Ionospheric absorption of HF ordinary radio signal in the atmospheric D-region

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Abstract The spread of ionospheric stations around the world in recent times is generally more concentrated in the middle and high latitudes. As a result, extensive studies using different observational techniques have been carried out there. However, these studies have provided valuable information concerning ionospheric dynamics, structure, processes and formation. Unfortunately, only a rather limited set of measurements exits in African sector of the equatorial lower ionosphere. Our concern is that, lack of extensive studies in this region is a major hindrance in global ionospheric modeling activities in the region below 100 km down to stratospheric and tropospheric altitudes. In this study, we have used three different theoretical models namely: ionogram reduction analysis, apparent height, and phase integral analysis techniques to compute the variations of absorption of HF radiowaves with frequency in a Chapman-type D-layer (60-95 km) at vertical incidence for ordinary component of the magnetoionic wave. In addition, frequency index of absorption using these techniques show that the non-deviative, deviative, and total non-deviative absorption in the absorption regime appear to obey a law of proportionality to the inverse cube power of the radio signal frequency in the range of about 2 to10 MHz. The values of frequency index were all obtained from linear regression lines. For ionogram reduction method, deviative, non-deviative, and total non-deviative absorption are estimated as 1.60, 1.96, and 2.17 respectively, whereas phase integral analysis technique gives a value near 2.06 in the 60-80 km height range. It is also observed that apparent height method constantly overestimates values of frequency index of absorption. However, the results here are in accord with the values from observational work for equatorial and low altitudes. Our results must improve considerable effort being made to investigate ionospheric propagation parameters in order to determine their effect on radio waves and the associated reliability of HF circuits. There are several processes responsible for the low and equatorial lower ionosphere absorption.

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