Global Responses of Gravity Waves to Planetary Wave Variations during SSWs Observed by SABER

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This study describes the global responses of observed gravity waves (GWs) to winter planetary wave (PW) variations during stratospheric sudden warmings (SSWs) using TIMED-SABER temperature measurements. Previous studies have shown responses of atmospheric temperature and parameterized GW drag to SSWs; however, the responses of actual global GW observations to SSWs have not been presented before. The responses are shown by calculating correlations between vertical components of Eliassen-Palm (EP) fluxes in the winter polar stratosphere and global GW temperature amplitudes derived from SABER observations. Consistent with previous ground-based and satellite observations, winter EP fluxes show positive correlations with GWs in the winter hemisphere. More interestingly, winter stratospheric EP fluxes are positively correlated with GWs in the tropics and in the summer mesosphere, indicating global variations of GWs in response to PW variations in the winter hemisphere. To study the mechanism of GW response to SSWs, global wind simulations from SD-WACCM are used. Zonal wind anomalies (differences in the wind before and during SSWs) extend from the winter stratosphere to the summer mesosphere. By comparing anomalies in background winds to the observed patterns in the correlations between GWs and winter EP fluxes, we find that regions of positive correlation follow changes in background winds and zero-wind lines. The results indicate that responses of SABER GWs in the summer hemisphere to winter PW variations during SSWs are likely caused by changes in GW propagation due to the changes in winds and atmospheric circulation. These observed changes in global GWs during SSWs can affect the ionosphere and thermosphere, and studying global GW variation during SSWs is important for understanding mechanisms of vertical coupling.

Keywords: Inter-hemispheric Coupling, Gravity Wave, Stratospheric Sudden Warming

