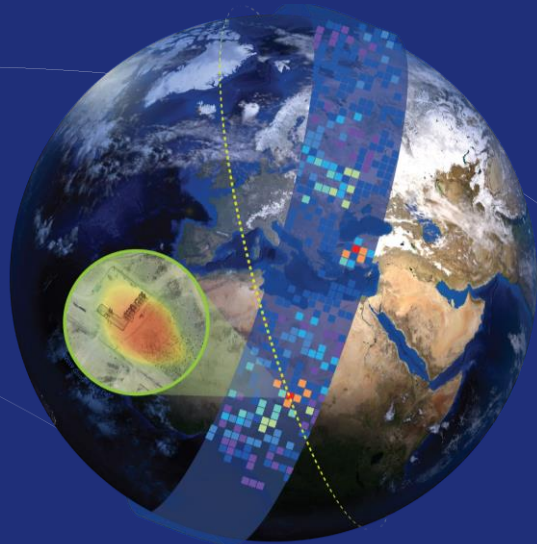


# CHALLENGES AND OPPORTUNITIES RELATED TO MONITORING METHANE EMISSIONS FROM SATELLITE AND AIRCRAFT



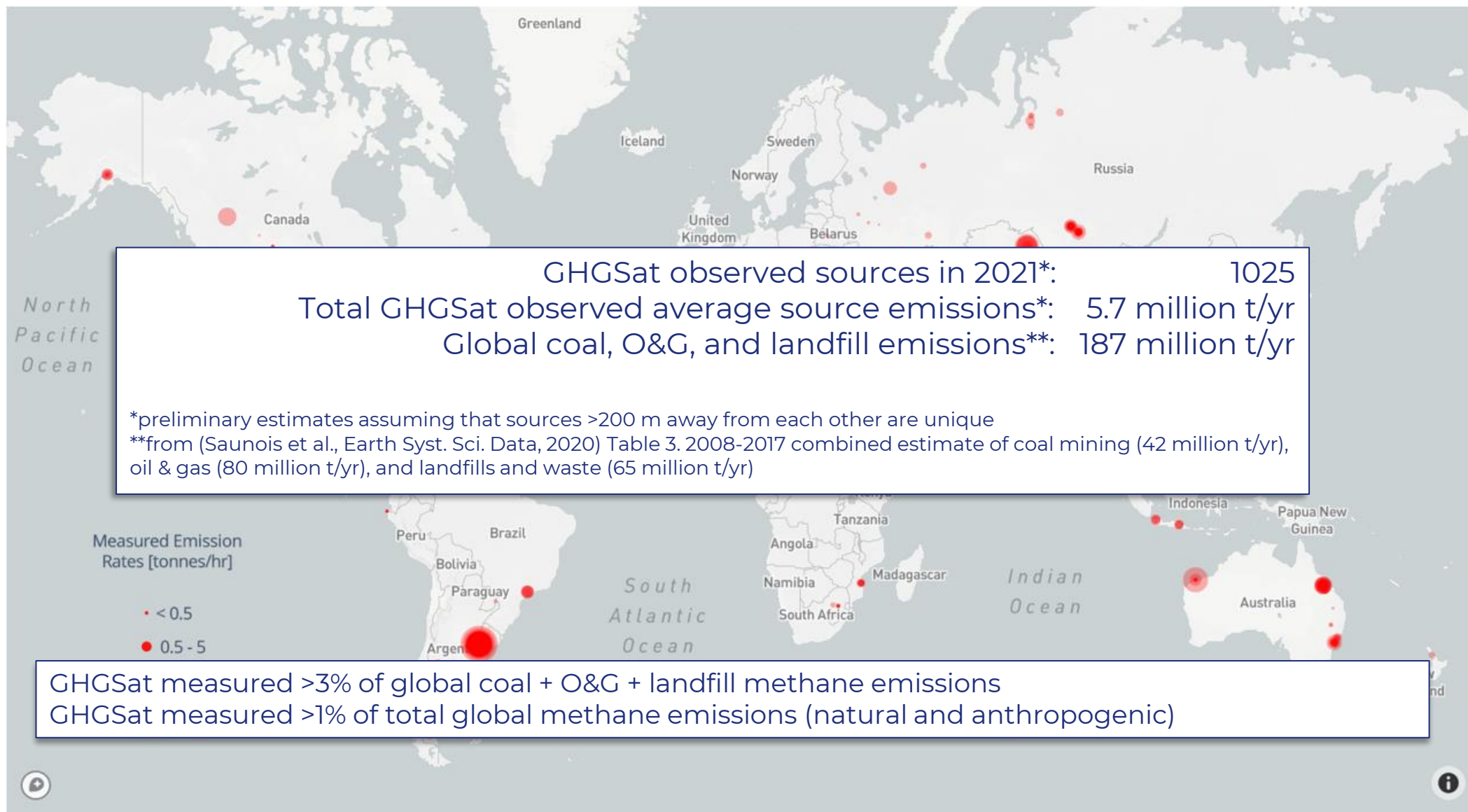
Ángel E. Esparza, PhD, P.E., CESCO  
Principal Technical & Policy Advisor | U.S. and LATAM

