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Working Group on Effects

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RECENT RESULTS AND UPDATING OF SCIENTIFIC AND TECHNICAL KNOWLEDGE

2009 JOINT REPORT OF THE INTERNATIONAL COOPERATIVE PROGRAMMES, THE TASK FORCE ON HEALTH[1] AND THE JOINT EXPERT GROUP ON DYNAMIC MODELLING

Report by the Extended Bureau of the Working Group on Effects

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[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 Convention's Executive Body.

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I. INTRODUCTION

1. At its twenty-sixth session in December 2008, the Executive Body, decided that the Working Group on Effects would prepare an annual review of the activities and results of the International Cooperative Programmes (ICPs), the Joint Task Force on Health Aspects of Air Pollution (hereinafter, the Task Force on Health) 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 and the Joint Expert Group on Dynamic Modelling, the 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 2009 workplan (ECE/EB.AIR/96/Add.2, item 3.1 (b)).

2. At its meeting in Geneva on 18 and 19 February 2009, the Extended Bureau agreed that the 2009 joint report would summarize results of the 2009 workplan under pollutant-specific topics. It noted the need to report in detail workplan items common to all programmes (ECE/EB.AIR/96/Add.2, items 3.1 (d) (i–v)) under cross-cutting issues. However, it decided to prepare a separate report on nitrogen (N) effects on the environment and health (item (i)) and on the update of the strategy of the effects-oriented activities (item (iii)). Other items (ii, iv and v) are presented in a separate document (ECE/EB.AIR/WG.1/2009/16), as together they provide a concise summary on indicators for the revision of the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol).

3. This report reviews the main accomplishments of the effects-oriented activities under seven pollutant-specific topics that follow the 2009 workplan items of the Working Group and are given in chapters I–VII. The general activities of the programmes and their recent relevant literature are reported the annexes.

II. ACIDIFICATION

4. Acidification remains a problem in some parts of Europe, although its effects are decreasing in Western Europe. Studies on ecosystems recovery, when acidifying deposition was significantly reduced, confirm the positive impact of emission reductions. Chemical and biological recovery was occurring, but more emission reductions are still needed.

5. ICP Forests measured and analysed mean N throughfall deposition, sum of ammonium (NH_4) and nitrate (NO_3), on 220 plots in Europe for the period 2001–2006. There were no significant changes in N throughfall deposition on more than 90 per cent of the plots. Mean throughfall sulphate (SO_4) inputs decreased from 7.2 to 5.8 kg ha^{-1} a^{-1} on 214 plots for the period 2001–2006. Significantly decreasing sulphur (S) inputs were observed on 9 per cent of the plots, but increases at none.

6. Soil solution analysis on 56 level II plots of the International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) did not reveal significant changes in pH, SO_4 and N concentrations for the majority of the sites. Significant changes in soil solution pH were found on five plots in soil depths of 40–80 cm for the period 2001–2006. On four, soil solution pH had increased. In general, the results of soil solution chemistry analysis were consistent with observed decreasing SO_4 inputs. SO_4 concentrations changed significantly on two plots in soil depths of 20–40 cm (one increasing, one decreasing). SO_4 concentrations in soil depths of 40–80 cm decreased on nine plots and increased on one plot.

7. ICP Forests evaluated data from 382 level II plots for the period 1995–2000. There were no negative effects of S and acid deposition on forest growth. It was assumed that such negative effects were outweighed by the positive effect of N deposition because of co-linearity between these variables. Evaluations focused on basal area increment of *Pinus sylvestris, Picea abies, Fagus sylvatica,* and *Quercus robur* and *petraea.*

8. Long-term records of surface water chemistry of the International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes (ICP Waters) showed that surface waters were recovering due to a decrease in S emissions in Europe and North America. Biological recovery was slow and not widespread. N was still a threat. Several areas in Europe would never achieve good (non-acidified) water quality with current legislation. Future reductions of both S and N were necessary to achieve biological recovery not influenced by acidification. A return to pre-industrial biodiversity was unlikely in most cases, because original species were extinct, new species had been introduced and biological processes were complex.

9. Critical loads for acidification of aquatic ecosystems were calculated for 16 sites of the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring). At 14 sites, the critical loads were lower than all those in the Coordination Centre for Effects (CCE) database for a grid cell corresponding to the site. These grid cells of 50×50 km^2 were defined in the modelling domain of the Convention’s Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP). Modelled S deposition for the year 2010, assuming either current legislation (CLE) and maximum technically feasible emission reductions (MFR), was lower than the critical loads for acidification at four sites. Assuming the MFR scenario, there would be no exceedance at seven sites in 2020.

10. ICP Integrated Monitoring had carried out a statistical trend analysis for the period 1996–2006 on data for open field and throughfall deposition, run-off and soil water. Significant downward trends of SO_4 concentrations in both open-field and throughfall depositions had been detected at most sites. Decreases in S emissions and deposition were positively linked to trends of SO_4 concentrations in soil and run-off waters, acid-neutralizing capacity, and somewhat to pH.

11. 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 submitted 2008 data on critical loads for acidification to the GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model to support the work on revising the Gothenburg Protocol and other air policies in Europe. The database included indicators on dynamic modelling, including the assessment of aspirational targets for acidification.

12. The Joint Expert Group on Dynamic Modelling acknowledged that the 2008 database of CCE on European dynamic modelling parameters was currently the best available database for the support of the revision of the Gothenburg Protocol. The Group emphasized that dynamic modelling of acidification and eutrophication contributed significantly to the Protocol's revision. The development and application of target load functions had been successfully completed under ICP Modelling and Mapping. The Group encouraged their widest possible use in integrated assessment modelling, in collaboration with effects-oriented bodies.

