The associations of winter Atlantic SST, Arctic sea ice, and East Asian surface temperature

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We are investigating the physical processes underlying recent winter cold anomalies over East Asia (EA). The Arctic region has experienced a rapid loss of sea ice in winter since the 1990s (Simmonds 2015), whereas EA has shown a large cooling trend during the winter months (Yao et al. 2017; Luo et al. 2017). Considerable research has been devoted to determining if there is a direct connection between these two occurrences, and what mediating factors might be present (Screen and Simmonds 2013; Luo et al. 2019a, b), such as high-latitude blocking (Luo et al. 2017, 2018). In addition, there is some evidence to indicate that anomalies in the North Atlantic Ocean can initiate teleconnection wave trains that can influence both Arctic sea ice and Eurasian climate (Simmonds and Govekar 2014; Luo et al. 2016, 2017).

Our analysis is aimed at determining which specific aspects of Atlantic SST variability might be linked to Arctic ice loss. We have undertaken this by decomposing winter SST variability into its first four EOF modes (Fig. 1) and exploring the 'downstream' impacts of each of these separately. Each mode induces a different large-scale circulation response. It is shown that the extent to which temperature over EA is impacted, in turn strongly depends on whether the sea ice anomalies are able to set up a persistent anticyclonic structure (or 'block') over the Ural Mountains region of western Russia (at about 60°E). Full details of the investigation are presented in Li et al. (2020).

References

Li, M. et al., 2020: Anchoring of atmospheric teleconnection patterns by Arctic sea ice loss and its link to winter cold anomalies in East Asia. *Int. J. Climatol.*, doi: 10.1002/joc.6637.

Luo, B. et al., 2017: Atmospheric circulation patterns which promote winter Arctic sea ice decline. *Env. Res. Lett.*, **12**, 054017, doi: 10.1088/1748-9326/aa69d0.

Luo, B. et al., 2019: The winter midlatitude-Arctic interaction: Effects of North Atlantic SST and high-latitude blocking on Arctic sea ice and Eurasian cooling. *Climate Dyn.*, **52**, 2981-3004, doi: 10.1007/s00382-018-4301-5.

Luo, D. et al., 2018: Changes in atmospheric blocking circulations linked with winter Arctic warming: A new perspective. *J. Climate*, **31**, 7661-7678.
Luo, D. et al., 2017: Increased quasi-stationarity and persistence of winter Ural Blocking and Eurasian extreme cold events in response to Arctic warming. Part II: A theoretical explanation. *J. Climate*, **30**, 3569–3587, doi: 10.1175/JCLI-D-16-0262.1.
Luo, D. et al., 2016: Impact of Ural Blocking on winter Warm Arctic–Cold Eurasian anomalies. Part II: The link to the North Atlantic Oscillation. *J. Climate*, **29**, 3949-3971.
Luo, D. et al., 2017: Winter Eurasian cooling linked with the Atlantic Multidecadal Oscillation. *Env. Res. Lett.*, **12**, 125002, doi: 10.1088/1748-9326/aa8de8.
Luo, D. et al., 2019: Weakened potential vorticity barrier linked to recent winter Arctic sea ice loss and midlatitude cold extremes. *J. Climate*, **32**, 4235-4261.
Screen, J. A., and I. Simmonds, 2013: Caution needed when linking weather extremes to amplified planetary waves. *Proc. Nat. Acad. Sci. USA*, **110**, E2327.
Simmonds, I., 2015: Comparing and contrasting the behaviour of Arctic and Antarctic sea ice over the 35-year period 1979-2013. *Ann. Glaciol.*, **56(69)**, 18-28.
Simmonds, I., and P. D. Govekar, 2014: What are the physical links between Arctic sea ice loss and Eurasian winter climate? *Env. Res. Lett.*, **9**, 101003.
Yao, Y. et al., 2017: Increased quasi-stationarity and persistence of winter Ural Blocking and Eurasian extreme cold events in response to Arctic warming. Part I: Insights from observational analyses. *J. Climate*, **30**, 3549–3568, doi: 10.1175/JCLI-D-16-0261.1.

