GHGSAT CONSTELLATION: LATEST RESULTS AND TROPOMI SYNERGIES

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Science and Systems Lead
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GHGSAT

Montreal-based (also Ottawa, Calgary, US, UK)

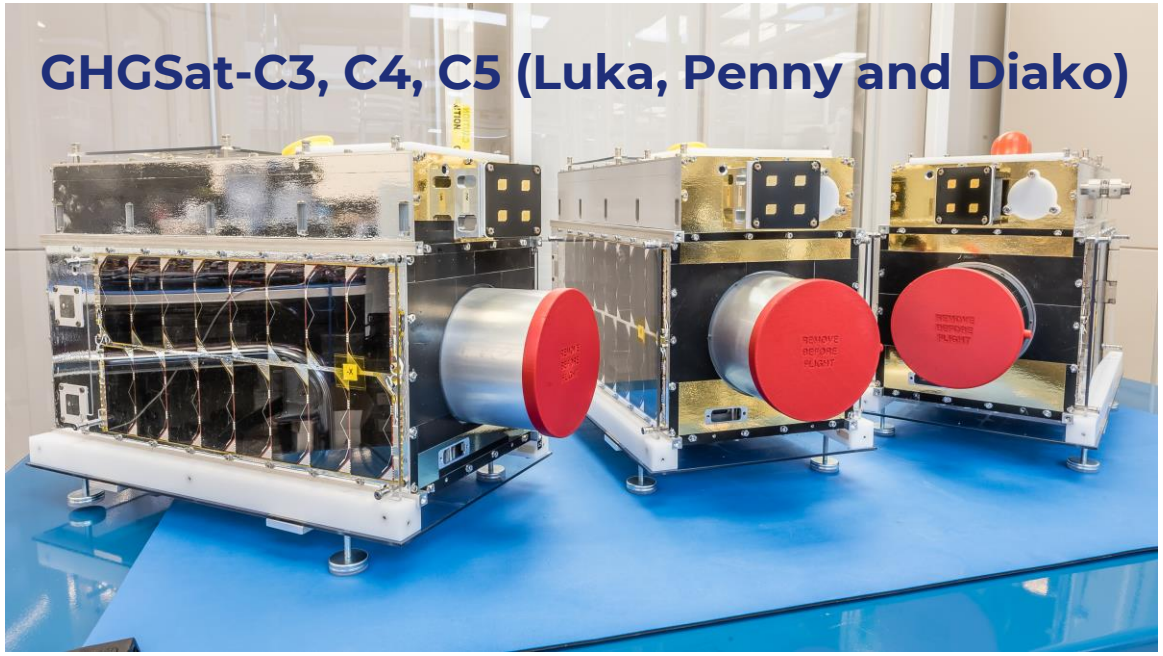
Constellation of small satellites custom-designed for methane sensing

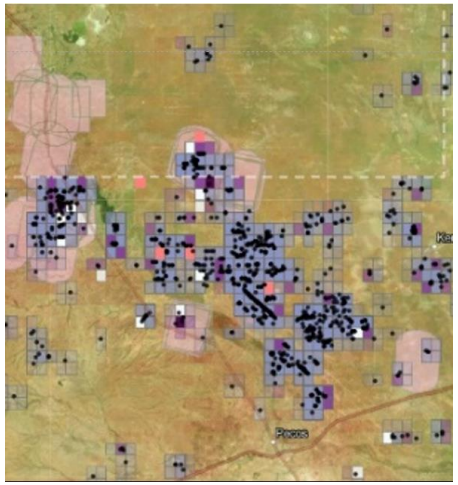
- 6 satellites now, 11 by 2023
- Single-site attribution (~25 m res) and sensitivity down to ~100 kg/hr

Aircraft instruments for surveys with enhanced sensitivity (~10 kg/hr) and resolution

Analytics for incorporating third-party data (satellite and ground-based)

- Global facility-level and gridded emissions
- Visualizations at global, regional and facility scale

