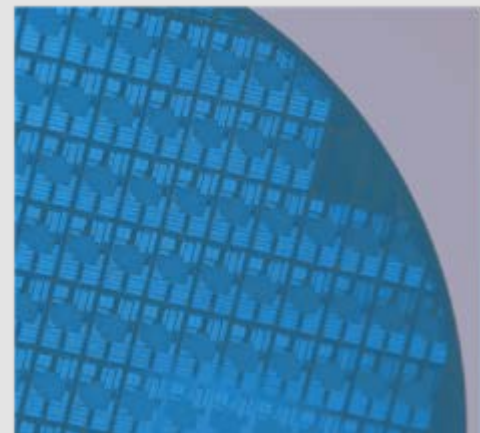




NOAA GMAC 2018

Open-Path Laser Dispersion Spectrometer
for Methane Emissions Mapping and
Quantification

Dr Graham Leggett
VP, Business Development



1. About MIRICO

2. Technology

- Laser Dispersion Spectroscopy (LDS)

3. Emissions Mapping and Quantification

- CH₄ release trials in collaboration with Shell Global Solutions International B.V.
- Mapping derived using Shell LightSource software
- Collaboration with NPL

4. Conclusions

ABOUT MIRICO



- Developer of rugged, high performance spectrometers for gas analysis
- Space science technology developed at Rutherford Appleton Labs
- Instruments offer precision, sensitivity, accuracy, and reliability
- Headquarters in Oxford, UK



Robust Space Technology



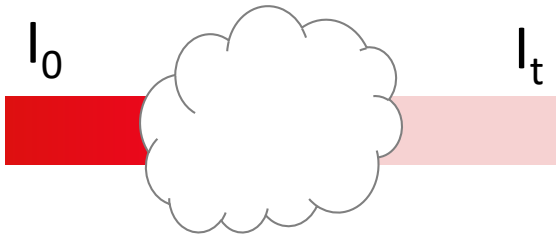
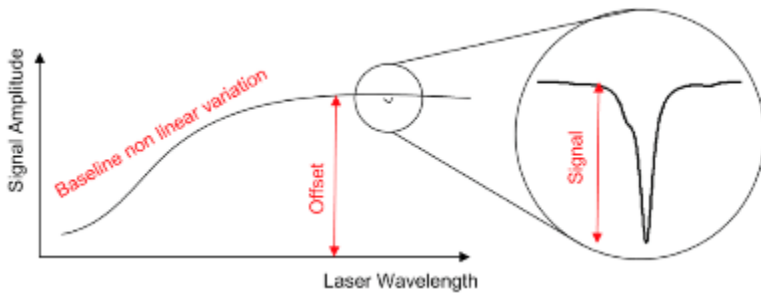
*Rugged & High
performance Analysers
for the field*



*Serving Multiple
Industries*

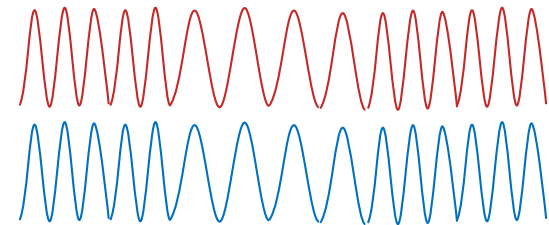
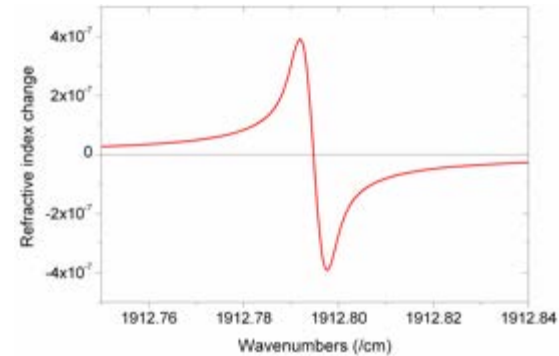


