

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

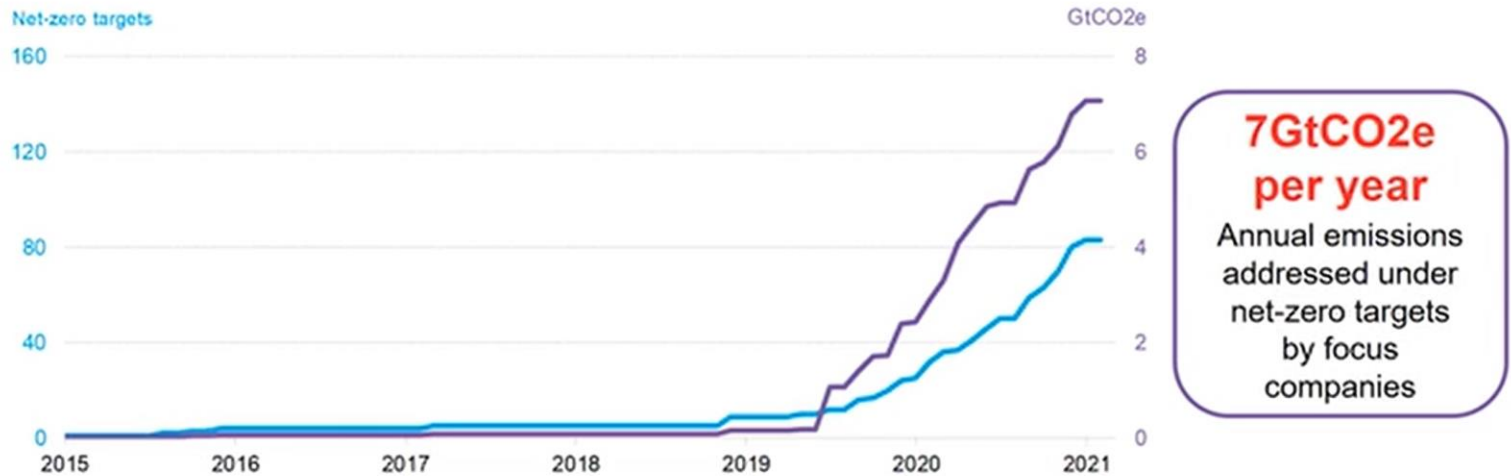
July 2021



# REASONS TO BE OPTIMISTIC

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

## Net-zero targets from Climate Action 100+ and expected emission reductions



Source: BloombergNEF, Bloomberg Terminal, CDP, CA100+, company filings. Note: Some net-zero targets cover Scope 3 emissions, meaning not all emissions in this chart are exclusive to each company. Emissions figure only includes emissions addressed under net-zero goal. If a company's target excludes Scope 3 emissions, these aren't plotted on this slide.

4 July 2021

BloombergNEF

## THE WALL STREET JOURNAL.

WORLD | ASIA | CHINA

### China Set to Launch the World's Largest Emissions-Trading Program

Carbon market will double the share of global emissions covered under such systems

## Forbes

Jul 3, 2021, 02:30pm EDT | 1,745 views

### President Biden's Climate Plan Is More Revolution Than Transition



Shell accelerates drive for net-zero emissions with customer-first strategy

### Shell accelerates drive for net-zero emissions with customer-first strategy

Feb 11, 2021

S&P Global  
Market Intelligence

20 May, 2021

### BP CEO sees IEA's net-zero-by-2050 report as aligned with company's strategy



July 14, 2021 10:09 AM EDT Last Updated 4 days ago

Sustainable Business

### EU proposes world's first carbon border tax for some imports

# METHANE MONITORING SATELLITES

Multiple Systems with Complementary Purposes



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

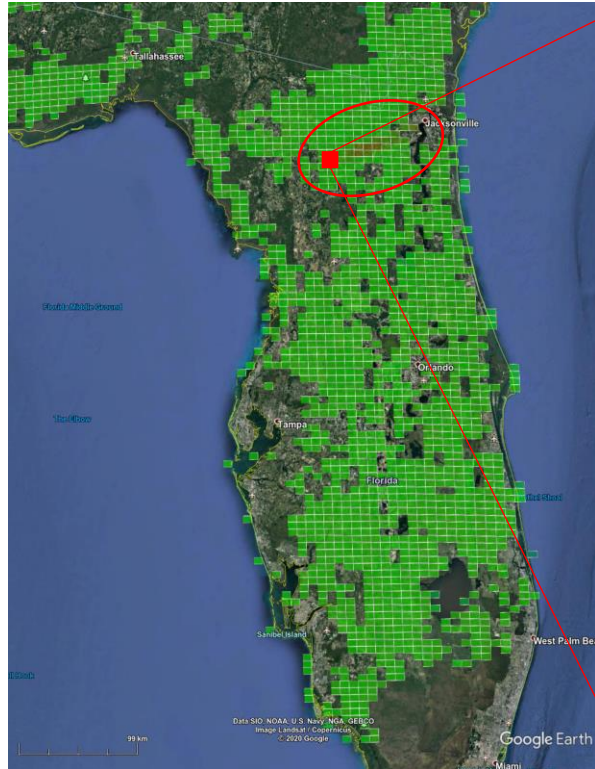
\*Not yet launched

# METHANE MONITORING SATELLITES

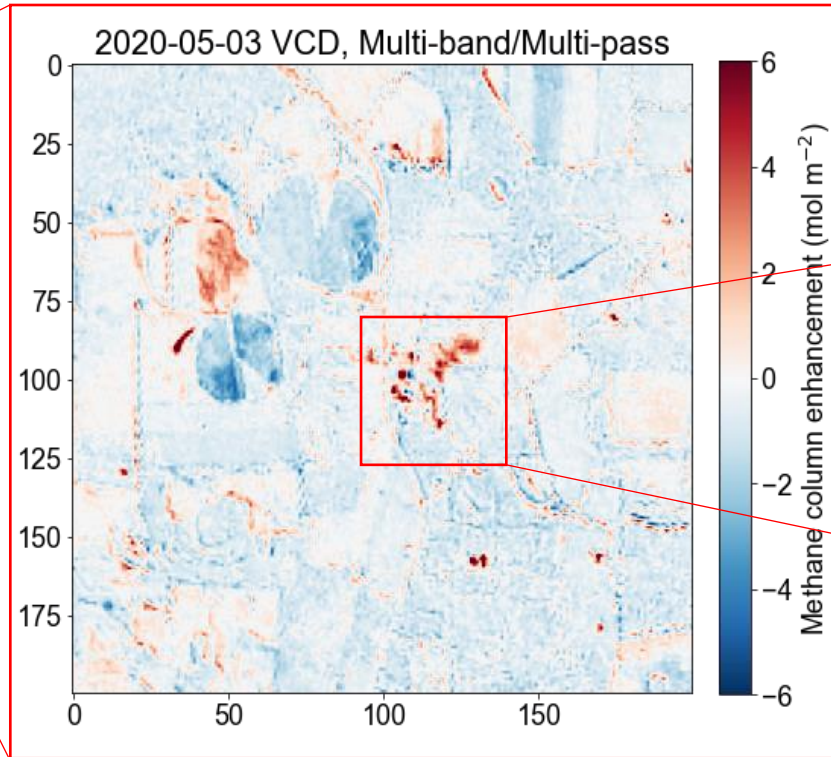
Example of global mapping satellites (Sentinel-5P and Sentinel-2) used to find a source