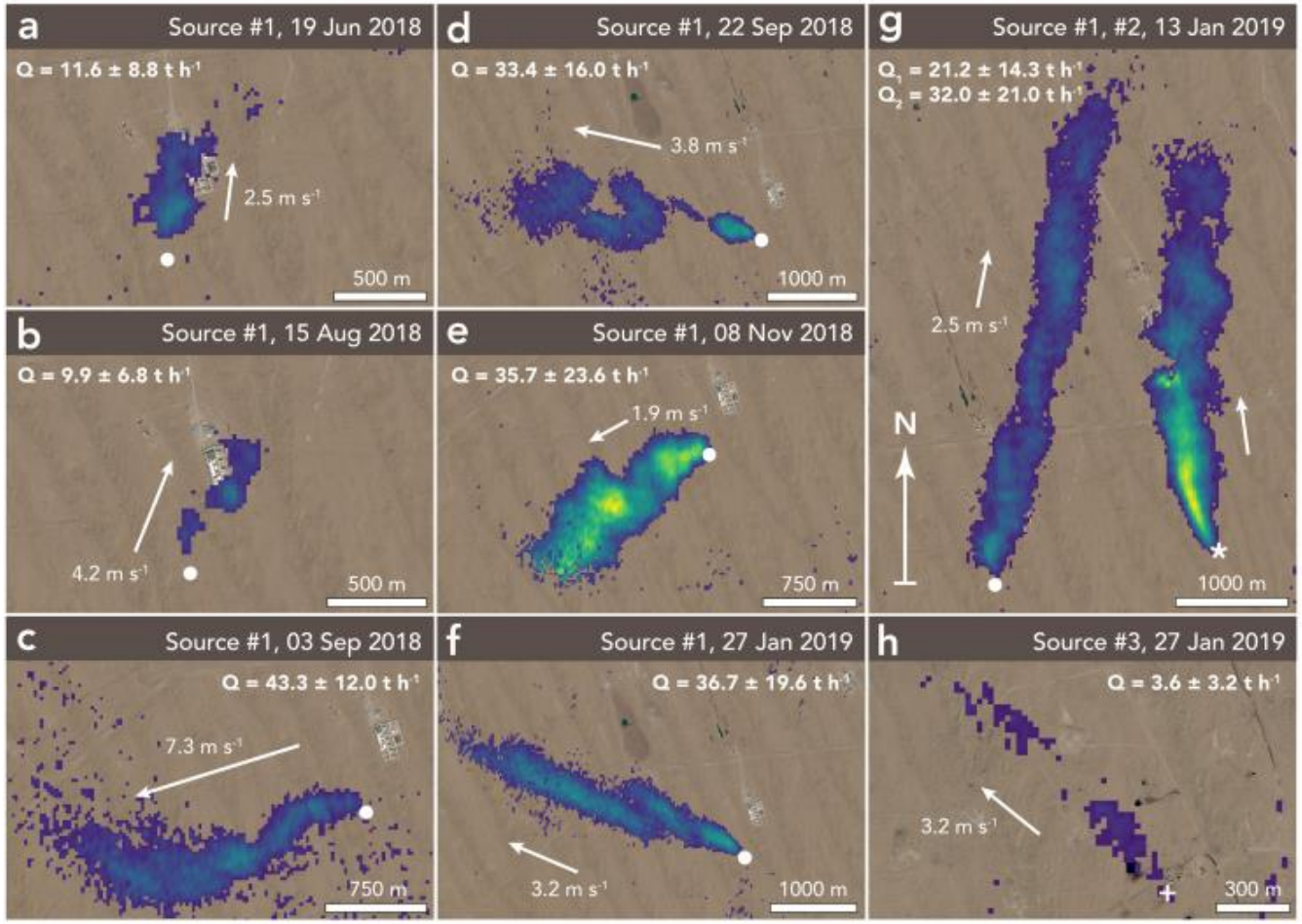




TROPOMI SYNERGIES

Turkmenistan 2018-2019

GHGSat-D (demonstration satellite)



Geophysical Research Letters, *46*, 13,507–13,516 (2019).

TROPOMI SYNERGIES

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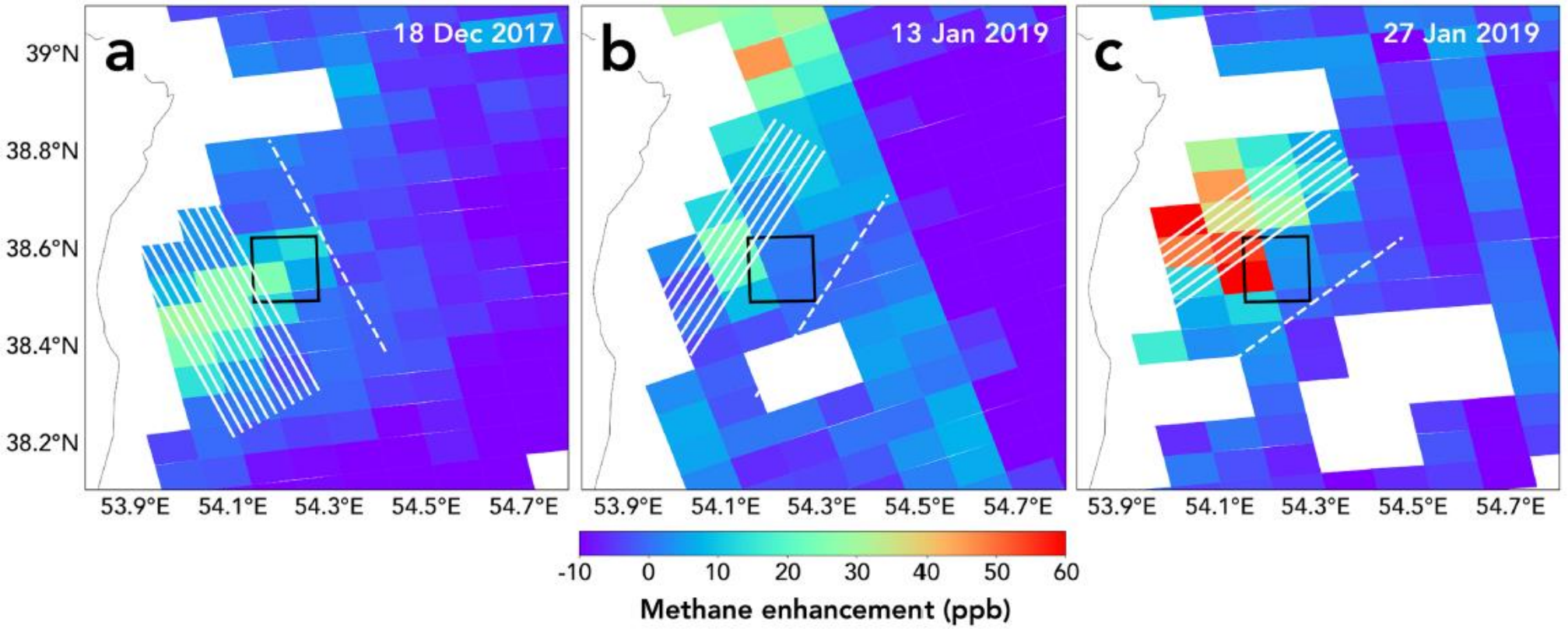
TROPOMI



