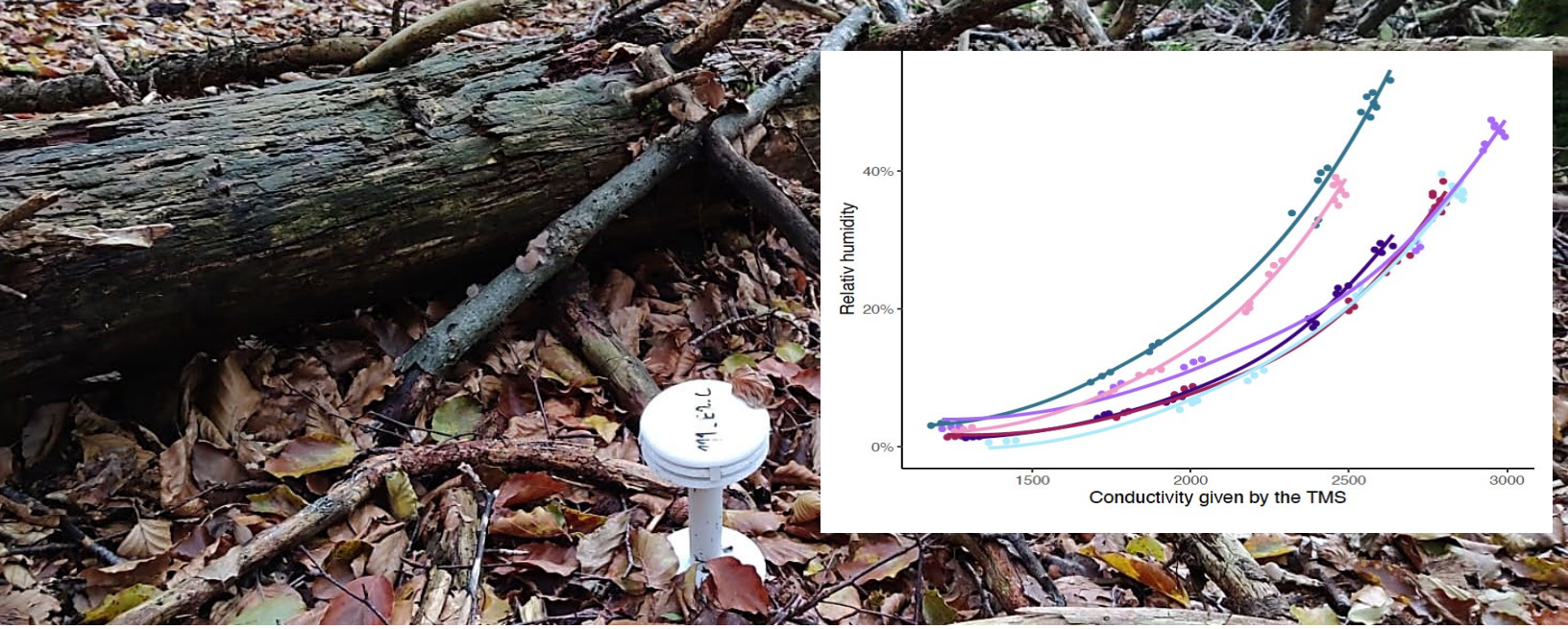

UNIVERSITÄT LEIPZIG

iDiv German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig

TECHNISCHE UNIVERSITÄT DRESDEN

UNIVERSITÄT GÖTTINGEN

CENTRE D'ECOLOGIE FONCTIONNELLE & EVOLUTIVE

Master's thesis opportunity

Title: ***Calibration challenges and potentials of low-cost microclimate sensors: a case study using the TOMST TMS-4 logger***

Background

Microclimate plays a crucial role in shaping ecological and environmental processes. High-resolution spatio-temporal measurements of variables such as temperature and soil moisture are key to understanding patterns in biodiversity, plant performance, ecosystem fluxes, and species distributions, especially under changing climate conditions.

Low-cost sensors like the TMS-4 logger from TOMST, which records air and soil temperature as well as soil moisture (via electrical conductivity), are widely used in ecological research. However, their raw data requires careful calibration for reliable and comparable measurements.

Numerous calibration datasets are available; including some with additional explanatory variables such as soil texture and SOC; but challenges remain. These include device-specific variability, the influence of soil texture, soil organic content, and temperature-dependent effects on conductivity measurements. Understanding and quantifying these limitations is essential, as is exploring the full potential of such devices under real-world conditions.

Project Objectives

The student will:

- Investigate calibration approaches and limitations using existing datasets (no fieldwork planned, but possible)
- Analyze logger-specific differences and environmental factors influencing sensor output
- Evaluate the reliability and potential of low-cost loggers for microclimate studies
- Apply statistical methods to identify key sources of error or variability
- Contribute to the improvement of calibration workflows and recommendations

Candidate Profile

We are looking for a motivated Master's student who:

- Is enrolled in a relevant program (e.g., Environmental Sciences, Data Science, Physics, Ecology, Forest Sciences, or similar)
- Has a solid background in mathematics or statistics
- Has experience working with large datasets
- Is familiar with or willing to learn the R programming language
- Is fluent in English and willing to write their Master's thesis in English, due to the international supervision team
- Shows interest in physical principles underlying sensor measurements (e.g., heat and electrical conductivity)

We Offer

- Supervision by an interdisciplinary and international team of researchers involved in many scientific platforms with unique opportunities
- Access to unique calibration datasets and ecological data
- The opportunity to work at one of four locations (Göttingen, Dresden, Leipzig/iDiv, or Montpellier/CEFE), full remote work is also possible if wanted
- Insight into real-world applications of environmental sensing and data analysis

Further details

Supervisors: Dr. Rémy Beugnon (iDiv, Leipzig University / University of Montpellier), Dr. Kerstin Pierick (University of Göttingen / TU Dresden), **Co-Supervison:** Dr. Simone Cesarz (iDiv, Leipzig University)

Your working place: You can work fully remotely or be located within the working groups of either Prof. Christian Ammer at the Georg-August University Göttingen, Prof. Bernhard Schuldt at Technical University Dresden, or Prof Nico Eisenhauer at the German Center of Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig located at Leipzig. We further offer an optional stay in Montpellier, France, with Dr. Rémy Beugnon at Centre d'Ecologie Fonctionnelle et Evolutive (CEFE), CNRS.

Duration: approx. 6 months

Application

Please send a brief motivation letter and your questions to remy.beugnon@idiv.de and kerstin.pierick@uni-goettingen.de.
The start of the thesis is flexible, but the earliest starting date is **October 2025**.

First read

Schnabel et al. 2025. Tree Diversity Increases Forest Temperature Buffering via Enhancing Canopy Density and Structural Diversity. *Ecology Letters*: 28, e70096 https://onlinelibrary.wiley.com/doi/10.1111/ele.70096

De Frenne et al. 2024. Ten practical guidelines for microclimate research in terrestrial ecosystems. *Method in Ecology and Evolution* 16: 269-294 https://besjournals.onlinelibrary.wiley.com/doi/10.1111/2041-210X.14476

Huang Y et al. 2023. Enhanced stability of grassland soil temperature by plant diversity. Nature Geoscience 17: 44-50. https://doi.org/10.1038/s41561-023-01338-5

De Frenne et al. 2021. Forest microclimates and climate change: Importance, drivers and future research agenda. Global Change Biology 27: 2279–2297. https://doi.org/10.1111/gcb.15569