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Working Group on Effects

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Item 4 of the provisional agenda
Recent results and updating of scientific and technical knowledge

2010 Joint report of the International Cooperative Programmes, the Task Force on the Health Aspects of Air Pollution and the Joint Expert Group on Dynamic Modelling

Report by the Extended Bureau of the Working Group on Effects

1. At its twenty-seventh session in December 2009, the Executive Body of the Convention on Long-range Transboundary Air Pollution (Air Convention) decided that the Working Group on Effects would prepare an annual review of the activities and results of the International Cooperative Programmes (ICPs), the Task Force on the Health Aspects of Air Pollution[1] and the Joint Expert Group on Dynamic Modelling. The work was done by the Extended Bureau of the Working Group (comprising the Bureau of the Working Group; the Chairs of the Task Forces, the Task Force on Health and the Joint Expert Group on Dynamic Modelling; representatives of the programme centres of the ICPs; and invited experts) in cooperation with the secretariat. The review is based on the information provided by the lead countries and the programme centres, and is submitted in accordance with the Convention's 2010 workplan (ECE/EB.AIR/99/Add.2, item 3.1 (b)).

2. At its meeting in Geneva on 24 and 25 February 2010, the Extended Bureau agreed that the 2010 joint report would highlight selected key results of the 2010 workplan and general activities of the programmes and their recent relevant literature in annexes to the report.

[1] The joint Task Force on Health Aspects of Air Pollution of the World Health Organization (WHO)/European Centre for Environment and Health (ECEH) and the Executive Body of the Convention on Long-range Transboundary Air Pollution.

I. Selected key results

A. Terrestrial acidification and eutrophication

3. The database of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was the basis for the calculation of 10 years deposition time trends for the mean of 150 forest monitoring plots. The decrease in sulphate inputs was confirmed and 50 per cent of the plots showed decreasing inputs, but no trends could be detected on the rest of the plots. Annual mean throughfall deposition currently amounted to 7 kg sulphur per hectare. Soil acidification remained a possible threat to forest vegetation in parts of Europe. Critical limits for the base cation to aluminium ratio (BC/Al) were substantially exceeded at 25 per cent of 160 plots. There were hardly any visible trends for nitrogen (N) throughfall and nitrate deposition in open fields, whereas a decrease from around 5 to 4 kg ammonium per hectare was observed in open field measurements. For the first time, clearly significant relations were shown between N deposition and the composition of ground vegetation based on the transnational data set. Enhanced N deposition had lead to significant changes in species composition towards more N-tolerant species.

4. The Programme Coordinating Centre of the International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes (ICP Waters) prepared a review report on effects of nutrient N on organisms in nutrient-poor freshwater ecosystems. It showed considerable evidence indicating that N enrichment through N deposition affected primary production in nutrient-poor boreal and arctic lakes. The finding challenged the reigning paradigm of freshwater primary productivity being limited by phosphorus (P), suggesting that additional N did not affect the growth of algae and other organisms.

5. The International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring) explored the relationships between exceedance of site-specific critical loads for acidification and eutrophication for terrestrial and aquatic ecosystems and measured chemical indicators. The magnitude of trends — i.e., slopes for observed run-off water fluxes and chemical concentrations for the period 1993-2006, and annual average run-off water fluxes and concentrations for the period 2002–2006 — were used as empirical impact indicators. Clear relationships between several of those impact indicators and critical load exceedance were observed for 2007, e.g., between measured acid neutralizing capacity (ANC) concentrations and the exceedance of the critical loads of acidity and between nitrate concentrations and the exceedance of the critical loads for nutrient N. That increased confidence in the regional scale critical loads mapping approach.

6. N effects were widespread over Europe. The International Cooperative Programme on Modelling and Mapping of Critical Loads and Levels and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping) had calculated with emission and deposition data as of May 2010 that 52 per cent of the area of the modelling domain of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) had been under threat of eutrophication in 2000. That area would remain at 38 per cent in 2020 and 2030. Most of the impacts appeared to be in Western Europe: 74 per cent of the European Union's 27 Member States (EU27) had been under threat in 2000, and 61 per cent of their territory was calculated to be under threat in 2020 and 2030.

