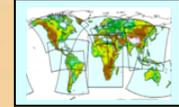


The CORDEX-Africa initiative: How RCMs simulate African climate?

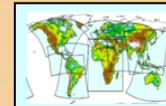
Grigory Nikulin and Colin Jones

Rossby Centre
Swedish Meteorological and Hydrological Institute



Many thanks to all RCM groups providing data:

HIRHAM5	(DMI, Denmark)
CCLM48	(CCLMcom consortium)
REMO	(MPI, Germany)
RACMO22	(KNMI, Netherlands)
ARPEGE51	(CNRM, France)
RegCM3	(ICTP, Italy)
PRECIS	(University of Cape Town, South Africa)
WRF311	(University of Cantabria, Spain)
MM5	(University of Murcia, Spain)
CRCM5	(Université du Québec à Montréal, Canada)



driven by ERA-Interim, Africa domain, 50 km, 1989-2008

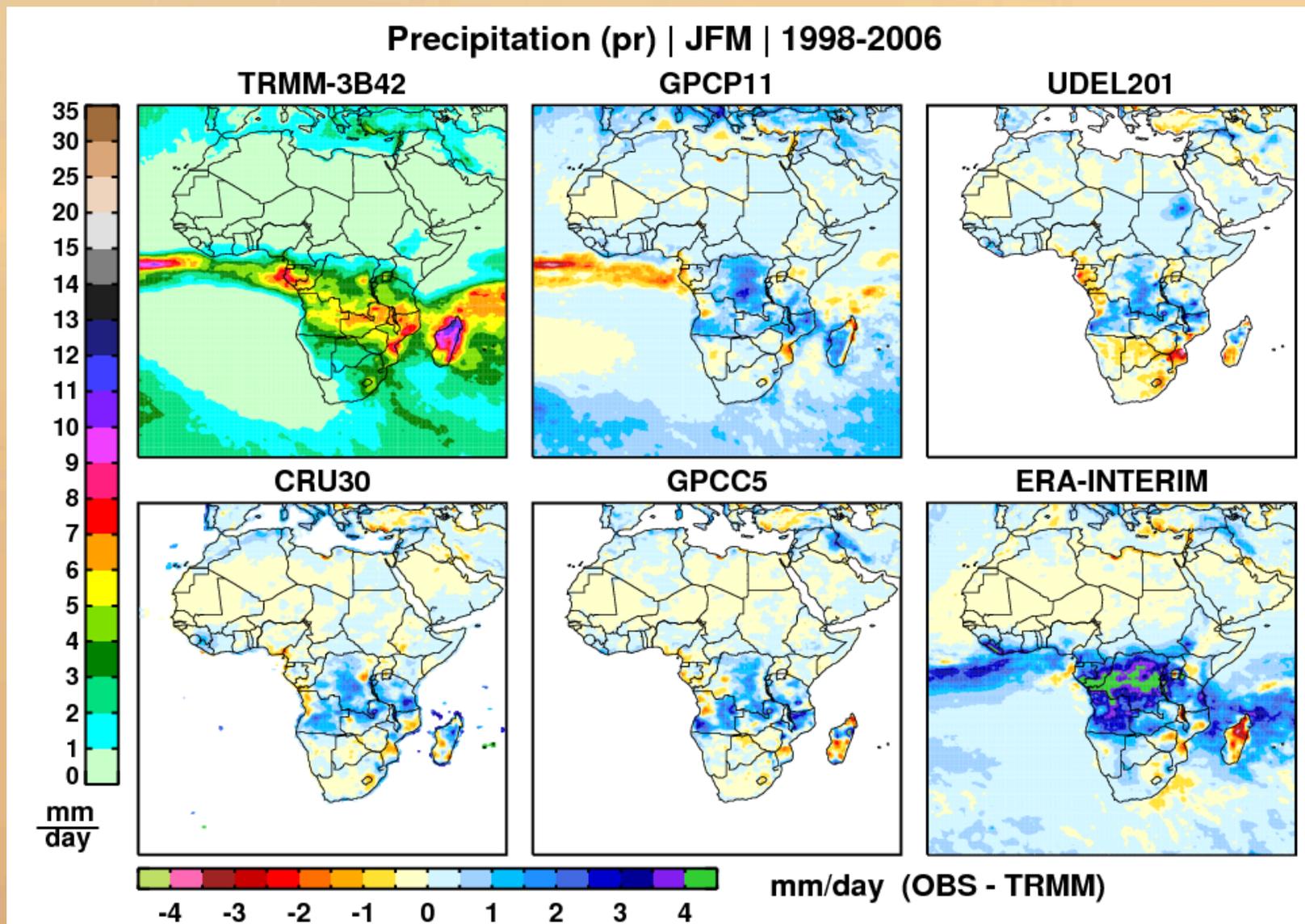
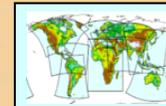
RCM data: 3-hourly precipitation:

- ✓ seasonal mean
- ✓ annual cycle
- ✓ diurnal cycle

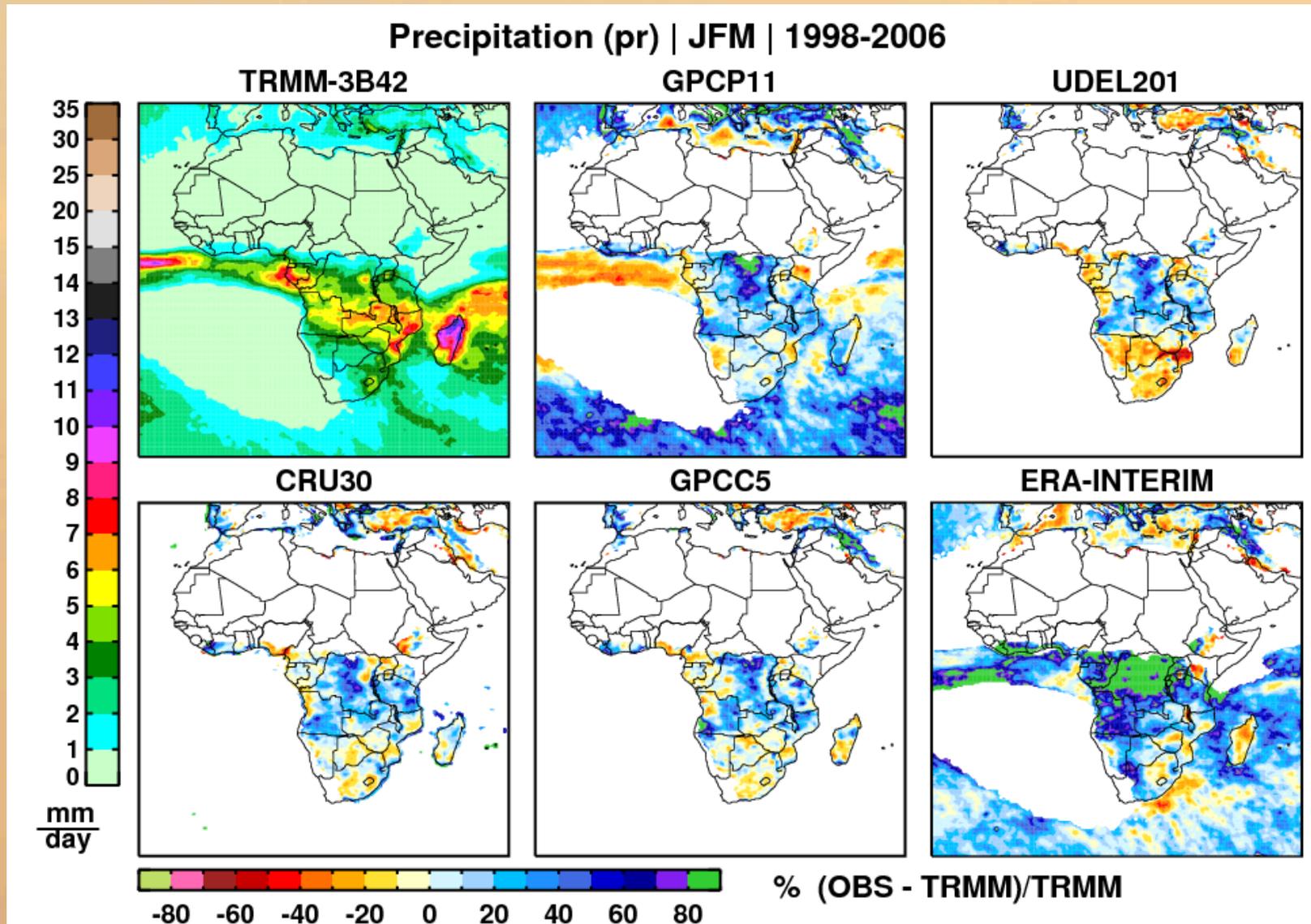
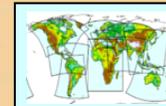
Gridded precipitation products:

