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Comment

# ***Interactive comment on “A two-channel, tunable diode laser-based hygrometer for measurement of water vapor and cirrus cloud ice water content in the upper troposphere and lower stratosphere” by T. D. Thornberry et al.***

## **Anonymous Referee #2**

Received and published: 10 October 2014

The manuscript discusses the development of and initial airborne field data collected by a new in situ water vapor and total water instrument intended for use in UT/LS/TTL environments. The instrument, called the NOAA Water instrument, utilizes mid-infrared wavelength-modulated tunable diode laser absorption and an in-flight calibration system to provide high accuracy and precision measurements of both water vapor and enhanced total water in clear air and cirrus cloud conditions from the NASA Global Hawk UAS platform.

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The paper is well written and clear, and should be published with only minor clarifications. The following is a list of statements that require additional clarification and/or rewording:

(Section) 2.1 / (Page) 8276 / (Line) 21: units of weight, although often colloquially given in kg, should be N. Or change “weight” to “mass.”

2.4 / 8279 / 5: suggest removing “37s” as it is not a common descriptor. The interested reader will see what the package is if he/she looks online for the specific detector model, which is given.

2.4 / 8280 / 2: “direct absorption” is more commonly used to refer to a detection method in which modulation is not used. I think what the authors mean here is better described by something like “DC,” in contrast to the “AC” components produced by the modulation. And this brings up a question: how is that DC component measured from the detector signals?

2.4 / 8280 / 3-4: the asymmetry described is really a result of the fact that the observed 2F signal is a combination of the second harmonic pure wavelength modulation signal and the first and third harmonics coupled through an amplitude modulation effect. The authors might consider changing the wording to something like “. . . due to combined wavelength modulation and intensity modulation effects,” and reference P. Kluczynski and O. Axner, “Theoretical description based on Fourier analysis of wavelength-modulation spectrometry in terms of analytical and background signals,” Appl. Opt. 38, 5803–5815 (1999), or similar.

2.5 / 8280 / 10: Is the airfoil-shaped pylon angled to null nominal aircraft pitch angle effects?

2.5.2 / 8282 / 28: What is the largest particle the authors would expect to be ingested by the instrument in TTL cirrus sampling? Would such a particle likely be fully evaporated?

2.6 / 8284 / 13: Are the stepwise calibration values always changed in the same manner

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/ direction? If yes, would the authors speculate on possible systematic errors associated with that procedure?

3 / 8285 / 27: Referring to Figure 7, why do the data show only values down to 2 ppm when the calibrations were done down to 0.5 ppm? Also, on Figure 7, why is N<sub>2</sub> given in “arbitrary” units? Since it is a normalized quantity, it shouldn’t have units (for example Volts/Volt). And the values should represent a real, understandable quantity, based only on the conditions in the cell (pressure, temperature, concentration, path-length), laser modulation parameters, and (perhaps) lock-in and/or A/D gains.

3 / 8286 / 23-25: I may have missed it, but it seems you refer primarily or exclusively to the cell temperature, not the gas temperature. The temperature stability appears to refer to the cell temperature. Is the gas temperature (inside the cells) measured? If so, is that the number that is being reported to be stable to 0.03 deg C? If it is not being measured, why was that choice made and what might the authors speculate could be the errors associated with uncertain / variable gas temperature?

3.1 / 8288 / 2-7: Does sample temperature belong on this list? In laboratory calibrations, did the authors ever introduce a sample with a variable temperature into the temperature-stabilized system to quantify any effects?

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Interactive comment on Atmos. Meas. Tech. Discuss., 7, 8271, 2014.

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