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Working Group on Strategies and Review
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Item 4 of the provisional agenda

REPORT OF THE FIRST MEETING OF THE EXPERT GROUP ON AMMONIA ABATEMENT */

Summary report

I. INTRODUCTION

1. The first meeting of the Expert Group on Ammonia, led by the United Kingdom, was held in Berne, Switzerland, from 18 to 20 September 2000. The meeting was hosted and organized by the Swiss Agency for the Environment, Forests and Landscape (SAEFL), Berne, in cooperation with the Swiss College of Agriculture (SCA), Zollikofen.

2. The meeting was attended by experts from the following Parties to the Convention: Austria, Belgium, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Russian Federation, Slovenia, Slovakia, Switzerland, United Kingdom. Representatives of the EMEP Meteorological Synthesizing Centre–West, the International Institute for Applied Systems Analysis (IIASA) and the European Fertilizer Manufacturers Association (EFMA) also participated in the meeting. The UNECE secretariat was also represented.

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3. The objective of the meeting was to initiate the work requested by the Executive Body at its seventeenth session (ECE/EB.AIR/68) after the adoption and signature of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone in Gothenburg, Sweden, in December 1999. The Expert Group on Ammonia was asked to prepare a framework code of good agricultural practice and to address uncertainties raised during earlier workshops, e.g. such as that held in Bratislava in 1999 (EB.AIR/WG.6/1999/6), and meetings within its scope of competence.

4. The meeting included a series of key plenary presentations, short plenary communications and posters covering the following items:

(a) Information on the status of the Convention on Long-range Transboundary Air Pollution;

(b) Presentation of a draft framework advisory code of good agricultural practice for reducing ammonia emissions, prepared by expert consultants;

(c) New data on ammonia emissions, ammonia abatement techniques (manure application, housing systems), ammonia abatement scenarios and critical loads of nitrogen exceedances;

(d) New results from studies on ammonia losses after urea application;

(e) Links between ammonia emission control and measurements of concentrations and deposition of reduced nitrogen compounds;

(f) The role of reduced nitrogen compounds in the EMEP model.

5. Two working groups were established to discuss:

(a) The draft advisory framework code of good agricultural practice for reducing ammonia emissions and new data on abatement techniques (Working Group 1);

(b) Uncertainties concerning the links between ammonia emission control and concentrations/deposition of reduced nitrogen compounds (Working Group 2).

6. After in-depth discussions, the meeting agreed on a number of conclusions and recommendations, which are presented below.

I. RESULTS, CONCLUSIONS, RECOMMENDATIONS

A. Working group 1: Draft advisory code of good agricultural practice for reducing ammonia emissions and new data on abatement techniques

7. The working group was given the tasks of agreeing a draft framework advisory code of good agricultural practice for reducing ammonia emissions and of assessing new ammonia abatement techniques for a review of the "Guidance Document on Control Techniques for Preventing and Abating Emissions of Ammonia," adopted by the Executive Body at its seventeenth session (Executive Body Decision 1999/1).

(i) Advisory code of good agricultural practice

8. Annex IX of the 1999 Gothenburg Protocol, "Measures for the Control of Emissions of Ammonia from Agricultural Sources", requires, within one year from the date of entry into force of the Protocol, Parties to establish, publish and disseminate an advisory code of good agricultural practice to control ammonia emissions. The advisory code is required to cover provisions for:

(a) Nitrogen management, taking account of the whole nitrogen cycle;

(b) Livestock feeding strategies;

(c) Low-emission manure spreading techniques;

(d) Low-emission manure storage systems;

(e) Low-emission animal housing systems; and

(f) Possibilities for limiting ammonia emissions from the use of mineral fertilizers.

9. A draft framework code was written by six experts from Germany, the Netherlands, Switzerland, the United Kingdom and the UNECE secretariat. The draft code was circulated to all participants in the Expert Group on Ammonia in due time before the meeting. A revised version based on further consideration and comments at the meeting was agreed by the Expert Group for submission to the Working Group on Strategies and Review at its thirty-third session (EB.AIR/WG.5/2001/7). The framework code includes advice on ammonia abatement techniques in all areas (a) to (f) in para 8 above. It is intended that Parties use this framework code document to formulate their own national code as required by the 1999 Gothenburg Protocol.

