High energy particles and waves in low and middle latitudes region according different satellite experimental data.

O.Grigoryan (1), K.Kudela (2), A.Petrov (1), H.Rothkaehl (3), V.Sheveleva (1).

(1) NPI MSU, 119992, Moskow, Russia.

(2) IEP SAS, 04353 Kosice, Slovakia.

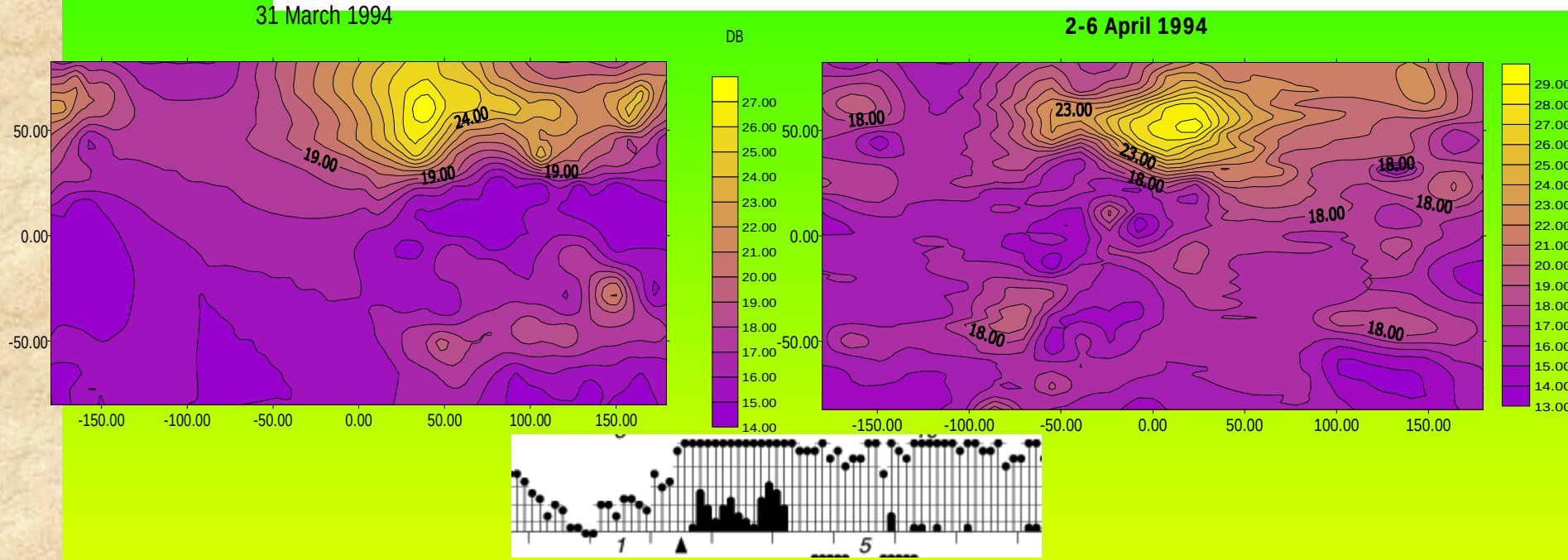
(3) Space Research Center ,PAS Warsaw, Poland

ACKNOWLEDGMENTS. Research partly supported by Polish Committee of Scientific Research GrantNo. 8T12E03920

