

East Asia winter Climate Outlook Forum 2016

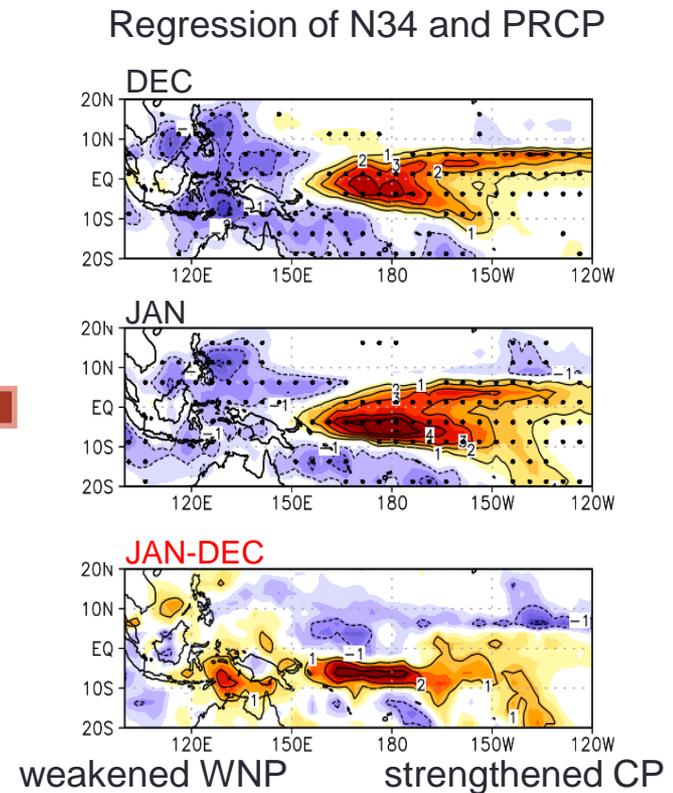
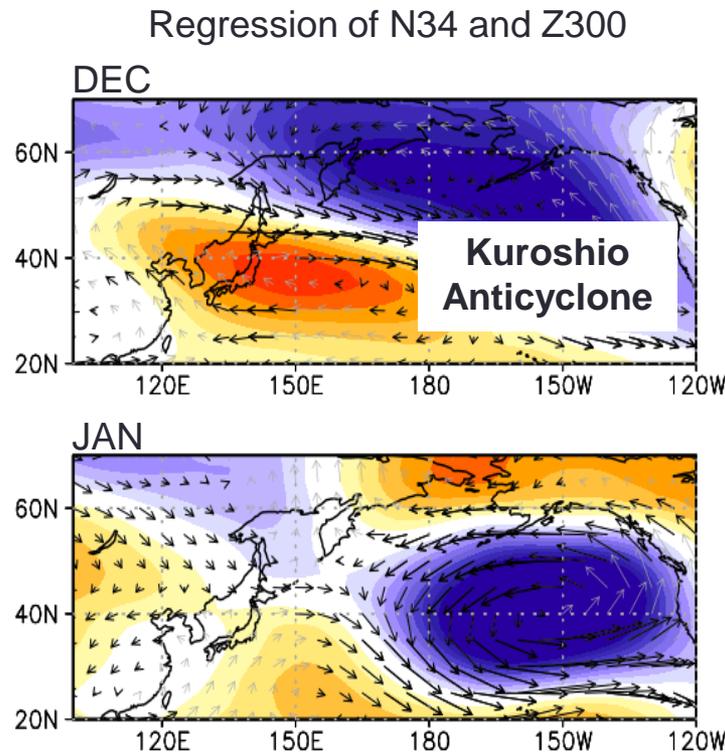


What controls ENSO teleconnection to East Asia?

Sunyong Kim and Jong-Seong Kug
Pohang University of Science and Technology

ENSO Teleconnection

Kim et al. (2016, *Clim. Dyn.*)

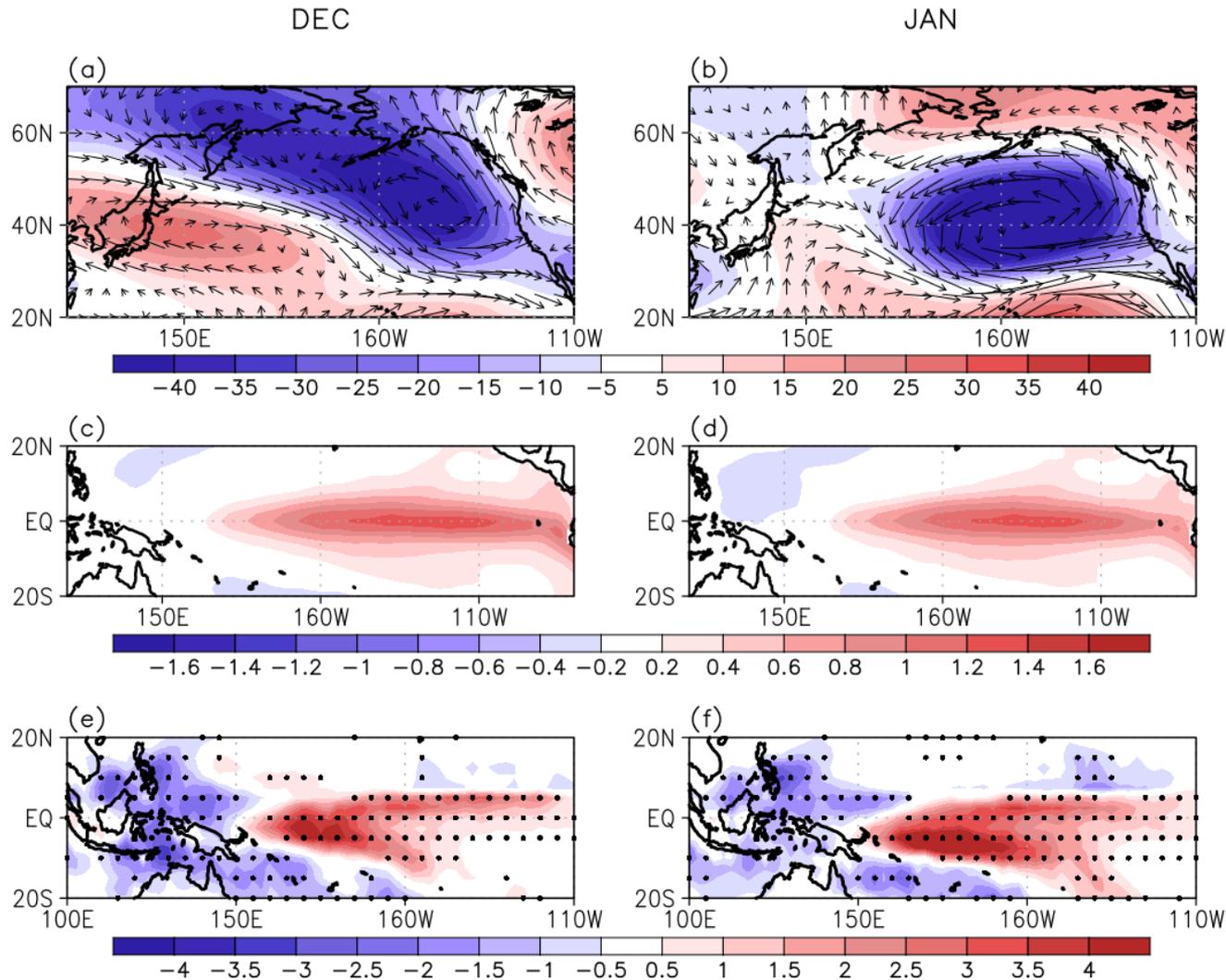


- ENSO teleconnections and impacts are quite sensitive to a detail structure of tropical precipitation anomalies
- Precipitation anomalies over WNP play a critical role in modulating ENSO teleconnections and impacts, particularly on East Asian climate.

