Flood and Lightening Early warning and Alerts

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भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

What is Early warning System?

WORLD METEOROLOGICAL ORGANIZATION

As per World Meteorological Organisation-

- An Early Warning System for floods, droughts, heatwaves or storms, is **an integrated system** which allows people to know that hazardous weather is on its way, and informs how **governments, communities and individuals** can act to minimize the impending impacts.
- **(सरकार, समुदाय और व्यक्ति)**
- **WMO has headquarters in Geneva, Switzerland founded on 23rd March 1950.**
- The World Meteorological Organization (WMO) is a specialized agency of the United Nations responsible for promoting international cooperation on atmospheric science, climatology, hydrology and geophysics.
- WMO is a consortium of National Meteorological and Hydrological Agencies of countries.

World Meteorological Day -23 March

Every year WMO day is celebrated with a theme to highlight the issues pertaining to Weather and climate community. This year's theme is **Early Warning and Early Action**

- Forecasts of what the weather will be are no longer enough.
- Impact-based forecasts that inform the public of what the weather will DO are vital to save lives and livelihoods.
- Yet one in three people are still not adequately covered by early warning systems.

(Refer-State of Climate Services 2020 Report: Move from Early Warnings to Early Action)

Early Warning and Early Action- the need of the hour

- **Weather, climate and water extremes are becoming more frequent and intense**
- **More of us are exposed than ever before to multiple related hazards, which are themselves evolving as a result if population growth, urbanisation and environmental degradation.**

- Greater coordination between National meteorological and hydrological services (IMD, CWC etc.), disaster management authorities and development agencies is fundamental to better prevention, preparedness and response to Weather and climate hazards.
- If we are prepared and able to act at the right time, in the right place, we can save many lives and protect the livelihoods everywhere, both now and in the future.

Impact Based Forecast

Focused on hazards → **Focused on impacts**

What the weather will be

Meteorological thresholds

"100mm in 48 hours"

"25 m/s winds"

What the weather will do

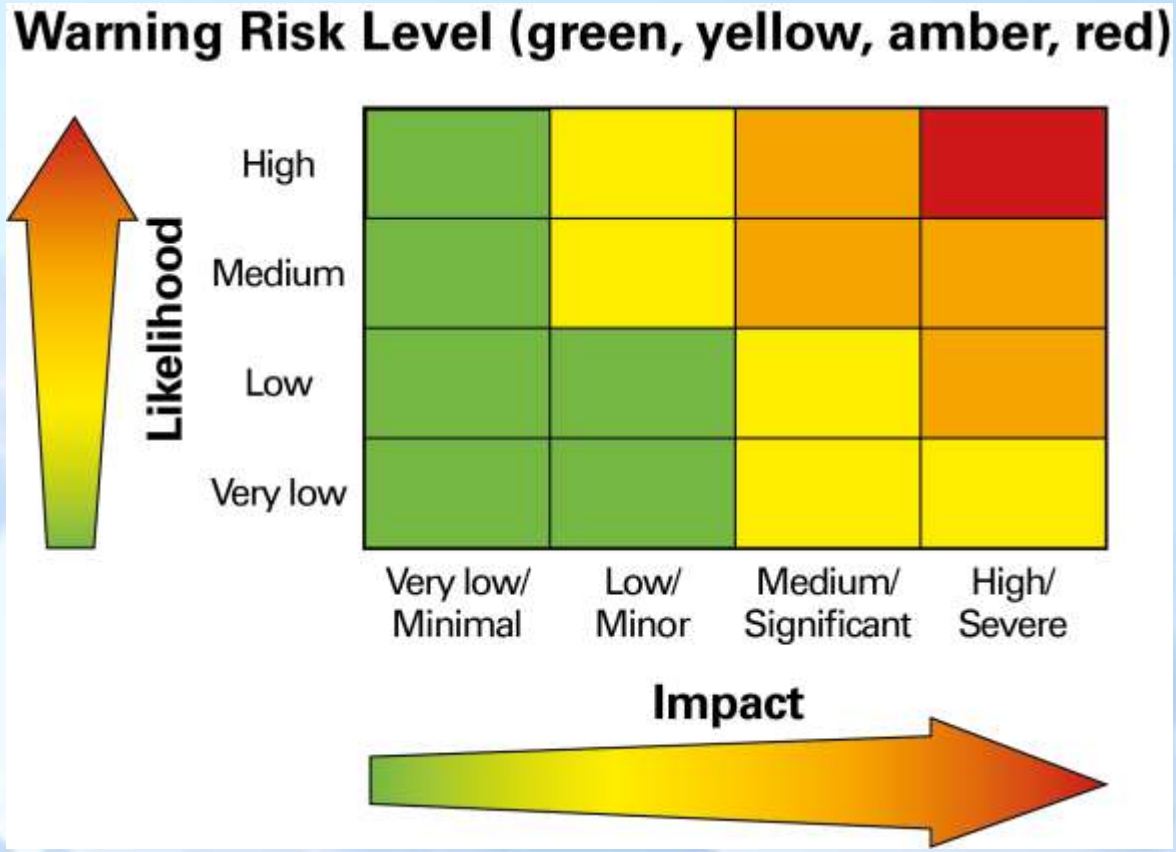
Impact warnings

"Cars overturning"

"Road closures"

