Geophysical Research Abstracts
Vol. 16, EGU2014-6641, 2014
EGU General Assembly 2014

The optical properties of hygroscopic soot aggregates with water coating

Yu Wu, Tianhai Cheng, and Lijuan Zheng
Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, China (wuyu@radi.ac.cn)

Anthropogenic aerosols, such as soot, have modified the Earth's radiation balance by scattering and absorbing solar and long-wave radiative transmission, which have largely influenced the global climate change since the industrial era. Based on transmission electron microscope images (TEM), soot particles are shown as the complex, fractal-like aggregate structures. In humid atmospheric environments, these soot aggregates tend to acquire a water coating, which introduces further complexity to the problem of determining the optical properties of the aggregates. The hygroscopic growth of soot aggregates is important for the aging of these absorbing aerosols, which can significantly influence the optical properties of these kinds of soot particles. In this paper, according to the specific volume fractions of soot core in the water coated soot particle, the monomers of fractal soot aggregates are modeled as semi-external mixtures (physical contact) with constant radius of soot core and variable size of water coating. The single scattering properties of these hygroscopic soot particles, such as scattering matrices, the cross sections of extinction, absorption and scattering, single scattering albedo (SSA), and asymmetry parameter (ASY), are calculated using the numerically exact superposition T-matrix method. The morphological effects are compared with different monomer numbers and fractal dimensions of the soot aggregates, as well as different size of water coating for these concentric spherical monomers. The results have shown that SSA, cross sections of extinction and absorption are increased for soot aggregates with thicker weakly absorbing coating on the monomers. It is found that the SSA of aged soot aggregates with hygroscopic grown are remarkably ($\sim$50% for volume fraction of soot aggregates is 0.5, at 0.670μm) larger than fresh soot particles without the consideration of water coating, due to the size of water coating and the morphological features, such as the monomer size, monomer numbers and the compactness of the soot aggregates. Further understanding of the optical properties of these water coated soot aggregates would be helpful for both environment monitoring and climate studies.