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Incidence of heavy rain at Minicoy

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ABSTRACT. Sixty years' rainfall data of Minicoy have been analysed and frequency tables of heavy rain have been presented. Rainfall associated with storms and depressions and with the first advance of the monsoon has been discussed. A preliminary study of squally weather has also been attempted.

1. Introduction

Recently the India Meteorological Department has taken up the responsibility of issuing warnings for anticipated heavy rainfall of 3″ and over in 24 hours at Minicoy. Minicoy is a small island in the Laccadives, about 275 miles to the west of Trivandrum. The island is devoid of hills or mountain ranges and is covered mostly by coconut palms. Orography has, therefore, to be ruled out as a factor in the production of rainfall at Minicoy; In fact it may be treated as a ship in the high seas. At present our knowledge of the mechanism of heavy rain at Minicoy is meagre and the forecaster usually resorts to certain "thumb rules". Climatological statistics is also an essential weapon in the armoury of a forecaster, and one of the aims of this paper is to provide the requisite climatological background.

2. Data

An observatory has been functioning at Minicoy since 1891, but uninterrupted rainfall data are available only from June 1897. Sixty years' data from June 1897 to May 1957 have been analysed and are discussed in this paper.

Table 1 gives the monthly and annual normals of rainfall and of rainy days at Minicoy. According to the usual convention a rainy day is a day on which 0·1″ or more of rain is recorded.

An examination of the rainfall normals of stations along the West Coast shows that the rainfall rapidly falls off south of Alleppey and is least at Kolachal which is the southernmost raingauge station on the West Coast. This is what can be expected from the lie of the Western Ghats. It is interesting that the rainfall normals of Minicoy are not far different from those of Trivandrum (*Mem. India met. Dep.*, 1949) which is on the same latitude as Minicoy.

In Table 2 are given the number of days of rainfall (in 60 years) within specified limits.

Since 2·5″ is plotted in the charts as 3″, which is the criterion for sending warnings for heavy rainfall for Minicoy, the number of occasions of rainfall of 2·5″ and more in 24 hours is presented separately in Table 3.

It will be noticed that February and March are free from heavy rains. There is a sudden increase in the incidence of heavy rains in May. This is mostly associated with the first advance of the monsoon and also storms and depressions. Heavy falls reach maximum frequency in June and gradually decrease as the monsoon season advances. A secondary maximum is reached in October.

There has been no year in which there was not at least one day of heavy rainfall. Nor has there been any year with more than seven days of heavy rain. The most frequent number is four per year while the average is three. Table 4 gives the actual distribution of heavy rain in 60 years.

There is no instance on record of heavy rain (2·5″ and more in 24 hours) having occurred

on three or more consecutive days. There have been 13 occasions on which Minicoy experienced heavy rain on two consecutive days. These are set out in Table 5. Heavy rain with "rather heavy" rain on the following day or preceding day has occurred on 48 occasions during the sixty-year period.

Although items 2, 6 and 9 in Table 5 are marginal cases they have been included in view of the very heavy rain that occurred on one of the two days.

In Table 6 are given the actual dates of exceptionally heavy rainfall (5" or more in 24 hours) at Minicoy. The heaviest rain on record was 8·39"on 23 May 1949.

Spells of rain lasting for at least four days with a minimum rainfall of 1" in a day are given in Table 7.

TABLE 1

Normals of rainfall and of rainy days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (inches)	1·83	0·71	0·88	2·30	7·00	11·6	8·86	7·81	6·30	7·28	5·48	3·37	63·42
Rainy days	2·6	1·2	1·5	3·5	8·7	17·0	13·7	11·8	10·1	10·6	7·7	4·3	92·7

TABLE 2

No. of days of rainfall within specified limits

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1" to 1·99"	25	11	11	29	88	143	117	85	66	82	73	38	769
2" to 2·99"	3	6	3	9	30	41	36	24	22	31	21	13	239
3" to 3·99"	1	0	0	2	7	13	5	4	9	4	2	5	52
4" to 5·99"	1	0	0	1	4	6	4	7	2	7	2	1	35
6" and over	0	0	0	0	1	0	1	1	0	0	0	1	4

TABLE 3

No. of days of rainfall of 2·5" or more

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
3	0	0	6	21	34	28	21	18	24	14	12	181

TABLE 4

Distribution of heavy rainfall days

Number of days of heavy rain in the year	Number of years
0	0
1	10
2	14
3	13
4	15
5	5
6	2
7	1
8 and more	0