ABSORPTION

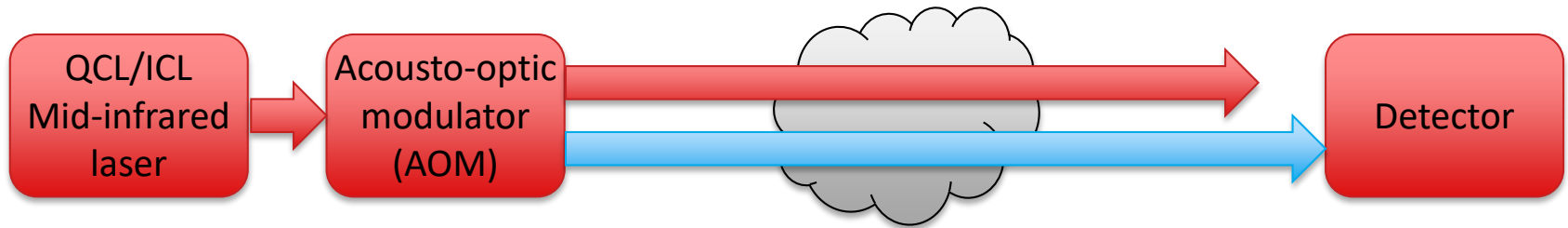


- Signal encoded in intensity of emitted beam
- Non linear after 10% absorbance
- Useful signal limited by intensity – susceptible to dust, water vapour, etc.

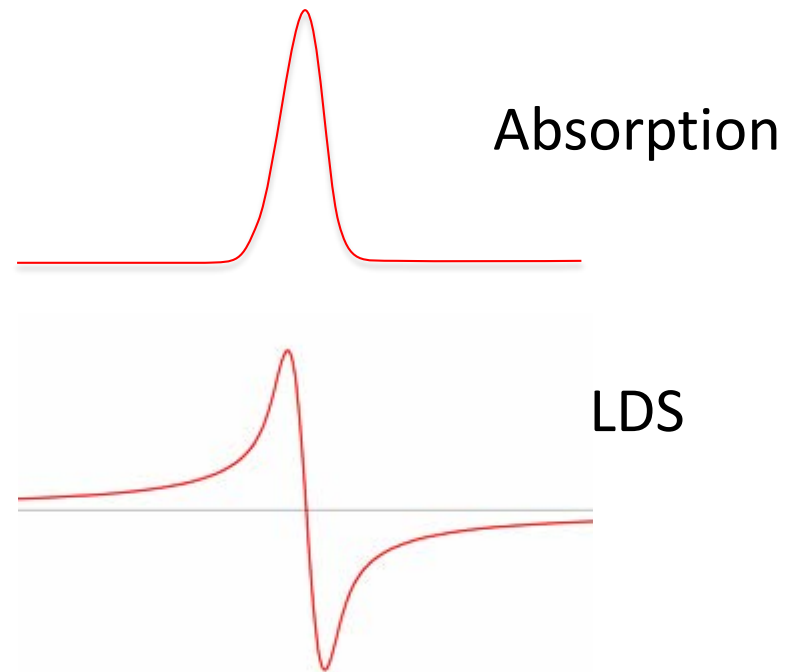
LDS

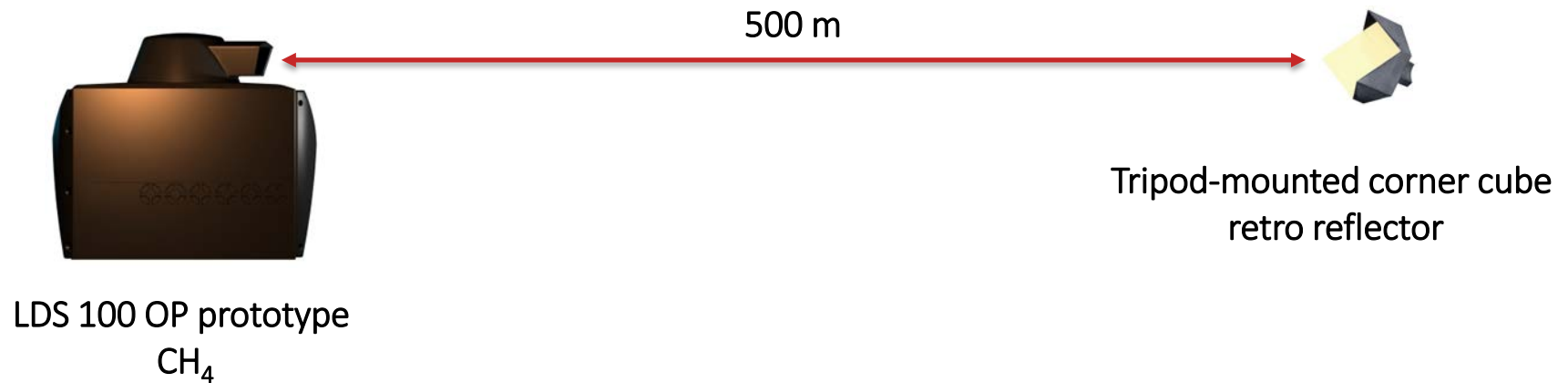


- Signal encoded in phase of beam
- Linear response over broad dynamic range
- Maintains sensitivity in “dirty” environments
- Immune to intensity fluctuations



