# Overview of the MethaneSAT mission for the quantification of anthropogenic methane emissions

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(presenting on behalf of the entire MethaneSAT team https://www.methanesat.org/team/**)**

→ THE EUROPEAN SPACE AGENCY

MethaneSAT in a snapshot

- Objective: to produce quantitative data on human-based methane emissions (mostly from the oil and gas sector, but also agriculture and others)

- Launched 4 March 2024, commissioning phase completed last week

- Data Platform and Missions Operations teams at MethaneSAT LLC (wholly-owned subsidiary of EDF); Science teams at Harvard, NIWA/New Zealand and EDF

- Mission specs:
  - Tasking mission: sampling of ~25 targets per day
  - 220 km coverage per site, 100x400 m spatial sampling
  - Revisit targets of interest up to every 3 days (baseline 2 weeks)
  - Spectral configuration (window, FWHM, sampling)
    - O_2: 1249-1305 nm, 0.2 nm, 0.06 nm
    - CH_4/CO_2: 1598-1683 nm, 0.25 nm, 0.08 nm

- Data products freely available:
  - Level 3: methane concentration maps
  - Level 4: total and point source emissions

→ available from Google Earth Engine, and also directly shared with IMEO's Methane Alert and Response System
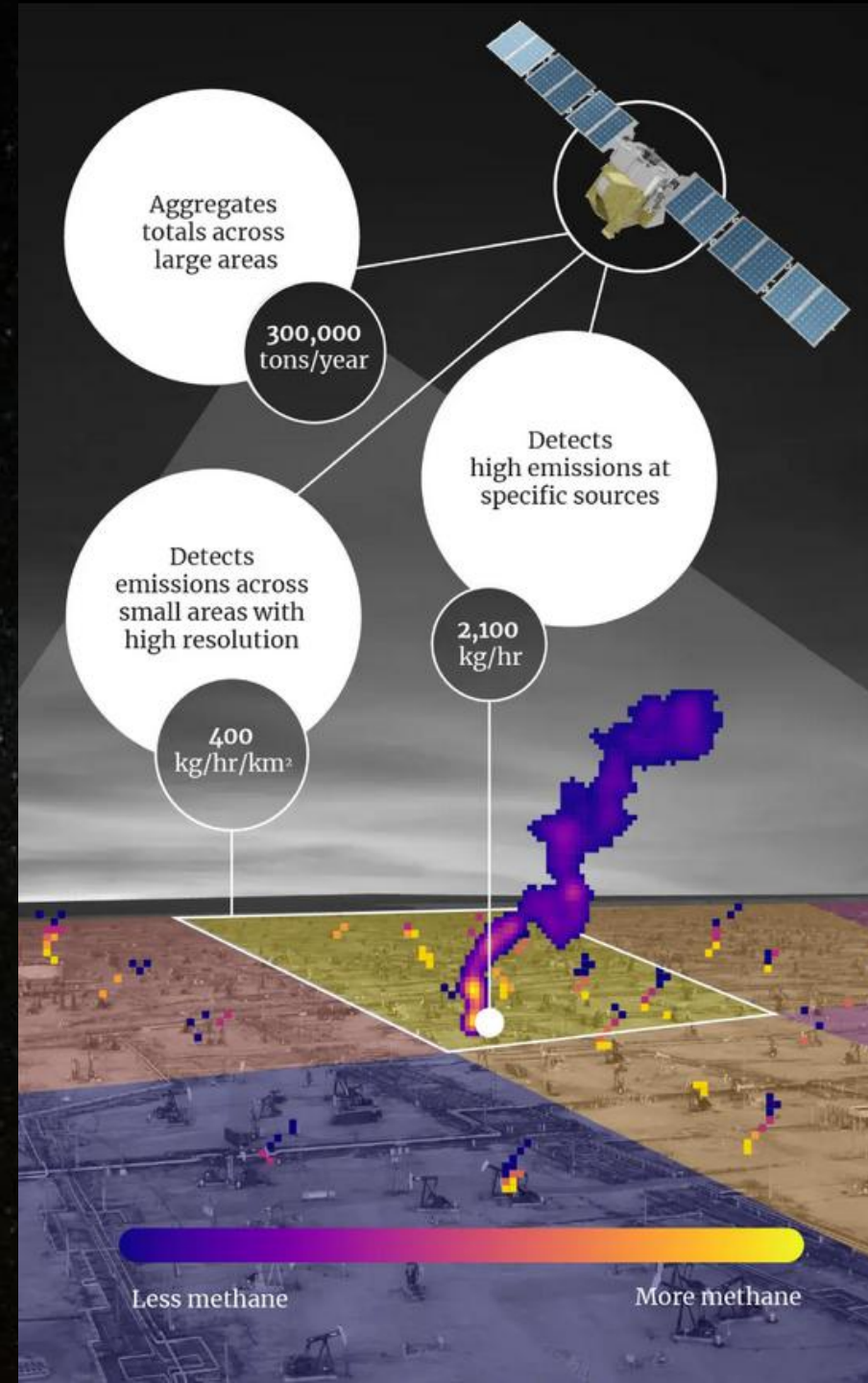
A complementary ecosystem of methane-detecting satellites, each with distinct capabilities and purpose

