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Atmospheric Measurement Techniques Discussions

Interactive comment on "Measurements of Humidity in the Atmosphere and Validation Experiments (MOHAVE)-2009: overview of campaign operations and results" *by* T. Leblanc et al.

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Reply to comments by referees of AMTD Manuscript # AMT-2011-52.

The authors wish to thank both referees for their useful and constructive comments. As they can see below, all comments were addressed in the revised manuscript, and are reflected by the yellow highlighting in the attached supplement (revised manuscript).

Referee #1 (amtd-4-C1222-2011): 1. Following the referee's suggestion, a

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new table (Table 1) was added , as well as the following text: "A large suite of balloon-borne in situ, ground-based active and passive remote sensing instruments and techniques were used during the campaign. The basic characteristics of these instruments are compiled in Table 1. Additional information can be found on the following MOHAVE-2009 webpage: http://tmf-lidar.jpl.nasa.gov/campaigns/mohave2009/Instruments_Species.htm"

2. Elevation site: added in Introduction, and the following sentence was added (lines 596-598): "Note that besides the instrumental optimization, the extended range of the three lidars observed during the campaign is facilitated by the high elevation of the observing site (2285 m)"

3. AT lidar: All discussions on the AT lidar were removed from the paper. There were only three water vapor Raman lidars in operation during the campaign, not four.

4. Thank you for noticing the mistype. Text corrected.

5. The sentence was re-worded to make it clearer

6. Oct 26: Indeed for the TMW system, there was no measurement on Oct. 26 due to a laser malfunction. There was no measurement at all for any "manually operated" instruments on Oct. 23 (rest day)

7. Origin of fluorescence: We added three sentences in the revised manuscript (lines 564-567) to briefly describe the origin of the fluorescence: "For ALVICE it is believed to have been caused by organic residues deposited on the telescope primary mirror (insects burned by the laser beam). For the STROZ system, it originated in the receiver optics. In this latter case, the issue was mitigated during the campaign by applying a blocking filter."

8. Fig. 8: Model output time is mentioned on the figure (see top title), and the lidar measurement time is on the bottom axis of the center figures. The text mentions Oct. 20. However there is no mistake as Fig. 8 does not describe this case (instead it

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describes a night with interesting short-timescale variations).

9. Misplaced sentence: Thank you for noticing. We removed the sentence.

Fig. 5: We agree that this figure is very busy. We removed the uncertainty bars to reduce the load on the plots. We agree that the 4 plots could be split into 2 plots at a time, and we will submit a version of the figure that complies with this suggestion.

Fig. 8: Color scale added

Fig. 15: Because it is still useful, we left the instrument names at the bottom of the figure. However we expanded the figure caption as suggested by the referee.

Typos: All typos fixed

Referee #2 (amtd-4-C1701-2011):

General comments: The authors thank Referee #2 for his general comments, in particular regarding the addition of a section on uncertainty on trends, and water vapor variability as found in the SPARC Report. Because AMT is primarily a journal dedicated to technique development, we do not think a discussion on this topic is within the scope of this paper. Such discussion requires a careful analysis of the already observed and/or future modeled trends, and would present a significant risk of ending up too speculative. The MOHAVE campaign was primarily set up to validate the lidar measurements in the UTLS, and we have made the main focus on the lidar (and its calibration) potential. However we understand the importance of such discussion, and we have added several sentences at the end of the conclusion that address the referee comment on the possibility to set up recommendations for NDACC. Several authors are part of the NDACC Lidar Working Group, and are currently working towards finding the best solution for the future archival of water vapor lidar data. The added sentences are as follows: “Yet [the campaign] showed that systematic quality control must be made for Raman lidar measurements in the UTLS as they appear to be easily subject to contamination by fluorescence. The planning of regular blind intercomparisons with

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robust measurement techniques such as the Frost-Point hygrometer is among the possible actions to take to prevent the inclusion of contaminated data in critical databases. A careful design of (or upgrade to) an instrumental setup insuring fluorescence-free signals must be considered the highest priority to insure a meaningful contribution to long-term records in the UTLS."

Minor comments:

1. Line 66: The study does not demonstrate the success of long-term monitoring, but demonstrates its potential for success.

2. Line 210: In the context of this study, we refer to the "routine" calibration methods, which include balloon-borne measurements, and ground-based GPS and Microwave Total Column measurements. It is mentioned throughout lines 210 to 215.

3. Line 316 (microwave): Text was re-arranged and clarified, and now reads: "Although the measurements shown in Nedoluha et al. (2011) showed absolute agreement with MLS to within 8% at 26 km, uncertainties in instrumental baselines can, depending upon the shape of the baseline, lead to much larger errors. Since June 2010 WVMS retrievals at Table Mountain are being calculated after applying a constant, small ($\sim$0.06K) single sine-wave baseline correction without additional baseline fitting. Over 16 months (and continuing), the retrievals show good stability compared to MLS, including an increase of $\sim$+0.44 ppmv (compared to $\sim$+0.27 ppmv for coincident MLS) from June-Sept. 2010 to June-Sept. 2011. The longer-term stability of this baseline remains to be determined".

4. Line 376 (GPS): The following two sentences (and three references) were added: "An early uncertainty analysis of GPS analysis methods (Bevis et al., 1994) indicated that estimates of PW with an accuracy of better than 2 mm plus 1% of the total PW amount are readily achievable using GPS observations. Continual improvements in data analysis methods have reduced this uncertainty to less than 1.0-1.5 mm (Mattioli et al., 2007; Thomas et al., 2010)."

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Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/4/C1876/2011/amtd-4-C1876-2011-supplement.pdf

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 3277, 2011.