Geophysical Research Abstracts
Vol. 17, EGU2015-13815, 2015
EGU General Assembly 2015

Spatiotemporal model evaluation across Europe: A methodology based on expert knowledge, multiple datasets, physiography, flow signatures and performance metrics

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The hydrological model E-HYPE is spatially distributed with an average subbasin size of 200 km2 for continental Europe. The third version of the model (E-HYPE v3.0) has recently been released, building on experience in setting up multi-basin models at the large scale using open data from readily available sources. A methodology adopting a stepwise calibration of the model is used to optimize model performance to multiple datasets including (a) satellite estimates of potential evapotranspiration and ice cover, (b) in situ snow depth measurements, and (c) 116++ discharge stations representing a variety of catchment sizes, hydro-climatologies, physiographies and anthropogenic influences across Europe. Furthermore, the model is evaluated against an independent validation set of 750 discharge stations. This assists on determining how well the model represents the spatiotemporal variation in flow signatures including low, mean and high flows, flashiness, coefficient of variation and various scales of temporal variation (daily, seasonal and interannual). Assuming that the stations sufficiently represent the variation in catchment scales, hydro-climatology and physiography across Europe, the spread in performance of the validation stations may be assumed to represent the uncertainty in predicting an ungauged basin. This assumption will be further explored.

Model evaluation using a large database of discharge data has the added value of informing on spatial errors, which can then be related to erroneous/uncertain input data (e.g. presence of undercatch in gridded precipitation databases), insufficient processes descriptions (e.g. groundwater recharge for a region), and limited knowledge on anthropogenic processes (e.g. extractions, regulation). This has then fed back into development of improved input data sets for precipitation, improved model process descriptions for irrigation and regulation and a new model module for deep aquifer interchange. E-HYPEv3.0 performs well for a variety of catchments scales and characteristics across Europe including representation of anthropogenic processes, i.e. extractions for irrigation and regulation for irrigation, water supply, flood control and hydropower. However, hydrological processes are still poorly described in some regions.

This presentation will describe the methods used and model performance accross Europe, as well as remaining challanges to improve the model in the next-coming version.