Atmos. Chem. Phys. Discuss., 7, S185–S188, 2007
www.atmos-chem-phys-discuss.net/7/S185/2007/

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 #1

Received and published: 13 February 2007

General comments

The manuscript briefly describes a new FUB radiation code for ECHAM5 GCM, its preliminary validation and the results of perpetual January simulations of the atmospheric response to the enhancement of the solar irradiance during the maximum of the solar activity with original and improved solar radiation code. This subject is highly relevant to the scope of ACP. The model and results presented in the manuscript are original. The new FUB radiation code is potentially interesting for modeling community. The description of the conducted numerical experiments is clear and other scientists can readily reproduce them. The manuscript is well structured and written. However, the paper has several major flaws (see specific comments) which do not allow me to recommend this paper for the publication. I would recommend the authors to resubmit the

paper concentrating on the proper description and careful validation of the radiation code.

Specific comments

1. The title of the paper is not properly describes the scientific content. I do not see how the paper will improve our understanding of the solar activity influence on the climate. The importance of the proper description of the UV heating rates is well known and commonly accepted since 1980's. The deficiencies of the ECHAM solar radiation code which hamper the model ability to simulate the stratospheric temperature and the response to the solar irradiance variability were mentioned in several publications (e.g., Steil et al., 2003; Egorova et al., 2004, 2005 and Cagnazzo et al., 2006). I was very surprised that the authors have not properly credited previous publications concerning the ECHAM solar radiation code.

2. The main conclusion of the paper concerning the necessity of high-resolution short-wave radiation code is not supported by the presented results. Actually, the authors did not try to establish what resolution is necessary for proper description of the heating rate response to the solar irradiance variability. They just compared ECHAM radiation code which has only one interval and does not include most of the UV spectrum with their new radiation routine and found obvious and predictable difference due to inclusion of the missing in ECHAM spectral region. Moreover, I would not qualify FUBrad as high-resolution code, because it is based on wide band Strobel-type parameterization (Strobel, 1978).

3. The description of the FUBrad is very short. The authors just mentioned the total number of spectral intervals and did not describe even what spectral intervals are considered. The introduction of the net heating rate is rather questionable, because in the absence of the chemical heat release it will lead to the pure lost of energy.

4. The validation of the FUBrad performance is very preliminary. First of all, the number of cases should be substantially increased. I would recommend to validate the code

ACPD
7, S185–S188, 2007

EGU

for several atmospheric models and solar zenith angles. It will give more complete information about the model performance.

5. The comparison of FUB, ECHAM5 and libRadtran results in Figure 1 is quite surprising. The obtained results concerning the performance of original ECHAM5 radiation code substantially differ from the results presented by Cagnazzo et al., 2006. The authors established that the original ECHAM5 code is in almost perfect agreement with other codes up to 60 km, while Cagnazzo et al., 2006 (e.g., their Figure 1) showed the deviation of about 3 K/day near the stratopause leading to the 5-8 K difference in the temperature in a broad agreement with the results published by Egorova et al.(2005). This controversy should be resolved, because the author's conclusion about the applicability of the original ECHAM code for the climate simulation could be misleading.

6. The comparison of the perpetual January simulation with previous FUB experiments is not correct and could lead to wrong conclusions.

Technical corrections

1. Page 47, line 15. I think that reference to the paper in preparation should be excluded.

2. Page 54, last paragraph, the reference about the observed temperature signal is missing.

3. Figure 1, 3. It would be helpful to plot also the deviation from the reference code. It would make the results more informative.

References

Cagnazzo, C. , E. Manzini, M. A. Giorgetta, and P. M. De F. Forster, Impact of an improved radiation scheme in the MAECHAM5 General Circulation Model, Atmos. Chem. Phys. Discuss., 6, 11067-11092, 2006.

Egorova, T., E. Rozanov, E. Manzini, M. Haberreiter, W. Schmutz, V. Zubov, and T.

ACPD

7, S185–S188, 2007

Peter, Chemical and dynamical response to the 11-year variability of the solar irradiance simulated with a chemistry-climate model, Geophys. Res. Lett., 31, L06119, doi:10.1029/2003GL019294, 2004.

Egorova, T., Rozanov, E., Zubov, V., Manzini, E., Schmutz, W., and Peter, T.: Chemistry-climate model SOCOL: a validation of the present-day climatology, Atmos. Chem. Phys., 5, 1557-1576, 2005.

Steil, B., Bruehl, C., Manzini, E., Crutzen, P. J., Lelieveld, J., Rasch, P. J., Roeckner, E., and Krueger, K.: A new interactive chemistry-climate model: 1. Present-day climatology and interannual variability of the middle atmosphere using the model and 9 years of HALOE/UARS data, J. Geophys. Res., 108(D9), 4290, doi:10.1029/2002JD002971, 2003.

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