

2nd International Conference on

ASTROPHYSICS AND PARTICLE PHYSICS

November 13-15, 2017 San Antonio, USA

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Ionospheric disturbances during solar proton events from ground GLONASS-GPS measurements in Kazan

Statement of the Problem: This work presents investigations of possible impacts of solar proton events (SPEs) on total electron content (TEC) responses.

Methodology: We have analyzed cosmic ray variations observed by the GOES satellite instruments versus GNSS-derived ionospheric electron content variations. GPS dual-frequency ground receiver has become an excellent ionospheric remote sensing technique in accuracy (better than 0.1 TECU in Slant Total Electron Content variation). In Kazan city (56 E, 49 N), the ground-based GPS-GLONASS receiver allows us to sense total electron content one per second for small scale ionospheric disturbances investigation. We have concentrated on solar proton events on March 2012 and June 2015 to study its possible ionospheric effect. Solar event fixed by GOES monitoring instruments, which measures parameters of the near-earth solar-terrestrial electromagnetic environment [GOES Data Collection System]. During this SPE, the flux of highly energetic protons from the sun is increased to $9 \cdot 10^5$ protons/cm²-s-sr March 8 2012 (Figure 1 top panel). Middle panel of Figure 1 shows geomagnetic field fluctuations caused by solar wind variations. The standard variation and spectra of TEC disturbances was calculated for each hour. Spectra have power-law behavior. Bottom panel of Figure 1 shows series of TEC standard variation and mean amplitudes of significant wave peaks.

Findings: The variability of the total electron content in homogeneities spectrum on scales less than 1 hour have been estimated for eveWWry second GPS phase data obtained. It is shown that in periods of increasing proton fluxes and in periods of decreasing proton fluxes on March 2012 and June 2015 the variance of total electron content fluctuations grow by increasing the intensity of the wave and turbulent processes.

Conclusion: It was found that turbulence growth and amplitude of wave disturbances increases during geomagnetic disturbances are related to proton event.

Biography

Olga Khutorova is Doctor of Science and Professor of Kazan Federal University, Institute of Physics. Her research interest areas are inhomogeneous structure of the atmosphere and at-mospheric remote sensing. She has published 216 scientific papers.

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