



Cyclonic storms and depressions over the North Indian Ocean during 2021

1. Introduction

During 2021, in all 10 intense low pressure systems formed over the Indian seas. These included; one Extremely Severe Cyclonic Storms (TAUKTAE), one Very Severe Cyclonic Storm (YAAS), one Severe Cyclonic Storm (SHAHEEN), two Cyclonic Storms (GULAB & JAWAD), one Deep Depression and four Depressions. Out of these 10 systems, 7 systems formed over the Bay of Bengal and 3 over Arabian Sea. One Extremely Severe Cyclonic Storm formed in Arabian Sea, one Very Severe Cyclonic Storm and one Depression formed over Bay of Bengal in pre-monsoon season. Monsoon season witnessed one Severe Cyclonic Storm over Arabian Sea, one Cyclonic Storm and one Deep Depression over Bay of Bengal. One Cyclonic Storm, two Depressions over Bay of Bengal and one Depression over Arabian Sea formed in the post-monsoon season.

The details of these systems are summarised below and also in Tables 1-3. The tracks are shown in Fig. 1.

2. Details of the systems

2.1. Depression over north Andaman Sea and neighbourhood (2-3 April 2021)

2.1.1. Under the influence of the cyclonic circulation over southeast Bay of Bengal and adjoining south Andaman Sea, a **Low Pressure Area** formed over the same region with the associated cyclonic circulation extended upto 5.8 km above m.s.l. on 31st March morning. It then persisted over the same region and lay over south Andaman Sea and adjoining southeast Bay of Bengal on 31st March evening. It then lay over south Andaman Sea and neighbourhood on 1st April morning which persisted over the same region with the associated cyclonic circulation extended upto 5.8 km above m.s.l. It lay as a **Well Marked Low Pressure Area** over central parts of Andaman Sea and neighbourhood on 1st April, evening. It further intensified into a **Depression** over north Andaman Sea and lay centred at 0530 hrs IST of the 2nd April 2021 near Lat. 11.0° N / Long. 96.3° E, about 400 km east-northeast of Port Blair (Andaman Islands). It remained practically stationary and lay centred at 0830 hrs IST of the 2nd April, 2021 near Lat. 11.0° N / Long. 96.3° E. It

moved north-northeastward and lay centred at 1730 hrs IST of the 2nd April, 2021 near Lat. 11.8° N / Long. 96.8° E, about 450 km east-northeast of Port Blair (Andaman Islands). It continued to move north-northeastward and lay centred at 0830 hrs IST of the 3rd April, 2021 over north Andaman Sea off south Myanmar coast near Lat. 13.2° N / Long. 97.6° E, about 420 km south-southeast of Yangon (Myanmar) on 3rd April. It further moved north-northeastward and weakened into a **Well Marked Low Pressure Area** over north Andaman Sea and adjoining south Myanmar coast at 1130 hrs IST of the 3rd April, 2021.

2.1.2. Other features observed

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

2.1.3. Realized weather

Rainfall associated with the depression over north Andaman Sea and neighbourhood indicated 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 over south Myanmar coast on 2nd April.

The chief amount of 24 hrs accumulated rainfall (≥ 7cm) ending at 0300 UTC of date during the life cycle of the system is presented below:

3 April 2021 : Port Blair-7.

2.2. Extremely Severe Cyclonic Storm 'TAUKTAE' over the Arabian Sea (14-19 May, 2021)

2.2.1. Under the influence of the cyclonic circulation over southeast Arabian Sea and neighbourhood, a **Low Pressure Area** has formed over the same region with the associated cyclonic circulation extended upto mid tropospheric level on 13th April. It then lay as a **Well Marked Low Pressure Area** over Lakshadweep area and

* Compiled by :A. Kashyapi and V. K. Shripad, O/o CRS, IMD, Pune – 411 005, India

TABLE 1

Brief Summary of Cyclonic Storms and Depressions over Indian Seas and neighbourhood during 2021

S. No.	Category	Life Period	Place/Time of landfall	Lowest Estimated central Pressure (hPa)	Max. wind Estimated (kts)	Highest "T" No.
1.	Depression	2-3 Apr	Weakened into a well marked low pressure area over north Andaman Sea and adjoining south Myanmar coast at 0600 hrs UTC of the 3 rd April	1000	25	1.5
2.	Extremely severe cyclonic storm 'TAUKTAE'	14-19 May	Crossed Saurashtra coast about 20 km northeast of Diu, near Lat. 20.8° N and Long. 71.1° E during 1000-1200 UTC of 17 th May. Weakened into a well marked low pressure area over Northeast Rajasthan at 1200 hrs UTC of 19 th May	950	100	5.5
3.	Very severe cyclonic storm 'YAAS'	23-28 May	Crossed north Odisha coast near Latitude 21.35° N and Longitude 86.95° E, about 20 km to the south of Balasore as a very severe cyclonic storm between 0500 & 0600 UTC of 28 th May. Weakened into a well marked low pressure area over Bihar and adjoining east Uttar Pradesh at 0000 hrs UTC of 28 th May	970	75	4.0
4.	Deep depression	12-15 Sep	Crossed north Odisha coast, close to south of Chandbali between 0000 & 0100 hrs UTC as a deep depression of 13 th September. Weakened into a well marked low pressure area over northeast Madhya Pradesh & neighbourhood at 0000 hrs UTC of 15 th September	990	30	2.0
5.	Cyclonic storm 'GULAB'	24-28 Sep	Crossed north Andhra Pradesh - South Odisha coasts near latitude 18.4° N and longitude 84.2° E, about 20 km north of Kalingapatnam with a maximum sustained wind speed of 75-85 kmph gusting to 95 kmph during 1930 & 2030 hrs IST (1400-1500 UTC). Weakened into a well marked low pressure area over western parts of Vidarbha and neighbourhood at 0600 hrs UTC of 28 th September	992	45	3.0
6.	Severe cyclonic storm 'Shaheen'	30 Sep - 4 Oct	Crossed Oman coast during 1900 to 2000 UTC of 3 rd October, near latitude 23.9° N and longitude 57.3° E, about 120 km west-northwest of Muscat as a severe cyclonic storm. Weakened into a well marked low pressure area over north Oman and adjoining United Arab Emirates at 1200 hrs UTC of 4 th October	984	60	3.5
7.	Depression	7- 9 Nov	Weakened into a well marked low pressure area over central parts of Arabian Sea at 0000UTC of 9 th November	1002	25	1.5
8.	Depression	10-11 Nov	Crossed north Tamil Nadu & adjoining south Andhra Pradesh coasts close to Chennai, near Lat. 12.95° N and Long. 80.25° E during 1730 and 1830 hrs IST. Weakened into a well marked low pressure Area over north Tamil Nadu & neighborhood at 0000 hrs UTC of 11 th November	998	25	1.5
9.	Depression	18-19 Nov	Crossed north Tamil Nadu coast between Puducherry & Chennai near Lat. 12.45° N and Long. 80.1° E during 0300-0400 hrs UTC of 19 th November, 2021. Weakened into a well marked low pressure area over north Tamil Nadu & neighborhood at 0006 of 19 th November	1000	25	1.5
10.	Cyclonic Storm 'JAWAD'	2-5 Dec	Weakened into a well marked low pressure area over northwest Bay of Bengal off West Bengal-Bangladesh coasts at 0000 hrs UTC of 6 th December	1000	40	2.5

CYCLONIC STORMS & DEPRESSIONS OVER THE NORTH INDIAN OCEAN DURING 2021

TABLE 2

Storms/Depressions statistics 2021

Name of the system	Winter		Pre-Monsoon			Monsoon			Post-Monsoon			Total	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov		Dec
Over the Bay of Bengal													
Depressions/deep depressions	-	-	-	1	-	-	-	-	1	-	2	-	4
Cyclonic storms	-	-	-	-	-	-	-	-	1	-	-	1	2
Severe cyclonic storms	-	-	-	-	-	-	-	-	-	-	-	-	-
Very severe cyclonic storms	-	-	-	-	1	-	-	-	-	-	-	-	1
Extremely severe cyclonic storms	-	-	-	-	-	-	-	-	-	-	-	-	-
Super cyclonic storms	-	-	-	-	-	-	-	-	-	-	-	-	-
Land Depression													
Depressions/deep depressions	-	-	-	-	-	-	-	-	-	-	-	-	-
Over the Arabian Sea													
Depressions/deep Depressions	-	-	-	-	-	-	-	-	-	-	1	-	1
Cyclonic storms	-	-	-	-	-	-	-	-	-	-	-	-	-
Severe cyclonic storms	-	-	-	-	-	-	-	-	1	-	-	-	1
Very severe cyclonic storms	-	-	-	-	-	-	-	-	-	-	-	-	-
Extremely severe cyclonic storms	-	-	-	-	1	-	-	-	-	-	-	-	1
Super cyclonic storms	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand total (Nos.)	-	-	-	1	2	-	-	-	3	-	3	1	10

TABLE 3

Ships Observations during 1st January to 31st December, 2021

Call Sign	Date/ Time (UTC)	Position of the Ship		Wind		Pressure PPPP (hPa)
		Lat. (Deg. N)	Long. (Deg. E)	Dir. (Deg.)	Speed (kts)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) Extremely Severe Cyclonic Storm 'TAUKTE' over Arabian Sea (14-19 May)						
AUBC	151800	19.0	70.4	330	10	1005.8
WLMQ	152100	18.3	68.8	330	36	1000.3
WLMQ	160300	18.3	68.0	330	21	1002.7
WLMQ	161200	14.7	68.0	310	21	1000.3
AUFH	170000	14.6	71.9	220	40	-
AUFH	171200	16.2	70.6	220	29	999.5
AUBC	171800	20.4	67.5	070	06	1004.0
(B) Very Severe Cyclonic Storm 'YAAS' over eastcentral & adjoining southeast Arabian (23-28 May)						
D5MS9	230600	11.5	88.0	250	28	1004.5
(C) Cyclonic Storm 'GULAB' over Bay of Bengal (24-28 September)						
No ship data						
(D) Severe Cyclonic Storm 'SHAHEEN' over northeast Arabian Sea and adjoining Kutch (30 September - 4 October)						
No ship data						
(E) Cyclonic Storm 'JAWAD' over southeast Bay of Bengal (2 December - 5 December)						
No ship data						

