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Comment

## ***Interactive comment on “Accuracy assessment of water vapour measurements from in-situ and remote sensing techniques during the DEMEVAP 2011 campaign at OHP” by O. Bock et al.***

**Anonymous Referee #2**

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Bock et al., AMTD, 2013 Accuracy assessment of water vapour measurements from in-situ and remote sensing techniques during the DEMEVAP 2011 campaign at OHP

This paper discusses the results from a campaign for water vapour measurement inter-comparisons using Raman lidars, various radiosondes, ground-based GPS receivers, and other instruments. In particular, four different methods are compared for the Raman lidar calibration, and comparisons of five different, but very closely located GPS receivers are made. For radiosondes, four different types are compared; among them, one type of MODEM radiosonde is evaluated in the literature for the first time. I am especially interested in the results from the five GPS receivers that confirmed the un-

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certainty of GPS Integrated Water Vapour (IWW) measurements to be 2%-3% in their case. Also, the comparisons of four different calibration methods for the Raman lidar measurements are very useful, and highlight insufficient understanding of the Raman lidar system by the unexplained large drifts in the lidar calibration factors just for a month.

I think that the manuscript can be published in AMT after considering my comments below.

Abstract. "Raman lidar water vapour measurements were useful to distinguish between which of the radiosondes were biased." I think this is a misleading sentence because readers would think that this is a general conclusion. First, Raman lidars need calibration by using measurements from other instruments such as radiosondes. Second, in their lidar systems, there are unexplained drifts in the lidar calibration factors, which are corrected without sufficient understanding of the causes. Finally, in their case, Snow White biases are primarily evaluated by using Snow White house-keeping data.

#### 1. Introduction.

p. 3443, l. 22. Nash et al. (2011) should be added. Also, correct the corresponding reference list. It is 2011, not 2010.

p. 3444, l. 23. Why ".. are expected to be more accurate than ..."? Cite reference papers.

p. 3445. Spell out a.g.l., IGN, and WVMR.

p. 3446, l. 6. Cite reference papers.

#### 2. Campaign and instruments

p. 3447. Hamatsu → Hamamatsu p. 3447, l. 29. Explain "Nimes radiosondes"

p. 3449, l. 7. This message would confuse the readers, who would wonder when and how they would get the investigation results. Please investigate first, then publish.

p. 3450, l. 1. Please add a photo showing how these payloads are assembled with one balloon. How multi-payload soundings are made and why a certain configuration is taken are one of the key for radiosonde intercomparisons. (See, e.g., Nash et al., 2011).

p. 3450, l. 6-8. Is it really possible that Raman lidars can be a reference in spite of the fact that lidars need calibration? Which altitude region do Raman lidars might be a reference?

p. 3450, l. 24-26. Nash et al. (2011) concluded (at page 132, Figure 8.2.5) that "In the lower troposphere, the CFH seems consistently wetter than all other four sondes with maximum wet bias of 5-10% near the surface. The other four sondes agree well with each other. At this point this bias in the lower troposphere is unexplained and is possibly related to the CFH electronic issue that has been identified or improper control with liquid water on the mirror surface (Miloshevich et al., 2009)."

p. 3451, l. 1. and elsewhere. Nash et al., 2010→2011 p. 3451, l. 2. Please describe the major changes from version 3.63 to 3.64 (is it an upper tropospheric solar-heating dry bias correction?).

p. 3451, l. 26. CFH → NOAA Frost Point Hygrometer (FPH)

p. 3452, l. 13. Temperature and pressure sensors and their sources of errors also need to be described. This is because the intercomparisons are made in geopotential or geometric height. (Are the lidar measurements with respect to geometric height?) Therefore, the uncertainty of height measurements should also be discussed.

p. 3452, l. 21. What do you mean by "absolute or relative accuracy"?

p. 3453, l. 2. multipath effect p. 3453, l. 8. These effects have ... ones p. 3453, l. 14. the roof of the main building

p. 3457, l. 19. bias → uncertainty Is the number "2.0%" for RS92 correct? (seems to be too large compared to other radiosondes)

### 3. Data processing and quality control

p. 3460. Is the calibration constant constant in altitude and in time (in theory)?

p. 3463, l. 1-2. I do not understand what is meant here.

### 4. Results

p. 3466, l. 16. "the origin of this drift is not yet explained." Some potential explanations are needed for a publication.

p. 3468, l. 10-11 (and elsewhere). "bias" should be "uncertainty." What do you mean by "fluctuations"? Are they due to the unstableness of the system or potential natural fluctuation of the air?

p. 3468, l. 13-19. The Raman lidar measurements need calibration by using radiosondes or GPS measurements. Furthermore, in the present case, there are unexplained drifts in the lidar calibration factor. Why are you able to say, "provide near absolute IWV measurements"?

We can compare different measurements. We can estimate the uncertainty of each measurement by considering potential error factors. But, usually, we do not know the true value in the atmospheric measurements. Thus, we do not know the "absolute" value (if it means the true value) and we do not know the bias from the true value. Please see, e.g., Immler et al. (AMT, 2010) for the formal terminology relating to measurements and uncertainties.

p. 3469, l. 13-15. I do not understand this part. Do you mean that the definition of the IWV (the altitude range) is different?

p. 3470, l. 5. What do you mean by "a software bias"? Does the software create data?

p. 3472, l. 22-24. I do not think that this can be said only with a few cases. Also, the Raman lidars need calibration by using radiosondes, etc. It is not clear how this fact affects the Raman lidar measurements if we are to use them as a reference. What is

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the altitude range where this might be the case?

In the rest of the manuscript, there are several locations where the same comments written above are applied.

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**AMTD**

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