September 22, 2022





# WHERE HAS GHGSAT OBSERVED IN 2021?

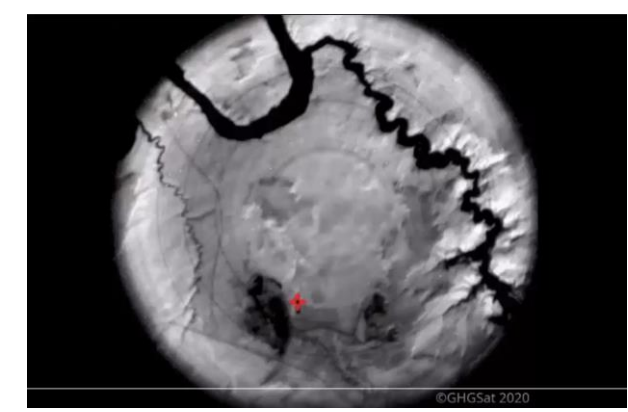
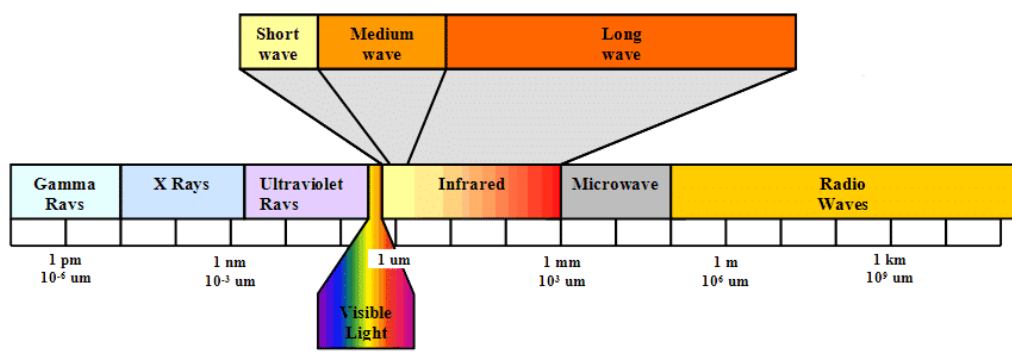
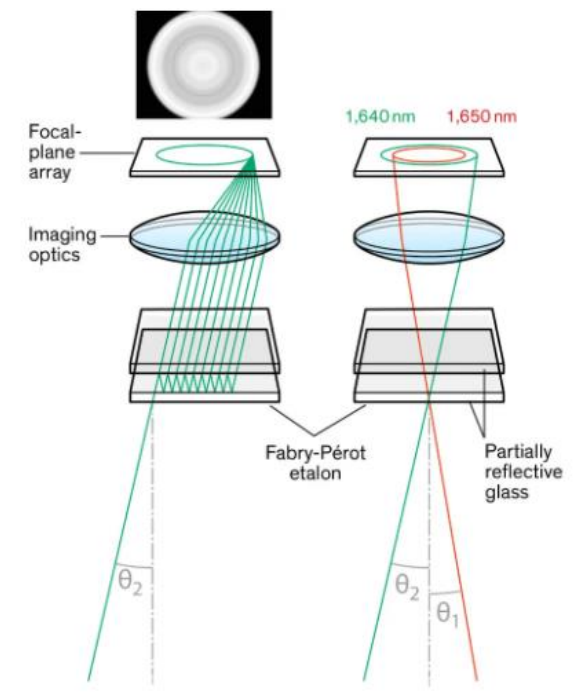
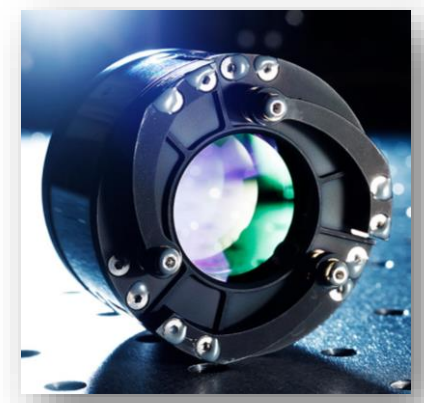




# INSTRUMENT

## Spectroscopy

- Wide-Angle, Fixed-cavity Fabry-Pérot (WAF-P)
- Shortwave infrared (SWIR)
  - 1600-1700 nm for methane

