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DIURNAL VARIATION OF MONSOON RAINFALL AT AN INLAND STATION IN THE BRAHMAPUTRA VALLEY

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ABSTRACT

The diurnal variation patterns of monsoon rainfall observed at Gauhati, an inland station in the Brahmaputra Valley, are presented in this paper. The four monsoon months show different variation patterns, with peaks occurring during early morning hours in June, August and September, and during late morning and late night in July. The mean hourly rainfall is a maximum in June and a minimum in September. The coefficient of variation of the mean hourly rainfall is highest in September (128%) and lowest in July (62%).

INTRODUCTION

THE diurnal variation of rainfall is an important feature in the tropics. A study of this parameter provides information not only on the atmospheric processes involved in the occurrence of rainfall in a particular locality, but is of great value in the hydrological forecasting and solution of problems relating to water management, road transport, agriculture, etc.

Several workers¹⁻¹⁰ have studied the diurnal variation of rainfall in India, but no work for a station in the Brahmaputra Valley appears to have been done. This valley is surrounded by high mountains on three sides with a narrow neck leading to the plains of Bengal. As this unique setting might have some influence on the diurnal variation of rainfall in the valley, a study on the diurnal variation of rainfall at Gauhati in the Brahmaputra Valley was made and the results are

presented in this note.

DATA AND ANALYSIS

Rainfall data for each hour were obtained from the rainfall records of the recording rain gauge installed at Gauhati University campus (26° 11'N, 91° 46'E). The data used are for the five years, 1969-1972 and 1978.

Plots of average rainfall for each hour, for the individual monsoon months June to September and for the season as a whole are shown in figure 1. The variations are not smooth and show many primary and secondary peaks. Using suitable binomial weights (say $n=12$), three point moving averages of the curves were obtained as shown in figure 1. Some of these smoothed curves seem to have an oscillatory character. The mean, the standard deviation and coefficient of variation of the hourly data were calculated and are presented in table 1.

TABLE 1

Mean, Standard Deviation and Coefficient of Variation of rainfall per hour per rainy day, for different months and for the season

Months	Average hourly rainfall in mm (\bar{x})	Standard deviation of \bar{x} (in mm)	Coefficient of variation of \bar{x} in %
June	0.82	0.56	69.01
July	0.67	0.41	61.82
August	0.54	0.46	85.64
September	0.30	0.39	127.93
Seasonal (monsoon)	0.67	0.33	49.30

RESULTS AND DISCUSSION

Figure 1 shows that the peaks of the average diurnal variation curves for each month and the season as a whole, are different, both numerically and in the times of occurrence. The June curve contains the maximum number of peaks, out of which three are greater than the mean rainfall of the hours. The June, August and September curves show prominent peaks near 0300–0500 hr IST. This peak is conspicuously absent in the month of July which shows two almost equally prominent peaks, one at 0900 hr IST and the other at 2300 hr IST. Another conspicuous peak occurs at 1700 hr IST in September. During the monsoon season as a whole, the diurnal variation curve of rainfall shows three prominent peaks each at 0300 hr IST, 0900 hr IST and 2300 hr. An examination of the curves for each of the individual years show that their behaviour is more or less similar to those of the mean curves, except that they are more erratic and that there are small shifts in the times of occurrence of the peaks.

The presence of morning maxima has been reported earlier in the rainfall at coastal stations,^{8,11} Trivandrum, Cochin, Bombay, Vengurla and Goa. An afternoon maximum has been observed at Nagpur³, an inland station, and at the hill stations⁵ Mahabaleswar and Kodaikanal. At Cherrapunjee, which has very heavy rainfall, night and early morning maxima are observed⁵. The diurnal variations of rainfall at Gauhati are seen to be less erratic than that at Trivandrum, Goa, Mangalore and Bombay.

The physical causes responsible for the various features of diurnal variation of rainfall observed in different parts are not yet well understood. However, most of the workers mentioned above, suggested that rainfall variation of the type observed is mainly caused by diurnal variation of surface heating and associated