Impact Based Forecast

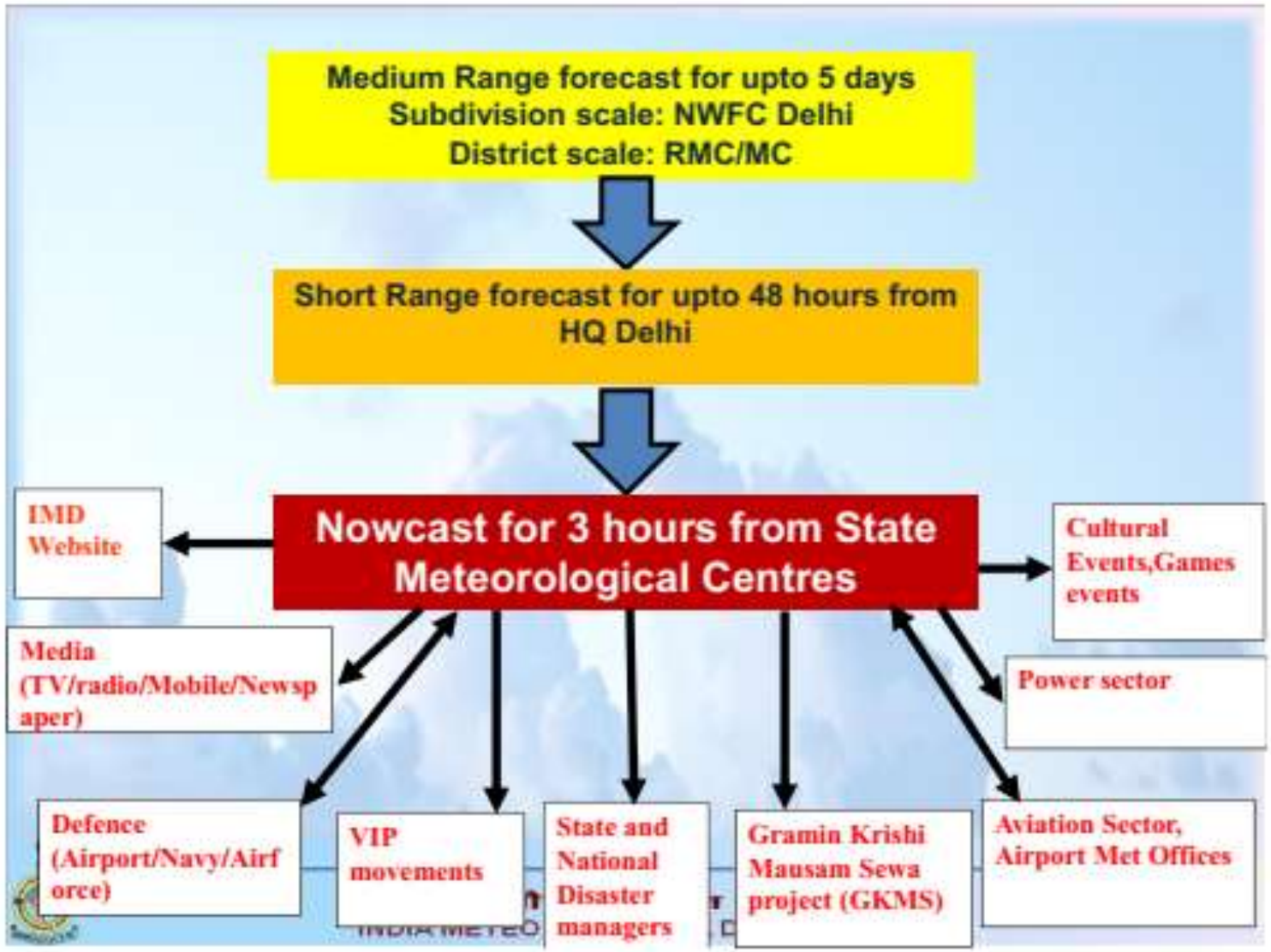
- Impact Based Forecast is being issued for all the districts taking into account probable impacts, weather events are going to have.
- IBF Color coded warnings are being warnings are being issued based on Likelyhood of weather event and probable Damage potential.
- Impact Based Forecast SOP and Risk matrix is under preparation



Early Warning System - NOWCAST

- **Since 2018, IMD is issuing district level nowcasts for severe weather for all districts of India round the clock at three hour intervals.**
- **Nowcasts warnings are issued for the following phenomena:**
  - **Thunderstorms and associated weather**
  - **Intensity of rainfall occurrence (light, moderate, heavy rainfall etc).**
- **Each nowcast may include 1 or more than 1 warnings which are classified in 19 categories.**
- **Normally 8 nowcasts are issued for each district in a day. (Every 3 hour)**

NOWCAST- Generation and Dissemination



3 Hourly Nowcast Color codes

- **Nowcasts are being issued by IMD for 732 Districts and 1089 stations all over India.**
- **In Uttar Pradesh, Nowcasts are issued for all 75 districts and 42 locations.**

i) No weather
ii) Light rain: < 5 mm/hr
iii) Light snow < 5cm/hr
iv) Light Thunderstorms with maximum surface wind speed upto 40 kmph
v) Slight dust storm: If the wind speed is up to 40 kmph and visibility is less than 1,000 metres but more than 500 meters due to dust
vi) Low cloud to ground Lightning probability (< 30% probability of lightning occurrence)

3 Hourly Nowcast Color codes

vii)·Moderate·rain:·5-15·mm/hr¤
viii)·Moderate·snow:·5-15·cm/hr¤
ix)·Moderate·Thunderstorms·with·maximum·surface·wind·speed·between·41·–·61·kmph·(In·gusts).¤
x)·Moderate·dust·storm:·If·the·wind·speed·is·between·41-·61·kmph·and·visibility·is·between·200·and·500·metres·due·to·dust¤
xi)·Moderate·cloud·to·ground·Lightning·probability·(30·-·60%·probability·of·lightning·occurrence)¤
xii)·Heavy·rain:·>15·mm/hr¤
xiii)·Heavy·snow:·>15·cm/hr¤
xiv)·Severe·Thunderstorms·with·maximum·surface·wind·speed·between·62·-·87·kmph·(In·gusts).¤
xv)·Very·Severe·Thunderstorms·with·maximum·surface·wind·speed·>·87·kmph·(In·gusts).¤
xvi)·Thunderstorms·with·Hail¤
xvii)·Severe·dust·storm:·If·surface·wind·speed·(in·gusts)·exceeding·61·kmph·and·visibility·is·less·than·200·metres·due·to·dust¤
xviii)·High·cloud·to·ground·Lightning·probability·(·>·60%·probability·of·lightning·occurrence)¤
xix)·Other·warnings·¤

Targets for Impact based forecasts for thunderstorm associated weather

- Automation of Accurate District level thunderstorm (and associated weather) forecasts in 1-5 day time scale
- Automation of Accurate location specific nowcasts of thunderstorm (and associated weather) up to village level
- Automation of Dissemination
- Automation of Verification and Crowdsourcing

Phenomenon- Thunderstorm (मेघ-गर्जन)

Thunderstorm is considered to HAPPEN/OBSERVED/REPORT over a station when thunder is heard by the observer.

