

**SST variability in the East Asian marginal seas:  
mechanisms for local and remote atmospheric impacts**

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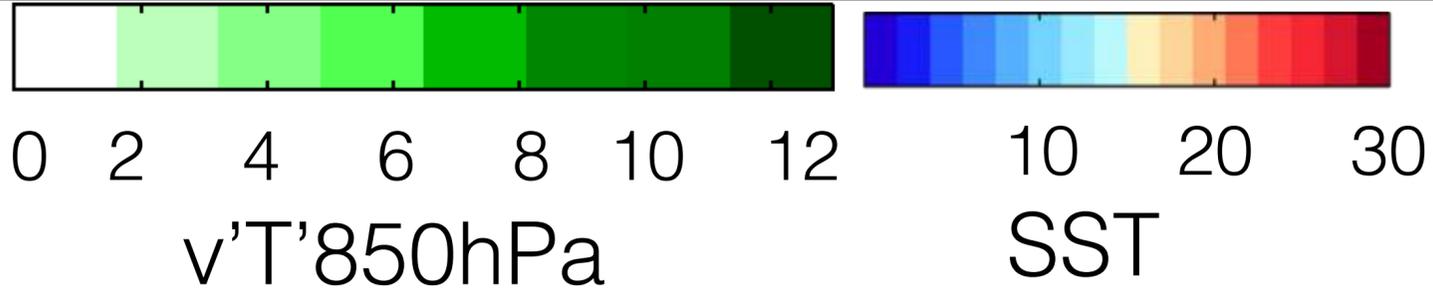
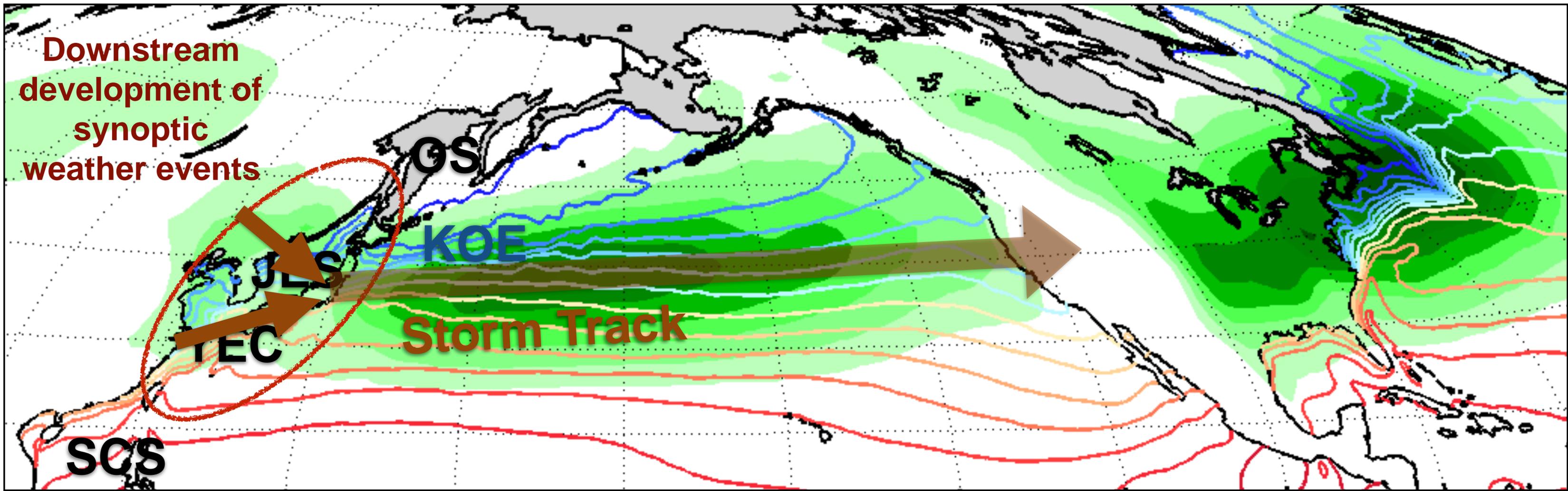
**Thanks to:  
Young-Oh Kwon (WHOI)  
Jimmy Booth (CUNY)**



# East Asian marginal seas

an active part of the North Pacific climate system?

