

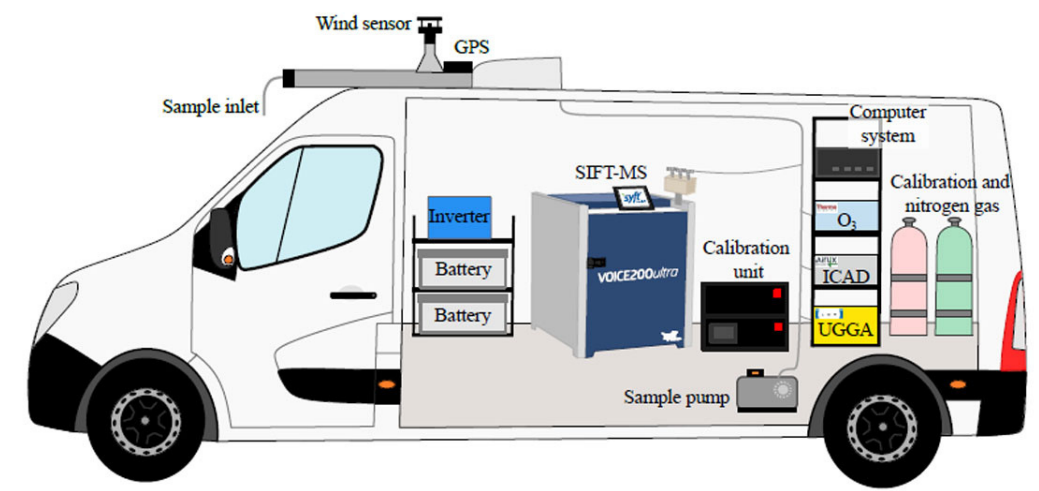
Using mobile measurements of methane to detect natural gas emissions in two medium sized UK cities

Thomas Moore^[1], James D. Lee^[1,2], James R. Hopkins^[1,2], Will S. Drysdale^[1,2], Marvin D. Shaw^[1,2], Sri Hapsari Budisulistiorini^[1]

1) Department of Chemistry, University of York, UK; 2) National Centre for Atmospheric Science, University of York, UK
email: tcm515@york.ac.uk

Introduction/Methodology

- Fugitive emissions from domestic natural gas networks already pose a challenge to reducing the methane emissions of a country and will become an increasing problem as existing infrastructure ages and becomes more prone to leaks.
- An algorithm developed in (von Fischer et al., 2018) and refined in (Weller et al., 2019) to determine "Leak Indications" (LIs) associated with the Natural Gas network from mobile measurements of methane.
- The WACL Air Sampling Platform (WASP) equipped with a Los Gatos Research ultra-portable greenhouse gas analyser (UGGA) for methane measurements. And a Voice200 ultra SIFT-MS to measure propane and butane, two other components in the UK's natural gas mixture.



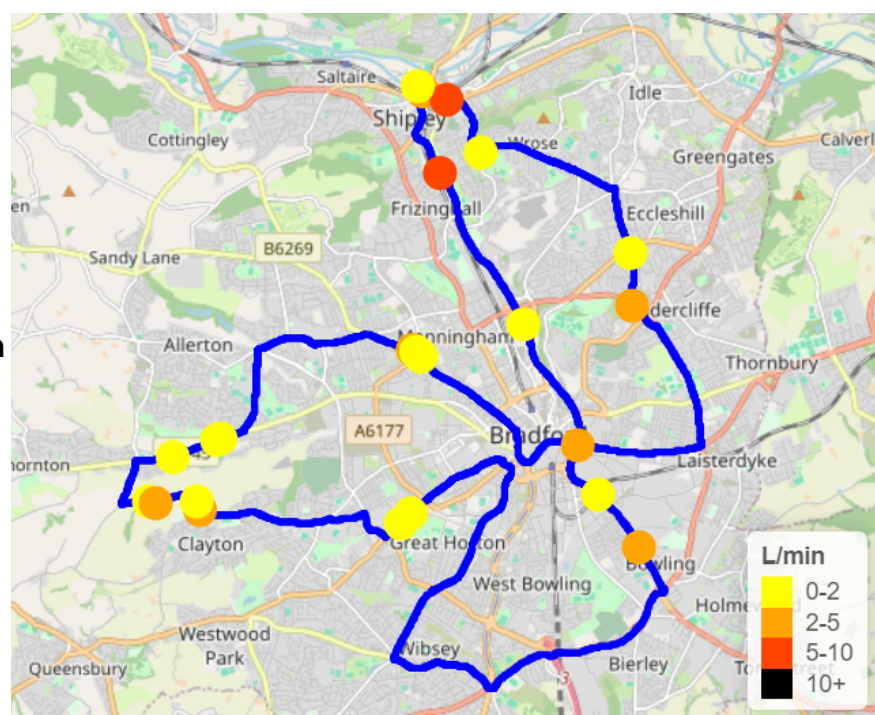
Schematics of the WACL Air Sampling Platform. (Wagner et al., 2021)

