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Title: Are Negative Arctic Oscillation Events the Opportunity for Sub-seasonal Forecasting?

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Abstract:

Negative phases of the Arctic Oscillation (AO) sometimes cause extreme cold conditions over hemispheric-scale regions in boreal winter. Reliable forecast of the events in a few weeks advance is demanded for effective use of forecast information. This study investigated the predictability of negative-phase AO events using archived datasets of real-time operational forecasts and hindcasts with the Japan Meteorological Agency (JMA) One-month Ensemble Prediction System (EPS). The AO index is computed by projecting daily sea level pressure (SLP) to the first mode of the empirical orthogonal function analysis of monthly SLP, and three AO phases, namely low, normal and high phases, are defined with thresholds of -0.5, 0.5 standard deviations. We used anomaly correlation (AC) as a skill measure and stratified ACs of 28-day averaged SLP and 500-hPa geopotential height (GPH500) for the three phases during December to March of 1979-2009. In the hindcast, a ratio of ACs above 0.7 for SLP (GPH500) in the low phases is roughly 30 (20) percent higher than that for the normal phases, suggesting that the low phase events are more predictable than the normal phase events. Further diagnostics using the horizontal eddy vorticity flux and the Eliassen-Palm flux indicate that the high predictability stems from some dynamical mechanisms of a synoptic eddy-mean flow interaction, meridional and vertical planetary wave propagation and associated eddy transport of momentum and heat. We focused on three negative phase events in December 2009, February 2010 and March 2013 showing remarkable skill in the JMA One-month EPS. We confirmed that the aforementioned mechanisms contributed to these events, and the EPS successfully reproduced them. The results indicate that there is inherent predictability in extratropical dynamics at a sub-seasonal time scale. With these results, we point out that the remarkable negative phase of AO is a window of opportunity for sub-seasonal forecasting.

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