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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulation of stratospheric water vapor trends: impact on stratospheric ozone chemistry" *by* A. Stenke and V. Grewe

A. Stenke and V. Grewe

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Point-to-point-reply:

General comments:

The reviewer suggested to include a section describing model deficits and strengths. The model climatology has been extensively validated, especially the model climatology in the Arctic stratosphere, e.g. Hein et al., 2001, and Austin et al., 2003. We included a short summary of the respective results to point out specific model weak-

nesses and strengths. Special effort is put on the modeled water vapor distribution. Therefore, we included Figure 3 showing the modeled water vapor and methane distribution as well as 2*CH_4+H_2O in the UT/LS region.

As the second major point the reviewer suggested to place more emphasis on the asymmetry between Arctic and Antarctic. Our model results indicate that the modeled water vapor perturbation affects the PSC activity in southern polar regions, but not in northern polar regions. We included a paragraph explaining these effects in detail (see below). Additionally, this major result of our study is highlighted in the abstract as well as in the conclusions. Within the conclusions section we added a paragraph discussing the potential response in the "real" atmosphere.

Finally, we restructured the conclusions section. We added a short discussion section to the result section comparing our model results with previous studies.

Specific recommendations:

Generally, we revised the whole text carefully and put special effort on clarifying all ambiguous points. I hope our efforts have been successful.
All $-$ signs have been removed as stated by the reviewer.

- abstract:
  We revised the abstract according to the referee's suggestions. Additionally, we stressed the difference between Arctic and Antarctic stratosphere more since this is a major result of our study.
- page 6562:
  We removed the error bar in Figure 1. Furthermore, we included a short para-

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graph discussing the results of Randel et al., JAS, 2004, in conjunction with the modeled water vapor trend.

- page 6565:
  Notation OH-S changed to OH_{Sp}.

- page 6568–6570:
  We removed the summary of atmospheric chemistry. The most important reactions are listed in the appendix. We refer to the respective reactions when the results are discussed.

- page 6572:
  The enhanced ozone production is associated with the enhanced methane oxidation caused by the OH increase. We revised this paragraph to clarify this point.

- page 6575:
  We changed this part of the text. The original text might imply that CHEM uses a constant temperature threshold for PSC formation which is lower than usually assumed. Therefore, we included a short description of the PSC parameterization in CHEM which is based on modeled temperatures and mixing ratios of H_2O and HNO_3.

- page 6576:
  The respective paragraph was changed according to the recommendations of the reviewer.

- page 6577:
  The surface UV calculation does not take into account any cloud effects. Therefore, we removed Figure 13 and the associated paragraph from the manuscript.

- page 6578:
  We put a stronger focus on the differences between the Arctic and the Antarc-

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tic stratosphere which are associated with a different impact of the water vapor increase on the PSC activity in both polar regions. Our model results indicate that the modeled water vapor perturbation affects the PSC activity in southern polar regions, but not in northern polar regions. To explain these differences we included a new figure (Fig. 11) which shows the modeled zonal mean temperatures at 50 hPa, 80°N/S. A discussion about the likely response in the "real" atmosphere was added to the conclusions section.
We replaced the reference WMO (1986) by the reference of the textbook of Seinfeld and Pandis (1998) which contains a complete description of atmospheric dynamics and chemistry.

- page 6580:
"The cooling effect on stratospheric temperatures" means the increasing GHG effect on stratospheric temperatures. The reviewer is right, there are large uncertainties regarding the increasing GHG effect and stratospheric water vapor trends, but a future increase in stratospheric water vapor is one possibility. We revised the respective paragraph, taking into account the current discussion on water vapor trends in the stratosphere. We tried to phrase this part of the conclusions carefully.

- Table 4:
We added the required information on latitude and time ranges in Table 4.

- Figure 2a:
The time period from 1950 to 1960 was used as spin up for the transient model simulation. Unfortunately I included the wrong figure in the manuscript. Figure 2a has been replaced by a new figure starting in 1960. A paper presenting the results of the transient model simulation (see footnote page 6561) has been submitted to ACPD recently and is now referenced.

- Figure 6,8,9:

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I am not sure about this comment. There are discrete tick marks at the abscissa which indicate the middle of the month.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 6559, 2004.