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Reduction of CMIP5 models bias using Cumulative Distribution Function transform and impact on crops yields simulations across West Africa.

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Different CMIP exercises show that the simulations of the future/current temperature and precipitation are complex with a high uncertainty degree. For example, the African monsoon system is not correctly simulated and most of the CMIP5 models underestimate the precipitation. Therefore, Global Climate Models (GCMs) show significant systematic biases that require bias correction before it can be used in impacts studies. Several methods of bias corrections have been developed for several years and are increasingly using more complex statistical methods.
The aims of this work is to show the interest of the CDFt (Cumulative Distribution Function transfom (Michelangeli et al.,2009)) method to reduce the data bias from 29 CMIP5 GCMs over Africa and to assess the impact of bias corrected data on crop yields prediction by the end of the 21st century. In this work, we apply the CDFt to daily data covering the period from 1950 to 2099 (Historical and RCP8.5) and we correct the climate variables (temperature, precipitation, solar radiation, wind) by the use of the new daily database from the EU project WATer and global CHange (WATCH) available from 1979 to 2013 as reference data.
The performance of the method is assessed in several cases. First, data are corrected based on different calibrations periods and are compared, on one hand, with observations to estimate the sensitivity of the method to the calibration period and, on other hand, with another bias-correction method used in the ISIMIP project. We find that, whatever the calibration period used, CDFt corrects well the mean state of variables and preserves their trend, as well as daily rainfall occurrence and intensity distributions. However, some differences appear when compared to the outputs obtained with the method used in ISIMIP and show that the quality of the correction is strongly related to the reference data. Secondly, we validate the bias correction method with the agronomic simulations (SARRA-H model (Kouressy et al., 2008)) by comparison with FAO crops yields estimations over West Africa. Impact simulations show that crop model is sensitive to input data. They show also decreasing in crop yields by the end of this century.

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