Sentinel-5P

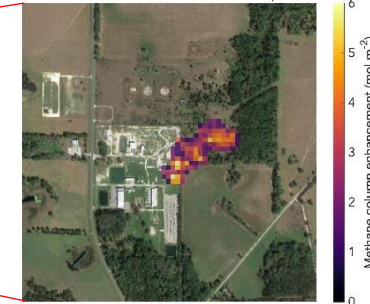


Sentinel-2



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

2020-05-03 VCD, Multiband/Multipass



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

**Sentinel-5P can find hotspots for Sentinel-2 to help find sources > 3,000 kgCH<sub>4</sub>/hr**

# METHANE MONITORING SATELLITES

Multiple Systems with Complementary Purposes

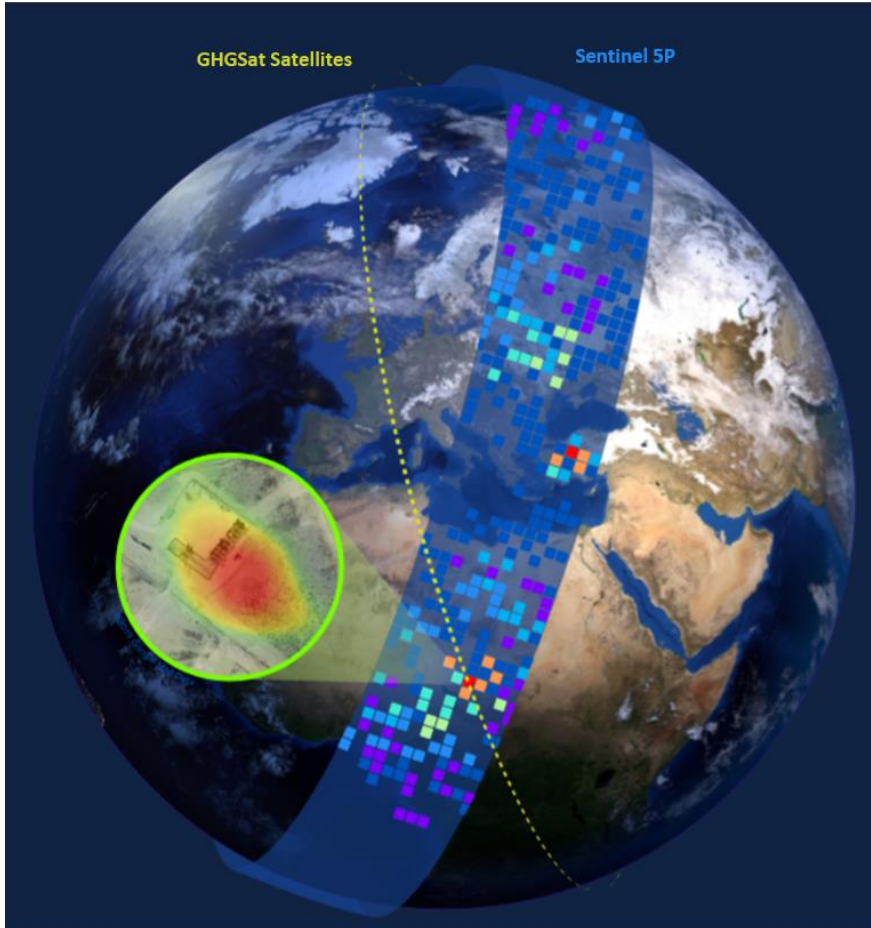


	Global Mappers	Regional Mappers	Facility Monitors
• Purpose	Inform climate models & advance science	Inform policy & advance science	Provide actionable info to customers
• Detection threshold	~10,000 kg/hr	~1,000 kg/hr	~100 kg/hr
• Spatial resolution	1000m-scale	100m-scale	10m-scale
• Coverage	Global	Basin	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 satellites
- Hundreds of plumes found around the world

## Geophysical Research Letters

Research Letter | [Open Access](#) | [CC](#) [f](#) [=](#) [S](#)

