वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद
Council of Scientific and Industrial Research
अनुसंधान भवन, 2, रफी मार्ग, नई दिल्ली-110001
Anusandhan Bhawan, 2, Rafi Marg, New Delhi-110001

No. : 5-1(17)/2008-PD

दिनांक/Date : 12.02.2026

कार्यालय ज्ञापन / OFFICE MEMORANDUM

विषय : बहु-खतरा प्रारंभिक चेतावनी निर्णय सहायता प्रणाली (MHEW-DSS): पूर्वानुमान और आपदा जोखिम न्यूनीकरण में एक डिजिटल परिवर्तन के सम्बन्ध में।

Sub : Multi-Hazard Early Warning Decision Support System (MHEW-DSS): A Digital Transformation in Forecasting and Disaster Risk Reduction - reg.

अधोहस्ताक्षरी को यह कहने का निदेश हुआ है कि सक्षम प्राधिकारी ने महानिदेशक, भारतीय मौसम विज्ञान विभाग, पृथ्वी विज्ञान मंत्रालय, भारत सरकार द्वारा उपरोक्त विषय पर जारी दिनांक 29th जनवरी 2026 के अर्ध शासकीय पत्र सं. DGM-HQ-1601014/2025-ISSD-HQ को सभी सीएसआईआर प्रयोगशालाओं/संस्थानों/इकाइयों को सूचना, मार्गदर्शन और अनुपालन के लिए अग्रेषित करने की स्वीकृति प्रदान की है।

The undersigned is directed to state that the Competent Authority has accorded approval to forward the DO letter No. DGM-HQ-1601014/2025-ISSD-HQ dated 29th January 2026 issued by Director General of Meteorology (DGM), Indian Meteorological Department (IMD), Ministry of Earth Sciences (MoES), Govt. of India on the subject mentioned above to all CSIR Labs./Instts./Units for information, guidance and compliance.

12/02/26

(अमरेन्द्र कुमार/Amrendra Kumar)
अवर सचिव (नीति प्रभाग)/Under Secretary (PD)

संलग्न/Encl. : यथोपरि/As above
प्रतिलिपि/Copy to:

1) सी.एस.आई.आर. की सभी राष्ट्रीय प्रयोगशालाओं/संस्थानों/मुख्यालय/एककों के निदेशक/प्रधान
The Directors/Heads of all CSIR National Labs./Instts./Hqrs./Units
2) सी.एस.आई.आर. वेबसाइट/ CSIR Website
3) कार्यालय प्रति/Office copy.

डॉ. मृत्युंजय महापात्र
मौसम विज्ञान विभाग के महानिदेशक,
विश्व मौसम विज्ञान संगठन में भारत के स्थाई प्रतिनिधि
विश्व मौसम विज्ञान संगठन के तीसरे उपाध्यक्ष
Dr. Mrutyunjay Mohapatra
Director General of Meteorology,
Permanent Representative of India to WMO
Third Vice President of WMO

सत्यमेव जयते
भारत सरकार
पृथ्वी विज्ञान मंत्रालय
भारत मौसम विज्ञान विभाग
मौसम भवन, लोदी रोड़
नई दिल्ली–110003
Government of India
Ministry of Earth Sciences
India Meteorological Department
Mausam Bhawan, Lodi Road
New Delhi-110003

DO No.: DGM-HQ-1601014/2025-ISSD-HQ
Date: 29 January, 2026

Dear Madam,

Greetings from India Meteorological Department (IMD).

IMD, MoES is the National Meteorological Service of the country to take meteorological observations, to provide current and forecast meteorological information and to warn against severe weather phenomena like tropical cyclones, thunderstorm, lightning, heavy rains and snow, cold and heat waves, etc., to safeguard life and property and to optimize weather-sensitive activities like Disaster Risk Reduction (DRR), agriculture, water management, power & energy, irrigation, shipping, aviation, offshore oil explorations, etc.

IMD has indigenously developed a **Multi-Hazard Early Warning Decision Support System (MHEW-DSS)** which is a digital platform that automates the decision making on critical weather forecasting processes and forecast and warning services to public, Government and non-government agencies as well as specific stakeholders. It integrates real-time data from satellites, radars, and ground & upper air based sensors into a centralized GIS enabled platform, replacing outdated manual workflows. It has capability to develop and issue impact based forecast and risk-based warning for all severe weather hazards. It also includes a public platform named **Mausamgram** (https://mausamgram.imd.gov.in/) which provides hyper local weather forecasts by entering the name of the place or Pincode of the place with the ambition of **Har Har Mausam, Har Ghar Mausam** (weather information to each house at any time). There are specialized modules available in IMD website (https://imdgeospatial.imd.gov.in/) for various services as listed above. The developed DSS empowers sectors like agriculture, aviation, marine, power, surface transport and above all disaster risk reduction.

IMD received National Award for e-Governance 2025 for its project, 'Multi Hazard Early Warning Decision Support System'. A brief document of MHEW-DSS (Annexure-I) is provided here along with PPT and a video (https://www.youtube.com/watch?v=16fa8svv4Vo) for easy understanding about the MHEW-DSS and its utility. The outcome and the benefits of MHEW-DSS are given in Annexure-II.

I would like to request you to use the products for MHEWDSS available at IMD public platform for getting the weather forecast and warning anywhere at any time. It may kindly be given wide circulation for effective utilization by the people and stakeholders.

With best regards,

Yours sincerely,

(**Mrutyunjay Mohapatra**)

Ms. N. Kalaiselvi,
Secretary
D/o Scientific & Industrial Research, New Delhi

Phone : 91-11-24611842, Fax : 91-11-24611792
E-mail : directorgeneral.imd@imd.gov.in / dgmmet@gmail.com / m.mohapatra@imd.gov.in

WEATHER ANALYSIS AND FORECAST ENABLING SYSTEM

INDIA METEOROLOGICAL DEPARTMENT NEW DELHI

MINISTRY OF EARTH SCIENCES

Project : Multi Hazard Early Warning Decision Support System

Initiation of Project: Nov. 2022

Date of launch : 15/01/2024 (by Hon’ble Vice President)

Operationally working since: 15/08/2023

BACKGROUND AND OVERVIEW

Weather Forecast Service

Daily Weather forecast

- 36 Meteorological Subdivision
- 750 Districts
- 7000 Blocks
- All Stations (Panchayat Level)
- Mausamgram
- Location Specific Forecast
- Pincode
- Panchayat
- Latitude & Longitude
- Click any Point

Validity Seven Days

Daily Severe Weather Warning

- Heatwave
- Coldwave
- Thunderstorm
- Heavy Rainfall
- Tropical Cyclone
- Gusty/Squally Wind
- Fog, etc.

Spatial scale at District, Station and Meteorological Subdivision

Validity Five Days

Specialised Forecast

- Aviation weather Forecast (Half an hour,3hr, daily 4 times)
- Marine Weather Forecast (Twice daily and 6 to 8 times during cyclone)
- Hydrometeorology bulletin (Quantitative Precipitation Forecast) to CWC
- Agriculture (Farmer's Weather Bulletin daily, Agromet Advisory Bulletin -twice a week valid for four weeks
- Transport
- Tourism
- Fishery
- Power
- Shipping

WEATHER FORECASTING AND MULTI-HAZARD EARLY WARNING PROCESS

Observational Network

- Surface
- Satellite
- AWS/ ARG
- RS-RW/Pi
- DWR
- Aviation weather
- Ship

INTEGRATION

Data collection

Data Processing

Data communication , Modeling & Forecasting Systems Climatological System

Generation of Forecast

Dissemination

End user production

Numerical Weather Prediction (NWP) Modeling with High Performance Computing System (HPCS)

Problem Identification for Formulation of Project

- Lack of Multi-Hazard Early Warning Decision Support System for forecasters and users anywhere at any time

FORECAST GAP

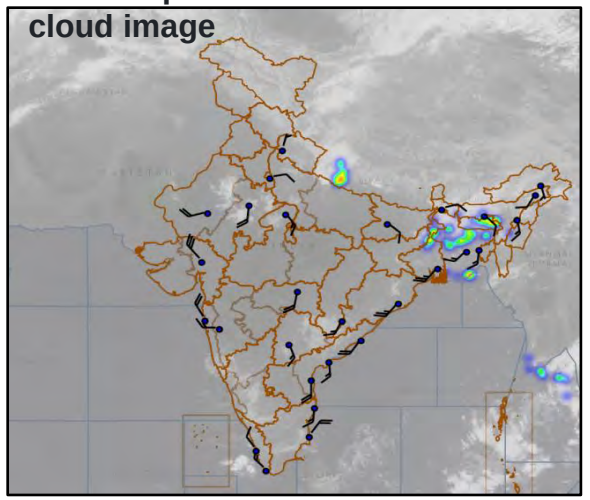
- **Fragmented System** (poor/ slow data communication and Less responsive system)
- **Observation issues** (No real time validation or error correction in meteorological observation)
- **Radar and satellite underutilisation** (No integration of large and upgraded datasets from satellites and radar though there is manifold increase in datasets with multiple satellites and more than 40 Radars)
- **Error prone manual processes** (Manual preparation of weather charts, analysis & products and **Manual forecast and warnings** generation & dissemination) leading to more time consumption, and less lead time for response and lack of confidence in forecast.
- **Customisation Lack** (No location specific customised foreast and warning)
- **Automation deficit** (Limited automation in preparation of Poor visualization and poor resolution of products through website as it could not be projected through native resolution in GIS).
- **Scalability** (Not scalable, Limited flexibility for India-specific needs) & No multi-hazard inter-operability
- **Technology dependency** (Vendor locking and reliance on foreign systems and hence poor maintenance)
- **Gap in Numerical weather prediction model** integration (though IMD runs 6 models daily twice and accesses 3-4 foreign models for weather forecasting**.**
- **Accessibility** (available to 12 out of 200 Forecasting Offices. Not web based)
- **Poor forecast accuracy**, no dynamic impact based forecast, risk based warning & public weather service

OBJECTIVE

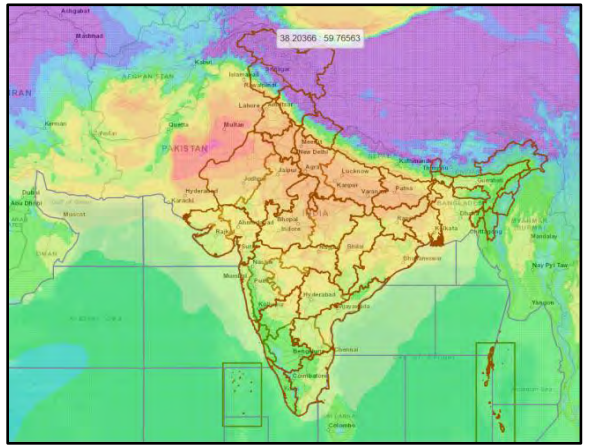
To Develop Indigenous Multi-Hazard Early Warning Decision Support System (DSS) aimed to ACTIONS:

- **Address all the problem areas** listed in previous slide.
- **Compare, Comprehend and Analyze** all atmospheric and Oceanic Observations in Real Time through round the clock watch
- **Track and decide Current Status Of weather** System and their Genesis, Evolution, structure and other Characteristics
- **Integrate and evaluate all numerical Weather prediction models** (7 in number) guidance
- **Operate collaboratively to develop consensus forecast** on each and every weather conditions including severe weather
- **Notify likelihood of occurrence and severity of weather** conditions expected
- **Summarise & issue Impact Based Forecast & risk based warning** of Severe Weather at district and location

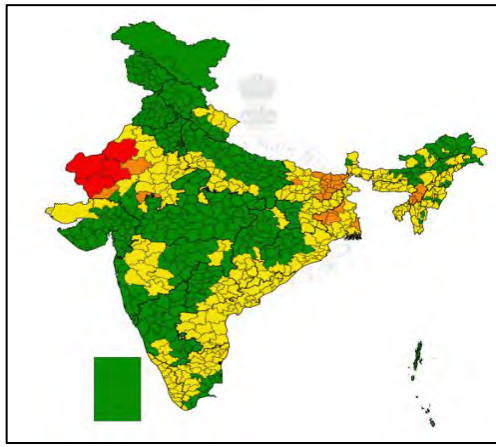
Wind observation at 1.5 km sumerimposed with satellite based cloud image



Streamline analysis of Wind observation at 1.5 km height



Mean Sea leval pressure analysis based on Numerical Weather Prediction Model Guidance



Multi-hazard impact based forecas and risk based warning graphics valid for next 24 hrs at district lev

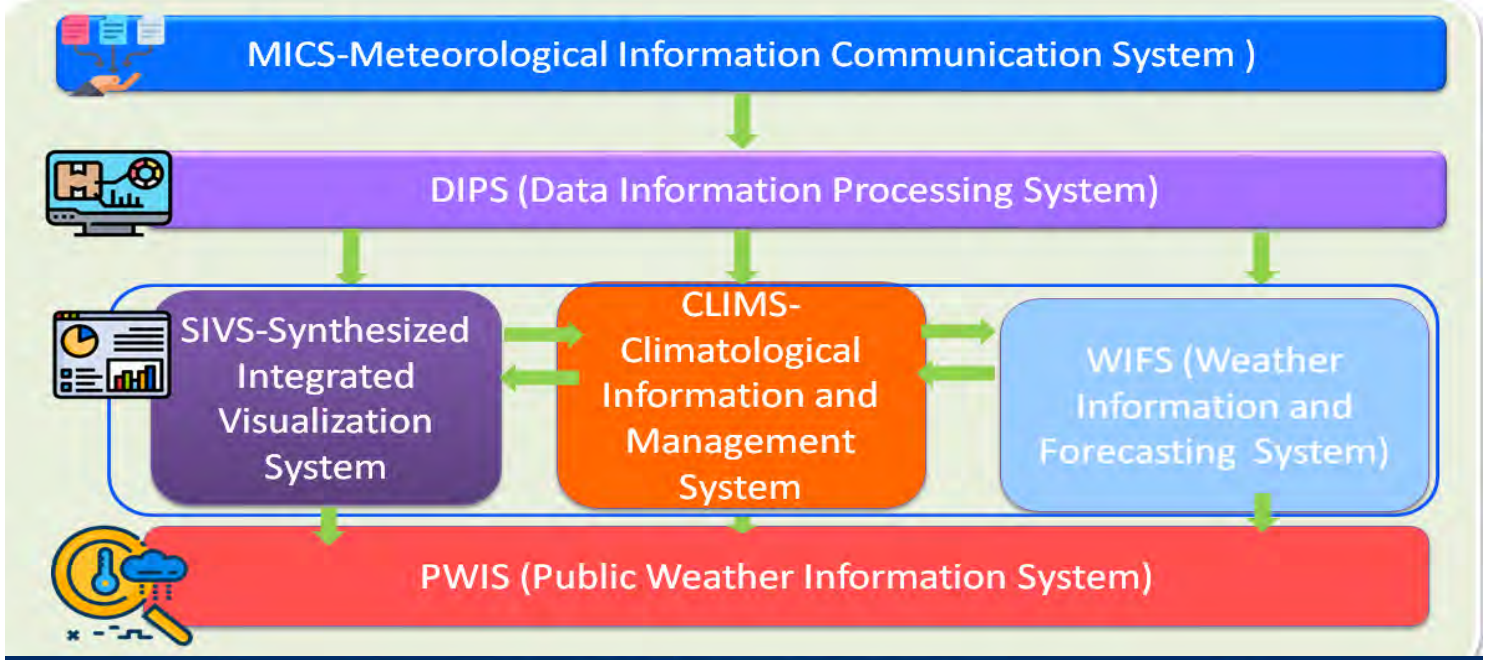
ΓMENT

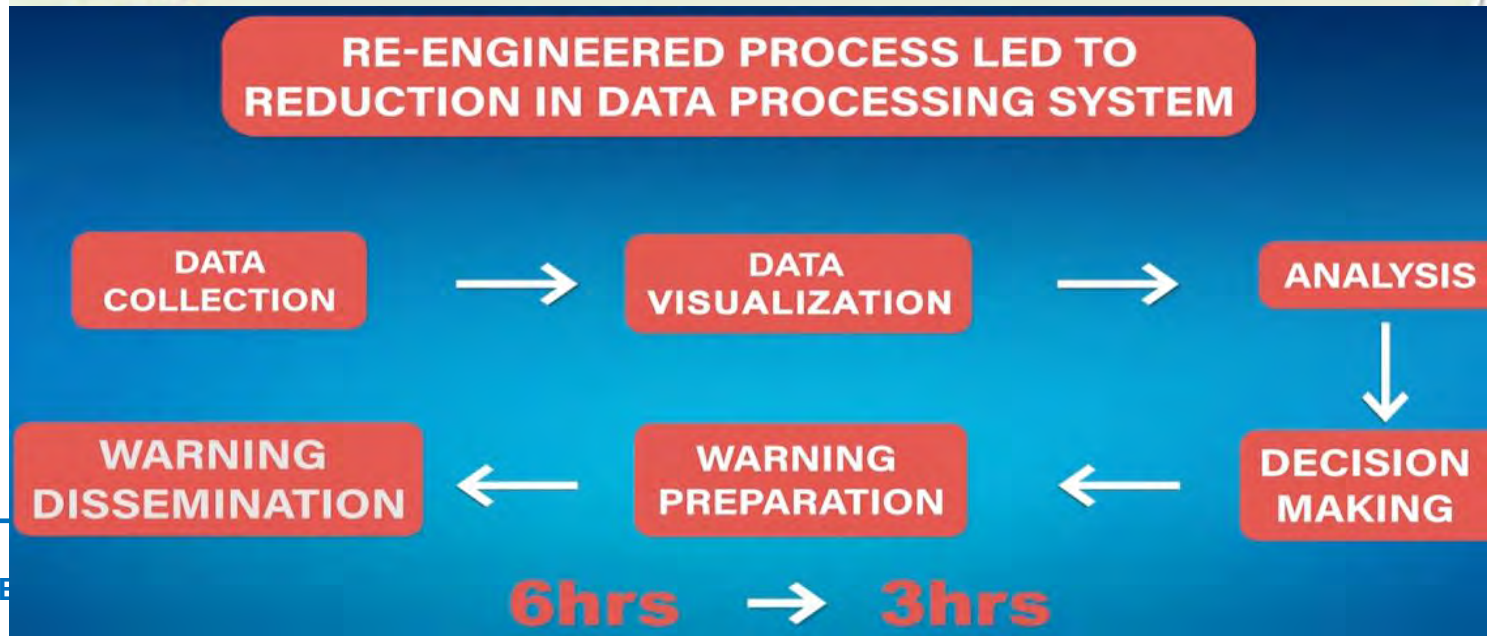
Years of Service to the Nation

WEATHER ANALYSIS AND FORECAST ENABLING SYSTEM (WAFES):DECISION SUPPORT SYSTEM (DSS): IMPLEMENTATION

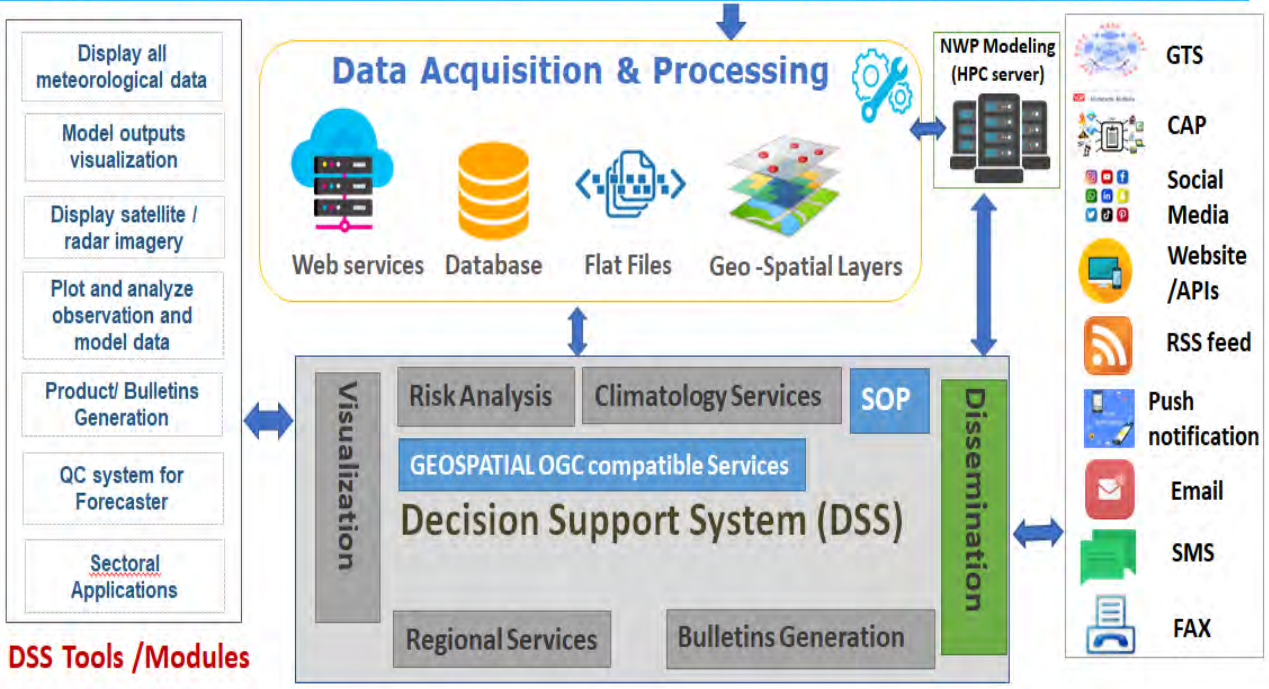
Methodology Adopted

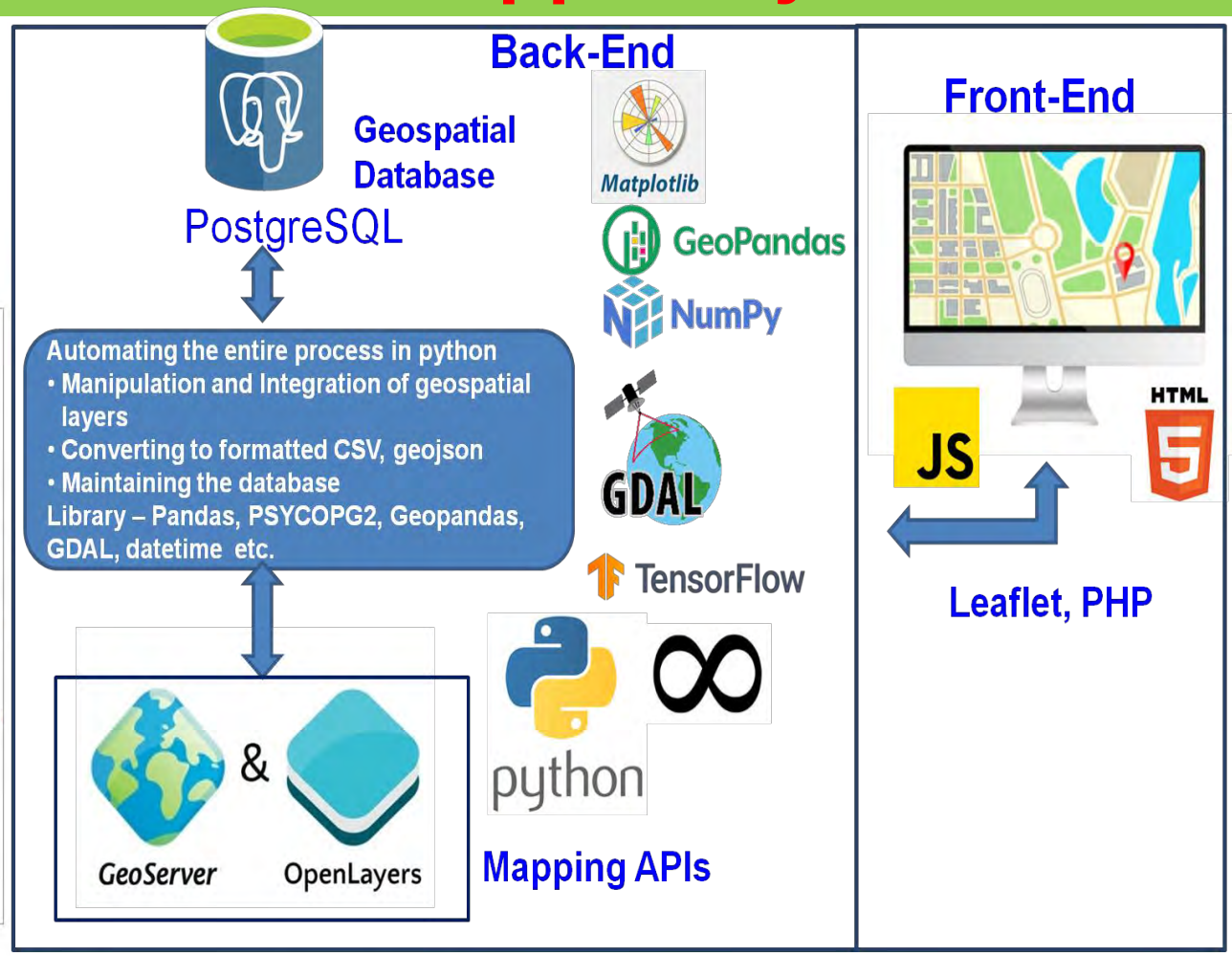
- Baseline study
- Problem identified
- Stakeholder consultation
- Design, development, testing, commissioning
- Capacity building and awareness
- Feedback mechanism





High level architecture for Decision support system





KEY SYSTEM CHARACTERISTICS

Interoperable	• Separate modules are interoperable in a single platform also enable seamless data exchange across ministries, agencies, and sectors • Integrates diverse datasets, models, and platforms through open standards
Scalable	• Scalable in time, space, new data format and technology • Supports future expansion to additional hazards, sectors, and spatial resolutions without redesign
Replicable	• It can be replicated for any and sector country in the World • Standardized procedures, protocols and interoperability
Efficient	• Real time forecast, impact based warning, reduced forecast preparation time by 50% , enhanced accuracy by 30%
Responsive	• Dynamic and user driven • Multi-channel dissemination(SMS, API, Mobile apps,website)
Transparent	• Traceable data pipelines, standardized methodologies,open protocol and open source technologies. • Auditability and accountability
Sustainable	• Long term operational framework with institutional support and capacity building • Training, upgrades and knowledge sharing

PROCESS RE-ENGINEERING ACCOMPLISHED

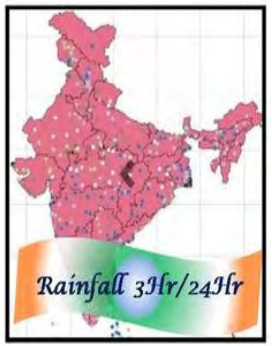
- **Over 90% of data collection, quality control, and real-time integration** has been automated for seamless ingestion from multiple sources to improve detection accuracy of weather systems and their impact.
- **Numerical weather modeling input** in decision making has **improved by over 95%,** enabling more accurate risk assessment for various hazards.
- **Forecast and warning generation has been fully (100%) re-engineered** to deliver real-time alerts for timely action. It led to
  - increase in **lead period from 5 to 7 days**,
  - **reduction in time to prepare the forecast by about 3 hrs** and
  - **increase in accuracy by about 15-20%**
- Dynamic GIS mapping, Decision Support System (DSS), and automated severe weather alerts have been implemented for the forecasters, common public, disaster managers and other stakeholders.
- Forecasting is now more accurate, efficient, and responsive to sector-specific needs across India.

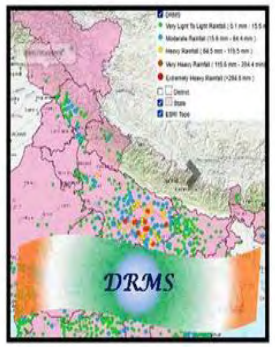
DSS-IBF Modules http://imdgeospatial.imd.gov.in/

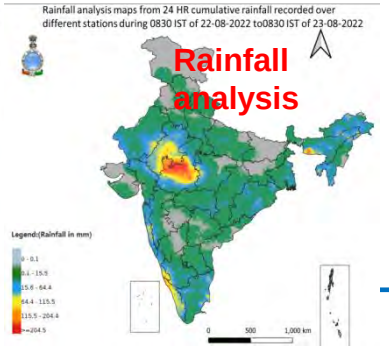
IMD has now introduced Web GIS based applications for all types of severe weather events like.

- Max/Min Temp, Hot day, Warm night
- Heat Wave Cold Wave, Heat Index
- Rainfall, 24hrs/3Hrs
- Heavy rainfall warning
- Cyclone Warning
- Marine weather Services
- Urban weather services
- Nowcast Services
- Agrometeorological Services
- Aviation weather serviceas
- Transport Services (RAIL/Highways)
- Mountain met and tourism
- Power sector Services

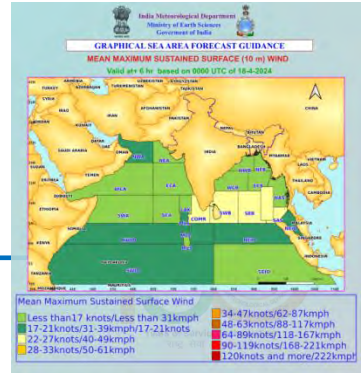
APPLICATIONS







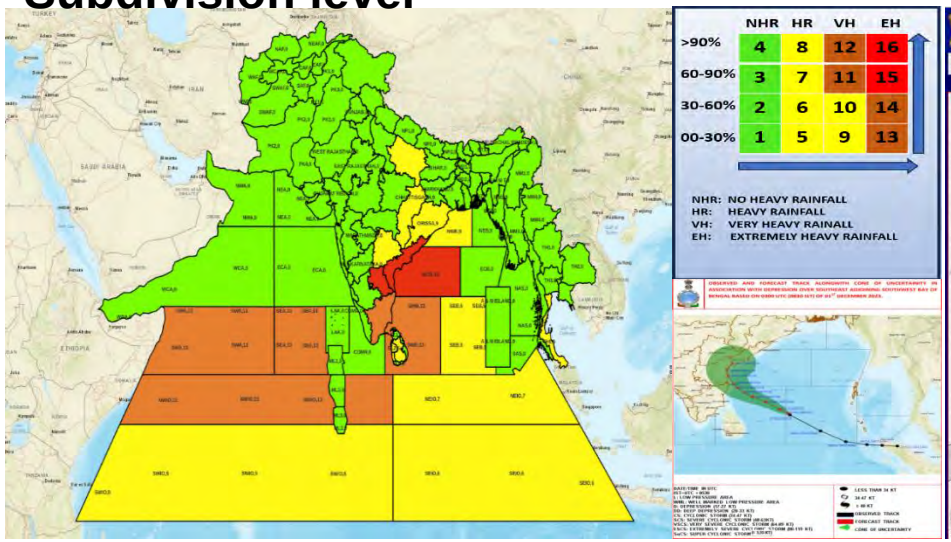
Sea area Bulletin graphics



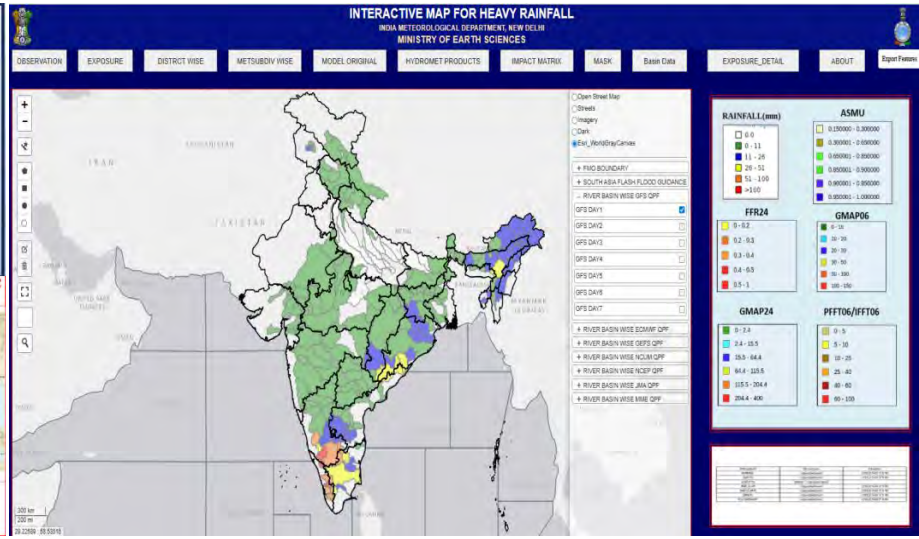
Multi-hazard interoperability : An example of Cyclone warning and Marine weather forecasting Services:

- South Asia Flash Flood Guidance (SA-FFG)
- Severe Weather Forecast Programme(SWFP)
- Quantitative Precipitation Estimate and Forecast (QPE & QPF)
- Storm Surge warning
- Heavy Rainfall warning
- Fisherman warning

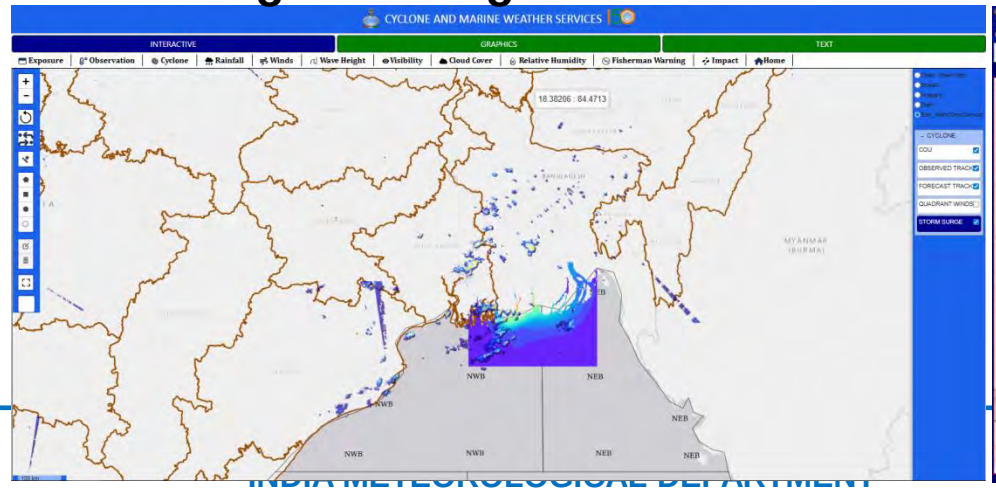
Heavy Rainfall warning at met. Subdivision level



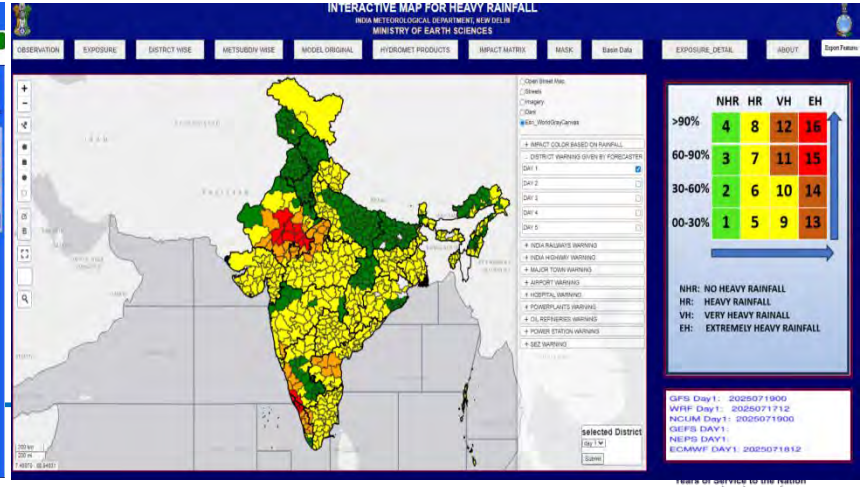
QPE/QPF for flood warning



Storm Surge Warning

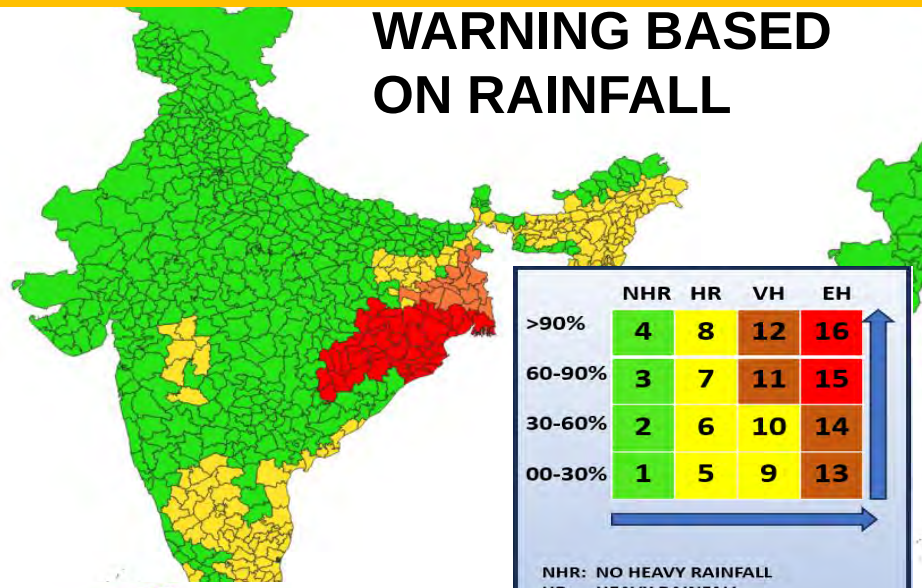


Heavy Rainfall warning at district level



Color Coded Warning For Cyclone Dana Based On 0830 IST of 23/10/2024 for 24/10/2024

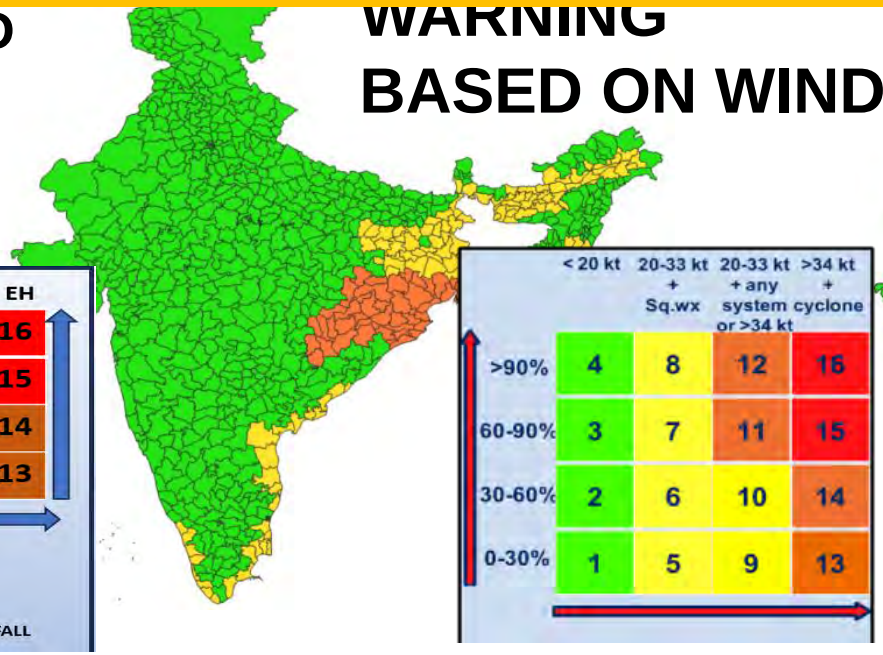
WARNING BASED ON RAINFALL



	NHR	HR	VH	EH
>90%	4	8	12	16
60-90%	3	7	11	15
30-60%	2	6	10	14
00-30%	1	5	9	13

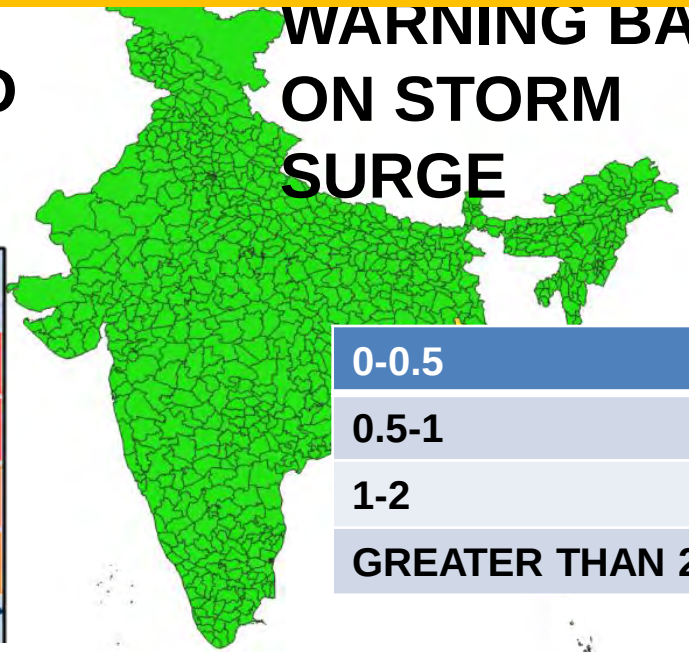
NHR: NO HEAVY RAINFALL
HR: HEAVY RAINFALL
VH: VERY HEAVY RAINALL
EH: EXTREMELY HEAVY RAINFALL

WARNING BASED ON WIND



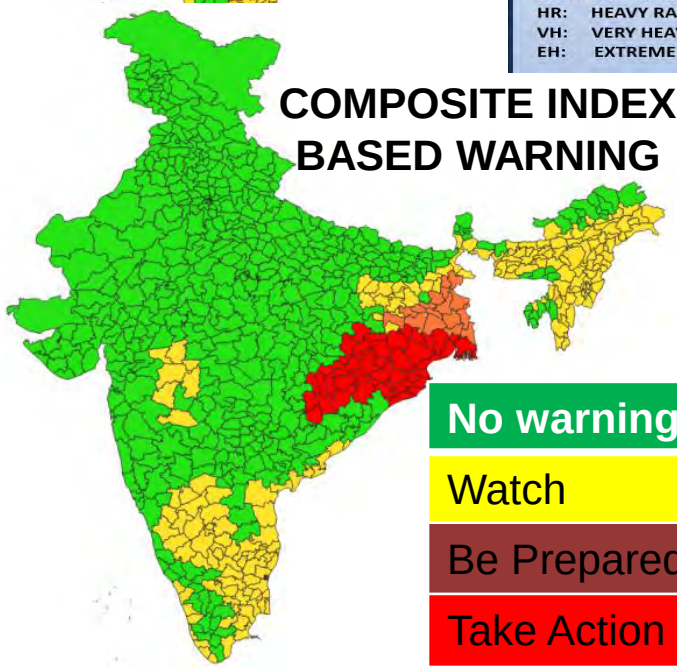
	< 20 kt	20-33 kt + Sq.wx	20-33 kt + any system or >34 kt	>34 kt + cyclone
>90%	4	8	12	16
60-90%	3	7	11	15
30-60%	2	6	10	14
0-30%	1	5	9	13

WARNING BASED ON STORM SURGE

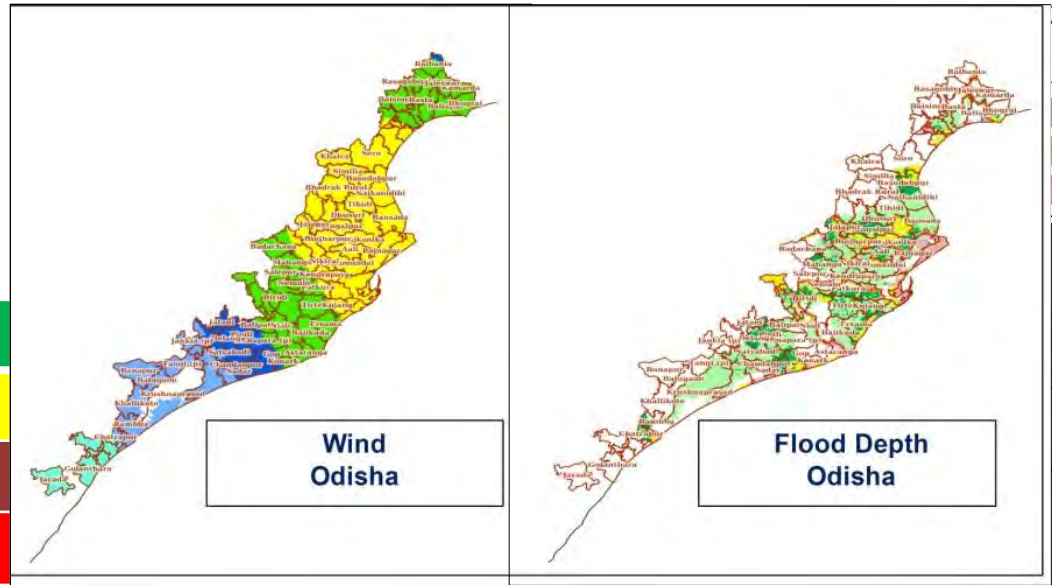


0-0.5
0.5-1
1-2
GREATER THAN 2

COMPOSITE INDEX BASED WARNING



No warning
Watch
Be Prepared
Take Action



State Boundary | District Boundary | Tehsil Boundary | Village Boundary

Wind Speed (Less than 31 Km/h) | Wind Speed (31 - 49 Km/h) | Wind Speed (49 - 61 Km/h)
Wind Speed (61 - 88 Km/h) | Wind Speed (88 - 117 Km/h) | Wind Speed (117- 166 Km/h)
Wind Speed (166 - 221 Km/h) | Wind Speed (Greater than 221 Km/h)

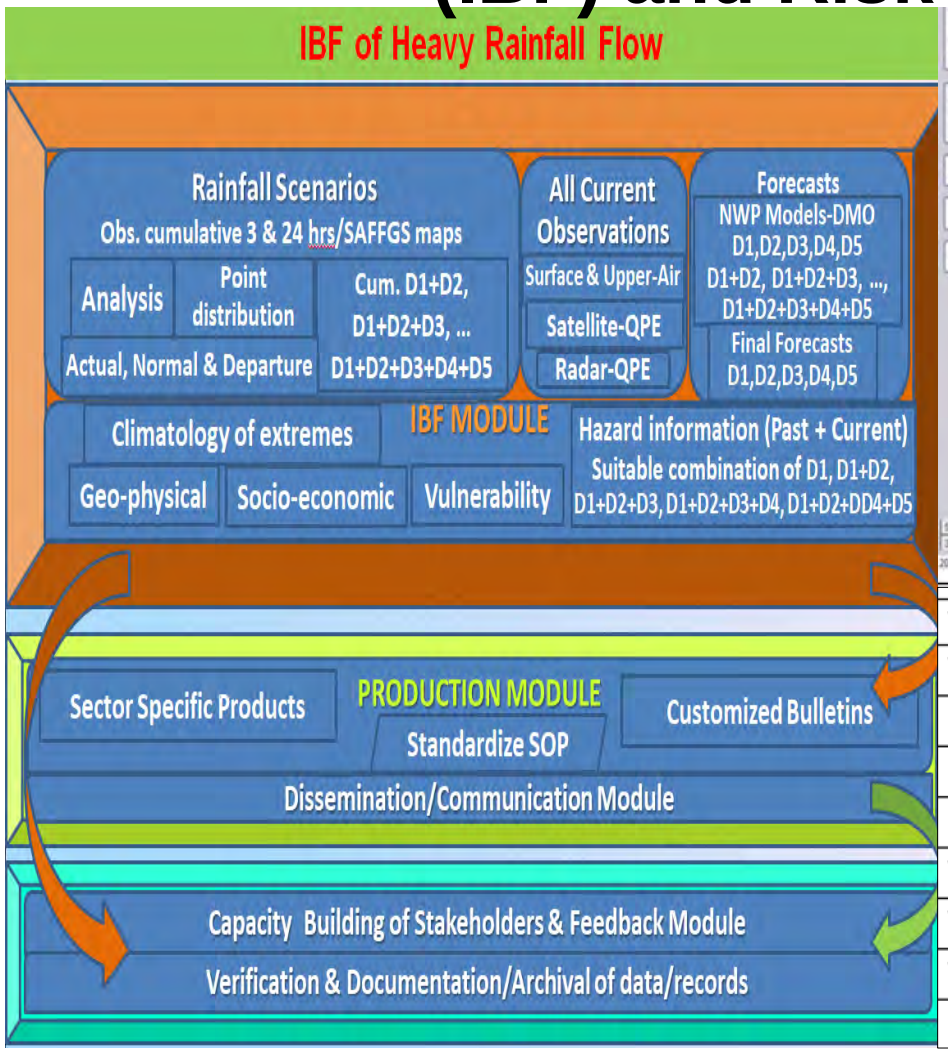
Wind

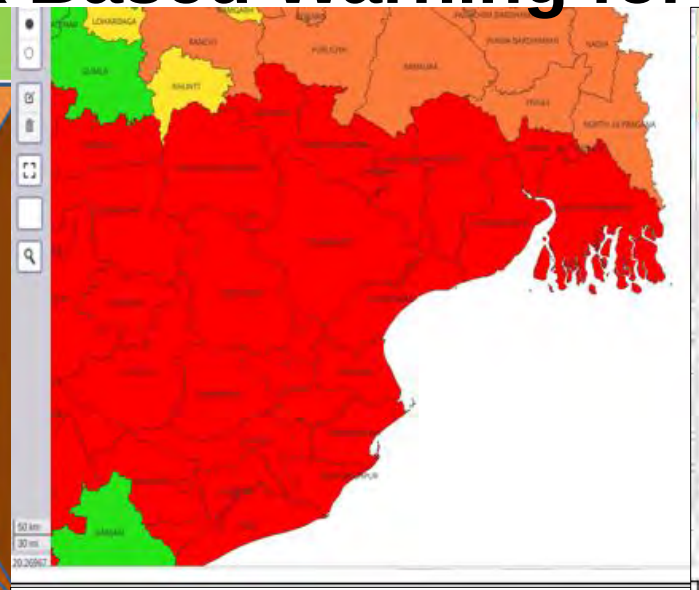
Very Low (Less than 0.25 m) | Low (0.25 to 0.50 m) | Moderate (0.50 to 1.0 m)
High (1.0 to 2.0 m) | Very High (2.0 to 3.0 m) | Extreme (Greater than 3.0 m)

Flood Depth

150 Years of Service to the Nation

Multi-hazard interoperability : An example of Impact Based Forecast (IBF) and Risk Based Warning for Heavy rainfall





Total Population Affected :155,000
Total No of Airport Affected :0
Railway Station affected: 4
Railway Network affected :East Coast Railway , South Eastern Railway
Hospitals affected: 4
Total No of SEZ affected: 1
Total No of Power Station affected:1
Total No of Power Plants affected:1
Major Towns affected:5

District: Bhadrak WARNING: RED (TAKE ACTION)

IMPACTS

- Flash flood/Water logging in low lying areas;
- Inundation of agriculture field;
- Possibility of some damage to informal/Kutcha road, wall collapsed of vulnerable kutcha houses;
- It may lead to significant rise in water level of rivers;
- Water logging in underpass road and occasional reduction of visibility causing traffic congestion in urban areas during intense spells of rain;
- Municipal services like electricity, water supply etc. will be affected to large extent;
- Supply and transportation will be affected at a few to many places for several days.

