

Statistical Analysis of Rain Height over Malaysia

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Abstract—Rain height is one of the key parameters in rain attenuation prediction. However, few studies on it had been carried out due to unavailability of data especially over tropics. Presented here is the result of eleven years zero degree isotherm height for eight locations over Malaysia. The studies had been carried out over two main seasons in the country (Northeast and Southwest Monsoon). The result shows that rain height is grossly under estimated by ITU-R P. 839-3.

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1. INTRODUCTION

Some parts of microwave frequency bands such as C and Ku bands are getting congested and the technology is advancing towards the use of Ka and V bands due to higher channel capacities and data rates demand. Satellite communication links operating within these frequency bands are immensely affected by hydrometeors such as rain, fog, hail, snow etc., of which rain is the most significant.

Rain height plays important roles in rain attenuation prediction models [1, 2]. Thus, extensive studies on rain height have been carried out by many researchers. The regulatory body for telecommunication operation has recommended a fixed value for different climatology regions [3]. ITU-R P. 839-3 describes effective rain height h_R from 0 °C isotherm h_i as:

$$h_R = h_i + 0.36 \text{ km.}$$

The effective rain height depends on type of rain. Rain height for frontal type of rain is assumed to extend up to 0 °C isotherm height while convective extend more than the 0 °C isotherm and may sometimes reach 10 km due to strong updrafts [4–8]. Studies have shown that rain height is seasonal dependent which suggests that height of rain might vary throughout the year especially in tropics regions [9–11]. Few studies on rain height are done in Malaysia with few locations for reference [9, 12]. Hence, there is need to carry out extensive analysis using eight locations which cut across the two regions (East and peninsular Malaysia).

2. DATA SOURCE

The 0 °C isotherm height used for estimation of rain height is derived from radiosonde observations. The data are extracted from NOAA (National Oceanic and Atmospheric) website for eight different locations in Malaysia. The radiosonde data location details of the locations are shown in Table 1. The radiosonde data are taken twice per day, one at 00:00 GMT and the other at 12:00 GMT corresponding to morning and late evening time. The derivation of the zero-degree isotherm height is based on 11 years radiosonde data between 2001 and 2011.

3. DISTRIBUTION OF RAIN HEIGHT OVER MALAYSIA

On the average of 11 years, Kota Bahru recorded the highest value while the lowest is observed in Bayan Lepas with corresponding value of 6.18 and 4.65 km respectively. The monthly average of Bayan Lepas is close to ITU-R rain height recommended value of 4.5 km (ITU-R P.839-3, 2001).

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