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Dominant Characteristics of early autumn Arctic sea ice variability and its impact on Winter Eurasian climate

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The present study investigated dominant characteristics of autumn Arctic sea ice concentration (SIC) interannual variations, and examined impacts of SIC anomalies in the East Siberian-Chukchi-Beaufort (EsCB) Seas on winter Eurasian climate variability and the associated possible physical mechanism. Results showed that the Arctic SIC variations in both September and October display a certain continuity to some extent, thus, we chose the September-October (SO) mean SIC as a factor to explore its delayed impacts on winter atmosphere. Dominant features of Arctic SIC variability in SO is characterized by sea ice loss in the EsCB Seas, with more evident interannual variability since the late 1990s. Such a change can be attributed to the central Arctic pattern of atmospheric variability. Along with the global warming, the interannual variation of sea ice in the EsCB Seas seemingly exerts an increasingly role in the Northern Hemispheric climate variability. When the EsCB sea ice decreases in the early autumn (SO), a barotropic response of wave number 2 structure with significant warming and positive geopotential height anomaly dominates the Arctic region a month later. Then, in the early winter (ND(0)J(1)), the Arctic anticyclonic anomaly extends southward into the central-western Eurasia and leads to evident surface cooling there. Two month later, it further develops toward downstream accompanied by a deepened trough, making the East Asia experience a colder late winter (JFM(1)), especially in the northeastern China. Meanwhile, enhanced North Pacific anticyclonic perturbation excites an eastward wave train and contributes to positive geopotential height anomaly around the Greenland. Combined with a cyclonic anomaly to its southeast, a dipole structure forms and favors negative surface temperature anomaly covering the western Europe. In addition, a weakened polar vortex in the lower stratosphere can be observed during the boreal winter. Similar atmospheric responses to EsCB sea ice loss are well reproduced in the simulation experiments, not only supporting the conclusions from observational analyses, but also illustrating the possible physical mechanism to some extent.