

**StatEO26, ESA-ESRIN – Frascati**

**From Demonstrator to Service:  
Operational Integration of High-  
Resolution Methane EO into European  
Statistical Workflows**

**Frédéric ROMAND**

**ABSOLUT SENSING**





**Satellite constellation to accurately detect and quantify methane (CH<sub>4</sub>) emissions up to daily revisit**

2021

2022

2023

2024

2025

2026

2027

Company founding

Copernicus Contributing Mission

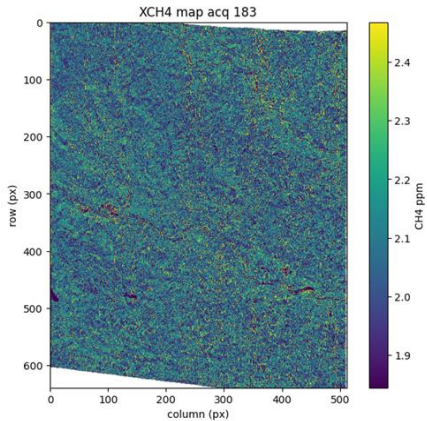
GEN1 demonstrator launch

First GEN2 batch launch



# CH4 Products

## Concentration Map



**Format:** Zarr (GEOtiff)  
**Scene size :** 10 km \* 10 km  
**Unit:** Geolocated column-averaged methane (XCH4) dry-air mixing ratio (ppmv)  
**GSD :**

- GEN1 : 50m
- GEN2 : 30m

## Emission Map



**Format:** GeoJSON & basemap  
**Unit:** kg/hour  
**Thresholds:**

- GEN1 : 150 kg/hour
- GEN2 : <50 kg/hour

# CH4 Services

SERVICES TYPE	SERVICE LEVEL AGREEMENT	PRODUCT Methane Concentration Map	PRODUCT Methane Emission Rate
Continuous Monitoring	Monthly - Point of Interest	L2A	L2A + L4A
Full Archive	Available at Scan Acquisition date + 30 days	L2A	L2A + L4A
Non Urgent Tasking		L2A	L2A + L4A



## Overall quality of column-averaged methane fraction estimation

From 129 successful acquisitions (2025)

XCH<sub>4</sub> median uncertainty of 111 ppbv (6 %)

Detection threshold: **127 kg/h** (for 2m/s wind speed, Jacob et al., 2016\*)

