

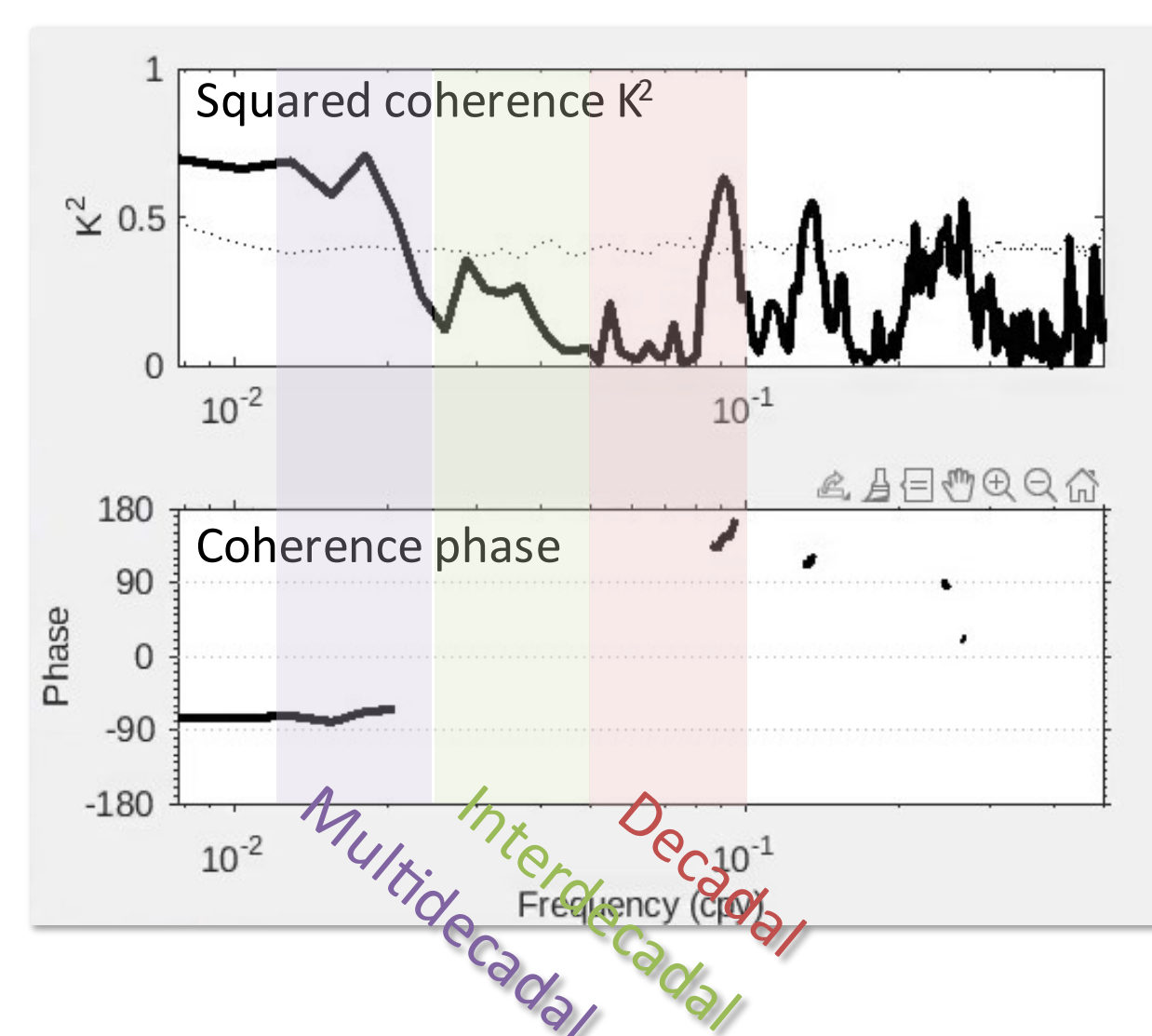
## Role of Ocean Heat in Arctic Warming

- The ocean plays a key role in the recent warming of the Arctic.
- The drivers of Atlantic ocean heat transport (AOHT) variability towards the Arctic are not clear, but *variability in the low-latitude Atlantic Meridional Overturning Circulation (AMOC)* is often implicated.
- Here we investigate whether internal variability of the AMOC at low-latitudes drives variability of Arctic climate.
- To that end, we analyze key metrics from an *ensemble of 38 CMIP6 model simulations* using coherence analysis.