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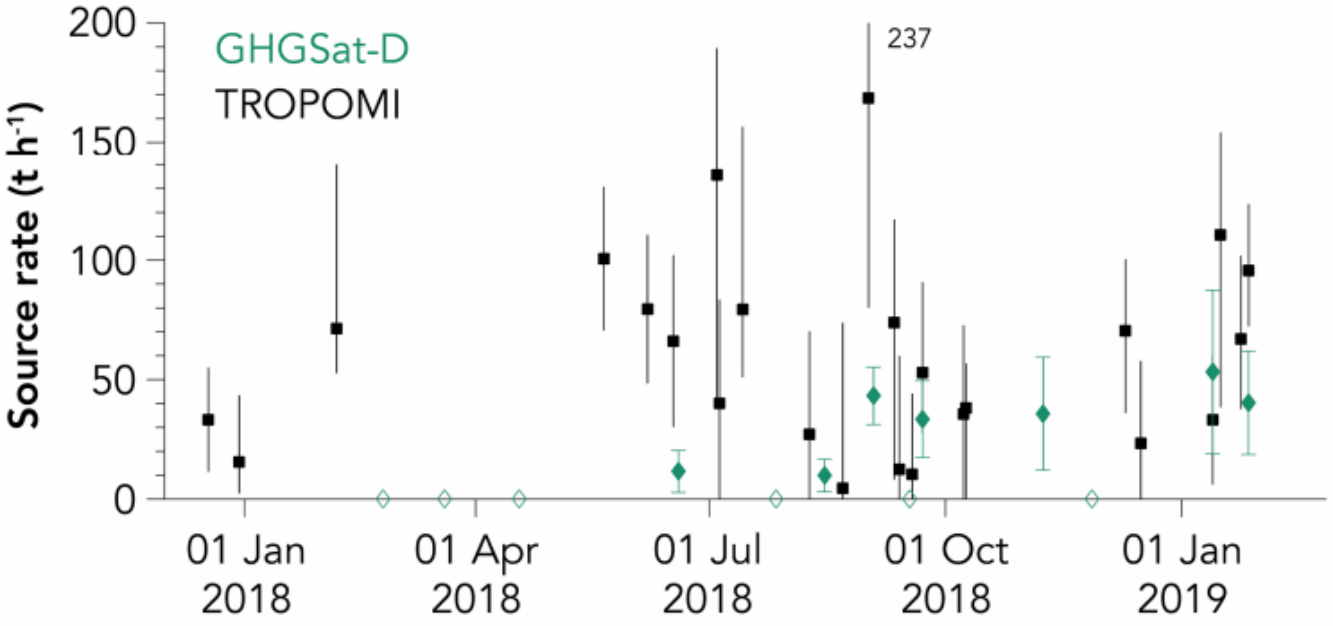


- Start of a highly fruitful, ongoing collaboration with SRON
- Major milestone for GHGSat prior to inception of our commercial constellation
- Validation of instrument and retrievals, in spite of imperfections in demo mission

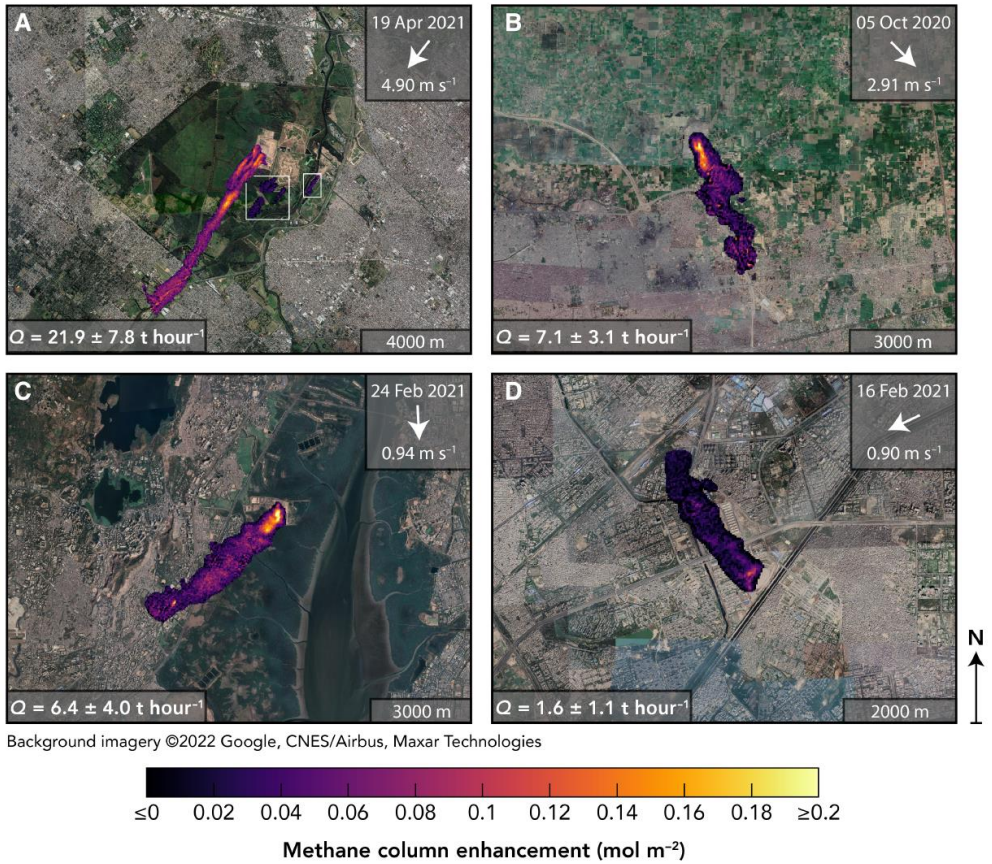
Geophysical Research Letters, *46*, 13,507–13,516 (2019).

