ADVANCE workshop on Sahel climate change
Columbia University, March 19-21 2007

Sahel rainfall variability in AMIP-type integrations

Alessandra Giannini
IRI for Climate and Society
The Earth Institute at Columbia University

The Earth Institute
AT COLUMBIA UNIVERSITY
Mobilizing the Sciences and Public Policy to Build a Prosperous and Sustainable Future

IRI

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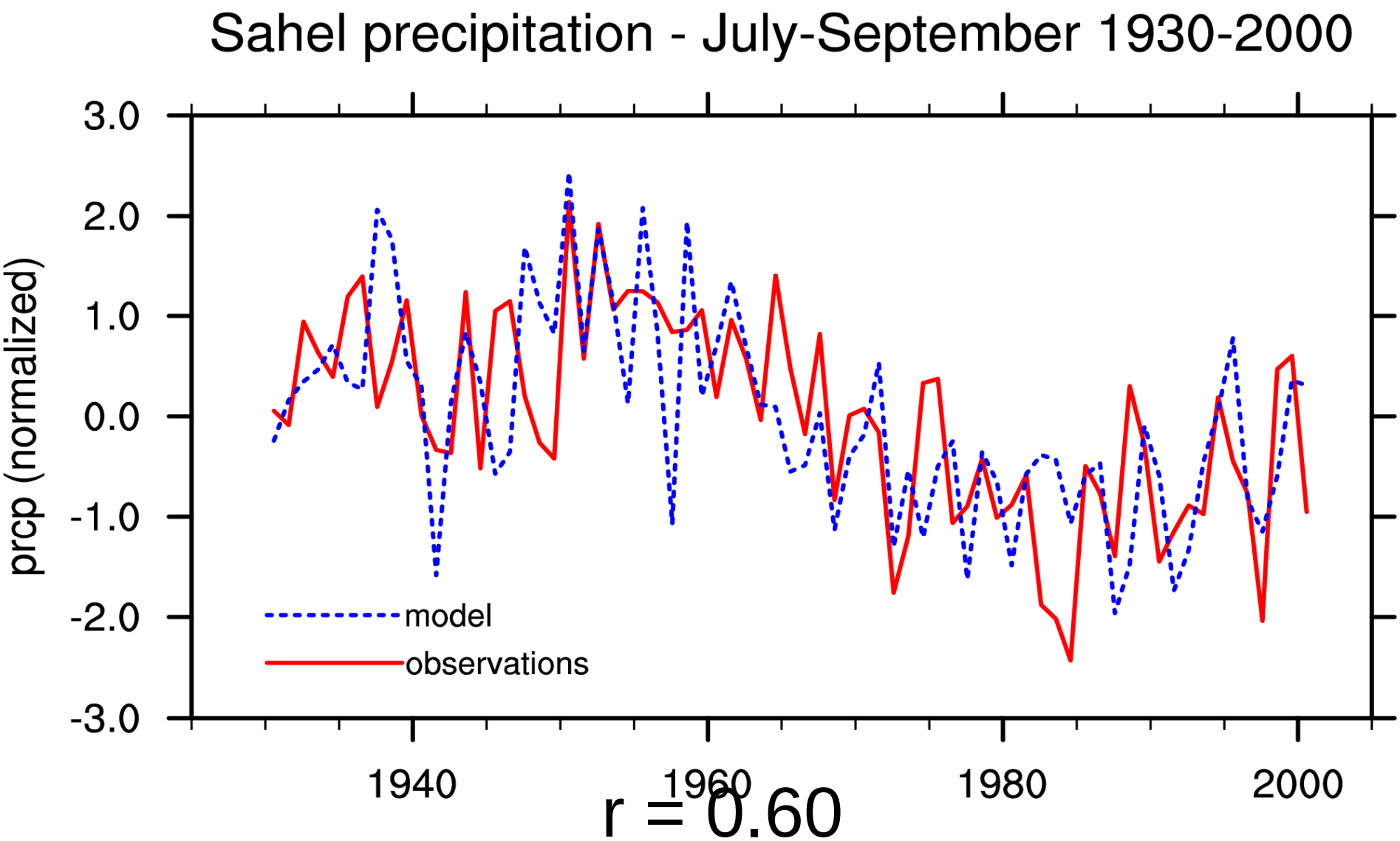

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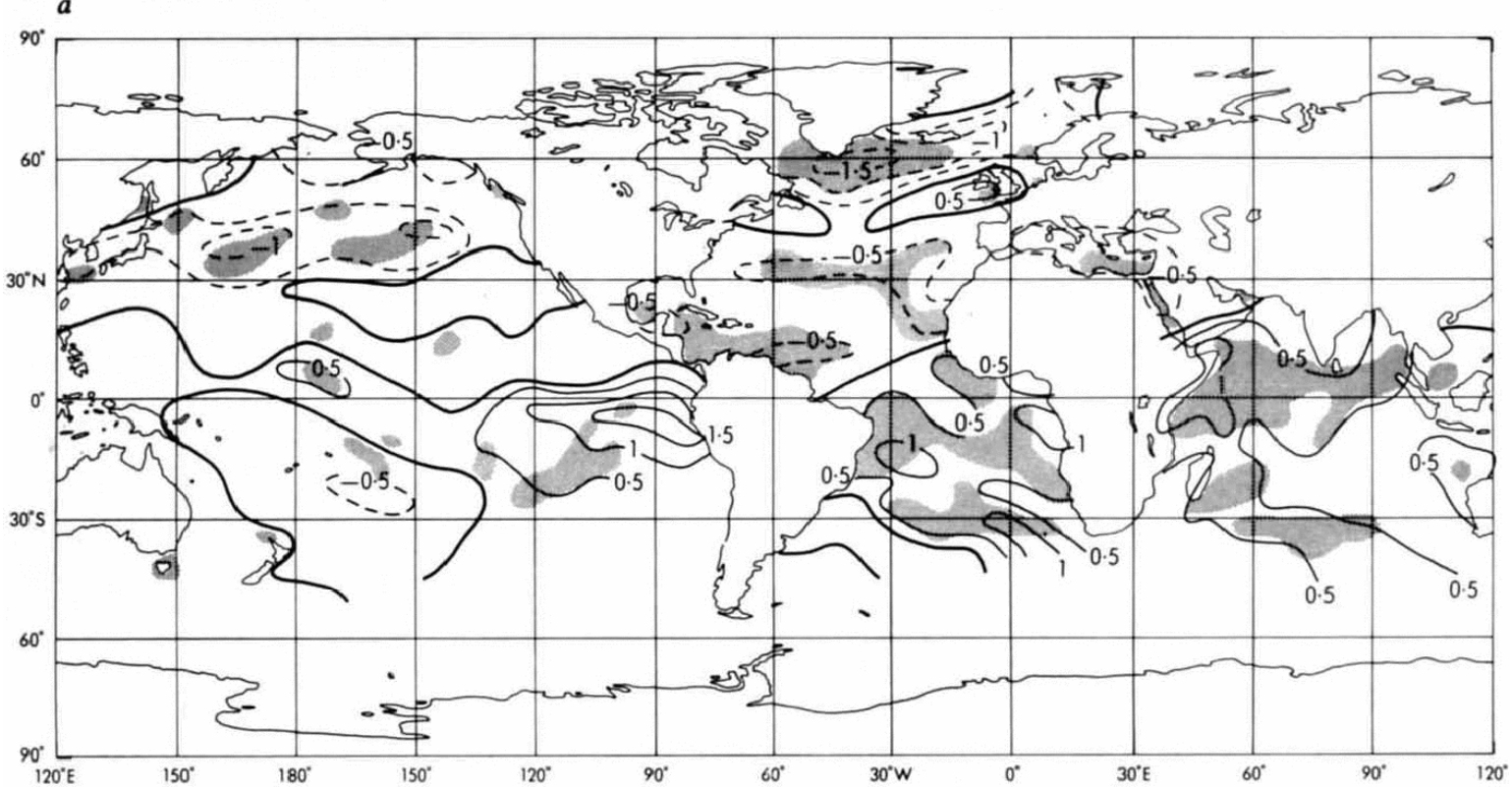
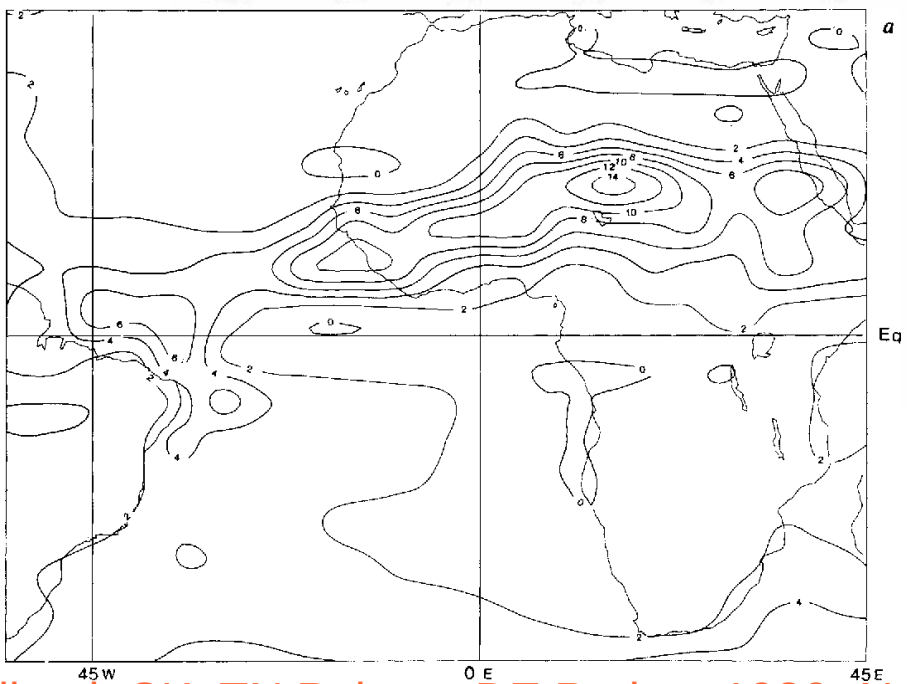
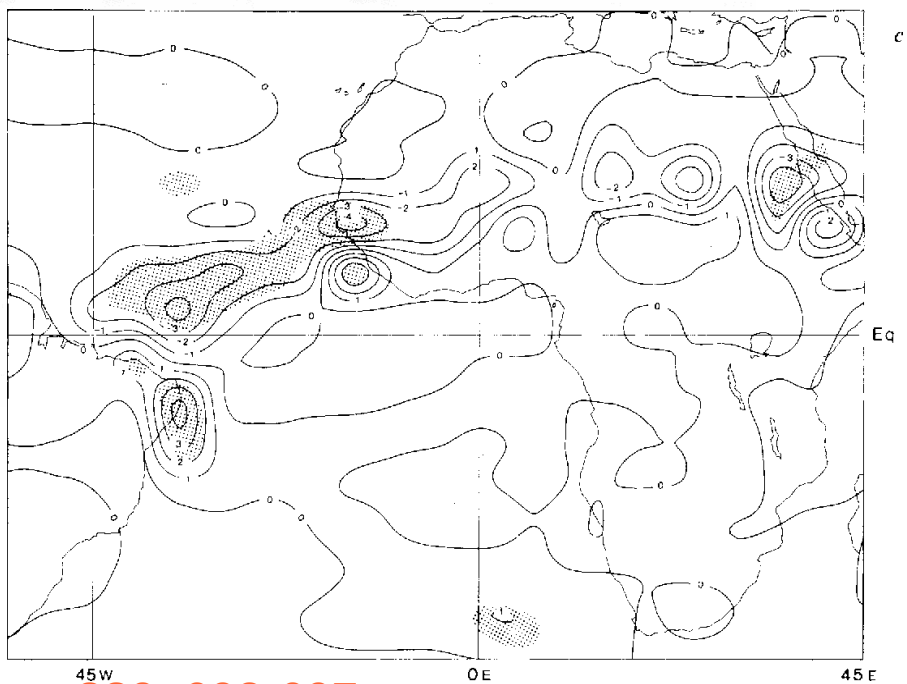


