MARS SUPPORT WITH SATELLITE METHANE DETECTION METHODS DEVELOPMENT

Global satellite-based tracking of point source super-emissions and open-pit coal mine top-down estimates

DONOR:
European Commission and the Global Methane Hub

BENEFITTING COUNTRIES OR REGIONS:
Worldwide

SECTOR:
Multisector

STATUS: **Analysis ongoing**

TIMELINE: **Latest publication 2025**

IMEO SCIENCE OBJECTIVE:

→ **Validation of measurement-based approaches**



KEY FINDINGS

The study demonstrates that VIIRS can be used to observe methane with high spatial resolution and effectively track super-emitter events multiple times per day. Combining VIIRS and TROPOMI observations enables both detection and source attribution, as well as cross-validation between instruments. Furthermore, integrating the three VIIRS satellites with Sentinel-3 SLSTR data provides global coverage at least four times per day, offering valuable insight into short-lived methane emission events. Overall, the study establishes the basis for a daily, global methane monitoring system.

RATIONALE

Diffuse, widespread emissions from open-pit coal mines remain challenging to quantify, and emissions from most open-pit coal mines are estimated using generic emission factors that often underestimate emissions. Accurate, reliable methods are needed to obtain measurement-based estimates.

Satellite sensors already in operation with high revisit frequency and the potential to detect methane—such as the Visible Infrared Imaging Radiometer Suite (VIIRS) satellite instruments—introduce the possibility of frequent methane monitoring at different times of the day. However, since these sensors were not initially designed to detect methane, their low sensitivity requires careful processing and analysis to extract methane emissions data.

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RELATED PUBLICATIONS

Daily global methane super-emitter detection and source identification (de Jong et al., 2025)

SIGNIFICANCE FOR DECISIONMAKERS

Identifying large point-source methane emissions with VIIRS sensors enables the detection and high-frequency monitoring of new emission sources, providing more accurate information on the duration and amount of methane released during emission events. This data increases transparency in the oil and gas sector and allows for independent emission estimates.

Empirical measurements from satellites provide more reliable emission estimates for open-pit coal mines.

STUDY APPROACH/ACTIVITIES

This study uses the Visible Infrared Imaging Radiometer Suite (VIIRS) satellite instruments to observe and quantify large methane plumes with 750 m resolution. It combines VIIRS with Sentinel-3 satellites to get global coverage at least four times per day and methane plume images multiple times a day. As one of the VIIRS satellites overlaps with those of the TROPOMI instrument, it directly compares TROPOMI's low-resolution, high-precision measurements with VIIRS's high-resolution, noisier measurements. Finally, it uses VIIRS to zoom in on plumes detected by TROPOMI to identify the facility and compare the observed methane plumes, finding good agreement within their respective uncertainties.

CATALYZING ACTION

The methodology to track methane plumes with VIIRS and Sentinel-3 was integrated into IMEO's Methane Alert and Response System (MARS), allowing UNEP to notify governments and companies of major emission events.

Open-pit coal mine emission estimates will support IMEO's Steel Methane Programme, which aims improve methane monitoring, reporting and mitigation in the steel supply chain, and will be integrated into MARS's satellite-based emissions database.

OTHER SUPPORTERS/STAKEHOLDERS

Principal Investigator: **Netherlands Institute for Space Research (SRON)**

The UN Environment Programme's International Methane Emissions Observatory (IMEO) exists to provide open, reliable, and actionable data to the individuals with the agency to reduce methane emissions. IMEO does this by integrating and reconciling data across sources, including its global methane science studies. IMEO supports measurement and research studies around the world to close the knowledge gap on methane emissions and provide policy-relevant insights to decisionmakers.