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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Mobile water vapor Raman lidar for heavy rain forecasting: system description and validation" *by* Tetsu Sakai et al.

Anonymous Referee #1

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The article presented by Sakai et al. is within the topics of AMT. It is clear in its approach and presents a very detailed validation of a new H2O Raman lidar. In addition, the opportunities offered by the water vapor lidars are relevant considering the increase of the extreme raining events. It deserves to be published. I have some minor corrections and remarks listed in the following:

Abstract L15. Changed their by the Introduction The requirement for data assimilation is more on the absolute value of the root-mean-square-error, less than 0.4 g/kg in the planetary boundary layer (Weckwerth et al). Biases are more problematic for data assimilation process and may induce large discrepancies.

Section 2.4 The investigation about the variation of K is a very interesting study. From our experience, it may be due to temperature instabilities in the trailer, although in our case we could not pinpoint whether it was due to PMT gain or filter CWL variations. Maybe the temperature of the air conditioning was set differently during the summer and the fall? The high voltages of the photomultipliers seem to be fixed; some authors vary the PMT gains to adjust for the signal/sky background noise ratio during daytime and nighttime. This means the PMT gain has been optimized for daytime limitations, and that the lidar could be more effective at night. Could you comment? Why was it necessary to adjust the focus? Because of the displacement of the trailer? Is your collimating lens an achromat? If not, it could explain the change of K with the change of focus.

Section 2.5 To improve the calibration process, especially for the overlap correction function in the lower layers, tethered balloon or kite can be used as in Totems and Chazette (2016). We are then certain of the location of the reference measurements, and we can renew it at will. The accuracy on w is then better. Totems, J. and Chazette, P.: Calibration of a water vapour Raman lidar with a kite-based humidity sensor, Atmos. Meas. Tech., 9, 1083-1094, doi:10.5194/amt-9-1083-2016, 2016. Could you comment on whether this correction of the overlap factor needs to be re-evaluated at the same time as K when the telescope is re-aligned/re-focused? Rather than PMT inhomogeneity, the incidence on the interference filters may have been modified by the change of focus, which is known to have a large impact. In Figure 5, there is a great variability of the observed overlap correction, what can explain this? Lidar noise? Radiosounding error? It may be necessary to distinguish different cases because it is an important point for the robustness of the measurement in the lower tropospheric layers. Can you evaluate or at least comment on the resulting uncertainty on w below 1 km altitude?

Section 3.1.1 Radiosounding errors should also be shown in Figure 6. L24-27. The decrease of the water vapor concentration could be seen on the in-situ measurements of weather stations. Perhaps the temporal evolution of one of these measurements should be added. Why would the laser energy have decreased? Is it because of cold, flash lamps and/or damage on optics? The differences with the modeling can be related to local effects and thus to the representativity of the measurement site at the mesoscale. They can also be due to a problem in the assimilation process if it does not integrate well the error matrices.

Section 3.1.2 L11. Typing error on “difference-wsonde”?

Section 3.1.3 This section should be merged with section 3.1.1.

Section 3.2 L11. A ground level in-situ measurement could have helped.

Section 3.3.1 It is not so clear whether assimilation is only about radiosounding. Are there no other types of data assimilated, such as spaceborne data? It would be better to show the scatter plot of the radiosounding/LA also.

Section 4 Change numbering.

It’s a very good job, congratulations.

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