F. Rokop

LONG-TERM NITROGEN DEPOSITION IMPACTS IN A TEMPERATE FOREST ECOSYSTEM IN AUSTRIA

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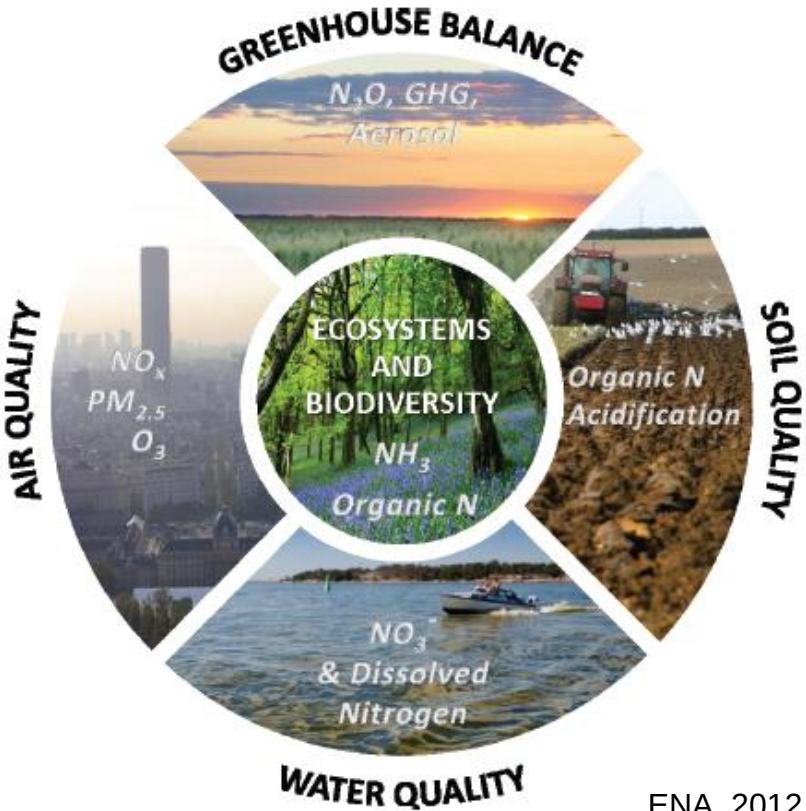

ENA, 2012

REACTIVE NITROGEN HARMS THE ENVIRONMENT

- **Nitrogen is an essential nutrient** but today emissions from agriculture and fossil fuel burning provide ¾ of the N input into the biosphere (in Europe)
- **Ecosystem effects** include tree nutritional imbalances, NO_3 loss to the groundwater, N_2O emissions, soil acidification, and biodiversity loss
- The annual costs of reactive N in the environment in the EU amount to 70 - 380 billion € (ENA, 2012)

