

## On certain aspects of rainfall at Cherrapunji

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**ABSTRACT.** This paper contains the analysis of the hourly values of rainfall at Cherrapunji for the years 1946-1949. By comparison, it is shown that the early morning periods 0100 to 0700 IST are more rainy in comparison to the periods 1200 to 1800 IST in the afternoon particularly during the more wet months April to October. It is explained that this preference of rainfall to the morning hours is to a large extent due to the increased frontal interaction of dry continental air from east or northeast with air from southwest to southeast having maritime characteristics.

Cherrapunji (Lat.  $25^{\circ}15' N$ , Long.  $91^{\circ}44' E$ ) is situated on the crest of the southern scrap of Khasi hills at an elevation of 4309 ft overlooking the plains of Sylhet. It stands on a thick-bedded sandstones bounded on two sides by precipices of 2000 ft sheer descent which closes in gorges debouching southwards on the plains.

Cherrapunji is well-known all over the world as the station with a record of highest rainfall in a year. The total rainfall at Cherrapunji is 425.23 inches in a year. Table 1 gives normal rainfall of Cherrapunji month by month. Maximum rainfall of 36.40 inches in 24 hours was recorded at Cherrapunji in June 1934\*.

Meteorologically, the year at Cherrapunji may be divided as follows—

Winter	December to February
Premonsoon	March to May
Monsoon	June to September
Post monsoon	October and November

During winter, weather is generally fine to fair with occasional light rain occurring under the influence of western disturbances which move eastwards through Tibet and Upper Assam. Premonsoon rainfall is mainly associated with thunderstorms. Southwest monsoon sets in in Assam by the first week of June, although during the latter part of May, rain associated with thunder

often continues for days, leading to conditions which are largely monsoonish. The bulk of rainfall at Cherrapunji *viz.*, 316 inches out of the total of 425 inches occurs in the monsoon season, June to September. During this period rainfall is maximum in June and minimum in September when the month's total is less than that in May. Rainfall during the post monsoon season is usually in the nature of thundershowers which occur fairly frequently in the first half of October. Rainfall in this season is, however, rarely heavy or continuous except when it is associated with a depression or a cyclonic storm.

In this paper, which has been based on hourly values of rainfall for the four years 1946 to 1949, the most noticeable feature that has been brought out is that the incidence of rainfall at Cherrapunji during the year as a whole and especially during the more wet months April to October shows a distinct preference to the early morning period 0100 to 0700 IST as compared with the six hour period 1200 to 1800 IST in the afternoon.

Table 2 shows the total rainfall month by month which occurred during the whole day and the periods 0100 to 0700 and 1200 to 1800 IST during 1946—1949 separately for each year and also the period of four years taken together. An examination of the annual table shows that while 35 to 55 per cent of rain in a month during the monsoon

\* Blanford had recorded a still higher figure of 40.8 inches for maximum rainfall at Cherrapunji on 14 June 1876  
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season fell between the period 0100 to 0700, the rainfall recorded during the six hour period 1200 to 1800 constituted only 6 to 12 per cent of the total. When we consider some of the individual months, the difference between the rainfall amounts in the two periods, suggesting a distinct preference for the morning hours, becomes very striking. For instance, in August 1946 while the total rainfall during the morning from 0100 to 0700 was 29.93 inches, the amount of rainfall recorded during the afternoon 1200 to 1800 hours was only 2.72 inches, or less than one tenth of what occurred in the morning. A similar feature, although in a somewhat less marked manner is noticed during the pre-monsoon and also the post monsoon season. During winter when rainfall is scanty, there is no appreciable difference in the rainfall recorded during these two different periods of the day. It is seen from the table for the four year period that about 38 per cent of monsoon rainfall during these years fell during the period 0100 to 0700 IST and only about 10 per cent during the period 1200 to 1800 IST. During the premonsoon season about 35 per cent of rain fell during the period 0100 to 0700 IST and about 14 per cent during 1200 to 1800 IST. During the post monsoon season rainfall during the period 0100 to 0700 and during 1200 to 1800 IST was 28 and 21 per cent respectively of the season's total.

