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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Evaluation of ARM Tethered Balloon System instrumentation for supercooled liquid water and distributed temperature sensing in mixed-phase Arctic clouds" *by* Darielle Dexheimer et al.

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We thank all of the reviewers for their valuable comments. Below, we have added some responses to the comments submitted.

1) Page 1, Line 14: Please provide a bit more clarification of which kind of in situ atmospheric measurements you did.

Response 1) We agree that the types of in situ measurements collected should be expounded. We have updated the text to read "of aerosol properties, cloud microphysical

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information, and thermodynamic structure”.

2) Page 6, Figure 2: The beginning of the second sentence in the caption seems to be redundant. If I understood it correctly, the Anasphere SLWC sonde next to the InterMet radiosonde is shown on the left, the Anasphere SLWC sonde above the Anasphere tethersonde is shown in the middle and the Reading SLWC sonde is shown on the right. I would ask you to reformulate the caption accordingly.

Response 2) We agree that this caption was poorly written and have revised it to read “Anasphere SLWC sonde left of InterMet radiosonde on TBS tether (left). Anasphere SLWC sonde above Anasphere tethersonde (center). InterMet radiosonde in center with Anasphere SLWC sonde on left and Reading SLWC sonde on right (right). “

3) Page 7, Figure 3: Figure 3 provides a good qualitative comparison of the sonde pairs, but I would recommend to include an additional figure to compare the measured distribution functions of SLWC. For that I would use only those times where both sondes had valid, non-zero readings, calculate the cumulative distribution function (or probability distribution function, whatever you like better) for each sonde and put the CDFs / PDFs for each pair of sondes in one plot.

Response 3) We appreciate this feedback and have added the recommended PDF figure.

4) Page 9, Line 10: I am pretty sure that you mean Fig. 4 instead of Fig. 7 for the figure reference.

Response 4) Corrected, thank you.

5) Page 11: I do not see a figure reference to Fig. 6.

Response 5) Thank you, a reference has been added.

6) Page 12, Figure 6: There is almost no contrast in the data points showing the SLWC. I would suggest plotting the values below the detection limit either white or transparent

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to enhance the contrast for the data that actually matter.

Response 6) We agree the contrast is insufficient and the figure has been replotted with SLWC values below the noise threshold of 0.02 g/m3 shown in grey.

7) Page 14: I do not see a figure reference to Fig. 8.

Response 7) Thank you, the reference is in line 25 of page 14, “Figure 8 shows the time series of the flight and Figure 9 compares the two SLWC profiles.”

8) Page 17: I do not see a figure reference to Fig. 10, Fig. 11 and Fig. 12.

Response 8) Thank you, these three figure references have been added.

9) Page 19: I do not see a figure reference to Fig. 13.

Response 9) Thank you, a reference has been added.

10) Page 20: I do not see a figure reference to Fig. 14.

Response 10) Thank you, a reference has been added.

11) Page 20, Line 14: Please describe the radiation correction of the DTS in more detail (reference or equation, if possible). It might be best to explain the radiation correction in Subsection 2.3.

Response 11) We appreciate the need for further detail and have expanded the existing section to include the text “While the multimode fiber used for TBS DTS measurements is white, some excess heating due to solar radiation could still occur. The iMet radiosonde temperatures are corrected within the collection software Skysonde, which was developed by the National Oceanic and Atmospheric Administration (NOAA), for solar radiation based on solar elevation and flight altitude. The correction factors were derived from a proprietary report developed by InterMet for NOAA (e.g., InterMet, 2009), and are not fixed but are interpolated between the solar elevations and altitudes shown in Table 2. In an effort to correct DTS temperatures for excess solar heating, the linear fit between the radiation-corrected iMet radiosonde temperatures and DTS temperatures was applied to the DTS temperature values for each flight. The mean RMSE between the iMet radiosonde temperatures and uncorrected DTS temperatures was 0.39 °C, improving to 0.32 °C after the corrections were applied to DTS temperatures." A table was also added of the correction factors that are applied to the iMet radiosonde temperatures.

12) Page 21, Line 10: When looking closely at Fig. 15, I do not see an increase of the temperature with altitude by more than 1 to 1.5 degrees Celsius. Please clarify where exactly the 3-4 _C warmer layer is located. Could it be the wrong figure that is put in the manuscript?

