



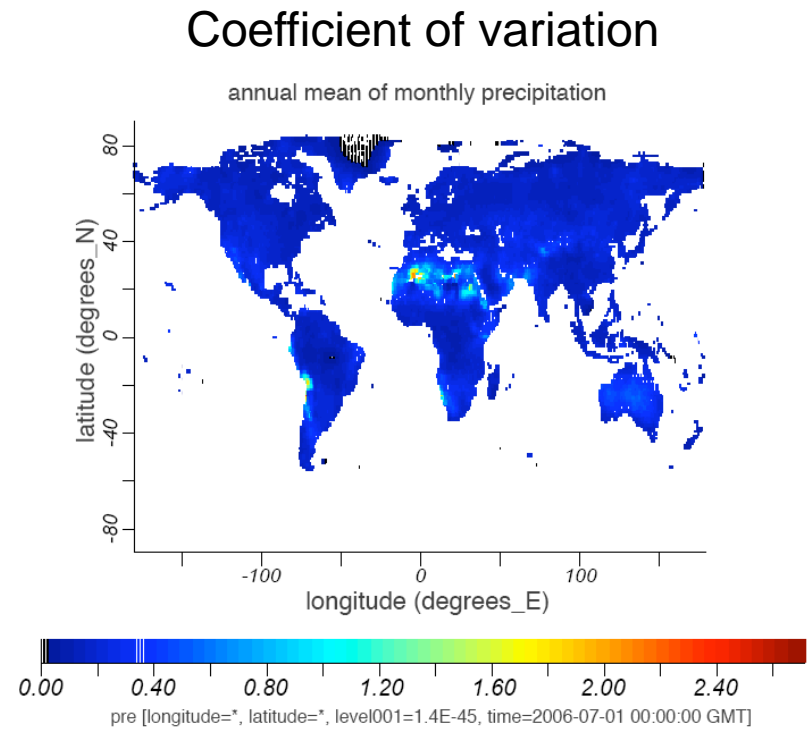
# **Global 7: a climate prospective**

**Carlo Buontempo**

**Dakar, November 17 2009**

# The region

- 12N to 20N: one wet season per year with a max in August, three max and three min
- Great variability when compared with the rest of the world on all time-scales (Green Sahara in 120-110, 50-40, and 10-8 kyear before present )
- West African monsoon (Land sea contrast), ITCZ migration, dry advection from the Sahara





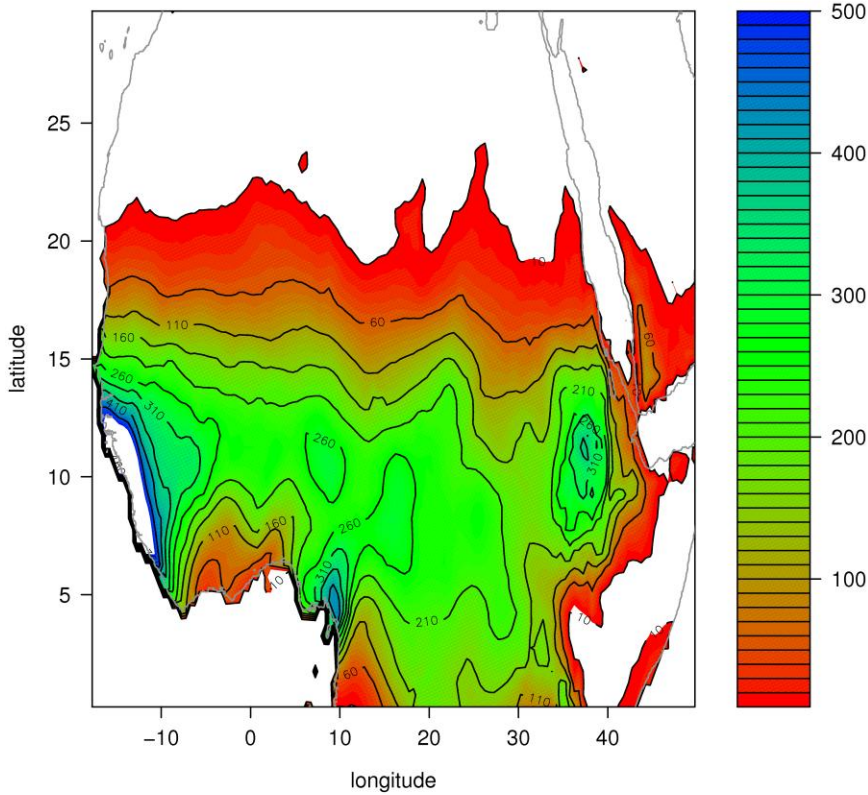
# Sahel in the XX century

- In the observational record we see a slight increase in precipitation around the mid century followed by a steady decline up until the late 80s. In more recent years a partial recovery has been observed.
- There is no consensus on the causes of this trend which can represent either a natural fluctuation of the climate or the effect of human intervention (aerosol loading and land use change)