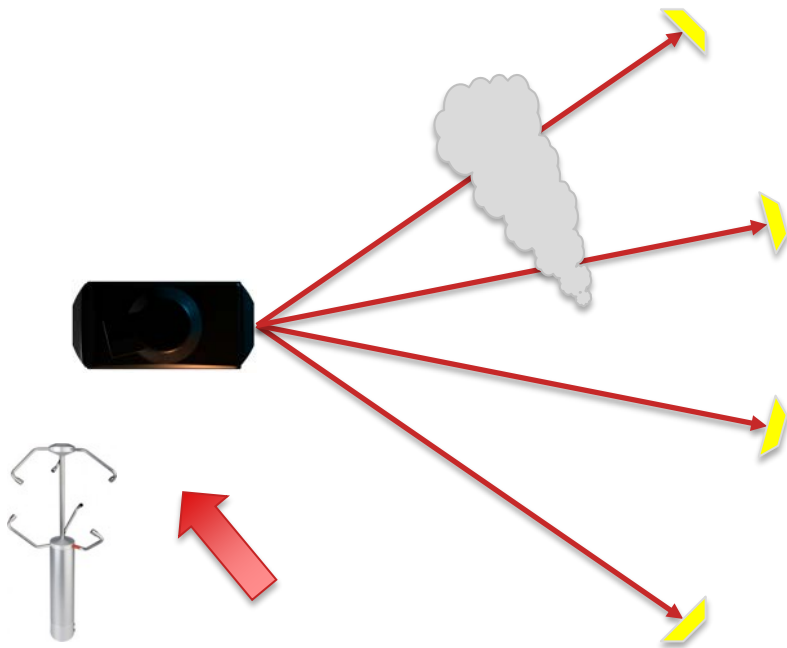
- Each frequency experiences different refracted index
- Results in different propagation time to detector



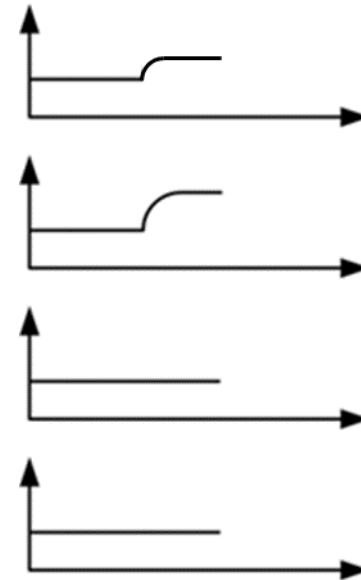


- 1 km total path-length (transmit and return)
- Manual alignment using visible laser
- ~1 hour deployment process

