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Penetration of electric field from the near-ground ULF source to the ionosphere under different configurations of the geomagnetic field

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The problem of the penetration of electric fields from atmospheric near-Earth ULF electric current sources to the ionosphere is investigated both within the dynamic simulations of the Maxwell equations in the frequency domain and within the simplified quasi-stationary approach.
Two cases of the geomagnetic filed lines are considered. The first case is the penetration of the geomagnetic filed lines deeply into the magnetosphere, whereas the second one is the return of these lines into the Earth' s surface. The proper boundary conditions are formulated.
It is demonstrated that in the first case the results of the dynamic simulations differ essentially from the quasi-electrostatic approach and the quasi-stationary approach is not valid there. In the second case the results of simulations are qualitatively the same both within the dynamic approach and within the quasi-electrostatic one. The values of the densities of atmospheric electric currents \sim 0.1 μA/mˆ{2} were used. Simulations have shown that the values of the electric fields within the ionosphere F-layer may reach 5 −10 mV/m and more.

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