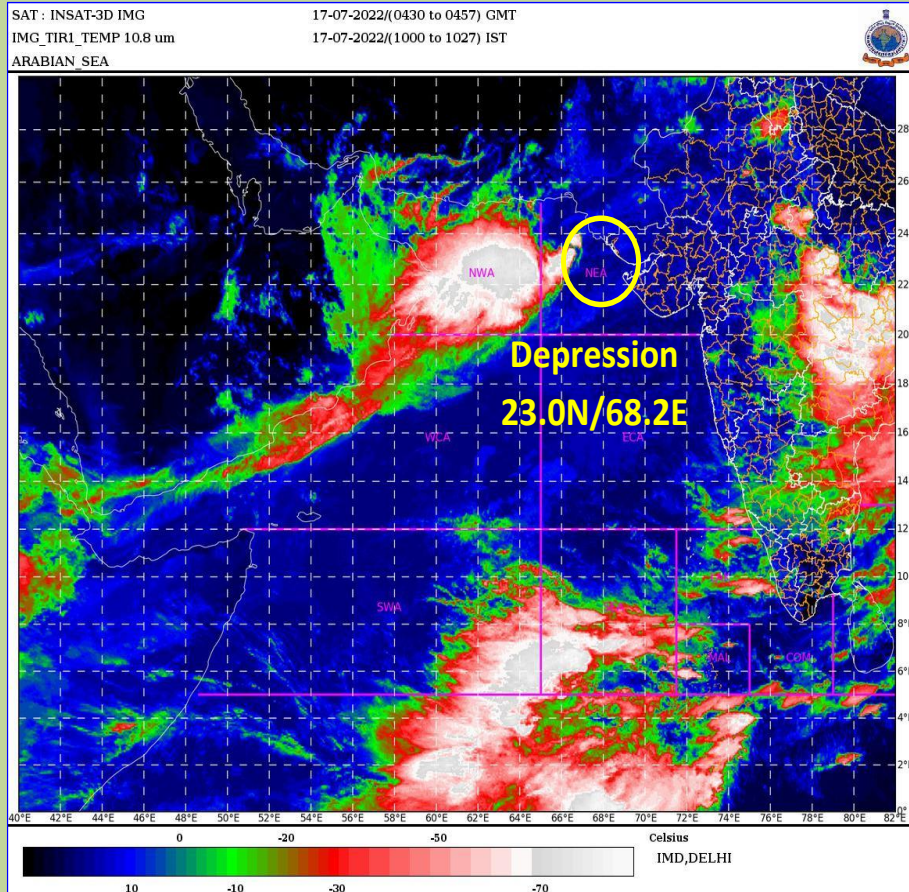




**GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT**

**Depression over Arabian Sea
(16th-18th July, 2022): A Report**



INSAT-3D enhanced Colored IR imagery based on 0430 UTC of 17th July

**Cyclone Warning Division
India Meteorological Department
New Delhi
July 2022**

Depression over Arabian Sea (16th-18th July, 2022)

1. Introduction

Under the influence of a cyclonic circulation over northeast Arabian Sea & adjoining coastal areas of Gujarat, a low pressure area was formed over the same region at 0000 UTC (0530 IST) of 15th July 2022. It lay as a well marked low pressure area over northeast Arabian Sea and adjoining coastal areas of Saurashtra & Kutch at 0300 UTC (0830 IST) of 15th July, 2022. At 0300 UTC (0830 IST) of 16th, Depression formed over Northeast Arabian Sea off Saurashtra coast.

The Depression over Northeast Arabian Sea moved nearly westwards and weakened into a Well Marked Low Pressure Area at 0000 UTC (0530 IST) of 18th July, over central parts of north Arabian Sea.

The observed track and best track parameters of the system are presented in Fig. 1 and table 1.

2. The salient features of the system were as follows:

- The system had a very brief life period of 42 hours with a track length of about 200 km.
- It developed very close to north Gujarat coast about and moved north-northwestwards parallel to the coast
- It weakened over the sea.

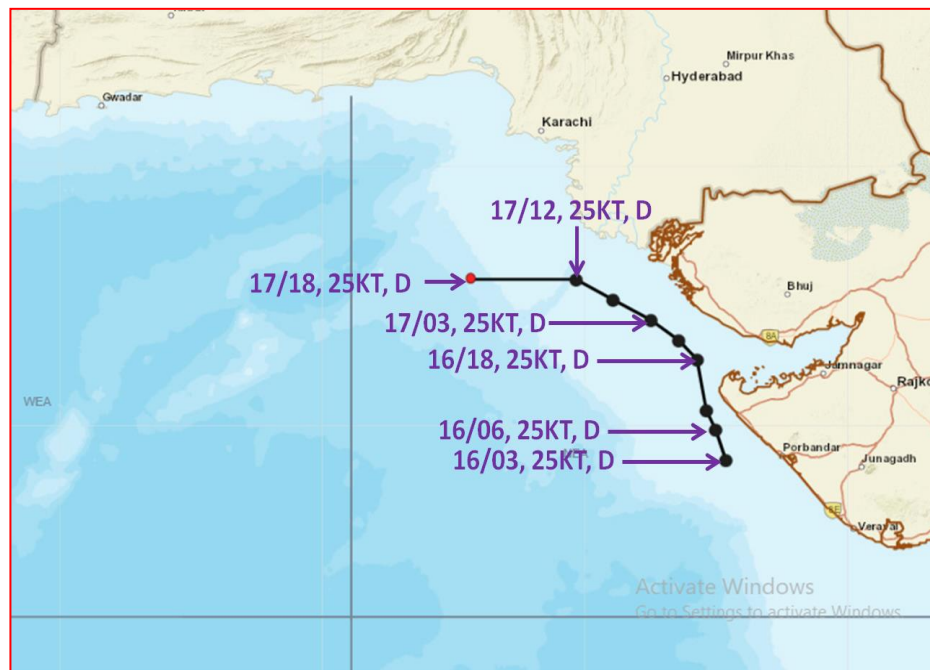


Fig.1: Observed track of depression over Arabian Sea (16th-18th July, 2022)

Table 1: Best track positions and other parameters of the Depression over Arabian Sea (16th-18th July, 2022)

Date	Time (UTC)	Lat.	Long.	C.I. No.	Estimated Central Pressure (hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at the Centre (hPa)	Category
16.07.22	0300	21.6	69	1.5	992	25	3	D
	0600	21.9	68.9	1.5	992	25	3	D
	1200	22.1	68.8	1.5	992	25	3	D
	1800	22.6	68.7	1.5	992	25	3	D
17.07.22	0000	22.8	68.5	1.5	992	25	3	D
	0300	23	68.2	1.5	992	25	3	D
	0600	23.2	67.8	1.5	992	25	3	D
	1200	23.4	67.4	1.5	992	25	3	D
	1800	23.4	66.3	1.5	992	25	3	D
18.07.22	0000	Weakened into a well marked low pressure area over central parts of north Arabian Sea						