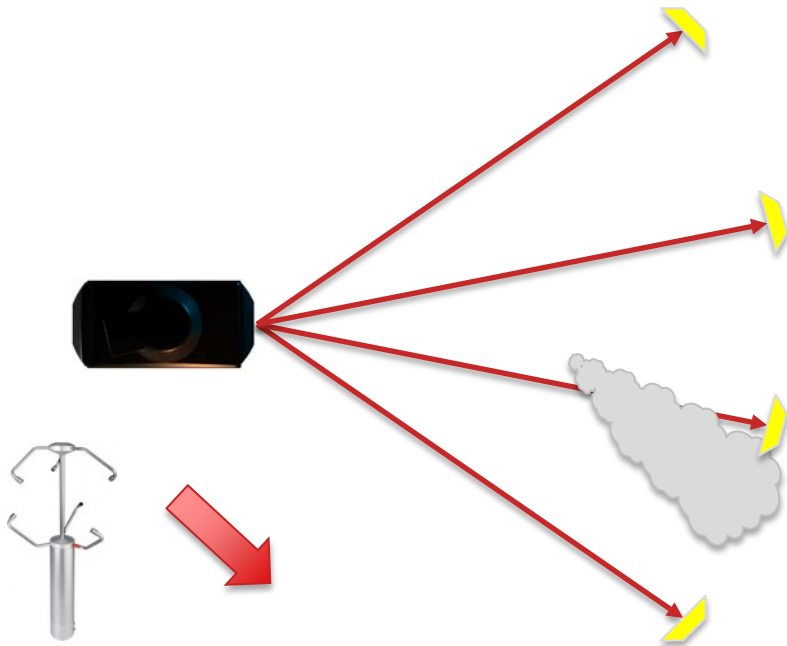
SIMPLE CASE OF POINT EMITTER



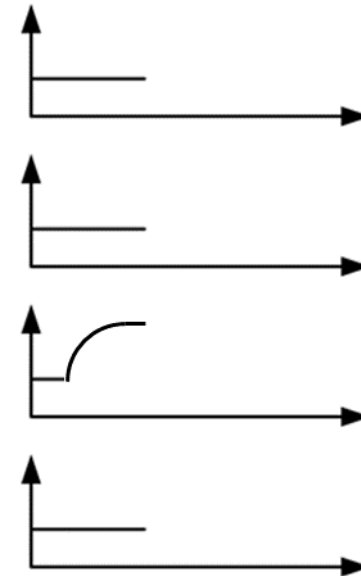
TEMPORAL EVOLUTION OF CH₄



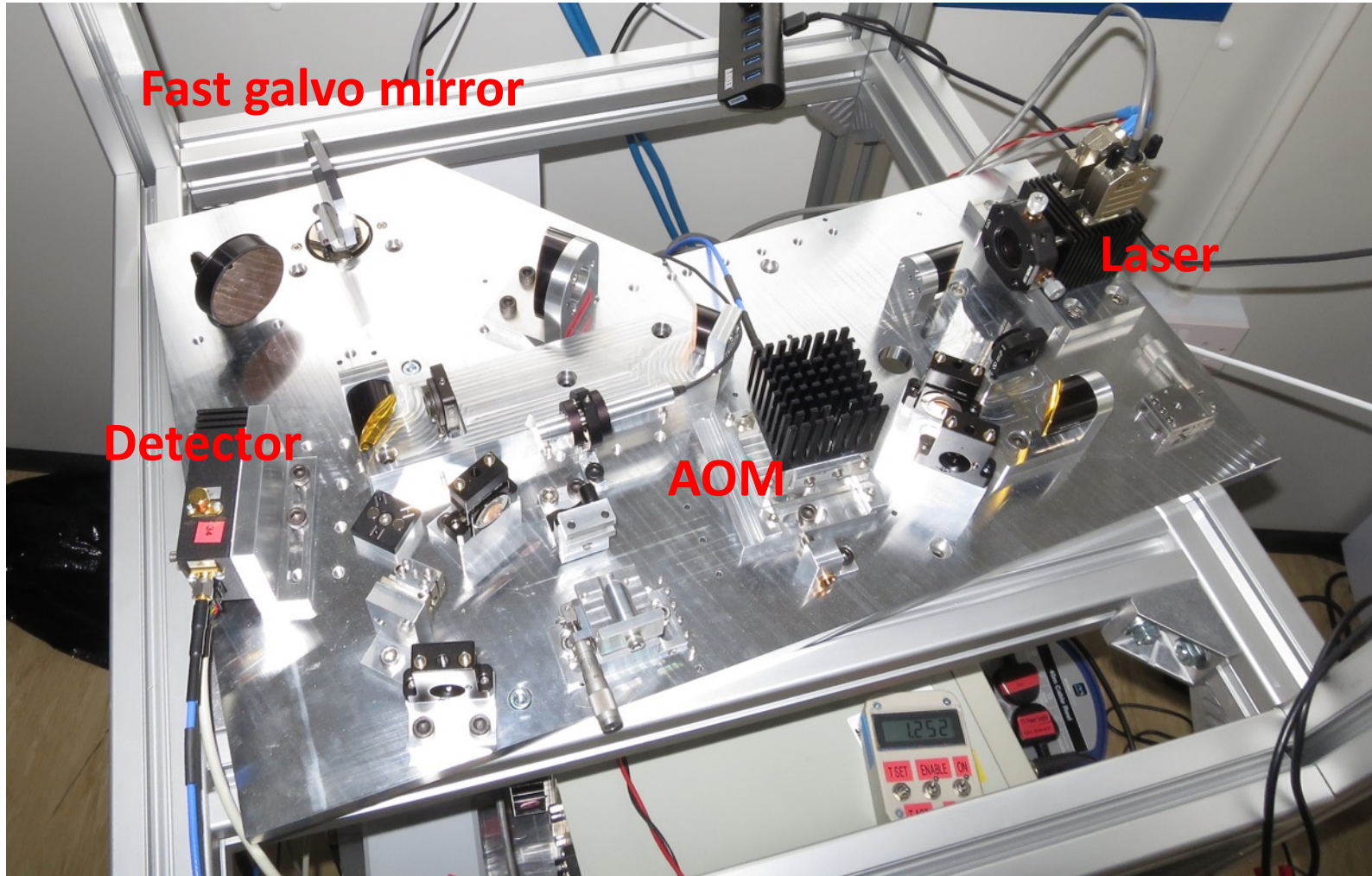
SIMPLE CASE OF POINT EMITTER