Global mapping	Area mapping	Location mapping
*7,000 m x 5,500 m pixels across 2,600 km swath	*100 m x 400 m pixels across 200 km swath	*30 m x 30 m pixels across 10-20 km swath

Global mapping
- ✓ Global & large-scale regions
- ✓ Large point sources

Area mapping
- ✓ Regional sources
- ✓ Point sources
- ✓ Sector-wide quantification

Location mapping
- ✓ Point sources
- ✓ Facility-level attribution

TROPOMI*
SCIAMACHY
GOSAT, GOSAT-GW (2024-)
CO2M (2026-)
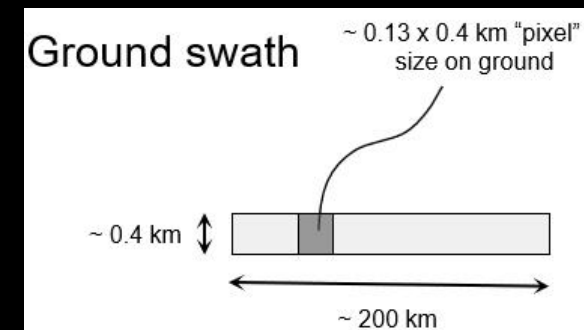
MethaneSAT*

GHGSat*
PRISMA
EnMAP
EMIT
CarbonMapper
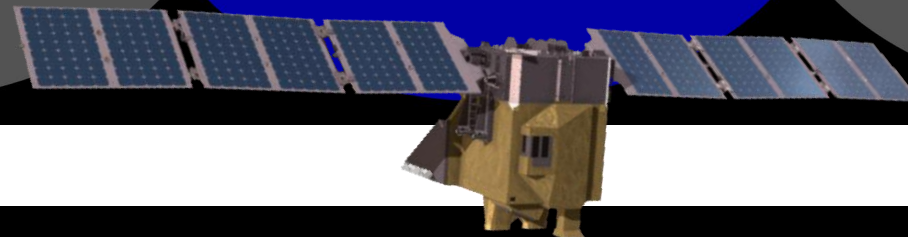
MethaneSAT will detect both concentrated point sources and dispersed area sources, in turn quantifying total emissions – thus advancing the state-of-the-art and filling major data gaps globally.

MethaneSAT Targets

- Over 300 target areas (200 km × 200 km) defined
- Initial focus on oil & gas regions (~200 targets) to meet mission objectives
- Other target categories: agriculture (~60 targets), cal-val, landfills, wetlands,
- Spectrometers "scan" the targets for 30 sec to generate spectral data cube

Ground swath — ~ 0.13 x 0.4 km "pixel" size on ground — ~ 0.4 km — ~ 200 km

Mission Baseline Goal:
Quantify methane emissions from at least the top-80% of global oil and gas production