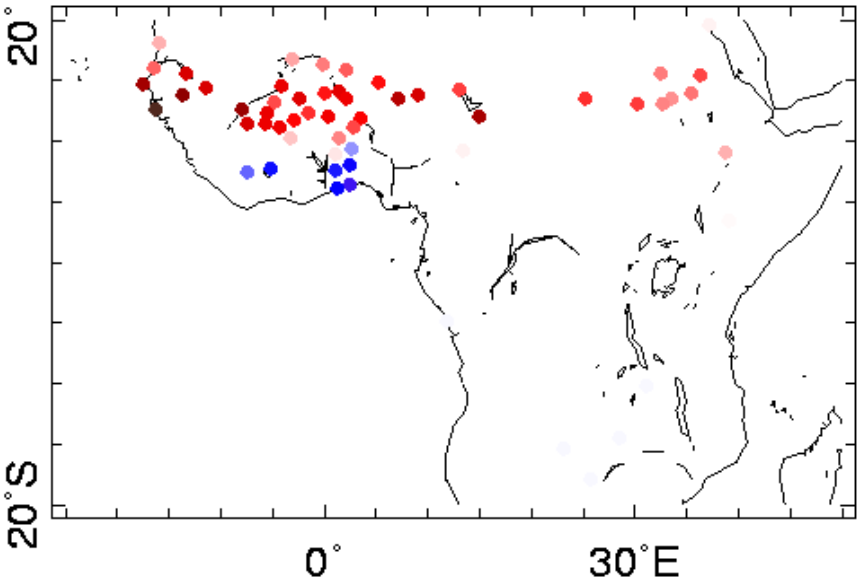


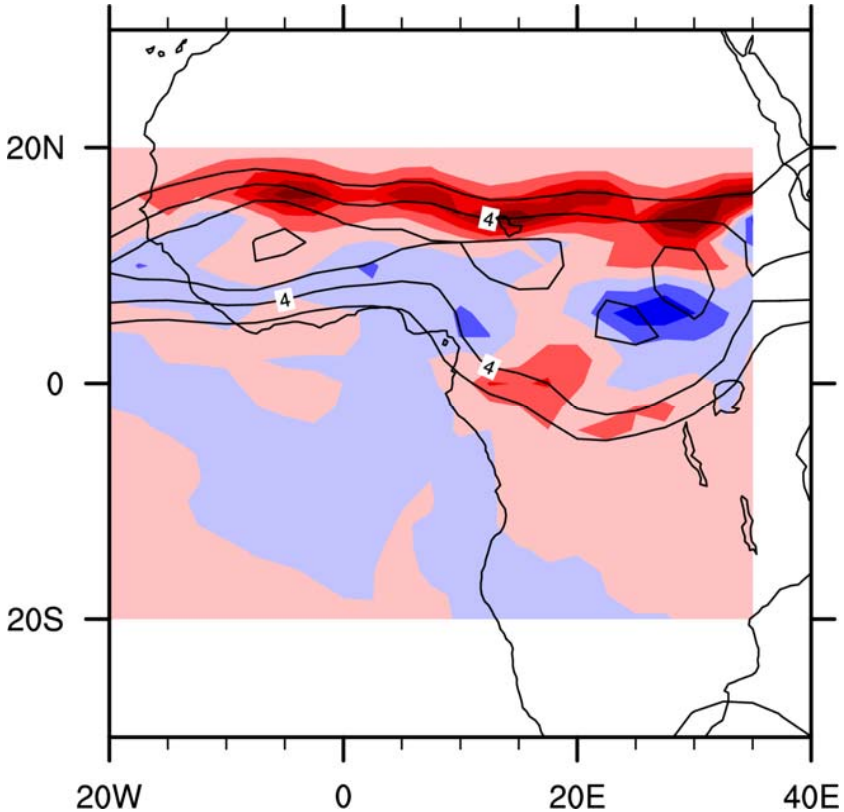


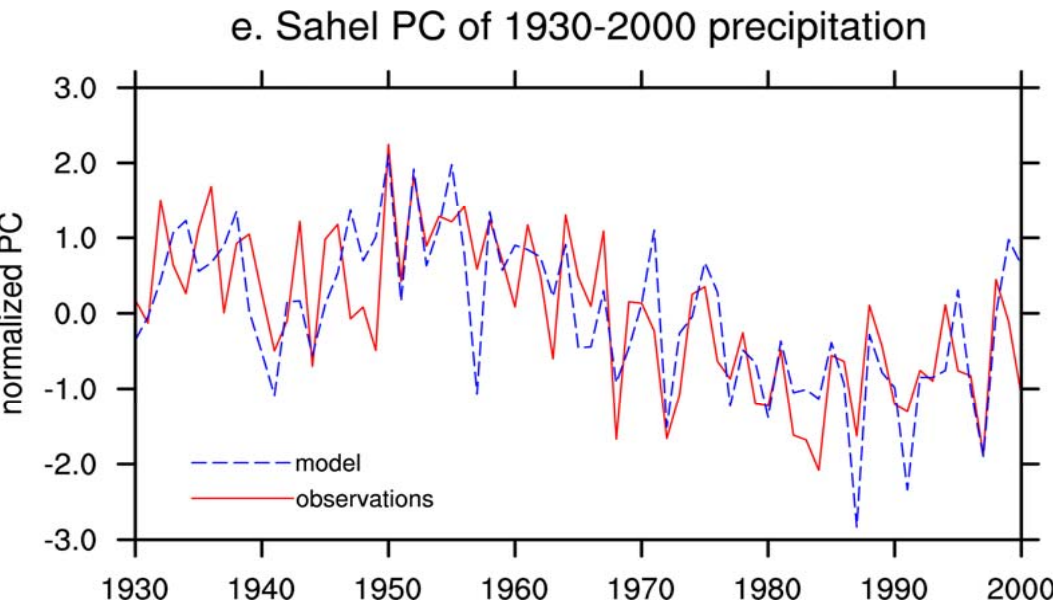
Folland, CK, TN Palmer, DE Parker, 1986. *Nature*, **320**, 602-607

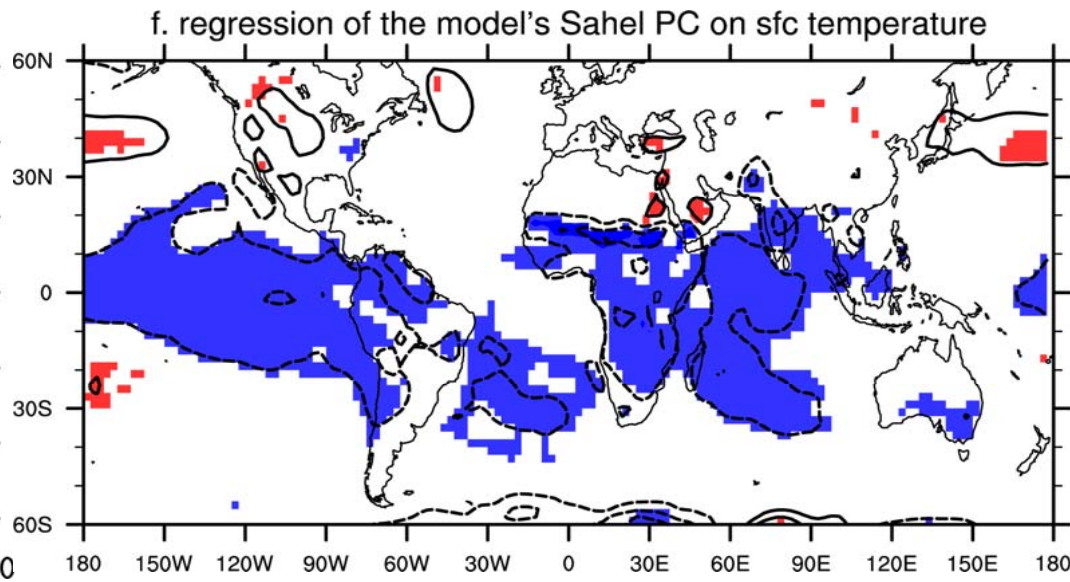
Variability in Sahel rainfall

(25% in obs, 21% in ens-mean)



