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Working Group on Effects

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Geneva, 29–30 August 2007
Item 4 of the provisional agenda

RECENT RESULTS AND UPDATING OF SCIENTIFIC AND TECHNICAL KNOWLEDGE

DYNAMIC MODELLING

Report by the Co-Chairs of the Joint Expert Group on Dynamic Modelling

1. This report describes the results of the seventh meeting of the Joint Expert Group on Dynamic Modelling held from 25 to 27 October 2006 in Sitges, Spain, presented here in accordance with the 2007 workplan (item 3.9).

2. Twenty-five experts from the following Parties to the Convention on Long-range Transboundary Air Pollution attended the meeting: Austria, Canada, Germany, Ireland, the Netherlands, Norway, Poland, Sweden, Switzerland and the United Kingdom of Great Britain and Northern Ireland. The International Cooperative Programme (ICP) on Integrated Monitoring, ICP Modelling and Mapping and ICP Waters, the Coordination Centre for Effects (CCE at the

Netherlands Environmental Assessment Agency) and the EMEP (Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants) Centre for Integrated Assessment Modelling (CIAM at the International Institute for Applied Systems Analysis (IIASA)) were represented. A Vice-Chair of the Bureau of the Working Group on Effects and a member of the UNECE secretariat also attended.

3. The meeting was co-chaired by Mr. A. Jenkins (United Kingdom) and Mr. F. Moldan (Sweden). It was organized by the Centre for Ecology and Hydrology (United Kingdom) and by the Swedish programme on International and National Abatement Strategies for Transboundary Air Pollution (ASTA).

I. AIMS AND ORGANIZATION

4. The objectives of the Joint Expert Group meeting were to:

(a) Consider a technical assessment of the 2005 CCE call for dynamic model data;
(b) Consider the 2006/2007 CCE voluntary call for dynamic model outputs;
(c) Consider the expansion and revision of existing dynamic modelling and target load coverage for acidity in Europe and the United States of America;
(d) Assess further development in dynamic modelling and target loads of nutrient nitrogen (N);
(e) Evaluate the key N and heavy metal processes for dynamic modelling;
(f) Assess the potential for, and progress in, dynamic modelling of heavy metals;
(g) Consider prediction of biological recovery in terrestrial and surface water systems;
(h) Assess the potential confounding impacts of climate change;
(i) Consider the potential for using dynamic model outputs in the review and possible revision of the 1999 Gothenburg Protocol;
(j) Assess dose-responses and stock at risk in relation to dynamic modelling;
(k) Consider links between observations and critical thresholds, loads and levels in relation to dynamic modelling;
(l) Determine the future strategy and role of the Group.

II. CONCLUSIONS AND RECOMMENDATIONS

A. General

5. The Joint Expert Group recognized the importance of the new harmonized land cover map for Europe, being completed by CCE, EMEP Meteorological Synthesizing Centre–West

(MSC-W), and the Stockholm Environment Institute. It would aid the calibration of dynamic models on a consistent basis.

6. The Group reemphasized the important difference between the critical loads and target loads. Target loads encapsulated all delays inherent in the acidification and recovery processes. They were deemed to represent the most appropriate mechanism for integrated assessment in the possible future review of the Gothenburg Protocol.

7. The Group took note of the proposal of CCE for a call for data in early 2007, including dynamic model output.

8. The Group requested EMEP to provide Europe-wide chloride deposition, updated base cation deposition, and updated projections of sulphur (S) and N deposition based on the current legislation scenario. This would ensure consistency of modelling approaches with regard to parameterization.

9. The Group recommended that all ICPs consider new ways of interpreting dynamic modelling output in a policy relevant manner. In particular, they should focus on the representation of recovery lag times. The Group will consider this issue at its next meeting.

10. The Group noted the work done by the ICPs on Forests, Integrated Monitoring, Modelling and Mapping, Vegetation, and Waters to determine the links between chemical concentrations and impacts on biological receptors. It urged further discussion at Task Force meetings, in particular on nutrient N impacts in both terrestrial and aquatic ecosystems.