- ✓ TRMM-3B42 (3-hourly, 0.25°, 1998-2008)
- ✓ CMORPH (3-hourly, 0.25°, 2003-2008)
- ✓ GPCP11 (daily, 1°, 1998-2008)
- ✓ GPCC5 (monthly, 0.5°, 1989-2008)
- ✓ CRU30 (monthly, 0.5°, 1989-2006)
- ✓ Univ. Delaware, v. 2.01 (monthly, 0.5°, 1989-2008)

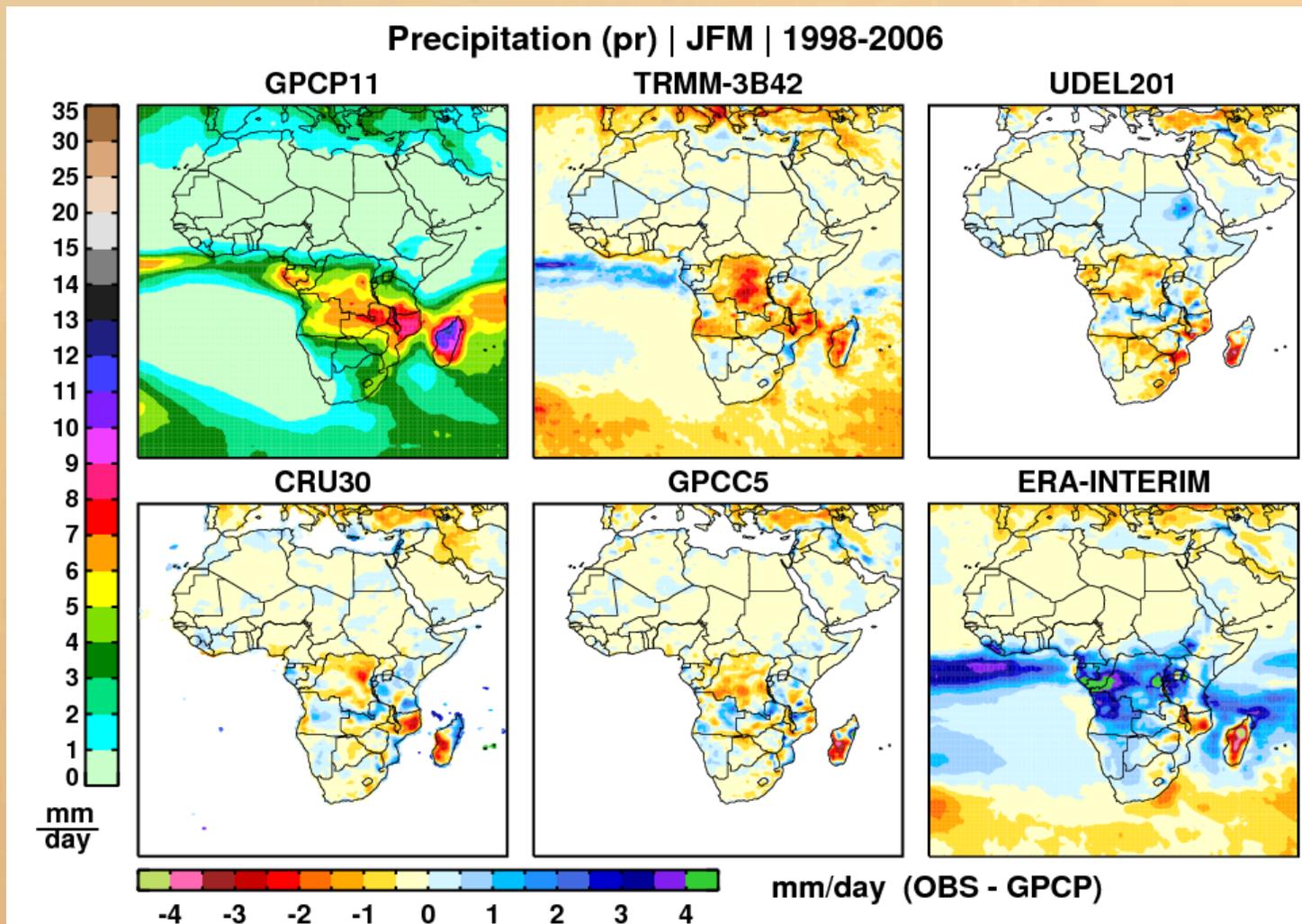
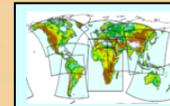
all different grids remapped onto the same 0.44 rotated grid



a systematic difference wrt TRMM-3B42



relative difference can locally reach 50% and more

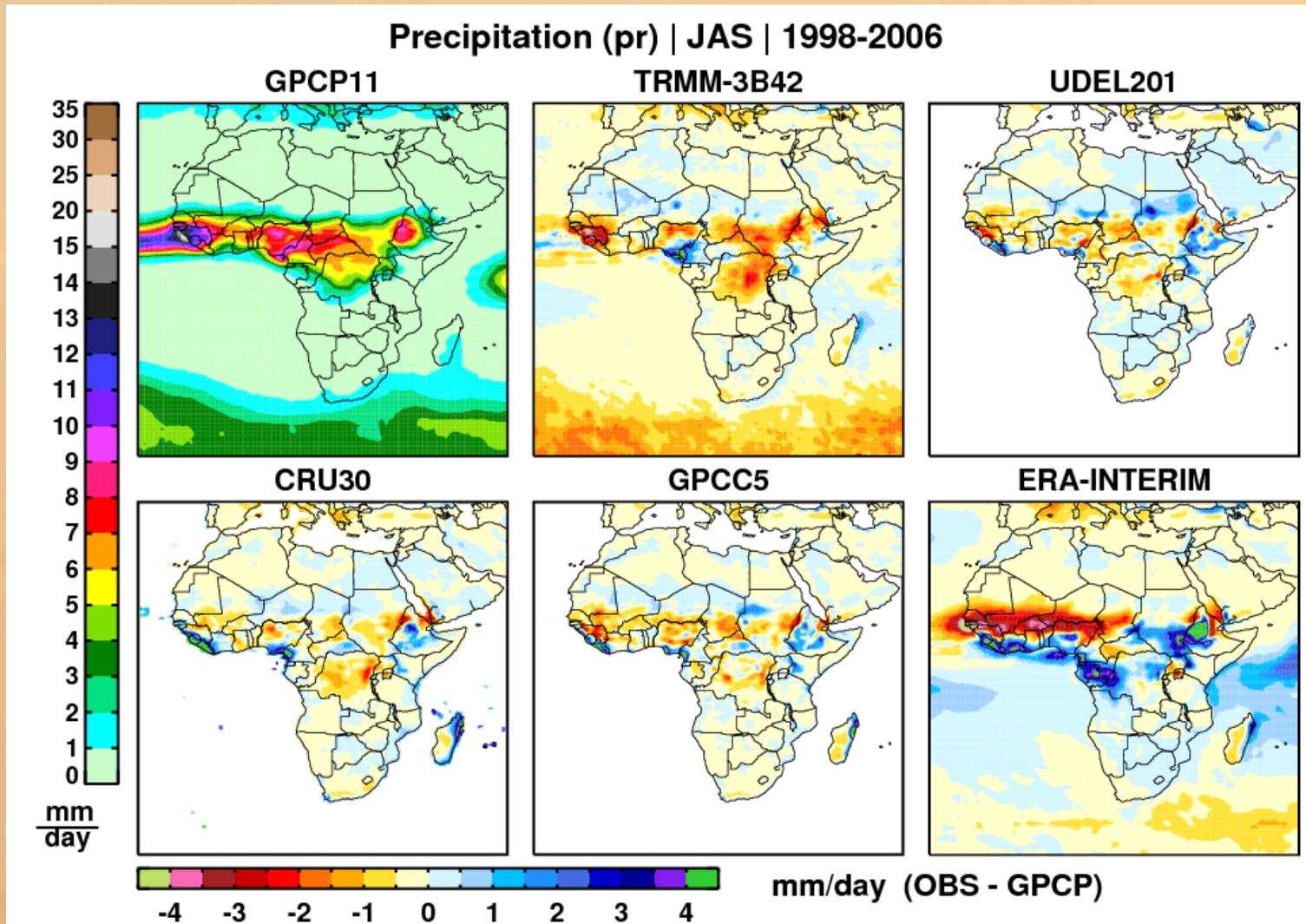


Satellite products are scaled to large-scale gauge monthly precipitation:

