EGU24-1125, updated on 08 Dec 2024
https://doi.org/10.5194/egusphere-egu24-1125
EGU General Assembly 2024

Climate-Informed-Seasonal Mixing Approach to Estimate Flood Quantiles

Abinesh Ganapathy[1,2], Bruno Merz[2,3], Sergiy Vorogushyn[2], and Ankit Agarwal[1,2]
[1]Indian Institute of Technology Roorkee, Department of Hydrology, Roorkee, India (abinesh_g@hy.iitr.ac.in)
[2]GFZ Helmholtz -Zentrum Potsdam, Section 4.4 Hydrology, Potsdam, Germany
[3]University of Potsdam, Institute of Environmental Science and Geography, Potsdam, Germany

Traditional flood frequency analysis assumes that the probability distribution is stationary over time. However, this assumption has been challenged, given widespread changes in catchments and climate. One of the inherent handicaps of the stationarity assumption is its non-inclusion of changes in extremes associated with future climatic conditions. To overcome this handicap, climate covariates can be incorporated into the estimation of flood probability through the non-stationary Climate-Informed Flood Frequency Analysis (CIFFA). The CIFFA methodology comprises 1) selection of predictands (usually seasonal maxima), 2) identification of suitable predictors (large-scale climate indices), and 3) derivation of a statistical link between predictands and predictors. Since CIFFA typically considers the flood peaks in the dominant season, its applicability to gauges, where flood extremes occur in several seasons, is limited. Here, we develop and test a novel non-stationary Climate-Informed-Seasonal-Mixing approach across various European basins. In the proposed Climate-Informed-Seasonal-Mixing approach, we fit the seasonal peak distribution (boreal seasons) with the location parameter conditioned on the selected covariate using the Bayesian Inference. The best climate covariates for each season among a set of predictors are identified based on widely applicable information criterion (WAIC), which computes log posterior predictive density and adjusts the overfitting using the effective number of parameters. Even the traditional stationary model could be a preferred model for any season if it has a minimum WAIC value. Following the estimation of seasonal distribution parameters, the annual flood quantiles are derived by multiplicatively mixing all the seasonal distributions. In order to demonstrate the performance of the proposed approach, we split the entire period into calibration and validation sets, fitting the model based only on calibration samples. The projected quantiles during the validation period are then compared with a benchmark model (traditional model fitted solely with validation samples). Our results suggest that for many gauges, the flood quantiles estimated by the proposed Climate-Informed-Seasonal-Mixing approach align with the baseline estimates where the traditional approaches fall short.