# Ocean Physical Properties and the Global Water Cycle

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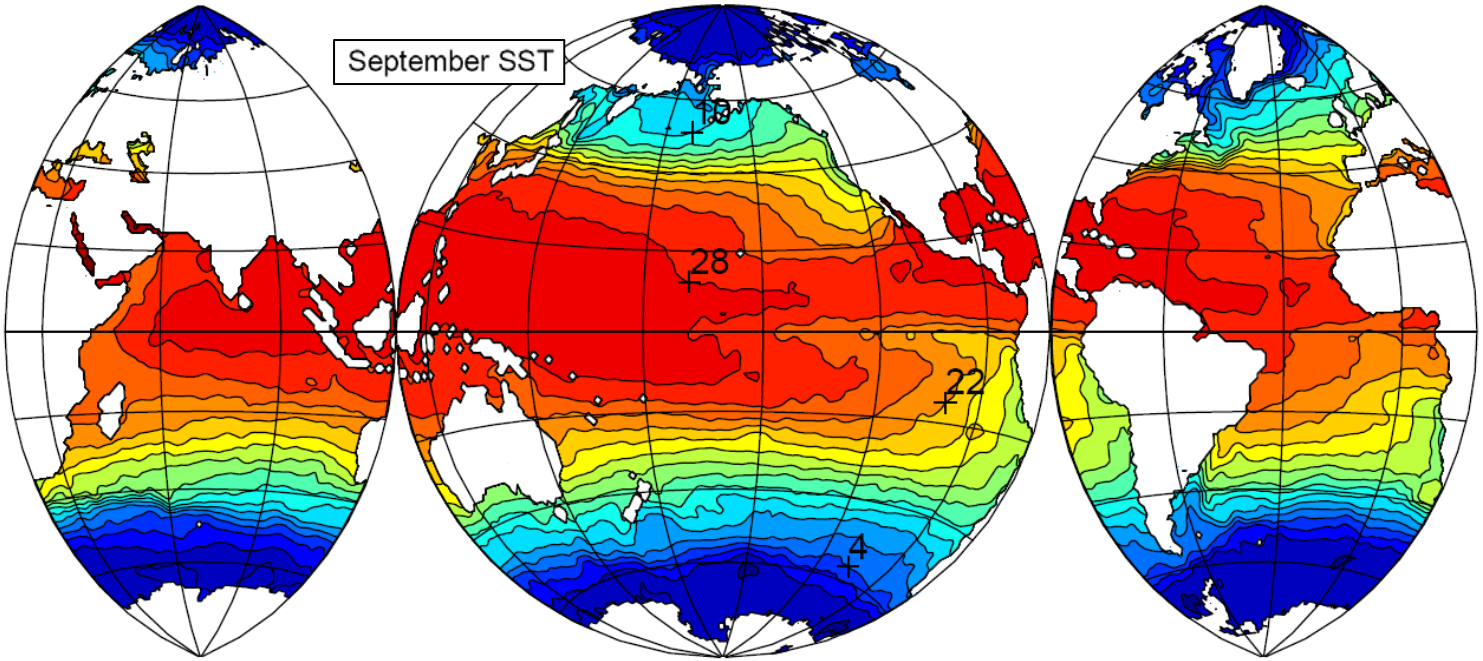
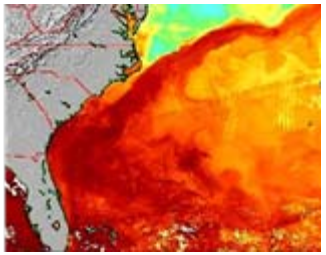
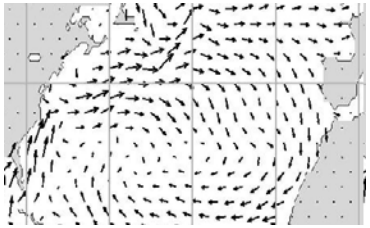


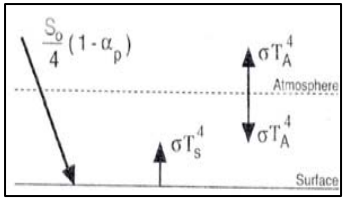
**Some graduate courses of special interest to other departments:**



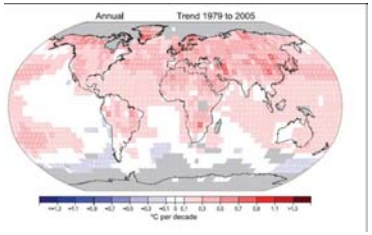
CLIM 412/EVPP 505 Physical Oceanography (minimal calculus)



CLIM 712 Physical Oceanography (calculus, some vector calculus)