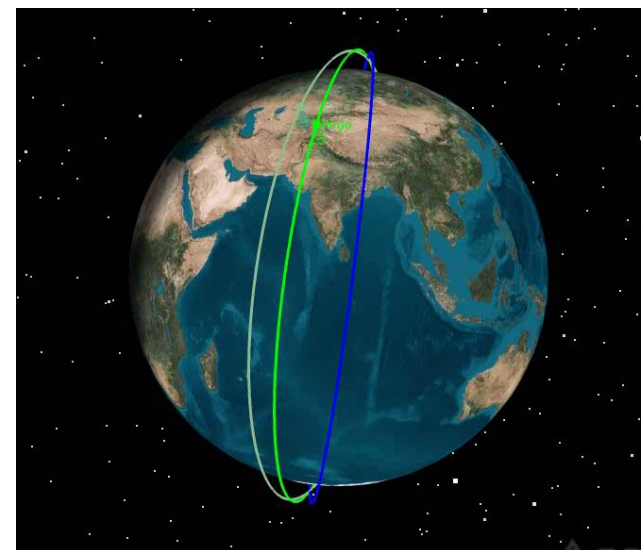
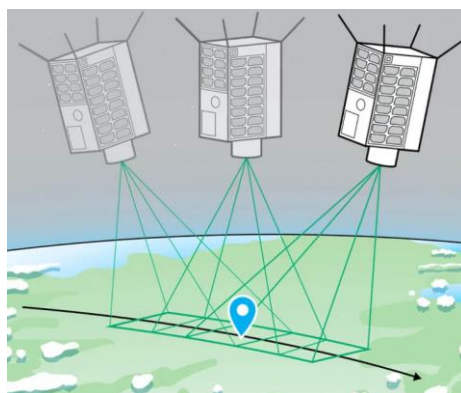
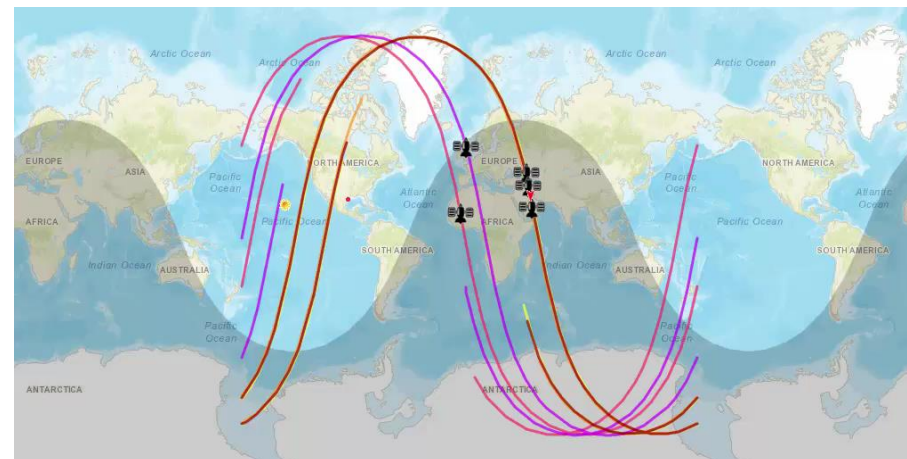
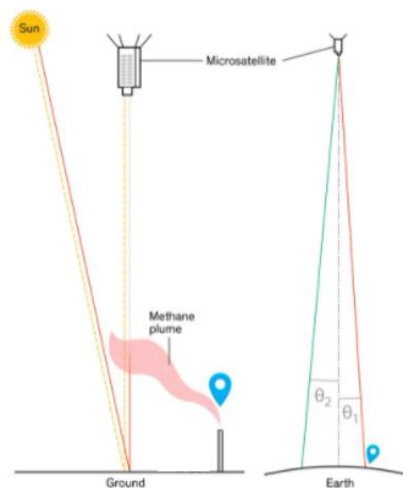




# HOW SATELLITES WORKS

## Onshore Monitoring

- 200 images
  - 200,000 pixels/image
- ~7.6 km/sec (~4.7 mi /sec)
- Orbit: Sun-synchronous Polar
  - Resolution: ~25 m
  - FOV: ~12 km x 12 km
  - Altitude: ~500 km
  - Orbits/day: 15