EAMS and KOE are dynamically linked through the *North Pacific storm track*

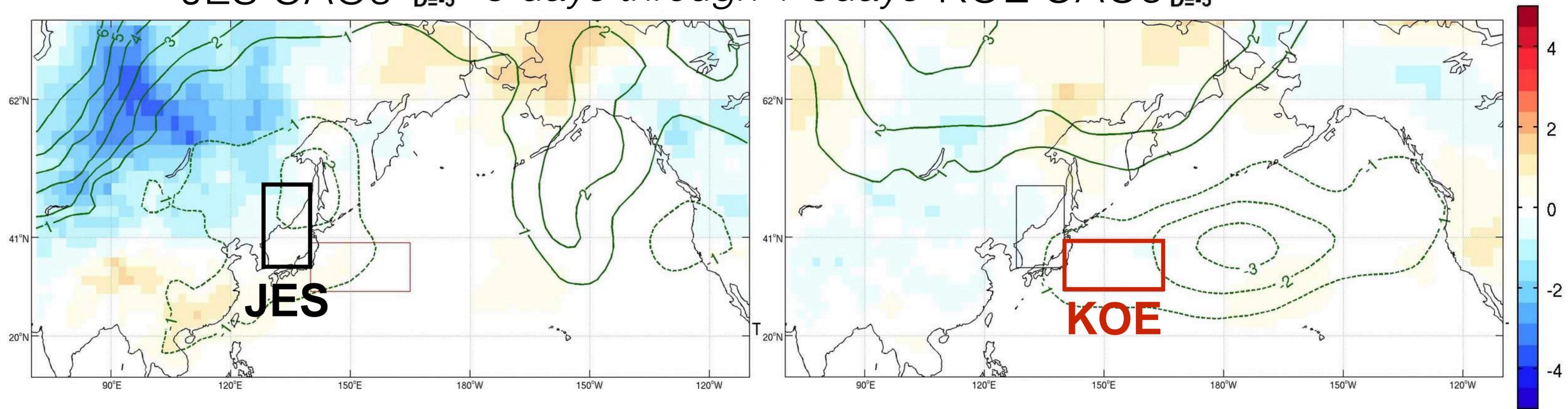


Downstream effect of the marginal seas is a unique process to the North Pacific

# Downstream development of weather events: Cold air outbreaks

## Composite evolutions of NCEP T2/SLP

JES CAOs  $D=-5$  -5 days through + 5days KOE CAOs  $D=-5$



Stronger temperature and circulation anomalies associated the JES CAOs T2  
