Pacific Decadal Oscillation in CCSM3 Large Ensemble Experiment

June18 2008

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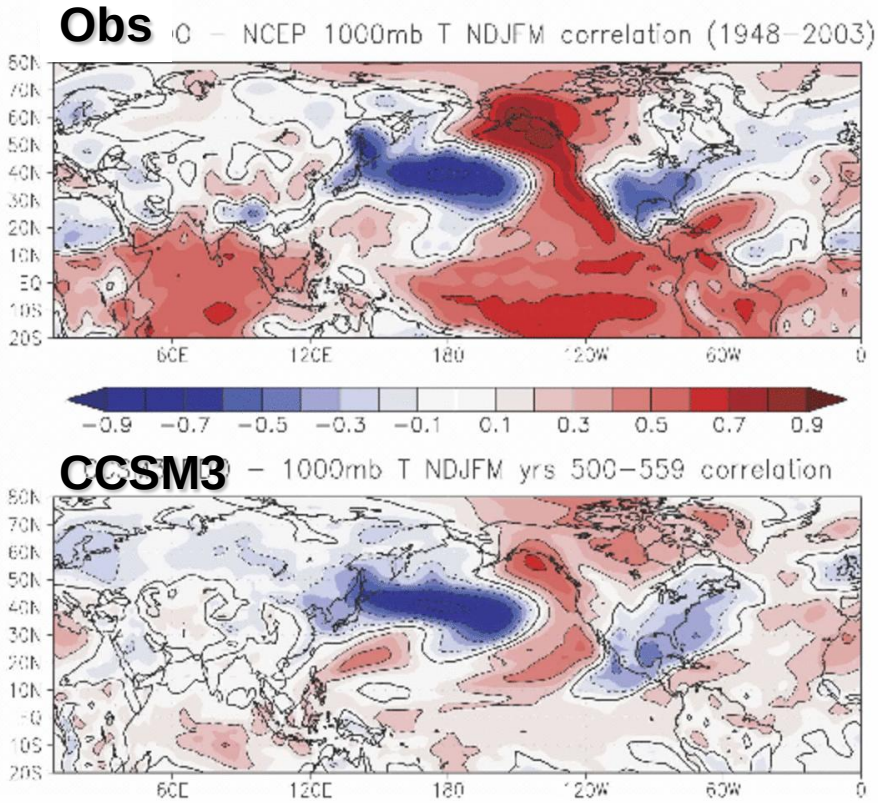
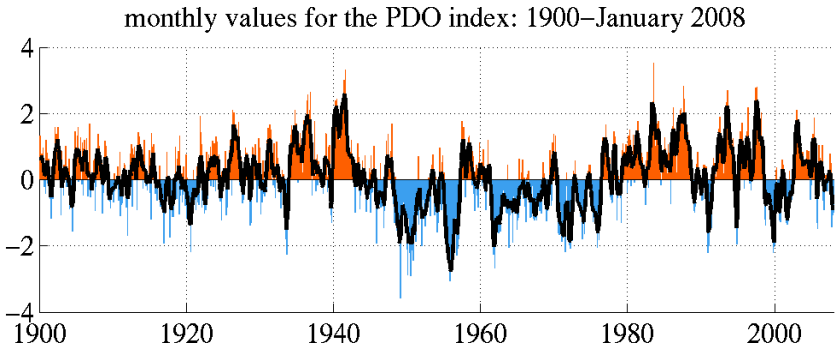
CCSM3 Large Ensemble Experiment

- T42
- One historical run ***1870-1999*** ➔ 30-member A1B scenario, ***2000-2061***
- ocn/lnd/ice same initial data; atm 1999-12-03 to 2000-01-14
- Bassi, Bluesky, Bluevista, Blueice

- CCSM CVWG & CCWG
- Data post processed & published at ESG (Gary Strand)
- Ongoing projects: CVWG webpage, or contact Adam Phillips



