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UNUSUAL WINTER PRECIPITATION OVER TAMIL NADU IN 2002

1. Northeast monsoon period (October-December) is the principal rainy season for Tamil Nadu accounting for 48 % of the annual rainfall. Southwest monsoon period (June-September) contributes 34 % of annual rainfall over the state. In the year 2001 northeast monsoon commenced over Tamil Nadu on 16 October and withdrew on 11 January 2002. In February 2002 from 1st to 5th there was significant rainfall activity in Tamil Nadu. The heavy spell caused substantial damage in the coastal area.

The average monthly rainfall over Tamil Nadu in February is 16 mm. As regards district wise distribution the variation is between 5.0 mm (Vellore) to 32.8 mm (Tirunelveli). Bhaskara Rao *et al*. (1986) studied the exceptionally heavy rainfall over Madras city in February 1984. Sridharan and Muthuchami (1990) concluded that during El-Nino years Tamil Nadu received normal or above normal rainfall during post monsoon season. Raj (1998) studied the withdrawal of northeast monsoon rainfall over Tamil Nadu and indicated that the withdrawal of monsoon some times takes place even after first week of January and found that during study period 36.7 % of the years the withdrawal date extended to January of next calendar year. In this paper synoptic situation that contributed to the unusual rainfall over Tamil Nadu in the winter of 2002 has been discussed and associated damage in coastal Tamil Nadu is presented.

2. The synoptic data pertaining to surface and upper air was collected from the Area Cyclone Warning Centre (ACWC) Chennai for the period 27 January to 4 February 2002. Radar data was collected from CDR Karaikal and Satellite data from INSAT for the period 26 January to 4 February. Rainfall data was taken from weekly and daily weather reports of ACWC, Chennai. Monthly mean temperature over the country was collected from Climate Diagnostic Bulletin of India prepared by India Meteorological Department.

3.1. Map of Tamil Nadu with adjoining area is shown in Fig. 1. Tamil Nadu receives 16 mm of rainfall in the month of February but its interannual variability is quite large. February rainfall was 186 mm in 1984 and nil in 1931, 1982, 1983, 1997. Trend analysis for 102-year period (1901-2002) shows no significant increase in rainfall. But in recent years some increase can be seen in rainfall in the month of February over Tamil Nadu (Fig. 2). From the time series of February rainfall prepared using data of 191 stations, it is observed that the decade 1981-90 received the highest rainfall of 27.6 mm followed