CLIM 410 Intro to Physical Climate System

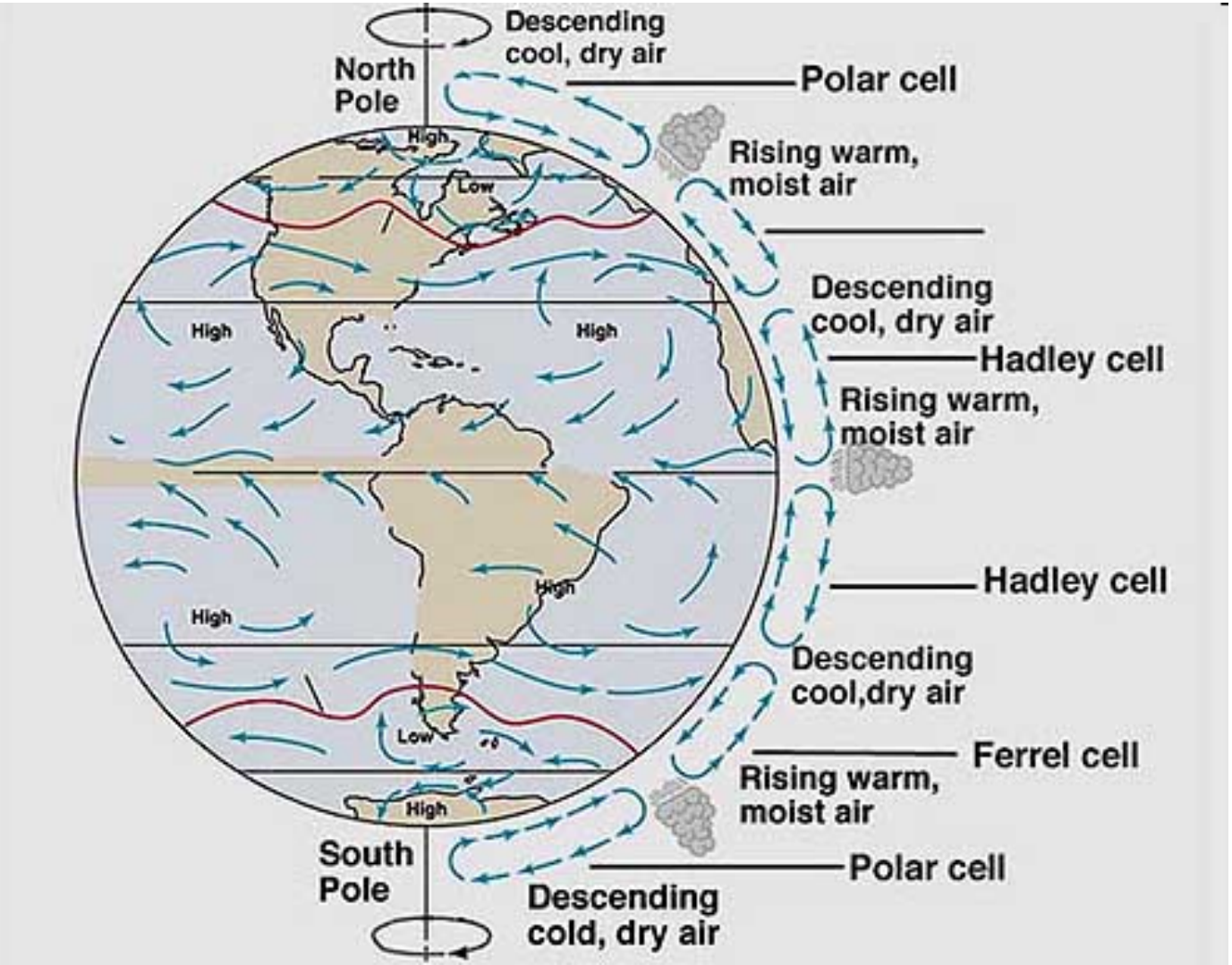



CLIM 690 Scientific Basis of Climate Change

**Dept of Atmospheric, Oceanic, and Earth Sciences**

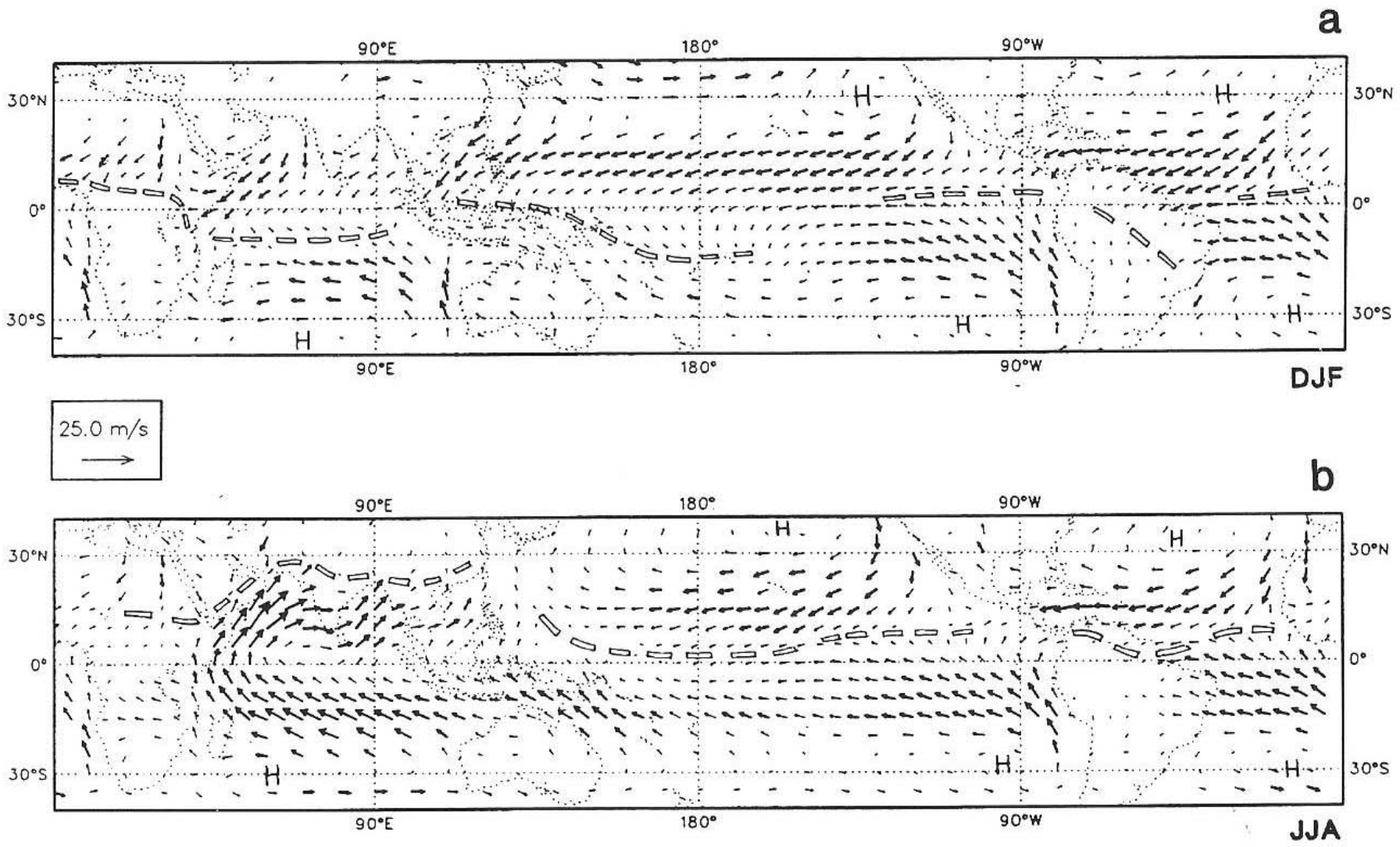
**http://aoes.gmu.edu**

# Large-Scale Atmospheric Circulation Patterns Influence Precip
## Ascending Air ➔ Precipitation; Descending Air ➔ Drought