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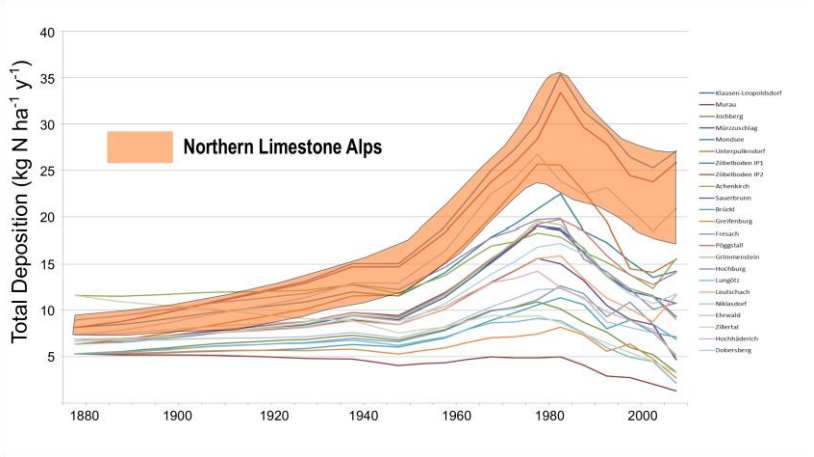
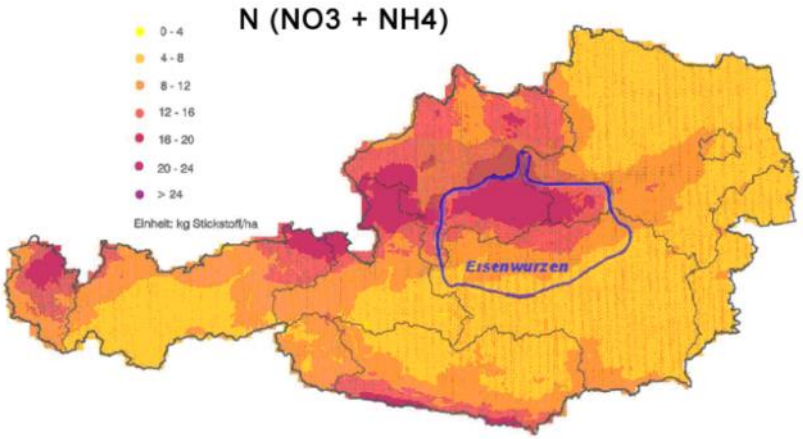
HIGHEST ATMOSPHERIC NITROGEN LOADS IN THE NORTHERN LIMESTONE ALPS



Total (dry and wet) N deposition since 1880

3-5 fold the preindustrial N deposition



Distribution of wet N deposition in Austria (Schneider 1998)

Highest N deposition in the humid Northern Limestone Alps due to precipitation and emission sources

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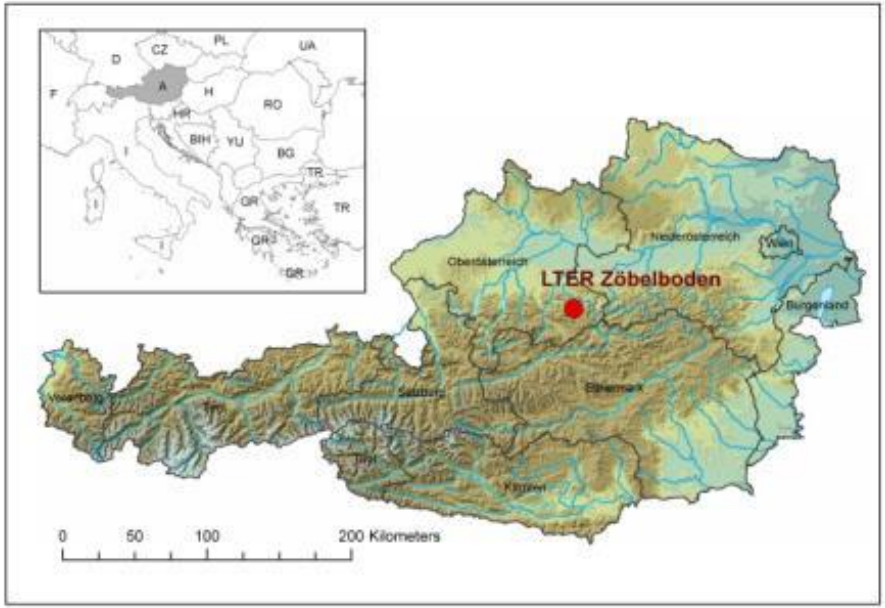
25 YEARS ECOSYSTEM MONITORING AT ZÖBELBODEN

- Forested, 90 ha Karst catchment (550 - 950 m a.s.l) in the Northern Limestone Alps
- Established in the year 1992 as the Austrian‘s contribution to ICP Integrated Monitoring (UN-ECE) of air pollution effects in Europe
- Today LTER Zöbelboden serves as a highly instrumented ecosystem monitoring and research site for the effects of air pollution and climate change including biodiversity



