Role of the East/Japan Sea SST variability in the atmospheric circulation in the North Pacific.

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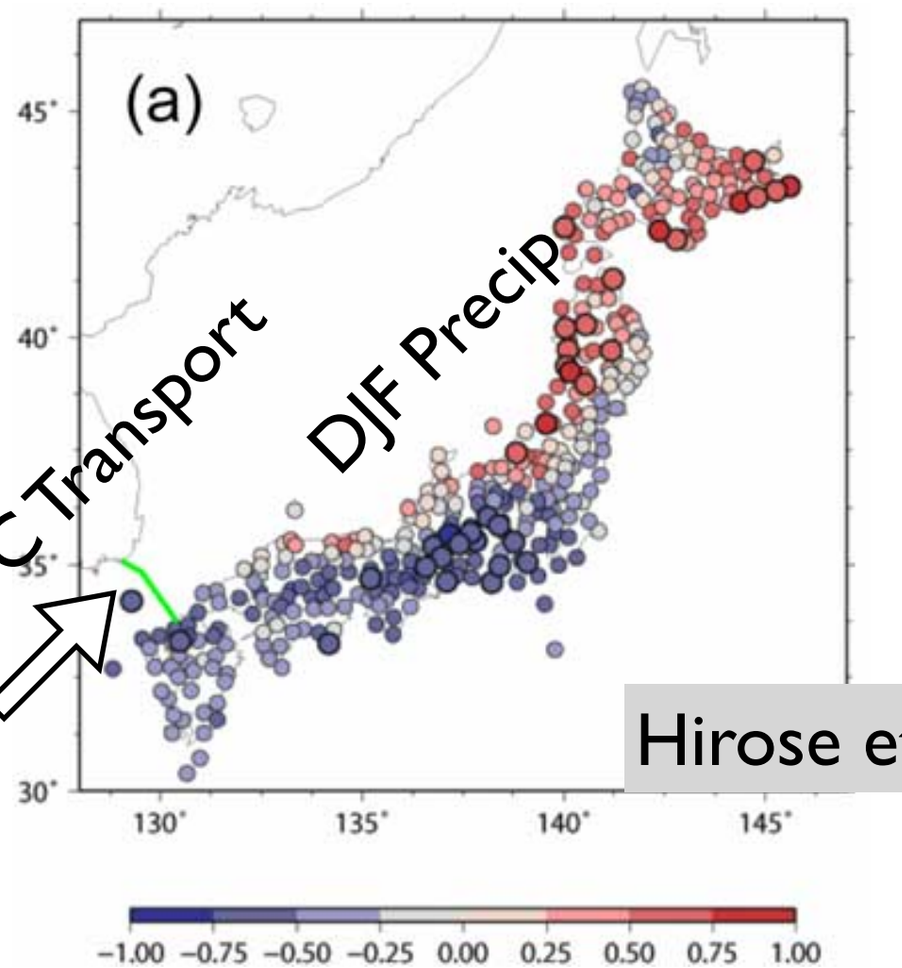
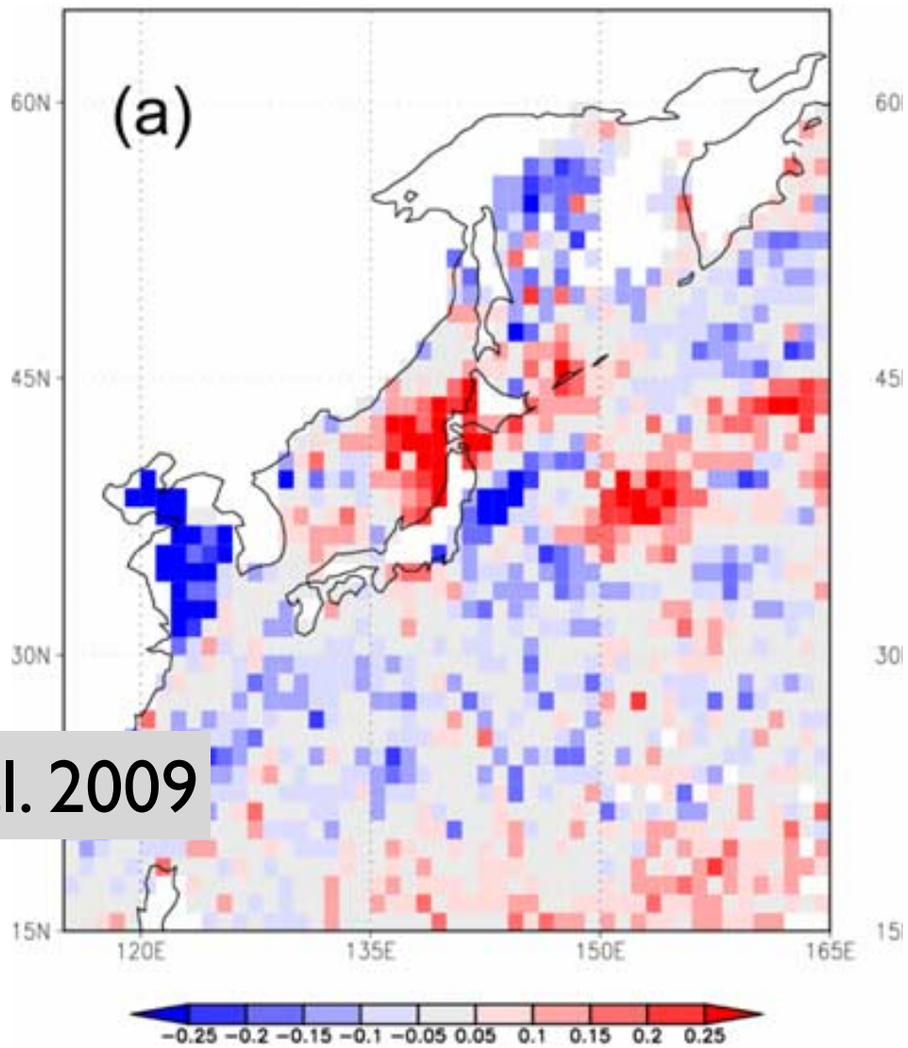
SST variability in the East Asian Marginal Seas is important for regional weather. Presumably it also plays some role in the downstream North Pacific circulation.

In the East/Japan Sea, the warm transport by the Tsushima Warm Current influences wintertime SST and precipitation.

Correlation
SON TWC Transport and DJF Precip.



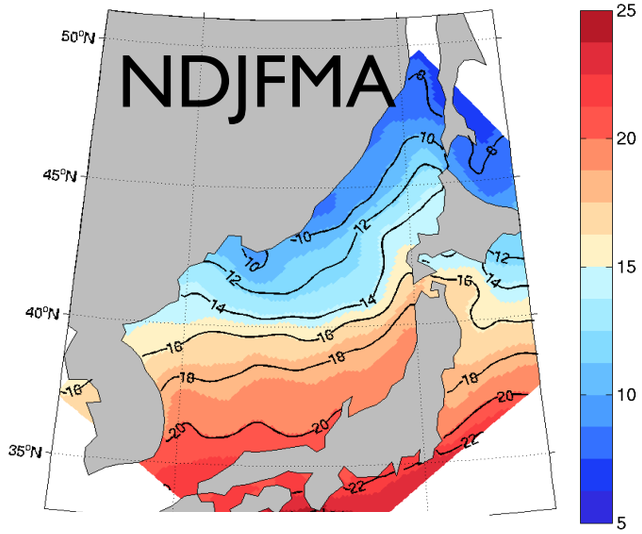
Correlation
SON TWC Transport and DJF SST.



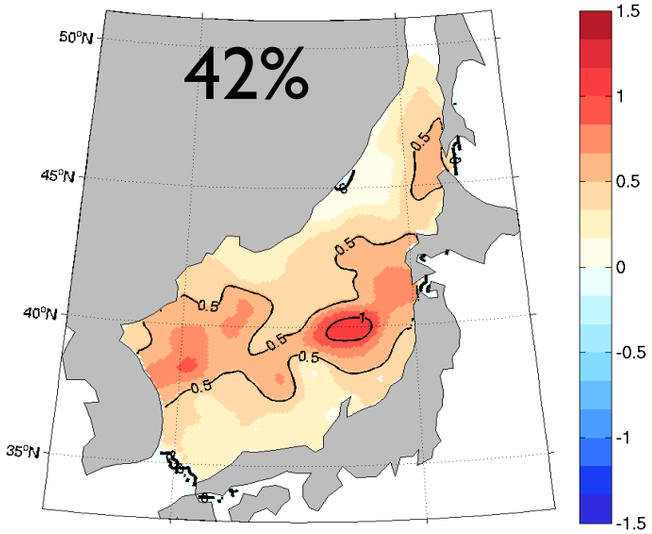
Hirose et al. 2009

Dominant modes of wintertime SST variability identified from the NOAA OISST (25 km, daily, 1982-2010)

