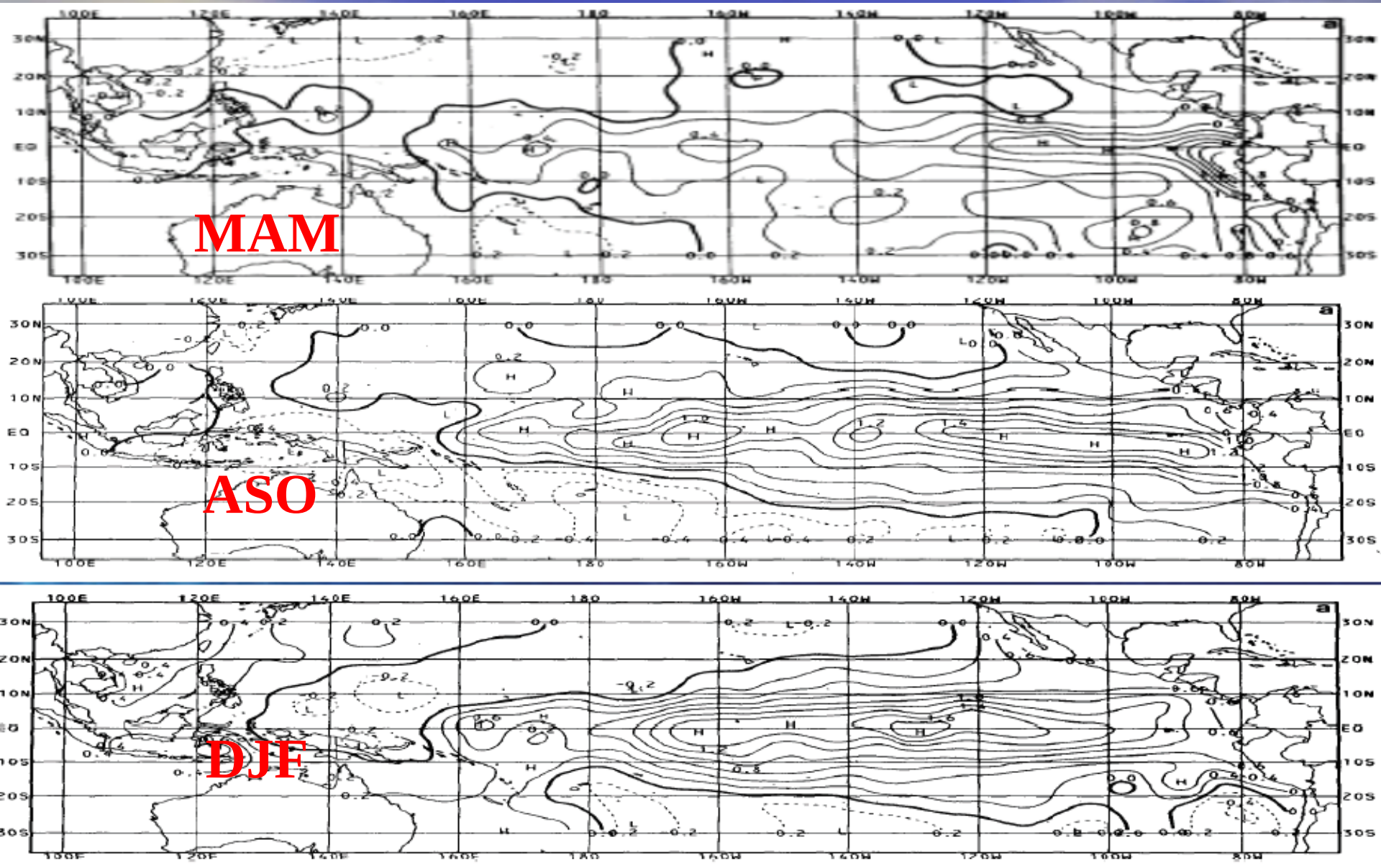
ENSO Multiplicity and Regime Sensitivity