III. NUTRIENT NITROGEN

13. N is an essential element for plant growth. Its cycle in biosphere has been modified by human activities, in particular by combustion processes and fertilizers. N has contributed to soil and water acidification, but its high environmental levels could modify distribution and relative proportions of species in ecosystems. Effects programmes were monitoring such effects.

14. ICP Forests evaluated the effects of S and N deposition on forest tree growth for 382 level II plots. The growth of *Quercus species* and *Pinus sylvestris* was positively related to mean annual temperature. For *Fagus sylvatica*, tree growth was significantly related to the difference between the long-term and yearly mean temperatures. The basal area increment of *Picea abies* showed no response to temperature. N deposition affected growth of all four species. The increase in growth by additional deposition of 1 kgN ha^{-1} varied between 1.2 and 1.5 per cent, depending on the tree species. The effect was smaller on soils already well supplied with N.

15. ICP Waters studied the link between N deposition and enhanced N leaching to surface waters, which could increase primary productivity. Co-limitation of phytoplankton by N and P was common. Enrichment of freshwaters with both nutrients usually resulted in higher production than enrichment with single nutrients. There were strong indications that growth of nuisance aquatic plants, such as the N-tolerant rushes *Juncus bulbosus*, was stimulated by atmospheric reactive N. Nuisance species changed the recreational use of the water (e.g. fishing, bathing) and affected ecosystem biodiversity.

16. Statistical analysis of ICP Integrated Monitoring data showed many fewer statistically significant trends for NO_3 than SO_4 in both open-field and throughfall deposition for the period 1996–2006. NO_3 concentrations and fluxes in run-off and soil water showed a mixed response, with both decreasing and increasing trends. Site-specific characteristics were considered important for determining ecosystem response to N input.

17. Critical loads for eutrophication of terrestrial ecosystems were calculated for 16 ICP Integrated Monitoring sites. At all 16 sites, the calculated critical loads were lower than all those in the CCE database for the EMEP grid cell corresponding to the site. Modelled N deposition for the years 2010 and 2020, assuming CLE and MFR, exceeded critical loads at all 16 sites. Empirical critical loads for eutrophication were compiled for the 16 sites and an additional 10 sites. They were higher than the calculated critical loads. Deposition according to CLE scenario for 2010 was lower than empirical critical loads at 11 of 26 sites. Deposition assuming MFR would not exceed empirical critical loads at any site in 2020.

18. The International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation) had analysed 3,000 moss samples collected during 2005/2006. The results showed that the lowest total N concentrations in mosses were observed in northern Finland and the northern parts of the United Kingdom of Great Britain and Northern Ireland. The highest concentrations were found in Central and Eastern Europe. Concentrations showed high correlations ($r = 0.55$–0.65 with $p<0.001$) with N compounds in deposition modelled by the Meteorological Synthesizing Centre-East (MSC-E) of EMEP. The spatial distribution of the concentrations was similar to that of the total modelled N deposition in 2004. However, modelled deposition tended to be relatively lower in Eastern Europe when compared with concentration. The total N concentration in mosses might potentially be used as an indicator of atmospheric N deposition with high spatial resolution and as an early indicator of ecosystems at risk from N saturation.

19. ICP Modelling and Mapping had compiled data on critical loads for eutrophication from its national focal centres (NFCs) in 2008 and included them in the GAINS model to support the revision of the Gothenburg Protocol and other air policies in Europe. The data included ecosystems classified according to the European Nature Information System (EUNIS) that also covered the Natura 2000 areas of the European Union (EU). CCE and the Centre for Integrated Assessment Modelling (CIAM) had collaborated in preparing scenario analyses using indicators which had not been included in the GAINS model and had initiated the provision of harmonized concentration and deposition data for use by all ICPs. ICP Modelling and Mapping had developed target loads for aspirational targets, tentative methods and data for scenario-specific information to assess robustness, including first biological indicators.

20. The critical load data of ICP Modelling and Mapping for European ecosystems, including the Natura 2000 areas, was increasingly being used. They supported development and use of indicators, which were part of the core set of indicators used the European Environment Agency (EEA) (including in its State of the environment 2010 report) and by the European initiative, Streamlining European Biodiversity Indicators 2010 (SEBI2010).

21. ICP Modelling and Mapping planned to prepare a first call to its NFCs in 2009–2010 to collect data relevant to biogeochemical process models and air pollution effects on biodiversity. The data would be used to regionally assess temporal changes of vegetation caused by air pollution and other drivers.

22. CCE had developed an ensemble assessment of impacts, which used empirical and computed critical loads to determine the robustness of critical load exceedance. Different dynamic models and dose-response functions were being used to increase the robustness of estimating air pollutant effects. The method enabled the demarcation of distinct areas where exceedance was (a) virtually certain, (b) very likely, (c) likely, (d) as likely as not, and (e) unlikely. The method was operational and could be used for further scenario analysis in collaboration with CIAM.

23. The Task Force on Health had noted it had no plans or readily available guidelines for quantification of health risks related to N. The suggested relevant monitored parameter was annual average nitrogen dioxide (NO_2) concentration.

24. The Joint Expert Group on Dynamic Modelling had assessed dynamic models of nutrient N in terrestrial systems, interactions between air pollution and climate change, biological responses and terrestrial carbon (C) sequestration. The Group concluded that these were developed to a stage suitable for target-setting. Several coupled models, e.g. For-SAFE-Veg and SMART-SUMO-MOVE, operated at regional scales. They provided tools to evaluate the changes in plant species assemblages and habitat suitability in relation to atmospheric deposition and climate change. Available ecosystem-level models required further testing and verification with observations. Data were needed to describe C pools and C/N ratios with a minimum of two measurements in time.

