Master thesis

Department of Environmental Systems Science (D-USYS)
Institute of Terrestrial Ecosystems (ITES)
Physics of Soils and Terrestrial Ecosystems (POSE)

Quantifying water balance and root water uptake in a forest stand using geophysical methods

WALDLABOR®
ZÜRICH

Motivation and Research Questions

Forest trees must optimize root water uptake to respond to prolonged dry periods due to climate change. Different tree species develop different strategies and root distributions to extract soil water. Point measurements based on soil water content sensors lack the spatial resolution to monitor changes in water content and root water uptake in the very heterogeneous subsurface. An alternative approach is the measurement of the electrical conductivity in the subsurface based on geoelectrical methods that depends on the water amount in the soil. By measuring both the time series of electrical conductivity and the relationship between electrical conductivity and water content, the soil water balance and root water uptake will be reconstructed. Additional sensors measuring water content will be installed to determine the soil specific relationship between geoelectrical properties and soil water content. The ultimate objective is to determine the dynamics of root water uptake for two different tree species. The measurements will be conducted in the "Waldlabor" at Zurich Hönggerberg.

You will:

- Learn to conduct measurements with electrical resistivity tomography and to interpret the measurements
- test various model approaches (Archies's law, fractal approaches) to quantify the relationship between water content and electrical conductivity
- You will learn numerical and experimental methods to link soil wetness patterns to root water uptake

Timeline

The thesis can be conducted in fall or spring season with the focus on the dominant process (root water uptake in spring and summer, leakage to deeper soil layers in winter).

If you are interested in the project, please contact andrea.carminati@usys.ethz.ch or peter.lehmann@usys.ethz.ch