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Atmospheric Measurement Techniques Discussions

Interactive comment on "GPS-PWV jumps before intense rain events" *by* Luiz F. Sapucci et al.

Anonymous Referee #1

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The manuscript presents a combined analysis of time series of precipitable water (PW) derived from GPS (Global Positioning System) observations and surface precipitation estimated from an X-band Radar. Both datasets were obtained in 2011 during the CHUVA Vale measurement campaign. The study mainly focusses on a statistical analysis of the relationships between precipitable water fluctuations and precipitation intensity (with wavelets in particular). The results suggest a potential of high-frequency PW for nowcasting.

A major originality of the manuscript lies in the particularly high frequency of the PW dataset: one minute. I had never seen GPS time series of PW provided with such a small temporal sampling, and I think that this is very interesting. I also think that this specificity of the study is not emphasized enough, for instance the abstract does not mention the 1-min sampling of precipitable water.

My main comments for now concern the presentation of the results.

A) In my opinion, the authors jump too quickly to statistical results. The results will be much more convincing with the addition of the time series centred on rain events, because I think that they must first present, and in much more details, these results (see specific comments).

B) This goes with some reorganization of the manuscript, with section 4 placed before section 3.

C) The datasets, methods and results are not all clearly separated. It would have been easier for the reader if the datasets, data processing and methods (wavelets...) had been presented before the results. In addition, such a structure would have prevented repetitions. In case you choose to stick to the present organization (apart from the one indicated in B), please make sure to remove unnecessary repetitions (I noted some in the specific comments below).

Specific comments

1) Page 2, introduction, "PWV data from a microwave radiometer (MWR) with high temporal resolution have been used to describe the observed relationship between the PWV and precipitation in the tropics (Muller et al. 2009). Muller et al. (2009) do not use any microwave radiometer (MWR), they use a a purely model-based approach. On the other hand, Holloway and Neelin (2010) is a proper reference.

2) Page 2, Introduction, references to studies using GPS PW: several references are given, they mainly concern American areas. Similar studies were carried out by Bock and colleagues in Africa (e.g. Bock et al. J. Geophys. Res. 2008) and in Europe, and very likely by others elsewhere.

3) Page 2, Introduction, paragraph "The motivation ...": the authors should clearly state at this point that they will use very high frequency datasets.

4) Page 3, section 2, first paragraph: the three last sentences ("During the CHUVA...

and precipitation." are unnecessary.

5) Page 3, section 2: the same information is given twice,

lines 7,8: "The CHUVA Vale campaign was carried out in São José dos Campos"

line 16: "The CHUVA Vale experiment performed in São José dos Campos City"

Please correct, be more concise

6) Page 5, "The time series of the precipitation fractional area around the GPS receiver observed by radar were calculated by determining the position of the GPS antenna in the gridded precipitation points and taking into consideration the area formed by points in the longitudinal direction for the same number of points in the latitudinal direction where the nearest point of the GPS antenna is located in the center of these areas": this sentence is unclear.

7) Page 5, "representative" in "Different areas were tested, and an area of 22x22 (longitudinal per latitudinal direction grid point values of rainfall intensity (mm h -1)) was found to be more representative of the observed area by GPS'. Can you precise what you mean with "representative" here? This is too vague.

8) Page 6, "The disdrometer time series has a good correlation with the 95 th percentile time series": how did you do precisely? The time samplings of these variables are 1 min and 6 min. Did you regrid the disdrometer time series, please precise. The same apply to the legend of Fig. 2.

9) Page 6, 1st paragraph of section 3, "As argued by Adams... in this region". These sentences are not so much about the methodology. They would be better placed in the introduction or discussion.

10) Page 7, section 3.1: I found that the paragraph was not always very clear.

For instance, the authors write "The methodology employed to process the GPS data in one-minute intervals did not provide any additional information." (line 6)

and a few lines below

"For this reason, it is necessary to take into consideration ... a short time step, e.g., the one-minute interval used in this study."

11) "expressive": this word is frequently used in the manuscript but I am not sure that is is appropriate (note that I am not a native English speaker).

12) Page 7, section 3.1, replace "A vertical line was put at the peak of the maximum precipitation in each event to simplify the analysis" by "For clarity, a vertical line was drawn for each precipitation maximum". This information is missing in the legend, where it would possibly be more appropriatly introduced.

13) Page 7, section 3.2: did you need to re-sample the GPS PW dataset on the 6 min time step of radar precipitation here? And if so, how? e.g. via sub-sampling, time averaging?

14) Section 3.5, Figures 5 and 6: correlations are not very high. You need to comment their magnitude. Also, the caption does not indicates the error bars not how they were drawn.

15) Page 8. You recall the same information several times. For instance, below, an information that was already given before.

lines 10-11: "...the results reported by Adams et al. (2013), who showed that the strongest water vapor convergence is typically $\sim$1 hour before heavy precipitation."

Page 7, lines 23-24: "... the water vapor may increase through low-level moisture convergence, as suggested by Adams et al. (2013)on the time scale of 32-64 minutes"

Please reorganize and avoid repetitions.

16) Raymond (1987) is missing in the list of references.

17) Section 4, inset in Figure 7: this is the first and only time that the fluctuations of

high-frequency GPS PW are presented. I think that this is late in the manuscript, and that this is not enough. I think that you have to present several of the cases presented in table 1, in the form of graphs jointly showing time series of radar precipitation (either fraction above 50 mm/h or another rainfall diagnostic) and GPS PW. I would prefer to see the 18 cases, organized by terciles, or at leat 3 of them per tercile.

I further strongly suggest to move section 4 before section 3 (see main comment B).

References

Holloway, C. and J. Neelin, 2010: Temporal Relations of Column Water Vapor and Tropical Precipitation. J. Atmos. Sci., 67, 1091–1105, doi: 10.1175/2009JAS3284.1.

Bock, O., et al., 2008: The West African Monsoon observed with ground-based GPS receivers during AMMA, J. Geophys. Res., 113 (D21105) doi : 10.1029/2008JD010327.

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