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Comparison of geostatistical approaches to predict low-flow indices in ungauged basins: TOPKRIGING and Physiographic space-based interpolation

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The prediction of low-flow indices in ungauged basins is a common task in a number of engineering applications. Recent studies highlight that geostatistical interpolation, which has been originally developed for the spatial interpolation of point data can be effectively applied to the problem regionalization of hydrometric information. This study focuses on a comparison between two innovative approaches to predict low-flows in ungauged basins. Both approaches do not need to identify a subdivision of the study area into homogeneous pooling - group of sites, which is generally a critical step in any regionalization study. The first one, named Topological kriging or TOPKRIGING, estimates the variable of interest along river networks taking both the area and the nested nature of catchments into account. The second technique, named Physiographic-Space Based Interpolation (PSBI), performs the spatial interpolation of the desired streamflow related variable (e.g., annual streamflow, low-flow index, flood quantile, etc.) in the bidimensional space of catchment descriptors. The x and y coordinates of this space are derived from a set of n>1 catchment descriptors through the application of multivariate techniques (e.g., principal component analysis).
We applied TOPKRIGING and PSBI to a broad geographical region located in northern-central Italy. The study area includes 51 gauged catchments, for which a number of physiographic descriptors are available. The techniques were applied to estimate low-flow indices both at hydrometric station and along the river network. The results obtained were compared in order to highlight the advantages and disadvantages for each methodology and quantifying the reliability of predicted low-flow indices in ungauged basins for both techniques.