ABSTRACT

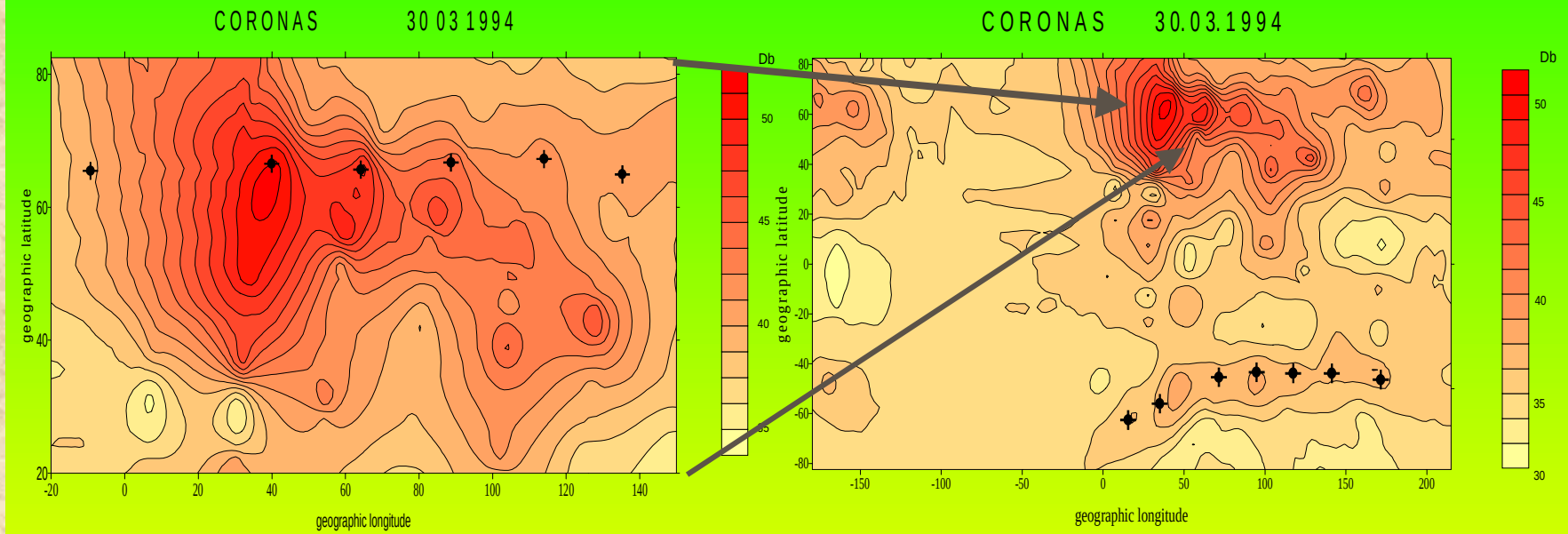
- **This work systematizes the experimental data of electron (E_e=20 keV - 1.2 MeV) fluxes and RF radio noises in frequency range 0.1 - 15 MHz near geomagnetic equator. These data obtained in different satellite experiments (MIR station, OHZORA, CORONAS-I, ACTIVE satellites) in the region of low and middle latitudes. The data of simultaneous registration of radioemissions and electron (E_e < 500 keV) fluxes onboard Intercosmos-24 satellite (ACTIVE) are analyzed in details. The special attention was given to altitudinal distribution and the dependence on geomagnetic activity level. It was established that when the electron fluxes are observed in both hemispheres the maximal spectral density of RF radio noises are registered in east hemisphere. The well-manifested global distribution features of the observed spectra appear as remarkable enhancement of spectral density over Europe and part of Asia. The correlations of local changes of the RF and high energetic particle distribution are discussed. The aim of this paper is to present relations between the distribution of RF emission and energetic particle precipitation pattern and to analyze the consequence of changes the local environment caused by human activity in the frame of Space Weather implication.**

CORONAS I HF diagnostic



Global distribution of HF emission in the ionosphere in the frequency range 0.1-15 MHz. The spectral intensity was integrated at night time 30.03.1994 during quiet condition and from 2 to 6.04.1994 during strong geomagnetic disturbances, recorded by SORS-1 instrument on board the Coronas-I satellite. The resolution is 5x5 deg; the units are DB/μV. It is evident that in the main phase of the geomagnetic storm. In the area over which the observed enhancement of HF noises during geomagnetic disturbances seems to be larger than for quiet conditions, the observed intensities of these noises are practically at the same level. In the auroral region at the longitude large than 150 deg the local enactments of radiations seems to be driven mainly by the natural particle precipitations

