The violent nature of explosive volcanic eruptions can fragment magma and solid rocks surrounding a volcano into particles as small as the size of aerosols. Dependent on magma composition, eruption conditions and the availability of volatiles during the eruption, the production of very fine volcanic ash particles varies from a few percent to more than 50 % of the total erupted mass flux. Here we describe the influence of the ash diameter on the dispersion and deposition of volcanic ash by numerical modeling. We use the regional scale three-dimensional on-line Eulerian atmosphere-chemistry/aerosol model REMOTE. We present model results for volcanic ash mass and particle number concentration, particle diameter and removal fluxes (wet and dry deposition, and sedimentation), and evaluation against measurements. In particular, the influence of wet deposition will be discussed. Model simulations have been carried out for the eruption of Eyjafjallajökull in April/May 2010 and that of Pinatubo in 1991. The results suggest that combined modelling with observations of volcanic ash mass and number concentration, and particle diameters after long-range transport may not only be used to evaluate model results but also to draw conclusions on the initial diameters at the source. However, more measurements of deposition fluxes in addition to mass and particle number concentration, and particle diameter, are necessary to allow closure studies for the evaluation of individual variables.