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Influence of the Western Pacific pattern on the wintertime Arctic stratosphere

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The Western Pacific (WP) pattern, which is characterized by a north-south dipole of height anomalies over the Northwestern Pacific, is one of the dominant teleconnection patterns and has substantial influence on weather and climate variability, especially over the Far East. The aim of this study is to show that the positive phase of the WP pattern acted as a precursor of a one-month lasting cold period in the polar stratosphere to increase polar stratospheric clouds. The WP pattern is defined as the first EOF of wintertime 500-hPa geopotential height anomalies over the Northwestern Pacific. The daily WP index is defined as the projection of the daily height anomaly field onto the EOF and the peak dates of the 18 strongest positive events have been selected for compositing. Over the Arctic, the composited stratospheric temperature anomaly remains negative for about a month after the peak of a positive WP event. This cooling occurs in conjunction with the reduction of poleward eddy heat flux above the tropopause level right after the peak, which indicates a weakening tendency in upward propagation of planetary waves into the stratosphere. This weakening of the tropospheric planetary waves results from the westward extension of an anticyclonic anomaly into the climatological-mean trough over the Far East. Synoptically, this evolution is characterized by the formation of a blocking high to the north of the Sea of Okhotsk, manifested as the cyclonic breaking of the planetary wave trough. Thus, this study presents a unique case where a blocking high over a subpolar region can induce cooling into polar stratosphere rather than warming.

Keywords: Western Pacific pattern, stratospheric temperature, planetary wave, blocking high, polar stratospheric cloud