Example – Permian Basin, USA
Targets aligned with orbital path
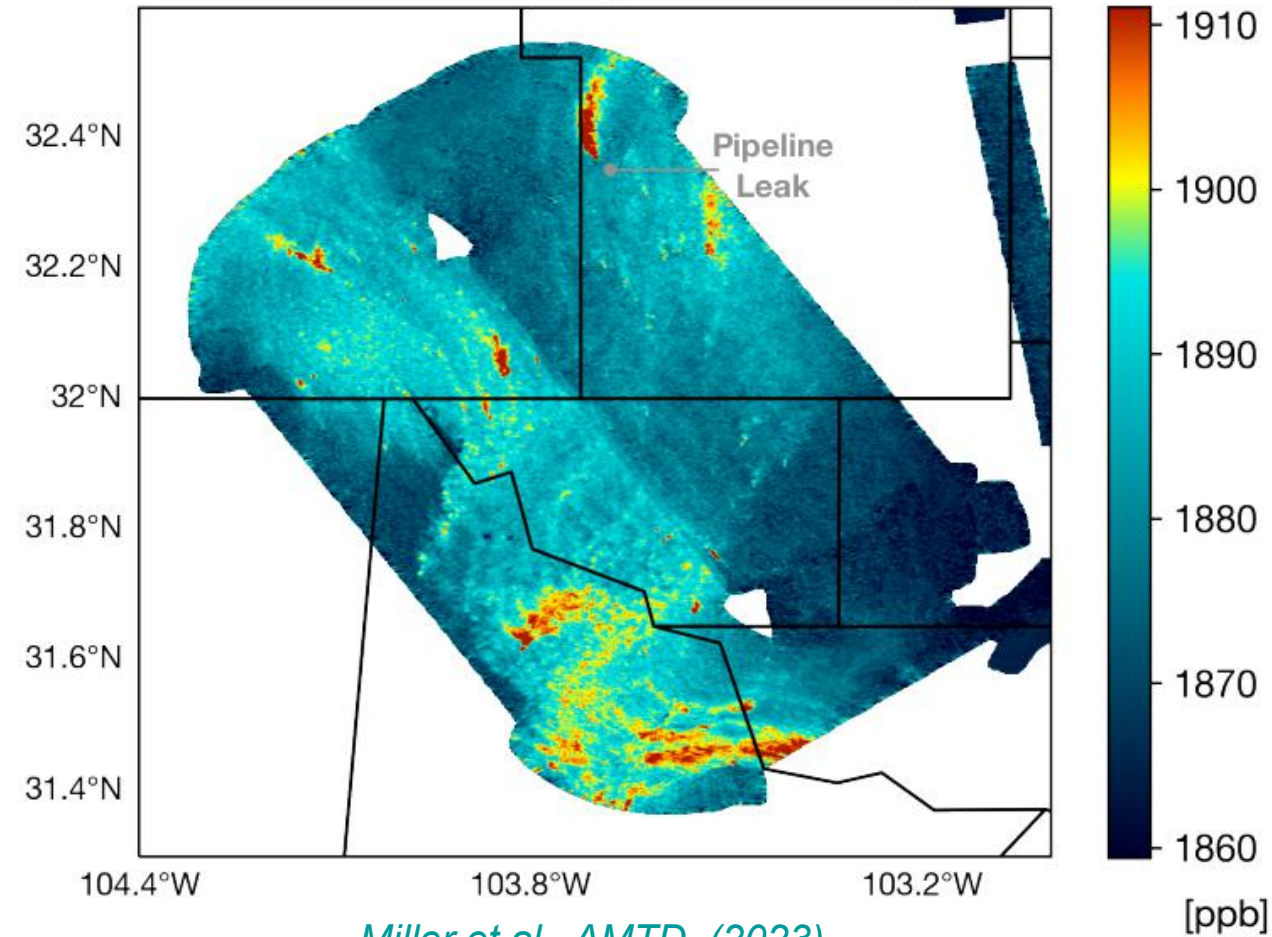335 337 336 338
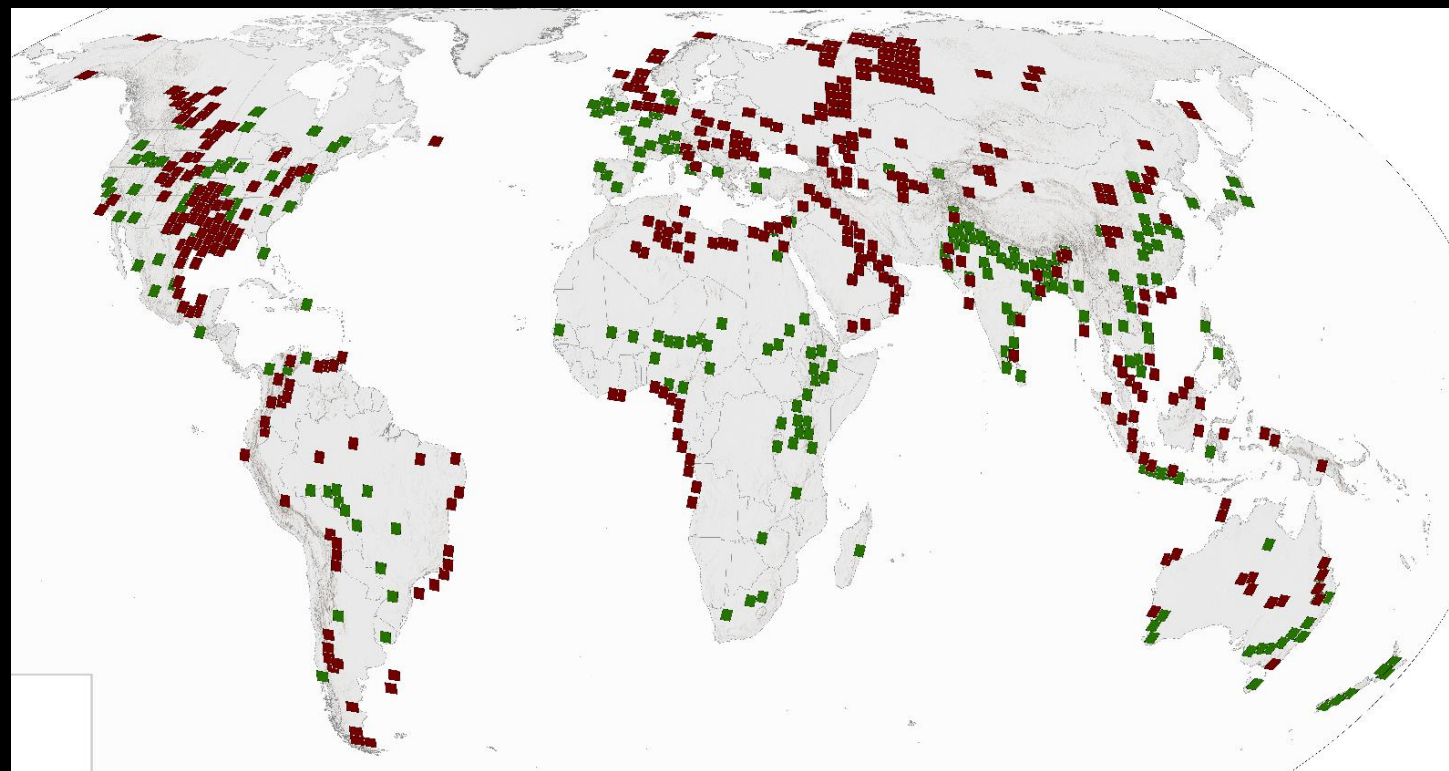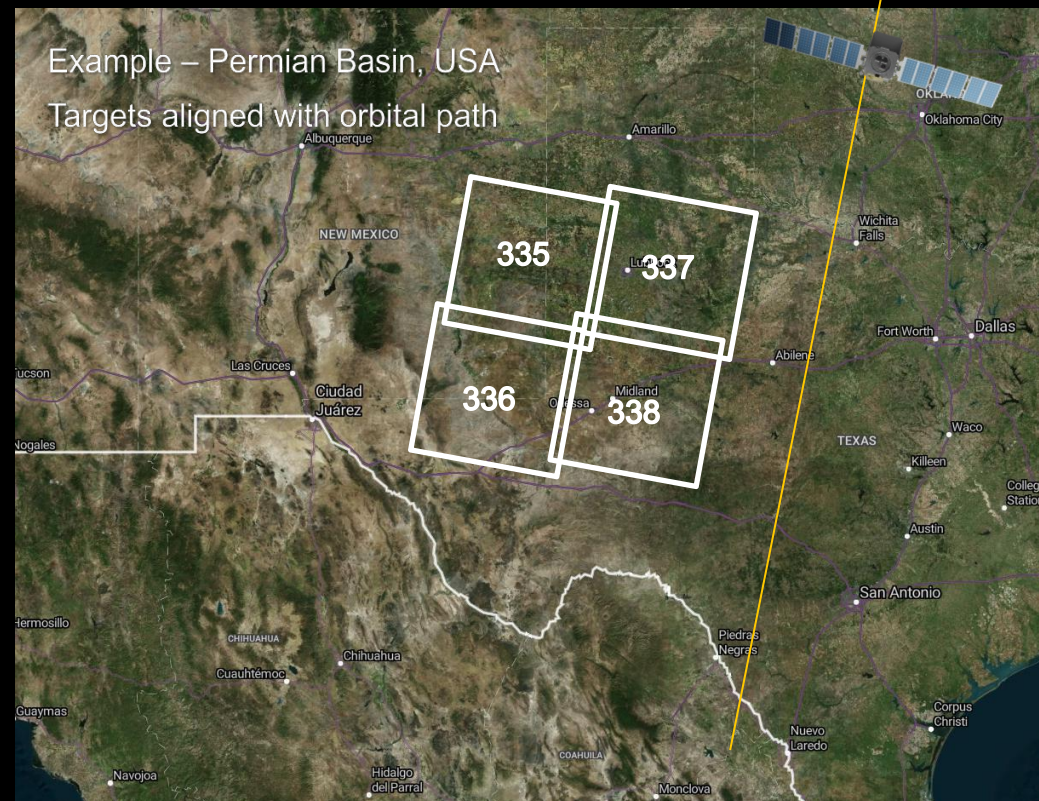
MethaneAIR - MethaneSAT's airborne version

