Authors' response to the review of the manuscript titled "Modification, Calibration, and Performance of the Ultra-High Sensitivity Aerosol Spectrometer for Particle Size Distribution and Volatility Measurements During the Atmospheric Tomography (ATom) Airborne Campaign"; submitted to AMT on August, 9, 2017

The authors would like to thank the reviewers of the manuscript for their careful and positive evaluations. Our responses are listed below in blue, while reviewers' comments are in black.

Apart from the minor changes suggested by reviewers we have updated data presented in Fig. 11. We have noticed that an incorrect dlogd values were used. The corresponding volatile and non-volatile fractions mentioned in Section 6.2 were also updated accordingly. These changed by ~1-2 % as compared to the initially reported values. This has not impacted integrated aerosol surface and volume concentration data reported here.

Reviewer #3 (received and published: 13 November 2017)

GENERAL COMMENT
The manuscript describes the results of a well-conducted study on the characteristics of two modified aerosol spectrometers (UHSAS) operated on the NASA DC-8 during the ATom airborne campaign. The implemented modifications concern mainly the stabilization of the sample flow at reduced and variable pressure levels which usually occur during airborne operation, and the introduction of a thermal denuder. The studies have been carefully designed and conducted, and the paper is clearly structured and well written. The topic fits well into the scope of AMT and the manuscript deserves publication after few minor revisions have been considered.

We thank reviewer #3 for positive evaluation.

Minor revision are requested for these topics:
1. In Section 5, potential uncertainties in particle sizing from the unknown refractive index and the unknown impact of particle non-sphericity are not discussed in detail. For comparison, a detailed study on the impact of refractive index and shape uncertainties on particle size distributions determined by an an optical particle spectrometer is reported by Fiebig et al. (2002) for the PCASP which uses almost similar collection optics as the UHSAS. The authors may link their findings to these results to get an estimate of the excepted range of uncertainties.

We are not entirely sure we have fully understood reviewer's comment.

In Section 5.1 we stated that we did not investigate the effect of particle shape on UHSAS sizing accuracy. The ATom project focuses on the remote atmosphere where well-aged particles (assumed to be spherical) are expected to dominate the submicron aerosol (outside of sea-salt and dust cases). Examples of uncertainties representative of conditions encountered during ATom flights are summarized in Table S3.

The paper by Fiebig et al. (2002) focuses on biomass-burning aerosol properties and associated uncertainties. We feel that linking these two studies is not straight forward, therefore we decided not to include a reference to this paper here.

In section 3.2 we have added few sentences that might be relevant to the reviewer's comment above: "The refractive index of soil dust may exceed the range of real refractive indices considered here. In addition, dust can be both absorbing and aspherical. When dust is an important component of the atmospheric aerosol, uncertainties in both the denuded and thermodenuded UHSAS instruments should be evaluated on a case-by-case basis using best estimates of refractive index and shape based on other measurements, coupled with optical simulations of instrument response."

2. Sections 3.5 and 3.6 may be combined since the only effect of pressure on particle sizing will arise from flow variations. A good example for the effect of an instable flow on the calibration of an optical particle counter is given by Bundke et al. (2015). The authors may refer to this instrument characterization study to compare their results.

We agree and we have combined these two subsections and modified section 3.5 header to: "The effect of pressure on sample flow and particle sizing"

We mention in Section 3.5 that this reduction in sample flow at low pressure sampling conditions is caused by a small leak in the optics block downstream of the detection region. Therefore, we directly measure the sample flow to account for this effect on concentration. Further, we have shown that the leak does not affect UHSAS sizing characteristics (Fig.S1). This is a unique situation to our instrument therefore we feel the suggested citation is not needed here.

3. In Section 3.1 the authors may add information n the size range of the produced aerosols. This would complete the information to the reader about the experiments performed in this study.

Thank you for noticing. We have added a size range and the sentence reads now:

Page 5 line 27: "Particles with a range of diameters between 0.05 and 1 µm were generated in two ways: 1) by using an atomizer to produce ammonium sulfate ($(NH_4)_2SO_4$), polystyrene latex (PSL) spheres, or di-2-ethylhexyl (dioctyl) sebacate (DOS) particles (Table 1); or 2) from new particle formation and condensational growth from limonene ozonolysis products in a flow tube reactor."

MINOR COMMENTS

Abstract: The abstract may be shortened to 250 – 300 words, e.g., the first sentence can be skipped and some details can be shifted to the text body.

Thank you for this suggestion, however we would like to keep the current version of the abstract.

Page 2, line 17: you may write: "to a size-proportional voltage pulse".

Corrected.

Page 2, line 25: I suggest rephrasing: "wished to dry the air sample and to install a thermodenuder used to distinguish non-volatile particles. These sample : : :"

Corrected.

Page 3, line 24: please modify "between 0.06 – 1 µm in diameter".

Corrected.

Page 10, line 6: It should read: “life time”.

We think “live-time” is used there correctly.

REFERENCES

Bundke, U., Berg, M., Ibrahim, A., Tettich, F., Klaus, C., Franke, H., Fiebig, M., and Petzold, A.: The IAGOS-CORE aerosol package: Instrument design, operation and performance for continuous measurement aboard in-service aircraft, Tellus B, 67, 28339, doi: 10.3402/tellusb.v67.28339, 2015.

Fiebig, M., Petzold, A., Wandinger, U., Wendisch, M., Kiemle, C., Stifter, A., Ebert, M., Rother, T., and Leiterer, U.: Optical closure for an aerosol column: Method, accuracy, and inferable properties applied to a biomass-burning aerosol and its radiative forcing, 107, doi:10.1029/2000JD000192, doi: doi:10.1029/2000JD000192, 2002.