Preparation of Impact matrix, Data Sources and Challenges-Part 1

DR R. K. JENAMANI

jenamanirk@gmail.com

Head, RSMC and

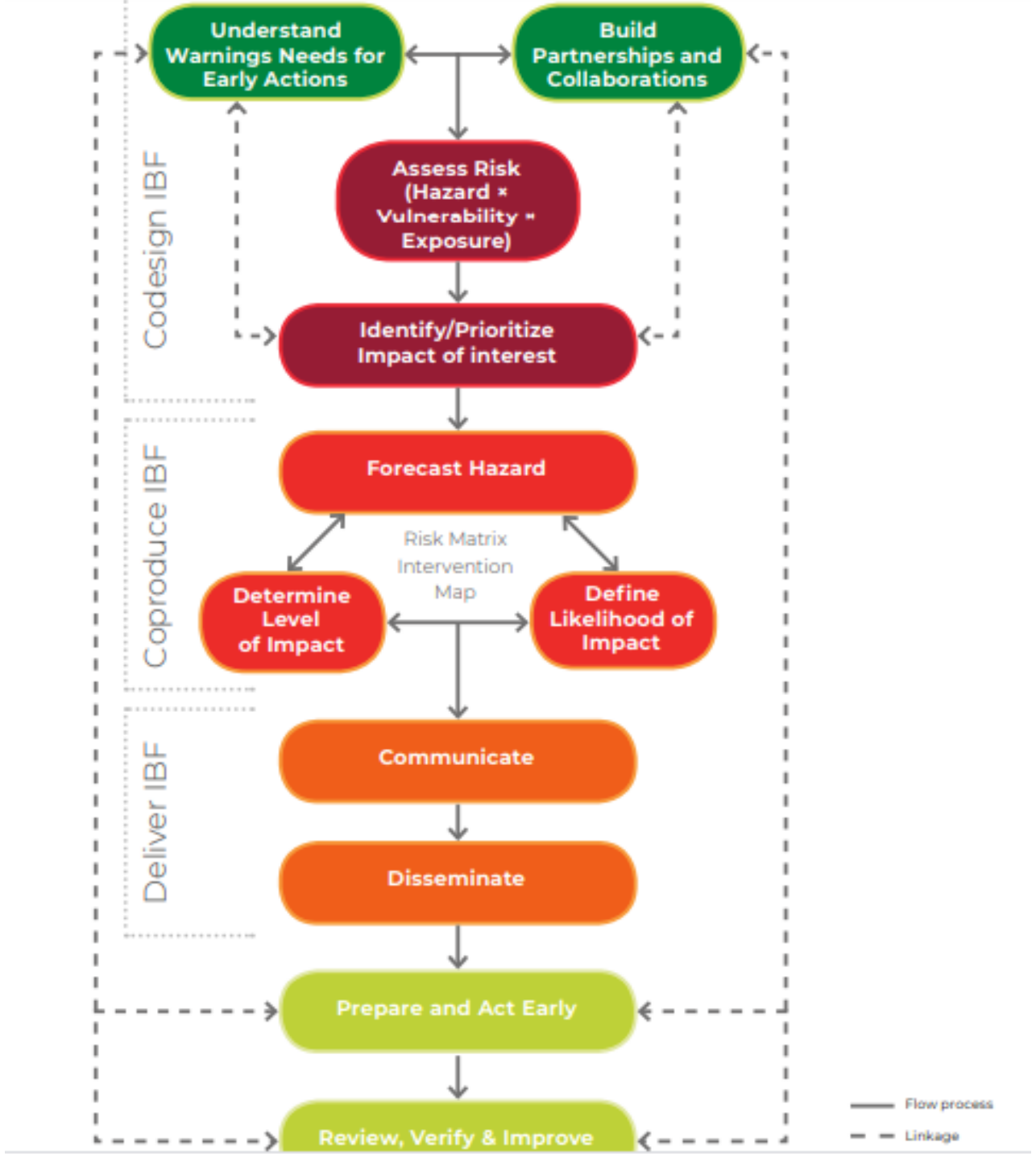
National Weather Forecasting Center(NWFC)

IMD, New Delhi

Preparation of Impact matrix, Data Sources and Challenges

- Hazard, Exposure, Vulnerability, Risk
- Preparation of Impact Based Forecast
- Preparation of Risk(Multi-hazard textual and graphical form using GIS/QGIS etc)
- Data Sources and Challenges

Methodological Framework of IBF and Warning Service



Methodological Framework of IBF and Warning Service

Based Weather Forecast and Warning Services(Risk based)-Data and Models

- **Hazard**
- **Meteorological or hydrological element that poses a threat**
  - Heavy rain Hazards, TS/DS Hazards(Tornado ? , Cyclone Hazards
- **Hazard Impact or loss Data**
- **Forecast Uncertainty(Nowcast, Synoptic and Model consensus, Extreme indices or Probability from EPS)-The limit of predictability imposed by the nature of the atmosphere**

Figure 2. Peril Classification at Family, Main Event and Peril levels. (Adapted from IRDR, 2014).

Figure 3. Conceptual framework for Human indicators in disaster loss (adapted from IRDR, 2015).

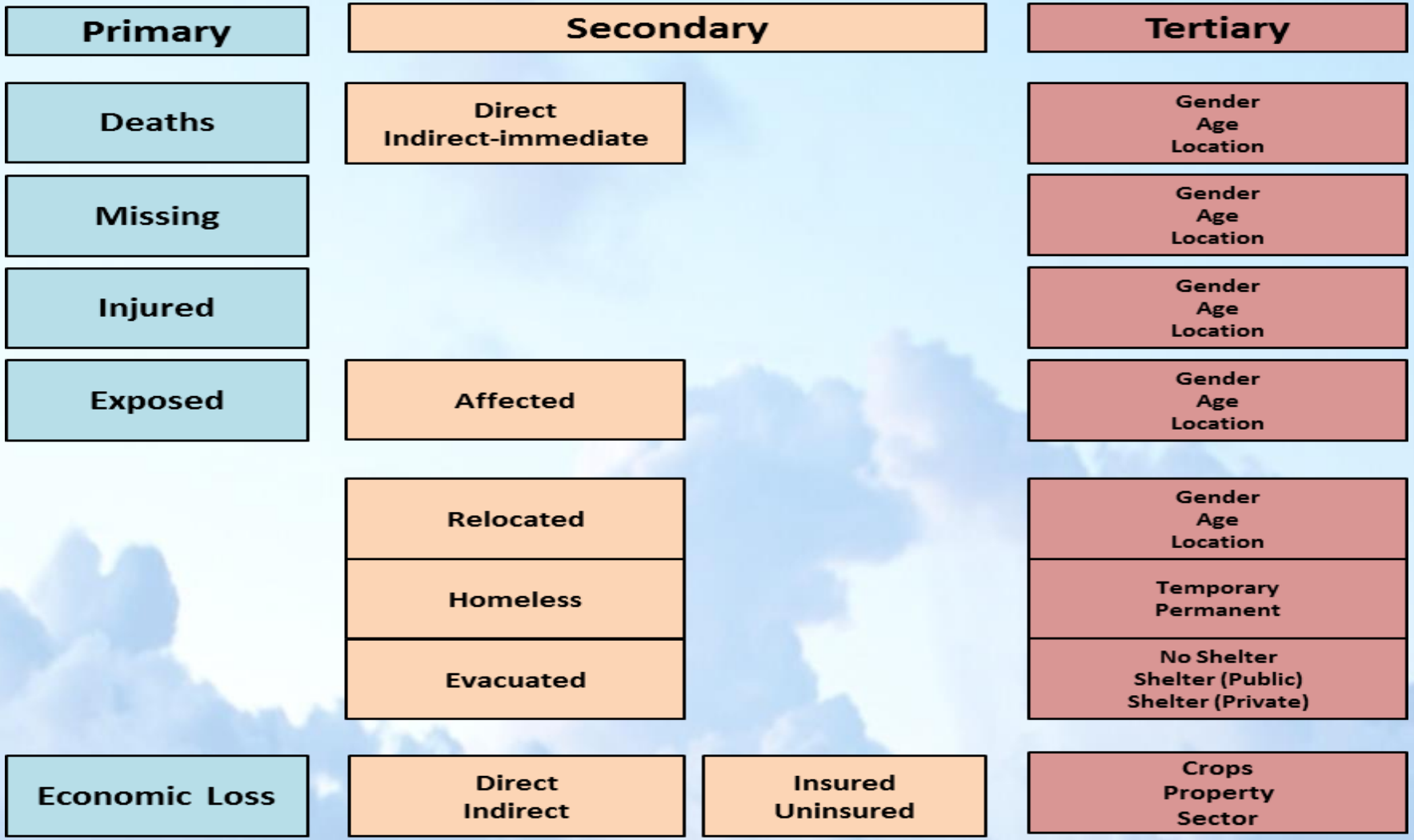
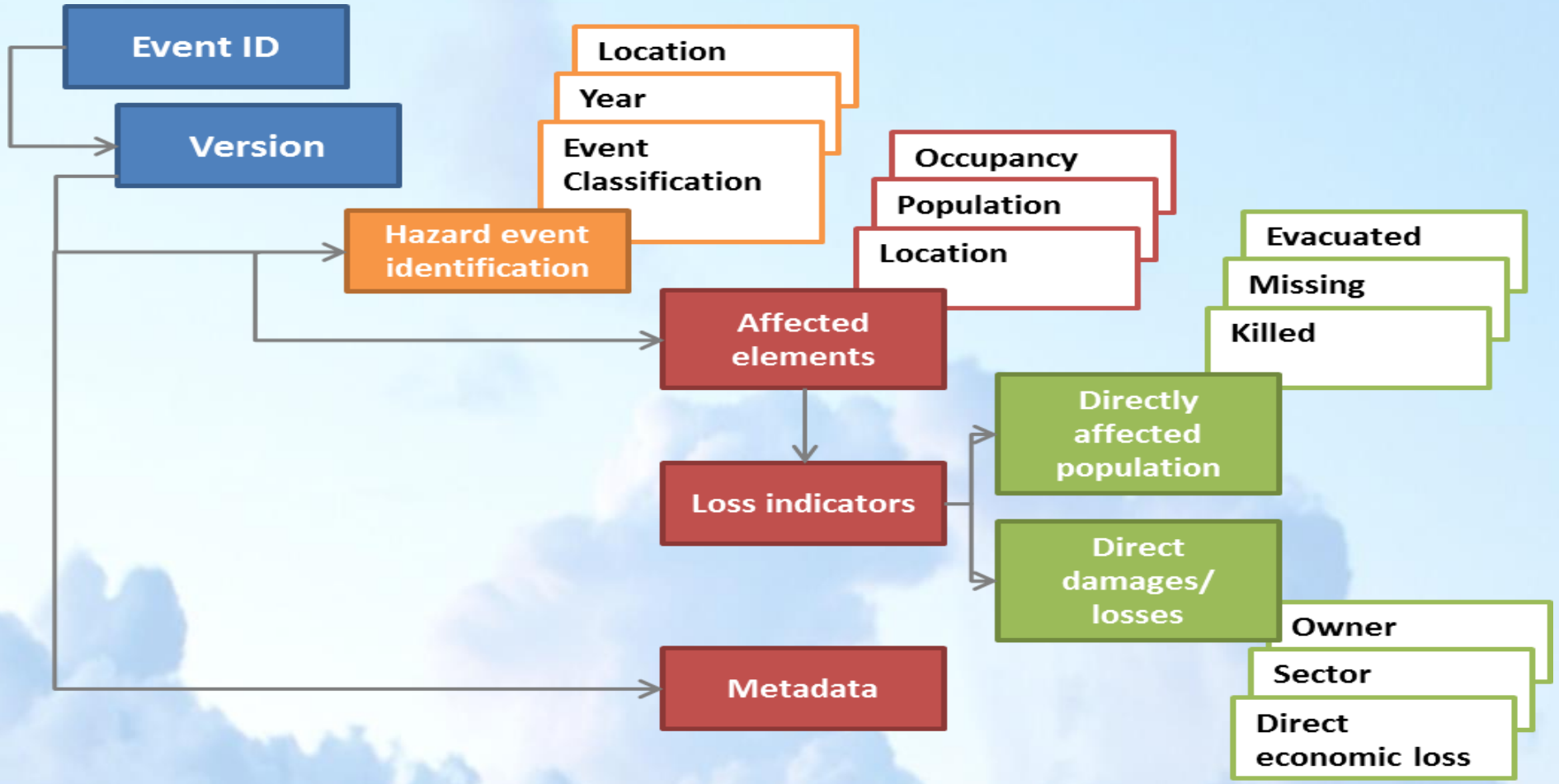


Figure 4. Joint Research Council conceptual data model for loss data (Adapted from Corbane et al., 2015).



Weather Type	Category(in terms of Impact)	Duration of occurrence	Year, date & Month (--/--/--)	State	Location/ Area affected (District/ Tehsil/Block)	Associated Impact		
						Types	Primary/Secondary/ Tertiary	Data
						Human casualties	Death	
							Injury	
							Missing	
						Livestock with type of species	Death	
							Injury	
							Missing	
						Evacuation	Number of people	
							Number of different livestock	
						Trees uprooted(Types and estimated numbers)	Small, medium, large	
						Infrastructural Damage	Crop (Type of crop, area & stage of crop)	
							Type of House and number	
						Affected community services	Hospital	
							School	
							Water supply	
							Other services	
						Transportation	Rail (name of route/rail traffic disruption)	
							Road/Highway (name of route/traffic disruption)	
							Airports (name)	
						Communication	Telephone towers (no of uprooted/bent)	
							Electricity supply {no of poles & towers (11/22/33 Kw lines)uprooted/bent}	
						Occurrence of flooding/ inundation /landslide	If yes, then area of occurrence of flood/Inundation and location/areas of landslide	

Table 2. Potential Data Sources for Hazard Impacts

Hazard impact data sources		
Hazard	**Impact**	**Data Repositories**
▸ National and regional hydrological and meteorological services ▸ World Meteorological Organization catalogue of extreme weather events ▸ Research institutes (e.g. Dartmouth Flood Observatory, UNEP, Copernicus, International Research Institute IRI, FloodList)	▸ *Primary data providers* - Government ministries (environment, social welfare, health, public works, energy) water; Civil Protection Agencies/National Disaster Management Authorities ▸ *Humanitarian sector* - Affected communities, traditional knowledge holders, practitioners ▸ *Media* - newspapers, social media	▸ *Data repositories* - (e.g. EM-Dat, Desinventar, Preventionweb) ▸ *Data collection methods*: Rapid damage assessments, Post Disasters Needs Assessments

In gathering historical datasets for a hazard, the following key questions may be helpful:

- What were the impacts?
- When did the impacts occur?
- Where were the impacts observed?
- What is the quality of the historical records?
- What was the magnitude of the hazard? This can be related to the return period.
- What is the frequency and geographic distribution of impacts from a particular hazard?
- How is the nature of the hazard expected to change in the future due to climate change, climate variability, socio-economic changes and other external drivers?

Key Ideas in Impact-Based Forecast and Warning Services

Exposure(Can be all)

—**Who or what may be affected in an area where a hazard may occur**

Vulnerability (Few may be vulnerable/Fully or partially, say Building/House-water entered, but no major damage, may completely)

—**The liability of exposed human beings, their livelihoods and property, to suffer bad effects when affected by a hazard (Sectors, Structure, Basic Services, Communities and Individual)**

Risk

—**The probability and magnitude of harm possible to humans, their livelihoods and assets because of exposure and vulnerability to a hazard(Low, Mod ,High)**

Definition to be followed of Hazard, Vulnerability and Exposure

- Hazard refers to the possible, future occurrences of natural or human-induced physical events that may have adverse effects on vulnerable and exposed elements. At times, hazard has been ascribed the same meaning as risk, but hazard is now widely accepted to be one component of risk and not risk itself.