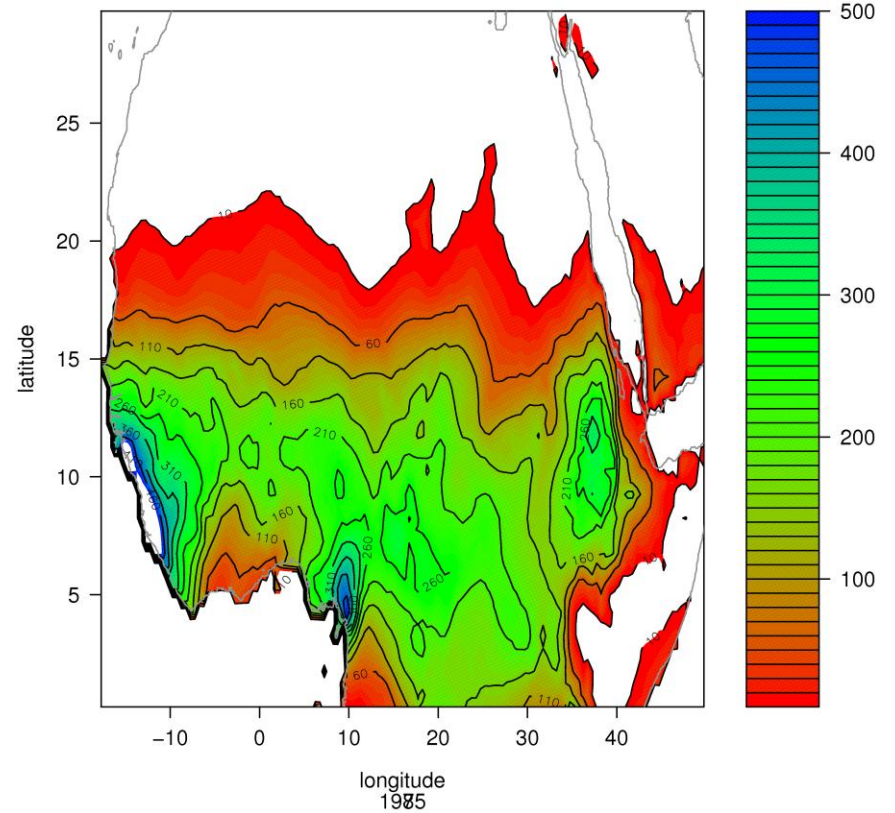


# Drought

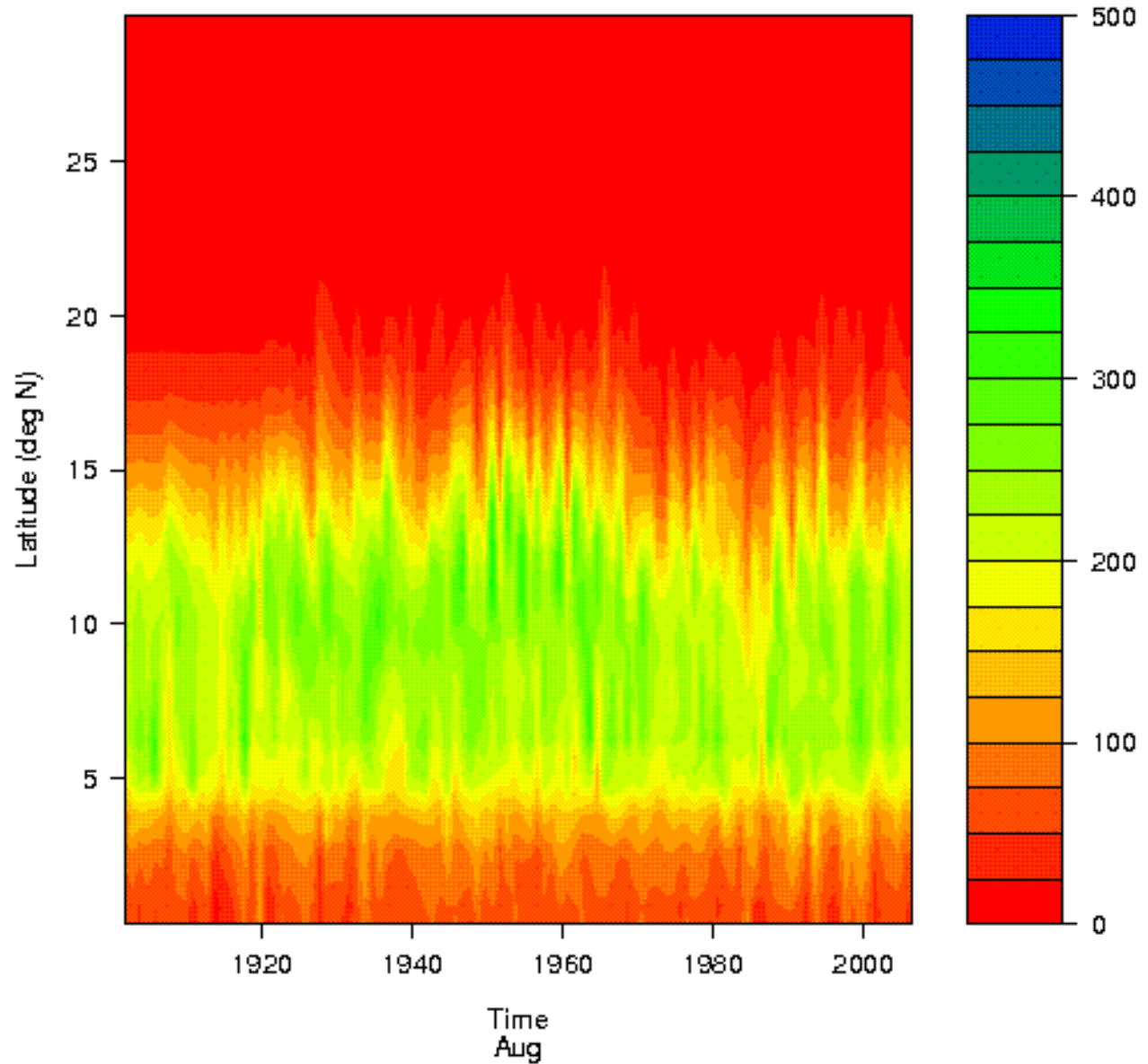
Mean precip over the XX century



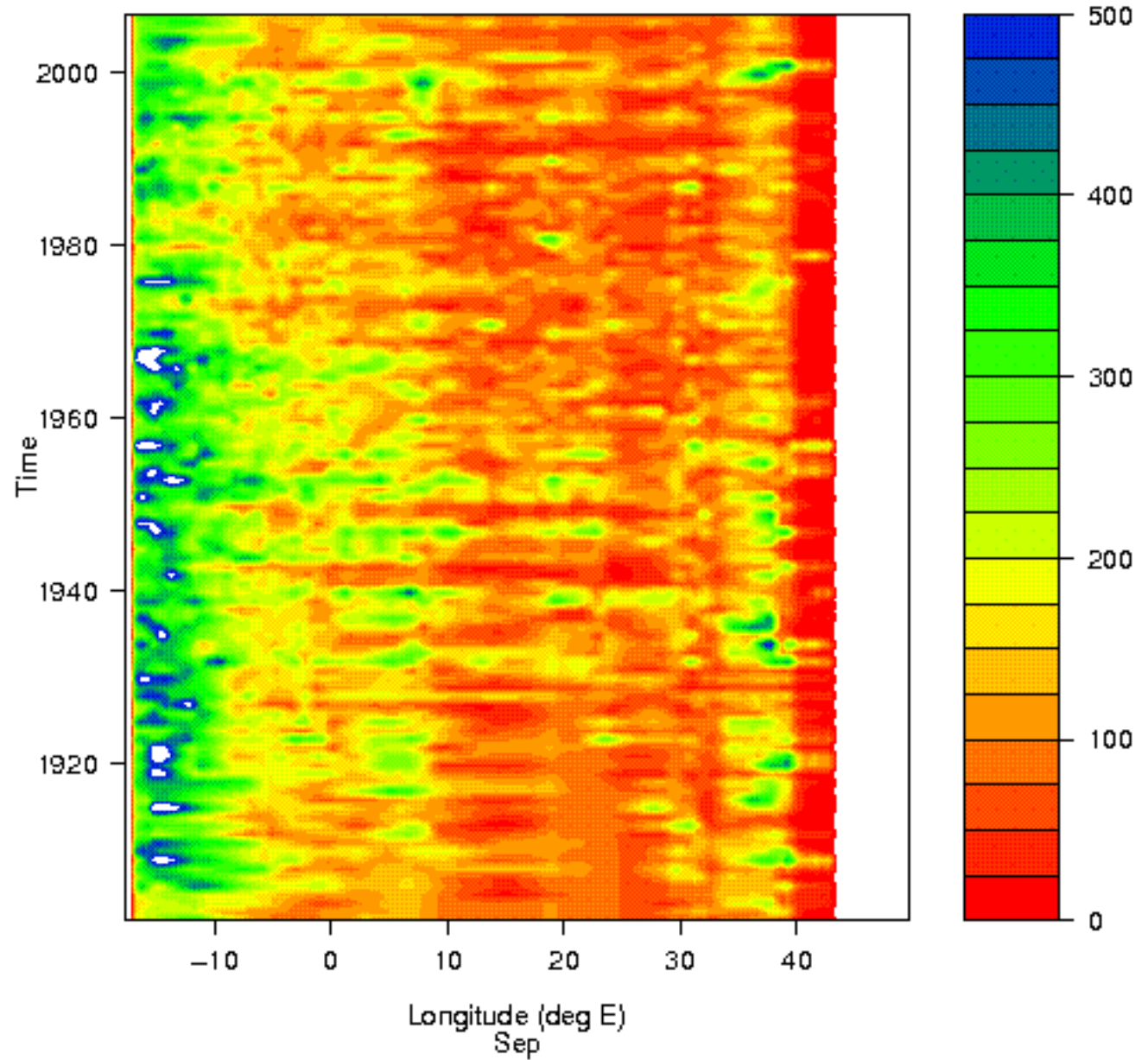
Mean precip for the period 1975-1990



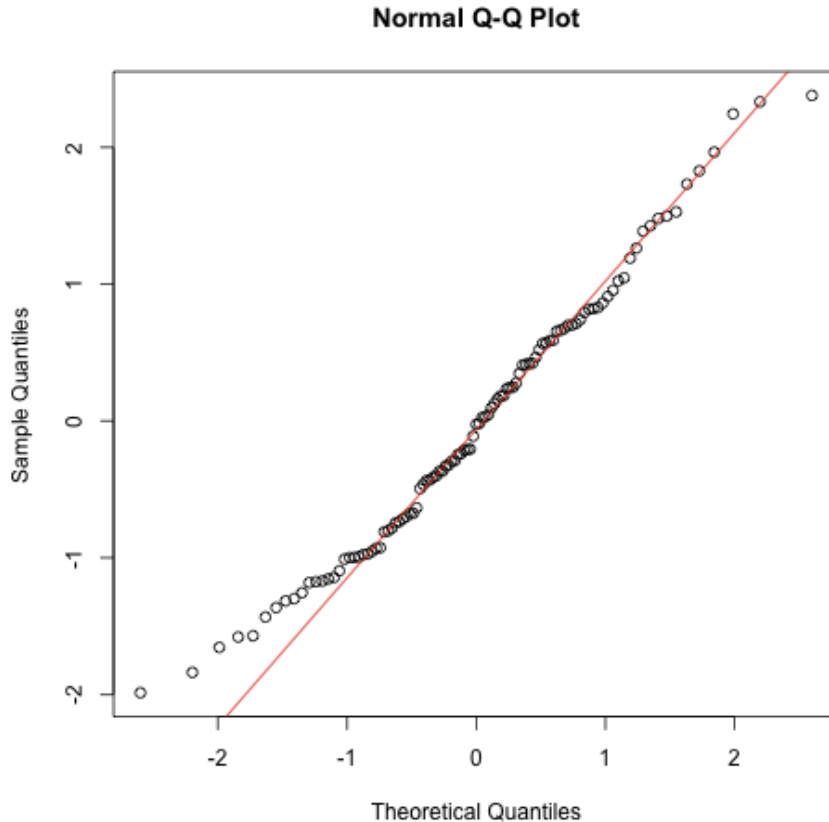
