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The influence of lunar phases on rainfall

R. GOBINATHAN and P. KALYANI

Department of Physics,

Government Arts College, Villupuram

and

P. RAMASAMY

A. C. College of Technology,

Perarignar Anna University of Technology, Madras

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ABSTRACT. The influence of lunar phases on the rainfall of 22 stations evenly spread over Tamilnadu was studied for a period of 21 years (1958-1978). Daily rainfall data were tabulated in relation to the lunar synodic cycle of 29.53 days which was divided into ten equal divisions. It was observed that the peak in the first quarter and the trough near the full moon were highly regular in all the cases. Further investigation was made with the rainfall data of three more stations (Trivandrum, Pune and Sibsagar) from different regions for a period of 30 years (1928-1957). The statistical test (Chi-square) applied for the rainfall data did not show any significant relation between the moon phases and the heavy rainfall. The appearance of the peak in the first quarter and the trough near the full moon was evident from the analysis of these stations.

1. Introduction

Bradley *et al.* (1962) suggested that there was a marked tendency for heavy rainfall on the third to fifth days after the configuration of both new moon and full moon. Adderley and Bowen (1962) reported that the meteoric dust got modulated when the moon's orbit was close to the plane of the ecliptic. The meteoric dust would then act as an ice forming nucleus. This theory generated considerable interest among the scientific workers and paved the way for several investigations in this field.

In their later work Brier and Bradley (1964) subjected the U.S. rainfall data to rigorous statistical tests and arrived at the conclusion that the association of lunar phases with the heavy rainfall was real. O'Mahony (1965) reported that there was a weak random influence of lunar phases on heavy rainfall. Kapoor *et al.* (1965) had restricted their studies to the region around Delhi for a period of 6 years. They reported that pronounced departures from the normal rainfall were noticed during third and fourth quarters of the lunar month.

Based on the results obtained by Rao and Reddy (1972) for some stations, Reddy (1974) arrived at the conclusion that the lunar tidal winds modify the circular pattern of southwest monsoon winds. Visvanathan and Nayasthani (1966) studied the distribution of rainfall of India in relation to the phases of the moon and concluded that the heavy rainfall tends to be more frequent during some periods of the lunar month than at others.

The present authors being very much impressed by the concluding remark of Berson and Deacon (1965) in which they have highlighted the value of a full scale study of the Indian

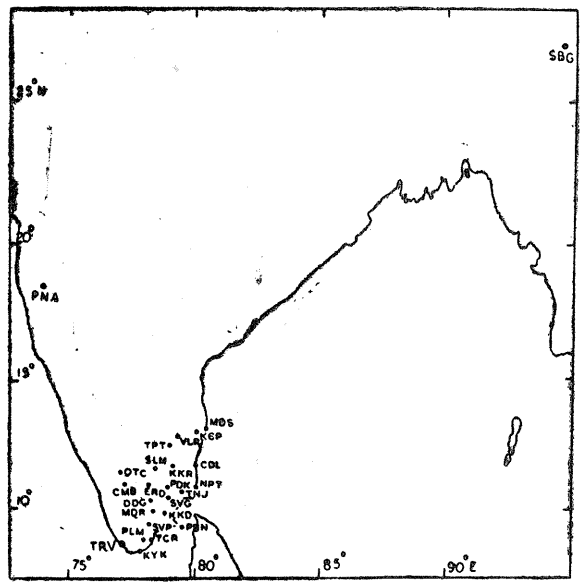

Fig. 1. Locations of the stations considered for the analysis

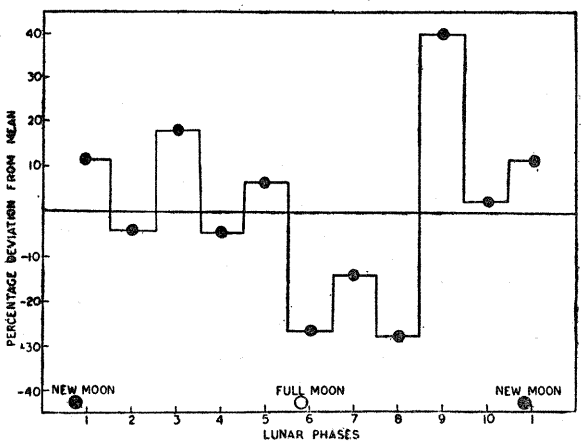

Fig. 2. Percentage deviation from the mean of all measurable rainfall at Nungambakkam over the period 1958-1978

