2356-8

Targeted Training Activity: ENSO-Monsoon in the Current and Future Climate

30 July - 10 August, 2012

Teleconnections associated with ENSO

SCHNEIDER Edwin Kahn

Center For Ocean Land Atmosphere Studies, COLA GMU
Institute For Global Environment and Society, IGES
4041 Powder Mill Road, Suite 302
Calverton 20705-3106 MD
U.S.A.

6. ENSO TELECONNECTIONS

A. OBSERVED ENSO EFFECTS

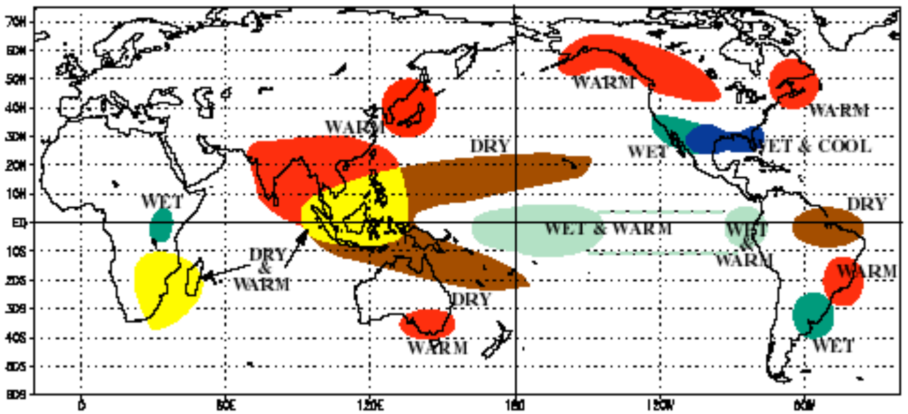
- GLOBAL
- ON PRECIPITATION
- ON RESOURCES
  - STREAMFLOW
  - MAIZE PRODUCTION
  - MALARIA

B. UNDERSTANDING OF ENSO TELECONNECTIONS

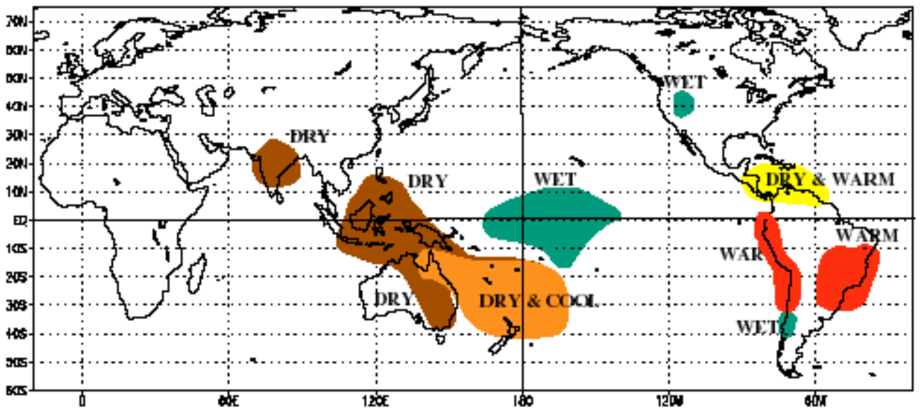
- SIMPLE COUPLED MODELS
- COUPLED CLIMATE MODELS

A. ENSO EFFECTS

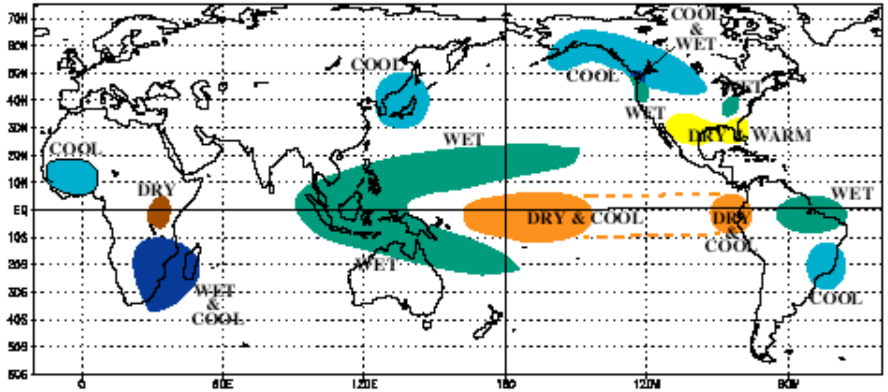
WARM EPISODE RELATIONSHIPS DECEMBER - FEBRUARY



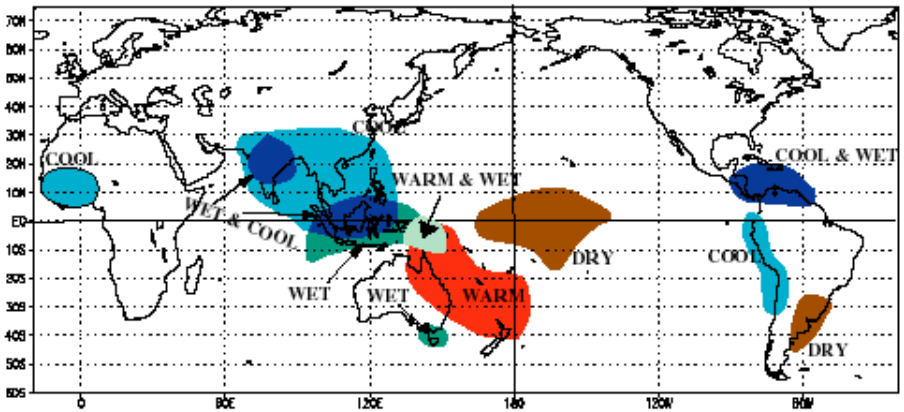
WARM EPISODE RELATIONSHIPS JUNE - AUGUST



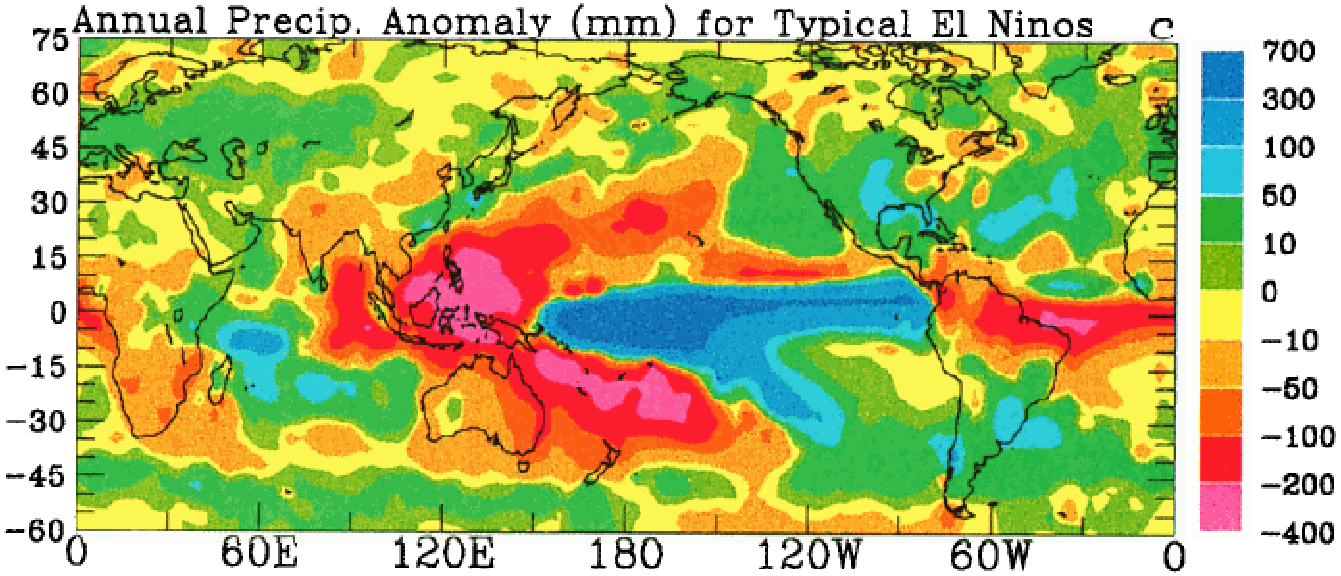
COLD EPISODE RELATIONSHIPS DECEMBER - FEBRUARY



COLD EPISODE RELATIONSHIPS JUNE - AUGUST



Climate Prediction Center
NCEP

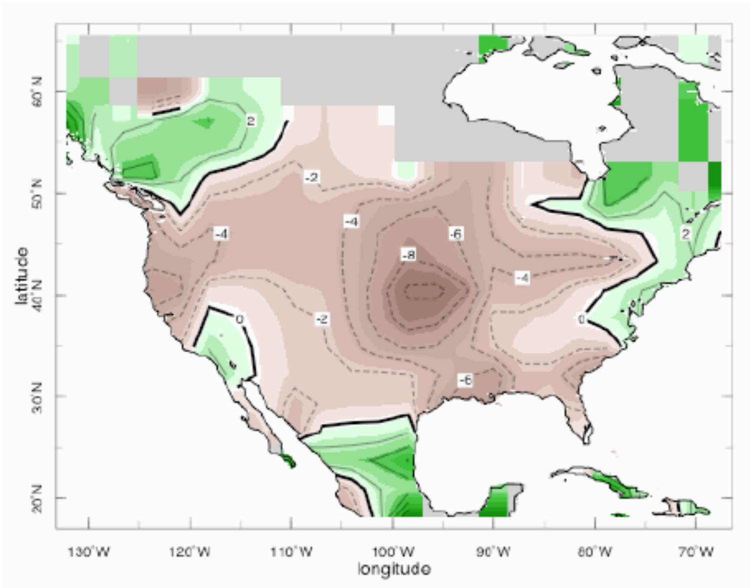


Dai and Wigley (2000) 1900-1998

Decadal time scale ENSO-related teleconnections (Cane and Clement)