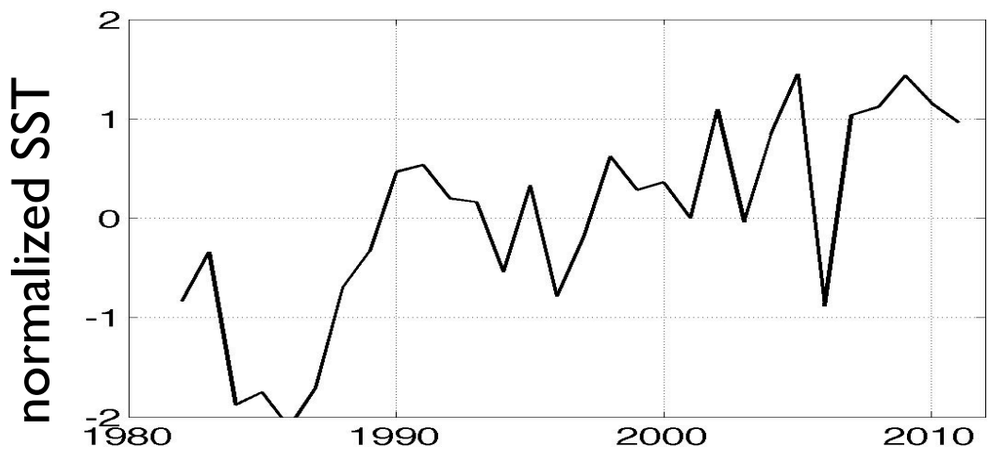
Climatology



EOF1

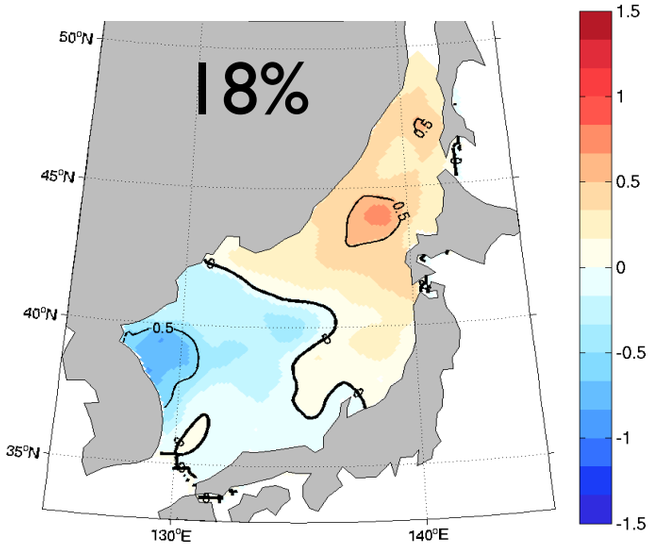


PC1

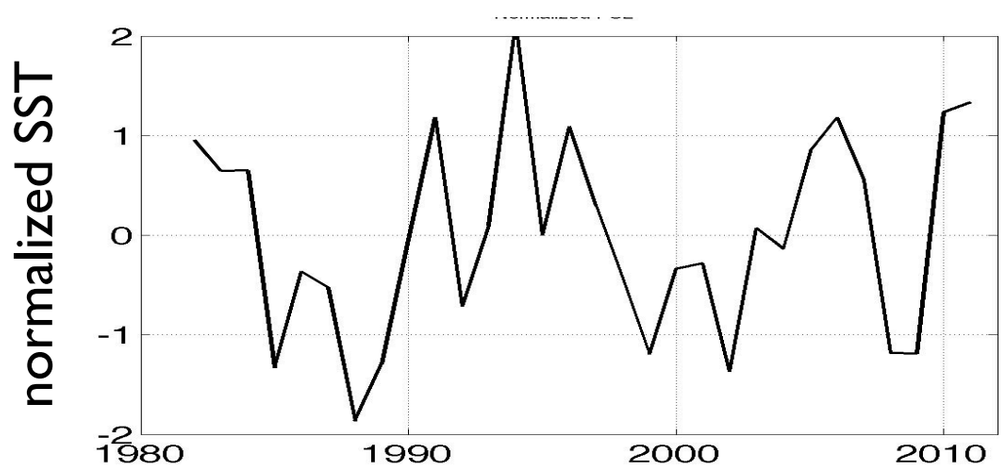


- Basin-wide warming/ cooling and a shift in front ≈ **Interannual**
1st CEOF in Minobe (2004)

EOF2



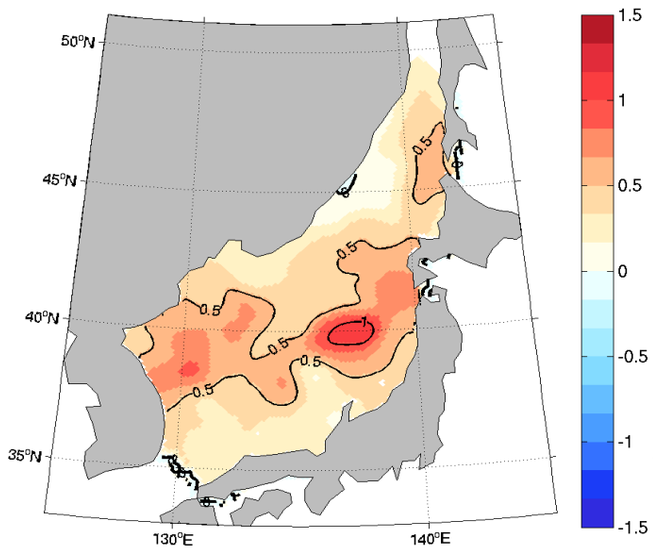
PC2



- Dipolar pattern in SST anomalies ≈ **Decadal**
1st CEOF in Minobe (2004)

How do these two dominant modes of SST anomaly patterns

EOF1



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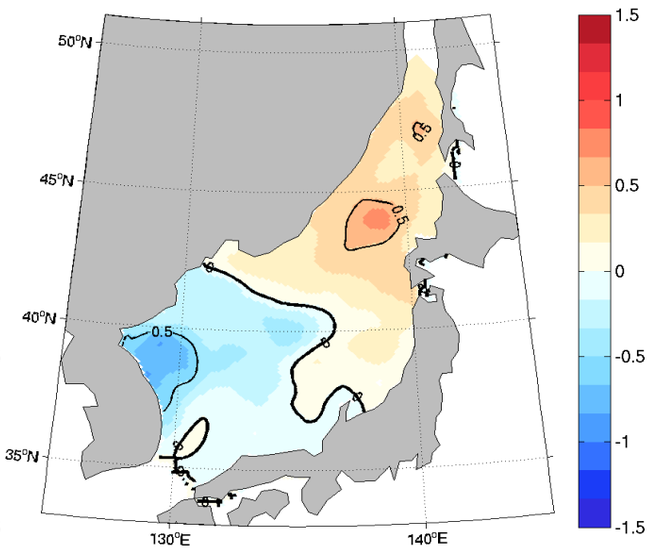


would impact the regional and large-scale circulation patterns?

