Subseasonal prediction of wintertime East Asian temperature based on atmospheric teleconnections

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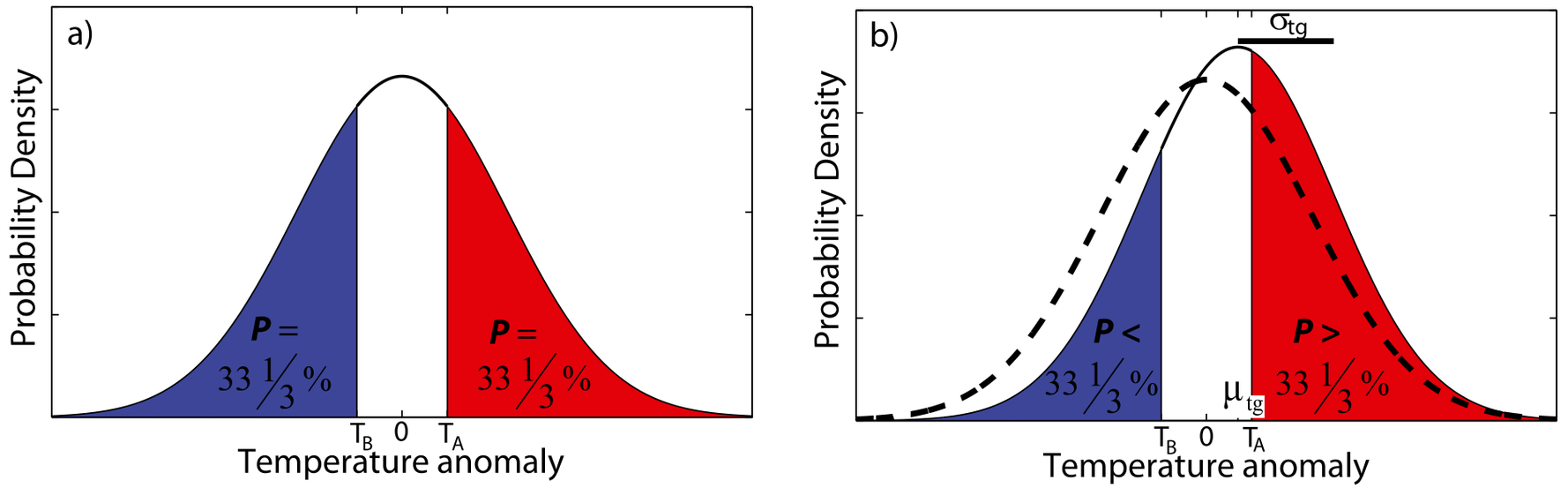
will appear in JCLI.

Motivation



Climatological winter T2m anomaly distribution, with terciles

Changes in distribution during a phase of climate mode

- Weekly probabilistic forecast of the **wintertime North American T2m** out to 6 weeks based on the **MJO**, **ENSO**, and **linear trend**.
- The **phase** information is the key to capture changes in the **Gaussian distribution** of the extratropical T2m response.

Johnson et al., *Weather and Forecasting*, 2014
NOAA CPC Week 3-4 Outlooks

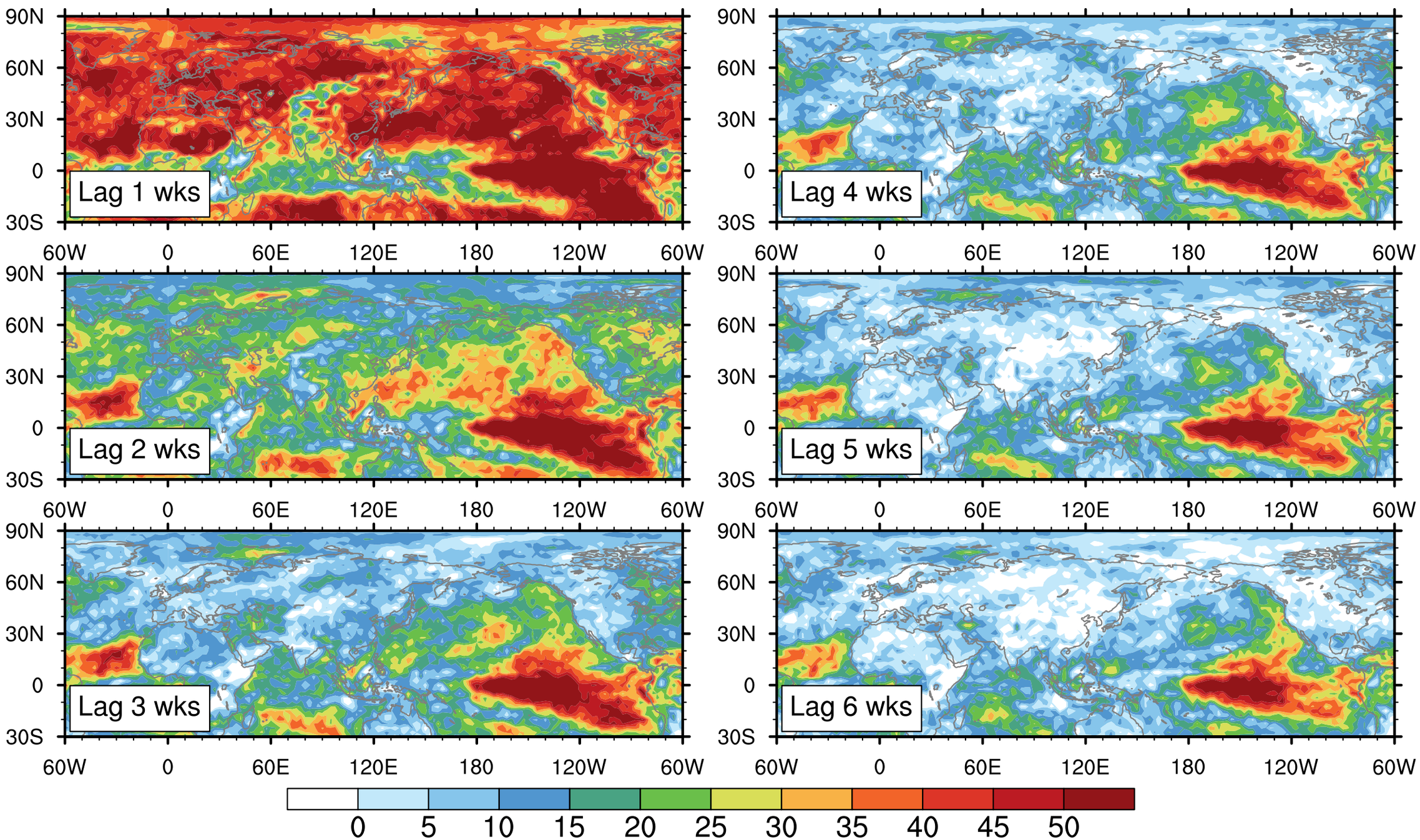
Why the atmospheric teleconnection patterns?

