

Cyclones and depressions over the Indian seas and neighbourhood during 1994*

1. Chief features

There were four cyclonic storms and four depressions over the Indian seas during the year 1994. Out of the four cyclonic storms, two formed over the Bay of Bengal. The first one formed in the pre-monsoon season, reached the intensity of severe cyclonic storm with a core of hurricane winds and crossed the Bangladesh-Myanmar coast. The second storm formed in the post-monsoon season, reached the intensity of severe cyclonic storm and crossed the east coast of India over Madras. The other two storms formed in the Arabian sea, one in the beginning of monsoon season and the other in the post-monsoon season. Both these storms moved westwards across the Arabian sea.

All the four depressions of the year formed over the Bay of Bengal. One formed in the premonsoon, one in the monsoon and the remaining two in the post-monsoon season. The depression in the monsoon season (17-20 August) and the one in the post monsoon season (4-7 October) intensified into a deep depression and crossed the east coast of India.

Tracks of these systems are given in Fig. 1 and their brief history is given in Table 1. Monthly frequencies are given in Table 2.

2. Pre-monsoon season (March-April-May)

One cyclonic storm and one depression formed during this season. Both these systems were over the Bay of Bengal.

2.1. Depression over the Bay of Bengal (21-24 March)

A depression formed over the southeast Bay of Bengal and adjoining south Andaman Sea on the evening of 21 March, with centre near $9.5^{\circ}\text{N}/90.5^{\circ}\text{E}$. The system moved initially in a north-northwesterly direction and then in a northeasterly direction and was centred near $13.5^{\circ}\text{N}/91.5^{\circ}\text{E}$ on 23rd morning.

The system, thereafter, remained practically stationary upto 24th morning over the northern parts of east central Bay and weakened into a low pressure area by 24th evening.

(i) *INSAT Cloud features* — INSAT reported the intensity of the system as T 1.5 on Dvorak's scale from 0900 UTC on 21 to 0600 UTC on 24. However, the centre was poorly defined.

(ii) *Rainfall* — Widespread rain with heavy falls at one or two places occurred over Andaman and Nicobar islands on 21, 22 and 23.

2.2. Severe cyclonic storm with a core of hurricane winds over the Bay of Bengal (29 April-3 May 1994)

A low pressure area formed over the Andaman Sea on the evening of 28 April. This intensified rapidly into a deep depression on 29 morning with its centre near 9.0°N and 91.5°E . Moving in a northwesterly direction, it intensified into a cyclonic storm on 29 evening with its centre near $10.0^{\circ}\text{N}/91.0^{\circ}\text{E}$. Then, it continued to move in a north-northwesterly direction and intensified into a severe cyclonic storm with centre near 12.0°N and 90.5°E at 1200 UTC of 30. It further moved in a north-northwesterly direction and intensified into a severe cyclonic storm with a core of hurricane winds with centre near 16.0°N and 90.4°E on the evening of 1 May. Then, it recurved and moved in a north-northeasterly direction and lay centred near 20.6°N and 92.0°E at 1200 UTC of 2. It crossed south Bangladesh-north Myanmar coast near 92.0°E around the midnight of 2 May. It weakened rapidly into a low pressure area on 3rd morning.

(i) *Pressure, wind and movement* — Estimated central pressure (ECP) was 940 hPa at 1200 UTC of 2. Maximum sustained winds were of the order of 115 knots during its peak intensity.

