Storage of "excess" nitrogen and $^{15}N/^{14}N$ ratios corroborate sizeable N_2 fixation in peat bogs

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Recent studies in North America and Scandinavia have suggested that pristine bogs are characterized by significant rates of microbial N_2 fixation that augments C storage in the peat substrate. Here we present two approaches that may corroborate these findings.

(1) We quantified a relationship between the measured N accumulation in 40-cm deep peat cores and a cumulative N deposition since the Industrial Revolution. The comparison between N input and N storage was made at 5 sites in the Czech Republic, three in the more N polluted north and two in the less polluted south. Peat cores were analyzed for N content and lead-210 dated. The N mass inventory was performed for the time span 2012-1885. The cumulative atmospheric input of reactive N (N_r) was calculated from Kopacek and Vesely (2005) and checked against deposition data from the GEOMON monitoring network (Czech Geological Survey; 1994-2012). The cumulative atmospheric N input was 2.6 times higher in the north than in the south (1350 vs. 530 kg N/ha). N storage in peat in the north was from 2390 to 4020 kg N/ha. N storage in peat in the south was from 1530 to 1620 kg N/ha. In the less polluted south, the peat stored 3.0 times more N than was the cumulative atmospheric input. In the more polluted north, the peat stored 2.2 times more N than was the cumulative atmospheric input. We conclude that N storage in *Sphagnum* peat was larger than the atmospheric deposition of N_r.

(2) We conducted an isotope inventory of seven N fluxes and pools at two peat bogs, one in the north and one in the south of the Czech Republic. N of *Sphagnum* (mean of -5.0 ‰) was isotopically heavier than N of the atmospheric input (mean of -10.0 ‰ for NH_4^+, and -7.9 ‰ for NO_3^-). If partial incorporation of reactive N from the atmosphere into the moss was isotopically selective, the residual N would have to be isotopically extremely light. Such N, however, was not identified anywhere in the ecosystem. We suggest that the moss contained an admixture of isotopically heavy N derived from atmospheric N_2 (0 ‰) via microbial fixation. We conclude that microbial N_2 fixation is a feasible explanation of both the storage of "excess" N relative to cumulative atmospheric deposition of N_r, and the $^{15}N/^{14}N$ systematics in Czech peat bogs.