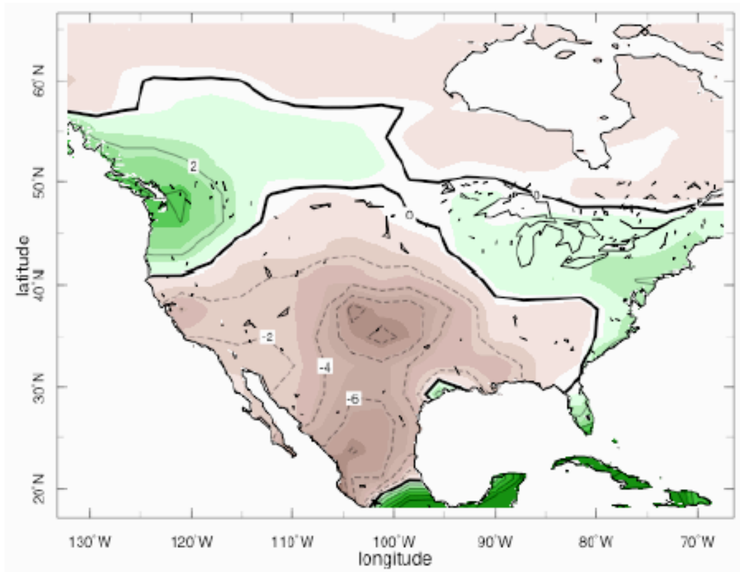
Precipitation Anomaly 1932-1939

OBSERVED



Contour interval = 2 mm/month

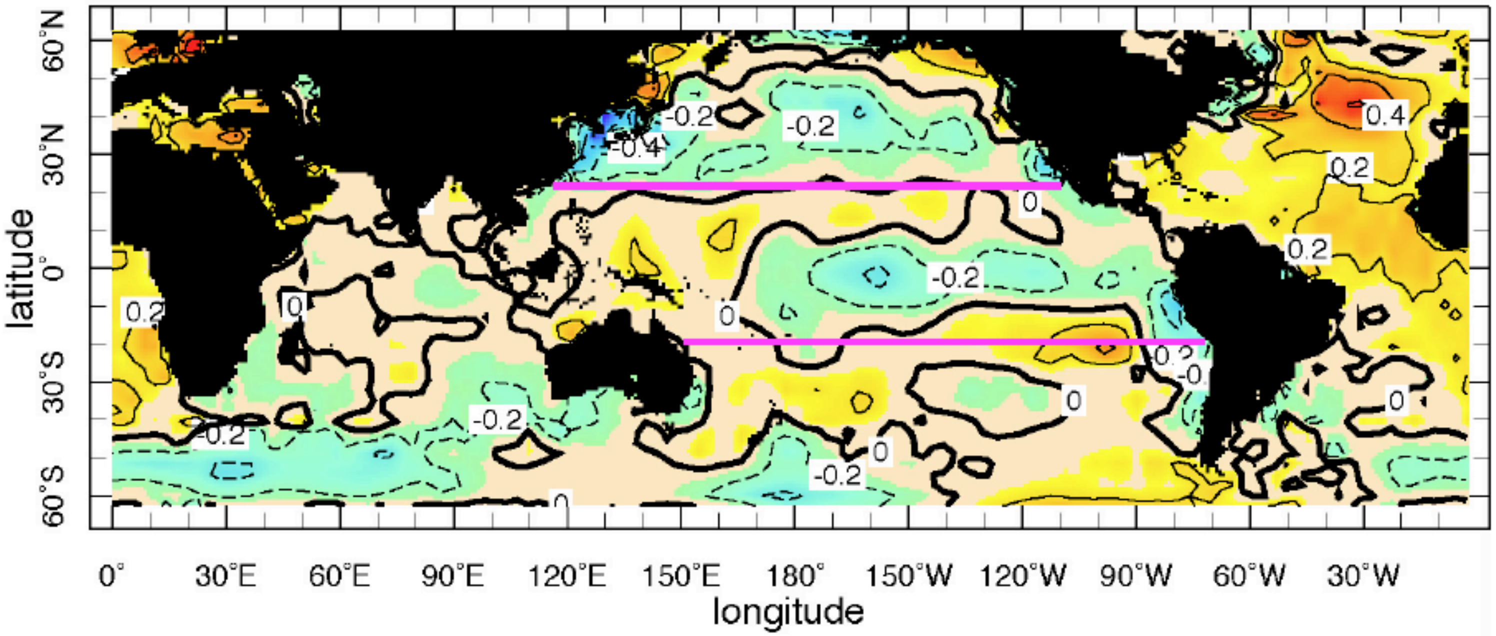
GOGA MODEL



GOGA MODEL = Global Sea Surface Temperature Specified

Sea Surface Temperature Anomaly
1932-1939

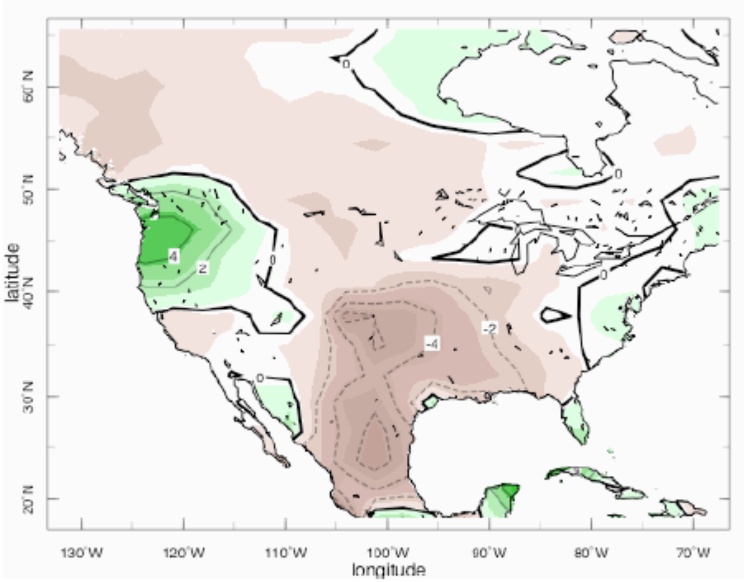
OBSERVED



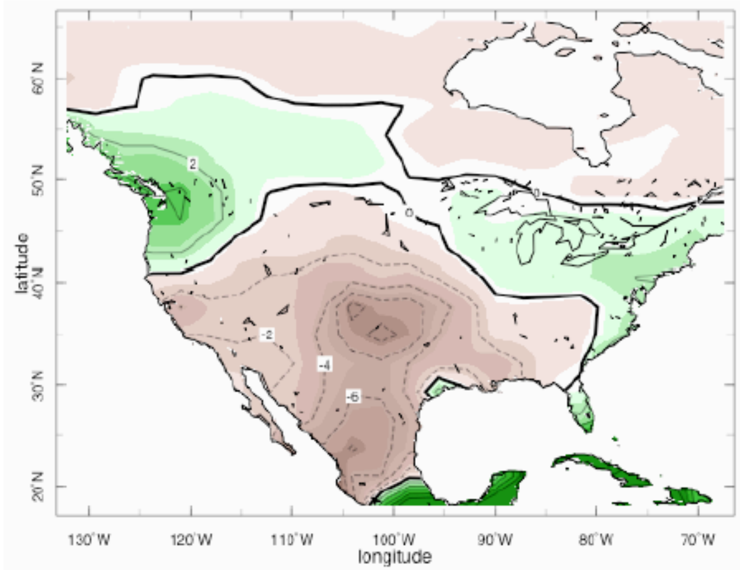
Contour interval = 0.2°C

Precipitation Anomaly 1932-1939

POGA-ML MODEL



GOGA MODEL

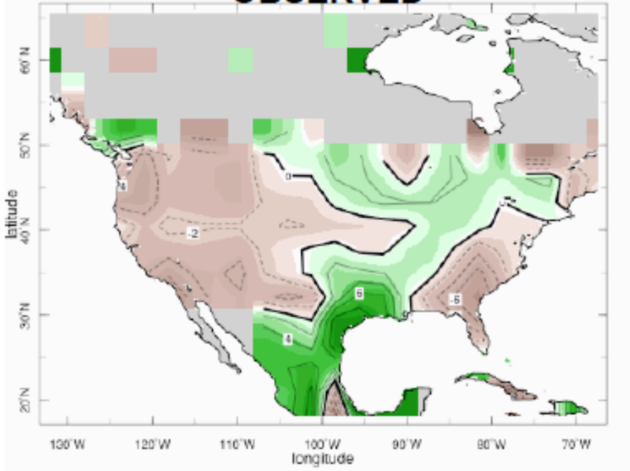


POGA-ML MODEL = Only Tropical Pacific Sea Surface Temperature Specified

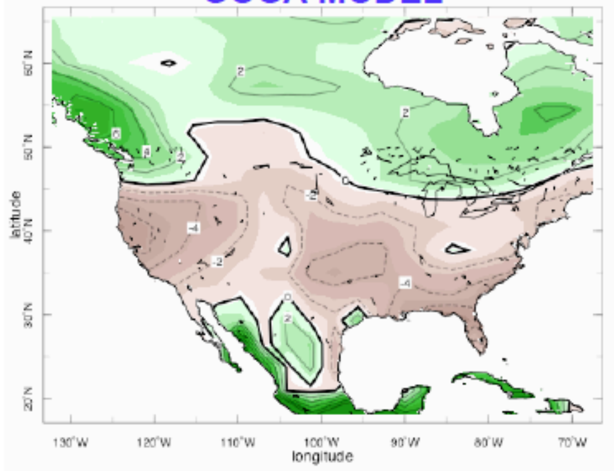
GOGA MODEL = Global Sea Surface Temperature Specified

