Report on Extreme Weather Events during January-May 2023

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 and 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. The passage of WDs under favorable 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 gives rise to 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 thunderstorms, dust storms, squalls and dust-raising winds. Some days, temperatures can shoot up under favorable conditions and give rise to heat waves and hot day conditions, especially along the northern plains and central parts of the country, the frequency of which is maximum in 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 2023.

2. Cyclonic Systems

During the winter season from January to February 2023, no tropical cyclone was formed in the winter season over the North Indian Ocean (NIO). However, a Depression over the southeast & adjoining southwest Bay of Bengal (30th January – 02nd February 2023) was formed during the season. During the pre-monsoon season from March to May (MAM) an Extremely Severe Cyclonic Storm (ESCS) “MOCHA” was formed over the Bay of Bengal.

The salient features of the cyclonic disturbances (CDs) over the north Indian Ocean (NIO) during the year 2023, the operational forecast performance of the India Meteorological Department (IMD) and new initiatives during the year are presented below:

2.1. Salient features of CDs over the NIO

Following CDs developed over the NIO during 2023 (Figure 1a-b):

• Depression over southeast & adjoining southwest Bay of Bengal (30th January –02nd February 2023)

• Extremely Severe Cyclonic Storm “MOCHA” over the Bay of Bengal (9th-15th May, 2023).

2.1.1 Depression over southeast & adjoining southwest Bay of Bengal

The track of the above two systems can be seen in Figure 1a-b. As seen in Fig. 1a, a cyclonic circulation developed over East Equatorial Indian Ocean (EEIO) and adjoining southeast Bay of Bengal (BoB) in the forenoon (0830 hrs IST/0300 UTC) of 25th January, 2023. It lay as a low pressure area over the same region in the morning (0530 hrs IST/ 0000 UTC) of 27th January, 2023 and as a well marked low pressure area (WML) over southeast BoB and adjoining EEIO in the forenoon (0830 hrs IST/0300 UTC) of 29th January, 2023. Under favourable environmental conditions, it concentrated into a depression over southeast and adjoining southwest BoB in the forenoon (0830 hrs IST/ 0300 UTC) of 30th January, 2023. It moved west-northwestwards till noon (1130 hrs IST/0600 UTC) of 31st January. Thereafter, it recurved southwestwards and crossed Sri Lanka coast between Batticaloa and Trincomalee near latitude 7.8°N and longitude