The cyclonic storm moved at the speed of 12 kmph in a north-northwesterly direction till 1st

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TABLE 1

Brief history of depressions and storms over Indian seas and neighbourhood during 1994

| S. No. | Type of system | Life period | Point of crossing the coast | Recorded/estimated central pressure | Recorded max. wind | Highest 'T' No. (Estimated) |
|--------|----------------|--------------|--|--|---|-----------------------------|
| 1 | D | 21-24 Mar | Dissipated over North Andaman Sea | — | — | 1.5 |
| 2 | SCS(H) | 29 Apr-3 May | South Bangladesh-north Myanmar coast near 92.0°E | 940 hPa at 1200 UTC of 2 (Estimated central pressure) | — | 6.0 |
| 3 | SCS | 5-9 June | Dissipated over Saudi Arabian coast | 980 hPa at 1200 UTC of 7 (ECP) | — | 3.5 |
| 4 | DD | 17-20 Aug | North Orissa coast near Chandbali | 992.5 hPa on 1300 UTC of 18 at Chandbali (Recorded) | — | 1.5 |
| 5 | DD | 4-7 Oct | Andhra Pradesh coast near Machilipatnam | 995.0 hPa on 1200 UTC of 5 at Machilipatnam (Recorded) | — | 2.5 |
| 6 | SCS | 29-31 Oct | North Tamil Nadu coast close to Madras | 989.3 hPa at Madras on 2140 UTC of 30 (Recorded) | Northerly 71 kt at Madras at 2050 UTC of 30 | 4.0 |
| 7 | D | 4 Nov | Tamil Nadu coast near Karaikal | — | — | 1.5 |
| 8 | SCS(H) | 15-20 Nov | Somalia coast | — | — | 4.0 |

D = Depression, DD = Deep depression, SCS = Severe cyclonic storm, SCS(H) = SCS with a core of hurricane winds.

The lowest estimated central pressure was 980 hPa at 1200 UTC of 7 when the system was a severe cyclonic storm.

(ii) *INSAT Cloud features* — The maximum intensity of the system reported by INSAT was T 3.5 on Dvorak's scale from 0600 to 1400 UTC on 7. INSAT imageries were very helpful in tracking the system particularly after 1200 UTC of 6th.

(iii) *Rainfall and damage* — In association with the system the southwest monsoon advanced into Konkan. Widespread rainfall with heavy to very heavy falls occurred over coastal Karnataka from 5th to 8th June and over Konkan & Goa on 6 June.

The system did not cause any damage in India.

3.2. Deep depression over the Bay of Bengal (17-20 August 1994)

A well-marked low pressure area formed over the northwest Bay of Bengal off west Bengal-north Orissa coast on the evening of 16 August. It intensified into a depression on 17 morning with its centre near 20.5°N and 88.5°E. Moving in a west-

northwesterly direction the system intensified into a deep depression on 17 evening. It crossed the north Orissa coast near Chandbali in the early hours of 18 August. It lay near 21.0°N and 85.0°E about 80 km northwest of Bhubaneswar on 18th morning. The system then moved in a northwesterly direction and weakened into a depression on 18 evening and was centred near 21.5°N and 82.5°E. The system continued to move in a northwesterly direction and retained its intensity as depression till 20 evening when its centre was near 26.0°N and 74.0°E. The system subsequently weakened into a well marked low pressure area over southeast Pakistan and neighbourhood on 21 morning.

(i) *INSAT Cloud features* — INSAT reported vortex with well defined centre from 0600 hrs of 17 to 0300 hrs of 18 with intensity T 1.0 to T 1.5.

(ii) *Rainfall and damage* — Widespread rains with heavy falls at a few places occurred over Gangetic West Bengal, Bihar on 17 and 18, over Orissa, east Uttar Pradesh, east Madhya Pradesh on 18, over Gangetic West Bengal, Bihar Plateau, Orissa, east Rajasthan, Madhya Pradesh, hills of west Uttar Pradesh and Haryana on 19 and over east Rajasthan, Gujarat, west Madhya Pradesh and Himachal Pradesh on 20 and 21.

