interpretation of Remotely Sensed data as well as other data such as rainfall, population, settlements not to mention but a few should be used to derive good mitigation stragies. Since mitigation is the cornerstone of emergency management, it therefore becomes a sustained action that will reduce or eliminate long term risks to people and property from natural hazards such as floods and their effects. This will definitely involve keeping of homes and other sensitive structures away from flood plains. Promotion of sound landuse planning based on this known hazard, “FLOODS” is one such form of mitigation that can be applied in flood affected areas within flood plain. Therefore future mitigation technologies and procedures should increasingly be based on the use of flood extent information provided by Remote Sensing Satellites like the NOAA AVHRR as well as information on the designated flood hazard and risk areas.

143 EFFECT OF HUMAN ACTIVITIES ON SUB-ALPINE VEGETATION IN KRKONOŠE MTS. NP STUDIED BY AIRBORNE REMOTE SENSING

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Sub-alpine zone of the Krkonoše Mts., Czech Republic, represent a unique ecosystem, rich in rare, endemic and relic species and populations. This ecosystem is extremely sensitive to human disturbances. The human impact is either local, often connected with tourism, or distant. Main types of local disturbances affecting the ecosystem are: mechanical disturbance of soil and plant cover (trampling); soil and water pollution; dispersal of undesirable or non-native plant diaspores; synantrophization; ruderalization; building activities; fragmentation of habitats and grazing pressure of over-populated roe and red deer. Air pollution, acid rain, nitrogen enrichment (eutrophication) and climate change are distant/global consequences of human activities.

The most expressive changes in this originally bases-poor environment are due to an unsuitable alkaline building material (dolomitic limestone; melaphyre) used in the 70s and 80s to pave some roads and walking trails. Such interference, enhanced by a high humidity, led to an alteration of chemical soil properties. Alkaline ions from the gravel are washed out, enriching the originally nutrient-poor environment and raising the pH values from 3 - 3.6 up to 8 in the road vicinity. The effect on the surrounding vegetation is profound, altering the natural species composition and facilitating an introduction and/or expansion of many problematic species. The expansive species can be categorised as (i) ruderal species (Urtica dioica; Rumex alpinus), (ii) species native to lower altitudes (Senecio fuchsii; Hypericum maculatum; Cirsium arvense; Tussilago farfara; Epilobium angustifolium) or (iii) expansive native species favoured by the conditions, naturally growing on humid patches richer in nutrients, such as terrain depressions, stream alluvia, surroundings of Pinus mugo shrubs and sites with long-lasting snow cover (Senecio nemorensis; Cirsium heterophyllum; Veratrum lobelianum; Deschampsia caespitosa; Molinia coerulea; Calamagrostis villosa; Bistorta major). These species are penetrating far into low competitive natural communities mostly dominated by mat-grass (Nardus stricta), forming lobes of affected vegetation reflecting the terrain conditions.

This phenomenon (so-called road ecotone) can be studied by remote sensing methods thanks to the fact that altered vegetation (species poor or even monospecific) is remarkable taller, having broader leafs and producing higher biomass than the oppressed natural communities typically dominated by mat-grass. In this study three different years (1986; 1989; and 1997) were compared, where years 1986 and 1989 were mapped from multispectral aerial photographs (channels 0.48, 0.54, 0.60, 0.66 and 0.84 μm; scale 1:22000). The data from 1997 were available as GPS ground measurements. Scanned multispectral aerial photographs were co-registered, the affected vegetation was delineated using different remote sensing methods (parallelepiped classification; NDVI; PCA) and geometrically corrected by registration into orthophoto images. The three years were compared to assess the changes in vegetation alteration, the rate of expansion and its trends. The results contribute to the understanding of the processes and assist in finding the best conservation strategies for this valuable sub-alpine ecosystem.

144 THE ESTIMATION FOR THE CHANGE OF ORGANIC POLLUTANTS AND HEAVY METALS BASED ON ITS DISTRIBUTION IN THE SEDIMENT OF THE SETO INLAND SEA, JAPAN

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As water pollution and red tide due to aquatic eutrophication in the Seto Inland Sea became a social issue at the beginning in the 1970's, various countermeasures were carried out by peculiar laws for environmental improvement in the Seto Inland Sea. We investigated how water pollutant loads in the basin and the water and the sediment qualities in the sea changed by the countermeasures, especially, in order to estimate the physical and chemical state of sediments in the Seto Inland Sea, the horizontal

distributions of Organic pollutants and heavy metals in the sediments were investigated. The changes of pollutant loads from effluent, census data associated with the loads and water qualities in the Seto Inland Sea were examined from public statistical tables and official data of national Environment Agency. The investigation of the sediment was carried out two times in 1980s (1981-1985) and 1990s (1991-1994) throughout all over the Seto Inland Sea. The results obtained in 13 sea areas were different in each sea area. It is generalized roughly that the environment of sediment becomes worse in the sea area where the basin has been carried out some development during 1980s to 1990s. On the other hand, it hardly changes in the sea area that the basin was developed before the first survey. The improvement of the sediment environment in this area could hardly be recognized from the results of this survey.

145 THE COLLECTIVE POPULATION HEALTH AS NEW SPECIAL PARAMETER FOR MONITORING CHANGES IN THE HUMAN ECOLOGY SYSTEM AT BELARUS

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The development of generalized parameter of collective population health has paramount significance, because it is important not only to define, as the population health in Belarus differs from the population health level in region, city, area, but also to reveal, on which diseases, in which levels and in which form (morbidity, mortality) this difference is displayed clearest.

The assumption is thus used, that if in any region achieve some optimum parameter, this parameter at certain ecological, social, economic conditions can be achievable and for the other population in regions, and it can be used as model. As a normal parameter, which is accepted for base, best parameters was chosen:
life expectancy - maximum level,
deaths rates - minimum level,
birth rate - middle of an interval between maximum and minimum level,
deaths rates by causes - minimum level.

The interval is defined as a difference between maximum and minimum level, was achieved in one of the regions. Generalized health parameters for each of investigated regions was determined by summation of range.

So, for example, such maximum and minimum level was observed from all Minsk, Brest, Vitebsk, Gomel, Grodno, Mogilev regions:
maximum life expectancy - 69.7 years;
birth rate max. - 11.1, birth rate min. - 8.9;
deaths rates max. - 14.7, deaths rates min. - 9.0
infancy deaths max. - 14.5, infancy deaths min. - 11.4.
standardized deaths rates by causes minimum: infectious disease - 8.1; neoplasms - 162.3; system circulatory - 407.9; system respiratory - 33.4; digestive system - 18.0; accidents - 117.4.

Results of our research demonstrate, that the best generalized parameter of collective health was achieved in city Minsk, where this parameter is equal 1.93, that characterizes the least deviation achieved from base. The worst generalized parameter is marked in Gomel oblast (6.29).

We established generalized parameter of collective health trend for 1990-1998 yeas in Minsk: $y = 1,446 + 0,9198x$; $r=0,87$ and Belarus (only urban population): $y = 0,2293 + 1,109x$; $r=0,95$, where y - generalized parameter; xi - yeas.

The distinctions between base and similar parameters of population health in researched regions can belong to the category probably eliminated and controlled, can objectively testify about real priorities in environment protection field, because the favorable ecological situation is considered as one of the paramount reserves for the achievement high health for all.

146 THE HYGIENIC ESTIMATION OF POPULATION HEALTH RESPONSES WITH AIR POLLUTION CHANGES AT BELARUS.

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The hygienic estimation of the air pollution hazard for population health was conducted according to the air pollution index `P`, accounting toxic substances, above air quality standards (maximum permissible concentration - MPC), chemicals quantity, their bio-equivalent impact on organism and their long-time average. Our classification includes 5 levels: permissible, weak, moderate, strong, dangerous.

According to data from 50 air control post for period 1980-1999 years we established the air pollution index `P` for our main cities such as Minsk, Brest, Vitebsk, Gomel, Grodno, Mogilev, Novopolotsk using monitoring levels of nitrogen dioxide, sulfur dioxide, particulate matter, carbon monoxide, formaldehyde and some specific substances. The hygienic estimation of air pollution index `P` trend made possible to characterize the ecological situation unfavorable, while hazard was indicated as permissible and weak (long-term daily average for lifetime).

The chromate-mass-spectrometric analysis of air quality in cites Minsk, Grodno, Mogilev, Novopolotsk, Mosir shows wide range of organic chemical compounds in respect of seasons. About 200 organic chemicals have been detected, the most part of them are alkanes, aromatic hydrocarbons - derivatives of benzene, cycloalkanes, aldehydes, alcoholes, phenols by quantity, as well as by concentration. Most wide range chemical with multiplied MPC are aldehydes, which detected from 15 kinds in Novopolotsk to 6 kinds in Minsk. We study the largest sources of atmospheric pollution such and possible negative impact on the air quality their harmful emission. We established, that Novopolotsk`s enterprises have not the aldehydes emission sources, but have chemical, petroleum-chemical, bio-chemical industry and electric-power station, that satisfy photochemical processes.

Also, in these cities Minsk, Brest, Vitebsk, Gomel, Grodno, Mogilev, we studied large population health on classical criteria - morbidity, mortality, birth rate, life expectancy and absolute vital potential for period 1980-1999 years. We analyzed causes of total deaths, restricted by age, and classified by specific categories, such as cancer, cardiovascular and respiratory diseases, accidents and infancy deaths. We carried out the retrospective epidemiological analysis of primary morbidity level some diseases: hypertension, cardiac infarction, angina pectoris, tonsillitis, pneumonia, bronchitis, asthma in adult and iron deficiency anemia, congenital anomaly, pneumonia, bronchitis, asthma in infant.

The most general connection between air pollution index 'P' and morbidity are established by mathematical modeling.

Medical and demographic parameters in their connection with quickly changing environmental and socioeconomic factors at certain time, as well as in dynamics, development and comparison characterize the population vital capacity.

147 DOES INHIBITION OF BACTERIAL HETEROTROPHS BY PETROLEUM HYDROCARBONS CAUSE CHAOS IN AN IMPACTED ESTUARINE ECOSYSTEM? : A CASE STUDY IN SINGAPORE.

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Ponggol estuary, located on the northeast coast of Singapore is impacted by anthropogenic activities such as construction, reclamation and recreational boating. This study looks into the temporo-spatial variations in heterotrophic bacterial production and bacterial biomass in relation to petroleum hydrocarbons, organic carbon, inorganic carbon, total carbon and other hydrobiological parameters. Results from this study reveal bacterial production in the range of 0.35 - 9.10 X1010 cells.l-1.h-1and a biomass of 0.12 to 41.7 X 105 cells.ml-1. Among the three stations choosen for the study, highest heterotrophic microbial production and total microbial biomass in the surface and subsurface waters

was observed at station 3 located upstream influenced by construction activities, reclamation and runoff from an adjacent monsoon drain carrying organic load. Bacterial production and total bacterial biomass registered comparatively lower values at station 1 at the marina, impacted by the discharge of sewage and spillage of fuel from the recreational boats berthed, and also from the passage of large tankers in the adjacent East Johor Strait. High concentrations of petroleum hydrocarbons was observed to inhibit bacteria at this station registering registering low production and biomass. Bottom waters at the sediment water interphase registered comparatively low bacterial production and biomass than the surface waters, due to anoxic conditions prevailing at the interphase region The inhibition of bacterial heterotrophs resulted in the non-utilisation and build up of organic carbon, creating very conducive conditions for the phytoplankton to bloom, a cause for a general ecological imbalance at this station. This explains the increased phytoplankton production and pigment concentrations at station 1 reducing the aesthetic quality of the water at the marina. Bacterial production and biomass were correlated with phytoplankton production, phytoplankton pigments and carbon concentrations in the water.

148 MEASUREMENT OF THE EQUILIBRIUM FACTOR BETWEEN RADON AND ITS PROGENY IN THE UNDERGROUND MINING ENVIRONMENT

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Various surveys conducted by many countries worldwide have demonstrated a link between the equilibrium factor and the radiological dose associated with inhalation of airborne radon and its progeny (daughter products). There is a growing concern about the health effects of radon on the population especially mine workers whose occupation lead to lengthy exposure to higher levels of radon and its progeny. In this study, a scintillation cell and a portable ML98 Radiation spectrometer for radon daughters were respectively employed to measure the concentrations of both radon and its progeny in the underground mining environment. The measured concentrations were subsequently used to calculate the equilibrium factor between radon and its progeny. The results obtained indicate that different underground locations have different levels of concentrations and ratios of radon and its daughter products. Accordingly, different values of the equilibrium factor were obtained at different locations. The differences can be ascribed to the difference in the grades of uranium at various locations and also to some environmental factors such as ventilation and deposition of radon daughters on surfaces or on atmospheric aerosol.

149 A CONDITIONAL SIMULATION APPROACH FOR ESTIMATING THE RISK ASSOCIATED WITH ANNUAL WATER ENTITLEMENTS IN WATER RESOURCES PLANNING AND MANAGEMENT APPLICATIONS

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At the start of each irrigation season, the New South Wales Department of Land and Water Conservation (DLWC), Australia, estimates how much water will become available for irrigation in the coming year. This estimate is presented as an allocation for each irrigator's licence, based on a minimum risk of failure. To establish this minimum risk, the DLWC uses the minimum observed historical twelve months long streamflow sequence.

Proposed here is a method that attempt to estimate the allocation, using a generated streamflow sequence with the same exceedance probability as the minimum observed sequence. This sequence is generated using a conditional nonparametric simulation model which is structured such that generation of the streamflow sequence incorporates both the short term (month to month) and long term (over-

year) dependence structure exhibited by the observed data. In addition, use of the nonparametric framework ensures an accurate representation of the distributional (assymentry and biomodality) and dependence (nonlinearity) attributes displayed by the observed data.

The model was applied to the 105 year long monthly inflow time series for the Burrendong dam on the Macquarie River in eastern NSW, Australia. Water allocations with the same exceedance probability as used by the DLWC were estimated for three separate cases, corresponding to "dry", "normal" and "wet" preceeding conditions.

150 EFFECTS OF SAND WINNING AND QUARRYING ON THE ENVIRONMENT IN ABLEKUMA, A SUBURB OF ACCRA, IN THE GREATER ACCRA REGION OF GHANA.

Oppong-Okyere Frederick (Biological Sc. II)
Collins Brobbey Edusei (Biological Sc. II)

Ablekuma is a village in the Amasaman district of Accra in the Greater Accra region. The biome is a coastal savannah with rich flora and fauna. The fauna includes Valanga nigricornis (grasshopper), Sciurus sp. (squirrel), Rattus norvigiecus (brown rat), Agama agama (agama lizard Adansonia digitata (baobab), Crotalaria sp. Acacia sp., Cynodon sp, Cymbopogan), Naja flava (yellow cobra) etc. The flora includes citrates (lemon grass) etc. There are also streams and rivers in the area.

Recent survey and research (MARCH 2001) has revealed that sand winning and quarrying which are undertaken by most unskilled youth in the area are having devastating effects on the environment. Sand winning which involve the removal of the topsoil and destruction of the vegetation which houses the flora and fauna have caused destruction of their natural habitat. This has pushed the animals into other areas where they are unlikely to survive. Erosion resulting from loss of topsoil causes low soil fertility. This has caused the villagers to look for new farmlands resulting in further vegetation destruction. The erosion causes rills and gullies.

The natural landforms (hills and rocks) are exploited for stones and concrete products for infrastructure. Blasting of the rocks by dynamites creates vents in the earth crust making the area more prone to earthquake effects (it is an earthquake zone). Wastewater from processed stones discharged into nearby water bodies pollutes them by increasing turbidity and decreasing oxygen concentration and this endangers aquatic life. These join the Densu River, which is a water processing plant that supplies some parts of Accra. Water-borne diseases like dysentery do occur when water is not well treated.

Deep trenches from the sand winning and quarrying collects water that breeds mosquitoes which are vectors of malaria, elephantiasis and typhoid (malaria and typhoid are most prevalent). Dust and sand particles released into the atmosphere cause respiratory tract infections like pneumonia, tuberculosis and coughs.

Noise pollution associated with quarrying causes hearing impairments. Constituents of dynamite into the atmosphere after blasting have carcinogenic properties. Rainfall figures have reduced and temperatures gone high and humidity has reduced. Socio-economic impact is high as inhabitants and workers spend money for treating infections and diseases.

151 RESPONSES OF FLOODPLAIN ECOSYSTEMS TO UNDERGROUND WATER REGIME CHANGES

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The inland-delta of the Danube is the territory between Bratislava and Komarno. Numerous Danube branches divided this territory and created a mosaic of floodplain ecosystems. Wetlands, wet meadows, floodplain forests and arable agricultural land had been flooded regularly and the underground water level was permanently high, within reach of the root systems of trees and shrubs. Together with excellent climate conditions the area became the most productive and fertile area of the country.

Starting approximately in 1850, dikes agains floods has been built. This influenced the hydropedological situation in the area, but the groundwater level remained still high. Later on, the gravel and drinking water exploitation in large extent, intensive agriculture drainage and finaly the construction of the Gabcikovo hydropower plant, this all caused significant changes. Mainly the decrease of groundwater level was obvious and very significant in greatest part of the area. Partially or completely different moisture conditions occured at sites with originally softwood, transitional and hardwood floodplain forest ecosystems. The quick reaction to the changes (decreased) groundwater level could be observed with herbaceous layer. Here, mainly the abundance decrease of hydrophilous species was the main feature in softwood and transitional floodplain forest ecosystems. In some cases in softwood floodplain ecosystems it came to the reduction of species number in herbaceous layer. This process lasted not longer than 5 vegetation periods after the groundwater level decrease. Significant reaction was observed with trees and shrubs few years later. Here leaf area index showed the sensibility, because already there came to the subsequent and slow decrease of leaf area index already in the second vegetation period after the groundwater level decrease. The trend in decrease of leaf area index is very significant in all 8 vegetation periods after the hydropower plant has been put into operation. Leaf area index of both tree and shrub species decreased in softwood ecosystems within 5 years to 50 % and in transitional and hardwood ecosystems to 25-40 % of the original one.

