ROLE OF INDIA METEOROLOGICAL DEPARTMENT IN MANAGEMENT OF METEOROLOGICAL HAZARDS IN INDIA

M MOHAPATRA

INDIA METEOROLOGICAL DEPARTMENT
NEW DELHI-110003
mohapatraimd@gmail.com

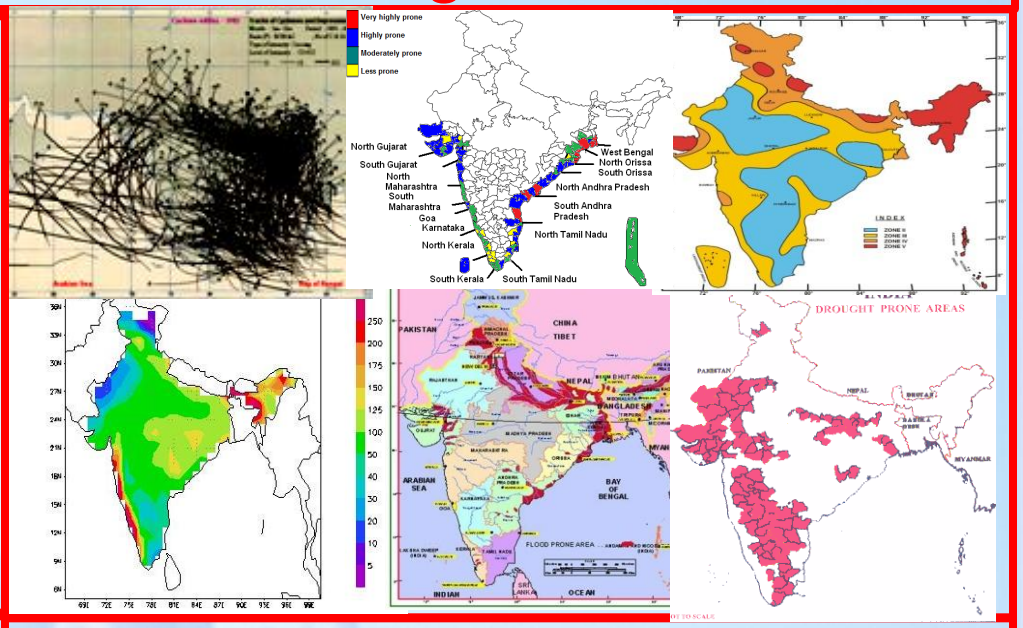
भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

Presentation layout

- Introduction
- Role of Meteorological Information in Disaster Risk Reduction (DRR)
  - Present Day Status,
  - Gap and
  - Future Need
- Conclusions

Major Natural Disasters and risk management in India

- Floods - Days
- Earthquakes - Second/Minutes
- Cyclones - Days
- Droughts - Months
- Landslides - Days
- Avalanches - Days
- Heat/Cold waves - Days/Weeks
- Tsunami - Minutes/ Hours
- Thunderstorm - Minutes/ Hours



Risk management

- Hazard Analysis and statistics
- Vulnerability Analysis
- Preparedness and Planning
- Early Warning System
- Prevention and Mitigation

Early Warning Components

- Obserbation, Monitoring and analysis
- Prediction
- Warning generation
- Warning dissemination
- Public education and Outreach
- Verification of warning

- India Meteorological Department : Earthquake and all Meteorological hazards
- Central Water Commission : Floods, Geological Survey of India : Landslides
- Indian National Centre for Ocean Information Services : Tsunami

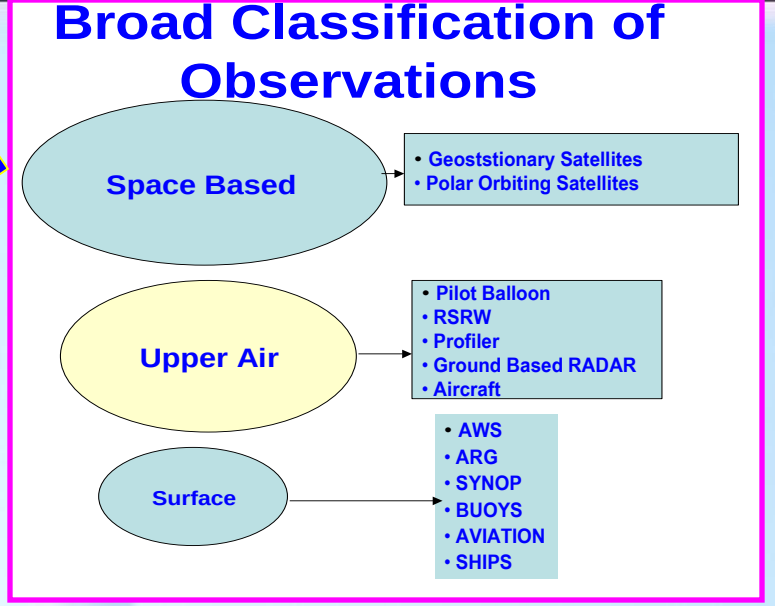
Role of Meteorological Information in DRR

- **Meteorological Information is used in several ways for Disaster Risk Reduction in India. Key roles are mentioned below:**
  - **Hazard Monitoring and Assessment**
  - **Early warning and mitigation.**
  - **Technical support in vulnerability analysis, mapping and risk assessment**
  - **Technical support in preparedness & planning,**
  - **Technical support in management of natural resources from disasters (Agriculture/Water resources, Energy Resources etc)**

Components of Early Warning

- Analysis And Prediction,
- Warning Products Generation, Presentation and Dissemination
- Warning Organisation
- Coordination With Emergency Response Units
- Public Education And Reaching Out
- The Post-event Review
- Pre-season Exercises

Monitoring and Forecast Process



Initial conditions (Observations)

Runs of different Models,

Consecutive runs from the same model,

Ensemble runs ("choosing the best member")