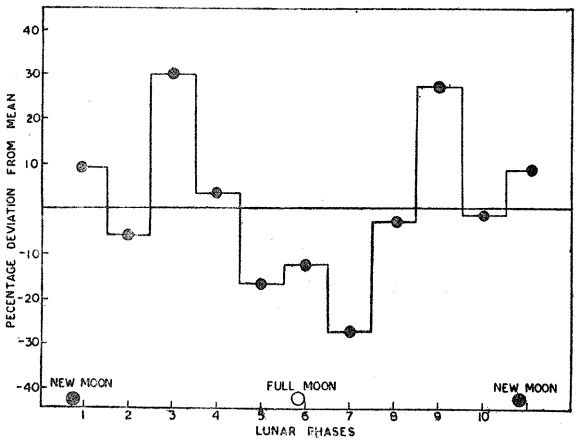

Fig. 3. Percentage deviation from the mean of all measurable rainfall at Nagapattinam over the period 1958-1978

region, analysed the rainfall data of 25 stations and in the present study, the effect of moon phases on the heavy rainfall in the Indian stations was investigated.

2. Description of the data

Nungambakkam (13 deg. N, 80 deg. E) and Nagapattinam (10 deg. N, 79 deg. E) are two stations on the east coast of southern part of the Indian Peninsula. The daily total rainfall data recorded at 0830 IST for the two stations were collected for the period of 21 years (1958-1978) from the Regional Centre of the India Meteorological Department at Madras. The daily total rainfall data recorded at 0830 IST were also collected from the Statistical Department of the State of Tamilnadu for the following stations: Kancheepuram, Vellore (NA) Tirupathur (NA), Cuddalore, Kallakurichi, Tanjore, Madurai, Dindugul, Trichirapalli, Pudukottai, Sivaganga, Pamban, Srivilliputhur, Tiruchendur, Palayamcottah, Kanyakumari, Coimbatore, Erode, Salem and Ootacamund. The locations of these stations, which are fairly evenly distributed over Tamilnadu, have been shown in Fig. 1.

Trivandrum (6 deg. N, 76 deg. E), Pune (18 deg. N, 74 deg. E) and Sibsagar (26 deg. N, 94 deg. E) were three other meteorological

stations considered for the analysis from regions of different climatic conditions. The data of this second set were based on the daily rainfall records of the three stations for the 30 years period (1928-1957). The inclusion of the data for these stations provided a completely independent check of the results based on the data of the period 1958 to 1978.

3. Analysis of the data

The calculations were carried out following the method of analysis of Berson and Deacon (1965). All rainfall data were tabulated in relation to the lunar synodic cycle of 29.53 days which was divided into ten equal divisions. Each division corresponded to about three days. New moon occurs between divisions 10 and 1 and full moon occurs between divisions 5 and 6. This approximate type of classification was quite sufficient to establish the occurrence of the peak in the corresponding quarter of the lunar month.

Out of 7660 days of the period of study of 21 years (1958-1978) rainfall days amounted to 1869 in the case of Nungambakkam and 1566 days in the case of Nagapattinam. When days having a rainfall of 2 cm and above were considered, the number of rainfall days were reduced to 383 for Nungambakkam and 435 for Nagapattinam. In Figs. 2 and 3 all measurable rainfall data are shown as the percentage deviation from the mean of the 21 years in relation to the lunar phases for Nungambakkam and Nagapattinam respectively.

In the case of other stations also all measurable rainfall data were considered for the analysis. The frequencies of daily rainfall at Trichirapalli (10 deg. N, 78 deg. E) and Salem (11 deg. N, 78 deg. E) exceeding 2 cm were 250 and 312 respectively. Figs. 4 and 5 represent the percentage deviation of total rainfall from the mean of the 21 years with respect to lunar cycle. The overall picture of the lunar effect on rainfall for the 21-year period of 22 stations of Tamilnadu has been presented in Fig. 6.

As before, for each of the three stations, (*viz.*, Trivandrum, Pune and Sibsagar) frequencies of daily rainfall occurrence of 2 cm or more were compiled with respect to various moon phases. The frequencies for these three stations during the 30 years (1928-1957) were: Trivandrum 779, Pune 281, Sibsagar 1139. The percentage deviations of total rainfall from the mean of the 30 years with respect to lunar phases were calculated and are presented for the respective stations in Figs. 7-9.

In order to ascertain the possible lunar effect on heavy rainfall, the frequencies of daily rainfall exceeding 2 cm were subjected to statistical tests. The frequencies of rainfall were tabulated against the corresponding lunar phases for the period of 21 years (1958-1978) for the four stations, *viz.*, Nungambakkam, Nagapattinam, Trichirapalli, and Salem and 30 years (1928-1957) for the other three stations, *viz.*, Trivandrum, Pune and Sibsagar. The possible lunar influence on heavy rainfall was tested by applying χ^2 test. The values of χ^2 for Nungambakkam and Nagapattinam were found to be 12.95 and 11.37 respectively. These were well below the expected value at 5 per cent significance level of 16.916 for 9 degrees of freedom. The χ^2 values of other stations, *viz.*, Trichirapalli and Salem, were computed to be 14.4 and 7.74. The χ^2 values for the second set of stations (Trivandrum, Pune and Sibsagar) were 15.05, 11.28 and 3.06 respectively. Thus the lunar influence on rainfall, as revealed by the χ^2 value, is not significant.

