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The ionosphere disturbances observation on the Kharkiv incoherent scatter radar

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he ionosphere plasma characteristics are responding on variations of solar and magnetic activity. The research of an ionosphere structure and dynamics is important as for understanding physics of processes and for radiophysical problems solution. The method incoherent scatter (IS) of radio waves allows determining experimentally both regular variations of the basic parameters ionosphere, and their behavior during perturbation. The equipment and measurement technique, developed by authors, are allows obtaining certain data about behavior of an ionosphere during various origin and intensity ionosphere perturbations.

The Institute of Ionsphere IS radar located near Kharkiv, Ukraine (geographic coordinates: 49.6oN, 36.3oE, geomagnetic coordinates: 45.7oN, 117.8oE) was used to observe the processes in the ionosphere. The radar is operate with 100-m zenith parabolic antenna at 158 MHz with peak transmitted power of $\tilde{2}$.0 MW. The double-frequency measuring channel mode with compound sounding signal was employed for experiments. That provided $\tilde{2}$0-km resolution in range $\tilde{1}$00-400 km and $\tilde{1}$00-km in range $\tilde{2}$00-1100 km.

Over a period of series of experiment are obtained data about variations of electron density simultaneous in the heights interval 100-1000 km, including three sun eclipses, two superstrong and a few moderate magnetic storms, as well as disturbance, is caused by powerful rockets starts.

During strong geomagnetic storm on November 8-12, 2004 was observed night time increasing of electronic temperature up to 3000 and ions temperature up to 2000K. Usually at this time temperature of ions is equal to temperature of electrons. During negative ionosphere storm was observed decreasing of electronic density at maximum F2 layer. The height of a F2 layer maximum was increased by 150 km and 70 km at daytime.

The interesting phenomenon - high-power backscatter signal coherent backscatter was observed first time during geogeomagnetic storm 29-30 may 2003. A usually observable spectrum of a dispersing medium has two identical on magnitude of a symmetrical extremum appropriate iono-acoustic waves. From distances 900 - 1300 km is registered high-power, unstable signal with a narrow-band spectrum This signal on the correlation, spectral and temporary characteristics are different both from incoherent scatter signal, and from signals reflected from space vehicles. At night time 9.11.2004 and day time 10.11.2004 anomaly signals - coherent backscatter were observed the same way as. It is derived, that the coherent backscatter was observed during a sharp decreasing of Dst index from approximately -40 up to -130 nTl for May 2003 and from approximately -120 up to -240 nTl for 9 November and from -160 up to -290 nTl 10 November 2004. During both event electron density in maximum F2 is increased. Similar characteristics midlatitude coherent backscatters were observed at Millstone Hill , on Irkutsk IS radar. On EISCAT radars was observed so-called naturally enhanced ion-acoustic lines (NEIAL) with similar spectra and amplitude-temporal characteristics.

The radar observations ionosphere plasma response on start of heaviest Russian launch vehicle ?Proton-K? was carried out at 25 December 2006. The distance from the rocket launch site and the site of observations is 2500 km. At heights of 250-320 km, a magnitude of the scattered signal sharply raised up to 2 times as compared to the period before start and in reference day on 21.12.2008 (fig. 3). In launch day is clearly seen there are two disturbed areas. The first disturbance was observed 8 min after rocket start. The calculated apparent velocity of disturbance propagation reached the value of 5.2 km/s. This velocity is typical for slow magneto-hydro-dynamic waves in the ionosphere. The second disturbance was observed 60 min after start. The calculated apparent velocity of disturbance propagation was about 700 m/s. The internal gravity waves propagate with similar velocities at the heights of the ionosphere F layer.

The moderate geomagnetic storm in April 2006 occurred on the phase of minimum of sun activity. It was caused al-

ternated positive and negative ionospheres perturbations that was accompanied of moderate changes of ionosphere plasma parameters. Experimentally obtained on the Kharkiv IS radar altitude-temporary dependences of disturbed ionosphere plasma parameters - electron density Ne, electronic Te and ionic Ti temperatures. During a main phase of storm the positive perturbation was observed (Ne is increased in 1.3 times), April 5, at maximum Dst - negative perturbation (Ne is decreased in 1.6 times), April 6 - positive perturbation (the second positive storm phase - Ne was increased at 1.33 times). During negative ionosphere storm the height of a F2 layer maximum was increased on 30-40 km. Measured ionic temperature in the day time is increased on $\tilde{1}50$, electronic temperature is increased on $\tilde{6}00$ (fig. 10.). Reference day is 01.0.2006.

There is the great interest in research into the comparison of anthropogenic and natural disturbances.