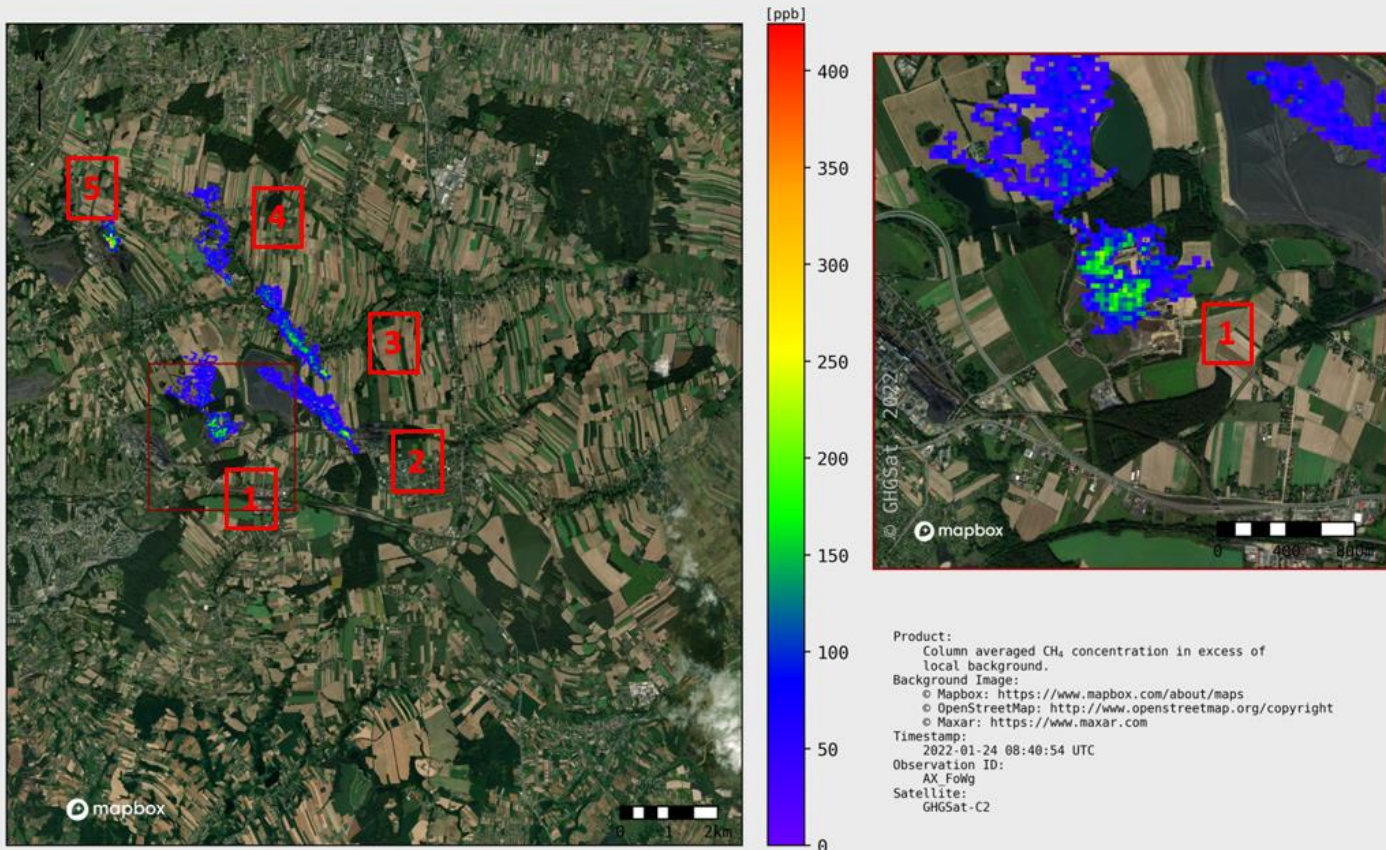




# EXAMPLES OF GHGSAT SATELLITE MEASUREMENTS

GHGSat-CX – Underground Coal Mine

Pniowek, Poland  
CH<sub>4</sub> Concentration Map



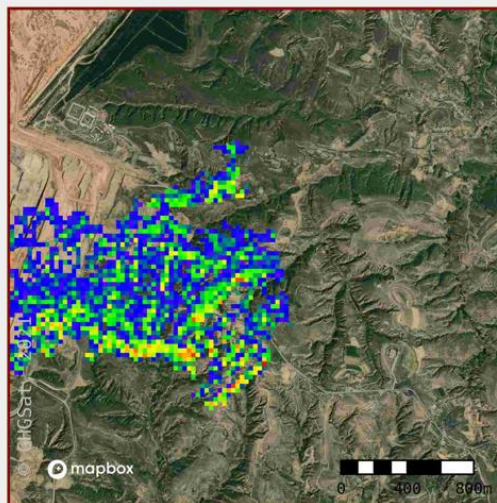
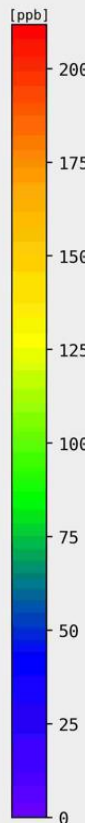
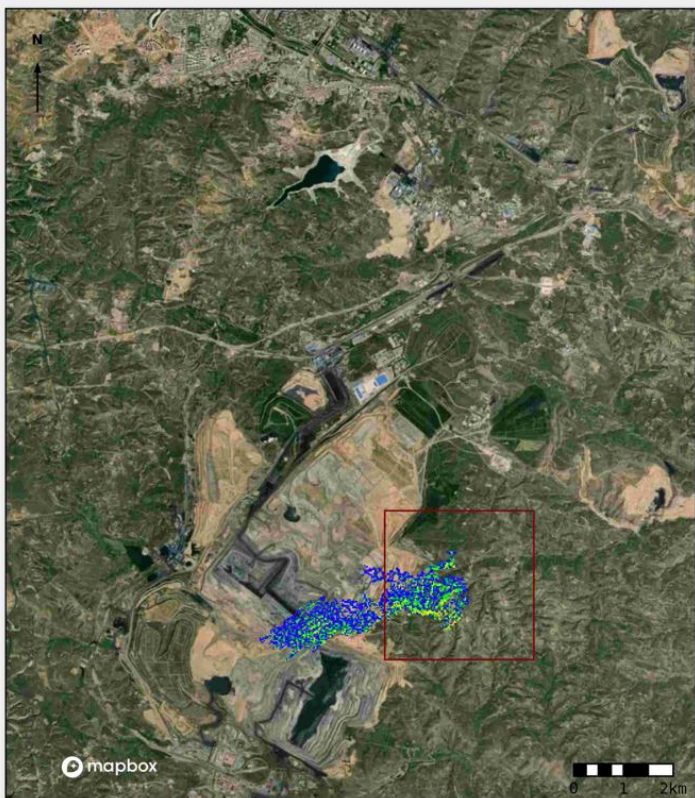
January 2022

- 1) 1,265 kg/hr
- 2) 1,815 kg/hr
- 3) 1,216 kg/hr
- 4) 898 kg/hr
- 5) 635 kg/hr



# EXAMPLES OF GHGSAT SATELLITE MEASUREMENTS

## GHGSat-CX – Open Pit Mine



Product:  
Column averaged CH<sub>4</sub> concentration in excess of local background.