Fugitive emissions in York and Bradford

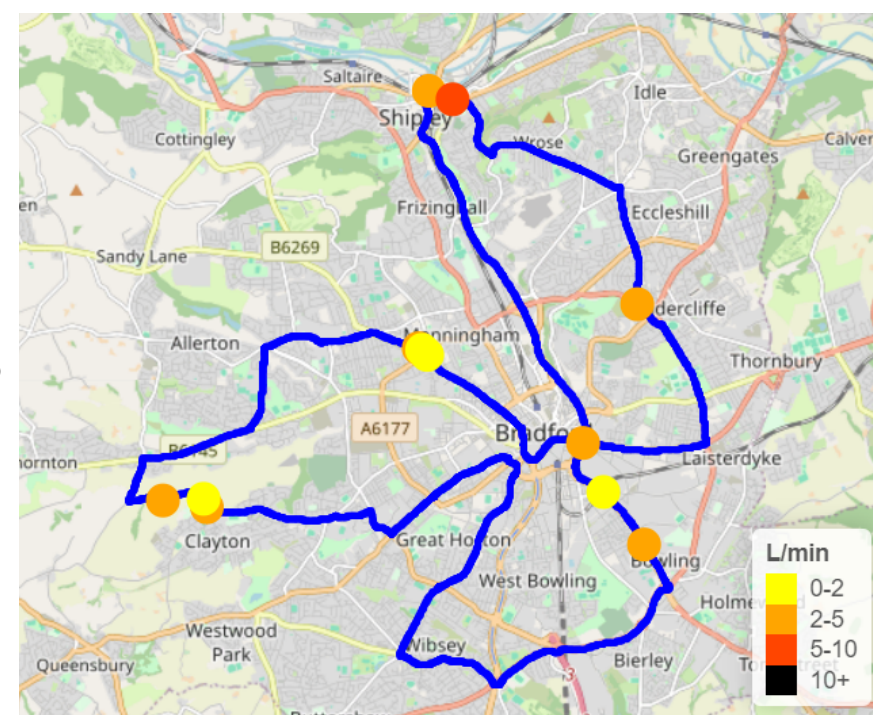
- Summer and Winter campaigns took place in York and Bradford, each campaign took place for ~1 week and consisted of ~10 drives per campaign.
- LIs were determined using both the methane detection algorithm and SIFT ratio of propane:butane. Those within the range of the UK's natural gas mixture (Bains et al., 2016) were considered indications of emissions from the UK's Natural Gas Network.
- Emission rates were quantified using the equation in (Weller et al., 2019): $\ln(\text{maxexcess } CH_4) = -0.988 + 0.817 * \ln(\text{emission rate})$

