

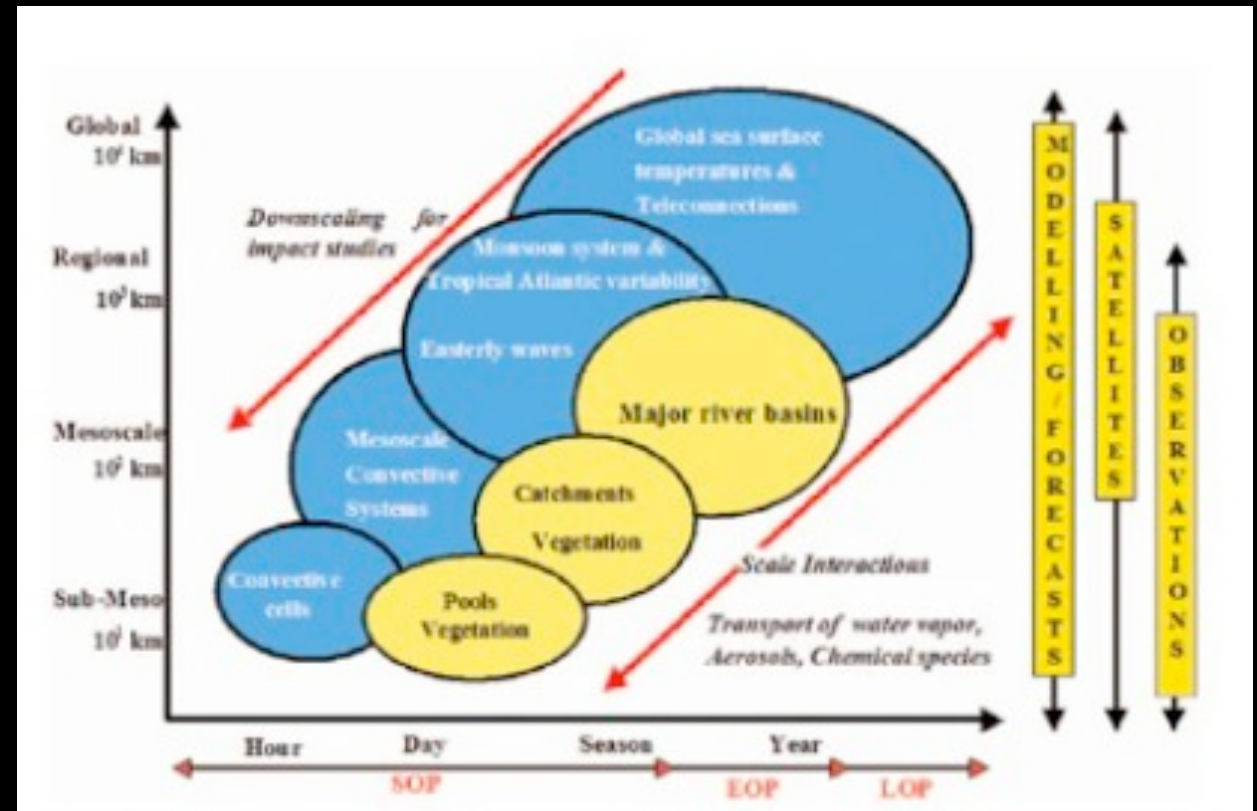
A satellite-style map of the African continent, showing the Sahara Desert in the north and the Congo Basin in the south. The map is centered on the continent, with the Atlantic Ocean to the west and the Indian Ocean to the east. The text is overlaid on the map.

Examining the West African Monsoon in SP-CCSM3.0

Rachel McCrary

Why Study the Monsoon?

- Multiscale interactions associated with the monsoon:
 - atmosphere, ocean, landsurface feedbacks
 - large-scale circulation to individual rain events
 - Complex dynamics - AEJ, AEWs, MCSs etc.



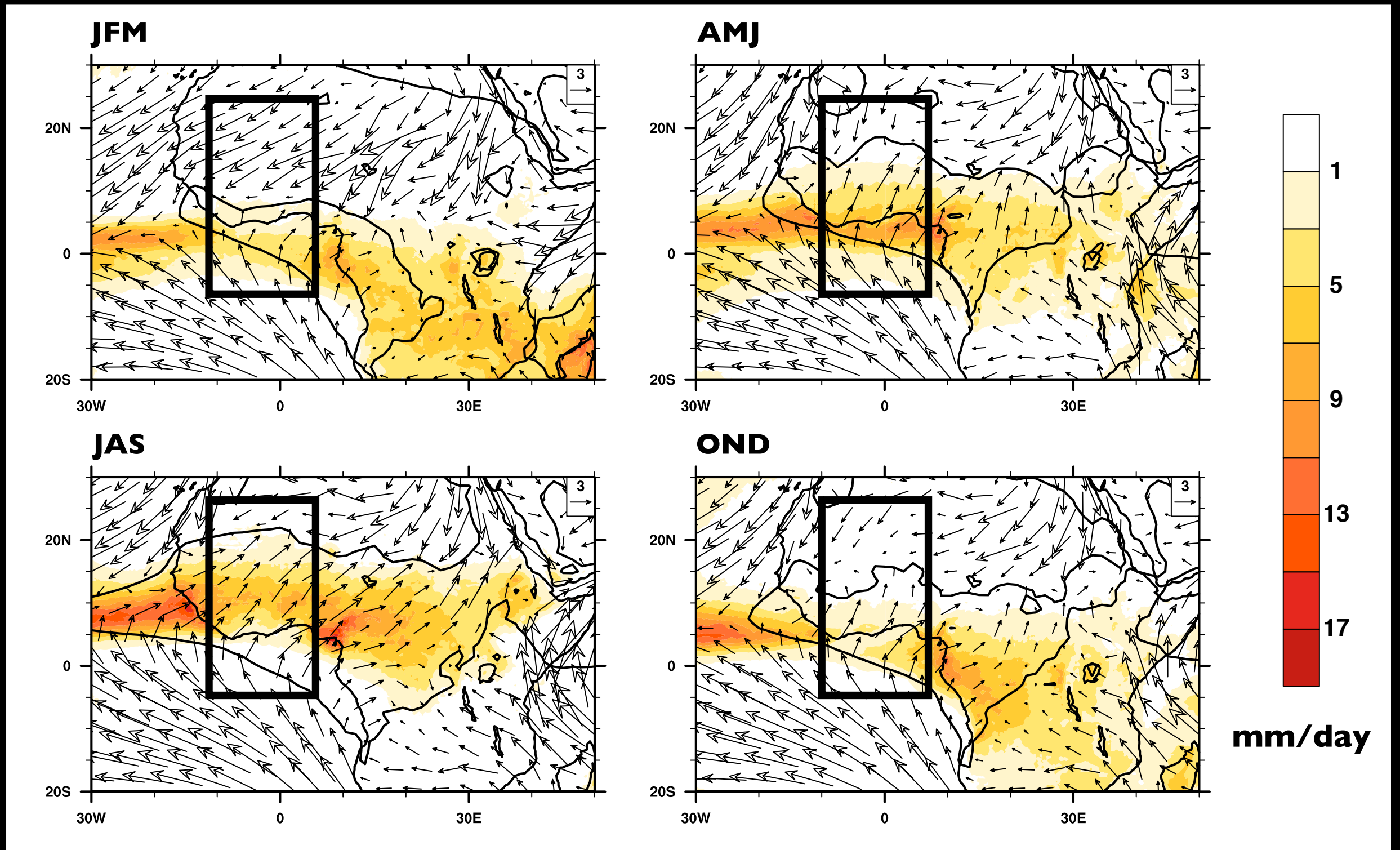
✓ Great test bed for the MMF

Models & Data sets

- **SP-CCSM3.0** - Christina Stan at COLA.
- **CCSM3.0** - “control”
 - ~24 years of daily output
 - 5 months of 3 hourly output
- **SP-CAM3.0** - AMIP run
 - Monthly mean output for 1989-2006

- **TRMM - 3B42 (precipitation)**
 - 1997-2010, 3 hrly precipitation 0.25x0.25 resolution
- **ERA-I - (dynamical fields)**
 - 1989-2010, 6 hourly output

