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On the Monthly Distribution of Precipitation in Sarawak

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ABSTRAK

Didalam kertas ini, kajian mengenai taburan hujan bulanan dan variasi taburan hujan di Sarawak dijalankan. Keputusan utama kajian ini boleh di ringkaskan seperti berikut; (i) jumlah keseluruhan hujan bagi setiap stesen tidak berubah sewaktu musim monsun baratdaya , (ii) tiada korolasi salingan diantara variasi taburan hujan dengan taburan hujan, dan (iii) nilai variasi taburan hujan berkurangan di selatan Sibu sewaktu enam bulan pertama didalam setahun.

ABSTRACT

In this investigation the study of the monthly distribution of precipitation and the rainfall variability of Sarawak is addressed. The principal results of this manuscript may be summarized as follows; (i) the total amount rainfall of each station remains unchanged during the months of the southwest monsoon season, (ii) no definite inverse correlation between rainfall variability and precipitation has been established, and (iii) lesser values of rainfall variability are reported south of Sibu during the first six months of the year.

Keywords: northeast monsoon, Sarawak, southwest monsoon, rainfall, ENSO, inverse correlation

INTRODUCTION

The objective of this manuscript is to gain a better understanding of the total monthly rainfall in Sarawak. To the authors' knowledge, only a single study has been conducted in this regard (Camerlengo et al. 1997). However, in that particular study, a considerably smaller number of stations, as compared with our investigation, was considered. Furthermore, the analyzed stations (in the previous investigation) had a dissimilar number of years. It has been established that inter-annual variability, primarily due to ENSO events, plays a significant role in the precipitation field. Therefore, a better and more exhaustive analysis of monthly rainfall in Sarawak is mandatory.

Our methodology is different from the previous study as we have arbitrarily chosen to consider rainfall data for the same period of time i.e. fifteen years (from 1982 to 1996).

Dale (1959) and Camerlengo and Somchit (2000) studied the rainfall variability of Peninsular Malaysia. No similar attempt has been made for Sarawak. Therefore, this study represents the first such attempt. In doing so, and in order to be able to make reliable comparisons, we have chosen to follow Dale' s (1959) method of computation of rainfall variability.

Due to the fact that all our stations are affected by similar inter-annual variability we strongly feel that this manuscript is timely and opportune.

DATA

Rainfall data of 11 stations were obtained from the Monthly Summary of Meteorological Observations published by the Malaysian Meteorological Service (1982-96). For this purpose, the monthly average of rainfall of each station is calculated.

The standard deviation of rainfall is relatively high, ranging between 50 % and 100 %. The standard deviation gives good perception of the dispersion coefficient.

The location of the stations as well as the name of each station are indicated in *Fig. 1* and Table 1, respectively.

