

Report on Extreme Weather Events during January-May 2021

1. Introduction

As per the definition used by IMD, January and February (JF) constitute the winter season whereas March, April and May constitute the summer or pre-monsoon season. The winter season is associated with the passage of Western Disturbances (WDs) originating in the Mediterranean Sea region passing through the northern parts of the country causing weather phenomena like rainfall/snowfall over the Western Himalayan Region and rain/thundershower activity over the adjoining plains. While moving eastward, the WDs cause weather activities over eastern and northeastern states. Passage of WDs under favourable conditions gives rise to the occurrence of hailstorms over these regions. In addition, the season is also characterized by fog, cold days, cold waves and similar other weather events, the spatial coverage and intensity of these being regulated by the frequency, intensity and latitudinal extent of the passing WDs. During this season, the extreme south peninsula also gets rainfall/thundershower activity associated with the passage of easterly waves. The interaction between the westerly systems and the high amplitude easterly waves occasionally give rise to the occurrence of severe weather over the central parts of the country. The pre-monsoon season from March to May (MAM) is mainly associated with convective weather phenomena like thunderstorm, dust storm, squalls and dust raising winds. Some days, temperatures can shoot up under favourable conditions and can give rise to heat wave and hot day conditions especially along the northern plains and central parts of the country, the frequency of which is maximum in the month of April and May. This season is also characterized by the formation of low pressure systems over the north Indian Ocean and their intensification into cyclones. In this report, an attempt is made to bring out the details of the extreme weather phenomena and their impact during the winter and pre-monsoon seasons of 2021.

2. Cyclonic Systems

During the winter season from January to February 2021, no intense system formed over the Indian Seas. However, during the pre-monsoon season from March to May, one low pressure area formed in the month of March over Arabian Sea and one depression (2-3 Apr) formed in the month of April over the Andaman Sea as seen in Figure 1. The two intense systems formed during the pre-monsoon season in the month of May are (i) Extremely Severe Cyclonic Storm (ESCS) TAUKTAE (14-19 May) over the Arabian Sea and (ii) Very Severe Cyclonic Storm (VSCS) YASS (23-27 May) over the Bay of Bengal. The track of the same can be seen in Figure 1.

Initially, a low pressure area was formed over southeast Arabian Sea and adjoining Lakshadweep area in the morning (0830 hrs IST) of 13 May 2021. In the same evening, it intensified into a well marked low pressure area over Lakshadweep area and adjoining southeast Arabian Sea. It further concentrated into a Depression (D) at 0830 hrs IST of 14 May, 2021, into a Deep Depression (DD) over Lakshadweep area and adjoining southeast and East Central Arabian Sea (ECAS) in the same afternoon (1430 hrs IST of 14 May) and into Cyclonic Storm (CS) TAUKTAE in the same midnight (2330 hrs IST of 14th) over the same region. It moved nearly northwards and further intensified into a Severe Cyclonic Storm (SCS) in the evening (1730 hrs IST) of 15th May and into a VSCS over ECAS in the early hours (0230 hrs IST of 16 May). There was rapid intensification of the system while moving north-northwestwards from noon (1130 hours IST) of 16 May and it became an ESCS in the early hours (0230 hrs 17 May). Thereafter, the system entered in to a marginally unfavourable environment, weakened gradually and crossed Saurashtra coast near latitude 20.8°N and longitude 71.1°E, close to northeast of Diu (about 20 km northeast of Diu) during 2000-2300 hours

