

First International AMMA Conference, Dakar 2005

Mechanisms of ocean-forced Sahel drought

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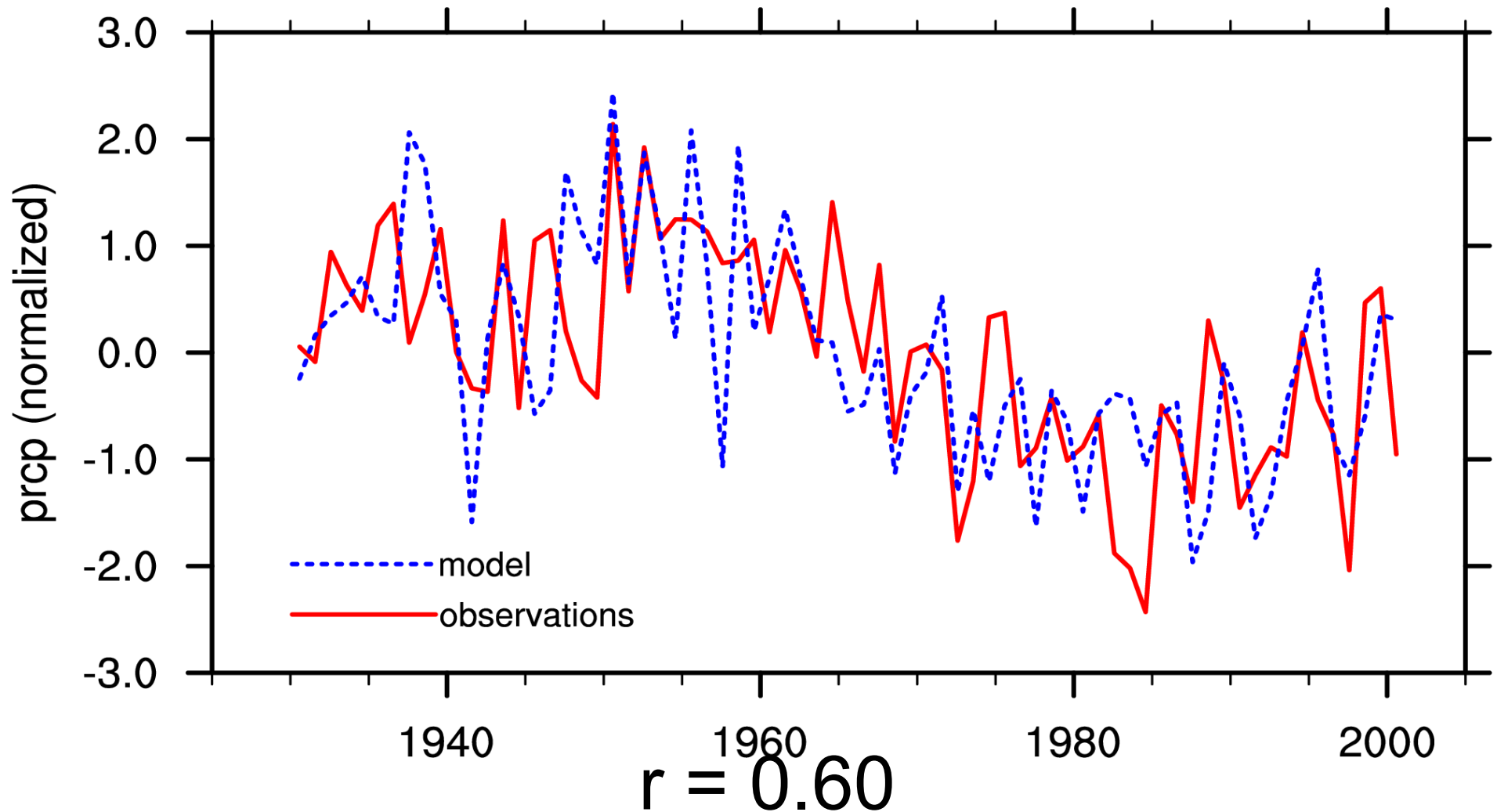
Michela Biasutti and Beate G Liepert
(Lamont-Doherty Earth Observatory)

The Earth Institute at Columbia University



What contribution from the climate diagnostics/
global climate change communities to AMMA?

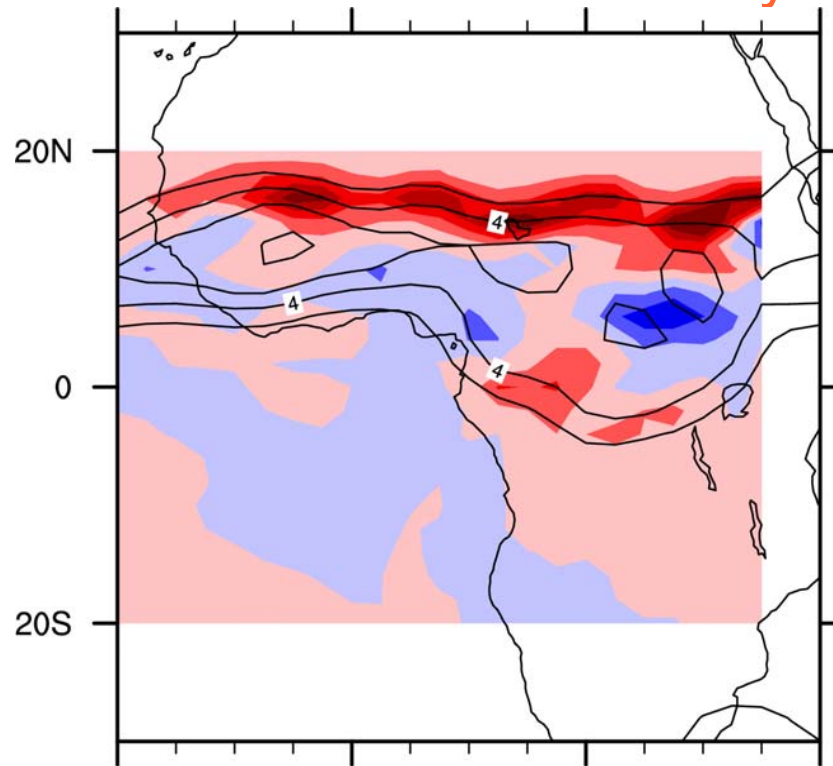
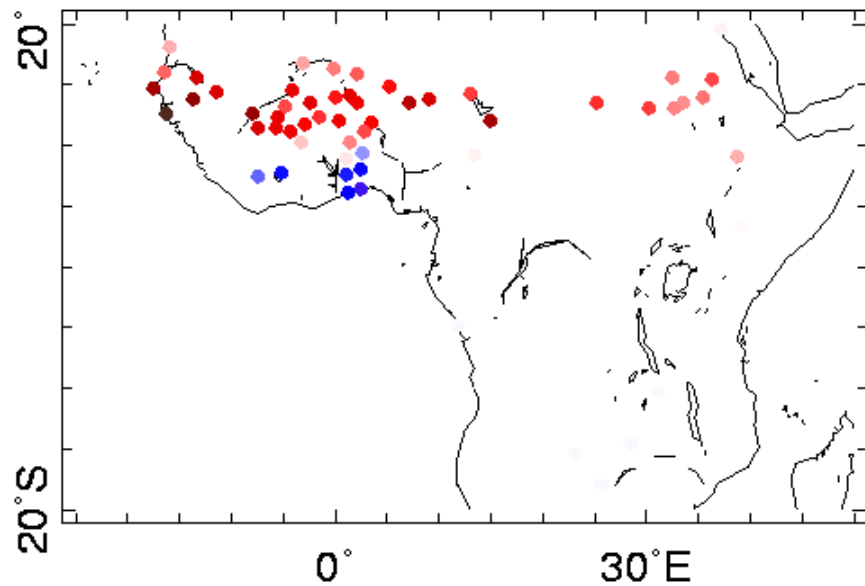
Sahel precipitation - July-September 1930-2000