7. Preliminary assessments by the Coordination Centre for Effects (CCE) on biodiversity indicators showed that 12 per cent of terrestrial ecosystems in the EMEP

modelling domain had been subject to a significant (>5 per cent) change of plant species diversity in 2000. That corresponded to 30 per cent of terrestrial ecosystems in EU27. The share of terrestrial ecosystems affected by significant changes of plant species diversity was projected to be 5 per cent in EMEP and 12 per cent in EU27 in 2020. Recent research using dynamic models of vegetation change also indicated that biodiversity changes had been mainly driven by N deposition during the past decade. Those changes were likely to be driven by climate change in the future. Modifications of land use were also a major factor. Models simulating impacts of N deposition on vegetation diversity under climate and land use change had indicated that it would not be possible to restore ecosystems to the state they had been in prior to the increase of atmospheric pollutants deposition in the twentieth century. However, models could indicate maximum pollutant depositions that would ensure ecosystems were able to recover to their sustainable structure and functions.

B. Ozone impacts on vegetation

8. Ten new and/or revised flux-based critical levels of ozone for vegetation were developed under the auspices of the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation). The accumulated ozone flux via the stomatal pores on the leaf surface was considered to provide a more biologically sound method for describing observed effects than the accumulated ozone concentration in air. The accumulated ozone flux was redefined as the phytotoxic ozone dose above a threshold of Y, POD_Y (previously described as the accumulated stomatal flux of ozone above a threshold Y, $AF_{st}Y$). From those flux-based critical levels, policy-relevant indicators for ozone effects on vegetation were proposed for agricultural crops, forest trees, grasslands and pastures, and grassland areas of high conservation value (for details see ECE/EB.AIR/WG1.1/2010/13).

9. Preliminary mapping of the POD_1 for forest trees for 2006 confirmed previous results obtained using the generic flux model for crops. Air pollution abatement strategies based on protecting only human health would not protect vegetation from adverse effects of ozone in the northern third of Europe.

C. Soiling of materials

10. The International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (ICP Materials) estimated the coarse particulate matter (PM_{10}) target for soiling of materials to be 20 µg m^{-3} for 2020 and 10 µg m^{-3} for 2050 (see ECE/EB.AIR/WG.1/2009/16). The target values for 2020 were exceeded in 3 sites for carbon steel, 5 sites for zinc and 11 sites for limestone in 2008–2009, out of a total of 24 sites tested.

D. Mercury in freshwater

11. ICP Waters had prepared a review report on mercury (Hg) in water, lake sediments and fish. It showed that Hg concentrations in fish were increasing in northern boreal lakes. Levels in fish in Europe and North America were frequently above thresholds advised for human consumption. The high and increasing Hg concentrations in fish were in contrast to the low concentrations in water and in lake sediment data, indicating reduced Hg deposition since the 1990s.

E. Human health and policy

12. The Declaration of the Fifth Ministerial Conference on Environment and Health, held from 10 to 12 March 2010 in Parma, Italy, confirmed that the prevention of disease through improved outdoor and indoor air quality was one of the regional action priorities. The ministers declared they would take advantage of the approach and provisions of the Air Convention's protocols and would support their revision, where necessary. They remained committed to continuing and enhancing their efforts to decrease the incidence of acute and chronic respiratory diseases through reduction of exposure to ultrafine particles and other particulate matter, especially from industry, transport and domestic combustion, as well as ground-level ozone, in line with the *WHO Air Quality Guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide: Global Update 2005* (WHO/SDE/PHE/OEH/06.02).

