

## ***Interactive comment on “Climatology of the aerosol optical depth by components from the Multiangle Imaging SpectroRadiometer (MISR) and a high-resolution chemistry transport model” by H. Lee et al.***

**Anonymous Referee #2**

Received and published: 21 January 2016

Summary: The MISR Joint aerosol (JOINT\_AS) level 3 products are a descriptive summary of the MISR Level 2 aerosol product. This paper evaluates the statistics of aerosol optical depth (AOD), as a function of different aerosol classes (non-absorbing, absorbing and non-spherical). The JOINT\_AS products are compared with statistics of SPectral RadlatioN-TrAnSport (SPRINTARS) model results, and are shown to agree well.

Overall: This is an interesting paper, and potentially very important for the aerosol community (thinking AEROCOM here). The paper is nice because it is relatively short. Of course, being short, there are loose ends. I would have really liked a comparison

C11885

of three things, MISR, model, and some sort of ground-based data, preferably in-situ. Although the authors reference MISR vs AERONET comparisons, I think a three-way comparison (MISR/SPRINTARS/AERONET) would have made sense here. Also, why SPRINTARS model (as opposed to a different model) ? And why only one week during July? I am wondering if using the 7km model (to compare with 17.6 km MISR) is not the best use of the model (why not 14 km, or 21 km?) I am just not satisfied with the amount of comparison; the paper begs another paper. On the other hand, if only going to use one week in July, then really focus on that one week only, and don't make assumptions about other years.

For an ACP paper, I generally like to see something with more insight. Yes, it is hard to compare models and retrievals. What I see is the beginning of useful study, but only the beginning. With the lack of temporal coherence between model and retrieval, I find the conclusions to be weak. In effect, the conclusions are that, there “can be misleading conclusions”, that “positive skewness . . . is indicative of large outliers that may be due to episodic events or differences in sampling that must be considered”, and that, “further research along these lines would clarify uncertainties of chemistry models on regional and global scales”.

Specifics:

Abstract: Page 33897 – henceforth 897

- Line 1: “Joint Aerosol = AS” What is the “joint” and why “AS?”

- Lines 13-15: This statement bothers me: “Overall, the AOD distributions of combined MISR aerosol types show good agreement with those from SPRINTARS.” While I understand what the authors are trying to do, the sentence appears to suggest that the model is being used to validate the observation-based data. I suggest instead something like: ‘The AOD spatial distributions retrieved from MISR and modeled by SPRINTARS agree with each other in a qualitative sense.’

C11886

Page 899:

- CCM is mentioned in line 22, but not defined until later. Also, this is for my own information – what is the difference between a CCM and a CTM? - Page 900:

- Line 5: “Unfortunately, the retrieval of AOD by type from satellite observations and using the retrieved AOD for chemistry model evaluation have been, and remain, a significant challenge.” Why it is a challenge? The paragraph goes on to provide a list of many satellite-model intercomparisons. This is a nice summary, but in a way, completely irrelevant to the hypothesis statement of the paragraph. - Instead, the reason why it is difficult to compare “observations” versus “model” data, is that it is a comparison of apples and oranges. Retrievals from satellites are defined by optical properties, and model output is defined by moving mass around. There is no one-to-one correspondence between optical properties and physical properties, meaning that the two communities have to meet in the middle.

Page 901: - Line 9: “74 “mixtures” based on eight “pure” particle types.” How does that work? Are some allowed to mix, and others are not? -

Page 902-03: - I would like more information on how the 74 mixtures gets brought back into the 8 “pure” types. And I am finding it difficult to comprehend the idea of the 8-dimensional histograms, and how the clustering then turns into something useful. Maybe a summary of the Braverman (2002) paper would be helpful, but I found that paper confusing as well.

Page 903-04 (and Figure 1):

- I understand that lots of whitespace on a plot is not desirable, but I think in this case, it would help the interpretation if the two axes spanned the same interval. Then it would be easily understood that absorbing and non-absorbing AOD are not equal. It might even be more useful to compare absorbing AOD versus total AOD (and then would easily understand single scattering albedo). - Line 10: How should this statement:

C11887

“here is very little covariance between the absorbing and non-absorbing AOD in this case” be interpreted as?