Observed Monsoon Rains

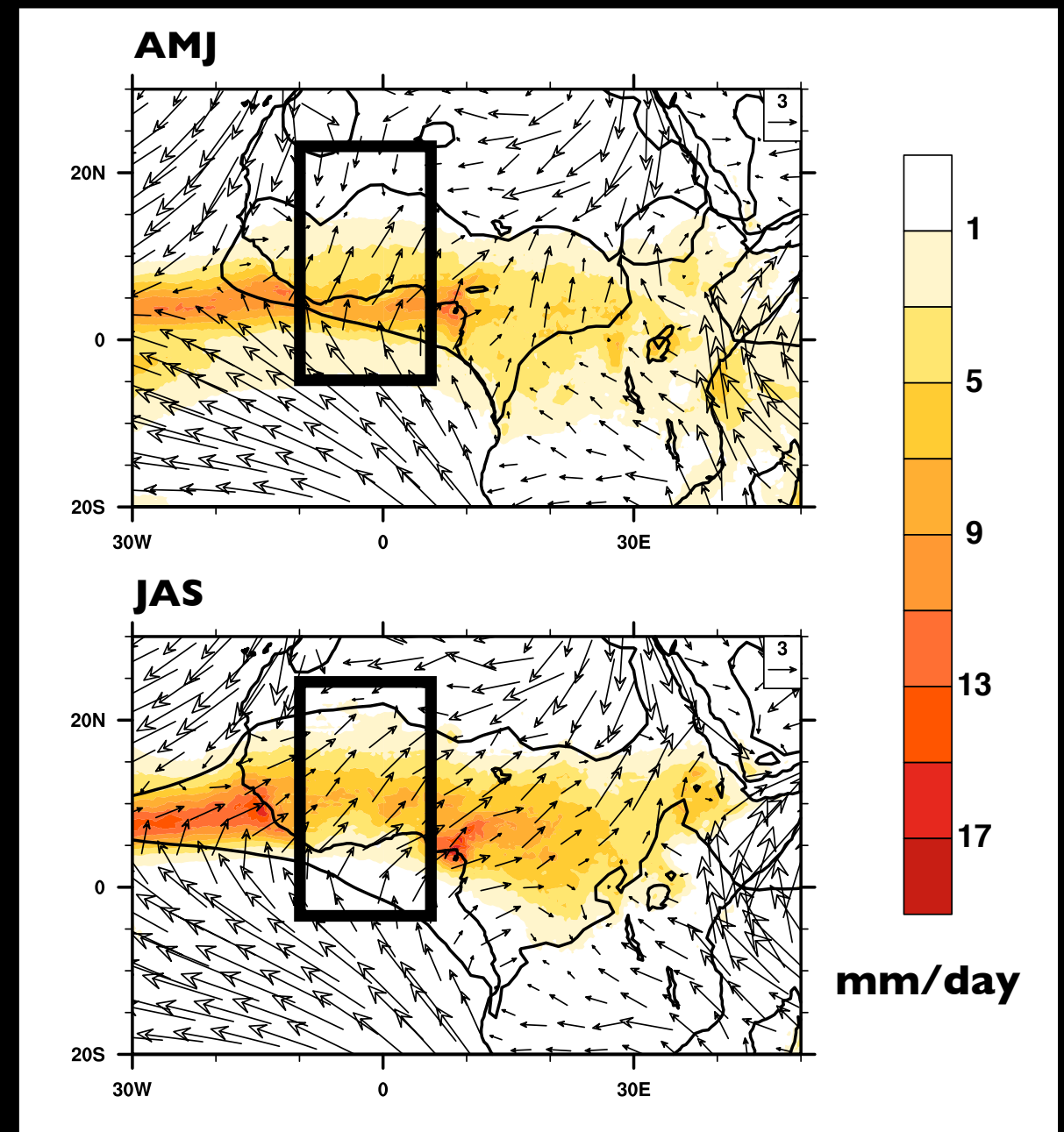
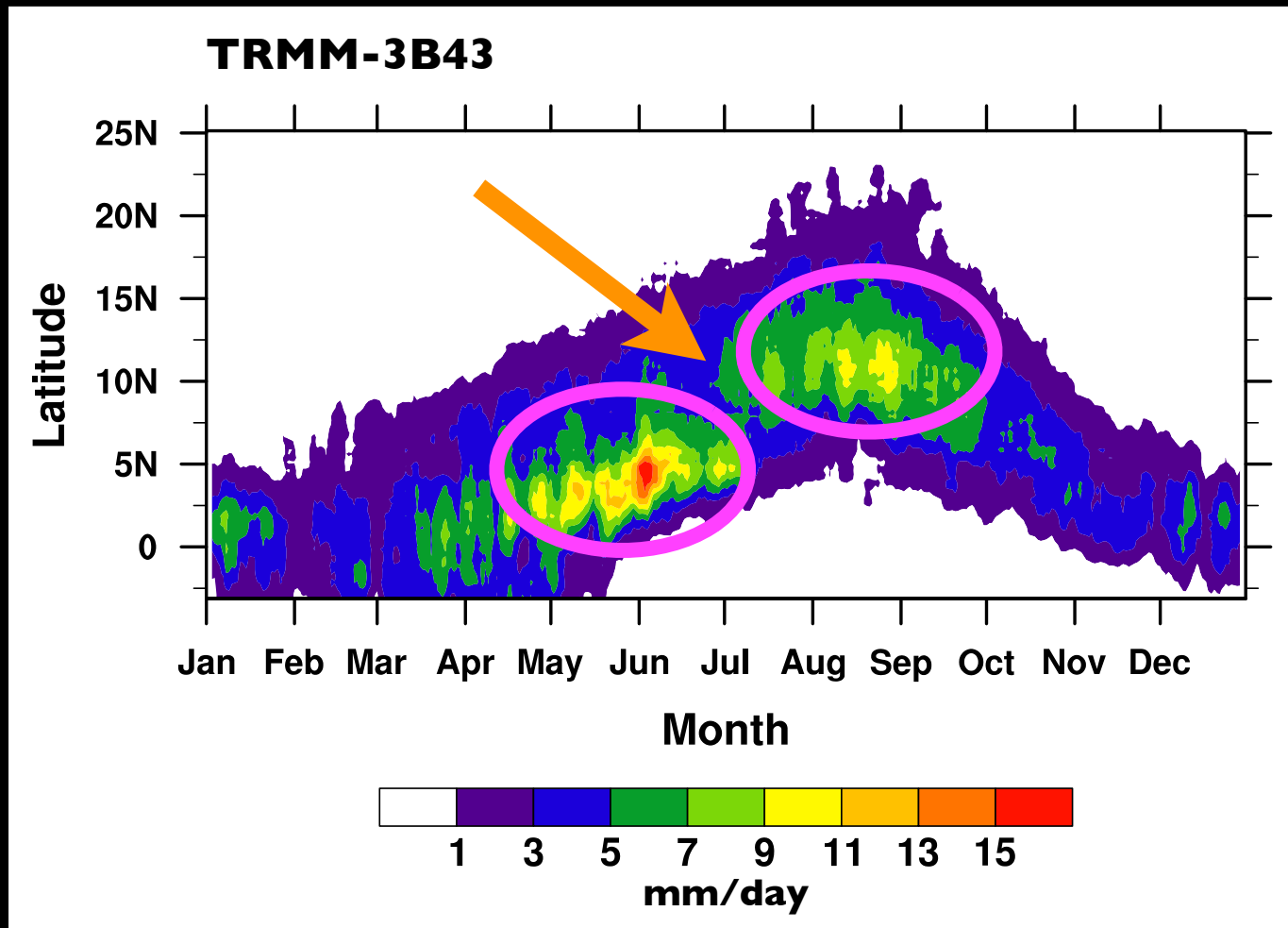


TRMM -3B43 precipitation (1997-2010)
ERA-I 925 hPa winds (1997-2010)

Observed Monsoon Rains

TRMM -3B43 precipitation (1997-2010)
Averaged between 10°W - 5°E

TRMM -3B43 precipitation (1997-2010)
ERA-I 925 hPa winds (1997-2010)