$$Q_{\min} = \frac{M_{\text{CH}_4}}{M_a} \frac{U W p q \sigma}{g}$$

M<sub>CH<sub>4</sub></sub>: methane molar mass

M<sub>a</sub>: air molar mass

U: wind speed

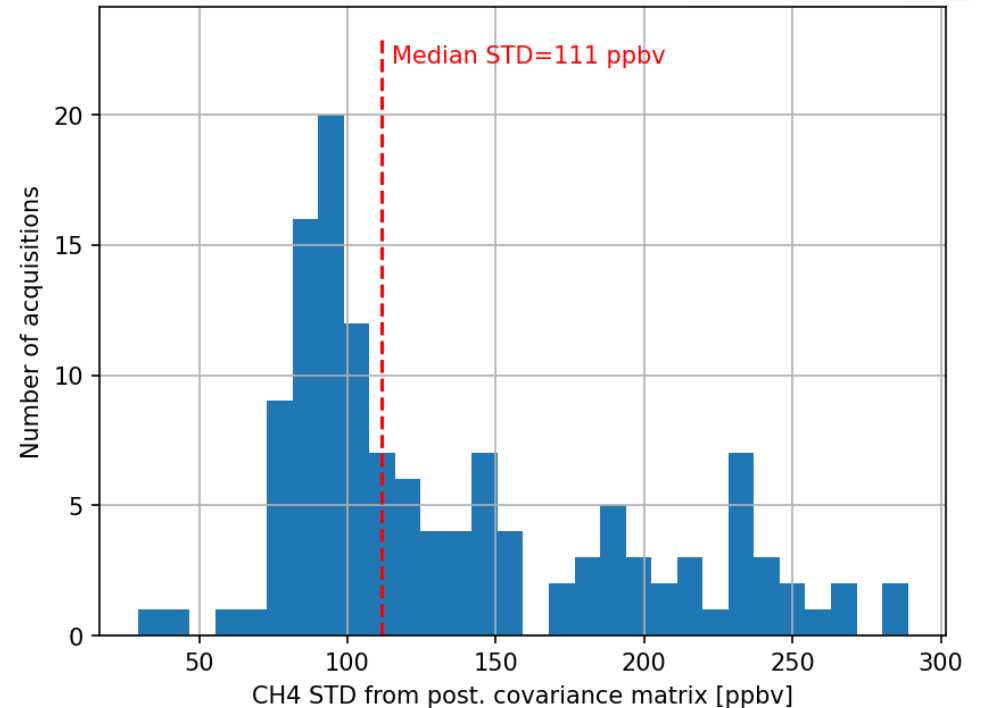
W: ground sampling distance

p: surface pressure

g: gravity constant

σ: XCH<sub>4</sub> precision

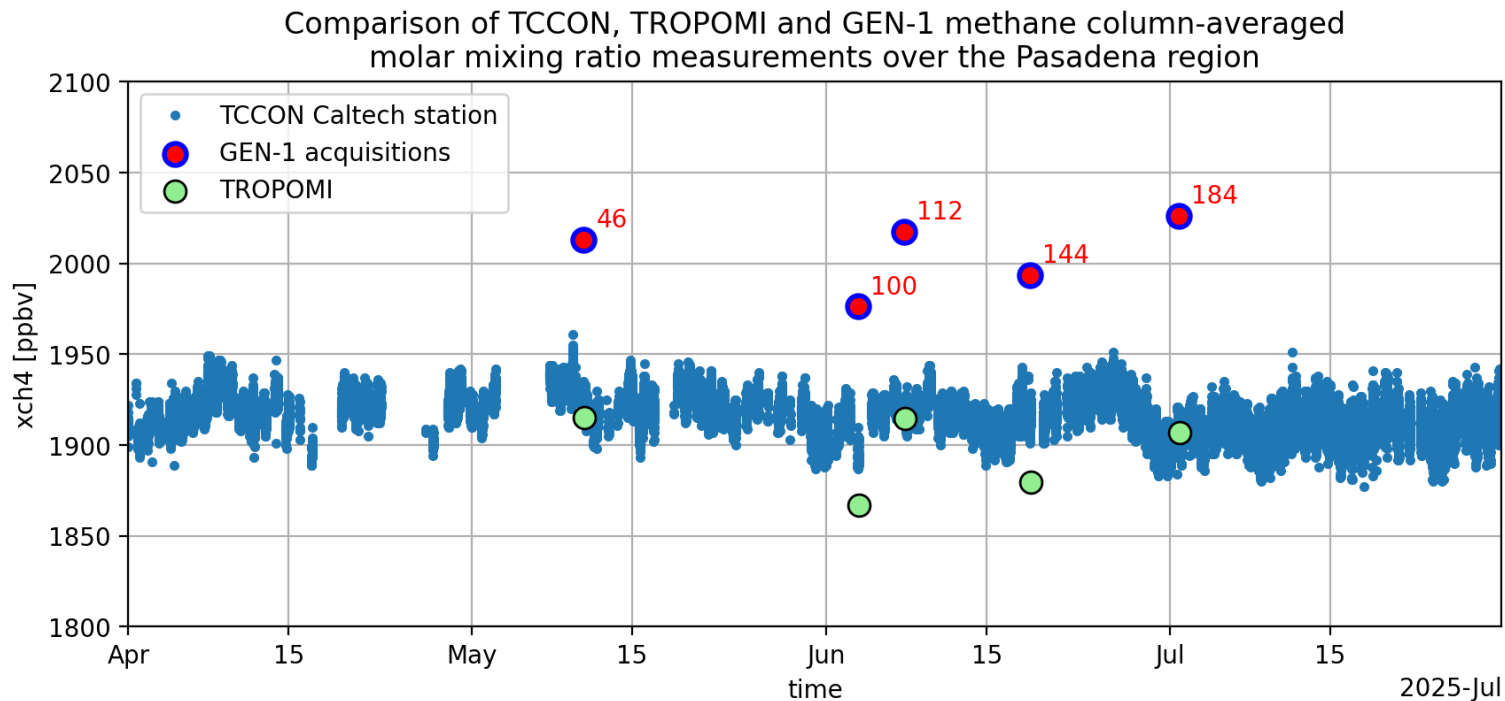
XCH<sub>4</sub> median standard deviation distribution



