EXPERIMENTAL TECHNIQUE OF MULTIPOSITIONAL FMCW SOUNDING OF ARTIFICIAL IONOSPHERIC IRREGULARITIES

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Abstract

Experimental results of HF radio waves scattering from artificial irregularities induced by "Sura"heating facility FMCW (chirp sounding) method as a diagnostic tool are presented. Elimination of the disturbed region of the ionosphere was performed from the point IZMIRAN, distant from "Sura" on about 500 km, and the scattered on the artificial irregularities signals were received at the distances 120 km, 560 km and 1100 km correspondently. An analysis of the simultaneous observations has shown that total frequency range of the scattered signals can reach up to 10 MHz.

1. Introduction

One of the perspective directions of remote diagnostics of the artificial ionospheric irregularities spectra is application of FMCW sounding. This method based on the measurements of aspect-scattered signals (bistatic mode of operation), in a comparison it with the classic pulse technique, allows to increase essentially the detection potential of a location due to high effective emitted power. One can expect that an application of the method in the practically monostatic mode of the radar operation can give an additional potential of SNR improvement due to the effect of refractive focusing of HF radio-waves in the ionosphere. In the given work experimental data on simultaneous measurements AFAS (Artificial Field Aligned Scattering) by method FMCW sounding on the paths of different extent and geometry are analyzed.

2. Results

The FMCW signals were radiated from IZMIRAN (not far from Moscow) by the transmitter with output power about 400 W loaded on rhombic antenna directed on "Sura" heating facility. Frequency range of scanning was 2-25 MHz with the sweeping speed equal to 100 kHz/sec). Two examples of the experimental data on aspect-scattered signals registration at the points located on distances from 120 km to 1100 km from "Sura" obtained in September 2010 were analysed: 09/22/2010 16:26 MT and 09/24/2010 12:31 MT (UT +3). The points of reception are: Rostov-on-Don, Nizhny Novgorod and special location point in 10 km from the transmitting device. In both cases on the path Moscow (IZMIRAN) – Rostov-on-Don the MUF is equal to 11 MHz, and aspect-scattered signals from the induced artificial irregularities are well visible in a range from ~15 MHz to ~ 18,5 MHz. As a rule, scattered signals are not visible at the Nizhny Novgorod. Only in one case in short time interval the traces were registered in frequency range from 10,5 MHz to 11.5 MHz when MUF was equal to 7 MHz. As for the special point not far distant from the transmitter the back-scattered signals were registered in a range from ~11 MHz to ~13,5 MHz in the conditions of strong ground wave interference.

With the measurements on a partial path the ordinary registered frequency range of aspect-scattered signals usually is equal to about 2 - 4 MHz. As was shown in this experiment the total frequency range of scattered signal traces appearance can be considerably expanded, up to ~10 MHz. Accordingly, it means that a range of the cross-section sizes of the induced geomagnetic field aligned irregularities, taking part in scattering of sounding waves, is widen out too.

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