Anonymous Referee #2

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The paper presents an analysis of OMI AOD uncertainties due to cloud contamination, aerosol layer height assumption, and aerosol model assumption over the ocean. This paper is interesting as it looks into the uncertainty sources through detailed and thorough analysis with AERONET, CALIOPSO, MODIS, and other datasets.

The manuscript can be improved and accepted after the following comments are addressed.

1. It is interesting that this paper, with a purpose to assess global OMI aerosol products, doesn't have a global map. I recommend a figure for multi-year climatology of global OMI AOD map be presented with AERONET AOD overlaid. The current Table 1 for AERONET list can be put into the appendix. The second figure can show the map of bias and correlation for each of these AERONET stations. These figures can provide a good overview of how bias and correlation are changing spatially.

A: We respectfully disagree with the reviewer's request and we do not think this figure is needed. This study is an algorithm evaluation study and there is no needed to carry out multi-year climatology AOD maps of OMI and Aeronet. Such maps and related analysis can be found in Ahn et al., 2014.

Ahn, C., O. Torres, and H. T. Jethva. 2014. "Assessment of OMI near-UV aerosol optical depth over land." J. Geophys. Res. Atmos. 119 (5): 2457–2473 [10.1002/2013JD020188]

2. Section 2.1.2. It says that OMAERUV has two different retrieval schemes, depending on the aerosol type defined. This is a bit confusing. Does the algorithm have an internal database to identify OMI pixel as either land or ocean pixel? Given the large footprint of OMI, it is very likely that the OMI pixel corresponding to the coastal or island AERONET maybe also affected by the fraction of land surfaces in that pixel. This level of details should be discussed as it can affect the retrieval accuracy as well. Similarly, MODIS retrieval has land and ocean retrieval algorithms, and the validation of AOD over the ocean can be tricky as well because AERONET sites are on land (coastal or island) and not over open ocean. MODIS AOD from ocean algorithm is more accurate, but coastal AOD has less accuracy. See Anderson et al., 2013, Tellus, for detailed discussion. Anderson et al., 2013, Long-term statistical assessment of Aqua- MODIS aerosol optical depth over coastal regions: bias characteristics and uncertainty sources, Tellus B, doi:10.3402/tellusb.v65i0.20805.
So, at least the manuscript should be clear about: (a) how OMI's two retrieval schemes operate over the costal and island regions, especially when ocean & land are mixed in the OMI pixel; (b) Is only AOD from MODIS Ocean algorithm used for evaluating OMI AOD?

A: No, the algorithm does not have two different approaches depending on the aerosol type. It does have different approaches whether the selected pixel is over land or over the ocean. We agree that the respective paragraph is confusing. So we added the following text in the same section to make this point more explicit: *"OMAERUV is structured internally as two different retrieval schemes depending whether the pixel has been identified as an "ocean" or "land" (or predominantly dominated by one type in the case of coasts) according to the ancillary surface type database (Torres et al., 2013)*".

Regarding the operation of the algorithm in coastal surfaces, no such detailed analysis exists. However, the OMI Level 1 algorithm determines the surface type flag. This flag is passed on downstream and ingested by the OMAERUV algorithm. This flag includes four types of ocean flags: "deep ocean", "continental shelf ocean", "shallow ocean" and "ocean coastline" . In the present analysis, only OMI pixels labeled as "deep ocean" , "continental shelf ocean" and "shallow ocean" were used for

comparison with Aeronet observations. We think this is the best it can be done with the resources available from OMI. Section 3, the second paragraph notes that in the comparison only pixels labeled as "ocean" are used.

Regarding the MODIS AOD data, only ocean MODIS data is used in this analysis. This explicitly said in beginning of section 2.2.

3. Dust nonspherical effect on AOD. It will be ideal that a scatter plot of AOD bias vs. scattering angle can be presented. So, the analysis from case studies can be more statistically significant. In addition, MODIS algorithm does consider non-spherical effect. Can the MODIS hybrid AOD vs. OMI AOD be in part due to non-sphericity effect? It is also interesting to note that in places downwind of Saharan dust, both spherical and non-spherical particles co-exist, and it is necessary to consider both (e.g., Wang et al., 2003, GRL, doi:10.1029/2003GL018697). In other words, replacing non-spherical phase function may improve retrieval in some cases, but not all cases. Itis good to discuss no-size-fit-all.

A: the reviewer makes a good point. MODIS aerosol products are probably impacted too because the MODIS DT algorithm does not use non-spherical models over the ocean. The non-spherical impact is most noticeable observed in the MODIS product FineModeFraction (FMF). For example, in the case over Cape Verde shown in this study, the respective map of MODIS FMF exhibits remarkable correlation between scattering angle and FMF. But there is no correlation between scattering angle and MODIS AOD. Communication with Robert Levy from the MODIS Dark Target aerosol team confirmed that this is a behavior frequently seen in MODIS data and will be addressed in future studies. Since this is a MODIS algorithm related issue, we choose not to dwell too much on it as it required to speculate and diagnose a different algorithm.

It should be reemphasized that we do not think that non-sphericity is not playing a major role in the MODIS AOD and here it is used as a diagnostic tool rather than a quantitative comparison tool, at least as far as comparisons with OMI AOD is concerned. As this study demonstrates, OMI underestimated the AOD by such large amount that MODIS AODs are good enough to demonstrate that there was a problem with the OMI retrieval.

4. Acknowledgements. -): there are many 'x' ....

A: text to this section was added.