Influence of the Inhomogeneous Structure of the Ionospheric Plasma on the ULF Noise Spectra

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The spectral characteristics of ULF magnetic noise fields associated with lightning worldwide activity and the influence of inhomogeneous structures like IAR (ionospheric Alfven resonator) and sub-IAR (a resonator in the ionospheric valley between the E and F layers) are determined by the local properties of the ionosphere above the ULF receiving point (P.Belyaev et al, J. Atm., Terr. Phys., 9, 781-795, 1990; E. Ermakova et al, Radiophysics and Quantum Electronics, 7, 555-569, 2007). Therefore, one can try to estimate the properties of the ionosphere above the receiving point basing on properties of the amplitude and polarization spectra of the ULF magnetic noise. The main parameter of the ULF noise polarization spectrum is the boundary frequency f_B which separates frequency region with left polarization (below f_B) from region with right polarization (above f_B). This frequency characterizes the influence of the sub-IAR resonator on ULF fields (E. Ermakova et al, Radiophysics and Quantum Electronics, 10–11, 605-615, 2013).

Simultaneous analysis of the ULF magnetic data recording from the mid-latitude observatories New Life (56N, 45.74E) and the Staraya Pustyn (55.66 N, 43.63E), and of the Ionosonde data, obtained at Vasilsursk observatory (56.13N, 46.1E), was done. It was detected the influence of sporadic *Es* layers on the amplitude and polarization spectra of the ULF magnetic noise. It is shown that the appearance of sufficiently intensive sporadic *Es*-layers with $f0Es > 3$-5 MHz can significantly change the parameters of the polarization, which is associated with a change in the optical thickness and quality factor Q of the ionospheric Alfven "sub-resonator" (sub-IAR). A distinct difference in the polarization spectra at stations with a base of 120 km during periods of absence of regional thunderstorm activity was also detected. Simultaneous analysis of the ULF and ionosonde data made it possible to conclude that the difference in the main parameters of the polarization spectrum at two stations is associated with the appearance of sporadic Es layers having a nonuniform horizontal distribution with characteristic scale of the order of the base between the stations. Numerical simulations using the model Es layers adequately explain the observed variations and the difference in the magnetic polarization spectra at the spaced stations.

It was also determined the typical dynamics of the main ULF fields spectra parameters in different phases of geomagnetic storm at mid-latitudes. The complete disappearance of the influence of the sub-IAR on the ULF noise spectra during the main phase and low values of the boundary frequencies during the recovery phase was detected.