- *Low-frequency variability of the atmosphere* can be predominantly described by recurrent and persistent teleconnection patterns.
  - With strong tropical convection, teleconnections *can* **persist longer than 2 weeks** (Dai et al. 2017).
  - The surface temperature anomalies may last longer than the circulation anomalies do.

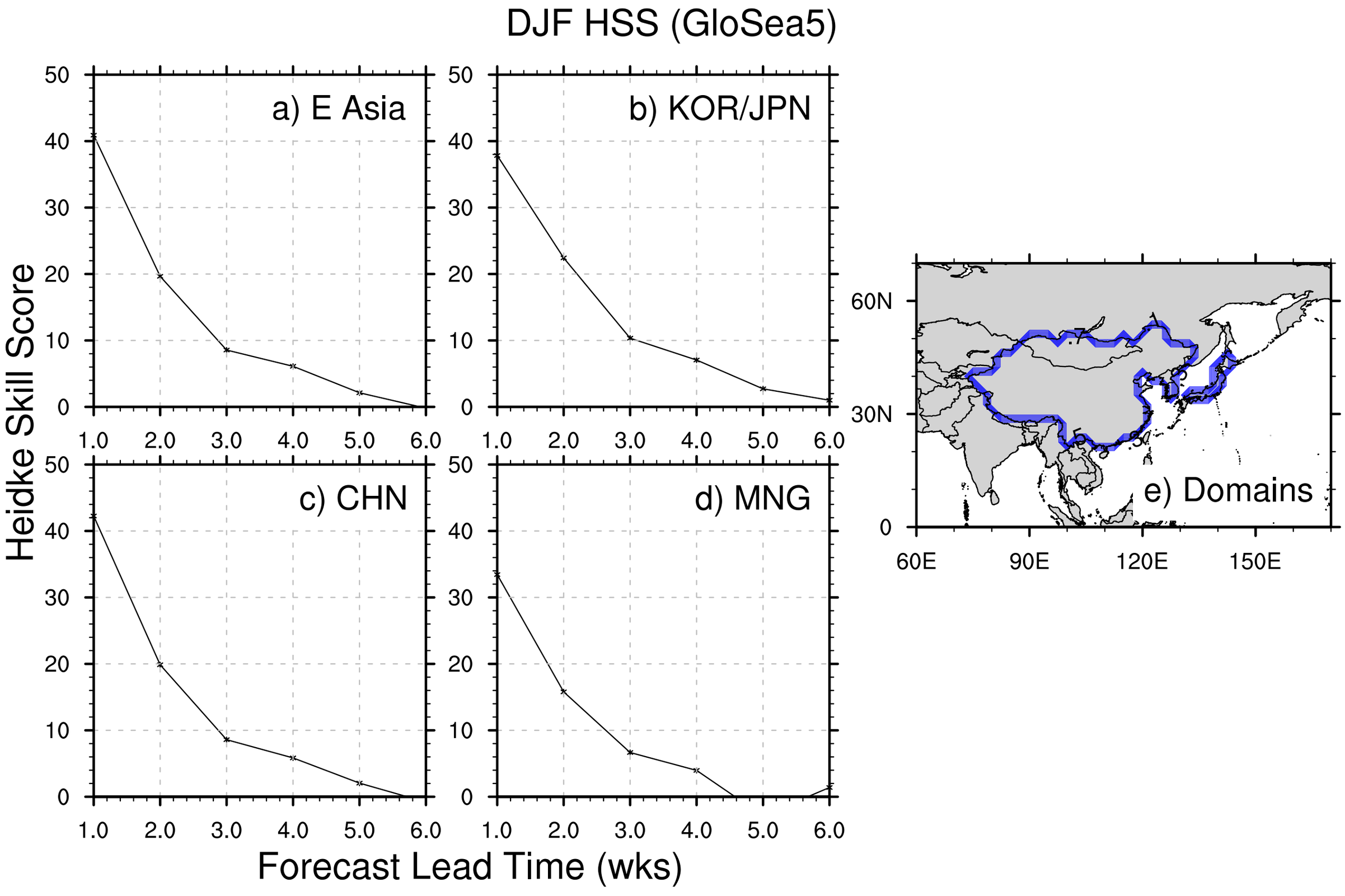
- East Asia may *not be geographically suited* to benefit from the impact of the ENSO or MJO.
  - The poleward propagating **Rossby waves, excited by ENSO or MJO, propagate downstream to North America**.

