

## ***Interactive comment on “Intercomparison of CALIOP and MODIS aerosol optical depth retrievals” by C. Kittaka et al.***

### **Anonymous Referee #1**

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30 September 2010 Atmospheric Measurement Techniques Discussions – Reviewer Report “Intercomparison of CALIOP and MODIS aerosol optical depth retrievals” – C. Kittaka, D. M. Winker, M. A. Vaughan, A. Omar and L. A. Remer This manuscript describes comparison of CALIOP and Aqua MODIS optical depths for what are primarily coincident measurements along NASA’s A-Train orbital path. Discussion is provided describing retrieval and physical biases that explain some of the differences seen between the two datasets. The narrative is mostly compelling. Figures and tables are mostly clear. The technical and scientific merits of the paper qualify easily within the guidelines of an AMTD submission.

My recommendation is for acceptance following minor revisions. In many places in

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the manuscript, context for the discussion is lacking. I have provided numerous spots where I think this is occurring, and hope that the Authors find the comments useful to improving the narrative. I have identified a potential concern with Fig. 2, which I address in detail. Finally, conclusions are lacking, and don't really tie in well with the intro. I encourage the Authors to reconsider their final thoughts in order to resolve some of the questions presented in motivation the overall discussion.

I will not need to see this paper again.

### Scientific and Technical Comments

Title – This paper compares AODs derived from CALIOP and Aqua MODIS. “Retrievals” sounds too much to this reviewer like a reference to the algorithms used to solve these values. Generic reference to MODIS implies Terra. It seems like this title could be broadened for clarity and impact.

P 3320 L 21 – Technically, aerosol particles is the proper term here with respect to radiative equilibrium, and other places, particularly with regards to any scattering influence.

P 3320 L 24 – Why hemispheric and not global?

P 3321 L 3 – CALIPSO acronym needs to be defined.

P 3321 L 9 – Active profiling \*can\* provide high vertical resolutions, but not necessarily (e.g., mesospheric lidars). Plus, one man's high resolution (i.e., GLAS retrievals of surface altimetry to cm) may not be another's. This likely should be reconsidered. Also, with respect to “above lower lying clouds”, the Authors are speaking specifically of nadir pointing instruments. But, what about below clouds for transmissive layers?

P 3321 L 13 – “. . .for the first time”. This is probably unfair to the GLAS team.

P 3321 L 15 – 1:30 at the equator.

P 3321 L 19 – AERONET has approximately 400 or so instruments. Not all of them

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have been used, as is talked about below, to validate MODIS and/or MISR AODs. Considering all of the GALION instruments, there are probably a fair fraction of datasets available relative to the number of AERONET measurements used to do the corresponding passive task. I understand what the Authors are saying here. There has to be a more thorough and considerate way of saying it, however.

P 3322 L 1 – The relevance of the dataset version numbers will be quickly lost on many readers. Either references are necessary here, or some discussion of the evolution of these datasets is necessary for context.

P 3322 L16 – A reference seems necessary after “improved calibration”.

P 3322 L18 – AERONET validation of MODIS occurs basically over land, though.

P 3322 L27 – Which retrievals?

P 3323 L 6 – MODIS also measures IR emission, I believe?

P 3323 L 7 – “viewing” swath

P 3323 L 11 – Last page, it was said that resolution was 500 m. Need to be consistent here.

P 3324 L 26 – Which retrievals?

P 3324 L 27 – Probably a new paragraph beginning at “Briefly”, and the Authors should probably be explicit in saying “the extinction coefficient”.

P 3325 L 3 – “are only performed”

P 3325 L 8 – “The extinction. . .” from an “elastic. . .”? Backscatter alone there seems incomplete. This discussion is incomplete, and very difficult for any non-lidar person to understand. Just saying the retrieval is under-constrained alone would be fine, except that it becomes ambivalent when transmittance is justified in the next sentence as being the panacea.

P 3325 L 12 – Are the Authors referring explicitly to CALIOP here with respect to whether or not transmittance method is rarely applied at night?

P 3325 L 16 – Here, transmissive clouds are introduced as qualifying for aerosol retrievals. See comment above.

P 3325 L 22 – “Feature\_Optical\_Depth\_532”. Also, again, a non-lidar person is going to be confused here. I know that the Authors are referring to 0.532 optical depth, and it may be obvious from the file name, but it should be clearly stated here as the “column 532 nm AOD”, as it is in a passage below. Also, here, it may be useful to just define for the reader that heretofore all instrument AODs refer to these two channels, or something like that.

P 3326 L 1 – Rather than “differences in sampling”, how about “representative bias”? Sentence is awkward.

P 3327 L 4 – Its not clear why being on the day side of the orbit is relevant here? If on one side of the orbit CALIOP falls to the east of Aqua, isn't it always east of it? Frankly, this whole discussion, and the presentation of Fig. 2 are not clear. If CALIOP is displaced to the east, then while the cross-track bias is 0 at the crossing point, isn't it still displaced 215 km to its east? I'm using context from a NASA LandSat online, and could have this scenario completely wrong. But, there is a webpage that displays how I'm visualizing this displacement:

[http://landsathandbook.gsfc.nasa.gov/handbook/handbook\\_htmls/chapter5/htmls/sensor\\_swath.html](http://landsathandbook.gsfc.nasa.gov/handbook/handbook_htmls/chapter5/htmls/sensor_swath.html)

Therefore, to my mind, Fig. 2 is wrong, and the satellite isn't tracking laterally across the MODIS track. But, this is only based on how I've read what is written here, and could totally have things botched. At any rate, I hope this discussion and these thoughts will encourage the Authors to either rewrite or reconsider this point, as it is highly relevant for project design and impact.

P 3327 L 13 – “use” in what?

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P 3327 L 14 – “divergent solution” to what? Its not clear what this entire paragraph is talking about. Its as if there is some discussion that was cut from the text here, and the context was not replaced?

P 3328 L 5 – I think this is the first reference to Collection 5. Most people are not going to know what this is here. Context is necessary.

P 3330 L 15 – If this were the result of statistical sampling, couldn't that be interpreted/derived based on sample size and justified?

P 3330 L 19 – What about dust? Dominated is a strong word.

Conclusions – At the beginning of the paper, it was argued that these comparisons would lead to insights into the strengths and limitations of both datasets. I would argue that no such insights are really provided here. And, that the conclusions should attempt to reconcile this claim in some manner. It's a highly useful report, and a novel means for constraining the two datasets in order to do very meaningful comparisons. But, at the end of reading this, there is really no basis for determining which instrument data stream is more reliable. Intuitively, you'd think it would be MODIS, and in fact I think I sense that impression in the way this paper is written. But, many of us understand the serious concerns in MODIS retrievals, and papers even beyond the references noted in this paper have been published investigating spatial/regional MODIS bias. There is even bias between Terra and Aqua sensors, alone! Clearly, there are some representative and regional biases pointed out in these results between the CALIOP and MODIS, and the discussion is quite rich with necessary justifications that are reasonable and well constructed. But, I'm left with a strong sense that the inherent bias/error/sensitivities for each sensor are drowning each other out, and limiting the real insights promised in the intro. This isn't so much a knock as a plea to resolve this paper with more care and context here in the concluding thoughts, rather than leaving what amounts to being a very superfluous ending.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3319, 2010.

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