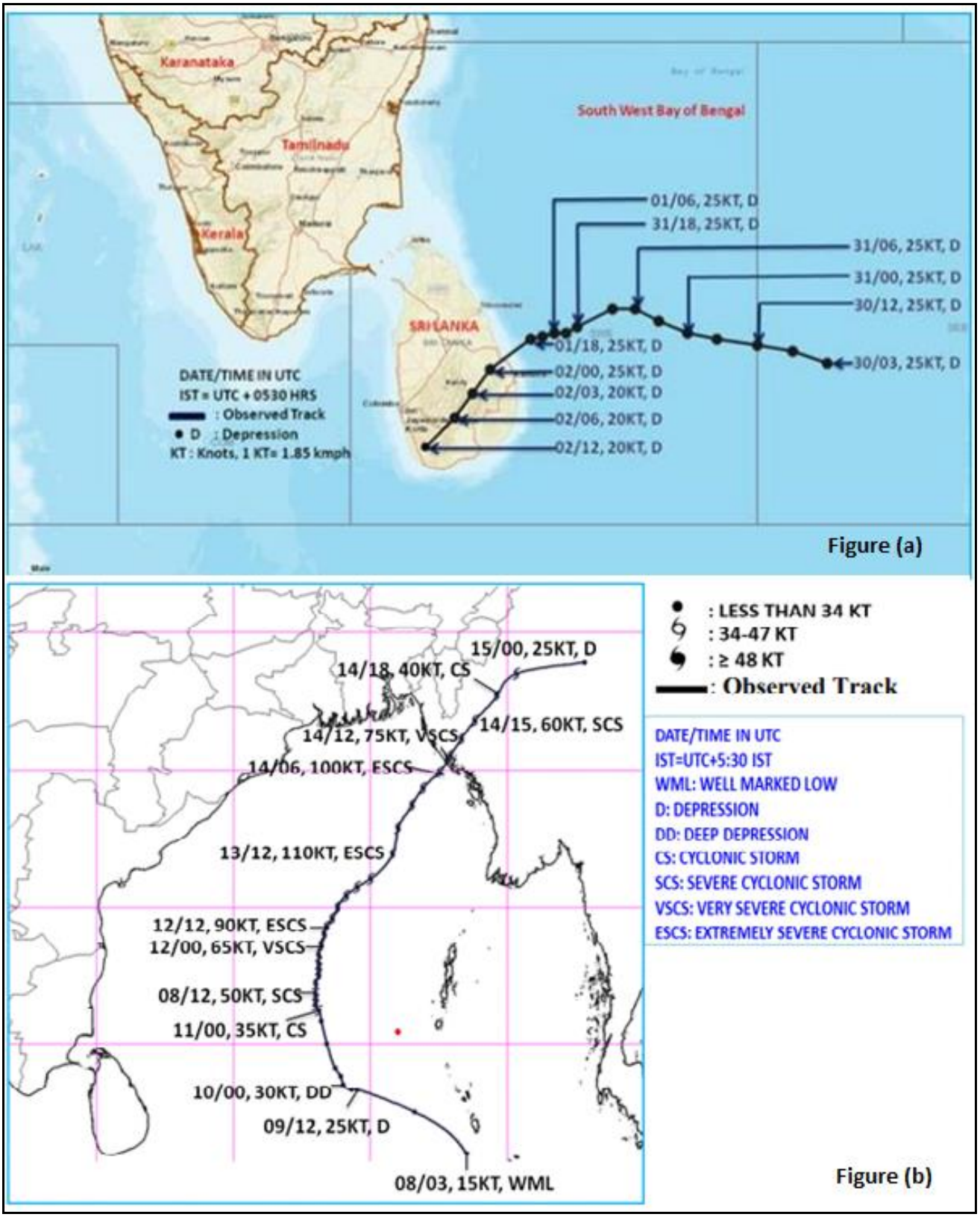

Figure 1: Tracks of Cyclonic Disturbances (a) Depression over the Bay of Bengal during January 2023 and (b) Extremely Severe Cyclonic Storm 'MOCHA' over the Bay of Bengal during January 2023.

81.6°E from 0330 to 0430 hrs IST of 2nd February, 2023 (between 2200 & 2300 UTC of 1st February). Continuing to move further southwestwards, it weakened into a well-marked low pressure area over Comorin and adjoining Gulf of Mannar and the west coast of Sri Lanka during midnight (around 2330 hrs IST/1800 UTC) of 2nd February, 2023. The Depression was monitored by INSAT-

3D enhanced colored imageries during the life cycle of the Depression southwest & adjoining southeast Bay of Bengal from 30Jan -02 Feb, 2023 as shown in Figure 2.

