

## Cyclones and depressions over the Indian seas in 1982

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### 1. Chief features

Five severe cyclonic storms and fifteen depressions developed in the Indian seas during 1982.

Of these two severe cyclonic storms each in the pre and post monsoon seasons developed over the Bay of Bengal. One such storm developed over the Arabian Sea during the post monsoon season. During the southwest monsoon, ten depressions none of which attained cyclone intensity developed with the break up of six in the Bay of Bengal, one in the Arabian Sea and three over land. The remaining five depressions, three over the Arabian Sea and two over Bay of Bengal occurred during the post monsoon season.

The tracks of these storms and depressions are shown in Fig. 1.

### 2. Bay of Bengal

#### 2.1. Severe cyclonic storm of 1-5 May

A well marked low formed over southwest Bay on 30 April. Moving northwards it concentrated into a depression on the morning of 1 May centred near 14.0 deg. N, 82.5 deg. E. The satellite classification at this stage was T 1.5 to T 2.0. Ship *ATPT* near 12.2 deg. N, 83.4 deg. E reported surface wind 230/18 kt at 0300 GMT. By 6 GMT the organization of the system as revealed by the cyclone detection radar at Madras clearly indicated its intensification as a cyclonic storm. The same afternoon satellite classification indicated the intensity of the system as lying between T 2.5 & T 3.5. Recurving northeastwards the storm lay close to north Andhra coast centred near 16.5 deg. N, 83.5 deg. E on 2nd morning. In the evening of 2nd it became severe cyclonic storm. Then the satellite classification from different centres lay between T 3.5 and T 4.5. Thereafter, it moved in an easterly direction and crossed Arakan coast around midnight of 4th about 125 km south of Sandoway. Continuing to move in an eastsoutheasterly direction it weakened over Thailand and neighbourhood by 5th evening.

The system was of hurricane strength between 3rd morning & 4th night when it was crossing the Arakan

coast. Ship *SZLP* near 16.2 deg. N, 88.5 deg. E (about 130 km south of the storm centre) reported at 12 GMT of 3rd, surface wind 230/50 kt and pressure 997 mb. At this time the intensity of the system was assessed by APT centres at Delhi and Bombay as T 5.5 (102 kt) based on 1330 GMT satellite imagery when the eye was clearly visible and Washington as T 6.0 (115 kt). The highest intensity was T 6.5 (127 kt) assessed by Washington based on 032100 GMT satellite imagery. Corresponding maximum sustained wind was estimated to be 95 kt/115 kt in gusts by Guam.

This system did not cause any significant weather over Indian region.

#### 2.2. Paradip severe cyclonic storm of 31 May-5 June

A low over east central and adjoining southeast Bay concentrated into a depression by the evening of 31 May. Ship *ATGH* near 15.2 deg. N, 92.6 deg. E (about 125 km northeast to the centre of the system) reported at 1200 GMT of 31 May surface wind 130/19kt and pressure 998 mb. The system was upgraded to a cyclonic storm in the morning of 1st based on the observations of ship *ATUF* near 16.4 deg. N, 92.4 deg. E reporting surface wind 120/36 kt at 0000 GMT and *ATGH* near 15.5 deg. N, 92.9 deg. E, surface wind 200/42 kt at 0300 GMT. The system moved in a northnorthwesterly direction and lay at 1200 GMT centred near 16.5 deg. N, 90.5 deg. E. At this stage the satellite classification of the system was between T 1.5 and T 2.5, corresponding to sustained wind speeds of 25 to 35 kt. It then moved northwestwards and lay on 2nd morning as a cyclonic storm centred near 17.5 deg. N, 89.5 deg. E. Ship *GXIJ* near 15.5 deg. N, 88.9 deg. E reported surface wind 290/27 kt. APT centres at Delhi and Bombay classified the system as T 3.0 (45 kt) on that morning. At 12 GMT ship *GXIJ*, about 300 km south-southeast of the storm centre, reported surface wind 220/30 kt. On 3rd morning, when the system lay centred at 19.0 deg. N, 88.0 deg. E, was upgraded into a severe cyclonic storm based on Bombay APT classification which indicated its intensity as T 4.0

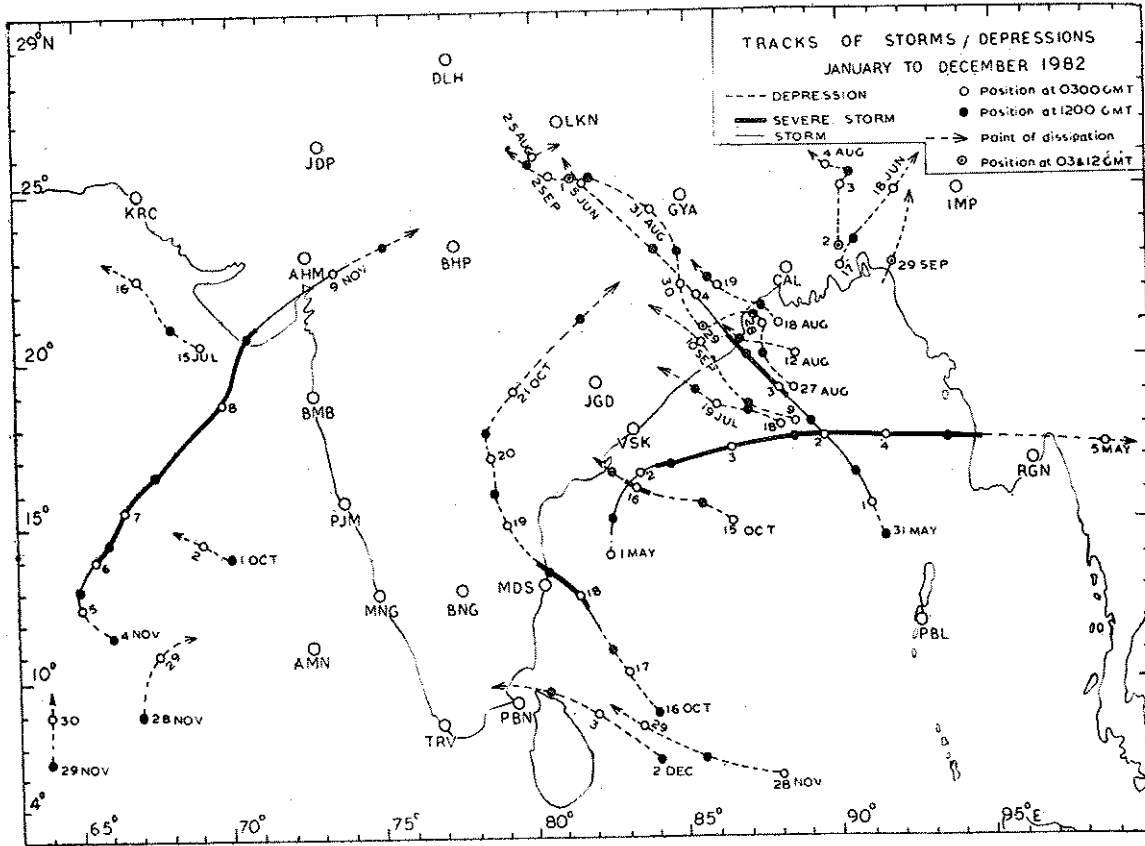


Fig. 1

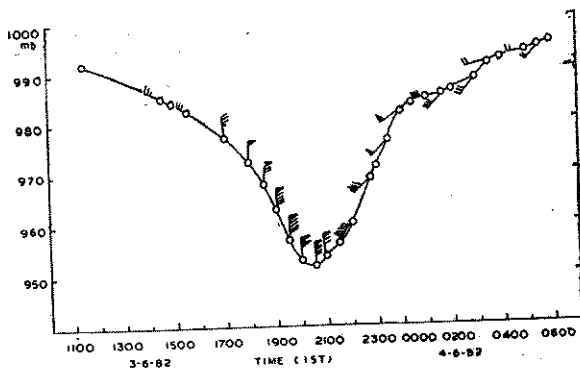


Fig. 2. Hourly observation of wind (kt) and pressure (mb) profile of severe cyclonic storm at Paradip on 3 & 4 June 1982 recorded by M. V. *Renusagar*.