25. The Joint Expert Group noted that the model applications predicted long time lags to recovery from N pollution, and that some impacts were irreversible. At some sites, the models indicated that intervention management might be required to reduce the magnitude of internal stores of accumulated N. Policymakers would need to be aware that, due to historical N inputs, reduction of present and future deposition below critical loads would not necessarily result in a recovery of biodiversity. This was due to the internal cycling and storage of accumulated N, a process known as self-eutrophication.

IV. OZONE

26. Precursors of ground-level ozone (O_3) are emitted by natural ecosystems and, in large amounts, by human activities. O_3 is a strongly oxidant gas. It can damage vegetation and human health. Its rural background levels have increased in recent years, although peaks have decreased.

27. ICP Forests reported no update on the effects of ground-level O_3 after its evaluations in 2008/2009.

28. ICP Vegetation had applied the Ellenberg modelling approach to European grasslands. The results predicted that coastal grassland communities and Mediterranean tall humid grasslands were the most sensitive to O_3 of all modelled communities. Other vegetation types,

such as upland grasslands, shrub heathland, forest fringes, dry and wet grasslands, were also predicted to be O_3-sensitive. This was based on a wide-ranging study using the proportion of sensitive species from those tested as indicators of sensitivity. The impact of N deposition on O_3 sensitivity was investigated in terms of the combined sensitivity of grasslands to O_3 and N deposition, based on empirical critical load ranges. The results showed that for different grassland types there was either no or a weak negative relationship in terms of the sensitivity to O_3 and N deposition.

29. ICP Vegetation had developed a multi-layer canopy flux model for productive grassland containing white clover (a legume) and rye grass. The leaf area index of the grassland species was the key driver for within-canopy distribution of O_3 flux. This model could identify the areas at most risk of O_3 effects on biomass. However, it was not yet possible to develop a quantitative flux-effect relationship for biomass, species composition or forage quality which would be sufficiently robust for Europe-wide application. A literature review revealed that O_3 concentrations observed in Europe could cause up to 20 per cent loss in nutritive quality for legumes. Nutritive quality of grasses showed a lesser response. The losses were mainly due to the negative effects of O_3 on the digestibility of the forage.

30. ICP Vegetation had found substantial evidence, in particular based on large-scale experiments in Sweden and Finland, that O_3 had significant adverse effects on vegetation at current ambient levels in the Nordic countries and Baltic States. Favourable climatic conditions and long summer days resulted in considerable O_3 uptake in vegetation, in particular in the southern parts of the Nordic countries. This had occurred despite O_3 concentrations being generally lower than in Central and Southern Europe. Risk assessments and integrated assessment modelling on O_3 impacts on vegetation would need to be flux-based.

31. The Task Force on Health's 2008 report "Health risks of ozone from long-range transboundary air pollution" had concluded that O_3 was one of the most important air pollutants associated with health in Europe. It was associated with 21,000 annual premature deaths in 25 EU Member States. Although models predicted slight reductions of exposure in the coming decade, current urban O_3 concentration trends did not indicate consistent decrements in O_3 levels. Recent results indicated an association of respiratory mortality with long-term exposure to O_3, which had not been included in earlier estimations. Currently implemented policies would not be sufficient to reduce impacts significantly during the next decade.

32. The Task Force on Health found little information on the effects of existing air pollution alert systems on population exposure and health impacts. This approach had limitations in terms of managing risks related to air pollution, in the absence of well-designed evaluation studies.

33. The Task Force on Health confirmed that the currently accepted indicator for O_3 effects on health was SOMO35 (annual sum of daily maximum mean eight-hour concentrations above 35 ppb), which could be based on monitoring or modelling. Results from monitoring in urban or suburban background locations covering 30 countries were in the Airbase of EEA.

V. PARTICULATE MATTER

34. Particulate matter (PM) originates from natural and anthropogenic sources. Particles may form in the atmosphere from precursor gases, such as sulphur dioxide (SO_2) and NO_2. PM can contain heavy metals and organic compounds. It poses a risk to human health and contributes to the soiling of materials.

35. The International Cooperative Programme on Effects of Air Pollution on Materials, Including Historic and Cultural Monuments (ICP Materials) had developed a new dose-response function for soiling of modern glass. It was the first one to include other pollutants (e.g. SO_2, NO_2) besides PM. It quantified soiling of transparent materials and could be used to map increased risk of soiling and related costs.

36. The Task Force on Health had taken note of recent results that strengthened previous evidence on health damage by PM. These amounted to 500,000 premature deaths annually and 5 million years of life lost in the EU Member States. The new evidence indicated significant public health benefits due to reduced PM exposure. Reductions had led to health improvements with little delay only. This affected cost-benefit analyses of the pollution reduction scenarios.

37. The Task Force on Health had also taken note of the substantial evidence confirming the hazardousness of biomass combustion emissions. Such emissions contributed comparable amounts of PM as fossil fuel combustion in many European countries, in particular residential wood-burning. Reduction of population exposure to domestic wood combustion was needed to prevent health risks.

38. The Task Force on Health recommended annual average coarse and fine PM (PM_{10} and $PM_{2.5}$, respectively) concentrations as key parameters to be monitored and reported to assess risks of PM. Regularly monitored PM_{10} data were available for 566 cities from 27 countries in 2006 in the Airbase of EEA. Data covered 22 per cent of urban population in the region, and were available for 416 cities from 26 countries in 2004.

VI. HEAVY METALS

39. Heavy metals are natural constituents of the earth crust, but at high concentrations they become harmful to the environment and humans. Anthropogenic emissions of some heavy metals have led to detrimental levels in some environmental compartments. Emissions have been reduced in recent decades and levels in the environment have also decreased. However, it remains important to continue monitoring these substances.

