From extreme Weather to Emissions: Unveiling the connection with IMEO's Methane Alert and Response System (MARS)

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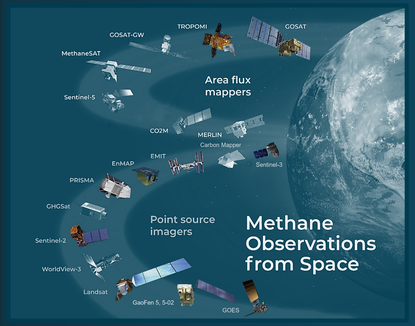
Abstract

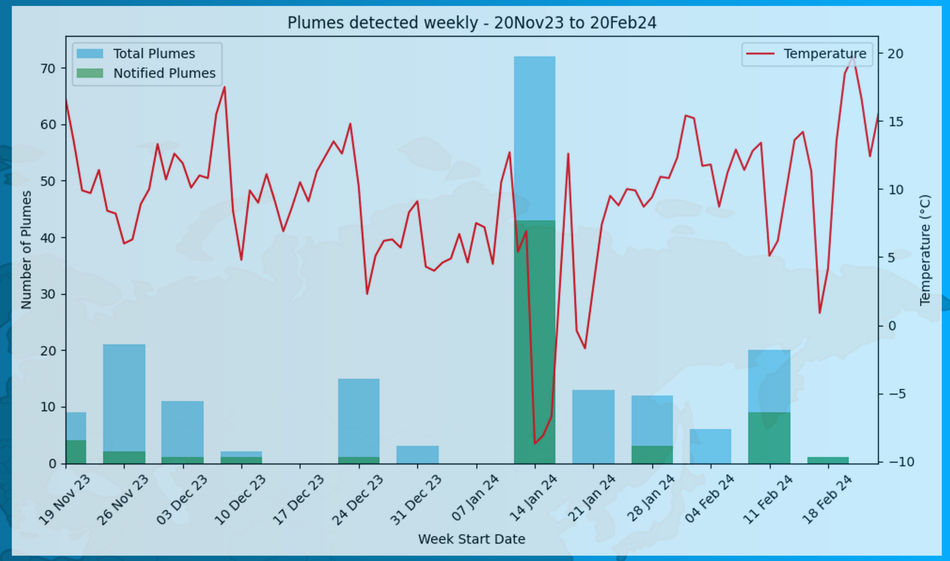
The Methane Alert and Response System (MARS), designed by UNEP's International Methane Emissions Observatory (IMEO), is the first global system connecting satellite methane detection to transparent notification processes that promotes on-the-ground emissions mitigation efforts. MARS uses several methane-sensitive satellites to build a monitoring and alerting system for large methane emissions on a global scale, which are then reported to governments and companies and tracks mitigation efforts. In January 2024, Texas experienced a cold snap, which triggered an unusual number of MARS methane emission alerts in the Permian Basin area. These emissions were observed by different satellites and space sensors integrated in the MARS system, such as the multispectral satellites Sentinel-2, Landsat, or Sentinel-3, the hyperspectral PRISMA, EnMAP and EMIT, or the geostationary satellite GOES. The identified emissions were notified to the relevant stakeholders and monitored over time.

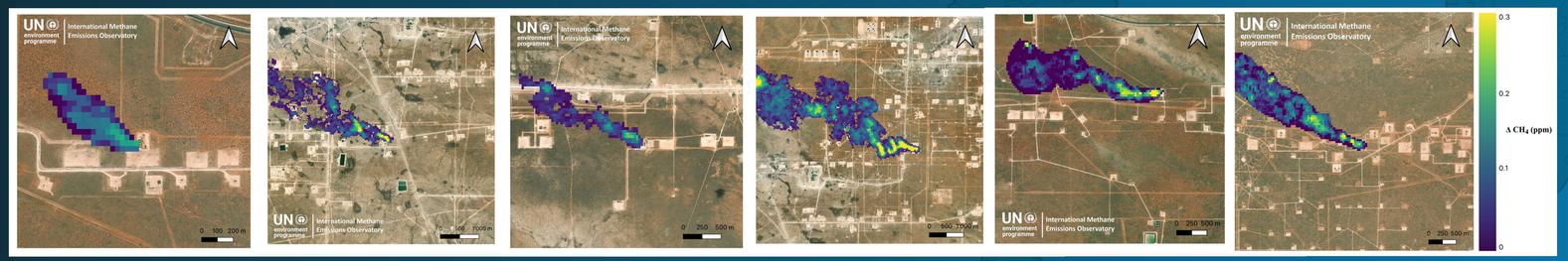
MARS uses the *full suite* of publicly available methane sensing satellites