Background Image:  
© Mapbox: <https://www.mapbox.com/about/maps>  
© OpenStreetMap: <http://www.openstreetmap.org/copyright>  
© Maxar: <https://www.maxar.com>

Timestamp:  
2021-12-20 02:27:05 UTC

Observation ID:  
-X35vK7

Satellite:  
GHGSat-C2

China  
December 2021

Point source 1: 2,162 kg/h ± 47%





# HOW AV WORKS


## Aircraft Monitoring

### FEATURES

 **Flight Altitude**  
Up to 3,000 m  
(10,000 ft above ground level (AGL))


 **Across-track Swath Width**  
~750 m swath width  
(at 10 000 ft AGL)

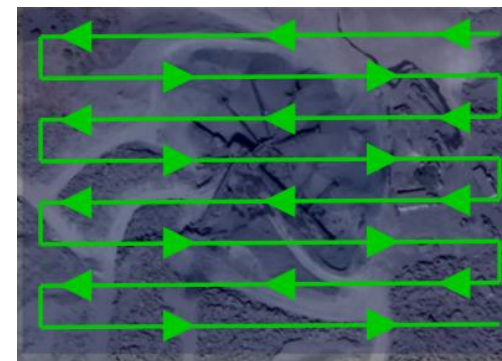
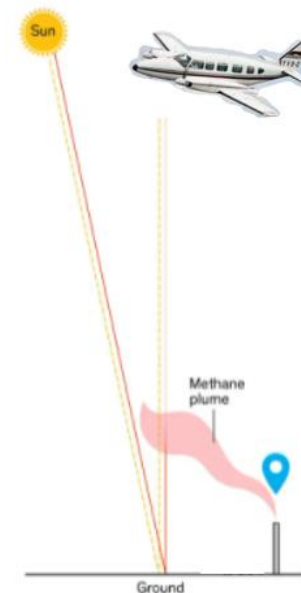
 **Ground Speed**  
120 knots

 **Spatial Resolution (GSD)**  
Under 1m (<3 ft)  
Altitude dependent

 **Area Surveys**  
385 km<sup>2</sup> / day  
(150 miles<sup>2</sup> / day)  
(at 10 000 ft AGL)

 **Linear Survey**  
Up to 500 miles / day  
(800 km / day)

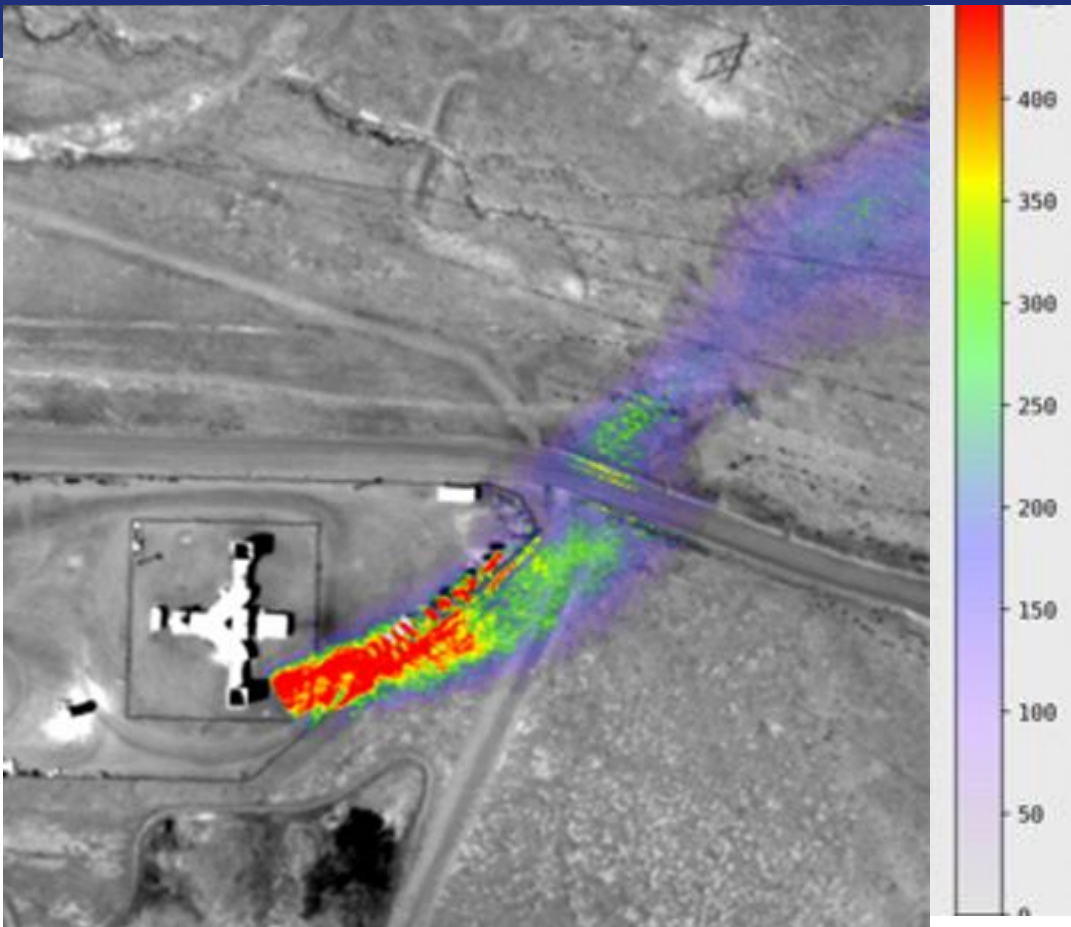
 **Detection Threshold**  
Between 10 and 35 kg/hr,  
depending on wind and  
acquisition parameters





