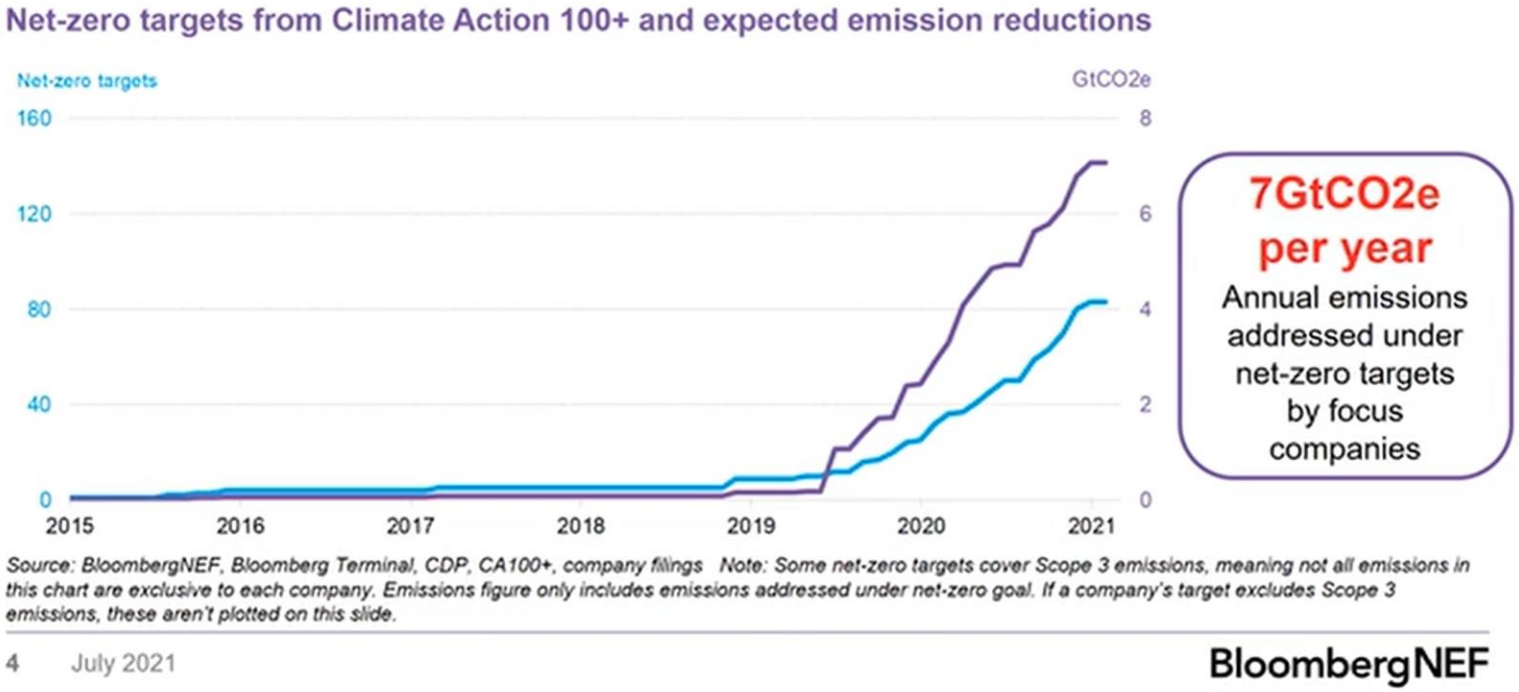
SHOW ME THE DATA: COMPLEMENTARY SATELLITES ARE PROVIDING GLOBAL TRANSPARENCY IN METHANE EMISSIONS - NOW

July 2021

GHGSAT

REASONS TO BE OPTIMISTIC

Strong push from public, markets, companies, investors, governments towards decarbonization



METHANE MONITORING SATELLITES

Multiple Systems with Complementary Purposes

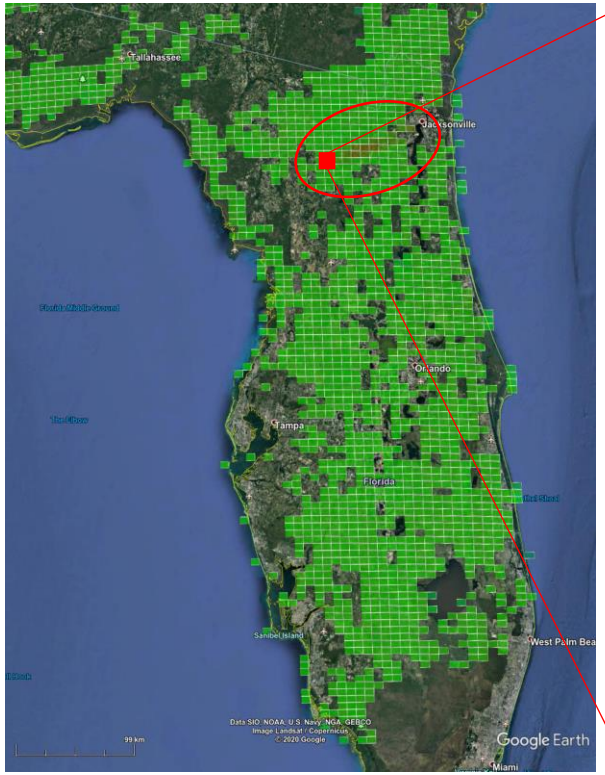
	Global Mappers	Regional Mappers
• Purpose	Inform climate models & advance science	Inform policy & advance science
• Detection threshold • Spatial resolution • Coverage	~10,000 kg/hr 1000m-scale Global	~1,000 kg/hr 100m-scale Basin
• Dedicated methane missions	Sentinel-5P	MethaneSAT*
• Multi/hyperspectral with methane sensitivity	Sentinel-2	PRISMA, EnMAP*