- Vulnerability refers to the propensity of exposed elements such as humans, their livelihoods, and assets to suffer adverse effects when impacted by hazards. The ability of a population or community to cope and adapt to disasters significantly impacts vulnerability. Coping capacity is the ability to react to, and reduce the adverse effects of experienced hazards, whereas adaptive capacity is the ability to anticipate and transform structures or organisations to better survive hazards.

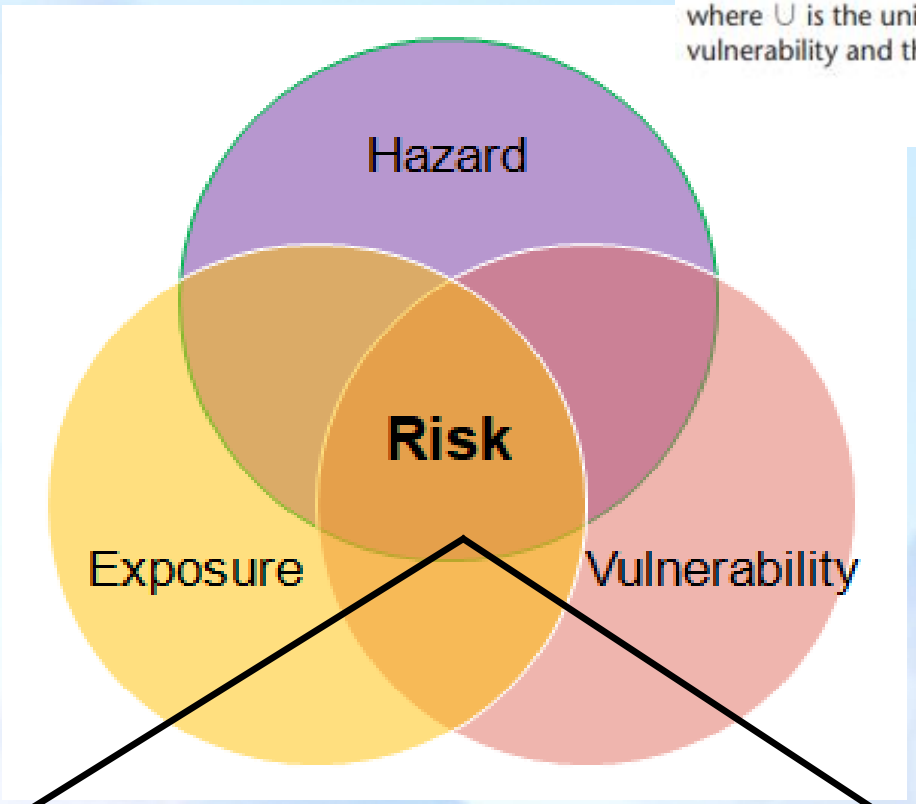
- Exposure refers to the presence of elements in an area in which hazard events may occur. Hence, if population and economic resources are not located in potentially dangerous settings, no problem of disaster risk exists. Exposure is a necessary, but not sufficient, determinant of risk. It is possible to be exposed but not vulnerable (for example by living in a floodplain but having sufficient means to modify building structure and behaviour to mitigate potential loss).

Risk Assessment

Risk may be mathematically expressed as:

$$|\,Risk\ of\ impact\ (x,\ t)\,| \equiv |\,hazard\ (x,\ t)\,| \cup |\,vulnerability\ (x,\ t)\,| \cup |\,exposure\ (x,\ t)\,|$$

where ∪ is the union of the level of hydrometeorological forecast uncertainty, the degree of vulnerability and the level of exposure. Risks:



Subjective

Climatological/past impact and discuss impact with stakeholders

Objective

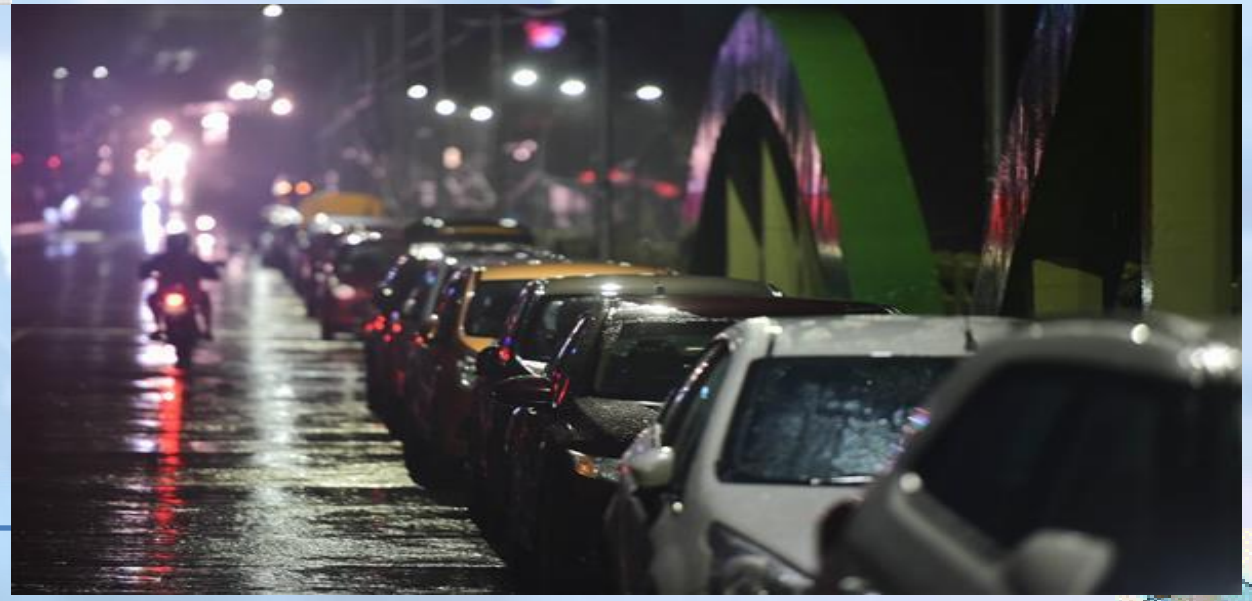
Impact models using vulnerability & exposure data set and meteorological information

Impact based system depends on

Two factors:

- **Hazard:** Intensity and Likelihood of weather system
- **Exposure and Vulnerability:** Non weather factors

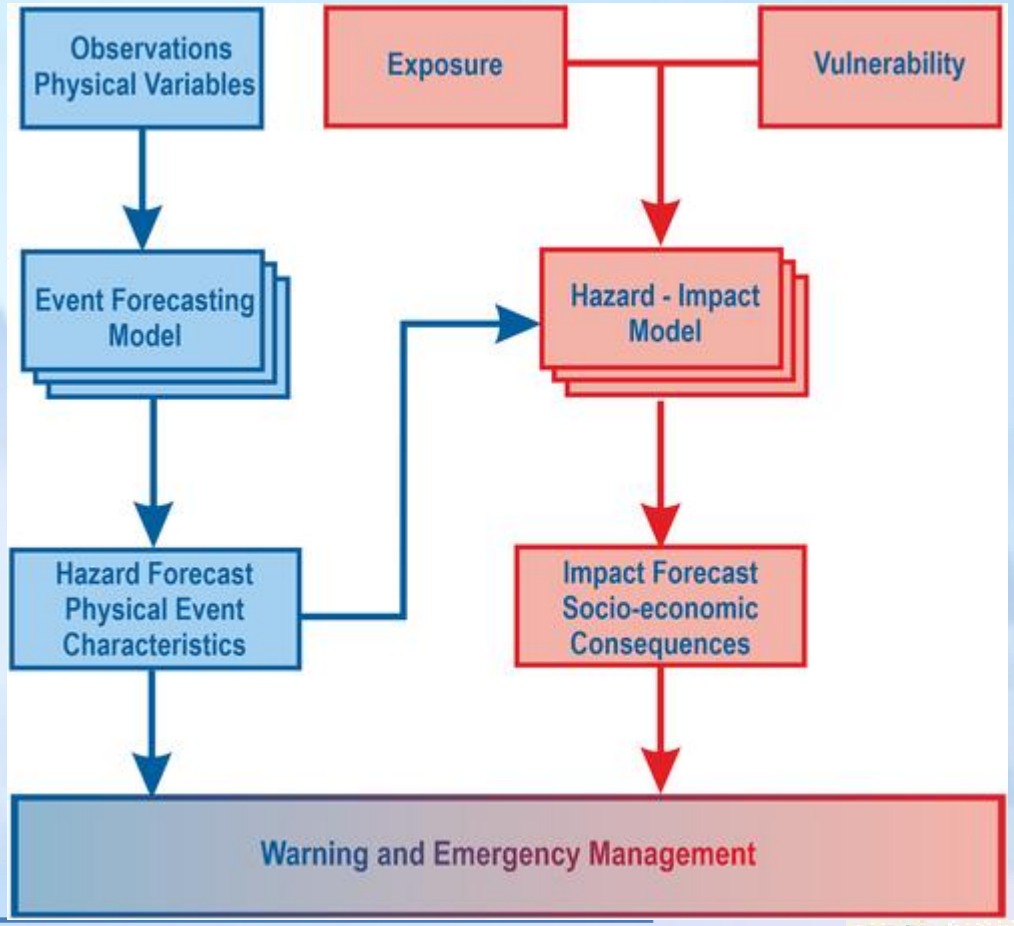
Wind /Rainfall Impact-Risk based warning



Risk may be mathematically expressed as:

$$|\,Risk\ of\ impact\ (x,\ t)\,| \equiv |\,hazard\ (x,\ t)\,| \cup |\,vulnerability\ (x,\ t)\ \,| \cup |\,exposure\ (x,\ t)\,|$$

where ∪ is the union of the level of hydrometeorological forecast uncertainty, the degree of vulnerability and the level of exposure. Risks:



Operational Shifts needed

Phenomenon-Based Forecasts	→	Impact-Based Forecasts
Products-Based Services	→	Decision Support Services
Meteorological Threshold-Based Warning	→	Impact Threshold-Based Warning (Risk based warning)

Deterministic (best forecast) → Probabilistic (uncertainty range)

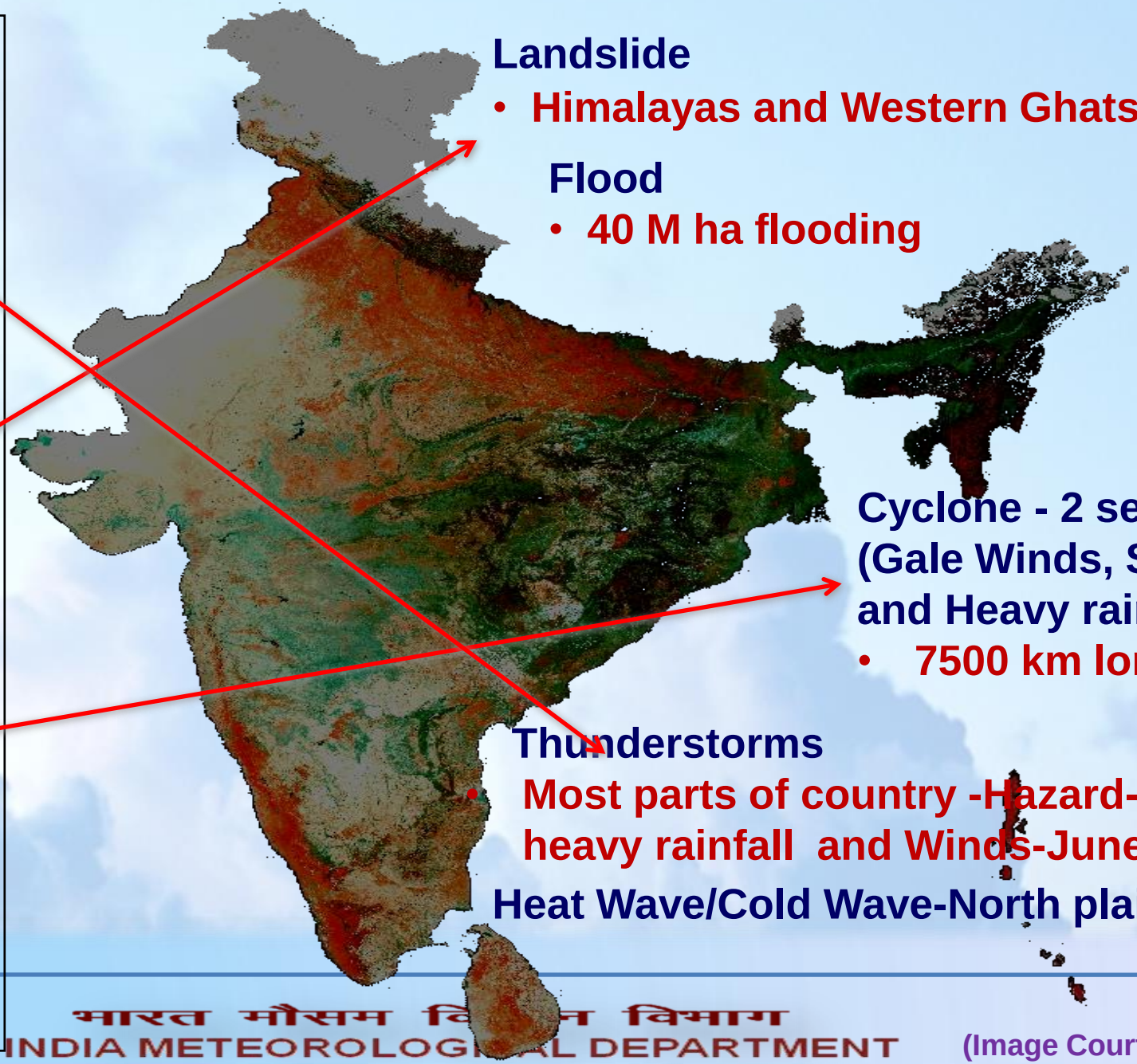
Progress in India : Severe weather Events as per Seasons, Hazards, Vulnerability, RISK

1.Winter Season(Jan-Feb)
- Dense fog, Cold wave, Frost and Heavy Snowfall

2.Summer Season(March-May)
- Thunderstorms, Dust storms and Lightning
- Cyclone Season-I

3.Monsoon Season(June-Sept)
- Heavy Rainfall and Flash Floods

4.Post Monsoon or Northeast Monsoon Season(Oct -Dec)
- Cyclone Season-II
- Heavy Rainfall and Flash Floods mainly in Peninsular India
- Starting Phase of Winter Severe Weather for north India



Landslide
- Himalayas and Western Ghats

Flood
- 40 M ha flooding

Cyclone - 2 seasons (Gale Winds, Storm surge and Heavy rains)
- 7500 km long coastline

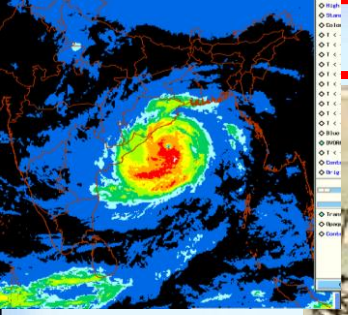
Thunderstorms
- Most parts of country -Hazard-Lightning, heavy rainfall and Winds-June-August