Objective and Data

- To understand the what **factors** control the **ENSO teleconnection to East Asia**
- To investigate the **intra-winter changes in teleconnection** pattern and **regional impacts over East Asia** associated with ENSO
- To support the observational arguments on the **relative roles of WNP and CP precipitation** in ENSO teleconnection
- To introduce the **multiple regressed index** calculated by multiple regression (**WNP and CP precipitation**) analysis which has the **better understanding** in ENSO teleconnection
- Daily temperature and precipitation data in **386 stations from China, Korea and Japan**
- Period: **1979-2012** (34 years)

What make the teleconnection differences?



Teleconnection
 $pcorr=0.46$

SST
 $pcorr=0.99$

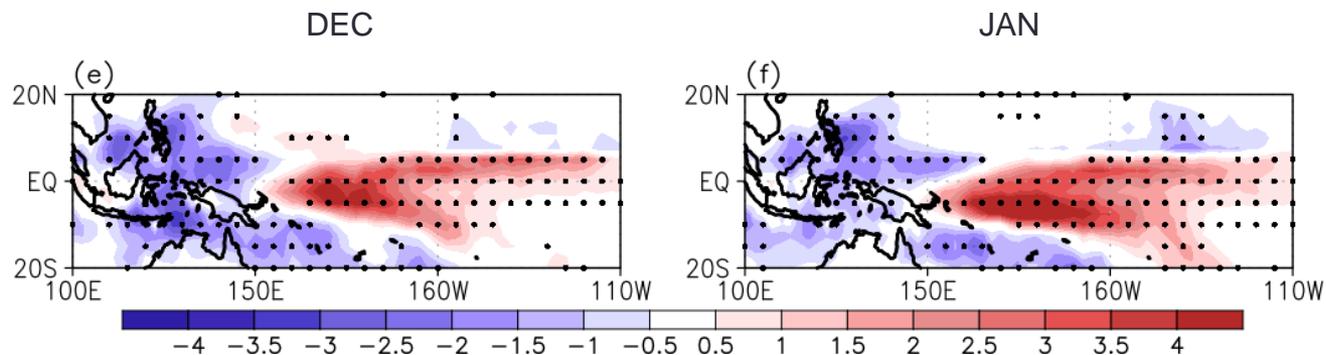
PRCP
 $pcorr=0.86$

The subseasonal changes in the tropical precipitation explain the sudden disappearance of the Kuroshio anticyclone from December to January.

Comparison of PRCP anomalies

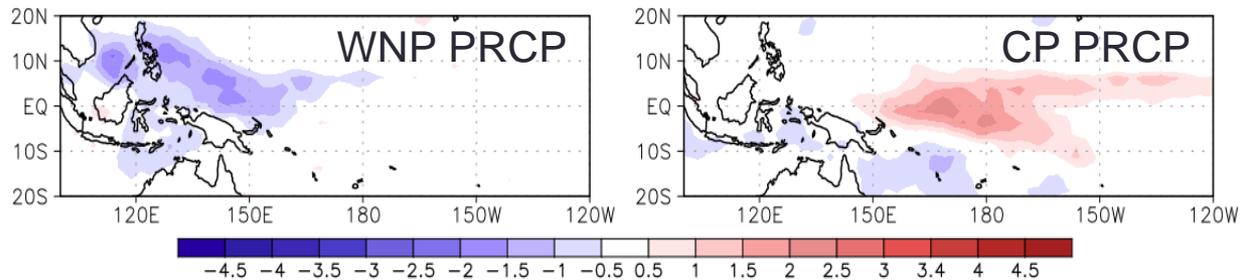
	El Nino		La Nina	
	WNP	CP	WNP	CP
DEC	-1.72	3.02	1.47	-2.22
JAN	-1.27	3.48	1.17	-2.39
DEC->JAN	17%↓	13%↑	20%↓	7%↑

Table. Mean equatorial central Pacific and western North Pacific precipitation anomalies (mm/day) in December and January during El Niño and La Niña events.



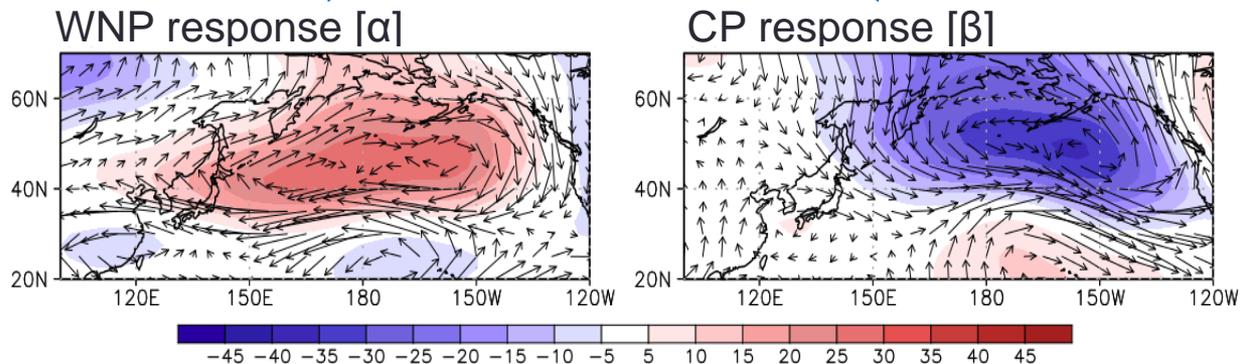
These **small differences** in the **tropical precipitation** can be enough to **explain** the **dramatic changes** in the **extratropical teleconnection**.