Distinctive pathways of extratropical cyclones (ETCs) (°C)  
JES CAOs produce T2 anomalies lingering over the KOE in  $D+1\sim 3$

How do the SST-Weather system interactions in the marginal seas affect the regional and KOE air-sea interaction?

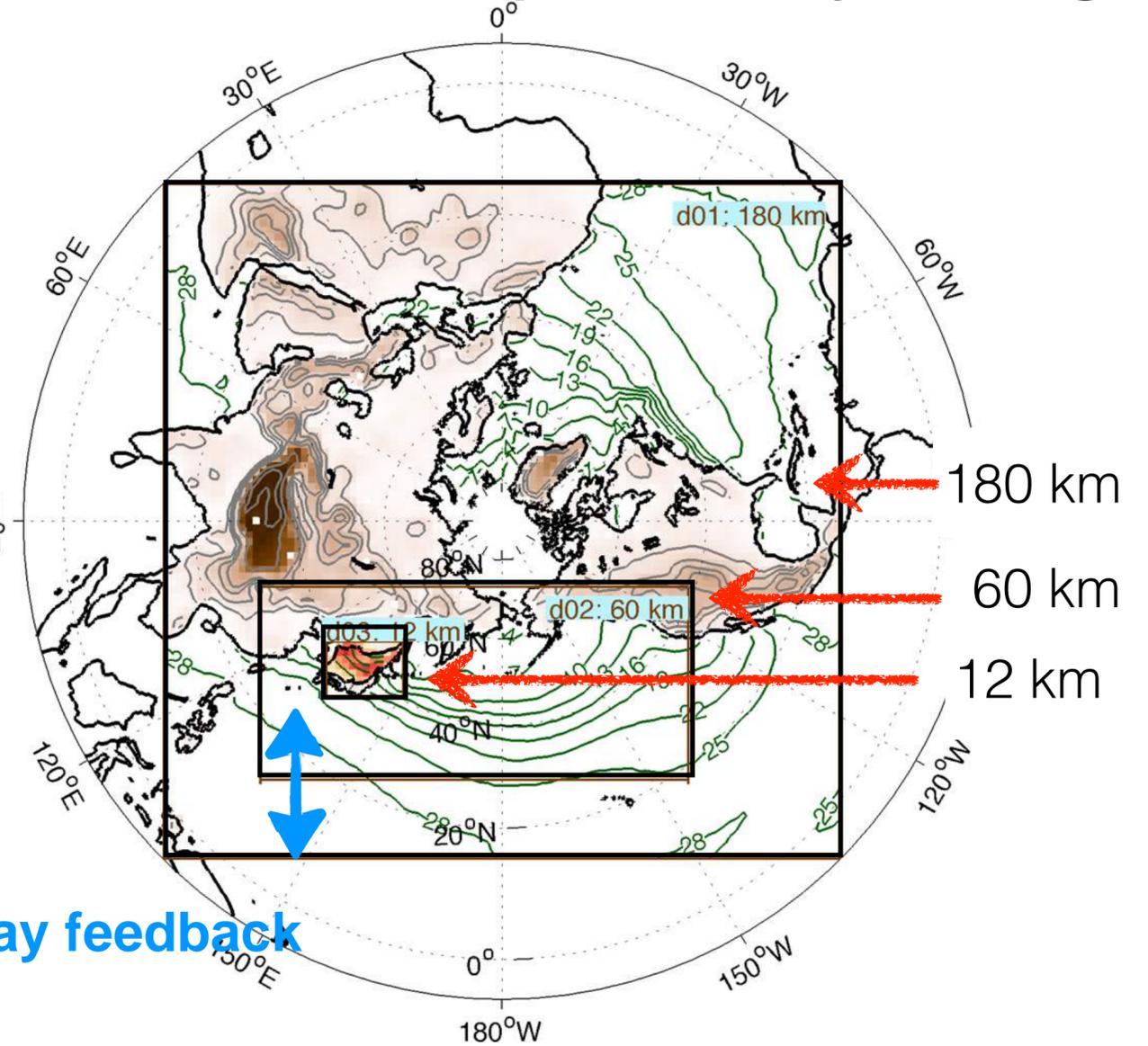
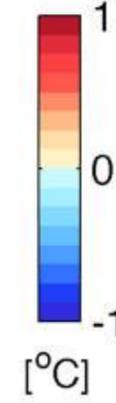
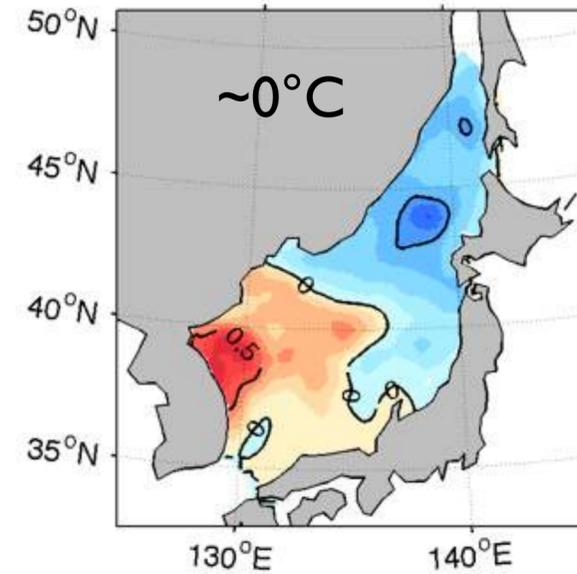
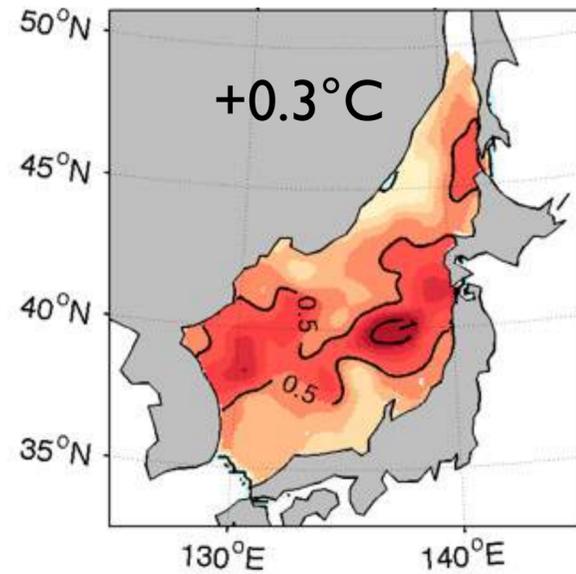
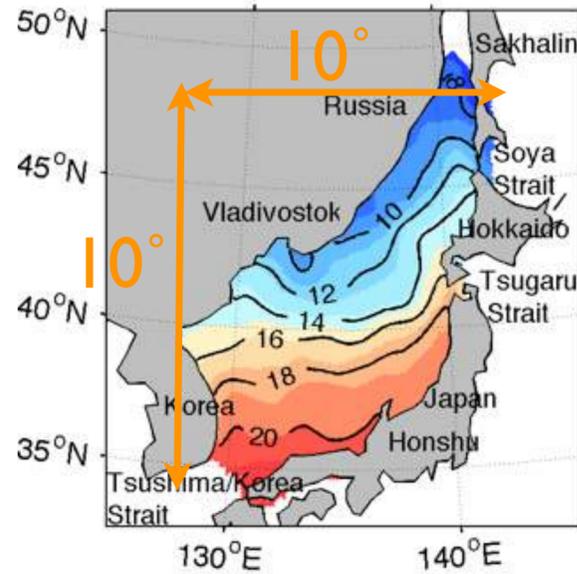
# Dominant SST patterns and atmospheric responses

