Editor Initial Decision: Reconsider after minor revisions (Editor review) (01 Jul 2014) by Dr. Yves Balkanski
Comments to the Author:
The corrections and the remarks from reviewers have benefited to the clarity of the paper. Nonetheless as mentioned by reviewer no2 the paper needs careful editing and the language needs to be improved before it can be published in ACP.

First let me make several suggestions that I would like the authors to consider in the next version:

-- The term 'amplitude' that is used in Tables 2, 3 & 4 is a normalized standard deviation and does not indicate the bias at the station. Could you please add a column to these tables that quantify the bias at each station.
@@ We have explained, in the revised manuscript, how a wrong assumption for the infrared refractive index may lead to a large error in the evaluation of the IR (10 µm) /Vis (500 nm) AOD coarse-mode site ratio. We hope it is now clear. We did not clearly state that the consequence of a wrong ratio is a bias between IASI and AERONET AOD. This has been now corrected. One sentence has been added line 238 of the manuscript and the next has been slightly modified.
These two sentences now read :
"… As a consequence, assuming a wrong refractive index directly leads to a bias between IASI infrared and AERONET visible AOD. The dramatic lack of knowledge of the true infrared refractive index model to use at each site explains our choice for the determination of "empirical" IR/Vis AOD coarse-mode site ratios through a fitting procedure. ..."

The idea of adding a column with the bias is not adapted. At least several columns would be required: bias assuming the MITR model, assuming the dust-like model, the Fouquart/Volz model, and the Revisited model, knowing that these four models are still an insufficient representation of the reality.

-- In the supplement it would be rapid to convert reff to r modal, since the reviewer prefers that presentation, I suggest that you make the change.
@@ Effective radius is a common variable to express particle size, in particular when dealing with radiative effects (Hansen and Hovenier, 1974). Definition of this parameter remains valid whatever the shape of the particle considered is, since it corresponds to the ratio of the mean volume to the mean surface times 3/4. Moreover, the effective radius directly characterizes the extinction properties of the distribution (Zender et al., 2004, Hansen and Travis, 1974). Distributions with different size but with same effective radius and effective width present similar optical properties. Therefore we made the choice of analyzing the particle size effect using this parameter, even if it is also possible to use the modal radius. The change proposed does not add a real scientific value.

Hansen, J.E., and J.W. Hovenier, 1974: Interpretation of the polarization of Venus. *J. Atmos. Sci.*, **31**, 1137-1160, doi:10.1175/1520-0469(1974)031<1137:IOTPOV>2.0.CO;2.
Hansen, J.E., and Travis, L.D. : Light scattering in planetary atmospheres, Space Sci. Rev., 16, 527-610, 1974.

-- I propose that you change everywhere in the text 'over sea' with 'over oceanic regions'.
@@ Change done. The expression “over land” has been left unchanged.

-- In your answer the following comment from reviewer 2, you mention adding a sentence to the text.
I am unable to look through the whole paper to try to find this sentence, so please help the editor by pointing out this sentence: 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?'
@@ It is in our answer to Reviewer **1** that we say: “…Moreover, comparisons with CALIOP are not possible at daily scale. However, work is in progress to analyze IASI results (AOD) at daily scale. One sentence has been added at the end of the paper.”
The (short) sentence added (line 646) says: “Work is in progress to analyze IASI results at daily scale. “
It has been rephrased:
“With the purpose of a still more acute comparison between IASI and AERONET, work is in progress to analyze IASI results at daily scale, over the tropics as well as over the mid-latitudes. Preliminary results, in particular over the Mediterranean Sea, are encouraging.”
The problem of the particle size, already discussed in Peyridieu et al., 2013, is out of the scope of this paper.