Hovmuller diagram for Sahelian rain



### Hovmuller diagram for Sahellian rain



# Large fluctuations

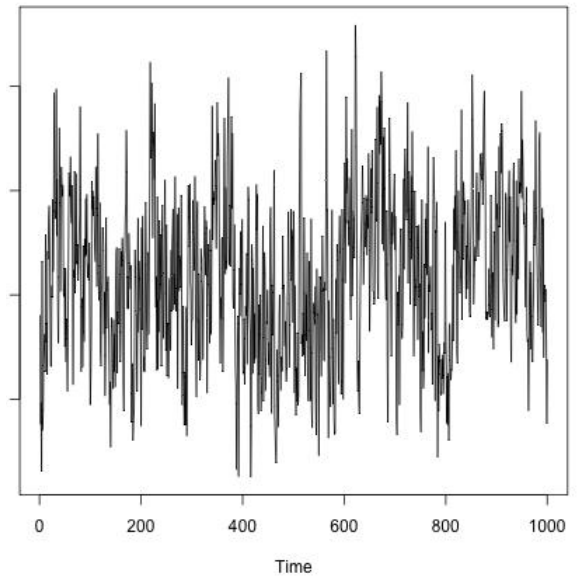
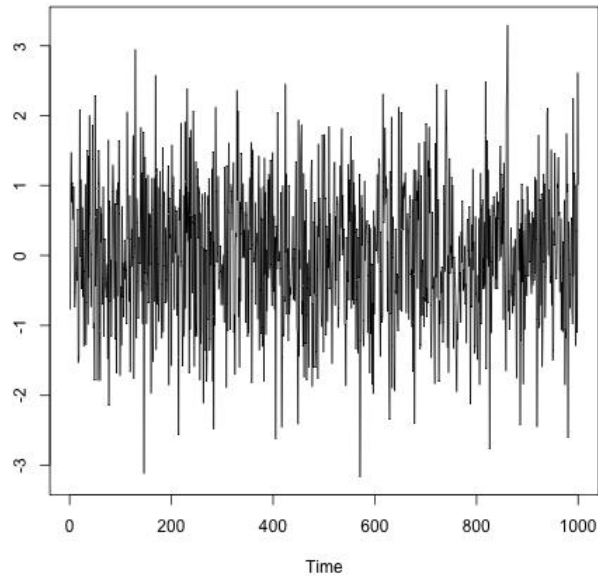
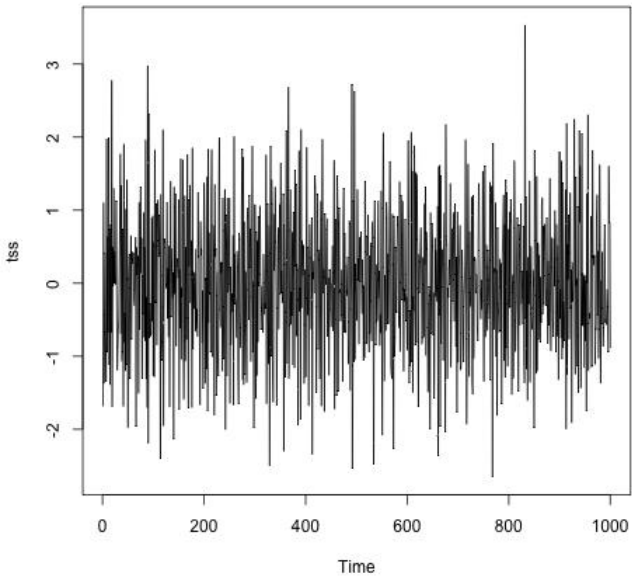