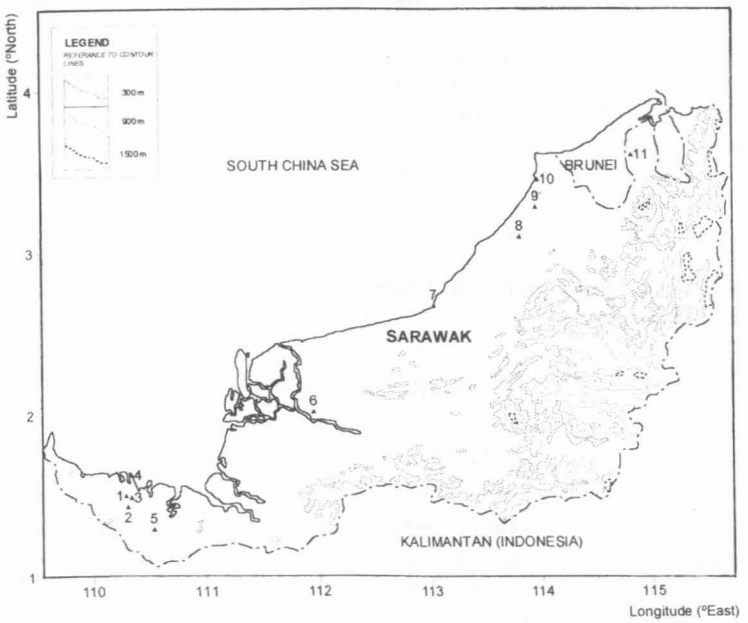

Fig 1. Location of the stations

DISCUSSION AND RESULTS

The retreat of the northeast (NE) monsoon season is mostly responsible for the larger rainfall values recorded in the southernmost part of Sarawak in January

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'	04° 05'	12
9	KABULOH	113° 58'	04° 05'	48
10	MIRI	113° 59'	04° 20'	17
11	UKONG	114° 51'	04° 33'	26

(*Fig. 2*). Indeed, the most salient feature during the first month of the year is the important gradient of precipitation in that particular area, where a decrease of 350 mm of rainfall is recorded between Rampangi and Tarat. (These two stations are approximately 60 km apart.)

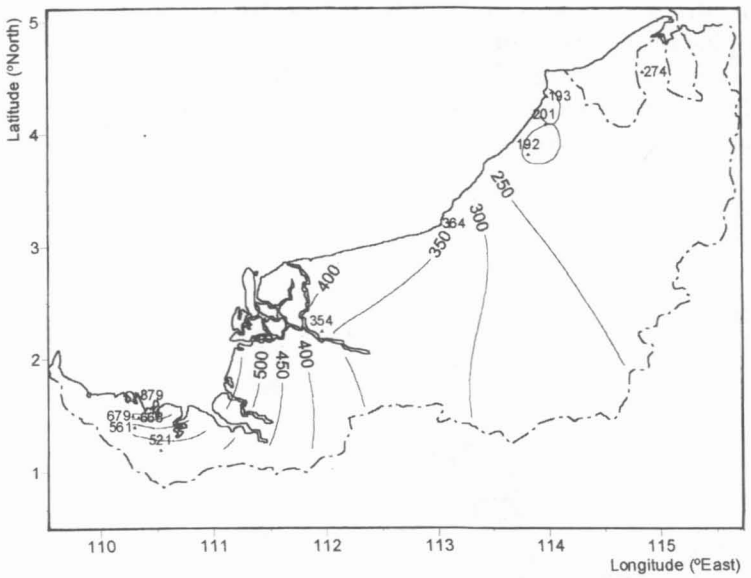

Fig 2. January: total amount of rainfall in Sarawak

A somewhat moderate decrease of rainfall is observed from Rampangi towards northern Sarawak. As a consequence of this, Sibu (roughly 200 km away from Rampangi) registers 354 mm of rainfall, and Miri (located at approximately 400 km from Rampangi) registers 193 mm.

An inverse correlation between total precipitation and rainfall variability is noticed in January (Table 2). As a consequence of this, lesser variability is recorded in areas with larger amount of precipitation, and vice-versa.

TABLE 2
Monthly rainfall variability of the stations used in this study

STATION	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
STAPOK	32	55	58	32	27	58	47	45	47	47	29	24	22
ARC SEMOGOK	32	59	39	39	29	21	48	45	31	28	22	15	10
KUCHING	26	57	52	38	27	50	45	52	38	34	29	21	12
RAMPANGI	32	67	50	42	33	61	70	62	68	55	74	43	18
TARAT	36	70	31	27	32	33	56	52	41	34	31	17	13
SIBU	40	58	30	38	39	53	51	70	38	28	18	34	15
BINTULU	61	63	59	55	37	52	37	59	35	23	28	24	16
KARABUNGAN	60	50	74	49	60	53	28	54	33	50	48	55	21
KABULOH	83	68	59	58	47	63	53	43	49	51	40	66	17
MIRI	64	64	65	42	39	49	54	42	48	54	42	48	17
UKONG	64	66	57	41	53	68	49	70	44	42	38	55	15

An important decrease of precipitation is recorded in February (*Fig. 3*). In particular, the southernmost part of Sarawak registers approximately 60 % of the precipitation recorded in the precedent month. It is interesting to notice that: (a) the important gradient of rainfall observed in that particular area during the preceding month has disappeared, and (b) with the single exception of Ukong, a gentler decrease of rainfall is noticed north of Karabungan.