Bradford

Methane Detection Algorithm



SIFT-MS ratio

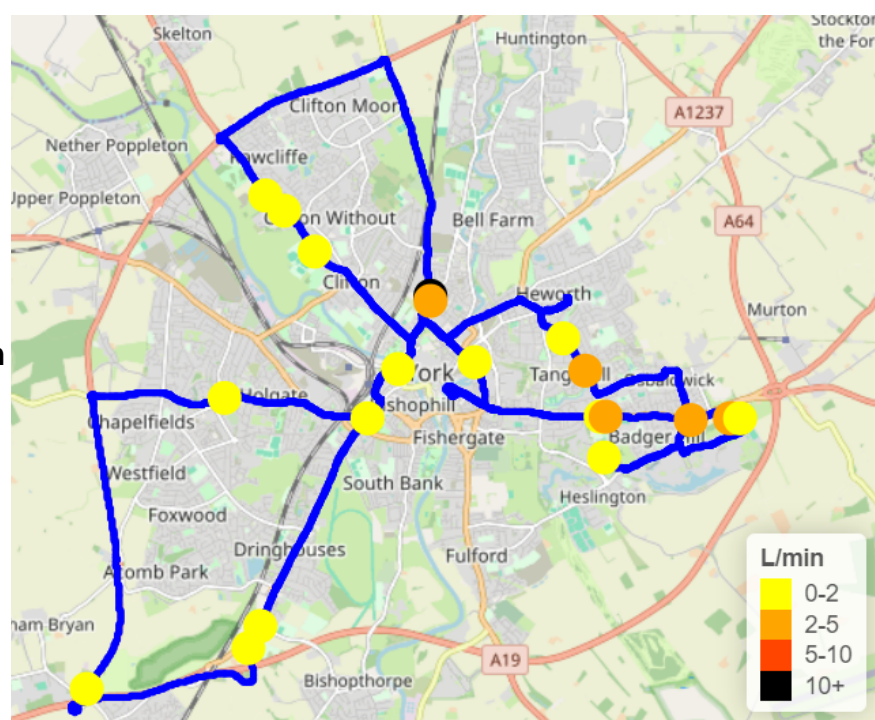


Bradford:

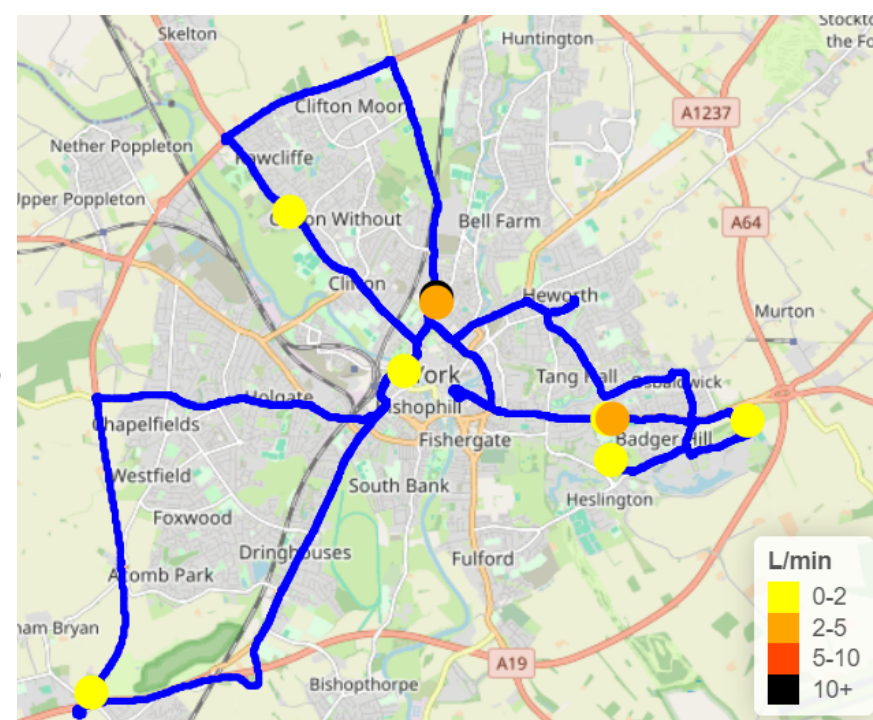
- Methane Detection Algorithm:**
- 23 LIs
 - Median Leak Rate: 1.80 L / min
- SIFT-MS:**
- 12 LIs
 - Median Leak Rate: 2.39 L / min

