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Factors influencing long range dependence in streamflow of European rivers

E. Szolgayová, G. Blöschl, and C. Bucher
Vienna University of Technology, The Centre for Water Resource Systems, Wien, Austria (szolgayova@waterresources.at)

Long term behaviour of riverflows and its dependence on climatic factors has become a widely discussed topic. Studies examining long term variations, such as trends in river runoffs or floods, and their dependence on various climatic and storage influencing factors, such as the global climatic oscillations or precipitation are becoming increasingly popular. One of the phenomena, which becomes apparent when observing time series over longer periods of time is long range dependence. This behaviour, though known for a long time, still remains unexplained. Thus it is of interest to investigate possible drivers influencing the long range dependence.

The long range dependence is numerically expressed by the Hurst coefficient. There is a wide range of methods for estimating this value. Many of these methods were extensively tested on synthetically generated data with different properties.

This work follows two main goals. First a comparison of the performance of several popular estimation methods applied to real (not synthetic) mean daily runoff time series (obtained mainly from the Global Runoff Data Centre) covering most of European area is offered. Second, correlations of the estimation results with various possible climate and storage related factors are investigated. In order to obtain a reasonable reliability of the estimation methods, only data sets of over 60 years of daily measurements were considered.

The results confirm long range dependence in the mean daily discharges of European rivers. All methods produced reasonably correlated estimates of the Hurst coefficient, with no significant dependence on the time series length. The value of the Hurst coefficient is significantly positively correlated with the mean discharge values, the mean annual temperature and the catchment area of the analyzed catchments. On the other hand negative dependence on mean annual precipitation was observed. This Europe wide study confirms correlations of the long range dependence in river runoff with climate and storage influencing factors, underpinning the need of investigating possible drivers of the runoff processes on regional scales as well and including these dependencies in the statistical runoff modelling.