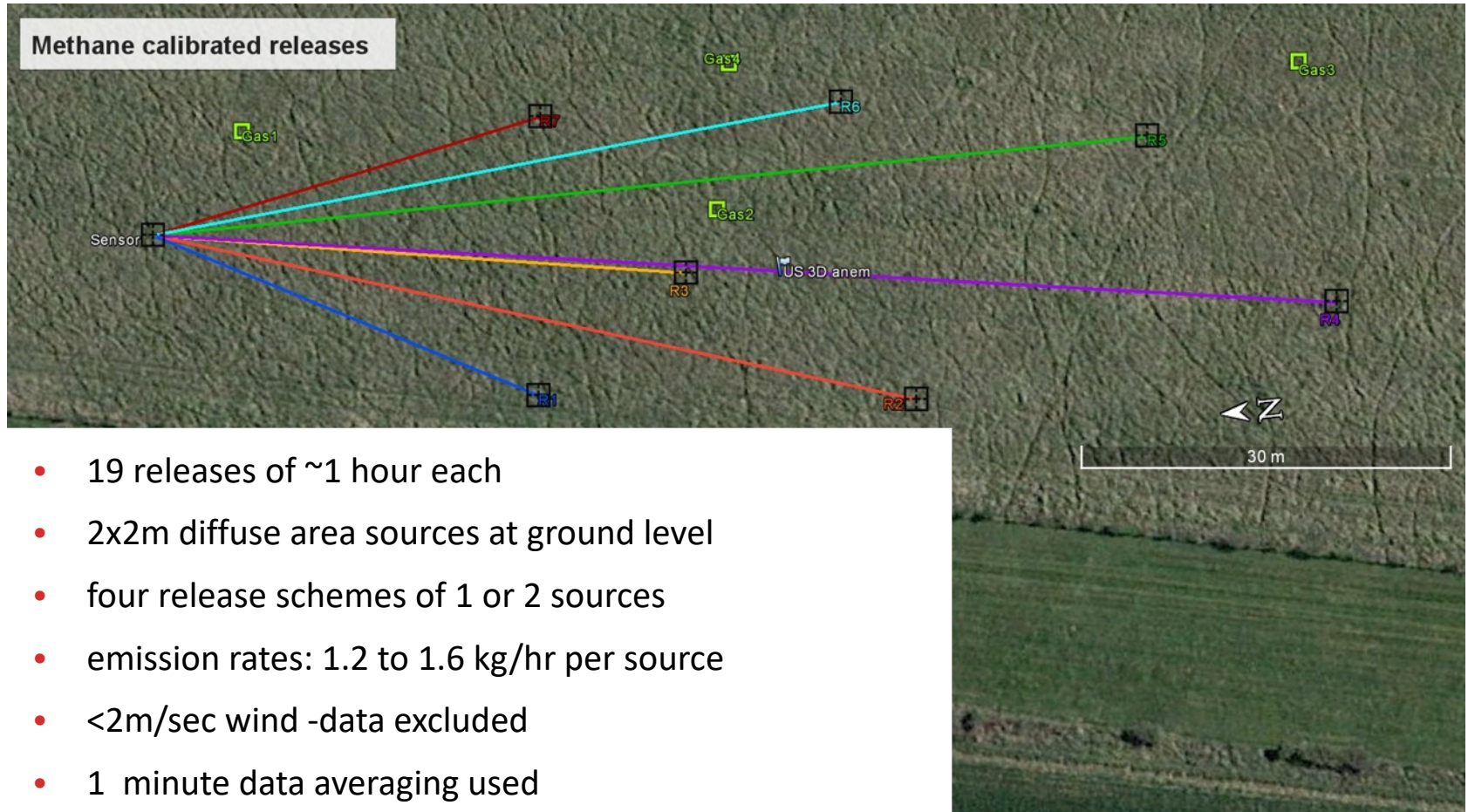
TEMPORAL EVOLUTION OF CH₄



MULTI-PATH CH₄ EMISSIONS MAPPING



MULTI-PATH CH₄ EMISSIONS MAPPING



MULTI-PATH CH₄ EMISSIONS MAPPING



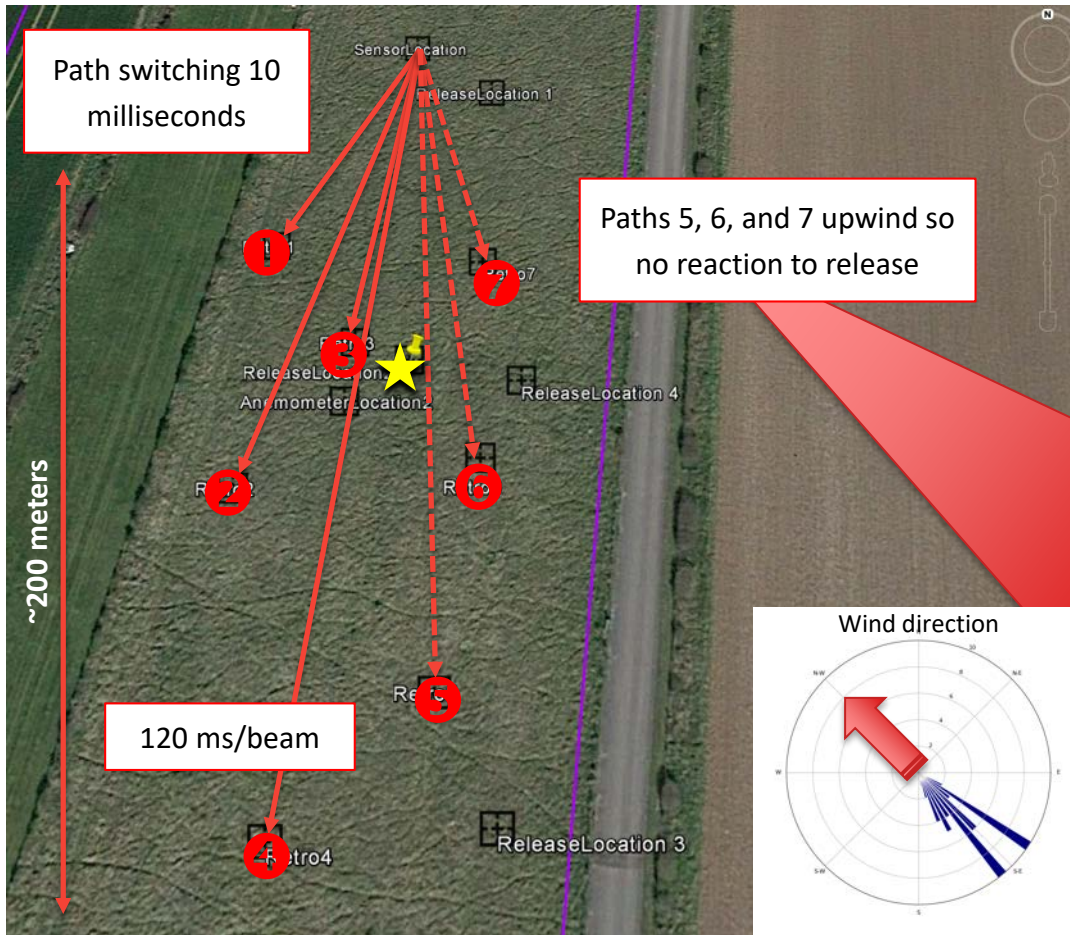
