TF HTAP WORKSHOP ON MODELLING OF HEMISPHERIC TRANSPORT OF AIR POLLUTANTS

17-19 OCTOBER 2007, JUELICH, GERMANY

Background

The Task Force on Hemispheric Transport of Air Pollution (TF HTAP) has as objectives to provide the UNECE Convention on Long Range Transboundary Air Pollution (CLRTAP) with a fuller understanding of intercontinental transport of air pollution in the Northern Hemisphere. In pursuing this objective, the TF HTAP is organizing a series of workshops, cooperative analyses, and assessment reports focused on a number of policy-relevant science questions (see Annex I). Reaching out beyond the geographical scope of the UNECE and the CLRTAP, the Chairs of the TFHTAP invite all interested experts to participate in these activities, regardless of their country of origin. The Chairs particularly invite experts in Asia, Northern Africa, and Latin America, to engage with experts from UNECE countries in Europe and North America.

The workshop in Juelich, 17-19 October, 2007 is particularly addressing issues related to modeling the transport and transformation of air pollution on the hemispheric scale, providing the scientific underpinning of the policy relevant questions in Annex 1. The workshop is organized into four sessions:

1. Presentation and discussion of the model experiments performed as part of the HTAP intercomparison to date.
2. Regional scale modeling and hemispheric transport
3. Future source receptor relationships: climate change and emission scenarios
4. Planning and prioritization of future experiments in the HTAP intercomparison.

The workshop conclusions and recommendations are to provide information for the assessment reports and future cooperative analyses conducted under the auspices of the TF HTAP as well as on generic research issues such as benchmarking and evaluation of model performance.

Session 1 - Presentation and discussion of the model experiments performed as part of the HTAP intercomparison to date.

To assess hemispheric transport, 4 world regions (North America, Europe, South Asia, and East Asia) were selected and the effect of a decrease of anthropogenic emissions of NO_x, CO, VOC, SO_2 and primary aerosols were assessed. The focus in this first set of experiments (SR1-SR6) was on the calculation of source-receptor relationships for ozone; but also the effects on deposition and aerosols were explored. To better understand the role of transport, a first set of artificial tracer experiments (TP1) was performed, focusing on CO. 26 models participated in the model experiments SR1-SR6 and TP1, but not all models performed all experiments. In this session, an overview of results will be presented, and further analysis discussed. In addition, individual model results will be presented to identify future research directions.

Some questions for this session are:

- To what extend is the spread of model results determined by transport or chemistry of emissions?
- What is the scalability of the results? How can 20% emission changes be translated to real emission changes?
- What do models tells us about transport to the Arctic?
- What could be benchmark observation data sets for HTAP models (and beyond)?
- Role of methane as an ozone precursor
- What further analysis of existing results is needed before continuing with further model experiments?

Session 2- Regional scale modeling and hemispheric transport

Global CTMs provide the framework for which intercontinental scale S/R relationships can be estimated. However, these global models often utilize coarse spatial and temporal resolutions and simplified physical and chemical parameterizations because of their computational limitations. Thus, it is important to evaluate how sensitive the predictions of pollution import/export into/from a region are to model resolution, and how predicted the S/R relationships vary within the region. Regional scale models, running on typical resolutions of 10-50 km, can be used to answer this question. World-wide several activities are taking place, addressing some of the issues. This session tries to identify the common issues regarding hemispheric transport of air pollution in various world-regions, with the objective to enhance exchange of information between the regional and global modeling communities. Specifically for the EMEP region the cooperation is foreseen with the EMEP Task Force on Measurements and Modeling and for the Asian region with MICS-Asia. A key issue for cooperation between the two communities is to identify mutual benefit from the cooperation. Cooperation may also allow more efficient use of limited resources.

Some questions for this session are:

- What are the methods presently used by regional models to address the influence of hemispheric transport?
- What are the common issues in the different world regions relating to HTAP, and what are the differences?
- How does the representation or parameterization of various key processes differ in global and regional models and how do these differences (and model resolution) affect estimates of hemispheric transport? These key processes include dry and wet deposition, convection, boundary layer/free troposphere exchange, and stratosphere/troposphere exchange. What experiments can be conducted to evaluate these differences? - Are there differences in the evaluation methodologies and benchmarked datasets for assessing regional models and global models with respect to estimates of HTAP? What datasets are available or are needed?
- Does the assessment of intercontinental source-receptor relationships require a nested system of global and regional models? What experiments can be conducted to test the value of nesting? Does the value of nesting differ across regions?
- How do we best represent future climate scenarios in regional models and how do we use meteorological downscaling and nesting approaches?

Session 3 - Future source receptor relationships: climate change and emission scenarios

Climate change may affect the export of pollution by specific meteorological conditions (e.g., convection, frontal passage, subsidence). A number of processes affected by climate are now identified, but coupled pollution-climate models predict rather diverse results under changed climate conditions.

