

Anonymous Referee #1

Received and published: 19 March 2014

Wang et al. present an algorithm for the retrieval of water vapor columns from spectral measurements in the blue spectral range. Such a retrieval is of high relevance, as it allows a consistent retrieval over land and ocean, and it can be applied to OMI measurements. I recommend publication on AMT after dealing with the following comments.

Dear reviewer,

We appreciate your review. We have revised our paper accordingly. Please find our detailed response to each point below.

Section 2.2.2: The authors find a strong effect of the in/exclusion of the spectral absorption of liquid water, at least for the wide fitting windows. Interestingly, the exclusion of liquid water results in the lowest statistical uncertainty of SCDs, though the results are obviously biased. I suspect that the liquid water absorption is not perfect (as it is hard to measure accurately in this spectral range). Please discuss.

We have compared the common mode for a water dominated orbit and a land dominated orbit. Results show that, without liquid water, there are apparent spectral structures in the common mode over the ocean but not over the land, with liquid water, the spectral structures in the common mode over the ocean are reduced, but some still remain, which suggest that there are errors in the liquid water reference spectrum used in the retrieval. To illustrate the point, we have added Figure 5 and the corresponding discussions in Section 2.2.2.

Section 3: While the retrieval of SCDs is described in detail in 2.2.1, and sensitivity studies of the impact of fit window and cross sections are provided in 2.2.2, section 3 is rather sketchy, and sensitivity studies are missing. Please add a description of the treatment of clouds for the calculation of AMFs. Are they considered to be lambertian reflectors, or 3d scattering objects? Note that the cloud pressure derived from O₂-O₂ absorption cannot be interpreted as physical cloud top pressure (see Acarreta et al., 2004). This should be discussed, and page 549 line 16 should be modified accordingly. This has a high impact on the H₂O AMFs due to the low scale height of H₂O! Please discuss why monthly mean profiles can be used for the calculation of AMFs despite the high temporal and spatial variability of atmospheric water vapor.

We have added sensitivity studies of AMF in Section 3. We treat clouds in the same way they are treated in the OMCLDO₂ product, i.e. Lambertian reflector with an albedo of 0.8. We use the monthly mean water vapor profiles to avoid using near real time assimilated water vapor profiles in our operational retrieval. We will investigate the effect of using water vapor profiles of higher spatial and temporal resolution in the future. The discussions have been added to the end of Section 2.1 and in the middle of Section 3.1.

Page 550, line 9: 2.99e-23 should be sufficiently precise. I would appreciate if one unit for water columns would be used consistently throughout the paper.

To aid unit conversion, we have included both molecule cm^{-2} and (precipitable) cm in the color bars of the Fig. 8 and Fig. 10. We have also added the conversion factor in the third paragraph of Section 4.

Page 550, line 20: I agree that there is a clear correlation between MODIS and OMI, but I would not call it a "linear relationship"; there are clear systematic deviations from a linear relation (e.g. for January: for MODIS values of 2 cm, most OMI values are lower, while for MODIS values of 5 cm, most OMI values are higher). This non-linear relation should be discussed. Due to the different sensitivities of MODIS over land and over ocean, the comparisons should be performed separately for land and ocean as well.

We have separated our comparison for land and ocean. Since MODIS data are most useful for the land due to low near IR albedo of the ocean, we concentrate this comparison for the land area. We have deleted the text about "linear relation". We have revised the discussions to correlation coefficients, means and standard deviations.

In addition to MODIS, in Section 4, we have added comparisons with the GlobVapour combined MERIS+SSM/I product. We have performed separate comparisons for the overall, land and ocean areas in Figure 9.

Page 551, lines 15-16: Why are the stripes removed at this stage? I would recommend to perform a stripe correction based on SCDs, before the application of AMFs. Please discuss.

Following your suggestion, we now remove the stripes from the SCDs before converting to VCDs. The results only change slightly.

Page 552, lines 10-11: I recommend to exclude Mountain sites from the comparison due to the OMI ground pixel size. Especially for Mauna Loa, the comparison is meaningless.

We have deleted the bottom row of this figure.