Multiple Regression



$$Z300' = \alpha \times PRCP_{WNP} + \beta \times PRCP_{CP}$$

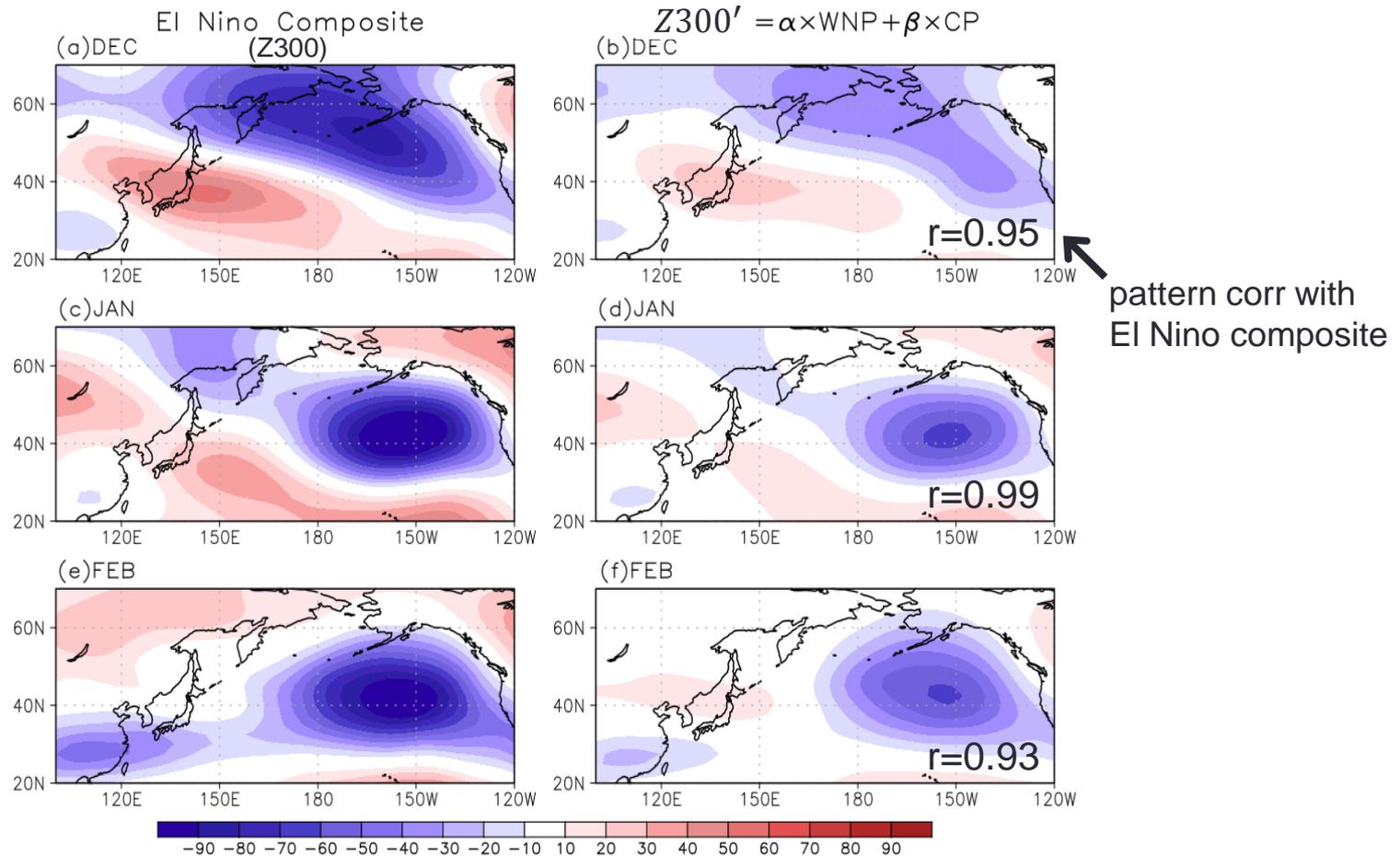
Rossby wave propagation



WNP and CP PRCP simultaneously affects the ENSO teleconnection.

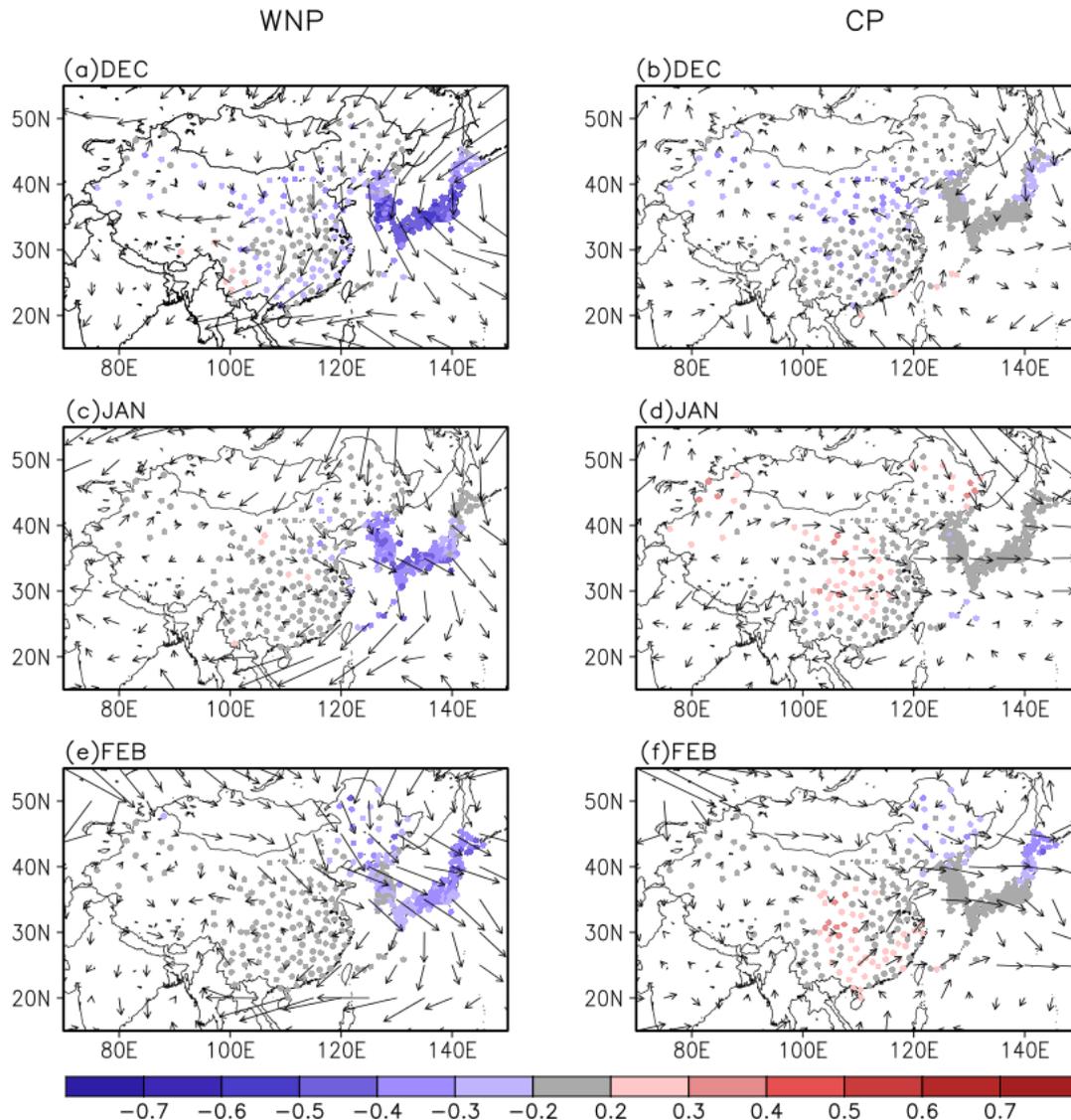
➡ There are opposite effects on teleconnection pattern over East Asia, which makes strong sensitivity of ENSO teleconnection.