TABLE 2
Storms/depressions statistics, 1994

| Name of the system | Winter | Pre-monsoon | | | Monsoon | | | | Post-monsoon | | | Total |
|---------------------------|------------|-------------|-----|-----|---------|-----|-----|-----|--------------|-----|-----|-------|
| | Jan to Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Over Bay of Bengal | | | | | | | | | | | | |
| Depression | - | 1 | - | - | - | - | 1 | - | 1 | 1 | - | 4 |
| Cyclonic storm | - | - | - | - | - | - | - | - | - | - | - | - |
| Severe cyclonic storm | - | - | - | - | - | - | - | - | 1 | - | - | 1 |
| SCS (II) | - | - | 1 | - | - | - | - | - | - | - | - | 1 |
| Total | - | 1 | 1 | - | - | - | 1 | - | 2 | 1 | - | 6 |
| Over land | | | | | | | | | | | | |
| Depression | - | - | - | - | - | - | - | - | - | - | - | - |
| Over Arabian Sea | | | | | | | | | | | | |
| Depression | - | - | - | - | - | - | - | - | - | - | - | - |
| Cyclonic storm | - | - | - | - | - | - | - | - | - | - | - | - |
| Severe cyclonic storm | - | - | - | - | 1 | - | - | - | - | - | - | 1 |
| SCS(H) | - | - | - | - | - | - | - | - | - | 1 | - | 1 |
| Total | - | - | - | - | 1 | - | - | - | - | 1 | - | 2 |

TABLE 3
Ship's observations (5-7 June 1994)

| S. No. | Call sign | Date/Time (UTC) | Position | | Wind | | Pressure (hPa) |
|--------|---------------|-----------------|-----------|------------|------------|------------|----------------|
| | | | Lat. (°N) | Long. (°E) | Dir. (Deg) | Speed (kt) | |
| 1. | SHIP | 051200 | 15.5 | 68.7 | 230 | 22 | 998.0 |
| 2. | DVRUNAD | 051800 | 17.7 | 68.1 | 250 | 23 | 998.5 |
| 3. | VWWK | 060600 | 15.4 | 72.5 | 300 | 15 | 999.3 |
| 4. | Sagar Samrat* | 060300 | 18.0 | 72.4 | 180 | 35 | — |
| 5. | Sagar* | 060300 | 19.2 | 71.1 | 330 | 10 | — |
| 6. | Sagar Samrat* | 061200 | 18.0 | 72.2 | 145 | 25 | — |
| 7. | Sagar Jyoti* | 061200 | 19.0 | 71.2 | 155 | 25 | — |
| 8. | Sagar* | 061200 | 19.2 | 71.1 | 160 | 30 | — |
| 9. | VWWK | 061200 | 15.4 | 72.5 | 300 | 15 | 999.3 |
| 10. | VWWY | 070600 | 17.9 | 68.9 | 230 | 30 | 997.0 |
| 11. | VTJR | 070600 | 15.8 | 69.5 | 220 | 22 | 997.0 |

