Can We Detect the Conversion of the Harding Street Power Plant in Indianapolis from Coal to Natural Gas Using Tower-based CO_2 Mole Fraction Data Alone?

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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. Long-term monitoring of urban emissions has typically been focused on areal emission, not point sources, but point sources can be a large fraction of urban emissions. We use carbon dioxide (CO_2) mole fraction data measured on towers in and surrounding Indianapolis as part of the INFLUX project 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. Analysis of 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. Emissions from the power plant should drop by roughly a factor of two given the conversion to natural gas. In Figure 1, probability distribution functions of Tower 10 afternoon CO_2 enhancement compared to the background Tower 1 indicate a significant decrease in the enhancements in 2016-2017 dormant time frame (Mar., Nov.-Feb.) compared to previous equivalent time periods, when the winds are from the west. Relatively little change from year to year is found when the winds are from the other directions. We also present progress toward quantifying emissions using plume dispersion modeling by evaluating plume events before and after the conversion as a function of atmospheric stability.

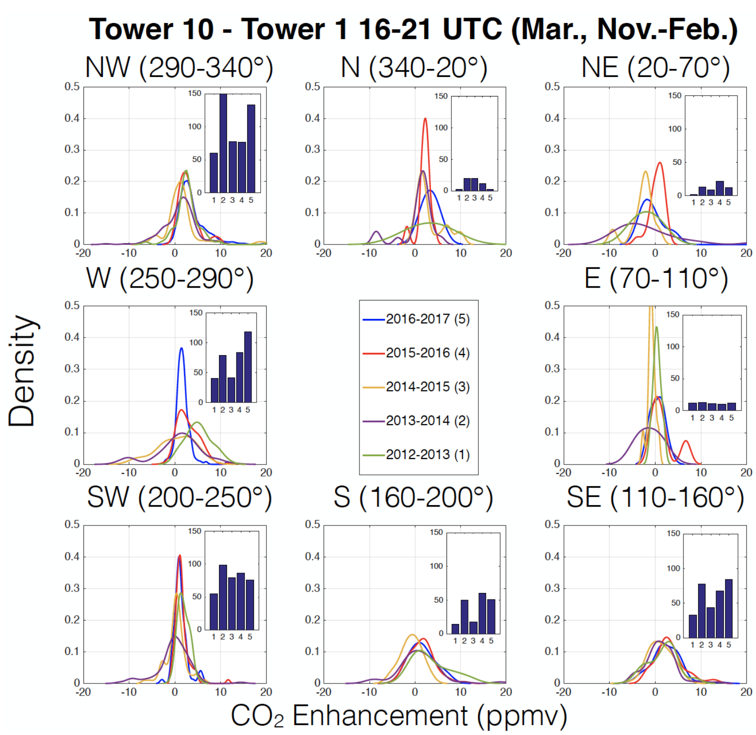

Figure 1. Probability distribution functions of afternoon CO_2 enhancement, segregated into wind direction sectors for the dormant season (Mar., Nov.-Feb.) of each of five time frames. Here CO_2 enhancement is defined as the difference between the CO_2 measured at the predominantly downwind Tower 10 and that measured at the predominantly background Tower 1. The inset plots show the sample size of hourly differences for each time frame. The time frame represented by a number from 1-5 is indicated in the legend.