11. The Group acknowledged dynamic modelling work in the United States, China and South-East Asia. It encouraged further exchange of information within and outside the Convention. It also acknowledged developments in Canada and supported the recent establishment of a national focal centre of ICP Modelling and Mapping.

B. Heavy metals

12. A simple dynamic model for calculating target loads and delay times for heavy metals was presented. The Group encouraged testing this and other models at sites for which good quality data were available. Close collaboration was foreseen if this issue became part of the workplan of the Working Group on Effects.

C. Nutrient nitrogen

13. The Group discussed the importance of treating total N fluxes in reduced and oxidized forms in effects models. They had different emission sources and potentially different impacts on eutrophication and biodiversity. In this respect, soil process representation was considered adequate in models, but links of reduced and oxidized N with ecosystem responses were poorly understood. The impact of ammonium deposition, in particular dry deposition, on plant response was not well understood.

14. The Group noted that current parameterization of impacts was constrained by data availability in some geographical areas. In particular, soil survey information collated for earlier acidification studies was not necessarily appropriate for nutrient N impacts. For example, little information existed on the impacts of N deposition, N availability and nutrient N status of calcareous grasslands.

15. The Group agreed that biodiversity-relevant indicators were well developed in aquatic systems, but such indicators and damage thresholds for terrestrial ecosystems were lacking. It suggested that the ICPs on Forests, Integrated Modelling, Modelling and Mapping, Vegetation and Waters identify endpoints and targets for nutrient N in sensitive ecosystems, to derive critical and target loads.

16. The Group noted that dynamic modellers should liaise directly with national conservation bodies to identify key ecosystems to be protected. Legislation on nature conservation should be considered.

17. The Group noted that the impact of forest management practices on carbon and N dynamics in soils required better understanding. It suggested that ICP Forests consider this issue.

D. Acidification

18. The Group confirmed that, according to present understanding, acid-neutralizing capacity (ANC) provided the most appropriate indicator of long-term biotic response in freshwaters.

19. The Group acknowledged significant advances in developing chemical-ecological dynamic models for salmonids. Continued work was required on potential impacts of climate change and genetic constraints on the recovery of viable, self-sustaining fish populations.

20. The Group noted that time to achieve biological recovery from acidification might be delayed or extended due to future climate change. The pathway to recovery would not

necessarily be same as the pathway of acidification. The return to historical 'reference' conditions might not be achievable. Analysis of ICPs' long-term monitoring data could provide new insights into climatic influence on ecosystem effects.

E. Review of the Gothenburg Protocol

21. The Group agreed on the following key points concerning acidification:

(a) The European dynamic model framework developed under the Convention was a major step forward. It should be used in scenario testing and integrated assessment for the review and possible revision of the Gothenburg Protocol;

(b) Model outputs were found to closely match observed trends in water chemistry and were consistent with critical loads;

(c) Models indicated that soils and surface waters would continue to recover after 2010 in areas with deposition below critical load, assuming emissions compliant with the Gothenburg Protocol;

(d) Models indicated major time delays, many decades, in chemical recovery at acidified sites with low weathering rates or deposition marginally below the critical load;

(e) Recovery in biological receptors would be further delayed, up to 10 years, after chemical recovery, but might never return to its original status.

22. The Group agreed on the following key points on nutrient N:

(a) Dynamic models describing carbon and N cycles and air pollution impacts for terrestrial and aquatic systems were available for scenario assessment. They were capable of linking atmospheric deposition, land management and climate change with impacts on terrestrial biodiversity, but required further development and testing;

(b) Many terrestrial ecosystems were currently N-enriched, with observed impacts on biodiversity. Model outputs indicated that ecosystems would continue to accumulate N after 2010, assuming emissions compliant with the Gothenburg Protocol, leading to further changes in biodiversity;

(c) Models have been developed and tested to assess changes in biodiversity. Clear definitions of "biodiversity damage", unwanted changes in biodiversity, were lacking;

(d) Model outputs have been tested against observations from terrestrial ecosystems, but time series data were sparse;

(e) Chemical and biological recovery would take many decades assuming emissions from the Gothenburg Protocol deposition. Ecosystems might already be irreversibly changed.

