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Atmospheric Chemistry and Physics Discussions

Interactive comment on "What's the real role of iron-oxides in the optical properties of dust aerosols?" *by* X. L. Zhang et al.

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This manuscript presents the importance that iron-oxides have to determine optical properties of dust. It shows how small variations of these oxides translate into large variations of the absorbing properties of dust. The authors provide a good review of the refractive indices of hematite and goethite, they then try to infer from measurements of total iron and or free-iron the range of hematite and possibly of goethite. From a proposed size distribution of dust, they study different mixing rules to document how optical parameters vary as a function of wavelength. Interestingly they show how these mixtures compare with the optical properties of pure illite as a proxy of dust without any iron-oxide. In itself, the paper is interesting and deserve after a few improvements that

I propose below before being published. With some more work, this paper could have come to even more robust conclusions and here are a few points where the authors could have push there reasoning further:

1/ The authors claim that goethite has not been quantified in dust. They oversaw a reference that they cite that just did that, the mineralogical database of Journet et al. (2014) provide a quantification of hematite and goethite in soils and also as these minerals are transported in the atmosphere. The authors could have more relied on that work to narrow down the range of iron-oxides that they study (they use 0%, 2.5%, 5.0% and 7.5% by mass as study cases).

2/ A thorough review of the single scattering albedo (SSA) measured for dust during campaigns or inferred from AERONET measurements would have helped the authors show that having more that 5% of iron-oxides by mass could hardly be reconciled with the SSA measured for dust in the absence of black carbon (BC).

3) The choice of the size distribution for dust particle size with an r0 of 0.5 and 0.7 μm and a σ of 2.0 is not well justified. Observations of dust size distribution can only be represented by at least 3 modes or more (see Osborne et al., 2008) and the authors would be better off considering several modes to infer dust properties.

Notwithstanding these remarks, which may or may not be addressed, I propose that the authors fix the minor points below before this paper is published.

Minor Points:

In the abstract you mention the 'climate forcing' of dust, strictly speaking it is better to refer to it as a climate perturbation as the majority of the dust in the column is from natural sources.

Page 3, lines 18 to 20: you could explain better that the radiative perturbation of dust has a positive of negative sign depending mostly on: underlying surface albedo, particle size distribution and mineralogy (see Liao and Seinfeld, 1999 and Claquin et al.,

1998).

Page 5, line 10: contrary to what is stated, Journet et al. (2014) provide the goethite fraction (in mass) globally and by regions for both the clay and silt fraction of dust.

Page 9, line 4: The reference LG1985 is not defined in the text and I could not find it in the reference list.

Page 16 lines 20-24 state: '' Based on the above reported results, we conclude that the iron-oxides account for approximately half of the mass of elemental Fe and for between 2 and 5% of the dust mass. Most of them are composed of goethite, representing between 50 and 75% of the iron oxide mass." How do you then justify the choice of your 4 cases : 0, 2.5, 5.0 and 7.5% hematite lines 14-17 page 17. Please indicate very clearly whether these fracions refer to mass fractions or volume fractions (since when you work with optical parameters you consider volume).

Page 19 lines 14 to 17. '' This is explained by Fig. 4b where the two datasets have the same 15 optical scattering and absorbing properties for _ < 0.55 μm but the dataset of QE1985 leads to higher optical absorption for _ > 0.55 μm.". Check the Figure you refer to, I could not reach your conclusion by looking at Figure 4b.

Page 21 line 27. The sentence that starts with 'Therefore, the employment of refractive indices. . .' is akward, replace it with 'Therefore, the use of refractive indices. . .'

Pages 21 and 22 have been hastily written, try to improve the text for these 2 pages.

The conclusions might need some work to extract better your main findings.

Thank you for this interesting contribution.

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Claquin, T., Schulz, M., Balkanski, Y., Boucher, O., 1998. Uncertainties in assessing radiative forcing by mineral dust. Tellus 50B, 491–505.

Liao, H., Seinfeld, J.H., 1998. Radiative forcing by mineral dust aerosols: sensitivity to key variables. J. Geophys. Res. 103, 31637–31645.

Osborne, S.R., Johnson, B.T., Haywood, J.M., Baran, A.J., Harrison, M.A.J., McConnell, C.L., 2008. Physical and optical properties of mineral dust aerosol during the Dust and Biomass-burning Experiment. J. Geophys. Res. 113, D00c03.

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