

## ***Interactive comment on “A surface reflectance scheme for retrieving aerosol optical depth over urban surfaces in MODIS dark target retrieval algorithm” by P. Gupta et al.***

**Anonymous Referee #2**

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Review of “A surface reflectance scheme for retrieving aerosol optical depth over urban surfaces in MODIS dark target retrieval algorithm” By Gupta et al., submitted to AMT

MODIS sensor has been flying on Aqua and Terra satellites and providing aerosol optical depth (AOD) data for close to two decades. One notable feature in the data is the persistent high bias over urban areas. This work aims at correcting the high bias over urban areas by deriving new surface reflectance ratios between blue/red and mid-IR bands that are a function of urban percentage (UP) and NDVIswir. The spectral surface reflectances derived by MODIS land algorithm at different wavelengths are used to stratify the data based on UP and ratios derived for different UPs. These ratios are then used in a standalone MODIS science code to generate retrievals over

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AERONET stations. It is my understanding that the stand-alone code is run only for matched datasets with AERONET stations and therefore the performance of the new approach outside of AERONET stations cannot be determined. Although the authors demonstrate that the performance of MODIS AOD retrievals is very good over urban areas with the new approach, the whole premise of this approach is circular. I highlight my reasoning below:

â€¢ The authors depend on spectral surface reflectances derived by MODIS land algorithm that is based on Vermote’s atmospheric correction algorithm. In this algorithm, surface reflectance is retrieved by simultaneously adjusting AOD and surface reflectance such that derived spectral surface reflectance ratios match a prescribed ratio. And that prescribed ratio is a fixed value globally for pairs of wavelengths. The prescribed global value itself is an average of values derived from matched MODIS radiances and AERONET AODs. Now the authors are using these surface reflectances at visible and mid-IR wavelengths to derive ratios, though stratified by UPs. The authors don’t specify this circularity – AOD is simultaneously derived in the land surface reflectance algorithm assuming aerosol models with optical properties that may or may not be similar to those used in the MODIS aerosol algorithm. What are known issues with this spectral surface reflectance product? The authors mention validation of the product but did the authors check to see if surface reflectances from the land algorithm are biased high over urban areas to give AODs biased low or in agreement with AERONET? There must be an entire section discussing this in the paper. Or else the authors have to derive their surface reflectance ratios from matched MODIS radiances and AERONET AODs but from AERONET stations with sufficient variation in UP. Would we able to see the UP range from 0% to 80% for these different AERONET stations? Without addressing this issue, the new retrieval (C6U) is an empirical correction at best to tune the AODs to match with AERONET data.

â€¢ There are other MODIS aerosol retrieval algorithms (e.g., MAIAC) that provide retrievals over urban areas. The authors have not made any effort to discuss MAIAC

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or attempt to compare these retrievals to MAIAC. While validating against AERONET stations is good, it is not clear how the algorithm performs away from an AERONET station.

â€“ Without providing a zoomed in version of the UP map, it is difficult to analyze how well UP varies with known urban/suburban/rural map (from google for example). Does a city have non-varying UP so a single AERONET station can represent the whole city or the size of the city matters?

â€“ Also, the retrievals are performed on MODIS radiances matched to AERONET data and archived. This, unfortunately, forces the validation to certain conditions and certain locations. We won't learn anything about retrieval quality, for example if it expected to change or not (in essence do we have retrievals moving from "medium" to "high" quality? Will quality of the retrieval remain the same with only the bias changing? It is not clear, even with the discussion on quality flags and such in Table 2. How does urban area factor into the setting of quality flag in the original C6 AOD? If it was not a factor at all in setting of the quality flag, why would it affect in C6U? For example, if quality of a retrieval is "medium" in C6 because zenith angle is high, it should still be "medium" in C6U but the retrieval bias may be low because of the tuned surface reflectance ratios. So, the whole discussion on page 15-16 has no bearing to this work unless MODIS C6 retrieval quality flags have something to do with urban land or surface reflectance value (magnitude).

â€“ The discussion related to Figure 6 does not make sense. If the authors found that March-April-May sampling is not high, why not do the figure for June-July-August for which they have DRAGON data and used it in Figure 7?

â€“ I am also confused as to why the authors feel that applying the same technique globally is a risk or the good results were unexpected? This is not clear. The MODIS land surface reflectance data is global and such should be applicable everywhere. Unless, the UP data outside of the US is not reliable. I didn't quite follow this discussion.

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In summary, this paper cannot be accepted in its current form. The circularity involving the surface reflectance retrieval in the MODIS land algorithm and how that is tied to using those retrievals to generate a surface reflectance scheme in MODIS aerosol algorithm must be explained. A new section should be added to the paper describing the MODIS land surface reflectance product performance over urban areas and what it means to use that product in the aerosol algorithm given the circularity.

Please also note the supplement to this comment:

<http://www.atmos-meas-tech-discuss.net/amt-2015-375/amt-2015-375-RC2-supplement.pdf>

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