- The distribution of rainfall in August deviates from a Gaussian especially for the dry tail
- Analysing the scaling properties of the time series it is possible to identify long-memory processes ( $H > 0.5$ )



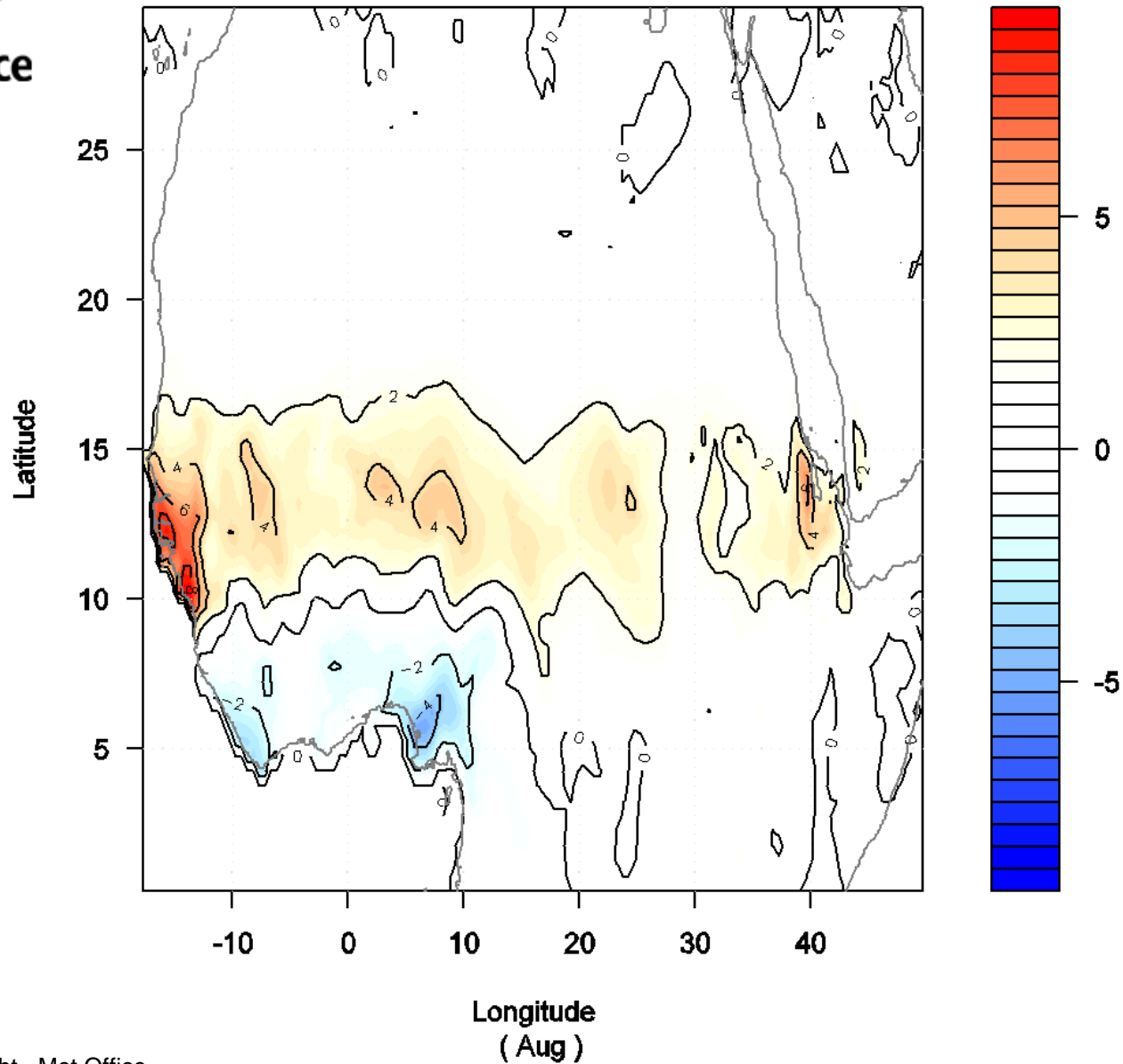


# Hurst exponent



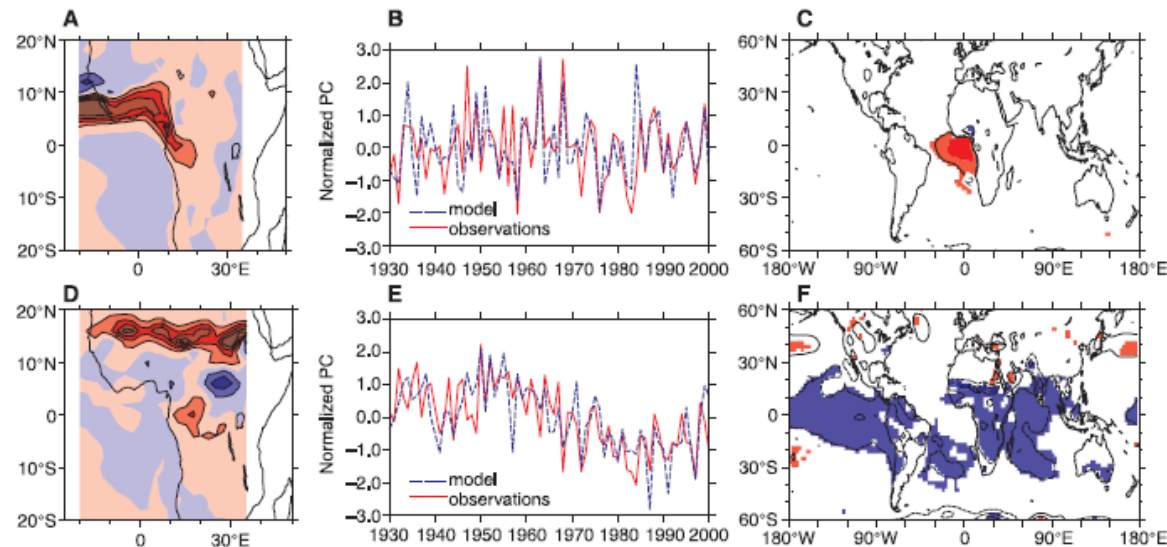


# Present day variability



# Climate variability

- Previous modelling studies have shown that sea surface temperature plays an important role in regulating Sahel precipitation.
- Sahel rainfall is negatively correlated with the Tropical Indo-Pacific SST and positively correlated with the Atlantic meridional SST gradient [Folland et al 1986, Giannini et al. 2003].

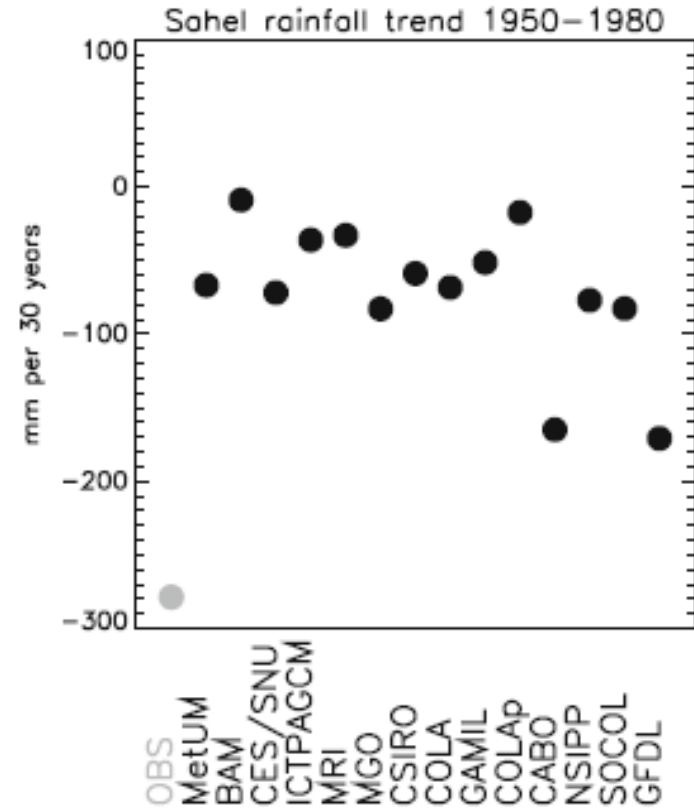
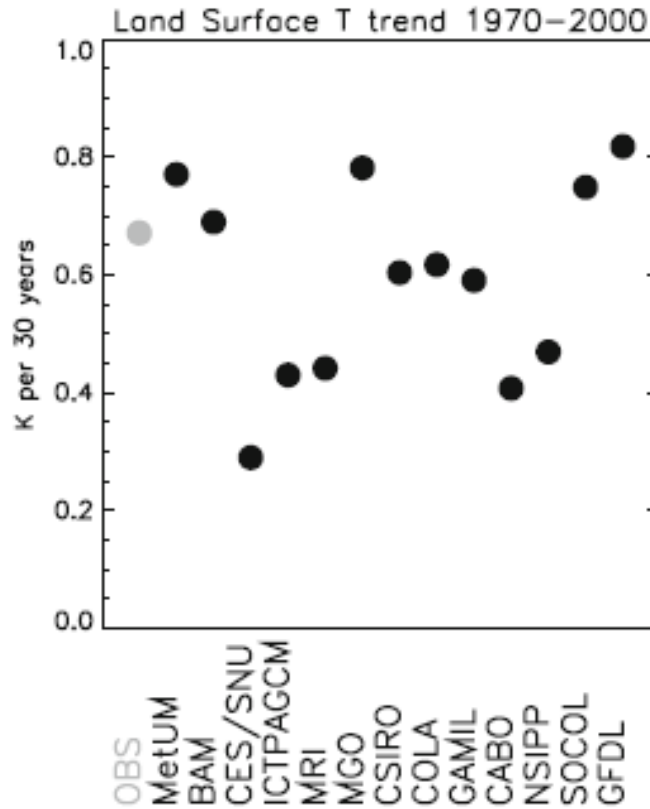




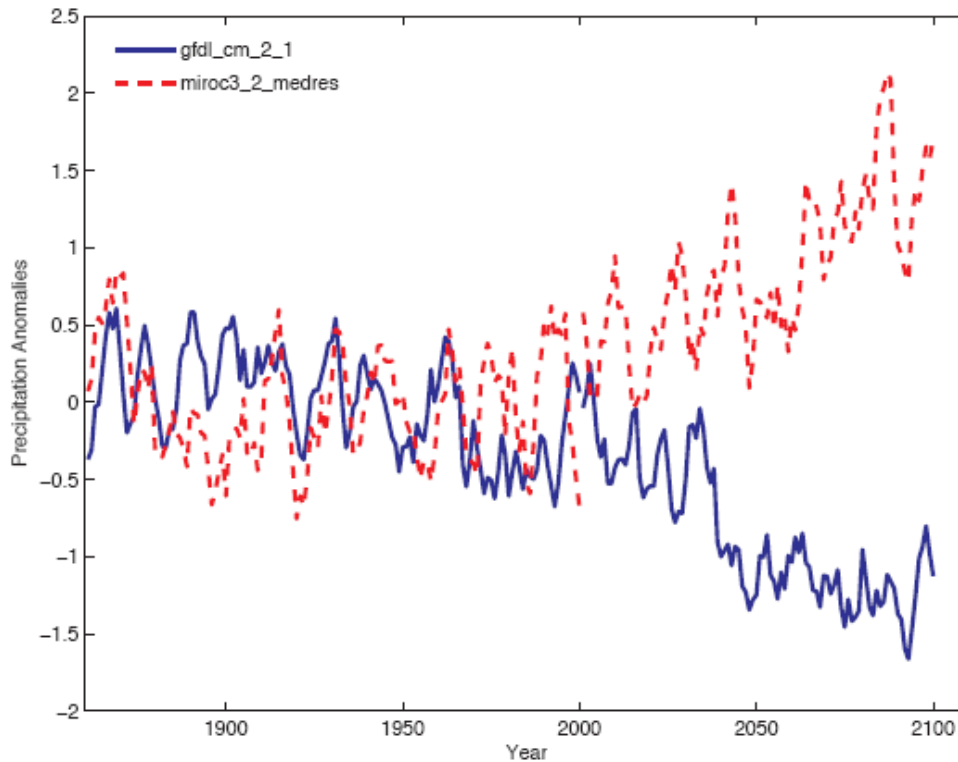
# Other driver

- West African monsoon and ITCZ movements are the main factors controlling the climate of the region.
- At least two others poorly modelled processes are likely to influence the rainfall variability in the regions: land surface feedback [Charney et al 1974 and 1975] and aerosol [Biasutti and Giannini 2006 and Solomon et al 2008]. The effect of these processes on the climate projections tends to be model dependent [Scaife et al 2009].

