

An advanced impact of Arctic stratospheric ozone changes on spring precipitation in China

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The effect of spring Arctic Stratospheric Ozone (ASO) changes on spring precipitation in China is analyzed using observations, reanalysis data, and the Whole Atmosphere Community Climate Model version 4 (WACCM4). We find that February–March mean ASO changes have a significant impact on April–May mean precipitation over the Loess Plateau and the middle–lower reaches of the Yangtze River—two important grain-producing regions with large populations. Changes in the polar vortex link the ASO to precipitation in China. Stratospheric circulation anomalies caused by ASO changes can propagate to the North Pacific. An increase in ASO leads to enhanced westerlies in the high and low latitudes of the North Pacific but weakened westerlies in the mid-latitudes of the North Pacific. The circulation anomalies over the North Pacific, forced by the increase of ASO, can extend westwards to East Asia, leading to an abnormal anticyclone in the East Asian upper and middle troposphere, and an abnormal cyclone in the lower troposphere. This enhances the warm and humid airstream from the Western Pacific to the Chinese mainland and strengthens upwelling over the Loess Plateau and the middle–lower reaches of the Yangtze River. These conditions enhance precipitation in central China during positive ASO anomaly events and reduce precipitation during negative events. The WACCM4 simulations support the results from our statistical analysis of observations and reanalysis data. Our results suggest that ASO variation can serve as a predictor of spring precipitation variation over the Loess Plateau and the middle–lower reaches of the Yangtze River.

Keywords: Arctic Stratospheric Ozone, Spring precipitation