Tree-water use recovery after drought-intermittent rainfall events

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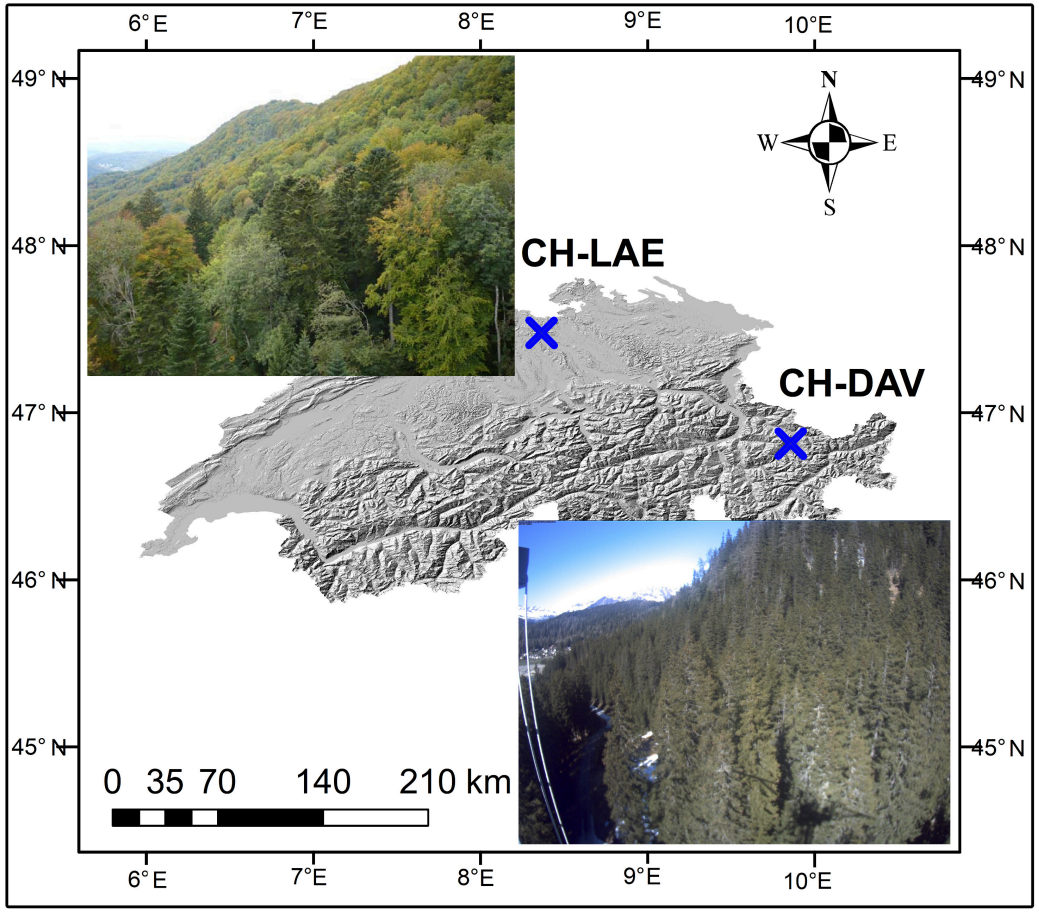
Motivation

- *Low drought-intermittent rainfall (LDIR),* i.e., low rainfall following dry conditions, typically re-wet top few centimeters of soil.
- Nevertheless, these LDIR could provide the much-needed short-term water supply during dry spells to the terrestrial ecosystem, especially trees.
- An efficient use of these LDIR could provide the trees with a buffer to withstand long drought conditions, which are expected to become more frequent and intense with climate change.

- **Objective:** To quantify the inter-species and intra-species tree water use (TWU) recovery (R_{TWU}) in terms of sapflow recovery following an LDIR event.
- **Hypothesis:** The main hypothesis tested here is that the intra-species differences in R_{TWU} are directly related to tree dimensions.

