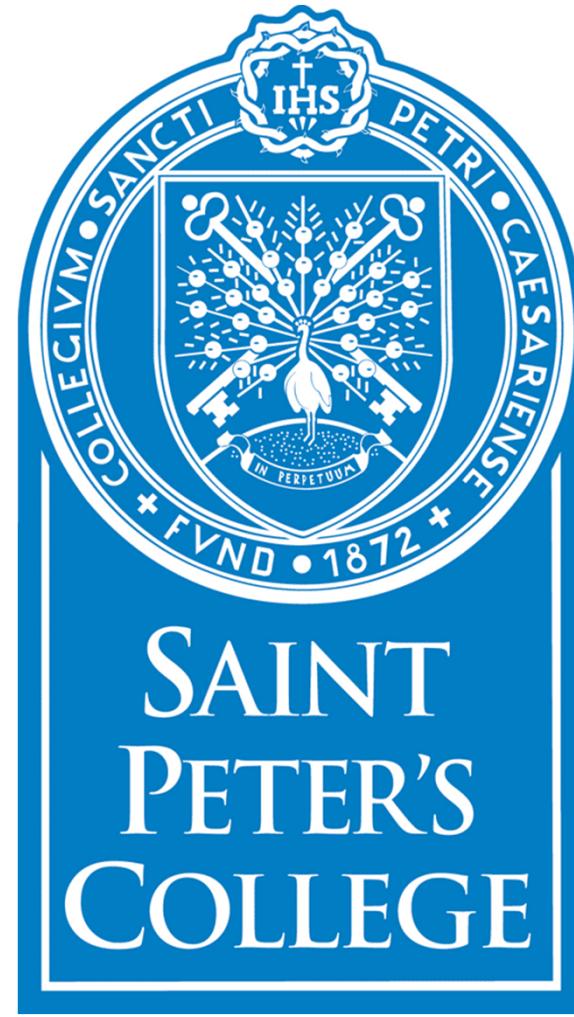




# Global Modeling of POPs Source-to-Receptor Air Transport to the Arctic with Climate Change: HYSPLIT-SV Lagrangian-Global Eulerian Model as a Research and Policy Tool

The Arctic as a Messenger for Global Processes, AMAP, Copenhagen, May 2011



Paul Bartlett (1), Mark Cohen (2), Beatriz Cárdenas (3), Abraham Ortiz (3), Roberto Basaldud (3)

(1) Saint Peter's College & City University of New York, U.S. [aurora2050@gmail.com](mailto:aurora2050@gmail.com) (2) Air Resources Laboratory, NOAA, U.S.

(3) Instituto Nacional de Ecología, SEMARNAT, Mexico