* Oil rigs

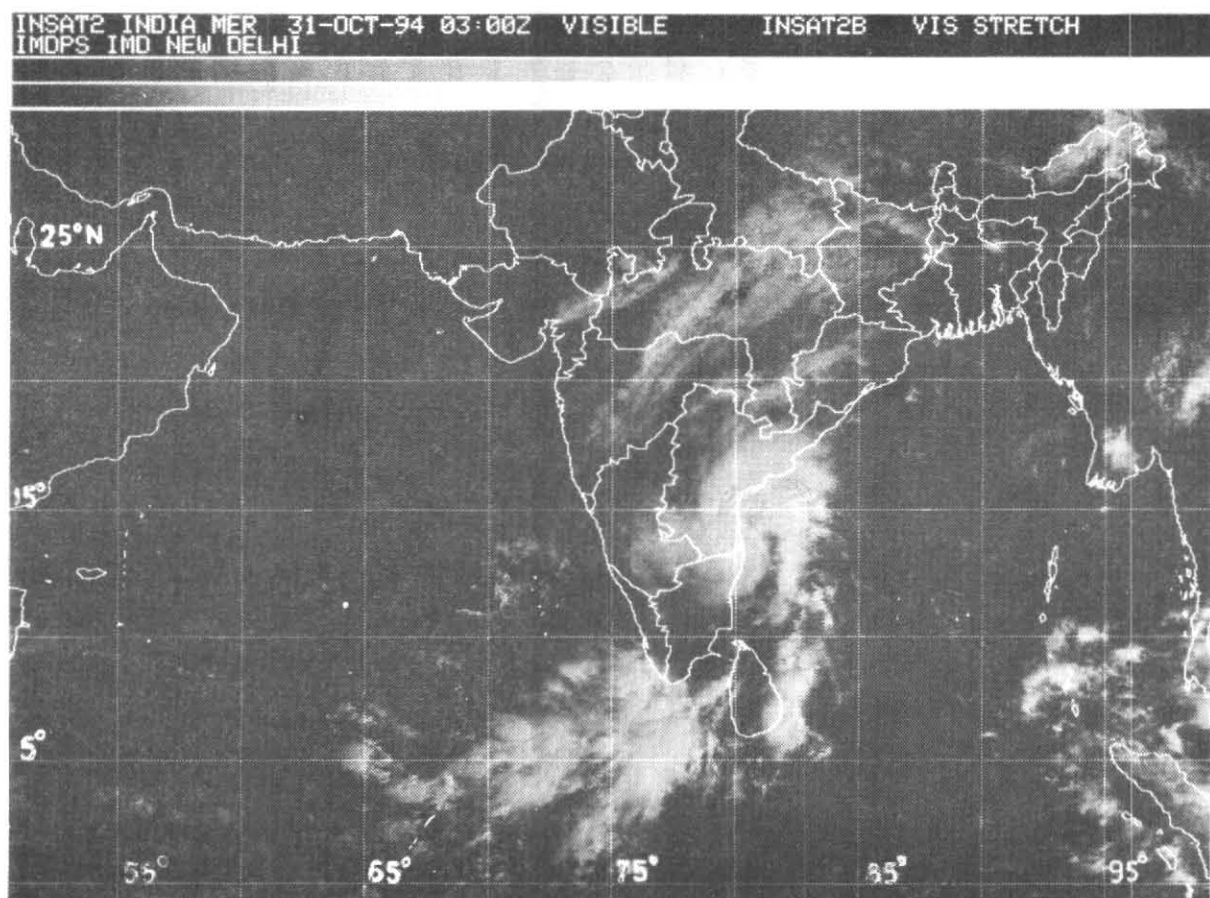


Fig. 2. INSAT-2B cloud picture of 31 October 1994 at 0300 UTC

The system caused floods and damage to the houses and property in the areas along the route of the system.

4. Post-monsoon season (October-December)

During this season, three systems, viz. : (i) depression (ii) deep depression and (iii) severe cyclonic storm, formed over the Bay of Bengal and one system, a severe cyclonic storm with a core of hurricane winds, formed over the Arabian sea.

4.1. Deep depression over the Bay of Bengal (4-7 October)

A well marked low pressure area formed over southern parts of west central Bay and adjoining south Bay of Bengal on 3 evening. It concentrated into a depression over the west central Bay on 4 evening with centre near 15.5°N and 82.0°E . The system moved in a northwesterly direction, intensified into a deep depression and crossed the Andhra Pradesh coast near Machilipatnam and lay near 16.5°N and 80.5°E on 5 morning. It then

moved in a north-northwesterly direction across Telangana (AP) and weakened into a depression on 6 morning and lay centred near 19.0°N and 78.0°E on 6 evening. The system then recurved and moved in a northeasterly direction and retained its intensity as depression upto 7 evening centred near 20.5°N and 79.5°E about 100 km southeast of Nagpur. It weakened into a well marked low pressure area over east Madhya Pradesh and neighbourhood on 8 morning.

(i) INSAT Cloud features/Radar

INSAT reported the maximum intensity of the system as T 2.5 from 1500 UTC of 4 October till the time of land-fall before 0300 UTC of 5.

Radar at CDR Machilipatnam tracked the system well and indicated spiral bands of clouds.