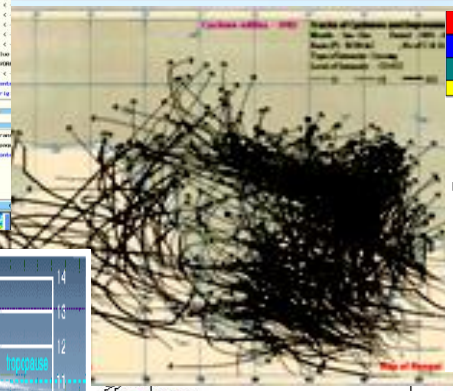
Heat Wave/Cold Wave-North plains of India

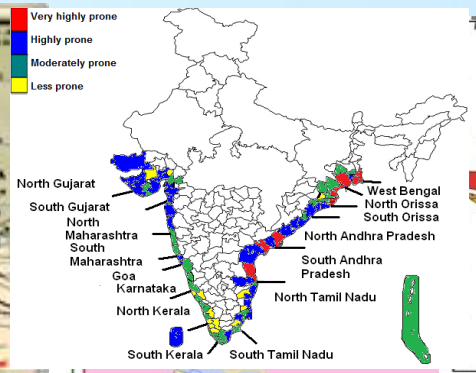
भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

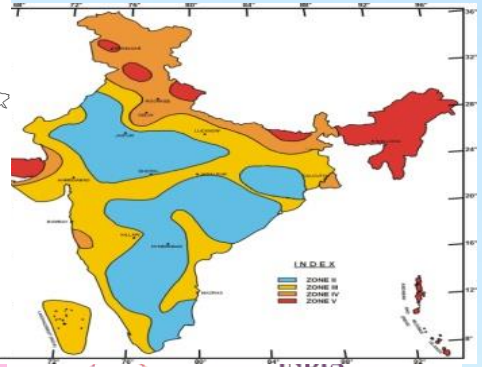
(Image Courtesy: ISRO)

Mapping of Major Natural Hazards

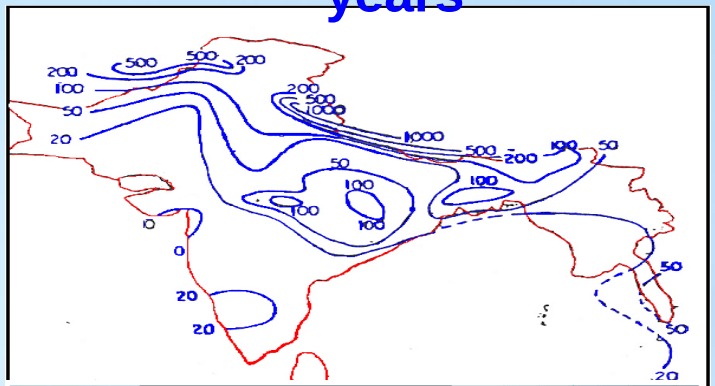


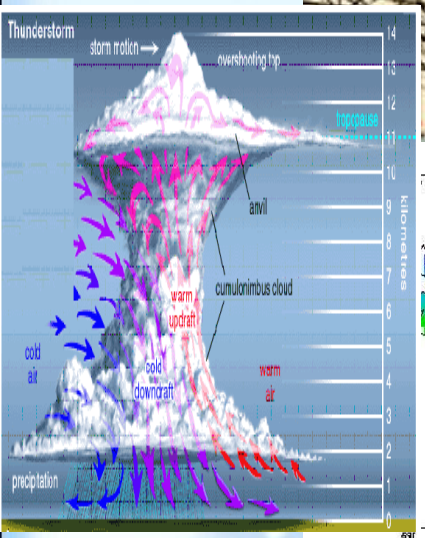


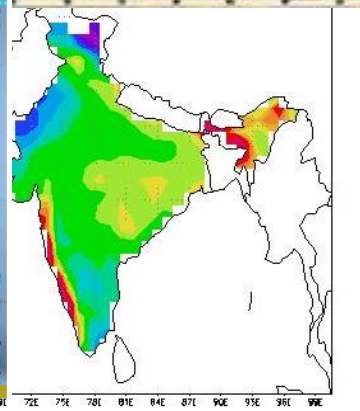


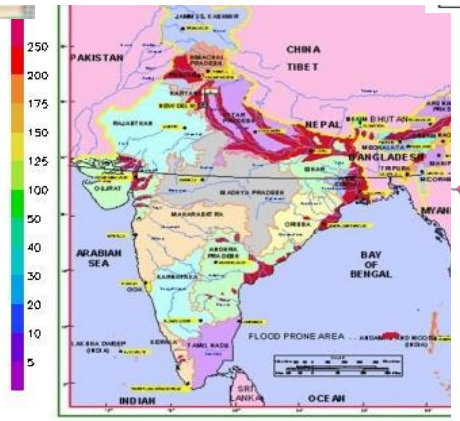


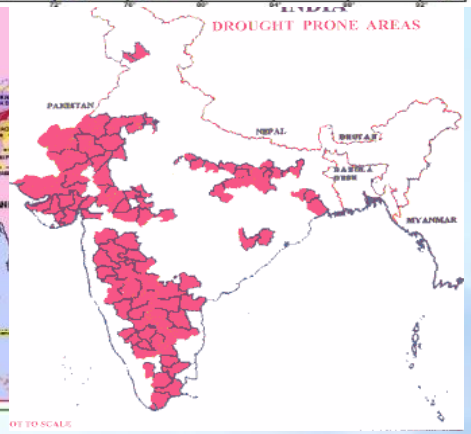
Frequency of Hailstorms in 100 years

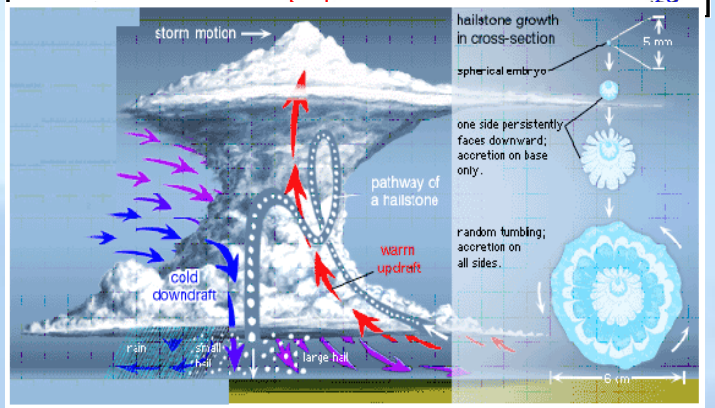




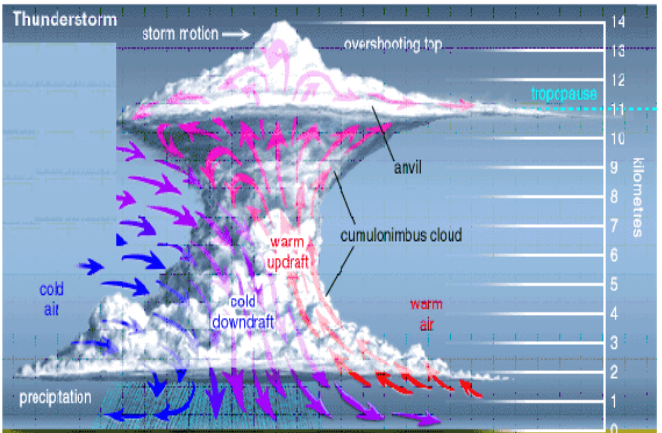


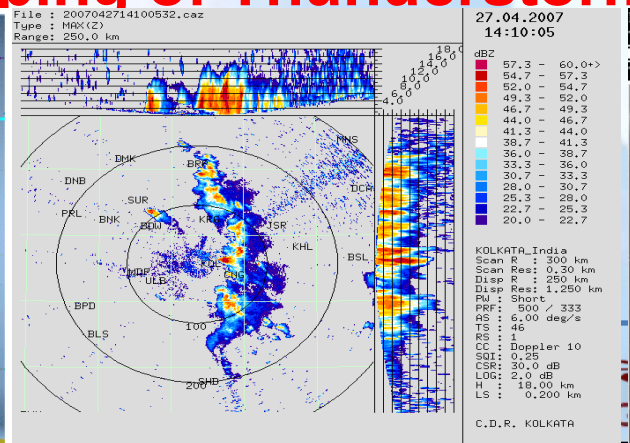


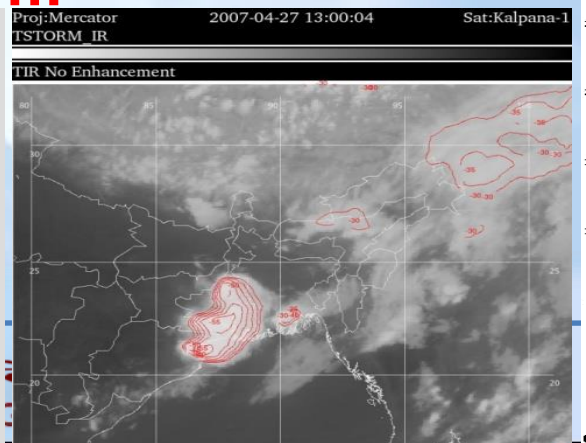


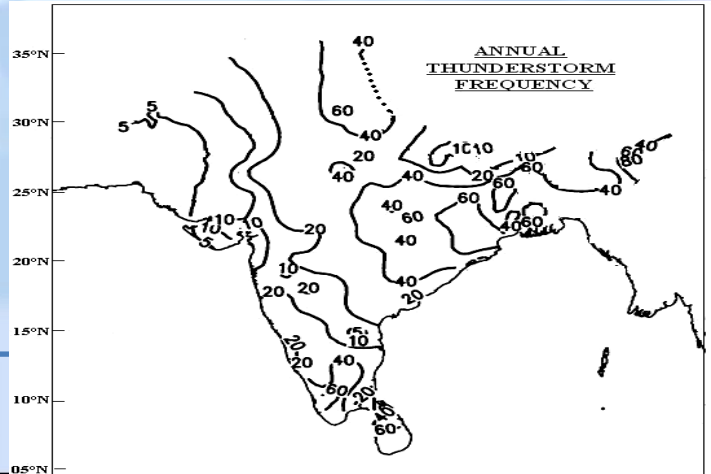


Mapping of Thunderstorm:

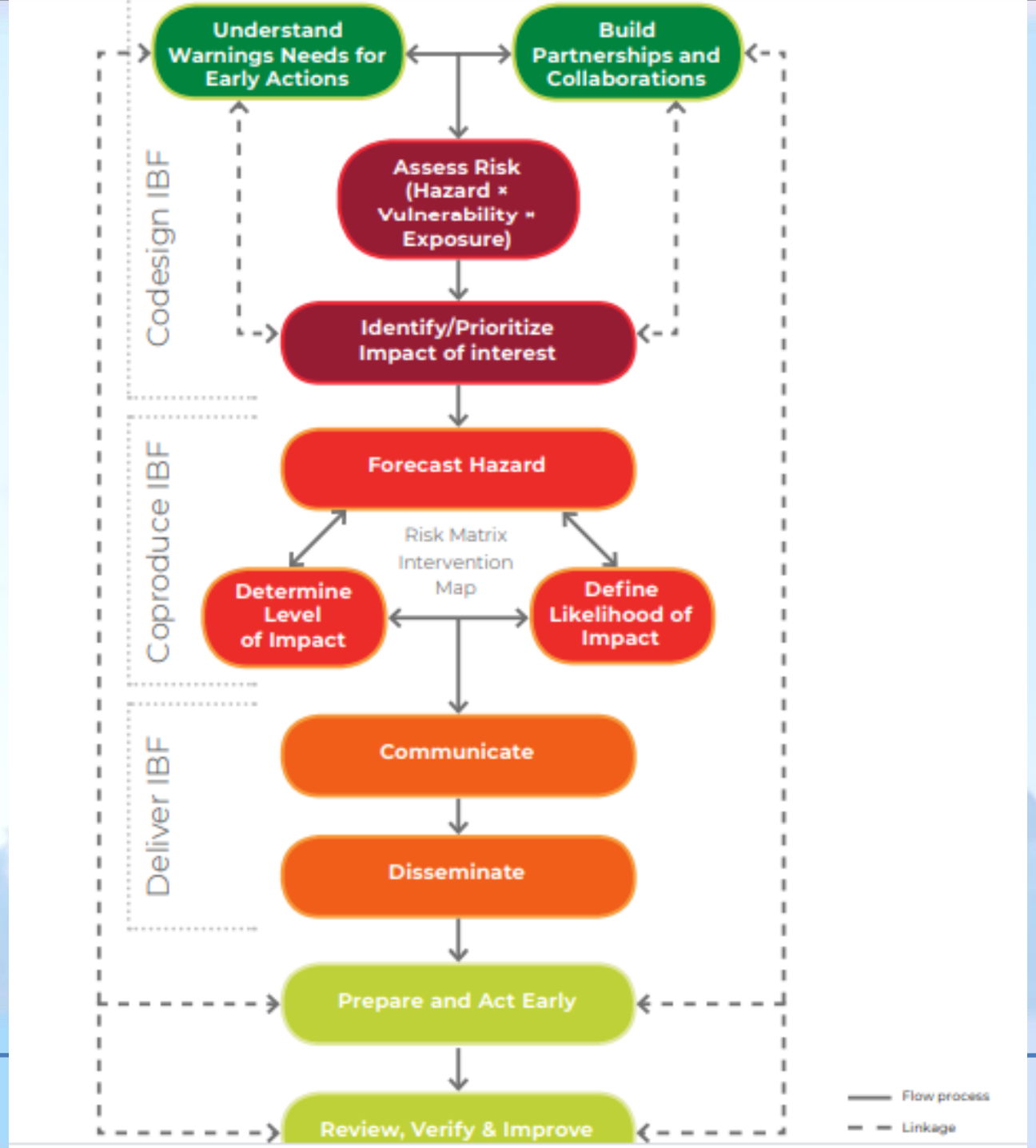








Methodological Framework of IBF and Warning Service



Methodological Framework of IBF and Warning Service

Typical Impact-based Forecast Users

- Members of the public
- Community leaders
- Government departments (agriculture, social welfare, public works etc.)
- Local government officials
- Disaster Risk Reduction and Civil Protection Agencies:
  - humanitarian agencies
  - development agencies
  - police
  - military
  - hospitals and health providers
  - local disaster managers
- Local businesses
- Transport services
- Energy providers and services
- Water providers and services
- Telecommunication providers and services

Analysing user needs and meeting requirements

Listed below are some sample questions to help identify users and their needs:

- Who is requesting impact-based forecasts and warnings or who could it be useful for?
- Who is using the forecasts for decision-making or to take early action?
- What forecast and warning information is currently being used?
- How is forecast and warning information used in practice?
- What challenges do users face at the onset of and during a hazardous event?
- What risks or impacts are users trying to reduce?
- How can forecasts and warnings provide appropriate information to enable informed decision-making and trigger action?
- At what spatial scale do users need forecast and warning information in order to act effectively?
- How much time do users need in order to anticipate and prepare?
- What would be the consequences of false alarms?

What forecasts and warnings already exist that can meet user requirements?

What capability is needed to produce the impact-based forecasts and warnings that will meet the user requirements?

Which existing forecasts and warnings can be adapted to meet the user requirements of impact-based forecast services?

