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Monthly Distribution of Preciptation and Evaporation Difference in Sabah and Sarawak

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ABSTRAK

Corak perbezaan kerdasan dan sejatan tahunan, P - E, sangat berbeza di Malaysia Timur berbanding di Semenanjung Malaysia. Ditunjukkan juga perbezaan ini adalah positif di Sabah dan di Sarawak. Nilai P - E yang lebih tinggi diperhatikan dibahagian selatan Sarawak, sementara nilai yang lebih rendah dicatakkan di utara. Peranan utama (taburan bulanan P - E) dimainkan oleh laluan dua kali Zon Penumpuan Intertropika (ITCZ). Peranan kedua dimainkan oleh angin timur laut dan barat daya.

ABSTRACT

In spite of the fact that the annual pattern of precipitation and evaporation difference, P - E, is completely different in East Malaysia compared to Peninsular Malaysia. It is shown that this difference is also positive in both Sabah and Sarawak. Higher values of P - E are observed in the southern part of Sarawak, while lower values are registered further north. The principal role of the monthly distribution of P - E is given by the double passage of the Intertropical Convergence Zone (ITCZ). The secondary role is given by both the NE and the SW monsoon winds.

Keywords: Intertropical Convergence Zone, Southeast monsoon, Northeast monsoon, inter-monsoon period

INTRODUCTION

El Niño represents the warm phase of the Southern Oscillation. This process is known by the acronym of ENSO (El Niño Southern Oscillation) events. Whenever ENSO events occur, droughts in Indonesia, Sri Lanka and southern India happen. During the 1982-83, the 1986-87 and the 1991-93 ENSO events, a significant distortion of the precipitation pattern has been registered in Peninsular Malaysia (Camerlengo *et al.* 1998). It is believed that local effects, such as monsoon winds and sea breeze, tend to mask the deficit of precipitation that occurs in this area during ENSO events. On the other hand, East Malaysia registers an important deficit of precipitation during the above three mentioned ENSO events (Camerlengo *et al.* 1997). Further investigation is needed to determine the variability of parameters other than precipitation, such as insolation, evaporation, incoming short wave solar radiation, sea surface temperature anomalies. To accomplish this task, a comparison between monthly climatological values of the above mentioned parameters and their monthly anomaly during ENSO events needs to be done.

A comprehensive knowledge of the climate of Malaysia is mandatory. The aim of our research is to gain a better knowledge of the principal dynamic aspects of the climatic pattern of Malaysia. In particular, the aim of the present study is to gain a better understanding of the monthly distribution of P - E in Sabah and Sarawak. No similar undertaking has been done before. Thus, this work represents the first of such an attempt. For this purpose, monthly records of ten stations are analyzed.

Our results are quite conclusive. It is established that the total amount of rainfall is greater than the total amount of evaporation. (In particular, P - E in Sarawak is higher than in Sabah.) This may be attributed to the fact that East Malaysia belongs to the "Maritime Continent" of the western Pacific and southeastern Asia (Philander 1990). Due to the fact that a low pressure system is usually located in Indonesia, the "Maritime Continent" is an area characterized by convective precipitation. This effect is frequently observed by satellite measurements in the form of outgoing long-wave radiation from the top of Cumulu-nimbus clouds.

The "Maritime Continent" undergoes an eastward migration during ENSO events. As a consequence of this, the climatic pattern of Southeast Asia suffers a severe distortion. Drought in Southeast Asia follows quite naturally, as registered in Indonesia and Australia during the severe 1982-83 ENSO event. In particular, palm oil production in the Philippines declines during an ENSO event (Glantz 1994).

The ultimate aim of our research is to understand how a "canonical" ENSO event disrupts the climatic pattern of Malaysia. Once this is known, we should be able to determine the economical losses of the Malaysian economy during ENSO events.

For the sake of convenience, the monthly distribution of P – E is only shown for typical months of both the north-east (NE) and the south-west (SW) monsoon seasons, as well as for a typical month of the transitional month between both monsoon seasons. As such, maps showing the monthly distribution of P – E for January, July and October are presented.

