

Diagnostics of a WN2-type major sudden stratospheric warming event in February 2018 using a new three-dimensional wave activity flux

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Observational features of atmospheric fields during a zonal wavenumber two (WN2) type major sudden stratospheric warming (MSSW) event that occurred in February 2018 (MSSW18) are analyzed using the Japanese 55-year Reanalysis, satellite measurements by a microwave limb sounder, and a new three-dimensional wave activity flux. MSSW18 was characterized by a clear polar vortex split, continuance of easterlies with remarkable double peaks, clear planetary-wave propagation in the easterly region of the upper stratosphere and extraordinary upward propagation of WN2 planetary waves from the upper troposphere whose peak was comparable to that during an MSSW event that occurred in January 2009 (MSSW09), although MSSW18 showed relatively modest warming, unclear disappearance of the stratopause and weak stratopause elevation compared to those during MSSW09. Further analyses revealed that wave packets propagated upward simultaneously in both the Eastern and Western Hemispheres. Those observed in the Eastern Hemisphere converged strongly at the western edge of the Aleutian High and most of them did not propagate into the upper stratosphere. The wave packets observed in the Western Hemisphere locally propagated into the upper stratosphere over North America despite the fact that easterlies were predominant there in the mature stage of MSSW18. Furthermore, our results revealed that the regions and levels of wave-packet attenuation corresponded well to the area of weak eastward phase tilt or the quasi-barotropic condition of smaller-scale waves during MSSW18, whereas during MSSW09 the westward phase tilts of smaller-scale waves were clearly visible in the upper stratosphere.

Keywords: Sudden stratospheric warming, Zonal wavenumber two, Wave activity flux