(ii) New data on ammonia abatement techniques

10. In light of new data on abatement techniques, the working group also reviewed the content of the "Guidance Document on Control Techniques for Preventing and Abating Emissions of Ammonia," that was adopted by the Executive Body at its seventeenth session (Executive Body Decision 1999/1). The document is required to be amended as knowledge and experience of ammonia control measures increase. The working group considered that there had been sufficient increase in knowledge and experience in certain areas to require an update of the Guidance Document and recommended that the Document be revised in the following areas:

(a) Manure storage techniques: The need to discourage the construction of new slurry lagoons should be included. Poultry manure storage and abatement efficiency figures for poultry manure also needed updating;

(b) Housing systems: Further knowledge was now available on solid floors for beef and dairy cattle housing, particularly ridged floors. For pig housing, the three functional areas should be revisited as should naturally ventilated systems and group housing systems. For laying hens, consideration was needed in advance of the new European Union (EU) legislation to phase out battery hens and move to aviary systems (evidence from Swiss poultry housing, which moved away from battery hens approximately ten years ago, could be helpful here);

(c) Feeding strategies and other measures: The feeding strategies section for pigs could be revised as new arrangements were now being applied on farms;

(d) Mineral fertilizers: This needed a thorough revision to reflect updated information on good practice in the use of mineral fertilizers. Wording from the draft framework code (EB.AIR/WG.5/2001/7) could be transposed into this section of the Guidance Document.

B. Working group 2: Establishing the link between ammonia emissions and concentrations/deposition of reduced nitrogen compounds

11. The working group examined the link between estimated national NH_3 emissions and measurements of NH_x concentrations and deposition. The impetus for the working group was the need to quantify independently the effectiveness of NH_3 emission abatement, since it is impossible to monitor national NH_3 emissions directly. The discussion was elaborated through national case studies of NH_3 emission reductions, including the Netherlands, where abatement measures have been implemented and eastern Europe where agricultural activity decreased after 1989. The group addressed NH_3 emission reporting, process understanding, process generalization, atmospheric monitoring requirements and assessment of compliance with agreed national NH_3 emission ceilings.

(i) Case studies of NH_3 emission change

12. In the Netherlands, less than expected reductions in NH_3 concentrations occurred between 1993 and 1997, referred to as the "ammonia gap". In Eastern Europe, it is often difficult to detect reductions in NH_x levels, even though emissions might have substantially decreased. From the analysis of data and modelling, it is concluded that the differences between the observed and expected trends can probably be explained by a combination of a) fluctuations in weather conditions; b) interactions with SO_2 and NO_y, which have changed as levels of these pollutants reduced over the period; c) lower than expected efficiency of abatement measures; and d) possible interactions with other changes in agricultural practices.

13. Putting together the findings from the Netherlands and other countries where emissions have changed, it can be concluded that:

(a) Reductions in concentrations and deposition are sometimes difficult to detect from single site data, but are seen with sufficient time and area averaging;

(b) The abatement policies in the Netherlands and Denmark have been successful in reducing NH_3 emissions, even if the expected decreases may not have been fully realized;

(c) More than expected reductions are seen in NH_4^+ aerosol, compared with less than expected reductions in gaseous NH_3, for example due to interactions with changing SO_2 and NO_x concentrations. This emphasizes the transboundary nature of NH_x pollution and the need for international agreement on emission controls.

14. It was recommended that comparisons between models and measurements for the Netherlands be updated by including all NH_3 sources directly in the model, and also comparisons made for other countries, or regions particularly for Eastern Europe and Denmark, where technical measures for NH_3 abatement have already been applied.

(ii) National emission estimates

15. Although the absolute values of national NH_3 emissions are subject to uncertainty, it is essential to report annual estimates using consistent methodology and input data to allow temporal trends to be assessed. The current reporting of national NH_3 emissions to the Convention is insufficient to analyze trends. The following recommendations were made:

(a) Ammonia emissions should be reported according to sub-sector activity (e.g. animal and fertilizer types). In addition, the contribution of each major component source to emissions (e.g. housing, storage, spreading, grazing) should be reported, except where the Emission Inventory Guidebook simple methodology is used. The statistics of sub-class activity assumed in the calculations should be also stated in submission of emission estimates, giving upper and lower uncertainty limits;

(b) Scientific justification should be provided for emission factors that deviate from the default values in the Emission Inventory Guidebook. A similar justification is needed to explain changes in methodology compared with reporting in previous years. The national submissions, including scientific justification, should be collated and published openly (including on the Internet);

(c) A review is necessary to determine why existing recommendations of the Task Force on Emission Inventories and Projections regarding emission data for NH_3 have not been implemented.

(iii) Process understanding

16. The extent of process understanding of atmospheric NH_x was recognized as a limitation to quantifying the link between emissions, concentrations and deposition. Although many processes are relatively well understood, the following issues need to be addressed:

(a) The mechanisms of NH_3 emission from solid manures, including interactions with composting;

(b) The mechanisms of dry deposition/bi-directional NH_3 exchange with different plant canopies, in particular the extent of soil/litter emissions and their recapture by an overlaying canopy;

(c) The biological controls on the NH_3 compensation point in relation to ecosystem functioning and management interactions in defining net dry deposition;

(d) The saturation of NH_3 dry deposition to plant cuticles near point sources and the advection

of NH_3 into forest stands;

(e) The interactions of NH_3 with SO_2 and NO_y chemistry, in particular dealing with the effect of chemical mixtures including SO_4^{2-} and NO_3^-, and the effect of cloud processing in remobilizing NH_3 from ammonium sulphates;

(f) The quantitative influence of SO_2 and NO_y on NH_3 dry deposition rates including the interaction with other ions on leaf surfaces.

