Detection of trends in urban CO_2 emissions: Results from the INFLUX tower network

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The overall objective of the Indianapolis Flux Experiment (INFLUX) is to develop, evaluate and improve methods for measuring greenhouse gas emissions from cities. The atmospheric-based top-down method of determining greenhouse gas emissions is complementary to inventories, allowing an independent assessment of emissions and the ability to quickly detect temporal changes in emissions. Cavity ring-down spectroscopic measurements of CO_2 on a network of towers began in Indianapolis in 2010. A regional atmospheric inversion system uses these data to infer urban emissions. Here we focus on the ability to detect trends in the Indianapolis CO_2 emissions from 2012 to 2015. Over the period, an agreement in the 3-year trend emerged from the comparison of inverse CO_2 emissions to annual estimates from energy use statistics despite differences in the year-to-year variability.

Furthermore, we use CO_2 mole fraction data alone to demonstrate the ability to quantify point source emissions, and their changes. The Harding Street Power Plant in downtown Indianapolis, like many power plants across the country, was recently converted from coal to natural gas, with the conversion being completed in March 2016. The Harding Street Power Plant is in the southwest quadrant of downtown, 6 km to the west of INFLUX Tower 10. Forward modeled CO_2 indicates that prior to the conversion of the power plant from coal to natural gas, 47% of the CO_2 mole fraction enhancement at Tower 10 was attributable to the electricity production sector. Using the standard deviation within the hourly CO_2 measurements as an indicator of plume strength, we detect changes in CO_2 plumes that are correlated with coal use at the Harding Street Power Plant.