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

D. J. Varon [✉](#) J. McKeever, D. Jervis, J. D. Maasackers, S. Pandey, S. Houweling, I. Aben, T. Scarpelli, D. J. Jacob

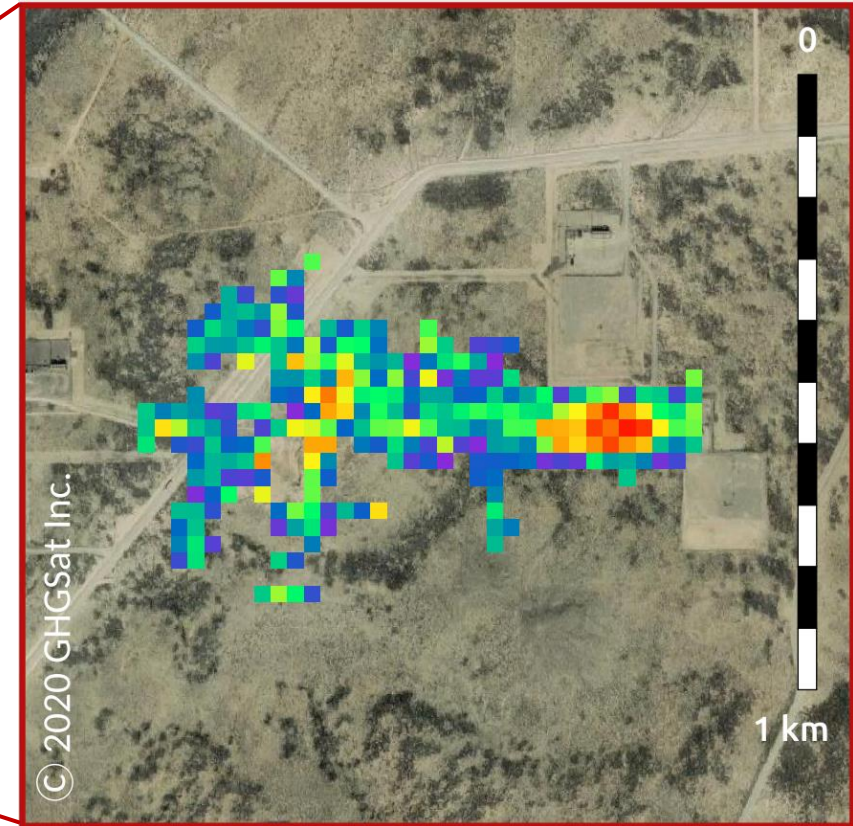
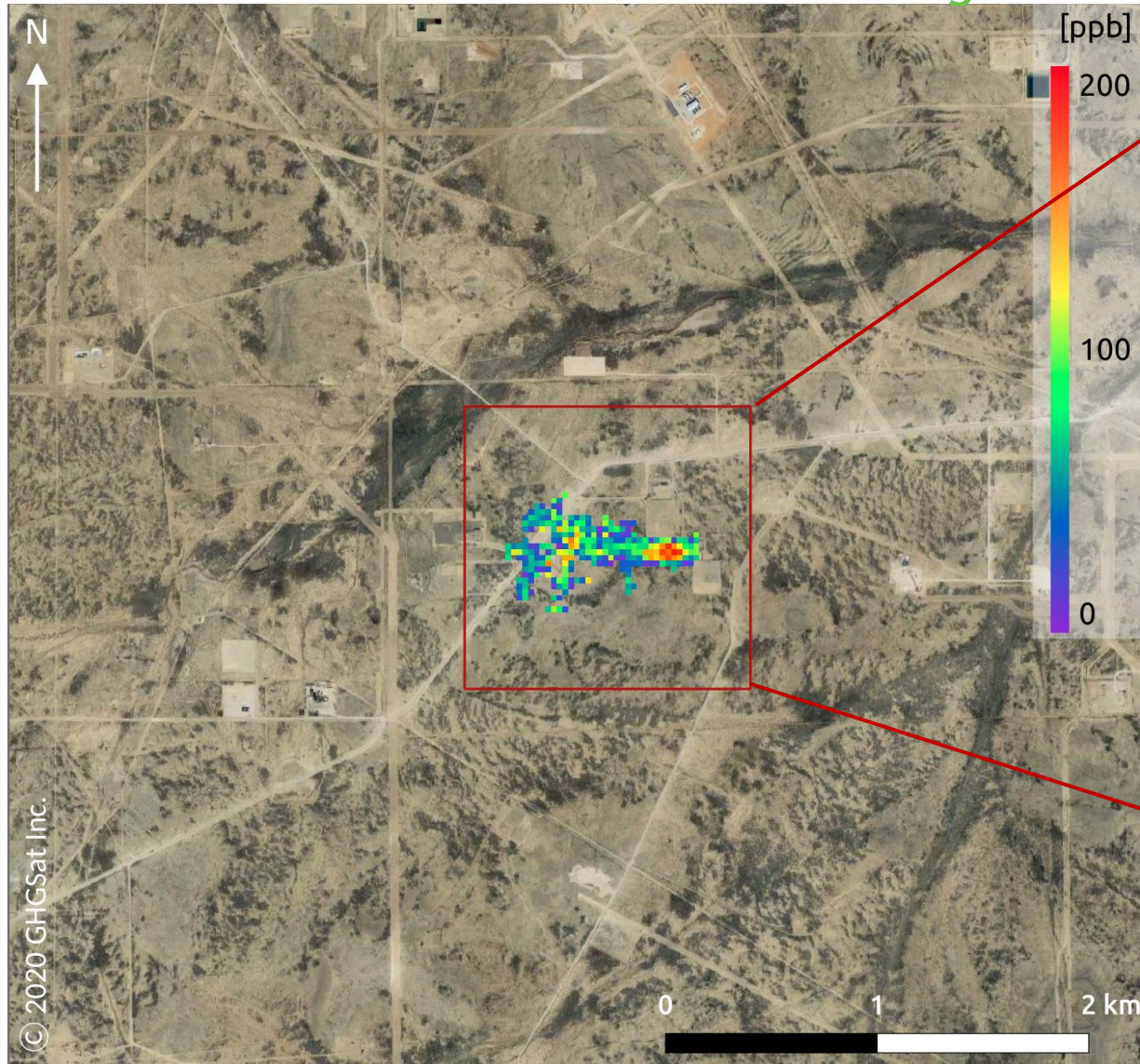
First published: 25 October 2019 | <https://doi.org/10.1029/2019GL083798> | Citations: 36

*Sentinel-5P can find hotspots for GHGSat to help find sources > 100 kgCH<sub>4</sub>/hr*



