National Meet on Disaster Risk Management
Trends and technologies

National Cyclone Risk Mitigation Project (NCRMP)

-- 27TH February 2023--

Presented by:

Harsh Gupta, IAS

JS & PD, NCRMP (NDMA)

Overview of activities undertaken in NCRMP.

N C R M P - N D M A

NCRMP-Phase I & II

Structural Interventions:

- Early Warning Dissemination System (EWDS)
- Multi Purpose Cyclone Shelters (MPCS)
- Roads
- Bridges
- Saline Embankments.
- Underground Electric Cabling (UGEC)

Photographs (NCRMP-I)

NCRMP-NDMA

EWDS Tower, Ganjam, Odisha

EWDS Tower installed on the roof top of MPCS, Ganjam, Odisha

Photographs (NCRMP-I)

NCRMP - NDMA

MPCS, E.Pallipalem, Prakasam District, Andra Pradesh

MPCS Adhual Block, Puri District, Odisha

NCRMP-NDMA

Photographs (NCRMP-I)

Road connecting to MPCS, Odisha

Road connecting to MPCS, AP

Saline Embankment, Keutajanga Block, Puri Dist., Odisha

Bridge, Vakalapudi, AP

Photographs (NCRMP-II)

NCRMP - NDMA

Goa

Gujarat

Kerala

Karnataka

Overview of activities undertaken in NCRMP.

N C R M P - N D M A

- **NCRMP-Phase I & II**

Non-structural Interventions:

NCRMP-I

- Hazard Risk Vulnerability Assessment (HRVA): *A Web based Composite Risk Atlas (Web-CRA)*
- Training and Capacity Building: *Development of training modules*
- Post Disaster Needs Assessment (PDNA): *Development of PDNA tools & long term recovery framework.*

NCRMP-II

- A Web based Dynamic Composite Risk Atlas & Decision Support System (Web-DCRA & DSS tool)
- Hydro-meteorological Resilient Action Plan (HmRAP)
- Comprehensive Multi-hazard Risk Financing Strategy (CMhRFS)
- Strengthening Disaster Risk Governance Framework in India: *Learning from Global Best Practices.*
- Capacity Building Training & Shelter Level Training
- Benefiting Monitoring & Evaluation Study (BME)

Overview of major activities proposed under next phase of NCRMP-II.

NCRMP-NDMA

A. EWDS to be scaled up to MHEWS.
   - Multi hazards include flood, lightening, Landslides, heat wave, drought etc.
   - Web based-EoC to be incorporated, which would be a sort of India Disaster Aware platform on lines of Disaster Aware in US.
   - This gets coupled with DCRA which would be further improved to incorporate climate change impact.
   - This would further get linked to strengthening of NDEM. It may be ultimately linked to the ICRER.
   - Use of CB for alert dissemination which would be explored through a different design approach under the overall CAP project of NDMA.

B. SDMAs/ DDMAs to be taken up for strengthening by providing support for manpower with proper Cadre and appropriate responsibilities.

Overview of major activities proposed under next phase of NCRMP

NCRMP-NDMA

C. Resilient infrastructure like SEs, power, fisheries, etc.

D. Development of training modules for volunteers, officials and elected representatives.

E. Retrofitting of certain lifeline buildings to make these resilient. These would lead to development of local building codal provisions and SR items.

F. Lightening and surge protection of important buildings . This would also lead to development of mechanism to ensure safety certification of buildings and electrical equipment from Lightening hazard.

G. Model Mitigation projects for landslide, urban flooding, coastal erosion etc.

NCRMP - NDMA

THANK YOU

Extreme Precipitation under Human-induced Climate Change

Subimal Ghosh

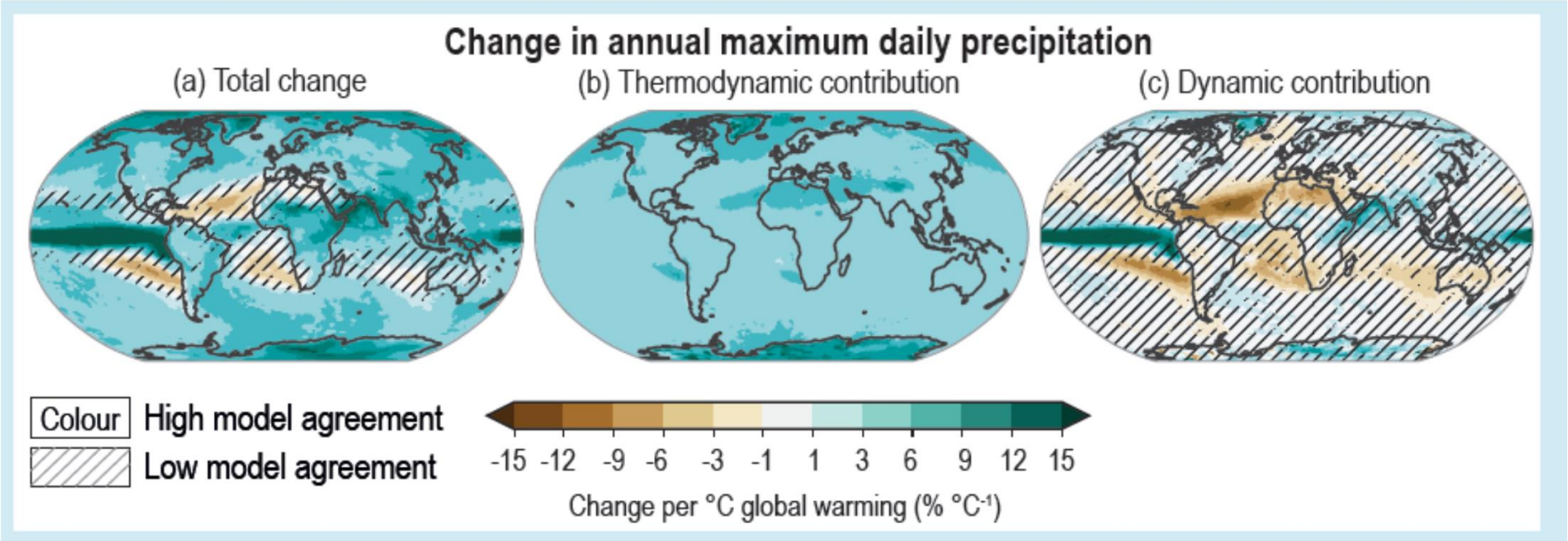
Interdisciplinary Program in Climate Studies & Department of Civil Engineering

IIT Bombay

Extreme/ Heavy Precipitation: Background

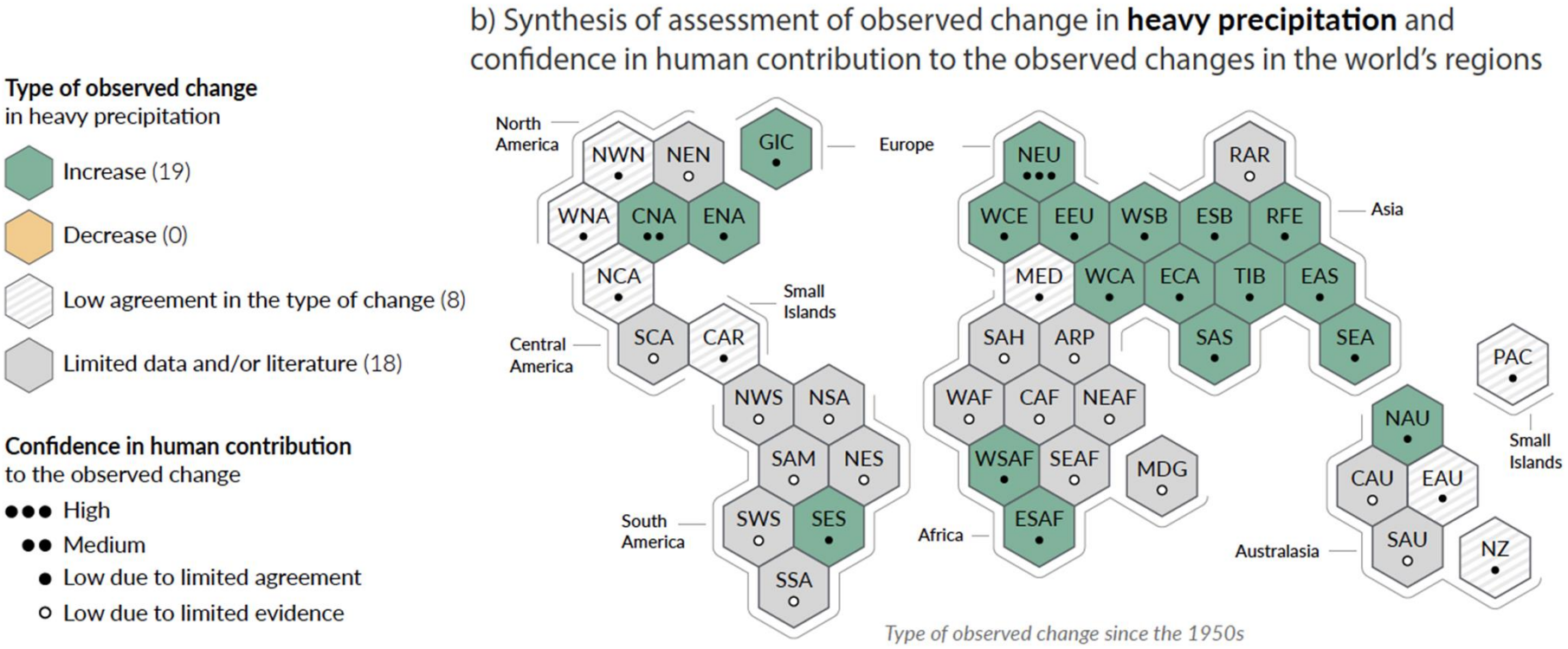
- Temporal Scales
  - Sub-daily
    - Lack of studies due to non-availability of data
  - Daily
    - Widely studies
  - Multi-day (5 days or more)
    - Got less attention
- Spatial Scales
  - Global
    - Warming → increases in the atmospheric water-holding capacity following the Clausius–Clapeyron (C-C) relation.
    - Reflected in Extreme Precipitation
  - Regional
    - Dynamic Changes: further modulates changes in extreme precipitation

Thermodynamic and Dynamic Contributions to Changing Precipitation



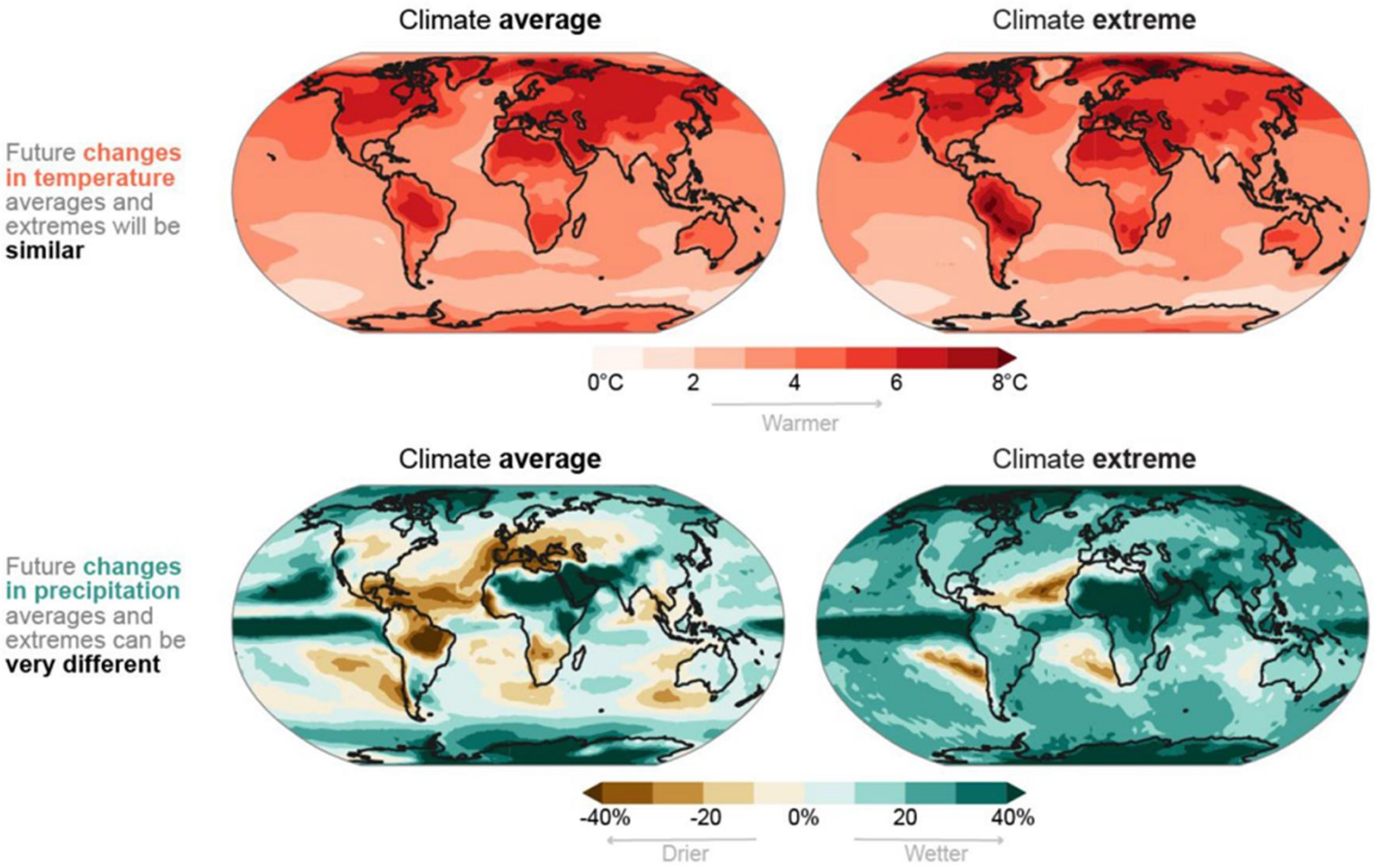
Source: IPCC AR6, WG-1, Chapter 11

Observed Changes in Extreme Precipitation Globally



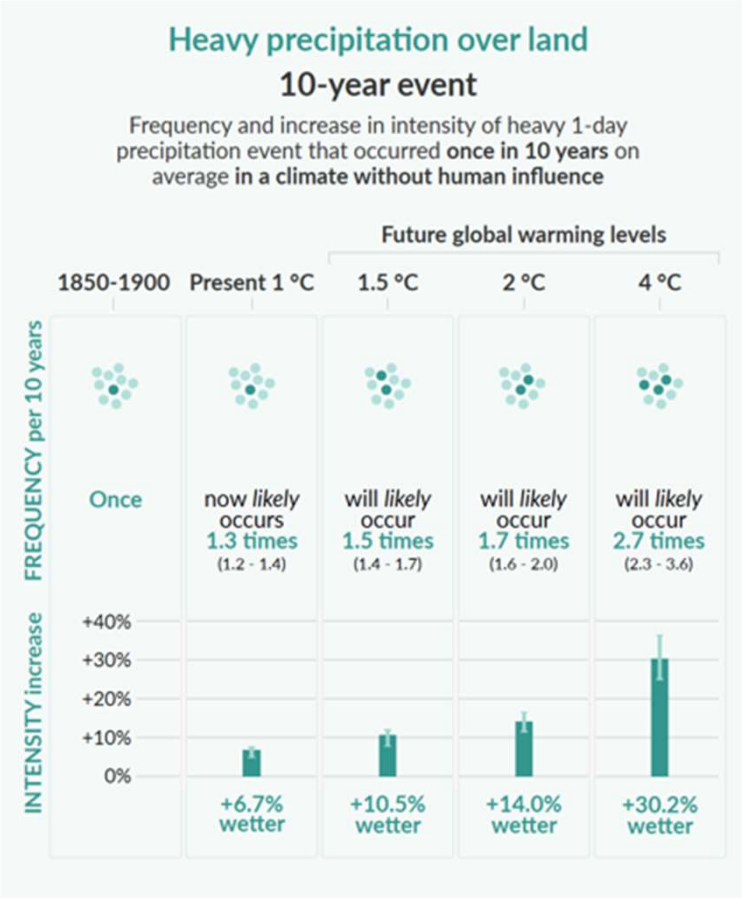
Source: IPCC AR6, WG-1, Chapter 11

Mean vs Extreme Precipitation Changes in Future



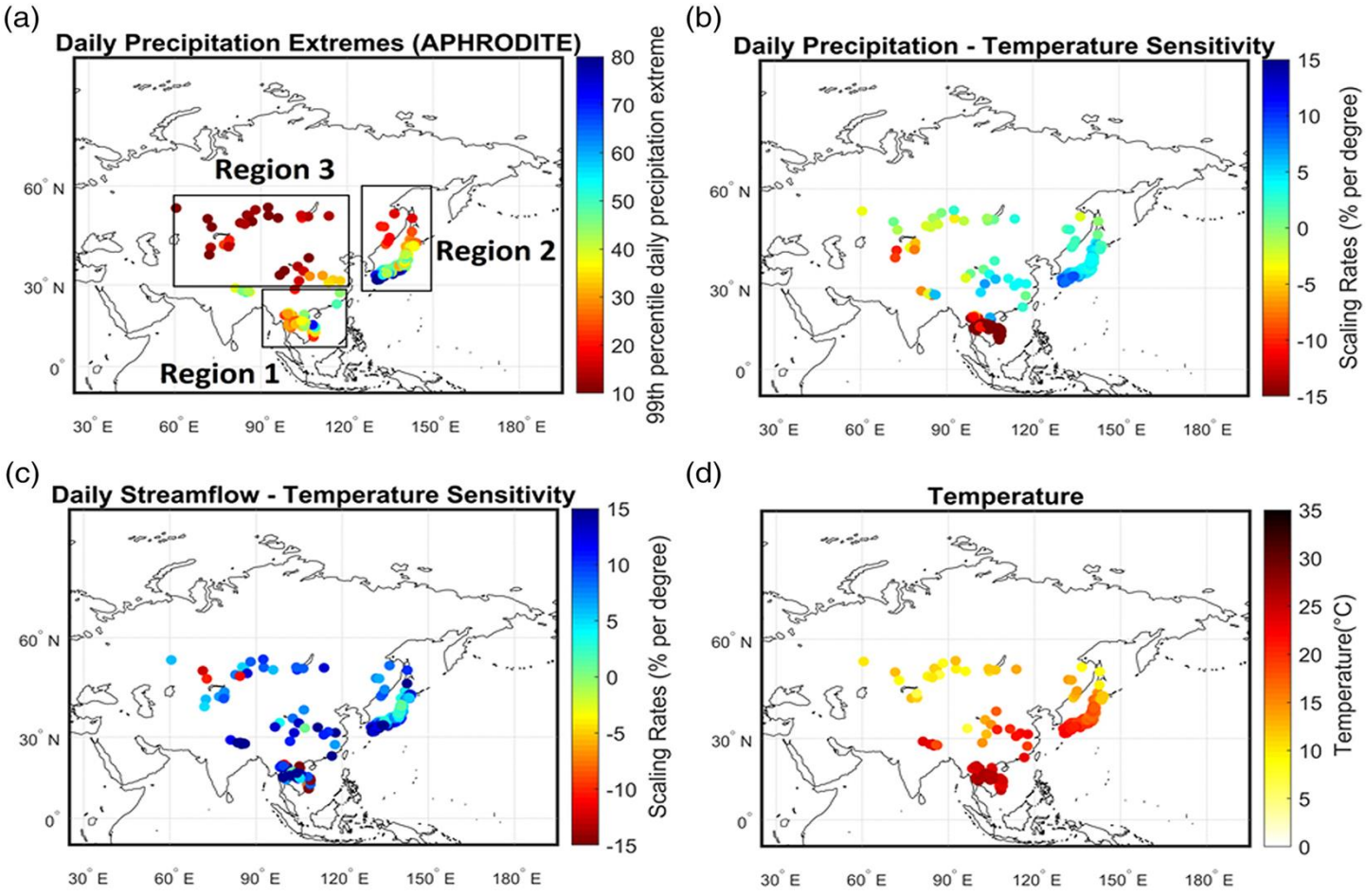
IPCC AR6, Chapter 11
4^0C Warming scenario

Future Changes at Different Warming Levels



- Increase in the intensity of extreme precipitation is at 7% per degree C warming
- Increase in the frequency of extreme precipitation will be non-linear with warming.
- Higher increases in frequency will be for rarer events.
- Regional scale increases will depend on regional factors, regional warming and dynamic changes

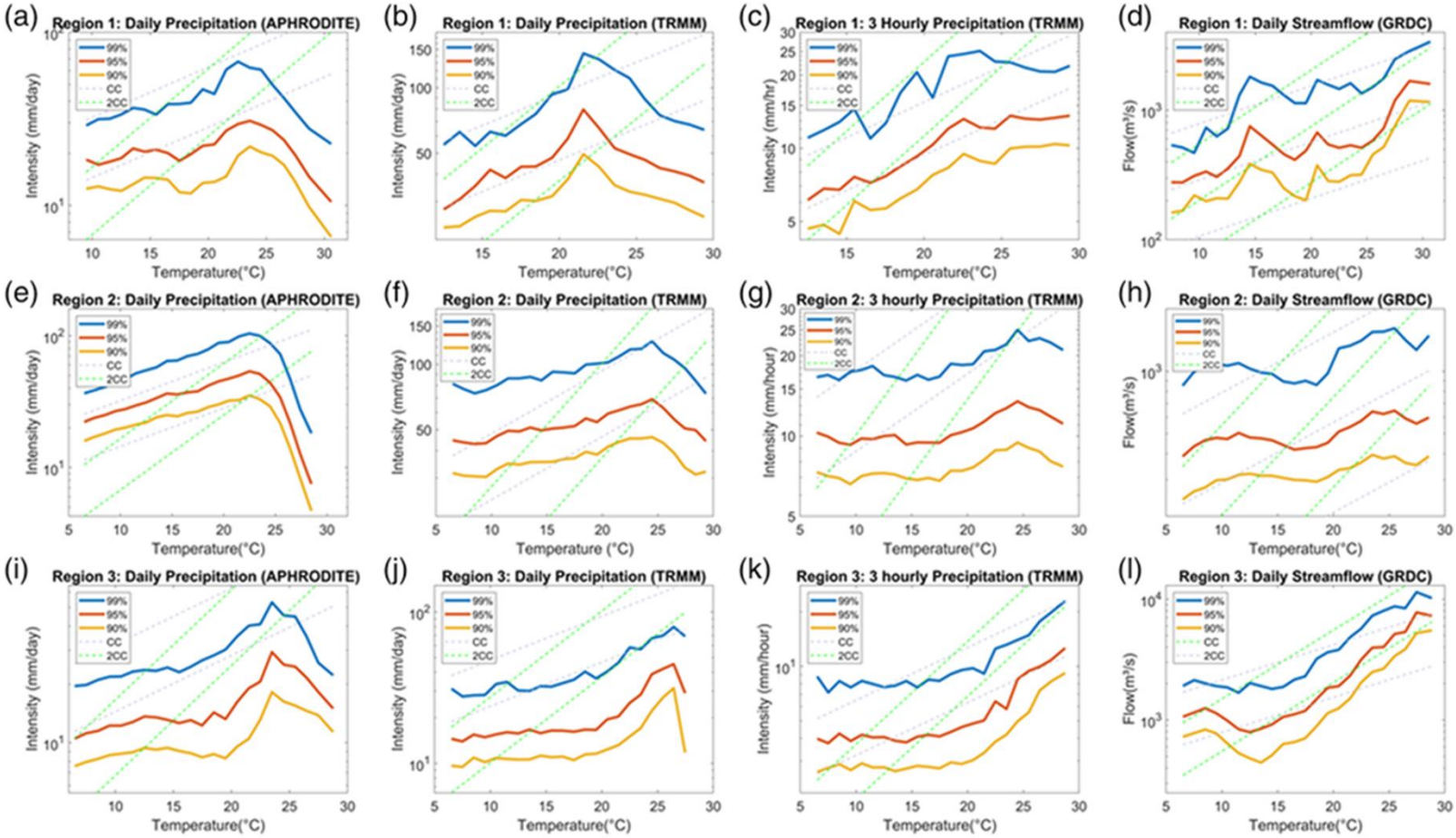
Scaling results over Central and South Asia