*Not yet launched

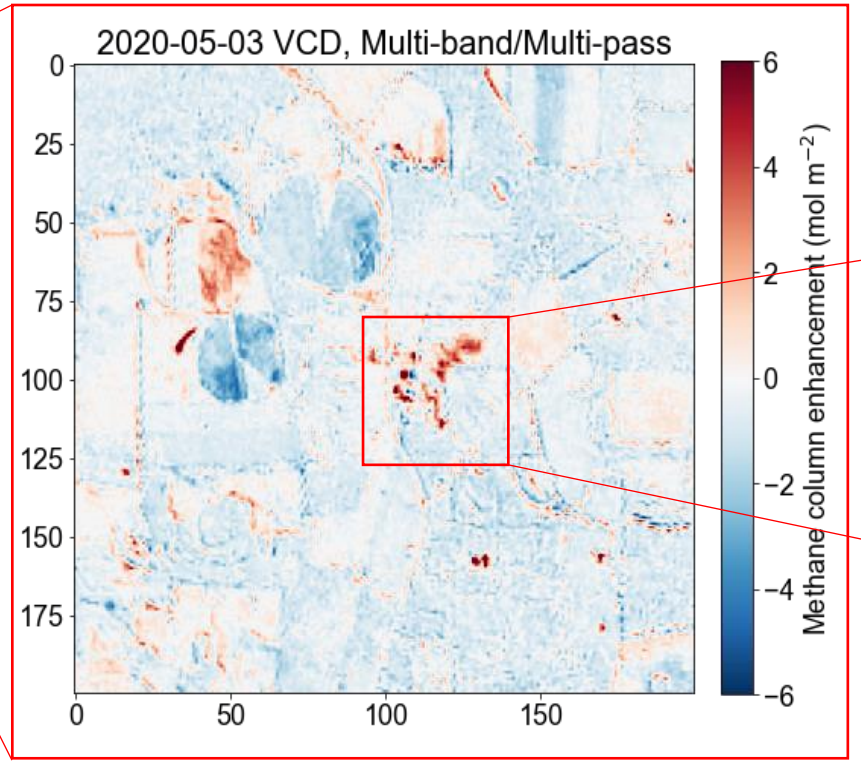
METHANE MONITORING SATELLITES

Example of global mapping satellites (Sentinel-5P and Sentinel-2) used to find a source

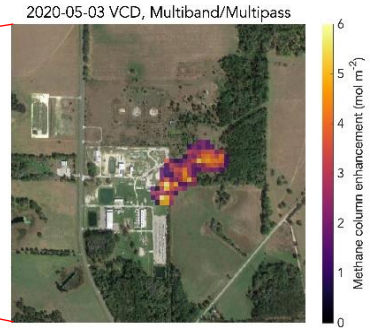
Sentinel-5P



Sentinel-2



Sentinel-2 retrievals and source rates verified against peer-reviewed GHGSat-D measurements



Source rate estimated at 31,100 ± 20,400 kg/h (1.25M cars driven for an hour)

Sentinel-5P can find hotspots for Sentinel-2 to help find sources > 3,000 kgCH4/hr

METHANE MONITORING SATELLITES

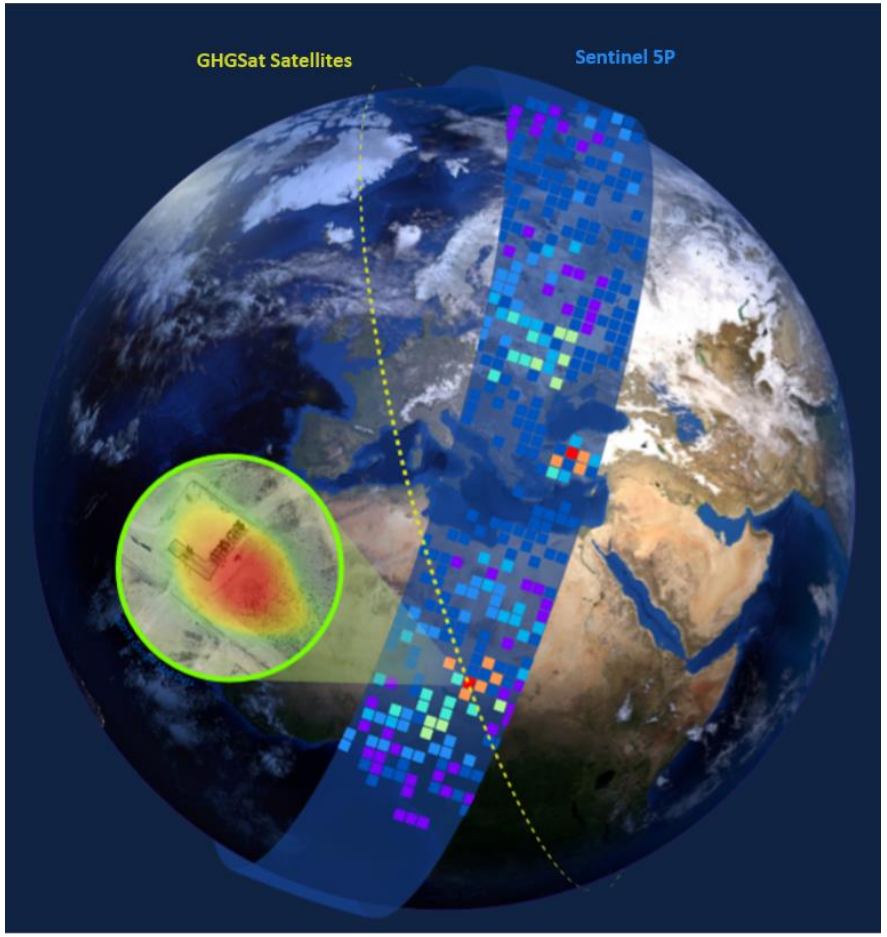
Multiple Systems with Complementary Purposes

	Global Mappers	Regional Mappers	Facility Monitors
• Purpose	Inform climate models & advance science	Inform policy & advance science	Provide actionable info to customers
• Detection threshold • Spatial resolution • Coverage	~10,000 kg/hr 1000m-scale Global	~1,000 kg/hr 100m-scale Basin	~100 kg/hr 10m-scale County
• Dedicated methane missions	Sentinel-5P	MethaneSAT*	GHGSat
• Multi/hyperspectral with methane sensitivity	Sentinel-2	PRISMA, EnMAP*	Bluefield*, CarbonMapper*

*Not yet launched

METHANE MONITORING SATELLITES

Example of tipping & cueing from global mapper to facility monitoring satellite



- GHGSat has been working with ESA/Sentinel-5P science team since 2019
- Use Sentinel-5P to “tip & cue” GHGSat satellites
  - GHGSat tasks satellites in pat based on locations and timing of hotspots identified by Sentinel-5P
- Almost 100 “persistent” sources worldwide identified by Sentinel-5P and targeted by GHGSat satelltes
- Hundreds of plumes found around the world

Geophysical Research Letters

Research Letter | Open Access

Satellite Discovery of Anomalously Large Methane Point Sources From Oil/Gas Production