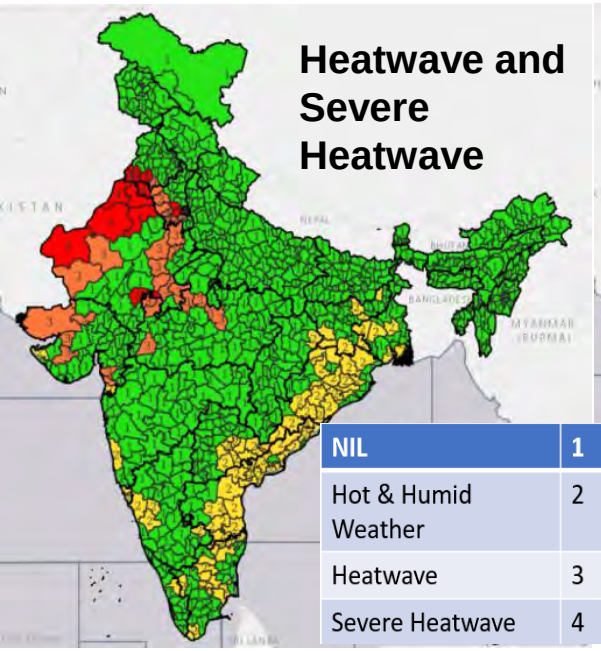
ACTION

- Keep arrangement for drainage of excess water from inundated agriculture fields;
- Avoid movement in urban areas specially during intense spells of rain; Postpone fertilizer/chemicals application in agriculture field;
- Keep livestock in safe place;
- Avoid movement in affected areas and move to safe place

Multi-hazard interoperability : An example of Heat Indices Prepared

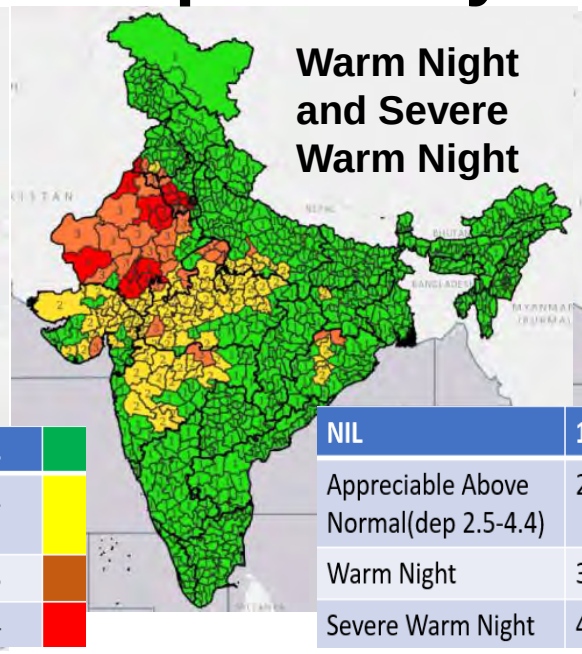
Daily

Heatwave and Severe Heatwave



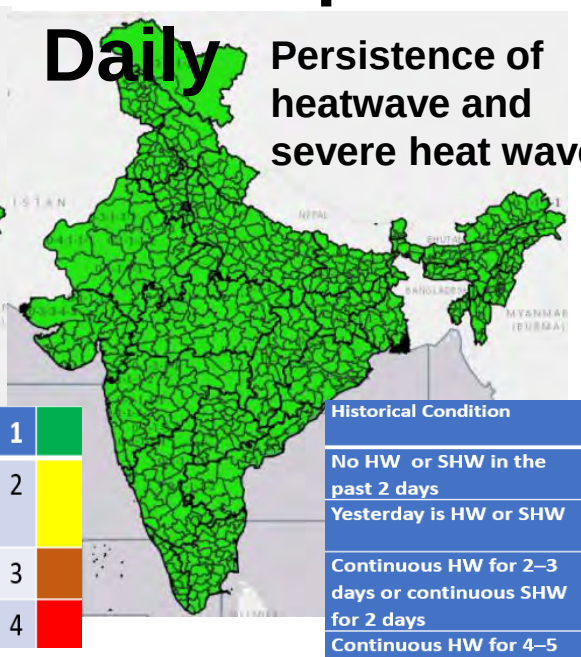
NIL	1	
Hot & Humid Weather	2	
Heatwave	3	
Severe Heatwave	4	

Warm Night and Severe Warm Night



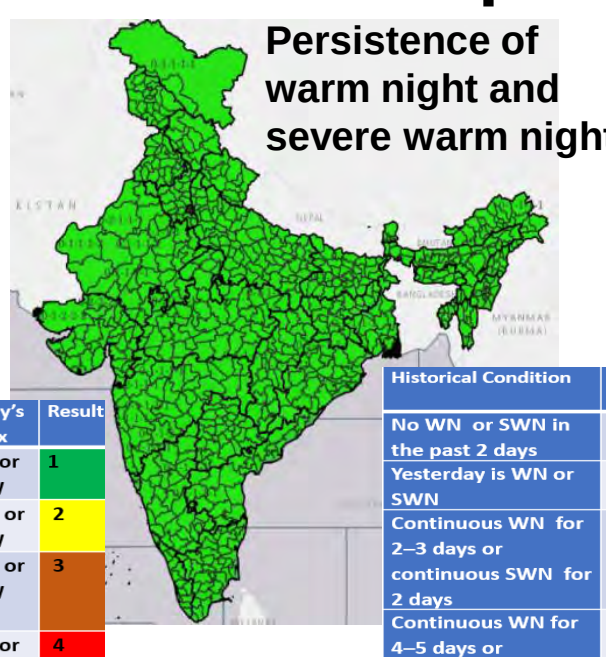
NIL	1	
Appreciable Above Normal(dep 2.5-4.4)	2	
Warm Night	3	
Severe Warm Night	4	

Persistence of heatwave and severe heat wave



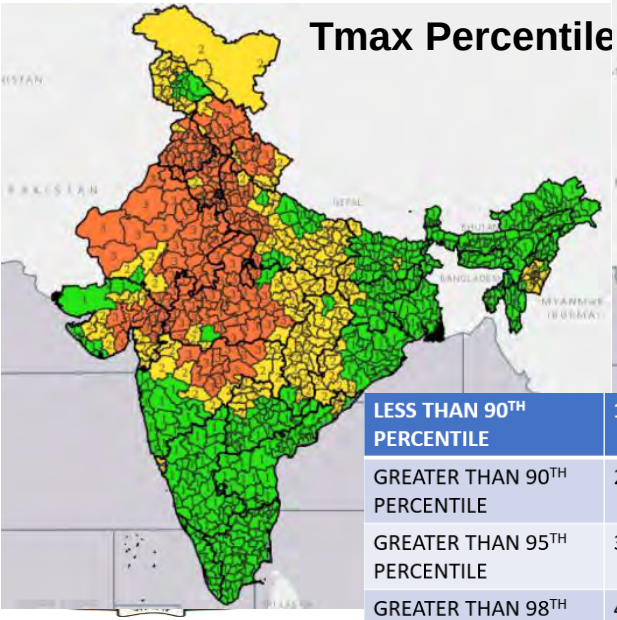
Historical Condition	Today's Index	Result
No HW or SHW in the past 2 days	HW or SHW	1
Yesterday is HW or SHW	HW or SHW	2
Continuous HW for 2–3 days or continuous SHW for 2 days	HW or SHW	3
Continuous HW for 4–5 days or continuous SHW for 3+ days	HW or SHW	4

Persistence of warm night and severe warm night



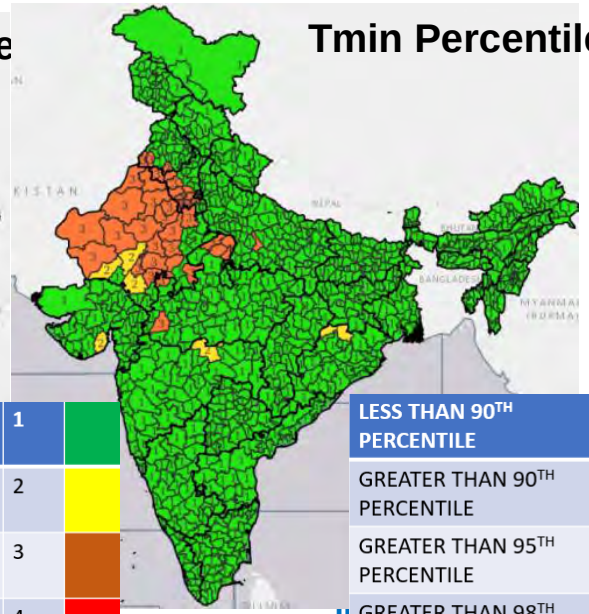
Historical Condition	Today's Index	Result
No WN or SWN in the past 2 days	WN or SWN	1
Yesterday is WN or SWN	WN or SWN	2
Continuous WN for 2–3 days or continuous SWN for 2 days	WN or SWN	3
Continuous WN for 4–5 days or continuous SWN for 3+ days	WN or SWN	4

Tmax Percentile



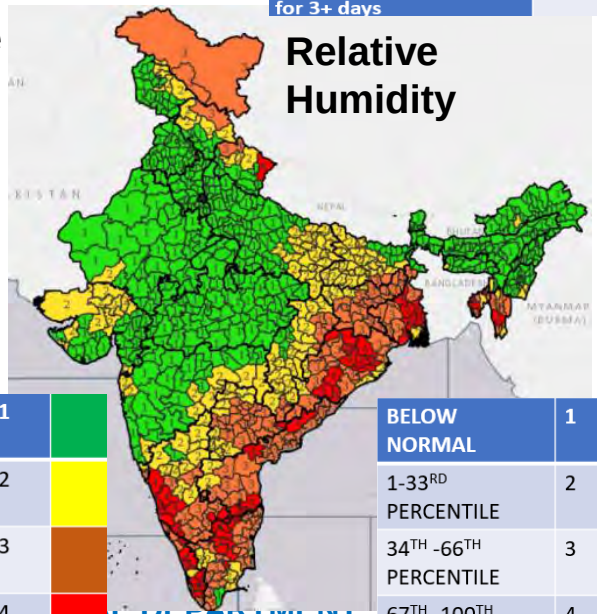
LESS THAN 90TH PERCENTILE	1	
GREATER THAN 90TH PERCENTILE	2	
GREATER THAN 95TH PERCENTILE	3	
GREATER THAN 98TH PERCENTILE	4	

Tmin Percentile



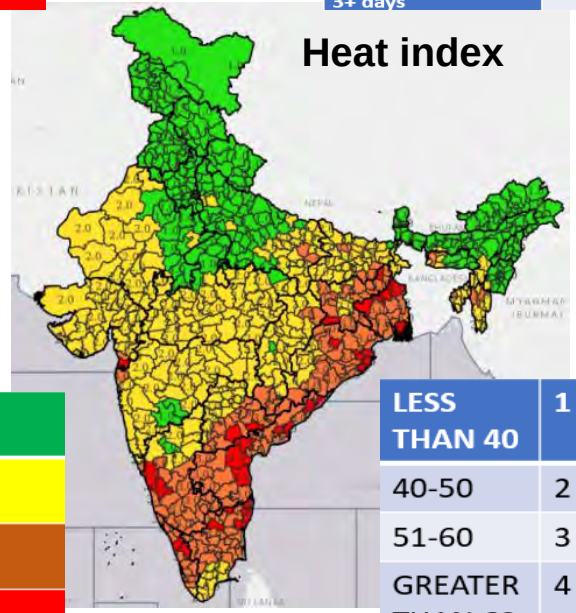
LESS THAN 90TH PERCENTILE	1	
GREATER THAN 90TH PERCENTILE	2	
GREATER THAN 95TH PERCENTILE	3	
GREATER THAN 98TH PERCENTILE	4	

Relative Humidity



BELOW NORMAL	1	
1-33RD PERCENTILE	2	
34TH -66TH PERCENTILE	3	
67TH -100TH PERCENTILE	4	

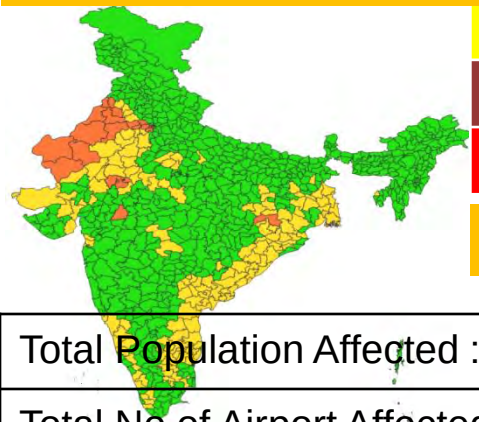
Heat index



LESS THAN 40	1	
40-50	2	
51-60	3	
GREATER THAN 60	4	

Multi-hazard interoperability : An example of Composite Index Based Heat Wave Watch & Warning

District:Jodhpur: ORANGE Warning (Be prepared)

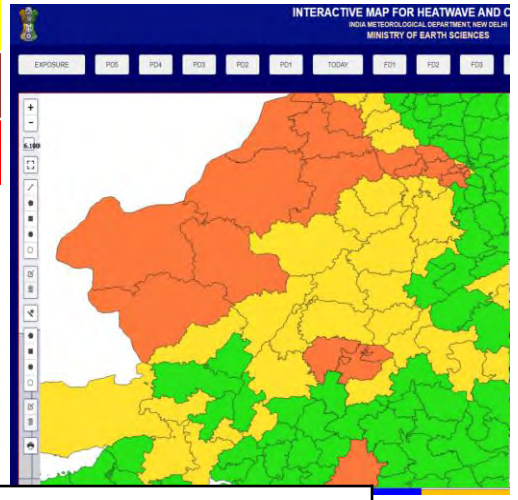


Heat wave Watch

Heat Wave Warning

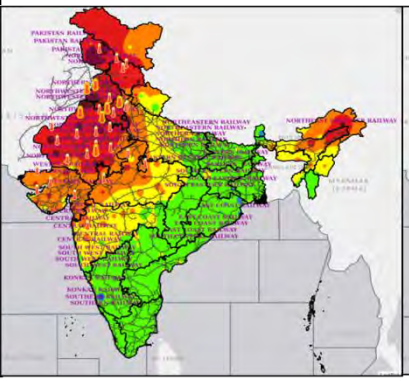
Severe Heat Wave Warning

District: Jodhpur

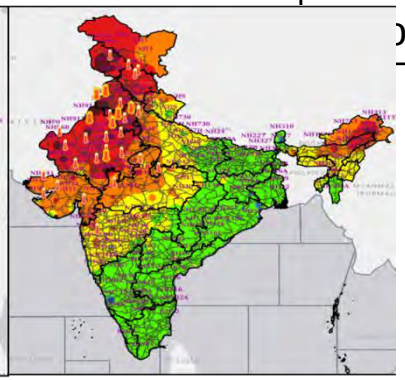


Total Population Affected :15.43 lakh
Total No of Airport Affected :1
Railway Station affected: 10
Railway affected :North Western Railway
Hospitals affected: 35

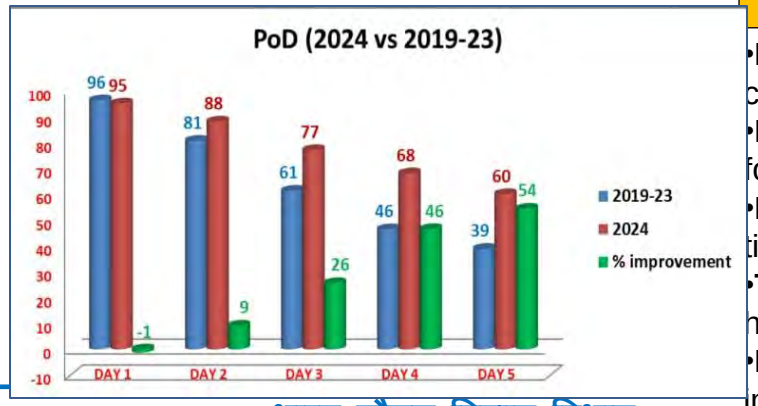
Total No of SEZ affected: 1
Total No of Power Station affected:6
Total No of Power Plants affected:4
or Towns affected:9



Maximum Temperature Departures with heat wave conditions overlaid with Indian Railway Network



Maximum Temperature Departures with heat wave conditions overlaid with Indian Road Network



भारत मौसम विज्ञान विभाग

INDIA METEOROLOGICAL DEPARTME

IMPACTS

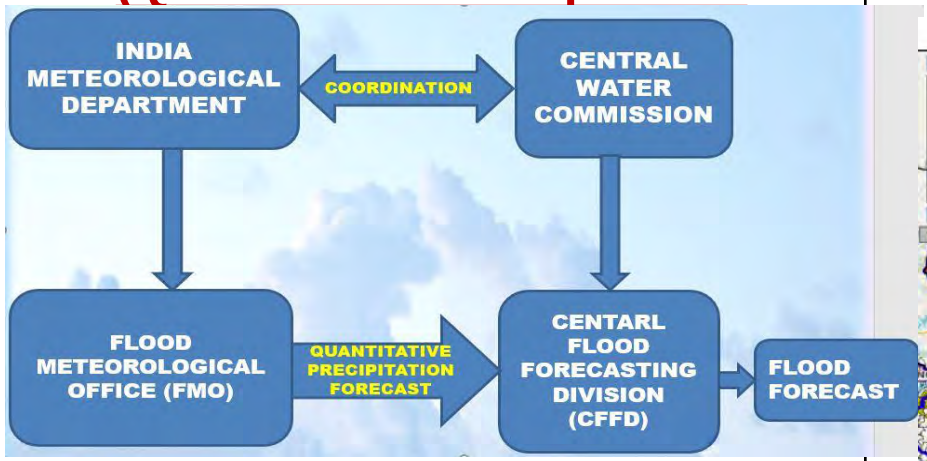
- **Human Health**: Increases risk of heatstroke, dehydration, and cardiovascular issues; vulnerable populations suffer most.
- **Agriculture**: Reduces crop yields, causes drought stress, disrupts planting/harvesting cycles.
- **Livestock**: Causes heat stress, reduced productivity, higher mortality.
- **Transport**: Damages roads/railways, causes delays and accidents, affects worker safety.
- **Economy**: Disrupts labor productivity, increases health and infrastructure costs.
- **Water Resources**: Increases evaporation, reduces freshwater availability, worsens droughts.

ACTION

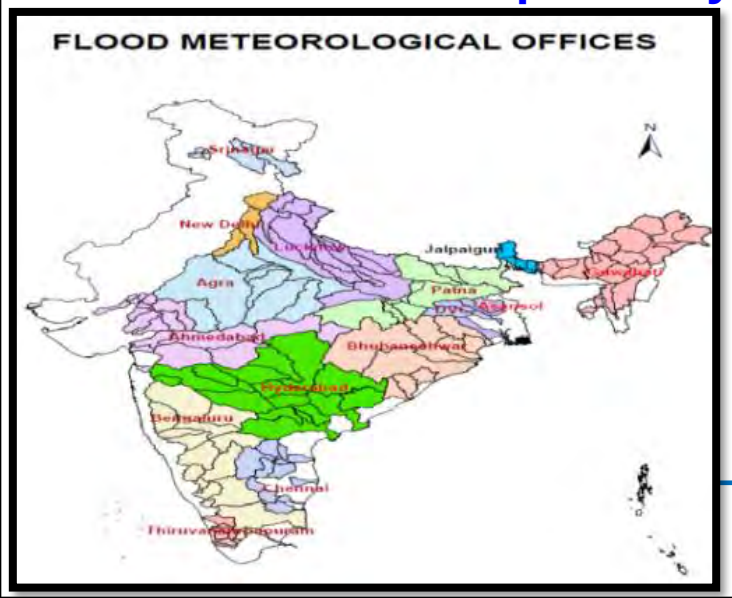
- **Human Health**: Improve heat warning systems, expand access to cooling centers, promote hydration and public awareness.
- **Energy**: Boost energy efficiency, diversify energy mix, upgrade grids for heat resilience.
- **Livestock**: Provide shade, ventilation, ample water; modify feeding times.
- **Transport**: Upgrade infrastructure for heat resilience, adjust work hours, enhance maintenance.
- **Economy**: Invest in heat-resilient jobs and technology, support heat-impacted sectors.
- **Water Resources**: Improve water conservation, build reservoirs, enhance drought planning.

Hydromet Services of IMD for Flood Forecasting

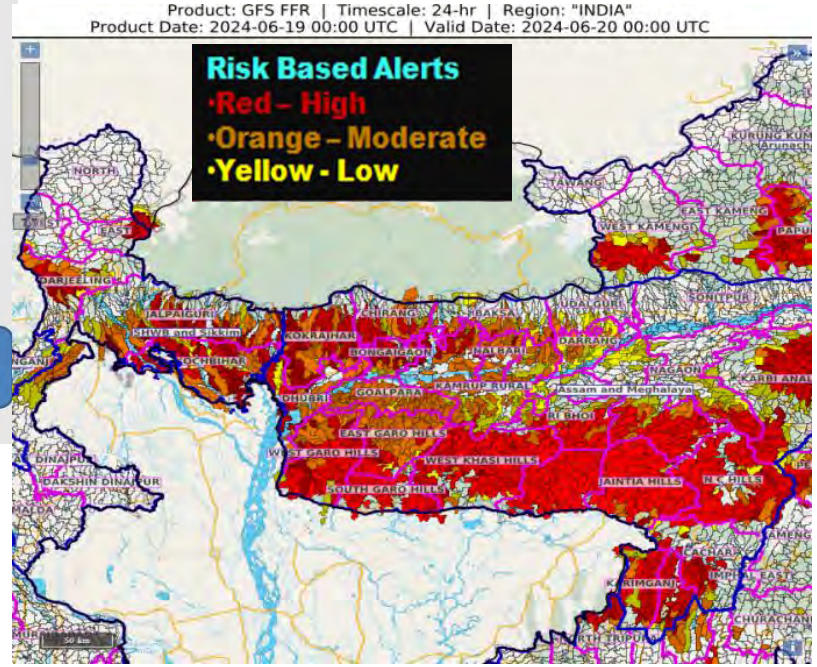
Riverine Flood Forecasting (Quantitative Precipitation



- **15 Flood Met. Offices provide rainfall forecast for 160 river sub basins valid upto 7 days**

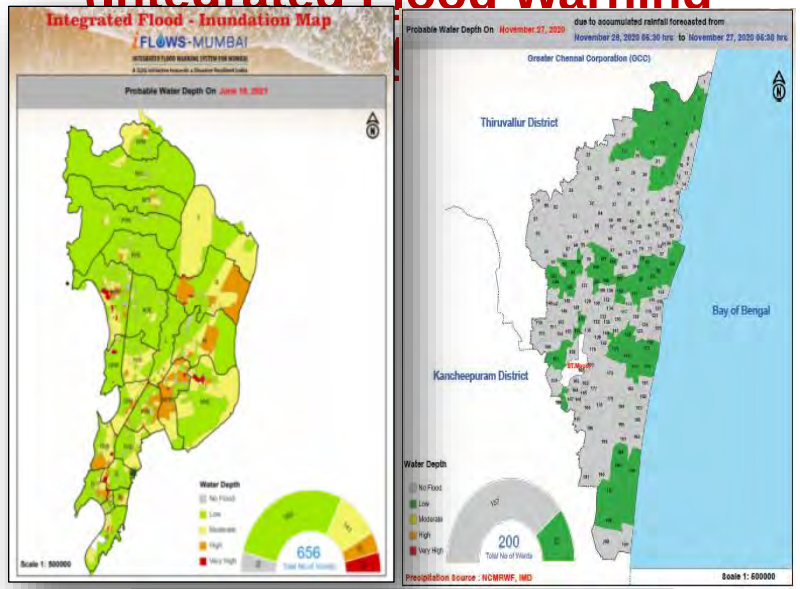


South Asia Flash Flood Guidance System (SAsiaFFGS)



- **Guidance for Bangladesh, Bhutan, India, Nepal, Sri Lanka.**
- **High resolution (4X4 km) and 30000 watersheds over Indian region.**
- **Capable of issuing flash flood Threat and risk for next 6 and 24 hours respectively.**

City Specific Flood Forecast (Integrated Flood Warning



Code	Water Depth (feet)
	No flood
	3-4
	4-5
	5-6
	>6

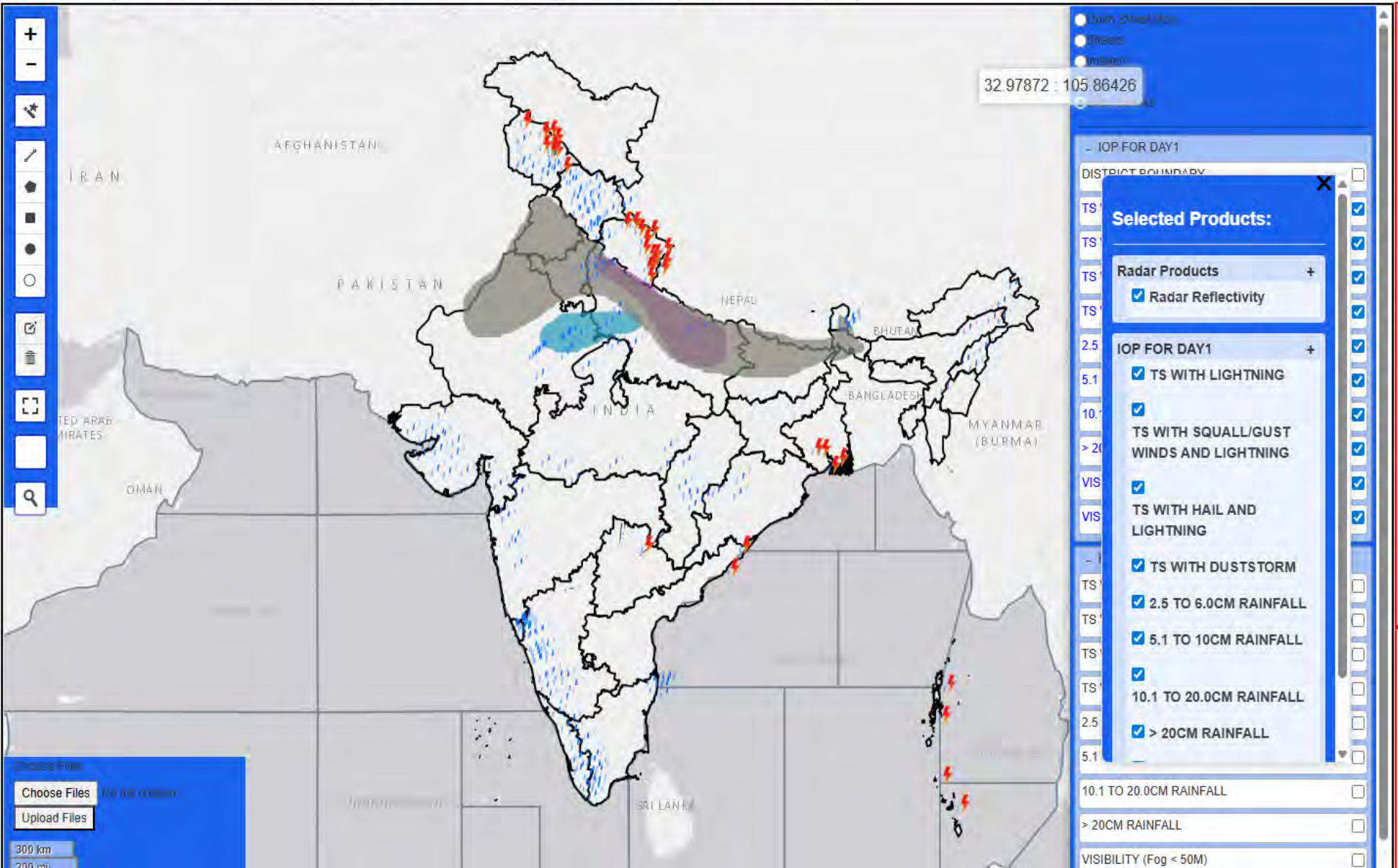
- **Implemented at Mumbai, Chennai and Kolkata**
- **Ward-wise probable water depth/inundation.**

THUNDERSTORM SERVICES

INTERACTIVE SYSTEM FOR NOWCAST SERVICES

Climatological Indices | Exposure | Metar | Synop | Model Output | Satellite | Mimic | Lightning | Radar | Sounding | MultiModal_Lightning | Home | Exposure Detail | Export Polygon

IOP View | IOP Edit | Generate IOP | Generate Bulletin | Generate PDF | Data Filter

