gmdd-7-C2642–C2644,-2014, Development of the GEOS-5 Atmospheric General Circulation Model: Evolution from MERRA to MERRA2.

Response to Reviewers

Reviewer 1

We thank the reviewer for the comments about the clarity of presentation, and have addressed the mislabeling of figures in the revised manuscript.

Specific Comments:

Section 3.2 would benefit from a bit more discussion of how the new source of nonorographic drag in the tropics was arrived as no reference is provided. How does it relate to other models schemes of tropical non-orographic drag? e.g. Manzini et al, 1997: Impact of the Doppler spread parameterization on the simulation of the middle atmosphere circulation using the MA/ECHAM4 general circulation model. J. Geophys. Res. or Scaife et al 2002: Impact of a spectral Gravity wave parameterization on the startosphere in the Met Office Unified Model. J Atmos Sci.

The new source is meant to better account for gravity waves excited by tropical convection, as described in Richter et al (2010). The other models mentioned by the reviewer include alternative techniques for modeling non-orographic sources of similar origin.

We have added an elaboration of the motivation for adding the new source of non-orographic gravity wave drag.

Section 4. This section might benefit from mentioning that lack of convergence in moist processes with increasing resolution is a common problem in atmospheric models. e.g. older studies Williamson 2008: Convergence of aqua-planet simulations with increasing resolution in the community atmospheric model, Version 3. Tellus. Pope & Stratton 2002: The processes governing horizontal resolution sensitivity in a climate model. Clim Dyn. Although the figures are slightly confusing it is still possible to understand the points being made in this section.

These additional citations for earlier studies that showed that there is a lack of convergence in moist processes with increasing horizontal resolution have been added.

Technical Corrections:

p7584 line 15 refers to Fig 9. Panels (a) and (b) look identical and don't show the difference referred in the text. I assume one of the panels is wrong.

Indeed, panels a) and b) are both from Experiment 5 (MERRA-AGCM). Panel b) has been replaced and now shows the result from Experiment 4.

p7588 line 1 says that Panels 16(a) to (c) show resolutions 1., 0.5 and 0.25 but the figure says 2, 1 and 0.5, which is correct? (Figure 17 has the same resolutions as Fig 16.)

The figure shows 2, 1 and 0.5 degree resolutions as stated in the figure caption. The text describing figures 16 and 17 has been corrected.

p7588 line 19 references Tokioka (1988) but this does not appear in the references at the end.

The proper reference has been added

Figure 7 - If colour key correct, then caption wrong as 1 degree is purple, 2 degree is blue.

The color key is correct, and the figure caption has been corrected to properly reflect the color coding.

Figure 12 - what is the grey shading on panels (c) & (f)?

The grey shading is to depict land surfaces. A statement was added to the caption to this effect.

Figure 18 - key has 2.5 degrees but figure caption has 2 degrees, which is correct?

The black line is the valid curve for the 2x2.5 degree resolution (2 deg lat, 2.5 deg lon). The figure caption has been modified to be consistent with the legend.

Figure 19 - Panels (b) and (c) both claim to be 0.5 degrees but look different. The units claim they are kg/m2/s but the colour bar has values of _100 should it be g/m2/s?

The units are kg/m2/day. The figure caption now reflects the correct units and also now correctly refers to panel c) as the figure for the 0.25 degree resolution.

Figure 20 - Again panels (b) and (c) both claim to be 0.5 degrees but are different.

The caption was corrected to refer to panel c) as the result from the 0.25 degree simulation.

References:

Richter, J. H., F. Sassi, and R. R. Garcia, 2010: Toward a physically based gravity wave source parameterization in a general circulation model. *J. Atmos. Sci*., **67**, 136--156.

Tokioka, T., K. Yamazaki, A. Kitoh, and T. Ose (1988), The equatorial 30–60 day oscillation and the Arakawa-Schubert penetrative cumulus parameterization, *J. Meteorol. Soc. Jpn.*, **66**, 883–901