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Abstracts

Résumés

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Peculiarities of variations in ionospheric parameters of the lower D-region during natural disturbances

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Introduction

In order to develop a reliable dynamic model of the lower ionosphere, it is necessary to carry out detailed studies of spatial-temporal changes in the lower D-region affected by disturbances having different natures. Natural sources-such as powerful earthquakes, volcano eruptions, strong thunderstorms, solar flares and magnetic storms, stratospheric heating processes, etc. - are the most important as they not seldom have a main effect on the ionosphere conditions and often take place. As a result of the effects of such sources, in the D-region a number of wave disturbances having different characters and natures are generated or increased, appreciable - often rather sufficient (>100%) - changes in the ionospheric parameters, such as the electron density $N(z)$ and the electron/molecule collision frequency $\nu(z)$, take place. The $N(z)$ and $\nu(z)$ changes in the lower D-region are the least studied. In the present paper, experimental results of investigations of the $N(z)$ and $\nu(z)$ changes in the lower D-region during some natural disturbances, carried out on the basis of analyzing the data obtained by a partial reflection (PR) at Kharkiv State University, are discussed.

Main Part

Amplitude measurements of the PR signals A and radio noises A_n were carried out using the equipment from [1] at a middle latitude near Kharkiv using a pulse length of 25 μsec on frequencies of 2-4 MHz at repetition rates of 1-10 per second. The observations are made during day-time or diurnal campaigns continuously, or in 30-90 min, or at constant solar zenith angles during the different seasons. Height-time $A(z, t)$ and $A_n(t)$ changes were analyzed for strong remote earthquakes (the total number of the events with the magnitude of M>5 amounting to n>200), over solar terminator passage period (n>100), strong thunderstorms (n=26), magnetic storms (n=9) and sudden ionospheric disturbances over the period of solar flares (n=8). On the basis of such an analysis, a number of peculiarities in $A(z, t)$ behaviour, relating to the lower D-region (z<75 km), were determined. In particular, during the events mentioned we observed increasing in the PR signal intensities, being several times higher; quasi-wave changes in $A(z, t)$ were observed as well. For such events, height $N(z)$ and $\nu(z)$-profiles were calculated using the known method. The calculation errors in $N(z)$ and $\nu(z)$ were $\delta \leq 30\%$ and $\delta < 50\%$, respectively. A specific feature was the following: the electron density in that part of the ionosphere, during the events described, increased several times if compared with that under the undisturbed conditions. The $\nu(z)$ at these heights changes in an ambiguous way: we observed both increasing in $\nu(z)$ which was more than the measurement error and decreasing in $\nu(z)$ with respect to the conditions undisturbed. These $N(z)$ and $\nu(z)$ changes lead to changes in the D-region conductivity. In order to describe physical properties of the D-region and model such events, we used a mechanism of charged-particle precipitation from the radiation belt and a mechanism of effects of radioactive and electromagnetic radiations of the surface layers of the Earth and its atmosphere.

G4.P.7 Open Session and Latest Results

Mid-Night Effect of Geomagnetic Storms on Propagation of ELF Atmospherics

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Background

The electromagnetic radiations of cloud discharge known as *atmospherics* provide important tool for the study of ionospheric propagation of ELF radio waves. The integrated field intensity of atmospherics (IFIA) at ELF band are being recorded in the Department of Physics, Tripura University in the diurnal basis. Apart from regular and seasonal variations, IFIA exhibits quasi-periodic variations during principal geomagnetic storms reported in Solar Geophysical Data Book [1].

Instrumentation

An inverted-L type antenna has been used to receive the predominantly vertically polarized atmospherics in an omnidirectional azimuthal pattern. The induced voltage at the antenna has been fed to a radio receiver tuned at 900 Hz via low pass filter. The AC output voltage has been detected which after further amplification is used to drive the recorder. An AGC has provided wide dynamic range.

Analyses and results

The IFIA at 900 Hz in the absence of cloud activity is characterized by sunrise- and sunset effects. The diurnal pattern of IFIA reveals higher level at night compared to that at day. The regular pattern is highly affected by local thunderstorms and cloud activity. During some nights IFIA exhibited sinusoidal-like variations which we call qusi-periodic variations. Out of 37 events 31 are closely correlated with principal geomagnetic storms having range of variation of horizontal componenet (H) greater than 100 gama. The amplitude of quasi-periodic variation s of IFIA were observed to increase with increase of range of variation of H. Time periods of variations of IFIA during different days were remarkably concentrated around 60 minutes.

Discussion

The quasi-periodic form of variations in nighttime IFIA suggest some wave induced disturbances in lower E-region of the ionosphere. The wave sources are the enhanced electric currents and precipitated particles heating over the polar cap region during geomagnetic storms. The Lorentz force and Joules heating effects can produece atmospheric gravity waves (AGWs) which manifest themself as quasi-periodic electron density perturbations termed as travelling ionospheric disturbances (TIDs). Large- scale TIDs with period 1 h and wavelength 1000 km [2] subsequently propagate equatorwards. In this case the earth-ionosphere waveguide experiencesa periodic modulations. This fact is signatured as quasi-periodic variations in IFIA.

Reference

[1] Solar Geophysical Data Book, NOAA, US Department of Commerce

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