The Coordinated Regional Downscaling Experiment

CORDEX

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General Aims of CORDEX

Generate a coordinated ensemble of high-resolution, historical/future regional climate projections for land-regions of the globe sampling; multiple GCM/RCP/RCM/ESDs methods. 1st phase uses CMIP5 historical-projection runs and ERA-interim boundary data

Make data accessible & useable in common format/file structure
Now ~99% same as CMIP5 and compatible with ESG2 (SMHI Africa-CORDEX data has been tested on ESG2, will be publicly broadcast late 2012)

Foster coordination between downscaling efforts & encourage local participation, in generating, analysing & communicating potential regional climate change and associated uncertainties & risks

Initial emphasis on African climate & IAV: START/WCRP sponsored 3 analysis/IAV workshops for an Africa-CORDEX team in 2011-12

Similar activities starting for East Asia, South/Central America and South Asia (this week)

CORDEX Phase I experiment design

Model Evaluation Framework

Climate Projection Framework

Multiple regions (Initial focus on Africa)
50km resolution (higher in some regions, Europe: 10km)

ERA-Interim BC
(1979)1989-2010

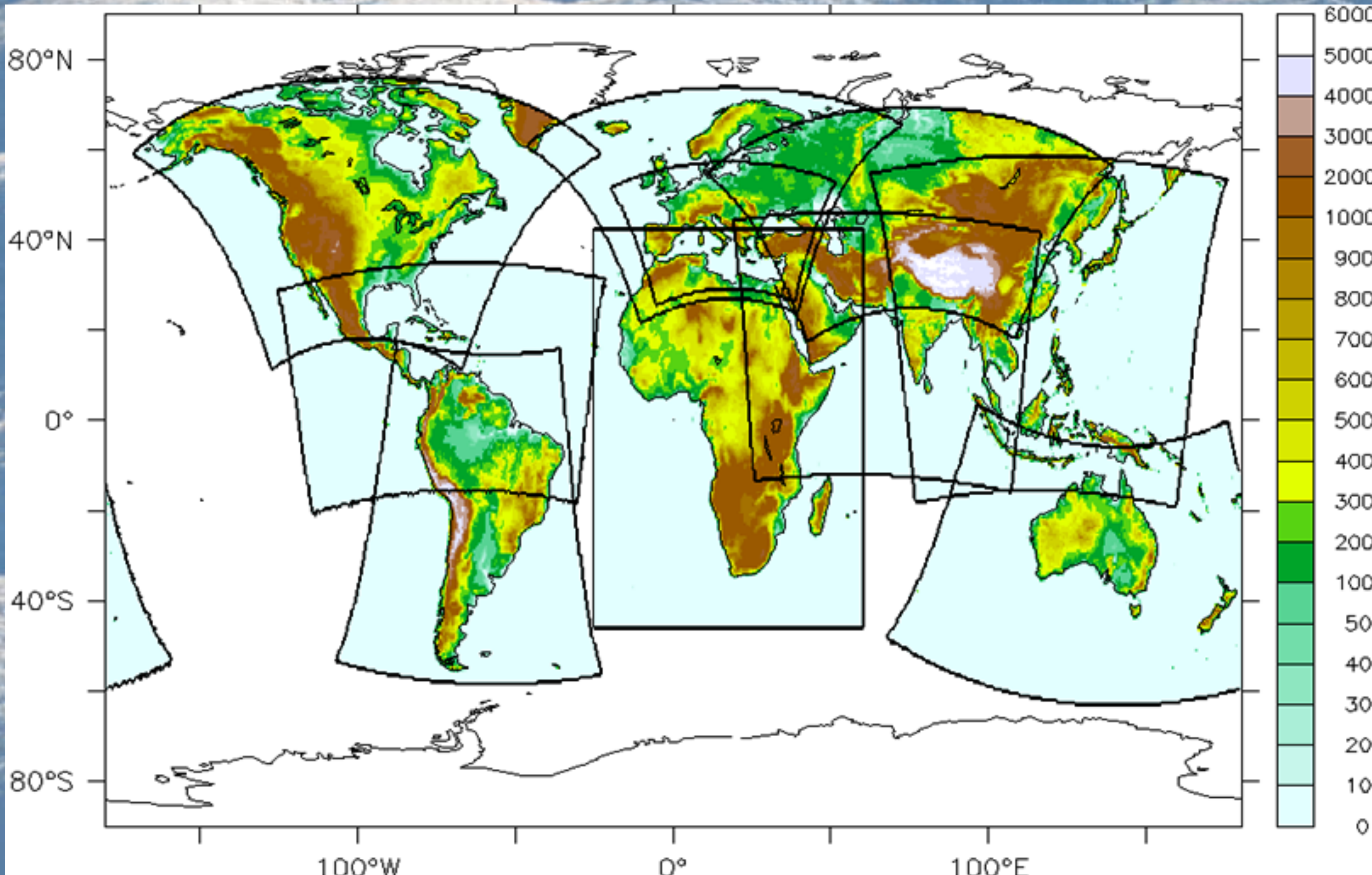
RCP4.5, RCP8.5
some RCP 2.6 runs

Multiple AOGCMs

Regional Analysis
Regional Databanks
Europe, Korea, S.Africa

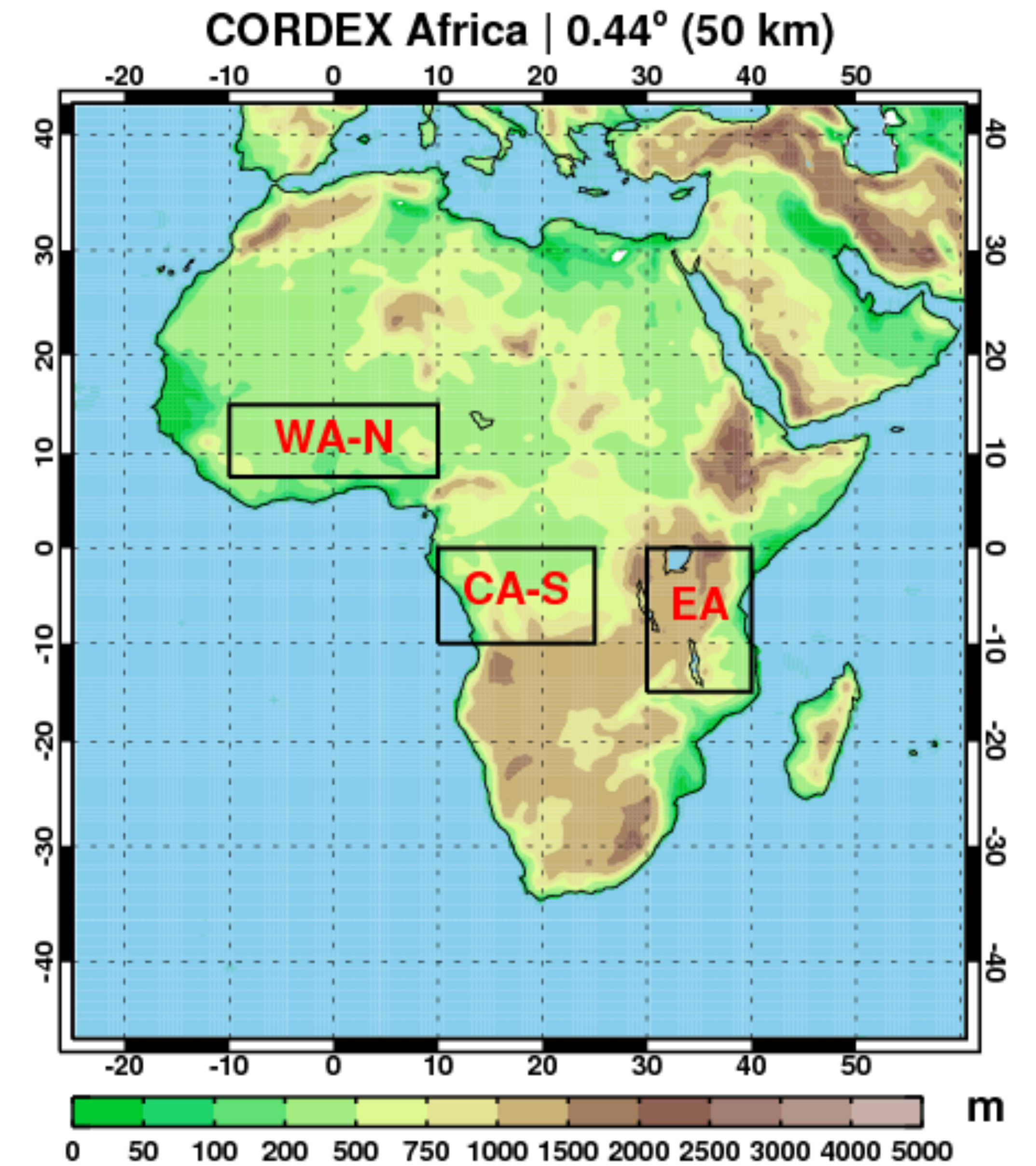
Regional Projections 1950-2100

CORDEX DOMAINS (also Arctic & Antarctica)



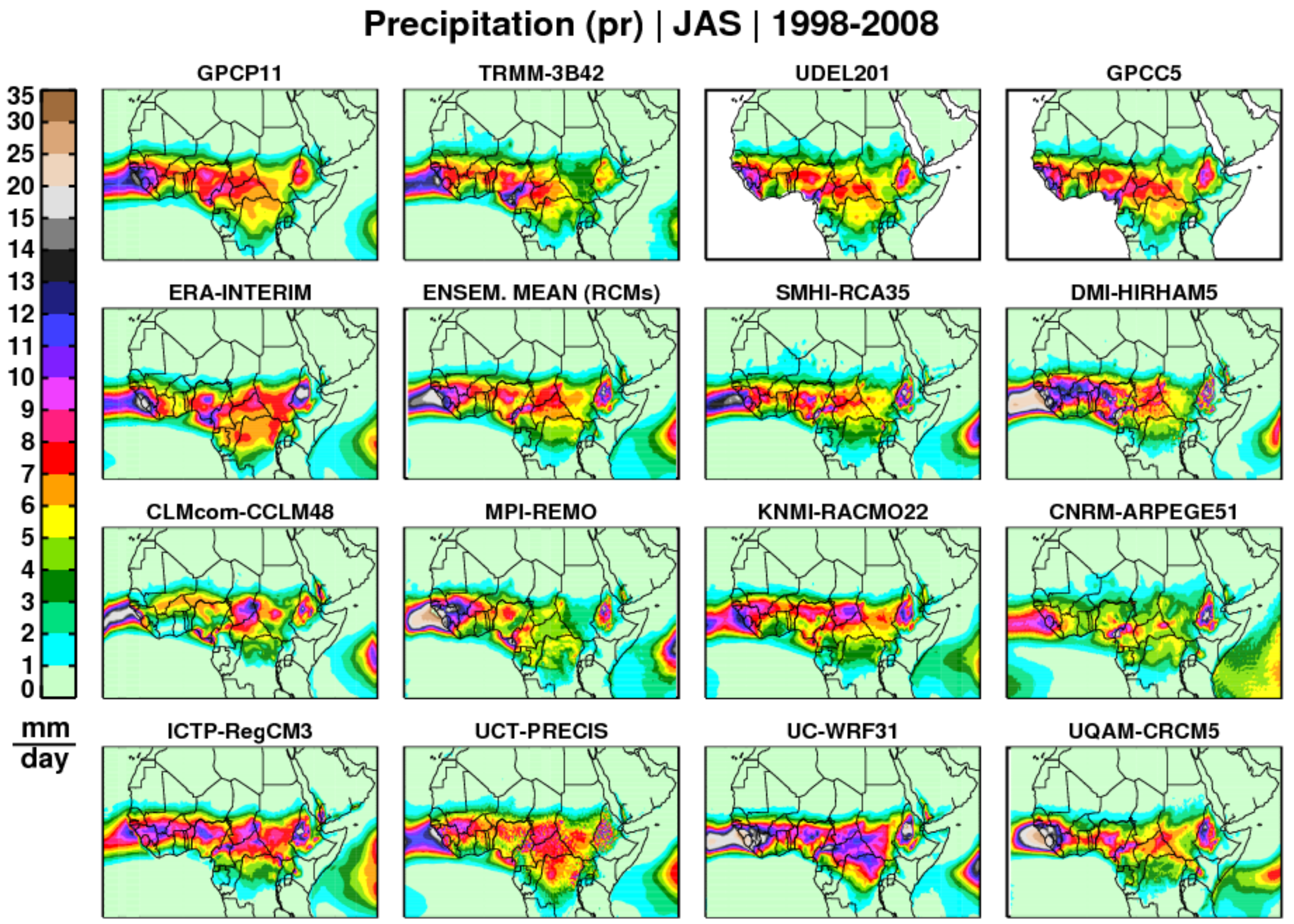
- 12 domains with a resolution of 0.44° (approx. 50x50km²)
- Initial Focus on Africa
- High resolution ~0.11°x0.11° for Europe (~6 institutions)

Examples from Africa-CORDEX



Evaluation of multi-RCM ERA-interim driven ensemble

JAS precipitation Africa-CORDEX RCMs using ERA-interim



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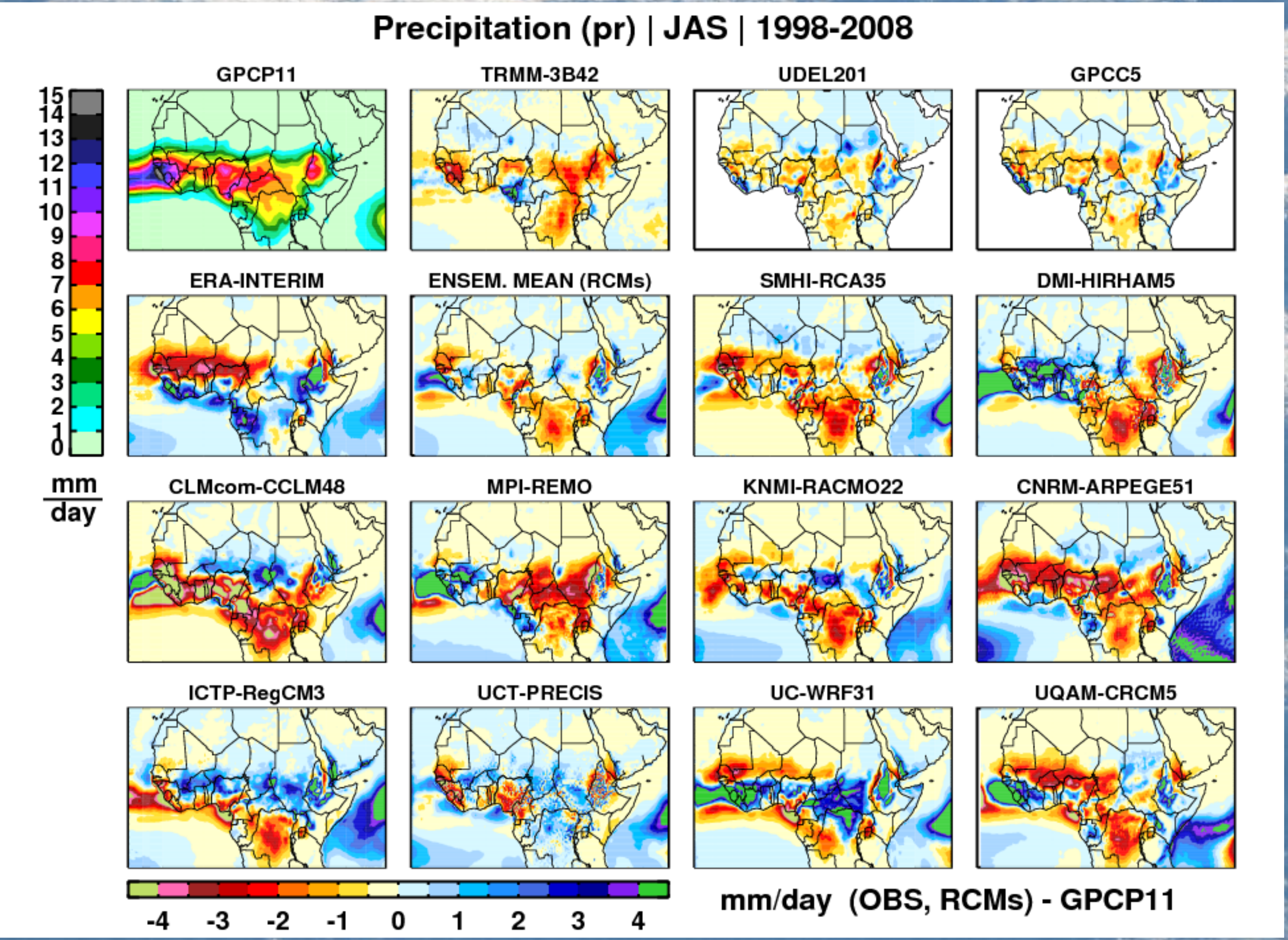
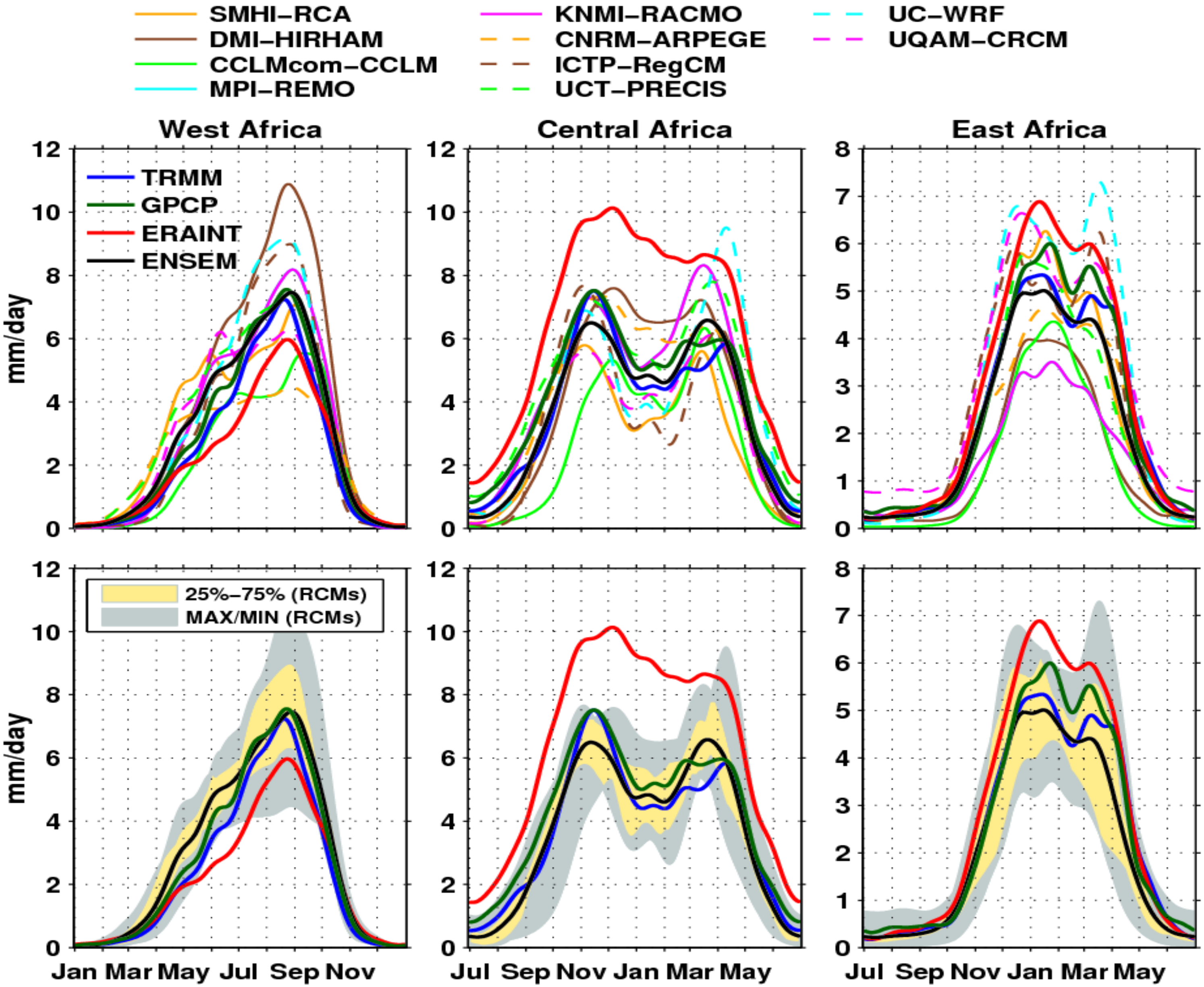
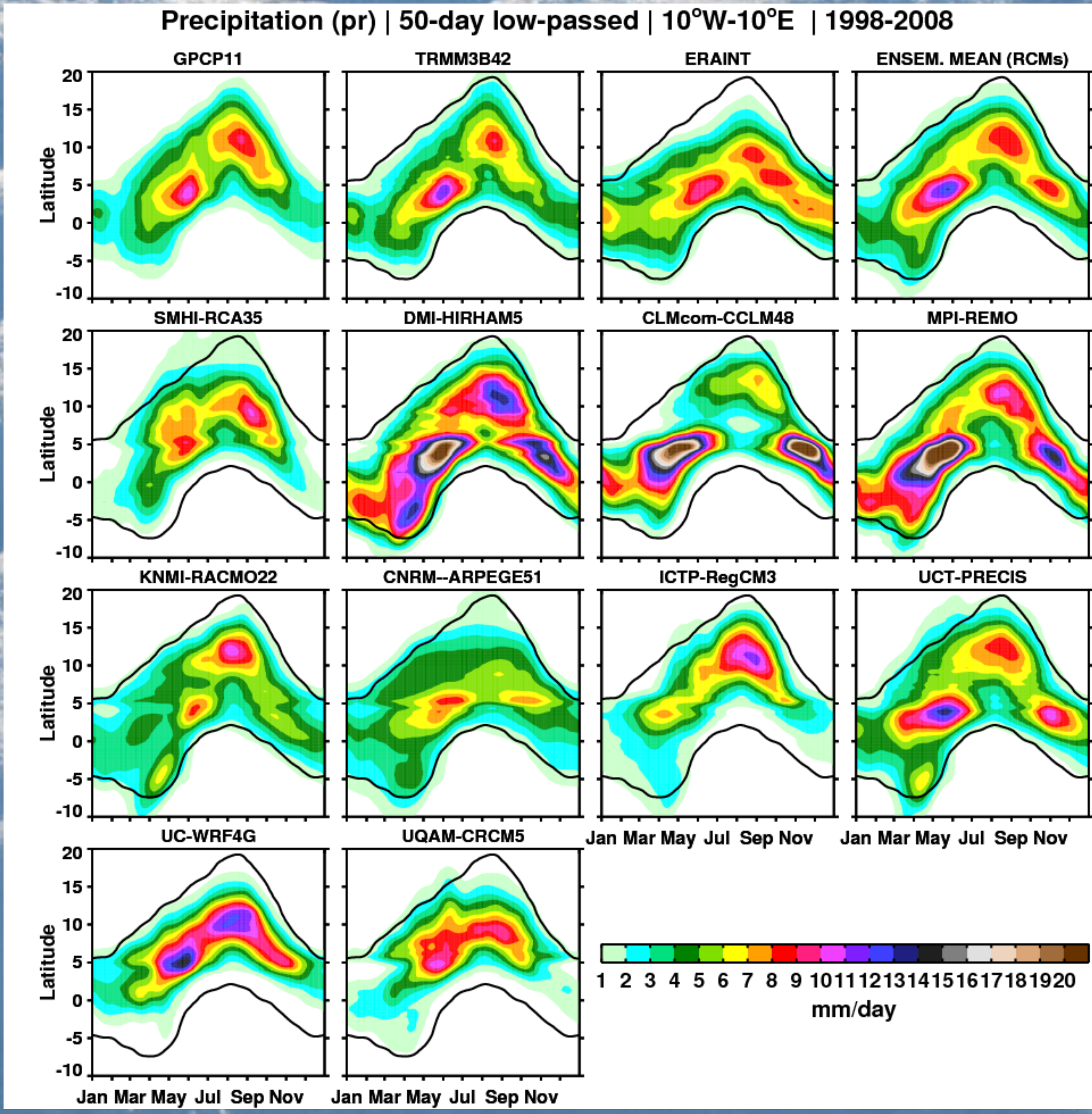


