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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Application of a Hygroscopicity Tandem Differential Mobility Analyzer for characterizing PM Emissions in exhaust plumes from an Aircraft Engine burning Conventional and Alternative fuels" *by* Max B. Trueblood et al.

Anonymous Referee #1

Received and published: 25 July 2018

This manuscript describes the design and performance evaluation of a Hydroscopic-Tandem Differential Mobility Analyzer (H-TDMA) as well as the subsequent field deployment to measure soluble mass fraction of aircraft engine PM emissions from CFM56-2C1 engines burning several fuels during the AAFEX II campaign. As the authors specify, this H-TDMA was designed for (1) field measurements involving mobile sources that are very costly to operate, (2) when exhaust sample plumes are available for only short periods of time, and (3) for varying ambient conditions.

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Discussion paper

Overall, the authors do a good job of describing in details the operation and characterization of the instrument. This study represents a substantial contribution to the field of aerosol hydroscopic property measurements. I recommend it be accepted for publication in Aerosol Science and Technology after minor revisions.

In addition, I include the following comments to help improve the readability and clarity of the manuscript:

1. There are a large number of abbreviations in this manuscript. I would recommend to include a list of abbreviations at the end of the text.

2. Page 3, line 12: In the text, the authors use the unit “L m-1” as the abbreviation of liter per minute. Since “m” is also used as the abbreviation for meter in many places in this manuscript, I would recommend to change the unit of flow rate to “L min-1”.

3. Page 7, line 9: The authors claim that u and s are assumed to be known, but they only provide the assumed value of u based on a previously published study. What is the assumed value of s used in this study?

4. Equation (2): Unit of the numerator (3.3×10-5), which seems cm K, should be added in the equation, because if the diameters are in nm in Equation (1), then the numerator would be (3.3×102) nm K.

5. Page 8, line 7: The authors indicate that osmotic coefficients can be related to the square root of the molality by a 6th order polynomial function with considerable accuracy. How accurate, 1%? I would recommend to present the formula and give an example to demonstrate its accuracy.

6. Page 8, lines 8: Also for the osmotic coefficients, the authors mention that “it is diameter dependent and must be taken into account,” but didn’t clarify how to take the diameter-dependence into account.

7. Page 9, Table 1 and Figures 7-11: The diameter of dry particles is defined as “Xd” in the text, but in those table and figures, it is presented as “Xd”. Please be consistent.

8. Page 15, lines 26: The authors claim that “The sulfur in the fuel is oxidized to SO2, which then undergoes rapid oxidation to SO3 and subsequently to sulfuric acid. . .” I agree with the authors that all the fuel sulfur is oxidized to SO2, but disagree that oxidization from SO2 to SO3 is rapid. In fact, it is very inefficient (∼1-5%), as the two cited references indicated.

9. Page 16, line 8: Reference, Gysel et al. (2007), is not presented in the reference section. Please verify.

10. Page 16, line 14: For fuel sulfur content (FSC), the authors use the unit of μg of sulfur per g of fuel, but in Table 2, the authors also sue the unit of ppm. Please be consistent.

11. Page 16, line 14: I don’t understand the meaning of “old and modern cruise conditions”.

12. Could the authors provide an estimate of experimental uncertainties of the determined GF and SMF results in Section 5?

13. Page 21, line 5: the referenced journal should be “Atmos. Environ.”.

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