Two precipitation maxima
Monsoon Jump

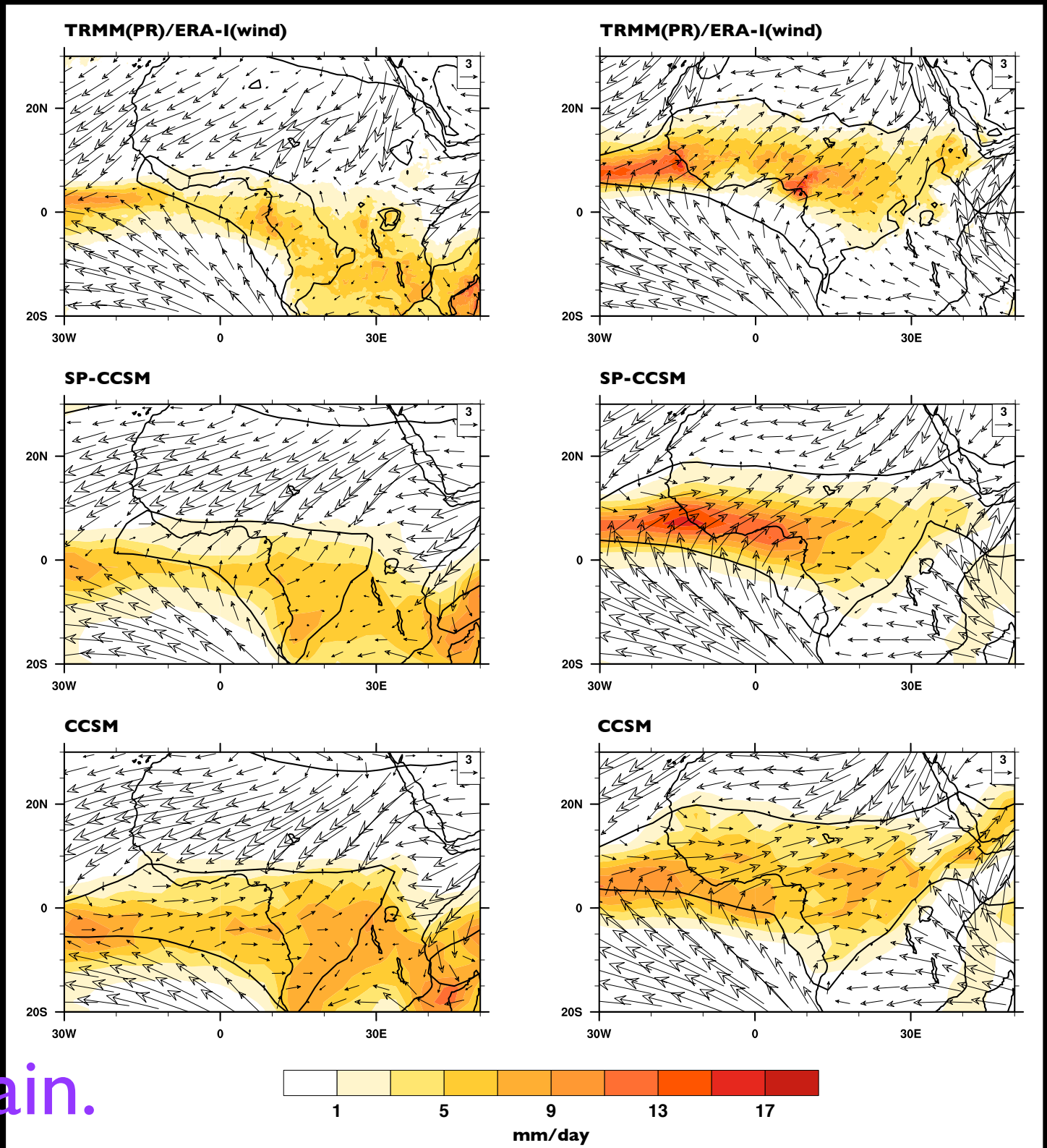
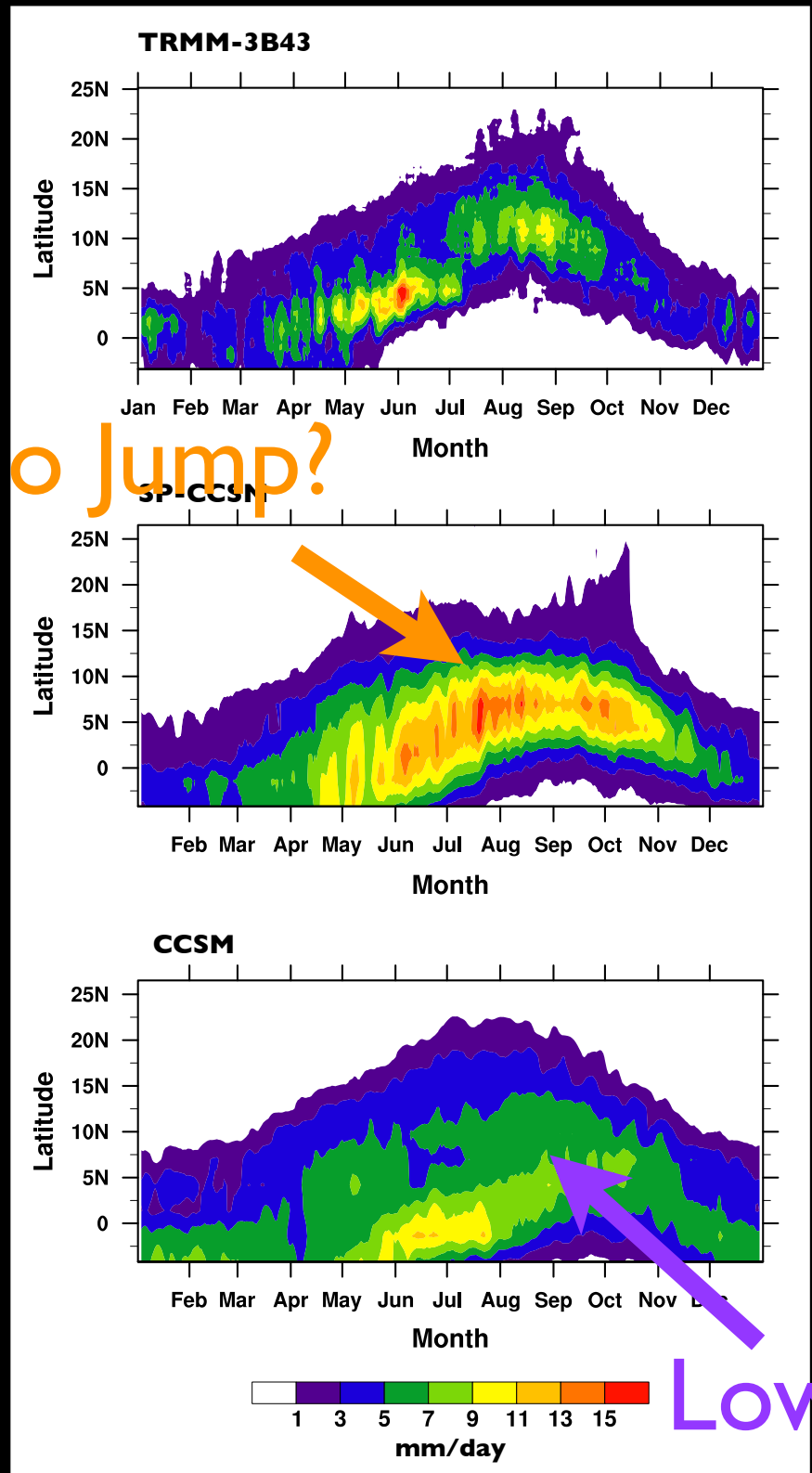
Seasonal Cycle of Rain

Precip. Avg. between 10°W-5°E

JFM

JAS

No Jump?