El Nino Composites: Seasonal Evolution (Z300)



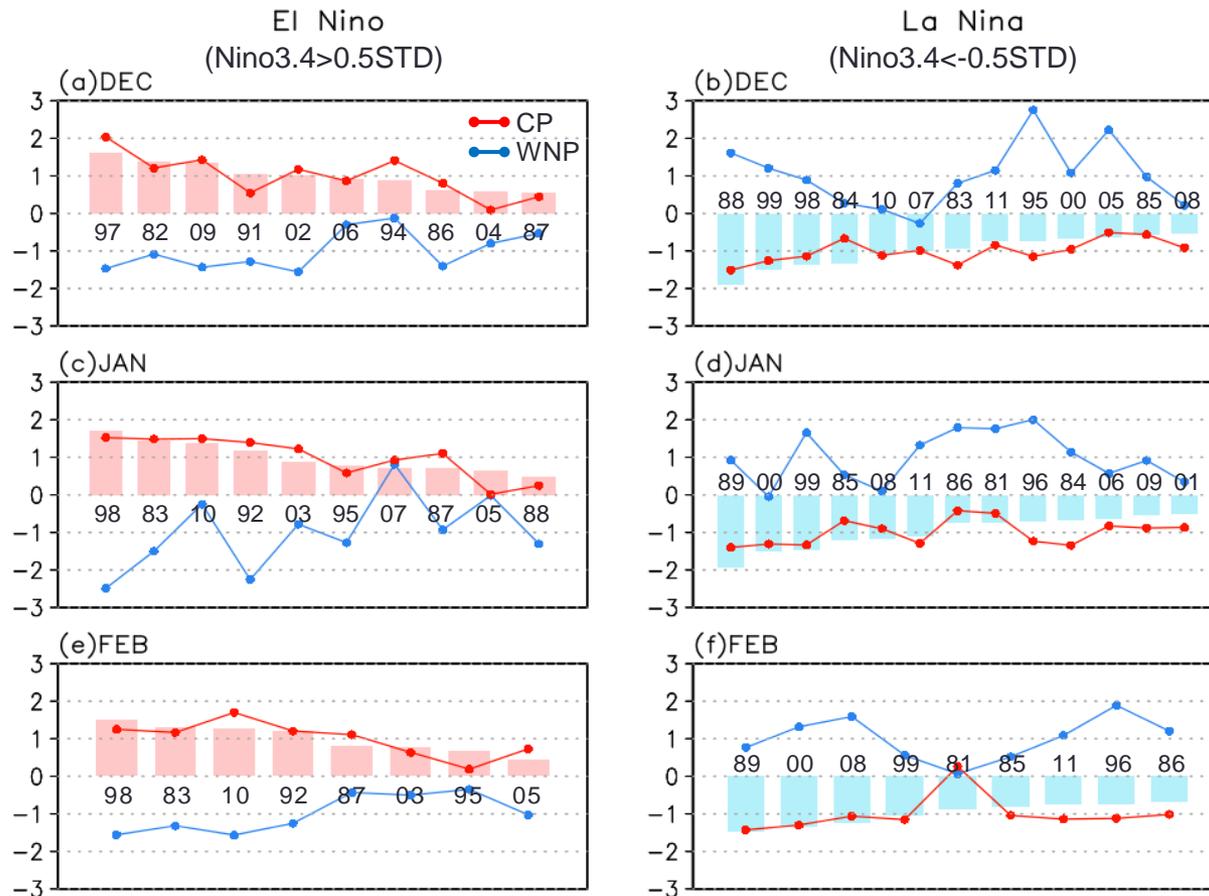
WNP and CP PRCP well explains not only the realistic ENSO teleconnections but also the seasonal evolution of El Nino.

Partial Correlation onto East Asian Climate: TEMP



- In order to **compare** the **relative roles** of the **WNP** and **CP PRCP**
- It is clear that **WNP PRCP response** is **dominant** over East Asia.
(WNP sign is reversed)

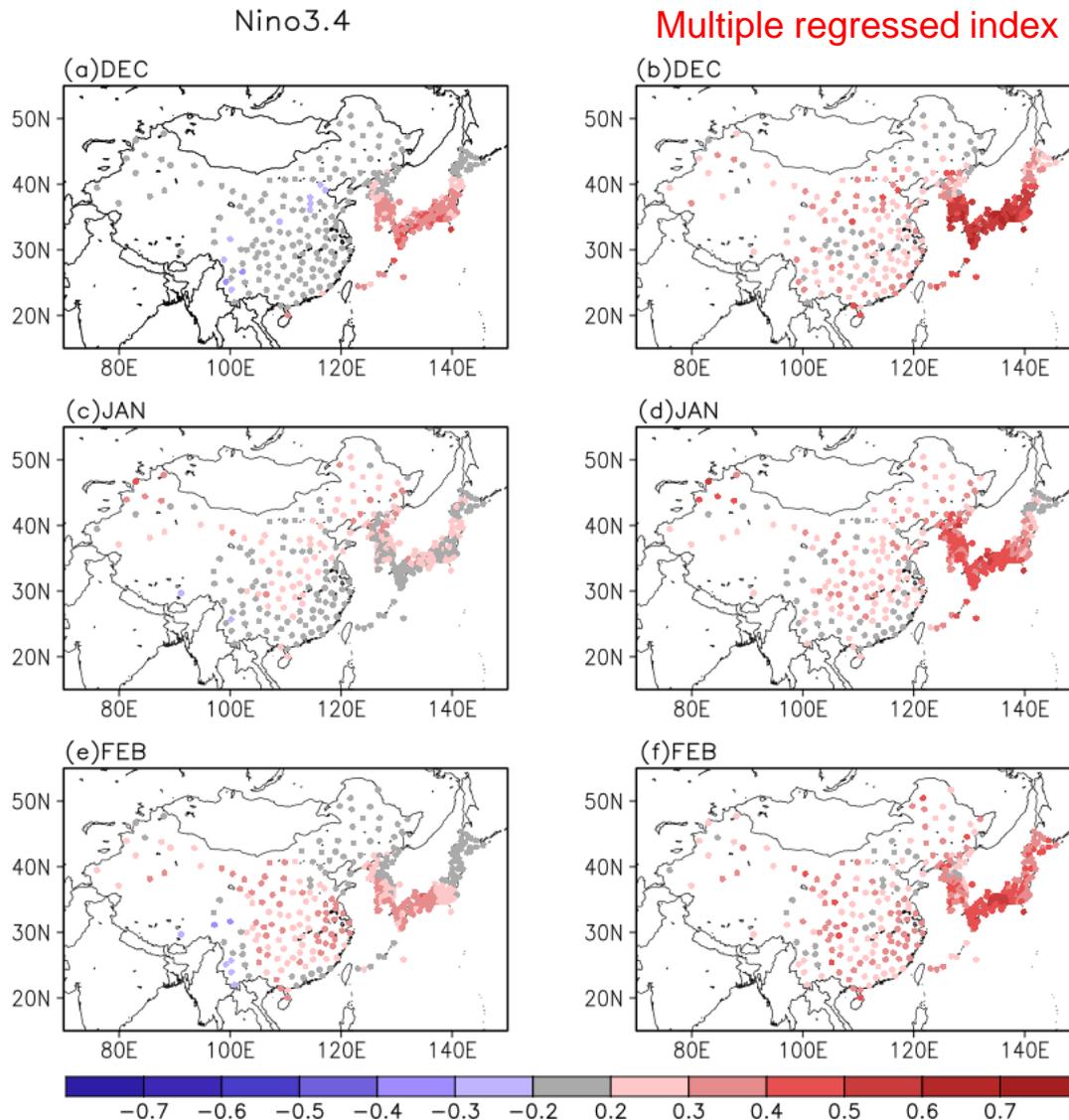
ENSO Diversity: WNP and CP Precipitation anomalies