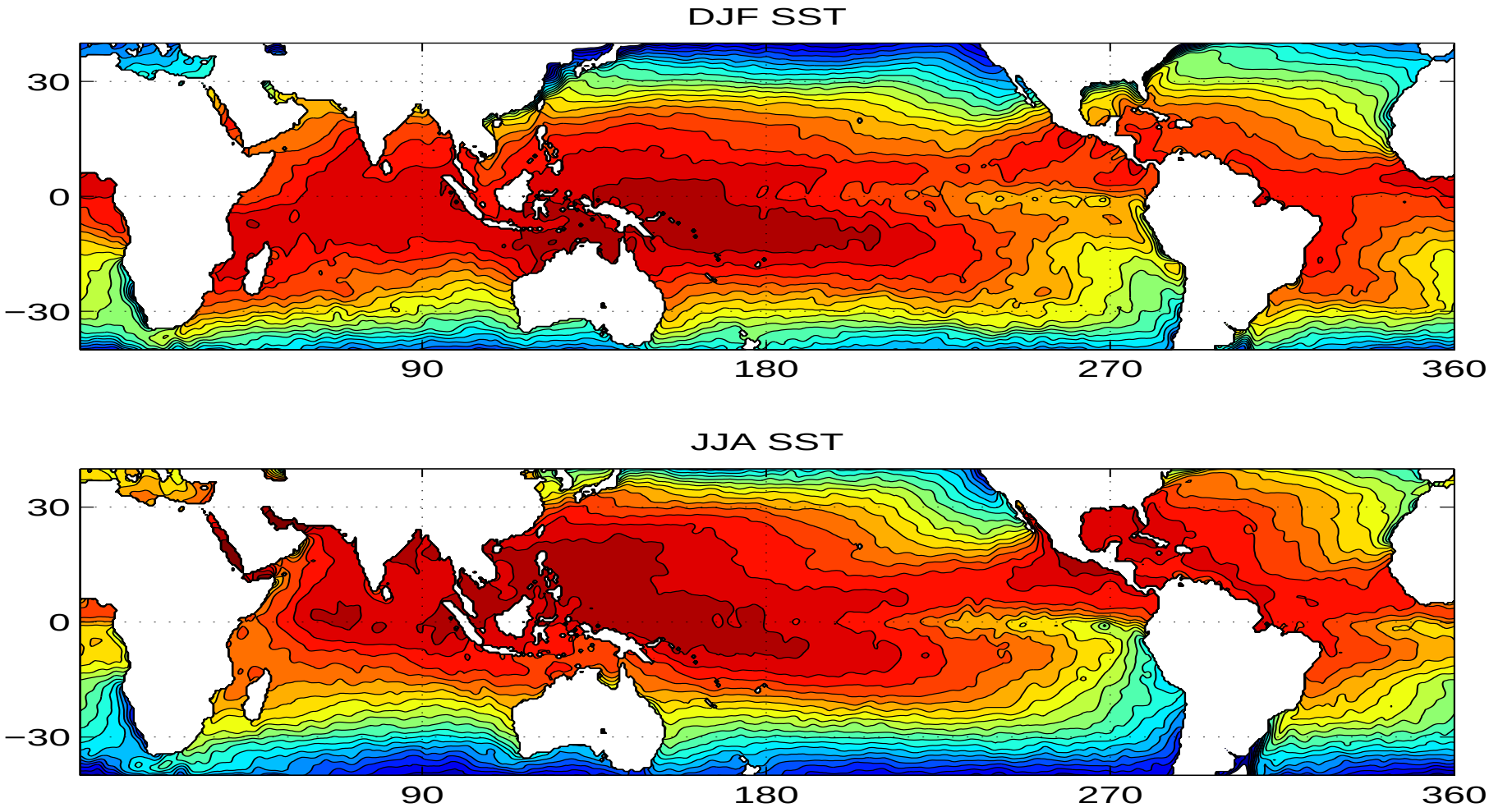



http://rst.gsfc.nasa.gov/Sect14/Sect14_1c.html

# Precipitation depends on latitude, longitude & time, associated with convergence of lower-troposphere wind



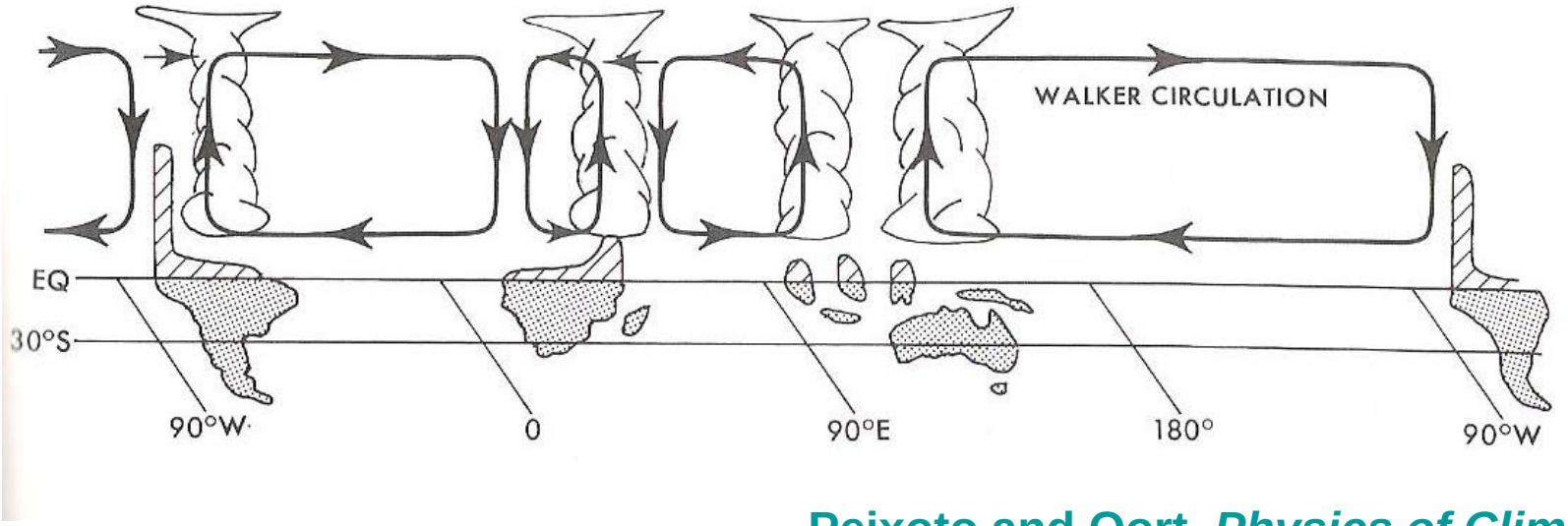
# Atmospheric Circulation is Strongly Influenced by Sea Surface Temperature (SST)



