

## Rainfall in Sarawak

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### ABSTRACT

The main objective of this study is to help understand, on a monthly basis, both the rainfall intensity and the distribution of rainy days in the state of Sarawak. Our results show that: (a) no direct correlation between the number of rainy days (the rainfall intensity) and the total amount of rainfall has been encountered, and (b) the rainfall intensity field is de-coupled from the number of rainy days distribution.

### ABSTRAK

Objektif utama manuskrip ini adalah untuk memahami, dalam konteks bulanan, keamatan taburan hujan dan taburan hari hujan di negeri Sarawak. Keputusan kami menunjukkan bahawa: (a) tiada korolasi jelas antara jumlah hari hujan (keamatan taburan hujan) dengan jumlah keseluruhan taburan hujan yang dicatatkan, dan (b) keputusan keamatan taburan hujan adalah tidak berpasangan dengan keputusan untuk jumlah hari hujan.

**Keywords:** Sarawak, rainfall, inter-monsoon period, direct correlation

### INTRODUCTION

Briefly, rainfall intensity is defined as the ratio between the total amount of monthly rainfall and the number of rainy days for that particular month. A rainy day may be defined as a specific day that rains more than 0.1 mm.

The aim of this study is to gain some understanding of Sarawak's rainfall distribution. To the authors' knowledge no previous undertaking of Sarawak's rainfall has been done before. Therefore, our study represents the first of such an attempt.

Unfortunately, as of to-date, the only available rainfall data of Sarawak pertain to its west coast. That is to say, there are no rainfall data at further inland and its mountains. Therefore, our results are rather preliminary and should be viewed in that context. A clearer picture of Sarawak's rainfall distribution will emerge in the near future whenever more rainfall stations are installed and in doing so, a better and more accurate data set becomes available.

We have previously investigated both the monthly distribution of the number of rainy days and rainfall intensity in Peninsular Malaysia. In order to

make comparisons, the reader is addressed to that particular manuscript (Camerlengo & Somchit, 1998).

### DATA

As in the Camerlengo and Somchit (1998) study, the rainfall data were obtained from the "Monthly Summary of Meteorological Observations" published by the Malaysian Meteorological Service (1982-96). In exactly the same way as in that particular study, the location of the stations as well as the name of each station is depicted in Fig. 1 and Table 1, respectively.

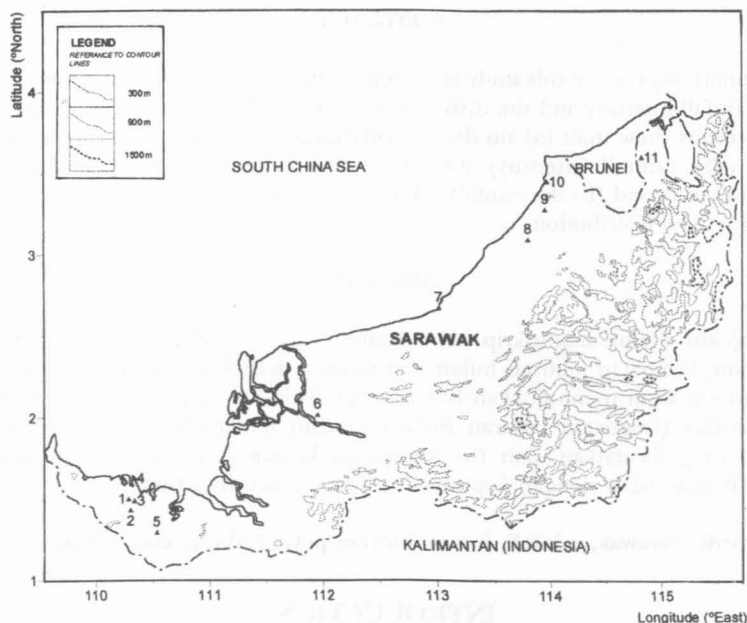


Fig 1. Location of the stations

Table 1  
Name of the stations used in this study

Number	STATION	Longitude °E	Latitude °N	Elevation (m)
1	STAPOK	110° 17'	01° 30'	13
2	ARC SEMOGOK	110° 18'	01° 24'	62
3	KUCHING	110° 20'	01° 29'	22
4	RAMPANGI	110° 20'	01° 41'	2
5	TARAT	110° 32'	01° 12'	12
6	SIBU	111° 58'	02° 15'	31
7	BINTULU	113° 02'	03° 12'	3
8	KARABUNGAN	113° 49'	03° 49'	12
9	KABULOH	113° 58'	04° 05'	48
10	MIRI	113° 59'	04° 20'	17
11	UKONG	114° 51'	04° 33'	26