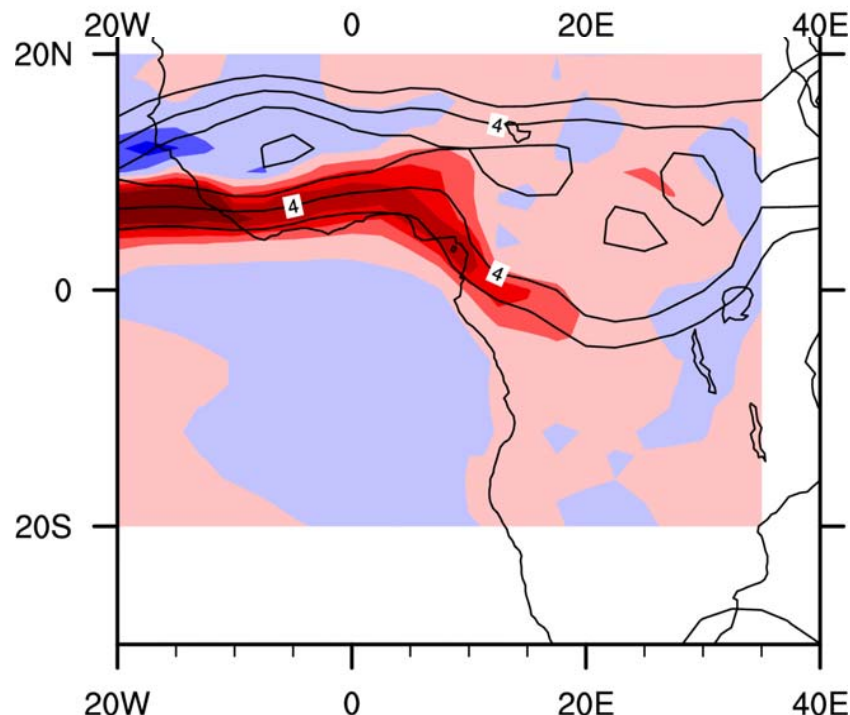
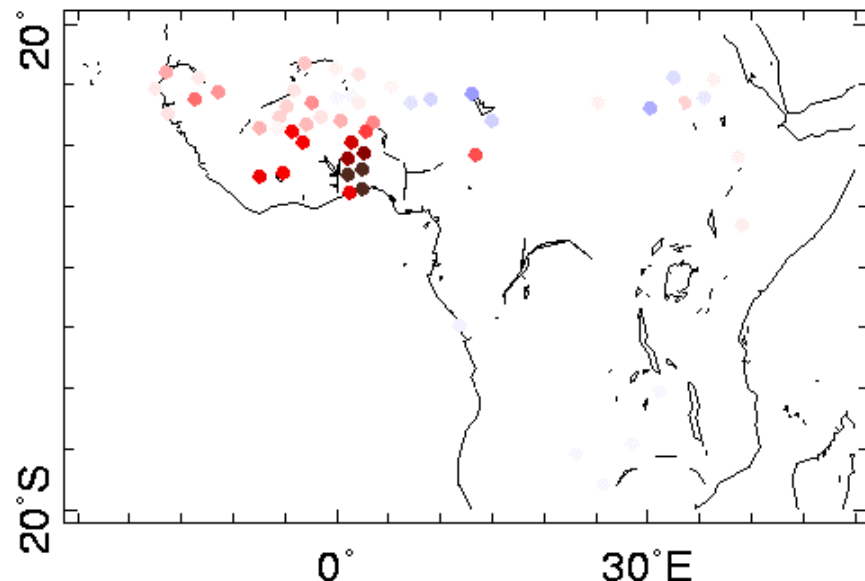
A. Giannini, R. Saravanan and P. Chang, 2003. *Science*, **302**, 1027-1030
Also see e.g. Bader and Latif, 2003 (GRL); Lu and Delworth, in press (GRL)