(ii) Rainfall and damages — Under the influence of the system, monsoon was active over coastal Andhra Pradesh and Rayalseema on 4 and 5. Widespread rains with heavy falls at a few places

TABLE 4

Ship's observations (29-31 October 1994)

| S. No. | | Date Time (UTC) | Position | | Wind | | Pressure (hPa) |
|--------|------|-----------------|----------------------|-----------------------|-------------|------------|----------------|
| | | | Lat. ($^{\circ}$ N) | Long. ($^{\circ}$ E) | Dir. (Deg.) | Speed (kt) | |
| 1. | ATZM | 290000 | 12.5 | 82.5 | 080 | 07 | 1010.4 |
| 2. | ATCV | 290000 | 6.0 | 86.2 | 230 | 15 | 1012.7 |
| 3. | VMTL | 290600 | 8.2 | 82.6 | 010 | 10 | 1011.0 |
| 4. | ATVC | 290600 | 6.0 | 85.0 | 250 | 10 | 1010.2 |
| 5. | VMKZ | 291200 | 7.6 | 82.6 | 050 | 04 | 1007.3 |
| 6. | ATVC | 291200 | 5.9 | 83.8 | 240 | 10 | 1012.6 |
| 7. | VVMG | 291500 | 8.8 | 82.9 | 350 | 10 | 1009.3 |
| 8. | VMTL | 300000 | 6.6 | 80.0 | 270 | 13 | 1009.9 |
| 9. | VVKY | 300000 | 7.3 | 78.9 | 000 | 02 | 1009.3 |
| 10. | ATZM | 300000 | 11.4 | 86.1 | 120 | 16 | 1009.4 |
| 11. | ATVC | 300000 | 5.8 | 81.6 | 230 | 12 | 1012.2 |
| 12. | VVMG | 300000 | 11.7 | 84.1 | 150 | 17 | 1011.1 |
| 13. | ATMR | 300600 | 13.0 | 80.3 | 020 | 25 | 1011.2 |
| 14. | VVMG | 300600 | 12.4 | 84.5 | 050 | 10 | 1011.2 |
| 15. | VVMG | 300900 | 13.2 | 84.8 | 070 | 02 | 1008.9 |
| 16. | ATZM | 310000 | 10.2 | 90.3 | 120 | 05 | 1012.2 |

occurred over coastal Andhra Pradesh, Rayal-seema, north Tamil Nadu and Karnataka and Madhya Maharashtra from 3 to 5 and over coastal Andhra Pradesh, Telangana, Vidarbha and Marathwada on 6 and 7.

Heavy rains caused floods in parts of Karnataka, Andhra Pradesh and Vidarbha. The system caused death of 38 persons in Andhra Pradesh.

4.2. Severe cyclonic storm over the Bay of Bengal (29-31 October)

A low pressure area formed over the southwest Bay and neighbourhood on the evening of 28 October. It concentrated into a depression on 29 morning and lay centred near 9.5° N and 85.0° E. It further intensified into a deep depression on 29 evening when its centre was near 10.5° N and 84.5° E. Moving in a west-northwesterly direction it further intensified into a cyclonic storm on 30 morning and was centred near 12.0° N and 82.0° E. It further intensified into a severe cyclonic storm at 1200 UTC of 30 and lay centered at 0300 UTC of 31 near 13.2° N and 80.0° E overland. The system crossed

north Tamil Nadu coast close to Madras between 0100 and 0200 UTC of 31 October. Moving in a northwesterly direction, it weakened rapidly into a deep depression on 31 evening when its centre was near 14.0° N and 78.5° E. The system then moved in a northwesterly direction and rapidly weakened into a low pressure area.

(i) *INSAT' Cloud features* — INSAT reported well organised clouds and vortex with intensity T 2.5 on Dvorak's scale at 0300 UTC of 30 when the system was a cyclonic storm. The peak intensity of the system was estimated T 4.0 from 0000 to 0400 UTC on 31 October. Fig. 2. is the satellite cloud photograph taken at 0300 UTC of 31 October.