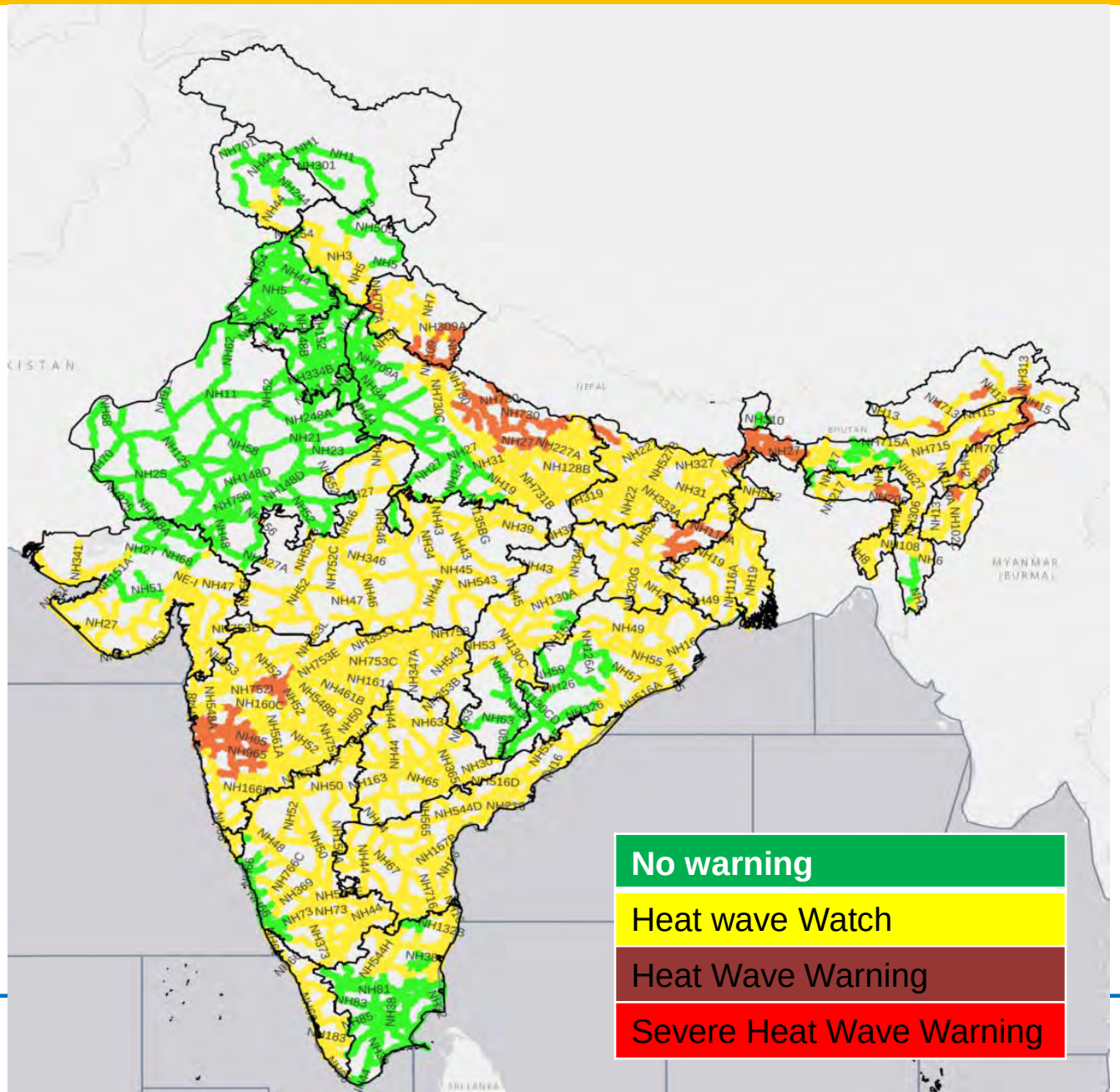


Warning Type

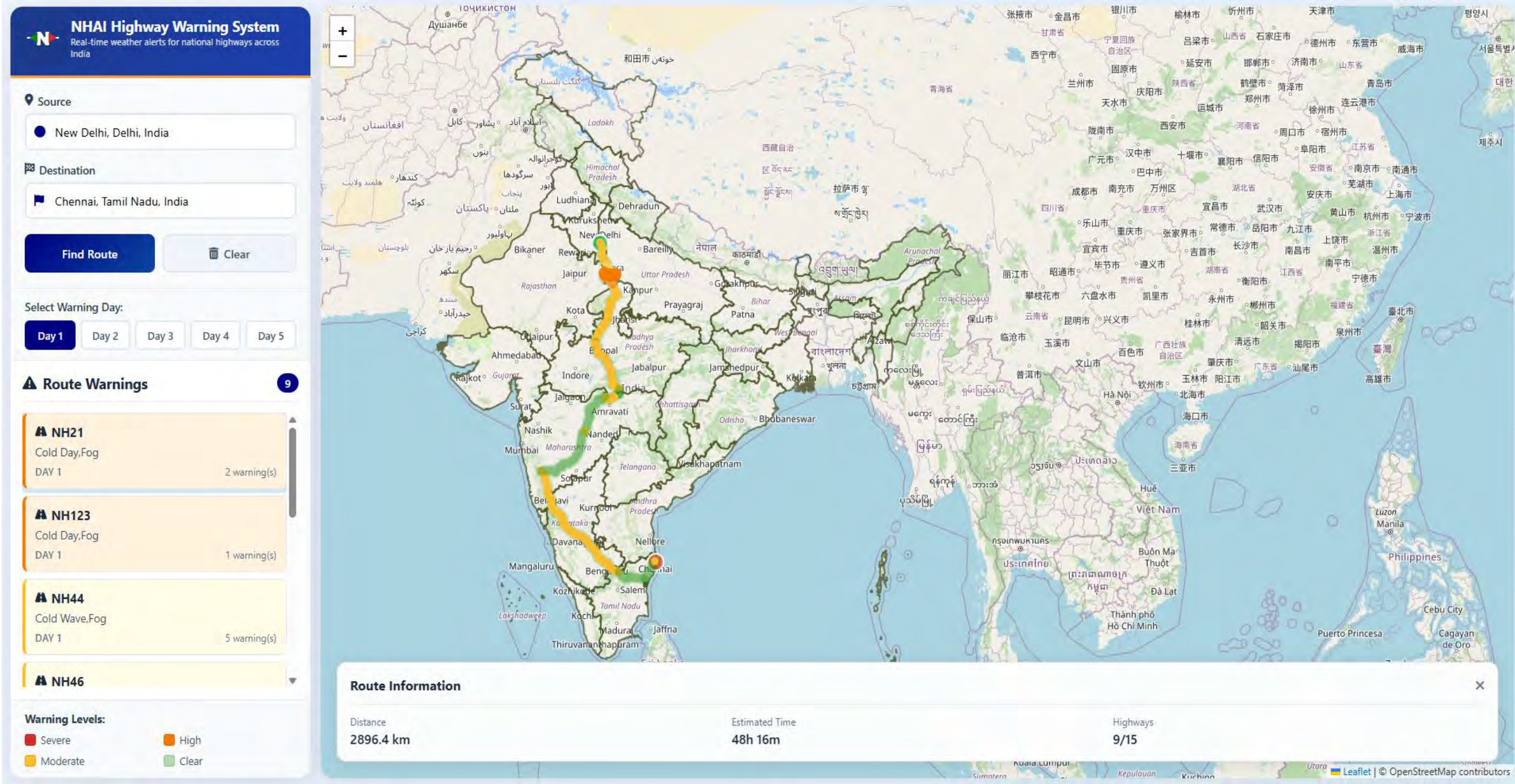
TS With Lightning	A1 / B1
TS with Squall/Gusty winds and Lightning	A2 / B2
TS with Hail and Lightning	A3 / B3
TS with Duststorm	A4 / B4
2.5 to 5.0 cm Rainfall	A5 / B5
5.1 to 10.0 cm Rainfall	A6 / B6
10.1 to 20.0 cm Rainfall	A7 / B7
>20.0 cm Rainfall	A8 / B8
Visibility(Fog <50 m)	A9 / B9
Visibility(Fog <200 m)	A10 / B10

Day 1 : 20260118

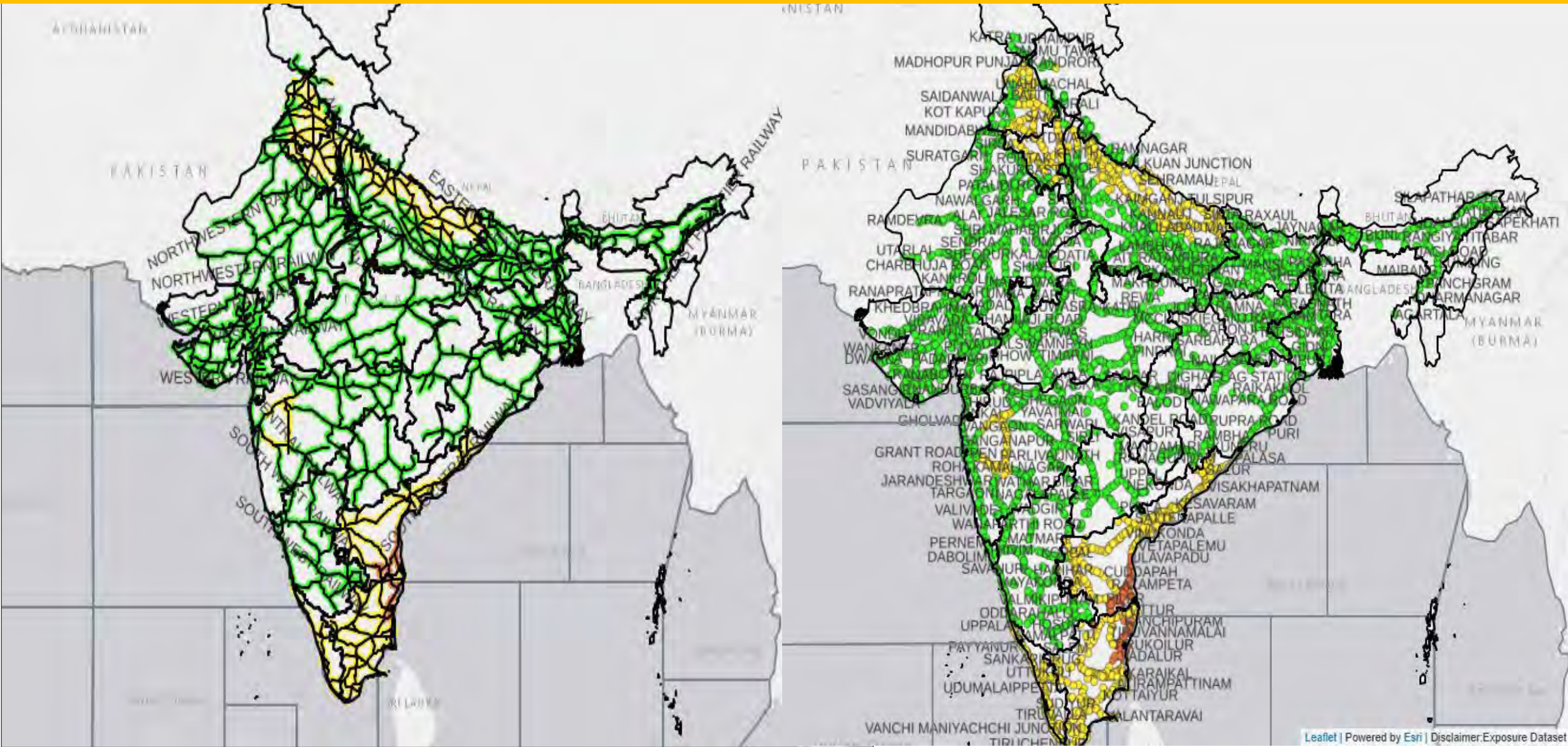
MULTI HAZARD WARNING FOR NATIONAL HIGHWAY



ROUTE FORECAST FOR NATIONAL HIGHWAYS

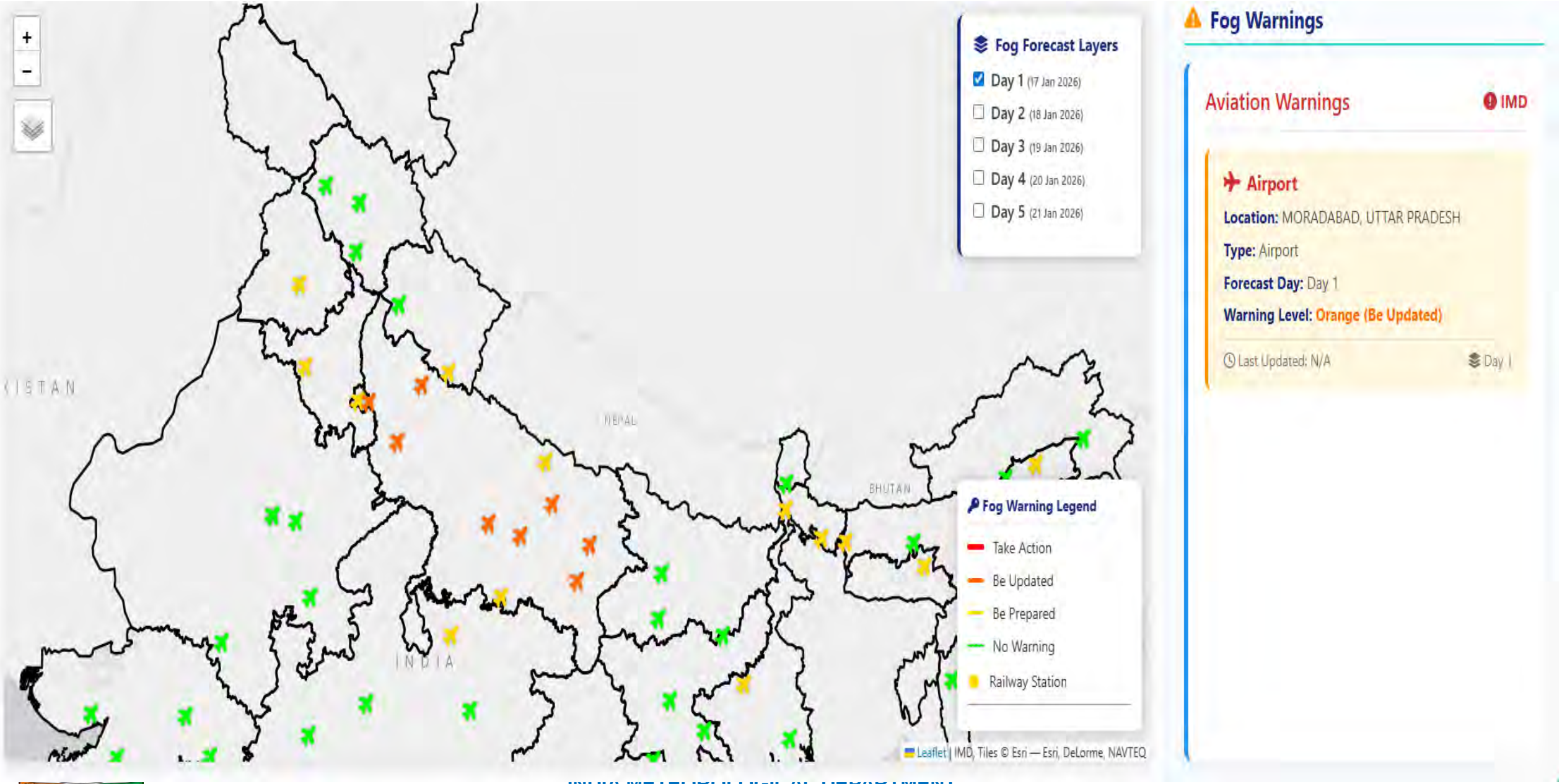


MULTI HAZARD WARNING FOR INDIAN RAILWAYS AND RAILWAY STATIONS

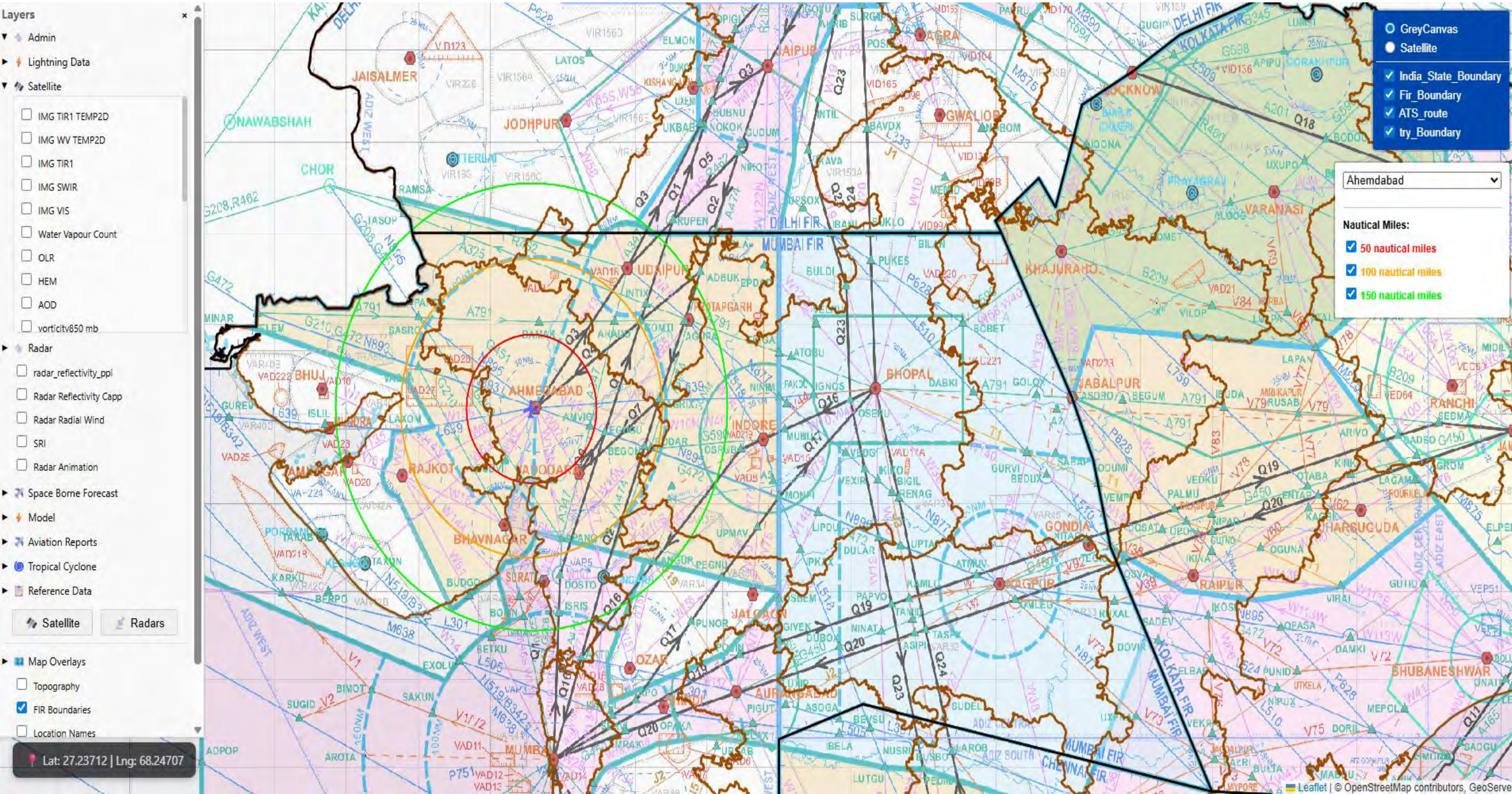


MULTI HAZARD WARNING FOR POWER SECTOR SERVCIES

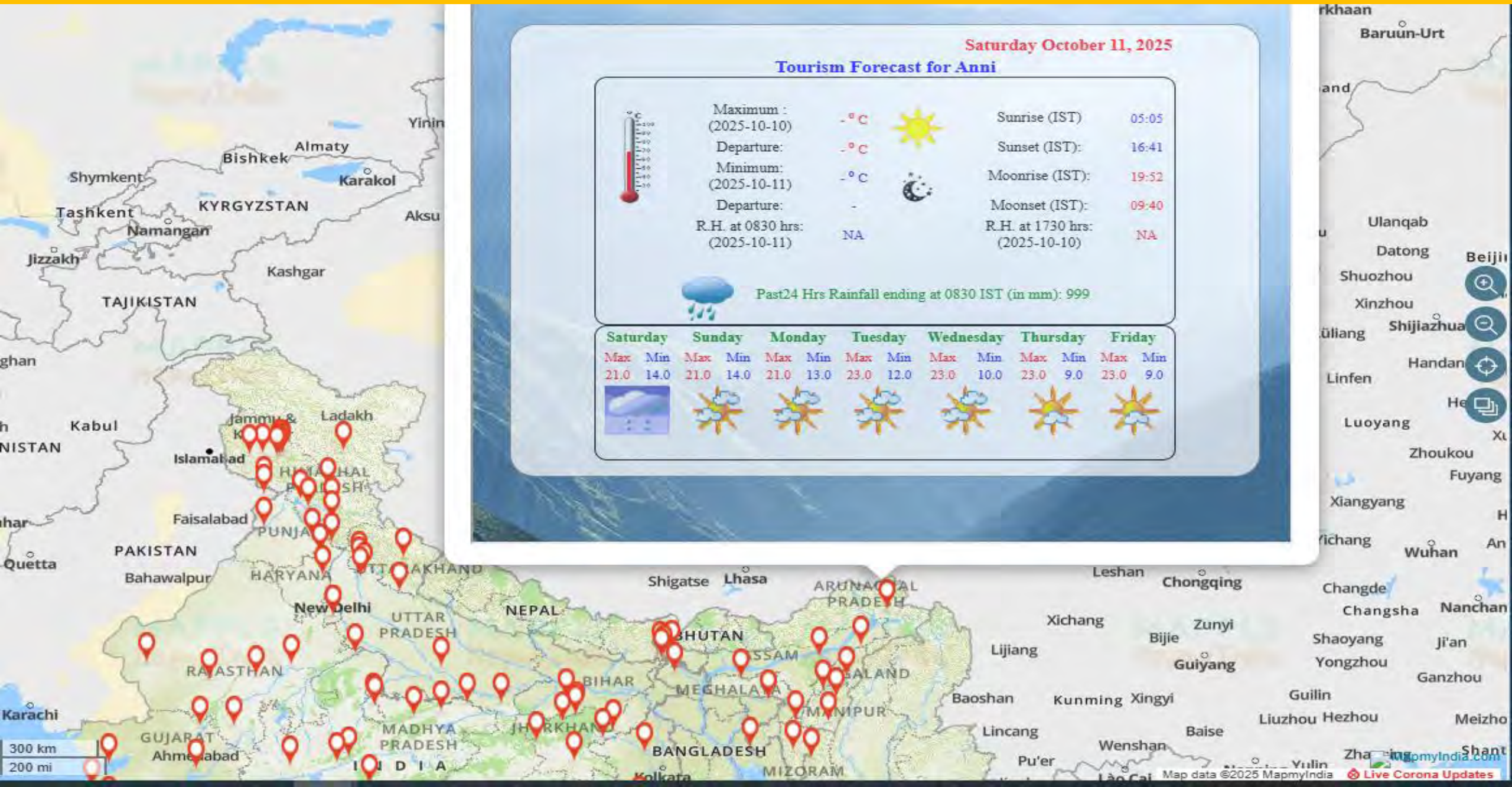
FORECAST FOR AVIATION SECTOR



MODULE FOR AVIATION SECTOR



TOURISM SECTOR SERVCIES

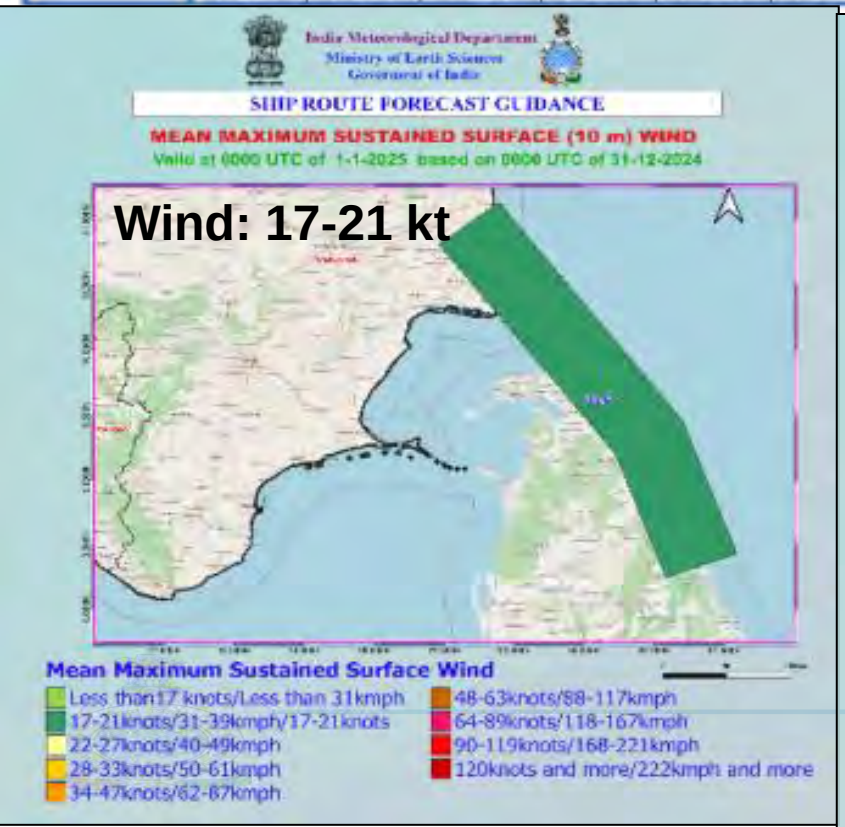


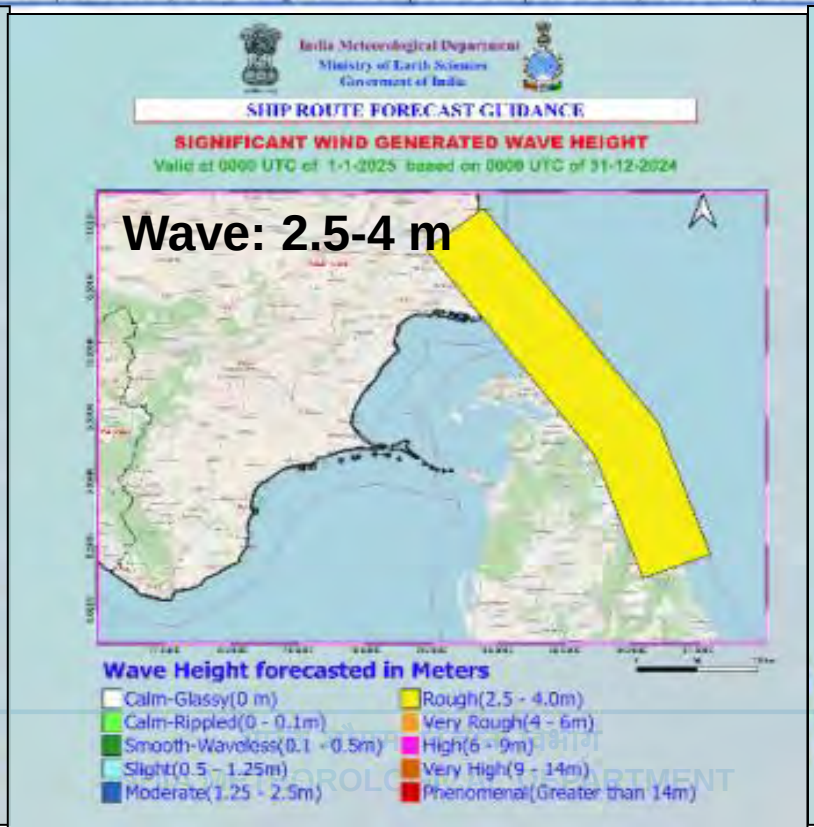
SHIP ROUTE FORECAST (3HRLY FORECAST UPTO NEXT 5 DAYS)