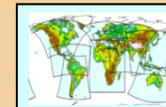
TRMM: 1998 - Aug 2005 GPCP (monitoring product, v2) and CAMS after

GPCP: GPCP v4 (up 2007) and monitoring product after

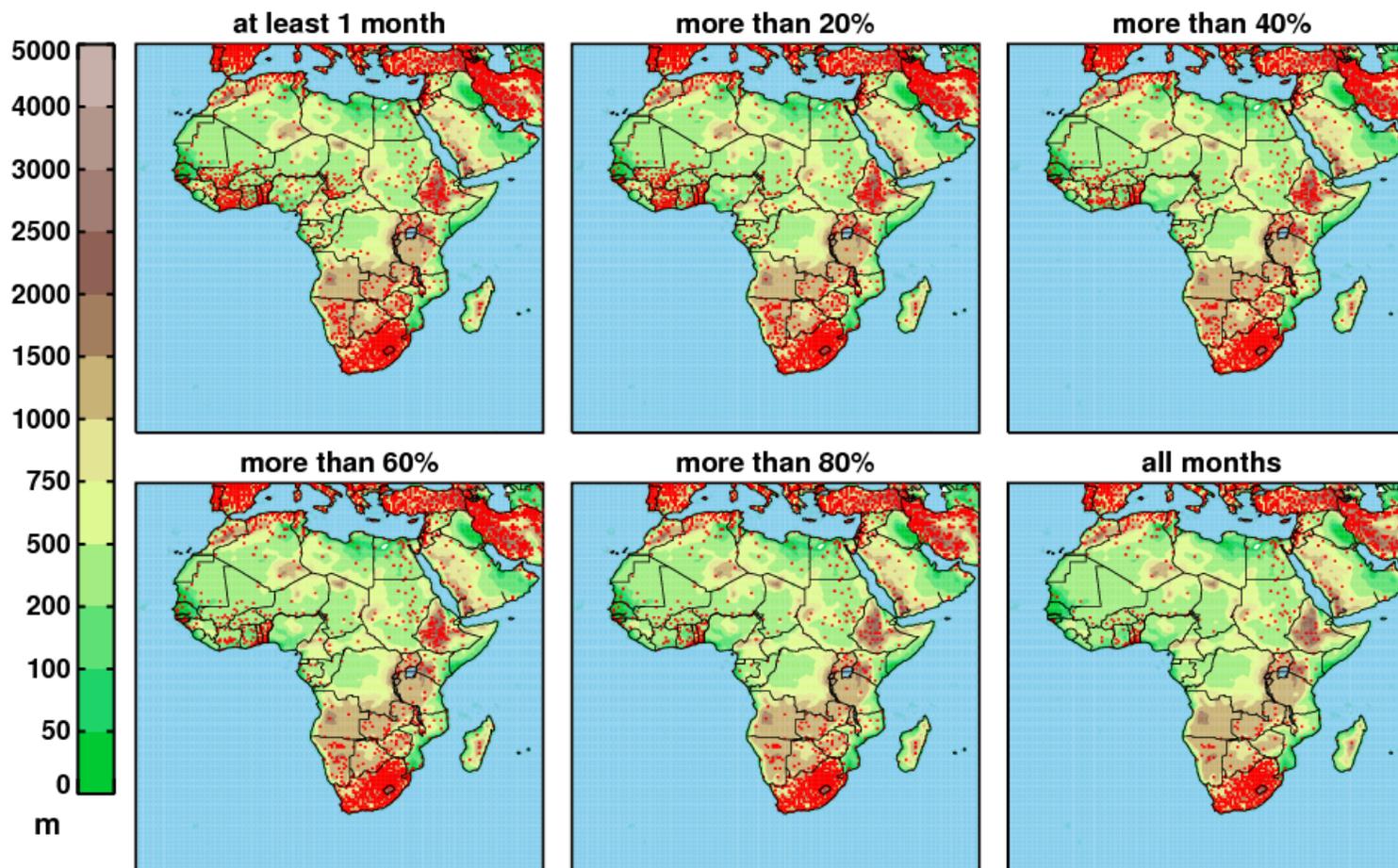
thanks to George Huffman (NASA GSFC)



ERA-Interim has the largest biases: precipitation is pure simulated variable (no assimilation with observations)



Availability of GPCC gauges | JFM | 1998-2006 (27 months)



too few or no gauge stations for all months over large regions
quality of gridded gauge based precipitation ??????

