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On the climate models performances to simulate the main predictors that influence the discharges in the Danube middle and lower basin

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The present study analyse climatic variables obtained from 4 global models of climate change: CNRM, ECHAM5, EGMAM and IPSL. The A1B scenario used both in IPCC and in the ENSEMBLES project was considered. The models performances to reproduce daily observations were tested for 3 variables that represent good predictors for the Danube discharge, precipitation and extreme temperatures from 10 stations located in the middle and lower Danube basin and the atmospheric pressure defined in grid points over Europe. The reference period for analysing the models performance compared to observations is from 50 to 100 years for precipitation and temperatures depending on observational data and 42 years (1958-1999) for the pressure field.

The simulation errors (bias) were calculated using 3 methods: the quantiles method using cumulative distribution functions (cdf), the method of differences in mean based on daily multiannual means and a combined method.

The simulation errors of the considered variables depend on the variable considered by the model and on the method. For example, for the pressure field the method of the differences in mean has a higher performance than the quantiles method for all the 4 models.

Excessive precipitation is underestimated by all the 3 methods and by all the models, ECHAM5 presenting the smallest errors.

Regarding the extreme values (percentiles greater than 95%) of maximum temperatures these are also underestimated by the 4 models. The best simulation of observations is realised by the model ECHAM5. Of interest for the minimum temperatures are the lowest values that are underestimated by the models excepting EGMAM that overestimate them. The smallest errors compared with observations are produced by CNRM and ECHAM5.

The verification of the correcting method efficiency is realised using cdf. The best adjustments for all the percentiles were found for the combined method used first to correct the mean values and then a new correction is applied for the extreme values.

After correcting the models depending the way of reproducing observations, the simulations correction for the 21st century are achieved.

Then different post–processing of corrected simulated variables are made. From analysing the signal-noise ratio in the pressure field it was found that two of the models present a significant anthropogenic signal in the Europe zone that was considered key zone for estimating discharges in the lower Danube basin.

The analysis of climate extremes indices revealed that for the air temperature field there is a clear tendency of increasing for the extremes in the 21st century comparing with the 20 century. Concerning the precipitation both indices of climate extremes, which refers to cases with abundant and those that emphasize dry periods have an increased occurrence of these extreme events in the 21st century compared with 20th century, namely an intensification of both dry and wet periods.

After correcting the models of the inherent errors it must be discussed the impact of climate changes upon the hydric regime. Therefore the climate variability of atmospheric circulation induces certain changes in Danube discharges. Using a non homogeneous hidden Markov model (NHMM) the discharge state is conditioned by the evolution of precipitation, atmospheric circulation type and temperatures. Using emission matrices and posterior probabilities and depending on simulated predictors for the 21st century, estimates of the discharge state in this century are obtained.

The probability to have extreme events (hydrological drought and great discharges) increases in the second half of the 21st century comparing to the first half.