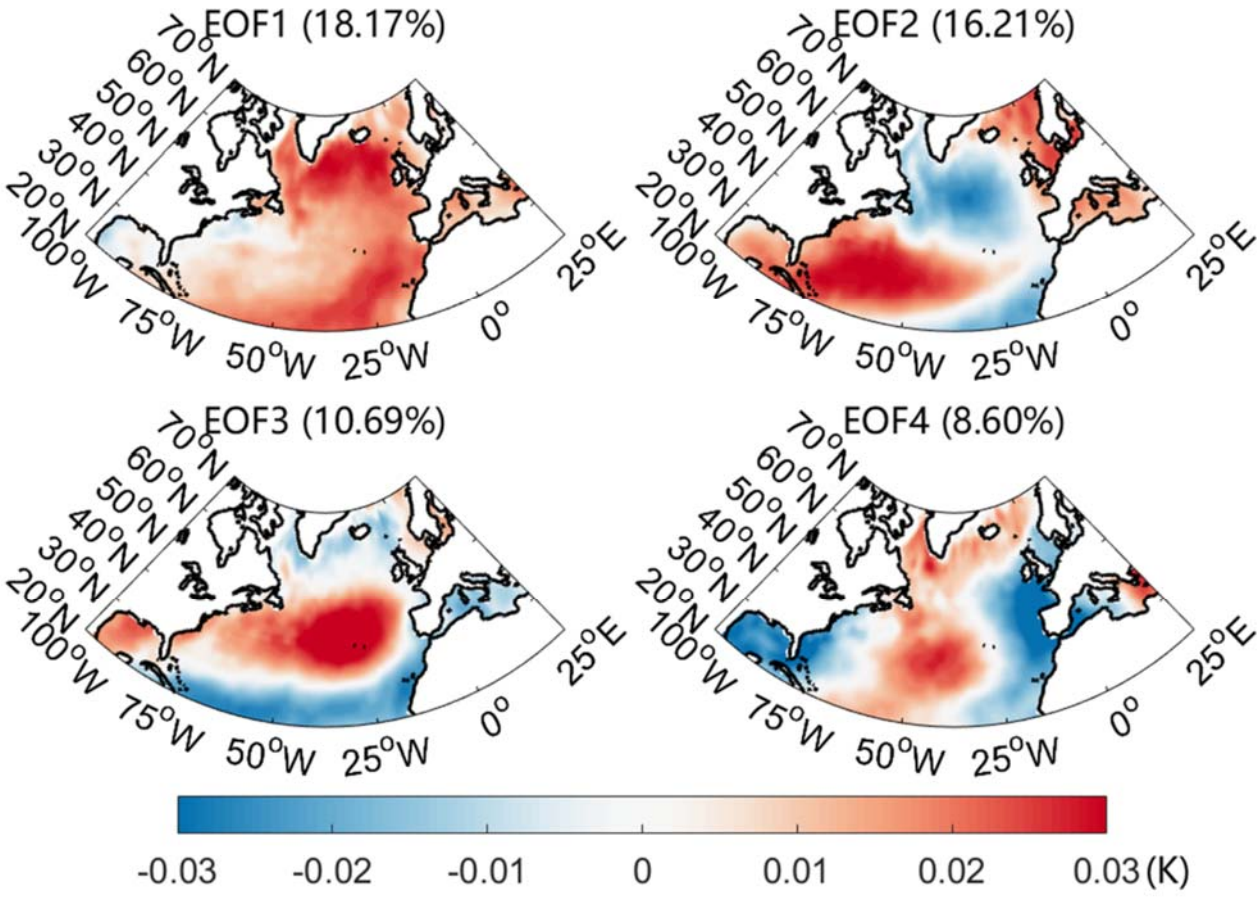

Fig. 1: First four EOFs of detrended and normalized winter (DJF) SST anomalies (for the period 1958–2016).