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Diurnal variation and intensity of rainfall over Tiruchirapalli Airport

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ABSTRACT. Hourly distribution of rainfall in different months and seasons, frequencies of intensities of rain and of the maximum intensities on rainy days over Tiruchirapalli Airport are summarised in this note, based on the available records of Casella siphon raingauge.

1. Introduction

Rainfall distribution over Tiruchirapalli Airport (Lat. 10°46'N, Long. 78°43'E) situated about 9 km to the south of the urban locality, has been discussed along with other meteorological elements in a Technical Note by Jagannathan (1949). However, data relating to hourly values of rainfall at Tiruchirapalli Airport are available only since June 1953, when a Casella siphon tube self-recording raingauge was installed, with the rim of the funnel at a height of 75 cm above ground, close to the ordinary raingauge in the observatory enclosure. The amounts recorded by the self-recording raingauge compare well with those measured from the ordinary raingauge. The present note gives the results of an analysis of the rainfall data, obtained from the charts of the self-recording raingauge at the Airport Observatory, during the eight-year period, June 1953 to May 1961.

2. Data

Totals of the hourly values of rainfall for different months of the eight-year period were determined and the means worked out. Rainfall tabulations in mm and tenths were directly available since the introduction of charts with metric units. For the earlier period, tabulations made correct to a cent were converted into mm and tenths and utilised. The average intenisties per hour were worked out from the amount of rain falling in successive intervals of 15 minutes, taken as a whole, on the lines of Krishnaswamy (1952).

3. General features of rainfall over Tiruchirapalli

Broadly speaking, there are two significant periods of maximum rainfall over Tiruchirapalli, one during April-May and the other from middle of August to end of November. The rainiest months, September to November, contribute to about 47 per cent of the annual rainfall. Moist air of sea origin generally extending to about 2 km overrun at 3·0 km and above by dry air with practically no sea travel, favour occurrence of thunderstorms during the transition months—April, May, September and October. Those of October are associated with greater rainfall amounts and intensity, which may be attributed to the relatively greater moisture content of the air in the lower levels, forming a part of the circulation round the low in the south Bay. Depressions and cyclones forming in the Bay and crossing Coromandal coast during October—November, also contribute to the maximum rain occurring in these months. About 70 mm of rain occur during December—January associated with westward movement of easterly waves, as they move across Ceylon coasts. Very little rain

TABLE 1

Average rainfall (mm) in 2-hourly periods
(percentages of 24 hr rainfall given in brackets)

	00 to 02	02 to 04	04 to 06	06 to 08	08 to 10	10 to 12	12 to 14	14 to 16	16 to 18	18 to 20	20 to 22	22 to 24 IST	Total for 24 hrs
Jan	1·2 (7)	0·8 (4)	0·7 (4)	0·9 (5)	2·3 (13)	3·3 (18)	4·5 (25)	3·0 (17)	0·7 (4)	0·4 (2)	0·2 (1)	0·1 (1)	18·1
Feb	..	0·8 (47)	0·6 (35)	0·2 (12)	..	..	..	0·1	..	..	..	..	1·7
Mar	0·6 (11)	0·3 (6)	..	0·5 (9)	..	..	0·9 (17)	1·4 (26)	1·7 (32)	..	..	..	5·2
Apr	0·8 (1)	8·2 (14)	0·5 (1)	0·7 (1)	0·2 (—)	1·6 (3)	2·0 (3)	4·3 (7)	11·3 (19)	21·8 (37)	4·4 (7)	3·4 (6)	50·2
May	0·6 (1)	0·6 (1)	1·0 (1)	0·8 (1)	6·0 (8)	1·2 (1)	3·2 (4)	7·4 (9)	6·6 (8)	24·1 (30)	22·9 (29)	5·2 (7)	79·6
Jun	0·3 (2)	0·2 (1)	0·2 (1)	1·6 (10)	0·1 (1)	..	..	1·0 (6)	7·7 (46)	3·8 (23)	0·9 (5)	0·8 (5)	16·6
Jul	2·5 (7)	2·3 (7)	0·3 (1)	0·1 (—)	0·1 (—)	0·4 (1)	0·1 (—)	0·6 (2)	2·9 (9)	5·1 (15)	14·4 (43)	4·8 (14)	33·6
Aug	3·3 (5)	3·0 (4)	0·3 (—)	1·2 (2)	0·1 (—)	..	0·9 (1)	1·5 (2)	5·3 (8)	8·0 (11)	30·8 (44)	15·0 (21)	69·4
Sep	8·5 (7)	2·3 (2)	0·6 (—)	..	0·6 (—)	0·2 (—)	0·8 (1)	5·0 (4)	15·8 (12)	19·7 (16)	53·5 (43)	19·0 (15)	126·0
Oct	23·7 (12)	12·0 (6)	5·7 (3)	4·5 (2)	2·0 (1)	3·1 (1)	1·7 (1)	2·9 (1)	22·8 (11)	31·3 (15)	53·8 (26)	40·2 (20)	203·7
Nov	8·2 (7)	11·8 (10)	9·2 (8)	5·2 (4)	4·0 (3)	10·6 (9)	15·3 (13)	17·5 (15)	10·0 (3)	9·7 (8)	9·2 (8)	7·9 (7)	118·6
Dec	3·3 (6)	2·3 (5)	2·7 (5)	4·2 (8)	5·8 (12)	6·8 (14)	3·7 (7)	7·5 (15)	4·4 (9)	2·6 (5)	2·2 (4)	5·1 (10)	50·6
Year	53·0 (7)	44·6 (6)	21·8 (3)	19·9 (3)	21·2 (3)	27·2 (3)	33·1 (4)	52·2 (7)	89·2 (11)	126·5 (15)	192·3 (25)	101·5 (13)	782·5