## Hemispheric WRF with multiple two-way nesting

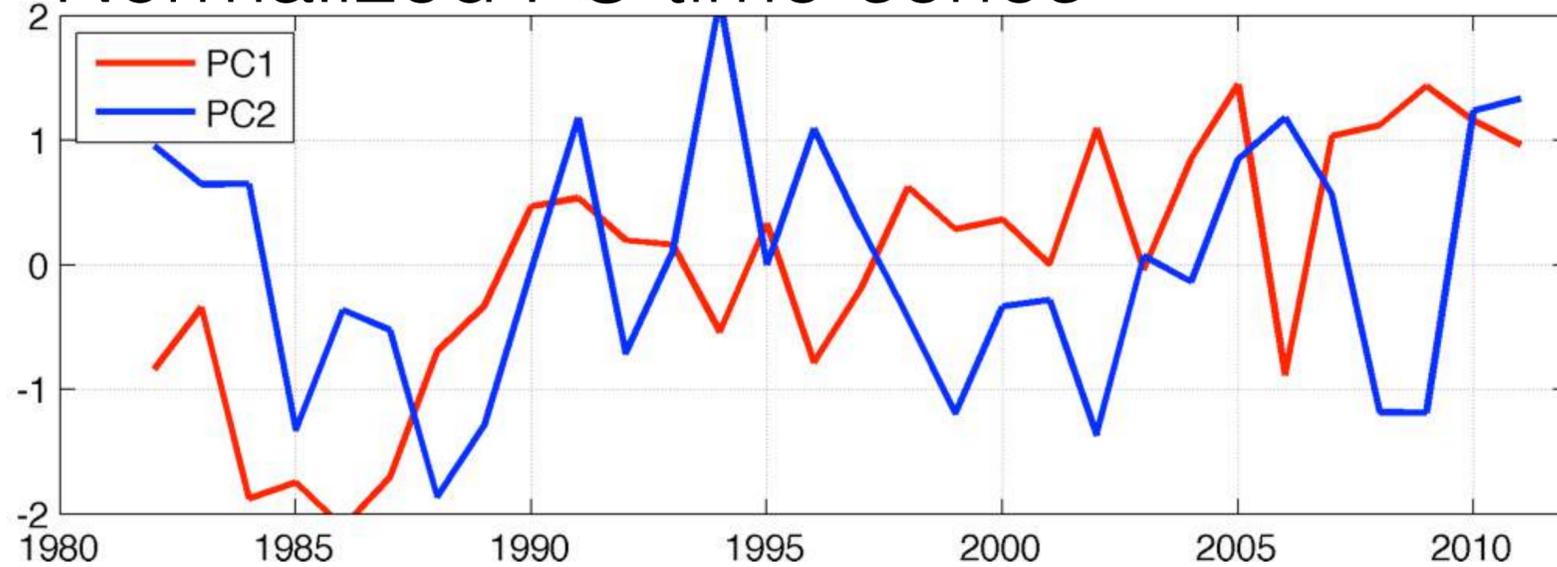
CTL: Winter climatology

EOF1 42%

EOF2 18%



Normalized PC time-series



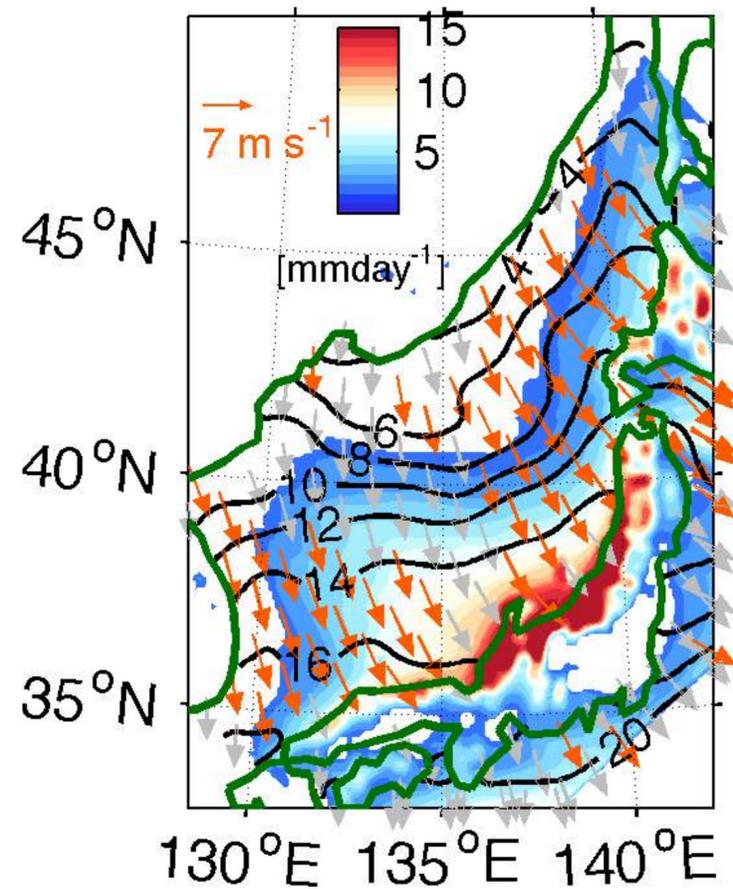
1/4° NOAA OI SST: NDJFMA, 1982-2013

- 6-mon (Nov-Apr) with 40 ensemble members
- Climatological SST everywhere except in JES
- EOF1P and EOF1N SSTA;

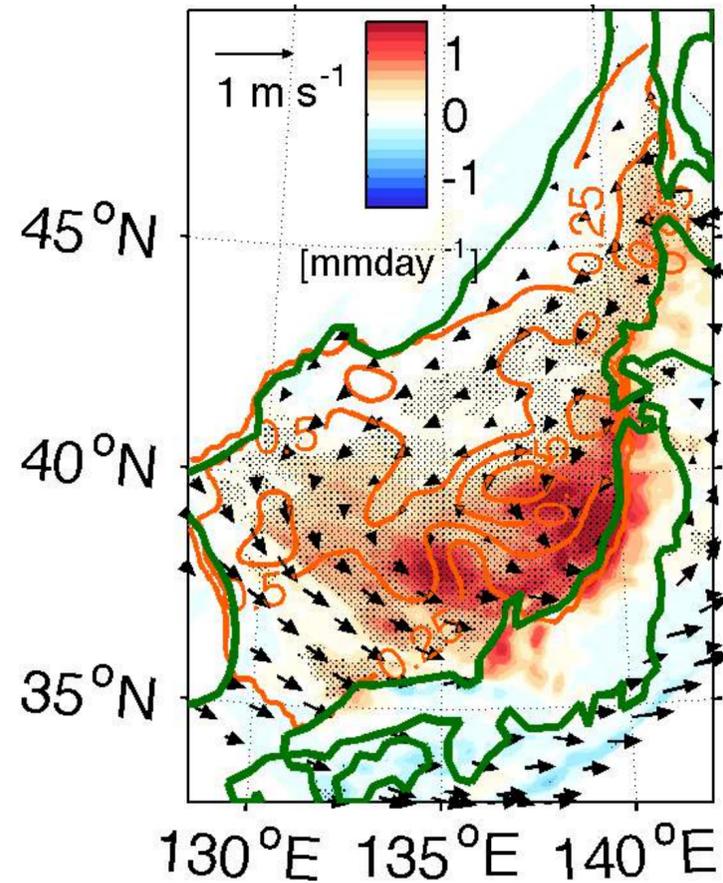
**Response: EOF1P-CTL, EOF1N-CTL**

Local atmospheric response is linear.