Table 3 gives, month by month, the number of rain hours during the whole day and the periods 0100 to 0700 and 1200 to 1800 IST for each year 1946 to 1949 and also season by season, for the four year period, taken together. The figures within brackets, give the percentage of total rain hours during the respective six hour periods in the morning and in the afternoon. It is seen from these tables that the chances of rain occurring during morning between 0100 and 0700 IST are definitely greater than during other hours of the day. This preference is most marked in the monsoon season during which 62 per cent of the hours in the morning between 0100 and 0700 IST are rainy, while for the day as a whole 46 per cent of the hours are rainy.

A very remarkable feature is brought out in Table 4 which gives the number of occasions during the four years under review, when rainfall of 2 inches or more in an hour

occurred at Cherrapunji during the interval 0100 to 0700, 1200 to 1800 IST and during the day as a whole. Out of 37 such occasions in all, 19 occurred during 0100 to 0700 IST, while there was no such occasion during the period 1200 to 1800 IST, showing that heavy continuous rain lasting for an hour is more likely to occur during morning hours and that chances of such rain occurring in the afternoon between 1200 and 1800 IST are very small.

In Table 5 are given the number of occasions of heavy rainfall during a short period of five minutes with an intensity of 2 inches or more per hour in different months during the period under consideration and also the frequency of incidence of such rain during the morning and the afternoon hours. It is seen that nearly half the total number of occasions of rainfall of such intensities occurred during the morning *i.e.*, from 0100 to 0700 IST and that the frequency of occurrence of such rainfall during the afternoon *i.e.*, 1200 to 1800 IST is proportionately much less than that during the rest of the day, although one would expect that in a tropical area like Assam, more intense showers of short duration would be more frequent during afternoon when insolation would help to increase the instability conditions in the moist air mass.

Turning to the meteorological aspect of the rather unexpected preference shown by rainfall at Cherrapunji to the morning hours of the day, one naturally wonders, if, besides the peculiar orographic features which help the unusually heavy rainfall at the station, there are some other important factors which provide an important mechanism for rainfall in this area. Had the orographic lift been the only or main mechanism of rainfall, one would expect the incidence of rainfall to be relatively greater during the afternoon hours when insolation would act as an additional favourable factor by increasing the instability in the atmospheric column. In this connection, it may be noted that the isobaric field in the lower levels which determines the wind distribution over Assam during the months March to September is a trough of low which becomes most well-marked during the southwest monsoon. Under the influence of this low, the winds up to at least 3000 ft over northeast Assam down to Khasi-Jayantia hills are predominantly easterly to

northeasterly, while the winds over lower Assam blow from southerly direction. The line of discontinuity between these two wind systems runs as a rule, from some northwesterly to southeasterly direction through a region fairly close to the Khasi-Jayantia range and frequently acts as a front, separating the relatively dry continental air from east or northeast from air with maritime characteristics from southwest to southeast. It would seem that the incidence of rainfall of the Cherrapunji area is besides the peculiar orographic features which cause unusually heavy rain in that area, helped to a large extent by this frontal interaction of these two air masses. The greater incidence of rainfall at Cherrapunji during the early hours of the morning is perhaps to be accounted for by the fact that the frontal activity becomes more marked during this period, because of greater radiational cooling during night of the drier air mass compared to that in the humid sector and a larger temperature contrast between the two air-masses, in consequence thereof.

Radiational cooling of the cloud top and consequently greater instability in the upper part of the cloud column during night may also be responsible partly for the greater rainfall activity at Cherrapunji during the early morning hours.

In conclusion, the author wishes to express his grateful thanks to Mr. A.K. Roy, Director, Regional Meteorological Centre, Calcutta, for suggesting this investigation and for his guidance in connection with the writing out of this paper.