York

Methane Detection Algorithm



SIFT-MS ratio

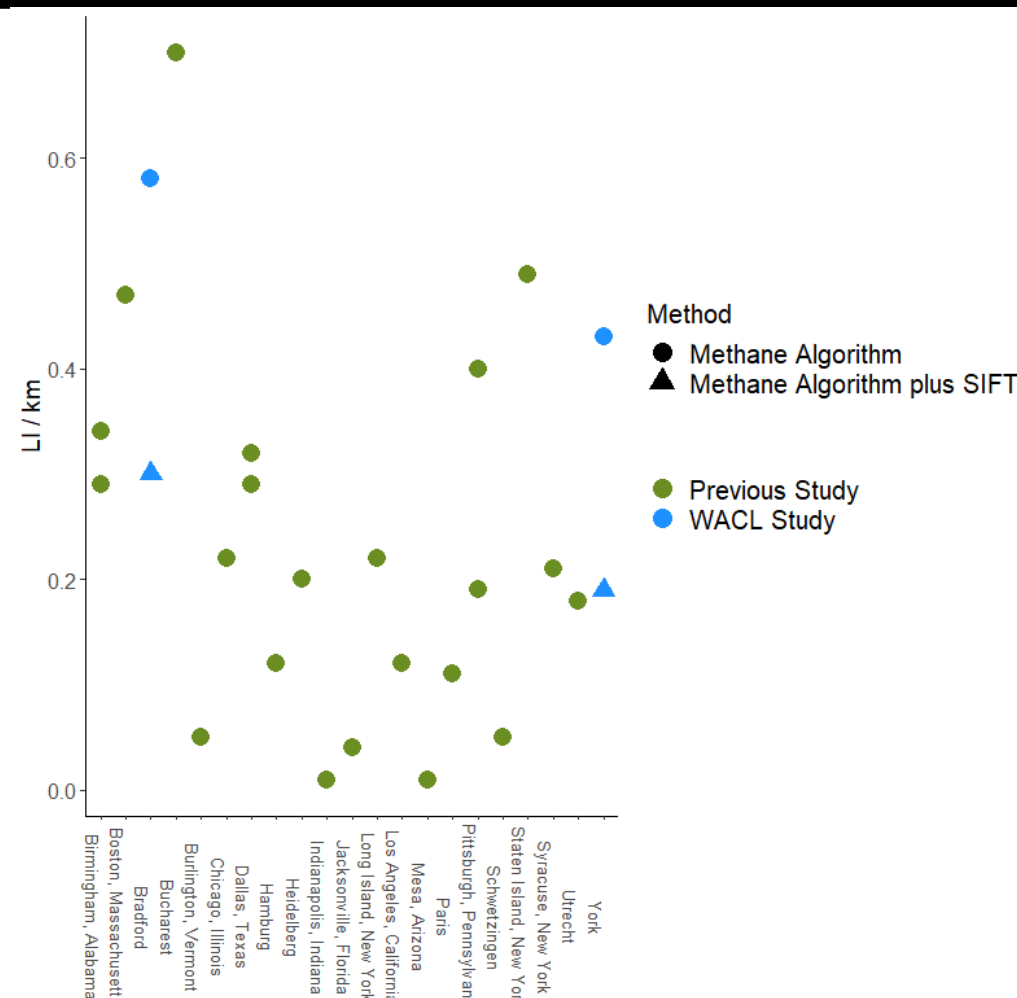


York:

- Methane Detection Algorithm:**
- 20 LIs
 - Median Leak Rate: 1.30 L / min
- SIFT-MS:**
- 9 LIs
 - Median Leak Rate: 1.37 L / min

Results & comparison to previous studies

- Average LI/km (Leak Indications per km) from previous studies = 0.23.
- York and Bradford LIs from the methane detection algorithm had a higher LI/km (**0.43-York, 0.58-Bradford**).
- Using SIFT-MS ratios as confirmation of natural gas reduced LIs by 48% in Bradford and 55% York.
- SIFT reduced LIs for both cities had a comparable LI/km to previous studies (**0.19-York, 0.30-Bradford**).



Comparison of Leak Indications/km to other studies

Future work

- Develop algorithm to include changes shown in (Maazallahi et al., 2020).
- Conduct controlled release experiment to understand the relationship between WASP measured concentrations and real release rates.
- York and Bradford will be repeated using 10 Hz measurements with Aerodyne TILDAS in order to use ethane:methane ratios for confirmation.
- Compare to the estimated emissions in the UK National Atmospheric Emissions Inventory (NAEI).

References & Poster PDF