- **A thunder is occasionally heard beyond the distance of 25 km.**
- **40 km may be considered as the maximum limit for the distance to which thunder can be heard from the source of lightening.**
- **The Climatology of thunderstorms will change appreciably, if the definition of thunderstorm at a station changed to include the days.**

By Meteorological Observer/ Weather Analyst-

(i) when a Cb cloud is detected by the radar and (ii) intense convection seen on satellite images

Therefore distance of source from observer and Cb cloud detection through Radar or Satellite is important to report the thunderstorm at the station.

Thunderstorm

- **Convective System:** Mesoscale in Nature

  Horizontal scale of ~ 10X10 km
  Vertical extent averaging ~ 15 km
  Time scale of about 1-6 hrs

- SEVERE THUNDERSTORMS and associated severe weather phenomenon like Hailstorms, Squall & Lightning occur when large scale systems interact with Mesoscale systems.
- **Forecasting a thunderstorm is one of the most difficult tasks in weather prediction, due to their rather small spatial (10km to 100 Km) and temporal (40 mins to 6 hrs) extension.**
- **Thunderstorm pose multi-hazards include strong winds, torrential rains, lightning, hail, flash flooding rains which have great socio-economic importance.**
- **Structure of these systems is complex due to interactions of complex physical processes. and the inherent nonlinearity of their dynamics and physics.**
- **Key air mass characteristics which contribute instability are warm, moist low-level air and cool, dry air aloft.**

Thunderstorm Intensity

- **Light Thunderstorm:**

Rain/thunder with max wind speed <41 kmph/21kts.

- Moderate Thunderstorm:

Rain/thunder with max wind speed 41-61 kmph/22-33 kts.

- **Severe Thunderstorm:**

Rain/thunder with max wind speed 62-87 kmph/34-47kts.

- Very Severe Thunderstorm:

Rain/thunder with max wind speed more then 87 kmph/47kts.

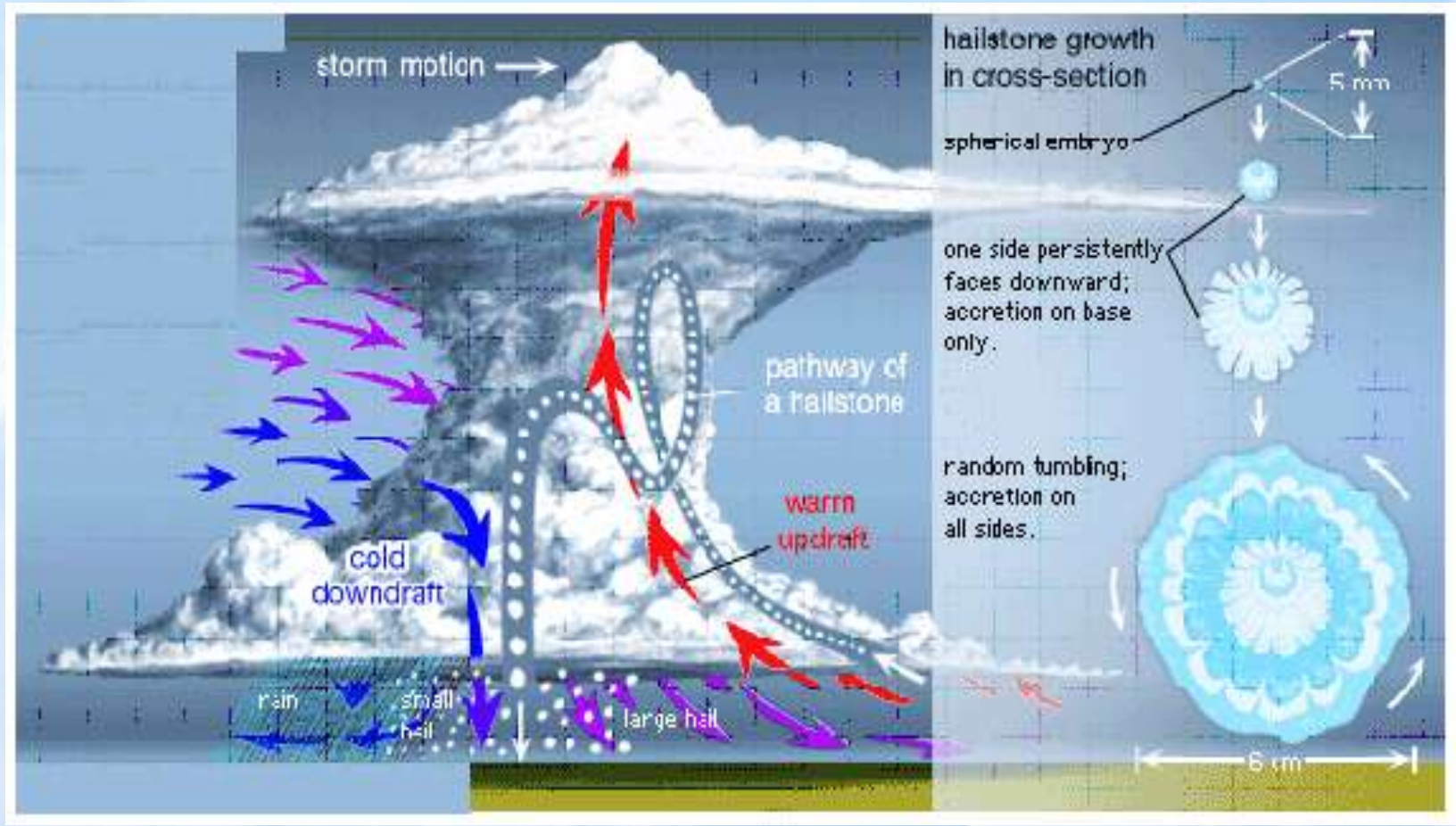
Near Gale	28 – 33 knots 50 – 61 km/h	Whole trees move	Wind impedes walking	
Gale	34 – 40 knots 62 – 74 km/h	Whole trees shake, twigs break	Windblown dust and dirt	
Strong Gale	41 – 47 knots 75 – 88 km/h	Branches start to break	**Light Damage:** Some damage to chimneys; twisting damage to signs; light weight awnings and canopies damaged; weak roofing lifts; windows may blow out; aircraft grounded.	
Storm	48 – 55 knots 89 – 102 km/h	Pushes over shallow-rooted trees		
Violent Storm	56 – 63 knots 103 – 117 km/h	Broken branches big enough to cause structural damage		
Hurricane Force	≥ 64 knots ≥ 118 km/h	Mature trees uprooted	**Moderate to Devastating Damage:** Roofs and some walls torn off; snaps powers lines; moving cars pushed off road or lifted; loose objects turned into missiles.	