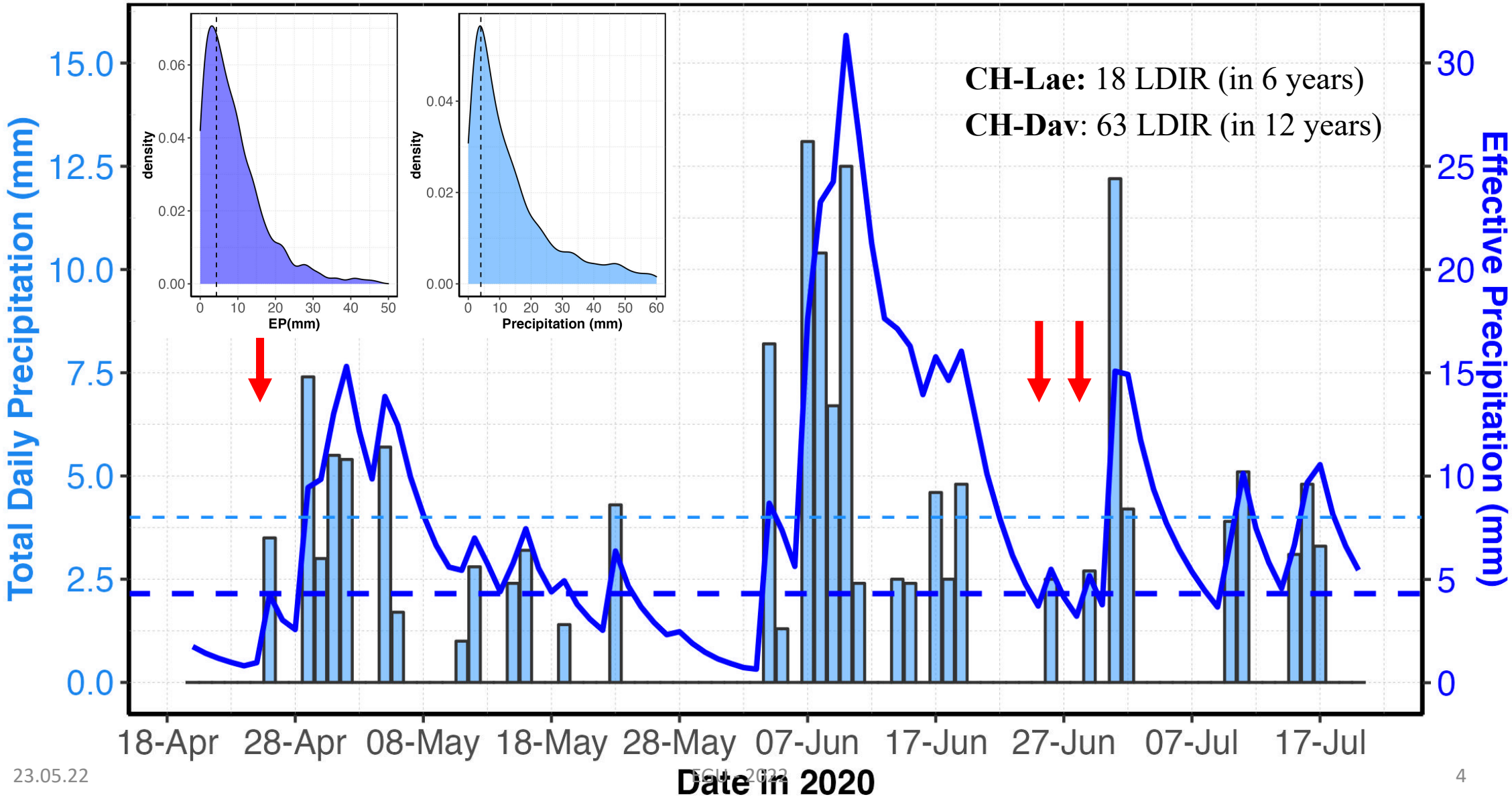
Data & Methods



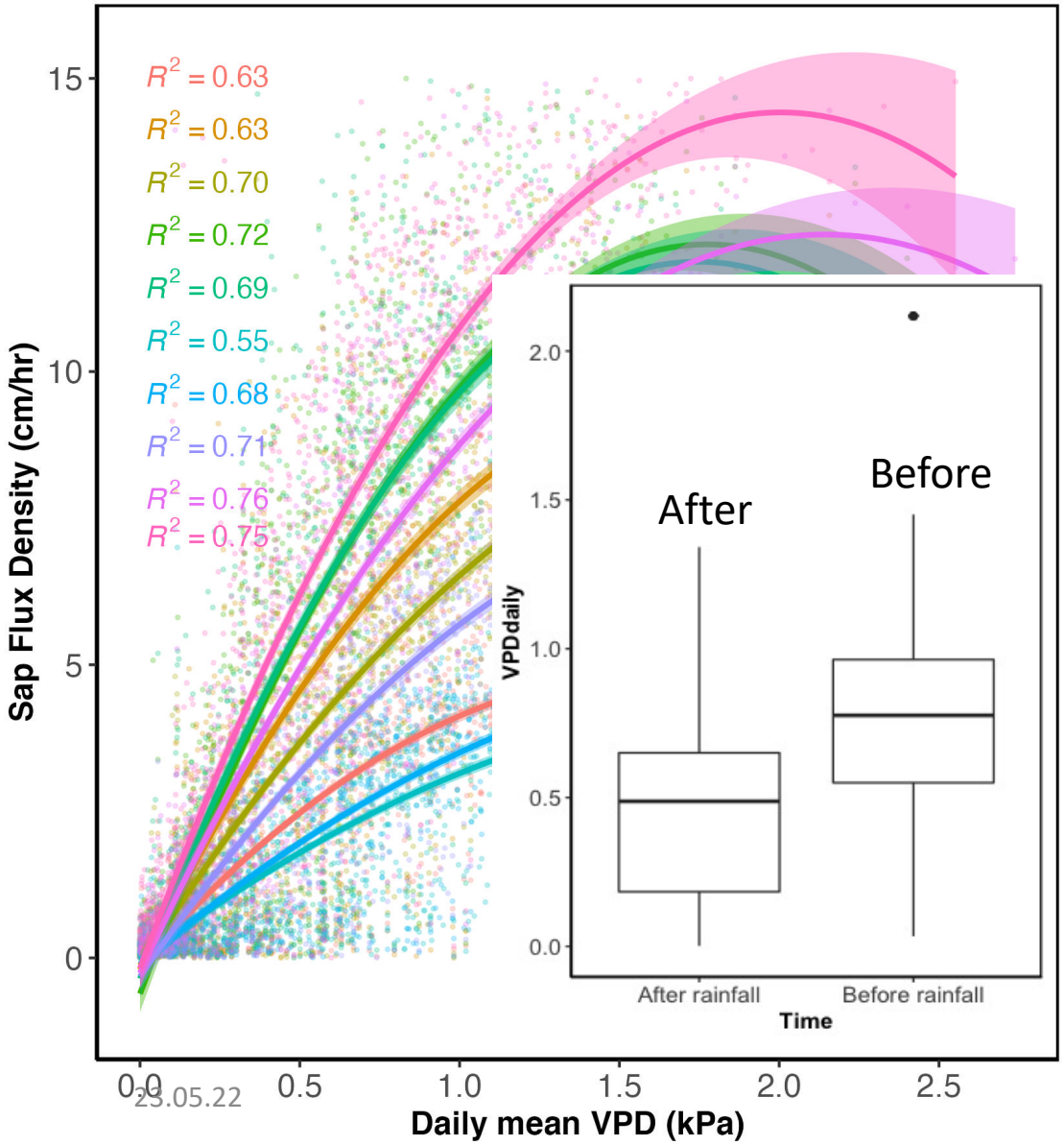
- **CH-Lae:**
  - Montane Mixed Forest.
  - Elevation of 689 m asl.
  - Site dominated by European Beech (*F. Sylvatica*).
  - Four European Beech and Four Norway Spruce (*P. Abies*) trees using thermal heat probes.
  - Time period – 2012-2015 & 2020-2021 (6 years)
  - Meteorological data available since 2004

