

Geophysical Fluid Dynamics Laboratory Review

June 30 - July 2, 2009



Sahel Drought: Past and Future

Presented by
Isaac Held

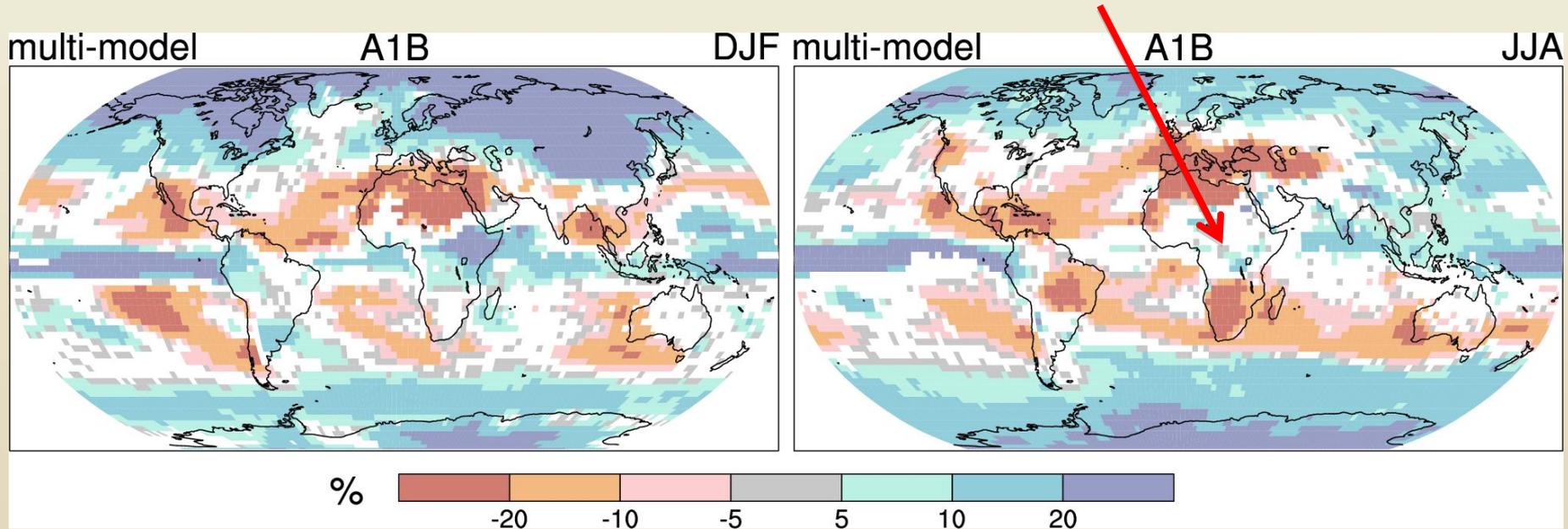
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Sahel Drought: Past and Future

**Rainfall projections remain very uncertain
in much of tropical Africa**



White areas => less than two thirds of the models agree on the sign of change

Percentage change in precipitation by end of 21st century:
AR4-SPM based on PCMDI-CMIP3 archive

