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Changes in Temperature and Circulation of the Mesosphere and lower Thermosphere induced by Gravity wave propagated from below: 3D model study

A. KRIVOLUTSKY[1], G. ZAKHAROV[1] and A. KLYUCHNIKOVA[1]
[1]*Central Aerological Observatory*

A global mechanistic gridpoint model with a vertical extension from the ground up to 130 km was used to investigate the sensitivity of the lower thermosphere and the mesosphere to gravity waves propagated from below. The size of the longitudinal grid of the model enables a resolution up to a zonal wave number 8. This appears to be sufficient for resolving the investigated large scale planetary wave structure. The model is based on the primitive equations expressed in spherical coordinates in the horizontal and log-pressure coordinates in the vertical. The equations are solved by using an explicit numerical scheme with a fixed time step of 225 s. To prevent the accumulation of energy at shorter spatial scales of the model a Shapiro filter is used. For heights above 100 km dynamical viscosity, thermal heat conduction, and ion drag are considered. Mechanical dissipation processes can be taken into account by using an explicit gravity wave drag parameterization (or a linear Rayleigh friction) approach. Concerning solar radiation water vapor, carbon dioxide, ozone, and molecular oxygen are taken into account. For terrestrial radiation water vapor, carbon dioxide (LTE and non-LTE), ozone, and nitric oxide are considered. The influence of gravity wave drag on general circulation of the middle atmosphere permitted to reproduce a warm winter and a cold summer mesosphere, as far as the opposite zonal mean circulation in the lower thermosphere. A new effect caused by gravity waves was found in model runs – warming of the lower thermosphere after SPEinduced ozone depletion.