Nitrate leaching and soil acidification in a long-term N-addition experiment to a sub-alpine forested catchment on Gleysol

Patrick Schleppi , Thomas Bär

Swiss Fed. Inst. for Forest, Snow and Landscape Research (WSL), Birmensdorf, Switzerland

Nitrogen addition experiment Alptal, central Switzerland

Picea abies forest on Gleysol over Flysch, 1200 m a.s.l., average temperature 6°C, precipitation 2300 mm/y.
Paired-catchment experiment: addition of 22 kg N/ha/year as NH_4NO_3 dissolved in rain water.
Control catchment with ambient deposition of 12 kg N/ha/year. Start of the experiment: 1995.

Precipitation chemistry

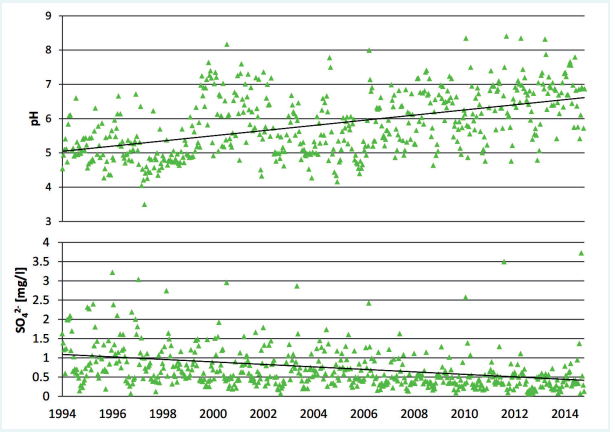
3 main trends:

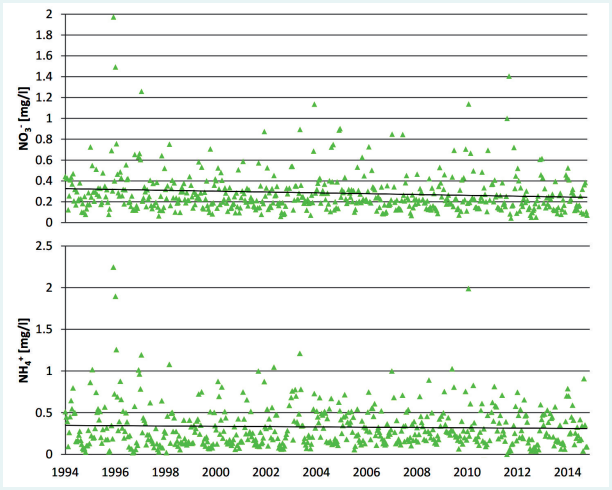
- pH ↑
- SO_4^{2-} ↓
- NO_3^- ↓

Also:

- Mg^{2+} ↑

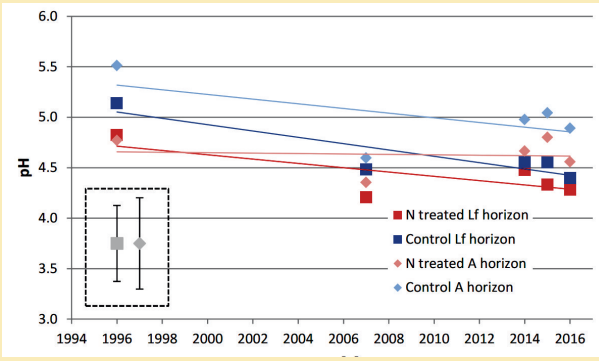
Not significant:
NH_4^+, Ca^{2+}, Na^+, Cl^-, DON

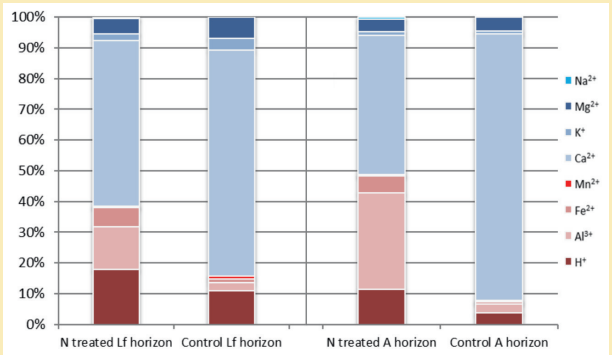




Soil acidification

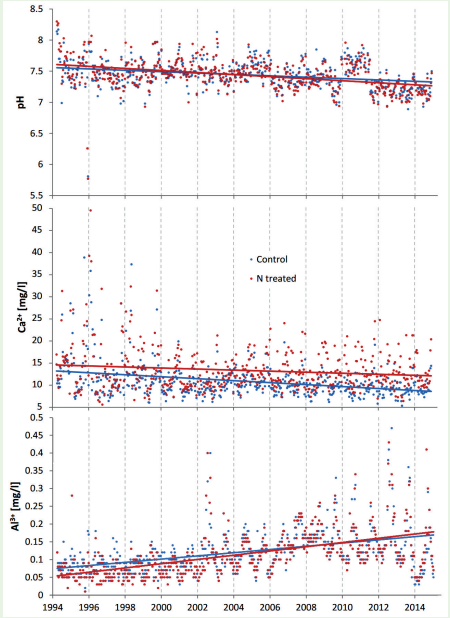
pH ↓ in control and N-addition catchments.
N addition => loss of base saturation on mounds.

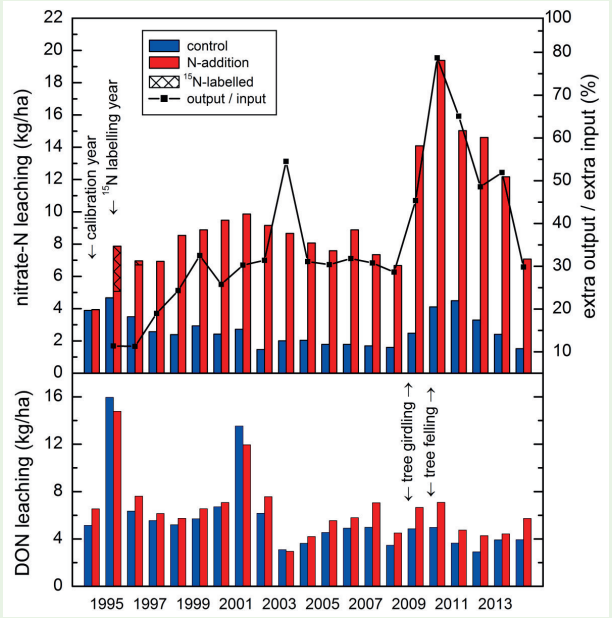




Runoff chemistry

Water pH ↓. Shift from Ca^{2+} to Al^{3+} leaching (also Fe^{3+} in the N-addition catchment).
Strong increase in NO_3^- leaching due to N addition, also after tree girdling and felling ½ of the trees. NO_3^- leaching controlled by precipitation NO_3^- (fast preferential flow) and by tree uptake, as shown by ^{15}N labelling. Most of the added N retained in the ecosystem, mainly in soil.





Conclusions

Signs of soil and water acidification in spite of a well-buffered bedrock and decreasing acid deposition rates.
N accumulation in the soil makes the forest more susceptible to NO_3^- leaching after disturbances.