How can India adopt ?-Steps to switch over to IBF

Event	Hazard	Warning parameters	Validity and lead time	Scale	Conventional Methodology	NWP Products	Users	Skill	Post event meeting for assessment
Heavy rainfall (conventional EWS)	-	24-H/3-H event intensity	Nowcast/SR-MR	Location, City, Dist and Met Sub-dIv	Synopt, CLIPER, Analog. Persistence, MOS	Reg to Global Det to EPS	DMs and PWS and some Sectorial	Upto 3 day 0.73 and 0.4 to 0.5 upto 5 days	Users meeting
Heavy rainfall (IBF and RBW	Floods:Pluvial (Surface Flood)/Flash flooding(especially Urban flooding) Coastal flooding(low tide/high tide and rainfall epochs) ▪ Riverine flooding ▪ Land slide and Land sink. ▪ Dam burst	Event and hazard and Impact details and a RISK Matrix	1-5 days at stages	do	Event forecasts, Hazard types and intensity likely , Exposures, Vulnerability and Risk estimates	Weather Models Hazard Models IMAPCT Models Exposure, vulnerability and Impact data	Municipality, Authority, Power sector authority, Telephone service provider, Hospital authority, Transport authority Animal husbandry DMA and NGO	To start	

Exposure Delhi-In pre 1980s vs 2020s vs 2030 if we compare

1980	2020	2030
Geo-physical exposures, Livelihood, population Socio-economic conditions, land use, urbanization, industries, roads and other infrastructures and development of various sectors	Changing exposure	
New Exposure come up	Basic service facilities like, Mobile phone, internet(banking and transport, reservations), drinking water supply, Power, Health(medical Services facilities) , Transportation	
		? Increase in Extreme weather event occurrences and changes characteristics, severity

Steps to be followed for MET Service provider to switch over from current conventional event based EWS to EVENT-Hazards based IBF and RBW needs

a) Dialogue between respective Hazard and Model scientists, Disaster data experts, forecasters, disaster managers, community leaders and other relevant users

b) Raw event forecast –threshold based warnings- Heavy, very heavy much easier than IBF and RBW because

- A forecaster can easily give the former forecast but for latter , he has to know details of the concern district/city, past data and must have aces to voluminous big data/information
- It needs Hazard forecast information combined with vulnerability and exposure data available with but to be formatted and easily accessible by national hydrological and meteorological services and partner organizations, to create a risk assessment
- Objective-: Forecaster officer in Duty, assess the impacts of the forecasted weather phenomenon and hazard likely and their intensity and consider their warnings based on the level and severity of those impacts at that particular location and /or for the target users/groups.

Typical Impact-based Forecast Users

- Members of the public
- Community leaders
- Government departments (agriculture, social welfare, public works etc.)
- Local government officials
- Disaster Risk Reduction and Civil Protection Agencies:
  - humanitarian agencies
  - development agencies
  - police
  - military
  - hospitals and health providers
  - local disaster managers
- Local businesses
- Transport services
- Energy providers and services
- Water providers and services
- Telecommunication providers and services

Steps to start IBF services and RBW by any NMS provider like MC/RWFC/NWFC

a. Identifying and understanding users

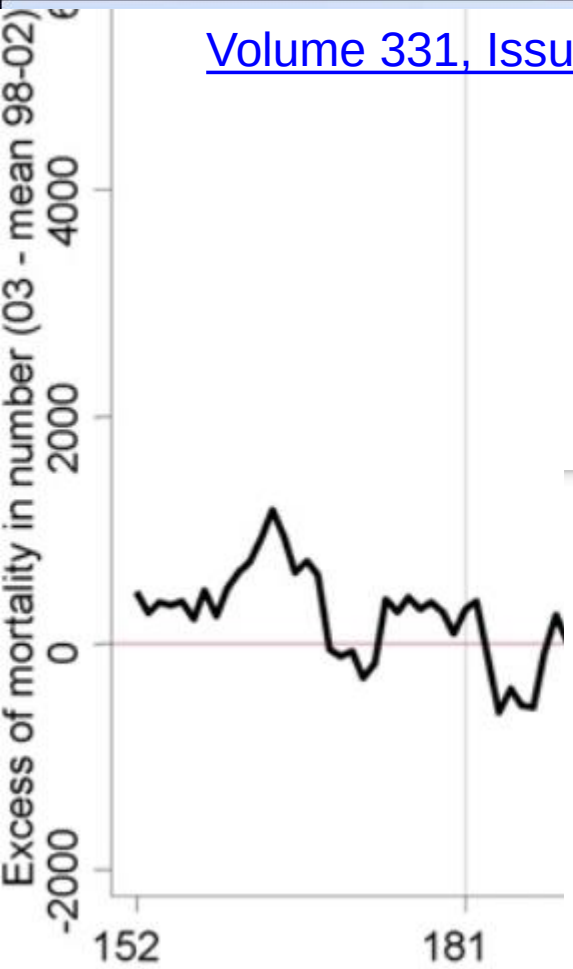
b. Which existing forecasts and warnings can be adapted to meet the user requirements of impact-based forecast services?- partners from health organisations or government health departments could provide relevant data on the health impacts of maximum daily temperatures. Combining and processing the two sets of information can produce an impact-based forecast for health impacts from high maximum temperatures.

c. **What capability is needed to produce the impact-based forecasts and warnings that will meet the user requirements?** **Some user requirements may not be immediately deliverable without significant changes within the national hydrological and meteorological service. Organisations may need to conduct a capability assessment and/or gap analysis to identify what infrastructure, resources or datasets are needed to deliver the appropriate level of impact-based forecasting. Once gaps are identified, a diagnostic can be made of if and how those gaps can be filled**

Understanding Risk and Impact

- The Future of Forecasts Typical questions to ask include:
- What are the vulnerabilities that lead to impacts?
- Which impacts cause the greatest suffering?
- Who is affected the most?
- Which impacts are the most difficult to deal with?
- How livelihoods are affected?
- Which sectors are affected the most?

Volume 331, Issue 2, February 2008, Pages 171-178



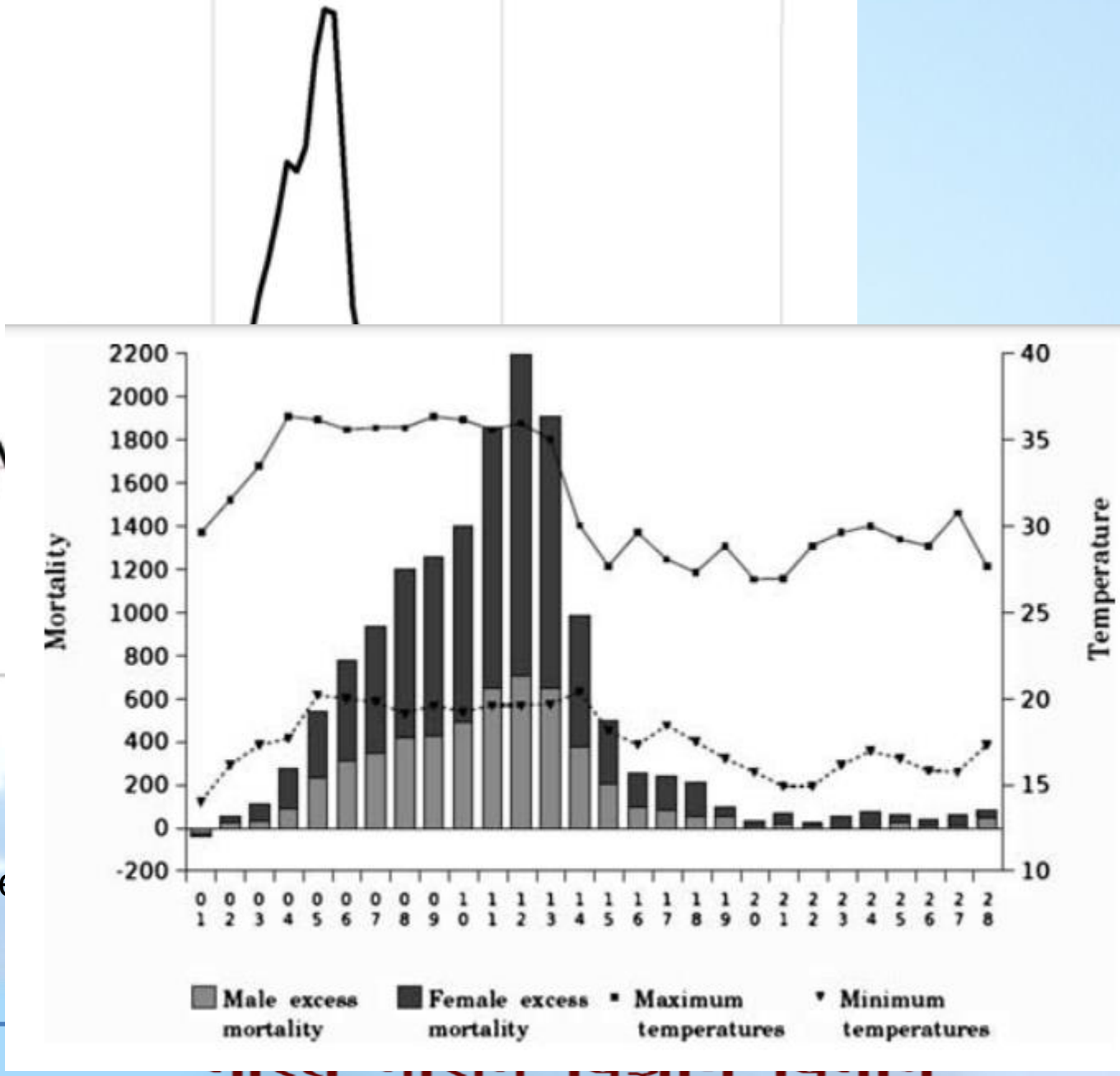


Fig. 1. Daily excess mortality and outside temperatures in France in August 2003.

Epidemiology /
Death toll excee
of 2003

In IBF we deliver-Risk maps-An all also

- Risk maps are an effective way of combining forecast hazard, vulnerability and exposure data into an easy to interpret visual aid.
- The responsibility for generating risk matrixes, risk maps, or any other tools which can be used to help present the level of risk in IBF can from Met or from any others
- Risk matrixes and risk maps are used individually and in combination to present assessments of risk for impact-based forecasting.

Risk Matrix

Green: No severe hydromet hazard expected

Yellow: Be aware

Orange: Be prepared

Red: Take action

LIKELIHOOD				
HIGH		2	6	10
MED		1	5	9
LOW			4	8
VERY LOW			3	7
	VERY LOW	LOW	MEDIUM	HIGH
	IMPACT			

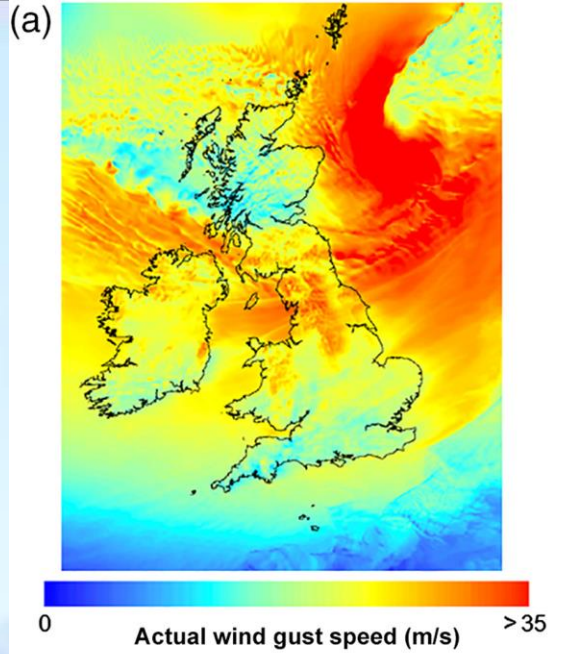
GREEN	NO SEVERE WEATHER EXPECTED
YELLOW	**BE AWARE**. There is a moderate risk of severe or a low risk of extreme weather occurring. *Remain alert and ensure you access the latest weather forecast.*
AMBER	**BE PREPARED.** There is a high risk of severe or a moderate risk of extreme weather occurring. *Remain vigilant and ensure you access the latest weather forecast. Take precautions where possible.*
RED	**TAKE ACTION**. There is a high risk of an extreme weather event occurring. *Remain extra vigilant and ensure you access the latest weather forecast. Follow orders and any advice given by authorities under all circumstances and be prepared for extraordinary measures.*

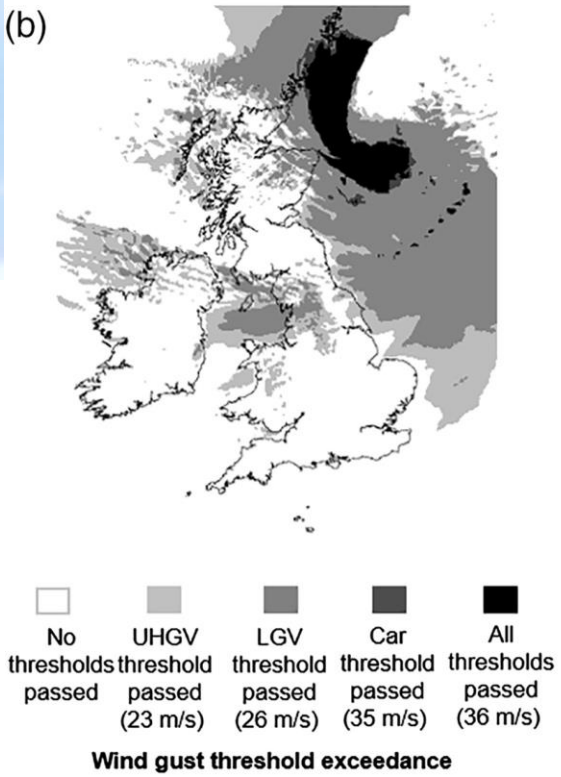
Minimal	Minor	Significant	Severe

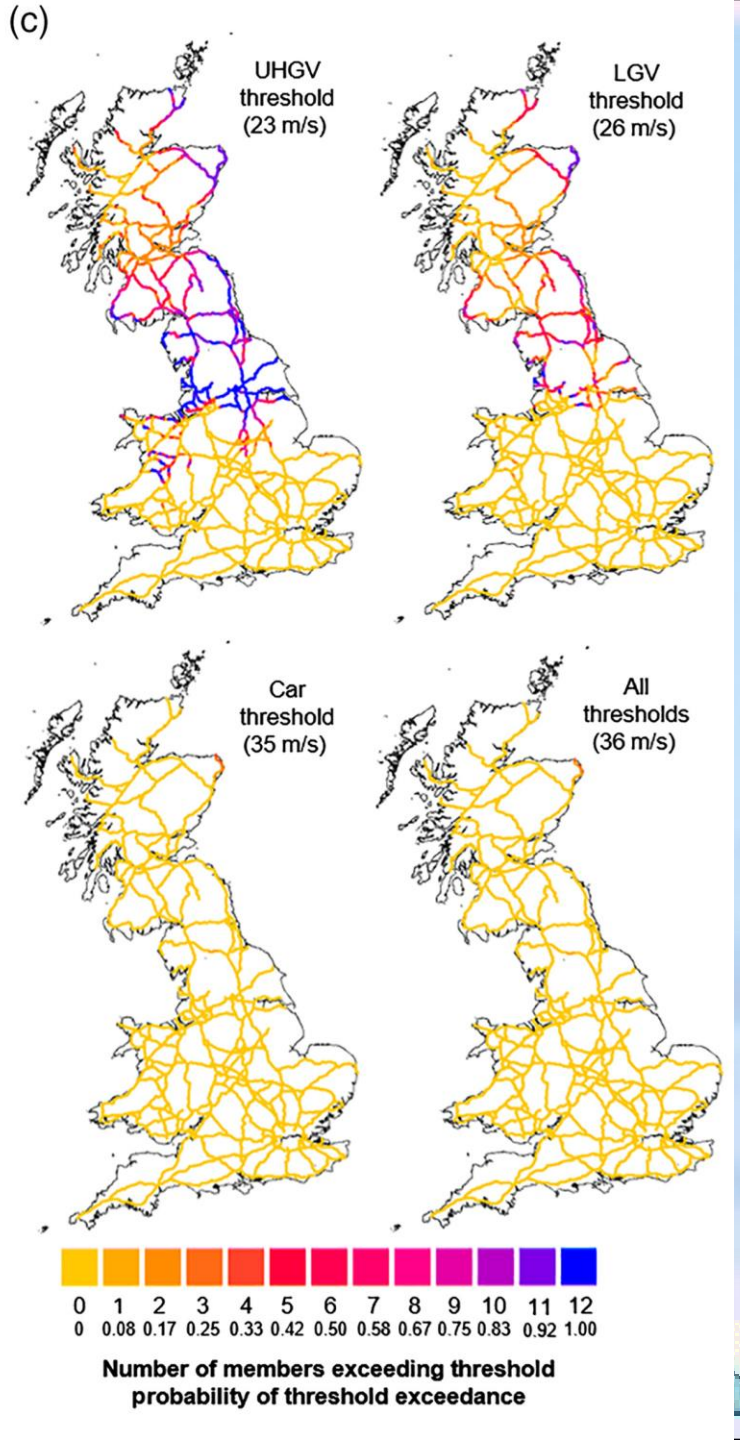
Assign a colour to the warning which is a combination of potential impact and likelihood (source: Met Office)