TROPOMI SYNERGIES

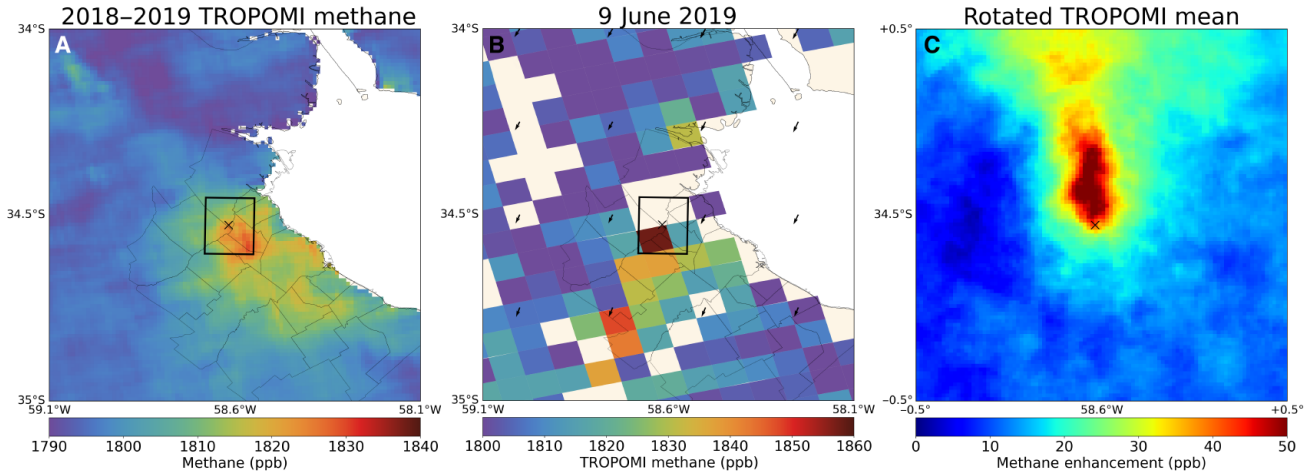
Maasakkers *et al.*, Sci. Adv. 8, eabn9683 (2022)

Landfill study 2018-2021

GHGSat-C1 and C2



TROPOMI



"Tip and cue" capability - emissions first found by TROPOMI, then GHGSat enabled site-level attribution and quantification.

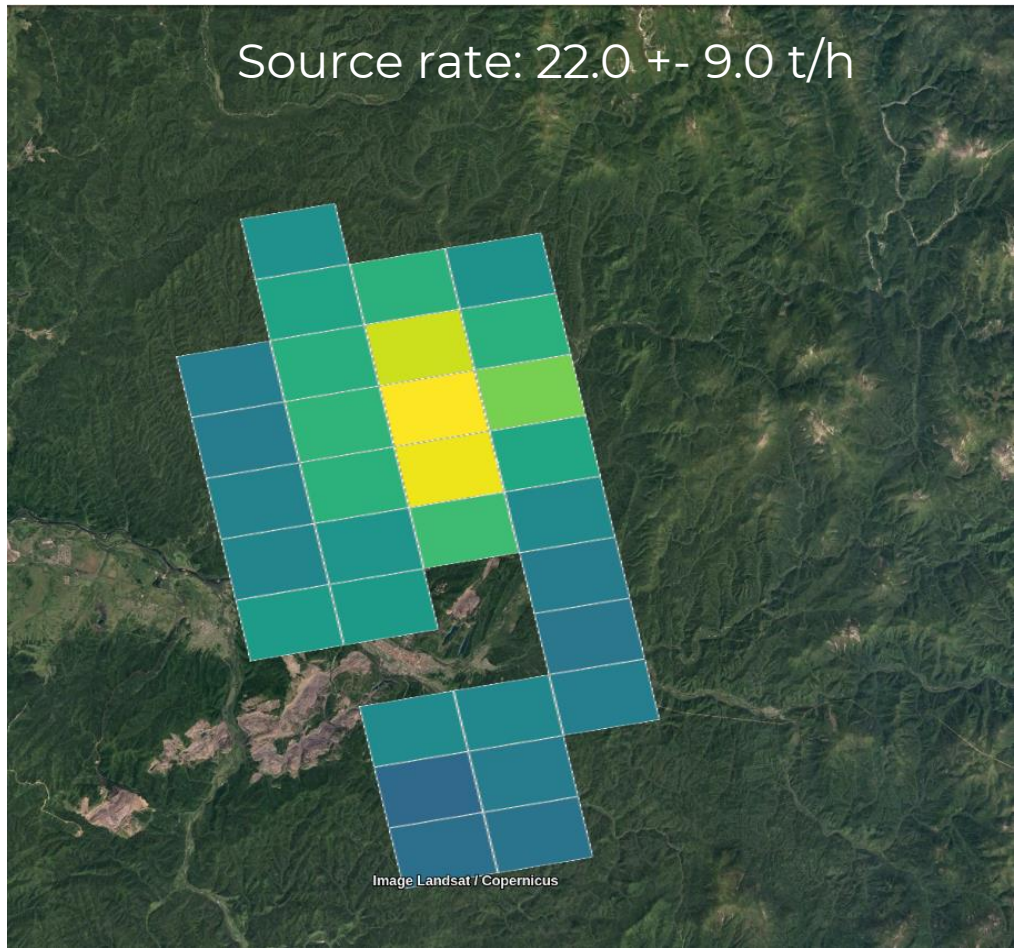
Comparisons with city-level inversions (TROPOMI)

