Meteorological and Greenhouse Gas Measurements for the Characterization of Errors in Mesoscale Carbon Inversions

T. Lauvaux[1], L. Diaz-Isaac[1], M. Butler[2], S. Feng[1], A. Deng[1], J. Liu[3], K. Bowman[3], K.J. Davis[1], X. Ye[1], B. Gaudet[1], M. Hardesty[4] and A. Brewer[4]

[1]The Pennsylvania State University, University Park, PA 16802; 814-769-0667, E-mail: tul5@psu.edu
[2]The Pennsylvania State University, Department of Meteorology, University Park, PA 16802
[3]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109
[4]NOAA Earth System Research Laboratory, Chemical Sciences Division (CSD), Boulder, CO 80305

From urban to continental scales, networks of meteorological and atmospheric Greenhouse Gas measurements are being deployed to densify long-term infrastructures intended to constrain carbon sources and sinks. Among these observing systems, both remote sensing and *in situ* measurements offer a wide range of observational constraints potentially able to evaluate and improve components of atmospheric modeling systems, at the center of the inverse calculation. Beyond assimilation strategies targeted for specific objectives, we present here different approaches to incorporate aircraft-, surface-, and satellite-based information in regional and local inversion problems. We determine model weaknesses and redefine the objectives of each inverse problem in order to identify the most valuable contribution of atmospheric data to specific inverse problems. We discuss here the joint use of meteorological and greenhouse gas data to evaluate surface fluxes and atmospheric transport, and possibly correct for current model limitations by implementing assimilation approaches. We present multi-model evaluation strategies using aircraft and tower *in situ* data for continental-scale inversions and compare our findings to high resolution inverse applications. Finally, we discuss vertical errors and their significant impact on inverse estimates at regional scales for both satellite and tower data inversion, opposed to the source attribution problem from horizontal advection errors as a cause of systematic errors at higher resolutions.

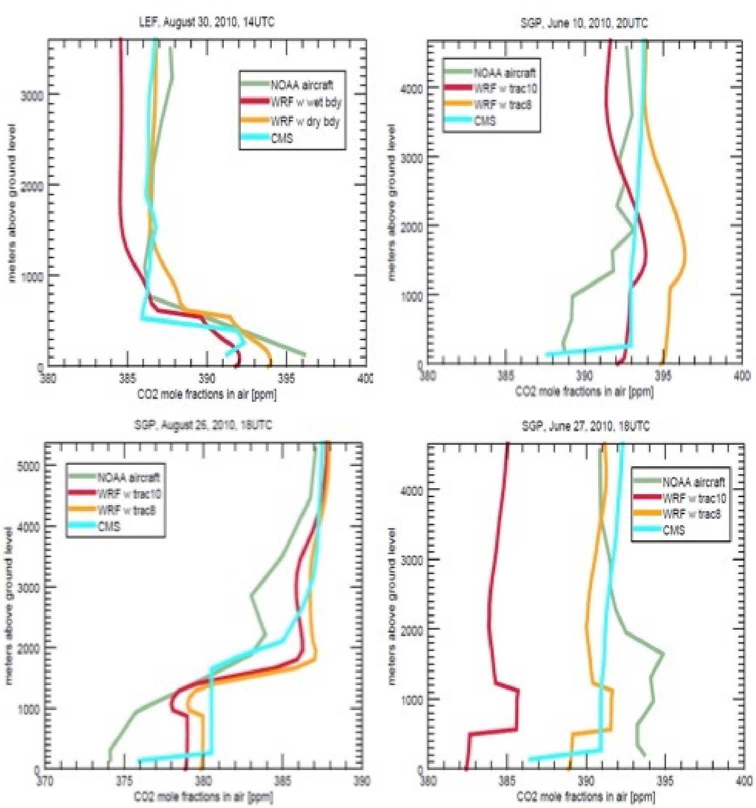

Figure 1. Comparisons of global CMS (GEOS-Chem) and regional WRF-Chem profiles to NOAA aircraft CO_2 flask data at four different sites collected over summer 2010. The model-data mismatch in vertical gradients indicate transport model errors in near-surface turbulent mixing.