Analysing regional climate change in Africa in a 1.5°C global warming world

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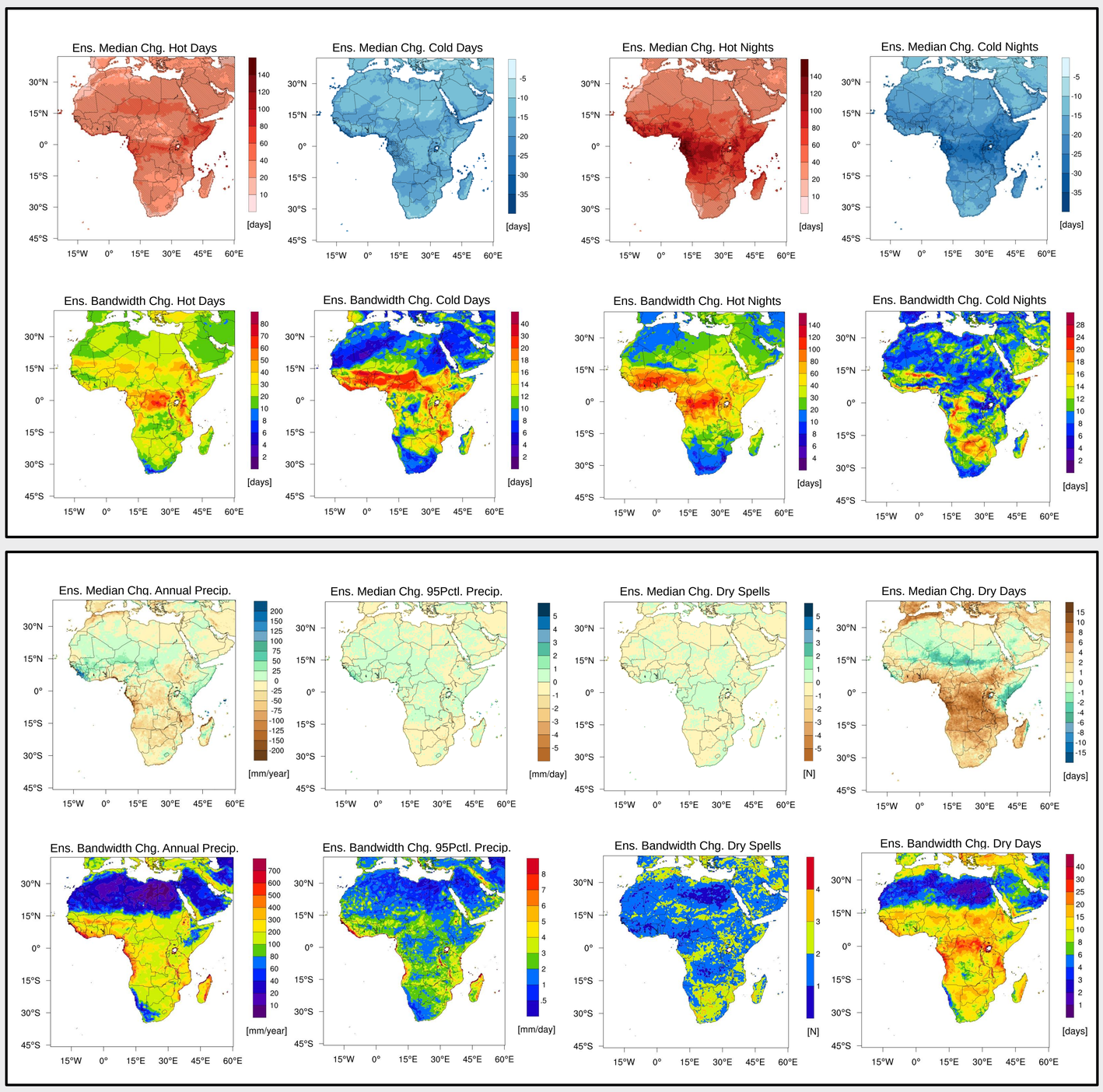
Introduction

At the 21st session of the UNFCCC Conference of the Parties (COP21) in Paris, a reaffirmation to strengthen the effort to limit the global temperature increase to 1.5 °C was decided. However, even if global warming is limited, some regions might still be substantially affected by climate change, especially for continents like Africa where the socio-economic conditions are strongly linked to the climatic conditions. Hence, providing a detailed analysis of the projected climate changes in a 1.5 °C global warming scenario will allow the African society to undertake measures for adaptation in order to mitigate potential negative consequences.