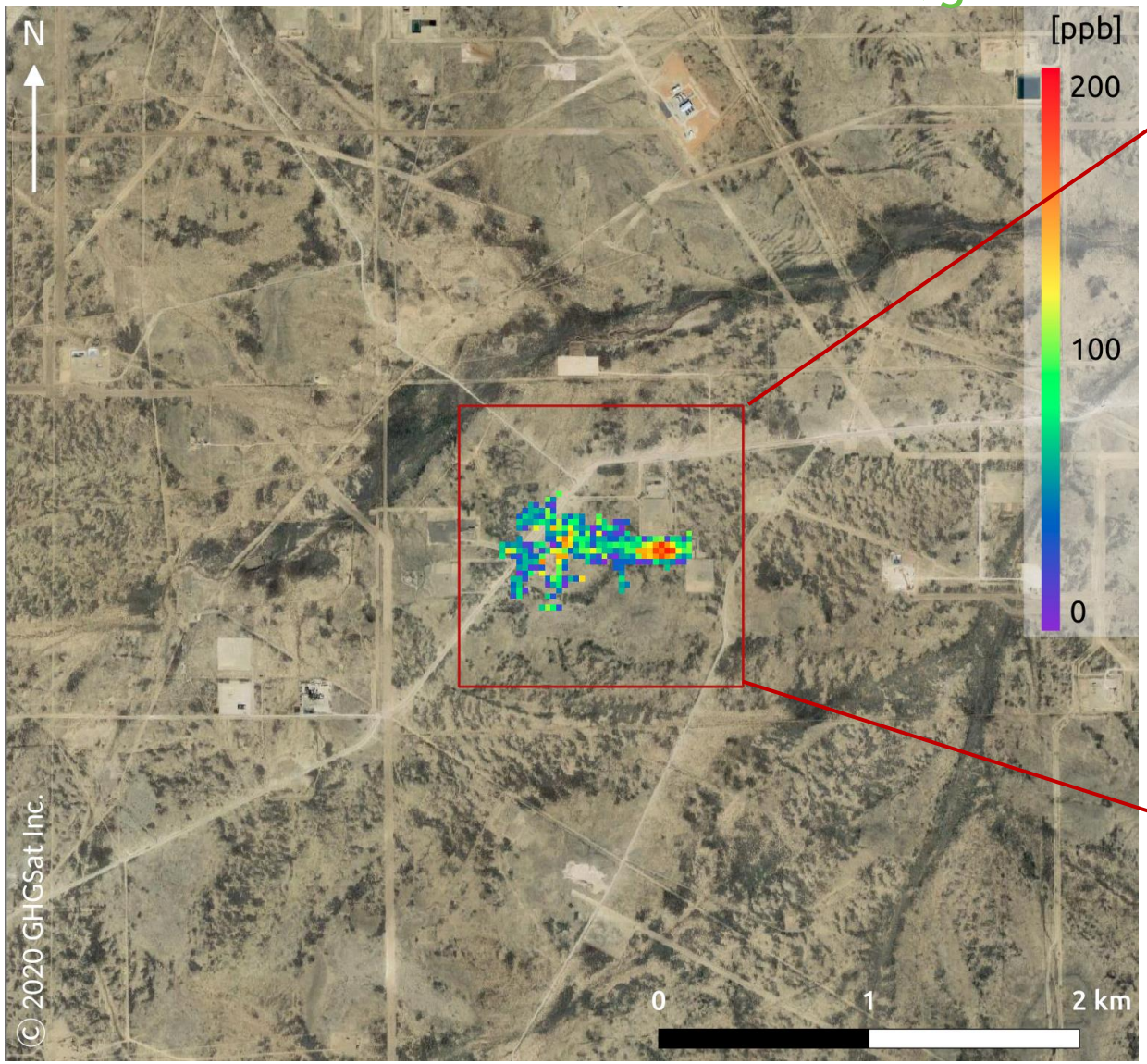
D. J. Varon, J. McKeever, D. Jervis, J. D. Maasakkers, S. Pandey, S. Houweling, I. Aben, T. Scarpelli, D. J. Jacob

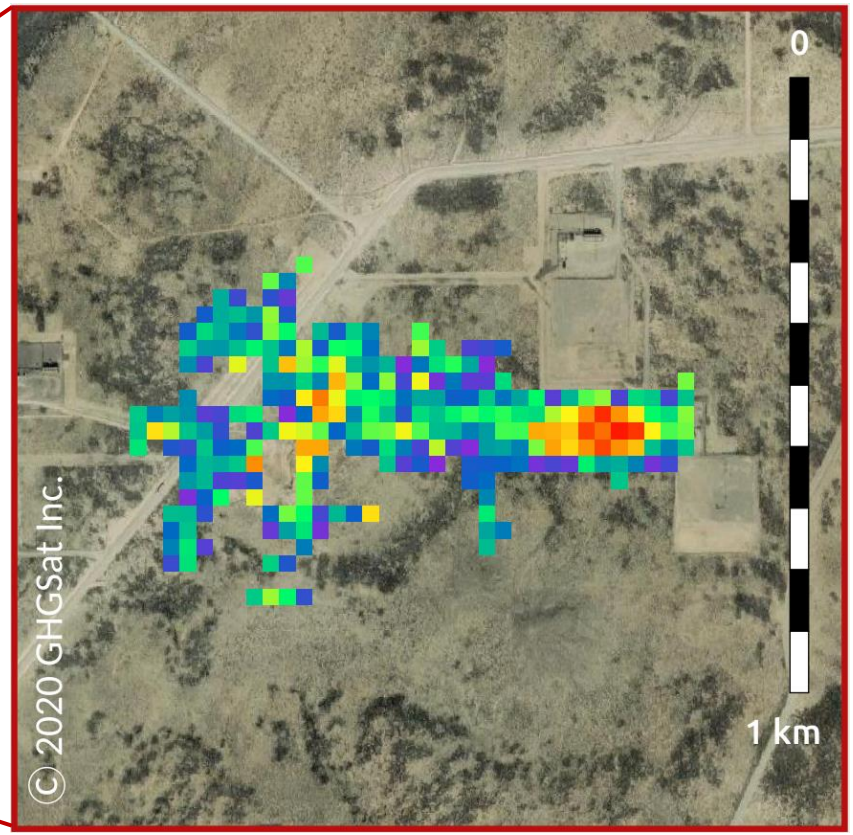
First published: 25 October 2019 | https://doi.org/10.1029/2019GL083798 | Citations: 36