**DISCUSSION AND RESULTS**

*Monthly Pattern of Rainy Days*

An important gradient of rainy days between Karabungan and Bintulu and a somewhat gentler gradient from Karabungan towards Ukong (the northernmost station) are recorded during the first month of the year. Furthermore, a larger number of rainy days is encountered at the southernmost part of Sarawak (Fig. 2). It may be stated that the January distribution of rainy days follows the same pattern as the January monthly rainfall (Camerlengo *et al.* 1999).

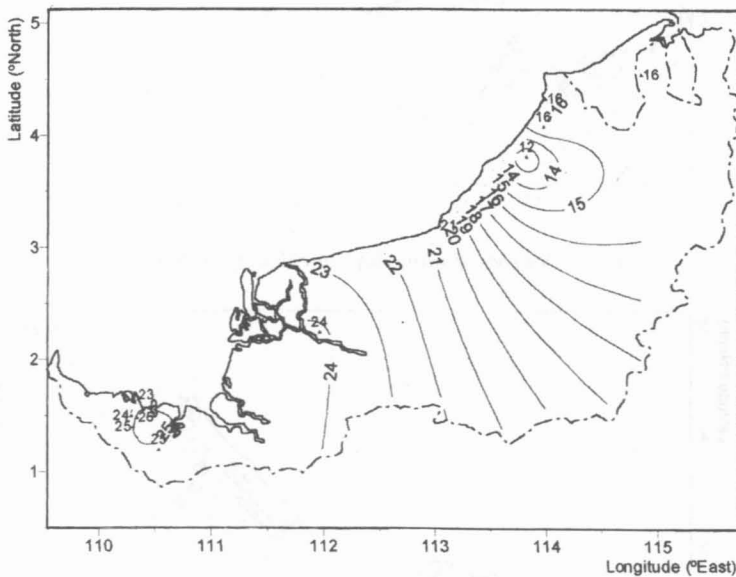


Fig 2. Number of rainy days in January in Sarawak

The retreat (southbound) of the NE monsoon may be attributable to the decrease of the number of rainy days recorded both in February and in March, where a milder gradient (compared to the antecedent month) between Karabungan and Bintulu still persists (Figs. 3 & 4). The same pattern as in the precedent month, larger (lesser) number of rainy days in the southern (northern) half, is observed.

As in the two precedent months, minimum number of rainy days is noticed in Karabungan in March. On the other hand, the largest number of rainy days is observed in Sibu during this particular month.

The end of the NE monsoon season makes the April distribution of rainy days to be somewhat more homogeneous than the one of the three previous months (Fig. 5). In particular, similar number of rainy days is observed at Ukong and south of Bintulu.