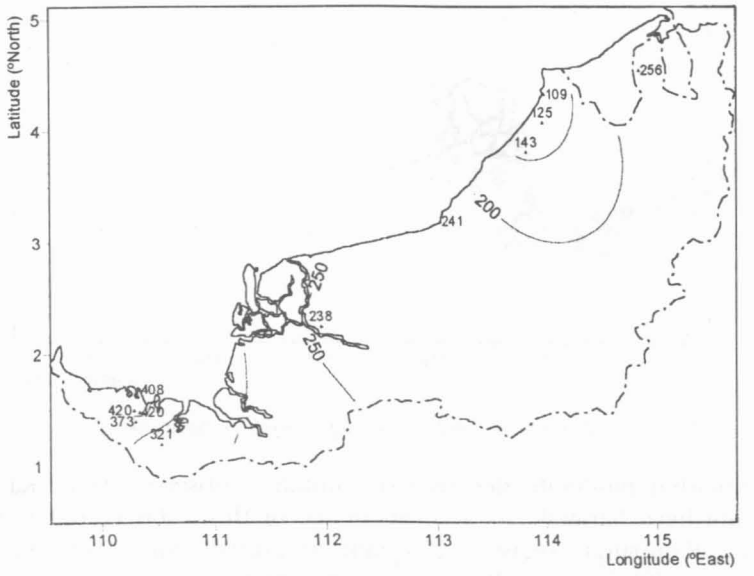

Fig 3. February: total amount of rainfall in Sarawak

A significant increase of rainfall variability is noticed in the southern part while similar values are observed in the northern half of Sarawak compared to the antecedent month (Table 2). Therefore, the inverse correlation between total precipitation and rainfall variability holds true for the southern half of Sarawak while for the northern half it becomes rather questionable.

No significant changes in both the total amount of rainfall and rainfall variability, except for the increase of total precipitation both in Sibu and in Tarat, are observed in March compared to the precedent month (Table 2). As a consequence of this, the above mentioned stations register a significant decrease in rainfall variability in March.

A decrease (increase) of precipitation is noted south (north) of Karabungan in April (*Fig. 4*). However, a decrease of rainfall variability is recorded at all stations during this particular month (Table 2). Therefore, the inverse correlation between total precipitation and rainfall variability does not hold true in this case.

