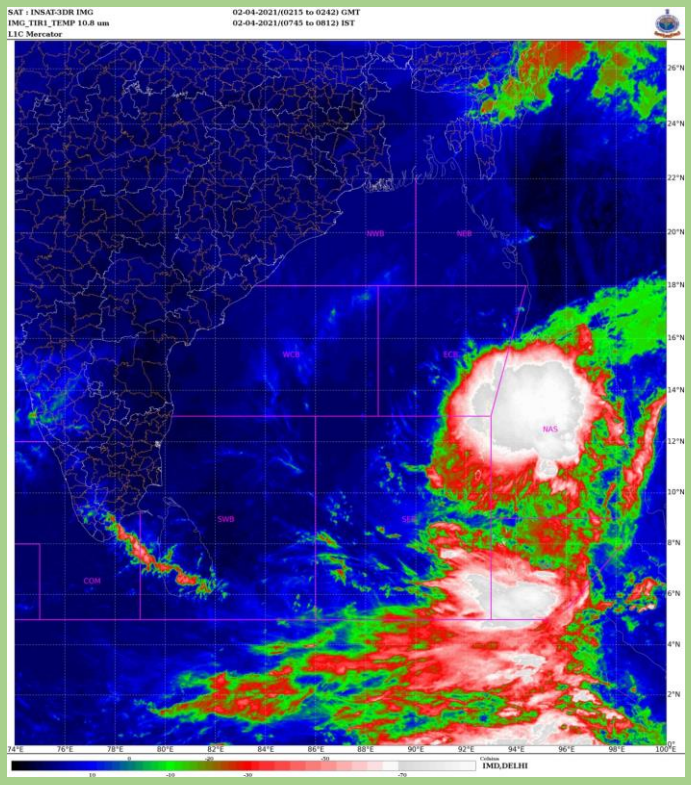
GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT

Depression over North Andaman Sea and neighbourhood (2nd – 3rd April 2021): A Report



INSAT-3D Satellite imagery at 0215 UTC of 2nd April, 2021 of Depression over north Andaman Sea

Cyclone Warning Division

India Meteorological Department

New Delhi

April, 2021

Depression over North Andaman Sea
(2nd – 3rd April, 2021)

1. **Introduction**

- The depression over North Andaman Sea originated from a low pressure area (LPA) which formed over southeast Bay of Bengal (BoB) & adjoining south Andaman Sea in the early morning (0000 UTC) of 31st March.
- It lay as a well marked low pressure area (WML) over central parts of Andaman Sea in the afternoon (0900 UTC) of 1st April.
- Under favourable environmental conditions, it concentrated into a Depression (D) over North Andaman Sea in the early morning (0000 UTC) of 2nd April.
- It moved north-northeastwards over North Andaman Sea and weakened into a WML around noon (0600 UTC) of 3rd April over North Andaman Sea and adjoining south Myanmar coast.
- The system caused light to moderate rainfall at most places with heavy falls at isolated places over Andaman Islands on 2nd April.
- India Meteorological Department maintained continuous watch over the Bay of Bengal and Andaman Sea since 18th March (13 days prior to formation of LPA over southeast BoB & adjoining south Andaman Sea on 31st March and 15 days prior to formation of depression over north Andaman Sea on 2nd April).
- The observed track of the system during 2nd – 3rd April is presented in Fig.1. Best Track parameters associated with the system are presented in Table1.

2. Salient Features:

The salient features of the system were as follows:

i. It was the first cyclonic disturbance of the year 2021.

ii. A total of 35 cyclonic disturbances (CDs) (maximum sustained wind speed (MSW) ≥ 17 knots) developed over the Bay of Bengal & Andaman Sea in the month of April during the period 1891-2020 (Fig. 2 a). Out of these, 28 developed into tropical cyclones (MSW ≥ 34 knots) and 7 maintained the intensity of depression/deep depression. Thus climatologically, there is 80% probability of intensification of depression into a TC in the month of April.

iii. Out of the 7 depressions/deep depressions during the period 1891-2020 in the month of April, 5 exhibited north-northeastwards movement, 1 weakened over Sea (1935) and 1 crossed north Tamilnadu coast. Thus, there is 71% probability of movement of depression forming over BoB and Andaman Sea in the month of April towards Myanmar (Fig. 2 b).

iv. The peak MSW of the depression was 40-50 kmph (25 knots) gusting to 60 kmph during 0000 UTC of 2nd April to 0000 UTC of 2nd April over the Andaman Sea. The lowest estimated central pressure was 1000 hPa during the period.

v. The life period (D to D) of the system was 30 hours (1 day & 6 hours) against long period average (LPA) (1990-2013) of 52 hours (2 days & 2 hrs) for depressions over BoB during pre monsoon season.

3. Monitoring of depression over north Andaman Sea

India Meteorological Department (IMD) maintained round the clock watch over the north Indian Ocean and the system was monitored since 18th March (13 days prior to formation of LPA over southeast BoB & adjoining south Andaman Sea on 31st March and 15 days prior to formation of depression over north Andaman Sea on 2nd April). First information about formation of depression around 1st April with low probability was indicated in the extended range outlook issued by IMD on 18th March. Thus the cyclone was monitored & predicted continuously from 18th March onwards by IMD.

The cyclone was monitored with the help of available satellite observations from INSAT 3D and 3DR, polar orbiting satellites. Various numerical weather prediction models run by Ministry of Earth Sciences (MoES) institutions and dynamical-statistical models were utilized to predict the genesis, track, landfall and intensity of the cyclone. A digitized forecasting system of IMD was utilized for analysis and comparison of various model guidance, decision making process and warning product generation.

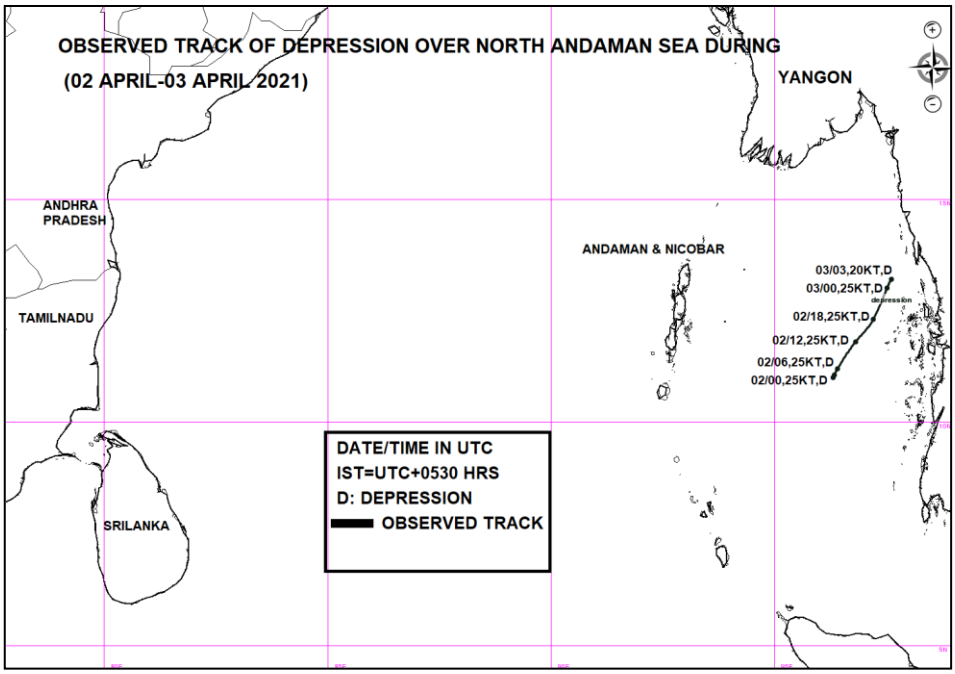


Fig.1: Observed track of depression over North Andaman Sea and neighbourhood (2nd-3rd April, 2021)