- Regional Scaling is not consistent across space
- Tropical region sees negative scaling, while extra-tropic high positive scaling
- Daily streamflow sees a positive scaling

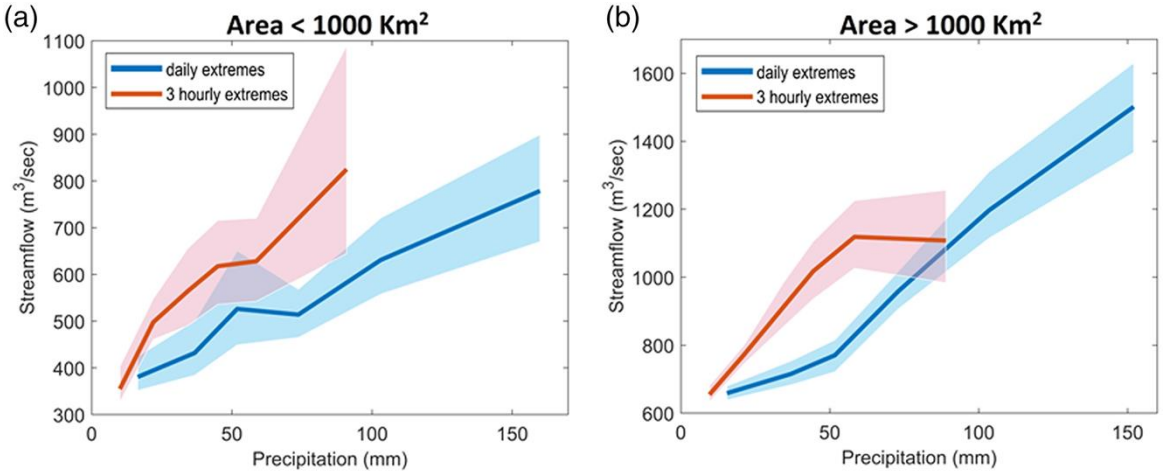
Ghausi and Ghosh (2020), GRL

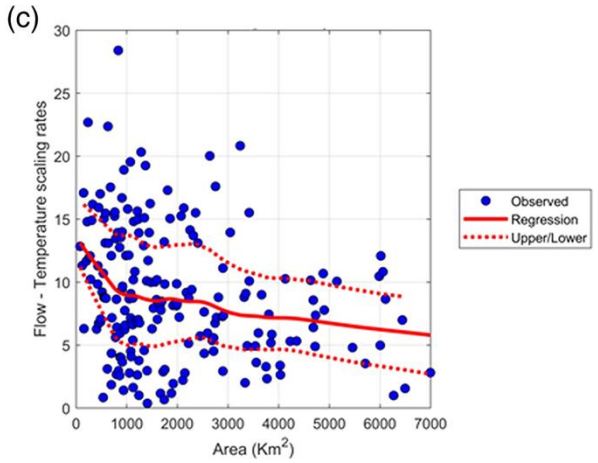
Opposite Scaling between Streamflow and Daily Precipitation Extremes



- Scaling changes with the duration of the extreme precipitation events
- The daily extreme precipitation scaling has a hook structure with breaking down at a high temperature
- This does not always happen at a sub-daily scale

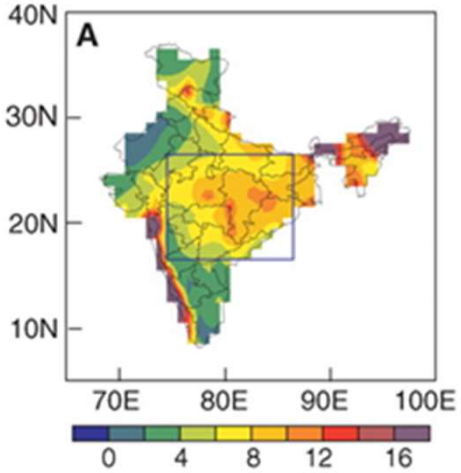
Small Catchments: Scaling rates driven by short duration extreme precipitation

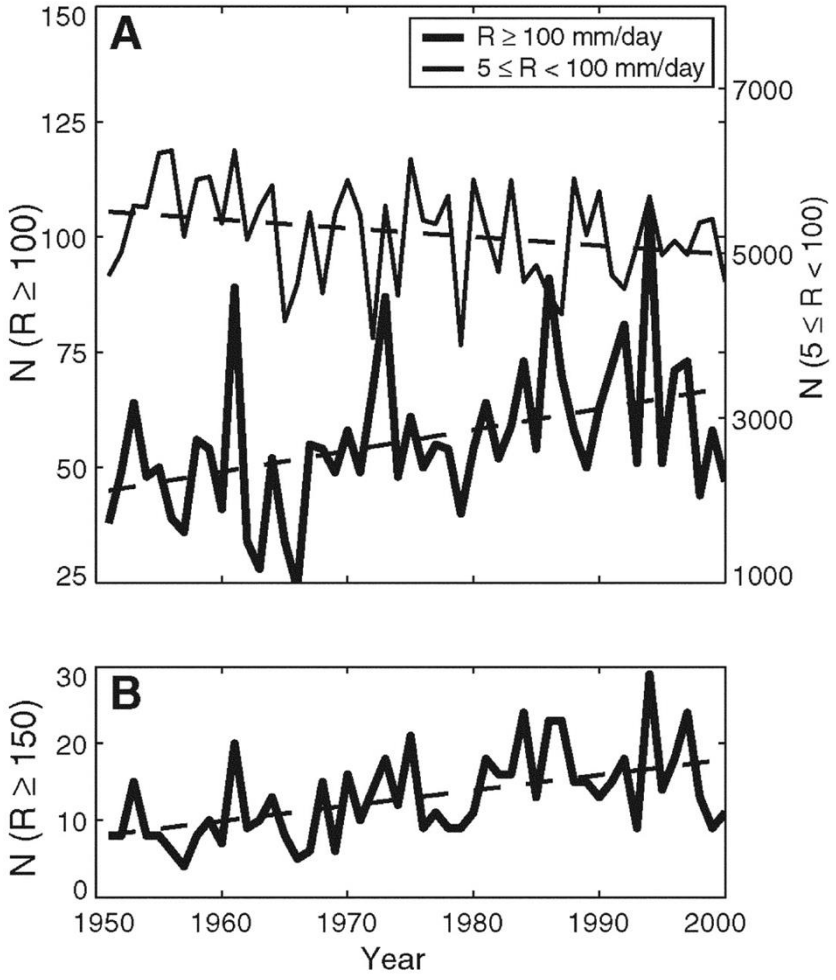




- Streamflow scaling depends on the catchment area
- Smaller catchment extreme flow follows sub-daily scaling

Extreme Precipitation Changes in India

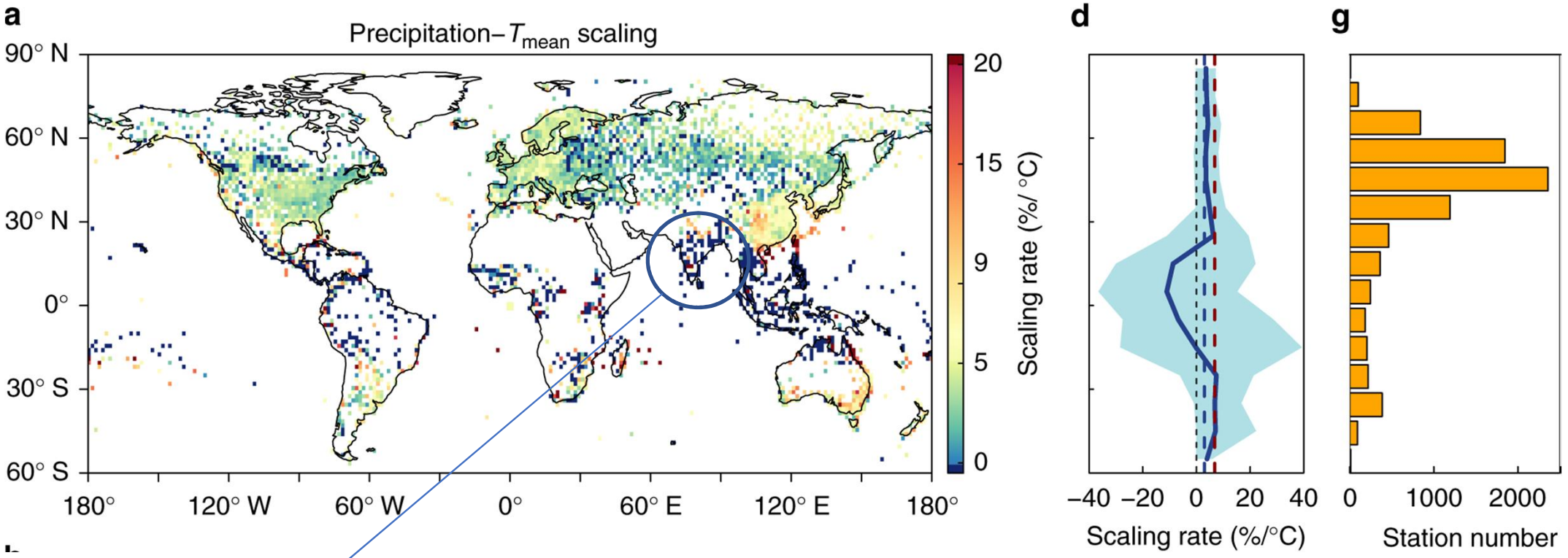




- India, specifically the central region has observed an increase in extreme precipitation
- The low to moderate rainfall events have reduced in India post-1950

Goswami et al. (2006), Science

Extreme Precipitation Scaling in the Tropics: Negative!

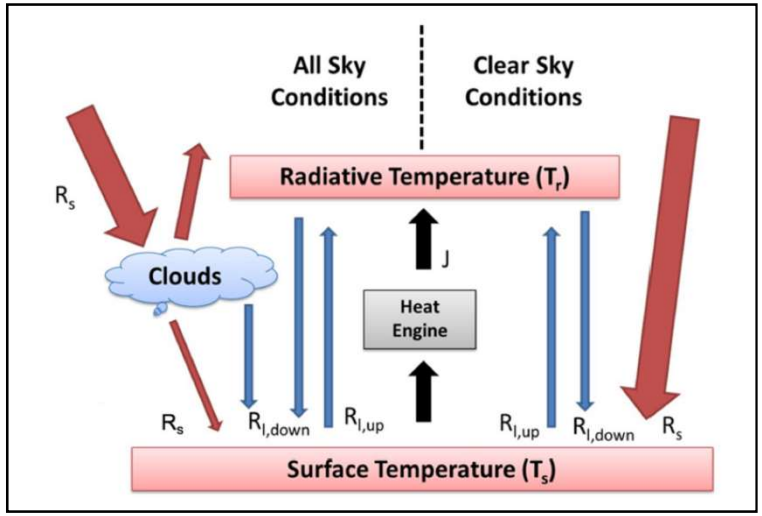


Negative Scaling over India

Yin et al., 2018 (Nature Communication)

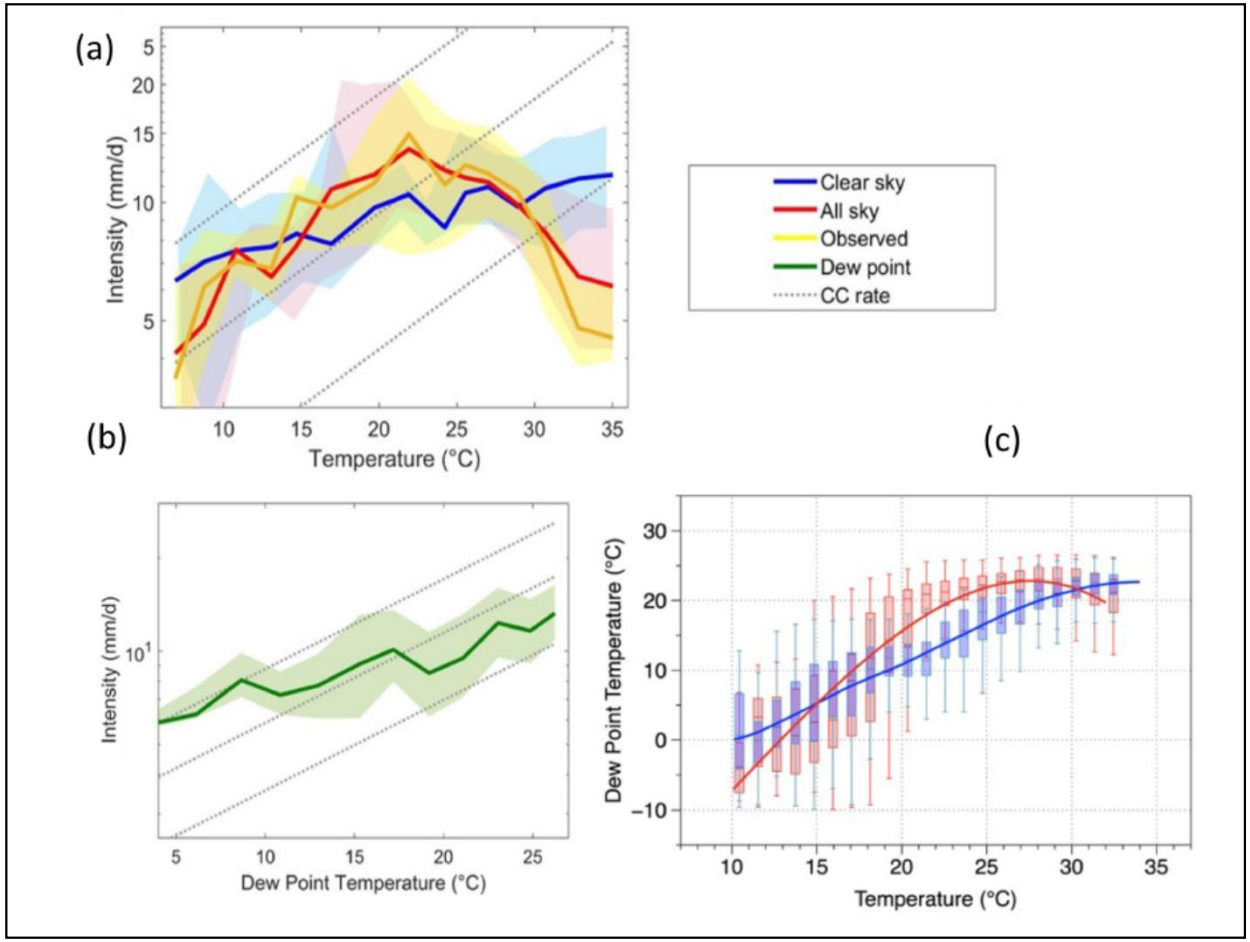
Possible Reasons

- Dew Point Temperature Scaling: Lack of moisture supply at a higher temperature
- Cloud induced radiative cooling at Surface

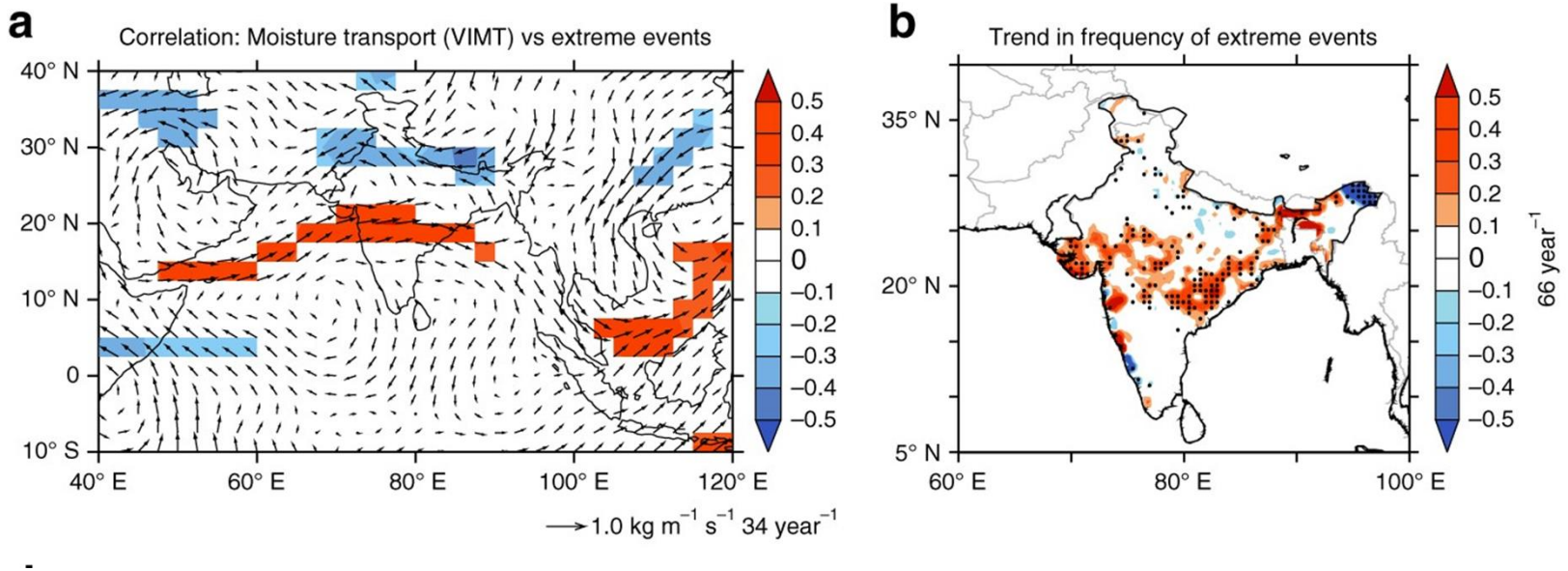


Ghausi, Ghosh and Kleidon (2022), HESS

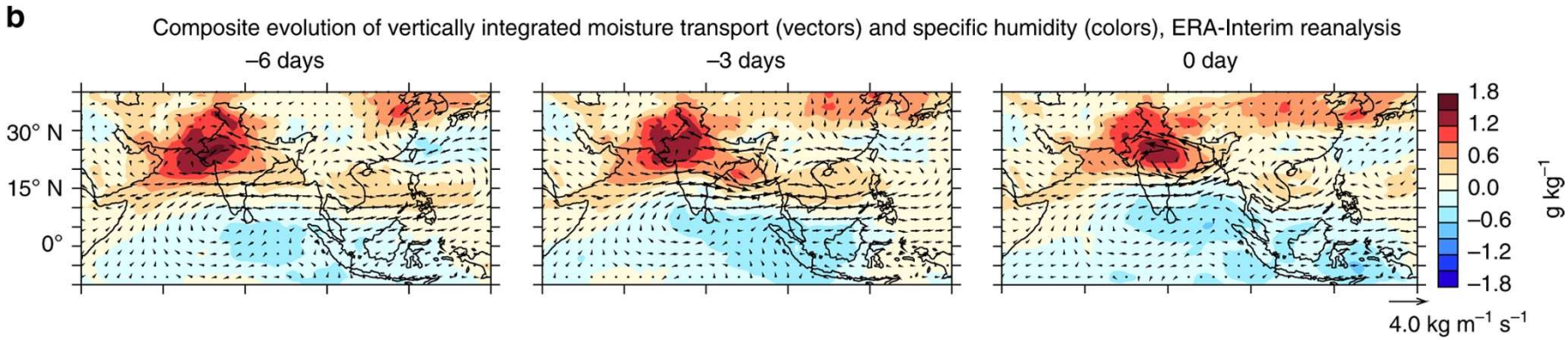
Scaling Rates in India



Wide Spread Extremes over Central India: Dynamic Factors

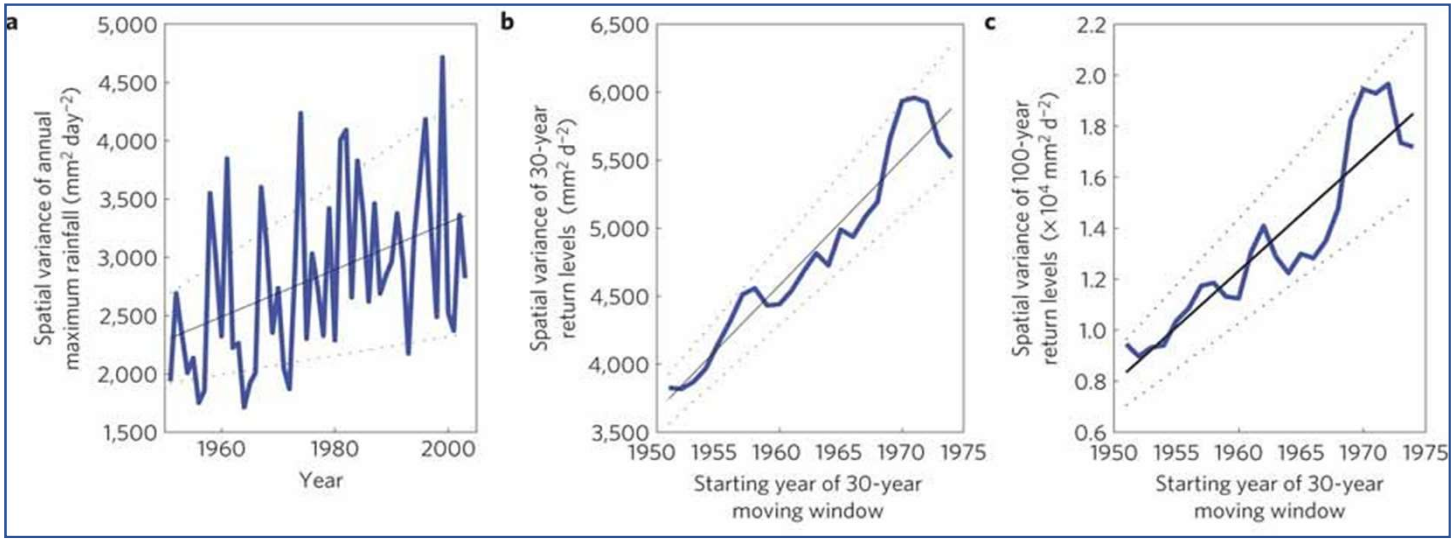


The increase of widespread extremes over Central India is due to the dynamic factors resulting from the Arabian sea warming



