Downscaling of climate parameters in Bode river basin in Germany using Active Learning Method (ALM)

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This study is a part of main program RIMAX "risk management of extreme flood events", which concerns itself of "extremes floodwater and damage potential in the Bode river basin in Germany „with the variable occurrence of flood events in this area for the past 1000 years.
The objective of the project is to produce the local climate time series (climate downscaling) as the input for a runoff model in the Bode basin for the last 1000 years on a grid of 5x5 km as well as the estimation of the spatial distributions and temporal variability of the precipitation, the amount of precipitation and further meteorological parameter (temperature, radiation and relative humidity) for this area.

A nonlinear downscaling based on Fuzzy rules has been used to produce 1000 year climate time series. The global model ECHO from Max Planck institute for Meteorology (MPI) with T30 resolution and 1000 years data has been used as the global model (GCM). The regional model REMO, with 10 km resolution and 20 years data has been used as the regional input. The observations, which include 30 years precipitation, radiation, temperature, wind and relative humidity, have been used as output (predictand).

In this study, two set fuzzy rules have been trained to describe the relationship between ECHO/REMO and REMO/Observation. The Fuzzy method used in this work is Active Learning Method (ALM). The heart of calculation of ALM is a fuzzy interpolation and curve fitting which is entitled Ink Drop Spread (IDS). The IDS searches fuzzily for continuous possible paths of interpolated data points on data planes. The ability of ALM to simulate the high values as well as the fluctuation of time series is much better than Takagi-Sugeno models, which have been used for downscaling in the last decade.

In the next steps, considering predictors from the ECHO time series and predictands from the REMO grid points, some ALM models are developed, which describe the fuzzy rules and the relationship between global and regional scales. These models are verified using checking data and then considering ECHO/REMO models and on the basis of last 1000 years of ECHO, the REMO time series as well as the local data are simulated. These simulated data are used as input-data for the runoff model ARCEGMO.