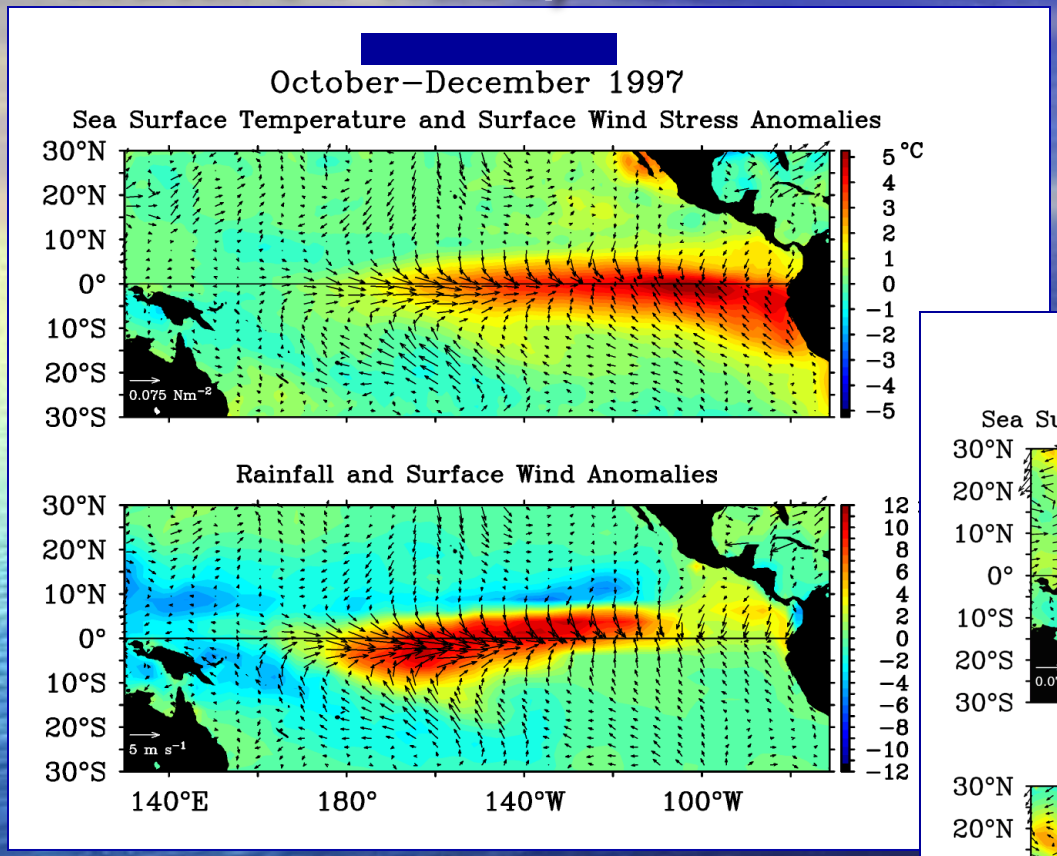
F-F Jin

University of Hawaii

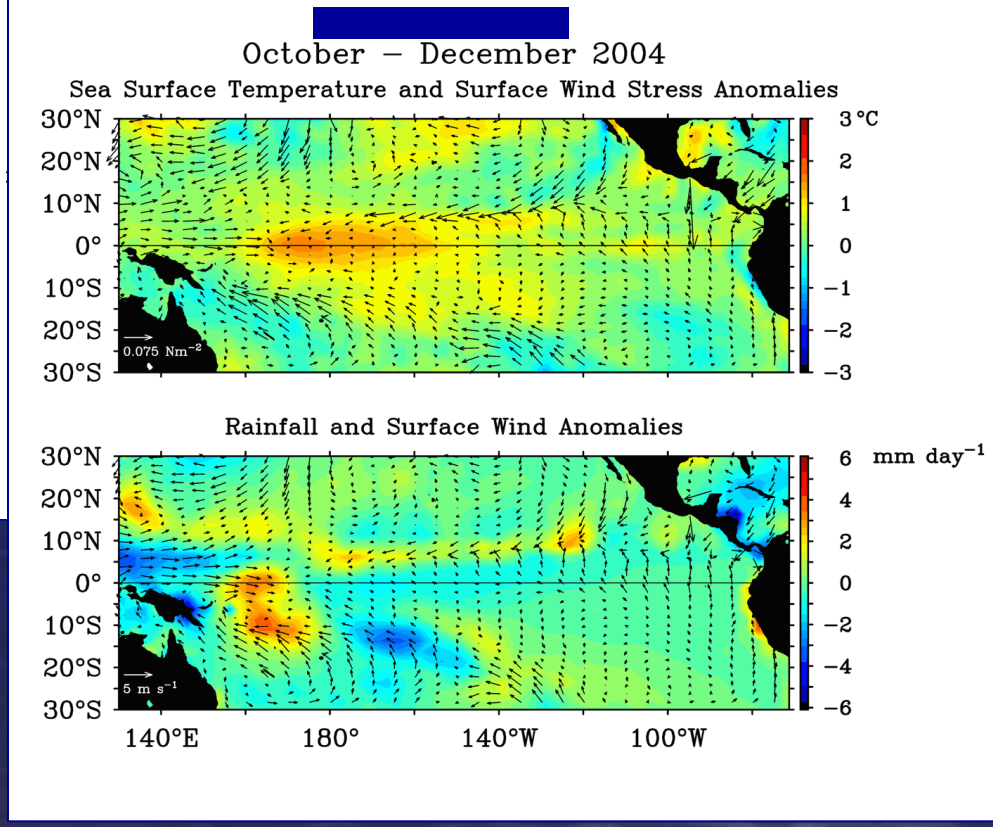
Rasmusson & Carpenter 1982



Mature Phase, 1997

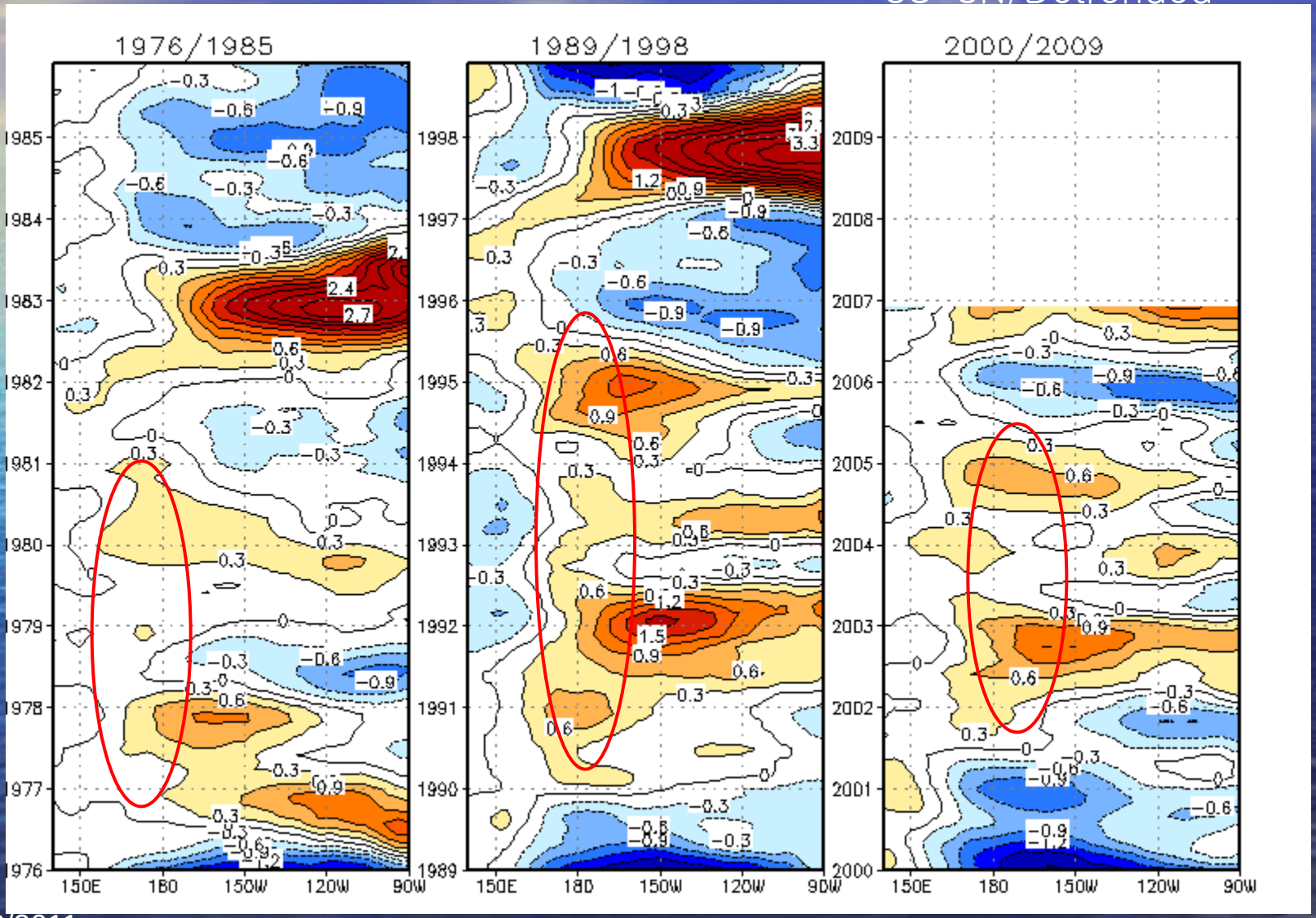


Mature Phase, 2004

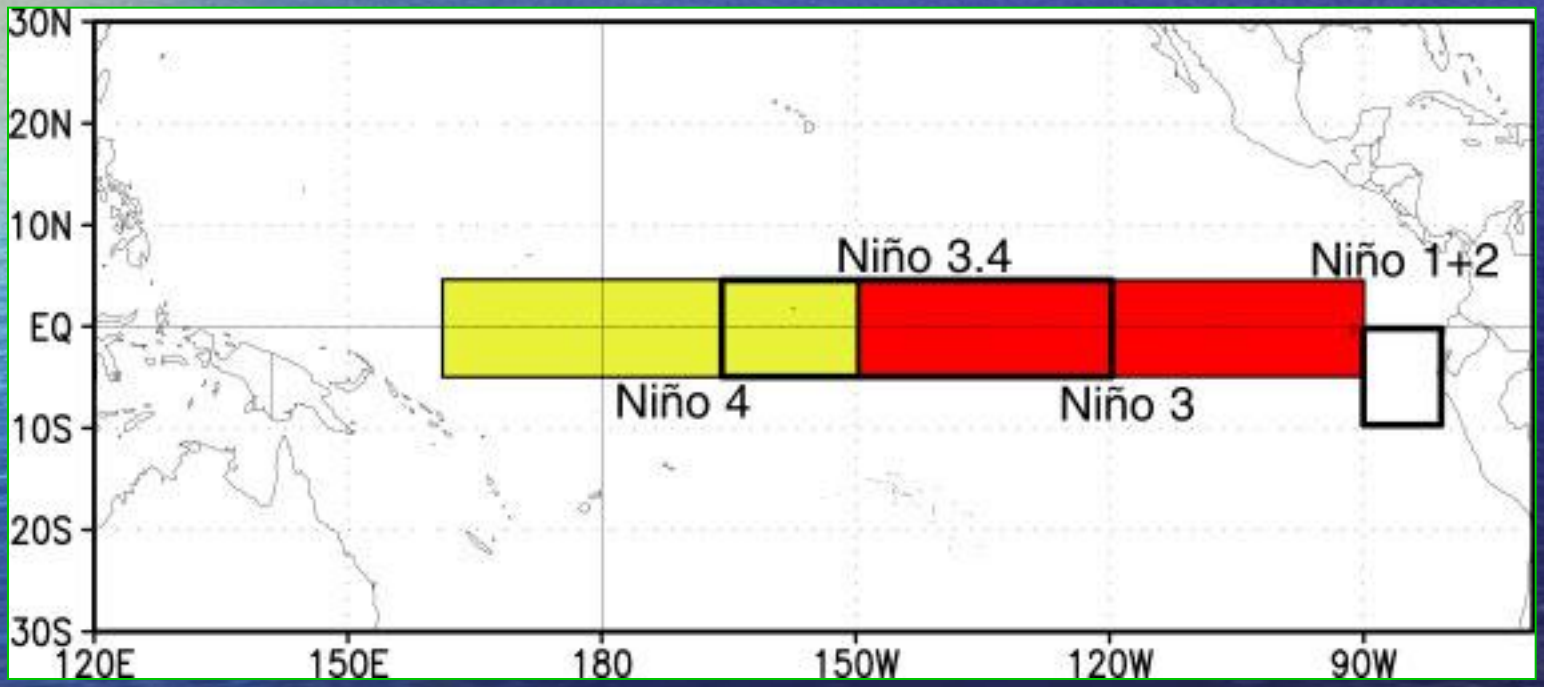


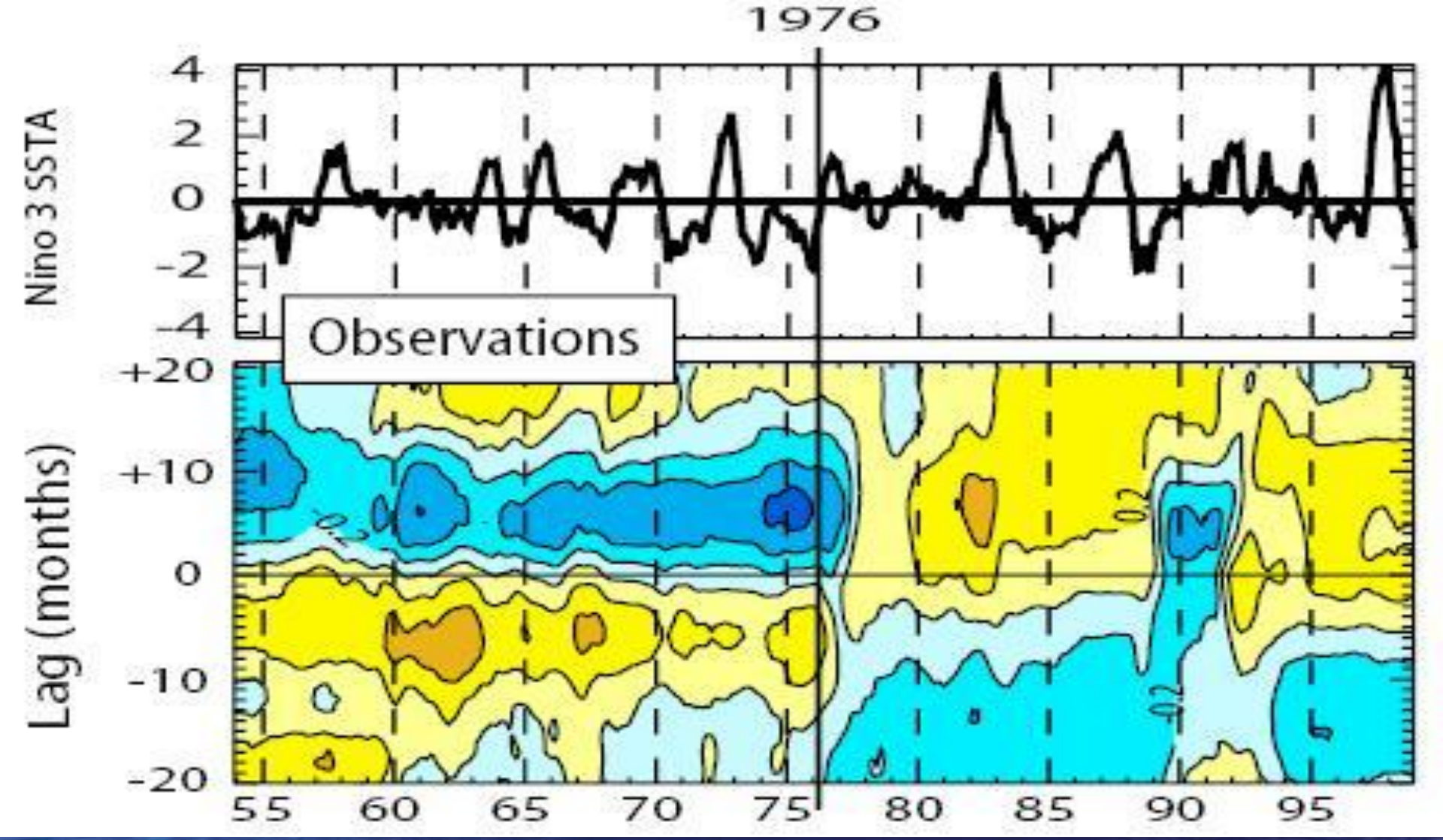
Precipitation Anomalies along the Equator

5S-5N/Detrended



Sea Surface Temperature Index Regions for El Niño and La Niña





Westward propagating before 76, eastward or standing after 76

ENSO regime changed !