# Equatorial atmospheric circulation includes rising and sinking air

**Rising ➔ precipitation**

**Changes in circulation ➔ changes in precipitation**




Peixoto and Oort, *Physics of Climate*

# El Nino-Southern Oscillation is Striking example of SST Impact



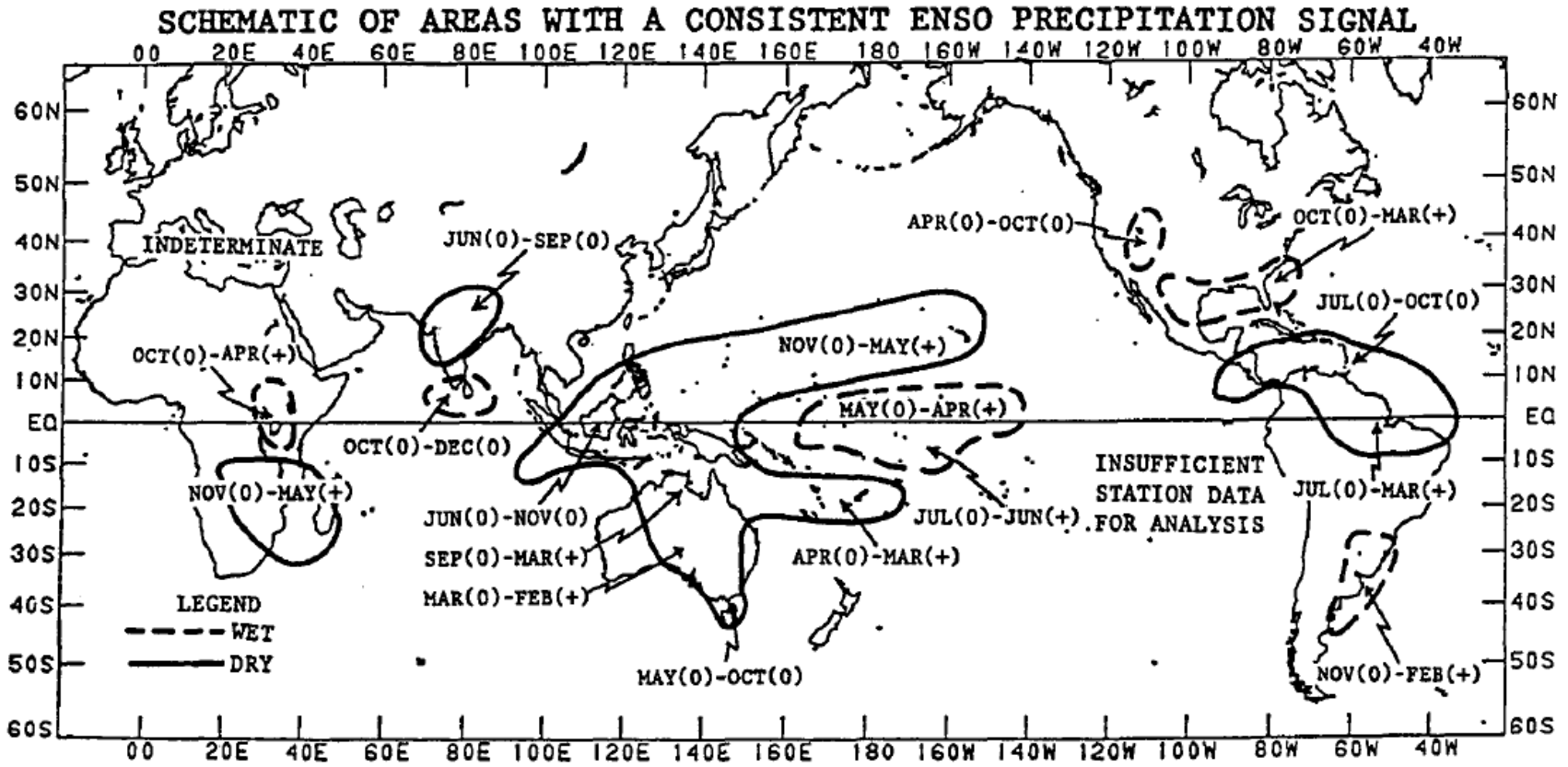



FIG. 21. Schematic representation of the principal ENSO-related precipitation

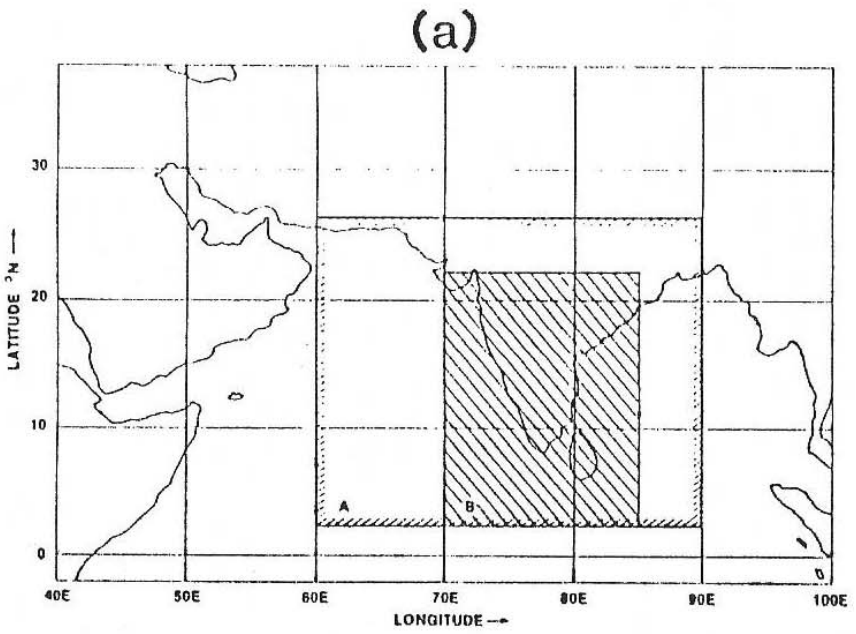
# Arabian Sea SST influences Indian Rainfall

