THE LOW IONOSPHERE ELECTRON DENSITY CHANGES DURING EVENTS OF THE EXTREME SOLAR ACTIVITY AS DEDUCED FROM VLF MEASUREMENTS

ALEKSANDRA KOLARSKI 1, Vida Žigman 2, Davorka Grubor 3

1 Institute for Geophysics, Belgrade, Serbia, aleksandrakolarski@gmail.com
2 University of Nova Gorica,Centre for Atmospheric Research, School of Environmental Sciences, Slovenija, vida.zigman@p-ng.si
3 Unversity of Belgrade, dgrubor@rgf.bg.ac.rs

It is well known that solar X-ray flares increase the electron density at the lower ionosphere edge and that it can be detected from changes in the VLF propagation through Earth-ionosphere waveguide. The influence of the CME and SEP events, usually accompanying the extreme X-ray flares, on the electron density at the ionosphere-atmosphere boundary, can be also studied using the VLF data and appropriate choice of the processes introduced into continuity equation. Several examples of electron density disturbances, induced by X class flares: X1.3 at 1054 UT on July 2005, X17 class flare at 1740 UT on September 7, 2005, X9 at 1018 UT on December 5 2006 and accompanying events, are analyzed. The lack of the proportionality between VLF amplitude/phase (determined by electron density) and X-ray irradiance in the case of huge flares, indicates that processes else than photoionization-dissociative recombination take place. The continuity equation, including the three-body recombination is solved. The time variation of the electron density height profile N(z,t) during disturbed conditions is evaluated and compared with calculations, obtained from the Wait's N(z,t) model developed for the simulation of VLF propagation. The accordance in the order of magnitude was found. Also, the effects of the series of events in period from January 15 - 22, 2005, were analyzed. The VLF recordings reveal the absence of regular diurnal pattern in amplitude and phase, suggesting that the high level of electron density persists through night hours. It can be explained by impact of energetic particles, colliding with atmospheric neutrals. The X-ray emission released in "bremsstrahlung" process cause the ionization of atmospheric constituents. The VLF signals on two traces, NAA/24 kHz (Maine, USA - Belgrade) and GQD/22.1 kHz (Skelton, UK - Belgrade), were recorded by AbsPal system and used in this study.

Solar X-rays, Earth-ionosphere waveguide, solar energetic particles

Aleksandra Kolarski, Institute for Geophysics, Batajnički drum 8, 11000 Belgrade, Serbia, tel. +381642093151, aleksandrakolarski@gmail.com