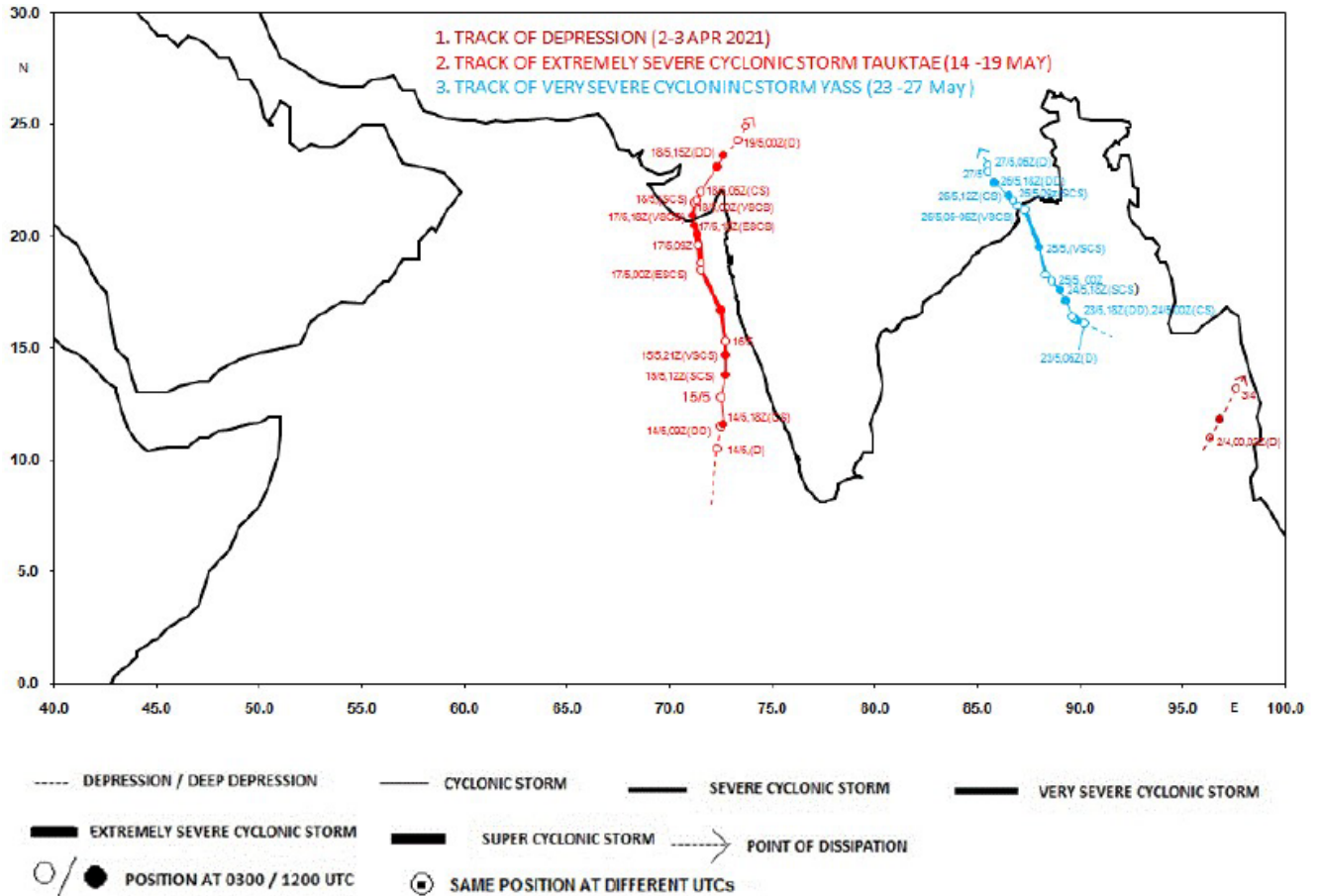


Figure 1: Track of Extremely Severe Cyclonic Storm (ESCS) TAUKTAE over the Arabian Sea during 14-19 May, 2021 and Very Severe Cyclonic Storm (VSCS) YASS over the Bay of Bengal during 23 to 27 May, 2021.

IST of 17th May, 2021 with maximum sustained wind speed of 160-170 kmph gusting to 185 kmph. During the landfall, the system moved slowly nearly northwards, as it started re-curving. After landfall, it weakened into a VSCS over Saurashtra in the midnight (2330 hrs IST) of 17th May. Thereafter, it started moving north-northeastwards and weakened into an SCS in the morning (0300 UTC) over Saurashtra and further into a CS around noon of 18th May, 2021 over Saurashtra and adjoining Gujarat region. Continuing to move north-northeastwards, it weakened into a DD over Gujarat region in the evening (1730 hrs IST) and into a D over Gujarat region and adjoining South Rajasthan in the midnight (2330 hrs IST) of 18th May (Figure 1).

India Meteorological Department (IMD) maintained round the clock watch over the north Indian Ocean and the cyclone was monitored since 6th May, about 7 days prior to the formation of low

pressure area over southeast Arabian Sea and adjoining Lakshadweep area on 13th May and 8 days prior to the formation of the Depression over Lakshadweep area. The cyclone was monitored with the help of available satellite observations from INSAT 3D and 3DR, SCAT SAT, polar orbiting satellites and available ships & buoy observations in the region. The system was also monitored by Doppler Weather RADARs (DWR) located at Thiruvananthapuram, Kochi and Goa. The Satellite imagery of 16 May and Reflectivity product from Doppler Weather RADAR Goa of 16th May, 2021 for the cyclone is shown in Figure 2.

The other system YASS started as a low pressure area over eastcentral BoB in the morning of 22 May. It lay as a well marked low pressure area in the same afternoon over eastcentral BoB. Under favourable environmental conditions, it concentrated into a Depression over eastcentral

SAT : INSAT-3D IMG
 IMG_TIR1_TEMP 10.8 um
 ARABIAN_SEA

16-05-2021/(1100 to 1126) GMT
 16-05-2021/(1630 to 1656) IST

(a)