Ongoing collaboration continues to help us identify new sites

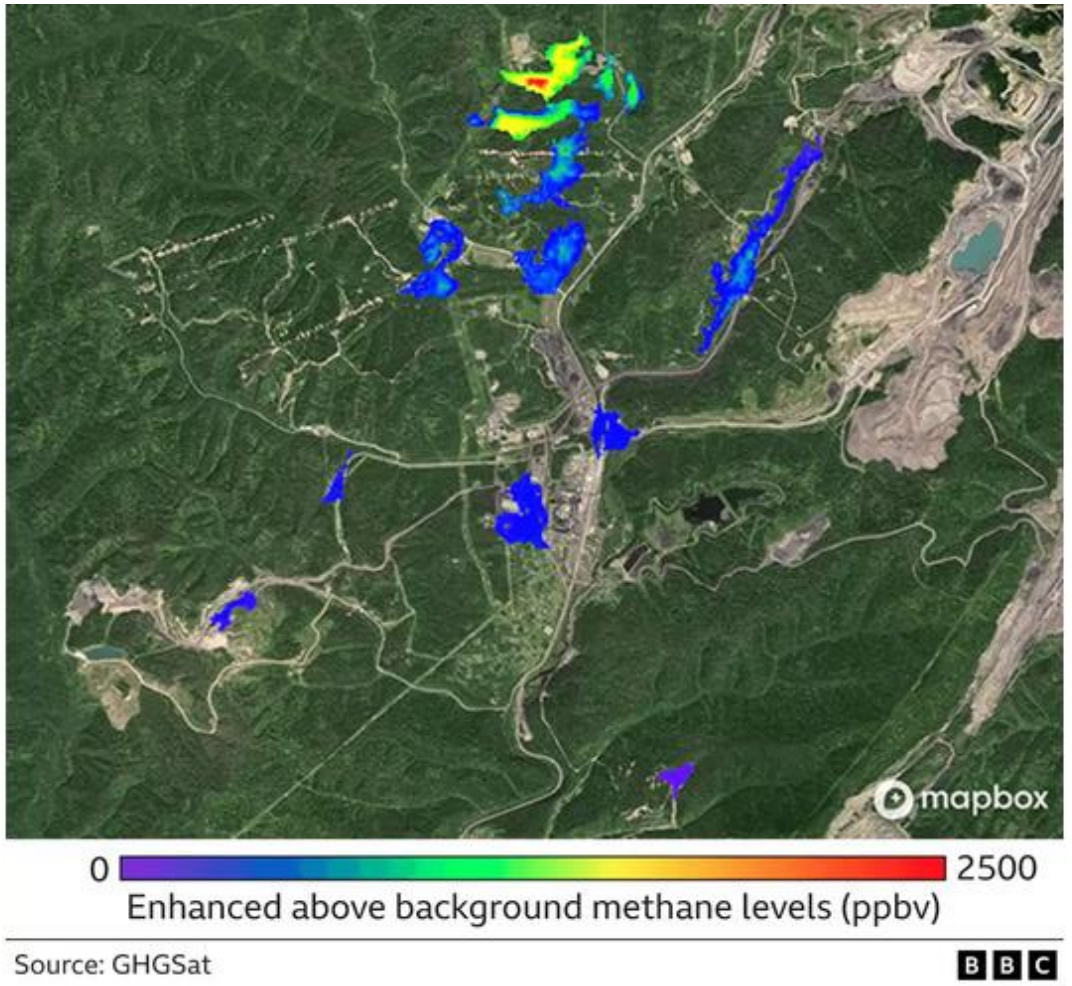
TROPOMI SYNERGIES

Surface coal mining, Russia 2022

TROPOMI



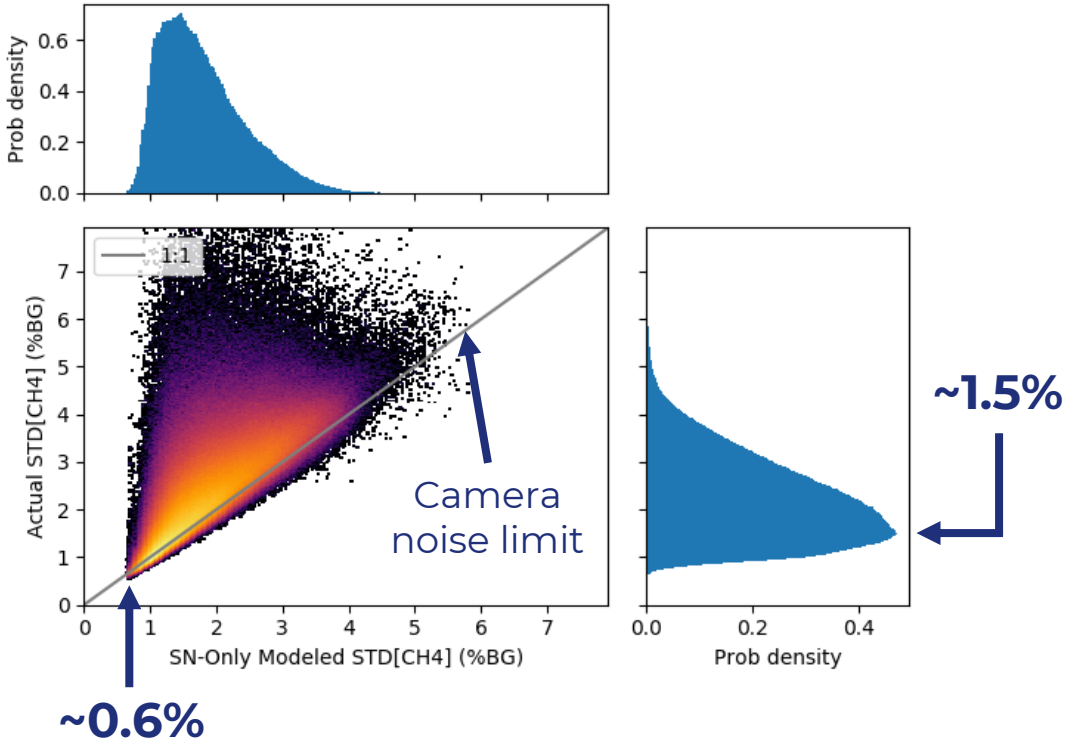
GHGSat



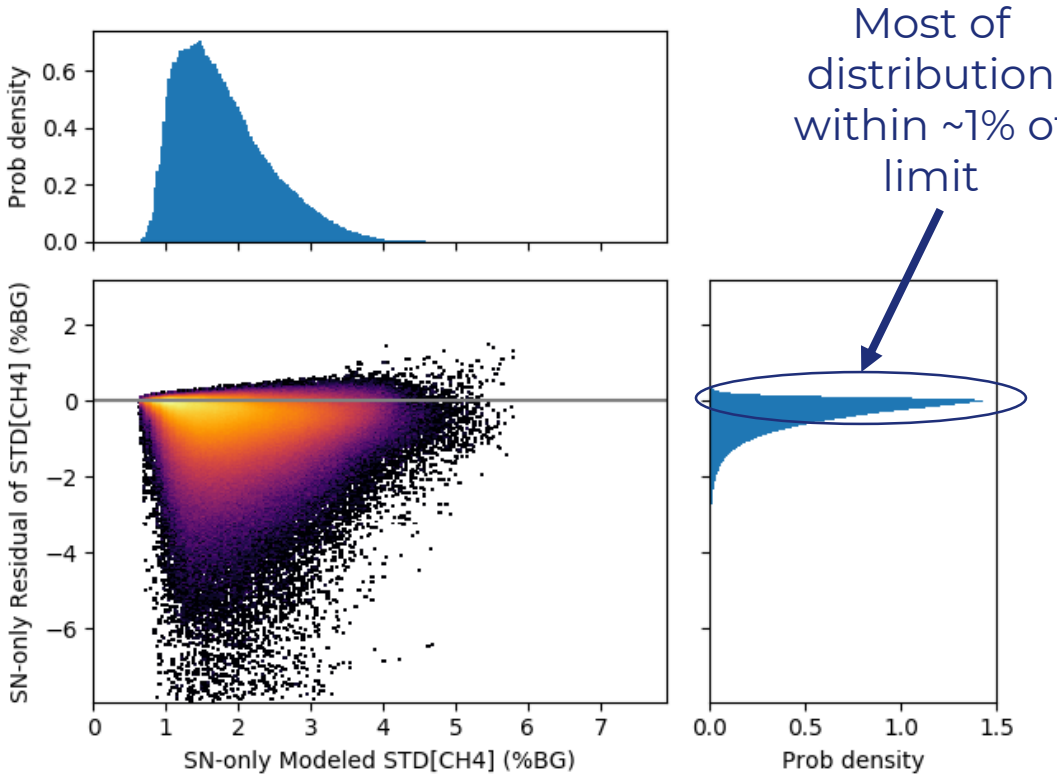
GHGSAT MEASUREMENT PERFORMANCE

Satellite column density noise analysis

Model: camera noise only



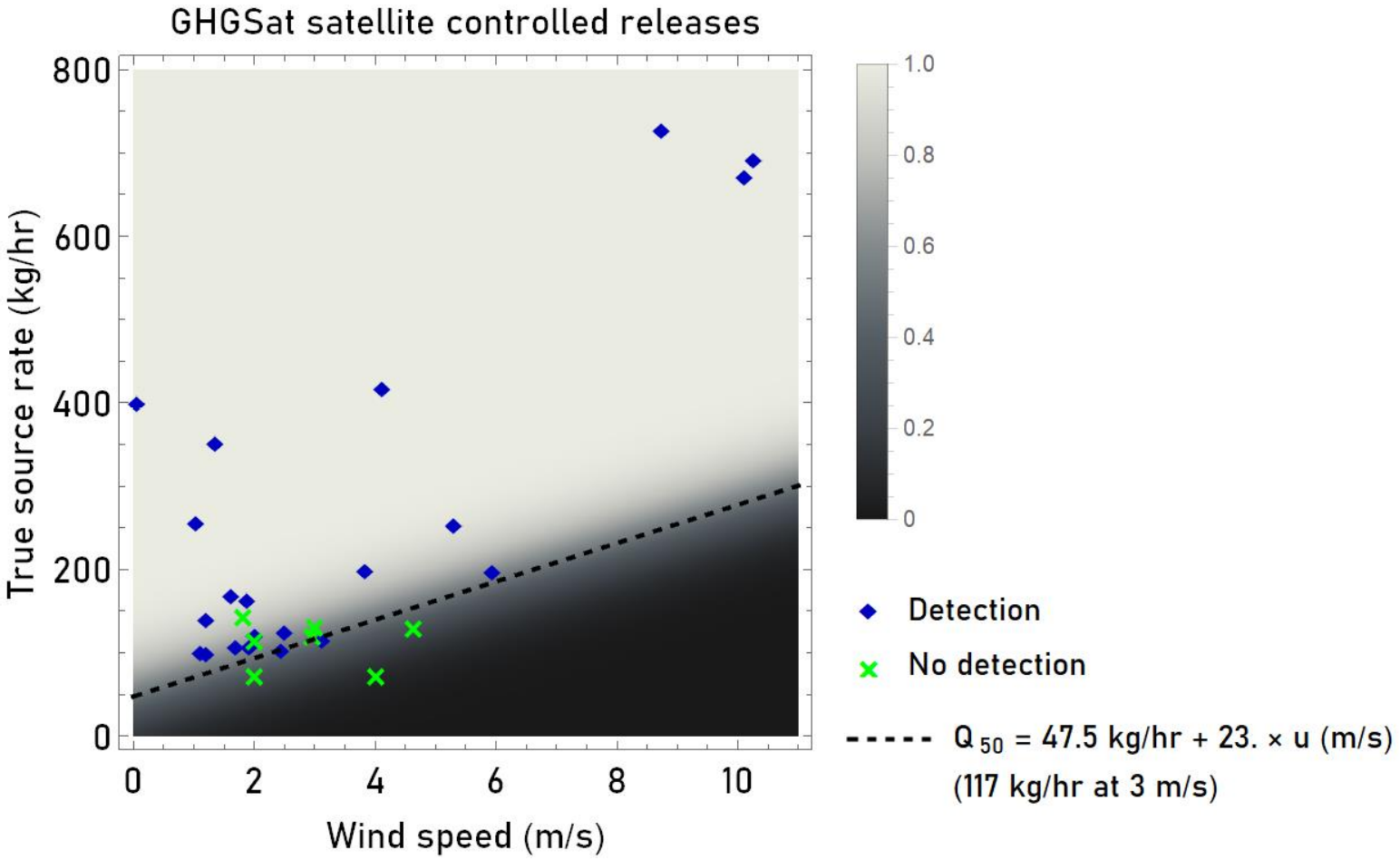
Residuals



