



Disaster Management in a Multi-Hazard Nation

Agenda, scope and learning objectives for a multi-hazard approach

Rahul Saxena
India Meteorological department , Lodi road

Multi-Hazard Landscape: Categories, Interactions & Cascades

Clear taxonomy, typical cascades, and systemic drivers shaping risk and response

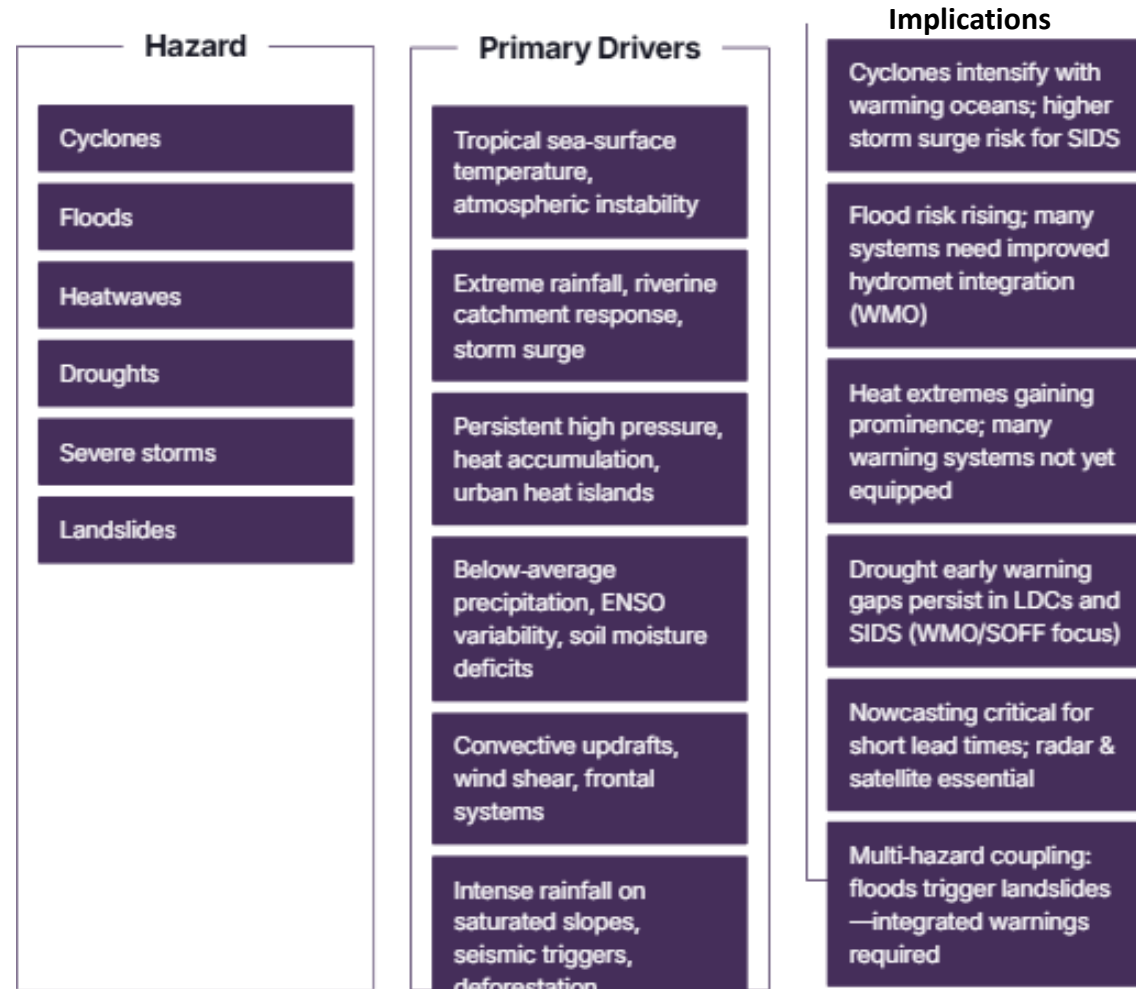
1. Primary Hazards Categories
 - a. **Natural : Primarily related to Meteorological /HydroMeteorological**
 - b. Technological : Industrial accidents (Cherbonyl , Bhopal)
 - c. Biological : Pandemics / Epidemics , Oil Spils
 - d. Others : Wars
2. Cascading interactions
 - a. Storm Surges -> Coastal Flooding -> Health Outbreaks
 - b. Heavy Precipitation -> Floods , Landslides -> Human and Livestock Casualties
3. Systemic Drivers
 - a. Climate Change , Unplanned urbanization , ecosystem degradation

