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Net photosynthesis in Sphagnum mosses has increased in response to the last century's 100 ppm increase in atmospheric CO_2

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Peatlands store >25% of the global soil C pool, corresponding to $\sim$1/3 of the contemporary CO_2-C in the atmosphere. The majority of the accumulated peat is made up by remains of Sphagnum peat mosses. Thus, understanding how various Sphagnum functional groups respond, and have responded, to increasing atmospheric CO_2 and temperature constitutes a major challenge for our understanding of the role of peatlands under a changing climate.
We have recently demonstrated (Ehlers et al., 2015, PNAS) that the abundance ratio of two deuterium isotopomers (molecules carrying D at specific intramolecular positions, here D6R/S) of photosynthetic glucose reflects the ratio of oxygenation to carboxylation metabolic fluxes at Rubisco. The photosynthetic glucose is prepared from various plant carbohydrates including cellulose. This finding has been established in CO_2 manipulation experiments and observed in carbohydrate derived glucose isolated from herbarium samples of all investigated C-3 species. The isotopomer ratio is connected to specific enzymatic processes thus allowing for mechanistic implicit interpretations.
Here we demonstrate a clear increase in net photosynthesis of Sphagnum fuscum in response to the increase of $\sim$100 ppm CO_2 during the last century as deduced from analysis on S. fuscum remains from peat cores. The D6R/S ratio declines from bottom to top in peat cores, indicating CO_2-driven reduction of photorespiration in contemporary moss biomass. In contrast to the hummock-forming S. fuscum, hollow-growing species, e.g. S. majus did not show this response or gave significantly weaker response, suggesting important ecological consequences of rising CO_2 on peatland ecosystem services. We hypothesize that photosynthesis in hollow-growing species under water saturation is fully or partly disconnected from the atmospheric CO_2 partial pressure and thus showing weaker or no response to increased atmospheric CO_2. To further test the field observations we grow both hummock and hollow Sphagnum species in controlled green-house experiments under varying combinations of water table, CO_2 and temperature. Preliminary results confirm our interpretations of data from field peat cores.

Ehlers, I., Augusti, A., Betson, T.R., Nilsson, M.B., Marshall, J.D. and J. Schleucher (2015) Detecting long-term metabolic shifts using isotopomers: CO_2-driven suppression of photorespiration in C3 plants over the 20th century, Proceedings National Academy of Sciences (PNAS), doi: 10.1073/pnas.1504493112