Nitrogen deposition and its impacts on soil and plant growth: perspectives from the Bois Chamblard study

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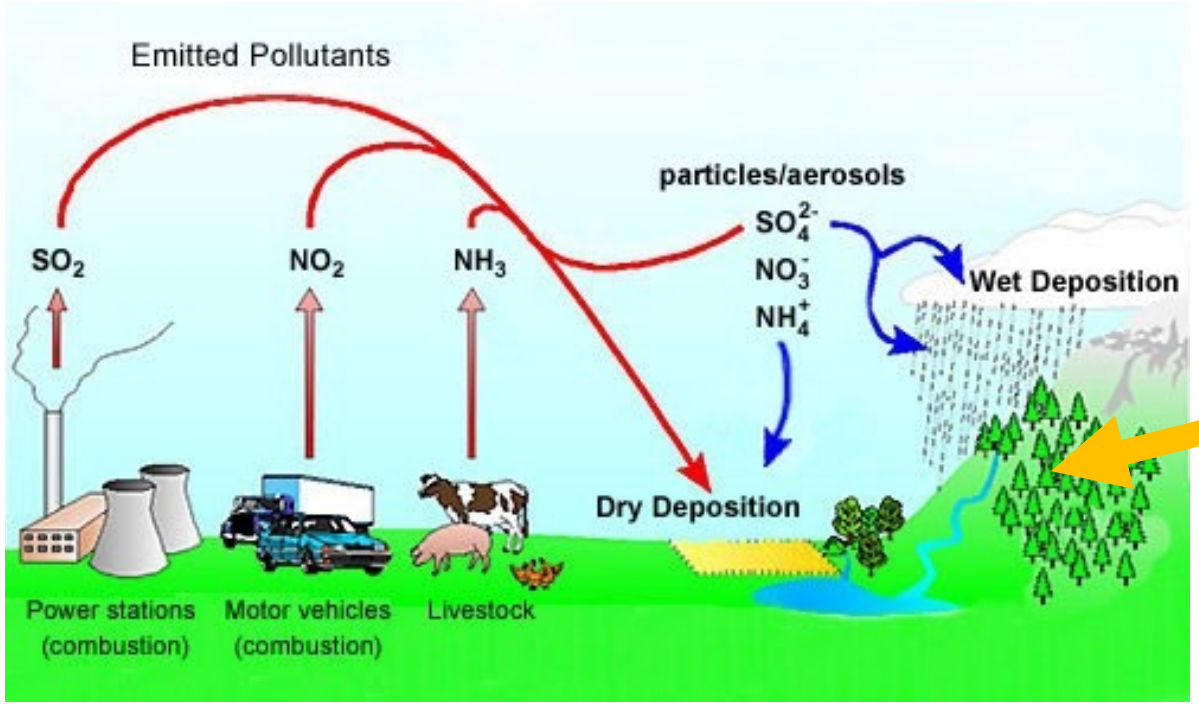
Motivation and Objectives

Pollution provides large amounts of macronutrients (N, P) to ecosystems via **dry** (gas + particles) and **wet** deposition



https://medium.com/@dorithelegacy8/acid-rain-4ebf6f8d01b3/

Lack of understanding of soil microbes and plant response (key factors for the ecosystem)

Our pilot study **investigates how pollution impacts plants and soil biota**

Collaboration: Prof. A. Buttler (WSL/ECHOS), Prof. C. Grossiord (WSL/PEARL)