spatial signature of July-September African rainfall variability

Sahel pattern



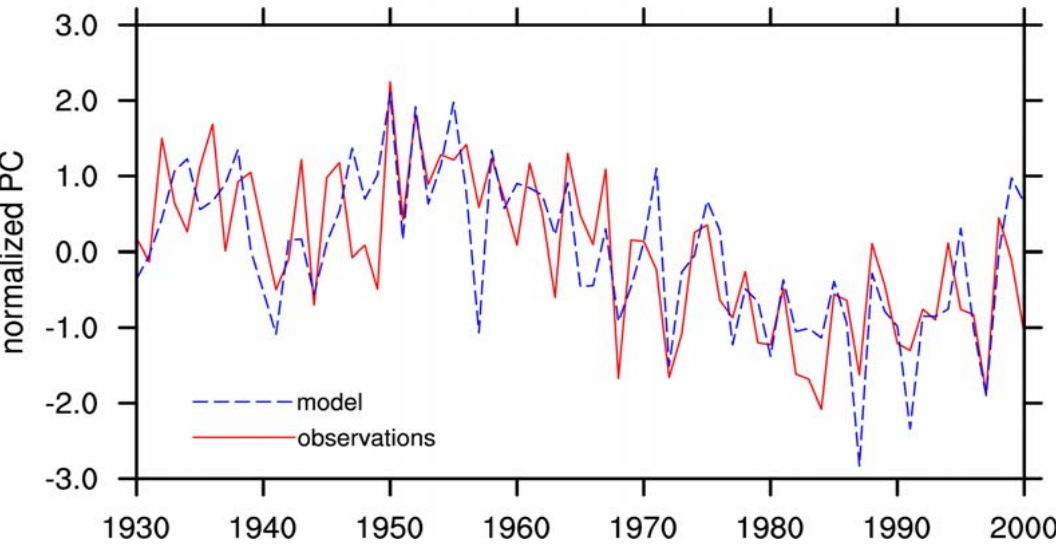
Gulf of Guinea pattern



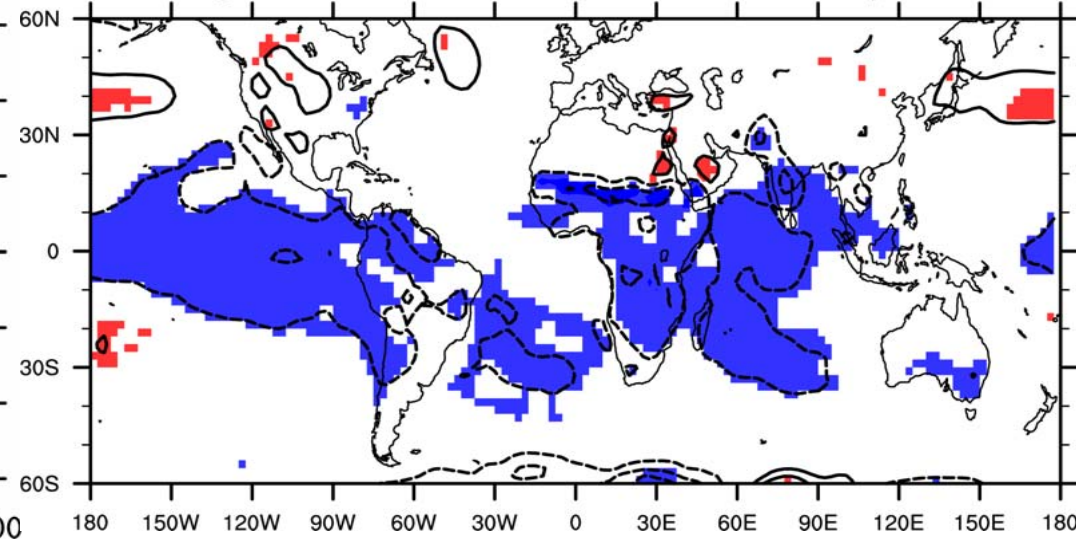
Giannini et al., 2005 (Clim. Dyn.)

temporal signature and relation to surface temperature

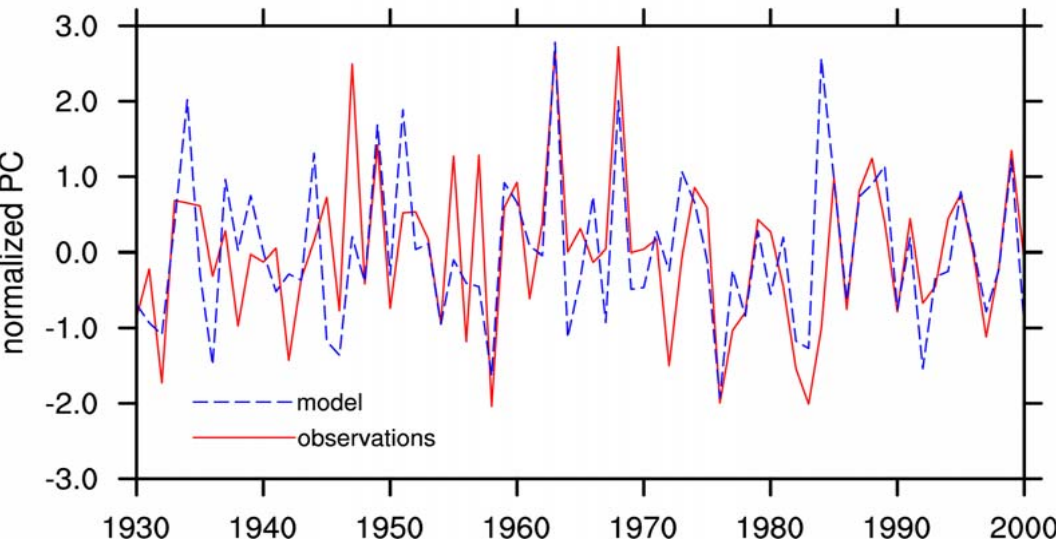
e. Sahel PC of 1930-2000 precipitation



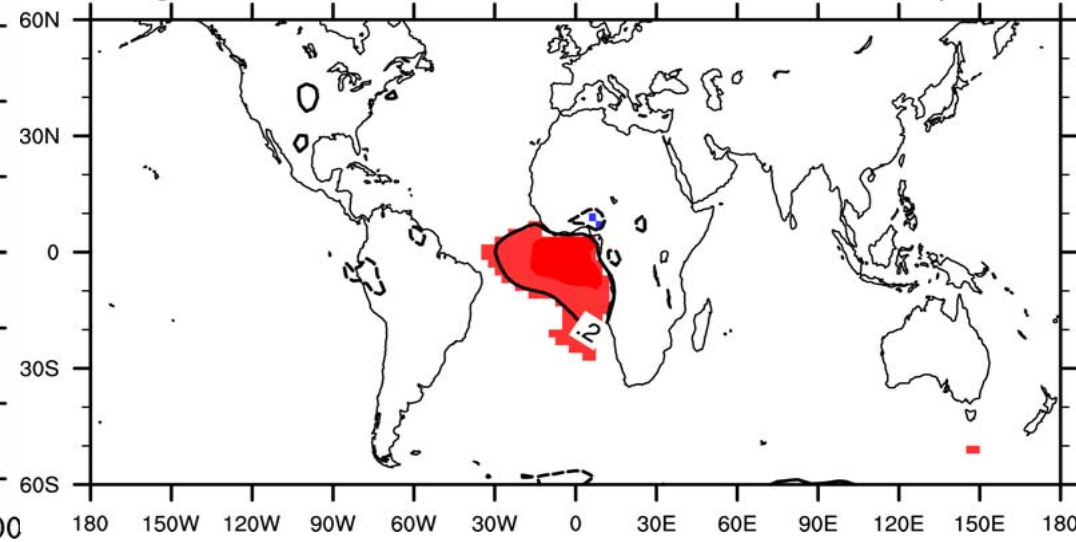
f. regression of the model's Sahel PC on sfc temperature



