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Nitrate leaching from a sub-alpine coniferous forest subjected to experimentally increased N deposition for 20 years, and effects of tree girdling and felling

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Atmospheric nitrogen (N) deposition can cause the eutrophication of otherwise N-limited ecosystems, including forests. Increased deposition rates were simulated in a small catchment within a spruce (*Picea abies*) forest at Alptal (central Switzerland, 1200 m a.s.l.). This treatment was applied by sprinkling rain water enriched with ammonium-nitrate (+25 kg/ha/year N) and compared with a control catchment receiving only rain water (12 kg/ha/year bulk N deposition) and where nitrate-N leaching amounts to approximately 3 kg/ha/year.

During rain events, nitrate concentration in runoff water was correlated with the water discharge, both showing simultaneous peaks. Labelling with ^{15}N showed that these peaks partly arise from nitrate deposited during the rain event itself. Preferential and lateral water flow promote very fast leaching in the upper layer of the gleyic soils. Nitrate losses doubled after only few weeks of the N addition experiment. This short-time effect was mainly driven by the hydrological characteristics of the site and could not be considered as a symptom of ecosystem N saturation. The ^{15}N signal disappeared from nitrate leaching within weeks as labelling stopped. Over the years, most of the added N was retained in the ecosystem, especially in the soil.

On each catchment, half of the large trees were girdled in the 15th year of the experiment and felled one year later. This resulted in a strong increase in nitrate leaching from the N-addition catchment, while only a small increase was measured in the control catchment. The abundance of ^{15}N during the leaching peak did not change compared to the preceding years. As a conclusion, the increased leaching appears to be induced by the reduced tree uptake and not so much by a remobilisation from the soil.