Wintertime T2m hindcast of GloSea5

simulated by KMA



Domain averaged HSS values

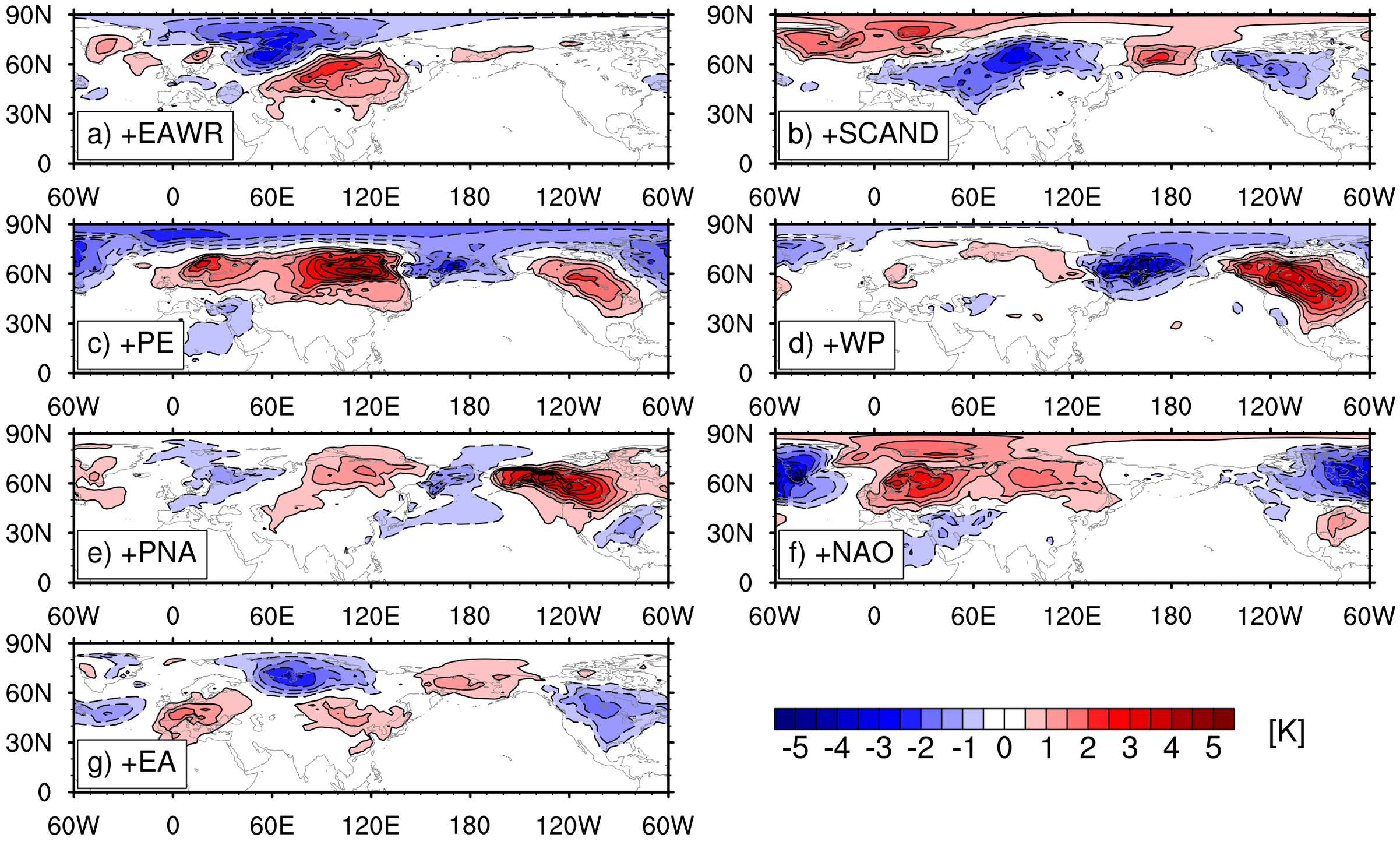


NH teleconnection patterns

- North Atlantic Oscillation (NAO)
- East Atlantic (EA)
- East Atlantic/Western Russia (EAWR)
- Scandinavia (SCAND)
- Polar/Eurasia (PE)
- West Pacific (WP)
- East Pacific-North Pacific (EP-NP)
- Pacific/North American (PNA)
- Tropical/Northern Hemisphere (TNH)*
- Pacific Transition (PT)

Rotated Principal Component Analysis
on Z500 over 20N-90N
(Barnston and Livezey MWR 1987)

Composites of DJF T2m anomalies



by 0.5 stddev

Phase model construction

- The 7-day running averaged T2m anomaly
  - 1 week (day 4 - 10)
  - 2 week (day 11 - 17)

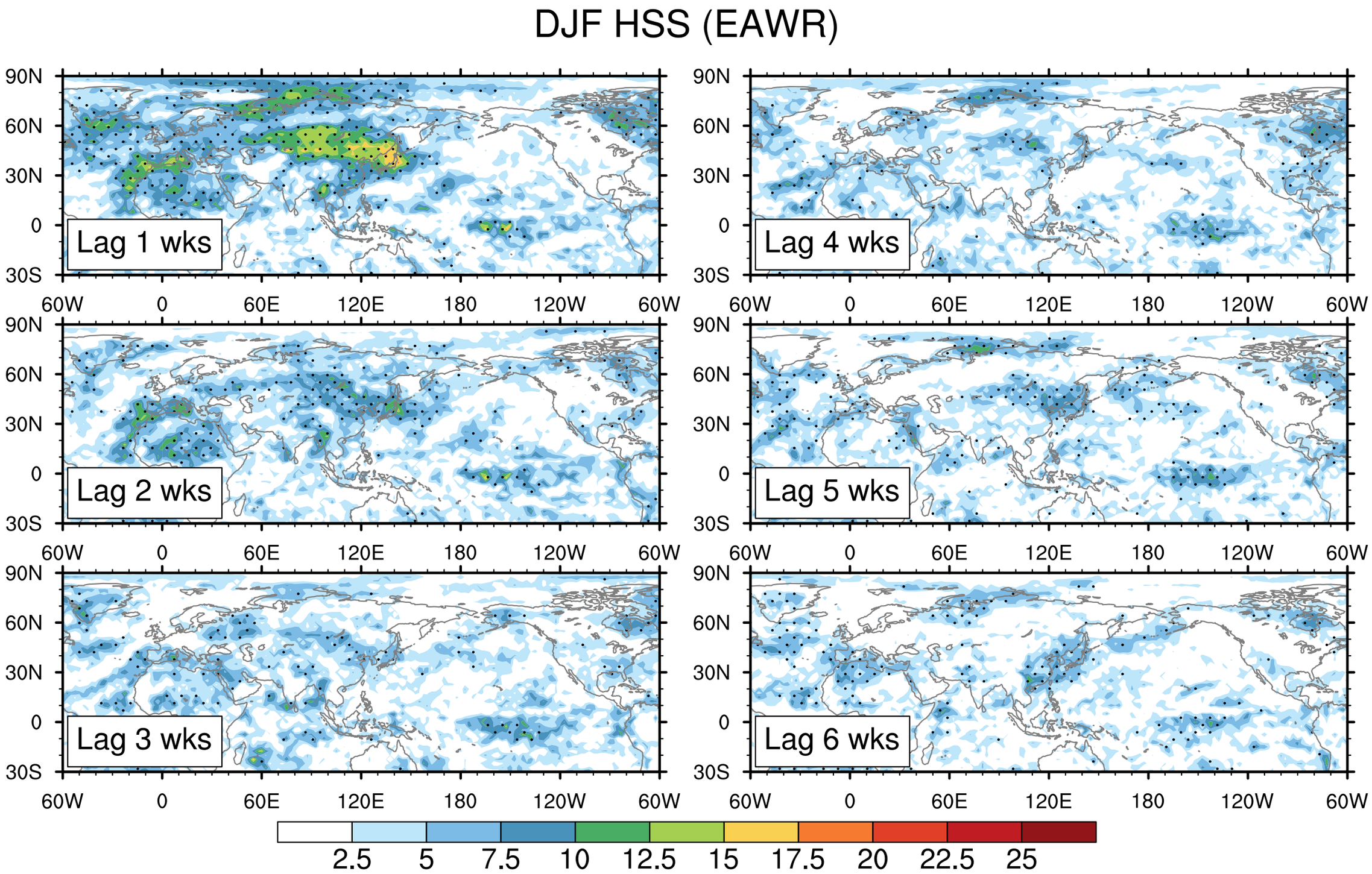
- Terciles at each grid point for each calendar day
  - T2m distribution centered at the chosen day with 21-d window

- Gaussian distribution
  - for a climate mode, its phases, and chosen lags,
  - compute mean and stddev.

