Geophysical Research Abstracts, Vol. 8, 10329, 2006
SRef-ID: 1607-7962/gra/EGU06-A-10329

Retention of atmospheric N deposition in soil: results from two contrasting sites in Switzerland

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In many studies on impacts of N deposition on ecosystems, the soil was found to be the main sink for deposited N. In order to improve our understanding of the mechanisms of retention, we simulated atmospheric N deposition through two joint ^{15}N labelling experiments in the field: two contrasted sub-alpine forest ecosystems were selected, both unfertilised and subjected to moderate atmospheric N deposition (12-16 kg/ha/year). The first site, Grandvillard (Western Switzerland) consists of a mixed forest (*Fagus sylvatica* L. and *Picea abies* L.) with a well drained and calcareous soil and a fast turnover of organic matter. The second site, Alptal (Central Switzerland) is a coniferous forest (*Picea abies* L.) with soils showing hydromorphous features and having an acidic humic layer. Plots (2.5 x 2.5 m) were labelled by a single addition of dissolved tracers, either $^{15}NH_4Cl$ or $K^{15}NO_3$. Retained ^{15}N was quantified in soil litter and organo-mineral layers as a function of time (1 hour to 1 year). Organo-mineral soil was further divided into 4 soil pools (extractable N, microbial N, roots N and N immobilised in soil). For selected sampling times, an acid hydrolysis was performed to obtain deeper insights into which organic fraction (labile or recalcitrant) N tracer was located. Twice a year, we also measured recovered ^{15}N in herbaceous vegetation.

Our results showed that at all sampling times and for both tracers and for both sites, the greatest part of the ^{15}N applied was found in the soil with recovery rates ranging between 0.28 and 1.30. The ^{15}N tracers were detected in all sampled pools already within one hour after labelling. Extractable ^{15}N recovery rates strongly decreased during the first hours to weeks. Inversely, recovered ^{15}N increased in immobilised soil nitrogen (ISN). Recovery rates were then more stable within the soil pools. The ratio of hydrolysable native N was constantly between 70 and 76% at the two study

sites. Ratios within recovered tracers ^{15}N showed to be in the same order of magnitude. On both sites, recovery rates within herbaceous vegetation were similar in the case of NO_3^- tracer application (10-15%). Inversely, much higher yield were found in Alptal for NH_4^+ labelling (20-25% versus 5-7% in Grandvillard) and the highest amount was identified within the mosses of this same site (more then 20%).

Our study confirms that the soil is the main sink for atmospheric N deposition. It is the case for both sites and for both deposition forms that are NH_4^+ and NO_3^-. We show that processes responsible for retention of deposited N in soil happen very quickly, i.e. within a few hours to weeks. Moreover, dynamics are very similar despite of the differences between sites. Since a third of the deposited N is in a recalcitrant (i.e. non-hydrolysable) form already after one week, we suppose that this fraction is immobilized in soil (through fixation by organic matter and clays). Besides, since recovery rates in soils are stable within one year despite of the turnover of organic matter, we think that biological recycling through the microbe-plants-SOM system is another mechanism that governs retention of deposited N in soil.