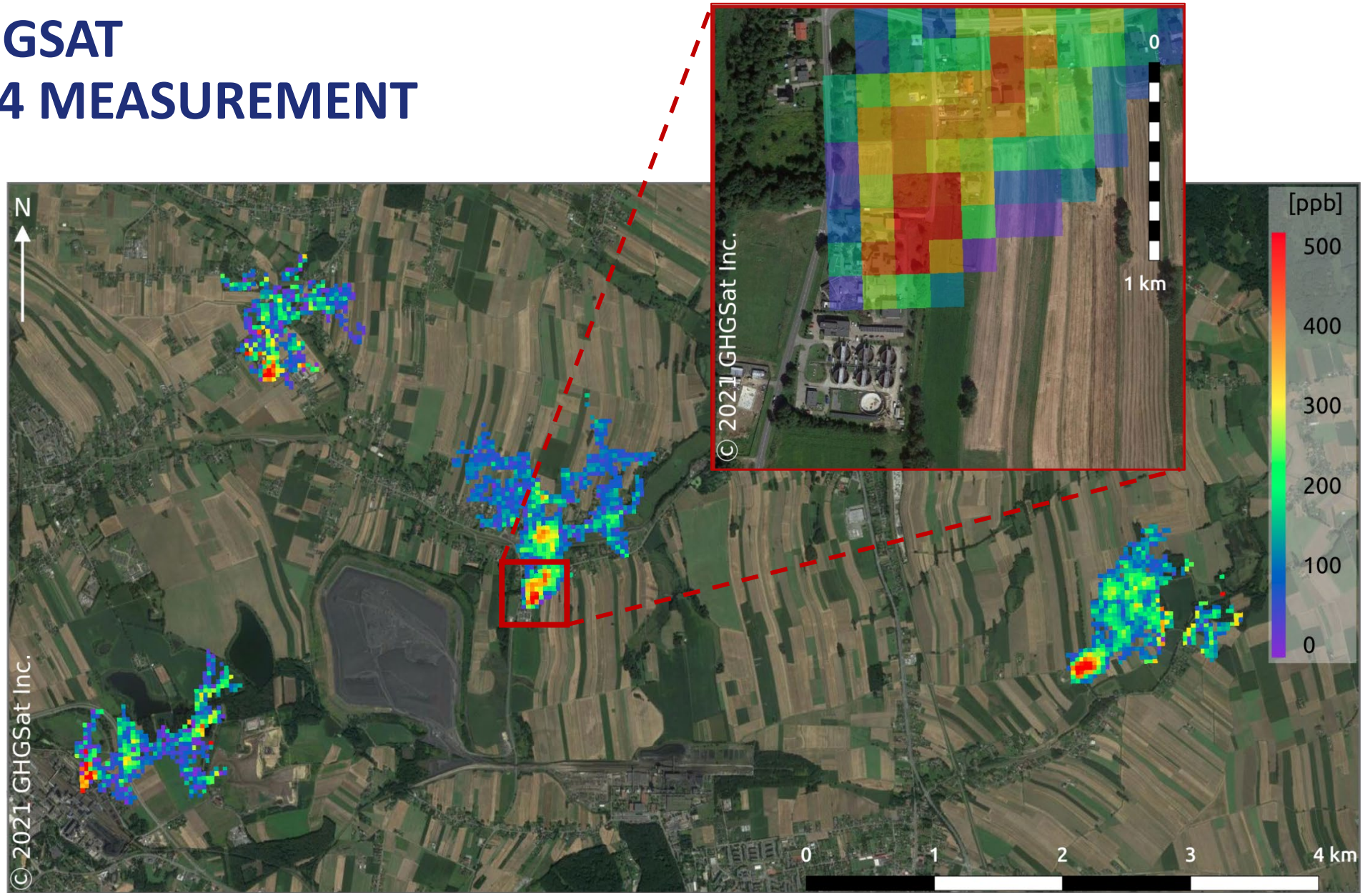
GHGSAT

RESULTS FROM THE GHGSAT CONSTELLATION'S FIRST YEAR + LATEST PHASE OF EXPANSION

D Jervis, M Girard, JP MacLean, J McKeever, A Ramier, M Strupler, E Tarrant, and D Young