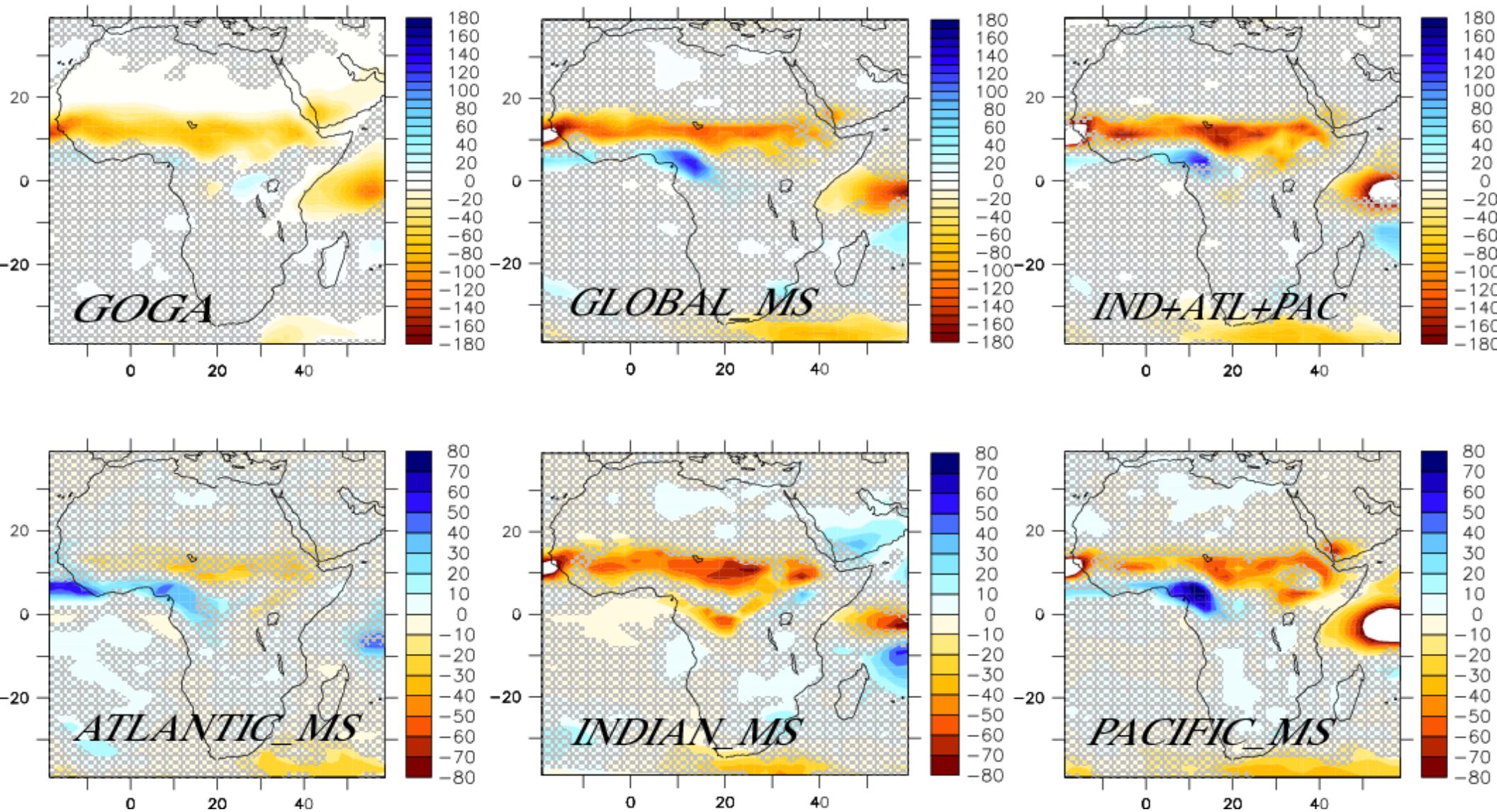
b. Gulf of Guinea PC of 1930-2000 precipitation