Precipitation Anomaly 1998-2004

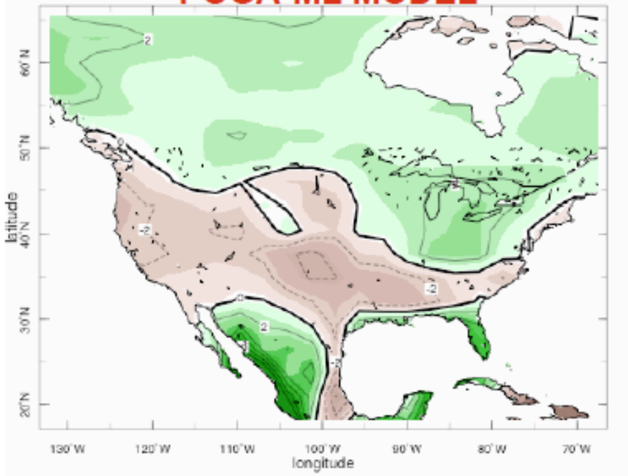
OBSERVED



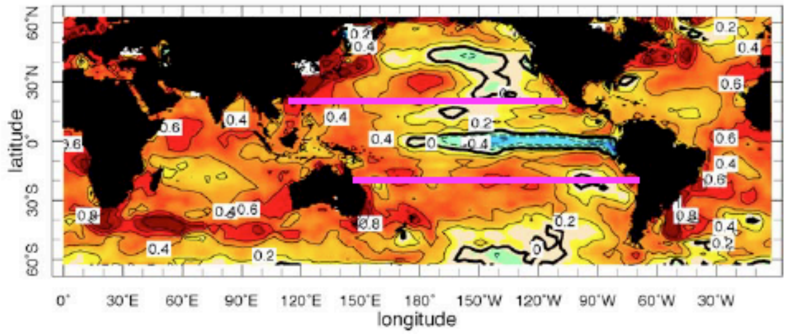
GOGA MODEL



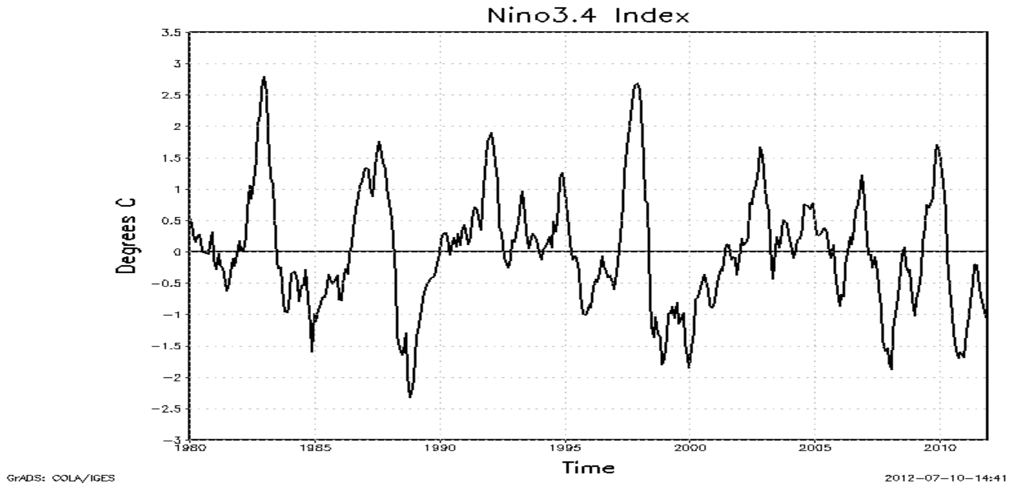
POGA-ML MODEL



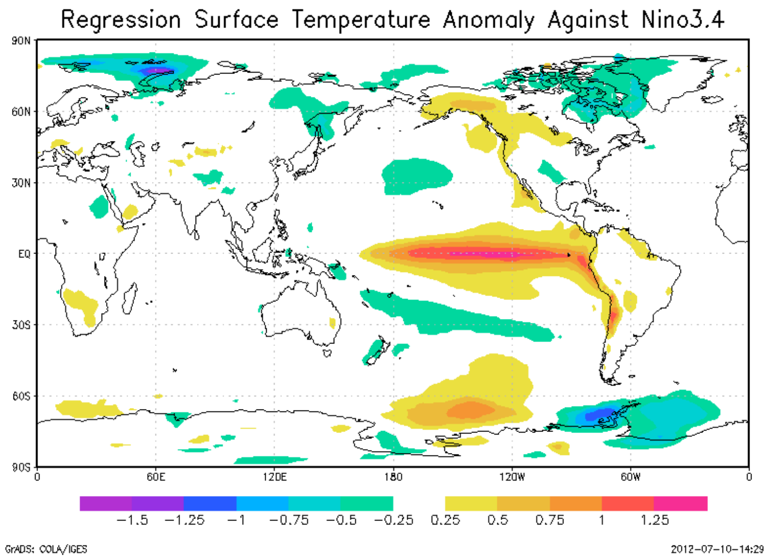
OBSERVED
SEA SURFACE TEMPERATURE



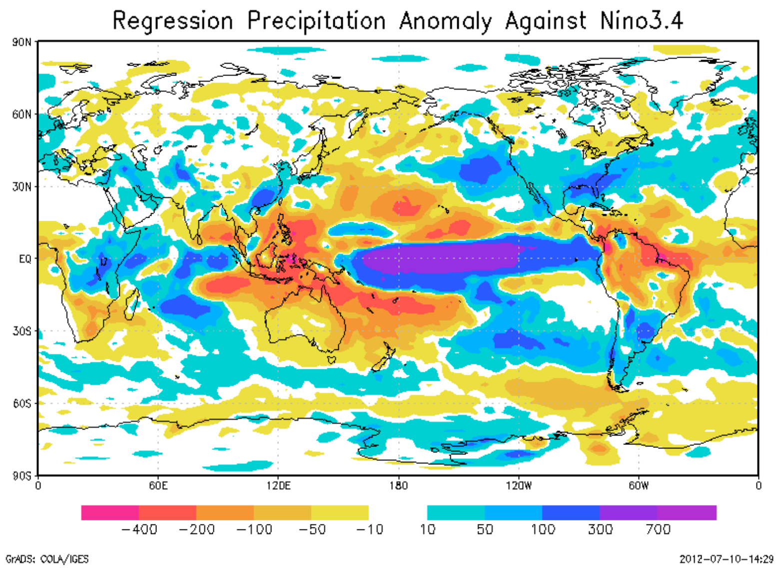
Regressions from NCEP Reanalysis 1980-2011