Squall (झोंकेदार हवा)

SQUALL: A sudden increase of wind speed by at least 29 kmph (16 kts), the speed rising to 40 kmph (22 kts) or more and lasting for at least one minute.

Moderate Squall: Surface wind speed (in gusts) upto 80 kmph

Severe Squal : Surface wind speed (in gusts) > 80 kmph



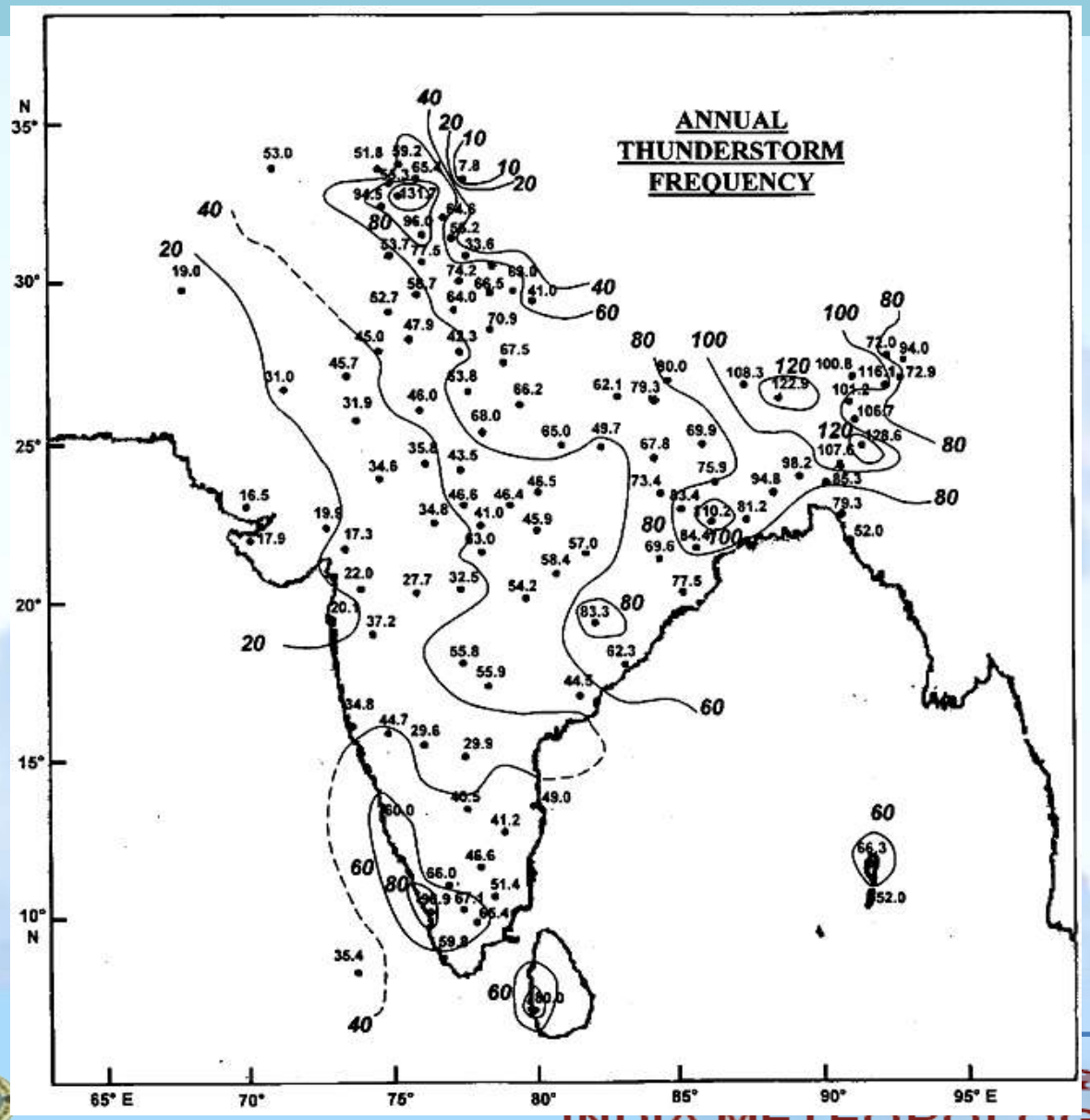
Duststorm (धूल भरी आँधी)

- **Duststorms,** which are raised dust in the air/atmosphere occur only in the plains of Northwest India. Locally these are known as ‘ANDHIS’.
- Duststorm activity starts in April and continues up to June. Frequency of occurrence of duststorms is at maximum in June.
- On a few occasions duststorms are followed by thundershowers.
- Intense surface heating, western disturbances and westerly trough are the main causes of duststorms.