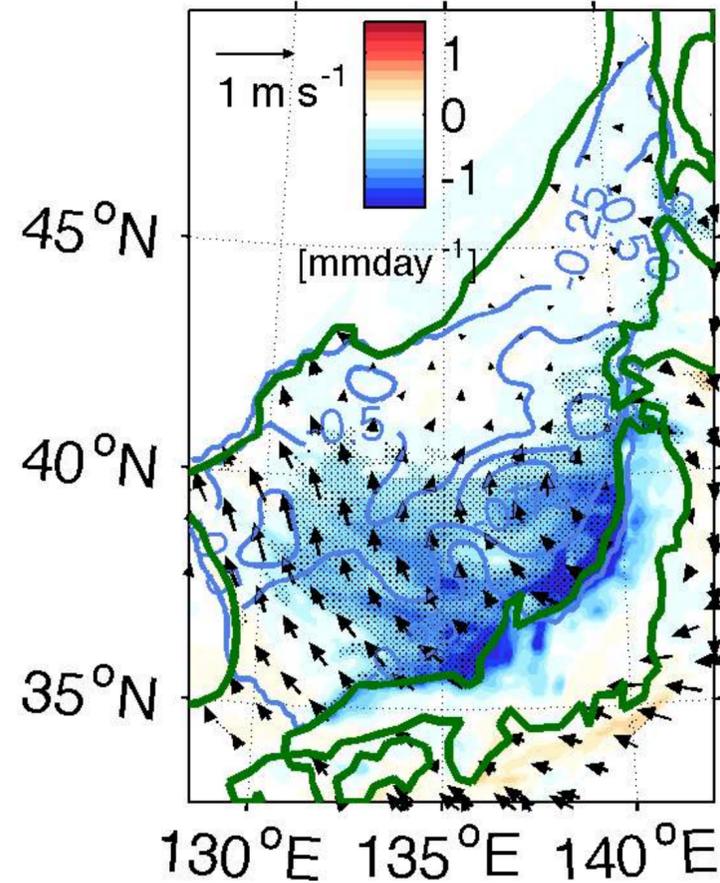
NDJ CTL



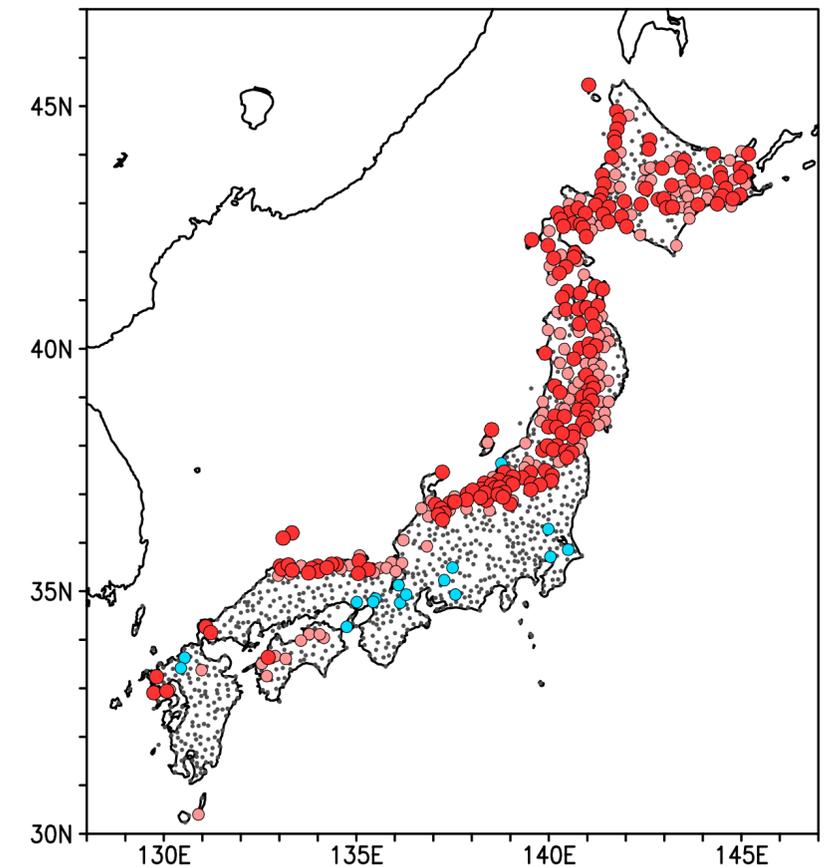
EOFIP-CTL



EOFIN-CTL



winter rainfall in Japan  
correlated with JES SST  
through THF



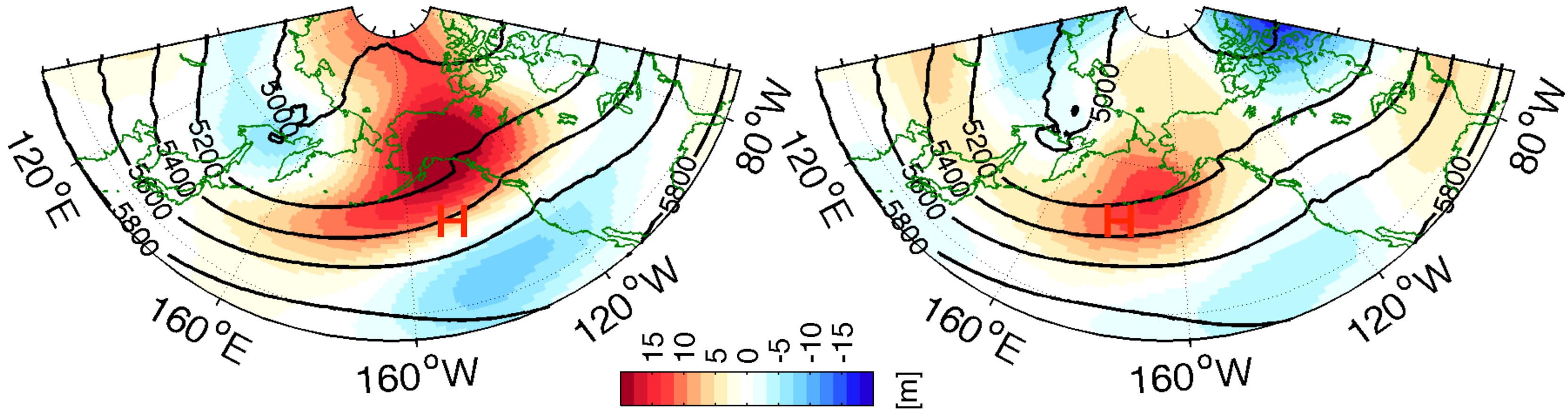
Prediction of intra-basin SST pattern is critical to regional weather variability and predictability

Sugimoto and Hirose 2014

Downstream response is not linear.

