I. INTRODUCTION

1. This report describes the results of the ninth meeting of the Joint Expert Group on Dynamic Modelling held from 20 to 22 October 2008 in Sitges, Spain, presented here in accordance with the Convention’s 2009 workplan (ECE/EB.AIR/96/Add.2, item 3.9 (d)) approved by the Executive Body at its twenty-sixth session.

A. Attendance

2. Twenty-one experts from the following Parties to the Convention on Long-range Transboundary Air Pollution attended the meeting: Austria, Canada, Denmark, France, Ireland, Netherlands, Norway, Poland, Sweden, Switzerland, United Kingdom of Great Britain and
Northern Ireland, and United States of America. The Coordination Centre for Effects (CCE), 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 International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes (ICP Waters) were represented. A member of the Bureau of the Working Group on Effects and a member of the Convention secretariat also attended.

B. Organization of work

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 the Swedish Clean Air Research Programme (SCARP).

II. AIMS AND ORGANIZATION OF THE MEETING

4. The objectives of the Joint Expert Group meeting were related to its work defined in the draft 2009 workplan items (ECE/EB.AIR/WG.1/2008/4/Rev.1), including items common to all effects-oriented programmes (subparas. d–h):

(a) To discuss the results of the 2007/2008 data submitted by the national focal centres (NFCs) of ICP Modelling and Mapping to CCE;

(b) To examine progress in dynamic modelling of nutrient nitrogen (N) in terrestrial systems, interactions between climate change and air pollution, biological response and terrestrial carbon (C) sequestration;

(c) To contribute to the revision of the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol);

(d) To consider airborne N impacts on the environment (in collaboration with the Task Force on Reactive Nitrogen and the Task Force on Integrated Assessment Modelling);

(e) To consider selected key monitored and modelled parameters;

(f) To discuss the update of the strategy of the effects-oriented activities;

(g) To explore merits of the different options for target-setting in 2020 and non-binding aspirational targets for the year 2050, in collaboration with the Task Force on Integrated Assessment Modelling and CIAM;
(h) To discuss further quantification of policy-relevant effects indicators such as biodiversity change, and their linkage to the integrated modelling work;

(i) To consider the future of the Joint Expert Group on Dynamic Modelling.

III. CONCLUSIONS AND RECOMMENDATIONS

A. Experience from the 2007/2008 data submission to the Coordination Centre for Effects

5. The Joint Expert Group acknowledged the efforts made by CCE to use and present the information submitted, given the magnitude of the task. Twelve countries had submitted dynamic modelling data. These were made compatible with critical loads. The synthesis prepared by CCE was available for integrated assessment.

6. The data submitted in response to the call represented the best available assessment. This should be further refined in future as new information and data become available. The Group suggested that this database be maintained according to latest knowledge, possibly through issuing further calls for dynamic modelling output in the future.

7. The Group encouraged ICPs to consider future needs of the Convention in relation to dynamic modelling as set out in the Convention’s workplan. In particular, dynamic models should be applied to address atmospheric deposition, land use and climate change interactions.

8. The Group noted that the scenario analysis by CCE using national applications of dynamic models indicated that a large number of Norwegian lakes would remain acidified in future, assuming emission scenarios with current legislation (CLE) and maximum technically feasible reductions. The acidity status was defined as the acid neutralizing capacity (ANC) in water being smaller than 20 µeq/l.

B. Progress on dynamic modelling of nutrient nitrogen in terrestrial systems, interactions between climate change and air pollution, biological response and terrestrial carbon sequestration

9. The Joint Expert Group considered an urgent need to pursue closer working relationships with the climate change and atmospheric chemistry modelling communities to properly address ecosystem effects. Important issues included the downscaling of climate processes and the upscaling of terrestrial biogeochemical processes, in particular the development of integrated and consistent approaches to dynamic modelling of N emissions and C sequestration.
10. The Group considered it important to reconfirm and emphasize that ecosystem effects underpinned policies on both climate change and atmospheric pollution.

11. The Group noted the need for a consistent approach to climate scenarios to be adopted by the modellers. It encouraged the use of historical climate data such as those available from the Climate Research Unit at the University of East Anglia in the United Kingdom. It also noted the need for a consistent approach to future climate scenarios, such as those provided by the European Union (EU) projects PRUDENCE and ENSEMBLES.