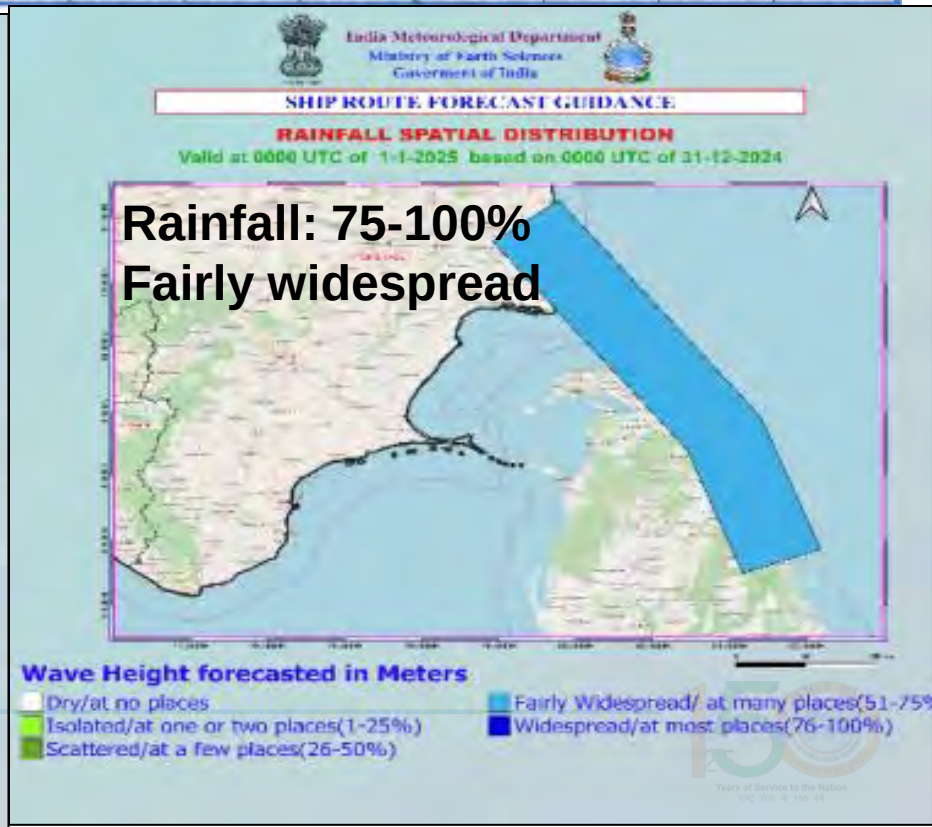
Parameters predicted: Wind, Wave, Weather and Visibility)

The weather forecast for the route between Nagapattinam Port to Kankesanthurai dated 31ST December 2024

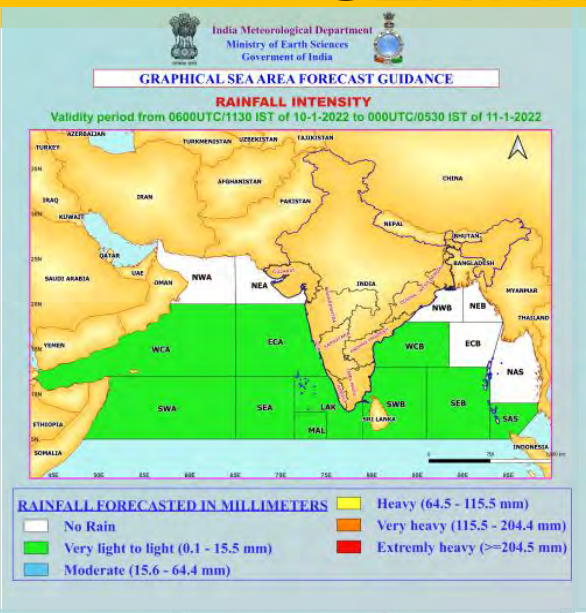
	Day 1: 31-December-2024								Day 2: 01-January-2025								Day 3: 02-January-2025			
	00 UTC	03 UTC	06 UTC	09 UTC	12 UTC	15 UTC	18 UTC	21 UTC	00 UTC	03 UTC	06 UTC	09 UTC	12 UTC	15 UTC	18 UTC	21 UTC	00 UTC	03 UTC	06 UTC	09 UTC
Wind (kt)	20.5	22.4	23.5	22	21.7	20.7	21.5	22.2	21	21.7	21.2	19.8	20.8	19.7	19.2	18.2	18.1	17.9	18	18.8
Wave (m)	4	4	4	4	4	4	4	4	4	4	4	3	4	3	3	3	3	3	3	3
Weather	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	WS	Fair	Fair	Fair	Fair
Visibility	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor

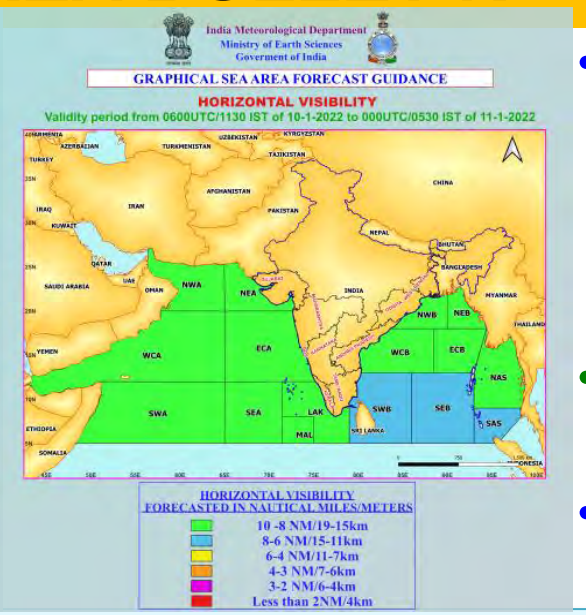


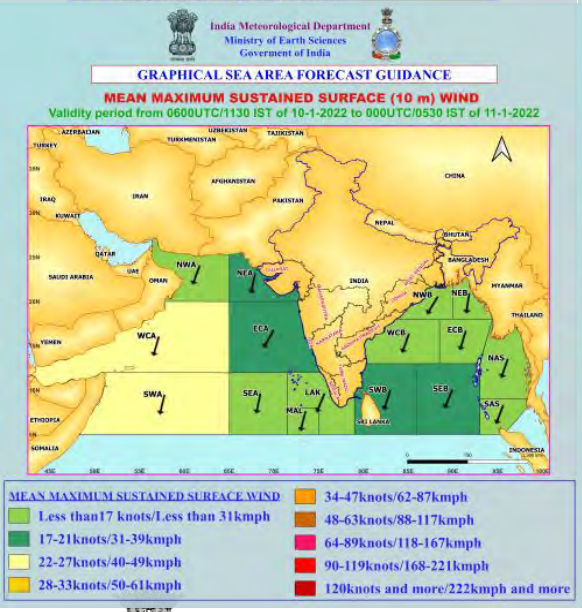




SEA AREA BULLETIN



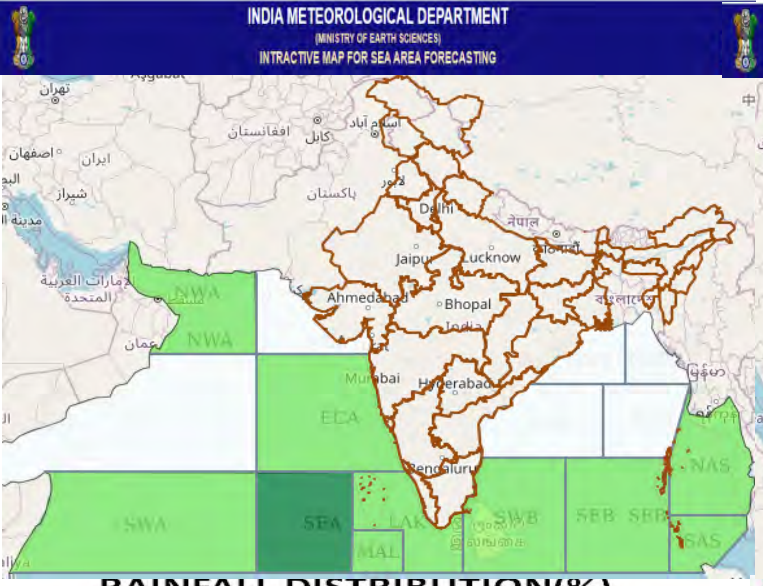


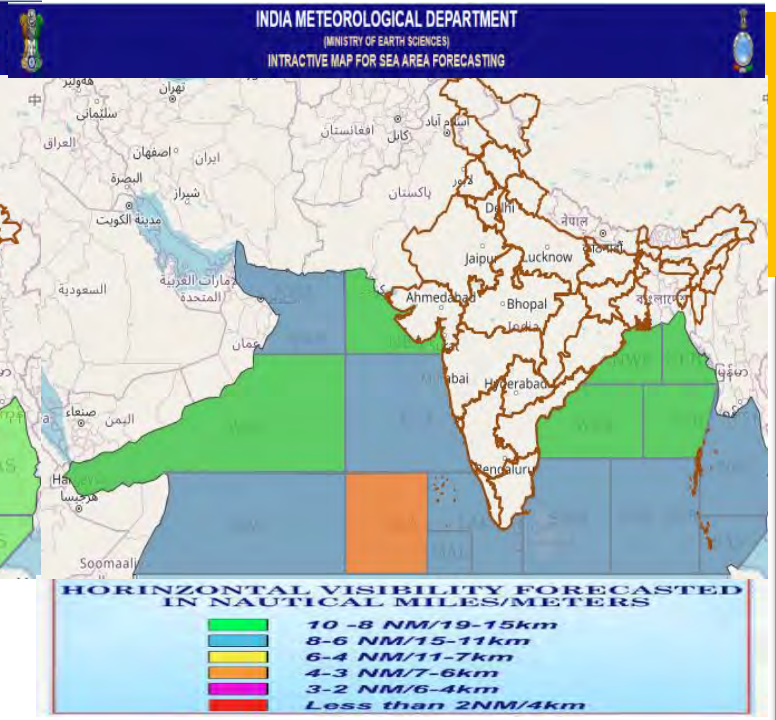


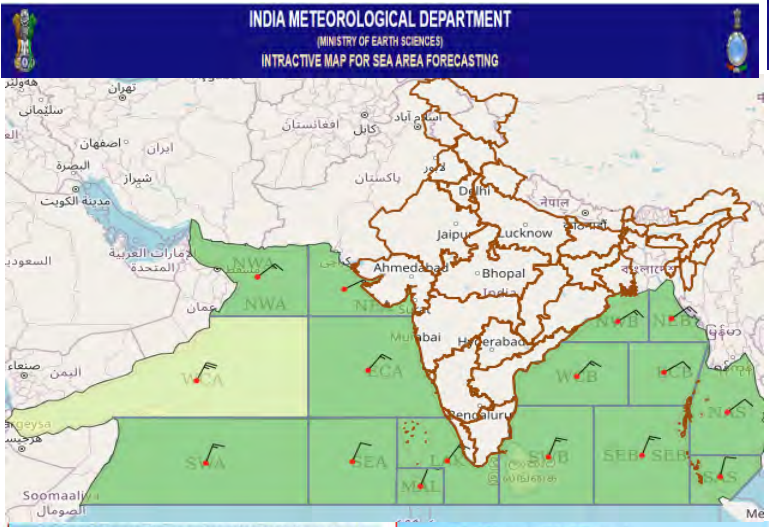
- Issued twice based on 0300 UTC & 1200 UTC (issued at +06 hrs) by IMD Kolkata for Bay of Bengal & IMD Mumbai for Arabian Sea.
- During Depression, additional bulletin at 1800 UTC.
- During cyclone, additionally at 0000, 0900 & 1500 UTC.

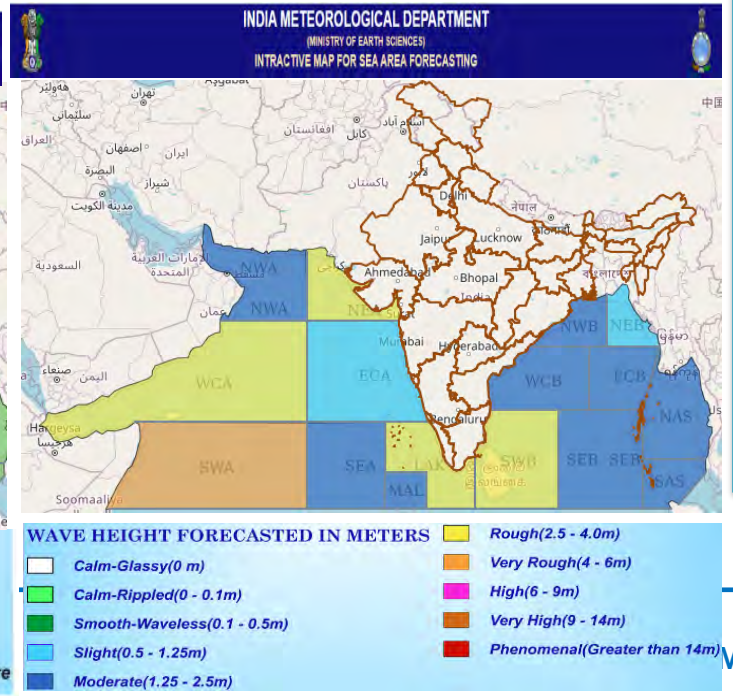
- **Part 1:** Information on weather system, location, speed of movement, extent of area affected, wind speed & direction in various sections of affected area
- **Part II :** Synoptic weather situation
- **Part III:** Forecast of (i)weather, (ii) wind and (iii) visibility.
- **Part IV:** Weather analysis.
- **Part V:** Observational data from ships in WMO codes.
- **Part VI:** Selected stations data & upper air reports.
- Broadcast by Navtex stations, put up on IMD websites www.rsmcnewdelhi.imd.gov.in, www.mausam.imd.gov.in.

Global Maritime Distress Safety System (GMDSS) Bulletin









Value added Multi model based guidance for:

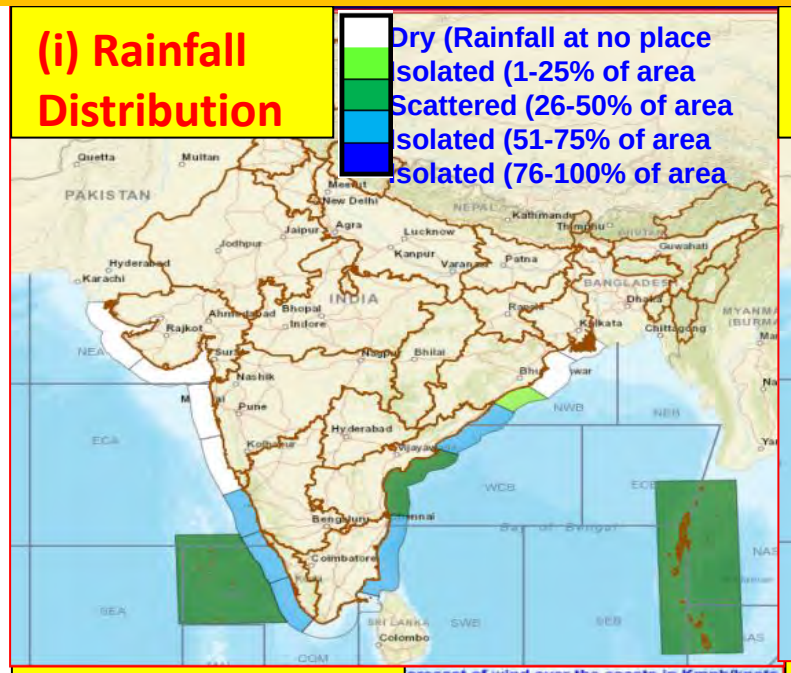
- ❖ mean maximum sustained wind (10m),
- ❖ rainfall (spatial & intensity)
- ❖ visibility
- ❖ significant wave height

Types of Bulletins:

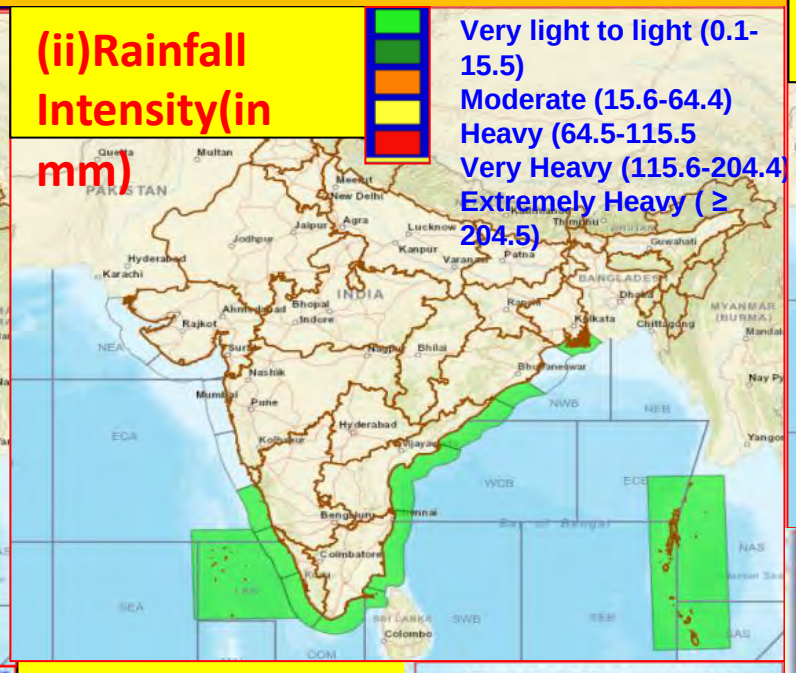
- ❖ Textual
- ❖ Graphical
- ❖ GIS for Met Area VIII(N)

Interactive maps for coastal weather

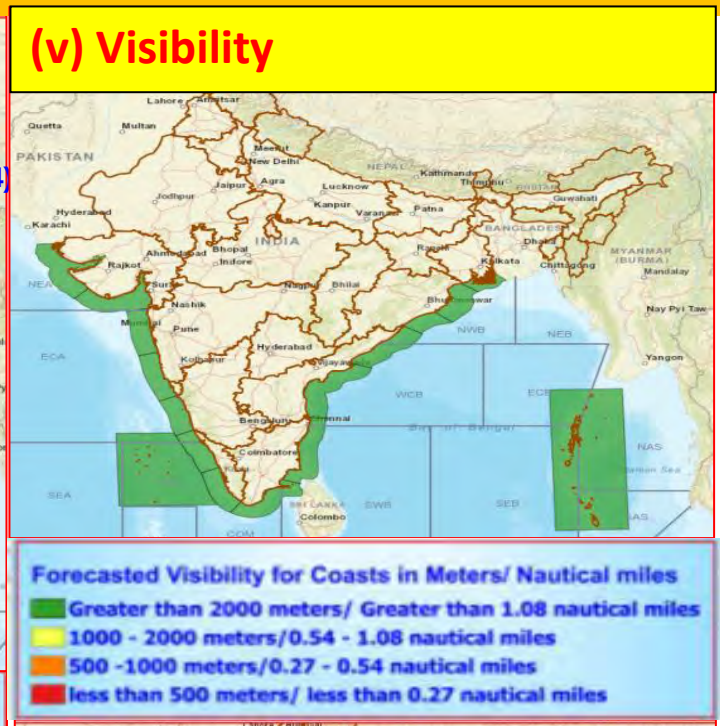
(i) Rainfall Distribution



(ii)Rainfall Intensity(in mm)

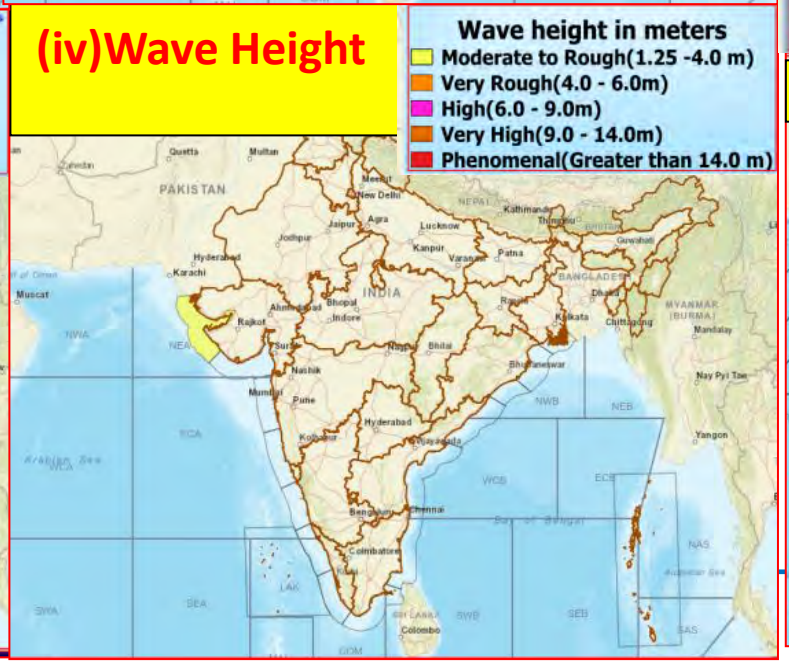


(v) Visibility



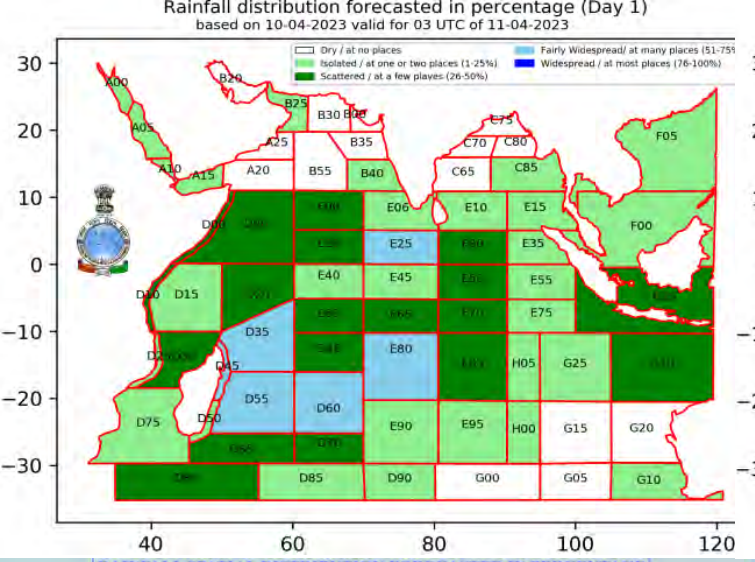
(iii) Winds over coastal water

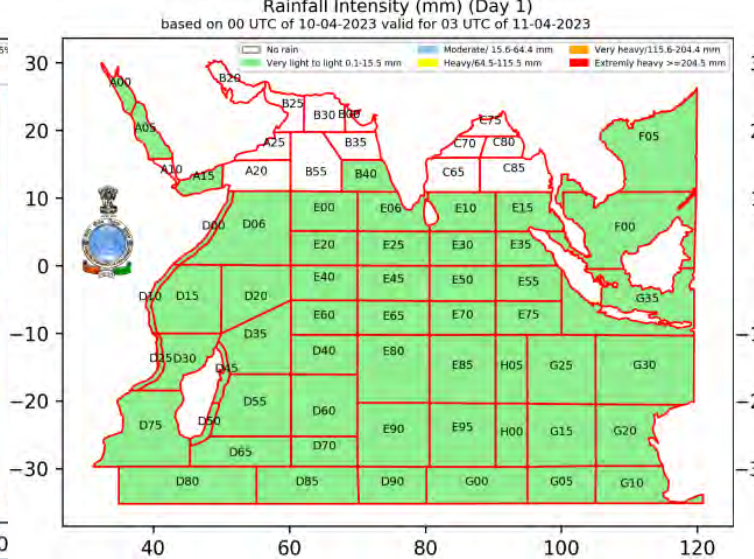
(iv)Wave Height

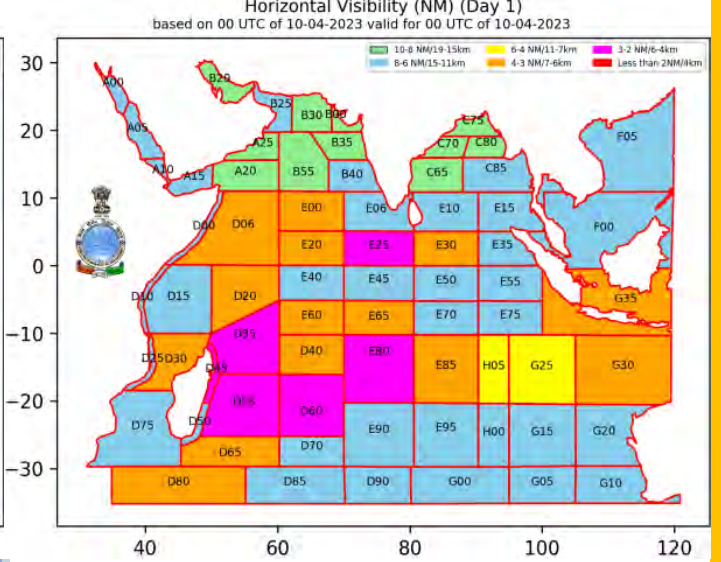


(vi) Winds over sea area

Fleet forecast graphics for Indian Navy Area is: 40-100E and 30S-30N



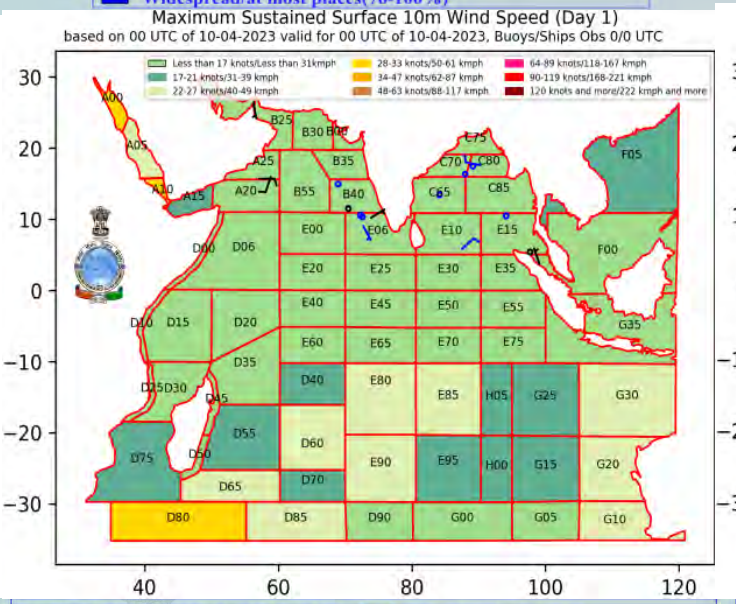


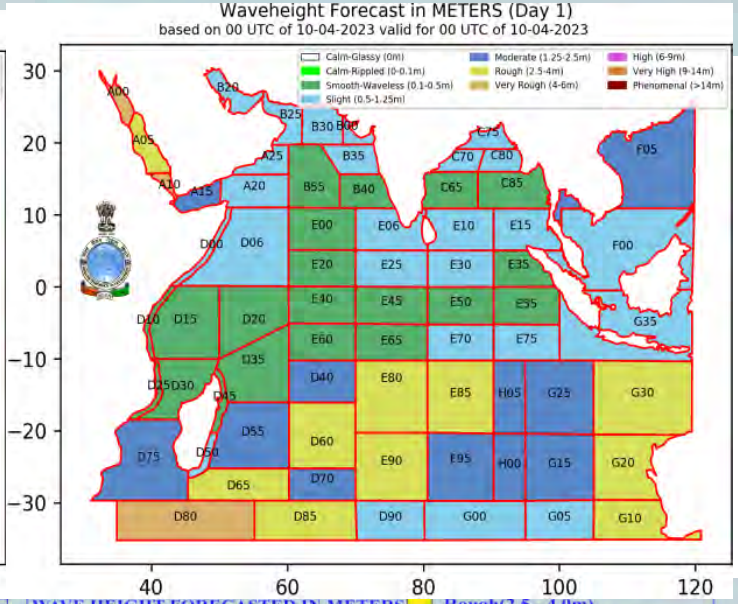


RAINFALL SPATIAL DISTRIBUTION FORECASTED IN PERCENTAGE
- Dry/at no places
- Isolated/at one or two places(1-25%)
- Scattered/at a few places(26-50%)
- Fairly Widespread/ at many places(51-75%)
- Widespread/at most places(76-100%)

