

Forest response to drought following a long-term soil moisture manipulation experiment – Fieldwork in Pfynewald, Switzerland (2 master projects)



Transpiration fluxes from land to the atmosphere depend significantly on the degree to which trees open their stomata to balance water for CO₂ exchange. However, it remains unclear how terrestrial ecosystems will respond to changes in atmospheric conditions (e.g., CO₂, VPD, etc.) and water availability on land, especially under more frequent droughts. Additionally, the effects of such long-term changes in trees' adaptation strategies and resilience under short-term dry conditions are not yet fully understood. To address this issue, we collect stable water isotopologues within a long-term (20-year) irrigation experiment in a drought-prone Scots pine-dominated forest in Pfynewald, one of Switzerland's driest regions. Our sampling includes plots with trees growing under naturally dry conditions (control), irrigated conditions (from 2003 to present), and previously irrigated conditions (irrigation stop; irrigated from 2003–2013; under control conditions since 2014).

Master Project 1 will involve tree xylem sampling and soil coring during the 2024 growing season (April–October). The student will conduct cryogenic extraction of water from tree xylem and soil samples collected in the field using a CVD extraction line at WSL Birmensdorf. The extracted water will then undergo further analysis with a Laser spectrometer in the WSL lab to derive stable water isotopes in the samples. The focus of the project is on tree water uptake strategies under different environmental conditions (short and long-term droughts).

Master Project 2 will involve several campaigns of pre-dawn and mid-day leaf water potential observations and sap flow extractions under the three treatment plots (Control, Irrigation, and Irrigation-Stop). The focus of the project will be on understanding tree water relations using the leaf water potential data collected at the field site, along with high-frequency in-situ dendrometer observations - indicating tree water deficit - in the three treatment plots, and

high-frequency in-situ meteorological and soil water potential data to understand trees' physiological response to dry conditions.

These observations, along with the ongoing in-situ observations of stable water isotopes in the field, will shed light on forest responses to long and short-term droughts.

Contact: The master projects will be carried out at the Department of Geography, Hydrology and Climate Group. The potential starting date is April/May 2023. Please contact Dr. Elham Freund (elham.freund@geo.uzh.ch) if you are interested in the topic, and the timing fits your master's program.