Roxy, Ghosh et al. (2018), Nature Communications

Increase in Spatial Variability



Ghosh et al. (2012)
Nature Climate Change

<u>Local Factors</u>

- Urbanization
- Land Use Land Cover Change
- Water management on land
- Aerosols and dust

Impacts of Urbanization

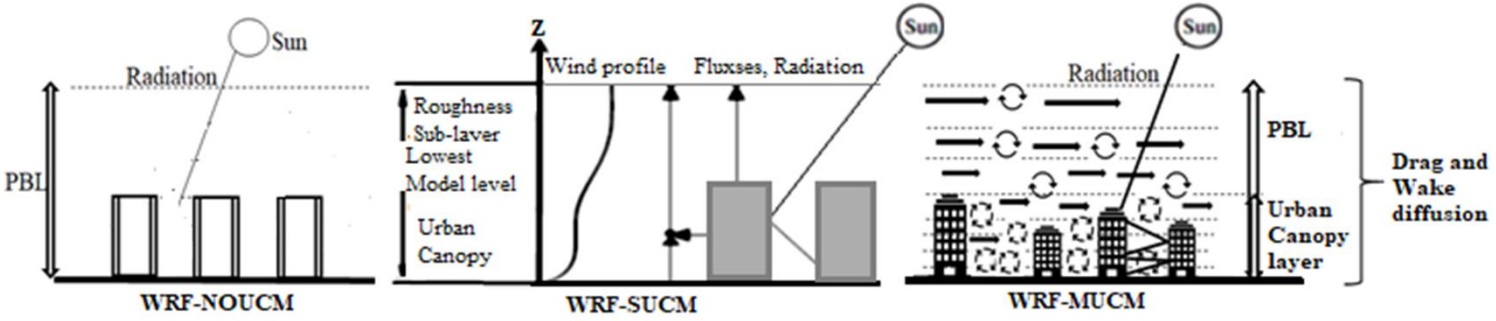
Mechanisms

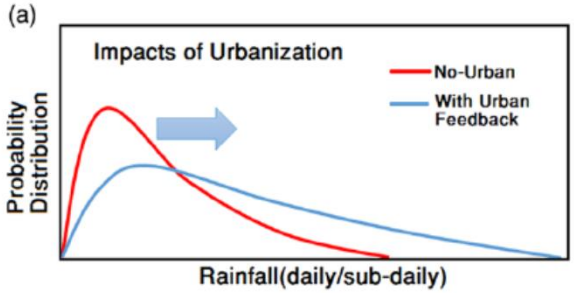
(i) Increases in atmospheric moisture due to horizontal convergence of air associated with the urban heat island effect

(ii) Urban aerosol emissions

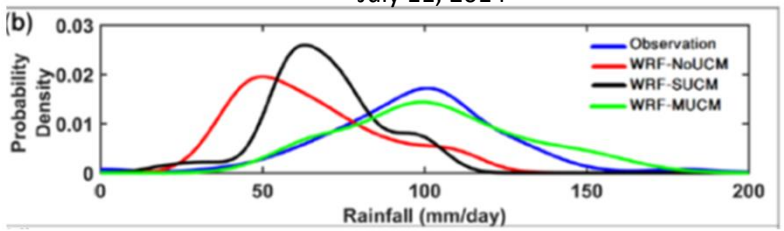
(iv) Urban structures that impede atmospheric motion

Urban Signature on Mumbai

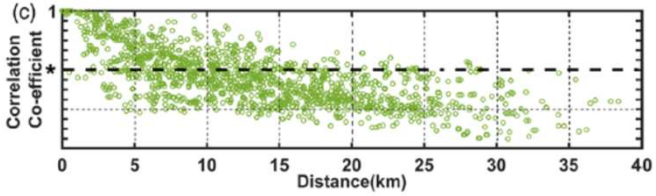




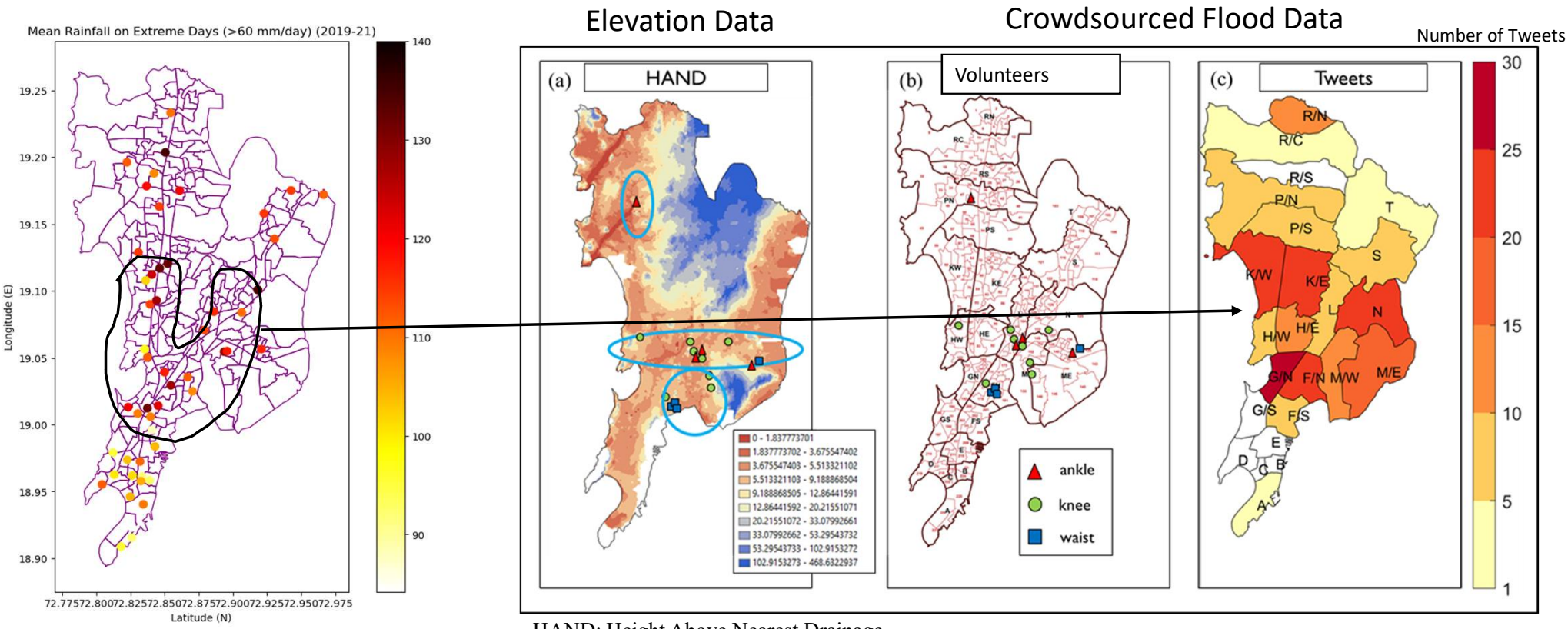
July 11, 2014



Paul et al. (2020)



Translating to Floods

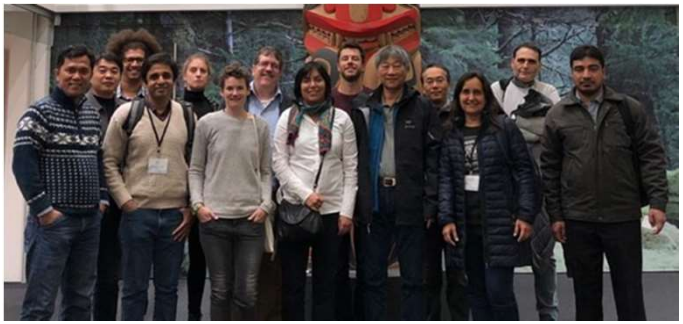


HAND: Height Above Nearest Drainage

Extreme rain resulting in local flooding over Mumbai

Acknowledgement

IPCC Assessment Report 6, Working Group 1, Chapter 11
Section 11.4 on Heavy Precipitation



Students

- Sarosh Alam Ghausi
- Supantha Paul
- Amey Pathak
- Shrabani Tripathy
- Sautrik Chaudhuri

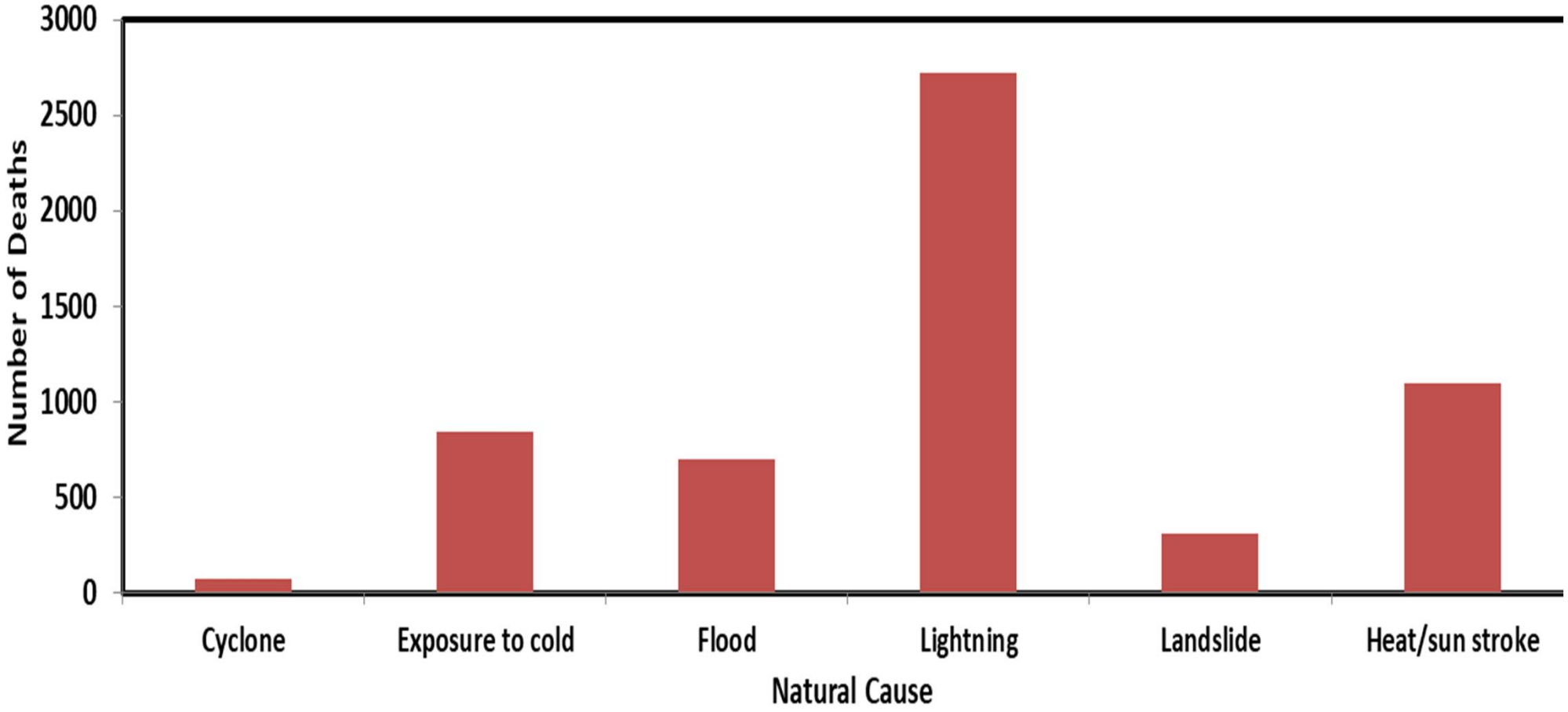
Thank You

Lightning : Disaster Risk Management

Dr. Sunil D Pawar

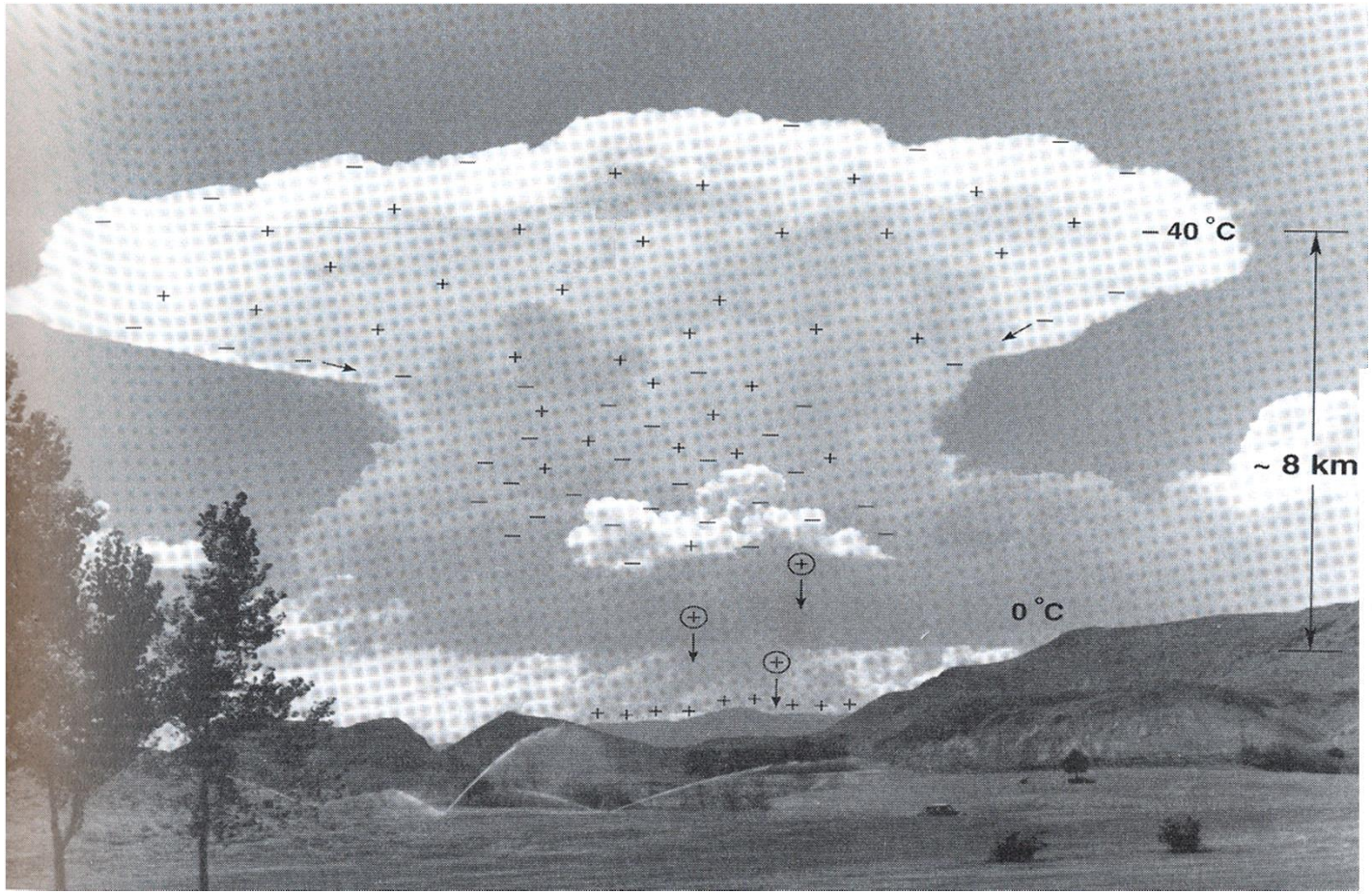
Indian Institute of Tropical Meteorology Pune.

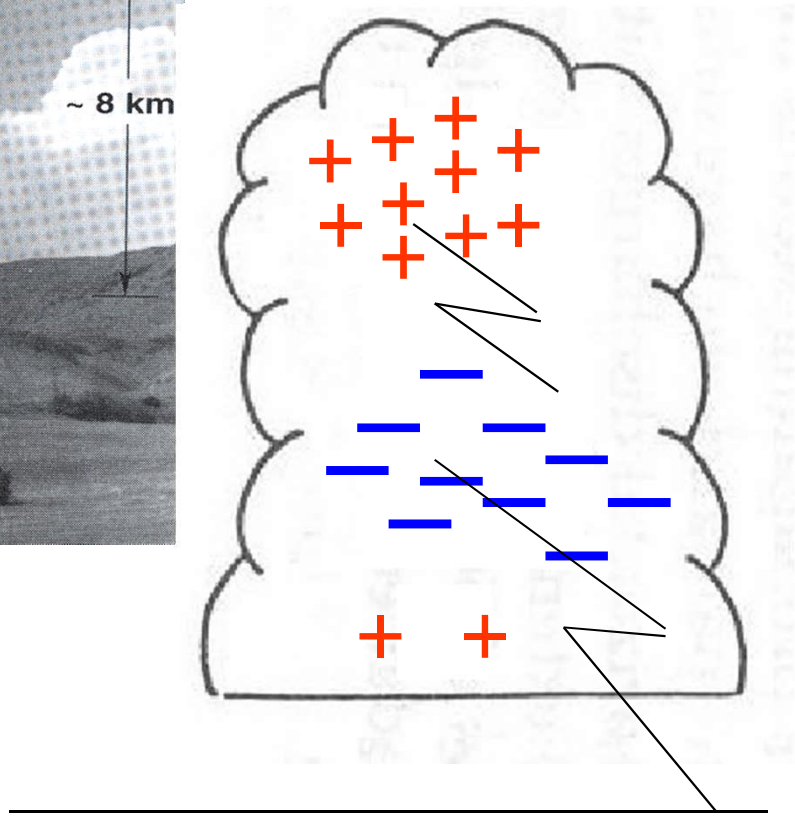
Deaths due to Natural Disasters in India (2010 to 2021)



What is lightning ?

Charge distribution inside thundercloud





i) Intra-cloud discharges

ii) Cloud-to-ground discharges

Cloud to ground lightning

Intra cloud lightning

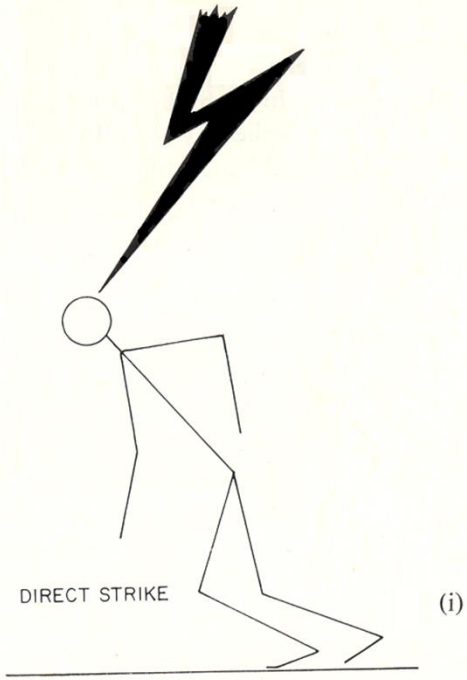

East -- http://hpwr
15:35:04 Wed Feb 18

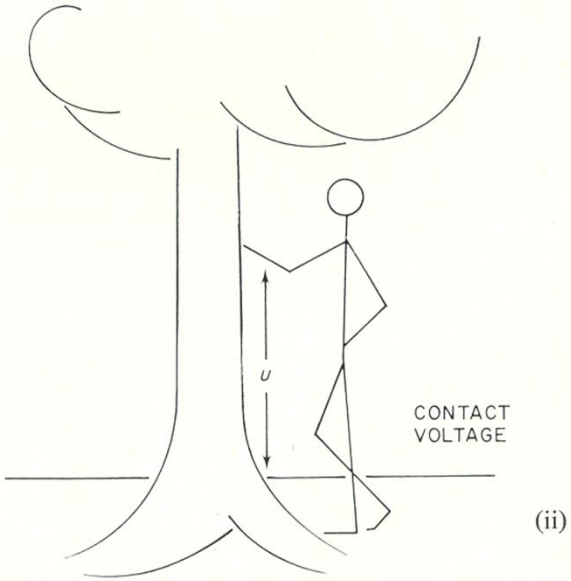
Gross features of discharges

- Currents flowing in a discharge 20,000 to 200,000 amp.
- Charge destroyed in a single discharge ~ 20 C.
- Electrical moment destroyed in a single discharge ~ 100 C km.
- Energy of a flash - 10^9 – 10^{10} J.

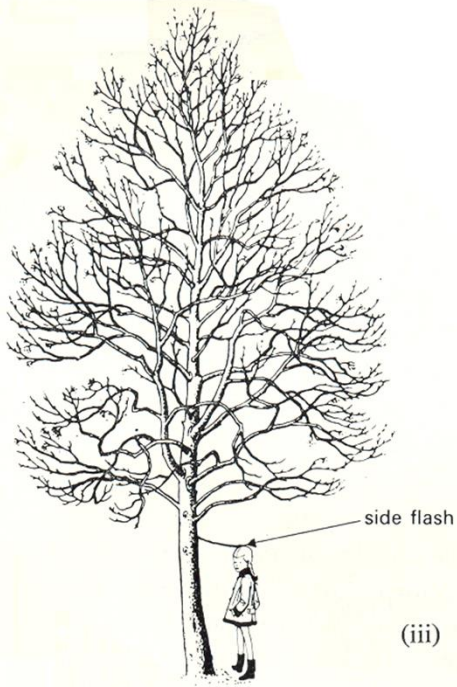
Lightning Hazards to Human and Animal

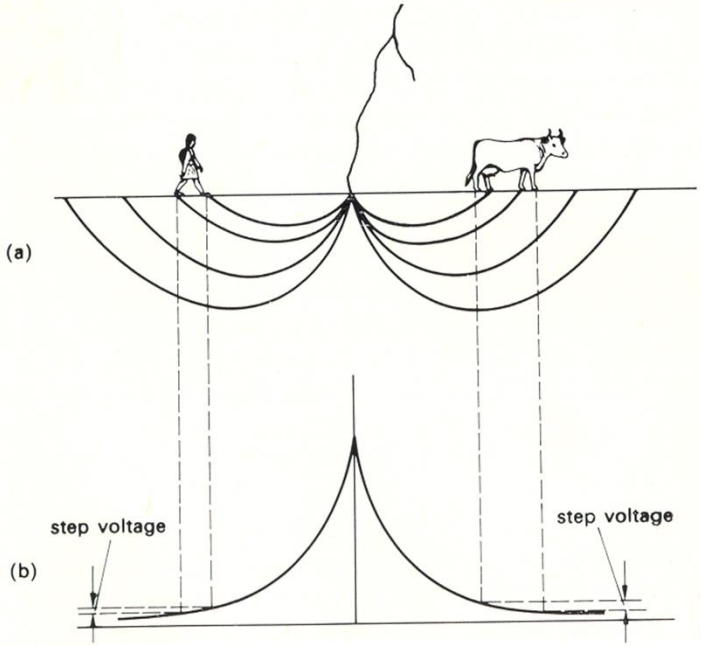
- Direct strike
- Contact voltage
- Side flash
- Step voltage





(i) Direct strike. (ii) Contact voltage: $u = i(R+R_e)+L\,\mathrm{d}i/\mathrm{d}t+u_s$, where, i is current flowing through the tree, R is the resistance of the tree between the highest point of the body touching the tree and earth, R_e is the "effective" earthing resistance of the tree, L is the inductance between the highest point where the body touches the tree and earth, and u_s is the potential drop between the bottom of the tree and the feet. (iii) Side flash. (iv) Step voltage: (a) current distribution and (b) voltage drop along ground. (Figures 3(iii) and (iv) reproduced with the permission of R. H. Golde, 1973.)