RAINFALL FORECASTED IN MILLIMETERS
- No Rain
- Very light to light (0.1 - 15.5 mm)
- Moderate (15.6 - 64.4 mm)
- Heavy (64.5 - 115.5 mm)
- Very heavy (115.5 - 204.4 mm)
- Extremly heavy (>=204.5 mm)

HORIZONTAL VISIBILITY FORECASTED IN NAUTICAL MILES/METERS
- 10 -8 NM/19-15km
- 8-6 NM/15-11km
- 6-4 NM/11-7km
- 4-3 NM/7-6km
- 3-2 NM/6-4km
- Less than 2NM/4km



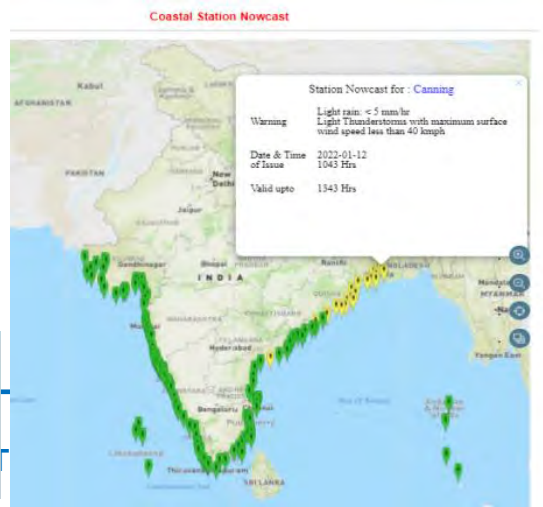


MAXIMUM SUSTAINED SURFACE WIND
- Less than17 knots/Less than 31kmph
- 17-21knots/31-39kmph
- 22-27knots/40-49kmph
- 28-33knots/50-61kmph
- 34-47knots/62-87kmph
- 48-63knots/88-117kmph
- 64-89knots/118-167kmph
- 90-119knots/168-221kmph
- 120knots and more/222kmph and more

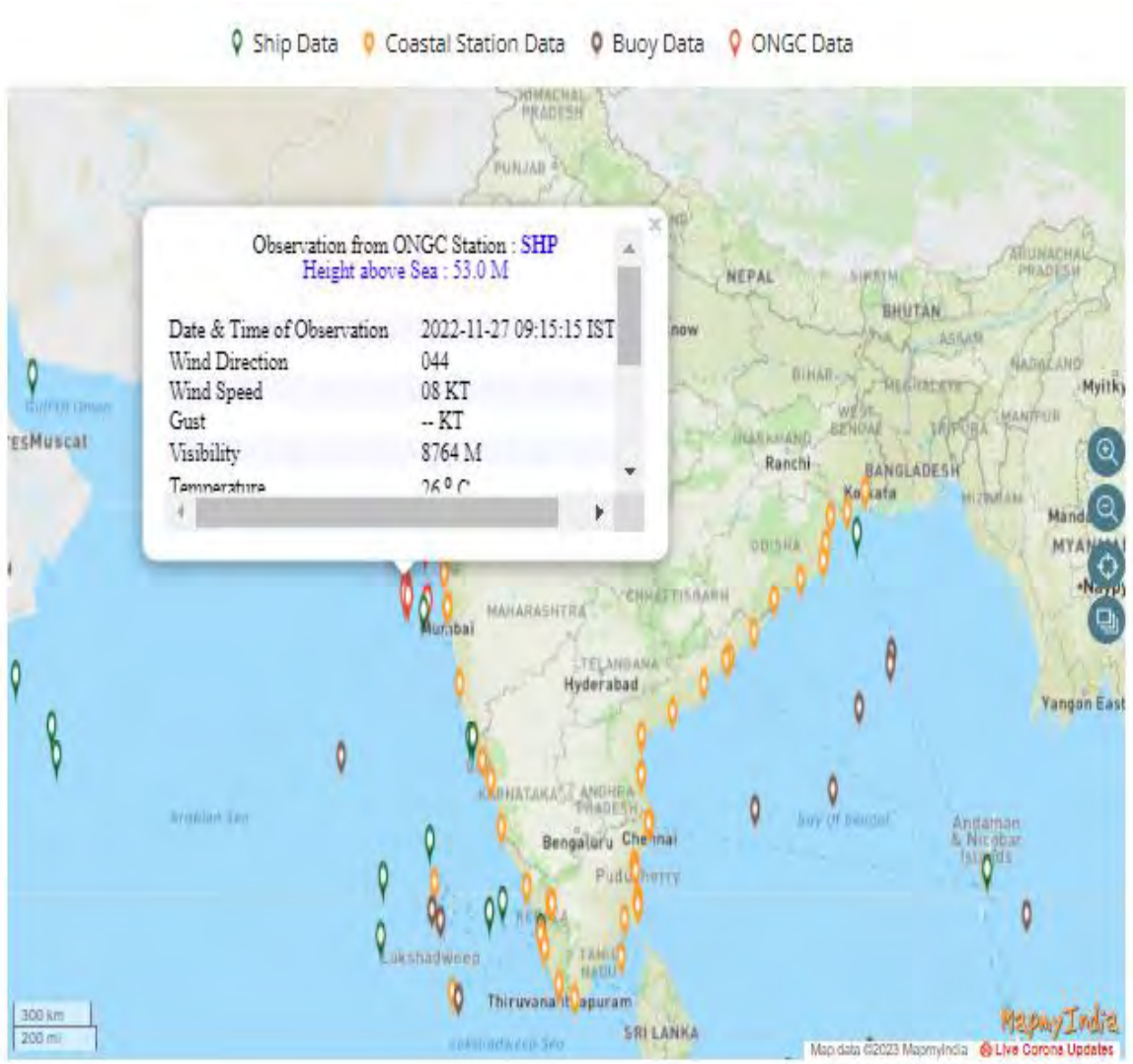
WAVE HEIGHT FORECASTED IN METERS
- Calm-Glassy(0 m)
- Calm-Rippled(0 - 0.1m)
- Smooth-Waveless(0.1 - 0.5m)
- Slight(0.5 - 1.25m)
- Moderate(1.25 - 2.5m)
- Rough(2.5 - 4.0m)
- Very Rough(4 - 6m)
- High(6 - 9m)
- Very High(9 - 14m)
- Phenomenal(Greater than 14m)

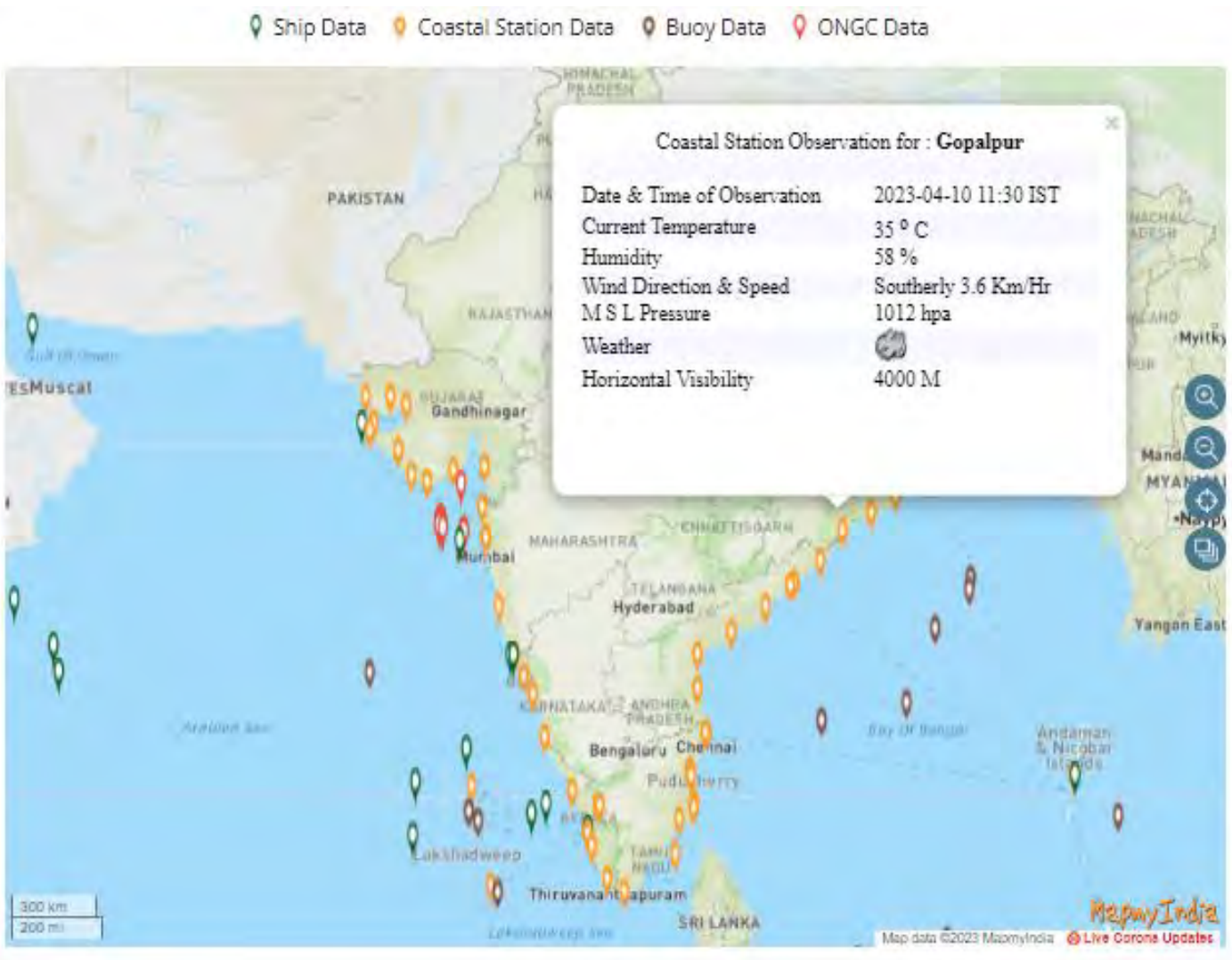
140 stations Nowcast Stations.

Real time display of Ship and Coastal Weather observations on website

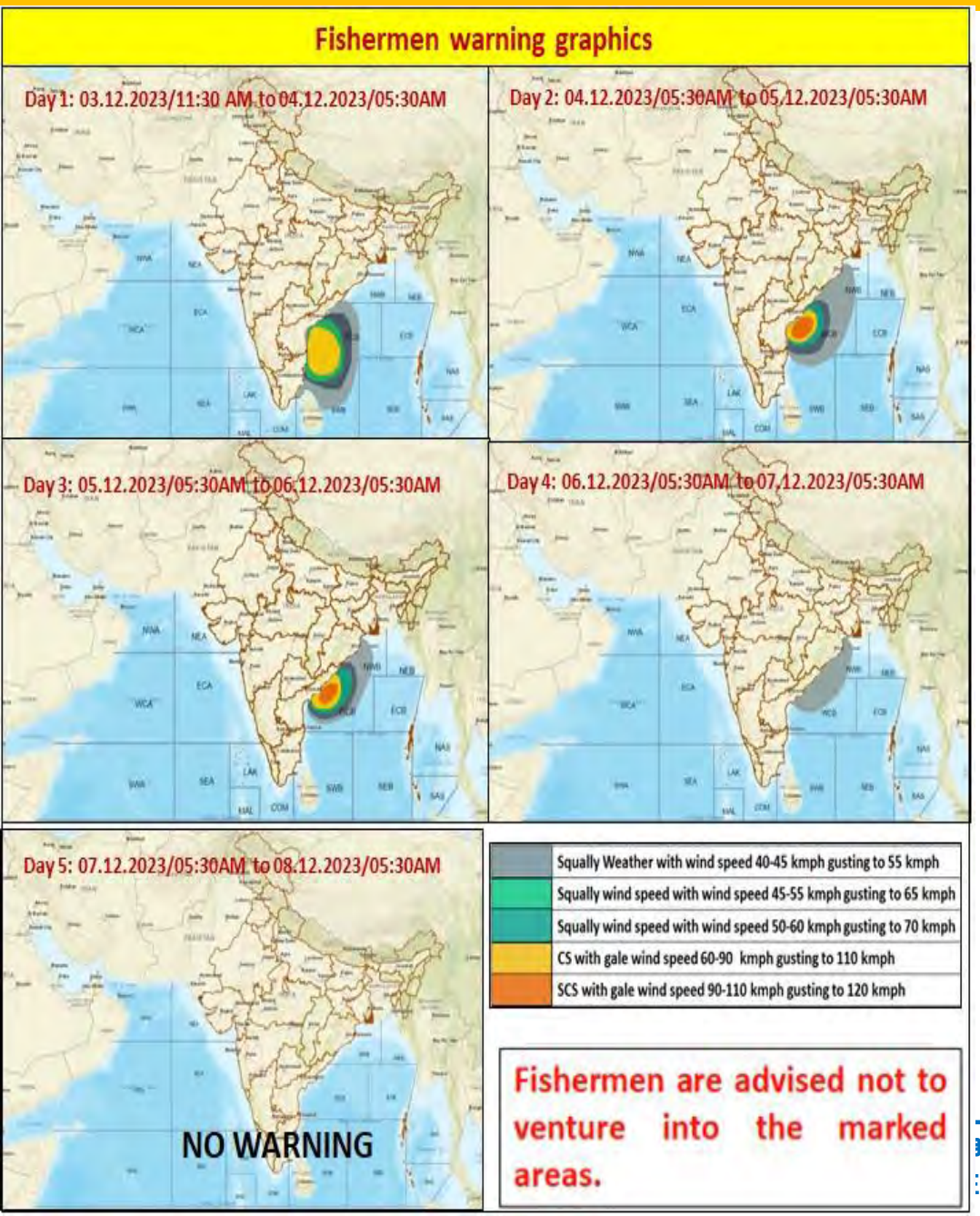


Realtime display of Actual Observations from coastal observatories, ships and buoys





Fishermen Warning Bulletins



- Issued whenever any one of the following is expected

(i) Wind speed expected to exceed 45 kmph

(ii) State of sea likely to be very rough or above,

(iii) Swells are expected,

(iv)Squally weather (fairly widespread to widespread rainfall & maximum sustained wind speed of 20 knots or more).

- Warnings are transmitted by telephone/FAX/email to AIR/Doordarshan stations in the maritime states.
- Warnings are broadcast four times a day (morning, mid-day, evening and night) by AIR in local language.
- During cyclone, issued every 3 hour for frequent broadcast.
- Warnings are uploaded on website and appended with other warning bulletins.
- Transmitted to fishery officials and registered fishermen through SMS/WhatsApp/Mobile App

Probablistic of Exceedance of winds (a) 25 knots and (b) 35 knots

Probability of exceedance of maximum sustained winds ≥ 45 kmph

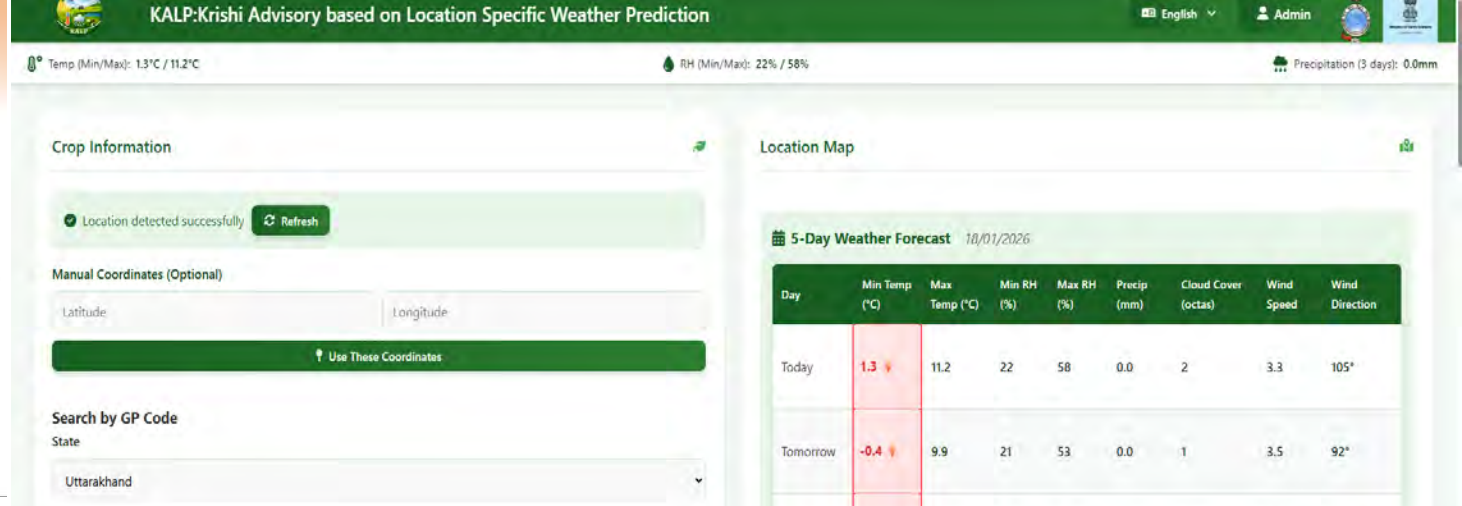
	Probabilty of exceedence
	Low (1-33%)
	Moderate (34-67%)
	High (68-100%)

Probability of exceedance of maximum sustained winds ≥ 62 kmph

	Probabilty of exceedence
	Low (1-33%)
	Moderate (34-67%)
	High (68-100%)

Krishi Advisory based on Location-specific weather Prediction

KALP



Pest & Disease Information

Brown Rust/Leaf Rust

Low Risk

Management

Current weather conditions are NOT favorable for Brown Rust/Leaf Rust development.

Mancozeb 75% WP @ 2.5 g/L or Propiconazole 25% EC of water

Black Rust

Low Risk

Management

Current weather conditions are NOT favorable for Black Rust development.

Mancozeb 75% WP @ 2.5 g/L or Propiconazole 25% EC of water

Agricultural Report

Current Crop Stage: Wheat

Advisory & Pest Info

Based on crop stage & weather conditions

Weather Advisory

Weather Alert: The following conditions exceed thresholds:

Low Temperature: Low minimum tempearture leads to Poor pollen viability and floret sterility

Threshold: 6.0

Recommendation: Immediate irrigation during frost nights will work as protective layer for crop against frost injury. Avoid the use of chemical sprays during cold spells.

Crop Stage: Flowering

Pest & Disease Information

Brown Rust/Leaf Rust

Low Risk

MAUSAM GRAM (HAR HAR MAUSAM HAR GHAR MAUSAM)

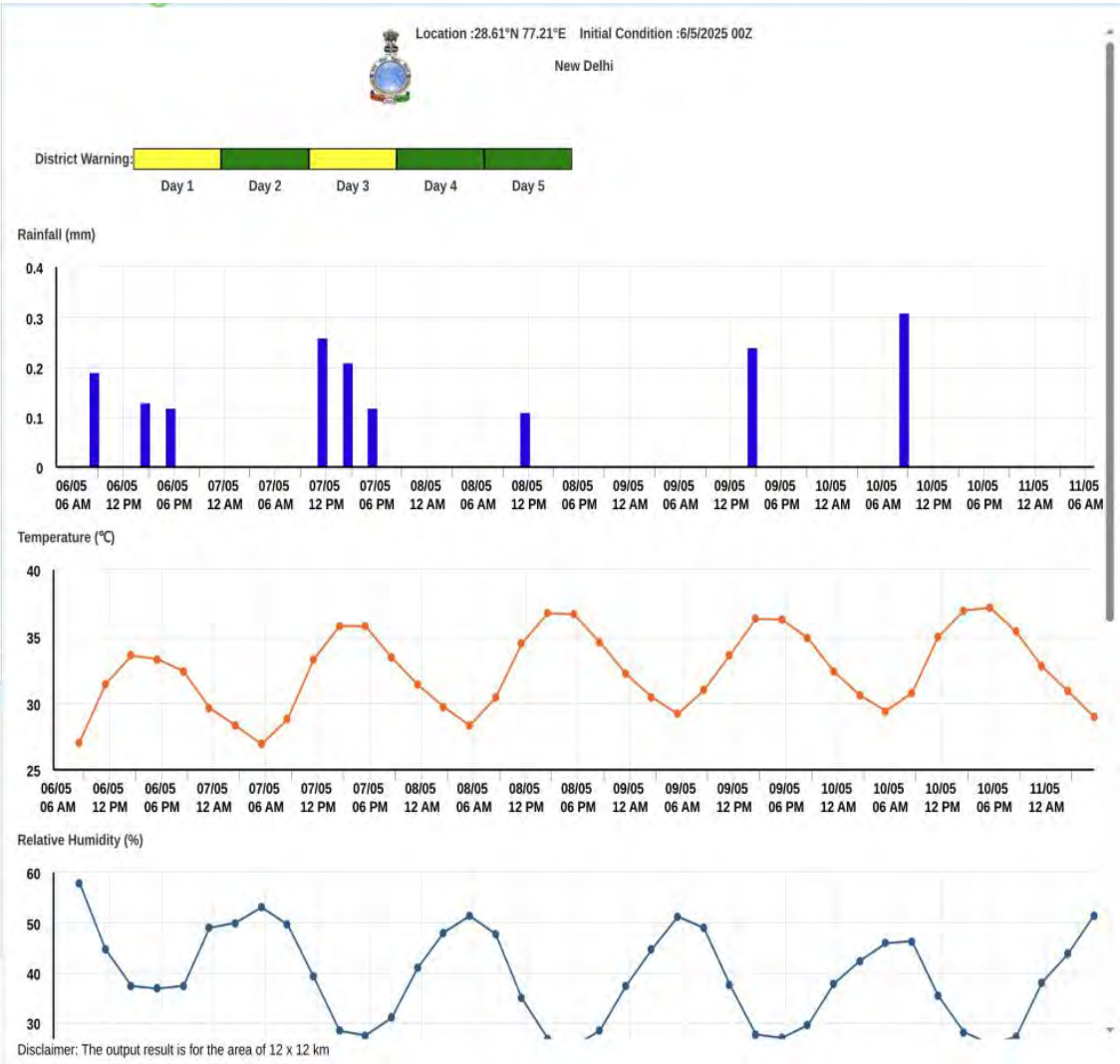
- Location Specific Forecast upto 10 days.

Forecast for

- 1.5 Lakhs pincodes locations,
- 5700 blocks,
- 624424 Villages and
- Any latitude & longitude or
- any location on the map based on single click

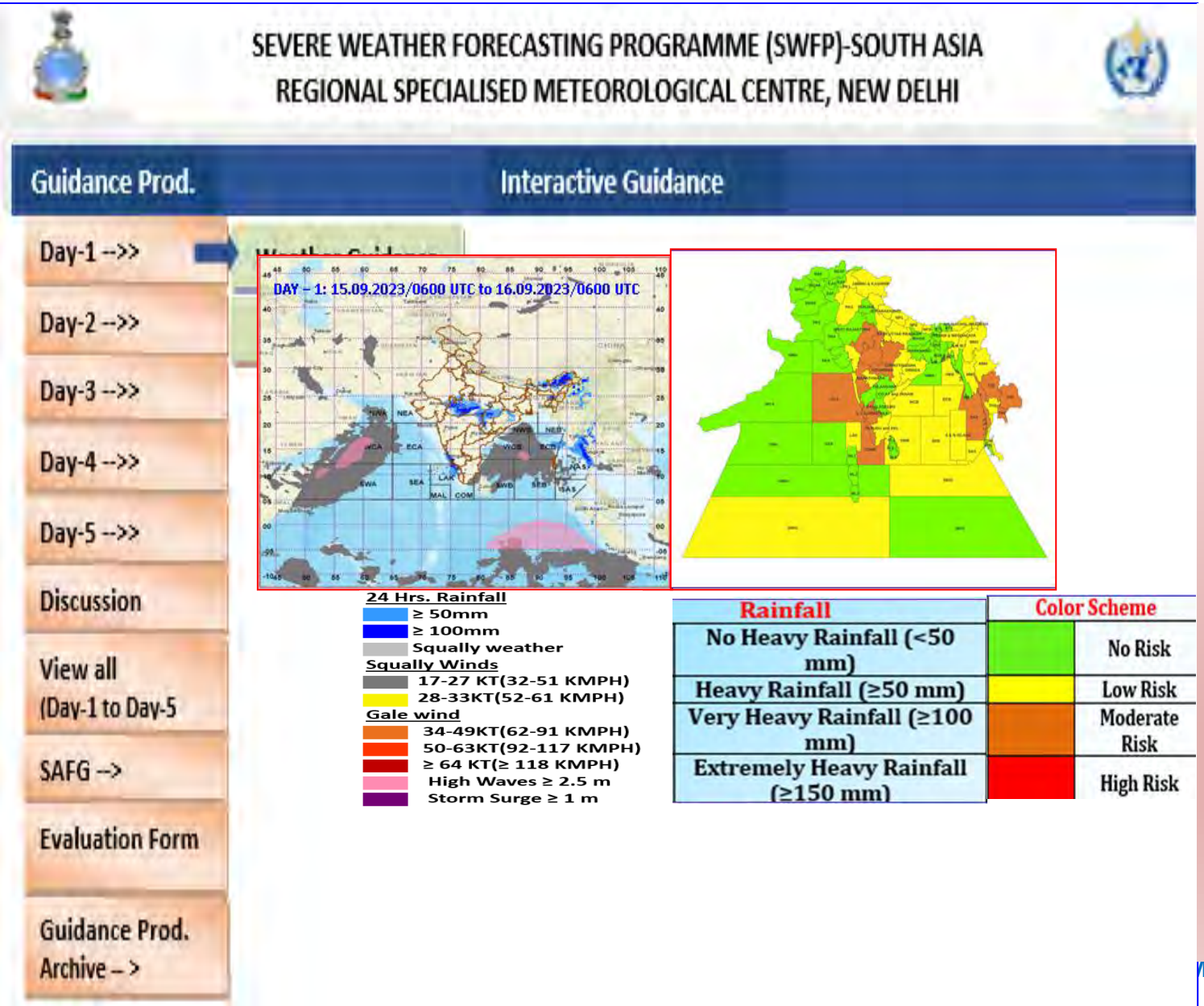
Available in

- IMD website : https://mausamgram.imd.gov.in
- Mobile App (Mausam)
- Sachet,
- E-Panchayat Seva
- APIs



- Forecast is available for every hour upto 36 hrs, every three hrs upto 5 days and every six hrs upto 10 days.