(ii) *Radar* — Cyclone detection Radar at Madras and Karaikal reported the centre and eye in almost all their observations between 0600 UTC of 30 and 0500 UTC of 31. CDR Madras reported vortex and open eye (with a diameter 25 kms near 12.3° N and 81.0° E.) while CDR Karaikal reported eye and centre near 12.0° N and 81.0° E at 1200 UTC of 30. At 0250 UTC of 31, CDR Madras reported eye (with diameter 35 km) near 13.5° N and 80.0° E.



Fig. 3. Guindy bridge, Madras—iron hoardings twisted and bent due to severe cyclonic storm (29-31 October 1994)

(iii) *Wind and pressure* — A ship ATMR near 13.0°N and 80.3°E reported wind $020^{\circ}/25$ kt and pressure 1011.2 hPa at 0600 UTC of 30 (Table 4). Madras reported northeasterly winds of 35 kt at 09 km asl and 2.1 km asl and northeasterly winds 45 kt at 700 and 500 hPa at 1200 UTC of 30.

Anemograph records at Meenambakkam (Madras) at 0220 hrs (IST) on 31 reported peak wind speed of northerly 71 kt (132 kmph). The sustained wind speed during this period was 43 kt (80 kmph). Tambaram air force station recorded maximum wind northwesterly 62 kt (116 kmph) at 0225 hrs (IST) on 31st.

(iv) *Rainfall* — Heavy rain occurred over northern parts of Tamil Nadu and southern parts of Andhra Pradesh on 31 October and 1 November. Widespread rainfall with heavy to very heavy falls occurred in Tamil Nadu on 27, 28 and 29 October and in coastal Andhra Pradesh on 1 and 2 November. Widespread rains with isolated heavy falls also occurred in north interior Karnataka and Kerala between 27 to 30 October.

Nungambakkam and Minambakkam in Madras city and Covelong, Ponneri and Red Hills in Chengalpattu MGR district of Tamil Nadu recorded rainfall ranging from 22 to 28 cm on 31 October and 4 to 10 cm on 1st November. Nellore, Prakasam and Guntur districts in Andhra Pradesh recorded rainfall of 4 to 6 cm on 31 October and 22-32 cm on 1 November. Guntur and Krishna districts received rainfall of 25-30 cm on 2 November.

(v) *Weather and damages* — Due to strong gale force winds, road and telecommunication system in Madras city was disrupted and many telephone

posts were damaged. A specimen photograph of damage caused is enclosed (Fig. 3.). A ship M.V. SAGAR anchored near Madras port was drifted to a distance of 10 km. Post cyclone survey report indicates that the height of tidal waves was of the order of 1-2 m along Tamil Nadu-South Andhra Pradesh Coast.

Due to very heavy rainfall and floods over Madras and Andhra Pradesh more than 30,000 huts in Tamil Nadu and more than 60,000 huts in Andhra Pradesh were damaged. More than 60,000 hectares of crop area were also damaged in Andhra Pradesh, 69 people died in Tamil Nadu and 235 in Andhra Pradesh due to this cyclone. The slow movement of the storm, while over land, caused continuous heavy rains over Andhra Pradesh leading to a greater loss. Total damage was of the order of Rs. 61 crores in Tamil Nadu and about Rs. 300 crores in Andhra Pradesh as estimated by the respective Governments.

4.3. *Depression over the Bay of Bengal (4 November 1994)*

A low pressure area formed over the southwest Bay and adjoining southeast Bay on 3 and intensified into a depression over southwest Bay on 4 morning when it was centred near 9.5°N and 83.5°E . The system rapidly moved in a west-northwesterly direction, crossed the Tamil Nadu coast near Karaikal around the midnight of 4th and weakened into a low pressure area by 5 morning.

(i) *INSAT cloud features* — On 4 morning INSAT reported vortex with intensity T 1.5. On Dvorak's scale.

(ii) *Rainfall and damage* — Widespread rain with isolated heavy falls occurred over south coastal Andhra Pradesh on 3rd and over Tamil Nadu from 3 to 6 November.