NINO3.4



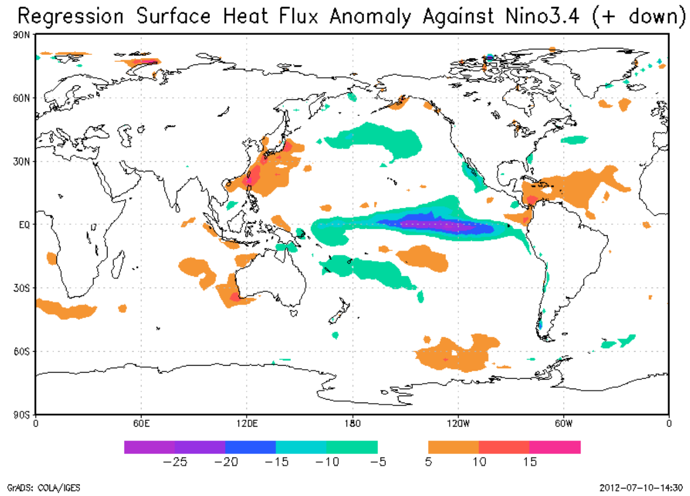
T SFC



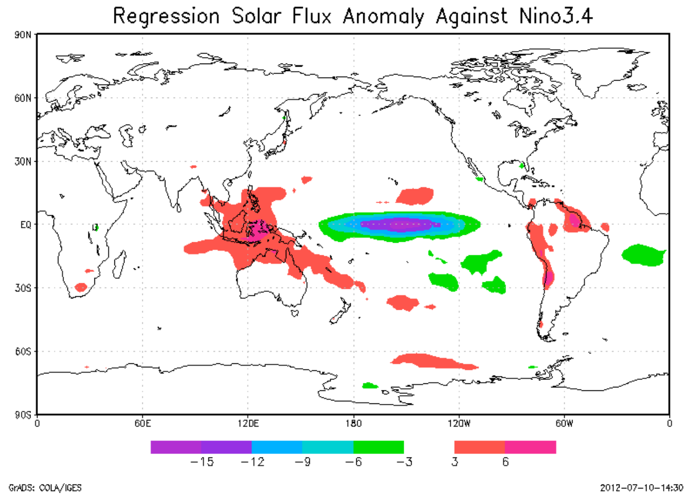
PRECIP

Surface Heat Flux

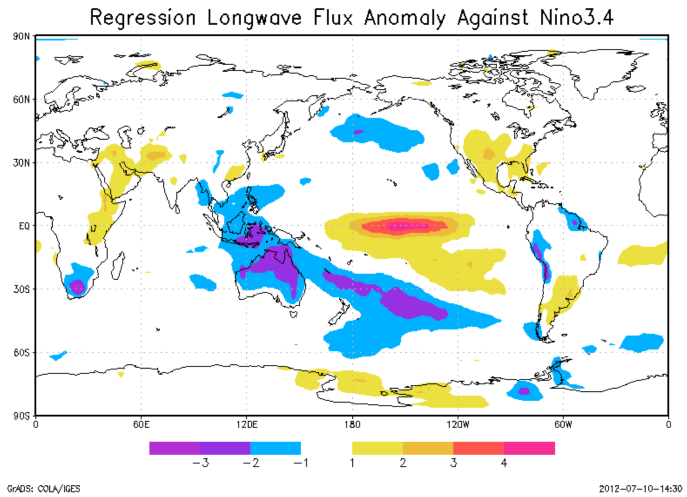
NET



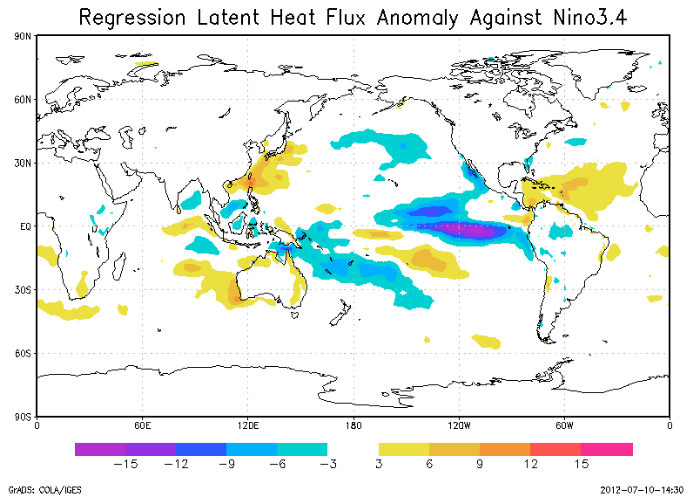
SOLAR

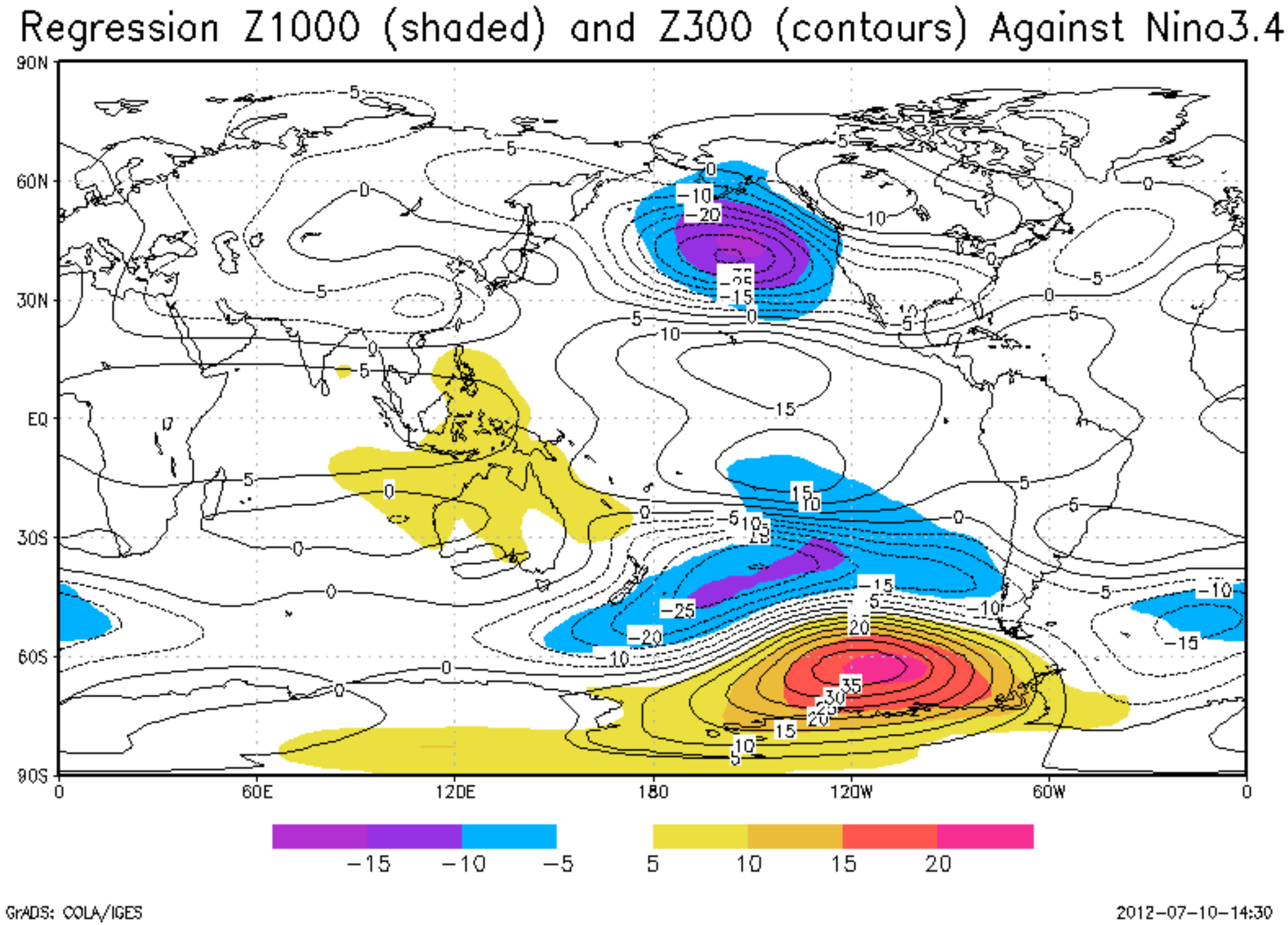


LONGWAVE

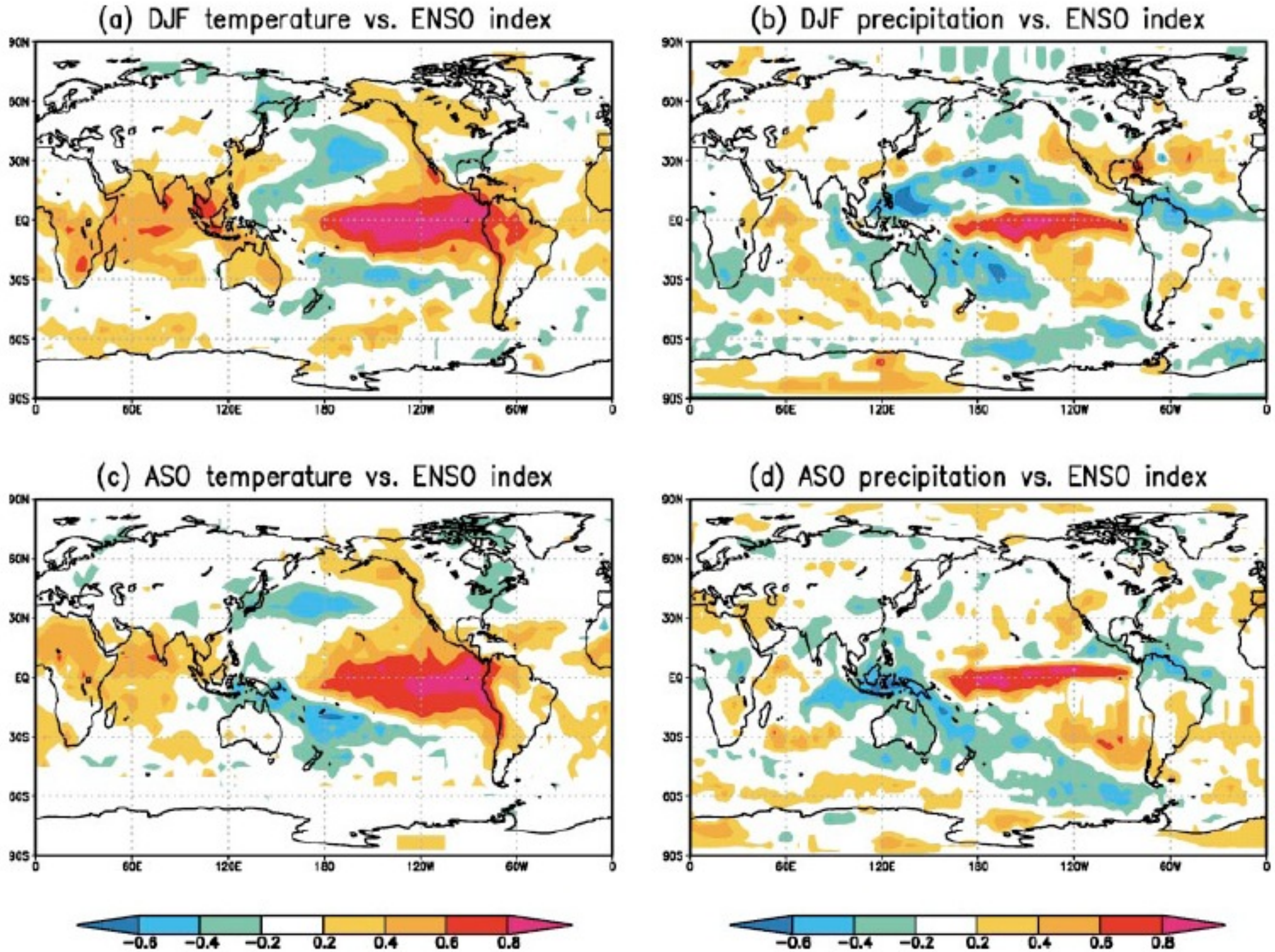


LATENT



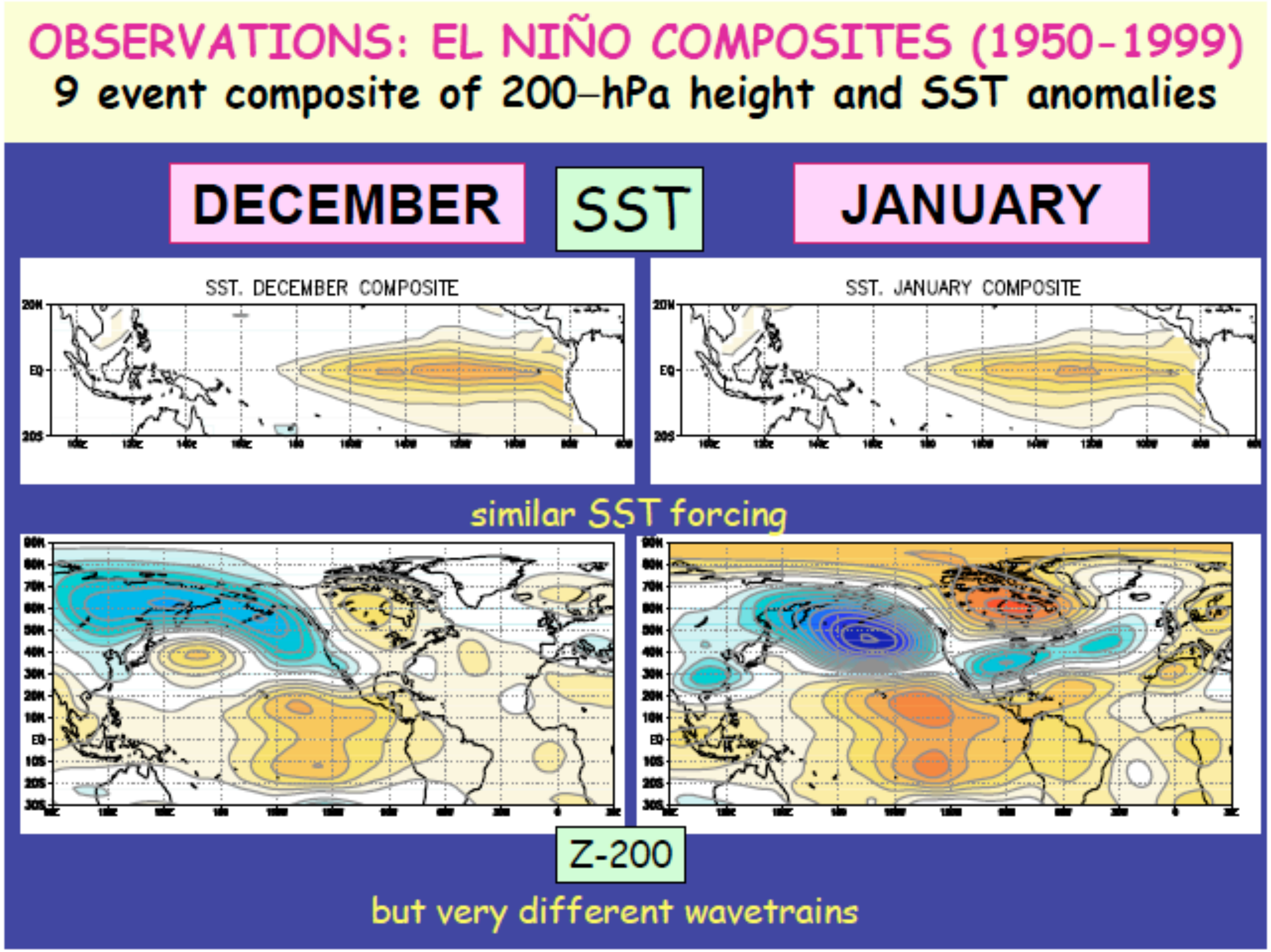

Regression Z1000 (shaded) and Z300 (contours) Against Nino3.4