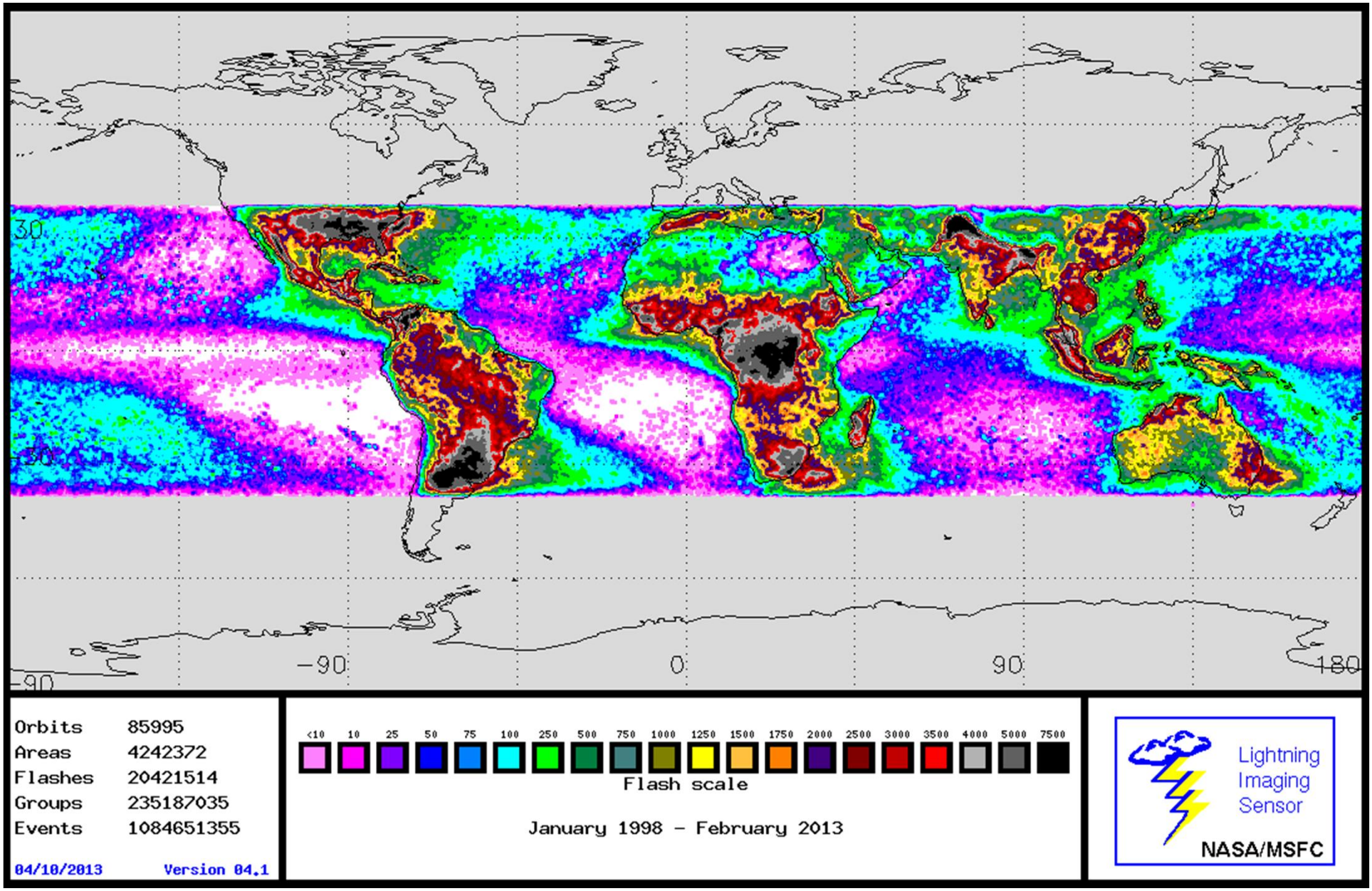




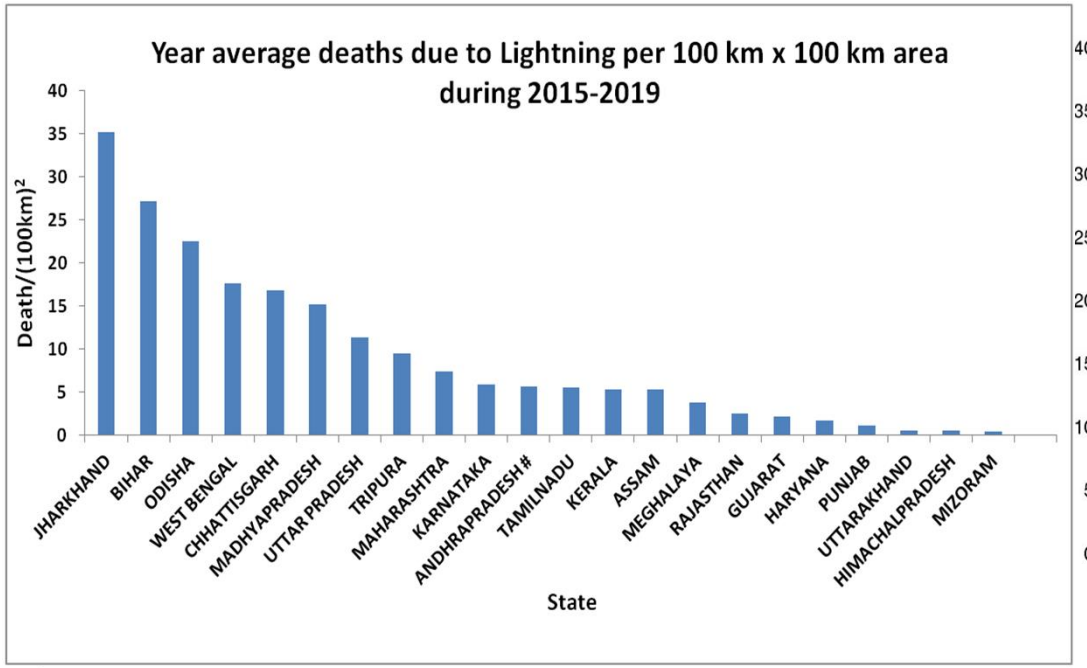
- Over 20, 000 people get affected by lightning all over the word and several thousand die due to lightning strike every year (Gomes and Kadir 2011).
- India every year more than 2000 people die due to lightning.

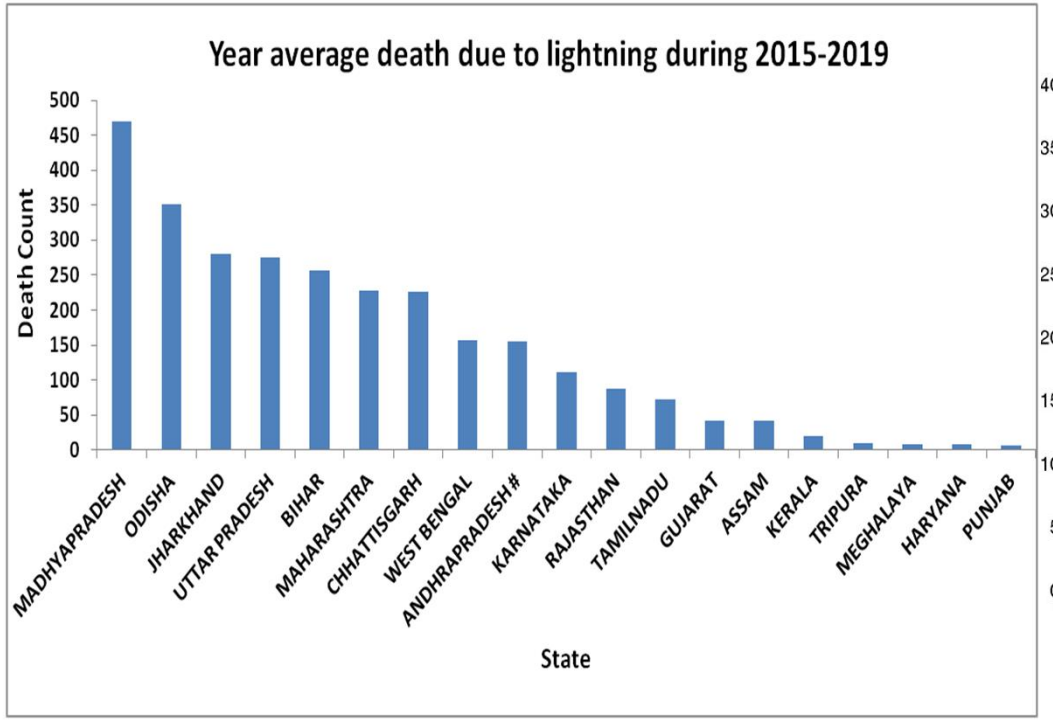
- The population density, literacy rate and urbanization of the region along with lightning density of the region play important role on number of lightning deaths in that region.

Global lightning distribution

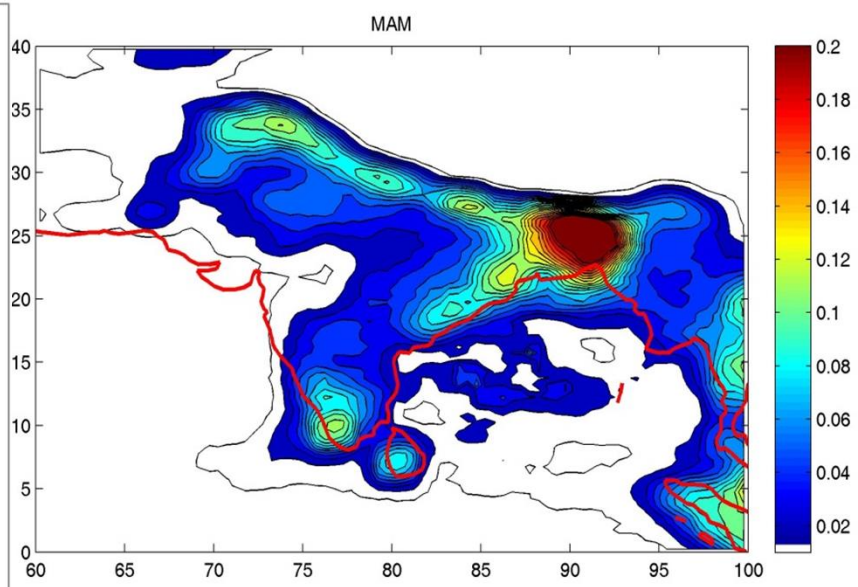


Lightning flash density Over Indian region

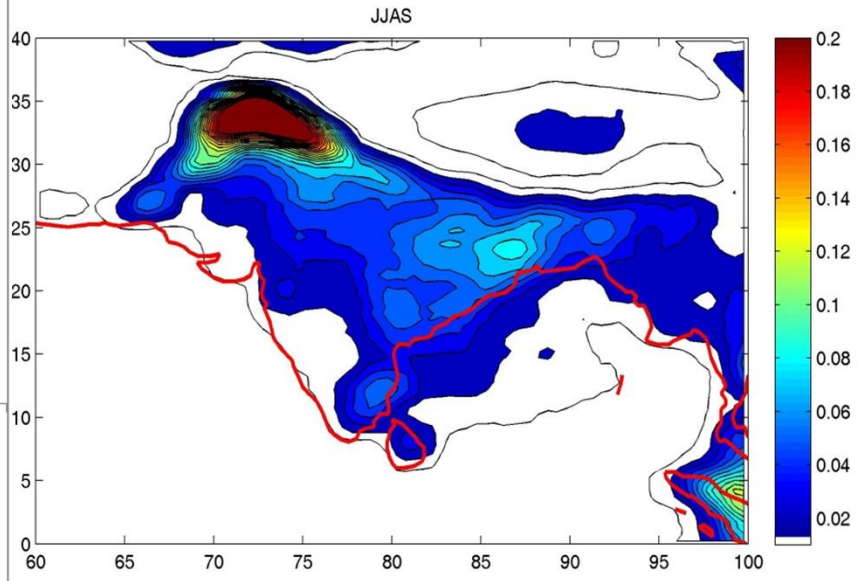




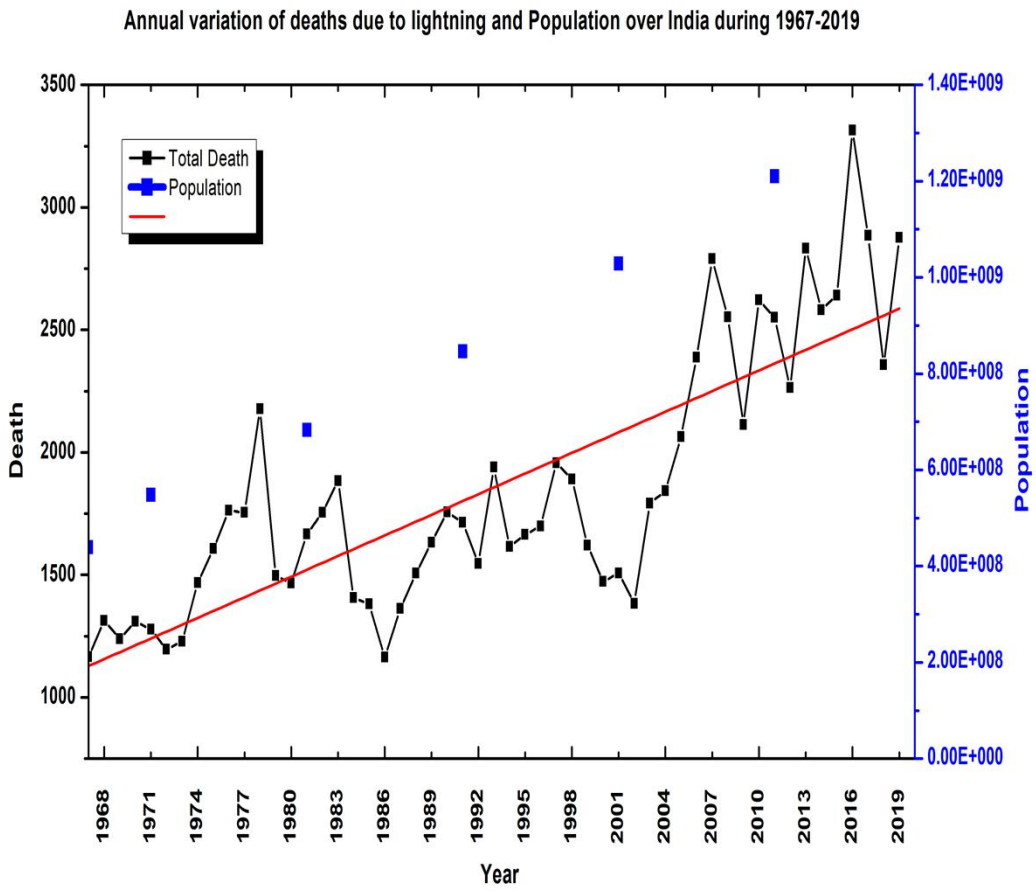
Pre-monsoon



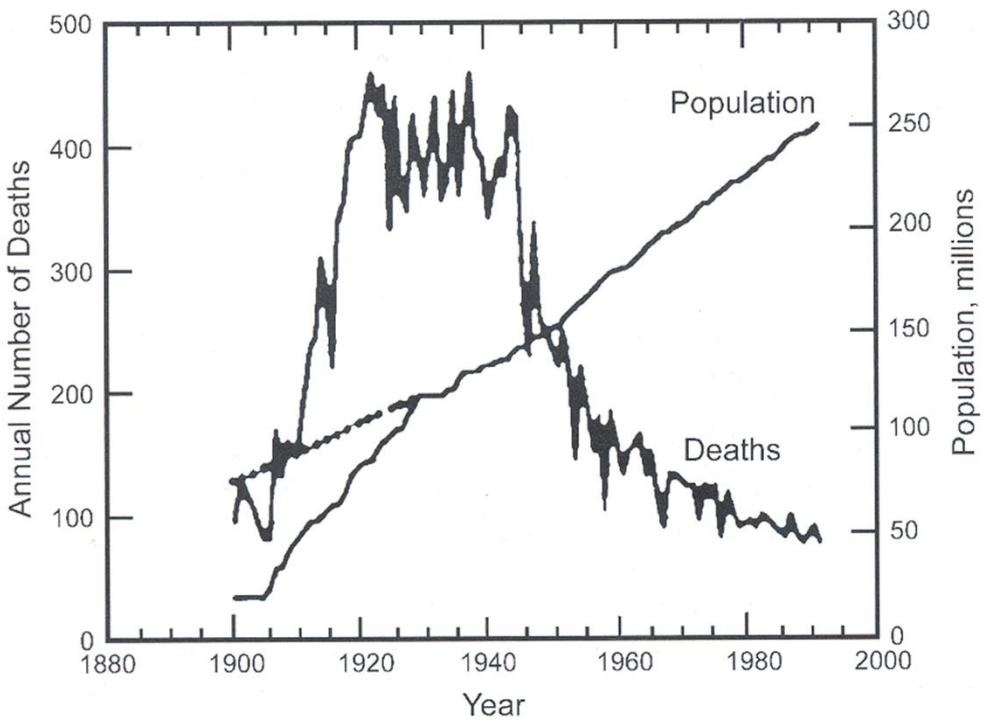
Monsoon



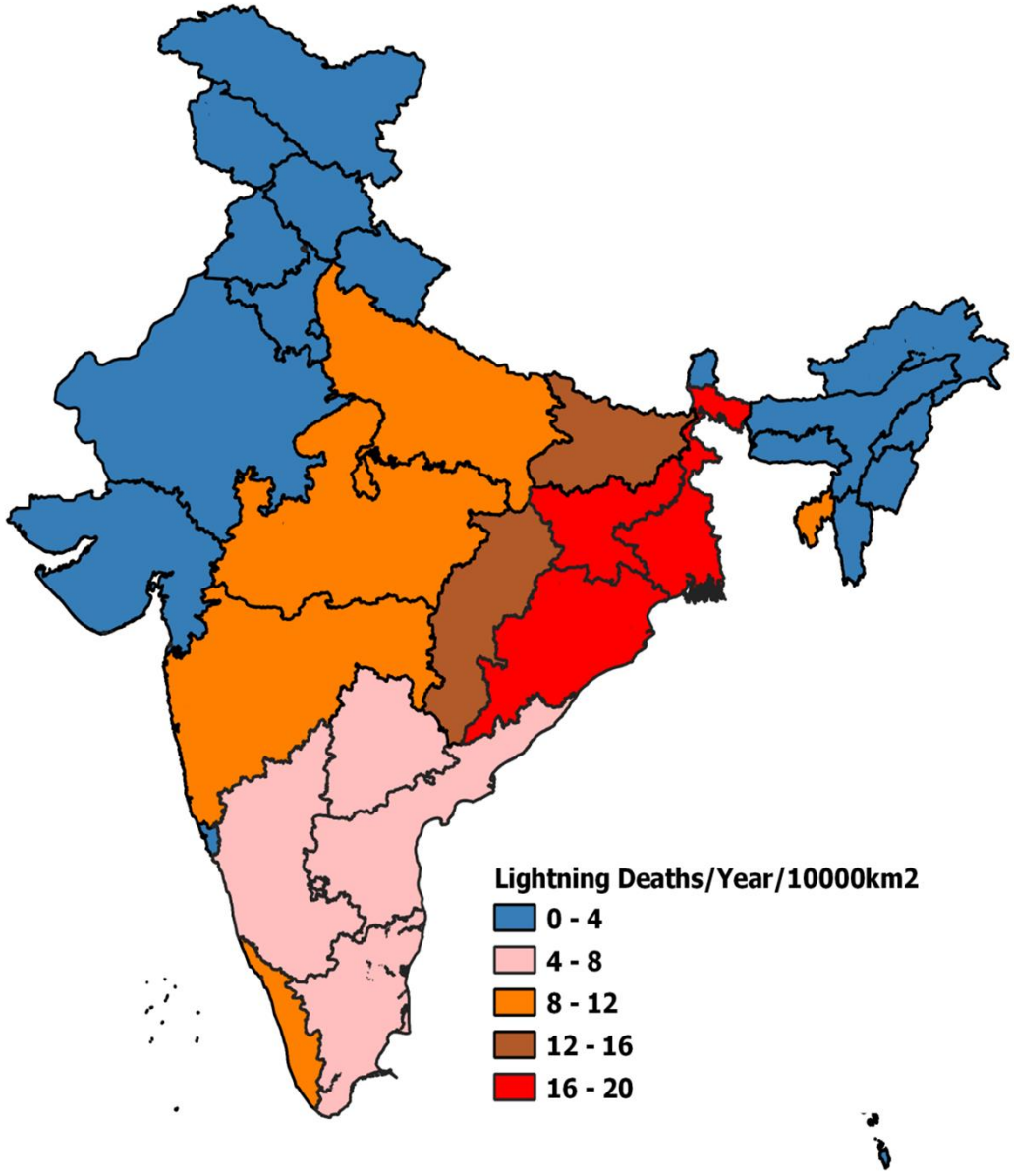
Lightning deaths over India



USA

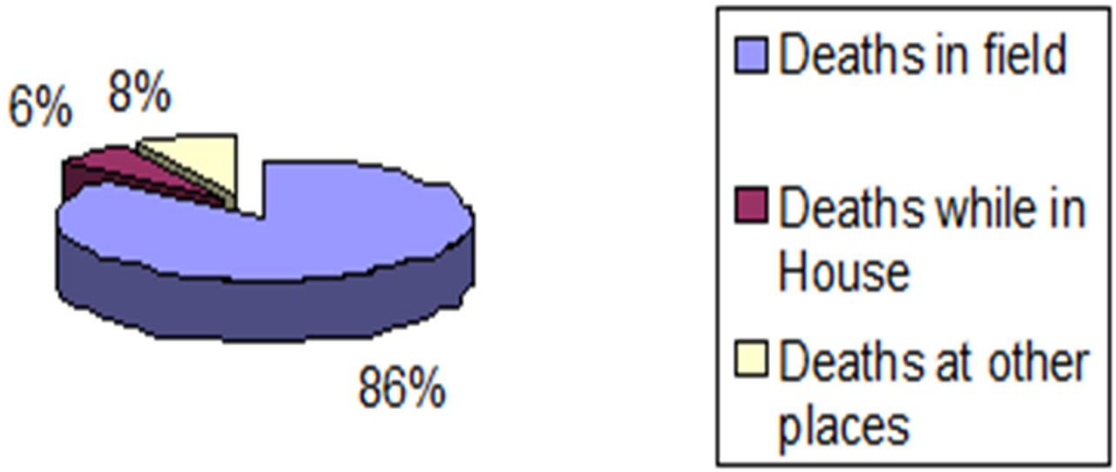


Lightning deaths over India



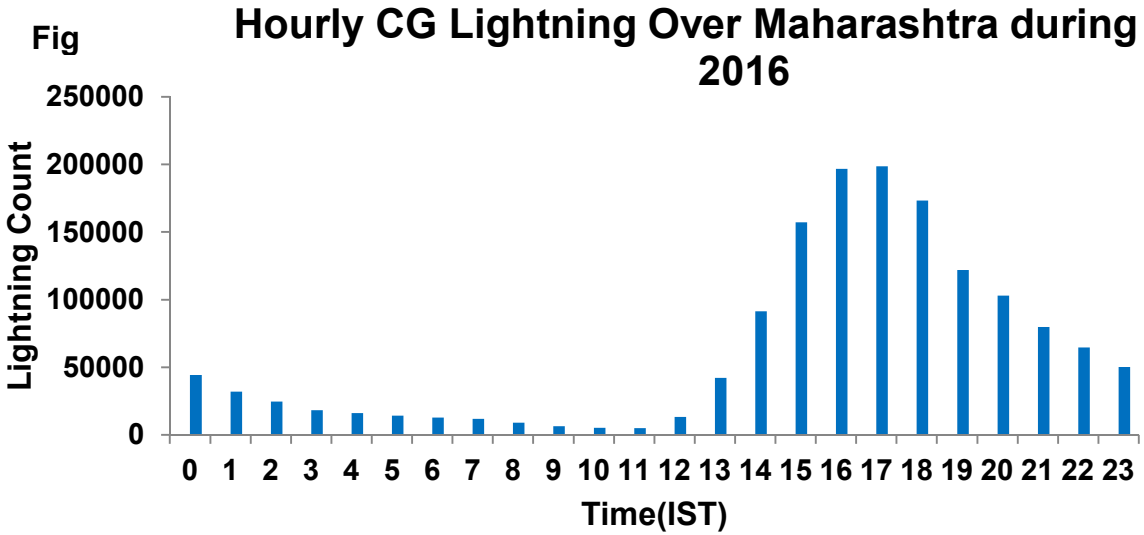
Victims of lightning

Location wise lightning deaths over Maharashtra (2004-2008)