(65 kt) and ship *UNNS* about 200 km southsouth-west of the storm centre reported at 0000 GMT surface wind 310/40 kt. Ship *SZBJ* about 450 km northeast of the storm centre reported at 0600 GMT surface wind 150/41 kt. Bhubaneswar reported at 0000 GMT at 0.9 km a.s.l. wind northnortheast/40 kt increasing with height to northnortheast/55 kt at 3.1 km a.s.l. Based on 0900 GMT satellite imagery, system was assessed between T 5.0 (90 kt) and T 4.0 (65 kt). Continuing to move northwestwards it lay at 1200 GMT about 70 km southeast of Paradip. Paradip and Bhubaneswar reported surface winds northerly/80 kt and northnorthwesterly/45 kt respectively. Consequently, it was upgraded to a hurricane at 1200 GMT. Paradip cyclone detection radar re-

ported 'open eye' from 1000 GMT of 3rd. The system crossed coast close to and north of Paradip near Baranipaniya around 2200 IST of 3rd. Then it moved westwards and lay as a cyclonic storm on 4th morning about 50 km north of Keonjargarh. NOAA-7 picture of the 4th morning may be seen in Fig. 4(a). Moving in a northwesterly direction it weakened over east Uttar Pradesh by 5th evening.

The ship M. V. *Renusagar* which was anchored at Paradip port experienced the full thrust of the storm on 3rd. It recorded the lowest pressure of 952.0 mb and northerly wind of 120 kt in gusts at 2035 IST. Wind and pressure profile as observed by the ship between 1130 IST of 3rd & 0600 IST of 4th are given in Fig. 2. Bhubaneswar recorded maximum wind of 60 kt at 2230 IST of 3rd. The centre of the storm was near and over Baranipaniya which was about 5 km northeast of main Mahanadi river between Paradip and False Point at about 2200 IST. Aul police station in Chandbali district witnessed calm wind and clear sky between 2200 & 2300 IST followed by high winds and heavy rain as the eye of the storm passed over the place.

The system was tracked by CDR, Paradip from 021900 GMT to 031300 GMT.

This system caused generally widespread rain/thundershowers in Andaman and Nicobar Islands, from 30 May to 4 June, Gangetic West Bengal on 3rd and 4th, Orissa on 4th, Bihar on 4th and 5th and scattered in Orissa on 3rd with isolated heavy

to very heavy falls in Andaman and Nicobar Islands from 30 May to 1 June and scattered in Orissa on 3rd and 4th.

As per reports the estimated tidal waves above normal tide was about 7 ft at *Baranipaniya* and False point Light house, about 2 m at Chandbali port.

The significant amount of rainfall (cm) were :

30 May	Kondul 10
31 May	Long Island 17
1 June	Nancowry 10, Car Nicobar 9
3 June	Paradip 9
4 June	Kendrapara 39, Paradip 26, Bhubaneswar 25, Kakatpur 24, Jagatsinghpur 22, Jenapur 20, Keonjargarh, Cuttack 17 each, Puri 16, Akhuapada 15, Talcher, Dhankanal, Pattamundai 14 each.

This storm caused considerable damage in Cuttack, Puri and Balasore districts of Orissa, the worst affected being Cuttack. Damage to Paradip port was severe. In the port two ships experienced minor damage and about 100 mechanised trawlers were lifted from the lagoon water and dumped on the sandy shores of Paradip port and a number of vessels were sunk. It blew away the wireless station at Paradip. As per the report of the revenue department of Orissa Government the cyclone affected a total population of 73.23 lakhs covering 25,000 sq. km in Orissa. Total number of human casualties were 245, injured 493 and cattle head lost 11,463. Number of houses fully or partially collapsed were 8.19 lakhs and saline inundated area was 0.89 lakh hectare. About 3390 km P.W.D. roads were damaged. A number of electric line towers and electric and telephone poles were damaged or grounded.

### 2.3. Deep depression of 18-19 July

A well marked low developed over northwest and adjoining west central Bay on 16th. It concentrated into a depression by 18th and lay centred at 0300 GMT near 18.0 deg. N, 88.0 deg. E. APT centre at Bombay classified the system as T 2.0 in the morning. Moving westnorthwestwards it intensified into a deep depression by 1200 GMT and lay centred at 18.3 deg. N, 87.0 deg. E. At this time surface winds reported at Paradip easterly/20 kt and Gopalpur northeasterly/15 kt. Coastal stations of Orissa indicated pressure departure from normal of the order of minus 6 mb. In the afternoon APT centre at Delhi classified the system as T 1.5 while Bombay as T 2.0. On 19th based on early morning's satellite (NOAA-7) imagery Delhi APT classified the system as T 2.0. Due to the system, strong monsoon conditions prevailed over west central Bay. Ship *SZLM* near 14.8 deg. N, 86.8 deg. E reported surface wind west-southwest/30 kt at 0300 GMT and at 0600 GMT ship *ATLH* near 17.0 deg. N, 86.6 deg. E and *ATUG* near 15.5 deg. N, 82.7 deg. E reported surface wind 250/30 kt and 300/28 kt respectively. At 1200 GMT of 19th it weakened into a depression and lay

close to Orissa coast between Gopalpur and Puri. Puri and Gopalpur reported surface winds southeasterly/20 kt and northnortheasterly/10 kt respectively. It crossed coast between Gopalpur and Puri by early night and lay as a well marked low over central Orissa on 20th morning. Moving northwestwards it merged with the seasonal trough by 22nd over south Uttar Pradesh and adjoining northwest Madhya Pradesh.

This system caused generally widespread rain/thundershowers in Orissa from 17th to 20th and in Bihar plateau on 21st with isolated heavy fall in Orissa from 18th to 20th.

The notable amounts of rainfall (cm) were :

18th	Nawarangpur 13, Gopalpur 9, Kakatpur, Madanpur, Rampur 8 each.
19th	Parlakhemundi 9, Pottangi 8
20th	Parlakhemundi 10, Kharior 8, Madanpur, Rampur, Surada and Pangati 7 each

### 2.4. Depression of 12 August

A well marked low formed over northwest Bay on 11th. It concentrated into a depression on 12th morning and lay centred at 03 GMT near 20.0 deg. N, 88.5 deg. E. It crossed north Orissa coast near Chandbali in the early morning of 13th and weakened into a well marked low over north Orissa and adjoining Bihar plateau. By 16th the low merged with the seasonal trough over northeast Uttar Pradesh and adjoining southeast Uttar Pradesh.

