

Interactive comment on “Interaction of chemical and transport processes during the formation of the Arctic stratospheric polar vortex” by D. Blessmann et al.

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Dear reviewer,
thank you for reviewing our paper and your helpful comments!

General comments

- a) Unfortunately, in a number of places in the manuscript, words like “spring” and “mid-winter” were erroneously used, where “early winter” would have been much more appropriate. We apologize for this and this has been corrected in a number of places. The reason for the confusion was in part due to earlier versions of

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the manuscript focussing also on later periods in the winter. However, this paper concentrates on the time period up to early winter and we hope that is clearer now.

We don't want to convey the impression that the studies of Kawa and Sinnhuber play a central role for this paper. So far, there is only a statistical correlation and no convincing mechanistic explanation for the relationship of early winter ozone and late winter columns. In addition, the variability of early winter ozone is an interesting topic of research by its own right, even if there would be no connection to the late winter total column. Hence, we have moved the paragraph to a less prominent position in the introduction and have rewritten part of the introduction.

It is formally correct that the model runs stop in March, but the latest data used is from January. We hope that this is sufficiently clear from the manuscript and does not lead to confusion.

- b) We agree that some additional discussion on how the results of this case study can be generalized and carried over to other winters is appropriate and helpful for strengthening the validity of our conclusions. The restriction to a single winter is due to computational constraints. We assume here that the basic conclusions from our paper will not be invalidated by the interannual variability in temperature, NO_x levels and transport, since the latitudinal, vertical and temporal gradients in the lifetime of ozone will mainly be determined by the solar insolation. We have now added some discussion of this to the paper. In addition, we performed some simple sensitivity runs to estimate the effect of interannual variability in temperature and NO_x. These runs show that interannual changes in temperature or NO_x are of second importance for the lifetime of the signal.
- c) and d) We have now changed the title and some other occurrences of this to avoid confusion. You are right, we cannot and do not discuss the possible feedback of chemistry on transport (e.g. by the influence of ozone on the radi-

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ation balance). We did not intend that “interaction” would be interpreted in the meaning of “feedback”, but understand that this can be very misleading. The original idea behind the title was based on the idea that chemistry can “influence” where variability in transport remains visible in the mixing ratios of species and, vice versa, that transport and mixing influences the lifetimes of species.

- e) Unfortunately, there does not seem to be much literature about the vortex development in fall. Obviously, most of the studies concentrate on the winter and spring season. In particular, I couldn't find any literature on the breaking and propagation of waves and its influence on the mean circulation, transport and mixing in autumn (September to November). I have added some references to the two paragraphs for the onset of the development of the vortex and the relaxation to the chemical equilibrium by NO_x chemistry. The best general description (and source for other papers) seems to be Kawa et al. (2003).

Specific comments

- Page 32284: Paragraph has been removed.
- Page 32285, line 9: Added reference to Kieseewetter.
- Page 32285, line 28: Changed as suggested.
- Page 32286, line 12: Added “unless there is some feedback on dynamics and transport” to the sentence.

Technical corrections

- Page 32285, line 14: Corrected.

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- Page 32285, line 29: Changed as suggested.
- Page 32286, line 8: Changed as suggested.

Additional changes by us

- The figures and discussion were restricted to levels below 750 K. Above 750 K, the passive ozone tracer in Figure 1b is not reliable. Since air masses which are above 750 K at the end of the model run were above the upper model boundary at the time of initialization (1 August), the passive ozone tracer cannot be initialized properly there.
- A paragraph discussing the effect of changing the date of the perturbation was added.
- In addition to the changes in grammar, style etc. suggested by you and the other reviewers, some paragraphs, including parts of the introduction and the conclusions and the figure captions were rewritten for more clarity (without changes in content). Some references were added or updated.
- A paragraph discussing the effect of changing the magnitude of the initial perturbation was added due to the request of reviewer 3.

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