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The role of refractive indices in measuring mineral dust with high-spectral resolution infrared satellite sounders: Application to the Gobi Desert

The paper titled 'The Role of Refractive Indices in Measuring Mineral Dust with High-Spectral Resolution Infrared Satellite Sounders: Application to the Gobi Desert' delves into the ramifications of employing intricate refractive indices to retrieve aerosol concentration and size during episodes of intense desert dust resuspension. The authors elucidate that utilizing complex refractive indices derived from laboratory measurements enhances the accuracy of estimating desert dust concentration and size through satellite measurements (specifically, IASI). They contend that the intricate refractive index stands as a critical parameter in retrieving physical parameters, thus emphasizing the necessity of meticulous selection. Nevertheless, certain aspects of the paper lack explication that would prove beneficial to the scientific community. Moreover, some sections suffer from insufficient referencing, while one figure exhibit inaccuracies. Hence, I suggest that the authors modify the manuscript with additional precisions before publication.

Major comments:

1/ **L87-88**: In the case study, authors mentioned that the essential part of the dust aerosol suspension process is associated with strong winds and they add: « particularly during the winter and spring months ». Why is more intense during these months, are they references mentioning that?

2/**L94:** Figure 1 shows the IASI brightness difference during the Gobi dust storm. I would suggest that the authors mention the number of IASI pixels studied in that entire scene because a part of these pixels will be the ones from which the authors will want to retrieve concentration and size in the following steps of the paper.

3/**L115-154**: Regarding the CRI data section, the authors give a detailed description of the measurements of each complex refractive index (CRI) but for easier reading, I would suggest to summarize the main information in a table adding also the resolution (missing in the manuscript) for each CRI retrieval.

4/**L150:** Authors comment that the VZ72 CRI dataset was obtained « from rainout precipitation rather than desert dust ». In that way, I am wondering if this dataset is really consistent to compare with the others retrieved in dry conditions. It might be a strong impact on optical properties according to the relative humidity.

5/**L165:** Authors introduce a brand-new radiative transfer algorithm ARAHMIS but did not give any reference. Is there an existing publication describing the potential of this code or a publication mentioning the application of this code in the literature?

6/**L251:** In the Measurement error covariance matrix, authors say that “in the case of IASI instrument the SNR is set to 500”. Why this typical value? IASI’s instrumental noise is changing according to the frequency, is it stable in the windows 750-1250 cm^{-1}?

7/ Figure 6 shows the impact of the CRI used to retrieve the effective diameter (D_e), the volume mixing ratio (VMR) and also points out the efficiency of the retrieval through the root mean square (RMS) parameter. However, by looking to the top middle of the plume (around 45°N-115°E) the RMS of all the CRI used seems to be identical but the retrieve VMR and D_e are strongly different. How these huge differences can be explained? I suggest that the RMS is a good indicator but is not sufficient alone to conclude that one CRI dataset is more accurate to another.

8/ It seems that there is a mistake in the Figure 7. The first panel (D_e) represents the effective diameter using DSC22 CRI but the lognormal distribution does not correspond to the Figure 6 map plot showing bigger diameter and the mean reported in the Figure 7 is not in adequation with the lognormal fit neither. At least, the mean diameter mentioned in the text L391: "3.1 µm" is not the same as the one reported in the Figure 7: "3.2 µm".

Minor comments:

1/**L27:** Missing reference for IPCC.

2/**L31-32:** A reference would be welcome to show the diversity of remote sensing instruments to capture mineral dust events.

3/**L43:** remove "of dust"

4/**L57-58:** Furthermore, Capelle et al., 2014…" the sentence is not clear for me. Could you rephrase?

5/ **L60:** add "are" in the sentence "These involved aerosol generation methods ARE more…"

6/**L285:** unit of C_{air} and description of L should be added.

7/**L286**: state vector instead of "vector state"

8/**L304**: replace Fig. 3 by Figure 3

9/**L338:** same comment

10/**L359** replace Fig. 7 by Figure 7

11/Some references are cited in the text but are not included in the Bibliography section. Also, Clarisse et a., 2021 should be included after Clarisse et al., 2019. Same for Sokolik et al., 1999 & 1998.