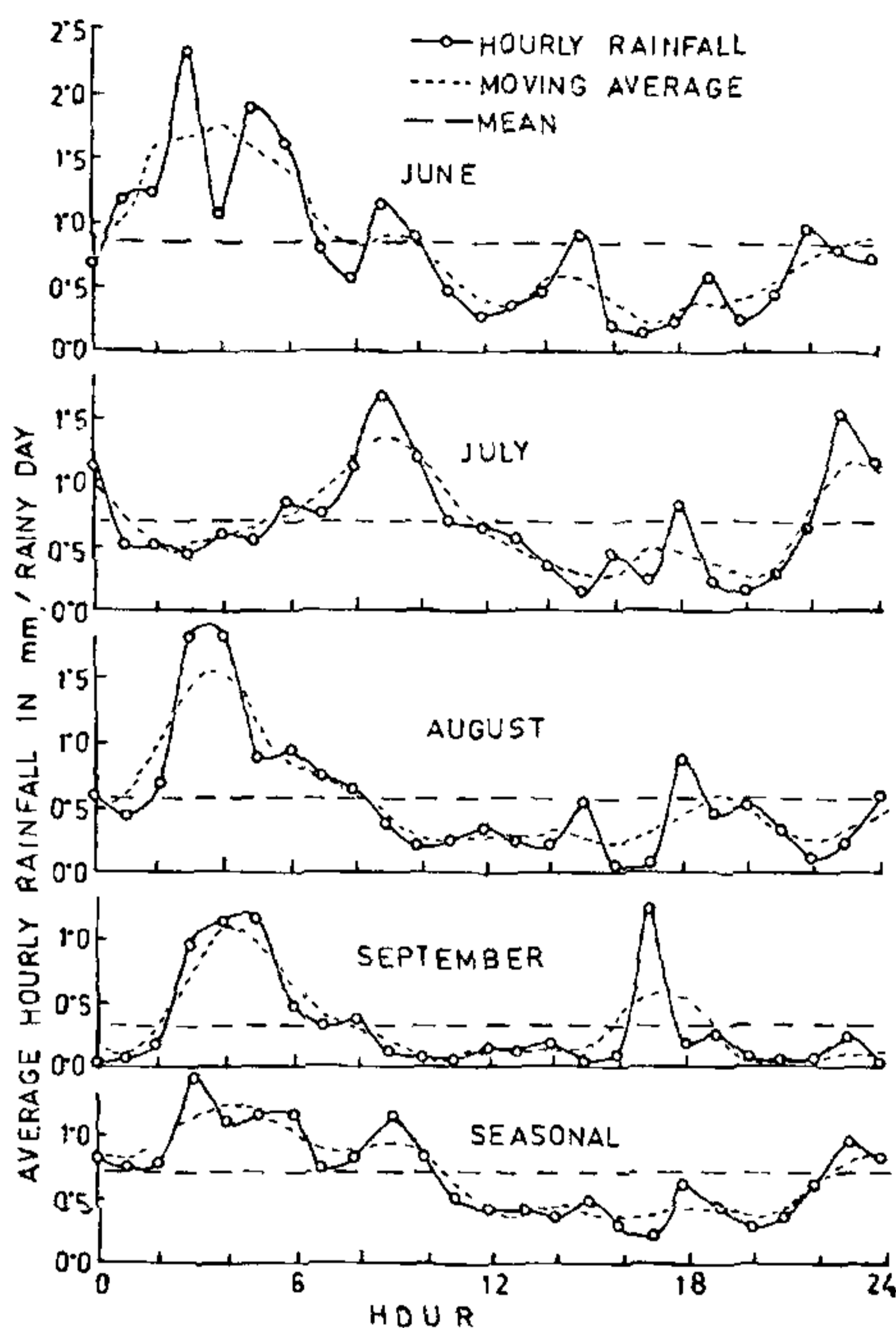


Figure 1. Diurnal variation of rainfall at Gauhati for (a) June, (b) July, (c) August, (d) September and (e) seasonal (monsoon).

local atmospheric circulation. According to Gray and Jacobson¹² differences in the radiational heating or cooling between the cloudy region and the surrounding cloud-free region lead to diurnal variations of rainfall. Where rainfall is caused by cyclonic storms or depressions, the diurnal variation is comparatively small¹³.

The early morning (0300–0500 hr IST) maxima observed in figure 1, in June, August and September may be due to the radiational cooling of the cloud layers. During the monsoon, the average cloud amount is quite high (6 octas) at Gauhati¹⁴. Radiational cooling of the top of the cloud layers during night could lead to internal instability in the layers which causes precipitation in the early morning hours. In the month of July some other effects, such as variations in wind and air temperature could delay the process of shifting the early morning maximum to late morning.

In the occurrence of the afternoon maxima at Gauhati solar radiation would appear to play a major role. As cloudiness decreases in September with a

corresponding increase in solar radiation, the afternoon maximum becomes more prominent.

Evening and early night maxima are the result of convective activity. During the day, surface heating leads to increased convective activity which produces instability in the atmosphere and leads to katabatic winds during the night. Such katabatic winds from Garo, Khasi and Jaintia Hills might produce rainfall in the evening and early night at Gauhati.

Table 1 shows that the average hourly rainfall per rainy day for the different months is a maximum in June and a minimum in September. The monthly rainfall normals for the monsoon period also show an almost similar behaviour. The coefficient of variation of average hourly rainfall is a maximum in September. The curves also indicate that only about 30% of the daily rainfall occurs in the late morning and afternoon hours (1000-2100 hr IST). Rainfall during the day hours (0600-1800 hr IST) is also observed to be less than that during the night hours.

CONCLUSION

Diurnal variation patterns of rainfall are different for each of the monsoon months at Gauhati. In June, August and September they show prominent peaks in the very early morning or late night which might be due to the effect of radiational cooling of the top of the cloud layers. During September, the higher amount of solar radiation received seems to play an important role in producing the afternoon maximum. The evening and early night maxima, specially in June and July, might be produced by katabatic winds from the neighbouring hilly areas.

The intensity of hourly rainfall is maximum in June and minimum in September. The present results may be considered to be tentative, as the data for only five years have been used in this study.

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SIMPLE DIAGNOSTIC TECHNIQUE FOR PLANT DISEASES OF MYCOPLASMAL ETIOLOGY

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MYCOPLASMAS which are also referred to, as wall-less bacteria have been widely reported to parasitise on several plant hosts¹. In affected plants the mycoplasma-like organisms (MLO)/mycoplasma-like bodies (MLB) occur as phloem delimited obligate parasites and induce diseases "yellows" of economic concern²⁻⁵. A major constraint in diagnosis of plant mycoplasma is that, except the spiroplasmas, they cannot be cultured in artificial media^{1,6,7}. The association of MLO in host plants can be reliably

detected by electron microscopy^{1,5} and fluorescence microscopical technique⁸ but they require elaborate procedures, expensive equipments and reagents. Therefore, a simple technique for quick diagnosis of mycoplasmal diseases is desirable. A diagnostic technique involving selective stains for plant diseases of viral etiology has been demonstrated⁹. In the detection of cultures of animal mycoplasmas and plant spiroplasmas on agar media the Dienes' stain is commonly used^{6,10,11}. Plant and animal mycoplasmas