Annex I

International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests

1. The twenty-sixth ICP Forests Task Force meeting was held from 30 May to 2 June 2010 in Garmisch-Partenkirchen, Germany. It was attended by 91 experts and national representatives from 29 countries. It addressed the following main topics: review and celebration of 25 years of forest condition monitoring; reports and results of ICP Forests; revision of the ICP Forests monitoring manual; and cooperation with the European Union's (EU) LIFE+ FutMon project and future financing.

2. The Task Force discussed the technical report and adopted the executive report on forest conditions in Europe. The expert panels presented updates of the different parts of the monitoring manual, which had been revised by the experts under the coordination of the Programme Coordinating Centre and the Programme's quality assurance committee. After final discussion, the updates were adopted by the Task Force for application from 2011 onwards. The Task Force also agreed on submission formats for monitoring data of the year 2011.

3. The expert panels and working groups of ICP Forests convened from 15 to 19 February 2010 in Tampere, Finland. The meeting took place in connection with the expert meetings of the FutMon project. The workshop prepared the ground for the technical revision of the monitoring manuals, including the standardized implementation of quality requirements.

4. The Programme Coordinating Group convened on 1 and 2 July 2009 in Hamburg, Germany. It was attended by 25 experts from 10 countries. Main items of the meeting were the future evaluation plan foreseen by the strategy of ICP Forests and a project proposal for submission to the European Commission under LIFE+. The evaluation plan was based on integrated evaluations in the fields of forest adaptability and vulnerability, forest nutrition and critical loads, climate change and biodiversity, and had been finally adopted by the Task Force in 2010.

5. Monitoring of 6,700 level I plots and 500 level II (intensive monitoring) plots continued. Results had been published in the 2010 technical report and in the 2010 executive report. The analyses on the monitoring data included: (a) mean deposition of ammonium, nitrate and sulphate on level II plots, as well as the temporal development of deposition for the period 1998–2007; (b) pH and BC/Al in soil solution on level II plots; (c) species composition of ground vegetation in relation to N deposition and other environmental influences; and (d) temporal and spatial trends of large scale forest condition (defoliation) on 6,700 level I plots.

6. The Programme Coordinating Centre continued its cooperation with the FutMon project management team at the Johann Heinrich von Thünen Institute in Germany on the establishment of a database system for online data submission and semi-automated validation checks. The database included level I and II data. Online data submission and semi-automated validation had become operational.

7. The national focal centre (NFC) of the United States and the Programme Coordinating Centre visited the United States Department of Agriculture in Washington, D.C., on 3 and 4 December 2009, including meetings with the Deputy Chief of Research and Development and with the Director of the International Program of the United States Forest Service. The visit also comprised a seminar on critical loads assessment with

delegates of the Environmental Protection Agency, the Forest Inventory and Analysis Programme, the National Park Service and others.

8. A number of coordination activities were routinely carried out by the programme centre including participation in expert panel meetings; representation of the programme at policy meetings and scientific conferences; maintenance of the programme's website (www.icp-forests.org); and data provision to third parties upon request with involved national experts.

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Annex II

International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes

1. The twenty-fifth ICP Waters Task Force meeting was held from 19 to 20 October 2009 in Burlington, Canada. It was attended by 36 experts from 16 Parties to the Air Convention. At present, 25 countries were participating in one or more of the activities of ICP Waters.

2. The Task Force considered progress reports from the programme centre and the national focal centres on results on trends in water chemistry, biological response, heavy metals and dynamic modelling. The presentations were published in ICP Waters report 100/10

3. The report on Hg in the aquatic environment was presented in its final form. The major conclusions from the report were that concentrations of Hg in fish were increasing while atmospheric deposition seemed to have decreased. Data on Hg in freshwater, lake sediments and fish were presented. Sediment data were quite extensive and indicated reduced Hg deposition since the 1990s. Levels in fish in Europe and North America were frequently above thresholds advised for human consumption. Recommendations on monitoring design for Hg related to long-range atmospheric deposition were also made.

