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Drivers of the long-term fate of deposited nitrogen in temperate forest soils

Liz Veerman (1), Albert Tietema (1), Karsten Kalbitz (2), and Jorien Schoorl (1)

(1) University of Amsterdam, IBED, Amsterdam, Netherlands (l.veerman@uva.nl), (2) Technical University Dresden, Dresden, Germany

Increased anthropogenic nitrogen (N) inputs can alter the N cycle and affect forest ecosystem functions. The impact of increased N deposition depends amongst others on the ultimate fate of N in the available N pools. Short-term studies (3-18 months) showed that the organic soil layer was the dominant sink for N. However, longer time scales are needed to investigate the ultimate fate of N. Therefore, the soils of four experimental forest sites across Europe were re-sampled $\sim$ 2 decades after labelling with 15N. The sites covered a wide range of N-deposition levels varying from 4.4 to 55 kg N ha-1 yr-1 to investigate the effects of different N treatments on long-term 15N recovery. Results showed that $\sim$ 2 decades after 15N addition, large amounts of 15N were still present in the soil. Signs of N saturation due to long-term N deposition were small but visible in the organic soil layers at two of the investigated sites. At some locations a shift had occurred from the organic soil towards the mineral soil as the largest 15N sink. Several soil and site parameters were identified as controlling factors for long-term 15N recovery. Soil organic matter (SOM) stocks and SOM turnover seemed the dominant factors controlling 15N retention. Low SOM turnover was characterized by low temperatures and a high ECEC, moisture content, forest stand age and precipitation. Forest N-status and N leaching were most important in the organic soil. Density fractionation, which is considered to be involved in long-term stabilization of SOM, showed that 15N recovery levels were highest in the heavy fraction of the mineral soil. These results confirm that these temperate forests are capable of retaining long-term increased N inputs preferably when SOM availability is high and SOM turnover and N-status are low.