

The action of powerful HF radio waves on the high latitude ionospheric F-region: experimental results obtained at the EISCAT/Heating in the northern Norway

**Blagoveshchenskaya N.F. (1), Kalishin A.S. (1), Borisova T.D. (1),
Yeoman T. (2), Haggstrom I. (3)**

(1) Arctic and Antarctic Research Institute, Sankt Petersburg, Russia

(2) University of Leicester, Leicester, Great Britain

(3) EISCAT Scientific Association, Kiruna, Sweden

e-mail: nataly@aari.nw.ru

Results from multi-instruments experiments carried out at the EISCAT/Heating facility located near Tromsø, Norway, from 2011-2016 are presented. During the experiments, a powerful HF radio wave of the ordinary (O-mode) or extraordinary (X-mode) polarization was radiated towards the magnetic zenith direction at frequencies within the 4.0–8.0 MHz lying below as well above the critical frequency of the F2 layer. The effective radiated power was of 150–850 MW. The EISCAT UHF incoherent scatter radar (930 MHz) at Tromsø, the CUTLASS (SuperDARN) HF coherent radar in Finland, the equipment for the narrowband stimulated electromagnetic emission (NSEE) observations at St.-Petersburg at a distance far away the HF Heater (about 1200 km), and ionosonde at Tromsø were utilized as diagnostics. Effects of the action of powerful HF radio waves of the ordinary (O-mode) and extraordinary (X-mode) polarization on the high-latitude ionospheric F region have been compared. The behavior and features of small-scale artificial field-aligned irregularities (AFAIs), parameters of the ionospheric plasma (electron density N_e and temperature T_e), Langmuir and ion-acoustic turbulences and spectral features of narrow-band stimulated emission (NSEE), registered at distance of the order of 1200 km from the heating facility, during O- and X-heating are considered in detail. Results from the Arctic and Antarctic Research Institute experiments provided for the first time a possibility to generate extremely intense artificial ionospheric disturbances under X-mode HF pumping. It is important that ionospheric disturbances are created under X-mode HF pumping at frequencies lying below, as well above the critical frequency of the F2 layer. NSEE spectra, recorded at a large distance (about 1200 km) from the Tromsø HF Heater, clearly demonstrated the generation of a wide variety of spectral components in the course of X-mode pumping, such as ion acoustic, electrostatic ion cyclotron, and electrostatic ion cyclotron harmonic waves (otherwise known as neutralized ion Bernstein waves). O-mode pulses did not exhibit any spectral structures in the NSEE spectra in the same geophysical conditions. The potential mechanisms of strong plasma modification in the F-region of the high latitude ionosphere induced by X-mode pumping towards the magnetic zenith are discussed.