

## ***Interactive comment on “An experimental study on light scattering matrices for Chinese loess dust with different particle size distributions” by Jia Liu et al.***

### **Anonymous Referee #5**

Received and published: 17 December 2019

#### General Comments:

In Liu et al. the paper focuses on describing the scattering function of a sample that was collected from the Chinese Loess Plateau and subsequently milled to change the physical properties of the particles. The major conclusion gleaned by the authors in the article is that the size of the particles affects the scattering properties. The paper does describe well the need for the research being performed on complex systems, but systematic experiments need to be performed to start to tease out some of that information instead of broad statements about size since that is what they were trying to control. The authors mention that the size distribution is the major factor, but refractive

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index and micro structure are not ignorable (line 237-240) and then seem to discount that the shape refractive index have little effect (line 318). They additionally mention that the Refractive index is different (Table 1), but do not seem to try and account for the difference using any kind of modeling to show that it is primarily size. Or identify as to why these are different for the same material.

This paper does not show significant new data or a new approach to understanding the optical properties of aerosol particles that had not been published previously by the group. The technique has been described by the authors at least twice previously in prior publications and one of the 2 sample sets is already published elsewhere (Liu et al. 2019 and 2018). The paper itself needs to be edited further and reorganized as there are multiple sections that are very similar but spread out through the paper. This paper appears to be more of an addendum to the Liu et al 2019 article than a stand-alone article. Based on these above points, I would be hesitant to recommend this paper for publication as is since there is little information that is novel and there are some unsubstantiated claims throughout.

Specific Comments:

Line 26: Please specify what this % is, from written it appears to be total aerosol loading worldwide.

Line 36: Please specify what 'r' refers to specifically.

Line 42: Remove "Without a doubt"

Line 55: 'Furthermore. . . scattering matrices' This sentence is not completely coherent and needs to be rewritten.

Line:99-100: What was the injection type for the laser particle sizer? Were they injected in solution or dry?

Line 101: Size comparison can be difficult between the two samples due the fact that the original dust sample has a bimodal distribution. This distribution itself will lead to

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very different scattering properties, whereas the milled sample is a more uniform size. What is the cause of the bimodal shape? Could this be due to a heterogeneity of mineral types being different sizes and having large differences in scattering properties that are then not comparable to the milled sample?

Line 103: It is stated that the majority of the particles are larger than 5 microns, but there is a peak at 3 and 10 microns. Please reword this section because you use a cutoff of 5 microns earlier for local vs. long range transport.

Line 105: Please define the peaks more clearly for both samples, with a peak maximum and additional parameters to describe the spread.

Line 110/Table 1: Why is there a difference in the refractive index if they are still the same material? Please provide the error associated with the measurements and propagate through the rest of the calculations.

Line 120: how are the samples for SEM prepared? Are they impacted on the surface or collected some other way?

Line 129: What is the detection limit of this instrument? You quote down to 0.0001 wt% in Table 2. This is mainly of interest since I do not know the limits of XRF.

Table 2: add an additional column with the difference between the pristine and milled samples. Also include that the characterization was performed by XRF in the caption.

Line 124: The aggregated particles are all on the large size of the size distribution, would this affect the scattering properties greatly or are they artefacts from particle collection for SEM analysis?

Figure 2: The SEM image for the pristine loess only shows particles in the 10s of microns, it is not a representative image of what the particles actually would look like since the peaks are at  $\sim 3$  and 10 microns. Additionally, the image for the 'milled loess' is the same as previously published in the prior manuscript. Please provide representative and comparative SEM images.

Line 126: What size ZrO<sub>2</sub> ball were used and were they milled wet or dry?

Line 153-160: I like that the detectors are defined differently, but it would be better to have a different description that ‘monitor’ and ‘detector’ as they are both the same pmt detectors just with different functions.

Figure 3: This does not seem necessary as the technique has been described twice previously.

Lines: 215-223: this paragraph is in an odd place as it references past tables and figures.

218: “loess dust become more irregular after milling process” How is this defined? If you are saying that they become more irregular, then you will need to actually do analysis of the particles themselves to show the change in the shape parameters. Based on the images seen, this statement cannot be made.

Line 241-253: This paragraph could be combined with the conclusion, it is very repetitive.

Figure 4/5: Could these be combined? You could have the synthetic scattering matrix as a different color and a line. It took me a while to see what the difference was between the 2 figures.

Figure 6: Could you specify all the samples that were used in this figure? Either here or in the text.

318-319: “other factors...” this is misleading, since there was no discussion on how the difference in RI affected the sample and no experiments were performed to single these factors out from the size effect. This is also in contrast to earlier where it is stated in line 239-240 “while other factors are also not ignorable”

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-236, 2019.

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