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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol composition of the tropical upper troposphere" *by* K. D. Froyd et al.

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We thank the anonymous referee for their comments. Several points of the text have been clarified, as detailed below.

Replies to Minor Points:

1. Additional details for the analysis routine, updates since 2001, and convective influence parameter definitions have been added to section 3.2. Multiple convective origins are not allowed for the same trajectory. Further details including cloud detection are given in the original Pfister et al. 2001 reference.

Figures 2 & 3 are designed to fit across 2 columns in the final print version. Sufficient detail will be given to discern individual points clearly. In the convective influ-

ence map (Fig. 3b), blue points indeed indicate some maritime influence for TTL and stratospheric air. Only points that had nonzero convective influence (and therefore a convective 'origin') are shown. The majority (>75%) of trajectories originating from TTL and stratospheric flight altitudes did not intersect maritime convection. This fraction is reflected in the altitude profile. The figure caption has been updated to clarify this point.

2. We have added detailed descriptions of aerosol type selection criteria to the Measurements section.

3. Total numbers of analyzed particles are listed in Figure 4 for the four broad altitude ranges. Also, captions of altitude profile plots detail the binning schemes and minimum number of spectra for each point. To this information we have added numerical labels to relevant altitude profile plots indicating the number of spectra averaged for each point.

4. The aerosol size distribution data in Fig. 6 is generated using an inversion algorithm scheme based on 5 size-selected CPC instruments with minimum cutpoints at 4, 8, 15, 30, and 64 nm, as detailed in the Brock et al. 2000 reference. The minimum at 10 nm between the nuclei ($\sim$4 nm) and Aitken ($\sim$20 nm) modes is indeed fairly consistent (though not always present) throughout CR-AVE. The 8 nm CPC raw data point should fairly well constrain the inversion algorithm at 10 nm. Brock et al., 2000 performed a sensitivity analysis of the inversion routine and estimates a $\pm$26% number uncertainty for sizes $\leq$10 nm due to the inversion algorithm and propagation of other measurement uncertainties. The number minimum in Fig. 6 is more than 10 times below the local maxima.

5. Secondary ice formation can act to increase cloud particle concentrations beyond the original nuclei concentration. Rime-splintering requires supercooled water droplets and takes place at much warmer temperatures. Cloud particles may shatter upon freezing, but shattering is favored for particles >50 microns. Tropopause subvisual cirrus have very low concentrations for D>50 microns. Additionally, collision rates for

these subvisual cirrus are very low owing to their unusually low density, and collision fragmentation is not expected to contribute.

6. Lead was observed sporadically in aerosols throughout the tropical regions studied. A short paragraph summarizing lead observations relevant to cirrus formation was added to Section 5.5. Mercury was frequently evident in tropopause level aerosols, consistent with the previous publications mentioned by the referee. We also refer the referee to a recent publication detailing mercury observations at the tropopause, Murphy et al., Environ. Sci. Technol., 40, 3163-3167, 2006.

Technical corrections identified by the referee were implemented.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 9399, 2009.