HF noises-Coronas I



The global distribution over Europe of mean value of the electromagnetic emission in the ionosphere in the frequency range 0.1-15 MHz on 30.03.1994 during strong geomagnetic disturbances, recorded by SORS-1 instrument on board the Coronas_I satellite. The characteristic increase of emission over Euroasia is visible and the conjugate point in southward hemisphere . The area where maximum particle flux was registered is indicated by cross points. The resolution is 5x5 deg; the units are DB/μV. The observed broadband emissions are a superposition of natural plasma emissions and man-made noises. Pumping the electromagnetic waves from the ground to the ionosphere and the penetration of energetic particles from radiation belts can, as a consequence, disturb top-side ionosphere and lead to the turbulence of ionospheric plasma.

THE EXAMPLE OF ELECTRON FLUX REGISTRATION AT MIDDLE LATITUDES IN DIFFERENT EXPERIMENTS

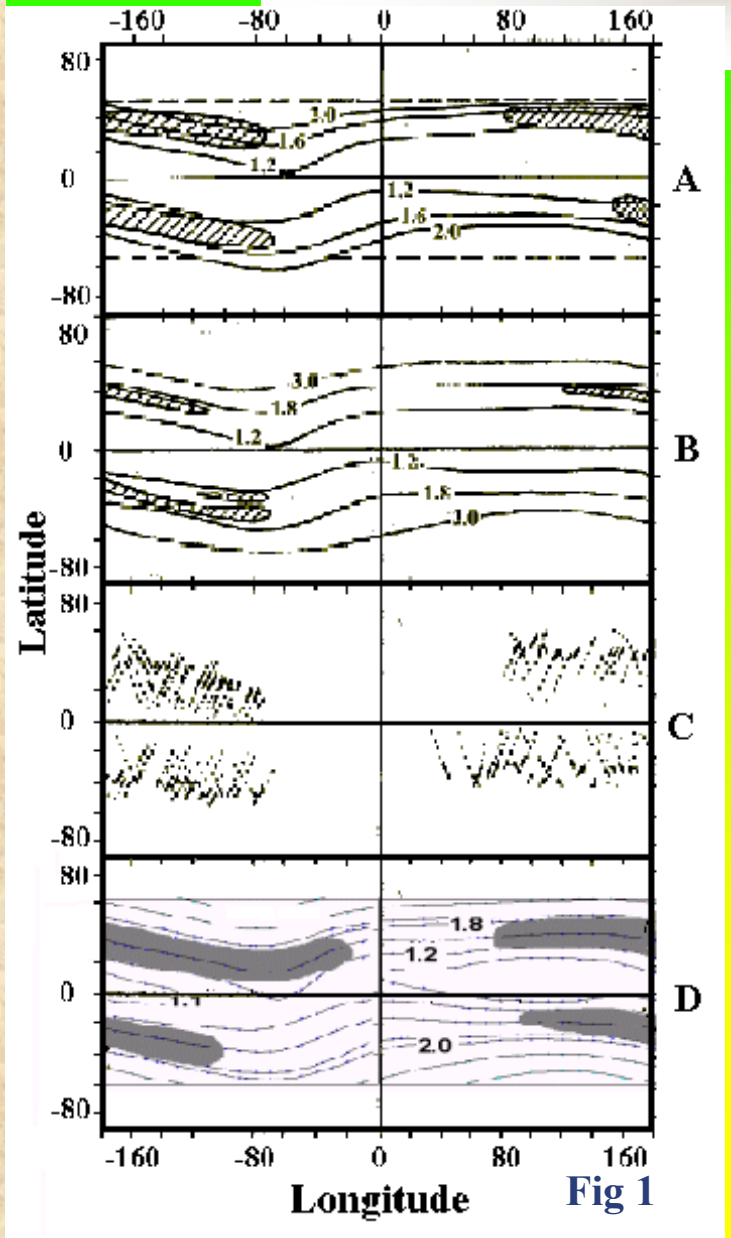


Fig 1

The electron fluxes under the inner radiation belt observed in different experiments since 1980th.