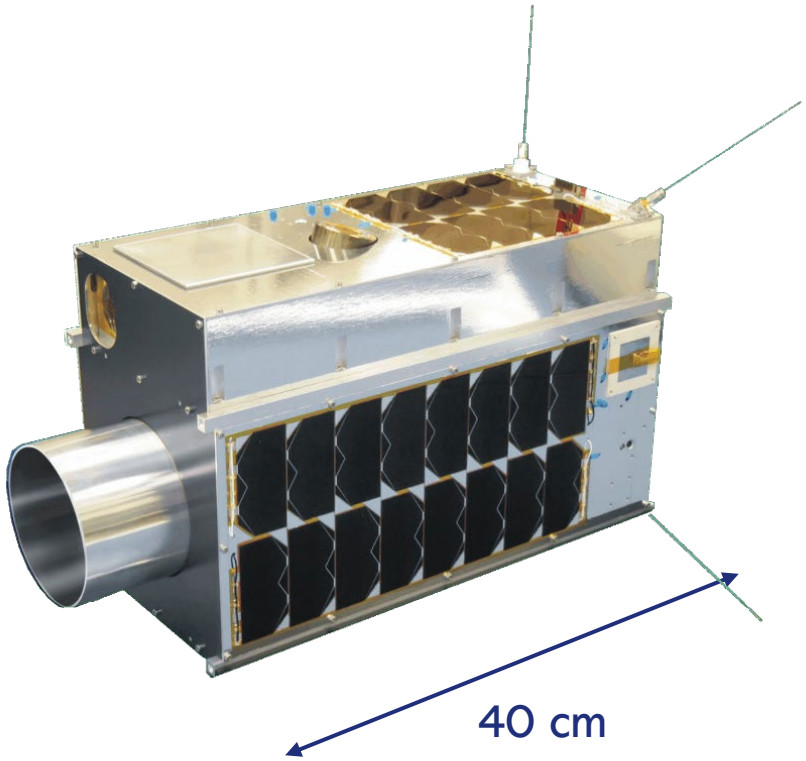
2022-07-12

GHGSAT
CH4 MEASUREMENT



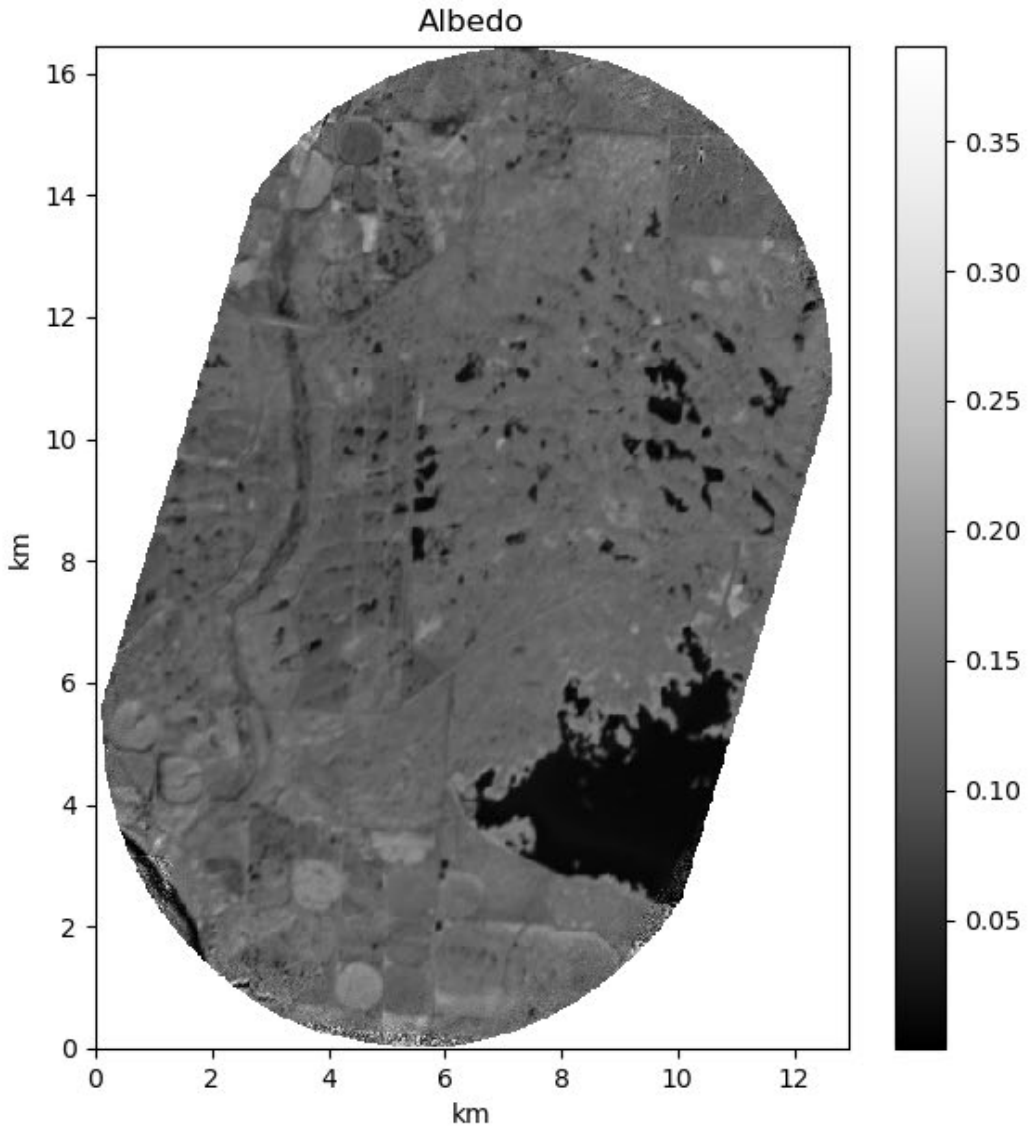
SATELLITE SENSOR DETAILS

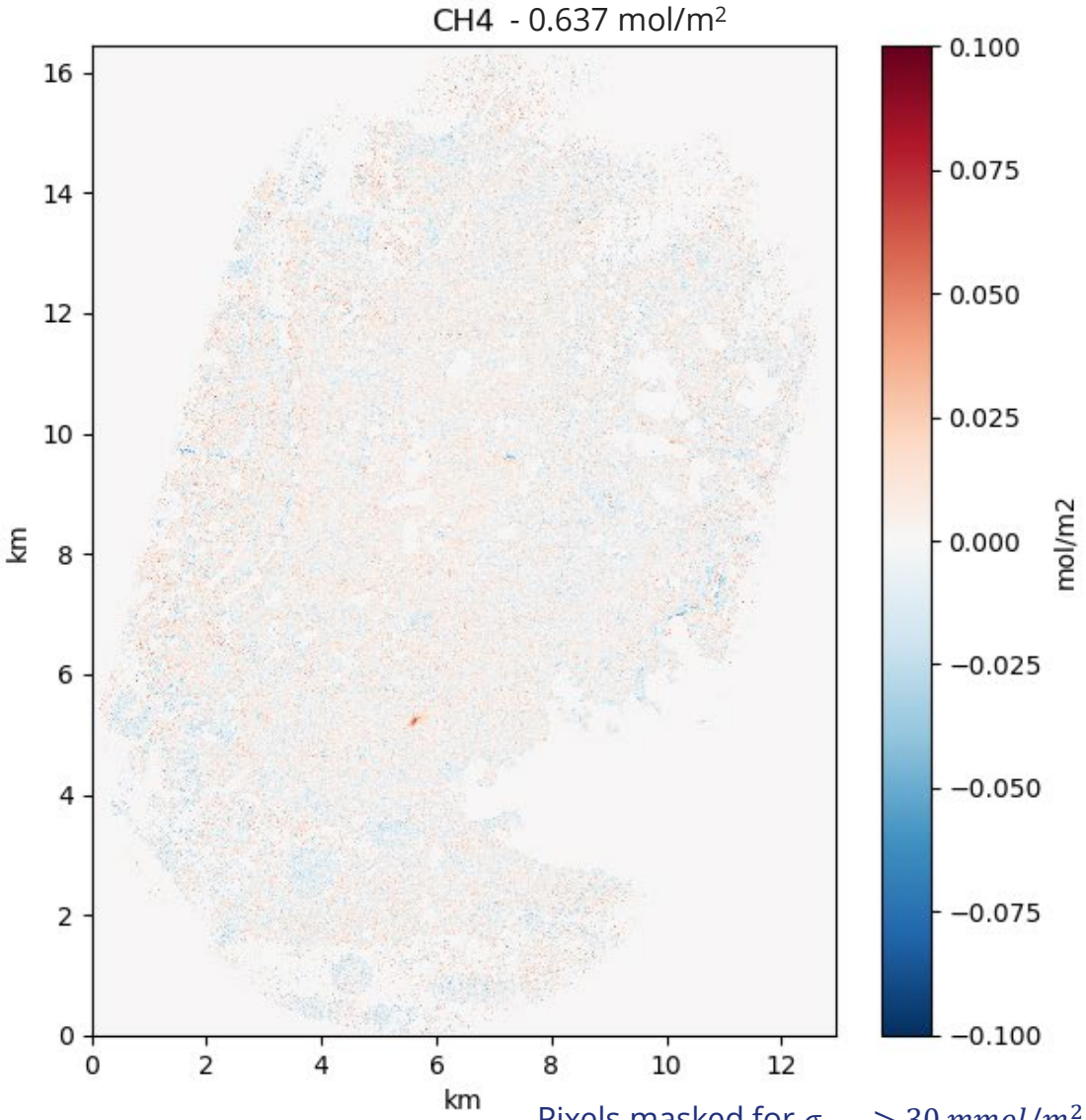
- *Launch dates:* Sept 2nd, 2020 (C1), Jan 24th, 2021 (C2)
  - ***C3, C4, C5 launched May 25th, 2022***
- 15 kg nanosatellite
- *Sun-synchronous orbit :* ~500 km altitude
- *Payload:*
  - Imaging Fabry-Perot spectrometer
  - Spectral region : 1.6 μm
  - **High spatial resolution (~25 m)**
  - Measurement domain: 15 km x 10 km (typical)
  - Always operate in **target mode**
- Measurement precision: **~1%** of background column density
- Emission rate detection threshold: ~**100 kg/hr**
- Average number of observations per day (per satellite): **15**
- Average site revisit opportunity time (mid-latitude, per satellite): **~14 days**