DATA

Monthly data of precipitation and evaporation at Kuching, Sri Aman, Sibu, Miri, Labuan, Kota Kinabalu, Sandakan, Bintulu, Kudat and Tawau are obtained from the "Monthly Summary of Meteorological Observations" published by the Malaysian Meteorological Service (1964-1993). The location of the meteorological stations as well as the years of monthly records are given in *Fig. 1.*

RESULTS AND DISCUSSION

In January the monthly distribution of P - E in East Malaysia is quite similar to the one observed in the east coast of Peninsular Malaysia (Camerlengo *et al.*

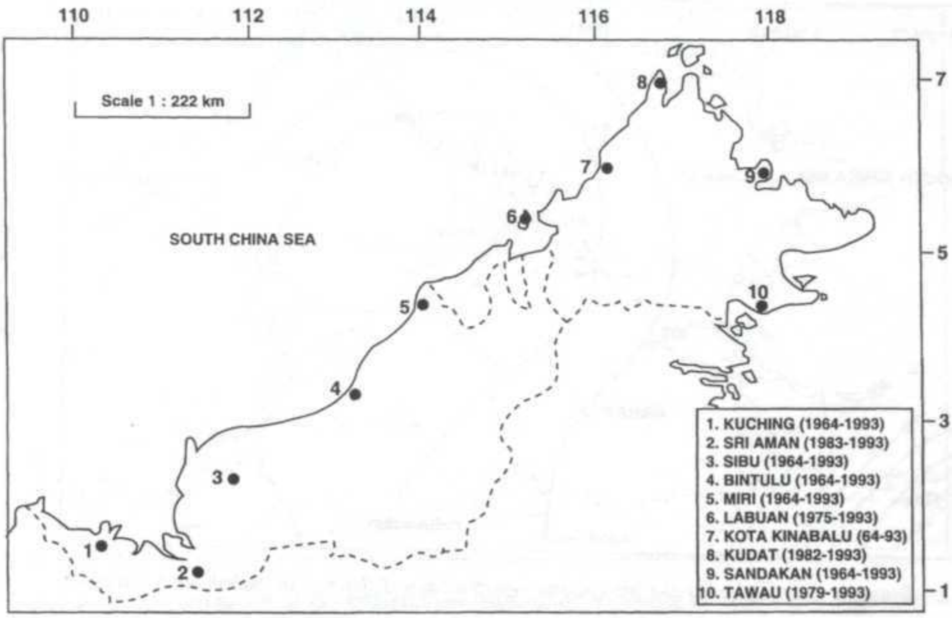

Fig 1. Location of both the precipitation and the evaporation stations being analyzed in this study. The years of records are indicated in parenthesis

1996). Higher values are registered in the southern part of East Malaysia, while lower or negative values are observed in Sabah (*Fig. 2*). The only exception is represented by Sandakan and Kudat. This may be attributed to their exposure to the NE monsoon winds. Higher values of P - E observed in Kuching, Sri Aman, Bintulu and Sibu may be explained by the southward motion of the convective area associated with the ITCZ.

The distribution of P - E has substantially lesser values in February compared to January, at all stations. This may be attributed to the fact that the ITCZ is in the southern hemisphere during February.

Negative values of P - E are observed in Sabah in March. The same situation is registered in the northern part of Peninsular Malaysia's east coast. Furthermore, Sarawak (with the single exception of Kuching) registers an increase of P - E in unison with the southern part of Peninsular Malaysia's east coast (with the single exception of Mersing (Camerlengo *et al.* 1996)). This phenomenon may largely be attributed to the fact that the sun crosses the equator on March 21st. It is well established that the ITCZ follows the motion of the sun (Necco 1980).

Negative values of P - E persist in Sabah during April. This may largely be attributed to the fact that April represents the transition period between the Northeast (NE) and the Southwest (SW) monsoon season (Nasir and Marghany 1996). Moreover, lower values are registered in Sarawak compared to the previous month. Cloudless skies prevail during the transition period. Thus, there is an increase of local evaporation values in April.

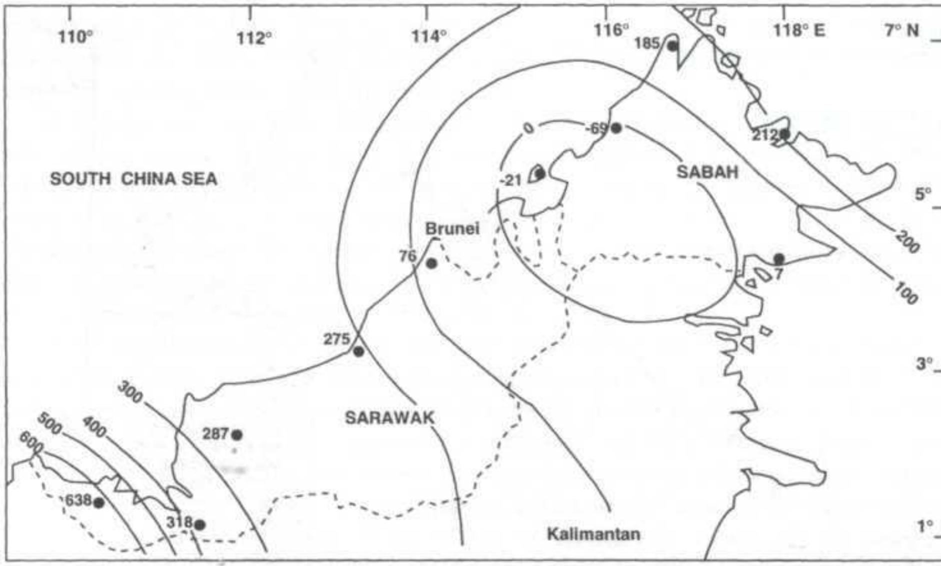

Fig 2. January distribution of the precipitation-evaporation difference in Sabah and Sarawak