Changes in species composition in herbaceous, shrub and tree layers were also significant and will be demonstrated at poster.

152 EUROPEAN NETWORKING OF LONG-TERM INTEGRATED MONITORING IN TERRESTRIAL SYSTEMS (NOLIMITS)

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NoLIMITS started as a two year (1999-2000) project funded by the European Network for Research in Global Change (ENRICH). The NoLIMITS vision is:

'To create a European network of sites for long-term integrated monitoring by bringing together existing operations. The network will make available policy relevant, scientific and educational information to address environmental changes and their consequences at local to global scales, and to provide a focus for collaborative interdisciplinary research between sites, networks and users.'

To date the following have been achieved under the NoLIMITS action:

- An informal network of European integrated monitoring sites and organisations
- Improved links between European *in-situ* research and monitoring communities, earth observation and modeling
- User communities have been engaged and their needs assessed
- A design concept for a network of networks
- A prototype Information Exchange Network [http://nolimits.nmw.ac.uk]
- A strategic implementation plan for the network.

153 SITE TYPOLOGY FOR ANALYSIS, MONITORING AND MODELLING IN ENVIRONMENTAL RESEARCH (STAMMER)

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There is now general agreement on the importance of the measurement of environmental change. Sampling schemes are now in place for air and water quality but the monitoring of soil quality is at a much earlier stage of its development in the UK
although several other countries have schemes in place. There are a number of stages involved in the development of soil monitoring schemes but one of the most important is site selection.

This should ensure comprehensive coverage of both the soil resource and the drivers of change whilst maintaining the number of sites as low as possible to minimise cost. Clearly, a number of alternative strategies are possible but the aim of this contribution is to assess the extent to which existing information may be used for this task.
A range of data is available to describe the Scottish soil resource but one of the more important is the National Soils Inventory, which contains information on soil profiles sampled on a 5km grid across the country. At each of the 3090 sites, a range of information has been recorded including soil type, vegetation type and climate. Combinations of these attributes have been used to develop a classification scheme for use at national scale, STAMMER, Site Typology for Analysis Monitoring and Modelling in Environmental Research.

Preliminary investigation showed that some rationalisation of the individual classification schemes was required. This greatly reduced the number of soil/climate/land cover combinations but the 20 most frequent combinations still only accounted for approximately 35% of the sites, reflecting the diversity of soils and land use in Scotland. However, it did allow some interesting relationships to emerge and highlighted some specific examples of soil/land cover combinations, which, although not extensive, may have greater environmental hazards associated with them and thus, should be specifically targeted for monitoring. For example, the majority of mineral alluvial soils in Scotland are under arable cropping or improved grassland management systems that require large inputs of fertilisers and agrochemicals. Transport of these chemicals needs to be monitored to safeguard surface and ground water resources.

The work has also given some insight into the applicability of some soil quality indicators to the Scottish soil resource. Two commonly used indicators are pH and soil organic matter content and whilst both of these may be readily applied to the largely mineral soils used for arable and intensive grassland they are unsuitable for most of the soil resource. Over half of Scottish topsoils are highly organic (>50% content) with low pH values (between pH 3 and 4) which, apart from extensive grazing, have little or no potential for food production. For these soils natural heritage objectives will be far more important and there is a need to derive meaningful indicators in this situation.

154 THE USE OF EQUIVALENT TEMPERATURE TO DIAGNOSE CLIMATE CHANGE

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Increases in both troposphere temperature and water vapor concentrations areamong the expected climate changes due to variations in greenhouse gasconcentrations . However both increments could be due to changes in thefrecuencies of natural atmospheric circulation regimes. Changes in thelong-wave patterns, dominant airmass types, strength or position ofclimatological "centers of action" should have important influences on localhumidity and temperatures regimes. For example it is known that the recentupward trend in the NAO accounts for much of the observed regional warming inEurope and cooling over the Northwestern Atlantic . However our knowledgeabout the influence of NAO on humidity distribution is very limited. In arecent study about distribution and trends in US surface humidity andtemperature both increments were found. They were consistent and alsoconsistent with apparent temperature, a measurement of human comfort thatcombine temperature and humidity, but it

was not detected any influence oflarge-scale dynamics on interannual humidity variations. Neither ENSO nor NAOwas significatively correlated with specific humidity anomalies. However thisstudy was limited to US. The objective of this study is to explore thepossibilities of analyzing together the pair temperature-humidity to diagnoseclimate change. A way of quantifing both magnitudes in a single variableconsists of using equivalent temperature (ET) defined as the temperaturethat an air parcel would have if water vapor were condensed out at constantpreassure, the latent heat released being used to heat the air. We calculatedthe ET at 850 hPa for the period 1958-1998. NCAR-NCEP reanalysis data wereused in this study. Global and Hemispheric mean annual values of ET werecalculated as well as mean values for latitude belts (0-30, 30-60º and60-90º). In general terms there are positive trends in the 9 analyzed series.The highest trend happens in the 30ºS-60ºS latitude band and the lowest inthe 60ºN-90ºN latitude. An oscillation of 4 years is common for all theanalyzed series. Significant correlations were found between most of NorthernHemisphere and Global ET series with the Arctic Oscillation and between allthe Southern Hemisphere and Global ET series with the Antartic Oscillation.Poor correlations were found with El Niño-Southern Oscillation except for thebelts 0-30º for both Hemispheres.

155 EFFECTS OF CO2 AND O3 AND THEIR COMBINATION ON POTATO GROWTH AND YIELD

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Plants are constantly exposed to the atmosphere, externally and internally, as the air is ventilated through the stomata. Carbon dioxide is essential to the plants, while others atmospheric species are beneficial, toxic or inert. Atmospheric change represented by elevated carbon dioxide and ozone levels, is likely to affect the physiology of plants, including the allocation of assimilates. For crops, this results in potential effects on the quantity and quality of the yield. Potato is the second most important crop in Europe and the fourth most important globally.

This presentation describes a field experiment performed in 1998. The experiment formed part of the EU program “Changing Climate and Potential Impacts on Potato Yield and Quality” (CHIP). Field grown potato (cv. Bintje) plants were exposed to elevated carbon dioxide (360 and 680 (mole mole-1) and ozone (non-filtered air and non-filtered air+25 nmole mole-1) concentrations separately and in combination, using open-top chambers. As far as possible the crop was cultivated as in conventional potato production. Growth variables were followed during the season and the quality and quantity of the yield were determined at the final harvest. Both ozone and carbon dioxide significantly affected the allocation of assimilates within the plants. Plants grown under elevated carbon dioxide produced a lower haulm biomass. The tuber biomass was not significantly affected, indicating that the plants maintained the amount of carbon assimilation needed to supply tuber growth. Plants grown in high CO2 however produced a larger number of tubers of lower average size, a quality aspect of potential importance for the industrial use of potato. In the elevated ozone treatment a smaller amount of tuber initials (tubers <15mm) was found at harvest. This indicates an earlier interruption of tuber initiation. A likely explanation is that ozone impeded the carbon assimilation and the assimilated resources were invested in haulm biomass (production and repair) at the expense of supplying tuber growth. This was also reflected in a significantly larger haulm:tuber ratio and a slightly lower tuber biomass (not statistically significant). Ozone also caused a reduced dry matter content of the tubers, a trait of significance for the industrial production of fried potato. A low dry matter content results in a larger fat content of the products. There were no statistically significant interactions between ozone and carbon dioxide effects on any of the growth or yield variables discussed in the present paper.

156 PECOMO: THE PAN-EUROPEAN FORUM FOR COUNTRYSIDE MONITORING

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Landscape monitoring has become an important topic over the last years, not the least because of the increasing recognition of the significance of landscapes in a policy context (e.g. the development of indicators of sustainable development in European countries or the recent adoption of the Landscape European Convention). A large number of sectoral monitoring programmes, e.g. in forestry or agriculture, are currently in progress within different European countries (e.g. Norway, Spain). However, there are few integrated national programmes (e.g. Countryside Survey in Britain) and so far no European initiative.
This has led a number of scientists from all over Europe to initiate PECOMO, the Pan-European forum for Countryside Monitoring. It will be a working group of IALE, the International Association for Landscape Ecology and has its own steering group (15 members representing many European countries). The objective of PECOMO is to create a structure for the production of an integrated assessment of landscape change and its associated causes and impacts on the European countryside.
Among other actions, the forum is carrying out an inventory of existing monitoring initiatives and their main characteristics, a prerequisite to investigate the availability of data collected in different parts of Europe and assess their potential for transfer and production of figures at the European scale. PECOMO is also working on the development of a consistent approach to land cover mapping to ensure the future transferability of information across Europe. Funding is also being sought to extend the activities of PECOMO. The main findings of the forum are presented in this poster.

157 LONG-TERM WATER QUALITY CHANGES IN FINNISH LAKES

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The aim of our work was to study statistically significant long-term trends of 11 water quality variables (alkalinity, pH, conductivity, COD_{Mn}, total N, NH_4N, $NO_{23}N$, total P, PO_4P, chlorophyll *a*, and colour) in Finnish lakes. In most cases each study lake had only one sampling site but, in some cases, several sub-basins of the largest lakes were included. As the 173 study sites were not randomly selected, the results do not give a fully representative picture of the whole Finnish population of 188 000 lakes (> 0.05 hectares). However, the study gives a good overview of the basic water quality of most important Finnish lakes. The data consist of water samples taken from the surface layer (0 - 2 m) of the study lakes during the winter (16 February - 15 April) and summer (16 July - 15 September) periods in 1970 - 1999.

We used the non-parametric Kendall Tau b test to detect water quality trends. In about 21% of the cases a statistically significant ($p < 0.01$) increasing or decreasing trend was observed. Major changes took place during the summer period. The following results refer to the summer period: Alkalinity showed an increasing trend at 51% of the study sites and a decreasing trend at only 1% of the sites. A gradual but clear recovery from acidification was also reflected by an upward pH trend at 25% of the sites. These positive changes are partly due to the decrease of point source loading and partly due to a clear reduction of acid sulphate deposition since the 1970s. Conductivity showed an increasing trend at 18% and a decreasing trend at 16% of the sites. Conductivity increased in lakes polluted especially by diffuse loading and decreased mostly in lakes polluted by industry or municipalities. COD_{Mn} increased at 2% and decreased at 19% of the study sites. Decreased COD_{Mn} values are at least partly due to a clear reduction of organic material loading originating from the pulp and paper industry. Total nitrogen concentrations changed only in few cases. However, inorganic forms of nitrogen ($NO_{23}N$, NH_4N) often showed a clear decreasing trend. Total phosphorus concentrations decreased at 12% and increased at 5% of the sites. PO_4P and chlorophyll *a* concentrations seldom showed an upward or downward trend.

158 MAIN THREATS TO BIOLOGICAL DIVERSITY IN THE TERRITORY OF BELARUS

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The Republic of Belarus ratified the convention on Biological Diversity in 1993. In compliance with its international commitments Belarus has developed the National strategy and Action Plan for the Conservation and Sustainable Use of biological Diversity and identified First-Priority Measures for the Ministers and Departments aimed at implementing the Action Plan.
Belarus bears the main responsibility in Europe for conservation of wetland ecosystems that are valuable both as habitats of rare and endangered species and for prevention of climate change. Despite its difficult economic situation, the need for overcoming the consequences of the Chernobyl incident and the increasing impact exerted by anthropogenic factors on the ecosystems, the Republic has seen a certain progress in the sphere of conservation of biological diversity and restoration of vulnerable ecosystems.
Natural threats
Global changes in the environmental conditions.
Introduction, invasion (intervention) and hybridisation.
Anthropogenic threats to biological diversity in various socio-economic sectors
General data. The most significant adverse changes in the condition of the wildlife have happened and continua to happen in Belarus as a result of a powerful anthropogenic impact both direct (hunting and extermination of animals) and indirect (liquidation or alteration of their habitat). Especially negative impact is exerted by such factors as the extensive inclusion of new natural territories into different spheres of human activities, ecologically unjustifiable drainage reclamation of boggy land and use of reclaimed facilities, non-observance of technology of use of poisonous chemicals and fertilizers, contamination of natural ecosystems by industrial waste, poaching, and the stress factor related to relation and development of the road network. Impacts exerted by the above factors are aggravated by a lack of ecological education and lack of responsibility on behalf many economic leaders and significant strata of the population, by the absence of efficient legal and economic leverage stimulating environment-conservation activities.
Almost all the above factors related to the wildlife have an adverse impact on the vegetation too (with the exception of the poaching and stress factors). Ecologically incorrect use of vegetation resources (berries, medicinal resources, mushrooms), gathering of these resources using forbidden techniques and devices without observation of the stipulated harvesting time periods may cause a significant damage to these irrecoverable resources.
Territorial planning and town construction.
Transport and road construction.
Agriculture. Agrarian land use is considered to be one of the most territorially expressed factors that influences biological diversity of ecosystems. Agriculture lands occupy 8,758,300 hectares (over 40% of the Belarusian territory). Besides, agrarian use of nature is one of the ancient intense kind of economic activities that has substantially change the spatial structure and functional features of the vegetation cover in the Republic. In general, ploughing of land, especially when accompanied by a preliminary drainage, decreases the number of natural localities for many species of plants and animals which, in the long run, brings to a reduction of habitat areas and alteration of their boundaries. On the other hand, the agrarian communities, that are formed, facilitate spreading of both indigenous and invasive species of cultured landscape as well as a change of the their areas.
Forestry. At present, forest vegetation, flora and fauna undergo important changes in connection with intensification of forestry management. Uneven distribution of woods remains: part of regions have been significantly deforested. Over 18% of the area covered with wood vegetation is under wood crops, i. e., phytocenoses with an incomplete basic and simplified floristic structure.
Hunting and pisciculture facilities.
Water facilities and drainage land reclamation. One of the causes of catastrophic impact of land reclamation in Belarus is the neglect of scientifically justified requirements related to the preservation of some areas including natural ecosystems as elements that are needed for the maintenance of biological diversity.
Fuel and energy complex and industry.
Defence.
Tourism and recreation activities.

Radiation contamination of the Belarusian territory as a result of the Chernobyl NPP incident

As a result of the Chernobyl NPP incident 23% of the Belarusian territory including 3,668 places of residence have become contaminated with radionuclides.

159 RECENT AND LONG-TERM (100 YR.) CHANGE ALONG THE SUFFOLK COAST.

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The Suffolk Coast is one of the most dynamic coastlines of the UK. Since 1992, as part of a regional programme initiated by the Environment Agency Anglian Region (formerly NRA), shoreline profiles have been monitored biannually at 68 points along the coast at 1km intervals. Long-term rates of erosion are derived from OS maps using historic high/low water positions. Historic maps of suitable accuracy date back to 1871. Further detailed surveys have been undertaken using DGPS. The aim of this study is to constrain predictions of coastal erosion under a rising sea-level scenario and inform coastal zone management decisions.

Rates of erosion and deposition have been calculated for the recent, 6 monthly, data and long-term 100yr data. Over the past 100 years erosion of the coast at Covehithe has increased from 4 myr^{-1} to 8 myr^{-1}, an increase of 4 myr^{-1}. However in other areas, notably Benacre Ness, deposition has become the dominant force, with a change from 1 myr^{-1} of erosion between 1871 and 1958, to 6 myr^{-1} accretion between 1992 and 1997. Short term changes may be deceptive, at Pakefield, 4m of accretion occurred during the 6 months between February and August 1992, with 1.5 m of erosion in the following 6 months. The average rate over five years indicates that very little change has occurred at this point, with an accretion rate of 0.1 myr^{-1}. The long-term rate of change at Pakefield is erosion at 2myr^{-1}.

The results of this study reveal considerable temporal and spatial variation in the rates of change, overall, erosion rates are increasing and coastal erosion in the north of Suffolk is greater than the south. Comparison of the long-term and recent data sets reveals significant changes in local erosion rates and a general increase in the rates of erosion over the past century, which may be attributed to an increase in the rate of sea-level rise or an increase in North Sea storminess.

160 LANDSCAPE AND ECOLOGICAL CHANGE ON THE VIRGINIA COAST

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The sandy barrier islands that lay off the Atlantic Coast of the Delmarva Peninsula are extremely dynamic. Shaped by storms and currents and an exceptionally high rate of local sea level rise (3mm/yr), the islands change shape and location, with some areas eroding or accreting tens of meters per year. Tracking those changes and understanding the ecological impact of those changes requires a combination of visualization and analytical techniques applied to historical maps, aerial photos and satellite imagery. Analyses of maps (extending back to 1693), aerial photos (1949 to present) and satellite imagery (1986 to present) using geographical information and remote sensing software show dramatic changes. The changes in island shape are mirrored by changes in the distribution and character of vegetation. On Hog Island, between 1949 and 1999, the rapid expansion of *Myrica* shrub thickets tracked increases in island width, but at an accelerated pace. On Parramore Island, which has been eroding rather than accreting, losses in tree cover have lagged slightly behind the reduction in island width. Landscape changes also affect the utilization of the landscape by birds. Overlaying nesting sites of Herring and Great Black Backed Gulls on Sandy Island in 2001 on a recent aerial photograph from 1994 shows little correspondence between topographic features and nests. However, these dramatic differences reflect dramatic changes in the island shape over the last 6 years, rather than variability in nest site selection. In addition to the specifics of change at a given site, access to information resources is an important part of understanding ecological change. The Long-Term Ecological Research Network provides a variety of information resources via the WWW at http://www.lternet.edu/DTOC.