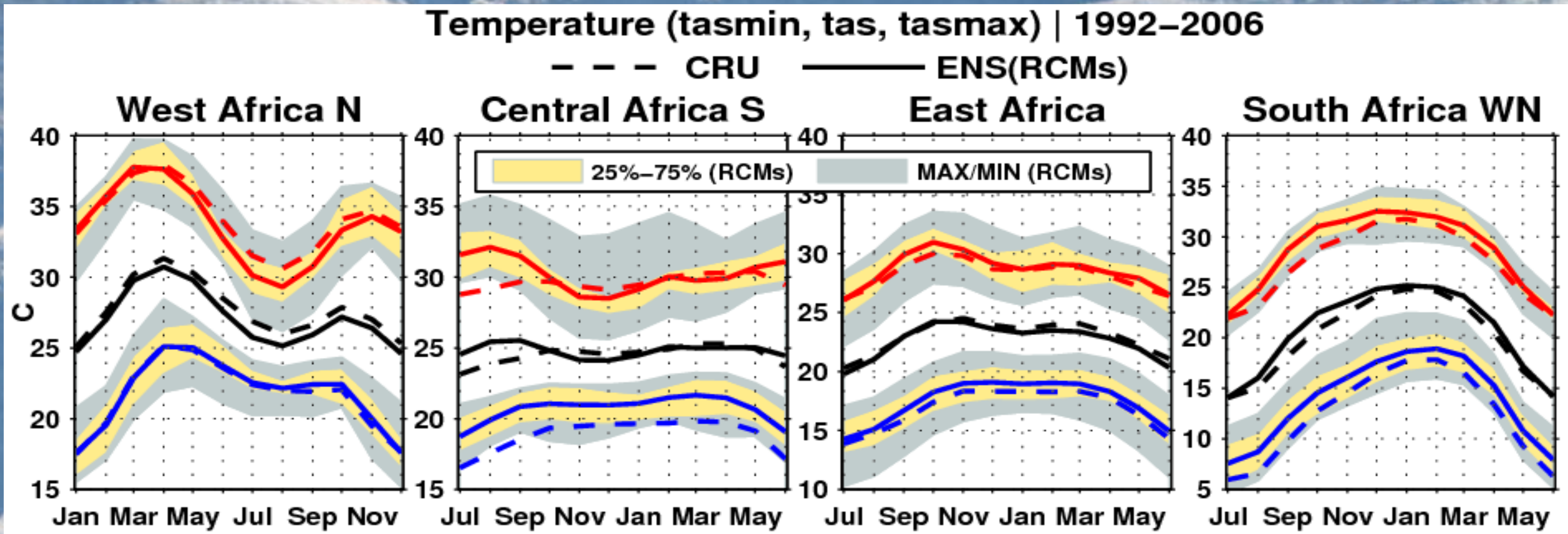
Annual cycle of precipitation for sub-regions of Africa Africa-CORDEX RCM ensemble



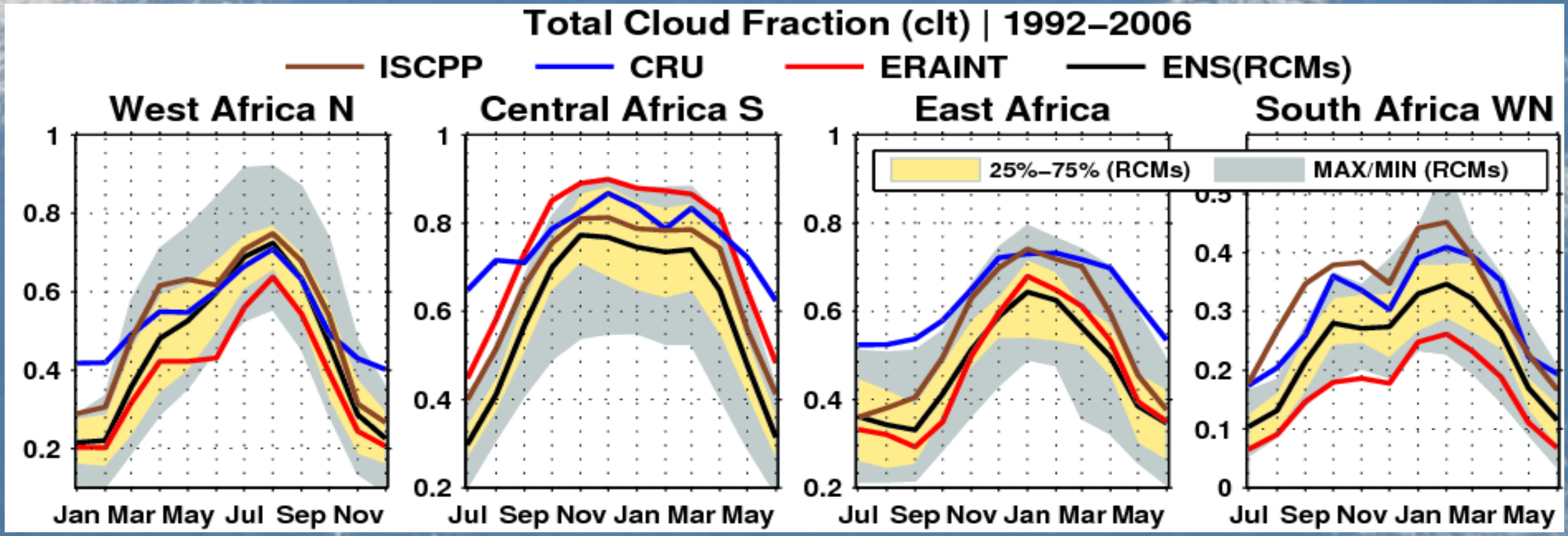
West African monsoon: Annual cycle of WAM poleward progression



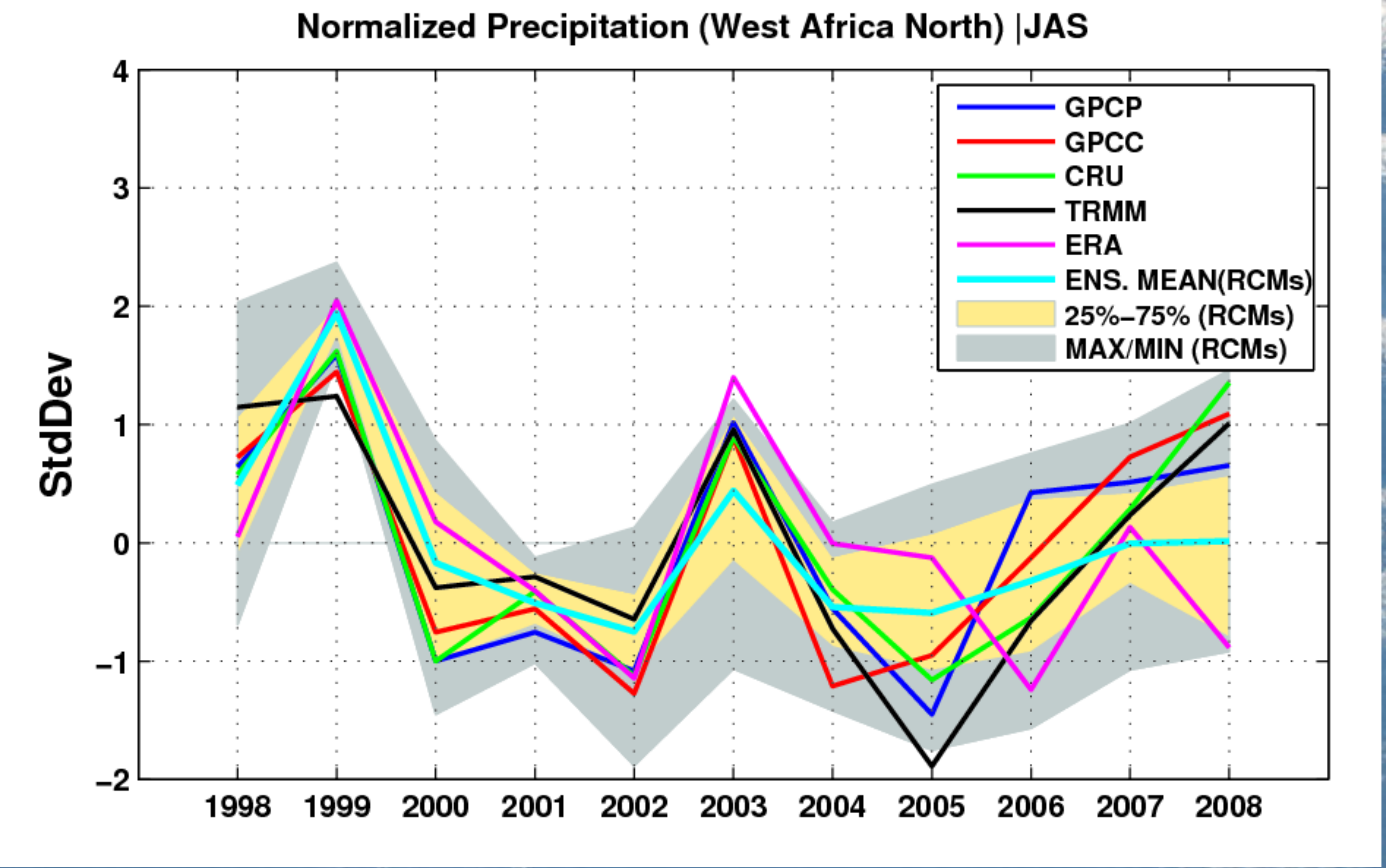
Annual Cycle of temperature: Africa-CORDEX RCMs



Annual Cycle of cloud fraction: Africa-CORDEX RCMs



Interannual variation of west Africa rainfall in Africa-CORDEX RCMs forced by ERA-interim