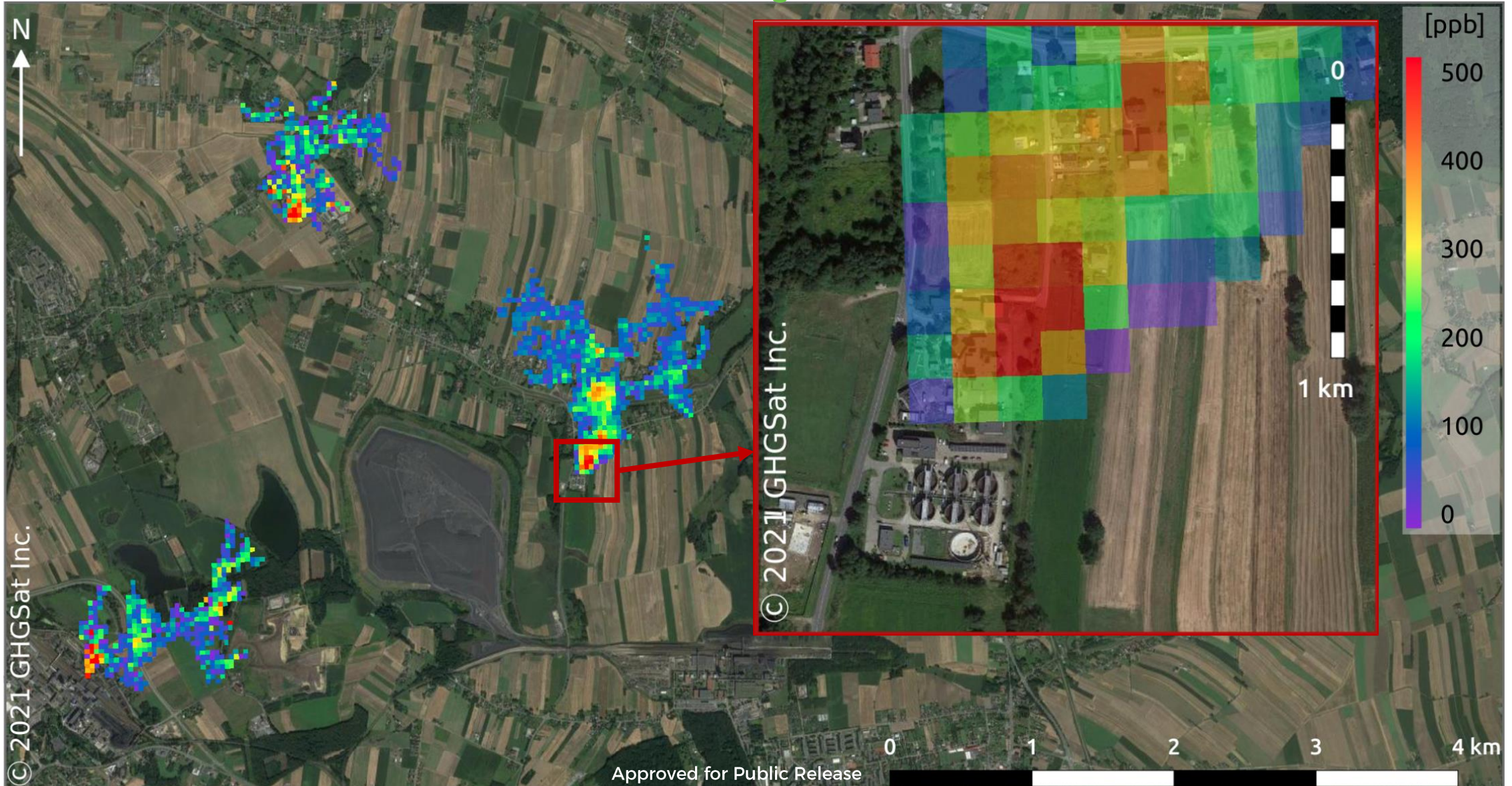
# ROUTINE FACILITY MONITORING IS HAPPENING NOW

Point source emissions monitored for oil & gas



# ROUTINE FACILITY MONITORING IS HAPPENING NOW

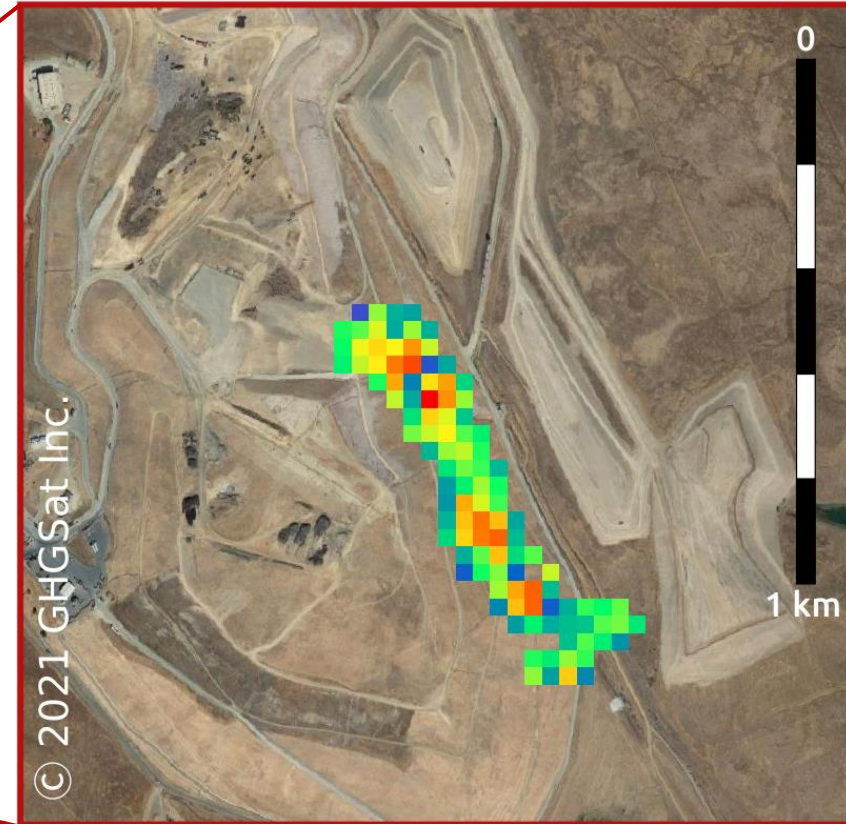
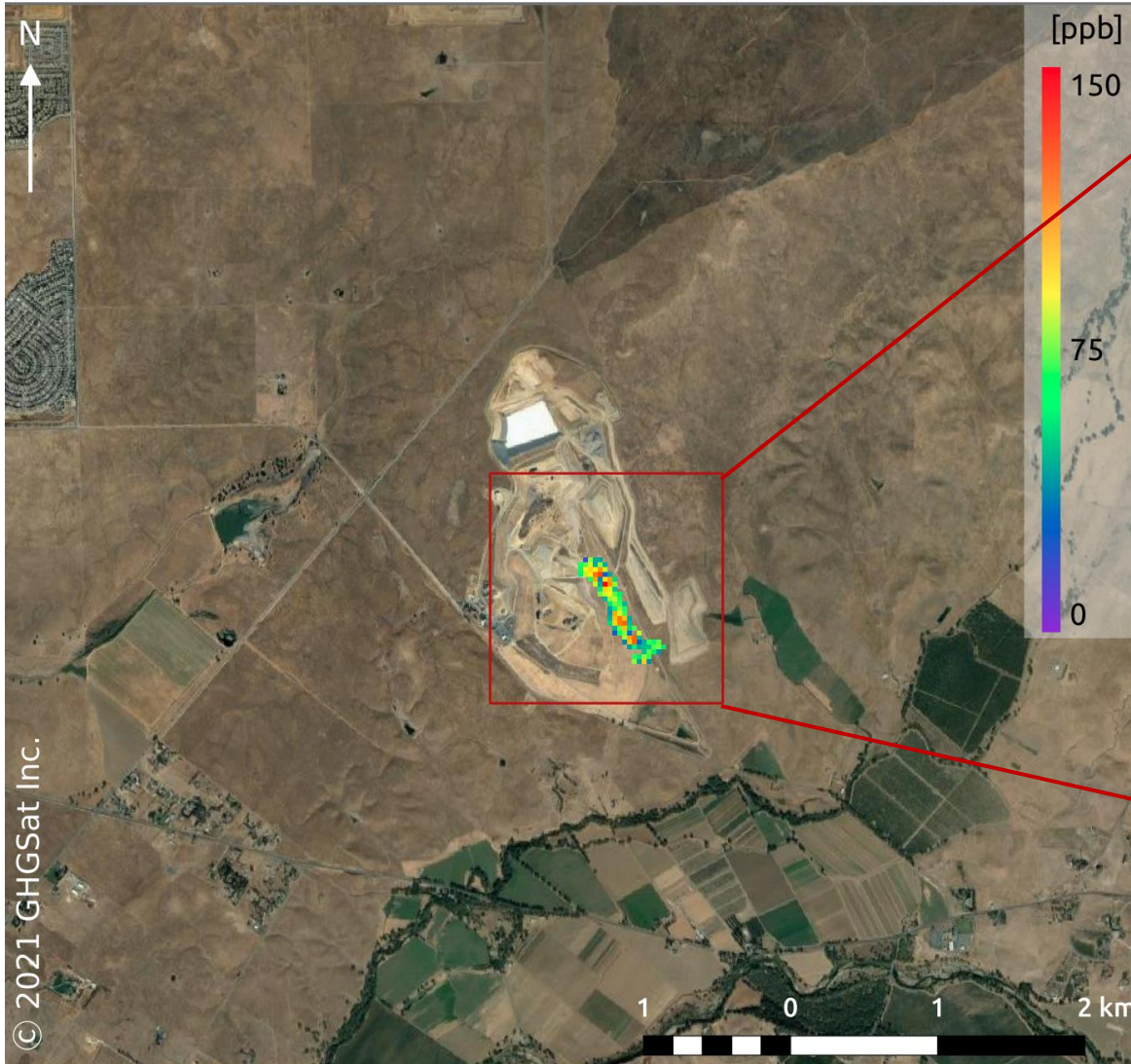
Point source emissions monitored for coal mining