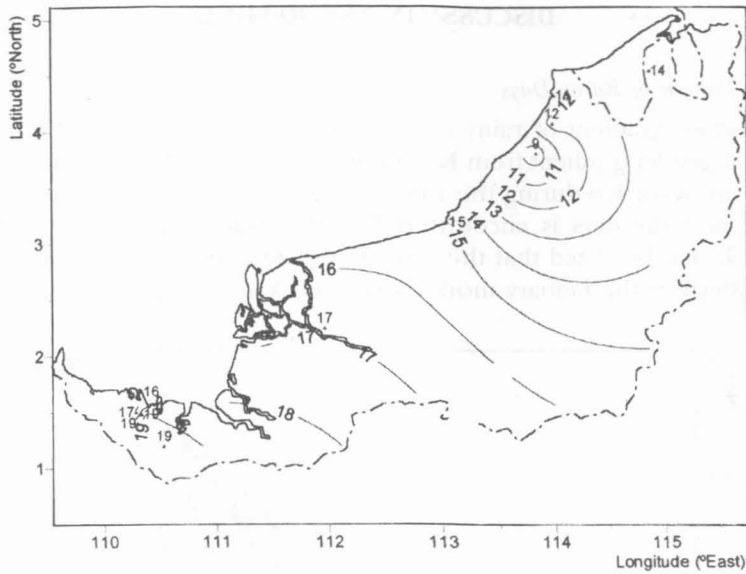


Fig 3. Number of rainy days in February in Sarawak

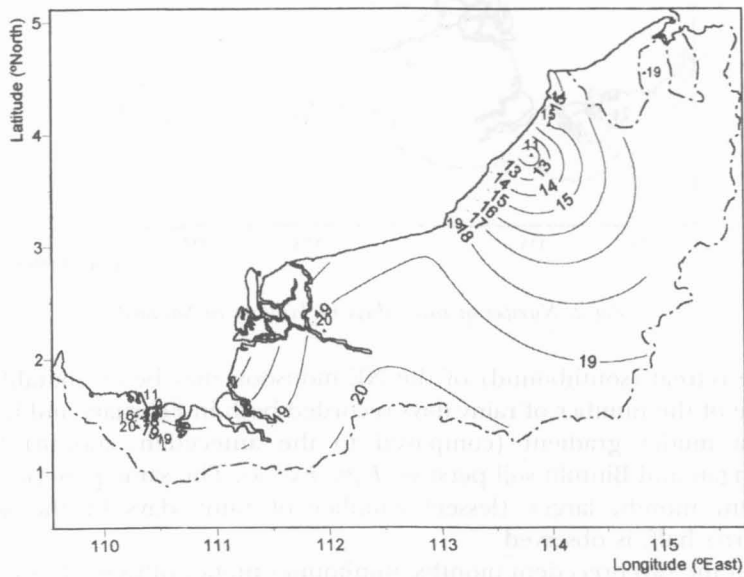


Fig 4. Number of rainy days in March in Sarawak

The first inter-monsoon period, represented by the poleward migration of the area of convergence ahead of the SE monsoon, is in May. In such instances, larger values of total rainfall are observed both in Peninsular Malaysia and in Sabah during this particular month (Dale 1959; Nieuwolt 1981). However, this feature is not noticed in Sarawak where there is no significant difference between both the April and the May total amount rainfall (Camerlengo *et al.*,

1999). This same situation prevails in the number of rainy days pattern of these two months.

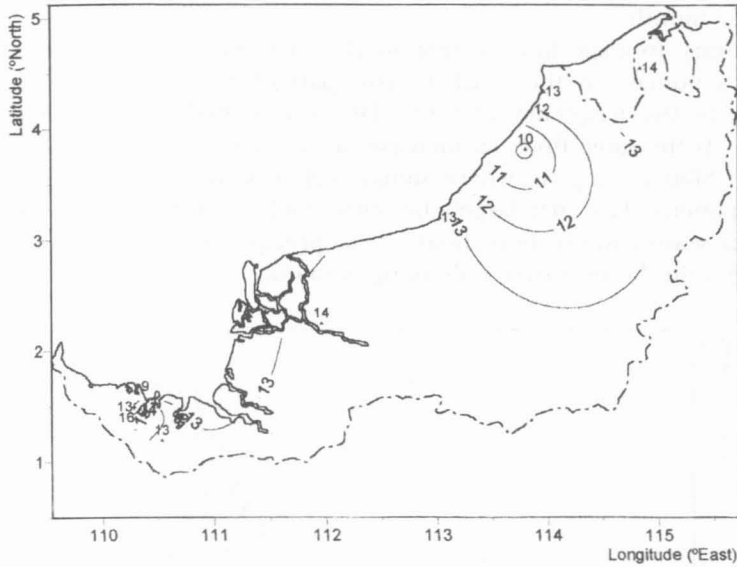


Fig 5. Number of rainy days in April in Sarawak

June is one of the driest months in Peninsular Malaysia. A slight decrease of rainfall, although not significant, is also observed during this particular month in Sarawak. This is also reflected in the respective distribution of rainy days where an abatement is also recorded (Fig. 6).

