Progress Towards a Multi-year Continental Inversion Using The Weather Research and Forecast (WRF) - Lagrangian Particle Dispersion Model and the North American Tower Network

C. Normile[1], L. Diaz[1], K. Davis[1], A. Jacobson[2], T. Lauvaux[1], N. Miles[1] and S. Richardson[1]

[1]Pennsylvania State University, University Park, PA 16802; 814-863-8601, E-mail: kjd10@psu.edu
[2]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309

Significant uncertainty in the carbon balance of North America is due to uncertainty in quantification of atmospheric transport. The development of a regional carbon modeling system based on the Weather Research and Forecast (WRF) model (Lauvaux et al., 2012) has enabled simulation of continental CO_2 mole fractions at high spatial and temporal resolution using many possible realizations of atmospheric transport. The system utilizes initial conditions, lateral boundary conditions, and biogenic surface fluxes from the Carbon Tracker system, and fossil fuel emissions from both Vulcan and the Carbon Dioxide Information Analysis Center. We present measurements and simulations of the seasonal and weather-driven patterns of the mole fraction of CO_2 in the Atmospheric Boundary Layer (ABL) and the vertical column across the continent. The simulations capture many but not all features of the observed distribution of atmospheric distribution of CO_2. We present simulations of differences in ABL and column CO_2 that are caused solely by atmospheric transport options present within the WRF (Figure 1), and preliminary evaluation of the consistency of these simulations with meteorological observations. Next steps include multi-year continental and regional inversions that include plausible variations in atmospheric transport and investigation of the potential benefits of column CO_2 observations from the Orbiting Carbon Observatory-2.

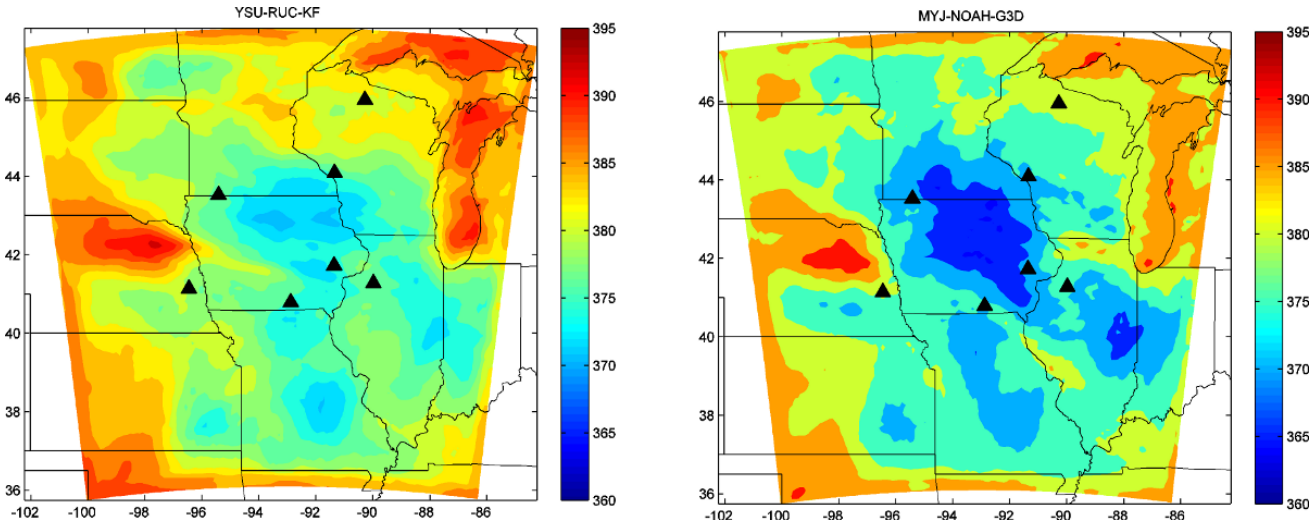

Figure 1. Simulated column CO_2 mole fractions in the U.S. midcontinent averaged over midday hours from 21 June to 21 July, 2008 using identical CO_2 surface fluxes and lateral boundary conditions, but different boundary layer, land surface and cumulus convection schemes within WRF.