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Earth-space rain attenuation prediction from rain rate data using simple attenuation model for a tropical location

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The prediction of rain attenuation has remained a major issue in implementing fade mitigation technique for the satellite signals at frequency greater than 10 GHz. So far, the time series prediction of rain attenuation has been based mainly on rain attenuation measurement over an earth space path. However the prediction of attenuation from the ground based rain rate measurements, which is an easier option, has not been addressed adequately. A major difficulty in predicting the attenuation from ground based measurement is to have a reliable model that gives the horizontal structure of rain rate variation. It is convenient to consider the simple attenuation model (SAM) to estimate rain attenuation over an earth-space path from the ground based rain rate information. In this model the horizontal structure of rain is indicated through an exponential relation with a rain rate decay parameter that is considered constant. However, this is not the case for different rain types which are often observed in the tropical region. Even during a single rain event, the type of rain can vary from convective to stratiform and the in-between case. In the present study, we have utilized the experimental measurements of rain attenuation and rain rate to retrieve the information of the rain rate decay parameter γ and used them to predict the rain attenuation. The rain attenuation over an earth-space path has been measured by receiving a Ku-band signal transmitted from satellite NSS-6 (geostationary at 950 E) at an elevation of 630 at Kolkata, India (22°34' N, 88°29' E), a tropical location, since June 2004 . Also, an optical rain gauge is operated at the satellite receiving site to measure the rain rate. The experimental measurements obtained during the period 2005-2007 have been utilized in the present study. From each set of simultaneous measurement of rain rate and rain attenuation, rain rate decay parameter γ has been calculated by solving the SAM model equation and then it is plotted against measured rain rate. The plotting is divided into two cluster one for low rain rate region and other for high rain rate region. For each region, the scatter plotting of γ is fitted with the power-law curve. Once the model equations for γ have been obtained , then using these model equations, γ is computed for a particular measured rain rate value and finally rain attenuation can be predicted using SAM model equation. This method is applied to predict time series of rain attenuation during all the rain events of the measurement period. The reliability of the technique has been tested by comparing the predicted rain attenuation values with the experimental measurements. It is observed for all the rain events that predicted values compared well with the measured values except at some instants where the attenuation values are very high (>15 dB). This type of predictor can be suitable for real time attenuation prediction from the ground based rain rate measurements during rain events which can have useful application in the context of fade countermeasure techniques.

Biography

Dalia Nandi obtained her BSc from University of Calcutta. She did her BTech, MTech and PhD from University of Calcutta. Presently she is working as an Assistant Professor in the Electronics and Communication Engineering Department of Indian Institute of Information Technology Kalyani, Government of India. She is a Senior Member of IEEE and IEEE GRSS Society. She has about 30 publications to her credit in reputed journals, conference proceedings etc. Her present research interest includes Satellite Communication, Atmospheric Science, Wave Propagation, Space Science, Remote Sensing, and Optical Communication.

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