TABLE 1

Normal monthly rainfall of Cherrapunji in inches

January	0.75
February	2.11
March	7.27
April	26.23
May	50.44
June	106.05
July	96.34
August	70.08
September	43.35
October	19.42
November	2.70
December	0.49
Yearly	425.23

TABLE 2

Month	Total Rainfall		
	Whole day	0100-0700 IST	1200-1800 IST
1946			
Jan	0.00	0.00	0.00
Feb	1.37	0.22 (16)	0.11 (8)
Mar	8.69	3.30 (38)	1.13 (13)
Apr	15.60	5.33 (34)	2.24 (14)
May	36.18	11.22 (31)	8.48 (23)
Jun	85.78	36.65 (43)	10.36 (12)
Jul	114.47	40.78 (36)	13.26 (11)
Aug	53.82	29.93 (56)	2.72 (5)
Sep	44.76	15.32 (34)	6.53 (15)
Oct	55.32	13.40 (24)	9.70 (18)
Nov	0.38	0.00	0.10 (26)
Dec	0.00	0.00	0.00
1947			
Jan	0.00	0.00	0.00
Feb	0.08	0.06 (75)	0.00
Mar	4.35	1.16 (27)	0.98 (23)
Apr	47.09	16.39 (35)	3.37 (7)
May	74.98	16.15 (22)	15.45 (21)
Jun	78.52	25.95 (33)	6.66 (8)
Jul	132.70	43.64 (33)	17.27 (13)
Aug	36.04	19.42 (54)	2.40 (7)
Sep	44.09	13.31 (30)	4.82 (11)
Oct	23.31	7.97 (34)	4.14 (18)
Nov	0.00	0.00	0.00
Dec	0.07	0.06 (86)	0.00

TABLE 2 (contd)

Month	Total Rainfall		
	Whole day	0100-0700 IST	1200-1800 IST
1948			
Jan	0.00	0.00	0.00
Feb	1.42	0.26	0.19
Mar	2.32	0.36	0.98
Apr	33.79	8.73	4.51
May	120.14	41.55	17.95
Jun	118.95	39.35	8.82
Jul	134.34	52.69	12.04
Aug	60.71	29.40	3.55
Sep	45.80	19.49	2.44
Oct	21.05	5.23	8.23
Nov	3.57	1.26	0.76
Dec	0.00	0.00	0.00
1949			
Jan	0.52	0.00	0.20
Feb	1.45	0.30	0.52
Mar	3.82	0.60	0.15
Apr	41.69	17.34	1.15
May	49.90	30.58	5.31
Jun	137.64	55.63	15.84
Jul	90.18	29.55	11.15
Aug	73.50	27.98	5.39
Sep	71.30	27.82	7.48
Oct	6.70	3.34	0.38
Nov	0.06	0.06	0.00
Dec	0.00	0.00	0.00

TABLE 2 (contd)

Month or Season	Total Rainfall during four years		
	Whole day	0100-0700 IST	1200-1800 IST
1946-1949			
Jan	0.52	0.00	0.20
Feb	4.32	0.84	0.82
Mar	19.18	5.42	3.24
Apr	138.17	47.79	11.27
May	281.20	99.50	47.19
Jun	420.89	157.58	41.68
Jul	471.69	166.66	53.72
Aug	224.07	106.73	14.06
Sep	205.95	75.94	21.27
Oct	106.38	29.95	22.45
Nov	4.01	1.32	0.86
Dec	0.07	0.06	0.00
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Winter	4.91	0.90	0.92
Pre-monsoon	438.55	152.71	61.70
Monsoon	1322.60	506.91	130.73
Post-monsoon	110.39	31.27	23.31
Year	1876.45	691.79	216.66

The figures within bracket give percentage of rainfall with respect to month's or season's total

TABLE 3

TABLE 3 (contd)