- Total, area and point source emission products generated from accurate XCH4 retrievals

- >50 flights campaigns over the main O&G producing basins in the US performed in 2023
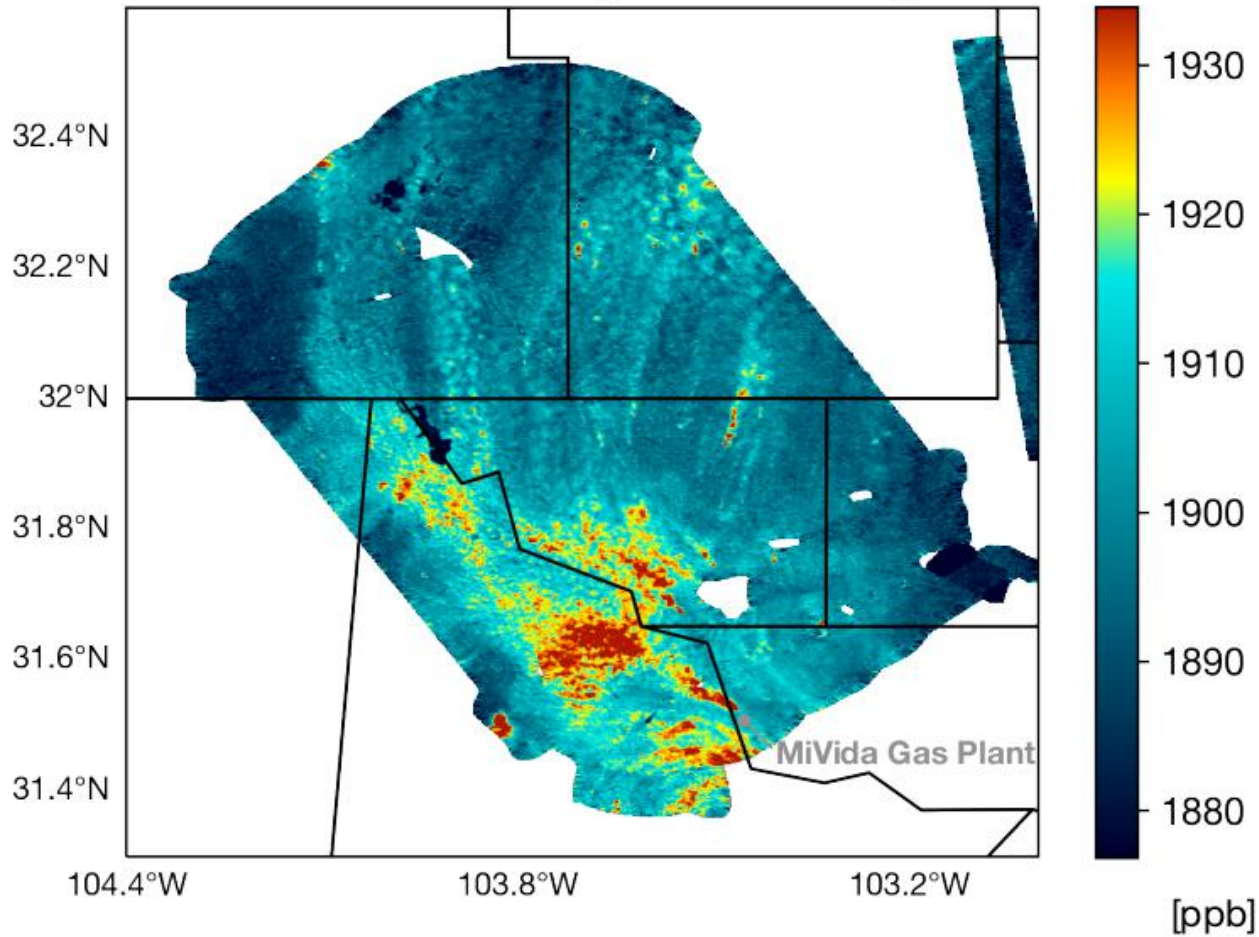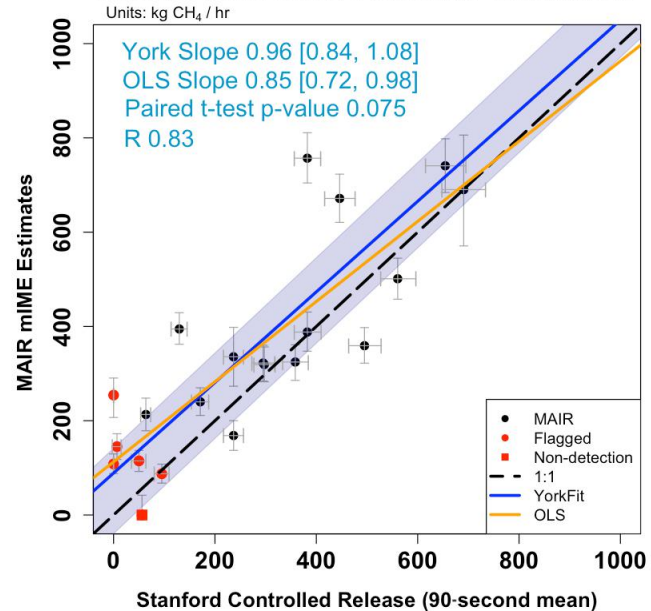