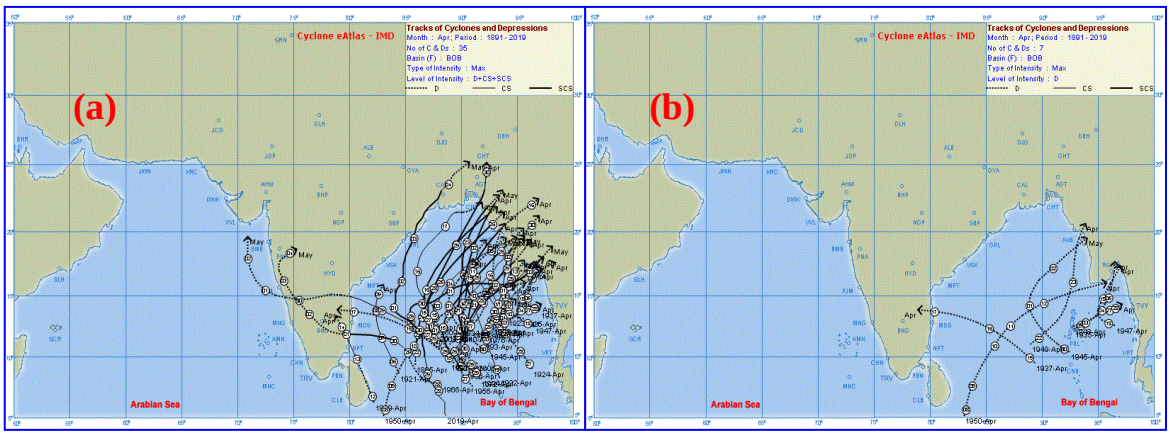


Fig. 2: (a) Tracks of CDs (MSW≥17 knots) and (b) tracks of depressions/deep depressions (MSW 17-33 knots) in the month of April during 1891-2020

Table: Best track positions and other parameters of the Depression over North Andaman Sea during 02nd- 03rd April, 2021

Date	Time (UTC)	Centre lat.^{0} N/ long.^{0} E		C.I. NO.	Estimated Central Pressure (hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at the Centre (hPa)	Grade
02/04/2021	0000	11.0	96.3	1.5	1000	25	3	D
	0300	11.0	96.3	1.5	1000	25	3	D
	0600	11.2	96.4	1.5	1000	25	3	D
	1200	11.8	96.8	1.5	1000	25	3	D
	1800	12.3	97.2	1.5	1000	25	3	D
03/04/2021	0000	13.0	97.5	1.5	1002	25	3	D
	0300	13.2	97.6	1.5	1004	20	2	D
	0600	Weakened into a Well Marked Low Pressure Area over north Andaman and adjoining south Myanmar coast						

3. Brief life history

3.1. Genesis

An active convective zone developed in the northern hemispheric near equatorial trough (NET), stretching from Malay Peninsula to the equatorial Indian ocean to the south of Sri Lanka from 26th March onwards. In this region, under the equatorial wave trough, the convection got organized into 3 distinct vorticity cells on both sides of the equator. Gradually one of this vortex got detached from the NET and evolved as a cyclonic circulation over southeast Bay of Bengal (BOB).

Under the influence of the cyclonic circulation which lay over southeast BoB & adjoining south Andaman Sea, an LPA formed over the same region at 0000 UTC of 31st March. On 31st March, the Madden Julian Oscillation (MJO) index lay in phase 5 with amplitude more than 1. It was forecast to continue in same phase till 3rd. Thereafter, it was forecast to move to phase 6 with amplitude remaining more than 1 for next 3 days. Thus, MJO phase and amplitude was supporting enhancement of convective activity over BOB till 3rd April. The tropical cyclone heat potential (TCHP) over the region was around 80 KJ/s and the Sea Surface Temperature (SST) was 29-30°C over the region. The low level positive vorticity was about 80-90 $x10^{-6}sec^{-1}$ over south Andaman Sea. Positive low level convergence was about 5-$10x10^{-5}$ sec^{-1} over south Andaman Sea. Positive zone of upper level divergence was 10-$15x10^{-5}$ sec^{-1} over south Andaman Sea. Vertical wind shear was moderate (10-20 kt) over Andaman Sea and adjoining eastcentral BOB. The upper tropospheric ridge ran along 10.5°N over the BOB. All these supportive conditions favoured formation of LPA over southeast BOB & adjoining south Andaman Sea on 31st.

Similar favourable conditions continued on 1st April. The low level positive vorticity was about 80-90 $x10^{-6}sec^{-1}$ over south Andaman Sea. The areal extension of positive low level convergence zone increased (5-$10x10^{-5}$ sec^{-1}) and was covering entire south Andaman Sea. The areal extension and magnitude of the zone of positive upper level divergence also increased ($20x10^{-5}$ sec^{-1}) over south Andaman Sea. It was south-southwest to north-northeast oriented. Vertical wind shear (VWS) was moderate (15-20 KT) over Andaman Sea and adjoining eastcentral BOB. It was higher towards the northeast sector. The upper tropospheric ridge ran along 12°N over the BOB. Under the influence of the anticyclonic circulation over southeast Asia and upper tropospheric

trough in westerlies running along 88^0E to the north of 15^0N, the low pressure system was forecast to move northeastwards towards Myanmar coast. Under these conditions, the system further consolidated and lay as a WML over the same region at 0900 UTC of 1st April.

Similar MJO and sea conditions prevailed on 2nd April. The low level positive vorticity remained same and was about 80-90 $x10^{-6}sec^{-1}$ over north Andaman Sea. The areal extension of positive low level convergence zone increased during previous 24 hours ($10x10^{-5}$ sec^{-1}) and was covering norh Andaman Sea to the east of Nicobar islands. The areal extension and magnitude of the zone of positive upper level divergence also increased ($30x10^{-5}$ sec^{-1}) over Andaman Sea. It was now more circular in shape and was coupled with the low level convergence zone. The VWS was moderate (15-20 KT) over Andaman Sea along the forecast track. It was higher towards the northwest sector. Under these conditions, the system concentrated into a depression over north Andaman Sea and neighbourhood at 0000 UTC of 2nd April. The upper tropospheric ridge ran along 13°N over the BOB. Under the influence of the anticyclonic circulation over southeast Asia and mid trospheric westerlies the depression was forecast to move north-northeastwards towards Myanmar coast.

3.2. Intensification and movement

At 0600 UTC of 2nd April, similar Sea conditions prevailed. The low level positive vorticity was same during past 06 hours and was about 80-90 $x10^{-6}sec^{-1}$ over Andaman Sea to the southeast of the system centre. The magnitude of positive low level convergence over the system area remained same during previous 06 hours (15-20 $x10^{-5}$ sec^{-1}). The positive upper level divergence remained organised with no change in magnitude ($30x10^{-5}$ sec^{-1}) and it lay over the system centre. It was coupled with the low level convergence zone. At 0600 UTC, a weak outflow prevailed in the upper levels. The VWS was moderate (15-20 KT) over north Andaman Sea along the forecast track. The upper tropospheric ridge ran along 13°N over the BOB.

At 1200 UTC of 2nd April, the low level positive vorticity increased slightly and was about 100 x10-6sec^{-1} over Andaman Sea to the southeast of the system centre. The magnitude of positive low level convergence over the system area remained same during past 06 hours (20 $x10^{-5}$ sec^{-1}). The positive upper level divergence decreased slightly in magnitude ($20x10^{-5}$ sec^{-1}) and it lay over the system centre. It was still coupled with the low level convergence zone. The Cirrus outflow increased in past 3-hours. The VWS decreased and was low to moderate (10-15 KT) over north Andaman Sea and along the forecast track. Under these conditions, the system maintained it's intensity. The upper tropospheric ridge ran along 13ºN over the BOB. In the upper level, similar conditions prevailed and the system moved north-northeastwards, under the influence of the anticyclonic circulation over southeast Asia and mid tropospheric westerlies.

At 0000 UTC of 3rd April, the system weakened slightly. The low level positive vorticity reduced and was about 50 – 60 $x10^{-6}sec^{-1}$ over Andaman Sea to the southeast of the system centre. The magnitude of positive low level convergence over the system area also reduced (5-10 $x10^{-5}$ sec^{-1}) and was seen along Myanmar coast to the northeast of the system centre. The upper level divergence became negative (05-$10x10^{-5}$ sec^{-1}) leading to subsidence over the system area. The VWS increased and was moderate (15-20 KTS) over north Andaman Sea. The mid-latitude westerlies in association with an upper tropospheric trough along 80°E dissolved the upper tropospheric ridge running along 13°N over the BOB. Under the influence of the anticyclonic circulation over southeast Asia and the mid tropospheric westerlies the depression continued to move north-northeastwards.

At 0600 UTC of 3rd April, the low level positive vorticity was about 50–60 $x10^{-6}$ sec^{-1} over Andaman Sea and adjoining south Myanmar coast. The magnitude of positive

low level convergence over the system area is around 5-10 $x10^{-5}$ sec^{-1} and was now seen along Myanmar coast. No upper level divergence is seen over the system area. The VWS was moderate to high (20-25 kts) over north Andaman Sea and adjoining south Myanmar coast. The adverse environmental conditions like enhanced VWS, decreased vorticity and decreased convergence over the area caused the system to weaken into a well marked low pressure area over north Andaman Sea and adjoining south Myanmar coast.