Multi Hazard : Extreme Weather Events

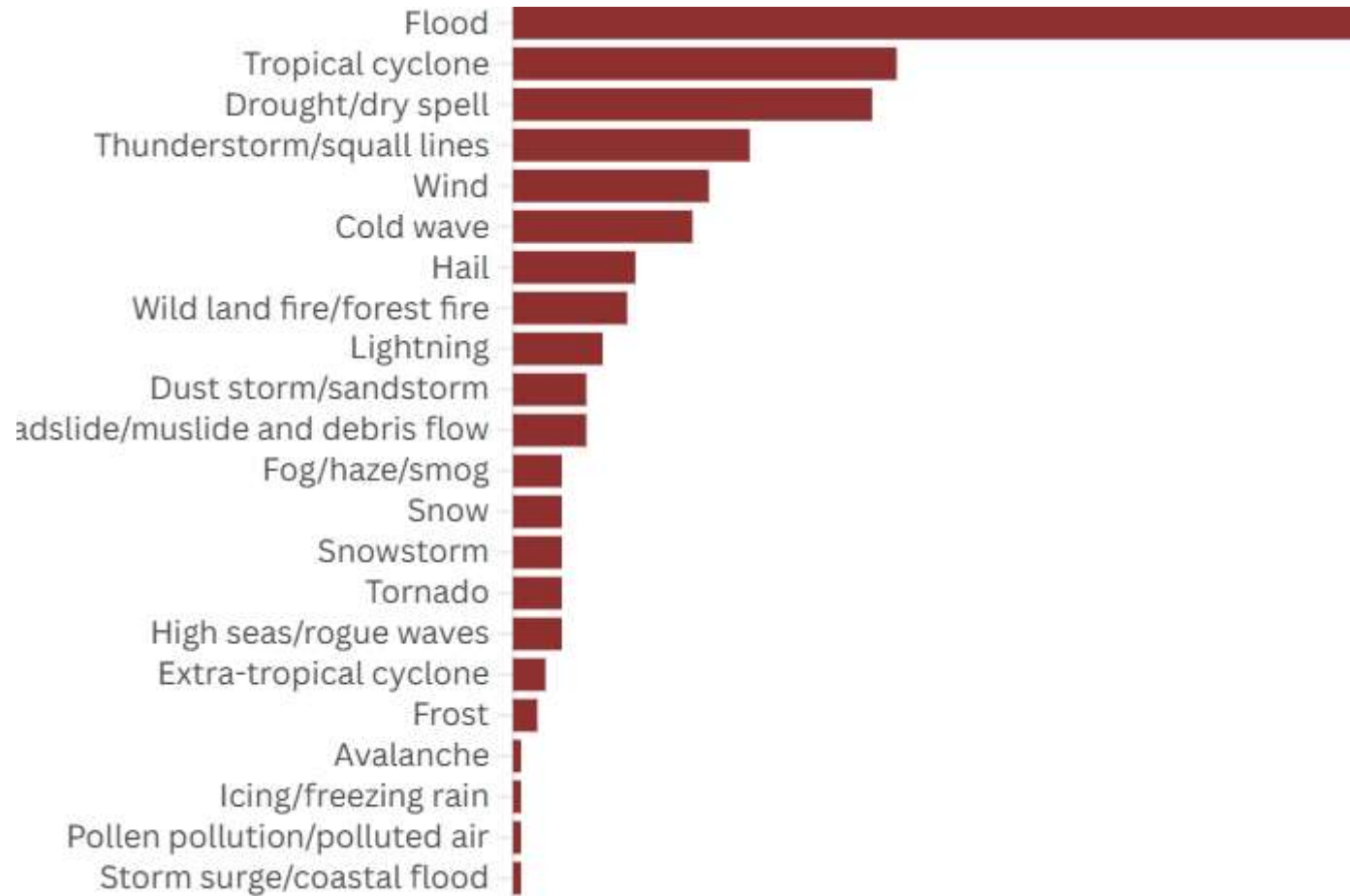
Extreme Weather Events:
India Meteorological Department (IMD) defines extreme weather events as rare occurrences for a particular place and time and threshold.

More than 600 reported extreme weather events, including 148 classified as “unprecedented”, displaced 824,000 and killed 1,700 people in 2024 Globally

2024 was the first calendar year of temperatures surpassing the key 1.5C warming limit

