Top-kriging method for regionalization of flood quantiles in ungauged river basins

Valentina Chiarello (1), Enrica Caporali (1), and Hermann G. Matthies (2)

(1) University of Firenze, Civil and Environmental Engineering, Firenze, Italy (valentina.chiarello@dicea.unifi.it), (2) Institute of Scientific Computing, Technische Universität Braunschweig, Braunschweig, Germany

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.

Top-kriging is here applied over the geographical space of Tuscany Region, in Central Italy. The analysis is carried out on the annual peak-streamflow time series recorded from 1923 to 2014 by 26 runoff gauges located in the Arno river basin. Flood quantiles corresponding to several return periods, particularly 10, 50, 100, 200, 500 year return periods standardized by the basin area are considered as specific runoff. An at-site flood frequency analysis is carried out at each station of the dataset. Empirical estimates of flood quantiles were determined by fitting appropriate probability distributions to the discharge data by means of the nsRFA R-package. Top-kriging gives 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 rtop R-package. 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.