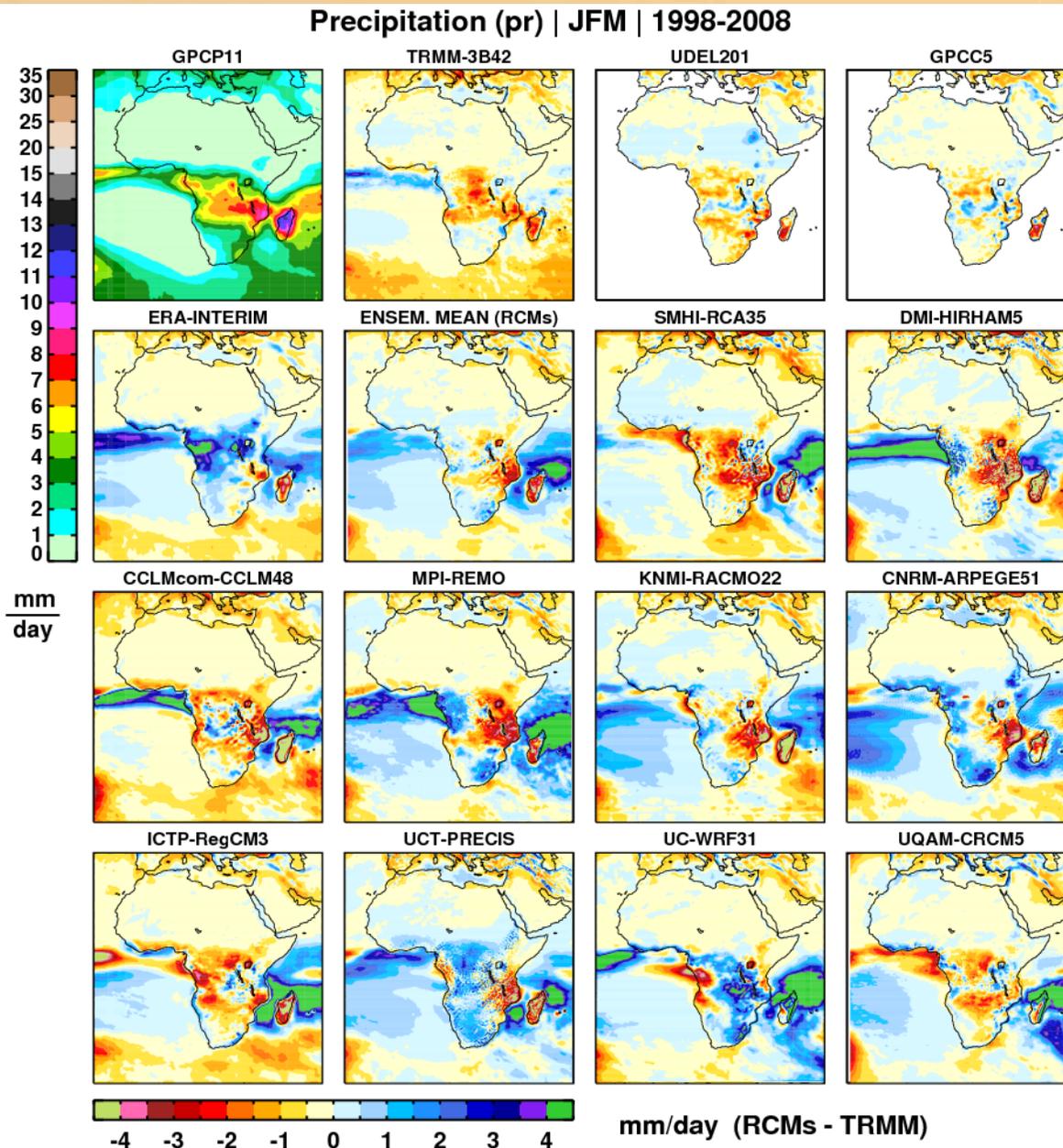


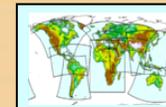
spatial patterns of biases are different

many RCMs show smaller biases than ERA-Interim

common feature is overestimation in eastern part of domain (quality of satellite products ?)

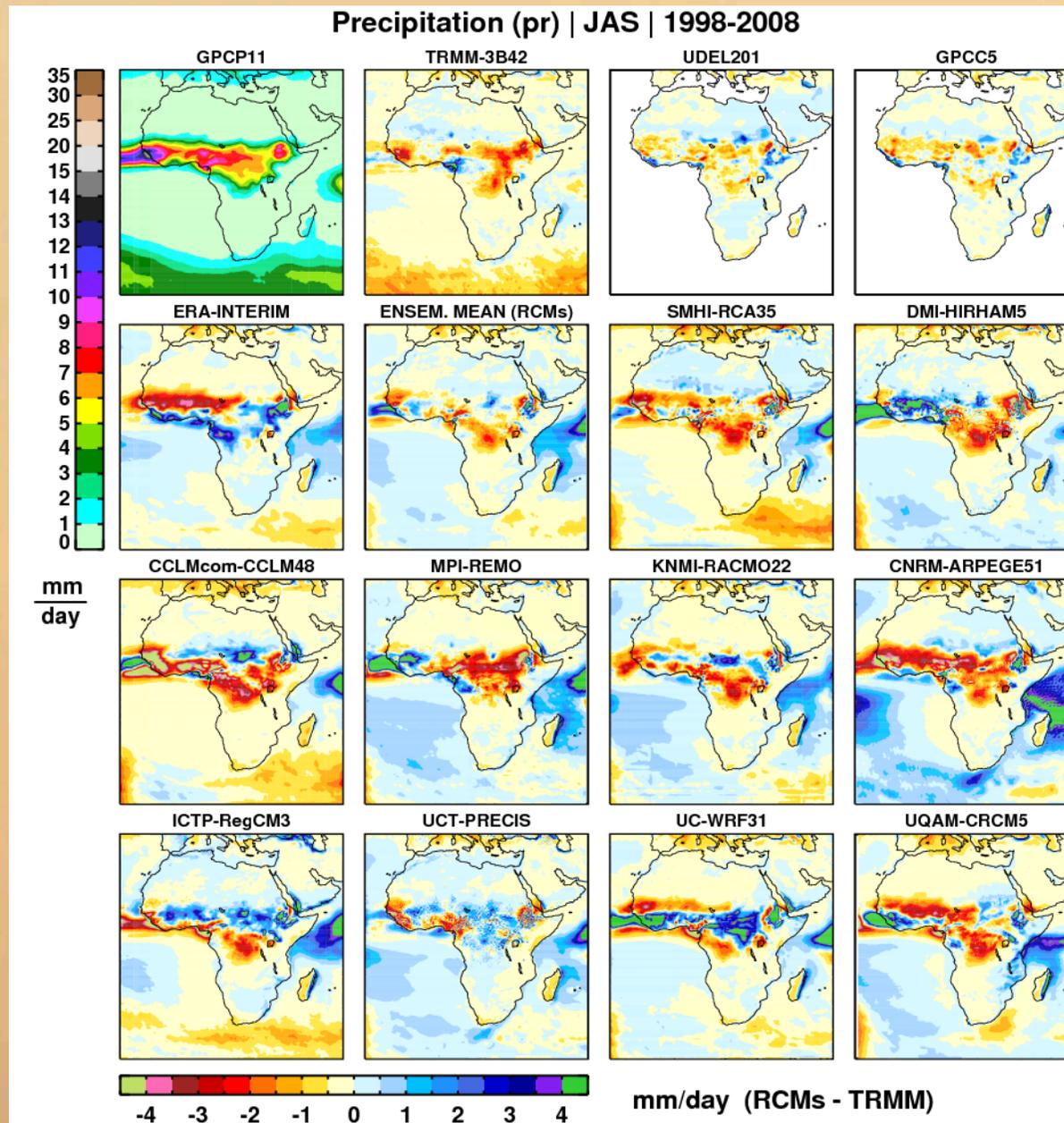
ensemble mean outperforms RCMs (cancelation of biases of opposite sign)