MULTI-PATH CH₄ EMISSIONS MAPPING



Temporal evolution of integrated CH₄ concentration over 7 paths

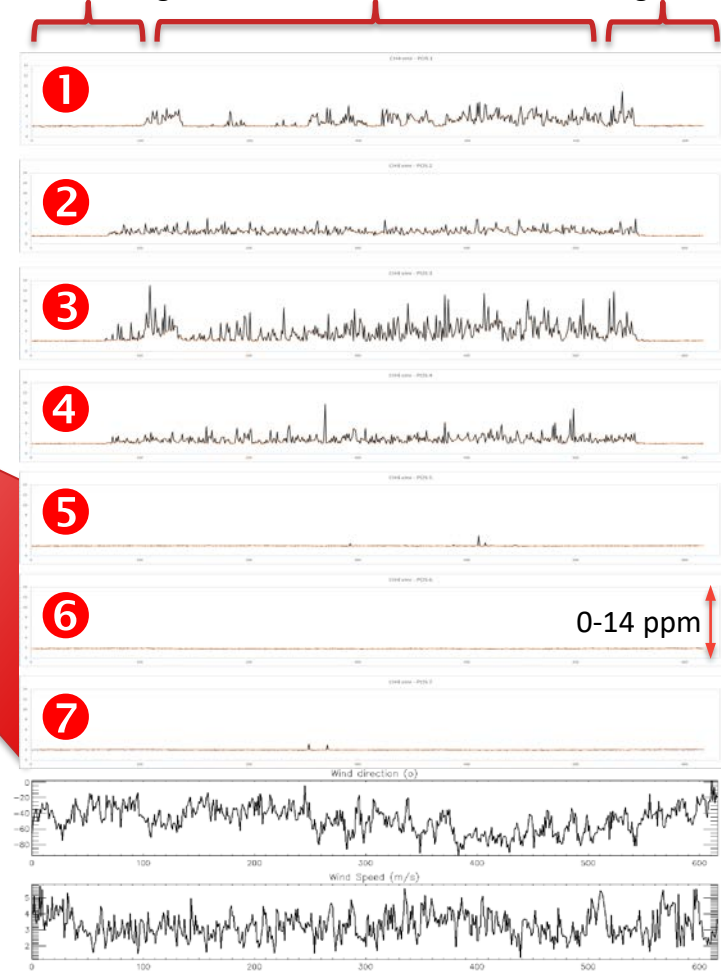
1s resolution - **~10 ppb** precision - **~1 ppm.m/√Hz**