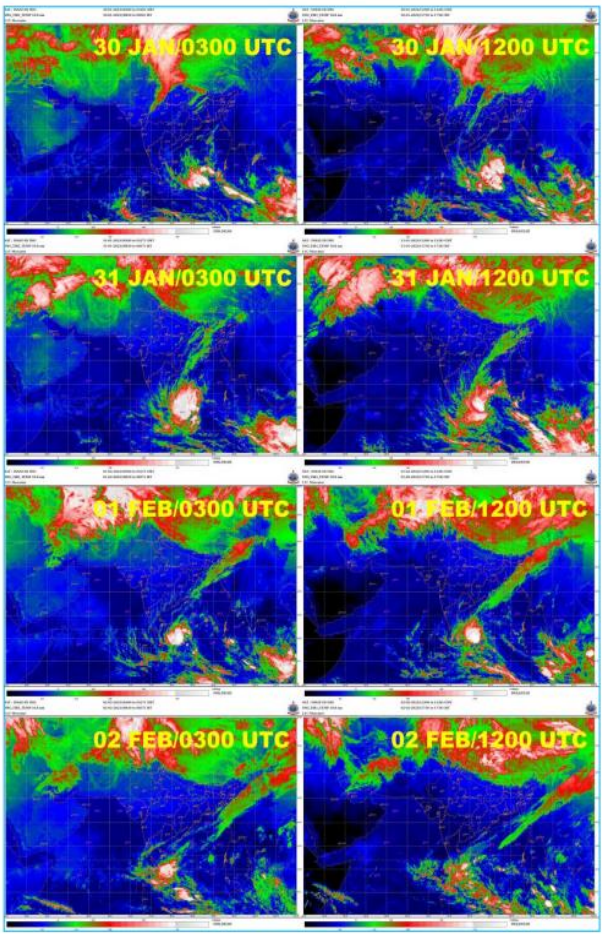

Figure 2: INSAT-3D enhanced colored imageries during the life cycle of Depression southwest & adjoining southeast Bay of Bengal during 30Jan -02 Feb, 2023.

2.1.2 Extremely Severe Cyclonic Storm "MOCHA" over the Bay of Bengal

As seen from Fig. 1b, a Cyclonic Circulation formed over the Southeast Bay of Bengal (BoB) and neighbourhood in the morning (0830 hrs IST/0300 UTC) of 6th May, 2023. Under it's influence a Low Pressure Area (LOPAR) formed over southeast BoB and adjoining south Andaman Sea in the morning (0830 hrs IST/0300 UTC) of 8th May 2023. It lay as a Well-Marked Low Pressure Area (WML) over the same region in the early morning (0530 hrs IST/0000 UTC) of 9th May 2023. It concentrated into a Depression (D) in the same evening (1730 hrs IST/1200 UTC) over Southeast BoB and lay centered at about 510 km southwest of Port Blair. It initially moved west-northwestwards and intensified into a Deep Depression (DD) in the early morning (0530 hrs IST/0000 UTC) of 10th May 2023 over southeast BoB and lay centred at about 540 km west-southwest of Port Blair. Thereafter, it moved north-northwestwards and intensified into a Cyclonic Storm (CS) "Mocha" pronounced as "Mokha" in the early morning (0530 hrs IST/0000 UTC) of 11th May 2023 over southeast BoB. From 11th morning (0830 hrs IST/0300 UTC), it started moving northwards and intensified into a Severe Cyclonic Storm (SCS) in the evening (1730 hrs IST/ 1200 UTC) of 11th May over the same region. ➢ Thereafter, it gradually started recurving north-northeastwards and intensified into a Very Severe Cyclonic Storm (VSCS) in the early morning (0530 hrs IST/0000 UTC) of 12th May over central BoB. Moving further north-northeastwards, it intensified into an Extremely Severe Cyclonic Storm (ESCS) at midnight (2330 hrs IST/ 1800 UTC of 12th May) over east-central BoB. Continuing to move north-northeastwards, it intensified further till early morning of 14th May. The peak intensity was 210-220 kmph gusting to 240 kmph over the east-central BoB from 13th midnight to 14th early morning. It then slightly weakened and crossed north Myanmar-southeast Bangladesh coasts between Kyaukpyu (Myanmar) and Cox's Bazar (Bangladesh) close to north of Sittwe (Myanmar) near latitude 20.3°N and longitude 92.8°E as an ESCS with maximum sustained wind speed (MSW) of 180-190 kmph gusting to 210 kmph during 1230 to 1430 hours IST of (0700 UTC to 0900 UTC) of 14th May. Thereafter, continuing to move north-northeastwards with a very fast speed, it weakened into a VSCS over westcentral Myanmar in the evening (1730 hrs IST/ 1200 UTC), SCS over the same region in the night (2030 hrs IST/ 1500 UTC) of 14th and further into a CS over westcentral & adjoining northwest Myanmar in the early morning of 15th May (0230 hrs IST of 15th/ 2100 UTC of 14th). Thereafter, it moved west-northwestwards and rapidly weakened into a depression over northwest Myanmar in the morning (0530 hrs IST/ 0000 UTC) of 15th May.

