Single-particle measurements of light-absorbing iron oxide aerosols and their radiative effects

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Iron oxide (FeOx) aerosols efficiently absorb solar radiation, causing a perturbation of radiation balance. A well-known FeOx aerosol is mineral dust, emitted from the erosion of arid and semi-arid soils. In addition to dust (natural FeOx), anthropogenic FeOx aerosols generated through combustion process have been reported recently. However, the size-resolved concentration of FeOx aerosols are not well understood because of the technical difficulty of single-particle measurement of FeOx particle. Furthermore, the importance of anthropogenic FeOx aerosols to climate has never been focused on. In this study, we performed ground observation of FeOx aerosols at Cape Hedo Atmosphere and Aerosol Monitoring Station (CHAAMS), Japan. We used a modified single-particle soot photometer (SP2) and transmission electron microscopy (TEM). Although the SP2 is conventionally used to measure individual black carbon (BC) particles, we applied it to measure FeOx aerosols using a new method (Yoshida et al., 2016). Optical properties of FeOx aerosols obtained by the SP2 and TEM show that the majority of FeOx aerosols were of anthropogenic origin. The mean mass concentration was 40.4 ng/m^3, approximately one third of that of BC (132 ng/m^3). We also theoretically estimated shortwave absorption of these aerosols using the size-resolved concentration observed by the SP2. The absorbing heating power of FeOx aerosols is estimated to be 2.3–6.4% of that of BC. This result indicates that anthropogenic FeOx aerosols, which has thus far not received attention, can have non-negligible light-absorbing ability comparting with brown carbon and mineral dust, well known light-absorbing aerosols.

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