[Reviewer 2]

This is a very valuable study that describes a methodology of deriving hematite and goethite concentrations from the UV-VIS single-viewing space imager EPIC aboard the DSCOVER. Obviously, deriving such detailed aerosol property as hematite and goethite concentrations from this type of space sensor requires numerous hypothesis and a priori information, however, the authors do quite a careful work on their educated definition. The methodology is then applied for a series of carefully selected case studies that fulfill the conditions for an optimal application of the methodology. The study also presents a revision of a large diversity of the refractive indexes of hematite and goethite reported in literature, and an analysis justifying the choice made in the study. Elements of validation of the obtained hematite and goethite concentrations using *in situ* data are presented as well, which is not an evident task for satellite derived aerosol property. I would like also to acknowledge the work done on revision of the literature. The study is certainly in the scope of ACP, it is a solid work and indeed worth the publishing. I have just a few main questions which I believe addressing could strengthen the study, but I leave to the authors to decide if to include the elements of reply in the manuscript or not.

The evaluation of the uncertainty in the derived percentage of iron oxide due to different refractive indexes assumed is very interesting and informative (Fig. 11). I would think about at least two other assumptions that require evaluation of the uncertainty in the derived concentrations.

- First, the real part of the refractive index, which is fixed. However, generally, the values of real and imaginary parts are related and the imaginary part is varying here. Specially, the real part of iron oxides is quite high (Fig. 1, a), so the real part of mixture is expected to vary quite a bit depending on the iron oxide fraction. I would suggest calculating the effective refractive index and simulate satellite signal for internal mixture of nonadsorbing dust host and iron oxides for the corresponding real and imaginary refractive indexes and then deriving (under the fixed real part assumption) the hematite and the goethite concentrations for this synthetic signal. How will it compare to the initially used hematite and goethite fractions? Indeed, it is mentioned in the paper that Di Biagio et al. 2019 conclude that the real part is generally source- and wavelength-independent with a range of 1.48-1.55, but this range seems to be big enough to cause the derived iron oxides fractions variability.

➔ Thank you for the valuable suggestion. The below figure (Figure R1-R3) shows the refractive index of mixture (based on the Maxwell-Garnett internal mixing rule) with respect to the iron oxide fraction which shows the sensitivity indirectly. As you mention, the real part of the mixture is expected to vary quite a bit depending on the iron oxide fraction. At 443 nm, the real part of the mixture varies with a range of 1.51-1.59, and the imaginary part of the mixture varies with a range of 0.0-0.03 for certain volume fractions of hematite (0–0.05) and goethite (0–0.03). The current MAIAC algorithm does not retrieve real part of the refractive index due to insufficient information contents, and the related sensitivity study regarding the real part of the refractive index is beyond the scope of this study. We will evaluate this uncertainty in the follow-on analysis.

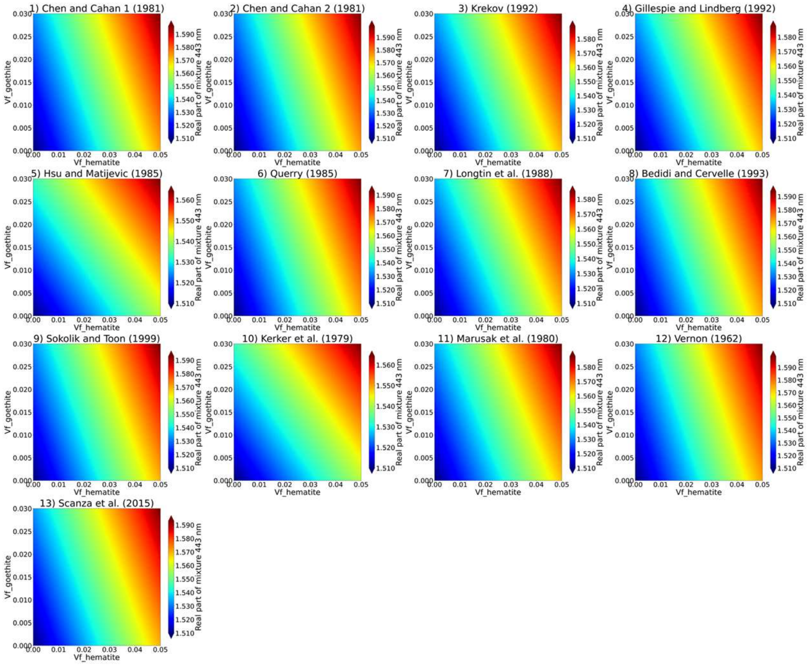

Fig. 1. Figure R1. Theoretical retrieval test. The real part of refractive index of mixture at 443 nm as a function of the hematite volume fraction (x axis) and goethite volume fraction (y axis) of MAIAC EPIC parameter using 13 models of hematite refractive index listed in Table 1.

