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# The influence of hydrology and seasonality on biogeochemical processes and greenhouse gas emissions from a sloping alpine peatland

**ANDREAS KAPPLER**[1,2], SOPHIE KUNZ[1,2], FLORIAN JUETERBOCK[1,2], OLAF A CIRPKA[1,2], REINHARD DREWS[1,2], KYLE MASON-JONES[1,2], ISABEL MONTE[1,2], YVONNE OELMANN[1,2], CHRISTIANE ZARFL[1,2], E. MARIE MUEHE[1,2,3], THILO STRECK[2,4] AND SIGRID VAN GRINSVEN[1,2]

[1]University of Tübingen
[2]Cluster of Excellence (EXC 3121): TERRA – Terrestrial Geo-Biosphere Interactions in a Changing World, University of Tübingen
[3]Helmholtz Center for Environmental Science UFZ
[4]University of Hohenheim

Recent research revealed that peatlands in alpine regions are more spatially extensive than previously assumed, reinforcing their importance for carbon storage in high-altitude ecosystems. Alpine peatlands are comparable to northern peatlands: they have a short growing season, strong seasonality, and are snow-covered for several months per year. While arctic and boreal peatlands are known to emit large amounts of greenhouse gases (GHG), it is largely unknown to which extent alpine peatlands release GHG under climate change and how this is influenced during the different seasons by the soil biogeochemical properties, hydrology, and plant community composition.

In a multidisciplinary study, covering (bio-)geochemistry, microbial ecology, plant science, and geohydrology, we investigate an alpine peatland in Vorarlberg (Austria) located at 1670 m a.s.l. altitude on a slight slope of a plain surrounded by mountains up to 2416 m a.s.l. (see photos). Methane flux field measurements with static chambers showed a strong seasonal variation with a surprising switch from methane uptake in certain locations in spring to methane emissions in summer, potentially indicating a large variation in redox conditions with the seasons due to changes in the hydrology. In winter, when the area is covered by >1 m of snow, the sampled alpine peatland remains partly uncovered due to the continuous input of 5°C spring water. This creates a unique environment in which microbial carbon cycling continues at a higher rate than at nearby sites and leads to ongoing methane emissions throughout winter. The strong methane emissions in summer depended strongly on day (high) and night (lower) and short-term weather in the days before/during the measurements, with higher emissions during hot, dry periods compared to colder, rainy periods. In addition, we observed a very large spatial variation, even within the 1 $m^2$ scale. This large spatial variation in GHG emissions is supported by a large variation in soil organic carbon and total nitrogen content between locations within the peatland site, as well as variations in the plant community, and seems to be linked to groundwater flows which is currently analysed in new field campaigns.



