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Geoscientific
Model Development
Discussions

Interactive comment on "The Lagrangian chemistry and transport model ATLAS: simulation and validation of stratospheric chemistry and ozone loss in the winter 1999/2000" *by* I. Wohltmann et al.

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Dear Jens-Uwe,
thank you for reviewing our paper and for your valuable comments!

Major comments

1. We rephrased the text on page 773, line 24–26 to make it more clear that supersaturation is the default configuration.

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It may be that some confusion arises here, because NAT particles are formed in two different modules in the model as pointed out on page 774, line 20 and line 24. You are right that observations indicate that supersaturation must be present for particles to form. This is considered in the actual model runs by assuming a supersaturation of 5 for HNO_3 over NAT in the equilibrium module (not in the particle module) (page 778, line 6). The description on page 773, line 24–26 only described the general features of the model and stated that either no supersaturation or a supersaturation could be set, but did not refer to any particular model run.

Indeed, in the particle module, particles are formed as soon as the temperature drops below the NAT formation temperature. We follow Carslaw et al., 2002 here. Since particle formation for the large NAT particles is badly understood, we think that approach is reasonable.

2. It is true that the supplement contains only a formal description of the figures and no interpretation. However, at several locations in the paper, we refer to the supplement and interpret the shown figures. We think giving an average deviation would not really add any additional value. An average deviation can easily be estimated just by looking at the figures. Additionally, the deviation is often a function of solar zenith angle, temperature, equivalent latitude, season and the quality of the measurement, which would require a much more detailed interpretation of the several hundred figures that are shown in the supplement. We think that would lead too far. The supplement is intended as an additional bonus which needs not to be known to understand the paper and will admittedly require some knowledge of stratospheric chemistry and transport for interpretation.

3. We agree that this is an interesting issue which would be worth a study of its own. However, we think this sort of study is clearly outside the scope of the paper, which is mainly a model description and validation paper. To estimate the ozone loss by the Match method in the model would require an additional model

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run, since the necessary information was not written to the output files we used in this study. It would also mean to write a considerable amount of new code, e.g. to implement the cluster trajectories which are used to sort out Match trajectories in divergent flow situations.

We agree that the Match method could show more ozone loss than the model since ozone loss in the Match method is determined by default only along trajectories that are inside the vortex and not affected by mixing, while the ozone loss shown in the paper is determined from all air parcels inside the vortex, which could have originated from outside the vortex some time earlier (or could contain air from outside the vortex by the mixing process).

Minor comments

1. I agree.
2. Unfortunately, no separate description of the chemistry module was published so far. I have added another reference where the model is shortly described.
3. Thank you for pointing me to this omission. The boundary layers are handled as described in the first part of the model description paper (GMD, 2, 153–173). I have added a comment to the paragraph.
4. Rephrased the paragraph to clarify this.
5. You are right. I clarified the text.
6. Done.
7. The altitude resolution at 20 km is about 1.25 km. The vertical resolution is now mentioned in the description of the model setup.

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8. Done.

9. The vortex-average data available extends only to 660 K. The vortex gets more permeable with increasing height, which prevents the application of the method in higher altitudes.

10. I assume this should read 785.24. Of course, this only applies to the circulation that was present during the 4 months of the model run. In lack of a better expression, I would like to leave the sentence as is.

11. Done.

12. Expressed a little bit more carefully.

13. Since there is no Figure 53, and the species on page 53 is NO_2, I am a little bit confused. In addition, there *are* figures showing both ClO (Figure 18) and ClO_x (Figure 20).

Interactive comment on Geosci. Model Dev. Discuss., 3, 769, 2010.