# Model world

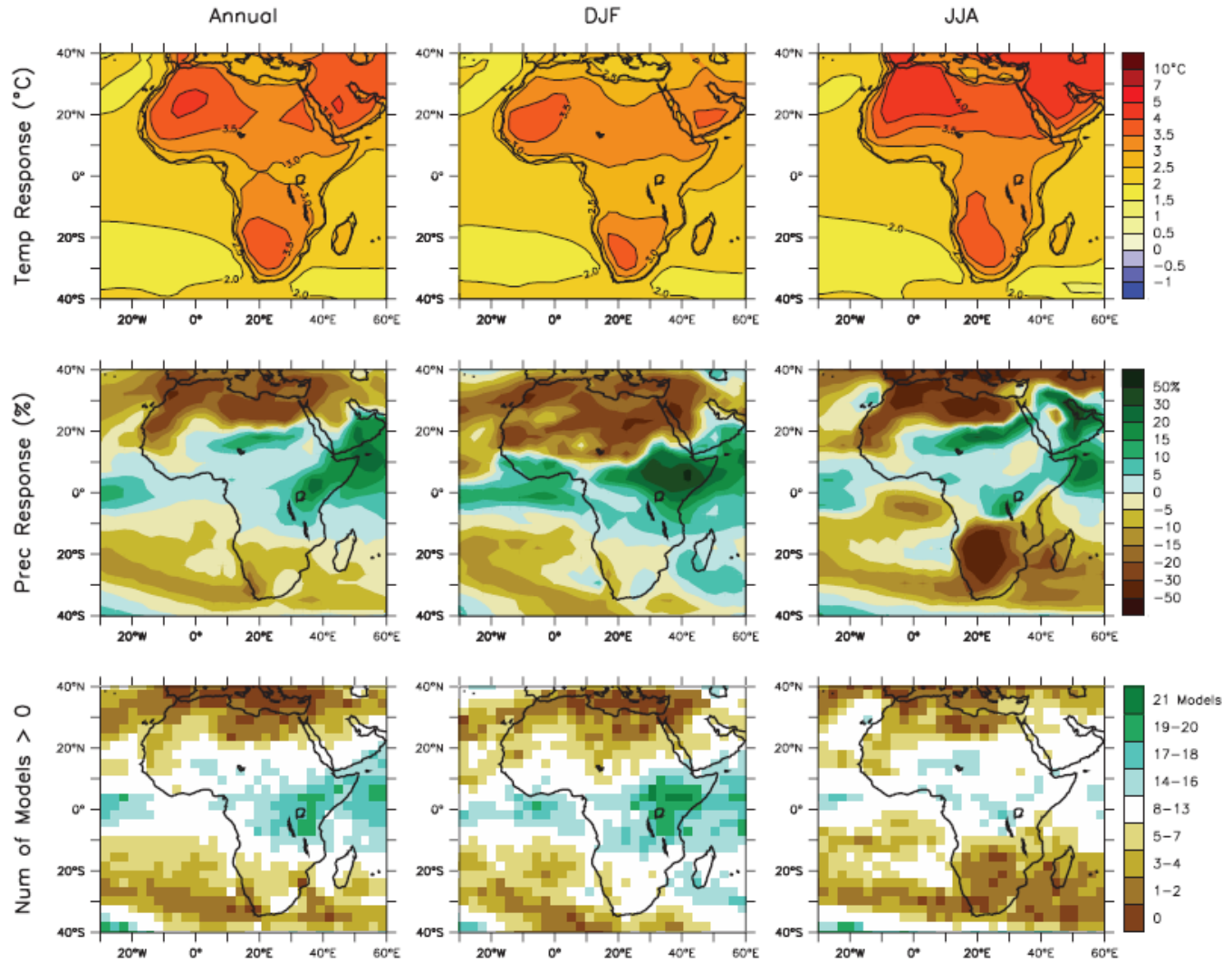


# Projections

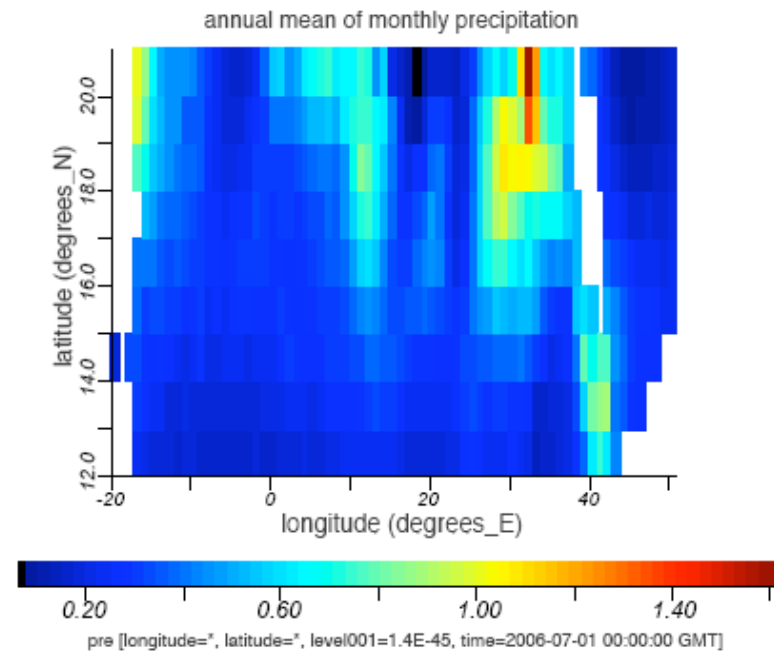
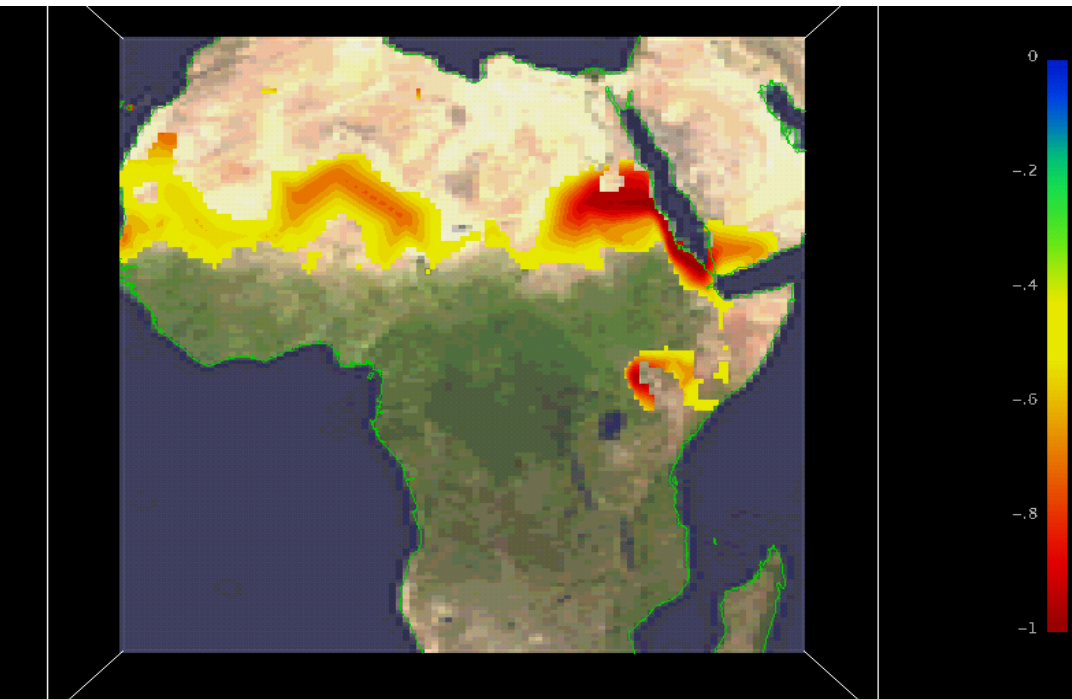


