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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulations of preindustrial, present-day, and 2100 conditions in the NASA GISS composition and climate model G-PUCCINI" *by* D. T. Shindell et al.

Anonymous Referee #2

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The paper describes a new version of the NASA GISS climate and composition model together with first applications of this model to study climate and composition changes between preindustrial, present-day and year 2100 conditions. One of the important features of the new model is the uniform, "seamless" treatment of chemistry from the surface into the lower mesosphere. This is an important step forward, since so far most models have only considered either tropospheric or stratospheric chemistry in a comprehensive way. This uniform treatment of tropospheric and stratospheric chemistry allows a more realistic investigation of the changes of stratosphere-troposphere exchange (STE) due to changes in climate and emissions.

The paper is in general well written and in my opinion deserves publication in Atmos. Chem. Phys. However, the paper in its current form is rather long and it may be worth considering to split the paper in two parts, with the first part describing the new model version and comparisons with observations for the present day (PD) scenario, and the second part focusing on changes of STE for different scenarios.

More specifically, the authors should try to better separate the more general discussion of the model from the more specific details for certain model experiments. E.g. I found the very specific statements on p. 4799, l. 20 ("... ozone climatology set to 1990s levels...") or on p.4803, l.23 ("Present-day simulations use seasonally varying climatological SST...") slightly out of place in the context of the model description. Just because the paper is very long, it is important to introduce a clear structure of the material.

Specific comments

p.4798, l.21: Is there a reason to use JPL-2000 reaction rate recommendations (i.e., Evaluation No. 13)? Evaluation No. 14 is available now for more than three years and very recently evaluation no. 15 was published. Are the photolysis cross sections in Fast-J2 based on JPL-2000 as well?

p. 4799, l.5-9: When I first read the sentence that a "simple temperature threshold for type I PSC" was used, I expected that this threshold temperature would be based on the Hanson and Mauersberger NAT equilibrium temperature. However, this is probably what is called here the "more sophisticated model"? Maybe you could explain briefly how the temperature threshold is defined. Although not relevant for the present paper: Does the "more sophisticated model based on Hanson and Mauersberger" really describe particle growth (as stated) or is this still an equilibrium scheme?

p. 4800, l.13: "... can influence photolysis rates": Is this calculated interactively in the current model?

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p. 4801, l.5: It would be useful to have a full list of the radiatively active gases included here. Just as examples, of course H2O will be included, but what about NO2?

p. 4800, Sec. 2.2: Tables 1 and 2 show that bromine compounds are included, but no bromine source gases. How are they treated? Moreover, for chlorine source gases how well does the grouping of all source gases into CFC-11 work? Has this been tested/published previously? How is the background of chlorine from natural sources treated? Is this released into the stratosphere or present also in the troposphere? Is there also a background of bromine from natural sources in the model? (The 2002 WMO Ozone Assessment estimates that roughly half of the present-day stratospheric bromine loading is from natural emissions.)

p. 4805, l.23: Convective drying: Is convective drying represented in the model and is this a relevant process in the model, or is this a more general statement here?

p.4811, l.11: "...the model correctly transports stratospheric ozone anomalies all the way to the surface...": What means "correctly" in this context?

p.4815, l.19: The discussion of the bromine compounds here is a bit of an oversimplification. In fact there are significant differences between the partitioning of the chlorine and bromine families that are ultimately responsible for the much larger ozone depletion efficiency of bromine as compared to chlorine.

p.4819, first and second paragraph: Explain why the A1B and the A2 scenarios were used. Explain briefly how they differ and on what assumptions/ scenarios they are based.

p.4820, l.2: "Q-flux" is jargon. Please explain or omit.

p. 4823, l.19: I don't fully understand this point. Table 6 shows that the ozone flux increases. So how could an increased ozone flux lead to a decrease in the ozone concentration? (I would buy your argument if the vertical mass flux increases only.)

p. 4847, Table 2: I have two comments regarding the list of reactions used: (1) The

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reaction N + NO as a sink of NOx in the upper atmosphere is missing and (2) heterogeneous bromine chemistry is missing. In particular the reaction of BrONO2+H2O on sulfate aerosols has not only an important impact on lower stratospheric (mid-latitude) bromine partitioning, but also on HOx and NOx partitioning.

p. 4849, Table 4: Please explain the meaning of "average difference" and "average bias". Is "average difference" an RMS difference?

p. 4852, Table 7: It would be interesting to have the PD values (in mm/s) included here.

Technical correction

p. 4800, l.1: "evaluated in Koch et al." should be "evaluated by Koch et al."

p. 4800, l.1: please explain acronyms before first used: DMS (I know what that is) and MSA (unfortunately I don't know what that is).

p.4814, l.23: "which is peaks at" should be "which peaks at"

p. 4818, l.1: explain acronym "IPCC TAR" (= third assessment report) when first used.

p. 4826, l. 15: "than in many areas" should be "that in many areas"

Use subscripts for chemical compounds in the reference list.

p. 4847, Table 2: Include an "M" on the rhs of eq. (56)

p. 4856, Fig. 2: Include label "Latitude" and "S" and "N" on y-axis.

p.4861, Fig.7: Include lat/lon of stations as in Fig. 8.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 4795, 2006.