PhD proposal at the University of Montpellier (France)

Numerical Modeling of Saltwater Intrusions in the Coastal Aquifers of Roussillon

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PhD scientific description

This PhD focuses on the risk of saltwater intrusion in the coastal aquifers of Roussillon and its impact on the quantity and quality of available freshwater resources. The research will specifically address the Plio-Quaternary aquifer of Roussillon (PQR), which is exploited at a rate exceeding 80 million cubic meters per year, primarily for drinking water and irrigation. Over the past 50 years, a decline in the piezometric level has been observed in this aquifer, while water demand continues to rise and climate change leads to sea-level rise, reduced precipitation, and increased evapotranspiration. These changes are likely to decrease recharge and increase the risk of saltwater intrusion. A thorough understanding of the processes governing fluid circulation in coastal sedimentary aquifers is therefore essential to adapt to this situation.

The multilayer structure of this aquifer, characterized by complex alternations of sand and clay, necessitates the development of models specifically tailored to these heterogeneities. The objective of this PhD is to develop numerical simulation tools to **describe saltwater intrusion processes in coastal aquifers with heterogeneous properties**. Models of increasing complexity will be developed as follows:

1. Construction of hydrodynamic models simulating saltwater intrusion in the PQR aquifer using existing software (Modflow-Seawat, i.e., traditional Darcy-based codes) and standard modeling assumptions;
2. Estimation of medium properties and simulation parameters through inversion of field data acquired via the Dem'Mer observatory located in Canet-en-Roussillon (France);
3. Development of physical models explicitly accounting for boundary conditions with the sea and the influence of meteorological and marine forcings on groundwater flow and pressure fluctuations.

The ultimate goal is to propose early warning and/or anticipatory tools to detect the onset of saltwater intrusion in exploited zones of the PQR aquifer and to adapt resource management accordingly. Socio-economic stakeholders directly affected by this issue will be involved in the project through interactions with the *Syndicat Mixte des Nappes de la Plaine du Roussillon* (SMNPR). The research will build on extensive data already collected from multiple wells on the site, including pumping tests and geophysical logging. The results will also be shared with all water resource managers in the Roussillon plain as part of the activities of the *Living Lab Aqua-Lab 66*, currently under development.

PhD context

This PhD is funded by the *HYDRAUMATH* project (PEPR Exploratoires-Math-VivES) and the *WISE-Adapt* project (Long Thematic Project 4 of UM). The PhD student will be employed by the University of Montpellier (UM) and enrolled in the GAIA doctoral school. The average gross salary is €2,300, which corresponds to an approximate net salary of €1,850 before income tax deductions. This remuneration includes social contributions and social security (which covers basic healthcare in France). This level of salary allows for a very comfortable standard of living in a city like Montpellier (southern France).

The PhD student will be hosted at the *Géosciences Montpellier* laboratory at the University of Montpellier, which is affiliated with the *Observatoire des Sciences de l'Univers OREME* (Mediterranean Observatory for Environmental Research). The PhD student will join the *TMP* team (Transport in Porous Media) and will work in the framework of the *Hydrosystems* research axis of the laboratory. The thesis will be supervised by Delphine Roubinet (CNRS researcher) and Frédéric Bouchette (Professor, University of Montpellier), with active co-supervision from Yvan Caballero (BRGM - the French Geological Survey) and Yohann Cousquer (Lecturer, Hydrosciences Montpellier). The student will benefit from the scientific framework provided by *HYDRAUMATH*, including mathematical collaborations with the teams of Catherine Choquet (University of La Rochelle), Carole Rosier (University of Côte d'Opale), and Mehmet Ersoy (University of Toulon and Var).

Required Skills

Background in applied mathematics and/or physics preferred.

Constraints and Risks

None. Funding available. The position remains open until a hiring decision is made, based on [un-]solicited applications.

Duration

36 months.

Contract Start Date

October 1, 2026 (flexible if necessary).

Application deadline

First deadline on May 15, 2026 — by sending a CV and academic transcripts to delphine.roubinet@umontpellier.fr and frederic.bouchette@umontpellier.fr