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Increased Quasi-Stationarity and Persistence of Winter Ural Blocking and Eurasian Extreme Cold Events in Response to Arctic Warming: Insights from Observational

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This study examines the relationship among winter cold anomalies over Eurasia, Ural blocking (UB) and the background conditions associated with Arctic warming over the Barents-Kara Sea (BKS) using reanalysis data. It is found that the intensity, persistence and occurrence region of UB-related Eurasian cold anomalies depend strongly on the strength and vertical shear (VS) of the mean westerly wind (MWW) over mid-high latitude Eurasia related to BKS warming.

Observational analysis reveals that during 1951-2015 UB days are 64% (54%) more frequent during weak MWW (VS) winters, which are 26.9 (28.4) days/winter, than during strong MWW (VS) winters. During weak MWW or VS winters as frequently observed during 2000-2015, persistent and large UB-related warming is seen over the BKS, together with large and widespread mid-latitude Eurasian cold anomalies resulting from increased quasi-stationarity and persistence of the UB. By contrast, when the MWW or VS is strong as frequently observed during 1979-1999, the cold anomaly is less intense and persistent, and confined to a narrow region of Europe because of a rapid westward movement of the strong UB. For this case, the BKS warming is relatively weak and less persistent. The midlatitude cold anomalies are maintained primarily by reduced downward infrared radiation (IR), while the surface heat fluxes, IR and advection all contribute to the BKS warming. Thus, the large BKS warming since 2000 weakens the meridional temperature gradient, MWW and VS, which increases quasi-stationarity and persistence of the UB (rather than its amplitude), and then leads to more widespread Eurasian cold events and further enhances the BKS warming.