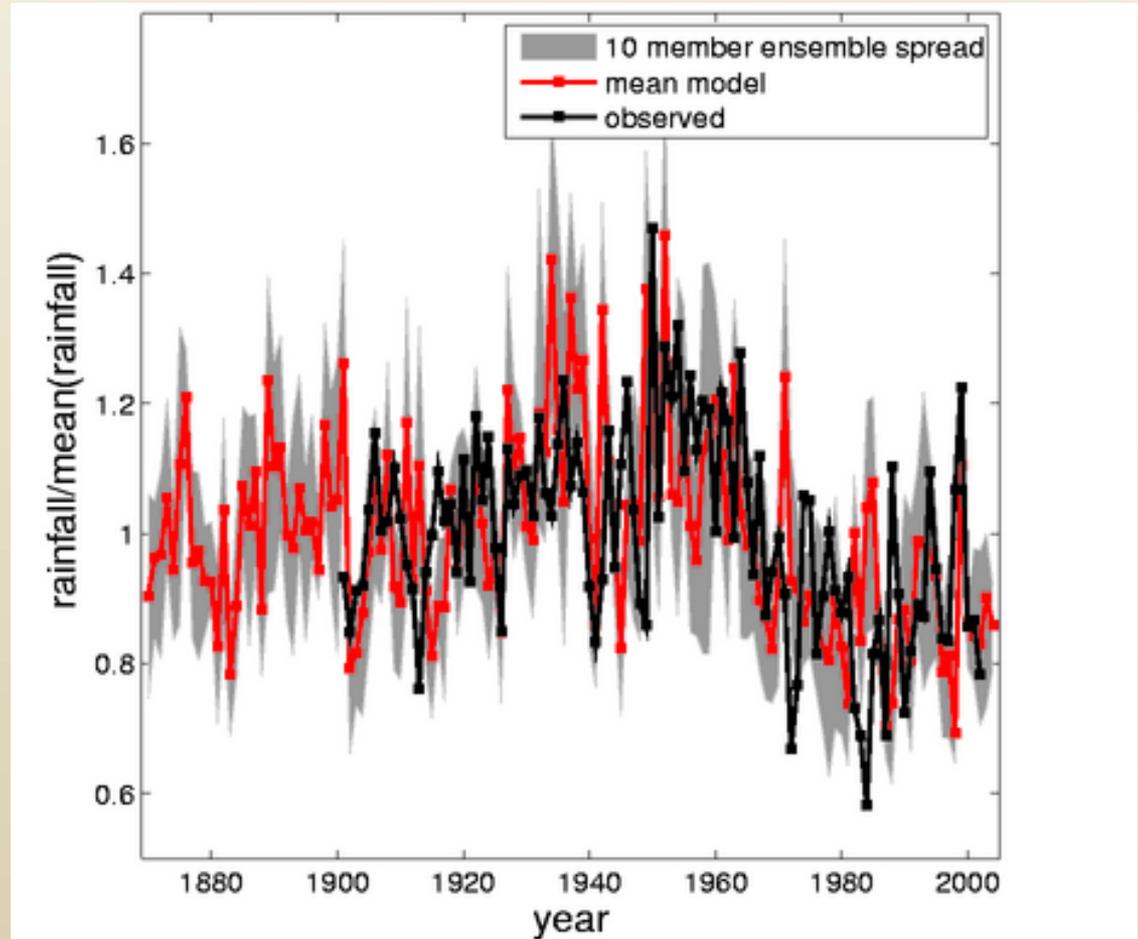
Sahel Drought: Past and Future



Sahel

**Observations =
CRU Summertime
precipitation in Sahel**

**AM2.1 with prescribed SSTs generates
remarkably good fit to observed Sahel rainfall variations**

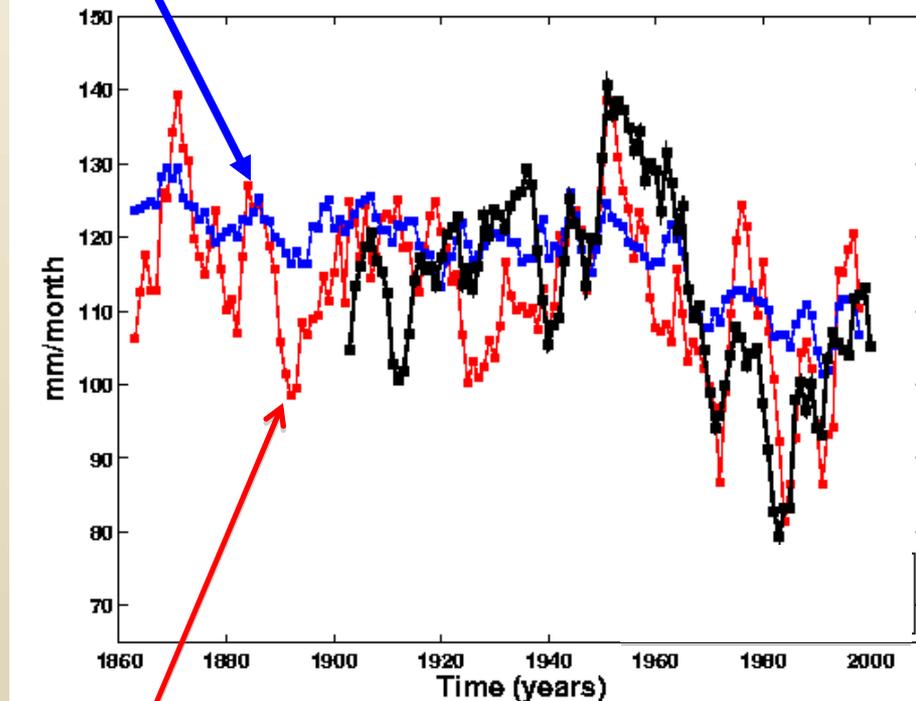


(Delworth, Lu, Zhang, Findell, Knutson)