WNP PRCP response is **diverse** in the El Niño forcing.

➔ It can determine the **diverse ENSO teleconnection** over East Asia. We need to consider the **inter-El Niño** and **-La Niña diversity**.

Impacts of ENSO (Potential Predictability): TEMP



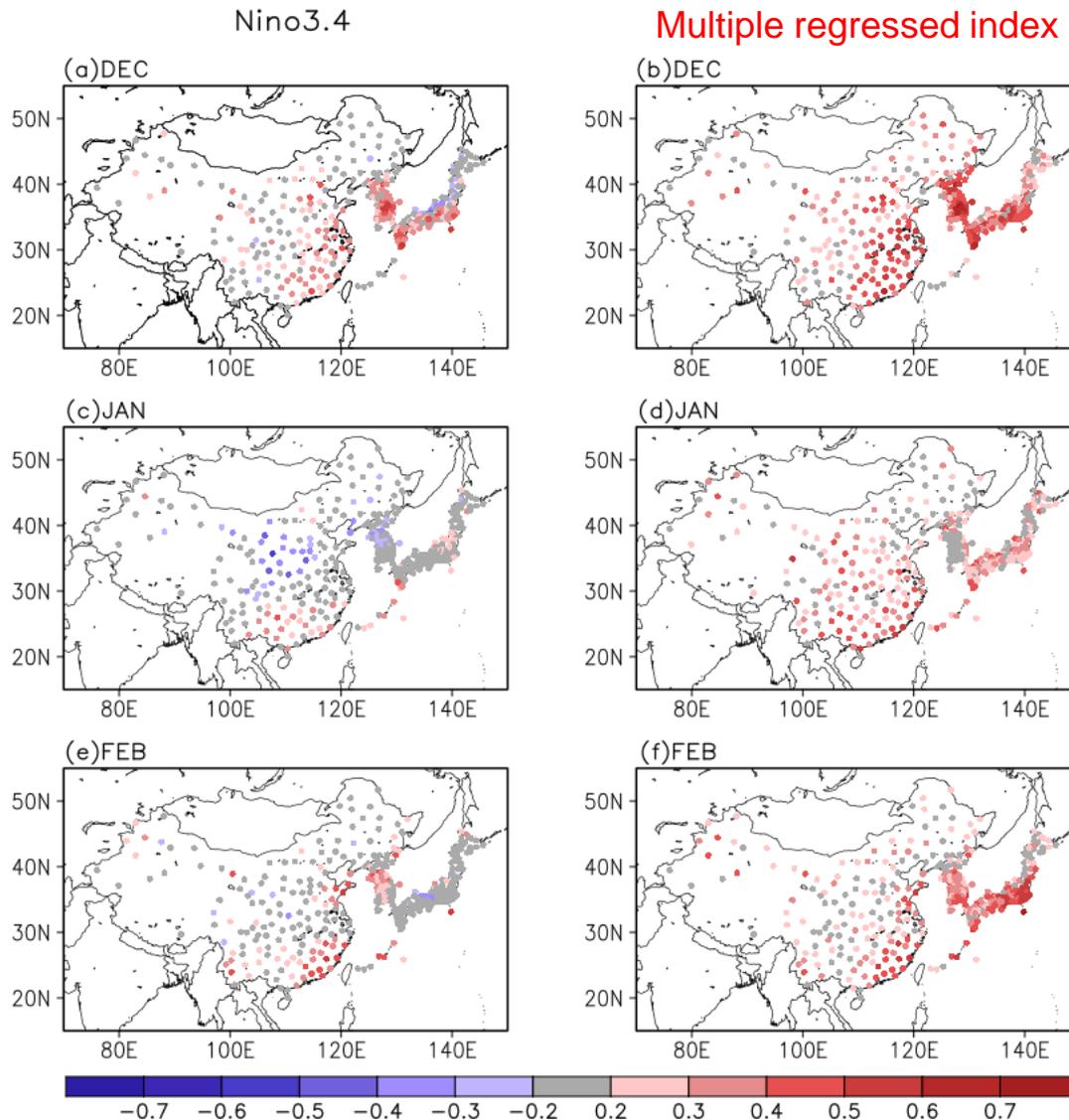
Correlation skill is improved!

Multiple regressed index (T')

$$T'(x,y,t) = \alpha(x,y) \times PR_{WNP}(t) + \beta(x,y) \times PR_{CP}(t)$$

Correlation skill for station data using the multiple regressed index is considerably improved in most stations.

