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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Role of external factors in the evolution of the ozone layer and stratospheric circulation in 21st century" *by* V. Zubov et al.

Anonymous Referee #4

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1 General comments

The authors analyse the different factors governing the development of the future ozone layer and stratospheric dynamics. By performing model experiments where ODS, SST and GHG concentration is varied combined and exclusively, theiy derive the corresponding contribution to temperature and ozone trends. The authors' main conclusion is that SST is a dominating factor for the future ozone development, and that future model intercomparisons should carefully plan this boundary condition to control its impact on model results. In addition, their study allows to evaluate the importance of non-linear interaction between ODS, GHG and SST, showing its role to be minor.

Whereas the authors present a clear and focussed study of the influence of main factors of future stratospheric ozone development by itself, it is not clear to which extent their main finding is new or if this study really brings any progress to the understanding of the underlying mechanisms. For example, even simple analysis of the strength of the BDC for the different scenarios is not undertaken in the paper (via mean age of air or stream functions), nor any analysis of planetary wave activity is presented. The authors do not put their results in context to other work and do not discuss possible differences or agreements. In addition, the authors themselves remark that the used SST in their experiments is somewhat extreme, leaving the reader with a mixed feeling how conclusive this study is.

I therefore cannot recommend publication of the paper in its present form. The study needs in my opinion additional experiments and a deeper analysis of underlying dynamical mechanisms to be publishable in ACP as a regular article. If the authors intended to bring to attention how important the SST/STI setup for model intercomparison are, one could also consider to present the result to the community as a technical note.

2 Specific comments

2.1 Some general aspects

1. The general importance of the SST for the strength of the BDC is not a new result and many aspects have been discussed in the literature (in addition to Deckert and Dameris 2008, or Kodama et al. 2007, see also eg. Rind et al. 2002, Garcia and Randel 2008, Olsen et al. 2007) applying similar analysis as presented by the authors. The authors should put their results in this context.

2. For model intercomparison projects like CCMVal the authors point to the role of

SSTs and that differences found between the models could strongly depend on the chosen SST. The clarification of the impact of SST and their implementation is therefore of substantial interest for such projects. For SOCOL however, the SST used is an extreme example. It would have been of more relevance esp. in the context of the CCMVal activity to use a SST in SOCOL which other model had applied and to analyse if SOCOL then is closer to the model mean. Perhaps the additional experiment with a different SST distribution (NCAR ESM) can be checked for that.

3. The extreme SST realisation used here calls for further analysis, for example comaprison of the SST field with a more typical realization in CCMVAL. Experiments are desirable where a moderate SST is applied and to see if the conclusions drawn in the paper are still valid, for example with regard to the RES term. In addition, it would be of further interest to study how sensitive results depend also on spatial patterns (low-lat/ mid-lat gradients) in the SST.

4. SST acts via planetary wave generation, propagation and breaking in the stratosphere on the strength of the BDC which itself affects ozone transport. None of these factors is analysed in the paper, and even an analysis of the model's BDC for the different realisations (for example using a mean age air tracer) is missing.

5. The paper lacks a discussion of the results with respect to previous work. It remains unclear if the conclusion presented in this paper are somehow new or if they are just in line with common knowledge.

2.2 More specific aspects

1. The model setup is hard to understand. Does it mean that after 10y spinup CO2 is slightly varied, and then the run is continued for two years, five times using the same start conditions? Do the five results of the second year represent the

ensemble, or the two years are used? Why did the autors choose this approach? Can the authors exclude a preconditioning of the ensemble member which could make the results not representative?

2. Inspecting Fig. 3-6 of WMO-report 2010 the SOCOL models and EMAC show a strong decline of tropical total ozone, despite they seem not to use the same SST data set (NIWA uses HadGEMI). This hints to a specific property of ECHAM type models. Can you comment on that?

3 Technical comments

Generally, the paper would strongly benefit from a correction by a native English speaker. Very often articles are missing, and expressions are sometimes unusual.

Page	Line	Comment
28468	L2	contributions
28468	L5	the atmospheric ...
28468	L6	you may write here: .., and the prescribed SST ... and leave the next sentence out
28468	L10	It was found
28468	L16	expression
28468	L20	which simulation do you mean?
28469	par 1	Just leave that paragraph out
28469	L20	The SST must be considered as an external factor because SOCOL and the majority of models participating in CCMVal have no interactive ocean.
28470	L9	y or years

28470	L11	use of article: the total tendency of the ozone layer and the dynamics throughout the 21st century; here and at many other places
28470	last para	start with line 1 on p28471
28471	l6	by some differences
28471	l25	latter
28472	Section 2.1	Has the model a (spontaneous or forced) QBO?
28475	l14	abs(x) > 0!
28476	l6	this conclusion cannot be drawn without analysis of the radiation budget, esp. analysis of vertical velocity
28476	l10ff	as before this conclusions are not drawn from material presented here. Please give a reference, or the necessary analysis.
28476	l25	what do you mean with SST forcing?
28476	l28	sentence ends abruptly.
28478	l8	Fig. 5d shows negative RES values in the polar SH. That means TOZ is smaller in the full run compared with the sum of single runs. Why is then the recovery acclerated?
28478	l28	..., that the resulting ozone reduction compensates completely ozone increases due to reduced ODS.
28479	l25	vanishing instead of dissipation
28487	Figure	a - d is not given in the Figure itself. Please use SI units.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 28467, 2012.