Knots: kt, 1 kt = 1.85 kmph, Time in IST= Time in UTC + 0530 hrs

D : Depression, WML : Well marked Low pressure area

3. Brief life history

3.1. Genesis

Under the influence of a cyclonic circulation over northeast Arabian Sea & adjoining coastal areas of Gujarat, a low pressure area formed over the same region in the morning at 0000 UTC of 15th July, 2022 and it lay as a well marked low pressure area over northeast Arabian Sea and adjoining coastal areas of Saurashtra & Kutch in the forenoon at 0300 UTC of same day, the 15th July. The Tropical Cyclone Heat Potential was around 60-80 KJ/cm² over northeast and adjoining northwest Arabian Sea becoming less than 50 KJ/cm² over Gulf of Oman and westwards. The Madden Julian Oscillation (MJO) index lay in phase 4 with amplitude less than 1. Low Level Vorticity increased during previous 24 hours and was around $150 \times 10^{-6} \text{ s}^{-1}$ to the southwest of system centre with vertical extension up to 500 hPa level. Low Level Convergence was $20 \times 10^{-5} \text{ s}^{-1}$ to the west of the system centre. Upper Level Divergence increased and was around $30 \times 10^{-5} \text{ s}^{-1}$ to the west of the system centre. Vertical Wind Shear was low to moderate (10-15 knots) around the system centre with gradual increasing trend over northwest Arabian Sea. Under these favourable conditions, the system concentrated into a depression at 0300 UTC of 16th July.

3.2. Intensification and movement:

At 1200 UTC of the 16th July, 2022 the Depression over northeast Arabian Sea off Saurashtra coast moved north-northwestwards. Sea Surface Temperature was

around 28-29°C over north Arabian Sea. Tropical Cyclone Heat Potential was around 60-80 KJ/cm² over northeast and adjoining northwest Arabian Sea became less than 50 KJ/cm² over Gulf of Oman and westwards. Low Level Vorticity was around 150x10⁻⁶ s⁻¹ to the southwest of system centre with vertical extension up to 500 hPa level. Low Level Convergence was around 20x10⁻⁵ s⁻¹ to the west of the system centre. Upper Level Divergence was around 20x10⁻⁵ s⁻¹ to the west of the system centre. Vertical Wind Shear was low to moderate (10-15 knots) around the system centre with gradual increasing trend over northwest Arabian Sea. Under these favorable conditions, the system maintained its intensity of depression.

The Depression over northeast Arabian Sea off Saurashtra and Kutch coasts moved west-northwestwards and lay centered at 0300 UTC of the 17th July, 2022. Sea Surface Temperature was around 28-29°C over northeast Arabian Sea with gradual decreasing trend over northwest Arabian Sea. Tropical Cyclone Heat Potential was around 60-80 KJ/cm² over northeast and adjoining northwest Arabian Sea became less than 50 KJ/cm² over Gulf of Oman and westwards. The Madden Julian Oscillation (MJO) index lay in phase 5 with amplitude less than 1. Low Level Vorticity was same around 150 X 10⁻⁶ s⁻¹ to the southwest of system centre with vertical extension up to 500 hPa level. Low Level Convergence increased and was 40x10⁻⁵ s⁻¹ to the southwest of the system centre. Upper Level Divergence was around 20x10⁻⁵ s⁻¹ to the west of the system centre. Vertical Wind Shear was low (05-10 knots) around the system centre & over northeast Arabian Sea with increasing trend over northwest Arabian Sea to moderate value of 20-25 knots. Total Precipitable Water imagery also indicates warm moist air incursion into the system core. Under these favourable conditions, the system maintained its intensity of depression.

The depression moved nearly westwards during previous 06 hours and weakened into a Well Marked Low Pressure area over central parts of north Arabian Sea at 0000 UTC of the 18th July, 2022 due to high vertical wind shear. Sea Surface Temperature was around 28-29°C over northeast Arabian Sea with gradual decreasing trend over northwest Arabian sea. Tropical Cyclone Heat Potential was around 60-80 KJ/cm² over northeast and adjoining northwest Arabian Sea. The Madden Julian Oscillation (MJO) index lay in phase 5 with amplitude less than 1. Low Level Vorticity was around 90-100 x10⁻⁶ s⁻¹ to the southwest of system centre with vertical extension up to 500 hPa level.

4. Monitoring through satellite:

India Meteorological Department (IMD) maintained round the clock watch over the north Indian Ocean (NIO) and the system was monitored well in advance. The system was monitored with the help of available satellite observations from INSAT 3D and 3DR, polar orbiting satellites and available ships & buoy observations in the region. Various numerical weather prediction models run by Ministry of Earth Sciences (MoES) institutions, global models and dynamical-statistical models were utilized to predict the genesis, track, landfall and intensity of the system. A digitized forecasting system of IMD was utilized for analysis and comparison of various models' guidance, decision making process and warning products generation.

4.1 Detailed feature observed through Satellites:

Typical INSAT-3D IR, visible, enhanced colored and cloud top brightness temperature imageries during life cycle of the system are presented in Fig. 3. As per INSAT 3D imagery, at 0300 UTC of the 16th July, 2022 the intensity of the system was C11.5. The cloud mass indicates shear pattern with convective cloud sheared to the west of system centre. Associated scattered to broken low and medium clouds with embedded intense to very intense convection lay over north and adjoining central Arabian Sea. Minimum Cloud Top Temperature was -93°C.

