Economic Commission for Europe

Executive Body for the Convention on Long-range
Transboundary Air Pollution

Working Group on Effects

Thirtieth session
Geneva, 27–29 September 2011

Item 4 of the provisional agenda
Recent results and updating of scientific and technical knowledge

**Modelling and Mapping**

Report by the Coordination Centre for Effects of the International Cooperative Programme on Modelling and Mapping Critical Levels and Loads and Air Pollution Effects, Risks and Trends

I. Modelling and mapping progress

1. The 27th meeting of the Task Force on Modelling and Mapping and the 21st Coordinating Centre for Effects (CCE) workshop were held back to back at the National Institute for Public Health and the Environment (Bilthoven, 18-21 April 2011).

2. The meeting was attended by 64 delegates from the following 25 countries: Belgium, Bulgaria, Canada, China, Croatia, Czech Republic, Finland, France, Germany, Ireland, Italy, The Netherlands, Norway, Poland, Portugal, Republic of Belarus, Republic of Moldova, Romania, Russia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, USA. The Bureau of the Working Group on Effects (WGE), the Bureau of the EMEP\(^1\) Steering Body, the International Cooperative Programme (ICP) on Vegetation, the ICP Waters, ICP Integrated Monitoring as well as the Coordination Centre for Effects (CCE) were represented.

3. The objectives of the meeting were the review of the call for data, the further development of models to assess the dynamics of soil chemistry and plant species diversity,

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\(^1\) Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
including their interactions, and the training of National Focal Centres (NFCs) in using these models in their countries.

4. The CCE presented the results of the call for data – for scientific use - issued in 2010 to encourage the NFCs (a) to revise their computed and empirical critical loads and to provide them in at least 5x5 km² resolution, (b) to apply the VSD+ - Veg model to their national dataset and (c) to collaborate with Habitat experts.

5. 18 NFCs submitted data and background documentation and most calculated acidification and nutrient nitrogen critical loads. 8 countries indicated their collaboration with Habitat Directive experts. 9 countries reported results for soil-vegetation modelling. Reception from the USA, for scientific use only, was acknowledged of a first, tentative and preliminary submission of critical loads related data including background documentation.

6. Following the results of the call for data, and the training session, the Task Force noted that the objectives of a proposed call for contribution on dynamic modelling applications may include:

   i. An overview of endpoints considered by the NFCs
   ii. Application of applicable biodiversity indices as summarized in the CCE Status Report 2010
   iii. The comparison of simulation results using different models: NFCs are encouraged to apply the VSD+ - Vegetation (made available by CCE model) as a common modelling basis
   iv. The comparison of simulation results using different sites: NFCs are invited to make sites data available to other NFCs, via the CCE-website
   v. Policy relevance: countries are invited to include nature protection areas (such as Natura 2000 areas) in their model testing
   vi. Regionalisation: NFCs are recommended to review the possibilities to use EUNIS classes, Natura 2000 and eco-regions as a basis for regionalisation
   vii. Complete the Vegetation database including the review of (a) the possible quantification of Ellenberg indices and (b) the applicability of the TRY database (http://www.try-db.org/index.php?n=Site.Database).

II. Using ICP M&M effects-based indicators for the support of the revision of the gothenburg protocol²

7. At the 40th session of the Task Force on Integrated Assessment Modelling (Oslo, 18-2- May 2011), the CCE presented results in 2020 of the effect-based assessment of 5 scenarios that were developed by Centre for Integrated assessment Modelling (CIAM, (Amann et al., 2011). Each scenario is based on a specific combination of the percentage by which the gap is closed between the application of Maximum Technical Feasible Reduction (MTFR) technology and Cost Optimal Baseline (COB).

8. The gap is defined by the difference of the effects that are attained in 2020 under COB compared to those under MTFR. This difference is computed using four specified indicators relative to health effects of fine particulate matter, acidification, eutrophication, and ozone formation. The scenarios and the gap closure percentages per scenario are

² 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone
indicated in Table 1 (excluding COB and MTFR that, under the current definition of “gap-closure”, imply 0% and 100% gap-closures respectively). Details on the scenario can be found in IIASA (2011).

Table 1: Summary of gap closure percentages for the impact indicators (source: Amann et al., 2011)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Health-PM</th>
<th>Acidification</th>
<th>Eutrophication</th>
<th>Ozone</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
</tr>
<tr>
<td>High*</td>
<td>75%</td>
<td>75%</td>
<td>75%</td>
<td>50%</td>
</tr>
<tr>
<td>MID</td>
<td>50%</td>
<td>50%</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>Low*</td>
<td>25%</td>
<td>25%</td>
<td>50%</td>
<td>25%</td>
</tr>
<tr>
<td>LOW</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
</tr>
</tbody>
</table>

The analysis of effects summarized in this report addresses the COB, LOW, MID, HIGH and MTFR scenarios. The High* and Low* scenarios focus on measures to reduce the gap for ozone effects. From the point of view of acidification and eutrophication these scenarios do not have sufficient discriminatory power from HIGH and LOW respectively.


10. In CCE (2010; 2011), in addition to area at risk, also other indicators, not implemented in the GAINS model, are quantified. These include exceedance magnitudes of empirical and computed critical loads as well as target loads and estimates of changes in the time needed for recovery or damage and changes of plant species diversity in Europe.

A. Acidification

11. Two indicators for acidification, i.e. area at risk of acidification and area at risk of not recovering before 2050 are illustrated in the following paragraphs.