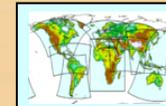




similar conclusions
to JFM

Ensemble mean
outperforms
individual RCMs

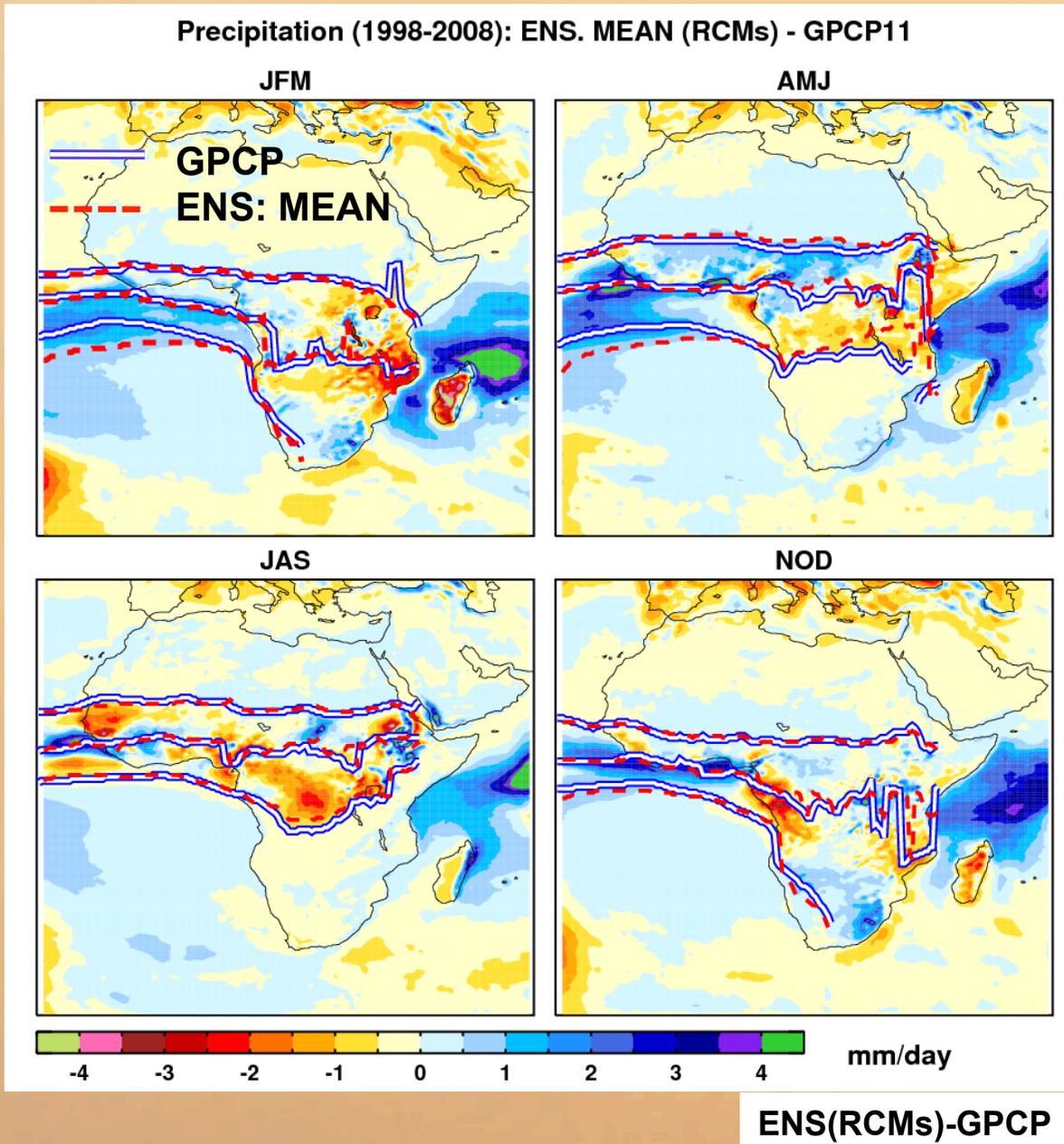


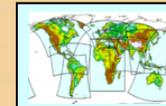


**Simple approximation:
maximum precipitation
in centre and 1 mm/
day on both flanks**

**large spread in
position of the rain
belt among
individual RCMs
(not shown, noisy)**

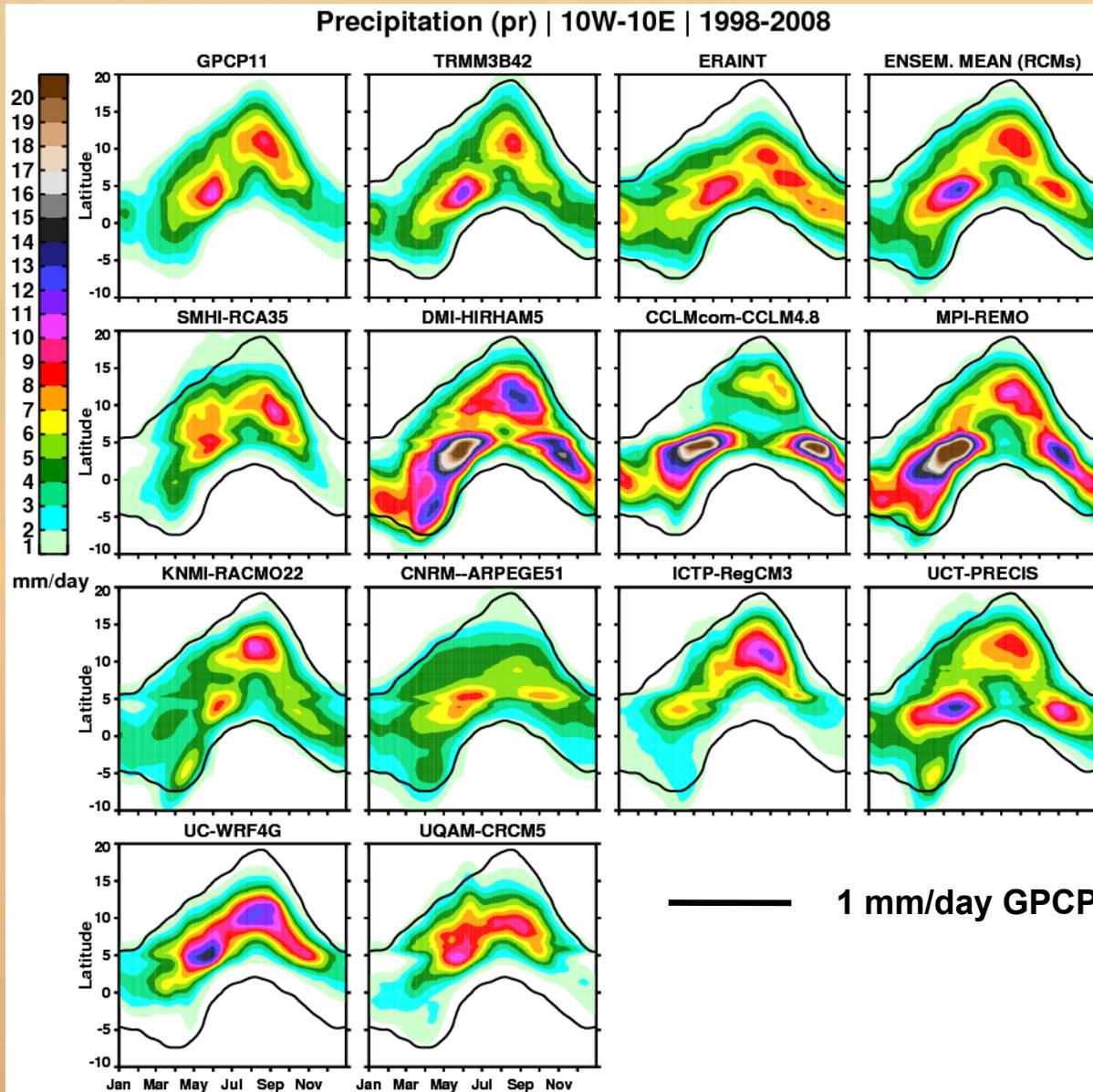
**ensemble mean well
coincides with
GPCP but south
flank in JFM and
AMJ over the
Atlantic ocean**

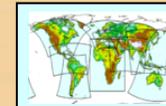




All RCMs produce a version of the WAM onset with different degree of distortion

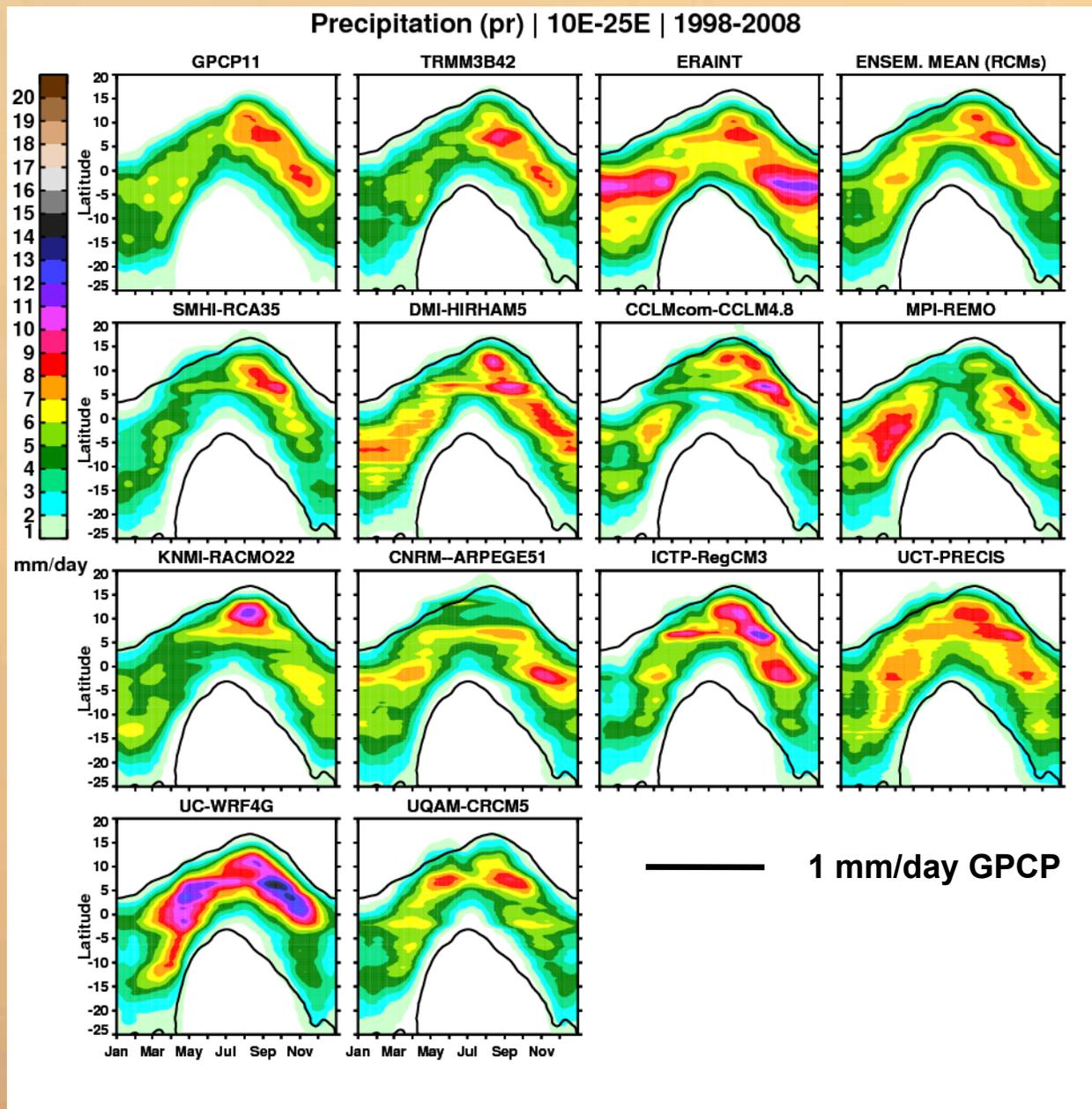
Ensemble mean corrects individual biases