4. Discussion and conclusion

The present investigations have shown that the overall relation between lunar phases and occurrence of heavy rainfall does not fully comply with the results obtained from the rainfall study of US and New Zealand. But the association of the prominent and consistent peaks in the first and fourth quarters was in close agreement with the findings of Bradley *et al.* (1962) and Adderley & Bowen (1962). The peak in

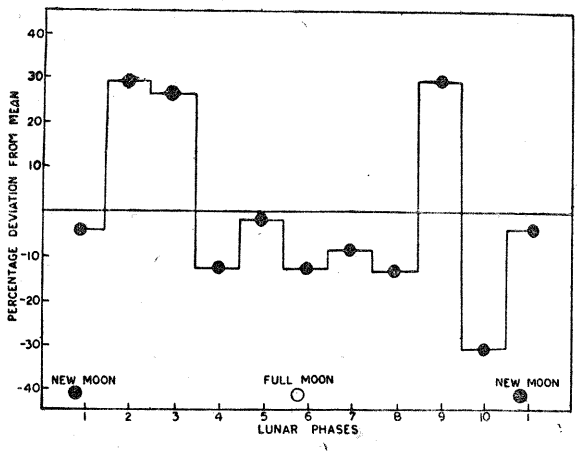

Fig. 4

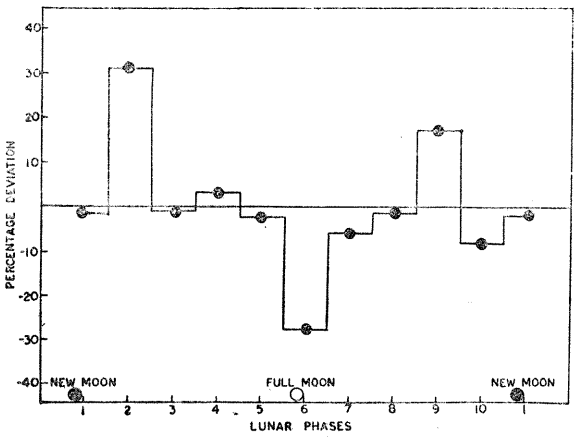

Fig. 5

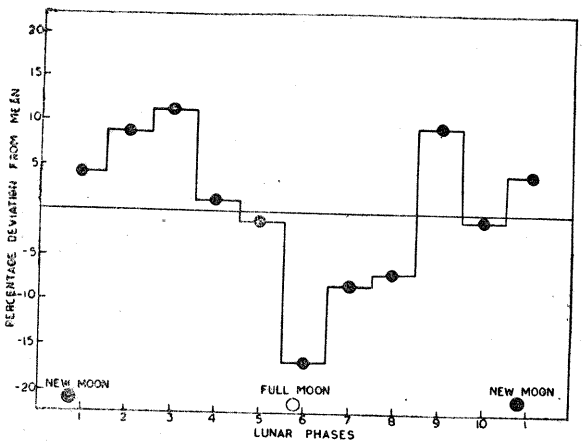

Fig. 6

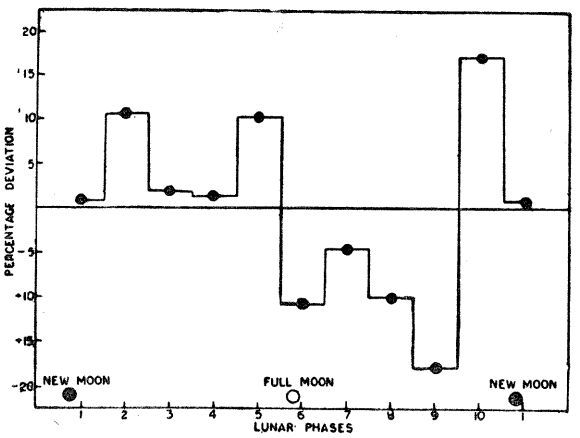

Fig. 7

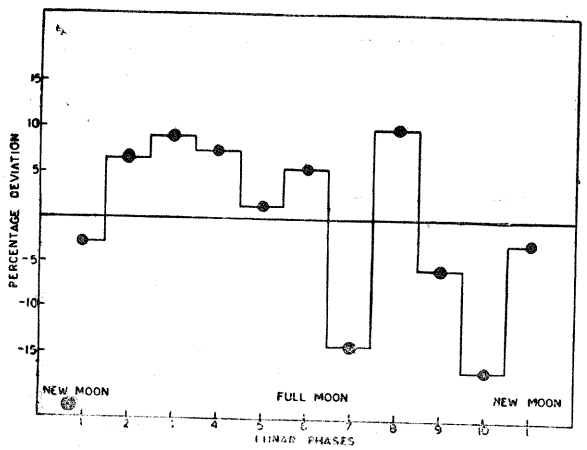

Fig. 8

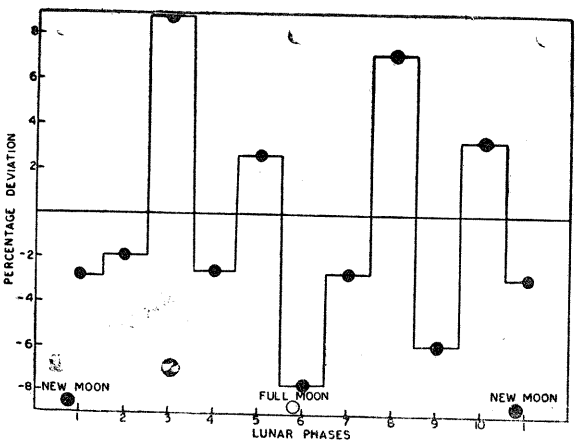

Fig. 9

Figs. 4-9. Percentage deviation from the mean of all measurable rainfall at (*i*) Trichirapalli over the period 1958-1978 (Fig. 4); (*ii*) Salem over the period 1958-1978 (Fig. 5); (*iii*) Tamil Nadu (22 stations) over the period 1958-1978 (Fig. 6); (*iv*) Trivandrum over the period 1928-1957 (Fig. 7); (*v*) Pune over the period 1928-1957 (Fig. 8) and (*vi*) Sibsagar over the period 1928-1957 (Fig. 9)

TABLE 1

Frequencies of daily rainfall exceeding 20 mm in ten divisions of the lunar synodic period

Stations (Years)	Phases in lunar synodic decimal										Total	
	1	2	3	4	5	6	7	8	9	10		
Nungambakkam (1958—78)	40	39	48	33	40	33	29	28	49	44	383	12.95
Nagapattinam (1958—78)	49	41	57	44	41	39	33	37	53	41	435	11.37
Trichirapalli (1958—78)	25	35	24	19	25	28	24	17	35	18	250	14.40
Salem (1958—78)	30	38	30	32	35	21	32	25	37	32	312	7.74
Trivandrum (1928—57)	88	83	74	71	87	70	85	68	58	95	779	15.05
Pune (1928—57)	25	37	37	29	26	33	19	25	27	23	281	11.28
Sibsagar (1928—57)	119	103	117	110	108	116	119	124	112	111	1139	3.06

Note : New moon between divisions 10 & 1 and full moon between divisions 5 & 6