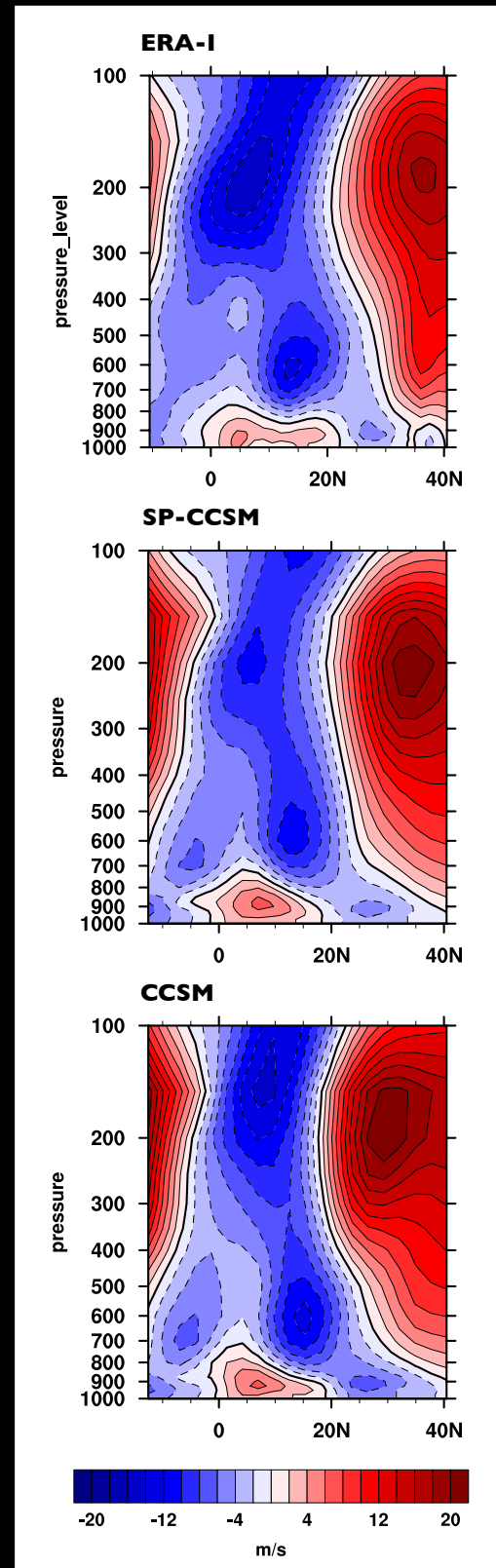
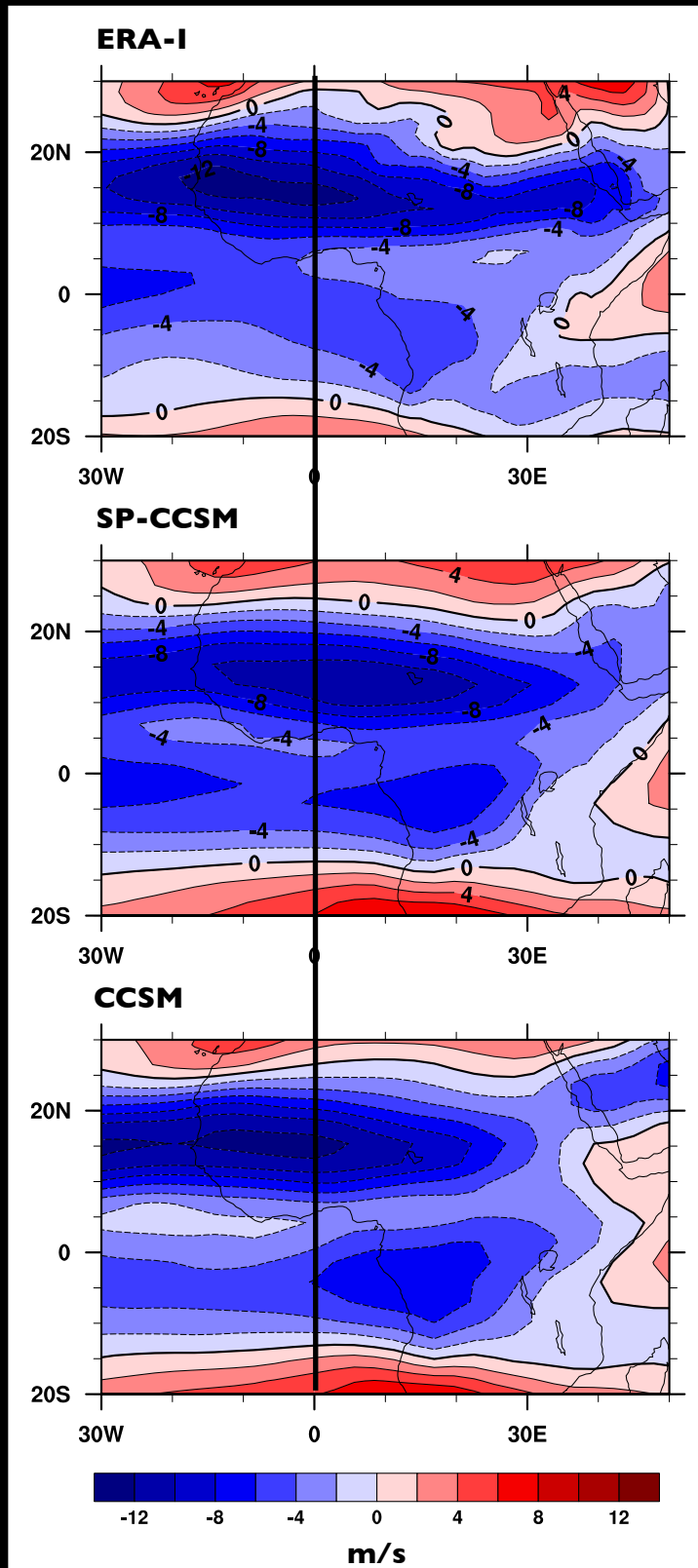


Low rain.

African Easterly Jet (JAS)

600 hPa - Zonal Wind

0° longitude - Zonal Wind

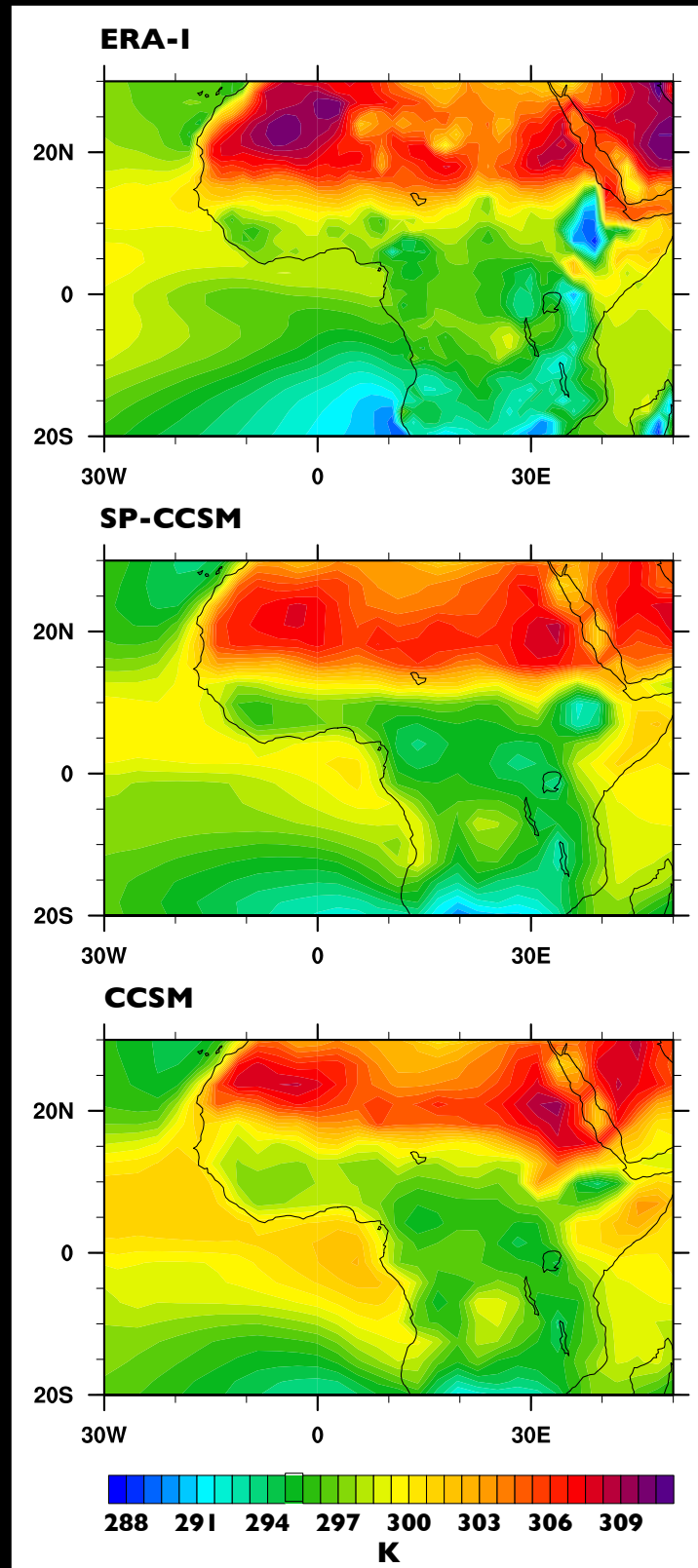
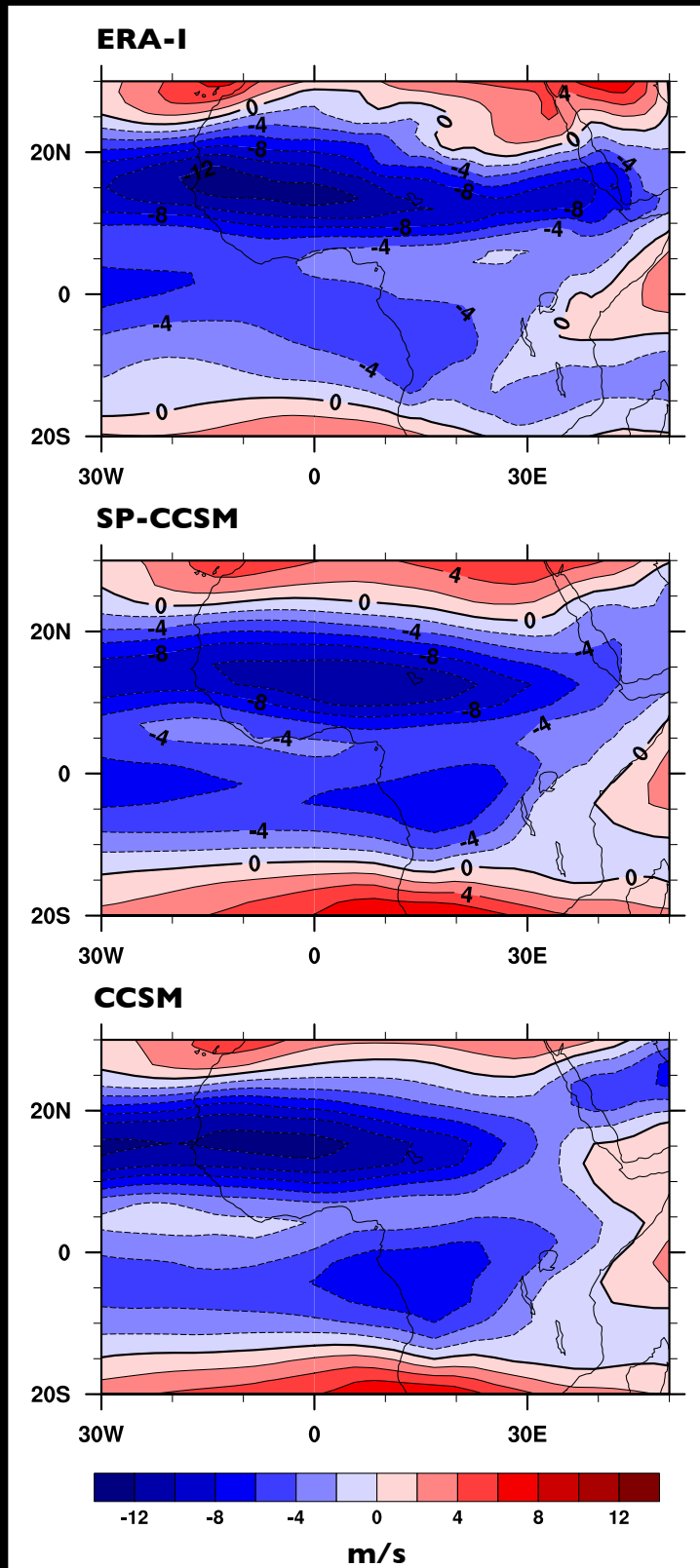