occurs during June—July and the months of February—March are mainly dry.

4. Results and Discussions

4.1. *Diurnal variation of rainfall*

4.1. 1. Table 1 gives the distribution of rainfall in two-hourly periods for the different months as well as for the whole year. Percentages of the total for all the twentyfour hours are given in brackets. During the period under study, average rainfall over Tiruchirapalli airport was only 2 per cent less than the normal rainfall values of Tiruchirapalli Cantonment observatory, considered for the year as a whole. Among the months which contribute to the bulk of the annual rainfall, the month of August was drier (—20 per cent), September and October wetter (13 and 14 per cent) and May and November nearly normal (—3 per cent and —5 per cent).

4.1.2. The diurnal variation of the amount of rainfall in the four different seasons, together for the year as a whole, is shown in the histograms (Figs. 1a to 1e). Total hourly rainfall are expressed as percentages of the 24 hours total in the graph.

4.1.3. It may be seen from Table 1 that the amount of rainfall recorded in any two-hourly period is highest in the months of September—October in the whole year. Maximum rainfall in two-hourly periods for the months April—May occurs during 1800—2000 IST, and gets shifted to 2000—2200 IST during August to October and to 1400—1600 IST in November.

4.1.4. During April—May, more than 60 per cent of the rainfall of the respective month, occurs during the period 1600—2200 IST, with a sharp rise at 1800 IST. A secondary maximum is seen between 0200—0400 IST in April. The amount of rainfall during the period 0600—1400 IST in April and May is less than 10 and 15 per cent respectively of the monthly total.

4.1.5. About 75 per cent of the rainfall of August—September occurs during the period 1600—2400 IST. There is a sharp rise in the

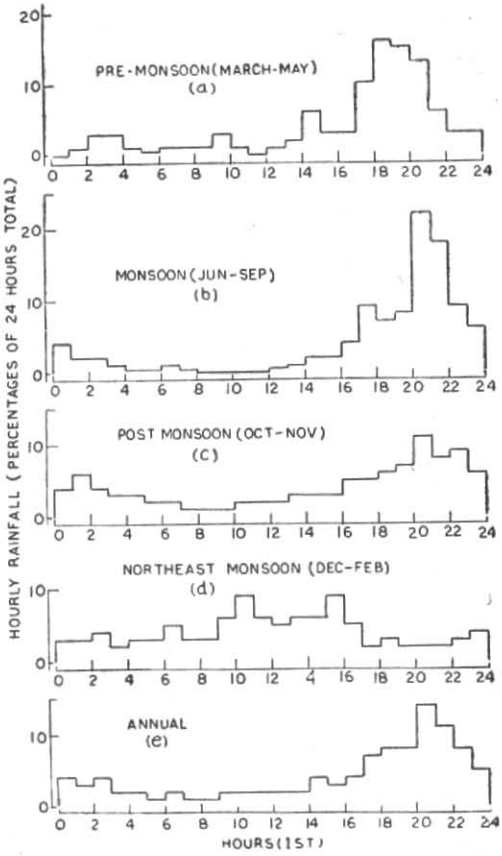

Fig. 1

TABLE 2

Numbers of fifteen-minute periods of rainfall with different intensities within specified limits, during the period of 8 years (June 1953 to May 1961)