**Abstract:** NOAA's Hybrid Single Particle Lagrangian Integrated Trajectory Semi-Volatile model (HYSPLIT-SV) has been developed with a new Eulerian module to incorporate the advantages of Eulerian and Lagrangian methodologies in one model. We present here some of the first test simulations of the HYSPLIT-SV GEM (Global Eulerian Model): a set of experimental source-to-receptor simulations from representative source points in North America, and other continents, to the Arctic. We evaluate the global and Arctic capabilities of HYSPLIT-SV's new Eulerian module in relation to its established Lagrangian capabilities with a set of semi-volatile organic air toxics.

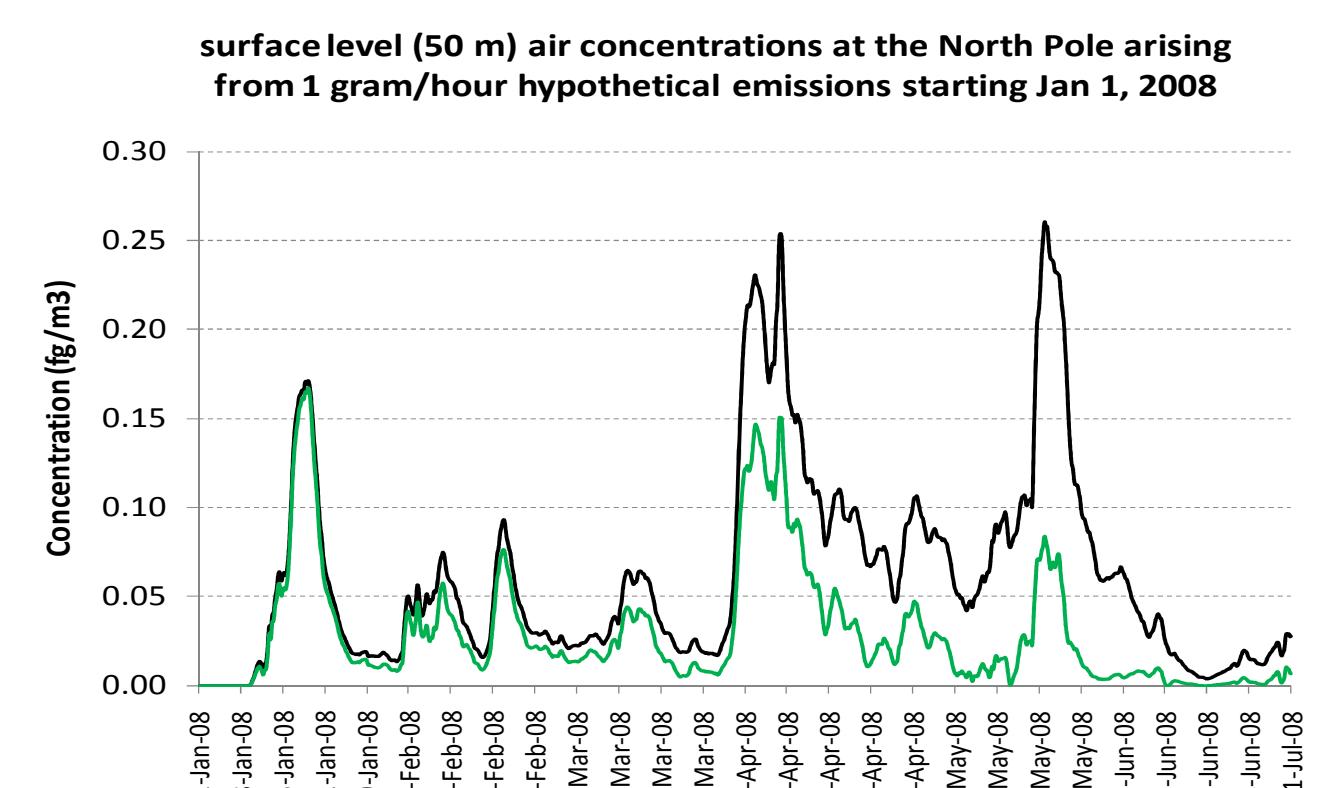
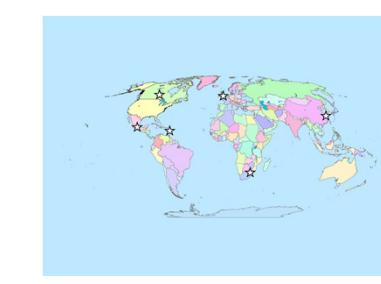
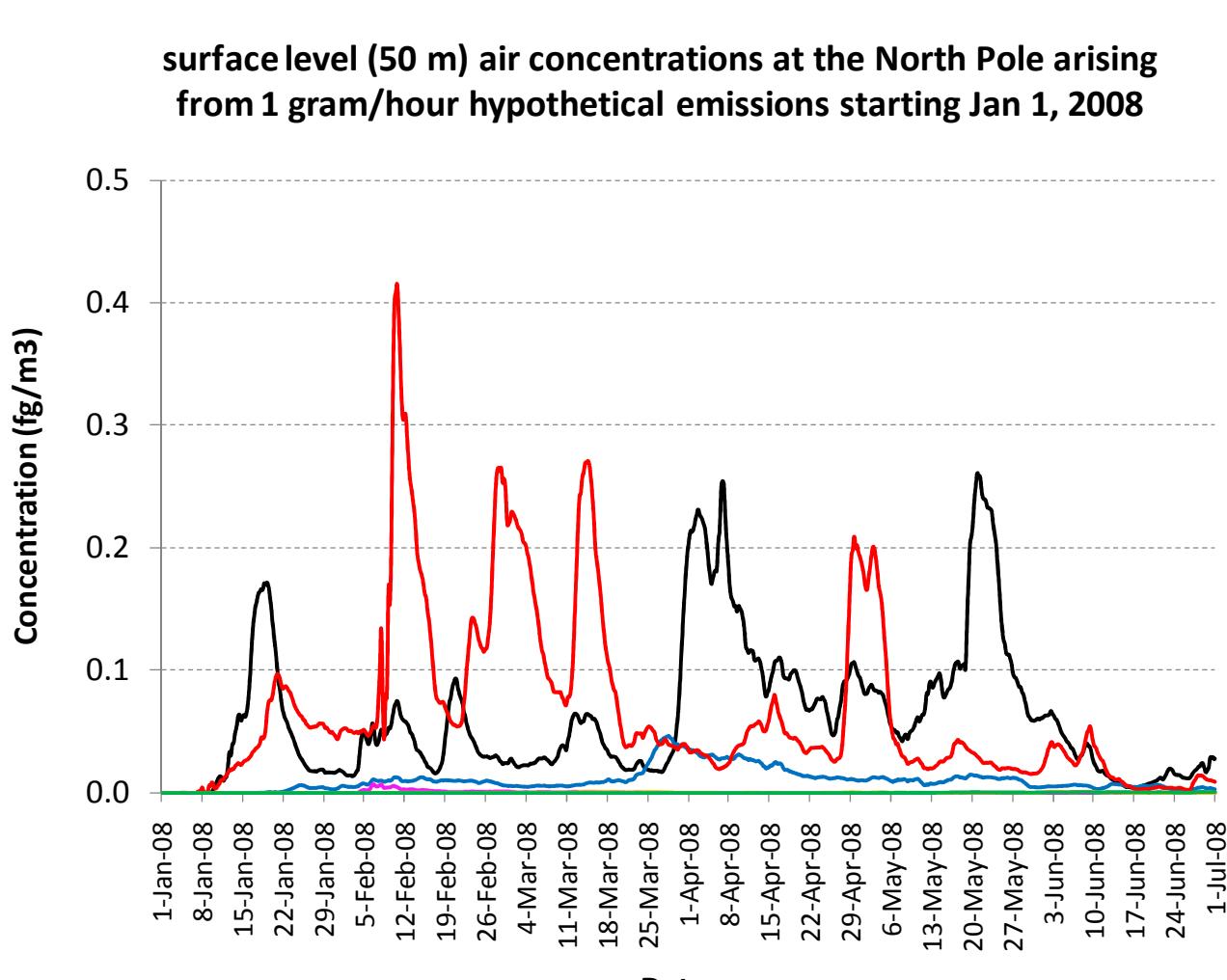
