Simulation of Round-The-World Signal Characteristics Using Waveguide Approach

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Summary

High-frequency round-the-world signals (RTW) were discovered at the 20th years of the past century [1]. It was showed by early measurements that the "twilight zone" was the sole region in which RTW propagation was possible. It was concluded later that the dominant propagation mode is an earth-ionosphere-earth hop mode near the great-circle line. It was determined experimentally [2] that RTW propagation is realized via the usual earth-ionosphere-earth hop modes in the daylight hemisphere and by ionosphere-ionosphere reflections, or 'tilt' modes, in a major part of the dark hemisphere. RTW properties were investigated in a number of experimental and theoretical works [3-6]. The question of ionospheric parameters diagnostics using RTW data was posed but it was not elaborated.

Significance of present study is connected with the problem that F2-region critical frequencies variations from day to day can reach considerable magnitudes especially for evening and morning hours even for quiet geomagnetic conditions but this variations are not described by used models of the ionosphere. In works [7-9] it was concluded that the F2-region critical frequencies (foF2) minimum magnitude over the propagation path exerts essential influence on RTW signal characteristics. This statement was tested by computations using International Reference Ionosphere [10] and developed at the Institute of Solar-Terrestrial Physics program complex for calculating HF signals characteristics on the base of waveguide approach [11]. The modeling results were compared with experimental data obtained at the Russian chirp-sounders network. The quantitative dependency between magnitudes of minimum F2-region critical frequency over the RTW paths and RTW signal maximum usable frequency values was obtained.

The way for the solution of the inverse problem of foF2 diagnostics can be the following. The region of minimum f_0F2 magnitudes over a path is determined on the base of model calculations. Then possible f_0F2 variations at this region are determined using the RTW maximum observed frequencies. On the base of this method we can investigate variations of f_0F2 over the RTW path connected with ionospheric conditions changing from day to day.

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