EGU21-10669
https://doi.org/10.5194/egusphere-egu21-10669
EGU General Assembly 2021

Inter-seasonal investigation of coupled C & N greenhouse gas fluxes in pristine northern ecosystems

Lona van Delden[1], Julia Boike[1], Eeva-Stiina Tuittila[2], Timo Vesala[3], and Claire Treat[1]
[1]Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Permafrost Research Section, Potsdam, Germany (lona.van.delden@awi.de)
[2]Department of Environmental and Biological Sciences, University of Eastern Finland, Joensuu, Finland
[3]Institute for Atmospheric and Earth System Research, University of Helsinki, Helsinki, Finland

Accurate annual greenhouse gas (GHG) budgets are the crucial baseline for global climate change forecast scenarios. On the other hand, the parameterization of these forecast models requires more than high-quality GHG datasets, but also the constant improvement of the representation of GHG producing and consuming processes. Extensive research efforts are therefore focusing on increasing our knowledge of the main GHG producing carbon (C) and nitrogen (N) cycles, though surprisingly not so much into their direct interaction. Most annual GHG budgets from pristine northern ecosystems are based on interpolated datasets from sampling campaigns mainly taken during the growing season. Within the ERC funded FluxWIN project, we are investigating how soil and pore water C & N interact and their biogeochemical GHG drivers change over seasons. Freeze-thaw events have previously been identified as significant GHG drivers by rapidly changing moisture and oxygen conditions in the soil matrix, but it remains unclear if and how C & N coupling contributes to these non-growing season emissions. Therefore, a fully automated static chamber system is monitoring GHG fluxes in high frequency at a boreal peatland ecosystem in Siikaneva, Finland. Nutrient stocks and biogeochemical dynamics within the soil matrix are compared to GHG soil-atmosphere exchange in the form of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) all year-round. We control for climatic variability and isolate differences in non-growing season emissions by using a moisture gradient from well-drained upland soils to adjacent wetland ecosystems. The use of these automated high-frequency GHG measurements in combination with year-round biogeochemical monitoring maximizes the likelihood of capturing episodic emissions and their drivers, which are particularly important during fall freeze and spring thaw periods. The gained information on the coupled C & N biogeochemical cycles will improve feedback estimates of climate change by including non-growing season processes in global-scale process-based models.