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OUTLOOK ON SOUTHWEST MONSOON ONSET OVER KERALA BASED ON ITS SUMMER RAINFALL

1. The southwest monsoon which sets in over Kerala by 1 June covers the entire India by 15 July. The onset of monsoon over Kerala (to be referred hereinafter as onset) evokes considerable public and scientific interest. The problem of foreshadowing the time of onset has received close examination in recent years. Reference to literature reveals that a variety of predictors—such as rainfall of Rhodesia, surface pressure of Darwin, upperwinds of Singapore and contour heights of isobaric surfaces over Australia during the preceding months—have been identified by Ramdas *et al.* (1954), Rai Circar *et al.* (1962), Reddy (1977) and Kung *et al.* (1982) to predict the time of onset. A review of this topic could be found in Das (1986). It is reasonable to expect that the air and sea temperatures, moisture depth and similar parameters over southeast Arabian Sea during the pre-monsoon period should exercise some influence over the process of onset. It is intended to examine this aspect in this note.

2. *Preliminary analysis* — During the present century, date of onset has varied between 11 May and 18 June (Rao 1976). Therefore, we considered only the first two months of the pre-monsoon season, *viz.*, March and April. As sufficient data on the parameters mentioned earlier were not easily available, apparently related parameters such as mean monthly surface air temperature and vapour pressure of Minicoy, Trivandrum and Cochin for March and April for the 25-year period 1951-75 were collected and studied. These parameters exhibited hardly any interannual variation and so could not, in any way, explain the substantial variation of time of onset. However, the rainfall of Kerala during March and April showed promise due to its high variability. It was, therefore, thought worthwhile to examine, in detail, this parameter for any possible relation with the time of onset. Kerala receives an average of 15 cm of rainfall during March-April.

3. *Data* — The 67-year period 1921-87 was chosen as the period of study. The date of onset as fixed by the India Met. Dep. and the rainfall of Kerala for the period 1 March to 30 April (hereinafter referred as Kerala summer rainfall) were computed/extracted from the climatological records of India Met. Dep. for the period of study. The rainfall expressed as percentage of normal and the dates of onset are presented in Fig. 1.

4. *Analysis of data* — Let X denote the Kerala summer rainfall percentage anomalies and Y the onset dates reckoned as number of days from 1 May. The mean and standard deviation (SD) of Y ($\overline{Y}$ and σ_Y) were 31.7 and 7.4 days respectively. The SD of X (σ_X) was approximately 40%. On the basis of the SD the range of Y was divided into three disjoint classes, *viz.*, $Y<\overline{Y}-\sigma_Y$, $\overline{Y}-\sigma_Y \leqslant Y \leqslant \overline{Y}+\sigma_Y$ and $Y>\overline{Y}+\sigma_Y$. These worked out to $Y \leqslant 24$, $25 \leqslant Y \leqslant 39$ and $Y \geqslant 40$. Similarly for X, the

TABLE 1

Relation between Kerala summer rainfall and onset

Y	X			Total
	<—40	±40	>40	
⩽24	0 (1.5)	7 (6.4)	3 (2.1)	10
25,39	3 (7.0)	33 (30.2)	11 (9.8)	47
⩾40	7 (1.5)	3 (6.4)	0 (2.1)	10
Total	10	43	14	67
Conditional mean of *Y*	40.5	30.6	27.8	

X : Kerala summer rainfall as percentage anomalies,

Y : Onset of monsoon at Kerala as number of days from 1 May

Note — The frequencies are given in brackets. No relation frequencies are given.

classes were $X < -40$, $-40 \leqslant X \leqslant 40$ and $X > 40$. Using the above clsases the contingency table (Table 1) was constructed (Panofsky & Brier 1968). The value of χ^2 in respect of the observed and no relation frequencies was found out to be significant at 5% level. The coefficient of contingency was 0.36. It is seen from Table 1 that if $X < -40$, then $Y \geqslant 25$ and if $X > 40$, $Y \leqslant 39$. Thus, substantially below/above normal Kerala summer rainfall is followed by normal or late/early or normal onset. If $|X| \leqslant 40$, there is no definite association though there is less chance of late onset.

The conditional means of *Y* when $X < -40$, $|X| \leqslant 40$ and $X > 40$ were found to be 40.5, 30.6 and 27.8 days respectively (Table 1). The first and last of the above three means were significantly different from the overall mean of 31.7 days at 1% and 5% levels respectively. The linear correlation coefficient between *X* and *Y* was -0.32 which is significant at 1% level.

The above analysis has shown that Kerala summer rainfall is significantly related to onset. The results based on contingency table did not change substantially if marginal changes in the limits of the classes of *X* and *Y* were effected.

5. *Discussions and conclusions* — From the analysis done, it can be concluded that strongly anomalous Kerala summer rainfall, which occurs on 36% of years, does serve as an indicator of time of onset. If the rainfall is below normal it is not followed by an early onset and if above normal is not followed by a late onset. A normal rainfall is not followed by a similar pefinite pattern though, by and large, it favours early or normal onset.

Prevalence of high air and sea surface temperature and presence of a deep layer of moisture over southeast Arabian Sea during summer should be conducive for early or timely onset of monsoon. Such features may also result in excess summer rainfall over Kerala. Similarly

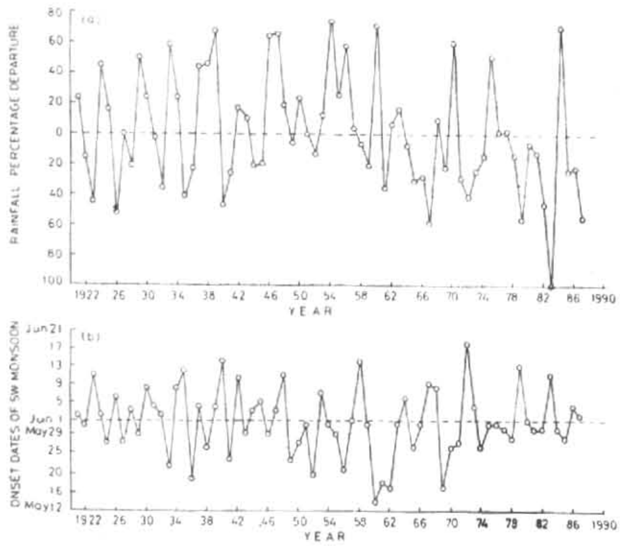

Fig. 1. Percentage departures of rainfall from normal for Kerala for March-April and southwest monsoon onset dates over Kerala during 1921-87

low air and sea temperature and inadequate moisture build up over Arabian Sea in summer could indicate unfavourable conditions for a timely onset and may manifest as deficient Kerala summer rainfall. This reasoning provides a plausible physical explanation for the above relationship.

Though it does not explain a high percentage of the variation of the date of onset, the Kerala summer rainfall is nevertheless a significantly related antecedent feature of the same. Further, there is a possible physical linkage in support of the statistically established relationship. It has, therefore, the potential to be a basis for providing an outlook on the time of onset of monsoon over Kerala by the beginning of May.

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