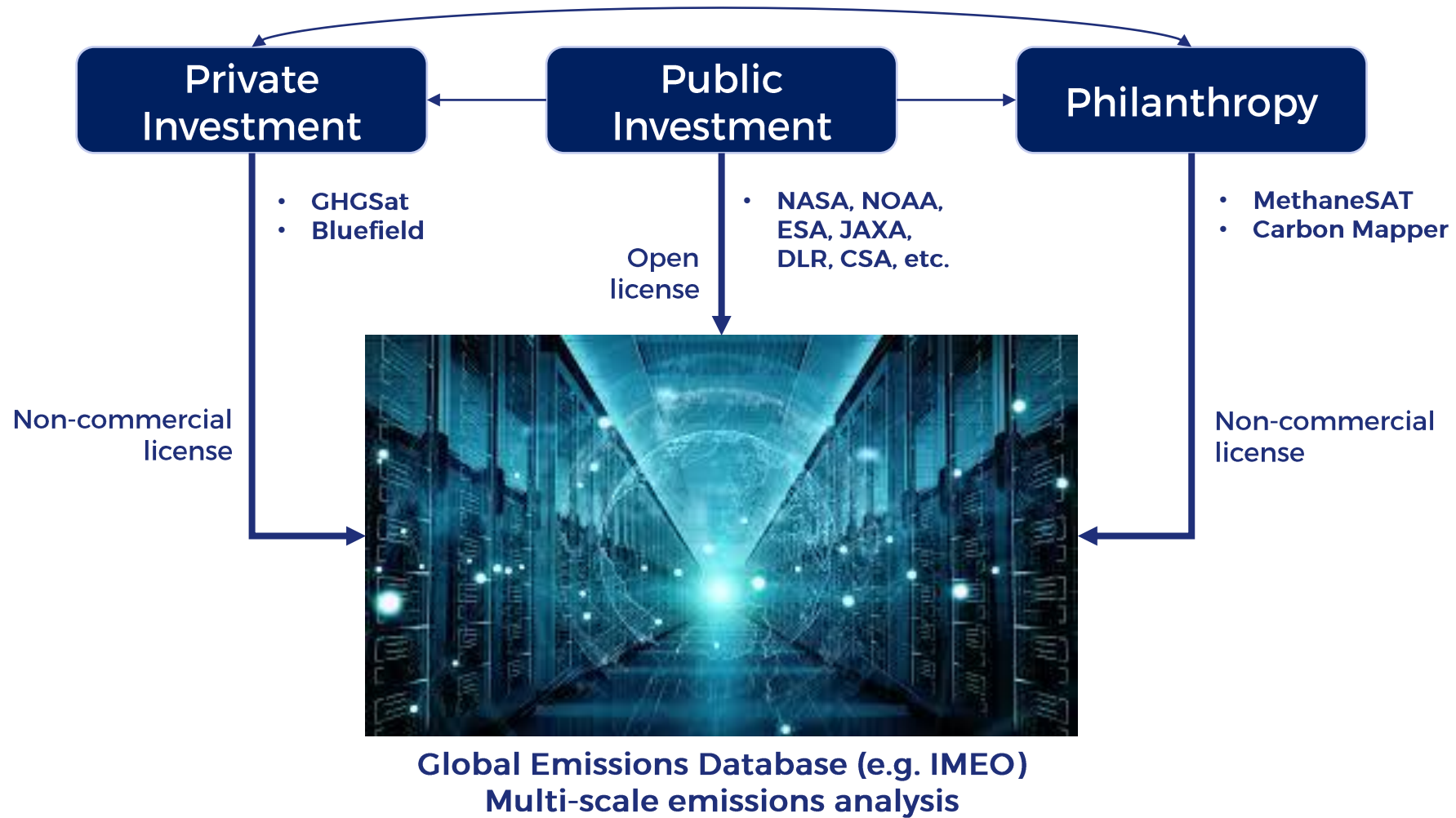
# ROUTINE FACILITY MONITORING IS HAPPENING NOW

