Review of "*A Comparative Analysis of In-Situ Measurements of High Altitude Cirrus in the Tropics",* by Cairo et al., MS No.: egusphere-2023-112.

This is an interesting article that uses the M55 Geophysica aircraft, to relate in-situ measurements of particle size distributions and the individual particle properties, to spectrographic and lidar measurements. The measurements were conducted in high altitude cirrus clouds, near the tropopause. Particle probe instrument comparisons are, as well as comparisons between spectrographic and lidar measurements, are conducted. Relationships are derived between the bulk particle properties-effective radius, ice water content, etc, and their backscatter properties.

I have numerous comments that should be considered in the revision of the manuscript. My major and minor comments appear below.

Major Comments

1. The discussion of instruments covers pages 5-8, and the analysis methods between 9 and 12, which I think is excessive, given that the written text is 20 pages in total. And there is virtually no discussion of the clouds sampled-the article is more of an instrument comparison study. There's a little discussion (a few sentences) just before the conclusions section but should have much more detail earlier in the manuscript. A discussion of earlier measurements in similar types of cloud conditions is warranted.
2. There are numerous acronyms used throughout the article. A table of the names associated with acronyms is warranted.
3. Another point: Given that your PSD instruments only measured up to 960 microns yet you are sampling convective outflow cirrus, is this a problem? Do you have any particles that are in the largest size bin?
4. Lines 398-400. It's a very smart idea to compare backscattersonde to the lidar data
5. Figure 4. Can you change the units to something that might be more meteorologically oriented, for example m^{-1}? This is very much the case for Figure 7-11, and ones that follow.
6. Section 4.3, Figures 7-1q. I feel strongly that the units for backscattering coefficient in the figures units km^{-1} sr-1 should be something that modelers, etc could use. These should be put in standard cloud physics units. Also, IWC should be in g/m^3. This would facilitate comparison with other studies (for example, IWC in Figure 11 to Thornberry *Thornberry, T. D., A. W. Rollins, M. A. Avery, S. Woods, R. P. Lawson,T. V. Bui, and R.-S. Gao (2017), Ice water content-extinction relationships and effective diameter for TTL cirrus derived from in situ measurements during ATTREX 2014, J. Geophys. Res. Atmos., 122, 4494–4507, doi:10.1002/.*
7. Lines 524-525. The greatest ambiguity in the results of the comparison is linked to the choice of particles' morphology. Perhaps you should temper this because the mass dimensional relationship and the masses of the small particles are not compared directly to FLASH.

8. The relative independence of β from Rmean and Reff confirms Nice as the main parameter governing the cirrus scattering properties at optical wavelengths. Does this result also fall out of the analytical relationships assuming gamma PSD and quasi-spherical ice particles?

Minor Comments

I have numerous minor comments that should be considered in the revision of the manuscript.

Line 3. in view to > with the goal of connecting

7. Hymalaian to Himalayan

14? What do you mean by "can be set"

26: Cirrus at higher altitudes. Regarding your statements about cirrus, it would be good to use the AMS Glossary of Meteorology definition.

58. Why cite only recent studies. You could add **Heymsfield**, A. J., and R. G. **Knollenberg**, **1972**: Properties of cirrus generating cells. J. Atmos. Sci., 29, 1358–1366, for example

85. properties. This is particularly…

98. Why not use the Self-Similar Rayleigh-Gans Approximation (Hogan and Westbrook, 2014), or DDSCAT?

118. developed by

265. This line should be part of paragraph on line 264.

285-330 Very nice, comprehensive calculations of how the aspect ratio affects the backscattering efficiencies.

339. Could you include the m-D relation you use in the text?

368-370 Very good determination of why the NIXE-CAPS data set was used.

Section 4.2. It's clever to use the backscatter model together with the measurements for find the best AR.

385. Remove i

405. backscattering should not be capitalized

408. range is

440. as seems to do > as well as SAD and IWC

441. as hardly change. Please rephrase

475 and and

512. We remind. We note that...