(1 of 5 datasets used for analysis)

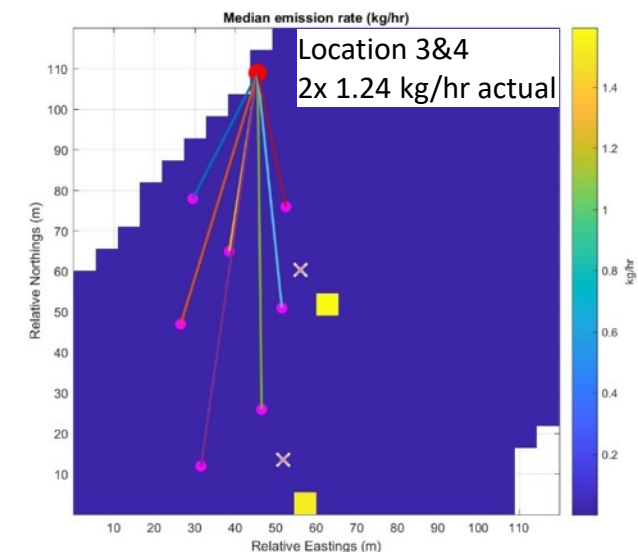
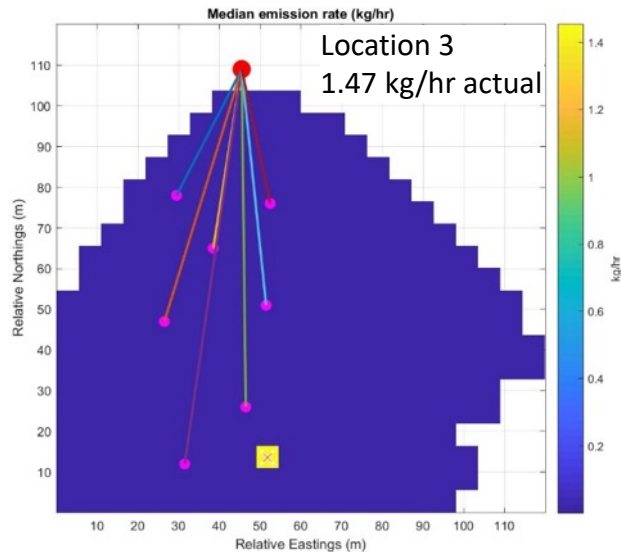
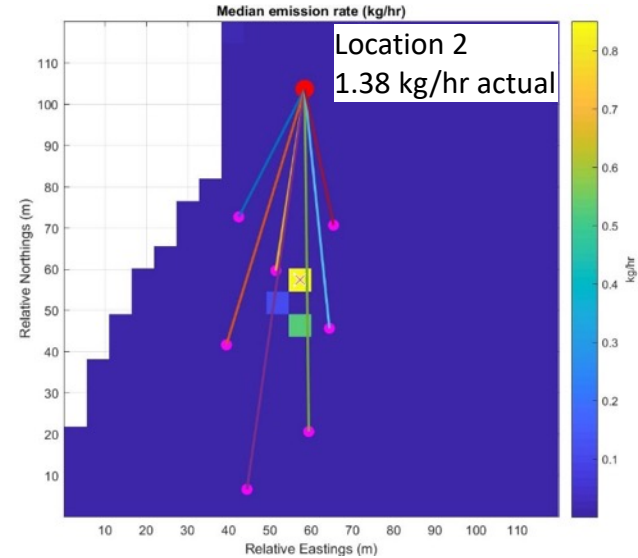
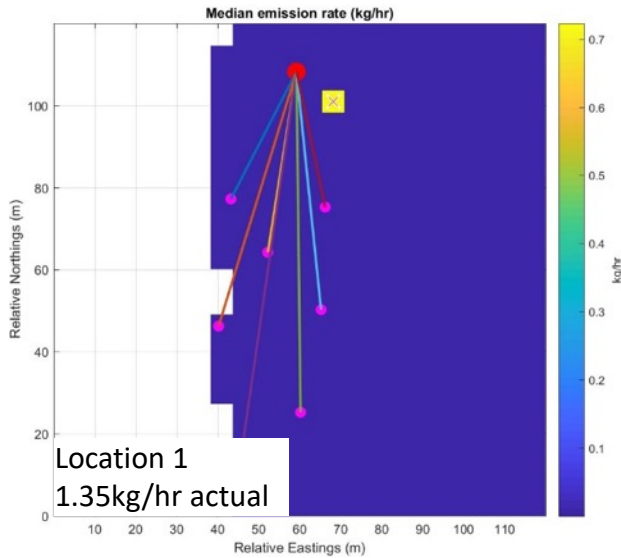


