



The impact of solar flares and magnetic storms on the Earth's atmospheric electrical parameters and VLF electromagnetic waves propagation

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Changes in solar activity lead to fluctuations in the speed of the solar wind, the appearance of cosmic rays flare and perturbations of the interplanetary magnetic field. Streams of solar cosmic rays directly alter profile of the atmospheric ionization rate and modulate the flux of galactic cosmic rays penetrating into the atmosphere. Changes in the conduction profile lead to increased atmospheric electric field at altitudes of 15 km and below, where formed and electrified clouds. In addition, the change in resistance of the air column above the thunderstorm generators of the global electric circuit leads to a change in the potential difference between the surface of the Earth and the ionosphere.

The "Mikhnevo" observatory near Moscow, Russia carried out monitoring measurements of amplitude and phase characteristics of VLF radio signals, the near surface electric field and the vertical current of the atmosphere. Variation of the electric field and currents modulated by solar flares were revealed. The effect of the temporary increase in the electrical parameters noticeable on smooth curves. During strong magnetic storm of March 17, 2015 perturbation of amplitudes and the phases of VLF radio signals were recorded that associated with the disturbance D-layer of the ionosphere on the paths of radio signals propagation. Analysis of the amplitude and phase characteristics of the VLF radio signals for the 2014-2016 has showed perturbations during geomagnetic storms and substorms with $K_p=7$ or below. Such perturbations are usually have local or regional character.