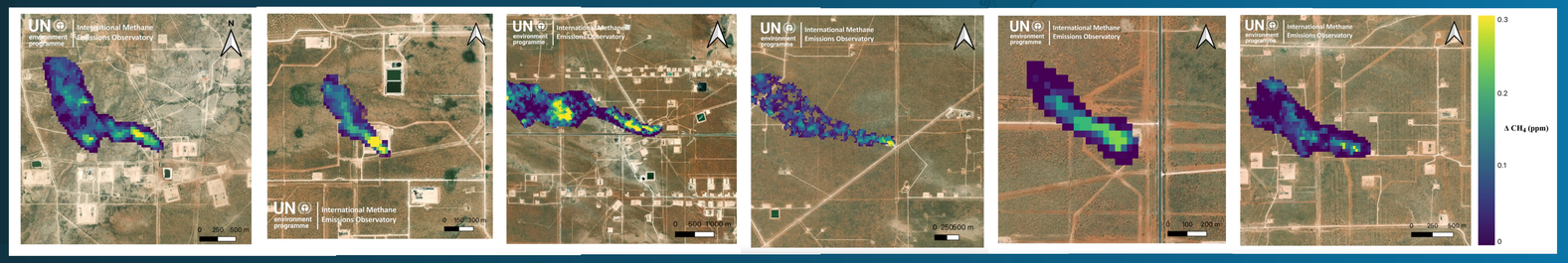


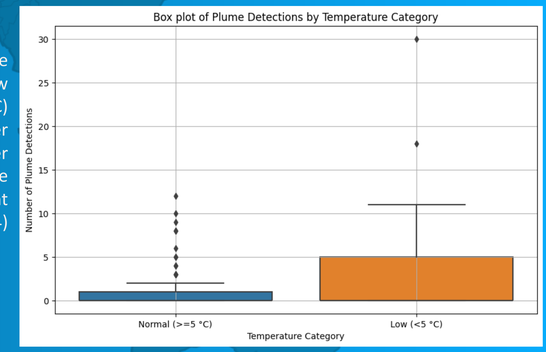
- On 13-16th January 2024, Texas experienced a winter storm, with temperatures falling below 0°C.
- Abnormally cold weather puts pressure on unprepared infrastructure, which can result in higher methane emissions.
- MARS monitored 210 oil & gas facilities in the Permian Basin
- For each facility, MARS defines a 2km x 2km square around it to analyze satellite data.
- MARS monitors these facilities with all available methane-sensitive high-resolution instruments: Sentinel-2, Landsat-8/9, PRISMA, EnMAP, EMIT, GOES, Sentinel-3.
- An AI model processes the imagery and generates preliminary alerts. A MARS analyst then validates these alerts, preparing notifications to governments and operators

- During the week of 14th – 20th January 2024, MARS notified 43 events in the region, detecting 72 emissions in total: close to 10 times more than other weeks.
- We observe a weak negative correlation (r = -0.27, p-value = 0.007) between daily average temperature and plume detections, indicating slightly more detections on colder days
- Oil and Gas sectors needs to prepare to increased occurrence of extreme weather events due to climate change,, with the risk of feedback loop



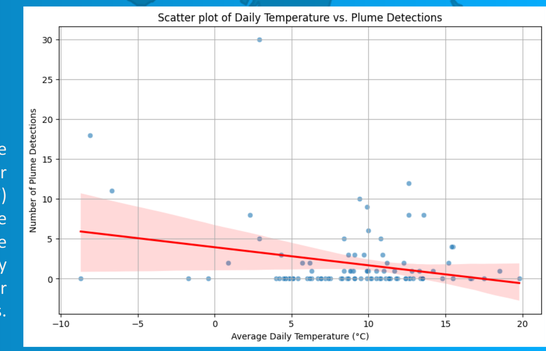






Box plot comparing plume detections between low (<5°C) and normal (≥5°C) temperatures shows higher average detections on colder days, although the difference is not statistically significant (p-value = 0.134)

Notified events on January 14th 2024 with PRISMA satellite.
12 events detected on overpasses (60km x 30km)



Scatter plot illustrating the weak negative correlation (r = -0.27, p-value = 0.007) between daily average temperature and plume detections, indicating slightly more detections on colder days.