Analysing regional temperature and precipitation dynamics in Africa from an ensemble of low emission climate change scenarios

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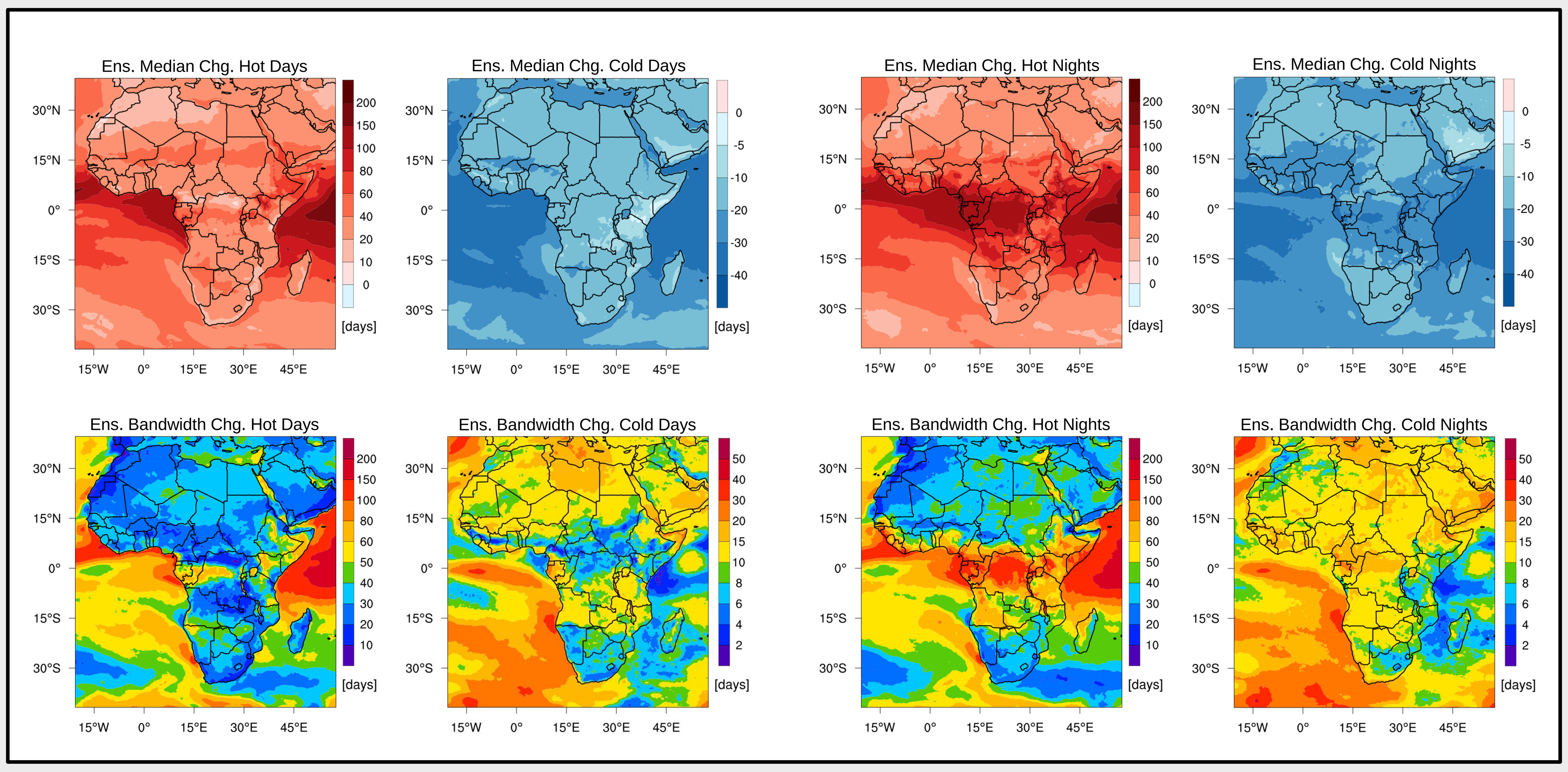
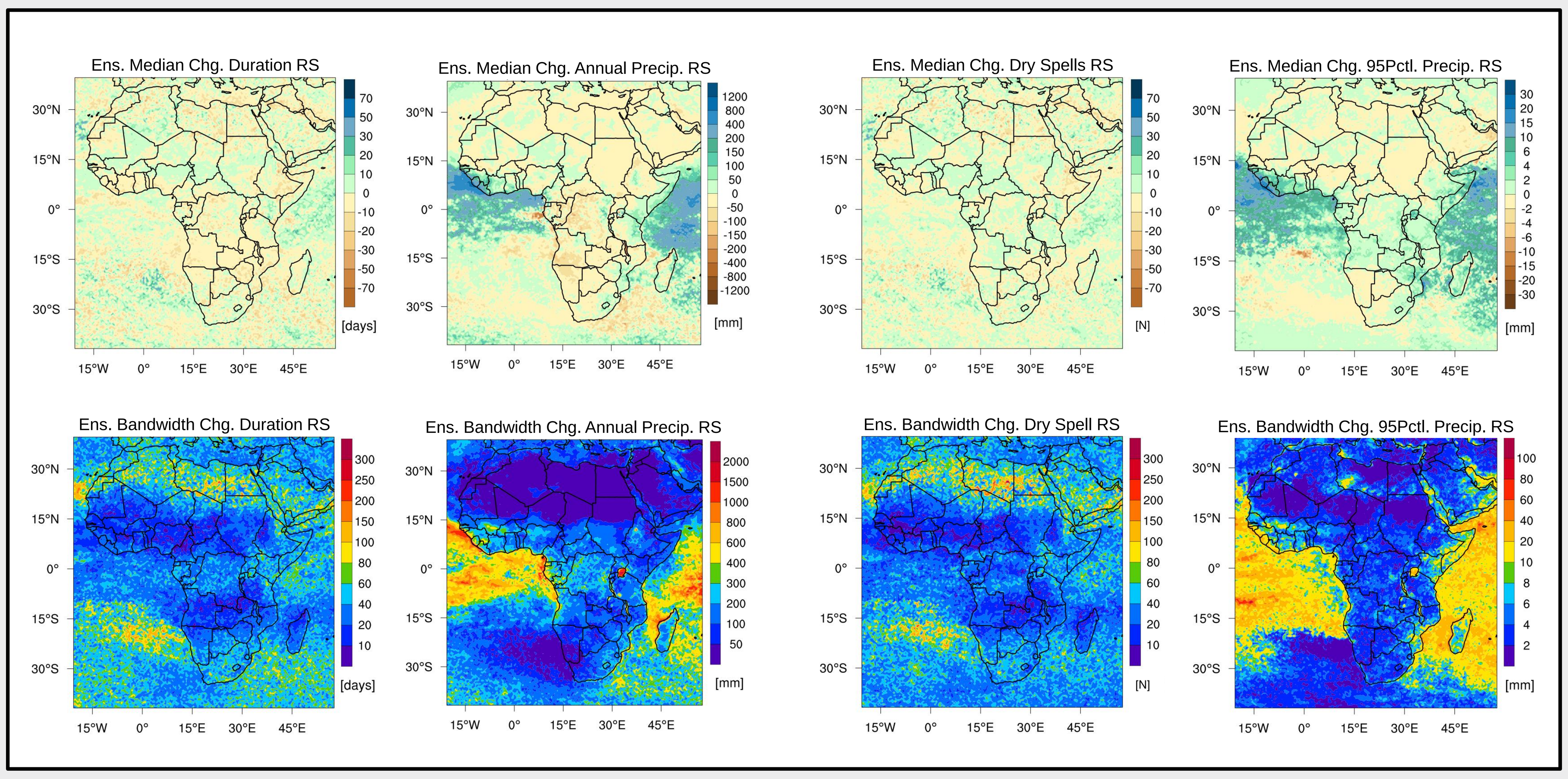
Introduction