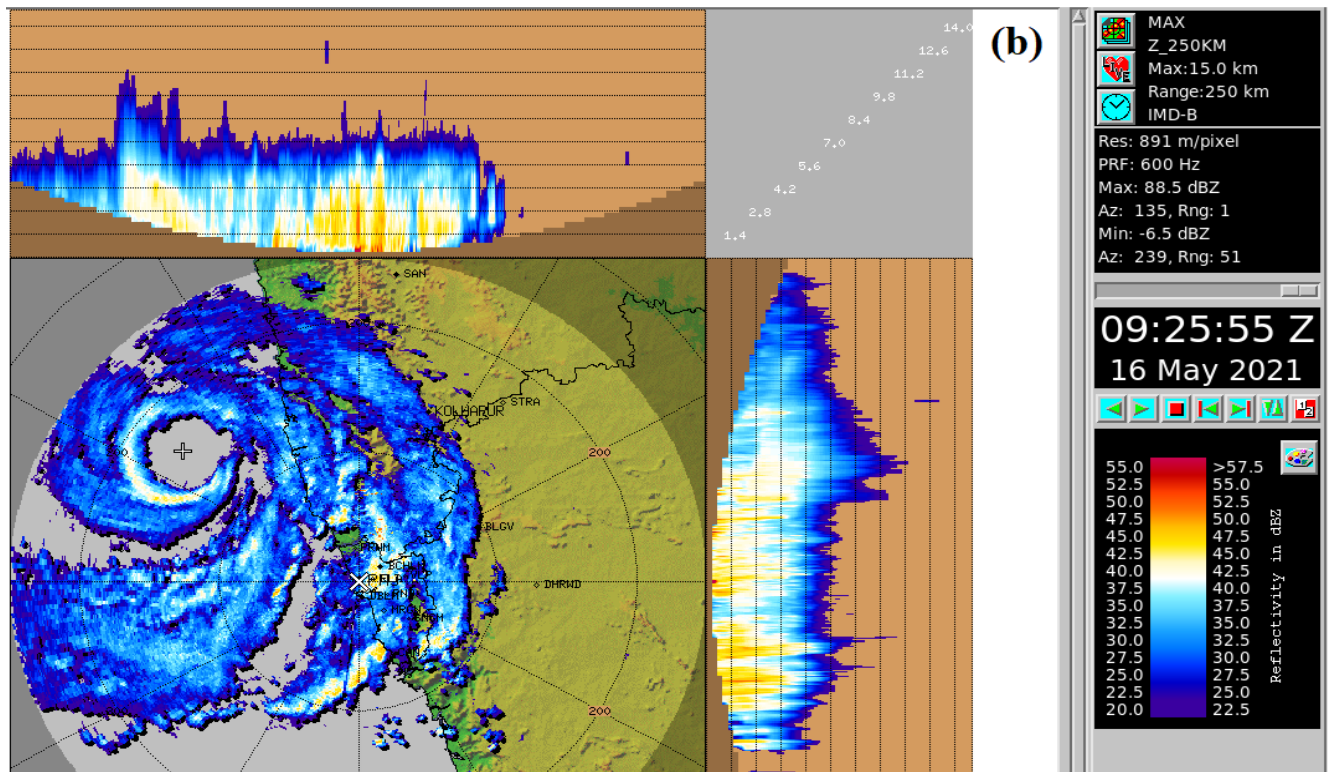
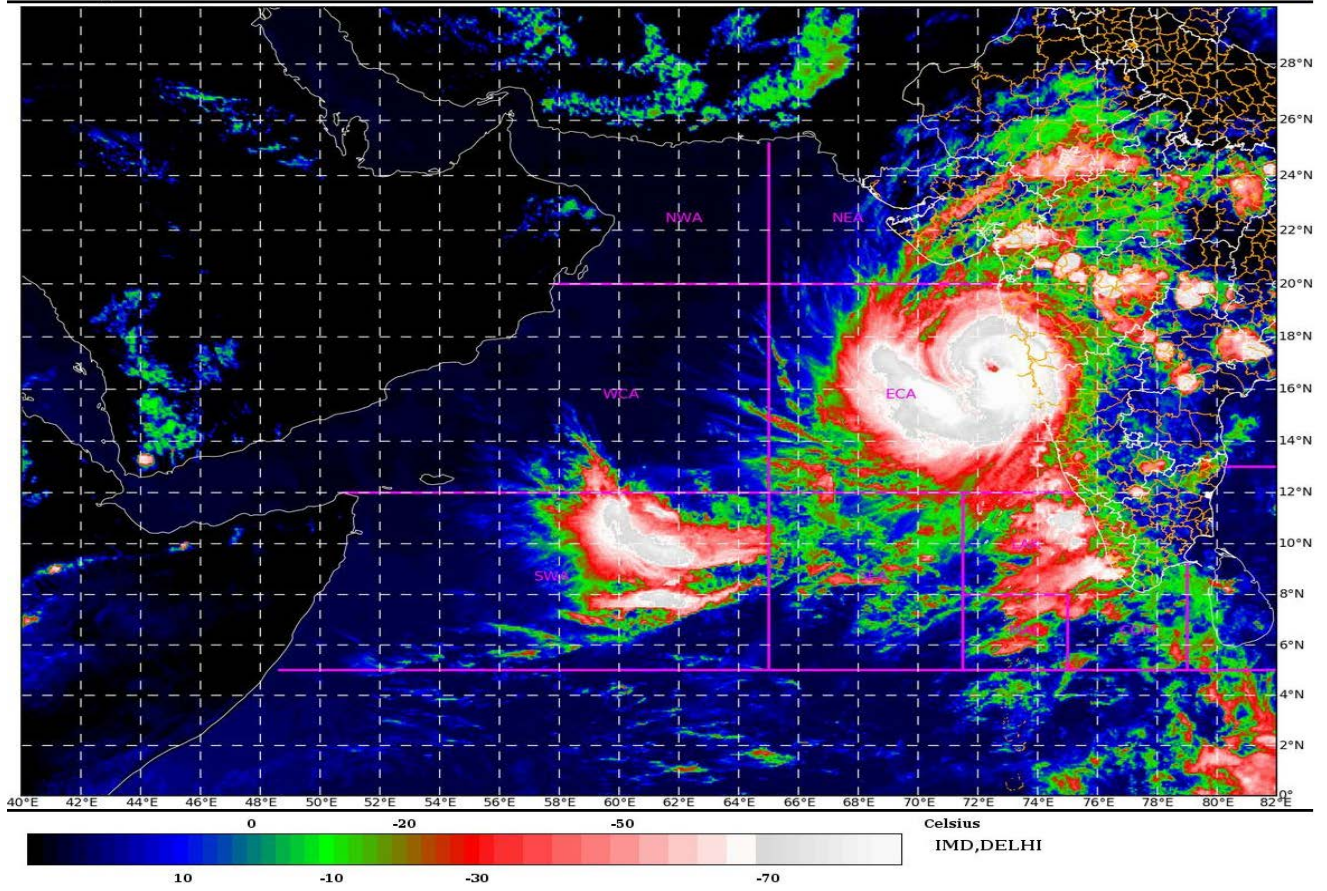


Figure 2: (a) INSAT 3D imagery of 16 May and (b) Reflectivity product from Doppler weather RADAR Goa of 16 May, 2021.