6 more satellites launching 2023 → 11 satellites in orbit by 2023 → Daily revisits

GHGSAT-C2 CONTROLLED RELEASE ALBERTA, CANADA 2021-03-04



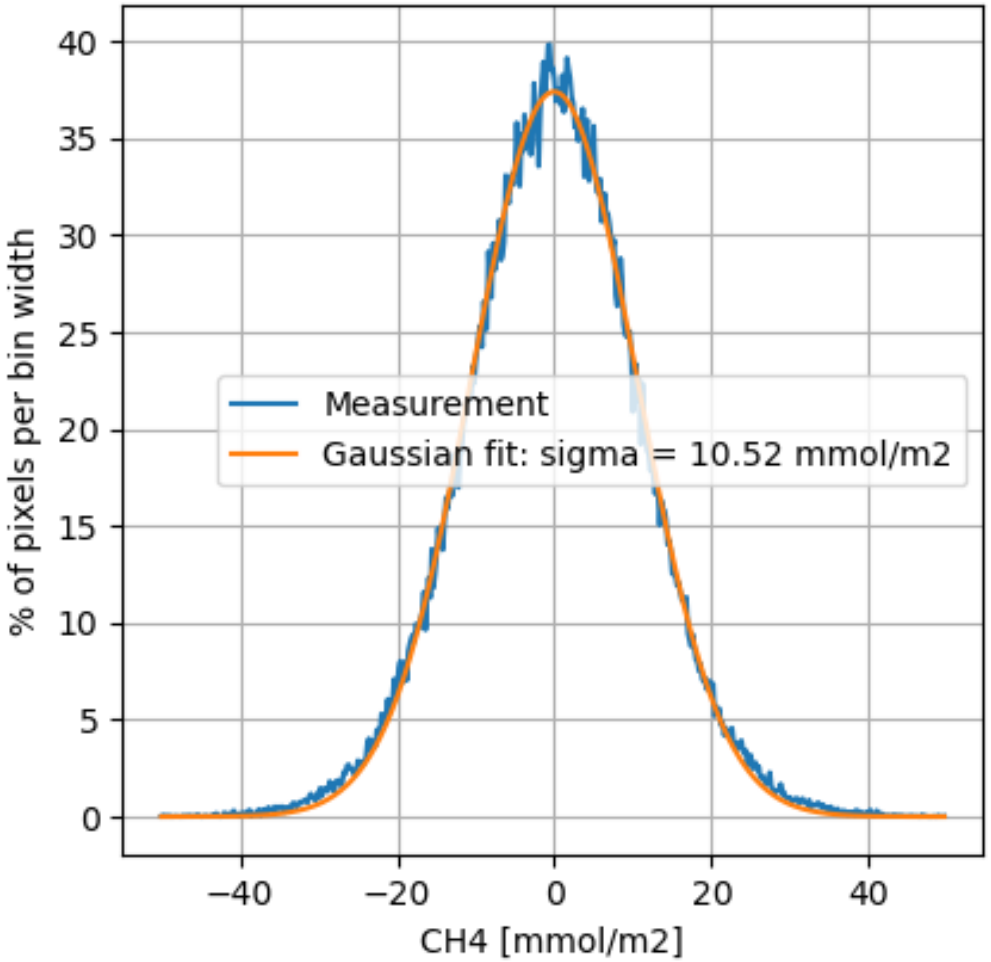


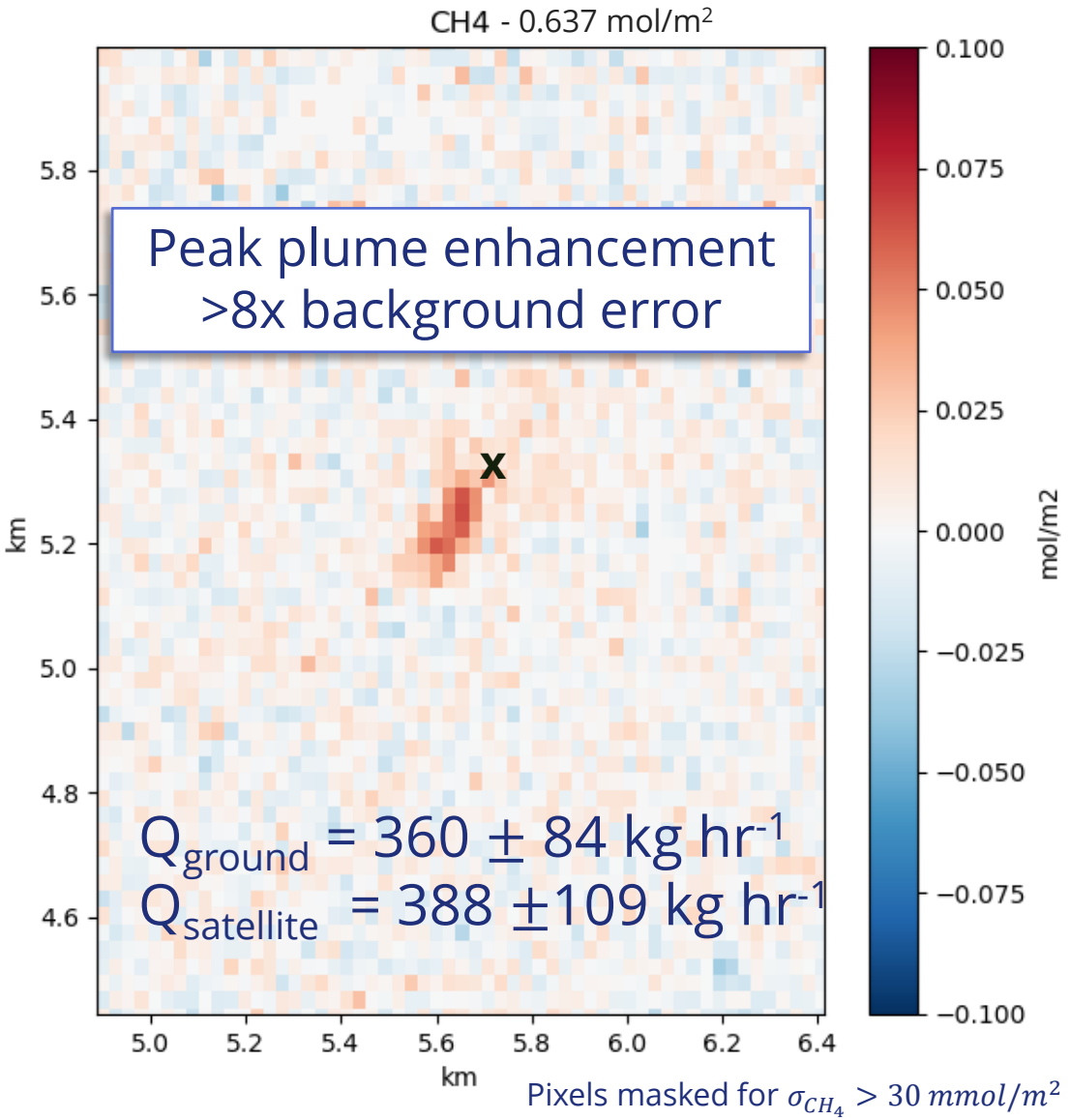
Pixels masked for $\sigma_{CH_4} > 30\ mmol/m^2$