Risk Matrix, Risk map, IBF maps etc

Calculating the hazard component. Raw wind gust data (a) from 12 Met Office Global and Regional Ensemble Prediction System UK (MOGREPS-UK) members (only member 3 is shown) is converted into a weighted wind gust field (b) through the application of the wind gust thresholds (Table 1). Hazard probability, based on the number of MOGREPS-UK members exceeding thresholds for each wind gust threshold, is applied to the road network (c). The example is from December 5, 2013, 10:00 UTC; the MOGREPS-UK run time was December 4, 2013, 15:00 UTC; the lead time of the data is *T* + 19 hr







Meteorological Applications
Science and Technology for Weather and Climate
Open Access
RMetS

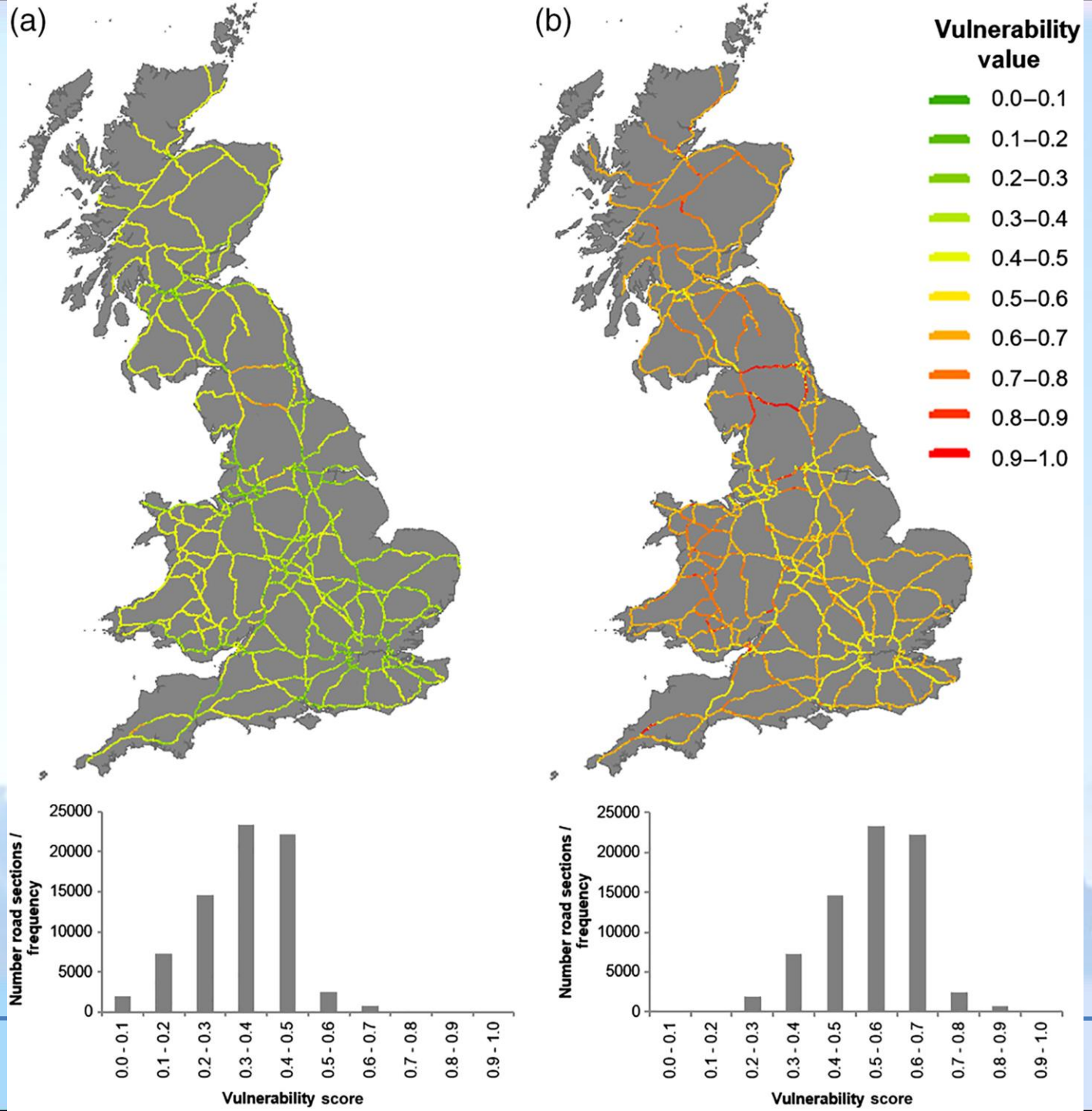
RESEARCH ARTICLE | Open Access

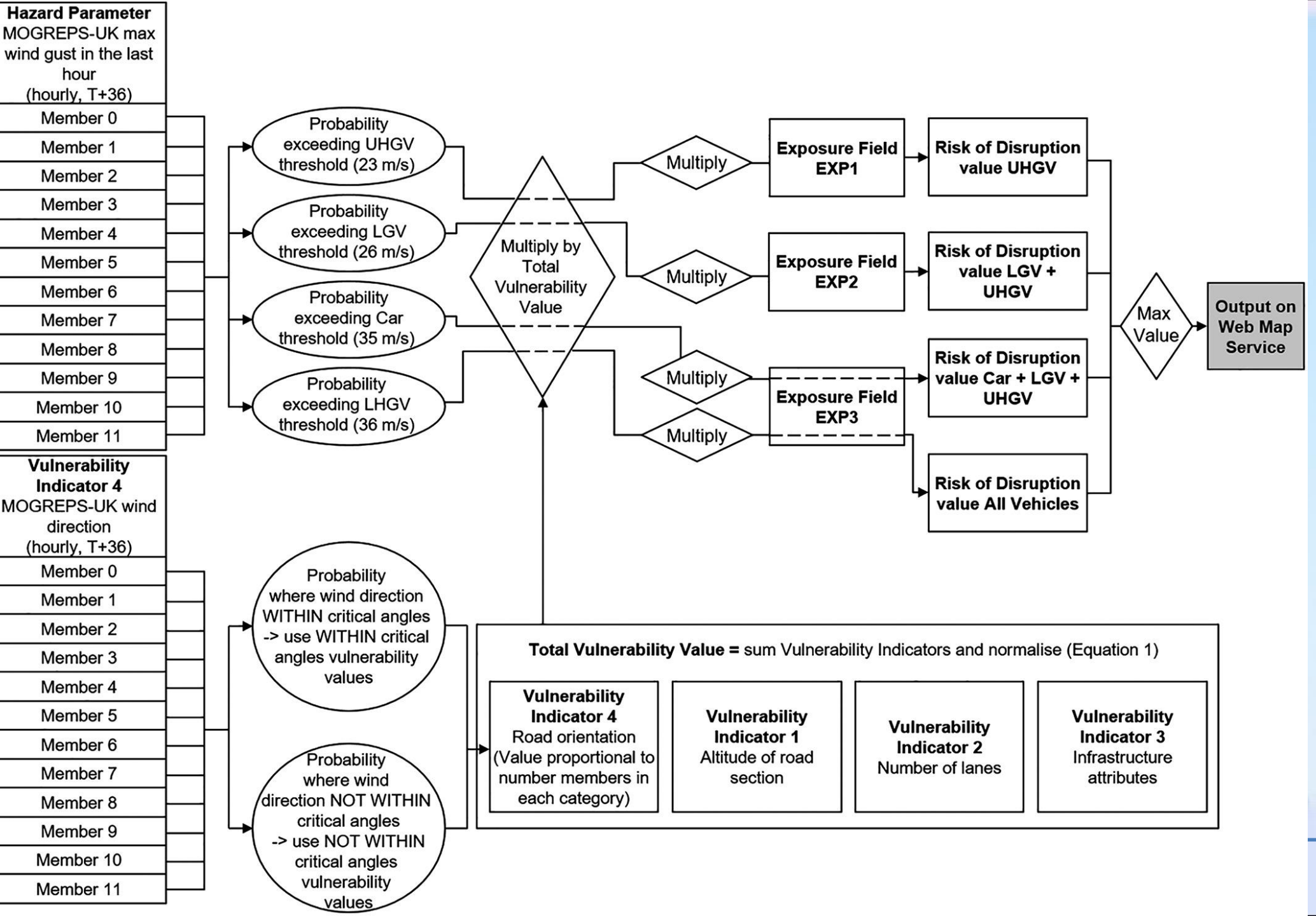
Developing a hazard-impact model to support impact-based forecasts and warnings: The Vehicle OverTurning (VOT) Model

Rebecca Hemingway, Joanne Robbins

First published: 03 July 2019 | https://doi.org/10.1002/met.1819 | Citations: 4

This article is published with the permission of the Controller of HMSO and the Queen's Printer for Scotland.


(a)
(b)
Vulnerability value
0.0–0.1
0.1–0.2
0.2–0.3
0.3–0.4
0.4–0.5
0.5–0.6
0.6–0.7
0.7–0.8
0.8–0.9
0.9–1.0
Number road sections / frequency
25000
20000
15000
10000
5000
0
0.0 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1.0
Vulnerability score
Number road sections / frequency
25000
20000
15000
10000
5000
0
0.0 - 0.1
0.1 - 0.2
0.2 - 0.3
0.3 - 0.4
0.4 - 0.5
0.5 - 0.6
0.6 - 0.7
0.7 - 0.8
0.8 - 0.9
0.9 - 1.0
Vulnerability score



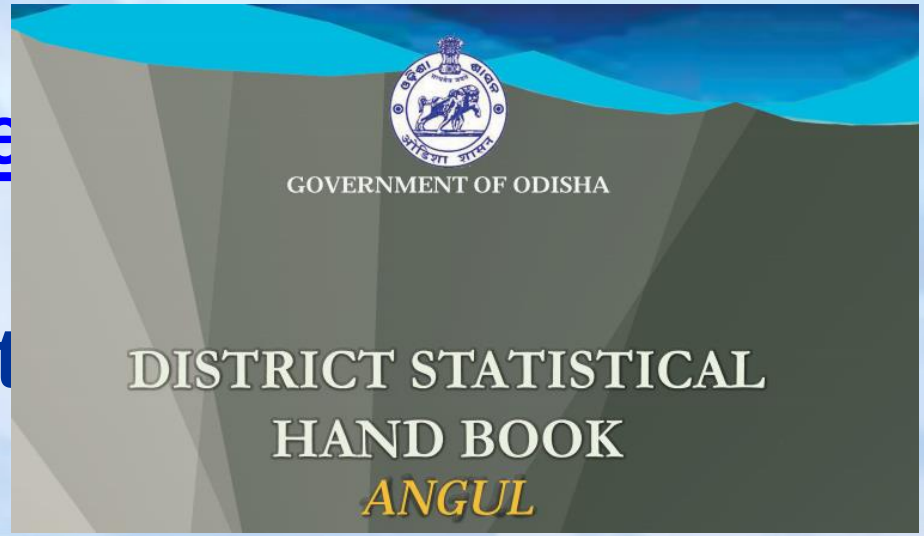
Vehicle OverTurning (VOT) model risk algorithm: A combination of hazard, vulnerability and exposure. The algorithm is executed for each road section for each threshold detailed in Section 3.1. The maximum risk value output is made available to operational meteorologists in the Met Office Operations Centre via a webpage (grey box). No other upstream outputs in the modelling process are made available to forecasters

	Vehicle speed (m/s)	Wind direction (°)									
		30	40	50	60	70	80	90	100	110	120
Unloaded heavy goods vehicle (UHGV) (mass = 7,500 kg, area = 50 m^2, height = 3.5 m)	5	39.1	34.5	31.8	30.0	29.0	28.9	29.1	29.5	30.9	32.8
	15	35.1	30.8	28.1	26.8	26.2	26.6	27.2	29.0	31.1	33.8
	25	31.4	27.1	24.8	23.4	**23.1**	23.2	24.1	26.2	29.1	33.2
Loaded HGV (LHGV) (mass = 15,000 kg, area = 50 m^2, height = 3.5 m)	5			45.0	43.1	41.8	41.2	41.2	42.0	43.1	
	15			42.0	40.1	39.2	39.1	40.1	41.7	44.1	
	25		42.1	38.5	37.0	**36.0**	36.2	27.7	40.1		
Unloaded light goods vehicle (LGV) (mass = 2,500 kg, area = 20 m^2, height = 2.5 m)	5	41.5	37.2	24.5	32.8	31.5	31.2	32.1	33.4	33.5	35.2
	15	38.3	34.1	30.8	29.3	29.1	29.1	29.8	31.2	33.5	36.5
	25	34.8	30.1	27.2	26.1	**25.5**	26.1	27.2	31.1	32.1	36.1
Car or small van	All speeds	**35.0**									

Table 1. Accident wind gust speeds (m/s) for vehicles with different aerodynamic parameters at different vehicle speeds and wind directions, adapted from Baker *et al*. (2008). Minimum accident gust thresholds, shown in bold, are rounded and used in the Vehicle OverTurning model

Data and Website shared

- **IMD Pune event climatological map and extremes**
- **IMD Pune** Disaster weather event data updated up to 2019 (1967 to 2019)**, City daily rainfall data**
- **https://bhukosh.gsi.gov.in/Bhukosh/MapViewer.aspx**
- **https://bmtpc.org/DataFiles/CMS/file m.html**
- **City Municaplity commissioner, Dist state DMA Site**
- **NDMA**



निर्माण सामग्री एवं प्रौद्योगिकी संवर्द्धन परिषद्

Building Materials & Technology Promotion Council

www.bmtpc.org

Ministry of Housing & Urban Affairs, Government of India

Not secure | bmtpc.org/topics.aspx?mid=56&Mid1=178

CLICK HERE TO REGISTER NOW

New Initiatives : Emerging Technologies

- Multi-Attributes Evaluation Methodology for Emerging Housing Technologies
- Compendium of Prospective Emerging Technologies for Mass Housing-3rd Ed.
- Construction & Demolition Waste - a Ready

E-Course on Vulnerability Atlas of India NEW...Launch of NAVARITIH : Certificate

- Vulnerability Atlas of India - 3rd Edition
- Hazard Maps of India
- Initiatives for Disaster Preparedness, Mitigation and Management
- Landslide Hazard Zonation Map of India
- Earthquake Hazard Guidelines
- Wind and Cyclone Hazard Guidelines
- Flood Hazard Guidelines
- Earthquake Tips

Home > Areas of work > Disaster mitigation and management > Hazard Maps of India

- Earthquake Hazard Map

- Wind Hazard Map

- Flood Hazard Map

(15,875 un | Cisco Web | WCSSP Inc | Day3_Talk7 | WCSSP Inc | WCSSP Inc | nccr moes | indunation | Google Ne | Pls see wel | Bhukosh
bhukosh.gsi.gov.in/Bhukosh/

Bhukosh

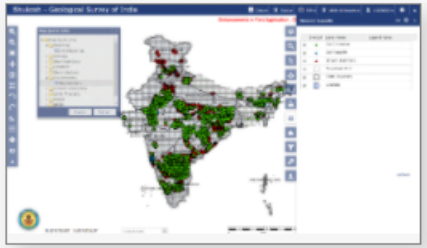
Bhukosh is a gateway to all geoscientific data of Geological Survey of India.

