

# ANTENNAS AND PROPAGATION

*Modeling, Simulation & Measurements*

Edited by

**MD. RAFIQUUL ISLAM** B.Sc., M.Sc., Ph.D., MIEEE  
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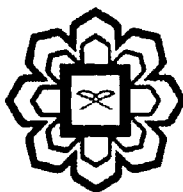
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## Chapter 27

# Investigation of Rain Attenuation at 38 GHz

Ahmad Fadzil Ismail<sup>1</sup> and Khairayu Badron<sup>1</sup>

### 27.1 Introduction

Millimetre wave bands for satellite links operations in tropical countries are indeed limited mainly due to high rain attenuation. The high attenuation experienced in this region is caused by significantly higher rainfall rates compared to other parts of the world. In the tropics, rain is the main consideration as the fading effect of other hydrometeors can be considered negligible [1, 2].

Currently, in many parts of the world there is rapid deployment of the K<sub>u</sub>-band frequency spectrum operations and usages. Future satellite operators including those in tropical region may soon have no other option but to progress up to the V-band frequency and above. The trend is very evident with the increasing demands for television broadcasting and other additional services [3]. However, the effects of rainfall on satellite signals at V-band frequencies in the tropics have not yet been completely investigated and quantified. Additional measured data, researches, experiments and analyses are considered necessary in order to obtain more awareness in this area. In the absence of an actual Earth-satellite-link, measured data acquired in Malaysia from a microwave link establishment should be able to provide some preliminary critical thoughts of the V-band link's characteristics. Such information is considered very pertinent and can be used as an initial groundwork plan for the engineers and researchers alike in the attempt to design a reliable Earth-space communication link design. The databases obtained are from measurement campaigns carried out in Universiti Teknologi Malaysia, Johor Bahru, Malaysia. The data provide new insights and excellent opportunities for concerned parties to examine the propagation characteristics in the tropical region and the likely effects to the Earth-satellite link.

### 27.2 Seasonal Variation of Rain Attenuation

Tropical climate experienced by countries along the Equatorial belt including Malaysia has no noticeable seasons such as Spring, Summer, Autumn, and Winter. In most locations in Malaysia, it is more common to have what is considered as 'wet' and 'dry' seasons. The seasons experienced could however fluctuate in length, time of occurrence, and severity of rain downpours. The features of Malaysian climate characteristic are of uniform temperature, high humidity and copious rainfall. Winds are generally light but gales do occur from time to time. Situated in the equatorial doldrums area, it is extremely rare to have a full day with completely clear sky even during the period of severe drought. On the other hand, it is also rare to have a stretch of days completely without sunshine except during the northeast monsoon seasons [4]. The seasonal wind flow patterns coupled with

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