



U.R. Hydrosyst mes continentaux anthropis s (HYCAR)

Internship offer University year 2020-2021

1. Topic

Simulation of a regulated basin using a semi-distributed hydrological model : the Seine River basin (France) and its reservoirs

2. Type of internship

End of university cursus or end of engineering school cursus internship

3. Period – Duration

Six months from February-March 2021

4. Host organism and supervisor

Host organism:

INRAE
UR Hydrosyst mes continentaux anthropis s (HYCAR)
1, rue Pierre-Gilles de Gennes CS 10030
92761 Antony Cedex
Web: <https://www.inrae.fr>

Supervisors:

Guillaume Thirel
David Dorchies
Olivier Delaigue
Tel: +33 1 40 96 69 65
Email: guillaume.thirel@inrae.fr
Web: <https://webgr.inrae.fr>

Applications (CV + motivation letter) are to be sent by email to the supervisor whose coordinates are provided above.

5. Internship allowance (if relevant)

Around 550 € a month

6. Profile of the candidate

- Good notions in hydrology and modelling
- Basic knowledge in climatology
- Knowledge in statistics
- Good programming skills (if possible R)
- Use of classical Microsoft Office tools (Word, Excel, etc.)
- Good redaction and oral skills

7. Possible follow up in a PhD

No, but potential PhD projects could be proposed in the host organisms on other topics (providing funding).

8. Description of the topic

- *Context*

Basin management stakeholders face more and more challenges including consequences of climate change. To help stakeholders, decision-making tools based on integrated basin modelling are more and more used. These models attempt to represent in a reliable mode the different components impacting the basin hydrology: natural flow from precipitation, evapotranspiration and groundwater fluxes; water withdrawals (drinking water, industry and agriculture) and regulation by reservoirs and dams. The Seine River basins includes several high stakes: strong needs in drinking water and irrigation, many industries, risks of high and low flows and 4 lakes-reservoirs aiming for high and low flows attenuation. Some years ago, the supervisors of this internship made a diagnostics of the impact of climate change on this basin and they showed that the increasing intensity of low flows would only be partly mitigated by the lake-reservoirs in the future, even if the management rules are improved (Dorchies et al., 2014).

The HYDRO team at HYCAR (INRAE Antony) developed semi-distributed hydrological models based on the airGR R package (<https://webgr.inrae.fr/logiciels/airgr>, Coron et al., 2017), allowing for simulating natural flows as well as human-related influences. This package will be used in this internship.

The European project IN-WOP studies the management rules optimisation of the 4 lake-reservoirs under climate change. This optimisation is based on an integrated model of the basin consisting on a semi-distributed model of the Seine River basin integrating water uses and the 4 lake-reservoirs management, that are managed by the EPTB Seine Grands Lacs (<https://seinegrandslacs.fr>). In addition, the PIREN-Seine research program coordinates research in the Seine River basin in an integrated manner, and this internship will be included in this effort and will be funded by the PIREN-Seine.

- **Objectives of the internship**

The objective of the internship is to set up a semi-distributed hydrological model of the Seine River basin down to Poses, integrating the different water uses and reservoirs regulation. This set up could be decomposed into several steps:

- Analysis of available hydrological stations data;
- Choice of hydrological stations that will be used for discretising the semi-distributed model into sub-basins;
- Integration of water withdrawals into the model;
- Choice of the hydrological model for each sub-basin depending on the calibration performances and basins characteristics (impact of snow or groundwater);
- Determination of model parameters (via calibration using different objective functions) and analysis of their temporal robustness.

- **Methodology / Work steps**

- Months 1-2: Literature review, water uses data retrieval, analysis of hydrological stations of the basin.
- Month 3: Getting started with the programming and modelling tools, running the semi-distributed hydrological model.
- Months 4-5: Test of the different configurations, calibration of the model.
- Month 6: Redaction of the internship report.

Depending on the progress and results, these results could be presented in a national or international conference.

- **References**

- Coron, L., Thirel, G., Delaigue, O., Perrin, C., Andréassian, V., 2017: The Suite of Lumped GR Hydrological Models in an R package, *Environmental Modelling & Software*, 94, 166-171, DOI: [10.1016/j.envsoft.2017.05.002](https://doi.org/10.1016/j.envsoft.2017.05.002).

- Dorchies, D., Thirel, G., Jay-Allemand, M., Chauveau, M., Dehay, F., Bourgin, P.-Y., Perrin, C., Jost, C., Rizzoli, J.-L., Demerliac, S., Thépot, R., 2014. Climate change impacts on multi-objective reservoir management: case study on the Seine River basin, France. *International Journal of River Basin Management*, 12(3): 265-283, [doi:10.1080/15715124.2013.865636](https://doi.org/10.1080/15715124.2013.865636).