Guest users can visualize and explore the data using Map Quick Links as well as search and find data of their area of interest. Registered users will enjoy the additional functionality of viewing Dynamic Legends, Downloading the data and Printing Maps as per prevalent policy.

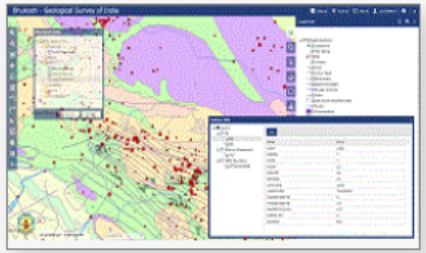
How to Download Data?


Geology 50K


Geology 2M


Geochemistry


Ground Geophysics


Seismotectonic


Landslide Inventory


NLSM


Meteorite

Login

Username

Password

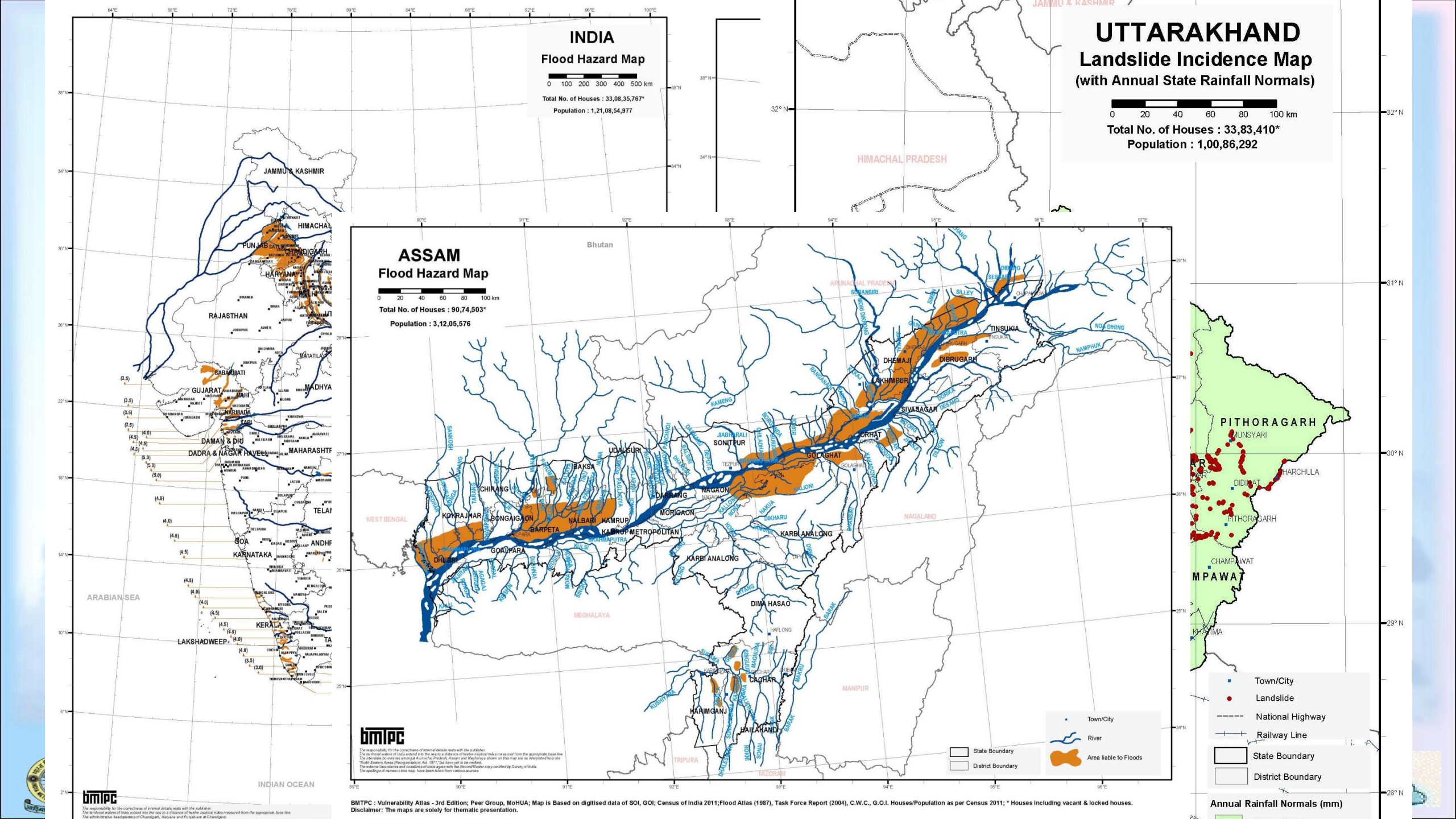
Login

Login as Guest

Copyright 2021 © Geological Survey of India

Total Hit : 247924 (Employees : 84662 Registered Users : 38697 Guest Users : 124565)

DWE 1967_2019_u....xlsx
Show all
INDIA METEOROLOGICAL DEPARTMENT

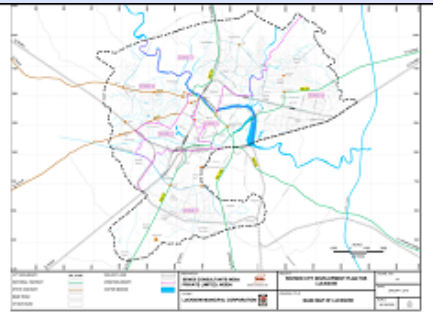


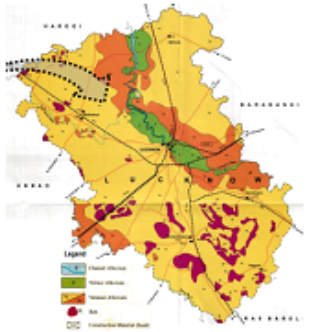
BMTPC : Vulnerability Atlas - 3rd Edition; Peer Group, MoHUA; Map is Based on digitised data of SOI, GOI; Census of India 2011;Flood Atlas (1987), Task Force Report (2004), C.W.C., G.O.I. Houses/Population as per Census 2011; * Houses including vacant & locked houses.
Disclaimer: The maps are solely for thematic presentation.

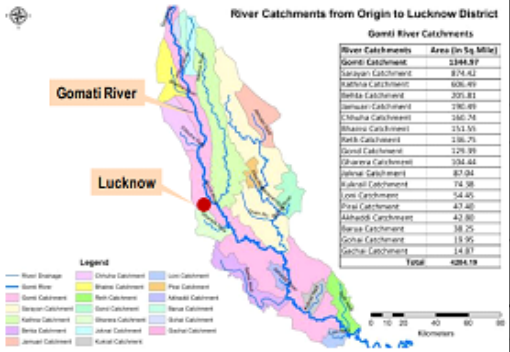
March 2021-“**Data format**" for Lucknow city for **Stage III**

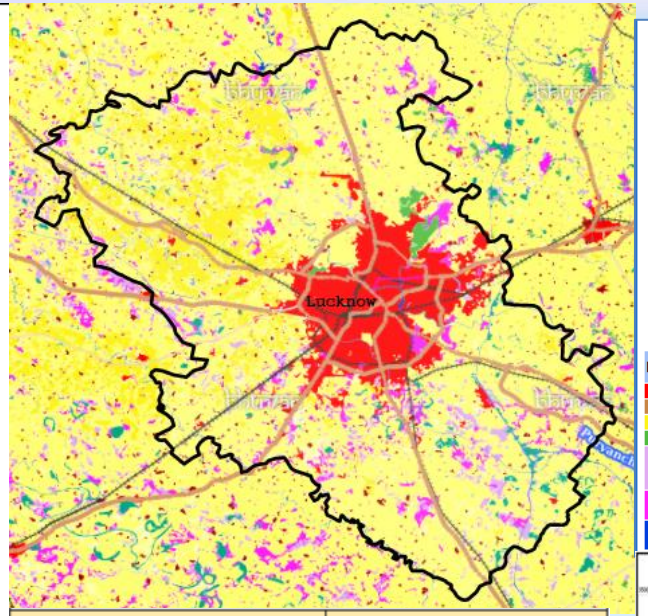
- 1. Climatology
- 2. Geophysical data
- 3. Physical data
- 4. Socio-economic data
- 5. Vulnerability
- 6. Impact & Response matrix
- 7. Reference

Geographical Location	26.5^{0}N - 27.15^{0}N / 80.20^{0}E - 80.50^{0}E, Altitude: 123 meter
Topography	• Lies in Ganga basin with flat alluvial terrain covered with sediments and sedimentary rocks. Zone-III of Earthquake. • Natural Hazards: Flooding, water logging along channels/canal banks, river bank erosion and Moderate zone of earthquake.
Physiography	1. Gomti Basin: Northern parts of the district, a flat plain sloping towards southern side. 2. Lucknow Uparwar Plain: Between Sai & Gomti rivers extending in east-west direction. It slopes from northwest to southeast direction. Numerous depressions like Tal/Jhil are there. These Tal are mostly located in the southeastern parts. 3. Upper Sai Catchments: It is along the course of Sai river in the southern parts of district. There are no of small tributaries of Sai which flow from north to south direction. The slope of the area is towards south.
Natural Drainage and Hydrology	Gomti & Sai rivers and their tributaries are main drainage besides Sarda Canala and its distributries.

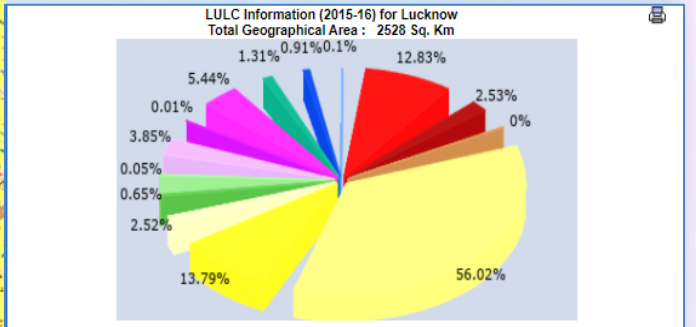




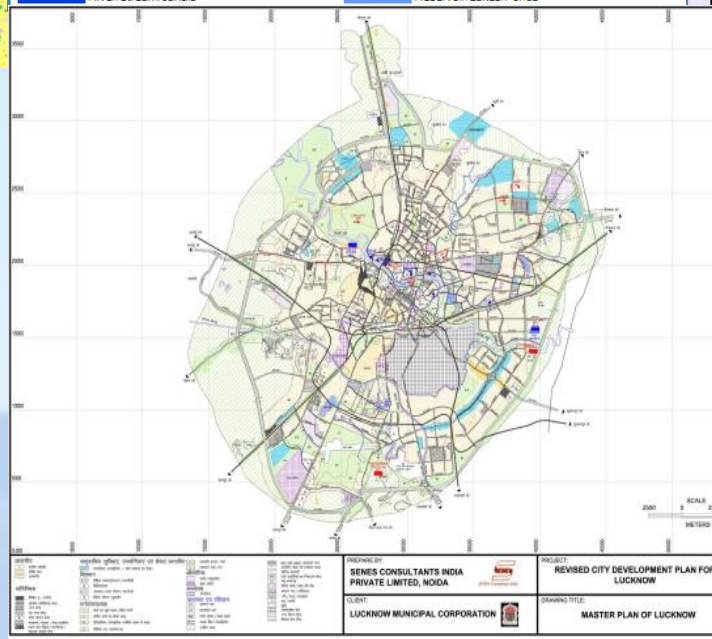




Classes	Classes
Built Up	**Grass / Grazing**
Urban	Grass/Grazing
Rural	**Barren / Waste Lands**
Mining	Salt Affected Land
Agricultural Land	Gullied/Ravinous Land
Crop Land	Scrub Land
Agricultural Plantation	Sandy Area
Fallow Land	Barren Rocky
Current Shifting Cultivation	Rann
Forest	**Wetlands / Water bodies**
Evergreen/ Semi Evergreen	Water bodies
Deciduous	Rivers/Streams/Canals
Forest Plantation	Inland Wetland
Scrub Forest	Coastal Wetland
Swamp/ Mangroves	**Snow and Glaciers**
	Snow/Glaciers

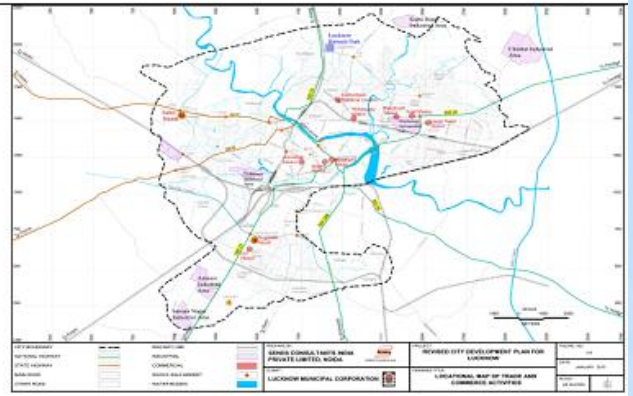


LULC Class	Area (Sq.Km)	LULC Class	Area (Sq.Km)
Builtup,Urban	324.24	Builtup,Rural	63.93
Builtup,Mining	0.04	Agriculture,Crop land	1416.1
Agriculture,Plantation	348.54	Agriculture,Fallow	63.82
Forest,Deciduous	16.39	Forest,Scrub Forest	1.38
Barren/unculturable/ Wastelands, Salt Affected land	97.28	Barren/unculturable/ Wastelands, Gullied/Ravinous Land	0.16
Barren/unculturable/ Wastelands, Scrub land	137.58	Wetlands/Water Bodies, Inland Wetland	33
Wetlands/Water Bodies, River/Stream/canals	22.9	Wetlands/Water Bodies, Reservoir/Lakes/Ponds	2.64

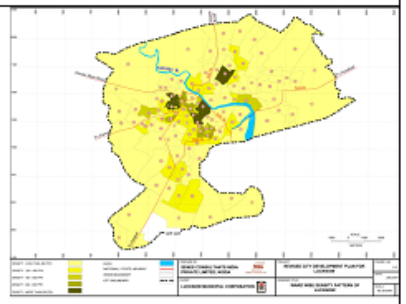


विज्ञान विभाग
OGICAL DEPARTMENT

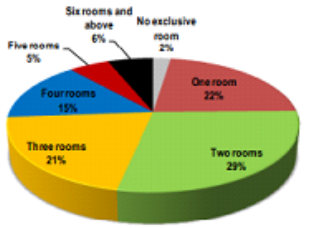
Physical Data of Lucknow

Road	National Highways: NH24, NH24B, NH25, NH28, & NH56 State Highways: SH40 & SH25	
Railway	Broad gauge and meter gauge both	
Industries	Chikankari cluster (SPV), Terracota toys cluster, Steel furniture cluster, Service enterprises, Education clusters. Hindustan Aerunautics Limited, Scooter India Ltd., Tata moters, PTC industries etc	
ustrial estates	Talkatora, Chinhat, Sarrojini Nagar, Amousi,	

