General comment:

The ACP special issue topic is "Anthropogenic dust and its climate impact" Is there some distinction that you can make between light absorbing iron compounds (or absorption in general) in natural mineral dust aerosol versus dust aerosol from soils that have been anthropogenically disturbed or affected?

It is a very good question. As we known that the wind-blown dust which generally occurs from natural processes is commonly severe in arid or semi-arid areas (e.g. desert, Gobi and alluvial deposits), but agricultural activities that disturb the soil can greatly increase the frequency and amount of wind-blown dust. Moreover, the anthropogenic dust also includes the fugitive dust from road and non-road (such as mining and building).

To our knowledge, the light absorbing iron compounds in natural mineral dust is hard to distinct with dust aerosol from anthropogenically disturbed soils (such as grassland and cropland) by the laboratory analysis. More recently, we have developed and verified a new numerical dust model which could simulate the dust emission progress over the anthropogenically disturbed cropland and grassland (Zhang et al. 2015). Once we taken the soil mineralogical distribution data (include hematite and goethite, till now, the only datasets are from Nickovic et al. (2012) and Journet et al. (2014)) into our modeling, we will calculated the effects of anthropogenic dust on optical properties and radiative forcing. However, these modeling results are also hard to be validated. In fact, coupling the soil and emitted dust mineralogy into dust model is a new development direction to accuracy evaluates the climate impact of dust. In ACPD and ACP, Scanza et al. (2015) has modeled dust as component minerals in the Community Atmosphere Model, and Perlwitz et al. (2015) has predicted the mineral composition of dust aerosols based on the brittle fragmentation theory. However, we are opposing to the latter one and the brittle fragmentation theory in the interactive discussion progress, more details in http://editor.copernicus.org/index.php?_mdl=msover_md&_jrl=10&_lcm=oc108lcm109w&_acm=get_comm_sup_file&_ms=28358&c=85559&salt=1619220327230502394. During the past two years, our research group had carried out the field and wind tunnel experiments to building the mathematical relationships between the threshold wind velocity, soil mineralogical composition and entrained dust mineralogy (XRD and SEM-EDX), and dust size distribution over different land use types (desert, Gobi, grassland and cropland), and will couple them into our WRF-CMAQ-FENGSHA model in the future two years.

As we mentioned in our manuscript that ten of 16 known iron oxides, hydroxides and oxide-hydroxides are known occur in natural rock-forming minerals. Another six types of high-iron particles are from anthropogenically industrial activities. And these high-iron particles in fugitive dust are easy to be identified, because of their spherical morphology which formed during the combustion. However, we also know very little to the optical properties of these particles.

Journet, E., Balkanski, Y., and Harrison, S. P.: A new data set of soil mineralogy for dust-cycle modeling, Atmos. Chem. Phys., 14, 3801–3816, doi:10.5194/acp-14-3801-2014, 2014.

Nickovic, S., Vukovic, A., Vujadinovic, M., Djurdjevic, V., and Pejanovic, G.: Technical Note: High-resolution mineralogical database of dust-productive soils for atmospheric dust modeling, Atmos. Chem. Phys., 12, 845–855, doi:10.5194/acp-12-845-2012, 2012.

Perlwitz. J. P., Pérez García-Pando, C., Miller, R. L.: Predicting the mineral composition of dust aerosols–Part 1: Representing key processes, Atmos. Chem. Phys. Discus., 2015, 15(3): 3493-3575.

Scanza, R. A., Mahowald, N., Ghan, S., Zender, C. S., Kok, J. F., Liu, X., Zhang, Y., and Albani, S.: Modeling dust as component minerals in the Community Atmosphere Model: development of framework and impact on radiative forcing, Atmos. Chem. Phys., 15, 537–561, doi:10.5194/acp-15-537-2015, 2015.

Zhang, X.L., Zhou, Q.Q., Chen, W.W., Wang, Y.Y., Tong, D. Q.: Observation and modeling of black soil wind-blown erosion from cropland in Northeastern China, Aerolian Research, doi: 10.1016/j.aeolia.2015.07.009, 2015.

Line 129

I did not see that the acronym IDAD was defined. Please spell it out once.

The related text has been revised as "the Aerosol Refractive Index Archive (ARIA) of Oxford University".

Line 208

Patterson and Gillette may have called this an accumulation mode but that does not fit the present concept of accumulation mode in aerosol science. Dropping that word does not detract from your discussion.

We have revised it and dropping this word.

Line 252

Define N, i.e. .... particle number concentration N = ...

We have revised as "for particle number concentration N=1"

Line 404

Briefly explain the inversions. I assume Koven and Fung; Formenti et al. are the references for the inversion procedure.

Yes, Koven and Fung (2006) and Formenti et al. (2014a) are the references for the inversion methods and comparisons with observed result from the AERONET.

Line 417

Explain what you mean by "advected dust aerosol". This condition would seem to be dependent on location.

As English is not my native language, and I have corrected as "the transported dust aerosol"

Line 726

Put the reference to Köhler after Krekov.

We have revised it.