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Working Group on Effects

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Progress in activities in 2014 and further development of effects-oriented activities

Dynamic modelling*

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

Summary

The present report is submitted for the consideration of the Working Group on Effects in accordance with the request of the Executive Body for the Convention on Long-range Transboundary Air Pollution in the 2014–2015 workplan for the implementation of the Convention (ECE/EB.AIR/122/Add.2, items 1.1.10, 1.1.11 and 1.3.13) and the Long-term Strategy for the Convention (ECE/EB.AIR/106/Add.1, decision 2010/18, annex).

The report presents a summary of recent work in dynamic modelling and of the discussion and other results from the fourteenth meeting of the Joint Expert Group on Dynamic Modelling (Sitges, Spain, 28–30 October 2013).

* The present document is being issued without formal editing.

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I. Introduction

1. The fourteenth meeting of the Joint Expert Group on Dynamic Modelling under the Working Group on Effects (WGE) was held from 28 to 30 October 2013 in Sitges, Spain.

2. Twenty experts from the following Parties to the Convention on Long-Range Transboundary Air Pollution (Convention) attended the meeting: Austria, Canada, the Czech Republic, Denmark, Finland, Germany, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom of Great Britain and Northern Ireland and the United States of America. The International Cooperative Programme (ICP) on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters), the International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring), the International Cooperative Programme on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends (ICP Modelling and Mapping), the Centre for Integrated Assessment Modelling (CIAM) of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants (EMEP) and the Bureau of the Working Group on Effects were also represented.

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 IVL Swedish Environmental Research Institute (Sweden).

II. Aims and organization

4. The aims of the Joint Expert Group meeting were to examine progress in dynamic modelling of acidification, heavy metals and nutrient nitrogen including the interactions between climate change and air pollution, biological response and terrestrial carbon sequestration. The aims were in accordance with the 2012-2013 workplan for the Working Group on Effects (ECE/EB.AIR.109/Add.2).

III. Conclusions and recommendations

A. Biological responses and targets

5. The Joint Expert Group applauded ICP Waters on its work on ecosystem services (ICP Waters report 115/2013) and on biodiversity (ICP Waters report 114/2013). Surface waters in 6 countries have been improving since 1980s with respect to indicators of biodiversity. Both rivers and lakes have improved over time; rivers at faster pace than lakes. Long term monitoring carried out by ICP Waters is crucial to show this clear example of the efficacy of air pollution control.

6. The Joint Expert Group encouraged ICP Waters to consider a revision of the Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends[1] (Mapping manual) with respect to the use of biological indicators in surface waters for setting critical loads.

[1] Task Force on Modelling and Mapping (Berlin: Federal Environmental Agency (Umweltbundesamt), 2004). Available from http://www.icpmapping.org/Mapping_Manual.

7. An example of linking plant diversity to abiotic parameters to map critical loads calculations including preliminary results was presented by the Coordination Centre for Effects demonstrating a possible way forward. It was stressed that criteria need to be decided on a national level. However, pan-European mapping might call for uniform indicators common for the whole mapped domain. Such assessment might be useful for the Convention, European Union and for individual Parties for assessment of future scenarios. Another example of mapping critical loads (CL) based on biodiversity was presented by Germany.

8. The Joint Expert Group discussed an on-going work in Sweden to use Natura 2000 sites for setting critical loads for nutrient nitrogen (N). Protecting Natura 2000 sites from CL exceedance might represent countries deposition reduction needs without further need for up scaling to the entire country area. Use of Natura 2000 sites to set critical loads based on biodiversity change has the advantage of not having to deal with the effects of land use to the same extent as outside protected areas, where changes in land use could have a major impact on biodiversity.

9. The Joint Expert Group also suggested that countries should encourage use of CL calculations in reporting compliance with the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (habitat directive). Furthermore, experts re-iterated that to protect species whole habitat needed to be protected.

10. The Joint Expert Group noted with satisfaction the further expansion of the relevé database including response functions used by the vegetation modelling community. The Joint Expert Group concluded that Alpine and especially Mediterranean eco-zones are still less well described European vegetation types. The Convention for the protection of the Mediterranean Sea against pollution (Barcelona Convention) includes coastal areas which might be useful to explore.

11. Consultation with habitat experts carried out in the United Kingdom by the Centre for Ecology and Hydrology resulted with a short list of preferred biodiversity indicators with widest acceptance. Similar lists need to be compiled also from other countries so that recommendation could be made for the all types of ecosystems within area of the Convention interest.

12. The Joint Expert Group discussed several indicators for biodiversity based CL calculations without strong preference for any single candidate. This work too needed to be continued.

13. Whether or not the biodiversity based CL will result in more or less CL exceedance for any given emissions scenario is dependent on the indicator and on the level of acceptable change. In general, biodiversity based CL tend to result in more stringent targets. Preliminary calculations indicate that to protect biodiversity further emission cuts would be required.