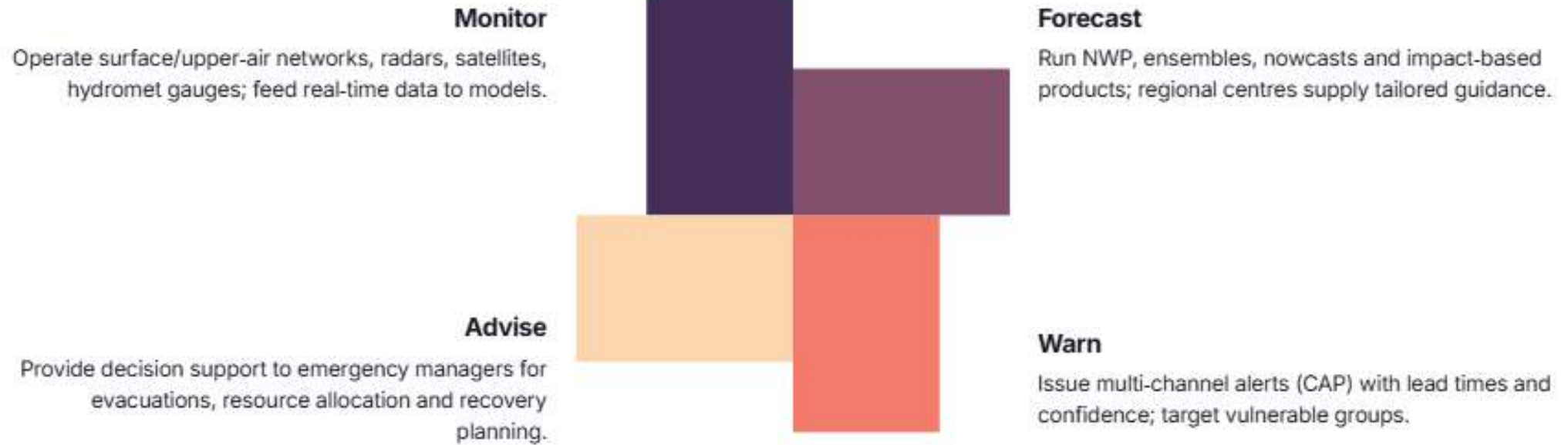


Extreme Weather Events in 2024



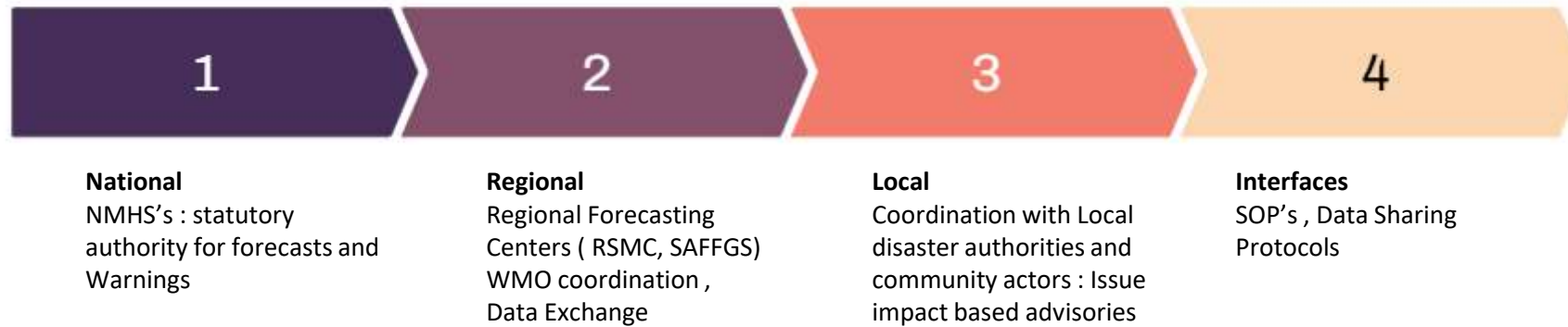
Key Functions of Meteorological and Hydrological agencies

How Met Agencies Monitor, Forecast, Warn and Advise to reduce multi-hazard risk



Where Meteorological Agencies Sit in Disaster Governance

Clarifies NMHS roles from national forecasts to community action and legal interfaces



Engaging Communities to Strengthen Multi-Hazard Preparedness

Co-production, education, and feedback loops that increase readiness and reduce false alarms

