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Geoscientific Model Development Discussions

Interactive comment on "Interaction of Small-Scale Gravity Waves with the Terdiurnal Solar Tide in the Mesosphere and Lower Thermosphere" *by* Friederike Lilienthal et al.

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Dear Prof. Dr. Gavrilov,

we wish to thank you very much for your valuable comments and ideas to help improve our mauscript. Below, we are addressing each of your comments.

1. Lines 95 – 100. The authors refer the GW spectrum used previously by Yiğit and Medvedev. However, there is no information about reasons of using this particular spectrum. May be it was described in previous papers. However, it would be useful to give short summary of these reasons.

The whole atmosphere gravity wave (GW) parameterization has been initially developed in the work by Yiğit et al. (2008), in which various spectral shapes have been tested. However, when the whole atmosphere GW scheme has been implemented into a GCM in the work by Yiğit et al. (2009), we have validated the GW source spectrum and found out that the utilized empirical source spectrum successfully reproduces the large-scale structure of the middle atmosphere dynamics. The chosen momentum flux values in the spectrum are comparable to the observed GW activity in the lower atmosphere. Therefore we use the original GW spectrum as the reference source spectrum with which we have experimented in our current study. Overall, it is important to note that the general principle in choosing a particular spectrum is to optimize the response of the middle atmosphere circulation.

2. In addition, the authors use spectral function of horizontal speed only. However, for complete GW characterization a second parameter (period or wavelength) is required. How much the GW parameterization is sensitive to changes in periods or wavelengths?

The horizontal wavelength of GWs in this parameterization is set to a representative value of 300 km, to which a significant portion of the small-scale GW activity can be statistically attributed to. All three-dimensional GCMs using a GW scheme assume a one-dimensional GW spectrum, often prescribing GWs in terms of horizontal momentum fluxes as a function of horizontal phase speeds. So, while we choose a single representative horizontal wavelength, a broad spectrum of phase speeds are implemented, i.e., 2-80 m/s. Thereby, we adopt a range of GW periods, as for a fixed wavelength, the period of wave is inversely proportional the phase speed. In a realistic atmosphere, the wave period is modulated by the background atmosphere.

The sensitivity of the parameterization with respect to the horizontal wavelength is relatively small, considering the typical ranges of a few hundred kilometers. These comments have been added to the revised version of the manuscript.

3. Lines 100 – 105. The authors perform three numerical experiments (labeled as

EXP1 – EXP3) using different values of GW momentum fluxes and different spectra of GW phase speed shown in Figure 1. It would be desirable to give a short description and instructions for readers, how considered GW parameters can correspond to different typical meteorological situations.

In general our GCM study is not designed to study variable meteorological situations. Rather the purpose of our whole atmosphere scheme is to represent the majority of the nonorographic GWs, including a broad rang of harmonics, in a statistical manner. A direct connection between individual waves and typical meteorological connections cannot be established in our framework. However, we acknowledge that a broad spectrum of gravity waves are generated by a range of weather processes, which our GW spectrum covers to a large extent. Often the observed and the modeled GW spectra are very variable and there are marked uncertainties. Therefore, here we perform a range of modest sensitivity tests within the range of established observations.

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