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
0
−15
−10
−5
5
10
15
20
GrADS: COLA/IGES
2012-07-10-14:30

Seasonality of Teleconnections



Schimel (2003)

From Bladé presentation 2008 ICTP Teleconnections Workshop



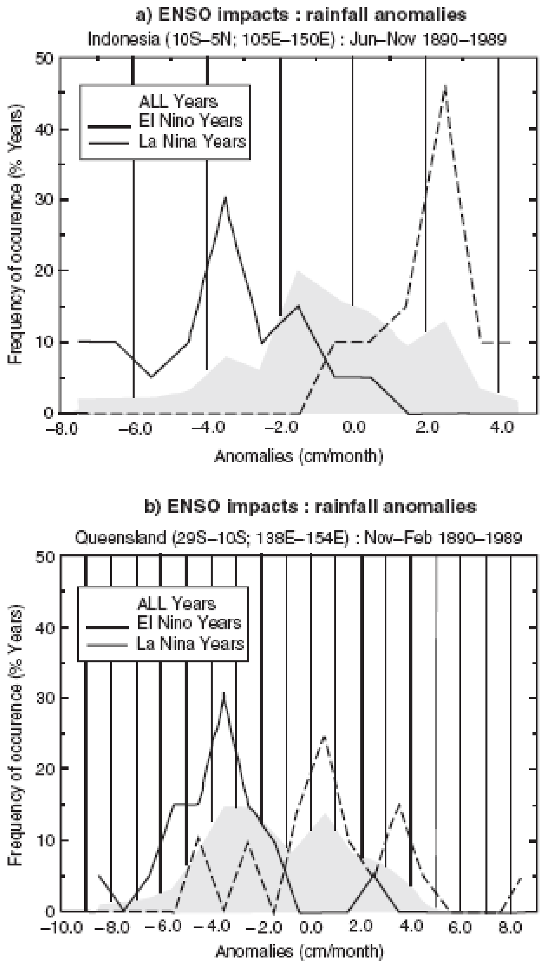


Figure 2.27. Rainfall anomalies a) Over Indonesia, and b) Over Queensland, Australia during warm ENSO years (solid) and cold ENSO years (dashed). The average over all years is shaded. (Courtesy of the IRI.)