Response 12) Thank you for this close review. An error was made with the color mapping and the map has been revised to better contrast the temperatures. The text has also been updated to read "Figure 16 depicts results from 7/10/18, when the continuous DTS temperature profiles and iMet radiosonde temperatures reveal a cooler layer at the surface below 100 m with a 1-1.5 °C warmer layer between 150 and 800 m, then another cooler layer above the inversion from 800 m to 1 km. The AMF3 radiosonde launch at 23:30 measured a similar temperature profile. The particle concentration measured by the POPS at a sample rate of 1 Hz demonstrates increased particle concentration within the temperature inversion, with fewer particles above the inversion and in the surface-cooled layer. The surface layer warmed in the afternoon and the base of the inversion layer became higher in altitude with time. An inversion was no longer present at 01:00 GMT, and the boundary layer became warmer and more well-mixed below 1 km. The particle concentrations measured by the POPS after 01:00 GMT were also similar at both measurement altitudes, which indicated the well-mixed boundary layer in the afternoon."

13) Page 21: I do not see a figure reference to Fig. 15 and Fig. 16.

Response 13) Thank you, references have been added.

14) Page 22, Fig. 15 and 16: It is hard to actually see where the inversion is located in the vertical temperature profile. Would it be more intuitive to localize if you plot the potential temperature instead of the temperature? And is there an explanation for the high near-surface temperatures in Fig. 16 around 19:40 UTC?

Response 14) Thank you again for this close review. The color mapping on this figure has been improved and the text has been revised to read "On 7/11/18 the surface layer below 200 m was roughly 2 °C cooler than on the previous day, as were temperatures in the inversion layer between 200 m and 1.2 km (Figure 17). POPS particle concentrations were elevated within the inversion layer and were similar to the observation on the previous day. Unlike the previous day, particle concentrations did not decrease to almost 0 above the inversion layer, indicating a less stratified aerosol profile. The base of the inversion layer decreased between 18:30 and 19:30, and a shallow ~50 m-deep warm layer was isolated around 400 m after 19:30. An iMet radiosonde on the tether corroborated this shallow warm layer measured by the DTS temperature profiles. No clouds were present within the TBS flight altitudes on either day. Elevated temperatures at the surface were caused by friction of the fiber against sharply-angled metal tubing as it entered and exited the calibration bath."

15) Page 23: I do not see a figure reference to Fig. 17.

Response 15) Thank you, a reference has been added.

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2019-117/amt-2019-117-AC2-supplement.pdf

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-117, 2019.

