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Working Group on Effects
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Item 6 (a) of the provisional agenda

JOINT EXPERT GROUP MEETING ON DYNAMIC MODELLING

Summary report on the second meeting
prepared by the organizers with the assistance of the secretariat

I. INTRODUCTION

1. The second meeting of the joint expert group on dynamic modelling took place under the auspices of the Working Group on Effects. It was organized by the Swedish programme on International and National Abatement Strategies for Transboundary Air Pollution (ASTA programme) in cooperation with the Centre for Ecology and Hydrology (United Kingdom).

2. The meeting took place on 6-8 November 2001 in Ystad (Sweden). It was attended by 28 experts from the following Parties to the Convention: Canada, Croatia, Czech Republic, Denmark, Finland, France, Germany, Netherlands, Norway, Sweden, Switzerland, the United States of America and the United Kingdom. The International Cooperative Programmes (ICPs) on Integrated Monitoring (ICP IM), Modelling and Mapping, Forests (ICP Forests) and Waters (ICP Waters), as well as the Coordination Center for Effects (CCE at the National Institute of Public

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Health and the Environment (RIVM), Bilthoven (Netherlands)), the Centre for Integrated Assessment Modelling (CIAM at the International Institute for Applied Systems Analysis (IIASA), Laxenburg (Austria)) and the Bureau of the Working Group on Effects were also represented.

3. The meeting was co-chaired by Mr. Alan Jenkins (United Kingdom) and Mr. Filip Moldan (Sweden).

II. AIMS AND ORGANIZATION OF THE MEETING

4. The objectives of the meeting were to:

(a) Review completed and ongoing dynamic model applications addressing the aims of the Convention;
(b) Explore and agree methods for presenting data;
(c) Explore and agree the methods for harmonizing outputs on a European scale;
(d) Determine chemical and biological targets and the timescale for achieving them;
(e) Assess the plans and outputs of ICPs with respect to dynamic modelling;
(f) Prepare plans and a timetable for further activities in dynamic modelling within the framework of the medium-term objectives of the Working Group on Effects.

5. The meeting was conducted in a series of plenary sessions addressing:

(a) Progress in dynamic modelling;
(b) Activities of ICPs;
(c) Methods for European-scale assessment;
(d) Further work.

6. Each of the sessions focused on addressing the following:

(a) The consistency of current and proposed methods across Europe;
(b) The appropriateness of the plans for dynamic modelling;
(c) Identification of key outputs and methods of presentation;
(d) Methodologies for a European-scale assessment of the effects of the implementation of the Gothenburg Protocol;
(e) Approaches to modelling soil and water;
(f) Methodologies for linking to integrated assessment models;
(g) The key advances in knowledge which are required;
(h) Identification of confounding factors such as global change;
(i) Uncertainty in dynamic model outputs.

III. CONCLUSIONS AND RECOMMENDATIONS

7. The joint expert group agreed on thirty conclusions and recommendations, here grouped into five sections.

A. Progress on dynamic modelling

8. The group noted that an assessment of recovery of surface waters across Europe from acidification was being undertaken as a part of the European Commission's Fifth Framework Programme project RECOVER: 2010. In 2002 the project would model the response of surface waters in sensitive areas of Norway, Sweden, the United Kingdom, Germany, Italy, Slovakia and the Czech Republic. The RECOVER: 2010 results would be made available to CCE for preliminary analysis and assessment.

9. The group attempted to identify the areas where dynamic modelling should be used to support the medium-term objectives of the Working Group on Effects. These areas should include all ecosystems for which critical loads had ever been exceeded as illustrated, for example, by the exceedance maps for 1980. The current and future state of dynamic modelling across Europe for soils and waters, as currently assessed, is given in annexes I and II, respectively.

10. Four countries had fine-scale regional dynamic assessments of soils in progress. These were Switzerland, the Netherlands, Germany and Sweden. A survey of further work in Europe was presented. Several other countries had pilot projects and demonstration studies in progress: Croatia, Hungary and the Czech Republic. Canada had also initiated dynamic modelling studies.

11. Different research groups were pursuing further development of models which might be of future use for the European assessment (eutrophication, climate change, heavy metals and the effects of ground-level ozone). Integration of forest growth, carbon cycling, nitrogen cycling and chemistry models was under way in the Swedish SUFOR programme. The model was expected to become operational during 2002. Other projects in the Netherlands and Sweden aimed to further develop and apply models for biological effects on forest vitality and vegetation biodiversity. The Meeting welcomed these efforts and urged these groups to make their research results available as soon as models became operational.