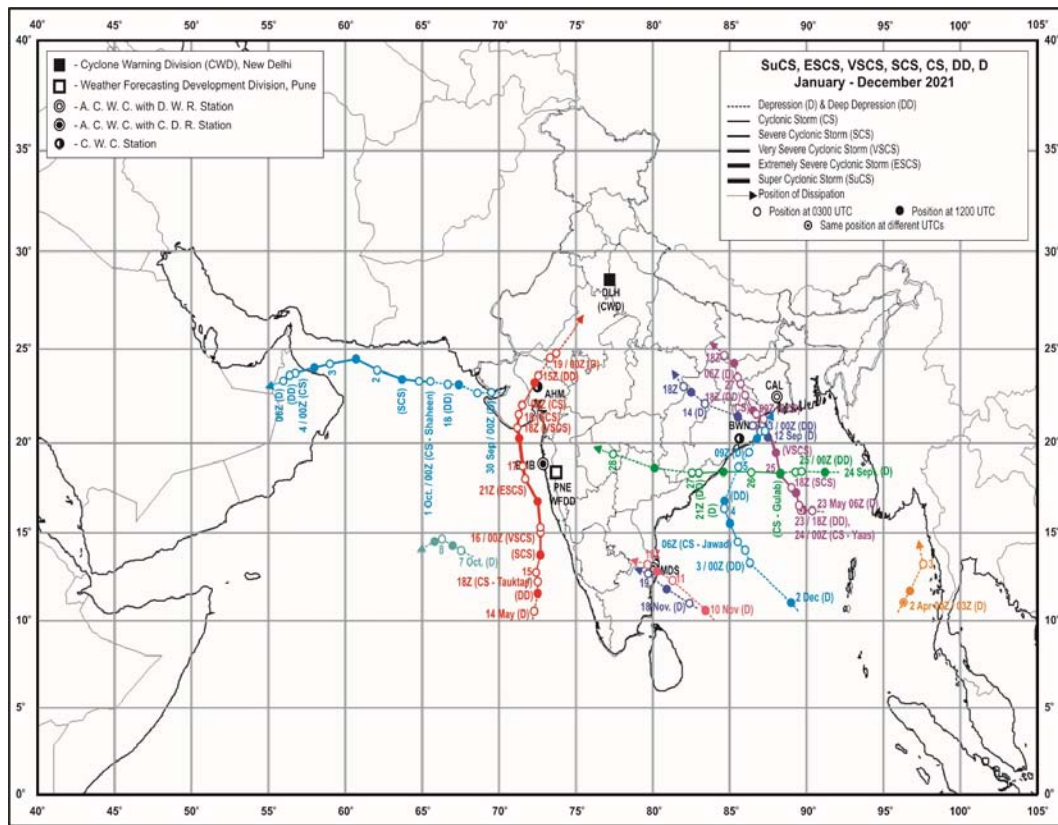


Fig. 1. Tracks of Storms and Depressions during the year 2021

adjoining southeast Arabian Sea 13th April evening which then moved east-northeastward and concentrated into a **Depression** and lay centred at 0830 hrs IST of the 14th May, 2021 over Lakshadweep area near Lat. 10.5° N / Long. 72.3° E, about 80 km south-southwest of AminiDivi. It moved north-northeastward and intensified into a **Deep Depression** and lay centred at 1430 hrs IST of the 14th May, 2021 over Lakshadweep area and adjoining southeast and eastcentral Arabian Sea near Lat. 11.5° N / Long. 72.5° E, about 50 km north-northwest of Amini Divi. It further moved north-northeastward and lay centred at 1730 hrs IST of the 14th May, 2021 over the same region near Lat. 11.6° N / Long. 72.6° E, about 55 km north-northwest of Amini Divi. It further intensified into a **Cyclonic Storm ‘TAUKTAE’ (pronounced as Tau’Te)** over Lakshadweep area and adjoining southeast and east central Arabian Sea at 2330 hrs IST of the 14th May, 2021. It moved north-northwestward and lay centred at 0830 hrs IST of the 15th May, 2021 over eastcentral and adjoining southeast Arabian Sea near Lat. 12.8° N / Long. 72.5° E, about 190 km north-northwest of Amini Divi. It moved nearly northward and lay centred at 1130 hrs IST of the 15th May, 2021 over eastcentral Arabian Sea near Lat. 13.2° N / Long. 72.5° E, about 290 km southwest of Panjim-Goa. It further moved nearly northward and

intensified into a **Severe Cyclonic Storm** and lay centred at 1730 hrs IST of the 15th May, 2021 over the same region near Lat. 13.8° N / Long. 72.7° E, about 220 km south-southwest of Panjim-Goa. It continued to move nearly northward and intensified into a **Very Severe Cyclonic Storm** and lay centred at 0230 hrs IST of the 16th May, 2021 over eastcentral Arabian Sea near Lat. 14.7° N / Long. 72.7° E, about 150 km southwest of Panjim-Goa. It further moved nearly northward and lay centred at 0830 hrs IST of the 16th May, 2021 over eastcentral Arabian Sea near Lat. 15.3° N / Long. 72.7° E, about 120 km west-southwest of Panjim-Goa. It moved north-northwestward and lay centred at 1430 hrs IST of the 16th May, 2021 over eastcentral Arabian Sea near Lat. 16.2° N / Long. 72.6° E, about 150 km west-northwest of Panjim-Goa. It continued to move north-northwestward and lay centred at 1730 hrs IST of the 16th May, 2021 over eastcentral Arabian Sea near Lat. 16.7° N / Long. 72.5° E, about 190 km northwest of Panjim-Goa. It further moved north-northwestward intensified into an **Extremely Severe Cyclonic Storm** and lay centred at 0530 hrs IST of the 17th May, 2021 over eastcentral Arabian Sea near Lat. 18.5° N / Long. 71.5° E, about 160 km west-southwest of Mumbai. It further moved north-northwestward and lay centred at 0830 hrs IST of the 17th May, 2021 over eastcentral Arabian Sea near

Lat. 18.8° N / Long. 71.5° E, about 150 km west of Mumbai. It continued to move north-northwestward and lay centred at 1430 hrs IST of the 17th May, 2021 over eastcentral and adjoining northeast Arabian Sea near Lat. 19.6° N / Long. 71.4° E, about 165 km west-northwest of Mumbai. It further moved north-northwestward and lay centred at 1730 hrs IST of the 17th May, 2021 over northeast and adjoining eastcentral Arabian Sea near Lat. 20.1° N / Long. 71.3° E, about 80 km south-southeast of Diu. It continued to move north-northwestward and lay centred at 2030 hrs IST of the 17th May, 2021 over northeast Arabian Sea near Lat. 20.5° N / Long. 71.2° E, about 35 km east-southeast of Diu. It moved north-northwestward and crossed Saurashtra coast close to 20 km northeast of Diu near Lat. 20.80° N / Long. 71.10° E during 2000-2300 hrs IST of 17th May. It weakened into a **Very Severe Cyclonic Storm** and lay centred at 2330 hrs IST of 17th May, 2021 over Saurashtra near Lat. 20.9° N / Long. 71.1° E, about 30 km north-northeast of Diu and moved north-northeastward which further weakened into a **Severe Cyclonic Storm** and lay centred at 0830 hrs. IST of the 18th May, 2021 over Saurashtra near Lat. 21.6° N / Long. 71.3° E, about 10 km east of Amreli. It moved north-northeastward and weakened into a **Cyclonic Storm** at 1130 hrs IST of 18th May, 2021 over Saurashtra and adjoining Gujarat region near Lat. 22.0° N / Long. 71.5° E. It lay centred at 1430 hrs IST of 18th May, 2021 over Saurashtra and adjoining Gujarat region near Lat. 22.5° N / Long. 71.8° E, about 35 km southwest of Surendranagar (Gujarat). It moved north-northeastward and lay centred at 1730 hrs IST of the 18th May, 2021 over Gujarat Region near Lat. 23.1° N / Long. 72.3° E, about 35 km west of Ahmedabad. It further moved north-northeastward and weakened into a **Deep Depression (remnant of the extremely severe Cyclonic Storm)** at 2030 hrs IST of the 18th May over Gujarat Region and lay centered near Lat. 23.6° N / Long. 72.6° E, about 60 km north-northeast of Ahmedabad. It further moved northeastward and weakened into a **Depression** and lay centred at 0530 hrs. IST of the 19th May 2021 near Lat. 24.3° N / Long. 73.3° E over south Rajasthan and adjoining Gujarat region, about 60 kms west-southwest of Udaipur (Rajasthan). It continued to move northeastward and lay centred at 0830 hrs IST of the 19th May, 2021 near Lat. 24.9° N / Long. 73.7° E over southeast Rajasthan and neighbourhood, about 30 km south-southwest of Udaipur (Rajasthan). It moved northeastward and lay centred at 1130 hrs IST of the 19th May, 2021 over east Rajasthan near Lat. 25.8° N / Long. 74.8° E about 150 km west-southwest of Jaipur (Rajasthan). It moved northeastward and weakened into a **Well Marked Low Pressure Area** and lay centred at 1730 hrs IST of the 19th May, 2021 over east Rajasthan and adjoining west Madhya Pradesh.

2.2.2 Other features observed

The peak maximum sustained surface wind of the cyclone was 180-190 kmph (100 knots) gusting to 210 kmph during 0530 hrs IST of 17th to 1130 hrs IST of 17th over the eastcentral Arabian Sea. The lowest estimated central pressure was 950 hPa during the period with a pressure drop of about 50 hPa at the centre as compared to surrounding. Thereafter, it entered marginally unfavourable environment, weakened gradually and crossed Saurashtra coast near Lat. 20.8° N / Long. 71.1° E, close to northeast of Diu (about 20 km northeast of Diu) during 2000-2300 hrs IST of 17th May, 2021 with the maximum sustained wind speed of 160-170 kmph gusting to 185 kmph. As the cyclone moved parallel to west coast, it caused heavy to extremely heavy rainfall activity, strong wind and tidal waves affecting Lakshadweep on 13-14, Kerala on 14-15, Karnataka on 15, Goa and south coastal Maharashtra on 15-16, north Maharashtra on 16-17, Gujarat, Daman & Diu, Dadra & Nagar Haveli on 17th and 18th. It's remnant also impacted northwest India with heavy to very heavy rainfall activity at isolated places over Rajasthan, Haryana, Chandigarh, Delhi, Uttar Pradesh, Uttarakhand on 19 May, 2021.

2.2.3. Realized weather

It caused heavy to extremely heavy rainfall activity, strong wind and tidal waves affecting Lakshadweep on 13-14, Kerala on 14-15, Karnataka on 15, Goa and south coastal Maharashtra on 15-16, north Maharashtra on 16-17, Gujarat, Daman & Diu, Dadra & Nagar Haveli on 17th and 18th. It's remnant also impacted northwest India with heavy rainfall at isolated places.

The chief amount of 24 hrs accumulated rainfall (≥7cm) ending at 0300 UTC of date during the life cycle of the system is presented below:

12 May, 2021

Lakshadweep : Agathi 8, Minicoy 1

13 May, 2021

Lakshadweep : Agathi 17, Amini 8, Minicoy 5

14 May, 2021

Kerala & Mahe : Mavelikara 15, Konni & Kayamkulam 14 each, Kayamkulam Agri 13, Neyyattinkara, Nedumangad & Kottayam 11 each, Kurudamannil & Varkala 10 each, Mancompu, Kozha, Vaikom, Haripad &

Kumarakam 9 each, Chalakudi & Aluva 8 each, Thritala, Kochi C.I.A.L. & Ernakulam South 7 each

Lakshadweep : Agathi 12

South interior : Balehonnur 7
Karnataka

15 May, 2021

Coastal : Mangaluru AP 8, Panambur & Karnataka Mangaluru 7 each

Kerala & Mahe : Kochi & Peermade 21 each, Kodungallur 20, Enamakkal 19, Ernakulam South 17, Kumarakam, Kannur, Kollam & Alapuzha 16 each, Chalakudi & Irinjalakuda 15 each, Ponnani, Pattambi & Vaikom 14 each, Cherthala, Kozhikode, Varkala, Mancompu & Thritala 13 each, Mavelikara, Aluva & Kayamkulam 12 each, Kurudamannil, Konni, Quilandi, Perumpavur, Taliparamba, Vellanikkara, Kochi C.I.A.L., Kottayam, Haripad, Vadakkancherry & Kozha 11 each, Kanjirappally, Munnar KSEB & Manjeri 10 each, Mahe, Perinthalmanna, Vadakara, Ottapalam, Punalur, Talassery & Hosdurg 9 each, Piravam, Nilambur, Angadipuram & Vytiri 8 each, Karipur, Thodupuzha, Kudulu & Neyyattinkara 7 each