- AEJ regulates rainfall amounts.
- Carries moisture away from continent
- Contributes to unstable environment - MCSs and squall lines.

African Easterly Jet (JAS)

600 hPa - Zonal Wind

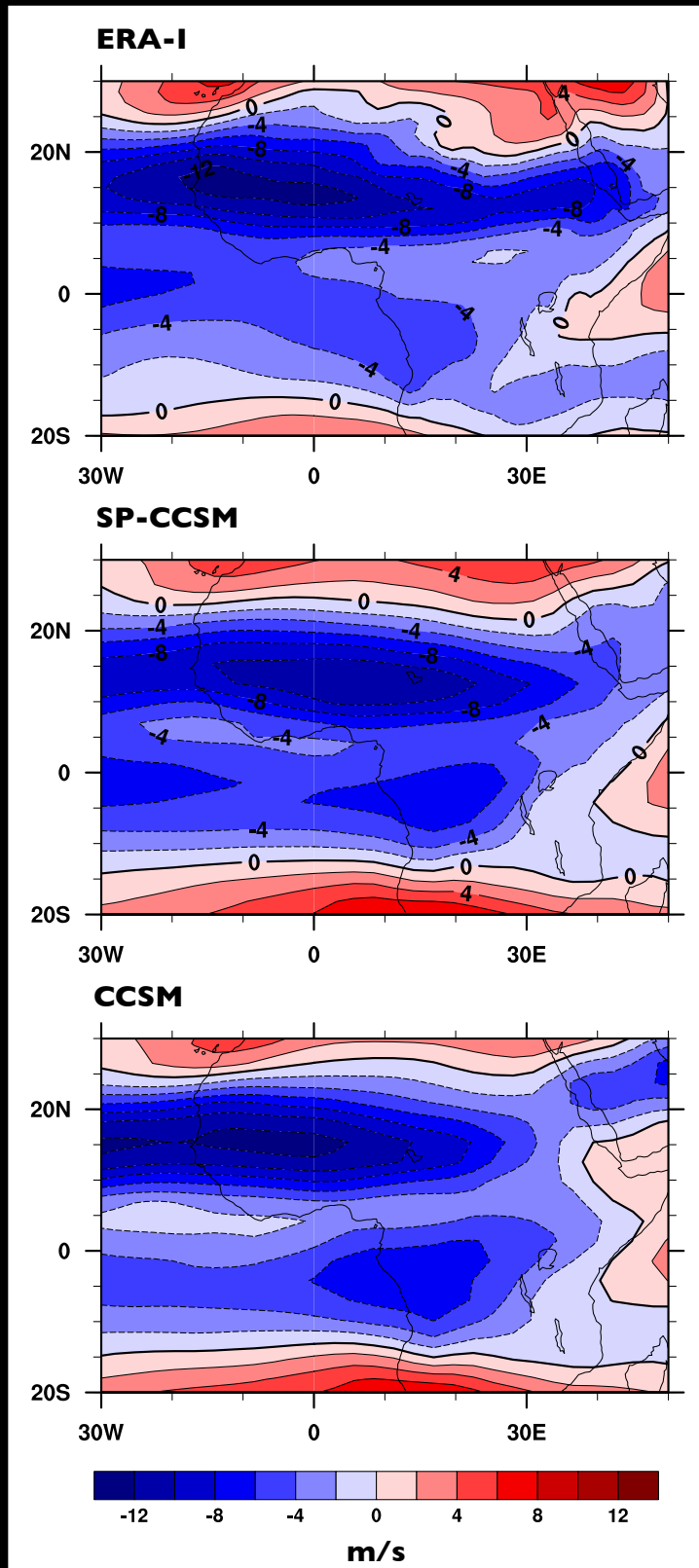
Surface Temperature



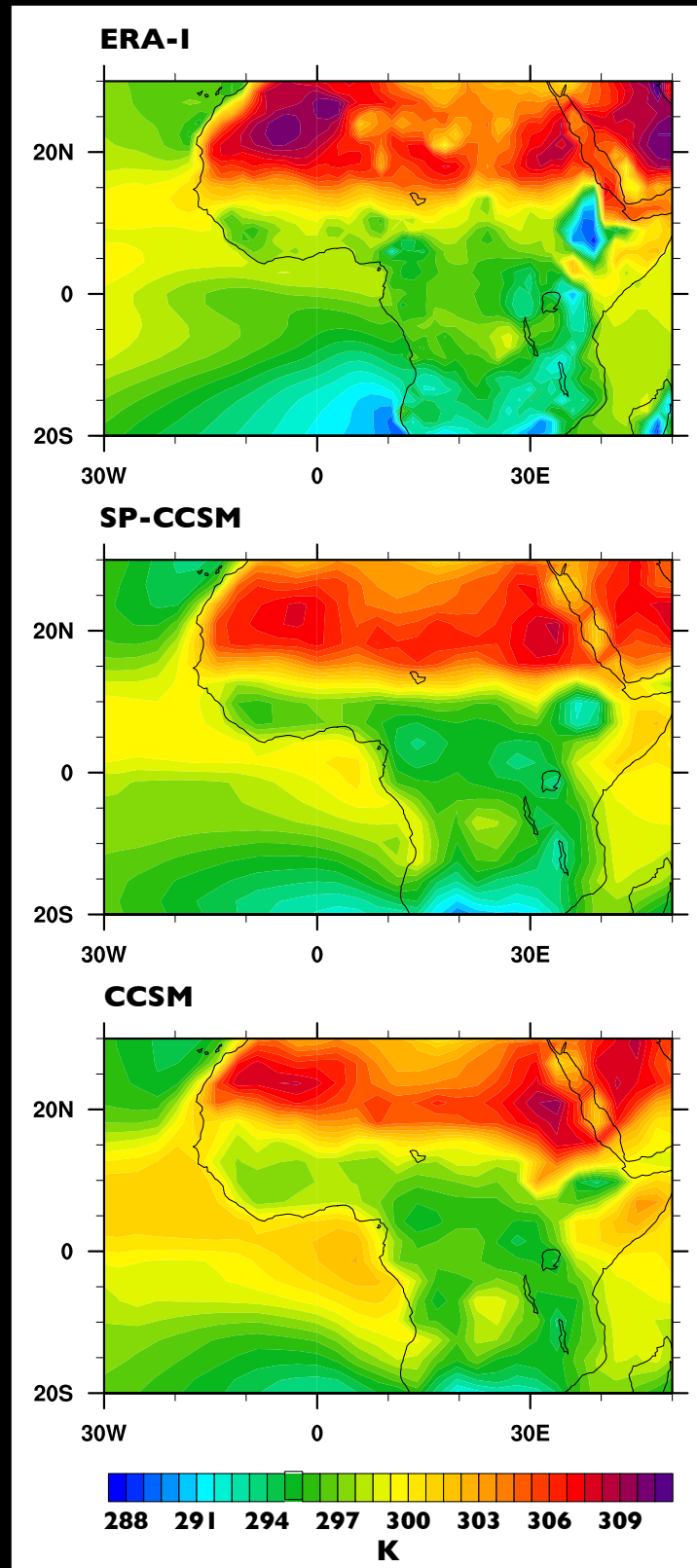
- Thermal wind - jet develops due to temperature gradients.
- Land - sea contrast?
- Atlantic cold tongue.