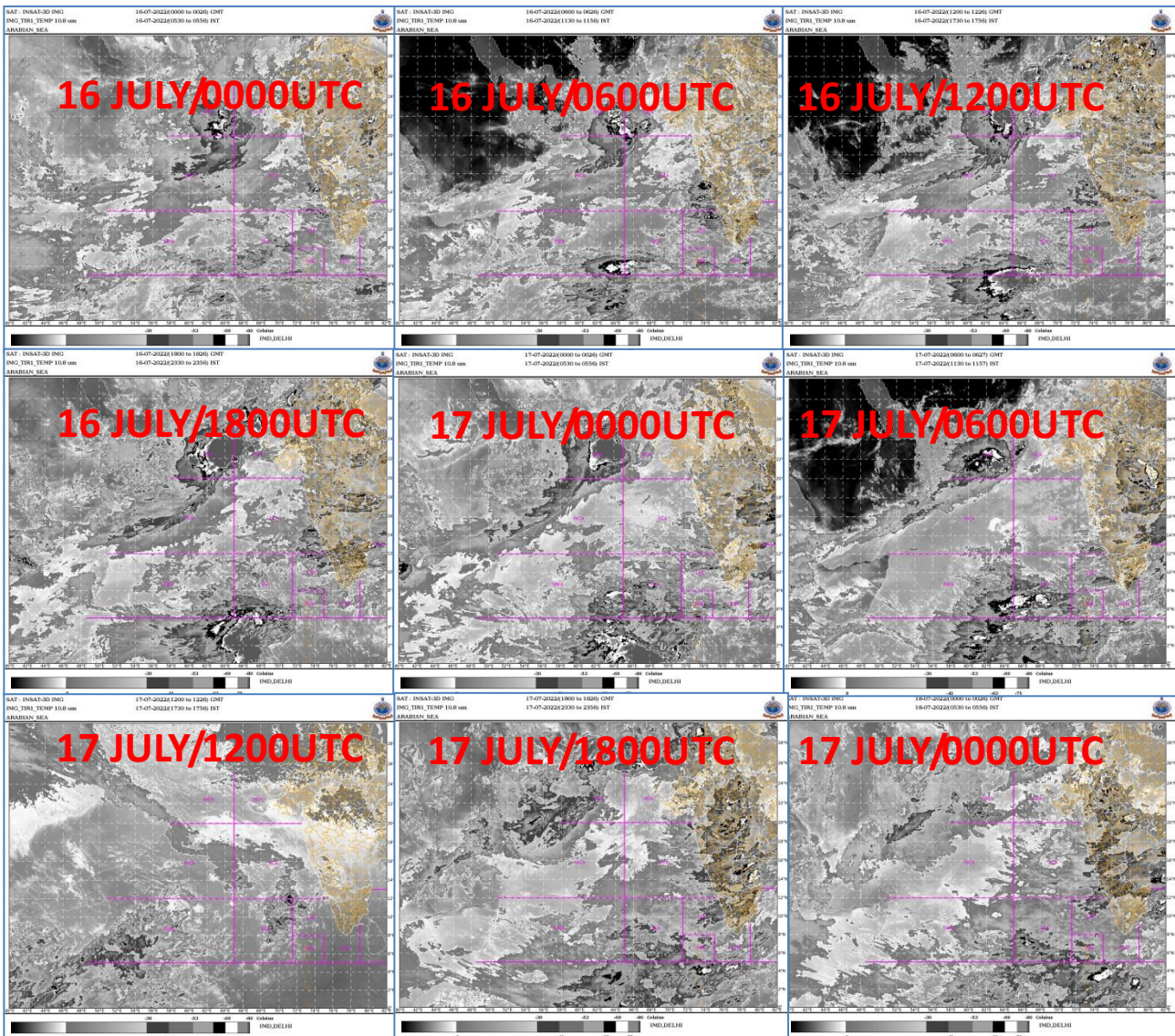


Fig. 3(i): INSAT-3D BD Curve imageries during 16-18 July, 2022

At 0300 UTC of 17th July, 2022 the intensity of the system was C11.5 and the Centre was clearly defined in visible imagery. The clouds were organised in shear pattern with convective cloud sheared to the west of system centre. Associated broken low

and medium clouds with embedded intense to very intense convection lay over north Arabian Sea. Minimum Cloud Top Temperature was -93°C .

At 0000 UTC of the 18th July, 2022 as per INSAT 3D imagery, associated scattered to broken low and medium clouds with embedded intense to very intense convection lay over central parts of northwest Arabian Sea. Minimum Cloud Top Temperature was -89°C . Associated intense convective cloud mass lay west to the system center.

