Geophysical Research Abstracts
Vol. 17, EGU2015-11255, 2015
EGU General Assembly 2015

Geostatistical prediction of stream-flow regime in southeastern United States

Alessio Pugliese (1), Attilio Castellarin (1), Stacey Archfield (2), William Farmer (2,3)

(1) University of Bologna, DICAM, Bologna, Italy (attilio.castellarin@unibo.it), (2) U.S. Geological Survey (USGS), Reston, VA 20192, USA, (3) Dept. of Civil and Environmental Engineering, Tufts University, Medford, MA, USA

A Flow-Duration Curve (FDC) represents the percentage of time (duration) during which a given stream-flow is equalled or exceeded over a given period of time. In many water-engineering applications FDCs need to be predicted for ungauged sites (Prediction in Ungauged Basins, PUB problem) using the information collected in donor neighboring gauged basins. We present an application of kriging procedures which makes the procedures capable of predicting FDCs in ungauged catchments. As many of the techniques proposed in the recent literature, the curve is predicted at the target site as a weighted average of empirical dimensionless FDCs that are constructed for neighboring streamgauges and standardized by discharge $Q*$. Geostatistical weights are obtained by applying two different interpolation techniques, i.e. Top-kriging (TK, see e.g. Pugliese et al., 2014) and Ordinary-kriging (OK, see e.g. Castiglioni et al., 2009), for interpolating a point streamflow-index computed as the overall negative deviation of each empirical curve from $Q*$, which we term Total Negative Deviation (TND). Empirical TND values can be used to assess the hydrological similarity between catchments and can be interpolated using TK or OK procedures along the stream-network. We consider period-of-record/annual, and complete/seasonal FDCs standardized by two different $Q*$ values, i.e. Mean Annual Flow (MAF) and Mean Annual Precipitation at catchment scale times the drainage area (MAP*), and we apply TK and OK in a wide study area in the Southeastern United States including 182 unregulated gauged catchments. The accuracy of the predicted FDCs is assessed comprehensively under different operational conditions through the (1) leave-one-out and (2) three-fold cross-validation procedures. The results are compared with six different methods for predicting FDCs from synthetically generated daily stream-flow series, which were recently analysed by U.S. Geological Survey. The application of OK and TK reveal similar performances independently of the interpretation of the curves (i.e. period-of-record/annual, or complete/seasonal) or $Q*$ (MAF or MAP*); at -site performances are satisfactory or good (i.e. Nash-Sutcliffe Efficiency NSE ranges from 0.60 to 0.90 for cross-validated FDCs, depending on the model setting), while the overall performance at regional scale indicates that OK and TK are associated with smaller BIAS and RMSE relative to the six benchmark procedures.

Acknowledgements: We thankfully acknowledge Alessia Bononi and Antonio Liguori for their preliminary analyses and Jon O. Skøien and Edzer Pebesma for their helpful assistance with R-packages `rtop` and `gstat`. The study is part of the research activities carried out by the working group: Anthropogenic and Climatic Controls on WateR AvailabilitY (ACCuRAcY) of Panta Rhei – Everything Flows Change in Hydrology and Society (IAHS Scientific Decade 2013–2022).

References

Pugliese, A., A. Castellarin, A., Brath (2014): Geostatistical prediction of flow–duration curves in an index-flow framework, Hydrol. Earth Syst. Sci., 18, 3801-3816,doi:10.5194/hess-18-3801-2014.

Castiglioni, S., A. Castellarin, A. Montanari (2009): Prediction of low-flow indices in ungauged basins through physiographical space-based interpolation, Journal of Hydrology, 378, 272–280.