

11.0 Long-Range Transport Challenge

Canadian Workgroup co-chair: **S. Venkatesh**

U.S. Workgroup co-chair: **Todd Nettesheim**

Under the Great Lakes Binational Toxics Strategy, Environment Canada and USEPA committed to:

“Assess atmospheric inputs of Strategy substances to the Great Lakes. The aim of this effort is to evaluate and report jointly on the contribution and significance of long-range transport of Strategy substances from worldwide sources. If ongoing long-range sources are confirmed, work within international frameworks to reduce releases of such substances.”

In support of this challenge, the U.S. and Canada have:

- Maintained the Great Lakes Integrated Atmospheric Deposition Monitoring Network (IADN) stations,
- Improved the integration of monitoring networks and data management, and
- Continued research on the atmospheric science of toxic pollutant transport.

Following the GLBTS’s 4-step analytical framework to evaluate and report jointly on the contribution and significance of long-range transport of GLBTS substances from worldwide sources, the Environment Canada and USEPA have accomplished the following:

Step 1. Information Gathering

To assess current activities and prepare a report on the state of the contribution and significance of long-range transport of GLBTS substances to the Great Lakes from worldwide sources.

ACTION: A literature review and assessment of the long-range transport of persistent toxic substances to the Great Lakes was undertaken in 1999, and a report entitled “*Long-range Transport of Persistent*

Toxic Substances to the Great Lakes: Review and Assessment of Recent Literature” was published by the Canadian firm ORTECH Environmental on March 27, 2000. Additional activities related to the information gathering step are noted below.

Canadian Studies

Lindane Transport to the Great Lakes Region from Application Areas in Saskatchewan: A three-dimensional Multicompartment Environmental Diagnosis and Assessment (MEDIA) model (Koziol and Pudykieiwcz, 2001) was used to investigate the transport and diffusion of pesticides applied to crops in the Saskatchewan and Quebec regions of Canada. The study indicated that there is potential for emissions from Saskatchewan to impact the Great Lakes region (see Figure 11-1). Simple air parcel trajectory analyses carried out by Waite et al. (2001) also show that emissions of lindane used on canola crops in Saskatchewan can be transported over the Great Lakes region (Figure 11-2).

Model Simulations of the Atmospheric Transboundary Contributions of Lead to the Great Lakes: A 3-D atmospheric transport model applied on a regional scale was used to study the contributions of industrial emission sources of lead from parts of Canada and U.S. to the Great Lakes. Although lead is not a Strategy substance, cadmium is. From a modeling point of view, their behaviors will be similar. Given the number of common sources for lead and cadmium in the study domain, the results for lead would be somewhat representative of the situation for cadmium. Environment Canada’s National Pollutant Release Inventory and USEPA’s Toxic Release Inventory were used to assemble the data on lead emissions for 1995 and 1996. The model performance was evaluated through comparison of model-simulated air concentrations of lead with those observed at a few IADN (Integrated Atmospheric Deposition Network) stations. The model simulations were used to estimate lead



loadings to the Great Lakes, including separate contributions due to Canadian and U.S. emissions sources (Daggupati and Ma, 2001). Figure 11-3 shows the estimated lead loadings for 1996.

Model Simulations of Mercury to the Great Lakes from Global Anthropogenic Sources: Canadian efforts are progressing on the development and testing of a global model for atmospheric transport of mercury (GRAHM – Global and Regional Atmospheric Heavy Metals model). The model, which has been run on 1 degree by 1 degree resolution, can be used to estimate the impact of global sources of mercury on the Great Lakes region. Figure 11-4 is an example of the output from the GRAHM model. Note that at this stage the model simulations only consider anthropogenic sources of mercury. Natural emissions will be included when an appropriate inventory of such emissions becomes available.