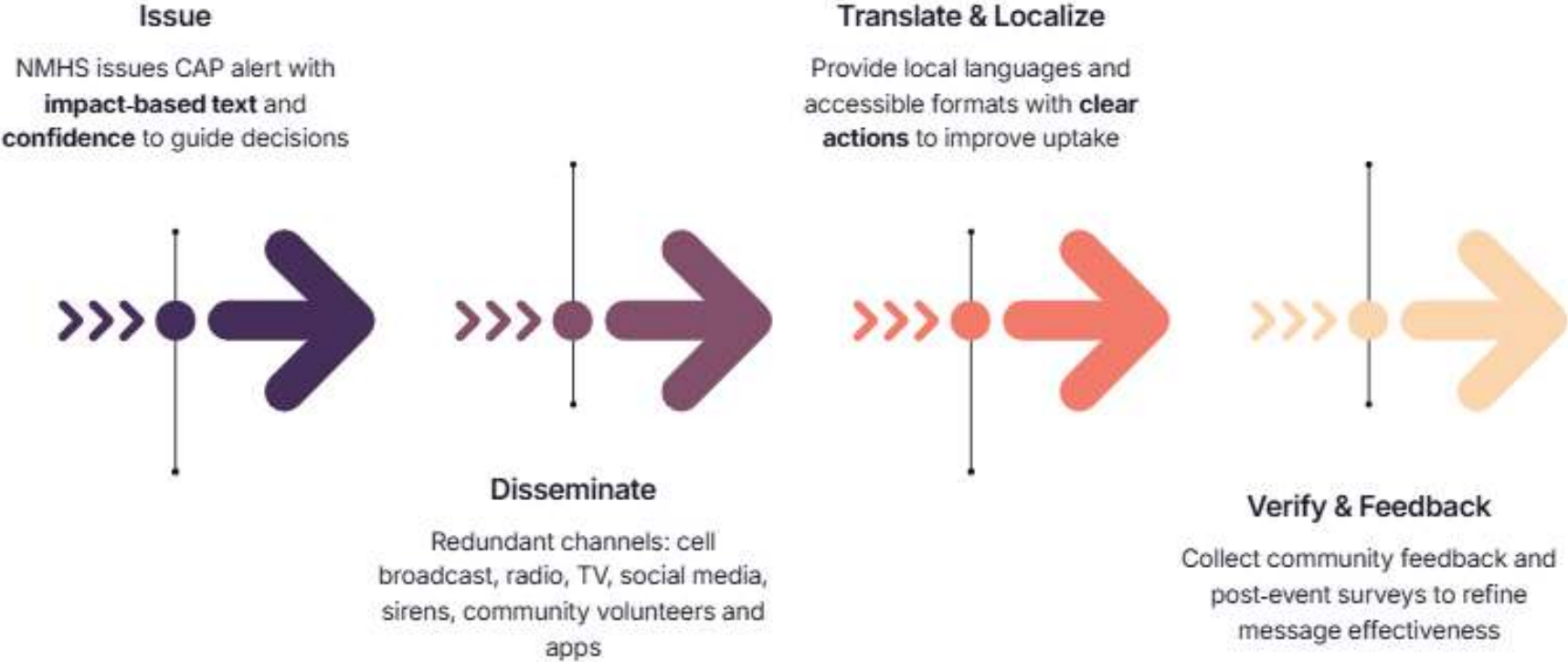
Design Workshops : Involve Local stake holders , Set actionable thresholds

Drills & Education : Regular Drills to build preparedness

Feedback & iteration : Post Event Reviews and community surveys .

Getting Alerts to people who need them

How NMHS's alert issuance, redundant delivery, Localization and community feedback, close last mile gap

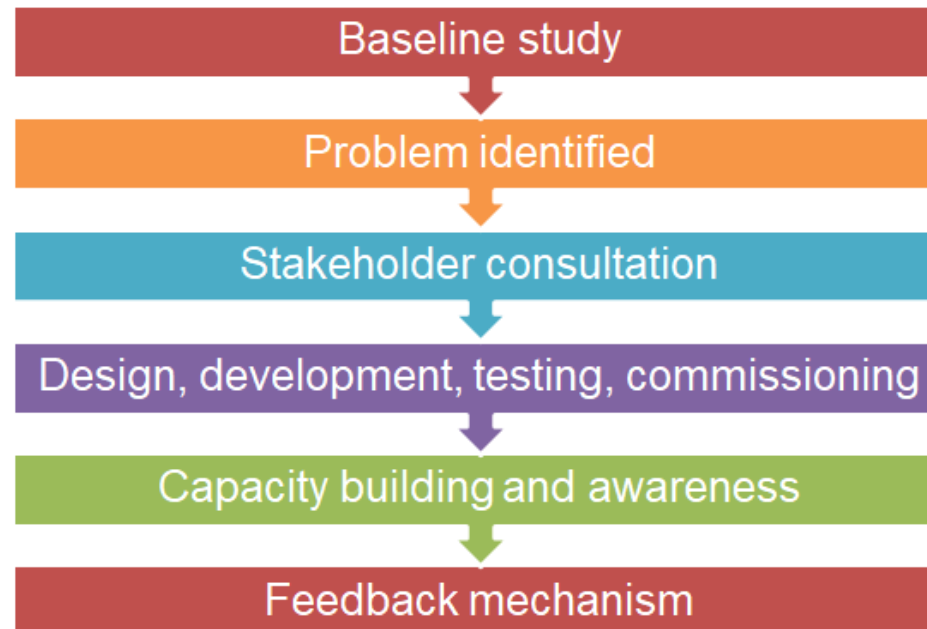


WEATHER ANALYSIS AND FORECAST ENABLING SYSTEM (WAFES):DECISION SUPPORT SYSTEM (DSS): IMPLEMENTATION

The entire process is based on Weather Forecasting and Warning Process Reengineering for digital transformation