Alexander et al. (2006): PDO lacks connections to the Tropics in CCSM3



http://www.jisao.washington.edu/pdo/

Mechanism of PDO

- **Atmospheric noise?**

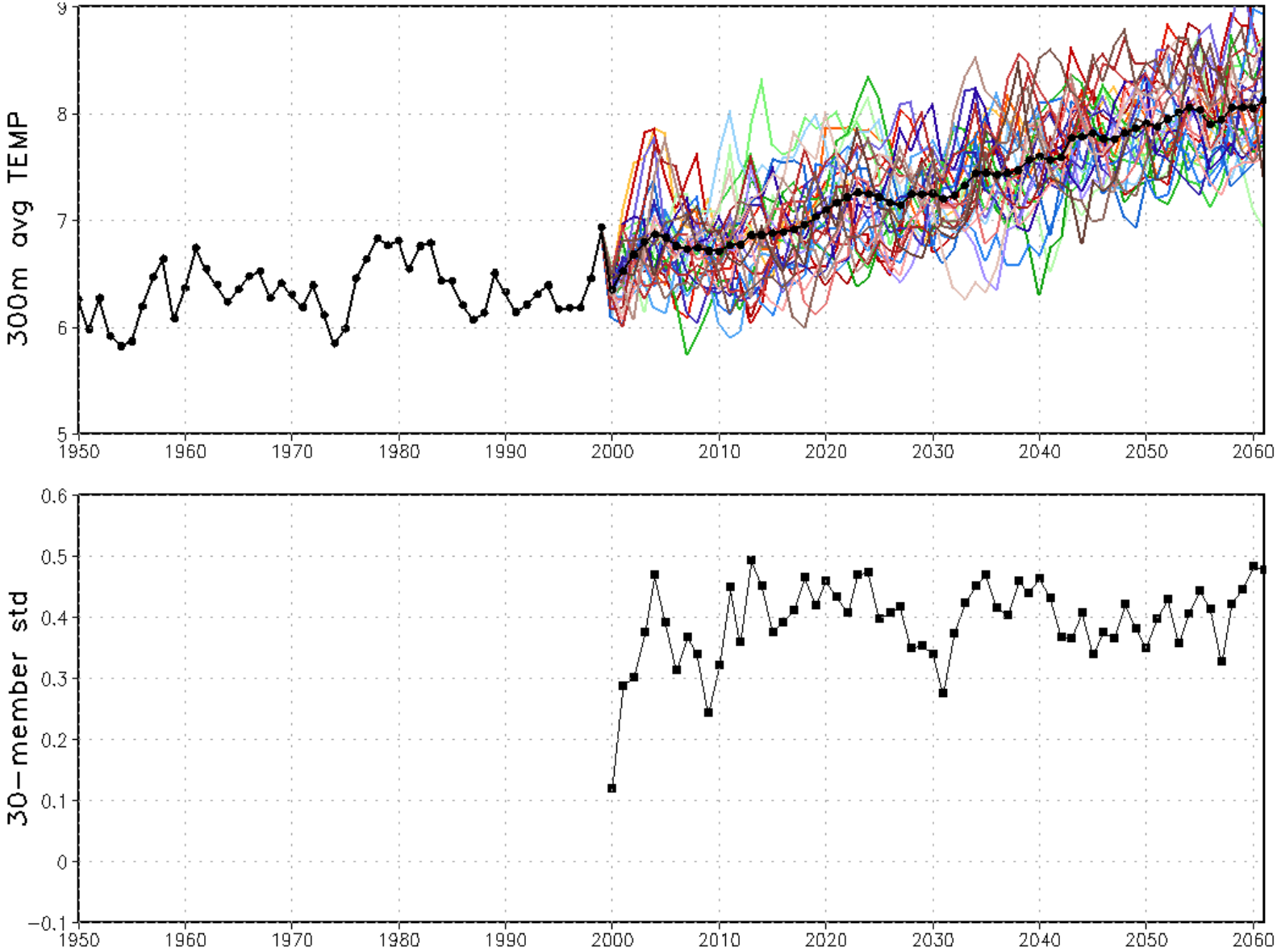
Hasselmann (1976)
Frankignoul and Hasselmann (1977)
……

- **Atm-ocn coupled mode?**

Latif and Barnett (1994, 1996)
Neelin and Weng (1999)
Kwon and Deser (2006)
……
Atm response to the decadal SST anomalies?

The mechanism of the decadal SST variability is important for decadal climate prediction.

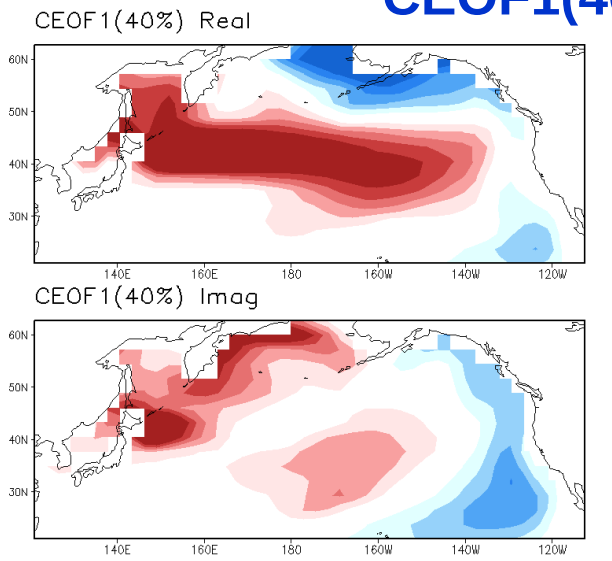
0-300m annual mean ocean temperature at 140°E-200°E, 40°N-50°N