The selection of forcing data from general circulation models (GCMs) is supposed to have an impact on dynamically downscaled regional climate change projections. In order to transfer the spread of projected climate change signals of the GCMs ensemble into the higher resolved regional climate model (RCM) projections, a multitude of GCMs representing the full range of possible future climate change has to be downscaled. An overview of the currently existing downscaled GCM scenarios for Africa shows an underrepresentation of simulations for the low emission scenario (RCP2.6) compared to the moderate emission scenario (RCP4.5) and the high emission scenario (RCP8.5) which are overrepresented.

In the framework of the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) project funded by the Federal Ministry of Education and Research, Germany, five low emission climate projection scenarios (RCP2.6) from different GCMs are downscaled with the regional climate model REMO (Jacob, 2001) for the CORDEX-Africa domain. The new low emission climate projections are already partly available at the Earth System Federation Grid (ESFG). Applying these new low emission climate projections, high resolution climate change information can be generated to handle the challenges of potential climate change for the economy and society in Africa. This information contains possible future changes in temperature and precipitation dynamics as well as derived indices such as number of cold and hot days, duration of rainy seasons and dry spells.

Results





Conclusion

Under the low emission climate scenario (RCP2.6) the applied GCMs project a bandwidth of the global mean surface temperature between 1.4 to 2.1 °C compared to the pre-industrial period. On the regional scale, only small changes in the precipitation based indices are projected for Africa by the regional climate model REMO. For the temperature based indices, the projected changes are stronger. The number of hot days and hot nights increases whereas the number of cold days and cold nights decreases.

Method

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

GCM	Realisation	Period
MPI-ESM-LR	r1i1p1	1950-2100
EC-EARTH	r12i1p1	1950-2100
GFDL-ESM2G	r1i1p1	1950-2100
IPSL-CM5A-LR	r1i1p1	1950-2100
HADGEM2-ES	r1i1p1	1950-2099

For each regional climate change projection the number of cold and hot nights as well as the number of cold and hot days, the duration of the rainy season, the dry spells, the annual sum and the 95th percentile of daily precipitation during the rainy seasons were calculated for 2071-2100* respective to 1971-2000. Subsequently, the ensemble median (50th percentile) and the ensemble bandwidth (ensemble max. minus min.) for each index were derived.

- 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 duration of the rainy season was calculated based on the definition by Liebmann et al. (2012), and the dry spells during the rainy seasons are determined by the number of periods in the rainy season with at least six consecutive days with daily rain amounts of less than 1 mm per day.

* The HADGEM2-ES climate change projection terminates in 2099.

References

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Liebmann, B., Blad, I., Kiladis, G. N., Carvalho, L. V., B. Senay, G., Allured, D., Leroux, S. & Funk, C. (2012): Seasonality of African Precipitation from 1996 to 2009. Journal Of Climate, 25(12), 4304-4322, doi:10.1175/JCLI-D-11-00157.1.

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