<https://doi.org/10.5194/acp-16-14371-2016>

## Validation over the Pasadena area

Five acquisitions over the Pasadena/Caltech area (May-June 2025)  
Compared with Sentinel-5P TROPOMI overpasses and TCCON ground measurements



TCCON  
(1917 ± 11) ppbv

TROPOMI  
(1897 ± 22) ppbv

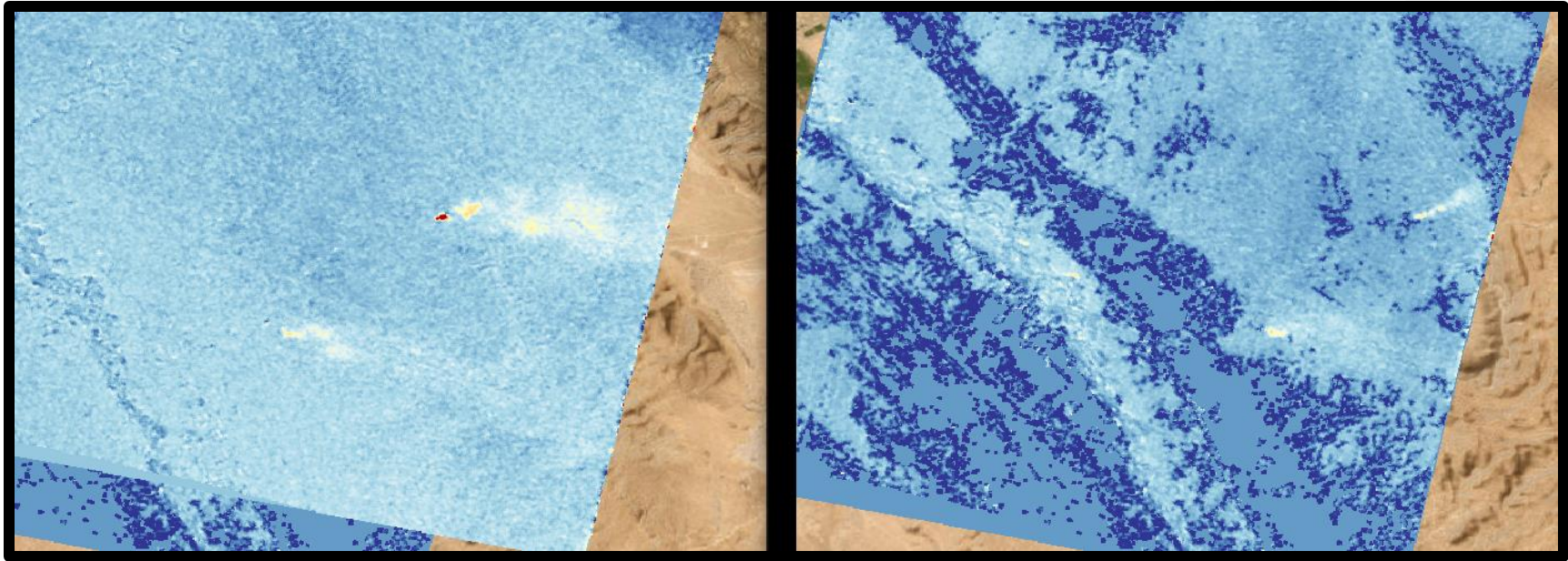
GESAT GEN1  
(2005 ± 20) ppbv

Systematic bias  
GEN1 vs TCCON  
4.6%

Positive offset does not hinder plume detection and quantification, as the method relies on relative methane enhancements