Aerosol acidity: effect on Gas and Particle deposition

Gas dep. = Fast Particle dep. = Slow

High pH and moderate LWC

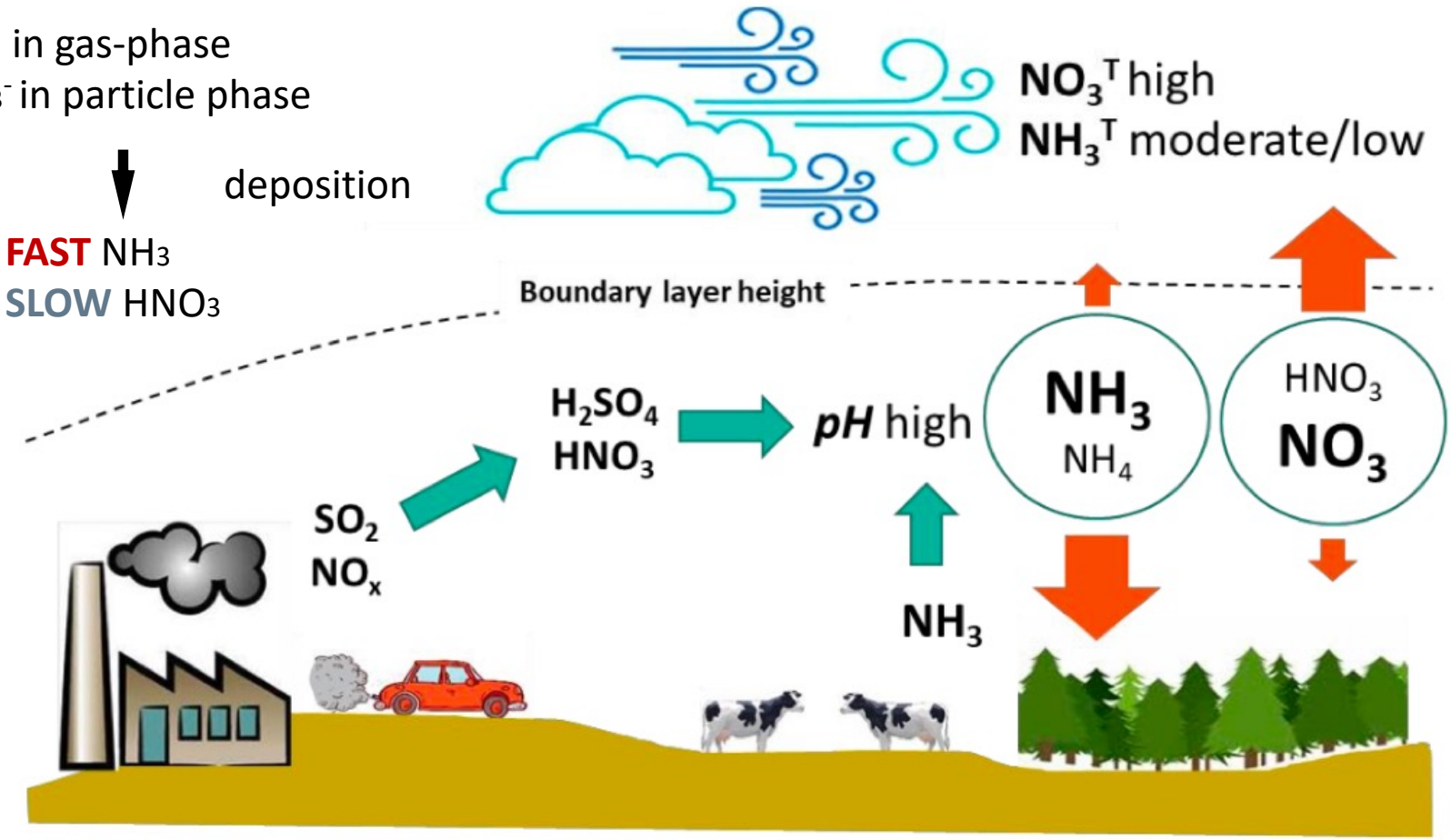
NH_3 in gas-phase