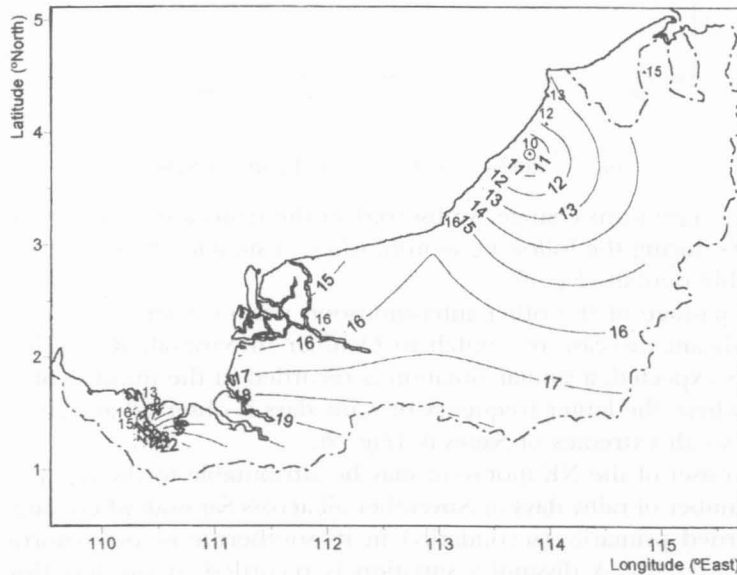


Fig 6. Number of rainy days in June in Sarawak

In spite of the fact that the July total amount of rainfall in both Rampangi and Tarat is somewhat similar, a significant gradient of the frequency (percentage) of rainy days is recorded between these two stations during this particular month.

Contrary to expectations, due to the fact that an increase of monthly rainfall is noticed in the southernmost part of Sarawak in August, a slight decrease in the frequency of rainy days is recorded in this particular area (Fig. 7). At the same time, an increase in the number of rainy days is noticed north of Sibu in August, where similar behavior is recorded in its monthly rainfall pattern. This may largely be attributable to the finalization of the SW monsoon season where both fields, total precipitation and number of rainy days, are quite homogeneous all along Sarawak.

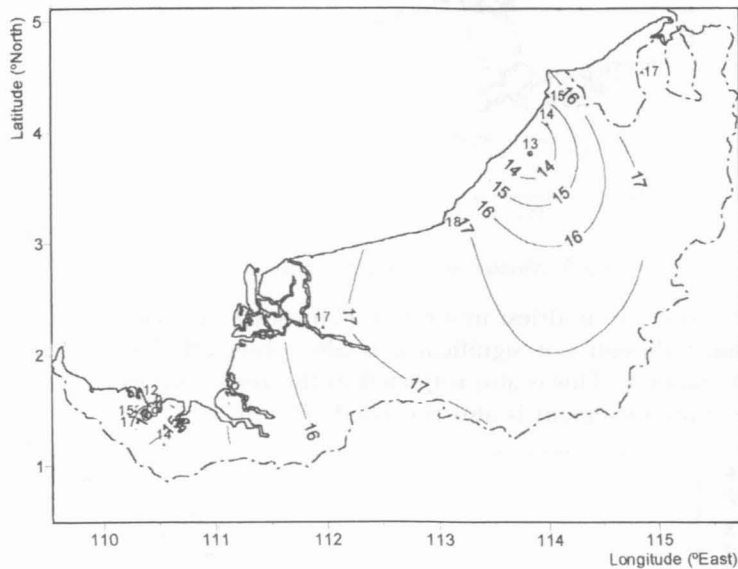


Fig 7. Number of rainy days in August in Sarawak

Not a significant change is observed in the distribution of the number of rainy days during the following month, where a similar situation is observed in its monthly rainfall (Fig. 8).

The passage of the other inter-monsoon period is largely responsible for the significant increase of rainfall in October in Sarawak (Camerlengo *et al.* 1999). As expected, a similar situation is recorded in the number of rainy days pattern where the larger frequency of rainy days is observed at both the north and the south extremes of Sarawak (Fig. 9).

The onset of the NE monsoon may be attributable to the further increase of the number of rainy days in November all across Sarawak where larger values are recorded primarily (secondarily) in its southernmost part (northernmost station) (Fig. 10). A dissimilar situation is recorded in the monthly rainfall distribution where a maximum value is observed at Ukong and somewhat lesser

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values at the southern part of Sarawak. However, in both fields, a minimum value is perceived at Karabungan.