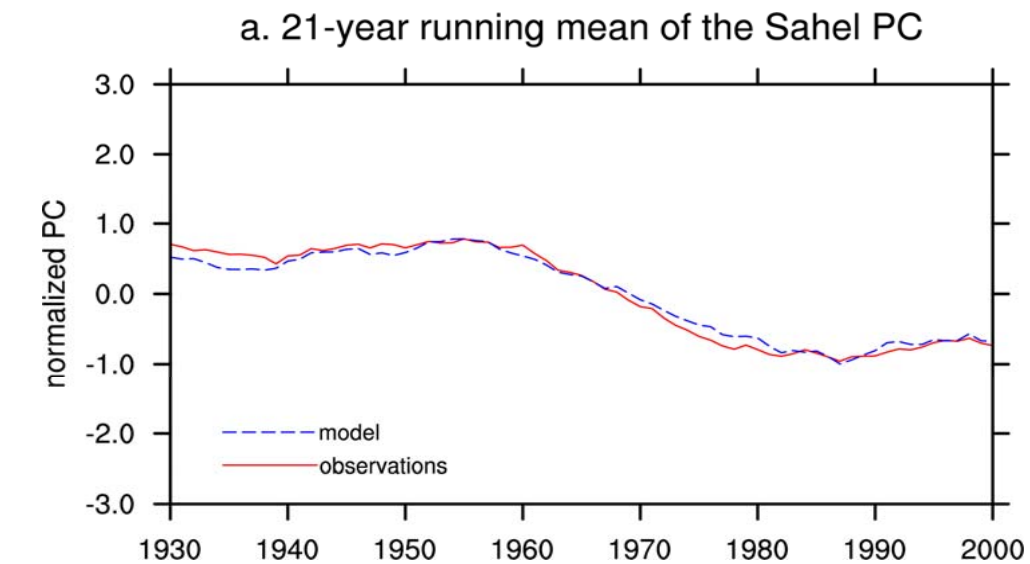


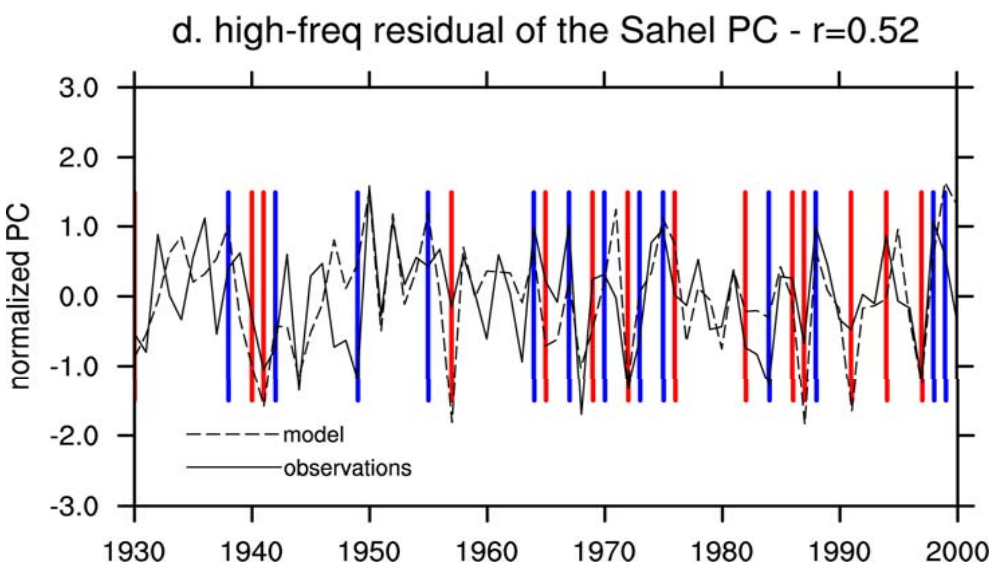


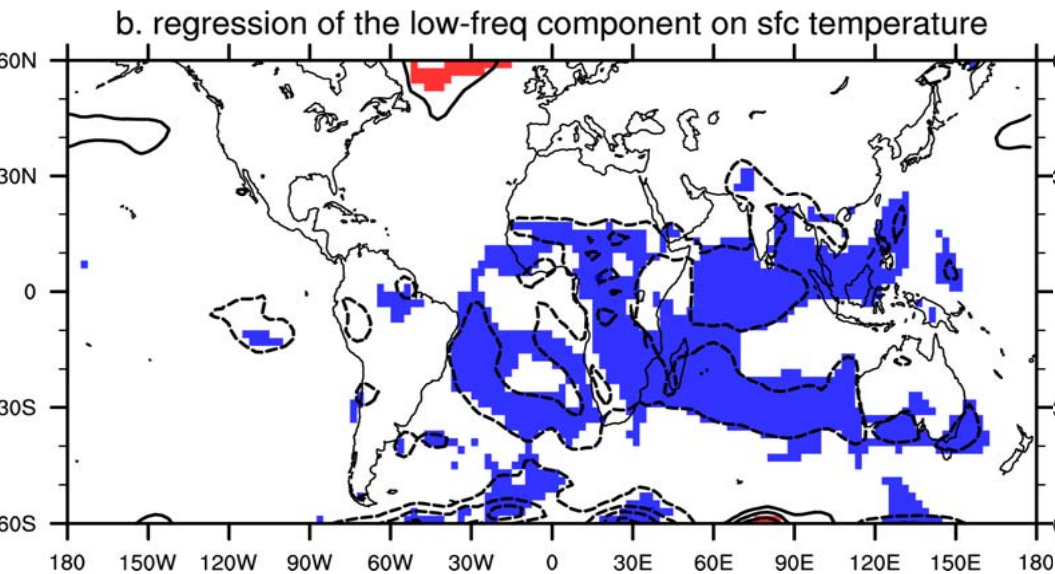


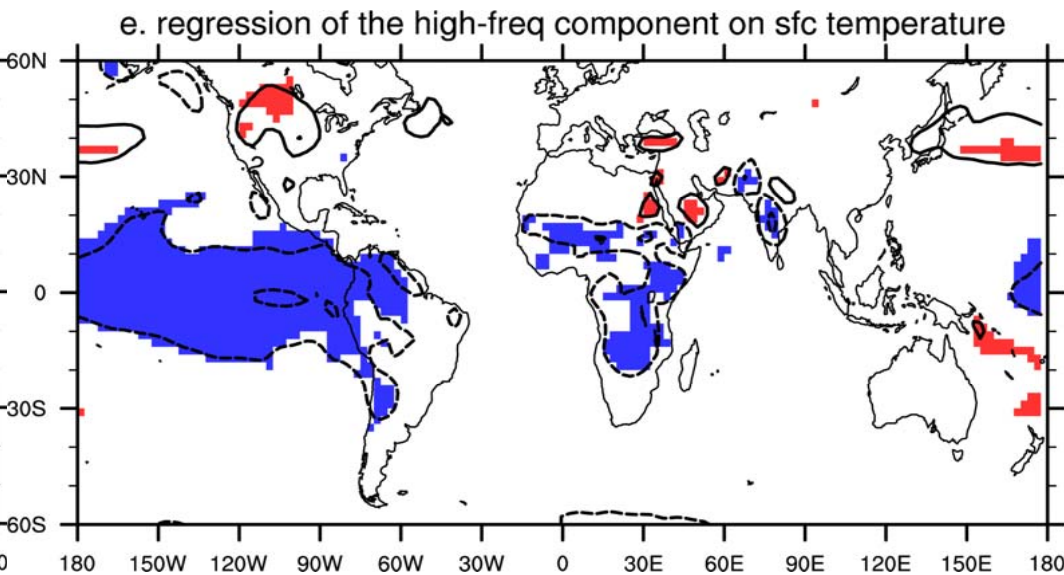
Giannini, A, R Saravanan, P Chang, 2005 (Clim. Dyn.)

Variability in Sahel rainfall: interdecadal and interannual time scales





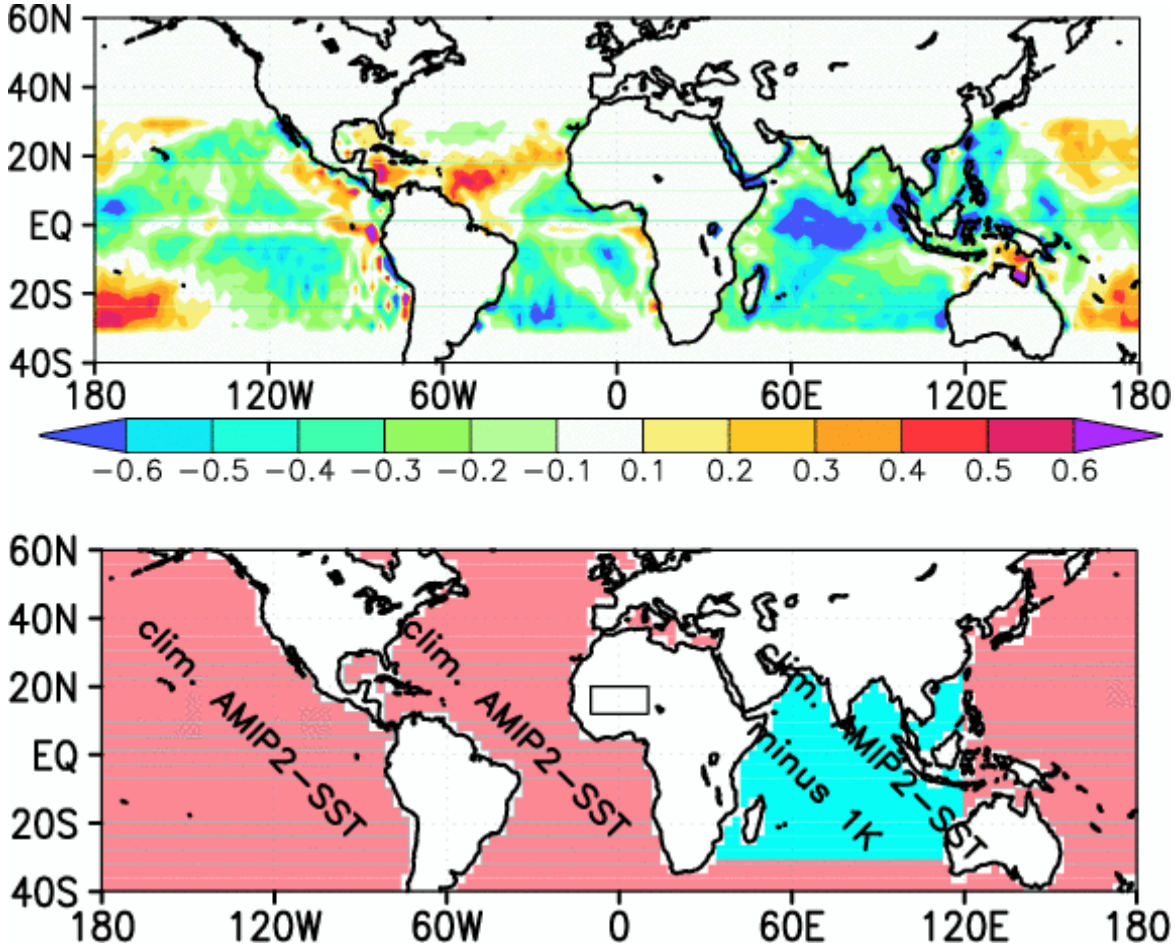




Giannini, A, R Saravanan, P Chang, 2003 (Science)

The role of Indian Ocean SSTs

20 years of cold SST minus climatology



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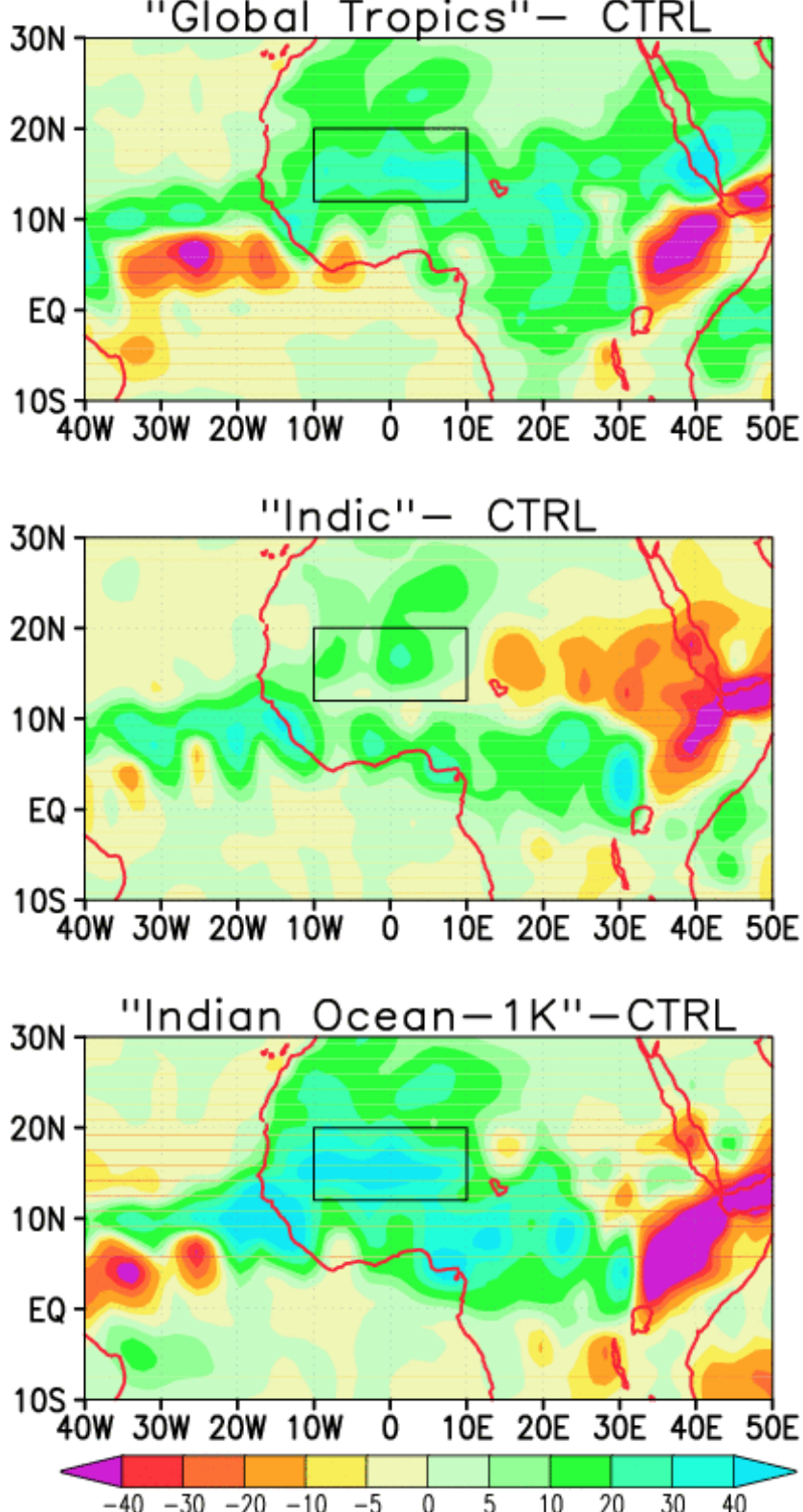
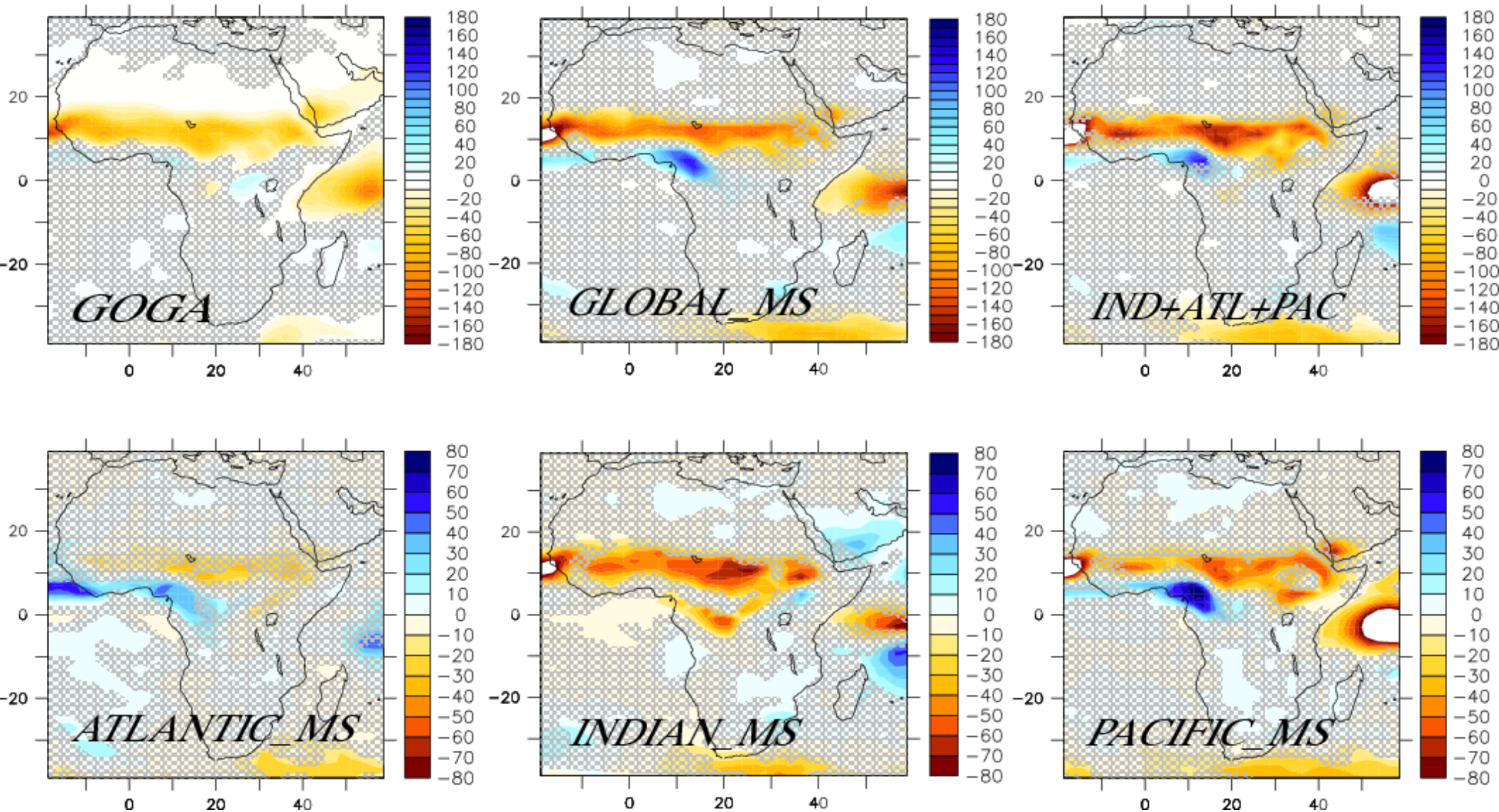
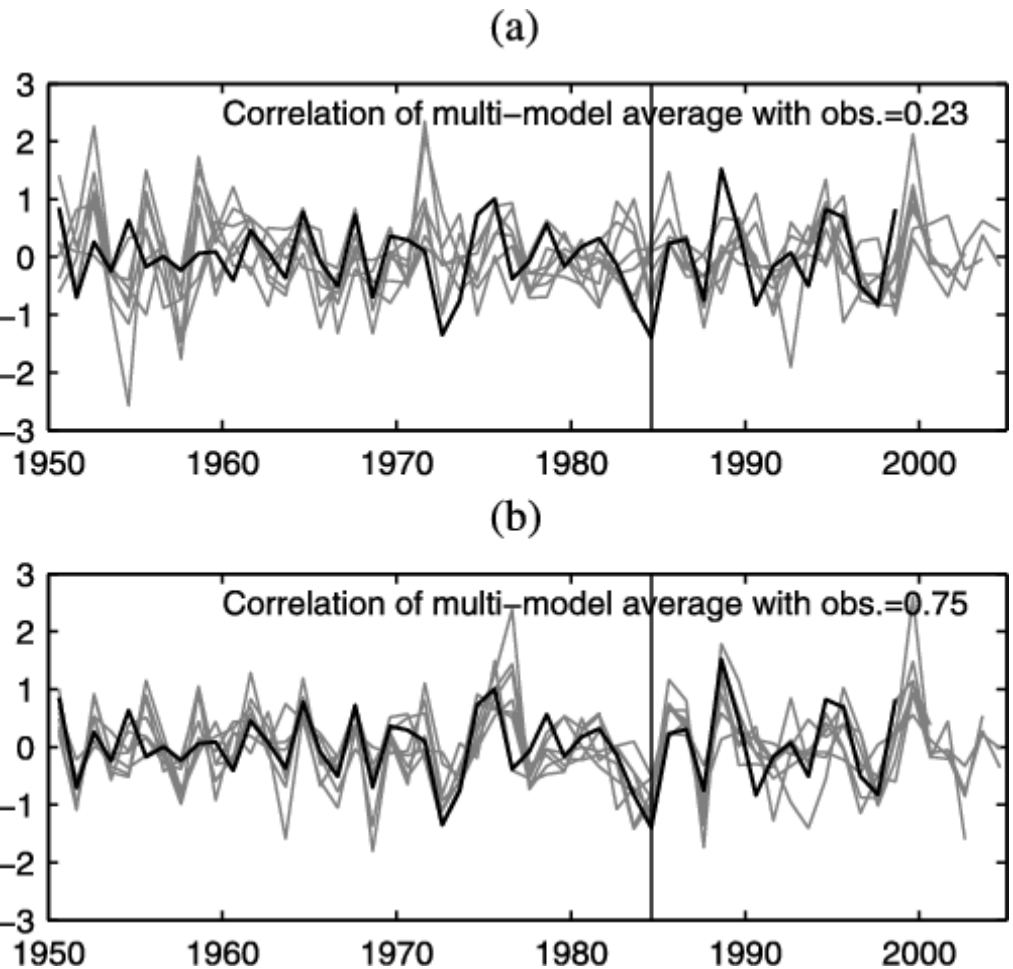