United States Studies

Mercury Monitoring and Modeling: USEPA is conducting a series of ambient monitoring studies to better understand the behavior of mercury in the atmosphere and the potential for very long-range transport. These studies involve the use of new measurement techniques to determine the relative concentrations of various (elemental and ionic) and physical (gaseous and particulate) forms of mercury in the atmosphere. These new techniques are being applied in surface and aircraft measurements to help apportion the deposition in the Florida Everglades between local and distant sources; in surface measurements in Point Barrow, Alaska, to study the observed depletion of atmospheric mercury during polar sunrise; and, in surface measurements at Cheeka Peak, Washington, to characterize trans-Pacific transport. Future studies are being planned in the Ohio River Valley, to examine the differences between local and distant sources, and at Mauna Loa, Hawaii, to characterize intercontinental and global transport processes.

The information from these measurement studies is being used to develop and evaluate a chemical mechanism for mercury that has been incorporated into USEPA's Community Multiscale Air Quality

model (CMAQ), a state-of-the-art Eulerian regional atmospheric fate and transport model. Through an international model comparison study being conducted under the auspices of the LRTAP/EMEP program, the CMAQ mercury mechanism is being compared to other models of mercury chemistry being developed by U.S. and international experts. Eventually these models will help apportion observed deposition between domestic emissions sources and foreign emission sources that contribute to the global circulation of mercury.

Remote Sensing Applications: USEPA, through a number of small individual grants and cooperative agreements, is examining the potential for integrating remote sensing and surface measurements to characterize inter-continental transport. Satellite and surface observations have been used to document an April 1998 dust event in the Gobi desert and its impact in North America. Additional studies using Probabilistic Transport Pathway Analysis have documented the transport of dust from the Gobi, Sahara, and Taklimakan deserts to North America.

International Transport of Air Pollutants (ITAP) Working Group: To improve USEPA's efforts to address intercontinental transport, the ITAP Working Group was formed within the Agency, co-chaired by the Office of Air and Radiation and the Office of International Activities. The main purposes of this working group are to: 1) share information across USEPA programs; 2) identify opportunities and needs for coordination; 3) provide a focal point for interaction with organizations outside the USEPA; 4) identify potential domestic and international policy gaps and opportunities; and, 5) identify capabilities, resources, and structures needed to effectively address ITAP issues. The activities addressed by the ITAP Working Group include international policy development, technology and information transfer, control technology development, emissions characterization, modeling and assessment, and ambient monitoring.

Intercontinental Transport of Air Pollution: Relationship to North American Air Quality. A Review of Federal Research and Future Needs - April 2001: This report was developed by the Air Quality Research Subcommittee of the