Africa-CORDEX RCM simulations driven by CMIP5 GCMs

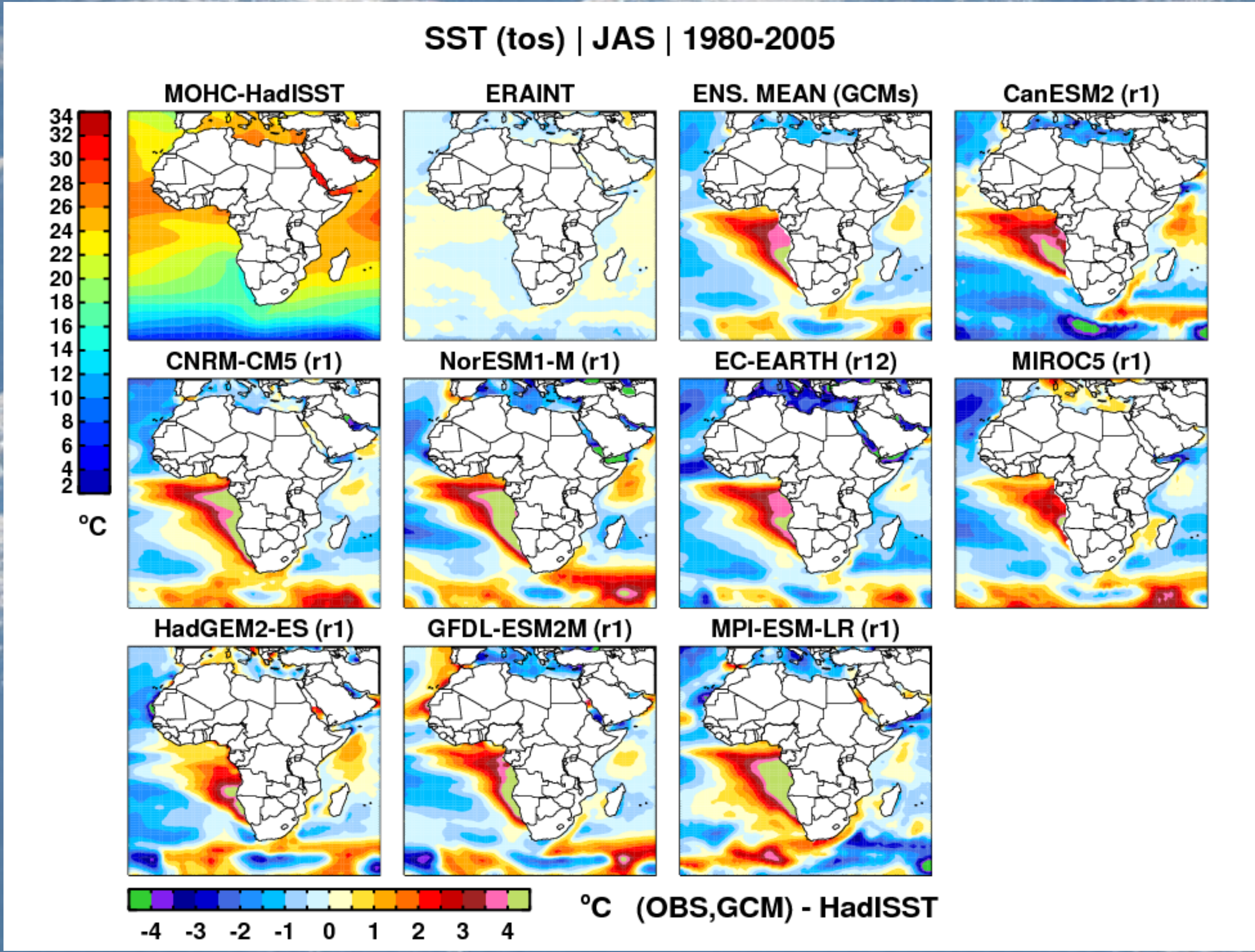
Evaluation of the historical period

SMHI- RCA4 Africa CORDEX 50km matrix

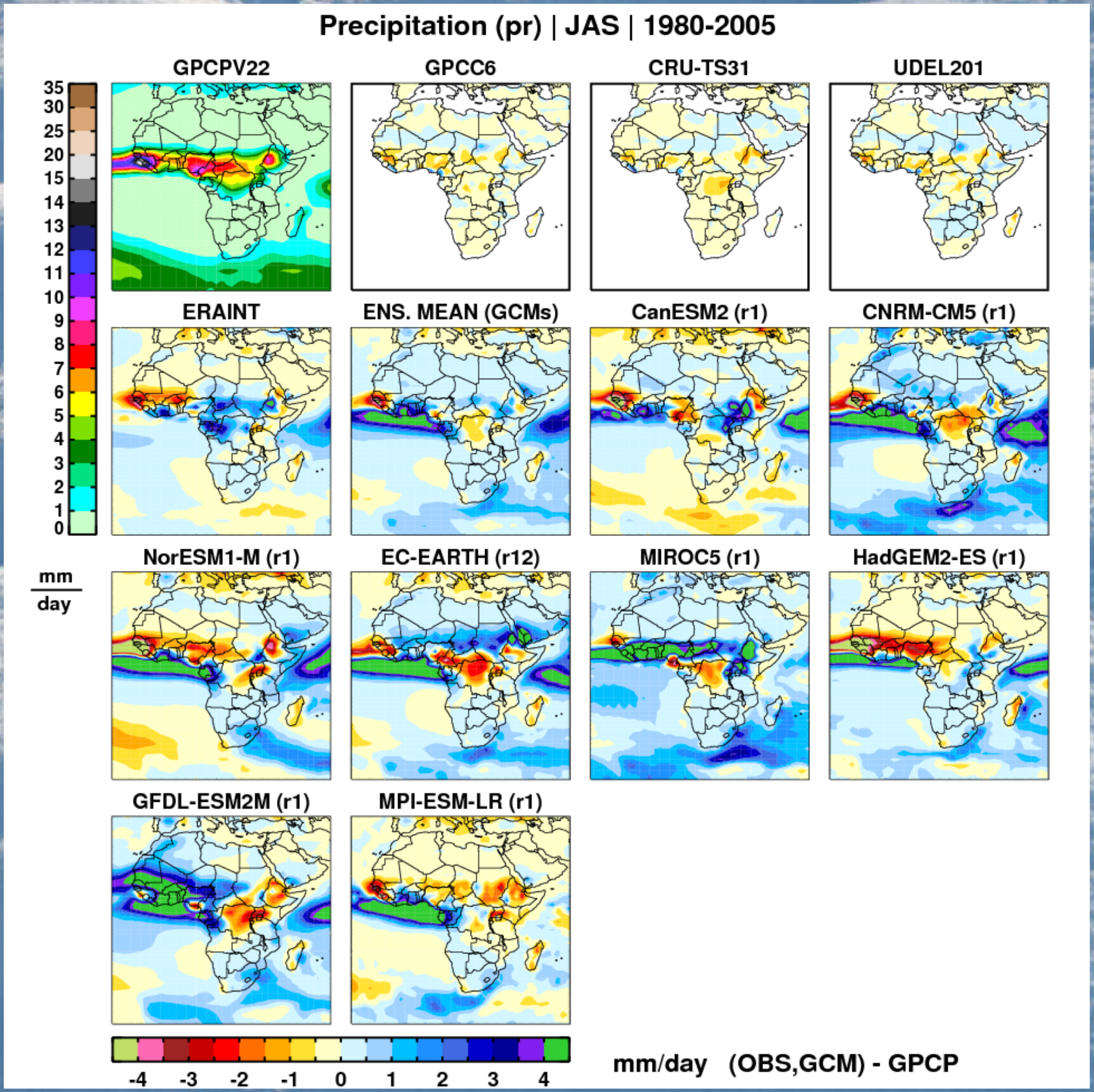
GCM	Historical 1950-2005	RCP8.5 2006-2100	RCP4.5 2006-2100	RCP2.6 2006-2100
EC-Earth	✔	✔	✔	✔
HadGEM	✔	✔	✔	✔
CNRM	✔	✔	✔	
MIROC5	✔	✔	✔	
NorESM	✔	✔	✔	
CanESM	✔	✔	✔	
GFDL-ESM	✔	✔	✔	
MPI-ESM	✔	✔	✔	✔
IPSL-CM	☑	☑	☑	
CSIRO	☑	☑	☑	
NCAR	☑	☑	☑	

✔ Completed ✔ Running ✔ Planned ☑ Possible

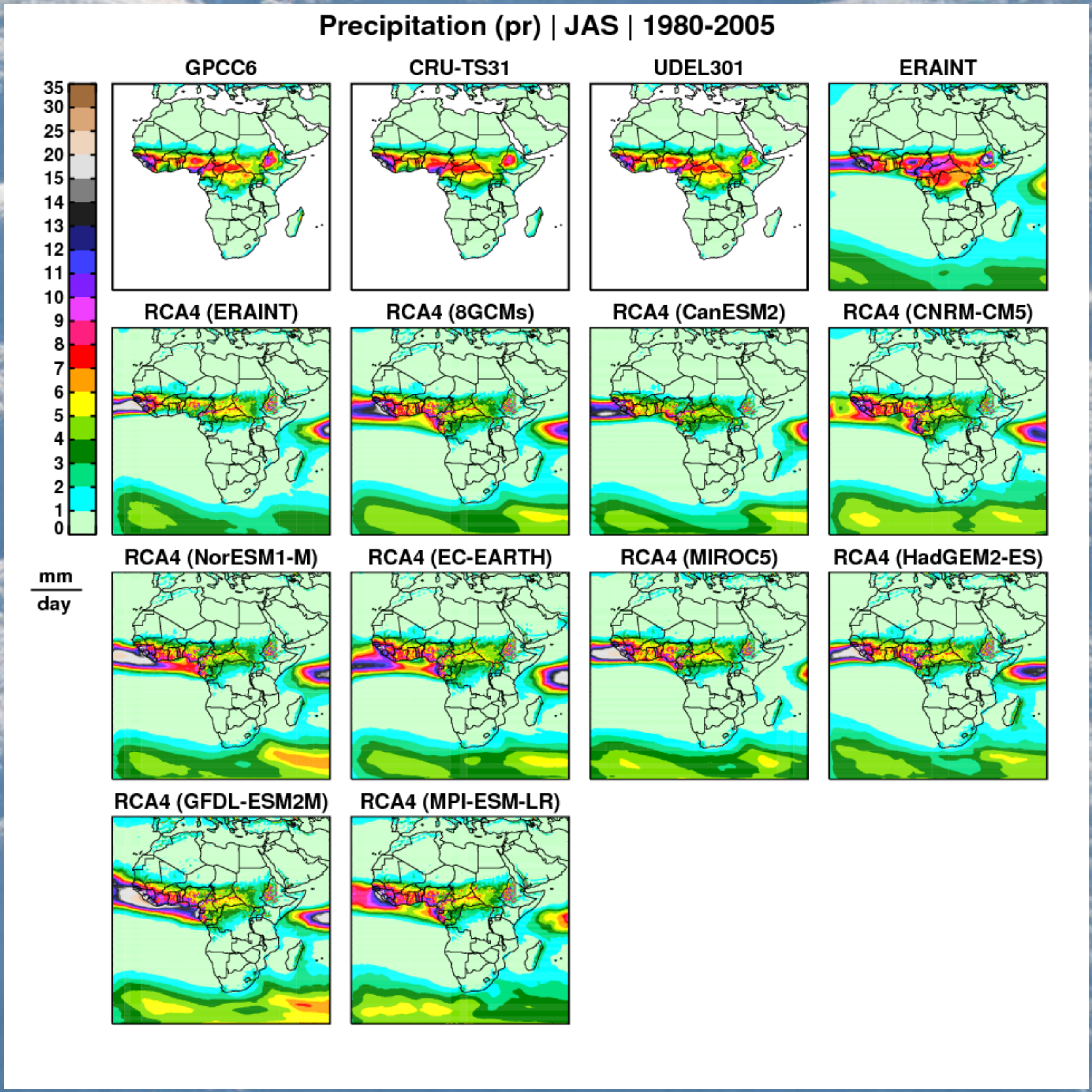
Systematic SST errors from CMIP5 GCM historical simulations

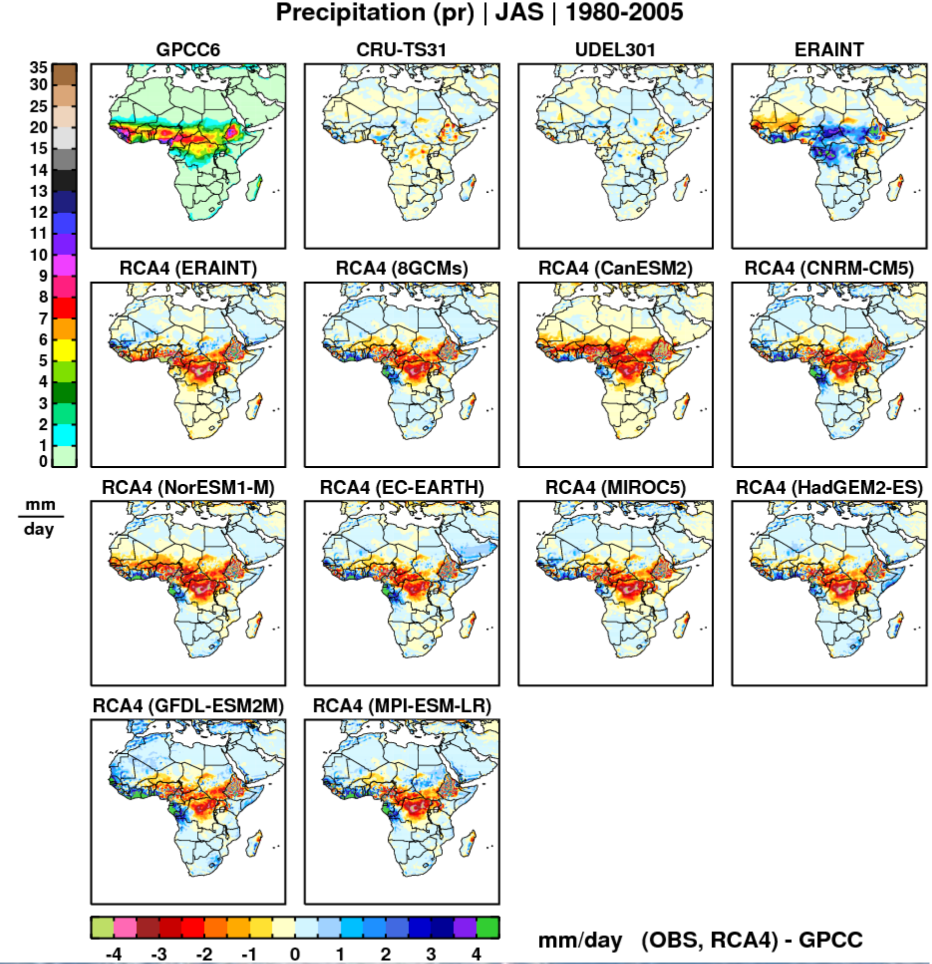


GCM precipitation errors reflect the SST error



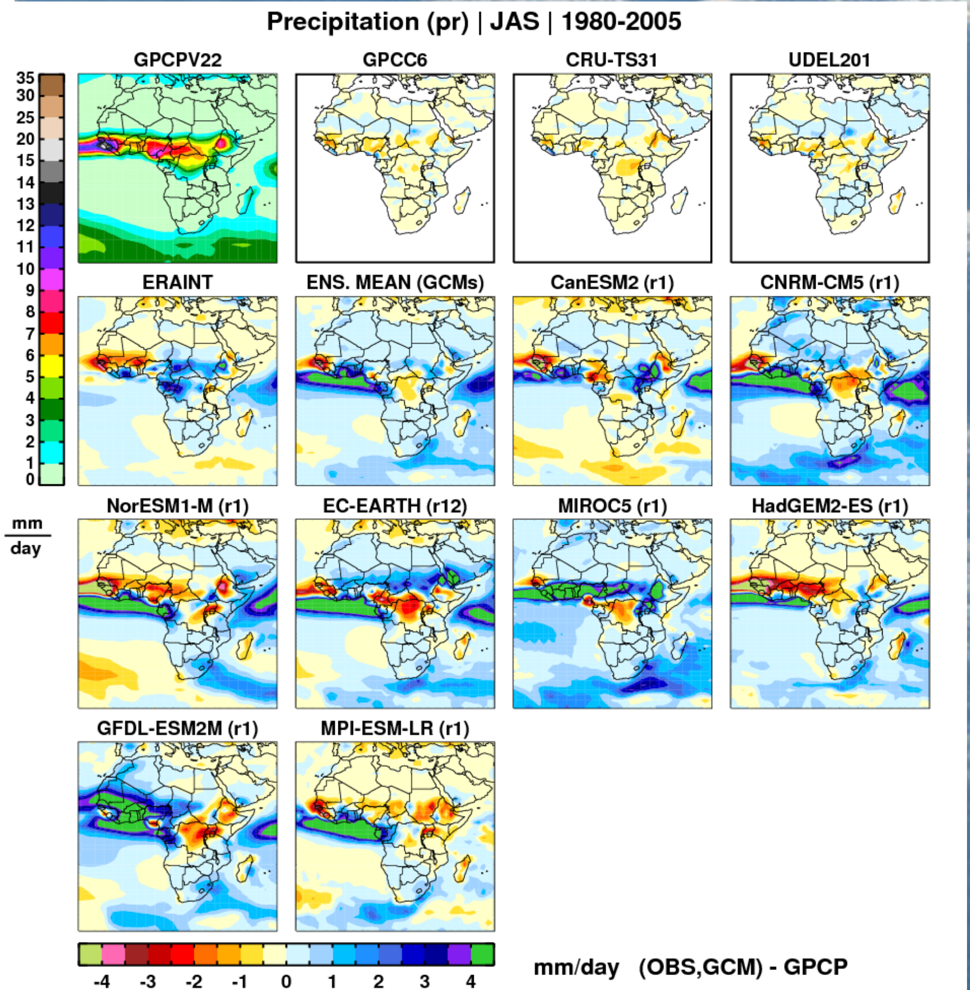
RCA4 Africa-CORDEX JAS mean precipitation





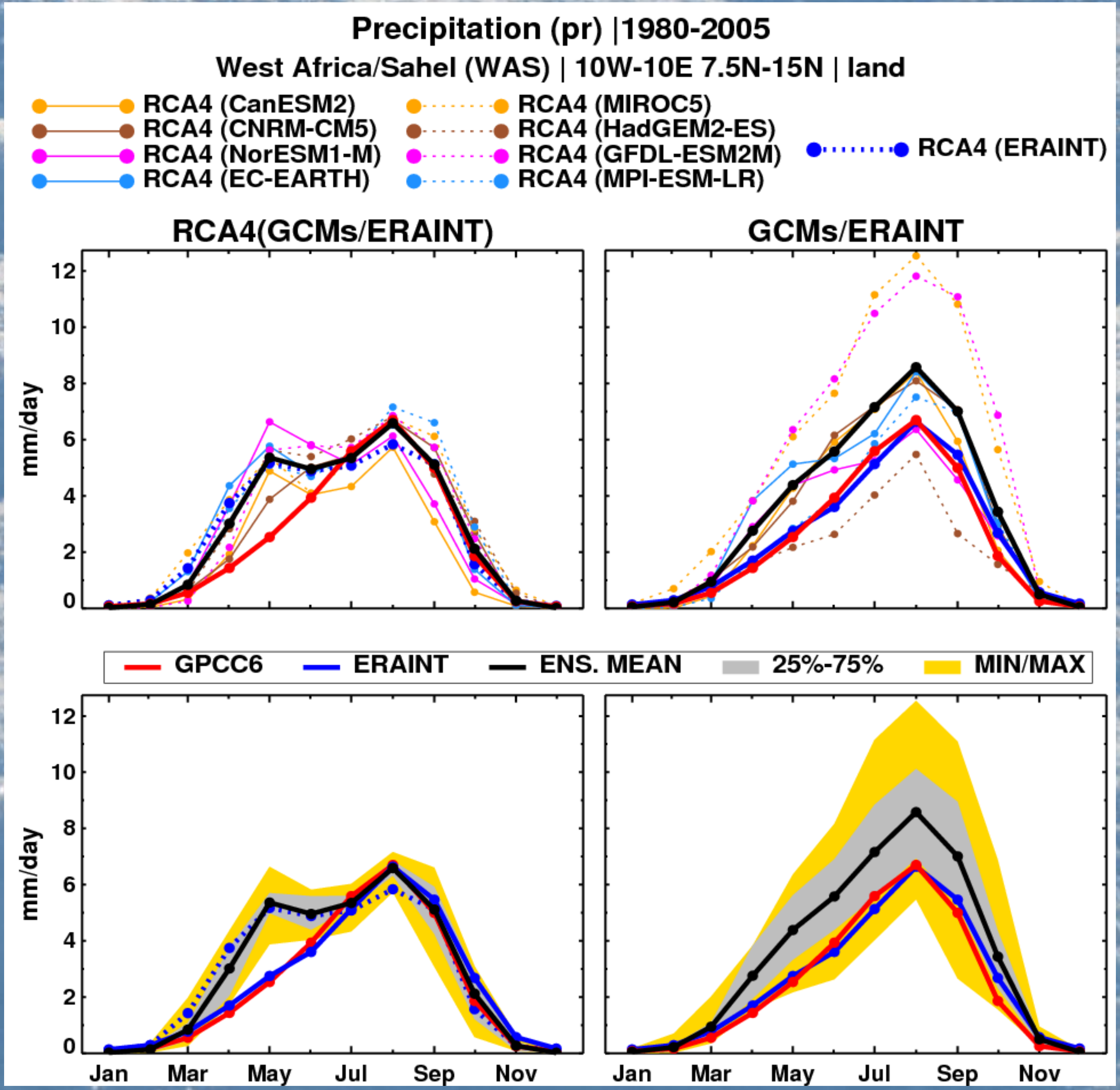
RCA4 Africa-CORDEX
JAS precipitation bias

