Intercomparison of the spatiotemporal precipitation patterns in CORDEX-Africa, CMIP5, CMIP6, gauge-based and satellite products over southern Africa

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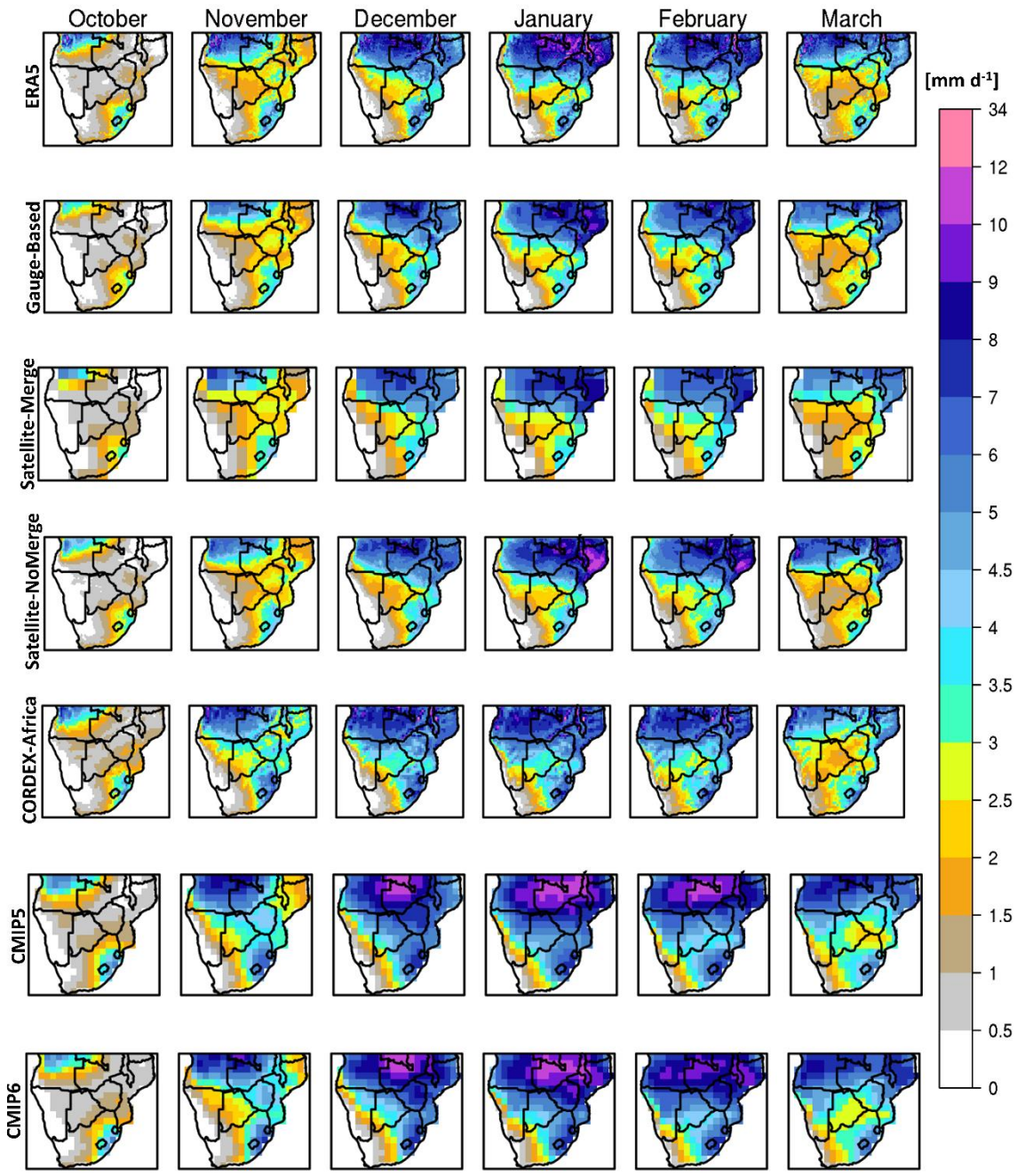
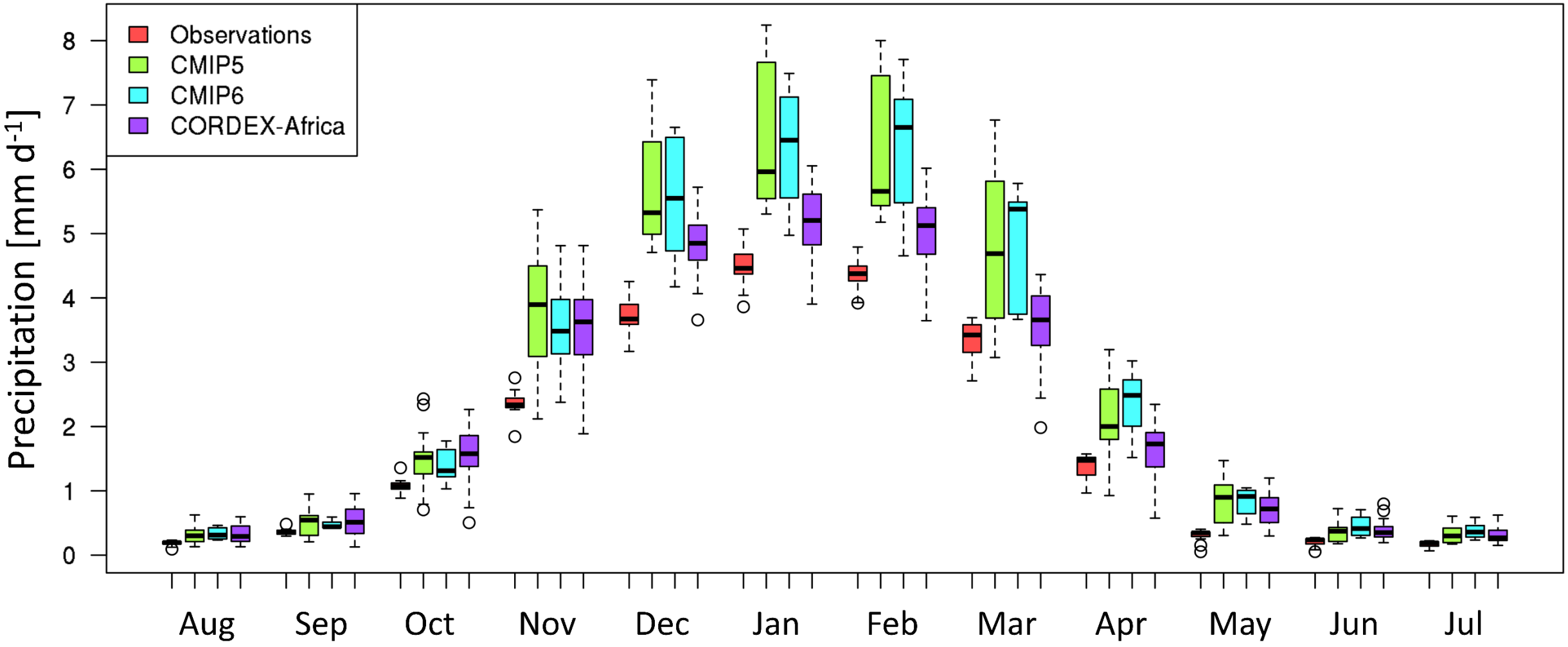