Lakshadweep : Agathi 10, Amini 8

16 May, 2021

Konkan & Goa : Canacona & Pernem 7 each

Coastal : Kollur 24, Manki, Kota & Puttur Karnataka 19 each, Kundapur 17, Bhatkal 16, Udipi 15, Dharmasthala 14, Mani 13, Mulki 12, Karkala, Shirali, Mangaluru & Kadra 11 each, Panambur, Karwar & Mudubidre 10 each, Belthangadi, Honavar, Gokarna & Vitla ARG 9 each, Sulya & Siddapura 8 each

North interior : Vijayapura 8
Karnataka

South interior : Hosanagara 19, Bhagamandala 17, Karnataka Kalasa & Virajpet 13 each, Linganamakki 9, Thalaguppa & Sagar 7 each

Kerala & Mahe : Mahe 24, Vadakara 23, Vytiri 21, Taliparamba & Talassery 17 each, Quilandi 16, Ernakulam South & Kochi I.A.F. 14 each, Kochi C.I.A.L., Aluva, Manantoddy & Irikkur 13 each, Kannur 12, Piravam, Perumpavur & Enamakkal 11 each, Kudulu, Thodupuzha, Karipur, Munnar KSEB & Varkala 10 each, Kozha, Vaikom, Nilambur, Neyyattinkara & Idukki 9 each, Vadakkancherry, Nedumangad, Parambikulam, Irinjalakuda, Perinthalamanna, Pattambi, Angadipuram, Kozhikode, Ottapalam & Peerumade 8 each, Chalakudi, Ponnani, Thiruvananthapuram, Ambalavayal, Mannarkkad, Myladumpara Agri. & Thritala 7 each

17 May, 2021

Konkan & Goa : Sawantwadi 37, Ratnagiri 36, Dodamarg 25, Panjim 23, Malvan 21, Kudal & Devgad 20 each, Kankavli 19, Vengurla 18, Mapusa 17, Lanja 16, Dabolim-Navy & Vaibhavwadi 15 each, Sangameshwar Devrukh 14, Guhagarh & Margao 12 each, Dapoli Agri & Harnai 8 each, Sanguem 7

Coastal : Kadra 11, Honavar & Kollur Karnataka 7 each

18 May, 2021

Gujarat Region : Umergam 18, Daman 15, Daman FMO 13, Surat City 9, Khanvel & Valsad 8 each, Silvassa 7

Saurashtra & Kutch : Bagasra 21, Gir Gadhada 19, Una & Savarkundla 17 each, Palitana 16, Amreli, Mahuva, Rajula, Khambha & Babra 13 each, Gadhada 11, Visavadar 10, Diu & Umralla 9 each, Bhavnagar 8, Dhari & Jesar 7 each

Konkan & Goa : Palghar Agri 30, Dahanu 28, Santacruz & Devgad 23 each, Sawantwadi & Colaba 21 each, Talasari 17, Canacona, Tbia & Kankavli 9 each, Murud & Wada 8 each

19 May, 2021

Gujarat Region : Nadiad 23, Mahudha & Anand 16 each, Daman FMO, Umergam & Matar 15 each, Pardi & Daman 14 each, Khambhat, Kheda, Tarapur & Vaso 13 each, Olpad, Khergam & Mahemdavad 12 each, Dhansura, Ahmedabad City, Jalalpor, Sojitra, Kathalal & Prantij, Wanakbori, Borsad, Navsari, Kapadvanj, Virpur & Modasa 10 each, Balasinor, Dahegam, Bayad, Bardoli, Talod, Madhban, Valsad, Hansot, Vadodara, Vagra & Meghraj 9 each, Bhiloda, Himatanagar, Kamrej, Anklav, Silvassa & Padra 8 each, Palsana, Gandevi, Thasra, Galteshwar, Idar, Vapi, Poshina, Chikhli, Sanand, Vijapur, Khanpur, Kaprada, Kalol, Dascroi, Mahuva, Lunawada, Danta, Malpur & Petlad 7 each

Saurashtra & Kutch : Gir Gadhada 19, Una 18, Bhavnagar 11, Rajula 10, Botad & Shihor 9 each, Visavadar, Palitana & Vallabhipur 8 each, Umrala 7

East Rajasthan : Veja 23, Kanva, Devel & Dungarpur Tehsil 14 each, Dhambola & Sarara 13 each, Girva & Aspur 11 each, Gogunda & Ganeshpur 10 each, Ajmer Tehsil, Raimagra & Dungla 9 each, Sagwara, Jhadol & Udaipur/D Aer 8 each, Ajmer, Tatgarh, Salumber, Nithuwa, Bari-Sadri, Loharia, Dhariabad & Badesar 7 each

20 May, 2021

Uttarakhand : Nainital 12, Mussoorie 10, Mukteshwar 9, Haldwani 8

Haryana, Chandigarh & Delhi : Jhajjar 12, Gurgaon 11, Mewat, Faridabad & Narnaul 8 each

West Uttar Pradesh : Bareilly 15, Meerut 9, Aligarh & Muzzafarnagar 7 each

East Uttar Pradesh : Gorakhpur & Varanasi 8 each, Sultanpur, Mirzapur & Jaunpur 7 each

West Rajasthan : Nagaur 7

East Rajasthan : Dholpur 10, Alwar 9, Jaipur 8, Dausa & Sikar 7 each

2.3. Very Severe Cyclonic Storm 'YAAS' over eastcentral and adjoining southeast Arabian Sea (23-28 May, 2021)

2.3.1. Under the influence of the cyclonic circulation over southeast and adjoining central Bay of Bengal, a **Low Pressure Area** formed over eastcentral Bay of Bengal with the associated cyclonic circulation extending upto mid tropospheric levels on 22nd May. It then lay as a **Well Marked Low Pressure Area** over the same region on 22nd evening. It then persisted over the same region on 23rd May. It concentrated into a **Depression** over the same region and lay centred at 1130 hrs IST of 23rd May, 2021 near Lat. 16.1° N / Long. 90.2° E, about 560 km north-northwest of Port Blair (Andaman Islands). It moved west-northwestward and lay centred at 1730 hrs IST of 23rd May, 2021 near Lat. 16.2° N / Long. 89.9° E, about 590 km north-northwest of Port Blair (Andaman Islands). It moved west-northwestward and intensified further into a **Deep Depression** and lay centred at 2330 hrs IST of 23rd May, 2021 near Lat. 16.3° N / Long. 89.7° E, about 540 km south-southeast of Paradip (Odisha). It remained practically stationary during past 6 hours and intensified into a **Cyclonic Storm 'YAAS' (pronounced as 'Yass')** and lay centred at 0530 hrs IST of 24th May, 2021 near Lat. 16.3° N / Long. 89.7° E, about 540 km south-southeast of Paradip (Odisha). It moved northwestward and lay centred at 0830 hrs IST of 24th May, 2021 over eastcentral Bay of Bengal near Lat. 16.4° N / Long. 89.6° E, about 530 km south-southeast of Paradip (Odisha). It moved north-northwestward and lay centred at 1730 hrs IST of 24th May, 2021 over the same region near Lat. 17.1° N / Long. 89.3° E, about 450 km south-southeast of Paradip (Odisha). It moved northwestward and further intensified into a **Severe Cyclonic Storm** on 2330 hrs IST of 24th May near Lat. 17.6° N / Long. 89.0° E. It continued to move northwestward and lay centred at 0830 hrs IST of 25th May, 2021 over westcentral and adjoining eastcentral and north Bay of Bengal near Lat. 18.3° N / Long. 88.3° E, about 280 km south-southeast of Paradip (Odisha). It moved north-northwestward and lay centred at 1130 hrs

IST of 25th May, 2021 over northwest and adjoining westcentral Bay of Bengal near Lat. 18.7° N / Long. 88.0° E. It further moved north-northwestward and lay centred at 1430 hrs IST of 25th May, 2021 over northwest Bay of Bengal near Lat. 19.1° N / Long. 88.1° E, about 200 km southeast of Paradip (Odisha). It continued to move north-northwestward and intensified into a **Very Severe Cyclonic Storm** and lay centred at 1730 hrs IST of 25th May, 2021 over northwest Bay of Bengal near Lat. 19.5° N / Long. 88.0° E, about 160 km east-southeast of Paradip (Odisha). It further moved north-northwestward and lay centred at 0830 hrs IST of 26th May, 2021 over northwest Bay of Bengal close to north Odisha coast near Lat. 21.2° N / Long. 87.3° E, about 40 km south-southeast of Balasore (Odisha). It continued to move north-northwestward and crossed north Odisha coast around Lat. 21.35° N / Long. 86.95° E, about 20 km to the south of Balasore as a very severe Cyclonic Storm. It lay centred at 1130 hrs IST of 26th May, 2021 over north coastal Odisha, near Lat. 21.4° N / Long. 86.9° E, about 15 km south-southwest of Balasore (Odisha). It further moved north-northwestward and weakened into a **Severe Cyclonic Storm** and lay centred at 1430 hrs IST of 26th May, 2021 over northeast Odisha, near Lat. 21.6° N / Long. 86.7° E, about 25 km west-northwest of Balasore (Odisha). It moved northwestward and further weakened into a **Cyclonic Storm** and lay centred at 1730 hrs IST of 26th May, 2021 over north Odisha, near Lat. 21.8° N / Long. 86.5° E, about 30 km west-southwest of Baripada (Odisha) which moved northwestward and weakened into a **Deep Depression** at 2330 hrs IST of 26th May, 2021 and lay centred at 0530 hrs IST of 27th May, 2021 over south Jharkhand and neighbourhood, near Lat. 22.7° N / Long. 85.5° E, about 70 km west-southwest of Jamshedpur. It moved nearly northward and lay centred at 0830 hrs IST of 27th May, 2021 over the same region, near Lat. 22.9° N / Long. 85.5° E, about 65 km southeast of Ranchi (Jharkhand). It moved nearly northward and further weakened into a **Depression** and lay centred at 1130 hrs IST of 27th May, 2021 over central parts of Jharkhand, near Lat. 23.2° N / Long. 85.5° E, about and 20 km east of Ranchi (Jharkhand). It further moved nearly northward and lay centred at 1730 hrs IST of 27th May, 2021 over Jharkhand and adjoining Bihar near Lat. 24.3° N / Long. 85.2° E, about 100 km north of Ranchi (Jharkhand). It moved northwestward and lay centred at 2330 hrs IST of 27th May, 2021 over south Bihar and adjoining Jharkhand near Lat. 24.7° N / Long. 84.8° E, close to west of Gaya and 110 km south-southwest of Patna. It moved north-northwestward and weakened into a **Well Marked Low Pressure Area** and lay centred at 0530 hrs IST of 28th May, 2021 over Bihar and adjoining east Uttar Pradesh. It then lay over eastern parts of east Uttar Pradesh and adjoining Bihar with the associated cyclonic circulation extended upto 7.6 km above m.s.l.

2.3.2. Other features observed

The peak maximum sustained surface wind of the cyclone was 130-140 kmph gusting to 155 kmph (75 kt gusting to 85 kt) during 0230 IST of 26th to 1130 IST of 26th over the northwest Bay of Bengal. The lowest estimated central pressure was 970 hPa during the period with a pressure drop of 28 hPa at the centre compared to surroundings. The system crossed north Odisha coast near latitude 21.35° N and longitude 86.95° E, about 20 km to the south of Balasore as a Very Severe Cyclonic Storm with maximum sustained wind speed (MSW) of 75 kts gusting to 85 kts (130-140 kmph gusting to 155 kmph) between 1030-1130 IST (0500-0600 UTC) of 26th.

