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Soil texture and soil respiration drive spatial variablity of CH_4 consumption on the plot scale

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Soil-atmosphere fluxes of trace gases vary between ecosystems and landscapes, but also at the plot scale. The production and consumption of carbon dioxide (CO_2) and methane (CH_4) underlie different spatial and temporal changes, und thus, their interrelation is difficult to unravel. Small-scale variability in soil properties is lower in more homogenous soil like Loess, but can be very high in alluvial soils. Small scale heterogeneity in soil properties can result in different growing conditions, plant communities and, thus, C input and greenhouse gas fluxes. We investigated the small scale variability of CO_2 and CH_4 fluxes in a homogenous Scots Pine stand in a former riparian flood plain with heterogeneous soil properties in 3 field campaigns: winter, early summer and late summer. Measurements were carried out at >50 points in each campaign along strata of diverse soil substrates/textures and ground vegetation. The soil was a source of CO_2 and a sink for CH_4. No correlations between the fluxes and only weak correlations between the fluxes and soil physical factors were observed when the data set was analyzed without separation into the different soil texture classes. During the winter campaign, CH_4 and CO_2 fluxes were significantly different between the soil-vegetation classes. Separating the dataset into the different texture classes showed that CH_4 consumption increased significantly with soil respiration. Methane consumption in the silt class was higher at a given soil gas diffusivity than in the sand class, indicating a higher or more active methanotrophic microbial population and thus better habitats in silt. CH_4 consumption increased with soil respiration in all strata, so that we speculate that the rhizosphere and decomposing organic litter (as origin of most of the soil respiration) facilitate a preferred habitat of methanotrophic microbes. These new findings derived from the winter data are currently being tested against the data of the summer campaigns.

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