TABLE 5

Instances of heavy rain on two consecutive days

Serial No.	Date	Amount (inches)
1	2 Nov 1891	5·53
	3	4·01
2	30 Dec 1898	7·38
	31	2·40
3	22 Nov 1900	4·17
	23	3·06
4	26 Jun 1902	2·67
	27	3·47
5	7 Jul 1906	2·95
	8	2·80
6	14 Oct 1909	4·60
	15	2·48
7	15 Jun 1916	2·62
	16	2·54
8	9 Jan 1926	2·81
	10	4·97
9	7 Jul 1929	2·49
	8	6·10
10	24 May 1932	3·21
	25	3·22
11	3 Jun 1937	3·28
	4	2·67
12	8 Oct 1940	2·64
	9	4·06
13	19 Jul 1947	2·74
	20	2·82

TABLE 6

Days of exceptionally heavy rain

Serial No.	Date	Amount (inches)
1	2-11-1891	5·53
2	30-12-1898	7·38
3	24-8-1899	5·26
4	6-11-1907	5·20
5	4-10-1910	5·05
6	8-5-1918	5·70
7	23-6-1926	5·85
8	8-7-1929	6·10
9	21-8-1930	7·90
10	7-6-1945	5·18
11	23-5-1949	8·39
12	31-5-1951	5·00

3. Storms and depressions

All the cyclonic storms from 1891 and depressions from 1925 to date were listed with a view to examine the rainfall at Minicoy associated with each cyclone and depression. In the prediction of heavy rainfall, the forecaster will necessarily deal with each individual situation on its merits and no generalisations can be made. However, the above study brings out the following broad features —

Post monsoon storms and depressions moving to the north of Minicoy do not generally cause heavy rain. To cite just one instance, the cyclonic storm of 3 to 10 November 1940 which formed about 150 miles to the northeast of Minicoy and moved initially

TABLE 7

Noteworthy spells of rain at Minicoy

S. No.	Date	Amount (inches)	S. No.	Date	Amount (inches)
1	10 Jul 1902	3·46	6 *(contd)*	22 Sep 1922	2·37
	11	1·03		23	1·32
	12	3·29	7	24 May 1932	3·21
	13	1·58		25	3·22
2	13 Aug 1905	1·05		26	0·96
	14	1·65		27	2·73
	15	1·17	8	22 May 1933	2·41
	16	0·84		23	1·29
	17	1·97		24	1·00
3	7 Jul 1906	2·95		25	1·22
	8	2·80		26	2·03
	9	1·96		27	2·29
	10	1·19		28	1·90
4	19 Aug 1917	1·10	9	3 Nov 1938	2·70
	20	1·18		4	1·39
	21	1·18		5	1·16
	22	2·15		6	1·45
5	8 May 1918	5·70	10	31 Aug 1946	2·30
	9	1·62		1 Sep	2·50
	10	2·36		2	1·00
	11	1·70		3	2·40
6	20 Sep 1922	1·18		4	1·50
	21	1·87		5	3·90

Note—Items 2 and 7 are marginal cases

west and later northwest, caused only light to moderate rains at Minicoy with a maximum fall of 0·87 ″ on the 5th. Ramakrishnan (1937) has found that in the case of the post monsoon cyclones in the Bay of Bengal moving into the Peninsula, rainfall extends more to the north of the track than to the south, and heavy rain also occurs in the northeastern sector. This is in agreement with the model (Fig. 1) of the post monsoon cyclone postulated by Desai and Rao (1954). The *Tm* air is more moist than the *Em*. Roy (1946) has also pointed out that in the *Em* of the post monsoon period, rainfall is less heavy and less continuous. When the post monsoon cyclones move to the north of Minicoy, Minicoy would lie in the *Em* or even in the *TcTm* air mass, and rainfall will not be so copious as in the northeastern sector of the cyclone.

The position is, however, different when the post monsoon cyclones move very close to or to the south of Minicoy. Heavy rain may be expected on such occasions since Minicoy would then be in the *Tm* air or very close to the *Tm-Em* front. For instance, in association with the severe cyclonic storm of 1 to 3 November 1891 which formed about 100 miles

east of Minicoy and moved in a westerly direction, the storm centre passing within a few miles south of Minicoy on the 2nd evening, Minicoy experienced a very heavy rain of 5·53″ on the 2nd and a further fall of 4·01″ on the next day. On more or less similar considerations one may expect heavy rain to occur at Minicoy during the stage of unsettled conditions prior to the formation of a cyclone.