(iv) Process generalization

17. Further work is required to improve the ability to translate understanding of the processes into models to quantify NH_x emission, dispersion and deposition. Attention needs to be given to the following issues:

(a) Improved data sets need to be collected regarding seasonality of agricultural practice and manure handling. The development of coupled emission, dispersion and deposition models incorporating the coupled dynamic link between emission and dispersion/deposition needs further attention;

(b) The parametrization of dry deposition for NH_3 incorporating stomatal and cuticular exchange pathways needs to be refined for application in atmospheric transport models. In particular, there is a need to collate compensation point parameters for different vegetation types and management conditions, together with appropriate land cover data;

(c) The treatment of cloud interactions in atmospheric transport models needs to be improved, including the potential for re-volatilization from ammonium sulphate;

(d) The findings of dynamic models of NH_3, SO_2 and NO_y interactions with leaf surfaces need to be summarized as simple steady-state approximations for incorporation into atmospheric transport models;

(e) Models should assess scenarios of changing SO_2 emission, separating the effect of cloud/ aerosol chemistry and dry deposition chemistry on NH_3 concentrations and deposition.

(v) Monitoring

18. The working group reinforced and added to the conclusions of the EMEP/WMO workshop on monitoring strategies held at Aspenaas Herrgaard, Sweden 2-4 June 1997. It was recognized that many of the recommendations from Aspenaas have not been adopted and it is suggested that a review is made to address the limitations of their implementation. This would be important if the recommendations of this working group were to be adopted.

19. It was noted that the main purposes of monitoring NH_x components were: a) to assess patterns of long-term deposition on ecosystems; b) provide validation for models predicting long-term trends and transboundary transport; c) assess whether pollution abatement policies have been successful. These points indicate priority needs to detect long-term trends and spatial patterns.

The third point is new, to help address compliance with the 1999 Gothenburg Protocol. This implies a requirement for increased monitoring of NH_x in source regions, in addition to current monitoring which focuses on remote areas.

20. The following recommendations made by the Working Group were highlighted as of particular importance:

(a) Sampling for total NH_x in air should be replaced throughout the EMEP network with separate sampling for gaseous NH_3 and aerosol NH_4^+. Less effort should be given to monitoring wet deposition on a daily basis, as weekly precipitation data is sufficient to assess long-term trends;

(b) Detailed temporal data (e.g. hourly) is only necessary at a few sites, with the focus being to understand process interactions, or to monitor dry deposition to key sites. A few such "super sites" should contrast source and sink regions;

(c) Cheap monitoring methods need to be implemented for low frequency NH_x sampling at many sites. Sampling with low flow rate denuder-filter combinations has been shown to operate reliably at weekly to monthly levels;

(d) Given the smooth distribution of aerosol NH_4^+, sampling is necessary at only few (5-30) sites per country. Since NH_3 is much more spatially variable than NH_4^+ aerosol, measurements at many more sites are needed for NH_3 than for NH_4^+. Monitoring for NH_3 should therefore be made with dense networks and a low sampling frequency to identify seasonal and long-term trends. Sampling should be stratified to cover regions dominated by different source types.

(vi) Compliance assessment

21. With the signing of the Gothenburg Protocol, it becomes important to establish compliance of national NH_3 emission ceilings. This needs to be done through a combination of improved emission reporting procedures and interpretation of adequate NH_x monitoring. Each of the above recommendations are therefore essential for proper establishment of compliance. The following key recommendations are made, noting that further discussion of compliance for NH_3 is essential:

(a) Adequate national monitoring of NH_3, aerosol NH_4^+ and wet deposition must be established as soon as possible and if at all possible, before NH_3 emission abatement strategies are put in place. The target should be for Parties to obtain at least 8 years monitoring data at several sites before the target year for emission ceilings of the 1999 Gothenburg Protocol, 2010.

(b) Monitoring of NH_3 must be sufficiently representative to assess national patterns, including representative concentrations in source regions. This will require a combination of measurements and modelling using spatial emission inventories.

II. PROCEEDINGS OF THE MEETING

22. The proceedings of the meeting, containing the extensive working group reports and the

background documents (presentations in the plenary, short communications, abstracts of the posters), may be obtained from the Swiss Agency for the Environment, Forests and Landscape (SAEFL), 3003 Berne, Switzerland, and through the UNECE secretariat in Geneva.