161 MONITORING OF ENERGY AND RESOURCE CONSUMPTION AS A TOOL TO PROMOTE ENERGY CONSERVATION IN RESIDENTIAL SECTOR

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While the natural resources are exhausting , the energy price will rise constantly. People in many countries know it and have learned to save. In our country only with a
rise in price of energy resources, activity in sphere of energy saving including residential sector begin to develop.
In Russia the residential sector is largest consumer of fuel and energy. The expenses of the government for support of this sector is about 100 billions of roubles annually.
The common area of buildings in Russia are about 5 billions sq. Í, for heating these area during one heating period about 400 mtoe spent and averages 25 % of annual power resources supply of the country.
According to some estimations the specific parameters of heat consumption for buildings in the Central part of Russia are 2.5 - 3 times more than in European countries.
Today the legislative base for energy efficiency and energy saving allowing to carry out politics in this direction is created by federal authorities.. These are the Federal "Law on Energy Conservation" and Federal program "Energy Conservation in Russia 1998 - 2005" with section "Energy Conservation in residential sector and utilities". This normative documents have formed the basis for development of the regional programs of resource conservation, taking into account local conditions. Despite of declarative character, it has given a push to development energy saving in regions.
In 25 regions of Russian Federation the regional Programs for Energy Conservation are developed and in 34 regions they are developing. People and authorities of regions need urgent, concrete actions sharper. The annual expenses for residential sector and utilities amounted from 35 up to 50 and more percents of the municipal budgets.
A payment for energy increase gradually now. With increase of the tariffs an individual account of energy and heat consumption is especially important. The measures for
energy saving will be developed step by step, in particularly by establish the new metering systems and equipment. As an experiment the two-tariff system was proposed, at which the extra payment is set for energy consumption higher than standard.
In electricity supply of cities this principle is easy to apply: everywhere there are counters. Now each muscovite spends on the average 100 kWh of an electricity per one month. It is luxury, accordingly to other countries it is known, that 80 kWh is enough. In such limits it is possible to keep the present tariff, and to take already commercial cost for each kWh above this limit.
The same principle should be applied to the account of heat supply and consumption.
The people begin to concern more attentively to everything, that consumes energy from a network, and improve heat isolation of the buildings. People will have stimulus to save energy.
The introduction and installation control and metering systems for heat and water consumption is a stage of most difficulties. Investors must be sure that the investments
in energy conservation quickly pay off, that the installation of devices will result, eventually, in economy of means as family, as well as municipal budget.
The spreading of information about energy saving measures in so-called demonstration energy efficient zones and spotlighting the achieved progress is needed.
The experience of installation of metering devices for account of heat in a some cities of the Moscow region has shown, that only installation of heat control devices results in decrease of consumption of heat on 10 - 15 % and respective reduction of a payment for consumed heat and energy.

162 WHY BIO-PHYSICAL AND SOCIAL SCIENTISTS CAN, BUT DO NOT SPEAK THE SAME LANGUAGE WHEN TALKING ABOUT SUSTAINABLE DEVELOPMENT.

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Scientists assert that integrated research is a foundation of Sustainable Development. However, they often presume that differences between the bio-physical and social sciences are hurdles in the way of integration. We show that this is not the case. The problem lies in the way environmental research is organised. The essay goes on to discuss how the problem is being resolved, and the implications for 'environmental science'.

163 THE IMPACT OF POPULATION ON THE CHANGING PHASE OF THE ENVIRONMENT: A CASE STUDY OF ALIGARH CITY:INDIA.

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In the recent years the whole world has closely seen a tremendous growth in the urban population than ever before. According to a UN report on the urban environment "about 3.3 billion i.e more than half of the world population will be living in the urban areas by the next decade". The urban population in developing countries is growing at the rate of 3.5% per year whereas this figure in the developed countries is less than 1%
per year.

In India the total urban population after independace i.e. in 1950 was only 62.44 million and by 1991 it was 217.18 million. A four times increase in the urban population was recorded. Similarly a three times increase was also recorded in the Aligarh city i.e it went up from 0.32 million in 1981 to about 1.0 million in 2000. This increase in the urban population is mainly due to the migration of the people from the rural araes in search of better job, education, better amenities and faclities.

Although urbanization is a healthy indicator for a country. But it also leads to the change the phase of the city environment specially in a country like India. Due to the increase in the number of the population the Aligarh city faces various environment related problems like heaps of garbage, untreated waste water looged in the differnt parts of the city, open clogged darains etc. which led to the serious environmnetal problems. All these problems becomes more acute at the time when municipality fails to do thier sanitary duties.

The present poster will try to highlight the some very utmost issues which led to change the phase of the environment of the medium size cities like Aligarh.

164 DEFORESTATION AND CARBON RELEASE FROM A TROPICAL FOREST ECOSYSTEM: A STUDY IN CHITTAGONG, BANGLADESH USING REMOTE SENSING AND IN SITU OBSERVATION

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Forest cover change is presently a topic of wide concern, as it is one reason behind global climate change. The current study has estimated the impact of deforestation on carbon release during the past three decades in south-eastern Bangladesh. The study area is located at the southern Chittagong where a considerable deforestation has been noticed. The study used Landsat MSS data of 1972, Landsat ETM and IRS pan data of 1999. Image pre-processing includes atmospheric and radiometric correction of satellite images. Different transformation and integration of TM and Pan image were done to improve the spatial and spectral accuracy of remote sensing data. The images were digitally and visually interpreted. Digital interpretation has been proceeded with a supervised classification technique and calculation of various vegetation indices. Visual classification has been followed by FAO and TREES classification system. Aerial photographs, vegetation maps and ground inventory supported the interpretation process. A field sampling was done at different vegetation classes to estimate the biomass, timber volume and carbon stocks. It was executed by laying out sample plots in different vegetation classes, which have been identified in the remote sensing image. Diameter at breast height (dbh) and height of all the trees inside of plots were measured and converted to volume and biomass using allometric relations. The result finally provides the carbon stocks from the ratio of timber volume and weight to carbon. A model has been developed relating to the spectral response of remote sensing image and carbon stocks. The amount of carbon in the historical year was simulated using this model. Overlaying the remote sensing images and carbon database for the synoptic study year results the loss of forest cover and the removal of carbon from the ecosystem. The study has developed a carbon release model to estimate carbon emission due to forest cover change in similar tropical environment. The result will be quite useful to estimate the amount of carbon emission due to tropical deforestation in similar ecosystem to explain the global climate change.

165 TRENDS OF PHOSPHORUS AND NITROGEN CONCENTRATIONS IN FINNISH RIVERS IN 1970 - 1999.

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Eutrophication is an extensive environmental problem in Finnish rivers. Before the 1990s water protection measures were directed to reduce particularly the loading from point sources. Phosphorus removal from industrial and municipal wastewater was started in the middle of the 1970s. The removal efficiency of phosphorus has been over 90% since the late 1980s and that of nitrogen about 30 %. During the last decade efforts have also been made to decrease the amount of diffuse loading by the implementation of different mitigation measures in agriculture.

The aim of this study is to investigate whether the water protection measures have led to decreases in phosphorus and nitrogen concentrations in Finnish rivers. The study is based on the long-term monitoring results of the mouths of 34 rivers discharging to the Baltic Sea. The river catchment areas cover over 90% of the Finnish territory and are characterised by a wide variety of hydrological and geological features, land-use patterns, and population density. In most of the rivers water quality monitoring was started in the middle of 1960s and the total number of analyses is over 20 000. The long-term mean flow varied between 3 to 600 m3 s-1 during the study period. The median phosphorus concentrations varied in different rivers from 10 to 150 µg L-1 and median nitrogen concentrations from 290 to 3400 µg L-1.

The non-parametric Kendall Tau b test was used to detect trends in nutrient concentrations. Decreasing trends were found particularly in some of the largest rivers formerly strongly loaded by municipalities and pulp and paper industry. Increasing trends in nutrient concentrations were detected in the southern parts of Finland especially in rivers flowing through agricultural areas.

166 IMPACTS OF CHANGES IN PLANT DIVERSITY ON THE MOUNTAIN ECOSYSTEM OF THE GARHWAL HIMALAYA AND STRATEGIES FOR ITS CONSERVATION

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The Garhwal Himalaya has been facing a number of ecological problems ranging from clearing of forests to invasion by exotic weeds. These factors have caused changes in the plant diversity in the ecosystems of montane and sub-montane zones. Natives of the region have destroyed the woody vegetation by clearing them mainly for obtaining fuelwood. The cattle population being in excess of the carrying capacity has affected the grazinglands adversely by overgrazing. The grazing pressure varies in different areas according to the cattle population and their proximity to grazinglands. Medicinal plants have been over-exploited for extracting raw material for drug manufacturing industries. Mining has devegetated some slopes in the outer areas of the Garhwal adding to the problem of soil erosion and landslides. The degraded and devegetated slopes, mined areas and roadsides have become susceptible to invasion by exotic species, which are the secondary colonisers. These include the species like Eupatorium glandulosum, Lantana camara, Celosia argentea, Tagetes minuta and Euphorbia royleana. Most of the invader plants have less economic importance than the species they replace. Eupatorium glandulosum is replacing the native grass and other herbaceous species in the montane region of the Garhwal Himalaya. This species has higher competitive ability and more productivity than the native species. Its abundant growth in the montane grasslands in this region of the Himalaya is causing changes in the plant diversity, productivity of palatable species and structure of such ecosystems. The spread of such species is a serious threat to the existence of native plant diversity of the region. The control of useless exotic species and the conservation of natural vegetation need immediate attention. Devegetated and degraded slopes require proper afforestation and other revegetation programmes.

167 A 21-YEAR STUDY OF THE EFFECTS OF CLIMATE ON BREEDING ACTIVITY AND TADPOLE STAGE DURATION IN THE COMMON TOAD, *BUFO BUFO*.

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In an ongoing long-term study of a breeding population of common toads Bufo bufo at a pond in southern England the daily arrival of sexually mature males and females and the dates of first spawn deposition were recorded each year since 1980. In addition, the dates of toadlet emergence were recorded annually since 1984 and the numbers of emergent toadlets estimated annually since 1988.

The timing of the main arrival of sexually mature toads at the breeding pond each year was highly correlated with the mean daily temperatures over the 40 days immediately preceding the main arrival. When temperatures were higher than average, breeding occurred significantly earlier in the year than when they were either average or lower than average. Since 1980, the toad breeding seasons were early in 5 years (1989, 1990, 1993, 1995, 1998), late in 2 years (1986, 1996) and average during the remaining 14 years. Evidence was found indicating that the migration to the breeding pond was influenced by two threshold factors, daylength (9 hr) and temperature (6oC). The breeding migration did not occur when the daylength was below 9 hrs. It was also highly correlated with the number of days, during the 40 days prior to the main arrival at the breeding pond, when the temperature was at or above 6oC. Although all of the 'early' breeding years occurred since 1989, and were associated with the occurrence of particularly mild winters, a significant trend towards earlier breeding in recent years compared with previous years was not found ($p=0.14$; $r2=0.11$; $n=21$).

The dates when spawn was first laid varied considerably between years from the earliest on 2nd February 1993 (day 33) to the latest on 19th March 1996 (day 79). The duration of the tadpole stage was up to 30 days longer in early spawning years than in late ones and was negatively correlated with the date on which spawn was first laid. Despite this, however, toadlets still emerged from the natal pond up to 36 days earlier in early spawning years than in late ones. The duration of the tadpole stage

was positively correlated with the proportion of days during the tadpole stage when the minimum ground temperature was at or below 0oC and the proportion of days when rainfall was 10 mm or more. Tadpole mortality was positively correlated with the proportion of days during the tadpole stage when the minimum ground temperature was at or below 1.5oC. No trend towards earlier spawning in recent years compared with previous years was found ($p=0.09$; $r2=0.14$; $n=21$).

This study has shown that variations in climate, between years, results in variation in the timing of breeding in common toads and that this has 'knock on' effects for the duration of the tadpole stage, tadpole mortality and the timing of toadlet emergence from the natal pond. The common toad therefore represents a suitable indicator species for studying some aspects of climate change.

168 INTEGRATING DATA FROM TWO EXPERIMENTAL APPROACHES TO REFINE ESTIMATES OF PEATLAND CARBON BALANCE

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The extent to which results from micrometeorological and static chamber techniques can be integrated to develop representative peatland methane fluxes was assessed with reference to UK data. Although micrometeorological techniques can integrate data over larger areas, it tends to be more temporally constrained. Flux data from static chamber techniques is more spatially constrained and can vary widely between studies, but tends to be less constrained temporally. No significant difference was found between fluxes measured using either technique, and it was therefore possible to use both data sets to refine estimates of UK peatland carbon balance.
Significant relationships ($P < 0.01$) were established between static chamber methane fluxes, and temperature and water table height at a regional scale. This suggests that much of the spatial heterogeneity which is characteristic of methane emissions in chamber studies may be attributable to microsite differences in peat temperature and water table-depth. The range of representative annual methane fluxes for UK blanket peats was narrowed by omitting outliers caused by extremes of temperature and water table depth, leading to a flux range of +2.0 to +15.0 g CH_4 m^{-2} y^{-1}. Using average UK peat area estimates, a methane source of +0.04 to +0.33 Mt CH_4 y^{-1} was calculated.
Using the same carbon dioxide data as previous estimates, the carbon balance of UK peatland became -0.86 to -1.24 Mt C y^{-1}; slightly higher than the estimate submitted in the UK's National Greenhouse Gas Inventory. However, if UK studies indicating that peatlands are a source of carbon dioxide are replicated, the peatland carbon sink could become an equally strong source (+0.66 to +1.02 Mt C y^{-1}). Until carbon dioxide budgets are refined and subjected to similar analyses, the inclusion of peatland carbon balances to meet emission reduction targets under the Kyoto Protocol should be treated with caution. Despite this uncertainty, it may be possible to refine annual peatland methane fluxes throughout the blanket bog region and elsewhere by integrating data from micrometeorological and static chamber approaches.

169 TRENDS AND VARIABILITY IN SOIL WATER CHEMISTRY AT A REMOTE UPLAND SITE IN MID-WALES

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Soil water has been regularly sampled from a stagnopodzol soil supporting acid grassland vegetation at Plynlimon between September 1984 and September 1994. Samples were collected every two week up to September 1988 and every 4 weeks there after. Samples were analysed for monovalent and divalent base cations, ammonium, sulphate, nitrate, chloride, total dissolved aluminium (Altot), dissolved organic carbon (DOC) and pH. Organic anion concentrations were estimated from DOC and pH using a simple model.

Time-series plots for pH and ANC in both the surface organic (Oh) and mineral Bs horizon reveal a gradual upward trend but with considerable short-term variability. Episodic seasalt deposition which results in temporary soil water acidification is responsible for much of the noise in the data. During

these events, soil water Na:Cl ratios become very low, departing significantly from the theoretical seawater value, and large depressions in soil water pH and ANC occur, implying ion exchange of Na+ for H+ in the surface horizons, with release of inorganic Al in the subsoil.

In the surface organic horizon, pH variations are buffered by reactions with dissolved organic matter which effectively behave like weak acids. The concentration of organic anions varies seasonally, with largest concentrations in the summer coinciding with the period of greatest DOC production. During the summer, organic anions can contribute up to 50 % of the total anion charge. The cyclical variation in organic and strong acid anion concentrations results in a similar variation in ANC, which becomes positive (exceeding +50 (Eq/l in individual samples) during the summer, but becoming negative (between -100 and -150 (Eq/l) in the winter. Within the Bs horizon, Al concentrations are more than double those in the Oh horizon, with approximately 75% present as inorganic aluminium. The resulting effect is that ANC values are predominantly negative and much lower than seen in the Oh horizon. The highest ANC values in the Bs horizon are observed in the summer / early autumn, which coincides with lowest strong acid anion concentrations and largest concentrations of organic anions. Soil water pH variability is low and given a limited role for reactions with dissolved organic matter, other buffering processes must be operating in this horizon. Most probably these are reactions involving Al-hydroxy species either on surfaces or in solution and/or the weathering of silicate minerals. Increased weathering is indirectly indicated by larger silica concentrations in the Bs horizon which are more than double those in the Oh horizon. The pool of weatherable minerals also increases with depth in the soil.

170 MONITORING ANTARCTIC MARINE INVERTEBRATES USING ARTIFICIAL SUBSTRATES.

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Variation in the structure of Antarctic marine benthic macrofaunal communities is being investigated using an artificial substrate that mimics a kelp holdfast community. The artificial substrate consists of a bundle of 3 nylon mesh pot scourers which are anchored to the benthos using weighted trays. The community recruited to the artificial substrates is dominated by peracaridean crustaceans (isopods, amphipods and tanaids), polychaetes and gastropods. This is the first time this technique has been used to sample benthic macrofaunal communities in Antarctic continental marine waters.

The use of artificial substrates in experimental ecology allows the investigator great control over the sampling procedure. The duration, timing and position of the substrate in the environment are chosen by the investigator, permitting the study of specific aspects of the ecology of the recruited community. The use of a standard, easily replicated unit also lends power to statistical analysis of samples. The purpose of this study is to determine whether artificial substrates can be used to monitor for impacts to benthic communities caused by human activity in Antarctica.

