LARGE-SCALE DISTURBANCES OF NEAR-EARTH PLASMA WHEN REACHING PROMISING POWER LEVELS OF THE SURA HEATING FACILITY

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The short-wave heating facility Sura is the only operating mid-latitude research device in the world on the active wave effect on near-Earth plasma. The maximum effective radiated power Peff of the Sura facility in the frequency range of 4.3–9.5 MHz is 80–280 MW, respectively.

At the HAARP heating facility, after reaching its project characteristics, a number of new effects was obtained due to the achievement of higher transmitter radiation power. Thus, the bar of scientific achievements realized at HAARP stimulated work to assess the possibilities of upgrading and other research facilities.

Based on the analysis of the existing infrastructure and the available scientific and technological capabilities in the work [1], the concept for the Sura heating facility upgrading, its appearance and practically achievable technical characteristics (P_{tr} = 2400 kW, P_{eff} = 500–1000 MW) were determined.

This paper presents the results of numerical simulation using a two-dimensional ionospheric SAMI2 model with a modified heating source model [2] and analysis of achievable parameters of thermal large-scale disturbances of near-Earth plasma during the device upgrading and implementation of promising radiation power levels of the Sura facility. To make simulation, a characteristic session dated March 13, 2023 was chosen, that corresponds to quiet geomagnetic conditions. At the same time, the effects of exposure in daytime conditions and conditions corresponding to late evening hours, that are fully satisfactory for artificial plasma density ducts generation, are separately considered. Fig. 1 shows the altitude-latitude distribution profiles of electron density and temperature for the prospective power levels of the Sura facility and the time point 18:10:00 UT (10 minutes after the heating source is turned on).

The obtained simulation results show that the parameters of plasma perturbations are highly non-linearly dependent on the power of the pump wave radiation. The perturbations growth saturates quickly with an increase in the power of the acting shortwave radiation due to the plasma redistribution in the abnormal absorption region.

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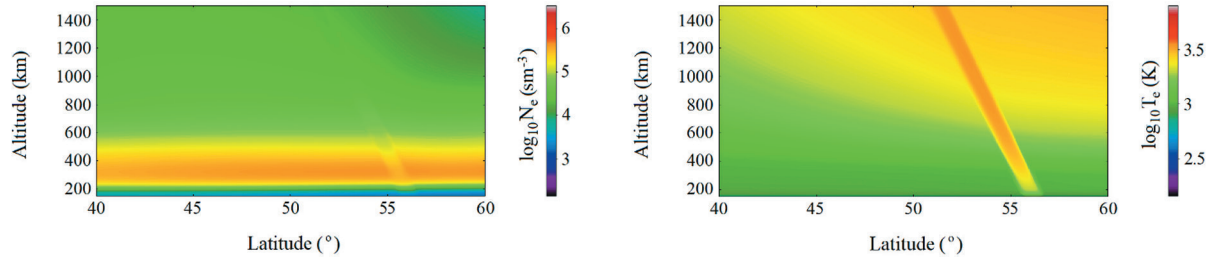

a *b*

Fig. 1. Altitude-latitude distributions of density (panel (*a*)) and electron temperature (panel (*b*))

References

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