4. The draft report on effects of nutrient N on organisms in nutrient-poor freshwater ecosystems was presented and discussed. There was considerable evidence that indicated that N enrichment through N deposition affected primary production in oligotrophic freshwater systems, especially at low N deposition. The report would focus on phytoplankton, benthic algae, macrophytes and invertebrates.

5. The Task Force continued the discussion on the process for an update of the Programme Manual. It would be finished by the next Task Force meeting.

6. Results from the twenty-third chemical intercomparison were reported. Altogether 68 laboratories from 27 countries had participated.

7. Results from the thirteenth biological intercalibration of invertebrates were reported. Six laboratories from five countries had participated. Ten laboratories participated on a regular basis in the intercalibration. The goal was to evaluate the quality and harmonize the taxonomic work.

8. Representatives of the ICP Waters programme centre actively participated in the meetings of the Programme Task Forces on ICP Integrated Monitoring, ICP Modelling and Mapping, the Joint Expert Group on Dynamic Modelling and the Task Force on Reactive Nitrogen.

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Annex III

International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments

1. The twenty-sixth meeting of the ICP Materials Task Force was held from 14 to 16 April 2010 in Watford, United Kingdom. The meeting was hosted by the Building Research Establishment (BRE), Watford. The meeting was attended by representatives from 12 Parties to the Air Convention.

2. The meeting was held in connection with an international workshop on corrosion exposures. The meeting was also attended by representatives from five countries of the Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects, as well as three Asian countries, three countries of the Air Pollution Information Network for Africa (APINA) and Argentina. In addition representatives from the United Nations Environment Programme (UNEP), the Global Atmospheric Pollution Forum (GAPF) and the Air Convention participated in the meeting.

3. Preliminary environmental data for the period October 2008 to November 2009, corresponding to the 2008–2009 material sample exposure, had been compiled and would be reported in 2011.

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Annex IV

International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops

1. The twenty-third meeting of the ICP Vegetation Task Force was held from 1 to 3 February 2010 in Tervuren, Belgium. It was attended by 53 experts from 18 Parties to the Air Convention. Also present were a representative from EMEP/Meteorological Synthesizing Centre–East (MSC-E) and four observers from Cuba and Japan (for details see: http://icpvegetation.ceh.ac.uk).

2. The main decisions at the twenty-third meeting of the Task Force were: (a) the adoption of 10 new and/or flux-based critical levels of ozone for vegetation (ECE/EB.AIR/WG.1/2010/13); (b) to produce state-of-knowledge reports on the impacts of ozone on food security, and the impacts of ozone on carbon sequestration and linkages with climate change; (c) to review the use of mosses as biomonitors of atmospheric deposition of persistent organic pollutants (POPs); and (c) to conduct a pilot study on mosses as biomonitors of POPs in the 2010–2011 European moss survey.

3. The ICP Waters Programme Coordination Centre organized a workshop on flux-based assessment of ozone effects for air pollution policy, which was held from 9 to 12 November 2009 at the Joint Research Centre (JRC) of the European Commission in Ispra, Italy (ECE/EB.AIR/WG.1/2010/13). It was attended by 42 experts from 12 Parties to the Air Convention. Also present were representatives of ICP Forests, the Task Force on Integrated Assessment Modelling, the Centre for Integrated Assessment Modelling (CIAM), EMEP/Meteorological Synthesizing Centre-West (MSC-W), JRC and the Convention secretariat.

4. The Programme Coordination Centre attended the workshop on air pollution and climate change, held from 19 to 21 October 2009 in Gothenburg, Sweden. The workshop agreed on the following conclusions and recommendations of relevance to ICP Vegetation: (a) there were clear co-benefits for reducing surface ozone concentrations for both air pollution and climate change policies (note: ozone is currently the third most important greenhouse gas); (b) the stomatal ozone flux method allowed climate change factors to be incorporated in future ozone risk assessments; (c) ozone and climate change impacts on vegetation were complex due to non-linearity of interactions and up-scaling from leaf to canopy to regional and global scale; (d) impacts of ozone on vegetation and feedbacks to climate needed to be incorporated in global climate models in order to better predict consequences for carbon sequestration and hydrological cycles in the future; and (e) more large-scale, long-term, multi-issues (i.e., air pollution and climate change interactions) field studies were required for parameterization and validation of model components.

