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Simulating planetary wave propagation to the upper atmosphere during stratospheric warming events at different mountain wave scenarios

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Parameterization schemes of atmospheric normal modes (NMs) and orographic gravity waves (OGWs) have been implemented into the mechanistic Middle and Upper Atmosphere Model (MUAM) simulating atmospheric general circulation. Based on the 12-members ensemble of runs with the MUAM, a composite of the stratospheric warming (SW) has been constructed using the UK Met Office data as the lower boundary conditions. The simulation results show that OGW amplitudes increase at altitudes above 30 km in the Northern Hemisphere after the SW event. At altitudes of about 50 km, OGWs have largest amplitudes over North American and European mountain systems before and during the composite SW, and over Himalayas after the SW. Simulations demonstrate substantial (up to 50 – 70%) variations of amplitudes of stationary planetary waves (PWs) during and after the SW in the mesosphere-lower thermosphere of the Northern Hemisphere. Westward travelling NMs have amplitude maxima not only in the Northern, but also in the Southern Hemisphere, where these modes have waveguides in the middle and upper atmosphere. Simulated variations of PW and NM amplitudes correspond to changes in the mean zonal wind, EP-fluxes and wave refractive index at different phases of the composite SW events. Inclusion of the parameterization of OGW effects leads to decreases in amplitudes (up to 15%) of almost all SPWs before and after the SW event and their increase (up to 40 – 60%) after the SW in the stratosphere and mesosphere at middle and high northern latitudes. It is suggested that observed changes in NM amplitudes in the Southern Hemisphere during SW could be caused by divergence of increased southward EP-

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