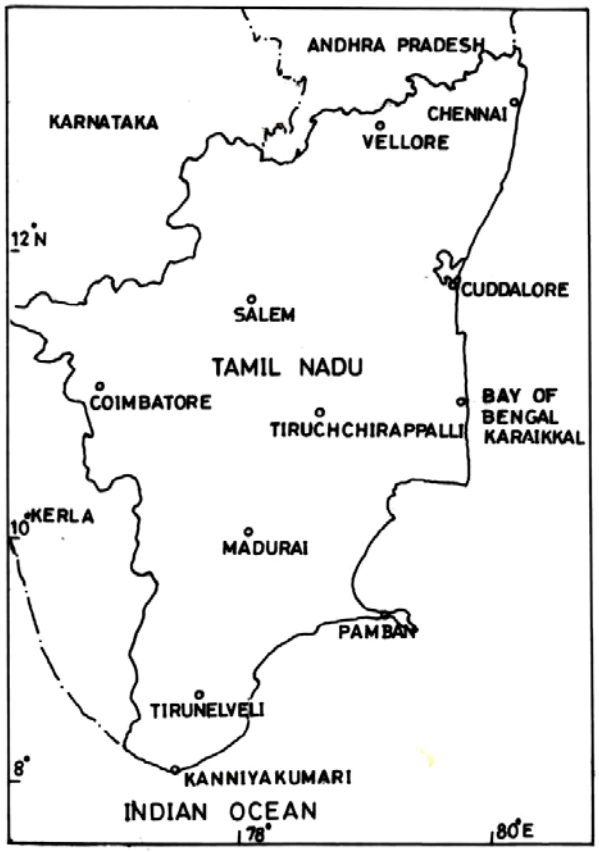


Fig. 1. Map showing Tamil Nadu with adjoining area

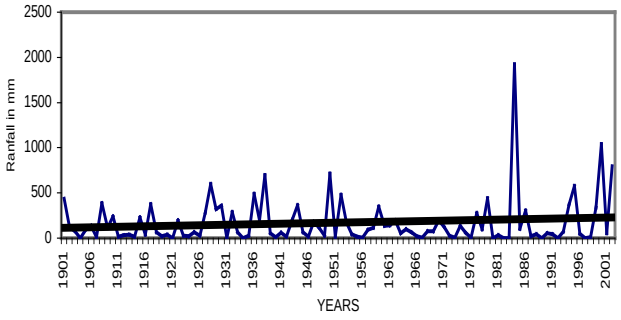
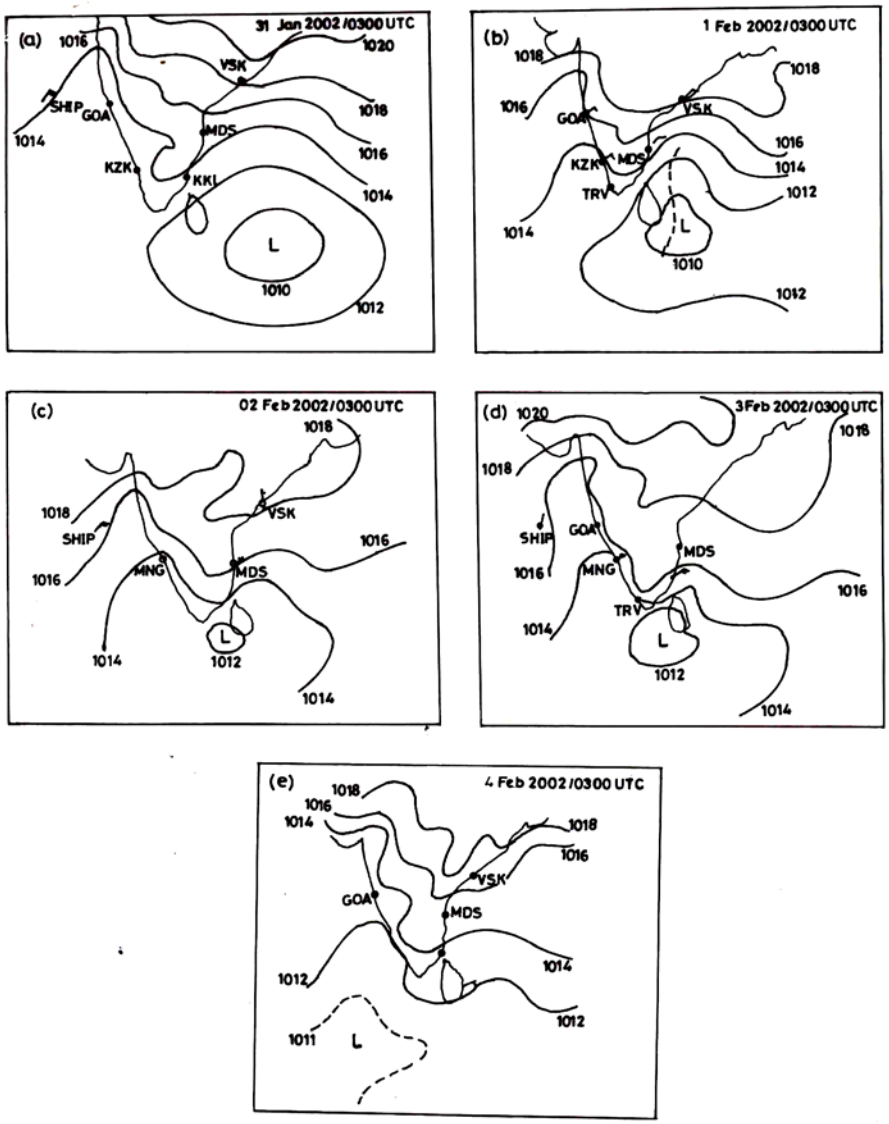


Fig. 2. Time series of rainfall over Tamil Nadu in February (1901-2002)

by 1921-30 with 21 mm. The least rainfall occurred in the decades 1911-20, 1931-40, 1961-70 and 1971-80. It is further seen that least decadal rains precede the two decades with larger amount of rainfall. It is also interesting to note that the decades with higher amounts of rainfall are characterized by small coefficient of variation. Table 1 gives years with February rainfall in the range 2-3 times the mean, 3-4 times the mean and > 4 times the mean rainfall. It is seen that all occasions of rainfall more



Figs. 3(a-e). Isobaric pattern during the period 31 January to 4 February 2002

than 4 times the normal occurred in the last 20 years (1984, 2000, 2002), the rainfall 3-4 times the mean occurred mainly in 25 year period 1926-50 and the rainfall in the range of 2-3 times the mean occurred in a cycle with 20 years period.

