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Assessment of climate change impact on water resources in the Upper Senegal basin

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This study assesses the potential impacts of climate change on water resources and the effect of statistical bias correction on the projected climate change signal in hydrological variables over the Upper Senegal Basin (West Africa). Original and bias corrected climate data from the regional climate model REMO were used as input for the Max Planck Institute for Meteorology-Hydrology Model (MPI-HM) to simulate river discharge, runoff, soil moisture and evapotranspiration.

The results during the historical period (1971-2000) show that using the bias corrected input yields a better representation of the mean river flow regimes and the 10th and 90th percentiles of river flow at the outlet of the Upper Senegal Basin (USB). The Nash-Sutcliffe efficiency coefficient is 0.92 using the bias corrected input, which demonstrates the ability of the model in simulating river flow. The percent bias of 3.88% indicates a slight overestimation of the river flow by the model using the corrected input. The evaluation demonstrates the ability of the bias correction and its necessity for the simulation of historical river regimes.

As for the potential changes of hydrological variables by the end of 21st century (2071-2100), a general decrease of river discharge, runoff, actual evapotranspiration, soil moisture is found under two Representative Concentration Pathways (RCP4.5 and RCP8.5) in all simulations. The decrease is higher under RCP8.5 with uncorrected data in the northern basin. However, there are some localized increases in some parts of the basin (e.g Guinean Highlands). The projected climate change signal of these above variables has the same spatial pattern and tendency for the uncorrected and bias corrected data although the magnitude of the corrected signal is somewhat lower than that uncorrected. Furthermore, the available water resources are projected to substantially decrease by more than -50% in the majority of the basin (especially in driest and hottest northern basin with RCP8.5 scenario) for all data, except the Guinean highlands where no change is projected. The comparison of simulations driven with uncorrected and bias corrected input reveals that the bias correction does not substantially change the signal of future changes of hydrological variables for both scenarios over the USB even though there are differences in magnitude and deviations in some parts of the basin.

Keywords :Climate change impact, signal, bias correction, Upper Senegal Basin, water resources