On 12th morning 2 closed isobars at 2 mb interval could be drawn. At 0000 GMT Calcutta, Balasore and Bhubaneswar reported winds eastnortheast/25 kt, northeast/20 kt and northnortheast/15 kt respectively at 0.9 km a.s.l.

This system caused generally widespread rain/thundershowers in Gangetic West Bengal, Bihar plateau and east Madhya Pradesh from 12th to 14th and in Orissa from 12th to 16th, with isolated heavy fall in Orissa on 12th and 14th, in Bihar plateau on 12th and in east Madhya Pradesh on 12th and 13th. The notable amounts of rainfall (cm) were :

12th	Champua 10, Puri, Dumka 9 each, Raigarh, Baripada 8 each, Ambikapur 7.
13th	Jagdapur 9
14th	Deogarh 7

### 2.5. Depression of 18-19 August

Under the influence of a moving low pressure wave from the east, a low formed over northwest Bay on 17th. It concentrated into a depression on 18th, centred at 0300 GMT near 21.0 deg. N, 88.0 deg. E. Moving westnorthwestwards it crossed north Orissa-West Bengal coast between Balasore and Contai in the night of 18th. Continuing to move slowly west-northwestwards it weakened into a well marked low over Bihar plateau and adjoining north Orissa and

east Madhya Pradesh by 20th. It moved over south Uttar Pradesh and adjoining northwest Madhya Pradesh by 24th.

On 18th morning pressure departure from normal was *minus* 5 to 8 mb along Orissa-West Bengal coast. However, the wind at 0.9 km a.s.l. at Bhubaneswar was eastnortheast/05 kt. In the evening when the system was close to the coast the wind at 0.9 km a.s.l. at Bhubaneswar backed to westnorthwest/20 kt and Calcutta reported eastsoutheast/25 kt. In the morning of 19th, the winds at 0.9 km a.s.l. at Calcutta and Bhubaneswar were southeast/20 kt and west/20 kt respectively. On 20th the strength of easterly winds at 0.9 km in the area of the system decreased to 15 kt.

The system caused generally widespread rain/thundershowers on 3 to 5 days in Orissa, Bihar, east Madhya Pradesh and plains of east Uttar Pradesh between 18th and 24th with isolated heavy to very heavy falls in Orissa from 18th to 22nd, Bihar plateau on 21st and 23rd, east Uttar Pradesh on 20th and in east Madhya Pradesh from 19th to 23rd.

The notable amounts of rainfall (cm) were :

18th	Cuttack 15
19th	Sambalpur 58, Hirakund 41, Rajkishorenagar and Deogarh 17 each, Rairakhol 16
20th	Champua 13
22nd	Baripada 19, Jashpurnagar 13.

According to press reports, the river *Narmada* was in spate and the coastal belt of Orissa was in the grip of floods. Unprecedented rainfall of 58 cm recorded on 19th at Sambalpur submerged half of the town.

#### 2.6. Depression of 27 August-2 September

In the eastern end of the monsoon trough which extended to west central Bay across north Bay, a low formed over north and adjoining central Bay on 26th. It concentrated into a depression on 27th morning when it was centred at 19.0 deg. N, 88.5 deg. E. Moving northwestwards it crossed north Orissa coast near Balasore on 28th night. It moved westwards on 29th and later on in a northwesterly direction and weakend into a low over central parts of Uttar Pradesh by 3rd and merged with the seasonal trough on 4th.

On 27th Sandheads reported surface wind northeast/20 kt and eastnortheast/15 kt at 00 and 03 GMT respectively. At 0000 GMT winds at 0.9 km a.s.l. at Calcutta, Balasore and Bhubaneswar were east-southeast/25 kt, eastnortheast/15 kt and northeast/15 kt respectively. Ship *ATGD* about 300 km south-east of the depression centre reported southwest/25 kt. APT centre at Bombay estimated the intensity as T 1.5 based on the satellite imagery of 272130 GMT. On 28th morning when the system came closer to the coast the winds at 0.9 km a.s.l. at Balasore and Bhubaneswar strengthened, reporting eastsoutheast/25 kt and northnorthwest/20 kt respectively, which at 1200 GMT further strengthened to southeast/30 kt and west-

northwest/25 kt respectively. Pressure departure from normal was of the order of *minus* 6 mb in the coastal areas of Orissa. On 29th morning though 3 closed isobars at an interval of 2 mb could be drawn, upper winds at 0.9 km a.s.l. around the system was between 15-25 kt. Pressure departure from normal was of the order of *minus* 6 to 7 mb. Between 03 and 12 GMT the depression remained practically stationary. At 1200 GMT Bhubaneswar reported surface wind southwest/20 kt and that at Paradip and Puri was southwest/30 kt.

On 30th the winds at 0.9 km a.s.l. around the system were between 20 & 30 kt. On 31st the pressure departure from normal around the system became positive and at the centre of the order of *minus* 1 to 2 mb indicating the filling up of the system. However, the isobar pattern and the upper winds at 0.9 km indicated its intensity as depression till 2nd evening.

Under the influence of this system rain/thundershowers were generally widespread on 3 to 5 days in Gangetic West Bengal, Orissa, Bihar, plains of Uttar Pradesh and Madhya Pradesh during 28th to 3rd with scattered to isolated heavy to very heavy falls in Orissa from 27th to 30th, Bihar plateau on 31st east Uttar Pradesh on 29th and 31st and from 1st to 3rd, west Madhya Pradesh on 31st and 3rd and in east Madhya Pradesh from 29th to 1st. The significant amounts of rainfall (cm) were :

27th	Dungripali 18
28th	Kakatpur, Phulbani 11 each
29th	Akhupada 25, Bolangir, Sonepur 22 each, Phulbani 21, Jenapur 19, Narsinghpur 18, Hirakund, Madanpur, Rampur, Titlagarh, Sakti 16 each, Rajkishorenagar 13
30th	Phulbani 48, Bolangir 40, Madanpur, Rampur 27 each, Bargarh 19, Titlagarh, Rairakhol 14 each
31st	Shakti 18, Chhatapur 11, Panna, Banbasa 10 each
1st	Allahabad 20, Balrampur, Patti 16 each, Bahraich, Panna 12 each, Rewa, Mantapur 11 each, Karwi, Maja, Handia 10 each.
2nd	Kaisarganj 19, Barabanki, Fatehpur, Neemsar, Bahraich 15 each, Sitapur 14, Biswan, Bhatpurwaghat 13 each.
3rd	Mahoba 22, Chhatapur 21, Khajuraho 15, Mot 14, Orai 13, Lalitpur 12, Mahroni 11.

According to reports the rivers *Mahanadi* and *Kathjuri* of Orissa were in floods causing widespread damage to property and loss of a few human lives. More than half of the districts of Uttar Pradesh were in the grip of floods. Moghalsarai and Varanasi railway links were cut off by the flood waters of *Ganga*. Some parts of Madhya Pradesh were also affected by floods.

## 2.7. Depression of 9-10 September

A low pressure area emerged into east central and adjoining northeast Bay on 4th across central Burma. It moved over northwest and adjoining west central Bay on 8th. Under the influence of another low pressure wave from the east across Arakan coast it concentrated into a depression on 9th morning centred near 18.0 deg. N, 89.0 deg. E. Moving northwestwards it crossed Orissa coast near Puri on 10th morning and weakened into well marked low over north interior Orissa and adjoining east Madhya Pradesh by the same evening. Continuing to move northwestwards the well marked low lay over southeast Uttar Pradesh and adjoining north Madhya Pradesh on 12th. Under the influence of a mid-tropospheric trough in westerlies it recurved eastnortheastwards and weakened further and merged with the seasonal trough over east Uttar Pradesh and adjoining Bihar plains on 14th.

