Geophysical Research Abstracts
Vol. 19, EGU2017-1236, 2017
EGU General Assembly 2017

Prediction of streamflow regimes over large geographical areas: interpolated flow-duration curves for the Danube region

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The present study aims at performing a statistical regionalization of streamflow regimes over large areas, with a special focus on the Danube region, producing a GIS data-layer to be made available for a broader use in the Danube region through the Danube Reference Spatial Data Infrastructure (DRSDI). Streamflow indices (e.g. Mean Annual Flow) as well as empirical period-of-record flow-duration curves (FDCs, i.e. streamflow values associated with 15 exceedance-probability values between 1% and 99.7%) are compiled by European Joint Research Centre (JRC) for ∼3000 discharge measurement points across Europe. The drainage area upstream each point is characterized in terms of physiographic and climate descriptors. First, we perform a comprehensive analysis of the relationships existing between selected indices of the streamflow-regime and catchment descriptors, focussing on Europe and the Danube region. Although our analysis shows the existence of statistically significant correlations between streamflow-regime indices and catchment descriptors for both areas, our preliminary investigation recommends against predicting the streamflow-regime through multiregression models based on the study dataset. Second, we consider geostatistical interpolation of the streamflow regime in the Danube region and we select the recently proposed procedure termed Total Negative Deviation Top-Kriging (TNDTK). The main aim of the second part of our study is twofold: (1) to test the viability of TNDTK for predicting FDCs over large geographical regions; (2) to develop indicators of the reliability of large scale predictions of FDCs. Predicted FDCs show a high accuracy for the entire Danube region (overall Nash-Sutcliffe efficiency computed on log-flows using a leave-p-out cross-validation procedure is equal to 0.938, 0.935, and 0.923, with p equal to 1 site, one third and half of the sites, in this order) and a statement on uncertainty is attached to each interpolated FDC in the Danube region (c.a. 4000 prediction nodes) by looking at the spatial variance of TNDTK predictions.