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Arctic Climate Spatio-temporal Modes of Winter Variability as Sources of Predictability

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The Arctic region has suffered a transformation in the past decades that will very likely continue in the future. Since the late 1970s declining trends in pan-Arctic sea ice extent and volume, and increasing trends in air and sea surface temperature have been observed. However, the region has a large natural climate variability that can usually be mistaken for a long-term forced response. Furthermore, this natural Arctic variability has been linked to mid-latitude weather extremes in the northern hemisphere, both as a cause and a as response. Disentangling natural variability and forced response is of critical importance from a climate change perspective.

Using observational evidence and advanced statistical methods (K-mean clustering and empirical orthogonal functions), we studied natural modes of variability in key Arctic climate variables (i.e. sea ice concentration, sea surface and near surface air temperature anomalies). The main objective was to identify spatio-temporal coherence in the detrended series and lag-lead correlations between variables.

Sea ice concentrations show three important main modes of variability during winter, as previously found (Fučkar et. al, 2016). Both atmospheric near surface temperature and sea surface temperatures can individually affect sea ice and partly explain some regional patterns of natural variability on seasonal timescales. Pan-arctic sea ice extent shows a delayed response of 1-3 months to near surface air temperature and about a year to sea surface temperature variations. This analysis highlights the importance of both ocean and atmosphere as modulators of sea ice variability and as sources of Arctic climate predictability.

References:
Fučkar, et al. Clusters of interannual sea ice variability in the northern hemisphere (2016). Climate Dynamics