

## ***Interactive comment on “Performance of WVSS-II hygrometers on the FAAM Research Aircraft” by A. K. Vance et al.***

**Anonymous Referee #2**

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### General Comments:

This work presents an intercomparison between five different airborne water vapor instruments using three different techniques to measure gas phase and total water. For the first time two WVSS-II laser spectrometers are included in an inflight comparison with other water vapor instruments. From a comprehensive dataset of around one hundred flights, cloud free regions are used to compare the general performance of the different instruments, whereupon the two WVSS-II diode lasers only differ in their inlet geometry. Additionally, the authors present case studies of in-cloud measurement sequences to discuss different inlet characteristics in ice and liquid water clouds and response times of the instruments. The manuscript is well written and suitable for publication in AMT considering the following points: Specific Comments:

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p. 8645 l. 23-25: Be more concise about how rounding increases uncertainty for higher humidity.

p. 8646 l. 22: How do you determine whether the inlet is inside or outside the aircraft boundary layer?

p. 8648 l. 21: Why was the heater of the sample chamber disconnected?

p. 8649 l. 5-9: If desorbing water was the reason for the higher lower limit one would expect a (probably very slow) decrease in the water vapor signal. Do you see something like that? Could it also be a small leak or an issue of the plumbing material?

Sec. 3: Did you check that you don't dismiss systematically specific temperature or pressure conditions when determining the offsets?

p. 8650 l. 9: What does “meaningful” mean here? From the lower panel in Fig. 7 I would think that a meaningful offset can only be determined for higher humidity, maybe above 0.4 g/m<sup>3</sup>. Does your filter retain values over the complete range or is it more a “high humidity” offset?

Sec. 4: In my opinion, the statement that instruments show good agreement within the IQR (e.g. p.8651, l.18 & 25) is not appropriate to judge the quality of the measurement or instrument, respectively since the IQR cannot be treated similar to an error bar. To assess the quality of the data, one has to acknowledge systematic deviations as well as scatter of the data. With the presented approach, if you have a certain systematic deviation, a larger scatter can make your data “better”, however the data quality is in fact worse. I suggest discussing scatter and systematic deviation separately and to avoid the term “agree within the IQR”.

Sec. 4 / Sec. 6: Although focusing on their relative performance: Since apparently all instruments tend to over read at low humidities, did you check (e.g. using RHi) if the measured values are in a reasonable range?

p. 8652 l. 1-3: Could you comment on possible reasons for a positive bias of the GE

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below 250K?

p. 8652 l. 13: Same as above, can you comment on reasons for the over reading of the WVSSF? Could desorption of water from the aircraft skin cause such a behavior? Sec. 5.2: Could you comment on the uncertainty of the mean volume radius? During the second cloud penetration there could be another issue since, in contrast to all other penetrations, the wvssR signal even exceeds the wvssF+LWC signal. Could this is a part of the cloud with a significant amount of smaller particles below the detection limit of the CDP?

Sec. 5.3: Since humidity is rather high in Fig. 7: are you sure that this was a pure cirrus and not a mixed phase cloud? Especially at high peaks in total water, it seems that the wvssR comes close or even exceeds values of the wvssF while being lower the rest of the time. This could indicate that the wvssR signal is sometimes altered by liquid particles. Do you know the cloud temperature?

Fig. 2 / Fig. 3: Both figures show a similar branch at humidities between 0.3 and 3 g/m<sup>3</sup> with large positive values indicating a significant under reading of the Buck CR-2. Do you know the reason for that?

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Interactive comment on Atmos. Meas. Tech. Discuss., 7, 8643, 2014.