EGU22-11770
https://doi.org/10.5194/egusphere-egu22-11770
EGU General Assembly 2022

Wadden Sea salt marshes - sinks or sources of methane and nitrous oxide?

Miriam Fuss[1], Peter Mueller[2], Norman Rueggen[1], and Lars Kutzbach[1]
[1]Institute of Soil Science, Center for Earth System Research and Sustainability (CEN), University of Hamburg, Hamburg, Germany (miriam.fuss@uni-hamburg.de)
[2]Institute of Plant Science and Microbiology, University of Hamburg, Hamburg, Germany

Salt marshes are vegetated coastal habitats recognised for their great potential to act as effective soil organic carbon sinks, driven by high rates of photosynthetic CO_2 uptake and effective long-term storage of organic matter under reducing soil conditions. However, it is poorly understood when and under which conditions salt marshes can act as sinks or sources of the powerful non-CO_2 greenhouse gases CH_4 and N_2O. A complex interplay of environmental factors characterises the biogeochemistry of these ecosystems. This interplay is in turn controlled by elevation in respect to mean high water level and thereby inundation frequency, forming three vegetation zones, which are on average flooded twice daily with every high tide (pioneer zone), twice per month with every spring tide (low marsh) and sporadically during storm surges (high marsh).

We measured land atmosphere fluxes of CH_4, N_2O and CO_2 at a salt-marsh site in Nordfriesland, Germany, combining a closed chamber approach with *in situ* measurements of portable infrared gas analysers. From June 2018 to September 2021 we conducted biweekly (Apr-Sept) and monthly (Oct-Mar) campaigns covering the elevational gradient throughout all vegetation zones from pioneer zone to high marsh.

All greenhouse gas fluxes indicated strong dependence on elevation. Ecosystem respiration CO_2 fluxes showed highest values in the high marsh. CH_4 emissions occurred mainly in the most frequently flooded pioneer zone (up to +0.60 $\mu mol*h^{-1}*m^{-2}$), whereas low and high marsh acted as net CH_4 sinks (down to -2.0 $\mu mol*h^{-1}*m^{-2}$). Contrastingly, N_2O mainly showed positive fluxes (up to +1.1 $\mu mol*h^{-1}*m^{-2}$) in the high marsh, and the more frequently flooded zones acted as net N_2O sinks (down to 0.21 $\mu mol*h^{-1}*m^{-2}$). Further analysis of environmental variables like soil temperature, flooding frequency, groundwater level fluctuations and plant community composition will follow to identify drivers of varying greenhouse gas fluxes.

Our findings show that salt marshes are not only effective in assimilating CO_2. They also show the ability to take up the strong greenhouse gases CH_4 and N_2O, emphasizing their important role in mitigating global warming.