Advances in the regionalization approach: geostatistical techniques for estimating flood quantiles

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The knowledge of peak flow discharges and associated floods is of primary importance in engineering practice for planning of water resources and risk assessment. Streamflow characteristics are usually estimated starting from measurements of river discharges at stream gauging stations. However, the lack of observations at site of interest as well as the measurement inaccuracies, bring inevitably to the necessity of developing predictive models. Regional analysis is a classical approach to estimate river flow characteristics at sites where little or no data exists. Specific techniques are needed to regionalize the hydrological variables over the considered area.

Top-kriging or topological kriging, is a kriging interpolation procedure that takes into account the geometric organization and structure of hydrographic network, the catchment area and the nested nature of catchments. The continuous processes in space defined for the point variables are represented by a variogram. In Top-kriging, the measurements are not point values but are defined over a non-zero catchment area.

Top-kriging is applied here over the geographical space of Tuscany Region, in Central Italy. The analysis is carried out on the discharge data of 57 consistent runoff gauges, recorded from 1923 to 2014. Top-kriging give also an estimation of the prediction uncertainty in addition to the prediction itself. The results are validated using a cross-validation procedure implemented in the package rtop of the open source statistical environment R The results are compared through different error measurement methods. Top-kriging seems to perform better in nested catchments and larger scale catchments but no for headwater or where there is a high variability for neighbouring catchments.