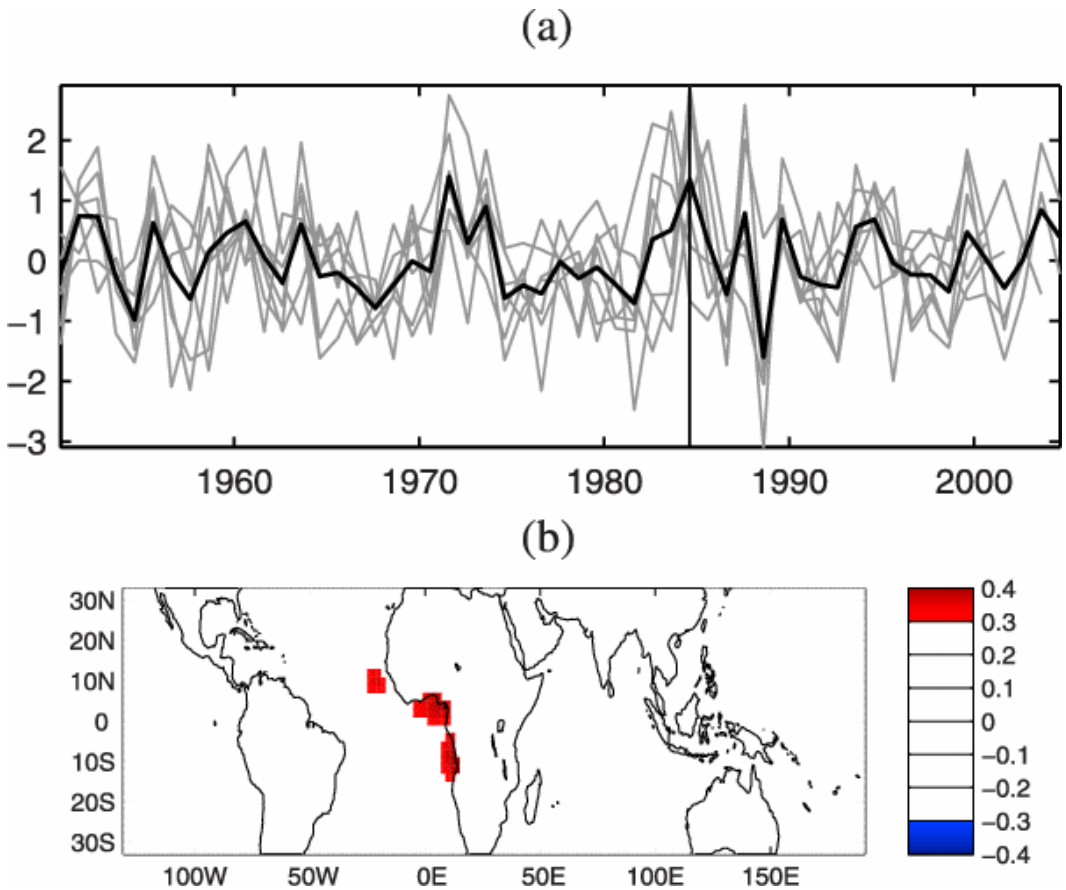
The relative roles of the Atlantic, Indian and Pacific Oceans



Lu, J, TL Delworth, 2005 (Geophys. Res. Lett.)

Application of ensemble techniques (S/N EOF) to filter signal and identify source of noise (error)





Tippett, MK, 2006 (Geophys. Res. Lett.)

Cess experiment: +2K globally (oceans)

GFDL CM2.0 GMAO(NSIPP1) NCAR CAM3

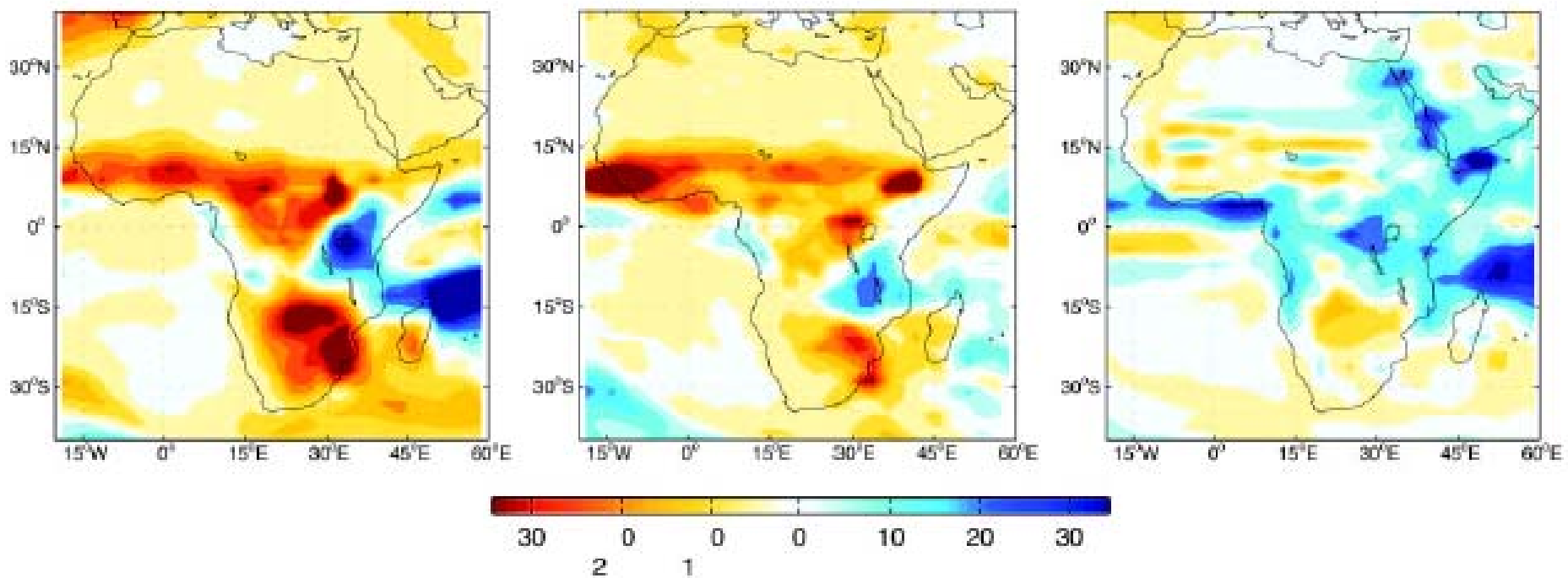


Fig. 5. The annual mean precipitation response of three atmospheric models to a uniform warming of ocean temperatures. (*Left*) The atmospheric component of CM2.0. (*Center*) A model developed at National Aeronautics and Space Administration's Global Modeling and Assimilation Office (J. Bacmeister, personal communication). (*Right*) The CAM3 model developed at the National Center for Atmospheric Research (J. Kiehl, personal communication).

