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Geoscientific Model Development Discussions

Interactive comment on "Improvements to stratospheric chemistry scheme in the UM-UKCA (v10.7) model: solar cycle and heterogeneous reactions" *by* Fraser Dennison et al.

Anonymous Referee #2

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An update of the UM-UKCA stratopsheric chemistry scheme is presented in this paper. The heterogeneous reactions have been extended to also include bromine reactions on sulphuric acid aerosol and polar stratopsheric clouds. Furthermore the photolysis rate calculations include now the 11-year solar cycle variability. The latter impacts total column ozone only in the order of 1-2%.Whereas the additional heterogeneous reactions improve total column ozone in polar winter and spring, especially over Antarctica. Both updates take the model to a standard other chemistry-climate models covering the middle atmosphere have achieved more than a decade ago. Nevertheless, I recommend publication. The paper is thoroughly written and the impact of the changes are generally well documented and helpful to modellers in this field. Furthermore it

provides a documentation on the development of the UM-UKCA model.

* General comments

- I support the criticism of Referee #1 concerning the statistical significance of the solar cycle simulation. A closer look at figure 2 reveals, that up to the year 2000 ozone anomalies closely follow the solar coefficient. This signal is lost after 2000, where it could be interpreted as noise around the zero line. The author's provide no statistical evidence (and I think they can not) to convince the reader, that the model is able to show the impact of the solar cycle on total column ozone (TCO). What to do? Either extend the simulation, as suggested by referee #1, and hope that the signal on TCO can then be certainly identified, or use a different indicator. TCO might not be the best indicator for the impact of the solar cycle on stratospheric ozone. The signal is rather small. For instance a time series which does not only look at TCO, but considers the vertical distribution of stratospheric ozone could save the day. Also to discriminate between hemispheres or tropics and mid latitudes might help. There could be compensating effects (chemical or dynamical ones), which lead to the noisy signal in TCO. All in all, I strongly suggest a more sound statistical analysis of the impact of the solar cycle on stratospheric ozone.

* Specific comments, additional comments on topics, which have not been covered by Referee #1:

- l20-30, p2: A GMD paper does not need to provide a complete extensive overview on the field. But at least the fact that some chemistry-climate models have included the heterogeneous stratospheric bromine reactions for a long time should be mentioned, e.g. see supplement of Jöckel et. al. ACP, 2006 and others.

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