- The climate projection for rainfall is highly uncertain with some coupled model predicting a strong dry anomaly, others predicting strong wet anomalies.
- Furthermore some authors expect that the future, GHG-forced change in Sahel rainfall could be controlled by different mechanism, not captured by the simple relationship that has characterised the past [e.g. Biasutti et al 2003].

# A worrying picture



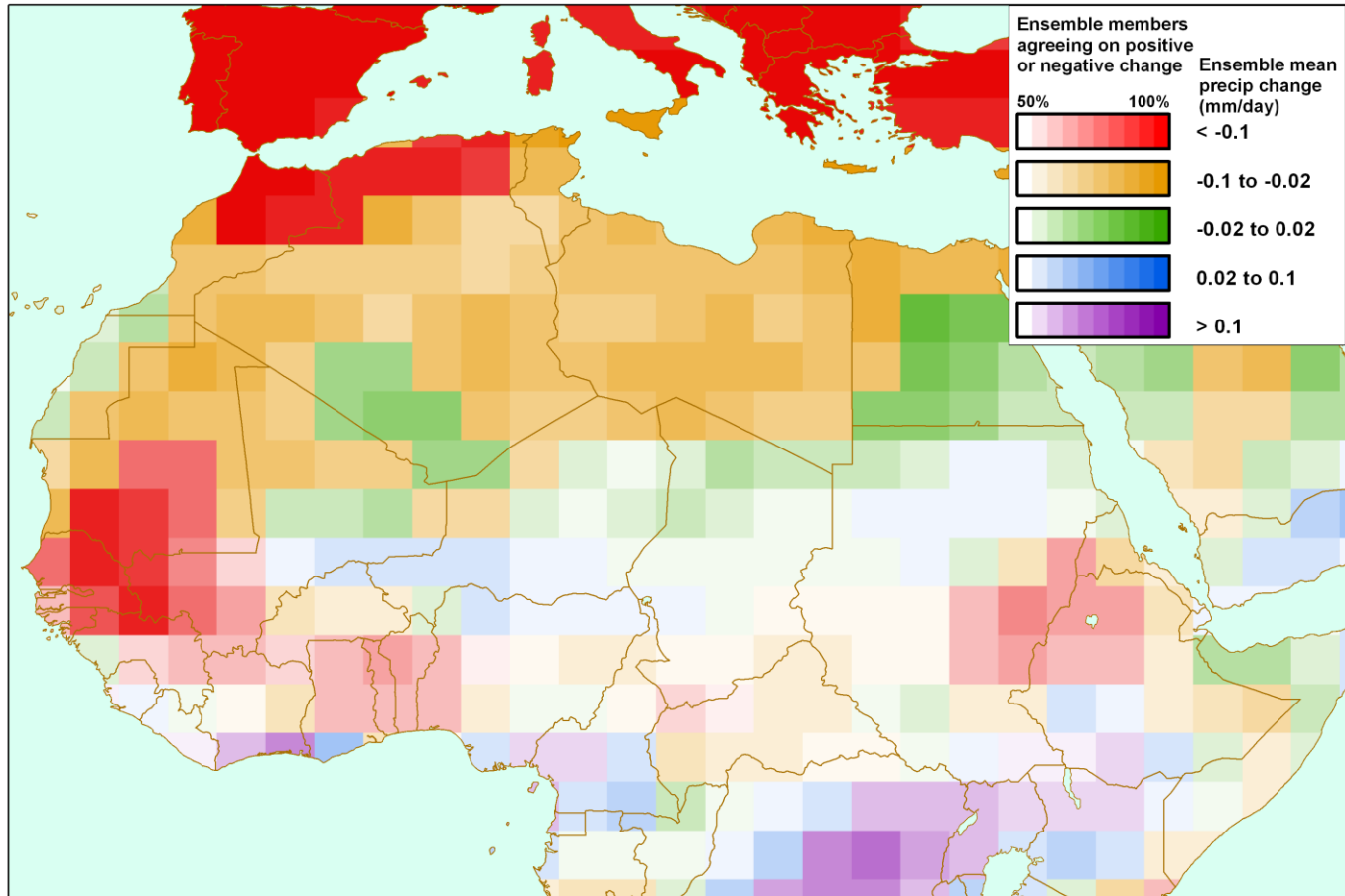