Held et al., *PNAS* 2005

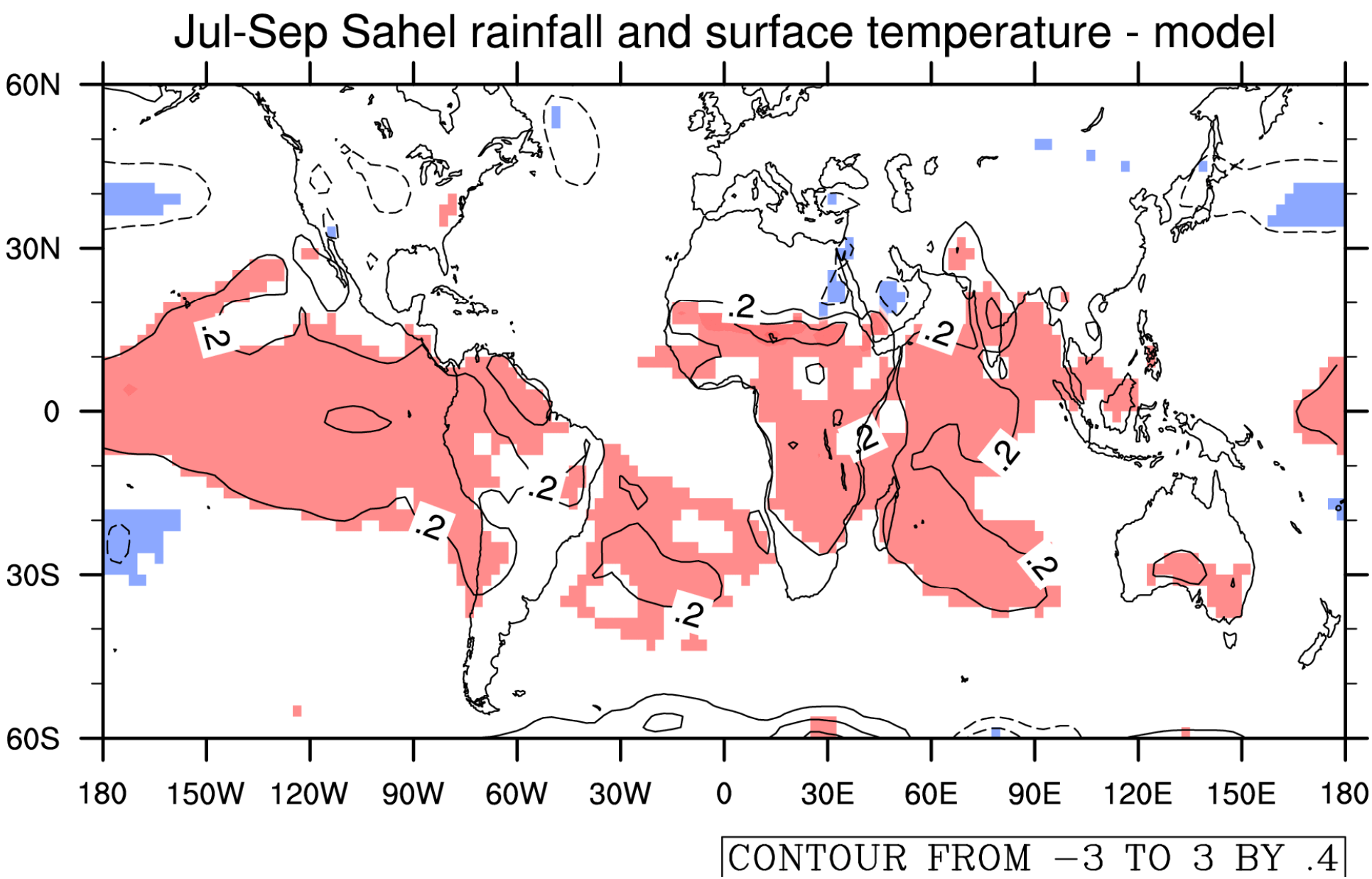
Two outstanding issues:

- if signal is ocean-forced, how do teleconnections work?

- what is the role of land surface-atmosphere interaction?

teleconnections:

equatorial (ENSO-like), monsoonal, ...


Jul-Sep Sahel rainfall and surface temperature - model
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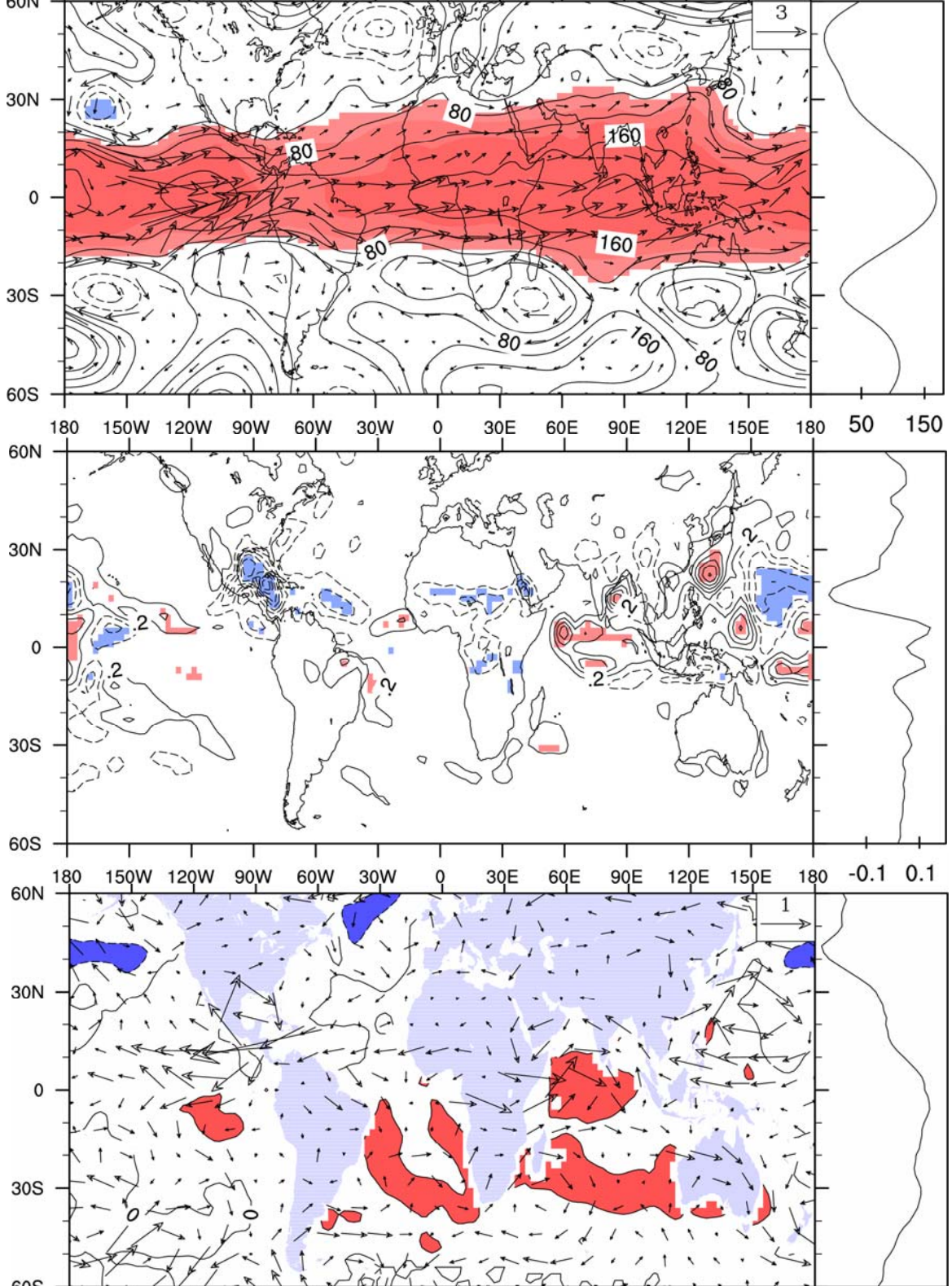
30S
60S
180
150W
120W
90W
60W
30W
0
30E
60E
90E
120E
150E
180
.2
CONTOUR FROM −3 TO 3 BY .4

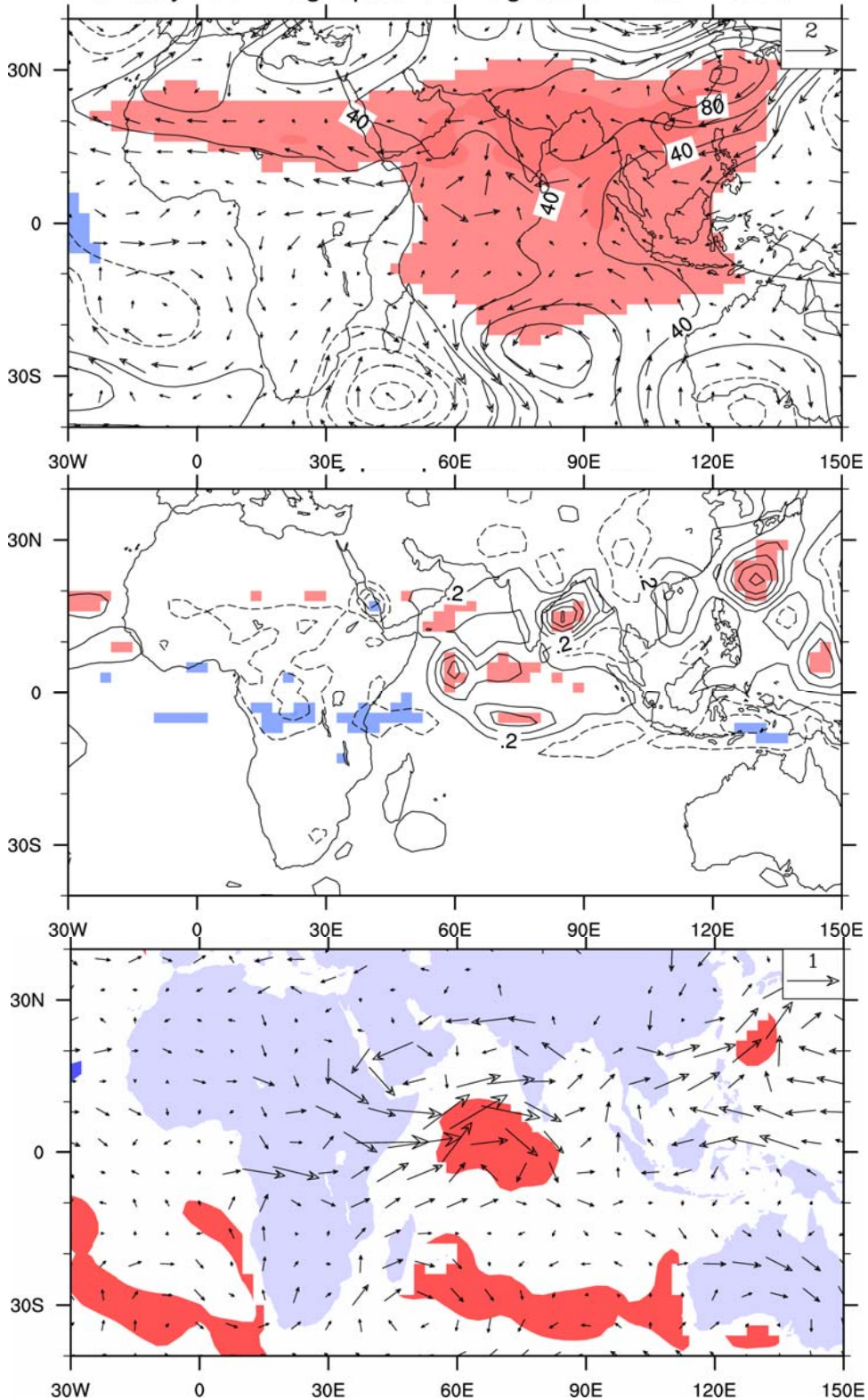


200 hPa h, (u,v)

precipitation

SST, 850hPa (u,v)

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



200 hPa h, (u,v)

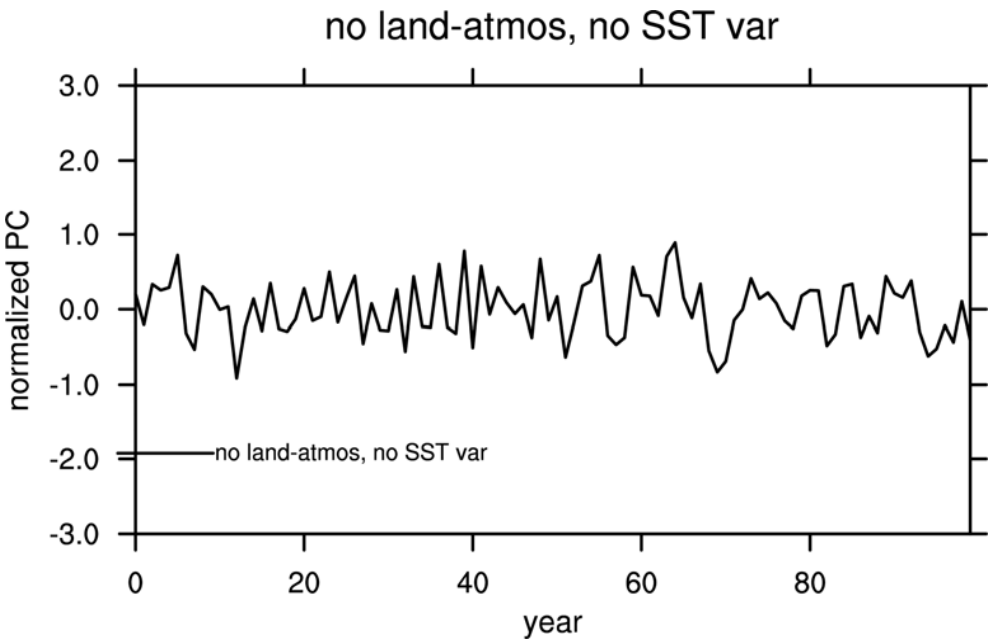
precipitation

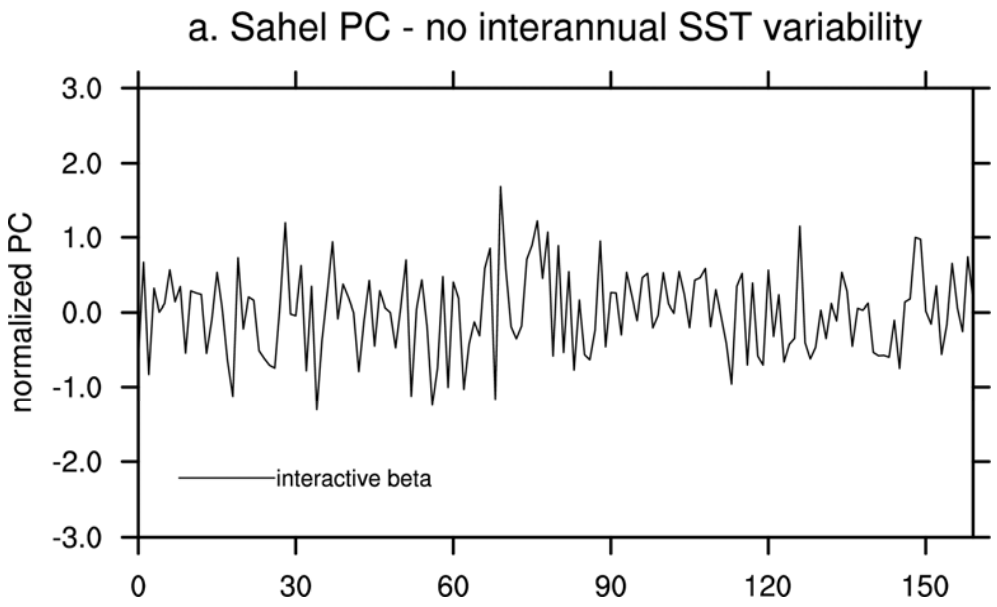
SST, 850hPa (u,v)

