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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

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*General comments*

The reviewer agrees with many comments made by reviewer 1 so that the major points have already been answered in the author comment to review 1. Both referees have suggested to include a section describing the model deficits and strengths relating to the simulated water vapour distribution. As stated in the author comment 1 we will include this required section in our manuscript. Furthermore we will include a section discussing our results with the respective model weaknesses in mind.

Both referees have also suggested to place more emphasis on the asymmetry between Arctic and Antarctic ozone chemistry. Therefore we will describe the polar ozone chemistry under perturbed conditions in more detail and discuss the results in respect of the unperturbed polar ozone distribution in the model.

*Specific comments*

- Page 6562 - modelled and observed water vapour trend over Boulder:
  As shown by Randel et al. (2004) there is a great disparity between the Boulder balloon data and the respective HALOE satellite data regarding the decadal changes (trends) for the period 1992–2002. The comparison between the modelled water vapour time-series and the Boulder balloon data is now somewhat uncertain. Therefore we agree with the reviewer to consider the new results of Randel et al. (2004) in this context.
- Page 6565 - notation OH-S:
  We used this notation since it has already been used by other authors like Lawrence et al., ACP, 2001. But since both referees made this comment the notation OH-S seems to be confusing so that we will change the notation.
- number of chemical reactions:
  We will shorten (or remove) the paragraph of atmospheric chemistry and keep only the most important reactions.
- Page 6572:
  The chemical solver is based on the family concept and is extensively validated in comparison to a commercial solver (FACSIMILE) (Steil et al., 1998). The mentioned numerical effects are not concerning the chemistry scheme, but the semi-lagrangian transport scheme, which may in some extreme cases lead to a counter



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gradient vertical transport (Grewe et al., 2002). As mentioned in the text, the unrealistic $ClONO_2$ increase occurs right after the initialisation of the model simulation at the upper boundary in the region of the Antarctic polar vortex edge. Since chemical effects of the simulated water vapour perturbation as well as dynamical effects are not appropriate to explain the $ClONO_2$ increase, numerical effects of the semi-lagrangian transport scheme are the most probable explanation. These numerical effects only affect the short-term experiment VOLC. The long-term experiments do not show such a behaviour. Therefore the main results of our study are not affected by this numerical effect.

- Page 6575:
  The value ≈190 K is indeed too general. The temperature threshold for PSC formation (pressure dependent) ranges between ≈190-195 K for Type I PSCs and ≈188-190 K for Type II PSCs. In the model temperature and mixing ratios of $HNO_3$ and $H_2O$ are used to calculate the formation of PSCs, and not only a constant temperature threshold. Unfortunately the text is misleading.

- Page 6576:
  We will revise the whole manuscript seriously and hopefully clarify the ambiguous points.

- Page 6578:
  Indeed the asymmetry between Arctic and Antarctic is an important result of our study. As mentioned in the reply to review 1 we will put more effort into explaining these interhemispheric differences.

- Page 6579:
  Figure 14 was included to summerise the results of the two different perturbation simulations (+1 ppmv and +5 ppmv). Indeed, there are only two points and the origin given. The linear relation between ozone response and stratospheric water vapour perturbation is not a main result anyway, but it is used to estimate the



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impact of the water vapour increase in the transient model simulation on the modelled total ozone decrease.

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