(a) EOF1P-CTL Z500

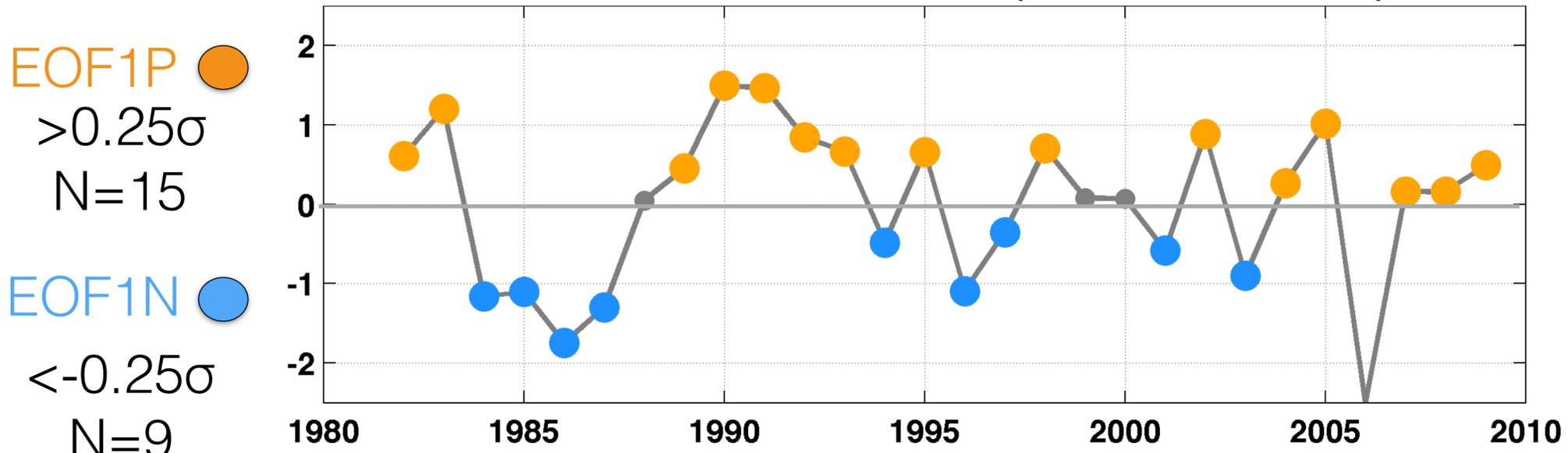
(b) EOF1N-CTL Z500



A downstream ridge response independent of SSTA with the intraseasonal time-scale and an equivalent barotropic structure

# Local linear & downstream nonlinear responses from NCEP reanalysis

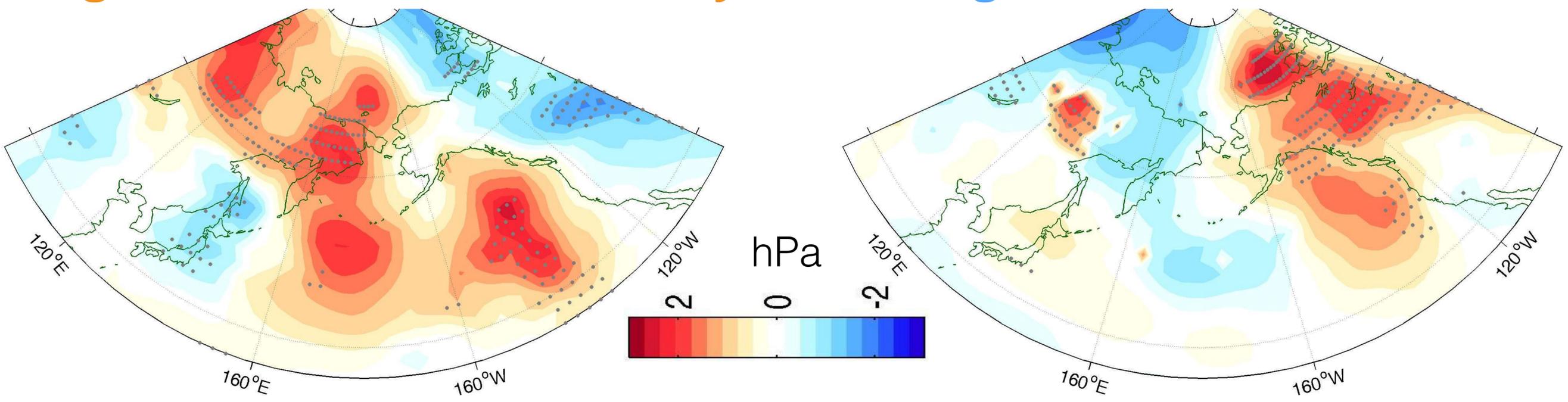
de-trended and normalized  
PC1 of the JES SST (1982~2009)



- Linear response near the forcing region
- Nonlinear (e-baro) ridge response in the downstream

**SLP regressed onto +ve PC1 only**

**SLP regressed onto -ve PC1 only**



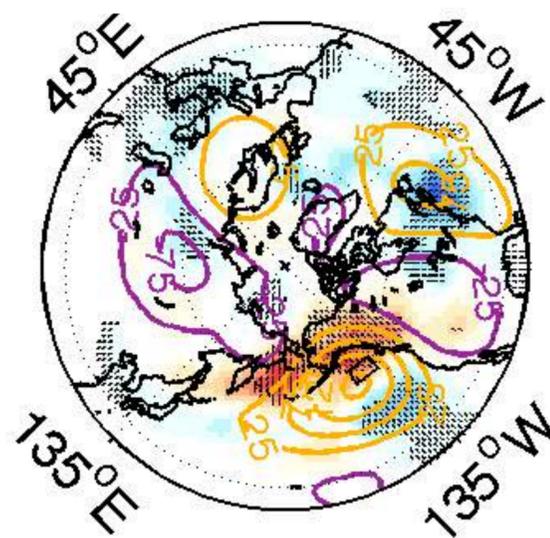
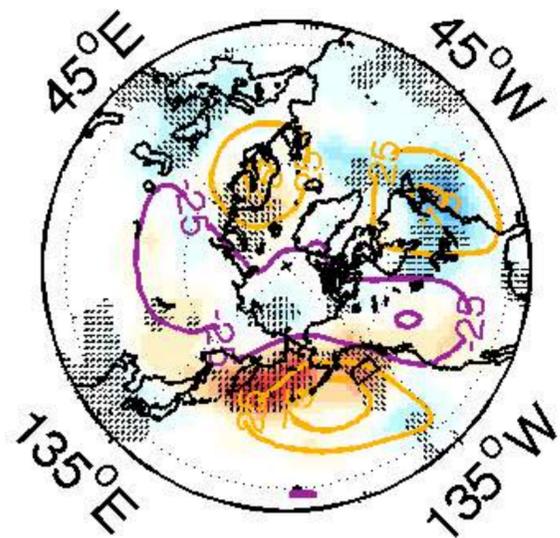
The influence of the tropical SST variability is removed