F. Dose-response relationships and stock at risk

23. The Group agreed that:

(a) Dose-responses between acidity in surface waters and biological impacts (based on ANC and pH) were well defined. There was evidence that nutrient N had significant impact in oligotrophic surface waters, but dose-response functions did not yet exist;

(b) Dose-responses for terrestrial ecosystems were complex and involved combined impacts of acidity and nutrient changes. Experts have compiled large survey and experimental datasets to derive dose-response functions for vegetation modelling. For acidification, these were mostly based on pH, rather than base cation to aluminium ratio, and for eutrophication on a range of soil and soil solution variables;

(c) Models provided means to relate changes in critical load exceedance to observed harmful chemical and biological change, and to estimate chemical and biological delays in both damage and recovery;

(d) Poor understanding was noted of dose-responses for nutrient N and key species in terrestrial and aquatic ecosystems. Damage thresholds should be identified to enable appropriate assessment of stock at risk;

(e) The ecosystem area for which dynamic modelling has been carried out covered about 670,000 km^2. It comprised predominantly forest soils in areas where critical loads for acidification were still exceeded.

G. Links between observations and critical thresholds, loads and levels

24. The Group agreed that:

(a) Dynamic models can be used to improve understanding of key processes and provide further information on key parameters to calculate critical loads, e.g. catchment weathering rates;

(b) Observations in time and space, e.g. monitored by ICPs, were deemed essential to calibrate and test models. Observations of chemical changes through time in surface waters confirmed that dynamic models were able to capture time delays in recovery from acidification;

(c) Appropriate information relating to critical thresholds for biodiversity in terrestrial systems was not available. This limited the value of dynamic model predictions related to target loads;

(d) Models have been linked to biological response models, both dynamic and empirical, and used to estimate time lags in recovery from acidification. For example, results from a Norwegian lake demonstrated that when the appropriate chemical threshold (ANC=25) was reached, the salmon population recovered in 7 to 10 years;

(e) Model outputs of the EU project RECOVER indicated that acidification would continue to be a significant problem after 2016 in 12 acid-sensitive surface water regions in Europe. After full implementation of current legislation, including the Gothenburg Protocol, commensurate adverse biological effects would occur in Italian Alps, southern Norway, southern Sweden, the southern Pennines in the United Kingdom, and Tatras mountains. More than 5 per cent of the ecosystems in each region would not meet the ANC limit value for protecting sensitive aquatic organisms;

(f) Models for terrestrial systems could be used for scenario assessment linking acidity, management and climate change. For example, the SUFOR (Sustainable Forestry in Southern Sweden) programme indicated that after implementation of the Gothenburg Protocol, 60 per cent of forest soils in Sweden would recover within the next 100 years. Forty per cent would remain acidified for the foreseeable future.

H. Future of the Group

25. The Group confirmed its workplan items for 2007 as adopted in the Convention's workplan (items 3.1 and 3.9).

26. The Group confirmed the need to hold a further meeting in 2007 to consider:

(a) Response to the CCE voluntary call for data in early 2007 in relation to other national modelling activities;

(b) Assess new developments in modelling nutrient N;

(c) Further consider chemical-ecological interactions;

(d) Review the incorporation of climate change impacts in dynamic models;

(e) Consider the role of dynamic models in possible revisions of the Convention protocols.

27. The Group did not agree on its draft 2008 workplan. It agreed that in spring 2007 its Co-Chairs would provide items for the draft 2008 workplan of the Working Group on Effects.
