Flood forecasting everywhere- putting PUB to work.

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ABSTRACT

In this study the Prediction in Ungauged Basins is taken very literally in that we present a system that enables the setting up and running a rainfall-runoff model, the Distance Distribution Dynamics (DDD) model for any catchment in Norway. The system (called HSO- Hydrologiske Simuleringer for Overalt) can be used in operational flood forecasting since hydrological simulation results for an arbitrary catchment are obtained in a few minutes. A GIS map tool is used to calculate catchment boundaries, the hypsographic curve and other catchment characteristics such as vegetation and mean annual discharge needed to estimate DDD model parameters. Terrain information and catchment boundaries are furthermore used to extract meteorological information from gridded (1 x 1 km) maps for both historical and forecast periods. The historical period may be of such a length (>30 years, daily temporal resolution) that the mean annual flood (MAF) can be reasonably estimated and compared to forecasted runoff values for hazard assessments. A flood forecaster is hence no longer limited to only assessing hydrological simulation results from hydrological models calibrated for a small number of gauged catchments. Rather, she can set up a model for ungauged catchments where the forecasted precipitation is the most intense or where vulnerable infrastructure is located. The relative comparison between simulated forecasted runoff and the simulated MAF is informative for hazard assessments and is not depending too much on how precise the estimate of the MAF is in absolute terms. However, estimates of MAF by HSO give an average error (RMSNE) of 23% which is identical to that of the regional flood frequency analysis (RFFA2018; Engeland et al, 2020) currently used operationally in Norway. Tested for 41 gauged catchments, the average Kling-Gupta efficiency (KGE) criterion is $KGE = 0.71$ without having the possibility of adjusting for volume errors. Using a pilot version of HSO in operational flood forecasting has resulted in the inclusion and the exclusion of geographical regions receiving flood warnings. Future developments include higher temporal resolution of meteorological input data so that flood forecasting and flood estimation can be carried out for smaller and faster responding ungauged catchments. Improved meteorological grids, and improved model algorithms will further improve the HSO.

Keywords: flood forecasting; ungauged catchments