Model runs

Forecaster

Decision maker

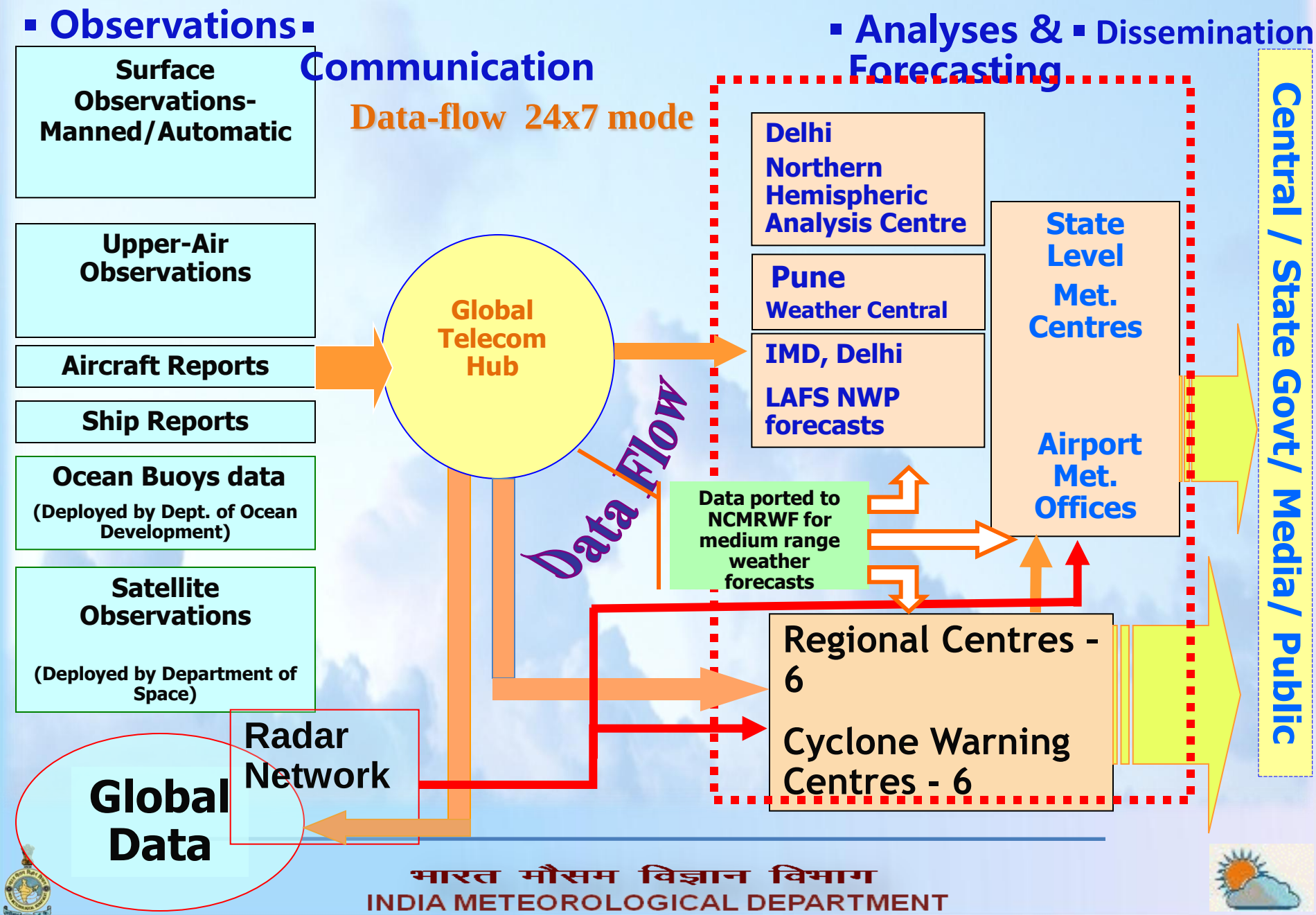
Action

Numerical forecasts

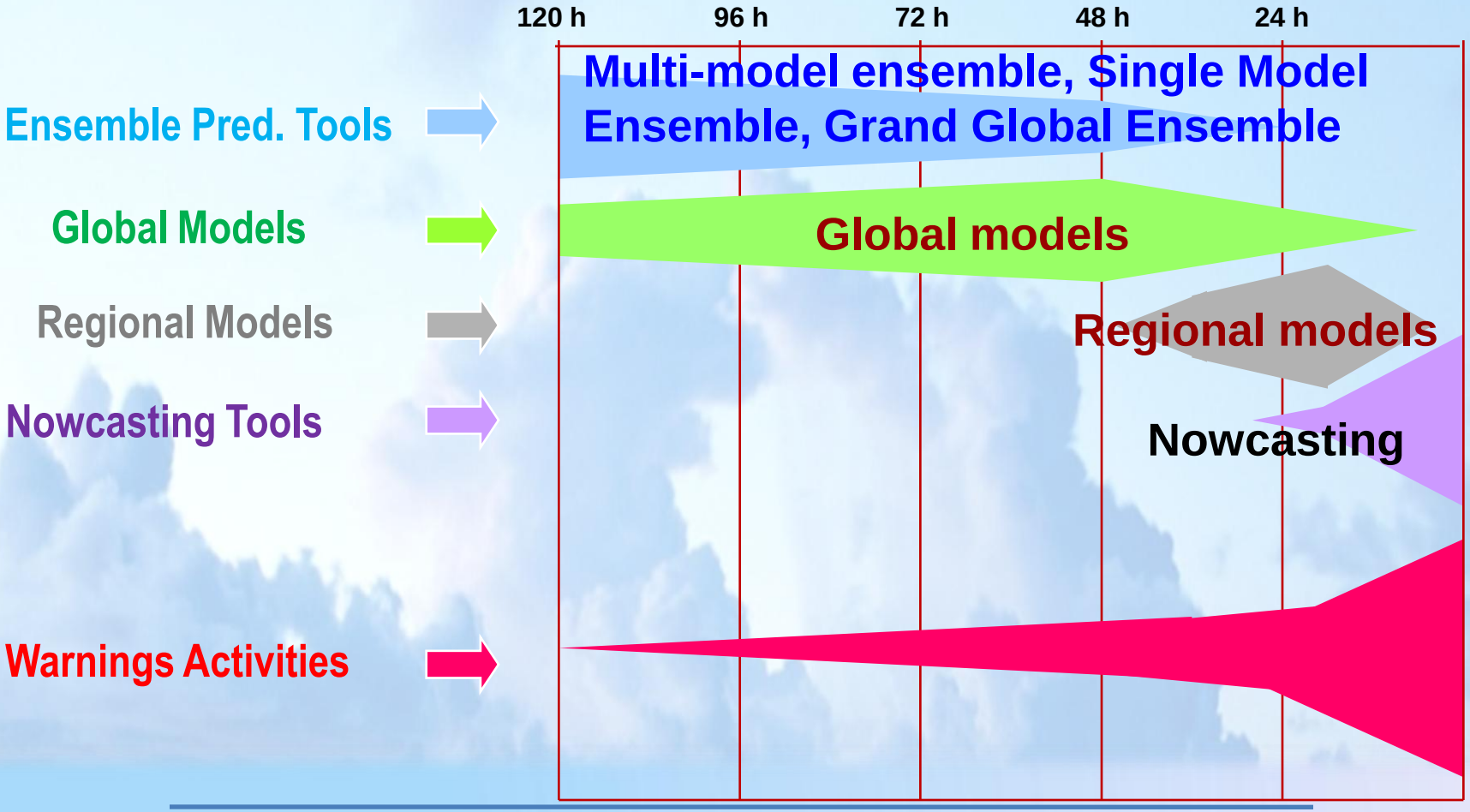
End forecast

Hazard Monitoring and Forecast Process

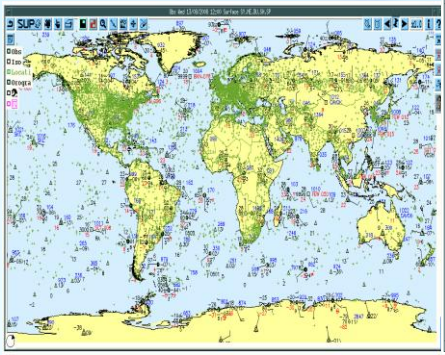
Hazard Weather Monitoring and Forecasting System

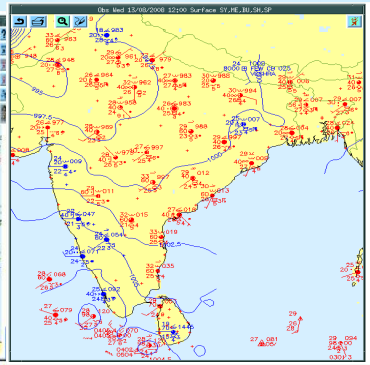


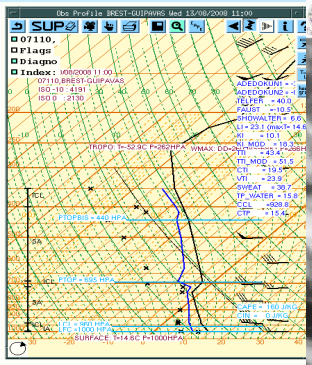
Numerical Weather Prediction (NWP) Modeling : Backbone for Early Warnings