❖ **Type-**

- **(I) Pressure gradient type (due to dust particles raised by strong winds (25-30knots) caused due to Low presuure area.** occur in Rajasthan & adjoining areas of south Haryana and West Uttar Pradesh in general during May and June
- **(II) Convective Type :- Dust raised due to downdraft winds of Convective clouds. (dust may go upto height of 2-3 kms)**

Annual thunderstorm Frequency



No. of thunderstorm days in a year-

Lucknow -49.9

Varanasi- 49.7

Bahraich- 29.0

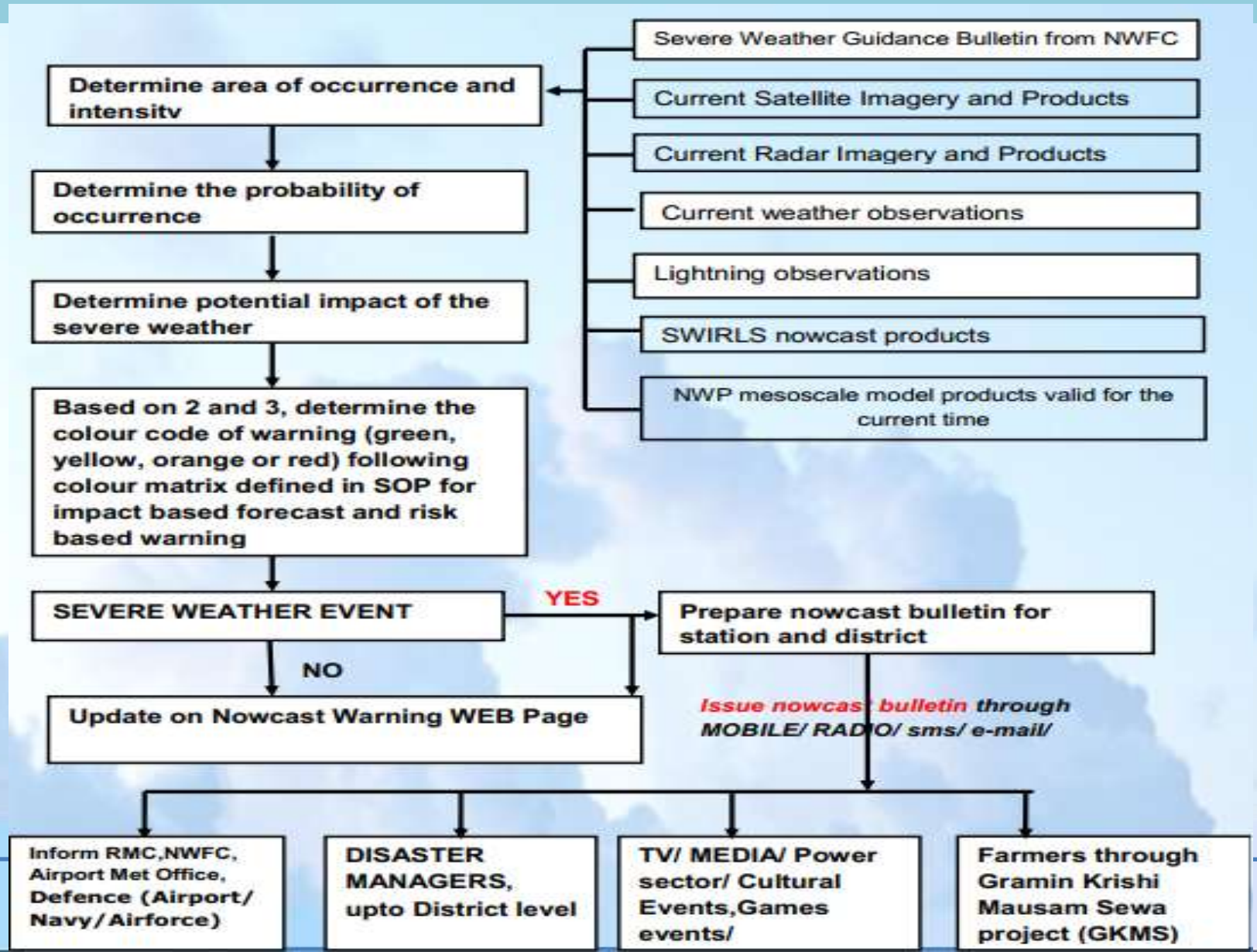
Gorakhpur- 62.1

Allahabad-65.0

Faizabad- 32.5

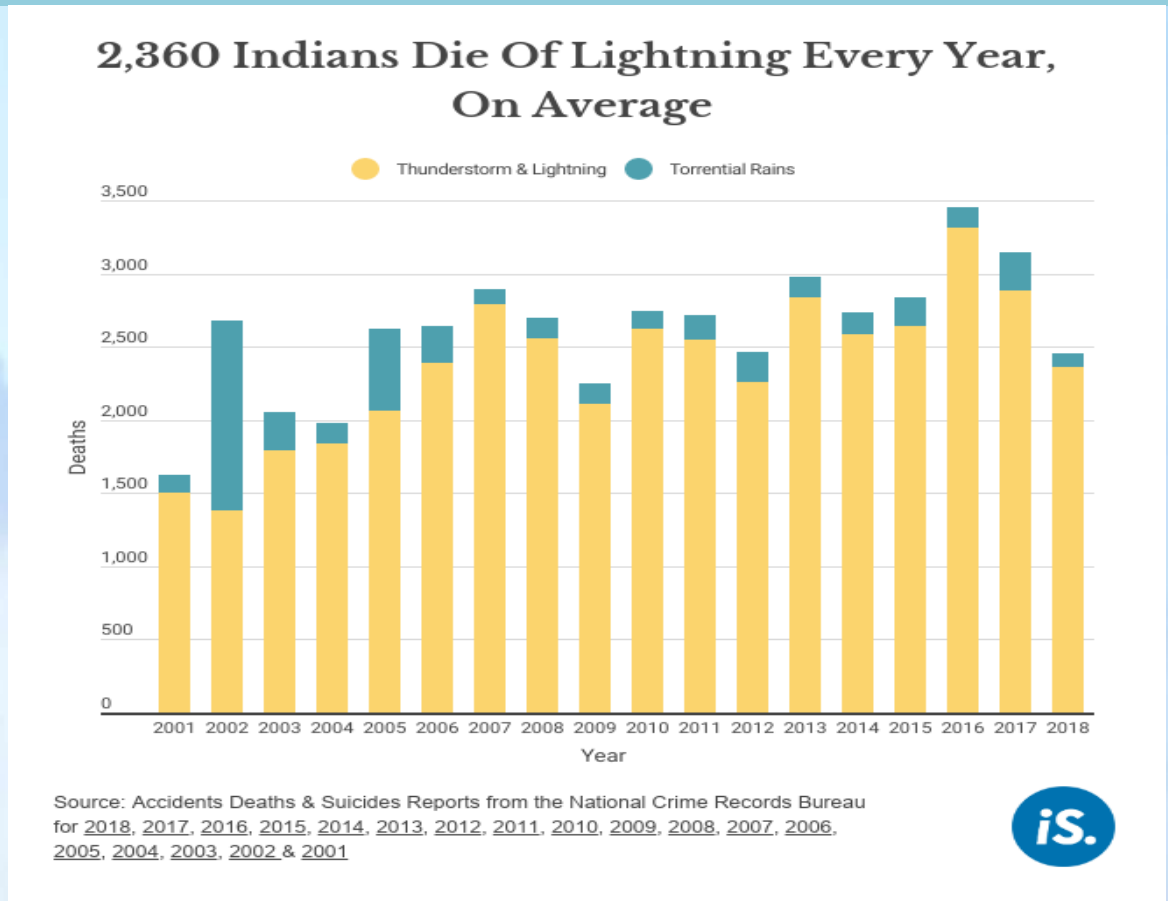
Agra-63.8

Decision tree for Nowcasting of Thunderstorm



Lightening

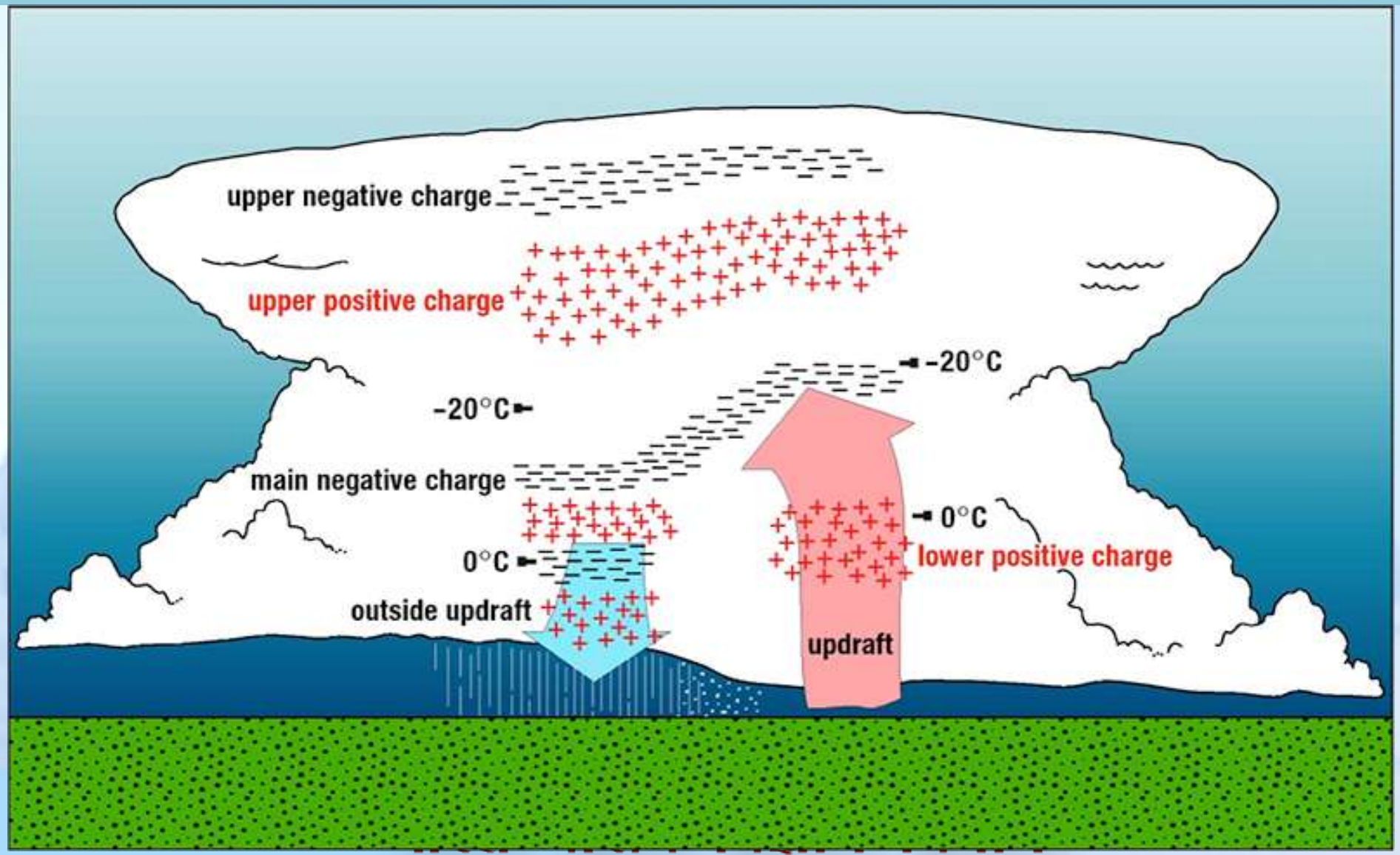
- **More than 40,000 deaths in 18 years**
- Nearly 42,500 people were killed due to lightning strikes between 2001 and 2018, according to NCRB data (see chart) on accidental deaths. The large proportion of these deaths were in rural India, with only 4% in urban settings, the South West Monsoon Lightning Report 2019, brought out by the Lightning Resilient India Campaign, shows.
- Uttar Pradesh (UP), Madhya Pradesh, Bihar, Odisha and Jharkhand reported the highest number of lightning fatalities in the country
- Lightning Early Warning- has improved a lot in last few years. IMD issues forecasts Medium range for 3-5 days, short range 1-3 days , nowcast 2-3 hours and Damini app 40 minutes location specific.