- Validation
  - Cross-year-out validation

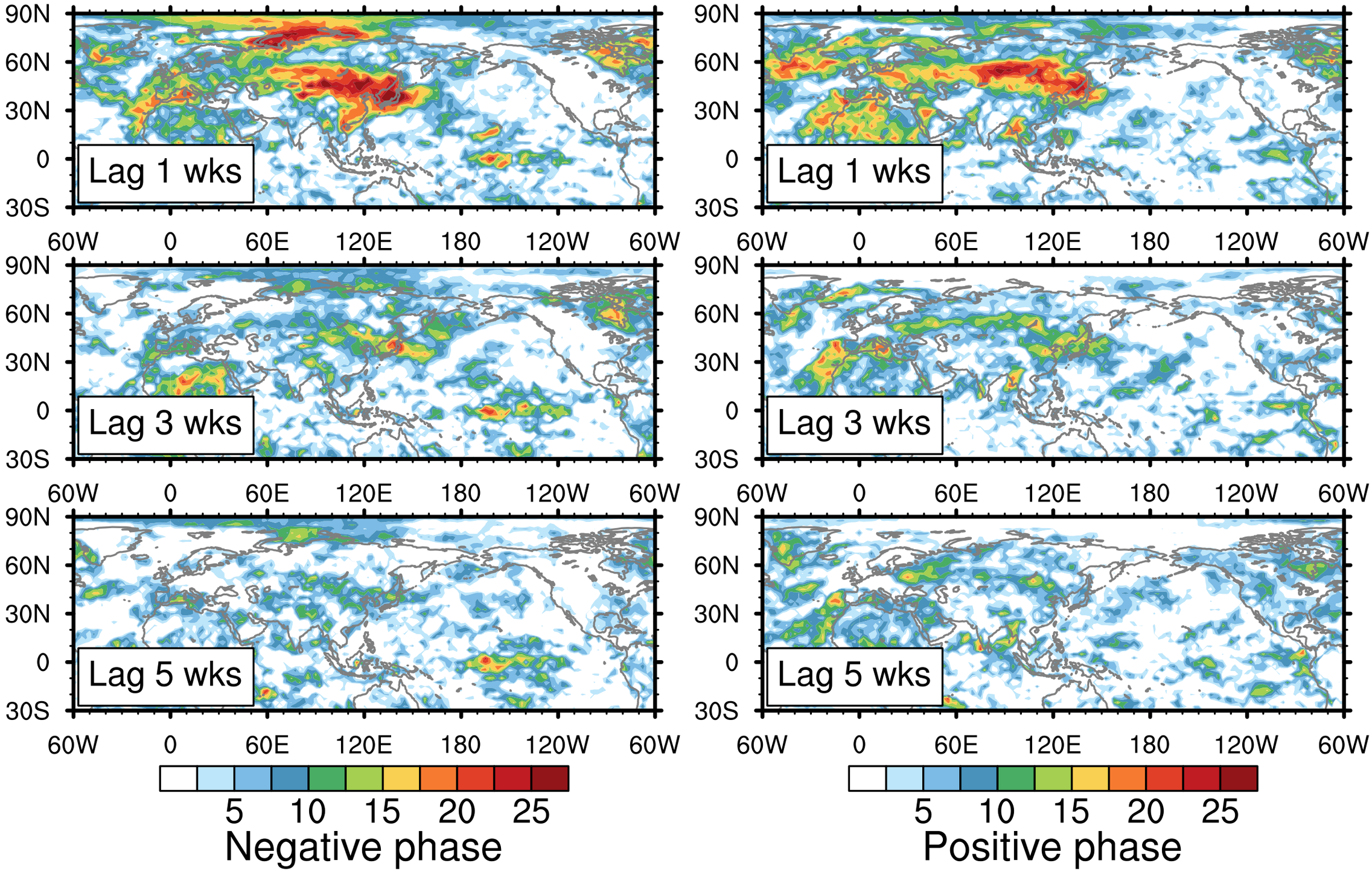
Statistical model prediction based on EAWR

Dots: the statistical significance at the 95th percentile using Monte Carlo resampling by reshuffling individual seasons