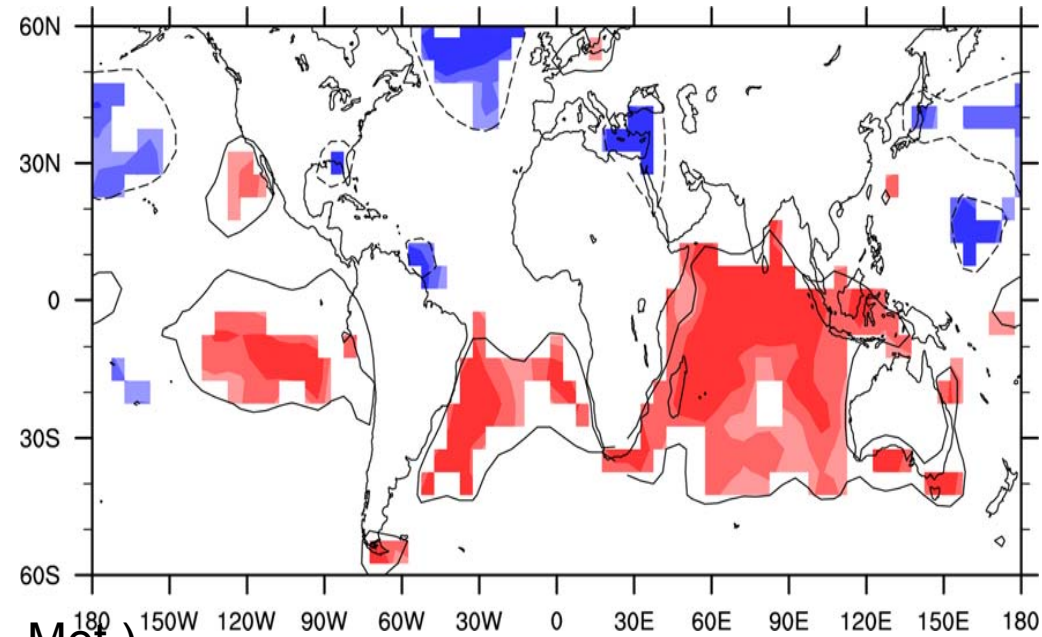
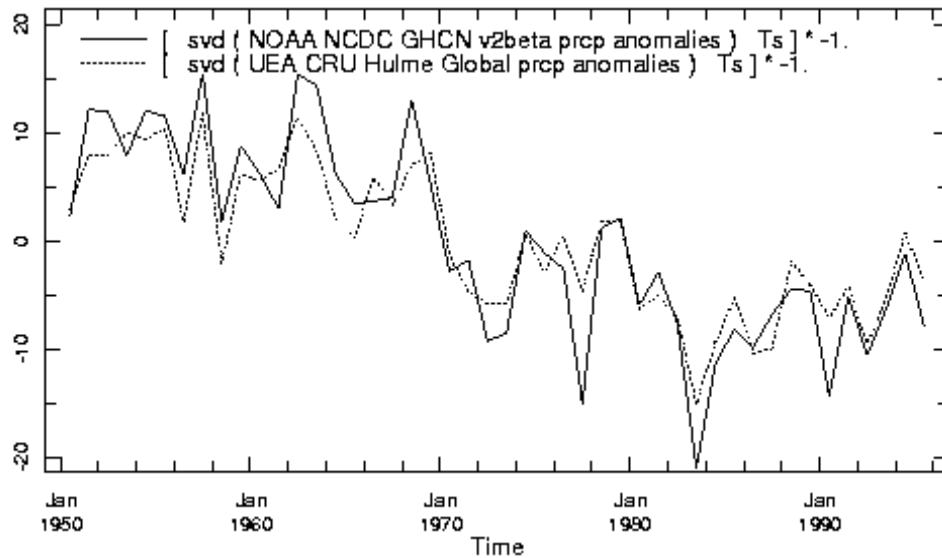
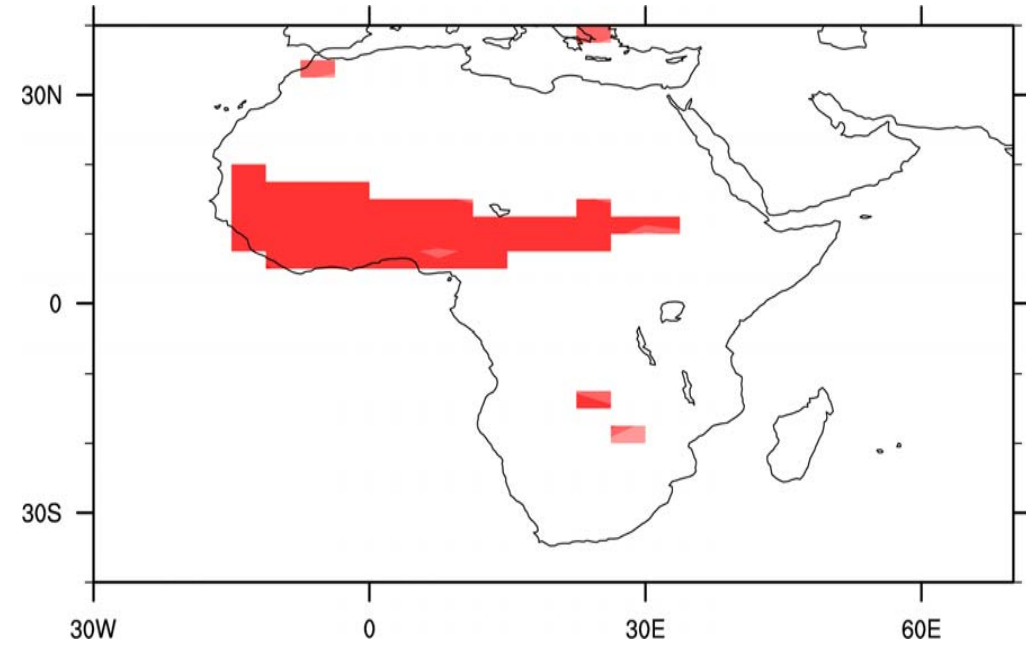
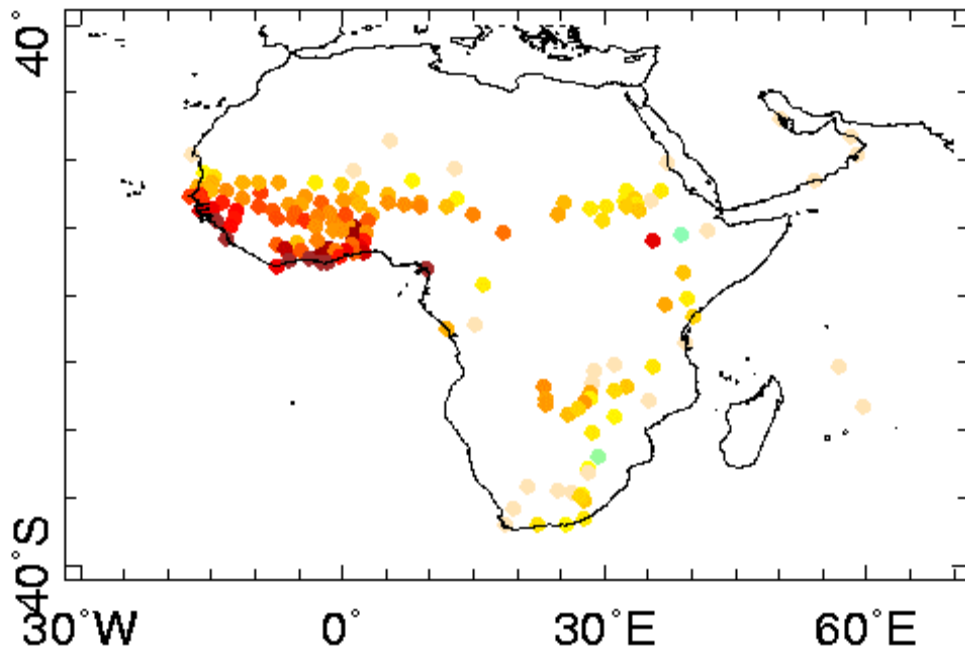
c. regression of the model's Gulf of Guinea PC on sfc temperature



The relative roles of Atlantic, Indian and Pacific SSTs



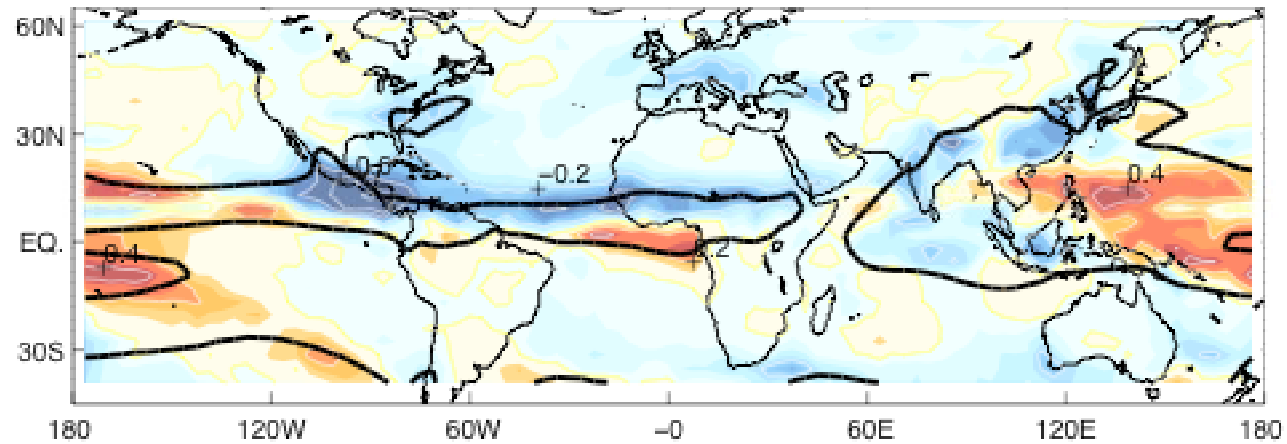
Observed, annual mean, continental scale variability (1950-1995)



