Assessment of the CORDEX-CORE Africa simulations: evaluation and uncertainties in the mean and extreme indices climate change signal

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1) Introduction

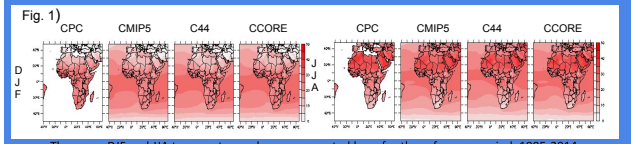
CORDEX-CORE is a new phase of CORDEX simulations with higher resolutions (0.22 degrees) consisting of two RCMs forced by three CMIP5 GCMs. This higher resolution ensemble could provide added value to regional climate change information however, since the data has just recently been released, more studies are required to validate and report on its climate change signal. Thus,The purpose of this analysis is to place the CORDEX core (CCore) brand new simulations within the context of the previous CORDEX 0.44 (C44) and CMIP5 simulations.

2) Methodology

We investigated the mean and extreme indices for temperature and precipitation over Africa using the CORDEX-CORE ensemble. These results are compared to the results of the driving models as well as to the lower resolution CORDEX-phase 1 ensemble (C44).

CMIP5	CORDEX 0.44	CORDEX-Core (0.22)
MOHC-HadGEM2-ES	CLMcom-CCLM4-CNRM-CERFACS-CNRM-CM5	RegCM-HadGEM
MPI-M-MPI-ESM-MR	CLMcom-CCLM4-ICHEC-EC-EARTH	RegCM-NorESM
NorESM	CLMcom-CCLM4-MOHC-HadGEM2-ES	REMO-HadGEM
	CLMcom-CCLM4-MPI-M-MPI-ESM-LR	REMO-NorESM
	DMI-HIRHAM5-ICHEC-EC-EARTH	REMO-MPI
	RegCM4-MOHC-HadGEM2-ES	
	RegCM4-MPI-M-MPI-ESM-MR	
	SMHI-RCA4-CCCma-CanESM2	
	SMHI-RCA4-CSIRO-QCCCE-CSIRO-Mk3-6-0	
	SMHI-RCA4-CNRM-CERFACS-CNRM-CM5	

3) Results



The mean DJF and JJA temperature values are reported here for the reference period, 1995-2014. All 3 ensembles show a reasonably good representation of the seasonal temperature, with a tendency towards a cold bias over the Sahara in both seasons and Southern Africa in JJA.

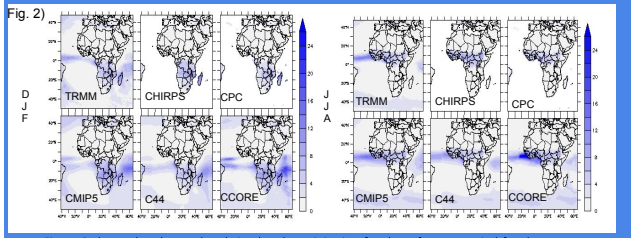


Figure 2 shows the observed and simulated precipitation for the reference period for the seasons DJF and JJA. All the 3 ensemble are within the observational uncertainty. CCore shows slightly more intense precipitation in both seasons with, for example, a good representation of the Ethiopian maximum in summer

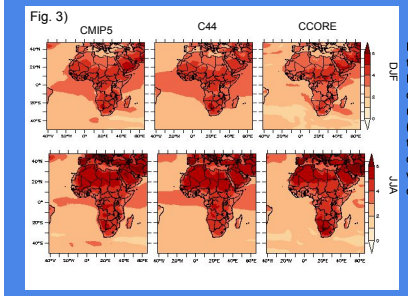
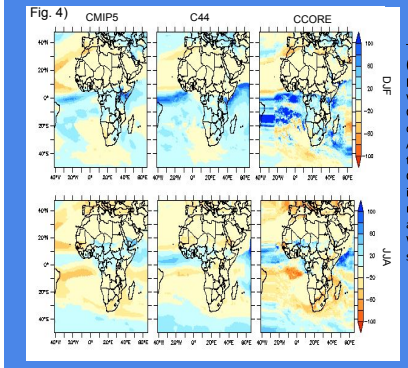
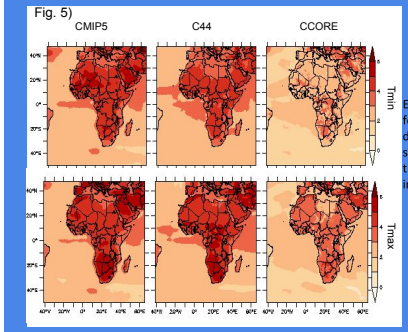


Fig 3. Reports the mean JJA and DJF temperature and change for the RCP8.5 scenario for the end of century time slice (2080-2099) with respect to the reference period (1995-2014). The climate change temperature signal is broadly consistent across the 3 ensembles, with a warming in DJF up to 4 degrees and 5 degrees in JJA.



The seasonal precipitation change (Fig. 4) Shows an increase in DJF precipitation over Central Africa which is more pronounced in CCore, and a more pronounced drying over Zambia, Southern Africa and Madagascar compared to the CMIP5 and C44. In JJA CCore shows a precipitation increase in the Sahel which is more pronounced than in CMIP5 and C44 and a drying in the Western Africa which is not shown by either of the two.



End of century climate projections for RCP8.5 for Tmin and Tmax are displayed in Fig. 5. Tmax shows a slightly smaller increase for CCore in the Sahara region, with a similar increase over the rest of Africa.

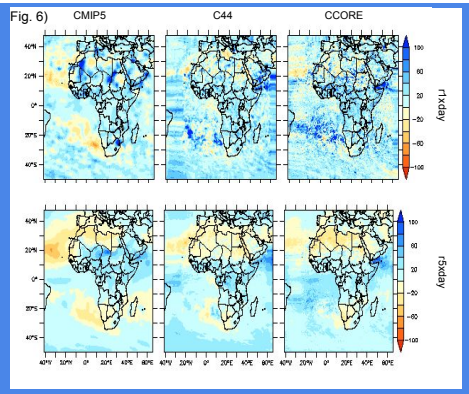
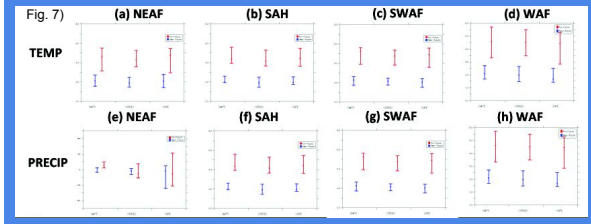
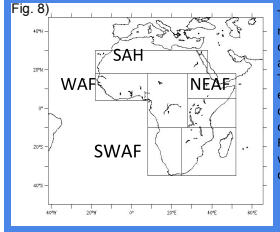


Fig. 6 shows the end of century projections for the extreme indices rx1day and rx5day. The Rx1day shows an increase in Central Western and Eastern Africa for all the 3 ensembles. An increase up to 40% is shown for Rx5day in CCore all over the continent except in Southern Western Africa. This increase stays between 20-30% for both C44 and CMIP5.





The whisker plots, in Fig 7., are shown for the 4 African regions reported in Fig. 8. The 3 ensembles are compared for the average temperature and precipitation anomaly for the near and far future RCP8.5 scenarios. The bar plots indicate the 5th and 95th percentile value of each of the ensembles. In all regions for temperature change the CCore shows the same range of uncertainty compared to the driving GCMs and the C44 ensemble. For precipitation the uncertainty range always overlaps with the C44 and CMIP5 ensemble, but is quite region dependent.

References:
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