In order to provide such climate change information, the existing CORDEX Africa ensemble for RCP2.6 scenario simulations has systematically been increased by conducting additional REMO simulations using data from various global circulation models (GCMs) as lateral boundary conditions. The new low emission climate projections are already available at the Earth System Federation Grid (ESFG). Based on this ensemble, which now consists of ten CORDEX Africa RCP2.6 regional climate model simulations from three RCMs (forced with different GCMs), various temperature and precipitation indices have been calculated for a 1.5 °C global warming scenario. The applied method to define the 1.5 °C global warming period has been already applied in the IMPACT2C project (http://impact2c.hzg.de/).

Results



Conclusion

In a 1.5°C global warming world, the CORDEX-Africa ensemble using the RCP2.6 emission scenario show strong changes for the temperature based indices. The number of hot days and hot nights increases whereas the number of cold days and cold nights decreases. In particular, the changes in the hot days and nights are for most cases higher than their double standard deviation for 1971-2000. The precipitation indices show only small changes. The number of dry days decreases slightly in the south Sahara region and increases moderately in equatorial and southern Africa.

Method

The multi-model ensemble analysis encompasses the following GCM RCP2.6 climate projections downscaled with different RCMs at 0.44 x 0.44 degrees for the CORDEX-Africa domain:

GCM	Realisation	RCM	1.5°C Period
MPI-ESM-LR	r1i1p1	REMO	2035-2064
MPI-ESM-LR	r1i1p1	RCA4	2035-2064
EC-EARTH	r12i1p1	REMO	2028-2057
EC-EARTH	r12i1p1	RCA4	2028-2057
HADGEM2-ES	r1i1p1	REMO	2005-2034
HADGEM2-ES	r1i1p1	RCA4	2005-2034
HADGEM2-ES	r1i1p1	RACMO2.2	2005-2034
MIROC5	r1i1p1	REMO	2021-2050
IPSL-CM5A-LR	r1i1p1	REMO	2009-2038
NORESM1-M	r1i1p1	RCA4	2049-2078

For each regional climate change projection the number of cold and hot nights as well as the number of cold and hot days, the annual sum, the 95th percentile of daily precipitation, the number of dry spells and dry days were calculated for the 1.5°C-period. This period was compared with the period 1971-2000. The warming of 0.46 K compared to the pre-industrial period was taken into account (Vautard et al. 2014). Subsequently, the ensemble median (50th percentile) and the ensemble bandwidth (ensemble max. minus min.) for each index were derived. Changes exceeding the double standard deviation of the 1971-2000 period has been hatched .

- The number of cold nights was calculated using the daily minimum near surface air temperature below the 10th percentile of daily minimum near surface air temperature.
- The number of cold days was calculated using the daily maximum near surface air temperature below the 10th percentile of daily maximum near surface air temperature.
- The number of hot nights was calculated using the daily minimum near surface air temperature above the 90th percentile of daily minimum near surface air temperature.
- The number of hot days was calculated using the daily maximum near surface air temperature above the 90th percentile of daily maximum near surface air temperature.
- The dry spells are determined by the number of periods with at least five consecutive days with daily precipitation amounts of less than 1 mm per day.
- The dry days are determined by the number of days with daily precipitation amounts of less than 1 mm per day.

References

R. Vautard, A. Gobiet, S. Sobolowski, E. Kjellström, A. Stegehuis, P. Watkiss, et al. (2014) The European climate under a 2 °C global warming. Environ. Res. Lett, 9, p. 034006 http://dx.doi.org/10.1088/1748-9326/9/3/034006

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