(i)Two Types of El Niño

2009

2006

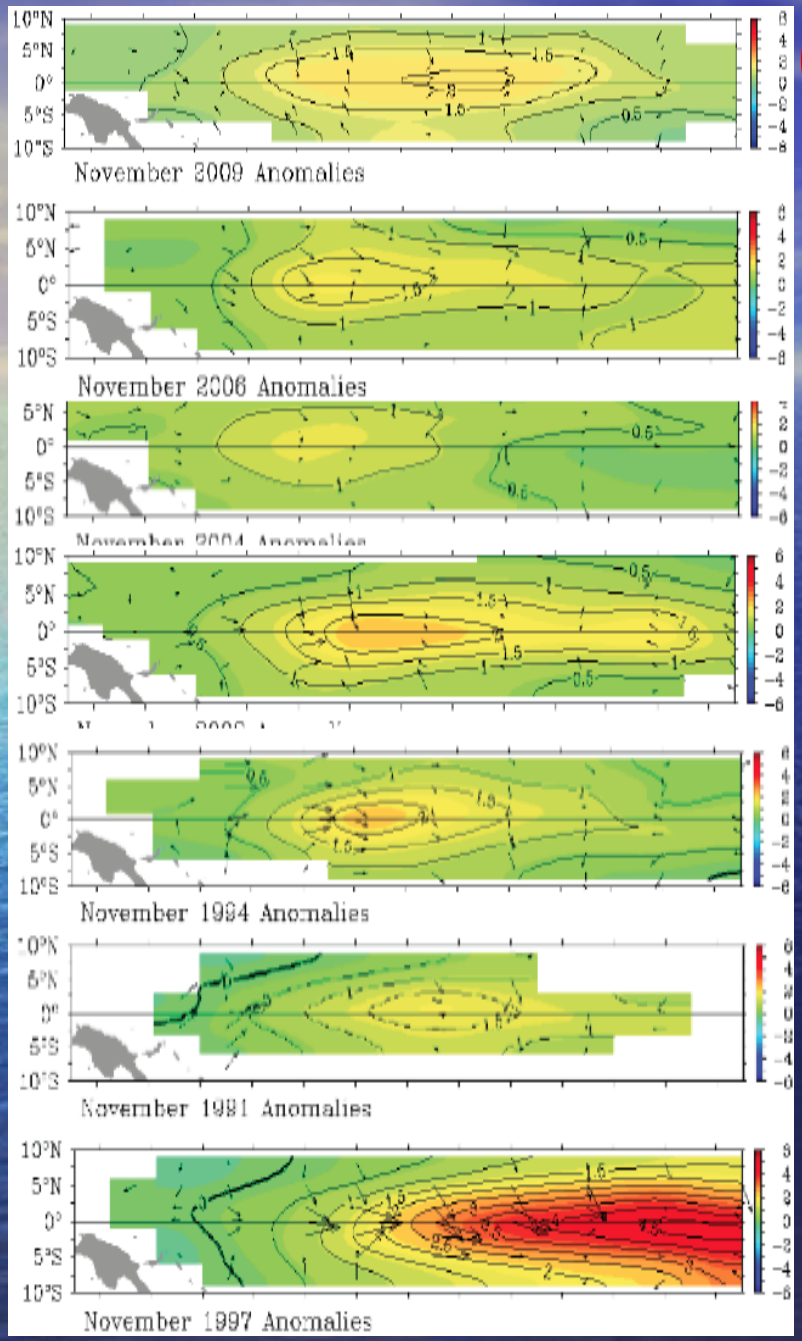
2004

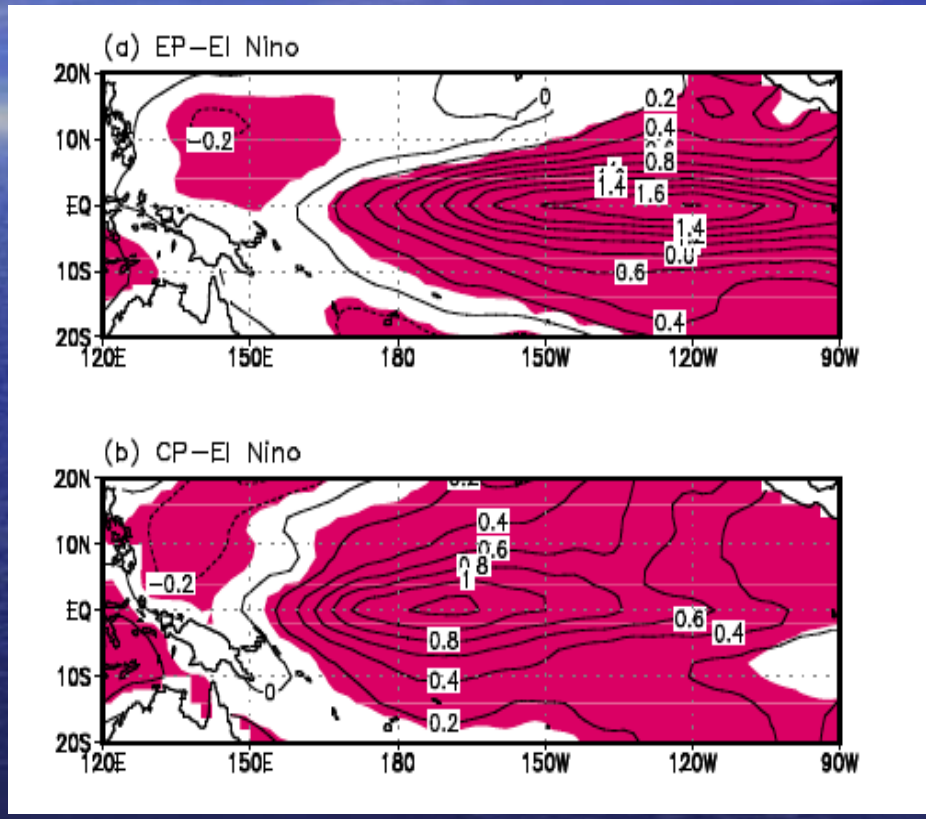
2002

1994

1991

1997

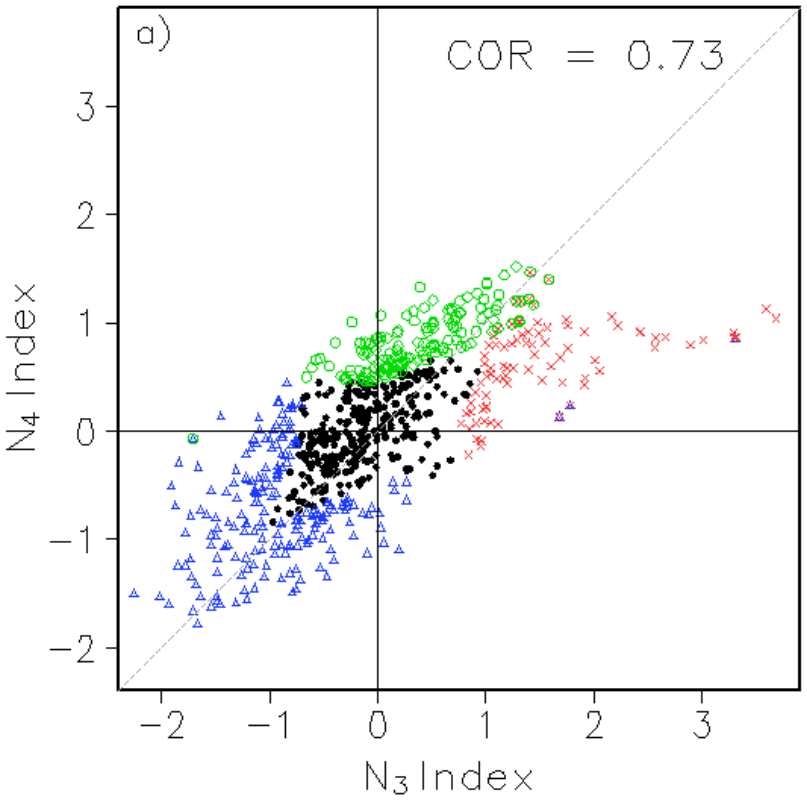


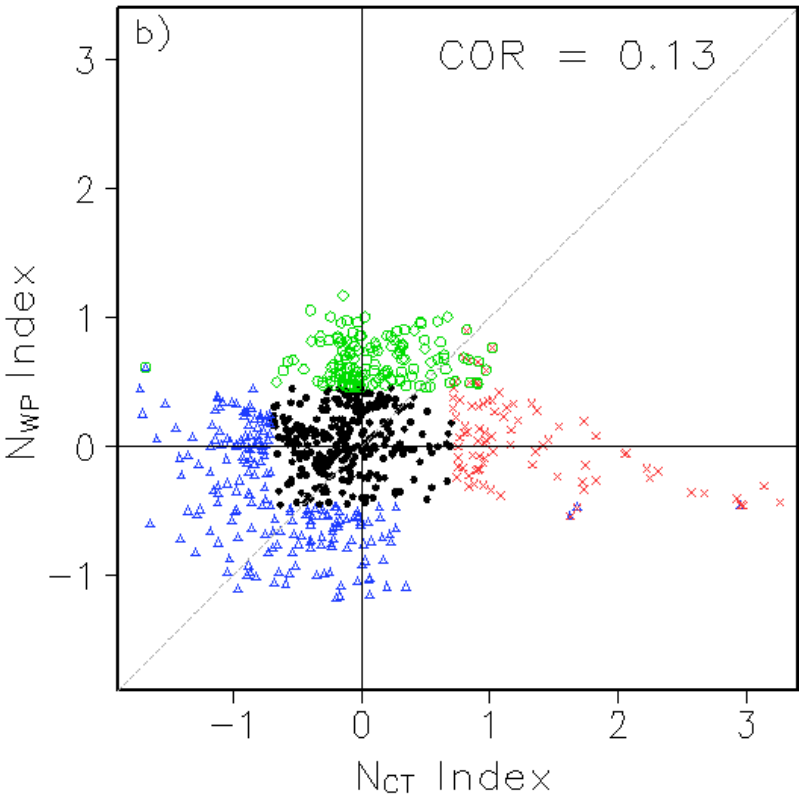


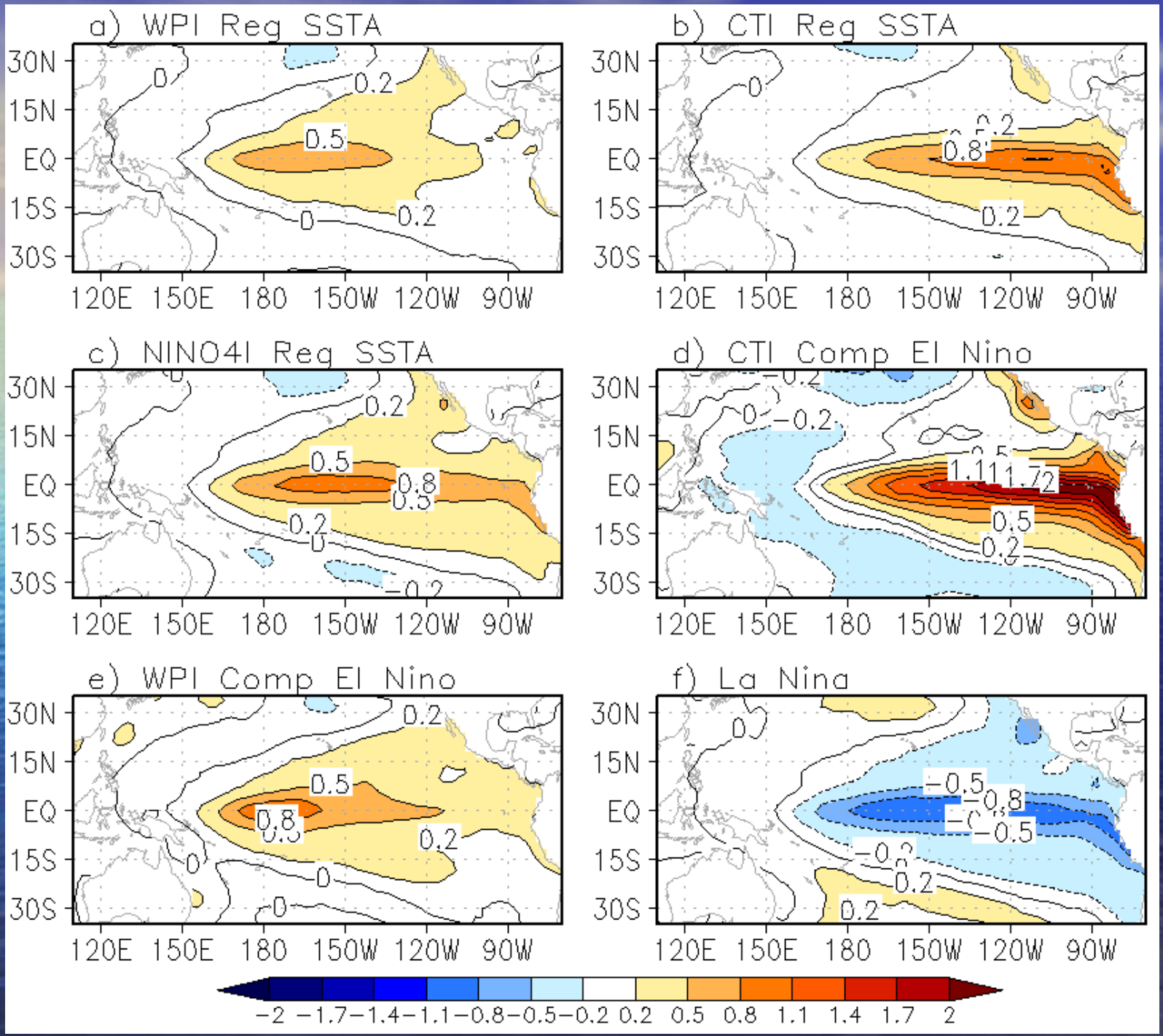
Yeh et al (2009)

WP and CT ENSO Indices (Ren and Jin 2010)

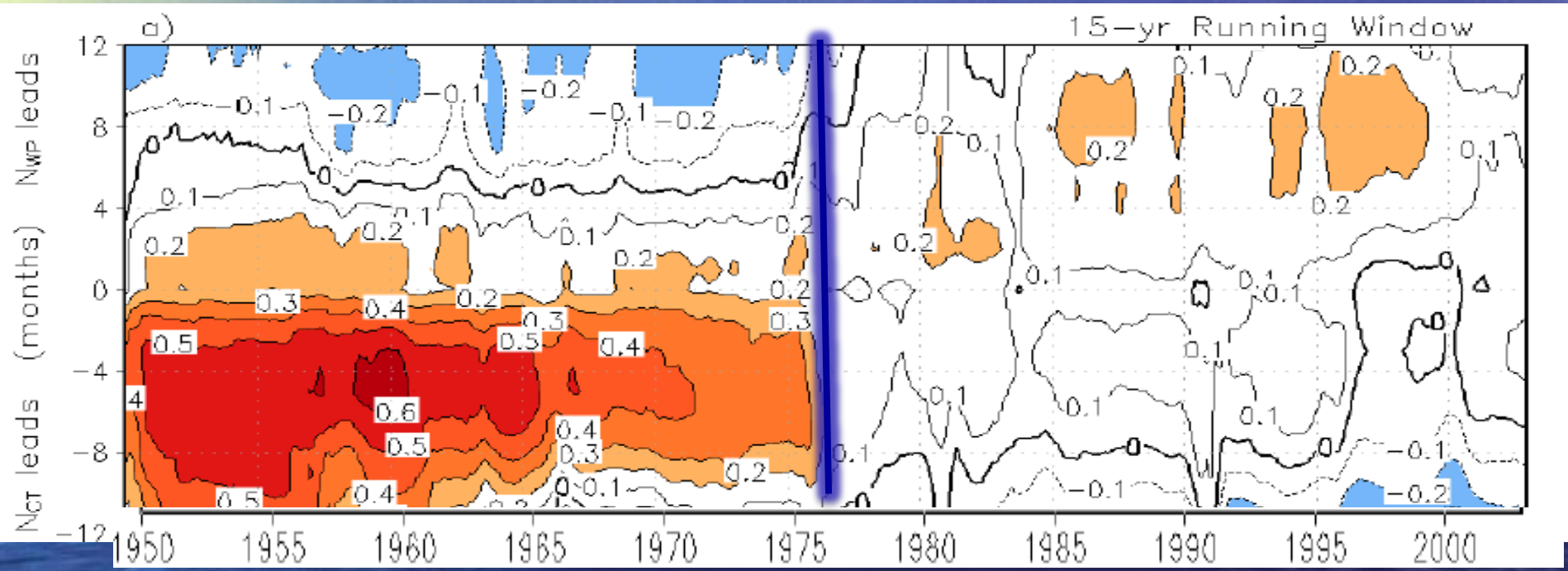
$$\begin{cases} N_{CT} = N_3 - \alpha N_4 \\ N_{WP} = N_4 - \alpha N_3, \end{cases} \qquad \alpha = \begin{cases} 2/5, & N_3 N_4 > 0 \\ 0, & \text{otherwise.} \end{cases}$$






a) WPI Reg SSTA
b) CTI Reg SSTA
c) NINO4I Reg SSTA
d) CTI Comp El Nino
e) WPI Comp El Nino
f) La Nina
30N
15N
EQ
15S
30S
120E 150E 180 150W 120W 90W
−2 −1.7 −1.4 −1.1 −0.8 −0.5 −0.2 0.2 0.5 0.8 1.1 1.4 1.7 2