GHGSAT-C2 CONTROLLED RELEASE

ALBERTA, CANADA 2021-03-04

RMS over whole domain:
1.6% of background

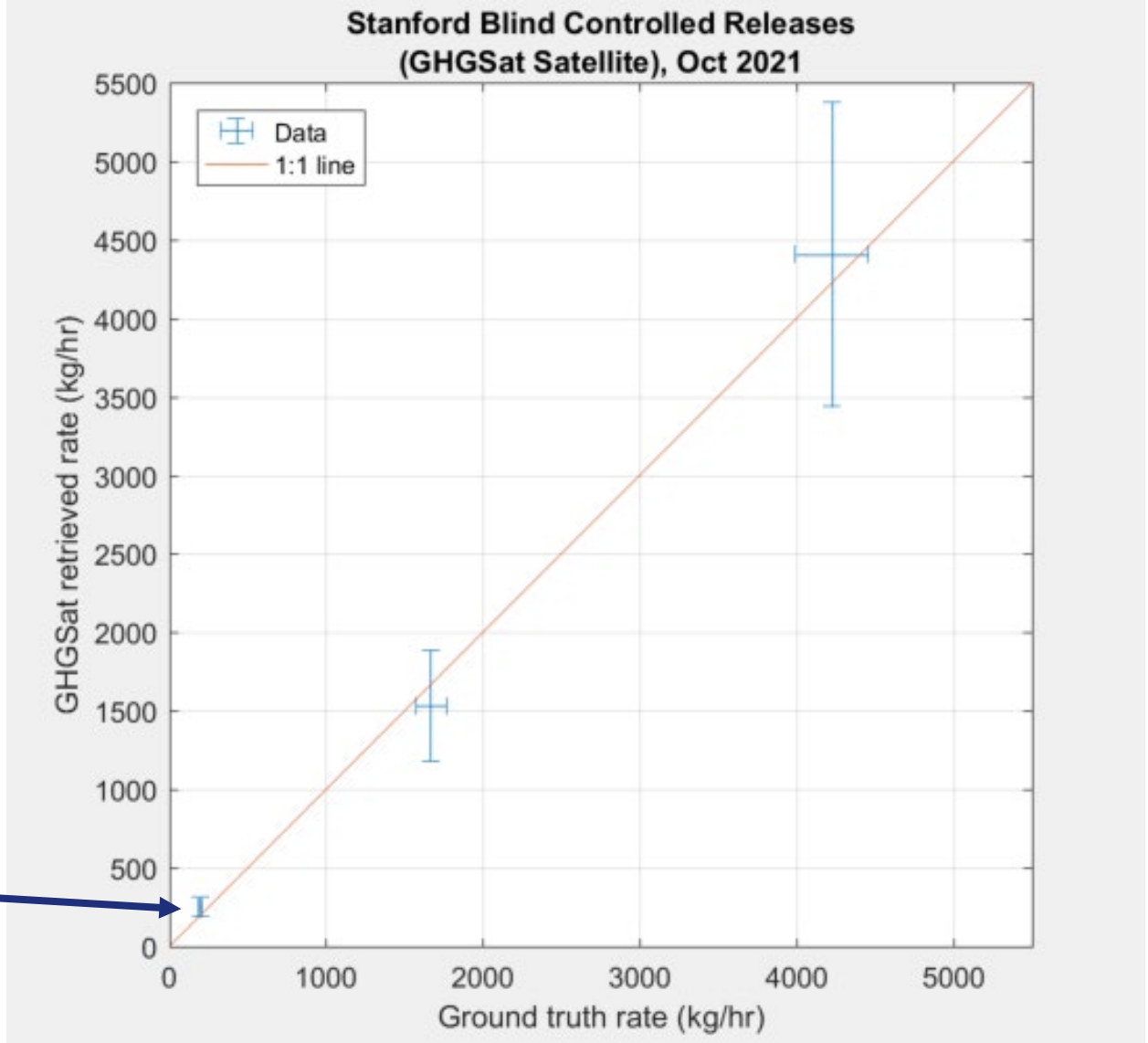




INDEPENDENT BLIND CONTROLLED RELEASE

Stanford single-blind controlled release campaign (Arizona, Oct 2021)*

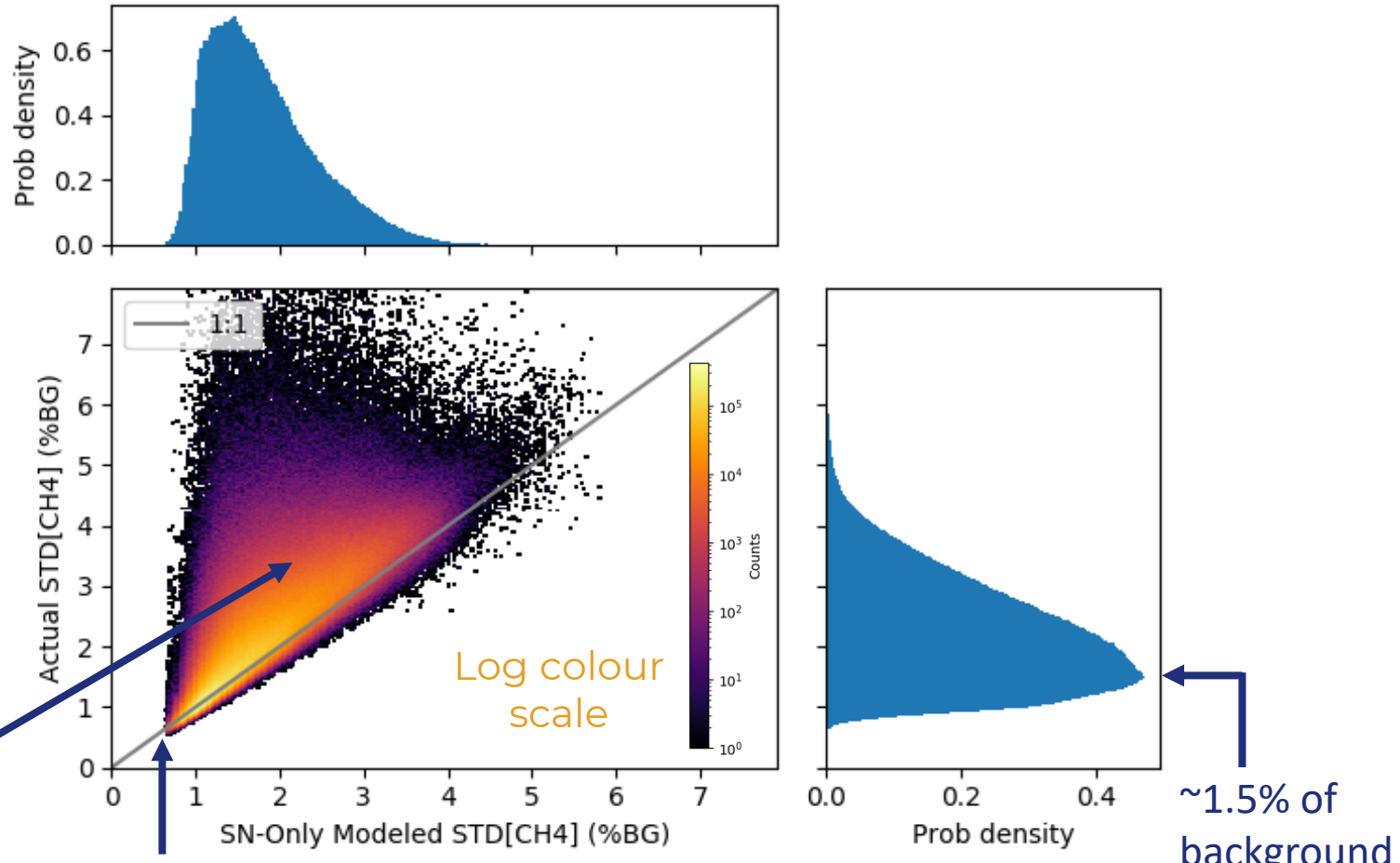
**not yet peer reviewed (Sherwin et al., 2022 in prep)*



197 kg/hr

GHGSAT-C2 COLUMN DENSITY MEASUREMENT PERFORMANCE

How does measured precision (*y-axis*) compare to the shot-noise prediction (*x-axis*)?