3.3 Features observed through satellite

Satellite monitoring of the system was mainly done by using half hourly INSAT-3D and 3DR imageries. Satellite imageries of international geostationary satellites Meteosat-8, high resolution polar orbiting satellites and scatterometer imageries from ASCAT/SCATSAT were also considered for monitoring the system. Typical INSAT-3D visible/ IR imageries, enhanced colored imageries and ASCAT (Met-Op A) imageries are presented in **Fig.3**. The system showed shear pattern during it's life cycle. The detailed satellite based features are discussed below.

As per INSAT-3D at 0300 UTC of 31st March, scattered to broken low and medium clouds with embedded intense to very intense convection lay over southeast BOB and adjoining Andaman Sea between latitude 5.0ºN & 10.0ºN and longitude 90.0ºE & 96.0ºE in association with the LPA over southeast BOB & adjoining south Andaman Sea. Minimum cloud top temperature is minus 93ºC.

The area of intense convection moved northeastwards and the number of clusters with intense to very intense convection also increased by 0300 UTC of 1st April. The clouds started organising around the low level cyclonic circulation (LLCC) over Andaman Sea. Scattered to broken low and medium clouds with embedded intense to very intense convection lay over central Andaman Sea adjoining southeast Bay of Bengal between latitude 6.0ºN & 12.0ºN and longitude 91.0ºE & 97.0ºE in association with the LPA. Minimum cloud top temperature was minus 93ºC. The microwave imagery indicated broad scale convective cloud banding features building up with the system.

At 0000 UTC of 02nd April, the system further organized and concentrated into a depression. The intensity of the system was characterized as T 1.5 The convection was organised as shear pattern. Scattered low and medium clouds with embedded intense to very intense convection lay over north Andaman Sea and neighbourhood in association with the system. Minimum cloud top temperature was -93°C.

At 0300 UTC of 02nd April, the intensity of the system was T 1.5. Convective clouds clusters sheared to the north of system centre. A new convective cloud mass emerged near the system centre. The area of very intense convection (-93°C) lay over north Andaman Sea & adjoining Andaman Islands to the northwest of system center. Broken low & medium clouds with embedded intense to very intense convection lay over north Andaman Sea and adjoining Andaman Islands between latitude 10.0°N & 15.0°N and longitude 92.0°E & 97.0°E. Minimum cloud top temperature is -93°C.

At 0600 UTC of 02nd April, the intensity of the system was T 1.5. The convection was organised as shear pattern. Convective clouds clusters were sheared to north. Three convective cloud clusters developed in the northern sector of the system in last 3 hours. The area of very intense convection (-93°C) lay over north Andaman Sea & adjoining Andaman Islands to the north of system center. Broken low & medium clouds with embedded intense to very intense convection lay over north Andaman Sea and adjoining Andaman Islands between latitude 10.5°N & 15.5°N and longitude 91.0°E & 97.0°E. Minimum cloud top temperature is -93°C.

At 1200 UTC of 02nd April, the intensity of the system continued to be T 1.5 with shear pattern. Convective clouds clusters were sheared to north. The three clusters merged into two around 0900 UTC. Out of these two, the northern cluster dissipated and the southern cluster moved north-northeastwards maintaining it's intensity. The area of very intense convection (-93°C) lay over north Andaman Sea & Gulf of Martaban to the north of system center. Broken low & medium clouds with embedded intense to very intense convection lay over north Andaman Sea and adjoining Andaman Islands between latitude 10.5ºN & 17.0ºN and longitude 93.5ºE & 97.5ºE. Minimum cloud top temperature was -93°C.

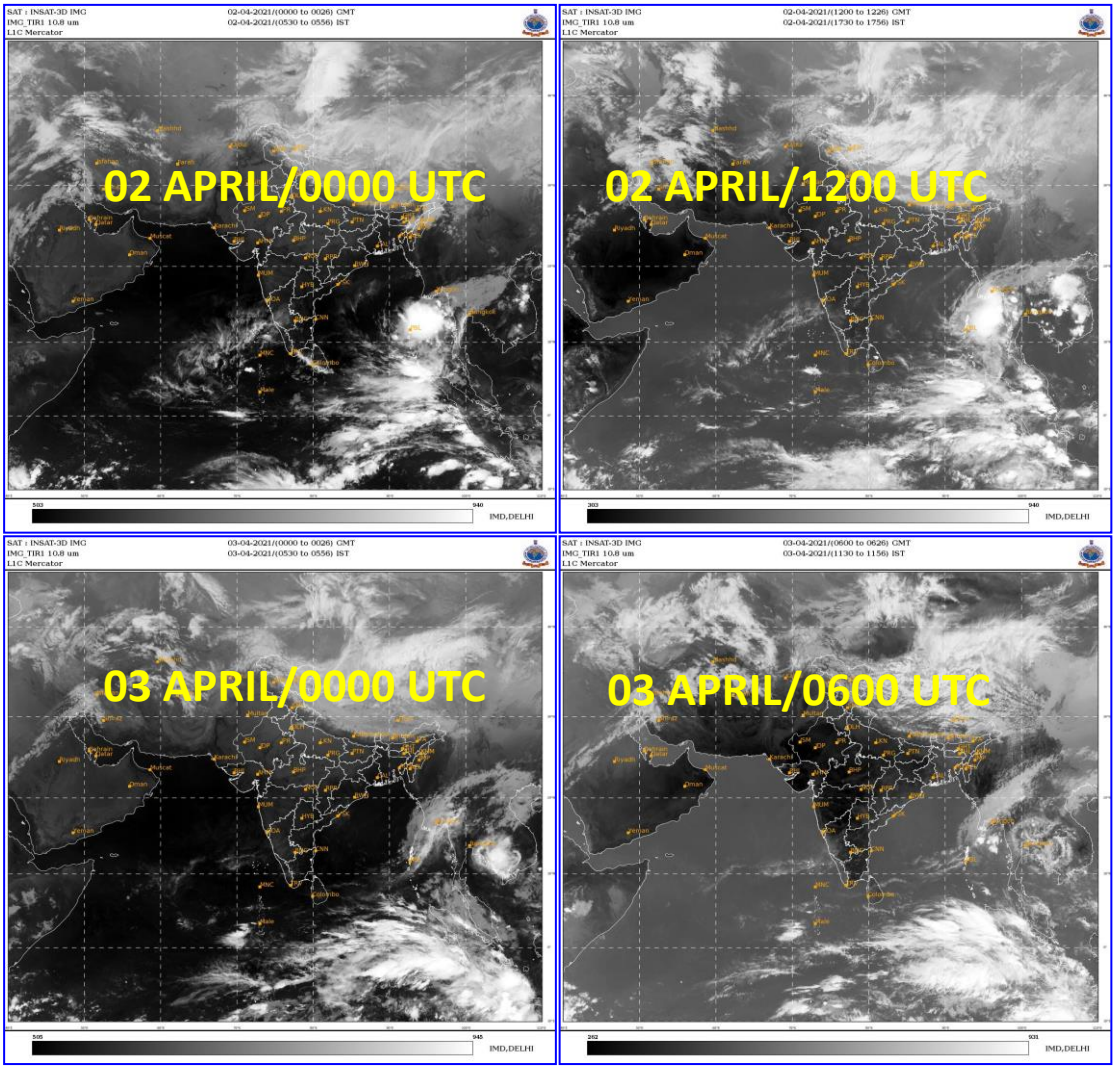


Fig. 3a: INSAT-3D IR imageries during life cycle of Depression over North Andaman Sea during 2nd-3rd April, 2021

At 0000 UTC of 03rd April, the intensity of the system was T 1.0/C.I. 1.5. The clouds got disorganized, however, the winds with maximum sustained intensity (MSW) of 20-25 kts prevailed over the region as per latest ASCAT and multi-satellite based derived winds. As a result the intensity was characterized as T1.0/C.I. 1.5. Associated broken low to medium clouds with embedded isolated moderate to intense convection lay over north Andaman Sea and adjoining Andaman Islands to the north of lat 11.5 ºN. Minimum cloud

top temperature of -44ºC was seen in the northwest sector. Convection and structure of the system indicated weakening in last 6 hrs.