12. The group recognized that significant progress in dynamic modelling had been achieved within the individual ICPs:

(a) ICP Waters would concentrate its effort on synthesizing the outputs of the dynamic modelling done under various projects (see annex II). It stressed the need to develop dynamic biological response models in the near future;

(b) ICP IM was planning a modelling exercise using the MAGIC model at five sites, initially, in order to assess model structure, process representation and preliminary uncertainty analysis;

(c) ICP Modelling and Mapping had hosted subregional workshops, whereas CCE had updated the dynamic modelling manual taking into account submitted comments and the views of the joint expert group;

(d) ICP Forests in collaboration with ICP Modelling and Mapping had further developed dynamic modelling on the level II plots where both deposition and soil solution chemistry data were available. The plan was to complete the effort on 200 forest plots possibly scaling up to the whole of Europe by 2004;

(e) ICP Materials planned to incorporate the time-dependent dose-response functions for predictions of damage under future scenarios.

B. Methods for European assessment

1. Assessment of the effects of implementing the Gothenburg Protocol

13. The joint expert group asserted that the major dynamic models currently in use showed mutually consistent outputs, when driven by the same input data. The various models, however, addressed different aspects and questions, and thus their outputs were complementary.

14. The group noted that there were basically two methodologies available for regional dynamic model applications. The first was to apply a relatively simple model (now under development by ICP Modelling and Mapping) on all sites and grid squares for which a critical load value was reported and the second was to use more complex existing models at a subset of these sites. For surface waters only the second was available.

15. The group felt that regionalization could be achieved using two approaches. One was to transform input data to the required grid scale and then apply the model. The second was to model the individual data (sites) and then scale up the model output. Both were acceptable for inclusion in the European-scale assessment. In the latter cases, the representativeness of the sites must be assessed in view of the critical loads already submitted (see paras. 16 and 17 below).

2. Input to the integrated assessment modelling

16. The group insisted that for the integrated assessment modelling there must be compatibility between input data for critical load calculations and for dynamic models. This must hold on a grid basis, and might result in a revision of critical loads. The group stressed that compatibility of critical loads and dynamic models was the responsibility of the individual countries.

17. The group agreed that model outputs must be designed with two end-user categories in mind. The first was as input to the integrated assessment modelling (on some European standard to be specified by the ICP Modelling and Mapping). The second was for other decision makers and the public nationally and internationally. Outputs should endeavour to maintain compatibility with previous critical load outputs such as maps.

3. Biological recovery models

18. The group pointed out that dynamic models at present focused on the time delays between deposition of sulphur and nitrogen (dose) and the changes in the chemical environment (response). Thus dynamic models currently evaluated the time required to obtain conditions suitable for key biological organisms. Additional time lags would occur due to delays in biological response to the changes in the chemical environment.

19. The group stressed that although important empirical data on biological response existed for aquatic ecosystems and, to a lesser extent, terrestrial ecosystems, dynamic biological recovery

models were lacking. The group strongly encouraged the development of such models. This would realistically require two to four years' work.

C. Recommendations to ICPs, EMEP and CIAM

20. The group urged ICP Waters, ICP Forests and ICP IM to continue their efforts to invite and strengthen dynamic modelling work in countries where there was little or no such activity (see annexes I and II). Further, the group encouraged ICP Waters to dovetail new efforts in Canada and the United States into ongoing efforts. It also urged the Task Force on Integrated Assessment Modelling to provide guidelines as soon as possible for the outputs that it required from dynamic models. These were likely to focus on "dynamic target functions" and "recovery isolines". It was recommended that ICP Modelling and Mapping and CCE should develop methods for summarizing these dynamic model outputs at the European level.

21. The group strongly hoped that: (i) ICP Modelling and Mapping would propose model output designs appropriate for European-scale use that could serve as a standard; (ii) ICP Forests and ICP Waters would commence work on dynamic biological models as soon as possible; and (iii) EMEP would provide current and historic deposition data for all major pollutants by 150 x 150 and 50 x 50 km grid square by ecosystem type to CCE as soon as possible.

22. The group stressed that EMEP participation at its next meeting was essential.

23. The group expected from CIAM new future scenarios of sulphur and nitrogen deposition (by grid square) beyond the year 2010. These could then be assessed by the dynamic models.

