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Atmospheric Measurement Techniques Discussions

Interactive comment on "Column water vapor determination in night period with a lunar photometer prototype" *by* A. Barreto et al.

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We would like to thank Referee #1 for all the constructive suggestions he proposed. They have been certainly useful suggestions we have incorporated into the revised version of this paper.

1) I find the paper sound for the most part, but would like to see some issues addressed (see below). One thing that should be clarified is how a modified Langley was performed with a single night's data and an uncertainty estimated.

>In contrast to sun-photometry, the calibration procedure in lunar photometry constitutes an important problem to overcome. At nighttime, we have a useful observational percentage <60% to perform a lunar photometer calibration, and, what is more, these

useful period do not cover the entire night due to the phase lag between sun and moon cycles (excepting for full moon events). It means we need nocturnal measurements at several lunar cycles in an operational mode in order to find the enough number of pristine nights to perform a statistical analysis of the Lunar-Langley uncertainty. Since the present paper presents the preliminary results of PWV obtained with a CE-318U prototype measuring in non-operational mode, we have performed its calibration using a single night. However, as we stated in Barreto et al. (2012), this calibration must be ideally computed as an average of several Lunar-Langley's obtained in a mountain-top station under suitable atmospheric conditions. We are working to provide in future studies a complete statistical analysis for Lunar-Langley uncertainty.

2) Lines 7-9 Did you compare nighttime with daytime PWV? Using 'quasi-simultaneous' for describing the daytime comparisons and not using 'quasi-simultaneous' for the nighttime comparisons suggested to me that you were comparing daytime and night time measurements of water vapor, which does not seem to be a good idea since water vapor is highly variable in a very short time. Please make what you did clear. For example, were you trying to demonstrate that the lunar retrievals and solar retrievals are comparable in accuracy?

>We agree with this comment. Certainly in some parts of the manuscript (page 768 in the abstract section and page 771 in introduction section) we used the word "quasi-simultaneous" for the diurnal PWV comparison, but it was not used when we were referring to the nocturnal Lunar Cimel versus GPS comparison (in spite of the fact that both diurnal and nocturnal comparisons were performed following the same criterion). As we mentioned in page 777, last paragraph, it is particularly important to establish an adequate coincidence criterion for comparing PWV measurements from different techniques due to the high spatial and temporal variability of the atmospheric water vapor, as the Referee suggests. So, we performed diurnal comparison (GPS versus Cimel AERONET) using "quasi-simultaneous" measurements within the time interval of $\pm$6 min. A similar time interval was selected for nocturnal comparison (GPS versus

Lunar Cimel). Regarding comparisons against RS92 PWV data, as we have only two values per day (around 00:00 and 12:00 UTC), we compared LC-RS92 PWV within the 22:00–0:00 UTC time period, and CA-RS92 PWV within 10:00–12:00 UTC.

>We will correct these mistakes on pages 768 and 771.

>Yes, the goal of this comparative study is to show that PWV accuracies from nocturnal and diurnal photometric measurements are comparable. This statement is critical when it comes to provide a continuous sequence of PWV measurements, using nocturnal measurements to fill the existing gaps in PWV inferred using sun-photometry.

3) Are you concluding that lunar retrievals of water vapor are much more accurate than GPS. Otherwise, why use lunar retrievals? Are they better than radiosondes in dry conditions? State the beneïňĄts of lunar retrievals of water vapor in the conclusions.

>What we have concluded from this study is that Lunar Cimel can perform nocturnal column water vapor measurements with an accuracy comparable to other standarized techniques, such as GPS and RS92 (see page 781, last paragraph). As we have mentioned in the question #2, the main goal of this comparative study is not to show that Lunar Cimel PWV accuracy is better than the accuracy of other techniques, but to show that all these techniques to determine PWV have comparable accuracies. This allows us to say that the combined lunar-sun photometry might provide a continuous sequence of PWV measurements, during day and nighttime.

>Regarding the retrievals in case of low or very low humidity conditions, we can conclude from Figure 4 that is precisely GPS the technique more affected by this condition (see 11 July), when high PWV discrepancies were obtained between Cimel AERONET and GPS. This is in agreement with previous findings from Schneider et al. (2010) (http://www.atmos-meas-tech.net/3/323/2010/amt-3-323-2010.html). They concluded that for PWV< 3.5 mm, the GPS systematically underestimates the atmospheric water vapor content.

>Another reason for using a lunar photometer to determine nocturnal PWV is the limited deployment of high precision GPS networks that allow obtaining PWV, mainly in remote regions. The use of different techniques is the only strategy to try to overcome the shortage of observations over large areas of the Earth and give a comprehensive global picture of an atmospheric component from ground. The Lunar photometry could be one of these techniques for the determination of PWV.

4) Most importantly, was the extraterrestrial calibration performed using only one night's data? Do you not need multiple measurements to establish an uncertainty for this? This is not how calibrations of sun photometers is usually done even on Mauna Loa.

>Answered in question #1. Anyway, the authors want to emphasize that despite using a single night to perform the instrument calibration, we have obtained PWV values quite similar and objectively comparable to those obtained from other techniques within the time period selected for this study. It leads us to conclude that this calibration is valid in this time period.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 767, 2013.