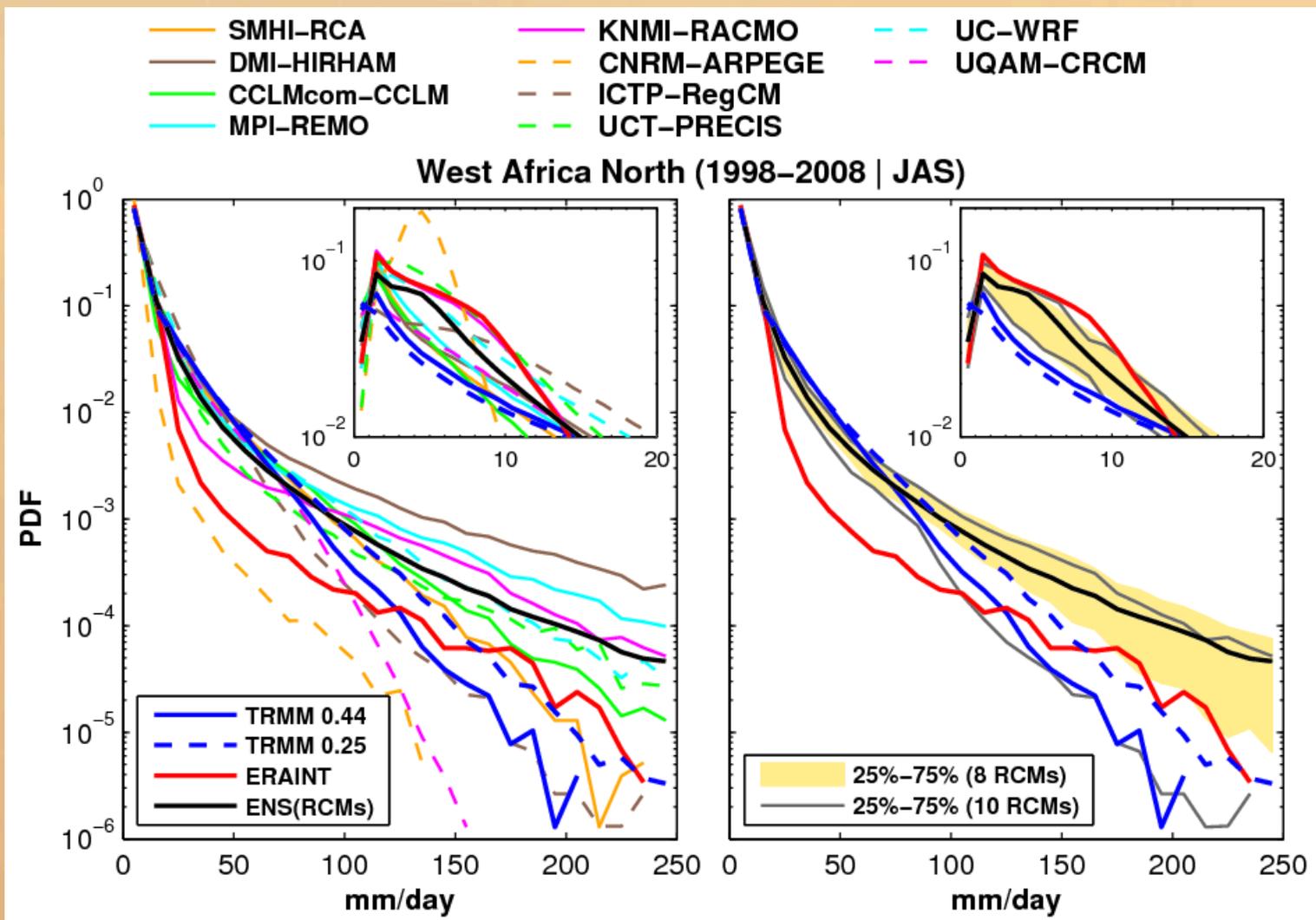
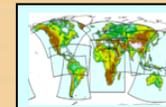




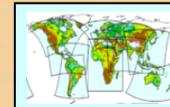
annual cycle with different degree of distortion

