The Impact of Arctic Sea Ice Melt on the Eurasian Winter Cooling Trend of Recent Decades

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In the northern mid-latitudes, observed surface temperature shows an apparent cooling trend in recent boreal winters even though the climate models predict continuous warming. Previous studies have suggested various explanations for the unexpected cooling trend. These can be grouped into three main categories: decreased net incoming radiation into the surface, changes in SST and enhanced heat uptake by the ocean circulation, and changes in surface conditions such as the Siberian snow cover and the Arctic sea ice. Among these, the changes in snow and sea ice are the most reasonable to understand the seasonal and regional inhomogeneity. However, because the Siberian snow cover has data uncertainty problems, we focus on the atmospheric circulation changes derived by the reduction of Arctic sea ice over the Barents and Kara seas (BK seas) in autumn (October to December). Although the connection between BK seas and Eurasian cooling is already studied in previous studies, they tended to focus on the interannual variability, not on the trend change. Here we examine the impact of the Arctic sea ice melt on the cooling trend. A significant co-variability is observed between autumn BK sea ice concentration and winter Eurasian surface air temperature. More importantly, both BK sea ice concentration and Eurasian surface air temperature have changed their trends around late 1990's and early 2000s'. This finding is further confirmed by the coupled model experiments. We can conclude that the sea ice reduction over the BK seas have a significant impact on the temperature trend change in recent Eurasian winters.

Key words: warming hiatus, Eurasian cooling, Arctic sea ice