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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)

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HEMISPHERIC TRANSPORT OF AIR POLLUTION

EXECUTIVE SUMMARY OF THE INTERIM REPORT OF THE TASK FORCE ON HEMISPHERIC TRANSPORT OF AIR POLLUTION

Report by the Co-Chairs of the Task Force

INTRODUCTION

1. This report provides input from the Task Force on Hemispheric Transport of Air Pollution to the first review of the 1999 Gothenburg Protocol as requested by the Executive Body at its twenty-fourth session (ECE/EB.AIR/89, para 36(e)).

2. The draft 2007 interim assessment report of the Task Force was discussed in detail at its third meeting held in Reading, United Kingdom. Further editing of the report will take place in the coming months. The executive summary of the report was discussed in detail. The Task

Force proposed amendments and asked the Co-Chairs to take these into account when finalizing the executive summary provided here.

3. The full text of the draft interim report of the Task Force is available at: http://www.htap.org/activities/2007_Interim_Report.htm .

I. MAJOR FINDINGS

4. Observations from the ground, aircraft, and satellites provide a wealth of evidence that ozone and fine particle concentrations in the UNECE region and throughout the Northern Hemisphere are influenced by intercontinental and hemispheric transport of pollutants.

5. The processes that determine the overall patterns of transport at this scale are relatively well understood and our ability to quantify the magnitude of transport is improving. Our improved understanding comes from an increasing body of observational evidence, including new information from intensive field campaigns and satellite-borne instruments, improved emissions inventories, and improved global and regional chemical transport models. The improved models can reproduce much of the observed spatial and seasonal patterns of intercontinental transport, as well as describe individual transport events; however, there are differences between models with respect to quantitative estimates of source-receptor relationships. The Hemispheric Transport of Air Pollution (HTAP) Model Intercomparison has provided the first set of comparable estimates of intercontinental source-receptor relationships from multiple models. This continuing effort will enable us to assess, and ultimately reduce, the variability and uncertainty in model estimates.

6. For ground-level ozone, there is a hemispheric background concentration of 20-40 ppb that includes a large anthropogenic and intercontinental component. As part of the HTAP Model Intercomparison, a set of emission perturbation experiments were conducted to compare model estimates of how emission changes in one region of the world impact air quality in other regions of the world. The preliminary results of these experiments suggest that, under current conditions, local and regional emission changes have the largest impact on surface air quality, but that changes in intercontinental transport can have small, but significant, impacts on surface concentrations. The benefits of measures to decrease intercontinental transport would be distributed across the hemisphere.

7. For fine particles, the impact of intercontinental transport on surface air quality is primarily episodic, especially associated with major emission events such as fires or dust storms. The intercontinental transport of both ozone and fine particles has large impacts on total atmospheric column loadings, which have significant implications for climate change.

8. The first set of coordinated experiments under the HTAP Model Intercomparison examined the global impacts of 20% emission reductions of relevant anthropogenic pollutants in four model regions, approximating North America, Europe, South Asia, and East Asia. The model experiment results suggest that a 20% decrease in anthropogenic nitrogen oxides emissions in any three world regions combined would achieve 30-70% of the reductions in annual mean ozone concentrations that would result from a 20% decrease in these emissions within the fourth region. For the mean concentration in the peak ozone season, this import-to-domestic response ratio is 10-30%. The perturbation experiments also suggest that changes in anthropogenic emissions of carbon monoxide and non-methane volatile organic compounds also have significant impacts on hemispheric ozone levels. Perturbation experiments focused on methane suggest that a 20% decrease in global methane concentrations may have as large, or larger, impacts on surface ozone concentrations as decreases in the intercontinental transport of other ozone precursors, as well as decreasing climate forcing of both methane and ozone.