ensemble mean outperforms most of RCMs





we can expect that TRMM underestimates precipitation

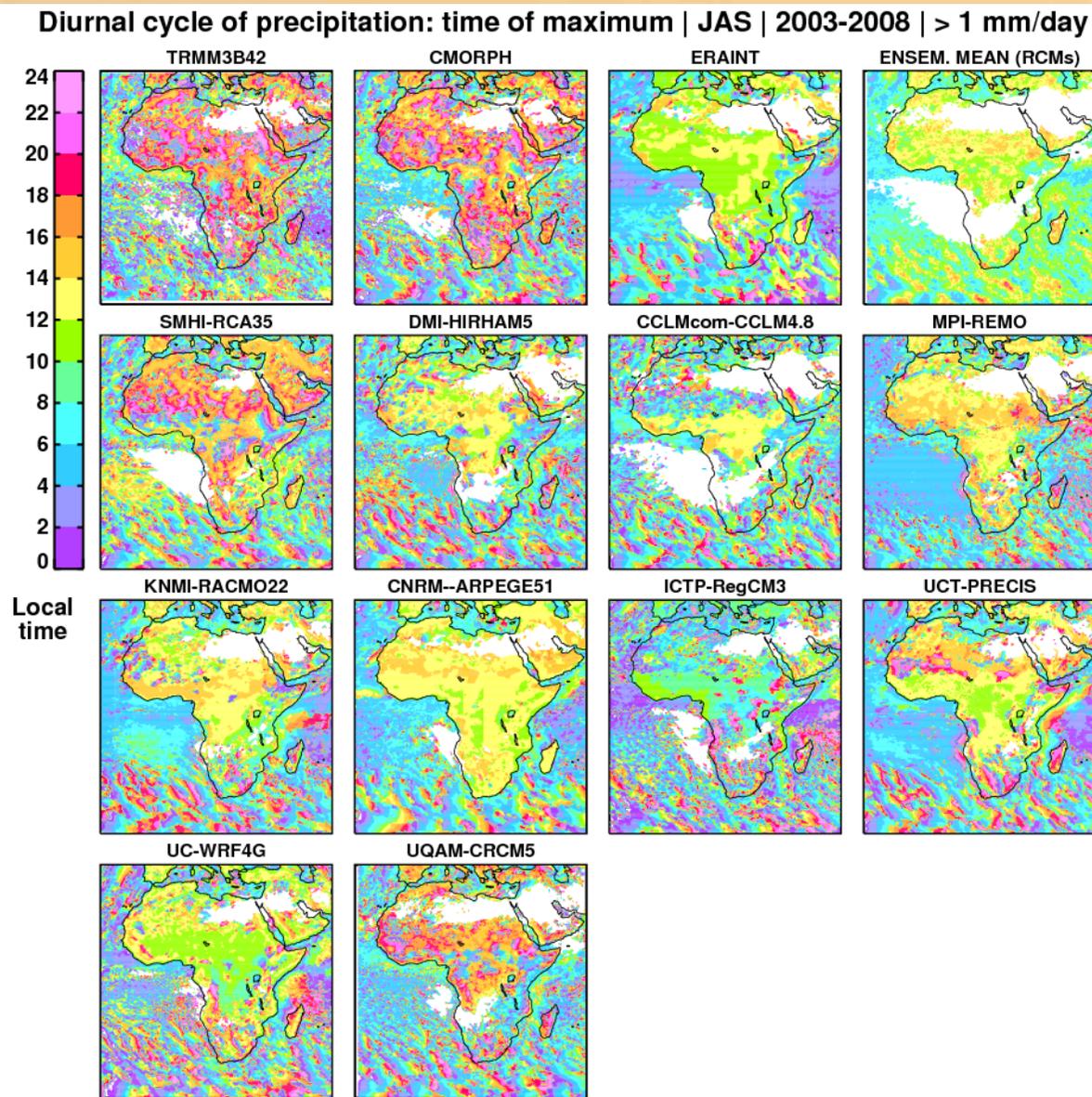


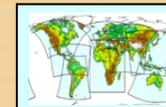
TRMM/CMORPH
afternoon - late evening

ERA-Interim
around noon

most of RCMs has
maximum around noon

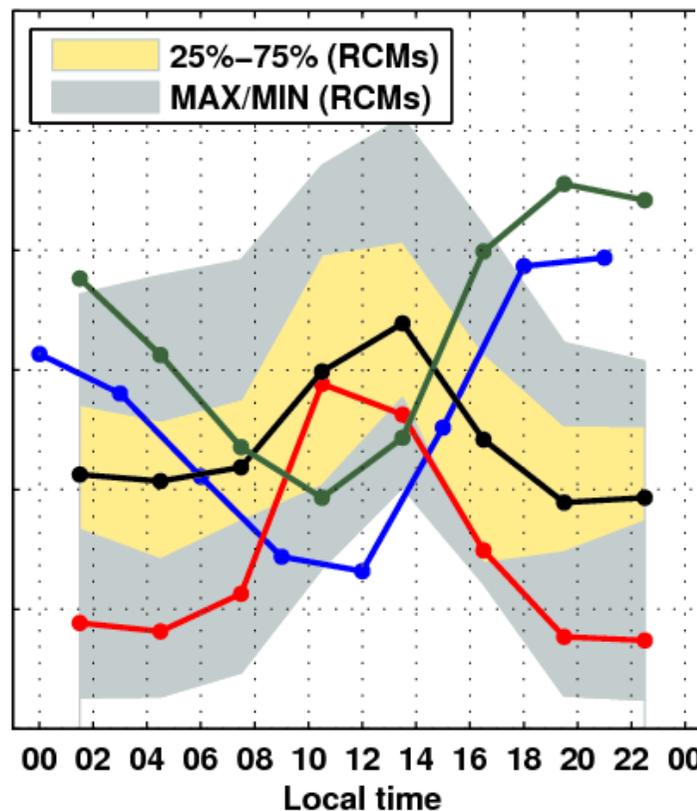
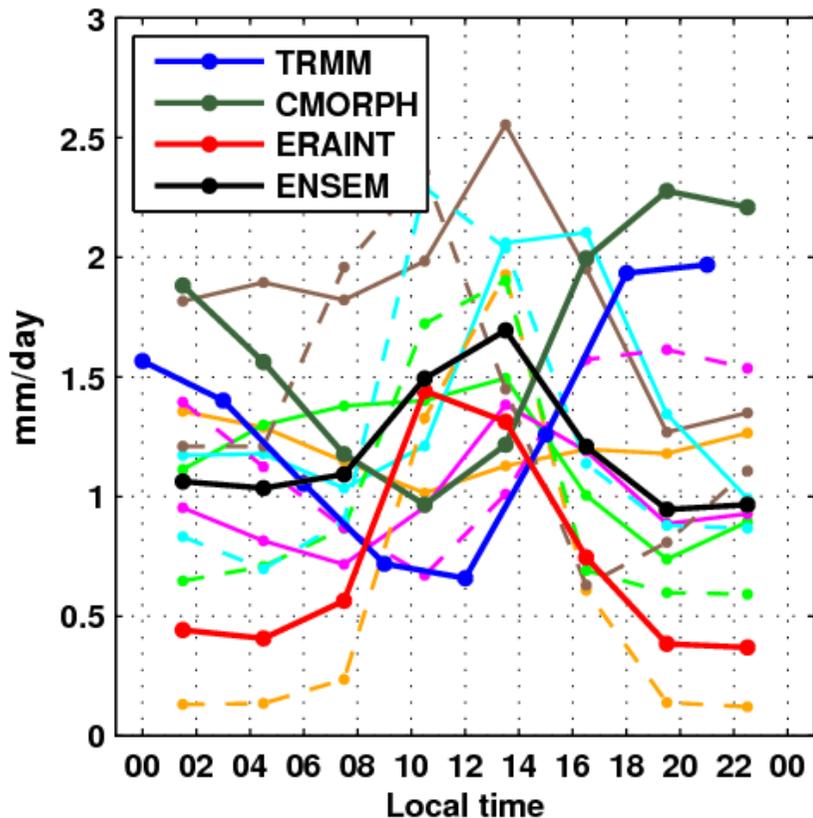
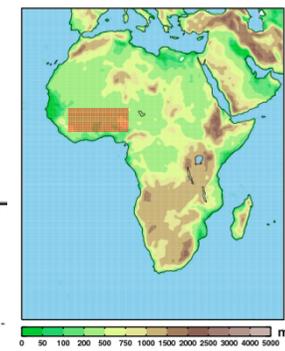
only RCA35 and
CRCM5 show similar
behaviour (both
have Kain-Fritsch
scheme)
UC-WRF as well



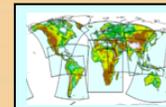


- SMHI-RCA
- KNMI-RACMO
- - - UC-WRF
- DMI-HIRHAM
- - - CNRM-ARPEGE
- - - UQAM-CRCM
- CCLMcom-CCLM
- - - ICTP-RegCM
- - - UCT-PRECIS
- MPI-REMO

