Detection and Quantification of Urban Greenhouse Gas Emissions: Ground-based Results of the INdianapolis FLUX (INFLUX) Experiment

N. Miles[1], T. Lauvaux[1], K. Davis[1], S. Richardson[1], D. Sarmiento[1], K. Wu[1], A. Karion[2], C. Sweeney[2], I. Vimont[3], J. Turnbull[4], M. Hardesty[5], A. Brewer[5], K. Gurney[6], I. Razlivanov[6], L. Iraci[7], P. Hillyard[7], P. Shepson[8], M. Cambaliza[8] and J. Whetstone[9]

[1]The Pennsylvania State University, University Park, PA 16802; 814-880-8087, E-mail: nmiles@psu.edu
[2]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309
[3]University of Colorado, Boulder, CO 80309
[4]GNS Science, National Isotope Centre, Lower Hutt, New Zealand
[5]NOAA Earth System Research Laboratory, Boulder, CO 80305
[6]Arizona State University, Tempe, AZ 85287
[7]National Aeronautics & Space Administration (NASA) Ames Research Center, Mountain View, CA 94035
[8]Purdue University, West Lafayette, IN 47907
[9]National Institute of Standards and Technology (NIST), Boulder, CO 80305

The INdianapolis FLUX (INFLUX) Experiment was designed to develop and evaluate methods for detection and attribution of greenhouse gas fluxes from urban environments. In addition to aircraft and flask measurements, the current INFLUX observation network includes twelve *in situ* towers instrumented for continuous measurements of CO_2/CO/CH_4, four eddy covariance flux towers, and a Doppler lidar. A Total Carbon Column Observing Network column remote sensing station was deployed for approximately four months. Results from the Hestia project provide high spatial/temporal resolution "bottom-up" emissions estimates. The modeling system includes the Weather Research and Forecast model and Lagrangian Particle Dispersion Model, combined with a Bayesian matrix inversion. Here we will present results from the *in situ* tower measurements and preliminary missions results from the inversion system. As shown in Figure 1, the model captures the overall ordering of the sites in terms of increase above background average CO_2 mole fraction, but the observations are 25% higher than the modeled values, on average. The discrepancy suggests an underestimate in the bottom up emissions estimate. The spatial structure of the difference between the posterior (inverse) and the prior emissions (Hestia) fluxes is shown in Figure 2. We investigate the sensitivity of the modeled results to the assumptions.

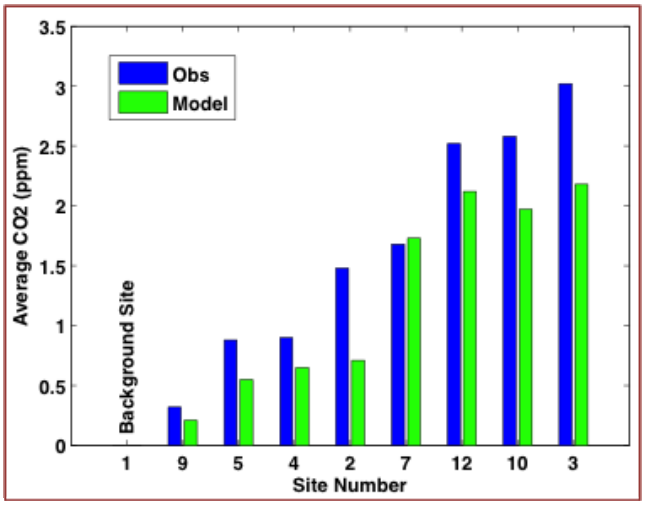

Figure 1. Shown in green is the observed averaged CO_2 mole fraction above background for INFLUX tower sites (1 Jan – 1 Apr 2013). Shown in blue are model results (prior to inversion) using a mesoscale atmospheric model and Hestia 2002.

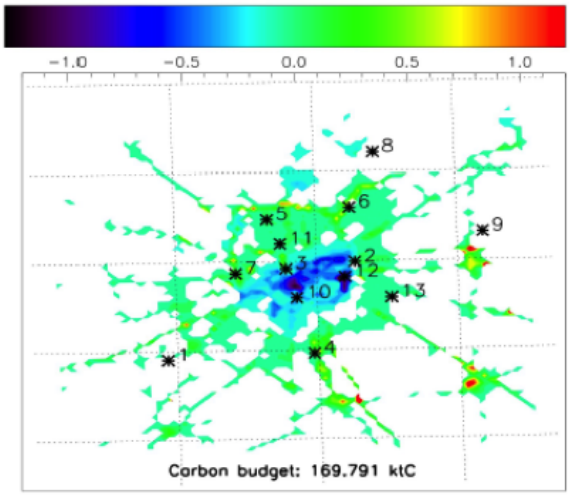

Figure 2. The spatial structure of the difference between the posterior (inverse) and the prior emissions (Hestia) fluxes for the period 6 Oct – 30 Nov 2012.