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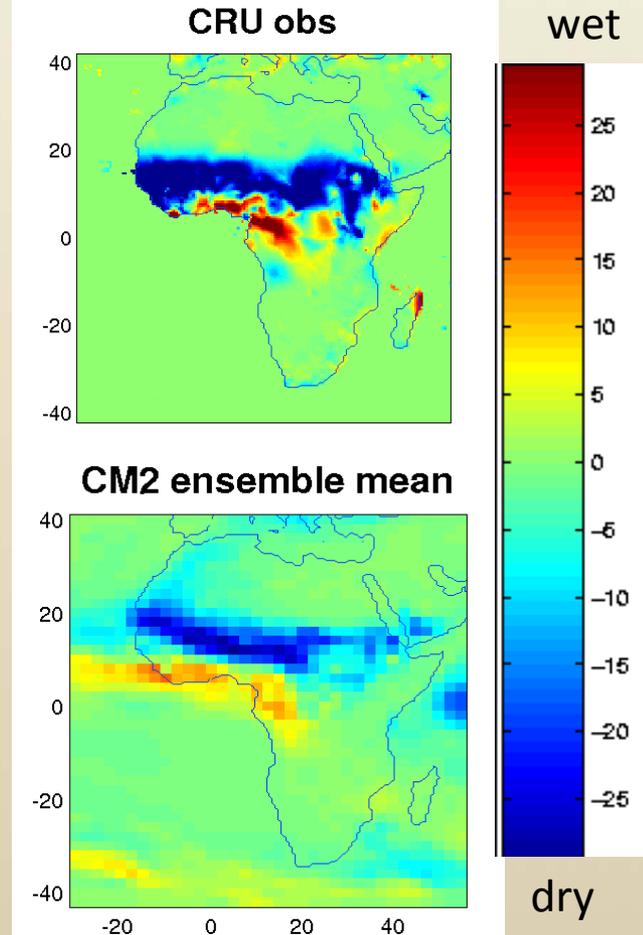
CM2.1 20th century simulations
also very realistic

