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First steps in incorporating data-driven modelling to flood early warning in Norway's Flood Forecasting Service

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The national Flood Early Warning Services (FEWS) in Norway use time-series of precipitation and temperature data as input to conceptual physically based rainfall-runoff models for forecasts. Runoff is forecasted in selected catchments and the warnings are based on regionalization of these. This concept proved useful in many catchments, however there are some exceptions, where forecasts are of worse quality. To improve this, data-driven modelling (DDM) techniques are sought applied.

The first objective of the study is to identify those DDM methods, which are feasible for application and can easily be fit in the present, well-developed procedures of the operational FEWS. Therefore an experiment is conducted, where about thirty years of daily accumulated precipitation and daily mean temperature as input and observed runoff as output data are used. This was repeated from five, regionally and physically different catchments. In each case different DDMs were developed and their simulation results compared to those generated by the operational (conceptual based) models and to the observations.

The methods of Artificial Neural Networks, Genetic Programming, Evolutionary Polynomial Regression and Support Vector Machines were used in the experiment. Various combinations of the last, the last two and the last three timesteps (in this case: days) of the data was tested as possible inputs. Forecast quality was described by Absolute Accumulated Error, Root Mean Square Error, Nash-Sutcliff Efficiency, the Ideal Point Error (combination of the previous) as well as by Taylor-diagrams.

The first comparisons show promising results, which need to be further examined. The follow-up study will first focus on standardizing and automating the tests on forecast quality to be able to perform the studies on a larger number of datasets, as well as for other forecast periods. We expect the DDM to perform better in cases where conceptual models don't perform well. In these cases the quality-describers will be refined to help identifying seasonal, geographical or other physical or temporal features, which will allow the preparation for hybrid use of data-driven and conceptual models. This way low forecast performance is expected to be improved by incorporating DDM to the existing conceptual modelling framework.