40. Concentrations of heavy metals at ICP Waters sites in remote areas were low compared to lakes and rivers in catchments with local emission sources. Based on national guidelines on assumed effects on aquatic biota, a number of sites had concentrations above critical limits.

41. ICP Waters had compiled information on mercury (Hg). Long-range transported Hg was a significant environmental problem, as it is the main source of highly toxic forms of Hg. In remote areas, Hg accumulated in fish above limits recommended for human consumption, in particular in lakes in northern boreal ecosystems in Northern America, Scandinavia, the northern parts of the Russian Federation and the Arctic. These lakes were not affected by local sources. Lake sediments documented temporal trends in atmospheric Hg deposition. They showed an increase, in particular after the start of industrialization, which had peaked in late twentieth century and gradually declined in the last 10–15 years. Regional lake surveys in these areas showed high Hg concentrations in fish, above the limit recommended for human consumption. Processes controlling levels of Hg in fish were complex. They were related to food web dynamics and catchment processes, which controlled Hg transport to lakes and rivers.

42. ICP Integrated Monitoring calculated mass budgets at its sites. The results indicated decreased deposition and run-off for Hg. For lead (Pb) and cadmium (Cd), no trends had been detected. The critical loads of Cd were higher than deposition. Deposition exceeded critical loads of Pb for sensitive soil layers. Critical loads for Hg were exceeded at Swedish background sites, in particular when deposition was calculated from throughfall and litterfall.

43. ICP Vegetation had observed that the decline in heavy metal emissions and depositions had resulted in a Europe-wide reduction in concentrations in mosses since 1990 for many metals, but not for chromium and Hg. Large deviations from the general European trends were found at national or regional scales. Europe-wide temporal trends agreed reasonably well with deposition modelled by EMEP for Pb and Cd. Concentrations had declined by 73 and 46 per cent respectively for Pb and Cd in Europe in the period 1990–2005, whereas the modelled deposition had declined by 70 and 41 per cent respectively. At the European scale, metal concentrations in mosses could be used as an indicator of temporal trends of atmospheric deposition for those metals.

44. ICP Vegetation had found the lowest concentrations of metals in mosses in Northern Europe and the highest in Belgium and Eastern Europe in 2005/2006. Bivariate analysis of the data showed the highest correlations between Cd ($r = 0.63$ with $p<0.001$) and Pb ($r = 0.73$ with $p<0.001$) concentration in mosses and modelled EMEP depositions, followed by total emissions and the share of urban land use in a 50–100 km radius. Correlations between the Hg concentration in mosses and modelled depositions or anthropogenic emissions were low. At least for Cd and Pb, the concentration in mosses could be used as an indicator of atmospheric deposition at a high spatial resolution.

VII. PERSISTENT ORGANIC POLLUTANTS

45. Persistent organic pollutants (POPs) are known to be transported over long distances via air and marine currents. They degrade in the environment very slowly, over decades or centuries. They are toxic and accumulate in food chains to concentrations that may lead to health problems in predators at the top of the chain.

46. The assessment by ICP Waters of POPs in the aquatic environment confirmed previous studies. Global distillation processes had led to elevated concentrations of contaminants in fish and lake sediments in Europe, North America and the circumpolar Arctic. Sites with long time series were scarce, but generally showed decreasing levels of POPs no longer in use. Levels of some new studied substances, such as brominated flame retardants, were probably rising.

VIII. CROSS-CUTTING ISSUES

47. ICP Forests had carried out a tree crown condition survey on a large-scale transnational 16×16 km² grid in 2008. It comprised 5,002 plots in 25 countries and 111,560 trees. The survey showed that 21.1 per cent of trees had needle or leaf loss of more than 25 per cent and could thus be classified as damaged or dead. After a peak in 2004 and 2005, tree crown condition of most main tree species had improved in the last two years. Trends varied between different species and years. Over many years, European and sessile oak showed the highest defoliation. Forest condition was determined by several factors. Insects, fungi, droughts, snow and storms were among the most frequently observed causes of direct damage.

48. ICP Waters had conducted a 2008 chemical intercomparison that had included a determination of major ions and heavy metals. Seventy-four laboratories from 29 countries participated, including seven laboratories from Asia. The intercomparison should continue with samples with low concentrations of elements, as this was the most relevant water quality for the work in the ICP Waters.

49. ICP Waters had undertaken a 2008 biological intercalibration of invertebrate fauna, including invertebrates from five countries. Five laboratories from four countries participated. Identification of the individuals and species was good. The mean quality assurance index was above 80 per cent for all laboratories. The taxonomic quality was sufficient for calculation of an acidity index. Ten laboratories participate on a regular basis in the intercalibration. Each laboratory participates on average every third year in the intercalibration exercise.

50. ICP Materials noted that the assessment of stock of materials at risk at a European scale required several methods, e.g. direct measurements, identikits, and satellite and census data. Identikits are generic building types developed to represent dominant styles of buildings found within a region. They also provide estimates of the average proportion of different materials used in their construction.

51. ICP Materials had created a database of immovable cultural heritage in Italy. It contained 1,194 entries for Milan and 3,799 for Rome in three categories: (a) castles and public palaces; (b) archaeological areas; and (c) churches and convents. Corrosion and recession effects of copper and limestone in most of the cases were higher than predicted with data from the Meteorological Synthesizing Centre-West (MSC-W) of EMEP. Data from monitoring stations would give more correct predictions.

52. ICP Materials had initiated material sample exposures in autumn 2008 at 24 sites in 16 countries. Results of corrosion of carbon steel, zinc and limestone, soiling of modern glass and teflon would be available in 2010.

