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Mapping, emission quantification, and attribution of methane enhancements across two European cities; Utrecht, NL and Hamburg, DE

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Methane is a potent greenhouse gas and the main component of natural gas. Methane escape from natural gas infrastructures contributes in global warming and economic loss. A financial damage of $90 million was estimated in Boston region as about 15 billion cubic feet of natural gas escape from natural gas distribution system annually (McKain et al., 2015). In-situ mobile measurements of methane mole fraction in ambient air in real-time is an effective and rapid method to identify and quantify local methane emissions in urban areas.

Between February and April 2018, we carried out extensive campaigns to measure methane concentrations at the street level in Utrecht, Netherlands, using Picarro G2301 cavity ring-down spectroscopy (CRDS) analyser mounted on a small van. In October and November 2018, we mapped CH4 mole fractions across Hamburg, Germany, using two CRDS instruments (Picarro G2301 and G4302). The G2301 instrument measures Methane (CH4), Carbon Dioxide (CO_2) and Water Vapour (H_2O) mole fractions while the G4302 measures atmospheric CH4, Ethane (C2H6) and H_2O mole fractions. Basic meteorological data (wind speed, 2D wind direction and temperature) were also collected on the vehicle. The campaign logistics were based on stable weather conditions, avoiding traffic rush hours, and passing each street at least two times.

The empirical equation from Von Fischer et al. (2017) was used to translate the methane elevations to emissions categories. The online measurements of C2H6 allow to quickly discriminate thermogenic from biogenic sources methane enhancements. In addition, air samples were collected from large methane plumes for lab characterization of isotopic signature of methane enhancement with high-precision isotope ratio mass spectrometry in order to distinguish different emission sources.

The results highlight that methane elevations are related to losses from the gas distribution system, industrial activates, domestic waste-water treatment plant, agriculture and uncomplete combustion of vehicles. The observations in Hamburg allow investigation of fugitive methane emissions in upstream, mid-stream and downstream of oil and gas industry.

Methane emissions from natural gas in Boston Kathryn McKain, Adrian Down, Steve M. Raciti, John Budney, Lucy R. Hutyra, Cody Floerchinger, Scott C. Herndon, Thomas Nehrkorn, Mark S. Zahniser, Robert B. Jackson, Nathan Phillips, Steven C. Wofsy Proceedings of the National Academy of Sciences Feb 2015, 112 (7) 1941-1946; DOI: 10.1073/pnas.1416261112

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