Evaluation of cloud properties in RCA4 CORDEX Africa ensemble

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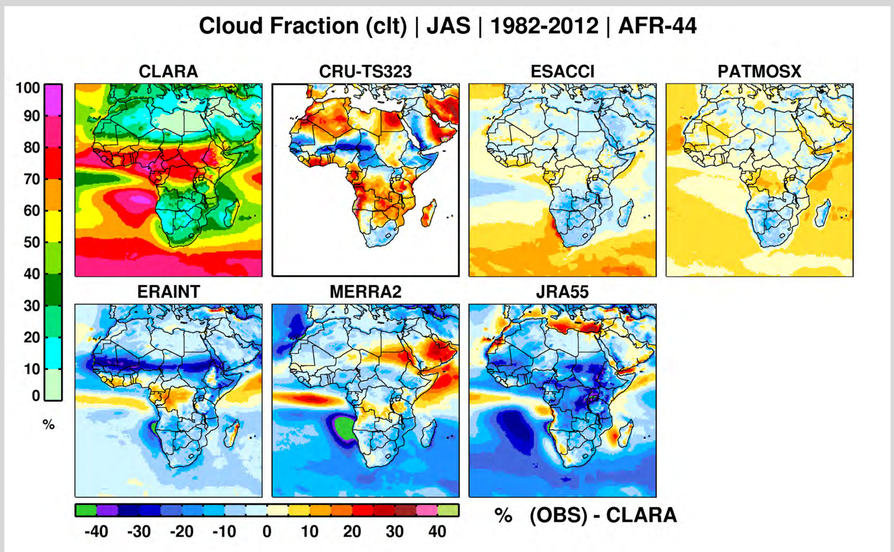


Fig 1: Observational uncertainties as represented by satellite (upper row) and re-analysis data (lower row) with upper figure representing total cloud fraction as compared to CLARA and lower representing correlation with CLARA dataset.

Highlights

- Global Climate Models (GCMs) are often used to downscale the climatic parameters on a regional scales and thus higher resolution dataset have an advantage of finer features..
- In light of recent advances in climate modelling and downscaling approaches, in the present study we have performed an evaluation of simulations by the regional climate model RCA4 CORDEX Africa region.
- Evaluation was for its ability to recreate cloud fraction in comparison to satellite observations and reanalysis dataset.
- The RCA4 simulations (driven with 10 different GCMs) are evaluated against different satellite based observations in historical period (1982-2012) over African region.
- Further, cloud data sets (both satellite products and RCA4 simulations) are evaluated against their ability to represent natural variability (produced by various tele-connections).
- This would help investigate if climate models can also, to a first order, reproduce these robust features of natural variability.
- Firstly various observational datasets are evaluated for their reproductive ability to represent the cloud fraction in the region.
- RCA4 simulations are evaluated against the gridded observational datasets in the area using cloud fraction as indicative variables along with various RCMs driven with ERAINT simulations.
- Spatial and temporal changes for the region are then calculated against observations to evaluate RCA4 for said variable.
- Thereafter, the observations and simulations are tested for their ability to reproduce natural variability, with focus on 3 tele-connections, NINA3.4, NINA3 and IOD indices.
- Correlation composites are further investigated to evaluate the effects of the tele-connection on the various climatic parameters.