12 pairs of acquisitions over identical sites to assess consistency  
<1% relative difference in median methane column across sites

Example over methane-emitting facilities



Despite partial cloud cover (right image), the same two emitters are detected

## Method: in-house improved Integrated Mass Enhancement

### Calibration release

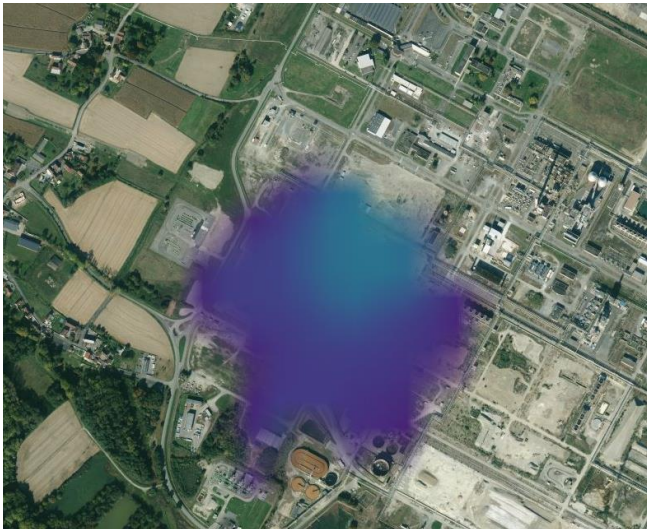
Summer 2025

True flux: 1000 kg/h

Wind Speed: 1.2 m/s

Estimated flux: 999.7 kg/h

Detectability (Jacob): 132 kg/h



### Calibration release

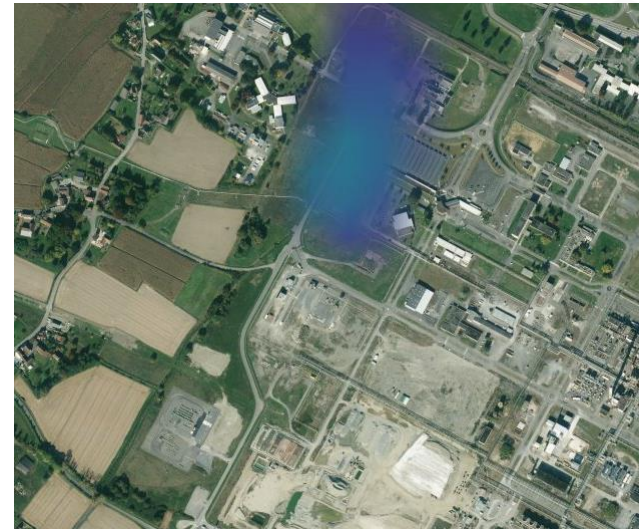
Early 2026

True flux: 500 kg/h

Wind Speed: 3.7 m/s

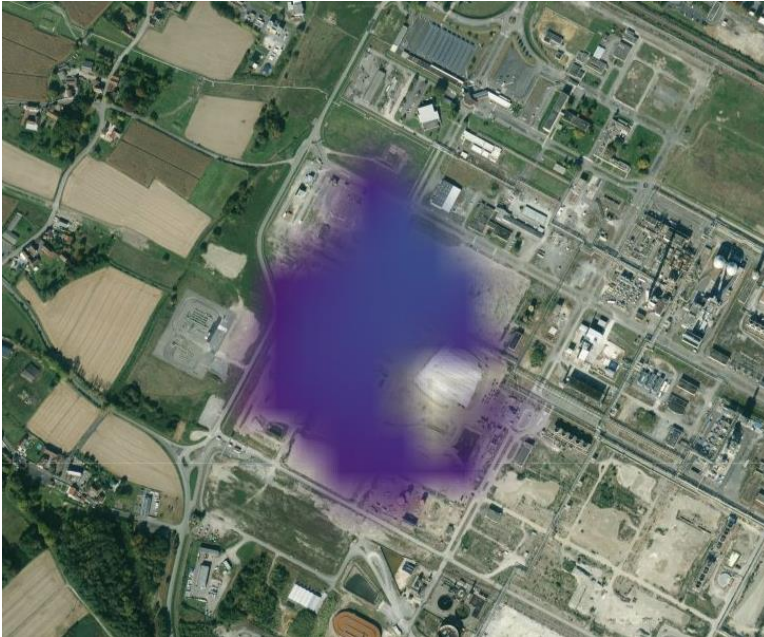
Estimated flux: 503.3 kg/h

Detectability (Jacob): 446 kg/h





## | Plume quantification - blind test



### Blind test release

Early 2026

True flux: 244 kg/h

Wind Speed: 0.68 m/s

Estimated flux: 250.6 kg/h

Detectability (Jacob): 93 kg/h