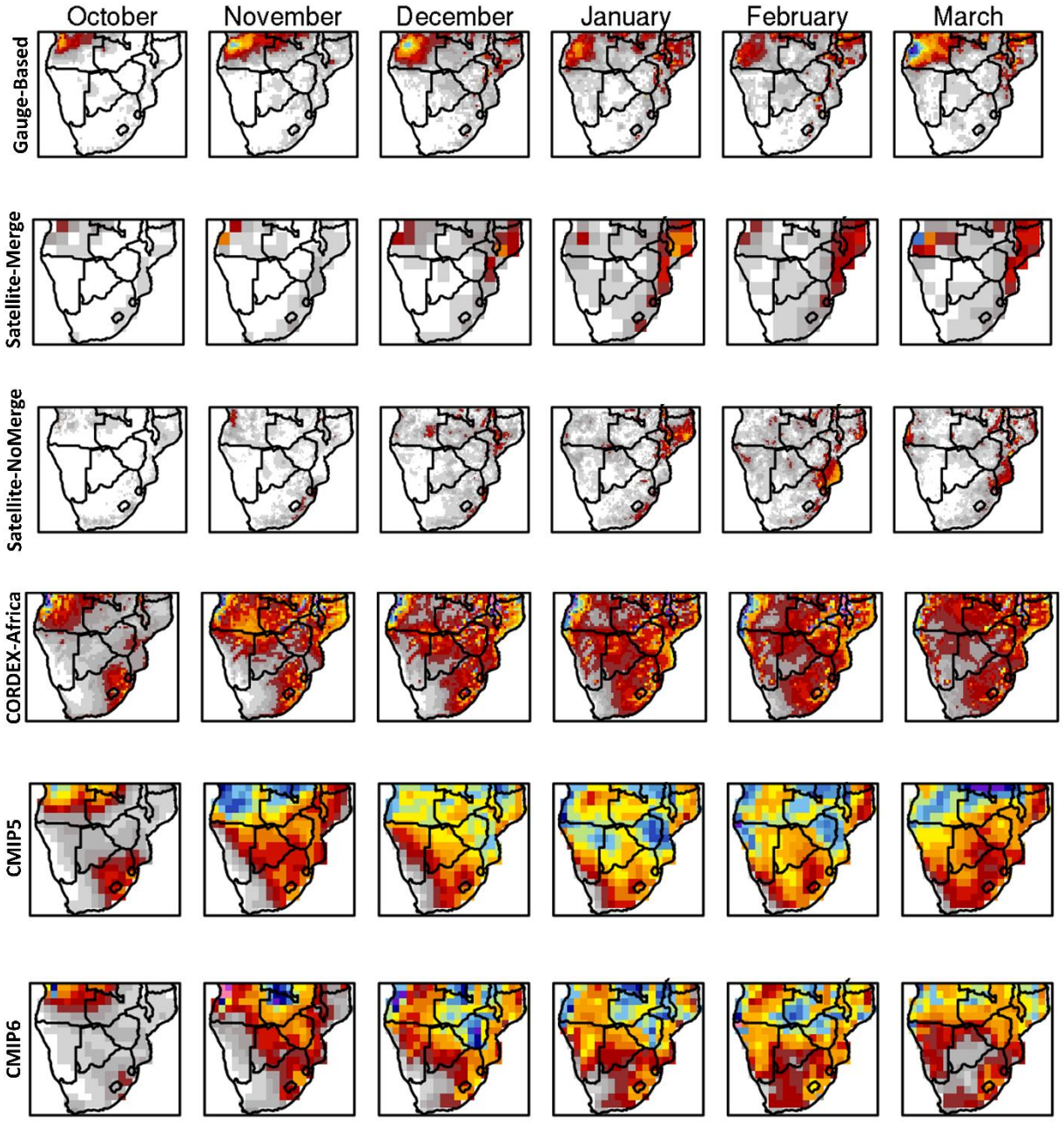
Monthly precipitation climatologies during the period 1986-2005 in mm d^{-1}.

