One-Dimensional Numerical Modelling of the Hydrodynamics of the Saône River

Background

The development of physically based models for temperature dynamics in large anthropised rivers has become necessary in the context of climate and global change, in order to refine predictions of future water temperatures. Two key issues emerge from recent literature: temperature propagation in complex flow conditions (diffluences, confluences, transverse structures, etc.) and exchanges with the groundwater. Initial simulations using the T-NET model (pers. comm. F. Moatar/F. Branger, Fig. 1) have shown that the temperature of the Saône River is poorly simulated, likely due to simplified hydraulic modelling and/or insufficient knowledge of contributions from the alluvial aquifer to the Saône River. To overcome these limitations while maintaining computational efficiency, we propose, within the framework of a Carnot "Water & Environment" project, to develop a temperature-transport module coupled with a one-dimensional hydraulic model. Ultimately, such a model could itself be coupled with physically based hydrological and thermal models at the watershed scale. The first step in this project is therefore to build a hydraulic model of the Saône River, with particular attention to dams and potential exchanges with the aquifer.

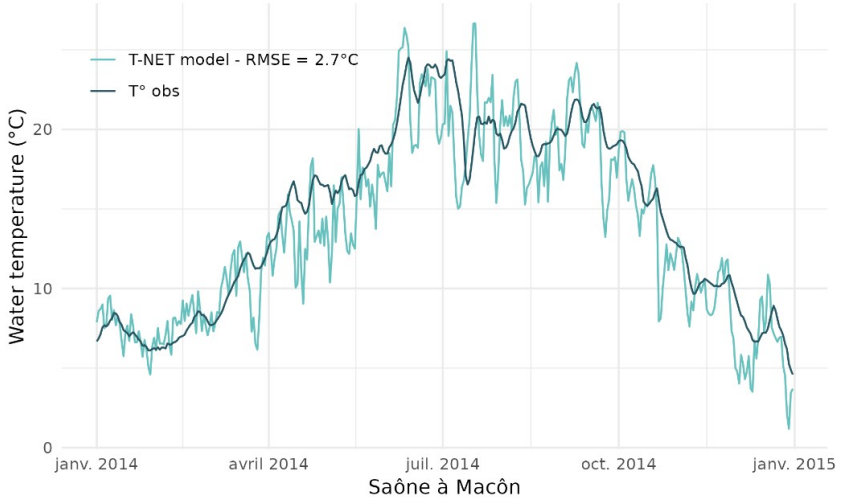

Figure 1 : Simulation of the Saône River temperature at Mâcon using the T-NET software coupled with a hydrological modelling using J2000..

Main objectives of the internship

The main objective for the intern will be to build a hydraulic model covering the entire Saône River from its confluence with the Doubs -or even from the confluence with the Echalonge stream in Haute-Saône- down to Lyon. The aim is to produce a hydraulic model capable of reproducing Saône River flow dynamics from low-water conditions to flood events, accounting as accurately as possible for existing hydraulic structures (dams with diversion channels, etc.) and including potential groundwater exchanges.

Internship tasks

The intern will first collect all available data required for building the model (bathymetric data, dam characteristics, water levels, etc.), based on the 2019 BRL study and supplemented with additional bathymetric data from VNF. He/she will assess whether further data are needed; field visits and measurements may be organised to complete the dataset. The intern's main task will then be to build the 1D model of the Saône River using the Pamhyr2 platform, and to calibrate and validate the Mage hydraulic solver for this Saône model. Finally, he/she will focus on river dams

and potential river–groundwater exchanges, and assess their impacts on the hydrodynamics of the Saône.

Practical information

Desired profile

Master's student (M1 or M2) or engineering student (2nd or 3rd year of the engineering cycle) in hydraulics or physical geography. The internship requires knowledge of open-channel hydraulics, ideally with experience in numerical modelling. Basic Python programming skills would be appreciated.
Autonomy, initiative, and teamwork skills are essential.

Internship

4 to 6 months

Allowance

Internship allowance of approximately €600 per month. Any travel expenses will be covered by INRAE under standard mission-expense procedures.

Lieu

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