Institute of Meteorology and Climate Research
Department Troposphere Research
On behalf of the CLM-Community

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Climate Limited-area Modelling Community

WCRP CORDEX

# Added value of regional downscaling with COSMO-CLM in the context of CORDEX-Africa

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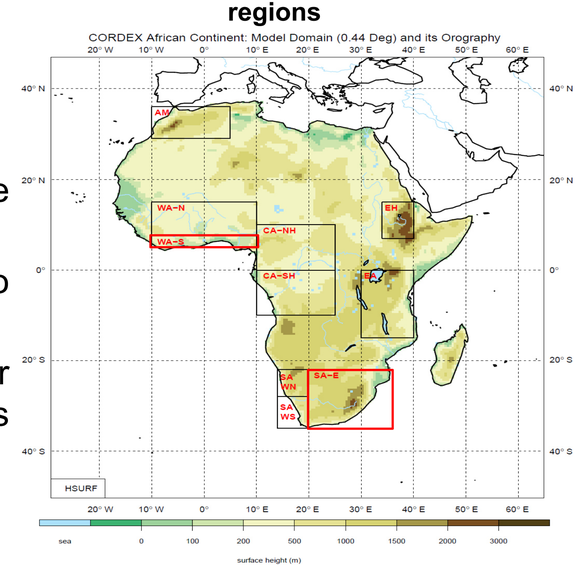
## Objectives and motivation:

- Provide regional information on future climate for planning and adaptation purposes.
- Spatial resolution (> 100 km) of General Circulation Models (GCMs) often too coarse to resolve climate relevant small-scale features like orography and differences in land use.
- Possible remedy: use a regional climate model (RCM) like COSMO-CLM to downscale GCM data to resolutions in the order of tens of km.
- This poster presents some exemplary results from an ensemble of four downscaled CMIP5 GCMs for vulnerable regions in Africa to assess the added value of the COSMO-CLM simulations and future conditions for Africa