Previous experiments – MIR station (see Grachev et al. (2002), SPRUT-VI experiment, altitude H= 350-400 km, electron energies E_e=0.3-1.0 MeV,), CORONAS-I satellite (see Kuznetsov et al (2002), altitude H~500 km, electron energies E_e>500 keV), OHZORA satellite (see Nagata et al. (1988), altitude H=350-850 km, electron energies E_e=190-3200 keV) revealed the existence of electron fluxes at L=1.2-1.8 (see Figure 1, panels A, B and C correspondingly).

We analyzed electron flux data obtained from Active satellite. Electron flux enhancement under the inner radiation belt at L=1.2-1.8 is evident (see fig 1 and 2).

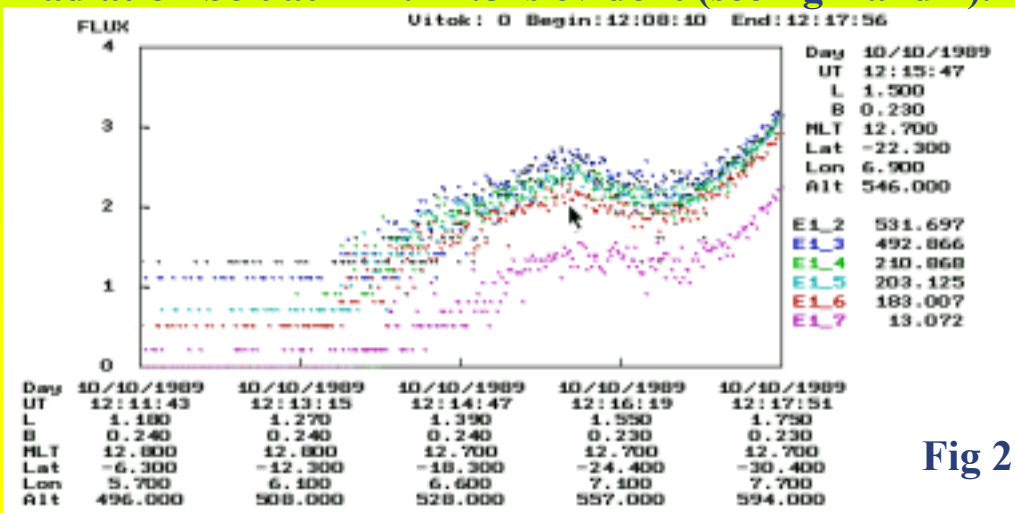


Fig 2

The map of electron flux registration obtained by ACTIVE satellite (April 1990 year)

