PARAMETERIZATION OF SIZE DEPENDENT PARTICLE DRY DEPOSITION VELOCITIES IN A GLOBAL CHEMISTRY AND TRANSPORT MODEL

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As part of the development of an aerosol module in MOCAGE, the global chemistry and transport model of Météo-France, the dry deposition velocity of particles has been parameterized as a function of the particle size, the surface properties, and the micrometeorological conditions near the surface. The principal framework of this study adapts the Slinn and Slinn's (1980) model. In this study, the gravitational settling velocity has been calculated according to the Stokes law, taking into account the noncontinuum effects for small particles. The aerodynamic resistance has been estimated as a function of the atmospheric stability, the surface roughness, and the wind speed. The grid surface roughness length has been calculated taking into account the contribution of the land cover and of the subgrid scale orography. The quasi-laminar layer resistance has been parameterized by considering the effects of both the Brownian diffusion and the inertial impaction. The calculation of particle deposition velocity has been performed over the year 2000 on the global domain for particle with a density of 1000 kg/m3, and using Météo-France operational meteorological analyses as an input for surface fields. Averaged over the global domain at a given time, particle deposition velocities range from 0.06 to 0.9 cm/s, from 0.01 to 0.06 cm/s, and from 0.5 to 5 cm/s for 0.01μm, 0.1μm, and 10μm of diameter particles, respectively. These values are close to results of other modelling studies, and also comparable with those of experimental studies with similar meteorological and environmental conditions. According to the global one-year average of deposition velocities, the land surface is more efficient in the capture of particles than the sea surface, for all the particle size. Deposition velocity shows a diurnal variation over land with a maximum at around 15h local time, and mid-latitudes have higher deposition velocities than tropical and polar regions. Deposition velocities appear to be higher in unstable atmospheric conditions than in neutral or stable ones. However, this tendency disappears with the increase of particle size and wind speed. They also increase with the surface roughness length, even if this trend diminishes with the atmospheric unstability. The global dry deposition flux of black carbon aerosols has been calculated with the parameterization presented above, and the GEIA emission inventory as the source term and a simplified wet deposition scheme. It accounts for about 10% of the total removal flux.