BoB in the noon (1130 IST) of 23rd May, 2021. It moved northwestwards and intensified into a DD over eastcentral BoB in the midnight (2330 IST) of 23rd May and into the cyclonic storm YAAS in the early morning (0530 IST) of 24th over the same region. It became a SCS in the midnight (2330 IST) of 24th May over eastcentral BoB and further intensified into a VSCS in the evening (1730 IST) over northwest BoB. Continuing to move north-northwestwards, it crossed north Odisha coast near latitude 21.35°N and longitude 86.95°E, about 20 km to the south of Balasore as a VSCS with maximum sustained wind speed (MSW) of 75 kts gusting to 85 kts (130-140 kmph gusting to 155 kmph) between 1030-1130 IST of 26th. Further moving north-northwestwards, it weakened rapidly into an SCS over north coastal Odisha in the afternoon (1430 IST), into a CS over north Odisha in the evening (1730 IST) and into a DD in the midnight (2330 IST) of 26th over north interior Odisha and adjoining Jharkhand. It weakened into a Depression over central parts of Jharkhand in the noon (1130 IST) of 27th. Thereafter, it moved northwestwards and weakened into a well-marked low pressure area over Bihar and adjoining southeast Uttar Pradesh (UP) in the early morning (0530 IST) of 28th May. It became a low pressure area over southeast UP and adjoining Bihar on 28th evening (1730 IST) and became less marked on 29th morning (0530 IST).

IMD maintained round the clock watch over the north Indian Ocean and the cyclone was monitored since 13th May, about 9 days prior to the formation of low pressure area over eastcentral BoB on 22nd May. The cyclone was monitored with the help of available satellite observations from INSAT 3D and 3DR, SCAT SAT, polar orbiting satellites and available ships & buoy observations in the region. The system was also monitored by Doppler Weather Radar (DWR), Paradip. The INSAT 3D satellite and radar image during VSCS YAAS for the date of 25 May are presented in Figure 3.

3. Significant Weather Events

The significant weather events those occurred during the winter and pre-monsoon season of 2020 as obtained from the Climate Diagnostic Bulletin, published by IMD Pune is shown in Figure 4a & 4b respectively.

4. Winter Season (Jan-Feb)

Glacier breaks, Snowfall (Avalanche), heavy Rainfall and Cold wave were the major weather events during the winter season, although hailstorm and heavy rainfall also caused damage to Rabi crops (Figure 4a) as discussed below.

