



BSc./MSc. thesis topic

Setup and test of an automated injection module for the water vapour stable isotope analysis of soil and plant samples

In hydrology and many other related disciplines water stable isotopes ($\delta^{18}\text{O}$, $\delta^2\text{H}$) are used as powerful tracers to study vegetation water use (time, space), investigate response mechanisms of forest ecosystems related to extreme events and to improve model representation of ecohydrological feedback processes. High-resolution water isotope data from the soil and plant compartments are therefore an essential prerequisite of many ecohydrological studies. For obtaining the water (vapour) isotopic composition of soils and plants, many different water (vapour) extraction methods exist. The water-vapor equilibration technique, first introduced by Wassenaar et al. (2008), combines a headspace equilibration method with isotope ratio infrared spectroscopy measurements to determine the isotopic composition of the soil or plant sample. A plant or soil sample is placed in a sealable, inflatable, gas-tight bag (usually a double re-sealable zipper storage bag or laminated aluminum bag) to create a closed system. The bag (Fig. 1) is inflated with dry synthetic air and left to equilibrate with the moisture of the soil or plant sample for a certain period of time (Orlowski, Pratt, und McDonnell 2016; Millar u. a. 2018; Wassenaar u. a. 2008; Santos Pires u. a. 2022; Gralher, Herbstritt, und Weiler 2021; Gralher u. a. 2018). After equilibration, the bag is punctured with a needle (through a previously applied silicon septum) that connects the bag to a water isotope analyzer.



Fig. 1: Gas-tight aluminum bag inflated with dry air.

Here, a micro-controller based automatic measurement system for the bags should be setup (lists of hard- software and material suppliers available) and tested for different soil and plant samples.

Requirements

- Interest in lab work, “MacGyver” skills
- Statistical analysis of the results

Supervision

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Literature

- Gralher, Benjamin, Barbara Herbstritt, und Markus Weiler. 2021. „Technical Note: Unresolved Aspects of the Direct Vapor Equilibration Method for Stable Isotope Analysis ($\delta^{18}\text{O}$, $\delta^2\text{H}$) of Matrix-Bound Water: Unifying Protocols through Empirical and Mathematical Scrutiny“. *Hydrology and Earth System Sciences* 25 (9): 5219–35. <https://doi.org/10.5194/hess-25-5219-2021>.
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