5. The Programme Coordination Centre continued its fruitful collaborations with the bodies and centres under the EMEP Steering Body, i.e.: (a) with EMEP/MSC-W, regarding mapping areas of vegetation at risk from ozone damage and comparison of the N concentrations in mosses with EMEP modelled atmospheric N deposition; (b) with EMEP/MSC-E, regarding the comparison of cadmium, lead and mercury concentrations in mosses with EMEP-modelled atmospheric deposition of those heavy metals; (c) with the Task Force on Integrated Assessment Modelling, regarding target setting for 2030 and developing aspirational targets for 2050, the development of policy relevant indicators for impacts of ozone on vegetation and ex post analysis as part of the process for the revision of the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol); and (d) with the Task Force on the Hemispheric Transport of Air Pollution, regarding contributions to the 2010 assessment report. Collaborations were also continued with the Task Force on Reactive Nitrogen.

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Annex V

International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems

1. The eighteenth meeting of the ICP Integrated Monitoring Task Force was held on 6 May 2010 in Uppsala, Sweden, following a 5 May workshop on the assessment of programme data. Twenty-nine experts from thirteen Parties to the Air Convention attended the meeting. The Chair of ICP Waters, a representative of ICP Forests, and a Vice-Chair of the Bureau of the Working Group on Effects also attended (for further details see: www.environment.fi/syke/im).

2. The national focal points had reported their 2008 results to the Programme Centre in December 2009. The Programme Centre had subsequently carried out a standard check on the results and incorporated them into its database.

3. Assessment and scientific work on priority topics continued. Progress reports had been included in the programme's annual report 2010, including on:

(a) Calculation of site-specific critical loads for acidification and eutrophication;

(b) Assessment of the relationships between critical load exceedance and empirical effect indicators;

(c) Compilation of data on biodiversity;

(d) Calculation of pools and fluxes of heavy metals and relations to critical limits and risk assessment;

(e) Calculation of fluxes and trends of N and sulphur compounds, base cations and acidity.

4. Data from sites of ICP Integrated Monitoring were being used in ALTER-Net, a long-term biodiversity, ecosystem and awareness research network (www.alter-net.info).

5. The Integrated Monitoring Programme had been represented at the Programme Task Force meetings of ICP Modelling and Mapping, ICP Forests and ICP Waters. Representatives had also attended the meetings of the LTER-Europe network (Long-Term Ecological Research; see www.lter-europe.ceh.ac.uk) and the related EU infrastructure project LifeWatch (www.lifewatch.eu). Cooperation was ongoing with those programmes.

Literature

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Annex VI

International Cooperative Programme on Modelling and Mapping of Critical Loads and Levels and Air Pollution Effects, Risks and Trends

1. The twenty-fifth meeting of the ICP Modelling and Mapping Task Force was held on 22 and 23 April 2010 in Paris, following the twentieth CCE workshop, which was held from 19 to 21 April. Experts from six countries and representatives of other ICPs, MSC-W and organizations outside the Water Convention attended. The relatively low participation resulted from flight restrictions due to airborne volcanic ash. The network of active national focal centres (NFCs) was stable. There was good collaboration between European and North American NFCs.

2. Responses to the call for data launched in autumn 2009 had been received from 11 countries. It allowed NFCs to carry out test runs with the very simple dynamic model including organic carbon and N dynamics (VSD+), with feedback reports to CCE, and to enlarge the amount of information held in a European database on vegetation. A training session was organized to train NFCs on how to use an updated version of the VSD+ model during the CCE workshop. It had been calibrated for and ran on 56 sites across Europe. VSD+ might be linked with vegetation modules (i.e., VEG, NTM and BERN). However, the methodology to model N impacts on vegetation at a regional scale required further development.