ENSO Regime Change



(i) 76 Climate mean state shift. (ii) ENSO regime change

Theory of WP and CT ENSO : multiple coupled modes

ENSO Regime & Multiplicity

Jin et al 1993

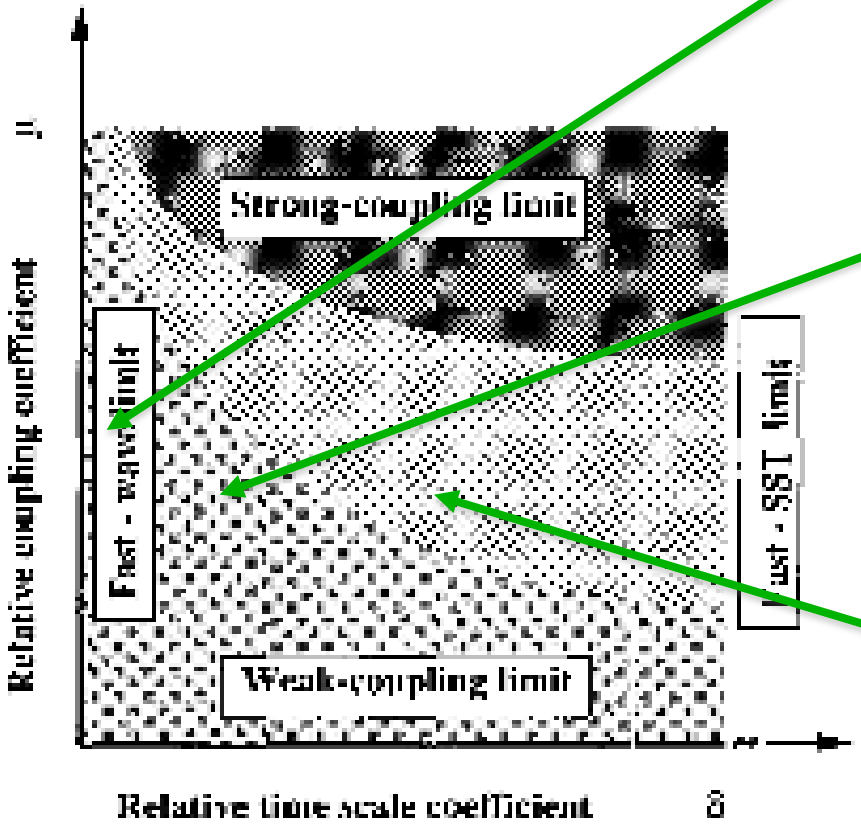
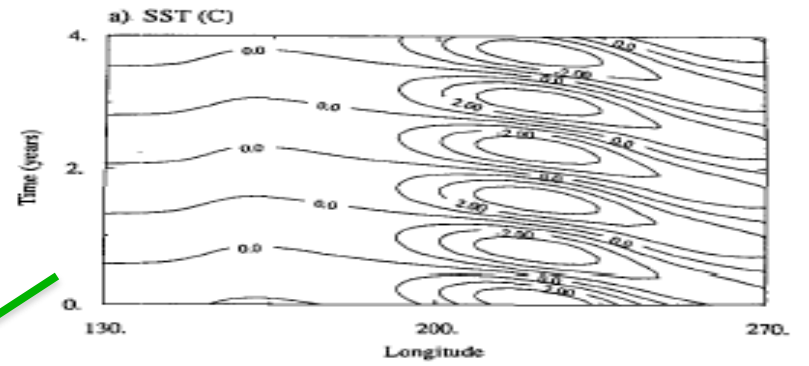
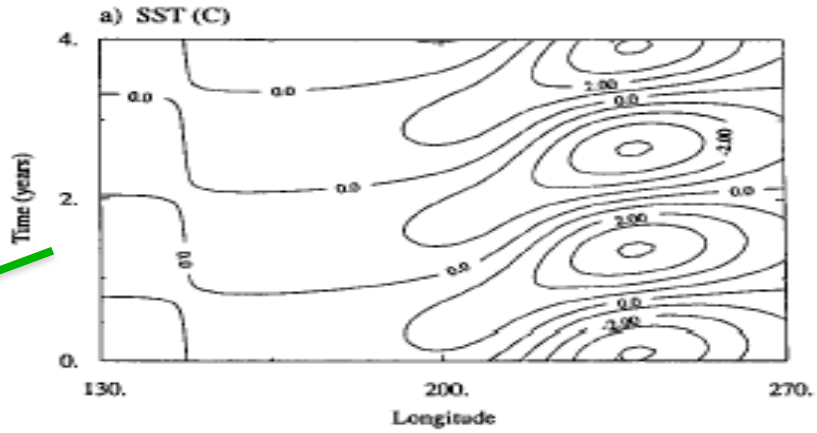
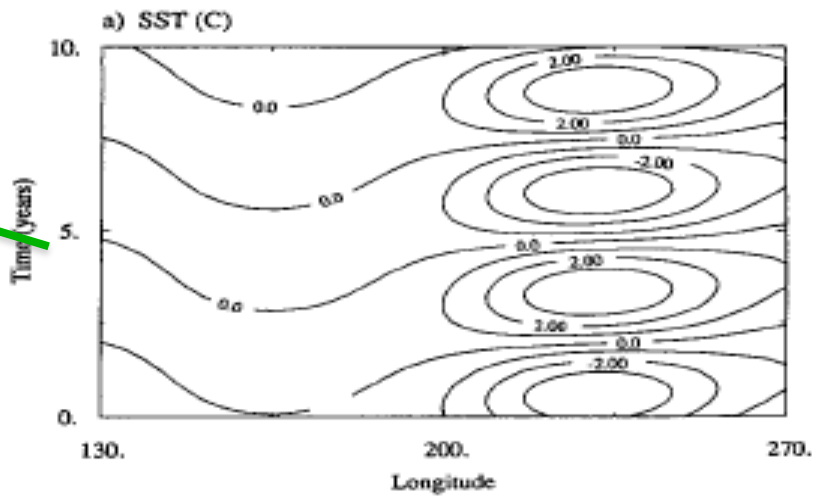


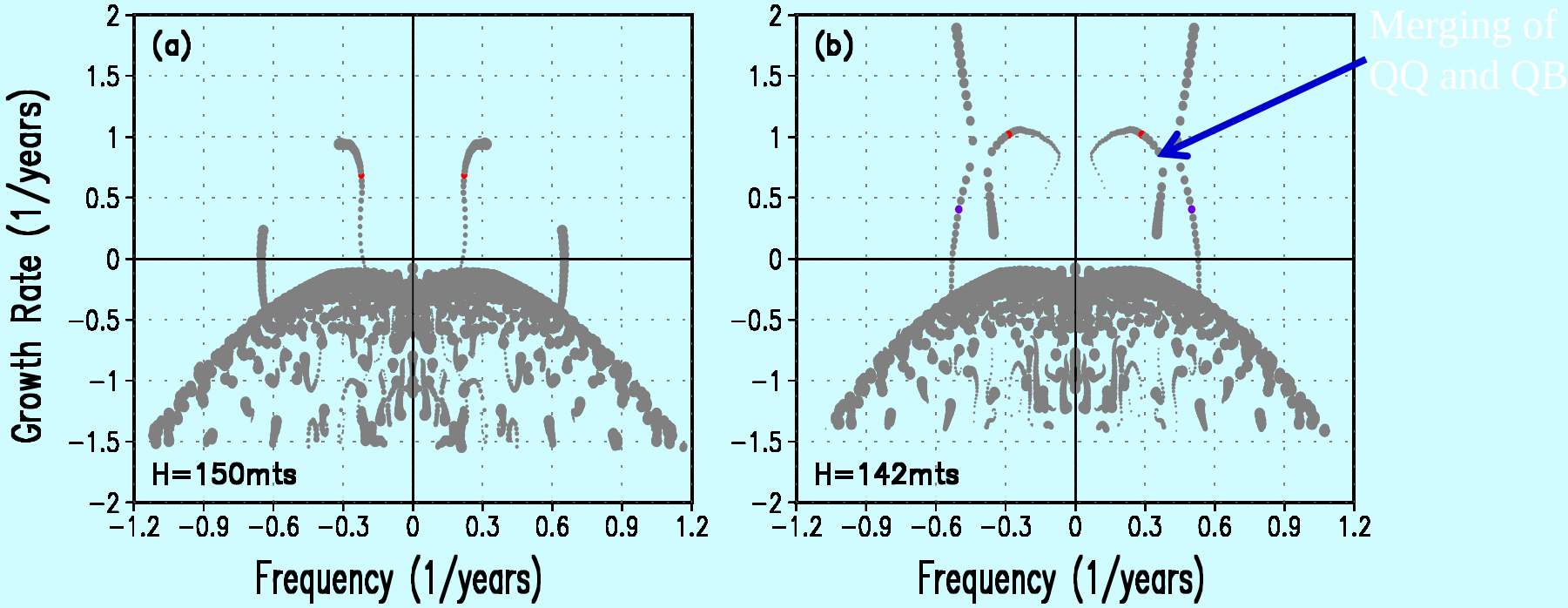
FIG. 1. Schematic regime diagram of the (μ, δ) parameter space showing regions of validity of various limits.