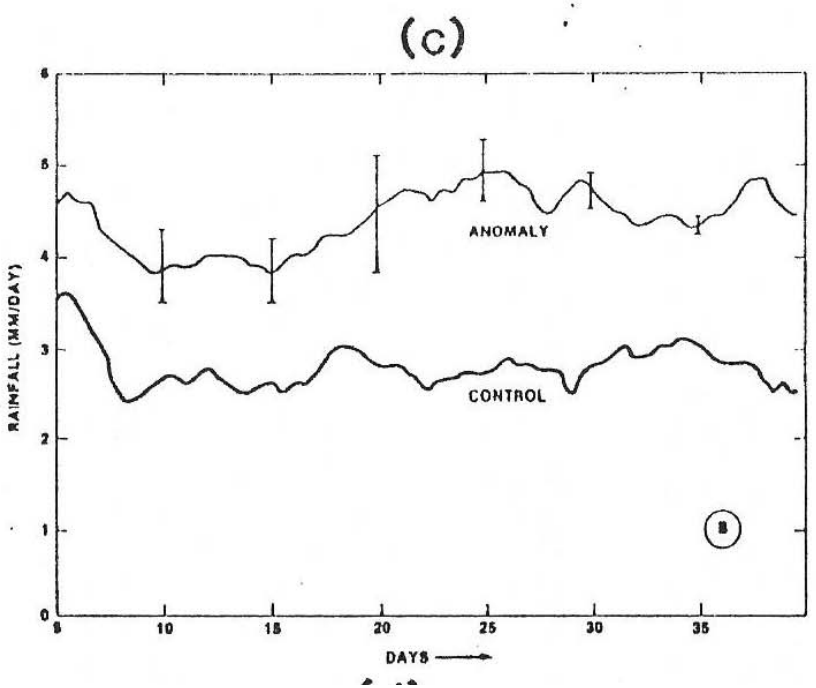
**(Shukla, 1981, *Proc Symp Meteor Aspects Trop Droughts*)**

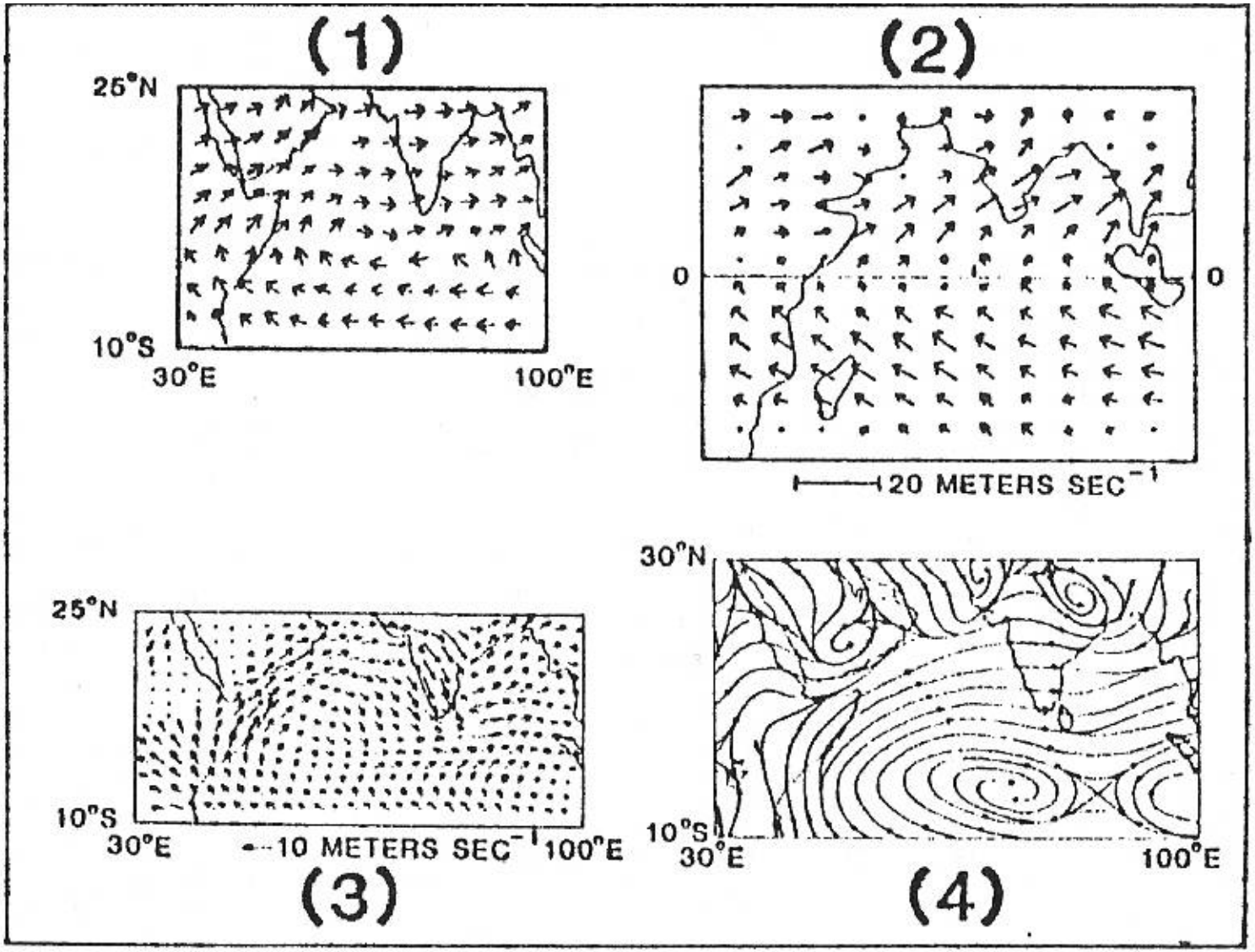
**Run Atmospheric General Circulation Model (AGCM)**

