

# Potential consequences of water limitation and drought-induced tree mortality on C and N cycling

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## Context

Reductions in tree growth and increased episodes of mortality as a response to drought have been recently documented in several bioregions across the world<sup>[1,2]</sup>.

The responses of drought-affected plants, soils and their microbial communities have long been considered separately.

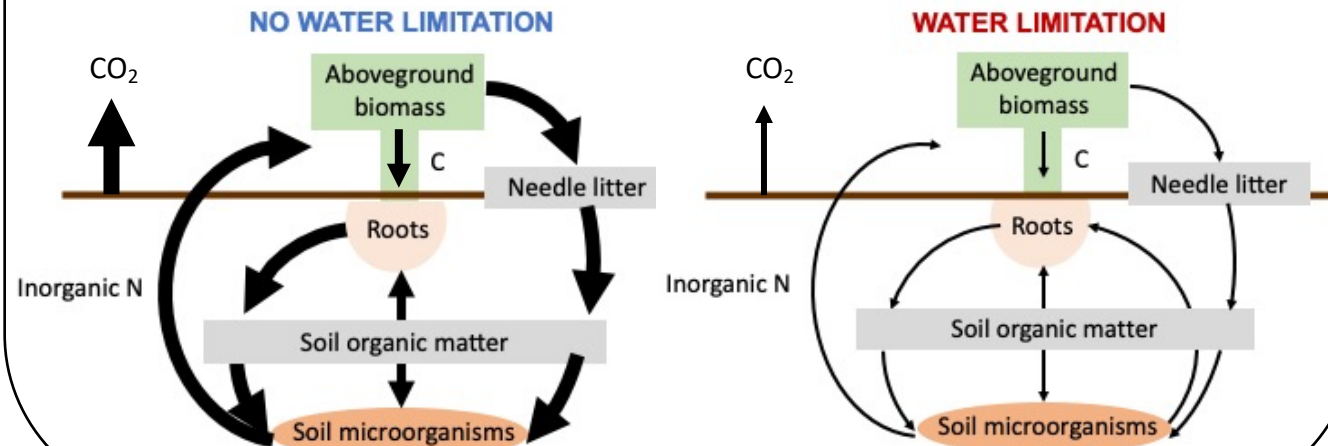
Water limitation induces a series of interconnected effects that act synergistically on the biological interactions between plants and soil microorganisms.

→ C and N cycling feedbacks

## Some hypothesized biogeochemical feedbacks

### A lower amount of water availability will:

- lead plants to invest in within-tree C allocation and in the maintenance of root systems.
- slow down the formation of stable soil organic matter from plant roots/rhizodeposits and needle litter.
- reduce the microbial transformation of plant litter to plant-available compounds ( $\text{NH}_4^+$ ,  $\text{NO}_3^-$ ), feeding back on plant nutrient assimilation.
- trees which are well adapted to less water availability will survive longer under extreme drought and higher atmospheric temperatures.



# A holistic and multidisciplinary experimental approach

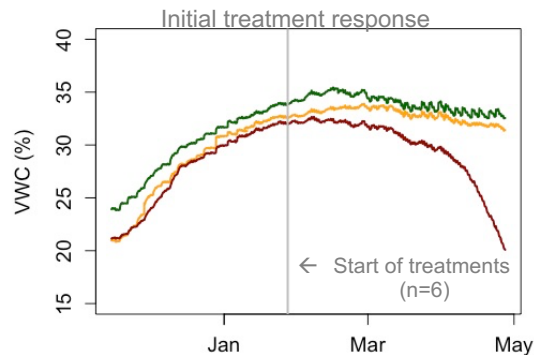
## Mesocosms

### 18 mesocosms featuring:

- Scots pine (*Pinus sylvestris* L.)
- native soil from a drought-affected Scots pine forest in Southern Switzerland (Pfywald, Valais) with high rates of tree mortality. Loam, pF 1.8 ~ 35 VWC %.

**3 treatments:** **Moist** (field capacity), **Dry** (40% reduction)\*, **Very dry** (75% reduction).

Duration of experiment (**3 years**)



\*max deviation from precipitation climatological normal predicted for Southern CH in summer<sup>[3]</sup>

## Performed experiments and analyses

We will follow the fate of decomposing <sup>15</sup>N enriched plant litter into the soil and **microbiome**.

A <sup>13</sup>C pulse labelling of tree crowns will be performed and traced through the system.

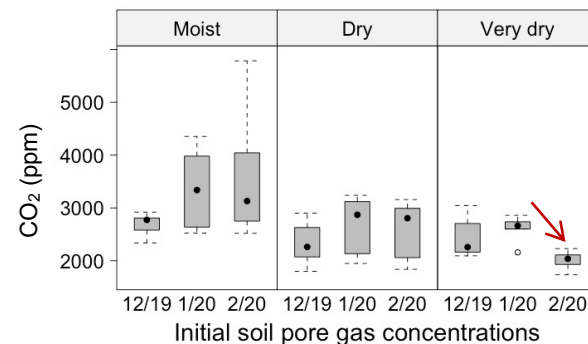


Tree gas exchange  
Net photosynthesis  
Chlorophyll fluorescence

Tree height  
Needle length/area  
Needle fall  
Root growth, biomass

Soil pore gas  
Basal respiration  
N-min, total N  
Soil organic C  
Soil density fractions  
Moisture, Temp sensors  
pH, CEC...

Soil microbiome  
(biomass, abundance, diversity, metabolism...  
→ PhD of Astrid Jäger)



References: [1]Allen et al., 2010, [2] Rebetez and Dobbertin, 2004, [3] <https://www.meteoswiss.admin.ch>

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