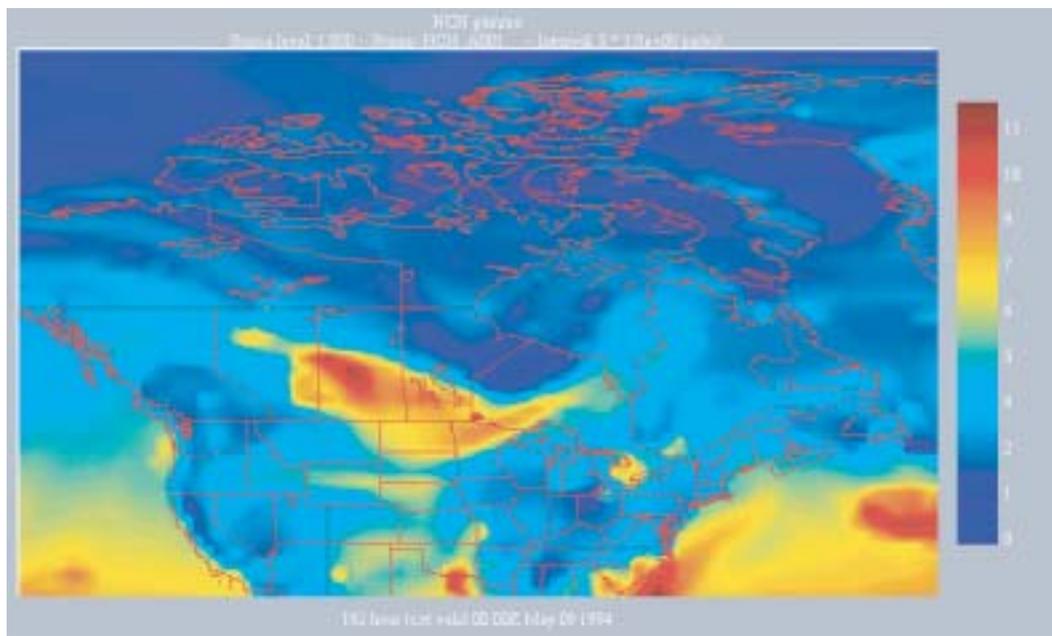


Figure 11-1: Model Simulated Ground Level Air Concentration of -HCH on May 9, 1994 (From Koziol, 2000)

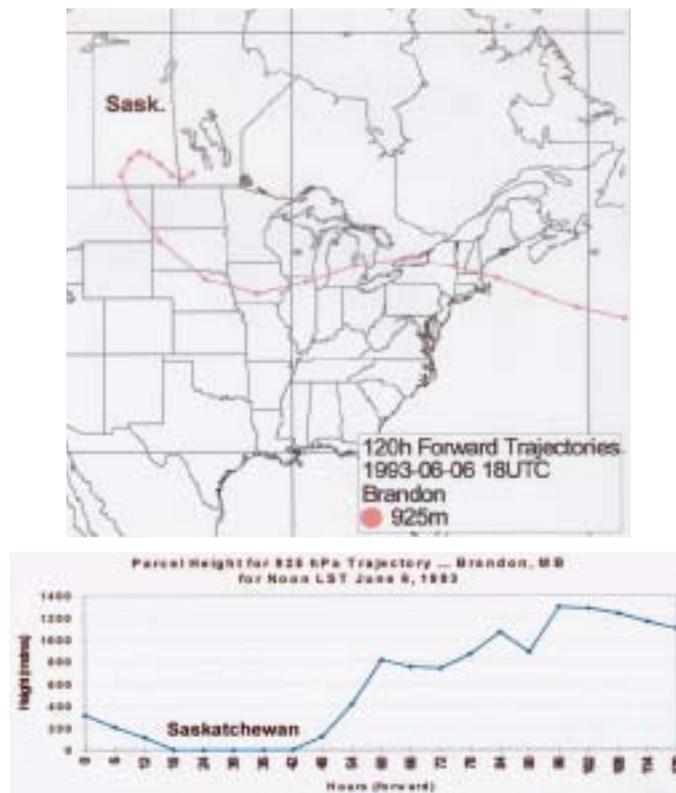


Figure 11-2. Trajectory Plot for An Air Parcel Originating from the 925 hPa Level at Brandon, MB at Noon L.S.T. on June 06, 1993



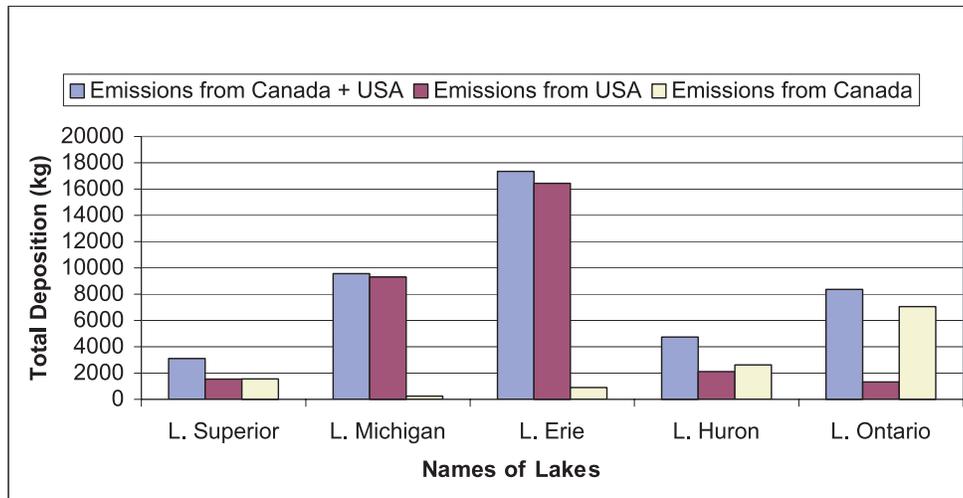


Figure 11-3. Yearly Total Deposition in 1996 to the Great Lakes from Lead Emission Sources from Canada and the U.S.

