

Post-doctoral position at University of Rouen Normandy

Subject area: Hydrology/Hydrogeology, Hydroclimatology, Machine learning and Data Mining

Duration: 24 months

Expected start date: October/November 2025

Salary: ~2400€/month (net salary)

Application deadline: 2025, September 1st

Location: Mont-Saint-Aignan (Normandy, France)

Laboratory: UMR CNRS 6143 M2C (Continental and Coastal Morphodynamics), University of Rouen Normandy, France. <https://m2c.cnrs.fr/>

Project description:

Groundwater resources are inevitably subject to the effects of environmental change, particularly climate change. Developing methods to assess their sensitivity to the magnitude of these changes and their future evolution is fundamental to adapting the use of this resource sustainably. On a large spatial scale, the impacts are highly variable, depending not only on the geographical location of the sites considered and the associated climatic context, but also on the local geological and hydrogeological context. In some cases, the structural geological complexity of aquifers makes it difficult to implement distributed physics-based modeling, or even conceptual modeling. In the former case, a thorough knowledge of the geometry and hydraulic properties of the various hydrogeological formations is essential, and in the latter, the construction of the conceptual model also requires a good understanding of the main hydrological reservoirs that must be distinguished for a relevant functional approach to the hydrosystem. The technical solutions provided by artificial intelligence methods, particularly neural network or deep neural network architectures, enable the development of relevant simulations of the temporal evolution of hydrosystem responses in terms of water levels or flow rates at aquifer outlets, without requiring extensive and not always fully available physical knowledge of the environment under consideration. However, they can still be reinforced by existing physical knowledge or understanding.

The objective of this work is to develop and test different neural network architectures in order to simulate time series of water levels or flow rates at aquifer outlets and springs or piezometric stations in selected areas over multi-year periods. The study will also explore possible adaptation to the specific physical contexts at selected areas by considering different ways of integration of physical constraints. Particular attention will then be paid to reflections on how neural network architectures could take into account physical contextual characteristics, on innovations in feature engineering, and on the interpretability and explainability of the developed models. Using hydrological and climatic data, as well as the available physical characteristics of the basins under consideration whenever possible, the developed models will be deployed to generate scenarios of sensitivity to climate variability and change, using either specifically designed climate extreme scenarios or state-of-the-art end-of-the-century climate projections. Finally, a comparison with previous projections based on other modeling works realized previously at some sites will be undertaken.

Required skills:

- PhD in Earth Sciences
- Significant experience in data science / data mining / machine learning and deep learning (e.g. Tensorflow/Keras or PyTorch)

Application:

Send an extended CV to : Nicolas Massei (nicolas.massei@univ-rouen.fr) ; Abderrahim Jardani (abderrahim.jardani@univ-rouen.fr) ; Matthieu Fournier (matthieu.fournier@univ-rouen.fr)

Selected applicants will be contacted after the application deadline for a 30-min webconference interview to be held in September 2025.