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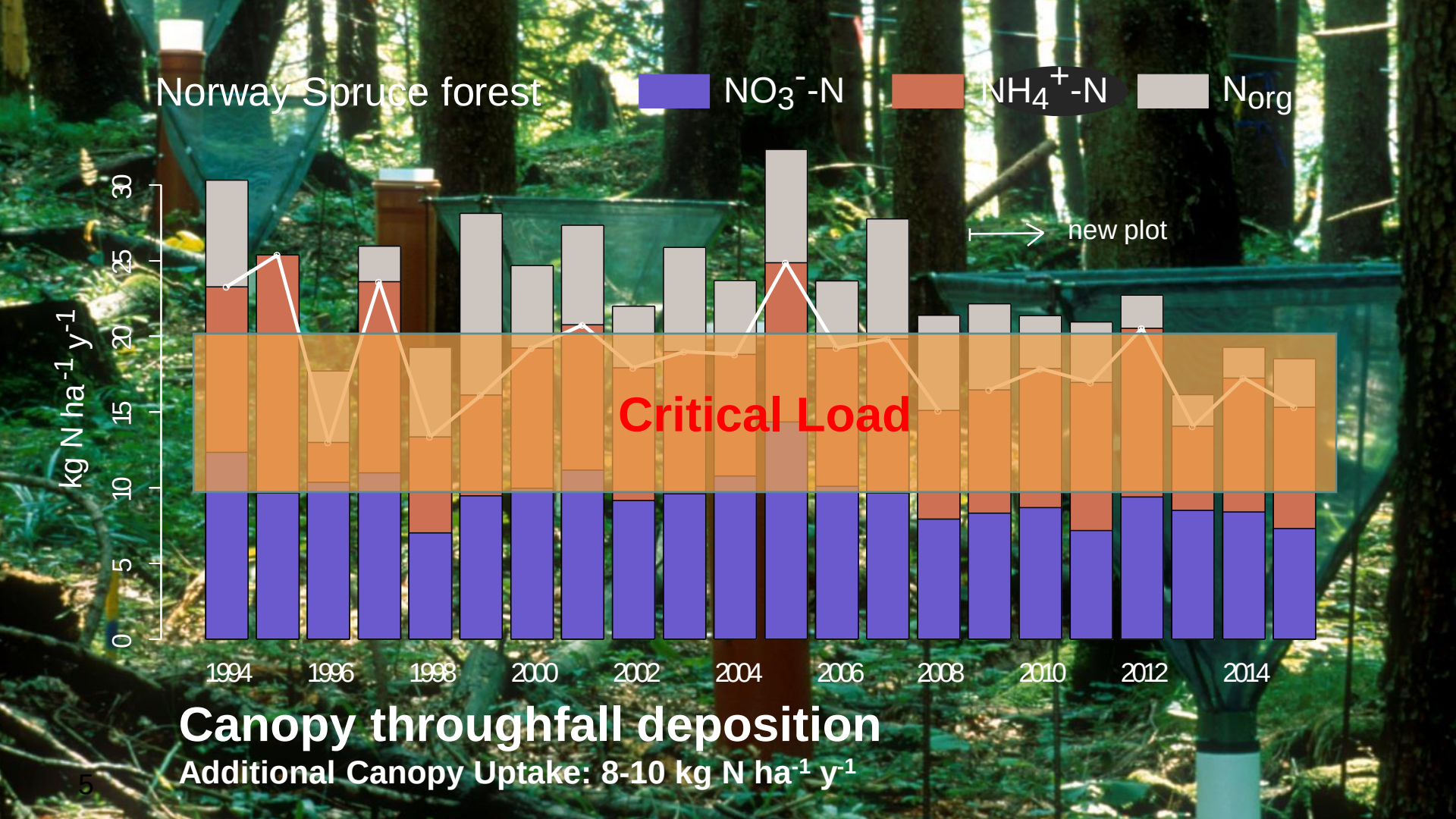
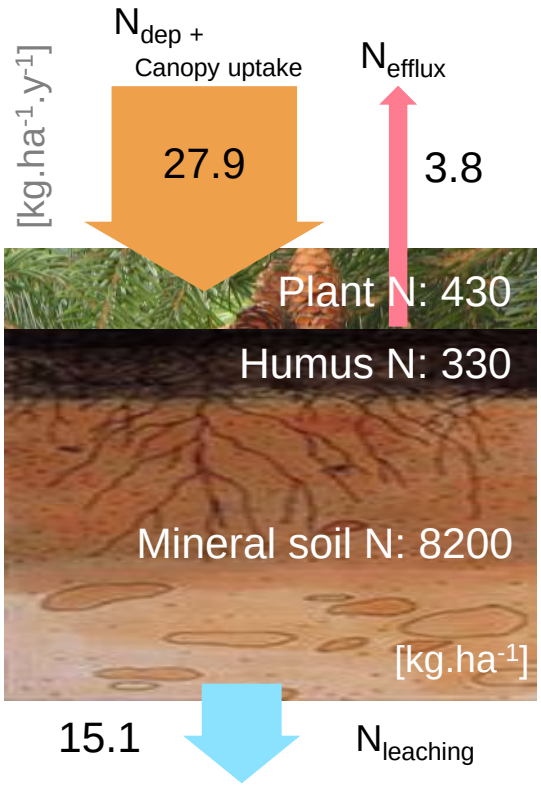


