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Parameterization of size-dependent particle gravitational settling for global atmospheric transport modeling

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Gravitational settling process of particles was parameterized as a function of the particle size and the air density for a global atmospheric chemistry and transport model and was applied to the simulation of black carbon aerosols. The settling velocity is found to be highly dependent on the particle size and steeply increases as the particle size increases whereas its increase with altitude is relatively tardy. The noncontiuum effect of small particles is appreciable and the deviation from Stokes law for 0.01ČÝm diameter particles is about a factor of 20. The simulation results show that the total black carbon aerosol mass in global atmosphere increases about 4% when the gravitational settling process was turned off. However, this increase is geographically not homogeneous and the high-latitude region in northern hemisphere appeared to be most highly affected by the lack of this process, an increase of about 7%. Near the surface, the largest deviation was found in the Antarctic and of less magnitude in the Arctic and subsidence region in northern hemisphere. It can be also deduced from these results that for the particles having larger radius and higher density than black carbon aerosols, such as mineral dusts, the deviation arising from the lack of the gravitational settling process will be aggravated.