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Geostatistical enhancement of european hydrological predictions

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Geostatistical Enhancement of European Hydrological Prediction (GEEHP) is a research experiment developed within the EU funded SWITCH-ON project, which proposes to conduct comparative experiments in a virtual laboratory in order to share water-related information and tackle changes in the hydrosphere for operational needs (http://www.water-switch-on.eu). The main objective of GEEHP deals with the prediction of streamflow indices and signatures in ungauged basins at different spatial scales. In particular, among several possible hydrological signatures we focus in our experiment on the prediction of flow-duration curves (FDCs) along the stream-network, which has attracted an increasing scientific attention in the last decades due to the large number of practical and technical applications of the curves (e.g. hydropower potential estimation, riverine habitat suitability and ecological assessments, etc.). We apply a geostatistical procedure based on Top-kriging, which has been recently shown to be particularly reliable and easy-to-use regionalization approach, employing two different type of streamflow data: pan-European E-HYPE simulations (http://hypeweb.smhi.se/europehype) and observed daily streamflow series collected in two pilot study regions, i.e. Tyrol (merging data from Austrian and Italian stream gauging networks) and Sweden. The merger of the two study regions results in a rather large area ($\sim$450000 km2) and might be considered as a proxy for a pan-European application of the approach. In a first phase, we implement a bidirectional validation, i.e. E-HYPE catchments are set as training sites to predict FDCs at the same sites where observed data are available, and vice-versa. Such a validation procedure reveals (1) the usability of the proposed approach for predicting the FDCs over the entire river network of interest using alternatively observed data and E-HYPE simulations and (2) the accuracy of E-HYPE-based predictions of FDCs in ungauged sites. In a second phase, we develop a module, to be added to the flow-duration curve prediction framework, capable of enhancing E-HYPE-based predictions of FDCs by modelling the residuals obtained from the first phase. Among all possible methods, we apply geostatistical modelling of residuals and, alternatively, regional regression, so that residuals between empirical and E-HYPE-base predicted FDCs are described in terms of geomorphological and climatic catchment descriptors.