Canopy throughfall deposition

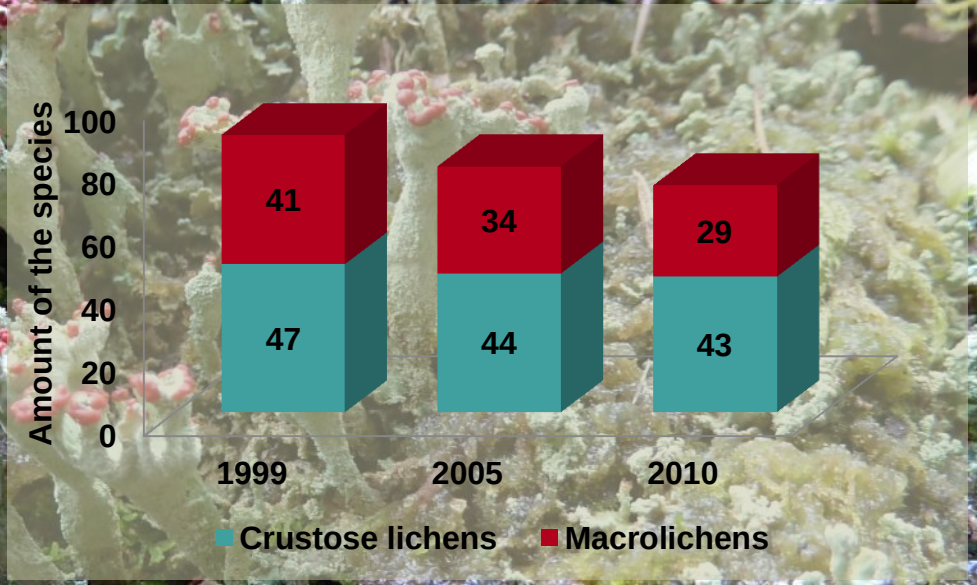
Additional Canopy Uptake: 8-10 kg N ha^{-1} y^{-1}

OPEN N CYCLE DUE TO CHRONIC N DEPOSITION



- Mull humus with low C:N ratio (17) and low microbial N immobilization
- From the total N deposition, 68% is lost to the groundwater (mostly NO_3^-) or as gaseous efflux (NO, N_2, N_2O)