Bombay APT classified the system as T 2.0 on 9th evening and T 2.5 on 10th morning. Maximum pressure departure from normal was *minus* 5.6 mb on 9th evening and 10th morning in association with the system.

The system caused generally widespread rain/thundershowers in Gangetic West Bengal, Orissa, Bihar, east Madhya Pradesh and plains of Uttar Pradesh on a couple of days with scattered to isolated heavy to very heavy falls in Orissa from 9th to 11th, Bihar plateau on 10th, Bihar plains on 13th and 14th, east Uttar Pradesh from 11th to 14th, in east Madhya Pradesh from 10th to 12th and in west Madhya Pradesh on 11th and 12th.

The significant amounts of rainfall (cm) were :

9th	Paradip 19, Puri 14
10th	Chaibasa 10
11th	Narsinghpur, Khaga 20 each, Fatehpur 17, Baberu 15, Chhatnag, Allahabad 14 each, Handia 13, Banda 12, Chilla-ghat, Jabalpur 11 each, Kunda 10.
12th	Bhraich 34, Elginbridge 33, Bhatpurwaghat 25, Barabanki 24, Mankapur, Unna 21 each, Fatehgarh 17, Safipur 16, Lucknow AP, Balrampur 15 each, Utraula 14, Kanpur 13.
13th	Bhraich 46, Elginbridge 25, Kakardarighat 24, Doomeriaganj 22, Bansi 18, Haraiya 16, Mankapur, Maharajganj 14.
14th	Basti 14, Padrauna 13.

According to press reports the overall flood situation in Uttar Pradesh and Bihar State which were under flood threat/flood from the last week of July continued to be grim. The floods in Orissa which was affected in the last week of August worsened after a brief respite due to incessant rains. Some loss of lives were reported from Uttar Pradesh.

## 2.8. Depression of 29 September

The low pressure area which developed over west central Bay on 25th, moved northeastwards and became well marked by 26th. Continuing to move northeastwards it crossed Chittagong coast north of Chittagong by 29th morning. At the time of crossing the coast it reached the intensity of depression. Moving northnortheastwards it weakened over Assam and adjacent States by evening.

Chittagong reported surface wind at 00 and 03 GMT of 29th south/55 kt and westsouthwest/35 kt. According to the information received from Bangla Desh Met. Office, the system had maximum sustained wind about 29 kt with isolated maximum gust upto 61 kt. The pressure departure from normal at Chittagong was about *minus* 5 mb on 29th morning.

## 2.9. Kakinada severe cyclonic storm of 15-16 October

A low formed over southeast Bay and adjoining north Andaman Sea on 12th. Moving northwestwards it concentrated into a deep depression over west central Bay on 15th morning and lay centred at 03 GMT near 15.5 deg. N, 86.5 deg. E. It intensified into a severe cyclonic storm by 16th early morning. Continuing to move northwestwards it rapidly weakened into a depression by evening and crossed north Andhra coast just to the south of Kakinada by midnight of 16th/early morning of 17th as a low and lay over north coastal Andhra Pradesh and adjoining Telangana by 17th morning.

In the morning of 15th the satellite classification of the system was T 2.0 and Guam bulletin indicated maximum wind 30/40 kt in gusts. At 06 GMT a ship 'IVND' about 150 km north of the centre of the system and another ship 'UGRA' about 30 km northeast of the centre reported surface winds easterly 20 kt and northeast/20 kt respectively. Based on 152150 GMT satellite imagery, APT centres at Bombay and Delhi classified the system as T 3.0 (45 kt) and T 3.5 (55 kt) respectively. The low level winds at Visakhapatnam, Gannavaram and Madras steadily increased and at 0.9 km a.s.l., they reported eastnortheast/30 kt, northeast/35 kt and northnortheast/25 kt respectively at 1800 GMT. From 152100 GMT the system was tracked by CWR at Machilipatnam till 160700 GMT. It reported 'eye' till 160000 GMT and then 'open eye' from 160100 to 160400 GMT. The severe cyclonic storm lay about 150 km southeast of Kakinada at 03 GMT when it reported surface wind northnortheast/15 kt. Pressure departure from normal along the north Tamil Nadu-south Andhra coasts was *minus* 1 to 2 mb. It was a narrow core system. At 0900 GMT the satellite intensity of the system was T 3.0 to T 3.5. At this time it was very close to coast near Kakinada which reported surface wind northnortheast/20 kt, pressure 1004.9 mb, wind at 0.9 km a.s.l. at Gannavaram was north/20 kt. Early morning satellite picture of 17th and coastal observations of 161800 GMT indicated that the system rapidly weakened into a depression over the coastal waters of Andhra coast and entered into land as a low pressure area near Kakinada.

This system caused widespread rain/thundershowers in coastal Andhra Pradesh with scattered very heavy falls on 17th. The significant amounts of rainfall (cm) were :

17th Bheemunipatnam 52, Visakhapatnam 37, Kalingapatnam 34, Anakapalli, Sabbavaram 28 each, Srikakulam, Nellimarla 26 each, Narasannapetta, Bhogapuram 25 each, Chintapalli, Pathapatnam 23 each, Yellamachali, Vizianagram 22 each, Kotru Chodavaram, K. Kotapadu 20 each.

According to press reports about 3000 huts were partially or completely damaged in Visakhapatnam. Exceptionally heavy rain claimed 4 lives. Loss due to damages to roads, minor irrigation canals etc estimated at a few crores in coastal Andhra Pradesh.

#### 2.10. Sriharikota severe cyclonic storm of 16-21 October

A low lay over southwest Bay off Sri Lanka-south Tamil Nadu coasts on 14th. It concentrated into a depression by 16th evening centred at 1200 GMT near 9.0 deg. N, 84.0 deg. E. Moving northwestwards it further concentrated into a deep depression on 17th evening and became a cyclonic storm by 171800 GMT as indicated by the radar observation of CDR, Madras. It further intensified into a severe cyclonic storm by 18th morning and lay at 0300 GMT centred near 12.7 deg. N, 81.5 deg. E. Continuing to move northwestwards it crossed south Andhra coast between Sriharikota and Dugarajapatnam around 2200 IST of 18th and weakened into a deep depression. It further weakened into a depression by 19th evening and moved north to northnortheastwards across Andhra Pradesh. It weakened over east Madhya Pradesh by 22nd morning. The recurvature of the system was due to a slow moving trough in mid and upper tropospheric westerlies across northern Peninsula.