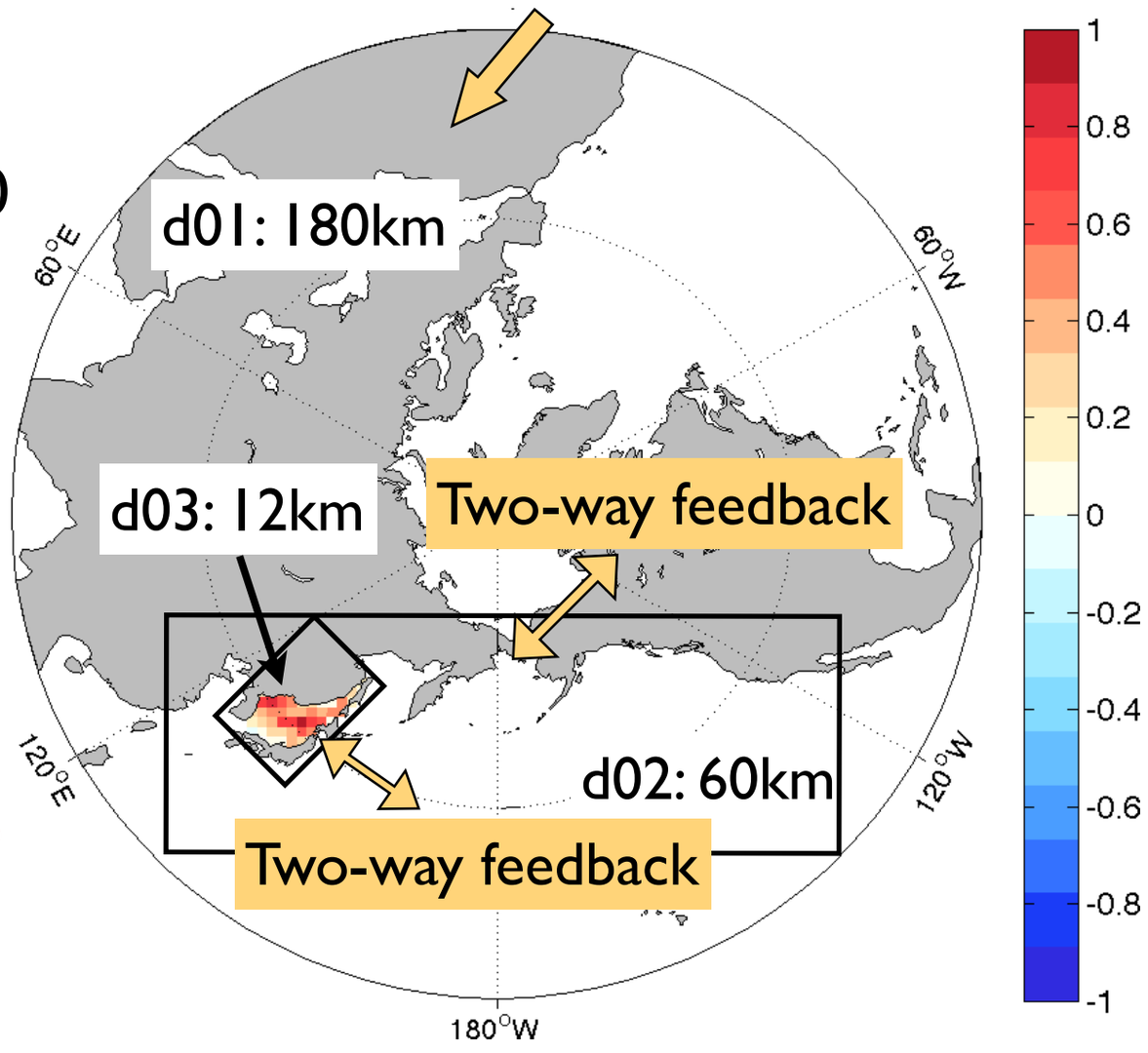
Regional atmospheric model simulation

- <u>Model: WRF 3.3</u>
- Lower BC:
  - NOAA daily climatology 1982-2010
- Lateral BC:
  - NCEP 6-hourly climatology 1980-2010
- 6 month integration: Nov.-Apr.

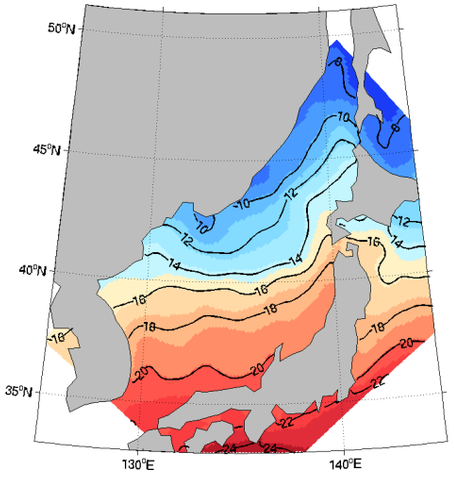
- CTL, EOF1P, EOF1M: **40-member**
- EOF2P, EOF2M: **20-member**

- Focus on November-January ***response***
  - Initial adjustment period
  - Quasi-equilibrium state

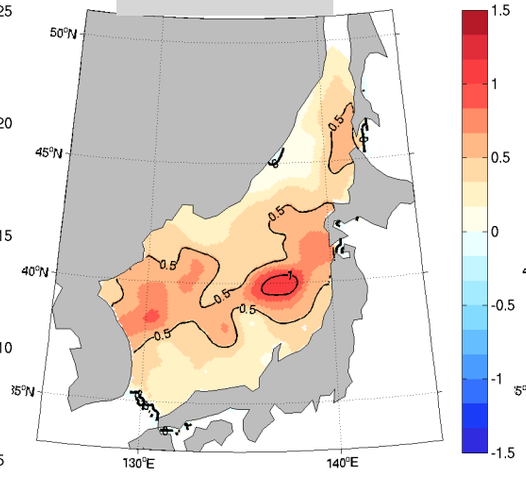
<u>Lateral BC</u>: NCEP 6-hourly climatology



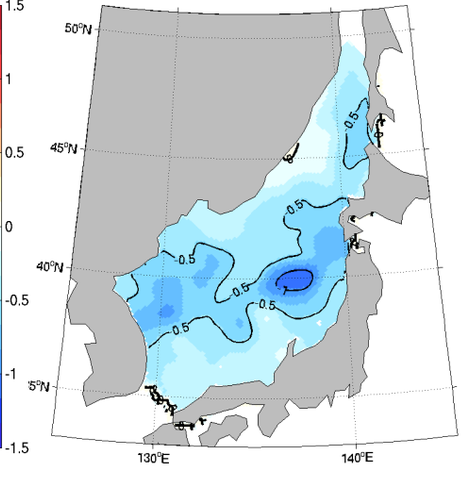
CTL



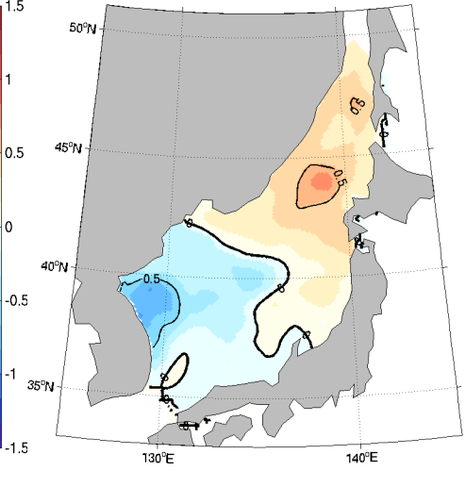
EOF1P



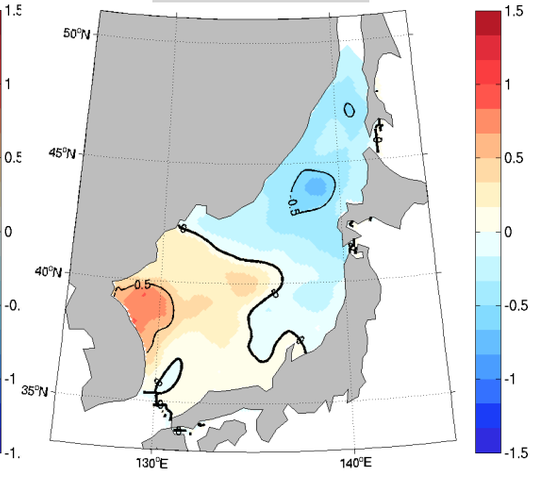
EOF1M



EOF2P

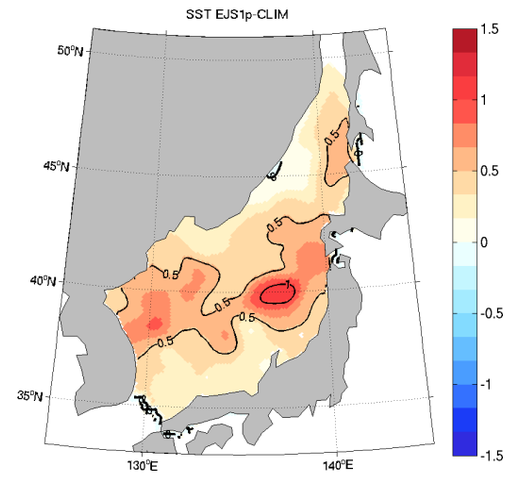


EOF2M



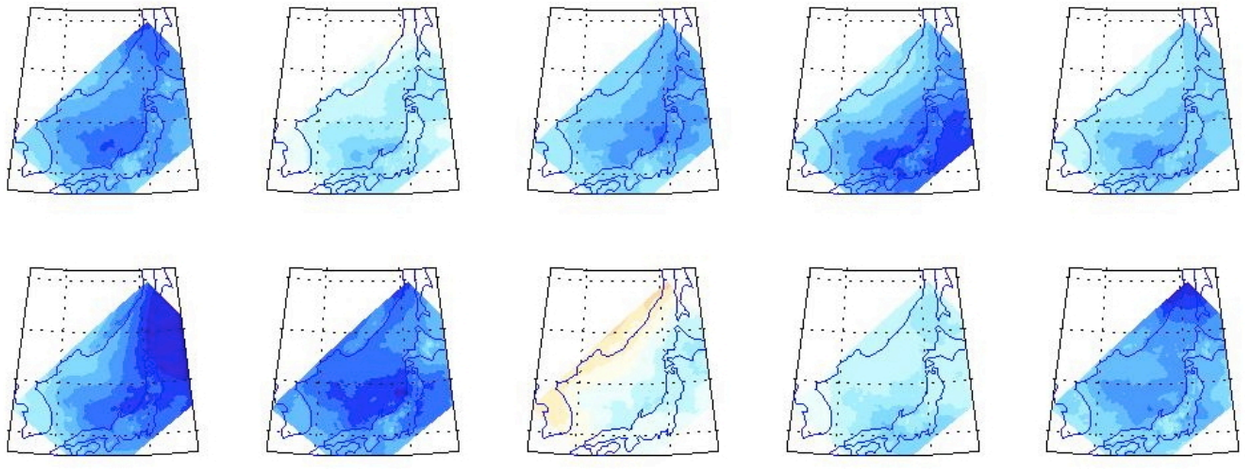
1. SLP responses for the different time-scale and ensemble averaging