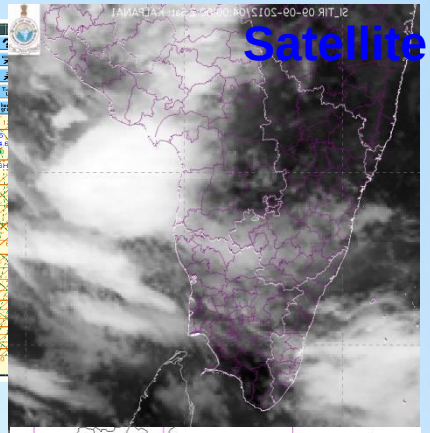


Technology for Decision Support System for Early Warning





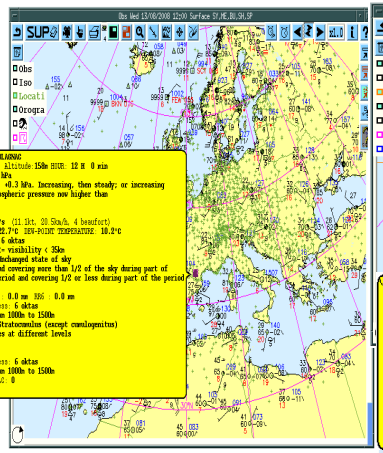


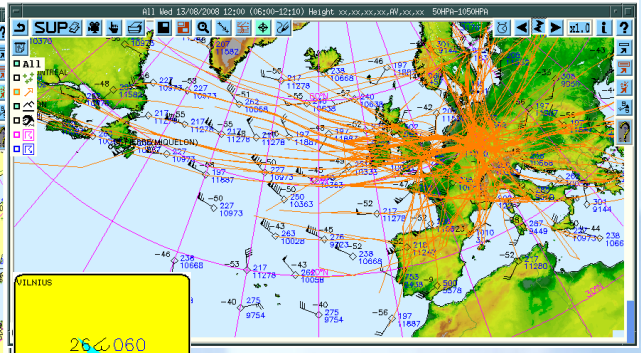


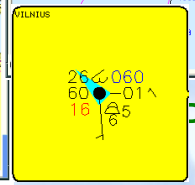
Satellite

Global plotting

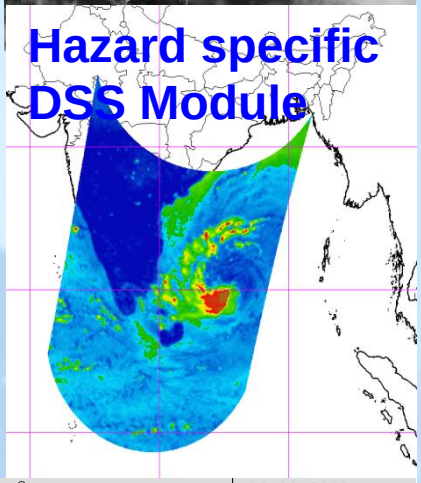
Conditional plotting





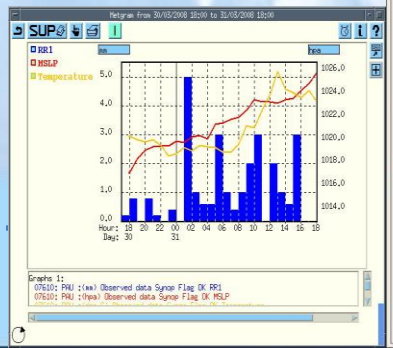


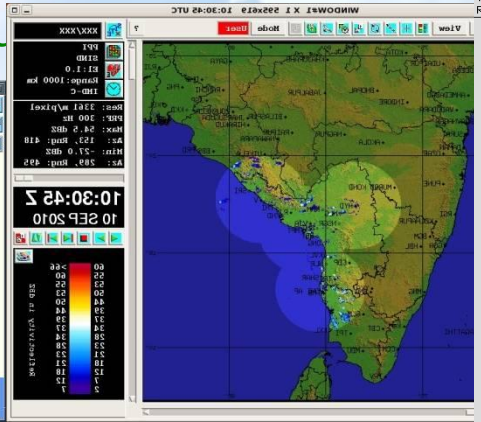
Plane trajectories

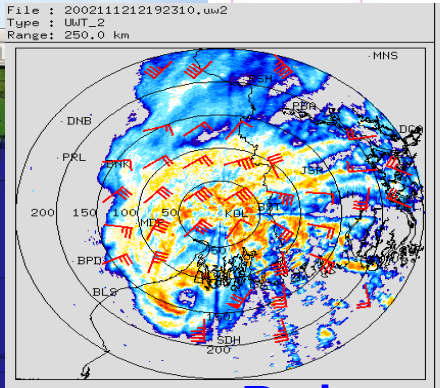


Hazard specific DSS Module

Gau







Radar

Forecasts in different temporal and spatial scales tailored for different users

- Spatial Scales
  - Meteorological Sub-division
  - District
  - Block (Proposed in 12th FYP)

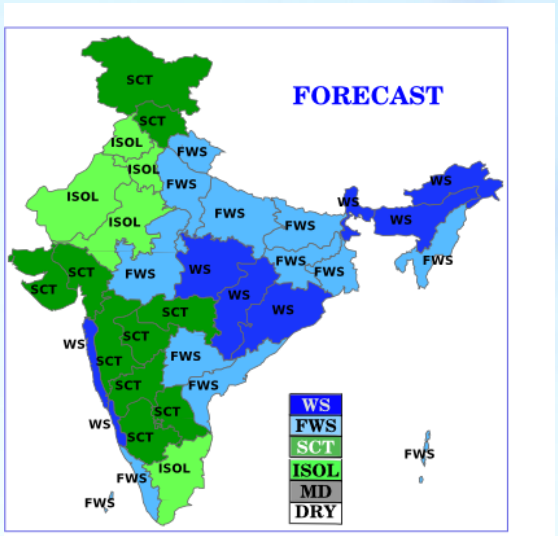
- Temporal Scales
  - Meteorological Sub-division : 7 days
  - District : 3 days
  - Block (Proposed in 12th FYP) : 3 days

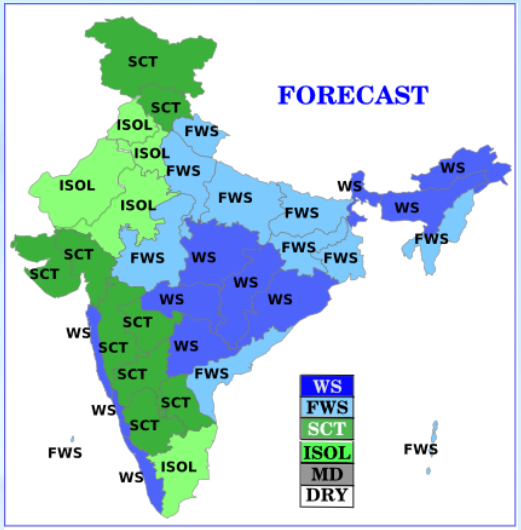
All these services need continuous improvement in accuracy and details; and improvement in observations through technological development would play a big role

