Correction of the plasma-chemical model of the ionospheric D-region based on the data of VLF-signals propagation

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Nowadays, the lower ionosphere of the Earth remains the least studied due to the diffuculty of experimental measurements and the large number of photochemical processes occurring in it. Despite the fact that a large number of research are devoted to the study of the state of the ionospheric D-region, the accuracy of predicting the behavior of ionospheric parameters under conditions of disturbances of various nature is still quite low. Therefore, the question of constructing a plasma-chemical model that will allow one to correctly describe numerically the variations of ionospheric parameters under calm conditions and under the disturbances is still open.

It is known that the amplitude-phase characteristics of VLF-signals propagating in the Earth-ionosphere waveguide are very sensitive to fluctuations in the electron concentration caused by perturbations of various nature, such as solar X-ray flares, magnetospheric storms, precipitation of charged particles, etc. This fact makes it possible to use the data of ground-based radiophysical measurements not only for verification, but also for correcting the used schemes of the ionization-recombination cycle and unknown values of the input parameters of the models. The least known of these are the concentrations of small neutral components and the values of reaction rate constants.

In this paper, we calculate the dynamics of the parameters of the ionospheric D-region during X-ray flares with a different set of unknown, but physically correct, input parameters of the plasma-chemical model. The results obtained are verified using ground-based radiophysical measurements accumulated at the Mikhnevo geophysical observatory (55°N 38°E). Clarification of values of inaccurately specified reaction rate constants from experimental data on radio wave propagation makes it possible to improve the accuracy of calculating the electron concentration under various heliogeophysical conditions.