Methodology Adopted





**WEATHER ANALYSIS AND FORECAST ENABLING
SYSTEM**
INDIA METEOROLOGICAL DEPARTMENT NEW DELHI
MINISTRY OF EARTH SCIENCES



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Project : Multi Hazard Early Warning Decision Support System

Initiation of Project: Nov. 2022

Date of launch : 15/01/2024 (by Hon'ble Vice President Sh Jagdeep Dhankar)

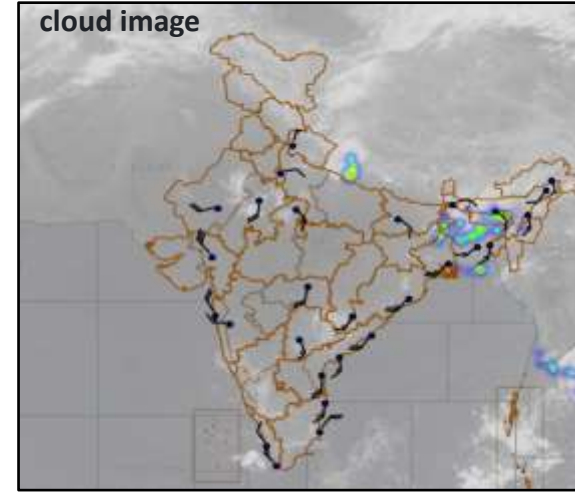
Operationally working since: 15/08/2023

OBJECTIVE

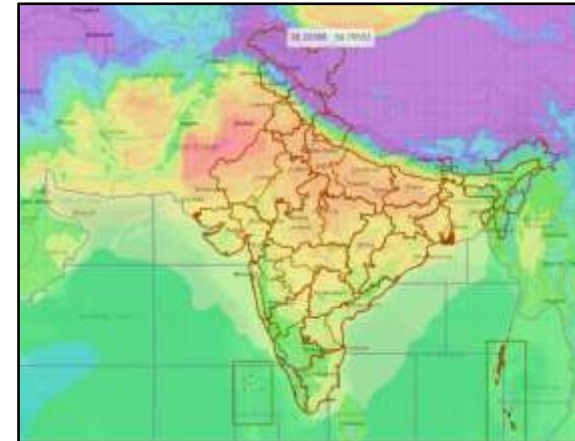
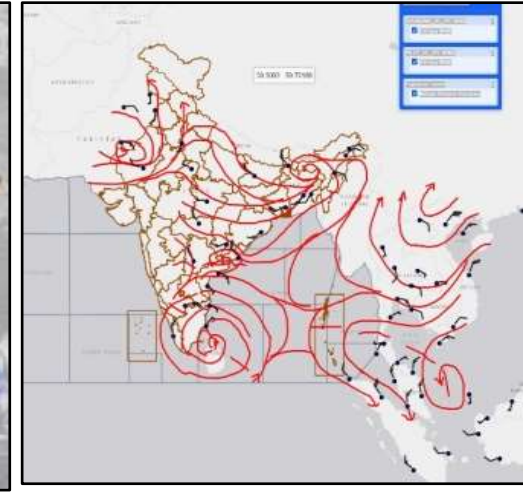
To Develop Indigenous Multi-Hazard Early Warning Decision Support System (DSS) aimed to **ACTIONS:**

- **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

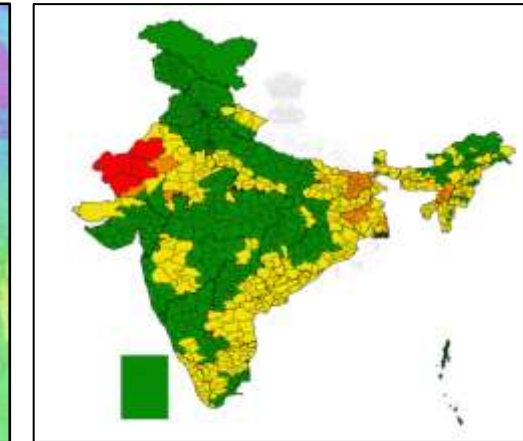
Wind observation at 1.5 km superimposed with satellite based cloud image



Streamline analysis of Wind observation at 1.5 km height



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



Multi-hazard impact based forecast and risk based warning graphics valid for 24 hrs at district level

