Groundwater resources investigation using time-lapse hydrogeophysical monitoring

Keywords: hydrogeology, geophysics, electrical resistivity tomography (ERT), electromagnetic induction (EMI), seismics, inversion, fieldwork, time-lapse monitoring.

Host laboratory: METIS UMR 7619, Sorbonne University, Paris

Duration: 6 months

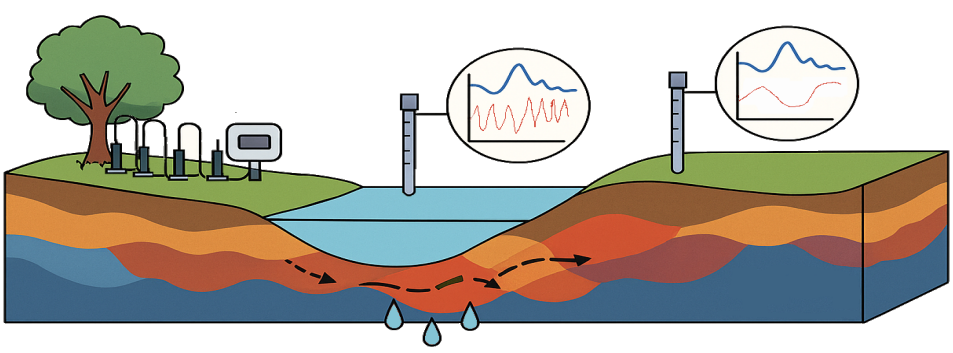
Level: Master's degree (MSc) or final-year engineering student

Project objectives

Groundwater resources are essential for drinking water supply, irrigation, and energy production. Global environmental changes increasingly affect groundwater resources. Quantifying groundwater-river exchanges remains a major challenge in hydrogeology. These water fluxes cannot be measured directly in the field and are therefore generally estimated using hydrogeological models constrained by hydrological observations and near-surface geophysical investigations.

The GWSBound project addresses this challenge. The study focuses on the Orgeval catchment (France), an environmental observatory belonging to the OZCAR Research Infrastructure, dedicated to the study of the Critical Zone and its water resources. The catchment has also been investigated for several decades within the framework of PIREN-Seine (Interdisciplinary Research Program on Water and the Environment of the Seine Basin), which funds this internship.

The Orgeval catchment benefits from long-term hydrological and hydrogeological monitoring. These observations are complemented by repeated geophysical surveys using electrical, seismic, and electromagnetic methods conducted every three months over an eighteen-month period.



The objective of the internship is to investigate groundwater-river exchanges by monitoring the evolution of hydrogeophysical and hydrogeological properties throughout a complete annual hydrological cycle.

Tasks

1. Geophysical data preparation and processing: Cleaning, formatting, and processing seismic datasets using existing scripts and workflows.
2. Geophysical inversion: Performing seismic data inversions to characterize subsurface structures and physical properties.
3. Integration of geophysical methods: Comparing and combining ERT, EMI, TDEM, and seismic datasets to improve geological characterization. Co-kriging approaches may be explored.

4. Time-lapse analysis: Investigating seasonal variations observed between monitoring campaigns and comparing temporal responses across geophysical methods.
5. Petrophysical modeling: Linking geophysical properties (electrical resistivity, seismic velocity) to hydrogeological and thermal parameters such as saturation, porosity, permeability, and thermal conductivity.
6. Development of a 4D hydrogeological model (x, y, z, t): Integrating geological, geophysical, and petrophysical information into a three-dimensional hydrogeological framework to simulate groundwater flow and evaluate model predictions against field observations. This work will be carried out in collaboration with a PhD student.

Required skills

- **Python programming**
- Strong proficiency in Python and its scientific ecosystem, including **os**, **NumPy**, **Pandas**, and **Matplotlib**, for data processing, file management, and scientific visualization. **This skill is mandatory.**
- **Hydrogeophysics and/or physics**
- Background knowledge in hydrogeophysics, geophysics, or physics is highly desirable for understanding and processing geophysical and hydrological measurements.

Additional qualifications

- Strong analytical and scientific reasoning skills;
- Ability to work both independently and as part of a multidisciplinary team;
- Interest in environmental research and sustainable water-resource management;
- Willingness to conduct fieldwork and follow experimental protocols.

Compensation and benefits

- Internship allowance: € 609 gross per month

How to apply

- Please send: a CV; a cover letter; and recent academic transcripts.
- **Application deadline:** 31 December 2026
- Interviews may be conducted either in person or remotely and may include a Python assessment.

Supervisors

- **Agnès Rivière**
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