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Geoscientific
Model Development
Discussions

Interactive comment on "Evaluation of the new UKCA climate-composition model – Part I: The stratosphere" *by* O. Morgenstern et al.

Anonymous Referee #1

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This article describes a new coupled chemistry-climate model that is the result of the coupling between the UK Met-Office GCM and an aerosol chemistry module. The model performances are evaluated in the stratosphere against meteorological data (ERA40) and chemical satellite data (UARS climatologies,…). Several diagnostics are also proposed to assess the strengths and weaknesses of the model. The methodology is sound and properly described. The paper is well written and clear and it perfectly fits the field of Geoscientific Model Development. The results will be useful to other scientists developing chemistry-climate models. This paper can be published as it stands. I just have some suggestions that the authors may wish to consider for improving the manuscript (see below).

P384, l15: I have a suggestion when a new version of the model will be developed.

If the problem is a warm bias around the tropical tropopause, there might be no need to ignore H2O as a prognostic variable in the chemical module. H2O has 2 sources in the stratosphere (flux of tropospheric H2O at the tropopause, the CH4 oxidation) with the temperature at the tropical tropopause controlling the H2O entry flux. It would have been preferable to impose temperature conditions at the tropical tropopause when calculating H2O supersaturation instead of fixing H2O. This would have allowed more degrees of freedom for stratospheric H2O.

P385, l18: No wet and dry deposition for chlorine and bromine species. Is it the case for all the species (HNO3 and so on)?

P385, l24: mixed NAT/ice particles? Probably PSC 2 particles, so ice particles.

P386, l4: They replace HCl and BrO? It would have been preferable to simply scale the sum of the chlorine (or bromine) species by the total chlorine (or bromine) tracer after the advection step in order to ensure that the sum is equal to the total tracer.

P386, l29: Why are the other heterogeneous reactions not affected by a change in aerosol loading?

P387, l23: the onset of the dehydration is somewhat late? Slight understatement. The dehydration should occur in winter, JJA. It occurs in spring (SON) in the model. Unless the seasonal variation of the temperature is shifted by a season, I would suggest to check the PSC scheme because the results are a bit strange. Is it possible that the JJA figure is in fact the SON figure?

P389: may be related to the tropical temperature bias. Is it a cause or a consequence? Is it a sign that there is a problem with Brewer-Dobson circulation? I would suggest to expand a bit more the discussion about the age of air.

P390, 1rst paragraph: There seems to be a confusion between the rate of ascent of the H2O anomaly (tape recorder) and the age of air. The rate of ascent of the H2O anomaly at the tropics depends on vertical velocity. The decay of the tape recorder signal mostly

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depends on the horizontal exchanges between tropics and mid-latitudes. The age of air profile depends on both processes: the ascent and the horizontal exchanges.

P391, l18: It is also possible that photochemistry is involved. If ozone is underestimated above, the photochemical production is higher lower down because the UV radiation (especially in the 200 nm window region leading to O2 photolysis) reaches deeper. A sort of self-healing.

P392, first paragraph: What does it tell us about Brewer-Dobson circulation?

P393, last paragraph: It is not surprising that there are differences between model and observed ClO. If the authors wanted to make a quantitative comparison, they should have tried to sample the model in the same way as the MLS data (dawn and dust) and not just day time sampling. If as stated there is an important diurnal variation in ClO, one needs to consider model ClO at the same local time as the measurements.

P394, first paragraph: The large positive bias in CFC lifetimes is consistent with a too slow B-D circulation. Preserving the order of CFC lifetimes is more a basic check of the codes than a validation of the model.

P395, l14: there might be a problem in polar temperature (see polar dehydration).

Interactive comment on Geosci. Model Dev. Discuss., 1, 381, 2008.

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