Mean of 8-member ensemble



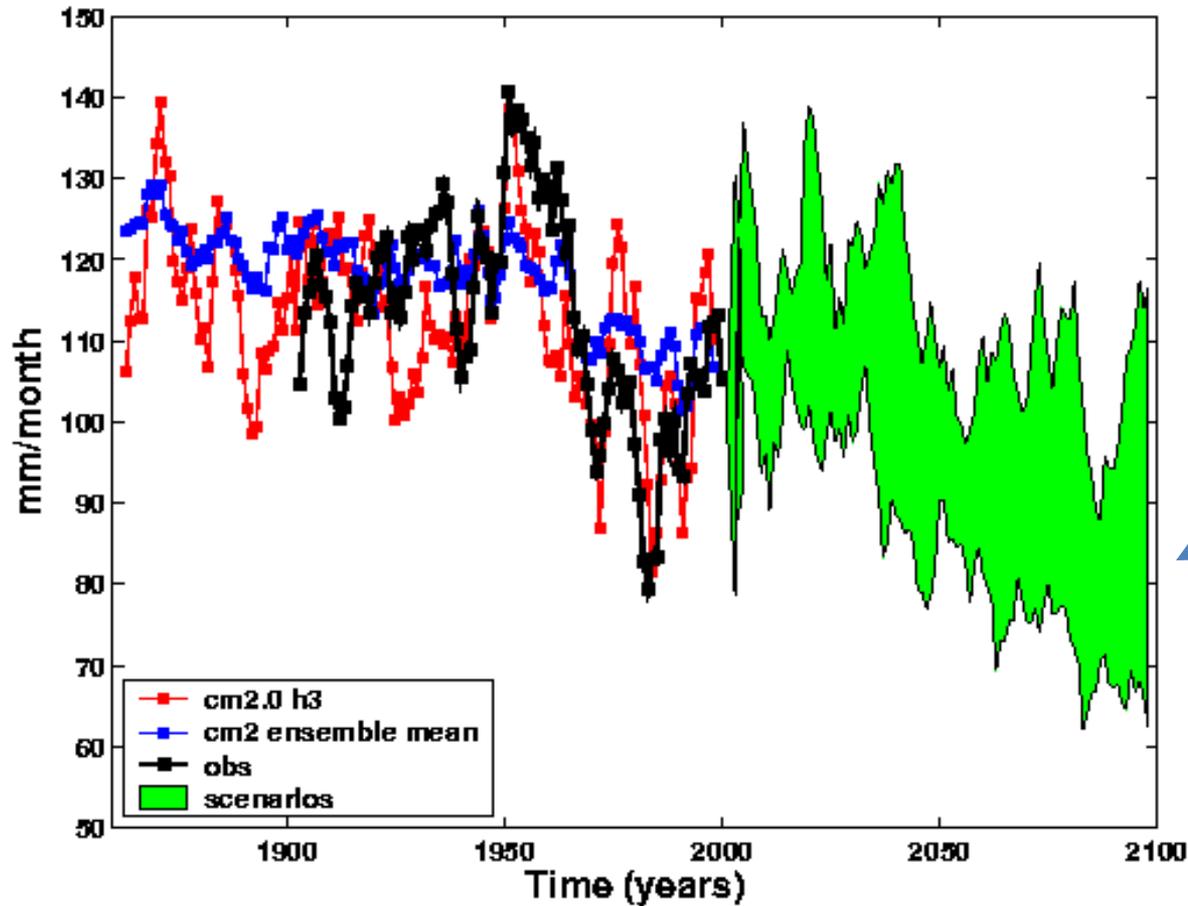
Single realization of CM2

(1980-2000) minus
(1960-1940) (mm/month)



Sahel Drought: Past and Future

CM2.1 future projections are for catastrophic drought in Sahel



Range of
SRES scenarios

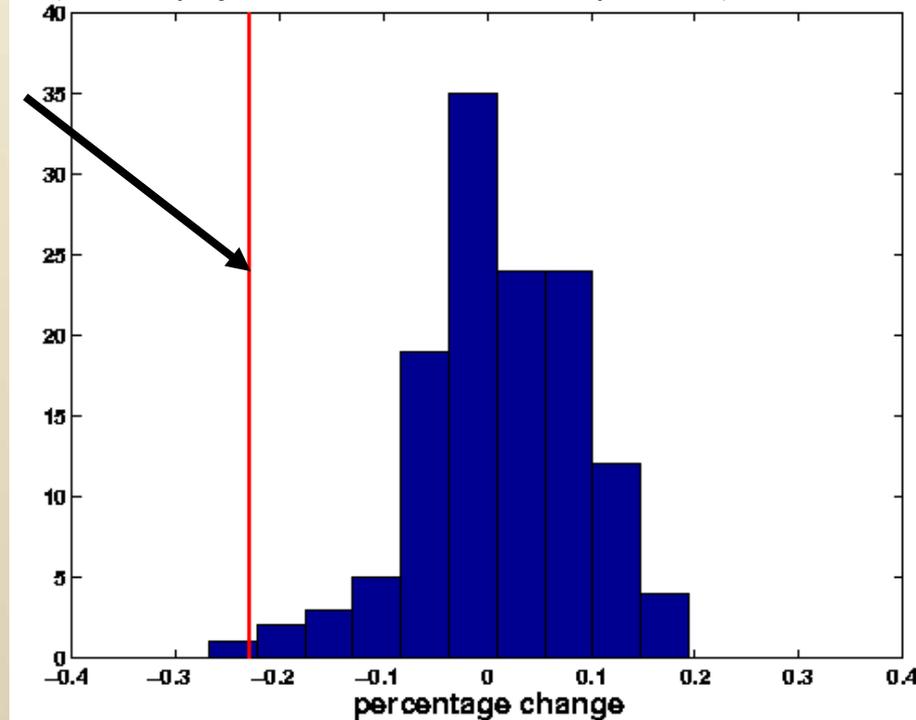
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Sahel drying in CM2 is outlier among world climate models

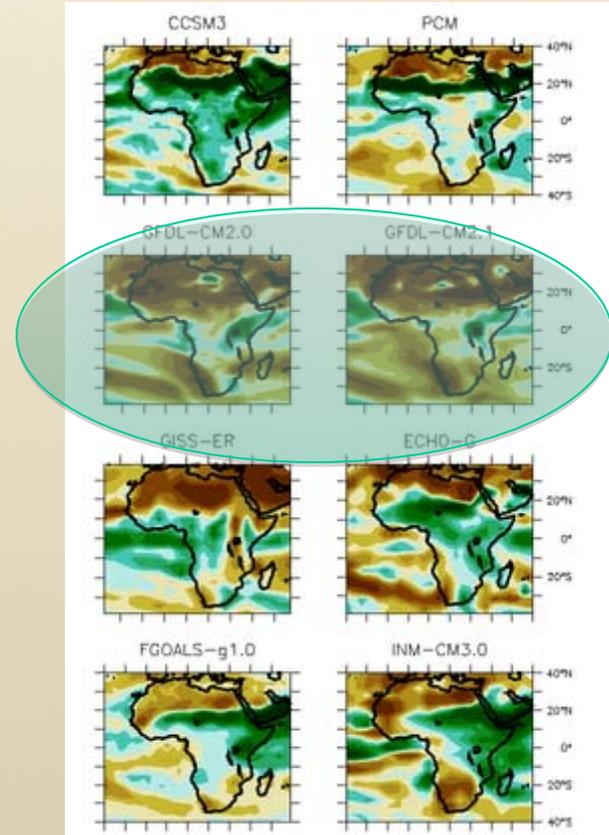
QUMP: 129 different mixed layer models
% Sahel precip response to 2xCO₂