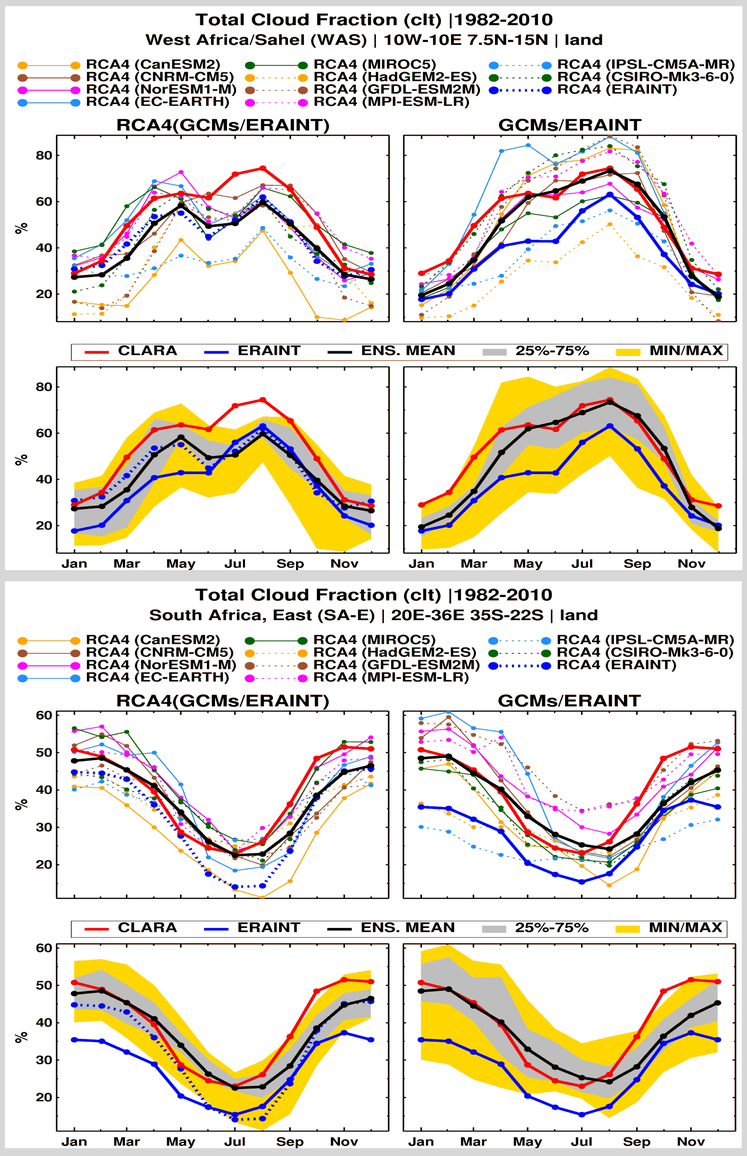
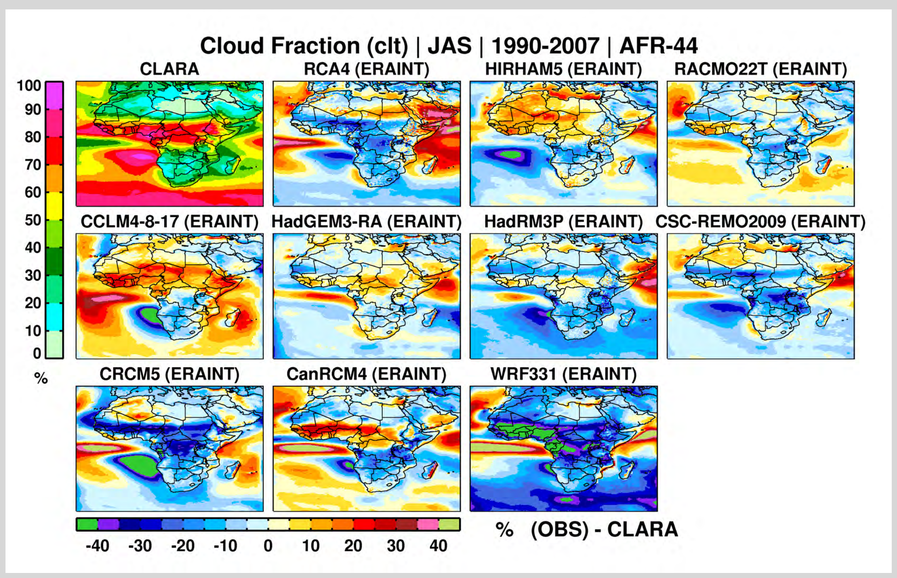


Fig 2: Annual cycle of total cloud fraction in Western Africa (upper) and Southern Africa-East (lower) in RCA droven by ERAINT runs of GCMS, GCMs with ERAINT and their associated uncertainities.

Fig:3 Total cloud fraction in seasonal mean (JAS) as represented by RCMs driven with ERAINT simulations as compared with CLARA dataset.