- **CH-Dav:**
  - Sub-alpine Coniferous Forest (Norway Spruce)
  - Elevation of 1639 m asl.
  - 15 Norway Spruce (*P. Abies*) trees using thermal heat probes.
  - Time period – 2010-2021 (12 years)
  - Meteorological data available since 1997

Method: LDIR events



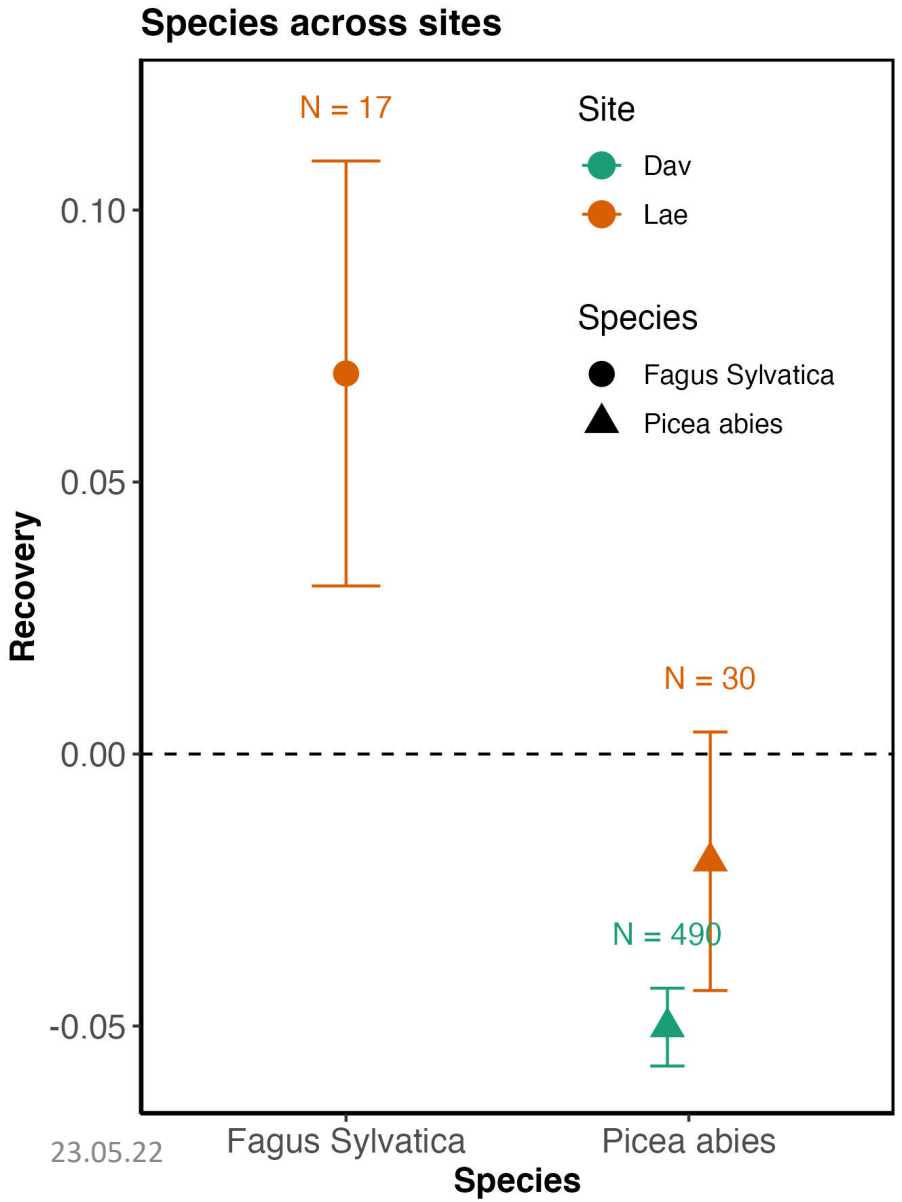
Method: TWU Recovery



- Sapflow is highly dependent on VPD.