From January to April, the situation in East Malaysia is strikingly similar to Peninsular Malaysia's east coast. Negative values in the northern part and positive values in the southern part exist.

May represents the onset of the SW monsoon season. Therefore, an increase of P - E values is observed in Sabah, in particular, in Labuan and Kota Kinabalu.

In June, positive values of P - E are observed, for the first time, at all stations in Sabah. At the same time, a decrease is observed in Sarawak (as compared to May). This may largely be explained by the northward motion of the ITCZ. The convective area associated with the ITCZ discharges its humidity in Sabah as it progresses northwards. Due to this same effect, precipitation in Sarawak is lesser than in the previous month.

A slight increase of P - E (with the exception of Kudat and Miri) is observed in July (*Fig. 3*). This may be attributed to the fact that precipitation values are higher (during July) due to the equatorward motion of the ITCZ, which in turn is related with the southern motion of the sun.

Due to the SW monsoon winds, the distribution of P - E is quite similar for both August and July. However, an increase of P - E is observed in September. This may largely be attributed to the fact that the sun crosses the equator on September 21st. The convective area associated with the ITCZ is responsible for the increase of precipitation being observed at all stations (with the single exception of Tawau) during September.

October P - E values are higher than in the previous month (*Fig. 4*). This should be attributed to the southward migration of the ITCZ. This effect is more obvious in the following month. Northeast monsoon winds are also responsible for larger precipitation values during November. These two combined

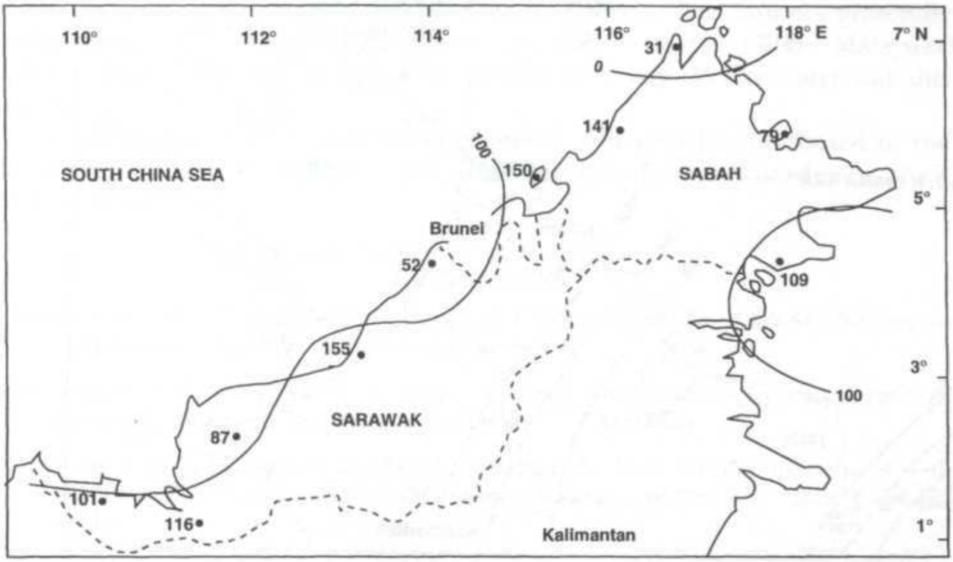

Fig 3. July distribution of the precipitation-evaporation difference in Sabah and Sarawak

