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Impact of climate change on greenhouse gas fluxes of (pre-) alpine grassland soils

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Embedded into the German Helmholtz Society funded infrastructure project TERENO IMK-IFU is running the (Pre-) Alpine Observatory covering several research sites in the Ammer catchment, South-Bavaria, Germany. TERENO was designed to study long term effects of climate change on terrestrial ecosystems. Due to cool and moist climatic conditions alpine grassland soils of moderate elevation (app. 1000m) are rich in soil organic carbon and associated nitrogen. In the framework of an in-situ climate change experiment we test the hypothesis that soil organic carbon and nitrogen are either volatilized (GHG emissions) or leached with seepage water due to increase in temperature. Field investigations are carried out in the (Pre-) Alpine TERENO Observatory covering several research sites in South-Bavaria, Germany. IMK-IFU has installed 36 lysimeters with undisturbed intact grassland soil cores (diameter 1m, depth 1.4m, 2-3 t of soil) and is operating them at three sites differing in altitude (Graswang 850m, Rottenbuch 750m, Fendt 600m). Lysimeters were partly translocated from higher elevation to sites at lower elevation and other soil cores still staying at the sites as controls. Along the altitudinal gradient mean annual temperature differences are δ1.5°C Graswang-Rottenbuch and δ 2.5°C Graswang-Fendt and slightly lower mean annual rainfall with decreasing altitude. We will present the first full year datasets of soil CO_2, N2O and CH4 emissions measured by manual as well as automatic chambers via a new developed robot system. Comparing emissions at the controls sites, and comparing the translocated soil cores, showed that the most significant differences were found for CO_2 and CH4 fluxes and less for N2O fluxes. Higher temperatures generally stimulated CO_2 and N2O emissions and lead to increased uptake rates of atmospheric CH4. Different dynamics of snow pack formation at the three sites investigated, caused pronounced differences in frost-thaw driven N2O emissions which significantly contributed to the annual budget. Pronounced diurnal patterns of emissions were observed in particular for soil CO_2 emissions, demonstrating the advantage of automatic measurements over manual measurements which need to be scaled to daily representative flux rates depending on the time of chamber sampling to avoid significant bias of the annual GHG emission budgets.