More specifically, from top to bottom:
ERA5 reanalysis dataset.
Gauge-based: Ensemble mean of datasets that were produced by employing spatial interpolation methods using rain gauges/station data.
Satellite-Merge: Ensemble mean of all satellite products that merge with rain gauges/station data.
Satellite-NoMerge: Ensemble mean of satellite products that do not merge with rain gauges/station data.
CORDEX-Africa: Ensemble mean of regional climate model simulations performed in the context of Coordinated Regional Climate Downscaling Experiment (CORDEX) – Africa domain.
CMIP5: Ensemble mean of general circulation models participating in the Coupled Model Intercomparison Project Phase 5 (CMIP5) that were used as forcing in the CORDEX-Africa simulations.
CMIP6: Ensemble mean of general circulation models participating in the Coupled Model Intercomparison Project Phase 6.

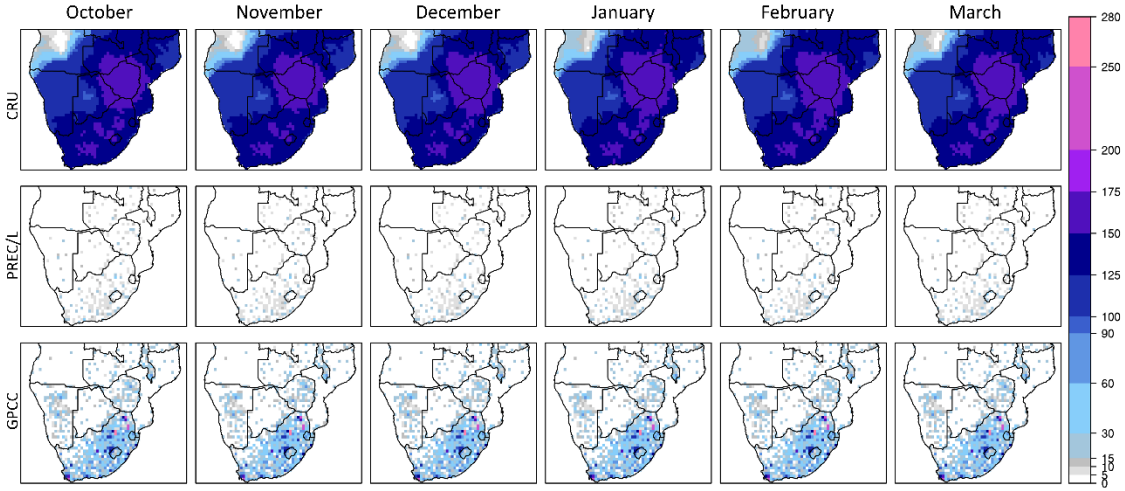
- Gauge-based products display similar pattern to satellite products that merge with rain gauges/station data.
- The CMIP5 ensemble overestimates precipitation during DJF over the northern part of southern Africa (SAF).
- The CMIP6 ensemble displays a similar behavior to CMIP5.
- The CORDEX-Africa ensemble reduces considerably (~3 mm/d) precipitation amounts over SAF.

Annual cycle of monthly precipitation during 1986-2005 for the ensemble of observational data (gauge-based, satellite and reanalysis), CMIP5, CMIP6 and CORDEX-Africa (land pixels only).

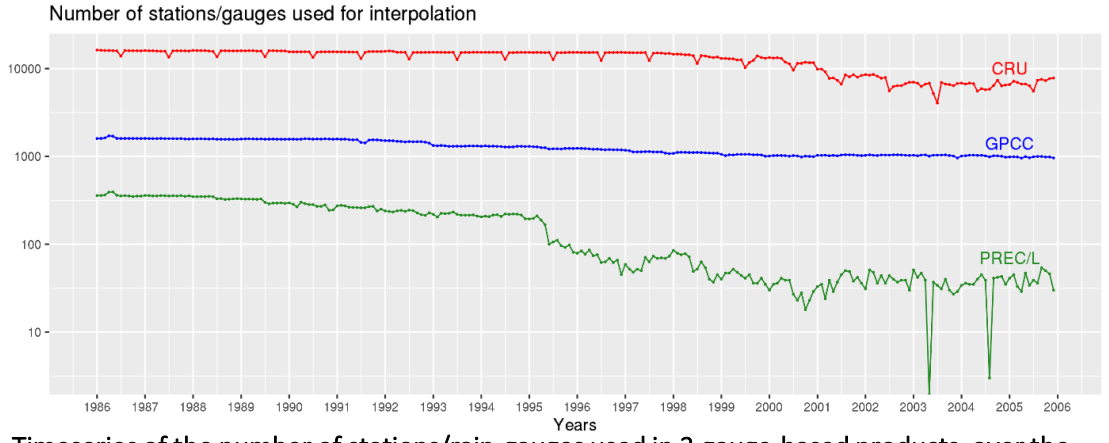




Standard deviation of monthly precipitation [mm d^{-1}] during the period 1986-2005. Rows indicate the ensemble means analyzed.



Total number of reporting stations/rain-gauges for each month during the period 1986-2005, used in the interpolation process of each gauge-based product (CRU, PREC/L, GPCC).

