THE INFLUENCE OF THE DESCRIPTION OF THE NEUTRAL ATMOSPHERE ON THE RESULTS OF MODELING THE EFFECTS OF THE FEBRUARY 2022 MAGNETIC STORM

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The global ionosphere-plasmsaphere coupling (GIPC) model developed at ISTP SB RAS [Tashchilin, Romanova, 2013] is based on solving a system of non-stationary equations for the balance of particles and thermal plasma energy in closed geomagnetic flux tubes, the bases of which are located at an altitude of 100 km. The description of spatiotemporal variations in temperature and concentration of neutral components O, O2, N2, H, N is based on data of the empirical thermosphere model MSIS 2.1, horizontal wind speeds were calculated using the HWM07 model. The input parameters of the MSIS 2.1 model are the daily and 81-day averaged values of the solar activity index F10.7 and the daily average value of the planetary index Ap. The model allows taking into account the disturbed state of the environment during magnetic storms and in this case the model accepts 7 values of Ap: daily average, 4 values for the last 9 hours, 2 daily average values for the last two days. Thus, in the best case, the MSIS 2.1 model (as well as the GIPC model using it) can reflect changes in the environment with a characteristic time of three hours.

Among other things, the SWARM satellites determine variations in their own non-gravitational accelerations, from which it is possible to reconstruct an estimate of the atmospheric density D at the orbital altitude [van den Ijssel et al., 2023]. Using these data as a reference, we varied the input daily average F10.7 index so that the difference ΔD between the MSIS model data and the measured densities was minimal.

We simulated the ionospheric parameters for the period February 1–7, 2022, using the MSIS 2.1 model taking into account the disturbed environment (SW(9) = –1) in two modes: using the real and corrected F10.7 values. In this work we show that regardless of the F10.7 correction, the model using MSIS2.1 correctly reproduces the diurnal cycle and restores the pre-dawn temperature peak. The height of the F2 layer maximum during the disturbed period turns out to be lower than predicted by the model.

REFERENCES

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