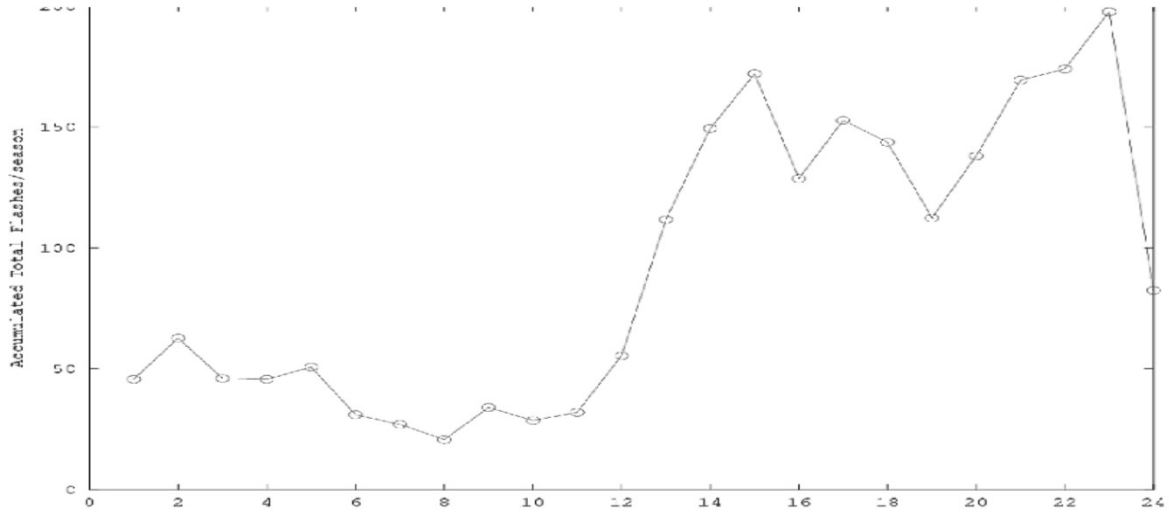


Diurnal variation of lightning over Maharashtra

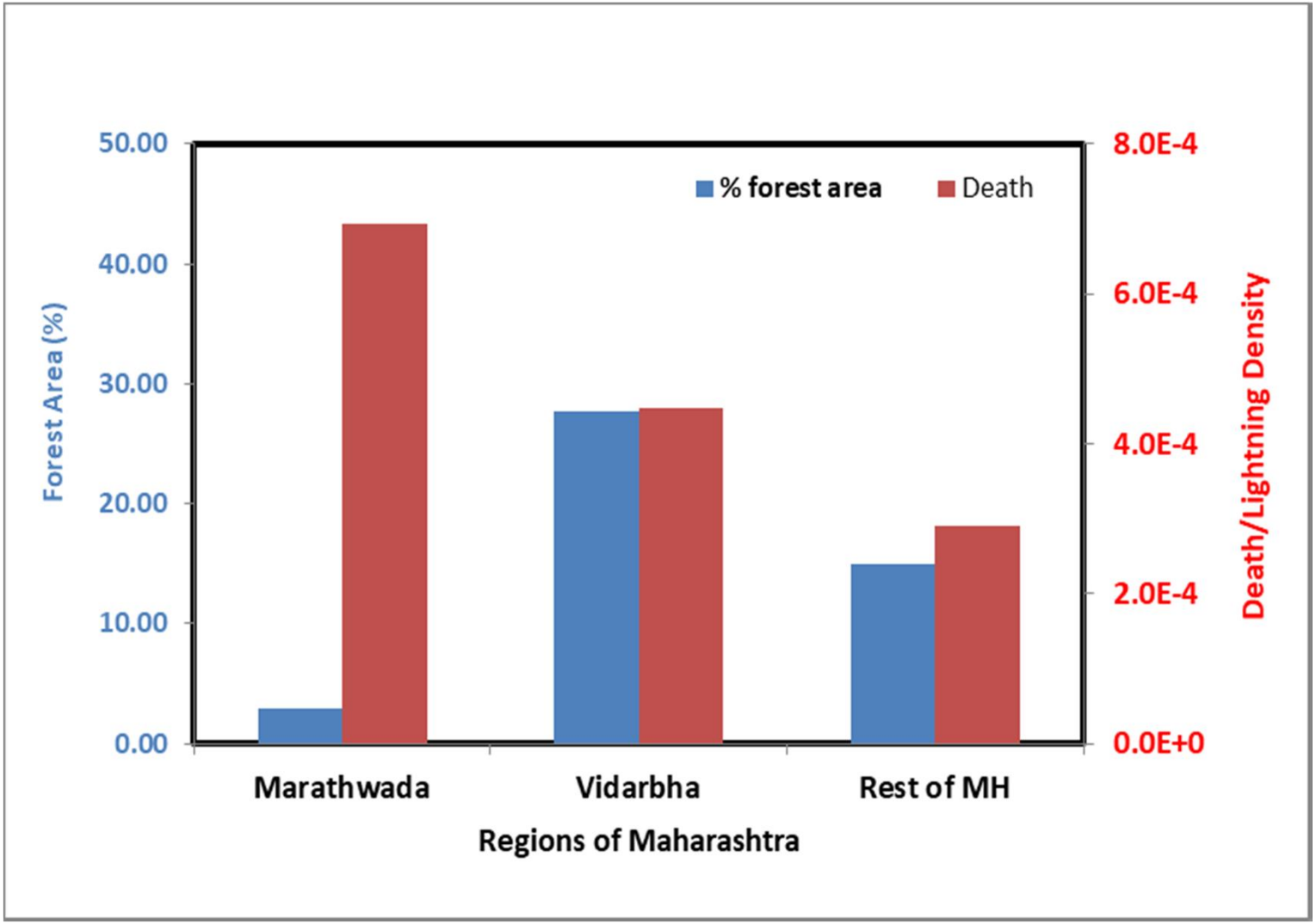
Fig



Guwahati

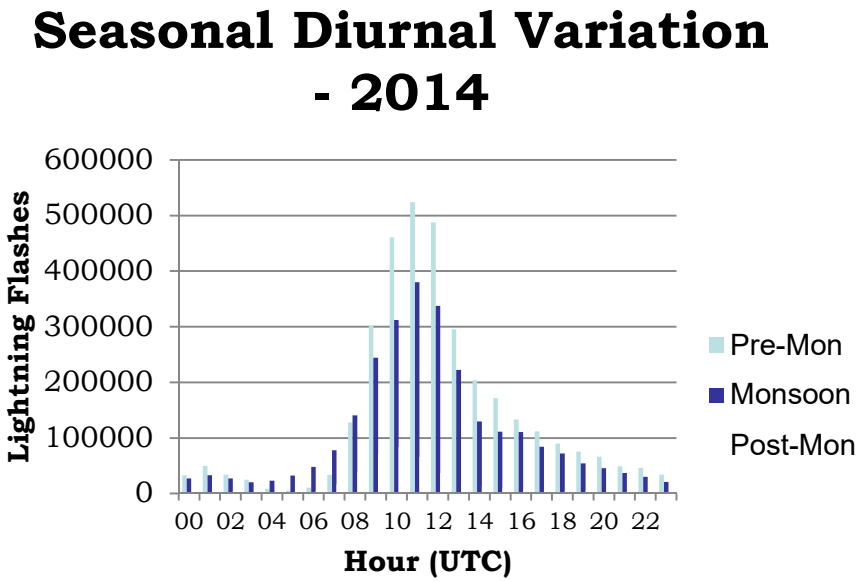


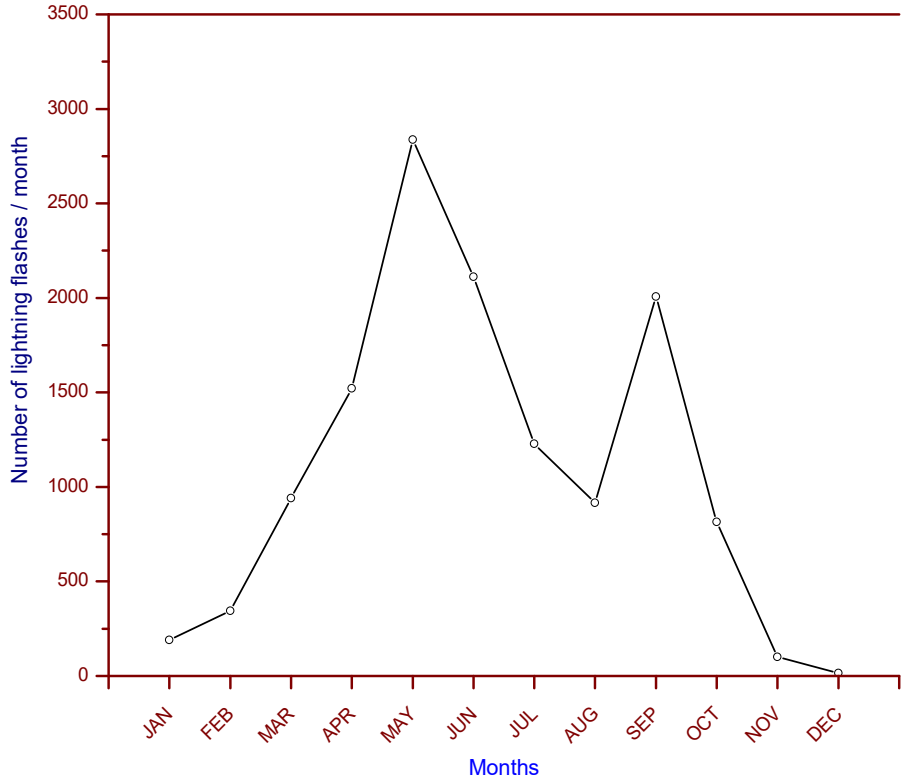
Lightning and forest cover

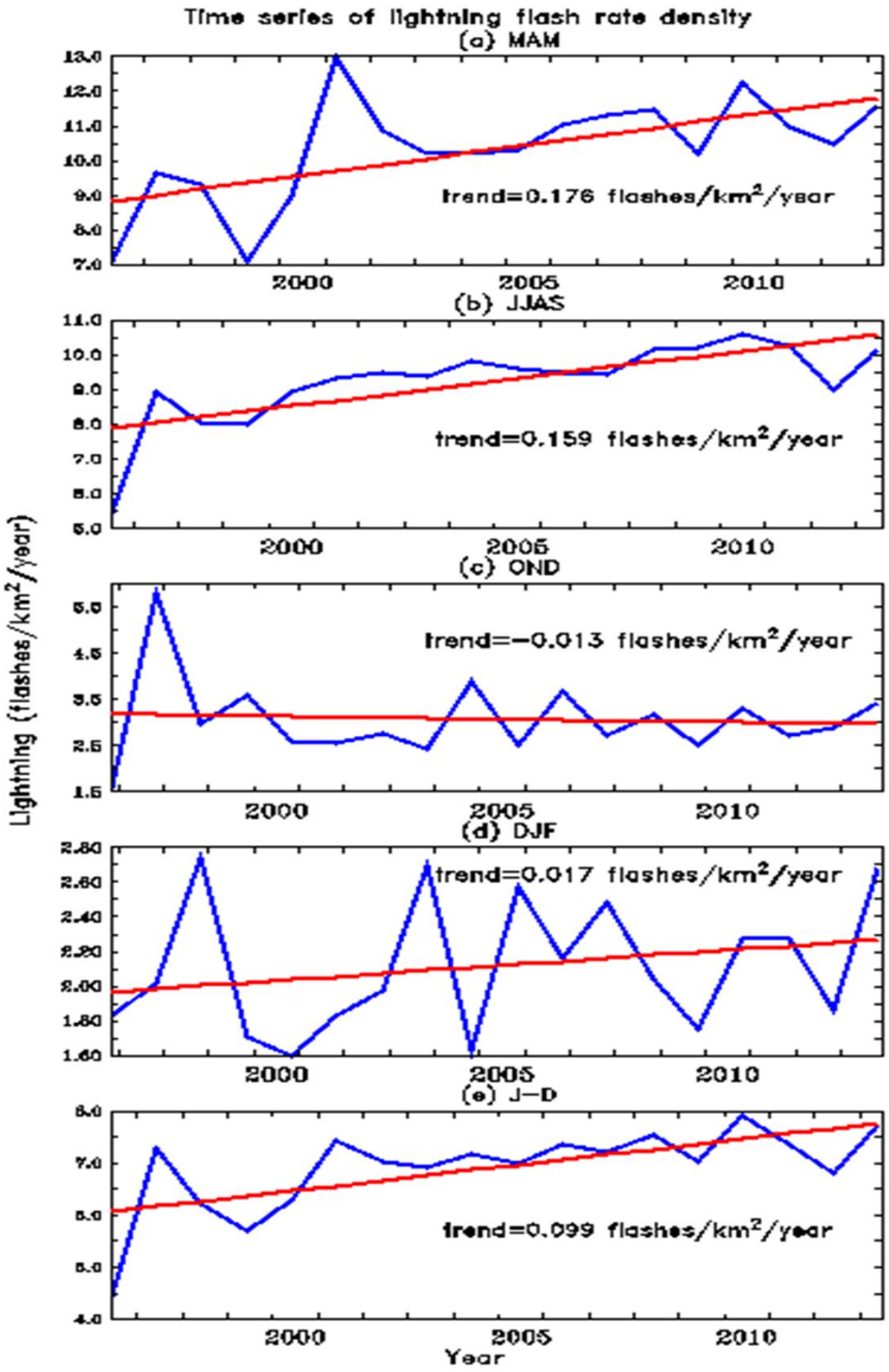


Climate change

Temperature variations and lightning







Premonsoon

Monsoon

Postmonsoon

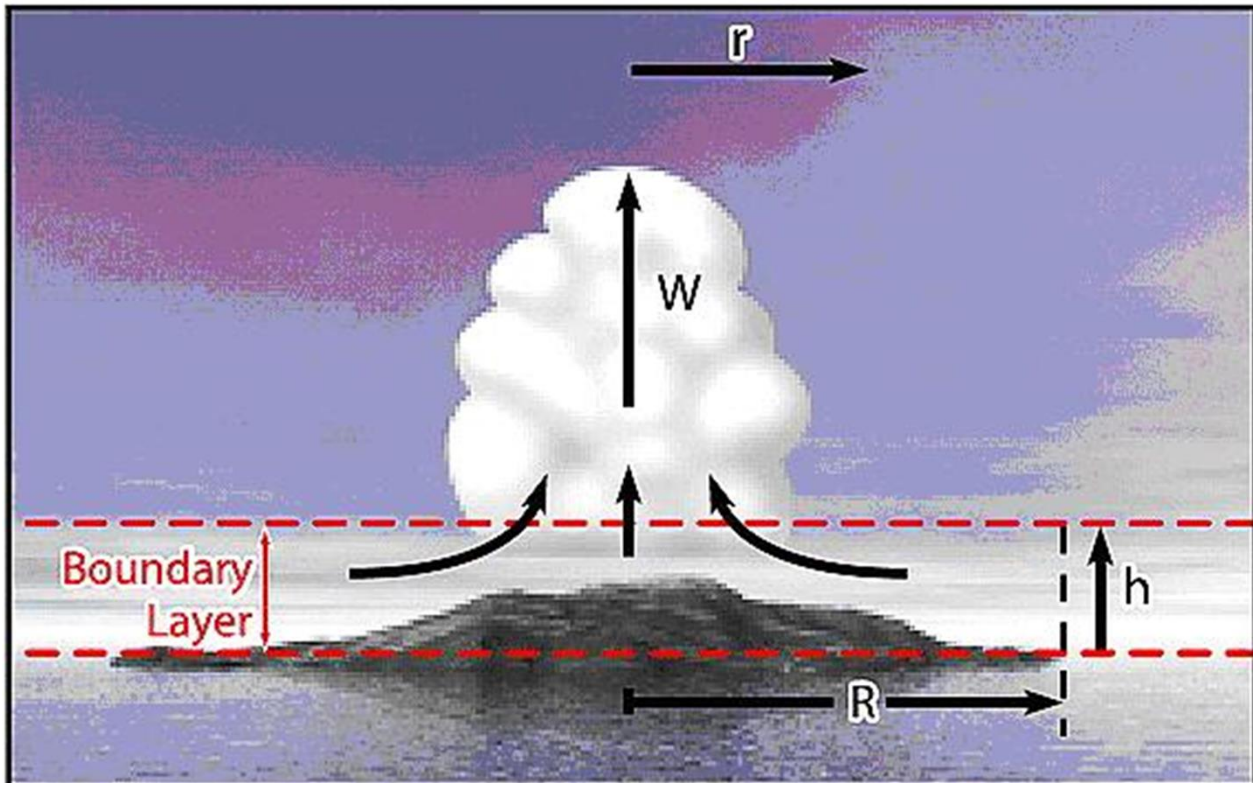
Winter

Annual

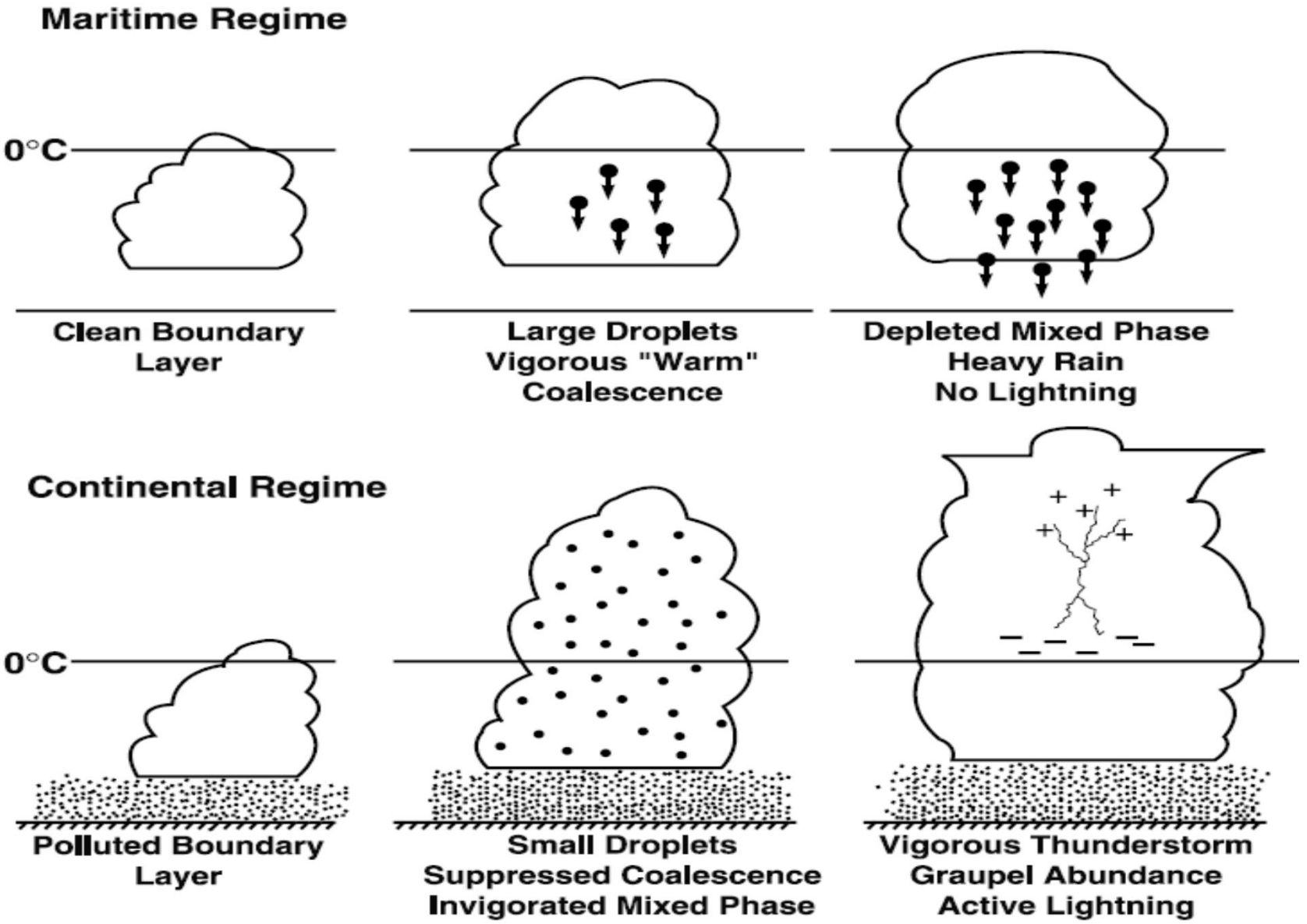
Lightning trends over India

Effect of increasing urbanization on lightning activity

Enhancement in lightning activity over big cities



Aerosol effect



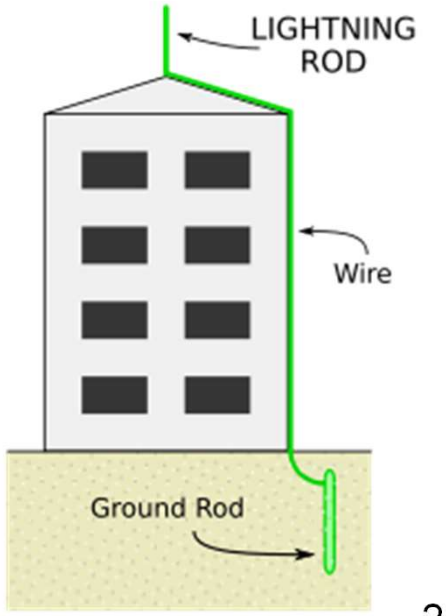
Risk Management

Protection Techniques

1. Conventional techniques
2. Non-conventional techniques

1. Diversion and shielding – primarily intended for structural protection

- Lightning rods
- Guard ring / a mesh of horizontal wires covering the top of structure
- Faraday cage



Surge protection

- Voltage crowbar,
- Voltage clamps,
- Circuit filters,
- Isolating devices

Protection can help -

- Lightning cannot be prevented; it can only be intercepted or diverted to a path that will, if well designed and constructed, not result in damage. While there is no single technology that can completely eliminate the risk of a direct strike and/or over voltage transients, a holistic approach to total facility protection can help safeguard almost any facility, equipment or person.