HIGH N DEPOSITION NEGATIVELY AFFECTS BIODIVERSITY



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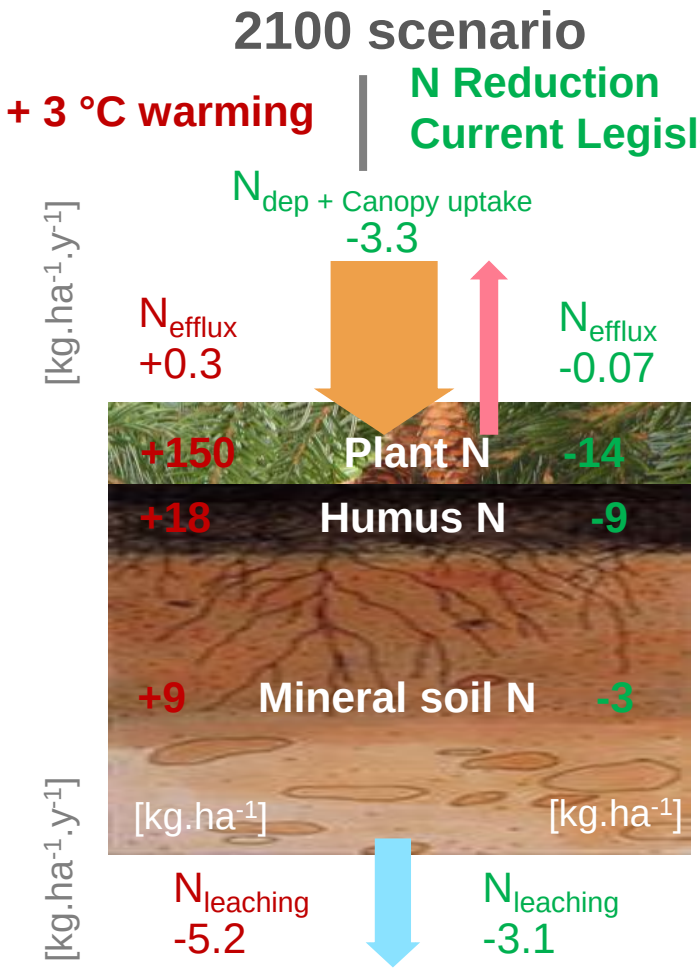


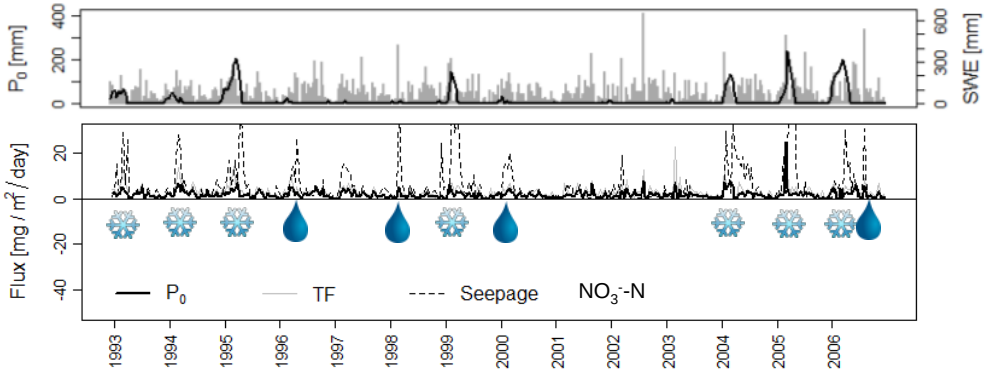
FUTURE REDUCTION IN N DEPOSITION AND CLIMATE CHANGE MAY INCREASE ECOSYSTEM N RETENTION

