Review of “Investigation of cirrus clouds properties in the Tropical Tropopause Layer using high-altitude limb scanning near-IR spectroscopy during the NASA-ATTREX Experiment”, by Colosimo and coauthors, AMT-2023-85

The focus of this article is on the mini-DOAS (Mini Differential Optical Absorption Spectroscopy) instrument, and its operation on the NASA Global Hawk aircraft during the Airborne Tropical TRopopause Experiment. The instrument provides limb scanning observations in the near-IR, facilitating the identification of ice and liquid water. To use the instrument’s capability, radiative transfer code was developed for this study. Comparison of the ice water path and ice water content retrieved from the instrument agreed reasonably well with the observations from the SPEC FCDP and the NOAA water vapor instrument.

I will focus on the observations with the particle probes (Hawkeye) and the comparison with the observations as this is my area of expertise. I’ll let others comment on the radiative transfer calculations and instrument design and capability.

Main comments

Line 68. Hawkeye is subject to considerable ice particle shattering. You briefly comment on this later in the article but I think it should be here. Also, I’m not convinced that the shattering removal techniques for the small particles effectively reduces or eliminates shattering. We have quite a lot of good data to show this.

183-185, 487-489. Use LIDAR to get the IWC and IWP. You can use LIDAR extinction data and a relationship between extinction and ice water content to also get SIWC and ice water path and to compare with the mini-DOAS instrument. See Heymsfield et al. (2014). Heymsfield, A., D. Winker, M. Avery, M. Vaughan, G. Diskin, M. Deng, V. Mitev, and R. Matthey, 2014: Relationships between Ice Water Content and Volume Extinction Coefficient from In Situ Observations for Temperatures from 0° to −86°C: Implications for Spaceborne Lidar Retrievals. *J. Appl. Meteor. Climatol.*, **53**, 479–505.

266. Are the sizes of the particles imaged by the CPI (their maximum dimensions) consistent with those sampled by the FCDP, because it's possible that particles >50 microns were present. In Woods et al. (2018), CPI images of particles as large as several hundred microns are shown (their Figure 5).

272, 448. Particle habit. I don’t necessarily agree that the particles are quasi-spherical. Are the images from the CPI consistent with spherical particles-ice density of 0.91 g/cmˆ3? You can clearly see this in Fig. 5 of Woods et al. (2018). Please comment on this. Also, see: Heymsfield, 1986: Ice particles observed in a cirriform cloud at −83 °C and implications for polar stratospheric clouds. *Journal of Atmospheric Science*, 43(8), 851–855.

The long averaging times of the mini-DOAS instrument are somewhat problematic.

Minor Comments

What were the temperatures sampled?

Line 43-45. CALIPSO/CALIOP can readily detect thin TTL cirrus.

70. Here you should mention how the IWC was derived from the Hawkeye instrument. You use the Hawkeye IWCs in Figure 8.

123. Can LIDAR extinction be used to derive absorption cross-sections of ice? Can the two be related? You do have the LIDAR data.

Eq. (5) and line 164. Is this the density of solid ice? Is M_{ice} the ice water content (IWC)? That's what it should be.

300. I like the sensitivity tests you did, varying the concentration and examining the results.

451-453. This should be inserted earlier, where Hawkeye is discussed.

457-460. Does the discussion here relate to Figure 8b? You do discuss Figure 8b later but it probably should be here. I really don't see the good agreement. Also, by "observations", do you mean the NOAA instrument?