(47-240329-C) **Fully-automated, Machine Learning-based, Satellite Methane Detection Algorithm Applied to Estimate Offshore Emissions**

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Anthropogenic methane sources are known to contribute significantly to global warming due to the high volume of sources and slow offset by natural sinks, rendering the detection of problematic leaks an important problem to tackle. Remote sensing of methane is a promising tool to monitor large areas with a high resolution and inform policy decisions, given its cost-effectiveness, low maintenance, and instantaneous results. Nevertheless, one of the main challenges in the satellite detection of methane plumes is the lack of automated and scalable methods to process images. In the past, several potential solutions have been proposed to reduce manual intervention in plume image segmentation from satellite data. For instance, Bruno et al. developed a machine learning algorithm capable of detecting methane leaks and estimate their emission rates from enhancement images and wind data [1]. Despite significant efforts and progress in the field, fully automated machine learning methods have not yet been applied to estimate emissions over large areas. In particular, some problematic areas are of special interest, due to large and recurrent known emissions, such as the Permian Basin, San Juan Basin, and the Gulf of Mexico [2]. Here, we propose an algorithm based on [1], adapted and improved to automatically monitor oil platforms in the Gulf of Mexico and reduce false-positives by including physics-informed training data. Our method is capable of live monitoring Sentinel-2 data over hundreds of oil platforms and automatically detect plumes with a high accuracy. Given current wind speed measurements, we can produce high-quality, reliable estimates for methane emissions from offshore platforms in the Gulf of Mexico.

References:

[1] Bruno, J., Jervis, D., Varon, D., and Jacob, D.: U-Plume: Automated algorithm for plume detection and source quantification by satellite point-source imagers, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2023-1343, 2023.

[2] Yuzhong Zhang *et al.* Quantifying methane emissions from the largest oil-producing basin in the United States from space. *Sci. Adv.* **6**, eaaz5120 (2020). DOI:10.1126/sciadv.aaz5120

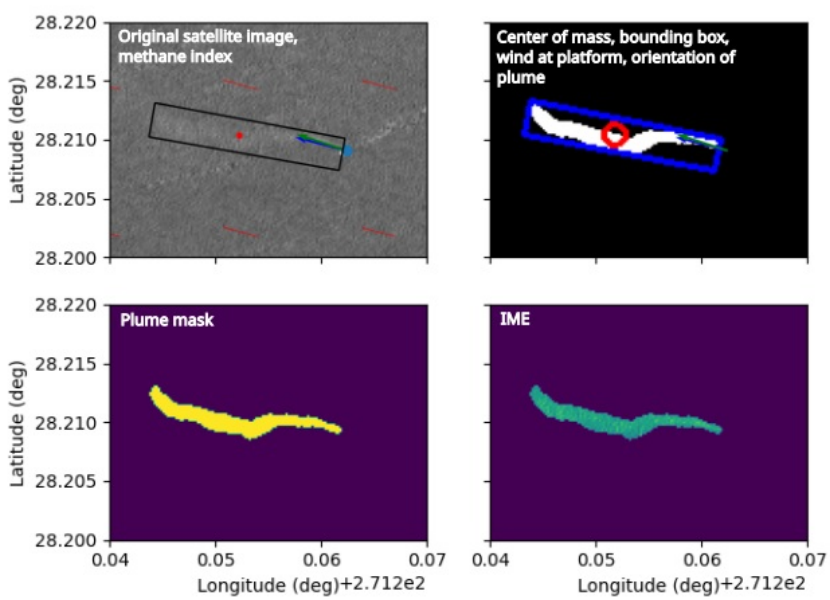

Figure 1. Methane leak detected at an oil platform (Devil's tower). (Top left) Methane enhancement calculated from Sentinel-2 infrared bands (SWIR2 - SWIR1)/(SWIR2 + SWIR1), with GFS wind vectors interpolated (red and blue arrows) and plume direction from mask (green arrow). (Top right) Plume's bounding box (blue polygon), center of mass (red circle), orientation of box with respect to the platform (green arrow). (Bottom left) Binary plume mask as obtained from convolutional neural network image segmentation. (Bottom right) Methane enhancement from plume.