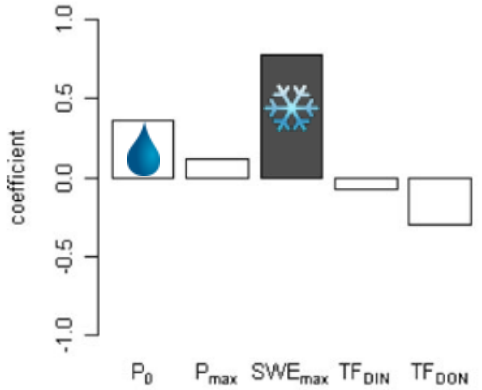
- According to current legislation **N deposition will decrease by ~3 kg N ha^{-1} y^{-1} causing less N loss**
- Expected **climate warming** will particularly **increase immobilization of N in trees**
- Overall N retention is expected to increase rendering the system **significantly less leaky**

CLIMATE AND DISTURBANCE EVENTS MAY BE MORE IMPORTANT IN FUTURE

- Scenarios rarely capture changes in seasonal variation and extreme climate events
- Droughts, stormflows and snow dynamics may change in an unexpected way
- Forest disturbances are predicted to increase
- What can we learn from the measured N dynamics?

CLIMATE EVENTS DRIVE NITRATE LOSS TO THE GROUNDWATER AND NOT THE AVERAGE CLIMATE





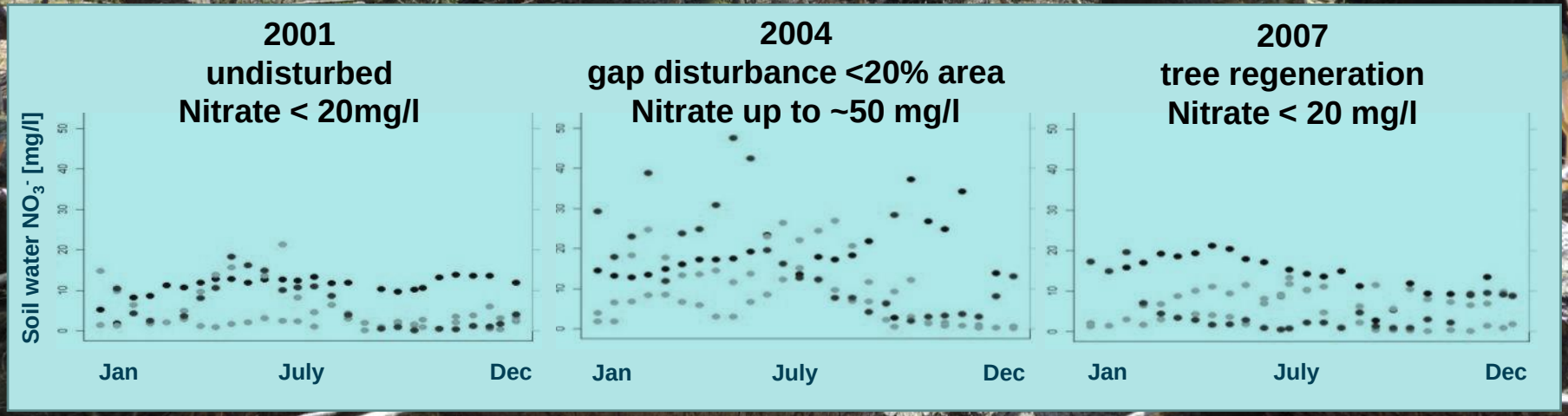
Long-Term climate and Nitrate fluxes

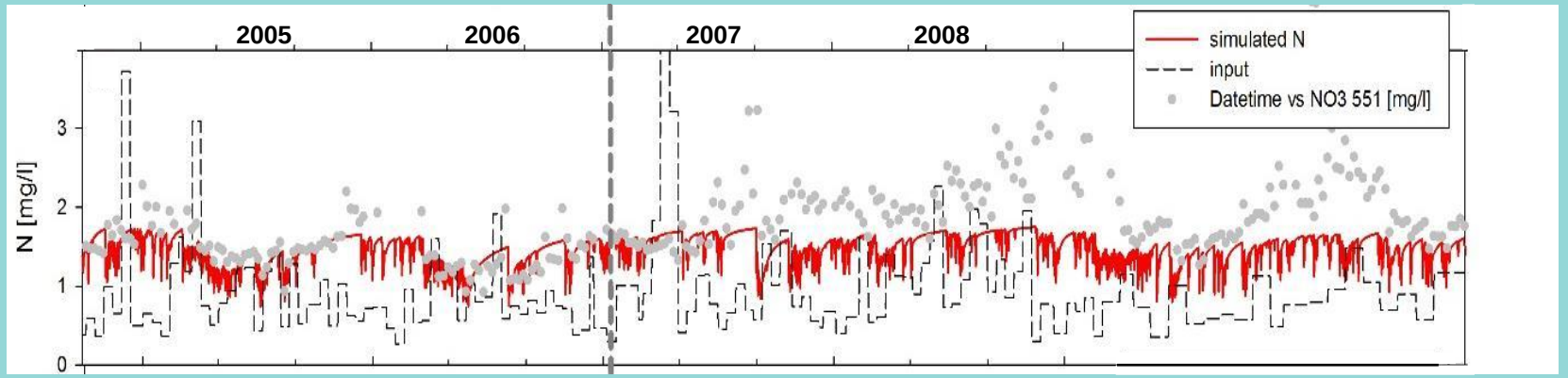
Very high variation in NO_3-N seepage fluxes

Coefficients of determination of NO_3 leaching

Nitrate leaching is predominately controlled by snow melt and heavy rain events

FOREST DISTURBANCE STRONGLY REDUCES N RETENTION CAUSING ELEVATED NITRATE LOSS





Catchment response to forest disturbance

Windthrow at approx. 5-10% of the catchment

