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Investigation of formation mechanisms of equatorial ionosphere F2-layer stratifications, F3- and G-layers

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Results of the research executed by means of the Global Self-consistent Model of the Thermosphere, Ionosphere, and Protonosphere (GSM TIP), developed in WD IZMIRAN are presented. This model is based on the numerical integration of the corresponding three-dimensional continuity, momentum and heat balance equations for neutral (O_2, N_2, O) and charged (molecular ions and atomic ions O^+ and H^+) particles in a range of heights from 80 km above a surface of the Earth up to $\sim$15 Earth radii including electromagnetic coupling processes as a single system. The model takes into account the discrepancy between the geographic and geomagnetic axes. Moreover in the given research the new block of ionospheric electric fields calculation in which the decision of the three-dimensional equation of a full current in the ionosphere preservation $\nabla\vec{j} = 0$ is carried out by its reduction to two-dimensional by integration on thickness of a current-carrying layer of the ionosphere along of geomagnetic field lines which are equipotential is used. In the given work the composition and temperature of a neutral atmosphere are calculated on the thermospheric model MSIS-90, and effects only of the dynamo field generated by thermospheric winds, i.e. in absence of the field generated by magnetospheric sources, were considered. Calculations were carried out for quiet equinoctial conditions in a minimum of solar activity ($F_{10,7}$=70).

Calculations have shown, that use of the new calculation block of the electric field in an ionosphere allows to receive such electric field on geomagnetic equator which is conformed to experimental data. Use of this field in calculations leads to stratification of the F2-layer at equatorial ionospheric station Jicamarca and forms the additional F3-layer predicted not so long ago theoretically and then found the experimental acknowledgement. Moreover it is shown, that on heights $\sim$1000 km ions H^+ form an

additional layer which can be identified as G-layer.

The research of formation mechanisms of stratifications F2-layer, F3- and G-layers has been carried out, which has shown that:

1. Stratifications of an equatorial F2-layer of the ionosphere, and accordingly F3-layer are formed only at presence of the east component of the electric field of sufficient amplitude ($\geq 0,2$ mV/m);

2. Meridional component of the electric field does not influence the formation of F3-layer, but can change time of appearance and disappearance of F3-layer, and also the value of foF2, foF3 andN_e(h) due to zonal drift of the thermal plasma having non-uniform distribution on geomagnetic longitudes caused by it;

3. G-layer is being formed on heights $\sim$1000 km by ions H^+ owing to taking into account of meridional component of thermospheric wind, which at the same time interferes with the formation of a F3-layer due to meridional electromagnetic drift, but contributes to maintenance of a night F2-layer not far from geomagnetic equator.