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Comment

Interactive comment on “Role of coarse and fine mode aerosols in MODIS AOD retrieval: a case study” by M. N. Sai Suman et al.

Anonymous Referee #1

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Major comments:

The authors present a local evaluation of the MODIS fine and coarse mode aerosol optical depth over a rural location in Southern India. The authors find that although total AOD is retrieved reasonably accurately ($R^2=0.71$), the appropriation between the fine and coarse mode is incorrect, which the authors attribute to incorrect fine and coarse aerosol models for the region. The validation of MODIS total AOD at Gadanki is not a new result, it has been previously reported in Kiran Kumar et al., 2013, although the Kiran Kumar result only compared AOD from 2009 and this paper presents comparisons from 2008–2011, the R^2 value is the same between the two papers.

My primary issue with this paper is that the fine mode fraction (FMF) from MODIS has

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already been shown to be primarily a function of algorithm assumptions and not of high enough quality for use in scientific works (Levy et al., 2010). It is not a particularly new finding that this is also true over South India. The author's assertion that the reason that FMF is incorrect is due to aerosol model assumptions is interesting and noteworthy; however, it is unsupported. I see that the authors in their response to Dr. Jethva have included a plot of seasonal SSA, this is certainly an improvement in the paper. However, considering the authors argue that the properties for both and fine and coarse mode are incorrect, I'm not sure how meaningful this mean SSA is. It is interesting that MODIS is able to capture the seasonal cycle of FMF, although not the magnitude; however, the authors do not provide a reason for this observation.

As the previous reviewers have mentioned, the attribution of the surface reflectance to the top-of-atmosphere reflectance is a large source of uncertainty in the MODIS aerosol retrieval that can change the FMF by changing the spectrum of the portion of the TOA reflectance attributable to aerosol. As the two previous reviewers mentioned, Jethva et al. (2010) have looked at this same issue in a different site in India, and found that the surface characterization dominated the errors in retrieving FMF more than aerosol assumptions. Additionally, changing the absorption of the coarse mode does not give the MODIS aerosol product additional skill in retrieving FMF over land because variability of the surface still dominates (Levy et al., 2013).

Overall, the authors need to further stress that FMF from MODIS is known to not be a physical quantity, and provide a good reason for studying this quantity despite its poor validation globally. If the aerosol models were to be shown to be incorrect (and that, indeed, this is the source of error in the MODIS retrievals), this would be a very interesting conclusion. However, there is not significant support for this.

Minor comments:

Table 1: Why is only MODIS-Terra shown, considering MODIS-Aqua is shown in many of the figures? Also, including RMSE and bias would be helpful.

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Section 2.1 : How is the sky-radiometer data interpolated to the MODIS wavelengths? Are gases accounted for properly in the computation of AOD?

Section 2.2 : Level 2 data is typically used for these types of validation studies, why was level 3 used?

Conclusion : The authors assert that Gadanki would have more sea salt than dust because it is far from desert and closer to ocean. This is an oversimplification. Dust has been shown to be a significant source of aerosol over the Arabian Sea (e.g. Tindale and Pease, 1999), and it would not be surprising for these aerosols to be transported across India. Perhaps some chemical transport model data would be helpful to support the dust vs. sea salt argument.

Additional References : N.W. Tindale, P.P. Pease, Aerosols over the Arabian Sea: Atmospheric transport pathways and concentrations of dust and sea salt, Deep Sea Research Part II: Topical Studies in Oceanography, Volume 46, Issues 8–9, August 1999, Pages 1577-1595, ISSN 0967-0645, [http://dx.doi.org/10.1016/S0967-0645\(99\)00036-3](http://dx.doi.org/10.1016/S0967-0645(99)00036-3).

Levy, R. C., Mattoo, S., Munchak, L. A., Remer, L. A., Sayer, A. M., Patadia, F., and Hsu, N. C.: The Collection 6 MODIS aerosol products over land and ocean, Atmos. Meas. Tech., 6, 2989-3034, doi:10.5194/amt-6-2989-2013, 2013.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 9109, 2013.

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