IX. REVIEW OF RECENT EFFECTS-ORIENTED ACTIVITIES

53. Information on the general activities carried out by ICPs and the Task Force since the twenty-seventh session of the Working Group on Effects, as well as the most important recent publications of their results, are summarized in annexes I–VII. Document ECE/EB.AIR/WG.1/2009/13 presents the full report of the ninth meeting of the Joint Expert Group on Dynamic Modelling and is not repeated as an annex. The references in annexes have been reproduced as received by the secretariat and are provided in English only.

Annex I

INTERNATIONAL COOPERATIVE PROGRAMME ON ASSESSMENT AND MONITORING OF AIR POLLUTION EFFECTS ON FORESTS

1. The twenty-fifth Task Force meeting was held from 24 to 26 May 2009 in Saint Petersburg, Russian Federation. It was attended by 103 experts and national representatives from 30 countries. It addressed the following main topics: (a) reports and results of ICP Forests; (b) cooperation with the EU project LIFE+/FutMon; and (c) collaboration with other international organizations. The Task Force adopted the technical and executive reports on forest condition in Europe and agreed on data submission formats for monitoring data of the year 2009.

2. The programme coordinating group convened on 6 October 2008 in Hamburg, Germany. It supported future contributions to forest monitoring under the LIFE+/FutMon project. The future tasks of the programme's dedicated groups, the quality assurance of ICP Forests and the future reporting system of the programme were specified. A forest monitoring week was being organized for 6 to 9 October 2009 with a main focus on future core plot selection for intensive monitoring. Details of demonstration projects for the development of new monitoring activities were being elaborated.

3. The dedicated groups of ICP Forests met for a combined expert meeting from 12 to 16 January 2009 in Hamburg, Germany. The joint organization of nine meetings enabled direct and efficient communication between experts from different disciplines. Methodologies and evaluation strategies for the new demonstration projects had been developed at the expert level. The necessity of an integrated approach of future monitoring activities was emphasized. This implied the use of the same raw data by several models and evaluation projects. The repetition of combined meetings was recommended.

4. Monitoring of 5,000 level I plots and 660 level II (intensive monitoring) plots continued. Results were published in the 2009 technical report and in the 2009 executive report. The following monitoring data were evaluated: (a) mean deposition of NH_4, NO_3 and SO_4 on level II plots, as well as the temporal development of deposition for the years 2001–2006; (b) concentrations of main elements and of acidification in soil solution on level II plots; and (c) temporal and spatial trends of large-scale forest condition (defoliation) on 5,000 level I plots.

5. The Programme Centre maintains close contacts and supports the research groups engaged in the evaluation of the programme's data. It was engaged in a collaborative evaluation of relations between deposition and temperature and forest tree growth on level II plots.

6. The Programme Centre was also engaged in the formulation of several project proposals for future co-financing of monitoring and evaluation activities. Enhanced activities were

envisaged for the coming years, in particular in the fields of biodiversity monitoring and climate change and O_3 flux modelling.

7. The Programme Centre is currently involved in the construction of a revised database system for online data submission and semi-automated validation procedures for level I and II data under a grant agreement with the European Commission. The Programme Centre is responsible for the central forest monitoring database also on behalf of the European Commission. Plot-specific results of previous evaluations are maintained in its database.

8. A number of coordination activities are routinely carried out by the Programme Centre, including: (a) participation in meetings of programme's dedicated groups; (b) representation of the programme at policy meetings and scientific conferences; (c) maintenance of the website (www.icp-forests.org); (d) data provision to third parties upon request; and (e) an update of the manual for harmonized sampling and monitoring, in close collaboration with involved national experts.

<u>Literature</u>

Fischer R, Granke O, Chirici G, Meyer P, Seidling W, Stofer S, Corona P, Marchetti M, Travaglini D (2009) Background, main results and conclusions from a test-phase for biodiversity assessments on intensive monitoring plots in Europe. *iForest* 2: 67–74 [online: 18 March 2009] - doi: 10.3832/ifor0493-002

Fischer R, Lorenz M, Köhl M, Becher G, Granke O, Bobrinsky A, Braslavskaya T, Chirici G, De Vries W, Dobbertin M, Kraft P, Laubhann, Lukina N, Nagel HD, Reinds GJ, Sterba H, Solberg S, Stofer S, Seidling W (2009) The condition of forests in Europe; Executive Report 2008.

Granke O, Kenter B, Kriebitzsch WU, Köhl M, Köhler R, Olschofsky K (2009) Biodiversity assessment in Forests – forem genetic diversity to landscape diversity. *iForest* 2: 1–3 [online: 21 January 2009] - doi: 10.3832/ifor0474-002.

Lorenz M, Fischer R, Becher G, Iost S, Mues V, Granke O, Braslavskaya T, Bobrinsky A., Clarke N, Lachmanová N, Lukina N, Schimming C (2009) Forest Condition in Europe; 2009 Technical Report of ICP Forests. Institute of World Forestry, Hamburg, 83 pp.+annexes.

Lorenz M, Granke O (2009) Deposition measurements and critical loads calculations: Monitoring data, results and perspective. *iForest* 2: 11–14 [online: 21 January 2009] - doi: 10.3832/ifor0478-002

Requardt A, Schuck A, Köhl M (2009) Means of combating forest dieback – EU support for maintaining forest health and vitality. *iForest* 2: 38–42 [online: 21 January 2009] - doi: 10.3832/ifor0480-002

Annex II

INTERNATIONAL COOPERATIVE PROGRAMME ON ASSESSMENT AND MONITORING OF ACIDIFICATION OF RIVERS AND LAKES

1. The twenty-fourth Task Force meeting was held from 8 to 10 October 2008 in Budapest. It was attended by 35 experts from 19 Parties. At present, 24 countries participate 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 are published in ICP Waters report 96.