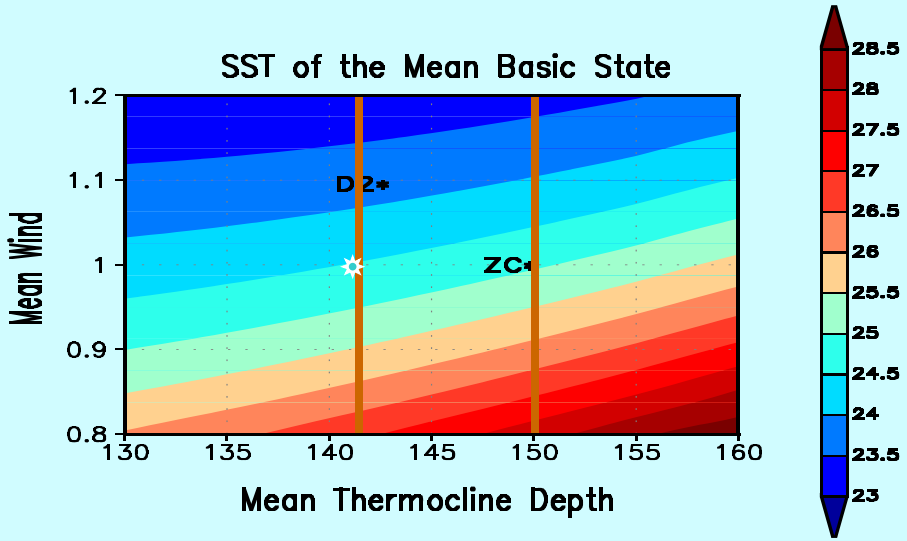




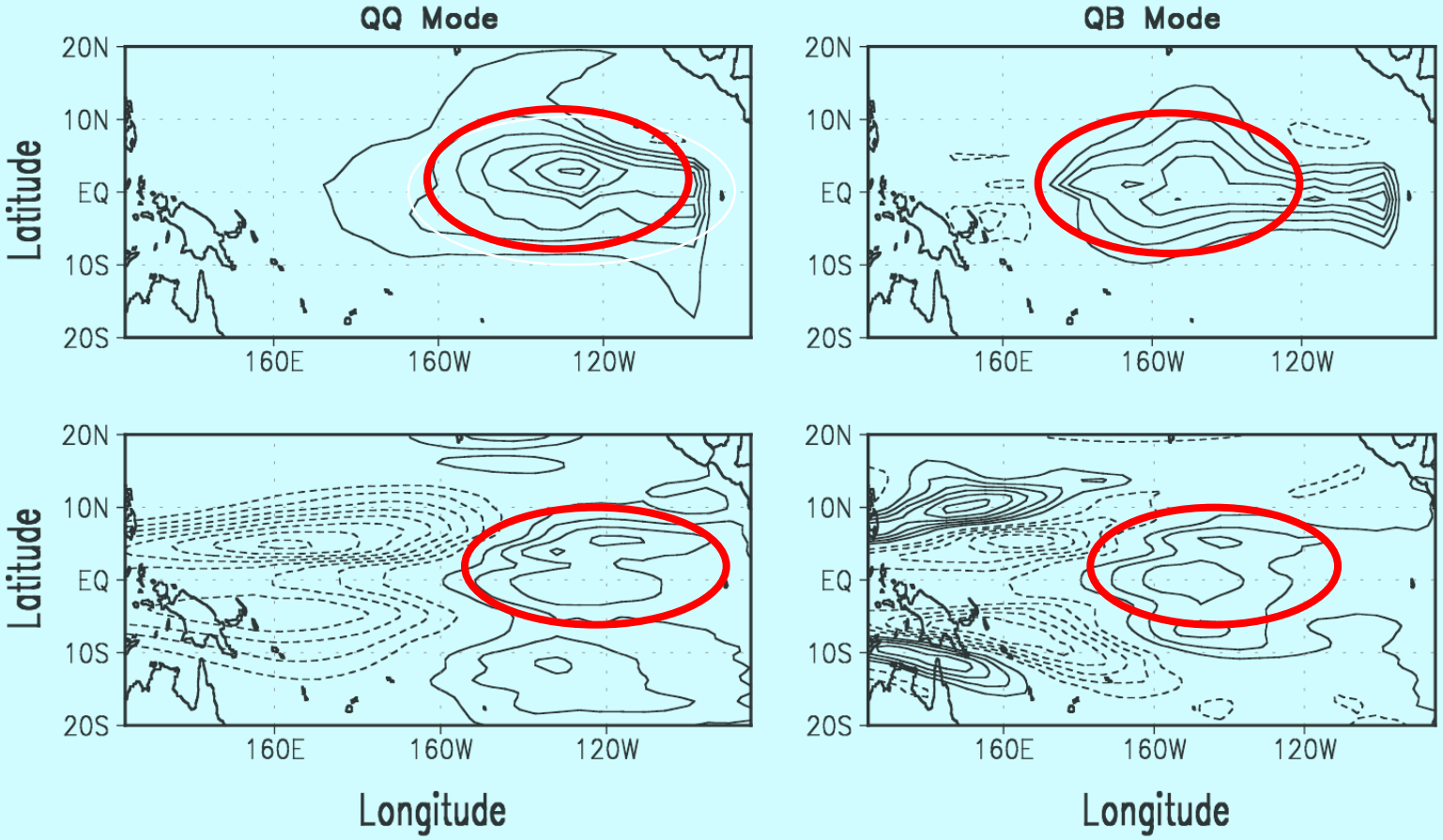


Eigen-value changes of ZC model following different intensities of the climatological wind from 80% to 120%