CMIP5 GCM Africa-CORDEX
JAS precipitation bias

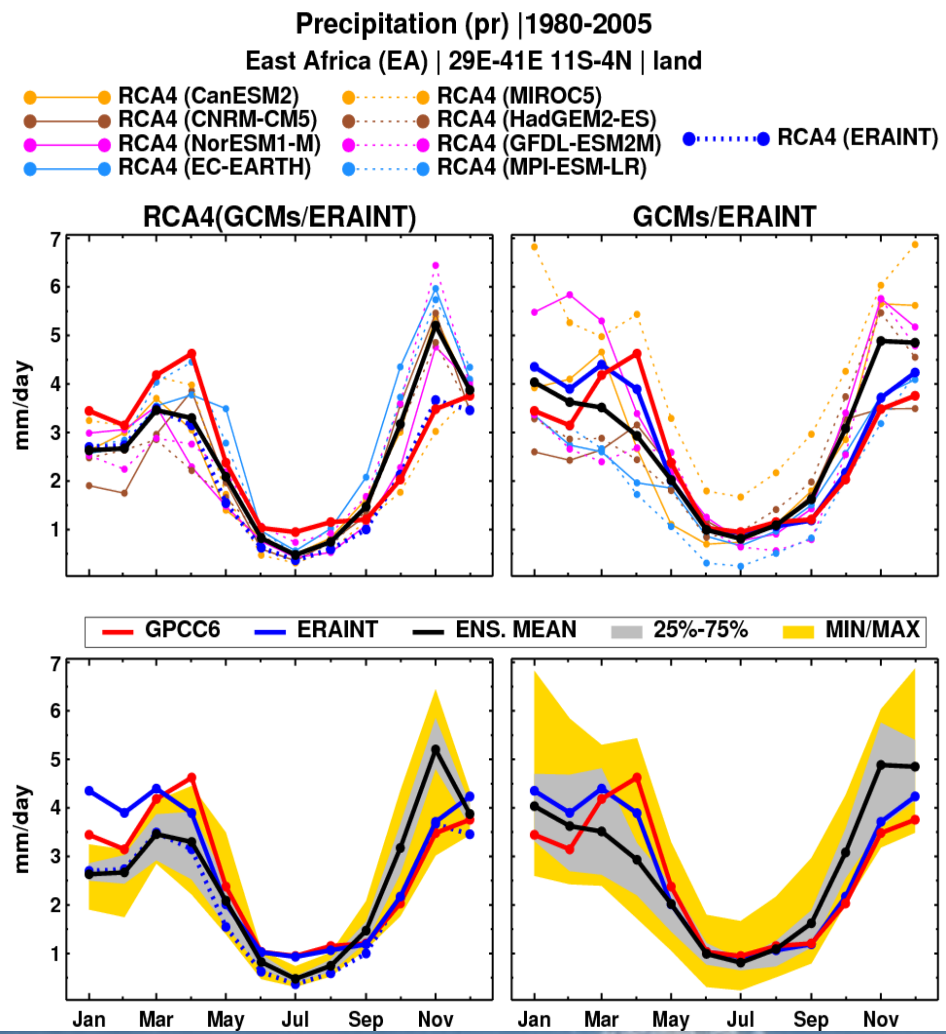


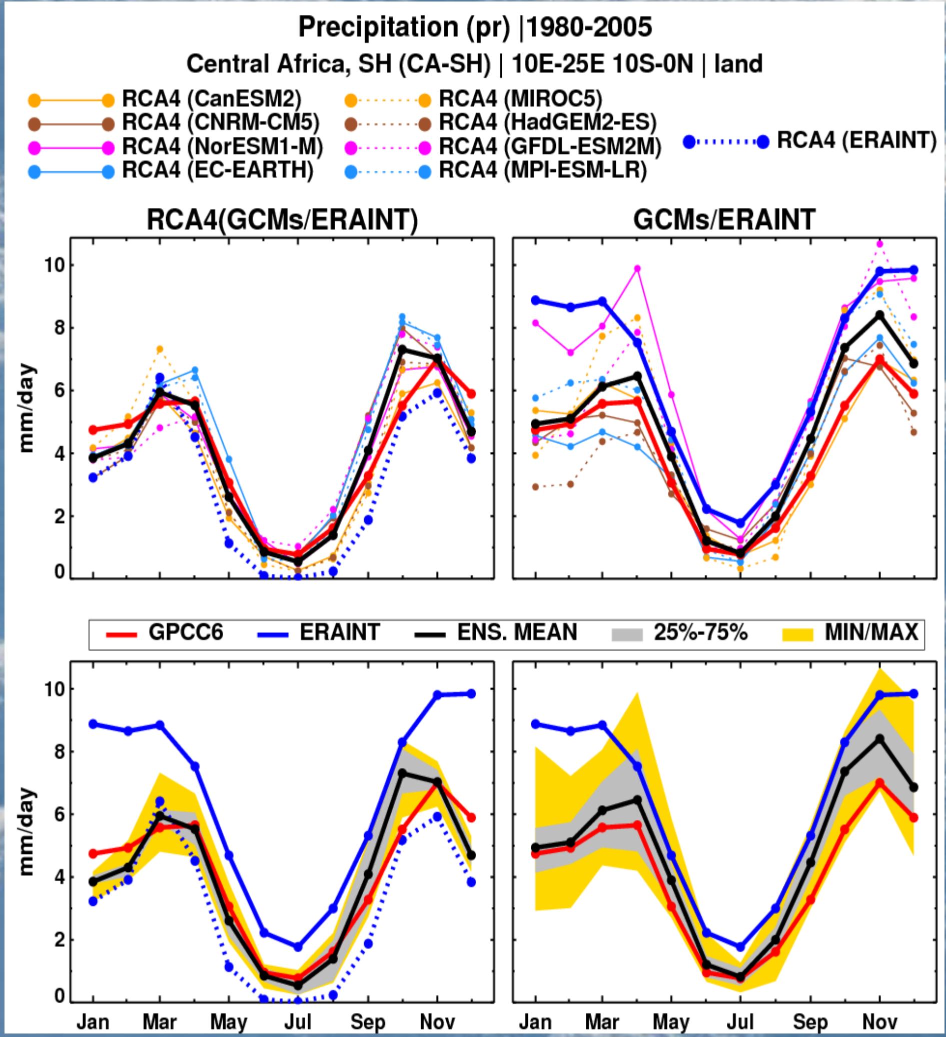
Spread generally reduced in RCA4(GCM) compared to GCMs

A clear signature of RCA4 physics seen irrespective of forcing GCMs

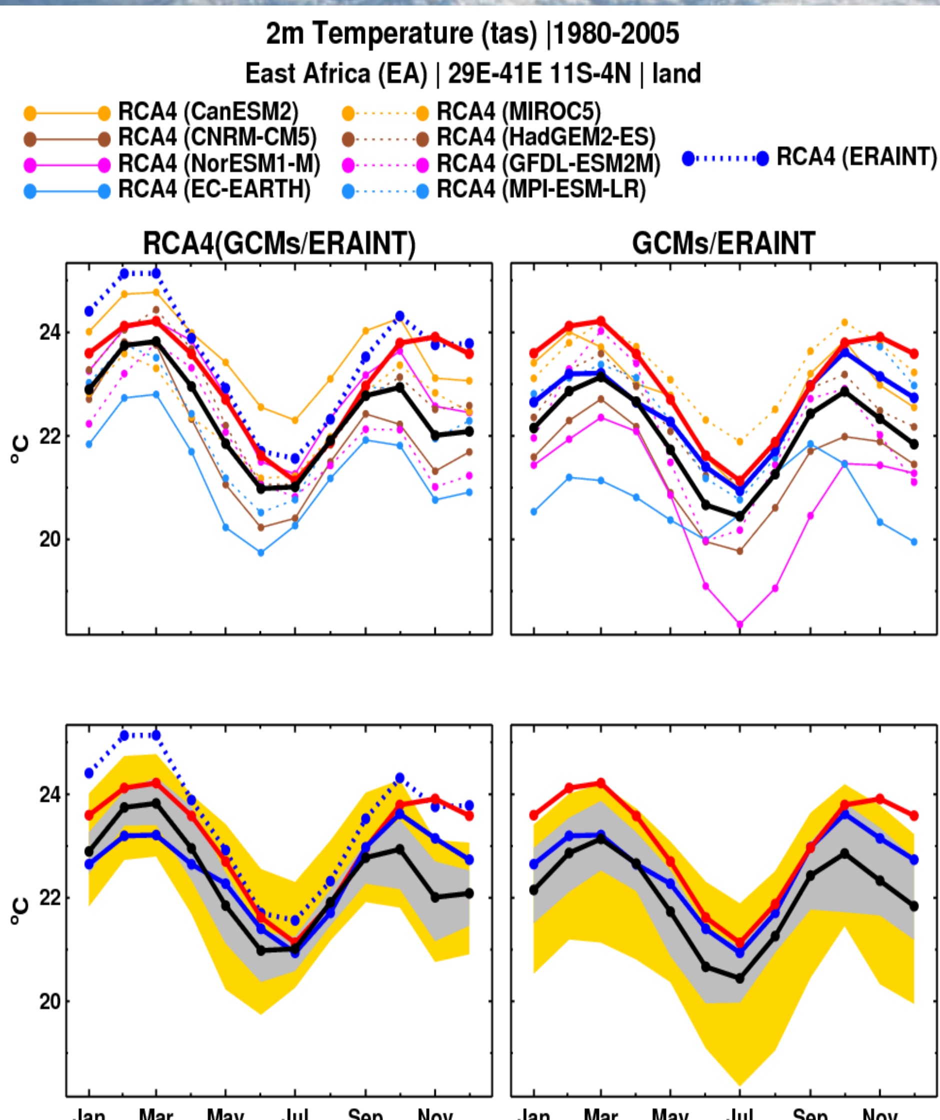


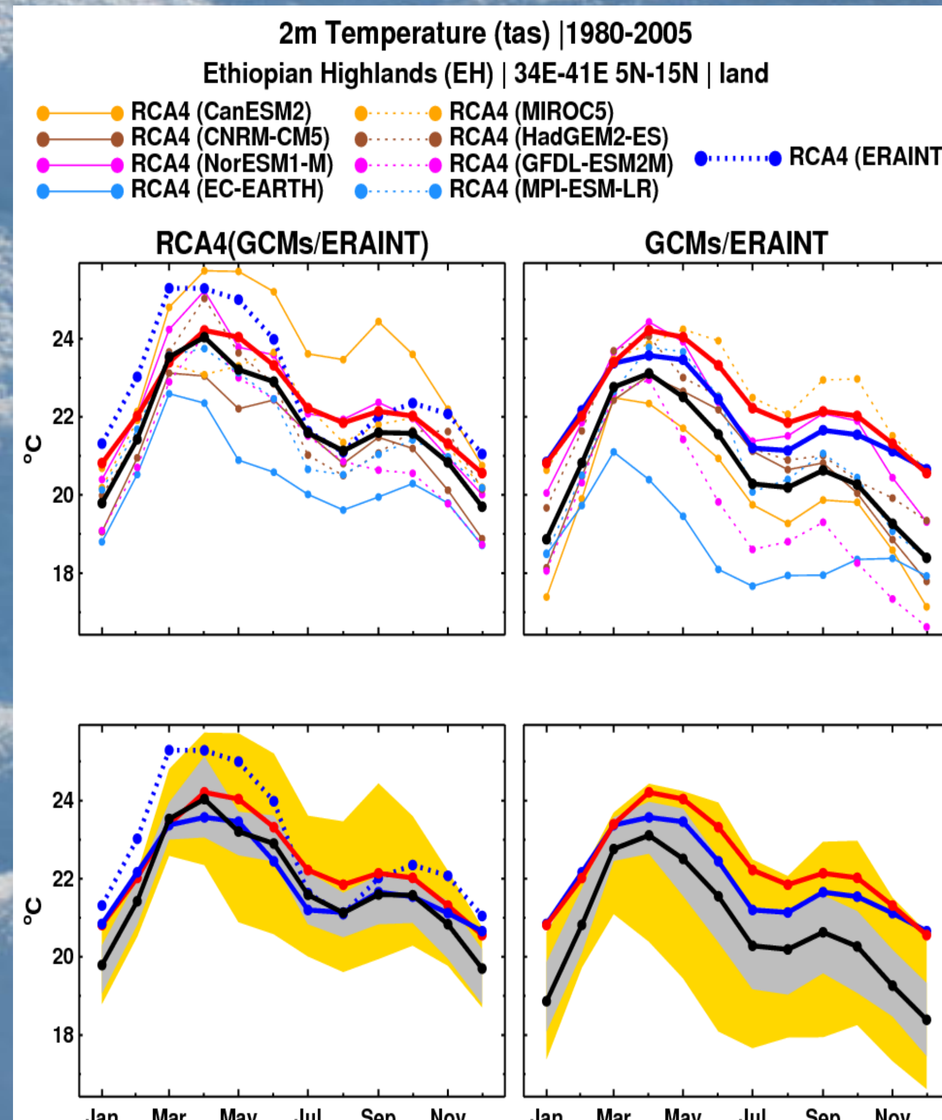
Annual Cycle of precipitation RCA4(GCM/ERA-int) and CMIP5 GCMs





Annual Cycle of 2m temperature RCA4(GCM/ERA-int) and CMIP5 GCMs

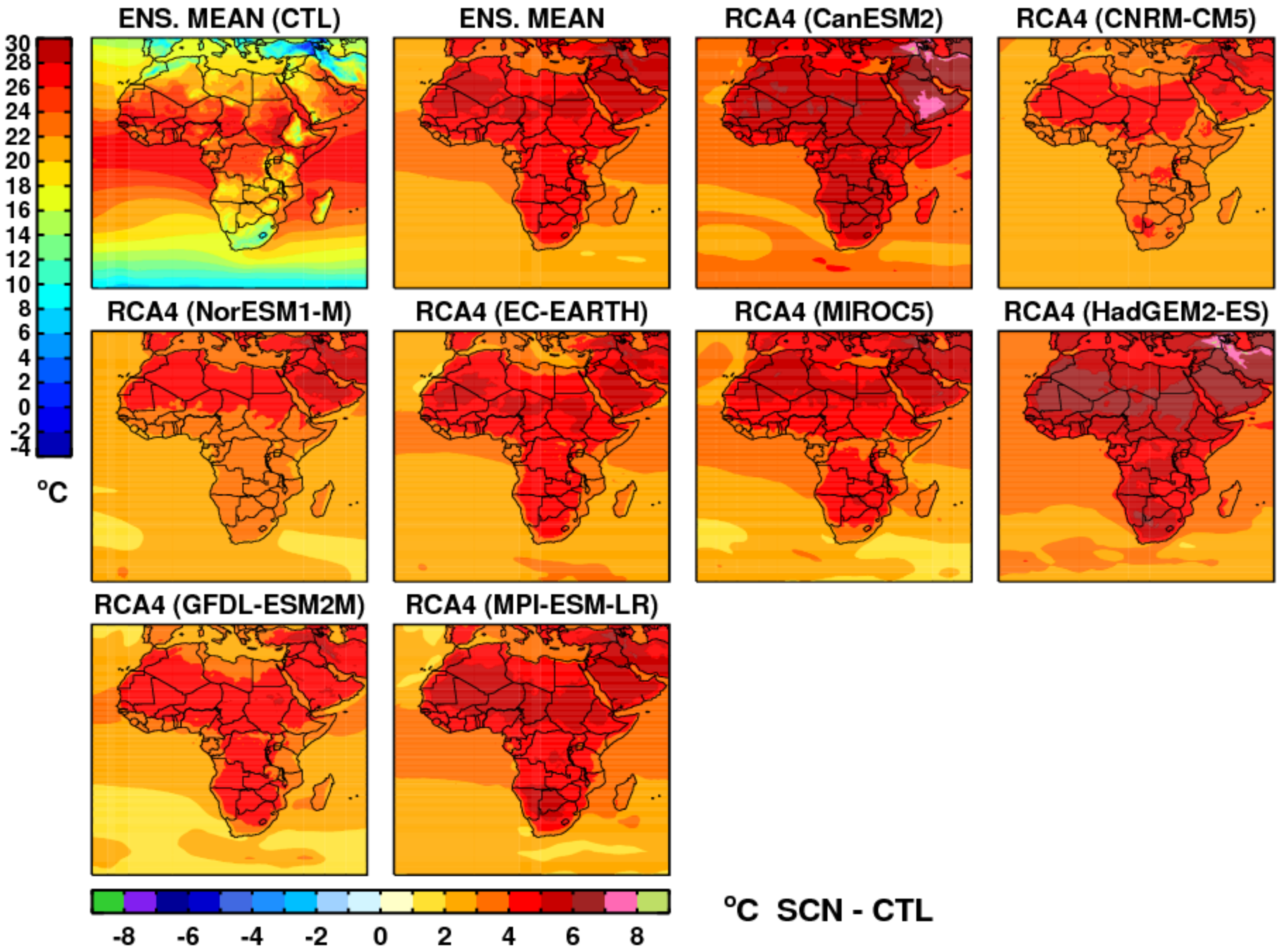




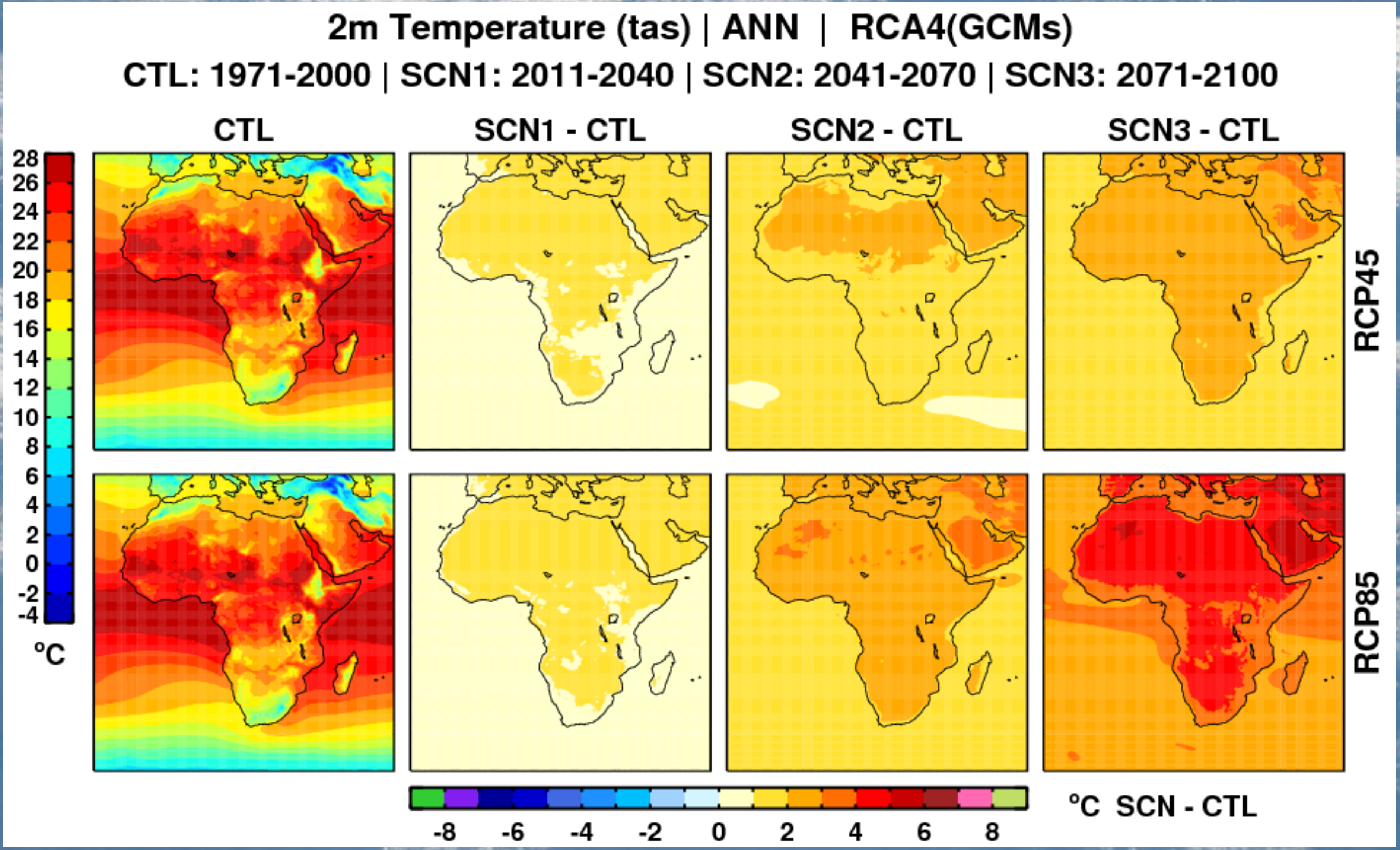
Africa-CORDEX RCM simulations driven by CMIP5 GCMs

