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APPLICATION OF OUTGOING LONG WAVE RADIATION IN FORECASTING ADVANCE OF SW MONSOON

1. The Inter-Tropical Convergence Zone (ITCZ) exhibits its spatial and temporal modulation in association with the advance of southwest (SW) monsoon over the Indian region. Gadgil and Guruprasad (1990) earlier attempted to delineate ITCZ using radiance data of NOAA Satellite over India and neighbourhood.

In this study an attempt has been made to analyse advance of SW monsoon over the Indian region using daily zonal mean outgoing longwave radiation (OLR) variations over 50° - 100° E longitudinal belt during May and mid-June when the monsoon onset occurs.

2. For this purpose daily OLR values in 2.5° lat/long grid, for the period 1987-91 from INSAT 1B Satellite have been utilised from 1 May to 15 June. The area under consideration 50° - 100° E and 22.5° - 35° N has been divided into three zones, i.e., 50° - 75° E, 75° - 80° E and 80° - 100° E. The latitudinal belt 22.5° to 35° N was divided into 7 grids of 2.5° . The mean OLR values in each grid were plotted against days and analysed. This enabled demarcation of low OLR values called "OLR tongue". The northern limits of monsoon (NLM) as given by the India Meteorological Department were averaged and plotted along with mean zonal OLR. Mean position of NLM was assumed as the mean position of lower and upper values of latitudes over the longitudinal belts.

3. OLR serves as a good index of cloudiness/precipitation, the higher value suggesting less cloudiness/rain (Ras-

musson *et al.* 1983). Probabilities of rainfall (≥ 2.5 mm/day) for various OLR thresholds as worked out by Kriplani *et al.* (1991) have been used. Accordingly, OLR values between 180 - 220 Wm^{-2} indicate 80-90% probability of rainfall (≥ 2.5 mm/day). OLR less than 180 Wm^{-2} enhances the probability beyond 90%.

(a) In 1991, the northward march of OLR tongue over 50° - 75° E started on 23 May (Fig. 1) and by 26 May reached 5.0° - 7.5° N belt. Another tongue of $OLR \leq 200$ Wm^{-2} moved northward reaching 5.0° - 7.5° N belt on 30 May. Over this belt the NLM was on 29 May. Advance of OLR tongue and NLM coincided over 7.5° - 10.0° N belt on 1 June; subsequently position of NLM over Arabian Sea was slightly north of OLR tongue.

Over 75° - 80° E belt during 1991 the tongue reached 5.0° - 7.5° and 7.5° - 10.0° N belts on 27 and 29 May respectively (Fig. 2). After 1 June, positions of the tongue and NLM approached each other and former arrived over Kerala on 29 May. Meanwhile, a second tongue in the range of 140 - 160 Wm^{-2} , indicating intense cloud organisation, appeared on 31 May close to the equator, moved faster and crossed 7.5° - 10.0° N belt on 1-2 June. This secondary tongue maintained its march to the northern latitudes 25° - 27.5° N till 11-12 June. Advance of monsoon on most days coincided approximately with position of tongue.

(b) In 1988 over 80.0° - 100° E belt i.e., over Bay of Bengal, a number of OLR tongues with northward propagation were seen. The NLM on 10, 16 and 19 May were in the vicinity of the tongue (Fig. 3). The monsoon onset occurred on 10 May when the tongue was moving unusually slightly towards south. It is believed that over the belt centred 7.5° N the onset of monsoon occurred on 15 May and not 10 May. The tongue moved to 15.0° - 17.5° N belt on 21 May. A secondary OLR tongue started moving north after 20 May