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

CAL/VAL: CONTROLLED RELEASES

Detection Limit

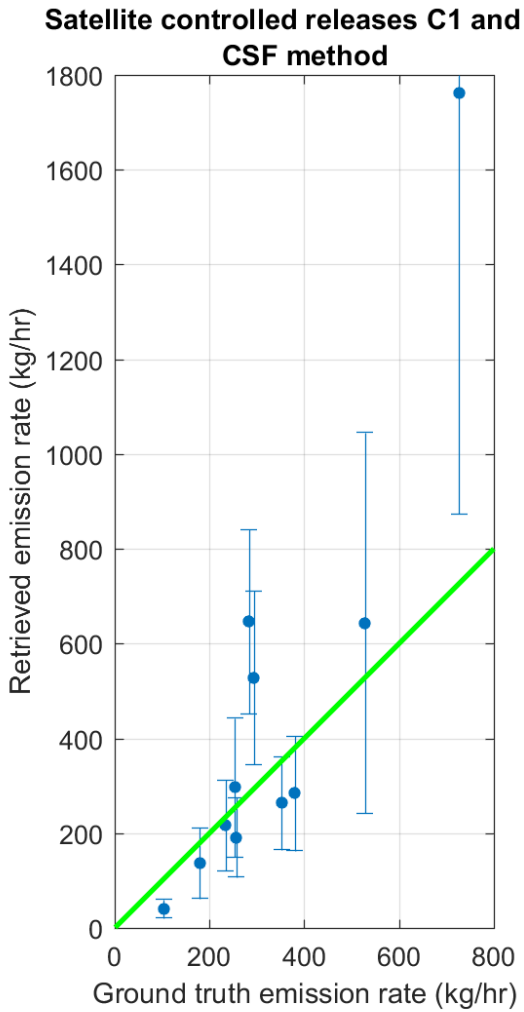


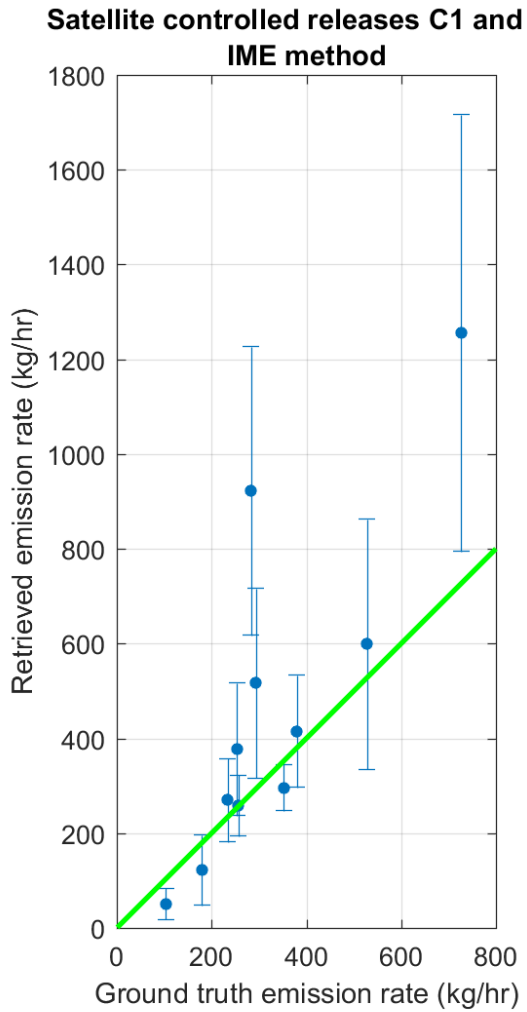
- Binary regression analysis (no binning required)
- Data from 2021-2022
- Internal and independently organized releases
- Fit model for probability of detection (PoD)
- Accounts for wind-speed dependence
- Threshold 117 kg/hr (50% PoD, 3 m/s)

White paper to be posted on ghgsat.com

CAL/VAL: CONTROLLED RELEASES

Quantification Accuracy





- Ongoing series of controlled releases by GHGSat in southern Alberta since C1 launch
- Also includes some single-blind releases with customers
- **Lowest rate detected: 103 kg/hr**
- Source rate retrievals: Similar results from cross-sectional flux (CSF) and integrated mass enhancement (IME) methods
- Error typically dominated by wind-related uncertainty

