

Interactive comment on “Solid particles in the tropical lowest stratosphere” by J. K. Nielsen et al.

Anonymous Referee #3

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“Solid particles in the tropical lowest stratosphere” by J.K. Nielsen et al. describes a series of in situ and remote observations conducted in Brazil in 2004. These observations indicate the presence of solid particles, assumed to be ice, at altitudes between 17.5 and 20.8 km in the lower stratosphere. The results described here provide evidence that the overshooting turrets of convective storm systems are capable of penetrating through the tropical tropopause layer into the tropical lower stratosphere. The authors also argue that this process is capable of hydrating the lower stratosphere. This paper offers a significant contribution to the current body of knowledge regarding water vapor transport processes in the tropical upper troposphere/lower stratosphere (UT/LS). Thus, I recommend publication of this work in Atmospheric Chemistry and Physics once the following comments are addressed by the authors.

Scientific Questions and Issues

Pg. 9007 - The authors state that, during observation period O1, particles were observed on the balloon descent but not during the ascent 22 min earlier. It is common for some balloon-based instruments (such as those that measure water vapor) to produce erroneous results on ascent because the air volume sampled by the instrument is swept out by the balloon immediately before sampling, as the balloon rises. Essentially, the balloon comes in contact with the air before the instrument does. A common solution in this case is report data only on descent, when the instrument precedes the balloon. If the authors wish to attach significance to the fact that the backscatter sonde observed no evidence of particles during the balloon ascent, they should argue that the balloon passing through the air before the instrument cannot influence the results. It seems possible, given the balloon diameter and ascent rate at these altitudes and the particle size, that the balloon could be scrubbing particles from the air sampled by the backscatter sonde.

Pg. 9007,9008 - The authors should state explicitly that only in situ data (backscatter sonde) is available during O1 on 21 February and that only lidar (and not backscatter sonde) data is available during O2 on 14 February, if this is the case. This is implied in the way the observations are described, but the reader is left wondering if complementary data was available on each day but omitted because the results are not consistent.

Pg. 9009 - In the results described by Popp et al. (2005), particles were observed containing specifically nitric acid, and not NO_y as described by the authors here.

General - There is a considerable and growing body of evidence that extreme supersaturations (relative humidities with respect to ice of approximately 200% or more) can exist near the tropical tropopause. These conditions could even be considered common in this region. See, for example, Jensen et al., Atmos. Chem. Phys., 5, 851-862, 2005. Since the authors of the paper reviewed here make considerable use of calculated ice frost point temperatures to argue for the existence, or lack thereof, of ice particles in the UT/LS, they should bear in mind that severe supersaturations can occur

with no observable ice water content. The authors might consider how the interesting results presented here fit into the high supersaturation “puzzle”.

Technical Corrections

Pg. 9017, end of second to last paragraph - There are a number of words in this sentence that should not be capitalized (cyclonic vortex, high altitude, northeast).

Pg. 9017, last paragraph - 3000 m³ and 50 000 m³ are not properly superscripted.

Fig. 1 caption - Should read “sounding recorded on 21 February”

Fig. 6 - The y axis label is particle median radius, in units of meters. This is a very awkward unit to cite for an ice particle size. Micrometers would be more appropriate.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 9003, 2006.

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Interactive Discussion

Discussion Paper