Miller et al., AMTD, (2023)

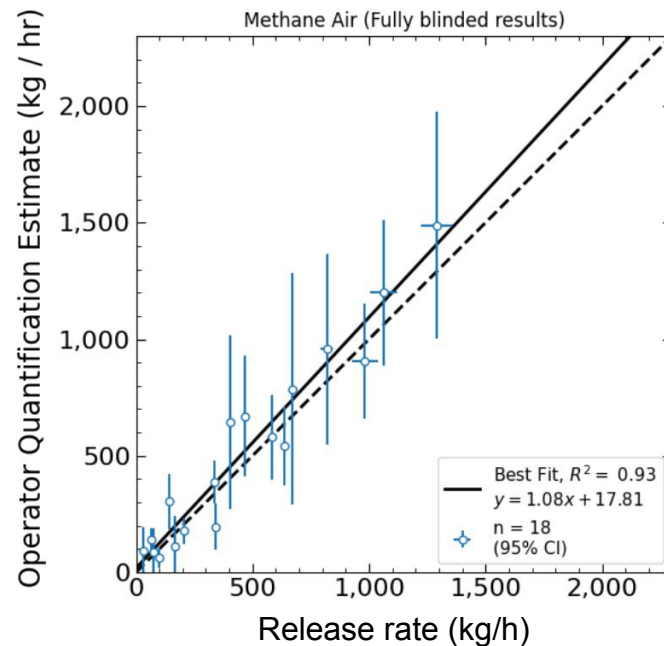# Detection & quantification of methane point sources with MethaneAIR