24. The group recommended that ICP Vegetation should be represented at the next meeting, so that issues related to nitrogen as a nutrient in non-forested semi-natural ecosystems could be considered and incorporated.

25. The group applauded the work of CCE in preparing the dynamic modelling manual. It urged that this manual should be completed and distributed as proposed.

D. Research needs and development

26. The group recognized gaps in knowledge with regard to nitrogen dynamics and encouraged continued research within ongoing and future national and international programmes. Such gaps were unlikely to be filled within the next few years and yet such data were necessary for integrated carbon and nitrogen cycle models. Such models were currently under development and were necessary over the next few years to make significant progress.

27. The group identified that best case/worst case nitrogen leaching scenarios must be used in dynamic modelling to address some of the uncertainty associated with nitrogen dynamics. It was important, however, to ensure consistency between dynamic and steady-state model application.

28. The group strongly agreed that there should be greater emphasis on the development of links between biogeochemical and biological response models for both aquatic and terrestrial ecosystems. It urged that this should be considered by the relevant ICPs.

29. It was agreed and recommended that uncertainty analyses of data and models should be undertaken on the European scale. Techniques and expertise for uncertainty and risk analyses were available. Some progress might be achieved in 2002-2003 through national research projects. Progress on the European scale, however, was unlikely unless sufficient new financial resources were made available.

30. The group highlighted the following confounding factors most likely to impact on the expected recovery of ecosystems to proposed and future abatement measures:

(a) Global change - including annual and seasonal changes in hydrology, temperature, atmospheric composition and sea-salt deposition;
(b) Land use and management - including forestry, biomass production and agriculture.

31. The group recommended that the consideration of global change and land use and management and other environmental drivers should be added to the existing modelling activities stepwise.

E. General

32. The joint expert group concluded that its role in the medium term was to:

(a) Review and assess dynamic model outputs produced by ICPs and national and international projects with respect to their relevance to the aims of the Convention;
(b) Review dynamic modelling approaches and methodologies as they were developed;
(c) Assist in the coordination of the activities of ICPs in dynamic modelling.

33. It reviewed the timetable for dynamic modelling activities as presented in the Draft medium-term work-plan for the further development of the effect-oriented activities (EB.AIR/WG.1/2001/5) and agreed that the timetable was ambitious but achievable.

34. In pursuit of this timetable the group noted the CCE plan to involve national focal centres of ICP Modelling and Mapping in the application of dynamic models and the related acquisition of data.

35. The group noted the ongoing and planned modelling efforts in Canada and the United States. The group would benefit from these model applications due to their different environmental conditions and from the exchange of scientific knowledge and information. It therefore strongly encouraged these countries to continue to participate in its activities.

36. The group emphasized that dynamic modelling was a time- and resource-consuming process and must be adequately funded to fulfil the potential for European-scale assessment in the review of existing protocols and the development of new ones.

37. The joint expert group on dynamic modelling concluded that it was necessary to meet again on 4-6 November 2002, in particular to review the progress on:

(a) National and European-scale model applications on the recovery of soils and waters;
(b) Dynamic modelling on level II forest plots;
(c) Regional applications of dynamic models in the United States and Canada;
(d) The development of the simple dynamic model;
(e) Dynamic modelling in the European countries not represented in the group at its present meeting;
(f) Requirements of CIAM for outputs for dynamic modelling;
(g) Deposition scenarios to be considered for use in dynamic modelling,

and to establish the current status and expected timetable with respect to dynamic modelling of biological responses in surface waters and in terrestrial ecosystems.

Annex I

Status of dynamic modelling of forest soils by country from which information is currently available