3.1.1. It is seen that in the year 1984 rainfall occurred mainly in the first three weeks of the month. It is further seen that about 6.2 cm rainfall occurred in each of the first two weeks and 4.9 cm in the third week. In the last week rainfall was not very significant. In this year the maximum rainfall occurred in the coastal districts of Thanjavur, Nagapattinum and Thiruvarur. However in 2000 the highest weekly rainfall of 7 cm occurred in the last week of the month. It is to be noted that in the first

TABLE 1

Years with February monthly rainfall exceeding two times the mean value

Range of rainfall	Years
2-3 mean	1908,1917,1939,1944,1959,1979,1994,1999
3-4 mean	1928,1930,1936,1938,1950, 1995
> 4 mean	1984,2000,2002

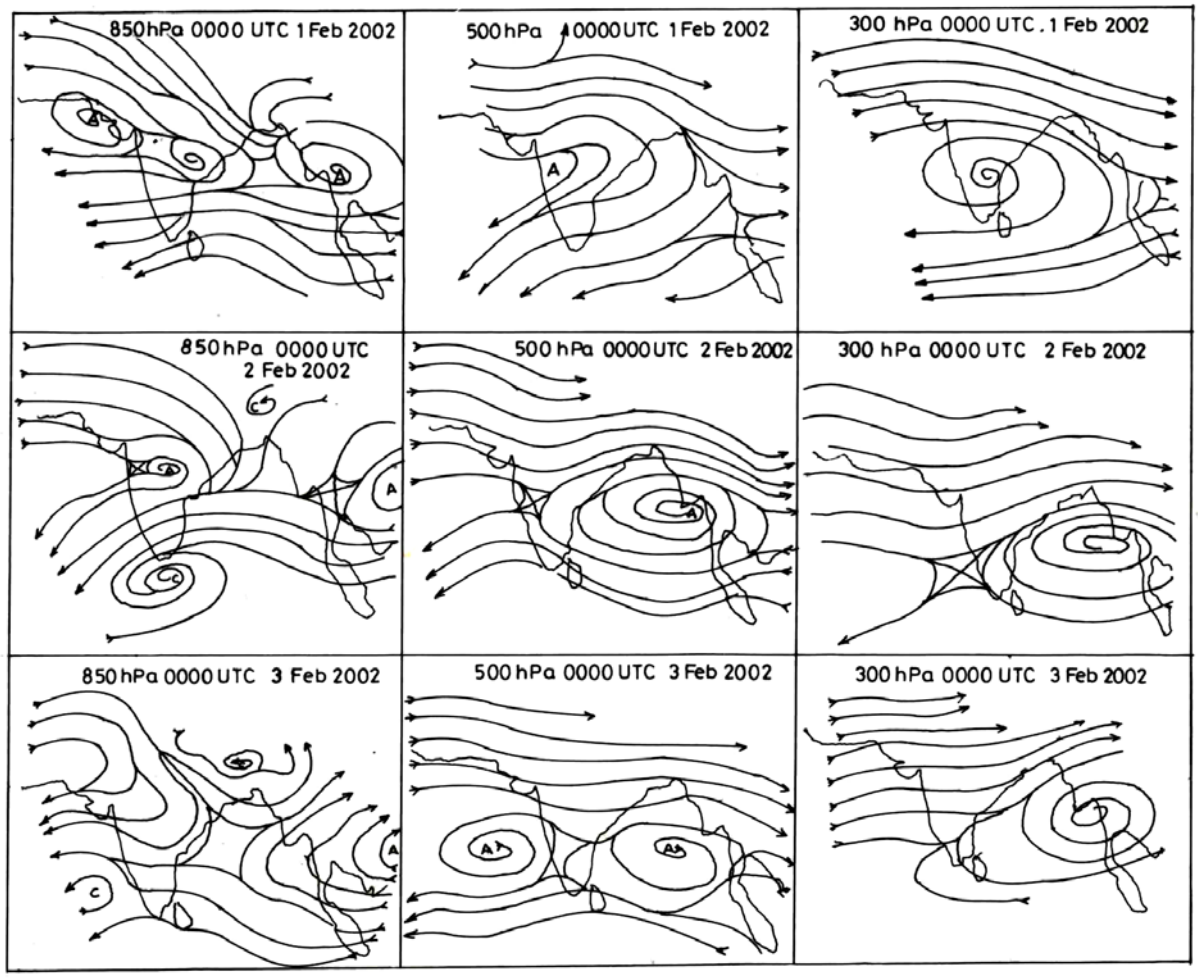


Fig. 4. Streamlines over India during 1st to 3rd February 2002

week itself the mean rainfall was reached. In the remaining two weeks only small amount of rainfall occurred.

3.1.2. Tamil Nadu received 80 mm of rainfall in February 2002. It is observed that the rainfall activity was mainly confined to first week and practically no rain in the other three weeks. On further examination it is seen that first week rainfall over Thanjavur and Cuddalore districts was 54 times the weekly normal rainfall. Nagapattinam, Ramanathapuram, Thiruvarur and Pudukottai districts received between 53 and 43 times the weekly normal rainfall. On examining the daily rainfall data it is seen that Chidambaram (Cuddalore district) recorded the highest rainfall of 25 cm on 3 February 2002. It is further seen that Kattumannarkoil (Cuddalore district) received cumulative rainfall of 37 cm during the period. 2nd to 4th.

3.2. *Synoptic situation* – On 31st January [Fig. 3(a)] a low is observed over south Bay near Sri Lankan coast. From this low a deep trough extended up to west central Bay on 1st February [Fig. 3(b)]. By 2nd [Fig. 3(c)] trough became weak and the low moved westward and was seen over Sri Lanka. The low further moved west and weakened over Comorin area on 3rd and by 4th it became insignificant. Fig. 4 gives the streamline pattern over India during 1st to 3 rd February 2002. A circulation over south Tamil Nadu and adjoining Sri Lankan coast is seen on 2nd at 850 hPa.

3.3. *Satellite data* - On examining the satellite data for the period 26th January to 3rd February it is seen that equatorial clouding is confined to below 5° N and east of 83° E on 26th January 0900 UTC. On 27th clouding drifted northwards up to 8° N with cirrus emanating from the