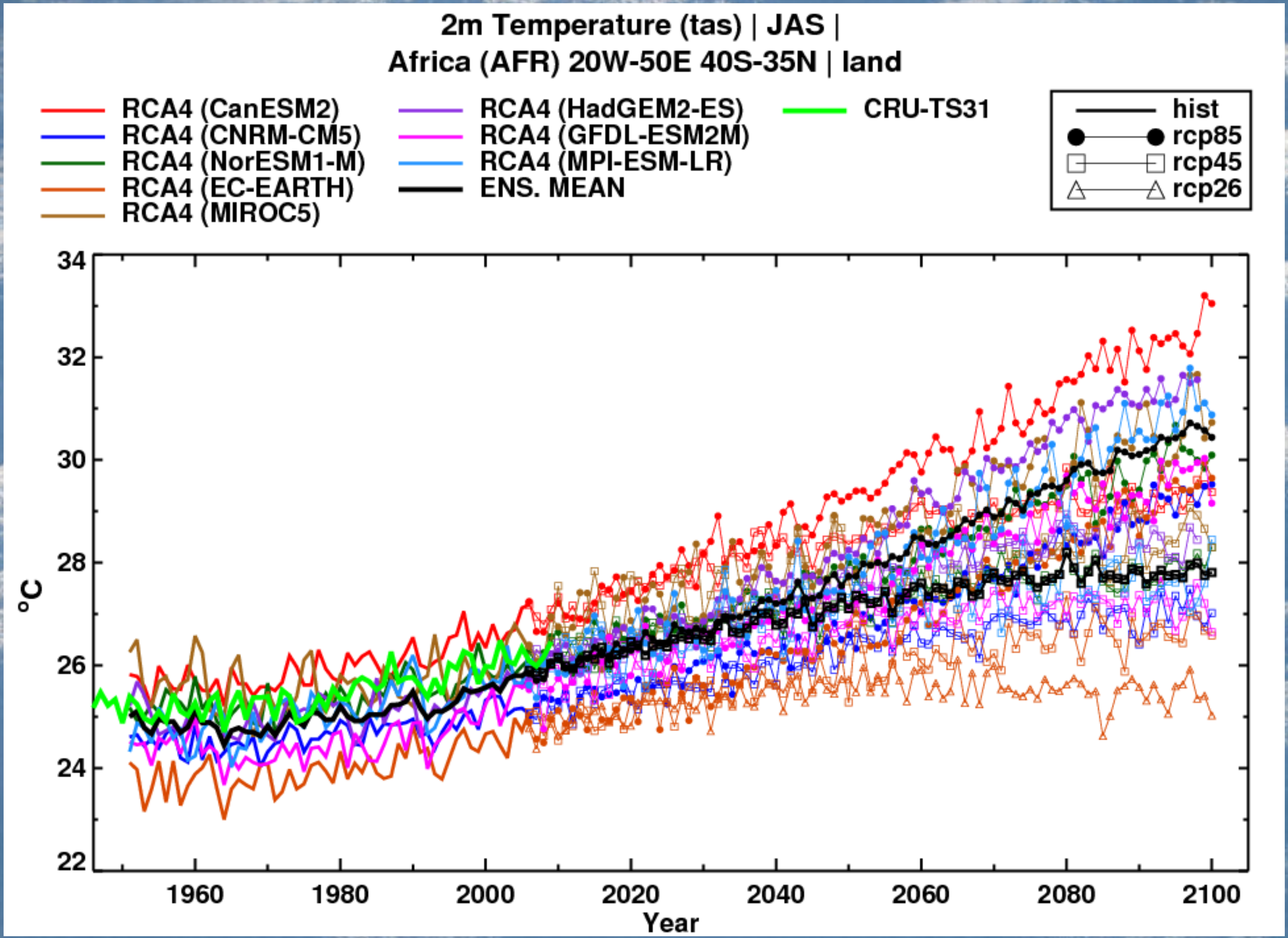
Evaluating & understanding regional climate change signals

2m Temperature (tas) | ANN | CTL: 1971-2000 | SCN: 2071-2100 | rcp85



30 yr annual mean, RCA4 ensemble mean temperature change





2m Temperature (tas) | JAS |
Africa (AFR) 20W-50E 40S-35N | land
RCA4 (CanESM2)
RCA4 (CNRM-CM5)
RCA4 (NorESM1-M)
RCA4 (EC-EARTH)
RCA4 (MIROC5)
RCA4 (HadGEM2-ES)
RCA4 (GFDL-ESM2M)
RCA4 (MPI-ESM-LR)
ENS. MEAN
CRU-TS31
hist
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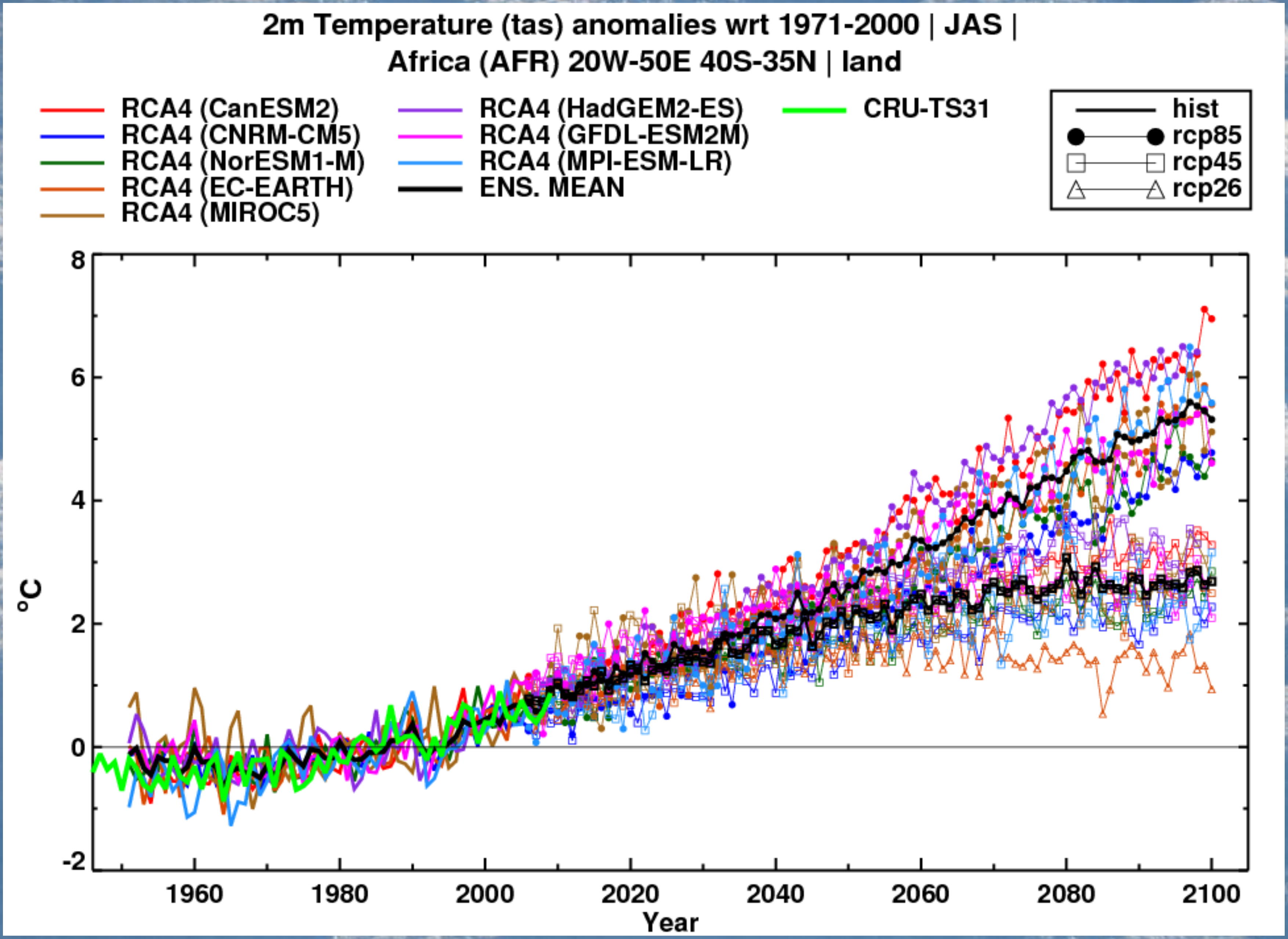
2m Temperature (tas) anomalies wrt 1971-2000 | JAS |
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RCA4 (MPI-ESM-LR)
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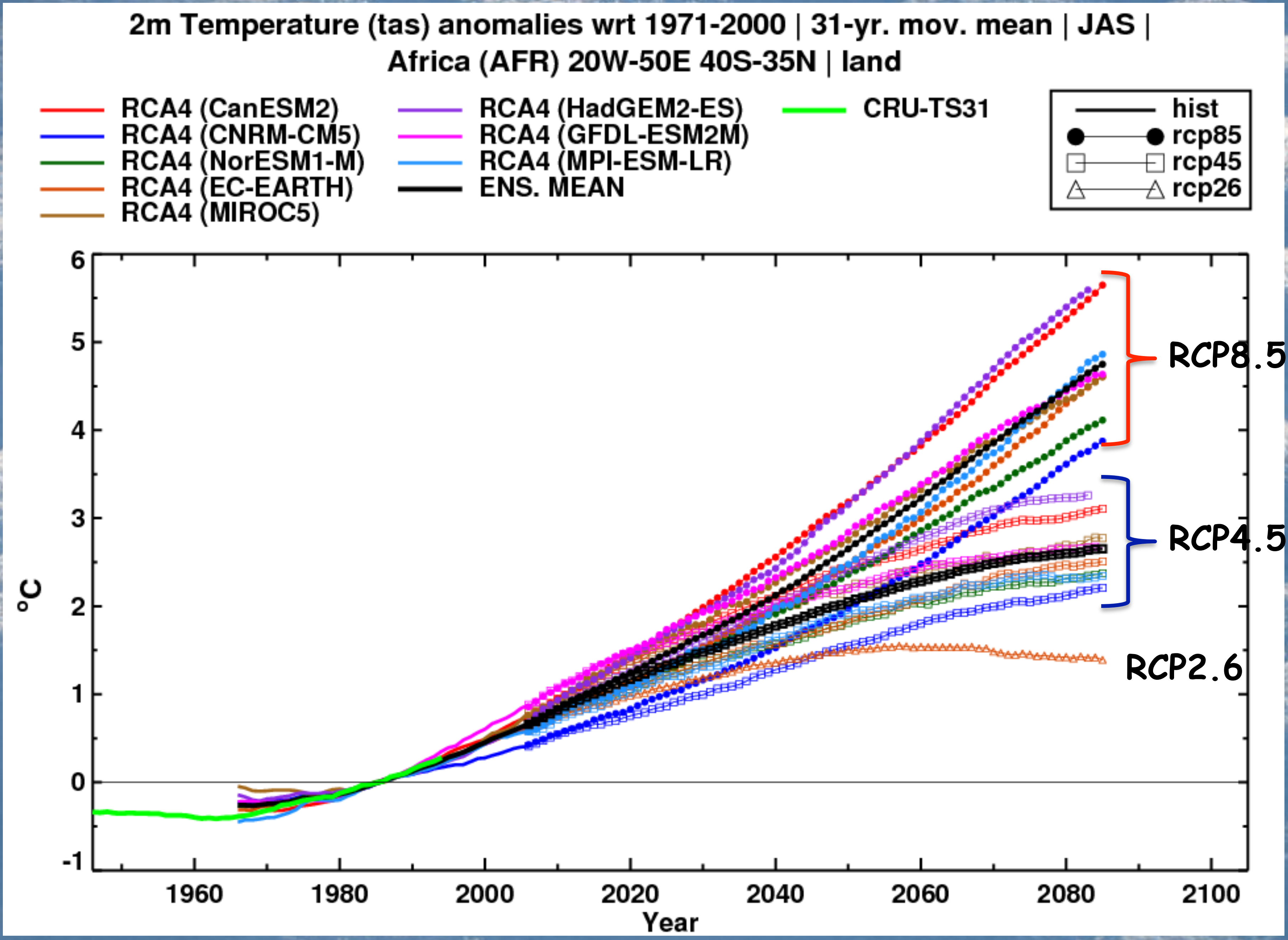
Year



2m Temperature (tas) anomalies wrt 1971-2000 | 31-yr. mov. mean | JAS |
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RCP8.5
RCP4.5
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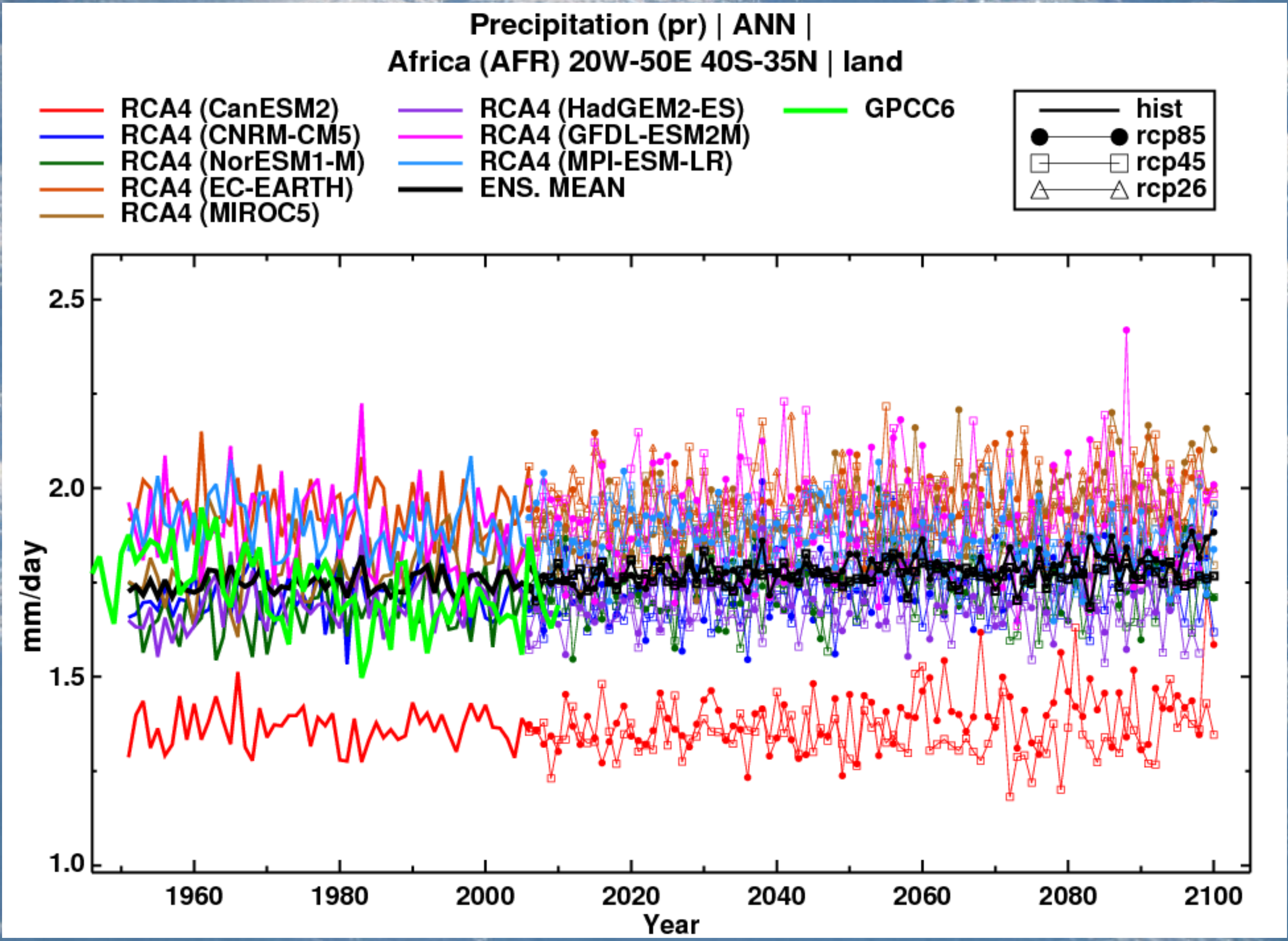
Precipitation (pr) | ANN |
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ENS. MEAN
GPCC6
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rcp45
rcp26
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mm/day
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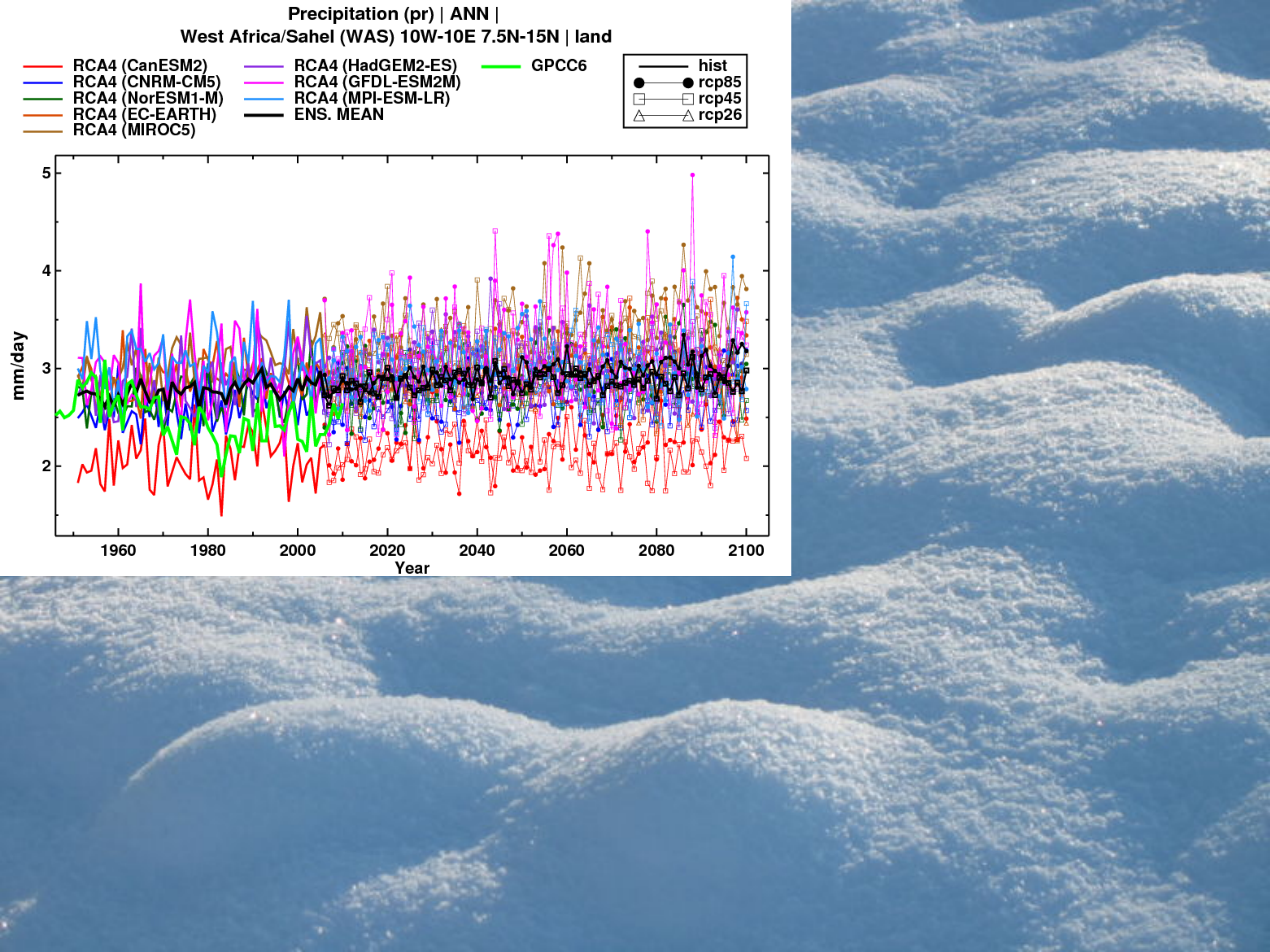
Year