Sentinel-5P can find hotspots for GHGSat to help find sources > 100 kgCH4/hr

ROUTINE FACILITY MONITORING IS HAPPENING NOW

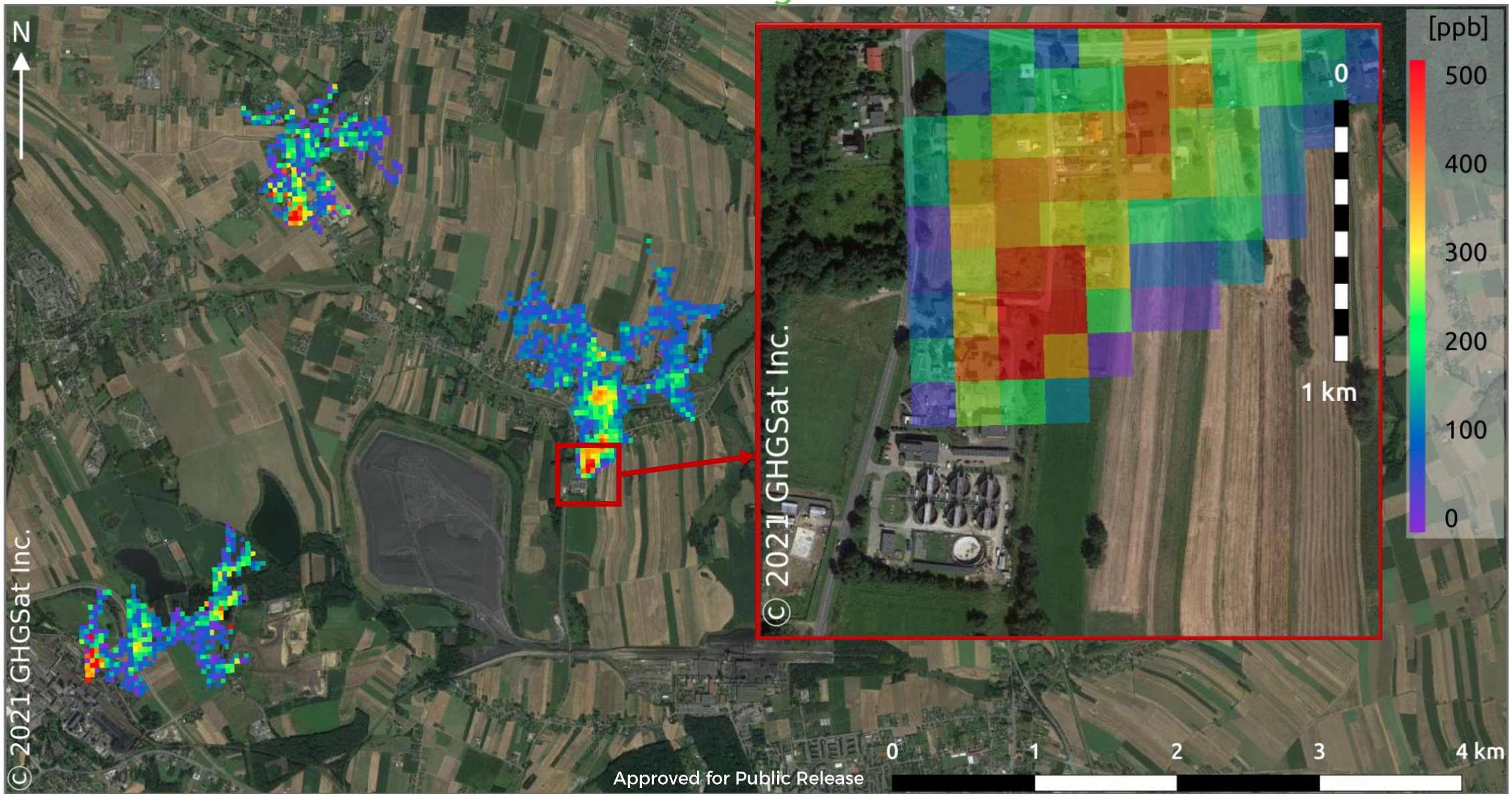
Point source emissions monitored for oil & gas





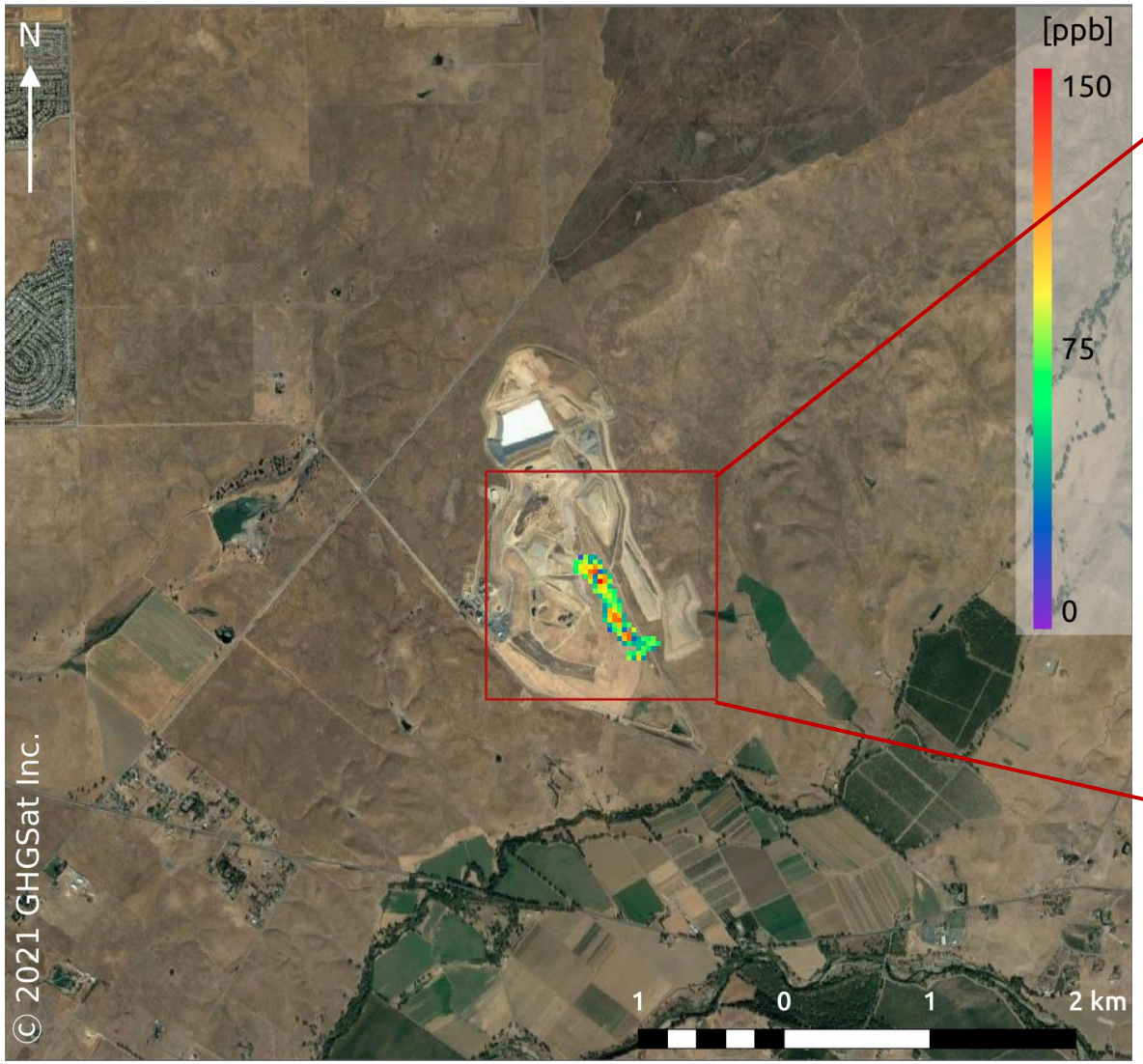
ROUTINE FACILITY MONITORING IS HAPPENING NOW