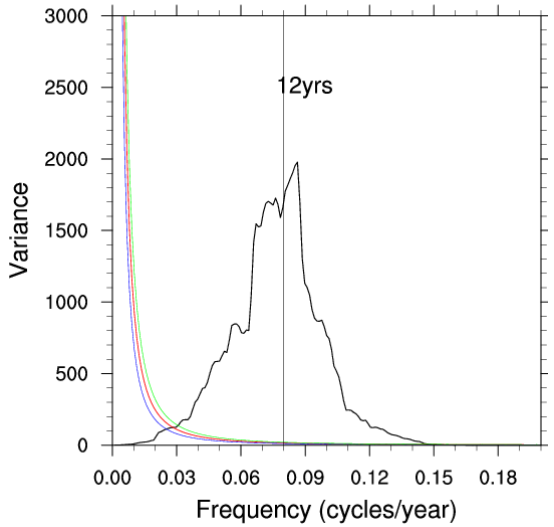


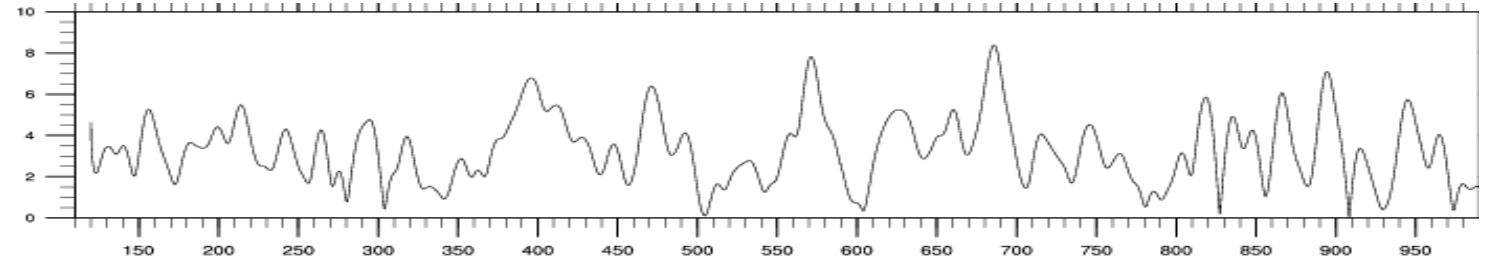
Complex EOF Analysis

monthly 10-20yr filtered SST from 900-yr CCSM3 T42 PDcntrl run

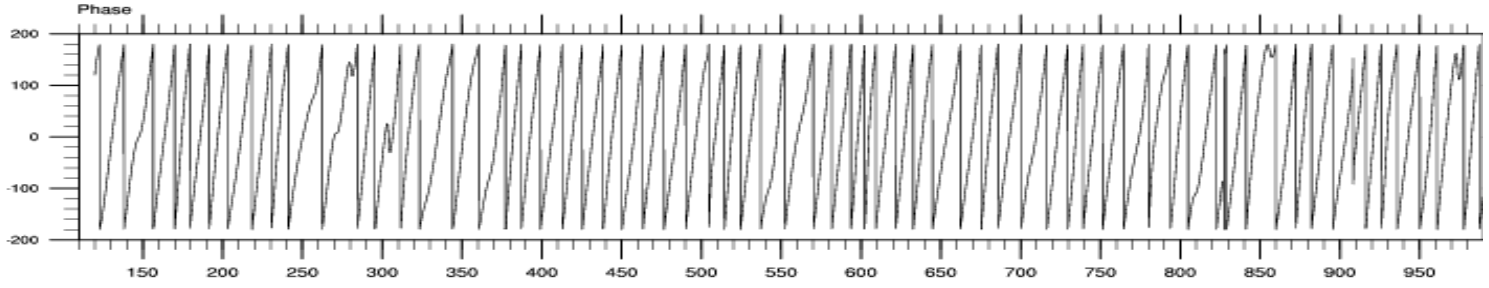
CEOF1(40%)