## Approach

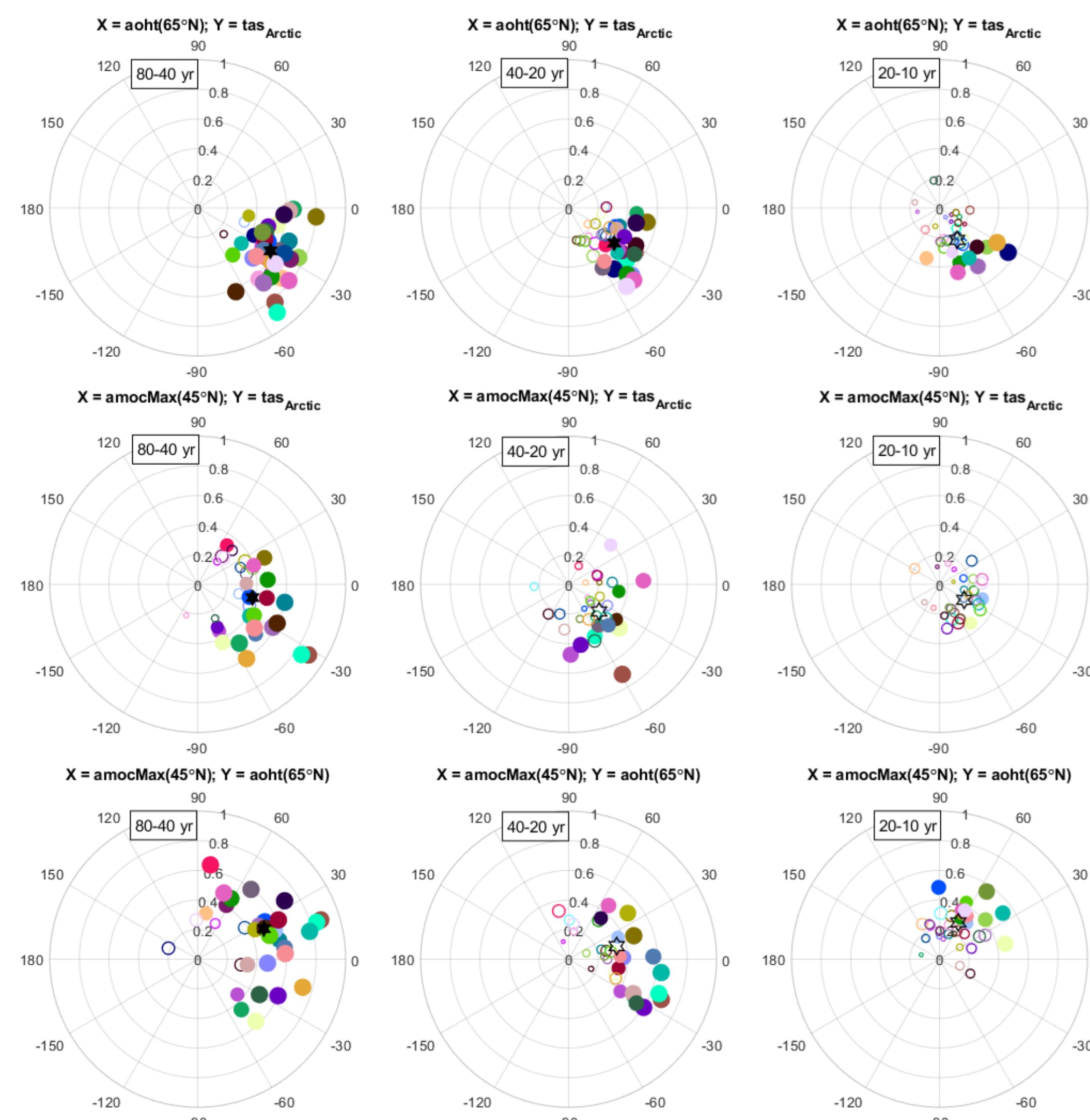
- We focus on pre-industrial control simulations longer than 250 years.
- We select models that saved *hfbasin* ( $\rightarrow$  *aoht*) and *msftmz/msfty* ( $\rightarrow$  *amocMax*).
- We also investigate Arctic surface air temperature ( $tas_{Arctic}$ ) and surface heat flux ( $hfds_{Arctic}$ ) north of 65°N.
- Atmospheric heat transport AHT is taken from Kurtakoti et al. (2024).
- We perform *coherence analysis* to determine relationships between two variables as function of timescale, with the phase lag as bonus.
- We test significance by estimating AR-1 parameters for each time series, and calculating coherence of 100 pairs of synthetic time series with these AR-1 parameters.

Example of coherence analysis between two time series. Dotted line in upper panel indicates 95% confidence level. Phase is set to NaN where coherence is below confidence level. Frequency bands for averaging are indicated. We use a 9-point Daniell filter to smooth the spectra.



## AOHT and AMOC Impacts on the Arctic

Is Arctic climate variability coherent with Atlantic OHT variability at 65°N and AMOC at lower latitudes?