(courtesy of Matthew Collins, Hadley Center)

CM2



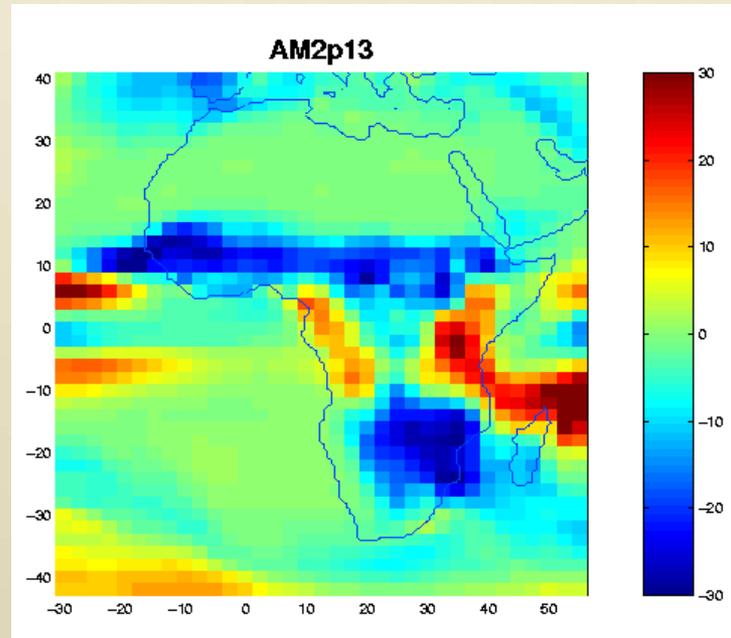
Precipitation projections for late 21st century in several CMIP3-AR4 models



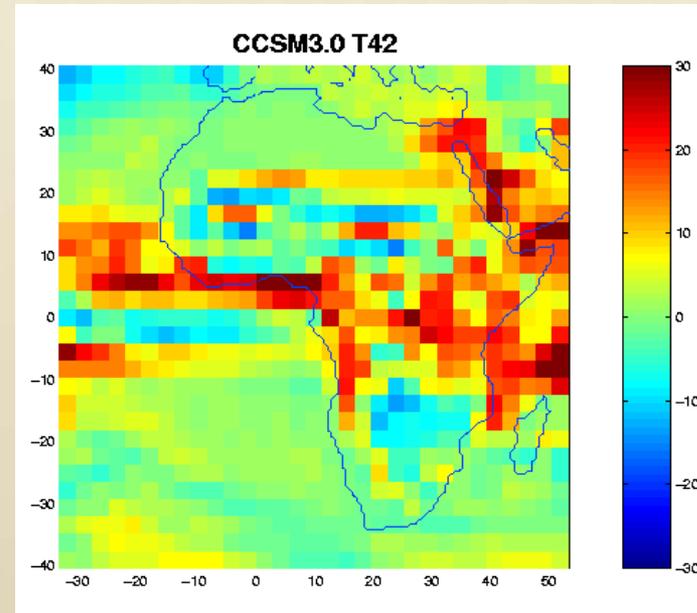
Sahel Drought: Past and Future

AM2/CM2 distinctive in that it dries the Sahel in response to uniform component of ocean warming

**GFDL
AM2**



**NCAR
CAM3**



+2K uniform SST perturbation: annual mean precip

What is responsible for the distinctive aspects of CM2?

Not likely the land model (based on preliminary AM2/LM3 exps),
Likely the convection/cloud parameterizations
(can modify result by manipulating this part of model).

Can we predict which models have drier/wetter Sahel from some features of control simulations?

Not yet - ongoing collaborative analysis of AR4 models with Columbia/Lamont (Sobel, Giannini, Biasutti, Kang).

AM3 should provide valuable new material for comparative analysis

Sahel Drought: Past and Future - Summary

Despite its outlier status, we continue to take CM2's projection for extreme drought in the Sahel very seriously, due to the quality of the overall CM2 simulation and especially the quality of its simulation of the 20th century African climate.

For a more extensive discussion, visit:

www.gfdl.noaa.gov/sahel-drought

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