Page 904-05 – - Lines 904-20 to 905-11: Does skewness of aerosol optical depth have any physical interpretation?

Page 905: - Lines 13- The fact that the model is NICAM; why does it matter for aerosols? - Lines 15- Really amazing that the SPRINTARS model is at 7 km globally. But the fact that it can only be run from 1-8 July seems to me that it is not yet the best model to do this comparison. Would a model run at 14km, or 20 km globally provide a more useful comparison to global MISR data, which is at 17.6 km resolution? 7 km seems like a waste – I would rather see full Julys and other months with SPRINTARS. - Lines 22 – 26: .. and then everything is being compared at 5°x5° resolution? I am also feeling uncomfortable with the “assumption that the AOD distribution does not change significantly from one year to the next during the month of July”. Scale is really important here. Maybe it would appear similar qualitatively, but maybe not. - - Page 905-06: - lines 26 – Lines 5: “We adopt this approach because we found that the JOINT\_AS product for the single month of July 2006 contained a significant number of missing values even at 5° × 5° spatial resolution. The missing data are likely due to cloud screening and locations being flagged as inappropriate for aerosol retrievals. . .”. Are data in SPRINTARS being excluded when SPRINTARS detects clouds? Can you tell from SPRINATRS whether there are conditions that MISR would have trouble with? - Page 906; line 8-20: I would like to see more discussion here. Maybe an expansion of table 1 that shows comparisons of the optical properties. Maybe these analogues make sense, from a qualitative sense, or even common sense standpoint, but I think rigorous comparisons of optical/physical assumptions are in order here (e.g.details of SSA, of fine/coarse lognormal radii, size distributions, etc. ).

Page 906-08, as related to figure 2 (actually relevant for figures 4 and 6 as well). - I am noticing the map panels look “smooth”. These are all created using 5° x 5° values? - Explanation for Figure 2: While I agree that qualitatively, the histograms for

C11888

PDFs from MISR and SPRINTARS look similar, the non-comparability of the time domain is concerning. Also, since there seems to be no attempt to screen out clouds in the SPRINTARS dataset, I wonder whether they are truly comparable (in a sampling sense). However, I do agree it is promising that the SPRINTARS model seems to capture the basic shape of the PDF. Or should I read it as “that MISR shows the basic shape of the model?” (I hope not). - Why do SPRINTARS panels tend to show lower “background” values than MISR? - Looking at Figure 2a: What is the source (or explanation) of MISR’s “non-absorbing” aerosol towards northeast of the map (that is not model sulfate). - Looking at 2c/d: What is the explanation for the unexpected (non-lognormal) behavior above AOT = 1.0 (or relative lack of values between 0.5 and 1.0). - P 907, lines 21: I beg to differ, I think that the histograms have very different shapes. The model one is very smooth and clearly lognormal-like, the MISR histogram is not. Just because one can envelope the entire histogram with a lognormal curve (e.g. p908; lines 10-12), is not sufficient. -

Page 909-discussing Figure 3

- I like Figure 3, but would like to see component types for the SPRINTARS model as well. Should panels  $A + B + C = D$  (and  $E + F + G = H$ )?

Since my comments on Figures 4 and 6 will be similar to those in Fig 2, I do not comment on them specifically. I do ask however, if MISR-model dust has any absorbing characteristics? That might explain why MISR’s “absorbing” aerosol is placed north of SPRINTARS’ “carbonaceous” aerosol in Fig 6.

Conclusions:

- For an ACP paper, I like to see something with far more insight. Yes, it is hard to compare models and retrievals. What I see is the beginning of useful study, but only the beginning. With the lack of temporal coherence between model and retrieval, I find the conclusions to be weak. In effect, the conclusions are that, there “can be misleading conclusions”, that “positive skewness . . . is indicative of large outliers that

C11889

may be due to episodic events or differences in sampling that must be considered”, and that, “further research along these lines would clarify uncertainties of chemistry models on regional and global scales”.

Yes, of course there should be another paper, and a future paper will give the authors an opportunity to cite their own paper. But I would much rather see a better comprehensive study in this paper. Maybe only focus on one region (e.g the China region) and study it in detail.

---

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 33897, 2015.

C11890