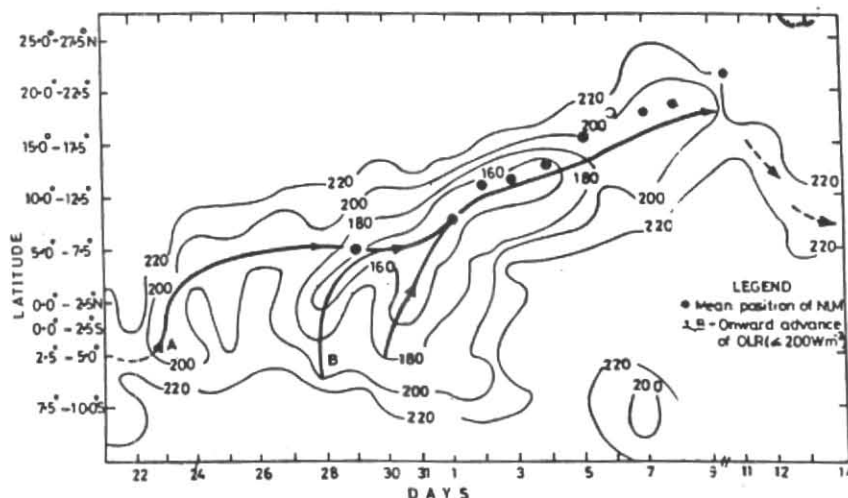


Fig. 1. Daily zonal mean OLR (Wm^{-2}) variations over 50° - 75° E during May-June 1991.