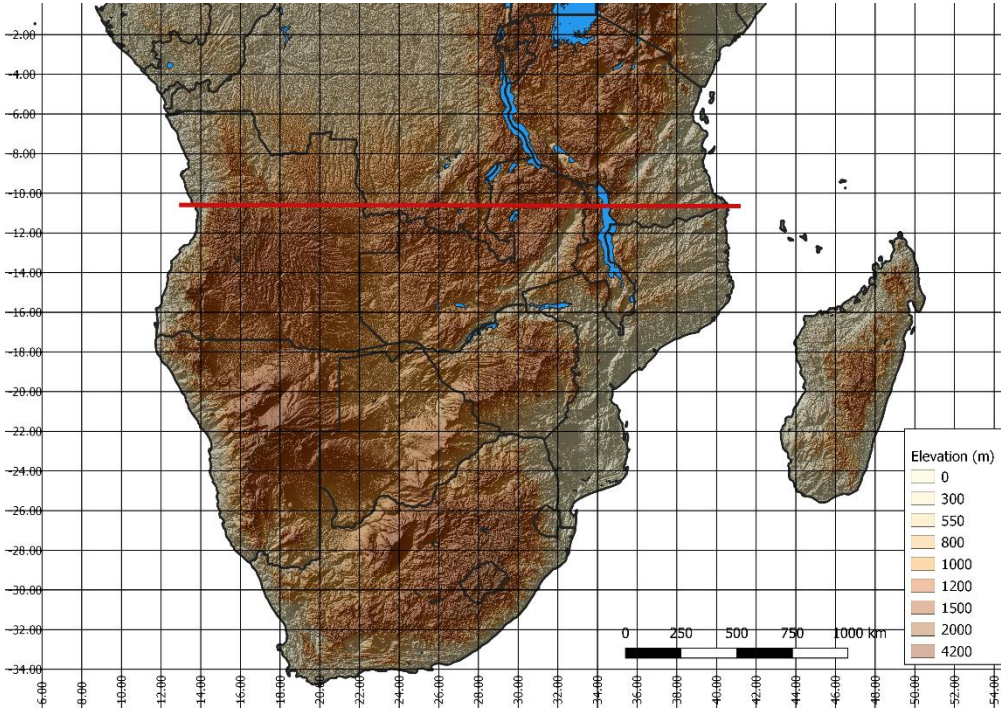


Timeseries of the number of stations/rain-gauges used in 3 gauge-based products, over the southern Africa region (10 °E to 42 °E and 10 °S to 35 °S).

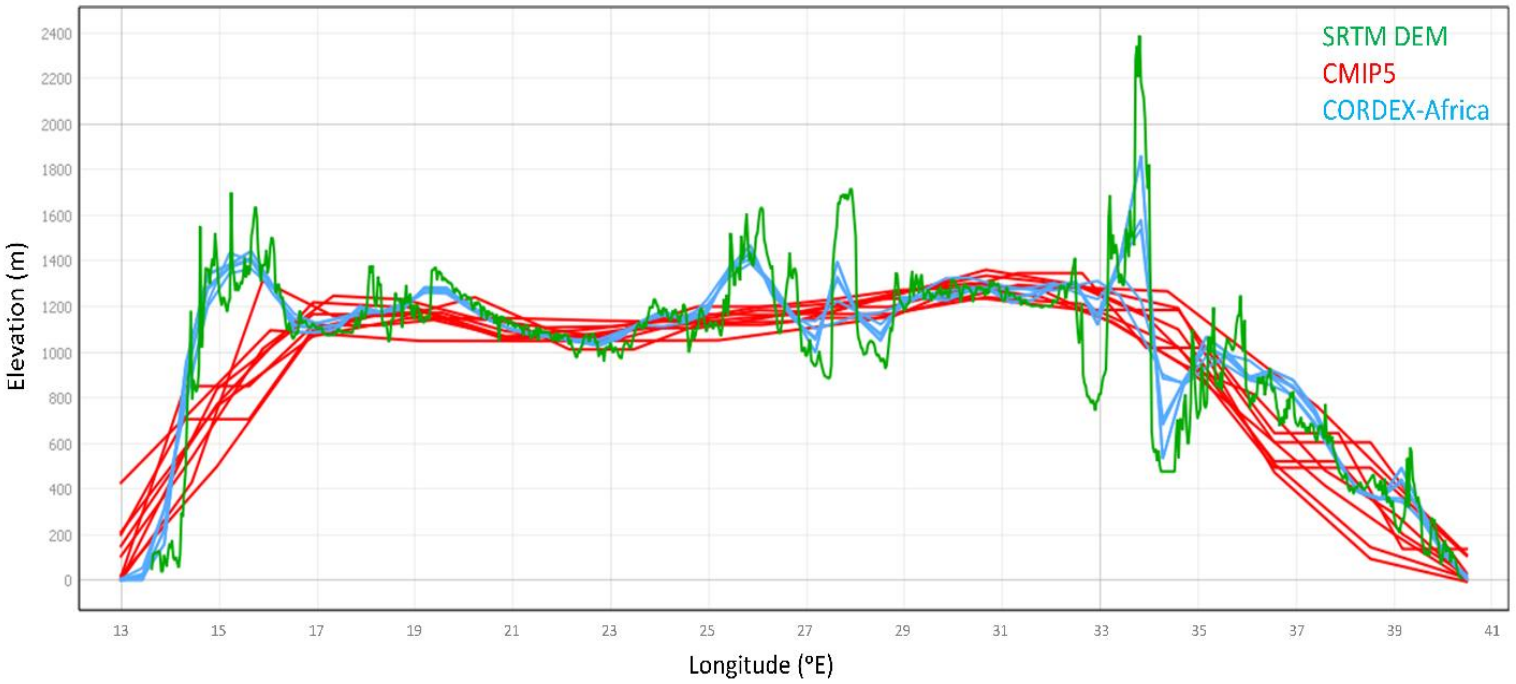
- Munday and Washington (2018) associated the systematic wet bias over SAF in CMIP5, with an intensified north-easterly transport of moisture that erroneously reaches SAF, due to the poorly represented orography in the region of Tanzania and Malawi. This is mainly caused due to the low resolution of CMIP5 models and the underrepresentation of elevation.

