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Discussions

Interactive comment on "Retrieval of desert dust aerosol vertical profiles from IASI measurements in the TIR atmospheric window" *by* S. Vandenbussche et al.

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The authors would like to acknowledge the Referee for his/her work in reviewing this manuscript, helping the authors to provide an improved version of their work. Two general comments from the Referee require an answer:

1) "Paper [...] needs some clarifications especially with respect to comparing retrieved aerosol parameters from IASI data, with those from A-Train instruments such as MODIS and Calipso."

The title of section 5.2 containing the comparisons with MODIS was misleading and

has been changed to "Optical depth analysis and comparisons with other satellite and literature data".

First paragraph of this section has been rewritten and now is (figure numbering from revised manuscript): "Figure 9 shows OD retrievals from IASI morning and evening measurements separately (binned in a 0.5°*0.5° horizontal map for better comparison with the other sensors), OD from MODIS Terra and Aqua (including Deep Blue over the desert), and the AAI from GOME-2 and OMI. The approximate time for each measurement is shown on the maps. Comparisons between the different instruments show that aerosols are detected at the same places and with spatial gradients coherent between all shown instruments/algorithms. Absolute values themselves are difficult to compare for different reasons, one of them being that IASI retrievals presented here consider only dust while the comparison data contain all aerosols. A second reason is that the particle sizes observable in thermal infrared are different from those observable at UV-visible wavelengths. Considering all that, the datasets presented in Fig. 9 may be considered as matching nicely in a qualitative way."

We have carefully rechecked sections related to CALIOP and we truly believe that these sections quite extensively describe the comparisons with CALIOP and nothing more could be added.

2) "Could the authors back up their claims (shown in the current version via kernel functions) by producing and showing jacobians with respect to aerosol amounts, as a function of height?"

As first answer to this comment, the authors would like to underline the fact that the definition of the averaging kernels as it is used in this work (Rodgers' reference cited in the paper) is as follows:

$AK = Gy\,K$ where K is the jacobians matrix and Gy the gain matrix defined as follows:

$Gy = (K^T\,Se^{-1}\,K + Sa^{-1})^{-1}\,K^T\,Se^{-1}$ where Se is the measurement error covariance

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matrix and Sa is the a priori covariance matrix

The following considerations lead to the conclusion that the altitude dependence observed in the averaging kernels (and variations of this dependence between different retrievals) arises from the Jacobians only:

- Se has no dependence with altitude anyhow

- In the vertical profile retrievals presented in this manuscript (step 1 of the strategy), Sa was defined as diagonal (100 %) with a vertical Gaussian correlation along 1 km length. This definition is the same at all altitudes of the retrieval, and the same for each retrieval, therefore no altitude dependence of the AK can be attributed to the definition of Sa

- The only remaining variable in the AK definition is the Jacobian matrix

The authors however had already verified that the jacobians (which are necessarily produced during the retrieval) did bear altitude information, and see no trouble at all in showing some of those.

The following figure and text were added to the manuscript at the end of section 3.3, before the last paragraph (figure numbering refers to the revised manuscript).

"Additional information on vertical sensitivity is given by derivatives of the radiance with respect to the aerosols amount in each layer (Jacobians). Examples of Jacobians for one specific case are shown in Fig. 5 (corresponding to the first vertical profile shown in Fig. 10, where the total OD is 0.7). The Jacobians were plotted in a different color for the two retrieval windows defined later in section 4.3, and the retrieved vertical profile of aerosols is plotted in grey (top x-scale). The Jacobians vary with the wavelength and in particular differ for the two retrieval windows. They show sensitivity to all altitude layers in both retrieval windows, some Jacobians being more sensitive to the lowest layers and others to the highest layers considered. Those Jacobians of course also depend on the atmospheric and surface states, but this figure shows that it is possible to have

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sensitivity along the whole vertical column even when the OD is non-negligible."

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 4511, 2013.

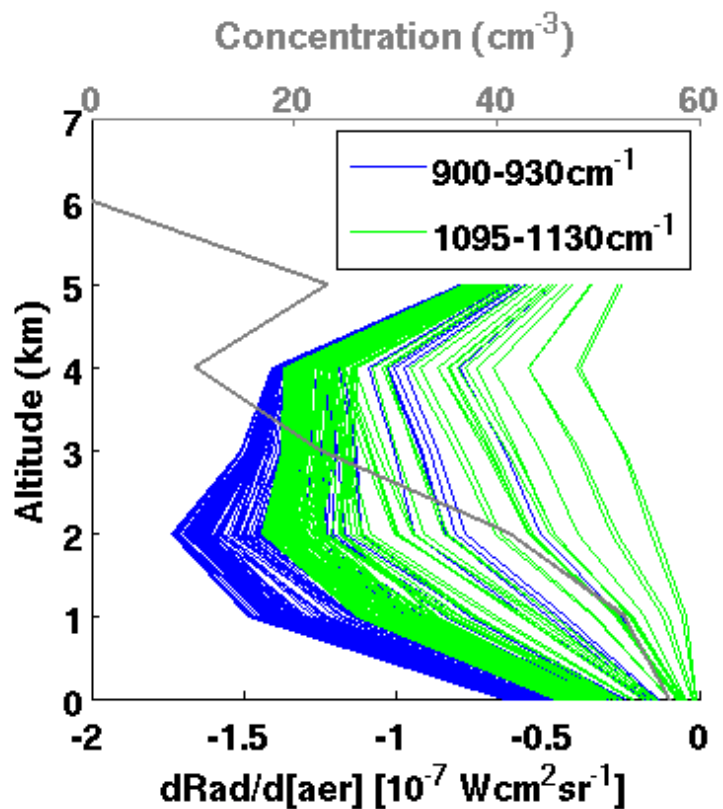Full Screen / Esc

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Fig. 1. Example of Jacobians for one specific case corresponding to the first aerosol vertical profile shown in Fig.9 (10 in revised manuscript). The retrieved dust profile is plotted in grey.