9. For fine particles, the perturbation experiments suggest that a 20% change in anthropogenic emissions in any three world regions combined would achieve between 4-18% of the change in annual mean anthropogenic fine particle concentrations (sulphate plus carbonaceous aerosols) that would result from a 20% decrease in these emissions within the fourth region. The import-to-domestic response ratios for surface deposition of sulphate, reactive nitrogen, and carbonaceous aerosols are similar to those for surface concentrations. The import-to-domestic response ratio of the annual mean aerosol column loading is significantly larger than that for the surface concentrations: 30-59% for sulphate and 13-32% for carbonaceous aerosols.

10. These results represent the average of the ensemble of participating models. There are differences between the models, as well as potential biases introduced by the design of the experiments, that have yet to be investigated.

11. The significance of intercontinental transport for the achievement of environmental policy objectives may change in the future due to changes in the magnitude and spatial distribution of emissions. These changes may be caused by the continuing implementation of pollution control measures, regional differences in the pace of economic development, the growth in shipping and aviation emissions, and the implementation of climate change mitigation measures. In addition, changes in transport patterns and emissions sources due to climate change and changes in the health and environmental objectives based on new knowledge about the impacts of air pollutants may change the significance of intercontinental transport.

12. The variability in current model estimates of transport magnitudes and the inability to explain some of the observed trends suggest that more research is needed to satisfactorily assess

the significance of intercontinental transport. In particular, further efforts are needed to improve: the accuracy and spatial and temporal resolution of emissions estimates; the spatial, temporal, vertical, and chemical resolution of the current observing system; and the description of some chemical and physical processes in current models.

II. RECOMMENDATIONS

13. Improving our assessment of intercontinental and hemispheric transport will require an integrated approach where the best available knowledge from observations, emissions, and models is combined. A robust observational system using multiple observational platforms and methods is needed to provide data for the evaluation and improvement of chemical transport models and emissions inventories. Further analytical efforts planned by the Task Force over the next few years are expected to decrease the range of current model estimates for source-receptor relationships and improve our confidence in the assessment of intercontinental source-receptor relationships.

14. Some of the key challenges that we face are outlined below. Addressing each of these challenges requires linking information across the areas of observation, emissions, and modelling to:

(a) Improve the modelling of transport processes using existing and new field campaign data. Focused evaluations of models using field campaign data is needed to improve descriptions of small-scale boundary layer venting, atmospheric subsidence, wet scavenging, and transport processes in the tropics.

(b) Improve global emissions inventories using existing information at the national and sub-national scale and inverse modelling and other methods to compare emissions estimates to ground-based, aircraft, and satellite observations.

(c) Identify and explain observed long-term trends by filling gaps in the observing system, developing reliable emission trends, and improving model descriptions. The current observational system has limited coverage and resolution in most regions of the world and provides limited information about the vertical distribution of pollutants. Better observational information is essential for improving the ability to detect and explain long-term changes.

(d) Develop a robust understanding of current source-receptor relationships using multiple modelling techniques and analyses of observations. The initial results of the HTAP Model Intercomparison provide some useful information about the significance of intercontinental transport, but further detailed analyses are needed.

(e) Estimate future source-receptor relationships under changing emissions and climate. Such scenarios should consider future years from 2020 to 2050 and 2100 and be coordinated with efforts under the Intergovernmental Panel on Climate Change.

(f) Improve organizational relationships and information management infrastructures to facilitate necessary research and analysis. Efforts should further the implementation of the strategy for Integrated Global Atmospheric Chemistry Observations (IGACO), building upon the World Meteorological Organization's Global Atmospheric Watch programme and contributing to the Global Earth Observation System of Systems.

15. Addressing the challenges outlined above will require the combined effort of many individual scientists; national research organizations; international research programmes, such as the International Geosphere-Biosphere Programme (IGBP) and World Climate Research Programme (WCRP); and governmental authorities. In this community effort, the Task Force can continue to play an important role as a forum:

(a) To identify scientific consensus concerning the current understanding of intercontinental and hemispheric transport as well as priorities for future research and development; to foster information exchange and collaboration;

(b) For raising awareness of transboundary and intercontinental air pollution in regions where the concept is less well known and facilitating crucial links among institutions both within countries and across regional and hemispheric scales.