HYSPLIT-SV is a dynamic atmospheric dispersion model with atmospheric chemistry and environmental fate processes including vapor-particle partitioning, degradation (e.g. via hydroxyl radical, ozone, photolysis) and deposition (wet and dry; gas and particle). Source-to-receptor simulations produce estimates of the efficiency of transport to a receptor as air concentrations and deposition (Air Transfer Coefficients [ATC]) which integrates the effects of meteorology and environmental fate processes. ATCs enable the development of estimates of source-to-receptor transport under conditions of changing and uncertain emission scenarios. ATCs also enable the development of Air Transfer Coefficient maps for individual receptors, for selected time periods, to enable interpretation of variations of monitored air concentration and deposition by analysis of the shifts in relative efficiency of transport between source emission regions.

This new version of HYSPLIT-SV is being evaluated and ground-truthed with ongoing HYSPLIT-SV research with dioxin emissions and air monitoring data in Mexico. For climate change insights, we plan to compare time periods covering Arctic Oscillations and other time periods that the Arctic stations can potentially use to distinguish changes in climate from changes in emissions, that they are difficult to with monitoring results alone. This work is a first stage in developing HYSPLIT-SV into a tool to better interpret Arctic air monitoring time series data and to develop HYSPLIT-SV as a tool to optimize economic source emission reduction strategies for global environmental benefits.

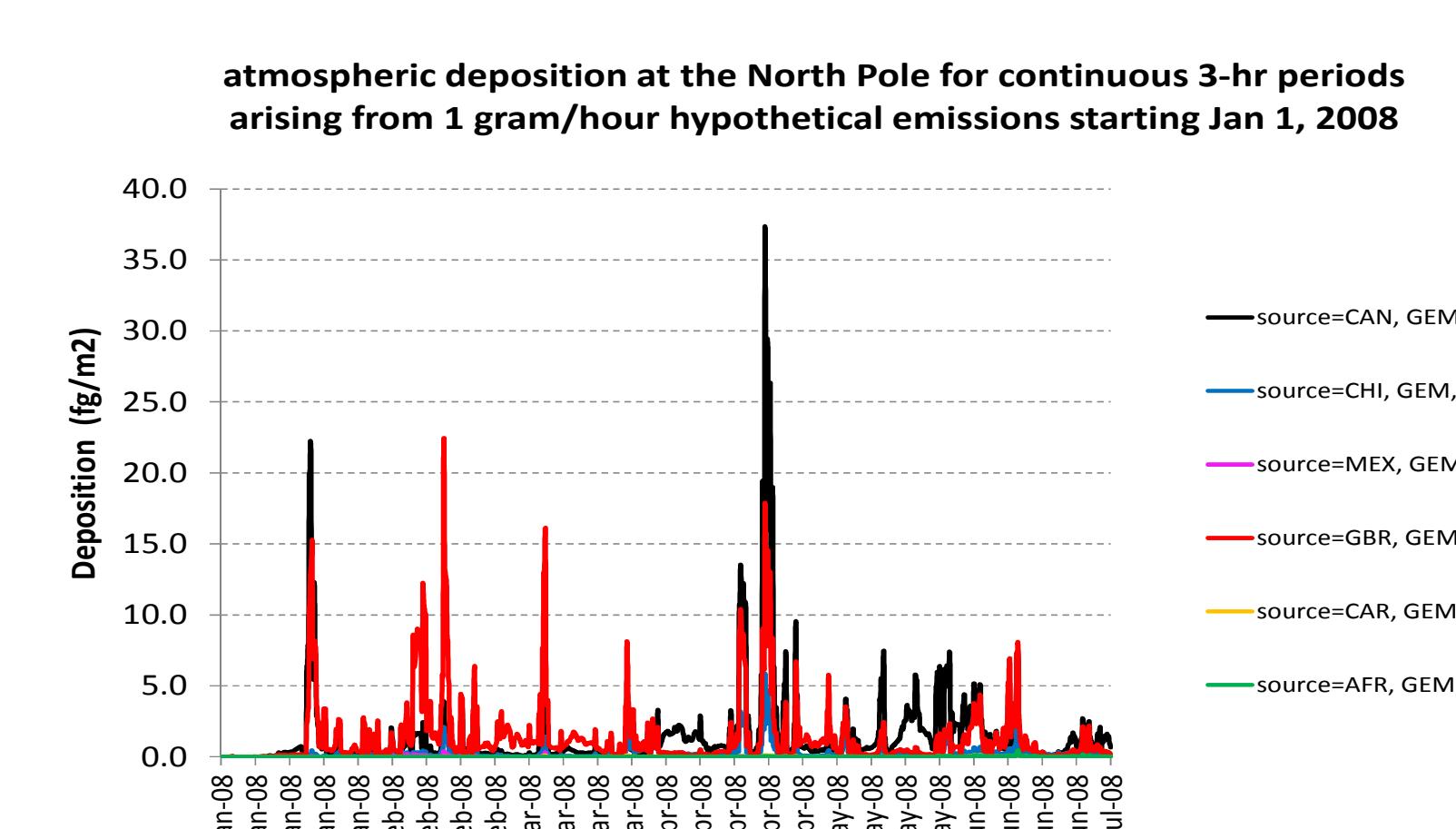
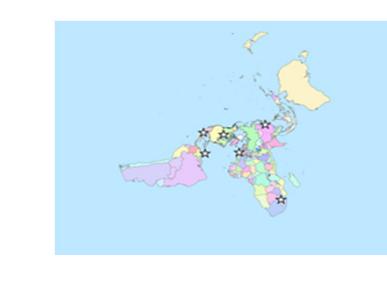
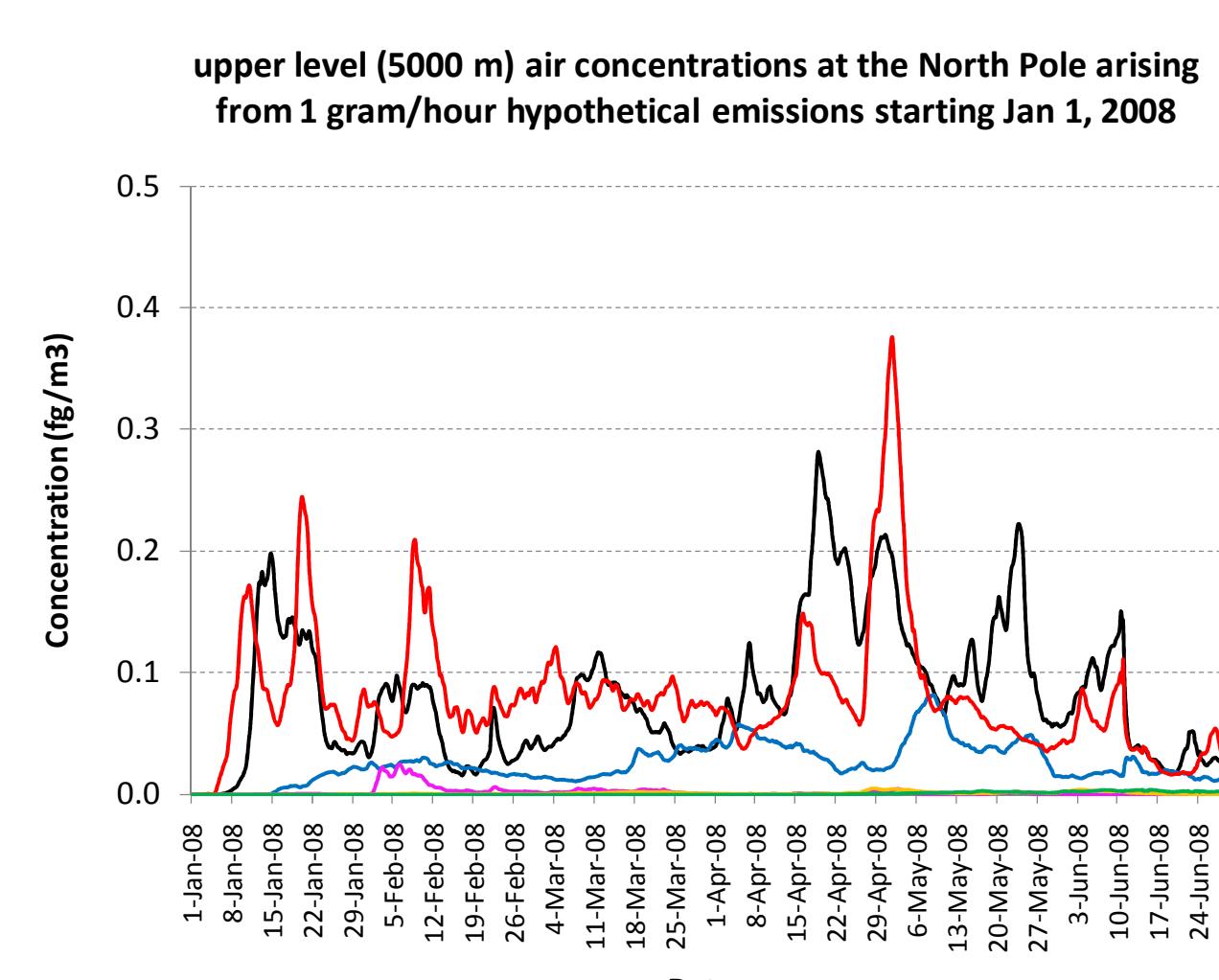
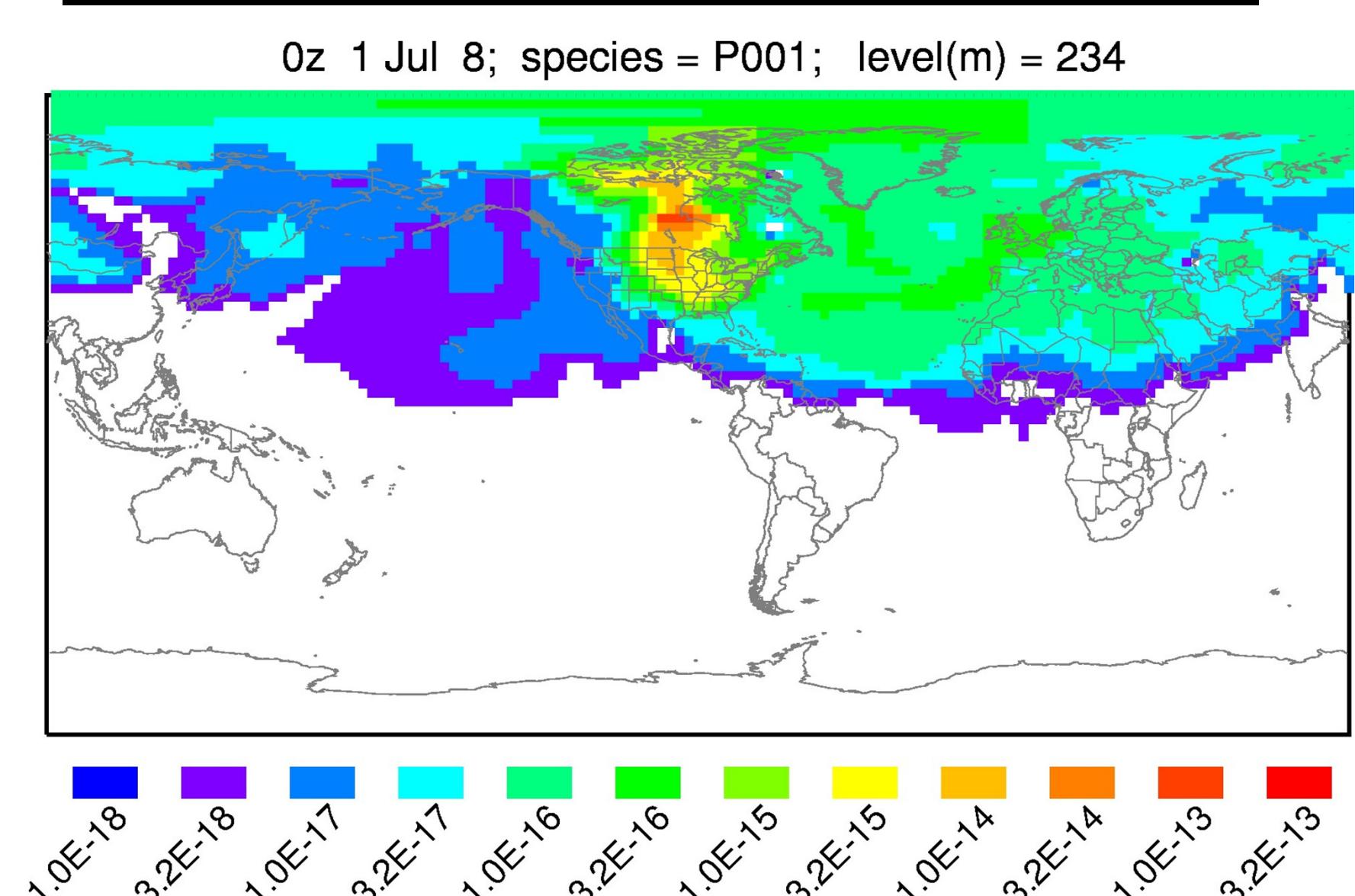
These graphs shows air concentrations of 2,3,4,7,8-PeCDF arising from 1 gram/hr hypothetical sources of 2,3,4,7,8-PeCDF at six different locations, using the Global Eulerian Model (GEM) version of HYSPLIT-SV. This is for the period from Jan-Jun 2008.