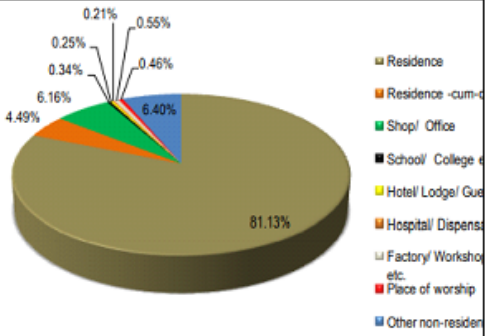
Socio Economic Data of Lucknow

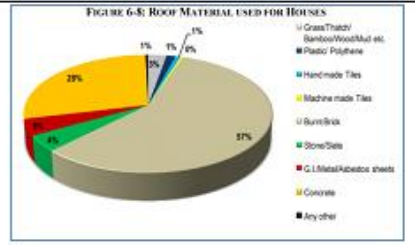
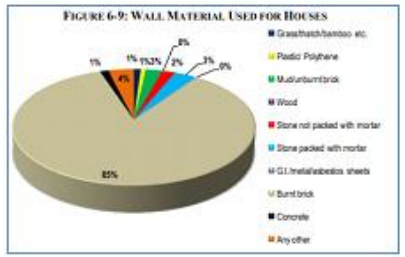
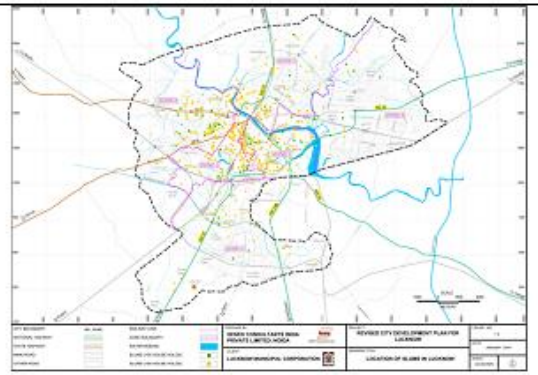
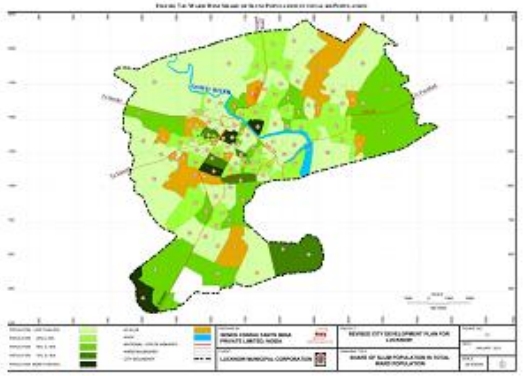
2011 Census				
Population	Total	Rural	Urban	
	4589838	1550842	3038996	
Area in Sq. Km.	2528	2057.3	470.7	
Density of Population	1816	754	6456	

No. of households	Normal	84645
	Institution	8516
	Houseless	5737

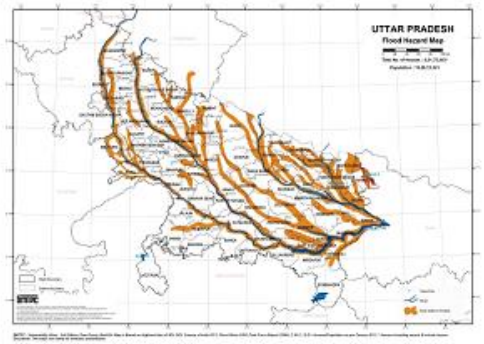


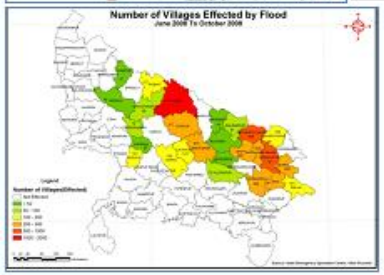
House distribution	No of census houses	666099
	Vacant census houses	65841
	Occupied census houses	600258
	Residence	482082
	Residence cum office use	26689
	Shop/Office	36595



Housing condition	28% houses are made of concrete material. 50 % roofs and 85 % walls are made of bricks.	 
Total no of cattle		280140
Slum Area	Total 609 slum out of which 502 are notified and 107 non notified. Total population of slum area is 772807 which is 26 % of total city population. 67 % slum are located in the core of city and 33 % slums are located in fringe ara.	 

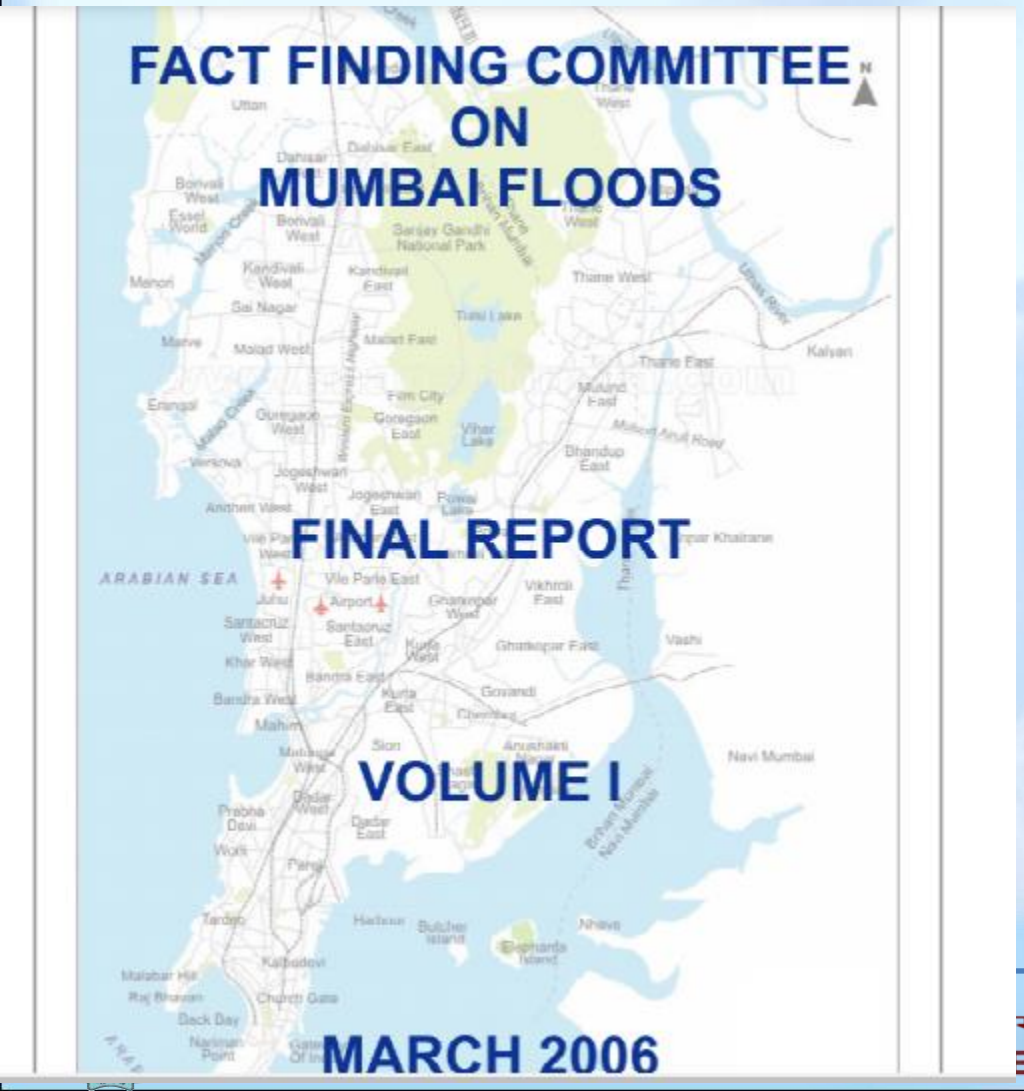
Vulnerability Data of Lucknow





Progress in the World, Issues and Challenges

a. Needs massive on-line documentation to refer available with state and central Govt site, District level NIC portals

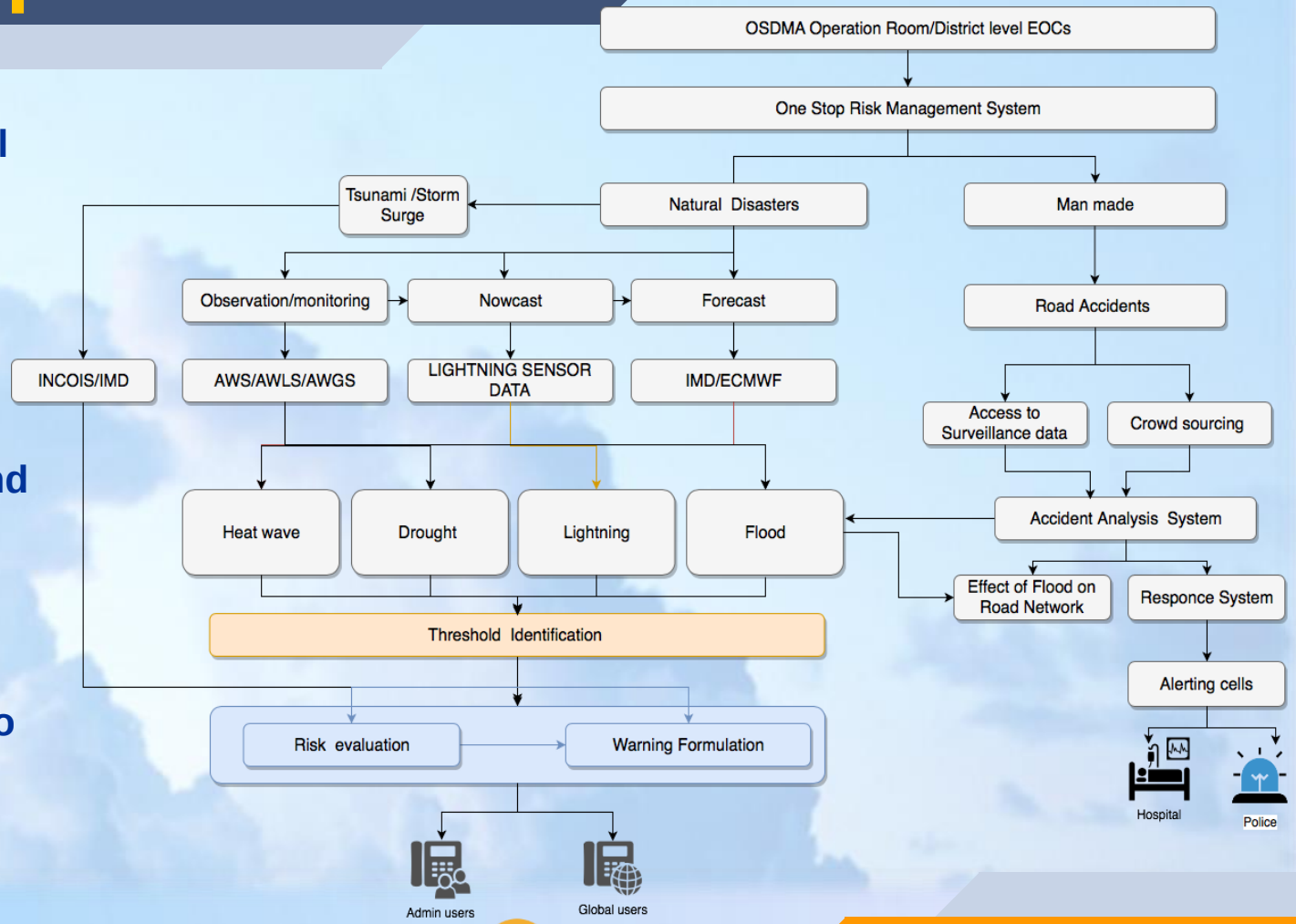


Collaboration

- WCSSP-Indo-UKMO and other UK centers
- RIMES-Regional Integrated Multi-hazard Early Warning System - http://www.rimes.int/
- TN SMART (TamilNadu System for Multi-hazard potential impact Assessment and emergency Response Tracking) is a web-based system -http://beta-tnsmart.rimes.int/index.php/login/login_form
- System for Assessing, Tracking, and Alerting Disaster Risk Information based on Dynamic Risk Knowledge (SATARK)–https://satark.rimes.int/Login/register

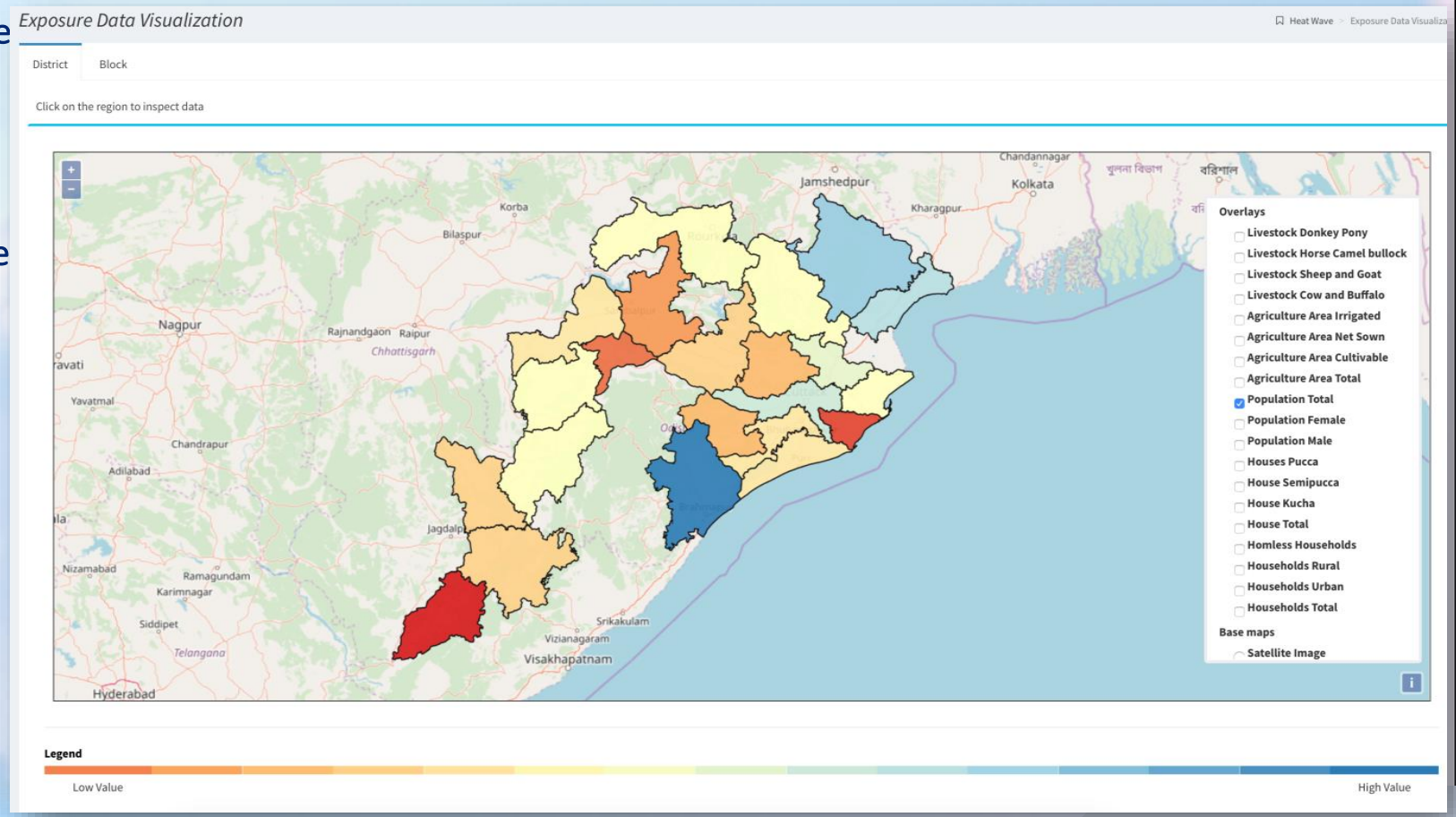
One Stop risk Management System

- Agreement for strengthening OSDMA technical capacity through development of a Decision Support System
- Initiated based on the TNSMART work in Tamil Nadu
- An integrated platform to archive, utilize ground data and threshold driven forecast products
- WebGIS layers of risk based information
- Timely dissemination of warning information to users
- SATARK is in Advanced stage of development