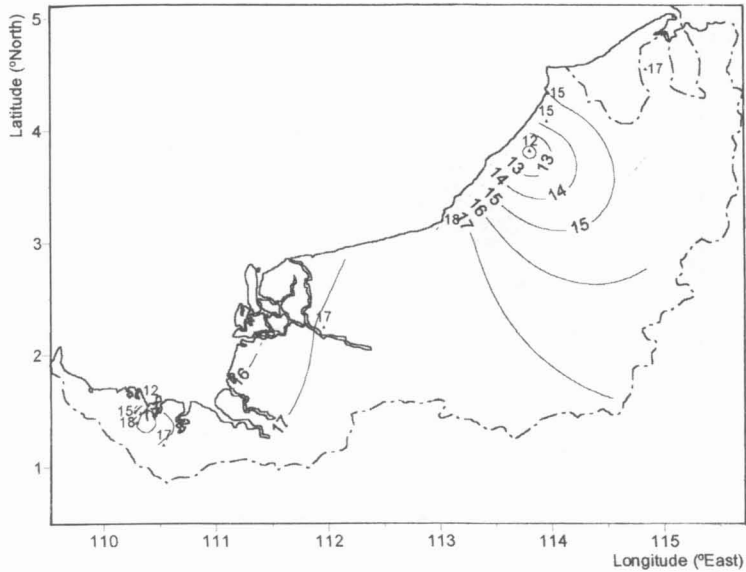


Fig 8. Number of rainy days in September in Sarawak

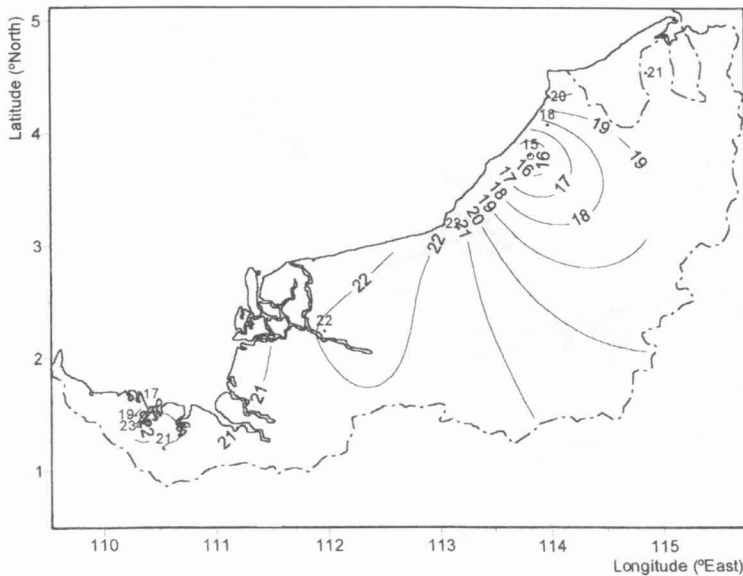


Fig 9. Number of rainy days in October in Sarawak

A larger number of rainy days is observed south of Bintulu in December (Fig. 11). As in all the previous months, a minimum value is perceived at Karabungan.