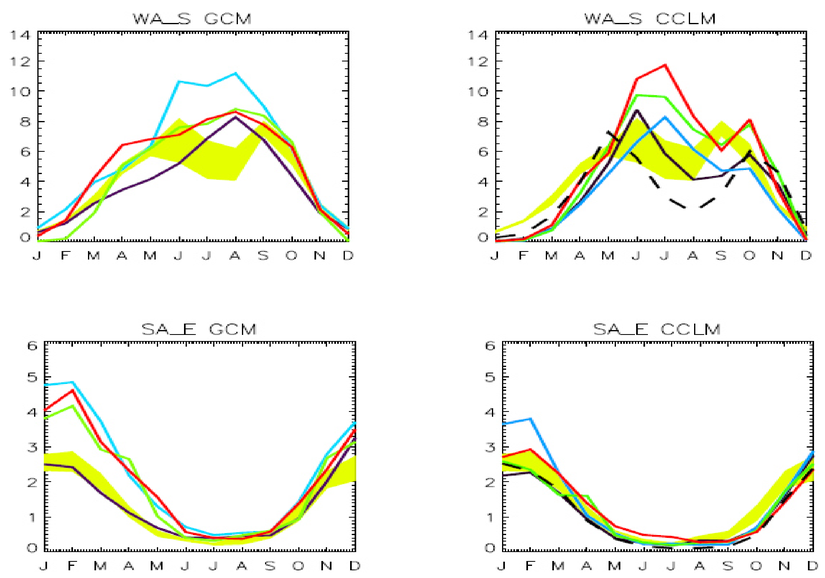
## Research questions to be answered

**Model domain and evaluation regions**




## 1. How well does the model reproduce the present climatology and impact-relevant quantities? Is there an added value?

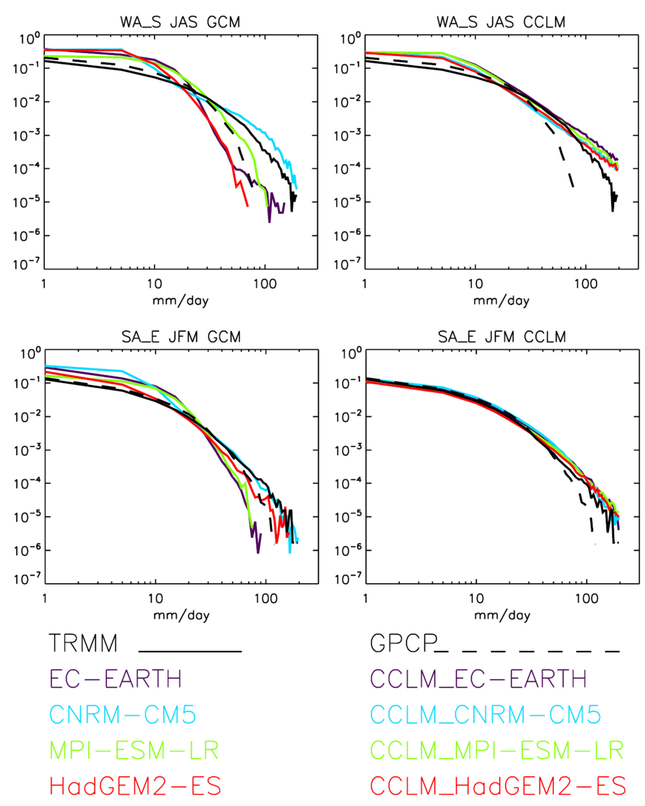
### Precipitation annual cycle



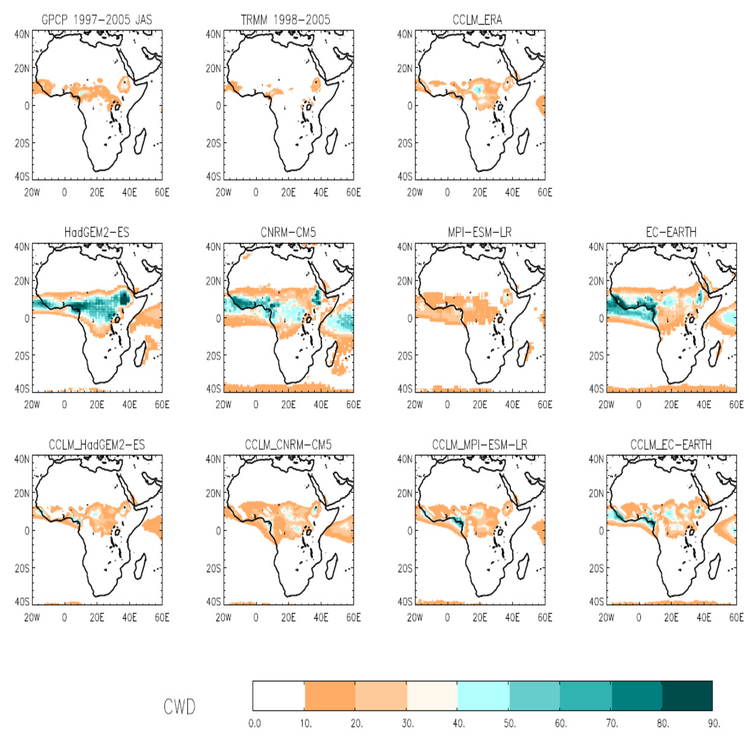

Annual cycle of daily precipitation, simulated by CCLM, is generally closer to the observations compared to that of the driving GCMs, particularly in JFM in South Africa (SA_E) and in the regions affected by the passage of the West African Monsoon (WA_S). There, COSMO-CLM is better able to reproduce the bimodal distribution, whereas the GCMs are in general not able to simulate this feature and they show a single maximum of precipitation in JAS.

