

Interactive comment on “Aerosols in the tropical and subtropical UT/LS: in-situ measurements of submicron particle abundance and volatility” by S. Borrmann et al.

Anonymous Referee #3

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The authors report airborne aerosol particle concentrations and volatility fractions in the UT/LS region for several campaigns and transfer flights. Comparisons are made to pre-Pinatubo measurements, and a recent small volcanic eruption is considered. A parameterization is given for aerosol mixing ratios above 360 K potential temperature.

Throughout the paper the authors emphasize vertical profiles of aerosol concentrations. Discussion on potential source regions, meteorological conditions, and aerosol transformations is limited and often not specific. Some interesting aspects are well described (the volcanic influence in the tropical stratosphere during AMMA), but little attempt was made to explain many of the highlighted features in the data. Overall, the

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authors largely address the goals listed in section 1, and the title is appropriate for the information provided. Although the lack of chemical and physical insight is somewhat disappointing, I do not find that a major revision is necessary. Please address the specific points below.

The most important contributions to the community are the concentration profiles taken under volcanically quiescent conditions and a variety of geographic locations, ultimately resulting in a parameterization that can be used to constrain global model predictions of UTLS aerosol. This is a valuable contribution and worthy of publication in ACP. However, a more chemical or physical approach to the analysis is lacking and would also be valuable for modeling studies and future measurements. Certainly flights within each campaign or region probed air with different chemical characteristics (O₃, NO_x, CO, N₂O) that may suggest different source regions. Even without a rigorous analysis of potential sources, it seems prudent to define typical ranges for important chemical tracers where available, and report whether obvious perturbation events (biomass burning plumes, stratospheric intrusions) were included in the averages. At minimum, the authors should give typical ranges for relevant chemical tracers where available for the various campaigns, describe how any data was or was not eliminated using chemical tracers or other external variables, and state whether their results are or are not applicable to background conditions. As one example, the upper right panel in Fig 2 shows what appear to be perturbation events with concentrations increasing by x10 or more at a given altitude range. Are these representative of background stratospheric conditions? Also, was there any attempt to remove cloudy flight segments?

The presentation of Figures 2 and 3 is difficult to follow since the sampled air contains a mixture of mid-latitude, sub-tropical, and tropical regions as well as tropospheric, stratospheric, and TTL. Consider either revising and possibly combining Figs 1 & 2, or at least clearly indicate the sampling altitude relative to the local tropopause. Similarly, the text on 24599 line 2-3 is unclear: Are all data in the top panels from above the tropopause? Also, line 8-9: is the “difference” between the lines referring to different

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potential temperatures? Clarify.

The paper is organized well into sections. However, some sections are too long and provide inconsequential details that distract from the central points. In particular, section 3.5 should be shortened considerably. Eliminate much of the detailed descriptions of volatility profiles in the first paragraph of 3.5 and combine this with the 3rd paragraph. Focus only on features of the data that support an important scientific point and can be discussed with some certainty. The 4th paragraph of 3.5 also contains redundancies (absolute vs fractional number, increase above 460 K).

24589 line 7: Change to "Part of the reason..."

24589 line 21-23: "At altitudes..." - incomplete or muddled sentence. Please reword.

24595 line 5: State the particle residence time at 250C.

24595 lines 23-25: The sentence starting "The counting..." contains grammatical errors and is unclear. Please reword.

24598 line 26: Can you give a reference for this definition of a nucleation event? If not, how was this definition chosen?

24600 lines 18-23: The authors highlight an apparent maximum in tropical aerosol mixing ratios around 340-360 K shown in Fig 6. Although this maximum does appear in several data sets including the historical 1987-1994 average, there is little data below this level to define a maximum here. Furthermore, this level is well below the tropical tropopause and therefore the interpretation in light of Brock et al 1995 is probably not warranted. The ~355 K level is instead probably the base of the TTL, as stated in the introduction. Please revise this interpretation accordingly.

24603 line 5: Change "properties" to "concentrations" or "loadings".

24603 line 8: Change "larger" to "supermicron", assuming the authors mean aerosols larger than COPAS detects.

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24604 line 16: Remind readers here that the MAS was measuring backscatter for accumulation mode aerosols.

24606, line 3: I suspect the cold point tropical tropopause levels were much higher than 360 K. 380 K?

Fig 1. Add squares of shaded areas to denote sampled regions for each campaign. Flight tracks could be added instead, but would probably be too busy.

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