NO_3^- in particle phase

↓ deposition

FAST NH_3

SLOW HNO_3



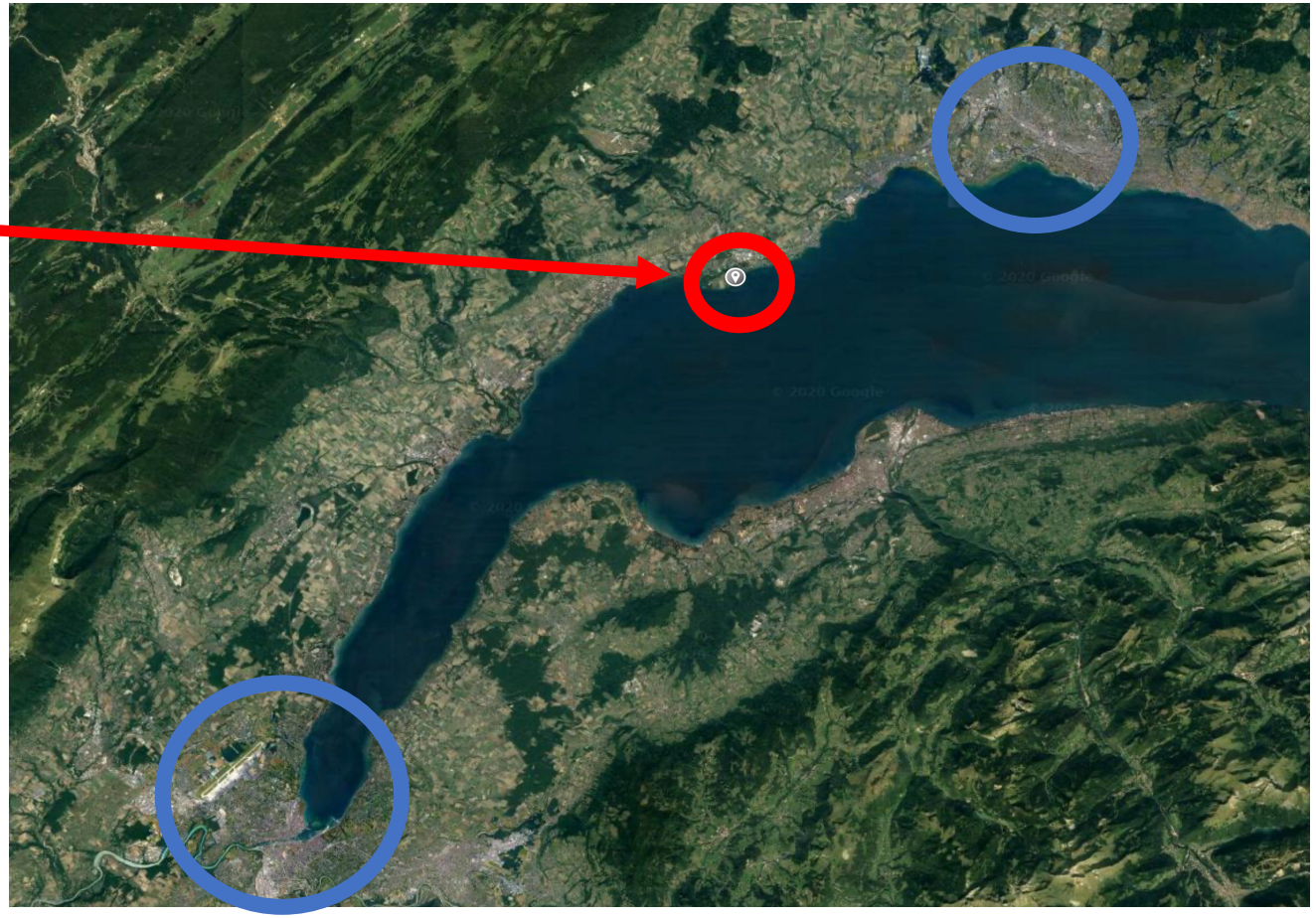
Nenes et al. ACP 2021

Field location

Semi Urban location: 1.2 M ab.

