



Multiple nitrogen (N) saturation indicators yield contradicting conclusions on improving N status of temperate forests in five LTER-Belgium/ICP Forests sites

Setup and hypotheses

We aimed to test the hypothesis that forest N status in northwest Europe has started to improve.

We evaluated the evolution of multiple N saturation indicators in five ICP Forests Level II plots in northern Belgium, using long-term soil solution and foliage datasets:

- Soil solution DON:TDN ratio (2005–2014)
- Soil solution DOC:NO₃⁻ ratio (2002–2014)
- Foliar N:P ratio (1999–2013)
- Foliar Bc:N ratio (1999–2013)

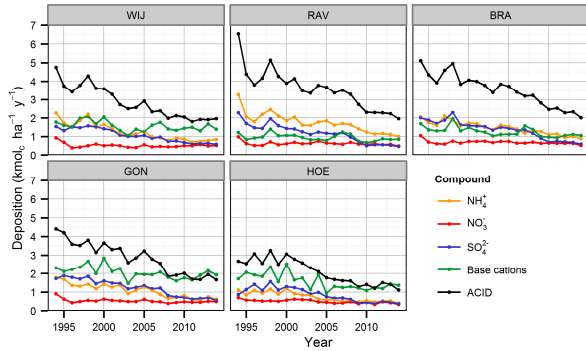
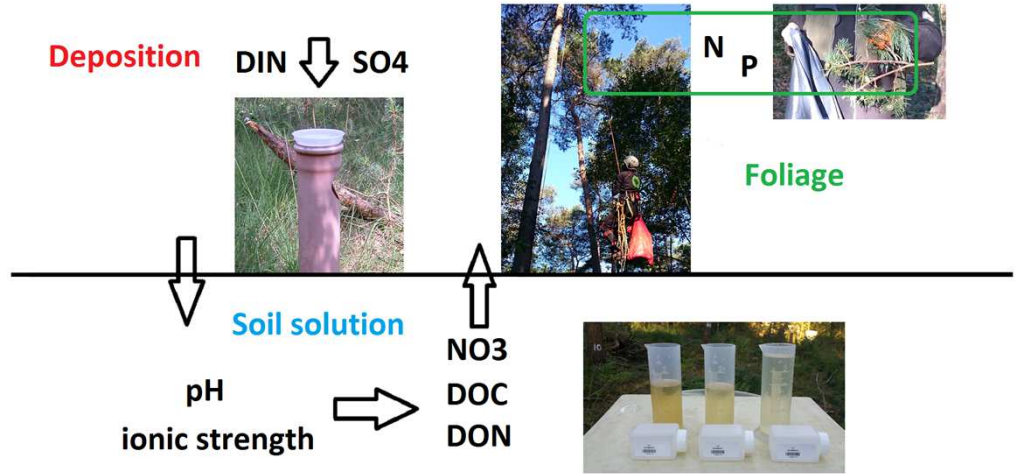


Fig. 1 Annual deposition (throughfall + stemflow) ($\text{kmol}_c \text{ha}^{-1} \text{y}^{-1}$) of NH_4^+ , NO_3^- , SO_4^{2-} , base cations ($\text{Ca}^{2+} + \text{K}^+ + \text{Mg}^{2+}$) and ACID ($\text{SO}_4^{2-} + \text{NH}_4^+ + \text{NO}_3^-$) (1994–2014).

Results

- The ratio of dissolved organic nitrogen (DON) and total dissolved nitrogen (TDN) in soil solution, DON:TDN increased since 2005 in all plots.
- The ratio of dissolved organic carbon (DOC) and nitrate (NO₃⁻) in soil solution, DOC:NO₃⁻ increased since 2002 in four out of five plots.
- The ratio of N and phosphorus (P) in foliage, N:P remained unchanged.
- The ratio of base cations (Bc = calcium + potassium + magnesium) and N in foliage, Bc:N remained unchanged.

Soil solution DON:TDN and DOC:NO₃⁻ ratio

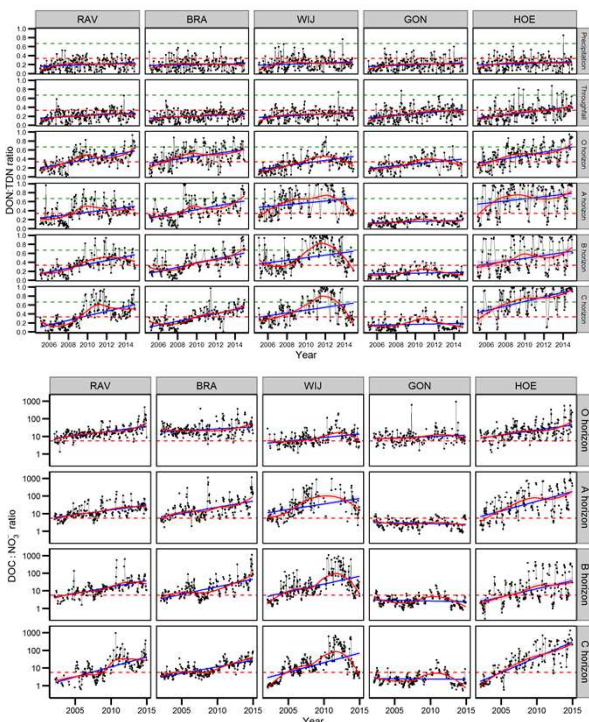


Fig. 2 Trend of soil solution DON:TDN ratio and DOC:NO₃⁻ ratio.

Tree nutritional status

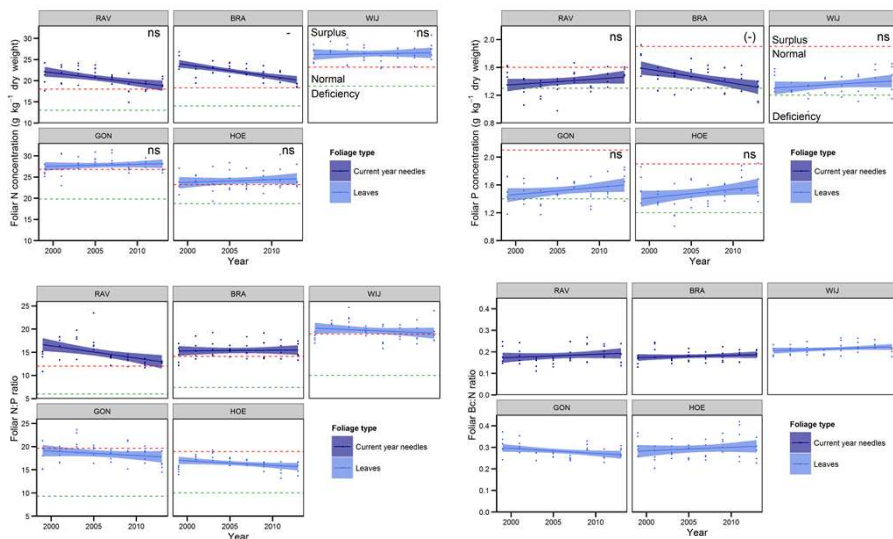


Fig. 3 Trend of foliar N and P concentration, N:P ratio and Bc:N ratio.

Conclusion

- Our research questions if common critical DOC:NO₃⁻ limits are stringent enough for European forest soils.
- Insight in forest recovery from N saturation requires a multiple indicator approach.