Indianapolis Flux Project (INFLUX): Development, Improvement and Assessment of Methods to Quantify Greenhouse Gas Emissions at the Urban Scale

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INFLUX was recently funded by the National Institute of Standards and Technology, to develop and assess methods of quantifying greenhouse gas emissons at the urban scale, using Indianapolis as the test site. The primary project goal is to develop better technique/approach for measurement of urban-scale greenhouse gas emission fluxes. Top-down atmospheric measurements will be obtained from aircraft flights and towers, and compared with bottom-up estimates from the Hestia block-level fossil fuel CO_2 emission inventory for Indianapolis. Measurement methodologies will be developed, with quantified uncertainties.

Indianapolis was chosen for this experiment, because it provides an excellent location to evaluate our ability to use top-down atmospheric observations to constrain urban-scale greenhouse gas emissions. Indianapolis is a medium-sized city, with fossil fuel CO_2 (CO_2ff) emissions of ~3.4 MtC yr^{-1}, providing a large enough signal to be readily detectable in the atmosphere. Indianapolis is located far from any other metropolitan areas, so the signal from Indianapolis can be isolated with relative ease. The terrain is flat, making the meteorology relatively simple. The Hestia bottom-up CO_2ff inventory product for Indianapolis is the highest resolution emission inventory available for any city in the world, allowing comparison of the bottom-up and top-down methods, to evaluate and improve uncertainties in both.

40 aircraft flights are planned over the two year duration of the project. Aircraft measurements will be made from a small plane, equipped with an ALAR system for continuous meteorological measurements, a Picaro cavity ring-down system for continuous CO_2, CH_4 and CO measurements, and 12-24 flask measurements per flight, for a host of trace gases including CO_2, CH_4, CO, $\Delta^{14}CO_2$ (used to estimate fossil fuel CO_2), stable isotopes of CO_2 and a suite of halocarbons and hydrocarbons. Two cell phone towers (>100m height) will be equipped for continuous measurements of CO_2, CH_4 and CO, and integrated flask sample measurements. Integrated flask samples will be collected as pooled samples of air collected only during appropriate meteorological conditions over each two week period. The current experimental period is two years.

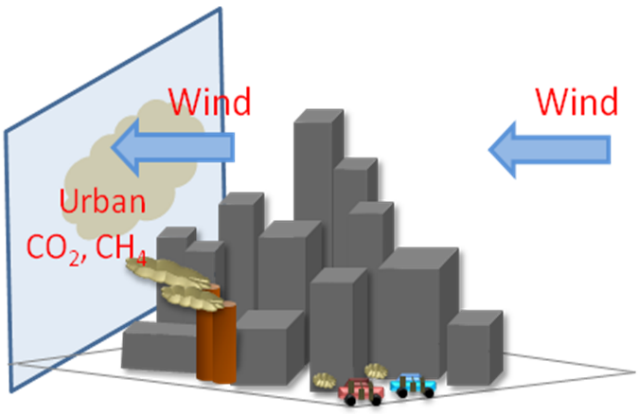

Figure 1. Visualization of urban plume experiment. As airmass travels over urban air area it picks up CO_2 and CH_4 emissions. These emissions are captured by the plane flying downwind of the plume.

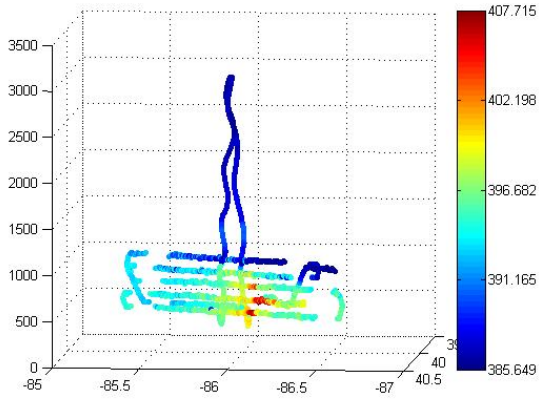

Figure 2. Actual measurements of CO_2 downwind of Indianapolis in April of 2007. The 10 ppm enhancements in the center of the plume make detecting CO_2 emissions from Indianapolis very easy.