

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

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M. Fromm has two objections to the article. The first one is that we do not consider recent literature reporting evidence of non-volatile solid biomass burning aerosols in the lower stratosphere (Siebert et al., *Annales Geophysicae* 2000 and Jost et al., *Geophys. Res. Lett.*, 2004). The second objection is that unpublished, but indeed public available data, from SAGE II, SAGE III, HALOE, POAM III or lidar observations, showing enhanced aerosols in the lowest stratosphere is not included in the discussion. These points are in line with one of the issues mentioned by referee #2, who disputes whether the particles consist of water.

Regarding the first objection: Admittedly the article should have discussed explicitly the possibility of the observed particles being composed of soot particles originating from biomass burning or desert dust, and reference to some of the publications that M. Fromm mentions, would have been appropriate. The occurrence of non-volatile particles in the lower stratosphere, which seems to occur more frequent than we initially

thought, does actually weaken the interpretation of at least the Feb. 14 2001 observation (O2) slightly. We should bear in mind that the observed solid particles could be non-volatile. This does of course not exclude the possibility that the airmass in which they resided had been lifted into the stratosphere by the convective systems peaking 200-250 km upwind a 4-7 hours before the observation.

Regarding the second objection: M. Fromm has - through private communications - kindly provided a series of 8 aerosol profiles with anomalies above the tropopause. They are all recorded at specific locations, mainly on the southern hemisphere, in January/February 2001 with the various instrumentations mentioned above. We have done a little study on these data, but before proceeding we need to clarify the conditions surrounding O2, the lidar observation from Bauru on February 14 2001. This also addresses concerns raised by referees #2 and #3, whether O2 is reported properly in the article. Fact is that O2 was obtained through a test-run with the micro-lidar soon after dark on the evening of February 14 2001 in Bauru. The cloud was present for 15 minutes, but unfortunately there was no absolute time measurement, i.e. we do not know exactly what time the measurement took place, but it must have been around 24UT (Feb. 14) +/- 2 hours. Furthermore, no Wyoming backscatter sondes were flown during this part of the campaign. Despite the lack of exact observation time of O2 we have now calculated a small ensemble of trajectories passing Bauru at 400-550 K (pot. temp.). The isentropic trajectories were calculated 10 days forth and 10 days back from February 14 2001, 24h00 UT, using ECMWF operational analysis data. None of these trajectories comes close to a match with the satellite/lidar observations provided by M. Fromm. We may insert a figure illustrating this point in the final version of the article, if the referees allow. What we conclude for now is that the particles of O2 and the particles observed by satellites and lidar are not parts of a single major troposphere-stratosphere intrusion, but rather being different “particle-clouds”. Even though these “particle-clouds” do not share history, they may still share physical explanation, but this is something that we do not plan to pursue further in this context. Another point that we would like to mention here is that the “O2 particle-cloud” is limited to about 15

minutes in time, and therefore presumably limited in space, - a reasonable guess being 10 km in horizontal extension. With the vertical thickness of approximately 2 km, the “particle-cloud” cannot be more than a few hours old, since a cloud of this shape would be stretched very fast by the large wind shear above the TTL.

In the Feb. 21 2004 case, we do have better information, and here we are confident that at least a part of the layer comes directly from a specific group of local thunderstorm turret observed with radar. Note that the trajectories in figure 2 spreads out like a fan and consequently the initial cloud-turrets are stretched to widespread thin plumes propagating westward, if they are mixed into the stratosphere. Parts of these (possible) plumes would have to coincide with the measurement. We do however acknowledge that the particles could be non-volatile. It is an open question whether this is the case, and we will have to incorporate this possibility in the article.

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