

Modeling and Experimental Observations of Radio Wave
Propagation by Reflection from the Es-layer at Short radio-lines
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Abstract - Sporadic E layer has essential influences on propagation of radio waves in decametric band, both expanding band of working frequencies, and blanketing of radio waves from overlying ionosphere. In report considered reflection of radio waves from Es layer on a Cyprus-Kazan path in the extent of 2600 km, at range of propagation limiting one-hop reflection for heights of arrangement of layer. Researches were spent by method of chirp sounding and pulse oblique sounding. The explanation of received results on expansion of usable band made on the basis of modeling reflections from spatial gradients of density of electronic concentration in Es-layer.

Frequency parameters of fbEs of Es-layer, obtained by ionospheric stations, more or less characterize the density of the electron concentration in the layer and its structure irregularities. There are large data numbers of these parameters obtained from an international network of ionospheric stations, which are formed using the prognostic model parameters of the layer. Therefore, in practice it is expedient to establish a correlation between radio waves signal level reflected from the Es-layer at oblique incidence, and values of frequency parameters defined by vertical sounding in the center of the path.

The Es-Layer has different effects on radio wave propagation, by the measured of appearance of the Es-layer on the Moscow-Kazan path in a regular ionosphere led the following results: 1) expanding the range of usable frequencies on 1.5 { 4.5 MHz during the day and \pm 1.5 to 0.5 MHz at night, at threshold of radio communication level equal to \pm 30 dB and \pm 45 dB; 2) the communication quality get worse during the night at the middle part of usable frequencies due to multipath, which is produced by the appearance of reflected signals from Es-layer, along (accompanying) with the signals reflected from the layer F2; 3) improving the quality of radio communication in the lower part of usable frequencies, regardless from the day time, due to the disappearance of multipath because of shielding by Es-layer the signals reflected from the F2-layer.

To analyze the observed distance-frequency characteristics (DFC) from the chirp sound carried out the modeling of DFC by both the IRI model and the model of a thin irregular Es-layer, the most often observed in the ionosphere. Formed algorithm of statistical modeling of radio-channels in the presence of Es layer to determine the distributions of the Es-level signals on the radio path, and the maximal usable frequencies of Es-layer of one-hop mid-latitude traces based on their technical equipment.

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