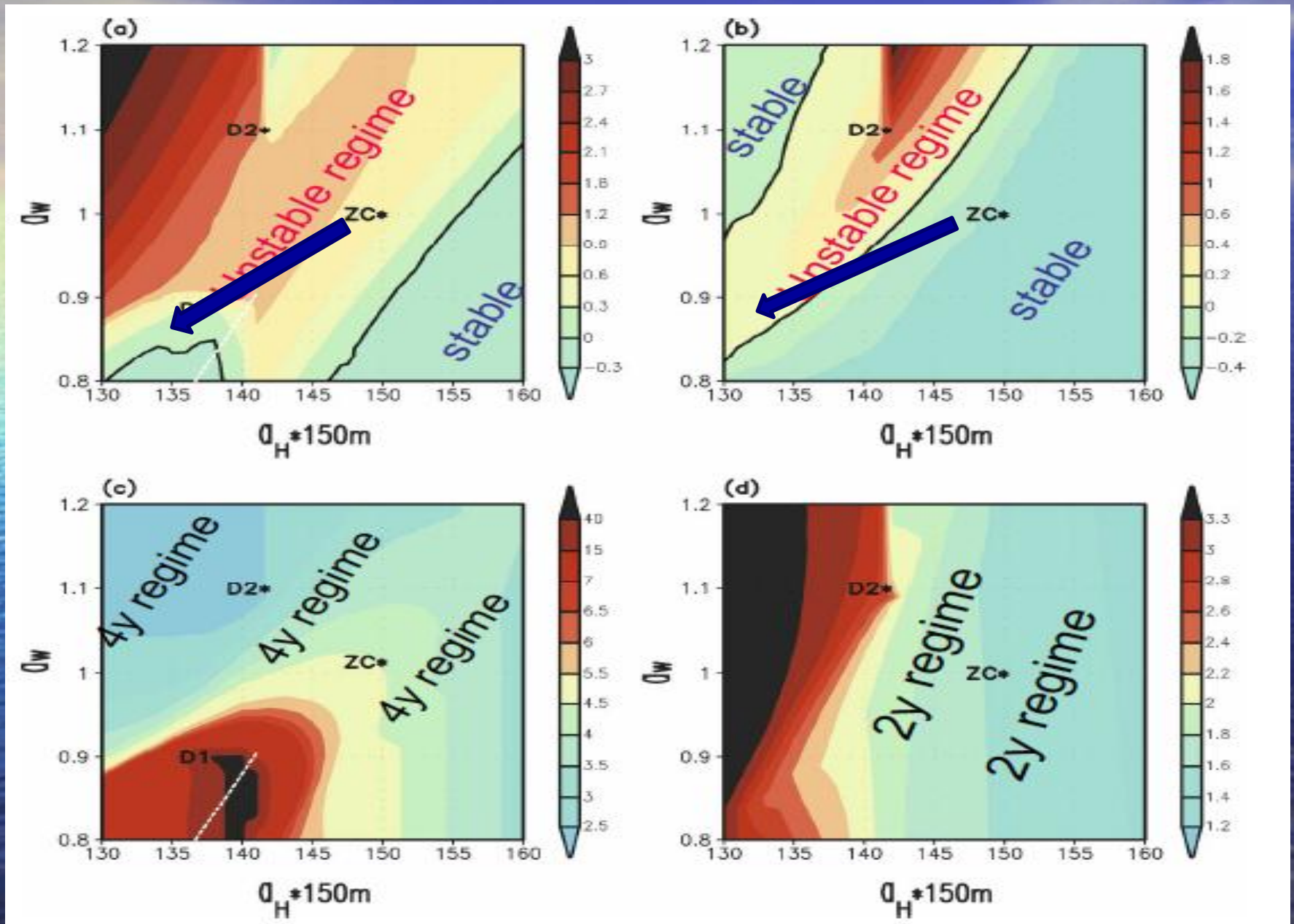


Eigen-vectors for QQ (CT) and QB (WP) modes



Sensitive Dependence of ENSO-Modes to Climate Change

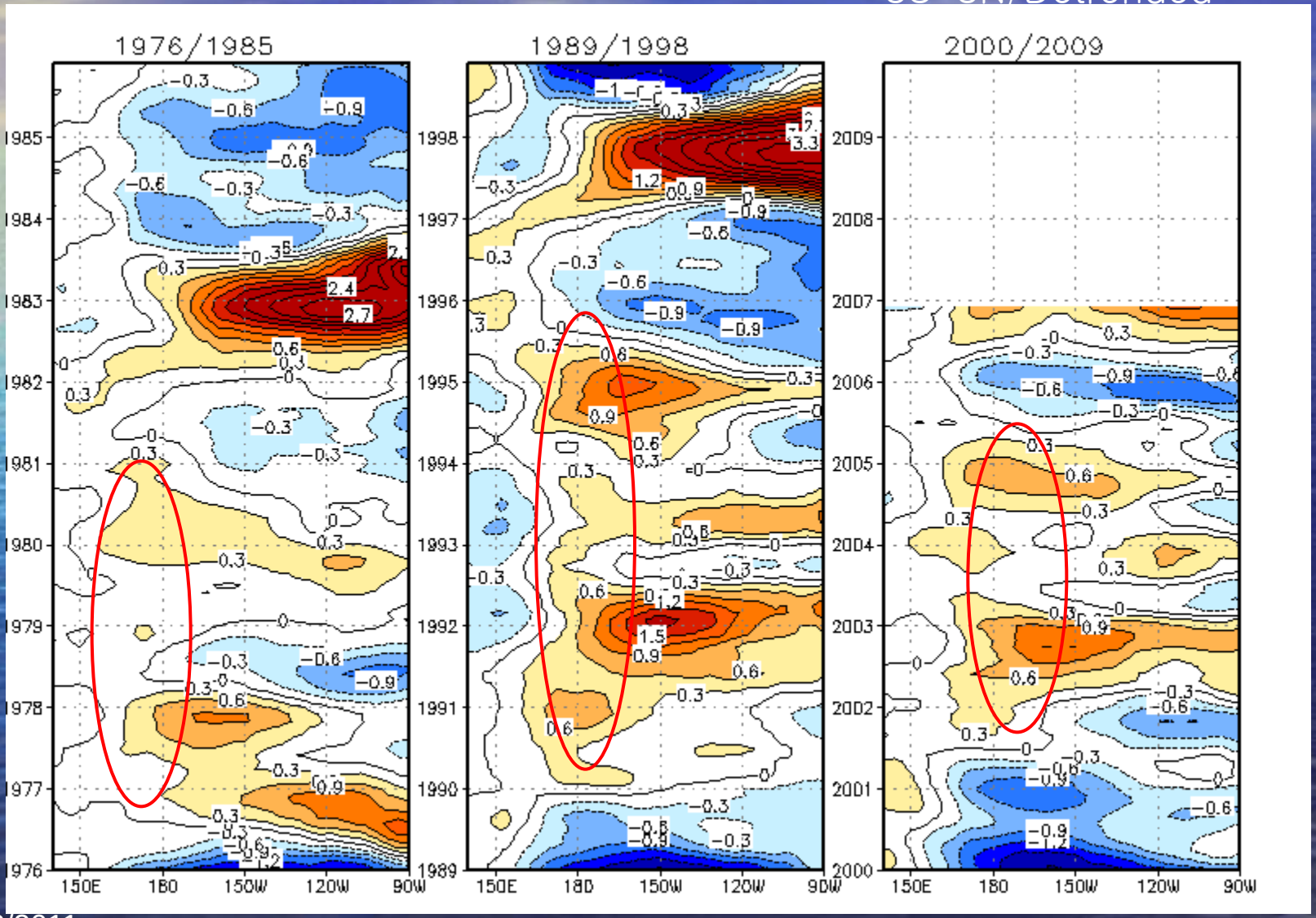
Regimes for CT-ENSO-like and CT-ENSO-like modes



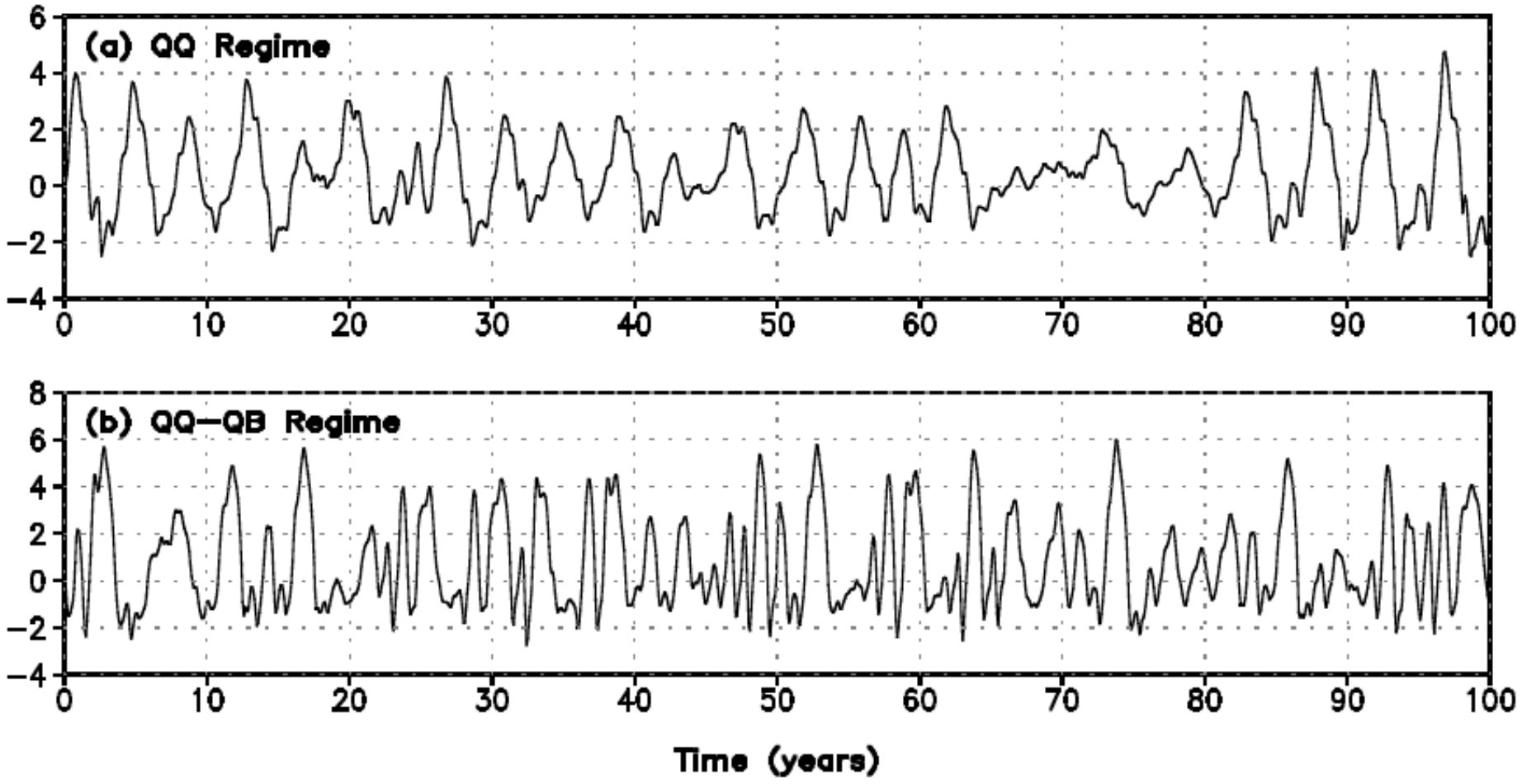
ENSO modulations

SST Anomalies along the Equator

5S-5N/Detrended

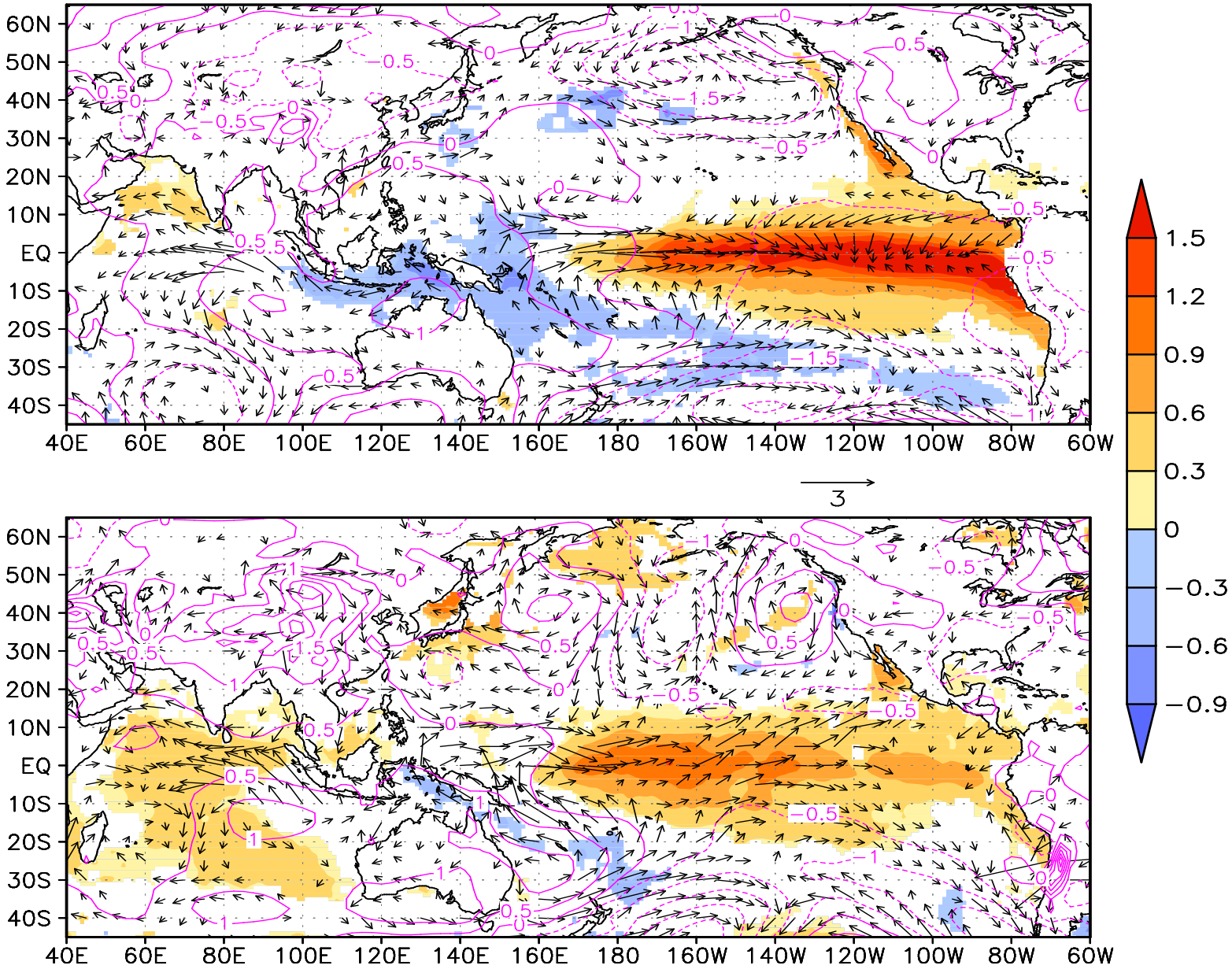


Bursting behavior of ENSO in QQ-QB regime:



