Sudden stratospheric warmings and anomalous upward wave activity flux

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Abrupt transitions in the polar winter stratospheric circulation such as sudden stratospheric warmings (SSWs) have profound impacts on stratospheric transport and surface weather. SSW-like events are a manifestation of strong two-way interactions between upward propagating planetary waves and the mean flow. The importance of sufficient upward wave activity fluxes from the troposphere and the preceding state of the stratospheric circulation in forcing SSW-like events have long been recognized. Past research based on idealized numerical simulations has suggested that the state of the stratosphere may be more important in generating extreme stratospheric events than anomalous upward wave fluxes from the troposphere. Other studies have emphasized the role of tropospheric precursor events. Here reanalysis data are used to define events of extreme stratospheric mean flow deceleration (SSWs being a subset) and events of extreme lower tropospheric upward planetary wave activity flux. While the wave fluxes leading to SSW-like events ultimately originate near the surface, the *anomalous* upward wave activity fluxes associated with these events are found to often originate within the lowermost stratosphere. The enhanced stratospheric wave fluxes and mean flow decelerations appear essentially synchronously, indicating strong mutual interactions between the waves and the mean flow. Constructive redistribution of wave fluxes and/or generation near the tropopause seem crucial for SSW-like events. Anomalous upward wave fluxes from the lower troposphere are, while found to be important for some events, overall appear to be less crucial.

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