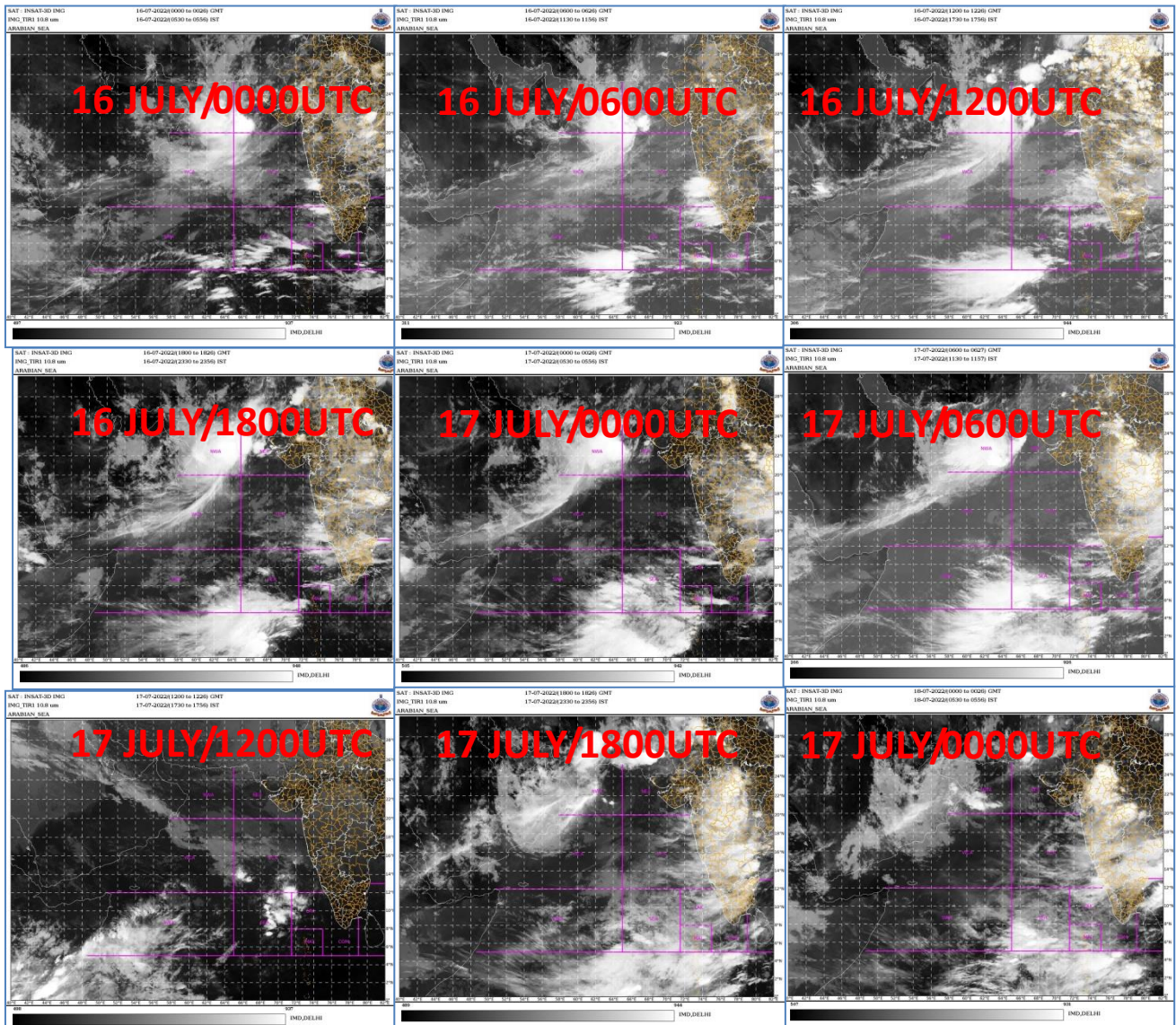


Fig. 3(ii): INSAT-3D IR imageries during 16-18 July, 2022

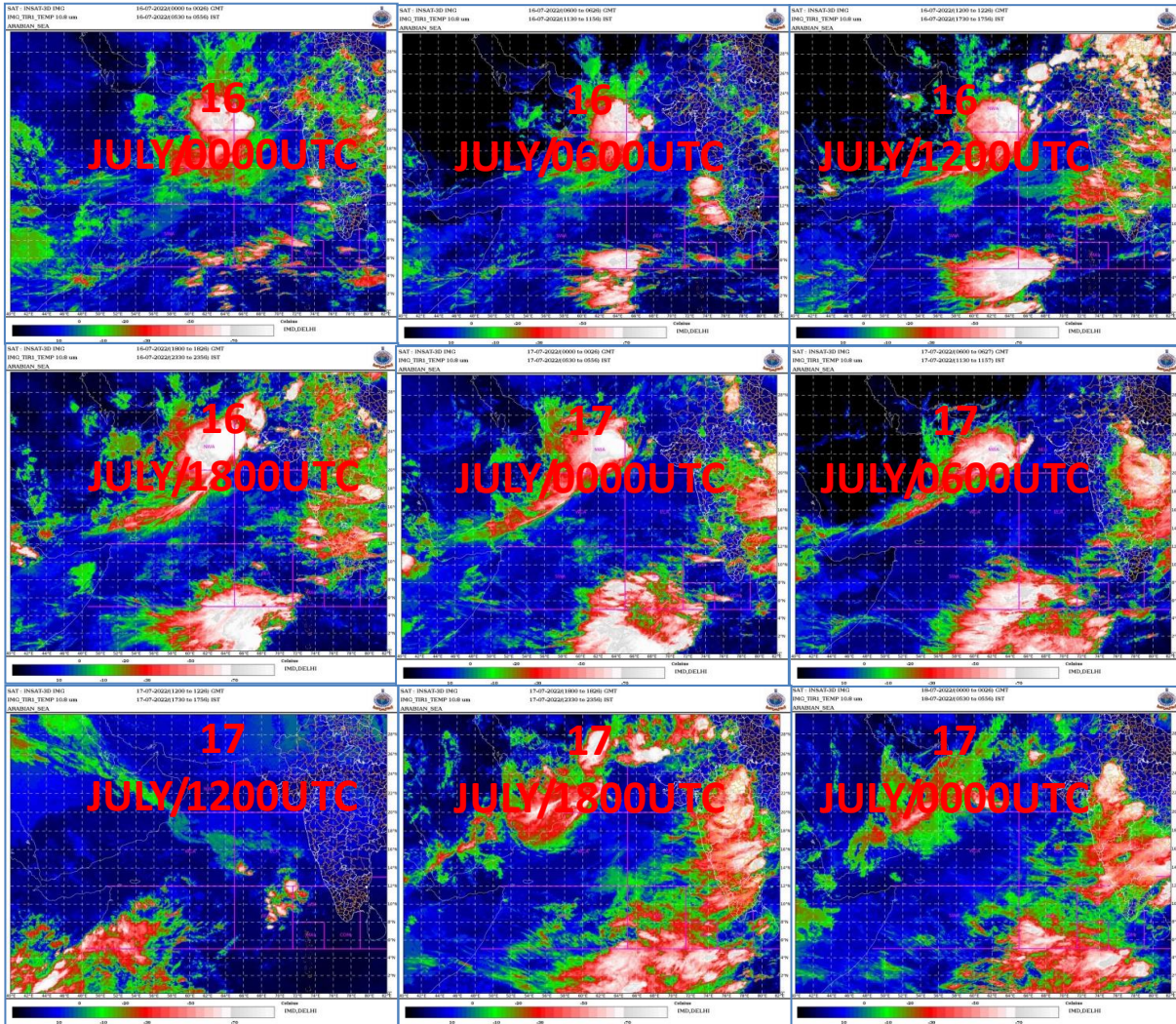


Fig. 3(iii): INSAT-3D NHC imageries during 16-18 July, 2022

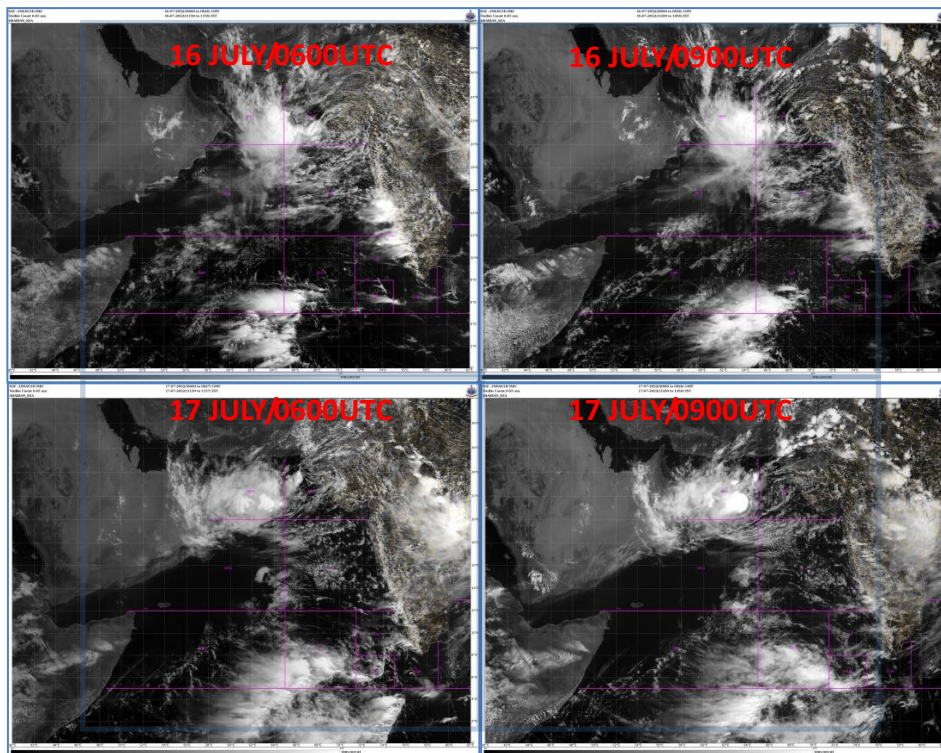


Fig. 3(iv): INSAT-3D Visible imageries during 16-18 July, 2022

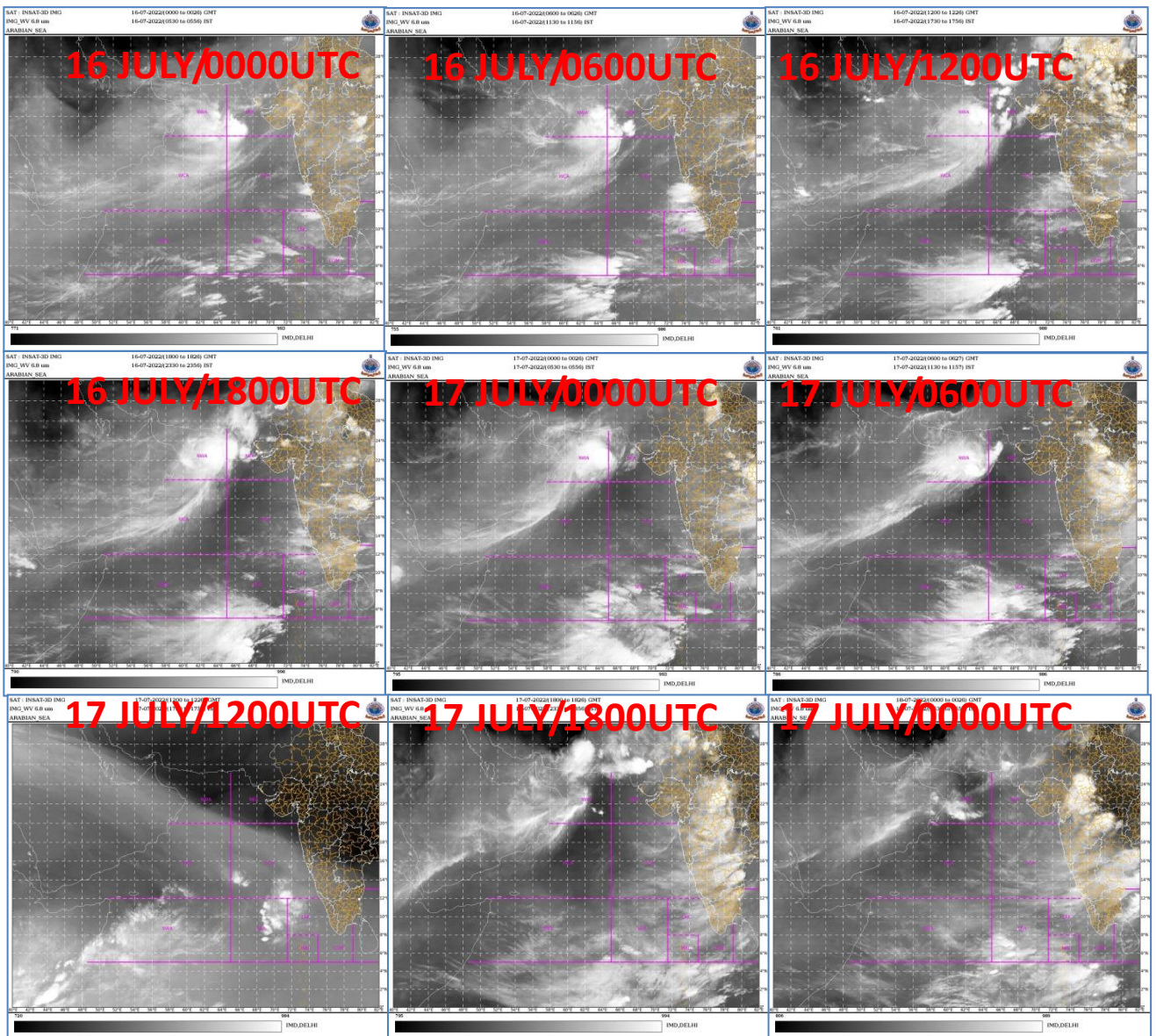


Fig. 3(v): INSAT-3D Water Vapour imageries during 16-18 July, 2022