Multivariate analysis of the community abundance and biomass data and univariate analysis of abundance data for selected taxa will be used to investigate faunal distribution patterns and their relation to physico-chemical environmental parameters including sediment chemistry and water quality data. These environmental parameters show distinct responses in proximity to sites used in the past for waste disposal from research stations in the vicinity of Casey Station. Sampling units have been deployed in a nested hierarchical design to examine differences in recruitment between adjacent bays, sampling potentially impacted and non-impacted sites and also investigating differences in recruitment between units deployed on soft sediments and those deployed on rocky reef.Session 6: Detection methodologies (poster session)

171 DATA SENSITIVITIES IN DETECTING CHANGE FROM GROUND BASED MONITORING

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The ability to detect real change from long term monitoring sites is fundamental to monitoring objectives and for use by land managers and policy makers. Interpreting real change from apparent change involves an intimate understanding of the nature of the data, its limitations, and logical objectives. The value of ground based monitoring data is often discounted by problems associated with spatial representation, methodology, observer error and data interpretation. The value of collaborative ground based monitoring in achieving attitudinal change should not be underestimated or judged entirely by the data collected itself. This paper looks at the collection and interpretation of data from long term rangeland monitoring sites in western New South Wales, Australia and how some of the problems of data limitations have attempted to be overcome through sound experimental design, data capture and analysis.

A network of 340 ground based monitoring sites was established in the semi-arid rangelands of western New South Wales, Australia in the 1989/90 period. The sites were established in order to aquire and deliver information to influence management , planning and land administration practices and to enhance understanding of rangeland functioning in order to minimise degradation. Sites are stratified across seven major rangetypes recording attributes such as ground cover species frequency and composition, perennial bush density and composition, soil surface condition and overstory cover. Sites are annually read by district scientific/extension officers of the Departmental with assistance from participating landholders.

Experimental and observer error has been reduced through a selection of robust methodologies, intense observer training, automated field data capture using specifically written software and an iterative process of data analysis employing biological rationale within uni and multivariate statistical approaches. Specific experiments to determine the significance of inter and intra observer error have been undertaken as part of the analysis. Through these processes data value has been optimised.

If monitoring occurs in collaboration with land managers the detection of change can occur at several levels, each important in involving the land manager, scientist and policy maker. Change maybe recognised by individual recollection, photographic sequences or data analysis. Influencing land management through policy may require substantive data analysis and interpretation, however a photographic sequence may be a more appropriate medium for influencing land management to a landholder. While remote rangeland monitoring techniques are rapidly being researched and funded, there is much to be gained from carefully planned ground based monitoring.

172 SPATIAL VARIATION IN GRAZING PATTERN AND ITS EFFECT ON UPLAND VEGETATION CHANGE

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The intensity of grazing by livestock is an important determinant of the floristic composition of moorland vegetation, particularly the balance between dwarf shrub species and grasses. Grazing animals exhibit clear preferences for particular plant species at different times of the year, and this, combined with the varying capacity of plant species to withstand grazing, exerts a strong influence on the distribution and dynamics of moorland vegetation. Conversely, the distribution of preferred vegetation types, together with factors such as the availability of shelter, influences the spatial distribution of grazing by livestock.

The occurrence of discrete spatial variation in grazing intensity has implications for agri-environment schemes, such as the Environmentally Sensitive Area and Countryside Stewardship Schemes, that aim to enhance the cover of Calluna vulgaris by limiting the density of stock present on a moor. A non-uniform pattern of grazing will lead to localised concentrations of stock that greatly exceed the overall stocking density and can have profound effects on the local vegetation. Such localised concentrations

can increase fragmentation of a species or increase its exposure to processes such as interspecific competition.

The effect of spatial variation in grazing intensity on moorland vegetation dynamics has been little studied. Plot studies have demonstrated that the spatial configuration and fragmentation of vegetation types within Calluna/grass mosaics influences the distribution of grazing livestock. However, most moorland is managed at a much larger scale with grazing units frequently in excess of several hundred hectares. On any single moor, the distribution and scale of different vegetation patches are likely to be considerably less uniform that those represented within small-scale experimental plots. An understanding of the spatial distribution of grazing at this larger scale is necessary in order to determine whether overall reductions in stocking rates can produce the maintenance or enhancement of heather moorland that is the objective of many upland agri-environment schemes. Such understanding can also be used in the development of initiatives to manipulate the pattern of sheep grazing, using small-scale measures to stimulate large-scale change in grazing pattern.

This paper reports on a study to quantify and characterise the spatial pattern of grazing by sheep over two areas moorland. Results are presented on an approach to manipulate the pattern of sheep grazing in order to achieve a more balanced mosaic of dwarf shrub and grass-dominated vegetation on two upland moors. Preliminary analyses indicate marked seasonal variation in spatial pattern of grazing pressure on key moorland plant species, such as Calluna, Vaccinium, Nardus and Molinia and suggests that localised manipulation of grazing can be used to enhance short-term grazing on under-grazed vegetation communities. Spatial statistical analyses are used to determine the extent of the effect across the whole moor and to ascertain whether localised manipulation of grazing pressure can effect large-scale change in grazing pattern to enhance the rate and/or direction of vegetation change on upland moor.

173 INDICATORS OF IMPACT AND SUSTAINABILITY

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Indicators of research impact are identified for small-scale multidisciplinary systems. Particular emphasis is put on the need to include multidisciplinary indicators - biophysical, economic, environmental, social, political and institutional - to address adequately the initial impact on the whole system and the pattern of changing pressures and responses between the different multidisciplinary components. Weighting issues and index formation are examined.

Scale of measurement is important for the choice of indicator. At the farm level, biophysical and environmental indicators are key, with some economic and social measurements also relevant. At the village and regional levels, economic, social, political and institutional indicators are more prominent, with some evidence of environmental values. At the national level, economic, environmental and political indicators are to the fore. Scale in the temporal sense is also important. Sampling according to the finest stratification ensures unbiased information. Database structure and internal linkages are discussed.

Positive impact is desirable, and negative impact must be counteracted. Indicators of sustainability may be different from indicators of impact in that sustainability aims to monitor changes in measures of positive impact. Multidisciplinarity is also a key issue in sustainability monitoring. Ideas for discussion of impact and sustainability by all involved stakeholders are summarised as an alternative to ill-defined indices.

174 UPLAND HEATHLAND MANAGEMENT: DETECTING AND UNDERSTANDING VEGETATION CHANGE IN RESPONSE TO SHEEP GRAZING.

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Over the past 50 years there has been a decline in the amount and quality of heather-dominated moorland across the UK. At the same time the importance of these habitats for rare and declining

species, and their contribution to biodiversity, has been increasingly acknowledged. The decline in heather moorland has been linked to a number of factors, including inappropriate burning and grazing regimes, drainage and increased atmospheric pollution. In response to this decline the Ministry of Agriculture, Fisheries and Food (MAFF) has in place a number of agri-environment schemes, including Environmentally Sensitive Areas (ESAs) and Countryside Stewardship Scheme (CSS). These schemes aim to encourage the maintenance and enhancement of heather on upland moors primarily by reducing stocking rates, and also by advising on appropriate moorland management practices. These schemes are typically assessed using heather as an indicator of success, while the associated species are rarely considered. These associated species can, however, have significant effects on the response of any one species to grazing management.

In this paper we present the effects of different stocking rates on upland heather moorland in Northumberland, England. We investigated the response of both species assemblages, and key indicator species within these assemblages, to two different stocking rates. The two stocking rates were 1.5 ewes/ha and 0.66 ewes/ha, equivalent to ESA Tier 1 and Tier 2 stocking rates for English upland dwarf shrub heaths. Plant species assemblages were identified using Detrended Correspondence Analysis (DCA) and fuzzy clustering techniques. Changes over time at both the community and individual species level were assessed using a mixture of DCA and analysis of variance.

The results indicate that the response to grazing management changes depending on the species assemblage. Those assemblages dominated by heather, or a mixture of heather and purple moor-grass, showed the greatest change in plant species composition over time. Areas dominated by purple moor-grass, and the wetter cotton-grass (Eriophorum) - bog moss (Sphagnum) areas, showed little change in species composition. Changes in individual key indicator species varied according to both the associated species assemblages, and the stocking rate applied. These results illustrate the variable response of different upland moorland vegetation types to different stocking rates. They also highlight the need to understand both community and species responses to grazing management, and develop tools that can integrate the effects of interactions between individuals into large-scale analyses of long-term vegetation change. This will assist in the development of cost-effective, sustainable management of upland heathland areas.

175 COMBINING TRADITIONAL KNOWLEDGE AND EXPERT ASSISTANCE IN URBAN PLANNING: FLOOD HAZARD MANAGEMENT IN DAR ES SALAAM, TANZANIA

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Dar es Salaam, one of the burgeoning Third World cities is faced with multiple environmental problems, including the degrading natural resource base, which trigger off serious socioeconomic and ecological risks to sustainable development. Given that about sixty percent of the residents live in unplanned areas, it is in some of these enclaves where the poor and the very poor relentlessly struggle to meet basic needs predominantly from Mother Nature.

One of the critical issues in the City planning process was the top-down approach whose consequences are better reflected in the hazardous lands. These areas, which due to natural and/or human induced causes are unsafe for human habitation and their socio-economic activities in the light of the available technology, are subjected to "eviction order" threats from the City authorities to hazardous land developers.

This paper aim to present key findings of a case study based on a bottom-up approach to urban planning. It employed a combination of traditional knowledge and expert assistance in managing settlement planning of a flood-prone area in Dar es Salaam. Its theoretical framework is pegged on a better understanding of the interactions, over time and space, between the external and internal physical factors and processes in catchment land units, on the one hand, and the human development activities and processes, on the other.

The study employed a Participatory Rural Appraisal (PRA) approach. A group of eight community members (including one lady) democratically drawn from the Community Development Committee (CDC) and seven urban planning experts (including two ladies) from the City Commission formed the PRA team. Using participatory tools the gender sensitive fifteen person team set out to democratically identify and assess environmental problems and opportunities for realizing an ecologically safe settlement through production of a Community Action Plan (CAP).

The PRA team defined the model area as Sunna Subward that extends from the Selender bridge estuary on the Ali Hassan Mwinyi road to the Morogoro road. The settlement was chosen for its ecological complexity. Field survey revealed that the severity of the flood disaster, flush floods, could be attributed to a combination of heavy storms, high tides at the Selender bridge estuary coupled with mangrove clearing, stone mining and housing densification. The final output was the community action plan to minimize risk, save lives, property and development infrastructure.

The paper concludes that successful management of hazardous lands is a function of a planning process that combines traditional environmental knowledge systems (TEKS) and modern-day science and technology (MEKS) as a basis for influencing the behavior of local communities in addressing natural and socioeconomic development issues. The next research agenda on management of hazardous lands should sharply focus on a participatory design of policy instruments directed towards enhancement of stakeholder planning capacity, promoting security of tenure, advocating community-based environmental conservation as pivotal to "rapid implementation and quick impact type development" over time and space.

176 A SCENARIO STUDY OF WATER QUALITY IN A DRINKING WATER SUPPLY RESERVOIR IN RESPONSE TO CLIMATE CHANGE

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Reservoirs represent a valuable water resource especially in countries without abundant natural lakes and groundwater aquifers. Climate change with variations in air temperature, precipitation and other meteorological parameters can bring about a broad spectrum of effects in reservoirs, e.g. change surface level fluctuations, stratification patterns, trophic conditions and productivity, hydrochemistry etc. The aim of the contribution is to show the effects of climate change in a small, dimictic reservoir used for drinking water supply.

Rimov Reservoir (48°50´N/14°40´E, volume - 32×106 m3, surface area - 2.03×106 m2, maximum/mean depth - 43/16 m, average hydraulic residence time - 95 days) is a canyon-type (length - 13 km, maximum width - 0.4 km), mesotrophic to eutrophic reservoir situated on the Malse River in South Bohemia. Its main purposes are storage of water for a drinking water treatment plant and flow maintenance. The effects of climate change on hydrodynamics and selected water quality parameters in this reservoir were studied by means of two-dimensional, laterally averaged water quality model CE-QUAL-W2 (US Army Corps of Engineers). Input data series were based either (i) on a 39-year series (1961-1999) of measured daily averages or (ii) on two artificial data series of the same length (39 years) generated with a stochastic weather generator with statistical parameters either identical with the measured data or changed according to the results of ECHAM4 for 2×CO2 conditions. Inflow into the reservoir was simulated using the Sacramento soil moisture accounting model.
Modelling results for the 2×CO2 conditions indicated the following changes in the reservoir in comparison with the contemporary conditions: (i) more pronounced surface level decreases in summer and autumn, (ii) shortening of winter stratification period and time of ice cover, (iii) increase of surface temperature in summer, (iv) decrease in the concentration of dissolved organic matter in the lacustrine

part of the reservoir, (v) increase of gradients in trophic conditions between the inflow and lacustrine parts, i.e. more eutrophic inflow reaches and mesotrophic conditions at the dam, (vi) shift towards phytoplankton groups with higher temperature optimum (e.g. cyanobacteria), which can mean a potential health risk to the produced drinking water.

177 SISSOO FOREST (*DALBERGIA SISSOO*, ROXB.) DECLINE IN NEPAL IN A CHANGING CLIMATIC ENVIRONMENT

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Sissoo (Dalbergia sissoo Roxb.) is a nitrogen fixing leguminous multipurpose tree species, occurring in the lowland region (called as"terai") of Nepal up to an altitude of 1000m. Sissoo tree species, dueto its fast growing nature, quality timber, easy propagation, droughtresistant etc. has become the most favorable plantation species forthe private as well as government sectors for the last 3 decades inthe region. Unfortunately, for the last few years, this tree specieshas been dying rapidly in the plantation forests. Their status,however, in the natural forest is still unknown. The primary visualsymptom for the decline is oozing out of red to reddish brown sap bythe trees. However in some plantations, trees start dying from thetop very rapidly without oozing sap, affecting trees of any age orsize. In some cases the trees die sudden. This type of decline ishappening all over in the Nepal terai No reasons for such declineshave been attributed until now. In Nepal, some studies have indicated that the die-back is directlyrelated to fungal pathogens such as Ganoderma lucidium or Polyporosspongiasum and insect borers belonging to families Scotidae,Buprestidae and Cerambycidae. However, such causes are only secondaryeffects, not the primary cause. There should be some abiotic causessuch as soil, air pollution, water, drought or other climaticconditions etc, which might have predisposed such decline. Untilnow little research has been done in the field of abioticenvironmental factors such as pollutants, climatic regime, soil, andothers in these forests. This paper discusses especially on thepossible role of soil factor on the sissoo decline.

178 MONITORING HABITAT FRAGMENTATION DUE TO LAND USE CHANGES USING MULTIDATE SATELLITE IMAGERY. CASE STUDY: OMAYED BIOSPHERE RESERVE (OBR)- EGYPT

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Biological communities and habitats are transient and naturally change in area, shape and spatial arrangement in the landscape. However, the impact of man, and growth of land used has resulted in rapid increase throughout the world of habitat modification, loss and fragmentation.
This paper represents an attempt to monitor these phenomena in the Western Mediterranean coast of Egypt. The Mediterranean coast forms the edge of great arid desert belt, which extends through a great part of Africa, but it has an increased rainfall owing to its proximity to the Mediterranean sea. The area under study is characterized by a distinct variety of landforms and habitats ranging from snow-white coastal sand dunes to clay/loam salt marshes and rocky ridges with skeletal shallow soils. El-Omayed biosphere reserve is a part of the western Mediterranean desert of Egypt. According to UNESCO, Man and Biosphere (MAB) Program, the Omayed Biosphere Reserve is divided into core zone (2 core zones in Omayed), a buffer zone, and a transition zone. The three zones cover a total area of about 700 km2. There are many development projects in the Omayed area that has affected the habitats and consequently the biodiversity in the Omayed Biosphere Reserve. Habitat loss has also been observed in OBR, subsequently extinction of species was encountered. The objectives of this paper is to assess the habitat fragmentation and the Biodiversity change in Omayed Biosphere reserve, using multidate SPOT satellite imagery, and identification of keystone species of different habitats in the area for restoring their environments. In the present study, land use changes were assessed by comparing spot imagery of 1987, 1993 and 1999. The analysis procedure is based on monitoring and assessing the changes in each of the habitats, separately, in the three dates, of acquired the Omayed area. New boundary definition of the OBR are suggested, which include less fragmented habitats and representative biodiversity for better conservation actions.

179 COMBATING DESERTIFICATION USING A COMBINED CHANGE DETECTION AND HISTORICAL APPROACH IN THE NORTH WEST PROVINCE OF SOUTH AFRICA

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Desertification is a major environmental problem in South Africa.
A national rapid appraisal conducted in 1998 highlighted areas with the highest status of desertification, some of which are in the semi-arid North West Province.
This area has had a varied political history, from colonial times through apartheid and the bantustan era to the present post-apartheid situation. This included the existence of one of the so-called independent republics of the apartheid era (ca. 1975 1994). This has resulted in many forced migrations and changes of land tenure with resultant impacts on the land.
The major desertification problems in this area are twofold, i.e. loss of vegetative cover, and the encroachment and densification of unpalatable thorn bush
This project has three interrelated thrusts: i.e Remote sensing, Historical research and Restoration ecology
1. Remotely sensed spatio-temporal inventory
Thus far no comprehensive analysis of the long term spatial and temporal extent of desertification has been conducted in the North West Province.
The only objective and accurate spatio-temporal data set readily available is the Landsat archive dating back to 1975, whilst aerial photography provides the only visual spatial record of land cover before 1975.
To date, land use patterns have been mapped from standard aerial photography and Landsat imagery for selected training sites. Post-classification change detection and analysis have been used to commence compilation of a spatio-temporal desertification inventory.
2. History of human activities potentially impacting on desertification.
Standard historical research methods are used to investigate the history of settlement, migration, and other human activities which might have caused desertification including
archival research on the particular areas identified as desertification hotspots for the purpose of this project, and
oral interviews with the inhabitants to record their versions of the history of the specific areas.
These findings are related to the spatio-temporal inventory to search for causal links between major socio-political events and desertification.
3. Restoration ecology: Land use practices and strategies to combat desertification
Work over past 6 years has developed skill in restoration ecology: i.e.
Optimal species selection and surface preparation
Different technologies for restoration including mechanical and biological methods
Participatory Action Research: restoration demonstration sites
Botanical surveys for quantitative assessment of range conditions
Improved understanding of the human impacts on desertification via the remotely sensed inventory and the historical analysis will guide adoption and transfer of restoration technology to the rural land users. This will also assist in informing policy for sustainable rural development. It is envisaged that this policy formulation will be optimally addressed through the South African Netherlands Research Programme on Alternatives in Development (SANPAD), in which local community involvement is paramount.