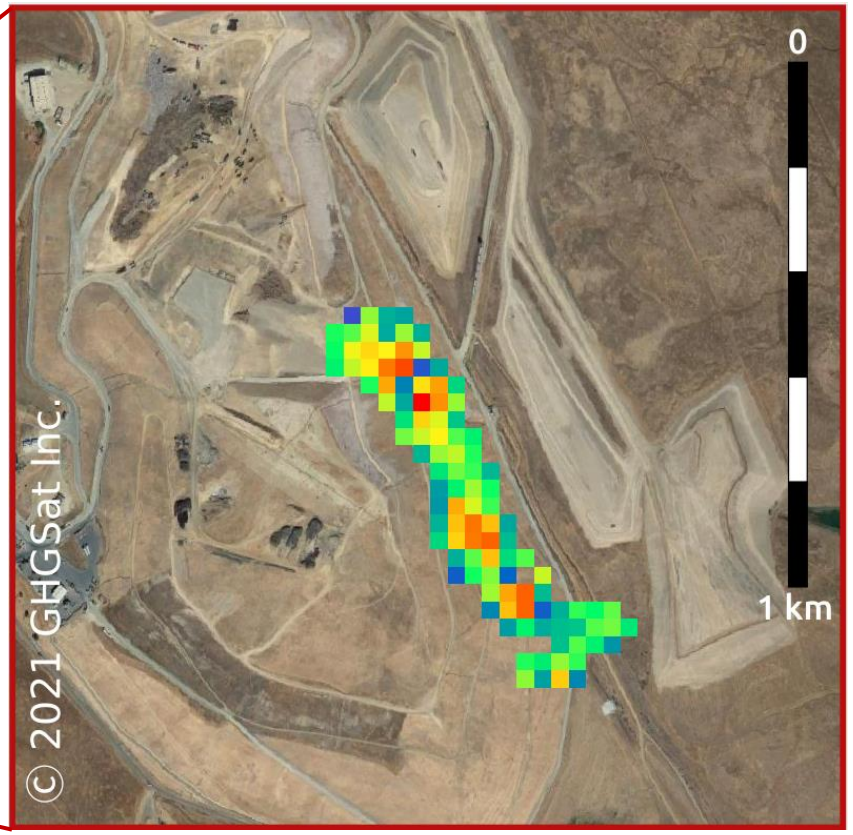
Point source emissions monitored for coal mining



ROUTINE FACILITY MONITORING IS HAPPENING NOW

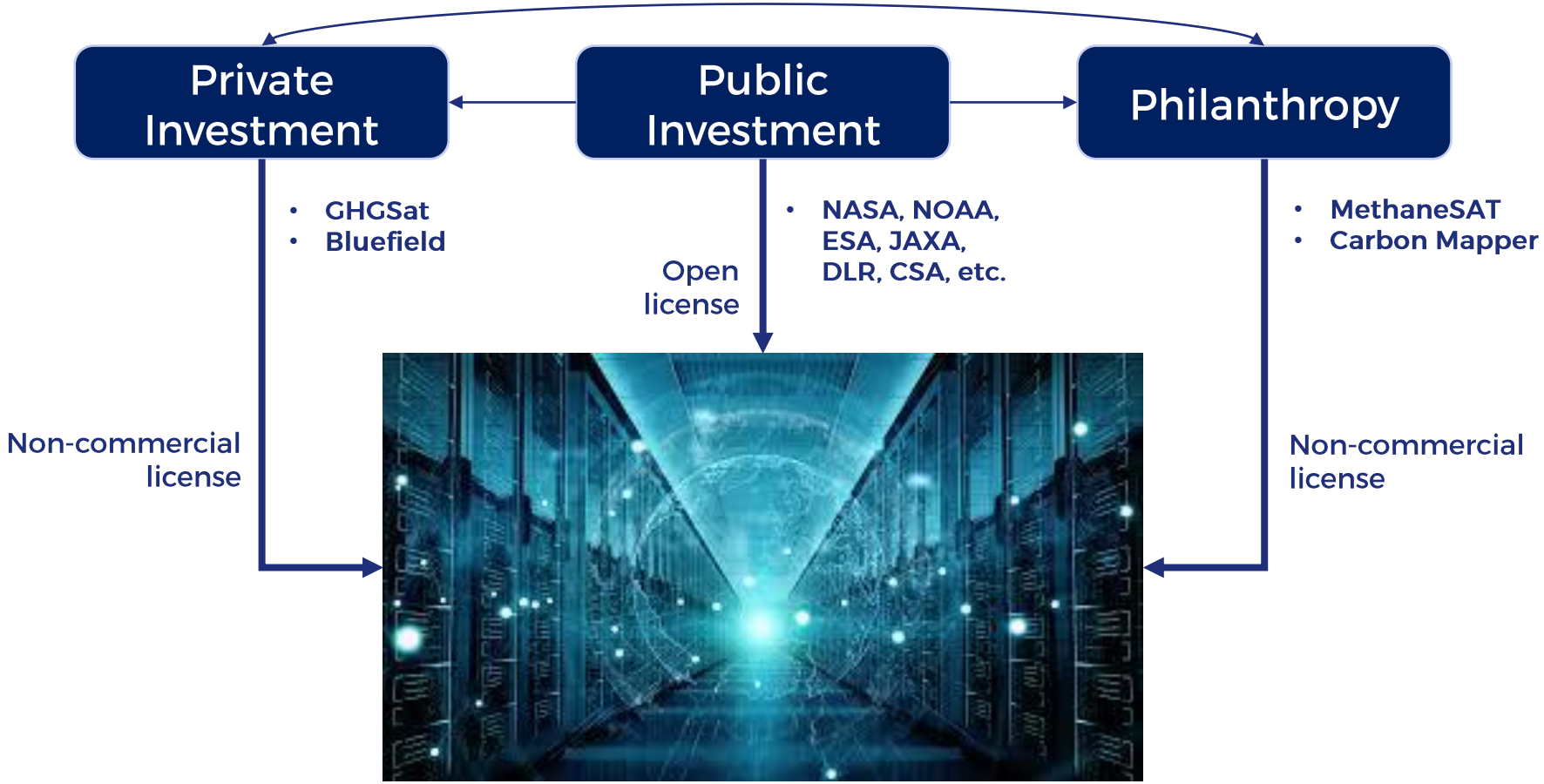
Point source emissions monitored for landfills





HOW CAN WE SUSTAIN GLOBAL GHG MONITORING?