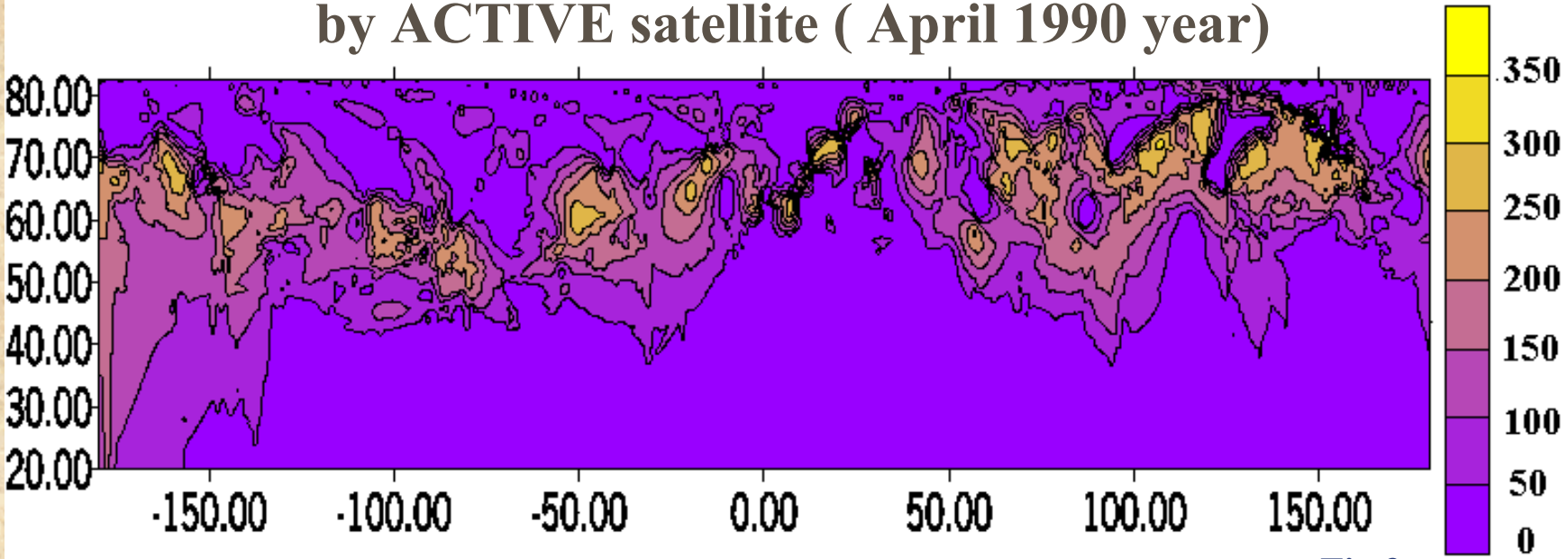


Fig 3

Figure 3 presents the ACTIVE satellite electron data obtained in April 1990 year. The altitude is 500 km The energy of electrons is E=44.2-69.9 keV. This map is constructed in geographical coordinates using the Kriging method. The dependence of electron flux distribution on longitude is seen. The enhanced electron fluxes are observed above continents. It can be caused by the work of broadcasting transmitters.

