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Impact of spatial microclimatic variability on carbon and nitrogen cycling leading to methane emissions during the non-growing season of Siikaneva, Finland

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Non-growing season greenhouse gas emissions are still underrepresented in observation systems as well as process-based models despite growing evidence of their importance to annual budgets in high latitude regions. We therefore investigate ecological and biogeochemical processes in global carbon and nitrogen cycles during the non-growing and shoulder seasons at Siikaneva, nearby Hyytiälä Research Station in boreal Finland. The FluxWIN project investigates the current underestimation of annual methane (CH_4) emissions from boreal ecosystems by combining high-frequency greenhouse gas measurements and biogeochemical monitoring. Identifying the processes leading to the large observed CH_4 emissions requires thorough analysis of potential meteorological drivers controlling the soil temperature, including radiative forcing, surface energy balance and snow pack characteristics. The location of our research site within extensive long-term scientific infrastructure allows us to compare the measurements obtained from our newly set up meteorological station at a well-drained upland forest site to the ones recorded about 1 km south-east at an ICOS station in open fen. While both stations are subject to the same large-scale meteorological forcing due to their spatial proximity, the different ecosystem types might produce very different microclimates with differing freeze-thaw and soil temperature dynamics, which has potential implications for local carbon and nitrogen cycling leading to CH_4 exchange. Controlling for spatial microclimatic variability will help us to evaluate the representativeness of our flux measurements and identified soil, geophysical and biogeochemical drivers when expanded to a larger spatial scale.