14. To reach the goal ‘No net loss of biodiversity’ there was a need to define the reference, which posed difficulty since biodiversity had already been changing. This work too needed to be continued.

15. The Joint Expert Group concluded that red-listed plant species were at risk of being overlooked if indicators such as species richness were applied. Such criteria could be misleading in naturally species poor environments. The effect of an indicator needed to be translated back to what it meant to what species, before decision of indicator applicability could be taken.

B. Nitrogen as a nutrient in terrestrial and freshwater systems

16. There is still uncertainty in the application of abiotic indicators linking nutritional status to vegetation. Indicators such as nitrate (NO_3) in soil solution, carbon to nitrogen ratio (C/N) in soil, base cation to nitrogen ratio (BC/N), mineralizable N, total N and carbon (c) pools were all being tested without clear conclusion as to which one to universally recommend. Indicators needed to correspond well to given biodiversity change index but they also needed to be measurable and modellable. It was important to continue this work.

17. The Joint Expert Group noted the efforts undertaken in Norway to investigate the possibility to establish CL for nutrient N on surface waters using biodiversity indicators.

C. Joint Expert Group outreach

18. The Joint Expert Group applauded the approaches taken by the Effects of Climate Change on Air Pollution and Response Strategies for European Ecosystems[2] (ECLAIRE) EU project and looks forward to further co-operation.

19. The Joint Expert Group congratulated on Finland's development of a web application to access the outputs from the Climate Change and its Impacts (ENSEMBLES) project[3] to show future impact of climate change. The Joint Expert Group recommended supporting such activities at national level since they provide means of communication between scientists, stakeholders and the public.

20. The Joint Expert Group noted that according to calculations presented by the International Institute for Applied Systems Analysis there was a potential of improving air quality by employing a number of measures with zero or even negative net societal cost. Furthermore, there was substantial potential of co-benefits of emissions reductions aimed at combating greenhouse gases to improve both acidification and eutrophication. Short term improvements had the potential to slow down global warming in the near future by 0.5^{o}C.

21. The Joint Expert Group noted increasing involvement of dynamic modelling community in collaboration with Chinese academies and scientists to solve air pollution issues related to food production, acidification and eutrophication.

22. The Joint Expert Group noted that the long-time lags between exposure to persistent organic pollutants (POPs) and the caused effects could be addressed by use of dynamic models. The Joint Expert Group could facilitate the dialog between the Stockholm Convention on POPs and the Convention to address these issues.

23. The Joint Expert Group noted with satisfaction the work of EMEP to produce the sodium deposition map of Europe. Tests are needed and also further work to include other base cations and sources other than sea salt.

D. Ecosystem services

24. The Joint Expert Group´s role – inter alia - is to provide science underlying quantification of ecosystem services related to air pollution. Dynamic modelling could inform the debate around different issues, however, valuation and setting priorities are less of the focus for the Group.

[2] See www.eclaire-fp7.eu/.

[3] See http://www.ensembles-eu.org.

25. The Joint Expert Group noted with satisfaction work on the ecosystem service modelling framework Land Utilisation and Capability Indicator (LUCI)[4] undertaken by the United Kingdom.

26. The Joint Expert Group concluded that dynamic modelling is useful for linking ecosystem services with air pollution. Four cases identified at the meeting were:

(a) Negative impact of ozone on biomass production;

(b) Eutrophying effect of N;

(c) Effect of N on C sequestration; and

(d) Impact of air pollution on drinking water sources (dissolved organic carbon (DOC), acidification).

Air pollution might call for management practices to maintain ecosystem services at risk due to enhanced deposition.

E. Monitoring and experiments

27. Meeting stressed that dynamic modelling applications at well documented sites keep expanding our understanding of interactions between climate change, air pollution and land use and the time scales involved. Maintenance and continuity of monitoring of such sites is of crucial importance for model development and verification.

28. The Joint Expert Group noted that long term N addition experiments and monitoring data keep adding to our understanding of changes which are taking place in ecosystems exposed to enhanced N deposition. Time scales of ecosystem change might be even longer (decades to centuries) than originally expected (years to decades).

F. Model development

29. The Joint Expert Group welcomed further development of the Model of Acidification of Groundwater In Catchments[5] (MAGIC model) to include several important interactions with respect to acidification and eutrophication and acknowledged improvement in model performance documented by model application at well documented sites in the Czech Republic, Norway and Sweden.

IV. Future of the Joint Expert Group

30. The Joint Expert Group concluded that its meeting in 2014 would be beneficial to review progress on: nitrogen as a nutrient in terrestrial and freshwater systems, on interactions between nitrogen, carbon and phosphorus, on biological responses and targets, on heavy metals, on base cations, and on ozone. The agenda should be further expanded by adding three issues only briefly touched upon during past meetings, namely: links to dynamic global vegetation models, links to the EMEP Task Force on Hemispheric Transport of Air Pollution and air pollution and ecosystem services.

[4] See www.lucitools.org.

[5] See http://www.ceh.ac.uk/sci_programmes/magic.html.