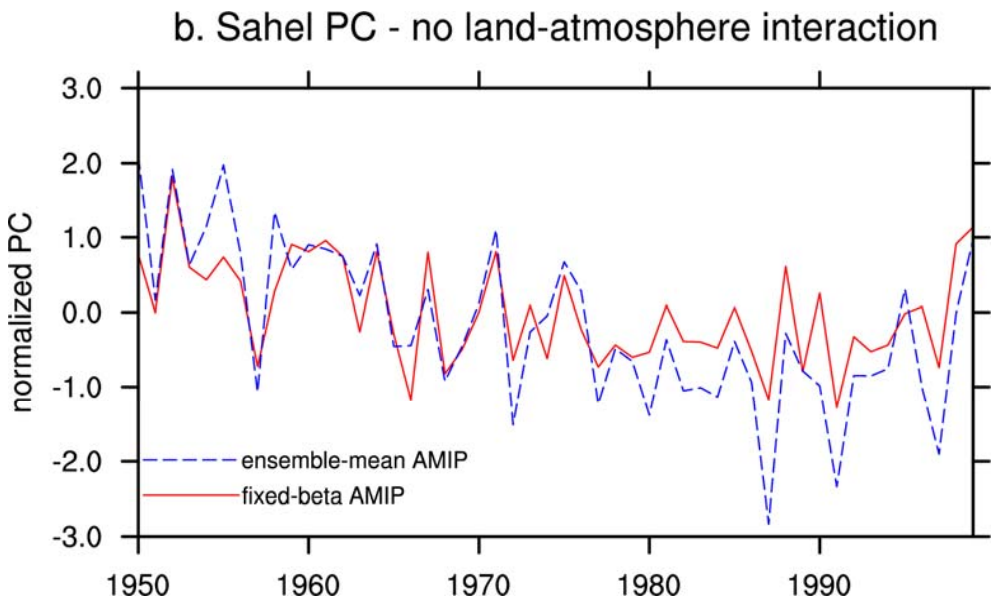
Giannini et al., 2005 (Clim. Dyn.)

land surface-atmosphere interaction:

is it a positive or negative feedback?







Giannini et al., 2003 (Science)

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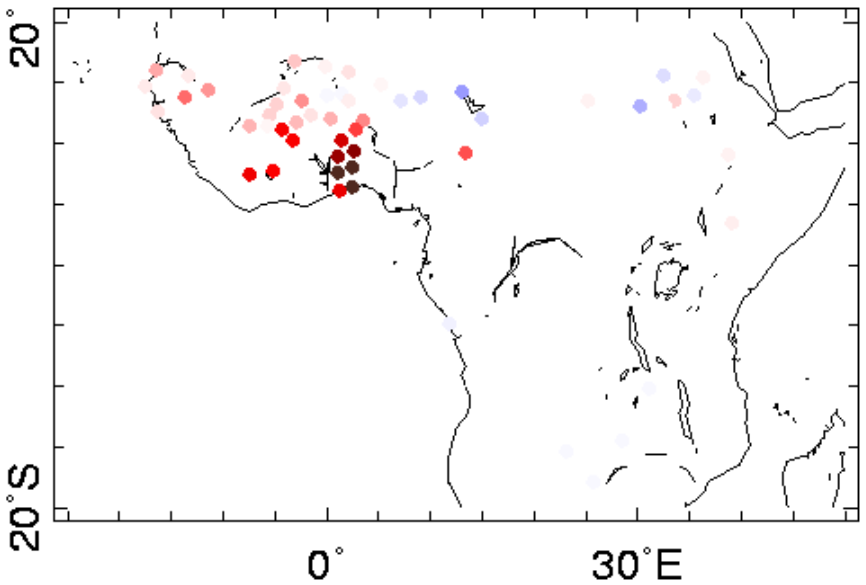
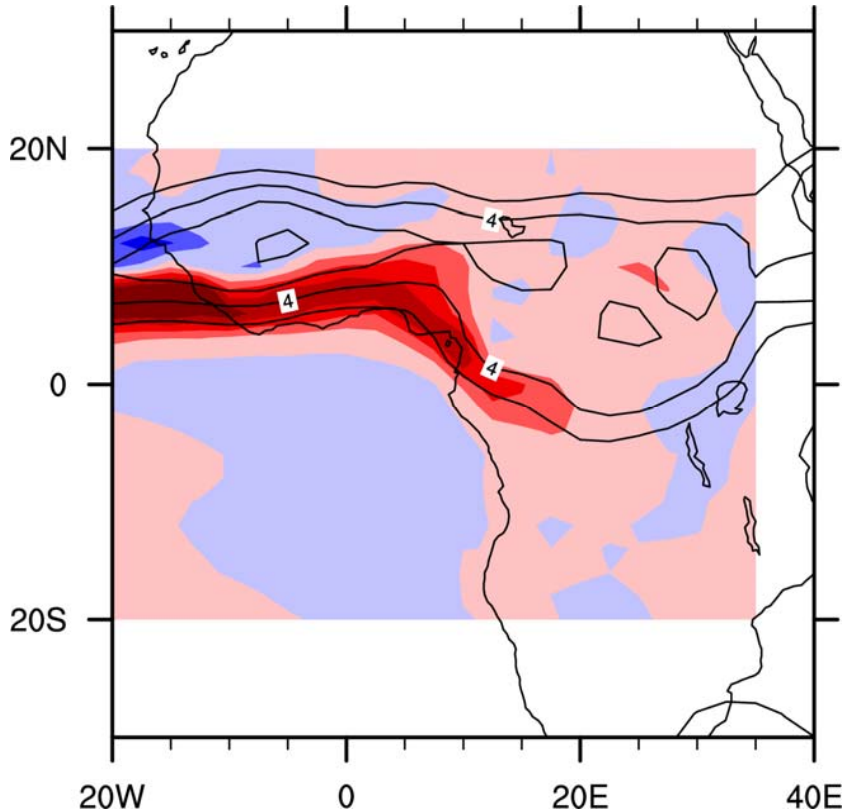
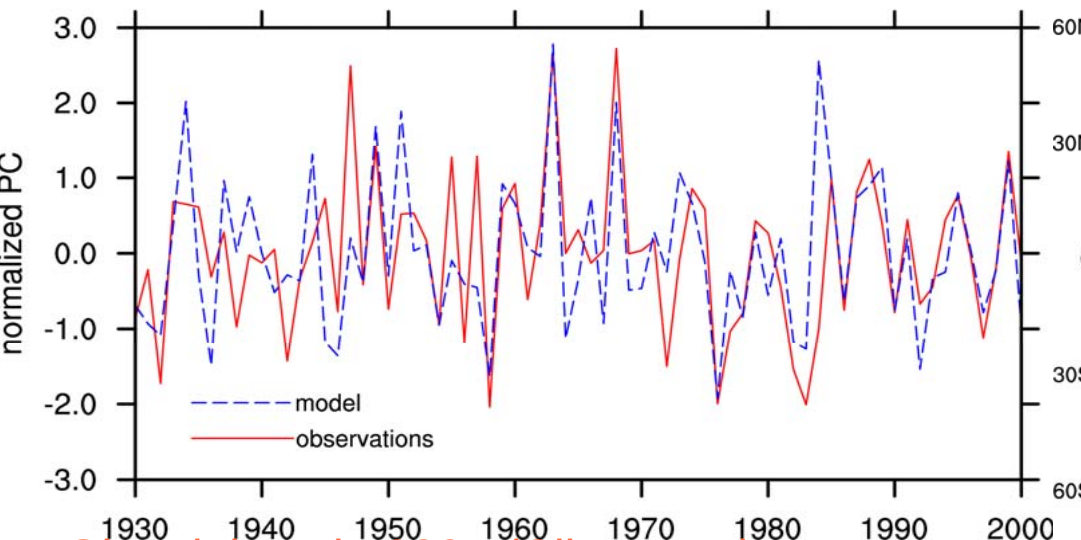
Variability in Gulf of Guinea rainfall

(15% in obs, 32% in ens-mean)