the third quarter of the lunar month as apparent in the previous studies was significantly absent in all the five cases (Figs. 2-6). But the peak appeared in the fourth quarter invariably in all the cases of Tamilnadu stations (Figs. 2-6). This was in accordance with the study of Kapoor *et al.* (1965) and Visvanathan (1965). The peak persisted in the first quarter in all the cases in agreement with the previous studies. Figures of a similar type were also obtained when the percentage deviation from the mean was plotted against the lunar phases for heavy rainfall exceeding 2 cm for the 4 stations of Tamilnadu (figures not shown).

As in the other cases, Figs. 7 to 9 of the second set of three stations for the period 1928 to 1957 present maxima in the first quarter and fourth quarter. The rainfall peak in the first and third quarters of the lunar month observed by other investigators have been obtained only in the case of Pune and Sibsagar (Figs. 8 & 9). Thus the second set of data for the period 1928 to 1957 serves as the check for the analysis of Tamilnadu stations. Among the stations studied, Pune was the only station which presented a figure with the trough near the full moon lagging in phase by one synodic decimal.

The statistical test applied for all the seven stations (*vide* Table 1) proves that the relation between the moon phase and the heavy rainfall is not significant. It is interesting to note that "all years" χ^2 value for Djakarta reported by Berson and Deacon (1965) also indicated that moon phase and heavy rainfall were not significantly related. But they were able to establish the lunar influence on rainfall when the period of study was split into 'active sun' and 'quiet sun' periods. Admittedly, statistical tests alone cannot be relied upon to explain results of the type presented here.

The figures of the present study do not bear very close resemblance to the curves reported by early workers in this field. But the peak in the first quarter and the trough near the full moon are highly regular in almost all the cases. Therefore, while this study confirms the influence of

lunar phases on rainfall as shown in earlier studies, a significant difference is observed with regard to the fourth quarter.

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