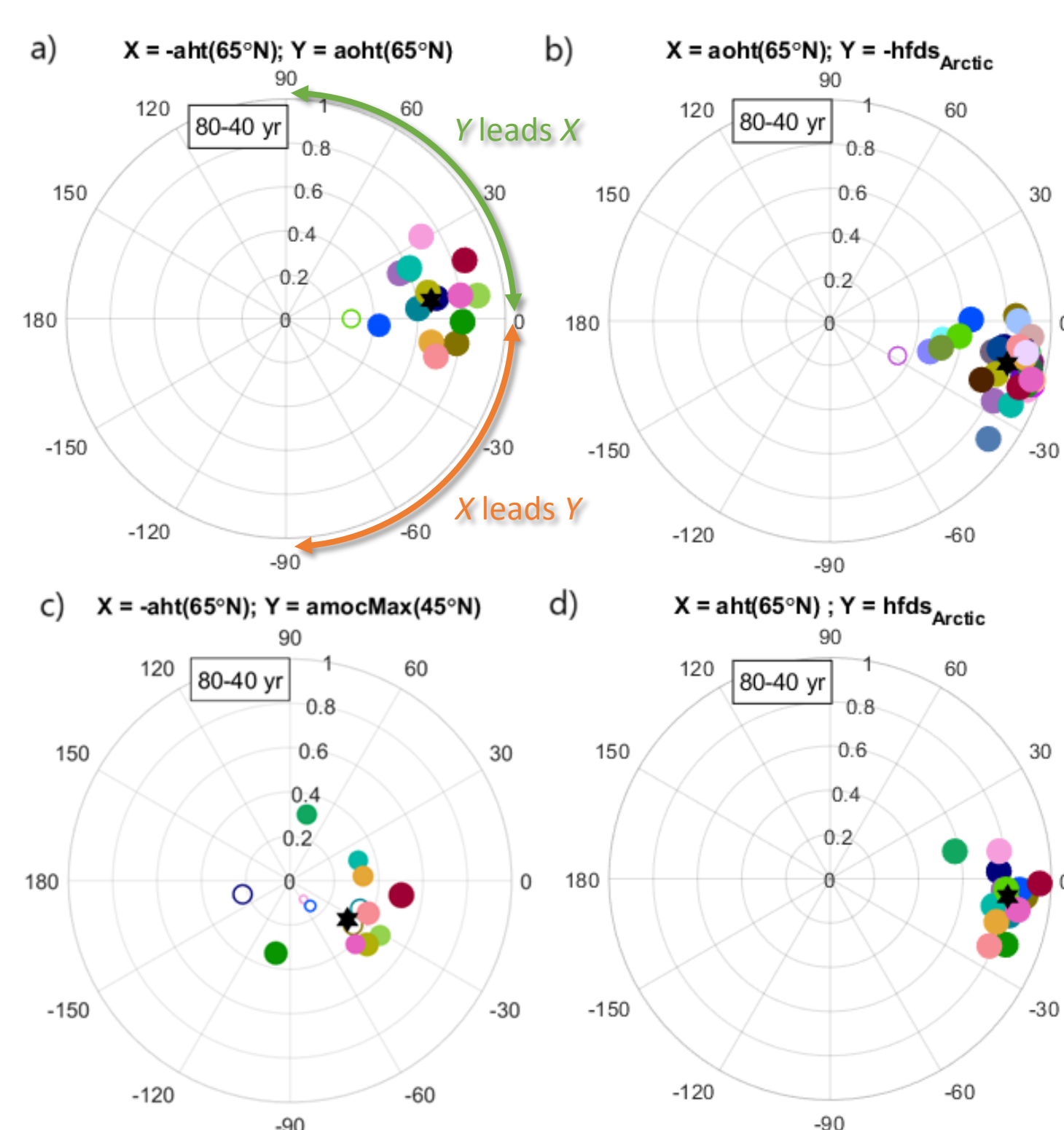


- Arctic climate is strongly coherent with OHT across 65°N, with AOHT leading by 30°.
- Most models also show a link with AMOC at 45°N on multidecadal timescales, with on-average AMOC leading slightly.
- But *AMOC at 45°N lags OHT at 65°N*, so it cannot drive variability in OHT towards the Arctic.

## Bjerknes Compensation

Does AMOC variability influence Arctic climate through an atmospheric bridge?

- On multi-decadal timescales, oceanic and atmospheric heat transport across 65°N are strongly anti-correlated, a process referred to as *Bjerknes Compensation* (Kurtakoti et al. 2024).
- OHT variability is communicated to the atmosphere through surface heat flux.
- AMOC variability at low latitudes is *anti-correlated with AHT* and is unlikely to influence the Arctic through an atmospheric bridge.