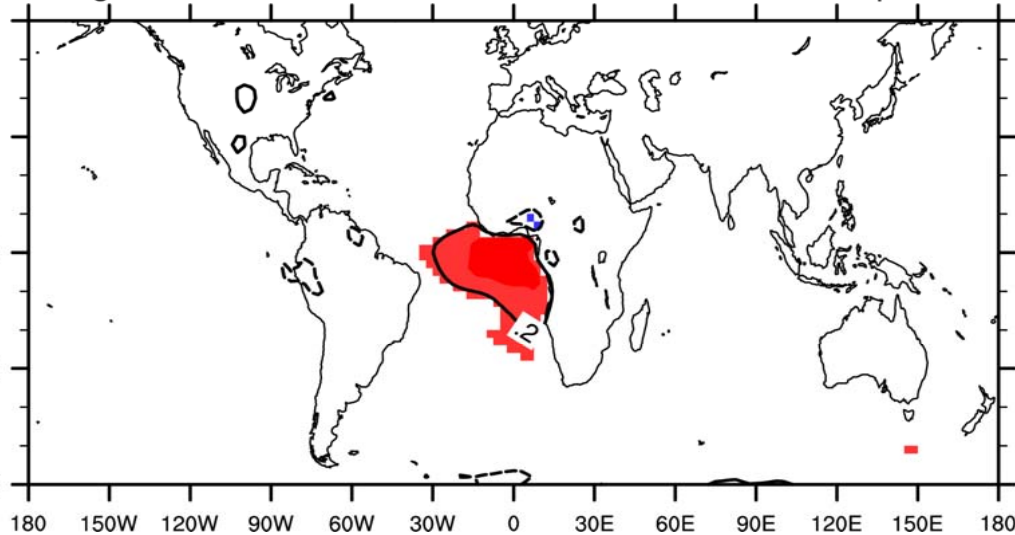




b. Gulf of Guinea PC of 1930-2000 precipitation

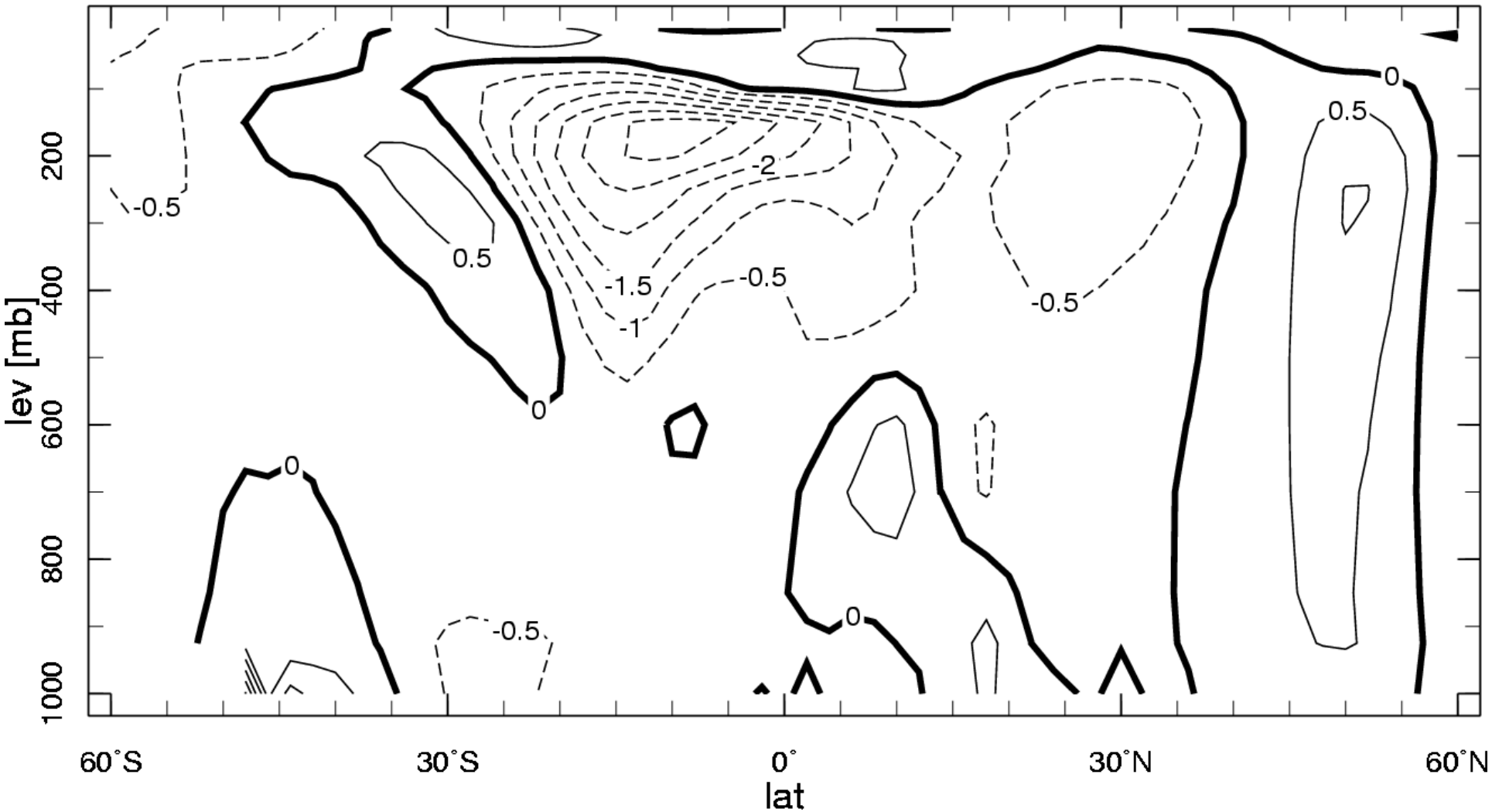


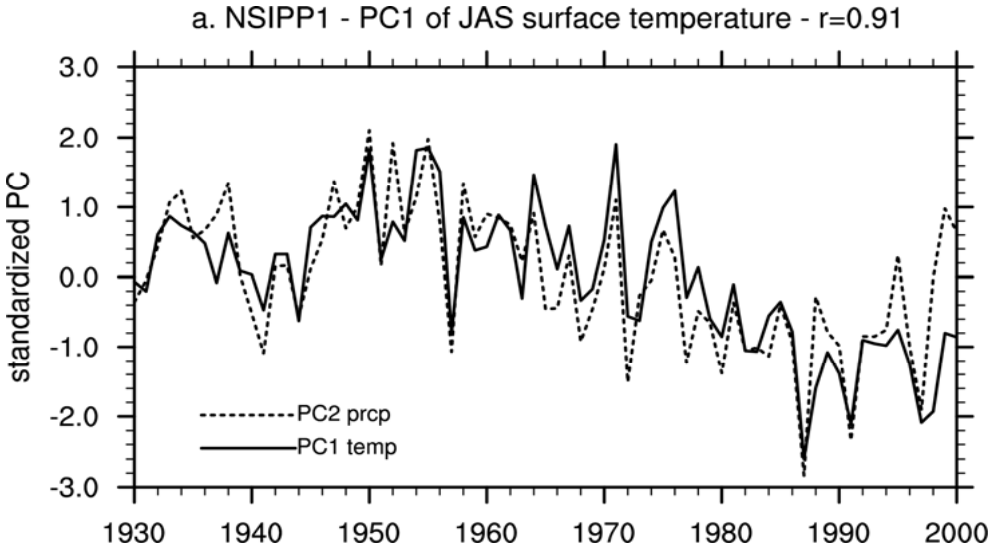
c. regression of the model's Gulf of Guinea PC on sfc temperature

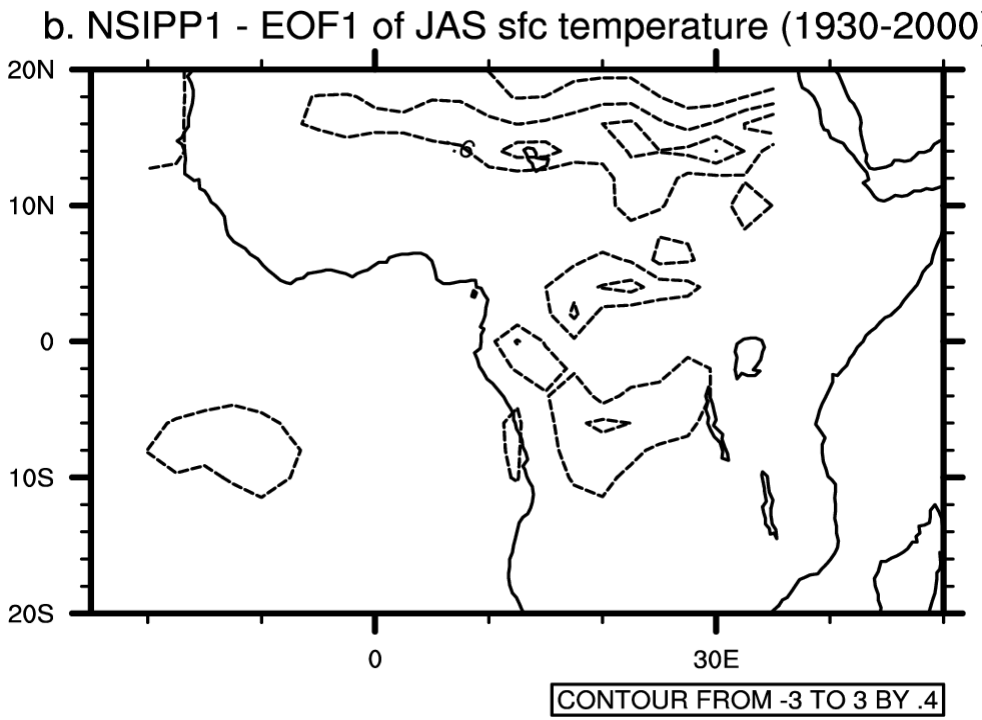


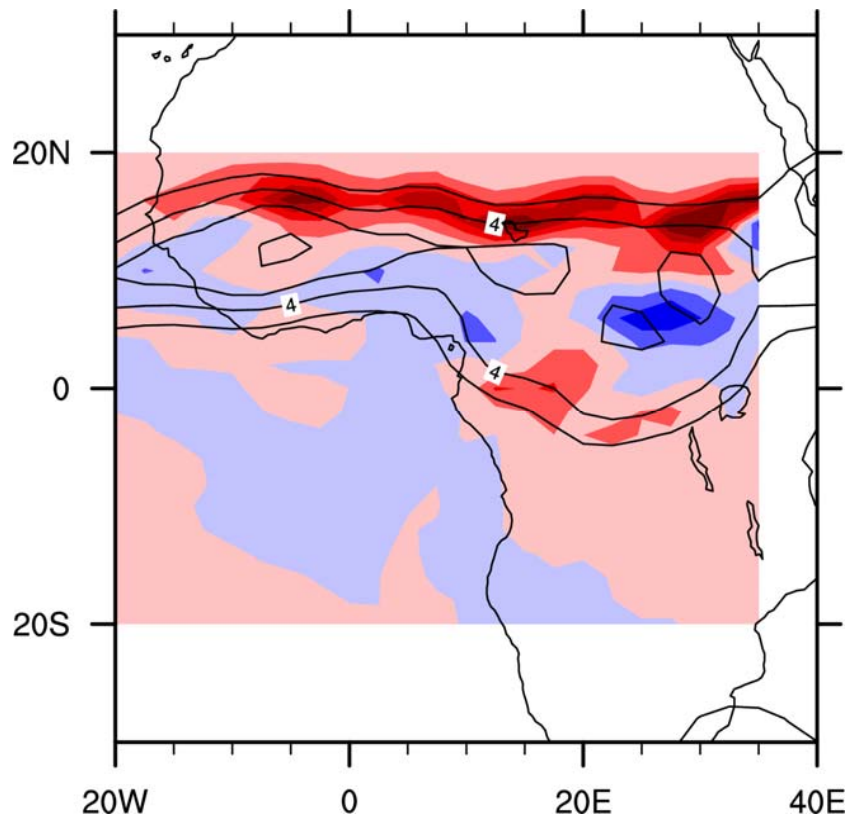
Giannini et al., 2005 (Clim. Dyn.)

Zonal wind component in 20W-35E --- NSIPP1 Neg-Cli (WET)

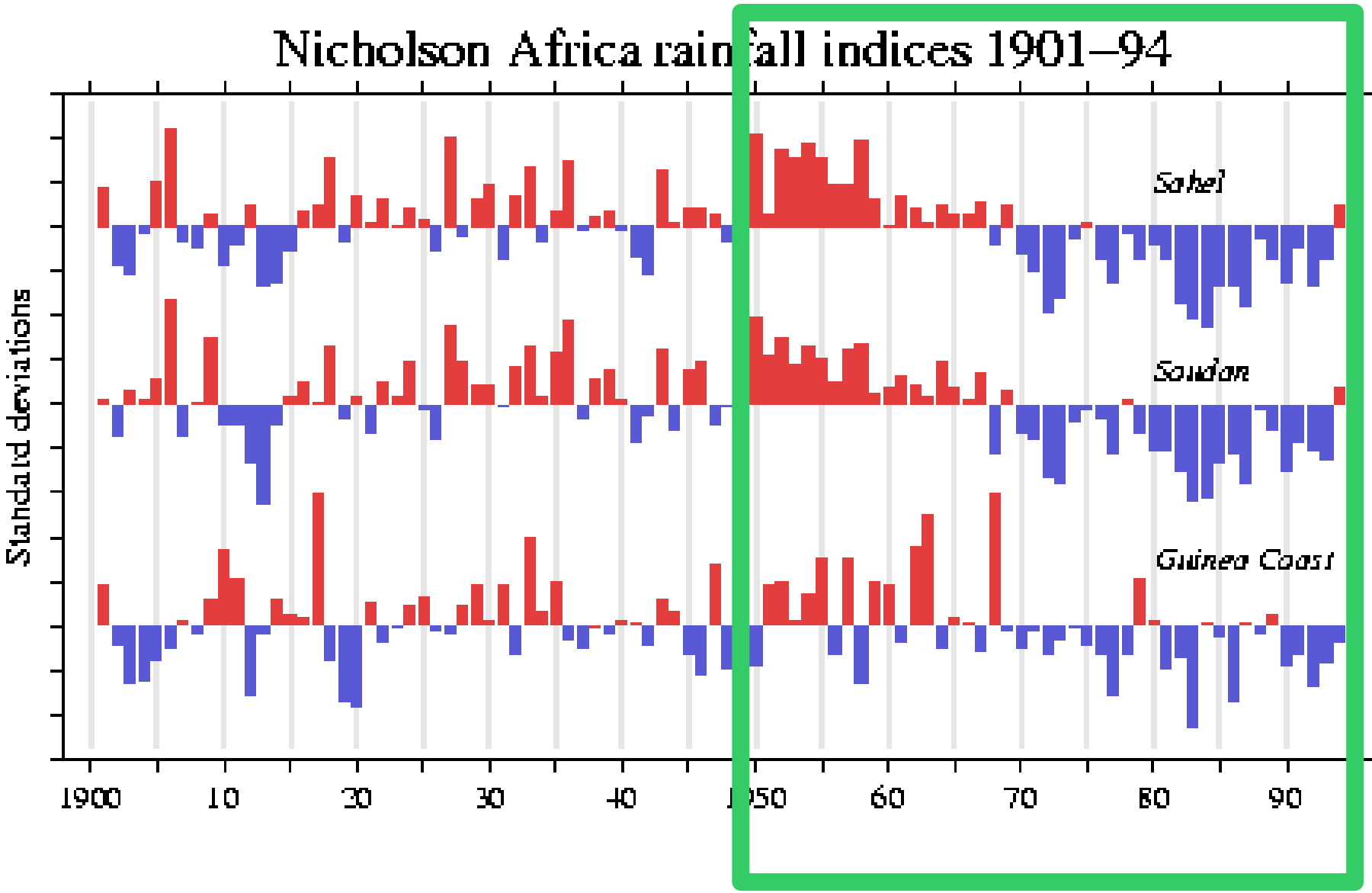




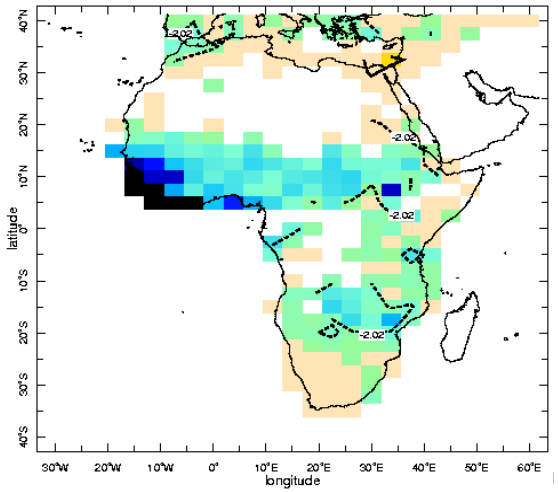




Giannini et al., 2005 (Clim. Dyn.)