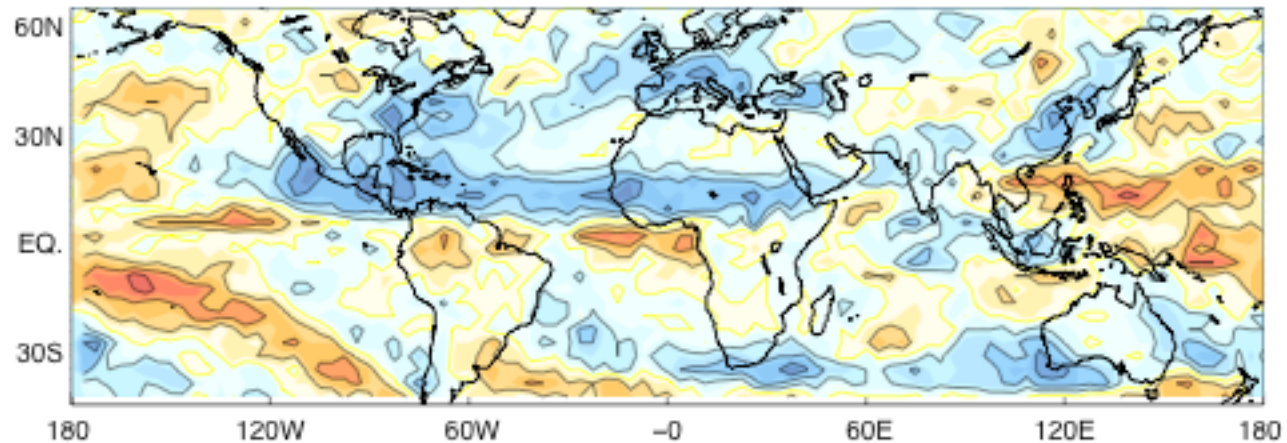
1. Also see, e.g. Nicholson 1986 (J. Clim. App. Met.)

19 Coupled GCM : XX-PI Precipitation Change

Across-Model Mean of JJA XX-PI Precipitation

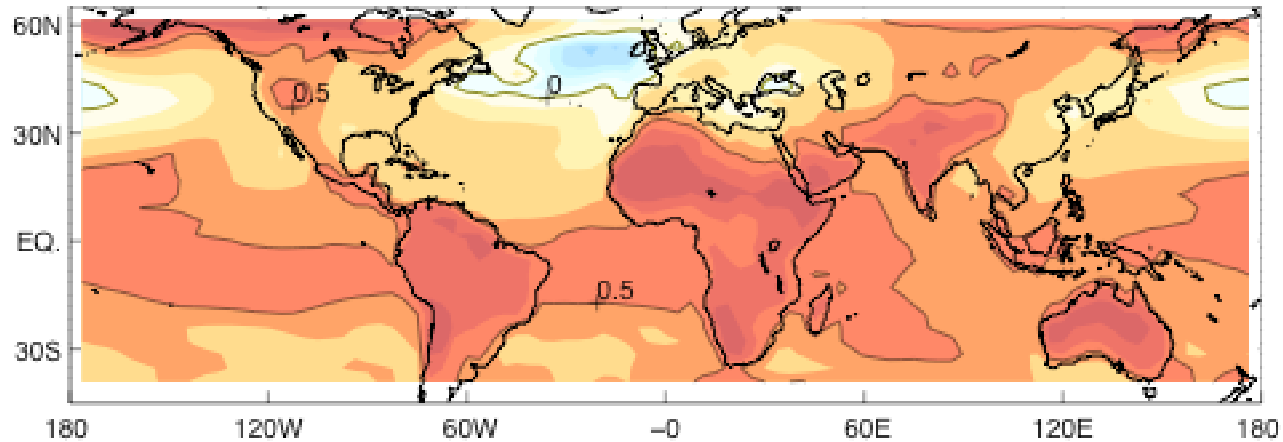


of Models with XX-PI JJA Precipitation $>.1$ ($<-.1$)

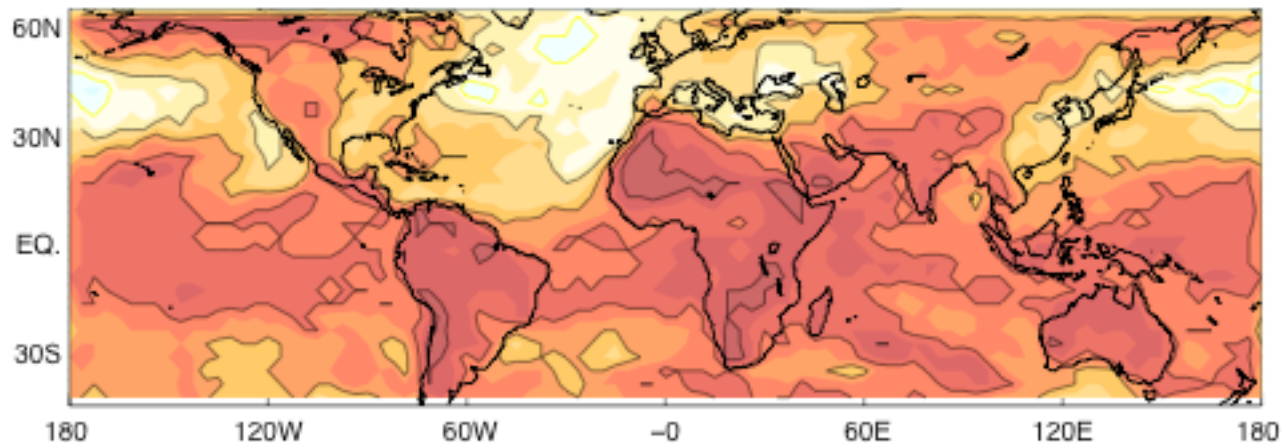


19 Coupled GCM : XX-PI Surface temperature change

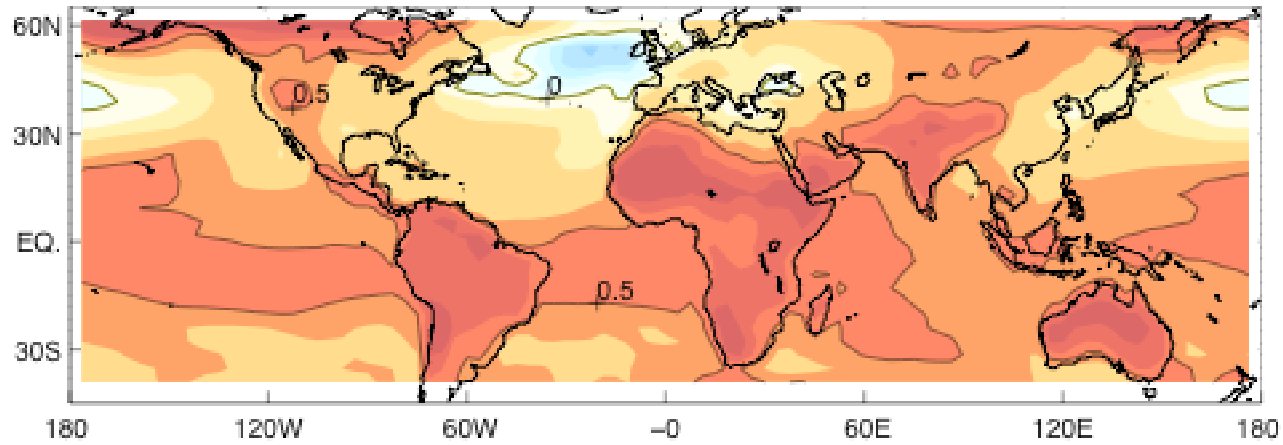
Across-Model Mean of XX-PI Surface Temperature



of Models with XX-PI Annual Mean Surface Temperature $>.4$ ($<-.4$)