THE DEPENDENCE OF ELECTRON FLUX DISTRIBUTIONS ON LEVEL OF GEOMAGNETIC ACTIVITY

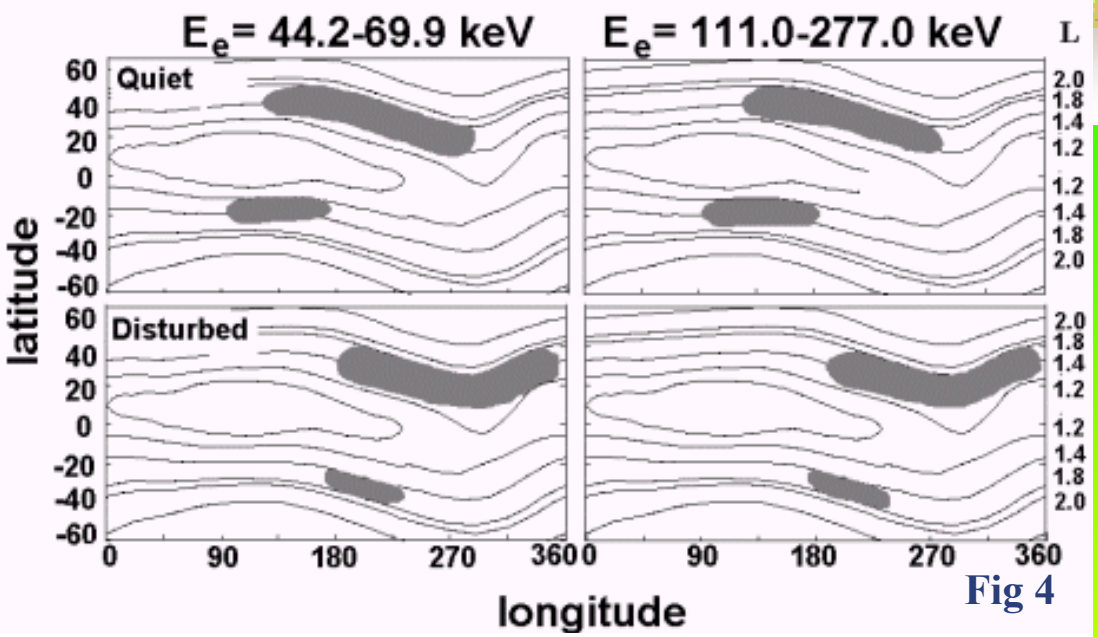


Fig 4

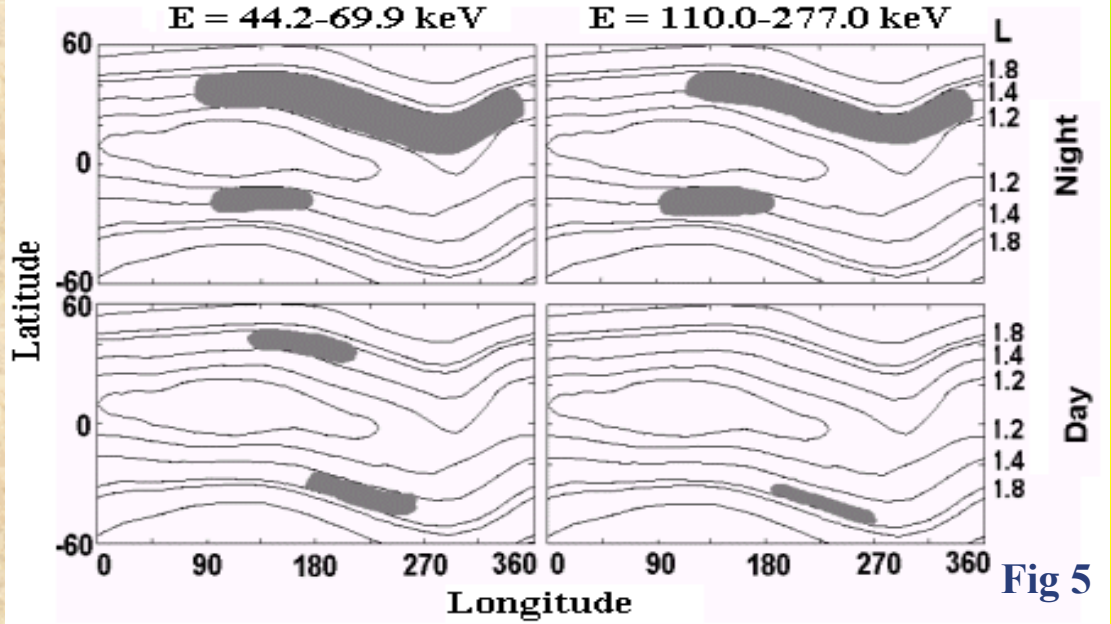


Fig 5

(see figure 4) AND
MAGNETIC LOCAL TIME
(see figure 5)
DAY 06:00 – 21:00 MLT
NIGHT 21:00–00:00-06:00 MLT

The observed dependences permit us to make the next conclusions:

- the electron distribution depends on geomagnetic activity. The precipitation zones shift to larger longitudes both in north and south hemispheres during the disturbed periods of geomagnetic activity;
- northern zone of electron precipitation exists mainly at night hours than at day hours;
- southern zone of electron precipitation shifts to larger longitudes at day hours, the latitudinal width of southern zone decreases at day hours;

