Geophysical Research Abstracts, Vol. 8, 04498, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04498

Simulation of the large-scale high-latitude F-layer modification by powerful HF waves with different modulation in the daytime

G.I. Mingaleva and V.S. Mingalev

Polar Geophysical Institute (PGI), Russian Academy of Sciences, Fersman Str.14, Apatity, Ru-184209, Murmansk region, Russia (mingalev@pgi.kolasc.net.ru)

The mathematical model of the high-latitude ionosphere, developed earlier, is applied to investigate how the modulation regime of the ionospheric HF heating facility near Tromso, Scandinavia, when it is located near the noon magnetic meridian, affects the large-scale high-latitude F-layer modification. The model produces time variations of the electron density, positive ion velocity, and ion and electron temperature profiles within the magnetic field tube carried over the ionospheric heater by the convection electric field. The velocity of the magnetic field tube along the convection trajectory coincides with the perpendicular (to the magnetic field) plasma drift speed which may be easily obtained by using the convection electric field. The calculations are performed for autumn (5 November) and middle solar activity ($F_{10.7}$=140) conditions under low geomagnetic activity (K_p=0). The maximal value of the effective absorbed power (EAP) is assumed to be 30 MW, with the HF wave frequency being equal to 7.05 MHz. Simulations were made both for CW transmission and for the pulse operation, with the amplitude of the HF wave being square wave modulated. The calculations were performed for different lengths of pulses and various time intervals between successive pulses. The frequency of HF waves was chosen to be close to the most effective frequency for the F2-layer modification. The results of simulation have indicated that, at the level where the wave frequency is close to the frequency of the electron hybrid resonance, a pronounced peak arises in the electron temperature profile due to the great energy input from the powerful HF wave. As a consequence the upward and downward ionospheric plasma fluxes arise from the level where the electron temperature peak is located. These fluxes produce visible changes of the electron concentration profile. The electron concentration can decrease in the wide height

range including the level of the F2-layer peak. It turned out that the most perceptible decrease in the F-region electron concentration takes place when the heater is operated continuously. For the pulse operation, the amplitude of the electron concentration variations depends on the ratio of the length of pulses to the time interval between successive pulses. The higher the latter ratio is, the more the electron concentration variation amplitude ought to be. The considerable decrease in the F-region electron concentration may be achieved when the heating facility is operated not only continuously but also pulsatily. Powerful HF waves should lead to a decrease of more than 20% in electron concentration at the level of the F-region peak in the daytime, with the results depending significantly on the ratio of the length of pulses to the time interval between successive pulses.