Evaluation of Nine Years of Methane Observations from a Tower Network in Indianapolis, Indiana

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Cities are a substantial source of methane emissions, containing both well-known point source leaks such as landfills, as well as more complex and densely scattered sources, such as leaks in the natural gas distribution system. Addressing these methane sources provides a potential pathway for cities to reduce their carbon footprint, but to quantify any reductions, methods must be established to detect changes in emissions over time. In this work we present nearly a decade (2013-2021) of continuous methane observations collected from a tower-based network in the city of Indianapolis, Indiana as part of the indianapolis Flux Experiment (INFLUX) research project. Using a weather transport model, influence functions are generated for each tower site, and a Bayesian inversion is performed in order to solve for methane emissions during the observational period. Overall, we find methane emissions for the city (defined by Marion County borders) to be ~20 Gg/year, in agreement with values obtained from aircraft mass balance estimates and Environmental Protection Agency (EPA) inventories. This emission rate is relatively constant across all years, including those in which a coal-fired powerplant transitioned to a natural gas powerplant, as well as throughout the onset of the COVID-19 pandemic. Furthermore, methane emissions remained consistent seasonally despite increased natural gas usage during the winter months. One potential reason for the strong consistency in emissions may be related to the dominance of a single, constant emission source, the South Side Landfill, which appears to be responsible for half of methane emissions in the city. The success of the tower network's capabilities of solving for a consistent methane emission rate throughout 8 years provides a testbed to measure and quantify the effects of future policies designed at targeting and reducing methane emissions in the city of Indianapolis. The consistency with inventories contradicts previous studies that suggest that urban emissions are generally underestimated. We hypothesize that Indianapolis benefits from relatively modern natural gas distribution infrastructure.

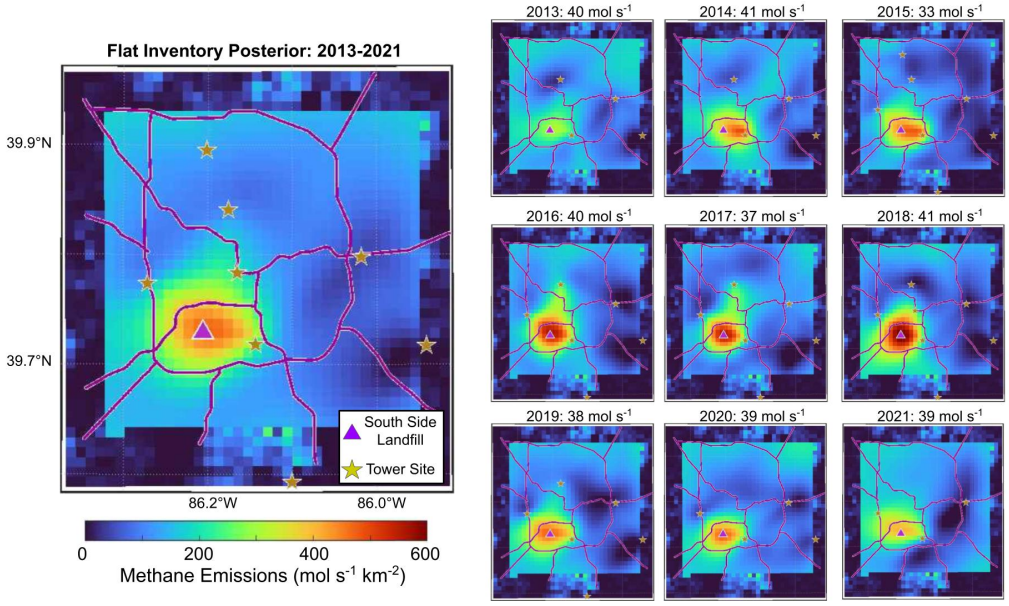

Figure 1. The mean monthly methane posterior fluxes in Indianapolis, Indiana from the years 2013-2021 starting from a flat prior. The location of the South Side landfill is plotted as a purple triangle in all panels. Towers which contained at minimum 60 daily downwind afternoon observations in a given year are also plotted on each panel.