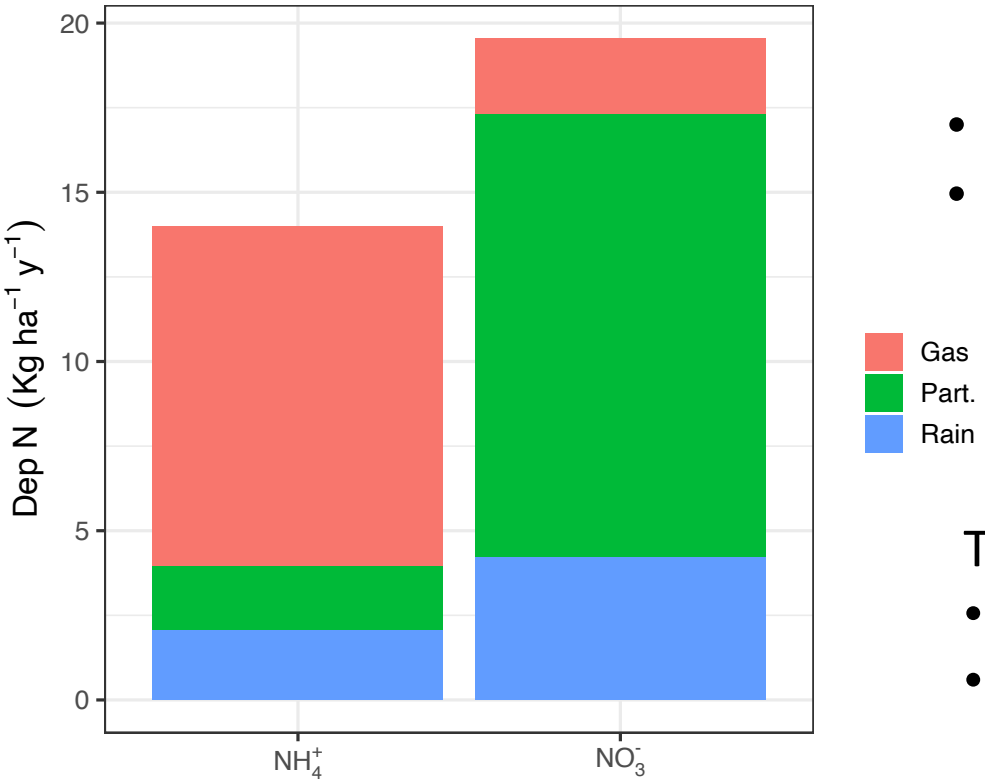
LAUSANNE

Sampling Site



GENEVA

N deposition – Wet + Dry



Aerosol pH ~ [2 , 3.5] = ”low” acidity

↓

- NH_3 from local sources (fertilizers?)
- NO_3^- in particle from regional sources (cities, highway)

Total N deposition ~ 33 Kg ha^{-1} y^{-1}:

- NH_4^+ = 13.9 (~40%)
- NO_3^- = 19.5. (~60%)

How this N deposition affect plants and soil?

Experiment Design for Oat

Exposed to Pollutants "OPEN"