Point source emissions monitored for landfills



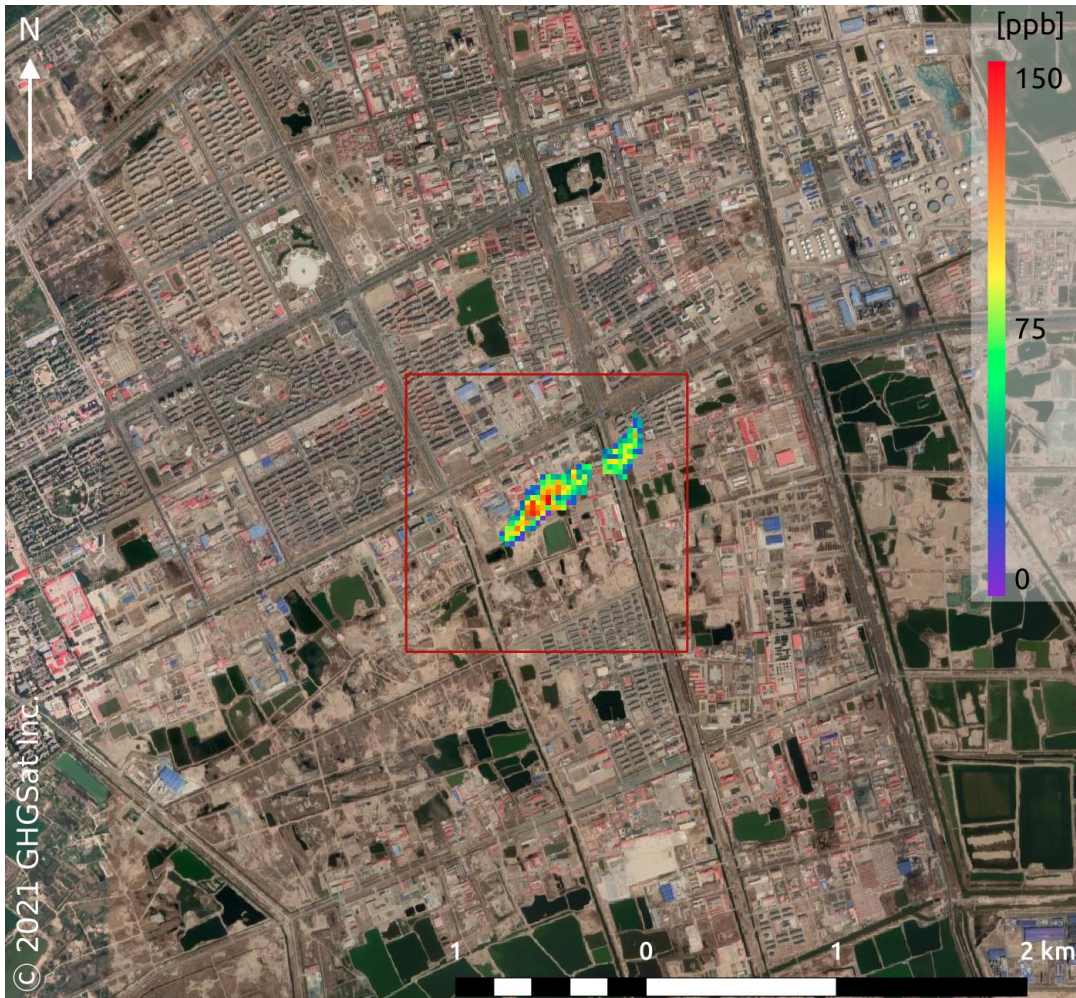
# HOW CAN WE SUSTAIN GLOBAL GHG MONITORING?

