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The benefit of climatological and reforecast data for simulating hydrological droughts in Switzerland

Stefanie Jörg-Hess (1), Silja Kempf (1), Felix Fundel (1,2), and Massimiliano Zappa (1)

(1) Swiss Federal Research Institute WSL, Zürcherstrasse 111, 8903 Birmensdorf, Switzerland (stefanie.joerg@wsl.ch), (2) now at Deutscher Wetterdienst, Frankfurterstrasse 135, 63067 Offenbach, Germany

Drought forecasting is important for risk management, preparedness and mitigation during low flow events. We elaborate on the effect of input quality on the hydrological response of two Swiss rivers during low flow events by using the fully distributed version of the hydrological model PREVAH (Precipitation Runoff EVApotranspiration Hydrotope Model). Observed and spatially interpolated meteorological variables as well as calibrated reforecasts from the probabilistic numerical weather prediction model COSMO-LEPS are used for meteorological model input within the period 1981-2000. The COSMO-LEPS reforecasts are calibrated using quantile mapping, which is a statistical method to correct systematic biases in the model climatology with respect to the observation climatology. We come up with different combinations (observations with COSMO-LEPS or calibrated COSMO-LEPS with COSMO-LEPS) of the six input variables (precipitation, temperature, wind, relative humidity, sunshine duration and radiation) to assess the sensitivity of each input variable on the quality of the low flow simulation. These simulations are compared to runoff observations and to a reference model run forced by observations.

By using single or multiple variables from the calibrated and original COSMO-LEPS reforecasts or meteorological observations the potential of PREVAH in generating low flow predictions is shown. With a seasonal varying threshold of different quantiles, duration, severity and magnitude of low stream flow anomalies are defined. It is shown by the example of the hydrological model PREVAH that precipitation is the relevant input variable to improve the low flow simulation substantially. However, depending on the catchment characteristics different meteorological variables are important during hydrological droughts. Further reasonable choices of enhanced variables can include temperature and relative humidity. Glaciers and snow melt were identified to have an effect on the sensitivity of the temperature variable. We identify, that for successful low flow simulation observed precipitation and temperature are essential, and that the other variables can be taken from reforecasts of numerical weather models without need of particular post-processing.