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ECONOMIC COMMISSION FOR EUROPE

EXECUTIVE BODY FOR THE CONVENTION ON
LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Steering Body to the Cooperative Programme for Monitoring and Evaluation
of the Long-range Transmission of Air Pollutants in Europe (EMEP)
(Twenty-fifth session, Geneva, 3-5 September 2001)
Item 5 of the provisional agenda

PHOTO-OXIDANTS, FINE PARTICLES, AND HAZE ACROSS THE ARCTIC AND NORTH ATLANTIC: TRANSPORT OBSERVATIONS AND MODELS*/

Note prepared by the host country of the workshop

Introduction

1. Some 60 atmospheric scientists and environmental policy officials from North America and Europe met on 12-15 June 2001, at Columbia University's Lamont-Doherty Earth Observatory in Palisades, New York, to assess the current state of knowledge about the transport of air pollutants across the Arctic and North Atlantic. The workshop brought together academic and government scientists from the global and regional air quality science communities with members of the international environmental policy community. Participants came from Canada, Denmark, Estonia, Germany, Norway, Republic of Moldova, Sweden, Switzerland, the United Kingdom, and the United States. A list of participants is provided on the workshop Internet site http://www.ciesin.columbia.edu/pph

2. The workshop was hosted by the Center for International Earth Systems Information Network (CIESIN) at Columbia University with primary funding from the United States Environmental Protection Agency and additional support from Environment Canada. The workshop was organized as part of the United States and Canada's ongoing participation and cooperation with EMEP in cooperation with the Arctic Council's Arctic Monitoring and Assessment Program (AMAP).

*/ This document has not been officially edited.

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I. BACKGROUND

3. For some time it has been recognized that persistent airborne pollutants may be transported over very long distances and impact remote environments. Over the last decade, however, there has been increasing evidence that air pollution problems traditionally managed as local or regional problems, such as tropospheric ozone and fine particles, are linked to phenomena at the hemispheric and global scales. The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone calls on Signatories to cooperate in improving:

> ... the scientific understanding of the long-term fate of emissions and the impact of emissions on hemispheric background concentrations of sulphur, nitrogen, volatile organic compounds, ozone, and particulate matter, focusing in particular on the chemistry of the free troposphere and the potential for intercontinental flow of pollutants (article 8).

4. This workshop was a step in furthering this commitment to cooperation and built upon a similar international meeting held in July 2000 in Seattle (United States) to promote cooperation in addressing the trans-Pacific transport of atmospheric contaminants (see Wilkening, K.E., L.A. Barrie, and M. Engle. Science, 290:65-67 (2000)).

II. OBJECTIVES

5. The primary objective of the workshop was to address the following questions:

(a) Does the current state of knowledge about the transport of photo-oxidants and fine particles (i) across the North Atlantic to and from North America and Europe and (ii) into and across the Arctic, allow the calculation of source-receptor relationships between anthropogenic emissions in North America and Europe and concentrations and visibility impacts in North America, Europe, and the Arctic?

(b) What are the key uncertainties in these source-receptor relationships?

(c) What research activities could help reduce these uncertainties?

(d) In pursuing these research activities, what are the potential roles for EMEP, AMAP, the Intercontinental Transport and Chemical Transformation (ITCT) activity of the International Global Atmospheric Chemistry (IGAC) Project, NARSTO (formerly the North American Research Strategy for Tropospheric Ozone), and the Project on the Transport and Chemical Transformation of Environmentally Relevant Trace Constituents in the Troposphere over Europe (EUROTRAC)?

III. SCIENTIFIC PRESENTATIONS

6. The workshop program included 38 oral and 10 poster presentations. These presentations

discussed research results from long-term monitoring programs, intensive field campaigns, and regional, hemispheric, and global air quality modelling studies. The workshop Internet site (see http://www.ciesin.columbia.edu/pph/) provides abstracts for each presentation as well as the presentation materials that have been made available by the authors. This site will be maintained at least through 2003.

7. The workshop concluded with a discussion of the implications of the research findings that had been presented and the research needs that remain. The conclusions and recommendations were as follows.

IV. Conclusions

8. For policy development at the international level, as well as at the national level, there is a demand for quantifying the linkages between air quality changes at the regional, hemispheric, and global scales. Understanding processes at the hemispheric scale is important because it sits at the intersection of concerns about regional air quality and concerns about global climate change.

9. There is well-documented evidence for intercontinental transport of ozone, fine particles, and their precursors. Observations and modelling assessments suggest that:

- The regular venting of continental emissions to the troposphere increases the Northern Hemispheric burden of pollutants;

- The impacts of this increasing burden on regional air quality are further magnified by episodes of rapid transport, which vary in frequency and magnitude of impact by season.

