

Detection of CH₄ emissions from permafrost peatlands with TROPOMI XCH₄

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Some fraction of the carbon in northern circumpolar permafrost will be released as CH₄ or CO₂ as permafrost thaws in the coming years. Recent column-averaged methane (XCH₄) observations (2018-2023) from the Tropospheric Monitoring Instrument (TROPOMI) on the Sentinel-5 Precursor satellite are assessed for evidence of CH₄ emissions from permafrost regions. Using the Weighting Function Modified Differential Optical Absorption Spectroscopy (WFMD) v1.8 TROPOMI XCH₄ data product, XCH₄ anomalies north of 50°N are calculated and averaged bi-monthly onto a high spatial resolution ($0.09^\circ \times 0.18^\circ \approx 10$ km) grid. Soil temperature anomaly maps (down to 1.5 m depth) are also generated from reanalysis data. Considering the XCH₄ and soil temperature anomalies along with information on soil carbon content and wind variability leads to a focus on Canada's Hudson Bay Lowlands (HBL). The HBL is an area of wetlands and peat underlain by continuous through to isolated permafrost, containing very high soil carbon content. With the HBL on the southern edge of the permafrost zone, it has been identified as vulnerable to thaw and high carbon emissions. Wind conditions in the HBL are also favorable for the detection of surface emissions from space. We find strong evidence in TROPOMI XCH₄ of enhanced CH₄ emissions correlated with elevated summer soil temperature for the HBL permafrost peatlands, although the attribution of CH₄ emissions to a specific geophysical process is difficult.

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