The SCATSAT (METOP-B) imageries during 16-18 July 2022 is provided in Fig.4. These ASCAT imageries indicated stronger wind in the southern sector of the system. These winds were in agreement with the intensity of the system.

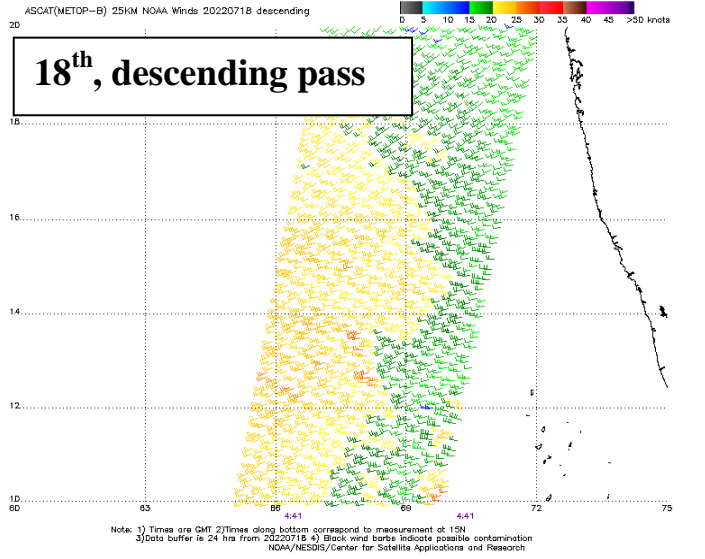
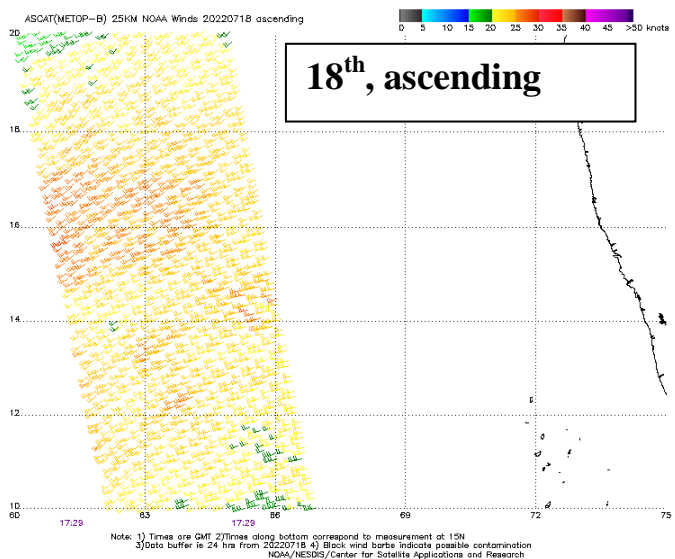
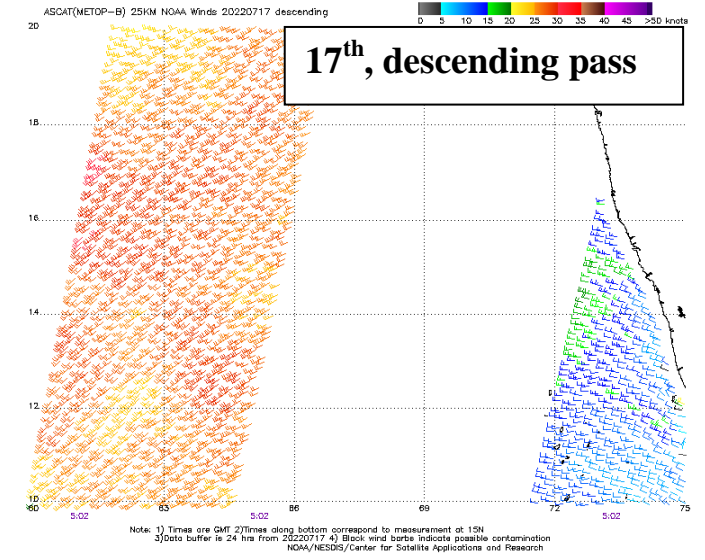
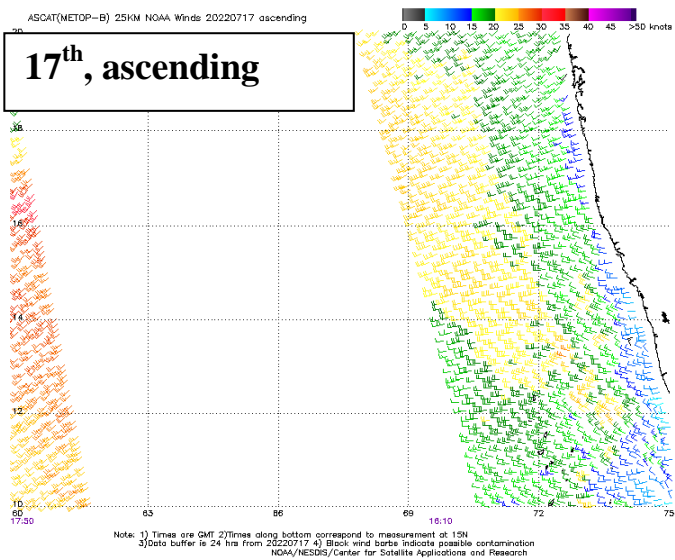
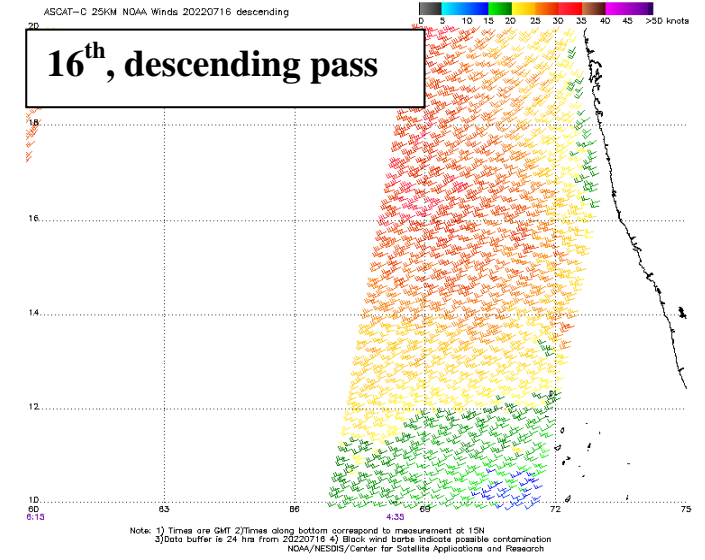
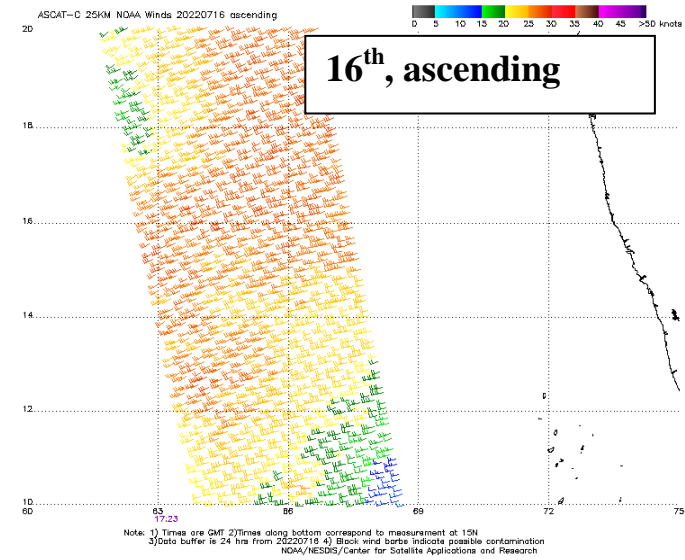