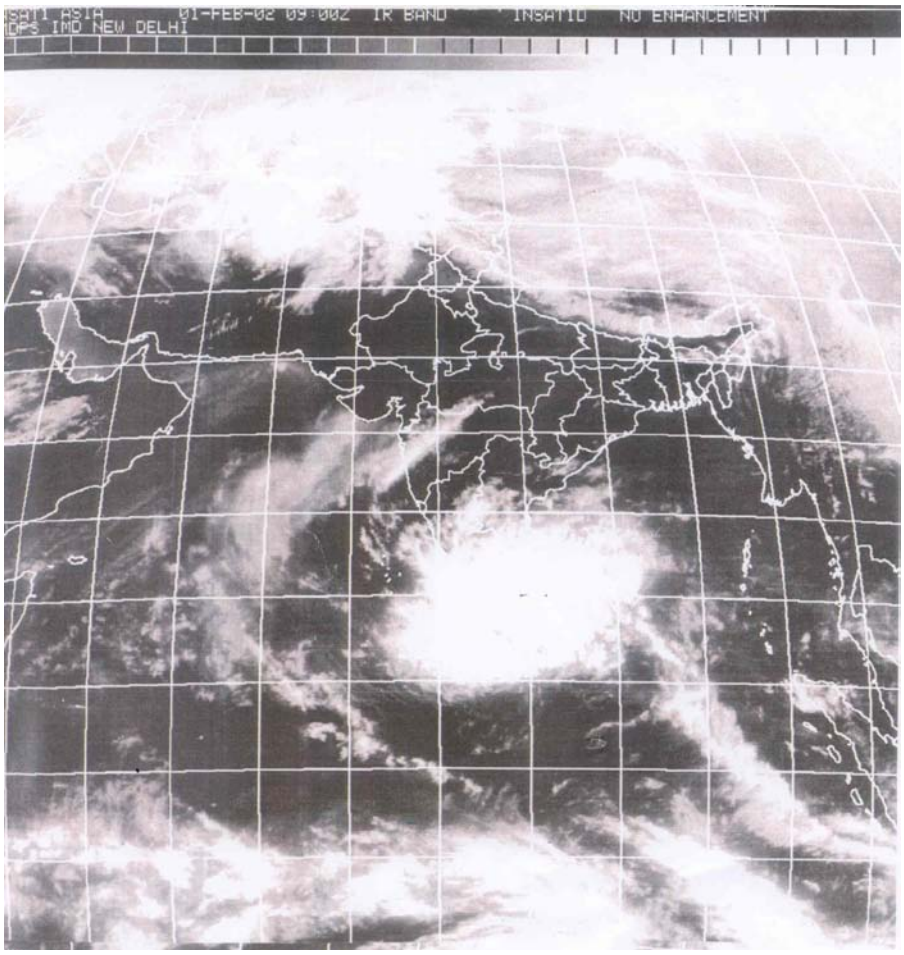


Fig. 5. INSAT ID cloud picture on 1 February 2002 (0900 UTC)