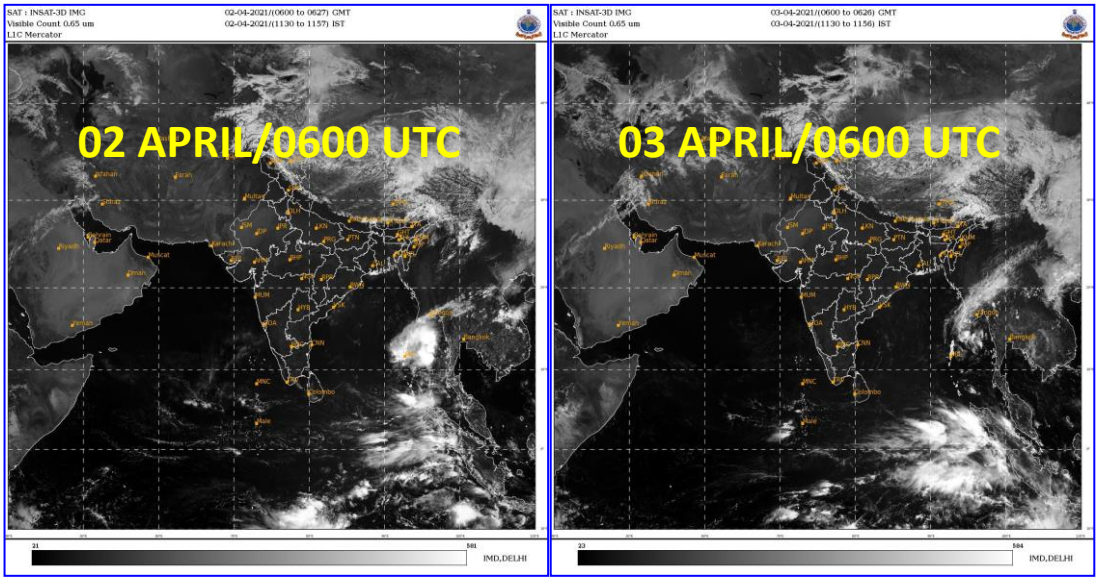


Fig. 3 b: INSAT-3D VIS imageries during life cycle of Depression during 02-03 April, 2021

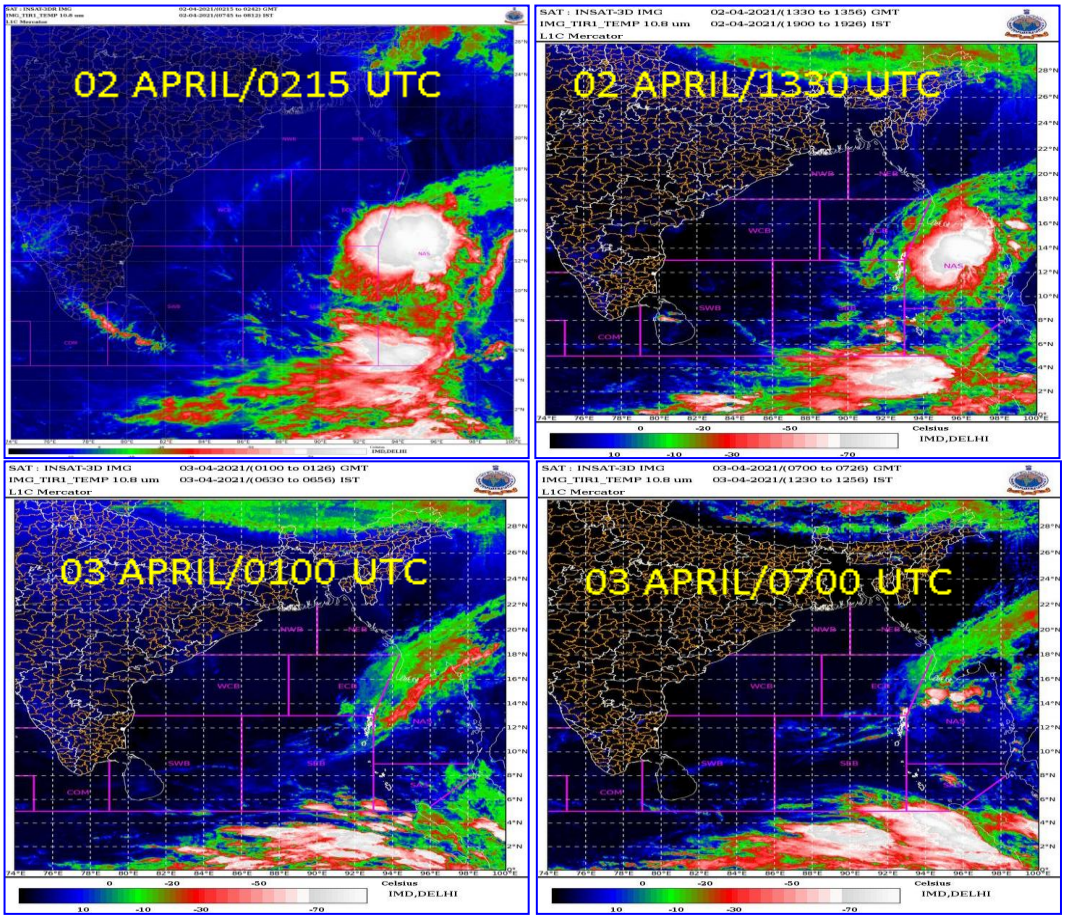


Fig. 3c: INSAT-3D enhanced colored imageries during life cycle of Depression during 02-03 April, 2021

At 0300 UTC of 03rd April, the clouds further showed disorganisation. However, low level clouds indicated the existence of low level cyclonic circulation. The multi-

satellite based derived winds indicated MSW of 20-25 KT around the system centre. Winds were higher in the southern sector. The scatterometer based winds also estimated to be around 20-25 KT. Thus, though the clouds showed disorganisation, based on the intensity of winds prevailing over the region, the intensity was characterised as T 1.0/C.I. 1.5. Associated scattered low and medium clouds with embedded intense to very intense convection lay over north Andaman Sea between latitude 12.0^{o}N & 15.0^{o}N and longitude 93.5 ^{o}E & 97.5 ^{o}E. Minimum cloud top temperature was minus 78^{o}C. Slight increase in convection in western sector of the system centre was seen during last 3 hours.

At 0600 UTC of 03rd April, the clouds remained same over north Andaman Sea. Maximum convection lay over north Andaman Sea to the northwest of system centre. The multi-satellite based derived winds indicated MSW of 10-15 KT to the east of system centre. The scatterometer based winds continued to show estimated winds around 20-25 KT. However, circulation features were not seen in the wind pattern. Thus, intensity of the system was characterised as T1.0/C.I.1.0. Associated scattered low and medium clouds with embedded intense to very intense convection lay over north Andaman Sea between latitude 12.5 ^{o}N & 15.5 ^{o}N and longitude 94.0^{o}E & 97.5^{o}E. Minimum cloud top temperature was -70^{o}C.

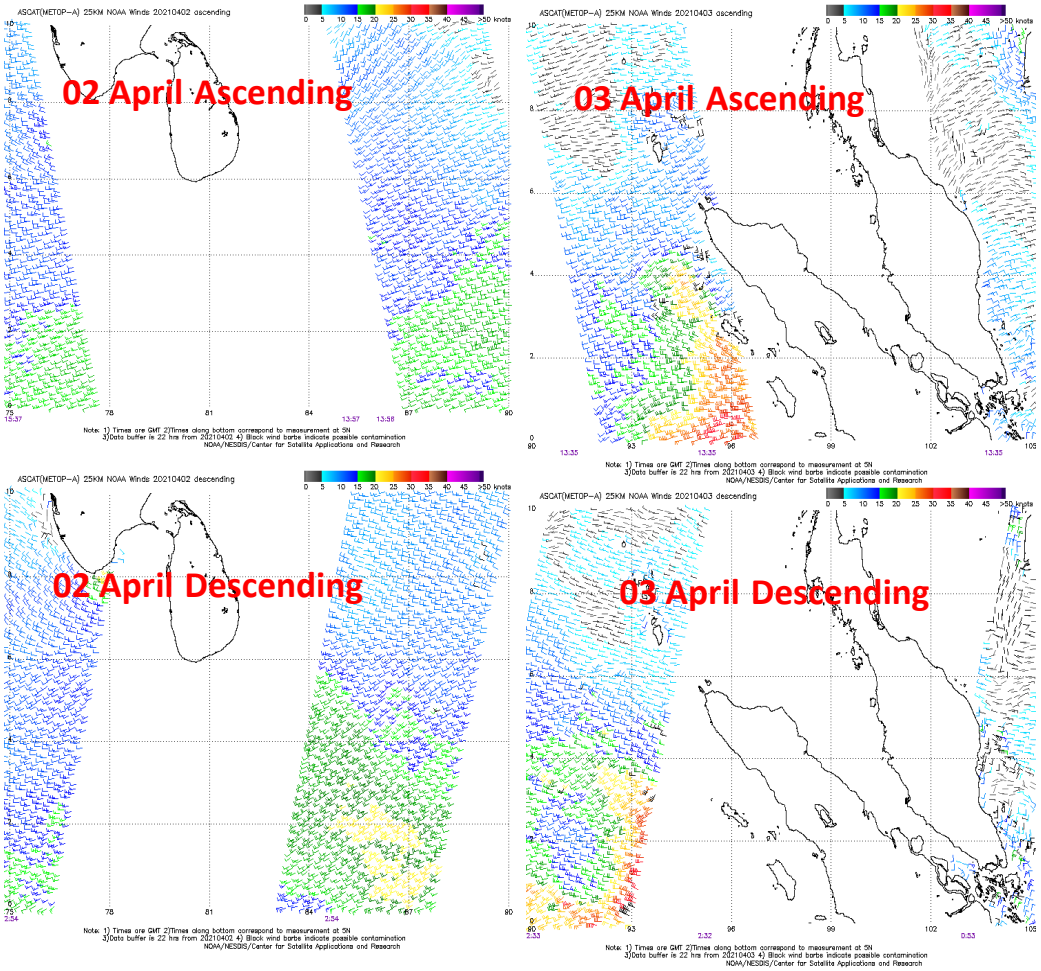


Fig. 3 d: ASCAT imageries during life cycle of Depression during 02-03 April, 2021