180 ARSENIC CONTAMINATION OF GROUND WATER IN THE ALLUVIAL AQUIFERS OF WEST BENGAL (INDIA): CAUSES, IMPACTS AND COMPREHENSIVE STRATEGY FOR SUSTAINABLE DEVELOPMENT.

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Arsenic contamination of ground water of West Bengal has been considered one of the largest ecological disasters in the world. Till date the literature survey revealed two broad trends in the field of

research i.e. clinical cum histo-pathological & geo-chemical, which could not address broader perspective of the problems.

This paper attempts to highlight various dimensions of present developmental paradigm changing trend and consequences, incorporates various socio economic and cultural factors which have shaped the present nature of chronic arsenicosis and establishes inter-linkages in order to develop a model for comprehensive sustainable strategy to eliminate arsenic menace.

Extensive survey have been conducted in arsenic affected villages covering nearly 9500 population including socio-economic background and culture, changing pattern of agricultural practice, impact of local environmental degradation along with epidemiological study of chronic arsenic poisoning and its implication for the given social system. Corresponding, state and national level agricultural policy, arsenic manifestation and government interventions have been incorporated.
Since mid 70's West Bengal adopted techno centric approach to revolutionize its agriculture sector leading to an increase in demand of water for irrigation. At the cost of gradual destruction of traditional water harvesting system, underground water irrigation has been given special attention, which resulted in its overexploitation. Studies showed that oxidation of insoluble arsenic pyrite of alluvial layer on account of its overexploitation has been responsible of its leaching into ground water. Poor people are more exposed to arsenic due to their occupational pattern ($p<0.005$). Deforestation and shrinking wastelands leading to non-availability of green vegetable and traditional fruits & declining production of pulses at state and national level (only sources of vitamins & protein for poor) resulted further aggravation of symptoms at significant level ($p<0.005$) among malnourished poor due to tardy detoxification (delayed metabolism of arsenic in human body). Emphasis to promote ground water for drinking purpose in rural area in order to prevent water borne diseases and simultaneous contamination of the water by arsenic enhanced its exposure to the rural people. Centralized nature of health services could not reach majority of the sufferers and introduction of water filter has been limited to selected areas. Disability and handicap arisen out of chronic arsenicosis were not given any importance despite the fact that these consequences aggravated the situation. Lastly sinking new hand pumps could no longer guarantee arsenic free water to the people.

For proper management of arsenic problem the present study findings helped to develop a model which is integrated and multisectoral in nature. The objectives are to reverse the unsustainable development process to right track, extending research from lab to field and monitoring of present process and intervention like measuring arsenic level in ground water, food chain, body tissue, soil etc, changing pattern of use of arsenic contaminated water after adopting new sustainable agricultural policy (i.e. gradual reduction of dependency on ground water and simultaneous revival of traditional harvesting system) and impact of therapeutic and preventive measure at community level.

181 ROLE OF POLYCHAETOUS ANNELIDS FOR MONITORING POLLUTION-INDUCED CHANGES IN A TROPICAL COASTAL ENVIRONMENT

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The polychaetes (Annelida) constitute a dominant functional component in the soft-bottom macrobenthic communities revealing a high plasticity and adaptability to different marine and coastal habitats. Analyses in differences in polychaete assemblages and habitat disturbance. These changes need to be considered in any environmental impact assessment or monitoring programme.The present study is designed to evaluate the effect of pollution on colonization and community structure of polychaetes in three ecologically distinct zones of Sunderban Biosphere
Reserve, eastern part of India. Polychaete samples were collected using a metallic quadrate and the physiochemical parameters (temperature, salinity, pH, dissolved oxygen, organic carbon, sand,silt, clay, total nitrogen and total phosphorous in the sediment) were analysed by standard methods. Bioaccumulation of heavy metals (Fe,Zn,Cu,Mn and Cr) were measured in the body tissues of polychaetes by aspirating the samples in flame AAS and total Hg by cold vapor AAS with MHS 10 and EDL system 2.

The polychaete assemblage, as a whole, represents an impoverish community which is characteristically different from each sampling site. Level of heavy metals in body tissues of polychaetes also reveals an interspecific and regional variations. The predominant polychaete fauna exhibited a distinct and unique assemblage as follows: (i) Mastobranchus indicus- Dendronereides heteropoda in the sewage-enriched 'sulphide clay' substratus
(ii) Perenereis cultrifera-Lumbrineris notocirrata -Ganganereis sootai at the mouth of Hooghly estuary with severe anthropogenic stress and contaminated with agricultural and industrial effluents and
(iii) Namalycastis fauveli-Lumbrineris polydesma at the site of comparatively less anthropogenic and industrial stresses facing the open sea, Bay of Bengal. Species belonging to the families Nereididae and Capitellidae seemed to respond in a characteristic manner with distance from the sources of organic input. P.cultrifera showed the maximum population density (5,500 no per meter square) during the
premonsoon months (March to May) at the mouth of the estuary and was strikingly absent in rest two zones. The absolute dominance of M.indicus at the mouth of sewage outfall, exclusion of most other species in this environment, tolerance of this capitellid worm to low dissolved oxygen and high accuMulation power of Cr in their body tissues are the notable aspects of this investigation and they might be used as "opportunistic" (indicator) endemic species. The log-transformed data (Y=log(x+1) Were computed to establish statistical relationships using a software programme (species diversity index, correlation coefficient, multiple regression analysis, principal component Analysis and analysis of variance).

The study demonstrates that polychaete is the major macroinvertebrate taxon thriving better in most stressed region of a pollution gradient and can provide a sensitive indicator of environmental change in response to anthropogenic (in this case mainly organic) inputs. An in-depth comparative polychaete community structure at multiple spatial scales is highly recommended for future environmental impact assessment in this fragile ecosystem.

182 ENVIRONMENTAL CHANGE IN UK RIVER CHANNELS: GEOMORPHOLOGICAL TYPOLOGIES AND MONITORING

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Rivers are the arteries of the landscape, integrating the impacts of change in atmospheric and terrestrial systems and delivering these to the coast. En route geomorphological processes create dynamic and diverse habitats, both in-stream and in riparian/floodplain ecotones. The dynamics of channel change have led to conflict with human resource development with the outcome that many river and riparian environments have been significantly modified and damaged. Responses to change in driving variables has become dampened or prevented, making detection of process-response links an important intellectual challenge.
Fluvial geomorphology is a key to understanding long-term river and floodplain processes of change; it is making an increasing contribution to environmental management of river basins and at the coast. In this paper the role of fluvial geomorphology in detecting, classifying and monitoring environmental change will be developed at three spatial scales: nationally, via the River Habitat Survey database, regionally, through repeated surveys in a network of research sites and at the catchment scale through use of standardised reconnaissance procedures. Whilst the objective classification of river channels remains elusive, a typology of river ‘styles’ and their responses to environmental change can become the basis of a much wider national appreciation of river dynamics, thus making a contribution to sustainable development.

183 MONITORING OF LARGE-SCALE ANTHROPOGENIC CHANGES IN A STATE OF THE ENVIRONMENT

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Globalisation of anthropogenic impacts on the environment in the last third of XX century caused by economical growth. For instance, significantly increased amounts of substances anthropogenically emitted to the atmosphere in a country often created problems for the whole region or even globally. Amongst such anthropogenic factors of subcontinental to global scale one can mention emissions of greenhouse gases (carbon dioxide, nitrous oxide, methane, etc.), nitrogen and sulphur oxides as well as ozone depleting substances (freons, etc.) to the atmosphere. This causes large-scale changes in chemical composition of the boundary layer of the atmosphere, atmospheric deposition, surface flux of ultraviolet-B solar radiation, and climate. Such changes are rather slow and of low to medium magnitude. However, they reveal almost everywhere, over regions, continents, even globally, and can cause substantial overall effect. For instance, tropospheric ozone caused losses in crop production in Europe exceeded 2 billion USD per annum in 1990th. Significant threats from projected climate change are well known. The mankind has already decided to take international measures aiming at controlling anthropogenic large-scale impacts on the environment (Framework Convention on Climate Change and the Kyoto Protocol, Convention on Long-range Transboundary Air Pollution, the Montreal Protocol, etc.). To be efficient these measures should be based on reliable environmental information on current status and trends. Such information can be provided exclusively by environmental monitoring systems. That is why they are crucially important for Society.

A system to monitor and detect large-scale environmental changes cannot be cheap. It requires systematic measurements of priority environmental variables over vast territory (region, continent, globe) and searching trends in averages over the territory. Therefore, such system should be based on the network observations. More wide basic measurements are also periodically to repeat for testing and improving monitoring methodologies as well for estimating range of natural variability of the monitored variables. The latter is extremely important for filtering procedures, i. e. for separation signal (a trend) from noise (natural variability).

Such monitoring systems exist and work successfully. Data provided by the International Long-Term Ecological Research Network (ILTER), Cooperative Programme for Monitoring and Evaluation of Long-Range Transmission of Air Pollutants in Europe (EMEP), Global Atmospheric Watch (GAW/WMO) and series of other international and national monitoring systems comprised the basis of environmental assessments for decision makers and public in last two decades.

The latter does not mean that everything is clear with monitoring theory and practices. At the current stage it is expedient to review environmental monitoring approaches and methodologies from the angle of recent achievements of ecological theory in understanding the cause-effect relationships in the biosphere. Practical issues (financial opportunities of countries) also should be taken into account. Large-scale measurement/observation programmes are to be simplified and oriented to use of rather universal variables sensitive to the major anthropogenic large-scale impacts.

184 MONITORING SUSTAINABILITY OF DEVELOPMENT IN THE REGION OF ISTANBUL

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The paper is aimed at outlining the basic principles and mechanisms of monitoring the sustainability of development in the region of Istanbul. The authors select several aggregates to measure sustainability of development based on the conception of weak sustainability. It is assumed that not only the total capital stock is not declining, but also that there is some trade off between various forms of capital. The results of the research are integrated in the model MIS (Monitoring Istanbul Sustainability). The development of this model includes two stages: first - formulating system of indicators, which reflects in the most realistic way the level of sustainability of the region and second - integrating these indicators into a generalised dynamic intergenerational input-output model.

To facilitate construction of such a model authors use set of indicators reflecting two possible sides of every form of capital: its depletion on one hand and its improvement on the other. The paper shed light on two basic problems: sectoral aspects of sustainability and the role of social capital as a homeostatic regulator within the system of sustainability. In sectoral aspect it is indicated that energy and transportation are main source of environmental degradation. The state of human capital is analysed taking into account the influence of the high level of unemployment and the high level of modern industrialisation in the region. The rising deterioration of natural capital is presented too. Demand-side management, alternative wastes management and other modern mechanisms are proposed to cope with the problems.

The authors also draw attention on the social capital in regulating sustainability emphasising the role of institutional aspects of the problem. Two features of social capital are considered in detail: the level of integration (consensus in ranking the social preferences) and the level of confidence (trust) among the members in society. The conclusion is that the economic system can reach sustainability in long run when there is strong and stable interaction between the level of integration and the level of confidence. In this case the social capital reveals completely its role as a feedback and results in Pareto optimal homeostatic regulation. Various indicators characterizing this process are analyzed as an attempt to find more realistic measures of this assumption.

As a pioneering work in this field the paper outlines the necessity of organising systematic monitoring of urban sustainability and indicates the institutional problems connected with the implementation of this task. Pre and post-monitoring problems are formulated in the context of integrating monitoring information in all levels of decision making process. The authors propose various institutional measures to improve the efficiency of monitoring activity and to find cost effective solutions in the existing decentralising setting of development of the region. These measures are formulated taking into account the modern visions on the behaviour of sustainable city.

185 DETECTING ENVIRONMENTAL CHANGE AND MEASURING THE IMPACT: A STUDY WITH REFERENCE TO CLIMATE CHANGE AND EMERGING INFECTIOUS DISEASES IN INDIA

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There are strong indications that a disturbing change in disease patterns has begun and that global warming is contributing to them (Paul Epstein,1997). Climatic changes related to global warming could foster dangerous outbreaks of cholera, dengue fever and malaria (World Wildlife Fund,1997). The spread of infectious diseases has accelerated not only because the world is warming, but because night time temperatures are rising faster than daytime temperatures. This has particularly disturbing implications for human health because the range of many disease-transmitting insects is limited chiefly by night time temperatures.
Malaria currently kills up to 2 million people each year and over 2 billion people are considered at risk of contracting the disease. Analyses show malaria outbreaks outside tropical regions becoming more common in the future. Even small variations in local microclimate can affect an insect vector's chances of survival, and therefore the disease transmission potential within a given area is increasing. Consequently, understanding and predicting the effects of environmental change on tropical diseases is crucial for their control. The purpose of the present study focuses on predicting and quantifying the changes in disease risk associated with environmental change, and quantifying the health benefits and costs in economic terms. In view of the regional importance of specific malaria vectors, a high priority is set to identification of sites representing geographical zones which are of strategic importance to the disease and where major environmental changes are in force.
The study is armed with empirical data on correlation between environmental change and impact of tropical diseases particularly with reference to Malaria. One of the most useful things tropical disease research can be predicting how, why and where disease risks increase, and implementing control measures to minimise these risks in advance of increased transmission. The study also probed into the spatio-temporal variation of malaria as a result of local regional and global variations in climatic conditions The emphasis was also laid in identifying the major dimensions related to Disease occurrence in relation to climate change, environmental, landuse and related development variables, demographic and socioeconomic characteristics. The study was based on the secondary data collected

at local, regional, national and international levels to substantiate the findings of the study. The data were analysed with the help of multivariate statistical technique factor analysis to explain the dimensions. It was inferred from the study that there is an increase in the malaria transmission potential and disease incidence associated with increased acreage of commercial tree crop plantations and extensive irrigation facilities which in turn probably resulted in the re-emergence of drug-resistance malaria transmission within these newly created habitats. Another important fact observed from the study revealed the relationship between landuse changes and risk of malaria or other tropical diseases in areas undergoing sustained environmental changes. The identification of major dimensions such as (Climate change and Increased Malarial incidence, Climate variability and Infectious and Communicable Diseases, Climate induced Environmental Change and Changing spatial pattern of Tropical Diseases etc.,) further confirmed the causal relationships between climate change and its impact on Human health.

186 PARTIAL MUTUAL INFORMATION: A USEFUL CRITERION FOR QUANTIFYING DEPENDENCE IN HYDROLOGICAL AND ENVIRONMENTAL APPLICATIONS

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Many engineering applications involve ascertaining the dependence between a variable we wish to estimate or predict, and several variables that, individually or together, could be used to formulate the prediction relationship. Finding the combination of predictors that lead to useful estimates of the response variable is not an easy problem to solve. Currently used approaches for identifying predictors, such as partial correlation, require the complete specification of the linear or nonlinear model one expects would apply. Furthermore, dependence is measured as a function of the quality of fit of the regression model, something that may lead to inaccuracies in the choices of predictors of the intent is to develop a probabilistic or stochastic relationship. In summary, one needs a generic measure of dependence that does not suffer from the problems mentioned above.

A nonparametric implementation of the mutual information criterion is presented here as a more generalised measure of dependence between two variables. Such a measure is ideally suited for applications such as time series analysis and probabilistic forecasting, as it is based on a complete characterisation of the joint probability distribution, instead of deviations off a curve of best fit. This paper presents a "partial" mutual information criterion that makes it possible for one to use the niceties of the mutual information criterion for identifying more than one predictors of the response variable. The data-based nonparametric kernel methods are used to characterise the distributional attributes needed in the estimation of the mutual information criterion values.

The method is tested on a range of synthetically generated datasets whose dependence attributes are known beforehand. Applications involving simple environmental engineering problems are used to illustrate the utility of the method.

187 A NONPARAMETRIC STOCHASTIC APPROACH FOR PRESERVING INTERANNUAL DEPENDENCE IN SEASONAL STREAMFLOW SEQUENCES FOR WATER RESOURCES PLANNING AND MANAGEMENT APPLICATIONS

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The estimation of risks associated with alternate plans and designs for water resources systems require generation for synthetic streamflow sequences that are representative of the observed record. The mathematical algorithms used to generate these inflow sequences are found lacking in two main respects: inability in preserving the dependence attributes particularly at large (interannual) time lags, and a poor representation of the distributional characteristics of the observed streamflow time series. Traditional approaches for representation this long term or over-year dependence in streamflow have

involved using stochastic disaggregation models. These models use annual streamflow simulations and disaggregate them into monthly values maintaining a prescribed (linear) annual to monthly dependence structure. In this process, the dependence structure at the year boundaries and between years is not reproduced. These models also use a restrictive representation of distributional attributes that makes it difficult to accurately exhibit any assymetry or multimodality that may be present in the data.

Proposed here is an alternative to such conventional approaches that naturally incorporates both observed dependence and distributional attributes in the generated sequences. Use of a nonparametric framework provides a simple and effective method for reproducing the observed probability density characteristics. A careful selectionof prior lags as conditioning variables imparts the appropriate short-term memory, while use of an "aggregate" flow variable defines as the sum of the flows during the past twelve months allows representation of interannual dependence in the generated sequences.

The nonparametric simulation model was tested on synthetic data sets with short and long term dependence structure and distributional attributes. The model was then applied to mmonthly streamflows from selected catchments in Australia and USA.