- Difference in before and after VPD complicates the recovery to be calculated as a simple difference in Sapflow (After – Before)
- We used a Random Forest regression:
  SFD ~ f(VPD, Rg, EP, DOY, Event-type) - SFD_{mod}

$$R_{TWU} = \frac{SFD_{obs} - SFDmod}{Max(SFD)}$$

Results: Species across sites



- Inter-species difference:

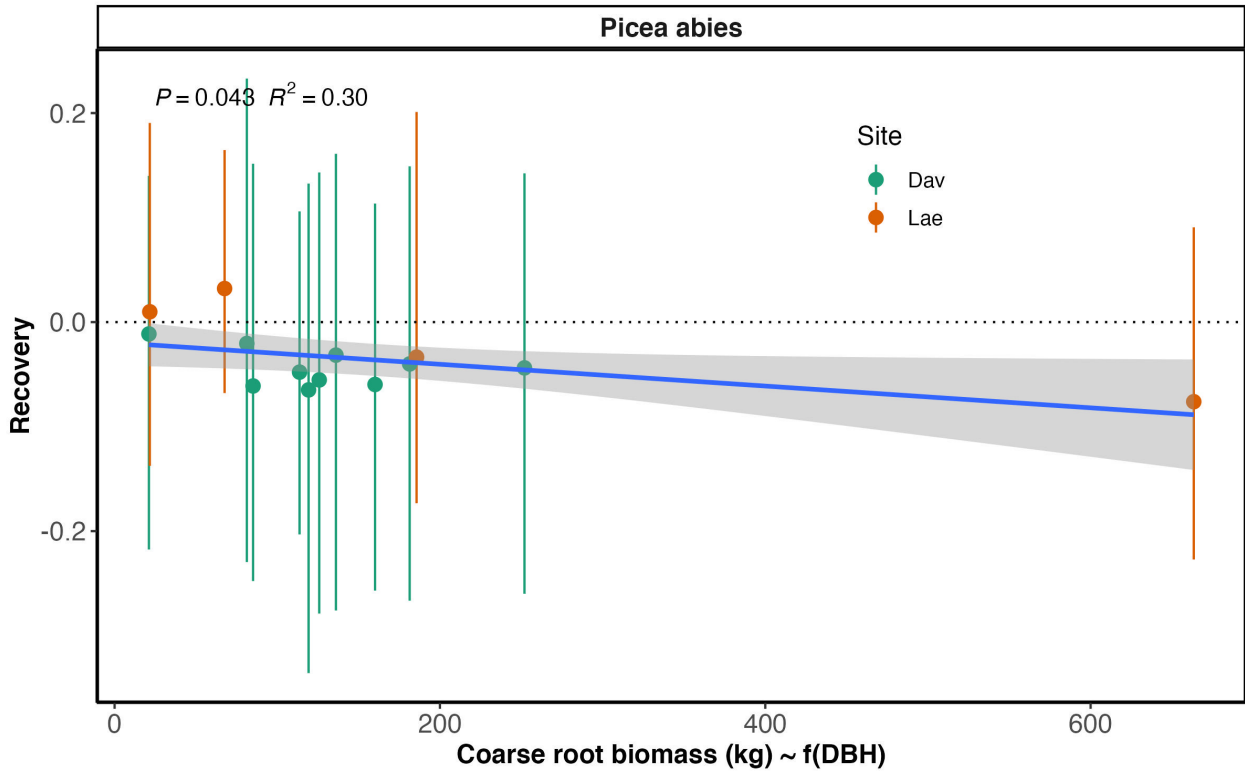
  Higher recovery for *F. Sylvatica* compared to *P. Abies*.