Fig.4: ASCAT imageries during Depression (16-18 July, 2022)

5. Dynamical features

IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10 m, 850, 500 and 200 hPa levels on 0000 UTC of 16th July are presented in Fig.5. The analysis wind and pressure fields on 16th July over northeast AS and close to the coast indicated the depression. It extended up to the 500 hPa.

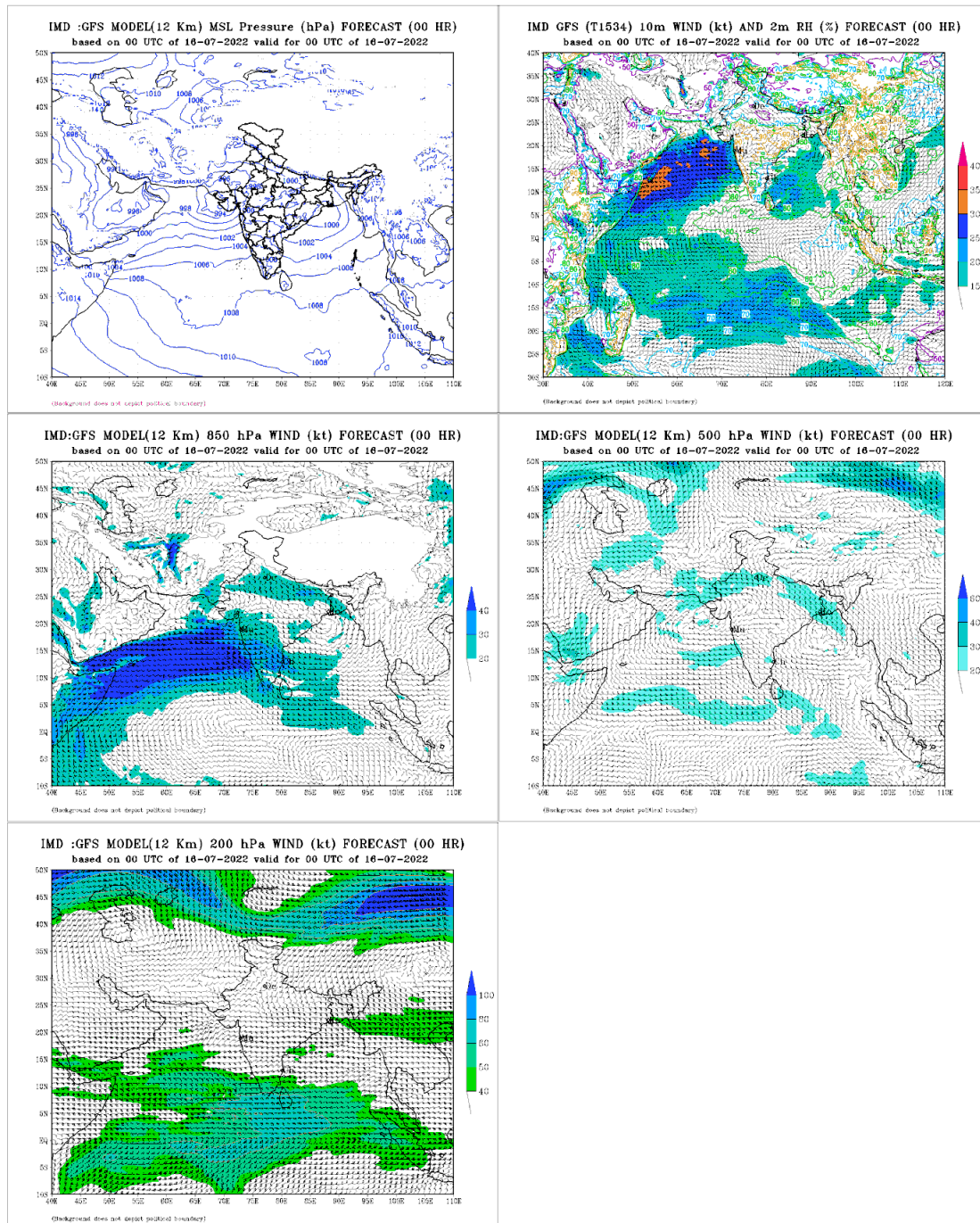


Fig.5 (i): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 16th July 2022

The analysis wind and pressure fields on 17th July over northeast and adjoining northwest AS indicated that the system was moving away from the coast.