Guanter et al., in preparation

- Validation with controlled releases
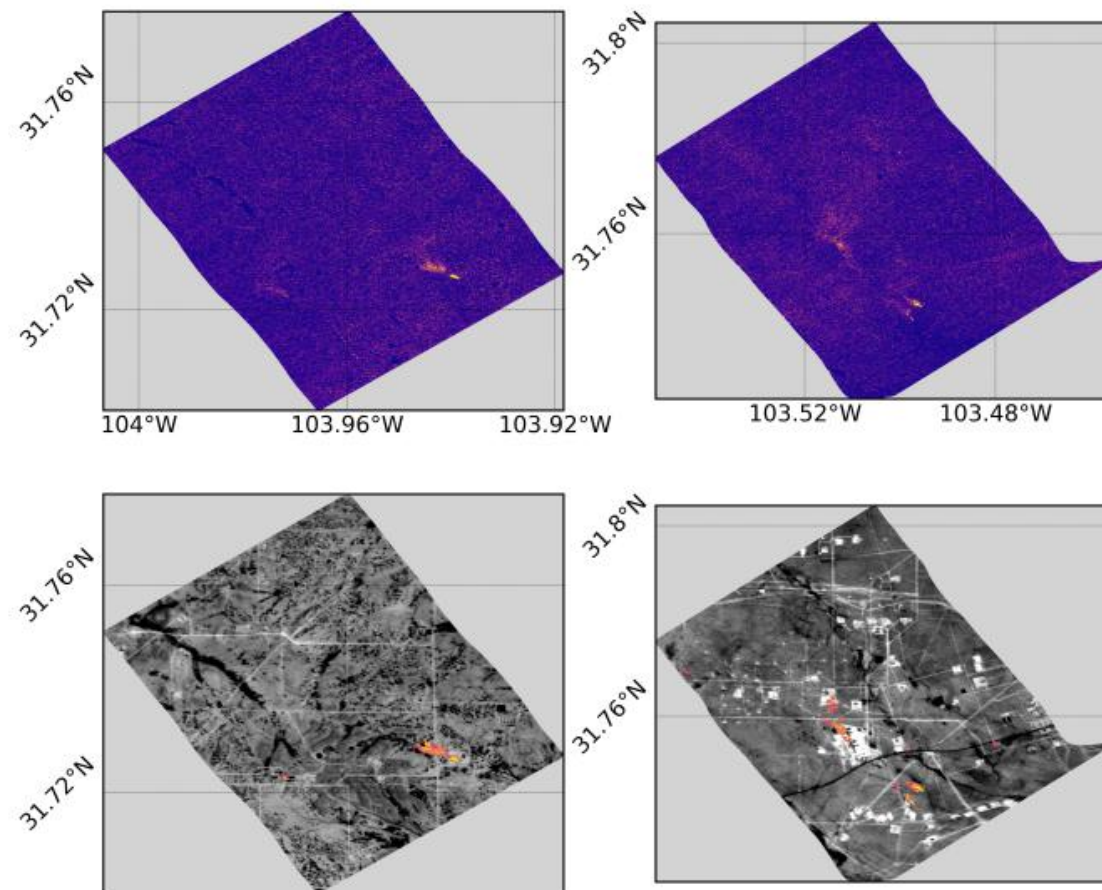- Flux rates estimated with the mIME and/or DI methods
- High sensitivity to methane at ~25-m sampling
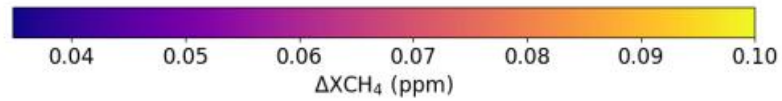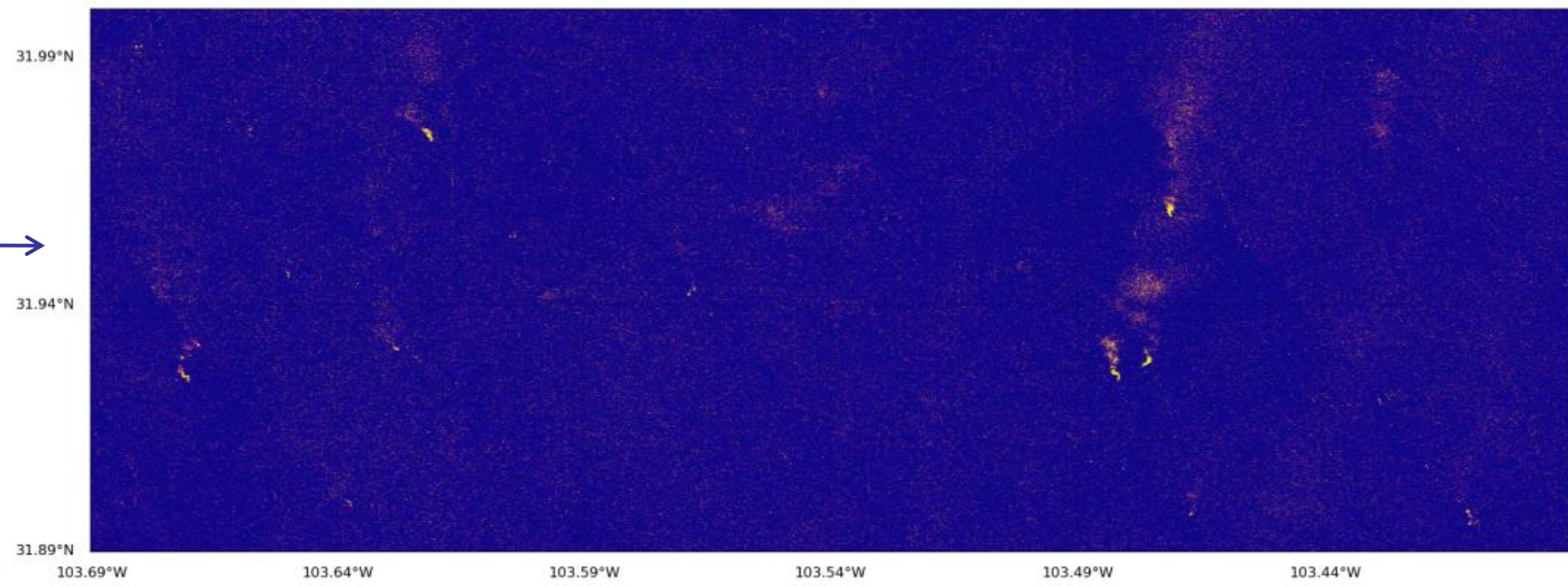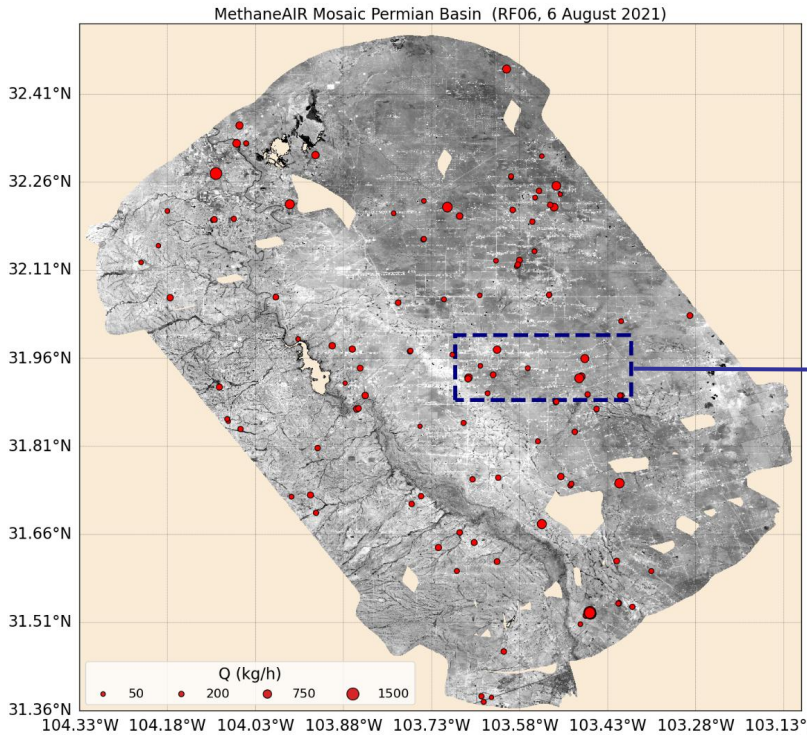