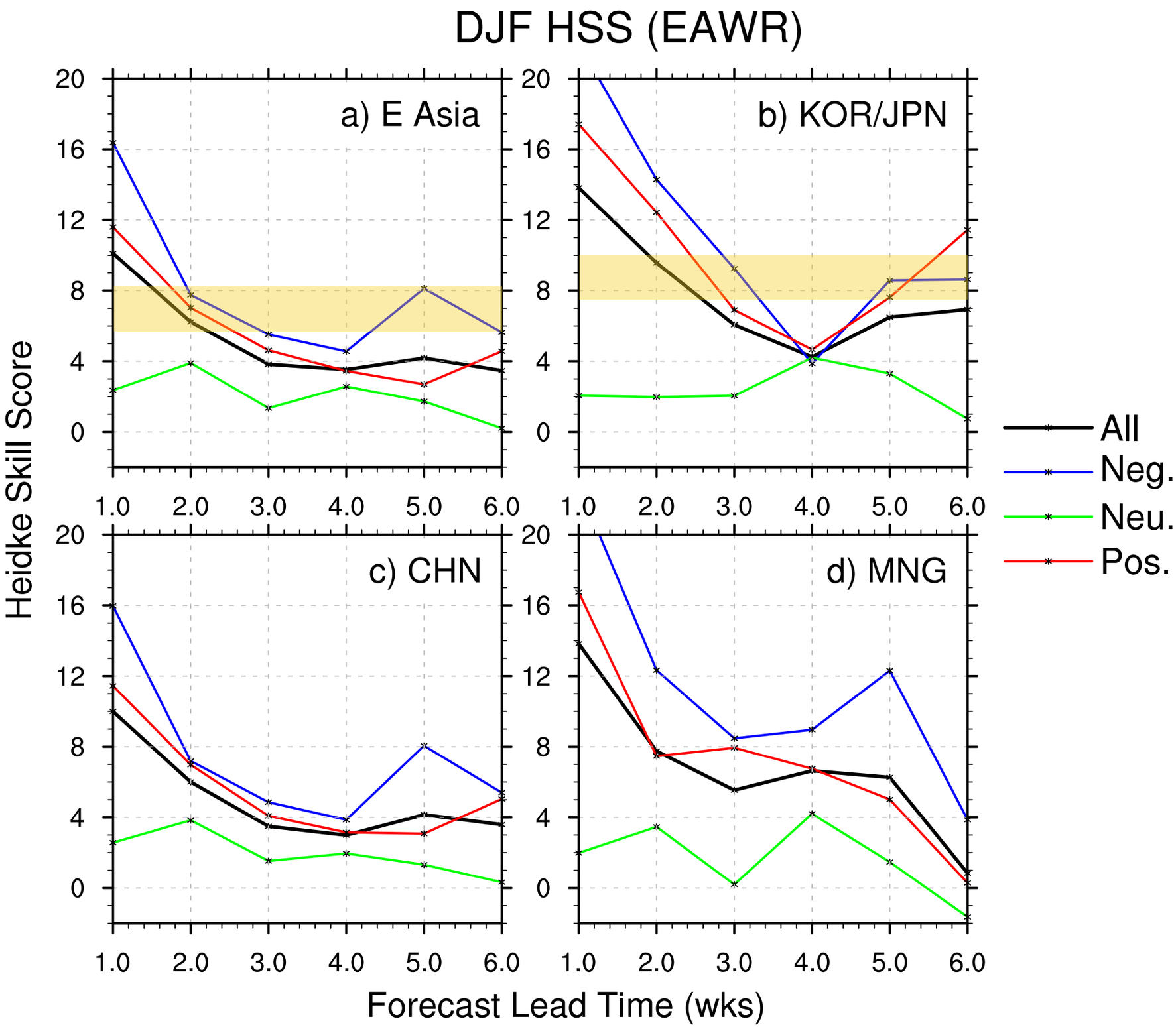


Active phases only

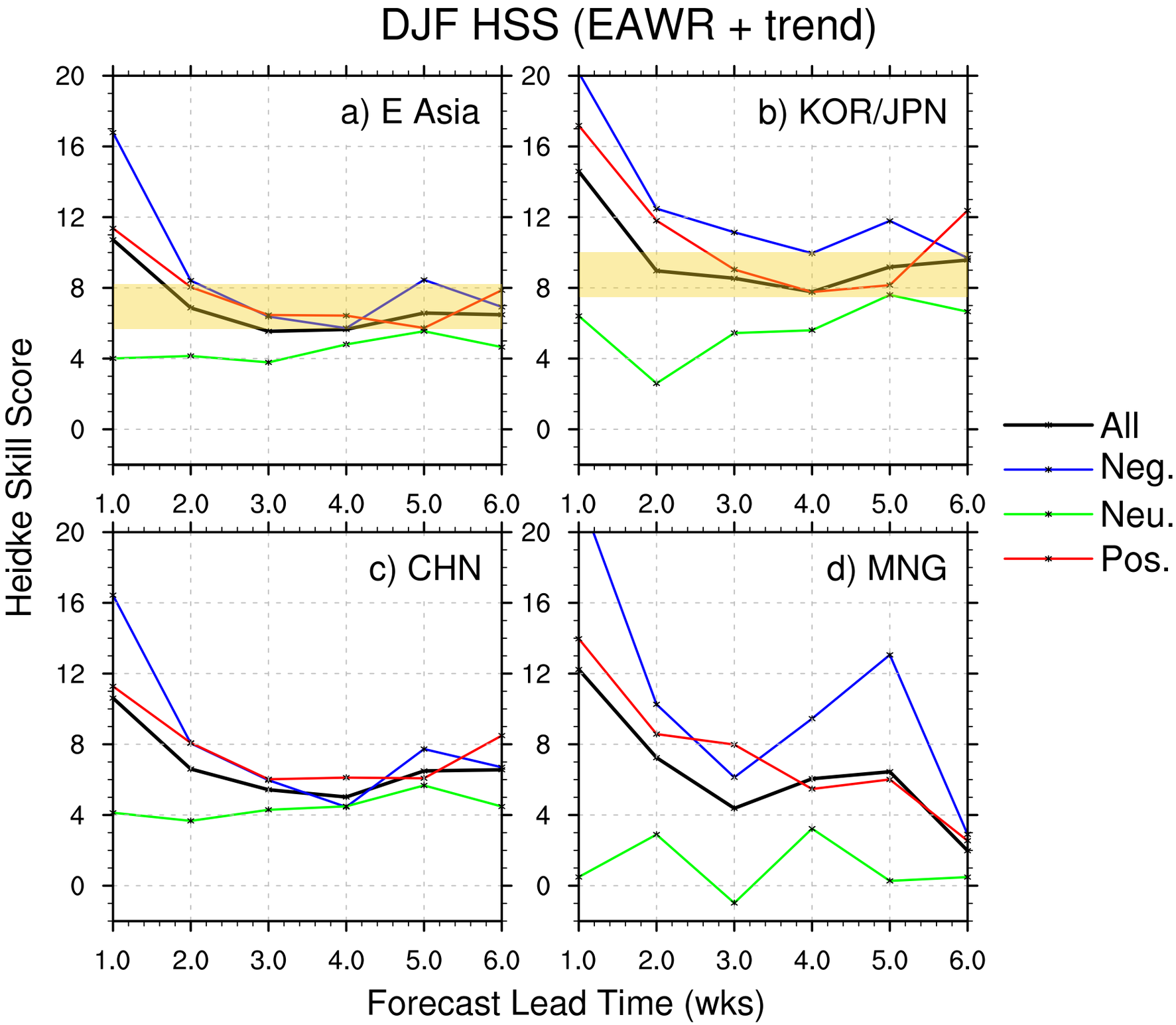
- Enhanced skills
- Nonlinear relations



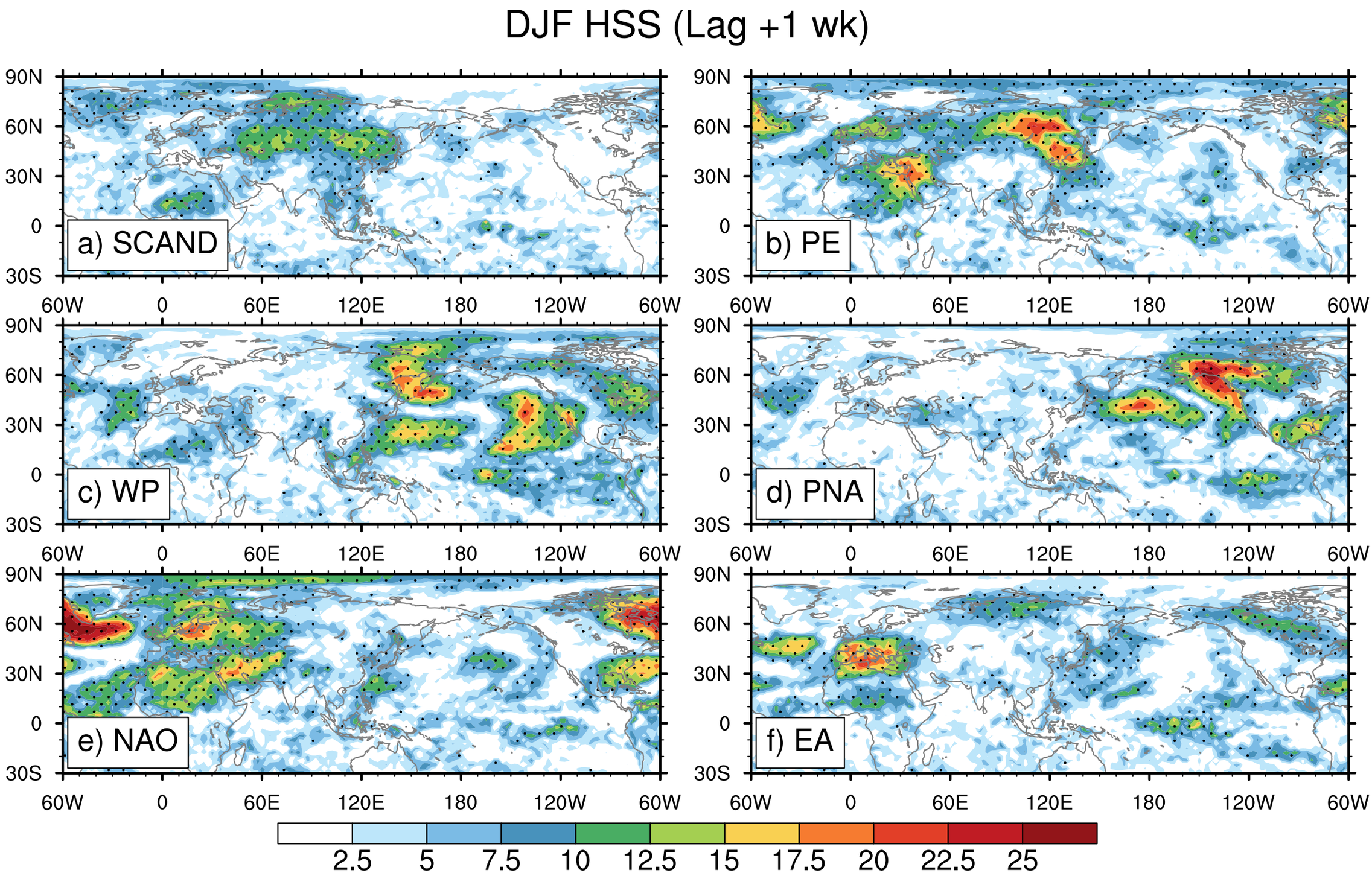
Domain averaged HSS for EAWR