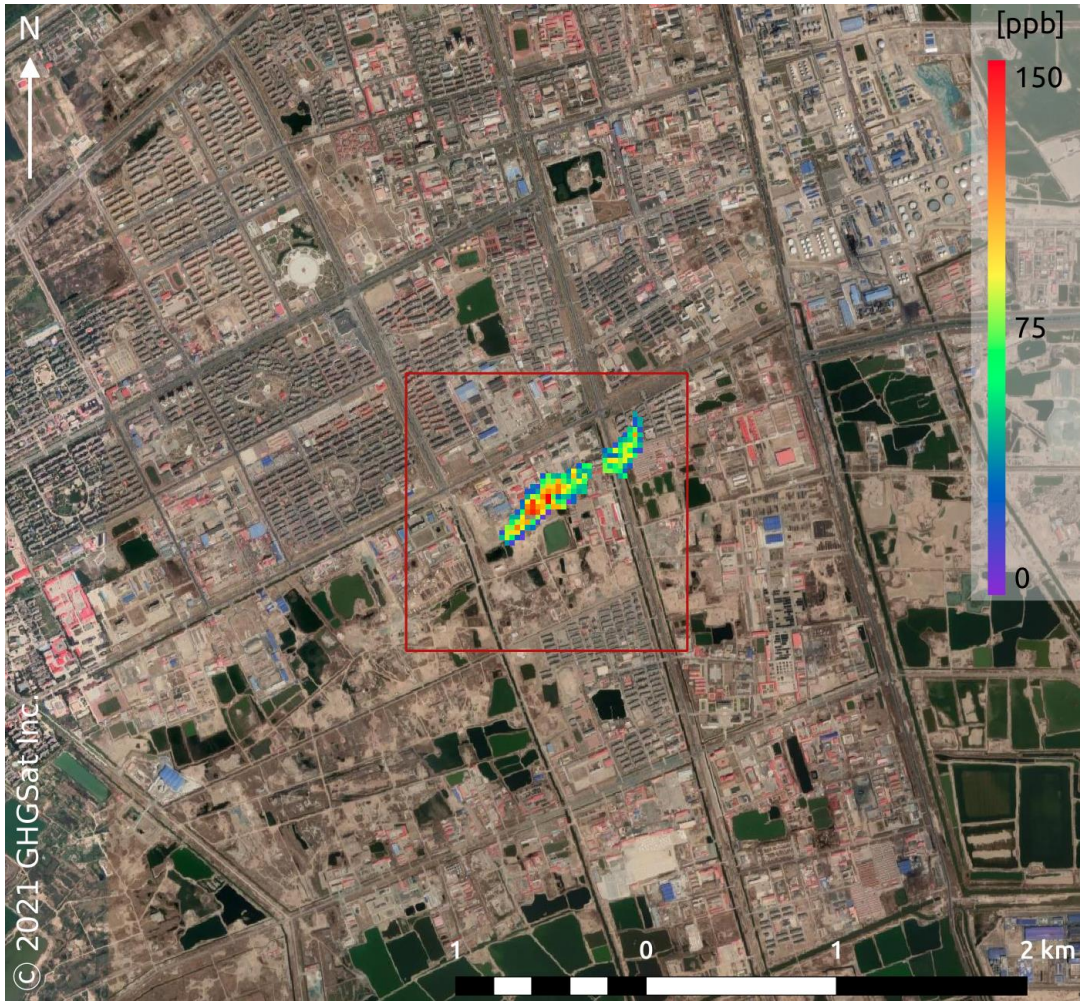
Many financing experiments are underway; global emissions database initiatives are starting