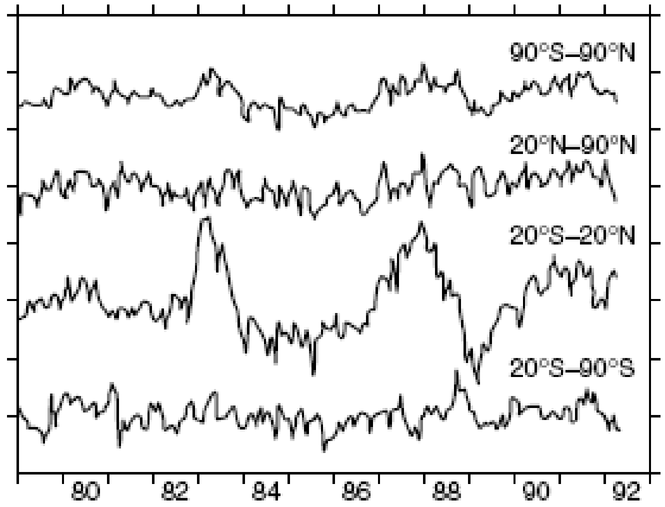
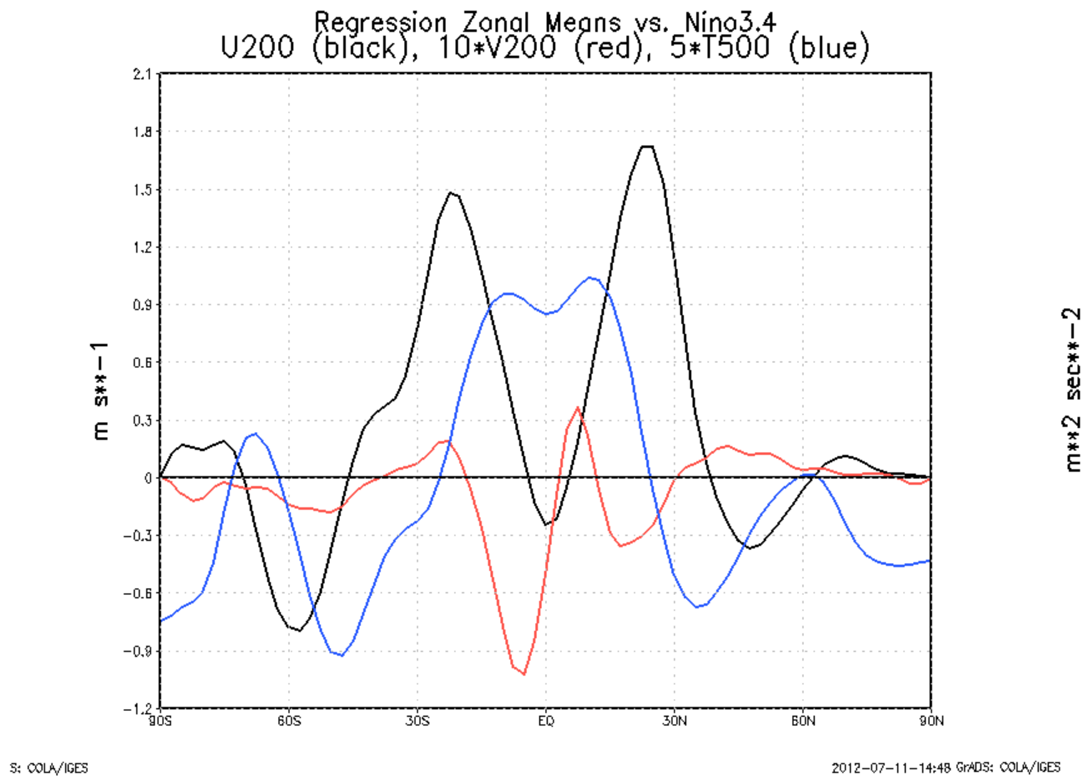
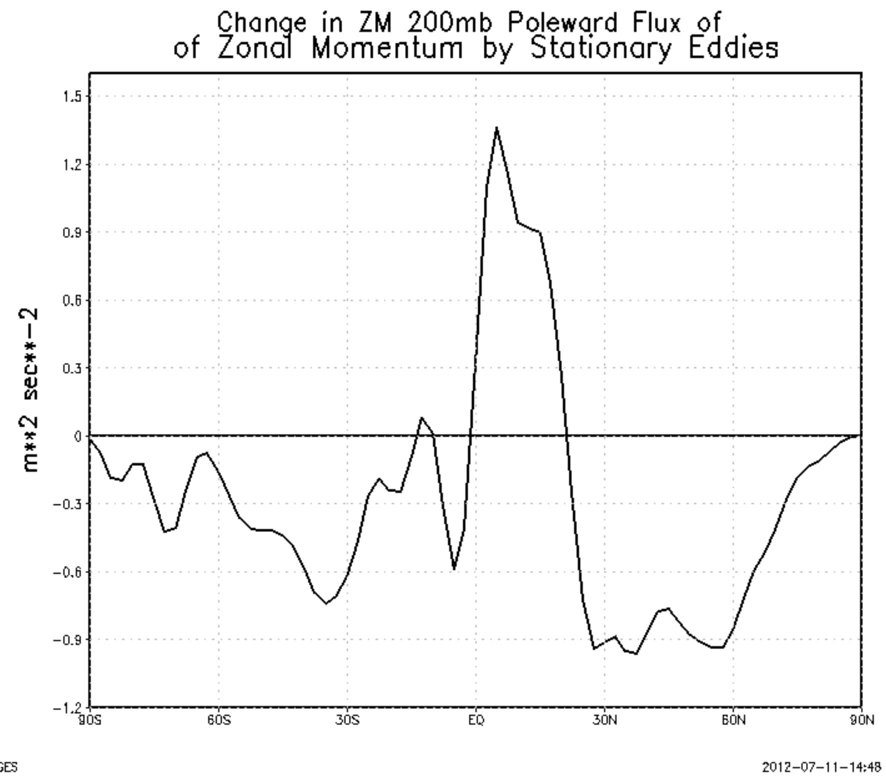


Figure 2.29. Zonally averaged temperature anomalies in the indicated latitude bands from the microwave sounding unit (MSU) vertically averaged over the atmosphere. The vertical tick interval is 0.5 K. (From Yulaeva and Wallace, 1994.)

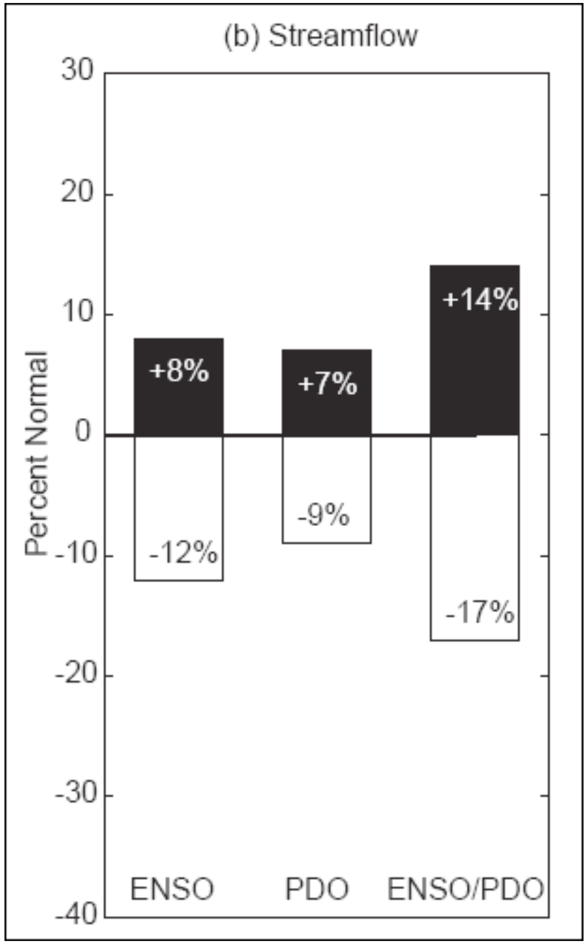
ENSO AFFECTS THE TEMPERATURE OF THE GLOBAL TROPICS AND THROUGH THIS THE GLOBALLY AVERAGED TEMPERATURE.

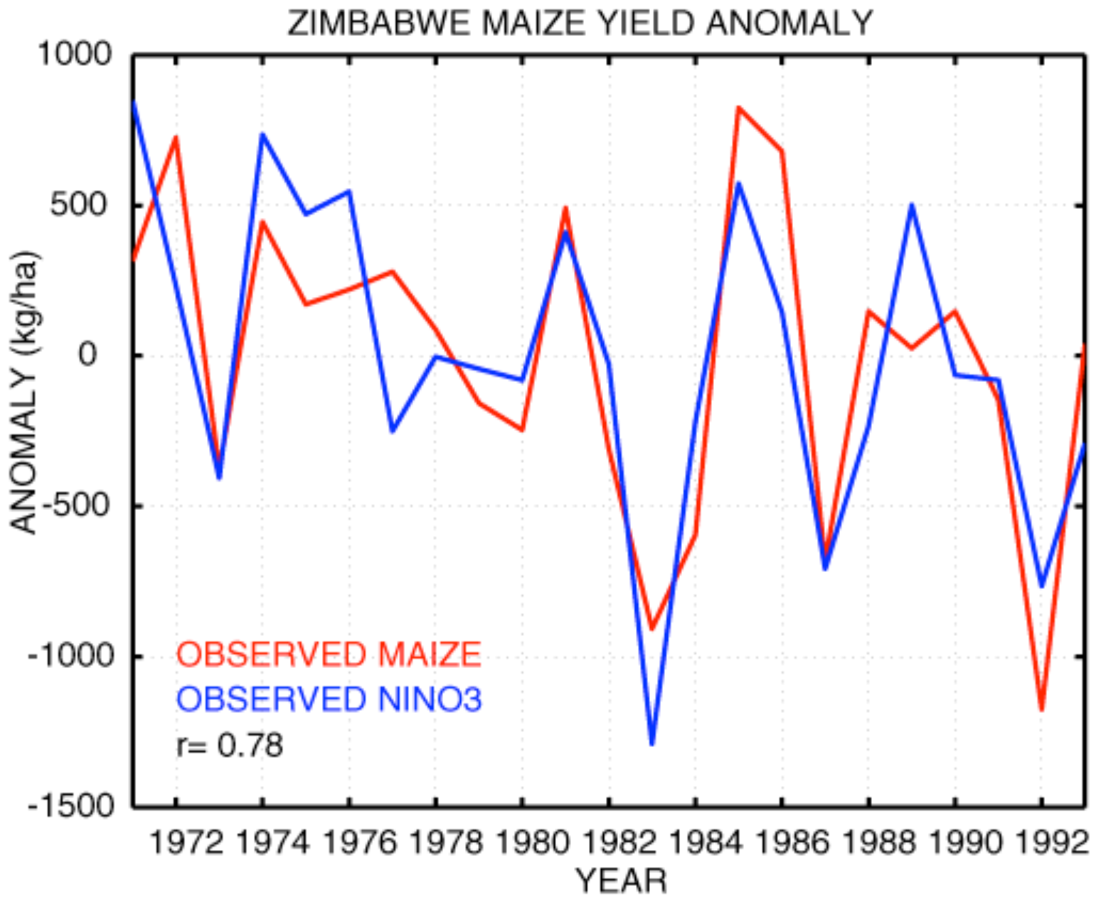
Regressions of NINO3.4 Against Zonal Means at 200mb
ENSO Teleconnections are Global



