

Manuscript: A sensitivity study on the retrieval of aerosol vertical profiles using the oxygen-A band

This is a useful paper which quantifies the amount of vertical profile information that can be extracted from satellite-based measurements in the oxygen-A band and studies the dependence of the information content on the spectral resolution and acquisition time of the sensors. For this purpose, the authors carried out numerical simulations with the radiative transfer model VLIDORT and used the optimal estimation theory to determine the amount of vertical information.

This paper is of great interest for researchers, who uses the principle of aerosol retrieval using O₂ A-band. Indeed, the paper details the potentials but also the limitations of the oxygen-A band in regards to the technical specifications of future space-born sensors. The work has been carefully carried out and the results are presented exhaustively. However, for the researchers who are not particularly familiar with the information content analysis, the paper can be very difficult to read because of the lack of examples. I encourage the authors, more particularly in the third paragraph, to give some practical examples to link the formalism with the context of the retrieval of aerosol vertical profiles.

Consequently, I recommend that the manuscript be accepted after minor revisions.

Page 8 - You assumed a constant solar zenith angle of 45° and an instrument looking down at 30° off-nadir. Does the observation geometry influence the results? Did you perform computations with other view and sun zenith angles?

Page 8 - For study cases with maritime aerosols and considering the chosen observation geometry, why did you not carry out the computations using the complete kernel-model BRDF/M instead of using a constant albedo? I am wondering if the use of the BRDF/M considering different wind speeds could impact significantly your results.

Page 9 and figure 1, page 33 - The term “marine-artic” is quite confusing. It is not a unique study cases but two different study cases. Instead of “marine-artic”, you should write “marine or artic”. It will help the reader to understand that it corresponds to two different study cases as shown on figure 4.

Page 12 - Could you give some examples of high quality future instruments?

Page 12, Eq. (7) - I may miss something but I do not understand why you divided Δv . According to Eq. (4) and Figure 2, $L_c(v)$ is in radiance units ($\text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1} = \text{J} \cdot \text{s}^{-1} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$). The numerator units are Joules, whereas the denominator units are $\text{J} \cdot \text{photon}^{-1} \cdot \text{cm}^{-1}$. It results that the N units are $\text{photon} \cdot \text{cm}$ and not photon.

Page 12, paragraph “Information content analysis” - In the third paragraph, I think that it quite difficult to identify the different steps of the methods from a practical point of view.

You use the wavelength-dependence radiances through the K matrix, don't you? What is the retrieved vector?

You wrote “*According to the Bayesian formalism, the sensitivity of the retrieval of a set of parameters, to the measurements (...)*”. Could you please give some examples of the retrieved parameters? It will help the reader.

Page 15 - You investigated the effect of different Sa on the total DoF for urban aerosol scenario and

nadir looking geometry. However, page 8, you indicated that you assume a constant instrument looking down at 30° off-nadir. Why did you change the value of the view zenith angle?

Page 15, line 22 - What do you mean by “extra information”? Please, could you clarify?

Page 16 - “The DoF improvement with spectral resolution of 2.7 (Urban) and (...) is similar for both scenario”. This sentence is not clear. You should write: “of a **factor** 2.7 Urban) and 2.8 (Highly polluted) “

Page 16 – Why is the DoF change surprisingly small in spite of the large change in aerosol extinction? Is there any physical explanations linked with scattering or absorption processes of aerosols or the surface?

Page 17 - “It evident that (...) polluted scenario”. Could you explain why?

Page 18 – Altitude ranges [5-**15**km] and [**15**-50km] do not correspond to altitude ranges on Figure 5b-f: [5-**10**km] and [**10**-50km.]