The ESCS "MOCHA" exhibited multiple recurvatures in it's track. Initially, it moved

westwards till 9th midnight (2330 hrs IST/1800 UTC) followed by west-northwestwards movement till 10th evening (1730 hours IST/ 1200 UTC) along the periphery of anticyclone located over the east-central BoB and the ridge ran near latitude 15°N. It then : Observed Track followed north-northwestwards track till 11th morning (0830 hrs IST/0300 UTC), under the influence of anticyclonic circulation over the South Andaman Sea. Thereafter, it moved nearly northwards till 11th midnight (2330 hrs IST/1800 UTC) under the influence of deep trough in westerlies and an anticyclone over the central Andaman Sea. It then moved north-northeastwards till 14th midnight (2330 hrs IST/1800 UTC) and east-northeastwards over Myanmar thereafter under the influence of the trough in westerlies lying to the left of the system in middle and upper tropospheric levels.

The satellite monitoring of the system was mainly done by using half-hourly INSAT 3D and 3DR imageries. Satellite imageries of international geostationary satellites Meteosat-8 & MTSAT and microwave & high-resolution images of polar-orbiting satellites NOAA series, Metops were also considered. Typical INSAT-3D enhanced colored imageries are presented in Fig. 3. The system showed a curved band pattern during genesis and a developing stage spiral band pattern during the mature stage. It showed a sheared pattern after landfall.

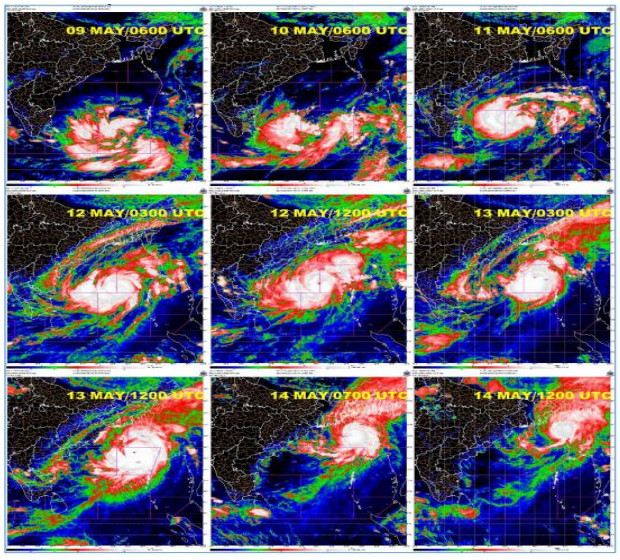

Figure 3: INSAT-3D enhanced colored imageries during life cycle of ESCS MOCHA (09 -14th May 2023).

3. Significant Weather Events

The significant weather events that occurred during the winter and pre-monsoon season of 2023 as obtained from the Climate Diagnostic Bulletin, published by IMD Pune is shown in Figure 3a & 3b respectively.

3.1. Winter Season (Jan-Feb)

Figure 4 shows significant weather events during the season (based on real-time media reports). From 1st January to 31st January, a total of 9 persons were reportedly claimed dead & one person missing. While in February no death or damage is reported due to any weather events. The details of causalities are given below, which are based on real-time media reports.

Cold Wave: A total of 5 persons reportedly claimed dead, during winter 2023, because of the Cold Wave with 4 in Fatehpur (Uttar Pradesh) on 10 January and 1 in Surguja (Chhattisgarh) on 6th January.