Country	Plans	National skills	Data	Modelling under way? (Past/present sites, model used)
Austria	Unclear	Sufficient	Sufficient	Unclear (50 sites possible)
Bulgaria	Insufficient	Insufficient	Insufficient	Yes (1 site, SAFE)
Croatia	Sufficient	Sufficient	Sufficient	Yes (15 sites, SAFE)
Czech Republic.	Insufficient	Sufficient	Unclear	Yes (20 sites, MAGIC/SAFE)
Denmark	Sufficient	Sufficient	Sufficient	No (93 sites, Heather, SAFE)
Estonia	Unclear	Sufficient	Unclear	No
Finland	Unclear	Sufficient	Sufficient	No (5 sites, SAFE, SMART)
France	Insufficient	Sufficient	Some	No
Germany	Sufficient	Sufficient	Sufficient	Yes (95/500 sites, SAFE)
Hungary	Sufficient	Sufficient	Sufficient	Yes (10+ sites, SAFE)
Ireland	Unclear	None	Insufficient	No (1 site, SAFE)
Italy	None	None	Unclear	No
Netherlands	Sufficient	Sufficient	Sufficient	Yes (800 sites, SMART)
Norway	Sufficient	Sufficient	Sufficient	Yes (690 sites, MAGIC)
Poland	Unclear	Sufficient	Sufficient	No
Russian Federation	Sufficient	Sufficient	Sufficient	Yes (5-20 sites, SAFE)
Slovakia	Unclear	Sufficient	Sufficient	No
Slovenia	Sufficient	Sufficient	Sufficient	Yes (1-3000 sites, SAFE)
Spain	None	Sufficient	Insufficient	No (1 site, SAFE)
Sweden	Sufficient	Sufficient	Sufficient	Yes (200 sites, SAFE)
Switzerland	Sufficient	Sufficient	Sufficient	Yes (600 sites, SAFE)
Ukraine	Insufficient	Insufficient	Sufficient	No (planned)
United Kingdom	Sufficient	Sufficient	Insufficient	Yes (200 sites, SAFE)

Annex II

Status of dynamic modelling of waters (acid-sensitive regions only)

		ICP sites	Soil data	Modelling	Comments (project/contact)
EUROPE					
Fenno-Scandian shield:	Norway	YES	YES	YES	RECOVER:2010 + national project
	Sweden	YES	YES	YES	RECOVER:2010 + national project
	Finland	YES	YES	YES	NMR - project
	Russian Federation – Kola	YES	NO	?	
	Russian Federation – Karelia	NO	?	NO	
Upland areas in the British Isles	Scotland	YES	YES	YES	RECOVER:2010 + national project
	Wales	YES	YES	YES	RECOVER:2010 + national project
	Northern England	YES	YES	YES	RECOVER:2010 + national project
	Ireland	YES	NO	NO	
Lowland Heaths/Forests:	SE England	NO	?	NO	
	Denmark	NO	?	NO	
	Germany – northern	YES	YES	YES	RECOVER:2010 + national project
	Netherlands	YES	?	?	
	Belgium	NO		NO	
Mid-European Forests	France – Vosges	NO	?	NO	
	Belgium – Ardennes	NO	?	NO	
	Germany – Black Forest, Harz Mountains	YES	YES	YES	RECOVER:2010 + national project
	Germany – Bavarian Forest, Mittelgebirge	YES	YES	YES	RECOVER:2010 + national project
	Czech Republic – Sumava	YES	YES	YES	RECOVER:2010
	Czech Republic, 14 catchments	YES	YES	YES	national project
Pyrenees	Spain	YES	YES	YES	EMERGE
	France	YES	?	?	
Alps	Italy	YES	YES		RECOVER:2010
	Switzerland	YES	NO	NO	
	Austria	YES	NO	NO	
Tatras	Slovakia	NO	YES	YES	EMERGE
	Poland	YES	?	YES	
SE Europe	Bulgaria	NO	?	NO	

NORTH AMERICA					
United States: North East	135 lakes, of which 35 in Adirondacks	YES	?	YES	EPA
	Maine, 90 high-elevation lakes	YES	?	YES	S.A. Norton, J.S. Kahl, J. Cosby
	New Hampshire, Hubbard Brook	YES	?	YES	C.T. Driscoll
United States: South East	Virginia, Shennandoah, 14 streams	YES	?	YES	J. Cosby
	West Virginia, 60 streams	YES	?	YES	J. Cosby
	National Stream Survey	YES	?	YES	NAPAP 1990
	Southern Appalachian Mountains, 164 streams	YES	?	YES	J. Cosby
United States: West Coast	San Bernadine Mts, Cascades, Sierra Nevada	NO	?	NO	
United States: Rocky Mountains	Colorado Front Range	NO	?	NO	
Canada: Nova Scotia	Kejimkujik, 3 lakes	YES	YES	YES	Env. Canada: T.A. Clair
Canada: Quebec	Lac Laflamme, 1 lake	NO	?	NO	
Canada: Ontario	Turkey Lakes, 4 lakes	YES	YES	YES	Env. Canada: D.S. Jeffries
	Haliburton-Muskoka, 8 lakes	NO	YES	YES	Trent University: P.J. Dillon
	Killarney/Sudbury, 2 lakes	NO	YES	YES	NLRS: J. Gunn
Canada: Alberta	Fort McMurray region	NO	?	NO	