



Internship offer

Hydrological modelling in karst environment : relating lumped parameter model structure with catchment attributes.

Hosting laboratory

HydroSciences Montpellier (HSM), HYDROPOLIS, 15 avenue Charles Flahault, F-34090, Montpellier

Supervisor

Vianney Sivelles (CNRS researcher)

Date et duration

6 month between january and august 2027. Compensation based on the current hourly rate.

Keywords

karst, hydrogeology, hydrology, hydrological modeling, uncertainties

Context

Karst systems are generally characterized by a duality of flow, involving both rapid and/or slow flows. This reflects the occurrence of physical processes at different spatial and temporal scales. The hydrological response of a watershed can be approximated using a hydrological model that converts meteorological variables (e.g., precipitation, temperature) into hydrological variables (e.g., discharge, water level). Among other approaches, conceptual reservoir models provide a functional framework for analysing a hydrogeological system at the watershed scale and describe the conversion of meteorological forcing into streamflow using empirical or conceptual relationships. While numbers of studies have shown the efficiency of lumped parameter hydrological models (LPHM) to simulate karst flow behaviour, none studies have shown inter-comparison between various karst systems, trying to relate the LPHM structure to catchment attributes. Indeed, most of studies focuses on a single catchment at a time and develops the suitable LPHM regarding the study area and the available data for parameter estimation. The scientific community now require to better handle the relation between karst aquifers structures and the associated LPMH structures. This would constitutes a significant milestones toward prediction in un-gauged basins (PUB) as well as for the quest for universality in hydrological models for karst environments.

The French KARST observatory network (SNO KARST) initiative of the INSU/CNRS recently published a database of hydrodynamic and physico-chemical continuous measurements over several karst systems in France (Cinkus et al., 2026). Also, the SNO KARST developps the KarstMod software (Sivelles et al., 2025) allowing to run LPHM assuming a wide range of model structures already tested in the literature. The main objective of the internship aims to investigates potential relations between LPHM structure with some catchment attributes.

Objectives and mission

- Analysing the complete SNO KARST database to derive the first order information about flow behaviour and propose a first round of classification regarding only observation data.

- Running systematic LPHM calibration over the various test sites and analyse the simulation results with a deep evaluation of both predictive and explicative dimension of LPHMs.
- Identifying the ensemble of a suitable model structures that satisfy the modeling objectives (regarding both predictive performance and consistency with the observation data).
- Running a summary of the results derived from both data analysis and hydrological modeling.
- Investigating potential relation between catchment attributes and LPHM structure.

Required education and skills

Second year of Master degree or last year of engineering school (i) in the domain of water sciences and/or earth sciences with a strong focus in hydrology and hydrogeology, or (ii) in the domain of data sciences and/or numerical modeling with an interest in water/earth sciences. Several skills are important for this internship : (i) skills in coding with R or python, (ii) knowledge in hydrology and hydrogeology in particular in karst environments and (iii) skills in numerical modeling. Applicant must have a solid interest for numerical modeling.

Applications

Application should be addressed by mail to Vianney Sivelles (vianney.sivelles@umontpellier.fr)

References

- Cinkus, G., Bondu, R., Aliouache, M., Jourde, H., Mazzilli, N., Arfib, B., Bailly-Comte, V., Batiot-Guilhe, C., Celle, H., Delbart, C., Fournier, M., Labat, D., Peyraube, N., Steinmann, M., Valdès-Lao, D., Baudement, C., Béranger, S., Binet, S., Boetsch, A., Brunet, P., Carrière, S.D., Chalikakis, K., Charlier, J.-B., Cousquer, Y., Défarge, C., Ducasse, J., Emblanch, C., Fabre, J., Fleury, P., Garin, T., Huon, J., Jardani, A., Johannet, A., Jouvès, J., Jozja, N., Justy, L., Ladouche, B., Lamarque, T., Lastennet, R., Léonardi, V., Lobry, O., Lorette, G., Loup, C., Marchand, P., Manière, L., Maréchal, J.-C., Martin, L., Muller, R., Massei, N., Naessens, F., Ollivier, C., Probst, A., Seidel, J.-L., Serene, L., Sivelles, V., Zappelli, A., 2026. Comprehensive dataset of continuously monitored hydrodynamic and physico-chemical parameters in various karst systems, France. Sci Data. <https://doi.org/10.1038/s41597-026-07561-0>
- Sivelles, V., Cinkus, G., Mazzilli, N., Labat, D., Arfib, B., Massei, N., Cousquer, Y., Bertin, D., Jourde, H., 2025. Improvement of the KarstMod modelling platform for a better assessment of karst groundwater resources. Hydrology and Earth System Sciences 29, 1259–1276. <https://doi.org/10.5194/hess-29-1259-2025>