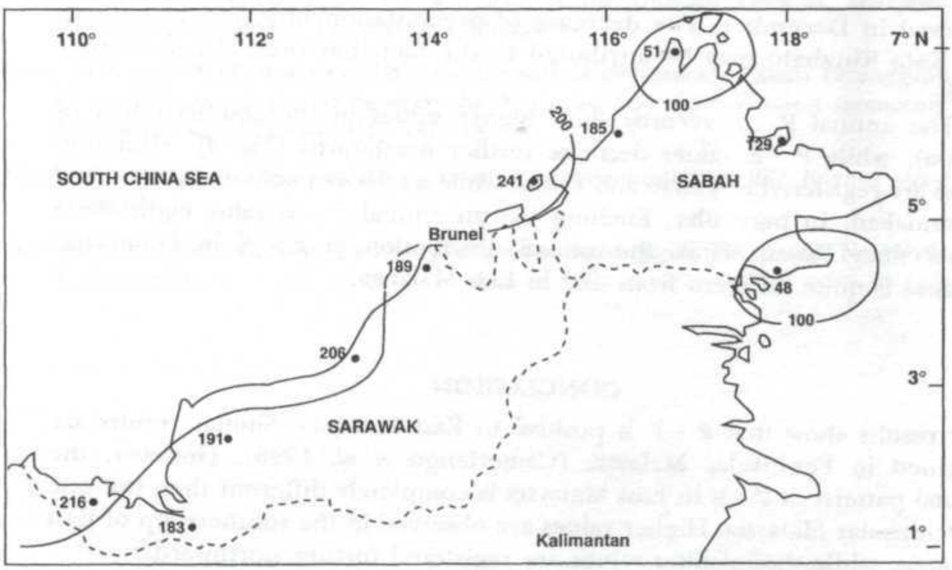

Fig 4. October distribution of the precipitation-evaporation difference in Sabah and Sarawak

effects - NE monsoon winds and the passage of the ITCZ - may be attributed to the high values of P - E observed in November.

The exposure of Sandakan, Kuching, Sibu, Miri, Bintulu, Sri Aman and Kudat to the NE monsoon winds is responsible for the increase of P - E values

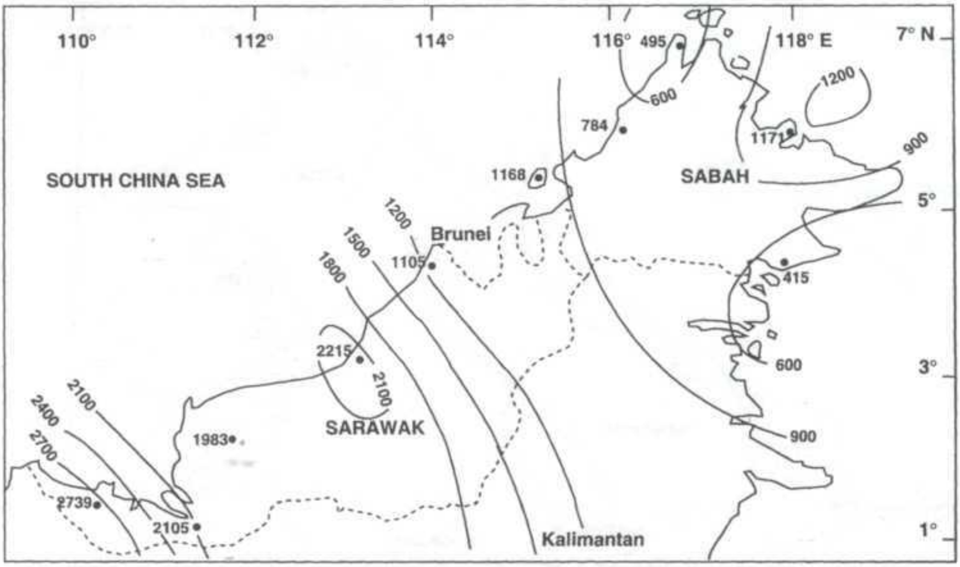

Fig 5. Annual distribution of the precipitation-evaporation difference in Sabah and Sarawak

observed in December. The decrease of precipitation observed in Labuan and Kota Kinabalu may be attributed to the fact that the ITCZ is further south.

The annual P - E records show higher values in the southern half of Sarawak, while P - E values decrease further northwards (*Fig. 4*). Minimum values are registered in Tawau and Kudat, while a relative maximum is observed in Sandakan. In particular, Kuching has an annual P - E value eight times higher than Tawau. Thus, the annual distribution of P - E in Peninsular Malaysia is quite different from that in East Malaysia.

CONCLUSION

Our results show that P - E is positive in East Malaysia. Similar results are obtained in Peninsular Malaysia (Camerlengo *et al.* 1996). However, the annual pattern of P - E in East Malaysia is completely different than the one in Peninsular Malaysia. Higher values are observed in the southern tip of East Malaysia, while diminishing values are registered further northwards.

The fact that P - E is positive verifies the fact that Malaysia is embedded in the "Maritime Continent" of Southeast Asia (Philander 1990).

The principal role of the distribution of P - E is given by the double passage of the ITCZ. The secondary role is given by both the NE and the SW monsoon winds. In this regard, previous results obtained for Peninsular Malaysia are confirmed.

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