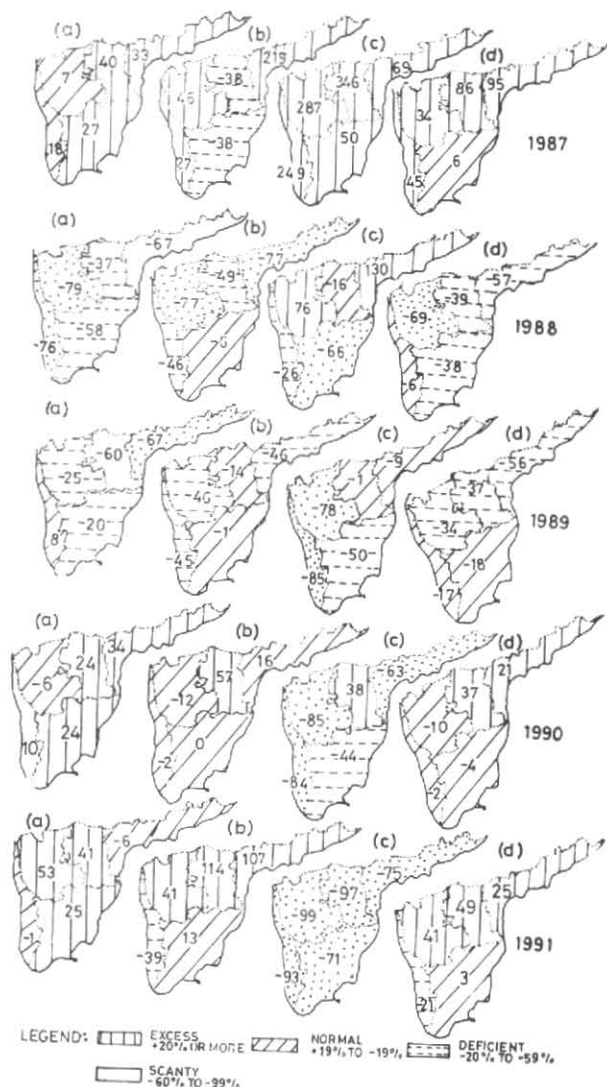


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RELATIONSHIP BETWEEN THE ACTIVITY OF SOUTHERN HEMISPHERIC EQUATORIAL TROUGH AS SEEN IN SATELLITE CLOUD DATA AND NORTHEAST MONSOON — A PILOT STUDY

1. The term northeast monsoon is often used to describe the period October to December. However, according to the India Meteorological Department's classification of the year into seasons, these three months constitute the post-monsoon season. It is also known as the retreating southwest monsoon season (FMU Rep. No. III-18.4 July 1973). October to December is the major period of rainfall in south peninsula, particularly the eastern half, comprising the meteorological sub-divisions of Coastal Andhra Pradesh (CAP), Rayalaseema, and Tamil Nadu. In Tamil Nadu this is the main rainy season accounting for about 60% of the annual rainfall in the coastal districts and about 40% to 50% in the interior districts of the State. In Rayalaseema, September and October are the rainiest months, contributing about 36% of the annual rainfall. Though the principal rainy season for South Interior Karnataka (SIK), Kerala and Arabian Sea islands is southwest monsoon, still rain continues till almost December in these sub-divisions, the period October to December contributing about 20% of the annual rainfall. An examination of the mean monthly rainfall in the various sub-divisions in the south peninsula during the northeast monsoon season has shown that for the south peninsula as a whole, October is the rainiest month. However, in Tamil Nadu, November is as rainy as October. By December the rainy season is practically over, when rainfall becomes very small except in Tamil Nadu. Considering the rainfall amounts received by the meteorological sub-divisions of south peninsula during northeast monsoon, long range forecast of rainfall for this season for these sub-divisions becomes equally important as is the case for the sub-divisions of northwest India and peninsula during southwest monsoon season.

In a recent study, Gupta and Prasad (1991) have demonstrated the existence of an inverse relationship between the activity of Southern Hemispheric Equatorial Trough (SHET) during pre-monsoon months of April and May and the subsequent southwest monsoon using data for 3 good monsoon years and 3 drought years. This relationship has been confirmed in a comprehensive study (Gupta and Prasad 1992). In this study, a method has been proposed to quantify the activity of SHET by assigning an activity index [SHET Activity Index (SAI)] ranging from 1 to 20. Regression equations have been developed using this index and rainfall for long range forecasting of rainfall during southwest monsoon season in different meteorological sub-divisions. An examination of the SAI and rainfall during northeast monsoon in the sub-divisions of south peninsula showed, in general, a positive relationship. Rainfall over south peninsula during northeast monsoon depends on the activity of the Northern Hemispheric Equatorial Trough (NHET). Synoptic systems develop in this trough zone which cause rainfall over south peninsula during this part of the year. A positive



Figs. 1(a-d). Percentage departure of rainfall during northeast monsoon; (a) October, (b) November, (c) December, and (d) October-December

(direct) relationship between SAI and northeast monsoon rainfall would suggest that NHET also becomes active during October to December along with the SHET during the years of good northeast monsoon and *vice-versa*. The purpose of this paper is to examine the relationship between the activity of SHET, NHET and the performance of the northeast monsoon.