Precipitation (pr) | ANN |
West Africa/Sahel (WAS) 10W-10E 7.5N-15N | land
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GPCC6
hist
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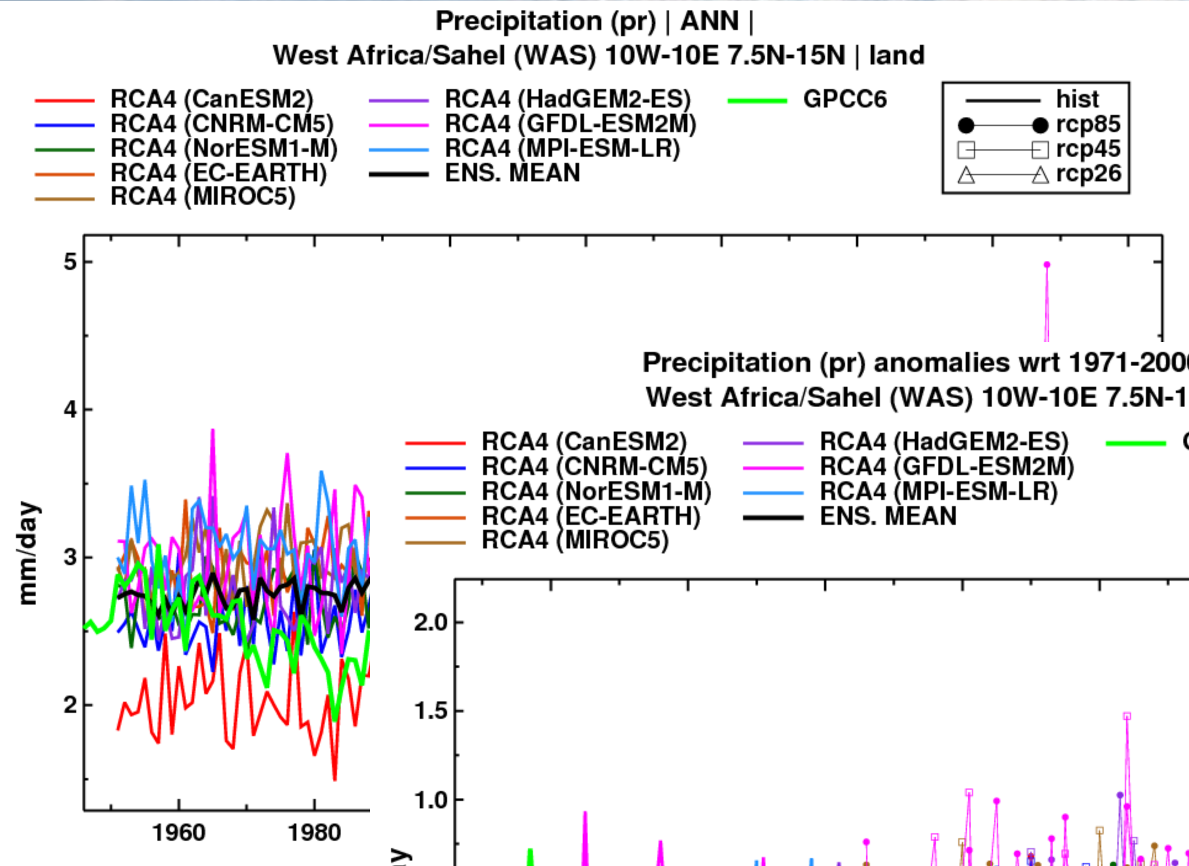
rcp26
mm/day
Year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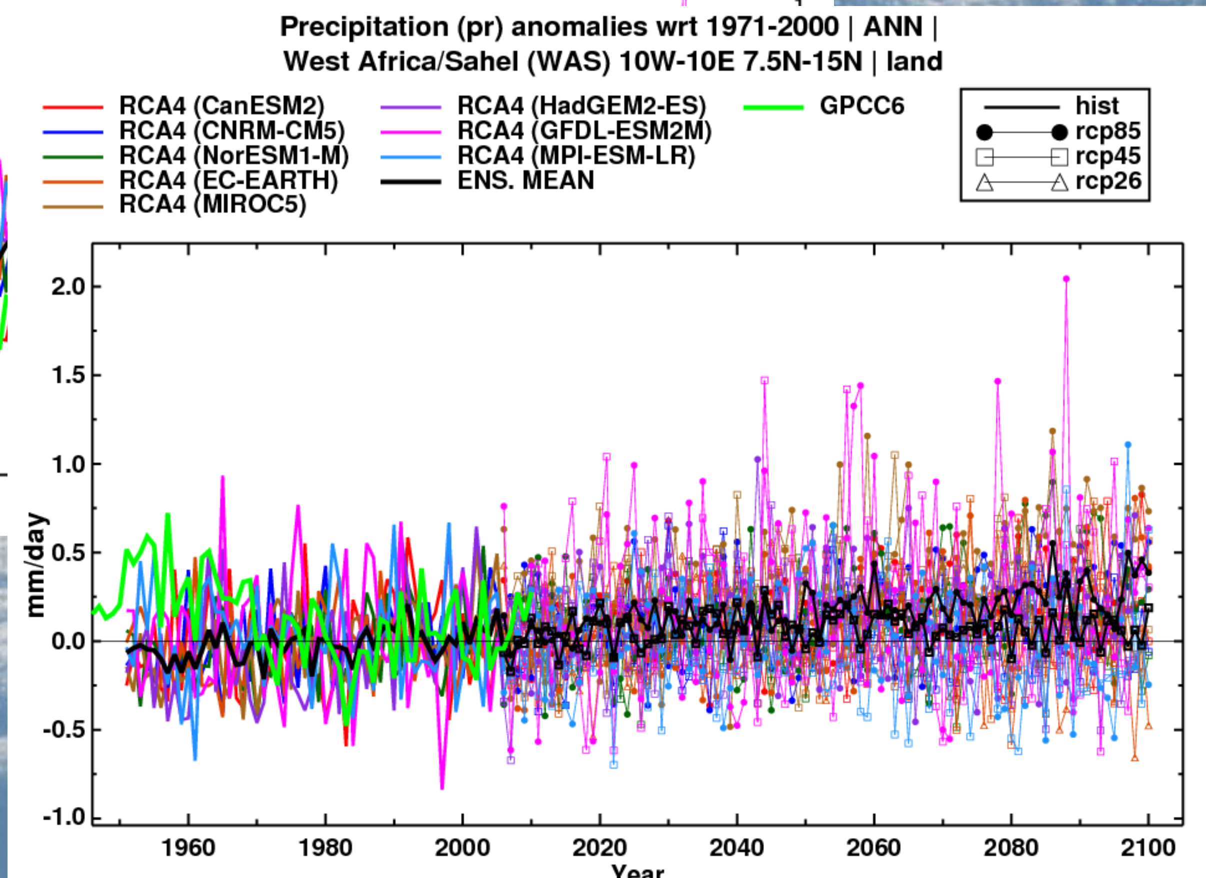
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mm/day
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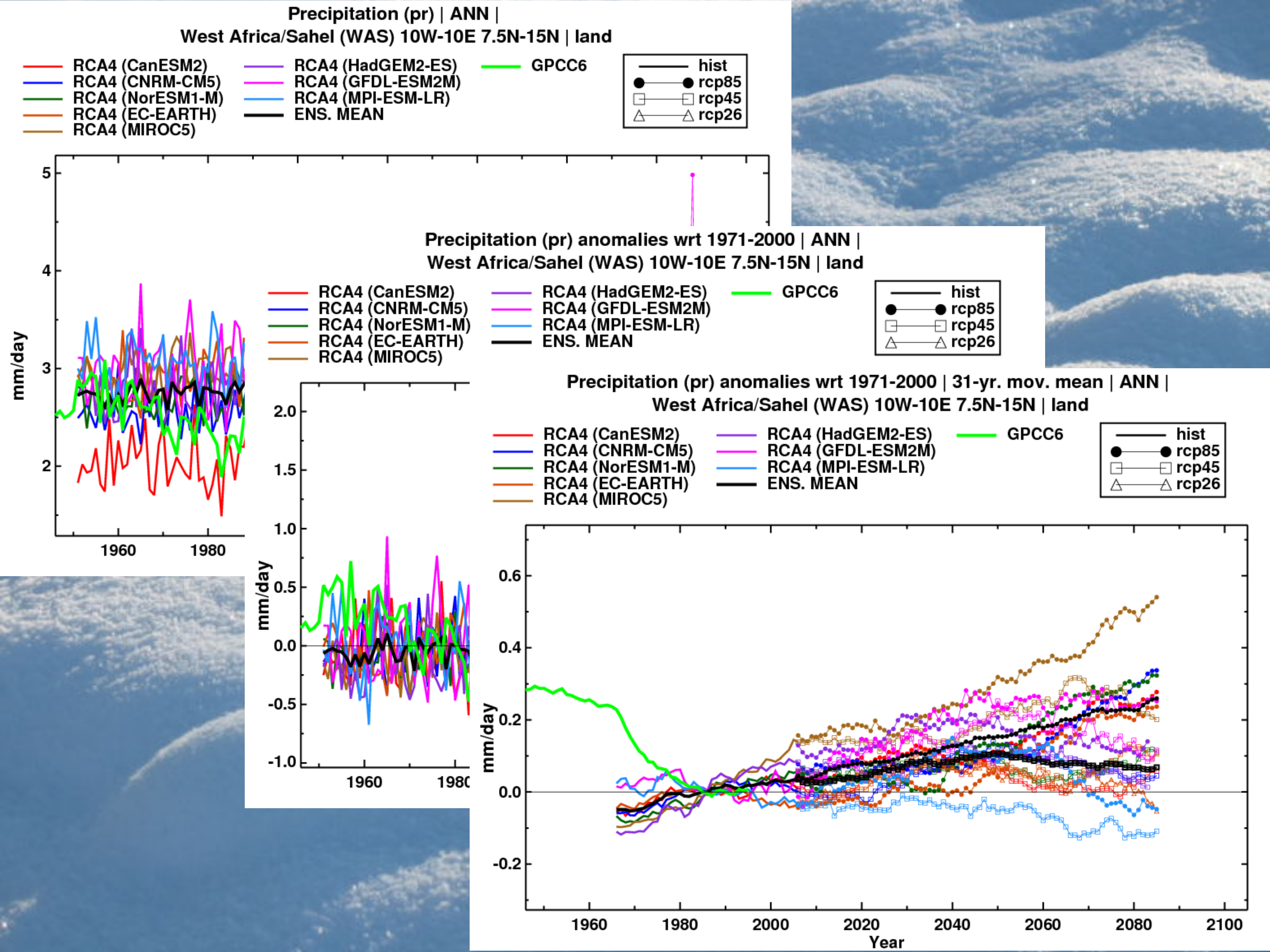
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GPCC6
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rcp26
mm/day
Precipitation (pr) anomalies wrt 1971-2000 | 31-yr. mov. mean | ANN |
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GPCC6
hist
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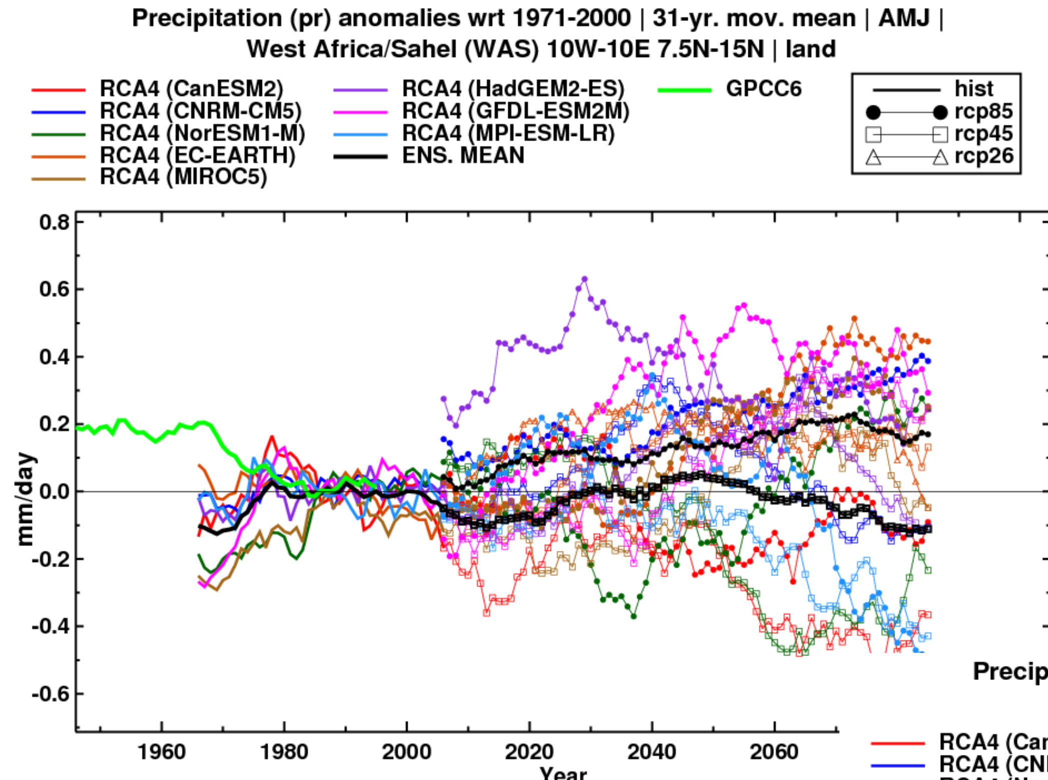
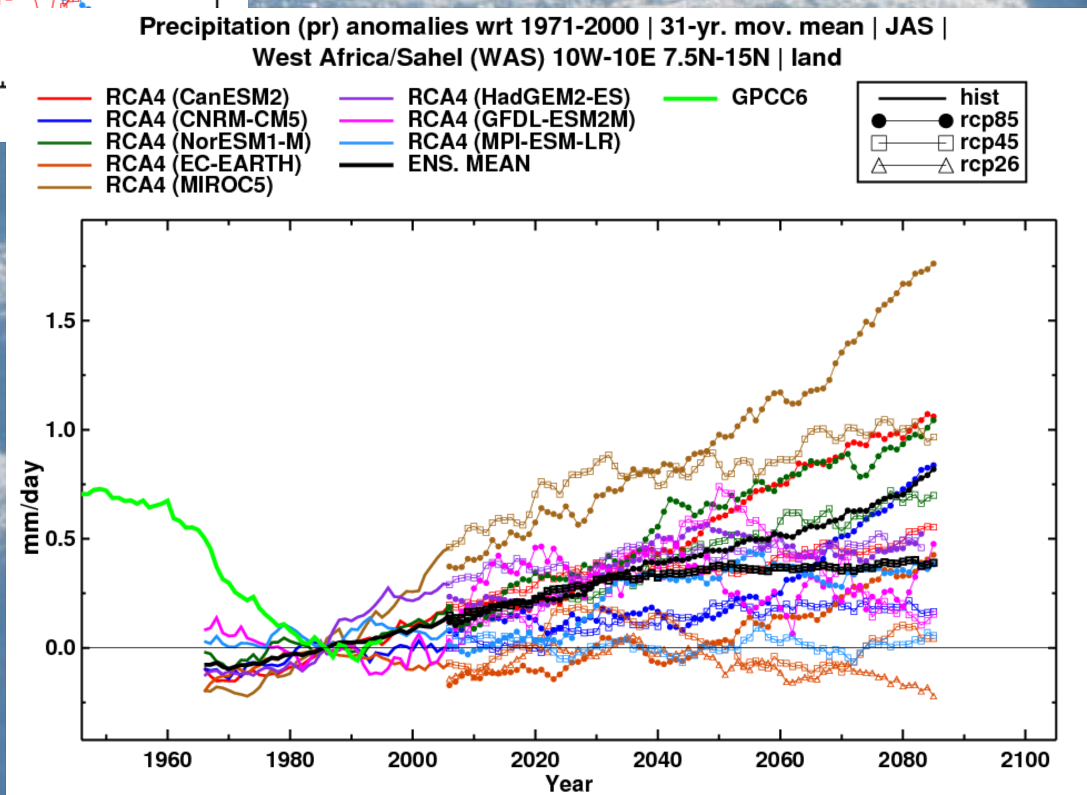
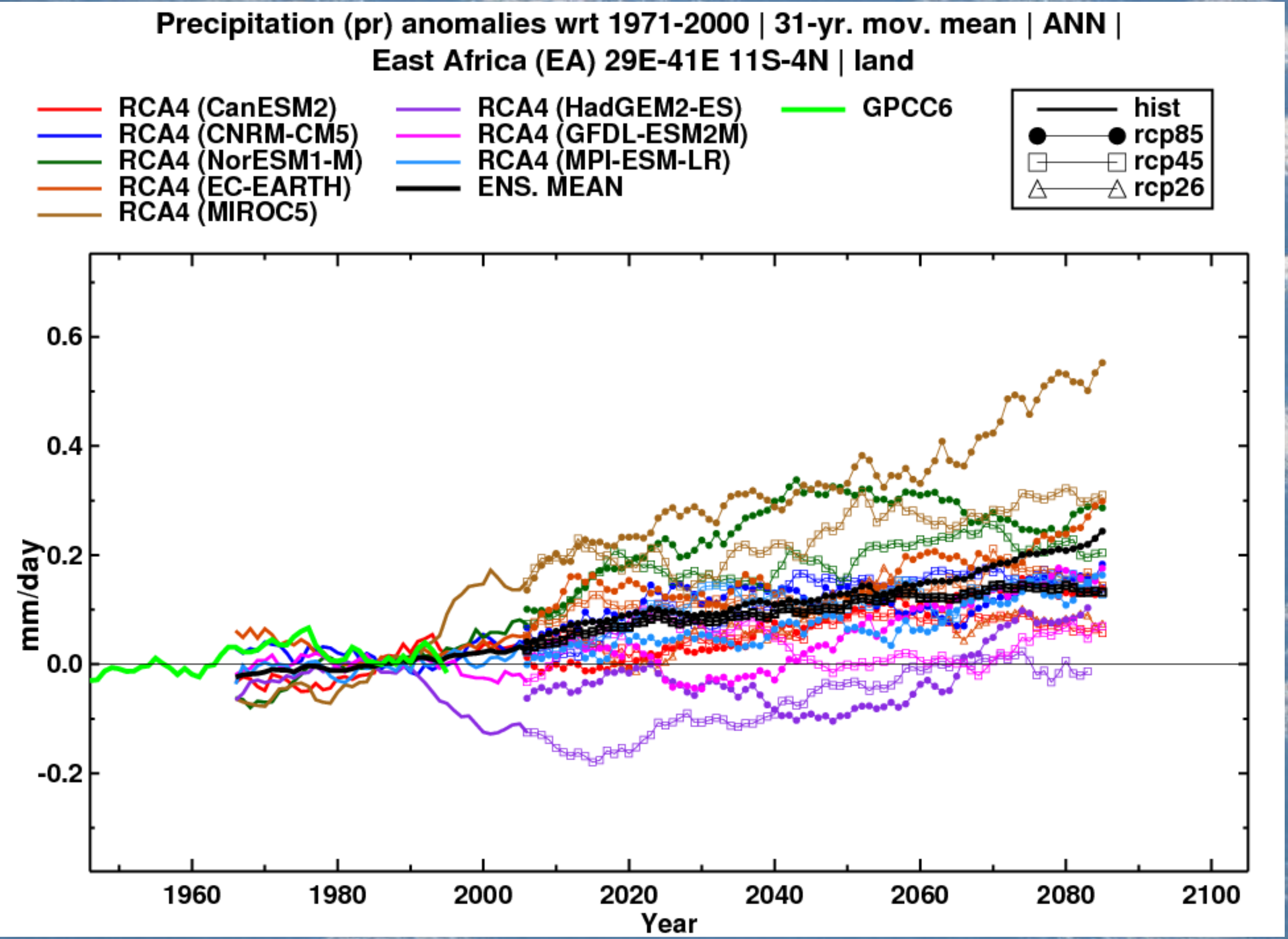
rcp26
mm/day
Year