1) **use climatological SST**
2) **use SST with warm anomaly**

**Warm SST ➔ more summer monsoon rainfall**

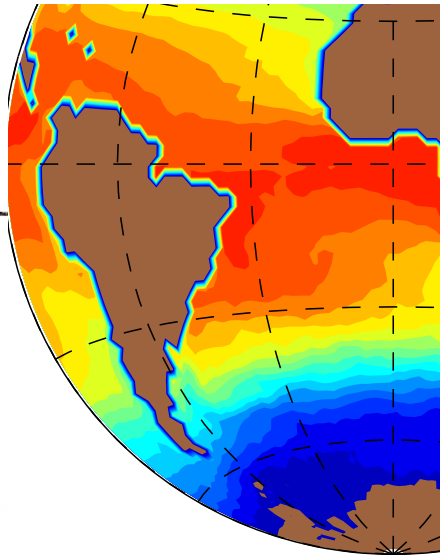


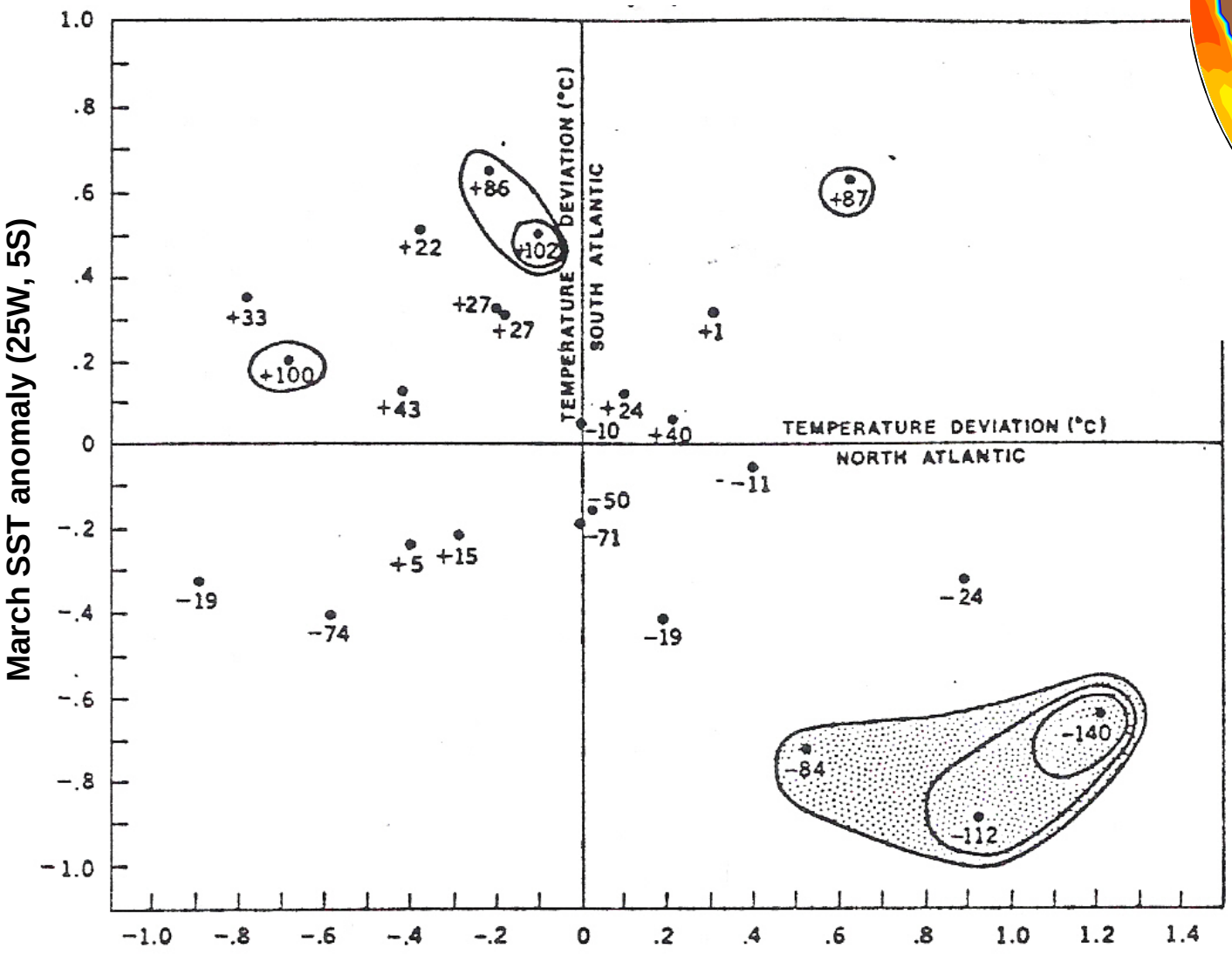






three anomaly runs. Panel (d) shows the low level wind field for: (1) GLAS model, (2) GFDL model, (3) NCAR model, and (4) Observations.