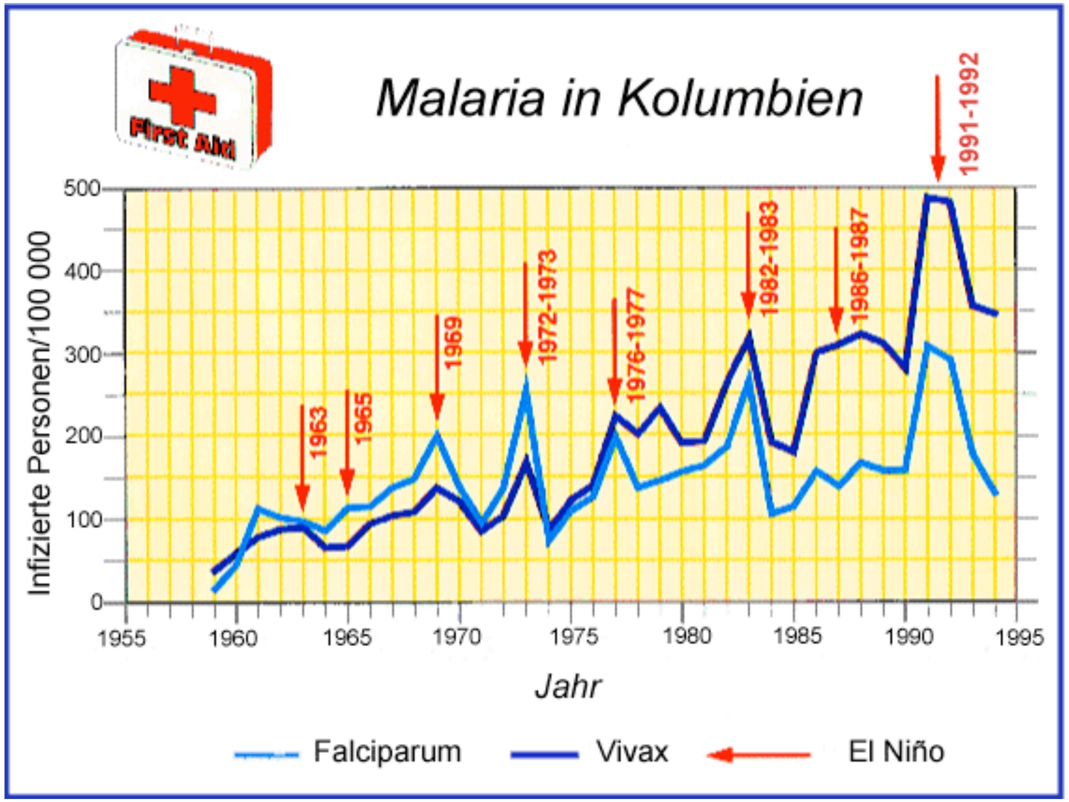


Streamflow in the Pacific Northwest of the US (Shaded corresponds to cold phases of ENSO)





(Cane et al, 1994)



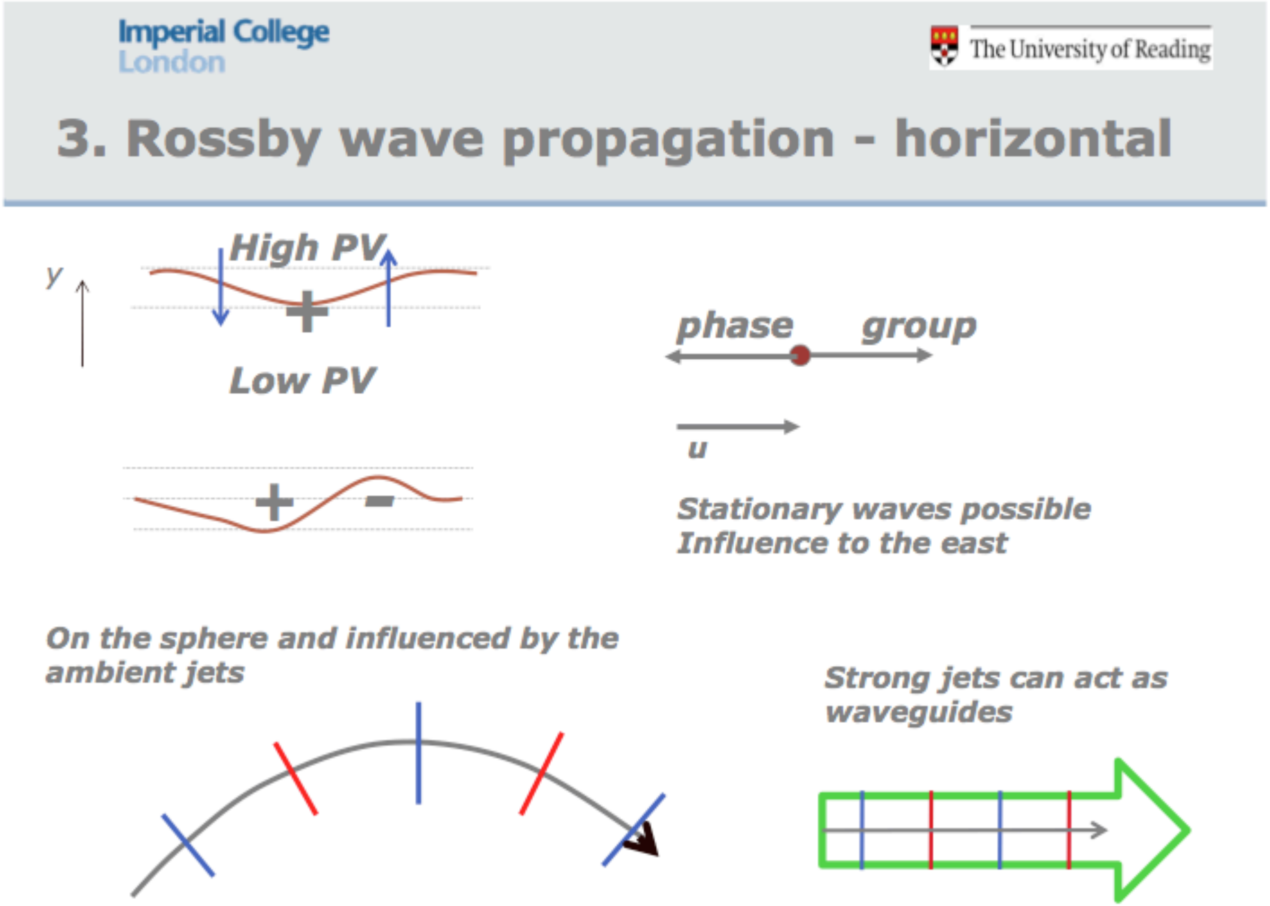
http://www.mpimet.mpg.de/en/aktuelles/presse/faq/das-el-nino-southern-oscillation-enso-phaenomen/

MECHANISMS FOR ENSO TELECONNECTIONS

A. ZONAL AND MERIDIONAL PROPAGATION OF ATMOSPHERIC ROSSBY AND KELVIN WAVES

B. WALKER CIRCULATION

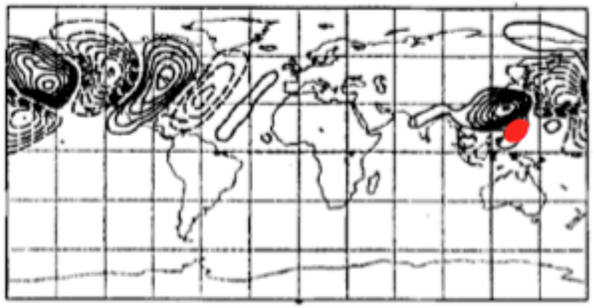
From Hoskins presentation at 2008 ICTP Workshop on Teleconnections