SLP response in 1-14 days

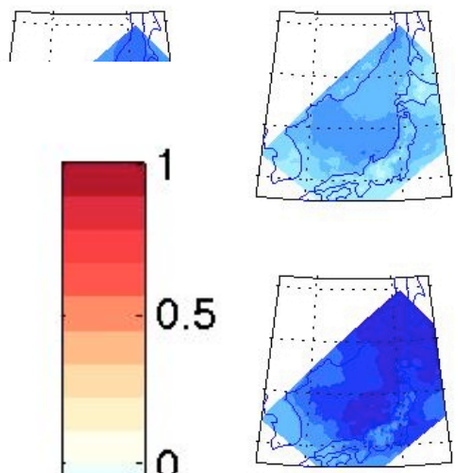


EOF1P-CTL

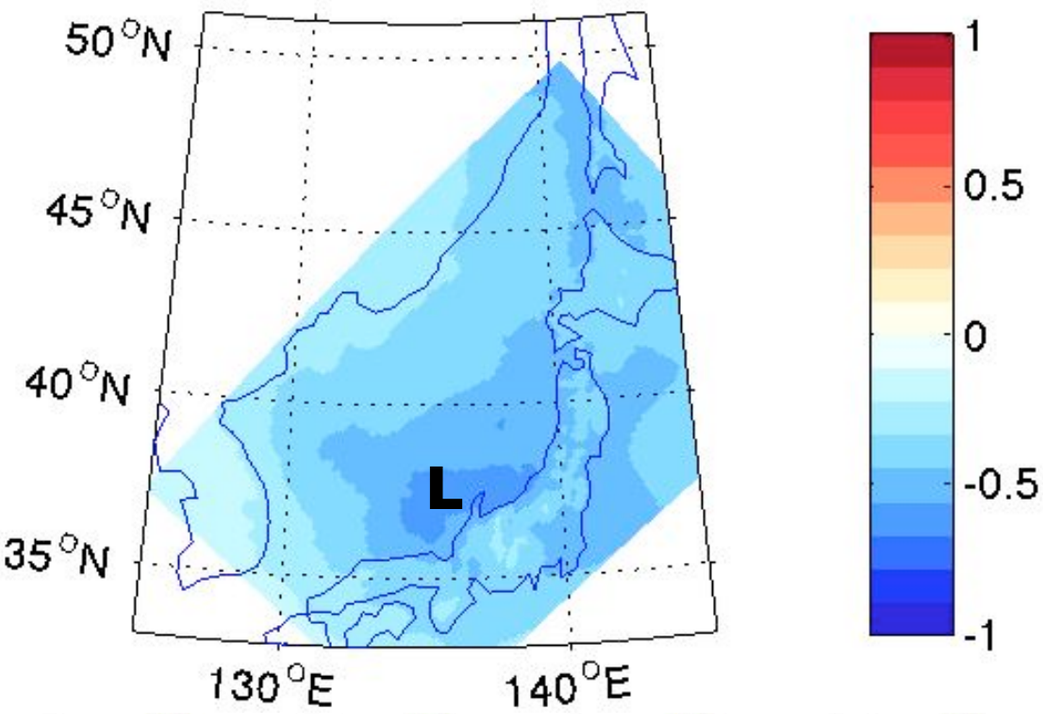
Ensemble member 1-10



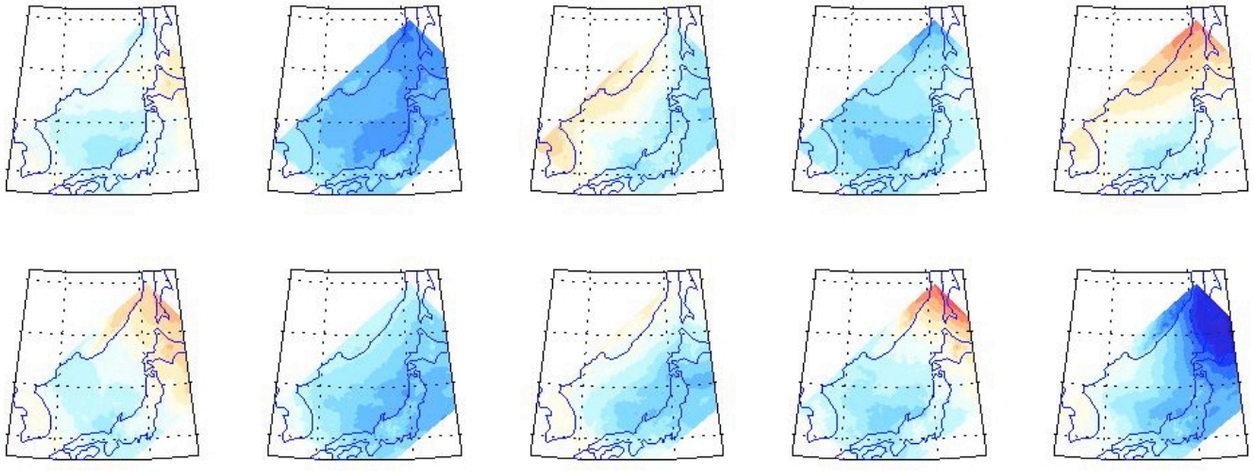
Ensemble member 11-20

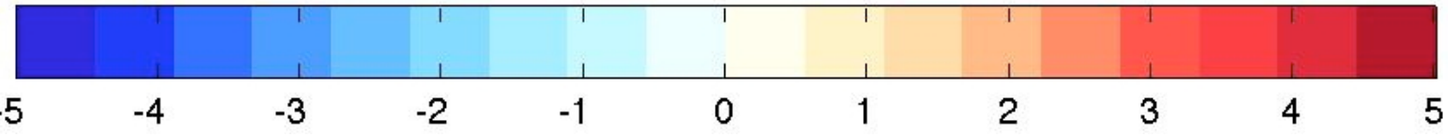


Ensemble mean 1-40



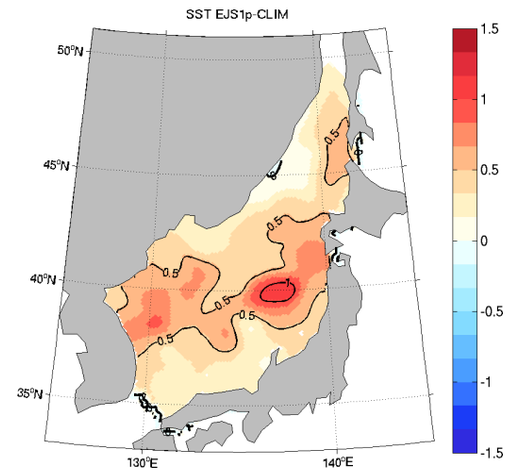
Ensemble member 21-30





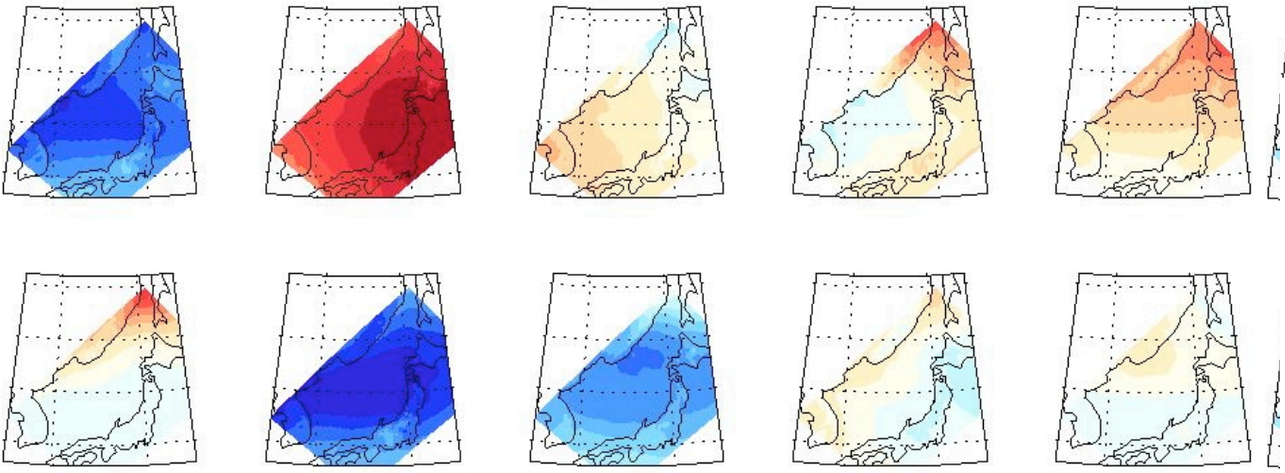
The deterministic SLP response to the diabatic forcing.

SLP response in 15-91 days

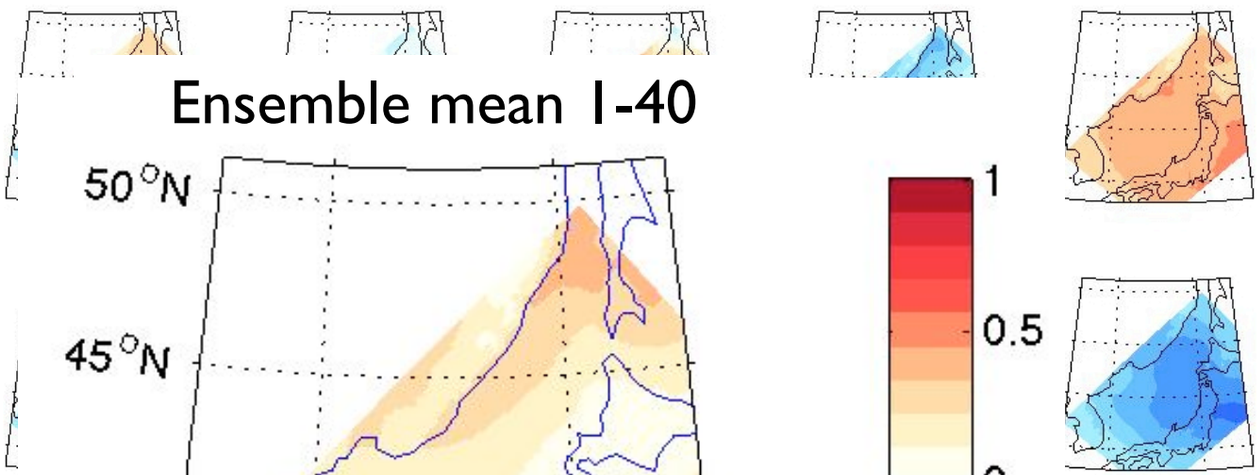


EOF1P-CTL

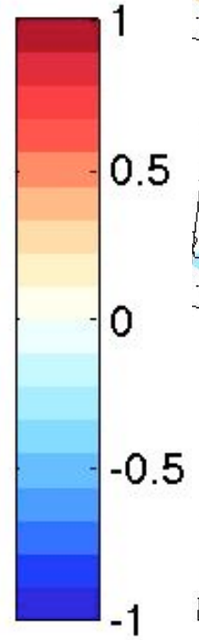
Ensemble member 1-10



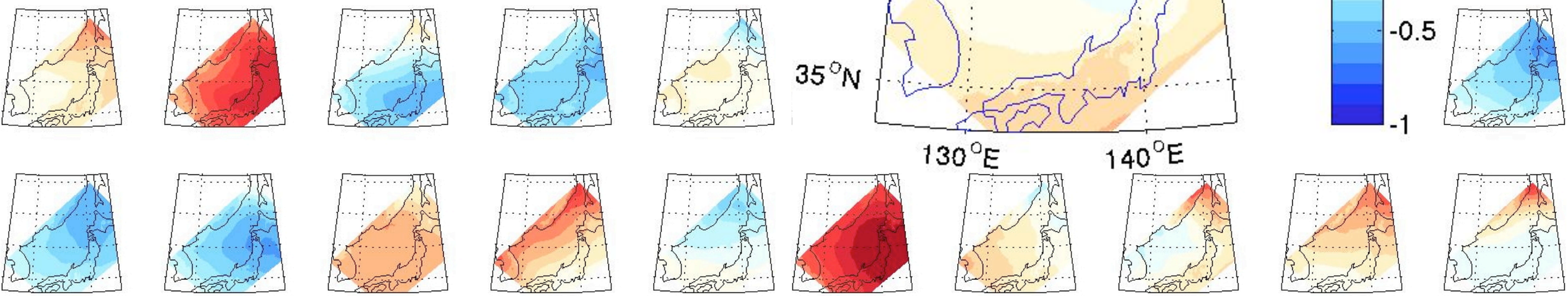
Ensemble member 11-20

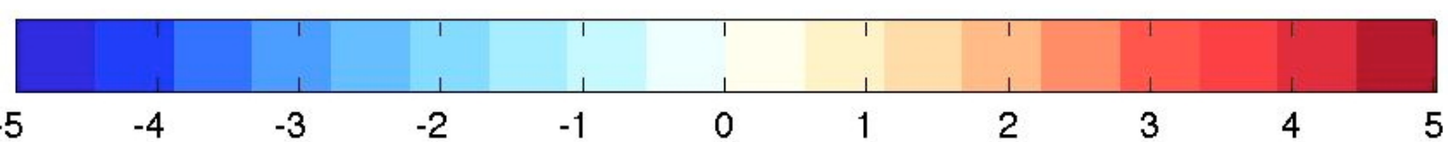


Ensemble mean 1-40



Ensemble member 21-30





[mb]

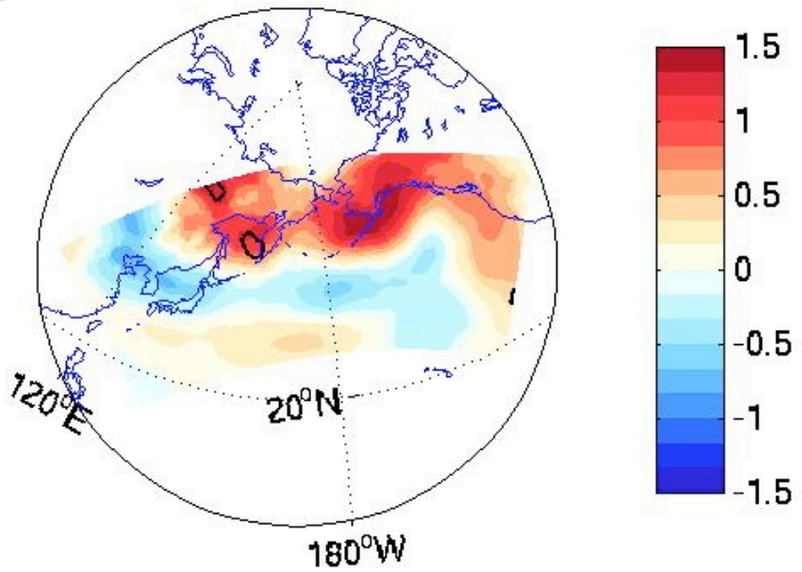
The quasi-equilibrium SLP response is chaotic.
due to the circulation change.

