

Interactive comment on “A Raman lidar at Maïdo Observatory (Reunion Island) to measure water vapor in the troposphere and lower stratosphere: calibration and validation” by H el ene V er emes et al.

FJ Immler

franz.immler@dwd.de

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General comments: The paper presents a novel instrument (LIDAR1200) with very interesting performance characteristics, new is probably also the concept of routinely calibrating such an instrument with GNSS IWV. The consideration about the accuracy of this technique are however somewhat questionable. The paper states that with the presented technique water vapor measurements in the UT/LS region can be routinely performed. Given the potentially large uncertainty of these measurements the usefulness of these observations are not fully demonstrated. There are some significant

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doubts about the estimation of the uncertainty of the calibration technique. As pointed out above, not enough evidence is provided that the new technique provides sufficient accuracy to study variability and long term trends in UT/LS water vapor concentrations. The opportunity of accessing all data of the instrument should provide the opportunity to reproduce results. However, the description of calibration and validation techniques is not sufficiently clear to allow full reproduction of results, for example, how the values in table 1 are calculated is not well described.

Quality of the Presentation: A good overview of related work and results is provided in the introductory part. The number of figures and tables could be reduced. Table 2 and 3 could be omitted, e.g the vertical resolution has already been shown in Fig. 1; the campaigns in fig. 5. Fig 13 and 14 are also not particularly useful.

More detailed Comments:

Introduction: Necessity and quantitative requirements (uncertainty, long term stability) could be better motivated: who needs this data for what (which models)? Which uncertainty would be required to be able to detect long term stratospheric water vapor changes? Section 1 A formula demonstration how WVMR is calculated from signals could be shown. Section 2.1 It seems somewhat questionable that with a telescope of 1.2 m Diameter (and 4 m focal length?) a signal from 15m distance can be detected, normally direct beams from that low an altitude will be obscured by the secondary mirror. It is likely that the observed signal is created from multiple scattering. Some considerations of the validity of the retrieval method under these circumstances should be added. Section 2.3.1 The data indicate an uncertainty in the GNSS IWV measurements of 8 -20 %. The GNSS calibrated lidar measurements can hardly be better than that. Section 2.3.4 I am not quite convinced by this analysis. It would have been better to consider the radiosonde data as reference and compare to the GNSS calibrated lidar results. Section 2.3.5 This suggests that under dry conditions (IWV=3mm) the calibration error can be as high as 66% (2mm accuracy in the GNSS IWV) Section 2.3.6 I disagree to the statement :” the uncertainty on the calibration coefficient of each pe-

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riod is mainly due to the term corresponding to the standard deviation divided by the square of the number of nightly calibration coefficients.” This calculation yields the uncertainty about the average of nightly coefficients, but this does not correspond to the uncertainty of the calibration, which is not based on this average. If I understand correctly, the lidar is re-calibrated every night using the GNSS, thus the uncertainty is not based on the average of the nightly coefficients but on the uncertainty of each individual calibration GNSS nightly value. This will be mainly determined by the uncertainty of the GNSS IWV measurement itself which, as pointed out earlier is not better than 8%, plus random errors. Figure 3 shows the differences between the GNSS calibration and other calibrations based on radiosonde, these differences are quite large and illustrate the uncertainty of the GNSS calibration technique. Section 3.4. It is unclear whether the lidar has been calibrated by the GNSS IWV or by the CFH data. The conclusion is not quite true, between 14 and 16 km the two instruments are not in agreement.

Typo: In line 33-34 a full sentence is repeated.

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