At 1200 GMT of 16th ship *ATSZ* near about 9.3 deg. N, 83.2 deg. E reported surface wind 010/20 kt. Based on 170850 GMT satellite picture, Delhi APT classified the system as T 2.0 (30 kt) and Washington as T 1.5 (25 kt). The same day at 1200 GMT ship *VWSY* about 200 km southsouthwest of the deep depression centre reported surface wind southwest/25 kt and ship *ATSZ* about 250 km to its northeast/20 kt. Based on 171800 GMT radar observation of CDR, Madras it was upgraded to a cyclonic storm. APT centres at Bombay and Delhi estimated its intensity as T 3.0 (45 kt) based on 172100 GMT satellite imagery while Washington as T 1.5. At 1800 GMT Madras reported eastnortheast/25 kt and Karaikal west/25 kt at 0.9 km a.s.l. CDR, Madras reported 'elliptical eye' of the system from 180400 GMT to 180700 GMT. The system was upgraded to a severe cyclonic storm on 18th morning at 0000 GMT. Madras wind at 0.9 km a.s.l. was northnortheast/35 kt and ship *VTBP* about 100 km northwest of the storm centre reported wind northnortheast/40 kt at 0630 GMT. This system was of a narrow core. In the afternoon Bombay APT classified it as T 4.0 or more (65 kt or more) and Washington as T 3.5 (55 kt). Madras wind at 0.9 km a.s.l. backed to northwest/40 kt. At 0300 GMT of 19th when the system lay 50 km north-

east of Cuddapah, 3 closed isobars at 2 mb intervals could be drawn. Pressure departure from normal over Rayalaseema and north Tamil Nadu was of the order of *minus* 3 to 6 mb.

Lowest pressure of 982.8 mb was recorded at Sriharikota at 2000 IST of 18th when it was close to the station. It reported maximum wind of 40/60 kt in gust at 2200, 2330 and 2400 IST of 18th. Lowest pressure of 994.8 mb and wind east/30 kt recorded at Nellore at 0130 hrs of 19th. Maximum wind of east-southeast/40 kt reported here at 0330 IST.

As per the report of the touring officer Dugarajapatnam reported 'calm' wind between 2135 & 2230 IST of 18th followed by strong southerly wind (about 120 kmph). Vakadu which is situated about 15 km to the west of Dugarajapatnam reported 'calm' wind between 2345 & 0015 IST followed by strong southerly winds. A part of the 'eye' of the storm was over Dugarajapatnam while it crossed the coast and moved across Vakadu. Coastal regions of south Andhra were not affected by tidal waves due to this storm.

This system caused generally widespread rain/thundershowers with scattered to isolated heavy to very heavy falls in Tamil Nadu on 18th and 19th, coastal Andhra Pradesh on 19th, 20th and 22nd, Rayalaseema on 19th, 20th, Telangana on 21st and east Madhya Pradesh on 22nd. The significant amounts of rainfall (cm) were :

18th	Nagapattinam 19, Chidambaram 10
19th	Rapur 31, Sullurpet 28, Tanali 26, Nayudupet 25, Srikalahasti 20, Nellore (taluk) 17, Badvel, Gudur, Koduru 16 each, Nellore obsy, Guntur, Rajanpet, Sidhcot 15 each, Cuddapah, Rapalle, Udayagiri 14 each, Avaniguda 13, Madras city 12, Sattenapalli, Parachur, Madras AP 11 each, Kavali, Ponnur 10 each.
20th	Piduguvalla 26, Narasaraopet 17, Bhimadole 14, Kurnool, Chirala 13 each, Siddipet, Nandikotkur 11 each, Nagar Kurnool, Ramannapet 10 each.
21st	Jagtiyal 22, Sriramsagar 18, Sirpur 16, Asifabad 12, Kamareddy 11, Oontur 10.
22nd	Kawardha 10.

As per report this storm claimed a total of 59 human lives. It did not cause any major structural damages. About 300 to 400 huts were partially damaged in Tamil Nadu. In Cuddapah district the number of houses damaged were about 2500. Lot of lemon orchards and plaintain gardens were destroyed by this storm in Nellore and Cuddapah districts of Andhra Pradesh.

#### 2.11. Deep depression of 28-29 November

In the equatorial trough, which was active in the last week of November a depression developed on 28th morning and lay centred at 0300 GMT near 7.0 deg.

N, 88.0 deg. E. Ships about 125-150 km southsouthwest/southwest of the system centre reported 25-30 kt winds. Moving westnorthwestwards it further concentrated into a deep depression by the same evening. Continuing to move westnorthwestwards it weakened into a well marked low pressure area by 29th evening over southwest Bay off Sri Lanka coast.

The system did not cause much of weather over Tamil Nadu.

### 2.12. Depression of 2-4 December

A low which lay over southeast Bay on 1st, moved westwards and concentrated into a depression over southwest Bay by 2nd evening centred at 1200 GMT near 7.5 deg. N, 84.0 deg. E. Thereafter moving initially northwestwards and then westnorthwestwards it crossed south Tamil Nadu coast near Tondi in the morning of 4th and weakened over land. Over sea area it was tracked by the satellite.

This system caused generally widespread rain/thundershowers in Tamil Nadu and Kerala on 4th with isolated heavy to very heavy falls in Tamil Nadu.

Noteworthy amounts of rainfall (cm) were :

4th	Pondicherry 13, Pamban 10, Chidambaram 8, Ramanathapuram, palayakottai, Tuticorin 7 each.
5th	Pondicherry 9.

## 3. Arabian Sea

### 3.1. Depression of 15-16 July

A low pressure area lay over Saurashtra and Kutch on 14th. It emerged into northeast Arabian Sea and concentrated into a depression on 15th centred at 0300 GMT near 20.5 deg. N, 69.0 deg. E. Pressure departure in west Saurashtra coast was of the order of *minus* 4 to 6 mb. Two closed isobar at 2 mb intervals could be drawn. However, APT centre at Bombay classified the system as T 1.0 based on satellite imagery of 0350 GMT. It moved westnorthwestwards and lay at 1200 GMT centred near 21.0 deg. N, 68.0 deg. E. Ship *VWCP* near 21.5 deg. N, 68.6 deg. E reported surface wind 130/16 kt. On 16th morning INSAT picture indicated that it broke into two circulations, one moving over land (Saurashtra and Kutch) and other over northeast Arabian Sea. By evening the system weakened *in situ* into a low and became unimportant by next day.

This system caused fairly widespread rain/thundershowers in Saurashtra and Kutch on 15th.

### 3.2. Deep depression of 1-2 October

The low which lay over east central Arabian Sea off Maharashtra-Goa-Karnataka coasts on 30 September, concentrated into a deep depression by 1st evening and lay at 1200 GMT centred near 14.0 deg. N, 70.0 deg. E. The system moved westnorthwestwards and weakened over the sea by 2nd evening.

APT bulletin from Bombay based on 011020 GMT imagery indicated the intensity of the system as T 2.0 (30 kt) and those from Delhi and Washington at T 2.5 (35 kt). Further Washington classified the intensity of the system as T 2.0 (30 kt) and T 1.5 (25 kt) based on 012230 GMT and 021010 GMT satellite imageries.

