Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-89-RC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "OMI Total Column Water Vapor Version 4 Validation and Applications" *by* Huiqun Wang et al.

Anonymous Referee #2

Received and published: 6 June 2019

In their paper, Wang et al. present an update of a total column water vapor (TCWV) retrieval in the visible spectral range using OMI spectra. They briefly document the changes made for the update and demonstrate the improvements within a validation study including measurements from microwave satellite and ground-based GPS. In addition, they show how the updated data might be used for studies on ENSO, Corn Sweat events, and atmospheric rivers.
Overall, the paper is nicely written and easy to read. However I have major concerns regarding the validation study, the drawn conclusions of this study and the case studies of possible applications. I will list my concerns below.

Printer-friendly version

Discussion paper

Major concerns

- Since this paper presents an update of an exising data set/retrieval, it is evident to clearly demonstrate that the update distinctively improves the algorithm compared to the previous versions. This is not done in this work. Hence I suggest that the authors also include comparisons between the reference data sets and the previous retrieval version.
- I am not fully convinced by the conclusions for the intercomparison between OMI data and GPS data. The linear fit has a slope of 0.82 even for clear-sky observations (radiance cloud fraction < 0.05) and for larger cloud fraction those fit results are actually missing. Additionally, I think that it is a simplification to focus on bias and standard deviation only for interpreting the data. Thus I suggest to include also the mean absolute error (MAE) in the validation study and to perform linear fits for the different cloud fraction thresholds. Furthermore, only some selected scatter plots of the intercomparison between OMI TCWV data and reference data sets are shown in this paper. I suggest that for each cloud fraction threshold the corresponding scatter plots and linear fits are displayed, which may be provided in an Appendix or Supplement to the paper.
- Although Section 4 shows very interesting insights in the application of the new data set, it does not really fit the scope of AMT and should be skipped. Nevertheless I think it might be interesting to see what the impact of other satellite data (AIRS, SSM/I, TES, etc.) will be on the respective case studies and how much better the OMI performs within this comparison. But this will be probably beyond the scope of this paper.

General comments

1. How strong are the cross-correlations between the considered absorption cross-sections (more precisely between H2O, liquid water, glyoxal)? Considering the retrieval fit window, since the 6n+d H2O line is partially included within this window, do you account for correction factors reported in Lampel et al. (2015)?

2. How large is the dependency on the MERRA-2 water vapor profiles and doesn‘t this mean that your retrieval is not fully independent from external data sets?

3. It would be very interesting to the reader to see which update step contributes most to the improvement (new fit window, new cloud product, new MERRA-2 data?).

4. Do you use the radiative or the geometric cloud fraction? The cloud fraction criterion of 0.05 seems very restrictive to me. What fraction of OMI data is filtered by this criterion?

5. Linear regression for land data: Why is the slope so bad? Please discuss in more detail the uncertainties of the SCD and the AMF.

6. El Nino study: Since you only consider clear-sky observations, your averaged data are biased. How strong is thus the influence/impact of clouds?

7. Corn Sweat study: Do you observe the increase of TCWV also in the GPS data?

8. AR study: I do not see the benefit of the description of the AR in Section 4.3.2, especially when this AR is already analysed in detail by Neimann et al. (2008). So the authors might think about skipping this section.

Specific comments

- line 10: please introduce the complete name for OMI (Ozone Monitoring Instrument)
- line 12: „various updates“ → more specific (e.g. updated cloud product, etc.)
- line 16: geometric/radiative cloud fraction?
- line 22: I think you meant 20-30 instead of 10-30 mm
- line 27: atmospheric river
- line 37: in situ
- line 38: „ground“ instead of surface
- line 41: the reference is Schröder et al. (2018)
- line 43: I would rather say clear-sky and cloudy-sky
- line 58: It is very unusual to mention results already in the introduction
- line 69: reference spectra for water vapor from the latest HITRAN database . . .
- line 74: please insert a line break
- line 86: Aura
- line 88: 1:30 PM local time (this is actually the equator crossing-time)
- line 95: The specifics of Version 4 are discussed . . .
- line 106: show

- line 125: „smaller toward the the lower right corner of the domain“ please rephrase this
- line 131: „5x10^23 molecules/cm²“ where is this value coming from?
- line 134: Shouldn‘t the residual be small as well as not contain any structures, i.e. it should be noisy?
- line 159: influence the AMF
- line 168 to 172: it would be very helpful to have a map showing the distribution of the GPS stations
- line 176: what are unphysical values? Please describe in more detail.
- line 180: the time window seems quite large, since water vapor can vary a lot during day. I think it would be better reduce the time range to plus/minus 1.5 hours
- line 185: which elevation database are you using?
- line 186: „we consider the OMI and GPS data that are less than 75 mm.“ why not higher values (e.g. 100 mm)?
- line 195 and 196: the references have to be switched
- line 209: please provide R^2 of the linear fit
- line 279: Isn‘t this also an instrumental issue (poor signal to noise ratio of OMI?)
- line 290: cycles
- line 291: which special cases?

- line 293 to 295: now you are using different requirements for the fit (e.g. higher TCWV threshold).
- line 373: Figure 7cd → Figure 7c) and 7d)
- line 376 and 377: decrease
- line 492: what is the weight of the OMI observations for your assimilated data? Can you provide a map for that? • line 556: „we recommend to consider only OMI data ...“
- Table 3: Please indicate the fraction of used data points to available data points in percent. Also split up the regression column into slope and intercept and coefficient of determination (R^2).
- Figure 1: please remove panel d) and replace it with Figure 2
- Figure 3: Please include a comparison for Version 3 and the linear fits in the scatter plots. Also colorbar in the bottom panel has no labels.
- Figure 10: Please zoom into the region of interest.
- Figure 12: Why does the model simulate rainfall in the northwest of Oregon even for the case with assimilated OMI data?

References

- Lampel, J., et al. "On the relative absorption strengths of water vapour in the blue wavelength range." Atmospheric Measurement Techniques 8.10 (2015): 4329-4346.

- Neiman, Paul J., et al. "Meteorological characteristics and overland precipitation impacts of atmospheric rivers affecting the West Coast of North America based on eight years of SSM/I satellite observations." Journal of Hydrometeorology 9.1 (2008): 22-47.
- Schröder, Marc, et al. "The GEWEX Water Vapor Assessment archive of water vapour products from satellite observations and reanalyses." Earth System Science Data 10.2 (2018): 1093-1117.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-89, 2019.

Printer-friendly version

Discussion paper