Central-Pacific El Niño: Pattern, Evolution, and Generation

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Two Types of ENSO

(Yu and Kao 2007; Kao and Yu 2009)

**Eastern-Pacific ENSO**

**Central-Pacific ENSO**

$\text{EOF applied to Residual SSTA} = (\text{SSTA}) - (\text{Regressed SSTA with Nino1+2/Nino4})$
Subsurface Ocean Temperature Evolutions
(Subsurface ocean temperature lag-correlation with the principal components)
Different Generation Mechanisms

Central-Pacific ENSO (atmospheric forcing)

Eastern-Pacific ENSO (related to thermocline variation)
CP-ENSO SST Variations

(Yu, Kao, and Lee, 2010)
EP/CP-ENSO Correlates with SLP

Walker Circulation

Hadley Circulation
Walker and Hadley Circulations

20°-30°N

Equator

thermocline
EOF Correlations with Pacific SLP and SST Anomalies
(Yu and Kim 2010a)
PC2-Correlated SSTA Evolution

lag-0

Lag+2

Lag+4
SLP anomalies regressed with the EP ENSO

SLP-EOF1

SLP-EOF2
Transition from EP to CP ENSO

1972-73 El Nino

1982-83 El Nino

1997-98 El Nino
12 CP El Nino Events since 1950
SST Evolution of CP El Niño
Three Evolution Patterns for CP El Nino

- **Prolonged Decay**
- **Abruptly Decay**
- **Symmetric Decay**

(Yu and Kim 2010b)
Predicting the *Onset* and *Decay* of CP ENSO
EP and CP ENSO in AR4 Models: Pre-Industrial Simulations

(Yu and Kim 2010c)
EP and CP ENSO in AR4 Models: Pre-Industrial Simulations
EP and CP ENSO in AR4 Models: Pre-Industrial Simulations
EP and CP ENSO Intensities
EP and CP ENSO Periods

(a) Scatter plot of EP period (year) vs. CP period (year)

(b) EP normalized power vs. period (years)

(c) CP normalized power vs. period (years)

Legend:
A: ERSST
B: HadISST
C: BCCRCM2.0
D: CCCMA-CGCM4
E: CCCMA-CGCM2.0
F: NCAR-CCSM3.0
G: CNRM-CM3
H: CSIRO-MK3.0
I: MIUB-ECHO
J: IAP-FGOALS1.0
K: GFDL-CM2.0
L: GFDL-CM2.1
M: GISS-EH
N: UKMO-HADCM3
O: UKMO-HADGEM1
P: INGV-ECHAM4
Q: INMCM3.0
R: IPSL-CM4
S: MIROC3.2-H
T: MIROC3.2-M
U: MRI-CGCM2.3.2a
CP ENSO Period and SST Distribution

The graph shows the distribution of SST (Sea Surface Temperature) across different longitudes, specifically highlighting the CP ENSO (Central Pacific El Niño-Southern Oscillation) period. The x-axis represents longitude, with values ranging from 120°E to 120°W, and the y-axis represents the scaled SDEV (Standard Deviation). The shaded area indicates a region of significant temperature variation or anomaly during the CP ENSO period.
EP ENSO Period and SST Width_Y

A: ERSST
B: HadISST
C: BCCR-BCM2.0
D: CCCMA-CGCMT47
E: CCCMA-CGCMT63
F: NCAR-CCSM3.0
G: CNRM-CM3
H: CSIRO-MK3.0
I: MIUB-ECHOg
J: IAP-FGOALS1.0g
K: GFDL-CM2.0
L: GFDL-CM2.1
M: GISS-EH
N: UKMO-HADCM3
O: UKMO-HADGEM1
P: INGV-ECHAM4
Q: INMCM3.0
R: IPSL-CM4
S: MIROC3.2-H
T: MIROC3.2-M
U: MRI-CGCM2.3.2a

Y (deg)
Summary

• There may exist two distinct types of El Nino: an Eastern-Pacific type and a Central Pacific type.

• Tropical Pacific Ocean interacts with the Walker circulation to produce the EP-El Nino but interacts with the Hadley circulation to produce the CP-El Nino.

• The onset of CP-El Nino is linked to subtropical SLP variations, while its decay is determined by the depth of the equatorial thermocline.