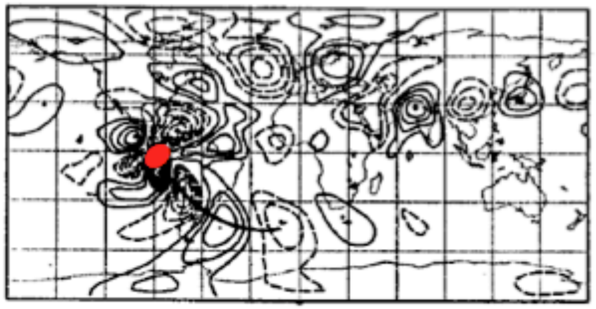
Imperial College London

The University of Reading

Propagation of Rossby waves from regions of tropical convection



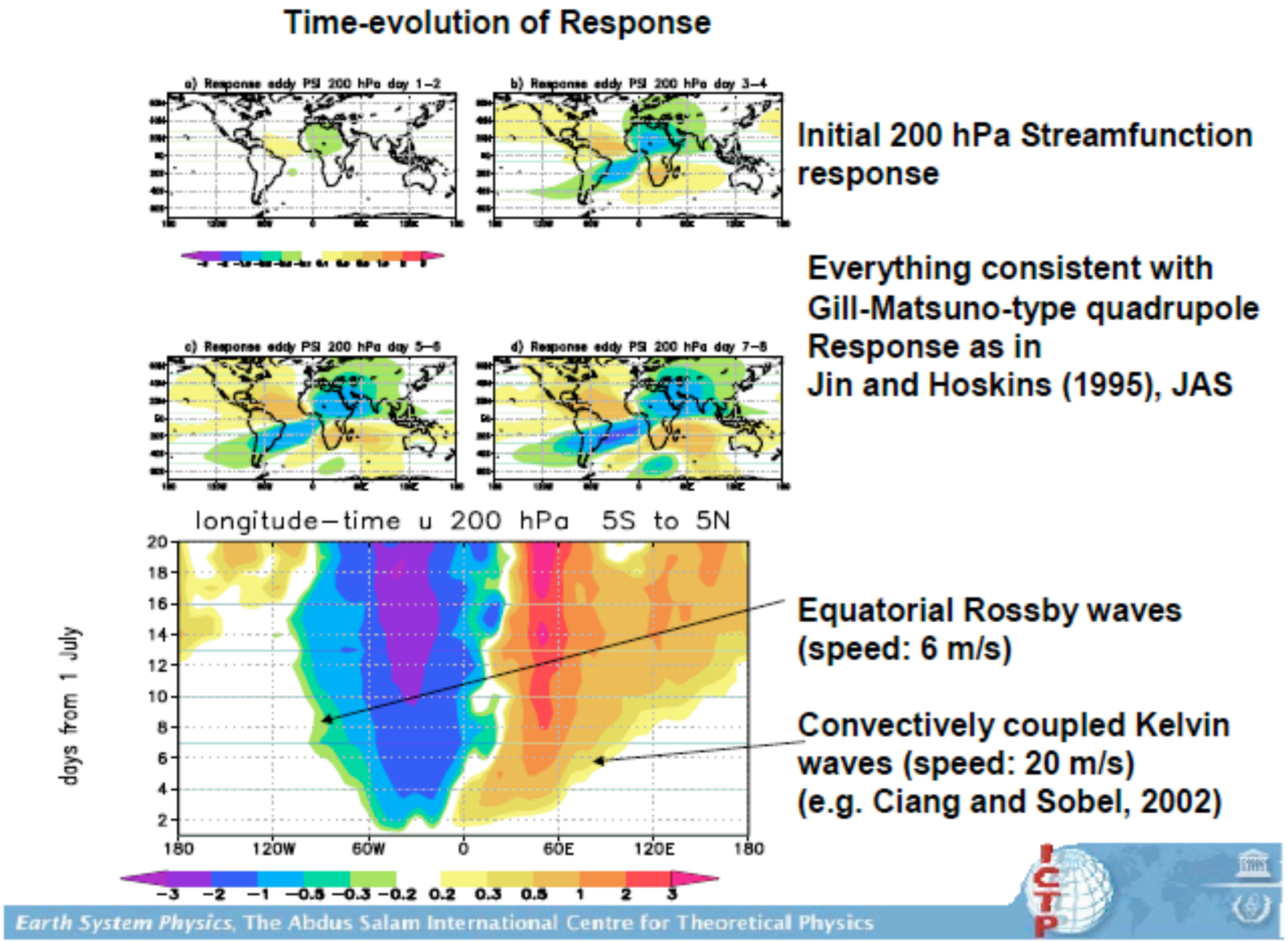
After 9 days



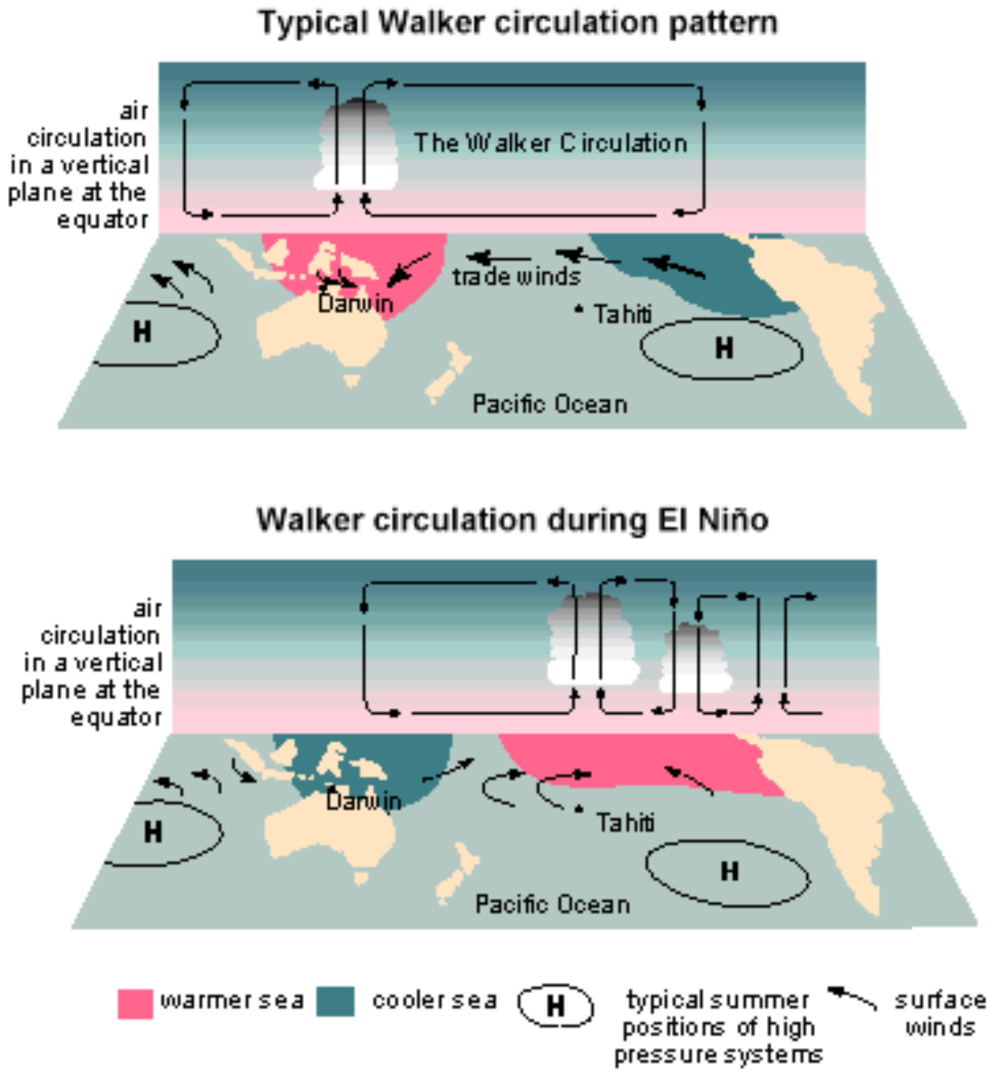
After 9 days

Ambrizzi and Hoskins (1997)

From Kucharski presentation 2008 ICTP Teleconnections Workshop



Walker Circulation



STATUS OF UNDERSTANDING OF ENSO TELECONNECTIONS

- **TROPICAL-EXTRATROPICAL TELECONNECTIONS**

  ROSSBY WAVE PROPAGATION

  - **STEADY LINEAR MODELS PRODUCE REALISTIC-LOOKING ROSSBY WAVE TRAINS FROM NEAR-EQUATORIAL HEATING**

  - **UPGRADING TO REALISTIC BASIC STATES LEADS TO UNREALISTIC ROSSBY WAVE RESPONSE CHARACTERISTICS UNLESS UNPHYSICAL DAMPING (A LA GILL MODEL) IS ADDED**

  - **LINEAR DYNAMICAL DIAGNOSTICS IMPLICATE A MIDLATITUDE VORTICITY SOURCE RATHER THAN LOW LATITUDE HEATING AS FORCING THE TELECONNECTIONS**
    - **THERE IS NO EXPLANATION FOR THE CAUSE OF THE MIDLATITUDE VORTICITY SOURCE OR ITS LINK TO THE TROPICAL HEATING**

- ZONAL TELECONNECTIONS WITHIN THE TROPICS: GIVEN THE ENSO HEATING, WHERE IS THE PRECIPITATION INFLUENCED IN THE REST OF THE TROPICAL BELT AND WHY?

  WALKER CIRCULATION
  - HEUISTIC PICTURE, BUT NO DYNAMICAL UNDERPINNING AND NO REAL APPLICATION

  TROPICAL WAVES

- EMPIRICAL LINEAR OPERATORS CAN BE DEVELOPED THAT ARE MORE SUCCESSFUL THAN LINEARIZED DYNAMICAL MODELS IN REPRODUCING KNOWN STATISTICS (GRINSUN AND BRANSTATOR 2007)