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Atmospheric Measurement Techniques Discussions

Interactive comment on "The airborne mass spectrometer AIMS – Part 1: AIMS-H_2O for UTLS water vapor measurements" *by* S. Kaufmann et al.

Anonymous Referee #2

Received and published: 25 January 2016

Review of AMTD-8-13525-2015 The airborne mass spectrometer AIMS – Part 1: AIMS-H2O for UTLS water vapor measurements

General comments: This manuscript describes the set-up, first applications and comparisons of a new mass spectrometer for aircraft measurement of water vapour with high sensitivity and in flight calibration. Key feature is a new spark discharge ion source generating hydronium ion clusters in air. The paper fits well in the scope of AMT, presents a novel method, and is well-written. Some aspects of the paper deserve clarification especially regarding the specification of the instrument performance in the lower mixing ratio range, the calibration method, and comparison with other instruments. Hence, I recommend publication after minor revisions as listed below. In flight comparison with established hygrometers like FISH or CLH should be sought in

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order to validate the AIMS-H2O capabilities to obtain reliable water vapour data for mixing ratios below 10 ppm.

Specific comments:

Page 13526 line 24: State which accuracy corresponds to which water mixing ratio.

Page 13527 line 2: Give the concentration range and degree of agreement for this comparison.

Page 13527 line 14-15: In part 2 (Jurkat et al., 2015), setup of the CIMS techniques with SF6- chemistry for measurement of the set of trace gases HCL, HNO3, HNO2, SO2, and ClONO2 are presented.

Page 13527 line 21-22: Formulate the second part of the sentence more clearly.

Page 13527 line 25-26: Either give absolute concentrations or write mixing ratios.

Page 13529 line 11: Add a reference for SHARC.

Page 13529 line 16: Figure 1 shows little information. You should replace it by a better picture and include arrows pointing to and identifying the different parts of the instrument.

Page 13531 line 10: Give the limits of the pressure regulation.

Page 13532 line 23: Give in this section the typical in flight calibration interval required to achieve the stated accuracy.

Page 13533 line 16-19: Formulate this sentence unambiguously regarding the : “The temperature is chosen such that the CE is becoming independent of temperature”.

Page 13534 line 6-9: Give the flow dependence and uncertainty of the CE e.g. in a plot.

Page 13534 line 10-12: Give the uncertainty of the reference instrument (MBW 373-LX) in comparable units and state the time intervals for characterisation measurements

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required to achieve the accuracy stated for the AIMS. Is the reference instrument traceable to national standards and hence the AIMS-H2O too?

Page 13534 line 15: State the precision and accuracy of the water mixing ratios (0.5±?) – (150±?) ppm that can be generated.

Page 13534 line 24-26: State the precision and accuracy of the water mixing ratios 0.5±? - 150±? ppm that can be generated. A table with the individual contributions to the uncertainties like MFC calibrations, reference, concentration and flow dependencies of the CE would be useful to show the major and minor contributors.

Page 13535 line 1: It should read Fig. 4 and not 4a.

Page 13538 line 2-3: Water vapour has only a small impact on NO2+ and an insignicant influence on NO+.

Page 13538 line 25-26: State the contributions of larger clusters for water mixing ratios below 500 ppm.

Page 13539 line 10: Label Figure 6 with a, b, c corresponding to the text. Why don't you plot m/z=37 and the ion ratio over the logarithm of the water mixing ratio? It would of course be interesting to see a calibration curve covering the whole measurement range from 0.5 to 500 ppm.

Page 13539 line 25: Define the parameters in equation 1 and give typical values. Did you test to normalise the m/z=37 to the total ion count or NO+ and did this improve the sensitivity?

Page 13540 line 20: Please make clear which sensitivity or accuracy value belongs to which mixing ratio in Table 1. You could also table the data for below 15 ppm and above separately.

Page 13542 line 6-8: The detection limit can of course be a useful parameter to characterise a hygrometer. You should add information on how the instrument limit of de-

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tection and the practical limit of quantification compare for the AIMS-H2O.

Page 13543 line 7: Could you complement Figure 7 with a plot of accuracy over water mixing ratio for the complete measurement range of the instrument (0.5 to 500 ppm)? In the caption of Figure 7 you should replace Eq.3 by Eq.4.

Page 13543 line 16: It would be useful to have one table listing all factors contributing to the instruments accuracy including their relative contributions.

Page 13545 line 7: Explain the data gap for 41000-41300 s. Mention the role of dilution correction for the period 33500-35600 s. Explain when the calibration was done.

Page 13546 line 11: A short description of the SHARK and WARAN instruments including references to both instruments should be added to the experimental section. Explain briefly how SHARC and WARAN are calibrated in comparison to the AIMS-H2O.

Page 13546 line 18-20: Discuss the accuracy of RHi values derived for both instruments and identify the role of the uncertainty of the air temperature.

Page 13546 line 27-28: Be more precise with this comparison.

Page 13547 line 11-12: Is 8-15% really a high accuracy? Why do you state here 8-15% and not 7-15% as before?

Page 13547 line 24: . . .DLR research aircraft. . . .

Page 13548 line 1-2: This sentence should be formulated more clearly.

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/8/C5173/2016/amtd-8-C5173-2016-supplement.pdf

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