### Impact-relevant quantities

PDFs of seasonal daily precipitation



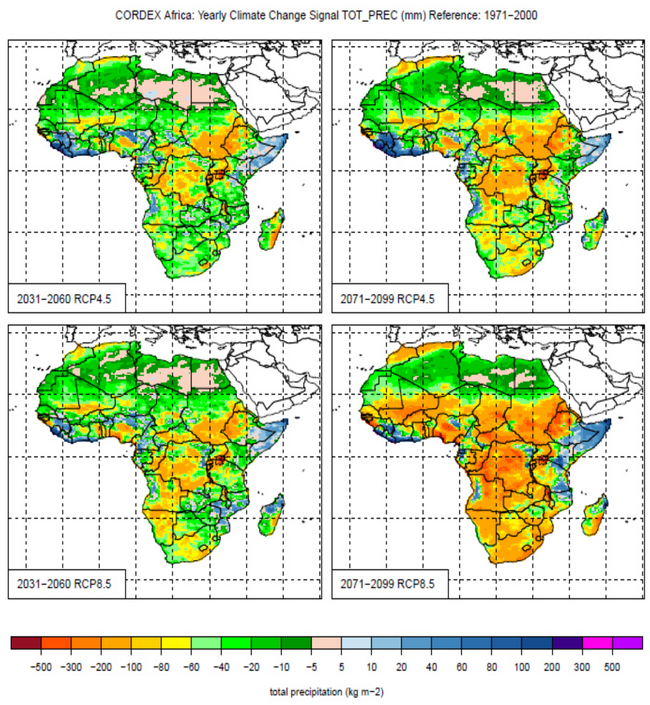

Number of consecutive wet days



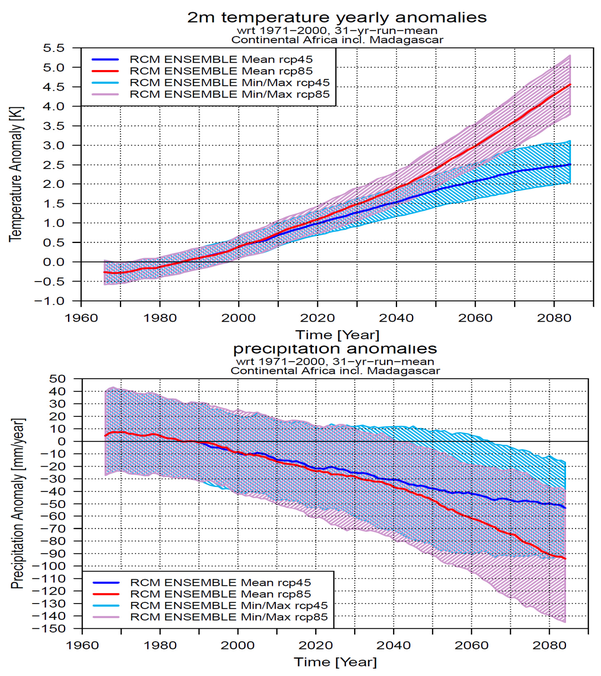

Impact models, such as hydrological and crop models, may be affected by extreme events, besides the annual/seasonal values of temperature and precipitation. Compared to GCMs, COSMO-CLM is better able to simulate some impact-relevant indices such as the number of consecutive wet (and dry) days, and the frequency (and mean intensity) of heavy rain events.

## 2. How is African climate going to be in the future?

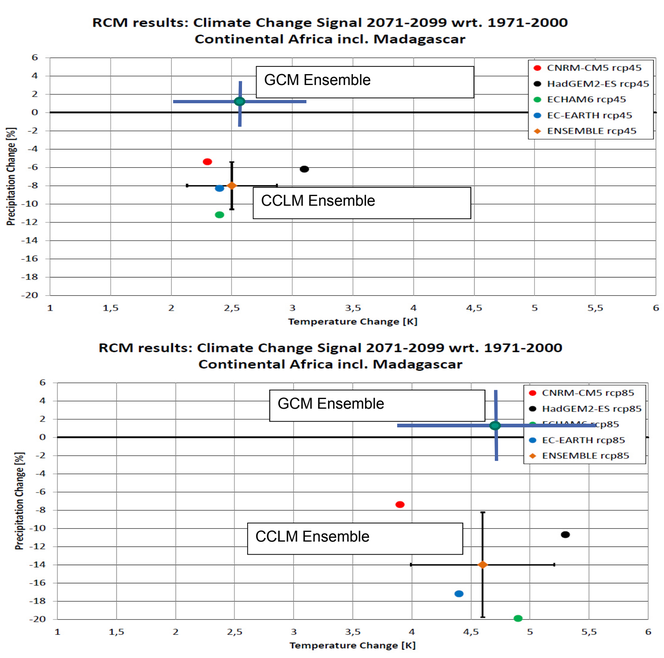
### Precipitation change signal




### Climate anomalies' trend




### Average climate change signal




**Temperature**: all simulations predict a positive climate change signal (about 2.5 for RCP4.5 and 4.7 for RCP8.5 at the end of the century). The mean temperature signal is similar to that of the driving GCMs.

**Precipitation**: future conditions become drier at continental scale ( about -8 % for RCP4.5 and -14% for RCP8.5 at the end of the century) for most of the African sub-regions, except the Horn of Africa. On average, the GCM ensemble shows a weak increase of precipitation of about 1% for the whole African continent, for both RCPs, in contrast with COSMO-CLM results.

**Take Home Messages**: RCMs like COSMO-CLM

- are better suited to assess climatology, extremes and climate indices than global models
- can help to identify most vulnerable regions for more focused and better informed planning of adaptation and mitigation measures under climate change conditions
- can provide very high resolution (< 10 km), physically consistent data needed by impact models
- However, assessment of robustness of results needs multi-model ensemble approach and more and reliable observations for model evaluation and improvement

**Literature:**
Panitz, H.-J., Dosio, A., Buechner, M., Luethi, D., & Keuler, K. (2014). COSMO-CLM (CCLM) climate simulations over CORDEX Africa domain: Analysis of the ERA-Interim driven simulations at 0.44 and 0.22 deg. resolution, *Clim. Dyn.*, 42, 3015-3038, DOI: 10.1007/s00382-013-1834-5

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Dosio, A., & Panitz, H.-J. (2016): Climate change projections for CORDEX-Africa with COSMO-CLM regional climate model and differences with the driving global climate models . *Clim. Dyn.*, 46, 1599-1625, Doi:10.1007/s00382-015-2664-4

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