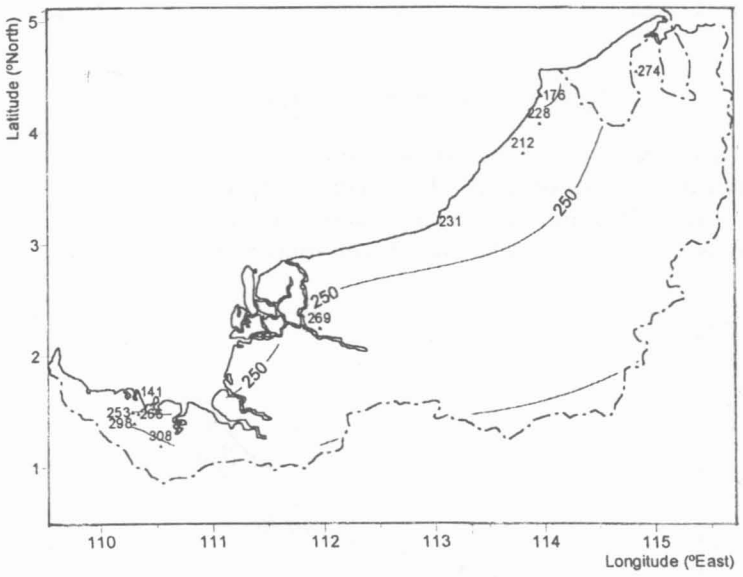

Fig 4. April: total amount of rainfall in Sarawak

No significant change in the total amount of rainfall is observed in May compared to the antecedent month. In spite of this, a slight abatement of rainfall variability is noticed in the southernmost part of our area of interest (Table 2). Again, the rule of thumb that states that there is an inverse correlation between total rainfall and rainfall variability becomes rather questionable (in Sarawak).

A further decrease of rainfall is observed in June compared to the previous month (*Fig. 5*). As a consequence of this, in general, a relative increase of rainfall variability is recorded (Table 2).

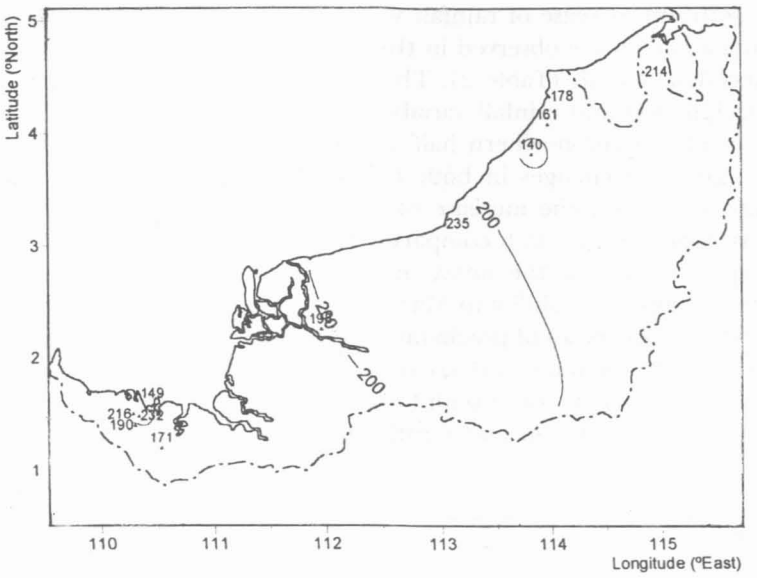

Fig 5. May: total amount of rainfall in Sarawak

The same pattern as in the previous months persists; namely, larger variability values north of Sibu. This occurs, in spite of the fact that the total amount of rainfall in June is similar all across Sarawak. Therefore, it is proven that there is no inverse correlation between total rainfall and rainfall variability.

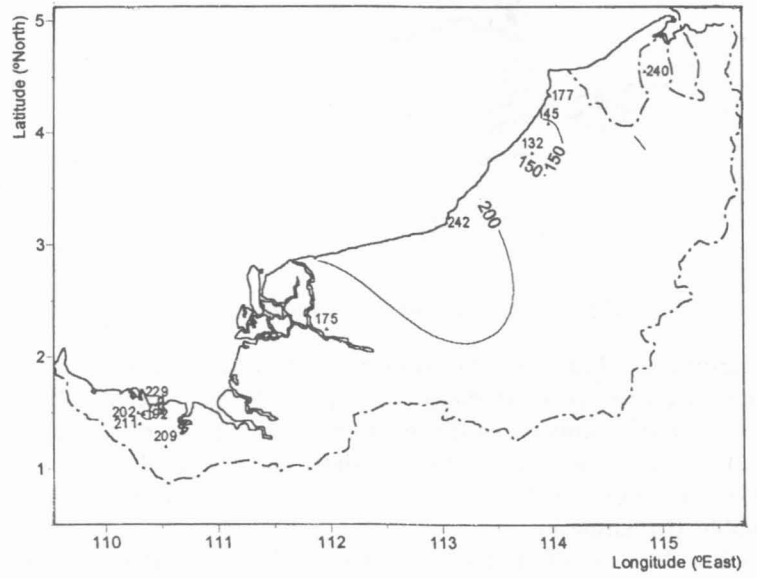

Fig 6. July: total amount of rainfall in Sarawak

No significant changes in the total amount of rainfall are observed in the following two months compared to June (*Figs. 5, 6 & 7*). In spite of this, a general decrease of rainfall variability is observed north of Sibu in July compared to the antecedent month (Table 2).

