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Soil CH_4 Fluxes in Typical Tundra of the Taimyr Peninsula, Siberia

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ABSTRACT

Among the most climate-vulnerable biomes, Arctic tundra contains large amounts of soil organic carbon stored in perennially frozen ground (permafrost), which can be released into the atmosphere as carbon dioxide (CO_2) and methane (CH_4) in a warmer climate. Given the 25–30 times higher global warming potential of CH_4 compared to CO_2, CH_4 release from permafrost degradation could account for ~ 50% of the future total radiative forcing. Currently, tundra ecosystems constitute a weak CH_4 source, however strong spatio-temporal variations of CH_4 fluxes observed across the tundra biome contribute the uncertainty range in predicting climate feedbacks in the Arctic. We investigated spatial patterns and magnitudes of soil CH_4 fluxes within different landscape units and vegetation types in typical tundra of the Taimyr Peninsula, Siberia. CH_4 fluxes were measured during the growing seasons of 2023 – 2024 using the chamber method. In general, mean soil CH_4 flux reached 0.86 μmol m^{-2} h^{-1}, ranging across tundra landscapes from -0.01 μmol m^{-2} h^{-1} (consumption) in patches of barren ground to 9.75 μmol m^{-2} h^{-1} (source) in sedge vegetation. The highest mean rates (2.39 μmol m^{-2} h^{-1}) were attributed to the overwetted marsh tundra, while significantly lower records were observed across frost-heaved (0.09 μmol m^{-2} h^{-1}) and moss tundra (0.19 μmol m^{-2} h^{-1}). In areas disturbed by all-terrain tracks, the mean CH_4 flux was 3-fold higher than in the undisturbed tundra and achieved 2.24 μmol m^{-2} h^{-1}, ranging from 0.97 to 2.99 μmol m^{-2} h^{-1} in moss and marsh tundra, respectively.

Keywords: climate, arctic, tundra, vegetation, methane, chamber

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References:

1. Kukavskaya, E.A.; Panov, A.V.; Makhnykina, A.V.; Groisman, P.Y. Fire and logging decrease soil CO2 efflux in Siberian central Taiga forests. *Forests* **2025,** *16*, 1057. DOI:10.3390/f16071057

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