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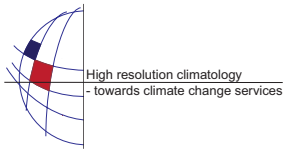

Probability of drought occurrence in the Rhine drainage basin during the 21st century

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Germany was struck by a recent hot spell and drought in 2003, which had a devastating effect on the environment and the society. Substantial interest has emerged in the probability of the occurrence of extreme events. Therefore the results of different regional climate models are analysed, which describe today's and future climate and the occurrence of extreme events.

To determine the size of uncertainty within regional climate model simulations, temperature and precipitation results of eight regional climate models from 1961 till 2000, with a horizontal resolution of 25 km are examined (RCM model data from the EU-Project ENSEMBLES). Their area means of three subregions in the Rhine drainage basin are compared to observation data sets. In order to describe future climate changes in the Rhine catchment area, numerous regional climate projections for the 21st century will be studied. These different regional climate projections were calculated with a large number of regional climate models embedded in information from various global models. The range of the regional climate projections will be evaluated using a value catalogue which has been specially designed for low water situations of the Rhine.

Furthermore a generalized time series decomposition technique was applied, which shows that the temperature time series can be described by a realization of the Gauss distributed random variable with time dependent mean and variance. The precipitation is represented by a Gumbel distributed random variable with time dependent location and scale parameters. The two parameters, which describe the distribution, are each linear combinations of several orthogonal functions: a constant, four trend functions, three functions describing the annual cycle and three functions describing the seasonal cycle. Besides fixed annual and seasonal cycle, changes in amplitude and phase are allowed. For the amplitude linear and quadratic time dependencies are considered. The superposition of several functions makes the detection of linear, progressively and regressively shaped changes in phase and amplitude of the annual and seasonal cycle possible. This technique makes it possible to determine the probability density function for each time step of the time series.

It is important to have a good understanding of the uncertainty of the regional climate model results, since their results are further used as forcing for hydrological models. These validation results are the first steps within the KLIWAS Project (German Federal Ministry of Transport, Building and Urban Affairs), who's final goal it is to describe the consequences of climate change for navigable waterways, which affects the role of the River Rhine as a major inland waterway.