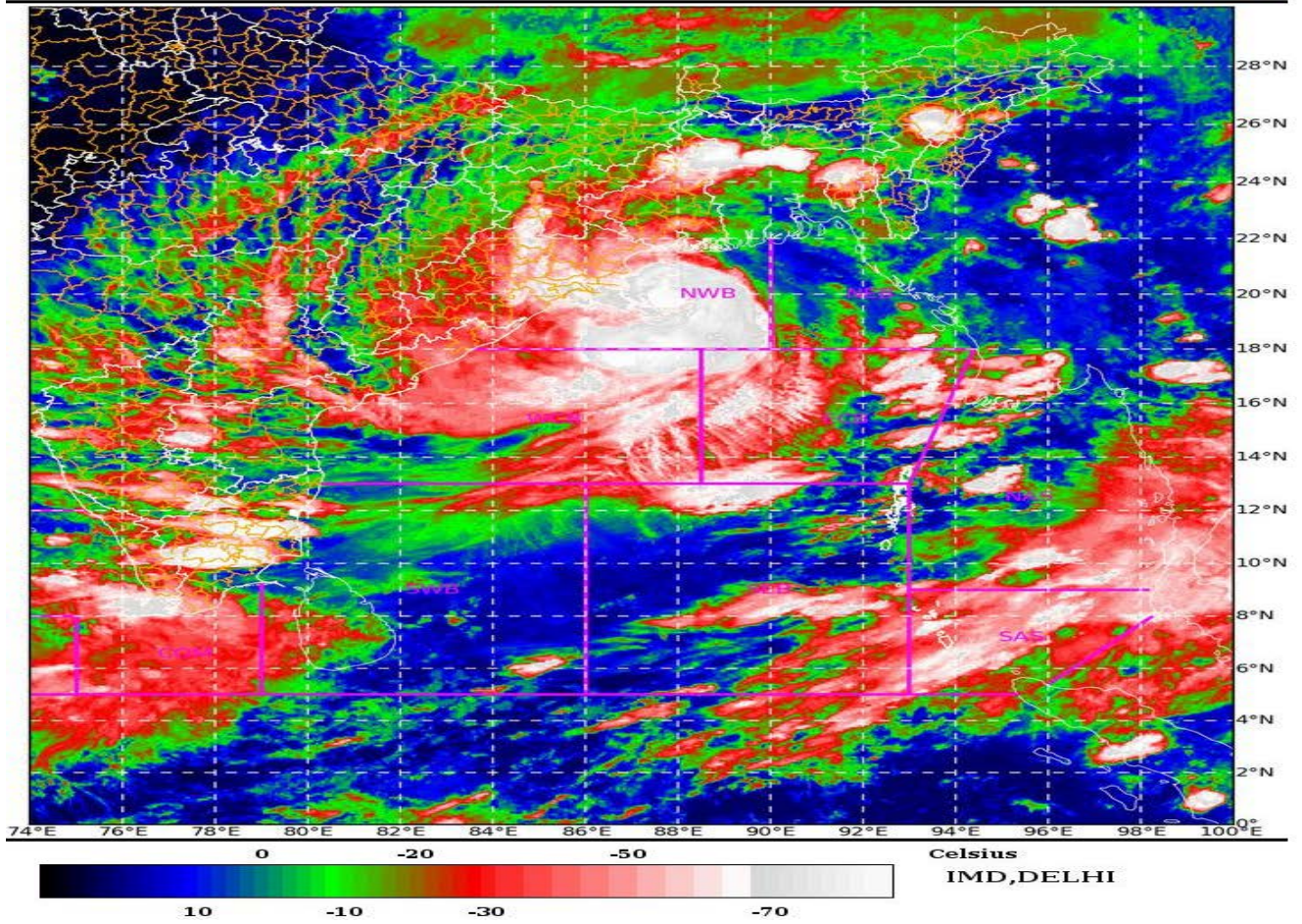
Floods & Heavy Rain: 70 persons reportedly claimed dead due to Nandadevi Glacier breaks at Joshimath in Chamoli district of Uttarakhand on 7th February which triggered flash flood in Dhaulti Ganga area. It caused heavy damage to Tapovan hydel project tunnel and also 13 villages on the bank of Alaknanda river affected and one bridge near Malari swept away. Due to heavy rains on 7th & 8th January and 18th & 19th February in 14 districts of Maharashtra Viz. Akola, Aurangabad, Beed, Jalna, Kolhapur, Latur, Nagpur, Nasik Osmanabad, Pune, Ratnagiri, Sangli, Sindhudurg & Solapur extensive damage to rabi crops were reported.

Snowfall: Total 6 persons reportedly claimed dead in the first fortnight of January. Of which, 4 persons reportedly claimed dead from Chamba, Lahaul & Spiti districts of Himachal Pradesh on 12th January. While, 2 persons reportedly claimed dead from Kupwara & Srinagar districts of Jammu & Kashmir on 6th January. Also, Bandipora, Baramulla, Ganderbal, Kupwara, Shopian districts of Jammu & Kashmir were affected on 6th January & 3rd, 4th February.

Cold Wave: Due to cold wave, total 5 persons reportedly claimed dead in the month of January, of which, 3 persons reportedly claimed dead from

SAT : INSAT-3D IMG 25-05-2021/(1300 to 1326) GMT
 IMG_TIR1_TEMP 10.8 um 25-05-2021/(1830 to 1856) IST
 L1C Mercator

(a)



(b)

