

Interactive comment on “Retrieval of Water Vapor using Ground-based Observations from a Prototype ATOMMS Active cm- and mm-Wavelength Occultation Instrument” by Dale M. Ward et al.

D. Adams (Referee)

dave.k.adams@gmail.com

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Review Ward et al. 2018 by David K. Adams

Recommendation: Minor Revision

The authors provide a detailed overview of an experiment carried out employing an ATOMMS instrument prototype between two mountaintops in southern Arizona. The article intends to demonstrate the unique characteristics of this technique of transmitting and receiving signals near the 22 and 183 GHz water vapor absorption lines

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along with other frequencies, thereby overcoming the limitation of the present satellite RO systems which cannot independently predict temperature and water vapor content. The results of this experiment are placed in the context of employing ATOMMS in future possible satellite occultation systems. Overall, the paper is well written and the technique fairly well-explained. With respect to the results of the experiment, there is necessarily some speculation as to atmospheric conditions in line of site measurement given the lack of precise local data sources, but this is the nature of all experiments and is not a weakness of the manuscript. Below

I make some general comments and seek clarification of a few issues, in addition to a few suggestions

on sentence structure and/or grammar.

Minor Comments.

Line 26 You can probably be a bit more emphatic here. Water is the most important greenhouse gas, critical in the energy balance, responsible for storms etc... Line 29 Should be Sherwood et al., (2010) And you should probably include a few more “big picture” type references related to water vapor in the climate system.

Line 30 Water vapor observations must be unbiased and capture the full range of variability in clear and cloudy conditions across the globe... This sentence is a bit awkward, it could be written in a more concise manner or turn into two sentences.

Page 2.

Satellite systems typically do not have sufficient temporal or spatial resolution to capture many of the important processes related to the distribution of water vapor (such as deep convection in the Tropics).

And if the satellite systems do have this appropriate temporal and spatial resolution (e.g. GOES water vapor channels), they only provide column water vapor and not its vertical structure. You should include a bit more detail in this paragraph to give greater

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force to your proposed system.

Line 19 Can you be specific as to what you mean here by insensitivity “(2) its insensitivity to water vapor in the colder regions of the troposphere and above.”

Line 28 I think you should write “It can also profile ozone ...”

Page 3

Line 2 Probably not necessary to include this “...we developed with funding from NSF,...”

Line 6 Clarify what you are referring to here “..and the forward modeled water vapor spectra,..”

Line 10 Don’t use contractions in formal writing. “...simply do not work.”

Line 16 Write “Sources of uncertainty ...”

Line 30 Write Refractivity and “the” extinction coefficient (or write coefficients)

The hydrostatic assumption would be very dubious during deep convective activity.

Page 4

Line 11. This is a bit unclear. “The gas phase optical depth is due to water vapor and dry air absorption, which introduces temperature and pressure dependence, and any attenuation due to hydrometers.” You are saying the gas phase optical depth is also dependent up the presence of non-gas constituents like hydrometeors?

Page 5

Again, not sure if this is necessary to state. “With funding from NSF,...”

Page 6.

Line 14 “ATOMMS High Band signals” should be

Page 7.

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Line 13. Which radar data are you referring to? You need to clarify this point.

Line 13 Write “By 16:30, the rain was considerably lighter”

Line 33. Can you back this statement up with any citations or some references. “This is likely the finest spectral resolution sampling of the 183 GHz line ever achieved in the field.”

Page 8. Line 22 Should this be capitalized AM

Page 9.

Line 30. What size of error should we expect given the use of local pressure measurements at each of the sites? That is, across the line of site, there should be some small variability of pressure given updrafts and downdrafts.

Page 11 Line 10 Probably more common “signal-to-noise ratio”

Page 13

Line 23 Write “comparison with independent, in-situ moisture...”

Page 14

Line 1-3 Maybe you could be a little bit more specific here referring to the map “ between the mountaintops on which instruments sit, while in-situ sensors are located on the ground at each end of the observation path and another in a valley below the observation path.”

Page 15

Line 17. Such behavior where moisture at the surface varies little while air aloft becomes significantly drier following summertime thunderstorms is common in this region (e.g., Fig. 4 in Kursinski et al. [2008]).

You can probably find a few more references that describe thermodynamic conditions after T-storms during the NAM

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Page 16

Line 21 “The nearby Tucson radiosonde indeed indicated that...” With all of the reference in the paper to this sounding, you should include it in the figures.

Page 18 Frequency of observations will always be an issue to some extent with the RO technique, particularly when the scales are of the time and space scales need for weather prediction.

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