Impact of Rain on Earth-Space Communication Link in West-Africa

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Abstract:
The impairment of radio signal at Ku band and above by rain is a key factor in satellite communication and radar remote sensing modelling. The major effect of rain on electromagnetic signals is by absorption and scattering. This effect is noticed both on the uplink and downlink at 0.01 % unavailability in an average year. The data bank used for the computation of the rain attenuation for a link to Nigeria Communication satellite (NigComsat II) for selected locations in West Africa was obtained from the International Telecommunication Union Radio Propagation Recommendation [10]. The input parameters obtained from ITU-R study group 3 data base were used in this study. The various results of the rain attenuation values at C, Ku, Ka, and V bands were presented on contour map. The results reveal lowest value is at C-band which gradually increases at Ku and Ka bands while the highest values of total attenuation are experienced at V-band for all the locations. Both uplink and downlink results at V-bands show constantly that total attenuation is more severe in countries like Togo, Liberia, Ghana, Benin, Ivory Coast, and Nigeria. It should be

noted that all these countries are in the tropical region of West Africa where rain accumulation and rain rate is very high.

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I. Intreduction

Rain, amongst all other hydrometeors possess a higher risk to communication signals at frequency above 10 GHz of all the impairment encountered by communication signal, attenuation of signals by rain is of great magnitude at C-band (6/4 GHz), Ku-band (14/12 GHz), Ka-band (30/20 GHz) and V-band (50/40 GHz) [1]. The atmosphere has different layers, the troposphere being the lowest is where propagation of electromagnetic radiation (radiowave) at higher frequency experiences severe attenuation to signal. This occurs either by absorption or scattering of the electromagnetic signal due to the interaction with rain particles along the path of propagation [2]. The availability and reliability of radiowave signal are thus affected due to reduction in the energy carried by the electromagnetic waves [3].

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