African Easterly Jet (JAS)

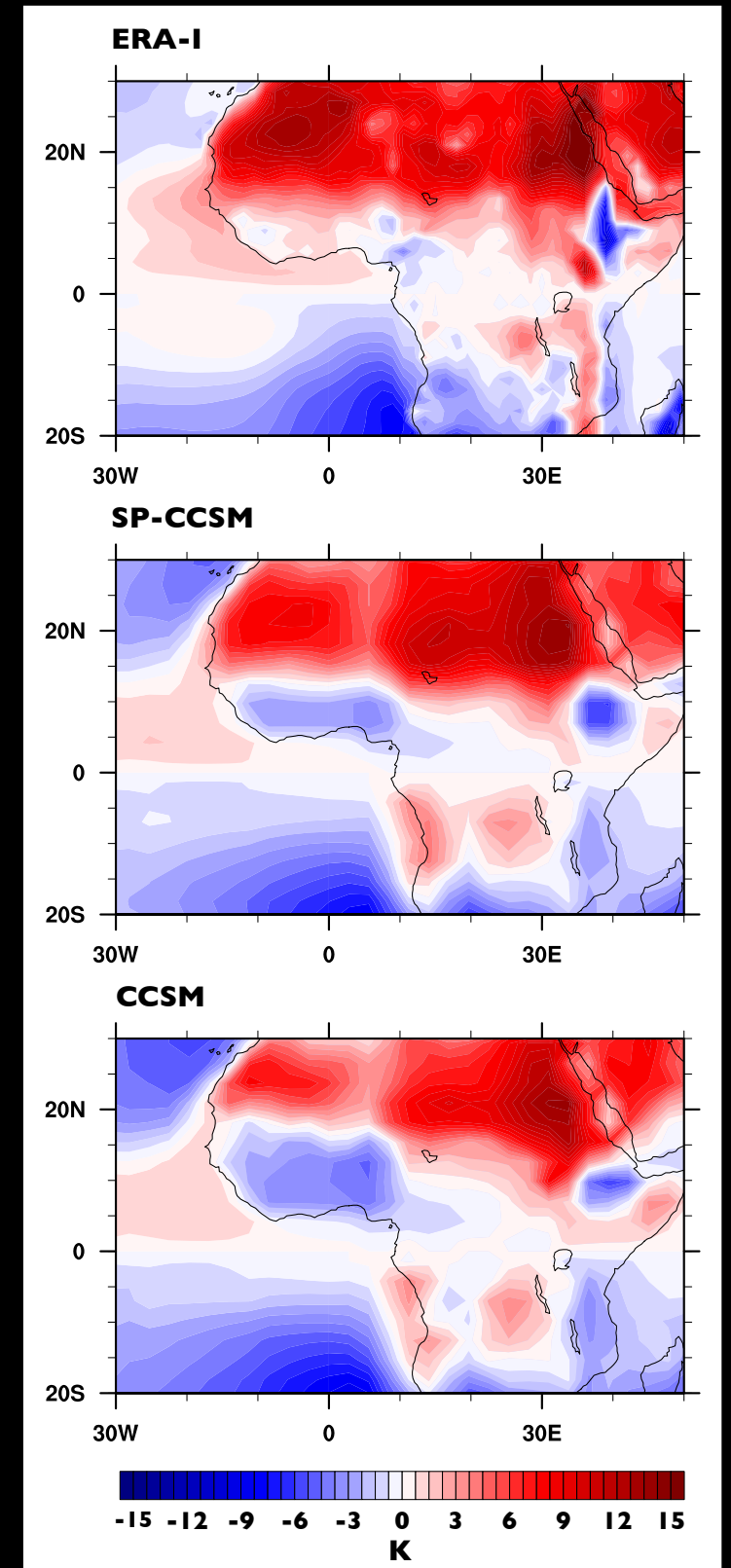
600 hPa - Zonal Wind



Surface Temperature



Surf. Temp. Anomalies



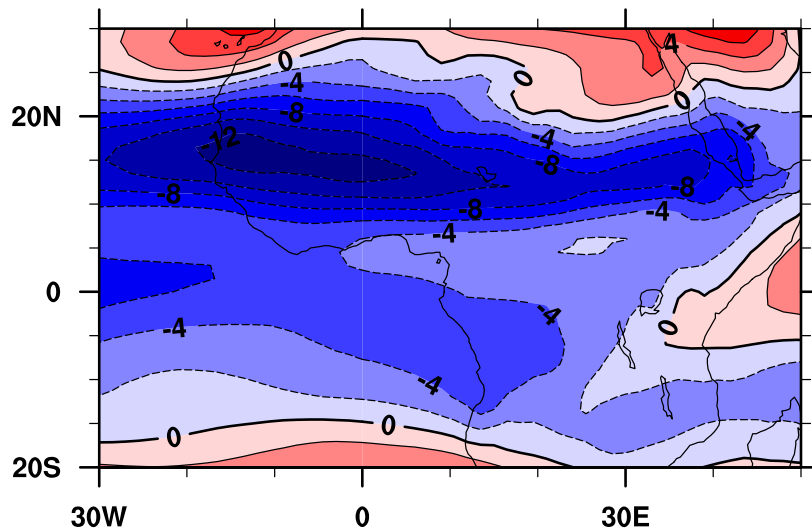
African Easterly Jet - Uncoupled (AMIP) simulations