Snowfall: A total of 4 persons were reportedly claimed dead & one person missing, during winter 2023, because of Snowfall with the death of 2 in Ganderbal (Jammu & Kashmir) on 12th January and 2 in Kargil (Ladakh) on 30th January.

3.2 Pre-monsoon Season (Mar-May)

Figure 5 shows deaths due to significant weather events during Pre-Monsoon Season (March to May) 2023. (Based on real-time media reports). During Pre Monsoon Season, a total of 310 persons were reportedly claimed dead, more than 320 persons injured, more than 10 persons missing & more than 1270 livestock perished. The details of causalities are given below, which are based on real-time media reports.

Lightning: A total of 219 persons were reportedly claimed dead, more than 120 persons were injured & about 750 livestock perished, during Pre Monsoon Season, because of Lightning. The areas affected by the events are the states of Maharashtra, Jharkhand, Bihar, Uttar Pradesh, Karnataka, Tamil Nadu, Assam, Madhya Pradesh, Chhattisgarh, Union Territory-Jammu & Kashmir, Andhra

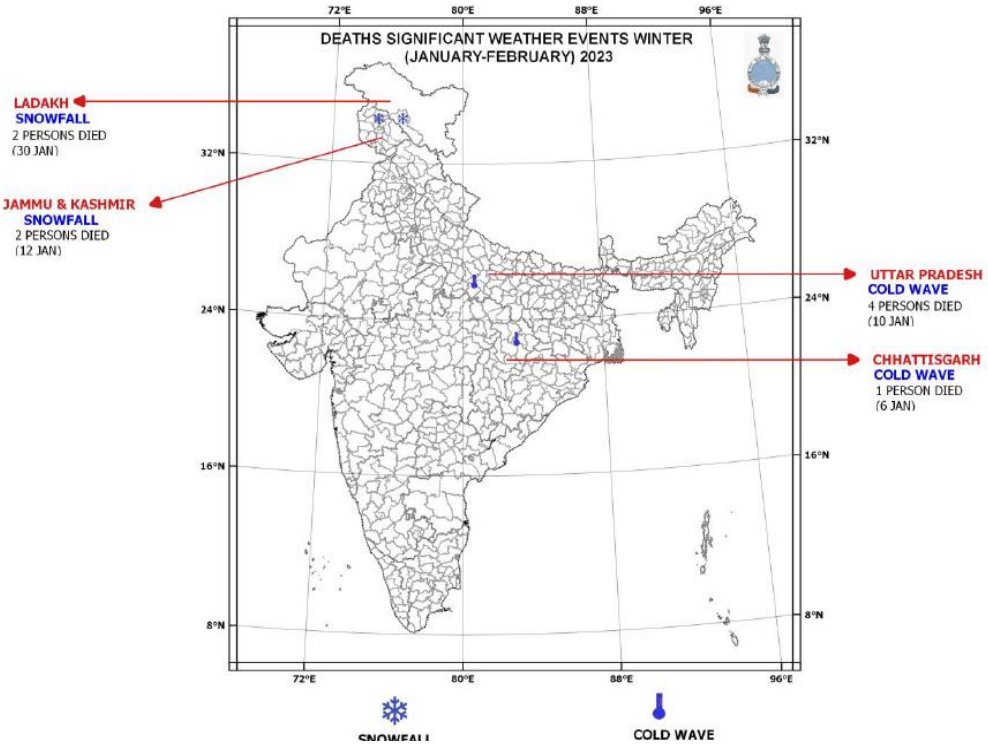

Figure 4: Significant weather events during the winter season (Jan-Feb) 2023 and associated death. (Based on real-time media report).