Rain funnels

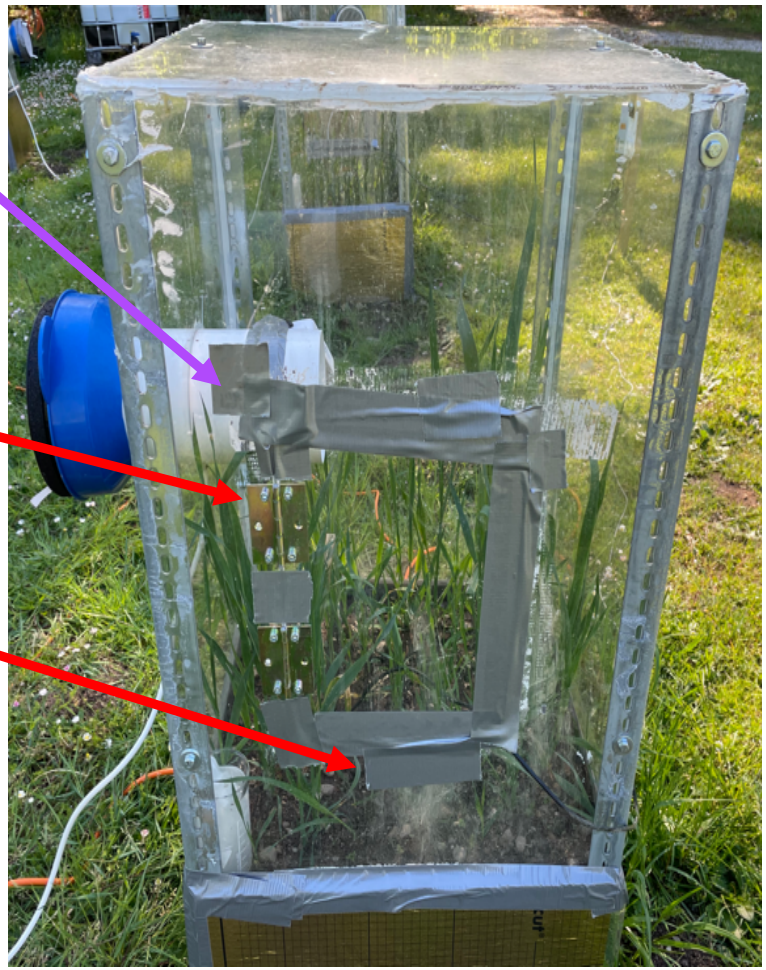
Open Fan

Air T and RH

Soil T and moisture

Not Exposed to Pollutant "CLOSED"