3. The call for data was also an opportunity to gather information on vegetation and soil relevant parameters in a budding European vegetation database.

4. The Task Force proposed to the Working Group on Effects to consider a call for data to NFCs in the autumn 2010, with a deadline in spring 2011, to compile high resolution critical loads, revise empirical critical loads, and continue work on the VSD+ model and vegetation modelling.

5. The Task Force expected intensified cooperation with the experts working with the EU Habitat Directive. Use of a common methodology between the Convention bodies and those experts in calculating critical loads should be proposed by the end of 2011, before the next reporting for the Habitat Directive in 2013. Guidelines for those experts would be drafted based on experience in the United Kingdom. They would provide information on critical loads calculations for the EU Natura 2000 sites.

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Annex VII

Joint Task Force on the Health Aspects of Air Pollution

1. The thirteenth meeting of the Task Force on Health was held on 26 and 27 April 2010 in Bonn, Germany. Twenty-eight experts from 20 Parties to the Water Convention attended the meeting. An observer from the European Commission (Directorate-General for the Environment) and WHO staff also attended.

2. The following technical papers were prepared and distributed in advance to the meeting:

(a) Review of newly accumulated (since 2008) evidence on the health impacts of particulate matter and ozone;

(b) Quantifying the health benefits of revisions to the EU's National Emission Ceilings Directive and the Convention's 1999 Gothenburg Protocol;

(c) Mortality and long-term exposure to air pollution: risk estimates for use in Europe;

(d) Mortality and long-term exposure to air pollution: calculating impact estimates;

(e) Conclusions of the workshop of the Health Effects Institute on further research to assess the health impacts of actions taken to improve air quality, held on 17 and 18 December 2009 in Dedham, Massachusetts, United States;

(f) Evaluation of hazards from five new substances proposed for inclusion to the Convention's 1998 Protocol on Persistent Organic Pollutants.

3. Data on PM_{10} exposure were analysed. The analysis was published as part of the WHO Environment and Health Information System (ENHIS).

Literature

Exposure of children to air pollution (particulate matter) in outdoor air (ENHIS fact sheet 3.3. Update December 2009). WHO 2009.

Annex VIII

Joint Expert Group on Dynamic Modelling

1. The tenth meeting of the Joint Expert Group on Dynamic Modelling was held from 28 to 30 October 2009 in Sitges, Spain.

2. Twenty-two experts from the following Parties to the Air Convention attended the meeting: Austria, Canada, the Czech Republic, Finland, Germany, Ireland, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom of Great Britain and Northern Ireland. Representatives from ICP Waters, ICP Integrated Monitoring, CCE and EMEP/CIAM at the International Institute for Applied Systems Analysis (IIASA) also participated.

3. The meeting was co-chaired by the United Kingdom and Sweden. It was organized by the Centre for Ecology and Hydrology (United Kingdom) and by IVL Swedish Environmental Research Institute (Sweden).

4. The objectives of the Joint Expert Group meeting were to examine progress in dynamic modelling of acidification and nutrient N, including the interactions between climate change and air pollution, biological response and terrestrial carbon sequestration, and workplan items common to all effects-oriented bodies.

5. The Expert Group strongly supported continuation of monitoring programmes undertaken by ICPs and by national agencies. Monitoring data allowed identification of regional patterns and dependencies, which could then be used for extrapolations. Wide-scale regional surveys also opened the possibility to develop new techniques for up-scaling.

6. The Expert Group welcomed current developments in the United States to embrace the critical loads concept as a management tool, and looked forward to increased participation of the United States in its activities.

7. The Expert Group agreed that a further meeting would be appropriate in one year's time. It would in particular consider progress in dynamic modelling of N as a nutrient in terrestrial systems, interactions between air pollution and climate change, biological responses, terrestrial carbon sequestration and the contribution of dynamic modelling to the revision of the Gothenburg Protocol.