- The surface elevation in the higher resolution CORDEX-Africa ensemble is represented more realistically.

- We assume that this has a further bearing on the moisture transport coming from the north-easterly part of SAF, by blocking it.

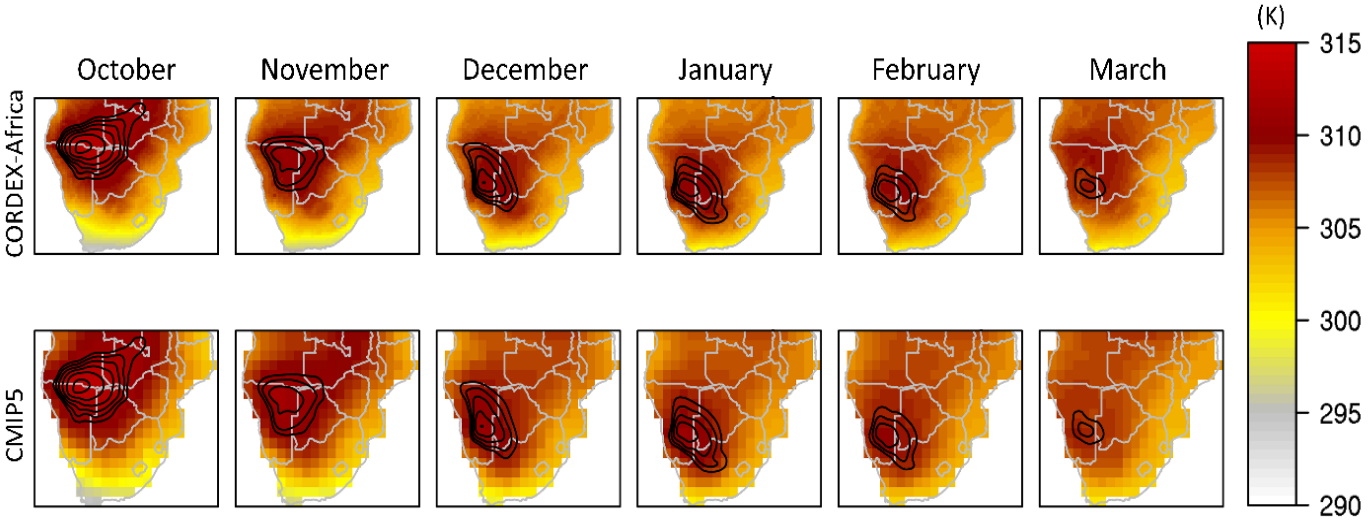


Surface elevation over the study region according to the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM). Red line indicates the cross section area.