West Africa North | JAS | 2003–2008

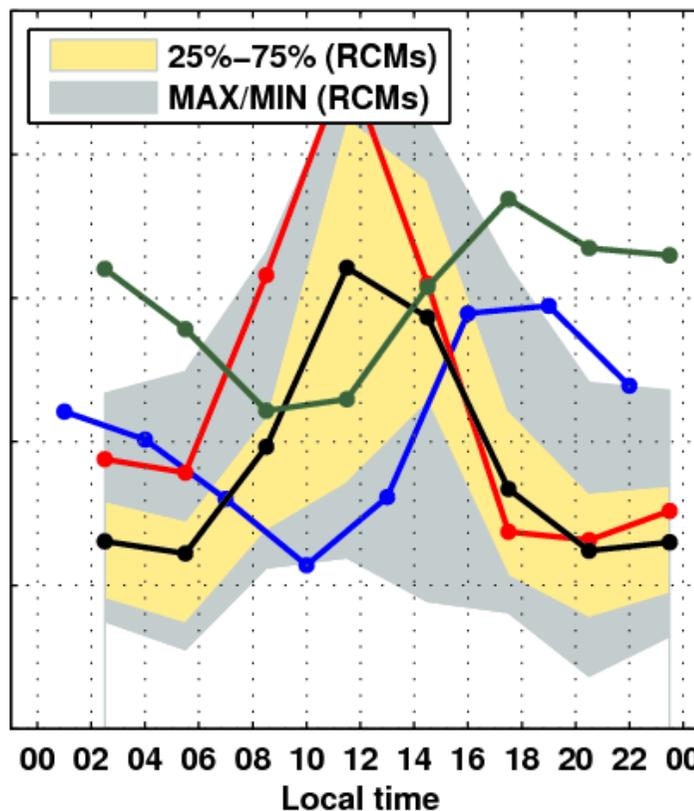
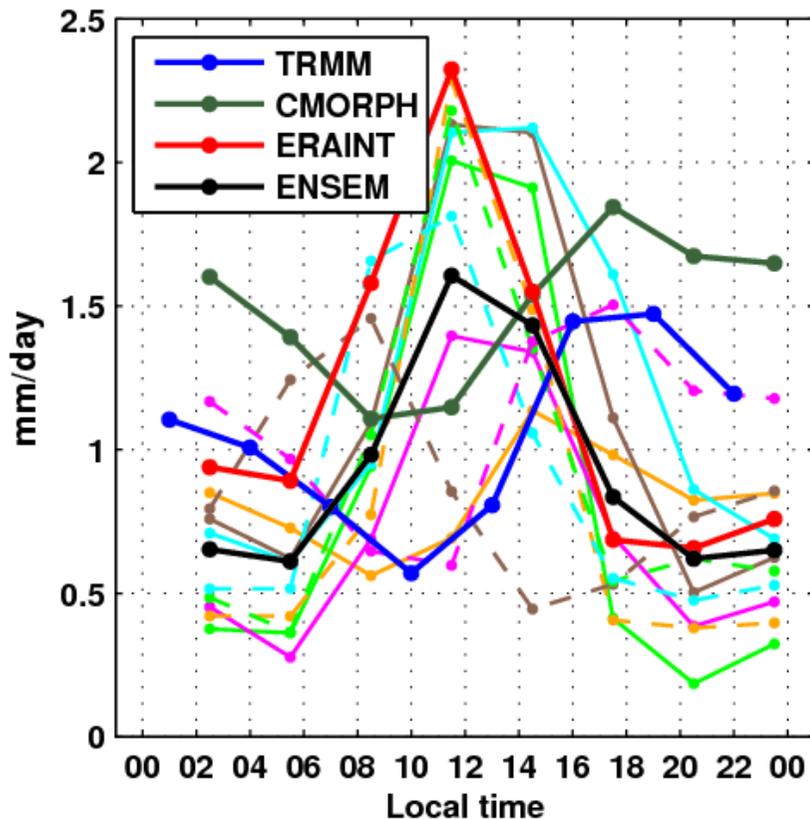
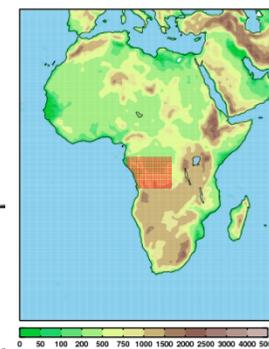


**RCA35 has too flat diurnal cycle
 only CRCM5 can reproduce diurnal cycle here
 ensemble mean cannot correct the phase of diurnal cycle**

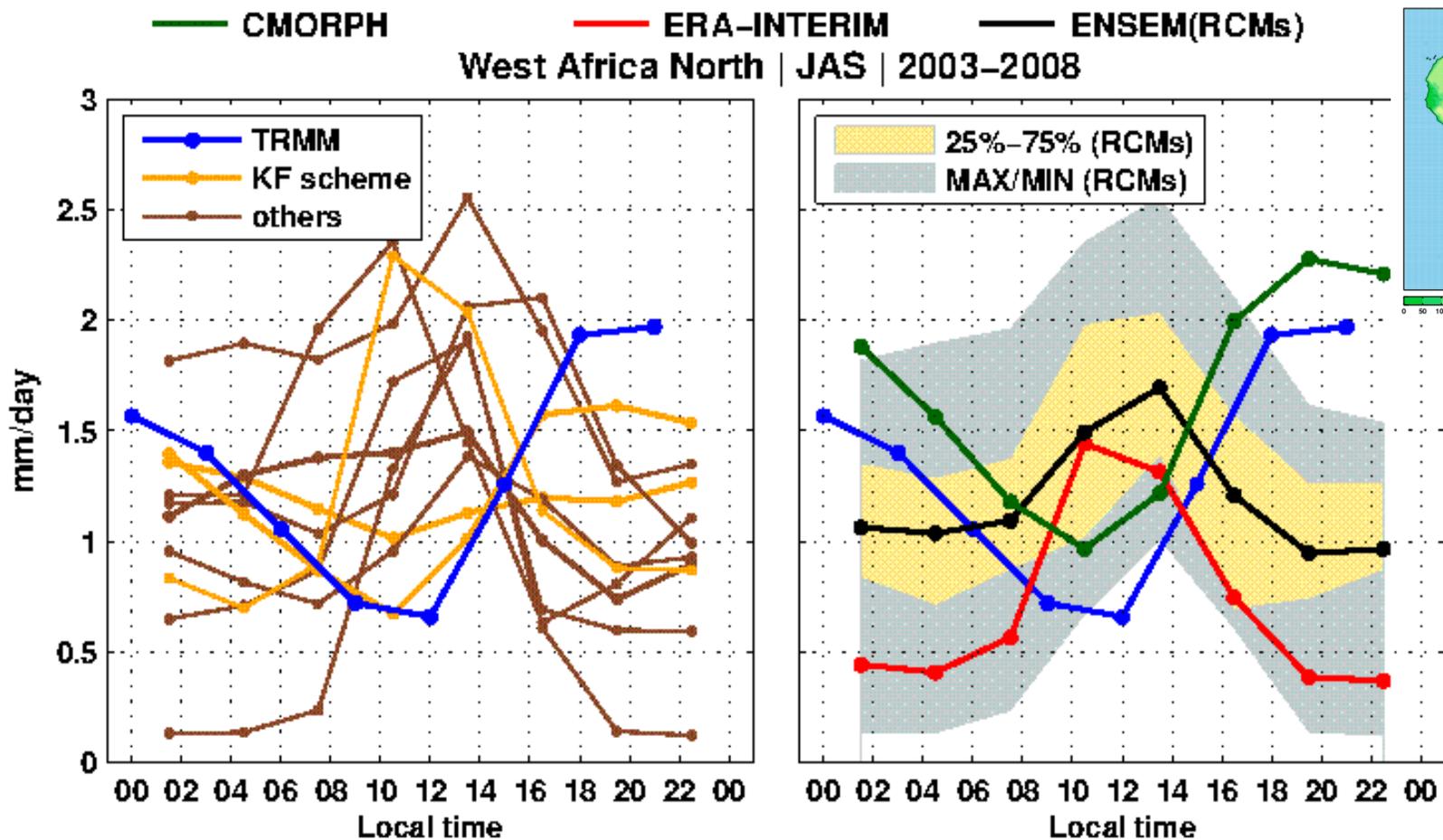
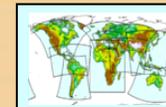


- SMHI-RCA
- KNMI-RACMO
- - UC-WRF
- DMI-HIRHAM
- - CNRM-ARPEGE
- - UQAM-CRCM
- CCLMcom-CCLM
- - ICTP-RegCM
- - UCT-PRECIS
- MPI-REMO

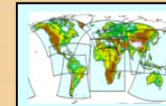
Central Africa South | JFM | 2003–2008



**CRCM5 and RCA35 (partly) can reproduce diurnal cycle
 large absolute difference between TRMM and CMORPH
 ensemble mean cannot correct the phase of diurnal cycle**



RCMs with the KF scheme may be more realistic in simulation of diurnal cycle of precipitation but it depends ...



- ✓ gridded precipitation product quality ?
should we use an ensemble of observations for RCM evaluation ?
- ✓ single RCM can reproduce some aspects but not all details of precipitation in Africa
- ✓ Seasonal mean and annual cycle
 - many RCMs improve the ERA-Interim which is used as boundary conditions and has large biases
 - ensemble average usually outperforms individual RCMs
- ✓ West African Monsoon
 - each RCM reproduces a version of WAM with different distortions
- ✓ Diurnal cycle of precipitation
 - almost all RCMs cannot correctly simulate diurnal cycle
 - simulation of diurnal cycle depends on convective scheme
 - ensemble averaging cannot correct the phase
 - Kain-Fritsch scheme may be better
 - influence of “wrong” diurnal cycle on other variables ???