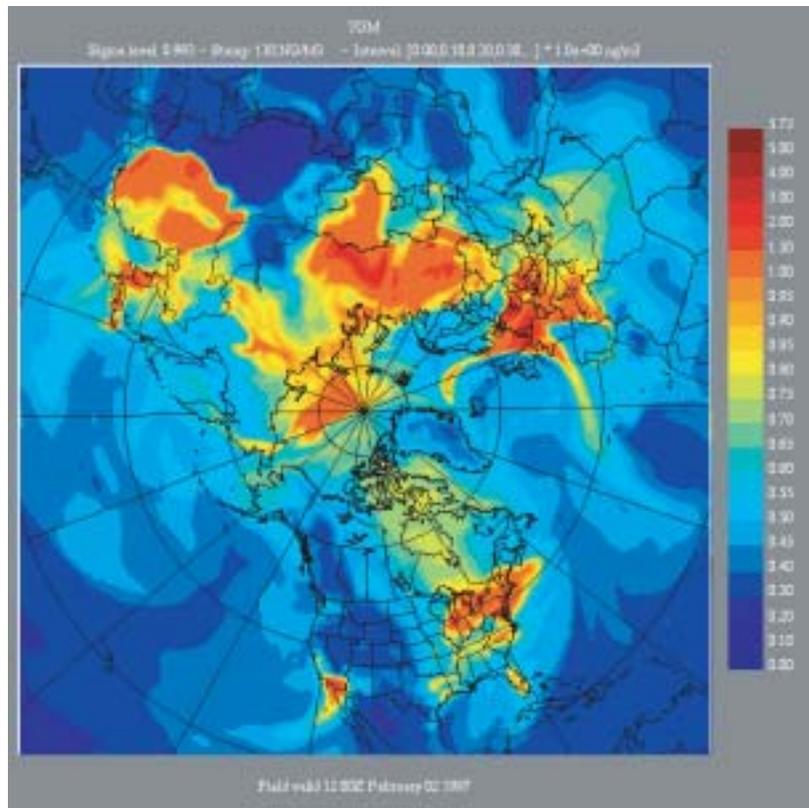


Figure 11-4. Sample Output from the GRAHM Model Showing Air Concentrations of Total Gaseous Mercury at 12Z on February 1997. (Figure Courtesy of A.P. Dastoor)



Committee on Environment and Natural Resources (CENR). The National Oceanic and Atmospheric Administration (NOAA) chairs this Subcommittee. The report provides a brief summary of U.S. research related to the intercontinental transport of air pollution, with an emphasis on how it relates to North American air quality. The report provides a brief overview of the science, identifying key knowledge and capability gaps, and is intended as an information piece to guide the development of future federal research programs relative to air quality.

Long-Range Transport of Persistent Bioaccumulative Toxics from Central America:

USEPA Region 5 is reviewing the potential for atmospheric transport of toxic substances from Central America to the Great Lakes, using available information on sources, meteorology, and chemistry. This effort will contribute to a framework for evaluating proposed projects to help Central American countries improve their capacity for management of pesticide use or other POPs chemicals.

Step 2. Analysis

Consult experts on knowledge gaps and options for a path forward.

ACTION: A bilateral experts workshop planned for October 2001 has been rescheduled for late 2002.

simulated atmospheric transboundary contribution of lead loading to the Great Lakes. Proc. NATO-CCMS Symposium on Air Pollution Modeling and its applications, Louvain-La-Neuve, Belgium, October 15-19, 2001

Intercontinental Transport of Air Pollution: Relationship to North American Air Quality. A Review of Federal Research and Future Needs. April 2001. Air Quality Research Subcommittee of the Committee on Environment and Natural Resources (CENR).

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References

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