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Relationship between the interannual variations of Arctic sea ice and summer Eurasian teleconnection and associated influence on summer precipitation over China

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The relationship between Eurasian mid-high latitudes teleconnection in summer and the interannual variations of Arctic sea ice concentration (SIC) from preceding spring to summer and the associated influence on East Asian summer precipitation during the period of 1980–2015 are investigated by using NCEP/NCAR reanalysis datasets and the Community Atmospheric Model version 3.1. Results show that the second Empirical Orthogonal Function mode of summer 500 hPa geopotential height field over mid-high latitudes of North Atlantic-Eurasian continent shows a clear "-+-+" pattern, with anomalous trough over the region from Greenland to North Atlantic, the Ural Mountains, the anomalous ridge over Europe and regions around Lake Baikal, which is similar to Eurasian (EU) teleconnection pattern. When the summer Eurasian teleconnection reveals "-+-+" ("-+-+") pattern, the light (heavy) SIC occurs in regions over Northern Barents Sea and Baffin Bay in preceding spring and over Northern Barents Sea in simultaneous summer, leading to deficit (excessive) summer precipitation over most regions to north of Yangtze River valley, especially over north Northeast China and the region between Yellow and Yangtze River valley. Further study shows that the persistence of light SIC tends to change the local surface turbulent heat flux from spring to summer, triggering the anomalous Rossby wave sources and the propagation of quasi-stationary Rossby wave activity flux southward and eastward from Arctic to East Asia. These physical processes ultimately result in the development of anomalous summer Eurasian teleconnection. In addition, corresponding to the influence of light SIC condition, the "-+" dipole pattern of anomalous Eurasian snow water equivalent (SWE) in April-May is observed over the region from the Ural Mountains to north of Lake Baikal. This dipole SWE pattern then changes the soil moisture and associated heat flux anomalies in the following summer, further resulting in the enhancement of summer Eurasian teleconnection. Accompanying with occurrence of "-+-+" Eurasian teleconnection, the Ural blocking and the East Asian trough are weakened. Meanwhile, the summer Asian subtropical jet stream is accordingly accelerated, with increasing of the westerly wind over subpolar regions and decreasing to the north of East Asian subtropical jet stream. This favors formation of anomalous anticyclonic circulation over the region to south of Lake Baikal, leading to weaker cold air activities. The aforementioned circulation system ultimately results in deficit summer precipitation over north Northeast China and regions between Yellow and Yangtze River valleys. Relative to heavy SIC conditions, the influences are inversed. By using the spring SIC index and late spring SWE index, we also establish a prediction model for the summer precipitation over Yangtze-Huaihe River valley. The hindcast results show that our prediction model can well predict the variation of summer precipitation of Yangtze-Huaihe River valley.