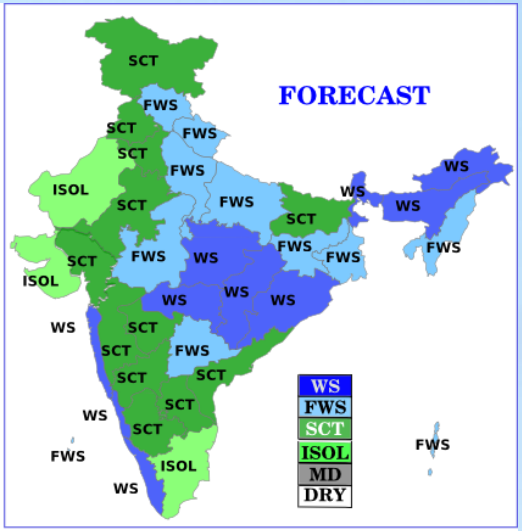
Warning Generation

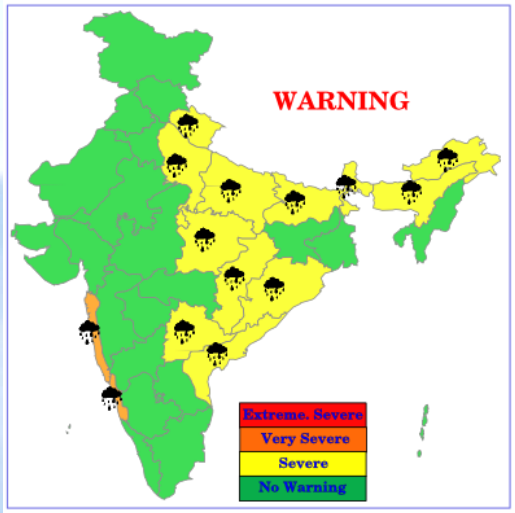
- ✓ Warning Elements
- ✓ Cyclone/Depression
- ✓ Heavy rainfall/snowfall
- ✓ Thunderstorm/Squall/Hailstorm
- ✓ Strong winds
- ✓ Storm surge and coastal inundation
- ✓ Heat/Cold Wave
- ✓ Frost
- ✓ Fog
- ❖ Warning is generated in both textual and visual form
- ❖ A Public Weather Service (PWS) system is in Place
  - TV system for public broadcast
  - Visumet for display
  - PWS for disaster managers
- ❖ criterion defined for each parameter
- ❖ SOP in place

WARNING PRESENTATION









Day 1 **Day 2** **Day 3**

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Information Technology for Early Warning Dissemination

- Global Telecommunication System
- VPN Circuits
- IVRS:
  (Toll free number 1800 180 1717)
- VSNL
- INMARSAT
- VSAT
- LAN
- HSDT
- National Knowledge Network
- Web based communication, Mobile Phone, SMS
- Web based Pilot Briefing System for civil aviation
- Radio/TV, Press
- Proposal for Development of centralized GIS based content managed website.

LINKAGE WITH DISASTER MANAGEMENT AUTHORITIES

- **NATIONAL LEVEL :**

1. CONCERNED MINISTRY ,NATIONAL DISASTER MANAGEMENT AUTHORITY
2. HIGHER OFFICIALS LINKED WITH DISASTER MANAGEMENT INCLUDING PORT, SHIPPING, TRANPORT, TELECOM AUTHORITIES
3. NATIONAL PRESS AND ELECTRONIC MEDIA

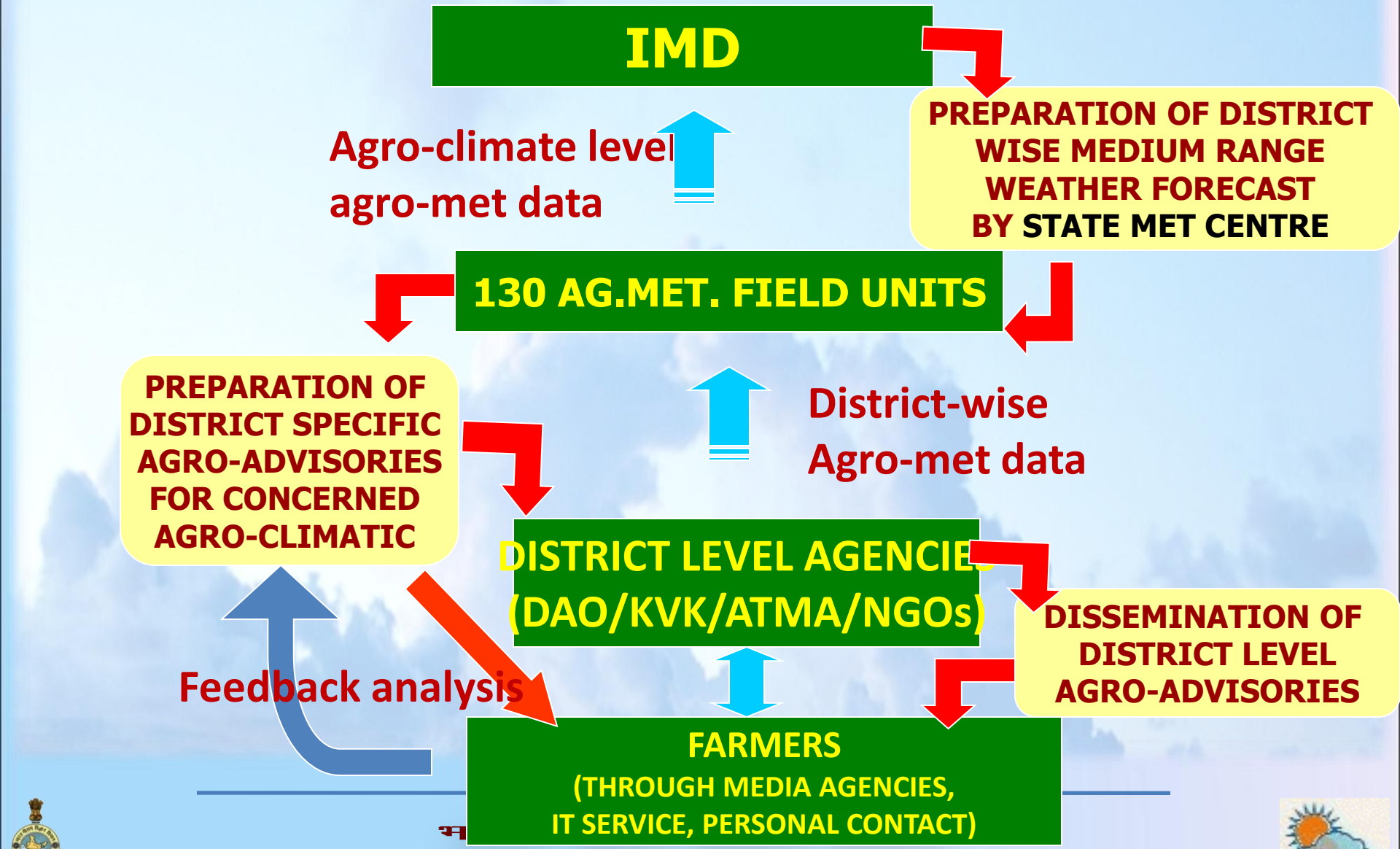
- **STATE LEVEL :**

1. CHIEF SECRETARY, SPECIAL RELIEF COMMISSIONER, STATE DISASTER MANAGEMENT AUTHORITY
2. REGISTERED WARNEES, FISHERMEN, PORTS, COASTAL SHIPS ETC
3. LOCAL PRESS AND ELECTRONIC MEDIA

