Review of paper:

Evaluation of IASI derived dust aerosols characteristics over the tropical belt

by Capelle et al.

Positives

- needed comparisons to demonstrate the capabilities of a new promising aerosol retrieval
- use of the right evaluation data (although for CALIPSO the nonsph. extinction should be used)
- sensitivity test to examine retrieval limitations (although size was not among them)
- nice overall structure of the paper

Concerns

- use of monthy coarse gridded matches is limiting (daily matches are way better)
- NO evaluation of the AOD bias – due to adjustment to AERONET AOD
- correlations are only meaningful, in case of sufficient variability
- correlations should distinguish between spatial and temporal applications
- correlating all data over a year confirms foremost seasonality (and not variability)
- the arguments for the elimination of outliers is not convincing
- retrieval of coarse effective radius is encouraged (could be validated against AERONET inv.data)

General comments

The paper evaluates retrievals of (coarse size) dust aerosol over lower latitudes via the high spectral resolution far-IR IASI sensor data. This new IASI retrieval method complements common solar reflection aerosol retrievals. Although, this method is only sensitive to larger aerosol sizes, the retrieval offers, aside from data on coarse mode aerosol amount, also (at least over oceans) data on coarse mode aerosol altitude. In this presentation, these retrieved IASI aerosol products are compared to trusted coarse mode AOD reference data of AERONET sun-photometry and to altitude information of the active space-borne lidar sensor of CALIPSO.

The evaluation concept is great, only the offered content disappoints. There is no evaluation of the AOD bias. As I understand it, the evaluated IASI AOD is corrected by multiplying multi-annual ratios of IASI (far-IR) AOD to AERONET(vis) AOD. What is the IASI AOD, if there is no AERONET station to scale to? Then there are these very coarse scales (monthly and 1.5*1.5deg), which brings up contaminating issue with regional representivity or averaging. I had hoped for daily data, which via more numerous samples would be also more meaningful. Then there is the use of correlations to demonstrate skill without really looking into the meaning of such correlations.

When a satellite product is evaluated, then answers are expected for data coverage and data accuracy, where the accuracy should address bias, spatial and temporal variability. Unless these elements (preferably at smaller scales) are addresses I consider this an incomplete effort.

Minor comments

tables and figures (I started here, because they need to be self-explanatory)

Table 1 The table lists 38 used AERONET sites. I wonder if this table is necessary, as location information and quality information (level 1.5 or level 2.0) could be directly incorporated into the other Tables 2/3/4

Table 2/3/4 These tables summarize correlation scores of coarse AOD over ocean and land (vs. AERONET) and of 'central' (?) AOD altitude over oceans (vs CALIPSO). If I evaluate I certainly would be interested in correlations. But I also would be interested in bias. Why are average biases not listed? Also correlations have a temporal (time-series) and spatial aspect (distribution). The listed station correlations are apparent temporal correlations (which should be mentioned). In order to summarize, these temporal correlations could be averaged over all stations. Aside from temporal correlations, there are also spatial correlations, which investigate the skill to reproduce spatial patterns. Once you merge all data you mix spatial and temporal aspects, so that the 'all site merged' correlation is not directly comparable to the individual temporal correlations (and it is on average much higher than individual correlations). In addition, the 'all merged correlation' are biased towards the performance at stations with more data-points. Finally a word of caution regarding correlations: Correlations are only meaningful, if there is variability. Thus, some info on the local variability could be nice.

Figure 1 This is far from perfect, since the 3-letter labels are really difficult to distinguish (even though a separate inset id offered for the Arabian peninsula (maybe the location crossed can be increased to much bigger black dots and possibly the station labels can be removed). It also would be nice to show by different (larger) symbols or colors, which data are used for ocean, for land and for altitude evaluations.

Figure 2 These are fairly wide size-distributions (but all least all are smaller than the assumed size in the look-up table). I also prefer to use (number) mode radius and std deviation, which are common input variables in MIE simulations … rather than effective radius and variance. I also wonder why there is only the link to 10um data. IASI has a lot of spectral information, so dust size could be of the retrieval

Figure 3/5/7 It would be nice, if some basic information on the Taylor diagram could appear in the captions (and not only the text). Say for instance that standard deviation ratios are the radial component and temporal correlation is show on the circular component.

I am puzzled why in Table 3 CapeVerde and Dakar, stations affected by significant dust, are doing so poorly?… but it probably has to do with the scales (when starting with the figures, I expected daily matches rather than monthly average matches). I also wonder about lower variability of IASI over land in Figure 5 … are scales again an explanation?

Figure 4/6/8 Aah, finally! Bias and difference statistics. Please include details on the boxes and whiskers in the captions.

… after reading later the document more carefully: This is NO\T the bias. The bias is not even investigated! But, it should.

Figure 9 Spectral dust absorption features in the far-IR are important to be considered in the IASI retrievals (and it might be nice to indicate agreement or even include data suggested by Sukolik)

Figure 10 This is quite a mess and not really convincing that red (assumptions) are better than blue (assumptions)… other than that there is variability. Do not use lines from station to station (as I automatically thought of a time-series) but rather use lines between red and blue symbols or just only symbols.