This graph shows the surface level air concentrations of 2,3,4,7,8-PeCDF and 2,3,7,8-TCDD arising from 1 gram/hr hypothetical source of the respective congeners at a location in Canada for the period Jan-Jun 2008

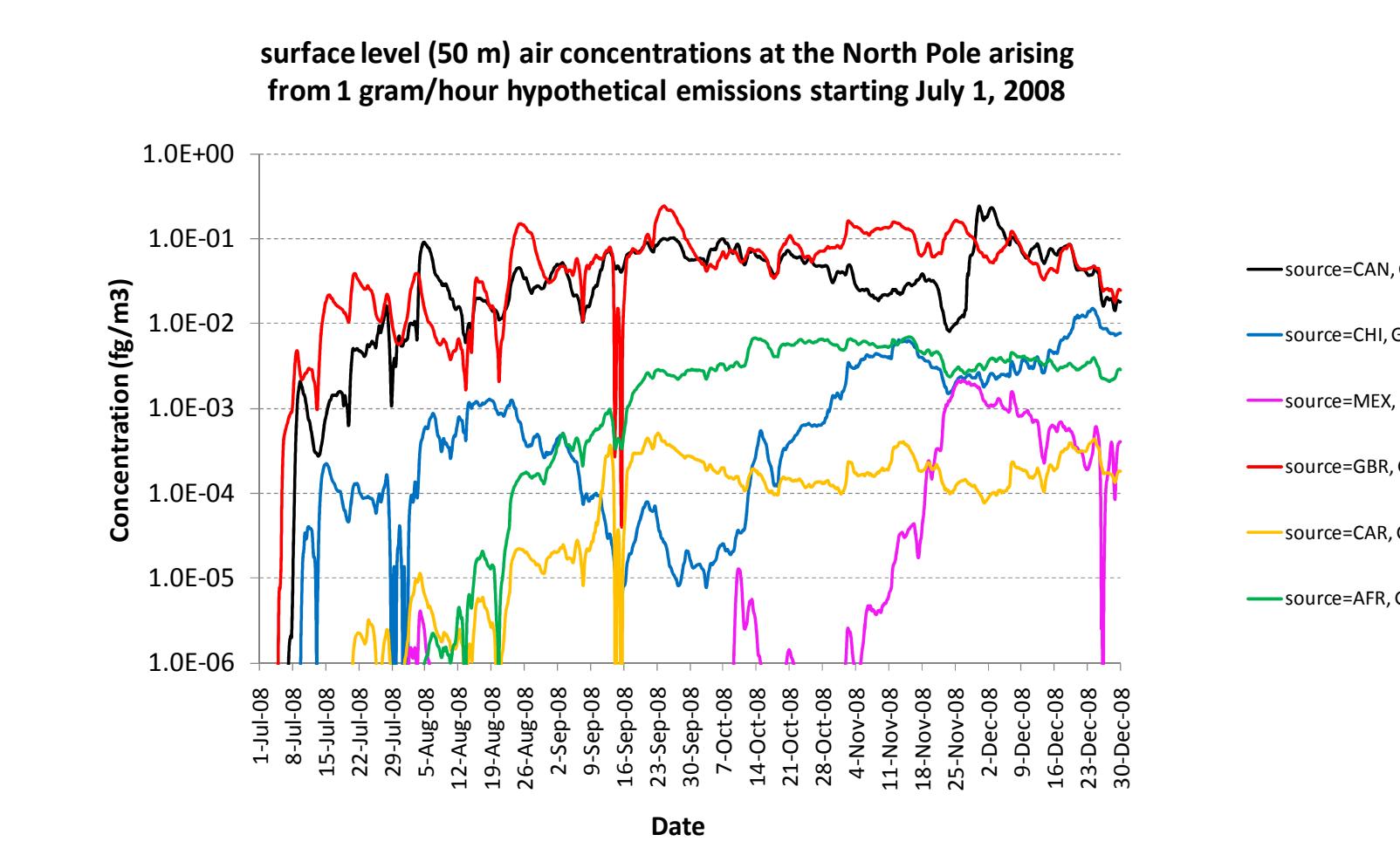
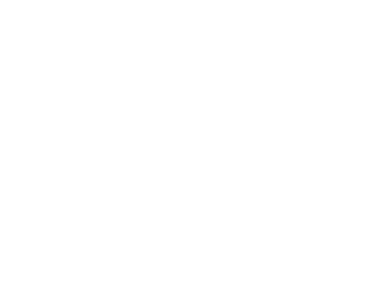
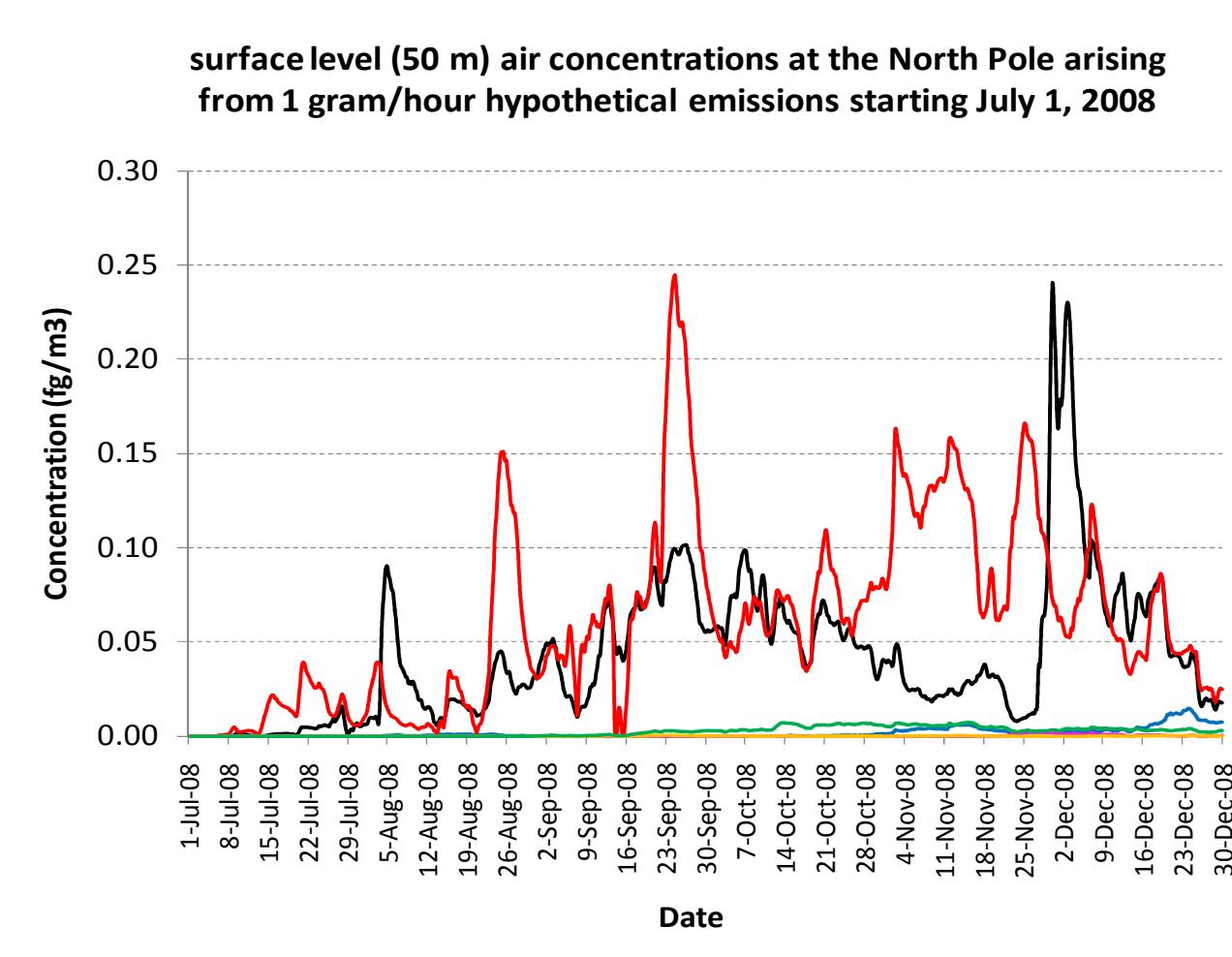
