Downscaling of precipitation in the catchment area of Bode using Active Leraning Method (ALM)

S. Sodoudi (1), E. Reimer (1)

(1) Free university of Berlin, department of Meteorology, Berlin, Germany
(sodoudi@zedat.fu-berlin.de / Phone: 030-83871137)

This project is a part of main program RIMAX "risk management of extreme flood events", which concerns itself of "extremes floodwater and damage potential in the catchment area of Bode river 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 as the input for a runoff model in the catchment area of Bode 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. Considering a parameter from observation dataset as predictand and some parameters from regional model as predictors the first fuzzy models have been developed. It is to be noticed that 15 year have been considered as training data and 5 years as checking data. The second Fuzzy models, which describe the relationship between global and regional scales (ECHO and REMO), have been developed in the second step. Regarding these 2 step fuzzy modelling, we achieve the objective of this project, which is the downscaling of climate parameter in the catchment area of Bode. There are 118

Stations in Bode, which have been classified into 4 groups using a low pass filtering. This classification makes the fuzzy modelling much easier and faster, because for each group there have been only two Fuzzy models developed. For the first group of stations the precipitation peak appears in summer, although for the second one, it appears in winter. The third group shows its maximum values in summer as well as in winter. The fourth group includes stations, which has its own characteristics; they are located in high land and mountainous region (Harz).

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 Fuzzy rules between REMO and observations have been provided for each group of stations. These Fuzzy models have been trained using 15 years data and verified using 5 years data. The simulated data agrees with observation; using 128 rules the high values of precipitation are exactly simulated. 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 some predictors (16) 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 large and regional scales. These models are verified using checking data. After these steps, considering ECHO/REMO models and on the basis of last 1000 years of ECHO, the REMO time series as well as the observations are simulated. These simulated data are used as input-data for a runoff model.