10% significance level

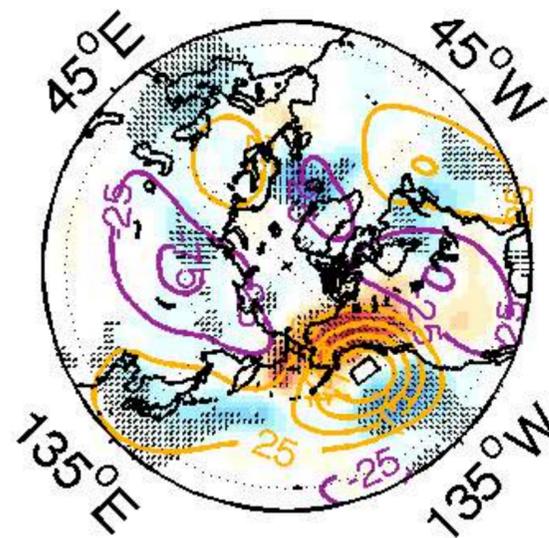
# Synoptic eddy vorticity flux reinforcing the blocking ridge response

Composite evolutions of synoptic and intraseasonal anomalies wrt a downstream block

Day-2 **EOF1P-CTL** Onset

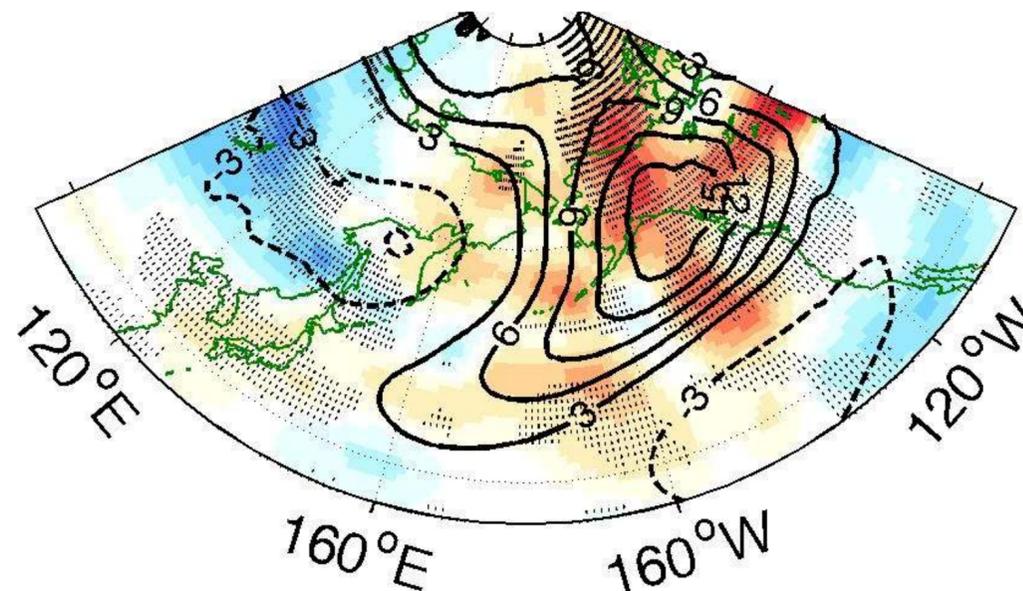


Day+2

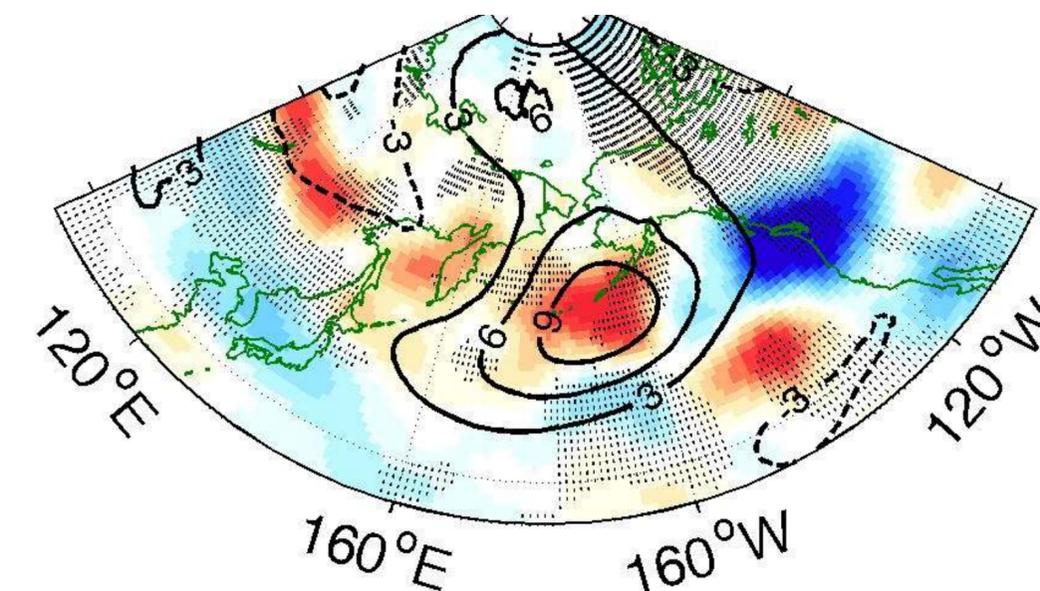


Enhanced baroclinic wave activity preceding the blocking ridge (Nakamura and Wallace 1990)

