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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aircraft measurements of microphysical properties of subvisible cirrus in the tropical tropopause layer" *by* R. P. Lawson et al.

R. P. Lawson et al.

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1) How are SVC defined in these measurements? As stated in the manuscript, the presence of SVC was "detected" using the CPI, which defined the physical boundaries of SVC encountered by the C-130. Because the CPI was operational on every SVC flight, this optimized the definition of physical boundaries of SVC encountered by the WB-57F. Also, as explained in the manuscript, quantitative 2D-S measurements of SVC were when the average 2D-S particle concentration was $>$ 5 L-1 for 5-km or greater without a containing continuous period of clear air (2D-S concentration $<$ 0.01 L-1) that was 1-km or greater.

2) CPI images shown in Fig. 6 were chosen subjectively in an effort to depict typical

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particle shapes observed in SVC. An alternative would be to show random images, but this could result in missing some of the significant shapes, since the quasi-spherical shapes predominate (see Fig. 8) unless several pages of images are shown, which is not practical.

3) and 4)

Large Particles: Reviewers #2 and #3 both question the significance of 2D-S and CPI measurements of the largest (i.e., $>$ 100 mm) particles. Both reviewers also call into question the significance of comparing our measurements with the 1973 measurements of Heymsfield (1986). Reviewer #3 states that there is a dearth of measurements and a difference in instrumentation between 1973 and 2006, so that there cannot be any special significance attached to the differing results. Our paper does not portend to be a complete climatological study of the TTL in the tropics. However, the WB-57F did cover 1800 km in most every direction from San Jose, Costa Rica, and this equates to about 100,000 L of air sampled by one channel of the 2D-S probe on the WB-57F. This is a substantial amount of sampling. The fact that only 18 ice particles $>$ 100 microns were observed suggests that these large particles are very rare, but this is not the same as a dearth of measurements. If there were more of these large particles the 2D-S probe would have seen them, so the measurements of low concentrations of large particles are significant. The significance of reporting that these large particles exist is mainly relative to water vapor measurements and the companion paper by Jensen et al. (2007). The point is that there is strong evidence that some large ($>$ 100 microns) particles are observed near the top of the TTL, and that this requires high values of water vapor, according to Jensen et al. (2007).

Particle Shape: Reviewers #2 and #3 both comment on our comparisons of the shapes of the particles reported by Heymsfield (1986) and in our study. Heymsfield (1986) report that the particles were mostly columnar and trigonal. If this were the case in our data set, then the CPI would have observed this, instead of finding that 84% of the particles are quasi-spherical. Reviewer #2 points out that the few replicator photos shown

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in Heymsfield (1986) may not be representative of the data set, and could be the result of human bias for selecting symmetric and interesting crystal shapes. We cannot comment on what Heymsfield decided to show in his paper, but the text does state that the composition was approximately 50/50 columnar and trigonal. Since our measurements of over 8,000 particles show a predominance of quasi-spherical particles, this is a significant difference from the 1973 measurements and needs to be noted. We do not suggest that possible differences in TTL chemistry and water vapor from 1973 to 2006 are responsible, only that these differences may exist.

5) The non-sphericity in the images of glass beads is due to optical aberations created when the beads transect different locations in the sample volume. Not all of the images shown in the figure are 20% prolate, and this estimate appears to be a maximum that appears in only one image. We intentionally show images with differing degree of optical aberrations so the reader can be aware of this effect. The aspect ratios are computed using an objective technique that defines the image perimeter, which generally appears to be spherical when applied to the glass beads (we do not show the perimeter because it interferes with the visual interpretation of the image).

6) The RICO data are shown because there were not enough infocus images in the CR-AVE data to make a statistically significant comparison. The RICO data are water drops, which are spherical, and therefore a good test of the basic performance of the Korolev algorithm itself. We do not make any claims as to how well the algorithm works with non-spherical particles.

7) We are using guidelines from Field et al. (2006), which suggests that particle shattering is not significant until the ice particles reach a maximum size of about 350 microns.

8) We looked for and saw no evidence of clustering.

9) The photos of the WB-57F and instruments are germane so that readers can visualize the form factor of the instruments and installations to discern for themselves if sampling issues may exist, such as airflow or crystal shattering. We agree that “ex-

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ploded" view is not too good. We now think that perhaps "zoomed" view is best, since this is a common term used in commercial software.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 6255, 2007.