We also used the amplitudes and the phases of the internal and external parts of the variational field in the evaluation of the pairs \( z^* \), \( q^* \), i.e. the coordinates of the vertical geoelectric cross-section, applying the procedure proposed by U. Schmucker [6] (Fig. 5). The electric resistivity values of the individual layers can be compared with the values of \( q^*[\Omega m] \) as a function of \( z^* [km] \) in the graph drawn in Fig. 5. The order of resistivity magnitudes is in agreement with the resistivity values of models EMAN 1, EMAN 2 and EMAN 3 at the depths of 600 km to 1400 km.

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References


CHARACTERISTICS OF THE IONOSPHERIC CORRECTION IN ULF WAVE DIAGNOSTICS OF THE MAGNETOSPHERE

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Summary: Amplitude and energy correction characteristics of the vertical propagation of ULF wave from the magnetosphere through the ionosphere to the Earth’s surface, necessary for micropulsation wave diagnostics of the magnetosphere by means of ground-based observations, are introduced on the basis of matrices of \( R - T \) coefficients [1–3]. The coefficients of vertical reflexibility, penetrability, transmissibility (or limpidity) and the absorption of the electromagnetic energy flux are defined, as well as analogous coefficients in the dimensions of the magnetic amplitude of the ULF wave, propagating through the given layer of the ionosphere. An exemplary model of the ionosphere is used to demonstrate the frequency variations of these characteristics in the ULF wave range.

The use of ground-based observations of micropulsations for ULF wave diagnostics of the magnetosphere requires, in the first place, the correction of the wave parameters for the propagation of the wave from a practically lossless magnetosphere, through a strongly inhomogeneous, anisotropic and loss-prone ionosphere to the Earth’s surface. By ionospheric correction we thus

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understand determining the frequency response of the ionospheric filter. In [1] we presented a method of numerical modelling of the vertical propagation of ULF waves through the ionosphere to the Earth's surface, based on the method of so-called \( R - T \) coefficients [2]. In [1, 3] we proved that the method of matrices of complex \( R - T \) coefficients permits the relation between the complex amplitude (and phase) in the wave vertically reflected from the ionosphere \((R)\), or the wave which has penetrated to the Earth's surface \((T)\), and the complex amplitude of the wave vertically incident at the ionosphere, to be determined.

In modelling the ionosphere [1, 3] the latter is represented by a system of plane-parallel homogeneous magneto-active layers, bounded from above by the \( N \)-th layer — the homogeneous halfspace of the lossless, however, anisotropic magnetosphere, and from below by the \( 0 \)-th layer — the homogeneous halfspace of the Earth's body with a finite specific conductivity \( \sigma_E \). The system of \( N - 1 \) intermediate layers also includes the layer of the unionized atmosphere (layer 1). The vertical dimensions of the layers have been chosen so that they are very small with respect to the local wavelength and also so that they approximate with sufficient accuracy the vertical change of the physical parameters of the ionosphere.

The medium in the individual layers is represented by a two-component electron-ion plasma with phenomenologically introduced partical collisions (including neutral particles). Anisotropy is related to the existence of a homogeneous external magnetic field with the inductivity \( B_0 \), arbitrarily tilted relative to the vertical direction of wave propagation (the \( z \)-axis is oriented positive upwards) in the plane of the magnetic meridian \((y, z)\).

The optional boundary of the \( N \)-th layer between the magnetosphere (from which the primary wave is incident) and the inhomogeneous ionosphere itself, together with the Earth's surface represent important reference surfaces for determining the correction characteristics of the ionospheric filter. We assume that only an isolated, partial wave mode \((p = 1, 2)\) is incident at the boundary of the ionosphere (layer \( N \)), which, in agreement with [4, 5], has the character of either and electron \((E)\) or ion \((I)\) wave, depending on the sense of rotation of its polarization vector, relative to the direction of the external magnetic field \( B_0 \). The wave reflected upwards, back into the magnetosphere, on the one hand, and the wave propagating into the ionosphere (the total wave at the boundary of the ionosphere), on the other, are generated at the boundary of layer \( N \). After the wave has passed through the ionosphere, a total wave is generated at the Earth's surface (boundary of the \( 0 \)-th layer).

With the aid of the calculated matrices of \( R \) and \( T \) coefficients we defined the real phase, amplitude and energy characteristics of all three types of waves which directly illustrate the measurable parameters of the wave above the ionosphere and at the Earth's surface, at both levels mentioned in [3]. They may therefore serve as suitable ionospheric correction coefficients. In this paper we shall not be concerned with the phase corrections in respect of the passage of the wave through the ionosphere, which will affect the polarization of the wave at the Earth's surface. They were partly dealt with in [3]. Here, we shall restrict ourselves just to explaining the meaning of the definitions of the amplitude and energy correction factors of the ionosphere, introduced in [3].

Assume vertical incidence of the \( p \)-th wave mode \((p = 1, 2, \text{ or } E, I)\). With the aid of the calculated \( R \) and \( T \) coefficients it is possible to determine the mean energy density of the magnetic wave component (average by period) for any frequency of a ULF wave (all characteristics involved are "monochromatic") at the outer boundary of the ionosphere, as well as at the Earth's surface [3]. The normed mean amplitude of the magnetic component of the total wave at the outer boundary of the ionosphere (the wave penetrating into the ionosphere) is defined by the coefficient

\[
\hat{R}_p = \sqrt{\left(\frac{e^N_p}{e^{DN}_p}\right)}, \quad p = 1, 2 (E, I).
\]

The quantities \( e^N_p \) and \( e^{DN}_p \) are the said mean energy densities of the magnetic com-