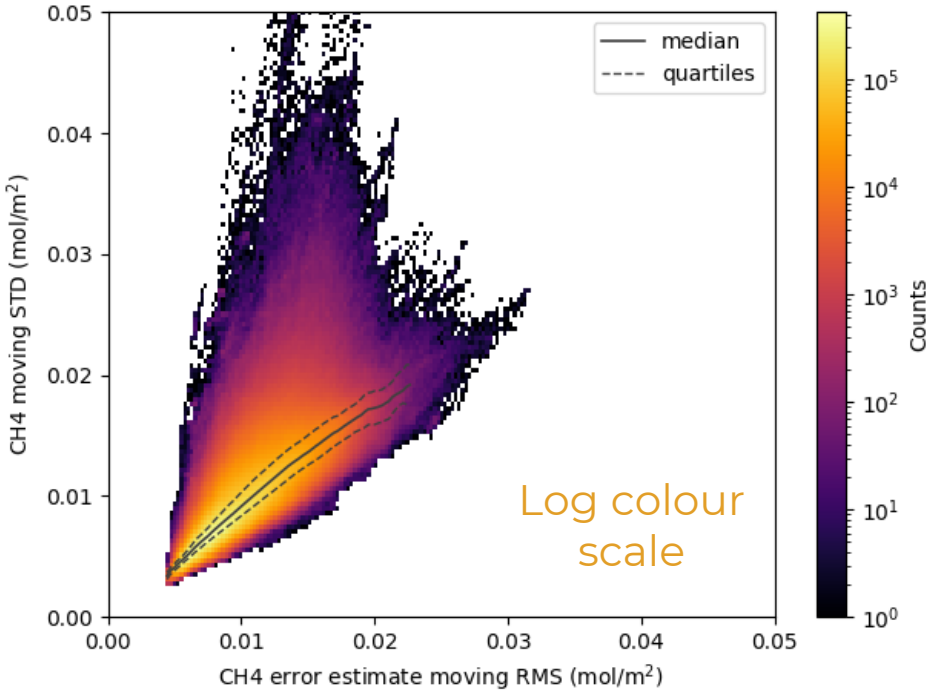


Method: Compute the standard deviation over a moving 500m x 500m ROI across the retrieval domains of all observations in past 3 months, excluding flagged pixels.

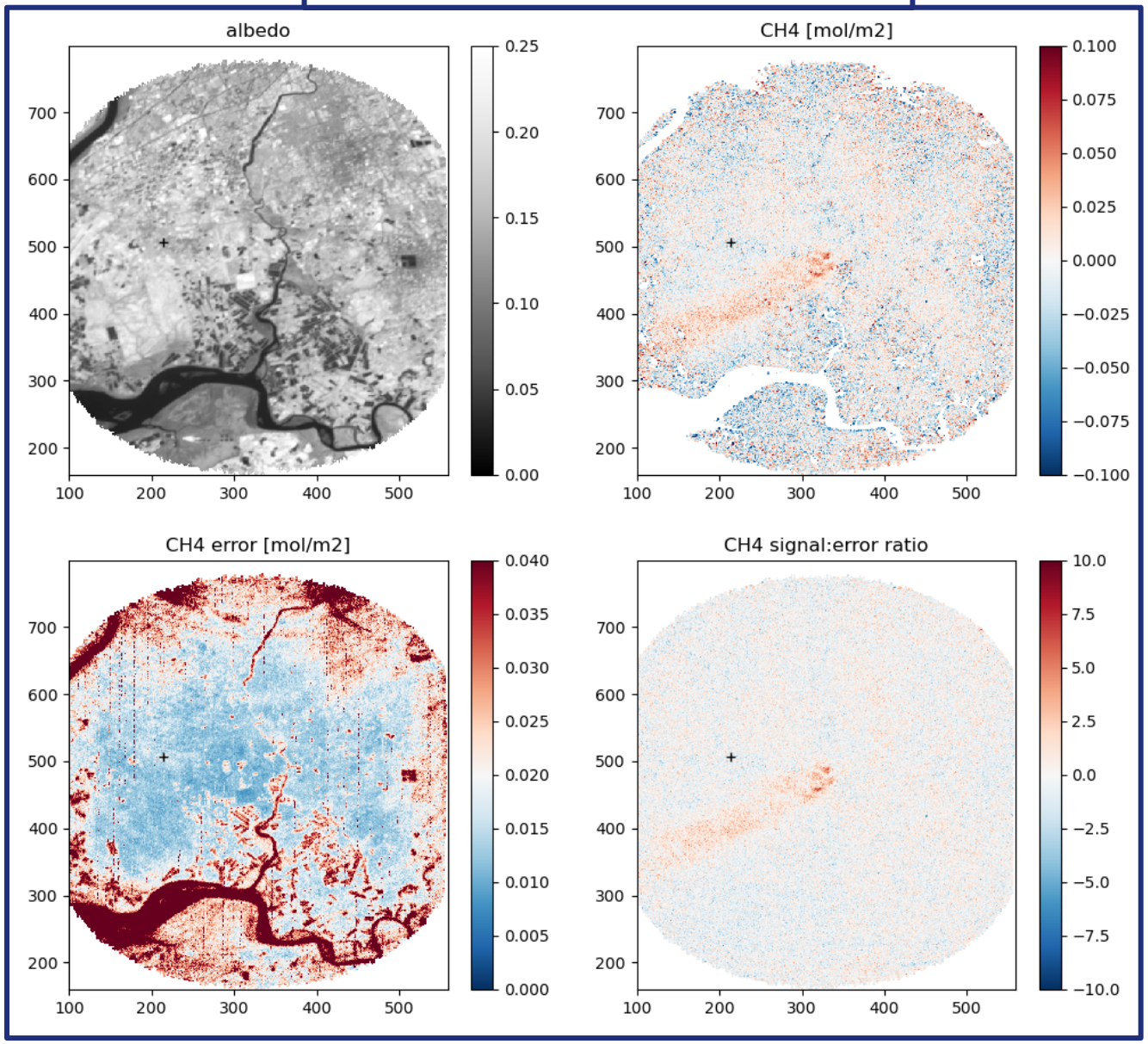
HOW ACCURATE IS OUR ERROR ESTIMATE?

We need an accurate error estimate to “flag” CH4 artefacts (i.e. to “flag” false positives)

Our posterior error estimate is calculated from the RMS of the residuals of the spectral fit and therefore includes contributions from both shot-noise and systematic error sources



Example of complex scene



WHERE DID GHGSAT DETECT EMISSIONS IN 2021?

