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CORDEX Climate Simulations for Africa using COSMO-CLM (CCLM)

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Africa is a key region of the international programme CORDEX (Coordinated Regional Climate Downscaling Experiment). The regional climate model COSMO-CLM (CCLM) has been used to contribute to the CORDEX Africa activities. An ensemble of projections has been created by downscaling the simulations of four global climate models (GCM), MPI_ESM_LR, HadGEM2-ES, CNRM-CM5, and EC-Earth. The historical reference period spans the time interval from 1950 until 2005. The projections are carried out for the period 2006 until 2100, using the two representative concentration pathways (RCP) RCP4.5 and RCP8.5. Thus, the whole ensemble consists of eight members.

The work presented focuses on climate change signals of temperature and precipitation for the near future period 2031 until 2060 and the end of the 21st century, 2071 until 2100. It is pointed out that the results have to be considered as one link in the chain of the multi RCM ensemble results that will be created within CORDEX.

For temperature all CCLM simulations lead to positive climate change signals over the whole African continent. The strength of the signal depends on the region and the forcing data. HadGEM2-ES driven simulations show the strongest increase, CNRM-CM5 driven simulations the weakest. Using RCP4.5 the ensemble average increase in the nearer future varies between 1.3 Deg (Gulf of Guinea region) and 1.9 Deg (Ethiopian Highlands and northern part of South-West Africa). For the whole continent the average change is about 1.7 Deg. At the end of the century the region dependent increase varies between 2 Deg and 2.8 Deg, for the whole continent the average change reaches 2.5 Deg. Using RCP8.5 the increase is stronger, on the average 2.2 Deg for the nearer future and 4.7 Deg for the end of the century. These ensemble signals for temperature are rather similar to those coming from the ensemble of GCMs being downscaled.
Considering precipitation, the RCM simulations consistently show drier future conditions for the whole African continent. The ensemble averages give -36 mm/year and -41 mm/year for the near future and RCP4.5 and RCP8.5, respectively, and -53 mm/year (RCP4.5) and -98 mm/year (RCP8.5) for the end of the century. The negative absolute changes are rather strong over the Ethiopian Highland and rather weak over the West Africa. However, looking at the individual ensemble members there is a large variability within the results. The CNRM-CM5 driven simulations, for example, solely lead to an annual increase of precipitation in West-African regions for both periods and RCPs, whereas, like the other simulations, they shows negative signals in the other regions This inter-forcing data variability is even stronger when analysing the seasonal climate signals. The negative continentally averaged change signals for precipitation due to the RCM simulations are contrary to the mean of the signal resulting from the GCM ensemble, consisting of those GCMs that have been downscaled. On the average the GCM ensemble shows a weak increase of precipitation of about 1% for the whole African continent.