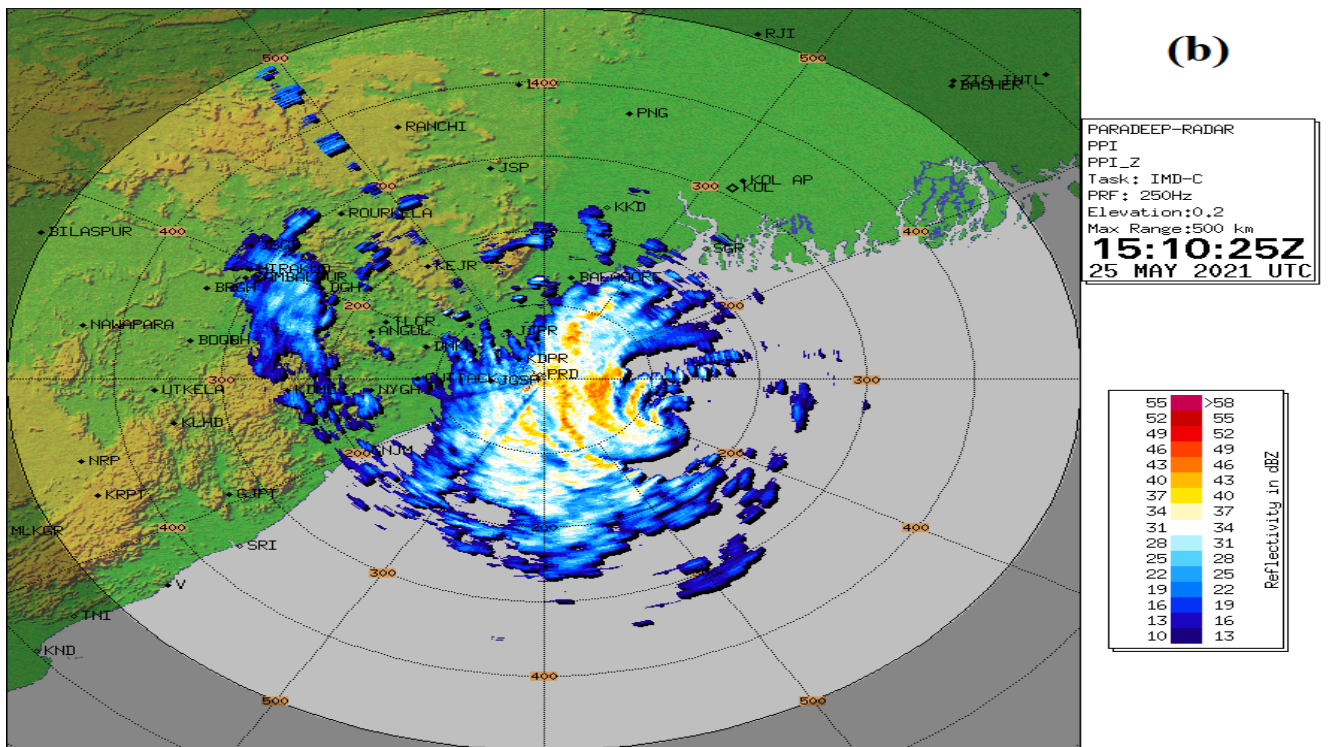


Figure 3: (a) Latest imagery of INSAT 3D and (b) Doppler Weather RADAR of Paradip of 25 May 2021.

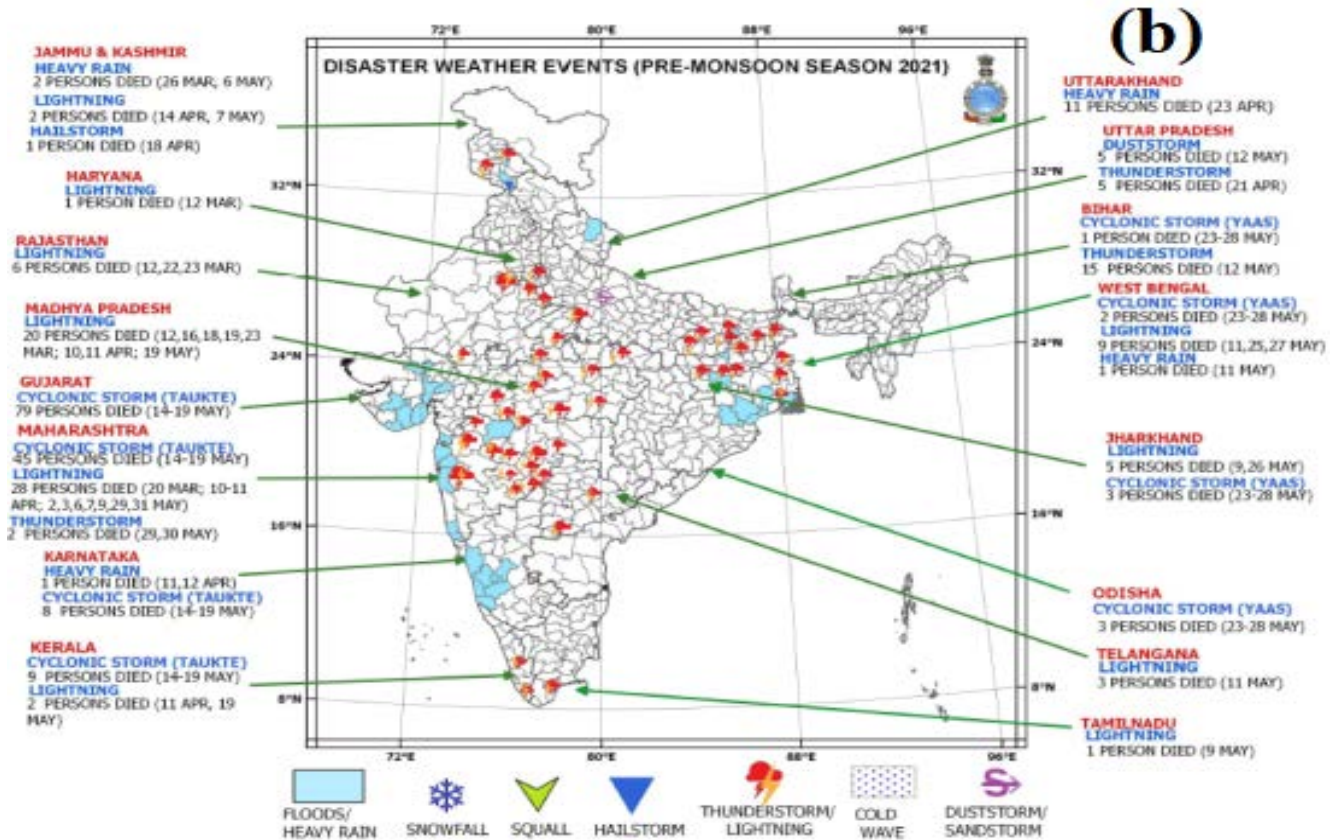
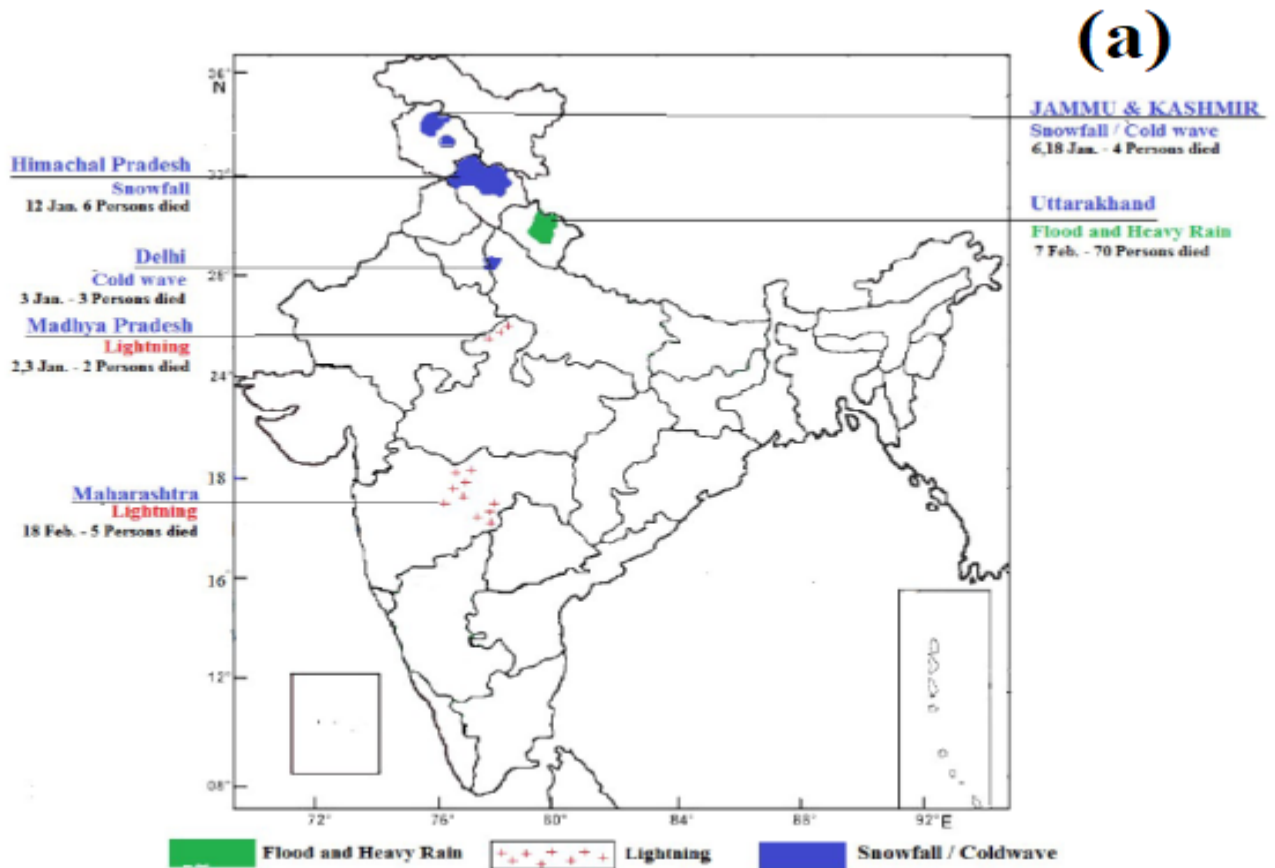


Figure 4: Significant weather events during (a) Winter and (b) Pre-monsoon seasons, 2021.

Union Territory (Delhi) on 3rd January and 2 children from Kulgam district of Jammu & Kashmir on 18th January.

Lightning: In total, 7 persons reportedly claimed dead during the season. Of which, 2 from Morena district of Madhya Pradesh on 2nd & 3rd January. While, 5 persons reportedly claimed dead from Buldhana, Jalna & Nanded districts of Maharashtra on 18th February.

Hailstorm: Due to hailstorm on 18th & 19th February in Jalna, Kolhapur, Nashik, Pune, Raigad, Ratnagiri, Satara, Sindhudurg districts of Maharashtra extensive damage to rabi crops including Wheat, Gram, Jawar, vegetables & fruit orchards including Grapes has been reported.

4.1 Pre-monsoon Season (Mar-May)

During the season, 273 persons reportedly claimed dead, more than 120 persons injured, 53 persons missing & more than 190 livestock excluding thousands of birds perished. Of which, more than 200 persons reportedly claimed dead, also more than 100 persons injured, 53 persons missing, more than 170 livestock perished in the worst hit month of the pre-monsoon month of May 2021 due to the different weather events, as given below:

Cyclonic Storms: Both the coasts of India were affected during the month of May 2021 due to the ESCS TAUKTAE (14th to 19th May) on the west coast and VSCS YAAS (23rd to 28th May) on the east coast. In total, 153 persons reportedly claimed dead, 94 injured and more than 50 were missing because of both the cyclones. Of these, 144 persons reportedly claimed dead due to TAUKTAE across the states in western India stretching from Kerala in the far southern part of the country to Gujarat in the northwest which includes 79 persons reportedly claimed dead from Gujarat (Amreli, Ahmedabad, Bhavnagar, Gir Somnath, Kheda, Patan, Rajkot, Valsad & other districts), 45 from Maharashtra (Palghar, Raigad, Sindhudurg, Thane, Jalgaon) including 26 persons on board the barge P-305 and another tugboat 'Varaprada' in the vicinity of district Mumbai City, 9 from Kerala, 8 from Karnataka (Chikmagalur, Dakshina Kannada, Shimoga, Udupi, Uttara Kannada), 3 from Goa.

While, in total 9 persons reportedly claimed dead due to YAAS, of which, 3 each from Odisha (Balasore, Keonjhar, Mayurbhanj) & Jharkhand (Koderma, Ranchi), 2 from West Bengal and one from Begusarai district of Bihar. Extensive damage to crops and public and private property was also reported.

Lightning: In total, 77 persons reportedly claimed dead during the season. Of which, 28 persons reportedly claimed dead from Aurangabad, Beed, Dhule, Hingoli, Jalna, Latur, Nashik, Osmanabad, Parbhani, Pune, Yavatmal districts of aharashtra (20th Mar.; 10th, 11th Apr.; 2nd, 3rd, 6th, 7th, 9th, 29th, 31st May), 20 from Betul, Bhind, Bhopal, Burhanpur, Damoh, Dhar, Guna, Khargaon, Satna, Sehore, Seoni, Shivpuri districts of Madhya Pradesh (12th, 16th, 18th, 19th 23rd Mar.; 10th & 11th, Apr.; 19th May), 9 persons from Hugli, Howrah, Murshidabad, Purba Bardhaman districts of West Bengal (11th, 25th & 27th May), 6 from Alwar, Bharatpur, Jhunjhunu, Udaipur districts of Rajasthan (12th, 22nd, 23rd Mar.), 5 form Bokaro, Latehar, Ramgarh districts of Jharkhand (9th & 26th May), 3 from Mulugu, Wanaparthi, Warangal Rural districts of Telangana (11th May), 2 each from Ernakulam, Thiruvananthapuram districts of Kerala (11th Apr., 9th May) & Anantnag, Rajouri districts of Jammu & Kashmir (14th Apr., 7th May), One each from Gurgaon district Haryana (12th Mar.) and Tuticorin district of Tamil Nadu (9th May).

Thunderstorm: Total 22 persons reportedly claimed dead & more than 70 livestock perished during the month of April & May of the season. Of which, 15 persons reportedly claimed dead from Banka, Bhagalpur, Bhojpur, Jamui, Katihar, Munger, Nalanda, Rohtas, Samastipur districts of Bihar (12th May), 5 from Parts of Uttar Pradesh (21st Apr.), 2 persons from Nashik & Nanded districts of Maharashtra on (29th & 30th May). Also, damage to crops, public & private property including houses, shops, electricity lines and poles reported from Bathinda, Patiala districts of Punjab (6th Apr.), Union Territory Chandigarh (6th Apr.), East Sikkim (9th Apr.), Jhabua district of Madhya Pradesh (14th Apr.), Aurangabad, Beed, Hingoli, Jalna, Jalgaon, Nanded, Osmanabad, Parbhani,

Pune, Sindhudurg, Solapur districts of Maharashtra (11th, 13th, 28th Apr. & 9th, 24th & 27th May) Floods & Heavy Rain: Total 15 persons reportedly claimed dead due to floods & heavy rains during the season. Of these, 11 persons reportedly claimed dead in an avalanche in the Chamoli district of Uttarakhand on 23rd Apr., 2 from Anantnag, Udhampur districts of Jammu & Kashmir (26th Mar., 6th May), while, one each from Davangere district of Karnataka (during 11th-12th Apr.) and other from Kolkata, West Bengal on 11th May. Also, due to heavy rains and flash flood, damage to crops, public and private property including bridge reported from Kupwara district of Jammu & Kashmir (29th Mar.), Ahmednagar, Akola, Aurangabad, Beed, Buldhana, Hingoli, Jalna, Kolhapur, Latur, Nanded, Nashik, Osmanabad, Parbhani, Pune, Sangli, Satara, Sindhudurg, Solapur, Washim districts of Maharashtra (19th, 20th Mar.; 14th Apr.; 7th, 9th May), Dakshina Kannada, Yadgir district of Karnataka (6th, 11th, 12th Apr.), East Sikkim (9th Apr.), Uttarkashi district of Uttarkhand (29th May), Ganderbal district of Jammu & Kashmir (7th May).

Dust Storm: 5 persons reportedly claimed dead from Hardoi district of Uttar Pradesh on 12th May. Thousands of birds perished from Jaisalmer district of Rajasthan (22nd Mar.). Also, damage to crops,

houses, transformers, etc. reported from Ajmer, Alwar, Barmer, Bikaner, Churu, Jaipur, Jaisalmer, Jhunjhunu districts of Rajasthan (22nd & 23rd Mar.).

Hailstorm: One person reportedly claimed dead from Kathua district of Jammu & Kashmir (18th Apr.). Also, extensive damage to crops, vegetables, different types of fruits & houses reported from Kota district of Rajasthan (7th & 8th Mar.); Ashoknagar, Bhind, Dhar, Guna, Khandwa, Morena, Shajapur, Ujjain districts of Madhya Pradesh (8th, 19th and 23rd Mar.); Aurangabad, Beed, Jalna, Hingoli, Parbhani, Pune districts of Maharashtra (20th, 21st Mar.; 9th May); East Sikkim (9th Apr.); Anantnag, Baramulla, Kulgam, Kupwara, Pulwama, Shopian districts of Jammu & Kashmir (7th, 15th, 21st and 31st May); Maldah district of West Bengal (11th May).

Gale: Damage to the Government School and residential house reported from Anantnag and Baramulla districts of Jammu & Kashmir (22nd & 23rd Mar.).

Acknowledgements:

This report has been prepared by Dr. D. R. Pattanaik based on inputs from IMD Pune and RSMC New Delhi after compilation with other available information.