Sensitivity of Dust Radiative Forcing to Representation of Aerosol Size Distribution in GCM Simulations

Yiran PENG[1], Jianqi ZHAO[2], Feng ZHANG[3], and Jiangnan LI[4]

[1] *Center for Earth System Sciences, Tsinghua University, Beijing, China*
[2] *Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China*
[3] *Key Laboratory of Meteorological Disaster of Ministry of Education, Nanjing University of Information Science and Technology, Nanjing, China*
[4] *Canadian Centre for Climate Modeling and Analysis, University of Victoria, Victoria, Canada*

Dust size distributions are generally represented with a two-mode scheme or a continuous scheme in global climate models. A two-mode scheme contains fine and coarse modes with fixed effective radius and effective variance for each mode. Instead, a continuous scheme portrays the size distribution with prognostic effective radius and effective variance. Size distribution of the two-mode scheme changes with a fine/coarse mode mass ratio. However, it is difficult to matching observations by simply tuning the ratio. Size distribution of the continuous scheme fits better to the AERONET observations in dusty sites. A new parameterization for dust optical properties is proposed for the continuous scheme. Shape of non-spherical dust particle is approximated using a rotational symmetric spheroid in optical property calculations. The parameterization is compared with the two-mode scheme for a set of idealized one-dimensional radiative transfer calculations. Sensitivity of dust radiative forcing to various attributes, including dust loading, dust solar heating rate, surface albedo, effective radius and effective variance are investigated. The parameterization applied in the Canadian global climate model (CanAM4) is evaluated with multiple surface and satellite observations in East Asia and in the globe.

Key words: dust aerosol, aerosol radiative effect, global climate model simulation,