Benchmarking multiple hydrology models at seventy catchments in southern Norway – work in progress

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ABSTRACT

Hydrological models are mathematical representations of the water cycle, primarily focusing on the land surface. They include processes of precipitation, snow, infiltration, evaporation, runoff, and more. The models are used to understand and predict the movement of water through the Earth's surface and subsurface, as well as to evaluate the impacts of land use, climate change, and other factors impacting the availability of water resources. In the hydropower industry, hydrological models have been used for decades to predict and forecast both mountain snowpacks and reservoir inflow. This is typically done by forcing the models with historical records and future weather data. The inflow forecasts are commonly used to optimize water usage for hydropower production but can also be used to evaluate different flood mitigating measures.

During the last sixty years or so, a huge number of different models have been presented in the hydrologic research literature. For practitioners as well as researchers it is a challenge to choose which models to use in different settings. One way to come around this challenge is to try out multiple models and measure the performance quantitively.

In this research, we have applied three different hydrological models in multiple configurations to seventy catchments in southern Norway. The first model is the Statkraft Hydrology Forecasting Toolbox (SHyFT), a distributed model that can be run in four different process configurations. The second model is the Neural Hydrology LSTM neural network models (NH-LSTM) developed by F. Kratzert and co-workers. The last model is the Distributed Regression hydrological Model (DRM), developed by Matheussen at Å Energi. This model combines a classical distributed hydrological model and an LSTM neural network.

The data used to calibrate and validate the hydrological models in this work comes from several sources and includes daily values of air temperature, precipitation, wind speed, relative humidity, and observed streamflow. It also has different sources of soil, land use, and terrain data. Open datasets from Unites States (CAMELS), Norway (The Norwegian Water Resources and Energy Directorate (nve.no) and The Norwegian Meteorological Institute (met.no)), EU (ECMWF-ERA5), along with internal datasets from Å Energi are used in this study.

In this research, a total of four experiments were conducted. For each experiment the historical data were split into a calibration and a validation period. The models were then calibrated using the Nash-Sutcliffe Efficiency (NSE) and the Kling-Gupta-Efficiency (KGE). After this, a benchmark of the different model's performances was carried out.

The initial results indicate that the SHyFT model performs better than the others. Further testing is ongoing, and the results will be presented at the conference.

Keywords: hydrology, benchmark, machine learning, conceptual, physical