3. The finalized 20-year report was presented. It summarizes the main findings of ICP Waters and also points to its future challenges. Special care was taken to the presentation of the report so that it could reach a wider audience than the usual scientists and policymakers. In addition, a brochure summarizing the main points of the 20-year report was prepared.

4. The draft report on Hg was presented and discussed. The aim is to focus on Hg as an environmental problem in the aquatic ecosystems only influenced by long-range transport of air pollution. The report summarizes the factors that influence spreading and accumulation of Hg in the environment, current knowledge on the status of long-range transported Hg in aquatic ecosystems (e.g. fish, sediments, water) within Economic Commission for Europe (ECE) region (i.e. North America and Europe), and recommendations for monitoring and measuring levels of long-range transported Hg in aquatic environments.

5. The Task Force discussed the process for an update of the Programme Manual. It recommended that updated Manual should be broader than presently and include methods for monitoring acidification, eutrophication, heavy metals and POPs in water and biota. It also recommended that the Manual should harmonize, where possible, with methods from the EU Water Framework Directive[2].

6. The importance of the EU Water Framework Directive was discussed and a position paper ("Links, complementarities and common interests between LTRAP[3] Convention and the EU Water Framework Directive") was presented. The Directive and the Convention share the same overarching goal, even if procedures and methods are not identical. The Directive aims to

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[2] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

[3] Long-range Transboundary Air Pollution.

cover all human impacts on water bodies primarily involving parties within river basins. The Convention focuses on transboundary pollution problems over river basin boundaries and involves Parties across river basins to solve problems. Initiatives from the ICP Waters representatives should be taken at the national level to approach river basin management and authorities, and to draw their attention to data available on small water bodies in headwater ecosystems.

7. Representatives of the Programme Centre of ICP Waters actively participated in the meetings of the Programme Task Forces of ICP Integrated Monitoring and ICP Modelling and Mapping, as well as the Joint Expert Group on Dynamic Modelling and a Nordic workshop on cooperation between the United Nations Framework Convention on Climate Change and the Convention.

Literature

Hovind H (2008) Intercomparison 0822: pH, Cond, HCO3, NO3-N, Cl, SO4, Ca, Mg, Na, K, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA-report SNO5660-2008, ICP Waters report 93/2008.

Skjelkvåle BL, De Wit H (editors) (2008) ICP Waters 20 year with monitoring effects of long-range transboundary air pollution on surface waters in Europe and North-America. NIVA-report SNO5684-2008, ICP Waters report 94/2008.

Fjellheim A, Raddum GG (2008) Biological intercalibration: Invertebrates 1208. NIVA-report SNO5706-2008, ICP Waters report 95/2008.

Skjelkvåle BL, Jenssen MTS, De Wit H (editors) (2008) Proceedings of presentations of national activities to the 24th meeting of ICP Waters Programme Task Force in Budapest, Hungary, 6-8 October 2008. NIVA-report SNO5770-2008, ICP Waters report 96/2008.

ICP Waters 20 year with monitoring effects of long-range transboundary air pollution on surface waters in Europe and North-America, Brochure.

Links, complementarities and common interests between LTRAP convention and the EU Water Framework Directive, Position paper, www.icp-waters.no.

Annex III

INTERNATIONAL COOPERATIVE PROGRAMME ON EFFECTS OF AIR POLLUTION ON MATERIALS, INCLUDING HISTORIC AND CULTURAL MONUMENTS

1. The twenty-fifth meeting of the Programme Task Force was held from 1 to 3 April 2009 in Madrid. The meeting was hosted by the National Centre for Metallurgical Research (CENIM), Madrid. The meeting was attended by 18 representatives from 12 Parties and the Convention secretariat.

2. ICP Materials was represented at the 2009 Workshop on non-binding aspirational targets for emission reductions for the year 2050.

3. ICP Materials was also represented at the twenty-fifth meeting of the Programme Task Force of ICP Modelling and Mapping.

4. The ICP Materials Task Force decided that this year the technical manual for the trend exposure programmes would be updated to include a detailed description of all 24 test sites used in the 2008/2009 material sample exposure.

5. The 2008/2009 material sample exposure would be completed in October–November 2009.

<u>Literature</u>

Kucera V, Tidblad J (2009) Development of atmospheric corrosion in the changing pollution and climate situation, Paper 3709, Proc 17th Int Corros Congr, NACE, Omnipress.

Annex IV

INTERNATIONAL COOPERATIVE PROGRAMME ON EFFECTS OF AIR POLLUTION ON NATURAL VEGETATION AND CROPS

1. The twenty-second meeting of the Programme Task Force was held from 2 to 4 February 2009 in Braunschweig, Germany. It was attended by 57 experts from 20 Parties to the Convention and also South Africa. The Chair of ICP Modelling and Mapping, representatives of ICP Forests and MSC-E, and Convention secretariat also attended. Details are available at: icpvegetation.ceh.ac.uk.

2. Attempts by the Programme Coordination Centre to stimulate participation by countries belonging to the Malé Declaration on the Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia. (Malé Declaration) in the twenty-second Task Force meeting had been unsuccessful due to a lack of appropriate funds. The Task Force urged the secretariat of the Malé Declaration to support the participation of experts in future Task Force meetings, and encouraged further activities on outreach to areas outside the ECE region.

3. The Programme Coordination Centre participated in the following meetings:

(a) The 2009 Workshop on non-binding aspirational targets for emission reductions for the year 2050;

(b) The second meeting of the Task Force on Reactive Nitrogen;

(c) The twenty-fifth meeting of the Programme Task Force of ICP Modelling and Mapping;

(d) The workshop on N deposition and Natura 2000 hosted by the European cooperation in the field of scientific and technical research (COST) action 729, held from 18 to 20 May 2009 in Brussels.

