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Identifying external influences on discharge time series: Long term variability of the Danube River flow and its relation to precipitation and temperature

Elena Szolgayová, Günter Blöschl, and Christian Bucher
The Centre for Water Resource Systems, Vienna University of Technology, Austria (szolgayova@waterresources.at)

Studies analysing the impact of climate related drivers, such as precipitation and temperature on discharge have become widely popular in the past years. It is especially interesting to see the impact of these factors from the long term perspective and the influence of these drivers on possible long range dependence in the discharge time series.

In this work we use cross – wavelet analysis in order to improve the understanding of interdependencies between discharge and the above named climate related drivers and to observe the long term variability of the river flows and its relation to temperature and precipitations. Analysis of the cross – wavelet spectra thus can help to explain the influence of the specific geographical conditions of the region on the discharge. Using the cross – wavelets thus helps to explain the long term behaviour and long range dependence in discharge from the process point of view. Such analysis obviously has to be done case based, observing the interaction between the discharge and the respective driver for different frequency intervals at different periods in time for a discharge gauging station separately.

We consider daily and monthly discharge time series from five discharge gauging stations of the Danube River in Germany, Austria and Slovakia and the areal average precipitation over their catchments and temperature time series for the respective discharge gauge. The cross – wavelets are used to analyze the general impact of precipitation on discharge using generated discharge and precipitation data in each station. A simple dual kernel convolution model is used to generate discharge from precipitation. From thus obtained data sets the cross – wavelet spectra are constructed and analysed in order to understand how does precipitation influence discharge, especially in the lower frequencies. The influence of different behavioral patterns in precipitation (simulating possible different physiographic conditions in the catchment), such as travel time in general or long range dependence on discharge can thus be analyzed.