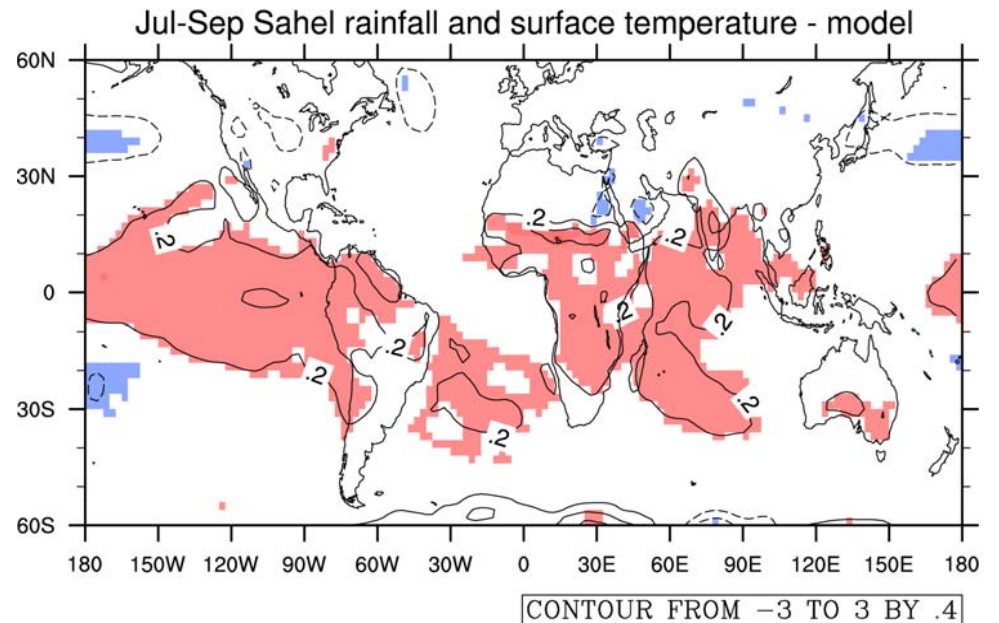
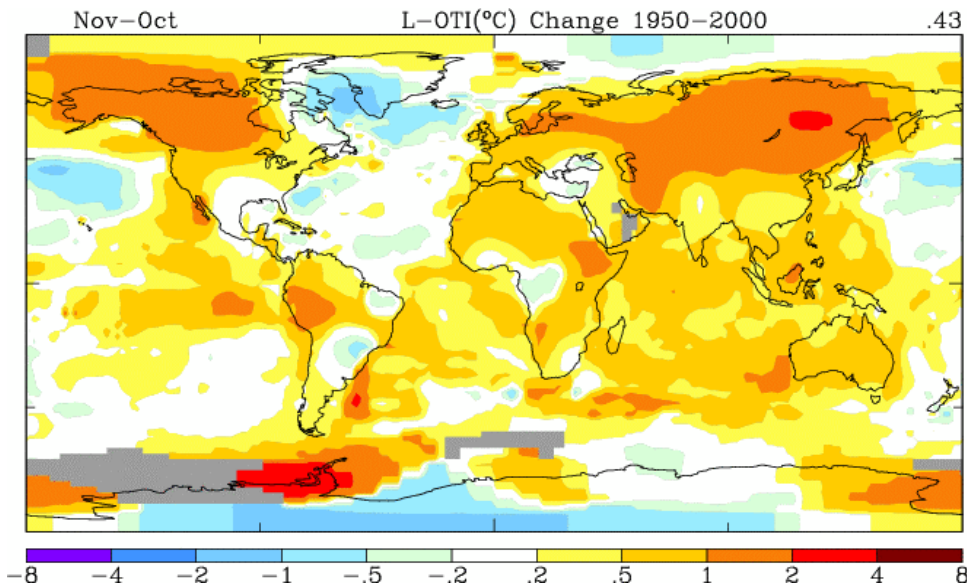