Impact based forecast under Severe Weather Forecast Programme (9 countries)

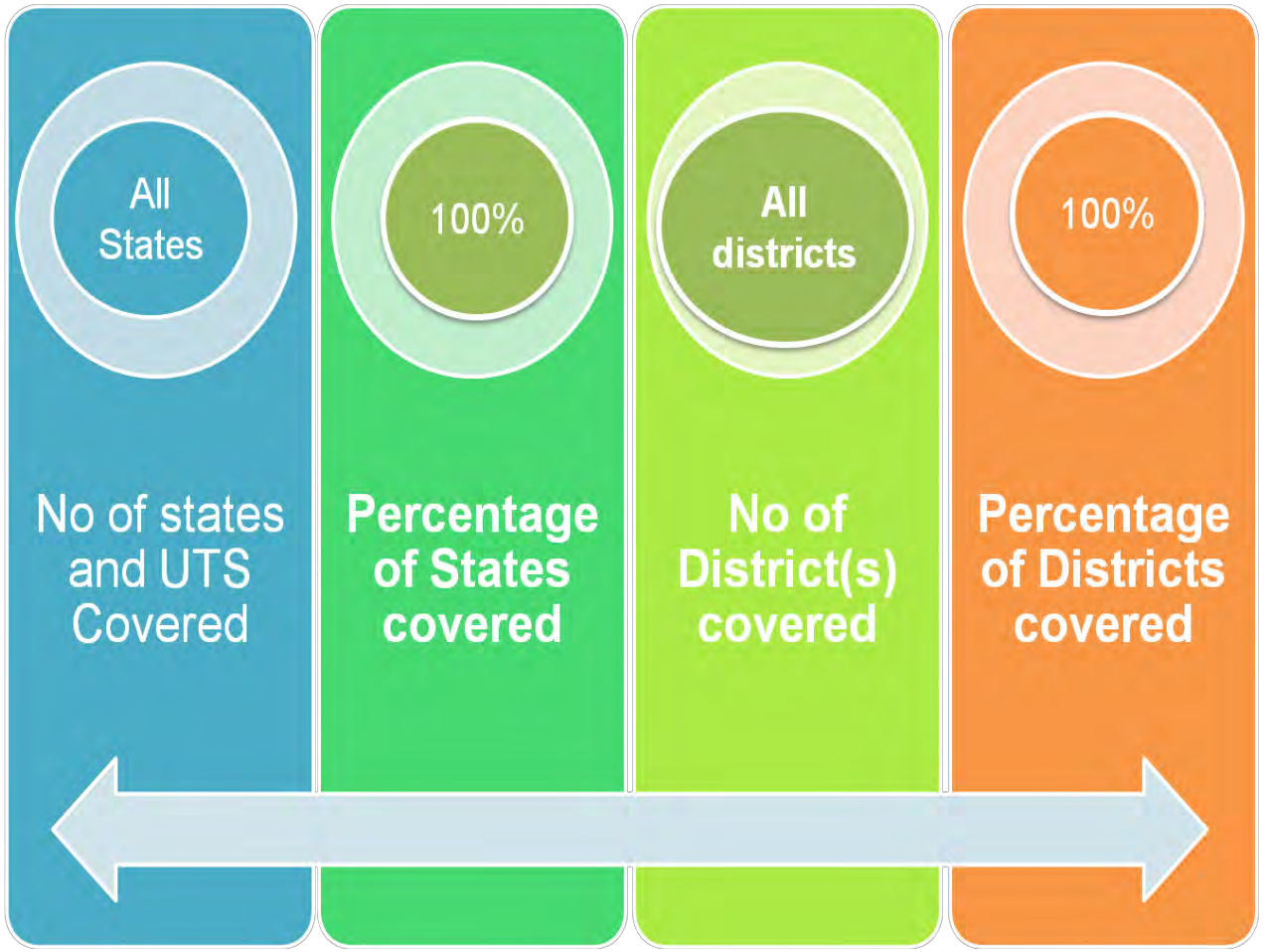


- Short Range (1-2 days)
- Medium Range (3-5 days)

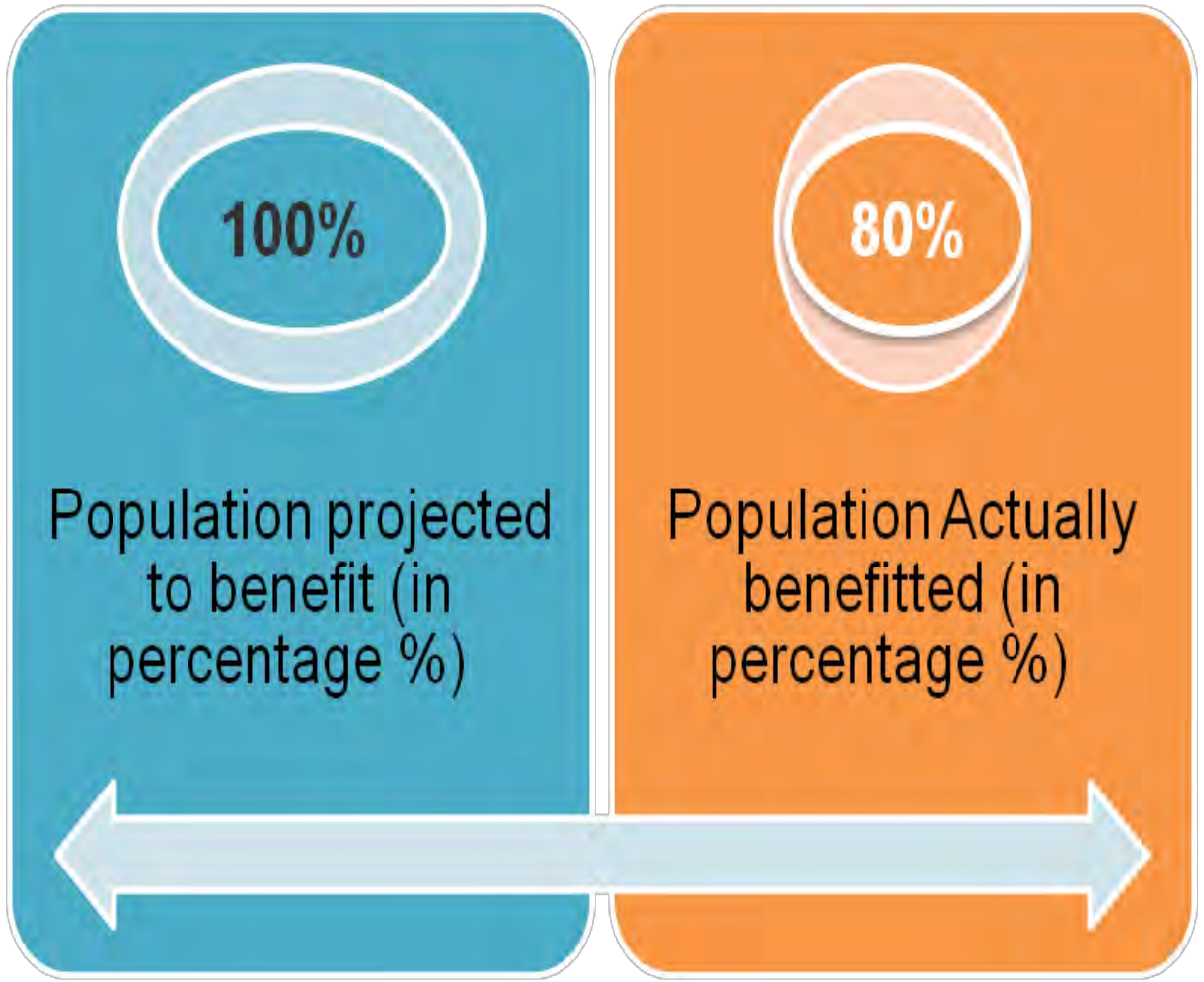
Guidance Products for next 5 days:

- Graphical WX forecast products
- Risk Guidance for precipitation & winds (graphical, tabular, GIS) for all 95 sub-divisions based on MME guidance from 5 global models (New)
- Discussion of main synoptic features, satellite features and forecast of heavy rainfall & strong winds
- Flash Flood Guidance

PROJECT COVERAGE-GEOGRAPHICAL SPREAD



PROJECT COVERAGE-POPULATION SPREAD



Services Rendered to various ministries of Government of India

APIs

More than 180 organizations are using IMD's API

- **NITI Aayog, Meity**
- **BEL**
- **Adani Green Energy Ltd**
- **AP Government, Commissioner ate of Agriculture**
- **Assam State Disaster Management Authority**
- **Arunachal Pradesh Government**
- **National Institute of Hydrology**
- **MP Goverment, SDMA**
- **NHAI, Indian Railways, NHPC, C-DOT,**
- **NDMA / SDMA, Incredible India , eNAM**
- **National Rice Research Institute Cuttack,**
- **SDMAs/ Agriculture Dept: AP, Odisha, Karnataka, MP, Chandigarh, Kerala, A&N Islands, Uttarakhand, J&K, UP, TamilNadu**
- **Department of Space**
- **KRC Net Portal (MoES),**
- **Disaster Management Support Group ISRO,**
- **ICAR-NIASM, National Programme on Climate Change and Human Health,**
- **RIMES**
- **Media**
- **Apple.com, Delhivery, Ola Cabs, Wipro, Tomorrow.io, TATA, L&T Power, Adani Green, iDigiCloud and many others**

Mobile Apps

as on 15 Jan 2026

Mausam App

Meghdoot App

Damini App

Download Mausam App

Android IOS

Common Alerting Protocol

- All IMD MCs and RMCs are integrated into NDMA CAP Platform and generating warnings

MET Centre	ALERT ISSUED	DISSEMINATED BY STATE	MET Centre	ALERT ISSUED	DISSEMINATED BY STATE	MET Centre	ALERT ISSUED	DISSEMINATED BY STATE
Agartala	2541	2402	Goa	563	76	New Delhi	394	169
Ahmedabad	1269	1045	Guwahati	1317	1005	Patna	1622	1493
Amravati	124	85	Hyderabad	1214	57	Raipur	1148	526
Bengaluru	4013	3937	Itanagar	291	248	Ranchi	3321	3161
Bhopal	5805	4683	Jaipur	1938	1859	Shillong	157	116
Bhubaneswar	201	52	Kolkata	4451	3912	Shimla	283	267
Chandigarh	2061	1530	Leh	16	8	Srinagar	61	53
Chennai	500	50	Lucknow	3467	2496	Thiruvananthapuram	1093	474
Dehradun	1342	1107	Mumbai	3685	257	Visakhapatnam	1153	869
Gangtok	981	535	Nagpur	780	128	TOTAL	45791	32600

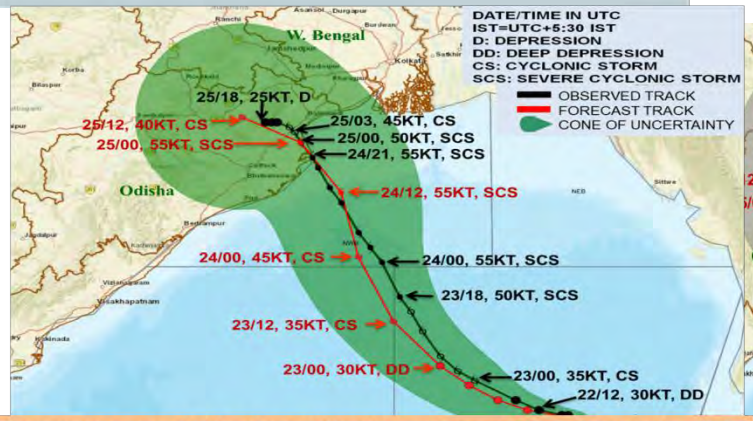
BENEFICIARIES OF THE PROJECT

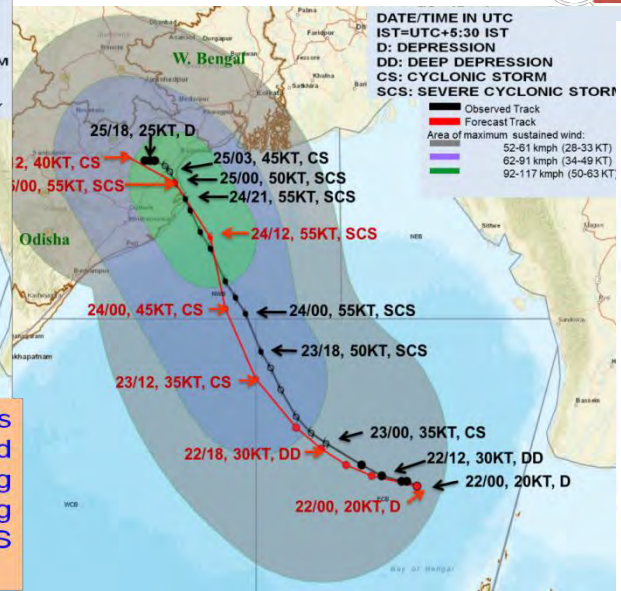
National

- All forecasters
- Disaster management authorities (NDMA, SDMA, NDRF etc.)
- Sectorial stakeholder(Urban, Power, Health, Energy, Agriculture, Aviation, Transport, Marine sector)
- General public

International

- Marine Weather Services over North Indian Ocean
  Aviation services in Asia Pacific
- WMO/ESCAP Panel for tropical Cyclone) member countries in North Indian Ocean
- Severe weather Forecasting program for 9 South Asian countries

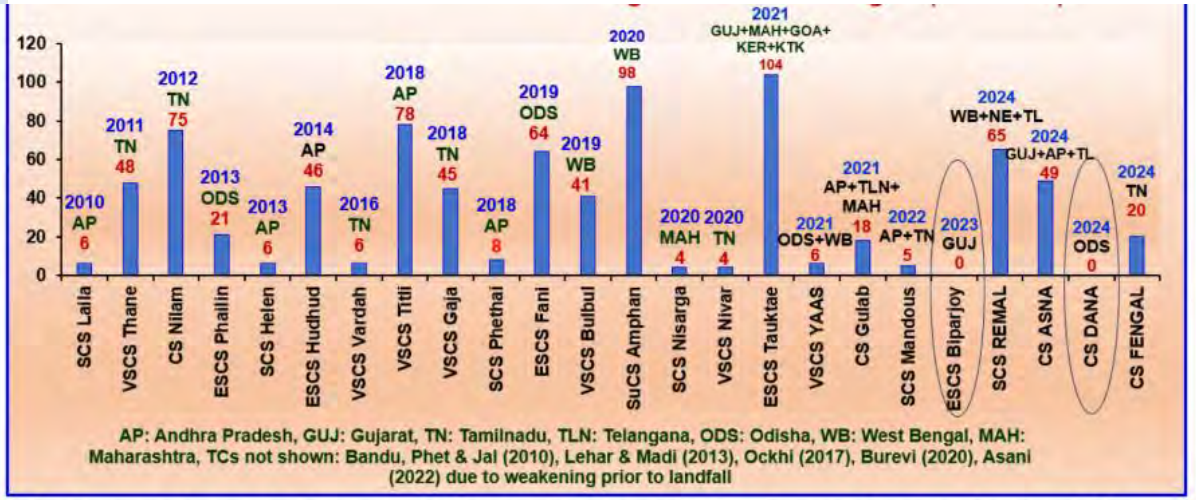




Cyclone and Marine Weather Services Module It is an interactive GIS enabled map showing track and intensity of a cyclonic disturbance. It is also being used for identification of low pressure system using model guidance for MSLP & 10m wind of GFS, GEFS NCUM, NEPS, WRF.

IMPACT IN TERMS OF TIME AND COST SAVING TO BENEFICIARIES

- Faster & More Accurate Weather Forecasts
- Reduced loss of life and property
- Cost savings of approximately **₹250 crores**
- DSS has successfully eliminated the procurement and dependance on foreign vendors, enhancing self-reliance and reducing operational expenses
- Accurate cyclone forecasts during Biparjoy (2023) and Dana (2024) resulted in zero deaths in Gujarat and Odisha.
- Evacuation costs reduced from ₹500 crores (1999) to ₹150 crores (2024).



CS: Cyclonic Storm, SCS: Severe Cyclonic Storm, VSCS: Very Severe Cyclonic Storm, ESCS: Extremely Severe Cyclonic Storm, SuCS: Super Cyclonic Storm

Area of Governance focussed under the given initiatives/innovation

Environment Conservation

- Weather chart plotting has been completely stopped in all IMD forecasting offices resulting in not only cost saving of approximately **Rs. 1.40 Cr.** per year but also environment conservation by saving of **2.57 tonnes** of **CO2** per year.

Water Conservation

- By introducing paperless work, **total water saved is 63 kilo liters** per year.

Energy Conservation

- Reduced IT infrastructure by automating all the process in one system. Resulting in the energy saving of approximately **211** MWhr per year, equivalent to **approximately 150** tons of **CO2** per year.

Education

- Capacity building through Digital literacy programmes on WebGIS-based forecasting, automated decision-making tools, and AI-based quality control systems to help users interpret WebGIS Visualizations.

Health

- Protecting public health by providing weather-based early warnings, climate information, and specialized services that hc help reduce disease risks and support health planning. Innovation has covered the health sector under "One-Health Mission" of Govt. of India by providing services to IMA.

Women and Child

- Alerts are regularly communicated to **Krishi Sakhis**, Pashu Sakhis, Sarpanch, Ward Members, and Panchayat Secretaries, ensuring last-mile preparedness and timely local act- Women and children benefit greatly from timely forecaasts during cyclones by helping authorities to safely shift them to nearby cyclone shelters (During Cyclone Biparjoy 1,206)

Area of Governance focussed under the given initiatives/innovation

Sustainable Farming

- Agromet Advisory Services and crop-specific advisories help in **preventing crop loss** (reduces **malnutrition), reducing water scarcity** or food insecurity. Adoption of weather advisories resulted in an additional income of **Rs. 12,500 annually per house hold** (in rain-fed areas. below the poverty line (BPL)) with overall **economic** benefit of **Rs. 13,331** crore per annum.

Reduces Malnutrition | Reduces Water Scarcity | Improves Food Security

Promoting Livelihoods

- Giving weather forecast and warnings to general public including rickshaw pullers, daily laborers etc.

Boosting Economy

- Total loss has been saved around **1700 crores** ; in comparison to **1998 "Kandla"** cyclone vs "Biparjoy" Cyclone 2023.
- **Reduction in** economic losses due to better preparedness in agriculture, transport, and infrastructure sectors.

Community Involvement in the form of Exhibitions, workshops, trainings, conferences, stakeholder meetings, social media campaigns, surveys

AWARDS AND RECOGNITION

National Award for e-governance 2025

Dr. Mrutyunjay Mohapatra received United Nations Sasakawa Award-2025 for Disaster Risk Reduction

6th Digital Transformation Award 2025

THANK YOU

- https://www.youtube.com/watch?v=-sdlVPojOg0
- https://youtu.be/ET68Nozu2fo?si=Y93oBSV8aSQl-qNN

Annexure -I

Multi-Hazard Early Warning Decision Support System (MHEW-DSS): A Digital Transformation in Forecasting and Disaster Risk Reduction

Introduction

The India Meteorological Department (IMD) is the nodal agency for providing weather forecasting and early warning services across India for various weather-related hazards. Earlier, IMD relied on semi-manual systems that were slow and less accurate. To overcome these issues, IMD designed and built a new digital system using open-source technology and in-house expertise. With this development India is no longer dependent on costly foreign systems.

The MHEW DSS works in real time and uses advanced tools like Geographic Information System (GIS) maps. This allows forecasters to quickly collect, analyze, and share weather information in an easy-to-understand way. However, before the introduction of the DSS, forecasting processes were largely manual, fragmented, and dependent on multiple standalone systems. These legacy systems lacked automation, interoperability, and timely dissemination, resulting in inefficiencies, limited lead time, and inconsistent communication among users. Recognizing the need for modernization, IMD undertook a major initiative to re-engineer its forecasting workflow through digital transformation. The Multi-Hazard Early Warning Decision Support System (DSS) was conceived to integrate all aspects of weather forecasting and hazard warning from observation to dissemination within a single, automated, and interoperable platform. The initiative reflects IMD's vision of a "Weather Ready and Climate Smart Nation" and embodies the philosophy of "Har Har Mausam, Har Ghar Mausam", ensuring that every household, sector, and region has access to timely and actionable weather information. The DSS aims to overcome critical gaps in earlier systems, such as fragmented data sources, slow communication channels, limited automation, and underutilization of radar and satellite datasets. By addressing these challenges, IMD has established a state-of-the-art, real-time, and impact-oriented forecasting framework that serves diverse stakeholders, from farmers and disaster managers to transport, power, and health sectors.

Objectives

The primary objective of the DSS is to build an integrated and indigenous system capable of delivering accurate, real-time, and impact-based multi-hazard forecasts across India. The system is designed to empower forecasters, decision-makers, and communities through improved information flow and timely early warnings. Specific objectives include the integration of multi-source atmospheric and oceanic data, automation of forecasting workflows, and generation of consensus-based forecasts from multiple model outputs. The DSS also aims to enable impact-based forecasting and risk-based warnings by the forecaster in IMD that translate technical meteorological data into actionable information for users. It provides localized forecasts up to ten days in advance, covering 1.5 lakh pincodes, 5700 blocks, and over six lakh villages through IMD's digital platform (Mausamgram https://mausamgram.imd.gov.in/). Furthermore, it

emphasizes scalability, open-source adaptability, and replicability across various sectors such as agriculture, transport, marine, energy, and tourism. The objective of the DSS was to enable forecasters to develop judicial weather warnings and forecasts. On the other hand a DSS is also developed general DSS to take their decision in their day today activities especially during weather hazardous situation to minimize the loss of life and properties and to optimize the socio-economic activities.

Strategy Adopted

The DSS development strategy centered around comprehensive process re-engineering of the entire forecasting and warning generation workflow. This involved automation, data integration, high-performance computing, and geospatial visualization to improve both efficiency and accuracy. The system integrates data from Radars, Automatic Weather Stations, satellite platforms, and ocean buoys to capture real-time atmospheric and oceanic conditions. Numerical Weather Prediction (NWP) models run by IMD are combined through a multi-model ensemble approach, allowing forecasters to identify the most accurate guidance for each scenario. The Weather Analysis and Forecast Enabling System (WAFES) serves as the analytical backbone of DSS. From analog mode of forecasting to digital forecasting system. It automatically generates diagnostic charts, dynamic weather products, and visualizations that aid expert consensus forecasting. A key feature of the DSS is its transition from conventional forecasting to impact-based forecasting (IBF) and risk-based warning systems. The DSS not only predicts the weather but also evaluates its implications on health, agriculture, energy, transport, and infrastructure. Color-coded warnings green, yellow, orange, and red convey varying levels of risk, making the forecasts actionable for disaster managers and local authorities. Multi-hazard interoperability has been achieved through a single GIS-enabled platform that unifies warnings related to cyclones, heavy rainfall, floods, heatwaves, and marine hazards. The WebGIS-based DSS allows visual comparison and integration of multiple data layers, ensuring consistent, non-redundant, and user-oriented forecast dissemination.

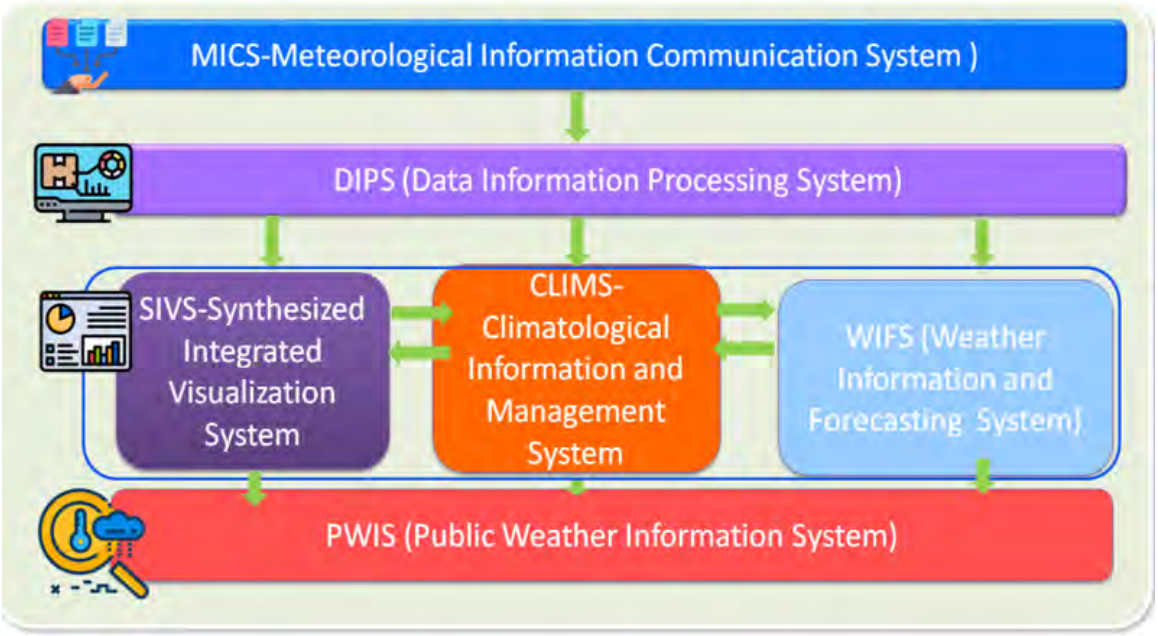


Figure 1: Components of Weather analysis and forecast enabling system (WAFES)

WAFES consist of five components namely

1. Meteorological Information Communication system (MICS)
2. Data information System (DIPS)
3. Synthesized Integrated visualization system (SIVS)
4. Public Weather Information system (PWIS)

While the MICS collecting data, accumulating them in a centralized platform, the DIPS scrutinizes data, applies the quality control and pre process the data before the analysis.
There is a large variation in the type of data commencing from manual observatories to that from Automatic weather Stations/Automatic Rain Gauge/Satellite/Radar among others. Also the time of collection of data also varies with different types of data. The DIPS processes all these heterogenous data and converts into a single format compatible with DSS. The developed DSS has got the capability to integrate HD5, netcdf, ASCII, BUFR, TIFF.
The process data are synthesized in an integrated visualization platform to visualize different layers of information like pressure, wind temperature, rainfall etc based on observation and models. It also help in comparing, comprehending and analyzing the various weather parameters, weather system, weather structure, genesis, evolution dissemination and its impact. To facilitate the decision making CIPS is utilized along with the CIMS and MICS. It helps in comparing the real time data with historical data assessing the extreme condition of observation data and forecast and hence the hazard and vulnerability potential. Weather information and forecast system enables comparing, comprehending and analyzing various data from numerical weather prediction models about seven in numbers and run twice a day based on 00 utc and 12 utc.

