



Géosciences pour une Terre durable  
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## GROUNDWATER TEMPERATURE AND GLOBAL CHANGES IN FRANCE

### Offer description

Ongoing climate warming is heating the subsurface by modifying the thermal regimes [e.g., Benz et al., 2024, <https://rdcu.be/eakfB>]. These water temperature changes impact groundwater chemistry and microbiology as well as the functioning of groundwater-dependent ecosystems such as rivers and wetlands [e.g., Koch et al., 2021, <https://doi.org/10.5194/hess-25-3053-2021>]. Warmer groundwater could reduce faunal diversity and increase the prevalence of microbes and contaminants.

The main scientific topic of this thesis is the characterization of thermal regimes of aquifers in France under the impact of ongoing global changes. It aims to answer the following research questions: What is the impact of recent and future global changes on groundwater temperature? Can we predict future groundwater temperature trends? What are the most vulnerable hydrogeological and climatic contexts in France?

The main scientific obstacle to a precise understanding of the impact of climate change on underground thermal dynamics is the significant lack of field observations. Data from BRGM databases and OZCAR Research Infrastructure (Critical Zone Observatories: Research and Application, <https://www.ozcar-ri.org/>) will allow to fill this gap. The data will be concatenated, verified, processed, interpreted and simulated through appropriate modelling approaches in order to understand thermal regimes of groundwater systems.

Several sites chosen for their representativeness of French hydrogeological contexts will be the subject of a deterministic modelling exercise to identify the main factors driving changes in groundwater temperatures in recent years and the respective roles of (i) climate change and (ii) human-origin changes of the groundwater cycle (groundwater abstraction, underground infrastructures, geothermal energy use).

### Requirements

Research Field : Geosciences or Physics or Environmental science

Education Level : Master Degree or equivalent

### Skills/Qualifications

- Experience with computer programming /scripting (Matlab, Python, R)
- Sound and quantitative understanding of groundwater flow (hydrogeology)
- Applicants must be proficient in oral French, and in both written and oral English
- Experience in fluid flow modelling in porous media is an advantage



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- Applicants must be able to work independently and in a structured manner and demonstrate good collaborative skills for leading interactions with data owners.

### **Scientific environment**

The PhD will be carried out in between G-eau (BRGM) and Géosciences Rennes (CNRS) research labs and supervised by Maria Klepikova and Jean-Christophe Maréchal.

Géosciences Rennes is a joint research unit (CNRS + University of Rennes) with 60 permanent researchers. It hosts ~10 foreign researchers/year, and publishes ~ 100 papers/year. The Rennes hydrogeology group is composed of 15 permanent staff and is internationally recognized as one of the leading group in this field.

G-eau is a joint research unit (INRAE, CIRAD, IRD, APT, IA, BRGM, UM) with 110 permanent researchers. Its GroundWater team develops research on heterogeneous aquifers. BRGM, the French Geological Survey, is in charge of groundwater monitoring and database building at the national level.

This position is offered in the frame of the recently funded ERC Starting grant (CONCRETER - Groundwater flow CONtrols on CRitical zone ThErmal Regime, 2023-2028), thus allowing to the candidate to actively collaborate with other members of the ERC team.

### **Please include in your application:**

- a brief account of the applicant's research interests and motivation for applying for the position;
- the names and contact information for two referees (one of these should be the main advisor for the master's thesis or equivalent thesis);
- a CV;
- transcripts and diplomas showing completion of the bachelor's and master's degrees (if you have not yet completed your master's degree, please submit a statement from your institution confirming that the master's thesis has been submitted);
- relevant certificates/references;
- a list of any works of a scientific nature (publication list).

The application and appendices with translations into English or French must be sent to [maria.klepikova@univ-rennes1.fr](mailto:maria.klepikova@univ-rennes1.fr) and [jc.marechal@brgm.fr](mailto:jc.marechal@brgm.fr).