

Gravity Wave Variation from the Stratosphere to the Lower Thermosphere During Stratospheric Sudden Warming Events

Han-Li Liu¹

¹ *High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado, USA*

Gravity waves may undergo large variation during stratospheric sudden warming (SSW) events. Dramatic change of large-scale wind during SSW can alter the propagation conditions of gravity waves, and as a result gravity waves with different and even opposite propagating directions may dominate in the mesosphere and lower thermosphere (MLT). The impact of such changes on the MLT circulation has been studied previously, mostly by employing gravity wave parameterization schemes in global models. Although a parameterization scheme can account for the change of wave propagation conditions, it does not realistically represent changes of wave sources, and suffers from the known uncertainties of gravity wave parameterizations schemes. Furthermore, distortion of the stratospheric polar jet by planetary waves leads to gravity wave generation by flow imbalance. With the rapid change of the planetary waves during SSW, the gravity waves associated would also change rapidly, as revealed by previous high-resolution modeling studies. Such changes cannot be represented in current parameterization schemes, and most high-resolution models do not extend into the lower thermosphere. In this study, we examine gravity wave variation from the stratosphere to the lower thermosphere during SSW using WACCM with high spatial resolution ($\sim 0.25^\circ$ in the horizontal and 0.1 scale height in the vertical). Simulations using this version of WACCM over 18 months have shown good comparisons with gravity wave observations, with regard to gravity wave energy density, momentum flux, seasonal variation, and intermittency. Two major stratospheric sudden warming events have been identified in the simulation, and they are used to analyze the variation of resolved waves during SSW events. We will in particular focus on variation of wave generation by the stratospheric polar jet, as well as the wave impacts in the MLT region.

Key words: gravity wave, stratospheric sudden warming, mesosphere and lower thermosphere, whole atmosphere coupling, high-resolution global model