12. The Group proposed that an international workshop on the impacts of climate change and N on terrestrial and aquatic biodiversity and the development of policy-relevant biodiversity indicators be held. Such a workshop was required to bring together existing work on indicators and indices and to translate these into parameters that could be predicted by dynamic models. The work on reference conditions for waters under the EU Water Framework Directive\(^1\) was considered a good example.

13. The Group noted the improved version of the very simple dynamic model (VSD) was being further developed by CCE with enhanced specification of C and N dynamics, which included controls on immobilization and sequestration based on C/N ratios. ICP Modelling and Mapping aimed to make VSD suitable to provide outputs for calculating critical and target loads for biodiversity, in accordance with the Convention’s workplan.

14. The Group emphasized that further model developments were required to improve biogeochemical representation. In particular, there was a need to improve modelling of pH and N to better address biodiversity issues. In addition, phosphorus, iron and organic N would need to be considered for inclusion in the dynamic models.

15. The Group concluded that dynamic models of nutrient N in terrestrial systems, interactions between climate change and air pollution, biological response and terrestrial C sequestration had been developed to the stage where their potential use was clear. However, the modelling community needed to continue its work to rigorously evaluate performance against observed data and manipulation experiments such as NITREX and RAIN.

16. The ecosystem level models available required further work on validation, ground truth and testing. The Group recognized that this was constrained in part by the availability of data on ecological changes. To this end, the Group encouraged stronger links to the monitoring work under ICP Forests, ICP Vegetation and ICP Integrated Monitoring. In particular, the Group requested data on C pools and C/N ratios with at least two measurements in time.

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17. The Group further requested that every effort was made to continue time-based measurements in ecosystems. It emphasized that the existence and continuation of long-term ecosystem monitoring were crucial for correct model predictions of future ecosystem status. Work was also needed to reconstruct the past ecosystem status using all available techniques, such as sediment cores, tree rings and pollen records. NFCs could be requested to identify relevant data available.

C. Revision of the Gothenburg Protocol

18. The Joint Expert Group emphasized that dynamic modelling made a clear and significant contribution to the revision of the Gothenburg Protocol, particularly in relation to nutrient N and acidification. ICP Modelling and Mapping had successfully completed the development and application of target load functions. The Group encouraged their widest possible use by the Task Force on Integrated Assessment Modelling, in collaboration with the Working Group on Effects.

19. The Joint Expert Group noted that whilst CCE had delivered its input to the revision of the Gothenburg Protocol on acidification modelling, much work remained to be done to establish relevant outputs for nutrient N. The target loads for biodiversity were likely to be very different than those for acidification.

20. The Group took note that model simulations on N predicted long time lags to recovery and that some impacts were irreversible. At some sites, intervention management might be required to reduce internal stores of accumulated N. Policymakers needed to be aware that, given the historical levels of N input, the 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, also known as self-eutrophication.

D. Airborne nitrogen impacts on the environment


22. The Group welcomed the opportunity to be represented at future Task Force meetings and in its expert work. The Group recommended that effects-based work on N should also considered and used by the Task Force. However, N emissions from ecosystems were being considered and also included in some ecosystem models.
E. Key monitored and modelled parameters

23. The Joint Expert Group recognized the key challenge of strengthening the link between currently monitored parameters, incorporated in dynamic models, and parameters relevant in predicting ecological impacts.

24. Target organisms, e.g. brown trout and trees, and dose-response relationships, where the key chemical parameters comprised, inter alia, ANC, base saturation and pH, had been identified and developed for acidification. Both target organisms and key chemical parameters were monitored widely. This link between monitored and modelled parameters was not so well established for nutrient N, biodiversity, and eutrophication of soils and water.

F. Strategy of the effects-oriented activities

25. The Joint Expert Group emphasized that ecosystem effects should remain fundamental to the Convention, and should be more widely used within EU legislation. It expressed its concern that funding for research on ecosystem effects was diminishing at both the EU and national levels.