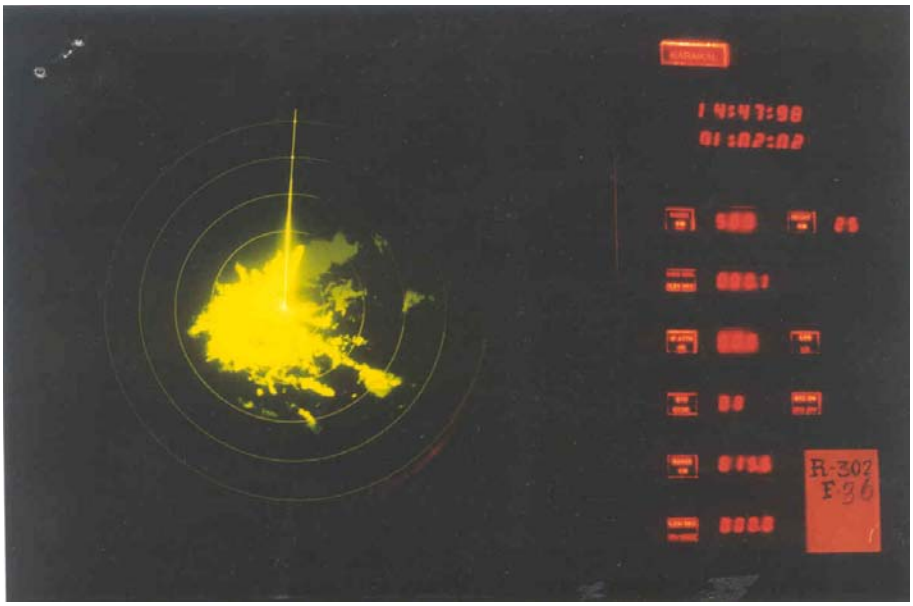
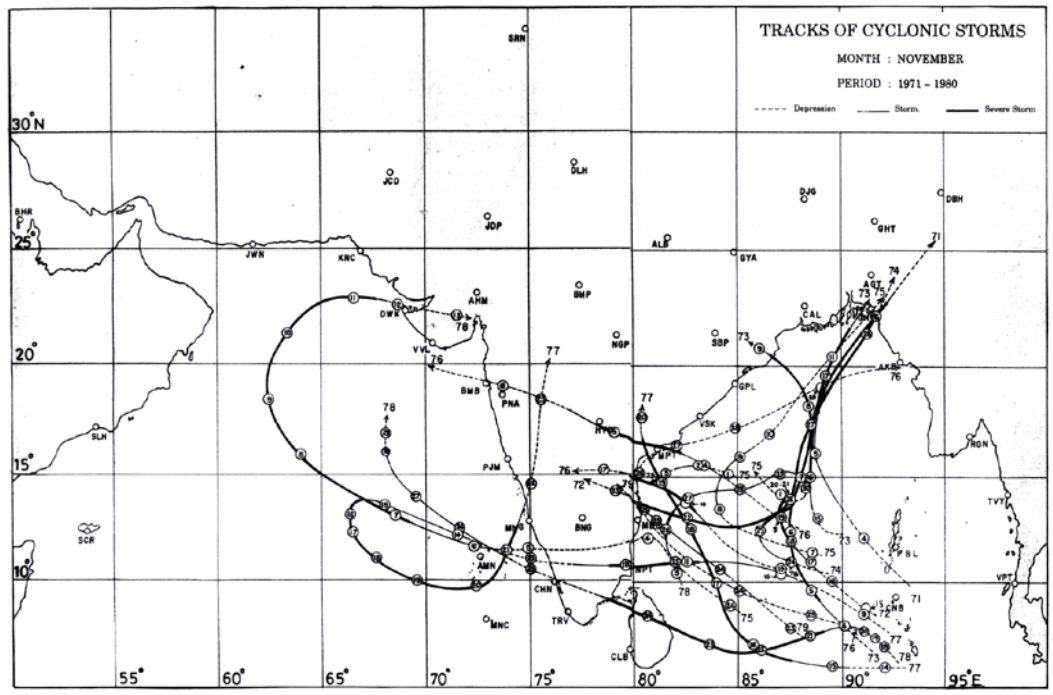
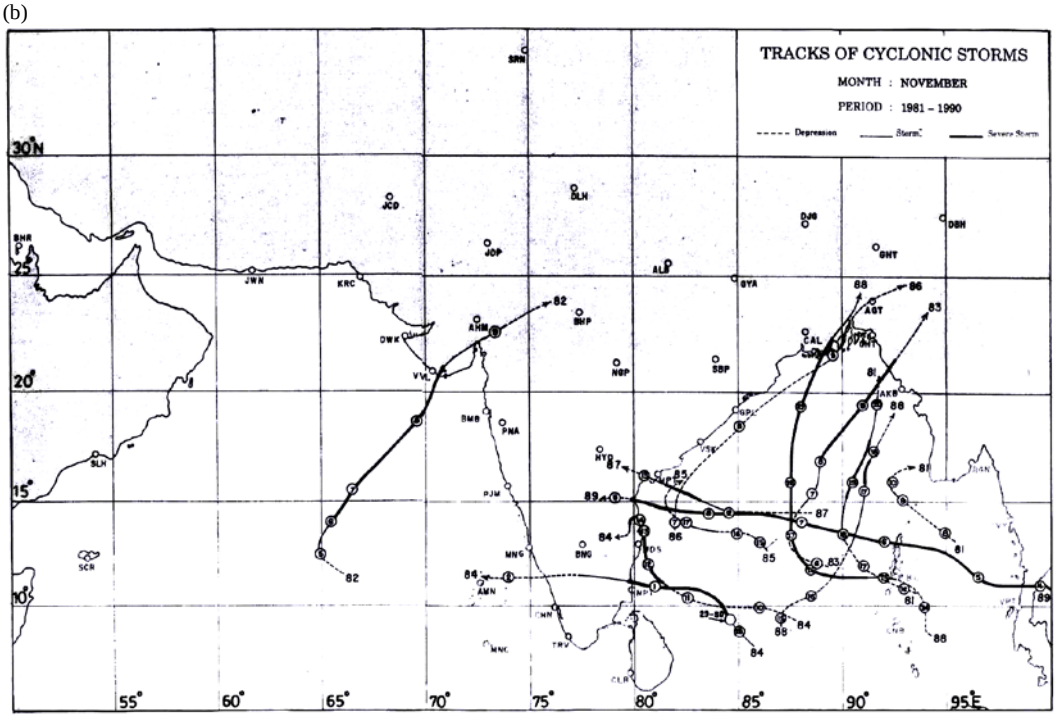


Fig. 6. Karaikal radar picture on 1 February 2002 (1500 UTC)

(a)



(b)



Figs. 7(a&b). Tracks of cyclonic storms in the Bay of Bengal (a) November (1971-80) and (b) November (1981-90)

cloud oriented SW-NE direction. It split into two parts on 28th one predominantly over Tamil Nadu and Kerala and the other east of 82° E and south of 9° N. The clouding on land dissipated, whereas the clouding over sea oriented WSW to ENE and extended from 80° E to Andaman Sea on 29th. The next day clouding concentrated into a small area bounded between east of 80° E south of 12.5° N, north of 4° N and west of 96° E and on 31st clouding was

