



PhD POSITION

Understanding agriculture and water resources interactions at a large scale through hydrological modelling

The French national research Institute for agriculture, food and environment ([INRAE](#)) is a public institution with a working community of around 12,000 people, including more than 200 research units and 42 experimental units located throughout France. The [AQUA](#) department conducts scientific research on socio-hydrosystems in the Anthropocene era. The main disciplines involved are biological, ecological, ecotoxicological, hydrological, hydromechanical, economic and social sciences. These disciplines are applied to aquatic ecosystems, water cycles and the transfer of biogeochemical elements in hydrosystems.

YOUR MISSION AND ACTIVITIES

■ Water resources are essential to human activities. The latter need abstraction and storage in reservoirs of large amounts of freshwater for agriculture, industry, electricity generation, navigation, and drinking water supply. Irrigation is the major water consumer (around 60 % of total consumed water in France and around 70 % globally), since a large part of the abstracted water does not flow back into water bodies but is “lost” through evaporation. The balance between irrigation water demand and resource availability is fragile, all the more because climate change could lead to a decrease in precipitation and streamflow, and an increase in the demand.

In this context, hydrological models – which are crucial for exploring possible climate change adaptation strategies – require integration of an explicit and reliable representation of irrigation. However, such integrated modelling faces two main obstacles. Firstly, water use modelling in agriculture is confronted with a lack of “field” data (statistical data or data from farmers’ declarations) on irrigated areas and “actual” volumes of water withdrawn. Secondly, irrigation is a complex process that can depend not only on climatic and agronomic factors, but also on socio-economic factors that influence farmers’ choices and propensity to irrigate.

The overall objective of the doctoral project is to improve our understanding of agriculture and (surface and underground) water resources interactions and to integrate these interactions into hydrological modelling at a national scale. This research will be based on well-established hydrological models that have been developed within the HYCAR research unit at INRAE and that represent natural hydrological processes. It will examine a large sample of river basins influenced by agricultural activities in France. The work will consist of:

1. Building a database on hydrology, agriculture and water abstraction from a large range of sources to enable integrated hydrological modelling. This includes evaluating the quality and representativeness of French datasets (e.g. National Bank for Quantitative Water Abstraction, <https://bnpe.eaufrance.fr/>), and the relevance of remote sensing-derived data (e.g. evaporation, soil moisture, vegetation indices) as a complement to field data.
2. Exploring different approaches to integrate irrigation into hydrological modelling. In particular, this will involve examination of the potential of artificial intelligence (machine learning) in representing the complex process of irrigation while making the most of available data. We will strive to quantify the uncertainties arising from the use of uncertain data and the model parametrisations.
3. Based on the integrated model developed, assessing the impact of irrigation on hydrological variables (in particular streamflow) and irrigation controlling factors, to better understand its possible future developments under changing climate.

YOUR BACKGROUND

- Expected training:
 - MSc in hydrology, agricultural sciences, environmental sciences, Earth sciences
- Technical knowledge and/or experience required:
 - Good programming skills (e.g. R, Python, Matlab, Fortran)
 - Ability to work with large datasets
 - Knowledge of geomatics
 - Modelling skills (in the field of hydrology and/or agronomy)
 - Basic knowledge of general hydrology
- Soft skills required:
 - Ability to work independently as well as part of a team.
 - Excellent scientific writing and communication skills in English

YOUR WORK ENVIRONMENT

- You will be working in the [HYCAR](#) research unit (Anthropised Continental Hydrosystems: Resources, Risks, Restoration; Antony site - 92), which brings together around forty scientists. The unit offers a highly dynamic, multidisciplinary research environment in the fields of modelling and observation, and is internationally recognised for its hydrological and ecological models and databases. It is divided in three teams working on ecological engineering (ARTEMHYS), fluvial hydroecology (HEF) and catchment hydrology (HYDRO). The unit uses state-of-the-art computer facilities and experimental equipment to carry out its research.
- You will be working in the [HYDRO](#) team, which has a staff of around twenty, including ten scientists and around ten PhD students, post-docs, contract engineers and trainees. The team's work aims to respond to major environmental and societal issues related to water, including the prevention and forecasting of hydroclimatic risks, water resource management and the assessment of the impact of climate change on hydrosystems. To this end, the team develops hydrological models and methodologies for applying these models to meet a variety of challenges (flood and low-flow forecasting, quantifying the impacts of climate change, etc.). It distributes various software packages for research and operational hydrology purposes (e.g. the [airGR](#) package).

QUALITY OF LIFE AT INRAE

By joining our team, you will benefit from:

- an interdisciplinary working environment within a research unit that carries out internationally recognised work in the field of water and anthropised continental hydrosystems
- an environment of scientific excellence within the [Université Paris Saclay](#), of which INRAE is a partner
- a [location](#) in Antony (92, Île-de-France), where around 150 people are working, with subsidised canteen facilities for lunches
- INRAE's commitment to [social and environmental responsibility](#) (SER)
- 25 days of holiday + 15 leave days per year
- possibility of home office up to two days a week
- access to [sport and cultural activities](#) (sports grounds and parks nearby)
- 75% of travel costs covered, with [easy access](#) to the site by public transport
- a Sustainable Mobility package if you use a personal bicycle or car-pool for your home/work commute
- a skills development scheme: [training](#), career guidance, etc.
- [social support](#): advice and listening, social assistance and loans
- [a range of holiday and leisure services](#): holiday vouchers, discounted accommodation, etc.
- [support for parenthood](#): CESU childcare, leisure services, etc.

↘ Practical information

- Research unit: UR Hydrosystèmes continentaux anthropisés: ressources, risques, restauration (HYCAR)
- Postcode + town: 92160 Antony, France
- Type of contract: doctoral contract
- Contract duration: 36 months
- Starting date: 01 October 2024
- Salary: €2,100 gross per month (with the following progression: €2,200 gross per month from 01/01/2025, and €2,300 gross per month from 01/01/2026)

↘ How to apply

Send a cover letter and CV to:
Fanny Sarrazin, research scientist

■ By e-mail : fanny.sarrazin@inrae.fr

! Deadline for applications: 20 June 2024

Information at: <https://jobs.inrae.fr/en/ot-22081>