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Urban greenhouse gas mole fraction in-situ measurements: Results from the Indianapolis Flux Experiment (INFLUX)

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The Indianapolis Flux Experiment (INFLUX) was designed to develop and evaluate methods for the measurement and modeling of greenhouse gas fluxes from urban environments. Determination of greenhouse gas fluxes and uncertainty bounds is essential for the evaluation of the effectiveness of mitigation strategies. The current INFLUX observation network includes twelve in-situ tower-based, continuous measurements of CO_2, CO, and CH4, flask sampling of 14CO_2 and other trace gases, and periodic aircraft sampling of greenhouse gases and meteorological conditions. Eddy covariance and radiative flux are measured at four of the tower sites, and a scanning Doppler lidar was installed in April 2013; both are used to quantify key boundary layer meteorological properties and evaluate model performance. Additionally, a total carbon column observing network (TCCON) column remote sensing station was deployed August - December 2012. The data from the towers, TCCON, and aircraft measurements are being used in an inverse-modeling approach to yield estimates of the urban area flux at 1 km2 resolution. Very high space/time resolution estimates of fossil fuel carbon emissions (Hestia project) offer state-of-the-art "bottom up" emissions estimates for the city and its surroundings. Here we present an overview of the progress from INFLUX, with a focus on tower-based results. With this high density of urban tower-based greenhouse gas measurements, we will quantify horizontal and vertical spatial patterns in atmospheric mole fractions of CO_2, CO, and CH4 in Indianapolis. The consistency of the observed horizontal gradients with that expected based on differences in land-cover contributions according to footprint analysis will be evaluated. The ability to correctly model transport and mixing in the atmospheric boundary layer, responsible for carrying greenhouse gases from their source to the point of measurement, is essential. Thus we investigate differences between the modeled and observed sensible heat flux, latent heat flux, air temperature, and wind speed.