

ARTIFICIAL MODIFICATION OF THE MAGNETOSPHERIC PLASMA DYNAMICS BY THE HF HEATING FACILITY

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Introduction

Modifications of magnetospheric plasma dynamics and related electromagnetic emission produced by artificial heating of ionosphere have been studied in the frame of INTERBALL project and Finnish EISCAT campaign. Two series of experiments were realized in October/November of 1996 and March of 2000 years. In 1996, the Tromso heating facility emitted HF signal (effective radiated power = 150 MW, carried frequency = 4.04 MHz) that was amplitude modulated at the frequency of 1733 Hz. The amplitude modulation in the year 2000 was in sequence 1 s – 500 Hz, 1 s – 1000 Hz and 1 s – no of radiation.

Electromagnetic emissions in the frequency range ULF/ELF/VLF as well as DC magnetic field and energetic particles flux in the energy range 10 eV – 20 keV were measured onboard INTERBALL-2 and MAGION-5 satellites at the altitude 2-3 Earth radii over the heater. Ground based magnetic field measurements have accompanied satellite observation during the heating experiment (IMAGE magnetometer network).

Experimental results

The most prominent effects were encountered by INTERBALL-2 satellite on 27.10.96 in the interval 21.31-21.38 UT. In the nearby zone of the heated magnetic flux tube were detected: i) strong variations of DC electric and magnetic fields, ii) electromagnetic turbulence in the frequency range up to 10 Hz, iii) burst of 0.1-6 keV electron and proton flux. The electromagnetic emission saucer type was detected few second after the start of heater. The low cut-off frequency of the saucer was very close to the frequency of amplitude modulation. The appreciable geomagnetic perturbation was detected by IMAGE magnetometer network just after the beginning of experiment.

During the 2000 series observations magnetospheric conditions were very quiet and only short saucers were detected, with the appearance well correlated with the interruptions of the HF emission.

Discussion

The most likely scenario is that the artificial disturbances of ionospheric plasma produce electrons of the energy up to few hundreds that can be injected from ionosphere to the magnetosphere. These additional electrons arrive freely to the altitude of few Earth radii and are increasing significantly the conductivity in the selected flux tube (up to 40%). In the case of sufficient energy storage in the magnetospheric tail substorm manifestations will begin with an advance of a few minutes and their intensity will be considerably greater than in the neighbourhood of the heated flux tube.

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