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Numerical modeling of the equatorial ionosphere on the basis of Global Self-consistent Model of Thermosphere, Ionosphere, and Protonosphere (GSM TIP)

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The equatorial ionosphere is the extremely interesting object of research. One of the main mechanisms, forming space-temporal structure of the equatorial ionosphere, is an electric field. It generates the equatorial electrojet, exerting the essential influence on electrodynamics of the equatorial ionosphere. The zonal component of the electric field together with ambipolar diffusion of thermal plasma along geomagnetic field lines forms such well known phenomenon as equatorial anomaly. Besides, in a vicinity of geomagnetic equator the zonal component of the electric field results under the certain conditions in stratification of the F2-layer of the ionosphere and formation of the additional layers, got names G- and F3-layer. All these irregularities of the thermal plasma distribution in the Earth's equatorial ionosphere present the undoubted interest for researchers.

In the given work the results of calculation on the Global Self-consistent Model of the Thermosphere, Ionosphere, and Protonosphere (GSM TIP), designed in WD IZMIRAN, are presented. This model is based on the numerical integration of the quasi-hydrodynamical equations of continuity, motion and heat balance of the neutral (O_2, N_2, O) and charged (the molecular ions and atomic ions O^+ and H^+) particles including processes of electromagnetic relationship as united system within the range of heights from 80 km above a surface of the Earth up to geocentric distance $\sim 15 R_E$. Mismatch of the geographic and geomagnetic axes of the Earth is taken into account in model. The new block of the calculation of the electric field in the ionosphere of the Earth is enclosed in model, in which decision of the three-dimensional equation of the conservation of the full current in the ionosphere is carried out by its reduc-

tion to two-dimensional by integration on thickness of a current-carrying layer of the ionosphere along geomagnetic field lines, along which electric field does not vary. At the same time composition and the temperature of the neutral atmosphere calculated with using of the model MSIS-90 and effects only dynamo field generated by thermospheric winds were considered. The calculations have been executed for quiet equinoctial conditions in a minimum of the solar activity 22.03.1987 ($F_{10,7}$=70).

It is shown the global distribution calculated in model of the electric field potential and critical frequency of the F2-layer of the ionosphere with distinctly expressed equatorial anomaly, daily variations of zonal components of the electric field, critical frequency and heights of the F2-layer maximum, calculated for equatorial station Jicamarca (11,9˚ S, 76˚ W), as well as vertical profiles of electron concentration for same station for different moments of time. It is shown that use of the new model of the electric field allows to describe not only equatorial anomaly, but also effects of the stratification of the F2-layer of the equatorial ionosphere bringing in formation predicted not so long ago theoretically and found the experimental confirmation of additional F3-layer, as well as G-layer, which for the first time has been mentioned enough for a long time, on heights $\sim$1000 km.