EGU22-6191
https://doi.org/10.5194/egusphere-egu22-6191
EGU General Assembly 2022


# An operational framework for data driven low flow forecasts in Flanders

**Tim Franken**[1], Cedric Gullentops[1], Vincent Wolfs[1], Willem Defloor[2], Pieter Cabus[2], and Inge De Jongh[2]

[1]Sumaqua, Leuven, Belgium (tim.franken@sumaqua.be)
[2]Vlaamse Milieumaatschappij, Brussel, Belgium

Belgium is ranked 23rd out of 164 countries in water scarcity and the third highest in Europe according to the Water Resource Institute. The warm and dry summers of the past few years have made it clear that Flanders has little if any buffer to cope with a sharp increase in water demand or a prolonged period of dry weather. To increase the resilience and preparedness against droughts, we developed the framework named hAIdro: an operational early warning system for low flows that allows to take timely, local and effective measures against water shortages. Data driven rainfall-runoff models are at the core of the forecasting system that allows to forecast droughts up to 30 days ahead.

The architecture of the data driven hydrological models are inspired by the Multi-Timescale Long Short Term Memory (MTS-LSTM, [1]) that allow to integrate past and future data in one prediction pipeline. The model architecture consists of 3 LTSM's that are organized in a branched structure. The historical branch processes the historical meteorological data, remote sensing data and static catchment features into encoded state vectors. These are passed through fully connected layers to both a daily and an hourly forecasting branch which are used to make runoff predictions on short (72 hours) and long (30 days) time horizons. The forecasting branches are fed with forecasts of rainfall and temperature, static catchment features and discharge observations. The novelty of the proposed model structure lies in the way discharge observations are incorporated. Only the most recent discharge observations are used in the forecasting branches to minimize the consequences of missing discharge observations in an operational context. The models are trained using a weighted Nash-Sutcliffe Efficiency (NSE) as objective function that puts additional emphasis on low flows. Results show that the newly created data driven models perform well compared to calibrated lumped hydrological PDM models [2] for various performance metrics including Log-NSE and NSE.

We developed a custom cloud-based operational forecasting system, called hAIdro to bring the data driven hydrological models in production. hAIdro processes large quantities of local meteorological measurements, radar rainfall data and ECMWF extended range forecasts to make probabilistic forecasts up to 30 days ahead. hAIdro has been forecasting the runoff twice a day for 262 locations spread over Flanders since April 2021. A continuous monitoring and evaluation

framework provides valuable insights in the online model performance and the informative value of hAIdro.

[1] M. Gauch, F. Kratzert, D. Klotz, G. Nearing, J. Lin, and S. Hochreiter. “Rainfall–Runoff Prediction at Multiple Timescales with a Single Long Short-Term Memory Network.” Hydrol. Earth Syst. Sci., 25, 2045–2062, 2021

[2] Moore, R. J. “The PDM rainfall-runoff model.” Hydrol. Earth Syst. Sci., 11, 483–499, 2007