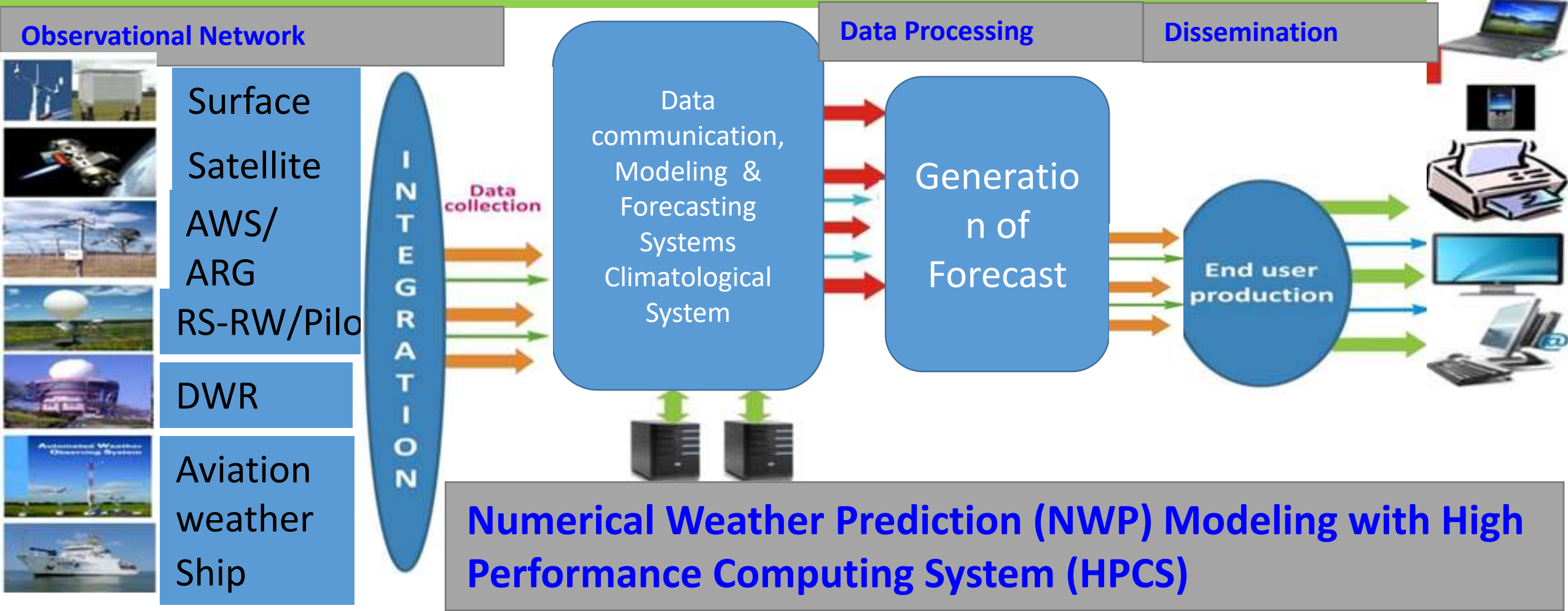
Problem Identification for Formulation of Project