4. Dynamical features

IMD GFS analysis fields of mean sea level pressure (MSLP), 10m wind, winds at 850, 500 & 200 hPa levels are presented in Fig. 4. The 10m wind analysis based on 0000 UTC of 31st March indicated a cyclonic circulation over south Andaman Sea and adjoining southeast BoB with vertical extension upto 850 hPa level. At upper level, the ridge was seen near 10^0N. On 31st the system lay as an LPA over southeast BoB and adjoining south Andaman Sea.

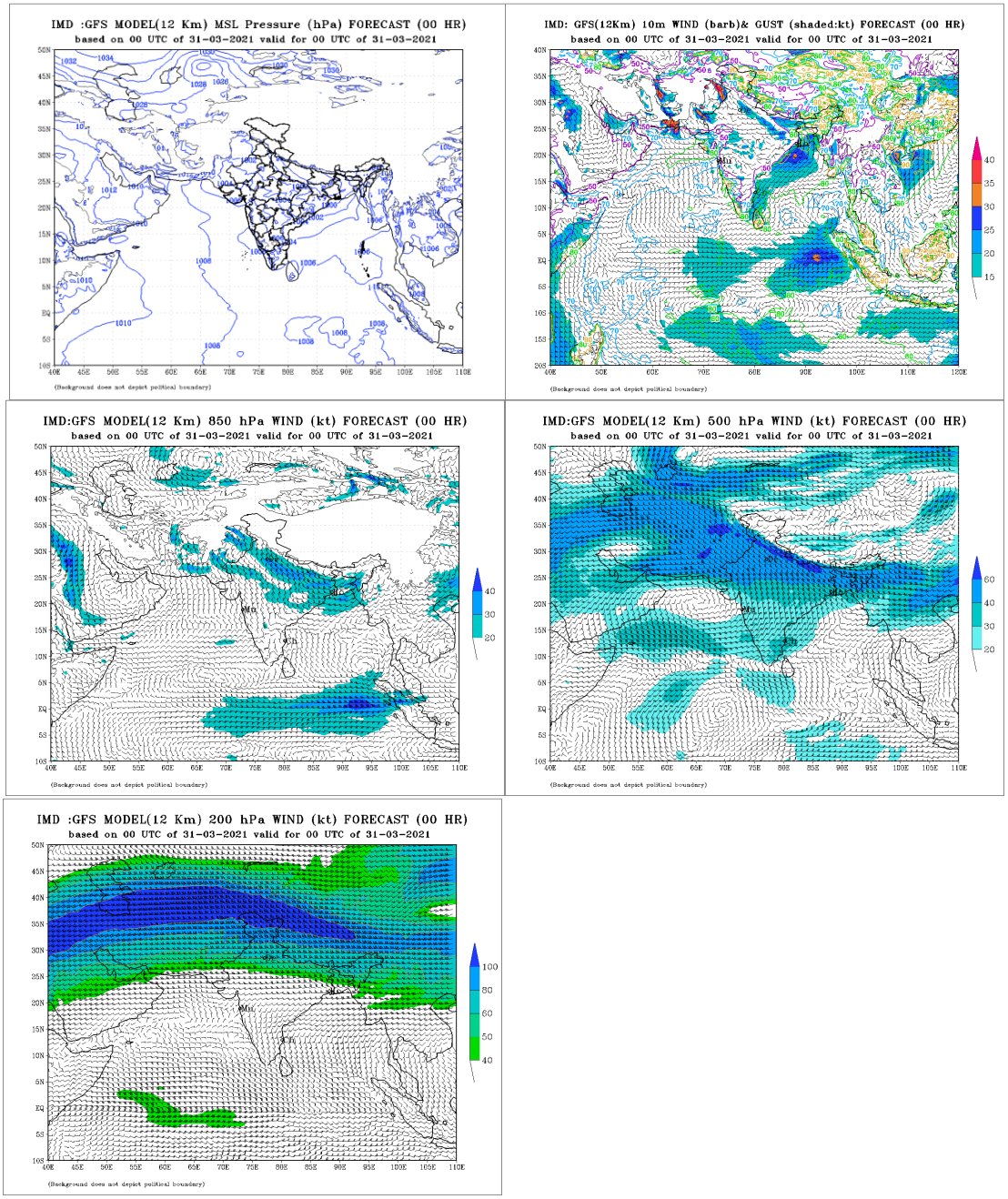


Fig.4 (a): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 31st March 2021

The 10m wind analysis based on 0000 UTC of 1st April indicated a cyclonic circulation over south Andaman Sea with vertical extension upto 850 hPa level. At upper level, the ridge was seen near 13^0N. IMD GFS could capture the presence of anticyclonic circulation over southeast Asia and westerlies to the north of 18^0N. On 1st April, the system lay as an LPA over south Andaman Sea.

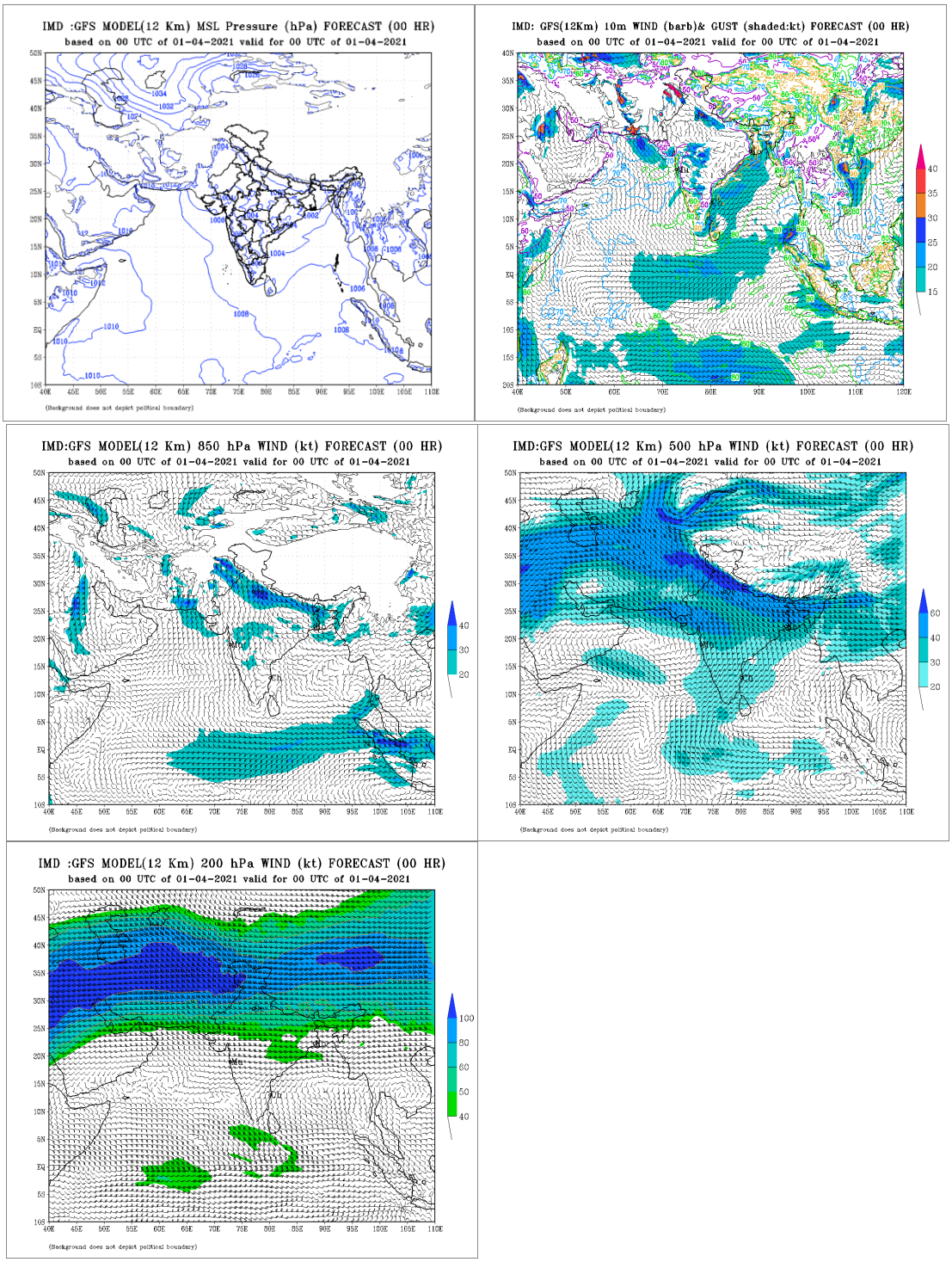


Fig.4 (b): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 1st April 2021

The isobaric analysis based on 0000 UTC of 2nd April indicated an LPA over south Andaman Sea with vertical extension upto 500 hPa level. At 200 hPa level, IMD GFS could capture the trough in westerlies extending upto central parts of BoB and the anticyclone over southeast Asia that indicated north-northeastwards movement of the system towards Myanmar coast. On 1st April, the system lay as a depression over north Andaman Sea.