12. The area at risk for acidification for each scenario is summarized in Table 2 for the geographical area of EMEP and the EU 27 respectively. The area at risk of acidification turns out to further decrease from COB to MTFR. Under MTFR only 1 (about 4 million ha) and 3% (about 6 million ha) of the area in the EMEP and EU27 region respectively is still at risk of acidification.

Table 2: Approximated percentage of the computed area at risk in 2020 of acidification in EMEP-Europe and the EU27.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>COB</th>
<th>LOW</th>
<th>MID</th>
<th>HIGH</th>
<th>MTFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRTAP-EMEP</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>EU 27</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
13. The area that will not recover from acidification by 2050 is identified by computing the area where acidifying depositions under COB and MTFR exceed the deposition thresholds (i.e. target loads) that are needed to achieve recovery in or before 2050. The result is illustrated in Table 3 showing that areas that exceed the target loads are larger than those where the critical loads are exceeded (Table 2). This is to be expected since target loads are lower than critical loads. If deposition would be equal to critical loads, recovery of areas at risk is only possible after 2050, except for the areas of which the critical load happens to be equal to the target load.

Table 3:

The percentage of the area at risk of not recovering from (i.e. exceeding target loads for) acidification before or in 2050 under COB and HIGH, depositions being kept constant at the 2020 level until 2050.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>COB</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRTAP-EMEP</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>EU 27</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

B. Eutrophication

14. Three indicators for eutrophication, i.e. (1) area at risk of eutrophication, (2) area at risk of not recovering before 2050 and (3) area at risk of a more than 5% change of biodiversity.

15. The area at risk of eutrophication (table 4) covers 37% (143 million hectare) and 58% (94 million hectare) in the EMEP and EU27 region respectively. The area at risk in the EMEP and EU27 region, while decreasing, remains high under MTFR, i.e. 21% (81 million hectares) and 36% (58 million hectares).

Table 4:

Approximated percentage of the computed area at risk in 2020 of eutrophication in EMEP-Europe and the EU27.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>COB</th>
<th>LOW</th>
<th>MID</th>
<th>HIGH</th>
<th>MTFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRTAP-EMEP</td>
<td>37</td>
<td>32</td>
<td>28</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td>EU 27</td>
<td>58</td>
<td>52</td>
<td>46</td>
<td>42</td>
<td>36</td>
</tr>
</tbody>
</table>

16. The area of not recovering from eutrophication by 2050 is identified by computing the area where eutrophying depositions under COB and MTFR exceed the nitrogen deposition thresholds (i.e. target loads) that are needed to achieve recovery in or before 2050.

17. Table 5 illustrates that the area at risk of not recovering before 2050 is as large as the area where critical loads are exceeded in the EMEP region (37%) and slightly larger in the EU27 (60%) (compared to results shown in Table 4).

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Table 5:
the percentage of the area at risk of not recovering from (i.e. exceeding target loads for) eutrophication before or in 2050 under COB and HIGH, depositions being kept constant at the 2020 level until 2050

<table>
<thead>
<tr>
<th>Area</th>
<th>Scenario</th>
<th>COB</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRTAP-EMEP</td>
<td></td>
<td>37</td>
<td>26</td>
</tr>
<tr>
<td>EU 27</td>
<td></td>
<td>60</td>
<td>45</td>
</tr>
</tbody>
</table>

18. The last indicator to be illustrated in this report expresses the area at risk of excessive nitrogen deposition causing more than 5% “change in biodiversity”, i.e. change in species richness (for semi-natural grass lands; sub-alpine scrub habitats), and similarity (of coniferous boreal woodlands), together covering slightly more than half, i.e. 53%, of European natural area.

19. The analysis of the “change of biodiversity” consists of a numerical estimation of the effect of scenario-specific nitrogen deposition in 2000 and 2020 on the species richness of (i) (semi-)natural grasslands (EUNIS class E) and (ii) arctic and (sub-)alpine scrub habitats (EUNIS class F2) and on the Sorensen’s similarity index of the understorey vegetation of coniferous boreal woodlands (EUNIS class G3 A-C). Thus “change of biodiversity” is used as a common name for any of these indicators.

20. This analysis is based on dose-response curves (Bobbink 2008, Bobbink and Hettelingh, 2011) that have been applied to these three EUNIS classes in Europe (Hettelingh et al. 2008a), using the European harmonized land cover map (Slootweg et al. 2009).

21. It is noted that this procedure is prone to many uncertainties. Firstly because it ignores nitrogen induced changes that may occur to other EUNIS classes for which no dose-response curves are yet available. Secondly, it assumes that available relationships between dose and response do not vary geographically, i.e. they are valid irrespective of where an area is located in Europe. Thirdly, some may consider it a tall order to assume that these dose response curves are representative for a broad regional scale, when these have been established using dose-effect information which is only available for a relatively small number of non-randomly chosen sites.

22. Moreover, the area at risk of a change in biodiversity was only computed if the latter was computed to be “significant”, i.e. when the indicator changed by more than 5% relative to the value of the indicator for the “control” area used to establish the dose-response curve.

23. Tentative results are shown in Table 6. The used indicators for biodiversity show a marked improvement of the protection of plant species diversity under MTFR compared to COB, thus confirming the direction of diminishing adverse effects already noted using indicators described below.
Table 6:

<table>
<thead>
<tr>
<th>Scenario % Area</th>
<th>COB</th>
<th>LOW</th>
<th>MID</th>
<th>HIGH</th>
<th>MTFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLRTAP</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>EMEP</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

24. The ensemble of the indicators described above provide a multiple view-point for use in policy support of the change of adverse effects induced by emission reduction alternatives as reflected in the scenarios COB to MTFR.

References