amplitude



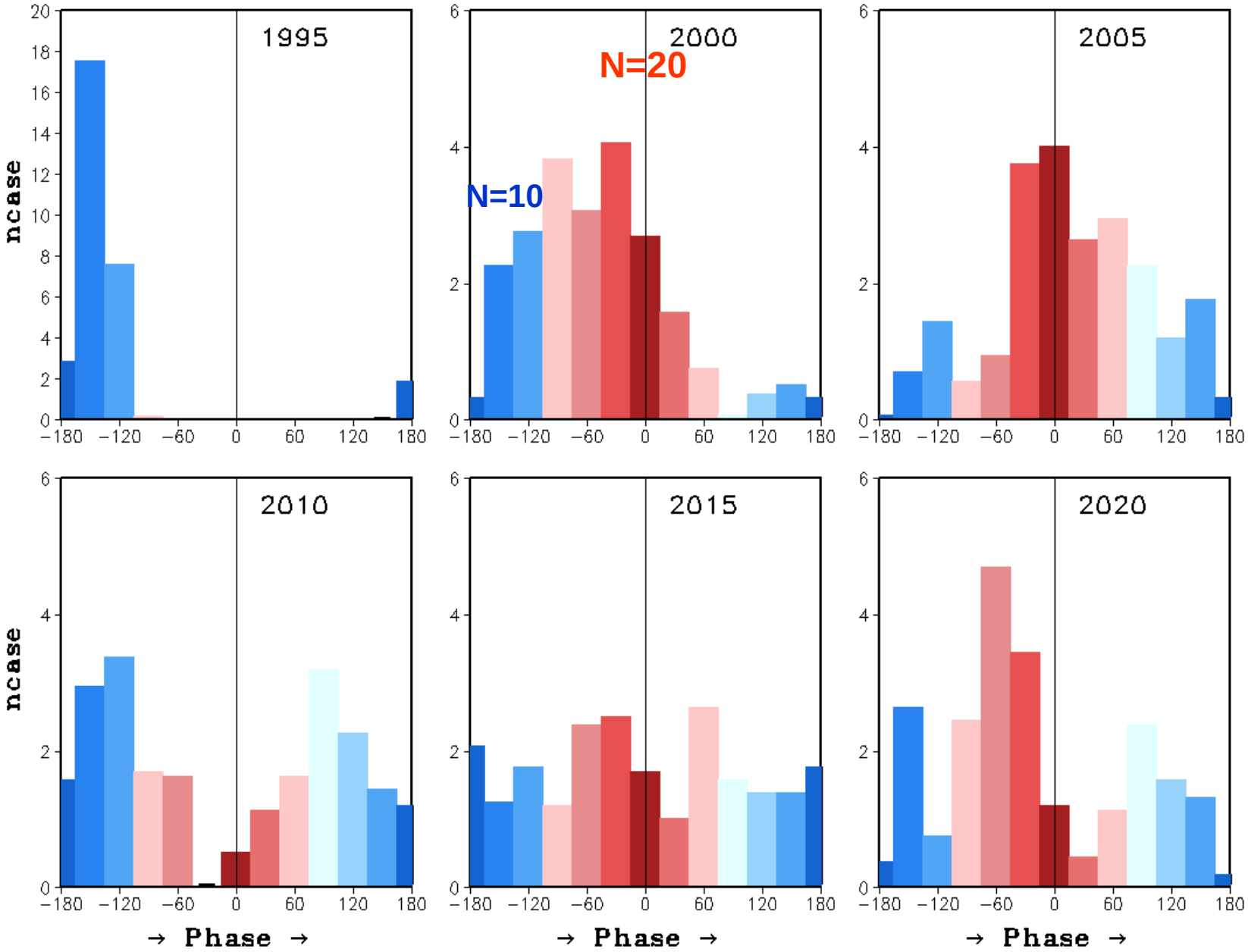
180

-180

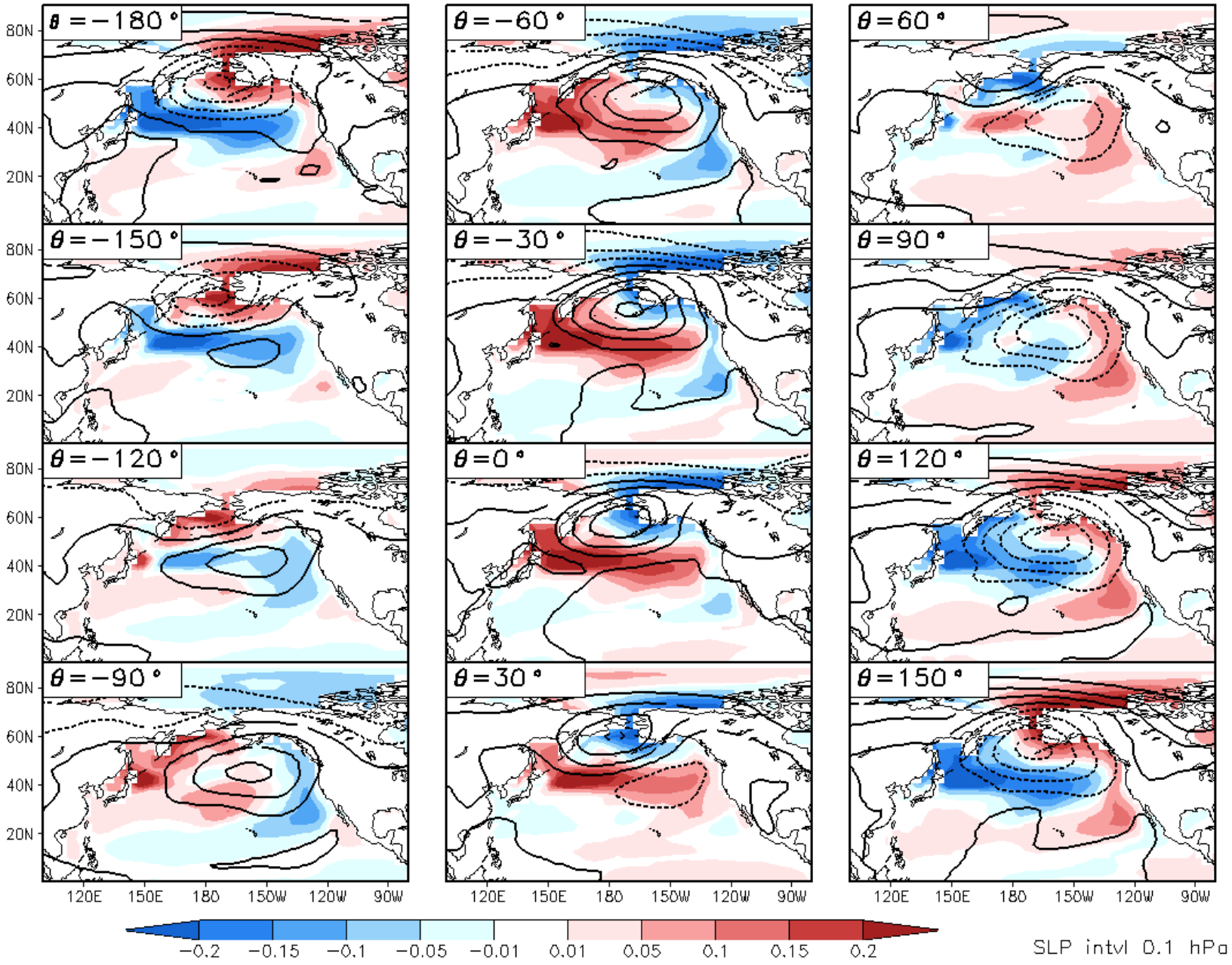
phase

