



MSc. thesis topic

Unravelling Decadal Trends and Climate Sensitivity of Soil CO₂ Efflux in a Norway Spruce Forest

Global forests represent one of Earth's most important carbon reservoirs, yet they are increasingly impacted by repeated and long-term extreme weather events. After photosynthesis, soil CO₂ efflux is the second-largest carbon exchange in terrestrial ecosystems, strongly influencing future climate trajectories. However, long-term observations of soil CO₂ efflux remain scarce, creating critical gaps in our understanding of how forest soils will respond to continued climate variability. This master's thesis addresses that gap by leveraging a decade (2012–2022) of soil CO₂ efflux measurements in a mature Norway spruce stand, integrated with high-resolution meteorological data from the ICOS station in Tharandt.

You will apply statistical time-series analyses to assess whether and how temperature and moisture controls on soil CO₂ efflux have shifted over time, testing how forest soils are adapting or becoming more vulnerable to warming trends and drought events.

Tasks

- Literature study on the topic of soil CO₂ efflux under varying environmental conditions
- Analyses of soil CO₂ efflux data collected during the growing seasons 2012–2022 along with soil and atmospheric data

Requirements

- Ability and willingness to work with large datasets
- Interest in statistical data analysis

Supervision

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Soil gas flux chamber, source:

<https://www.licor.com/products/soil-flux/products>

You are welcome to write the thesis either in English or in German.

If you are curious, don't hesitate to get in touch!

Literature

- Acosta, M., Darenova, E., Krupková, L., & Pavelka, M. (2018). Seasonal and inter-annual variability of soil CO₂ efflux in a Norway spruce forest over an eight-year study. *Agricultural and Forest Meteorology*, 256–257, 93–103.

<https://doi.org/10.1016/j.agrformet.2018.03.005>

- Borken, W., Xu, Y., Davidson, E. A., & Beese, F. (2002). Site and temporal variation of soil respiration in European beech, Norway spruce, and Scots pine forests. *Global Change Biology*, 8(12), 1205–1216. <https://doi.org/10.1046/j.1365-2486.2002.00547.x>

- Wang, Y., Hao, Y., Cui, X. Y., Zhao, H., Xu, C., Zhou, X., & Xu, Z. (2014). Responses of soil respiration and its components to drought stress. *Journal of Soils and Sediments*, 14(1), 99–109. <https://doi.org/10.1007/s11368-013-0799-7>