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Spring Dust over the Tibetan Plateau and Connections with North Atlantic SST Variability

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Dust is a major component of atmospheric aerosol worldwide, greatly affecting regional and global climate. A dust belt can be clearly found at altitudes higher than 6 km over the downwind direction of the TP at latitudes of around 30°–40°N, crossing the Pacific Ocean and extending to North America during spring. Dust is uplifted to the midtroposphere over the source regions; then, frequent, deep, dry convection prevailing over the TP during spring can cause convective overshooting that uplifts the dust aerosols to the upper troposphere. The TP thus acts as a channel for transporting dust from the lower atmosphere to the upper troposphere, enabling the long-range zonal transport of dust around the Northern Hemisphere. Estimated spring dust mass flux (DMF) showed a significant declining trend over the TP during 2007-2019. The total spring DMF across the TP was mainly affected by DMFs over the Tarim Basin, while the spring DMF across the TP in the mid-troposphere was also connected with DMFs over the northwest Indian Peninsula and Central Asia. Inter-annual variability of spring DMF across the TP was strongly correlated with the North Atlantic winter sea surface temperature (SST) tripole. The North Atlantic winter SST tripole anomalies persist into the subsequent spring, and induce a corresponding atmosphere response. A strong positive North Atlantic winter SST tripole anomaly strengthens the upper-level westerly jets, enhancing air flow towards the TP mid-troposphere; together, these circulation patterns cause anomalous cyclonic conditions in the lower troposphere, especially over the Tarim Basin, via the eastwards propagation of a Rossby wave train. These atmospheric circulation conditions are likely to increase the frequency of dust occurrence and promote the transport of dust onto the TP.