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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Towards a better representation of the solar cycle in general circulation models" *by* K. M. Nissen et al.

Anonymous Referee #3

Received and published: 12 February 2007

GENERAL COMMENTS

The paper by Nissen et al. presents the improved FUB high-resolution shortwave radiation scheme (FUBrad) and compares this scheme with that of Fouquart and Bonnel (FB). There are two main results presented in the paper. (1) For moderate solar conditions, below about 70 km, both the FB and the FUBrad schemes give heating rates close to those of a detailed radiative transfer code and, hence, should produce realistic results in climate integrations. (2) The low-resolution FB scheme can not, however, provide an adequate response to solar cycle variations. Because the FB scheme is widely used in different atmospheric GCMs, these results are quite interesting to the modelling community. The topic is well suited for publication in Atmospheric Chemistry and Physics and this manuscript should definitely be published after addressing the

referee's comments (also those of the second reviewer).

Similar to the second reviewer, my main concern is that the paper does not give an answer to the main question: how many spectral intervals a shortwave scheme should have to adequately represent the solar cycle variability? The paper would considerably benefit if the authors could carry out such a study. Otherwise, I would recommend to change wording throughout the paper to not give a misleading impression to the readers.

It would also improve the paper if the authors could show comparison of the two (FB and FUBrad) schemes with the detailed radiative transfer code for a few conditions, rather than just for mid-January at the equator.

SPECIFIC COMMENTS

p. 49, L16-17. (a) Please indicate whether chemical energy is converted to heat in the model or it is considered to be lost for the energy budget. (b) Do you take into account that part of the energy absorbed in the Lyman-alpha line is also converted to chemical energy? (You only mentioned the Schumann-Runge bands and continuum here.) If you do not, the results shown in Fig. 4 appear to be misleading (and incorrect).

p. 49, L18-19: "backscattering... in considered... by Strobel (1978)." To account for backscattering in the Chappuis and Huggins bands, do you use a constant prescribed albedo or rather albedo calculated in the model? Please specify (and give a value, if constant albedo is used).

p. 49, L23. How did you couple two schemes? Please provide some details.

p. 51, L7-9. Are these data used only in calculations presented in section 3? Please be more specific.

p. 51, L10-11. Some inconsistency here. You use data for the mid-latitude summer atmosphere, but show results for mid-January at the equator. Please comment on it. Also, it will considerably improve the paper if you show comparison for a few different

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conditions (i.e., mid-latitude summer and winter, sub-polar summer, etc).

p. 53, L4. "...at 90S". I would prefer to see results for mid-January at the equator, which is consistent with Figs. 1,3. In addition, it is very likely that contribution from the Schumann-Runge bands and continuum is larger at the equator than it is at 90S.

p. 61, Fig. 2. Are these approximated (or geopotential) heights or rather approximated pressure levels?

p. 64, Fig. 5. See "p. 61, Fig. 2." comment.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 45, 2007.