~ 70 episodes

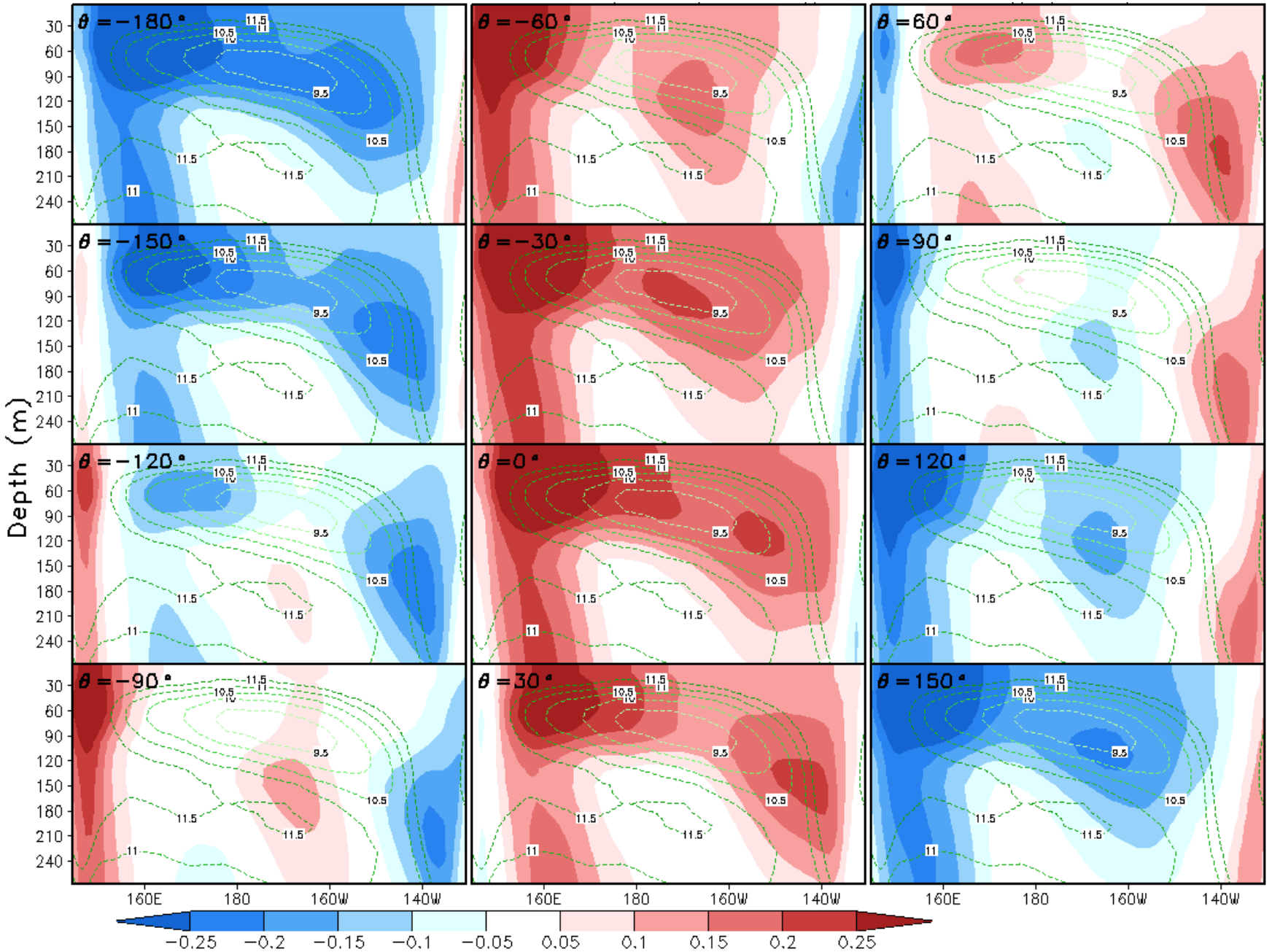
Probability density function of the PDO phase in the 30 members



