Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-160-AC3, 2016

Atmospheric Measurement Techniques Discussions
Open Access
EGU

Interactive comment on "Advancements, measurement uncertainties, and recent comparisons of the NOAA frostpoint hygrometer" *by* Emrys G. Hall et al.

Emrys G. Hall et al.

emrys.hall@noaa.gov

Received and published: 25 July 2016

The authors would like to thank all of the anonymous referees for their constructive comments helping to improve this manuscript. Below, we provide detailed responses to each of the comments. Manuscript changes are listed below the author's response when warranted.

Anonymous Referee #3

Received and published: 8 July 2016

General:

Printer-friendly version

Discussion paper

I agree with the assessment of the two reviewers which already appeared in the open discussion: this is a very thorough study describing the functional principle, history, accuracy and reliability of the NOAA frostpoint hygrometer FPH, that recorded the important 30-year stratospheric water vapor series at Boulder, USA. The paper is well organized and fluently to read. I recommend it for publication in AMT and have only some minor remarks which are listed below in the specific comments.

Specific comments:

1. Page 1, line 17: '... decreasing the uncertainty in the thermistor calibration fit to less than 0.01 âŮęC over the full range of frostpoint temperatures (-93 âŮęC to +20 âŮęC) ...' For T > 0 âŮęC the temperature of phase change is the dewpoint, so maybe better say '... over the full range of frost- or dewpoint temperatures ...'.

Author's response: Corrected.

2. Page 1, line 19: '... water vapor intercomparisons are presented, including the excellent agreement during AquaVIT-2 chamber experiments ...' Excellent agreement of what is presented ?

Author's response: Good catch. We have added text explaining the agreement between the FPH and MC-PicT-1.4.

Author's change in manuscript: The sentence now reads: "Results from multiple water vapor intercomparisons are presented, including the excellent agreement between the NOAA FPH and the direct tunable diode laser absorption spectrometer (dTDLAS) MC-PicT-1.4 during AquaVIT-2 chamber experiments over six days that provides confidence in the accuracy of the FPH measurements."

3. Page 1, lines 24 - 26: To my feeling these statements need references.

Author's response: We have added references to the first two sentences. Dessler et al. 2008 was added to the first and Held and Soden, 2000 to the second sentence.

4. Page 2, 2nd paragraph: Here you might want to include a new reference pointing to the importantance of long term stratospheric water vapor monitoring by baloon sounding: Müller, R., A. Kunz , D. Hurst , C. Rolf , M. Krämer , M. Riese (2016): The need for accurate long-term measurements of water vapor in the upper troposphere and lower stratosphere with global coverage, Earth's Future, 4, doi:10.1002/2015EF000321.

Author's response: We have added a sentence along with the suggested reference in the introduction.

Author's change in manuscript: The following sentence was added in the fourth paragraph of the introduction: "Müller et al. (2016) argue for a large network of frostpoint hygrometers with global coverage spanning many decades because of the climatic importance of water vapor."

5. Page 2, lines 17 - 22: Another recent publication where core hygrometers are compared (also showing results from the AquqVit-1 and 2, MACPEX, etc.) is: J. Meyer, C. Rolf, C. Schiller, S. Rohs, N. Spelten, A. Afchine, M. Zöger, N. Sitnikov, T. D. Thornberry, A. W. Rollins, Z. Bozóki, D. Tátrai, V. Ebert, B. Kühnreich, P. Mackrodt, O. Möhler, H. Saathoff, K. H. Rosenlof, and M. Krämer (2015): Two decades of water vapor measurements with the FISH fluorescence hygrometer: a review, Atmos. Chem. Phys., 15, 8521-8538, doi:10.5194/acp-15-8521-2015, 2015. In this study it is stated that the agreement of hygrometers has improved from overall up to 30 % or more to about 5–20 % at < 10 ppmv and to 0–15 % at > 10 ppmv.

Author's response: We have added a sentence along with the suggested reference.

Author's change in manuscript: The following sentence was added after the Rollins et al., (2014) reference in the fourth paragraph of the introduction: "Corroborating these findings, Meyer et al. (2015) show agreement between a core group of hygrometers has improved over the past two decades from $\pm$ 30 % or more to approximately $\pm$ 5–20 % for mixing ratios under 10 ppmv."

6. Page 8, section 3.1 ff: It would be nice to convert errors and uncertainties of the frostpoint measurement in H2O mixing ratios.

Author's response: We have converted the temperature measurement errors into absolute and relative differences in water vapor mixing ratio throughout the thermistor calibration section.

Author's change in manuscript: We have modified the second sentence in section 3.1 to read: "Between 0 °C and -79 °C the curve fit was better than ± 0.06 °C (Fig. 4) that translates to at most a 0.5–1.1 % difference in water vapor mixing ratio over the entire flight (+20 °C to -93 °C) or in terms of absolute differences 0.06 ppmv when analyzing stratospheric data.

Author's change in manuscript: In section 3.3 we have added the following text: "The new 6-point fit converts to at most a 0.08–0.2 % difference in water vapor mixing ratio over the entire flight or 0.01 ppmv, in terms of absolute differences, when looking specifically in the stratosphere."

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-160, 2016.

Printer-friendly version

Discussion paper