2.3.3. Realized Weather

As the cyclone crossed the coast on the full moon day, there was combined impact of astronomical tide and storm surge leading to higher tidal wave. The astronomical tidal wave over Bhadrak, Balasore, Purba Medinipur and 24 Pargana districts on this day ranged from 3 to 5 meters. In addition the extremely heavy rainfall over north coastal Odisha districts helped in enhanced inundation of coastal areas.

Initially in its formative stage, it caused heavy to very heavy rainfall and squally winds and tidal waves over Andaman & Nicobar Islands on 23rd and 24th May. It caused heavy to extremely heavy rainfall activity at isolated places over coastal Odisha on 25th May and heavy to very heavy rainfall at a few places and extremely heavy rains at isolated places on 26th May over north Odisha. It caused heavy to very heavy rainfall activity at isolated places over Gangetic West Bengal on 26th May and heavy to extremely heavy rainfall over Sub Himalayan West Bengal on 27th. It also caused heavy to extremely heavy rainfall over Jharkhand on 26th and 27th, over Bihar and east Uttar Pradesh on 27th and 28th May. As the system developed in the advance phase of monsoon, it had sufficient moisture and caused higher rainfall with heavy to extremely heavy rainfall activity over north Odisha, Jharkhand, West Bengal, Bihar and east Uttar Pradesh.

The chief amount of 24 hrs accumulated rainfall (≥7cm) ending at 0830 hrs IST of date during the life cycle of the system is presented below.

23 May, 2021

Andaman & Nicobar Islands : Long Island 10, Maya Bandar 9

24 May, 2021

Andaman & Nicobar Islands : Port Blair 7

25 May, 2021

Andaman & Nicobar Islands : Hut Bay 11, Carnicobar 8

Gangetic West Bengal : Contai 9

26 May, 2021

Odisha : Chandbali 29, Rajkanika & Garadapur 25 each, Marsaghai & Kujanga 23 each, Nawana & Tirtol 21 each, Paradip 20, Pattamundai, Balikuda & Derabis 19 each, Astaranga 18, Bhadrak 17, Kendrapara, Dhamnagar & Soro 16 each, Jagatsinghpur 15, Tihidi, Bari & Alipingal 14 each, Jajpur, Nilgiri, Akhuapada & Basudevpur 13 each, Chandikhol & Bonth 12 each, Korei & Kakatpur 11 each, Danagadi 10, Jenapur, Nischintakoili & Bhograi 9 each, Niali, Anandpur & Kaptipada 8 each, Joshipur, Jaleswar, Salepur, Mahanga, Chandanpur, Rairangpur, NH5 Gobindpur, Balimundali, Betanati, Balasore & Jhumpura 7 each

27 May, 2021

Odisha : Nawana 28, Joda 27, Joshipur 25, Lathikata & Jhumpura 21 each, Champua, Keonjhar & Panposh 20 each, Basudevpur 19, Chandikhol & Karanjia 17 each, Rajgangpur & Mandira Dam each, Swam-Patna & Deogarh 13 each, Tiring 12, Udala, Gurundia, Barkote, Hatadihi, Tihidi & Pallahara 11 each, Ghatagaon, Lahunipara, Sharpada, Soro & Bamra 10 each, Binjharpur, Laikera, Jajpur, Kirmira & Talcher 9 each, Sukinda & Kuchinda 8 each, Telkoi, Kaptipada, Deogaon, Jenapur, Rairangpur, Bargaon, Kankadahad, Kolabira, Danagadi, Pattamundai & Bhadrak 7 each

Jharkhand : Chaibasa 21, Mandar 18, Ranchi 15, Chakradharpur 13, Torpa 12, Kuru, Jamshedpur & Kharsema 11

each, 10 Nimdih, Ramgarh & Jamshedpur 9 each, Chandil, Chatra, Manatu, Hariharganj & Hendigir 8 each, Shilaichak, Koner & Chandrapura 7 each

Gangetic West Bengal : Diamond Harbour & Phulberia 11 each, Kharidwar 9, Labpur, Purihansa & Kalyani SMO 8 each, Uluberia, Mangalkote & Kangsabati Dam 7 each

Sub Himalayan West Bengal & Sikkim : Rongli, Damthang, Darjeeling & Gyalsing 9 each, Pedong & Pakyong 8 each, Sankalan, Mangan, Singhik & Khanitar 7 each

Bihar : Sherghati 7

Uttar Pradesh : Light to moderate rainfall occurred at many places over East Uttar Pradesh

28 May, 2021

Sub Himalayan West Bengal & Sikkim : Malda 31, Sukiapokhri & Darjeeling 11 each, Damthang & Gyalsing 8 each

Gangetic West Bengal : Debagram 13, Barrackpur 12, Amtala & Durgachack 10 each, Dum Dum & Alipore 9 each, MO Salt Lake, Diamond Harbour, Kalyani SMO, Bagati & Nalhati 7 each

Jharkhand : Rajmahal 23, Koner & Tilaiya 11 each, Koderma & Hariharganj 10 each, Hazaribagh 9, Tenughat 7

Bihar : Manihari 25, Kadwa 24, Barari 23, Purnea 21, Parsa & Katihar North 18 each, Amaur 16, Banmankhi, Arwal & Sheikhpura 15 each, Vaishali, Rupauli, Saraiya & Murliganj 14 each, Siswan, Umarkhand, Ghosi, Chapra, Madhipura & Jamui 13 each, Hisua, Koilwar, Gaya Aero, Mahua, Harnaut & Islampur 12 each, Ekangersarai, Narhat, Lakhisarai, Singheshwar, Bodh Gaya, Maharajganj, Sandesh, Sherghati & Nawada 11 each,

Kursela, Pachrukhi, Balrampur, Marhaura/Amnaur, Chand, Barh, Udai Kishanganj & Rajgir 10 each, Halsi, Patahi, Jandhaha, Barahara, Patna Aerodrome, Bihta, Jalalpur, Barauni, Matihani, Morwa / Tajpur, Saurbazar, Dinara, Charpokhari & Goraul / Doli 9 each, Kako, Hathwa, Barhiya, Narpatganj, Colgaon & Bihar Shrif 8 each, Hussainganj, Barauli, Tekari, Khagadia, Simrii, Bikram, Adhwara, Rajauli, Makhdumpur, Mushari, Bhore, Motihari, Tarari, Suryagadha, Jahanabad, Supaul, Marsrakh, Chandan, Bagaha, Araria & Sangrampur 7 each

East Uttar Pradesh : Chanderdeepghat 13, Gaighat 10, Ballia & Ayodhya 7 each

29 May, 2021

Bihar : Tribeni / Balmikinagar 21, Darbhanga 18, Bagaha & Basua 17 each, Balrampur & Kadwa 16 each, Hayaghat 15, Gaunaha, Mushari & Kodawanpur 13 each, Ramnagar, Goraul / Doli, Rosera & Muzaffarpur 12 each, Jaley & Barh 11 each, Saraiya, Baigania & Sonbarsa 10 each, Matihani, Minapur, Jhanjharpur, Kishanganj, Jandhaha, Sheikhpura, Tarapur, Madhwapur, Bahadurganj, Supaul, Saurbazar, Jainagar & Umarkhand 9 each, Purnea, Belsand, Morwa / Tajpur, Dhengbridge, Samastipur, Madhipura, Thakurganj, Sangrampur, Nirmali & Barauni 8 each, Harnaut, Cheria B. Pur, Parbatta, Aryari, Vaishali, Patahi, Siswan, Barbigha & Nauihatta 7 each

East Uttar Pradesh : Bansi Tehsil 21, Nichloul 19, Nautanwa 17, Trimohanighat & Maharajganj 15 each, Kakrahi & Pharenda 14 each, Chanderdeepghat & Balrampur THE 11 each, Balrampur 10, Bansi, Tulsipur, Uska Bazar 9 each, Gorakhpur 8 and Shoharatgarh, Domeriaganj, Ramnagar & Birdghat 7 each

2.4. Deep depression over northwest Bay of Bengal (12-15 September, 2021)

2.4.1. Under the influence of the cyclonic circulation over eastcentral Bay of Bengal and neighbourhood, a **Low Pressure Area** formed over eastcentral and adjoining northeast Bay of Bengal with associated cyclonic circulation extended upto 7.6 km above m.s.l. tilting southward with height on 11th September morning. It then persisted over the same region. It then lay over central and adjoining north Bay of Bengal 11th September evening. It lay as a **Well Marked Low Pressure Area** over northwest and adjoining westcentral Bay of Bengal 12th September morning. It then persisted over the same region. It lay over northwest and adjoining westcentral Bay of Bengal off Odisha coast at 1430 hrs IST of 12th September. It further concentrated into a **Depression** over northwest Bay of Bengal and adjoining Odisha coast and lay centred at 1730 hrs IST of the 12th September, 2021, near Lat. 20.3° N / Long. 87.4° E about 70 km east of Paradip (Odisha) which moved west-northwestward and intensified into a **Deep Depression** and lay centred at 0530 hrs IST of the 13th September, 2021, over northwest Bay of Bengal, very close to north Odisha coast, near Lat. 20.5° N / Long. 86.9° E, close to southeast of Chandbali (Odisha). It further moved west-northwestward and crossed north Odisha coast, close to south of Chandbali between 0530 and 0630 hrs IST as a Deep Depression with maximum sustained wind speed of 30 knots and lay centred at 0630 hrs IST over north coastal Odisha, very close to Chandbali. It moved further west-northwestward and lay centred at 0830 hrs IST of 13th September, 2021, over north coastal Odisha, near Lat. 20.9° N / Long. 86.5° E, about 20 km west-northwest of Chandbali. It moved further west-northwestward and lay centred at 1430 hrs IST of 13th September, 2021, over north interior Odisha, near Lat. 21.4° N / Long. 86.0° E, about 50 km east-southeast of Keonjhar (Odisha) and continued to move west-northwestward and lay centred at 1730 hrs IST of 13th September, 2021, over north interior Odisha, near Lat. 21.4° N / Long. 85.5° E, close to Keonjhar (Odisha). It moved further west-northwestward and lay centred at 0530 hrs IST of 14th September, 2021, over north interior Odisha and adjoining north Chhattisgarh, near Lat. 22.0° N / Long. 83.6° E. It moved further west-northwestward and weakened into a **Depression** and lay centred at 0830 hrs IST of 14th September, 2021, over north Chhattisgarh and adjoining north interior Odisha, near Lat. 22.1° N / Long. 83.4° E, about 80 km west-northwest of Jharsuguda (Odisha). It continued to move west-northwestward and lay centred at 1130 hrs IST of 14th September, 2021, over north Chhattisgarh and neighbourhood, near Lat. 22.4° N / Long. 83.0° E. It moved further west-northwestward and lay centred at 1730 hrs IST of 14th September, 2021, over

north Chhattisgarh & adjoining east Madhya Pradesh, near Lat. 22.7° N / Long. 82.5° E, about 90 km south-southwest of Ambikapur (Chhattisgarh). It continued to move west-northwestward and weakened into a **Well Marked Low Pressure Area** over northeast Madhya Pradesh and neighbourhood at 0530 hrs IST of 15th September 2021. It then lay over central parts of north Madhya Pradesh and neighbourhood with the associated cyclonic circulation extended upto 5.8 km above m.s.l.

2.4.2. *Other features observed*

Moving west-northwestwards, it intensified into a deep depression over northwest Bay of Bengal very close to Odisha coast in the early morning (0000 UTC/0530 hrs IST) of 13th and crossed the north Odisha coast, close to south of Chandbali between 0530 & 0630 hrs IST (0000 & 0100 UTC) as a deep depression with maximum sustained surface wind speed of 30 knots (50-60 kmph).

2.4.3. *Realized weather*

Under the influence of deep depression, active to vigorous monsoon conditions prevailed leading to extremely heavy rainfall at a few places over Odisha on 12th & 13th, at isolated places over Chhattisgarh on 13th and over East Madhya Pradesh on 14th. In conjunction with another low pressure area over Gujarat, extremely heavy rainfall at a few places also occurred over Saurashtra and north Konkan on 13th September. Low level convergence of wind & enhanced moisture incursion from the Bay of Bengal in association with a trough extending eastwards across the system also caused extremely heavy rains at isolated places over West Bengal on 14th September.

The chief amount of 24 hrs accumulated rainfall (≥7cm) ending at 0830 hrs IST of date during the life cycle of the system is presented below.

12 September, 2021

Odisha : Paradeep 13, Jagatsinghpur, Tentulikhunti & Balikuda 10 each, Kujanga & Tihidi 9 each, Bari, Rajkishorenagar & Derabis 8 each, Cuttack, Rajgangpur, Kalampur, Lahunipara, Alipingal, Rajkanika & Marsaghai 7 each

13 September, 2021

Odisha : Astaranga & Kakatpur 53 each, Balikuda 44, Kantapada 38, Niali 37, Puri 34, Gop & Satyabadi 33 each, Ragunathpur 32, Balipatna &

Kendrapada 28 each, Marshaghai & Kujanga 27 each, Jagatsinghpur & Pipili 26 each, Tirtol 25, Brahmagiri 24, Paradeep & Chandikhol 22 each, Derabis 21, Tangi, Birmaharajpur & Bhubaneswar 20 each, Boudhgarh & Krishnaprasad 18 each, Garadpur 17, Nayagarh, Ullunda, Harabhangha, Phulbani, Binjharpur, Bolagarah, Mahanga & Sonapur 15 each, Salipur & Banpur 14 each, Odagaon, Bari & Ranpur 13 each, Jajpur, Banki & Cuttack 12 each, Dashpalla & Rairakhol 11 each, Lakhanpur 10

14 September, 2021

Odisha : Talcher 39, Birmaharajpur 37, Tikarpara 35, Sonapur 28, Boudhgarh 26, Patnagarh & Banarpal 25 each, Bolangir, Hindol & Paikmal 24 each, Kantamal & Parjang 23 each, Barmul & Belpada 22 each, Bari, Jenapur, Phiringia, Gaisilet & Mahanga 21 each, Angul, Nawapara, Kamakhyanagar, Tarva & Athmalik 20 each, Altuma, Harabhangha, Banki, Gania & Narsinghpur 19 each, Rajkishorenagar, Phulbani, Kankadahad & Agalpur 18 each, Jharbandh, Binjharpur, Bhuban & Dhenkanal 17 each, Daitari, Athgarh, Khairamal, Rajghat, Chandikhol, Khaprakhol, Padampur 16 each, Ullunda & Salebhatta 15 each, Sukinda, Danagadi & Tikabali 14 each, Balasore, Telkoi, Komna, Tigiria, Salepur & Naraj 13 each, Dunguripalli, Daspalla & Cuttack 12 each, Jaleswar, Korei, Loisingha, Jajpur & Rairakhol 11 each, Rengali, Turekela & Sainatala 10 each, Barpalli, Madanpur Rampur, Jagannath Prasad, Karlamunda, Harichandanpur, Burla, Baliguda, Chendipada, Kaniha, Atabira, K Nuagaon & Kotagarh 9 each, Chandbali, Bhadrak, Akhuapada, Nh5 Gobindpur, Kalinga, Pallahara,

Kujanga, Rajkanika, Raikia, G Udayagiri, Bargarh, Similiguda, Daringibadi, Bonth, Batli, Mundali, Dhamnagar & Jujumura 8 each, Bhograi, Nawana, Anandpur, Belaguntha, Khandapara, Bijepur, Niali, Kaptipada, Narla, Bhanjnagar, Nischintakoili, Belgaon & Betanati 7 each

Gujarat Region : Kaprada 19, Dharampur 17, Waghai 14, Valsad 13, Valsad kvkaws 12, Dholera, Umergam & Dangs 11 each, Vansda 10, Quant, Uchchhal & Khergam 9 each, Surat City, Subir, Daman & Chhota Udepur 8 each, Mangrol, Pardi & Surat 7 each

Saurashtra & Kutch : Lodhika 52, Visavadar 47, Kalavad 41, Dhoraji 25, 24 Targhadia, Junagadh & Kotdasangani 21 each, Rajkot, Junagarh & Keshod 20 each, Gondal & Jamkandorna 19 each, Paddhari 18, Ranavav 16, Talala & Mendarda 15 each, Porbandar 14, Malia 13, Vanthali, Jamnagar, Jamjodhpur & Upleta 12 each, Dhrol, Manavadar, Vadia & Bhesan 11 each, Lalpur, Kutiana, Bhanvad & Kalyanpur 10 each, Jetpur, Tankara & Jamnagarkvkaws 9 each, Una, Veraval & Diu 8 each, Gir Gadhada & Dwarka 7 each

Chhattisgarh : Gariabund 20, Basana 19, Magarlod, Bagbahara & Chhura 14 each, Kurud 13, Rajim, Mahasamund & Saraipali 11 each, Raipur & Labhandih 10 each, Patan 9, Arang, Mana Raipur, Kartala & Abhanpur 8 each, Sakti, Bilaigarh, Saja & Gandai 7 each

15 September, 2021

Gangetic West Bengal : Kharagpur 28, Midnapore 28, Kalaikunda & Mohanpur 27 each, Midnapore 26, Uluberia AWS 20, Contai & Diamond Harbour 18 each, Durgachack 17, Dum Dum 16, MO Salt Lake 14, Barrackpur 13, Lalgarh & Burdwan 12 each,

Jhargram 11, Alipore & AMFU Kakdwip 10 each, Harinkhola, Canning & Digha 9 each, Bagati 8, Kalyani 7

Chhattisgarh : Pendra Road 18, Dhamtari 15, Marwahi 13, Gurur 12, Dondilohara & Mainpat 11 each, Pendra, Jashpurnagar & Mungeli 10 each, Balod, Dongargaon, Lakhanpur & Kota 9 each, Gariabund, Gundardehi, Mohla, Chhuikhadan, Surajpur, Katghora & Bemetera 8 each, Duldula, Batoli, Khairagarh, Ambagarh Chowki, Rajpur, Pusaur, Gandai, Baloda Bazar, Sarangarh & Manora 7 each

West Madhya Pradesh : Khirkiya 11, Budhni & Bhimpur 7 each

East Madhya Pradesh : Amarkantak 24, Lanji 13, Balaghat 10, Karanjia 9, Kotma 8, Channodi & Lalburra 7 each

Odisha : Chandanpur 15, Ghatagaon 13, Bhograi & Sundargarh 12 each, Kakatpur 11, Deogaon & Banaigarh 10 each, Lathikata & Bangiriposi 9 each, Jamsolaghat, Gurundia, Lahunipara & Jharsuguda 8 each, Gunupur & Jaleswar 7 each

Gujarat Region : Mangrol 16 and Mahuva & Chhota Udepur 7 each

Saurashtra & Kutch : Mangrol (J) 16, Vanthali & Junagadh 10 each, Malia, Jamkandorna & Jamjodhpur 9 each, Rajula, Anjar & Bhanvad 7 each

Vidarbha : Gondia 7

2.5 Cyclonic Storm 'GULAB' over Bay of Bengal (24-28 September, 2021)

2.5.1. Under the influence of cyclonic circulation over eastcentral Bay of Bengal and neighbourhood, a **Low Pressure Area** formed over eastcentral Bay of Bengal and neighborhood on 24th September. It lay as a **Well Marked Low Pressure Area** over eastcentral and adjoining northeast Bay of Bengal with the associated cyclonic

circulation extended upto mid tropospheric levels tilting southwestward with height 24th September afternoon. It concentrated into a **Depression** and lay centered at 1730 hrs IST of 24th September, 2021, over eastcentral and adjoining northeast Bay of Bengal near Lat. 18.3° N / Long. 91.2° E, about 670 km above m.s.l. east-southeast of Gopalpur (Odisha). It further moved westward and intensified into a **Deep Depression** and lay centered at 0530 hrs IST of 25th September, 2021, over north and adjoining eastcentral Bay of Bengal near Lat. 18.4° N / Long. 89.7° E, about 510 km east-southeast of Gopalpur (Odisha). It moved westward and lay centered at 0830 hrs IST of 25th September, 2021, over northwest and adjoining westcentral Bay of Bengal near Lat. 18.4° N / Long. 89.3° E, about 470 km east-southeast of Gopalpur (Odisha). It moved nearly westward and intensified into **Cyclonic Storm 'GULAB' (pronounced as Gul-Aab)** and lay centered at 1730 hrs IST of 25th September, 2021, over northwest and adjoining westcentral Bay of Bengal near Lat. 18.3° N / Long. 88.3° E, about 370 km east-southeast of Gopalpur (Odisha). It continued to move nearly westward and it lay centered at 0830 hrs IST of 26th September, 2021, over northwest and adjoining westcentral Bay of Bengal near Lat. 18.4° N / Long. 86.4° E, about 180 km east-southeast of Gopalpur (Odisha). It further moved nearly westward and lay centered at 1430 hrs IST of 26th September, 2021, over northwest and adjoining westcentral Bay of Bengal near Lat. 18.4° N / Long. 85.3° E, about 110 km east-southeast of Gopalpur (Odisha). It moved nearly westward and lay centered at 1730 hrs IST of 26th September, 2021, over northwest and adjoining westcentral Bay of Bengal near Lat. 18.4° N / Long. 84.6° E, about 50 km east-northeast of Kalingapatnam (Andhra Pradesh). It weakened into a **Deep Depression** over north Andhra Pradesh and adjoining south Odisha at 0230 hrs IST of 27th September, 2021. It further moved westward and lay centered at 0830 hrs IST 27th September, 2021 over south Odisha and adjoining south Chhattisgarh near Lat. 18.4° N / Long. 82.5° E, about 65 km east-northeast of Malkangiri (Odisha) which moved west-northwestward and further weakened into a **Depression** and lay centered at 1730 hrs IST of 27th September, 2021 over north Telangana and adjoining south Chhattisgarh and Vidarbha near Lat. 18.6° N / Long. 80.1° E, about 65 km east-southeast of Ramagundam (Telangana). It further moved west-northwestward and lay centered at 2330 hrs IST of 27th September, 2021 over north Telangana and adjoining Vidarbha near Lat. 18.7° N / Long. 79.4° E, about 135 km east of Nizamabad (Telangana). It moved west-northwestward and lay centered at 0530 hrs IST of 28th September, 2021 over Telangana and adjoining areas of Marathwada and Vidarbha near Lat. 18.9° N / Long. 78.0° E, about 25 km northwest of Nizamabad (Telangana). It moved west-northwestward and lay

centered at 0830 hrs IST of 28th September, 2021 over southwest Vidarbha and neighbourhood near Lat. 19.4° N / Long. 77.3° E, about 60 km east-northeast of Parbhani (Marathwada). It moved west-northwestward and weakened into a **Well Marked Low Pressure Area** at 1130 hrs IST of 28th September over western parts of Vidarbha and neighbourhood which lay over northwest Vidarbha at 1730 hrs IST of 28th September. It lay over north Madhya Maharashtra and adjoining Gujarat region and southwest Madhya Pradesh in the morning of 29th September and then lay over south Gujarat region and adjoining Gulf of Khambhat with the associated cyclonic circulation extended upto mid-tropospheric levels at 0830 hrs IST of 29th September.

2.5.2. Other features observed

The cyclonic storm intensified gradually and reached its peak intensity of 75-85 kmph gusting to 95 kmph around noon (1130 hours IST/0600 UTC) of 26th September. Continuing to move further westwards, it crossed North Andhra Pradesh and adjoining south Odisha coasts near Lat. 18.4°N / Long. 84.2°E (20 km north of Kalingapatnam) with maximum sustained surface wind speed of 75-85 gusting to 95 kmph during 1930-2030 IST of 26th September.

2.5.3. Realized weather

When the system was in developing stage, it caused heavy rainfall at a few places over eastcentral Bay of Bengal and eastcentral & adjoining northeast Bay of Bengal respectively. The region of heavy to very heavy rainfall gradually moved westwards towards westcentral Bay of Bengal during 24th & 25th. On 26th, it caused heavy to extremely heavy rainfall at a few places over north coastal Andhra Pradesh & adjoining south Odisha coasts. On 27th, the system caused heavy to very heavy rainfall over central parts of India extending from coastal Andhra Pradesh, Telangana, Madhya Pradesh, Marathwada, Gujarat region. On 28th, Gujarat-Saurashtra region witnessed heavy to very heavy falls with extremely heavy rainfall at isolated places.

The chief amount of 24 hrs accumulated rainfall (≥7cm) ending at 0830 hrs IST of date during the life cycle of the system is presented below.

26 September, 2021

Odisha : Khariar 7

Coastal Andhra : Avaniigada 14, Bapatla 7
Pradesh &
Yanam

Telangana : Golkonda & Sangareddy 10 each,
Domakonda & Chandur 8 each

Tamil Nadu, : Marakkanam 13, Neyveli 8,
Puducherry & Kurinjipadi & Cuddalore 7 each
Karaikal

27 September, 2021

Coastal Andhra : Visakhapatnam, Gajapathinagaram
Pradesh & & Nellimarla 28 each, Mentada 25,
Yanam Pusapatirega 24, Garividi,
Denkada & Gantyada 19 each,
Anakapalle & Salur 18 each,
Bondapalle 17, Cheepurupalle 16,
Ranastalam & Therlam 15 each,
Chodavaram 14, Vizianagaram,
Vepada, Bheemunipatnam &
Kalingapatnam 13 each, Bobbili,
Araku Valley & Amalapuram 12
each, Kakinada, Merakamudidam
& Vijayawada 11 each, Polavaram,
Palakoderu, Chintalapudi &
Koyyalagudem 10 each,
Chintapalle, Srungavarapukota,
Palakonda, Tadepalligudem,
Narsipatnam, Yanam, Bhimadole,
Tanuku & Yelamanchili 9 each,
Palasa, Nuzvid, Seethanagaram &
Parvathipuram 8 each,
Vararamachandrapur, Paderu,
Balajipeta, Chintur, Eluru,
Mandasa, Garugubilli, Tekkali,
Kaikalur & Velairpad 7 each

Odisha : Pottangi 15, Mahendragarh 9,
Mohana & Nandapur 8 each,
Lamataput, Semiliguda & R.
Udayagiri 7 each.

28 September, 2021

Odisha : Cuttack 13, Gajapati 8, Jajpur 7

Chhattisgarh : Dantewada 18

Coastal Andhra : Vishakhapatnam & West Godavari
Pradesh & 13 each, Krishna & Vijaywada 8
Yanam each

Telangana : Jakranpalle 23, Navipet 21, Dhar
Palle 21, Ranjal, Dich Palle &
Armur 18 each, Nandipet,
Chandurthi & Sirsilla 17 each,
Jammikunta & Bheemgal 16 each,
Yeda Palle, Makloor,

Ellanthukunta, Jukkal,
Sarangapur & Velpur 15 each,
Nizamabad, Bodhan, Nirmal,
Shriramsag pocha & Dilawarpur
14 each, Mudhole, Mogullapalle,
Mallapur, Balkonda &
Laxmanchanda 13 each,
Srirampur, Nizam Sagar &
Domakonda 12 each, Mortad,
Venkatapur, Gundala, Elagaid,
Tadwai Mlg & Peddapalle 11 each,
Kusumanchi, Naga Reddipet,
Konaraopeta, Kammar Palle,
Metpalle, Madhira, Manthani,
Machareddy & Bhiknur 10 each,
Sultanabad, Parkal, Kamareddy,
Burgampadu, Pinapaka, Chegunta,
Khanpur, Gambhiraopet,
Thimmapur, Banswada, Madnur,
Mulug, Boath, Ibrahimpatnam &
Julapalle 9 each, Mustabad,
Shadnagar, Choppadandi,
Shayampet, Shamirpet,
Papannapet, Karimnagar, Pitlam,
Tupran, Govindaraopet,
Dharmaram, Aswapuram &
Dummugudem 8 each,
Yellareddypeta, Varni, Hakimpet,
Kotgiri, Ramgundam, Bhupalpalle,
Manuguru, Karimnagar,
Venkatapuram, Manchal, Tekmal,
Chigurumamidy, Lingampet,
Birkoor, Bomraspeta,
Ramayampet, Kothaguda,
Bejjanki, Narayankhed, Tadwai,
Kondurg, Bhadrachalam, Medak &
Sadasivanagar 7 each

Marathwada : Nanded 15, Aurangabad 13, Beed
11, Osmanabad & Latur 10 each,
Jalna 8, Hingoli & Parbhani 7 each

Vidarbha : Chandrapur 10, Buldana 9

Madhya : Jalgaon 11, Kolhapur 7
Maharashtra

West Madhya : Dewas 7
Pradesh

Gujarat Region : Mehsana 9

Saurashtra & : Amreli 12, Gir Somnath 8,
Kutch Jamnagar, Junagarh, Morbi &
Porbandar 7 each

29 September, 2021

Gujarat Region : Khanvel 37, Silvassa & Umerpada 22 each, Palsana 19, Bharuch 18, Maktampur & Madhbun 17 each, Dang, Nanipalson & Garudeshwar 16 each, Kaprada, Dholera, Tilakwada & Dediapada 15 each, Khambhat & Nizer 14 each, Hansot, Narmadakvk & Dangkvk 13 each, Waghai 12, Rajpipala, Kukarmunda, Uchchhal & Dholka 11 each, Subir, Dhandhuka, Choryasi, Nandod, Ukai, Valsad & Naswadi 10 each, Vagra, Surat City, Gandevi, Valia, Ankleshwer, Vansda, Sagbara, Kamrej, Surat, Khergam, Tarapur, Borsad & Pardi 9 each, Vadodara, Songadh, Daman, Netrang & Jhagadia 8 each, Navasari, Vapi, Dharampur, Sojitra, Mahuva, Nadiad, Bardoli, Karjan, Arnej, Dabhoi, Umergam & Valod 7 each

Saurashtra & Kutch : Jamnagar 14, Targhadia 11, Lodhika, Gondal & Barvala 10 each, Rajkot, Kotdasangani & Botad 9 each, Chuda, Junagadh & Babra 8 each, Chotila, Jamkandorna, Vadia, Chotila, Jetpur & Dhoraji 7 each

Madhya Maharashtra : Shahada 18, Harsul 15, Akkalkuwa & Shirampur 14 each, Peth 13, Surgana, Taloda & Jamner 12 each, Nandurbar, Igatpuri & Yeola 11 each, Ozarkheda 10, Dhadgaon / Akrani, Trimbakshwar & Lonavala 9 each, Nandgaon & Girnadam 8 each, Shirpur, Savlivihir Agri, Parola, Pachora & Bhadgaon 7 each

Marathwada : Khultabad 14, Vaijapur 11, Paithan 10, Gangapur 9, Kannad 7

2.6. *Severe Cyclonic Storm 'Shaheen' over northeast Arabian Sea and adjoining Kutch (30 Sep - 4 Oct, 2021)*

2.6.1. The **Well Marked Low Pressure Area** over south Gujarat region and adjoining Gulf of Khambhat lay over Saurashtra and adjoining south Gujarat region 29th September afternoon. It then lay over Saurashtra and neighbourhood with the associated cyclonic circulation

extended upto mid tropospheric levels on 29th September evening which then concentrated into a **Depression** over northeast Arabian Sea and adjoining Kutch and lay centered at 0530 hrs IST of 30th September, 2021, near Lat. 22.7° N / Long. 69.5° E, about 50 km east-northeast of Devbhoomi Dwarka (Gujarat). It moved nearly westward and lay centered at 0830 hrs IST of 30th September, 2021, over northeast Arabian Sea off Gujarat coast, near Lat. 22.7° N / Long. 68.6° E, about 60 km west-northwest of Devbhoomi Dwarka (Gujarat) which moved nearly westward till 1130 hrs IST of 30th September, 2021. It moved west-northwestward and lay centred at 1730 hrs IST of 30th September, 2021, over northeast Arabian Sea off Gujarat coast, near Lat. 23.1° N / Long. 67.4° E, about 190 km west-northwest of Devbhoomi Dwarka (Gujarat). It continued to move west-northwestward and intensified into a **Deep Depression** and lay centred at 2330 hrs IST of 30th September, 2021, over northeast Arabian Sea off Gujarat coast, near Lat. 23.3° N / Long. 66.8° E, about 180 km south-southwest of Karachi (Pakistan). It further moved west-northwestward and intensified into a **Cyclonic Storm 'Shaheen'** and lay centred at 0530 hrs IST of 1st October, 2021, over northeast Arabian Sea and neighbourhood near Lat. 23.2° N / Long. 65.3° E, about 260 km south-southwest of Karachi (Pakistan). It moved west-northwestward and lay centred at 0830 hrs IST of 1st October, 2021, over central parts of north Arabian Sea, near Lat. 23.2° N / Long. 64.9° E, about 440 km west-northwest of Devbhoomi Dwarka (Gujarat). It moved west-northwestwards and intensified into a **Severe Cyclonic Storm** and lay centred at 1730 hrs IST of 1st October, 2021 over northwest and adjoining northeast Arabian Sea, near Lat. 23.4° N / Long. 63.7° E, about 370 km east-southeast of Chabahar Port (Iran) and further moved west-northwestwards and lay centred at 0530 hrs IST of 2nd October, 2021, over northwest Arabian Sea, near Lat. 23.8° N / Long. 62.4° E, about 240 km east-southeast of Chabahar Port (Iran). It continued to move west-northwestward and lay centred at 0830 hrs IST of 2nd October, 2021, over northwest Arabian Sea, near Lat. 23.9° N / Long. 62.1° E, about 210 km east-southeast of Chabahar Port (Iran). It further moved west-northwestward and lay centred at 1730 hrs IST of 2nd October, 2021 over northwest Arabian Sea and adjoining Gulf of Oman, near Lat. 24.5° N / Long. 60.7° E, about 90 km nearly to the south of Chabahar Port (Iran). It moved west-southwestward and lay centred at 0530 hrs IST of 3rd October, 2021 over Gulf of Oman and adjoining northwest Arabian Sea, near Lat. 24.3° N / Long. 59.5° E, about 160 km southwest of Chabahar Port (Iran). It moved west-southwestward and lay centred at 0830 hrs IST of 3rd October, 2021 over Gulf of Oman and adjoining northwest Arabian Sea, near Lat. 24.2° N / Long. 59.0° E, about 90 km northeast of Muscat (Oman). It moved west-

southwestward and lay centred at 1430 hrs IST of 3rd October, 2021, over Gulf of Oman and adjoining northwest Arabian Sea near Lat. 24.1° N / Long. 58.3° E, about 50 km north-northwest of Muscat (Oman). It moved west-southwestward and lay centred at 1730 hrs IST of 3rd October, 2021, over Gulf of Oman and neighbourhood near Lat. 24.0°N / Long. 58.0° E, about 60 km north-northwest of Muscat (Oman). It moved west-southwestward and crossed Oman coast during 0030 to 0130 hrs IST of 4th October, near Lat. 23.9° N / Long. 57.3° E, about 120 km west-northwest of Muscat (Oman) as a Severe Cyclonic Storm with a maximum sustained wind speed of 95-105 kmph gusting to 115 kmph. It moved west-southwestward and weakened into a **Cyclonic Storm** and lay centred at 0530 hrs IST of 4th October, 2021, over north Oman and adjoining United Arab Emirates (UAE) near Lat. 23.7° N / Long. 56.8° E, about 160 km nearly west of Muscat (Oman). It continued to move west-southwestward and weakened into a **Deep Depression** and lay centred at 0830 hrs IST of 4th October, 2021, over north Oman and adjoining United Arab Emirates (UAE), near Lat. 23.5° N / Long. 56.4° E, about 200 km nearly to the west of Muscat (Oman). It continued to move west-southwestward and further weakened into a **Depression** and lay centred at 1130 hrs IST of 4th October, 2021 over north Oman and adjoining United Arab Emirates (UAE), near Lat. 23.3° N / Long. 56.0° E, about 250 km west-southwest of Muscat (Oman). It moved west-southwestward and further weakened into a **Well-Marked Low Pressure Area** and lay centred at 1730 hrs IST of 4th October, 2021 over the same region and then became unimportant for the Indian region.

