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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of an improved radiation scheme in the MAECHAM5 General Circulation Model" *by* C. Cagnazzo et al.

Anonymous Referee #1

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GENERAL COMMENTS

The paper by Cagnazzo et al. describes a new shortwave radiation scheme implemented in the MAECHAM5 General Circulation Model. According to the results presented, use of this new radiation scheme results in a considerable improvement of the model results.

The topic is well suited for publication in Atmospheric Chemistry and Physics. However, the paper contains several serious shortcomings that makes it unacceptable for publication in ACP. In addition to some scientific issues, the paper is full of different technical mistakes. In my opinion, such an unprepared manuscript should not be published even in ACPD. Therefore, I recommend the author to prepare a good quality

manuscript and resubmit it to ACPD.

My main concerns are related to the validation procedure. First, I don't think that comparison of parameterizations with line-by-line schemes for only one zenith angle and only one O3 vertical profile is enough to validate parameterizations. I would prefer to see daily averaged heating rate profiles calculated for different conditions, e.g., for tropics, and mid-latitude summer and winter. Second, it looks extremely strange that the reference (line-by-line) scheme has different spectral range than spectral ranges used in either parameterizations. How does it affect the comparison? Also, the fact that the line-by-line and SW6 schemes compared well throughout the model domain suggests that there is a very small (even negligible) contribution from both 185-200 nm and 3333-4000 nm spectral intervals. If it is so, why to include these intervals in the parameterization? Third, you have extended the shortwave limit of the parameterization from 250 nm down to 185 nm. However, you didn't include strong absorption by O2 between 185-242 nm. The O2 absorption is especially important in the Schumann-Runge bands (shorter than 205 nm) where it dominates the O3 absorption. How does it affect your scheme?

SPECIFIC COMMENTS

p. 11072, L22-23: Spectral ranges treated are all different in your schemes (185-4000 nm for SW6, 250-4000 nm for SW4, and 200-3333 nm for LBL). How the heating rates can be compared then? How does it affect the results?

p. 11073, L1: The total solar irradiance varies between about 1365-1367 W m-2. Please justify your choice of 1349 W m-2 (by the way, I wouldn't call this value the solar constant). And please provide description of how you divided the flux at the model top between different spectral bands in both SW4 and SW6 schemes.

p. 11074, L5-6: ... heating rate is largest (12-16 K/day) at 1 hPa the South Pole and ranges between 8 and 10 K/day in the mesosphere - Looking at Figure 2, one can see that the heating rate at 1 hPa at the South Pole is 16 K/day (you gave a specific grid

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point, so there is only one value of heating at this point), and it varies in the mesosphere from 0 up to 16 K/day. Please be specific describing the figures.

p. 11074, L12-13: ranging between 1 and 3 K/day in the lower summer stratosphere - it is ranging within the same limits in the lower winter stratosphere too. Please be accurate with your description.

p. 11074, L10-19: Since your model lid is higher than 1 hPa, it would be more useful to compare the model results with a dataset extended above 1 hPa, not with the NCEPCPC analysis. Also, it would be more informative if you also show model biases.

p. 11074, L20: Can we believe in the NCEPCPC data at 1 hPa if 1 hPa is the upper boundary for the NCEPCPC analysis?

p. 11074, L20-21: With the exception of the polar region in winter the CTRL temperature bias is generally negative. - The bias is positive in winter only in the Southern hemisphere. Please be accurate.

p. 11075, L5-6: cannot be associated.. - It is associated, but not a direct effect.

p. 11075, L7: adjacent patterns of temperature minima and maxima... - which patterns do you mean? Please be more specific.

p. 11076, L7-8: the heating rate difference ranges between 1.2 and 1.4 K/day in the full mesosphere - What do you call the full mesosphere?