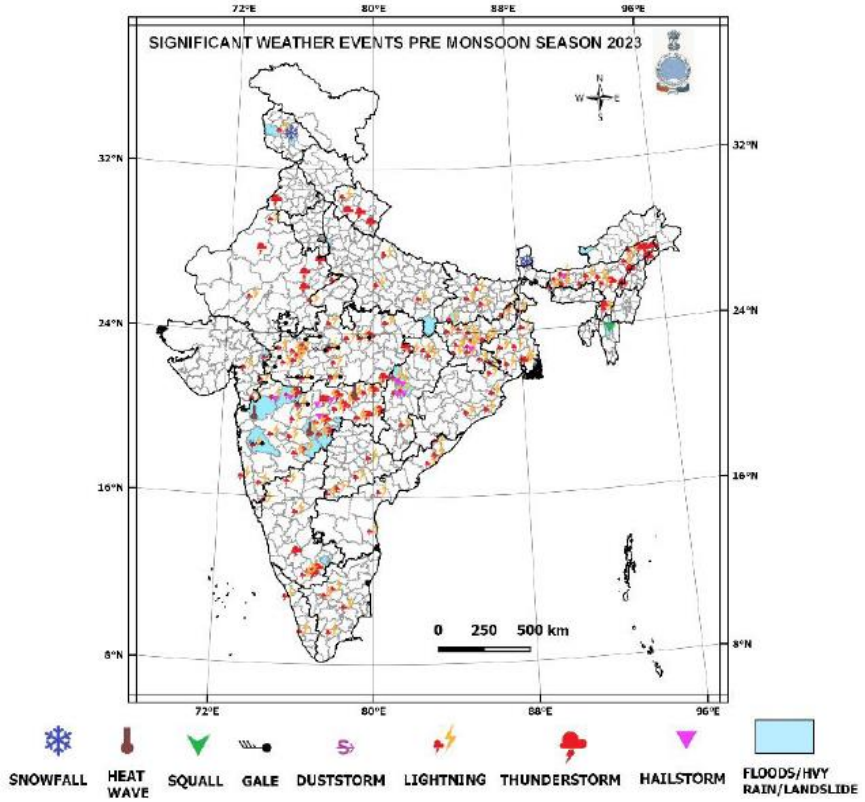

Figure 5: Significant weather events during pre-monsoon (Mar-May) 2023 and associated death. (Based on real-time media report).

Pradesh, Telangana, Uttarakhand, Gujarat, Rajasthan, West Bengal, Odisha and Kerala.

Thunderstorm: A total 47 persons were reportedly claimed dead, 81 persons were injured & 79 livestock perished during Pre Monsoon season, because of the Thunderstorm. The areas affected by the events are the states of Maharashtra, Rajasthan, Madhya Pradesh, Uttarakhand, Karnataka and Punjab.

Heavy Rains, Floods & Landslides: A total of 23 persons were reportedly claimed dead, 69 persons were injured, 11 persons missing & 87 livestock perished, during Pre Monsoon season, because of heavy rains, floods & Landslides. The areas affected by the events are the states of Mizoram, Uttar Pradesh, Union Territory-Jammu & Kashmir, Maharashtra, Karnataka, Gujarat, Arunachal Pradesh and Chhattisgarh.

Snowfall: A total of 8 persons were reportedly claimed dead & 11 persons were injured, during Pre Monsoon season, because of Snowfall. The areas affected by the events are the states of Sikkim and Union Territory-Jammu & Kashmir.

Gale: A total of 6 persons were reportedly claimed dead, 17 persons were injured & 2 livestock perished, because of Gale. The areas affected by the events are the states of Maharashtra, Jharkhand and Madhya Pradesh.

Heat Wave: A total of 5 persons reportedly claimed dead because of Heat Wave from Nagpur, Nashik & Parbhani districts of Maharashtra on 12th & 21st May.

Hailstorm: A total of 2 persons reportedly claimed dead, 4 persons injured & more than 350 livestock perished during pre-monsoon season. The areas affected by the events are the states of Chhattisgarh, Assam and Maharashtra.

Squall: 16 persons were injured due to a Squall in Aizawl, the state capital of Mizoram on 5th May.

Acknowledgments

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.