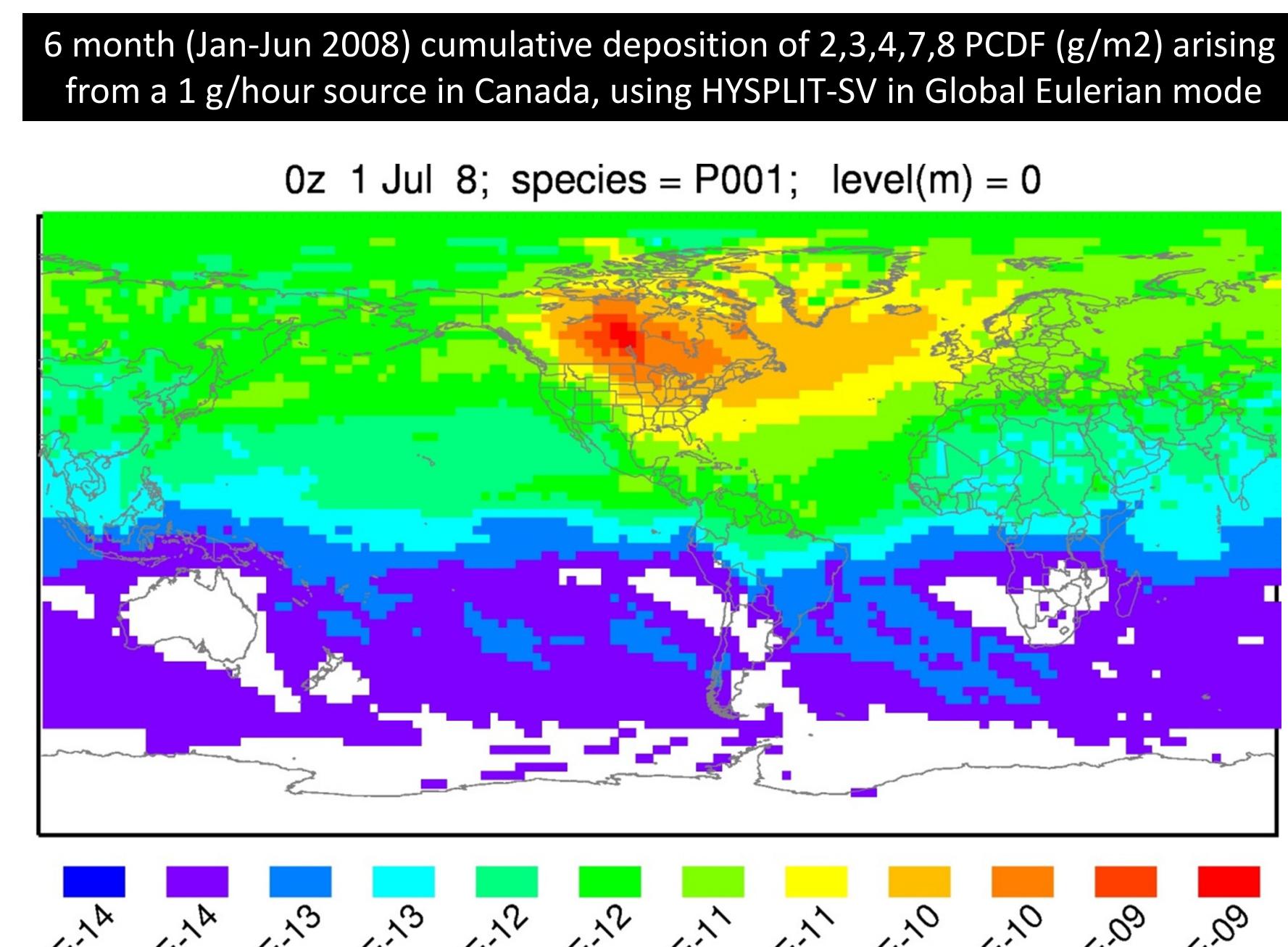
2,3,4,7,8 PCDF weekly snapshot air concentration (g/m<sup>3</sup>) arising from a 1 g/hour source Canada, using HYSPLIT-SV in Global Eulerian Mode



source=CAN, GEM, pcdf  
source=CHI, GEM, pcdf  
source=MEX, GEM, pcdf  
source=GBR, GEM, pcdf  
source=CAR, GEM, pcdf  
source=AFR, GEM, pcdf



source=CAN, GEM, pcdf  
source=CHI, GEM, pcdf  
source=MEX, GEM, pcdf  
source=GBR, GEM, pcdf  
source=CAR, GEM, pcdf  
source=AFR, GEM, pcdf



source=CAN, GEM, pcdf  
source=CHI, GEM, pcdf  
source=MEX, GEM, pcdf  
source=GBR, GEM, pcdf  
source=CAR, GEM, pcdf  
source=AFR, GEM, pcdf