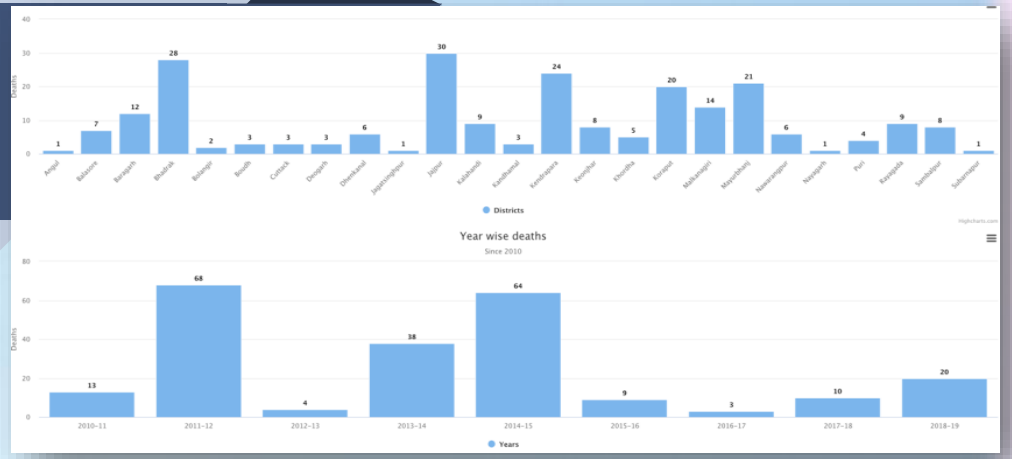
Exposure Database

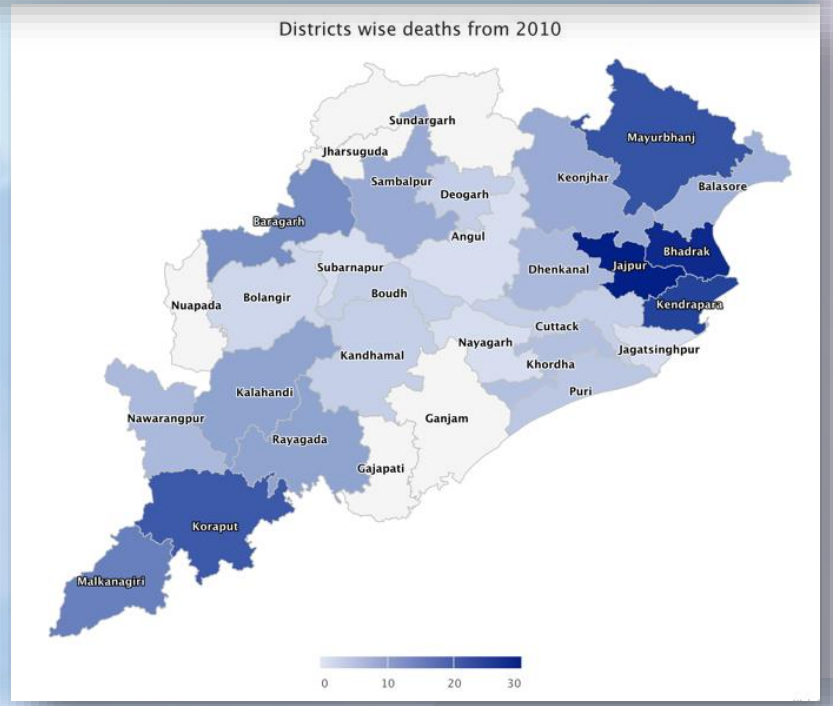
- Integrates all sectoral district level data colle from various departments so far
- Dynamic risk formulated based on the exposure and hazard intensity
- Exposure database estimates different paramete exposed to different disasters.
- This includes:
  - population (male, female),
  - livestock's,
  - Houses with types and details
  - Agricultural area
  - Critical facilities



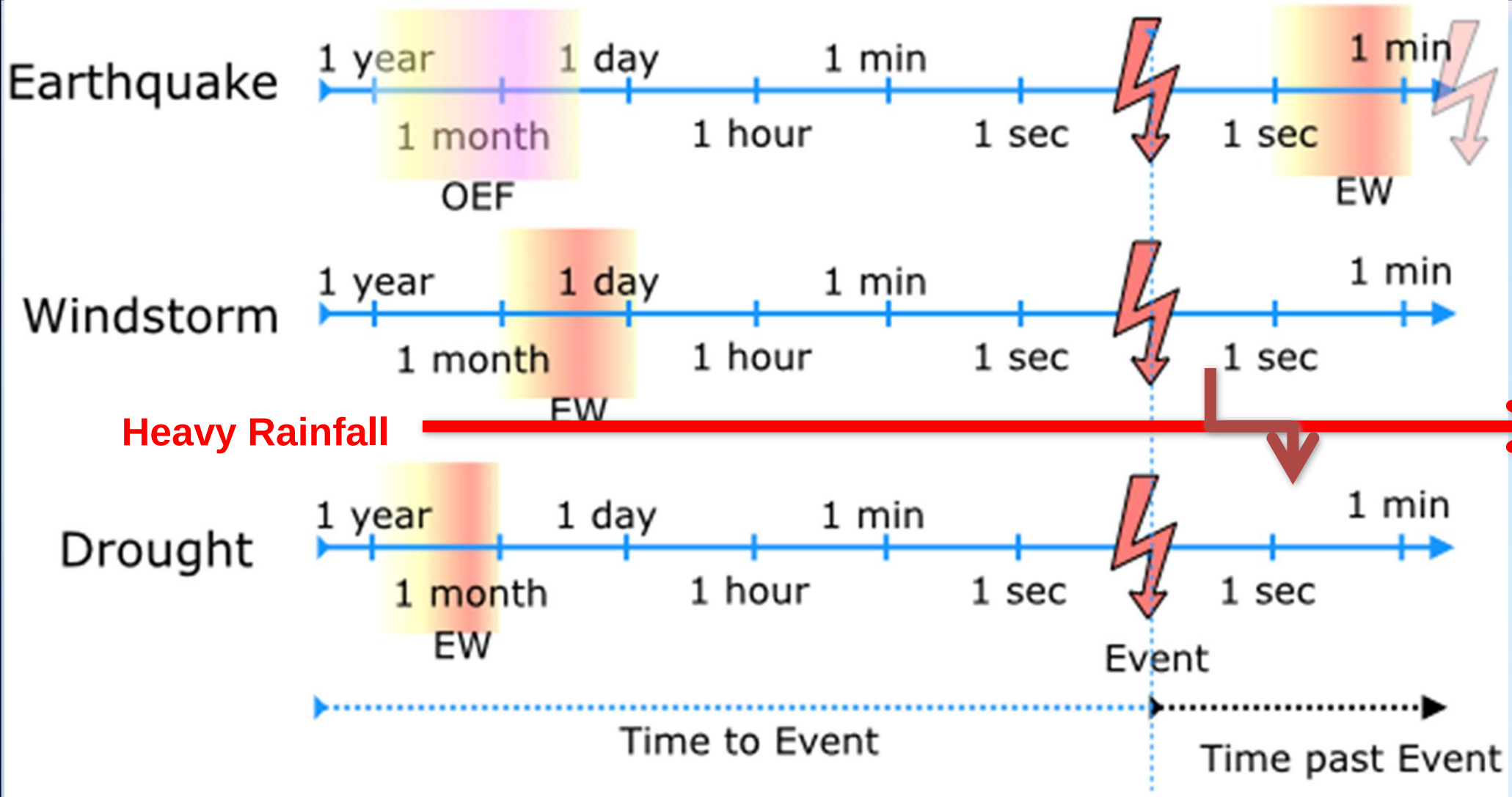
Disaster Archive

- Disaster impact profile module houses the time series of historical disaster related information at block and district level.
- The module has options to interactively generate infographics on disaster frequency and its associated impacts, district-wise.
- This dynamic module will enable experts to key in all relevant data pertaining to a disaster through a data entry panel such as damages, economic losses, injured humans, missing persons etc. at both district and block levels.
- Infographic representation of historical data for better understanding.





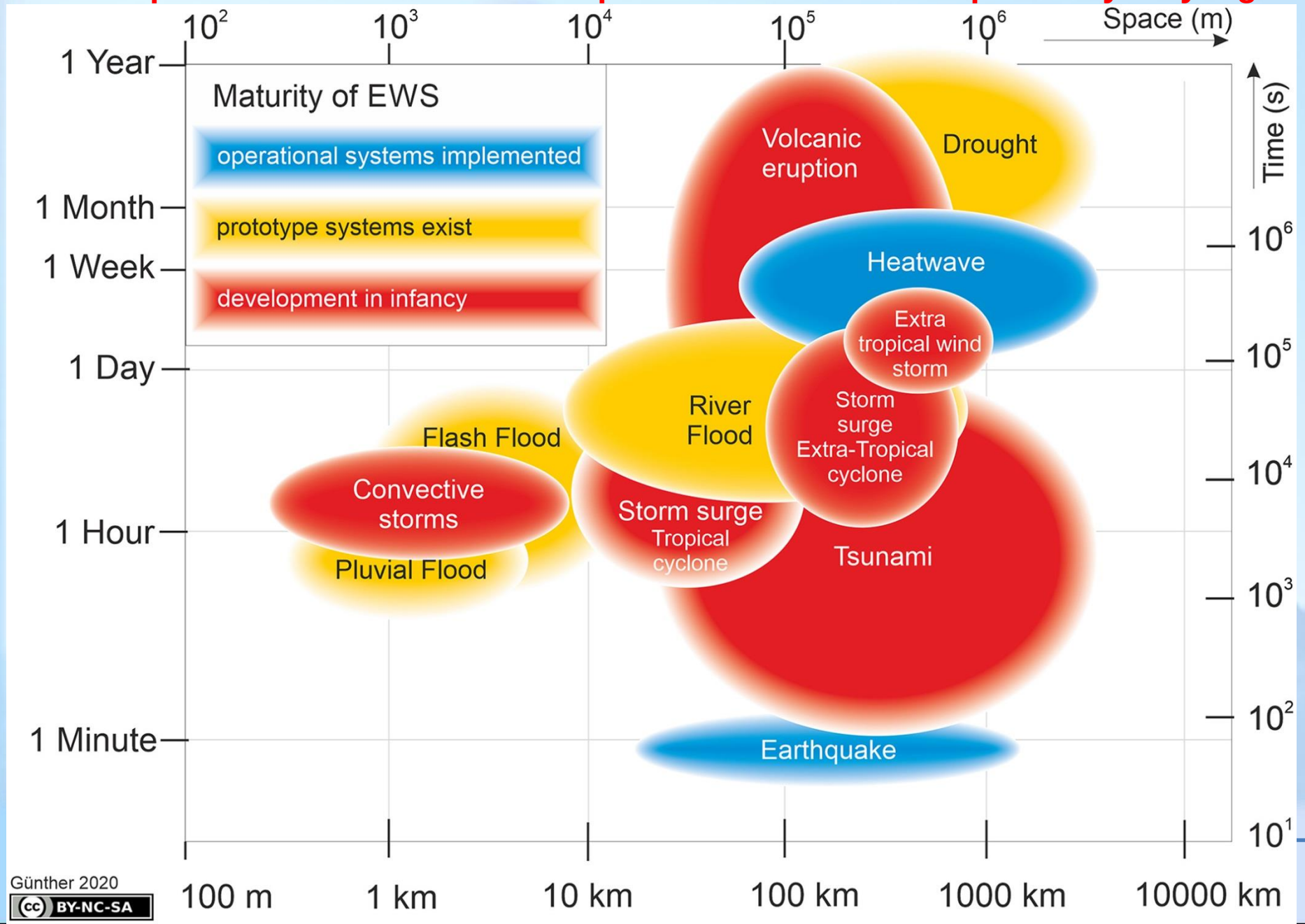

UK SPACE AGENCY
Cabinet Office
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
SEPA
Scottish Environment Protection Agency
Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL
Ordnance Survey
Department for Environment Food & Rural Affairs
Natural Hazards Partnership
Delivering coordinated assessments, research and advice on natural hazards for governments and resilience communities across the UK
NERC
SCIENCE OF THE ENVIRONMENT
Government Office for Science
National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL
Public Health England
National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL
Environment Agency
Met Office
Llywodraeth Cymru
Welsh Government
HSE
The Scottish Government
14/0463 Feb 2017



b. scheme of the cascading effects of the heavy rain event from say D10 to Day 0 and Day +10 and foot prints of three commonest: event, hazard and impact

- **Windstorms and Heavy rainfall can be forecasted with lead times from a couple of hours to several days. The lead times of droughts are even longer, in the range of one to several months.-Merz et al, 2020- https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020RG000704**

Hazards-natural phenomena with a specific magnitude that unfold with a given space-time footprint and with the potential for adverse consequences. The event footprint may vary significantly across hazards.



Günther 2020

BY-NC-SA

- Examples are short-term, local-scale events, for example, localized heavy rainfall event causing pluvial floods with event duration and extent in the order of 1 hr and 1 km, to drought/riverine flooding covering 100s of km and for days - **Merz et al, 2020**

Use of IBF and RBW

1. Organizations and individuals can make critical decisions to ensure that resources and supplies are in place to take early action and to respond as soon as it is safe to do so.
2. Increase in Extreme weather event occurrences and changes characteristics, severity
3. **Impact based Financing -Estimating Resource allocation needed from an impending disaster timely and to make Impact based financing for better managing the disasters**
4. **Demands are there from newly sectors(power, health, transport, urban pockets) for National Met service**
5. IBF and RBW and **observations-Insurance financing and settlement more logically**

A lot of future lies with IBF;Weather – Impact on consumer demand and Market

- Exploring true extent of sales as driven by weather.
- The range of weather dependent verticals very vast

Weekly increase in sales when temperature is 1° F hotter

- 2% soft drinks 
- 24% air conditioners 
- 11% suncare products 
- 4% Infant Apparel 
- 13% hedge trimmers 

Weekly increase in sales when temperature is 1° F colder

- 2% Soup 
- 15% Portable heater 
- 25% Mousetraps 
- 2.5% Softline goods 
- + 5000 units lipcare 

Source: 'Profit of One Degree' by wxtrends.com

THANKS