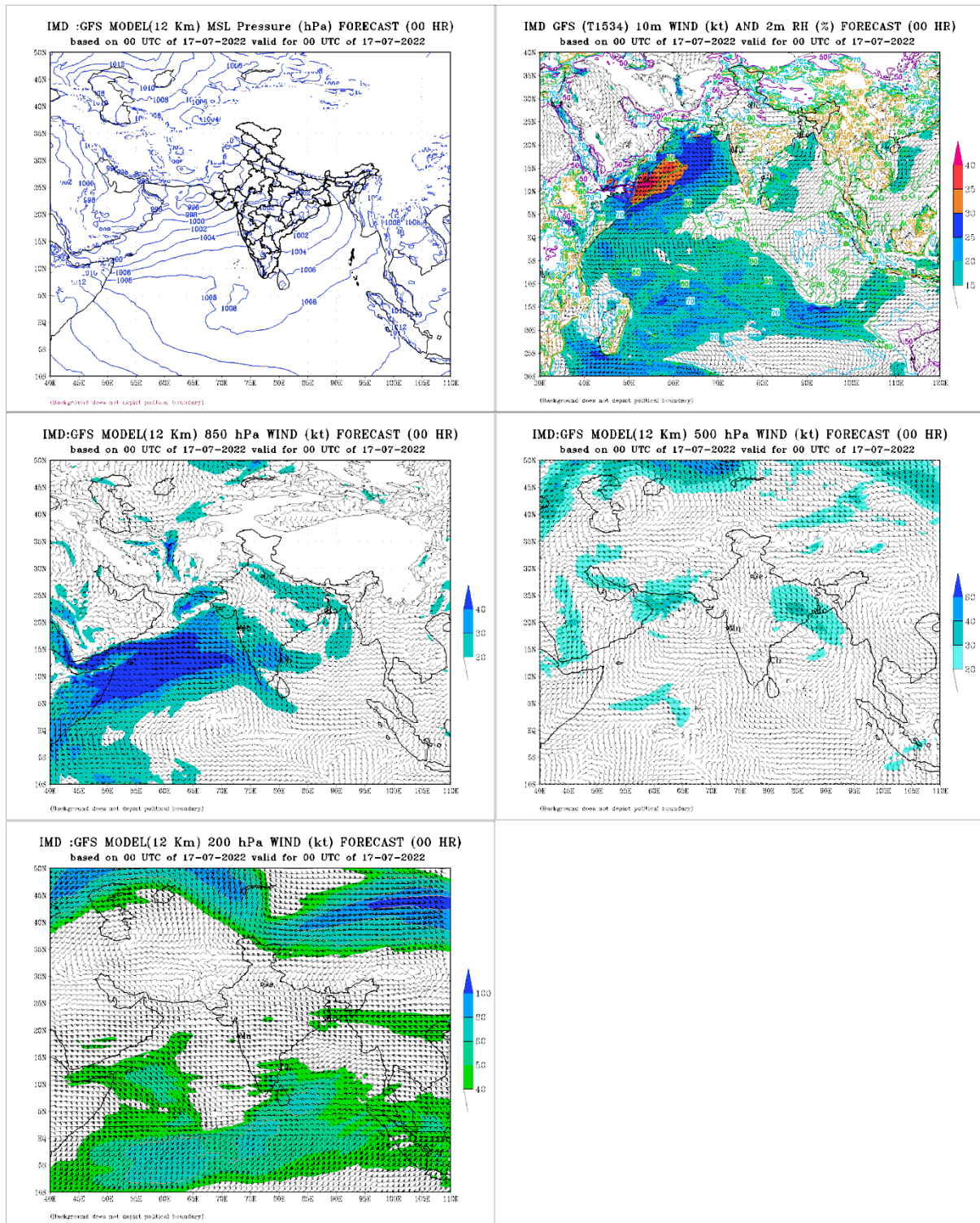
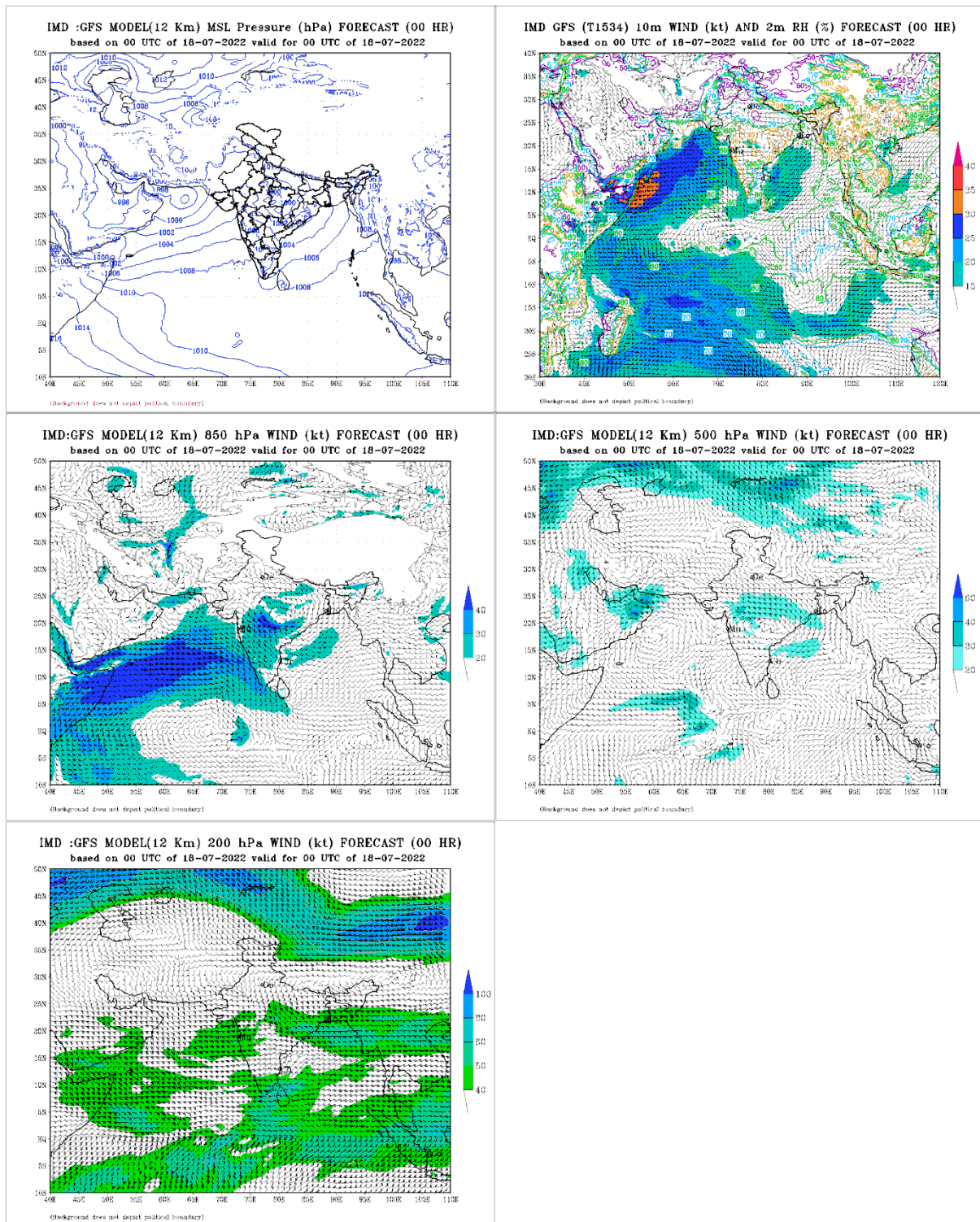


Fig.5 (ii): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 17th July 2022

The analysis wind and pressure fields on 18th July over northwest AS indicated that the system was further moved northwestwards.



