



Formation of the Surface Space Charge Layer in Fair Weather

Alexander Redin, Gennady Kupovykh, and Anton Boldyreff
Russian Federation (boldyrev@sfedu.ru)

It is widely known that the positive space charge, caused by electrode effect action, is obtained near surface in fair weather. Space charge density depends on the different local features: meteorological conditions, aerosol particles concentration, convective transfer of the surface layer. Namely space charge determines the local variations of electric field. Space charge could be negative in condition of strong ionization rate in thin air layer near surface.

The electrodynamic model, consisting of transfer equations of light ions and nucleuses, generated by interactions between lights ions and aerosol particles, and Poisson equation. The turbulent transfer members, electric field near the surface, the mobility of positive and negative ions, recombination coefficient, ionization rate, the number of elementary charges on the nuclei were took into account in the model equations.

The time-space variations of positive and negative small and heavy ions, electric field, electrical conductivity, current density and space charge, depending on aerosol particles concentrations, turbulence and convective transfer ionization rate, aerosol particles size and number of charged on the particles are calculated.

The mechanisms of turbulent and convection-turbulent surface layer electrodynamic structure forming in dependence of single and multi-charged aerosol particles for different physical and meteorological conditions are investigated. Increasing of turbulent mixing intensity leads to increasing of character electrode layer thickness, decreasing of space charge density value, decreasing of electric current conductivity value. The electrode effect of the whole layer remains constant.

Increasing of aerosol particles concentration leads to decreasing of electrode effect within the whole electrode layer and increasing of electric field values, decreasing of space charge density values and current conductivity density.

It was received that increasing of the aerosol particles concentration under weak turbulent mixing leads to increasing of the negative space charge density and its displacement to the surface level. Under severe contamination condition the electrodynamic structure of surface layer is primarily determined by negative space charge, generated by nucleuses.

It was received that in case of small aerosol particles the surface layer electrodynamic structure is basically established by single- and double-charged particles. Single-charged and double-charged as triply-charged, fourfold-charged and fivefold-charged aerosol particles primarily affect on electrodynamic structure of the surface layer in case of increasing of aerosol particles size.

The local variations of the electric field in different conditions were studied. Theoretical results are in a good agreement with experimental facts.