Dynamics of cosmic rays and ionospheric parameters during periods of increased solar activity and magnetic storms

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In the work, variations of cosmic rays and ionospheric parameters during periods of strong and moderate magnetic storms of 2010-2015 were studied according to the data of ground stations. The data of the neutron monitors of Apatity, Cape Schmidth (Russia) and Kingston (Australia) stations and data of ionospheric stations Paratunka (Russia, Kamchatka), Wakkanai (Japan) and Norfolk (Australia) were analyzed (we used the resources www.nmdb.eu, http://spidr.ionosonde.net/spidr and http://wdc.nict.go.jp). The study is based on new methods of data analysis, described in [1, 2]. The application of these methods made it possible to describe an adequate model of the time course of cosmic rays and in their dynamics to identify abnormal intensities (pre-increases) arising 8-20 hours before the onset of strong magnetic storms. Such anomalies in cosmic rays were first discovered and described in [3, 4]. Their timely detection is of interest in space weather problems [3, 4]. A comparison with the dynamics of the ionosphere parameters showed that during the pre-increase periods in cosmic rays, an appreciable increase in the electron concentration of the ionosphere was observed and positive ionospheric storms lasted from 10 hours to one and a half days. Ionospheric disturbances were observed at different stations with a possible time delay of up to several hours. During the periods of the main phases of magnetic storms, the intensity of cosmic rays was significantly reduced (Forbush-lowering effect), and intense and prolonged (from 12 hours to several days) negative storms appeared in the ionosphere.

Analysis of the events of 2010-2015 showed a high correlation of the allocated effects in cosmic rays with anomalous processes in the ionosphere at the analyzed stations. The results of a number of works [for example, 5] testify to repeated observations of this anomalous effect in the ionosphere, but questions related to its nature and mechanisms remain open for the time being. The results obtained, according to the authors, indicate the solar nature of the identified anomalous changes in the parameters of the ionosphere. This confirms the hypothesis proposed in [5] that such anomalies in the ionosphere have an external source and are associated with a certain channel of energy penetration from interplanetary space and the magnetosphere.

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