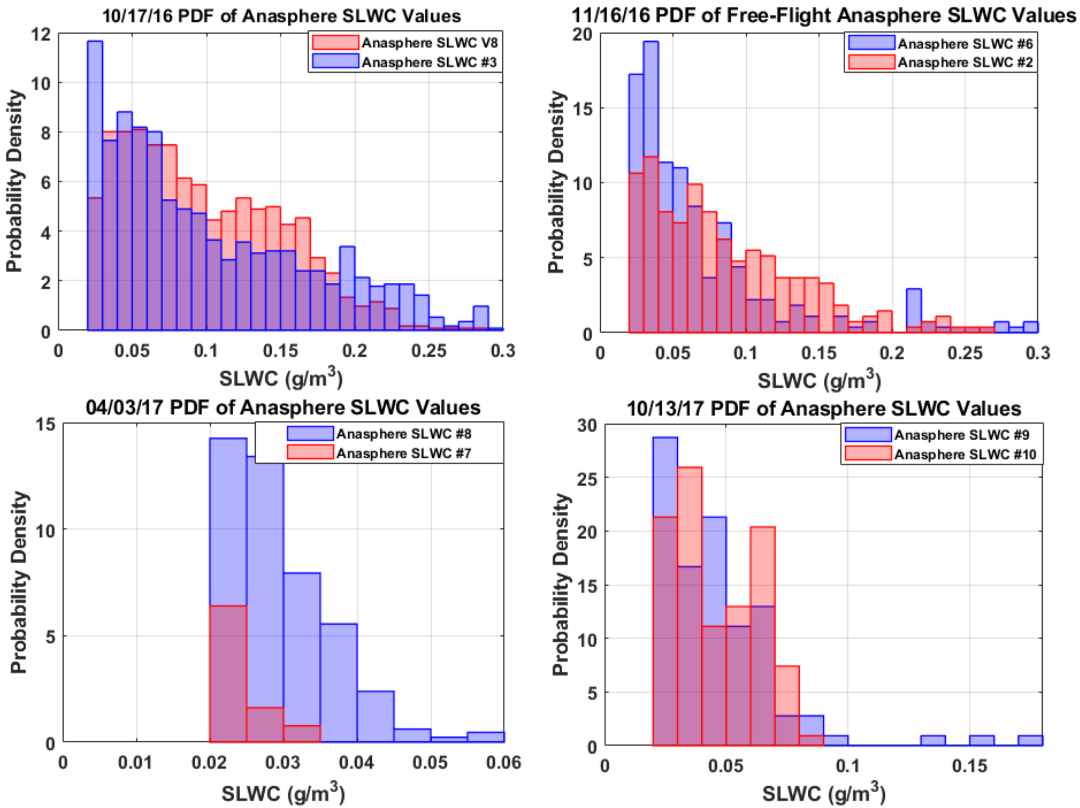

Fig. 1. PDFs of four side-by-side comparison flights of Anasphere SLWC sondes.

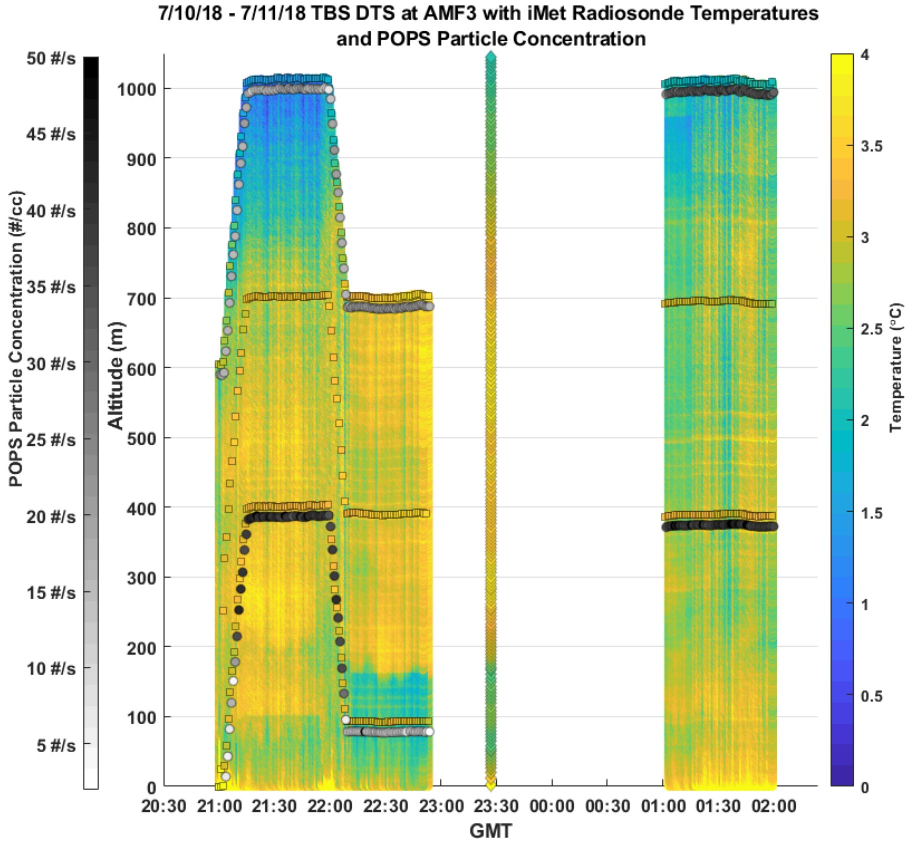

Fig. 2. 7/10/18 – 7/11/18 TBS DTS profiles at AMF3 with TBS iMet temperatures (squares), free-flight radiosonde temperatures (diamonds), and POPS particle concentrations (circles).

