North Pacific Oscillation and Its Association with SST Variations in Tropical Pacific

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CWB Climate Forecast Operational Systems

- OPGSST
- NCEP GDAS IC
- Pre-Processing
- Global Model Forecast
  - GFS/OPGSST
  - GFS/CFS
  - ECHAM5/OPGSST
  - ECHAM5/CFS
- Regional Model Fcst
  - CWB-RSM
  - NCEP-RSM
- Statistical Downscaling
- Taiwan Area Forecast
- CWB DDS
- CWB 2-T CFSv1

气象局氣候預報作業系統
CWB Climate Forecast Operational Systems
• The initial conditions used by CWB 2-tier Monthly-to-Seasonal Climate Forecast System for retrospective and operational forecasts are from NCEP.

• CWB is currently developing an experimental 1-tier climate forecast system. A new 1-tier operational CFS is planned to be built in 2016-2020. The required data assimilation for retrospective and operational forecasts are beyond what CWB can do. The future systems need to continue depending on NCEP CFS products.

• Understanding NCEP CFSv2 and CFSv3-to-be is essential for climate forecast capacity building at CWB.
Evaluating the **North Pacific Oscillation and Its Association with SST Variations in Tropical Pacific** in CFSv2 decadal (30-yr) runs
North Pacific Oscillation

(2nd EOF of SLP Anomalies over 20°N-60°N)

(Calculated from CFSR, 1979-2009)
Western North Pacific Tropical Cyclones and Two Types of ENSO

FIG. 5 Composites of track density anomalies in JASO for (a) EPW, (b) CPW, and (c) EPC years. Light (dark) contours show statistical significance at the 90% (95%) level. (Kim, Webster, Curry 2011)
NPO Index and NINO Index
(5-year running means)

Before 1990
Central T. Pacific SSTA is less related to extratropical atmosphere, but more related to eastern tropical Pacific.

After 1990
Central Pacific SSTA is closely related to Extratropical atmosphere (i.e. NPO), but less related to eastern tropical Pacific.
SSTA Regressed onto NPO

before 1990 (1979-1990)
Central-Pacific SST Variability
Two Types of ENSO

(Yu and Kao 2007; Kao and Yu 2009)
Change of SST Variability *Before* and *After* 1990

• The decadal change of extratropical-tropical interaction is a possible cause for the shift of ENSO from the EP type to the CP type.

• What causes the change in the extratropical-tropical interaction?
Change of mean SLP *Before* and *After* 1990

(deviations from the long-term mean)
**Strength of Walker/Hadley Circulation**

**Walker Circulation**

- **before 1990**
- **after 1990**

HC : $[v_{200mb}] - [v_{850mb}]$ averaged over Pacific 120°E-80°W along 10°N

**Hadley Circulation**

- **before 1990**
- **after 1990**

WC : 500mb vertical velocity difference b/w (180°W-120°W) and (100°E-150°E) along equator

Oort and Yienger (1996)
Walker and Hadley Circulations

thermocline

20°-30°N
After 1990

CP El Nino

thermocline

20°-30°N

Equator
CFS Decadal Run

30-Year Run Initialized in Year 1980
NPO and NINO Index in CFSR and CFS DR

CFSR

1990

CFS DR

1990
North Pacific Oscillation
SSTA Regressed onto NPO

CFSR

CFS DR
Mean Circulation Strength

Walker Circulation

Hadley Circulation

![Walker Circulation Graph](chart1.png)

![Hadley Circulation Graph](chart2.png)
Summary

• North Pacific Oscillation produced a stronger influence over tropical Pacific SST variations after 1990.

• The stronger influence is a likely cause for the shift of El Nino from the Eastern-Pacific type to the Central-Pacific type.

• The increased influence of NPO over tropical Pacific SST is related to the strengthening of the Hadley circulation and weakening of the Walker circulation after 1990.

• The extratropical influence is undersimulated in the 30-year CFS Decadal Run (initialized in 1980), the exact cause of which is yet to be identified.
THANK YOU... 謝謝...
Central-Pacific SST Variability