

Experimental study of the ionosphere response to natural hazard processes and phenomena by the VLF/LF sounding of lower ionosphere

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The work is a review of studies of the lower ionosphere effects caused by space weather events (geomagnetic storms, X-rays and proton bursts, relativistic electron fluxes) as well as natural hazard events in the lithosphere (earthquakes, volcanic eruptions), hydrosphere (tsunami propagation) and atmosphere (planetary waves, change in atmosphere characteristics, cyclones, tropical cyclones). Measurements from a network of Very Low and Low Frequency (VLF/LF) receivers are used for investigation of these processes and phenomena. We analyse the electromagnetic narrow-band signals from ground-based navigational transmitters and transmitters of time service which are deployed all over the world. Such signals are reflected from the boundary between the atmosphere and ionosphere and they are sensitive to perturbations in the lower ionosphere. At present our network consists from eleven receivers that give us possibility to control high seismic active regions of the Far East and Alpine - Himalayan belt. The main results of VLF/LF sounding of lower ionospheric disturbances of different nature are presented. We present both anomalies in the signals revealed for case study and statistical, correlation and spectrum analysis. The recent development of the VLF/LF observation systems in Europe, Asia and North America can allow us to improve the accuracy and reliability of the information about properties and position in the ionosphere of perturbed region and thus contribute to both the basic ionospheric research and its applications. The use of data from a network of observations makes it possible to separate the local VLF/LF perturbations from large-scale or global anomalies related to space weather conditions.