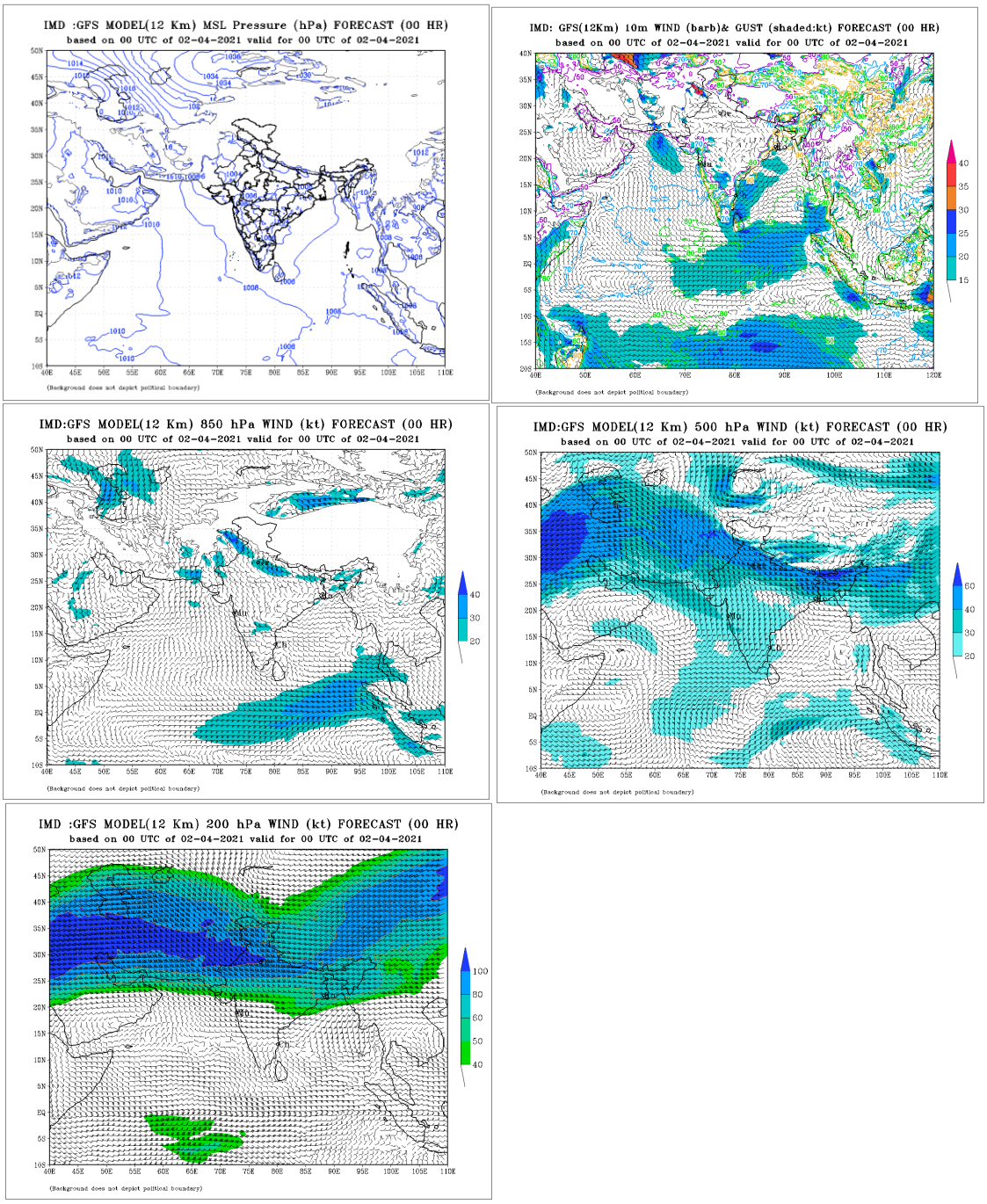


Fig.4 (c): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 2nd April 2021

The isobaric analysis based on 0000 UTC of 3rd April indicated an LPA over north Andaman Sea with vertical extension upto 850 hPa level. At 200 hPa level, IMD GFS could nicely capture the trough in westerlies extending upto central parts of BoB and the anticyclone over southeast Asia that indicated north-northeastwards movement of the system towards Myanmar coast. On 3rd April, the system lay as a depression over north Andaman Sea and adjoining south Myanmar coast.

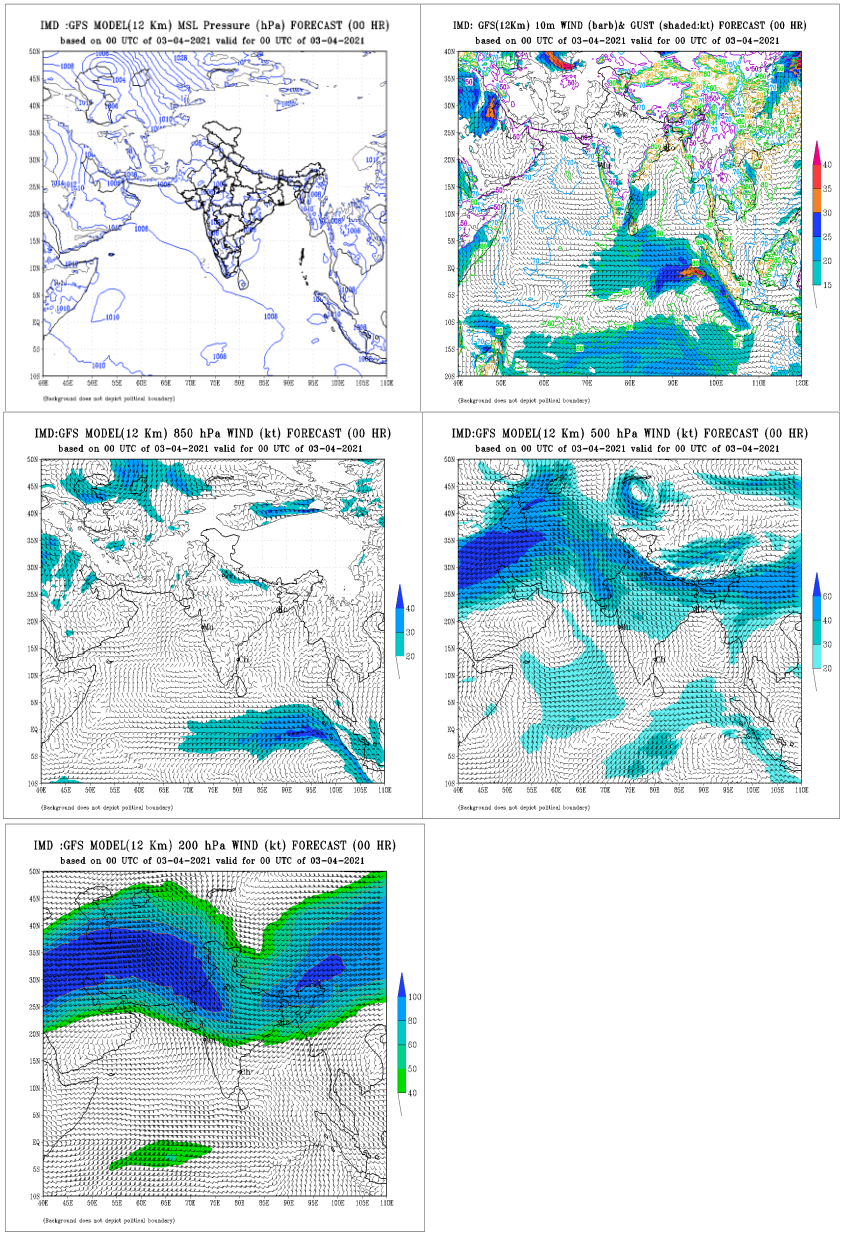


Fig.4 (d): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 3rd April 2021

The IMD GFS could detect the genesis of this system about 10 days in advance. However, it highly overestimated the intensity during the period of five days ahead of actual genesis. Also there was inconsistency in the prediction of the track of the system beyond five days forecast period. During the five days lead period before the genesis, **IMD GFS underestimated the actual intensity of the system. However, movement was captured well by the model during this five day period.**

5. Realized Weather:

5.1 Rainfall

Rainfall associated with the depression over north Andaman Sea and neighbourhood based on IMD-NCMRWF GPM merged gauge rainfall data is depicted in **Fig 5**. It indicates that system caused heavy to very heavy rainfall during 30th March to 2nd April over Andaman Sea. It is seen that light to moderate rainfall (2-4 cm/day) occurred at most places with heavy falls at isolated places over Andaman Islands and light rainfall at few places with over south Myanmar coast on 2nd April.

