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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Denitrification by large NAT particles: the impact of reduced settling velocities and hints on particle characteristics" *by* W. Woiwode et al.

Anonymous Referee #1

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This paper showed comparison of HNO3 measured and simulated vertical profiles inside the Arctic vortex. MIPAS measurements. It is well written and structured.

I have one major concern. The main conclusion is that the reduced sedimentation velocity of NAT particles in the CLAMS simulation may improve that agreement of gas phase HNO3 profile with airborne MIPAS-STR measurement.

The main conclusion depends on the results shown by Figure 7 (25.January) and Figure 8 (30. January). On 25 January, PSCs were observed. The HNO3 partitioning between gas phase and condensed phase (NAT and STS) depends critically on temperature. Therefore, one should focus more on 30. January, as the temperature was well above T-NAT and all HNO3 is in the gas phase.

Panel (a) of Figure 8 shows that the maximum HNO3 of CLaMS calculation lies around 400 K, while the MIPAS-STR data show maximal values around 420 K. The peak value of CLaMS is higher than MIPAS-STR.

The author made only sensitivity tests for sedimentation velocity of NAT particles. However, other factors may also influence the vertical redistribution of HNO3: for example temperature and NAT nucleation rate coefficient would like to see the results of the following sensitivity runs:

1) Increase or decrease the overall temperature by e.g. 1K;

2) Decrease the NAT nucleation rate by 50% and increase the rate by 100% and 200%;

3) Some combinations of 1) and 2).

In addition, in the present study, only NAT formation on dust particles is considered. However, in January 2010, synoptic ice PSCs were also observed (e.g. Engel et al, ACD 2013). NAT can also nucleate on ice particles forming PSC mix2 enhance (Engel 2013). It is totally unclear, how the NAT on ice effect the HNO3 redistribution. If the NAT number is too high, they may have less denitrification potential than fewer but larger NAT particle.

It would very useful, if the author could also implement NAT formation on ice. One can only make the conclusions after the sensitivity tests have been performed.

Minor points: 1) P1, line 23-25; The sentence "In situ observations by the particle probe FSSP-100 during the RECONCILE campaign indicate unexpected large potential NAT (nitric acid trihydrate) particles inside PSCs. " is misleading. The FSSP data show very large particles, possibly NAT, if the particles were spherical and compact. Rephrase: During the RECONCILE campaign, apparent very large NAT (nitric acid trihydrate) particles were observed by : In situ observations by the particle probe FSSP-100 inside

PSCs. I think that the word “apparent” is important, because this large size is the effect of the instrument.

2) P2, L4-6, “The results of our study support the hypothesis that denitrification is produced by significantly aspheric (i.e. columnar) compact NAT particles which are characterised by reduced settling velocities.” One cannot exclude the possibility that the NAT particles are not compact and have a smaller density. Suggest: The results of our study indicate that the NAT particle may sediment with a reduced velocity than when they are spherical and compact indicating either the NAT particles are not compact or they are highly non spherical.

3) Add the corresponding size distribution obtained from CLaMs simulation for the same time and same location into Figure 1 would be great.

4) Figure 4. The figure caption is confusing: is the plotted quantity continuum extinction or continuum absorption coefficient? In the figure caption, “continuum extinction” is used and in the label, “continuum absorption”.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 5893, 2014.