CONCLUSIONS AND OUTLOOK

- Long-term high N deposition in the Northern Limestone Alps has resulted in forest ecosystems with particularly **open Nitrogen cycles**
- Future **reduction in N deposition** according to current legislation **and climate change will cause higher N retention**
- **Future changes in climate events** may have a significant impact on how the ecosystem and the karst catchment will be able to retain Nitrogen
- The expected increase in **forest distrubances may additionally cause N pollution pulses** with long-lasting consequences on drinking water quality
- The ICP IM and LTER site **Zöbelboden will be part of LTER-CWN**, a network for the investigation of extreme climate events on C, N and water cycles in Austrian ecosystems

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GLOBAL LITTER DECOMPOSITION STUDY

TEA COMPOSITION

Unilever

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TeaComposition H_2O – Global Aquatic Litter Decomposition Initiative

Contact: Stacey Trevathan-Tackett
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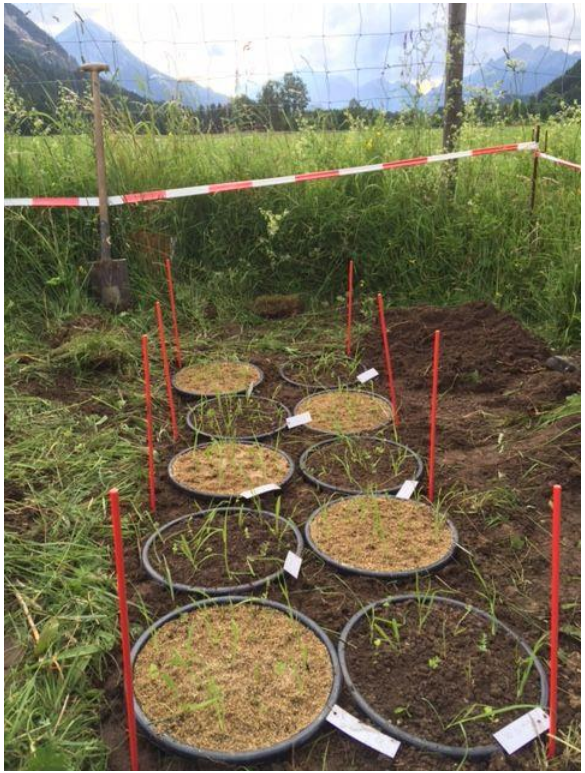
Common Metric: Phytometer



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