EGU24-19450, updated on 26 Apr 2024
https://doi.org/10.5194/egusphere-egu24-19450
EGU General Assembly 2024

WOLFHydro: a modular framework for multi-model hydrological simulations

Christophe Dessers, Pierre Archambeau, Benjamin Dewals, Sébastien Erpicum, and Michel Pirotton
ULiege, Applied Sciences, Urban and Environmental Engineering, Belgium (c.dessers@uliege.be)

In hydrology, a plethora of modelling approaches exist. They differ in several aspects, including the underlying hypotheses (empirical, conceptual vs. physically based) and the spatial discretisation (lumped, semi-distributed, gridded). The advent of machine learning or AI techniques further expands the spectrum of available modelling options. In this context, there is a growing scientific interest in systematically comparing existing models, understanding the reasons behind their relative performance, and applying multi-model approaches to increase the reliability of the outcomes. However, few research has been carried out so far to compare all these types of models in the same framework, namely using similar input data, pre-processing procedures, parameter optimisation algorithms and strategy, objective function, etc.

WOLFHydro, developed by the HECE group at the University of Liège, offers such a framework. It addresses a flexible simulation tool organised in 'modules' and capable of representing any catchment, thus keeping a tuneable level of complexity and details in the description of all the physical processes at work, while remaining in the same modelling environment and starting from exactly the same input data. The software parcels out a catchment into sub-catchments or evaluation points, which are arranged in a topology network. Each module can contain a chosen type of model (physically based, conceptual, empirical) with the desired spatial representation (lumped, gridded, semi-distributed) to be assembled and facilitate the creation of hybrid models. The software also accommodates anthropogenic structures, such as dams, storage basins, or any other hydraulic structure defined by a set of operation rules customable by the user.

The software currently contains a number of models developed in-house, as well as widely accepted ones (GR4H, VHM, etc). They have been validated and tested on several Belgian catchments, in particular for the 2021 extreme floods in the Vesdre and Amblève valleys. The software also features post-processing tools and a GUI interface to facilitate inspection of the results.

Thanks to its versatility, WOLFHydro aims at reducing biases in model comparisons conducted in separated frameworks, improving our understanding of dominant hydrological processes, improving the evaluation of the influence model structure complexity, and carry out ensemble modelling.