Scavenging of aerosol particles by large water drops 2. The effect of electrical forces

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Journal of Geophysical Research, Volume 102, Issue D20, p. 23937-23946

The effect of electrical forces on the collection efficiency of millimeter-sized water drops collecting micron-sized aerosol particles has been investigated in a laboratory experiment. The observations show higher collection efficiencies for drops of 3.6- to 4.8-mm diameters than reported in some of the earlier studies for smaller drops. The limited and sparse data obtained in our experiments show that the collection efficiency of a drop is higher when it is charged or interacts with the aerosol in the presence of an electric field. The collection efficiency shows a maximum when the drop charge of either polarity is in the range of 10^{-12} to 10^{-11}C. The data show that the drop surface charge density required for this maximum decreases with the increase in drop size but is independent of the particle size. However, the peak value of collection efficiency is higher for larger particles. Moreover, the total charge on the drop required for this maximum remains almost constant at about $2\text{-}3\times10^{-12}$C. The collection efficiency increases with the increases in the electric field, and the effect of the electric field is stronger for larger drops. In high fields, the drop collection efficiency shows a maximum for particles of diameter between 3.5 and 5 μm. The change in collection efficiency for the same change in particle size is larger for higher electric fields. Distortion of large drops and the consequent charge accumulation on the rim of the drop has been proposed to explain the results. The decrease in collection efficiency for large values of drop charge and electric field support the drop-to-particle charge transfer during their interactions.

Keywords: Atmospheric Composition and Structure: Aerosols and particles, Atmospheric Composition and Structure: Cloud physics and chemistry, Atmospheric Composition and Structure: Pollution-urban and regional
DOI: 10.1029/97JD01834