Nowcasting of lightning

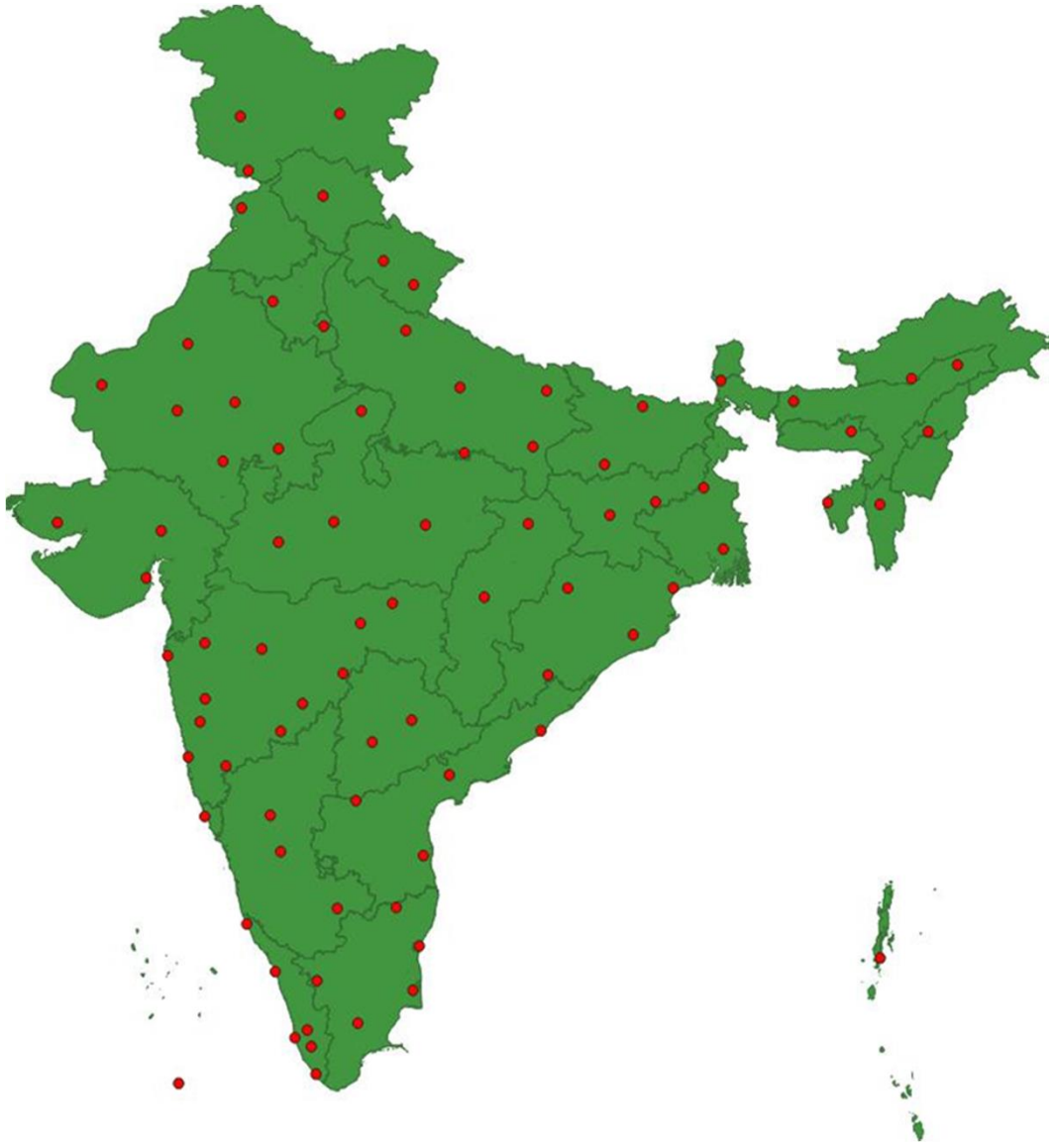
Lightning detection network and Damini app

Applications of Lightning Detection Network

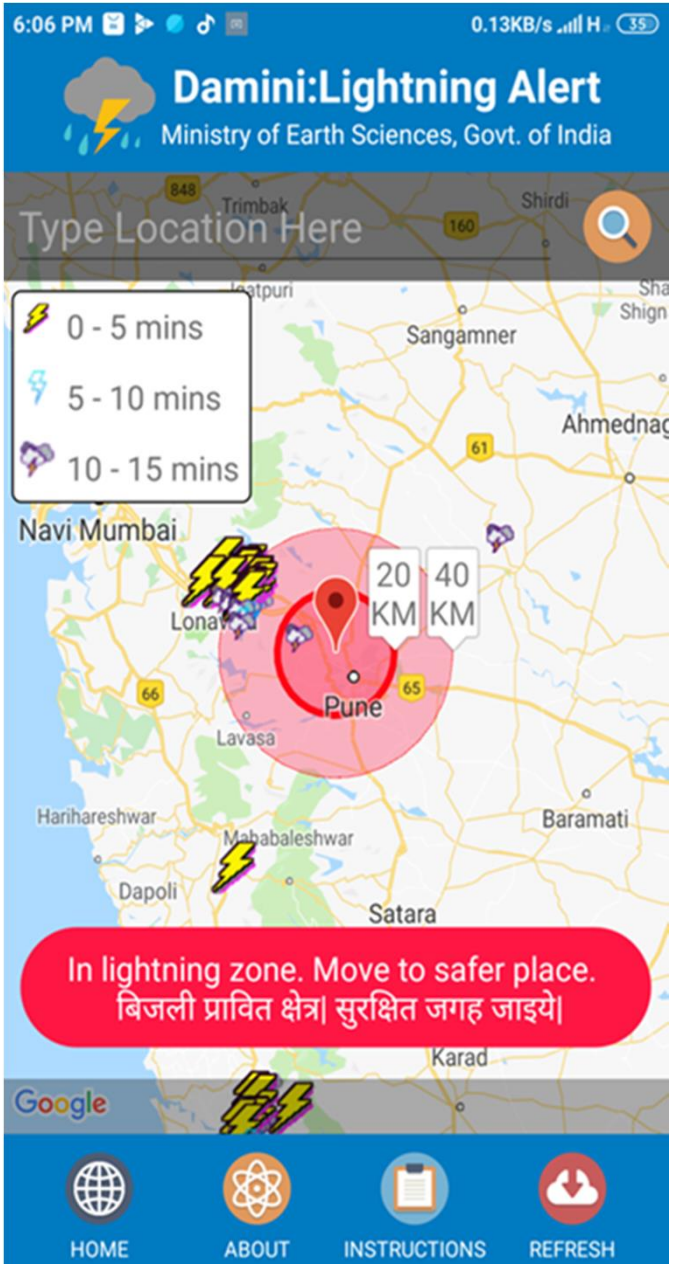
- Use of Lightning Detection Network to identify lightning prone areas.

- This network can also be effectively used for very short range forecast (nowcasting) of the lightning activity.

Location of Sensors installed



Damini App

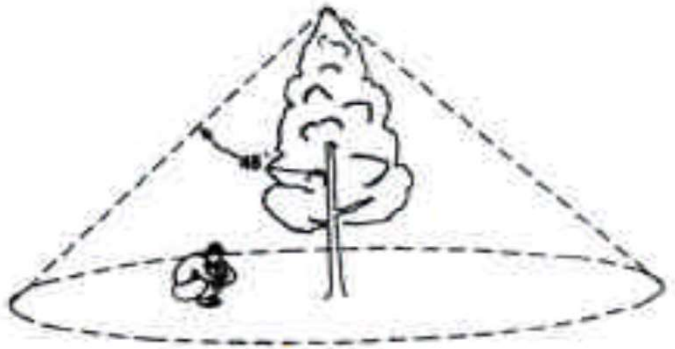

6:06 PM
0.13KB/s
Damini:Lightning Alert
Ministry of Earth Sciences, Govt. of India
Type Location Here
Trimbak
Shirdi
Sangamner
Ahmednag
0 - 5 mins
5 - 10 mins
10 - 15 mins
Navi Mumbai
20 KM
40 KM
Pune
Lavasa
Harihareshwar
Mahabaleshwar
Baramati
Dapoli
Satara
Karad
In lightning zone. Move to safer place.
बिजली प्रावित क्षेत्र| सुरक्षित जगह जाइये|
Google
HOME
ABOUT
INSTRUCTIONS
REFRESH

Lightning Awareness programs

- Educating people about of lighting
- Safe shelters for human and livestocks during lightning

Educating people about of lighting

- Advise the people to restrict their movement outside during thunderstorm periods.
- Advise them to stay inside houses, huts as far as possible and keep the flooring and walls of the houses dry.
- Not to stand below/near trees.
- Install lighting arrestors in tall building and isolated houses.



SUGGESTED POSTURE NEAR TREE IF SURPRISED BY LIGHTNING ARROUND

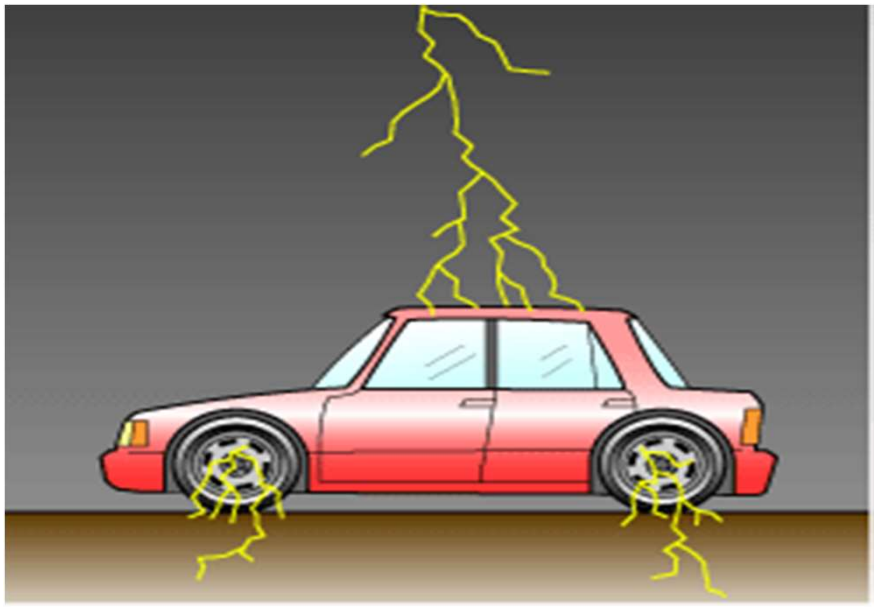
Some basic Do's and Don'ts during thunderstorm

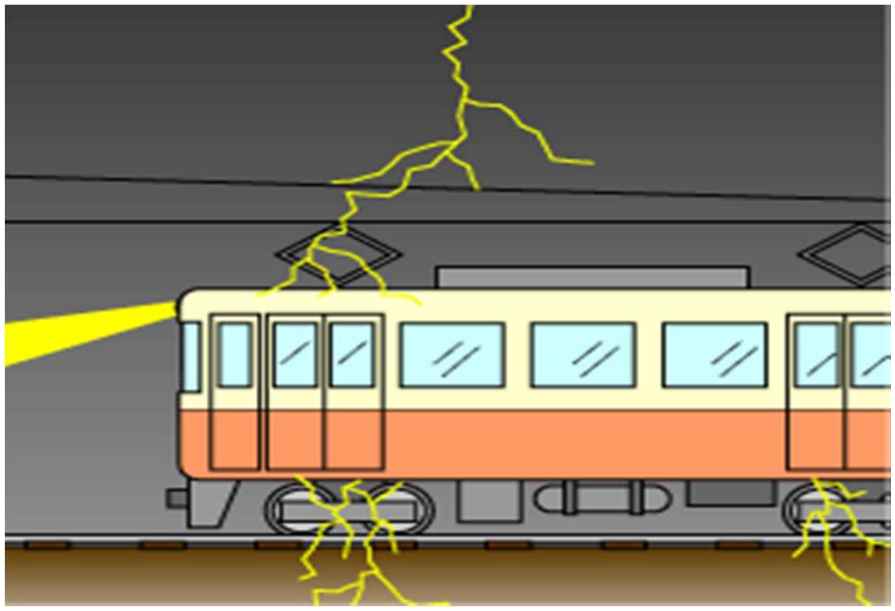
- Stay or go indoors! If you hear thunder, don't go outside unless absolutely necessary. Remember, by counting the seconds between the flash and the thunder and dividing by 3, you can estimate your distance from the strike (in km).

- Stay away from anything that could conduct electricity. This includes fireplaces, radiators, stoves, metal pipes, sinks, and phones.

- Don't use any plug-in electrical appliances like hair dryers, electric toothbrushes, or electric razors. If lightning strikes your house they can conduct the charge to you.

- **Stay in your automobile if you are travelling. Automobiles give you excellent lightning protection.**





- **A safe vehicle is a hard-topped car, SUV, minivan, bus, tractor, etc. (soft-topped convertibles are not safe) . If you seek shelter in your vehicle, make sure all doors are closed and windows rolled up. Do not touch any metal surfaces.**

- **Do NOT seek shelter under tall isolated trees. The tree may help you stay dry but will significantly increase your risk of being struck by lightning. Rain will not kill you, but the lightning can!**

Some Lightning Myths and, reality

1. **MYTH**: *Lightning never strikes the same place twice.*

   FACT: Lightning often strikes the same place repeatedly, especially if it's a tall pointy isolated object. The Empire State Building used to be used as a lightning laboratory, since it is hit nearly 25 times a year. Places prone to lightning are places to avoid when thunderstorms are nearby

2. **MYTH:** If it's not raining, or if clouds aren't overhead, I'm safe from lightning.

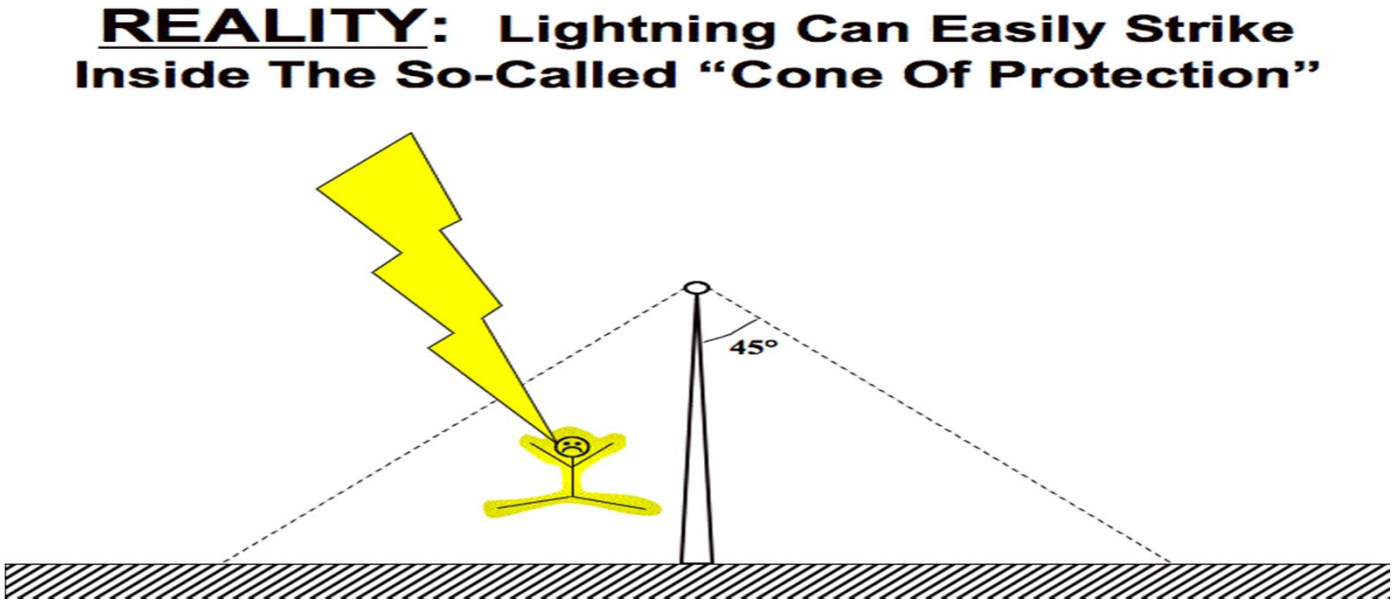
   FACT: Lightning often strikes more than 5 kilometer from the thunderstorm, far outside the rain or even thunderstorm cloud. 'Bolts from the Blue', though infrequent, can strike 15-20 Km. from the thunderstorm. Anvil lightning can strike the ground over 80 Km. from the thunderstorm, under extreme conditions

3. MYTH: Structures with metal, or metal on the body (jewelry, watches, glasses, backpacks, etc.), attract lightning

FACT: Height, pointy shape, and isolation are the dominant factors controlling where a lightning bolt will strike. The presence of metal makes virtually no difference on where lightning strikes. Mountains are made of stone, but receive many strikes each year. When lightning threatens, take proper protective action immediately. Don't waste time shedding metal off your body, or seeking shelter under inadequate structures. But while metal doesn't attract lightning, touching or being near long metal objects (fences, railings, bleachers, vehicles, etc.) is still unsafe when thunderstorms are nearby. If lightning does happen to hit it, the metal can conduct the electricity a long distance (even over 100 meter) and still electrocute you.

10. **MYTH:** Go near a tall pointy isolated object when thunderstorms threaten, to be within the 45° “cone of protection”

FACT: The “cone of protection” may be a myth! While tall pointy isolated objects are statistically more likely to be struck by lightning, it’s not nearly reliable enough to rely on for safety. Lightning can still strike you near the tall object. Besides, the lightning electricity will likely spread out along the surface of the ground and can still kill you over 30 meter from the “protecting” object. Also, if you are close to or touching the tall object, you can be electrocuted via side flash or contact voltage.



NO PLACE OUTSIDE IS SAFE NEAR A THUNDERSTORM

Thank You

Cyclogenesis and Cyclone Forecasting

Dr.K.Sathi Devi, Scientist G
National Weather Forecasting Centre
India Meteorological Department
New Delhi-110003

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

Classification of Low Pressure Systems

Low pressure system	T Number	Maximum sustained surface wind speed		
		knots	mps	kmph
Low (L)/ Well Marked Low	T 1.0	< 17	< 9	< 31
Depression (D)	T 1.5	17-27	9-14	31-49
Deep depression	T 2.0	28-33	15-17	50-61
Cyclonic storm	T 2.5-3.0	34-47	18-24	62-88
Severe cyclonic storm	T 3.5	48-63	25-32	89-117
Very Severe cyclonic storm	T 4.0-4.5	64-89	33-46	118-166
Extremely Severe Cyclonic Storm	T 5.0-6.0	90-119	47-61	167-221
Super Cyclonic Storm	T 6.5 -8.0	120 and above	62 and above	222 and above

TYPES OF POTENTIAL DAMAGES ACCOMPANYING TROPICAL CYCLONES

- CYCLONE
- LOCAL TIDES
- LOCAL COASTAL CONFIGURATION

→ STORM SURGE

- FLOODING OF COASTAL AREAS
- EROSION OF BEACHES
- LOSS OF SOIL FERTILITY FROM SALINE INTRUSIONS

WIND

- DAMAGE TO STRUCTURES
- LOSS OF POWER/COMMUNICATION
- INJURIES & LOSS OF LIFE
- DESTRUCTION OF CROPS, VEGETATION, LIVE-STOCK

RAIN

- CONTAMINATION OF WATER SUPPLY SYSTEM
- LAND SUBSIDENCE
- FLOODING OF INLAND AREA

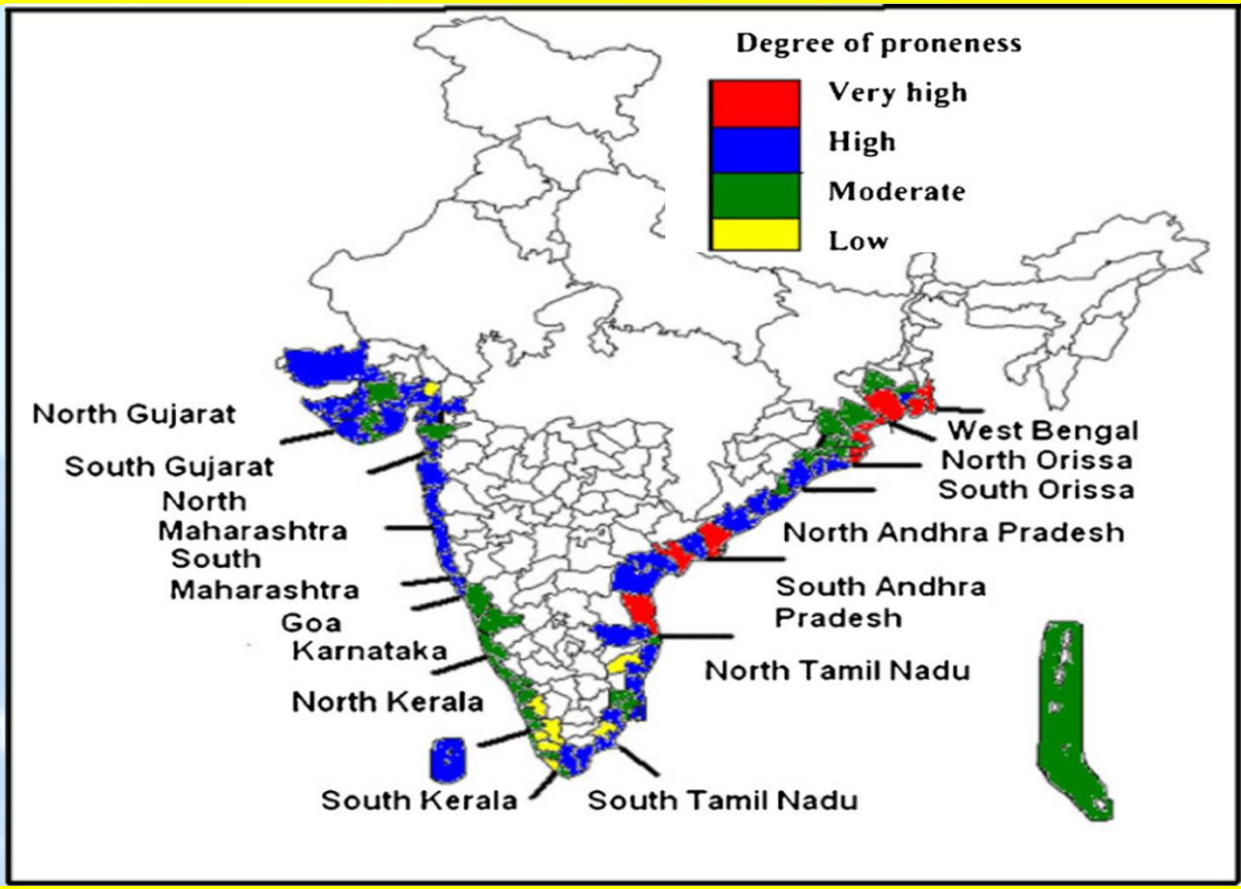
Cyclone Hazard Analysis

Cyclone Hazard Prone Districts

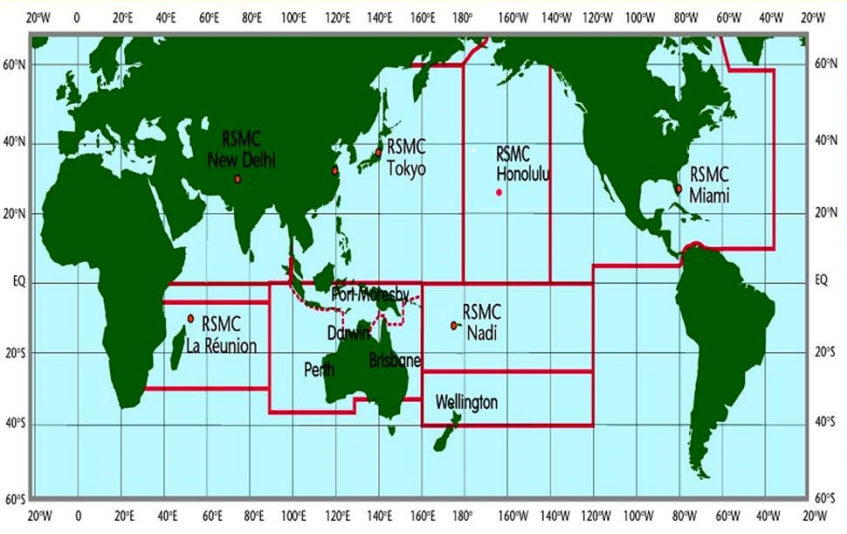
Based on:

- Frequency
- Intensity
- Wind Strength
- Probable Maximum Precipitation(PMP)
- Probable Maximum Storm Surge(PMSS)

Most Vulnerable States:
West Bengal, Odisha, Andhra Pradesh



Institutional Mechanism for Cyclone Warning

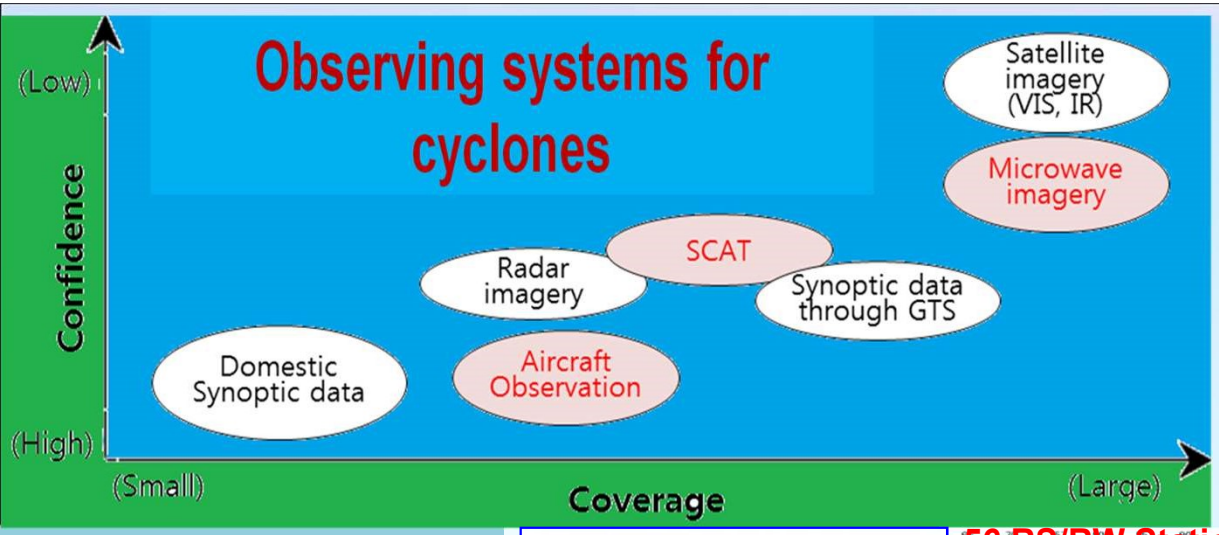


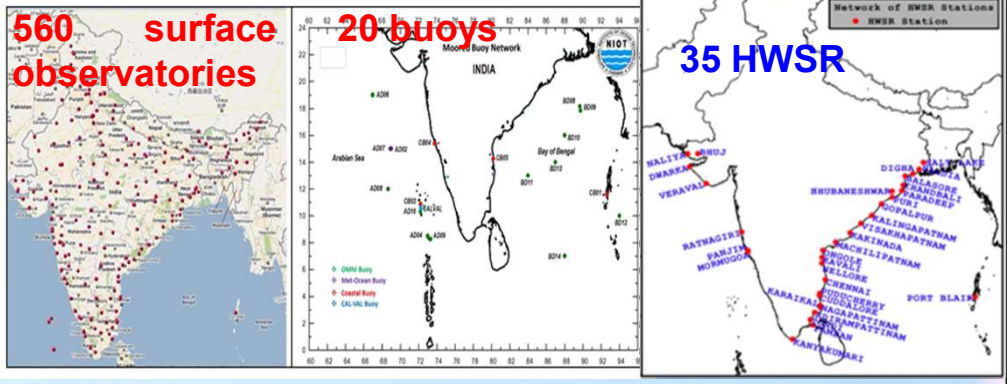
National Responsibility:

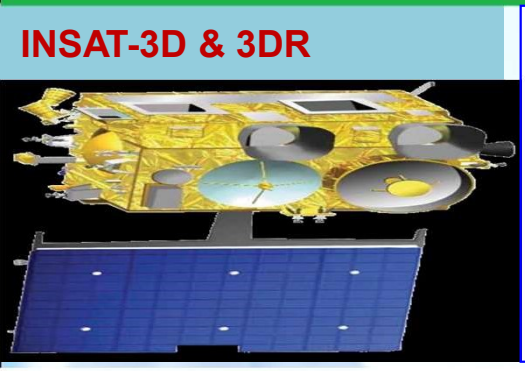
IMD is mandated to monitor and issue warnings for cyclones over North Indian Ocean. IMD carries out this responsibility in the national level with support from 3 Area Cyclone Warning Centres and 4 Cyclone Warning Centres.

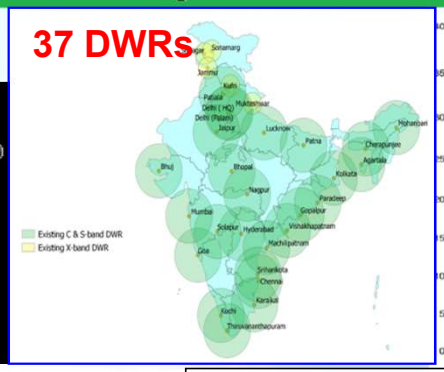
International Responsibility:

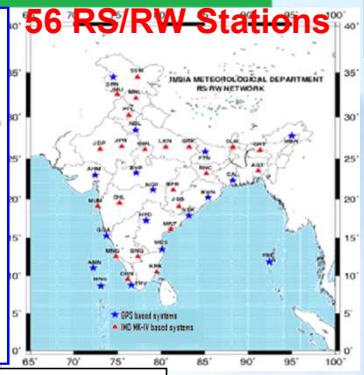
- **IMD also acts as RSMC (1/6) to provide tropical cyclone advisories to 13 countries under WMO/ESCAP Panel (Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka, Thailand, Yemen, UAE, Saudi Arabia, Qatar, Iran.**
- **IMD is the Nodal agency to provide severe weather guidance (heavy rainfall, strong winds, waves and storm surge) to 9 member countries (Thailand, Myanmar, Bangladesh, Bhutan, Nepal, India, Maldives, Sri Lanka, Pakistan)**
- **Acts as a Tropical Cyclone Advisory Centre for International Civil Aviation (1/7)**
- **Provides Global Maritime Distress Support System (GMDSS) over NIO for Met area VIII(N).**

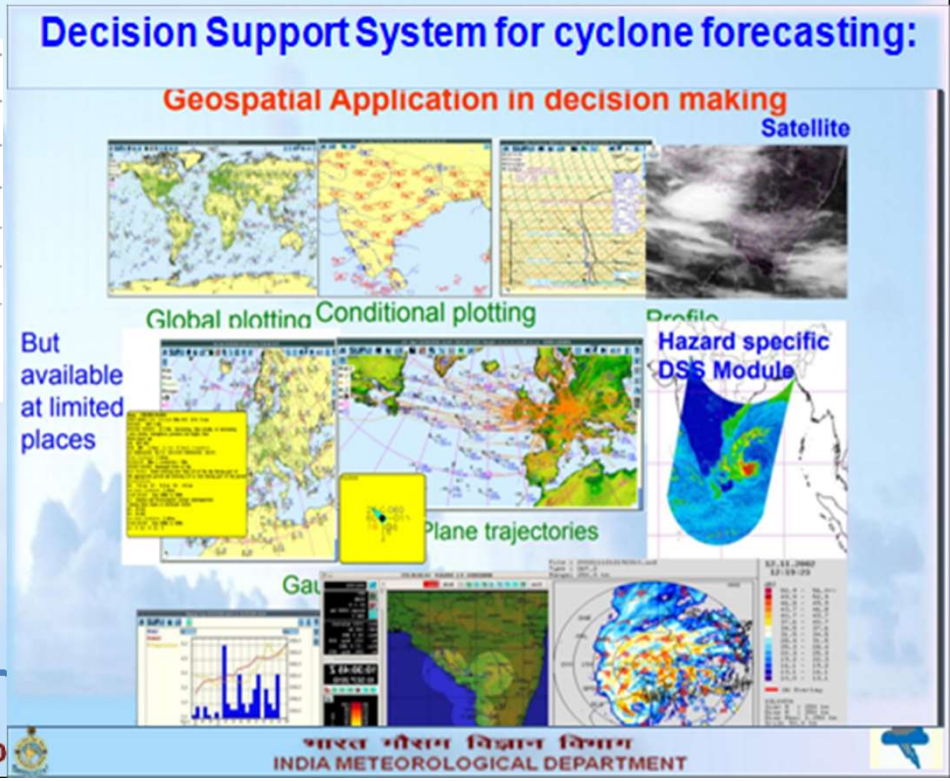

Observing systems for cyclones
Confidence
(Low)
(High)
(Small)
Coverage
(Large)
Satellite imagery (VIS, IR)
Microwave imagery
SCAT
Radar imagery
Synoptic data through GTS
Domestic Synoptic data
Aircraft Observation

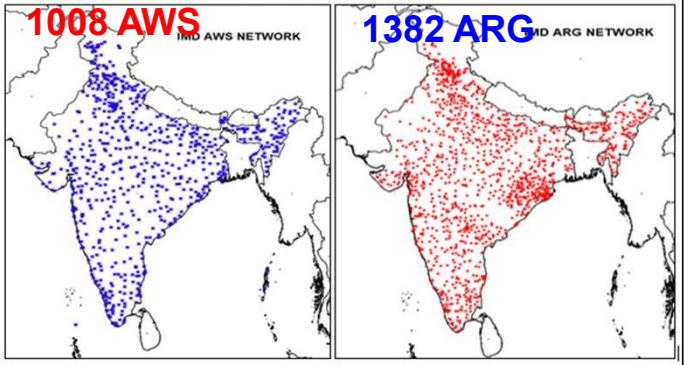

560 surface observatories
20 buoys
35 HWSR
INDIA
Network of HWSR Stations
HWSR Station


INSAT-3D & 3DR

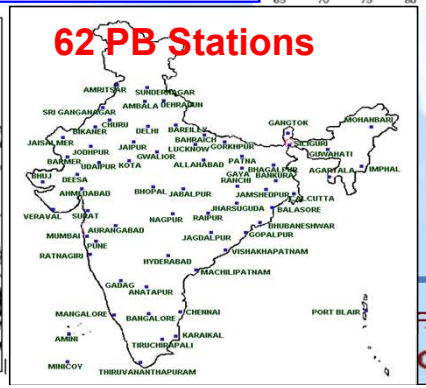

37 DWRs
Existing C & S-band DWR
Existing X-band DWR


56 RS/RW Stations
INDIA METEOROLOGICAL DEPARTMENT
RS-RW NETWORK

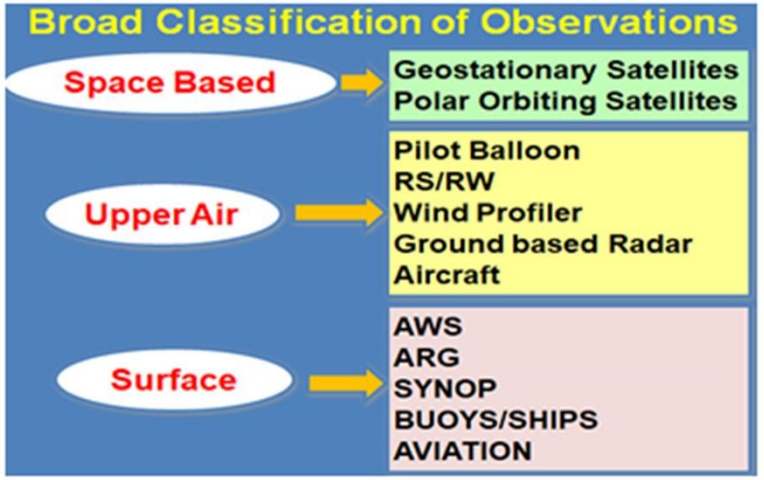

Decision Support System for cyclone forecasting:
Geospatial Application in decision making
Satellite
Global plotting
Conditional plotting
But available at limited places
Hazard specific DSS Module
Plane trajectories
INDIA METEOROLOGICAL DEPARTMENT


1008 AWS
IMD AWS NETWORK

1382 ARG
IMD ARG NETWORK


62 PB Stations

Monitoring and Forecasting Process

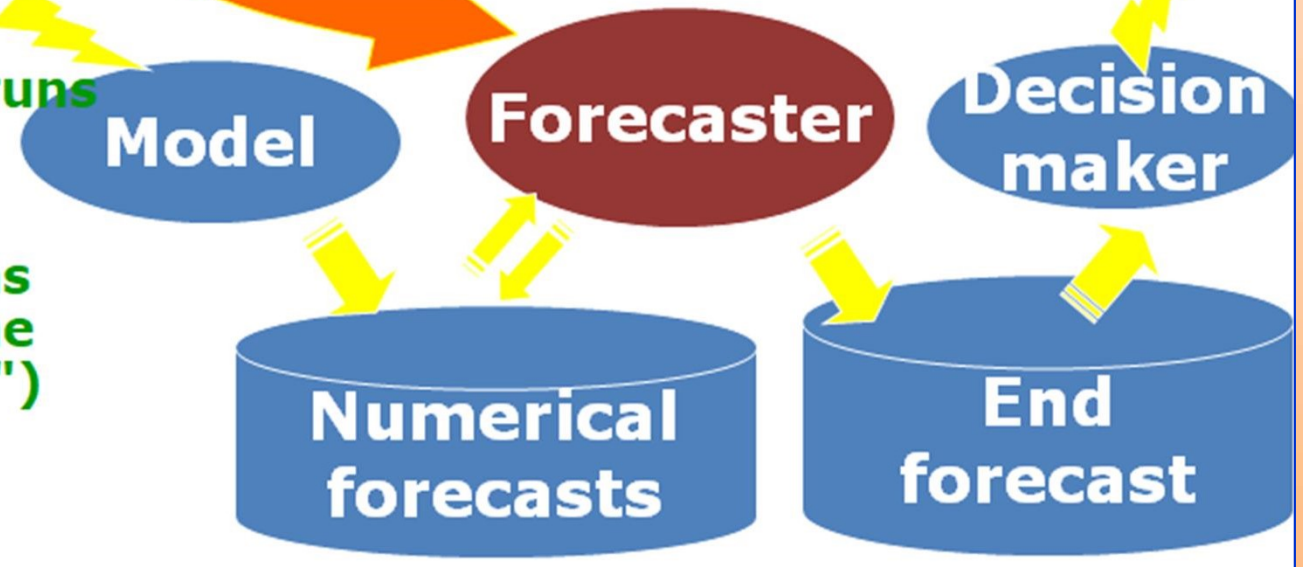


Initial conditions (Observations)

Runs of different Models,

Consecutive runs from same model,

Ensemble runs ("choosing the best member")



- Hazard and Risk analysis
- Preparedness
- Early Warning system (EWS)
- Prevention
- Mitigation

Tropical Cyclone Forecast

- Genesis
- Location of centre
- Movement (past and forecast track)
- Intensity (Wind, pressure(estimated central pressure, pressure drop))
- Structure (horizontal and vertical wind and thermal structure)
- Size (Radius of Outermost closed isobar, Radii of quadrant winds, Radius of Maximum Wind)
- Convective clouds associated with the system
- Weather (rainfall, squally/gale wind, storm surge, waves)

Genesis Forecast

Seasonal

Not Issued

- Insufficient data
- Large interannual and intra-seasonal variability
- Low skill

Extended Range

From 22nd April, 2018 onwards
Every Thursday

Valid for next 15 days with quantitative forecast of cyclogenesis as LOW (1-33%), MOD (34-67%), HIGH (68-100%)

Short to medium Range

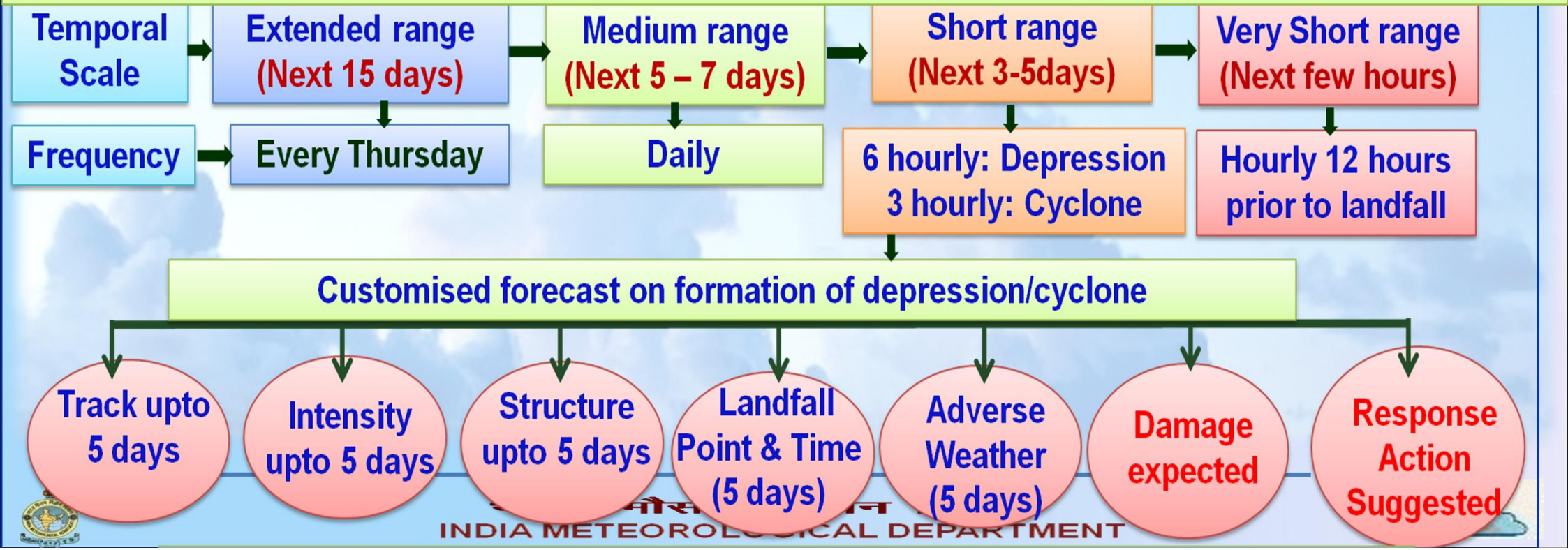
Issued Daily based on 03Z observations
June, 2014 for 72 hours validity
April, 2018 for 120 hours validity

Valid for next 5 days with cyclogenesis forecast as NIL (0%), LOW(1-33%), MODERATE (34-67%), HIGH (68-100%)

Utility: Help in planning & preparedness by DM agencies.
Helps forecasters to improve monitoring & forecasting in medium range based on extended range prediction.