- **DISTRICT LEVEL :**DISTRICT COLLECTORS, REGISTERED WARNEES
- **LAST MILE CONNECTIVITY :**
- SATELLITE BASED WARNING DISSEMINATION SYSTEM PLACED AT OFFICE OF BDO/ TEHSILDAR/ SCHOOL/ POST OFFICES/ CYCLONE SHELTERS
- DTH
- ALL INDIA RADIO
- **STEPS ARE BEING TAKEN TO FURTHER IMPROVE THE LINKAGE BETWEEN THE DISASTER MANAGERS AND IMD THROUGH**
  - ONGOING MODERNISATION PLAN OF IMD, NCRMP of NDMA

Sectoral Applications

District level Agrometorological Advisory Services



Flood Warning: Basic Structure

IMD

Meteorological Observations

Weather Forecast Models

Weather Forecasts

CWC

Hydrological Observations

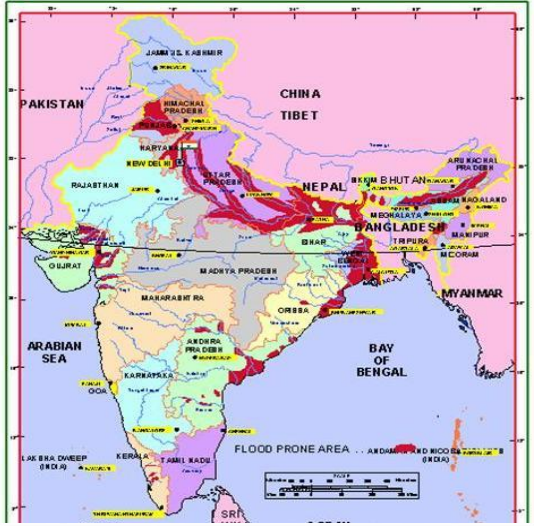
Hydrological Model

Flood Warnings

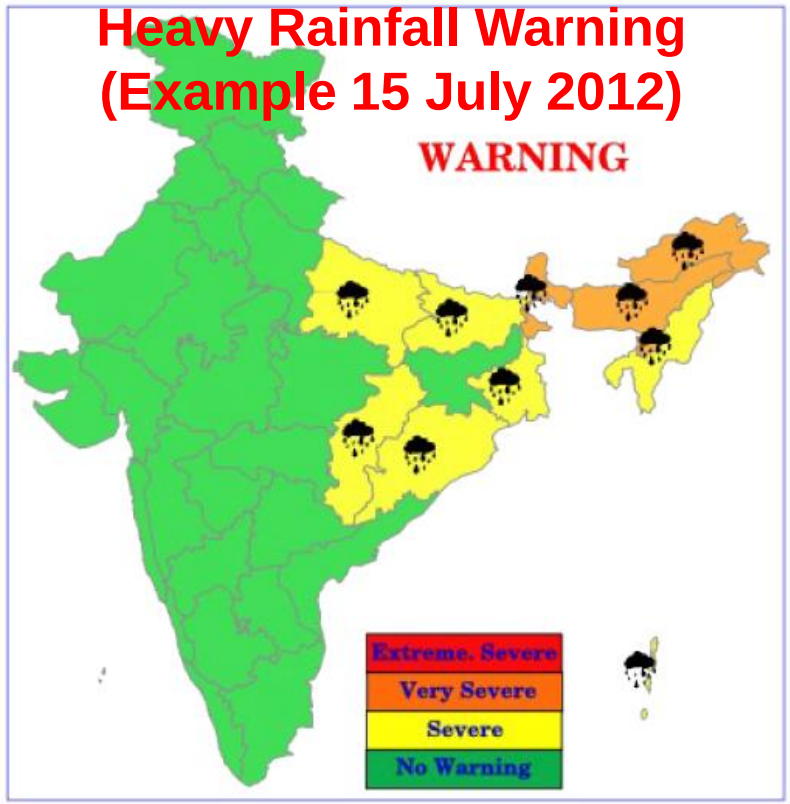
Streamflow Forecasts

FLOOD WARNING

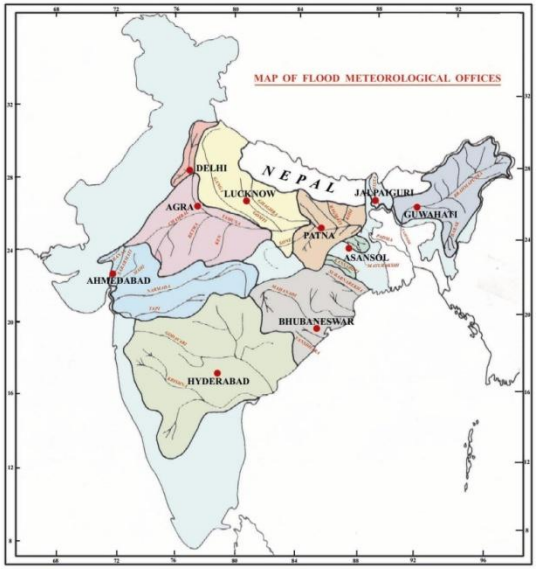
- Real time Hydro-meteorological observations
- Real-time communication and modeling capability
- Decision support system for issuing quantitative precipitation forecast (QPF) and heavy rainfall warning in place
- Urban flash flood forecast needs to be introduced



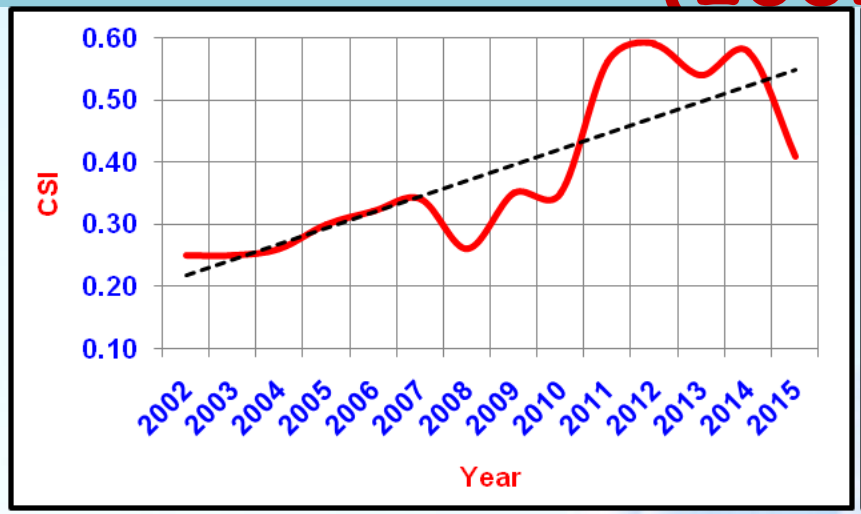
Heavy Rainfall Warning (Example 15 July 2012)

