Author Response to Reviewer #2

Joseph Girdwood

We thank the reviewer for their comments and welcome their input into the manuscript.

Response to general comments:

The concern for the diameter change of a droplet when exposed to a temperature field is completely valid. With an angle of attack of -10°, the simulated temperature of the air at the sample volume is 280.19K and the temperature of the air at the inlet was 280.23K. At the time the manuscript was written, we did not consider the 0.04K change in temperature to have a considerable effect on droplet diameter, or the relative humidity of the air. We have amended the manuscript to reflect our assumptions more clearly, since not stating them was an oversight on our behalf.

Water coating the light collection optics is an important factor to consider, not only with the UCASS instrument, but with all cloud probes. Both condensation and direct liquid deposition can attenuate the collected light, thus reducing the observed scattering cross section magnitude. Since the temperature change between the sampling volume and ambient air was 0.04K, the condensation risk here was negligible, although it was considered that, at faster airspeeds, anti-fog coatings may have needed to be applied on the collecting optics. Direct liquid deposition of water droplets onto the elliptical mirror—the largest exposed optical surface, and principal scattered light collector—was a greater concern. The UCASS elliptical mirror was designed with a surrounding circular groove in the chassis, in order to prevent the droplets—which get deposited on the inner airflow surfaces near the inlet—flowing onto the optical surfaces. The UCASS was tested with this inner chassis configuration in Smith *et* al. (2019) where it was found that droplet deposition on the optical surfaces was limited. This has been added to Sect. 2.1 for clarity.

Temperature, pressure, airspeed, aircraft GPS/attitude data, and humidity are essential parameters which accompany UCASS data. The reason why temperature and humidity data are not discussed in this paper is because lightweight sensors themselves require extensive testing and validation on UAVs, which is far beyond the scope of this paper. It is planned that the next iteration of UCASS has integrated temperature, pressure, humidity, and airspeed data, since these are essential for deriving useful data products.

Lawson *et* al. (2001) and Tsay and Jayaweera (1984) both observed Arctic stratus cloud to be laterally homogeneous, which can be assumed to be the case within the 3 km by 2 km UAV operations region discussed in this paper.

The error here is defined as one standard deviation over the vertical-spatial and temporal averaging periods for the Talon-mounted and static UCASS units respectively. This is now shown as error bars on Fig. 10 and 11.

Response to minor comments in order:

- A is the area around the sample area origin where a particle was considered to be sampled, 10 mm in this case. The manuscript has been amended.
- The concentration unit has been amended and dN/dlog(Dp) has been used throughout for consistency.

References

Smith, H. R., Ulanowski, Z., Kaye, P. H., Hirst, E., Stanley, W., Kaye, R., Wieser, A., Stopford, C., Kezoudi, M., Girdwood, J., Greenaway, R., and Mackenzie, R.: The Universal Cloud and Aerosol Sounding System (UCASS): a low-cost miniature optical particle counter for use in dropsonde or balloon-borne sounding systems, Atmos. Meas. Tech., 12, 6579–6599, https://doi.org/10.5194/amt-12-6579-2019, 2019.

Lawson, R. P., Baker, B. A., Schmitt, C. G., & Jensen, T. L. (2001). An overview of microphysical properties of Arctic clouds observed in May and July 1998 during FIRE ACE. Journal of Geophysical Research: Atmospheres, 106(D14), 14989–15014. https://doi.org/10.1029/2000JD900789.

Tsay, S.-C., & Jayaweera, K. (1984). Physical Characteristics of Arctic Stratus Clouds. Journal of Climate and Applied Meteorology, 23(4), 584–596. https://doi.org/10.1175/1520-0450(1984)023<0584:PCOASC>2.0.CO;2.