Review for **"Variability of Bulk Water Vapor Content in the Marine Cloudy Boundary Layers from Microwave and Near-Infrared Imagery"** by Millán et al, submitted to Atmospheric Chemistry and Physics

General comments:

This paper presents an assessment of boundary layer water vapor from satellite data. The method applied is based on a 16-year dataset of collocated near-infrared and microwave satellite observations.

In general, the paper is well structured, and provides some new interesting results. However, it needs some minor revisions before it can be published.

Specific comments:

p.2, l.4-5: you should mention that the datasets are derived from **satellite** observations

p.2, l.30-31: Other months do not show this inconsistency? What are the reasons for that?

p.2, l.34-35: Is this error (between 5 and 10 %) the error of the near infrared channels? Or the error of CWV? What about the error between cloudy and cloud-free cases? Is there a dependency on solar zenith angle?

p.3, l.6-7: Do you mean that you use only clouds that have been classified as "only liquid"? It is not clear here how you deal with mixed-phase clouds. The whole sentence should be rephrased for better clarity.

p.3, l.12-13: The monthly standard deviation of BL-CWV depends strongly on the variability of the boundary layer height (CTH). Have you checked this dependence?

p.3, l.31: Did you only use Arctic/Antarctic radiosondes? Which latitude belts did you include?

p.4, l. 10ff (and Fig. 2): I think that the variability within 6 hours is much larger than over 10 km. I guess most of the uncertainty reduction in the 1 hour/1km analysis comes from the shorter time range. Have you tried to keep 10 km (or even more) and reduce the temporal distance to 1 hour? In addition, 1 km drift of radiosondes is easily reached already within the boundary layer, therefore, I would suggest to neglect this "strong" 1 km criterion and rather focus on the temporal matching.

p.4, l. 20-23: It is known that GPS-RO data are missing some lower level inversions (especially below 1000 m above ground). How do you deal with this fact? Does it introduce a bias in your comparison?

p.5, l.3 (and Fig. 4): It is a bit misleading that you call the algorithms “AMSR-MODIS” and “GPS-RO”. This suggests that the GPS-RO algorithm is independent, however you use GPS-derived CWV above the inversion and then subtract it from AMSR total column. Therefore, you are not comparing independent data here. Please comment on that!

p.5, l.7: Although slope and RMS decrease, the correlation coefficient also decreases. Do you have an explanation for that?

p.5, l.10-18: Is it possible that different viewing geometries or high solar zenith angles play a role in the uncertainties? If so, did you make separate analyses for different solar geometries or for different regions of the Earth?

p.6, l. 33-34 (and Fig. 7): What is the reason for the lower LTS in the Canarian region? Is it due to frequent advection of unstable air masses from the Saharan desert?

p.7, l.3: Why did you reverse the order of the regions here (compared to p.7, l.1)?

p.7, l.21-25: What are the model constraints? Vertical temperature structure? CWV? CTH?

p.7, l.26-27: I cannot see an overestimation since you are plotting normalized values in Figure 9. It would be good to see absolute values from the model! Does the magnitude of the overestimation is in line with the findings in Figures 2 and 4?

p.8, l.18: You are mentioning only here the restrictions of your method to homogeneous cloud fields during daylight. Does that affect the overall validity of your results? Do you expect a diurnal cycle?

p.8, l.23-25: This sentence (That is version2.0 (…) algorithm) is not necessary in the summary.

Figure 8: Please provide information on the monthly variation of BL-CWV and BL-CTH, e.g. showing error bars or box-and-whisker plots

Figure 9: Since you plot normalized values, the unit [mm] is not correct!

Technical corrections:

p.1, l.20: replace “are” by “is”

p.1, l.24: “process**es**”

p.3, l.22: “criterion”, not criteria

p.3, l.24: “grid**d**ing”

p.3, l.25: “represent” (not “represents”)

p.5, l.1: “coast” (not “cost”)

p.6, l.31, p.7, l.10: “4 K” (without degree sign)

p.8, l.14: “remain”, not “remains”

p.8, l.32: “over”, not “on”

p.8, l.32: “Sc-Cu”: You never introduced these acronyms

Fig. 9 (caption): please correct: Normalize**d** (…) The number**s** (…) coefficient**s** (…)