Courtesy of Todd Mitchell, UW/JISAO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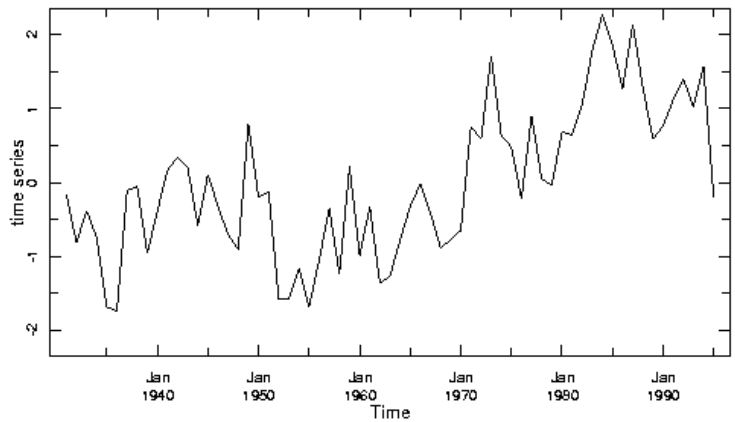
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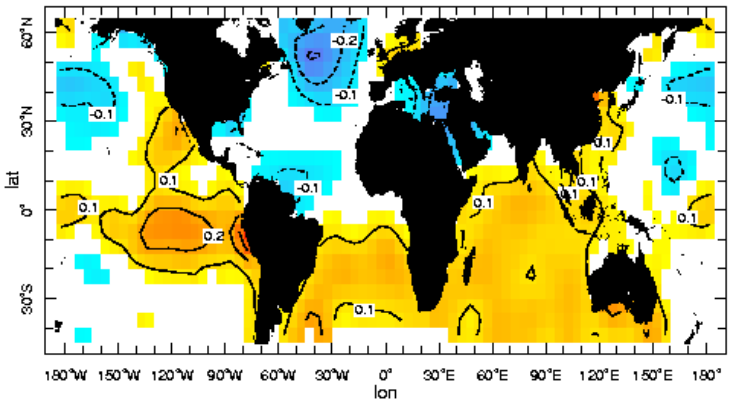
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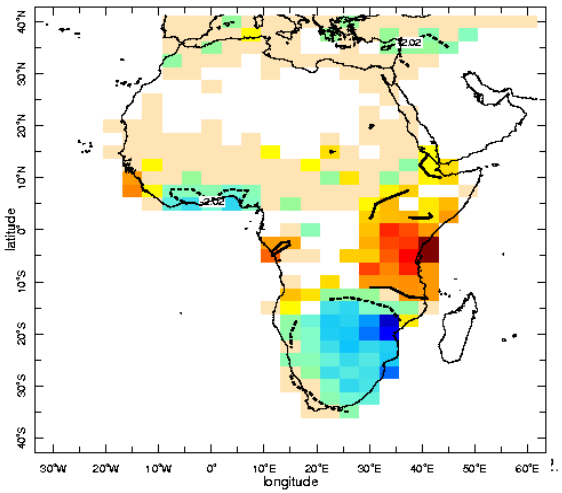
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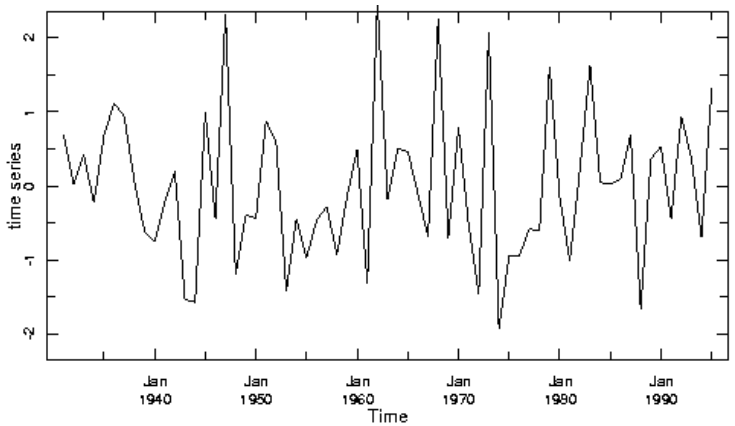
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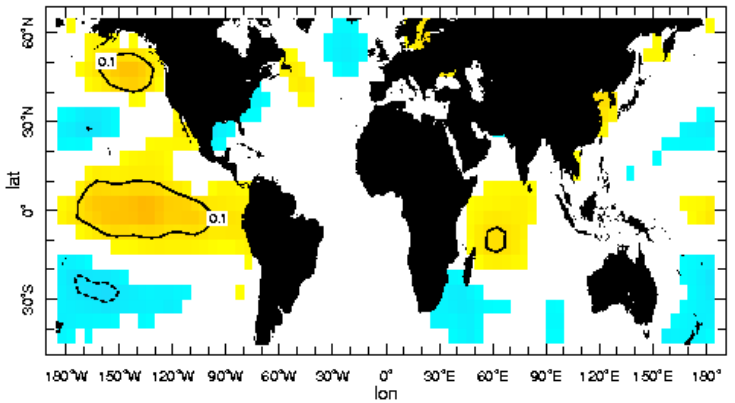
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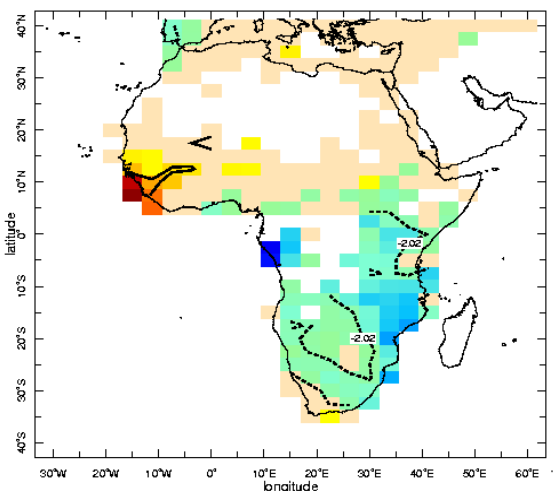
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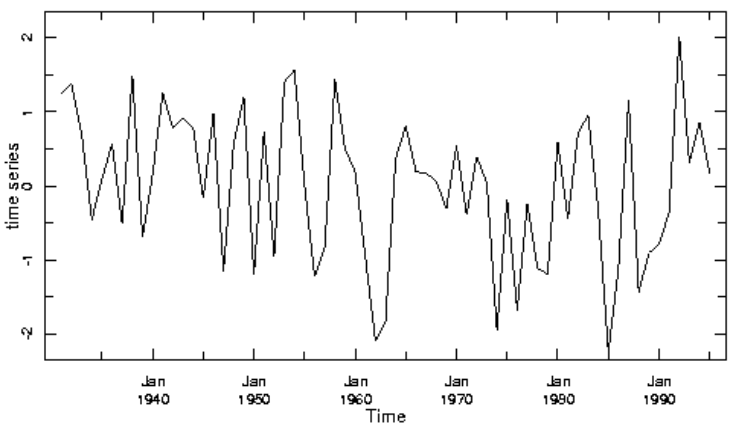
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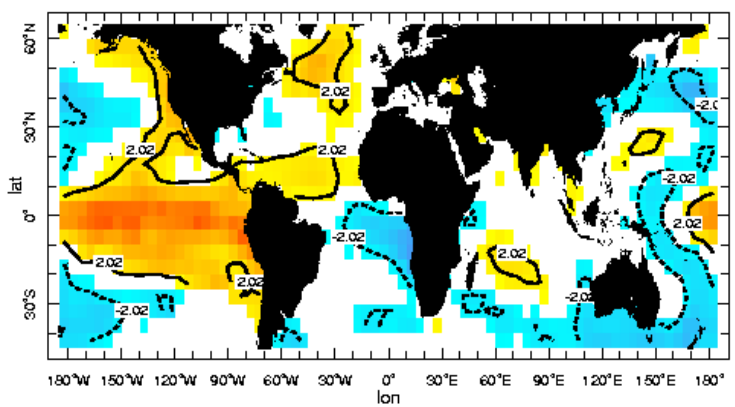
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-2.02

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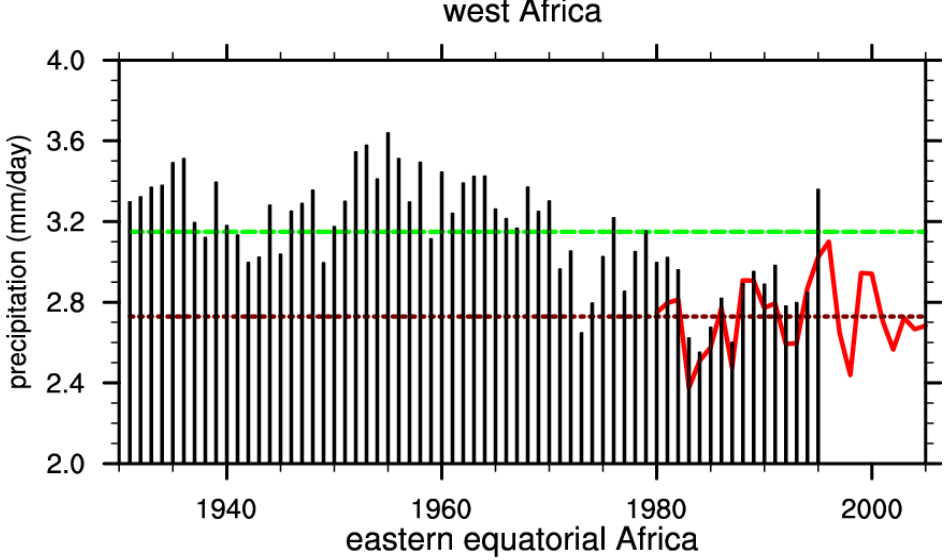

Eastern eq Africa:
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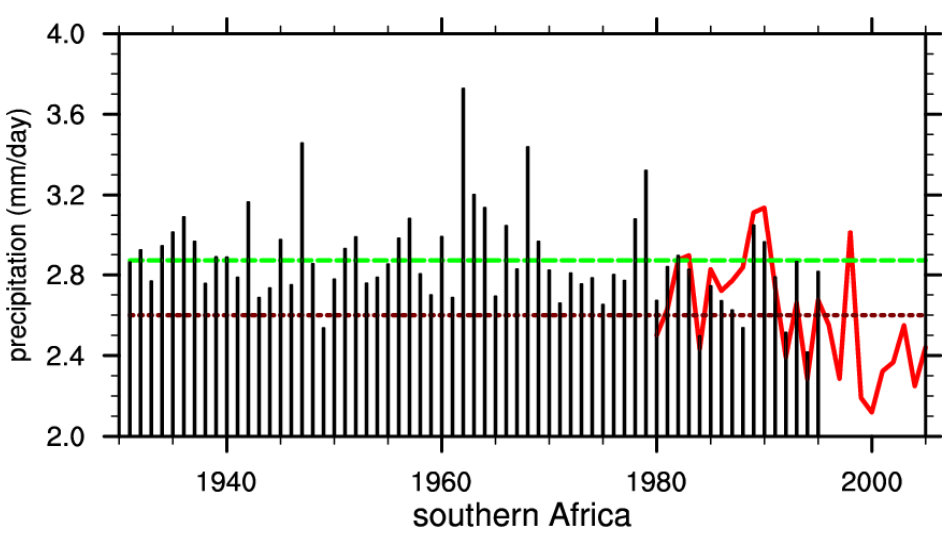

Southern Africa:
25-10S, 20-40E