188 FUR- BEARING ANIMALS OF BURYATIA

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Nowadays the most spread animals are sable, squirrel. Averageannual state purchases of squirrels'fur are fluctuating during 5 years:1955-1959 - 485000, 1970-1974 - 189000, 1975-1979 - 202000.
The levels of sables'fur state purchases are diminishing:1963 - 8,1thousands,1981 - 2,9th., 1995 - 1,3th., 1996 - 2,2th., 1997 -1,9th., 1998 - 2,1th.
Up to this day there haven't been defined the unify methods of determining the quantity of these animals. There was made a retrospective analysis of principles and methods of econimic use of this natural resourse f.e sable, In order to evaluate objectively the possible consequenses of antropogenic influence of industrial use of Buryatia.The reflection of the situation of the quantity of representatives of fauna are dynamics of quantity of these animals.

Animal	Years	
	1995	1998
squirrel	143345	490000
sable	11500	13000
fox	1500	3200
elk	6200	6800
ÉÚÀÂÒ	12000	18300
ËÁÂÁÒÇÁ	14000	16900
wild boar	2000	4400
reindeer	1500	2500
roe	24000	35000
wolf	2000	2000
bear	2000	2000

Now the number of wolves is growing: 1992 - caught 170, 1998 - 475,. The quantity of wolves in Buryatia depends on the migration of them from Mongolia, thus ecological niche remains filled up.

189 THE UK ENVIRONMENTAL CHANGE NETWORK

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The UK Environmental Change Network (ECN) is the UK's long-term, integrated environmental monitoring and research programme. ECN gathers information about the pressures on and responses to environmental change in physical, chemical and biological systems. It is supported by a consortium of 15 sponsoring organisations and 9 research organisations and is co-ordinated by the Centre for Ecology and Hydrology. ECN can provide data relevant to issues such as climate change, air and water pollution, land use change and biodiversity loss. The objectives of ECN are:

- To establish and maintain a selected network of sites within the UK from which to obtain comparable long-term datasets through the monitoring of a range of variables identified as being of major environmental importance
- To provide for the integration and analysis of these data, so as to identify natural and man-induced environmental changes and improve understanding of the causes of change
- To distinguish short-term fluctuations from long-term trends, and predict future changes
- To provide, for research purposes, a range of representative sites with good instrumentation and reliable environmental information.

There are currently 12 terrestrial sites and 42 freshwater sites in the ECN network. Sites range from upland to lowland, moorland to chalk grassland, small ponds and streams to large rivers and lakes. Each of the sponsoring organisations provides one or more sites and covers the costs of ECN measurements at those sites. There is no central funding for the network. As well as integrated, long-term environmental data, ECN sites provide well-instrumented locations for many short and long-term environmental research projects.

190 LEARNING FROM WATCHING THE WORLD CHANGE

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Environmental change has many dimensions and education is fundamental to them all. If society is to mitigate and adapt to environmental changes education is required at all levels from those who's lifestyles and businesses will be affected to those doing research and devising response policies. Environmental research and monitoring organisations have an important role to play in the educational process at all levels.

The Environmental Change Network is the UK's long-term integrated environmental monitoring program. It intensively monitors many aspects of environment change at 12 terrestrial and 42 freshwater sites throughout the UK. ECN's primary role is to deliver information for scientific research and policy formulation, but it also provides training for the scientists of tomorrow and actively promotes the use of its information resources for educational purposes in schools and colleges.

ECN is particularly keen to promote the use of electronic tools for teaching and already provides easy access to information resources that allow teachers and students to explore environmental change issues for themselves. These resources include real data in summary and raw formats, photographic records of change, and hourly updated weather data from an automatic weather station. ECN has also developed bespoke products for learning about environmental change, such as a set of tutorials designed to help students learn about weather and climate change. Climate change indicators developed for informing policy decisions could also be used for teaching.

ECN recently organised an event at the Royal Society in October 2000 called Teaching Environmental Change 2000 (TEC2000). The objectives of this event were to: (i) promote the teaching of environmental change; (ii) demonstrate computer-based tools developed to facilitate learning about environmental change; and (iii) steer the development of teaching aids by environmental research and monitoring organisations. One of the key conclusions of this event was the need to bridge the gap between what environmental organisations have to offer for educational purposes and what teachers need in their classrooms. ECN is keen to initiate measures to help bridge this gap.

Although ECN already provides data and information to support teaching that is easily accessible over the Internet, we feel we can do better. We would therefore like to repackage our resources to optimise their educational potential. The aim of this paper will be to present developments in ECN's educational thinking and resources in response to follow-up activities and partnerships initiated by TEC2000.

191 ANTHROPOGENIC RADIATIVE FORCINGS AND CHANGES IN TEMPORAL PATTERN OF SURFACE AIR TEMPERATURE IN MONSOON CLIMATE

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An important driver of environmental change is climate. Increase in greenhouse gas concentrations since preindustrial era have led to a positive radiative forcing of climate, tending to warm the surface and to produce other changes of climate. Tropospheric aerosols have led to a negative direct forcing and possibly also to a negative indirect forcing of a similar magnitude. Primarily the negative forcing is focused in particular regions and subcontinental areas, it can have continental to hemispheric scale effects on climate patterns. Environmental and socio-economic systems in the Indian Subcontinent are very sensitive to all India summer monsoon activities. Surface air temperature in the monsoon climate is vital for number of reasons including its significance in agriculture, water resources, hydrology, industry and planning. An accurate and reliable portrayal of change in the temperature due to climate change is therefore very important in the perspective of impact of climate change on socio-economic and environmental system.

The skill of current generation of global climate models, in their long-term simulations, to replicate the observed atmospheric behavior on a wide range of spatial and time scales provides support in applying these models to the regional climate change projections induced by anthropogenic radiative forcings. The skill of a coupled atmosphere ocean climate model (ECHAM3 + LSG) at T21 resolution to simulate the temporal pattern in area-averaged annual mean surface air temperature over Indian subcontinent in three different numerical experiments viz.; control, GHG and GHG plus aerosol is examined. The significance of anthropogenic radiative forcings in the simulation of temporal pattern of the temperature has been examined. The model has superior skill in reproducing the observed trend and interannual variability in area-averaged annual mean surface air temperature during the past century in GHG plus aerosol experiment. The model's ability to simulate the observed pattern in the temperature over the area of interest could be improved by better representation of meso-scale forcings such as monsoon trough, complex orography and parameterization scheme for convection and land surface processes in the model.

192 MONITORING AND PREDICTION OF ANTHROPOGENIC CLIMATE CHANGE : CASE OF DELHI

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The most apparent impact of anthropogenic stress on city local climate is the modification of the atmosphere environment by land use activities. The rapid growth of urbanization and industrialization inevitablly leads to higher consumption of energy usually reflected in increasing pollutant emissions. Industrial cities like Mumbai, Calcutta and Delhi are having in their atmosphere pollutants like SO2, NOX, CO, hydrocarbons (hc), metal dust fluorides, pesticides, flyash, soot and occasionally radioactive substances. The paper analyses anthropogenic climate change detection taking empirical case study from Delhi Metropolitan City. Delhi is also known as Land locked city. Because, it is situated between the Great Indian Desert (Thar Desert) of Rajasthan to the west, the central hot plain to the south, and in North Himalayan region. Delhi with 8.42 million population is the third largest city of India. As Nation's capital city it has become a nucleus activities exist in the west, south and south - east zones of the city. Traffic congestion is a product of the rapid increase in the number of road vehicles. The trend in pollution emissions like CO2 from all sectors show upward trend due to rapid growth of urbanization in association with vehicularization and industrialization. The number of register motor vehicles has increased more than ten times during 1974-94. Among Metropolitan cities, Delhi has the largest number of motor vehicles. Industrial emissions have been considerably increasing over a period. The total number of industries in Delhi was about 8000 in the year 1951 which steeply increased to 93000 by 1993. Major responsible sources of SO2 emission in Delhi Metropolitan city are industrial sector and thermal power plants. National Environmental Engineering Research Institute (NEERI) has estimated that these thermal power stations produce SO2 about 25550 tonnes per year. Total SO2 emissions are estimated about at 45000 tonnes per year by 2000. Like SO2 emissions, the dominant sources of SPM emissions are industry and thermal power plant. In 1990,

total SPM emission was about 115700 tones per year and will increase to 122600 tonnes per year by 2000. More than 90 per cent of industrial NOX emissions are from thermal power stations.

The levels of air pollution which is discharged from various sources concentrate in a particular area depends largely on local meteorological conditions, existing regulations and urban geometry. The application of dispersion theory and knowledge of local weather conditions are necessary to determine the intensity of greenhouse gases. The impact of Delhi on its local climate are likely to change in climatic parameters, however, varies with each climatic variables. These annual pattern indicate that with maximum and minimum temperature for Delhi have positive anomalies. The difference in maximum temperature, shows maximum from March to November and January, February and December months are minimum in values. The pattern from difference in daily maximum and minimum temperature has shown Safdarjung is warmer than Palam, Safdarjung is situated very close to core of City i.e. Rajiv Chowk (Connaught Place) in central and Yusuf Sarai in South. These core area of city exhibit warm pockets due to the thermal radiation emissions. The thermal radiant emitance from different surfaces in Delhi like green areas, concrete roads, tar roads, built-up areas are found to be responsible for the formation of several warm pockets instead of a single intense 'heat island'. There is no clear identification and explanation for intense "heat island" due to meagre data it is very difficult to delineate several warm pockets. Inadvertent modification with respect to temperature, relative humidity and surface wind were evident not only when data within the core area of city were compared with city's fringe area. Surface wind speeds are found high in the core area of the city at times of light winds, with strong winds however there is a decrease. Despite Delhi urban geometry and wind direction, the city's core area shows wind direction tends to frequently change in accordance to urban geometry. Temperature is higher and relative humidity is lower in the core city area as compare to its fringe area. The precipitation ratio shows the intensity of precipitation tends to increasing trend.

193 URBAN LAND USE AS DRIVERS OF ENVIRONMENTAL CHANGE IN DELHI

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The rapid growth of urbanization and industrialization inevitably leads to higher consumption of energy usually reflected in increasing environmental pollution. The most apparent impact of anthropogenic stress on local climate of the metropolitan cities is the modification of the atmosphere environment by land use activities. Industrial cities like Mumbai, Calcutta and Delhi are having in their atmosphere pollutants like SO2, NOX, CO, hydrocarbons (hc), metal dust fluorides, pesticides, flyash, soot and occasionally radioactive substances. The paper analyses anthropogenic climate change detection taking empirical case study from Delhi Metropolitan City. Delhi is also known as Land locked city. Because, it is situated between the Great Indian Desert (Thar Desert) of Rajasthan to the west, the central hot plain to the south, and in North Himalayan region. Delhi with 8.42 million population is the third largest city of India. As Nation's capital city it has become a nucleus activities exist in the west, south and south - east zones of the city. Traffic congestion is a product of the rapid increase in the number of road vehicles. The trend in pollution emissions like CO2 from all sectors show upward trend due to rapid growth of urbanization in association with vehicularization and industrialization. The number of register motor vehicles has increased more than ten times during 1974-94. Among Metropolitan cities, Delhi has the largest number of motor vehicles. Industrial emissions have been considerably increasing over a period. The total number of industries in Delhi was about 8000 in the year 1951 which steeply increased to 93000 by 1993. Major responsible sources of SO2 emission in Delhi Metropolitan city are industrial sector and thermal power plants. National Environmental Engineering Research Institute (NEERI) has estimated that these thermal power stations produce SO2 about 25550 tonnes per year. Total SO2 emissions are estimated about at 45000 tonnes per year by 2000. Like SO2 emissions, the dominant sources of SPM emissions are industry and thermal power plant. In 1990, total SPM emission was about 115700 tones per year and will increase to 122600 tonnes per year by 2000. More than 90 per cent of industrial NOX emissions are from thermal power stations. The levels of air pollution which is discharged from various sources concentrate in a particular area depends largely on local meteorological conditions, existing regulations and urban geometry. The application of dispersion theory and knowledge of local weather conditions are necessary to determine the intensity of greenhouse gases. The impact of Delhi on its local climate are likely to change in climatic parameters, however, varies with each climatic variables. These annual pattern indicate that with maximum and minimum temperature for Delhi have positive anomalies. The difference in maximum temperature, shows maximum from March to November and January, February

and December months are minimum in values. The pattern from difference in daily maximum and minimum temperature has shown Safdarjung is warmer than Palam, Safdarjung is situated very close to core of City i.e. Rajiv Chowk (Connaught Place) in central and Yusuf Sarai in South. These core area of city exhibit warm pockets due to the thermal radiation emissions. The thermal radiant emitance from different surfaces in Delhi like green areas, concrete roads, tar roads, built-up areas are found to be responsible for the formation of several warm pockets instead of a single intense 'heat island'. There is no clear identification and explanation for intense "heat island" due to meagre data it is very difficult to delineate several warm pockets. Inadvertent modification with respect to temperature, relative humidity and surface wind were evident not only when data within the core area of city were compared with city's fringe area. Surface wind speeds are found high in the core area of the city at times of light winds, with strong winds however there is a decrease. Despite Delhi urban geometry and wind direction, the city's core area shows wind direction tends to frequently change in accordance to urban geometry. Temperature is higher and relative humidity is lower in the core city area as compare to its fringe area.

194 CHANGES IN ENVIRONMENT POLLUTION LEVEL IN THE PROTECTIVE ZONE OF THE „KONIN" ALUMINUM SMELTER

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The „Konin" Aluminum Smelter was built in 1960 - 1966 in the agricultural area. Its annual aluminum output reaches 50,000 tons. The smelter is an important source of air pollutants, particularly fluorine and PAHs. Poor control of emissions from the smelter in the first years of its activity created a great hazard for people and the natural environment which, among others, resulted in people displacement and stopping their natural agricultural activity. From the beginning of the smelter activity intensive research works have been carried out in various compartments of the natural environment in the vicinity of the smelter. The results of a long-term monitoring investigation (1969 - 2000) of air, soil, plants, and water contamination are presented. Many fold reduction in a contamination level of all investigated compartments was observed. The improvement of the environment quality enabled the area in the vicinity of the smelter to be recovered for agricultural purposes.

195 TRENDS IN STREAM CHEMISTRY IN UPLAND CATCHMENTS IN WALES AND EFFECTS OF FOREST MANAGEMENT.

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Stream water chemistry often mirrors atmospheric solute inputs, varies significantly with season and provides an integrated assessment of the effects of land management within the catchment. Here we describe stream water chemistry trends from two upland sites, Beddgelert forest in north Wales and Plynlimon, mid-Wales, where analyses have been conducted regularly by CEH since the early 1980s . Both sites include catchments dominated by first rotation Sitka spruce plantations which were clear-felled, and replanted with Sitka spruce.

At both sites, nitrate-N concentrations in streams draining mature first rotation forests (40-60 years old) were higher in winter following a well established a pattern seen more clearly from adjacent moorland catchments at both sites. Nitrate-N concentrations in the mature forest streams were consistently higher throughout than in the moorland, as observed in other forest and moorland catchments in Wales.

Following clear-felling, a pulse of nitrate was observed in the streams in common with many other studies world-wide. This peaked within 1-2 years of felling, followed by a gradual decline; the pulse had passed 3-4 years after felling. During the post-felling phase, this decline is explained by the rapid re-vegetation of the site, through replanting and natural regeneration of spruce, accompanied by vigorous regeneration of grasses and bryophytes. These acted as a substantial sink for nutrients, with grasses in the early stages being replaced by tree uptake after a few years. Vegetation re-establishment caused nitrate concentrations to decline virtually to zero in summer during the period from 4 to 12

years after felling, when tree canopy closure was again complete. Interestingly, at this stage both winter and summer concentrations started to rise.

There is currently great interest in introducing continuous cover forestry (CCF) as the main management regime for upland conifer forests in Wales. CCF involves retaining patches or individual trees of varying ages in an intricate mix, and clear felling never occurs. It is an inherently more desirable management system for aesthetic reasons, and may have the added benefit of eliminating the high nitrate concentrations of older forest stands and the pulses at clearfelling, along with the associated acidification problem.

196 LAND USE DRIVERS AND SPATIAL SCALE DEPENDENCE IN PONDICHERRY REGION, INDIA (ABSTRACT)

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Interpretations of how land use/cover driving forces act and interact is still controversial, especially with respect to the assessment of the relative importance of the different forces and factors underlying landuse decisions in specific cases(Turner et al., 1994). An illustrative case study (Skole&Tucker, 1993) demonstrated that landuse changes are tied to numerous human factors and operate across many spatial and temporal scales. An attempt has been made in this case study to divide the causal factors of land use change into bio-physical and socio-economic drivers. Each set of drivers are then analyzed at different spatial and temporal scales. The importance of certain kinds of drivers over others, has been identified and linked cross scales with the latest tools in application, remote sensing and geographic information systems. Demographic factors are the main drivers of land use change at all scales, whereas the biophysical conditions merely act as constraints to where and what changes take place. At the village level, land degradation(land use change) is highly related to the percentage of population living under poverty line. On the other hand, land tenure system and per capita loan availability appear to be the major drivers at the farm level. As a part of this research study (funded by the Department of Science and Technology, Govt. of India), the consequences of these scale dependent land use changes- especially erosion, fertility reduction, and sea water incursion- have been studied elaborately. Land use planning under the premises of "Living with Global Change", is suggested as a policy measure to achieve landscape configurations which don't compromise the short and long term futures of Pondicherry Region. An extensive use of PC-Arc/Info GIS software (3.42 b Version) is the landmark of this research work.

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197 INTEGRATED ASSESSMENT OF POLLUTION EFFECTS ON TERRESTRIAL ECOSYSTEMS IN ESTONIA

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Estonian National Environmental Strategy (NES, 1997) has evolved from the Policy on Nature Conservation and Sustainable Use of Natural Resources (1989). Monitoring pollution levels and enforcement of emission legislation based on these monitoring data have been key aims of Estonian environmental strategy. Priority environmental issues are specified in the NES together with 10 policy goals.

