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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Detection of reactive nitrogen containing particles in the tropopause region – evidence for a tropical nitric acid trihydrate (NAT) belt" *by* C. Voigt et al.

C. Voigt et al.

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We thank the referee for the review. In the following we address his/her comments.

P6848, 1st full paragraph:

We have explored the parameter space as suggested. Specifically, we did the following sensitivity tests:

Baseline

No T shift

H2O = 2 ppmv

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Interactive Discussion

Discussion Paper

H2O = 10 ppmv

HNO3 = 0.2 ppbv

HNO3 = 1 ppbv

no upwelling

The results were essentially unchanged except for the cases of no temperature shift and very low HNO3 concentration (0.2 ppbv). In these two cases, only a few of the observed reached zero radius (in reverse time), and we cannot explain the existence of these particles based on in situ growth of NAT.

Detailed suggestions:

Title: We do not claim to have detected a NAT belt. We argue that based on the observational evidence and the model simulations, we find evidence for a tropical NAT belt. We think the wording is appropriate.

P14148/L15

We are not aware of a measurement of PAN in the tropical TTL. PAN concentrations in the TTL will depend production and loss rates, and in particular on concentrations of precursor species and photolysis rates.

P14151/L5

We calculated TNAT and TICE based on the measured temperature, H2O,g and HNO3,t concentrations. The calculation of TICE is detailed on P14149, first full paragraph. The calculation of TNAT is detailed on P14151, first paragraph. Here we added: based on the detected temperature, H2O,g and HNO3,t concentrations. Using HNO3,t instead of HNO3,g in the formulation of Hanson and Mauersberger (1988) may introduce errors of less than 0.1\% in the derivation of TNAT.

P14152/L8

ACPD

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We assume the reviewer is referring to P14152/L18. There were aircraft campaigns in the northern Sahara (e.g. SAMUM1&2), with the aim to detect desert dust.

P14152/L26

We added (see Fig.3)

P14153/L15

Typo has been corrected

Section 6:

As described in the revised manuscript, the trajectories were calculated using 3-hourly wind fields on model levels. The vertical wind field is discarded (because of spurious noise), and we use the sum of the assumed upwelling velocity and the particle fallspeed to calculate the vertical transport of the particle. As discussed above, the results do not change if we omit the upwelling velocity. We agree that the ascent rate is radiatively balanced and have changed the manuscript accordingly.

The trajectories that appear to "explode" in reverse time are not a result of assumed upwelling speed. Rather, they occur because when the particles get large (in reverse time), a vicious feedback sets in. They are ascending faster as they get larger (in reverse time) into warmer, more NAT subsaturated air, resulting in accelerating growth (in reverse time). The bottom line is that for these particles and assumed environmental conditions, we can't explain their existence from in situ growth as NAT particles. We have attempted to clarify this point in the revised manuscript.

P14157/L7

We now mention lower SNAT in connection to the Luo et al (2003) reference.

Fig.6

Caption has been changed.

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Fig.7

The reference to a detailed evaluation of temperatures and water vapour in ECHAM4L39(DLR)/CHEM/ATTILA is given in Stenke et al., 2008 on P14156/L21. The comparison of the model to detected NOy fields is given on P14157/L2-3.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 14145, 2008.