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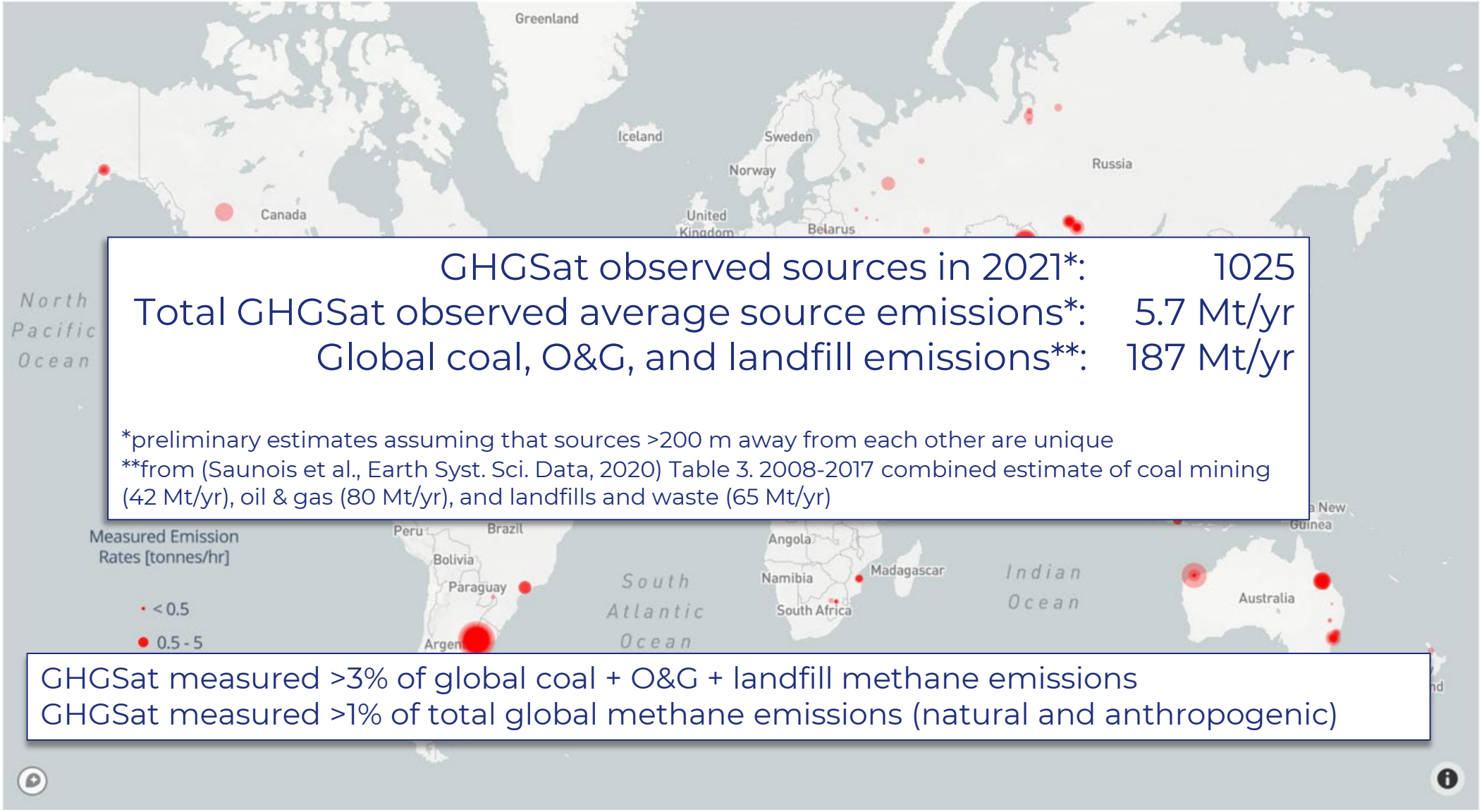


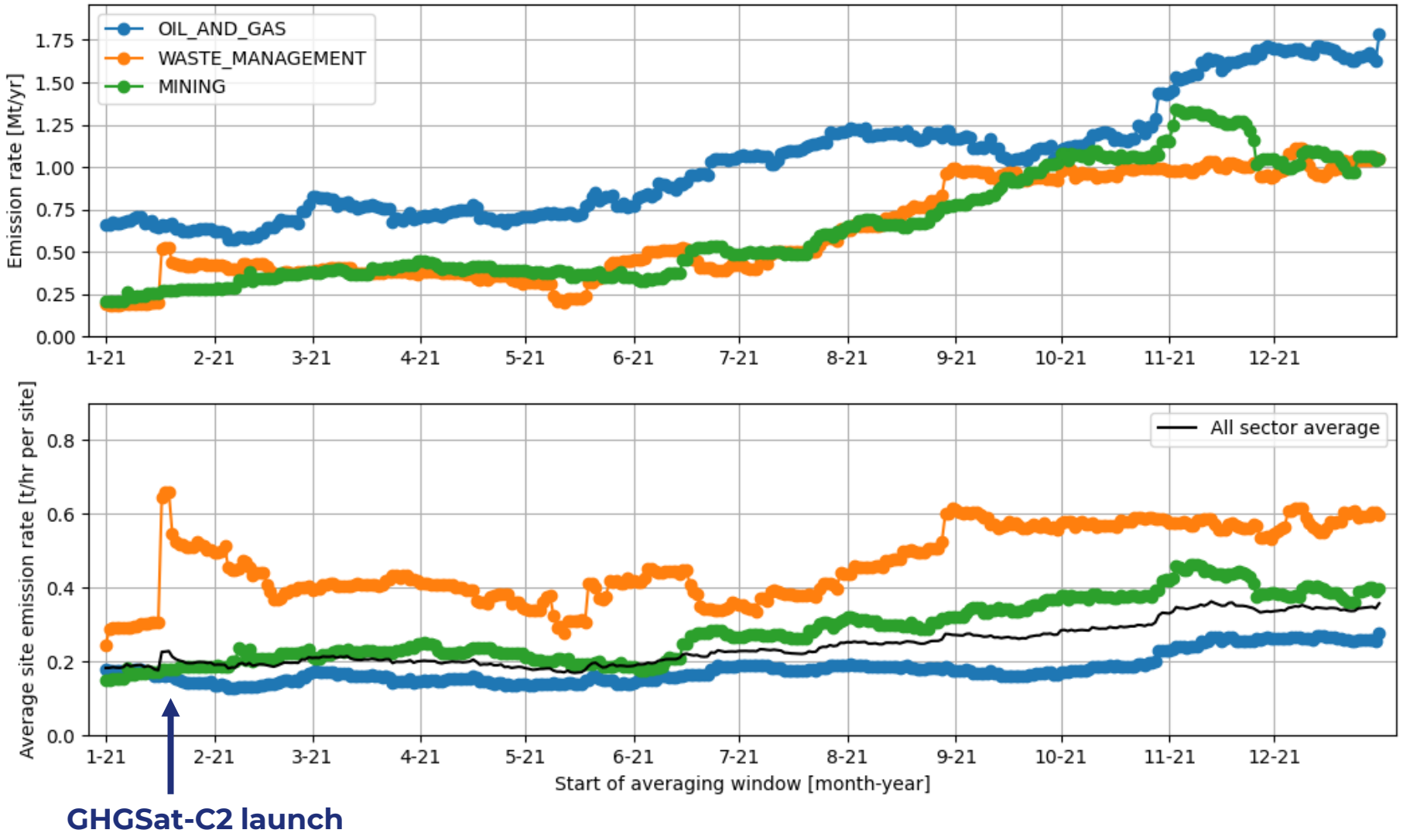
GHGSat observed sources in 2021*:	1025
Total GHGSat observed average source emissions*:	5.7 Mt/yr
Global coal, O&G, and landfill emissions**:	187 Mt/yr