-- Please substitute the following sentences:
‘ Aerosols in the coarse mode much affect infrared radiation contrary to aerosols in the fine mode. Dust and sea-salt particles are the main components of the coarse mode, the latter usually remaining in the bottom of the planetary boundary layer, to which infrared radiances collected at satellite level are poorly sensitive. ‘
with
'‘ Coarse mode aerosols have a higher contribution to infrared radiation compared to fine mode aerosols. Dust and sea-salt particles are the main components of the coarse mode, the latter usually remaining in the planetary boundary layer, at which altitudes infrared radiances collected at satellite level show poor sensitivity. ‘'
@@ Done

-- Your answer to the following reviewer comment misses the point he/she is trying to make:
"The CALIOP mean altitude is calculated in this way in order to avoid the critical influence of the lidar ratio on the estimation of the extinction coefficient (and the optical depth), which might impact a mean altitude estimation"
I do not totally agree. I am not convinced the authors make best use of the CALIOP products. In dust dominated regions it should be possible to compare the extinction profile from CALIOP to the dust occurrence frequency from IASI. I believe this is important to better understand the differences between the IASI and CALIOP profiles. At the very least this discussion needs to be extended to the point that a hypothesis is put forward how the bias would look like. As discussed here and later in the text, it sounds more like an excuse, which leaves the reader with no conclusion."
@@ The 4 references added in support to our extensive answer to the Reviewer actually address dust dominated regions. Moreover, the problem again raised by the Reviewer is also discussed in the reference Tsamalis at al., 2013, given in the text. Finally, let us recall that with an uncertainty of 40% (http://www-calipso.larc.nasa.gov/products/) either for the

extinction coefficient or for the optical depth of a single layer detected by CALIOP, mainly due to the uncertainty on the lidar ratio, CALIOP cannot be seen as an absolute reference. Comparing one option to the other is out of the scope of this paper.

-- For the following remark, the information missing on your part is what critieria you used to come up with 7%?
'Here, the test distance has been chosen so that about 7% of the items are eliminated."
How much do the IASI results change if the 7% items are included. If one would use the IASI product one would not have the chance to see which 7% of the cases should be removed. Any recommendation for users? How shall the IASI be used as a constraint by climate modellers? "
@@ The answer to the important question of "how much do the IASI results change if the 7% items are included" is given along the text. See, for example, line 310, line 351, for the AOD. For the altitude, see lines 412-415. The choice of 7% results from an analysis of the risk of masking the real performance of the results by keeping undesirable data. This is said in the text. "Outliers", or wrong retrievals, are systematically seen in datasets resulting from the analysis of observations, particularly at global scale. Actually, methods (statistical, etc.) do exist to identify most of these undesirable data. Regarding the use of IASI data as a constraint for climate models, assimilation of IASI retrievals is one of the ways presently considered. As an example, assimilation of IASI-derived methane concentration (Crevoisier et al., ACP, 2013) at ECMWF has proven being very useful.

-- Please replace the following paragraph:
"A few remarks are necessary to a better understanding of the following analysis. First, the signal induced on IASI observations by each variable of interest, here AOD or altitude, depends on the intensity of the variable. This is however less trivial for the altitude but, generally, the higher the altitude the larger the signal. This is due to the decreasing thermal contrast between the surface and the atmosphere when approaching the surface. For that reason, infrared sounders show a limited sensitivity to the boundary layer. Second, the signal induced by altitude is intrinsically smaller than that induced by AOD: retrieving accurate altitude is more difficult, even more for low AOD. Third, IASI, a remarkably accurate and stable instrument, has a drawback with the larger noise of its short wavelength channels used for a good disentangling of the AOD and altitude respective signals; this difficulty has more impact on the altitude than on the AOD."
with:
A few remarks are necessary to explain the analysis below. First, the signal induced on IASI observations by each variable of interest, here AOD or altitude, depends on its magnitude. This is however less trivial for the altitude but, generally, the higher the altitude the larger the signal. This is due to the decreasing thermal contrast between the surface and the atmosphere when approaching the surface. Hence, infrared sounders show a limited sensitivity to the boundary layer. Second, the signal induced by altitude is intrinsically smaller than that induced by AOD: retrieving accurate altitude is therefore more difficult, even more so for low AOD. Third, IASI, a remarkably accurate and stable instrument, has a drawback with the larger noise of its short wavelength channels used for a good disentangling of the AOD and altitude respective signals; this difficulty has more impact on the altitude than on the AOD.
@@ Done

-- With the following remark the reviewer asked for proper English:
""The box and whiskers results (Fig. 5) are significantly degraded / The Taylor diagram for the altitude over sea"

Please replace these sentences with:
"The box and whiskers diagram over land (Fig. 5) show results that are significantly degraded compared to the ones over the oceans (Fig. 3). The Taylor diagram that depicts the altitude of the dust layer over the oceans..
@@ Done