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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modelling the effect of denitrification on polar ozone depletion for Arctic winter/spring 2004/05" *by* W. Feng et al.

Anonymous Referee #1

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This paper presents model calculations on the effect of denitrification on Arctic ozone depletion. It is shown that a model with a detailed microphysical PSC scheme produces HNO3 (and by inference denitrification) in better agreement with observations than a model with a simpler equilibrium scheme or even a model without denitrification at all. The paper is in general well written and I recommend publication in ACP after consideration of a few mostly minor comments.

General comment

The result that denitrification affects Arctic ozone depletion is not new at all. I suggest to include a reference to Waibel et al., Arctic ozone loss due to denitrification, Science, 283, 2064-2069, 1999. Clearly the detailed microphysical scheme in the model results in a much better agreement with observed HNO3 than the simpler equilibrium scheme.

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However, the impact on modeled chlorine activation and ozone seems to be rather small (conclusions, page 3869: "...with a small effect on Arctic ozone loss"). So I don't understand why one of the conclusions is that "simulation of the impact of denitrification on ozone depletion...requires a detailed microphysical scheme" (abstract, p. 3858, l. 17-19 and conclusions, p.3869). Secondly, it is stated in the abstract that "use of the DLAPSE scheme improves the simulation of Arctic ozone depletion compared with the inferred partial column ozone loss from ozonesondes and satellite data". From the data in Table 2, the difference between EXP_A and EXP_B again seems rather small and I wonder if this difference is significant, given the large scatter of the inferred ozone loss from various observations. In fact, the discussion on p. 3867 appears to be much more cautious than the statement in the abstract.

Specific comments

p. 3860: "A feature of the MLS technique...": I believe this applies to ASUR as well?

Table 1 lists the different treatments of denitrification in the different model runs. Are the PSC surface areas as used for the chemistry the same in all model runs?

Figs. 1 and 2: Are the horizontal bars on the ASUR curves error bars? If so, what kind of error do they represent? And why is the ozone error apparently so large below 25km and suddenly so much smaller above 25km?

Fig. 3: I guess it would be much more straight forward to show all differences with respect to the observations. I.e., (EXP_A-ASUR)/ASUR*100, (EXP_B-ASUR)/ASUR*100, etc. In the current form the large differences to EXP_C (no denitrification) are highlighted, but it is more difficult to judge how good EXP_B agrees with the observations.

p. 3868, l. 6: can you give numbers for EXP_A here as well, i.e. by how much the modeled ozone loss improves using the detailed scheme? This information ($\sim$10DU) is only found in the next paragraph, if I understand this correctly. I suggest to combine the

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discussion of Figs. 7 and 8 and not to treat this as two independent pieces of evidence.

p. 3868, l. 26: "too strong chlorine activation": compared to what? ASUR / MLS data? The difference in chlorine activation (or more precisely modeled ClOx and HCl) seems small between EXP_A and EXP_B. If you believe this is a conclusion from this study, it would be good if you could show by how much chlorine activation changes / improves between EXP_A and EXP_B. (See my comment to Fig.3 above.)

p. 3869, l.8: "The simulations are QUITE SENSITIVE to the PSC schemes used in the model, with a SMALL EFFECT on Arctic ozone loss": To me this sounds self-contradicting. Do you mean "quite sensitive" with respect to NOy, with "a small effect" on ozone loss?

Technical corrections

p. 3859, last line: what is the meaning of "thereafter" here?

p. 3861, l.9 remove "as" before "vertical coordinate"

p. 3865, l.16: include "the" before "model"

p. 3866, l. 12: remove "which" before "consistent"

p. 3868, l. 22: "a three-dimensional chemical transport model" or "the three-dimensional chemical transport model SLIMCAT"

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 3857, 2011.