



Methane Fluxes at Northern Latitudes using Atmospheric Inverse Modeling and Earth Observations of Soil Freeze/Thaw and Atmospheric Methane Columns

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Novel Earth Observations of atmospheric greenhouse gases and the cryosphere have the potential to fundamentally increase our understanding of the carbon cycle at high Northern latitudes. We will present our on-going ESA project on quantifying methane (CH₄) emissions in the Northern Hemisphere, and investigating their connection to the soil freezing and thawing at boreal latitudes. We combine methods for the quantification of CH₄ emissions by applying data from Earth Observing (EO) satellites and global atmospheric methane inversion model estimates. The EO data consist of a global soil freeze/thaw estimate obtained from the ESA Soil Moisture and Ocean Salinity (SMOS) mission as well as retrievals of atmospheric column-averaged methane obtained from the Greenhouse Gases Observing Satellite (GOSAT) and Sentinel 5 Precursor TROPOMI (S5P-TROPOMI) observations. These EO data will be used in global atmospheric methane inversion model, CarbonTracker Europe – CH₄, simulations, focusing on (1) the identification of CH₄ sources in the Northern Hemisphere and (2) providing analysis on the trends and seasonal variability of methane emissions. EO data will be used to assess the spatial variability of the emissions and to better quantify the contributions from regions dominated by anthropogenic emissions and by natural emissions, especially those from wetlands. Further, EO data will be used to create proxies of the seasonality of the natural methane emissions, focusing on the timing and length of the autumn freezing period and springtime melting period.