It is interesting to notice that the largest values of rainfall variability are recorded both in Sibu and Ukong during August. This, in spite of their high amount of rainfall, is recorded during this particular month at both stations.

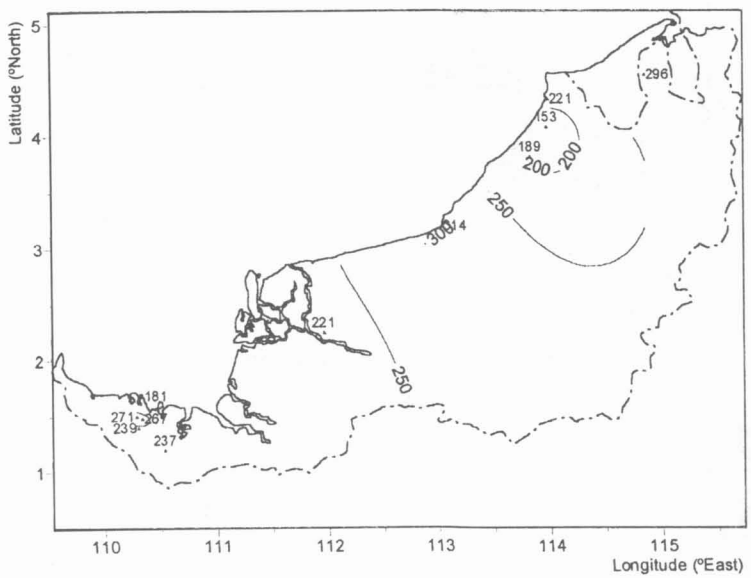

Fig 7. August: total amount of rainfall in Sarawak

September represents the last month of the southwest (SW) monsoon season. As such, no significant change on the total amount of rainfall is recorded compared to the previous months during the boreal summer (*Fig. 8*). However, a slight decrease in rainfall variability is noted compared to the antecedent month.

October represents one of the inter-monsoon periods (Nieuwolt 1981). As such, both the retreating SW monsoon and the advancing NE monsoon cause the formation of a broad area of convergence that favours uplifting with the consequent convective activity. This may help to explain the augmentation of rainfall in this particular month as compared with the previous one (*Fig. 9*).

It is also interesting to notice that the total amount of rainfall is larger in October than in the other inter-monsoon period, May. Nieuwolt (1981) attributes this to the fact that the degree of convergence in May is less strong than in October. On the other hand, no significant change in the rainfall variability is observed in this particular month compared to September.

