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Eddy-covariance methane flux measurements over a European beech forest

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The role of forests in global methane (CH_4) turnover is currently not well constrained, partially because of the lack of spatially integrative forest-scale measurements of CH_4 fluxes. Soil chamber measurements imply that temperate forests generally act as CH_4 sinks. Upscaling of chamber observations to the forest scale is however problematic, if the upscaling is not constrained by concurrent 'top-down' measurements, such as of the eddy-covariance type, which provide sufficient integration of spatial variations and of further potential CH_4 flux components within forest ecosystems. Ongoing development of laser absorption-based optical instruments, resulting in enhanced measurement stability, precision and sampling speed, has recently improved the prospects for meaningful eddy-covariance measurements at sites with presumably low CH_4 fluxes, hence prone to reach the flux detection limit. At present, we are launching eddy-covariance CH_4 measurements at a long-running ICOS flux tower site (Hainich National Park, Germany), located in a semi natural, unmanaged, beech dominated forest. Eddy-covariance measurements will be conducted with a laser spectrometer for parallel CH_4, H_2O_v and CO_2 measurements (FGGA, Los Gatos Research, USA). Independent observations of the CO_2 flux by the FGGA and a standard Infrared Gas Analyser (LI-7200, LI-COR, USA) will allow to evaluate data quality of measured CH_4 fluxes. Here, we want to present first results with a focus on uncertainties of the calculated CH_4 fluxes with regard to instrument precision, data processing and site conditions. In future, we plan to compare eddy-covariance flux estimates to side-by-side turbulent flux observations from a novel eddy accumulation system. Furthermore, soil CH_4 fluxes will be measured with four automated chambers situated within the tower footprint. Based on a previous soil chamber study at the same site, we expect the Hainich forest site to act as a CH_4 sink. However, we hypothesize that our measurements might also reveal short CH_4 emission periods when soils become water-saturated. Nonetheless, CH_4 emissions by plants could also result in a close to neutral net CH_4 flux.