2. *Data and method* — We have examined 5 years (1987-1991) INSAT cloud data and monthly and seasonal rainfall data for the meteorological sub-divisions of CAP, Rayalaseema, Tamil Nadu, SIK and Kerala. Reference to a recent paper by Prasad *et al.* (1988) is suggested for the details of the analysis of satellite cloud data.

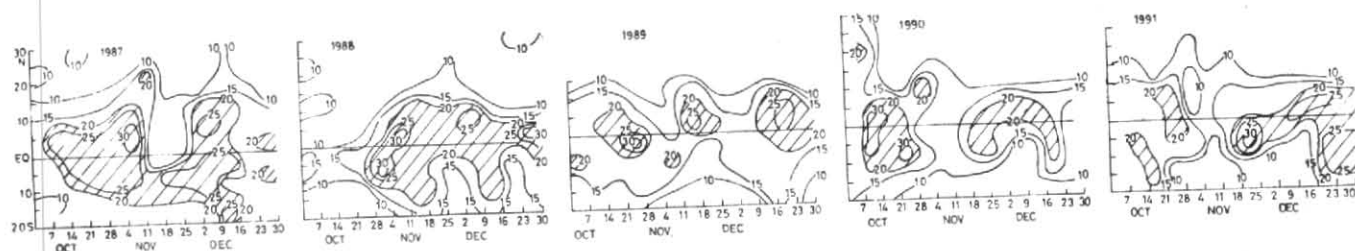


Fig. 2. Time-latitude cross-section of weekly mean cloudiness

3. Discussion

3.1. *Rainfall*—Percentage departures of rainfall for the sub-divisions of CAP, Rayalaseema, Tamil Nadu, SIK and Kerala for the months of October, November and December and for the season (October to December) as a whole for the years 1987–1991 are shown in Figs. 1(a–d). In the year 1987, four out of the five sub-divisions received excess rainfall. The rainfall was also normal to excess in October and excess in all sub-divisions in December. Rainfall was also excess in November except in the sub-divisions of Rayalaseema and Tamil Nadu where it was deficient. The rainfall picture is just reverse in the year 1988. There was a major failure of rainfall in October and November and also in the month of December except in the sub-divisions of CAP and SIK. Rainfall in the year 1989 is more or less similar to that in the year 1988. Rainfall was generally good in the year 1990 except in the month of December when it was very much reduced. This was also the case in the year 1991. However, November 1991 was more rainy. For the south peninsula as a whole the years 1987, 1990 and 1991 could be termed as the years of excess to normal rainfall and the years 1988 and 1989 could be termed as years of deficient rainfall.

3.2. *Weekly mean cloudiness*—The time-latitude cross-section of weekly mean cloudiness for the months of October to December 1987–1991 are shown in Fig. 2. Appearance of spells of increased cloudiness covering the areas mainly between 10° S and 10° N is common to all the years studied here. This suggests that both the equatorial troughs, *i.e.*, SHET and NHET are active at the same time. This may be mainly because of the close proximity of the two troughs during this season. It appears difficult to discern the two troughs in the time-latitude cross-section. However, they are easily discernible in the charts of mean cloudiness for individual weeks for the region 20° S to 20° N and 40° E to 100° E (not reproduced here). Appearance of a positive relationship between the two troughs during the season, as evident from the data presented here,

which is also seen to exist between the activity of SHET during pre-monsoon months of April and May and rainfall over south peninsula during northeast monsoon would suggest that the northeast monsoon is a part of southwest monsoon. It has been termed as “retreating southwest monsoon” by Indian meteorologists.

4. *Conclusions*—There is, in general, a positive (direct) relationship between the activity of the two equatorial troughs in the Indian Ocean during the period October to December and thereby a direct relationship exists between SHET and northeast monsoon rainfall.

The results of this study are tentative. Data of some more years are being studied and the results shall be reported soon.

5. The authors are grateful the Director General of Meteorology for the facilities and data used in this study.

References

- Gupta, G.R., and Prasad, Onkari, 1991, *Mausam*, **42**, pp. 145-150.
- Gupta, G.R. and Prasad, Onkari, 1992, *Jalvigyan Sameeksha*, **VII**, pp. 83-97.
- India Met. Dept., FMU Rep. III-18.4., July 1973, Northeast monsoon.
- Prasad, O., Rama Sastry, A.A., Hansda, A.K. and De, U.S., 1988, *Mausam*, **39**, pp. 201-206.

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