26. The Group noted that dynamic modelling had a clear role in demonstrating and quantifying future ecosystem effects. Regional data sets comprising thousands of sites were routinely modelled. The models were linked to the grid-based outputs of large-scale deposition models. Climate and land-use change could be included and linked to the outputs from large-scale climate change models.

G. Options for target-setting in 2020 and non-binding aspirational targets for the year 2050

27. The Joint Expert Group noted that targets should be focused on concepts such as “good status” or “favourable conservation status”, similar to the concepts in the EU Water Framework Directive and the EU Habitats Directive.

28. The Group noted that both models and monitoring data indicated that historical reference states were not a valid target for remediation, as they were potentially unachievable according to model simulations.

29. The Group agreed that biodiversity targets were currently not well formulated. It was difficult to calculate target loads for biodiversity without identifying potential land management

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strategies. Previous site management history was also extremely important in terms of present and future response.

30. The Group noted that aspirational target-setting should include the concept of protecting appropriate ecological receptors. It emphasized the need to consider emission reductions beyond the maximum technically feasible reductions.

31. The Group noted that originally neither critical loads nor dynamic models included possible combined effects of other drivers, such as climate change. The relative importance of air pollution as a key driver of ecosystem change, however, had shifted. The Group concluded that the concept of aspirational targets should be used to bring air pollution, climate and land use drivers together in an overall evaluation.

32. As an example, empirical data suggested that lakes acted as C sinks of similar strength to the ocean. They could also be an important source of greenhouse gases. The processes were linked to acidification status. Dynamic modelling could provide a quantification and assessment of all these aspects.

H. Policy-relevant effects indicators such as biodiversity change linked to integrated modelling

33. The Joint Expert Group took note of a methodology to calculate critical loads based on biodiversity that was proposed by several modelling teams. The concept was presented in the CCE workshop in 2009 and it is being further tested and refined. It further noted that coupled models such as For-SAFE-Veg and SMART-SUMO-MOVE were now operating at regional scales. These would provide tools to evaluate the changes in plant species assemblages and habitat suitability in relation to atmospheric deposition and climate change. The Group acknowledged that significant progress had been made with these coupled models and that further efforts were being made to model air pollution, climate change and land use change in an integrated manner. The Group also noted the existence of model systems not presented at the meeting, such as MOBILE/BERN.

34. The Group noted that it was important to ensure that parameters used in different models were consistent when applied in model chains. Assumptions regarding species competition might not be valid over very long time scales (50–100 years or more). The Group considered that sensitivity analysis and quantification of uncertainty were critical to model chains, since biodiversity predictions were made at the end of the calculations.
I. The future of the Joint Expert Group

35. The Joint Expert Group noted that it had provided a forum to develop a consistent methodology for dynamic modelling within the Working Group on Effects. It had also supported the modelling capability now held at CCE and its NFCs. The Group had also provided a forum for wider consideration of relevant science within the framework of the Convention, e.g. dose-response relationships, chemical and biological receptors, and other ecosystem drivers.

36. The Group noted that the continued and increasing importance of dynamic modelling by effects-oriented programmes was reflected in the decisions and workplans of several Convention bodies, which had identified the need for dynamic modelling in the work for the revision of the Gothenburg protocol, in particular:

   (a) Helping to define long-term aspirational goals for 2050 that took into account changing climate and land use management;

   (b) Responding to the request from the Task Force on Reactive Nitrogen to address the dynamics of N processes;

   (c) Applying the regional dynamic modelling tools in the work of the Task Force on Integrated Assessment Modelling.

37. The Group took note of the immediate challenge for dynamic modelling under the Convention to provide further input to the revision of the Gothenburg Protocol. In the long term, many challenges would remain and could provide a basis for work beyond the revision of the Protocol.

38. The Group agreed that its tenth meeting would be held in October 2009. It would address, in particular:

   (a) The needs of the Convention that could be answered by dynamic modelling;

   (b) Progress in dynamic modelling nutrient N in terrestrial systems, interactions between air pollution and climate change, biological responses, terrestrial C sequestration, links to earth system models, and heavy metals;

   (c) The further contribution of dynamic modelling to revision of the Gothenburg Protocol.

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