# EXAMPLES OF GHGSAT AIRCRAFT MEASUREMENTS

GHGSat-AV – Underground Coal Mine



United States – San Juan Coal Mine Vent

2021

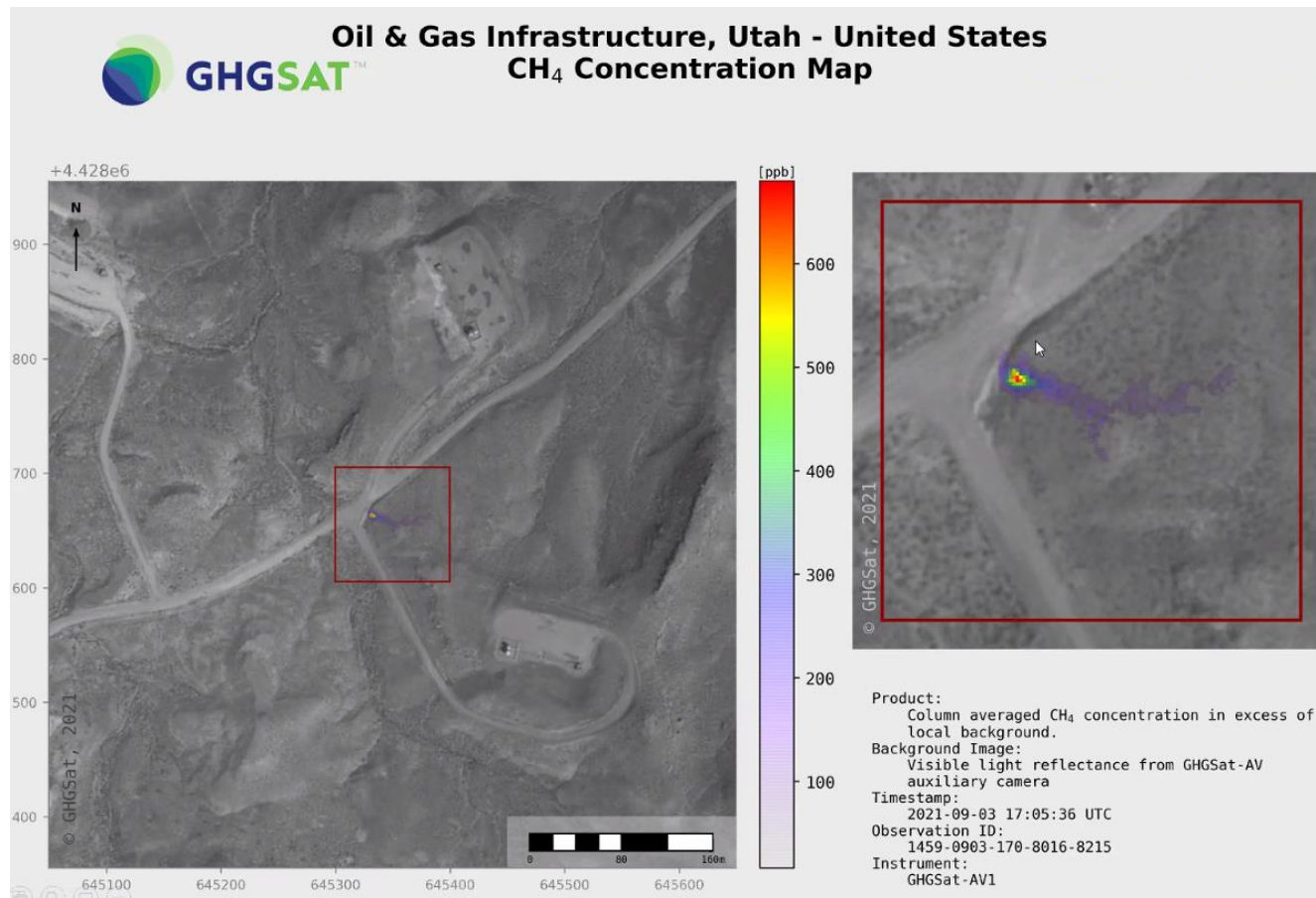
Point Source: 300 kg/hr





# EXAMPLES OF GHGSAT AIRCRAFT MEASUREMENTS

GHGSat-AV



Emission rate: 87 kg/hr



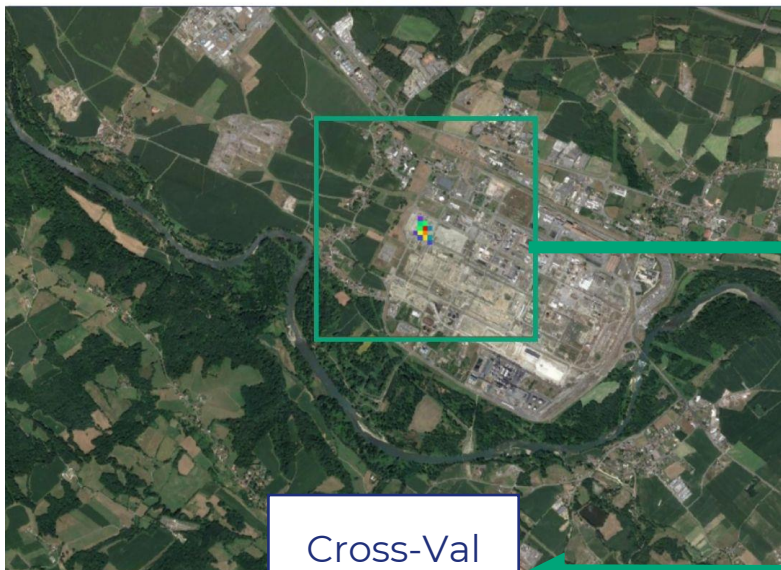
# A TIERED SYSTEM-OF SYSTEMS

Analytics + Satellites + Aircraft + Targeted Facility Surveys