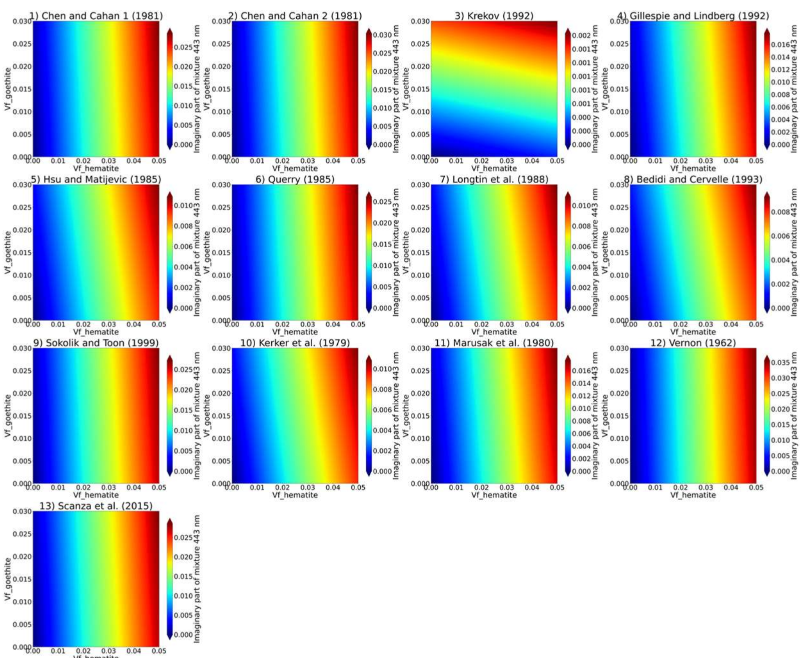

Fig. 2. Figure R2. Theoretical retrieval test. The imaginary part of refractive index of mixture at 443 nm as a function of the hematite volume fraction (x axis) and goethite volume fraction (y axis) of MAIAC EPIC parameter using 13 models of hematite refractive index listed in Table 1.

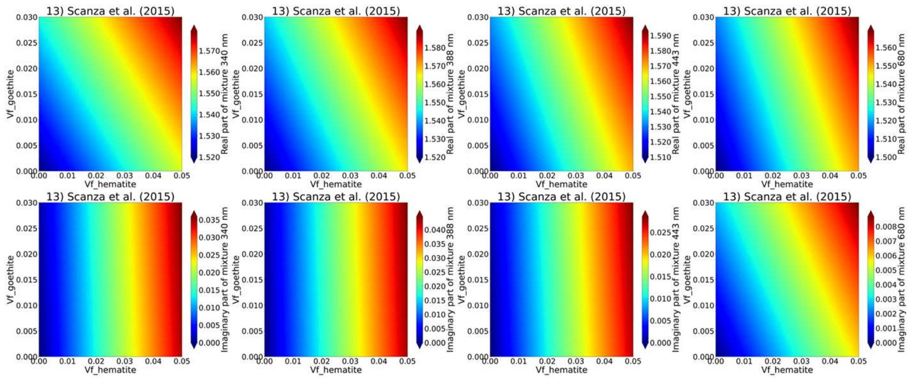

Fig. 3. Figure R3. Theoretical retrieval test. The real part (top row) and imaginary part (bottom row) of refractive index of mixture at 340, 388, 443, 680 nm as a function of the hematite volume fraction (x axis) and goethite volume fraction (y axis) of MAIAC EPIC parameter.

- Second, 1 km aerosol height is assumed. The assumption is justified by generally good agreement of EPIC derived absorption with AERONET, but this is on average and fluctuations in specific cases are expected. The dust over hot desert surfaces, specially over Sahara, is lifted to rather higher than 1 km altitudes and sensitivity of UV to the dust altitude is known. What if to conduct a similar test as in the case of real refractive index? That is, to simulate the satellite signal for dust at different altitudes and invert for the iron oxides fractions using the fixed (1 km) dust altitude. These exercises can evaluate uncertainty in the derived fractions due to these two assumptions and provide a valuable error bar. The effect of presence of carbonaceous aerosols (mixture with smoke) can be evaluated in the same manner.

  Response: Thank you for the important comments. We are planning to provide the hematite/goethite contents for both 1km and 4km in the next version of the MAIAC EPIC. The effect of the presence of carbonaceous aerosols (mixture with smoke) will be also evaluated as a future study. The figure below shows the effect of assumed dust layer height (1km, 4km) on derived iron oxide fractions for the dust case 8. The iron oxide fraction tends to decrease for the elevated dust layer due to decreased b and k_0 values. In other words, for elevated dust aerosol it takes less absorption to create the same reduction of the top-of-atmosphere reflectance in the UV.

  We can mention two points in this regard:

  1) As EPIC also has O2 A- and B-bands sensitive to aerosol profile, we initiated the work to expand MAIAC EPIC algorithm and provide a suite of (AOD, k_0, b, and effective height) from the UV-Vis-NIR measurements including A- and B-bands;
  ~~2)~~ We are also developing a framework to evaluate pixel-level retrieval uncertainty which will be provided in the future. Currently, such analysis is beyond the scope of this paper.

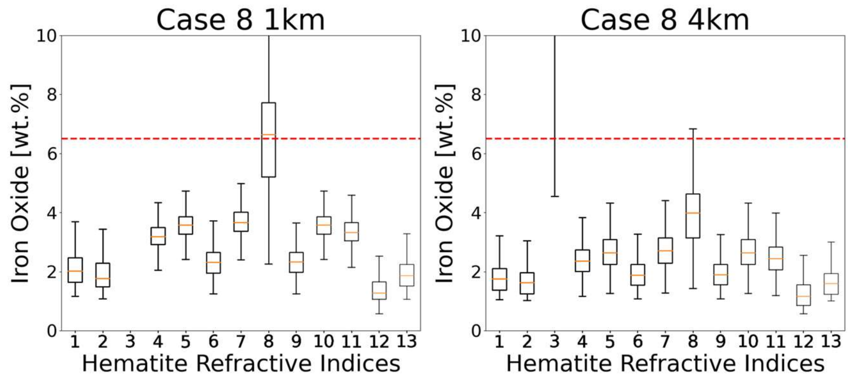

Fig. 4. Figure R4. Box and whisker plot of iron-oxide content by mass (wt.%; y axis) for 13 models of hematite refractive index for the dust cases 8 (left: 1 km, right: 4 km). Red horizontal dashed line on each figure shows the maximum expected iron-oxide content (6.5 wt.%) based on in situ measurements.