Theory of Rain Fades; Measurement Done at Ku-band Satellite Link in a Tropical Region

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The results on rain attenuation measurements made on 11.65 GHz signal from INTELSAT 701 at Suva (Lat.: 18.08° S, Long.: 178.3° E), a tropical region, during the period of Apr'02–Mar'03 are presented in this paper. Rainfall at Suva was often frequent and heavy with average accumulation per month exceeding 150 mm. In the tropics, heavy rainfall has intense pockets of rain surrounded by larger regions of less intense rainfall. Rain-rate and attenuation measurement showed good correlation, since the site had a high elevation angle of 68.5, which increases the probability of having only one rain cell in the propagation path. Deep fades (> 7 dB) on 11.65 GHz were often short lived. They collectively occurred for 7.4 hrs of year at the site and were mostly recorded during the evening hours. Fading occurs through the process of absorption (minor) and scattering (major) by water droplets present in the propagation path. The finite conductivities of the water droplets make it an imperfect dielectric (complex quantity) medium and at 11.65 GHz, attenuation due to absorption is calculated to be 0.015 dB/km. The absorption coefficient (α) increases with frequency. The process of attenuation by scattering is determined by the scattering parameter δ, which is a function of the radii of the raindrops and the frequency of the signal. At the observed frequency, Rayleigh scattering happens when it is drizzling and in cloud and fog where each molecule in a droplet behaves like an individual dipole which scatters the radiowave in all directions. Mie scattering occurs at high rain-rate where the drop size is comparable or larger than the wavelength, hence, the Fresnels' relation for the reflection and transmission of the EM wave at the boundary of two media (water and air) of different refractive indices are applicable. The imperfection in the dielectric constant leads to a complex transmission coefficient and as a result, causes the received signal to be depolarized.