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Changes in Temperature and Precipitation Extremes during the 21. Century in Germany

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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 monthly mean temperature and precipitation time series from 1950 until 2100 were computed using the three dimensional hydrostatic regional climate model REMO. The gool is to determine possible changes in mean climate and climate variability.

The Special Report on Emission Scenarios (SRES) A1b, B1, A2 of the Intergovernmental Panel on Climate Change (IPCC) are used to prescribe the concentrations of greenhouse gases in the model atmosphere. A double nesting dynamical downscaling procedure is applied: The global coupled atmosphere-ocean general circulation model ECHAM5/MPI-OM is used with a horizontal resolution of 200 km (T63) as lateral driving fields for REMO on 50 km resolution. The achieved results are needed as forcing for REMO on 10 km horizontal resolution.

We apply a generalized time series decomposition technique, 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 discribe 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. This technique makes it possible to determine the probability density function for each time step of the time series.

The most striking results, which are found analysing the temperature time series, are

different trends in the mean for each scenario. In scenarios A1b und A2 the mean rises about 5 K from 2000 to 2100 and in the scenario B1 about 3.5 K covering all of Germany. The standard deviation decreases in winter and increases in summer only in the southern part of Germany for the scenario A1b. The probability of very high temperatures in summer increases at the end of the 21st century according to the scenario A1b. Analysing the precipitation time series no trend can be found in the scale or shape parameter covering all of Germany. In scenario A1b the probability of precipitation falling under the 5% percentile increases from 2050 to 2100 for the months August, September and October.