

Interactive comment on “Development and Assessment of a High Spatial Resolution (4.4 km) MISR Aerosol Product Using AERONET-DRAGON Data” by Michael J. Garay et al.

Anonymous Referee #2

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The paper illustrates results of a prototype MISR algorithm at 4.4 km resolution, and demonstrates its improved performance with respect to the standard 17.6 km product with an assessment against relatively closely spaced DRAGON AERONET sites. As the authors point out, the availability of the DRAGON AERONET sites is a game-changer for enabling the assessment of the higher resolution product, and the performance is impressive and important to document. Overall, this is an interesting, well organized and easy-to-read paper. However, there are some areas where more details or clearer explanations would improve the manuscript. Some of these suggested additions are critically important, but since all suggested changes should be very easy for the authors to implement, they can be considered only minor revisions.

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General comments:

The new MISR 4.4 aerosol product is mentioned for the first time in the same paragraph that describes the work of Kahn et al. 2010, Kalashnikova et al. 2013, etc. identifying specific performance issues with the V22 MISR algorithm. However, it is not stated whether these issues are addressed in the prototype 4.4 km algorithm or whether the prototype 4.4 km algorithm is different from V22 only in the resolution. In some parts of the manuscript, it seems clear that there are other changes besides just the resolution (for example, the bottom of page 9 where it is mentioned that the cost functions have been changed). However, in the discussion and conclusions, it states that the improvements did not require significant changes to the algorithm itself. It is very important to clarify and explain what algorithm differences there are between V22 and the prototype algorithm, and the mechanisms by which these changes lead to the observed improvements. This should be made clearer throughout the manuscript, in the introduction, methodology section, results, and discussion. The improvement is impressive regardless of whether it was solely due to the resolution change or not, but it's important for readers to understand how the algorithm changes produced the improvement.

Specific comments: Page 3, lines 7-11. The descriptions of the issues found by Kahn et al. (2010) should probably be expanded and clarified somewhat. What does "a small gap" mean? That description is evocative, but fairly ambiguous; I can think of several possible meanings. Similarly, what does "missing particles in the aerosol look up table" mean? Does this mean particle types? Does it mean that the particle types in the look up table did not adequately represent all observed aerosol types? Perhaps most importantly for the context of the current manuscript, was there any explanation (or speculation) for the systematic underestimate when AOD was greater than 0.4 (lines 10-11)?

Section 2: Figures 1 and 2 refer to a version of the 4.4 km prototype that was analyzed using the local mode data, whereas Figures 4-7 refer to a different version of the

prototype algorithm that uses different input data, at least. Please add some text early in section 2 mentioning that there are two different prototype algorithms, so it doesn't come as a surprise later in the section. Also, please make some distinction in the figure captions. Are there any other algorithm differences between these two versions besides what data is used for input? If so, make sure to describe them in the methods section.

Page 6, lines 11-30. There's a fairly ambiguous transition between the observation that the MODIS high resolution retrieval did not improve MODIS performance and the idea that the high resolution AERONET data is a requirement for adequate assessment of high resolution satellite products. The second paragraph makes a very good point about requiring a high resolution assessment data set. This paragraph starts neutrally "A further point", but do you mean to suggest that the assessment technique is part of the explanation for why the MISR high resolution product shows better performance and the MODIS high-res product didn't? After reading the conclusions, it seems that you are making this suggestion, so it should be made more explicit here where it is first brought up. Is the high resolution assessment the primary reason for the difference? If it is, then would a comparison of MISR 4.4 km with the "permanent" AERONET stations that MODIS used would also show little or no improvement? And would a comparison of MODIS 3 km product using the DRAGON sites be expected to show improvement? If this is not the primary explanation for the different results, do you have any explanation or theory what other factors are at play?

Section 2.3. Does this describe both the V22 algorithm and the prototype 4.4 km algorithm? Differences between them should be described here.

Page 9, line 26-27. "The fall-off evident in the V22 17.6 km resolution retrievals is greatly mitigated, if not eliminated entirely". Why? Please explain the mechanism by which going to higher resolution corrects a large bias at high AOD values. Or if there is more required than just the higher resolution, explain that. This is a critically important point of the paper and really needs to be explained well.

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Page 9, line 30. "Relaxation of the thresholds on the chi-squared parameters to admit better spatial coverage". Relaxing the cost function seems like potentially a pretty significant change. Doesn't this mean that you are allowing the models to represent the aerosols a little less well than they do in V22? Would relaxing these thresholds also result in better spatial coverage in the V22 17.6 km resolution retrievals? This point seems like it needs more supporting material to understand its implications.

Page 10, line 12. When you say "the greatest benefit of the 4.4 km resolution MISR aerosol retrievals", it's not clear whether you mean the benefit of the higher resolution, or the benefit of the new prototype retrieval and all associated changes (of which the higher resolution is just one). Indeed, the better coverage is described as being due to the relaxation of the cost function, and not (or not primarily) due to the higher resolution, although later it is implied that it is due to the higher resolution because it can get in closer to exclusion zones.

Figures 2 and 4 are described as regressions both in the captions and the text, but there is no regression line shown, only a one-to-one line and prescribed error bars. It's important to show the regression lines if you describe this as a regression. Also consider including the slope in the statistics describing the regression (in the figure legend as well as the text). Are the RMSE values calculated with respect to the one-to-one line or the regression?

Technical comments:

Page 6, line 9. "Most significant improvements" (missing word)

Page 10, lines 27-30. These two sentences are both true but seem to give the opposite impression (high res has better coverage because of getting closer to exclusion zones; low res has better coverage because of fewer exclusion zones). So I suggest tweaking the wording and the transition between the two sentences. "In contrast" might make more sense than "for example".

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The figures are too small to see the detail we are being directed to notice, without zooming in to 200% or even 400%. The AERONET data circles are not much bigger than a period in the figure caption and the color bar text is much, much smaller than the text in the caption. Please blow up the figures and remake the color bar text to make it easier on the reader.

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