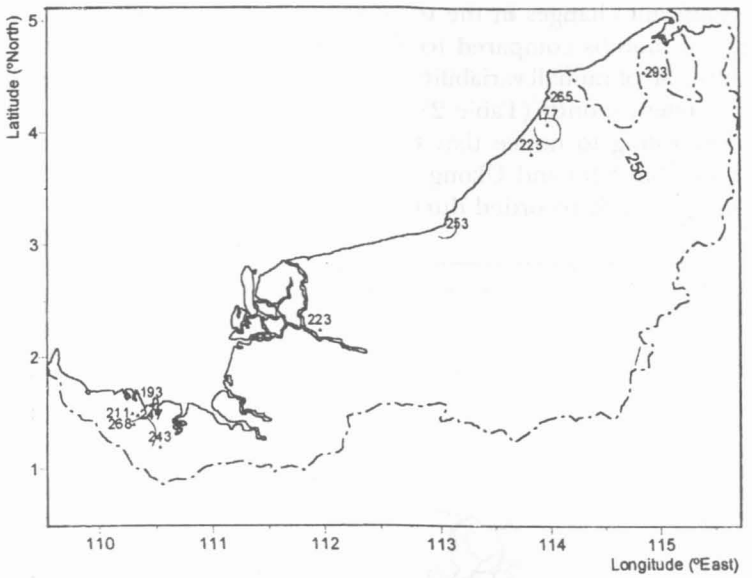

Fig 8. September: total amount of rainfall in Sarawak

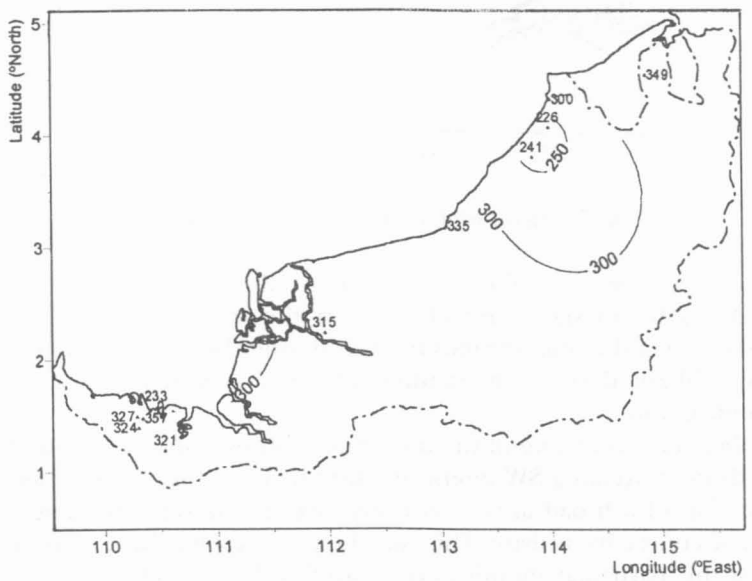

Fig 9. October: total amount of rainfall in Sarawak

The onset of the NE monsoon shows a slight increase of rainfall in November (*Fig. 10*). This is supported by a decrease of rainfall variability which is more significant south of Sibu.

The equatorward migration of the NE monsoon is largely responsible for the significant increase of rainfall in the southernmost part of Sarawak, where

a correspondent decrease of rainfall variability (in that particular area) is also noticed during the last month of the year (*Fig. 11*).