Including the linear trend



Predictions for lead time of 1 week



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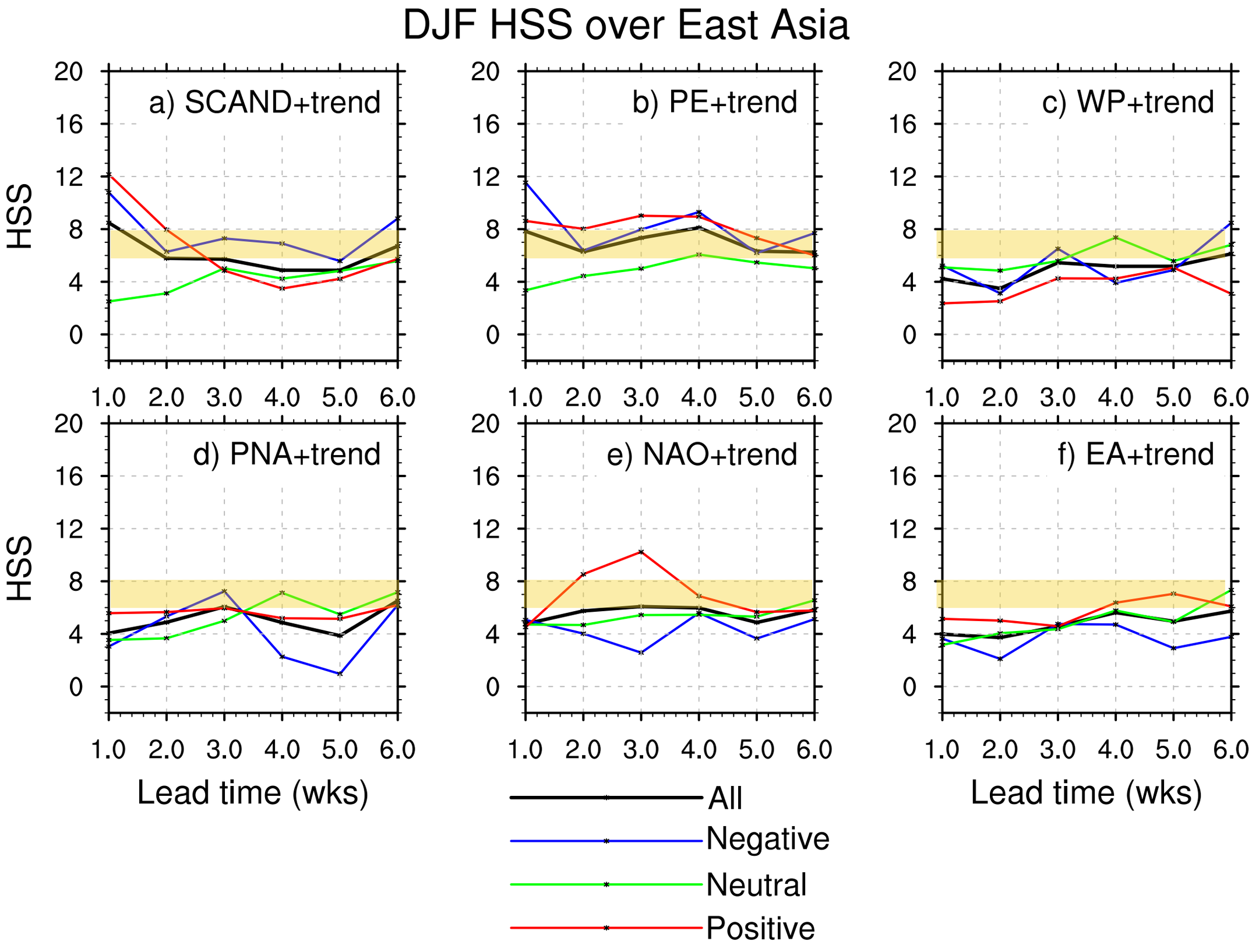
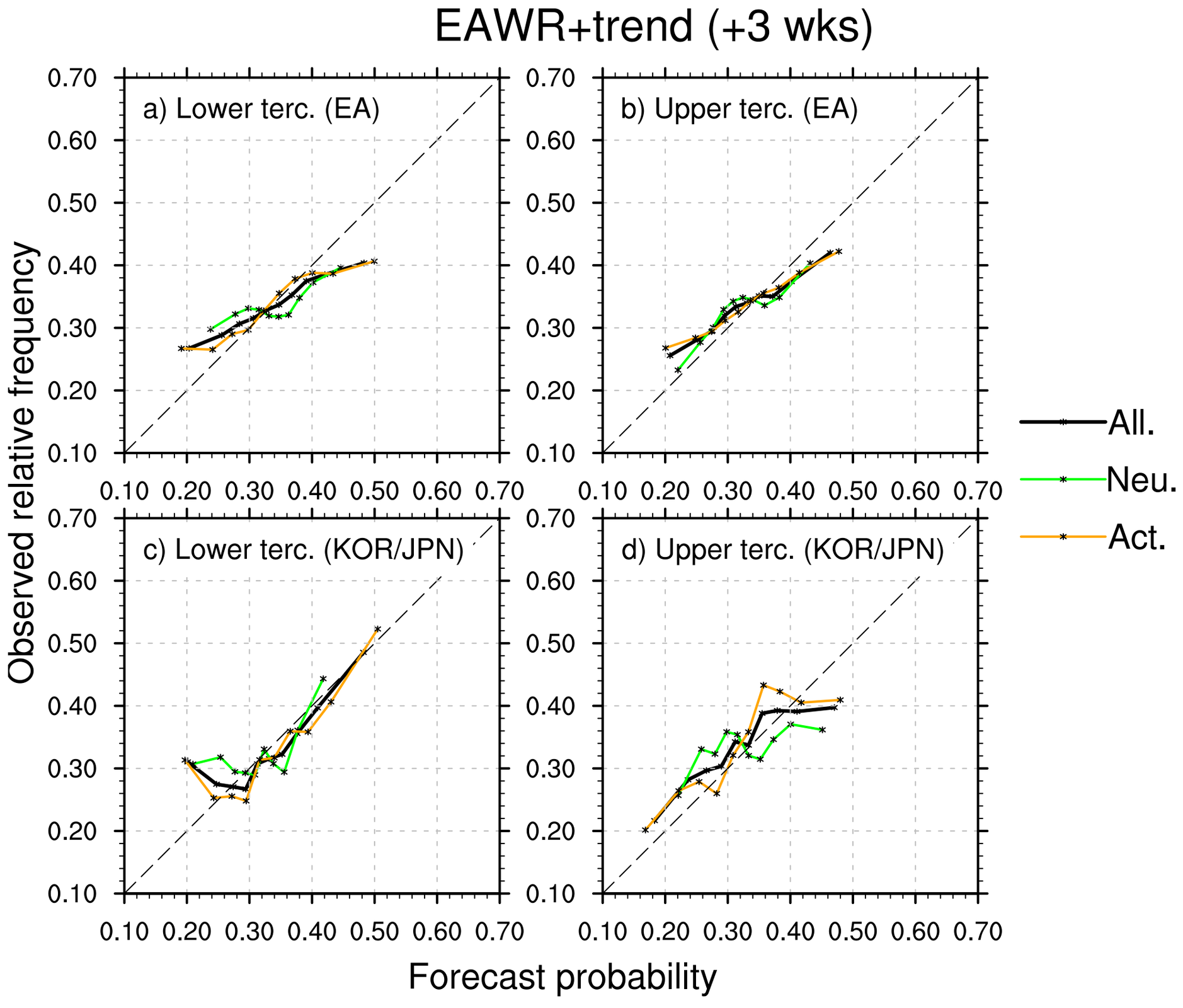


Calibration func.

Each star contains 10% of the forecasts.

Overconfident,
but better calibrated
for active phases.



Summary

- Seven NH **atmospheric teleconnection patterns** are employed for **wintertime subseasonal prediction of SAT**.