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

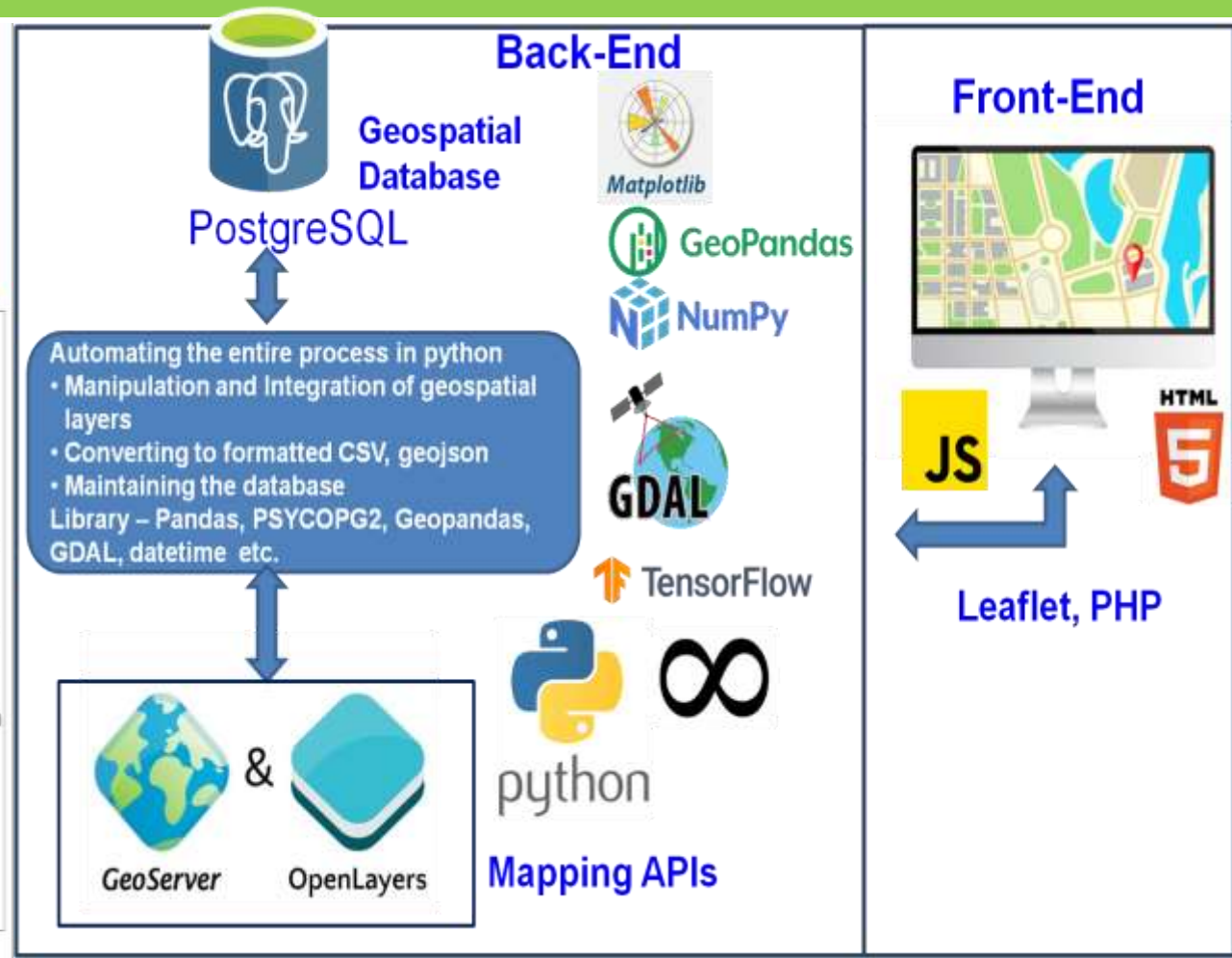
FORECAST GAP

- **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 forecast 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

Weather Forecasting and Multi-Hazard Early Warning Process



High level architecture for Decision support system

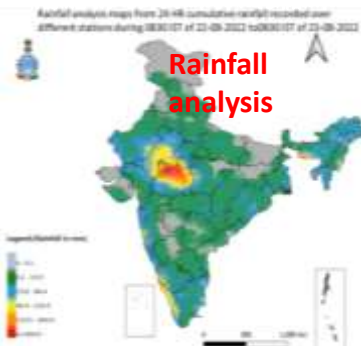
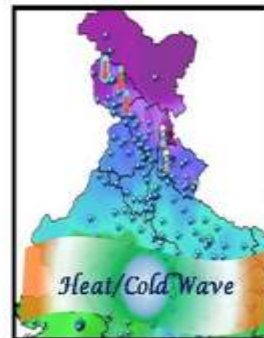




IMD has now introduced Web GIS based applications for all types of severe weather events like.

- ❖ 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 services
- ❖ Transport Services (RAIL/Highways)
- ❖ Mountain met and tourism
- ❖ Power sector Services

APPLICATIONS



Sea area Bulletin graphics



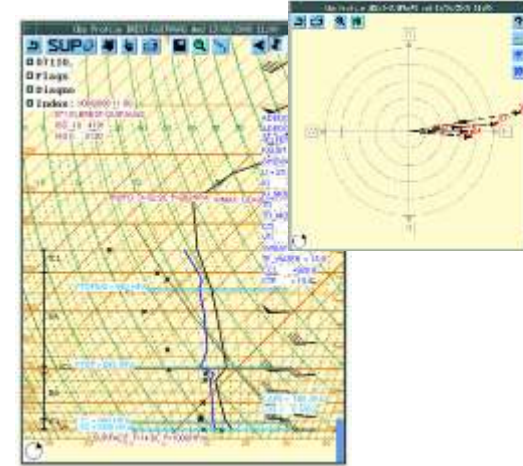
IMD initiatives : Modernisation of Forecasting System