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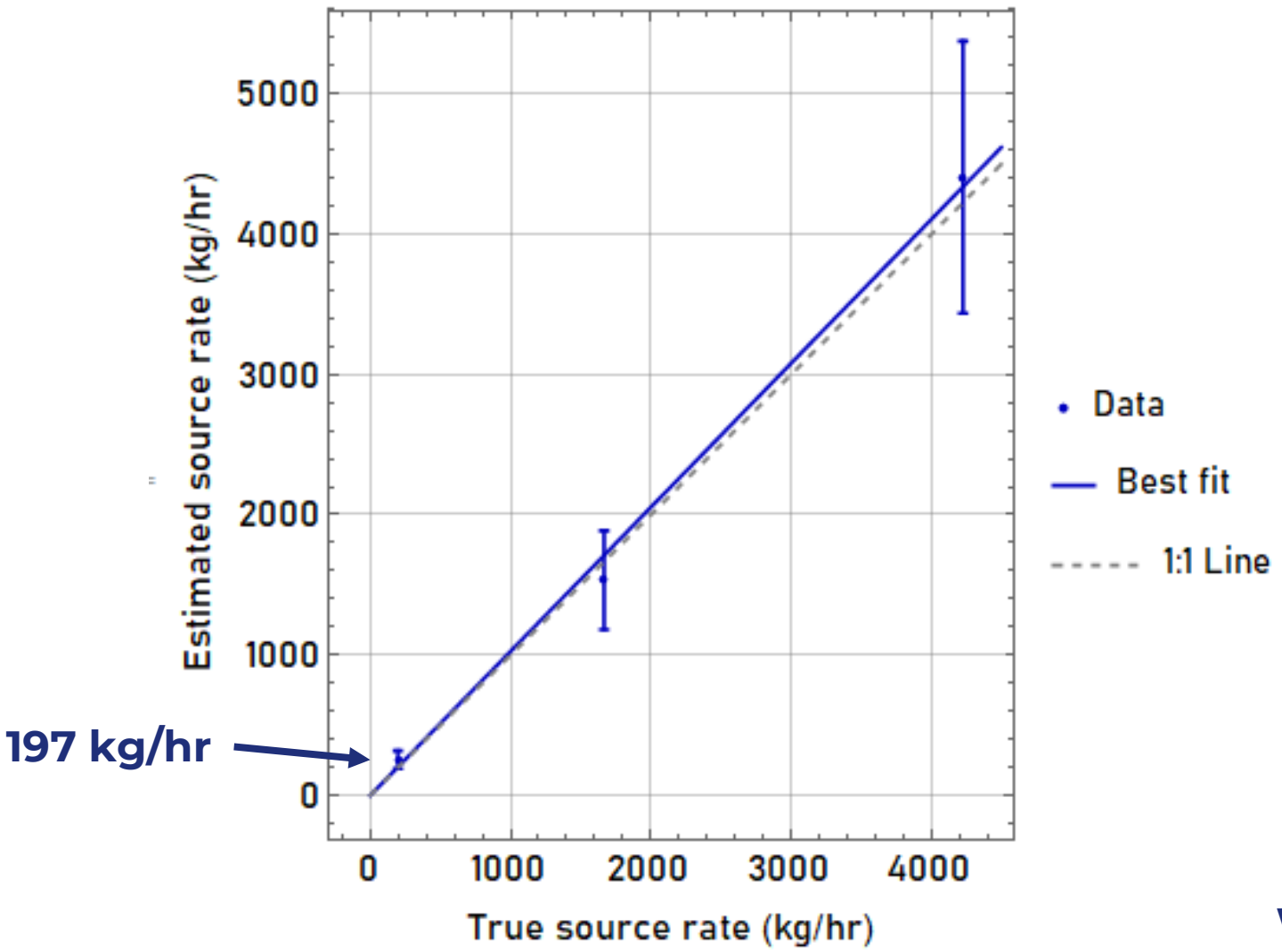
CAL/VAL: CONTROLLED RELEASES

Quantification Accuracy: Single-blind study by Sherwin et al



- Study run by Adam Brandt's group (Stanford) in AZ, Oct 2021
- Also other satellites, aircraft instruments and teams for retrievals
- Successful single-blind quantification of all three GHGSat satellite releases
- Lowest rate: 197 kg/hr (5 minute average prior to measurement)
- Sherwin et al (2022) https://eartharxiv.org/repository/view/3465/

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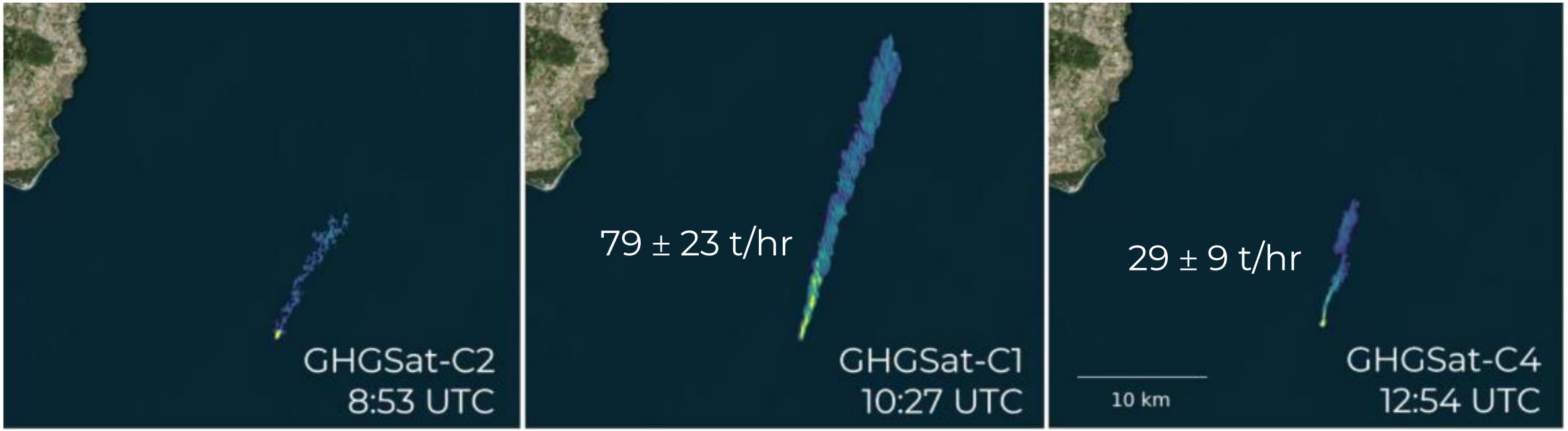
NORD STREAM 2 PLUME DETECTIONS

Achieved with GHGSat Glint Mode (in development)



GHGSat Glint Observations Sept 30th, 2022

Time (UTC)	Satellite	Lat/Lon (plume origin)	Glint Scattering Angle	Effective albedo	Estimated source rate (t/hr)
8:53	C2	54.88°/15.41°	45°	0.007	N/A
10:27	C1	54.88°/15.41°	10°	1.02	79 ± 23
12:54	C4	54.88°/15.41°	30°	0.04	29 ± 9

GHGSAT DATA FOR RESEARCHERS

ESA Third Party Mission since May 2022

NASA CSDA – Contract awarded October 2022

THANK YOU