Sensitivity of response to the different number of ensemble averaging

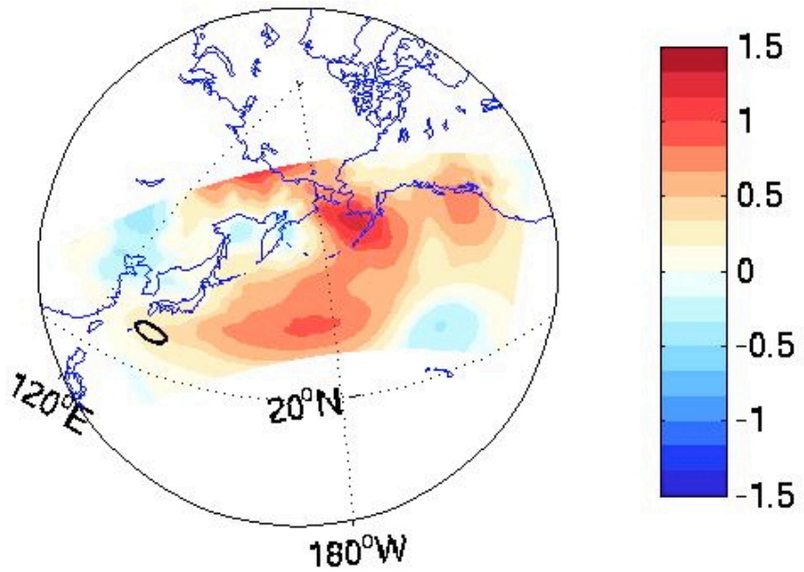
EOF1P-CTL

15-91 day

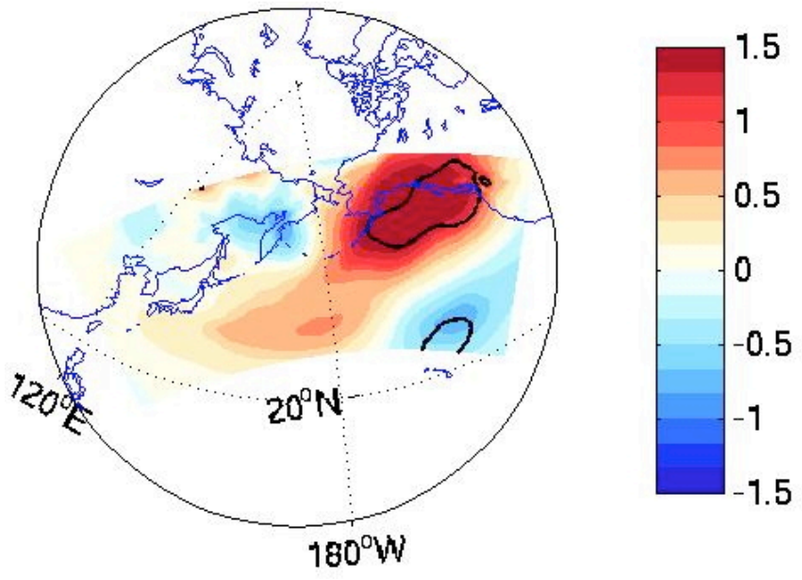
1-10 member mean



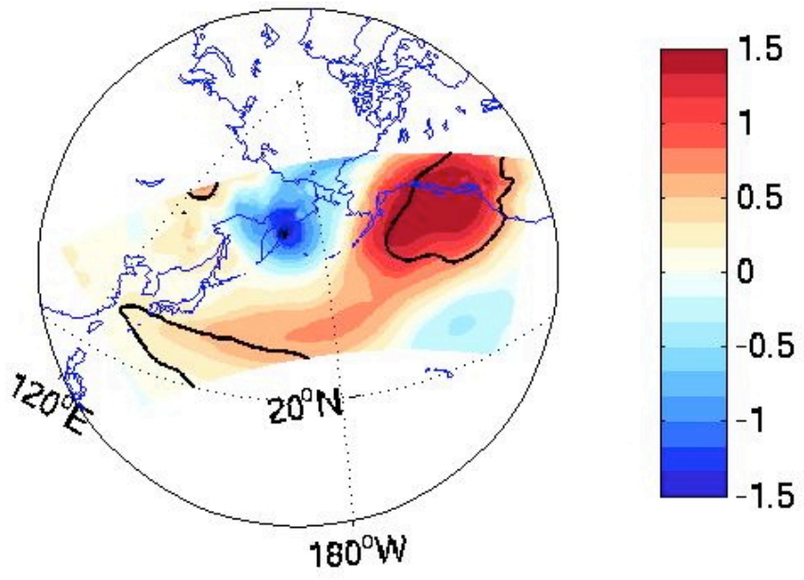
1-20-member mean



1-30 member mean



1-40 member mean



Black contours: significant at 95%

Some robust and significant SLP response emerge as more ensemble members are used for averaging.

2. Local response in precipitation in NDJ (15-91 day)

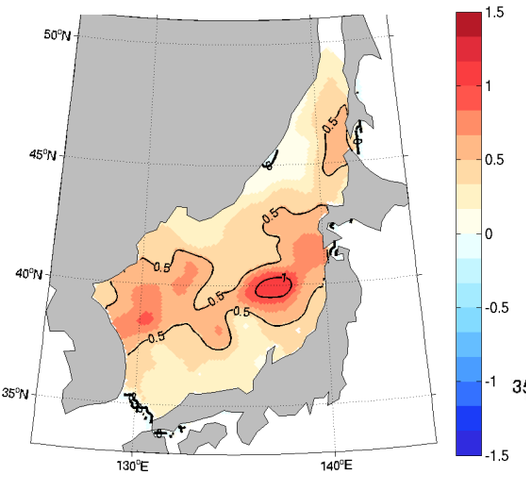
15-91 day averaged responses in precipitation

