A "characteristic number" approach to relate stream flow dynamics to land properties

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Land characteristics influence stream flow dynamics. However quantifying the influence of basin characteristics on discharge time series is not straightforward. Most commonly such relationships are assessed in the process of fitting rainfall runoff models where model parameters are linked to properties of topography, hydrogeology, soils and vegetation or land cover in general. The difficulties with such approaches have been highlighted increasingly in recent studies related to ambiguity in parameter identification and choice of model structure.

Here we replace strong assumptions on the model structure with the proposition that the dynamic of a time series can be sufficiently summarized by a "characteristic number". In this study we use a variety of measures to characterize short and long term dynamics of streamflow, which are among others: the coefficient of variation, higher order moments, the lag one auto correlation, correlation length, entropies, slopes of logarithmic spectral densities and Hurst coefficients. Once derived the values are compared to various catchment properties including topography and soil characteristics, by means of modern supervised learning methods. This enables to isolate combinations of land properties that significantly influence particular stream flow dynamics.

We analyze a large set of central European stream flow series representing small catchments. Stream flow time series are obtained from the European Water Archive (EWA) and catchment boundaries and properties are assembled from various European databases.