2.6.2. Other features observed

The peak maximum sustained surface wind speed (MSW) of the severe cyclonic storm 'Shaheen' was 110-120 kmph (60 knots) during 1800UTC of 1st Oct to 1500 UTC of 2nd Oct with lowest estimated central pressure of 984 hPa. When the system crossed Oman coast during 1900 to 2000 UTC of 3rd October, near latitude 23.9° N and longitude 57.3° E, about 120 km west-northwest of Muscat as a severe cyclonic storm with a maximum sustained wind speed of 95-105 kmph gusting to 115 kmph. Continuing to move further west-northwards till evening (1730 hours IST) of 2nd October, it recurved west-southwestwards and crossed Oman coast during 0030-0130 IST of 4th Oct with wind speed of 95-105 gusting to 115 kmph.

2.6.3. Realized weather

Rainfall associated with Severe Cyclonic storm 'Shaheen' indicated that the system caused heavy to extremely heavy rainfall over Gujarat and Saurashtra

region on 29th September. Thereafter, the rainfall belt shifted gradually from northeast Arabian Sea to northwest Arabian Sea during 30th Sep and 1st Oct. On 2nd, heavy to extremely heavy rainfall was observed over northwest Arabian Sea and adjoining Gulf of Oman. On 3rd, coastal Oman received heavy to extremely heavy rainfall.

The chief amount of 24 hrs accumulated rainfall (≥7cm) ending at 0830 hrs IST of date during the life cycle of the system is presented below.

30 September, 2021

Gujarat Region : Vagra 10, Hansot 9, Ankleshwer 9, Khambhat 7

Saurashtra & Kutch : Visavadar 29, Lilia & Khambhalia 14 each, Kalyanpur, Amreli, Mangrol (J), Jafrabad & Bagasra 13 each, Jesar, Jamnagar, Amreli kvkaws 12 each, Keshod, Lalpur, Veraval, Kalavad & Rajula 11 each, Kutiana 10, Talala, Malia, Gariadhar, Dwarka & Palitana 9 each, Anjar, Mendarda & Lodhika 8 each, Talaja, Mundra, Okha, Rajkot, Bhesan, Upleta, Manavadar, Savarkundla & Bhavnagar 7 each

Pakistan : As per media reports, the cyclone caused light rain and gusty winds in parts of Karachi on September 30th. The city's Millennium Mall on Rashid Minhas Road also saw heavy traffic due to three electric poles falling on the area

4 October, 2021

Oman : As per media reports 369 mm of rainfall was reported in the Wilayat of Al-Khaboura, the highest in association with the storm on 4th October. 290.8 mm of downpour was recorded in Suwaiq and Al-Khaboura at 167.9 mm

2.7. Depression over eastcentral Arabian Sea (7-9 Nov, 2021)

2.7.1. Under the influence of cyclonic circulation over southeast and adjoining southwest Bay of Bengal, a **Low Pressure Area** formed over central parts of south

Bay of Bengal with the associated cyclonic circulation extended upto 5.8 km above m.s.l. on 27th October which lay over southwest Bay of Bengal and neighbourhood on 28th October morning. It then lay over southwest Bay of Bengal off Sri Lanka coast. It lay over southwest Bay of Bengal and adjoining Sri Lanka off Tamil Nadu coast on 29th October morning. It then persisted over the same region It lay over Sri Lanka off Tamil Nadu coast on 30th October morning and then persisted on 31st October. It lay over Comorin area and adjoining north Sri Lanka coast on 1st November and Comorin area and neighbourhood on 2nd November. It lay over Lakshadweep area and adjoining southeast Arabian Sea on 3rd November and persisted on 4th November which lay over southeast and adjoining eastcentral Arabian Sea on 5th November and lay over eastcentral and adjoining Arabian Sea on 5th November evening and lay as a **Well Marked Low Pressure Area** over eastcentral Arabian Sea with the associated cyclonic circulation extended upto 5.8 km above m.s.l. on 6th November. It concentrated into **Depression** over same area and lay centred at 0830 hrs IST of 7th November, 2021, near Lat. 14.0° N / Long. 67.5° E, about 700 km west-southwest of Panjim (Goa). It moved northwestward and lay centred at 1730 hrs IST of 7th November, 2021, over eastcentral Arabian Sea near Lat. 14.3° N / Long. 67.0° E, about 740 km west-southwest of Panjim (Goa). It further moved west-northwestward and lay centred at 0830 hrs IST of 8th November, 2021, over same area near Lat. 14.7° N / Long. 66.4° E, about 800 km west-southwest of Panjim (Goa). It further moved west-southwestward and lay centred at 1730 hrs IST of 8th November, 2021, over eastcentral and adjoining westcentral Arabian Sea near Lat. 14.6° N / Long. 65.9° E, about 860 km west-southwest of Panjim (Goa). It continued to move west-southwestward and weakened into a **Well Marked Low Pressure Area** over central parts of Arabian Sea on 9th November morning and then persisted over the same region with the associated cyclonic circulation extended upto 5.8 km above m.s.l.

2.7.2. Other features observed

The peak maximum sustained surface wind speed (MSW) of the system was 40-50 kmph (25 knots) during 0300 UTC of 7th Nov to 0600 UTC of 8th Nov with lowest estimated central pressure of 1002 hPa.

2.7.3. Realized weather

Rainfall associated with the depression over eastcentral Arabian Sea indicated higher rainfall activity in the northern sector. As the system was moving away from Indian coast, no adverse weather occurred over the west coast of India due to this system.

2.8. Depression over southwest Bay of Bengal (10-11 November, 2021)

2.8.1. Under the influence of cyclonic circulation over southeast Bay of Bengal and neighbourhood, a **Low Pressure Area** formed over the same region with the associated cyclonic circulation extended upto 4.5 km above m.s.l. on 9th November. It lay over central parts of south Bay of Bengal 9th November evening. It lay as a **Well Marked Low Pressure Area** over southeast and adjoining southwest Bay of Bengal on 10th November morning. It then lay over central parts of south Bay of Bengal on 10th November. It moved west-northwestward and concentrated into a **Depression** and lay centred at 1730 hrs IST of 10th November 2021, over southwest Bay of Bengal, near Lat. 10.6° N / Long. 83.4° E, about 420 km east-southeast of Puducherry. It continued to move west-northwestward and lay centred at 0530 hrs IST of 11th November, 2021, over southwest Bay of Bengal, near Lat. 12.0° N / Long. 81.4° E, about 170 km east-southeast of Chennai. It further moved west-northwestward and lay centred at 0830 hrs IST of 11th November, 2021, over southwest and adjoining westcentral Bay of Bengal, near Lat. 12.3° N / Long. 81.2° E, about 130 km east-southeast of Chennai. It continued to move west-northwestward and lay centred at 1730 hrs IST of 11th November, 2021, over the same region, near Lat. 12.9° N / Long. 80.3° E, about 15 km southeast of Chennai. It crossed north Tamil Nadu and adjoining south Andhra Pradesh coasts close to Chennai, near Lat. 12.95° N / Long. 80.25° E during 1730 and 1830 hrs IST of 11th November, 2021, with a maximum sustained wind speed of 45-55 kmph gusting to 65 kmph. It lay centred at 1830 hrs IST over north coastal Tamil Nadu near Lat. 13.0° N / Long. 80.2° E, close to Chennai. It weakened into a **Well Marked Low Pressure Area** and lay centred at 0530 hrs IST of 12th November, 2021 over north Tamil Nadu and neighborhood.

2.8.2. Other features observed

When the system crossed north Tamil Nadu & adjoining south Andhra Pradesh coasts close to Chennai, a maximum sustained surface wind speed was 45-55 kmph gusting to 65 kmph with lowest central pressure of 998 hPa on 11th November.

2.8.3. Realized Weather

Rainfall associated with the depression indicated that active northeast monsoon and the system caused heavy to very heavy rainfall on 9th & 12th and heavy to very rainfall at a few places with extremely heavy rainfall on 10th & 11th over Tamil Nadu, Puducherry and Karaikal. It also

caused heavy to very heavy rainfall at a few places over Rayalaseema and coastal Andhra Pradesh on 11 & 12 November.

The chief amount of 24 hrs accumulated rainfall (≥ 7 cm) ending at 0830 hrs IST of date during the life cycle of the system is presented below.

9 November, 2021

Tamil Nadu, Puducherry & Karaikal : Chengalpattu 12, Kanyakumari, Toothukudi & Villupuram 9 each, Puducherry & Tenkasi 8 each, Kanchipuram 7

Kerala & Mahe : Kottayam 10, Kollam 9, Malappuram 8

10 November, 2021

Tamil Nadu, Puducherry & Karaikal : Thirupoondi 31, Nagapattinam 29, Bedaranyam 25, Thalanyar 24, Karaikal 29, Thiruthuraiipoondi 22, Peravurani 20, Karambakudi 18, Echanviduthi 17, Thanjavur, Mayiladuthirai & Tarangambadi 16 each, Madukkur 15, Mannargudi & Mayiladuthurai 14 each, Nannilam, Muthupettai, Adiramapatnam & Sirkali 13 each, Valangaiman, Manjalaru, Kumbakonam, Ayyampettai & Manalmedu 12 each, Pandavaiyaru, Needamangalam, Kudavasal, Vettikadu, Lower Anaicut & Kollidam 11 each, Vallam, Manamelkudi, Avudayarkoil & Jayamkondam 10 each, Budalur, Tiruvaiyaru & M.O. Pondicherry 9 each, Mimosal & Rasipuram 8 each

11 November, 2021

Tamil Nadu, Puducherry & Karaikal : Tambaram 23, Cholavaram 22, Ennore 21, Gummidipoonai & Red Hills 18 each, Mahabalipuram & Peerambur 17 each, Nungambakkam 16, Ambathur & Thomaraipakkam, MGR Nagar 15 each, Chembarabakkam, Meenambakkam, Taramani, Anna University & Chennai 14 each, Ponneri 13, Kelabakkam, Satyabama, Thiruppurur,