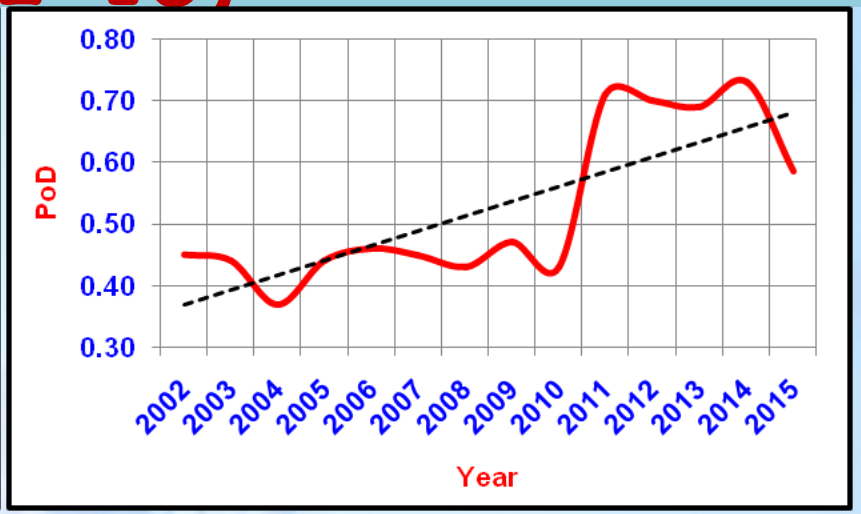


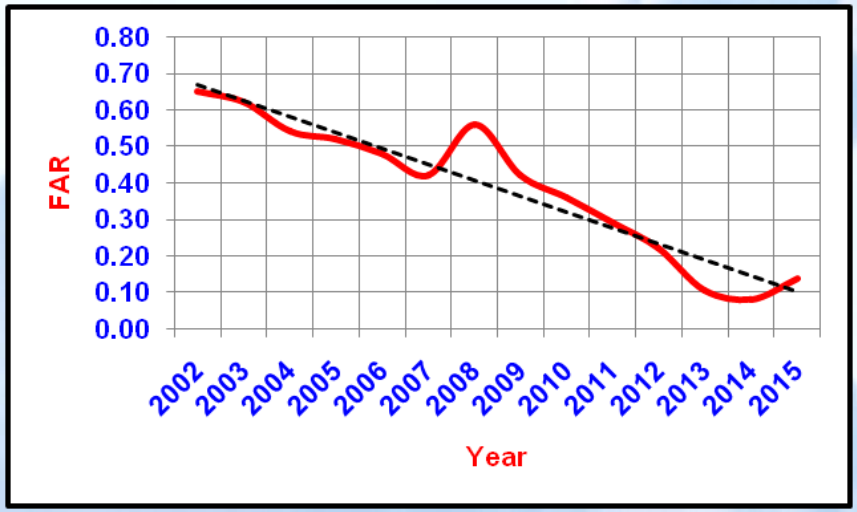
Heavy rain at one or two places	>6.5 cm or more	
Heavy to very heavy at one or two / at a few places	>12.5 cm or more	
Heavy to very heavy at a few places or extreme heavy	>12.5 cm or more	
No warning	Nil	

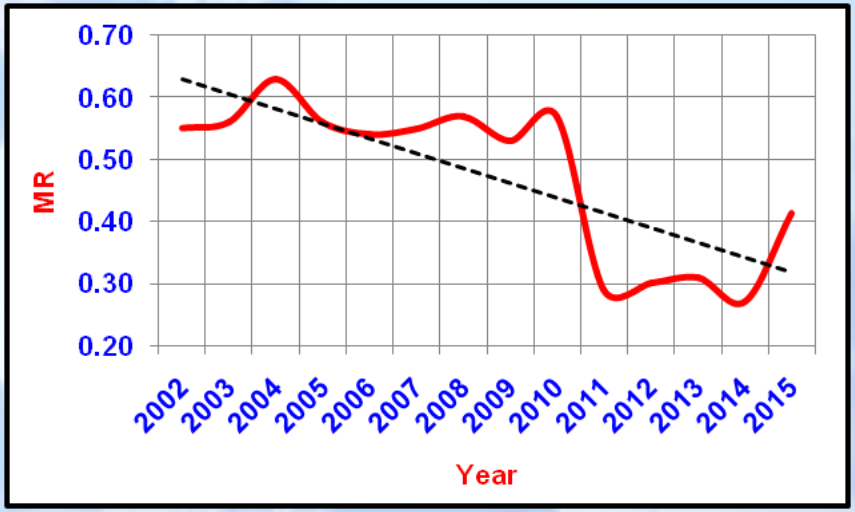


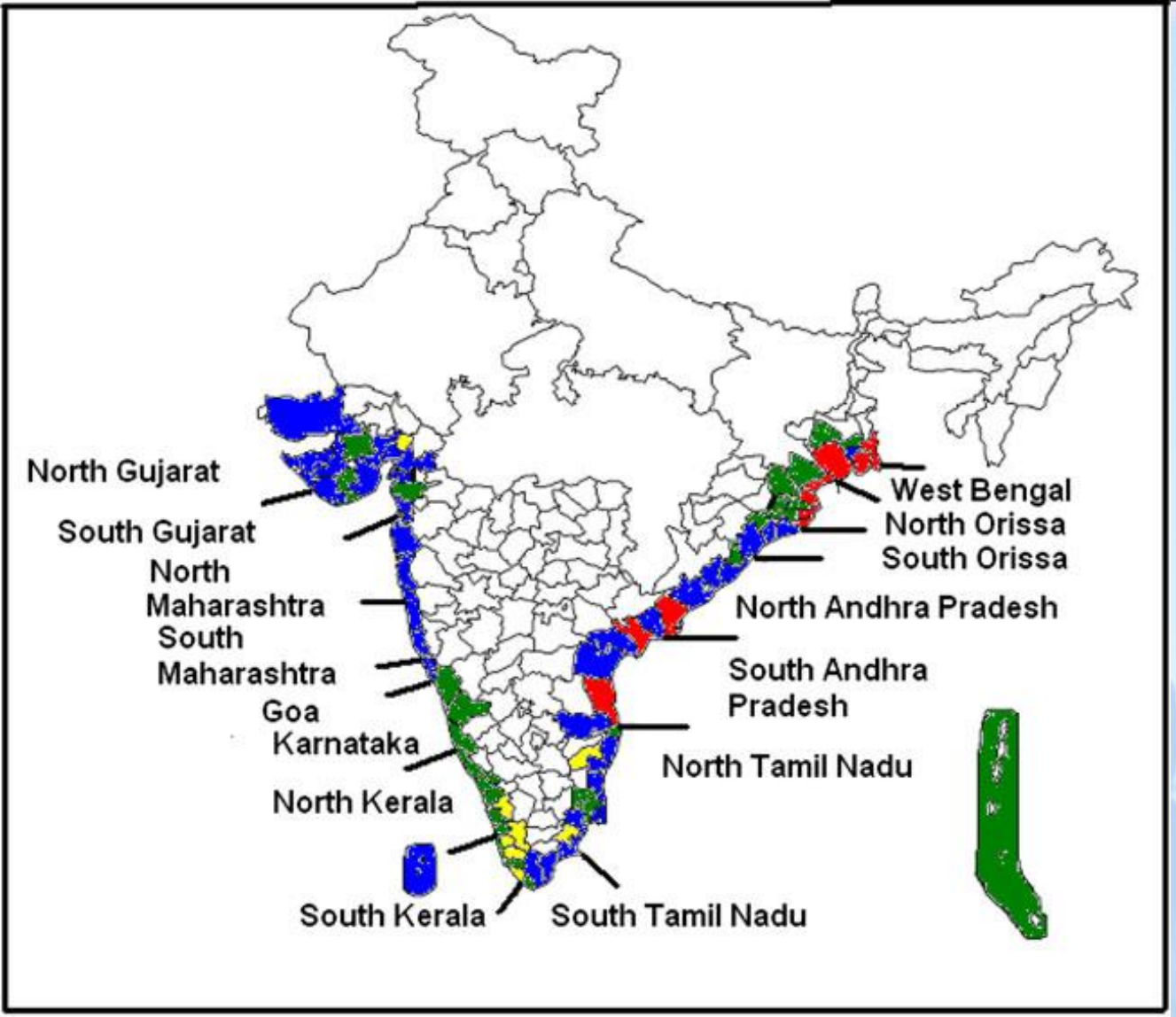
TREND IN HEAVY RAINFALL WARNING (2002-15)