Impacts of ENSO (Potential Predictability): PRCP



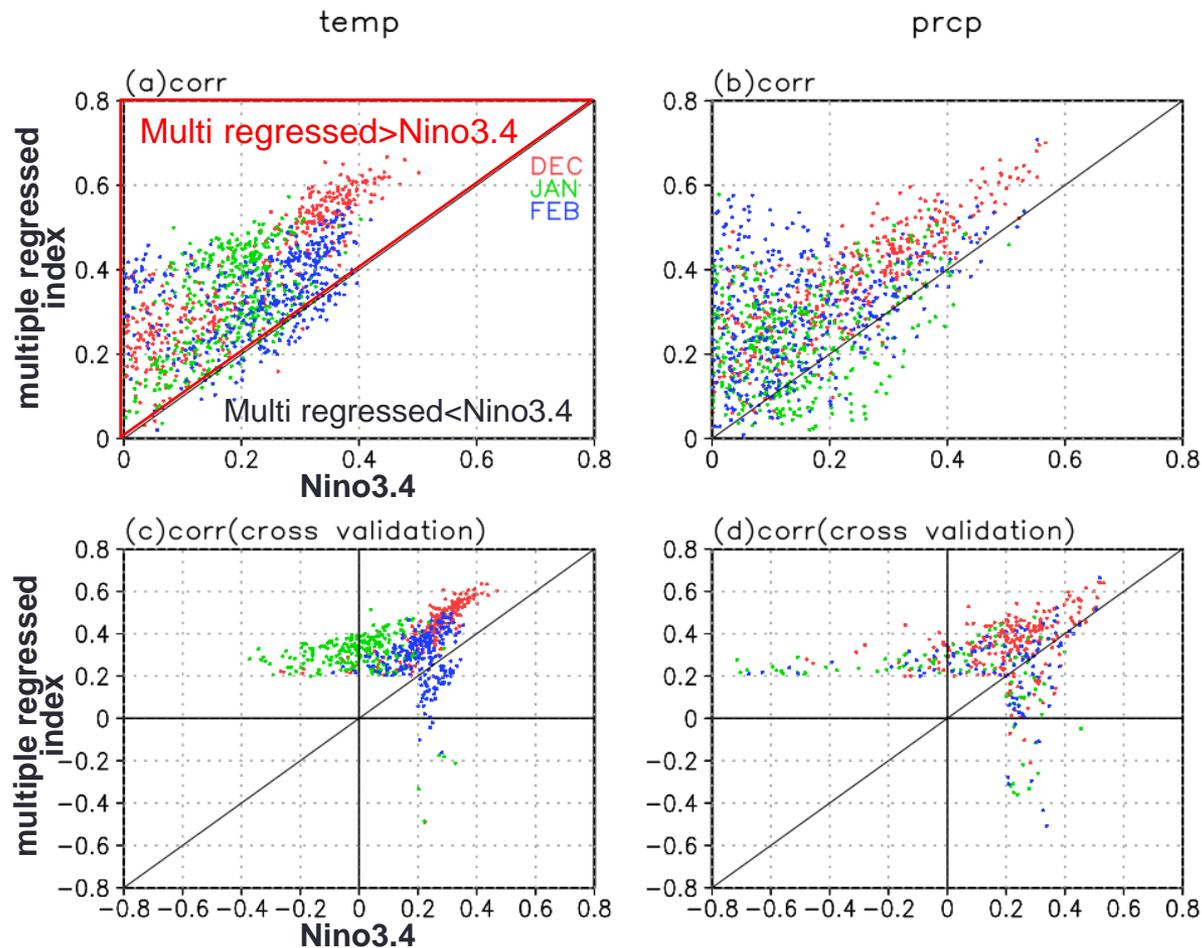
Correlation skill is improved!

Multiple regressed index (P')

$$P'(x,y,t) = \alpha(x,y) \times PR_{WNP}(t) + \beta(x,y) \times PR_{CP}(t)$$

Correlation skill for station data using the multiple regressed index is considerably improved in most stations.

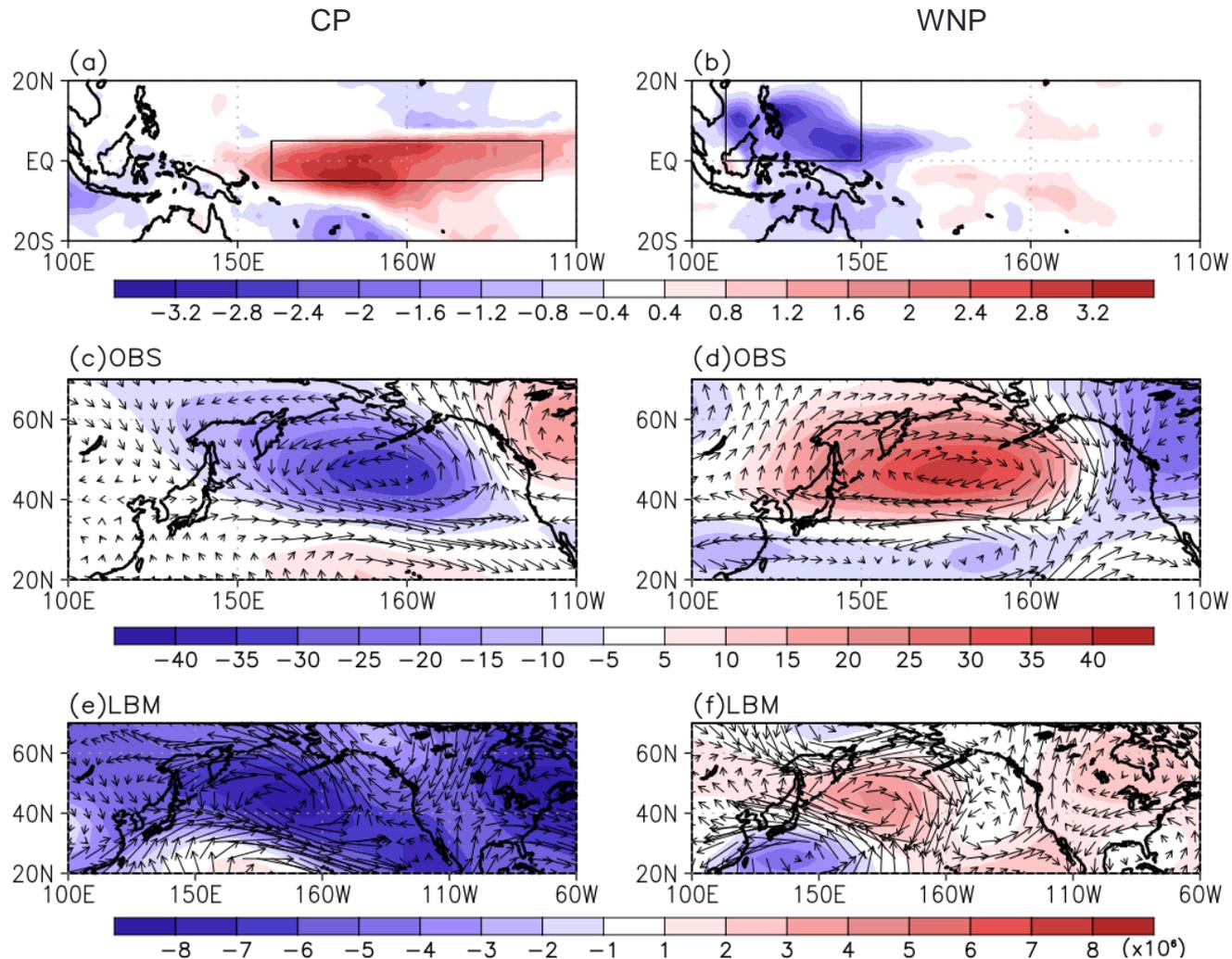
Comparison: Nino3.4 vs. MREG[WNP,CP]



The correlation skills using the multiple regressed index is improved than using the Nino3.4. It is consistent with the cross validation method ($r > 0.2$ only).

