

# Classifying the tropospheric precursor patterns of sudden stratospheric warmings

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Classifying the tropospheric precursor patterns of sudden stratospheric warmings (SSWs) may provide insight into the different physical mechanisms of SSWs. Based on 37 major SSWs during the 1958–2014 winters in the ERA reanalysis data sets, the self-organizing maps method is used to classify the tropospheric precursor patterns of SSWs. The cluster analysis indicates that one of the precursor patterns appears as a mixed pattern consisting of the negative-signed Western Hemisphere circulation pattern and the positive phase of the Pacific-North America pattern. The mixed pattern exhibits higher statistical significance as a precursor pattern of SSWs than other previously identified precursors such as the subpolar North Pacific low, Atlantic blocking, and the western Pacific pattern. Other clusters confirm northern European blocking and Gulf of Alaska blocking as precursors of SSWs. Linear interference with the climatological planetary waves provides a simple interpretation for the precursors. The relationship between the classified precursor patterns of SSWs and ENSO phases as well as the types of SSWs is discussed.