Paper submitted to *Atmospheric Measurement Techniques*, in collaboration with the Laboratoire de Météorologie Dynamique

## GESat GEN1: In-Orbit Performance Review of a Compact SWIR Fizeau Interferometer for Facility-scale Methane Detection and Quantification

Florian Pignol<sup>1</sup>, Sébastien Dorgan<sup>1</sup>, Pablo Jais<sup>1</sup>, Frédéric Romand<sup>1</sup>, Grégoire Hein<sup>1</sup>, Cyril Crevoisier<sup>2</sup>, Nicolas Meilhac<sup>2</sup>, Vincent Cassé<sup>2</sup>, Raymond Armante<sup>2</sup>

<sup>1</sup>Absolut Sensing, Toulouse, France

<sup>2</sup>Laboratoire de Météorologie Dynamique, Paris, France

**Mission overview and instrument concept**

platform, orbit, Fizeau interferometer, push-frame acquisition

**Forward model and retrieval framework**

radiative transfer, instrument modeling, optimal estimation

**In-orbit results and performance**

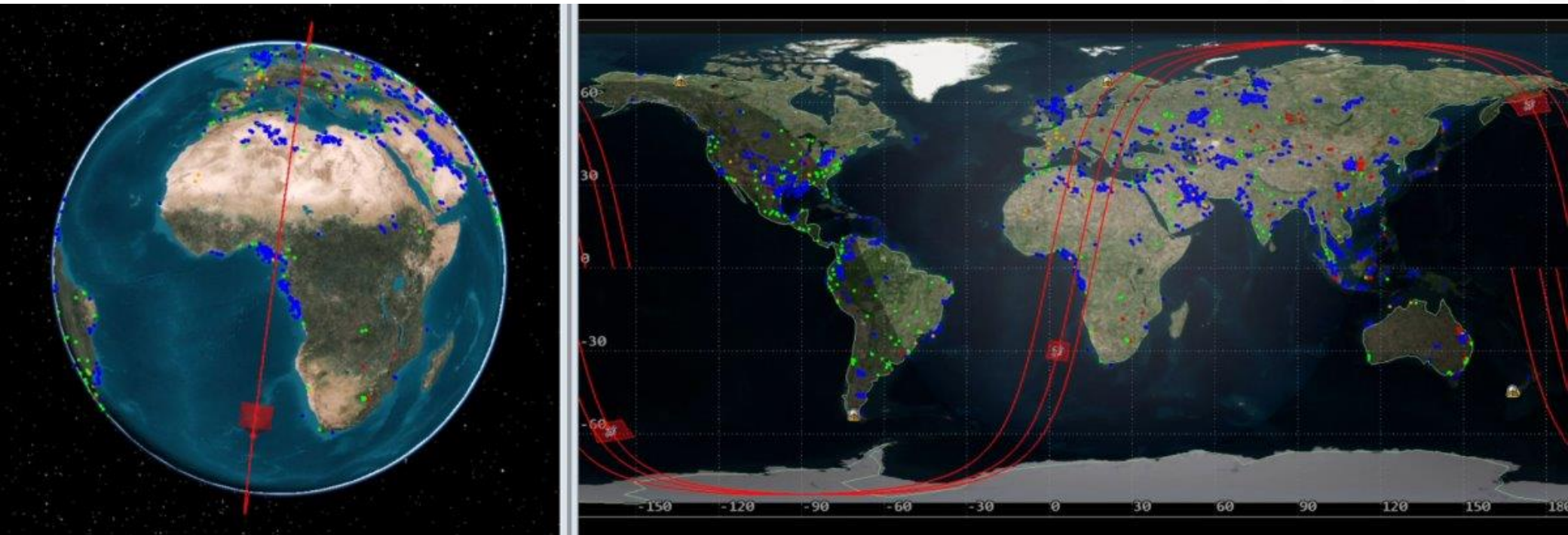
calibration, retrieval quality, comparison with COCCON, TCCON and TROPOMI