Global Emissions Database (e.g. IMEO)
Multi-scale emissions analysis

PRIVATE INVESTMENT

There is a growing market for GHG emissions data and insights

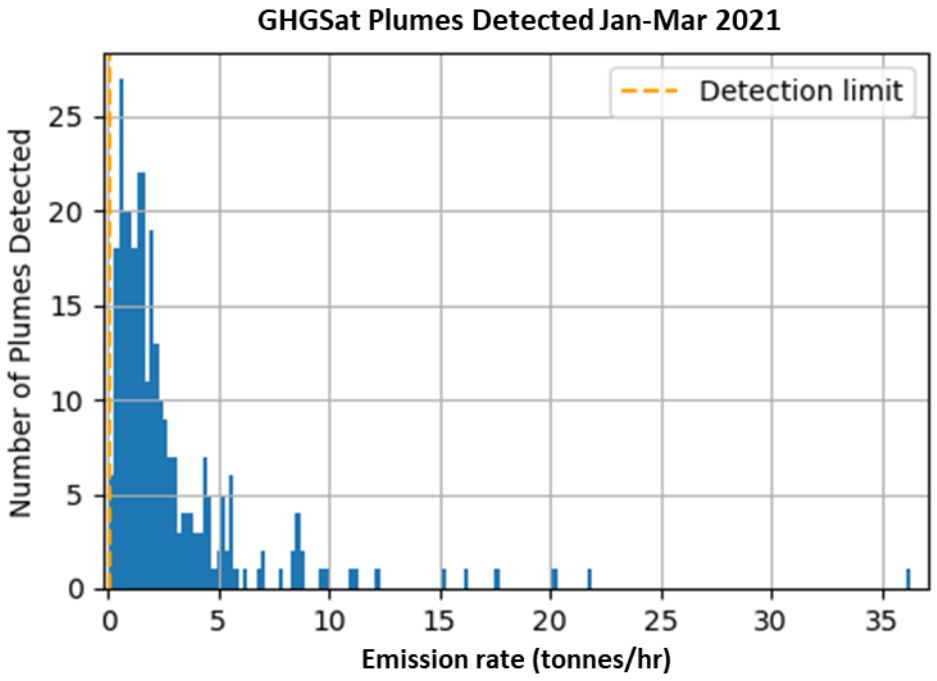


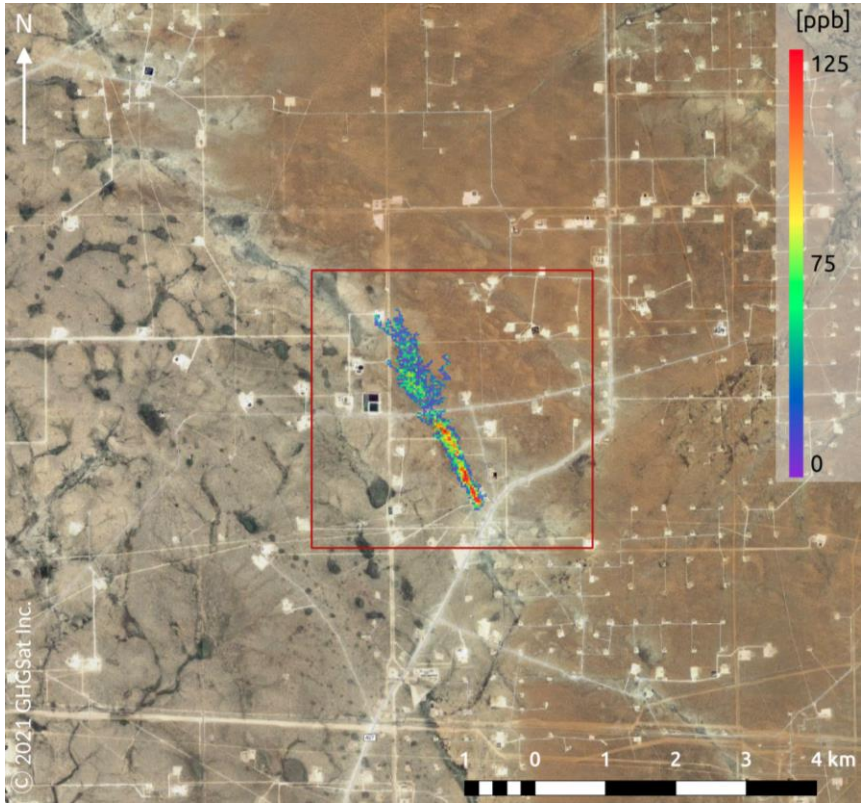
Methane leak in a city of 14 million people
Measured by GHGSat-C2 on May 5th, 2021; background is © 2021 Google Map Data

- Industrial operators are motivated to purchase by:
  - Revenue imperative
  - Investor pressure
  - Regulatory compliance
  - Health & safety of staff and public
- Governments are motivated to purchase by:
  - Regulatory performance
  - Inventory verification
- Analysts are motivated to purchase by:
  - Unique insights
  - Activism

MARKETS NEED: THRESHOLD AND ATTRIBUTION

Must detect smallest possible emissions, with unambiguous identification of the source





Measured by GHGSat-C2 on Feb 1st, 2021;
background is © 2021 Google Map Data

> 70% of emissions detected by GHGSat are below the detection threshold of public satellites

MARKETS NEED: AFFORDABLE SERVICES

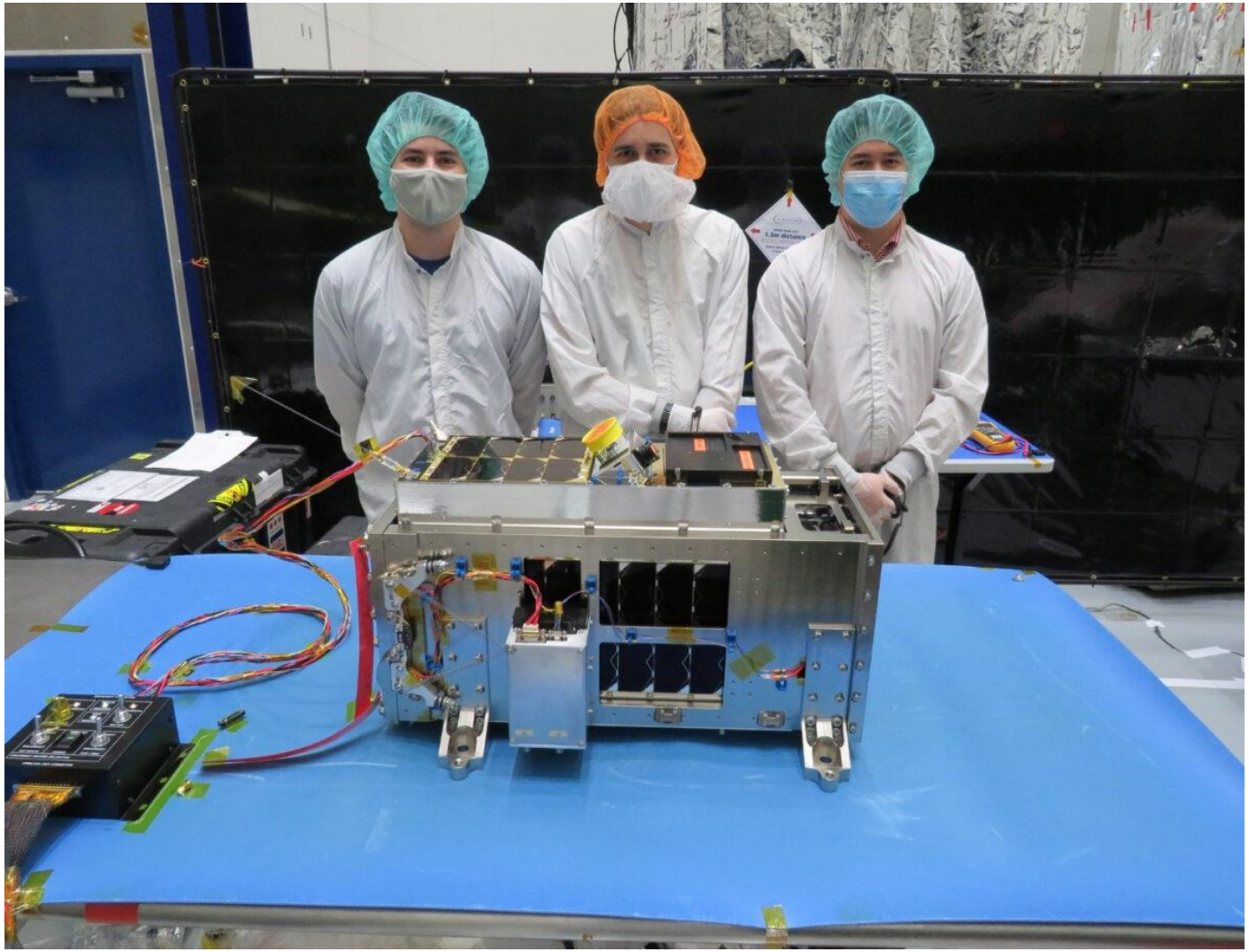
Small satellites enable monitoring services at attractive prices

Proven performance from 3 GHGSat satellites in orbit today:

- GHGSat-D (“Claire”): 22 Jun 2016
- GHGSat-C1 (“Iris”): 02 Sep 2020
- GHGSat-C2 (“Hugo”): 24 Jan 2021

