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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Interannual-to-decadal variability of the stratosphere during the 20th century: ensemble simulations with a chemistry-climate model" *by* A. M. Fischer et al.

Anonymous Referee #2

Received and published: 29 August 2008

General comments:

The paper analyzes an ensemble simulation of the Chemistry Climate Model SOCOL covering the 20th century. The nine ensemble members are simulated in transient mode with a set of prescribed external forcing sources which make use of recently reconstructed and re-evaluated data products. The manuscript focuses on the evaluation of simulated long term stratospheric ozone and dynamics. Therefore the ensemble simulations of total ozone column, vertical ozone distribution and estimated ozone trends are compared to different observational ozone data sets. The model representation of dynamical features is analyzed by comparison with ERA40 and NCEP

Reanalysis. In this context several dynamical diagnostics like the strength of the sub-tropical jet and the polar vortex, the Eliassen-Palm flux and it's correlation with polar temperature and springtime total ozone are calculated and evaluated. In general the ensemble simulation of ozone anomalies and dynamics in the (sub-)tropical belt is in good agreement with observations which allows the quantification of decadal variability in this region in relation to the variability of the forcing parameters. In the Antarctic lower stratosphere the negative ozone trend is underestimated by the ensemble simulation, while the model representation of the Arctic polar vortex is too strong.

The manuscript provides a useful contribution to the discussion of long term variability of stratospheric chemistry and dynamics during the 20th century. The paper is well-written, with a detailed description of the boundary conditions, and a well structured results section. The internal model variability in the Arctic is discussed with the conclusion that the largest ensemble spread is found here. Several dynamical diagnostics are evaluated for the NH polar stratosphere. I think the paper would benefit from a short discussion of the internal variability of the SH polar stratosphere (i.e., it is not totally clear from the figures shown in the paper that the internal model variability is larger in the Arctic than in the Antarctic. See also detailed comments below). After improving the specific comments discussed below the paper is suitable for publication in ACP.

Specific comments:

page 14372, line 10: I couldn't find the full name for the acronym SOCOL.

page 14373, line 22: Write "CCMVal" instead of "CCMval" throughout the manuscript.

page 14373, line 23: Define the acronym SPARC.

page 14377, line 4: Replace "GHG" with "GHGs".

page 14379, line 1: Replace "had" with "have".

page 14383, line24-26: It looks (based on the time series shown in Figure 4) that the internal variability of the seasonal cycle in the Antarctic is quite large as well, maybe

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even of comparable magnitude as the internal variability of the seasonal cycle in the Arctic.

page 14383, line 27 - page 14384, line 7 : Please explain why the run with the restricted ozone mass fixer leads to a more realistic seasonal amplitude in the tropics compared to the run with the globally applied mass fixer. Such an explanation will be useful to understand why the restricted mass fixer is applied instead of the global one (which would in the first place seem to be a more natural choice here).

page 14384, line 13-17: As already noticed for the zonal means the amplitude of the seasonal cycle at the different stations is clearly underestimated by SOCOL. This should be added to the text. The last sentence might be misleading in this context.

page 14385, line 29: Is the EESC time series taken at the boundary (as given in Figure 2c) or at the individual altitude where the trend is estimated?

page 14390, line 27-28: "modeled EPz" - are individual ensemble members or the ensemble mean meant here? It was mentioned earlier that the modeled EPz at 100 hPa is in reasonable agreement with the observations (especially in the NH). Is that consistent with the now mentioned lower modeled EPz?

page 14391, line 3-9: How do you analyze the RMC? Is it only through looking at the tape recorder signal in the tropics?

page 14393, line 23-24: It is not totally obvious that the largest internal model variability is found in the north polar region: the time series of TOZ seems to have similar internal variability in the north and south polar region, PVS is only shown for the north polar region and EPz shows similar internal variability in the NH and SH.

page 14394, line 12: Insert "variability".

page 14394, line 27 - page 14395: Reformulate this sentence: "in very good agreement ..." with what?

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page 14406: N2O or NO2?

page 14410, page 14411: the merged SBUV(/2) data set is given for 9 layers with the lowest layer from 1000 to 64 hPa.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 14371, 2008.

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Interactive Comment