Pre-monsoon storms in the Arabian Sea usually bring heavy rain to Minicoy. For example, the Calicut cyclone of 24-25 May 1932 caused 3·21″ of rain at Minicoy on the 24th, followed by 3·22″ of rain on the 25th.

Boothalingam and Srinivasan (1950) have shown that when pre-monsoon storms in the Bay of Bengal approach the Coromandel coast, heavy rain occurs in the Malabar coast also. It is, however, noticed that this belt of heavy rain does not extend to Minicoy until the storm is about to emerge into the Arabian Sea.

As already stated, the above conclusions should be used with the greatest caution in forecasting heavy rain on the basis of synoptic charts. The interesting point, however, is that except in the case of the severe cyclonic storm of November 1891 which passed right over Minicoy and the May 1949 depression which synchronised with the first advance of the southwest monsoon, none of the other instances of exceptionally heavy rain listed in Table 6 was associated with any storm or depression either in the Arabian Sea or Bay of Bengal. It is hoped to make a study of these situations separately.

4. First advance of the monsoon

Ramdas, Jagannathan and Gopal Rao (1954) have given the dates of establishment of the southwest monsoon along the various sections of the West Coast of India during the years 1891 to 1950. The rainfall at Minicoy during the sixty years under analysis was examined from this point of view, and it is seen that the onset of the monsoon at Minicoy is almost simultaneous with that along the Travancore-Cochin coast. Pre-monsoon

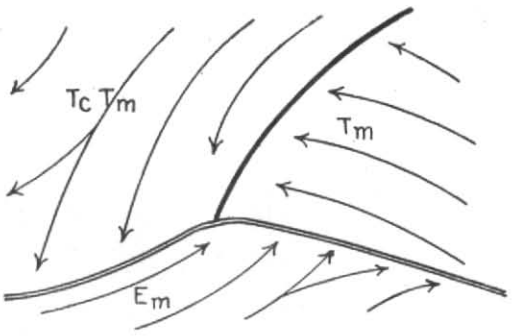

Fig. 1

thundershowers do occur at Minicoy, but in most years it is possible to recognise the first advance of the monsoon with its characteristic persistent rainfall and to draw a line between the pre-monsoon thundershowers and the regular monsoon rains. Often, there is a spell of clear weather before the onset of the monsoon. Indeed, in some years there have been no pre-monsoon thundershowers at all.

The rains ushering the southwest monsoon at Minicoy have been moderate (0·38″—1·25″) on 28 per cent of the years and rather heavy (1·26″—2·49″) on 40 per cent of the years. Only on 20 per cent of the years can the rainfall associated with the first advance of the monsoon be classified as heavy (2·50″—3·49″) while occasions of very heavy rain (3·50″ or more) are limited to 12 per cent. Even so, the heavy or very heavy rain has seldom lasted more than a day, the rest of the epoch being characterised by light to moderate rains.

5. Sporadic heavy rain in winter

Occasionally in the winter months of December to February a long spell of dry rainless days is suddenly broken by a burst of heavy rain lasting just for one day with a rapid improvement in weather thereafter. From the sequence of surface pressure changes, upper winds and weather at Hambantota, Colombo and Trivandrum it is possible to recognise the westward travel of low pressure waves across Ceylon and Comerin. Sometimes the sudden rainfall at Minicoy may be associated with a depression moving in the belt just

south of the equator in the south Indian Ocean. After affecting Minicoy, the low pressure wave referred to above is often lost sight of, and ships' observations and the upper wind changes at Minicoy give the impression that the low pressure wave has become unimportant. What has probably happened is that the low pressure wave or 'pulse' has moved south across the equator to feed the southern depression (Malurkar 1951).

6. Squally weather

A preliminary examination of the weather diary of Minicoy shows that spells of squally weather are much more numerous and prolonged even though the accompanying rainfall may not always be heavy. Pronounced squally weather is invariably associated with the first advance of the southwest monsoon and also with every fresh strengthening of the monsoon current. Squally weather also prevails whenever storms and depressions are within a reasonable distance of Minicoy and when conditions are unsettled in the southeast Arabian Sea preliminary to the formation of a cyclonic storm. Squally weather can also be expected when the northeast monsoon is vigorous in Madras under the influence of a depression or accentuated trough in the Bay of Bengal and on occasions when low pressure waves move westwards across the Comerin Maldives areas.

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