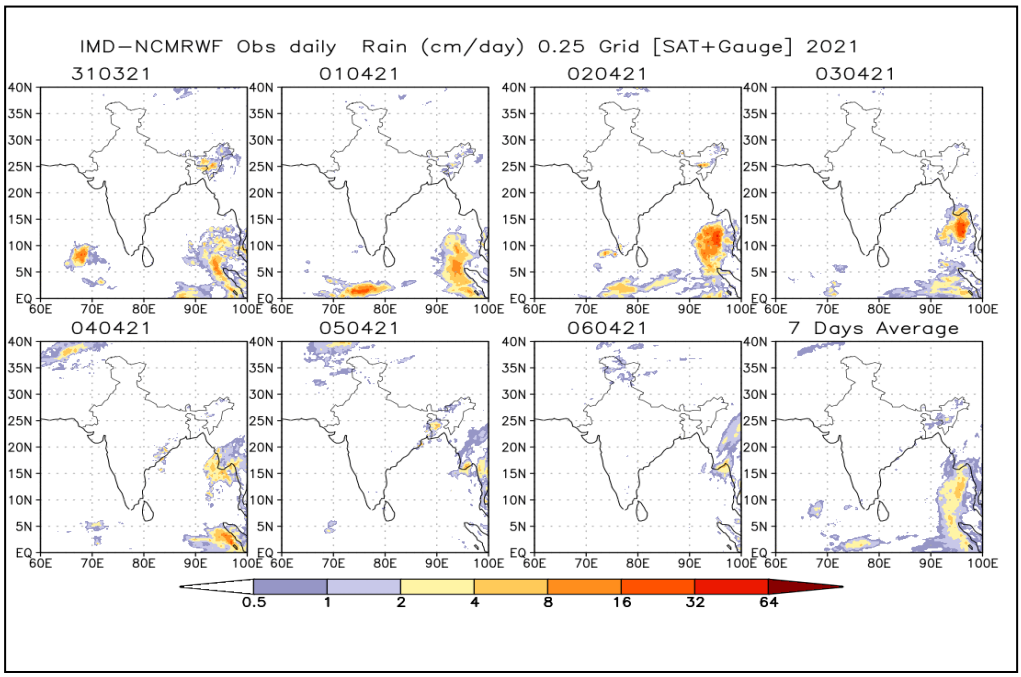


Fig.5: IMD-NCMRWF GPM merged gauge rainfall during 02nd – 03rd April and 7 days average rainfall (cm/day)

Realized 24 hrs accumulated rainfall (≥7cm) ending at 0830 hrs IST of date during the life cycle of the system is presented below:
Light to moderate rainfall occurred at most places with isolated heavy falls over Andaman Islands during past 24 hours ending at 0830 hrs IST of 3rd April 2021:
Port Blair reported 7 cm rainfall during the above period.

5.2. Realised Wind

Realised estimated maximum sustained surface wind was 40-50 kmph gusting to 60 kmph over Andaman Islands on 2nd April.

6. Damage due to the system

No damage was reported in association with this system.

7. Operational Forecast Performance

7.1. Genesis, Track and Intensity Forecast

- First information about likelihood of formation of depression over southeast BoB and adjoining south Andaman Sea around 1st April with low probability (1-33%) was indicated in the extended range forecast issued on 18th March (13 days prior

to formation of LPA over southeast BoB & adjoining south Andaman Sea on 31st March and 15 days prior to formation of depression over north Andaman Sea on 2nd April).

- In the next update issued in the extended range forecast issued on 25th March, cyclogenesis was predicted around 2nd April with low probability (6 days prior to formation of LPA over southeast BoB & adjoining south Andaman Sea on 31st March and 8 days prior to formation of depression over north Andaman Sea on 2nd April).
- The Tropical Weather issued at 0300 UTC of 29th March indicated the probability of cyclogenesis over southeast & adjoining south Andaman Sea during 1st-2nd April with low probability.
- The first Special Message issued at 1400 hours IST of 31st March indicated cyclogenesis on 2nd April.
- The first bulletin issued at 0900 hours IST of 2nd April indicated that the depression would intensify marginally upto deep depression stage, maintain it's intensity till 3rd April and move north-northeastwards towards Myanmar coast. No landfall was predicted since beginning and no intensification into a TC was predicted since beginning.
- Typical observed and forecast tracks alongwith cone of uncertainty and wind distribution demonstrating accuracy in track and intensity prediction are presented in Fig.6.

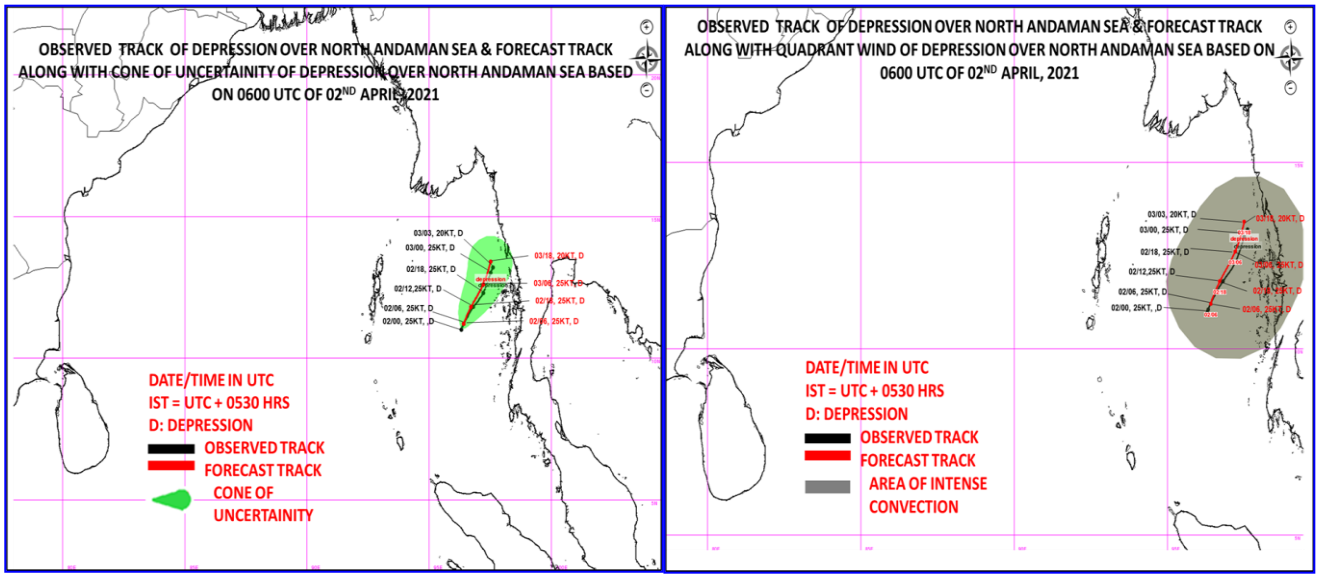


Fig.6: Typical observed and forecast track of depression over north Andaman Sea at 0600 UTC of 2nd April demonstrating accuracy in track and intensity prediction

7.2. Adverse weather forecast verification

The verifications of adverse weather like heavy rainfall and gale wind forecast issued by IMD are presented in Tables 2-3. It is found that the adverse weather was predicted accurately and well in advance.

