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Comment on acp-2022-92

Anonymous Referee #2

Referee comment on "Chemical analysis of the Asian tropopause aerosol layer (ATAL) with emphasis on secondary aerosol particles using aircraft-based in situ aerosol mass spectrometry" by Oliver Appel et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-92-RC2, 2022

General comments:

This paper discussed the unique aerosol and gas measurements aboard a high-altitude aircraft. It provided a promising dataset for atmospheric research, especially for understanding the aerosol particle composition within the Asian Tropopause Aerosol Layer (ATAL). The authors presented a very useful tool – ERICA-AMS for the atmospheric study and shared the exciting results from July and August 2017. The paper is well written. The topic is well aligned with the journal scope and should be considered for publication after minor revision.

Specific comments:

Page 9, lines 256-262. The discussion about Fig 2 in this section can not support this statement. "Consequently, the ATAL chemical composition is largely determined by the relative contributions of new particle formation and secondary particle growth at altitude compared to the upward transport of already nucleated secondary or of primary particles from below." Maybe include the gas phase measurements to indicate the new particle formation trend?

Figure 2 showed the sulfate concentration increased from 0.5 – 1 .5 ug/m^3 above 19 km. However, Figure 3 showed that the particle number concentrations from COPAS or UHSAS were less than 90 #/cc. What does the size distribution above 19 km? Are those particles all sulfuric acid? Even if we assume they were ammonium sulfate and larger than 110 nm, the integrated mass seemed still lower than the AMS data.

Figure 5: are those data points are from the averaged data? If so, what is the uncertainty?

Section 3.3 provided essential information about the mixing state of the aerosol particles. The abstract also mentioned, "…the majority of the particles encountered in the ATAL consisted solely of secondary substances, namely an internal mixture of nitrate, ammonium, sulfate, and organic matter. These particles are externally mixed with particles containing primary components as well." Does the mixing state remain the same at different aerosol particle sizes? Do you see a spatial variance in the mixing state?

Figure 10, It is not clear to me what the particle fractions for each particle type are. For example, at 300 nm, primary was 15%, type 1 – 65% or 40%, type2 68% or 5%? Should they add up to 1?

Figure 14, why is there no data above 19 km?

Line 528: 'The ERICA mass spectrometry data will be available in the Edmond database

(Edm, 2017) and the Halo database (Hal,2017).’ Should data be available by now?