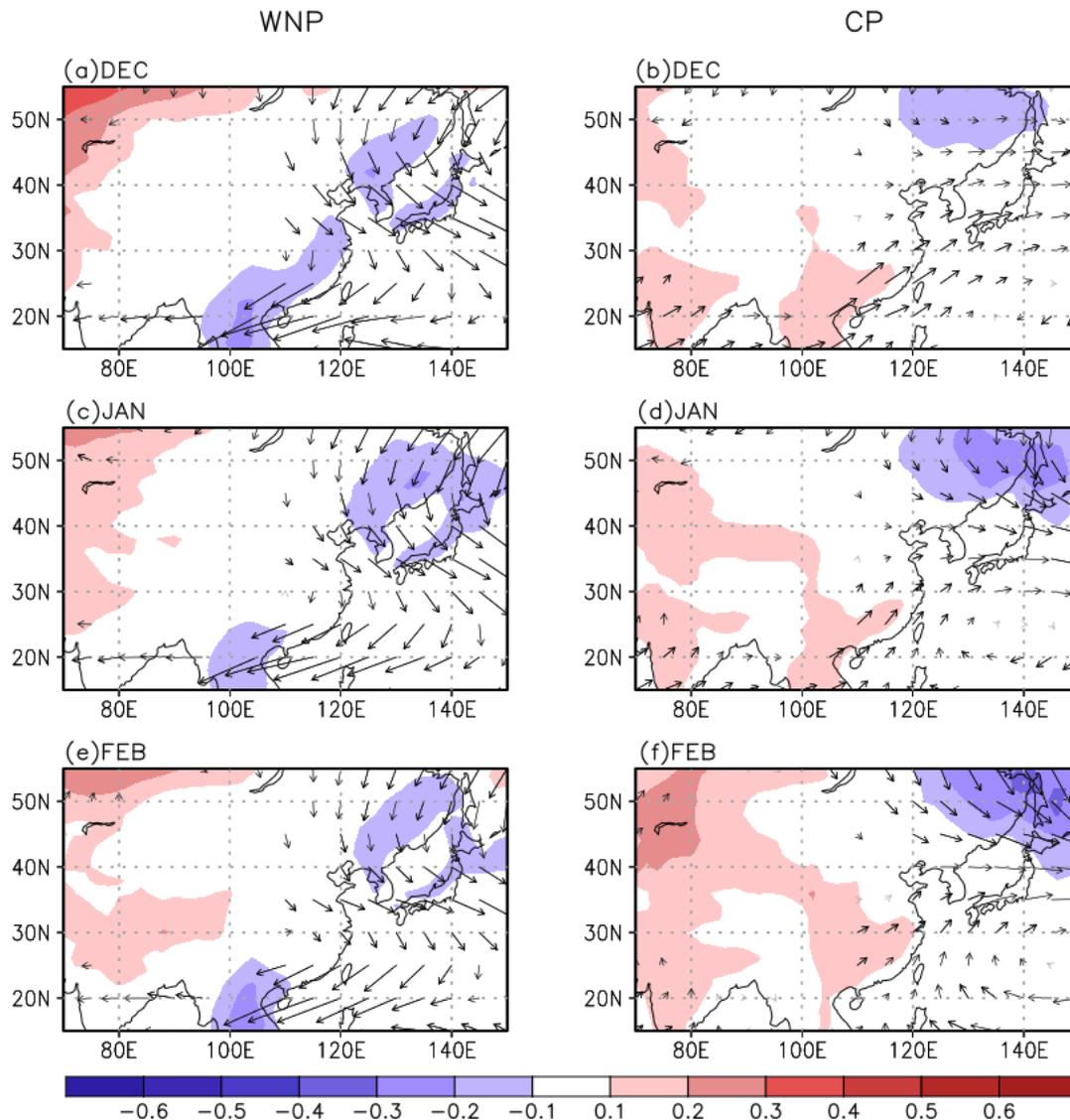
LBM Experiments

- Linear Baroclinic Model (developed by Prof. M. Watanabe)
- Prescribed heating from observed precipitation patterns



The **LBM experiments** support the observed **relationship** between the **tropical precipitation** and **extratropical teleconnection**.

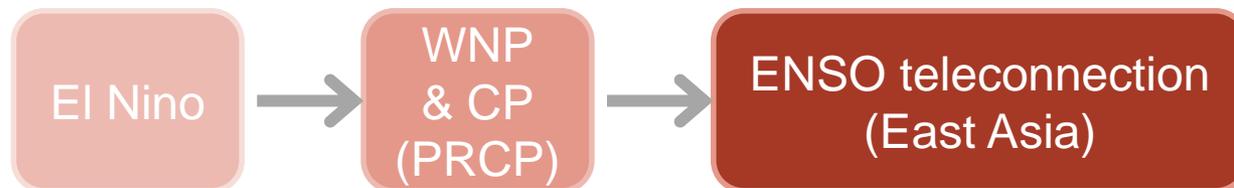
[CMIP5] Multiple Regression onto East Asian Climate: TEMP



- Historical runs by 40 climate models
- 1901-2000 (100 years)
- CMIP5 models simulate well the relative roles of the WNP and CP precipitation impacts in East Asia (WNP sign is reversed)

Summary

- The **WNP and CP precipitation** anomalies associated with ENSO have **opposite effects** on teleconnection pattern over East Asia, which makes **strong sensitivity of ENSO teleconnection**.
- WNP precipitation plays an important role in generating El Nino impacts over East Asia.
- Based on the roles of WNP and CP precipitation, the **multiple regressed index** can explain **more climate variance** over East Asia, consistent with **El Nino diversity**.



