EGU General Assembly 2020

EGU2020-19928
https://doi.org/10.5194/egusphere-egu2020-19928
EGU General Assembly 2020

Size distribution functions of submicron aerosol and approximation based on the direct Kolmogorov equation

Otto Chkhetiani[1], Evgeny Gledzer[1], and Natalia Vazaeva[1,2]
[1]A.M.Obukhov Institute of Atmospheric Physics of Russian Academy of Sciences, Moscow, Russian Federation (ochkheti@gmail.com)
[2]Bauman Moscow State Technical University, Moscow, Russian Federation

The particle size distribution function is one of the characteristics reflecting the composition of aerosol during sand lifting and removal in desert regions. This characteristic, in addition to known practical applications, is important in describing radiation processes during the exchange of heat fluxes and in forming cloud systems in the models of atmospheric dynamics. Fine dust-aerosol fractions (less than 2 μm in diameter) are especially important for the atmospheric radiation budget, because such fractions (having a significant lifetime) most efficiently interact with short-wave solar radiation. One of the central regularities in considering the size distributions of simulated dust-aerosol particles is the following formula based on the so-called fragmentation process and verified using a large amount of empirical data $N(d) \sim d^{-2}$. Similar dependence for particles with size $d > 1$ μm is associated with the consideration of the fragmentation process as a particle splitting according to the log-normal distribution.

Results of field measurements taken in the near–Caspian (2002, 2003, 2007, 2009, 2010, 2011, 2013, 2014, 2016 years) and near–Aral-sea (1998) deserts under the conditions of weak winds (almost in the absence of saltation processes) and strong heating of the land surface are given. These results show that the fine mineral dust aerosol (0.1-1 μm) considerably contributes to the total aerosol content of the atmospheric surface layer under such conditions. The scaling of daytime mean size d distribution at a height of 2 m is close to d^{-5} in contrast to the law d^{-2} for fraction $d > 1$ μm.

Different compositions of aerosol particles at $0.1 < d < 1$ μm, and $d > 1$ μm, including multicomponent fractions (less than 1 μm) may result in different probabilities of their integration and disintegration, which, finally, determine equilibrium particle size distributions. The simplest distribution approximations based on the Kolmogorov direct differential equation are given.

This study was supported by the RFBR (19-05-50110) and the Presidium of the Russian Academy of Sciences (programs 12 and 20).