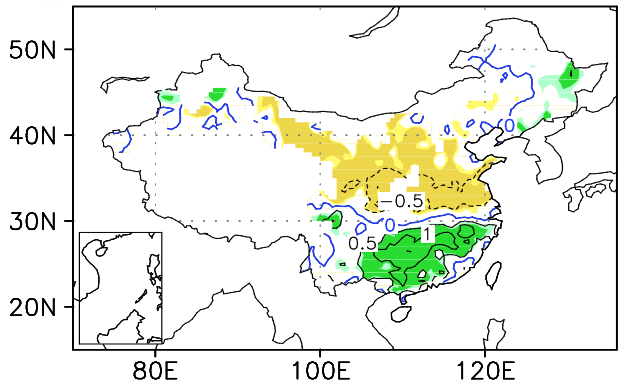
ENSO regimes and their related regional climate shift during boreal autumn

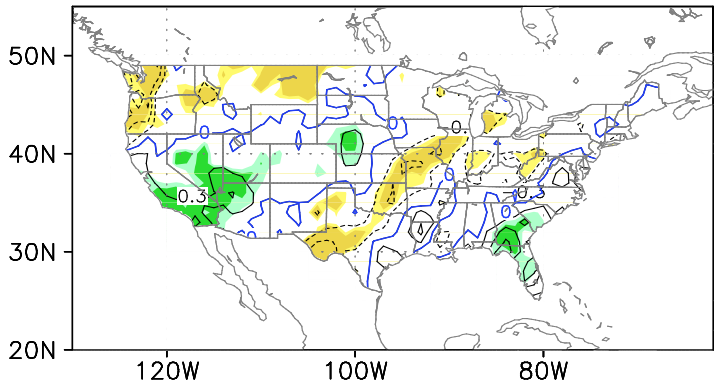
El Nino Composite SLP and Winds



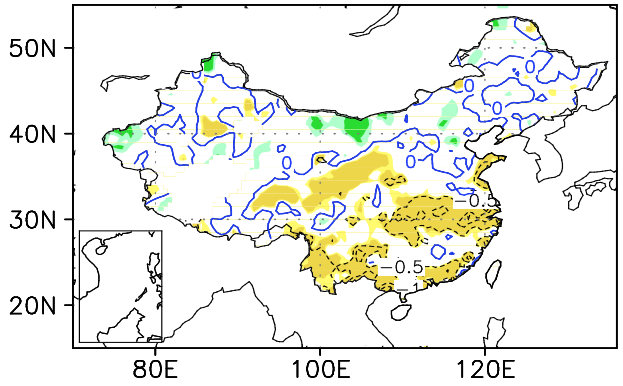
Regional Rainfall Anomalies associated with ENSO

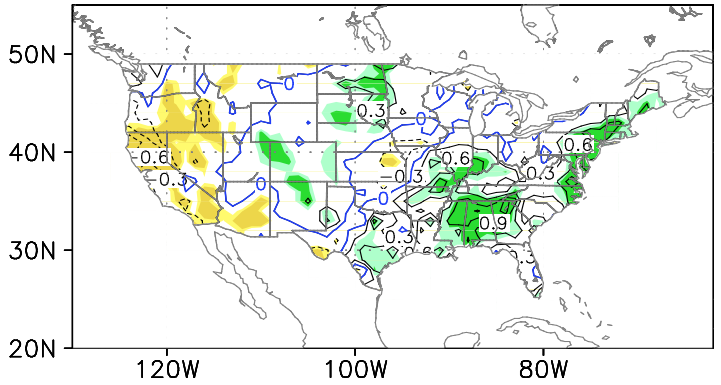
CT El Nino



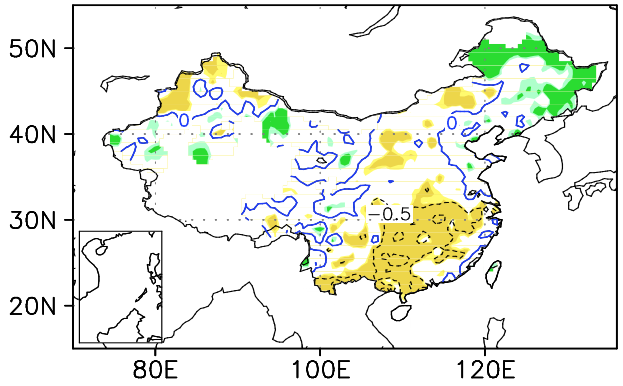


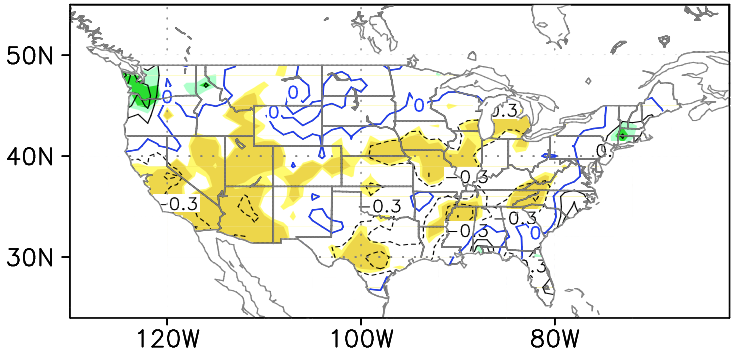
WP El Nino



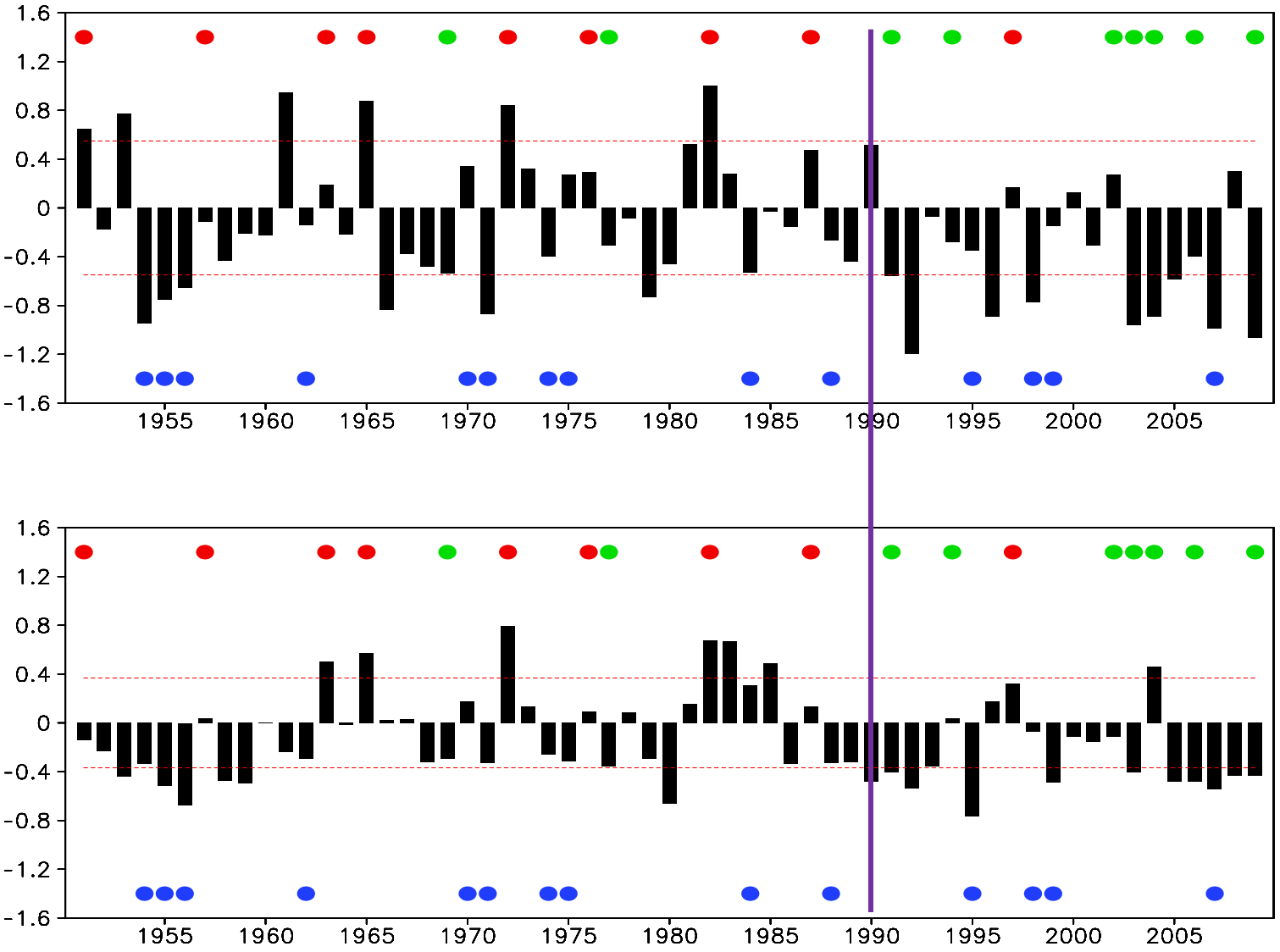


La Nina





Regional Rainfall Shift



Summary

- Current climate state supports ENSO multiplicity, thus the co-existences of two-type ENSO modes. This ENSO regime is sensitively to relatively small changes in climate mean state.
- Interaction of two types of ENSO may lead to large internal ENSO modulation.
- Two types of ENSO may have different impacts on regional climate.
- Further study is needed to understand and assess ENSO potential regime changes due to GW using CGCMs.