Dynamics of IGW and Traveling Ionospheric Disturbances in Plasma of Ionosphere with Sharp Gradients of Basic Parameters of Medium

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We study the dynamics of the solitary nonlinear internal gravity waves (IGW), as well as traveling ionospheric disturbances (TID) of the electron density excited by them at the heights of the ionosphere's F-region, for conditions close to those of the F-layer assuming that the source of initial perturbation has the pulse character. We consider the cases when the solitary IGW and TID propagate in the regions with sharp gradients of the ionospheric parameters such as electron density, temperature, scale heights for the ions and neutral particles etc.

Taking into account the weak nonlinearity at heights of the ionosphere F-region, from the hydrodynamic equations for the neutral gas we obtain the equation which is the generalization of the KP equation for the velocity of the neutral component and describes the nonlinear IGW solitons and nonlinear wave packets with the structure determined by both the coefficients (they are the functions of the ionospheric parameters which are the functions of space coordinates and time) and the form of the sort of perturbation and accordingly the type of source as well.

To study the excitation by the IGW solitons of the middle- and large-scale TID for the conditions close to those in the F-layer, we include also the continuity equation for electron density (with due account of magnetic inclination and the processes of ambipolar diffusion, ionization and recombination) into the full set of the equations.

We solve the obtained set of the equations analytically and numerically taking into account the dependence of the coefficient functions on coordinates and time, including the most interesting cases when the sharp gradients of them take place. As particular cases we consider the frontal regions of the solar terminator and solar eclipse.

The results obtained describe the dynamical structure, evolution and transformation of the IGW and TID at heights of the ionosphere F-layer including its strongly heterogeneous regions.