Little change in early Part of WAM season



Significant increase in late part of WAM season
Also seen in CMIP5 GCMs


Precipitation (pr) anomalies wrt 1971-2000 | 31-yr. mov. mean | ANN |
East Africa (EA) 29E-41E 11S-4N | land
RCA4 (CanESM2)
RCA4 (CNRM-CM5)
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ENS. MEAN
GPCC6
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rcp45
rcp26
mm/day
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-0.2
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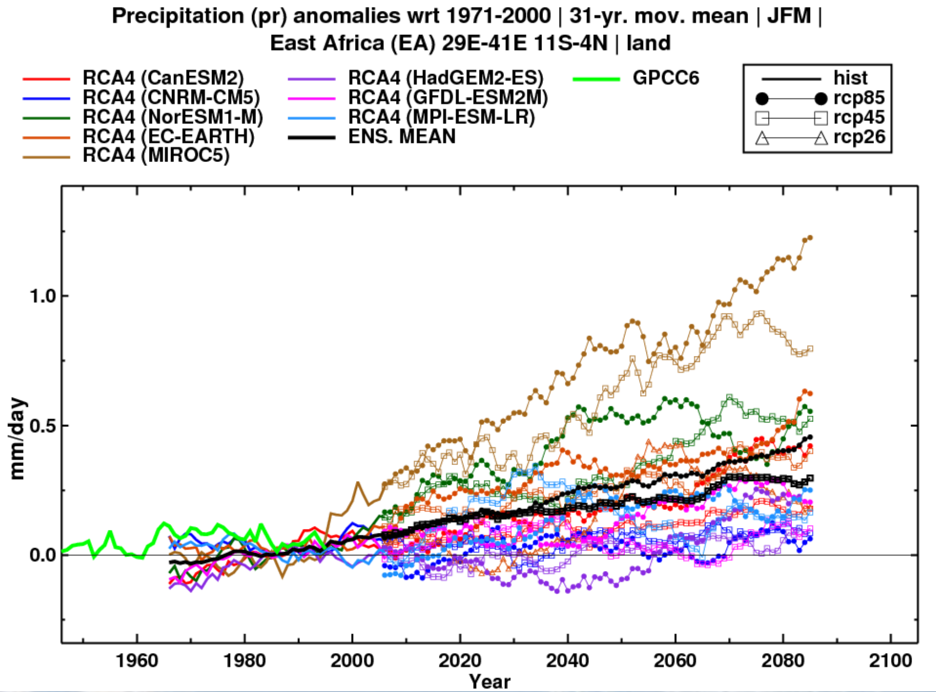
Year


Precipitation (pr) anomalies wrt 1971-2000 | 31-yr. mov. mean | JFM |
East Africa (EA) 29E-41E 11S-4N | land
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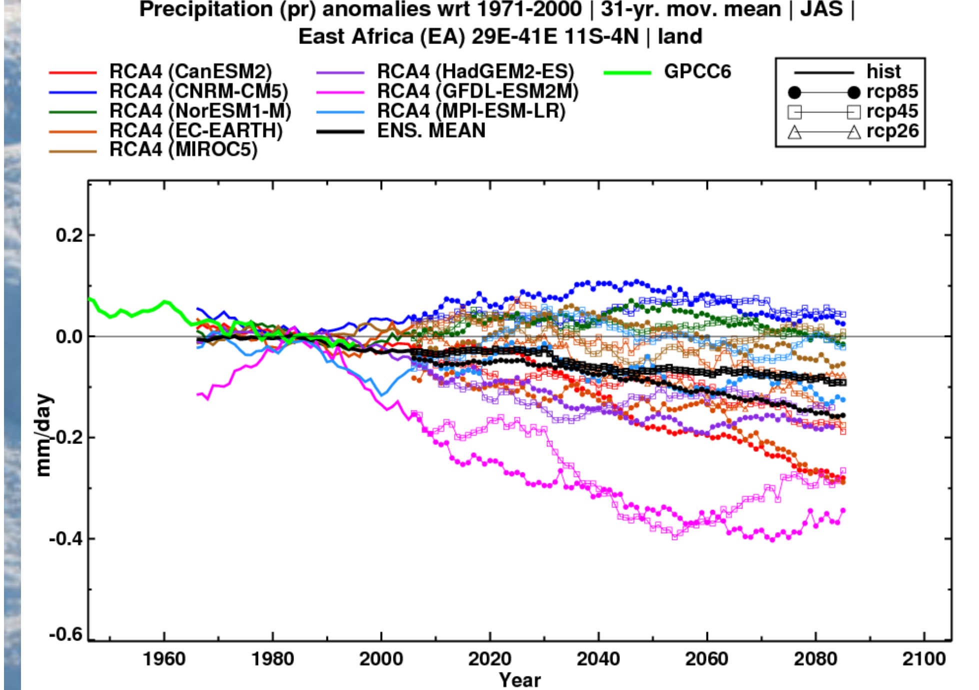
Precipitation (pr) anomalies wrt 1971-2000 | 31-yr. mov. mean | JAS |
East Africa (EA) 29E-41E 11S-4N | land
RCA4 (CanESM2)
RCA4 (CNRM-CM5)
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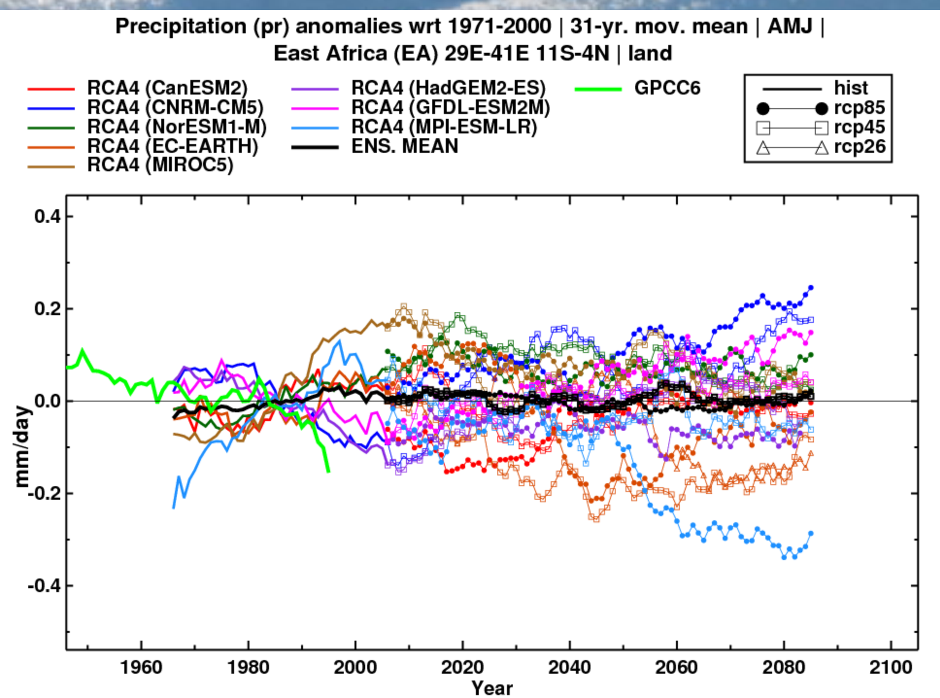
Year


Precipitation (pr) anomalies wrt 1971-2000 | 31-yr. mov. mean | AMJ |
East Africa (EA) 29E-41E 11S-4N | land
RCA4 (CanESM2)
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mm/day
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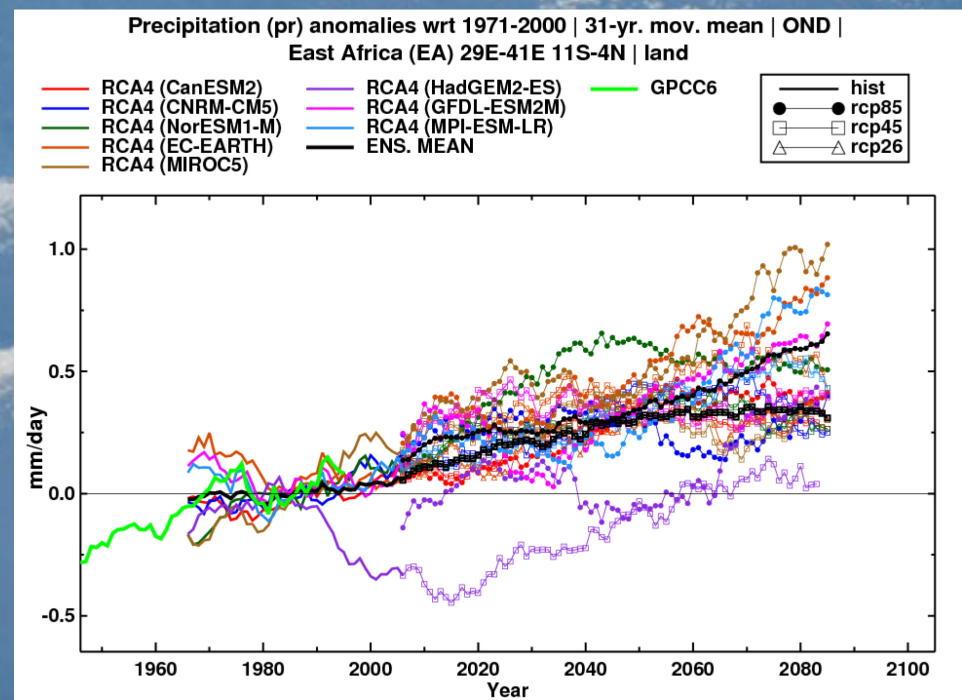
Precipitation (pr) anomalies wrt 1971-2000 | 31-yr. mov. mean | OND |
East Africa (EA) 29E-41E 11S-4N | land
RCA4 (CanESM2)
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RCA4 (NorESM1-M)
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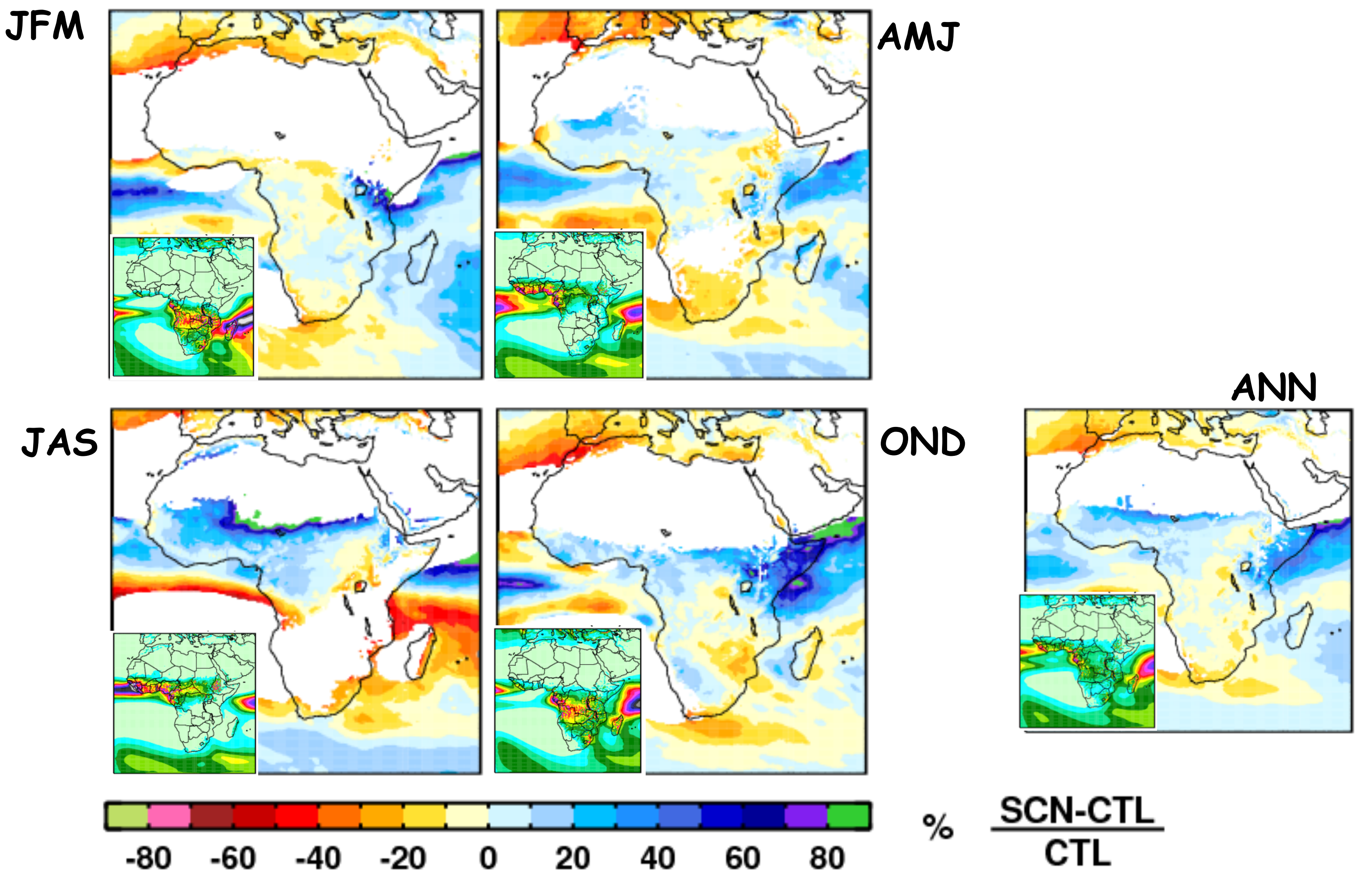
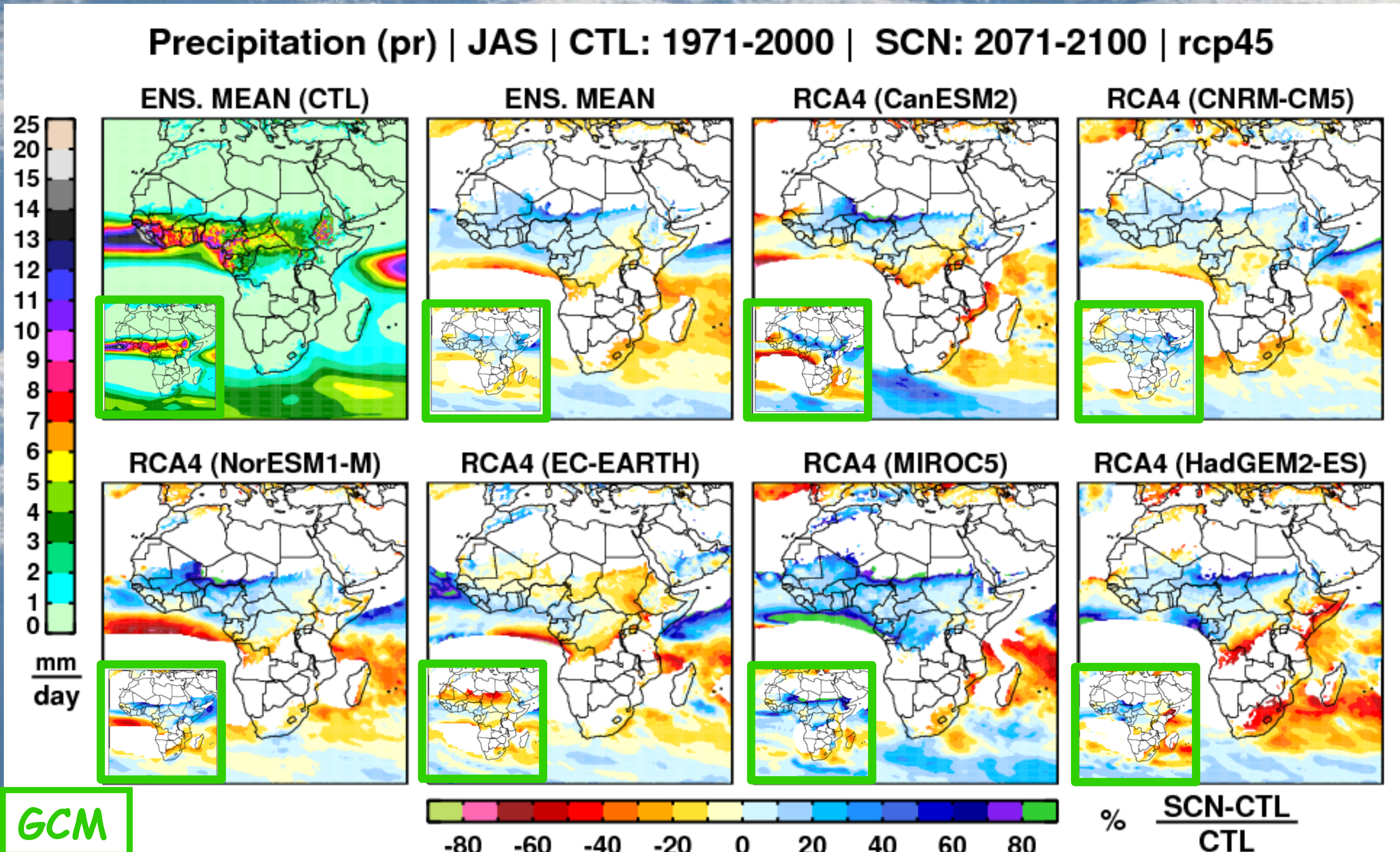
ENS. MEAN
GPCC6
hist
rcp85
rcp45
rcp26
mm/day
Year

