Master Thesis Janus Sensor

Working Title: Comparison of the performance from a newly developed soil moisture sensor with an established sensor with specific focus on dry conditions.

Duration: 6 months
Start: As soon as possible
Language: English

Background Information

Accurate soil water content (SWC) measurements are essential for hydrological, agricultural and environmental applications. Most commercial soil moisture sensors perform well under wet and intermediate soil moisture conditions, but become increasingly unreliable as soils dry.

The **Janus sensor** is a newly developed low-cost soil moisture sensor designed to overcome this limitation. The development of the sensor is still at its infancy stage, but the concept is already established. It combines two measurement principles:

- Capacity measurements for medium to high SWC
- Pore-air humidity measurement for dry SWC

By combining both approaches, the sensor aims to measure the full range of SWC from saturation to extremely dry conditions.

Project Description

The objective of the thesis is to calibrate the Janus sensor and evaluate it against an established reference, here the SMT100 soil moisture sensor. A particular emphasis is on sensor performance under dry soil conditions. The project combines laboratory experiments with data analysis and includes:

- Calibration of both sensors (Janus and SMT100)
- Determination of the soil hydraulic properties through laboratory measured water retention curves (ku-pF, pF4.2)
- Development of calibration functions for both capacity and pore-air humidity measurements
- Performance comparison across different soil and substrate types

Measurements will be conducted on a broad range of substrates:

- Standard soil textures: sand, silt, loam
- Project-specific substrates:
    - 3 mine residue deposits
    - 1 organic rich soil (degraded peatland), 2 mineral soils (shallow mountain soil - Ranker, deep soil from lowlands or gently sloping hills – Cambisol/ Braunerde)

Depending on the available time, the performance in organic rich soils can be evaluated as well. Additionally, the derivation of the water retention curve can be refined with additional measurements in pressure pot apparatus.

Proposed Timeline

Month 1-2: Literature review, laboratory experiments

Month 3-4: Data analysis, interpretation

Month 5-6: Thesis writing

Supervision: Deep Chandra Joshi, Stefan Norra

Scientific support: Karoline Kny

What You Will Learn

- Understand the fundamentals principles of soil physics and soil hydrology
- Gain hands-on experience with soil moisture sensors
- Water retention curve measurements
- Key soil physics laboratory methods
- Data analysis in R or Phyton

Who We Are Looking For

We are looking for a motivated Master student with an interest in soil science and hydrology. Experience with laboratory work, data analysis and/or programming is beneficial, but not essential.

If you are interested, please contact Dr. Deep Chandra Joshi (deep.chandra.joshi@uni-potsdam.de).