EOF1P-CTL  $\partial Z/\partial t$



EOF1N-CTL  $\partial Z/\partial t$

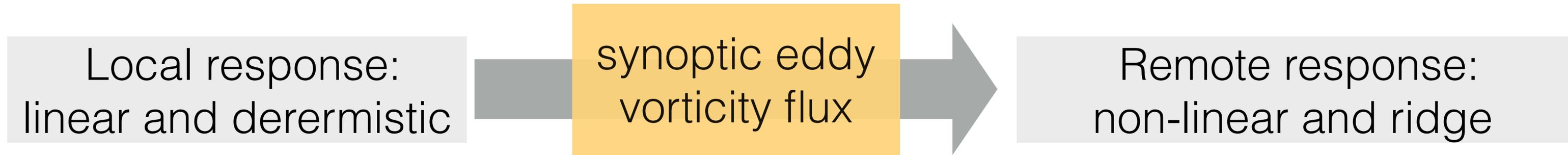


$$\partial Z/\partial t = (f/g) \nabla^{-2} \left[ -\nabla(\overline{v'\zeta'}) \right]$$

Positive  $\partial Z/\partial t$  due to synoptic eddies over low-frequency ridge response (e.g., Kushnir and Lau 1992)

# Summary and Discussion

## ***How do the SST-Weather system interactions in the marginal seas affect the regional and KOE air-sea interaction?***

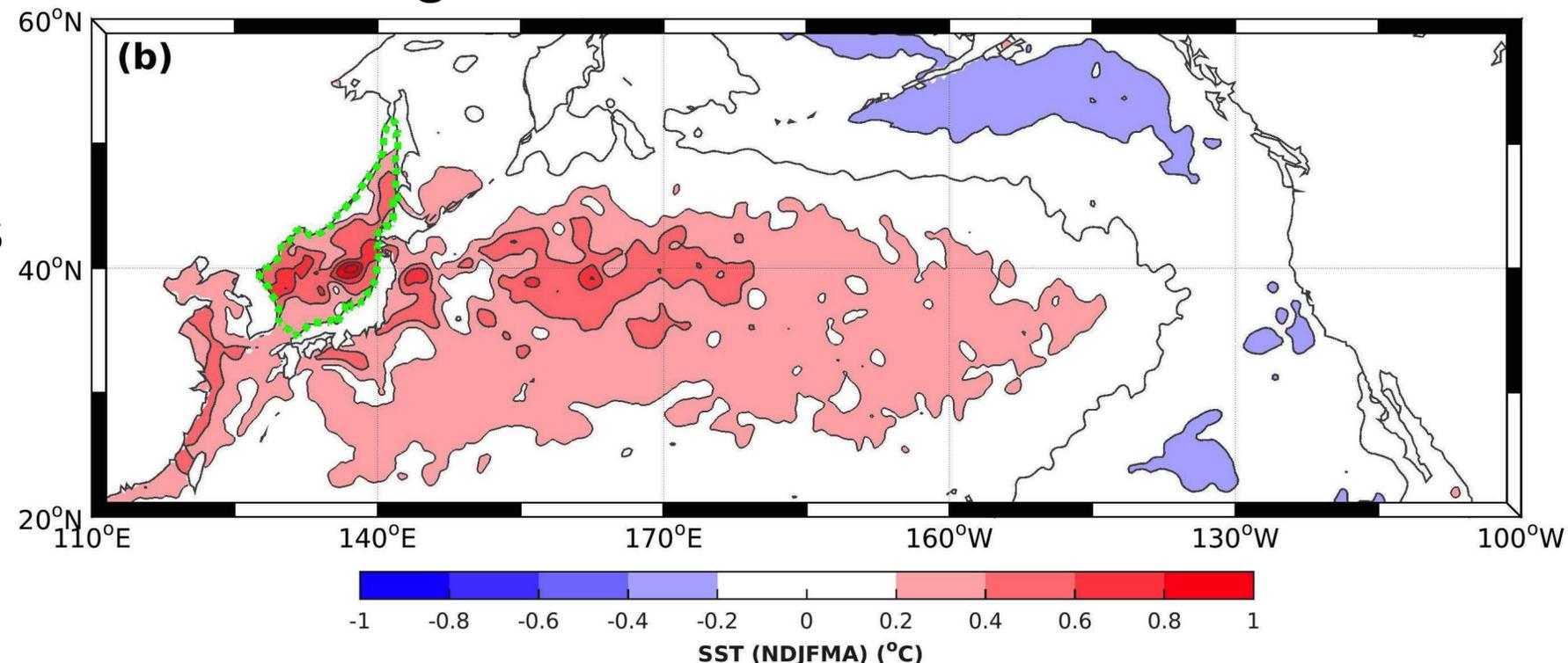


SST-weather system interaction is critical for regional weather and climate

Potential impact on decadal North Pacific atmospheric variability

- Additional factors to be considered in
- (1) Part of the basin-scale SST patterns
  - (2) Remote influence from the tropics
  - (3) thermodynamic air-sea coupling

Regression of SST to JES PC1



Thanks!  
[hseo@whoi.edu](mailto:hseo@whoi.edu)

Seo et al. 2014:  
On the effect of the East/Japan Sea SST variability on the North Pacific atmospheric circulation in a regional climate model. *JGR-Atmos.*, **119**, 418-444