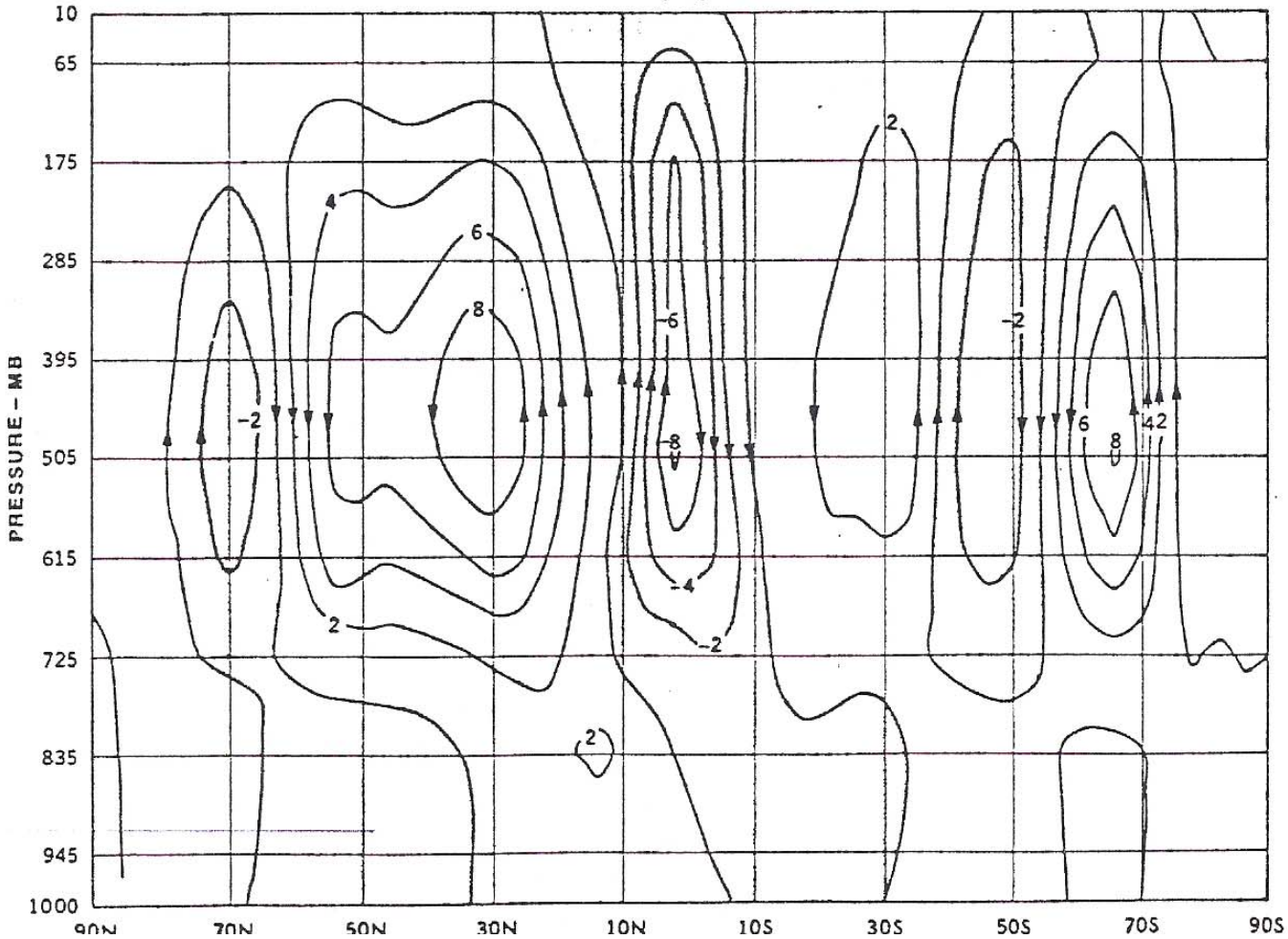
**March-May Precipitation Anomaly (39W, 4-5S) in mm**





# Atmospheric Circulation Anomaly from SST Anomaly

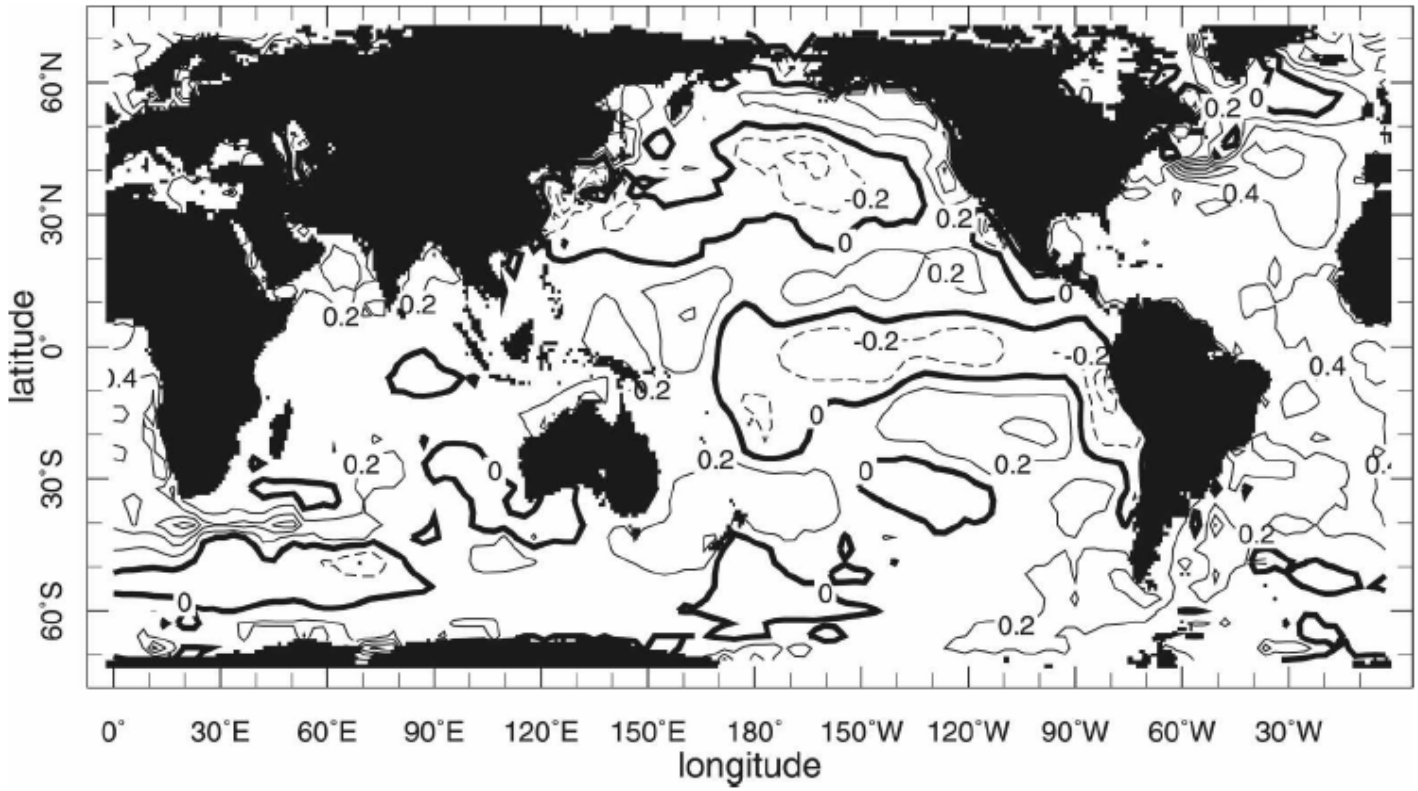
**(AGCM results, difference between
run with warm/cold anomaly SST
and
run with climatological SST)**



