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Fate of atmospherically deposited NH4+ and NO_3- in two temperate forests in China: temporal pattern and redistribution

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The impacts of anthropogenic nitrogen (N) deposition on forest ecosystems have been well recognized. However, our understanding of the fate of deposited N and its retention dynamics in different ecosystems is limited. This study used the 15N-tracer method to investigate both the short-term (1 week - 3 months) and long-term (1 - 3 years) fates of deposited NH4+ or NO_3- in two forests in northeastern China, namely a larch plantation forest and a mixed forest. We determined retention dynamics of 15N-labelled NH4+ or NO_3- (by following the recovery of the 15N) in different ecosystem compartments over three years. In the first three months, total N retention declined from 97 -100% to 52 - 72% in the larch forest and from 84 - 88 to 53 - 56% in the mixed forest, indicating a rapid initial loss of newly deposited N regardless of forest type. Here after, 15N retention stayed relatively constant in both forests, but retained 15N was redistributed from the organic layer to the mineral soil with no significant change in plants over time. At the end of three years, 15N retention were 48 - 51% and 42 - 47% in the larch and mixed forest, respectively, suggesting that once retained over the first growing season, most deposited N was recycled within ecosystem in the long-term. The N retention efficiency in our studied forests was lower than that observed in many temperate forests in Europe and US. But leachate 15N loss was minor (<1% of the added 15N). Total N retention did not significantly differ between NH4+ and NO_3- inputs in either forest. However, the distribution of NH4+ and NO_3- inputs in different ecosystem compartments was distinctly different, with higher 15NO_3- retained in plants (while lower retention in organic layer) than found for 15NH4+. This suggests that NO_3- deposition could be more beneficial to forest growth and CO_2 sequestration into plant biomass. The distinctly different retention of deposited NH4+ and NO_3- may have long-term consequences, which has important implications in environmental policy development to regulate anthropogenic deposition of NO_3- and NH4+ and their impacts on forest ecosystems.

Keywords: 15N tracer, temperate forests, N retention and redistribution, N deposition, northeastern China