Fi.5(iii): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 18th July 2022

Thus IMD GFS could capture the genesis and movement correctly.

6. Realized Weather:

6.1 Rainfall:

Under the influence of depression, widespread rainfall occurred mainly over the sea area. Daily rainfall distribution based on merged gridded rainfall data of IMD/NCMRWF during 14-20 July, 2022 is shown in fig.6.

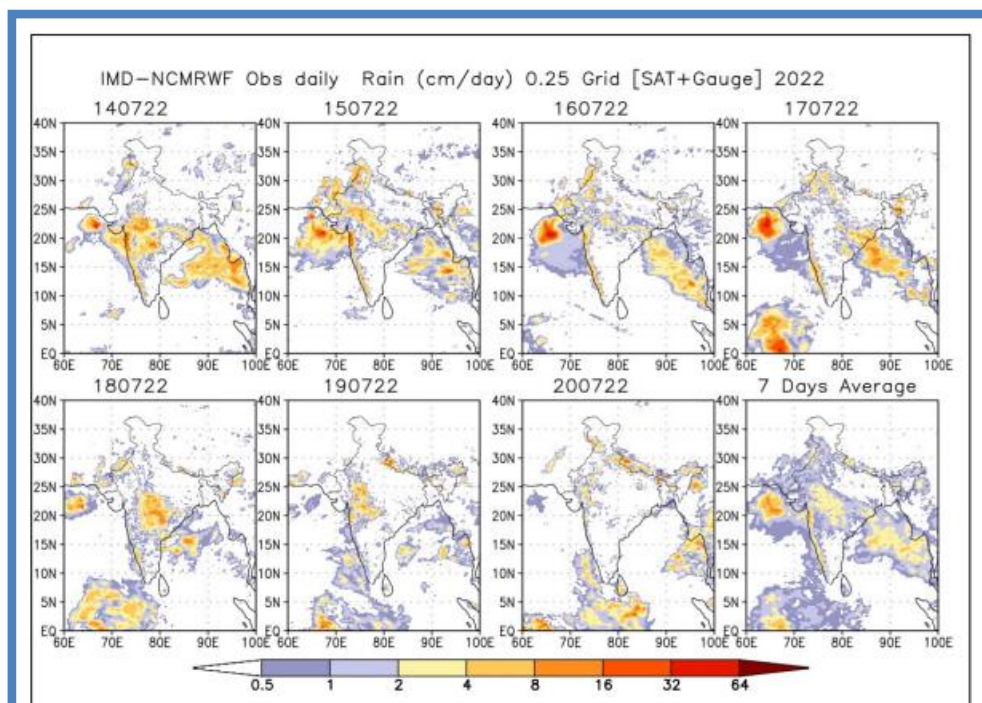


Fig.6: Daily rainfall distribution based on merged gridded rainfall data of IMD/NCMRWF during 14 - 20 July, 2022

7. Damage by Deep Depression

No damage was reported due to Depression.

8. Bulletins issued by IMD

The system was monitored continuously since 7th July (about 10 days prior to formation of depression over northeast Arabian Sea). In association with this system, 2 extended range outlooks, 4 tropical weather outlooks, 10 national bulletins to central & state level disaster managers, 10 special tropical weather outlooks for WMO and WMO/ESCAP Panel member countries including Pakistan, Iran & Oman, 10 bulletins under global maritime distress system for ships plying in high seas, 3 press release, 6 hourly SMS to registered public at RSMC website & disaster managers and frequent updates on whatsapp, facebook, tweeter were issued by IMD to trigger early action.

Bulletins issued by Cyclone Warning Division of IMD in association with the system are given in Table.2.

Table 2: Bulletins issued by Cyclone Warning Division, IMD, New Delhi

S. No.	Bulletins	No. of Bulletins	Issued to
1	National Bulletin	10	1. IMD's website 2. FAX and e-mail to Control Room NDM, Ministry of Home affairs, Control Room NDMA, Cabinet Secretariat, Minister of Sc. & Tech, Secretary MoES, DST, HQ Integrated Defence Staff, DG Doordarshan, All India Radio, DG-NDRF, Director Indian Railways, Indian Navy, IAF, Administrator.
2	RSMC Bulletin	10	1. IMD's website 2. All WMO/ESCAP member countries through GTS and E-mail. 3. Indian Navy, IAF by E-mail
3	Press Release	3	1. Disaster Managers, Media persons by email and uploaded on website
4	Facebook /Twitter	6 times	Highlights uploaded on facebook/twitter since formation of low pressure area.

10. Summary and Conclusions:

Under the influence of a cyclonic circulation over northeast Arabian Sea & adjoining coastal areas of Gujarat, a low pressure area formed over the same region in the morning (0530 hours IST) of 15th July, 2022 and it lay as a well marked low pressure area over northeast Arabian Sea and adjoining coastal areas of Saurashtra & Kutch in the forenoon (0830 hours IST) of same day, the 15th July. Under favourable environmental conditions, it concentrated into a depression in the forenoon (0830 hours IST) of 16th July over northeast Arabian Sea off Saurashtra coast. It moved nearly northwards till midnight (2330 hours IST) of 16th July. Thereafter, it started recurving and moved west-northwestwards gradually till evening of 17th July. It then moved westwards and weakened into a well marked low pressure area over central parts of north Arabian Sea in the morning of 18th July. The remnant continued to move westwards and weakened into a low pressure area over central parts of north Arabian Sea in the afternoon of 18th July and further weakened into a cyclonic circulation over northwest Arabian Sea by the evening of same day. It lay as a cyclonic circulation over northwest Arabian Sea off Oman coast in the forenoon of 19th July. It further moved westwards and layover Saudi Arabia and adjoining northeast Oman in the forenoon of 20th July. It became less marked thereafter.

11. Acknowledgements:

India Meteorological Department (IMD) and RSMC New Delhi duly acknowledge the contribution from all the stakeholders and disaster management agencies who contributed to the successful monitoring, prediction and early warning service of system. We acknowledge the contribution of all sister organisations of

Ministry of Earth Sciences including National Centre for Medium Range Weather Forecasting Centre (NCMRWF), Indian National Centre for Ocean Information Services (INCOIS), National Institute of Ocean Technology (NIOT), Indian Institute of Tropical Meteorology (IITM) Pune, research institutes including Indian Space Research Organisation for their valuable support. The support from various Divisions/Sections of IMD including Area Cyclone Warning Centre (ACWC) Mumbai, Cyclone Warning Centre (CWC) Ahmedabad, Numerical Weather Prediction Division, Satellite and Radar Division, Surface & Upper air instruments Divisions, New Delhi and Information System and Services Division is also duly acknowledged.
