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Simulating influence of QBO phase on planetary waves during a stratospheric warming in a general circulation model of the middle atmosphere

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One of the important factors of dynamical interactions between the lower and upper atmosphere is energy and momentum transfer by atmospheric internal gravity waves. For numerical modeling of the general circulation and thermal regime of the middle and upper atmosphere, it is important to take into account accelerations of the mean flow and heating rates produced by dissipating internal waves. The quasi-biennial oscillations (QBOs) of the zonal mean flow at lower latitudes at stratospheric heights can affect the propagation conditions of planetary waves. We perform numerical simulation of global atmospheric circulation for the initial conditions corresponding to the years with westerly and easterly QBO phases. We focus on the changes in amplitudes of stationary planetary waves (SPWs) and traveling normal atmospheric modes (NAMs) in the atmosphere during SSW events for the different QBO phases. For these experiments, we use the global circulation of the middle and upper atmosphere model (MUAM).

There is theory of PW waveguide describing atmospheric regions where the background wind and temperature allow the wave propagation. There were introduced the refractive index for PWs and found that strongest planetary wave propagation is in areas of large positive values of this index. Another important PW characteristic is the Eliassen-Palm flux (EP-flux). These characteristics are considered as useful tools for visualizing the PW propagation conditions.

Sudden stratospheric warming (SSW) event has significant influence on the formation of the weather anomalous and climate changes in the troposphere. Also, SSW event may affect the dynamical and energy processes in the upper atmosphere. The major SSW events imply significant temperature rises (up to 30 - 40 K) at altitudes 30 - 50 km accompanying with corresponding decreases, or reversals, of climatological eastward zonal winds in the stratosphere.