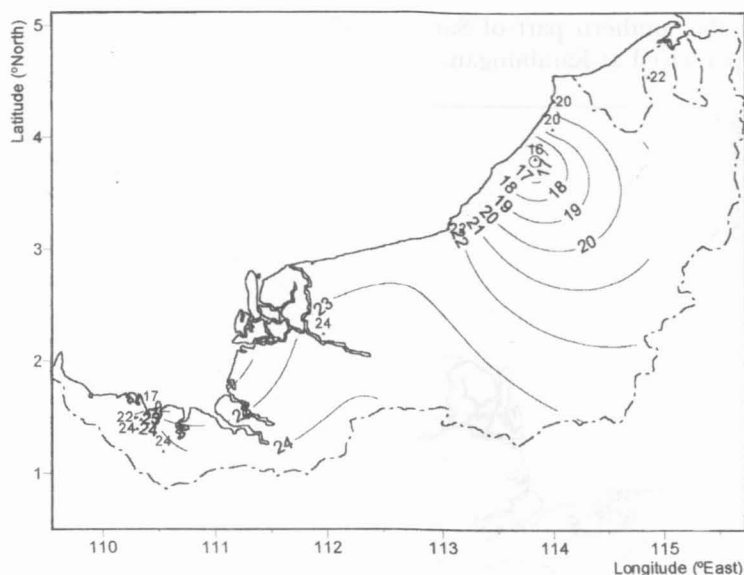


Fig 10. Number of rainy days in November in Sarawak

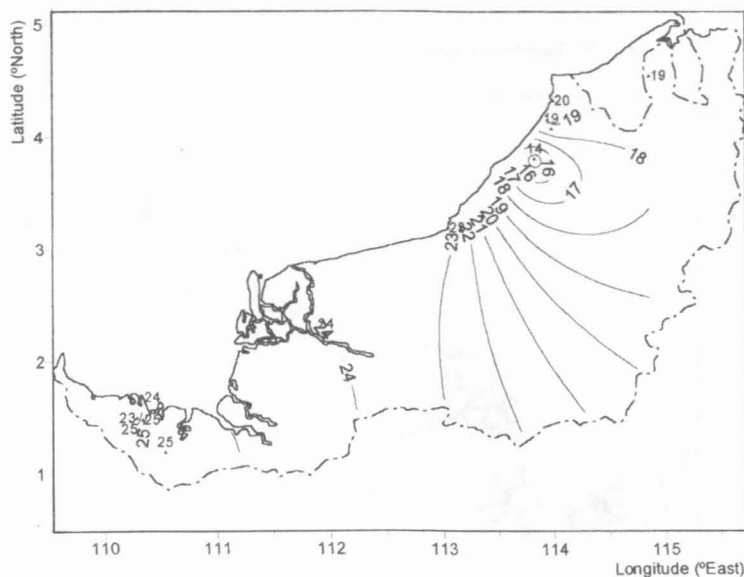


Fig 11. Number of rainy days in December in Sarawak

On an annual basis, larger values are recorded south of Bintulu and a significant minimum value is reported at Karabungan where the number of rainy days are approximately 60 % of the ones observed at Tarat (Fig. 12). The number of rainy days increases significantly from Karabungan towards Ukong.



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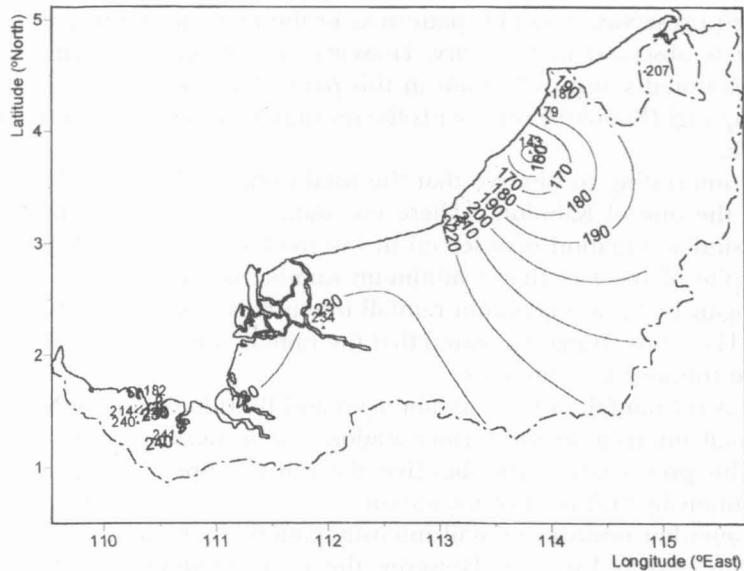


Fig 12. Number of rainy days on an annual basis in Sarawak

#### Distribution of Rainfall Intensity

A primary (secondary) maximum of rainfall intensity is noticed at the southern tip of Sarawak (in Ukong) in January (Table 2). Nevertheless, a minimum value is reported at Miri.