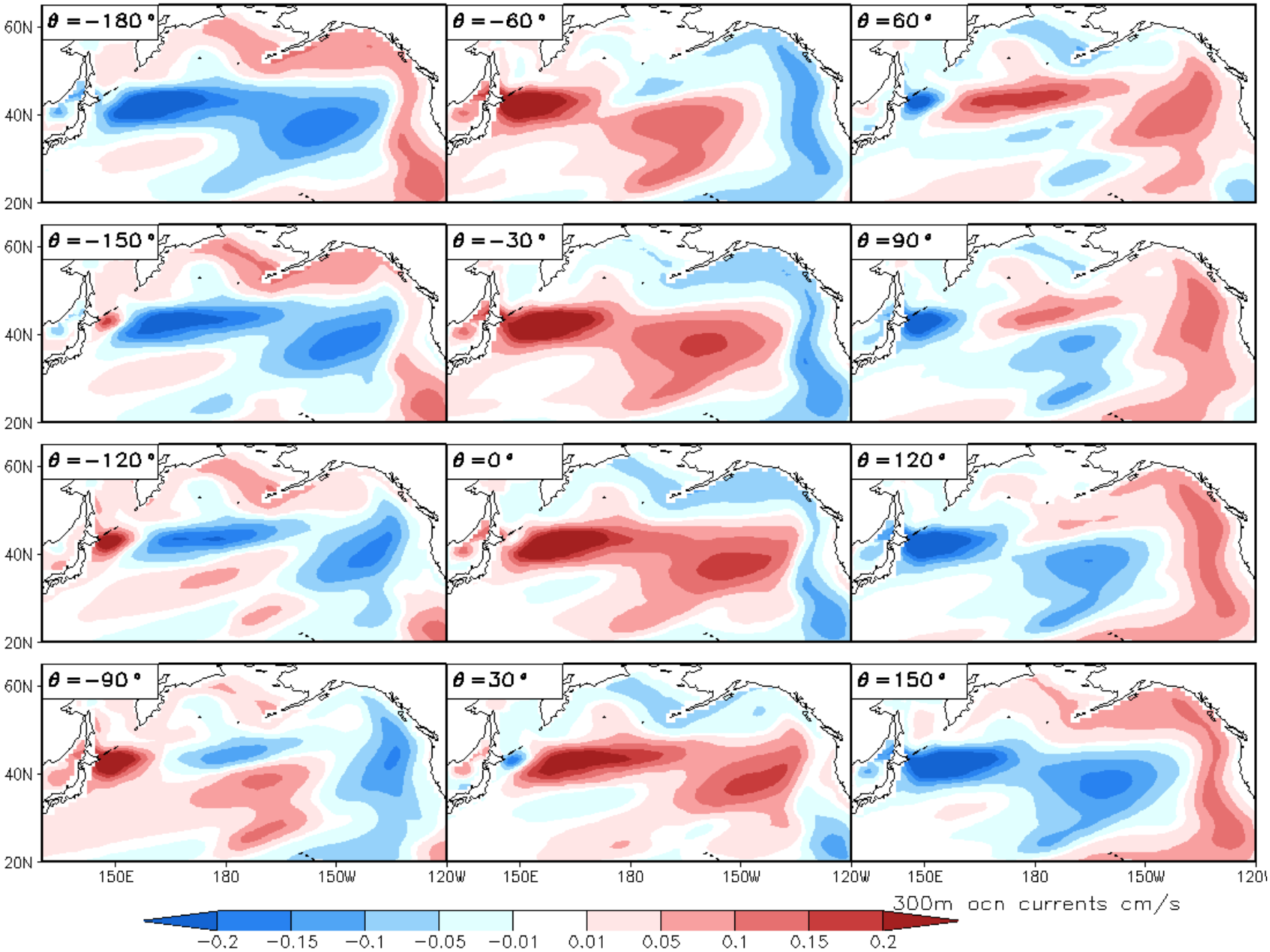
SLP/SST composite based on CEOF temporal phase θ (~70 cases)