*preliminary estimates assuming that sources >200 m away from each other are unique
**from (Saunois et al., Earth Syst. Sci. Data, 2020) Table 3. 2008-2017 combined estimate of coal mining (42 Mt/yr), oil & gas (80 Mt/yr), and landfills and waste (65 Mt/yr)

GHGSat measured >3% of global coal + O&G + landfill methane emissions
GHGSat measured >1% of total global methane emissions (natural and anthropogenic)

GHGSAT OBSERVED EMISSION TRENDS SINCE JAN ‘21

Rolling 90 day average

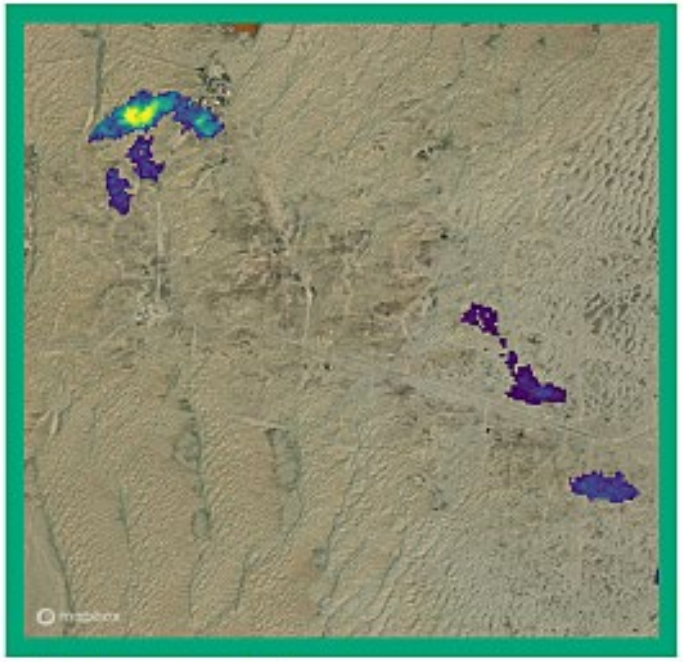


C3, C4, AND C5 “FIRST LIGHT”

Observed first plumes 3 days after launch (May 28, 2022)

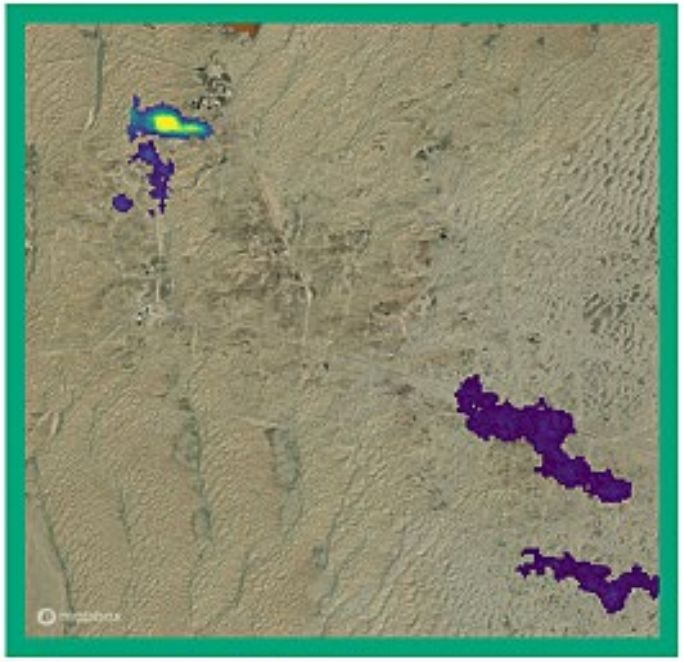
Nearly simultaneous observations over same site

GHGSat-C3 "Luca"



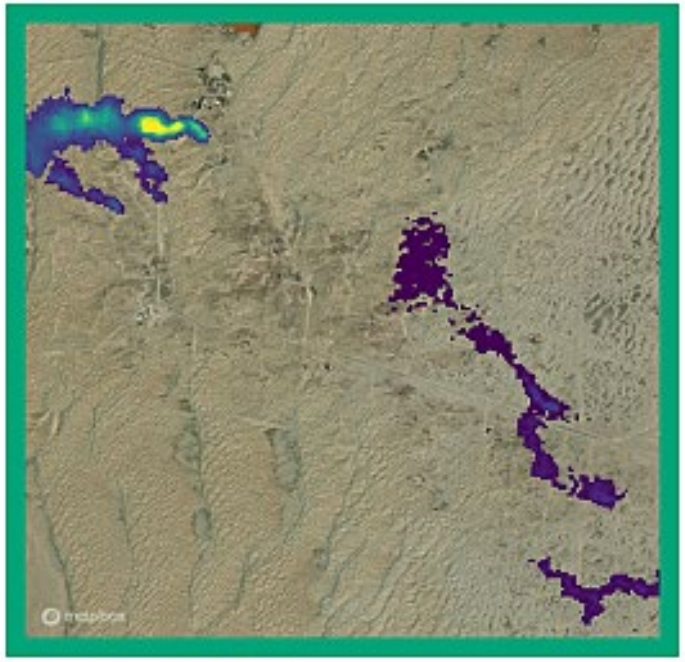
Oil & Gas - Central Asia
28-05-2022
10:08:30 UTC

GHGSat-C4 "Penny"



Oil & Gas - Central Asia
28-05-2022
10:07:30 UTC

GHGSat-C5 "Diako"



Oil & Gas - Central Asia
28-05-2022
10:07:52 UTC

THANK YOU