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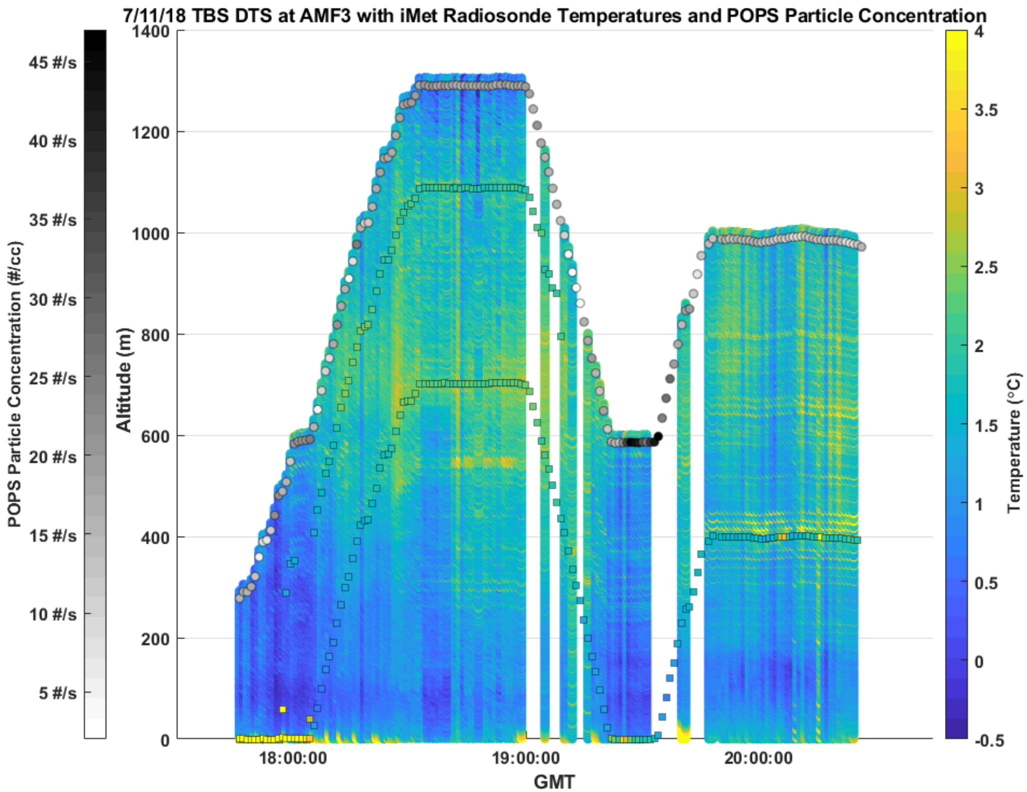

Fig. 3. 7/11/18 TBS DTS profiles at AMF3 with TBS iMet temperatures (squares) and POPS particle concentrations (circles).

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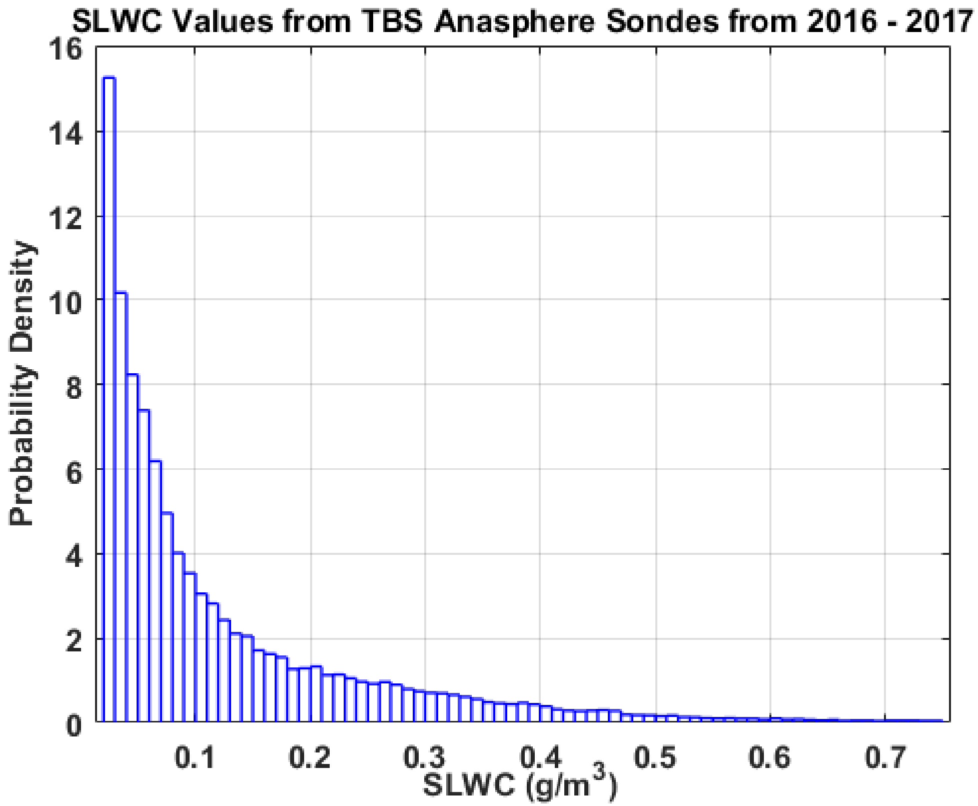

Fig. 4. TBS Flight of two SLWC sondes with concurrent free balloon radiosonde launch at 10/13/17 23:27 UTC.

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