Geophysical Research Abstracts
Vol. 13, EGU2011-9946, 2011
EGU General Assembly 2011

Spatially smooth estimation of low-flows: Canonical-Kriging and Top-Kriging

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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 of regionalization of hydrometric information. This study compares two innovative and kriging-based approaches for the prediction of low-flows in ungauged basins. The first one, named Canonical-Kriging or Physiographic-Space Based Interpolation (PSBI), performs the spatial interpolation of the desired streamflow index (e.g., annual streamflow, low-flow index, flood quantile, etc.) in the space of catchment descriptors. The second technique, named Topological kriging or Top-kriging, predicts the variable of interest along river networks taking both the area and nested nature of catchments into account. Canonical-Kriging and Top-kriging are applied for the regionalization of Q_{355} (i.e., the streamflow that is equalled or exceeded 355 days in a year, on average) over a broad geographical region in central Italy, which contains 51 gauged catchments. Both techniques are cross-validated through a leave-one-out procedure at all available gauges and applied to a subregion to produce a continuous estimation of Q_{355} along the river network extracted from a 90m DEM. The results of the study show that Top-kriging and Canonical-Kriging present complementary features and have comparable performances (Nash-Sutcliffe efficiencies in cross-validation of 0.89 and 0.83, respectively). Both techniques provide plausible and accurate predictions of Q_{355} in ungauged basins and represent promising opportunities for regionalization of low-flows.