Last years a number of positive changes have taken place in Estonian environment. The content of heavy metals in mosses has decreased in comparison with the early 1990s. Occurrence of different kind of damages on decidious trees has not been frequent. Those facts indicate that air pollution with heavy metals and other pollutants has also diminished during recent years. The pH-level of precipitation fluctuates in different parts of Estonia. Studies of critical loads show the actual nitrogen deposition in North-East Estonia and West-Estonian islands coinciding with the limits for pollution endurance. This pattern also applies to the summary deposition of sulphur and nitrogen in South, North and North-East Estonia.

The Estonian ecosystems have importance in European and worldwide aspect, so it is necessary to pay special attention to the vulnerability and adaptation assessment of ecosystems and landscapes on the climate change. Every new linear structure brings along the appearance of new limiting areas, new ecotons and thus the appearance of new biotopes. Integrated monitoring of air pollution effects on ecosystems and long-term data gathered at integrated monitoring sites and their supporting areas will give us possibility to study meteorological, climate change and anthropogenic impact on ecosystems and find species which could serve as bioindicators for the impact.

Satellite remote sensing in Estonia dates back to 1992. Mapping data generated from satellite images of different dates can also be used for biodiversity and bioproductivity evaluation and for change detection analysis on different levels of aggregation.

The Environmental Indicator System and the State of the Environment Report will make links to the policy goals and specific targets and are important to measure progress towards goals by trend analysis and environmental sensitivity mapping. The aim of the integrated assessment is to prepare information that will draw on the data held in more than one database in a synergistic fashion. The development of a framework for the use of the environmental data and Geographical Information System in an operational application requires development of quality control procedures governing the nature of the derived information.

Key words: Estonian environment, integrated assessment, remote sensing, mosses, precipitation, forests.

198 A WORKING TECHNIQUE OF DATA MANAGEMENT IN AN AGRO-ECOLOGICAL PROVINCE

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To set up an ecological data base of working technique is the fundamental work in database share. The ecological database in Henan Province area depending on Fengqiu Station was established. The paper focuses on the Meta-database, management skill, data structure, file coding and etc.

Key words: Agro-Ecological system, Meta-database, management skill, data structure, file coding.

199 A POLICY STUDY ON ECOLOGICAL DATA MANAGEMENT -- EXAMPLE FOR FENGQIU AGRO ¨CECOLOGICAL EXPERIMENT STATION.

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The paper briefly introduced the policy frame on CERN about data management, with emphasis on the establishment of policy on data management of Fengqiu Agro-Ecological Experiment Station of China, based on the substantial conditions of the station. The policy includes the organization of data management, duty of running system and providing and using data, QA/QC, countermeasure of eco-data resources sharing.

Key words: policy on data management, duty of running system, duty of providing and using data, data resources-sharing.

200 TRANSMISSION AND SHARES OF METADATA IN THE CERN NET AT THE FENGQIU AGRO-ECOLOGICAL EXPERIMENT STATION.

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This paper briefly introduced the coding of the metadata, projects, special reports, institutional materials, and maps, etc. and considered the substantial condition of Fengqiu Agro-Ecological Experiment Station. The unit formation of classification - coding to the metadata used by the Secretariat of Chinese Ecosystem Research Net(CERN) was also described. The emphasis was put on the discussion of linkage and transmission between the unit coding of CERN and the coding of Fengqiu Ago-ecological Experiment Station with a result which can be applied to both communication in CERN and data management in ecology.

Key words metadata, coding, data communication, linking and translation

201 SUSTAINABILITY OF RANGELAND UTILIZATION BY NOMADIC PASTORALISTS IN ETHIOPIA

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Sustainable use of rangeland by nomadic pastoralists is a key issue of concern in Ethiopia. This part of the country constitutes the arid and semi-arid regions and covers nearly 40% of the total area. Livestock production is the main asset to these people and shows diversity in production systems. The biological and socio-economic servo-mechanism of the pastoraslists is characterized by an event driven, unrestricted mobility in response to rainfall and other episodic events. This enables them to secure feed for their livestock.

Different factors contribute to rangeland degradation in this part of the country. The unpredictable low and erratic rainfall and extreme temperatures seldom provides an optimum environment for plant growth. The high number of animals of varying quality has resulted in high grazing pressure. Human population growth also needs to be worth mentioning. From the government side, the main problems include relocation of the pastoralists for development purposes such as state farms, game reserves, etc. and lack of adequate data and reporting procedures on range resources and their utilization. Besides, policy makers are largely deaf to arguments to consider traditional knowledge in reformulating the production system that can work sustainably under the prevailing situations. The effects of these constraints on the sustainability of rangeland use and on the social life of this segment of the society are numerous. Low carrying capacity of the grazing land implies that the productivity of the livestock is negatively affected. Recurrent drought due to unpredictable rainfall and high grazing pressure has resulted in devastating loss of their economic and survival base. The most important environment concerns are desertification and loss of bio diversity, which in fact, have progressed in some parts of this area. The two major social effects are poverty and uncontrolled urbanization. Further more, the growing population pressure and/or decreased available grazing land has loosened the pastoral organization and traditional tolerance, that have resulted in conflicts and anarchic system.

Short-term efforts to ameliorate the negative effects of the pastoralists on their environment may focus on tactics such as bush control, range rehabilitation, and improved drought security, but this will not give long-term solutions. Therefore, measures for the sustainable development of the rangeland must closely look at both directly related variables (vegetation, soil, etc) and indirectly related variables (precipitation, mobility, marketing etc.) in an adaptive and multidisciplinary approach. Besides, it must consider the "two social scaffoldings for sustainability", namely; awareness, education and participation of this segment in the decision making process and the establishment of institutional framework to deal with all resource problems of the targeted groups.

202 CANADA'S ECOLOGICAL MONITORING AND ASSESSMENT NETWORK'S CORE MONITORING VARIABLES: EARLY WARNING INDICATORS OF ENVIRONMENTAL CHANGE

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This paper reports on the evaluation of existing ecological monitoring variables from a variety of sources to select a suite of core variables suitable for monitoring at the Ecological Monitoring and Assessment Network (EMAN) sites located across Canada. The purpose of EMAN is to promote the acquisition of relevant and consistent data that can be used to report on national trends and provide an early warning of ecosystem change. Existing monitoring variables were evaluated in two steps. In the first step, three primary criteria were used to pre-screen preliminary variables. In the second step, a more detailed evaluation considered twenty criteria based on data quality, applicability, data collection methods, data analysis and
interpretation, existing data and programs, and cost effectiveness to select a draft set of core monitoring variables (CMV). An ecological framework was developed to organize the CMV in a manner that permitted a gap analysis to confirm the CMV assessed a wide range of relevant environment components. The suite of CMV were then tested to determine their effectiveness in detecting ecosystem change caused by stressors with ecosystem responses that have been well documented in the literature. This project is part of a process lead by Environment Canada to select CMV to detect and track ecosystem change at EMAN sites. It is anticipated that the proposed CMV will undergo future discussion and development leading to the final selection of a suite of CMV for use at EMAN sites.

203 DETECTING CLIMATE CHANGE BY MONITORING: SEEING THE WOOD FOR THE TREES

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Detecting climate change itself should be relatively straightforward, and detecting its effects on regular, repeatable biological events (dates of bud burst, flowering and insect or bird migration) only a little less so. Detecting relatively subtle trends in the composition of plant or animal communities, however, may be much more difficult. After five years of field climate manipulations applied to two contrasted limestone grasslands, we have identified several obstacles to detecting the impacts of climate change on plant communities.
We applied field manipulations of local climate to limestone grasslands at Buxton, Derbyshire, UK and Wytham, Oxfordshire, UK. Wytham was under arable cultivation until relatively recently and is still in a dynamic, early-successional state; it is drier, warmer and more fertile than Buxton. Buxton is ancient, stable sheep pasture. Nearly half the species at Wytham are monocarps, while slow-growing sedges, which make a large contribution to the biomass at Buxton, are largely absent. Both sites are species-rich. We applied three climate treatments: (i) elevation of winter temperature by 3ºC, using soil heating cables, (ii) summer drought, using automatically-operated, semi-transparent polycarbonate rainshelters and (iii) additional (deionised) water to provide the equivalent of 20% more than the ten-year average summer precipitation. Heating was applied factorially with drought and supplemented rainfall. Plant performance was monitored by point quadrat analysis at regular intervals.
These manipulations are applied annually and are quite extreme. They represent climate scenarios that may not occur, if at all, for another 50-80 years. They are therefore a useful yardstick to answer the

question: how easy is it to recognise the effects of these known climate change simulations? The answer, for different reasons, turns out to be very similar at Buxton and Wytham.
At Buxton, five years of climate manipulations had very little effect on either biomass or species composition. Neither total biomass, nor biomass of perennial grasses or forbs, the two main components of the vegetation, were significantly altered by the climate treatments. Only the sedges responded: biomass was depressed by winter warming and substantially increased by watering in summer. In sharp contrast, substantial treatment effects were observed at Wytham; temperature and rainfall manipulations significantly affected total biomass, perennial grasses and perennial forbs. At Wytham, species composition changed dramatically, but most of this was a successional trend followed by all plots, regardless of treatment. At both sites, total biomass fell in response to natural droughts in 1995 and 1996, and this interannual effect was larger than any treatment effect.
Thus the effect of the sustained application of climate manipulations was difficult to detect at both sites; at Buxton because both species composition and biomass were highly resistant to the treatments, and at Wytham because successional changes in species composition were greater than treatment effects. At both sites, transient changes in biomass in response to natural extreme events were greater than any treatment effect.

204 OXIDATIVE STRESS AND LIGNIFICATION IN LEGUMINOUS SPECIES GROWN IN MINI-FACE RINGS UNDER ELEVATED CO2

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Reliable data about plant response to elevated CO2 are necessary to any climatic variation forecasting: in fact, through photosynthesis, plants can contribute to control atmospheric CO2 concentration. Information about plant long term response to elevated CO2 were scarce up to a few years ago, in consequence of the limited duration of most experiments; moreover, almost all the experiments were done in controlled environments, and the extrapolation of results to natural environments was difficult. Nowadays the need for long term experiments, done in environments as close as possible to the natural ones is widely recognised. From this point of view, the "FACE" ("free air CO2 enrichment") technology offers the possibility of CO2 fumigation in the open, without modifying the environmental parameters apart of CO2 concentration.
In the experiments presented here, some semi-natural leguminous species (Vicia hybrida, Vicia sativa and Trifolium repens), grown for three years in mini-FACE rings under 560 mmol mol-1 CO2, were analysed for their oxidative status and their level of lignification, compared to plants grown under normal CO2 levels. In particular, we evaluated (in stems and leaves): 1) total protein content, 2) lipid peroxidation (in terms of malondialdehyde production), 3) kinetics of guaiacol/syringaldazine peroxidase activities, 4) guaiacol peroxidase isoenzyme patterns, 4) total lignification (by a Zeiss axioskop equipped with a Leica Qwin image analysis system).
The results indicated in all cases a marked decrease of lipid peroxidation in leaves and stems of plants grown under elevated CO2, compared to control plants. Guaiacol/syringaldazine peroxidase activities of Vicia hybrida leaves and stems significantly decreased under elevated CO2, whereas an opposite trend was noticed in Vicia sativa and Trifolium repens. Interestingly, such variations of peroxidase activities seem to be more evident in the early phases of the vegetative growth of the plants, confirming the trend also noticed in a previous experiment (Sanità di Toppi and Raschi, 1999). Peroxidase isoenzyme pattern did not significantly change in response to elevated CO2 in any of the three species investigated. Microscopical analysis indicated slower lignification of xylem vessels in the early growth stages, particularly in Trifolium repens stems.
In general, from the results obtained so far, it might be inferred that the effects of elevated CO2 levels on lignification and on antioxidative enzymes 1) are species-specific, 2) may be of a some account only in the early phases of vegetative growth, and 3) are rapidly compensated by a prompt process of "down-regulation" with the sequel of the growth season.
Reference: Sanità di Toppi L. and Raschi A. (1999). Oxidative stress in a semi-natural grassland community grown in mini-FACE rings under elevated CO2. International Workshop "SNACE, FACE and OTCs CO2 enrichment at the leaf/air interface and/or at the root/soil interface; results in growth and development of plants". Maribor, Slovenia, 14-17 October 1999, abstract book, p. 44.

205 STRENGTHENING HUMAN DIMENSIONS OF PROTECTED AREA MANAGEMENT PLANNING: LESSONS LEARNED FROM THE SUBIC BATAAN NATURAL PARK, PHILIPPINES

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The establishment of an integrated system of protected areas is the Philippine's flagship strategy in arresting the rapidly declining biodiversity. Potential and declared protected areas, however, are almost always inhabited and the source of various products and needs of both migrant and indigenous communities. The decline of these areas also result from many conflicting government policies and actions on nature conservation and protection, on the one hand, and economic policies on the other hand. This situation calls to attention many practical and ethical questions regarding the proper integration of ecological and human use values and the right interfacing of science and policy in decision-making concerning the planning and management of protected areas.
A case study of the planing and management of the Subic-Bataan Natural Park, a highly biodiverse rainforest adjacent to an equally ecologically-rich marine ecosystem ,situated in the provinces of Zambales and Bataan in the Philippines is presented. The Subic portion of the protected area is a former United States naval base which has been turned into a special economic and freeport zone as part of the bases conversion policy of the government. The rapid urbanization and land use changes that have since occurred as a result of the economic development and globalization policy of the government are creating pressures on the area's biodiversity and exposing a group of indigenous peoples to a different physical and cultural environment that threaten traditional controls and relationships with their natural environment. The same development pressures also threaten the Bataan side of the park., which is a home to an estimated 3,000 migrants and 300 indigenous inhabitants. The planning for the Subic portion utilized an ecosystem management approach which considers ecosystem sustainability as the ultimate goal of protection. This approach is based on an interdisciplinary, comprehensive, participatory and systematic determination of ecological and human use values of protected areas and the integration of these values into a holistic management plan, taking into account the need for economic development, cultural conservation, ecological protection and compliance with global, national and local policies and imperatives. The issues concerning human dimensions of protected areas planning and lessons learned from the case study sites are presented. Recommendations regarding science-policy integration and strengthening human dimensions of protected areas planning are forwarded.

Key words: Biodiversity, protected area planning and management, indigenous peoples, migrant communities, urbanization, land use changes, ecosystem management, ecosystem sustainability, science-policy integration, human dimensions

206 EFFECTS OF ELEVATED ATMOSPHERIC CARBON DIOXIDE ON SOIL MICROARTHROPOD POPULATIONS IN ALFALFA

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The ongoing change in atmospheric composition is likely to affect terrestrial ecosystems in many ways, including changes in net primary productivity, ecosystem structure and nutrient cycling rates. Some of these changes will be mediated by direct and indirect modifications of soil biota. The work aimed to elucidate the influence of elevated atmospheric CO2 on soil microarthropod communities in alfalfa grasslands, in relation to the changes in plant composition. Alfalfa was fumigated for two years in open top chambers; control included both a non fumigated chamber treatment and a non fumigated open air treatment. Soil samples were extracted at the end of both growing seasons; the microarthropods were extracted by a Berlese-Tullgren device, and counted and identified as wide taxonomic groups. Plant material was analysed to assess changes in composition.
Leaf mineral content was decreased in carbon dioxide fumigated plants; the reduction in microarthropod densities that was evidenced under elevated CO2 can be ascribed to these differences

in composition. In the non enriched open top chambers arthropod density and community diversity significantly increased with respect to samples taken under open air conditions. These results may be ascribed to the higher temperature inside the open top chambers.

207 ENVIRONMENTALISM: AN EMPIRICAL TEST OF ENVIRONMENTAL ATTITUDES IN MORE AND LESS DEVELOPED COUNTRIES

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Environmentalism has become a major discourse of social theory in the latter stages of the twentieth century. It has a unique position in social theory because it challenges dominant Western culture. Environmental attitudes, as a component and indicator of environmentalism, has been investigated in the United States and other Western countries. However, this investigation is rare in non-Western countries.

The recent development of global socio-economic system indicates globalization of environmental issues. Environmental problems such as ozone layer depletion and global warming not only affect Western developed countries; they affect non-Western undeveloped countries as well. Accordingly, environmental issues exist across countries. However, environmentalism dispersed with a different from and content around the World. Environmental attitudes were measured as components and indicators of environmentalism with three dimensions; the dimensions are worldview, concern, and commitment. The findings indicated that pro-environmental attitudes with three dimensions vary across countries. However, comprehension and content of environmental values are different for each country. Environmental attitudes are differently constructed for each country. The three dimensions of environmental attitudes are differently affected by individual demographic characteristics and societal characteristics. The findings supported two main theoretical perspectives. First, the findings supported the social constructionist perspective that environmental attitudes as indicator and component of environmentalism are socially constructed and each country has its own environmentalism structure. Second, the post-materialism thesis was also supported by the findings that the effects of individual demographic characteristics on the each dimensions of environmental attitudes are different. Individuals who have lower education level, older, and non-urban residents have anthropocentric form of environmentalism as materialist value. However, individuals who have higher education level, younger, and urban residents have ecocentric form of environmentalism as post-materialist value. Findings also identified that anthropocentric form of environmentalism is higher among less developed countries, and ecocentric form of environmentalism is higher among developed countries.

The data on environmental attitudes are based upon an international environmental survey; International Social Survey Program of Inter-University Consortium for Political and Social Research, Michigan (ICPSR-6640). The data originally consist of 21 countries; however, this study included only 18 countries. The data on human development level are compiled from the United Nations Human Development Program, Human Development Report (1996). This study uses multi-level regression analysis or Hierarchical Linear Modeling (HLM).

