# POST-DOCTORAL POSITION

## Hydro-economic modeling for sustainable groundwater management (Aquitaine, France)

**Duration:** 2 years
**Start:** last quarter 2020
**Location:** Bordeaux (ENSEGID institute), with field trips and trips to Montpellier BRGM center
**Application deadline** : July 26th 2020

### Scientific issue

A hydro-economic model (HEM) is an integrated model combining a representation of economic processes and a representation of hydro(geo)logical processes (Harou *et al.*, 2009). It accounts for the complexity of the interactions between human activities and water resources in a given territory. This type of model can be used to investigate the impacts on water resources and on economic agents of various scenarios: climatic or socio-economic changes, different strategies for water management, demand-side management, etc. In this sense, it constitutes a tool to inform decision-making. HEMs are often based on global and linear hydro(geo)logic models. The HEM developed in this post-doctoral project will use a distributed physically-based groundwater flow model.

This post-doctoral project is part of the Eaux-SCARS project, a large research and development program in hydrogeology, focusing on strategic aquifers in the north of the Aquitaine Basin, for which a concerted interdepartmental management is necessary to ensure their sustainability over the long term. This ambitious 6-year action program should improve the understanding of the dynamics of these deep aquifers.

The applicant will be in charge of (i) developing a hydro-economic model with the MARTHE flow model (Thiery, 2015), then (ii) implementing the coupled model to the Agenais-Périgord territory (Figure 1), which experiences quantitative water management issues. The developed HEM will ultimately provide a tool for exploring scenarios and potential management/adaptation measures, assessing their environmental and economic impacts.

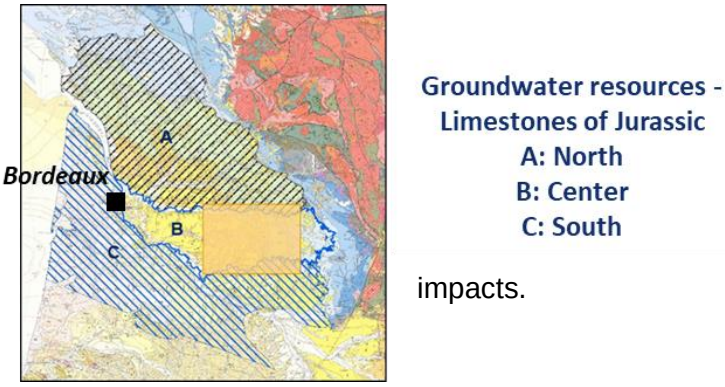


*Figure 1 : Study area*

### Programme

The post-doctoral project will include 3 main tasks:

- **Task 1**: **Development of the economic model for the study area**

The first part of the post-doc will consist in building the economic model for the Agenais-Périgord territory. It will be built so as to address local water management issues.

The first step will be the construction of the conceptual model, in parallel with the data collection necessary for the implementation. In collaboration with members of the Eaux-SCARS project, it will be necessary to characterize the different water uses (agriculture, drinking water, etc.), their dependence to water resources, as well as their dynamics, in order to be able to represent them appropriately in the model. This will include projecting the evolution of water demand for different uses in the future, characterizing the economic value of water in its different uses, and representing their adaptation dynamics to different levels of water supply. It will also be necessary to define the management objectives to be optimized. In a second step, this conceptual model will be implemented in a programming software.

- **Task 2: Coupling the MARTHE hydrogeological model with the economic model**

The second task will be the coupling of the two models. It is a matter of interfacing the MARTHE model with the developed economic model at each time step, so that they can exchange information (Figure 2).

This interface will allow i) to retrieve information related to the state of the hydrosystem from MARTHE, and pass it to the economic model; ii) run the economic model for this time step to perform an economic optimization; iii) retrieve the results in terms of optimal abstractions and pass them to MARTHE; and iv) (re)run MARTHE to reassess the state of the hydrosystem for these abstraction levels for this same time step. These steps will be iterated until convergence.

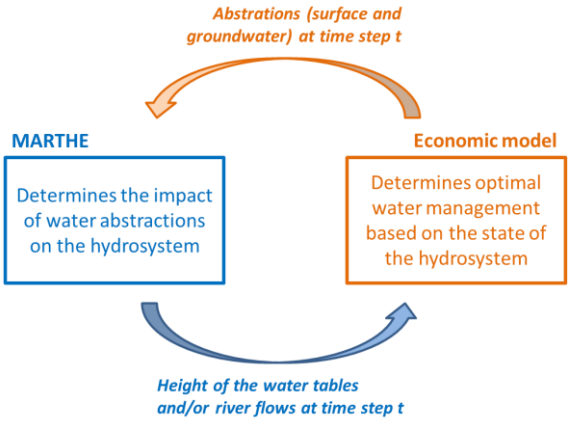


*Figure 2 : Coupling the MARTHE model and the economic model*

- **Task 3: Application of the coupled model to the Agenais-Périgord territory**

The hydro-economic model built in the previous tasks will be used to explore different scenarios of the evolution of water resources, water uses and water management in this territory, in collaboration with the Eaux-SCARS project team.

This case study will be based on a local extraction (whose extension is to be defined) of the North-Aquitaine hydrogeological model (MONA, Buscarlet *et al.*, 2019) based on the MARTHE calculation code.

The post-doctoral project will lead to at least one scientific publication in an international journal.

## Required profile:

Experience in modeling
Experience in optimization
Strong foundations in Python, Fortran, GAMS, MATLAB desired
Economic skills desired
Skills in environmental sciences (hydrogeology) and / or agronomy will be appreciated
Ability to work interdisciplinarily

## Contact:

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## Bibliography:

Buscarlet E., Cabaret O. and Saltel M. (2019) – Gestion des eaux souterraines en Région Aquitaine -Développements et maintenance du Modèle Nord-Aquitain de gestion des nappes – Module 1.1 – Année 2 – Convention 2015 – 2020. BRGM/RP-68863-FR, 49 p., 33 ill., 7 tabl., 2 ann.

Harou J. J., M. Pulido-Velazquez, D. E. Rosenberg, J. Medellín-Azuara, J. R. Lund, and R. E. Howitt. Hydro-economic models: concepts, design, applications, and future prospects. Journal of Hydrology, 375:627--643, 2009. doi:10.1016/j.jhydrol.2009.06.037.

Thiery, D.: Code de calcul MARTHE - Modélisation 3D des écoulements dans les hydrosystèmes -Notice d'utilisation de la version 7.5. Rapport BRGM/RP-64554-FR,306 p., 150 fig., 2015.