## | Commercial sites currently monitored

262 sites monitored worldwide

1 month revisit time, depending on location

Over 100 plumes detected in ~ 1 year



 Oil & Gas

 Coal

 Landfill

 Other



A solution made for inventories and analysis

**GESat**

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POI monthly monitoring



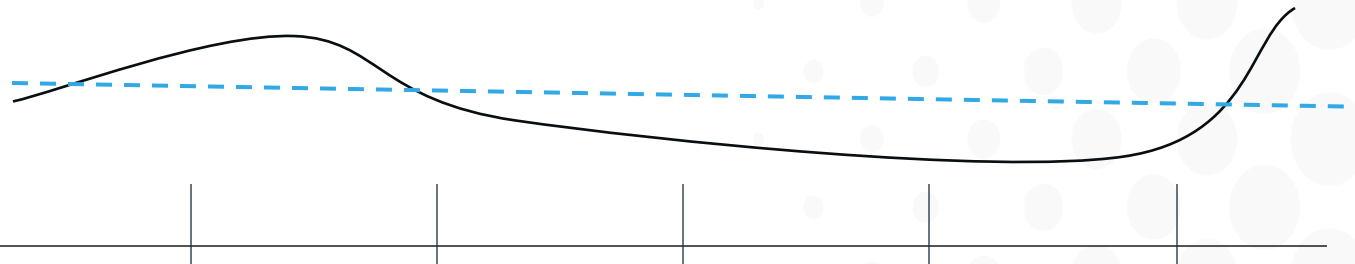
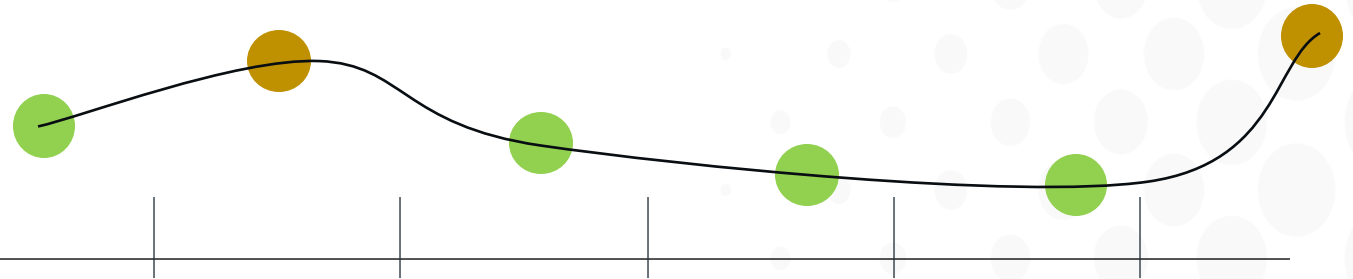
Trend analysis

POI mean period value

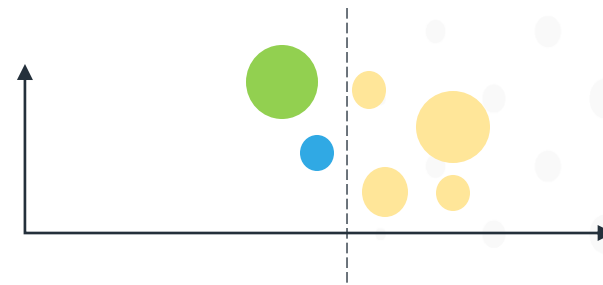


Outlier analysis

POI mean trend factor



POI latitude  
Emission sector



Emission rate

Thank you for your attention

For further information  
[contact@absolut-sensing.com](mailto:contact@absolut-sensing.com)