10. Intercontinental transport of pollutants is important with respect to accumulated pollutant exposure. As air quality standards and objectives are made more stringent, the contribution of intercontinental transport to exceedances of those objectives will increase. While the control of local and regional emission sources can address many air quality problems, the contribution of intercontinental transport to these problems, as well as the contribution of local and regional emission sources to the increasing hemispheric burden, should be considered in air quality management.

11. Given expected changes in the distribution of emissions in the Northern Hemisphere, the significance of intercontinental transport may increase in the future.

12. Developing quantitative source-receptor relationships on intercontinental scales is difficult due to the non-linearity and coupling of the large variety of physical and chemical processes involved. This complexity challenges the limits of the abilities of our current models.

13. While current models are beginning to provide estimates of these source-receptor relationships, these estimates are highly uncertain (a factor of 2 or more). Designing an

observational strategy to evaluate these uncertainties is a significant challenge, but such a strategy is necessary to quantify better the impacts of intercontinental transport.

V. Recommendations

14. To improve the understanding of the intercontinental transport of air pollutants in the Northern Hemisphere, a systematic approach to model evaluation, long-term monitoring, intensive observational studies, and emissions inventory development is needed. The linkages between regional and global air quality and climate change and variability also need to be better understood. The communication between the various scientific communities addressing these issues could be improved. Specific recommendations in each of these areas are summarized below.

A. Model Evaluation

15. Develop a plan for a targeted evaluation of the ability of models to simulate

- Intercontinental transport on an event basis and a long-term, statistical basis; and,
- Trends in the hemispheric distributions of important chemical species.

16. Include both model-to-observation comparisons and model-to-model comparisons in the model-evaluation plan. Model-to-observation comparisons should test the ability of models to predict past events and historical trends. Model-to-model intercomparisons should involve comparison of predictions of state variables, estimates of transport contributions / source-receptor relationships, sensitivities to systematic perturbations, and predicted impacts of different meteorological drivers or scenarios.

B. Long-Term Monitoring

17. Maintain and enhance existing observation networks and capabilities, especially the World Meteorological Organization's Global Atmospheric Watch (GAW) program. In this respect, EMEP is recommended to extend its close cooperation with GAW.

18. Identify and give appropriate priority in resource planning to observation sites and techniques that are well-suited to characterizing intercontinental transport, such as coastal and high elevation sites and sondes and remote sensors.

19. Develop new observational tools and networks, especially to obtain information about conditions above the planetary boundary layer, which make effective use of satellite-based and ground-based remote sensors and capture the potential of observational platforms of opportunity (e.g. commercial aircraft, military aircraft, and ships).

20. Make more effective use of existing observational databases, especially those that help identify and characterize transport events and processes, such as those that provide information about aerosol chemical composition or stratospheric-tropospheric exchange.

C. Focused Intensive Field Campaigns

21. Continue to conduct focused, intensive field campaigns to probe transport processes and fill in the information gaps not addressed by long-term monitoring (e.g. surface stations and satellites).

22. Integrate into the design of intensive field campaigns:

- In situ measurements in the free troposphere;
- Models that capture the interaction of meteorology and chemistry;
- Large-scale remotely-sensed data to extrapolate from case studies to larger scales; and,
- The development of merged data sets.

D. Emissions

23. Develop improved emissions information, especially for input into models, with a priority given to:

- Biogenic and geogenic sources;
- Sources in the upper troposphere (e.g. lightning, aircraft);
- Sources in the marine boundary layer (e.g. ships);
- Developing nations; and
- Persistent substances (including persistent organic pollutants and heavy metals) that may serve as transport tracers.

24. Design observation strategies to help evaluate and improve emissions inventories that are traditionally developed based on activity data, as opposed to ambient measurements.

25. Improve the mechanisms for sharing emissions data between North America and EMEP, and improve the global air-quality modelling community's access to high-resolution emissions inventories developed for regional and local air-quality modelling.

E. Linkages

26. Explore how climate change and variability affects emissions and transport processes, thereby changing the influence of intercontinental transport on regional air quality.

27. Recognize the common objectives of climate and air quality research, and cooperate to maximize the effectiveness of research investments in the two areas.

F. Communication and Collaboration

28. Improve communication and collaboration across the various scientific communities interested in the intercontinental transport of air pollutants through:

– Computer web-based information sharing and discussion sites (e.g., by expanding the workshop website, http://www.ciesin.columbia.edu/pph); and,

– Continuing periodic meetings, either individual workshops or sessions at larger conferences (such as IGAC's annual meeting).

29. Support collaboration through:

– Improving the compatibility or documentation of formats for observation, emissions, and modelling data sets;

– Establishing meta-data catalogues and reviews of observation, emissions, and modelling data sets; and,

– Supporting the development of accessible, distributed archives and retrieval software.

30. Arrange another meeting in approximately one year that brings together scientists from across the Northern Hemisphere to share progress in understanding intercontinental transport.