	Intensities (mm/hr)						
	<12·5	12·5 and above but <25·0	25·0 and above but <50	50 and above but <75	75 and above but <100	>100	Total
January	135(94)	8(6)	1(—)	..	..	..	144
February	3(75)	1(25)	..	..	..	..	4
March	19(86)	..	3(14)	..	..	..	22
April	158(80)	18(9)	11(6)	6(3)	4(2)	..	197
May	248(83)	24(8)	16(5)	7(2)	5(2)	..	300
June	125(91)	10(7)	3(2)	..	..	..	138
July	163(88)	16(8)	6(3)	2(1)	1(—)	..	188
August	319(88)	23(6)	20(5)	2(1)	2(1)	..	366
September	345(80)	37(8)	45(10)	5(1)	6(1)	1(—)	439
October	718(85)	72(8)	49(6)	10(1)	5(1)	..	854
November	867(92)	54(6)	17(2)	3(—)	..	..	941
December	513(95)	19(4)	8(1)	..	..	..	540
Year	3613(88)	282(7)	179(4)	35(1)	23(1)	1(—)	4133

Percentages are given in brackets

percentage at 2000 IST followed later by a sharp fall at 2200 IST. In October, there is a significant percentage of rainfall extending upto the early hours after midnight, although the peak is maintained during 2000—2200 IST. The two-hourly period of 2000—2200 IST of September—October together contributes 13 per cent of the annual rainfall.

4.1.6. During November—December, the rainfall is evenly distributed throughout the 24 hours with relatively higher values during day-time.

4.1.7. From the histograms presented in Fig. 1, for the different seasons, it is seen that —

(*i*) 69 per cent of the rainfall of the pre-monsoon season, 83 per cent of the monsoon season and 57 per cent of the post monsoon season occur during the period 1700—2400 IST. As regards the northeast monsoon period only 23 per cent of the rainfall occurs during this period.

TABLE 3

Average number of rainy days with maximum intensity within specified limits in the four fifteen-minute periods of each full hour

(Rainy day is the day with a total rainfall of 0·3 mm or more between 00–24 IST)

	Average number of rainy days with maximum intensity			Average duration of rainfall in minutes corresponding to	
	<25 mm/hr	25 mm/hr and above but <50 mm/hr	50 mm/hr and above	25 mm/hr and above but <50 mm/hr	50 mm/hr and above
Jan	3·4	0·1	..	..	..
Feb	0·6	..	..	..	..
Mar	0·9	0·3	0·1	..	..
Apr	4·4	2·1	1·1	21	17
May	6·3	2·0	0·9	28	25
Jun	4·5	0·1	..	..	..
Jul	4·5	0·6	0·1	15	..
Aug	8·2	1·7	0·6	29	16
Sep	9·9	2·6	0·4	35	33
Oct	15·0	4·4	1·4	31	31
Nov	12·2	1·4	0·4	24	15
Dec	6·7	0·9	..	20	..
Year	76·6	16·2	5·0	28	22

(*ii*) During the monsoon season, there is a sharp rise in rainfall at 2000 IST followed by a sharp fall at 2200 IST.

(*iii*) About 25 per cent of the rainfall of post monsoon season occurs during the period 0000—0600 IST.

(*iv*) 40 per cent of the northeast monsoon rain occurs during day time with two maxima — one between 1000—1100 IST and the other between 1500—1600 IST.

(*v*) For the year as a whole, the period 1700—2400 IST contributes 60 per cent of the rainfall, with a sharp rise at 2000 IST.

4.2. *Intensity of Rainfall*

4.2.1. Table 2 gives the numbers of 15-minute periods in which different intensities of rain were recorded. Fifteen-minute periods are the first, second, third and fourth quarters in every full hour period. Table 3 shows the average number of rainy days with maximum intensity for the day within specified limits during the fifteen-minute periods. Average duration of rainfall in minutes corresponding to intensity 25·0 mm/hr and above but less than 50 mm/hr and also for 50 mm/hr and above are also given in the table. This duration is got by dividing the total duration of spells in which the maximum intensities occurred in each day, by the number of rainy days under the respective category.

4.2.2. It may be seen from Table 2 that a fair number of periods of rainfall intensities exceeding 25 mm/hr generally occur in the months of April, May and later August to November. Rainfall intensities exceeding 50 mm/hr occur roughly in about half the number of occasions of intensities exceeding 25 mm/hr during April—May and one in four during August to October. Such occasions are invariably associated with thunderstorms. There are also about 2 per cent of the number of periods during April and May and 1—2 per cent in August to October experiencing intensities of over 75 mm/hr. However, in all the months, roughly in 90 per cent of the total number of periods, the intensity was below 12·5 mm/hr. Highest intensity of 160 mm/hr was recorded on 26 October 1955 between 2000—2015 IST.

4.2.3. From Table 3, it may be seen that there can be 3—4 rainy days with the maximum intensity for the day exceeding 25 mm/hr during September—October and 1—2 days in April—May, August and November, with duration roughly extending from 20—30 minutes. There can also be about one occasion, in the months of April, May and October having maximum intensity of rainfall exceeding 50 mm/hr with duration between 15—30 minutes. About 45 per cent of such maximum intensities occur within the hours 1800—2100 IST during the months April, May and August to October.

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