600 hPa - Zonal Wind

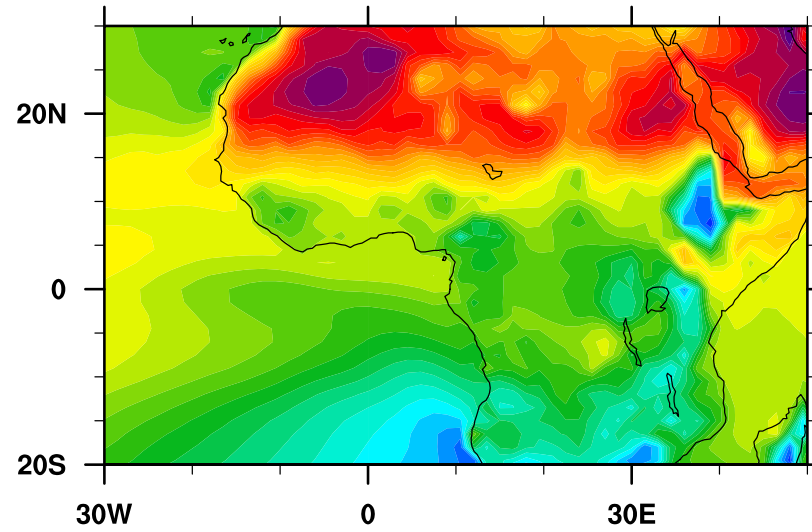
Surface Temperature

Surf. Temp. Anomalies

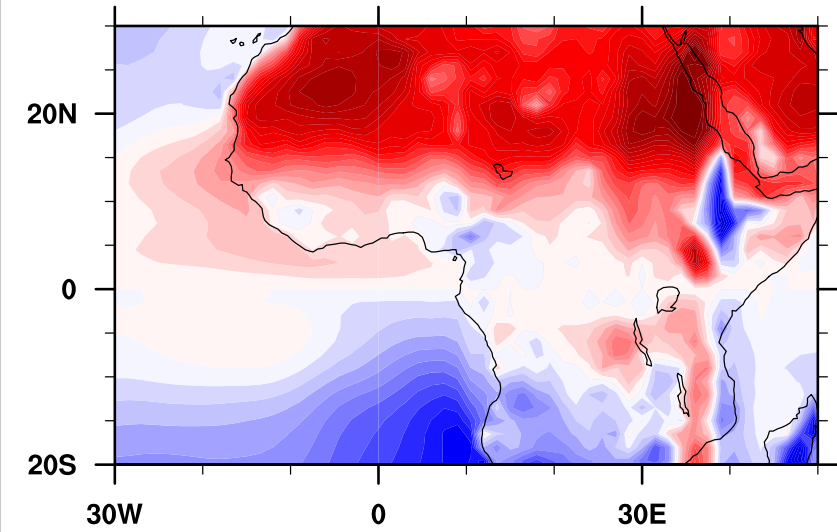
ERA-I



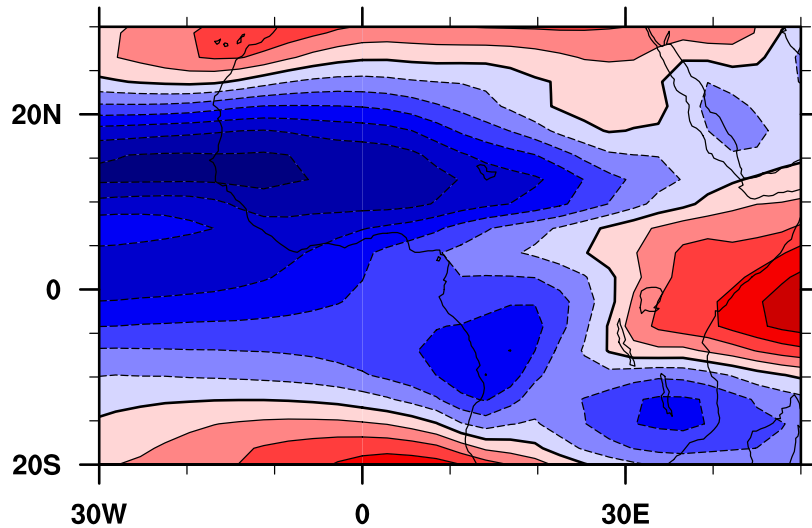
ERA-I



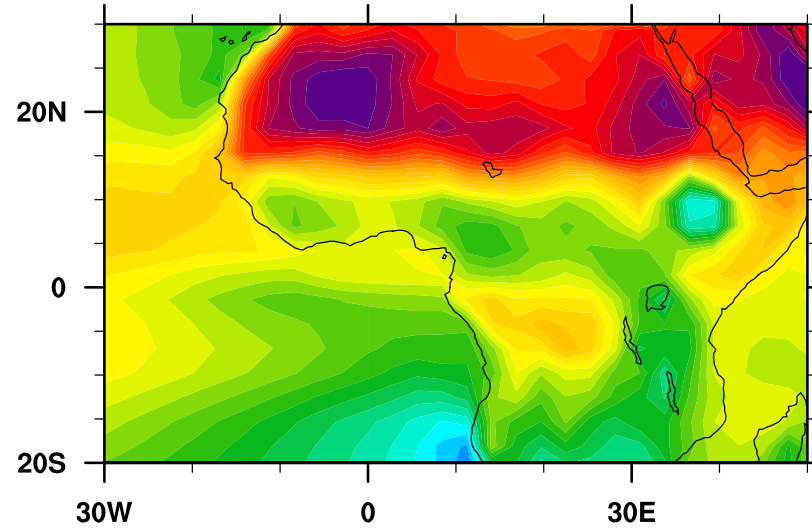
ERA-I



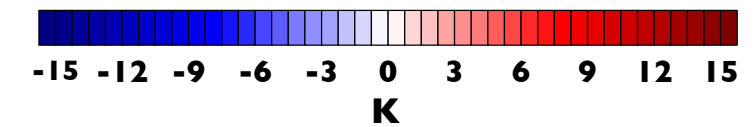
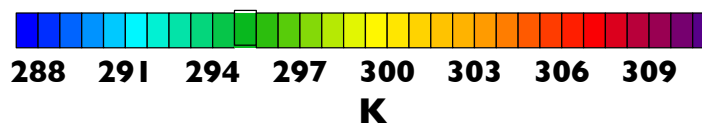
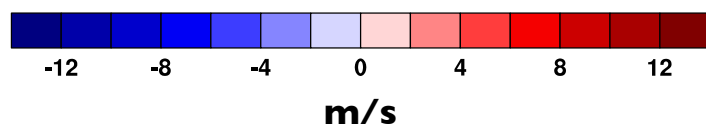
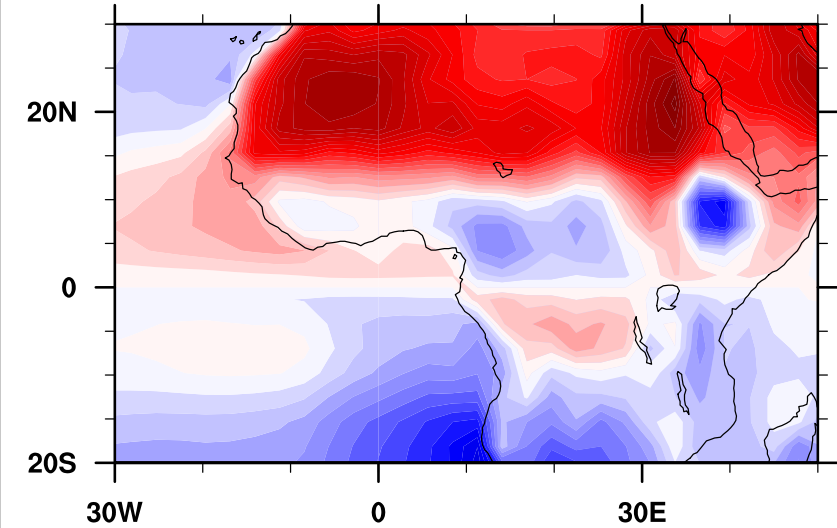
SP-CAM3.0



SP-CAM3.0



SP-CAM3.0



Composite JAS fields

African Easterly Waves

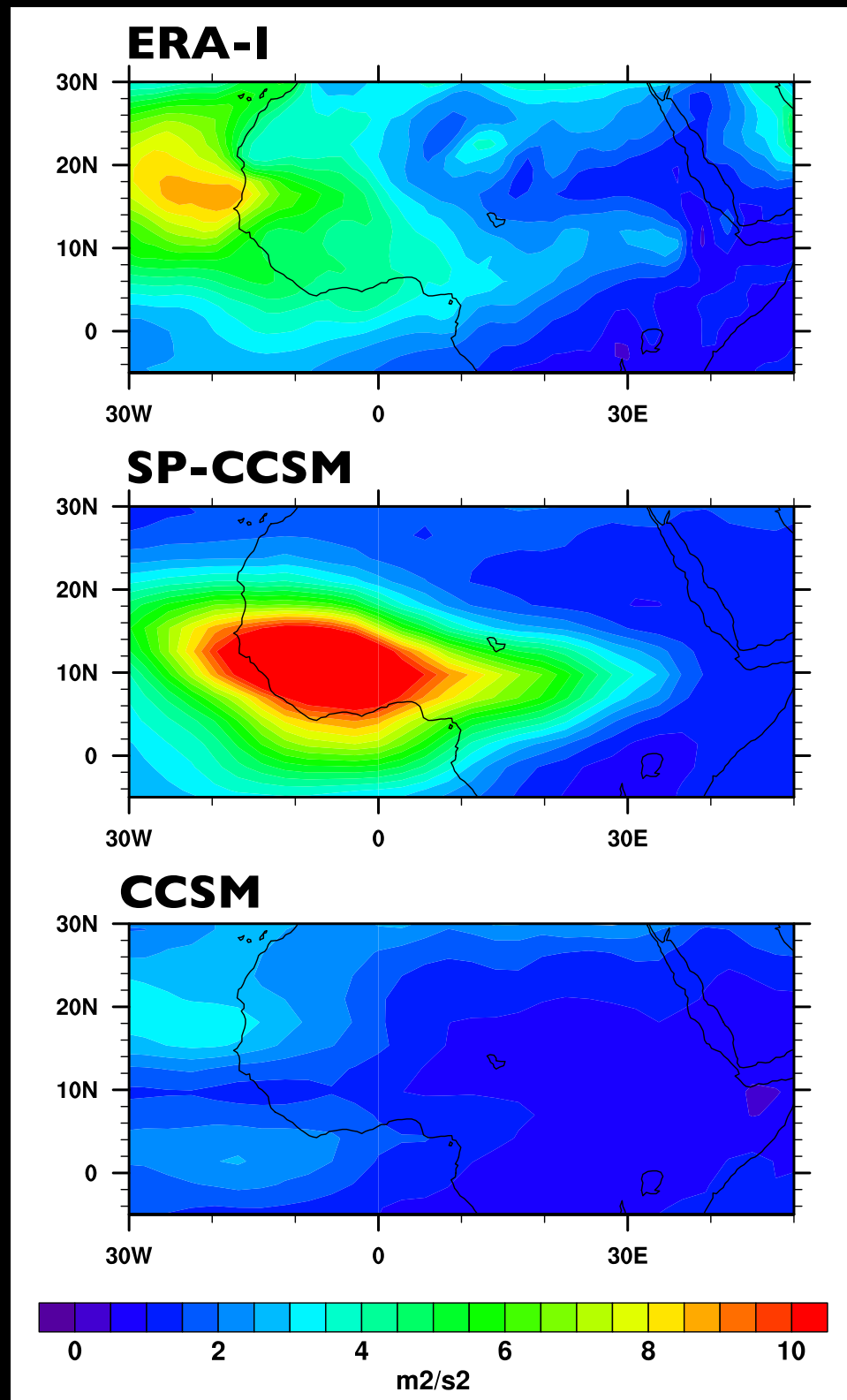
- Major source of atmospheric variability over West Africa.
- Primary modulator of precipitation on synoptic timescales.
- Often act to initiate hurricanes in the Atlantic.
- Baroclinic westward propagating disturbances with a period of 3-5 days and wavelengths of 2000-5000 km.
- Exhibit significant intraseasonal variability that is not well understood.