The DSS compares the NWP models output at the initial state of ocean and atmosphere with an actual observations hence find out the best performing model also the multi model average as selected by the forecaster, necessary bias correction thus can be made in the model forecast by comparing with initial observation and calculation the consensus average value from multi model ensemble technique. Further the DSS helps in calculating the extremity on hazard expected (eg Heavy rainfall, very heavy rainfall, extremely heavy rainfall) along with likelihood of occurrence of hazard (low, moderate, high)probability of occurrence of heavy rainfall in a given district.

Further DSS assess the impact of extreme weather predicted based on the likely hood of occurrence and severity of hazard in scale 1 to 16. It assigns the color code Green, yellow, orange and red corresponds to low intensity and low probability, to hazard with high intensity and high probability.

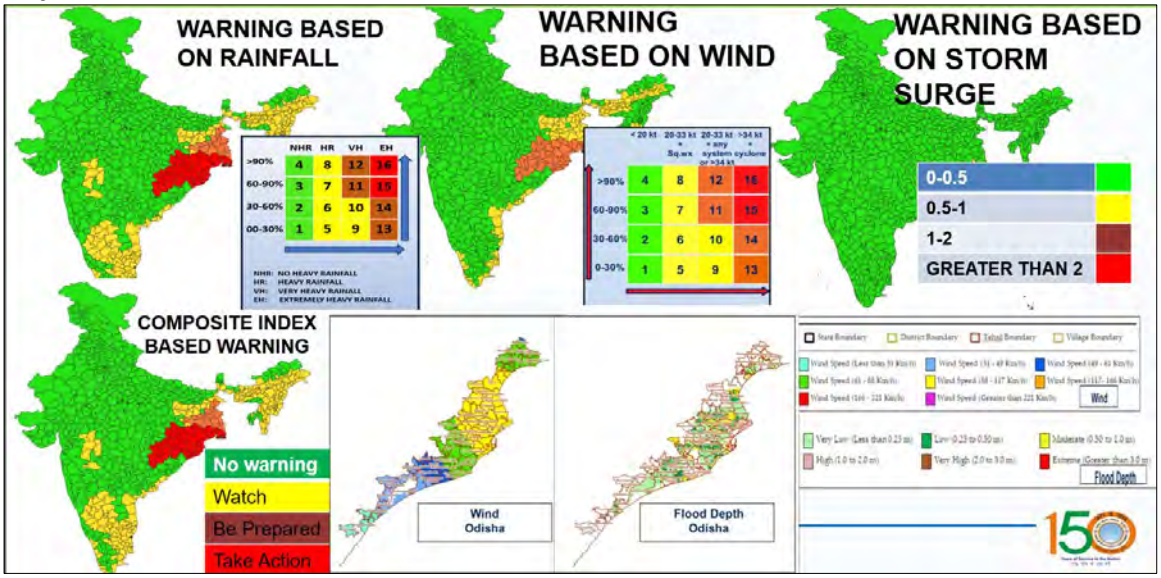


Figure 2 Multi-hazard interoperability : An example of Color Coded Warning For Cyclone Dana Based On 0830 IST of 23/10/2024 for 24/10/2024

The IBF thus generated has further attributed in terms of socio-economic parameters like impact on house, roads, bridges, culverts, various utilities like school, hospitals, shelters, infrastructure like power, electric poles, telecom etc and expected action to be taken thereof. These exercise are carried out for each severe weather parameters in a multi hazard scenario and the highest weightage is given to the most severe and most likely hazard.

Once the product are generated these are pushed to front end of DSS meant for general public, stakeholders. The first guess of IBF from DSS is generated at 10:30 IST based on observation of 5:30 IST to 8:30 IST which help the forecaster to add values and finalize the forecast through exchange of knowledge, experience and expertise in interpreting meteorological observation and model guidance through a video conferencing system.

Technology adopted

TO carry out the above mentioned task the system architecture integrates a geospatial data workflow combining PostgreSQL/PostGIS, Python-based automation, and web mapping interfaces for efficient data management and visualization. Geospatial datasets from multiple sources are processed and integrated in Python using libraries such as Pandas, GeoPandas, GDAL, NumPy, and PSYCOPG2, enabling automated data cleaning, conversion to CSV/GeoJSON, and database maintenance. The processed data are stored in a PostgreSQL geospatial database and published through GeoServer for web-based mapping services. On the front end, interactive visualization and user access are provided via Leaflet, JavaScript, HTML5, and PHP, allowing users to view, query, and analyze geospatial information in real time. This integrated backend–frontend framework ensures automation, scalability, and seamless dissemination of dynamic spatial data for decision support and forecasting applications.The DSS has various automatic dissemination methds like sms,emails, whatsapp, graphical buleetin including common alterting protocol which gives alerts directly to the affected common public.

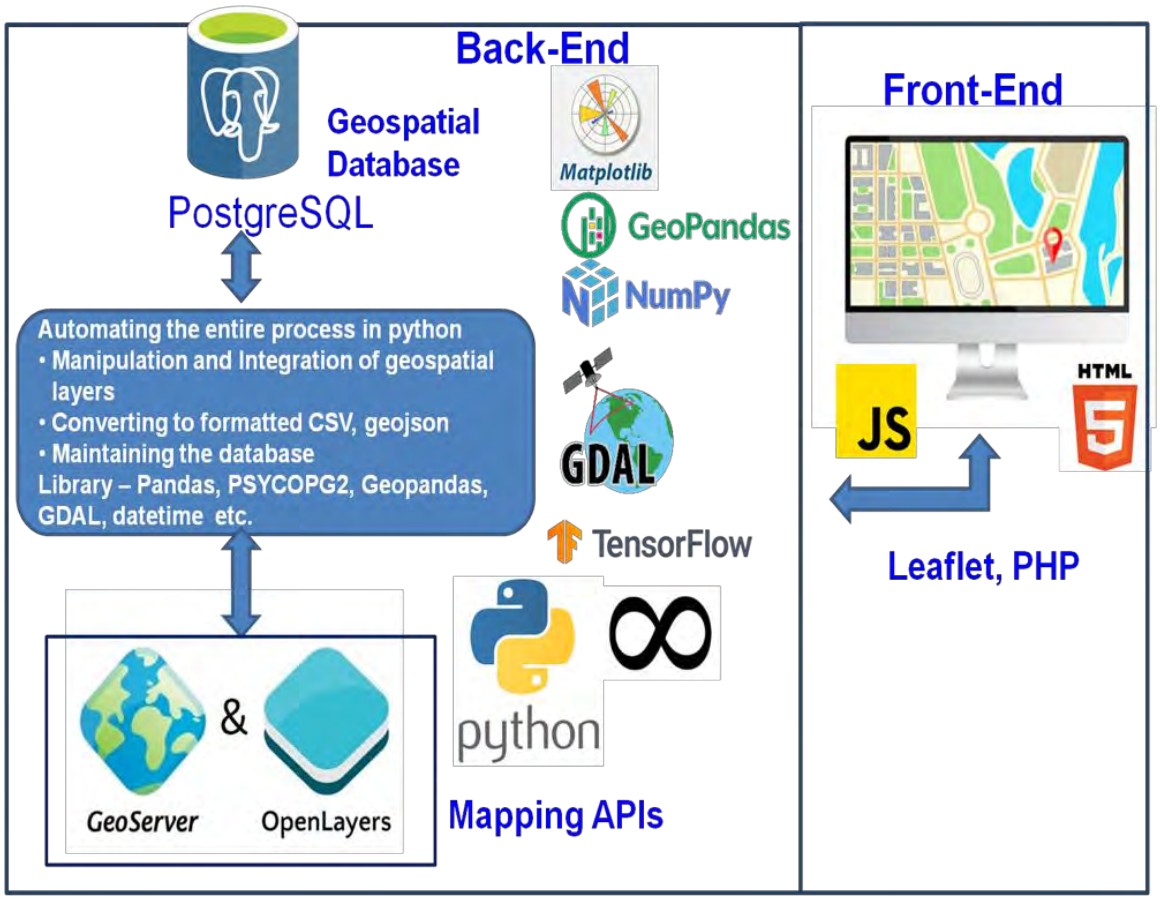


Figure 3 Technologies used in development of MHEWS-DSS

Achievements and outcome

The implementation of the DSS has resulted in measurable improvements in the efficiency, accuracy, and scope of weather forecasting in India. More than ninety percent of data collection, quality control, and integration processes have been automated, allowing seamless data ingestion from multiple sources. The forecast preparation time has been reduced by approximately three hours, while the forecast lead time has increased from five to seven days. Integration of real-time observational data with NWP guidance has enhanced accuracy by fifteen to twenty percent. Prior to DSS, different IMD divisions operated independently, producing uncoordinated forecasts for various phenomena. The new system consolidates all forecasting modules within a single interoperable framework, ensuring synergy among outputs, consistency in warning messages, and improved confidence among users.

Sectoral services have expanded significantly through DSS including

- Agriculture,
- Transport sector (customized weather modules have been developed for Indian Railways and National Highways, providing route-specific forecasts)
- Marine sector benefits from three-hourly ship route forecasts for up to five days, covering wind, wave, and visibility parameters.
- Urban
- Power
- Hydrology
- Tourism
- Health
- Aviation

These applications further demonstrate the scalability of DSS. Dissemination and outreach have expanded exponentially. During extreme weather events, over sixty-nine million targeted alerts have been issued. The DSS has also earned national and international recognition

Conclusions

The Multi-Hazard Early Warning Decision Support System has significantly strengthened India's disaster preparedness, operational efficiency, and institutional capability. Multi-hazard interoperability ensures faster, coordinated decision-making among disaster management agencies, thereby reducing casualties, infrastructure losses, and economic disruption. The system's adoption has led to tangible socio-economic benefits, including improved agricultural resilience, better energy planning, safer transportation, and enhanced public health preparedness during extreme events such as heatwaves. By integrating forecast dissemination with local

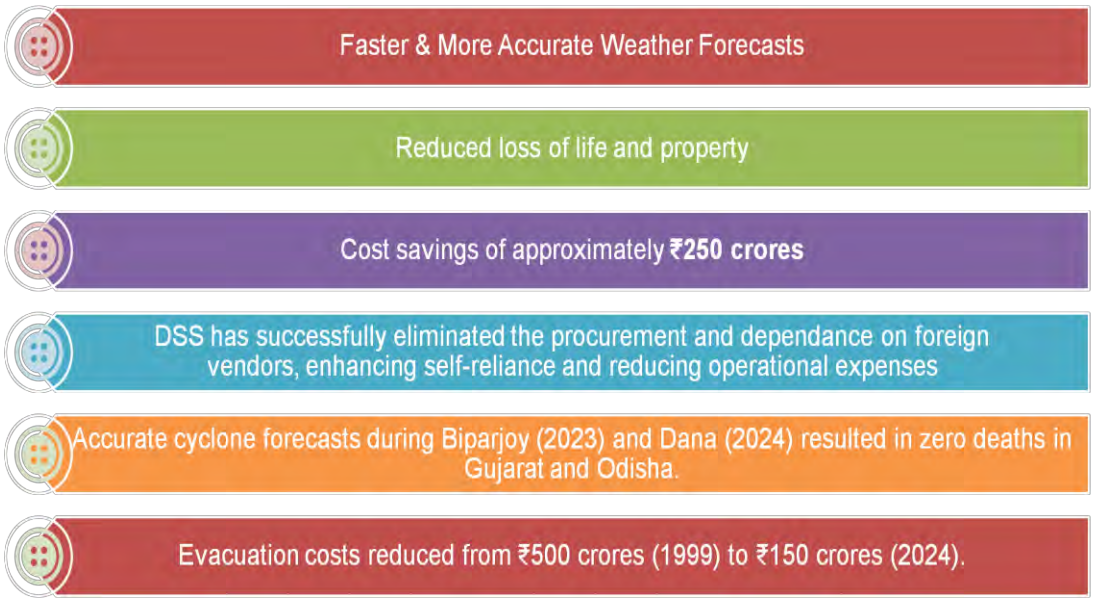


Figure 4 Major impact of DSS

governance structures, the DSS empowers panchayats, farmers, and communities to make timely, informed decisions. This democratization of weather information fosters community-level resilience and aligns with national goals of sustainable and inclusive development. The DSS represents a transformative milestone in India's meteorological history. It embodies the convergence of scientific innovation, digital governance, and public service. By modernizing forecasting through automation, interoperability, and impact-based analysis, IMD has positioned India as a global leader in multi-hazard early warning systems and disaster resilience. The DSS demonstrates the integrated role of technology, science, and governance protecting lives, livelihoods, and ecosystems in a changing climate.

The various public modules of the Multi-Hazard Early Warning Decision Support System are readily accessible at https://imdgeospatial.imd.gov.in/.

Figure 5: Geospatial Services web page

Stakeholders & Key Beneficiaries

The MHEW-DSS benefits multiple categories:

- Government: National and State Disaster Management Authorities, ministries (Agriculture, Power, Urban and Rural, Health, Marine, Surface transport, Aviation etc.
- Citizens: Farmers, fishermen, rural and urban populations.
- Businesses & industries: Aviation, transport, energy, marine, and agriculture sectors.
- Regional partners: South and south East Asian and Middle East countries under IMD's Regional Specialized Meteorological Centre mandate.
- Thus, the DSS acts as both a national public good and a regional support system.

Key Benefits / Value Creation

Benefits are multi-dimensional:

- Government: Approx ₹250 crore cost savings, better disaster preparedness.
- Citizens: life-saving early warnings (Zero loss of life due to cyclone Biparjoy (2023) and Dana (2024), better service delivery.
- Business & economy: Power sector savings of ₹500 crore annually; reduced losses in agriculture, fisheries, marine, onshore and offshore industries, surface transport, Indian Railways, aviation and agriculture etc.
- Economy: Estimated economic benefit of ₹13,331 crore annually across rain-fed districts.
- Environment: Reduced disaster impacts and improved climate resilience.

Award and Recognition:

List of Awards:

1. Government of India , Department of Administrative Reforms and Public Grievances presented National Award for e-Governance 2025 (Silver) for Multi Hazard Early Warning Decision Support System

2. IMD DG Dr Mruntyujay Mohapatra awarded with the prestigious UNDRR award “THE SASAKAWA AWRD” for disaster risk reduction 2025.

3. The India Meteorological Department (IMD) has won the Award of Excellence at the Digital Transformation Summit 2026. This prestigious honor recognizes IMD’s ‘Multi-Hazard Early Warning Decision Support System’ for its innovation and excellence in public service delivery.”

Annexure-II

Outcome of the initiative of Multi hazard Early Warning Decision Support System (MHEW-DSS) of IMD

1. Introduction

The Multi-Hazard Early Warning Decision Support System (MHEW-DSS), implemented by the India Meteorological Department (IMD) under Mission Mausam, represents a comprehensive digital transformation of India's weather forecasting, early warning, and dissemination framework. The initiative has significantly strengthened public awareness, preparedness, and resilience by delivering timely, accurate, and impact-based weather and climate information to nearly 80% of India's population through automated, digital, and multi-channel platforms and covering entire Indian region and neighbouring countries.

2. Enhanced Public Awareness and Risk Understanding

The MHEW-DSS has enabled timely, accurate, and impact-based weather warnings to reach the general public and stakeholders by significantly improving public awareness of hazards such as cyclones, floods, heavy rainfall, heat waves, cold waves, thunderstorms, and lightning. By shifting from generic forecasts to impact-based and location-specific warnings and forecast (Mausamgram), the system allows citizens to clearly understand *what the weather will do*, rather than just *what the weather will be*.

The use of WebGIS based MHEW-DSS portal, mobile applications Mausam, SMS alerts, WhatsApp dissemination, Common Alerting Protocol (CAP), and media platforms ensures that warnings are accessible to diverse population groups, including rural, coastal, remote, urban communities and all other central and state government stakeholders. The data and warning is also being shared through API to various stakeholders.

3. Awareness through Digital and Community-Level Engagement

Extensive awareness programs, workshops, webinars, exhibitions, and stakeholder meetings are being conducted to familiarize the public, local authorities, and sectoral users with the new system. Continuous engagement through training programs, demonstrations, surveys, and feedback mechanisms ensured that beneficiaries could interpret forecasts correctly and act on them effectively.

4. Transparency, Trust, and Responsiveness

Automation and digitization have made the warning system transparent, faster, and more reliable, reducing forecast preparation time by 50% and improving accuracy by 30%. The seamless, faceless, end-to-end digital delivery of services has enhanced public trust in official warnings and increased compliance with advisories during extreme events.

5. Sector-Specific Outcomes:

The outcomes of the initiative span multiple sectors, including environment and water conservation, energy, education, health, women and child welfare, sustainable farming, livelihood promotion, economic growth, good governance, and international collaboration. The following sections present the details of the impact of this initiative on various sectors.

- **Environment Conservation**

IMD's MHEW-DSS products have contributed to environment conservation by monitoring climate and air quality, issuing forecasts and early warnings for extreme weather, and supporting water and natural resource management, which has aided renewable energy growth and reduced disaster-related environmental damage. Long-term climate data helps formulate environmental policies and promote sustainable development.

Before implementation of the project, 40 IMD forecasting offices were printing 16 weather charts (A0 size and 100 GSM) daily for forecasting. With the implementation of MHEW-DSS, chart plotting has been completely stopped in all IMD forecasting offices. This has resulted in both cost savings and environment conservation. Taking Rs. 20/- as the cost of one A0 chart paper (233,600 numbers or 23.4 tonnes) of 100 GSM and Rs. 40/- as the cost of printing one A0 chart, the total saving for chart paper amounts to Rs. 46.72 lakhs per year and for printing Rs. 93.44 lakhs per year. In addition, the cost of stationery (pen, pencil, eraser, etc.) used for plotting and analysing charts was around Rs. 32,000/- per year.

If all three components are combined, the total saving is approximately Rs. 1.40 crore per year. In terms of carbon emissions, this amounts to a saving of 2.57 tonnes of CO_2 per year.

- **Water Conservation**

MHEW-DSS contributes to water conservation by providing products for accurate rainfall forecasts, monsoon predictions, drought and flood early warnings, and long-term climate data. These support efficient reservoir management, irrigation scheduling, groundwater protection, and watershed planning. IMD's agromet advisories guide farmers to use water efficiently, reducing wastage and supporting sustainable water resource management.

The system supports water management including: (i) reservoir management, (ii) flood management, (iii) groundwater management, (iv) agricultural planning, and (v) drought management. MHEW-DSS helps IMD provide desired products and data for these purposes by comparing, comprehending, analysing, and developing products through a fully digital, paperless workflow.

Considering the conservation achieved by discontinuing A0 size 100 GSM chart paper (233,600 numbers), the total water saved is 63 kilolitres per year (233,600 × 0.27 litres), assuming one A0 size 100 GSM chart paper requires 0.27 litres of water for production. This saving is equivalent to the annual drinking water requirement of 60 persons, assuming a consumption of 3 litres per day per person.

- **Energy**

MHEW-DSS has significantly contributed to the energy sector by providing products to issue solar radiation, wind, rainfall, and temperature forecasts essential for solar, wind, and hydropower generation. It offers extreme weather warnings that protect power infrastructure and supports grid management through demand forecasting. IMD's climate data also aids renewable energy planning and national energy policies.

Additionally, MHEW-DSS has eliminated the need for plotters and printers for chart printing, reduced IT infrastructure for bulletin preparation and printing, and removed dependence on

tele-printers and fax systems for data and forecast dissemination. Annual maintenance costs have also been reduced by automating all processes into a single system.

Assuming 1200 watts of power consumption per office per day for these purposes, the energy saving is approximately 210,240 kWh (1200 W × 40 offices × 365 days × 12 hours per day on average), equivalent to Rs. 10,51,200/- per year at Rs. 5/- per unit.

- **Education and Capacity Building**

The project included extensive capacity building, awareness, and communication initiatives to ensure effective adoption and utilization of the automated system. Training programs were conducted for IMD personnel on WebGIS-based forecasting, automated decision-making tools, and AI-based quality control systems.

Awareness campaigns were launched for stakeholders including farmers, disaster management teams, aviation authorities, and other sectoral users to ensure effective utilization of real-time weather data. Digital literacy programs were introduced to help users interpret WebGIS visualizations and automated outputs for improved decision-making.

User manuals for the public and forecasters, as well as administrative manuals, were prepared. IMD also contributes to the education sector by promoting weather and climate literacy through bulletins, maps, and reports, conducting awareness programs, providing disaster warnings to ensure school safety, and supporting higher education by offering climate data for research. IMD's online tools and weather resources help students understand meteorology and environmental sciences.

- **Health**

IMD plays an important role in protecting public health by providing weather-based early warnings, climate information, and specialized services that help reduce disease risks and support health planning. The innovation covers the health sector under the "One Health Mission" of the Government of India by providing services to the Indian Medical Association (IMA).

Deaths due to timely issuance of early warnings and health advisories for severe weather events such as cyclones, heat waves, cold waves, heavy rainfall, thunderstorms, and lightning have reduced considerably. IMD weather data and forecasts are crucial for predicting outbreaks of vector-borne diseases such as malaria, dengue, chikungunya, and Japanese encephalitis. Based on IMD inputs, actions taken by civic agencies have reduced cases of vector-borne diseases.

Forecasts generated using MHEW-DSS cover human health, animal health (livestock, fisheries, poultry), agricultural health, and environmental health (air, water, soil). IMD issues heat-wave forecasts, temperature advisories, and Heat Action Plans for states, helping prevent heat-stroke cases, guide hospitals in emergency preparedness, and support public awareness campaigns. AQI and pollution forecasts help vulnerable populations take preventive measures. Early warnings also enable timely evacuation, pre-positioning of medical teams, and disease-prevention measures during disasters.

- **Women and Child Welfare**

Women and children benefit significantly from timely IMD forecasts and warnings. During cyclones and other severe weather events, IMD warnings help authorities safely shift women, children, and pregnant women to cyclone shelters. Alerts support schools, hospitals, and families in protecting children and ensuring continuity of essential services.

Air quality reports, agromet advisories, and climate information strengthen nutrition programs, rural livelihoods, and community resilience. Alerts are regularly communicated to Krishi Sakhis, Pashu Sakhis, Sarpanch, ward members, and Panchayat Secretaries, ensuring last-mile preparedness and timely local action for the protection of women and children.

- **Sustainable Farming**

IMD provides Agromet Advisory Services to farmers twice a week, along with crop-specific advisories. Weather-based agro-advisories help prevent crop loss, reduce water scarcity, and address food insecurity. Farmers who implemented IMD-recommended practices reported an average annual household income of Rs. 3.02 lakh, compared to Rs. 1.98 lakh for those who adopted none, indicating a 52.5% increase in income due to optimal utilization of advisories.

Among agricultural households in rain-fed areas below the poverty line, adoption of weather advisories resulted in an additional income of Rs. 12,500 per household annually. The overall economic benefit across rain-fed districts was quantified at Rs. 13,331 crore per annum, highlighting the role of advisories in supporting climate-vulnerable farming systems.

Warnings and advisories are disseminated through WhatsApp groups, SMS, Common Alerting Protocol, and mobile applications such as Mausam and Meghdoot ensuring timely delivery to farmers.

- **Promoting Livelihoods**

MHEW-DSS supports livelihoods by providing weather forecasts and warnings to the general public, including rickshaw pullers, daily labourers, fishermen, and informal sector workers. IMD promotes livelihoods by reducing weather-related risks, increasing productivity, and safeguarding income across agriculture, fisheries, tourism, transport, and renewable energy sectors. Timely information enables better planning and protection of assets, ensuring livelihood security for millions.

- **Boosting the Economy**

The initiative has reduced economic losses through better preparedness in agriculture, transport, infrastructure, and other sectors. Government agencies save significant resources in relief and rehabilitation through proactive mitigation. For example, cyclone warnings during Phailin (2013) and Hudhud (2014) helped the power sector save around Rs. 500 crore each.

Additionally, Rs. 590 crore in ex-gratia payments and Rs. 32 crore in evacuation costs are saved for each landfalling cyclone, compared to Rs. 437 crore towards the cost of IMD's modernisation programme during 2007–10. These outcomes demonstrate the strong economic returns of investment in early warning systems.

- **Improving Governance / Good Governance**

The manual decision-making process of IMD has been reengineered with digital transformation as the main objective of this project. All processes of the Multi-Hazard Early Warning System, including data collection, data analysis, identification of weather systems, study of the evolution of weather systems, and forecasting of weather systems in terms of lifespan, characteristics, and associated weather conditions valid for up to five days, have been reengineered and established through this DSS via digital transformation. This has enabled better visualization, accessibility, accuracy and seamless warning dissemination to all stakeholders for efficient data sharing. Additionally, it has facilitated the standardization of data and information, enhancing interoperability across systems. The MHEW-DSS has brought (i) interoperability, (ii) improved quality, accuracy, consistency and delivery of services, (iv) reduced computational infrastructure and (v) reduced manpower. The manpower optimization after the introduction of MHEW-DSS has saved 3 Manpower one for manual plotting the weather charts, one for manual analysing and one for manual chart movement per 6 hours at each forecasting station. The total saving for manpower is four persons for each role per station per day which comes to around Rs. 57.6 Cr. per year (4 persons X 12 months X 40 forecasting offices X (Rs. 1.5 lakh per person per month salary for manual analysis + Rs. 1 lakh per person per month salary for plotting + Rs. 50,000 per person per month salary for manual chart movement).

6. International and Regional Collaboration

MHEW-DSS supports international cooperation by providing severe weather warning assistance to neighbouring countries including Bangladesh, Maldives, Myanmar, Oman, Pakistan, Qatar, Sri Lanka, Thailand, UAE, and Yemen. IMD's Regional Specialized Meteorological Centre (RSMC) functions are strengthened through real-time data sharing, training, and coordinated warning dissemination. This collaboration enhances regional disaster preparedness, supports global meteorological cooperation, and positions India as a leader in multi-hazard early warning services.

Through integrated technology, automation, capacity building, and community engagement, MHEW-DSS has significantly enhanced public awareness and resilience across sectors. The initiative has empowered citizens, strengthened governance, protected vulnerable groups, conserved natural resources, boosted economic efficiency, and reinforced India's leadership in disaster risk reduction and international collaboration.