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



# PRIVATE INVESTMENT

There is a growing market for GHG emissions data and insights



Methane leak in a city of 14 million people

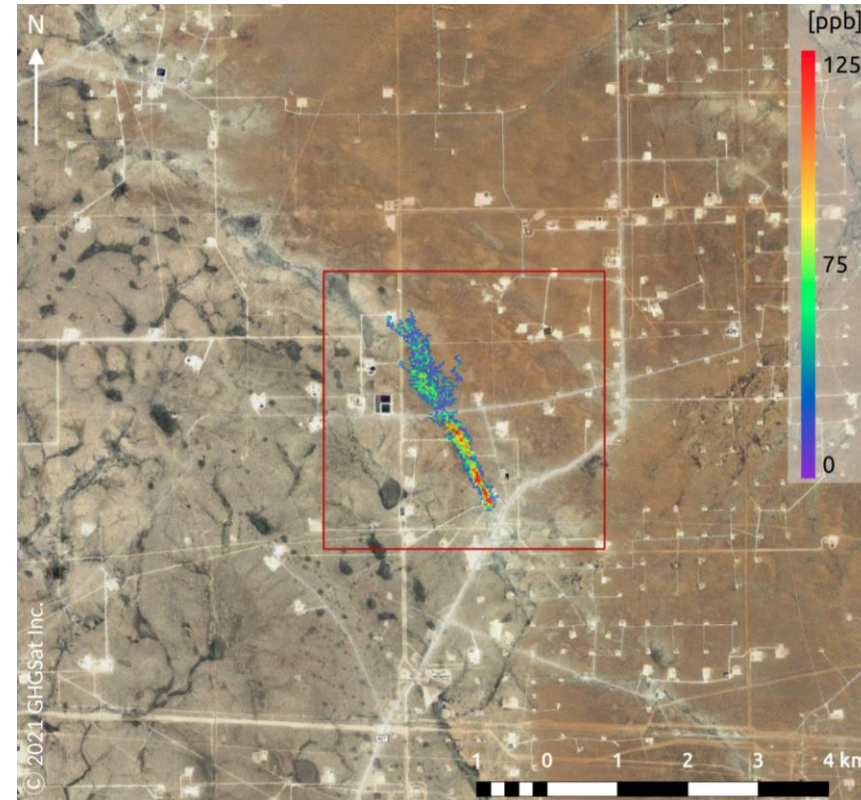
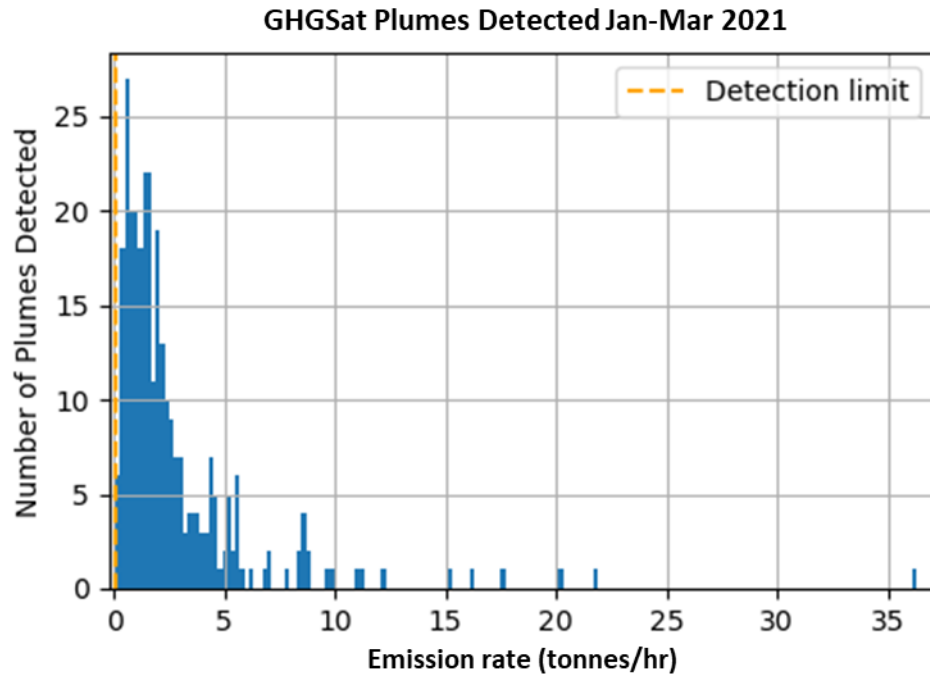
Measured by GHGSat-C2 on May 5<sup>th</sup>, 2021; background is © 2021 Google Map Data

- 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 1<sup>st</sup>, 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

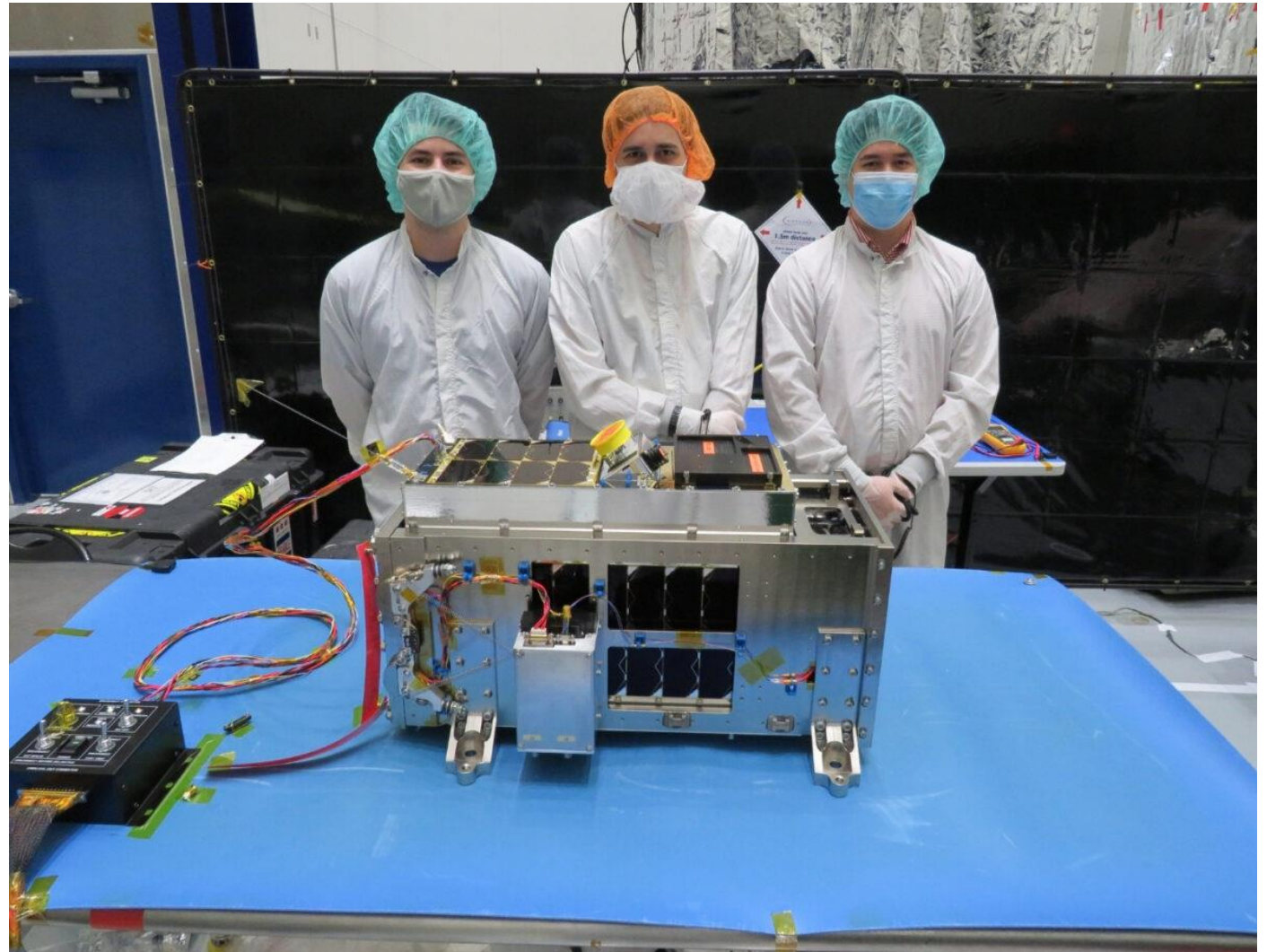
Small satellites enable monitoring services at attractive prices

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:

