TECHNISCHE UNIVERSITÄT DRESDEN

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Technische Universität Dresden, 01062 Dresden

MSc. thesis topic

Investigating Groundwater Recharge by a Novel Approach Using the LWF Brook90 Model and Soil Water Isotope data

Key Words: Groundwater Recharge, Soil Water Isotopes, LWF Brook90 Model, Soil Moisture Dynamics

Background

Understanding groundwater recharge is crucial for effective water resource management. Previous studies have used models like Hydrus-1D, focusing on soil moisture alone. The LWF Brook90 model, known for its robust handling of soil-vegetation-atmosphere transfer processes, offers a new perspective for applying this method for the very first time in combination with stable water isotopes.

Problem statement

While existing models provide insights into groundwater recharge, there is a lack of comprehensive studies using the LWF Brook90 model, which may offer improved understanding of soil-vegetation interactions and their influence on recharge processes in such areas.

Research Objectives

1. Set up the LWF Brook90 model for groundwater recharge estimation using isotope data
2. Analyze the interplay between soil water isotopes and soil moisture dynamics in different climatic and land use scenarios using this model.
3. Compare the effectiveness of LWF Brook90 with previous models (Hydrus 1D) in simulating groundwater recharge.

Methods

The research will involve:

1. Preparation and analysis of soil water isotopic data from selected karst sites.
2. Calibration and adaptation of the LWF Brook90 model to the chosen environments, integrating isotopic and soil moisture data (Julia programming language, similar to Python/Jpyter).
3. Comparative analysis of model outputs with field data across different seasons to validate model accuracy.

Pre-requisites

1. Background in hydrology (basic isotope hydrology knowledge), environmental science, or related fields.
2. Proficiency in data analysis and modelling, preferably with experience in Julia, R, Pyhton, Jupyter or similar programming languages.
3. Willingness to engage in modeling and collaborate with international teams.

Supervision

- Prof. Dr. Andreas Hartmann (IGW at TU Dresden) & Cover Prof. Dr. Natalie Orlowski (Institute of Soil Science and Site Ecology at TU Dresden)
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Literature

1. Sprenger, M., et al. (2015). Estimating flow and transport parameters in the unsaturated zone with pore water stable isotopes.
2. Berthelin et al.: https://gi.copernicus.org/articles/9/11/2020/
3. Relevant studies on LWF Brook90 model applications in different hydrological contexts, e.g. https://docs.juliahub.com/General/LWFBrook90/0.1.2/
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5. Meusburger K., Trotsiuk V., Schmidt-Walter P., Baltensweiler A., Brun P, et al. https://doi.org/10.1111/gcb.16332
6. Literature on soil-vegetation-atmosphere interactions.

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