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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Propagation of gravity waves and its effects on pseudomomentum flux in a sudden stratospheric warming event" *by* In-Sun Song et al.

Anonymous Referee #1

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Review of manuscript: "Propagation of gravity waves and its effects on pseudomomentum flux in a sudden stratospheric warming event", by In-Sun Song, Changsup Lee, Hye-Yeong Chun, Jeong-Han Kim, Geonhwa Jee, Byeong-Gwon Song, and Julio T. Bacmeister.

This paper investigates the effect of four-dimensional propagation of gravity waves in time-varying background winds on their properties (pseudomomentum fluxes, wavenumber) during the occurrence of a sudden stratospheric warming. The main motivation is that GW parameterizations implemented in climate models generally neglect these effects (columnar, instantaneous propagation is generally enforced in the

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GW schemes), and it is important to assess the missing effects on the redistribution of momentum flux and GW forcing. The authors do not find a big difference between 4D and 2D propagation in terms of latitude-height structure of the total momentum fluxes, but do find a significant difference in terms of the magnitude of the momentum fluxes, with much larger fluxes in the 4D scheme. The effects of curvature on the magnitude of the fluxes seems to be as important as the effect of horizontal wind shear.

The study is well-written and easy to follow, and the results are relevant and timing, aligning with current efforts to better understand GW processes in order to improve their parameterizations in climate models. I have a few, very minor comments, and I believe the paper is basically publishable as is.

Comments

1. Some parts of the introduction seem a succession of references, and sometimes it is difficult to follow/understand the line of argument (e.g., paragraphs in page 2).

2. Page 3, line 8-9. Richter et al (2010) attributed the improvement in the SSW frequency in WACCM to the turbulent mountain stress parameterization (which improves near-surface winds and planetary wave generation), not to the source-based nonorographic GW scheme.

3. Section 3. Why do the authors use both ERA-Interim and MERRA fields, if they basically cover the same altitude range? Why not just one reanalysis?

4. Page 10 line 11-12. “Zonal F p s in each OGW ensemble member have locally substantial deviations from the ensemble mean (Fig. 3c) in the major mountain areas”. This may be true, but it is not discernible in the figure.

5. Figure 8. I may be missing something, but how is it possible that the number of GW packets increase with height in the 2D simulation? If I understand correctly, in the 2D case the only process adding wave packets to a given column is wave generation at the source level.

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