Poonamallee 12 each, Thirukalukundram, Kattukuppam 11, Chengalpattu, Tiruvallur & Uthukottai, Sriperumbudur, Villupuram & Marakkanam 10 each, Maduranthagam, Koratur & Pondi 9 each

Coastal Andhra : Sullurpeta 18, Tada 14
Pradesh & Yanam

Rayalaseema : Satyavedu 11, Tirupati 8, Puttur 7

Kerala & Mahe : Aryankavu 18

12 November, 2021

Rayalaseema : YSR : Kodur 17, Rajampet 13, Chittoor, Puttur & Nagari 12 each, Pullampeta 11, Royachoti & Penagaluru 10 each, Sambepalle, Satyavedu, Kalakada & Tirupathi 9 each, Utukuru, Cuddapah, Thottambedu & Pakala 8 each, Srikalahasthi, Vempalle, Chinnamandem, Atlur & Kadiri 7 each

Tamil Nadu, Puducherry & Karaikal : Kanyakumari & Suralacode 15 each, Perunchani Dam 13, Tiruttani 12, Boothapandy, Wallajah, Tiruvallur & Pallipattu 11 each, Mylaudi & Cholavaram 10 each, Gummidipoondi 9, Uthukottai, Vembakkam, Tiruvannamalai, Chennai : DGP Office 8 each, Arakonam, Kalavai, MGR Nagar, Kanchipuram, Salem, Yercaud, Vellore, Katpadi, Kottaram & Nagarcoil 7 each

Kerala : Idukki 14, Thodupuzha & Thiruvananthapuram 11 each, Ernakulam 7

Coastal Andhra : Nellore & Tada 11 each, Kavali Pradesh & 10, Atmapur 8, Vinjamur, Rapur, Yanam Kandukur & Venkatgiri 7 each

2.9. Depression over Bay of Bengal (18-19 November, 2021)

2.9.1. A Low Pressure Area formed over south Andaman Sea & adjoining Thailand coast with the

associated cyclonic circulation extended upto 5.8 km above m.s.l. on 0830 hrs IST of 13th November. It lay over central parts of Andaman Sea on 14th morning and then persisted over the same region. It lay over north Andaman Sea and neighbourhood on 15th November morning and then persisted over the same region. It lay over southeast Bay of Bengal and adjoining north Andaman Sea on 16th November morning. It then lay over southeast Bay of Bengal on 16th November. It lay over southeast and adjoining southwest Bay of Bengal 17th November morning. It then persisted over the same region. It lay as a **Well Marked Low Pressure Area** over southwest and adjoining westcentral Bay of Bengal off north Tamil Nadu-south Andhra Pradesh coasts on 18th November morning. It further concentrated into a **Depression** over southwest Bay of Bengal off north Tamil Nadu coast and lay centred at 0830 hrs IST of 18th November, 2021, near Lat. 11.0° N / Long. 82.3° E, about 290 km east southeast of Puducherry. It moved west-northwestward and lay centred at 1730 hrs IST of 18th November, 2021, over southwest Bay of Bengal off north Tamil Nadu coast, near Lat. 11.8° N / Long. 80.9° E, about 120 km east-southeast of Puducherry. It further moved west-northwestward and crossed north Tamil Nadu and adjoining south Andhra Pradesh coasts between Puducherry and Chennai near Lat. 12.45° N / Long. 80.1° E during 0300-0400 hrs IST of 19th November, 2021. It lay centred at 0530 hrs IST of 19th November, 2021, over north coastal Tamil Nadu and neighbourhood, near Lat. 12.5° N / Long. 80.0° E, about 60 km south-southwest of Chennai. It continued to move west-northwestward and lay centred at 0830 hrs IST of 19th November, 2021, over north Tamil Nadu, near Lat. 12.7° N / Long. 79.7° E, about 60 km east-southeast of Vellore. It further moved west-northwestward and weakened into a **Well Marked Low Pressure Area** over north interior Tamil Nadu and adjoining Karnataka and Rayalaseema at 1130 hrs IST of 19th November, 2021.

2.9.2. Other features observed

When the system crossed north Tamil Nadu coast between Puducherry and Chennai, a maximum sustained surface wind speed was 40-50 kmph (25kts) with lowest central pressure of 1000 hPa on 19th November.

2.9.3. Realized Weather

Rainfall associated with the depression over Bay of Bengal indicated heavy to very heavy rainfall at a few places over north Tamil Nadu & south Andhra Pradesh and at isolated places over Rayalaseema and north interior Karnataka on 18th November. On 19th, heavy to very heavy rainfall at a few places over north interior Tamil Nadu, south Andhra Pradesh, Rayalaseema and north

interior Karnataka with extremely heavy rainfall at isolated places over north interior Tamil Nadu and Rayalaseema.

2.10. Cyclonic Storm 'JAWAD' (pronounced as JOWAD) over southeast Bay of Bengal (2-5 December, 2021)

2.10.1. **ALow Pressure Area** lay over south Thailand and neighbourhood with the associated cyclonic circulation extended upto mid tropospheric level on 30th November and lay over central parts of Andaman Sea and neighbourhood on 30th November evening. It then persisted over the same region on 1st December. It lay over southeast Bay of Bengal and adjoining Andaman Sea on 1st December evening. It then lay as a **Well Marked Low Pressure Area** over the same region on 2nd December morning. It then lay over southeast Bay of Bengal. It moved west-northwestward and concentrated into a **Depression** and lay centred at 1730 hrs IST of 2nd December, 2021, over southeast Bay of Bengal near Lat. 11.0° N / Long. 89.0° E, about 960 km south-southeast of Vishakhapatnam (Andhra Pradesh). It moved northwestward and intensified into a **Deep Depression** and lay centred at 0530 hrs IST of 3rd December, 2021, over westcentral and adjoining south Bay of Bengal near Lat. 13.4° N / Long. 86.4° E, about 580 km south-southeast of Vishakhapatnam (Andhra Pradesh) which moved north-northwestward and lay centred at 0830 hrs IST of 3rd December, 2021, over westcentral Bay of Bengal near Lat. 14.0° N / Long. 86.0° E, about 480 km south-southeast of Vishakhapatnam (Andhra Pradesh). It further moved north-northwestwards and intensified into **Cyclonic Storm 'JAWAD' (Pronounced as JOWAD)** and lay centred at 1130 hrs IST of 3rd December, 2021, over west central of Bengal near Lat. 14.5° N / Long. 85.5° E, about 420 km south-southeast of Vishakhapatnam (Andhra Pradesh). It continued to move north-northwestwards and lay centred at 1730 hrs IST of 3rd December, 2021, over westcentral Bay of Bengal near Lat. 15.5° N / Long. 85.0° E, about 300 km south-southeast of Vishakhapatnam (Andhra Pradesh). It further moved slightly northwards and lay centred at 0530 hrs IST of 4th December, 2021, over westcentral Bay of Bengal near Lat. 16.2° N / Long. 84.9° E. It further moved nearly northwards and lay centred at 0830 hrs IST of 4th December, 2021, over westcentral Bay of Bengal near Lat. 16.4° N / Long. 84.8° E, about 210 km east-southeast of Vishakhapatnam (Andhra Pradesh). It then moved slightly northwestward and lay centred at 1430 hrs IST of 4th December, 2021, over westcentral Bay of Bengal near Lat. 16.5° N / Long. 84.7° E, about 200 km east-southeast of Vishakhapatnam (Andhra Pradesh). It moved northward and weakened into **Deep Depression** and lay

centered at 1730 hrs IST of 4th December, 2021, over westcentral Bay of Bengal near Lat. 16.9° N / Long. 84.8° E, about 180 km east-southeast of Vishakhapatnam (Andhra Pradesh). It moved north-northeastward and lay centered at 0530 hrs IST of 5th December, 2021, over northwest and adjoining westcentral Bay of Bengal near Lat. 18.2° N / Long. 85.4° E, about 130 km south-southeast of Gopalpur (Odisha). It further moved north-northeastward and lay centered at 0830 hrs IST of 5th December, 2021, over northwest and adjoining westcentral Bay of Bengal near Lat. 18.7° N / Long. 85.6° E, about 90 km east-southeast of Gopalpur (Odisha). It moved north-northeastward and further weakened into a **Depression** and lay centered at 1430 hrs IST of 5th December, 2021, over northwest Bay of Bengal close to Odisha coast near Lat. 19.5° N / Long. 86.2° E, about 50 km southeast of Puri (Odisha). It moved northeastward and lay centered at 1730 hrs IST of 5th December, 2021, over northwest Bay of Bengal close to Odisha coast near Lat. 20.1° N / Long. 86.9° E, about 30 km above m.s.l. southeast of Paradip (Odisha). It further moved northeastward and weakened into a **Well Marked Low Pressure Area** over northwest Bay of Bengal and adjoining West Bengal-Bangladesh coasts at 0530 hrs IST of 6th December, 2021.

2.10.2. Other features observed

The peak maximum sustained wind speed (MSW) of the cyclone was 70-80 kmph (40 knots) gusting to 90 kmph during 3rd/1200 UTC to 4th/0000 UTC. Dhamra port reported south-southeasterly winds of intensity 32 knots gusting to 35 knots at 4th/0600 UTC. Thereafter, the system started weakening under unfavourable conditions (enhanced wind shear, dry air incursion into the core of system, lower ocean thermal energy, land interactions and unfavourable Madden Julian Oscillation index). The lowest estimated central pressure (ECP) was 1000 hPa during the period with a pressure drop of about 8 hPa at the centre as compared to the surroundings.

2.10.3. Realized weather

The rainfall associated with Cyclonic storm 'JAWAD' indicated that the system caused heavy over south Andaman Sea on 29th November. The rainfall belt gradually moved west-northwestwards, causing heavy to very heavy rainfall at few places over south Andaman Sea

on 30th November and at many places over Andaman Islands on 1st December. It caused widespread heavy to very rainfall at a few places with extremely heavy falls at isolated places over westcentral Bay of Bengal on 2nd December. On 3rd, it caused scattered heavy to very rainfall with isolated extremely falls over westcentral Bay of Bengal off north Andhra Pradesh & south Odisha coasts. On 4th, decrease in rainfall activity is seen with isolated heavy to extremely heavy rainfall over westcentral Bay of Bengal off Odisha-Gangetic West Bengal coasts. On 5th December, heavy to very heavy rainfall at few places over north Odisha, Gangetic West Bengal and south Bangladesh coasts is seen.

The chief amount of 24 hrs accumulated rainfall (≥7cm) ending at 0830 hrs IST of date during the life cycle of the system is presented below.

5 December, 2021

Odisha : Chhattarpur 9, Purushottampur & Banpur 8 each, Behrampur, Digapahandi, Gopalpur, Paradip CWR & Nayagarh 6 each, Balikuda, Astaranga, Garadapur, Kantapada & Chandikhol 5 each

6 December, 2021

Odisha : Erasama 23, Paradip 20, Balikuda 15, Kujanga 14, Nuagaon, Marshaghai & Garadpur 13 each, Tirtol, Rajnagar & Kakatpur 12 each, Astaranga 11, Mohakalpara & Niali 10 each, Raghunathpur & Derabis 9 each, Kendrapara, Patamundai, Delang & Kanas 8 each, Jagatsinghpur, Nimapara & Tangi Choudwar 7 each

Gangetic West Bengal : Tarakeshwar 18, Bagati & Burdwan 13 each, Kalyani & Barrackpur 12 each, Mohanpur & Kharagpur 11 each, Dum Dum 10, SaltLake, Midnapore, Kalaikunda & Uluberia 9 each, Harinkhola 8, Manteswar, Jhargram, Lalgarh, Alipore & Canning 7 each

