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Title: *High Arctic Tundra – a potential sink for atmospheric nitrogen deposition: Highlights from 15N recovery experiments in Svalbard*

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Arctic tundra ecosystems are threatened by pollution from both chronic and extreme atmospheric nitrogen (N) depositions, caused mainly due to increases in the long-range transport of reactive N species from pollution sources at lower latitudes. Extreme N deposition events could deposit up to 80% of the total annual N deposition in just a few days, and exacerbated by increases in the global temperatures and shipping emissions in the north. Since the productivity of the tundra ecosystems is nutrient-limited, even modest increases in N deposition could represent very major additional supply of nutrients to these sensitive systems. Therefore, all forms of enrichment, whether extreme episodic or chronic, require urgent characterisation because they are occurring in conjunction with rapid climate change in theArcticand thus have the capacity to greatly impact upon carbon storage in these ecosystems.

Here we report the N (^{15}N) recovery from the first-ever field simulation study of extreme N deposition events (short-term) and recovery of N from a melting snowpack after 10-years (long-term), within the plant-soil system in the high arctic tundra.

Both these experiments were established on tundra at Ny-Ålesund, Svalbard (78º55'N; 11º56'E). Short-term extreme N deposition events were simulated once each summer from 2009-2012 at rates of 0, 0.4, 4 and 12 kg N ha^{-1} yr^{-1} applied as NH_4NO_3 solution using a plot scale N-addition experiment. ^{15}N tracers were used in the second year (2010) to quantify the fate of the acutely deposited N ($^{15}NH_4{}^{15}NO_3$) in the plant, soil, microbial and leachate pools over two growing seasons. Separate applications of NO_3^- and NH_4^+ were also made to additional plots to determine the importance of N form in determining the fate of N.

In the long-term N recovery experiment, ^{15}N was applied at 1 and 5 kg N ha^{-1} yr^{-1} immediately after snowmelt in 2001 as either $Na^{15}NO_3$ or $^{15}NH_4Cl$. This experiment was conducted to mimic the accumulated atmospheric N released from a melting snowpack during early summer thaw. Audits of applied ^{15}N were undertaken after 10 years of N application (2011), by determining the amounts of labelled N in the vegetation, soil and microbial fractions.

^{15}N recovery results from both the extreme and chronic deposition events demonstrate high N retention capacity by the arctic tundra plant-soil communities, indicating tundra to be the potential sink for long-range N pollution. However, there were differences in the fate of ^{15}N in both the events, indicating the importance of the timing of the deposition events in the Arctic.