## Analytics

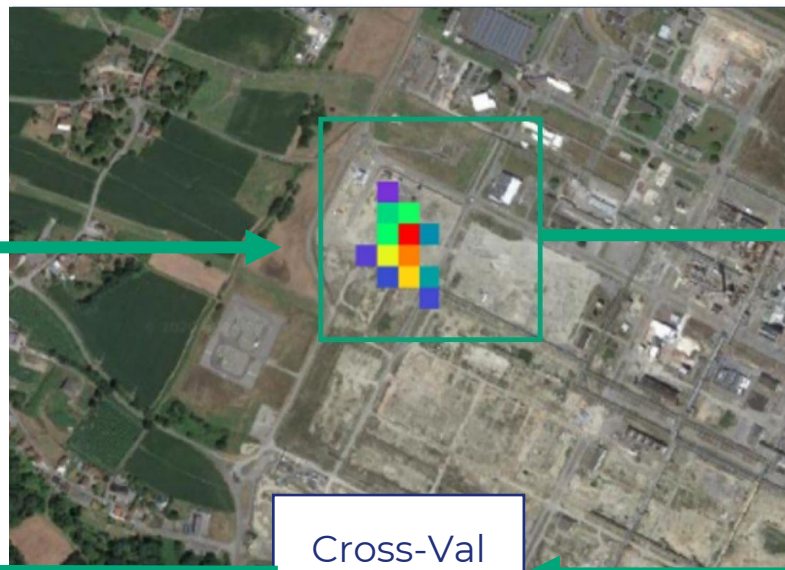
AI with data from GHGSat and third-party satellites to predict areas at higher risk of emissions



## GHGSat

TIP & CUE

<30 m pixels, monthly coverage with satellites



## Aircraft - UAV Sensors

TIP & CUE

<1 m pixels, bi-annual coverage with fleets of sensors in key areas

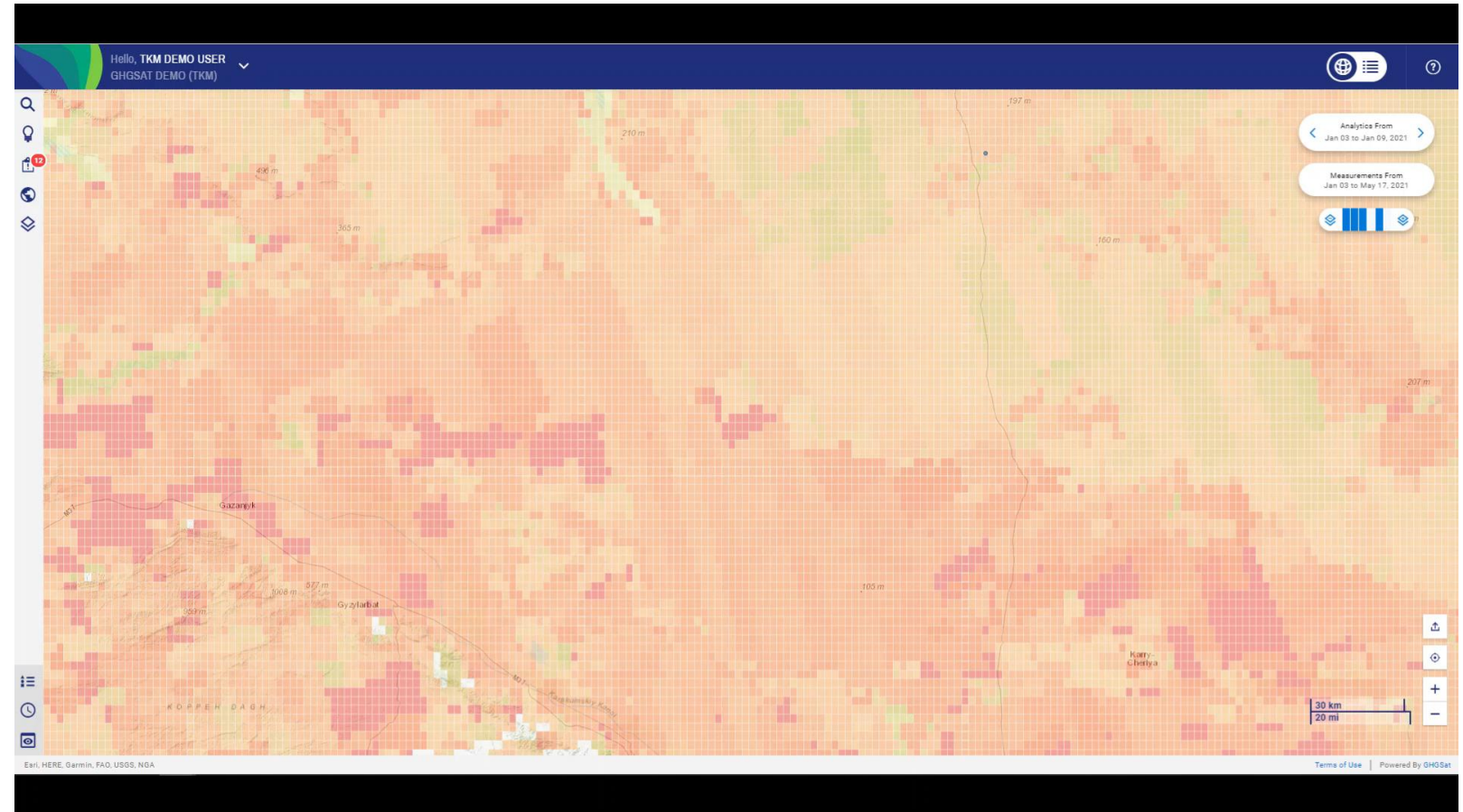
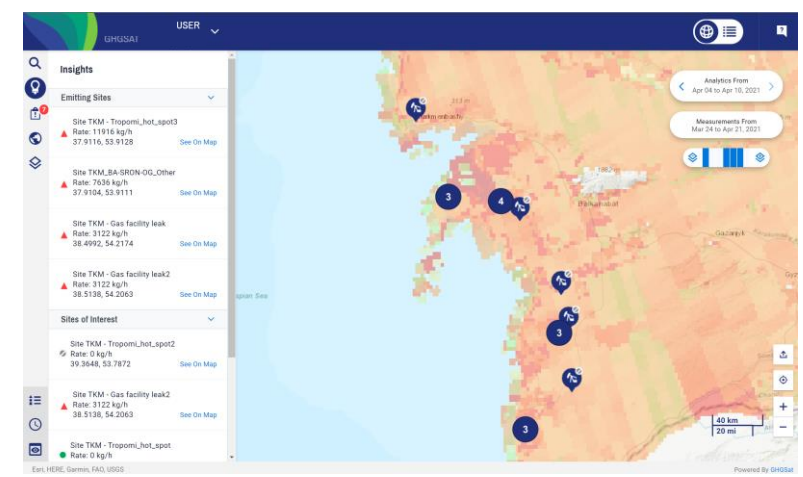