Cross section of surface elevation at 10.5 °S across southern Africa for the SRTM DEM, the surface elevation as represented in the CMIP5 and the surface elevation as represented in the CORDEX-Africa ensembles.

Location and intensity of the Angola Low pressure system in the CORDEX-Africa and CMIP5 ensembles.

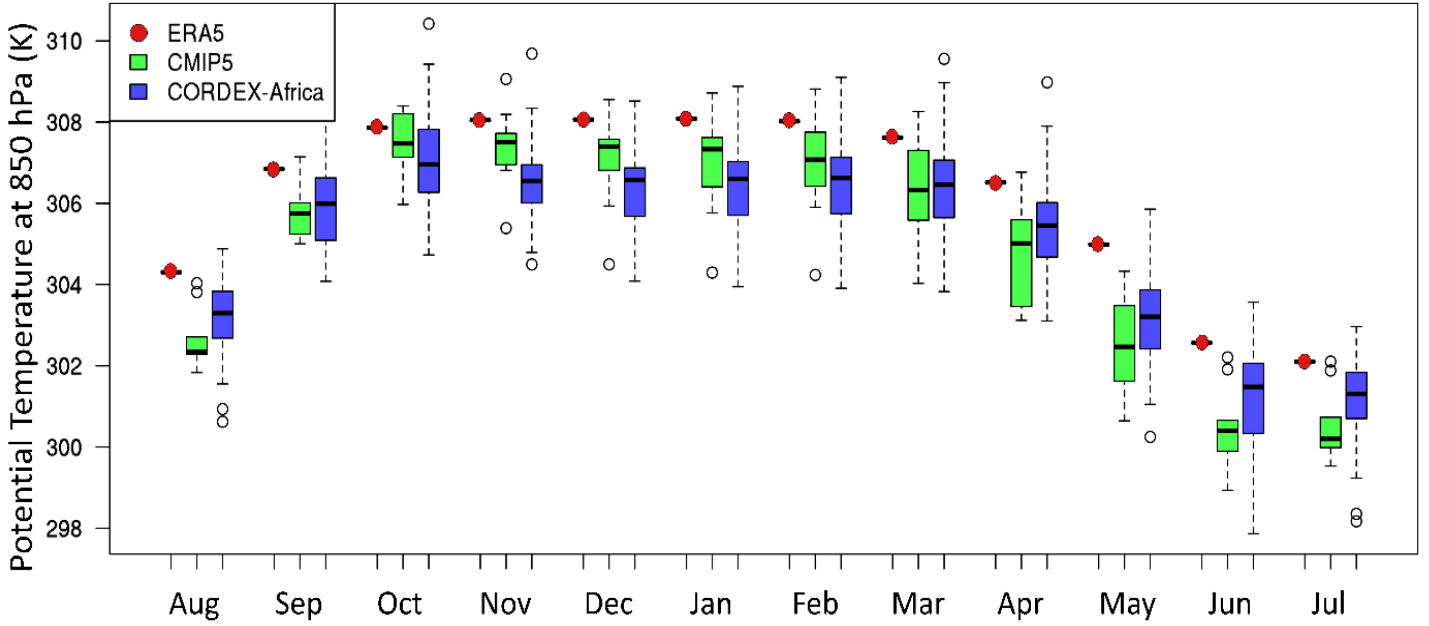


Potential temperature at 850 hPa for CORDEX-Africa (top) and CMIP5 (bottom). Contours display potential temperature at 850 hPa from ERA5. The first contour is at 311 K with an interval of 0.5 K.

During the rainy season (Oct-Mar) the CORDEX-Africa ensemble displays lower values, with larger uncertainty, compared to the CMIP5 ensemble.

Taking into consideration the association between precipitation and the strength of the AL, we can deduce that the AL has a weaker representation in the CORDEX-Africa ensemble, relative to CMIP5.

Annual cycle of potential temperature at 850 hPa (theta850) during 1986-2005 for the CMIP5 and CORDEX-Africa CORDEX-Africa ensembles.



Read more at:

Karypidou M. C., Katragkou E., Sobolowski S. P., Precipitation over southern Africa: Is there consensus among GCMs, RCMs and observational data? (***submitted in GMD***).

Connect at:

Thank you!