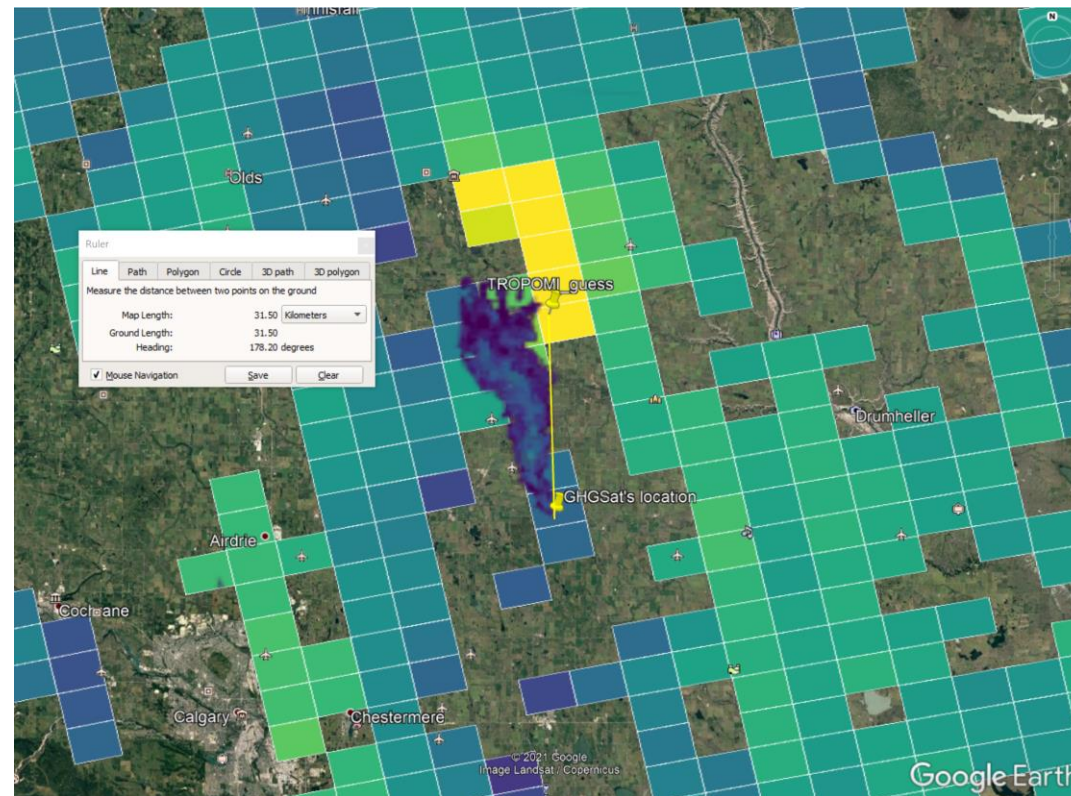
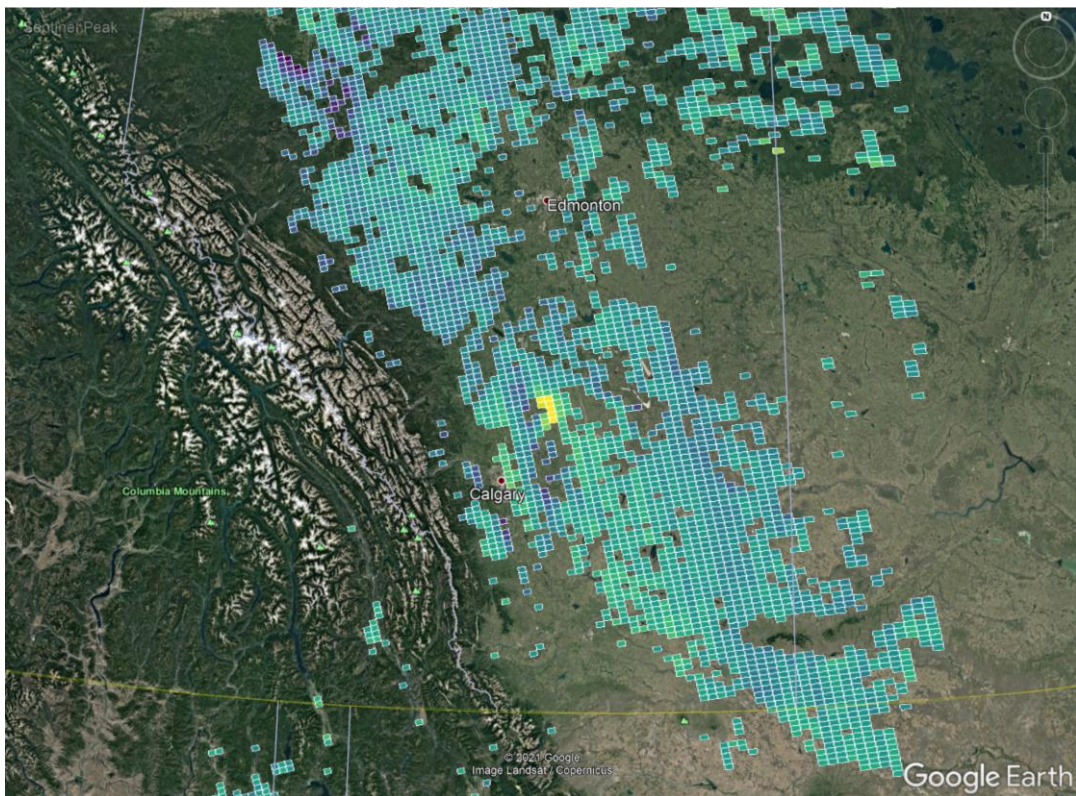
- GHGSat-C3/C4/C5: Summer 2022
- GHGSat-C6/C7/C8: Winter 2023
- GHGSat-C9/C10/C11: Summer 2023





# 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

- Find smallest possible emissions ✓
- Unambiguous identification of sources ✓
- Find emissions fast, anywhere in the world ✓
- Differentiate intermittent vs persistent sources ~
- Global models ~
- Generate reliable insights ✗
- Generate consistent insights ✗

## Status

- Today: 100 kgCH<sub>4</sub>/hr
- Today: 25 m resolution
- Today: tip & cue
- Need: daily revisits
- Need: aggregate multiple sources
- Need: quote uncertainty, minimize false positives
- Need: verify & validate across systems; focus less on the headlines, and more on quality



**GHGSAT**

Making a difference today  
**SENSING TOMORROW**