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The N balance of a UK ombrotrophic bog: Resilience of N sink capacity despite chronic atmospheric reactive N deposition

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Northern peatlands are considered the most important terrestrial carbon store which also contains four times the amount of nitrogen (N) per area compared with mineral soils, making up more than one-tenth of the world's soil N pool. Peatlands play an important role in modulating the climate, mainly through sequestration of atmospheric carbon dioxide (CO_2) into peat C, which depends, among others, on the availability of reactive nitrogen (Nr) to mosses. Chronic atmospheric Nr deposition in the UK (range: $<$6 - $>$25 kg N ha^{-1} y^{-1}) has been above the critical load for functional and structural changes to peatland mosses, thus threatening to accelerate their succession by vascular plants as well as increasing the possibility of Nr export to downstream ecosystems. The N balance of peatlands has received comparatively little attention, mainly due to the difficulty in measuring gaseous N losses (N_2 + N_2O) as well as the Nr inputs due to biological nitrogen fixation (BNF). In this study we have estimated the annual N balance of an ombrotrophic bog (Migneint, N. Wales) by measuring monthly *in situ* N_2 + N_2O gaseous fluxes using an adapted ^{15}N-Gas Flux method[1] with low level additions of ^{15}N tracer (0.03 kg ^{15}N ha^{-1}). Fluvial N export was monitored bi-weekly and through a continuous record of DON flux ($>$ 80% of fluvial N), while wet and dry atmospheric N deposition (NO_x + NHx) was modelled on a 5 x 5 km grid. Long term N accumulation in the peat profile (up to 125 cm depth) was measured[2] at 9 kg N ha^{-1} y^{-1}. Gaseous N losses were a significant budget term (7 kg N ha^{-1} y^{-1}) and almost double the fluvial N losses (4 kg N ha^{-1} y^{-1}). However, the combined N loss terms were lower than the atmospheric Nr input (13 kg N ha^{-1} y^{-1}), indicating that the Migneint bog is a resilient N sink despite the chronic deposition of Nr. Furthermore, to support the long term N accumulation in peat, BNF must be actively fixing atmospheric N_2 at an estimated rate of $\sim$7 kg N ha^{-1} y^{-1}, which is supported by preliminary data on the BNF capacity of peat mosses in this bog. This highlights the importance of BNF for the natural N economy of peatlands and the need to better understand its regulation and its resilience to climate change and Nr deposition pressures.

References

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