Month	Total number of rain hours			Month	Total number of rain hours		
	Whole day	0100-0700 IST	1200-1800 IST		Whole day	0100-0700 IST	1200-1800 IST
1946				1948			
Jan	0	0	0	Jan	0	0	0
Feb	13	2	5	Feb	30	6	6
Mar	41	(15) 13	(38) 8	Mar	22	(20) 5	(20) 3
Apr	90	(32) 35	(20) 18	Apr	157	(23) 50	(14) 26
May	173	(39) 44	(20) 46	May	315	(32) 99	(17) 69
Jun	401	(27) 145	(27) 59	Jun	349	(31) 115	(22) 43
Jul	416	(36) 138	(15) 70	Jul	500	(33) 167	(13) 77
Aug	293	(33) 116	(17) 29	Aug	280	(33) 117	(15) 26
Sep	216	(40) 69	(10) 38	Sep	240	(42) 82	(9) 38
Oct	227	(32) 66	(18) 50	Oct	110	(34) 22	(14) 42
Nov	14	(29) 0	(22) 5	Nov	72	(20) 17	(38) 18
Dec	0	0	(36) 0	Dec	0	(24) 0	(25) 0
1947				1949			
Jan	0	0	0	Jan	4	0	1
Feb	3	2	0	Feb	22	5	(25) 6
Mar	44	(67) 7	(20) 9	Mar	36	(23) 10	(27) 2
Apr	160	(16) 54	(30) 25	Apr	167	(30) 63	(6) 18
May	219	(34) 61	(16) 48	May	171	(38) 61	(11) 29
Jun	265	(28) 78	(22) 44	Jun	447	(36) 141	(17) 85
Jul	451	(30) 145	(17) 68	Jul	398	(31) 132	(19) 61
Aug	207	(32) 75	(15) 31	Aug	408	(33) 125	(15) 63
Sep	246	(36) 75	(15) 45	Sep	248	(30) 93	(15) 27
Oct	132	(30) 37	(18) 30	Oct	48	(37) 17	(11) 7
Nov	0	(28) 0	(23) 0	Nov	2	(35) 2	(14) 0
Dec	3	2	0	Dec	0	(100) 0	0
		(67)					

The figures within bracket give percentage of rain hours with respect to month's total

TABLE 3 (contd)

Month or Season	Total number of rain hours		
	Whole day	0100-0700 IST	1200-1800 IST
1946-1949			
Jan	4	0	1
Feb	68	13	17
Mar	143	35	22
Apr	574	202	87
May	878	265	192
Jun	1462	479	231
Jul	1765	582	276
Aug	1188	433	149
Sep	950	319	148
Oct	517	142	129
Nov	88	19	23
Dec	3	2	0
Winter	75 (0.9)	17 (0.8)	18 (0.8)
Pre- monsoon	1595 (18)	502 (25)	301 (15)
Monsoon	5365 (46)	1813 (62)	804 (27)
Post- monsoon	605 (10)	161 (11)	152 (10)
Year	7640 (22)	2493 (28)	1275 (15)

The figures within bracket show the number of hours with rain expressed as a percentage of the total number of hours with or without rain during the period

TABLE 4

Year and Month	Number of occasions of rainfall 2" or more per hour		
	Whole day	0100-0700 IST	1200-1800 IST
1946 Jun	3	1	0
Jul	5	2	0
Aug	1	1	0
1947 Apr	2	0	0
May	2	0	0
Jun	5	3	0
Jul	2	0	0
Sep	1	1	0
1948 May	5	2	0
Jun	4	2	0
1949 May	4	4	0
Jun	3	3	0
Total	37	19	0

TABLE 5

Number of occasions of heavy rainfall during a period of five minutes with an intensity of 2" or more per hour during 1946-1949

Month and Season	Total number of occasions		
	Whole day	0100-0700 IST	1200-1800 IST
Jan	0	0	0
Feb	0	0	0
Mar	5	1	0
Apr	57	21	4
May	85	37	11
Jun	96	45	9
Jul	22	5	3
Aug	24	13	1
Sep	13	6	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Winter	0	0	0
Pre- monsoon	147	59	15
Monsoon	155	69	13
Post- monsoon	0	0	0
Year	302	128	28