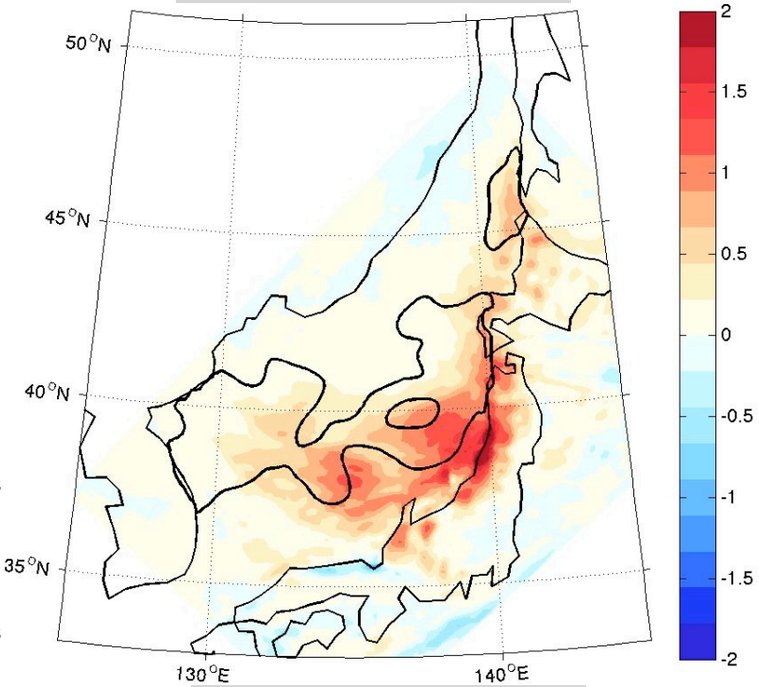
EOF1P-CTL

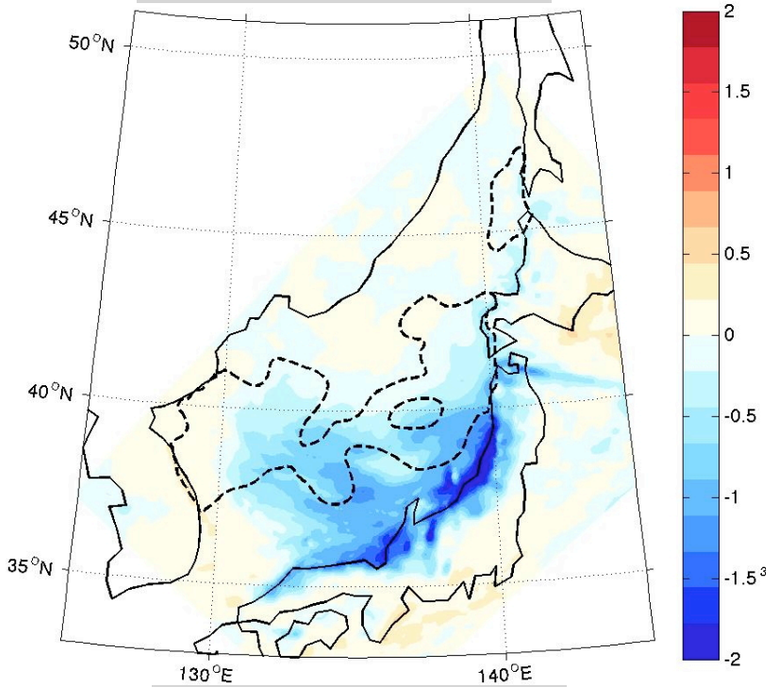
EOF1M-CTL

mm/day

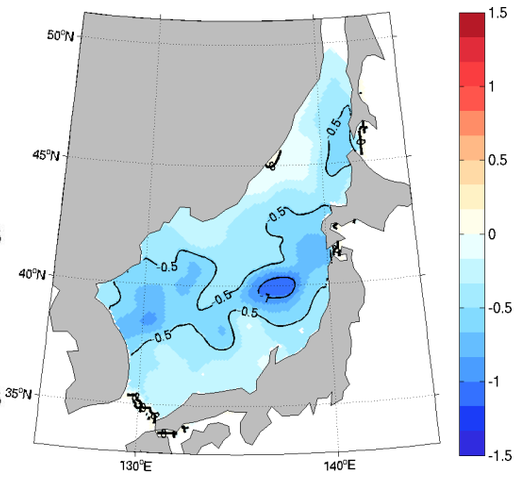
SST Anom







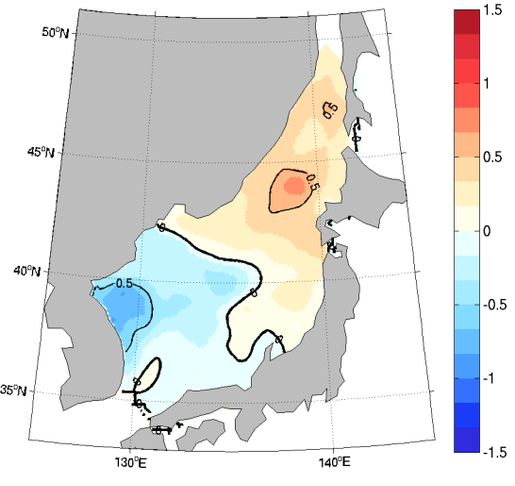
SST Anom

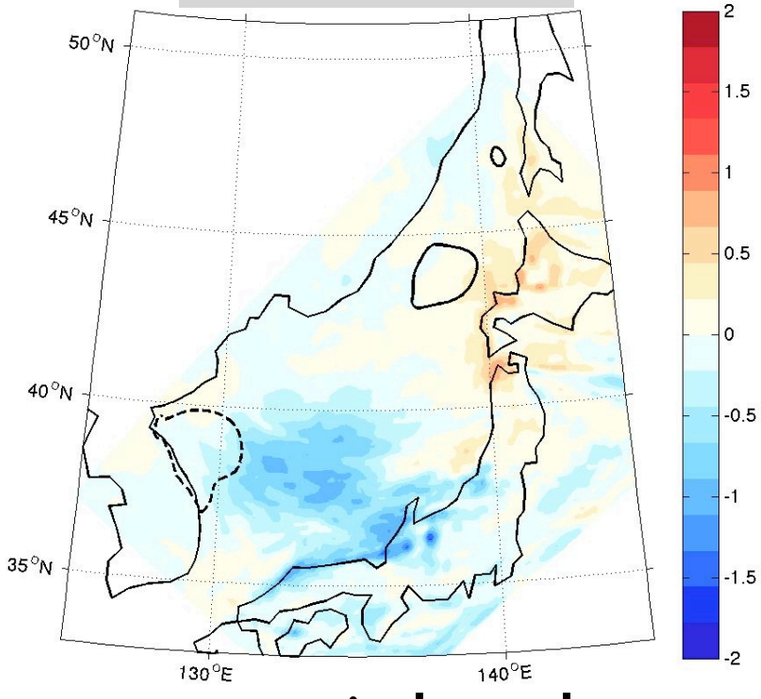


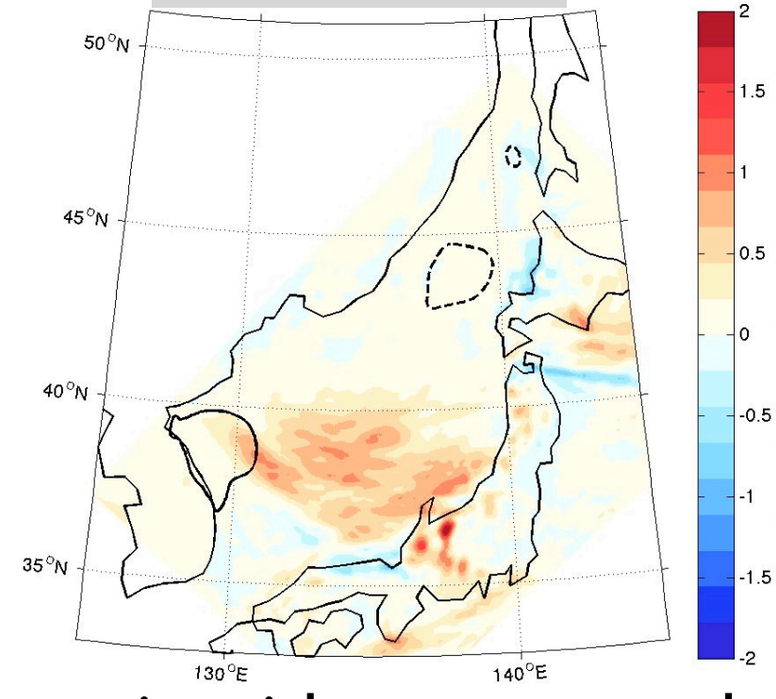
EOF2P-CTL

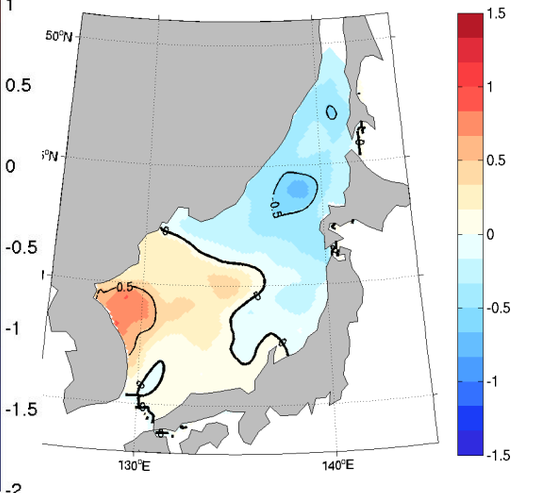
EOF2M-CTL

SST Anom







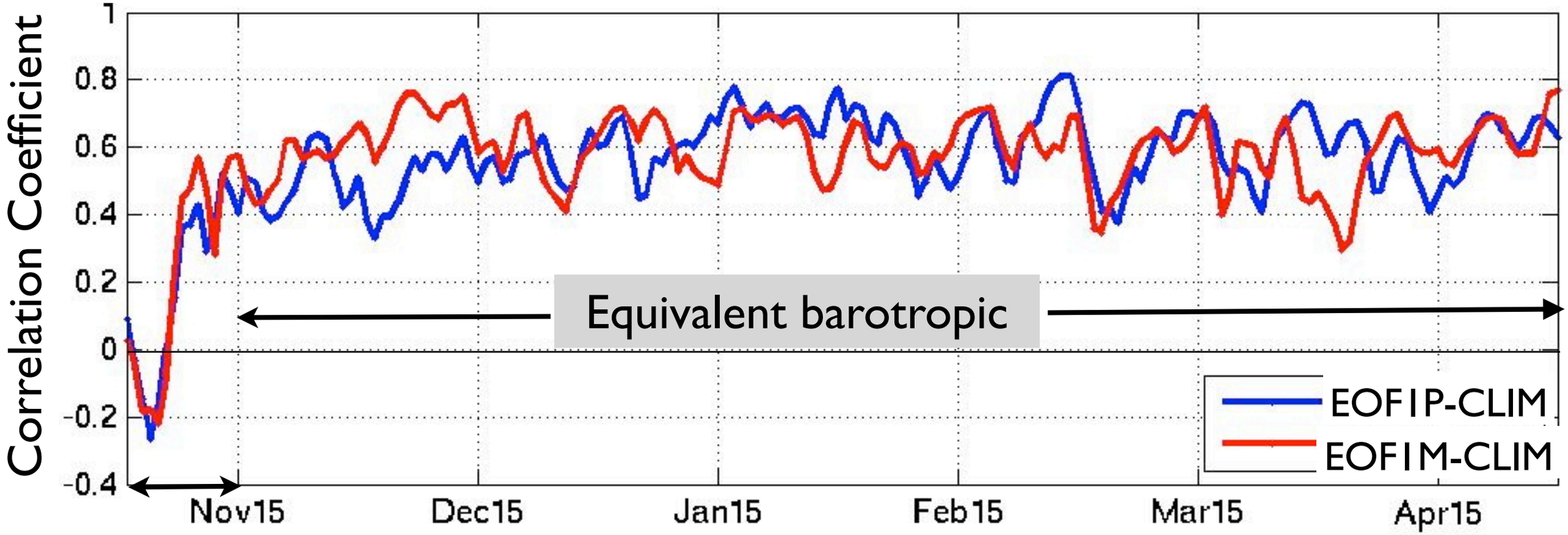


Precipitation response is largely symmetric with respect to the polarity of prescribed SST anomalies.

3. Downstream responses in atmospheric circulation

The initial baroclinic response is followed by an equivalent barotropic structure

Time-series of pattern correlation in geopotential height anomaly at 200mb and 850mb



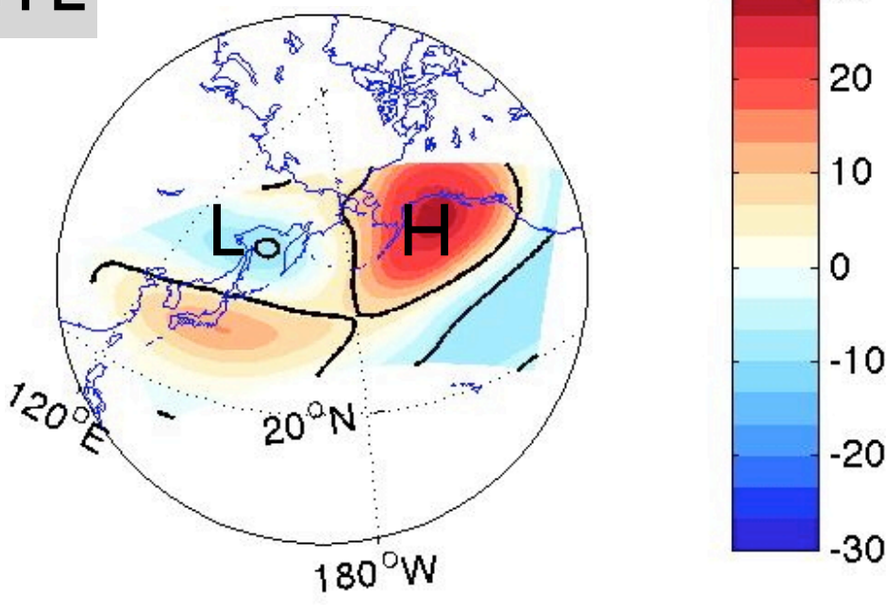
14 days

Baroclinic initial response and a fast transition toward the barotropic structure