The questions regarding climate change to be addressed in this session are;

- What model results are available for changing S/R relationships under changed climate conditions, where do they agree, what are the differences?
- What experiments would be necessary to understand the differences?
- What climate change and air pollutant emission scenarios should be used to address future HTAP? Which timeframe?
- How best should the consequences of climate change and future emission changes for HTAP be assessed on the regional scale?

Session 4 - Planning and prioritization of future experiments

To provide further input to the 2009 assessment report, additional common experiments are planned. Thus far a number of issues have been identified that could be carried forward in these experiments (scheduled for 2008/2009). They involve:

- a linkage to measurement campaigns that are targeted at intercontinental transport
- Source-receptor relationships under future climate conditions
- Impacts of future air pollutant emission scenarios on source-receptor relationships

Some questions for this session are:

- What Publications in scientific journals may be possible?
- Did we identify the most relevant issues for further studies, given the logistical constraints and interests of the modeling community?
- What other experiments are already planned in the context of AC&C, AEROCOM, or other activities that could be used, integrated, or modified for the purpose of HTAP assessment?
- How to coordinate the HTAP future climate and emission scenarios with the IPCC 5th assessment report effort?

- Annex I

TF HTAP Policy-Relevant Science Questions

1. How does the intercontinental or hemispheric transport of air pollutants affect air pollution concentration or deposition levels in the Northern Hemisphere for ozone and its precursors; fine particles and their precursors; compounds that contribute to acidification and eutrophication; mercury; and persistent organic pollutants?
    1.1. What evidence do we have of transport pathways and mechanisms from intensive field studies? From observations? From model predictions?
    1.2. How do the transport pathways differ by pollutant? By source region? By season?
    1.3. What processes need to be better understood to describe the relative significance of intercontinental transport?
    1.4. How do processes at the intercontinental or hemispheric scale affect processes at the local or global scales? (Synoptic scale meteorological events/cycles; Hadley circulation; etc.)

2. More specifically, for each region in the Northern Hemisphere, can we define source-receptor relationships and the influence of intercontinental transport on the exceedance of established standards or policy objectives for the pollutants of interest?
    2.1. What observational evidence exists for attributing pollutant concentrations or deposition levels to source regions or countries?
    2.2. Using predictive chemical transport models, what are possible methods for calculating source-receptor relationships? At what spatial resolution (geographic region, individual countries) can such methods be applied reasonably?
    2.3. How can models with different spatial resolutions be nested within one another to provide an appropriate level of spatial resolution for the entire hemisphere or globe?
    2.4. What improvements are needed to global and regional transport models to better simulate atmospheric processes to enhance source-receptor predictions?

3. How confident are we of our ability to predict these source-receptor relationships? What is our best estimate of the quantitative uncertainty in our estimates of current source contributions or our predictions of the impacts of future emissions changes?
    3.1. What metrics and techniques are most appropriate for evaluating global and regional model simulations with observations and for quantifying uncertainties?
    3.2. Do we have a sufficient database of observed concentrations and deposition levels to evaluate the predictions of current models? How can this observational database be improved for the purposes of evaluating models? Should we develop a set of standard observational platforms and measurements to enhance data consistency globally?
    3.3. Do we have sufficient observational data bases to track long term progress and change in transport and deposition patterns?
    3.4. Do we have sufficient data on emissions and the trends in driving forces needed for making reasonable future projections? How can this data be improved?

3.5. What physical or chemical processes must be better understood to improve our confidence in our estimates of source-receptor relationships? What is the minimum level of certainty in our understanding of these processes that must be attained before reasonable/useful estimates can be made?

4. For each country in the Northern Hemisphere, how will changes in emissions in each of the other countries in the Northern Hemisphere change pollutant concentrations or deposition levels and the exceedance of established standards or policy objectives for the pollutants of interest?

   4.1. Is there a simple relationship between changes in emissions and changes in pollutant concentrations and deposition levels?

   4.2. How is the predicted relationship affected by the spatial resolution of the model?

5. How will these source-receptor relationships change due to expected changes in emissions over the next 20 to 50 years?

   5.1. How might emission quantities and spatial distributions change over the next 20 to 50 years?

   5.2. How should future emission scenarios be constructed?

6. How will these source-receptor relationships be affected by changes in climate or climate variability?

   6.1. How will meteorological changes predicted by climate modeling studies affect major transport or chemical processes?

   6.2. Are there significant feedbacks between the transported air pollutants and regional climate and meteorology?

   6.3. Are there significant feedbacks between transported air pollution and potential changes in land use, vegetation, or ecosystems, especially with respect to natural emission sources?

   6.4. Are there predictive relationships between climate system indices that can be used to estimate the impact of changing climates on hemispheric transport of air pollutants?

7. What efforts need to be undertaken to develop an integrated system of observational data sources and predictive models that address the questions above and leverages the best attributes of all components?