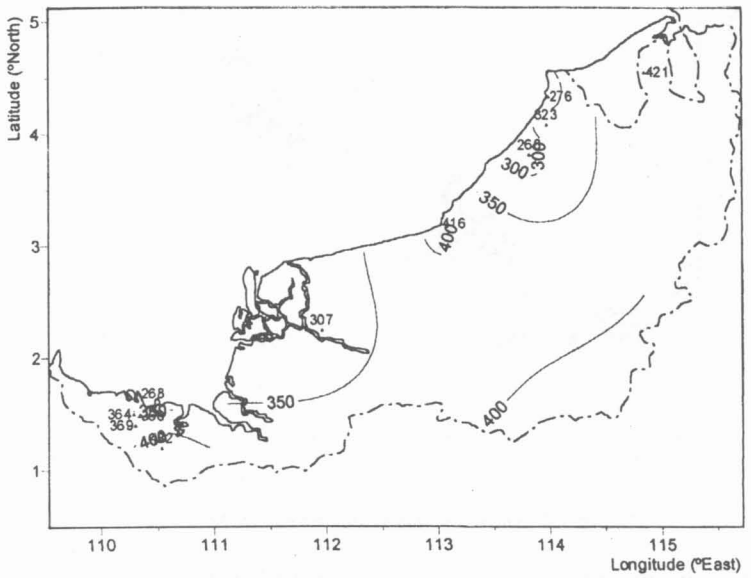

Fig 10. November: total amount of rainfall in Sarawak

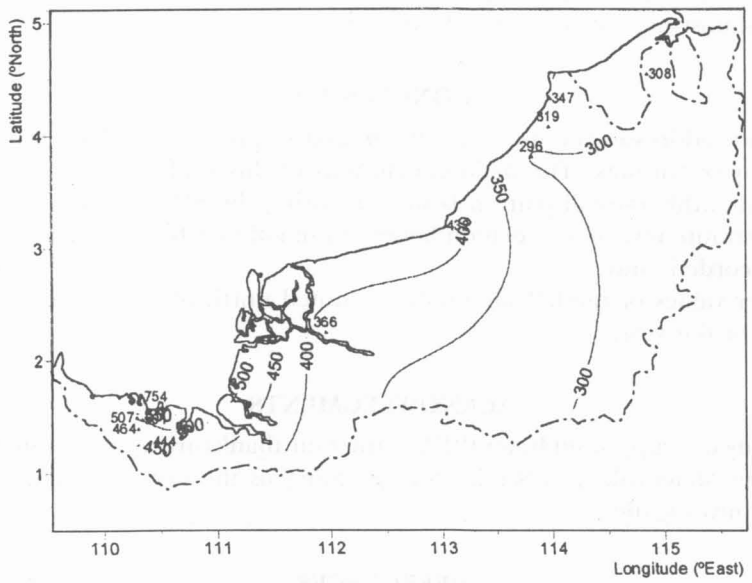

Fig 11. December: total amount of rainfall in Sarawak

On the other hand, no significant change in the total amount of rainfall is recorded, north of Sibu, in December. However, an increase of rainfall variability is noticed north of Sibu.

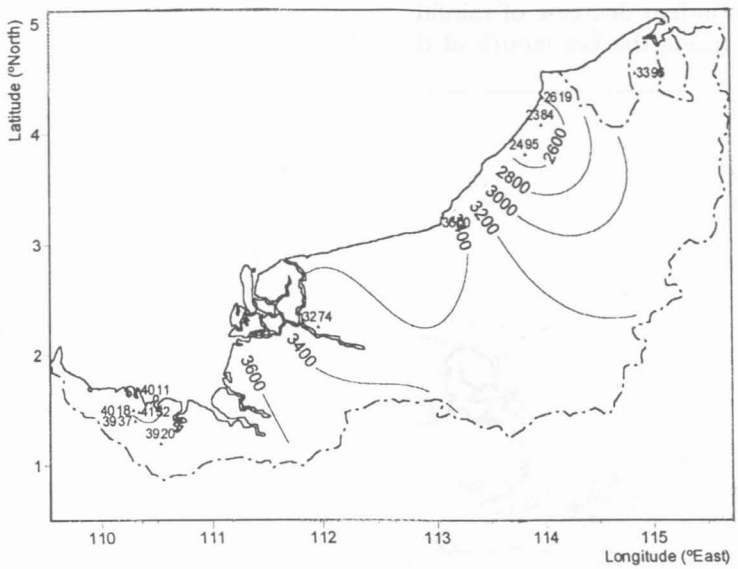

Fig 12. Annual amount of rainfall in Sarawak

Larger amount of annual rainfall is observed in the southernmost part of Sarawak (*Fig. 12*). Lesser amount of precipitation recorded at Sibu may be explained by the fact that this station is further inland than the ones in the southernmost part of our area of interest.

CONCLUSION

This study addresses the monthly distribution of precipitation and the rainfall variability of Sarawak. The main conclusions of this study are:

i the monthly rainfall pattern is similar during the SW monsoon,

ii no definite inverse correlation between rainfall variability and precipitation is recorded, and

iii larger values of rainfall variability are noted north of Sibu during the first half of the year.

ACKNOWLEGMENTS

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