p. 11076, L21-22: Above, in the mesosphere, this situation facilitates the deceleration of the easterlies/westerlies in the summer/winter hemisphere... - But you have received stronger mesospheric easterlies/westerlies in the summer/winter hemisphere (Figure 5.) Please clarify what you mean by facilitating the deceleration.

p. 11078, L4: consistent with increased ice clouds - It is also consistent with increased H2O.

p. 11078, L7: Below 200 hPa EXP is about 3 % moister than CTRL - Below 500 hPa I

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would say. Between 200-500 hPa it is 3-9 % moister.

p. 11078, L9: the EXP lower - what is lower in the EXP?

p. 11078, L21: 3 K/day - this is for the 24-hour daylight, isn't it? Please clarify to avoid misleading interpretation.

P. 11080, L7-9: Coupled atmosphere ocean GCMs had not be mentioned in the paper before. How did you make this conclusion?

p. 11084, Table 1: There is a strong absorption by O2 at wavelengths shorter than 250 nm (Schumann-Runge bands and Herzberg continuum) that should be also included.

TECHNICAL AND TYPOGRAPHICAL CORRECTIONS REQUIRED

I have spotted quite a few spelling mistakes and so would recommend the authors to always run a spell-checker on manuscripts prior to submission. I would also recommend to increase the size of all contour labels.

p. 11068, L12: ratiation - should read radiation.

p. 11069, L20: entire atmosphere is not the same thing as the model domain. Please re-phrase.

p. 11069, L25: earlier cycle of the model - do you mean earlier version of the model?

p. 11070, L11: the full atmosphere - do you mean the model domain?

p. 11071, L13: he - should read The.

p. 11071, L21: the top of the atmosphere - should read the top of the model.

p. 11071, L24: proprieties - should read properties.

p. 11072, L11: he - should read The.

p. 11073, L10: Does Figure 1 show results for the summer mid-latitude profile of O3, for a clear-sky and aerosol free atmosphere, and for a fixed zenith angle of 60 degrees?

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Please clarify these points in the figure caption.

p. 11073, L22-24: In my opinion, this text can be removed since it does not give any information.

p. 11075, L3: ... of the summer hemisphere and winter hemisphere... - why not to say in the both hemispheres?

p. 11075, L20: solsticial - should read solstitial.

p. 11075, L22: the net shortwave and longwave heating rate... - only total radiative heating is shown in Figure 5. Please be clear.

p. 11076, L17: Fig. 5 (upper left) - should it be upper right?

p. 11077, L1-2: ... but at the South Pole stratopause in the summer hemisphere the difference in larger in January... than in July. – Very confusing sentence. Sounds like there is a 12-month summer at the South Pole stratopause.

p. 11078, L3: insteance - should read instance.

p. 11079, L2: solsticial - should read solstitial.

p. 11079, L27: strospheric - should read stratospheric.

p. 11080, L6: ratiative - should read radiative.

p. 11088, Fig. 2: Looks like the difference is shown in the top panels and heating rates are shown at the bottom. This is opposite to what is written in the caption.

p. 11088, Fig. 3: Very confusing figure caption. (a) There is no middle panels in the figure; (b) looks like that contour intervals on the top-left panel is 10 K, not 1 K as written in the caption; (c) looks like light (dark) shading shows 95 % (99 %) significance, i.e., opposite to what is written.

p. 11089-1092, captions of Figures 4-7: What does shading mean?

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p. 11090, Fig. 5 caption: here after, dashed contour line represent negative values - Does it mean that dashed lines in Figures 3-4 represent positive values?

p. 11090, Fig. 5 caption (and elsewhere): 20-year average, not 20-years average.

p. 11091, Fig 6: Very confusing figure caption. For example, middle and bottom panels can not show the same fields as Figure 4 (Figure 6 shows latitude-height distribution, whereas Figure 4 shows latitude-time dependence at 1 hPa).

p. 11091, Fig 7: The caption is misleading. Top panels show heating not temperature.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 11067, 2006.