4. Coordination activities carried out by the Programme Coordination Centre included: (a) restructuring and updating of the ICP Vegetation website; (b) production of a leaflet on widespread evidence of O_3 impacts on vegetation in Europe; and (c) the extension and updating of databases such as OZOVEG (O_3 effects on vegetation), which target heavy metal and N concentration in mosses.

5. ICP Vegetation participants conducted a pilot study to investigate the potential for bean (*Phaseolus vulgaris*) to be used as a biomonitor of O_3 in Europe in summer 2008. Bean seeds of the strains S156 (O_3 sensitive) and R123 (O_3 resistant) from North Carolina (United States) were

exposed to ambient air at 11 sites and O_3 exposure-response studies were carried out at four sites. At all sites, a clear distinction in the extent of visible injury symptoms between the S156 and R123 biotypes was apparent, with the visible injury symptoms observed in the S156 biotype at O_3 concentrations with a threshold for effect of about 35 ppb (12-hour mean). Pod weights, expressed as the ratio for sensitive to resistant, were comparable to those from an earlier study in the United States. However, the best O_3 parameter for use with effects data had not yet been identified, and no flux model existed for beans to date. Participants judged the pilot study to be a success and were keen to repeat the study in future years, with efforts to be focused on establishing a flux-effect relationship for beans.

6. The Programme Coordination Centre was organizing the next O_3 critical levels workshop on flux-based assessment of O_3 effects for air pollution policy. It was tentatively scheduled to be held from 10 to 12 November 2009 in Ispra, Italy, in collaboration with the European Commission’s Joint Research Centre and the Convention secretariat. The aim of the workshop is to improve application of flux-based methods described in the *Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends.*

Literature

Emberson LD, Bueker P, Ashmore MR, Mills G, Jackson L, Agrawal M, Atikuzzaman MD, Cinderby S, Engardt M, Jamir C, Kobayashi K, Oanh NK, Quadir F, Wahid A (in press) Dose-response relationships derived in North America underestimate the effects of ozone on crop yields in Asia. *Atmospheric Environment.*

Harmens H, Mills G, Hayes F et al. (2009) Air pollution and vegetation. ICP Vegetation annual report 2008/2009. (All references by Harmens et al. are available at icpvegetation.ceh.ac.uk)

Harmens H, Mills G, Menichino NM, Bender J, Weigel H (2009) Programme and abstracts of 22nd Task Force Meeting of the ICP Vegetation, 2–5 February 2009, Braunschweig, Germany.

Harmens H, Norris D and participants of the moss survey (2008a) Spatial and temporal trends in heavy metal accumulation in mosses in Europe (1990-2005). Programme Coordination Centre for ICP Vegetation, Centre for Ecology and Hydrology, Bangor, UK.

Harmens H, Norris D, Cooper D, Hall J and participants of the moss survey (2008b) Spatial trends in N concentrations in mosses across Europe in 2005/2006. ICP Vegetation, Defra contract AQ0810.

Vandermeiren K, Harmens H, Mills G, De Temmerman L (in press) Impact of ground-level ozone on crop production in a changing climate. In: Singh SN (editor) Climate change and crops.

Annex V

INTERNATIONAL COOPERATIVE PROGRAMME ON INTEGRATED MONITORING OF AIR POLLUTION EFFECTS ON ECOSYSTEMS

1. The seventeenth meeting of the Task Force was held on 7 May 2009 in Tallinn, after a workshop on the assessment of programme data held on 6 May. Thirty-one experts from 13 Parties attended the meeting. The Chair of ICP Waters and a member of the Convention secretariat also attended. Details are available at: www.environment.fi/syke/im.

2. The national focal points reported their 2007 results to the Programme Centre in December 2008. The Programme Centre carried out standard check up of the results and incorporated them into its database.

3. The Programme Centre prepared the technical report, “Assessment of long-term trends of deposition and surface water quality”.

4. Assessment and scientific work on priority topics continued:

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

(b) Calculation of fluxes and trends of N and S compounds, base cations and acidity;

(c) Calculation of site-specific critical loads for acidification and eutrophication.

5. Progress reports on these topics are included in the programme’s annual report 2009. Further work on these topics was planned. An assessment project on biodiversity data had started.

6. ICP Integrated Monitoring sites data were used in the following EU projects: (a) the Integrated Project to Evaluate Impacts of Global Change on European Freshwater Ecosystems (EURO-LIMPACS; www.eurolimpacs.ucl.ac.uk); and (b) ALTER-Net, a long-term biodiversity, ecosystem and awareness research network (www.alter-net.info). Both projects ended in early 2009.

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

Literature

Aherne J, Posch M, Forsius M, Vuorenmaa J, Tamminen P, Holmberg M, Johansson M (2008) Modelling the hydro-geochemistry of acid-sensitive catchments in Finland under atmospheric deposition and biomass harvesting scenarios. *Biogeochemistry* 88(3):233–256.

Kleemola S, Forsius M (editors) (2008) 17th Annual Report 2008. Convention on Long-range Transboundary Air Pollution, ICP Integrated Monitoring. The Finnish Environment 28, Finnish Environment Institute, Helsinki, Finland. 121 p. ISBN 978-952-11-3190-5 (pbk.). ISBN: 978-952-11-3191-2 (PDF).

Posch M, Aherne J, Forsius M, Fronzek S, Veijalainen N (2008) Modelling the impacts of European emission and climate change scenarios on acid-sensitive catchments in Finland. *Hydrology and Earth System Sciences* 12: 449-463.