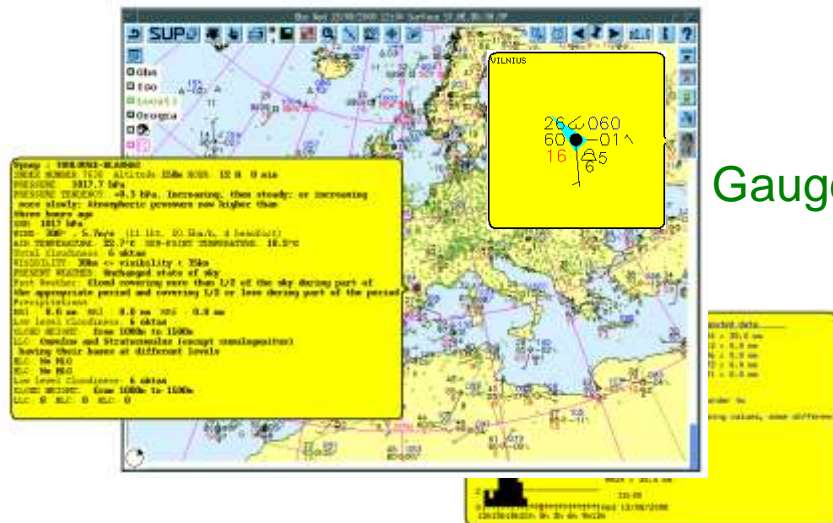
Global plotting



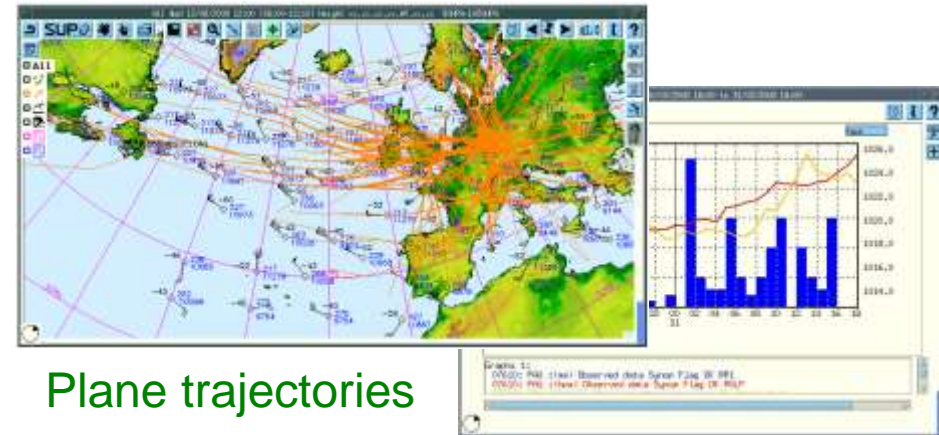
Conditional plotting



Profile



Gauges



Plane trajectories

Flash Flood Guidance System

GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT
HYDROMET DIVISION
FLASH FLOOD GUIDANCE CELL

Persistent Flash Flood Threat (PFFT) till 1130 IST of 12.07.2021:

Moderate to high threat over few watersheds and neighborhood of Thane, Palghar, Sindhudurg and Ratnagiri districts of Konkan & Goa met subdivision, Vasad district of Gujarat met subdivision, Nashik district of Madhya Maharashtra met subdivision.

Moderate threat over Mirzapur and Raipur district of Jammu and Kashmir met subdivision.

Surface runoff/floodation may occur at some fully saturated watersheds & low-lying areas due to expected persistent rainfall in next 06 hours.

PFFT-06hr 2021-07-12 06:00 UTC

Threat Based Alerts
Red - High
Orange - Moderate
Yellow - Low

PFFT-06hr 2021-07-12 06:00 UTC

Threat Based Alerts
Red - High
Orange - Moderate
Yellow - Low

Disclaimer: This is only a guidance bulletin and not a warning for flash floods.

Contact: WMO Regional Centre (SASIAFFGG), Hydromet Division, Flash Flood Guidance Cell
Phone: 011-43824355/011-43824410
Email: casiaffg.ind@gmail.com

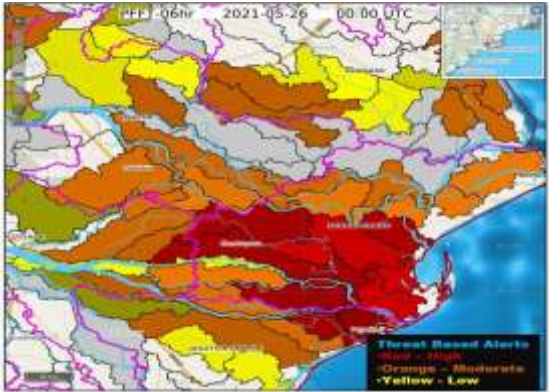
Flash Flood Threat for Suburban Mumbai dated 9 June 2021 – Observed Rainfall is 210 mm in 24 hours.



Roads waterlogged, rail services hit as heavy rain lashes Mumbai | See photos, videos



Flash Flood Threat for Districts of Odisha dated 26 May 2021 – Observed Rainfall is 300 mm in 24 hours.



Trees uprooted, roads flooded, people living in darkness as cyclone Yaas batters Odisha

Officials are yet to assess the damages caused by the storm in the two districts but said that it appears that destructions have been less than previously feared.



By PTI: BALASORE: Trees and electric poles were uprooted, low-lying areas inundated while houses here were badly damaged as Cyclone Yaas left a trail of destruction in Odisha's coastal districts of Balasore and Bhubaneswar on Wednesday.

THANKS