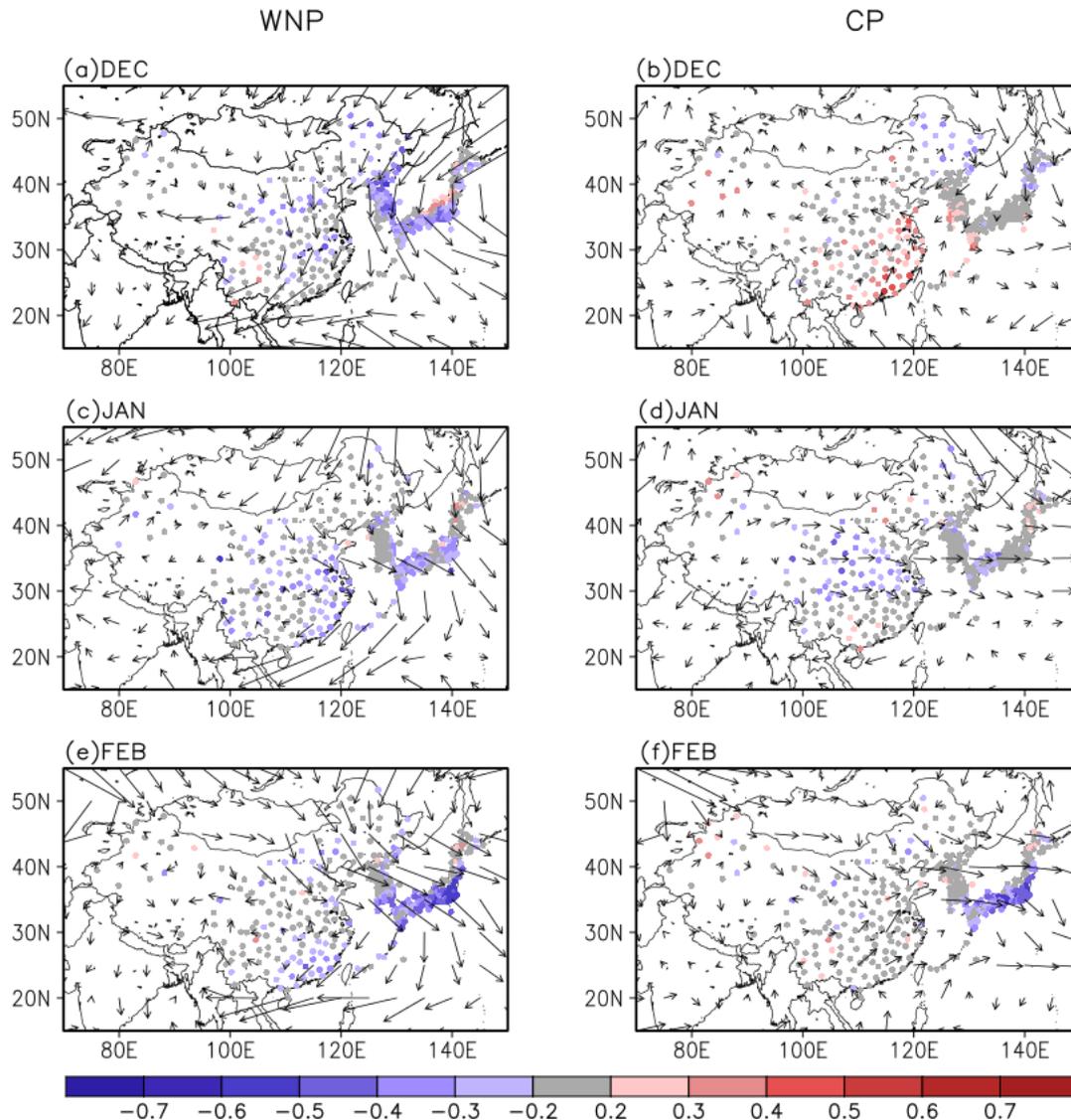
East Asia winter Climate Outlook Forum 2016



Thank you for your attention.

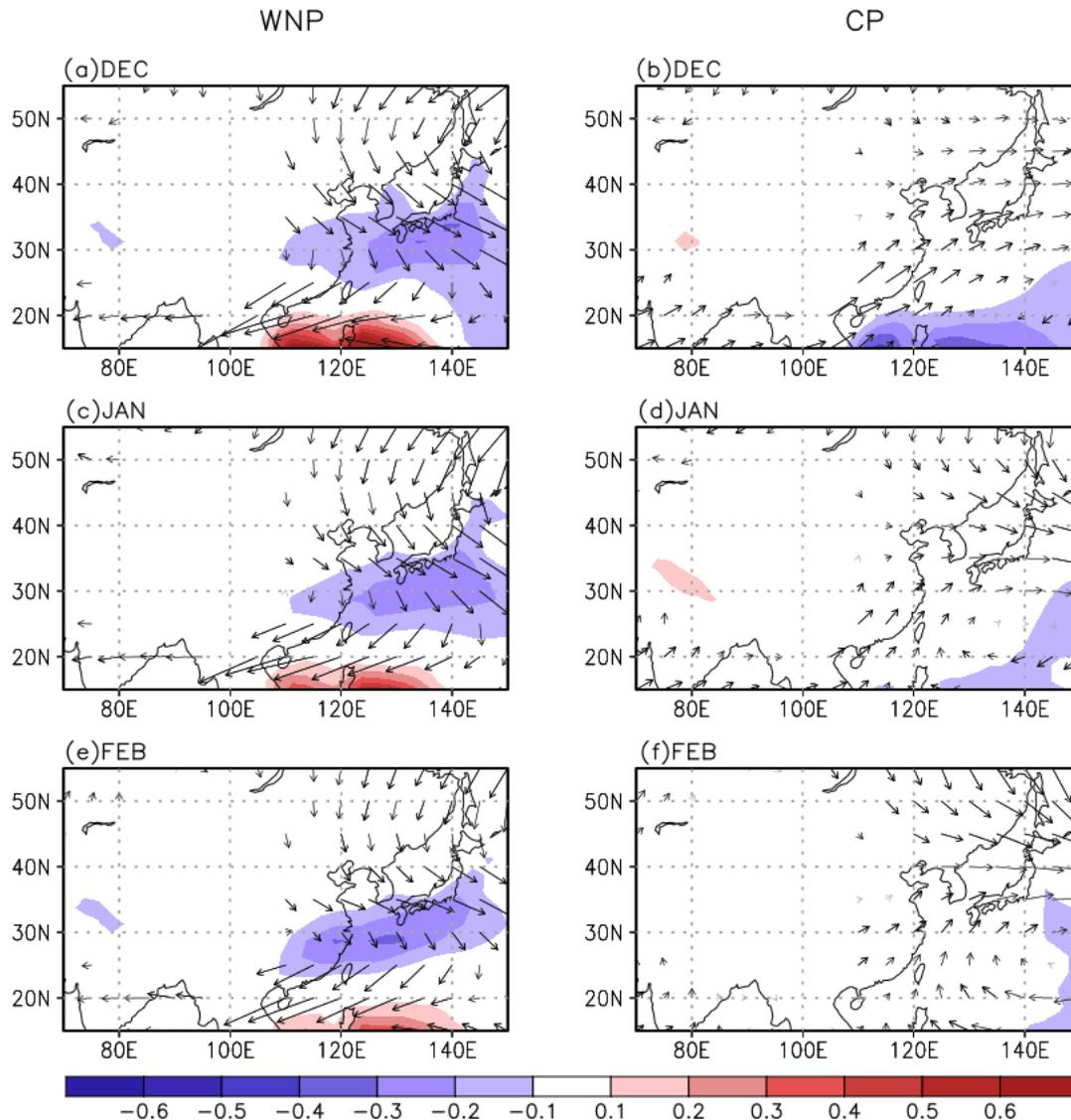
sunyongkim@postech.ac.kr

Partial Correlation onto East Asian Climate: PRCP



- In order to **compare** the **relative roles** of the **WNP** and **CP PRCP**
- It is clear that **WNP PRCP response** is **dominant** over East Asia.
(WNP sign is reversed)

[CMIP5] Multiple Regression onto East Asian Climate: PRCP



- Historical runs by 40 climate models
- 1901-2000 (100 years)
- CMIP5 models simulate well the relative roles of the WNP and CP precipitation impacts in East Asia (WNP sign is reversed)