Linking Barents Kara sea ice in autumn to the winter atmospheric circulation

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There has been debate on whether autumn sea ice loss can affect the winter northern hemisphere atmospheric circulation, and in turn explain some of the recent extreme winter weather (Gao et al., 2015). To help address this issue we examine the relationship of Barents-Kara sea ice concentration in October and November with atmospheric circulation in the subsequent winter, using reanalysis and observational data. To better isolate mechanisms the analyses are performed on data with the 5-year running means removed. This reduces the potential effects in our analysis of slowly-varying external driving factors, such as global warming. We show that positive (negative) Barents-Kara sea ice concentration anomaly in autumn (October and November) is associated with a positive (negative) North Atlantic Oscillation-like (NAO) pattern with lags of up to three months (King et al., 2015). Further analysis shows that the stratosphere-troposphere interaction may provide the memory in the system: a positive (negative) sea ice concentration anomaly in November is associated with a strengthened (weakened) stratospheric polar vortex and these anomalies propagate downward leading to the positive (negative) NAO-like pattern in the late December to early January. This stratospheric mechanism may play a role for Barents-Kara sea ice anomalies in December, but not for October. Consistently, Eliassen-Palm, eddy heat and momentum fluxes suggest that forcings of the zonal winds are relatively strong in November. These results are consistent with the late winter impact of declining autumn sea ice. Further analyses based on observational analysis and from the Norwegian Climate Prediction model indicate a great degree of predictability exists in the Nordic Seas and Barents Kara Seas. Together these results provide promise for predicting climate in the region. An activity we are pursuing under the EPOCASA (www.epocasa.no) and GREENICE (www.greenice.no) projects.

References

Gao, Y., J. Sun, F. Li, S. He, S. Sandven, Q. Yan, Z. Zhang, K. Lohmann, N. Keenlyside, T. Furevik, and L. Suo, 2015: Arctic sea ice and Eurasian climate: A review. *Advances in Atmospheric Sciences*, **32,** 92-114.

King, M. P., M. Hell, and N. Keenlyside, 2015: Investigation of the atmospheric mechanisms related to the autumn sea ice and winter circulation link in the Northern Hemisphere. *Clim Dyn.***,** accepted subject to minor revisions.