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Comment on acp-2021-599

Anonymous Referee #1

Referee comment on "Inferring iron-oxide species content in atmospheric mineral dust from DSCOVR EPIC observations" by Sujung Go et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-599-RC1, 2021

Review comments on "Inferring iron oxides species content in atmospheric mineral dust from DSCOVR EPIC observations" by Go et al. submitted to ACP

&&&GENERAL COMMENTS&&&

The iron oxides contents of goethite and hematite in mineral dust play a key role to quantify the dust light absorption, and then influence its radiative effect. Even though the different spectral behavior of refractive indices, the direct retrieval of goethite and hematite concentration from remote sensing measurements is difficult due to the limited information content. This paper, based on the existing EPIC MAIAC product of aerosol type and spectral imaginary refractive indices, proposed a method to infer columnar goethite and hematite mass/volume concentrations by fitting the EPIC MAIAC spectral (UV-Vis) imaginary refractive indices assuming the Maxwell-Garnett effective medium mixture of non-absorbing host and absorbing hematite and goethite. The results are evaluated with in situ measurements. Overall, this study is well-written and within the scope of ACP. I would recommend this paper to be published in ACP after some comments and concerns being addressed.

- Since it's a sequential approach relying on the product of EPIC MAIAC spectral (UV-Vis) imaginary refractive indices (k), the quantitative validation of spectral k product is critical while not included in this study. The SSA validation by Lyapustin et al. (2021, FRS) may imply the quality of k. However, I would suggest to perform the validation of EPIC MAIAC k product directly and to quantify the uncertainty of derived hematite and goethite concentrations due to input k uncertainty.
- In my view, EPIC MAIAC dust detection is another key information used to select pixels and perform the hematite and goethite inversion. The authors claimed that some dust + mixed/smoke aerosol cases, which are classified into dust, may affect the retrievals for some specific regions. In this sense, I would encourage to include the maps of AE in the analysis which may provide some insights for dust detection.

- How do you evaluate the derived columnar goethite and hematite mass concentration with in situ near-surface measurements? How do you assume the vertical distribution? Please clarify in the text.
- The quality/clarity of the figures (e.g., Figures 1, 5, A1, S1) can be improved.

&&&SPECIFIC COMMENTS&&&

Figure 1: the quality/clarity of the figure should be improved.

Line 107: a recent study by Wang et al. (2021, 10.1016/j.atmosenv.2020.117959) developed an algorithm to derive aerosol components from effective density and spectral refractive indices.

Section 2.1: You mentioned the validation results of MAIAC EPIC SSA. Have you evaluated the MAIAC EPIC imaginary part of refractive index (k), since the fitting of MAIAC EPIC k is then used to derive hematite and goethite?

Line 180: the link does not work, please check.

Line 215: why don't you fit real part together with imaginary part?

Line 227: what do you mean flexible retrievals?

Equations 11-13: So, you use the coarse mode volume concentration to approximate the total, right? Then the $C_{v,\ hema} = C_{vc} \times f_{hema}$ is named as the hematite total volume concentration. Is the coarse mode hematite volume concentration more precisely?

Line 283: Could you explain why the algorithm does not retrieve dust aerosol over South America and southern Africa?

Figure 5: There are more cloud-free pixels in the RGB images than that in the AOD, SSA, Hema and Goet plots. Could you explain how these pixels are selected?

Line 449: How do you convert hematite and goethite volume / mass concentrations to the iron-oxide mass fraction? sum of them? It seems missed in the methodology.

Line 469: with a size range of 2-6 days? Please check.

Line 486: The colocation method should include also in the main text. What's the spatial resolution of the product? Why the spatial window is different over Australia (+/-3 degree)?

Line 586: Why do you use the threshold AOD>1.0? Is it for dust detection?

Line 589: Since it may contain some mixed / smoke aerosol cases, I would suggest to include maps of AE in Fig S2-S5 that may provide some insights for aerosol types.

Line 634: real refractive indices -> real part of refractive indices

Line 708: the reliable product of spectral imaginary part of refractive indices is a precondition