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Interactions of planetary and orographic gravity waves during stratospheric warming in the middle atmosphere.

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Sudden stratospheric warming (SSW) events are the most prominent processes, during which the troposphere and stratosphere demonstrate the dynamical coupling. We investigate interactions between stationary orographic gravity waves (OGWs) and planetary waves during winter and spring months in the Northern Hemisphere, when SSWs frequently occur. A parameterization of dynamical and thermal effects of OGWs generated by the Earth's surface topography has been developed. This parameterization was included into the numerical model of general circulation of the middle and upper atmosphere (MUAM). Influence of OGWs on the mean flow and planetary waves in the troposphere and stratosphere during the SSW is analyzed.

Spatial distributions of planetary wave amplitudes and their changes due to variations in the OGW generation and propagation were simulated for 10-day intervals before, during, and after the SSW event. We analyzed stationary planetary wave (SPW) modes with zonal wave numbers m = 1 - 4 and eastward and westward propagating planetary wave (PPW) modes having m = 1 and 2 with periods 5, 10, 16 and 4, 7 days, respectively.

The results of simulation show that SPW amplitudes increase during the SSW and decrease after the event. Taking into account of OGW dynamical and thermal effects in the MUAM leads to a decrease of SPW amplitudes in winter stratosphere. Amplitudes of the westward PPWs are larger than eastward ones and they increase during the SSW. Accounting of OGW effects in the MUAM leads to the changes of PPW amplitudes in both hemispheres. These changes are responsible for the corresponding changes in the mean flow and temperature of the middle atmosphere. For example, zonal wind increases in the mid-latitude stratosphere due to OGW accounting.