MAIR Controlled Release Validation
Units: kg CH_4 / hr

York Slope 0.96 [0.84, 1.08]
OLS Slope 0.85 [0.72, 0.98]
Paired t-test p-value 0.075
R 0.83

Chulakadabba et al, AMT (2023)

Methane Air (Fully blinded results)

Best Fit, R^2 = 0.93
$y = 1.08x + 17.81$
n = 18 (95% CI)

El Abbadi et al., ES&T, (2024)

ΔXCH_4 (ppm)

Detection & quantification of methane point sources with MethaneAIR

Subset Mosaic ($\Delta XCH_4 > 1\sigma$) - MethaneAIR Campaign Permian Basin, 6 June 2021

MethaneAIR Mosaic Permian Basin (RF06, 6 August 2021)

ΔXCH_4 (ppm)

Q (kg/h)

Guanter et al., in preparation
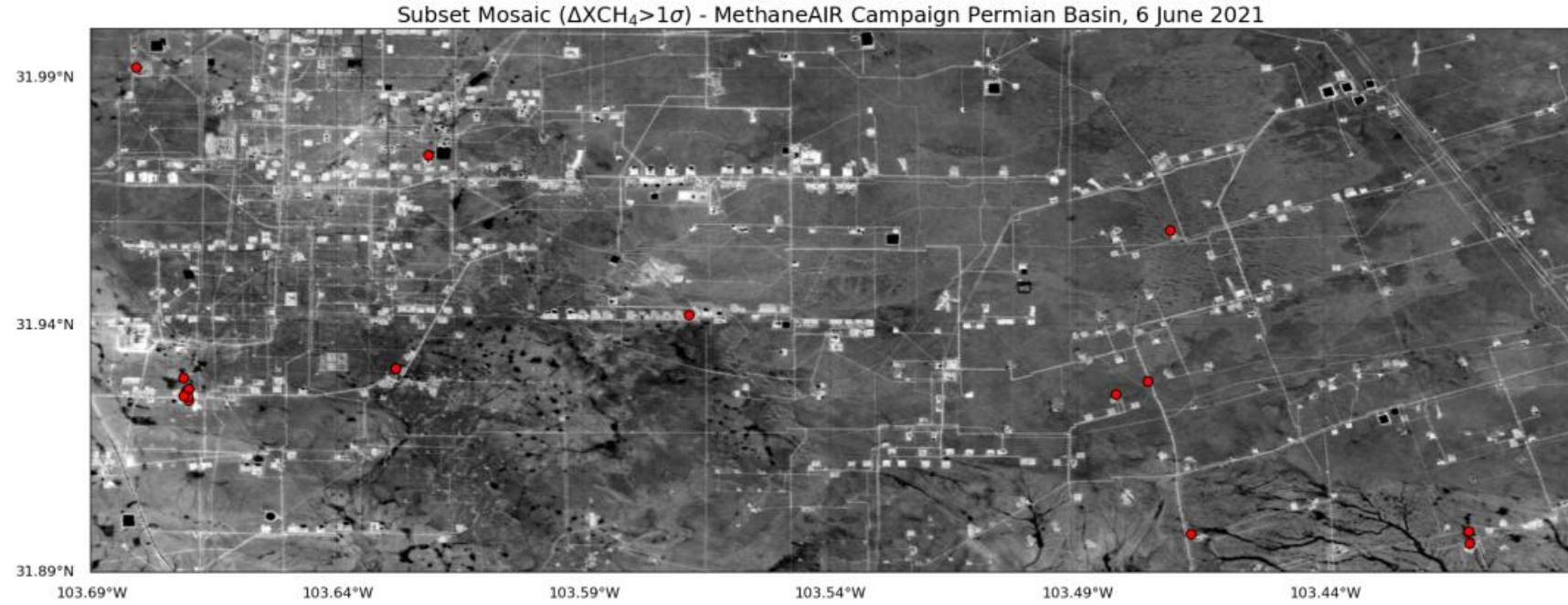
MethaneAIR and MethaneSAT L4 products on the Google Earth Engine