# Would Advance Knowledge of 1930s SSTs Have Allowed Prediction of the Dust Bowl Drought?*

RICHARD SEAGER, YOCHANAN KUSHNIR, MINGFANG TING, MARK CANE, NAOMI NAIK, AND JENNIFER MILLER

(2008, *J. Clim.*)

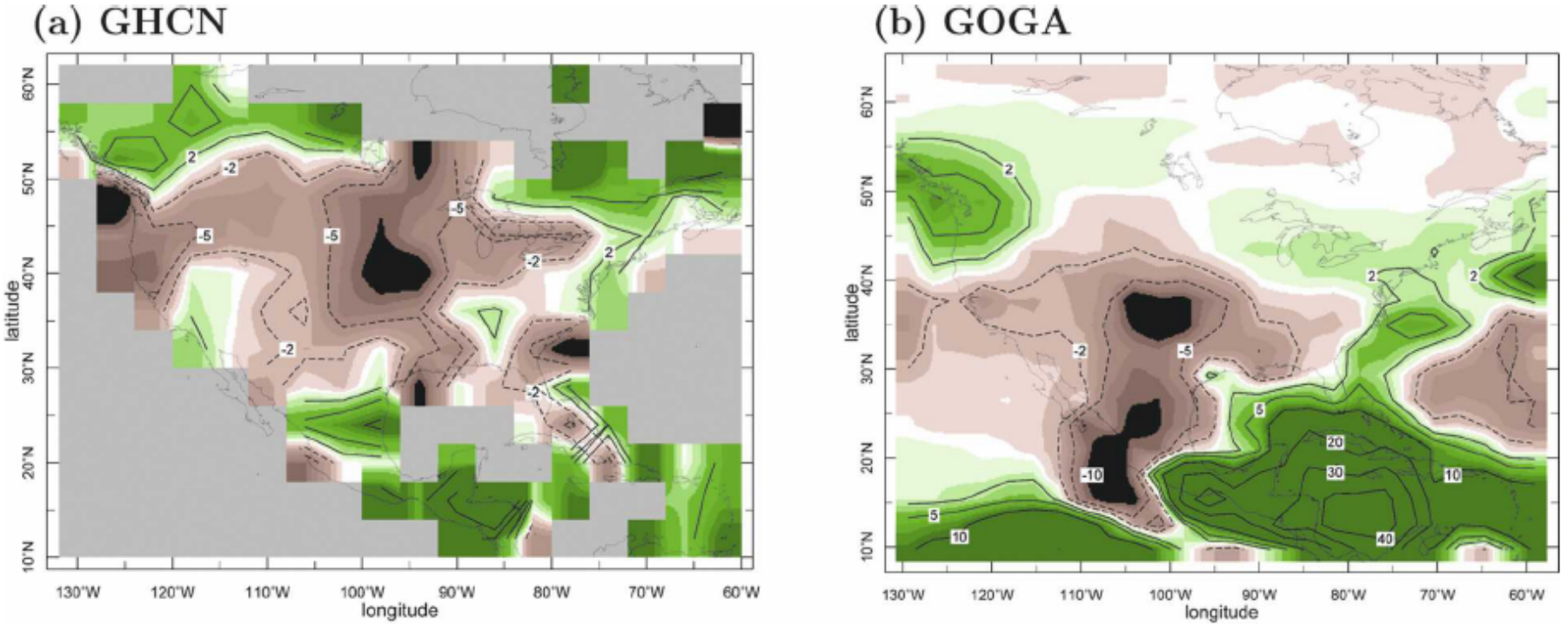



**Observed SST 1932-1939 anomaly relative to 1856-1928 climatology.**

## Observed and modeled precip anomaly (mm/month)

**Global Hist. Clim. Network Obs**

**Global Atm Global Ocean (SST) Model**



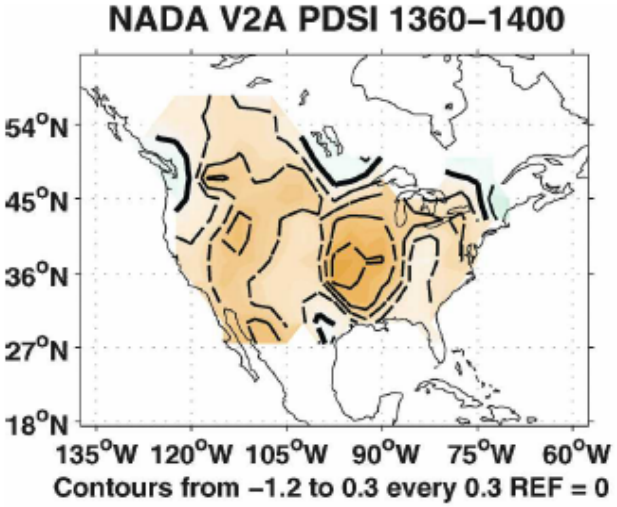

**cold tropical Pacific and warm N Atlantic ➔ large multiyear US drought**

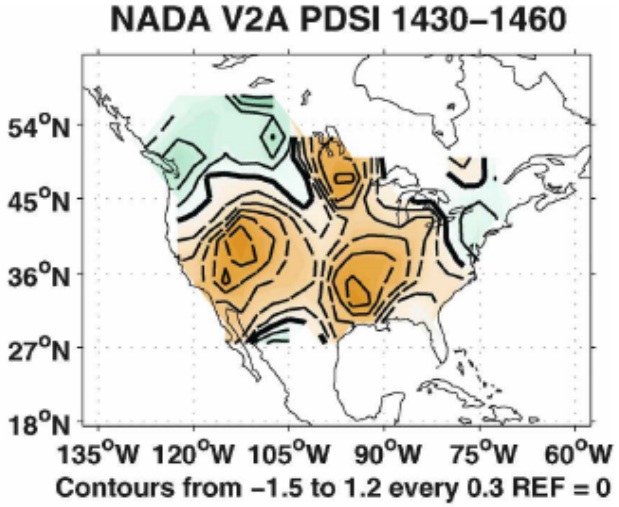
# Tropical Pacific Forcing of North American Medieval Megadroughts: Testing the Concept with an Atmosphere Model Forced by Coral-Reconstructed SSTs*

Seager et al (2008b, *J. Clim.*)

## Palmer Drought Severity Index (PDSI)

**Reconstruction from Tree Rings**




**Model Forced by La Nina SST**