Table 2  
Monthly rainfall intensity in Sarawak

STATION	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
STAPOK	29	25	19	16	14	17	13	18	14	17	16	22	19
ARC SEMOGOK	22	20	18	15	14	12	14	14	15	14	15	19	16
KUCHING	26	22	18	14	13	14	12	15	13	15	15	20	17
RAMPANGI	38	26	24	13	13	17	18	15	16	14	16	32	22
TARAT	21	17	21	16	14	13	9	17	15	15	18	18	16
SIBU	15	14	17	14	13	14	11	13	13	14	13	15	14
BINTULU	18	16	17	12	13	17	15	18	14	15	19	18	16
KARABUNGAN	16	15	25	19	17	14	14	15	19	16	17	21	17
KABULOH	13	10	10	15	14	14	12	11	12	13	16	17	13
MIRI	12	10	12	12	14	14	14	14	18	15	14	17	14
UKONG	17	18	14	14	16	15	16	15	17	17	19	17	16

It is interesting to notice that the rainfall intensity at Karabungan is identical to the one of Bintulu. This, in spite of the fact that that the total amount of rainfall in the latter station almost doubles the one of the former station for this particular month.

Although preserving a similar pattern as in the previous month, a decrease of intensity is observed in February. However, a significant abatement of total rainfall is noted south of Bintulu in this particular month.

Rampangi (Kabuloh) represents the maximum (minimum) rainfall intensity in March.

It is interesting to observe that the total rainfall of March of Karabungan doubles the one of Kabuloh. (These two stations are separated by only a few km.) A similar situation is observed in the rainfall intensity distribution.

In spite of the fact that a minimum number of rainy days is recorded at Karabungan in April, maximum rainfall intensity is observed in this particular month. Therefore, it may be stated that the rainfall intensity field is de-coupled from the number of rainy days.

The April rainfall of both Karabungan and Bintulu is similar. Nevertheless, the rainfall intensity in the former station is considerably larger than in the latter. This points out to the fact that there is no direct correlation between rainfall intensity and total precipitation.

A somewhat uniform rainfall intensity pattern (compared to the previous months) is observed in May. However, the same situation as in April prevails where a maximum value is recorded at Karabungan. Furthermore, a secondary maximum is also perceived at Ukong.

With the exception of the southern tip of Sarawak where a large disparity of intensity values is reported, not a significant change in the intensity field is observed in June.

It is interesting to observe that the June rainfall intensity field is rather more homogeneous than both the total rainfall and the number of rainy day fields for this particular month.

A considerable decrease of rainfall intensity is noticed at the southern tip of Sarawak in July, where a minimum value is reported at Tarat. On the other hand, a maximum value is observed at Ukong, the northernmost station of Sarawak.

The July rainfall of Bintulu is 80 % higher than that of Karabungan (Camerlengo *et al.*, 1999). However, the rainfall intensity at both stations is practically similar for this particular month.

While the rainfall intensity increases in August in the southern tip of Sarawak, maximum values are observed at Bintulu and Stapok.

A large gradient of rainfall intensity is recorded between two neighboring stations, Karabungan and Kabuloh, where both extremes - maximum and minimum - are recorded in September.

It is also interesting to notice that in spite of the fact that the monthly rainfall in Ukong (293 mm), is considerably larger than in Karabungan (223 mm), rainfall intensity in the latter station is somewhat larger than in the former. Again, no direct correlation between rainfall intensity and total monthly precipitation may be established.

October's as well as September's rainfall intensity is confined to a very limited range of values.

In spite of the fact that the October rainfall is larger than that in the antecedent month, not a significant change in the rainfall intensity field of these two months is observed.

Maximum values of rainfall intensity reported in both Bintulu and Ukong in November are a direct consequence of the larger values of the total amount of precipitation observed in these two stations during this particular month. On the other hand, a minimum of rainfall intensity is recorded at Sibiu.

A slight increase of intensity values is reported north of Bintulu while no significant changes are reported south of this station during this particular month.

An important increase in rainfall intensity is reported in the southern tip of Sarawak where larger values of precipitation are reported during December.

Annually, the southernmost part of Sarawak registers the larger values of rainfall intensity in correspondence with the larger values of annual rainfall observed in that area.

### CONCLUSION

The main conclusions of this study may be summarized as follows:

1. There is no significant direct correlation between the number of rainy days and the total amount of rainfall for a given month.
2. The rainfall intensity field is de-coupled from the number of rainy days distribution, and
3. No significant direct correlation between rainfall intensity and total amount of precipitation for a given month has been encountered.

### ACKNOWLEDGMENTS

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