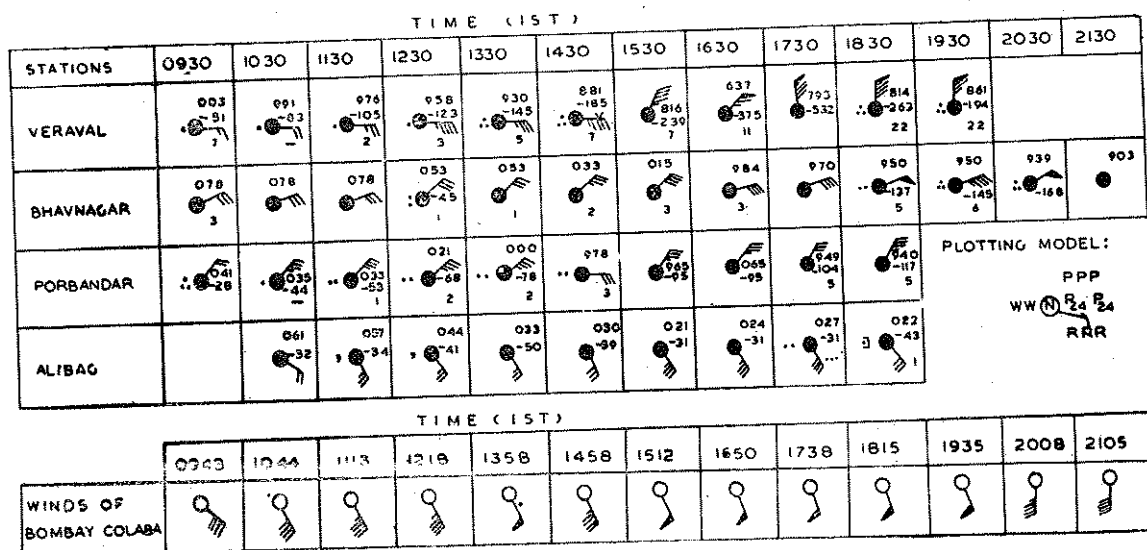
This system did not directly affect the weather over the country.

### 3.3. Severe cyclonic storm of 4-9 November

A low lay off Kerala coast on 31 October. It moved westwards and concentrated into a depression over southeast Arabian Sea by 4th evening centred at 1200 GMT near 11.5 deg. N, 66.0 deg. E. Moving northwestwards it intensified into a cyclonic storm by 5th morning. It moved northwards till evening and then recurved northnortheastwards and further intensified into a severe cyclonic storm by 6th morning and lay centred at 0300 GMT near 14.0 deg. N, 65.5 deg. E. Moving northeast/northnortheastwards it crossed south Gujarat coast about 5 km west of Kodinar between 1000 and 1100 GMT of 8th (near about 1700 IST) and weakened into a cyclonic storm by 9th morning when it lay 50 km to the northeast of Baroda. Thereafter it weakened rapidly into a low over southwest Madhya Pradesh by 10th morning and became unimportant by 11th.

Bombay APT classified the system as T 2.0 (30 kt) based on 041000 GMT satellite imagery. A ship from southeast Arabian Sea, which was near the system reported 10-15 kt southwesterly/southerly winds. Bombay and Delhi APT centres classified the system as T 3.0 (45 kt) and T 2.0 (30 kt) based on 050420 GMT satellite imagery. Ship *ATHQ* about 300 km southsouthwest of the storm centre reported wind 240/19 kt at 0300 GMT of 5th. In the afternoon APT Bombay indicated T 3.5 (55 kt). However, ship observations from the storm field were absent. Bombay APT classified the system based on 052250 GMT and 060950 GMT satellite imageries as T 3.5 while Delhi as T 3.0. Ship observation near the storm centre was absent on 6th and on 7th morning. However, at 060000 GMT, ship *ATQO* about 500 km to the southsoutheast of the storm centre reported wind 240/32 kt and the same ship at 1200 GMT about 450 km to its south reported 250/30 kt. Upper winds along the west coast increased. At 0.9 km a.s.l. Goa reported 180/35 kt and Ratnagiri 190/30 kt at 0600 GMT and 1200 GMT respectively. The storm circulation was extensive covering almost whole of the Arabian Sea from 6th onwards till its landfall on 8th. On 7th even Porbandar reported surface winds east/15-20 kt and ships plying between Lats. 8 deg. & 9 deg. N in the south Arabian Sea reported westerly winds of the order of 10-25 kt. On this day T-classification from Bombay and Delhi APT centres was T 4.0 (65 kt) and T 3.5 respectively in the morning and that as T 4.5 and T 3.5 respectively in the afternoon. At 1200 GMT ship *JJEG* about 200 km east of the storm centre reported wind 130/42 kt and pressure 1000.0 mb and ship *BARJAN* about 350 km westnorthwest to its centre reported wind 020/23 kt and pressure 1005



Fig. 3. Hourly observations for 8<sup>th</sup> November, 1982

mb. On 8<sup>th</sup> several ships reported from the storm fields. They are listed below :

Call sign of the ship	Time of obsn. (GMT)	Wind direction (°) and speed (kt)	Approx. distance from the storm centre	Pressure (mb)
Not given	0000	140/37	NE-150 km	989.1
ATGH	0200	180/60	SE-200 km	1001.5
Sagar Samrat	0300	115/50	ESE-75 km	976.7
ATJS	0400	120/60	ESE-225 km	1002.8

T-Classification of the system on 8<sup>th</sup> Morning [Fig. 4(b)] was 5.5 made by Bombay and 4.0 by Delhi. Bombay (Colaba) reported surface wind southeast/40 kt at 0725 IST which increased to southsoutheast/50 kt at 1458 IST and continued upto 1935 IST. Alibag reported surface wind southsoutheast/40 kt at 1830 IST. Hourly value of pressure, wind and pressure change for 24 hours between 03 & 16 GMT and wind at Alibag between 0948 & 2105 IST are given in Fig. 3.

In the afternoon of 8<sup>th</sup> when it was about to cross coast, Veraval reported lowest pressure of 963.7 mb and wind northeast/65 kt at 1000 GMT, which became 979.3 mb and north/80 kt at 1100 GMT indicating that the storm crossed coast close to and to the east of Veraval. In the afternoon Bombay classified it as T 5.5 and Delhi T 5.0. The pressure departure from normal at 1200 GMT of 8<sup>th</sup> was of the order of minus 16 to 19 mb at Veraval, Porbandar and Bhavnagar. Bhavnagar reported surface

wind 080/50 kt. It appears from the report of the touring officer that most of the places in Saurashtra experienced gale winds ranging from 120 to 150 kmph (65/80 kt) on 8<sup>th</sup> afternoon and night.

After crossing coast near Kodinar the storm moved northeastwards and passed very close to Baroda and lay at 03 GMT of 9<sup>th</sup> 50 km northeast of Baroda. At 00 GMT of 9<sup>th</sup> Ahmedabad reported eastnorth-east/45 kt at 0.9 km a.s.l.

This storm recurved from Lat. 13 deg. N, which is unique. Generally in the month of November storms in Arabian Sea recurve from latitude north of Lat. 15 deg. N. The recurvature of this storm from such a low latitude could be attributed to upper tropospheric ridge over the south Peninsula. At 1200 GMT of 5<sup>th</sup> winds at Minicoy at 250 and 200 mb were southwest/05 kt and S/05 kt respectively. An aircraft reported on 6<sup>th</sup> morning from about 12 deg. N/64 deg. E wind at 250 mb as S/25 kt. It moved along the periphery of the upper tropospheric ridge.

This system caused generally widespread rain/thundershowers in Konkan and Madhya Maharashtra on 7<sup>th</sup>, Gujarat State on 8<sup>th</sup> and 9<sup>th</sup> with scattered to isolated very heavy falls in Saurashtra and Kutch from 7<sup>th</sup> to 9<sup>th</sup>. The notable amounts of rainfall (cm) were :

7 <sup>th</sup>	Bhesan 31, Kutiyana 25, Kodinar 17, Khamba 13.
8 <sup>th</sup>	Bhesan 63, Lathi 25, Khamba 18, Kodinar, Babra, Veraval 15 each, Hari 14, Jafrabad, Una, Mangrol 13 each.