Degree of proneness

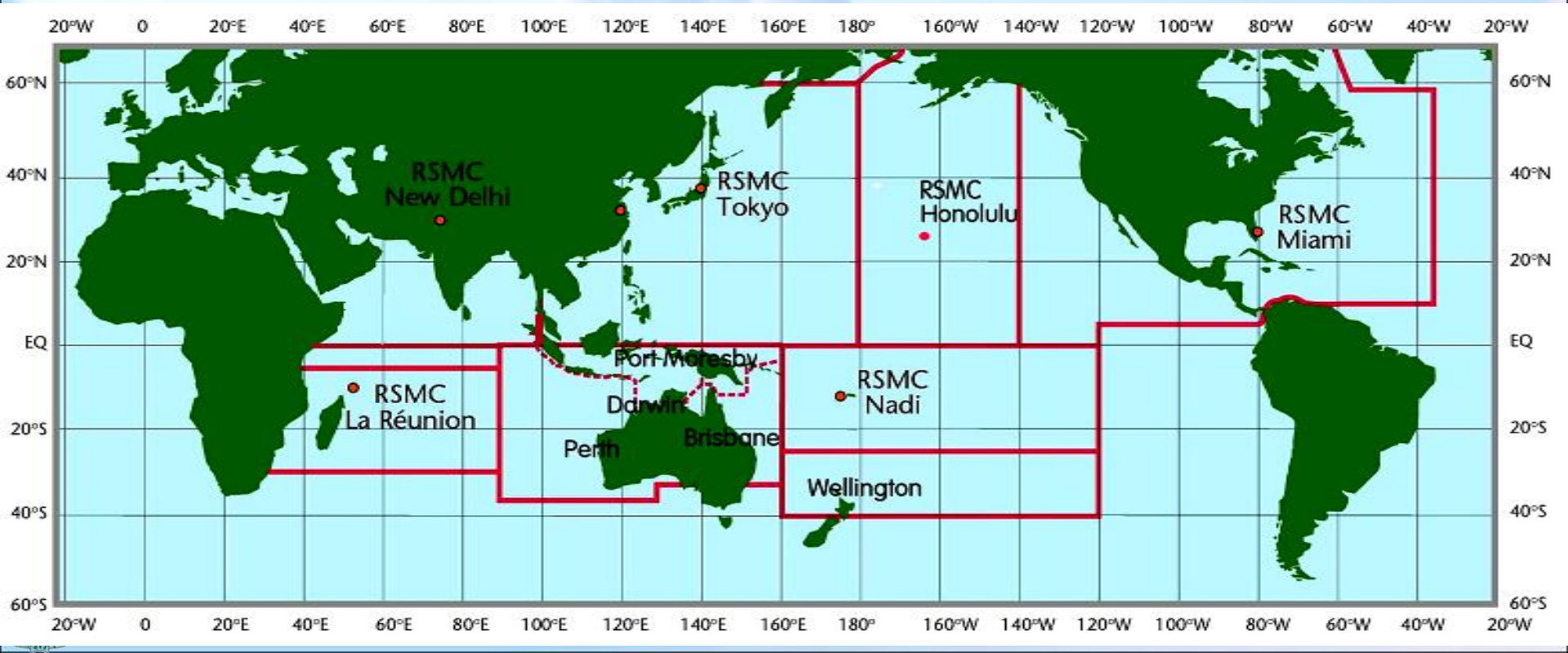
- Very high
- High
- Moderate
- Low

Cyclone hazard prone districts of India based on

- frequency of total cyclones,
- total severe cyclones,
- actual/estimated maximum wind,
- Probable Maximum Storm Surge (PMSS) associated with the cyclones and
- Probable Maximum Precipitation (PMP) for all districts

Cyclone Warning through Regional Specialised Meteorological Centre (RSMC)-Tropical Cyclone, New Delhi

- Monitoring and prediction of Cyclones over the North Indian Ocean
- Issue of Tropical weather outlook/ Cyclone Advisories to the WMO/ESCAP Panel Countries (Bangladesh, Myanmar, Thailand, Srilanka, Maldives, Oman and Pakistan) and Tropical Cyclone Advisories for Aviation as per guidelines of ICAO



User specific warning : Example: Cyclone Warning

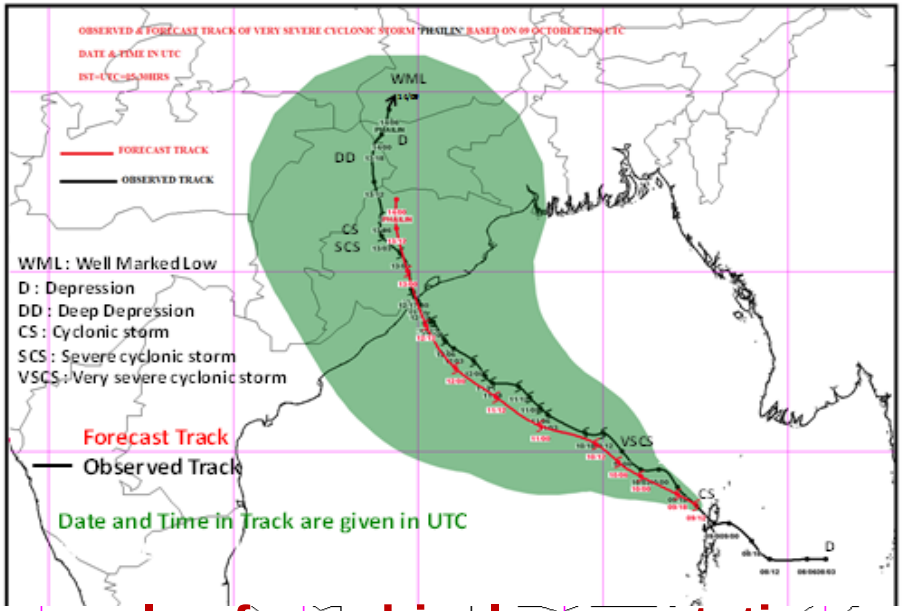
- **Four stage cyclone warning**
  - Sea area bulletin
  - Coastal weather bulletin
  - Bulletins for Indian navy
  - Fisheries warnings
  - Port warnings
  - Aviation warning
  - Bulletins for departmental exchanges
  - Bulletins for AIR/ Doordarshan/ press
  - CWDS bulletins
  - Warnings for registered/ designated users.

