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Possible impacts of Arctic extreme cyclones on cold spells in China during 2015

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Abstract Global weather and climate have changed dramatically over the past few decades, and the frequency of extreme weather events has increased, which has attracted more attention. Extreme cyclones (ECs) entering the Arctic from the mid-high latitude North Atlantic can cause anomalous warming in the Arctic region, which is closely related to extreme weather events in the mid-high latitudes and is very harmful. In this study, we have explored the physical processes and mechanism of two extreme cyclones (EC1 and EC2) affecting the cold spells in China during January and February 2015, using ERA-Interim reanalysis data and observation data from China meteorological stations. The results show that the anomalous warming occurs in the lower and upper atmosphere near the EC center. When ECs move northward from the mid-high latitude North Atlantic, the upper level warm anomaly and ridge expand to the Arctic region, and the polar vortex is squeezed and breaks up. Then the mid-high latitude trough deepen and move southward over China, and the northerly flow behind the trough lead to the cold air intrudes southward into China, which results in cold spell occurring in China. Further analysis shows that the anomalous warming accompanied by ECs promotes the development of the mid-high latitude troughs and ridges through the energy dispersion of Rossby wave. By comparison, there are significant differences between EC1 and EC2 in terms of occurrence and track. Compared with EC2, EC1 occurs in higher latitudes and have an eastward track, which result in a wider range of cold spell, but its intensity is slightly weaker than EC2. These results indicate that the occurrence, development and movement of extreme cyclones have important effects on the cold spell in China. It also should be pointed out that we need more EC events for further study in the future work from the perspective of the differences of the occurrence and track of ECs in the mid-high latitude North Atlantic, and provide an important indicator for weather forecasts of cold spell in China.