

Interactive comment on “A novel retrieval of daytime atmospheric dust and volcanic ash heights through a synergy of AIRS infrared radiances and MODIS L2 optical depths” by S. DeSouza-Machado et al.

Anonymous Referee #2

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This paper presents, compares and validates two dust height retrieval approaches. One based purely on AIRS data, and one using both MODIS and AIRS. In general, the science and ideas behind the paper are interesting. It is one of the very few papers that attempts a synergistic IR/VIS retrieval, and in this respect this study is a valuable contribution to the literature.

However, the presentation choice of the results, which mostly relies on averages, makes it practically impossible to assess the algorithm properly, particularly how it

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performs on individual observations. Also the description of the algorithm should be expanded and would benefit from additional illustrations. So while I can potentially see a lot of value in the paper, I have to suggest a major revision (where the main comments below are taken into account). After this, the paper really should be reviewed again prior to publication in AMT.

Main comments.

1. Algorithm description.

- dust ash detection: there is whole section (2.1) on the dust detection, but in the end it is not clear what flag was used. Is it the flag from the AIRS L1/L2 products? In any case, it would be worth given details on which channels were used.

- retrieval itself: how are clouds taken into account?

- ECMWF data is used for the water vapor, ozone and temperature profiles and surface parameters. Were the AIRS L2 products not considered? Why not?

- It would be very useful to give an actual example on one day of data in the retrieval section: for instance a 6 panel plot over a large (Africa and Europe and Asia) scene with lat/lon scatterplots (not gridded) consisting of:

AIRS alone: (1) retrieved OD (2) retrieved altitude (3) χ^2

AIRS/MODIS: (1) MODIS OD /4 (2) retrieved altitude (3) χ^2

A plot like this would allow to illustrate and discuss the retrieval algorithm much deeper.

- The scatter plots above could also be used to evaluate the 1:4 OD conversion factor. This choice is not at all motivated in the manuscript and seems to contradict recent published results which suggest a factor typically between 1 and 2, e.g. Capelle, V., Chédin, A., Siméon, M., Tsamalis, C., Pierangelo, C., Pondrom, M., Crevoisier, C., Crepeau, L., and Scott, N. A.: Evaluation of IASI-derived dust aerosol characteristics over the tropical belt, *Atmos. Chem. Phys.*, 14, 9343–9362, doi:10.5194/acp-14-9343-

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2014, 2014.

- In addition, for the AIRS alone retrieval, it would be nice to show an example of a χ^2 minimization, showing both the observed and calculated spectrum. This would also give the reader an idea of which microwindows were used for the retrieval.
- Which effective radius was used for the lognormal size distribution?

2. Presentation of the comparison

To evaluate the dust altitude retrieval products, currently only timeseries over larger boxes are presented. It is not clear whether this was done because the results on individual observations are unsatisfactory. For example, the dust flag could have been chosen so that only the observations with a very large OD are detected, and this could in turn considerably help the altitude retrieval in achieving good results. As the authors show, when OD is low, information on the altitude is low (at least for the retrieval which uses only AIRS). The figures I suggested above should at least partially help to assess this. In addition, it would be very good to show high resolution averaged OD and height global seasonal maps (for the two algorithms + Gocart + CALIPSO). This will be a lot of figures, but in my opinion is the only way in which the data and algorithm can be analyzed properly by the reader.

- 3. In general, what is also lacking from the manuscript is a description and comparison of other IR dust retrieval algorithms (in particular then the mature algorithm of LMD, see the paper cited above and references therein).

Minor comments:

P445 Line 4-8: it is unclear before reading the paper that actually two retrieval algorithms are presented. I suggest reformulating this sentence.

P448 Line 3: 'though less sensitive than the above'. This is not valid in general and is partially contradicted what is said below (and also depends on particle type, size and altitude)

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P448 Line 9 'quite different', do you mean that the CO slicing method cannot be used for dust retrievals? please clarify

P449 Line 4-8: this description is again unclear without having read the paper before. Please reformulate

P449 In the AIRS instrument description, please add overpass time.

P453 Line 20: yes, but also on the accuracy of the atmospheric and surface parameters, and on cloud contamination?

P454 Line 3: 'would be' or 'is'? please clarify the meaning of this sentence

P457 Perhaps move all the instrument descriptions in one place in the paper.

P458 Line 8: "which is a combination of the over ocean is" this is unclear (typo?) please clarify

P459 Line 21: remove extra brackets

P460 Please specify the lat/lon coordinates of the areas that were used.

Interactive comment on *Atmos. Meas. Tech. Discuss.*, 8, 443, 2015.

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