The depression formed just 3 days after the passage of the cyclonic storm (29-31 October) and hence caused further damage to crops and property in coastal district of Tamil Nadu and south Andhra Pradesh.

4.4. *Severe cyclonic storm with a core of hurricane winds over Arabian Sea (15-20 November 1994)*

A trough of low moved from the east into south east Arabian sea and neighbourhood on 14 evening

TABLE 5

Ship's observations (14-19 November 1994)

| Call sign | Date/ Time (UTC) | Position | | Wind | | Pressure |
|---------------------|------------------------|--------------|---------------|----------------|---------------|----------|
| | | Lat. (°N) | Long. (°E) | Dir. (Deg.) | Speed (kt) | |
| ATJV 15 Nov 1994 | 140600 | 08.4 | 78.4 | 360 | 16 | 1011.1 |
| VRUP7 | 150600 | 09.5 | 66.8 | 090 | 20 | 1009.6 |
| VTFX | 150600 | 11.9 | 74.1 | 100 | 07 | 1010.0 |
| ATKZ | 150600 | 08.8 | 76.4 | 090 | 17 | 1009.8 |
| VRUP7 | 160600 | 10.3 | 60.2 | 045 | 15 | 1010.3 |
| MJTC | 161200 | 09.8 | 65.2 | 090 | 20 | 1007.2 |
| //// | 161200 | 10.4 | 60.2 | 070 | 25 | 1005.2 |
| DELO | 162000 | 07.5 | 57.7 | 360 | 20 | 1008.2 |
| //// | 170000 | 11.0 | 57.0 | 070 | 20 | 1007.7 |
| //// | 170000 | 06.4 | 60.0 | 270 | 20 | 1007.0 |
| //// | 170600 | 11.5 | 54.5 | 015 | 10 | 1012.8 |
| VRUP7 | 170600 | 11.4 | 54.7 | 020 | 10 | 1012.8 |
| ATMS | 180600 | 13.7 | 80.9 | 100 | 12 | 1005.2 |
| VTKT | 180600 | 12.2 | 74.8 | 360 | 06 | 1012.3 |
| ATUF | 180600 | 08.0 | 70.0 | 330 | 10 | 1011.8 |
| UWKY | 181200 | 12.4 | 74.4 | 270 | 10 | 1012.6 |
| VWPX | 190600 | 16.7 | 84.0 | 070 | 17 | 1012.5 |
| ATKE | 190600 | 08.8 | 76.3 | 070 | 05 | 1011.0 |
| OVWF | 190600 | 15.4 | 71.7 | 050 | 10 | 1013.4 |
| ABRW | 190600 | 07.0 | 78.6 | 030 | 20 | 1013.0 |

and rapidly intensified into a depression, centred near 9.0°N and 65.5°E on 15 morning. It moved very slowly west-north-westwards and intensified into a deep depression and was centred near 9.5°N and 64.0°E at 0300 UTC of 16. The system remained practically stationary and intensified into a cyclonic storm. The system moved slowly in west-southwesterly direction and lay with its centre near 8.0°N and 60.0°E at 0300 UTC and near 8.0°N, 57.0°E at 1200 UTC of 18. The system remained stationary and intensified into a severe cyclonic storm at 1800 UTC of 18. Later it moved in a westerly direction and rapidly intensified into a severe cyclonic storm with a core of hurricane winds with centre near 8.0°N and 54°E on 19 morning. Moving in a westerly direction, the system weakened into a severe cyclonic storm

on 19 evening, crossed Somalia coast and further weakened into cyclonic storm on 20 morning when its centre was near 8.0°N and 49.5°E. The system then rapidly weakened over Somalia. Ships observations from the storm field are given in Table 5.

(i) *INSAT cloud features* — INSAT reported vortex with maximum intensity T 4.0 on Dvorak's scale from 0000 to 0900 UTC on 19 November.

(ii) *Rainfall and damages* — Lakshadweep area received widespread rainfall on 13, 14 and 15 November.

The system did not cause any damage over India.