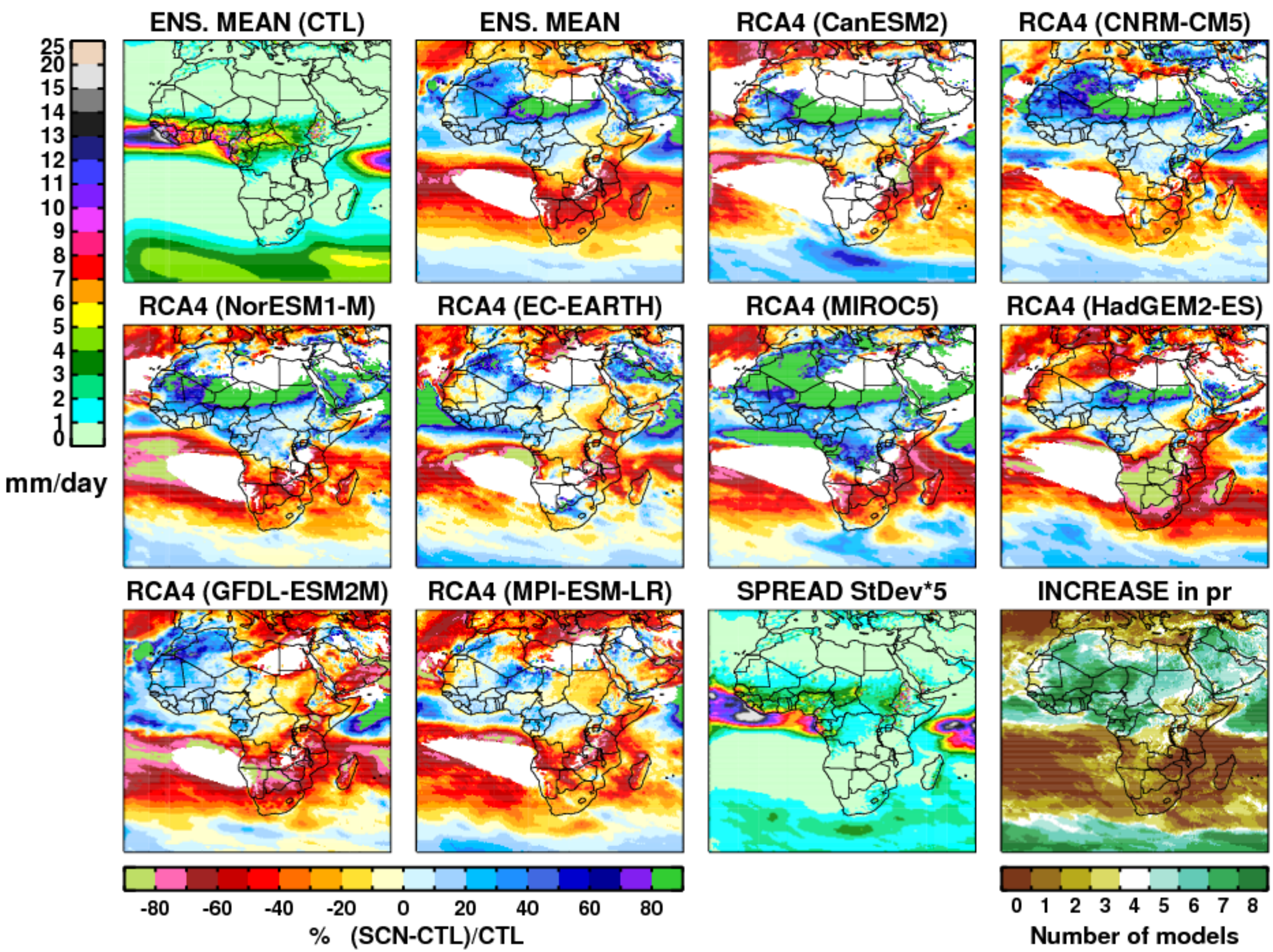
Seasonal mean precipitation change RCP8.5 2071-2100 vs 1971-2000



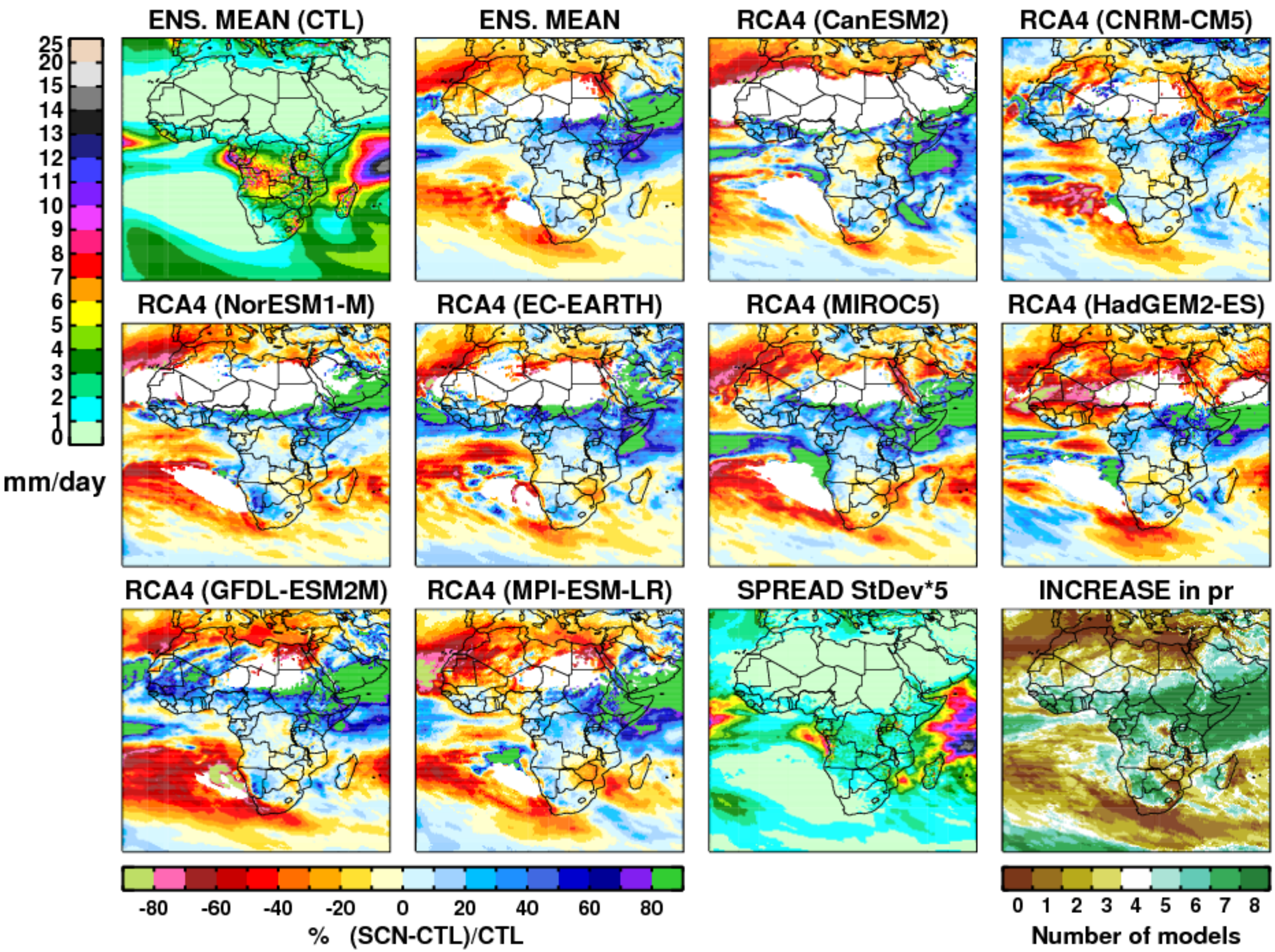
Same RCM different GCM boundaries: Precipitation changes

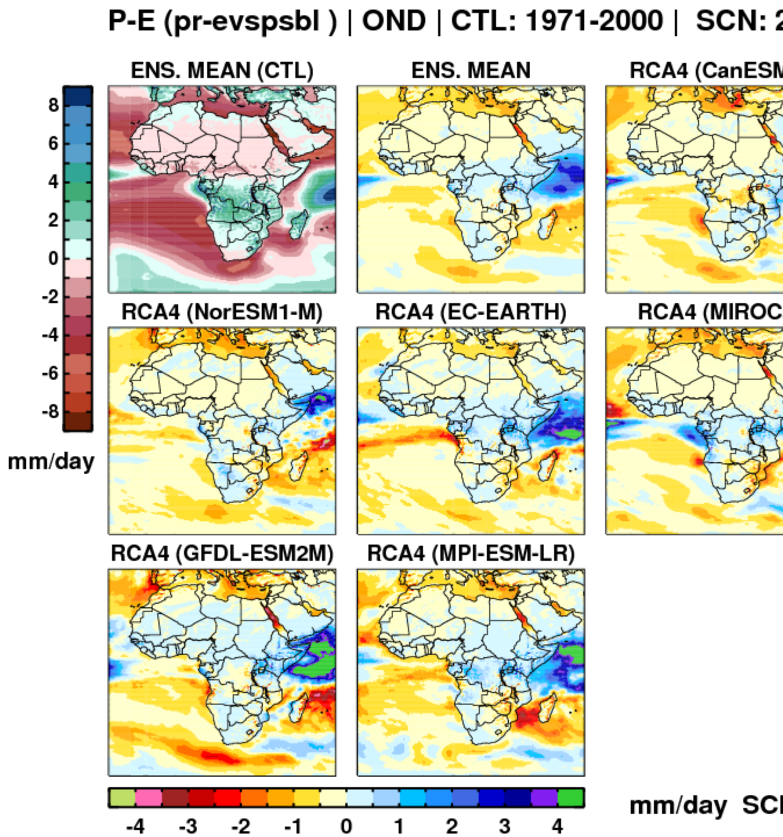


Precipitation (pr) | JAS | CTL: 1971-2000 | SCN: 2071-2100 | rcp85

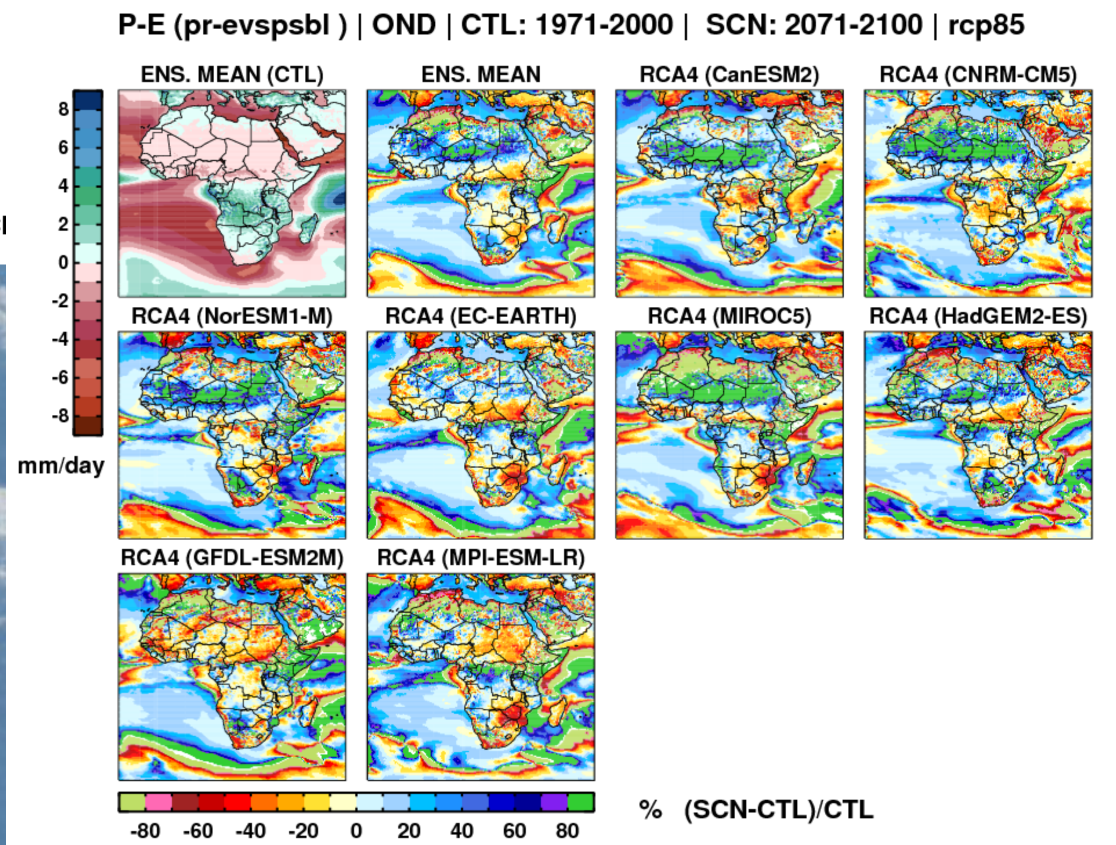


Precipitation (pr) | OND | CTL: 1971-2000 | SCN: 2071-2100 | rcp85



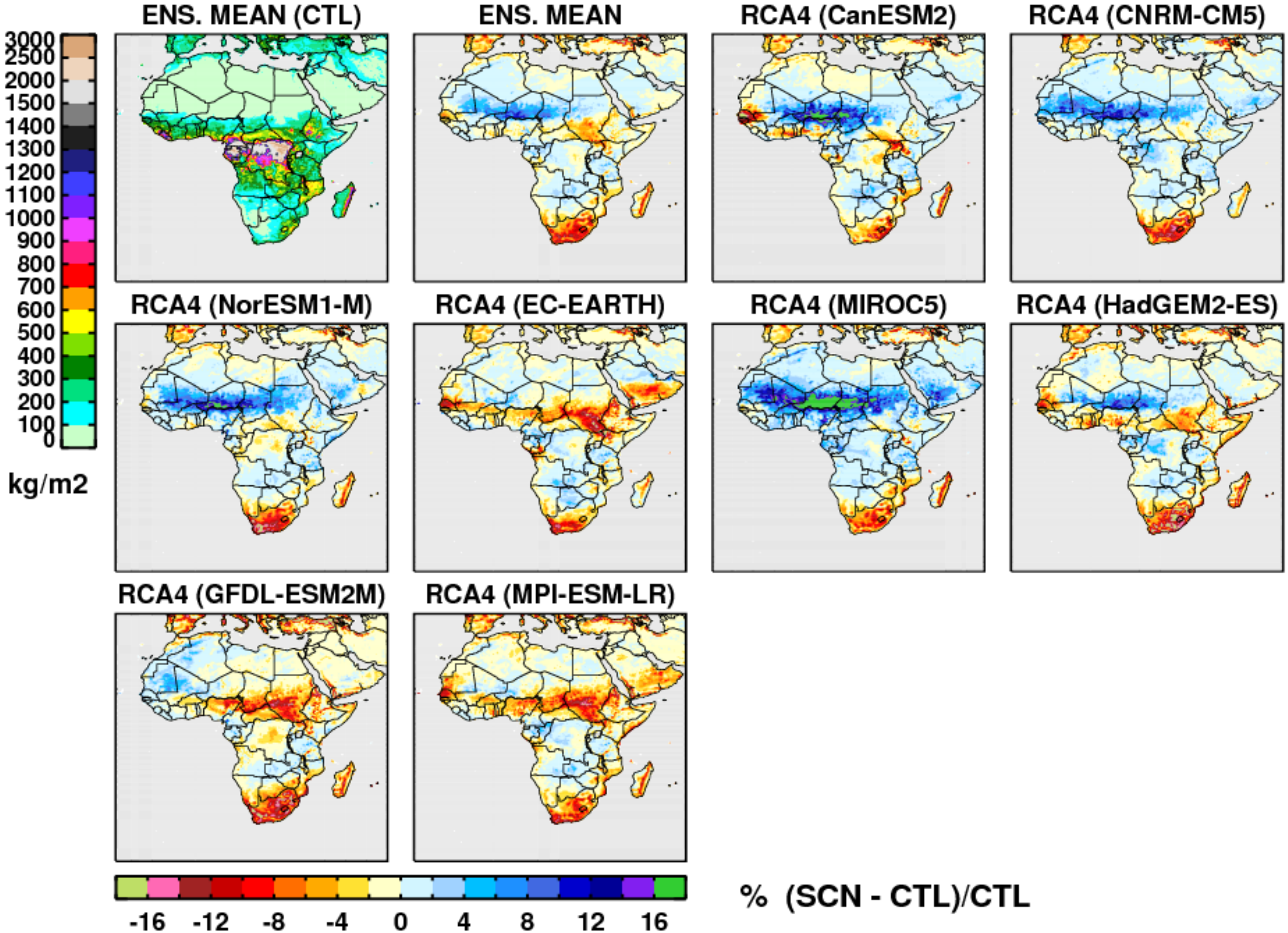


P-E absolute change
RCP85 end of century

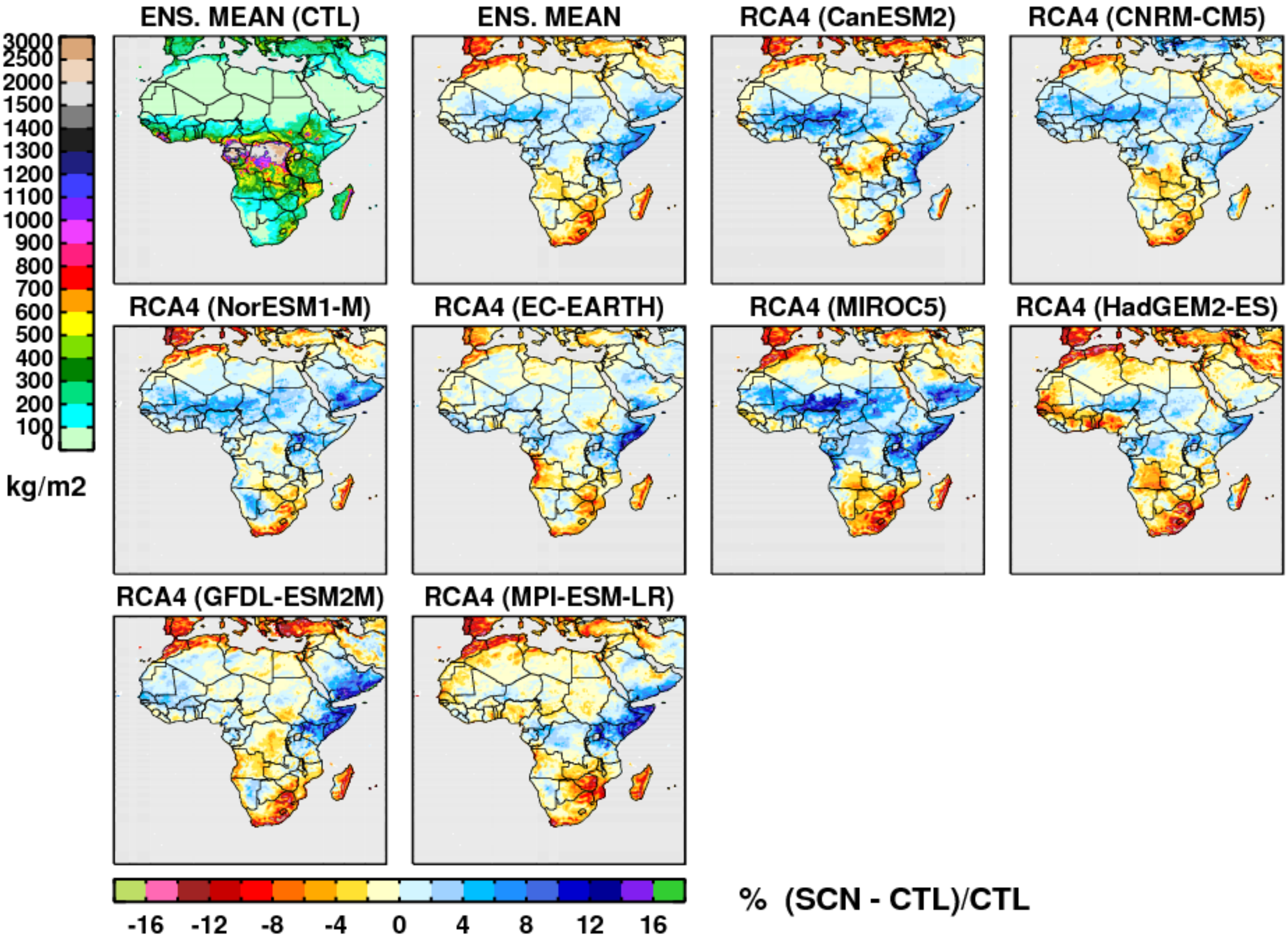


P-E percent change
RCP85 end of century

Soil moisture (mrso) | JAS | CTL: 1971-2000 | SCN: 2071-2100 | rcp85



Soil moisture (mrso) | OND | CTL: 1971-2000 | SCN: 2071-2100 | rcp85



And now South Asia……