ELECTRON FLUX DISTRIBUTION IN THE REGION OF THE IONOSPHERIC TROUGH

Electron flux

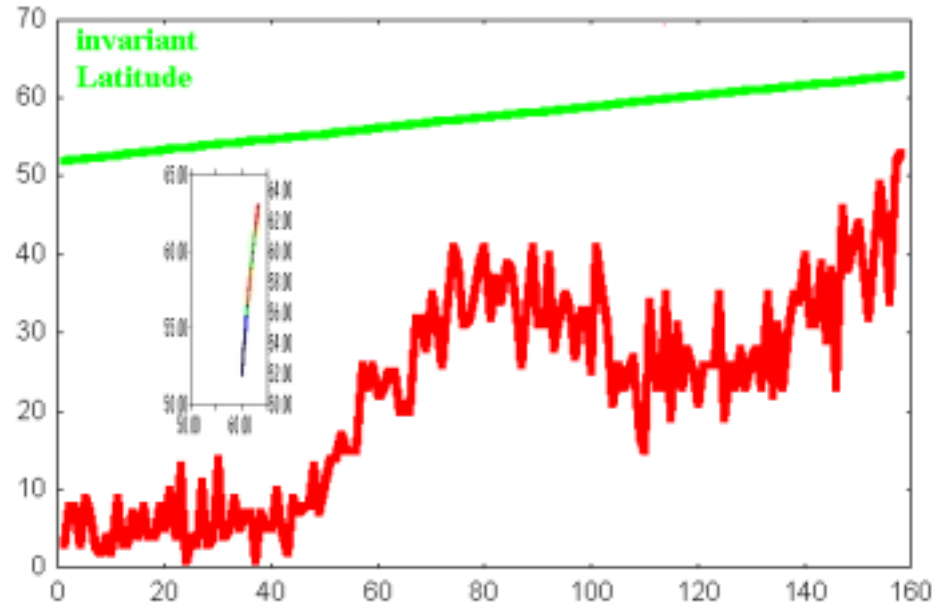
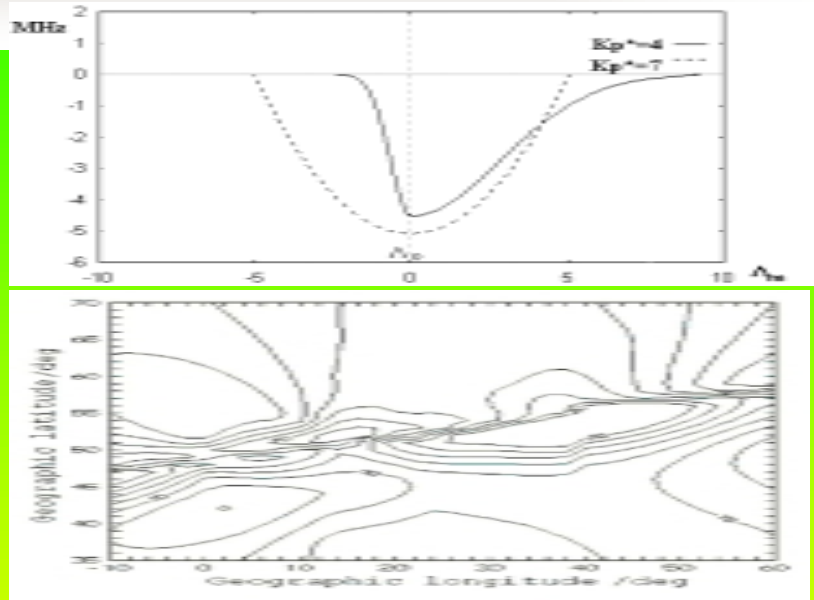


Figure presents a satellite pass through the region of ionospheric trough. Green line is the value of invariant latitude, the red line show the electron flux (energies 44.2-69.9 keV). At Y axis shows both the flux level and value of invariant latitude in function of time. The empirical position of the ionospheric trough minimum is 62°±5° in the above presented case .

$\Lambda_M(°) = 66.3 - 2.35\ Kp - 0.55\ t$, for $-6 < t < 6$

This value is coincides in error ranges with experimental value.



Depth of the trough at midnight given by the model for Kp*=4 (solid line), Kp*=7 (dotted line), Kp*and along invariant latitude sample instantaneous map of foF2 (x10 MHz) for 10 May 1992 at 22 UT with Kp*=7 given by the model and HF waves diagnostics data gathered on the board of APEX satellite.