Quantification of urban CO_2 emissions in Indianapolis and Auckland

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Cities are often leading the way in CO_2 emission mitigation efforts, both to address the climate challenge and the many associated co-benefits for urban areas. They to understand their emissions both to assess the potential of carbon mitigation strategies and to evaluate the success of such strategies. Commonly, national-level CO_2 reporting is downscaled to provide city-scale emission estimates. Different downscaling methods can produce differences of 50-100% for an individual city, too uncertain to provide meaningful guidance on typical emission reduction targets of 20-30%.
The long-running Indianapolis Flux Experiment (INFLUX) aims to develop and assess methods to constrain urban greenhouse gas emissions that be applied to cities around the world. INFLUX brings together new high-resolution (in both space and time) inventory assessments, a multi-year record of in situ CO_2, CH_4 and CO from tower-based and aircraft-based atmospheric measurements along with a complementary suite of 50 trace gases and isotopes from flasks, and atmospheric modelling. Together, these provide high-accuracy, high-resolution, continuous monitoring of GHG emissions from the city. We compare the bottom-up data product, and top-down tower-based atmospheric inversion and aircraft-based mass balance, in combination with flask observations of radiocarbon in CO_2, to show that urban fossil fuel CO_2 emissions can be constrained to better than 10%, sufficient to allow assessment of proposed emission reduction targets. We will also present early results from a new study in Auckland, New Zealand, where we work directly with Auckland Council and New Zealand's Ministry for the Environment. We use lessons learned from INFLUX and other studies to tailor the research design and outputs to address the most pressing stakeholder questions and data gaps. This has led to an immediate focus on the partitioning of Auckland's CO_2 fluxes into fossil fuel and land carbon exchange.