15-91 day mean geopotential height responses

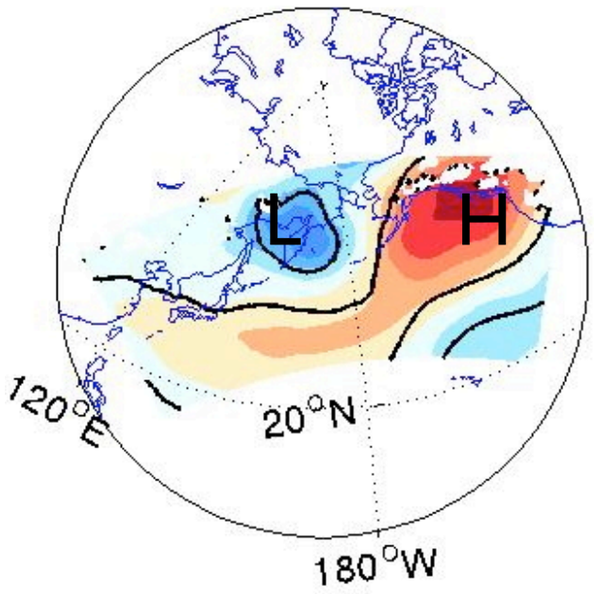
EOF1P-CTL

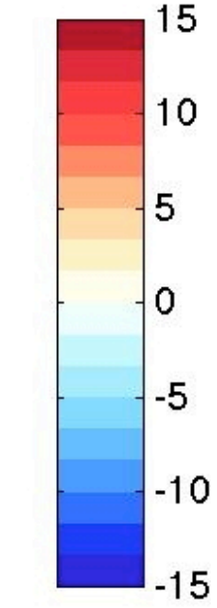
200 mb HGT



- An equivalent barotropic height response

850 mb HGT



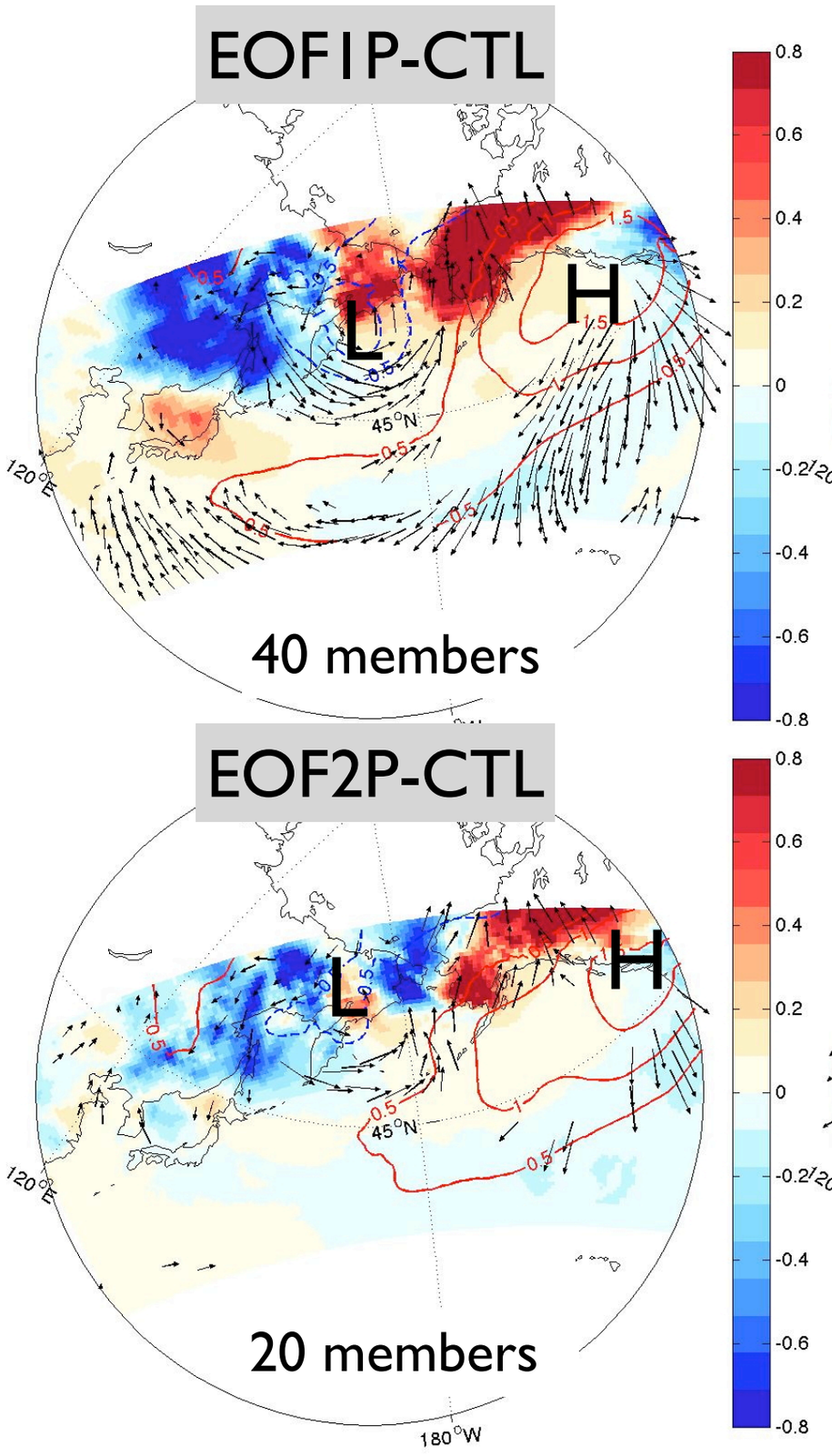


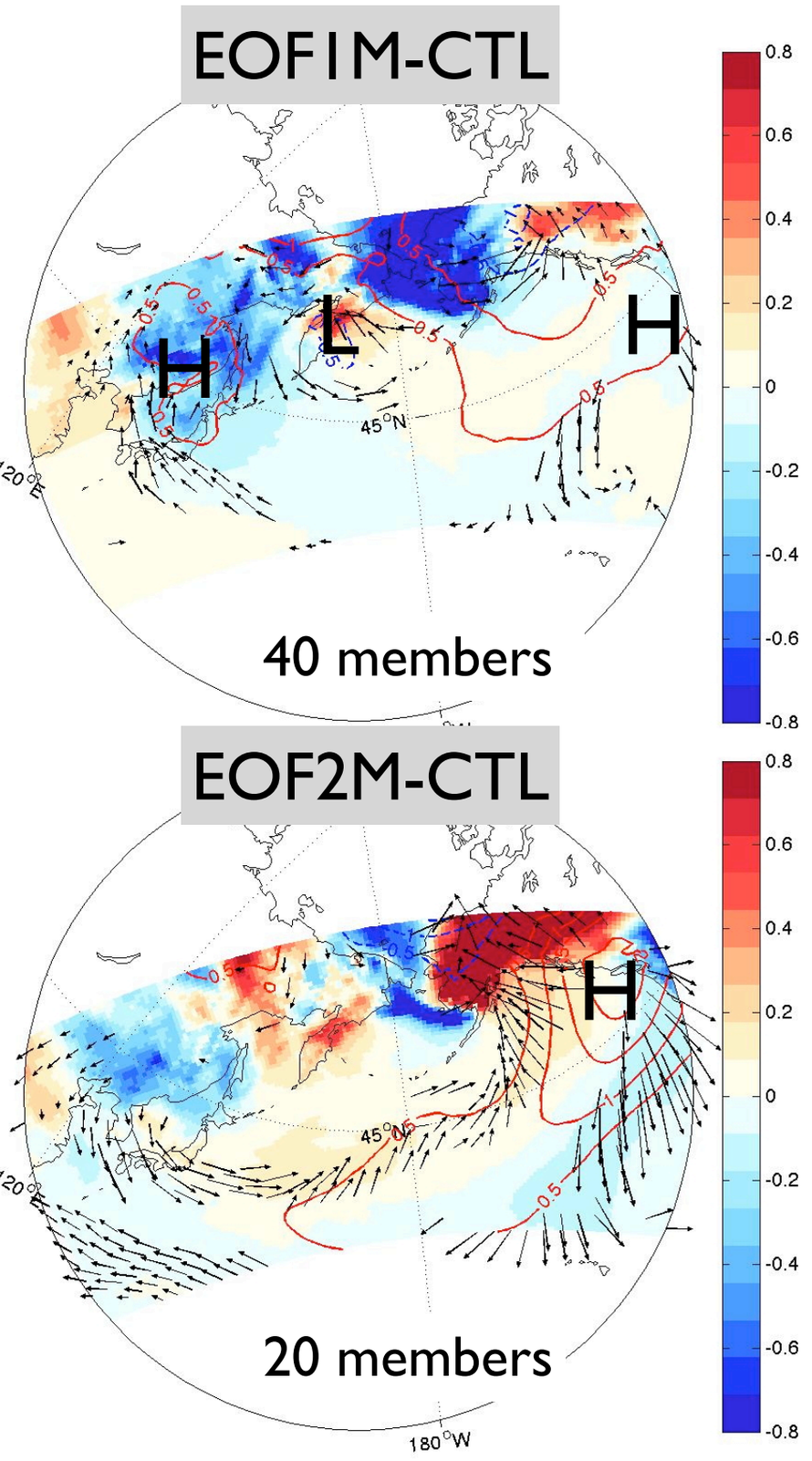
- High in the Pacific Northwest.
- Low over Kamchatka Peninsula

Black contours: significant at 95%

40-member ensemble mean

There are some common circulation responses regardless of SST forcing.





Showing responses in Tair, 10m-wind and SLP

- Responses are distinct over forcing region, depending on the sign of diabatic forcing.

- SLP High in Pacific NW and Low over the Kamchatka Peninsula are shown as somewhat common feature.

Summary

- Two dominant modes of wintertime SST variability produce differing circulation responses during the two periods of
  - *Initial adjustment*: a deterministic and baroclinic response to the diabatic forcing
  - *Quasi-equilibrium*: a chaotic circulation response with an equivalent barotropic vertical stricture
    - A statistically significant response pattern is identified after averaging 40 ensemble members.
- Precipitation response is largely symmetric with respect to the polarity of prescribed SST anomalies.
- SLP High in the Pacific Northwest and Low over the Kamchatka Peninsula tend to commonly appear regardless of the sign and pattern of SST anomalies.

Thanks!