Responses to Anonymous Reviewer #2 (Manuscript # acp-2019-812)

First of all, we would like to thank the anonymous reviewer for his/her thoughtful review and valuable comments to the manuscript. In the revision, we have accommodated all the suggested changes into consideration and revised the manuscript accordingly. All changes are highlighted in RED in the revision. In this point-to-point response, the reviewers' comments are copied as texts in BLACK, and our responses are followed in BLUE.

General comment:

This paper by Huang et al. reveals by model simulations the importance of the dust refractive indices (RIs) for the model development of its optical properties. They show that the scattering matrix elements of different kinds of dust particles can be reasonably reproduced by choosing appropriate RIs even using a fixed particle geometry and that a change in the RI can strongly affect the appropriate shape parameters to reproduce the measured dust phase matrix elements. The study indicates that the development of corresponding optical models can potentially be simplified by considering only variations over different RIs. The study should be a welcome addition to the literatures on modeling and measurements of dust optical properties and their radiative effects. The paper is well written in general, though the model used needs to be introduced more specifically and the parameters presented to be described more clearly. I would recommend the paper be published after minor revisions.

Response: Thanks the reviewer for the suggestions. The comments on the model, the presentations of parameters, and the result interpretations can significantly improve the quality of the manuscript, and make the paper more solid. The following presents our point-to-point responses as well as the revision for the manuscript.

Minor/Technical issues:

1. P2, L5: What implications of this study for better quantifying these two fundamental parameters? This issue may also need to be highlighted in the conclusions.

Response: Thanks for the constructive comments. In fact, single scattering albedo and

asymmetry factor are introduced as two examples of the various optical properties. This study mainly discuss the scattering matrix elements, so we omitted the two parameters in the revision. With better constrain on particle RI, the estimation on the SSA and asymmetry factor will definitely improve.

2. P2, L7: There are two literatures given in the References corresponding to Xu et al., 2017 here.
Response: We have used "Xu et al., 2017a" and "Xu et al., 2017b" to distinguish the two literatures, and the corresponding statements are corrected in the revision.

3. P2, L10: There are two literatures given in the References corresponding to Bi et al., 2018 here.
Response: The citations have been specified as "Bi et al., 2018a" and "Bi et al., 2018b" in the revision.

4. P3, L20: There are two literatures given in the References corresponding to Bi et al., 2011 here.
Response: Thanks for the careful review, and we have corrected the references accordingly. Sorry for the mistakes, and we have double checked the references.

5. P4, l11: Several types of dust particles?
Response: Thanks for the suggestion. We have corrected the phrase.

6. P6, Eq. (2): What are i and j stand for, respectively? Their ranges should be given in the equation. Should it be Pij in the denominator?
Response: As this study didn't consider d_{ij} other than d_{11}, so we simplified the discussion relative to the evaluation. In other words, Eq. (2) is unnecessary now, and we have deleted it.

7. P6, L6: Is this summation really used in the following sections? If so, an equation might be given here.
Response: We found that the optimal refractive index that gives the smallest d_{11} is normally consistent with that gives the smallest summation, so we consider only d_{11} in the manuscript and didn't directly use the summation here. To avoid confusion, we

have removed the corresponding discussions.

8. P7, L1-2: Do you mean element(s) or element ratio(s) here?
Response: Thanks for the suggestion. It is quite standard to present the scattering matrix elements besides P_{11} using their ratios to P_{11}, because the large variations can hardly be presented in the linear axis and the logarithmic axis cann't be used due to negative values. We think there will be little difference between element and elment ratio, so we try to keep text simple by using "elements" in the manuscript.

9. P7, L17: the literature for Nousiainen, 2014 is missing in the References.
Response: Thanks. The literature referred here should be "Nousiainen and Kandler, 2015", and we have corrected this in the revision.

10. P8, L1-2: Where is d11 shown in the figure? The phrase "element ratios" might be more suitable for P11/P11(30 degree), P12/P11, and P33/P11? Are all P11 in the denominator for 30 degree? Since these ratios are frequently used, their definitions (or meanings) need to be given in Sect. 2.
Response: Thanks for the constructive comments.
The d_{11} values are not directly shown in the manuscript, we just listed some of there as example. We give the various d_{11} with different RIs when the phase function of feldspar are discussed as examples (the smallest d_{11} together with the optimal RI are bold):

Refractive index	$1.4+10^{-3}$	**$1.55+10^{-3}$**	$1.55+10^{-2}$	$1.6+10^{-3}$	$1.8+10^{-3}$	$2.0+10^{-3}$
d_{11} (Feldspar)	13.56	**0.51**	2.54	0.87	6.14	10.12

(2). Thanks for the suggestion, we have added the following sentence in the text:
"*Noted that the phase functions will be presented by normalizing $P_{11}(30°)$ to 1, i.e., showing $P_{11}(\theta)$ / $P_{11}(30°)$, and the other nonzero scattering matrix elements are normalized with respect to P_{11}.*"

11. P14, L2-3, L16-17, and L24-25; P16, L3-4; P17, L5-6 and L10-12; P18, L14-15 and L16; P19, L1-2 and L5-7: Are these literatures referred in the main-body text?

Response: Sorry for the mistakes. These literatures were referred in an early version of this manuscript, and we forgot to delete them for the submission. Some of those literatures are cited in the revision, and we have deleted these that are not referred. As mentioned above.

12. P22, Fig. 3 and P23, Fig.4: Is P11 for 30 degree in all the Y-axis?

Response: There is no problem with the labels, and we have double checked them. Because only the relative values of the phase function matters, it is normally presented with certain normalization. In this study, as the measurement phase function cannot be normalized by the standard integral value, we just present them by dividing the value at scattering angle of 30^o, so there is $P_{11}/P_{11}(30^o)$ for the y-axis.

13. P24, Fig.5: Are measurements referred by black dots? Legends (or descriptions) of the plots need to be given.

Response: Thanks, the measurements are referred by black dots and the descriptions of the plots have been added to the corresponding caption in the revision.