Ocean Temp at 40 N: Composite (shading) & Climatology (contour)

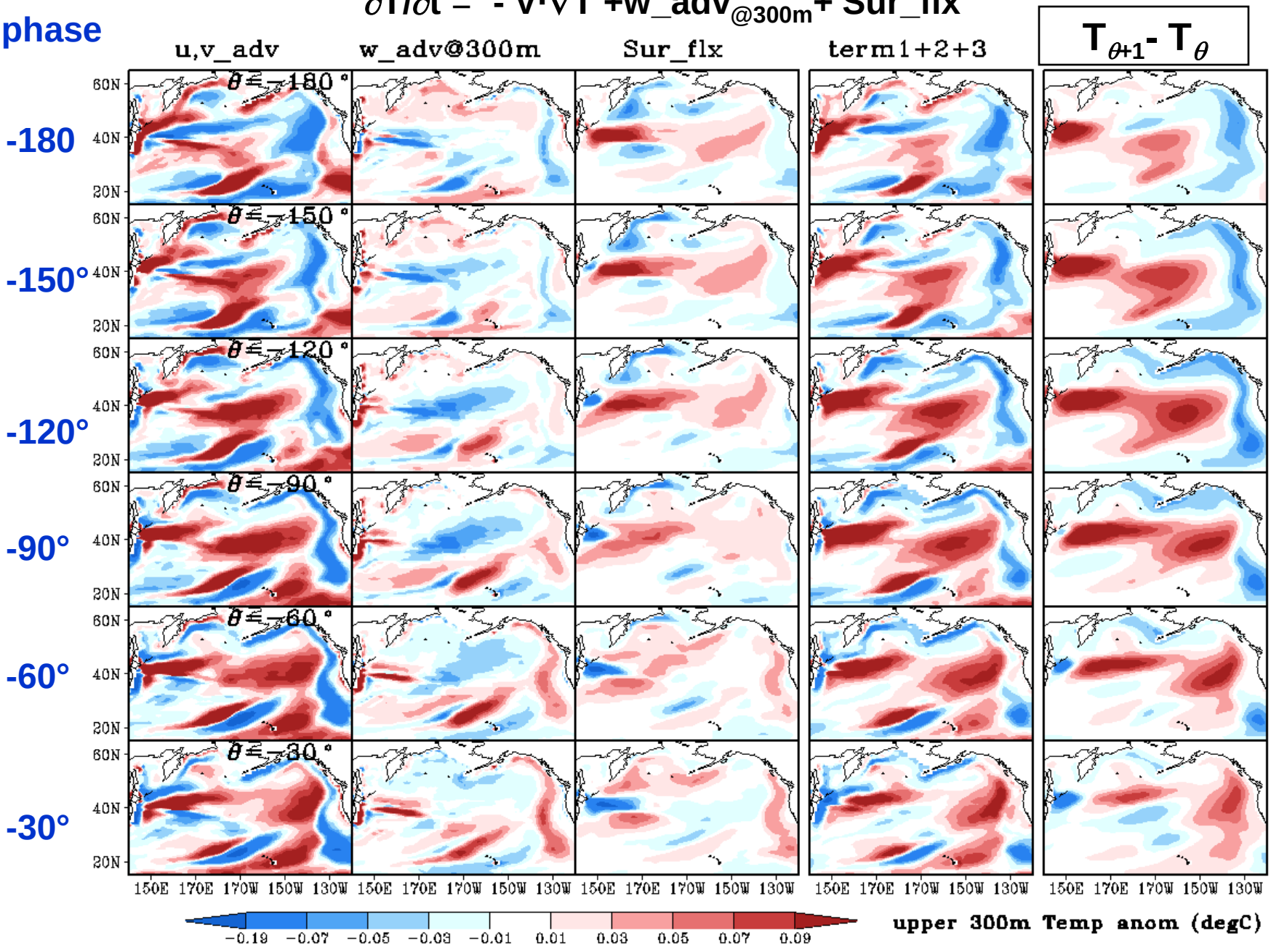


Upper 300m ocn TEMP composite based on CEOF temporal phase θ

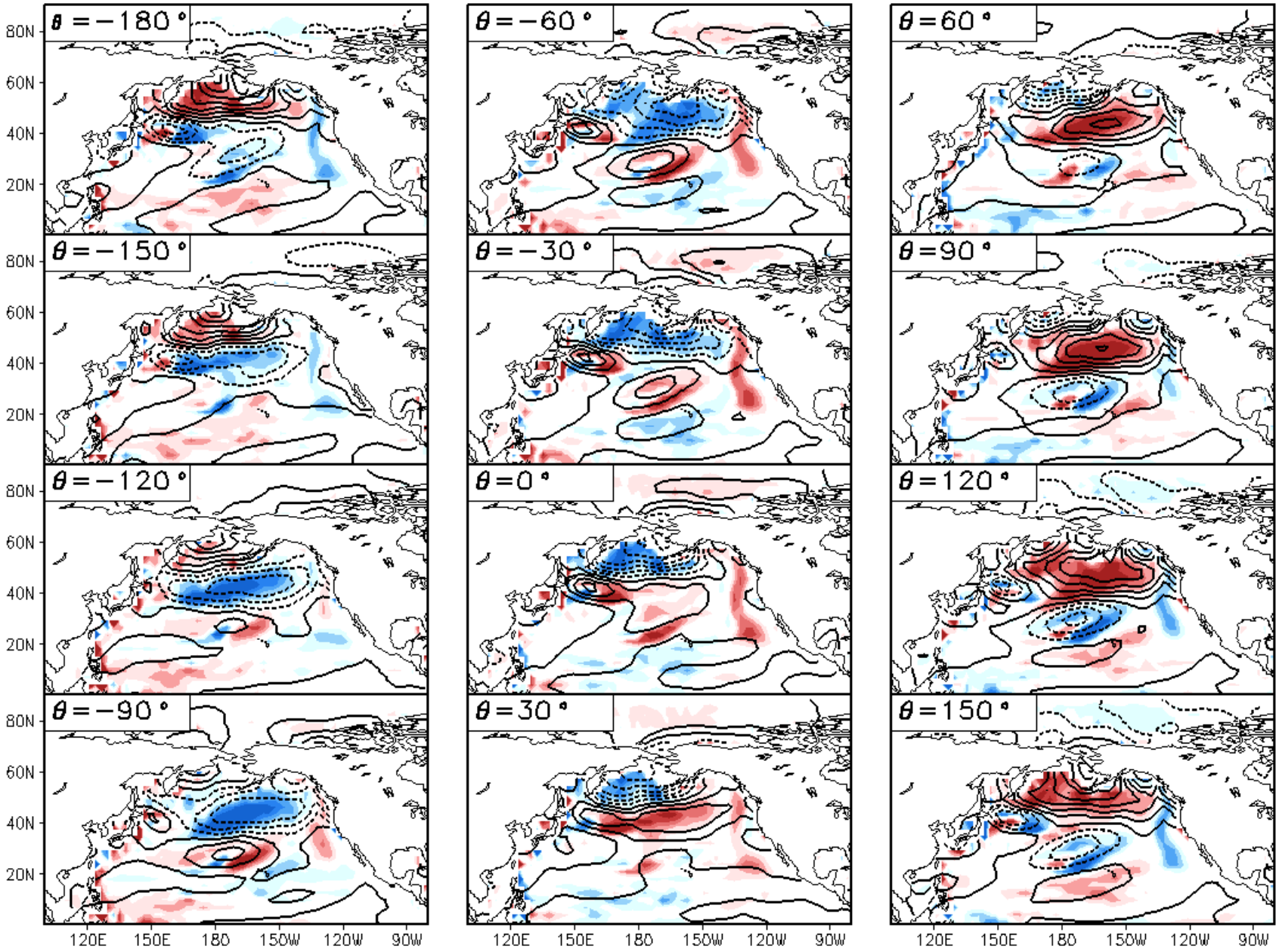


Ocean top 300 m heat budget

$$\partial T/\partial t = - V\cdot\nabla T + w\_adv_{@300m} + Sur\_flx$$



ω_{300m}/curl(τ) composite based on CEOF temporal phase θ (~70 cases)



Summary

- Some decadal predictability is suggested in the first ten years in the large ensemble experiment

- The decadal ocean temperature anomalies are mainly caused by horizontal temperature advection and surface heat flux. The deep ocean doesn’t play an active role.

- The air-sea coupling needs to be further studied.