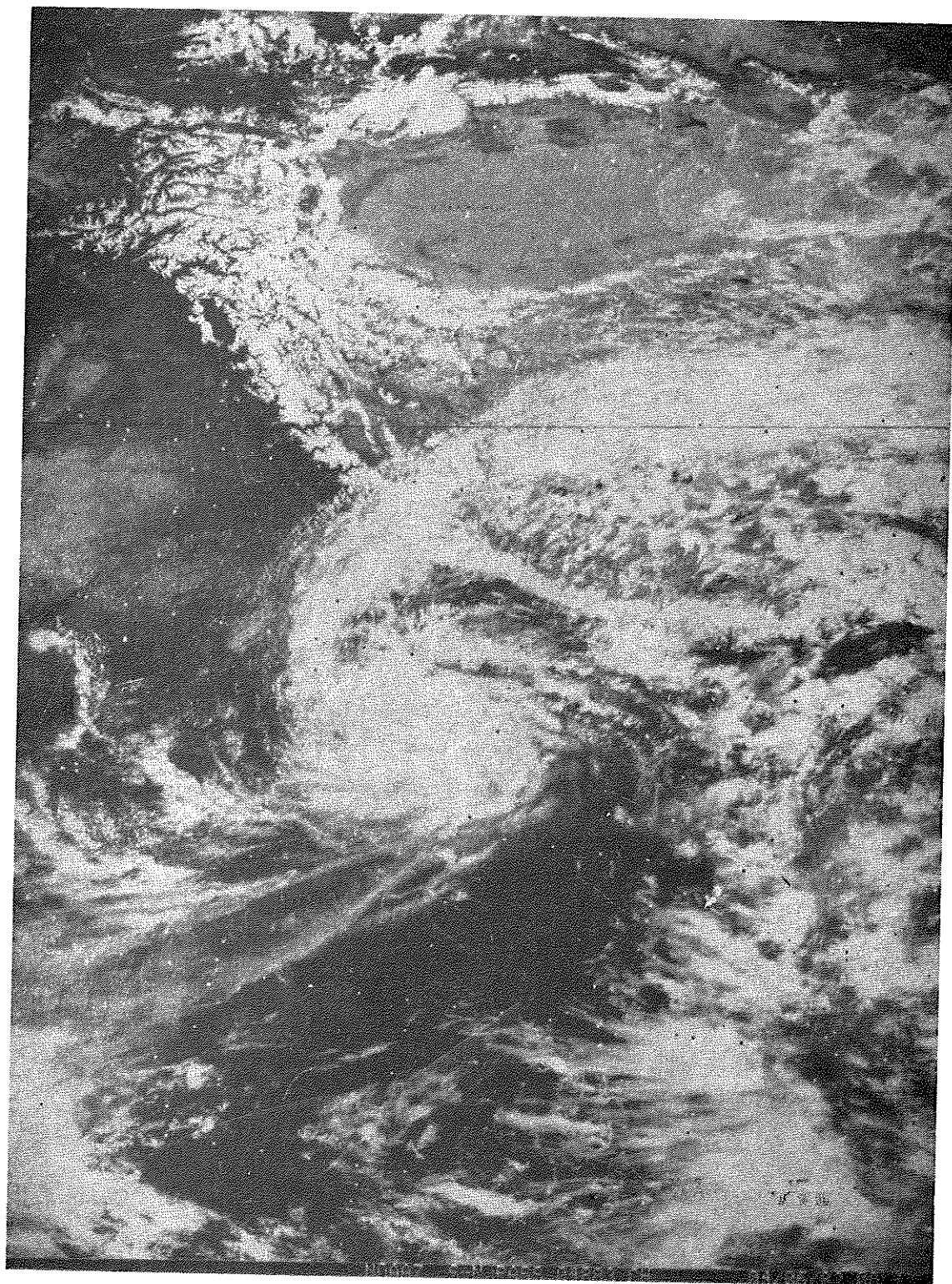


Fig. 4(a). NOAA-7 picture of 4 June 1982 (morning) of Orissa severe cyclonic storm

8(b)

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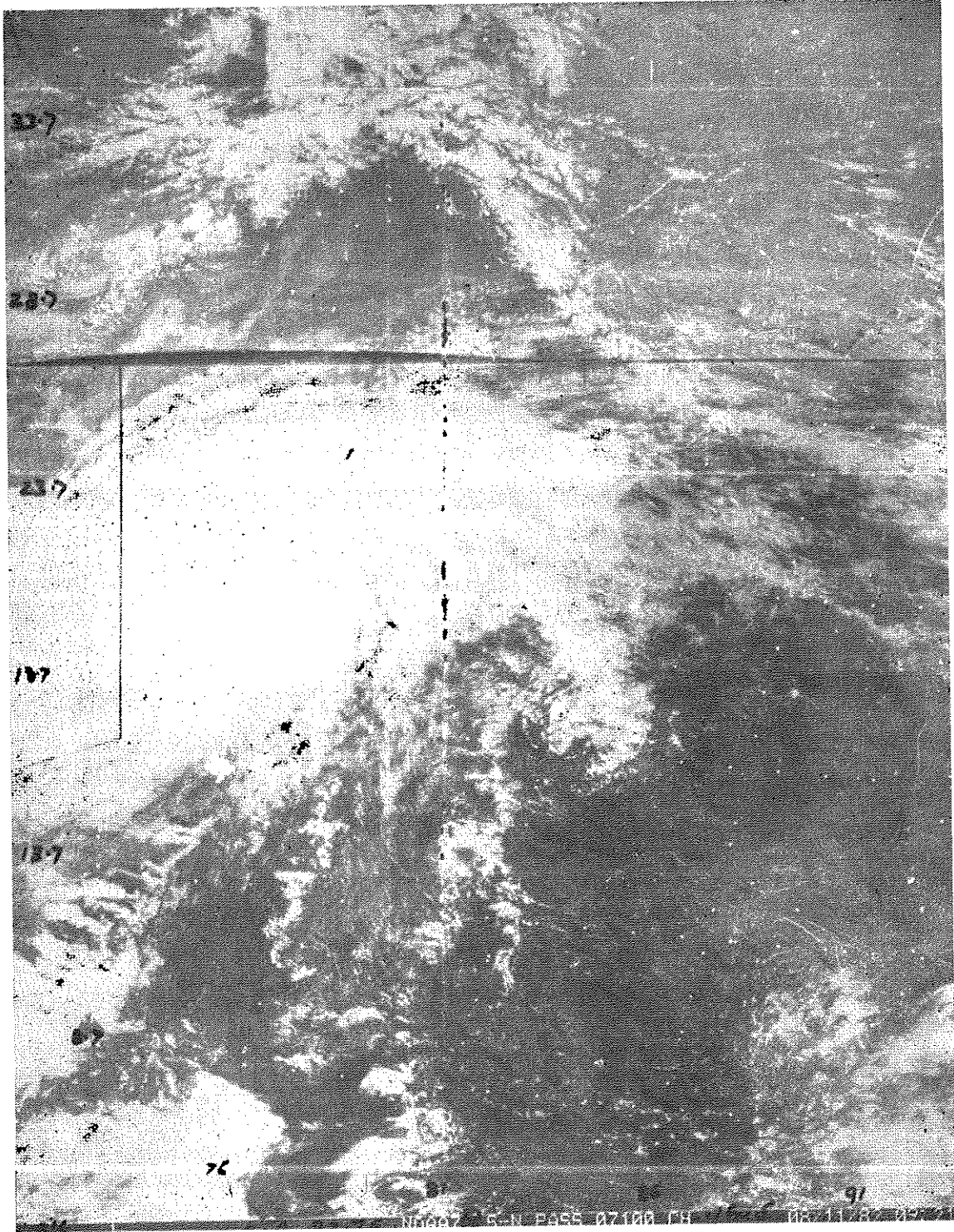


