Methane emission flux estimation from offshore oil and gas platforms with a dispersion model and airborne measurements.

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Aims:

- Estimate emission fluxes from oil and gas facilities with:
  - Airborne CH_4 measurements
  - ADMS 6 dispersion model
- Evaluate the methodology with published mass balance fluxes

Methodology:

Airborne measurements:

- BAE-146 Research Aircraft
- Fast Greenhouse Gas Analyzer: CO_2, CH_4 and H_2O
- 1-10Hz measurements, 10-100m spatial resolution

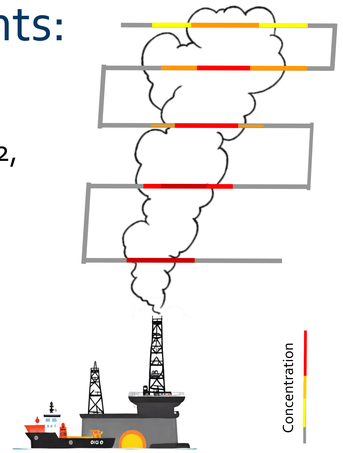
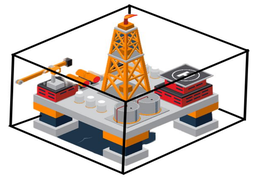


Figure 1. Plume chasing: Fly downwind of the plume and measure at different heights.

ADMS 6:

- Normal distribution along the plume's centreline
- Skewed Gaussian concentration
- Platforms as volume sources



Case study: Uncontrolled Elgin platform methane release in 2012

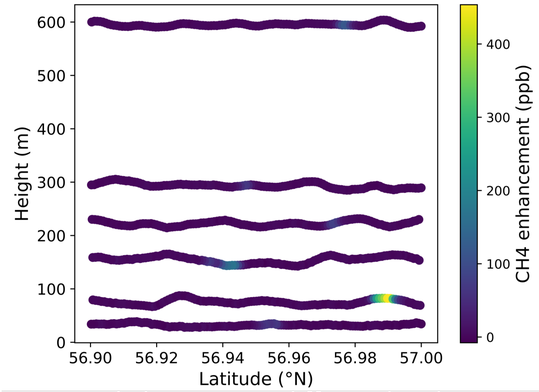


Figure 2. Flight passes at different heights 5NM from the source with marked CH_4 enhancement

Emission flux estimation:

Initial model run:

1. Unknown source emission flux
2. **Initial flux input in ADMS of 100 g/s of CH_4**
3. ADMS heatmap outputs at different heights sampled by aircraft
4. Select ADMS enhancement data ONLY over aircraft sampling area for each height

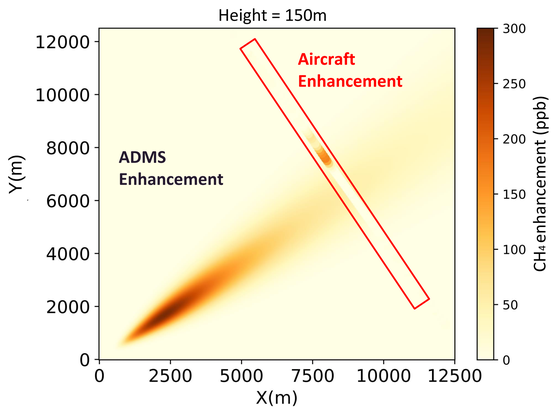


Figure 3. Heatmap of ADMS (black) and Aircraft enhancements (red) at a height of 150m. Colour scale: CH_4 enhancement (ppb)

Airborne measurements and model outputs :

1. Calculate peak area for aircraft and ADMS enhancements at different heights
2. Fit a function to peak areas against heights.
3. Integrate function: Obtain a peak area value that corresponds to the overall enhancement
4. Calculate source flux with a ratio between ADMS and aircraft enhancement

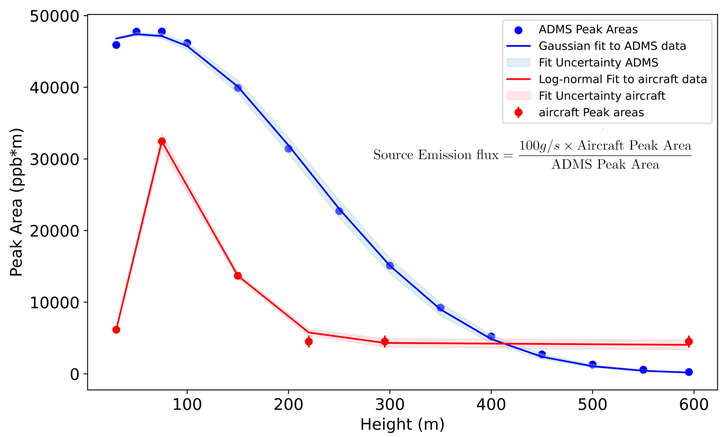


Figure 4. Log-normal and Gaussian fits to aircraft (red) and ADMS(blue) peak areas against heights.

Results and next steps

- Source emission flux for Elgin uncontrolled release:

45.85 ± 3.85 g/s

- In Lee, 2018 two mass balance equations used to calculate fluxes for different boundary layer conditions.
  - Stable BL: 550 ±710 g/s
  - Mixed BL: 590 ± 210g/s
- Calculated flux value falls within the stable BL result, however, big uncertainty.
- Studied ADMS variability to the size, and position of the source as well as variations in meteorology.
- Next steps: Inverse modelling approach for flux estimations, assess more sources of uncertainty, use the methodology with different datasets.

References

Lee, J D. et al. (Mar. 2018). "Flow rate and source reservoir identification from airborne chemical sampling of the uncontrolled Elgin platform gas release". In: Atmospheric Measurement Techniques 11.3, pp. 1725–1739. ISSN: 1867-8548. doi:10.5194/amt-11-1725-2018.