Response to Anonymous Referee #1 (amtd-8-C4933-2016-1)

Our responses are written in italic.

We thank the reviewer for his/her appreciation of our work and his/her helpful comments.

General comments: This manuscript is an instrument paper describing the new airborne mass spectrometer AIMS-H2O, with in-flight calibration, for fast and accurate atmospheric water vapor measurements. The innovations of this instrument include: * a novel pressure-controlled gas discharge ion source designed for the direct ionization of ambient water vapor, which is different from the CIMS-H2O instrument of NOAA (Thornberry et al., 2013). * a bypass flow to ensure short resident times (and consequently fast time response), * a new in-flight calibration source based on the catalytic reaction of H2 and O2 on Pt to generate H2O. In addition to instrument description, the paper also includes comparisons with other water vapor instruments. The paper is very well-written and thorough. Its scope is a good match for AMT. Hence I recommend that the paper should be accepted subject to minor revisions listed below. The paper will be useful for presenting a new airborne hygrometer with in-flight calibration to improve accuracy at the low mixing ratios of the UT/LS. Section 1 Introduction is excellent motivating the need for this new instrument (to resolve past discrepancies in water vapor measurements). Section 2 Setup likewise is very well-written describing the instrument details, and I like the rest of the paper as well. The science merit is excellent and, in fact, I have no suggestions to improve the science content, only minor comments. The text comments here are the same as the pdf supplement.

Specific comments:

1. page 13526, line 19: I recommend changing “well defined” to “well-defined”

changed

2. page 13526, line 24: The Abstract and Table 1 list accuracy “between 7 and 15 %” but the Summary states accuracy between 8 % and 15 %. Is it 7 or 8? Please explain.

The 8% in the summary are an older value only considering the first of both evaluation methods presented. The value is changed accordingly.

3. page 13526, lines 11 and 12: could you please add one sentence to explain how a residence time < 0.2 s results in a time resolution of 4 Hz? I would expect 5 Hz, unless there is a delay, smoothing or other aspect of mass spectrometry (I am not familiar with mass spec details).

The 4Hz resolution is given by the sampling rate of the mass spectrometer itself. However, we had to make sure that the residence time in the inlet is shorter than the sampling period in order not to limit our time resolution by the residence time. The sentence is now extended to make this point clear.

4. page 13526, line 25 (and also on page 13528, line 28): change “Contrail and Cirrus Experiment” to “CONtrail and Cirrus ExpeRimenT” to capitalize the letters of “CONCERT”.

changed

5. page 13527, lines 7-10: I am not a mass spectrometry expert but would like a brief description (perhaps just a sentence or two) of the various techniques: CIMS, PTR-MS and “artificial ionization and characterization of ambient air”.

A comprehensive description of the measurement techniques can be found in the references. However, we added a sentence in order to distinguish between the indirect methods CIMS and PTR-MS and direct measurements of (ionized) ambient air.

6. page 13527, line 26: please change “ppmv” to “parts per million by volume (ppmv)” here, the first time that ppmv appears in the manuscript.

changed

7. page 13529, line 19: make the text clearer that backward-facing inlets sample gas phase only. I suggest writing “can be operated with either a backward or forward facing inlet geometry to sample the gas phase only or the sum of gas phase and (evaporated) particles, respectively.”

We changed the sentence to make this point clearer.

8. page 13529, line 21: please change “slm” to “standard liters per minute, slm”.

changed

9. page 13533, line 25: at various places in this manuscript, the authors use flow units of sccm or slm. I recommend using the same units for consistency throughout the manuscript.

We agree, units for gas flow are consistently changed to standard liters per minute.

Minor editing comments:

1. page 13545, line 15 (and also page 13547, line 1): please change “focussed” to “focused”.

2. page 13547, line 24, please change “reserch” to “research”.

3. In Figure 2: please change “Inflight calibration” to “In-flight calibration” for consistency with the captions of Figures 2 and 3.

4. In the Figure 2 caption: please change “focussed” to “focused”.

5. In the Figure 4 caption: please change MOhm to Mohm.

6. In the Figure 8 caption: ML-CIRRUS campaign is 2014, not 2015. Also change “fligth” to “flight”.

7. In the Figure 9 caption: change “consequently” to “consistently”.

Thank you for the remarks, they are now corrected in the manuscript.