



Statistical downscaling of global climate scenarios for the 21-st century to estimate hydrological extreme events in the Danube basin

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The goal of this study is to emphasize the changes in hydro meteorological variables simulated by global climate models, variables that represent good predictors for the Danube discharges.

There were processed the following GCMs: CNRM - CM3, ECHAM5 – MPI, EGMAM and IPSL - CM4 by considering the A1B scenario within stream1 experiment in the ENSEMBLES project, available from (<http://cera-www.dkrz.de/>).

Daily values from March, April and May (MAM) for 42 years for: the pressure at sea level (SLP) over Europe (30N-65N; 0-40E), precipitation at 10 stations from the middle and lower Danube basin and discharges at Orșova (situated in the Danube lower basin but representative for the middle basin) were analysed.

The observation data are for the period 1958-1999 (web-sites ECMWF and ECA&D). In the 21-st century 2 periods (2009-2050) and (2051-2092) were considered in order to realise comparisons with the observations.

For all simulations both the pressure and precipitation values were corrected of bias related to the reference period (1958-1999). In the pressure field, the predictors from three key zones were selected as being significant in the precipitation behaviour. These zones are centred on the points (45N; 12.5E), (42.5N; 17.5E) and (40N; 25E).

The precipitation values are downscaled by means of non homogeneous hidden Markov model (NHMM) with 7 states in which the three indices of sea level pressure: the laplacian values, the mean pressure values and the WE gradient values in the key zones are considered as predictors. After downscaling the daily precipitation with NHMM, a simulation was done on 100 realizations each with 42 years and 90 days for each year.

Then a fitting was done to GEV and GP distributions estimating in this way precipitation amounts corresponding to a return period of 100-years and probability distributions for 2 periods in the 21-st century (2009-2050) and (2051-2092).

The results are slightly different for the two basins. For instance, it was observed that for the middle basin the models estimate an increasing of the return level compared with the observations while for the lower basin, the models indicate generally a decreasing of the return level corresponding to the return period of 100 years.

Taking into account the link between local scale (Orsova discharges) and atmospheric circulation (SLP in the key zone obtained for the observed data), the estimations of the states of the atmospheric circulation in the 21-st century is achieved, by means of the simulations provided by the 4-GCMs. The results lead to the conclusions that an increase of the extreme hydrological events occurrence is expected especially in the second part of the 21- st century.

In addition to the above description, daily values of precipitation, minimum and maximum temperature at 10 stations situated in the Danube middle and lower basin were analyzed from the point of view of occurred changes in the climate extremes indices (CEI) in 21- st century compared to the 20-th century, considering values simulated with the 2 global models CNRM and IPSL for 100 years. From the 27 CEI analyses for the extreme temperatures in the 21-st century comparative with the 20-th century, the most significant results show a significant increasing of the tropical nights number and of summer days, a decreasing of intervals with cold days and days with frost. Concerning the precipitation both the indices which put in evidence the dry periods and very wet intervals present a light trend of increase in the 21-st century in comparison with 20-th, namely there is an increase trend of the extreme events in the precipitation in this century in the comparison with the last century.