- **Pre-cyclone watch – Issued at least 72 hrs in advance indicating formation of a cyclonic disturbance – potential to intensify into a Cyclone and coastal belt to be affected.**
- **Cyclone Alert- Issued at least 48 hrs in advance indicating expected adverse weather conditions.**
- **Cyclone warning – Issued at least 24 hrs in advance indicating latest position of Tropical Cyclone, intensity, time and point of landfall, storm surge height, type of damages expected and actions suggested.**
- **Post-Landfall Outlook- Issued about 12 hrs before landfall & till cyclone force winds prevail; District Collectors of interior districts besides the coastal areas are also informed.**
- **Finally a 'De-Warning' message is issued when the Tropical Cyclone weakens or have no adverse impact.**

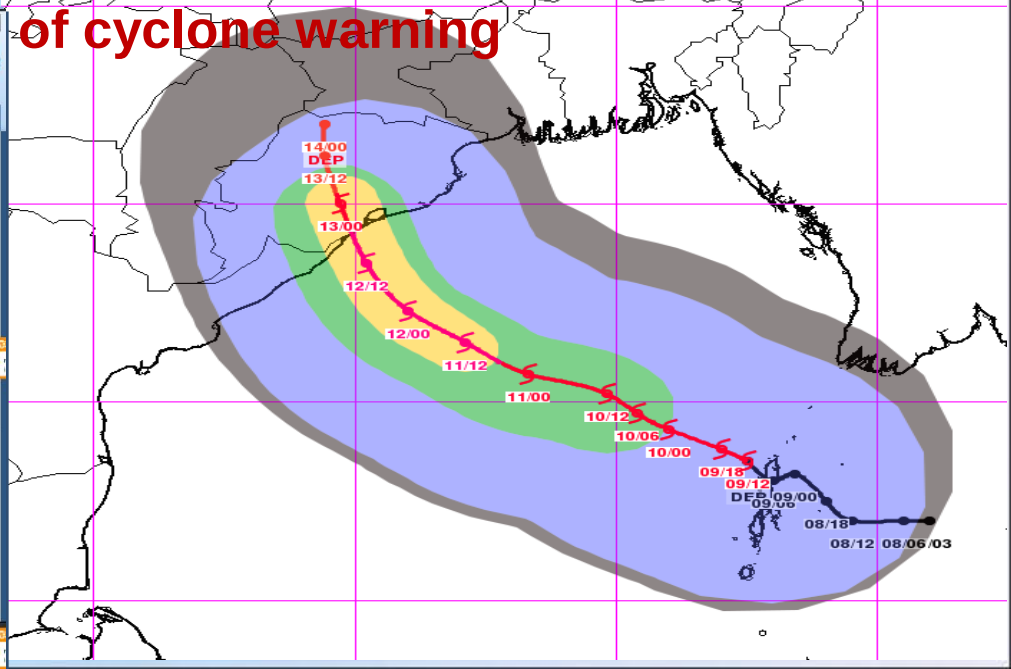
Warning Bulletin

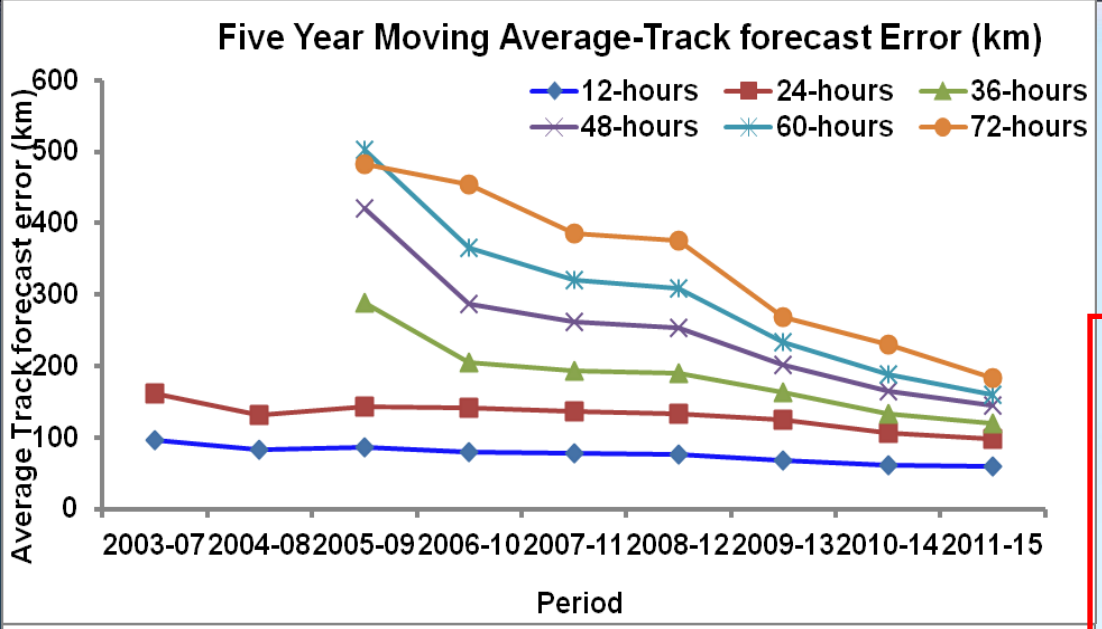
- Preamble
- Monitoring
  - Location, Intensity
- Prediction and warning
  - Movement, Intensity
  - Landfall
  - Weather (Rainfall, wind and storm surge)
- Advice and Suggested action

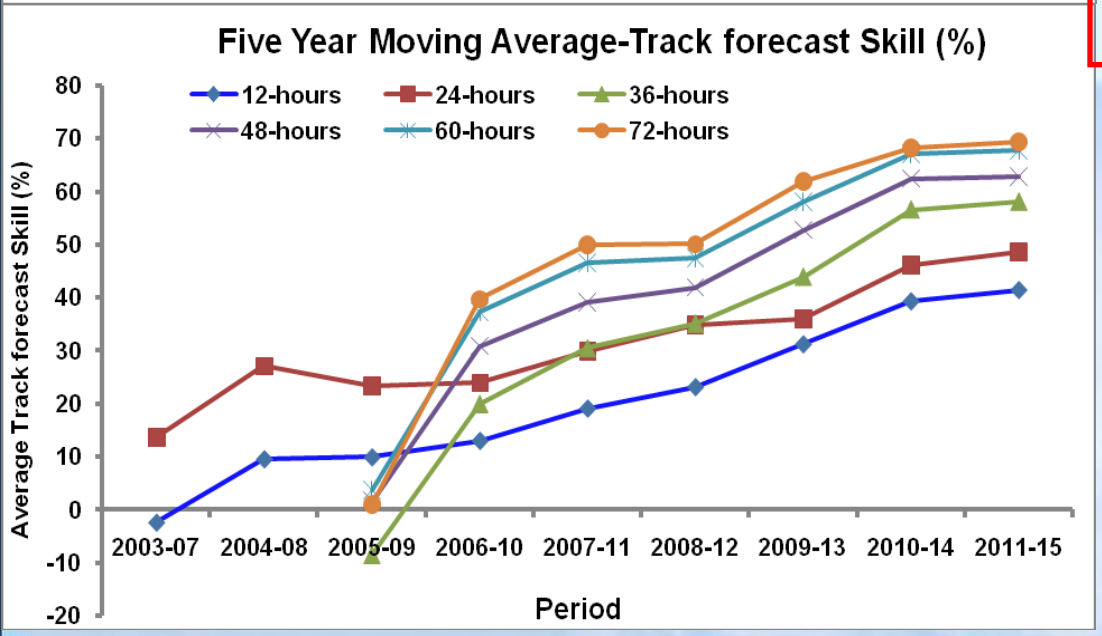
Observed and Forecast Track based on 1200 UTC of 09 October 2013



Example of graphical presentation of cyclone warning







Average landfall error in km (2011-15)

Lead	Error	Lead	Error
12 hr –	36.5	24 hr-	56.3 km,
36 hr –	60.6	48 hr-	93.5 km
60 hr –	95.2	72 hr-	105.7 km

IMD's future plans for enhancement of its forecasting capabilities

- Scale up Observing Systems
  - Surface, Upper Air, Radar and Satellite
- Improve Data assimilation & NWP Models
  - Meso-Scale, Global and Climate
- Forecasts
  - Block level forecast, location specific & Agro-met Advisories
  - Nowcast, Extended Range & Seasonal Forecast
  - Climate Scale
- Decision Support System for various sectoral applications
- Improved information dissemination system

Thank you