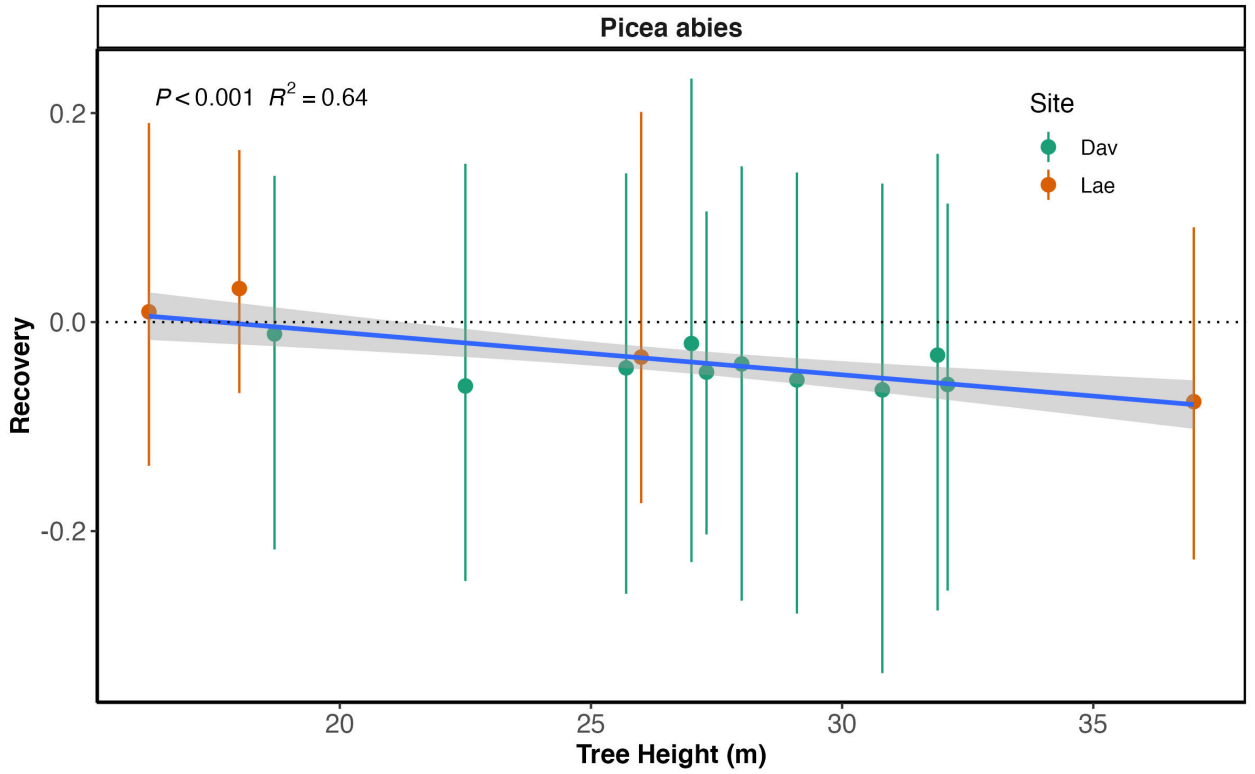
- For the same species, no site specific difference in $R_{TWU:}$

  Recovery at the mixed stand (CH-Lae) was higher than at the monoculture stand (CH-Dav) for *P. Abies*.

Shallow rooting Spruce does not benefit from the rewetting of the top soil better than Beech.

Results: Intra-species





- Recovery vs. Coarse root biomass ~ f(DBH) & Tree Height.
- Confirms our hypothesis – R_{TWU} is related to tree dimension.