TABLE 2

Loss of life and damage to property in some of the coastal districts of Tamilnadu

District	Human loss	Cattle loss	Hut damage	Crop damage (Hectares)	Damage to irrigation	Damage to road
Nagapattinam	3	9	14	116,298	323m	323 km
Thiruvarur	0	1	3186	125,527	75	316
Tanjavur	1	449	474	74853	536	86.3 km
Cuddalore				57200		66
Ramanathapuram			45		118	
Pudukottai	1	11	210	7406	252	899
Thirunelveli	1			4.42		
Total	6	470	3929	324086		

confined to only small area around Sri Lankan coast. The cloud started entering land on 1st Feb at 0000 UTC and it covered most of the area of Tamil Nadu and Kerala by 0900 UTC as shown Fig. 5. On 2nd it covered more area and moved further westward and on 3rd cloud started dissipating.

3.4. *Radar data* - Fig. 6 gives the Karaikal radar view of the system on 1st February. It is found that the predominant cloud is south of Karaikal and radar reports indicate that the height of the cloud varied between 10-12 km on 1st. The next day (2nd) curvature is seen in the clouds and height varied between 8-9 km. On 3rd the curvature decreased and some sign of dissipation is noticed.

3.5. *Relationship between unusual rain and regional temperature, El-Nino and cyclonic storms in the preceding post monsoon season* - An analysis was done to relate the February rainfall with February temperature over the country for the period 1974 to 2002. During this period in 17 years the temperature of the country was above normal out of which only on 3 occasions February rainfall over Tamil Nadu was more than 2 times the normal. In rest of the years the rainfall was normal/ below normal. Therefore it can be concluded that the February rainfall has no relation with warming of the country.

Though in the recent El Nino year 2002 Tamil Nadu received unusual rain in February but on examination of past data it is seen that only an opposite relationship exists between February rainfall and El-Nino. How ever it is noticed that out of 17 years when February rainfall is above two times the mean rainfall, only two years (1979 & 2002) were El Nino years and during rest of the years the southern oscillation index is positive except in the years 1959 & 1994. The correlation between February rainfall and southern oscillation index for the period 1901 to 2002 works out to 0.154 which is significant at 5% level.

Figs. 7(a&b) gives the tracks of cyclonic storms in the Bay of Bengal in November during the decades 1971 to 1980 and 1981 to 1990. It can be seen that the cyclone activity is high during 1971 to 1980 compared to 1981-90. It is noticed that corresponding subsequent winter rainfall is less during 1971-80 compared to 1981-90. From this it can be concluded that whenever cyclonic activity in the post monsoon season is less, the subsequent winter rainfall is high. Further to substantiate this conclusion *t*-test was applied. During this period of study the mean value of cyclonic storms during post monsoon period is 1.5 before 1983 and it is 0.8 thereafter. The mean February rainfall is higher after 1983 than the earlier period. Therefore it can be concluded that the burst of rainfall activity in February is mostly occurring in the years in which earlier post monsoon season cyclone activity is less. For instance, in the year 1994 the cyclone activity in south west Bay is less and subsequent February rainfall is 58 mm which is more than three times the mean rainfall. Same is the case during the years 1984, 1999, 2000 and 2002.

3.6. *Damage* – Table 2 gives the damage caused due to heavy rainfall in coastal districts of Tamil Nadu . It is seen that maximum damage occurred in Thiruvarur, Nagapattinam and Tanjavur districts where the rainfall was also maximum. The damage was mainly to the harvested/ready for harvest crops. Crops over an area of 3.2 lakh hectares were submerged/damaged due to flooding and caused substantial loss of revenue to the

farmers of Cauvery delta region. The damage was not only confined to crops but many irrigation tanks (981) were damaged due to flood and more than 1000 km length of roads were also damaged in coastal districts. Total loss estimated by the state Government was around rupees 310 crores.

4. The study has indicated that more than 4 times the normal monthly rainfall in February occurred in Tamil Nadu in recent years and least decadal rains precede decades with larger amount of rainfall. Since rainfall activity in February is not very uncommon in Tamil Nadu, agricultural operations may be planned judiciously to avoid damage to crops.

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