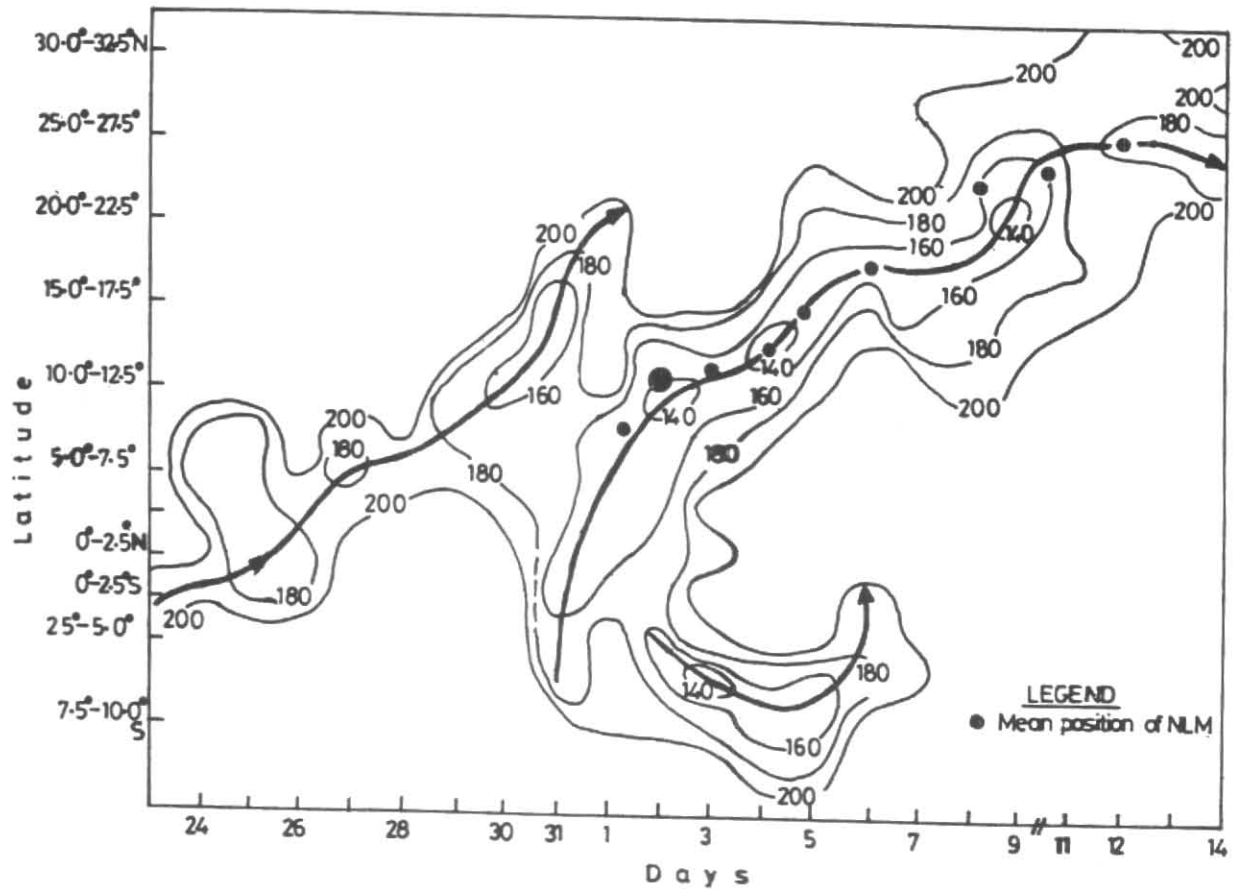


Fig.2 . Same as Fig.1 but for 75°- 80°E during May-June 1991

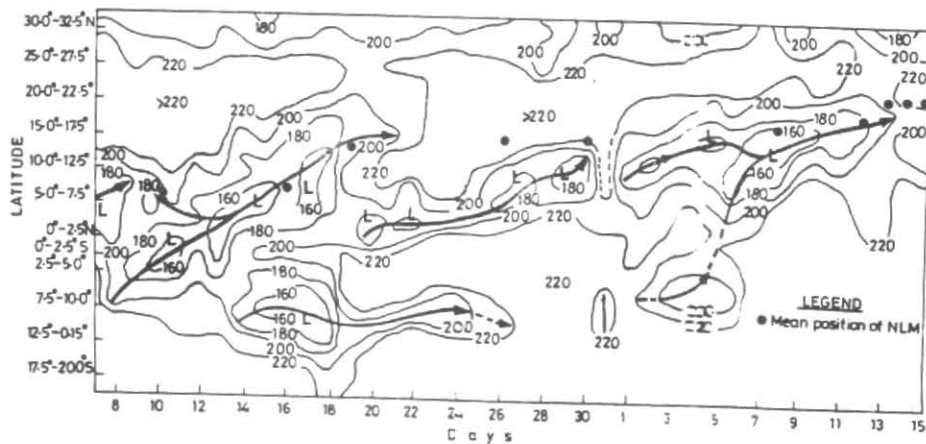


Fig.3. Same as Fig.1 but for 80°- 100°E during May-June 1988

reaching around 15°N on 30 May when NLM too passed over the 15.0°-17.5°N belt. On 31 May the tongue showed slight southward movement in association with a trough off Tamil Nadu coast but started moving northward again and crossed 15.0°- 17.5°N belt on 5 June.

A third tongue also moved north from lower latitudes and merged with the second tongue along 12.5°- 15°N on 7 June. The combined system moved further north upto 20°-22.5°N on 13 June. The NLM on 9, 12 and 13 June nearly coincided with position of OLR tongue. The forma-

tion and movement of third OLR tongue was related to a formation and movement of a low pressure area over the head Bay on 8 June.

(c) During 1987 and 1989 also the tongue (*i.e.*, OLR $\leq 200 \text{ Wm}^{-2}$) could be associated with northward progress of SW monsoon from lower latitudes. The OLR tongue during 1990 (Figure not shown) over the Arabian Sea was generally between $190\text{--}200 \text{ Wm}^{-2}$ and was located in $5.0^\circ\text{--}7.5^\circ\text{N}$ zone on 13-15 May. It moved slowly, reaching $12.5^\circ\text{--}15.0^\circ\text{N}$ belt on 20 May. Thereafter, the OLR value in the tongue generally exceeded 220 Wm^{-2} (except during 24-26 May). Due to these high values of OLR it is believed that the monsoon advance was rather slow initially.

Based on 147 daily cases analysed for the period 1987-91, the position of advance of SW monsoon over Indian Seas and the peninsula was correlated with the position of OLR tongue. The correlation between the two was 0.75 indicating high degree of association of NLM with OLR tongue.

4. The following conclusions would be drawn from the study:

- (i) A "tongue of low" exists in zonal mean OLR values which normally move northward at the time of progress of monsoon. Its propagation be taken as indicative of northward advance of monsoon over the region.

- (ii) The position of this tongue and position of NLM generally coincide.
- (iii) The advance of the tongue is more marked when its mean zonal value is less than 200 Wm^{-2} .
- (iv) The merging of secondary and tertiary tongues from lower latitudes with the primary tongue at higher latitude enhance its strength and its northward march becomes faster.

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