Lightening Detection

- **IITM and IAF ground based lightning Networks -** to detect, locate and map the total lightning (Intra-Cloud (IC) and Cloud -to-Ground (CG) to understand the physics of lightning.
- **Odisha, West Bengal Jhrkhand and Karnataka states were recorded highest numbers of lightning strokes counts**
- **Deaths and major impact due to lightning strokes were observed mainly in Uttar Pradesh, Bihar, Maharashtra region of India.**
- **Building of Lightning safety structures which can be used prior to lightning strikes or making of present structures safe to lightning in Rural region of India is essential requirements for safety due to lightning.**

Lightening – Charge distribution



Moderate to severe Thunderstorm -04th May 2022

भारत सरकार
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लखनऊ - 226009

Government of India
Ministry of Earth Sciences
India Meteorological Department
State Weather Forecasting Centre
Lucknow -226009

दिनांक:04/05/2022 Date:04/05/2022

जारी करने का समय: 22:40 बजे (भा.मा.स.) Time of Issue 22:40 Hrs. IST

To,

1. The Districts Magistrate Etawah, Kannauj, Hardoi, Kanpur, nagar, Kanpur Dehat, Auraiya, Hardoi, Lucknow, Balrampur, Siddharth Nagar, Basti.
2. Relief Commissioner, Uttar Pradesh, Lucknow.
3. All India Radio Gorakhpur/ Lucknow.
4. Door Darshan Lucknow.
5. National Weather Forecasting Centre, New Delhi.
6. Regional Weather Forecasting Centre, New Delhi.

Sub. : Rain/Thundershowers/ Hailstorm/Lightning/Squall Nowcast.

VALIDITY	SEVERE WEATHER PHENAMENA VERY LIKELY/MOST LIKELY	IMPACT	ACTION SUGGESTED	DISTRICT AFFECTED (ISOLATED/A FEW/MANY PLACES)
03 Hrs. (upto 01:55 Hrs. IST) on dated 05/05/2022	Light to Moderate Thunderstorm (Maximum Surface wind upto 60 Kmph in gusts) with lightning and Rain	•Minor damage to loose / unsecured structures	•People are advised to keep a watch on the weather for worsening conditions and be ready to move to safer places accordingly.	At a few places over Kanpur, nagar, Kanpur Dehat, Hardoi, Lucknow, districts and adjoining areas.
	Moderate to Severe Thunderstorm (Surface wind upto 87 Kmph in gusts/Squall) with lightning and Rain	•Damage to thatched huts. •Roof tops may blow off. Unattached metal sheets may fly.	•People are advised to stay away from weak walls and structures and take shelter in pukka structures. •People in affected areas to remain indoors and avoid water bodies and flying projectiles. •Farming operations to be temporarily suspended during occurrence of event. •DO NOT take shelter under trees and particularly under isolated tree as these conduct electricity.	At isolated places over Etawah, Kannauj, Hardoi, Auraiya, Siddharth Nagar, Basti, Unnao districts and adjoining areas.
	Thunderstorm associated with Hailstorm	•Major damage to Kutcha structures and tin and asbestos roofed houses, cars.	•People are advised to stay away from weak walls and structures and take shelter in pukka structures. •People in affected areas to remain indoors.	At isolated places over Etawah, Kannauj, Hardoi, Auraiya, Siddharth Nagar, Basti, Balrampur, Unnao, Kanpur Nagar districts and adjoining areas.

Meteorological Centre
Lucknow-226009

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दिनांक:05/05/2021 Date: 05/05/2021

जारी करने का समय:00:25 बजे Time of Issue: 00:25 Hrs. IST

To,

1. The Districts Magistrate Hardoi, Unnao, Lucknow, Sitapur, Barabanki, Raebareli, Ayodhya, Bahraich, Gonda, Shrawasti, Balrampur, Siddharth Nagar, Maharajganj, Sant Kabir Nagar, Gorakhpur, Farrukhabad, Kannauj, Amethi .
2. Relief Commissioner, Uttar Pradesh, Lucknow.
3. All India Radio Gorakhpur/ Lucknow.
4. Door Darshan Lucknow.
5. National Weather Forecasting Centre, New Delhi.
6. Regional Weather Forecasting Centre, New Delhi.

Sub. : Rain/Thundershowers/ Lightning Nowcast.

VALIDITY	SEVERE WEATHER PHENAMENA VERY LIKELY/MOST LIKELY	IMPACT	ACTION SUGGESTED	DISTRICT AFFECTED (ISOLATED/A FEW/MANY PLACES)
03 Hrs. (upto 03:50 Hrs. IST)	Light to Moderate Thunderstorm (Maximum Surface wind upto 60 Kmph in gusts) with Lightning and Rain	•Minor damage to loose / unsecured structures	•People are advised to keep a watch on the weather for worsening conditions and be ready to move to safer places accordingly.	At a few places over Farrukhabad, Kannauj districts and adjoining areas.
	Moderate to Severe Thunderstorm (Maximum Surface wind upto 87 Kmph in gusts/squall) with Lightning and Rain	•Minor damage to loose / unsecured structures •Damage to thatched huts.	•People are advised to take shelter in pukka structures and avoid taking shelter under trees. •Farming operations to be temporarily suspended during occurrence of event. •Also move away from electric poles and wires. •DO NOT take shelter under trees and particularly under isolated tree as these conduct electricity.	At an isolated places over Hardoi, Unnao, Lucknow, Sitapur, Barabanki, Raebareli, Ayodhya, Bahraich, Gonda, Shrawasti, Balrampur, Siddharth Nagar, Maharajganj, Sant Kabir Nagar, Gorakhpur, Amethi districts and adjoining areas
	Thunderstorm associated with Hailstorm	•Major damage to Kutcha structures and tin and asbestos roofed houses, cars.	•People are advised to stay away from weak walls and structures and take shelter in pukka structures. •People in affected areas to remain indoors.	At an isolated places over Hardoi, Unnao, Lucknow, Barabanki, Ayodhya, Siddharth Nagar, Maharajganj, Raebareli, Gonda dist. and adjoining areas

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दिनांक:05/05/2021 Date: 05/05/2021