Across-Model Mean of XX-PI Surface Temperature

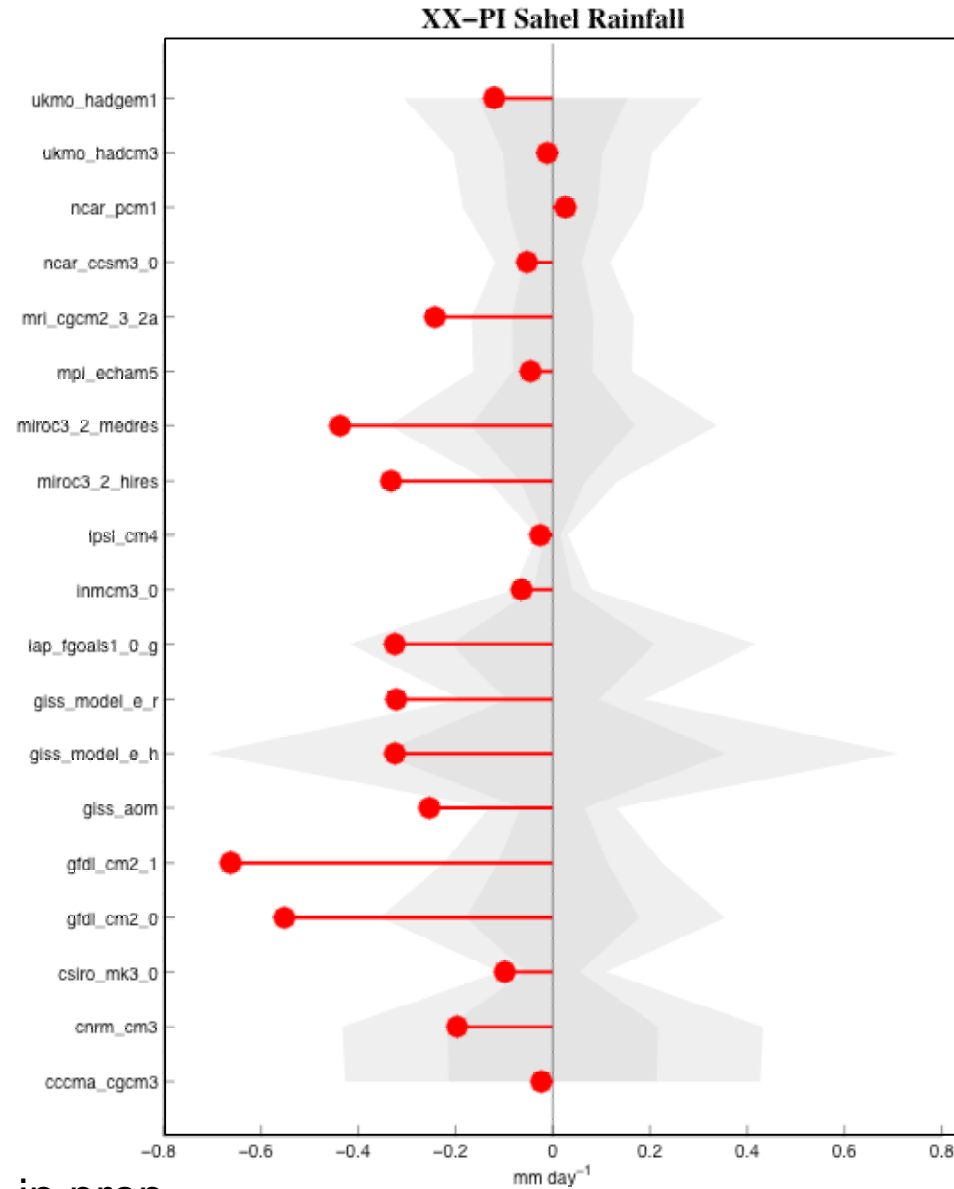


NASA/GISS analysis of surface temp – linear trend 1950-2000
Hansen et al. 1999 (J. Geophys. Res.)

regression of NASA/NSIPP1 Sahel PC and sfc temp
Giannini et al. 2003, 2005



19 Coupled GCM : Sahel XX-PI Rainfall Change

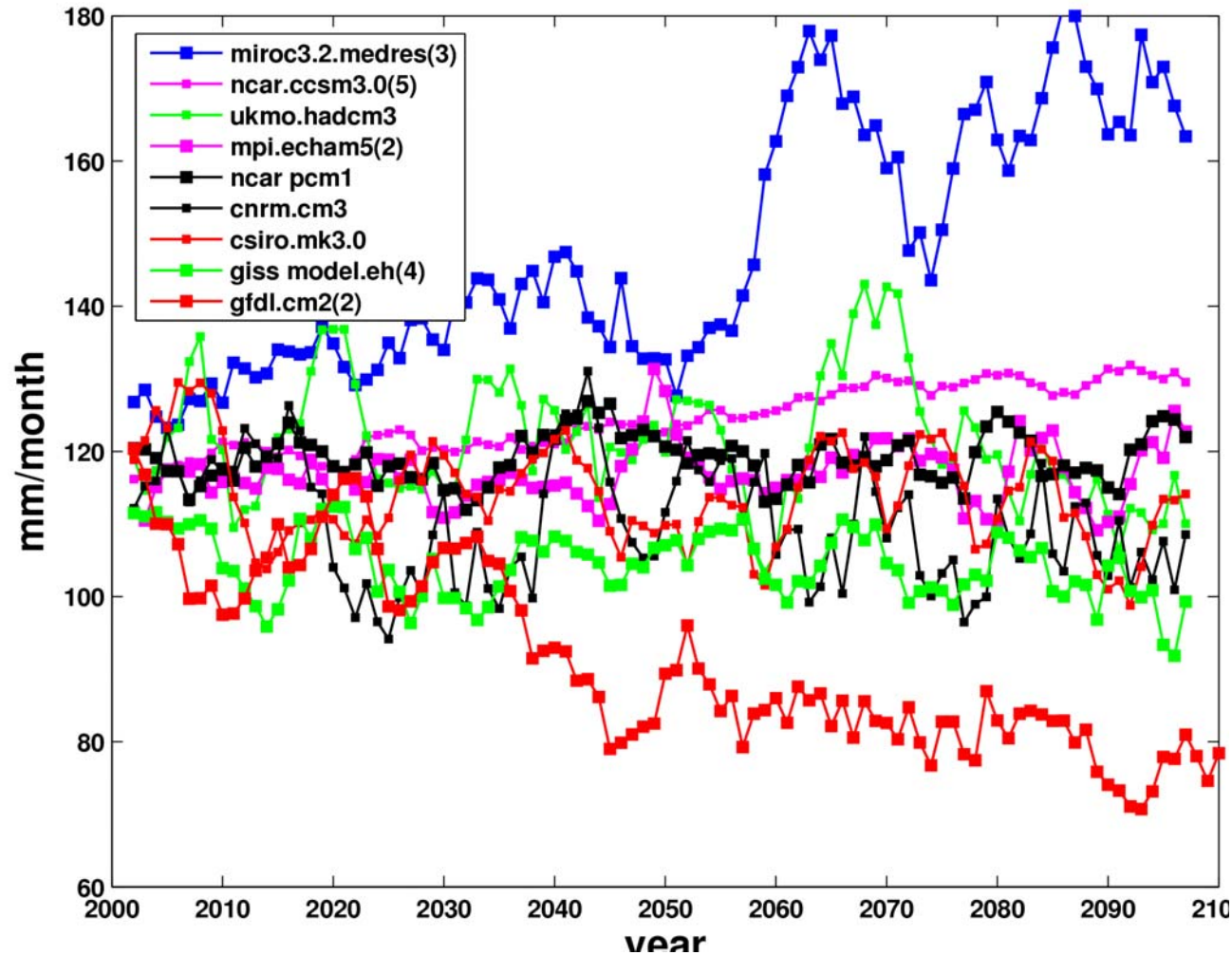


Biasutti and Giannini, in prep.

CAVEATS:

- the amplitude of variability in models is still only a fraction of the observed variability (need to include land surface/vegetation/dust feedbacks?)
- the IPCC simulations do not allow to separate “natural” (e.g. solar irradiance, volcanic aerosols) from “anthropogenic” (e.g. aerosols and greenhouse gases emitted in the process of industrialization) forcings

21st century outlook for Sahel precipitation



Courtesy of Isaac Held, Jian Lu, Tom Delworth et al, GFDL

CONCLUDING REMARKS:

- African climate variability and change are inextricably tied to variations and trends in the global climate system
- Recent trends in the global oceans and in continental precipitation can in part be ascribed to anthropogenic climate change

-->> drought in the Sahel was in part a consequence of anthropogenic climate change (greenhouse gases and aerosols)

-->> need for more global-scale climate research to understand implications of the climate change that is still to come