Abundance and emission flux of the anthropogenic iron oxide aerosols from the East Asian continental outflow.

Early Career Scientist

Presenting Author:
Atsushi YOSHIDA, The University of Tokyo, Department of Earth and Planetary Science, Tokyo, Japan, ayoshida@eps.s.u-tokyo.ac.jp

Co-Authors:
Sho OHATA, The University of Tokyo, Department of Earth and Planetary Science, Tokyo, Japan
Nobuhiro MOTEKI, The University of Tokyo, Department of Earth and Planetary Science, Tokyo, Japan
Kouji ADACHI, Meteorological Research Institute, Tsukuba, Japan
Tatsuhiro MORI, Tokyo University of Science, Department of Physics, Tokyo, Japan
Makoto KOIKE, The University of Tokyo, Department of Earth and Planetary Science, Tokyo, Japan
Akinori TAKAMI, National Institute of Environmental Studies, Tsukuba, Japan

Abstract:

Anthropogenic iron oxide (FeO$_x$) aerosols can affect atmospheric radiation, marine biogeochemistry, and human health. However, due to a lack of observational data, their atmospheric abundance and emission flux are not well understood. In this study, we observed size-resolved concentrations of FeO$_x$ (170–2100 nm) and black carbon (BC, 70–850 nm) aerosols at a remote site in the East China Sea in March 2016 using a modified single-particle soot photometer (SP2). Light signals from individual particles obtained by the SP2 and morphology and compositions analyzed by transmission electron microscope revealed that most of observed FeO$_x$ aerosols are anthropogenic magnetite-like particles. Clear correlations between mass concentrations of FeO$_x$ and BC ($R^2 = 0.717$) and between FeO$_x$ and carbon monoxide (CO) ($R^2 = 0.718$) in air masses from China were obtained, which indicates that their emission sources are spatially similar. Their correlation slopes of mass concentration (ng/m$^3$) are ~0.3 and 0.0015, respectively. Based on the correlation slopes and reported emission inventories of BC and CO in China, we estimate emission flux of anthropogenic FeO$_x$ aerosols from China to be 0.183–0.372 FeTg/yr. Assuming that FeO$_x$/BC and FeO$_x$/CO emission ratios remain constant for anthropogenic sources, we also estimate global emission flux of anthropogenic FeO$_x$ aerosols to be 0.669–0.935 FeTg/yr. This value is comparable to that of the current emission inventories of total Fe (FeO$_x$ + non-FeO$_x$) in PM$_{10}$ from fossil fuel combustion (0.51–0.87 FeTg/yr), although our estimate limits only FeO$_x$ particles with 170–2100 nm in mass equivalent diameter. Our results indicate that the current emission inventories of Fe aerosols from fossil fuel combustion are likely to be underestimated.