## References

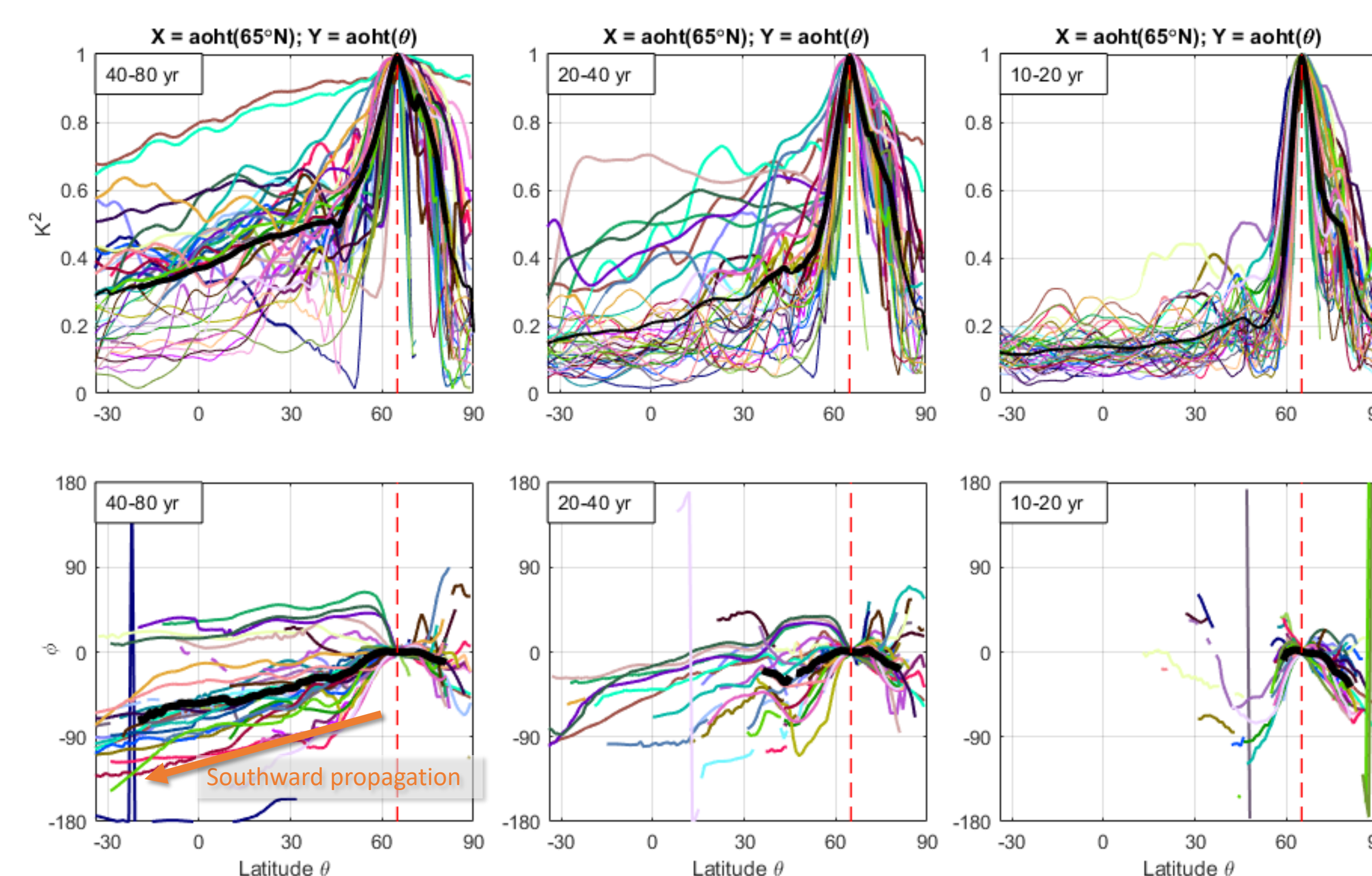
- Kurtakoti et al. (2024). Sea ice and cloud processes mediating compensation between atmospheric and oceanic meridional heat transports across the CMIP6 preindustrial control experiment. *Journal of Climate*, 37(2), 505-525.

## Acknowledgements

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## Meridional Coherence of Atlantic OHT

Is Atlantic OHT variability at 65°N coherent with AOHT at other latitudes (regardless of mechanism!)?



- Models agree that AOHT at 65°N is coherent with AOHT at latitudes between 60° and 80°N (Nordic Seas).
- Models also agree that on decadal timescales, *there is no coherence with AOHT at lower latitudes*.
- On multidecadal timescales, most models show coherence with AOHT at lower latitudes, but the model spread is large.
- Wherever this coherence is significant, the phase lag is increasingly negative going southward, suggesting a *southward* propagating signal.
- Our analysis does not support the narrative that low-latitude AMOC variability affects the Arctic through northward heat transport.*