Interpreting Total Gaseous Mercury Observations with Lagrangian and Eulerian Atmospheric Models: A Canadian Perspective

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Total gaseous mercury (TGM) concentrations at monitoring sites in Canada were simulated using the Stochastic Time-Inverted Lagrangian Transport (STILT) model. The model was modified in this work to deal with Hg depositions and high stack Hg emissions. The model-predicted Hg concentrations were compared with observations, as well as with the results from an Eulerian-based (CMAQ) simulation, in which the same emission and meteorology inputs were used. The comparisons show that STILT predicted Hg concentrations show better agreement with observations than those predicted by CMAQ. Furthermore, Fourier spectra indicated that high-frequency variability in the Eulerian model was severely damped while captured by the Lagrangian approach, due to the latter's ability to account for near-field influences. STILT was also applied to quantitatively assess relative importance of different upstream source regions for the selected episodes. The results indicated that the substantial source regions of the observed low Hg concentrations were some nearby cities and towns in Northeastern Ontario, and that elevated observations at three sites were mainly due to the contributions of significant point sources and areas in Southern Ontario, Ohio, Virginia and Michigan. Additionally, this work has illustrated the potential of STILT to interpret and identify source regions of pollutants in the future.

Figure 1. Locations of the three monitoring sites: Burnt Island, Egbert and Point Petre.

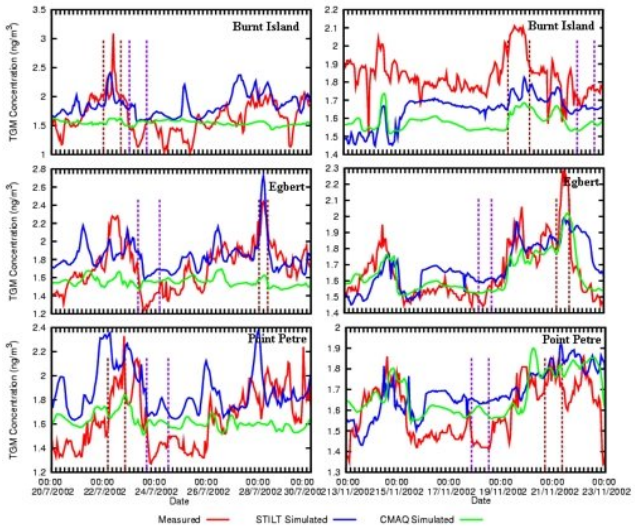

Figure 2. Total Gaseous Mercury (TGM) concentration comparisons among observed (red), STILT modeled (blue), and CMAQ-modeled (green) for two simulation periods: Jul 20-29 (right) and Nov 13-22 (left), 2002 for Burnt Island (top), Egbert (middle) and Point Petre (bottom).