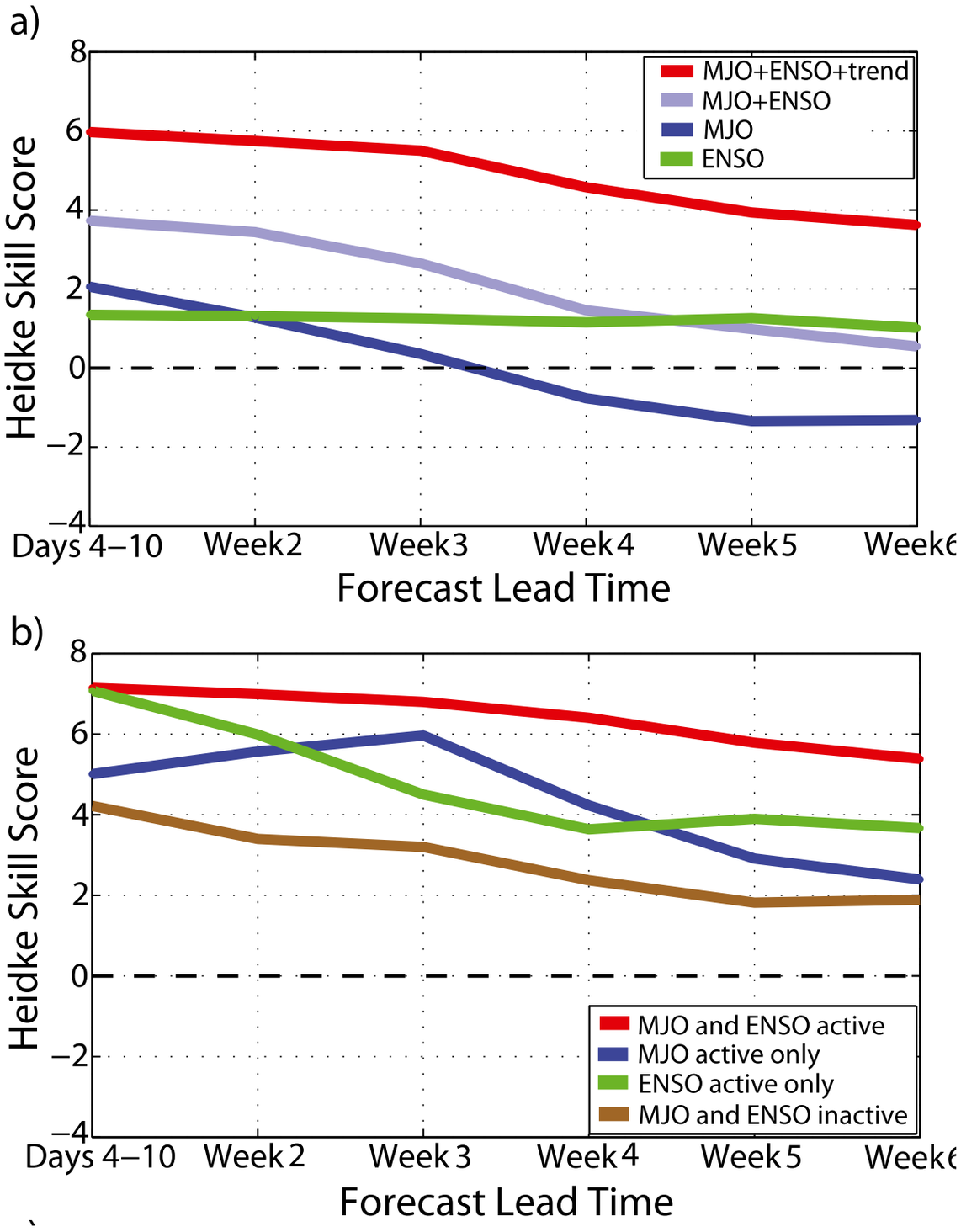
  - For East Asia, the EAWR, SCAND, and PE patterns, which are positioned **upstream of the region**, make a substantial contribution.
    - ✓ Our approach using atmospheric teleconnections has implications for other regions of the globe.

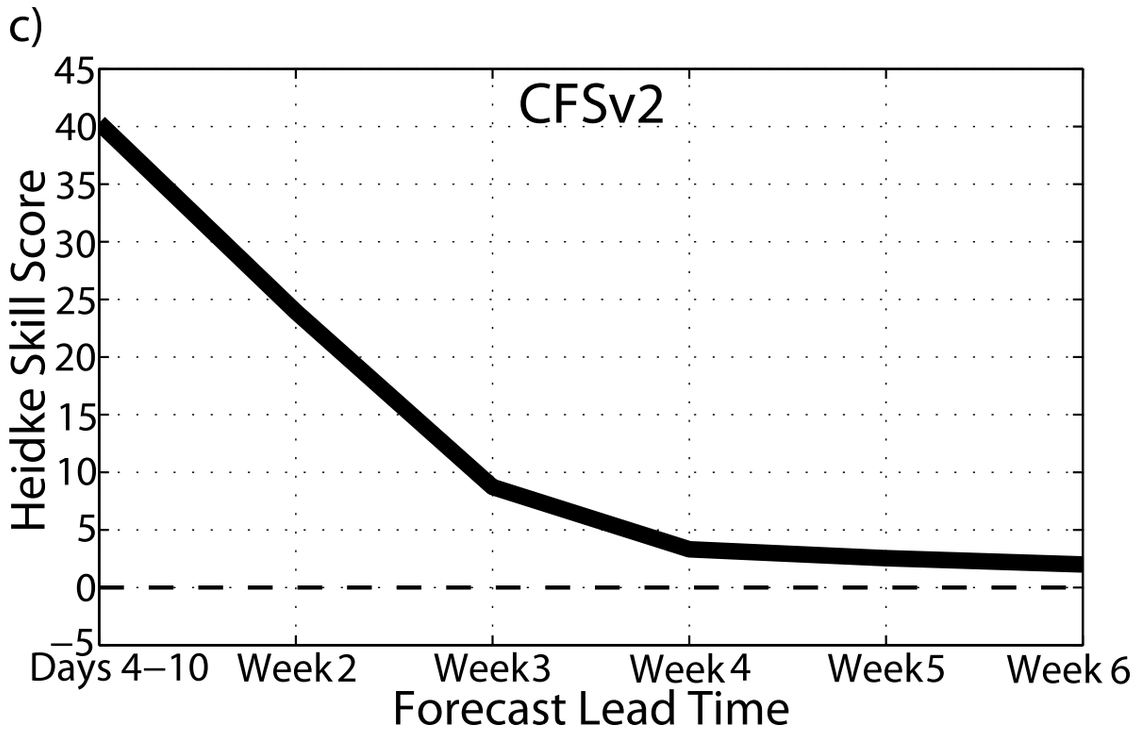
- The statistical model generates forecasts that show comparable skill with that of dynamical model **at a lead time of 3-4 wks and longer.**

Thank you

감사합니다

The results of Johnson et al.





Heidke Skill Score (HSS)

$$\mathrm{HSS} = \frac{(H - E)}{(T - E)} \times 100$$

- H: the number of categories forecast correctly
- E: the expected number of categories forecast correctly just by chance
- T: the total number of forecasts

- HSS = -50 : completely wrong set of forecasts
- HSS = 100 : perfect set of forecasts
- HSS = 0 : the expected HSS for a randomly generated forecast