Now to the text:

Abstract

you "mention normalized standard deviation" ? Better explain what is means so the associated value of 0.96 is better understood (are you saying that the standard deviation is on the order of the mean). If so, it seems unfair since a large portion of it may be related to seasonality and not to local variability. … later in the text I found out that your normalized std.deviation is, just the ratio between the standard deviation of the test data (IASI) and that of the reference data (AERONET) and then a value close to 1.0 is desired.

I also miss in the abstract on what scales the IASI data are evaluated. That has to be in the abstract.

The sentence starting with "To the reasons listed above … " does not make sense to me

When mentioning the importance to climate, there should be also mentioned that IASI data could be very important to constrain IN concentrations in modeling as information on dust (the main ice nuclei) and altitude (distribution) is given. Certainly, if in addition also dust size could be addressed (e.g. 2um reff of 4um reff?) that would be an even better constraint.

Introduction

What is meant with "particles in the coarse mode are less efficient in their interaction with visible wavelength … " this is very unfortunately phrased, as coarse mode aerosol has the same or even larger AOD in the visible (compared to the far infrared). If a comparison to fine-mode aerosol was meant, then it still depends on the AOD involved for fine-mode and coarse mode … please rephrase.

IASI

The second step of the method determines the 10um AOD and the AOD central altitude. Does this mean only the far-IR spectral data (and dust refractive indices) are only used at 10um?

Give some more detail how the coarse mode effective radius is determined … as apparently only one (wide) dust distribution is given.

I am disappointed that only monthly averages are used (I had hoped for daily data matches). This makes the comparison rather general. But when already using monthly average, have you given a thought on comparing the 'retrieved' coarse mode aerosol effective radii to those of the AERONET inversion?

AERONET

The temporal mismatch (daytime AERONET and 9.30pm IASI) is a handicap. Also how are the monthly SDA data determined (I only can hope that coarse mode AOD of individual samples is averaged).

CALIOP

It would have been much better to use from CALIOP data the non-spherical extinction data as they relate directly to dust.

Method

I do not get the 1.5*1,5 grid … I thought it is 1*1?

What defines a valid month value for each data-set (give the minimum # of samples) ?

I am confused about the ratio between AERONET coarse mode AOD and IASI AOD. The plan here (as I understand) is to evaluate the IASI skill to determine coarse AOD, size from spectral information and altitude. Now if you prescribe the local conversion factor this does NOT test the skill of IASI to get reliable coarse mode AOD data. And what will you do in cases that there is not matching AERONET sample? Then also all these box and whisker plots address monthly variability but NOT bias. I hope this is not true. If so, please do NOT prescribe a ratio based on AERONET, as your LUT already uses (based on size assumption and refractive indices) such a ratio…. and the paper should evaluate the retrieval skill (without cheating). In any case you should your LUT make a function of size (assuming one size or size distribution will not work, since especially over the Sahara effective dust sizes are often larger) and there is sufficient spectral info in the IASI sample to address size.

With respect to IR/vis AOD ratios larger than 1.0: This is possible, if sizes are larger (ca 5um radius) and narrower in the width (the assumed 2.2 std deviation of the LUT is way too large and will smooth spectral detail). To make proper use of IASI spectral information you should use narrower size distributions variances between 0.3 and 0.5.

Why are outliers removed? Is this not cheating? Although you offer potential reasons for outliers, how do you know that these reasons apply? If you cannot proof it you have to keep the outliers.

Results

(reminder: Just add the explanation of Taylor and Box plots in the figure caption)

The box plots show difference between “AERONET/IASI average scaled” IASI AOD and AERONET AOD. By leaving the “ …” aspect out, there may be misunterpretations.

The mixing should not be a problem … if the SDA method work. Of course if other particles cling to coarse aerosol the refractive indices could be affected but given the uncertain impact from changing refractive indices, I am not sure if the mixing has a big impact on the retrieval.

I agree that the temporal mismatch near sources could be a problem on a daily basis - but not so much on a monthly basis unless there are regular repeating wind-strength cycles.

In the sensitivity studies changes in the assumed refractive indices are one aspect and size assumptions (which are not investigated) are another. I am not so sure we learn so much from a different
refractive index if the size-assumption is incorrect.

If you think that time-series are important for a subchapter you should at least present a figure (I do not like references to supplements) either at least a figure or remove the text.

Discussion

The bias issue is side-stepped … at least problems with the multi-annual IR/vis AOD ratio are acknowledged.

One problem may be the refractive index assumption … but a bigger problem is the fixed size and an unrealistic wide size-distribution. Any retrieval improvement should make size a flexible parameter.

If you use daily data (despite the exact temporal mismatch) … there will be many more matches and the evaluation will be more meaningful.

The last paragraph mentioned “the overall agreement for AOD”. This is an overstatement, as the paper only shows a reasonable temporal correlation. Spatial correlation and bias skill have not been demonstrated.