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Attenuation(Fading) Due To Clouds South Kordofan (Sudan)

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Abstract: *In this paper, cloud characteristics in relation to radio wave propagation over some selected locations in South Kordfan -Sudan . It is seen that low cloud occurrence is quite significant. The performance of radio systems deteriorates due to cloud attenuation as well as due to cloud noise temperature. Based on the cloud attenuation results, at 10 GHz, 16 GHz, 32 , 44 GHz and 70 GHz has been determined for the aforesaid stations. The results, presented here are useful to design earth- space communication links over this aforesaid location in Sudan.*

I. Introduction

Microwave and millimeter wave frequency bands are in great demand in Sudan for requirement of more channels as will as higher data transmission in radio communication system[1] .But the frequency *above 10 GHz has significant attenuation by cloud. Attenuation due to cloud for different frequencies has been studies.* Cloud attenuation was primarily due to absorption by the cloud droplets, and scattering losses were secondary. With increase in operating frequency the attenuation due to clouds also increases. According to the data of the weather stations,in South Kordfan August and September are the cloudiest months. The clearest sky is in April and May.

II. About Cloud

II-1 Cloud classification

Clouds are classified in two ways, by *height* and by *form*

Classification by form

_ *Cirriform* – Cirriform clouds are very high, thin, and wispy. They are composed mostly of ice crystals.
_ *Cumuliform* – These clouds are puffy, and develop vertically. They generally have flat bottoms. There are often individual cloud units. They are associated with unstable atmospheres.
_ *Stratiform* – These clouds are generally flat and spread out (sheet like). There may be breaks in the clouds, but no distinct, individual clouds. They are associated with stable atmospheres.

Classification by height

_ *High clouds* – bases are above 20,000 feet
_ *Middle clouds* – 6500 to 20,000 feet
_ *Low clouds* – bases below 6500 feet
_ *Clouds of vertical development* – clouds which do not fit nicely into one of the three height categories above.

III. Calculation Of The Specific Cloud Attenuation

The specific cloud attenuation is a function of clouds' liquid water content and a coefficient, which is a function of frequency and temperature. In this case, we consider the value of clouds' water content[3] is 1 gm/m^3 because the direct measurements at a point in space are problematic , and cloud temperature is 265 K for different frequencies have been estimated and presented in table 1 for cloud thickness of 1 Km. The specific cloud attenuation (σ) was expressed as :

$$\sigma = (4.43 \text{xMx} 10^{0.0012(291-T)^{-1}} x 1.16)/\lambda^{2\,2} \qquad (1)$$

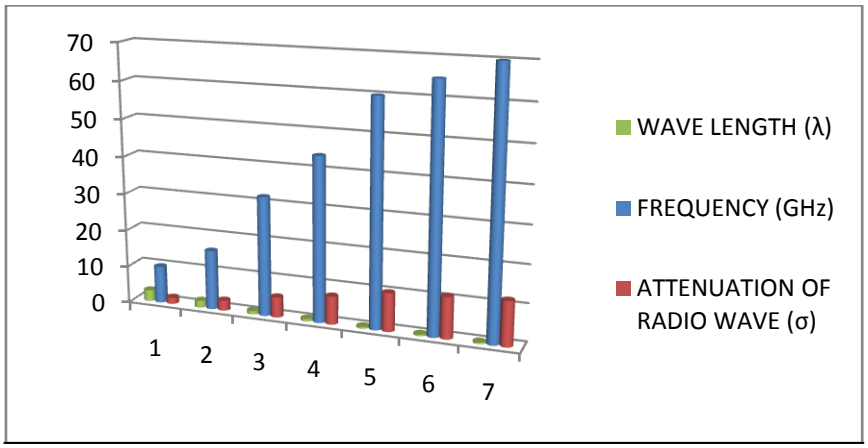
$$\lambda = C/F \qquad (2)$$

where T is the temperature in K.and λ (cm) is wave length it is equaled depend on frequency. We solve the above equations by using excel software .

WHEN TEMPERATURE IN KELVIN = 265:-				
FREQUENCY (GHz)	**WAVE LENGTH ( )**	**ATTENUATION OF RADIO WAVE ( )**		
10	3	1.713115382		
16	1.875	2.740984611		
32	0.9375	5.481969222		

44	0.681818182	7.53770768
60	0.5	10.27869229
65	0.461538462	11.13524998
70	0.428571429	11.99180767

***Specific cloud attenuation* TABLE -1**



Simulation for attenuationFig-1

IV. Conclusion

Cloud attenuation due to cloud liquid water contents has been obtained using the equations above. The linear relationship is obtained between different frequencies and attenuation over the frequency range 10 to 70 GHz gives an estimate of Cloud contribution to signal attenuation when cloud liquid water content is 1 . Cloud occurrences over a station indicate about the weather condition in relation to precipitation. The extra noise in terms noise temperature, which is generated by the cloud, degrades the signal-to- noise ratio of the satellite receivers[4,5]. For example, when cloud moves in the antenna beam, the total system temperature increases from the clear- air-system noise temperature. The effect of increase of noise temperature is more severe for low-noise-receiving satellite systems. Such exercise is to be done for as many locations as possible over the Sudan subcontinent. This result: are useful for estimation performance and design of satellite communication in microwave .

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