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## ***Interactive comment on* “Some implications of sampling choices on comparisons between satellite and model aerosol optical depth fields” by A. M. Sayer et al.**

### **Anonymous Referee #2**

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1. This paper addresses the important question of how sampling affects comparisons between satellite AOD fields and models. It present three recommendations that represent useful points for making satellite-model comparisons:

(1) Sample the model according to the actual satellite coverage (2) Assess whether satellite sampling within a model grid cell is adequate (3) For daily aggregation of satellite data, the median is more robust against outliers than the mean

Of these, (1) and (3) are often applied, whereas (2) is rarely considered by others. The discussion of Point (2) is especially worthwhile. I favor publication after the authors make some clarifications. Also, I note that several key points appear in the text later

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than where they seemed to initially come up as issues – I’ve kept these notes, in case it might be of use to either raise the points earlier, or reference the later discussions.

2. P17793, line 9. “. . . aggregated to provide 366 daily fields. . .” Are these global fields for 366 spatial cells over the globe, or something else?

3. P17793, line 12. “. . . by averaging all the GEOS-Chen daily fields. . .” You do a nice job pointing out that different spatial and temporal aggregation schemes lead to different results. Please explain what weighting you used here. Line 21. “. . . sampled in the same way . . .” Meaning that the model is sampled only for times and locations having AATSR aerosol retrievals?

4. P17793, line 27. “. . . if these events are not coincident. . .” A lot is buried in these words, and you list in the rest of the paragraph some of the key factors involved, but it might be worth making some additional comprehensive observations here. For example, one common view is that the longer the sampling period, the more representative the sparse satellite data will be of the actual aerosol field. However, this is not always true, as systematic sampling effects are not reduced by averaging. Other examples: AATSR mid-morning coverage will never capture the afternoon peak of biomass burning, and there is the whole suite of issues associated with instantaneous as well as seasonal cloud effects on aerosol retrievals, as you discuss later in the section.

5. P17794, line 24. “. . . the finest common grid . . .” However, you also need adequate sampling, or be willing to allow for gaps.

6. P17794, line 27. “. . . any retrievals suspected of this contamination should be discarded . . .” This might be too conservative for some applications, and depending on the cloud masking process and the complexity of the scene, this can create biases too.

7. P17795, line 2. You might add some references here about 3-D cloud effects (e.g., Marshak, Wen, Di Girolamo, etc.).

8. P17795, line 6. You might see what Zhang and Reid (JGR 2006) did for MODIS in

regard to enhanced cloud screening. It helped for assimilation, though it might not in itself leave you with a representative aerosol field in some places.

9. P17795, lines 18-21. ff. Alternatively, there might just not be enough information in the remote sensing data to sort this out. On the next page, you essentially make an arbitrary decision about how to handle cloud masking. It might be worth presenting the main points of the cloud contamination more directly. Also, there are papers by Twohy, Tahnk, and Coakley that are relevant here.

10. P17796, lines 25-28. (1) How do you arrive at the AOD uncertainty trends for land and ocean? I can guess, but you might mention it here. (2) The relative spatial coverage of retrievals within the model grid cell might also be an important consideration for weighting individual points. For example, if many points are clustered in one corner of the cell, they might receive lower individual weights than points spread more uniformly over the region, which would be important if there are AOD gradients. Weighting points only by a function of retrieval quality does not take this into account.

12. References: An updated version of Martonchik et al. (1998): Martonchik, J.V., R.A. Kahn, and D.J. Diner, 2009. Retrieval of Aerosol Properties over Land Using MISR Observations. In: Kokhanovsky, A.A. and G. de Leeuw, ed., Satellite Aerosol Remote Sensing Over Land. Springer, Berlin.

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