Fig. 4(b). NOAA-7 picture of 8 November 1982 (morning) of Gujarat severe cyclonic storm

V.V. Nagar 45, Dhari 44, Amreli 35, Gariadhar 32, Talaja 25, Anand, Veraval, Gadhada, Junagadh, Visavadar 22 each, Talala 21, Savarkundla, Vallabhipur 20 each, Botad, Shihor 19 each, Mangrol 18, Borsad, Baroda 17 each, Godha, Bhavnagar, Nadiad, Mehmdabad 16 each, Liliya, Patlad, Khambat 15 each, Bhesan, Una, Malia 14 each, Madarada, Keshod, Palitana 13 each.

According to the report of the touring officer estimated tidal wave above the normal tide was about 1.5 m at Mangrol, 2 m at Diu, more than 2 m at Veraval and 3 m at Jafrabad.

According to reports this cyclone took a toll of 507 lives in Gujarat State and 4 in Konkan. Amreli, Bhavnagar and Junagadh districts reported 237, 154 and 51 deaths respectively. Loss of live-stock in the State reported to be 1,50,332. About 12624 pucca and 54549 kutcha buildings were completely destroyed. The crops damage was estimated at of Rs. 127.23 crores.

#### 3.4. Deep depression of 28-29 November

A low pressure area formed over Maldives area on 26th. Moving westnorthwestwards it concentrated into a depression over southeast Arabian Sea by 28th evening and lay centred at 1200 GMT near 9.0 deg. N, 67.0 deg. E. Moving northwards it further concentrated into a deep depression by 29th morning centred near 11.0 deg. N, 67.5 deg. E. By the same evening it weakened into a low pressure area over southeast and adjoining east central Arabian Sea. The system was mainly tracked by the satellite.

This system caused scattered rain/thundershowers over Lakshadweep on 29th and 30th.

#### 3.5. Depression of 29-30 November

Satellite imagery showed that while the deep depression in the southeast Arabian Sea was weakening, another depression developed over southeast and adjoining southwest Arabian Sea by 29th evening. It moved northwards and weakened over south Arabian Sea by 30th evening. This system was tracked by the satellite.

This system did not cause any weather over the country.

### 4. Land depressions

#### 4.1. Depression of 18-19 June

A low lay over northwest angle Bay on 16th. It concentrated into a depression on 18th morning cen-

tered at 0300 GMT about 100 km south of Dhaka. At 0000 GMT of that day at 0.9 km Agartala reported southeasterly/25 kt and Calcutta northnorthwesterly/20 kt. 2 closed isobars at an interval of 2 mb could be drawn. Pressure departure from normal was of the order of *minus* 5 to 6 mb. Moving northnortheastwards it lay at 1200 GMT close to Dhaka. On 19th morning it lay about 90 km northnortheast of Agartala. By this evening it weakened into a well marked low over Assam and Meghalaya and dissipated by next day.

This system caused generally widespread rain/thundershowers on 2 to 4 days in Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura and West Bengal & Sikkim between 17th & 20th with isolated heavy to very heavy falls in Gangetic West Bengal on 18th, Assam and Meghalaya from 18th to 20th and in Sub-Himalayan West Bengal & Sikkim and Nagaland, Manipur, Mizoram and Tripura on 20th. The notable amounts of rainfall (cm) were :

18th	Chaparmukh 13, Cherrapunji 11, Panagarh 8.
19th	Chaparmukh 19, Cherrapunji 12, Silchar 8.
20th	Cherrapunji 29, Gauhati, Tezpur AP, Rangiya, Agartala AP 8 each, Baghdogra, Gohpur 7 each.

#### 4.2. Depression of 2-4 August

Under the influence of a low pressure wave moving westwards across Arakan-Chittagong coasts, a low formed over north Bay and adjoining Bangla Desh and Gangetic West Bengal on 1st. It concentrated into a depression on 2nd morning centred near 23.0 deg. N, 90.0 deg. E. At 0000 GMT Agartala reported wind southeasterly/30 kt at 0.9 km a.s.l. Two closed isobars at an interval of 2 mb could be drawn. It remained practically stationary till evening. Then moving northwards it lay near Tura on 3rd morning. It again remained practically stationary there till 3rd evening. Then moving westwards it weakened into a low by 4th evening over Sub-Himalayan West Bengal and merged with the seasonal trough by next day.

This system caused generally widespread rain/thundershowers in Assam and Meghalaya and Nagaland, Manipur, Mizoram and Tripura from 2nd to 4th, in Gangetic West Bengal from 1st to 3rd and Sub-Himalayan West Bengal and Sikkim on 5th with isolated heavy to very heavy falls on 1 to 2 days.

The notable amounts of rainfall (cm) were :

1st	Sandheads 19
2nd	Sandheads 20, Contai 8, Calcutta (Alipore) 7.
3rd	Agartala 21, Cherrapunji 17, Kailashahar 11, Gohpur, Calcutta (Alipore) 7 each.
4th	Dhubri 13, Shillong 9, Agartala 8.
5th	Malda 11, Cherrapunji 8.

According to reports torrential rains in different parts of Assam caused floods affecting 650 villages in the State.

#### 4.3. Depression of 25 August

The remnant of 18-19 August depression lay as well marked low pressure over south Uttar Pradesh and adjoining northwest Madhya Pradesh on 24th. It concentrated into a depression on 25th morning centred about 50 km southsouthwest of Kanpur. It dissipated *in situ* by the evening into a low. The low moved northeastwards and merged with the seasonal trough over east Uttar Pradesh by 27th.

On 25th morning 2 closed isobars at an interval of 2 mb could be drawn. At 0000 GMT the winds at 0.9 km a.s.l. at Lucknow was eastsoutheast/20 kt and at Gwalior north/30 kt. By evening the wind at Lucknow at 0.9 km a.s.l. decreased to southeast/10 kt.

This system caused generally widespread rain/thundershowers in Uttar Pradesh from 25th to 28th with isolated heavy to very heavy falls in east Uttar Pradesh on 26th and 27th, plains of west Uttar Pradesh on 25th and 26th and hills of west Uttar Pradesh on 26th and 27th. It also caused fairly widespread rain/thundershowers in Madhya Pradesh on 26th.

The significant amounts of rainfall (cm) were :

25th	Bareilly 19, Sahaswan 17, Baisuali, Etah 15 each, Atrauli 12, Mainpuri 11, Aligarh 9.
26th	Farrakhabad 16, Mukteshwar 12, Bareilly, Etah, Kheri, Ranikhet 9 each, Shahjahanpur, Bandasuar 8 each, Fatehgarh, Ghatanpur 7 each.
27th	Mauranipur, Sitapur 11 each, Lansdowne 10, Neemsar, Tikunia, Ghatanpur 9 each, Katorniaghat 8, Kanpur AP, Khaga, Sandila 7 each.