

Interactive comment on “Sensitivity of middle atmospheric temperature and circulation in the UIUC GCM to the treatment of subgrid-scale gravity-wave breaking” by F. Yang et al.

Anonymous Referee #3

Received and published: 31 October 2006

This paper presents the response of the UIUC GCM to several configurations of the Alexander and Dunkerton (1999; AD1999) parametrization of gravity-wave drag. The effort is undertaken as part of a tuning exercise designed to improve the middle atmosphere winds and temperatures of the MST-GCM. It is suggested in the introduction that "lessons learned here may shed some light on future development of gravity-wave forcing parametrizations for GCMs."

Unfortunately, this goal is not realized. Part of the reason is that the authors convey little physical understanding of the gravity-wave parametrizations that they employ. The authors treat both the orographic and non-orographic gravity-wave schemes as black

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

boxes.

For example, the orographic scheme is turned off above 10hPa (pg. 9090). Why? How was this done? Was momentum simply discarded or did the authors undertake this modification in a way that conserved momentum. Do any of the results depend on this artificial modification to the orographic gravity-wave scheme?

There is little if any physical discussion of the increased complexity of the AD scheme in going from the AR1999 to AR2003 configuration. We are only told: "In the tropics, the parameters depend on the phase of the zonal wind at the source level. Outside the tropics, the constraints on gravity waves were treated differently for the Northern and Southern Hemispheres and for different seasons" (pg 9094, l. 8-10). Of course one could look to Alexander and Rosenlof (2003) to decipher what are the physical underpinnings of these changes. However, we are told in the next paragraph that these are still insufficient to realize good climatological winds and temperatures in the MST-GCM. The authors then point to the improved AR2003_M configuration, which was the culmination of extensive tuning. The reader is directed to Table 1 for details given no hint as to the physical changes to AR2003 that were thought to have brought about improvement.

The authors seem to suggest that there is some intrinsic value in the improvement obtained with their AR2003_M configuration. However, the reader is provided no physical insight as how such benefit was derived. Further, other modeling efforts regularly obtain much better looking winds and temperatures with constant time and space sources of the non-orographic gravity waves (e.g. Scinocca JAS 2003), which have been shown to have little dependence on the particular scheme employed (McLan-dress and Scinocca JAS 2005). This fact does not seem to be appreciated by the authors.

For the reasons outlined above I cannot recommend this paper for publication in APCD.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 9085, 2006.

S4219

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper