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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Quantifying the range of the dust direct radiative effect due to source mineralogy uncertainty" *by* Longlei Li et al.

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COMMENT

For indices of refraction of Corundum (Al2O3) from the UV to thermal-IR, please see Koike et al., Icarus, 114, 203-214, 1995. The imaginary refractive index at 0.4 microns is 0.043 and at 0.5 microns is 0.0382 and at 0.6 microns is 0.0367 from ISAS (Table A1). These values are ~1/4th those for iron oxide (e.g., which is around 0.15 at 0.5 microns), thus definitely important. The authors are correct that it will depend on concentration and whether Al2O3 can be a surrogate for Al in a mixture. These are important issues to mention.

RESPONSE

Many thanks to the reviewer for the comment! We provide a little bit more information about Al2O3 below to address this comment.

One of the pure crystal lattices of Al2O3 is referred to as alpha-Al2O3 or corundum. One may expect the alpha-Al2O3 or corundum in a metamorphic or plutonic environment, or in regions where heavy minerals are concentrated (communication with Dr. Konrad Kandler), but it is not as common as the minerals we considered in our manuscript. The complex refractive index (CRI) that we took from Toon and Pollack (1976) and presented in our first reply to Reviewer 1 (Fig. R1 of 'Response to Referee 1') is exactly for this type of Al2O3 (alpha-Al2O3 or corundum). As we had already thoroughly discussed in our first response to the Reviewer #1 ('Response to Referee 1'), it is impossible for alpha-Al2O3 to exert considerable influence on the dust direct radiative effect (DRE) estimate.

There is no discrepancy on the CRI of Al2O3 between Toon and Pollack (1976) and Koike et al., (1995): the CRI the Reviewer #1 was showing is not for alpha-Al2O3 or corundum but for gamma-Al2O3, a second kind of Al2O3 crystal lattice. This gamma-Al2O3 should not influence dust DRE either, simply because it is exceedingly rare in dust aerosol particles. We had stated in our first reply to the Reviewer #1 ('Response to Referee 1') that "as temperature increases, the absorption coefficient (related to the ImCRI) for the pure crystal aluminum oxide can increase by dozens of times at the visible bands". For the reference of Reviewer #1 and other readers, Toon and Pollack (1976) obtained the indices at the room temperature and/or at 1200 degree and stated their Table 2 as an upper limit. Therefore, the CRI they obtained is suitable for use and was used in our first reply ('Response to Referee 1') to demonstrate that Al2O3 has little influence on the dust DRE estimate. Unfortunately, Koike et al. (1995) did not provide the specific temperature (they just reported it as "high temperature") at which the authors made the measurement. In any way, we believe that the CRI from Koike et al. (1995) should not be used by one who is interested in DRE by dust aerosol in the Earth's atmosphere.

Based on all information we presented here and in our first response to Reviewer 1 ('Response to Referee 1') , we think that there would be no problem without mentioning aluminum oxide in our manuscript.

REFERENCE FOR THIS PART

Koike, C., Kaito, C., Yamamoto, T., Shibai, H., Kimura, S. and Suto, H.: Koike-Al2O3-1995.pdf, Icarus, 203–214, 1995.

Toon, O. B., Pollack, J. B. and Khare, B. N.: The optical constants of several atmospheric aerosol species: ammonium sulfate, aluminum oxide, and sodium chloride, J. Geophys. Res., 81(33), 5733–5748, doi:10.1029/JC081i033p05733, 1976.

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