# Sensitivity analysis





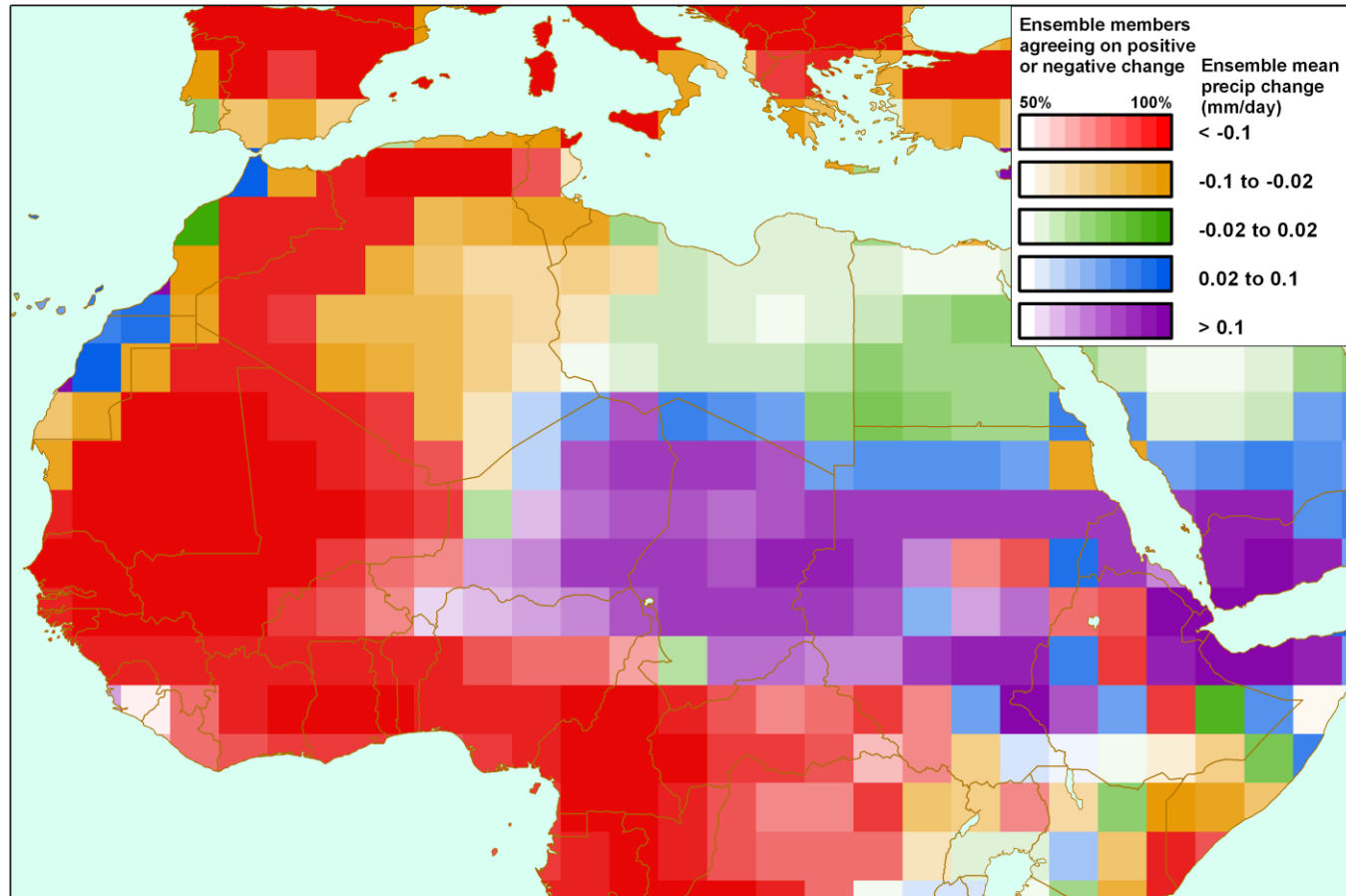
# IPCC projections

Change in jja precipitation for ar4 ensemble (Difference)



# QUMP projections

Change in jja precipitation for qump ensemble (Difference)





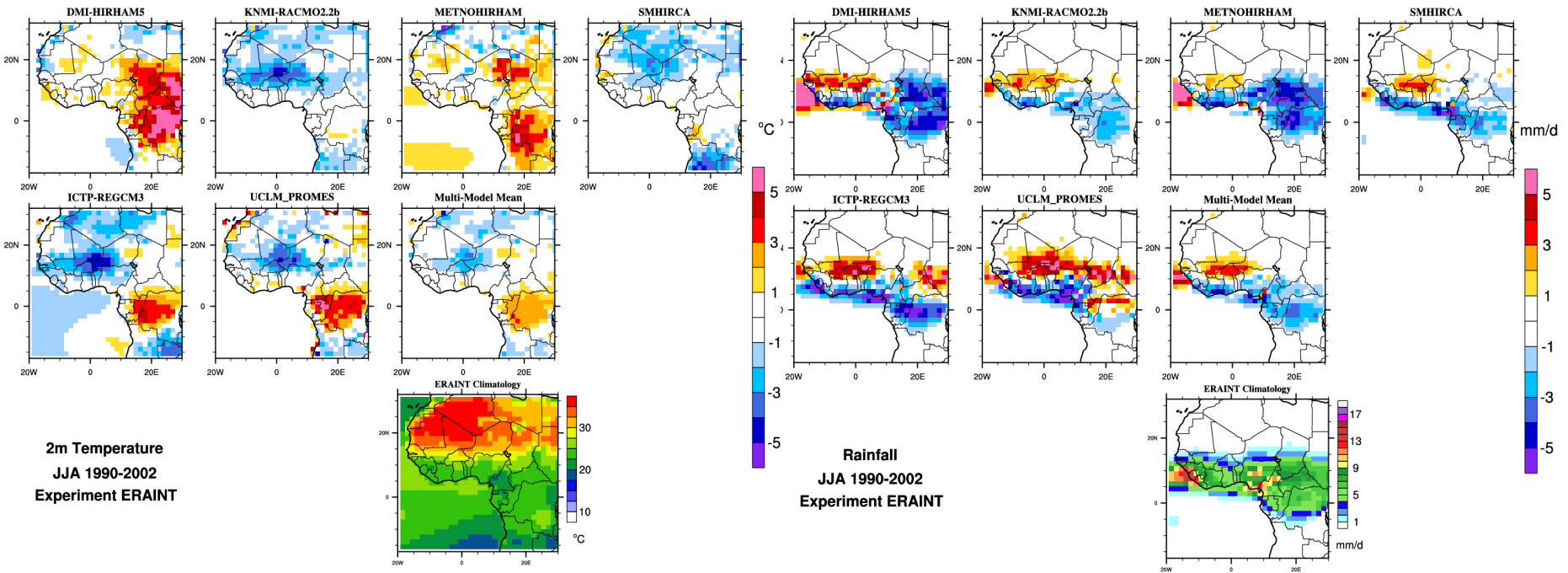
# Outlook

- Great effort over the last 10 years
- AMMA
- WAMME
- ENSEMBLE

We need more of these projects!!



# More research is needed





# Conclusion

[Carlo.Buontempo@metoffice.gov.uk](mailto:Carlo.Buontempo@metoffice.gov.uk)