The influence of the magnetic field inclination to the quasistationary electric field penetration from ground to the ionosphere

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Interest in lithosphere-ionosphere relations is largely caused by the desire to forecast earthquakes, since numerous satellite measurements show perturbations of the ionospheric electric field associated with them. Nowadays, the most popular models consider the lithosphere as a generator that generates an electric current or electric field in the atmosphere near the surface of the Earth. These models take into account the atmosphere and the ionosphere as a united conductor and are based on a stationary model of electrical conductivity. In other words, they consider the penetration of a quasistationary electric field from the earth's surface into the ionosphere as the physical process that provides the lithosphere-ionosphere coupling. The basis for the appearance of such models is the numerous observations of disturbances in the vertical component of the atmospheric electric field before and after earthquakes. Nowadays, three-dimensional and two-dimensional models are known, within which it has been shown that electric fields penetrating due to electrical conductivity cannot practically be detected by satellite measurements against the background of the ionospheric fields always existing due to magnetospheric and ionospheric generators. However, such models are created for a vertical magnetic field, and therefore are applicable only at high latitudes.

The purpose of this work is to build a quantitative model of the penetration of a quasistationary electric field from the earth's surface into the ionosphere for an inclined magnetic field. A two-dimensional model is constructed for a case when the earthquake preparation zone is extended in magnetic latitude.

The elliptic boundary-value problem, based of the electrical conductivity equations, is formulated. It is reduced to a system of ordinary differential equations via a Fourier expansion. Analytical solutions are obtained for the exponential height distribution of atmospheric and ionospheric conductivity, as well as numerical solutions for the height distribution of conductivity, corresponding to the experimental data.

As a result of the studies, well-known approximate estimates of the decrease of the strength of the electric field penetrating into the ionosphere with increasing magnetic field tilt are confirmed and detailed.