Table 2: Verification of Heavy Rainfall Forecast

Date/ Base Time of observation	24 hr Heavy rainfall warning ending at 0300 UTC of next day	Realised 24-hour heavy rainfall ending at 0300 UTC of 3rd April
31.03.2021 /0300UTC	Heavy to very heavy rainfall very likely at isolated places over Andaman & Nicobar Islands on 1st April, 2021.	Light to moderate rainfall occurred at most places with isolated heavy falls over Andaman Islands during past 24 hours ending at 0830 hrs IST of today, the 3rd April 2021. Port Blair reported 7 cm rainfall during the above period.
01.04.2021/ 0300 UTC	Heavy rainfall very likely at isolated places over Andaman & Nicobar Islands on 1st April, 2021.	
02.04.2021/ 0300 UTC	Light to moderate rainfall at many places with heavy falls at isolated places (upto 6.5-12 cm) very likely over Andaman Islands and light to moderate rainfall at a few places over Nicobar Islands on 2nd April, 2021.	
03.04.2021/ 0300 UTC	Light to moderate rainfall at few places (upto 6 cm) very likely over Andaman & Nicobar Islands during next 24 hours.	

Table 3: Verification of Squally/Gale wind forecast

Date/Base Time of observation	Gale/ Squally wind Forecast at 0300 UTC of date	Realised 24-hour Gale/ Squally wind Forecast at 0300 UTC of date
31.03.2021 /0300UTC	31st March 2021: Squally winds (speed reaching 40-50 kmph gusting to 60 kmph) very likely over south Andaman Sea & adjoining Southeast Bay of Bengal. 1st April, 2021: Squally winds (speed reaching 40-50 kmph gusting to 60 kmph) very likely over south Andaman Sea & adjoining Southeast Bay of Bengal 2nd April 2021: Squally winds (speed reaching 45-55 kmph gusting to 65 kmph) very likely over north Andaman Sea	Estimated maximum sustained wind speed of 40-50 kmph gusting to 60 kmph were observed over Andaman Sea on 2nd April.
01.04.2021/0300 UTC	1st April, 2021: Squally winds (speed reaching 40-50 kmph gusting to 60 kmph) very likely over south Andaman Sea & adjoining Southeast Bay of Bengal 2nd April 2021: Squally winds (speed reaching 45-55 kmph gusting to 65 kmph) very likely over Andaman Sea 3rd April 2021: Strong winds (speed reaching 30-40 kmph) very likely over north Andaman Sea	
02.04.2021/0300 UTC	Squally winds speed reaching 45-55 kmph gusting to 65 kmph very likely over Andaman Sea becoming 50-60 kmph gusting to 70 kmph from	

	today evening till tomorrow morning. Squally winds speed reaching 45-55 kmph gusting to 65 kmph very likely over Andaman Sea during the subsequent 12 hours. Squally winds speed reaching 40-50 kmph gusting to 60 kmph are also very likely over and around Andaman & Nicobar Islands during next 24 hours.	
03.04.2021/0300 UTC	Squally winds speed reaching 40-50 kmph gusting to 60 kmph very likely over north Andaman Sea during next 06 hours and decrease thereafter.	

7.3 Warning Services

Bulletins issued by Cyclone Warning Division, New Delhi

- **Track & intensity forecast:** IMD continuously monitored, predicted and issued bulletins containing track & intensity forecast for +12, +24 and +36 lead period till the system weakened into a low pressure area. The above forecasts were issued from the stage of depression onwards along with the cone of uncertainty in the track forecast every six hourly during the Depression period.
- **Cyclone structure forecast for shipping and coastal hazard management** The radius of maximum wind and radii of MSW ≥28 knots was issued every six hourly giving forecast for +12, +24 and +36 hrs lead period.
- **Adverse weather warning bulletins:** The tropical cyclone forecasts alongwith expected adverse weather like heavy rain wind and strong wind was issued with every six hourly update to central, state and district level disaster management agencies including MHA NDRF, NDMA for all concerned states along the east coast of India including Tamil Nadu, Andhra Pradesh, Odisha, West Bengal and Andaman & Nicobar Islands. The bulletins also contained the suggested action for disaster managers and general public in particular for fishermen. These bulletins were also issued to Defense including Indian Navy & Indian Air Force.
- **Warning graphics:** The graphical display of the observed and forecast track with cone of uncertainty and the wind forecast for different quadrants were disseminated by email and uploaded in the RSMC, New Delhi website (http://rsmcnewdelhi.imd.gov.in/) regularly. The adverse weather warnings related to heavy rain and gale/squally wind were also presented in graphics alongwith colour codes in the website.
- **Warning and advisory through social media:** Daily updates (every six hourly or whenever there was any significant change in intensity/track) were uploaded on face book and tweeter regularly during the life period of the system.
- **Warning and advisory for marine community:** The six hourly Global Maritime Distress Safety System (GMDSS) bulletins were issued by the Marine Weather Services division at New Delhi and bulletins for maritime interest were issued by Area cyclone warning centres of IMD at Chennai, Kolkata and Cyclone warning centres at Bhubaneswar and Visakhapatnam to ports, fishermen, coastal and high sea shipping community.

- **Fishermen Warning:** Regular warnings for fishermen for deep sea of south BoB and Andaman & Nicobar Islands were issued since 30th March 2021. Special Advisories were also issued in the extended range outlook for Andaman & Niobar Islands on 1st April.
- **Diagnostic and prognostic features of Depression:** The prognostics and diagnostics of the systems were described in the RSMC bulletins and tropical cyclone advisory bulletins.

Statistics of bulletins issued by RSMC New Delhi and Area Cyclone Warning Centre Kolkata, Chennai, Cyclone Warning Centre Bhubaneswar and Visakhapatnam in association with the depression over Andaman Sea are given in **Table 4 & 5.**

Table 4: Bulletins issued by RSMC New Delhi

S.N	Bulletin type	No. of Bulletins	Issued to
1	Special Message on formation of LPA	2	1. IMD's website, RSMC New Delhi website 2. FAX and e-mail to Control Room Ministry of Home Affairs & National Disaster Management Authority, Cabinet Secretariat, Minister of Science & Technology, Headquarter Integrated Defence Staff, Director General Doordarshan, All India Radio, National Disaster Response Force, Chief Secretary, Government of Tamil Nadu, Andhra Pradesh, Odisha, West Bengal and Andaman & Nicobar Islands.
2	National Bulletin	8	1. IMD's website, RSMC New Delhi website 2. FAX and e-mail to Control Room Ministry of Home Affairs & National Disaster Management Authority, Cabinet Secretariat, Minister of Science & Technology, Headquarter Integrated Defence Staff, Director General Doordarshan, All India Radio, National Disaster Response Force, Chief Secretary, Government of Tamil Nadu, Andhra Pradesh, Odisha, West Bengal and Andaman & Nicobar Islands.
3	RSMC Bulletin	8	1. IMD's website 2. WMO/ESCAP member countries through GTS and E-mail.
4	GMDSS Bulletins		1. IMD website, RSMC New Delhi website 2. Transmitted through WMO Information System (WIS) to Joint WMO/IOC Technical Commission for Ocean and Marine Meteorology (JCOMM)
5	Warnings through SMS	Frequently	SMS to disaster managers at national level and concerned states (every six hourly) 369 to disaster managers by IMD Headquarters
6	Warnings through Social Media	Daily	Cyclone Warnings were uploaded on Social networking sites (Face book and Tweeter) since inception to weakening of system (every six hourly).
7	Press Release	2	Disaster Managers, Media persons by email and uploaded on website

Table 5: Statistics of bulletins issued by Area Cyclone Warning Centre (ACWC) Kolkata & Chennai and Cyclone Warning Centre (CWC) Bhubaneswar (BBN) & Visakhapatnam (VZK)

S.No.	Type of Bulletin	No. of Bulletins issued			
		CWC BBN	ACWC Kolkata	CWC VZK	ACWC Chennai
1.	Sea Area Bulletin	NIL	18	NIL	3
2.	Coastal Weather Bulletins	06	18	9	NIL
3.	Fishermen Warnings issued	12	6	15	06
4.	Port Warnings	08	1	04	03
5.	Heavy Rainfall warning	NIL	2	NIL	NIL
6.	Strong Wind Warning	NIL	NIL	1	NIL
7.	Gale Wind Warning	NIL	NIL	NIL	NIL
8.	Storm Surge Warning	NIL	NIL	NIL	NIL
9.	Information & Warning issued to State Government & other Agencies	NIL	NIL	35	NIL
10.	SMS	NIL	1	102	NIL
11.	Whatsapp Message	17472	NIL	164	NIL
12	Facebook	29	NIL	17	NIL
13	Twitter	32	NIL	17	NIL
14.	Press Release	NIL	NIL	2	NIL

11. Initiatives during Depression over North Andaman Sea:

- Advisory for fishermen and other maritime operations were issued on 1st April itself in the Extended range Outlook.
- Pre Cyclone Exercise for the season was held on 1st April itself. First time, the participants included senior level officers from State Governments also including all the coastal states of India apart from disaster management agencies at Central Level.

12. Acknowledgement:

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