Filter Fan

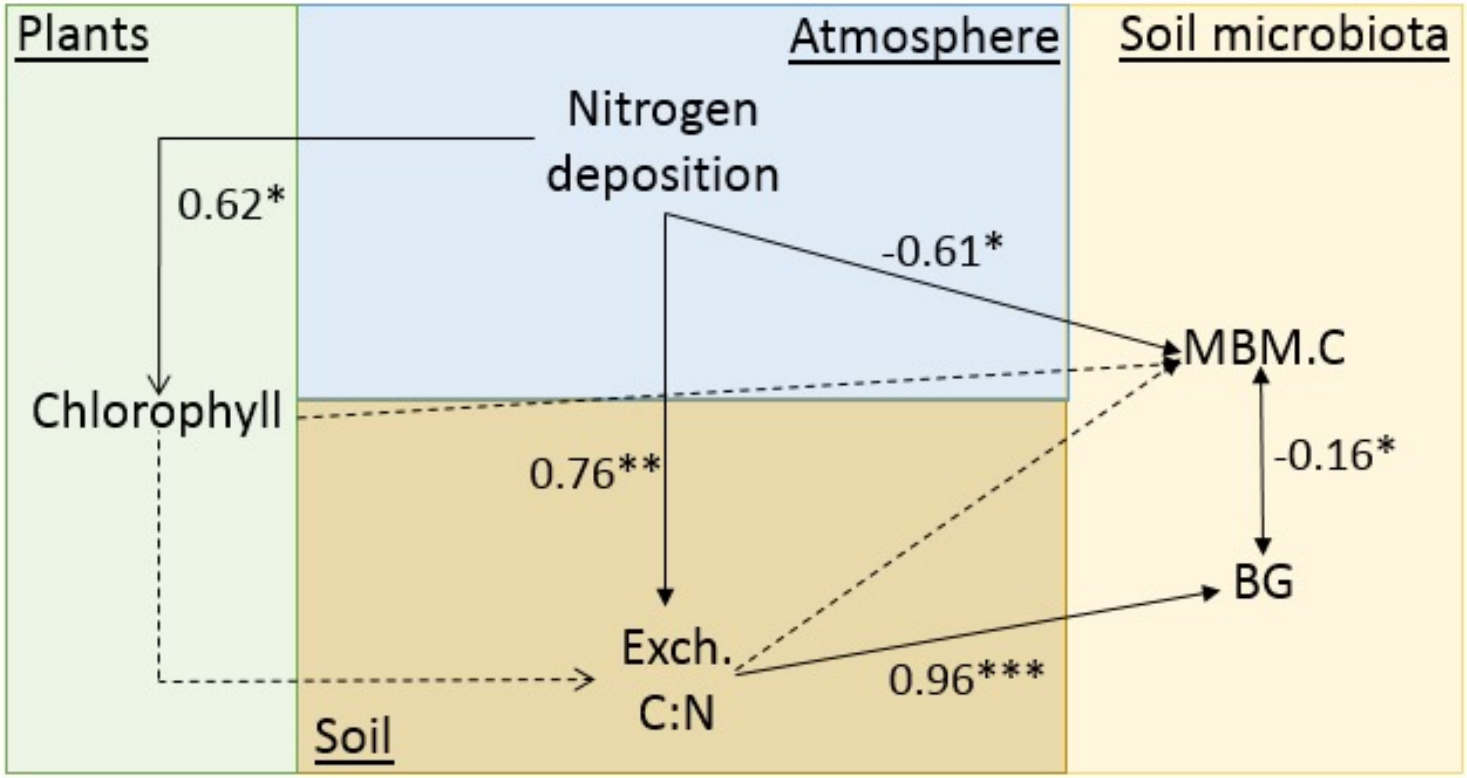


8 times more N deposition

Milli-Q for watering

Structural Equation Model

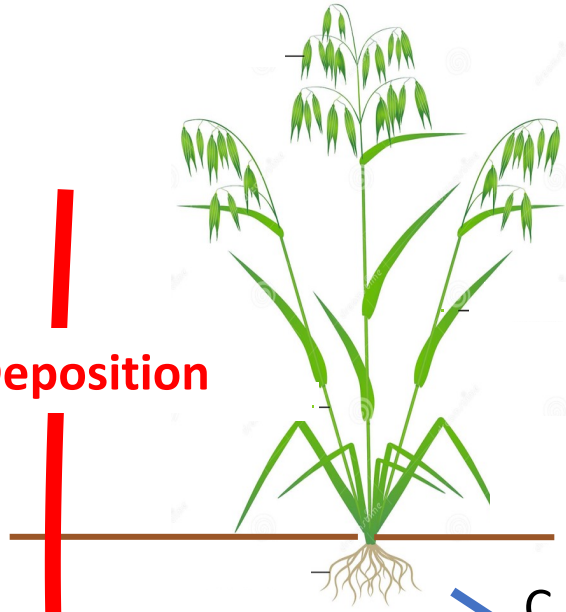
Fitting parameters of path analysis: P=0.06 , RMSEA=0.39 , SRMR=0.15 and CFI=0.85



SEM indicates that N deposition causes a direct and indirect changes in plant, soil and microbial ecosystem components.

The effect N deposition was of similar magnitude on the three evaluated ecosystem components.

Soil-Plant system WITH pollutants



N Deposition

Total C:N < 15

Mineralization

C is missing microbes hunt for C from OM, exceeding N is released in the soil as NH_4NO_3

C Rhizo deposition from plants increases nutrient availabilty for microbes

C Rhizo-deposition

Higher C:N
Faster immobilization

Crop uptake

NH_4^+ / NO_3^-

Microbiome

Org. Mat.

Fungi/Bacterial
~ 100% higher

Higher C:N -> slower Mineralization

Conclusions

ATMOSPHERE

- Atmospheric conditions in the region favour long range transport of NO_3^- (**slow dry deposition/rain composition**) and short range transport of NH_3 (**fast dry deposition**)

- Atmospheric N deposition is dominated by NO_3^-

SOIL PLANT interaction

Atmospheric N deposition **in soil with plants :**

- Increases plant chlorophyll content and C Rizho-deposition
- Increases microbes nuntrients harvesting activity
- Induces a shift in microbial community towards more fungi populated
- Activates the community to nutrients stocks decomposition -> stronger priming Effect

Thanks for your attention