208 CANADA'S ECOLOGICAL MONITORING AND ASSESSMENT NETWORK: SCIENCE-BASED AND POLICY-RELEVANT

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Note: this paper was also presented as an oral paper – see no. 55

209 CLIMATE FLUCTUATIONS OF THE ADRIATIC AND MEDITERRANEAN BOTTOM WATER MASSES

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The paper investigates the generation of bottom water of the Eastern Mediterranean and its relationship to the atmospheric fluxes, primarily evaporation - precipitation and heat fluxes. The most favorable place where the generation of very dense (cold) water is in progress is the North Adriatic, due to high surface heat losses, as it is broad and very shallow, and prone to the strong winter cold outbreaks

coupled by the Bora wind bringing cold and dry air masses from the land to the sea. Therefore, very dense water is generated, and it can be traced on its way to the bottom layers of the Eastern Mediterranean. CTD data collected in the Adriatic in this century (1911-14 and 1951-1990 intervals) were used to correlate in the climatological sense the percentage of dense water to the river discharges and surface buoyancy fluxes in the area where dense water is primarily forming (North Adriatic). The results outline the preconditioning phases for dense water generation, and the time necessary that a subsurface vein of dense water comes from its source to the Otranto Strait (outlet from the Adriatic sea to the Mediterranean). Moreover, an increase in salinity from the beginning of 20 century has been detected, as a result of decrease in fresh water inputs caused by natural variations as well as by human influences. An increase in salinity, and therefore in density, have an impact also to the sea level rise, as observed increase in sea level is lower in the Mediterranean Sea than in the adjacent Atlantic Ocean.

210 MODELLING OF SOLUBLE CONTAMINATION DYNAMICS IN RIVER BASINS.

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A methodology of soluble contamination transportation by water having been worked out for river basins is introduced. Except receiving a continuous hydrograph of runoff and water - balance characteristics of a basin it allows to calculate contamination drift by river runoff for any time interval (days, months, years, decades) and to determine the amount of the contamination that is within river basin for any date.

The worked out methodology is based on the distributed model of runoff formation and includes the additional blocks:

- One of soluble contamination dynamics on soil (snow) surface,
- One of soluble contamination dynamics in being calculated soil layers.

Contamination transportation by surface (slope and channel), soil and ground waters is also taken into account. The changes have been made in the corresponding model blocks for that reason.

There is a close correlation of contaminant migration with the runoff formation process intensity, therefore contamination dynamics and its drift beyond the bounds of the territory have been considered with the account of all the factors.

The essential and algorithmic content of this universal system differs from other not so many famous models with distributed input and parameters. Above all, the main differences concern such important items as surface and underground runoff formation, soil water dynamics, phase transitions in soil, prechannel and channel runoff transformation.

The model is oriented on usage of simple meteorological information (air temperature and moisture deficiency, height and duration of liquid precipitation), but also it applies approaching increasing effectiveness of the information.

As the output of the model except runoff hydrographs at the points of concentration and soil humidity and temperature dynamics in the estimated points the following information on contamination is received:

1. Contamination runoff depth in the point of concentration or the group of points of concentration if the territory is within several river basins;
2. Contamination depth as a state variable in the representative points of the basin's territory at any time moments we are interested in with the day discreteness.

Mass conservation law both for water and for the contaminant in the given river basin is continuously observed in the model. In this working out the amount of the contaminant is determined by its depth in snow cover, soil surface, calculated soil layers (CSL) all over soil strata or in underground water volumes. Such form of expression is convenient during various calculations, generally balance ones.

Calculations of the soluble contaminant distribution within the basins of rivers Velt, Seduiha, Neruta, Sengyaha (Pechora river basin) have been made with the help of the model. Contamination of these basins occurs as a result of spilling of the fuel couple: non-symmetric dimethylhydrozine (NDMH) and nitric tetraccid (NT) over the territory.

As a result of modelling it was received that at the end of the first year already the contaminant has distributed within the upper eight calculated soil layers (CSL). Two lower CSL because of constant freezing turned out to be free of the contaminant, though the seventh one had its signs. Almost all contaminant is contained in CSL in the adsorbed state.

Contaminant's washing out has been carried only by seasonal soil runoff and got into the channell system at once, from which it probably quickly was drifted into Pechora and into the sea. Long stagnation (for years) of the contaminant in the bogs and lakes of Small Land tundra is possible.
Direct getting of the contaminant from the soil column into the ground waters according to the data of modelling didn't take place.
There is also the information on the annual contaminant's runoff depth from the surface of the territory. Relative concentration decreases bit by bit (in 8.5 times from the beginning of calculation till the 20-th year without the account of the additional input of the contaminant).
The modelling data have been compared with the observations at the separate spots of contamination in these regions and the conclusion has been drawn about the adequate description of the soluble contaminant drifting process from the mentioned territories.
Theoretically the problem should be posed wider: the unity of the processes of runoff formation, erosion and two kinds of contamination different by the form of water and contaminant interrelations should be postulated. This difference is evident and it is dictated by the degree of the contaminant's solubility in water.

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211 THE APPLICATION OF MULTIVARIATE TECHNIQUES IN ASSESSING THE EFFECTS OF CLIMATE CHANGE ON BIODIVERSITY AT DIFFERENT SPATIAL SCALES.

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The Centre for Ecology and Hydrology, in collaboration with Oxford University, has developed a European environmental classification for the assessment and monitoring of effects of climate change on biodiversity at different spatial scales. The classification was constructed using various multivariate techniques from the database for 5500 half by half degree cells for the wider European window, developed by the University of East Anglia (UEA) for the TIGER programme.
A statistical rule set created from the classification allows any cell size down to 1 x 1 km to be allocated to one of the 64 classes from its climate and altitude characteristics. Currently, this procedure has been used at its original resolution of half by half degree cell size across Europe and at a 10 x 10 km cell size across Great Britain.
A number of climate change scenarios from different climate models provided by UEA have been assessed using the allocation procedure. By using the outputs from these climate models , the predicated movement of climate classes can be determined throughout Europe and at higher resolution for Great Britain.
At the European scale, the greatest predicted changes in environmental diversity occur in Iberia and around the Mediterranean fringe. These areas show substantial decreases in the diversity of the region indicated by a fall in the number of classes present mainly due to the extension of two arid classes. The other major changes are in Northeast Europe where large uniform classes were sensitive to the scenarios but the implications are more difficult to determine.
Using the half x half degree resolution, major changes can be seen in Great Britain with areas north and west of the Severn / Wash line becoming more oceanic where as those to the south and east becoming more continental.
When the same scenarios are imposed in Great Britain using the 10 x 10 km resolution a new climate class was identified as being present whose distribution is centred in eastern Denmark. This is because the half by half degree cells smooth local variation. Two hyper-oceanic classes also extended to the east with implications biodiversity.

The different scenarios show climate classes with continental affinities moving into Britain agreeing with other results from the TIGER programme. This ability to draw on classes from outside the immediate domain is an important feature of this classification when carrying out assessment at a local scale.
Within Great Britain particular areas are seen to be sensitive to the predicted change when using the higher resolution e.g. the Cairngorm plateau is affected by the extension of oceanic classes. Such changes have important implications for vegetation, habitats and biodiversity. Isolated populations of plants at the edge of their distribution are likely to be affected by such changes because there are no refuges to retreat to.
Further implications of the scenarios will be considered in conjunction with the recent empirical evidence of climate change. Further applications of the classification will also be discussed.

212 REPORTING ON THE STATUS OF NATURE IN FLANDERS, BELGIUM

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Reporting on the status and change of nature in Flanders is a main task of the Institute of Nature Conservation. From this year on a new team has been formed to co-ordinate this task. Biennal publication of a 'Nature Report' has been scheduled. It will consist of four main themes:
1. The status and change of nature in Flanders on the species, biotope and landscape level.
2. The processes that drive the change: fragmentation, pollution, introduced species, nature management etc.
3. The public perception and support for nature conservation
4. Analysis of nature conservation policy: designation of natural areas, links with international policies, links with environmental policy etc.
The Institute of Nature Conservation acts as a data co-ordination center gathering data that have been collected by both professionals (government, institutes, universities) and volunteers on different topics and scale levels. The Nature Report team will both aim to increase the data-quality through support and information for data-suppliers and stimulate cross usage of data. To facilitate the latter, the team will set-up reference monitoring sites across Flanders where simultaneous monitoring (atmosphere, soil, (ground)water, vegetation, fauna) will allow construction and calibration of models combining different aspects.
The main aim of the report is to provide the Flemish government with feedback information on the planning, instruments, execution and effects of its nature conservation policy. At the same time we will aim to co-ordinate the activities with similar initiatives in Flanders (forest monitoring of the Institute of Forest and Wildlife management) and in Europe.

213 PARTICIPATORY MONITORING AND ENVIRONMENTAL PLANNING IN URBAN AREAS.

Wilkinson, M.M.

Note: this paper was also presented as an oral paper – see no. 61

214 MONITORING THE IMPACTS OF CLIMATE CHANGE ON HEALTH

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Climate change poses direct and indirect threats to human health. In Europe, the principal concerns are in relation to the direct effects of exposure to heat and cold, extreme weather events (storms and floods), the frequency of food and water-borne illness and spread of vector-borne disease.

We have examined evidence on the pattern of these diseases and the methods of monitoring climate-driven changes in them as part of the NoLIMITS (Network of Long Term Integrated Monitoring Sites)

project, a preparatory action of the European Union ENRICH (European Network for Research in Global Change) programme.

Climate change may be reflected in measurable changes in the frequency of climate-sensitive diseases over time, in their seasonal pattern (e.g. longer transmission seasons for certain diseases), or in their geographic distribution (e.g. shifts of vector-borne disease towards the poles or to higher altitudes).

The proportion of deaths due to the direct effects of heat and cold may be determined from daily time-series analyses. Such analyses provide a basis for calculating annual attributable burdens of disease, and hence for monitoring change heat and cold-related deaths over the long term. However, climate change is a gradual process detectable only by monitoring meteorological conditions over decades. The impact of climate change on health will therefore be similarly slow to evolve. But over the long term, changes occur in non-climatic risk factors, and perhaps also in disease detection/recording. These factors may modify the trend in climate-related health impact, or tend to obscure it. In relation to heat-related mortality, for example, the annual attributable burden of deaths may be modified by such factors as change in underlying health status of the population (especially the prevalence of cardiovascular and respiratory disease which are probable determinants of susceptibility), housing quality (e.g. use of air conditioning), social conditions and human behaviour.

In the case of vector-borne disease, it is the geographical distribution that is of primary interest. Again this requires consideration of non-climatic determinants. For example, malaria, once widespread in Europe, has disappeared from all but a few areas over the last century despite little alteration in climate: the effects of changes in land use, improved health care and other factors have predominated. It is likely that similar non-climate factors will be the major determinants of vector-borne disease in the future.

Despite a number of methodological challenges, comparisons of climate-disease associations and vector distributions in different geographical locations can provide evidence from which to assess trends in climate-related health impacts and evaluate the effect of modifying factors. It is evidence of this kind that may be most useful in assessing the future health risks of climate change and how they may be mitigated.

215 COLUMBIA EARTHSCAPE: PREPARING FOR TOMORROW'S ENVIRONMENT THROUGH EARTH LITERACY.

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In the past decade, students, teachers, and the public worldwide have been using the Internet as a resource for learning and reference in increasing numbers. Since 1998, Columbia University Press, the university's computing center, and faculty have collaborated to find ways to use new developments in digital technology to disseminate effectively cutting-edge curricular materials, research, and analysis in Earth/environmental sciences by embarking on a highly original project that has the potential to transform the way students learn about the Earth and interact with it on every possible level. The result of this work, called Columbia Earthscape, will provide a model for others to follow in the years to come. Discussions with scholars at Columbia University and nationally have revealed that internet-accessible, online publishing has the potential to solve a fairly specific problem in scholarly communication and education: timely access to cutting edge, interdisciplinary, carefully selected, and easily searchable research and teaching tools in the rapidly-emerging interdisciplinary field of Earth sciences. Scholars and teachers have reacted with enthusiasm to the prospect of having access to a moderated, interdisciplinary scholarly online publication that would provide access to a wide variety of material being produced in this field. As a result of this enthusiasm, a critical mass of high- quality Earth sciences scholarship and teaching material has been identified as available for electronic distribution with support from its producers. Based on the design and development work done at Columbia with scholarly online publishing, the goal of this project is to create a fully-integrated, highly selective, interactive online resource for educational materials in this field, and to evaluate the ongoing value and economic viability of providing these services on a sliding-scale, subscription-based, cost-recovery model to academic libraries, public institutions/facilities related to the environment, and individuals. The project seeks to address the inability of libraries in many countries to obtain research or teaching materials on the environment because of cost and promote a baseline "Earth literacy"

among students and the public at large as necessary for an informed citizenry facing a changing environment.

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216 DECONSTRUCTING A LONG-TERM STREAMWATER NITRATE RECORDS FROM A PAIRED CATCHMENT STUDY

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This study uses time series analysis to examine long term streamwater nitrate concentration record from a pair of catchments at the Coweeta Hydrologic Laboratory, North Caroline, USA. Monthly spot concentrations were available from 1970 through 1997 for two forested catchments, one of which was clear-felled in 1977 and the other maintained as a control. The time series were decomposed into their trend and annual cycle before modelling as an autoregressive (AR) process. AR models were calculated for both an expanding and a moving window so that pre-felling could be directly compared with the effects of tree clearance. In comparison with flow records for both of the catchments transfer function-noise models were calculated on a moving window basis and the impulse functions derived.

Analysis shows that:

both catchments show an annual memory effect, but that the clear-felled catchment shows, in addition, a six month memory effect;

the annual effect in the control catchment responds to drought conditions while in the felled catchment it reflects the change in vegetation;

the sixth month effect in the felled catchment responds to drought conditions independent of the annual effect and of logging operations;

the control catchment shows no significant impulse function with respect to flow while for the felled catchment a distinct impulse develops overtime subsequent to logging, but also responds to drought conditions.

Time series analysis represent a useful technique to understand the integrated response of catchments to both natural and anthropogenic changes.

217 LONG TERM RECORD OF DISSOLVED ORGANIC CARBON FROM AN UPLAND RIVER IN THE UK.

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The River Tees drains an extensive region of the upland peat of the Pennine Hills, Northern England, and as a consequence the river contains high loads of dissolved organic carbon. Daily monitoring of dissolved organic carbon (water colour - degrees Hazon) has been conducted at the Broken Scar water treatment works on the River Tees from 1970 to the present day. The time series were decomposed into their trend and annual cycle before modelling as an autoregressive (AR) process. AR models were calculated for both an expanding and a moving window. In comparison with river flow records maintained for the same site a transfer function-noise model was calculated on a moving window basis and the impulse functions derived.

Analysis shows:

an increasing trend in colour levels in the river, that does not correspond to any changes in river discharge;

a bimodal distribution for daily colour levels consistent with the event-based occurrence of dissolved carbon in the river; and

a significant impulse function that varies according to drought conditions.

The increasing trend in water colour is consistent with increasing temperatures in the region over the period of the series. This is interpreted as drier summers leading to increased draw-down of upland water tables giving rise to increased oxidation of the upland peat and development of larger pools of mobile organic carbon.

218 EFFECTED ON CLIMATE VARIATIONS ON THE QINGHAI-TIBET PLATEAU TO ECOSYSTEM

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After analysis for climate variations from 1961 on the QinghaiTibet Plateau, the results shows that the rainfall of average year and autumn this region, which yearly changes was smaller, were not obviously changed .The rainfall of autumn (in December to February) and spring (in March to May) were yearly increased, that tendency ratio for climates were 2.6mm/10a and 3.6mm/10a respectively, but summer was decreased with tendency ratio for 6.5mm/10a. The rise rate of air temperature at turned green was yearly decreased, the decline rate of that at withered and yellow was yearly increased. As a result of these climates changes, the kobresia height, which is main dominant species on the QinghaiTibet Plateau, decreased to 35cm from 68cm in the late eighties. The development percentage of florescence and seed maturity of herbage decreased all 2550%, that degree value were less than 50%.The greenness and dry yield of grassland were declined about 7080%.
Key words: Climate variation, Geographical distribution, Alpine meadow, Ecology

219 CLIMATIC ADAPTABILITY FOR PLANTING BRASSICA RAPA ON ALPINE MEADOW IN SOUTHERN QINGHAI

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To plant Brassica rapa on meadow in southern Qinghai was conducted. The results were showed at the optimal date for planting Brassica rapa, the decline of temperature in autumn and the high and low daily temperature were the major factors affected it to grow and acquired high yield. The specie of Brassica rapa should be planted in better climatic and flat area below 4500m above sea level. This will be important for developing manual succulence and instructing stock raising products.

Key words: planting Brassica rapa, climatic adaptability, Alpine meadow.

220 ANALYZING THE EVOLVEMENT OF PLANT COMPOSITION AND RELATION WITH ITS METEOROLOGICAL FACTORS ON THE QINGHAI-TIBET PLATEAU

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Analyzing the nature pasture on the Qinghai-Tibet Plateau, the anomaly coefficient of Poa crymophila community in nature pasture was little, keeping 50-100%; and that of Leymus tianschanica community

was more less; the largest one was Stipa purpurea community, keeping 75-200%. The species of Stipa purpurea, Artemisia scoparia and Poa crymophila displayed a feature of weak resistance to dry and the sensitive to dry. The species of Carex moorcroftii and Leymus tianschanica had strong adapt-ability for climate showing strong resistance to dry. The specie Carex moorcroftii had strong adapt-ability for climate and resistance to dry, but the water was the main factor of climate controlling its growth. Its monthly changes of density always decreased by month.

Key Words: plant composition; evolving-change; meteorological factors; Qinghai-Tibet Plateau