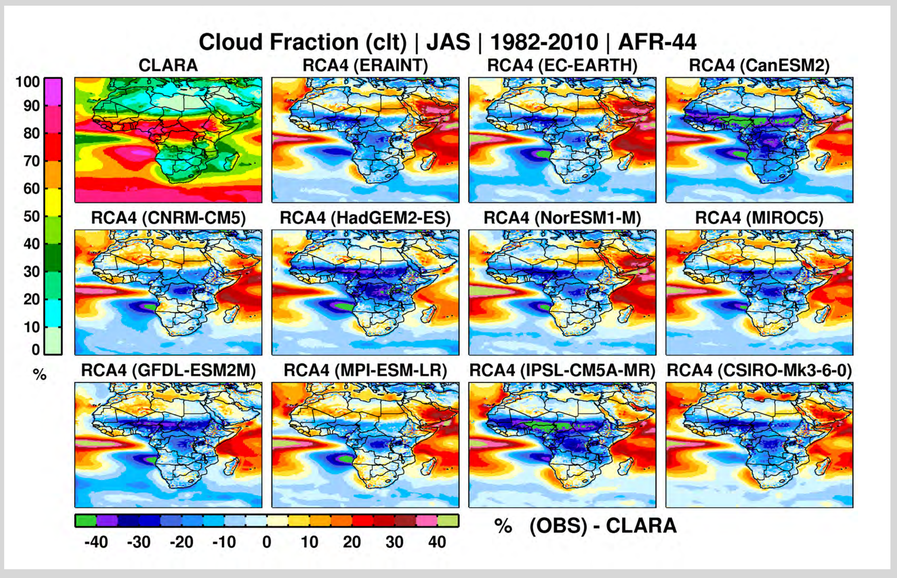


Fig:4 Total cloud fraction in seasonal mean (JAS) as represented by RCA4 driven with various GCMs simulations as compared with CLARA dataset.

Results

- CLARA, ESACCI and PATMOSX are based on the same satellites and are in good agreement with each other.
- CRU shows less consistency compared to other datasets, underestimates inter-annual variability which could be due to lack of data points (consistency) especially in central Africa.
- Sattelite data are closer represntation of the cloud fraction in the study region and thus CLARA was chosen to evaluate the RCMs.
- Generally, WRF, CRCM5 and RCA4 underestimates the mean cloud fraction as comapared to CLARA.

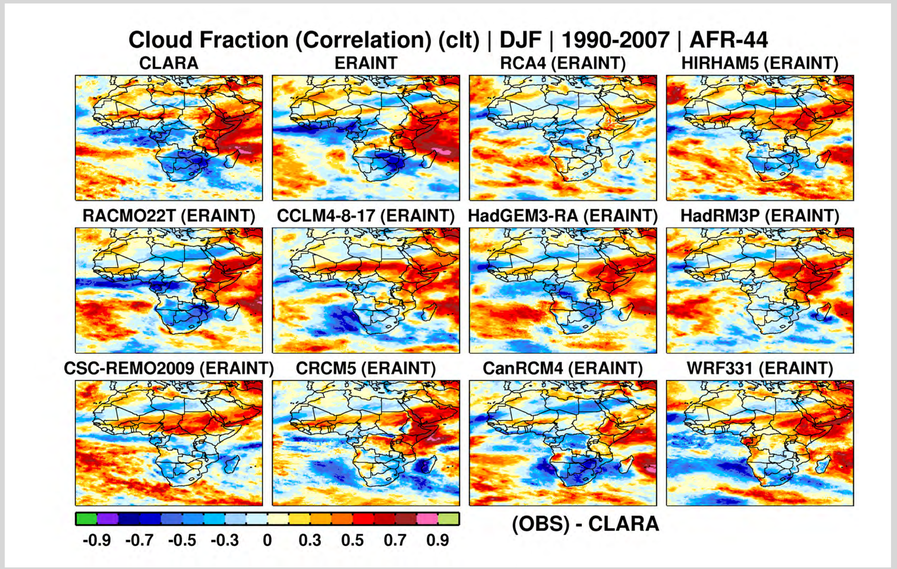


Fig 5: Correlation of RCM runs driven by ERAINT simulation with ENSO during DJF period

Results

- There is stronger control from GCMs in southern Africa compared to West Africa
- RCMs have strong varied cloud response to ERA-Interim, especially the stratocumulus regions off the southwestern parts and deep convective regions in Sahel and Arabian Sea areas.
- RCA4 underestimates cloud fraction in both regions when CLARA used as reference
- Correlation analysis also suggests that RCA4 and HIRHAM5 underestimates the relationship of ELNINO with cloud in Southern African region.
- Various RCMs have different capabilities when compared to reproduce mean cloud fraction in the region and thus uncertainities involved.

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Data Availability: RCM data is amde available within CORDEX framework and can be downloaded from ESGF, for details visit: www.cordex.org
ESA-CCI: http://www.esa-cloud-cci.org/
PATMOSX: https://cimss.ssec.wisc.edu/patmosx/
CLARA: https://wui.cmsaf.eu/safira/action/viewDoiDetails?acronym=CLARA_AVHRR_V001

FRACTAL: The Future Resilience for African CiTies And Lands (FRACTAL) project funded through the Future Climate For Africa (FCFA) program. FRACTAL is a four-year project with the overarching aim to advance scientific knowledge about regional climate responses to human activities (such as burning fossil fuels, changing land cover, etc.) and work with decision makers to integrate this scientific knowledge into climate-sensitive decisions at city-regional scale. FRACTAL is designed to work across disciplines and foster collaboration between researchers, city government officials and other decision makers in southern Africa. http://www.fractal.org.za/