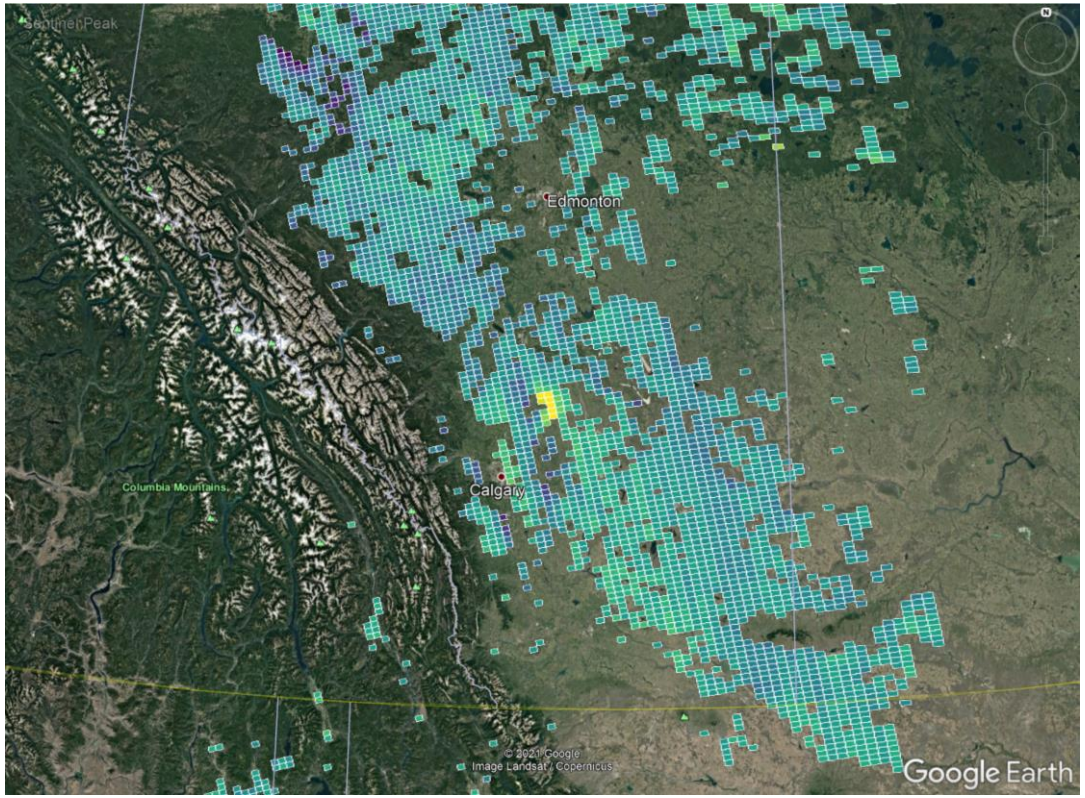
Future launches include:

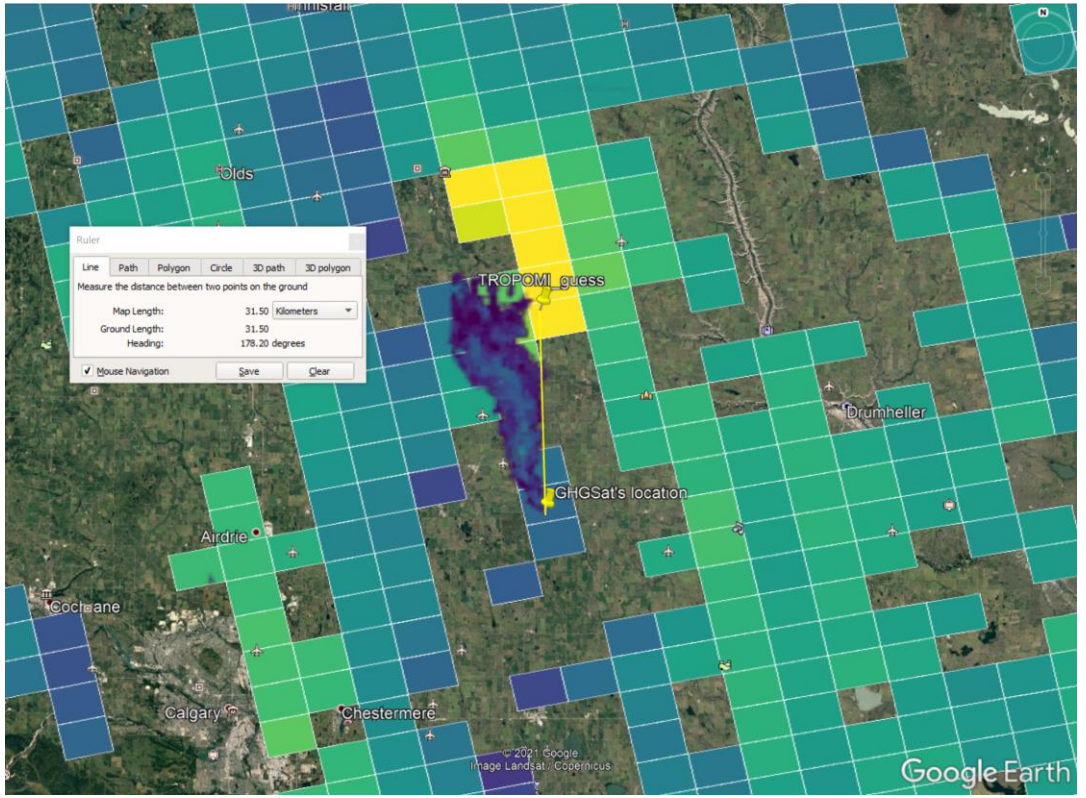
- GHGSat-C3/C4/C5: Summer 2022
- GHGSat-C6/C7/C8: Winter 2023
- GHGSat-C9/C10/C11: Summer 2023



MARKETS NEED: RELIABLE INFORMATION

False positives like this discredit satellite monitoring





- TROPOMI enhancement identified in early April 2021; third-party reported “TROPOMI_guess” to media
- GHGSat identified the actual source 30 km south of the TROPOMI enhancement in an area with many facilities

ROADMAP FOR WORKING WITH OTHER SATELLITES

"Coopetition"

Key Requirements		Status
• Find smallest possible emissions	✓	• Today: 100 kgCH_4/hr
• Unambiguous identification of sources	✓	• Today: 25 m resolution
• Find emissions fast, anywhere in the world	✓	• Today: tip & cue
• Differentiate intermittent vs persistent sources	~	• Need: daily revisits
• Global models	~	• Need: aggregate multiple sources
• Generate reliable insights	✗	• Need: quote uncertainty, minimize false positives
• Generate consistent insights	✗	• Need: verify & validate across systems; focus less on the headlines, and more on quality

GHGSAT

Making a difference today

SENSING TOMORROW