Earth Engine Apps

https://showcase.earthengine.app/view/methanesat
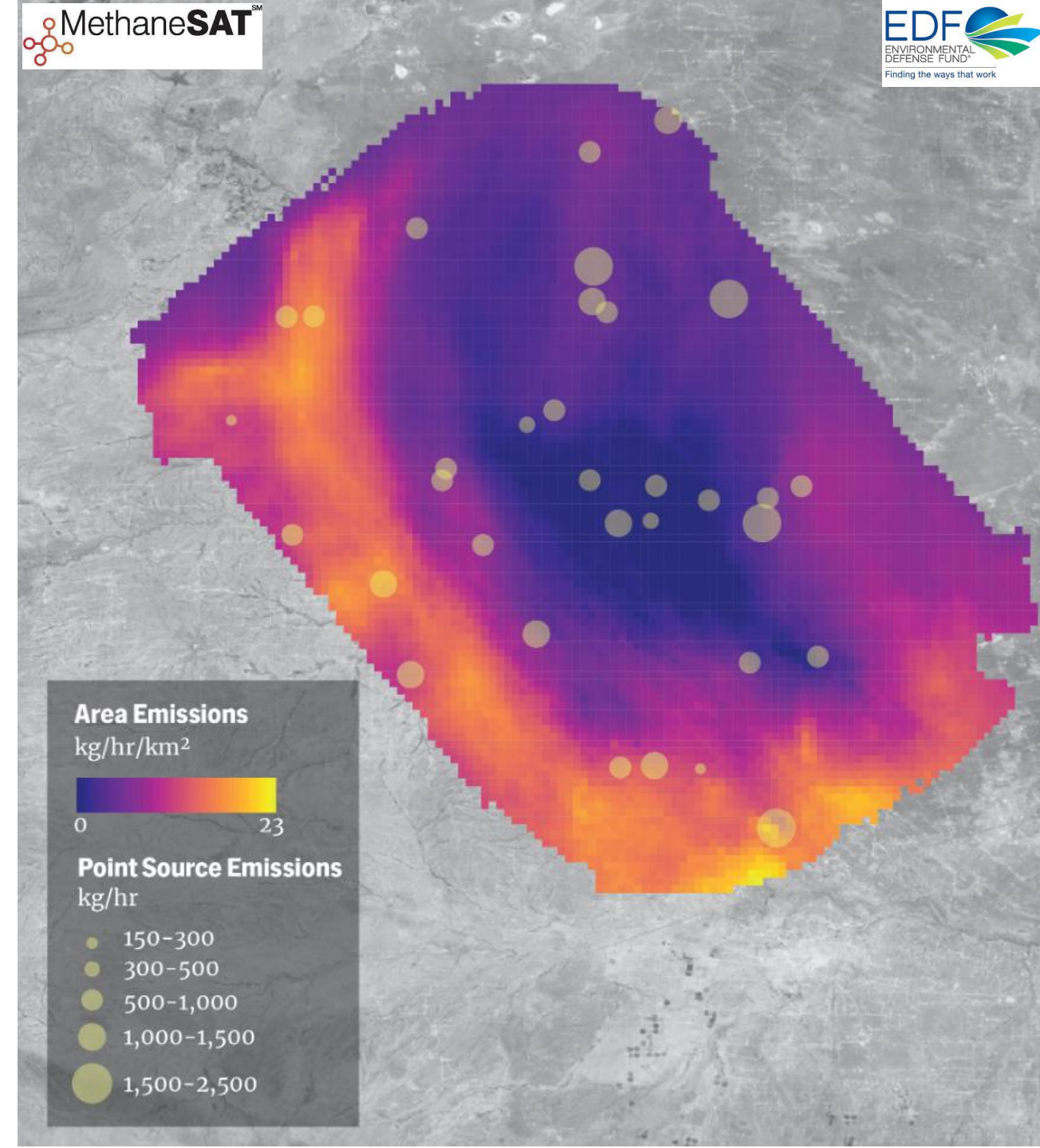
Wrap-up:

- MethaneSAT is expected to fill the observation gap between global flux mapping missions and high-spatial resolution imagers

- MethaneAIR: becoming an airborne program on its own

- Point source + area emission products freely available

- MethaneSAT data coming up very soon (and collaboration with ESA always welcome :))

Thank you for your attention!

MethaneSAT

EDF
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Finding the ways that work

Area Emissions
kg/hr/km²

0   23

Point Source Emissions
kg/hr

· 150-300
· 300-500
○ 500-1,000
○ 1,000-1,500
○ 1,500-2,500