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A closer investigation of associations between Autumn Arctic sea ice and central and east Eurasian winter climate

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Whether recent Arctic sea ice loss is responsible for recent severe winters over mid-latitude continents has emerged as a major debate among climate scientists owing to short records of observations and large internal variability in mid- and high-latitudes. In this study, we divide the evolution of autumn Arctic sea ice extent during 1979-2014 into three epochs, 1979-1986 (high), 1987-2006 (moderate) and 2007-2014 (low), using a regime shift identification method. We then compare the associations between autumn Arctic sea ice and winter climate anomalies over central and eastern Eurasia for the three epochs with focus not only on the mean state, but also the extreme events. The results show robust and detectable signals of sea ice loss in weather and climate over western Siberia and East Asia. For the mean state, anomalous low sea ice extent is associated with a strengthening of the Siberian high pressure, a weakening of westerly winds over north Asia, leading to cold anomalies in central Asia and northern China. For the extreme events, the latitude (speed) of the jet stream shifts southward (reduces), the wave extent amplifies, blocking high events increase over Ural Mountains, leading to increased frequency of cold air outbreaks extending from central Asia to northeast China. These associations bear a high degree of similarity to the observed atmospheric anomalies during the low sea ice epoch. By contrast, the patterns of atmospheric anomalies for the high sea ice epoch are different from those congruent with sea ice variability, which is related to the persistent negative phase of the Arctic Oscillation. We also found that the ENSO plays a minor role in the determination of the observed atmospheric anomalies for the three epochs. Support for these observational analysis is largely corroborated by independent atmospheric model simulations.