# SPECTRA

Analytics platform

- Analytics layers cover regions of interest
- Access to data from satellites and aircraft-based sensors
- Archive of historical satellite and aircraft observations
- Global Survey Service of massive emissions





# WHAT IS NEXT?

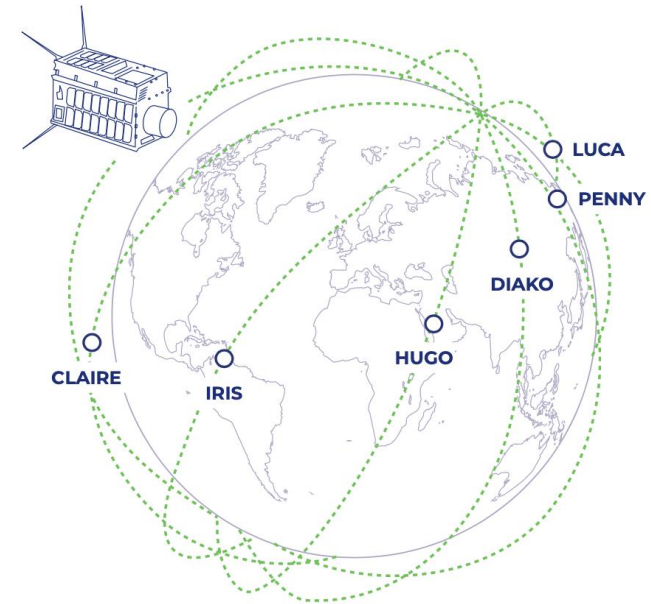
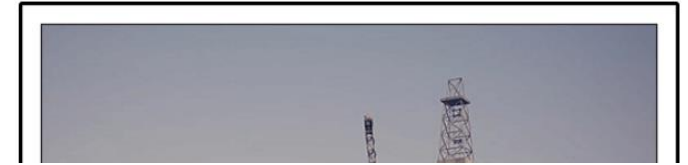
- Expand satellite constellation to 10+
  - GHGSat C6-C8 → Q1 2023
  - GHGSat C9-C11 → Q4 2023
- Enhance capability to include offshore targets
  - Commercial → 2023

## Chevron, Shell, Total Partner with GHGSat in Tackling Methane Leaks

BY MORGAN EVANS  
July 14, 2021

Share on: [Twitter](#) [Facebook](#) [LinkedIn](#)

Chevron Corp., Royal Dutch Shell plc, and TotalEnergies SE are taking to the skies with Canada's GHGSat as part of a year-long research project to detect offshore methane (CH<sub>4</sub>) leaks by satellite.





THANK YOU

Ángel E. Esparza  
Cell: (915) 208-8979  
aesparza@ghgsat.com

GHGSat Inc.  
Tel: 514-847-9474  
[info@ghgsat.com](mailto:info@ghgsat.com)  
[www.ghgsat.com](http://www.ghgsat.com)