Annex VI

INTERNATIONAL COOPERATIVE PROGRAMME ON MODELLING AND MAPPING OF CRITICAL LOADS AND LEVELS AND AIR POLLUTION EFFECTS, RISKS AND TRENDS

1. The twenty-fourth meeting of the Task Force was held on 14 and 15 April 2008 in Stockholm, after the nineteenth CCE workshop held on 11 and 12 April. Experts from 21 countries and representatives of other ICPs, MSC-W and organizations outside the Convention attended. The network of active NFCs was stable. There was good collaboration between European and North American NFCs and with China.

2. Critical loads data were used in the GAINS model to support the revision of the Gothenburg Protocol. They would also be used in ex-post effects analyses of emission scenarios.

3. The effects of N inputs on biodiversity, especially in terrestrial ecosystems, have been the focus in recent years. Critical loads and dynamic modelling are being further developed and applied. Discussions and developments in 2009 focused on: (a) further development of biodiversity and other indicators for use in integrated assessment; (b) definition of reference points or developments; and (c) coupled modelling of the effects of air pollution, climate change and management on ecosystem dynamics, including biodiversity. ICP Modelling and Mapping planned to revise empirical critical loads took into account dynamic models and dose-response functions. This project was co-funded by the Netherlands (CCE), Germany and Switzerland.

4. The Task Force had proposed a call for input data to NFCs for use in currently best available dynamic vegetation models, planned for autumn 2009. The initiative would enable tentative regionalized dynamic modelling at CCE, in collaboration with a project co-funded by Sweden and Switzerland. Preparatory work would be done on developing a simplified dynamic model, applicable Europe-wide and linked to vegetation modules. These were based on the experiences with complex site-specific models presented in CCE workshops in 2008 and 2009.

5. The Task Force expects intensified cooperation with EMEP, for example with respect to applying high-resolution deposition data. The exceedance of critical loads for N was used as a headline indicator of risk to biodiversity by SEBI2010 project and also by Eurostat. Cooperation at the national and European levels explored improved relationships between critical load exceedance, N impacts and objectives set according to the EU Habitats Directive[4] and comparable national legislation. This applied to all areas, including Natura 2000 areas in EU Member States. Cooperation with nature conservancy agencies should be intensified, especially at the national level.

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[4] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora.

6. The Task Force had participated in the development of N assessment for multiple media and effects for some years. It would cooperate with the Task Force on Reactive Nitrogen, in particular on the development of effects indicators and the use of multimedia N budgets.

Literature

Ashmore M, De Vries W, Hettelingh J-P, Hicks K, Posch M, Reinds GJ, Tonneijck F, Van Bree L, van Dobben H (2008) Environmental and health impacts of air pollution. In: Sokhi RS (editor) World Atlas of Atmospheric Pollution. Anthem Press, London, New York, ch. 6, pp 77-93.

Forsius M, Posch M, Aherne J (2008) Assessing links between climate change and air pollution effects using site-specific data: Development of a model framework. In: Kleemola S, Forsius M (editors) 17th Annual Report 2008. ICP Integrated Monitoring. The Finnish Environment 28, pp. 28-38. Finnish Environment Institute, Helsinki, Finland.

Hettelingh J-P, Posch M, Slootweg J (editors) (2008) Critical load, dynamic modelling and impact assessment in Europe: CCE Status Report 2008. PBL Report 500090003, Coordination Centre for Effects, Bilthoven, Netherlands, 231 pp. www.mnp.nl/cce

Mayer AL, Vihermaa L, Nieminen N, Luomi A, Posch M (2009) Epiphytic macrolichen community correlates with modeled air pollutants and forest conditions. *Ecological Indicators* 9: 992–1000.

Posch M, Seppälä J, Hettelingh J-P, Johansson M, Margni M, Jolliet O (2008) The role of atmospheric dispersion models and ecosystem sensitivity in the determination of characterisation factors for acidifying and eutrophying emissions in LCIA. *Int J Life Cycle Ass* 13(6): 477–486.

Posch M, Reinds GJ (2009) A very simple dynamic soil acidification model for scenario analyses and target load calculations. *Environmental Modelling & Software* 24: 329–340.

Posch M, De Vries W (2009) Dynamic modelling of metals – time scales and target loads. *Environmental Modelling & Software* 24: 86–95.

Reinds GJ, Posch M, De Vries W (2009) Modelling the long-term soil response to atmospheric deposition at intensively monitored forest plots in Europe. *Env Poll* 157(4): 1258–1269.

Spranger T, Hettelingh JP, Slootweg J, Posch M (2008) Modelling and mapping long-term risks due to reactive nitrogen effects: An overview of LRTAP Convention activities. *Env Poll* 154(3): 482–487.

Annex VII

JOINT TASK FORCE ON THE HEALTH ASPECTS OF AIR POLLUTION

1. The twelfth meeting of the Task Force on Health was held on 25 and 26 May 2009 in Bonn, Germany. Twenty-five experts from 21 Parties to the Convention attended the meeting. An observer from the Oil Companies' European Organization for Environment, Health and Safety (CONCAWE) and WHO staff also attended.

2. In preparation to the meeting, information on the air pollution alert systems existing in nine Member States was collected and made available to the participants.

3. A technical paper ("Health effects of biomass combustion") was prepared and made available. It analysed information on the sources and emissions of the pollutants, their impact on air quality and population exposure, and health effects.

4. Data on the coarse PM (PM_{10}) exposure was analysed. It was published as a part of the WHO Environment and Health Information System (www.enhis.org).

5. A report "Health risks of ozone from long range transboundary air pollution" was published.

<u>Literature</u>

WHO (2008) Health risks of ozone from long range transboundary air pollution. World Health Organization. XIII+93 pp. www.euro.who.int/Document/E91843.pdf

Exposure of children to air pollution (particulate matter) in outdoor air (ENHIS fact sheet update 20 October 2008). European Environment and Health Information System 2008, www.enhis.org/object_document/o4741n27382.html

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