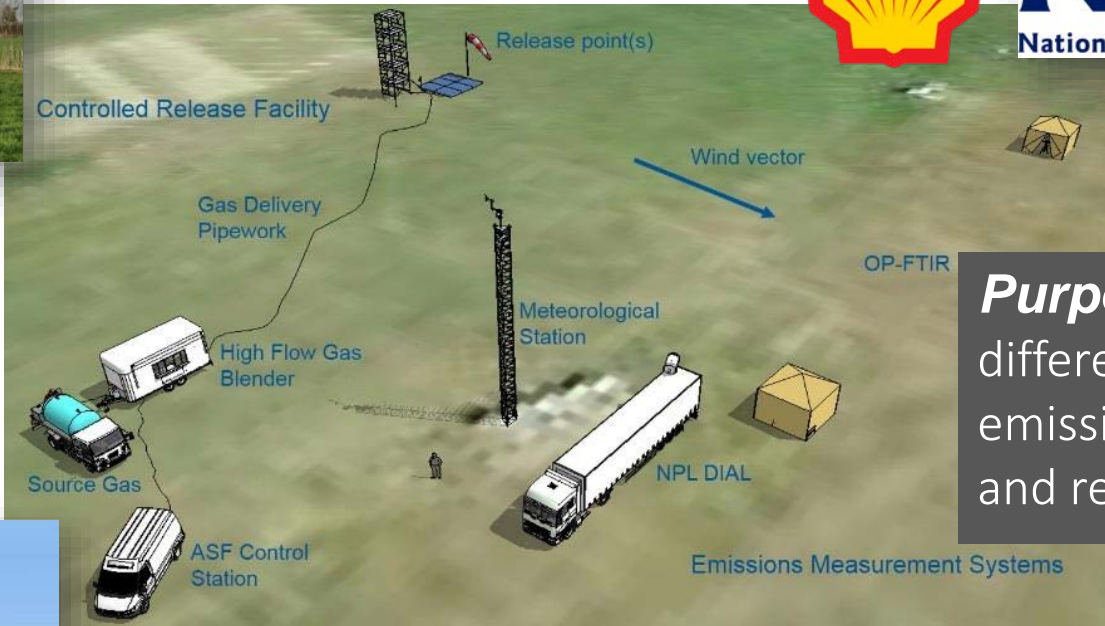
Release Location 2 ★

7 min background 40 min release 7 min background

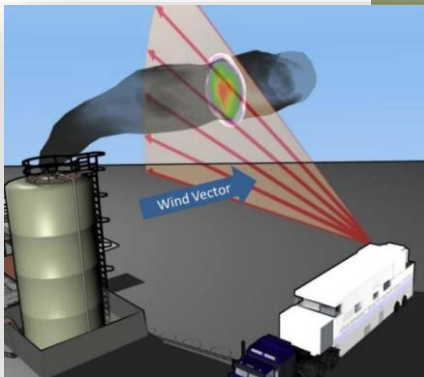


MULTI-PATH CH₄ EMISSIONS MAPPING



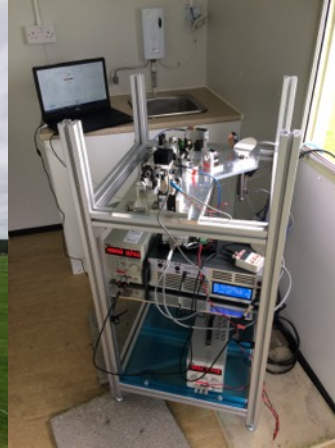


Purpose: Test at different heights, emission scenarios and release rates.



Pollutant Species	Emission Rate per primary channel
Methane (as natural gas)	2.0 – 35 kg/h
Propane (as LPG)	2.5 – 50 kg/h
Nitrous Oxide	5.0 – 90 kg/h
Carbon Dioxide	5.0 – 90 kg/h

NPL TRIAL



- Successfully taken LDS from laboratory to field
- Confirmed path-length and sensitivity
- Confirmed operation in variable atmospheric conditions
- Demonstrated scanning technique for large-area mapping

ACKNOWLEDGEMENTS



THANK YOU

QUESTIONS?



graham@mirico.co.uk



+44 7715 676751

 **MIRICO**

www.mirico.co.uk