

Interactive comment on “Fast simulators for satellite cloud optical centroid pressure retrievals, 1. evaluation of OMI cloud retrievals” by J. Joiner et al.

Anonymous Referee #2

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In general, this is a very interesting paper that discusses the development and testing of a fast simulator to provide estimates of the cloud Optical Centroid Pressure (OCP) given a vertical profile of optical extinction. While a number of relatively minor suggestions are provided to correct grammatical issues or refine figures, two major suggestions should additionally be considered before publication in AMT.

Major suggestions:

1. Section 3: with regard to the use of the CloudSat 2B-Tau product. .this is based only on CloudSat data, not a combined CloudSat-CALIPSO product such as in the

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2B-GEOPROF-Lidar product that provides a much more accurate cloud geometrical profile. The CPR on CloudSat is insensitive to small ice particles and ultimately low optical thickness ice clouds (i.e., cirrus), but this is a strength of CALIOP (the lidar on CALIPSO) so the combined product would be more useful to evaluate the OCP cloud pressures for cirrus clouds and for discrimination of multilayered clouds too. The paper would be strengthened considerably by complementing the current work with further analysis using the combined lidar/radar product.

2. Section 5.1, comparisons with CloudSat-based fast simulator over land. As shown in Figs. 7 and 8, there is a cluster of pixels where the CloudSat-based OCPs near 400 hPa, and both the OMI OCP algorithms infer significantly higher pressures. The authors suggest that part of the problem could be due to a snow-covered surface or perhaps multilayered clouds. But this is something that could be explored further by the authors by looking at the co-located MODIS and CloudSat products within the OMI FOVs. My thought is that the MODIS data, or even the CloudSat data, could be used to separate the OMI FOVs into those with homogeneous scenes as opposed to inhomogeneous scenes. That is, separate the OMI FOVs into those with multiple cloud heights from those with single-layered clouds. Or separate those FOVs for which the MODIS cloud mask has clear-sky pixels over a snowy surface. This section could, and should, be strengthened by actually digging a little deeper in the co-located data sets to better quantify where the major OCP differences come from. Perhaps use of the 2B-GEOPROF-Lidar product would be useful here, too.

If these suggestions were explored further, the discussion of the final two figures, Figs. 15 and 16, would probably be able to provide more useful insight as to why the differences are so large in specific regions.

Minor suggestions:

grammatical suggestion: change "in order to" → "to" throughout the paper. The words "in order" are superfluous. . .but this is simply a suggestion.

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abstract, last line: "small fraction of OMI pixel" → "small fraction of an OMI field of view (FOV)" Suggest using pixel to refer to an imager such as MODIS, and perhaps using FOV for a larger field of view such as OMI. The sizes are very different. Again, simply a suggestion here and throughout the paper if implemented.

page 4, paragraph beginning with "Cloud OCP errors have been calculated. . ." In this paragraph, a number of papers are listed that intercompare various OCP retrievals with simulations, but no results are summarized. It would be useful for a reader that is not intimate with these previous studies to have a bit of a summary included as to the pertinent findings of these previous studies.

Section 2.1.2: it would be useful to provide some details regarding the surface albedo climatology used in this study, such as the pertinent spatial and spectral details, whether it is a static or monthly product, etc.

Section 3: cloud simulations are listed, but the simulations are quite vague. Are separate simulations performed for water and ice clouds? If so, provide details separately for water and ice simulations. For the ice clouds, it would be useful to discuss optically thin versus optically thick ice cloud results.

Section 4.2, page 13: "Rayleighscattering" → Rayleigh scattering

Section 4.2, last sentence: "with bias of 7.4 hPa, standard deviation of 82 hPa, and correction coefficient of 0.89" → with a bias of 7.4 hPa, a standard deviation of 82 hPa, and a correction coefficient of 0.89

Section 5.2, last sentence of first paragraph: "with higher a cloud" → with a higher cloud

Section 5.4: it is clear that the large size of the OMI FOV is not optimal for inferring OCP for sub-pixel scale clouds such as trade cumulus.

Figures 5-16: please consider labeling each of the two panels in each of these figures, with an (a) and (b). This would help clarify what is in each figure.

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Figure 5: the solid blue curve is listed as the result of a standard fast simulator in the upper panel, but is denoted as a weighting function in the caption. Please clarify.

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