Hurricane Ivan

African Easterly Waves

Composite JAS variance of V-wind



- 2-6 day band-pass filtered variance of V-wind.
- SP-CCSM - overestimates AEW variability
- CCSM - no apparently AEW activity

African Easterly Waves

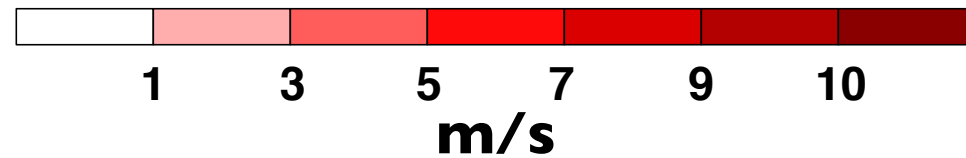
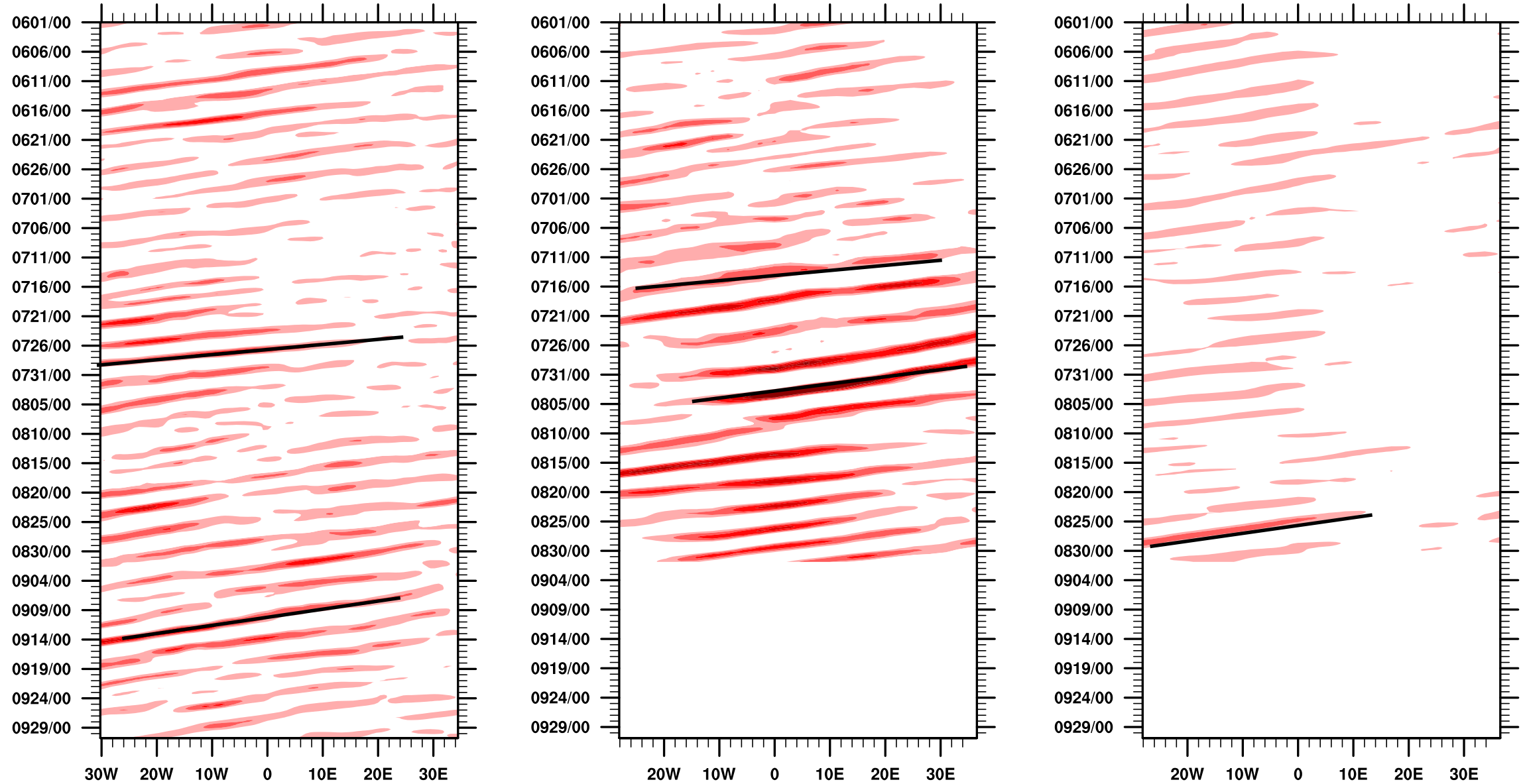
June

Sept.

ERA-I

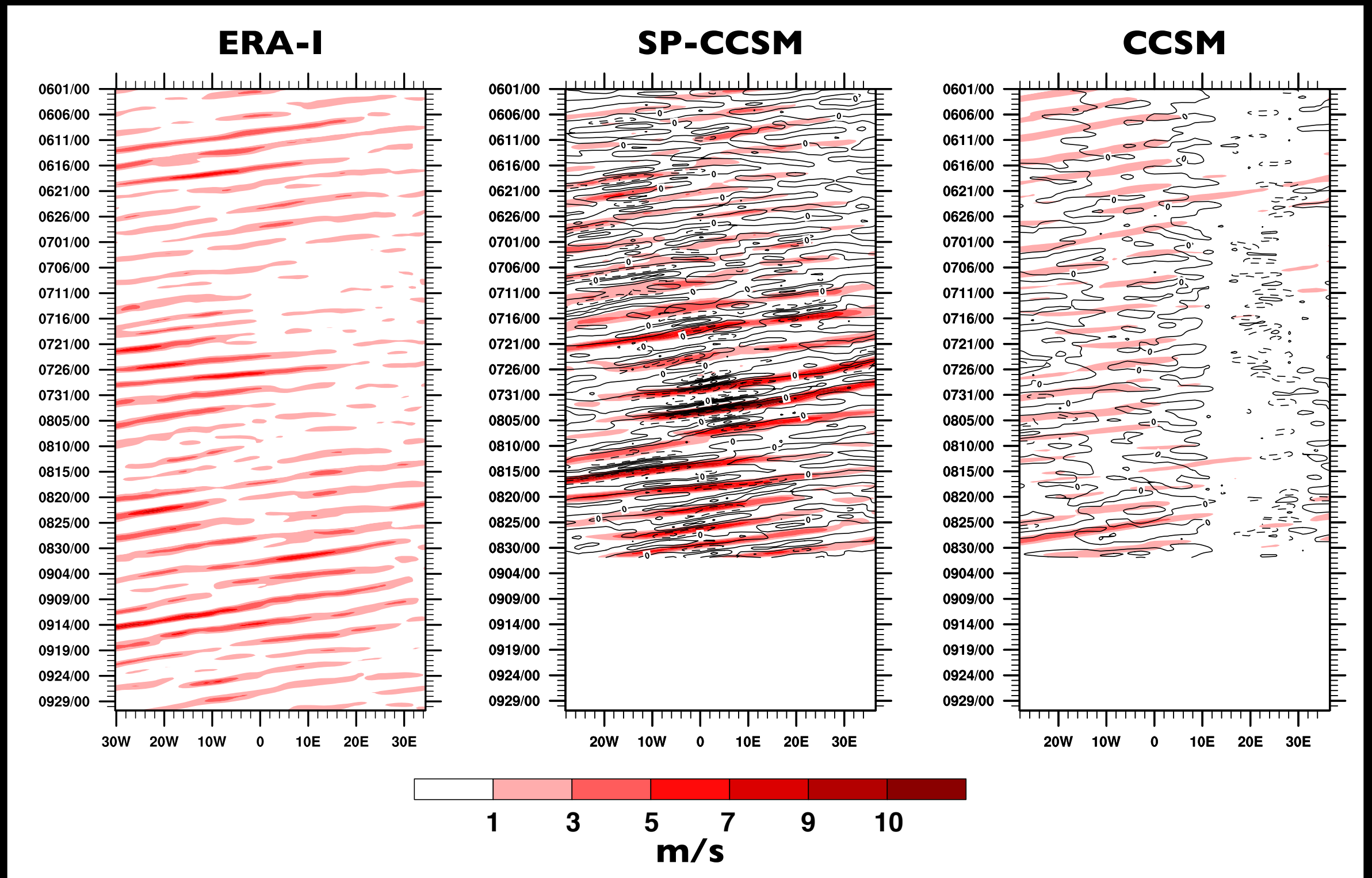
SP-CCSM

CCSM



2-6 day band pass filtered V-wind averaged between 5°N-15°N

African Easterly Waves



2-6 day band pass filtered V-wind (contours) and precipitation (lines) averaged between 5°N-15°N

Summary

- Explicit representation of cloud processes allows for improved representation of the seasonal cycle of rainfall over West Africa.
- Coupled versions of CCSM3 better represent the AEJ when compared to atmosphere-only simulations.
- The MMF enhances synoptic scale variability over West Africa.

What's Next?

- Synoptic-mesoscale interactions?
- Feedbacks between convection and AEWs.
- How does convection change in the E-W and N-S directions over West Africa?
- Kelvin waves in the MMF? Interaction with AEWs over Africa.

**** NEED: subdaily (3hrly?) GCM and CRM scale output!!!****