जारी करने का समय:03:30 बजे Time of Issue: 03:30 Hrs. IST

To,

1. The Districts Magistrate Unnao, Lucknow, Raebareli, Amethi, Barabanki, Ayodhya, Gonda, Basti, Ambedkar Nagar, Sultanpur, Azamgarh, Jaunpur, Pratapgarh, Sant Kabir Nagar, Gorakhpur, Mau, Ghazipur .
2. Relief Commissioner, Uttar Pradesh, Lucknow.
3. All India Radio Gorakhpur/ Lucknow.
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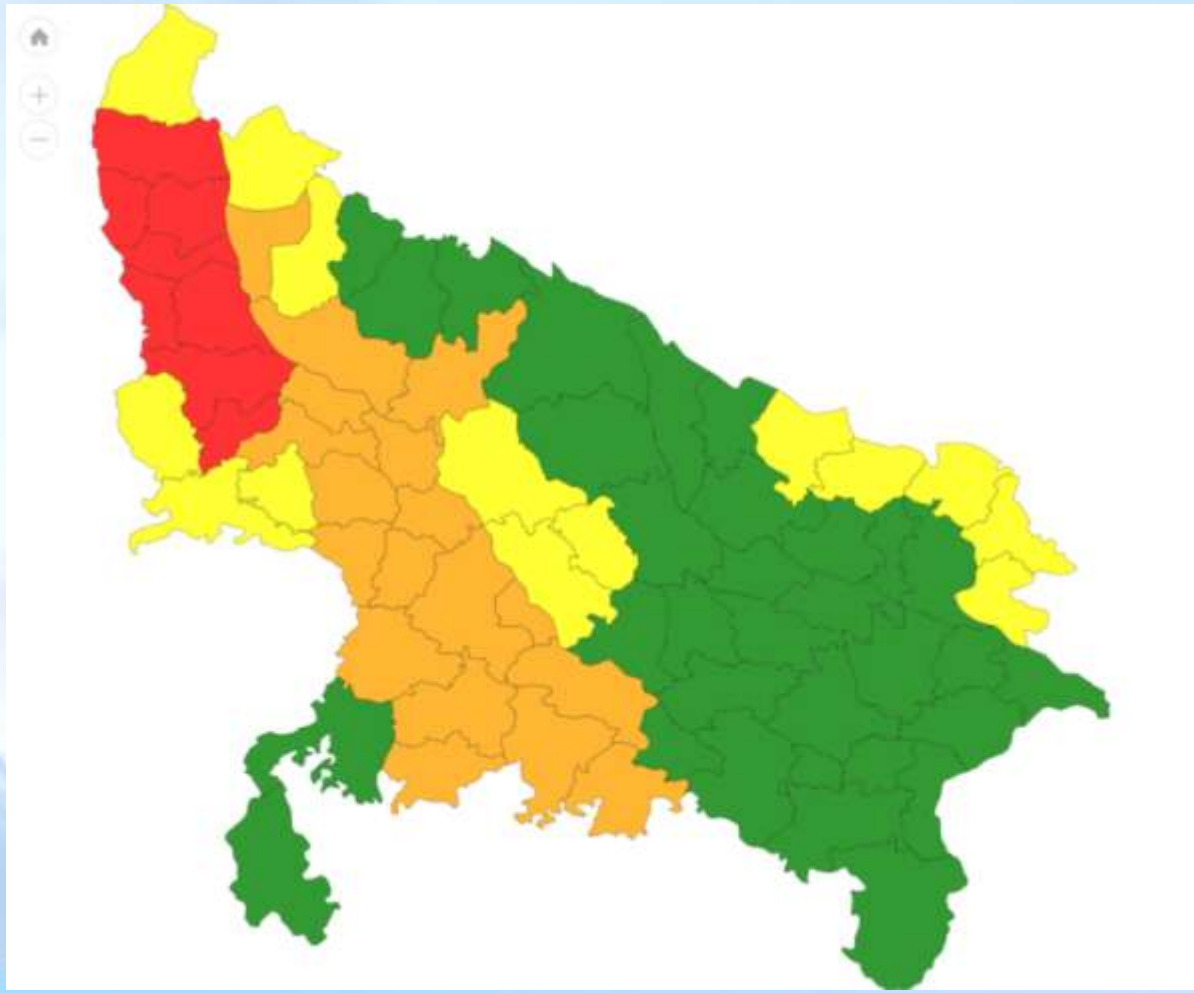
Sub. : Rain/Thundershowers/ Lightning Nowcast.

VALIDITY	SEVERE WEATHER PHENAMENA VERY LIKELY/MOST LIKELY	IMPACT	ACTION SUGGESTED	DISTRICT AFFECTED (ISOLATED/A FEW/MANY PLACES)
03 Hrs. (upto 06:50 Hrs. IST)	Light to Moderate Thunderstorm (Maximum Surface wind upto 60 Kmph in gusts) with Lightning and Rain	•Minor damage to loose / unsecured structures	•People are advised to keep a watch on the weather for worsening conditions and be ready to move to safer places accordingly.	At a few places over Unnao, Lucknow, Barabanki, districts and adjoining areas.
	Moderate to Severe Thunderstorm (Maximum Surface wind upto 87 Kmph in gusts/squall) with Lightning and Rain	•Minor damage to loose / unsecured structures. •Damage to thatched huts.	•People are advised to take shelter in pukka structures and avoid taking shelter under trees. •Farming operations to be temporarily suspended during occurrence of event. •Also move away from electric poles and wires. •DO NOT take shelter under trees and particularly under isolated tree as these conduct electricity.	At an isolated places over Raebareli, Amethi, Ayodhya, Gonda, Basti, Ambedkar Nagar, Sultanpur, Azamgarh, Jaunpur, Pratapgarh, Sant Kabir Nagar, Gorakhpur, Mau, Ghazipur districts and adjoining areas
	Thunderstorm associated with Hailstorm	•Major damage to Kutcha structures and tin and asbestos roofed houses, cars.	•People are advised to stay away from weak walls and structures and take shelter in pukka structures. •People in affected areas to remain indoors.	At an isolated places over Basti, Ambedkar Nagar, Sultanpur, Azamgarh, Jaunpur, dist. and adjoining areas

Meteorological Centre
Lucknow-226009

Districtwise warning issued for 04th May 2022



सादर धन्यवाद