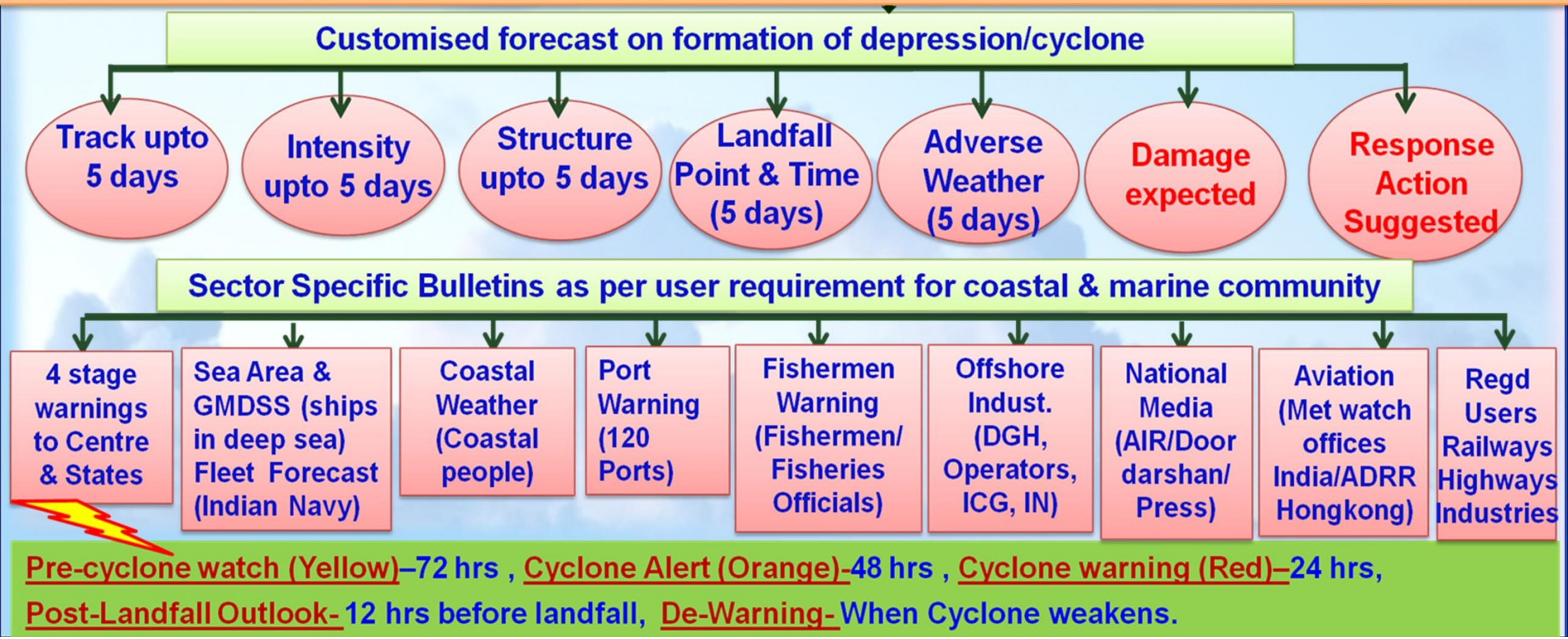
Cyclone Forecasting & Warning Process (Seamless Flow):

- Seamless forecast & warning product generation commencing with extended range forecast and followed by medium range, short range and nowcast
- Pre-genesis forecast at low pressure area stage
- Customised forecast on formation of depression
- Issue of special bulletin daily from low pressure stage

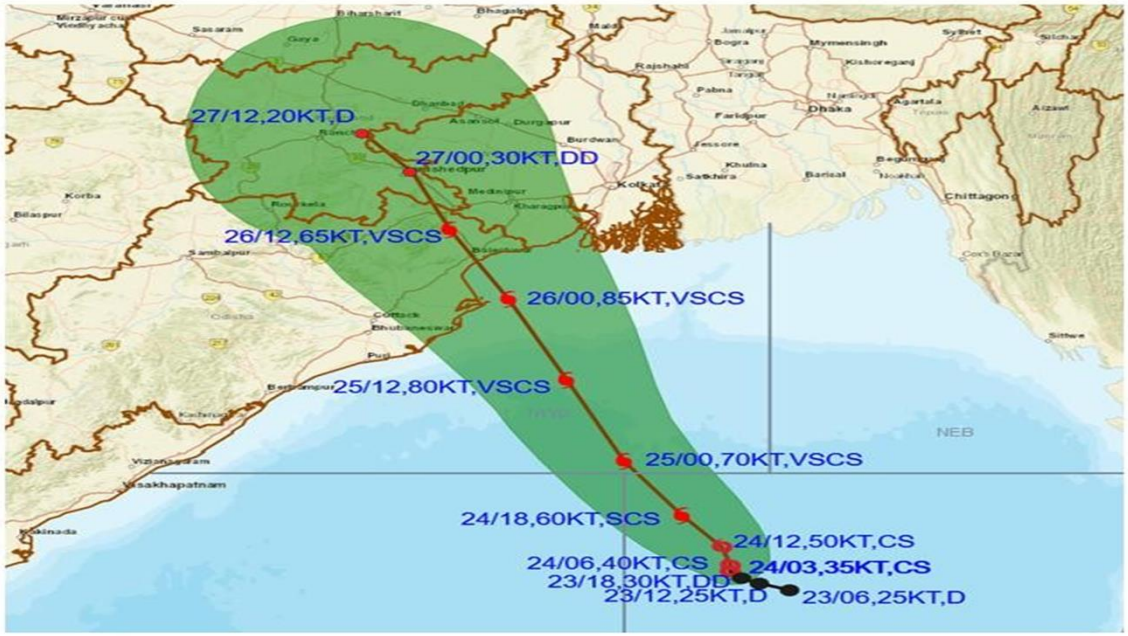


Cyclone Warning Services

- Seamless warning process commencing from low pressure stage
- Continues through medium range, short range & nowcast through four stages
- Customised forecast for each specific users and stakeholders



OBSERVED AND FORECAST TRACK ALONGWITH CONE OF UNCERTAINITY OF CYCLONIC STORM "YAAS" OVER EASTCENTRAL BAY OF BENGAL BASED ON 0300 UTC OF 24th MAY, 2021



DATE/TIME IN UTC
IST=UTC + 0530
L: LOW PRESSURE AREA
WML: WELL MARKED LOW PRESSURE AREA
D: DEPRESSION (17-27 KT)
DD: DEEP DEPRESSION (28-33 KT)
CS: CYCLONIC STORM (34-47 KT)
SCS: SEVERE CYCLONIC STORM (48-63KT)
VSCS: VERY SEVERE CYCLONIC STORM (64-89 KT)
ESCS: EXTREMELY SEVERE CYCLONIC STORM (90-119 KT)
SuCS: SUPER CYCLONIC STORM (≥ 120 KT)

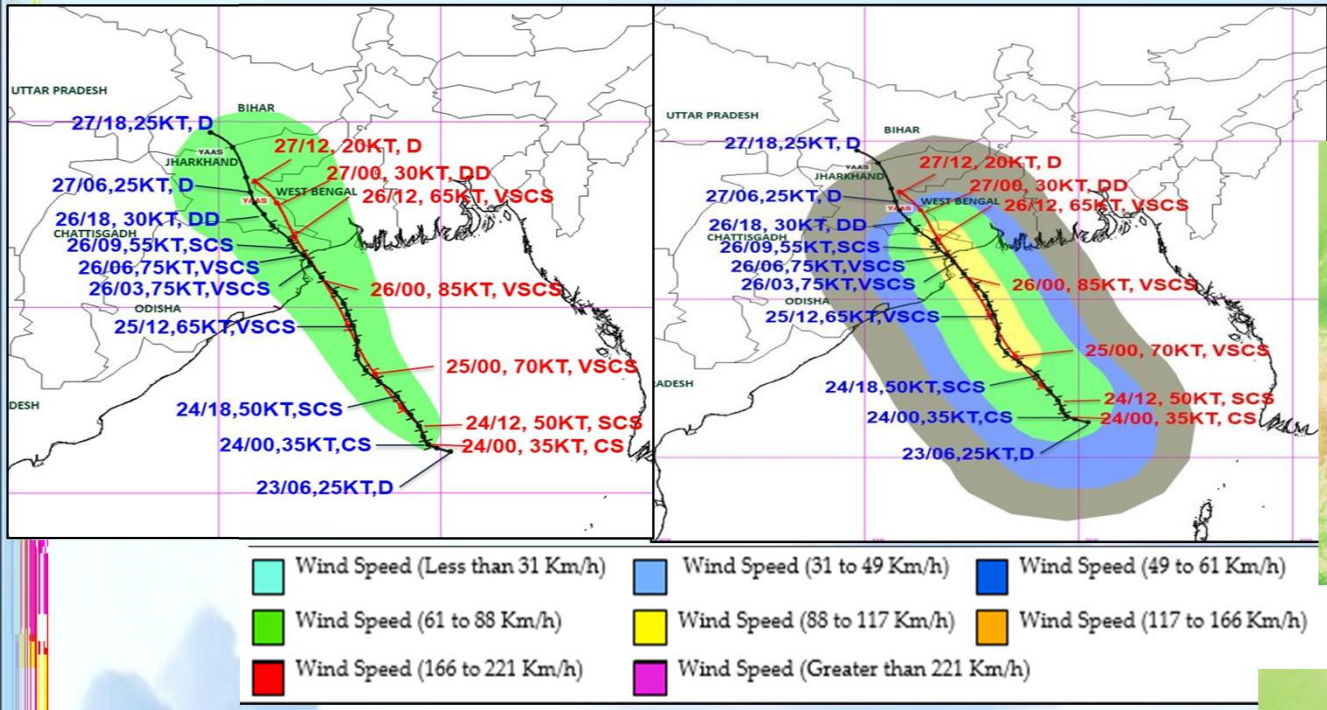
LESS THAN 34 KT
34-47 KT
≥ 48 KT
OBSERVED TRACK
FORECAST TRACK
CONE OF UNCERTAINTY

Observed & Forecast tracks of cyclone on GIS Platform introduced in June, 2020)

- This has enabled to visualize forecast more clearly with better understanding.
- Helps in effective decision making

https://ddgmui.imd.gov.in/dwr_img/GIS/previewcyclone.html

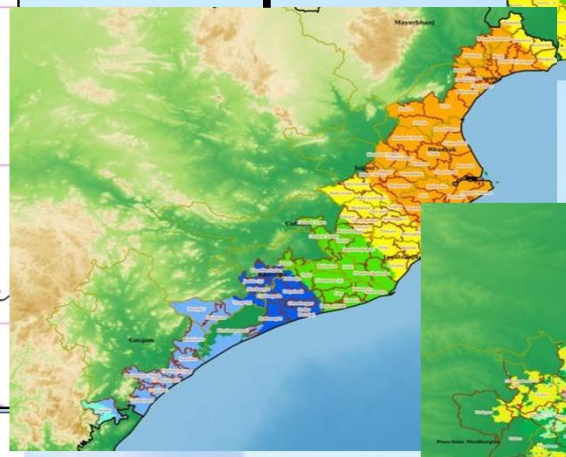
WEB-DCRA & DSS

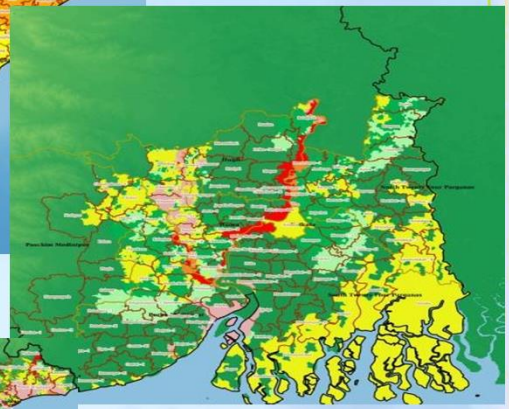


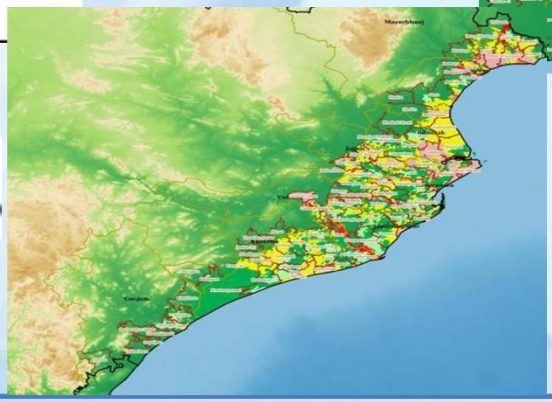
Wind Speed (Less than 31 Km/h)
Wind Speed (31 to 49 Km/h)
Wind Speed (49 to 61 Km/h)
Wind Speed (61 to 88 Km/h)
Wind Speed (88 to 117 Km/h)
Wind Speed (117 to 166 Km/h)
Wind Speed (166 to 221 Km/h)
Wind Speed (Greater than 221 Km/h)

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)

Wind Impact







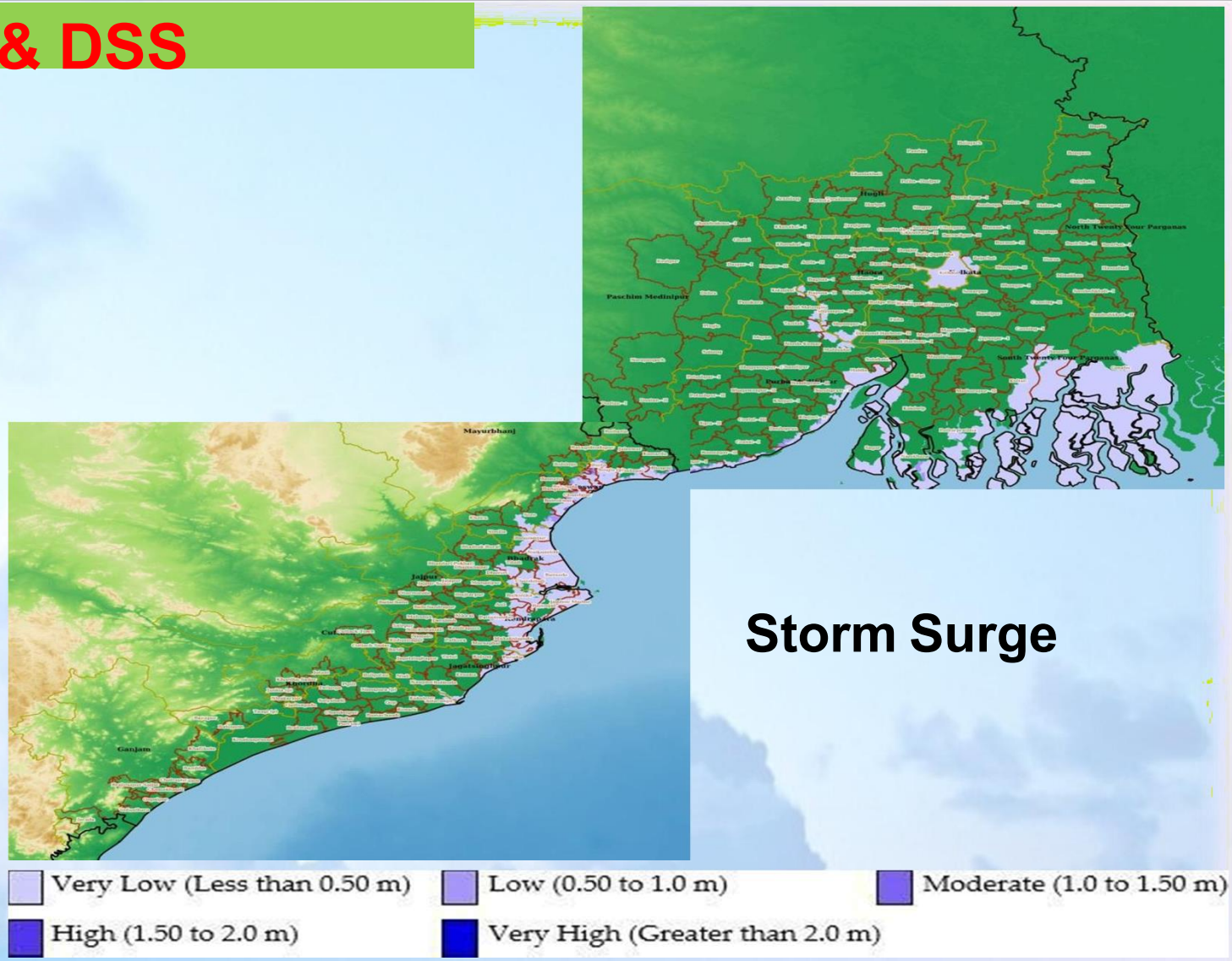
Flood /Inundation

Cyclone YAASH: IBF based on 0600 UTC of 25th May 2021

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

WEB-DCRA & DSS

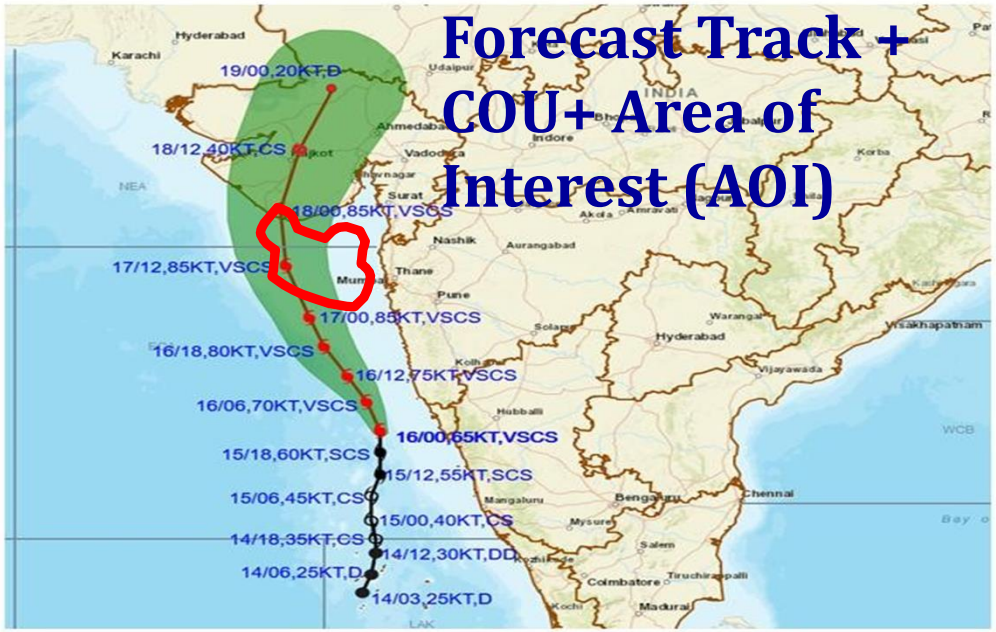
Cyclone YAASH: IBF based on 0600 UTC of 25th May 2021



Storm Surge

Specialized Forecast for Offshore E & P Operators

Forecast Track + COU+ Area of Interest (AOI)



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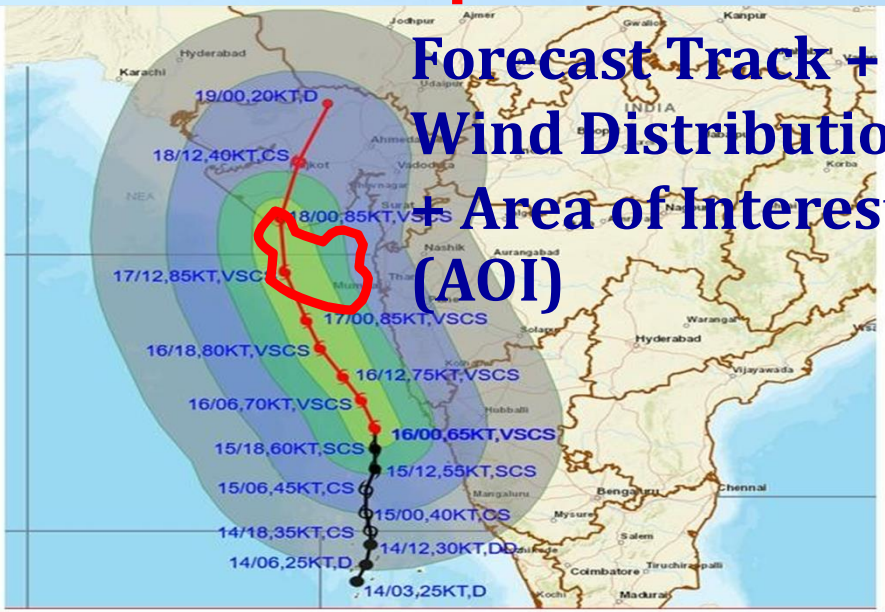
SCS: SEVERE CYCLONIC STORM (48-63KT)
VSCS: VERY SEVERE CYCLONIC STORM (64-89 KT)
ESCS: EXTREMELY SEVERE CYCLONIC STORM (90-119 KT)
SuCS: SUPER CYCLONIC STORM (≥ 120 KT)

LESS THAN 34 KT
34-47 KT
≥ 48 KT
OBSERVED TRACK
FORECAST TRACK
CONE OF UNCERTAINTY

Forecast Track + Wind Distribution + Area of Interest (AOI)



DATE/TIME IN UTC
IST=UTC + 0530
L: LOW PRESSURE AREA
WML: WELL MARKED LOW PRESSURE AREA
D: DEPRESSION (17-27 KT)
DD: DEEP DEPRESSION (28-33 KT)
CS: CYCLONIC STORM (34-47 KT)
SCS: SEVERE CYCLONIC STORM (48-63KT)
VSCS: VERY SEVERE CYCLONIC STORM (64-89 KT)
ESCS: EXTREMELY SEVERE CYCLONIC STORM (90-119 KT)
SuCS: SUPER CYCLONIC STORM (≥ 120 KT)

LESS THAN 34 KT
34-47 KT
≥ 48 KT
OBSERVED TRACK
FORECAST TRACK
CONE OF UNCERTAINTY
AREA OF MAXIMUM SUSTAINED WIND SPEED:
28-33 KT (52-61 KMPH)
34-49 KT (62-91 KMPH)
50-63 KT (92-117 KMPH)
≥ 64 KT (≥118 KMPH)

IMPACT OVER THE SEA

MSW (knot/kmph)	Impact	Action
28-33 (52-61)	Very rough seas	Total suspension of fishing operations
34-49 (62-91)	High to very high seas	Total suspension of fishing operations
50-63 (92-117)	Very high seas	Total suspension of fishing operations
≥ 64 (≥118)	Phenomenal	Total suspension of fishing operations

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

Specialized Forecast for Offshore E & P Operators

Wind forecast with radii of influence based on 0530 hrs IST of 16th May, 2021

Forecast Hour	Date /Time (IST)	Position		Forecast Intensity Category	Wind (KT)		Radii of Influence (NM)													
							R28				R34				R50				R64			
		Lat (°N)	Long (°E)		MSW	Gust	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE
00	16/0530	15.0	72.7	VSCS	65	75	160	200	240	250	80	100	150	150	40	60	80	80	25	30	30	35
12	16/1730	16.5	72.0	VSCS	75	85	160	200	240	250	80	100	150	150	40	60	80	80	25	30	30	35
24	17/0530	18.1	71.2	VSCS	85	95	160	200	240	250	80	100	150	150	40	60	80	80	25	30	30	35
36	17/1730	19.5	70.7	VSCS	85	95	160	200	240	250	80	100	150	150	40	60	80	80	25	30	30	35
48	18/0530	21.0	70.6	VSCS	85	95	160	200	240	250	80	100	150	150	40	60	80	80	25	30	30	35
60	18/1730	22.6	71.0	CS	40	50	160	200	240	250	80	100	150	150								
72	19/0530	24.2	71.7	D	20	30																

Note1: Lead period of forecast is 72 hours in case of depression and upto 120 hours in case of cyclones over deep sea

Note 2: Maximum sustained wind and wave characteristics correspond to the values in core region.

Note 3: Forecast movement (speed/direction) is average movement for next 06/12 hours and direction is given in 16 points of compass.

Note4: MSW: Maximum sustained wind speed is the 3 minute average wind speed in any sector around the disturbance. Gustiness is about 10-20% of the MSW.

Note 5: Radii of influence are expressed in terms of R28: radial extension of winds ≥28 kt, R34: radial extension of winds ≥34 kt, radial extension of winds ≥50 kt, R64: radial extension of winds ≥64 kt,

Specialized Forecast for Offshore E & P Operators

TABLE 4: CYCLONIC DISTURBANCE FORECAST FOR ARABIAN SEA & MAJOR AREAS OF E&P OPERATIONS BASED 0530 IST OF 16TH MAY, 2021

SL	LOCATION	CURRENT LOCATION OF DISTURBANCE		CURRENT DISTANCE AND DIRECTION FROM CENTRE OF CYCLONIC DISTURBANCE		FORECAST PARAMETERS WHEN THE INSTALLATION WOULD BE NEAREST TO THE CYCLONE PATH							
		LAT (°N)	LONG (°E)	DISTANCE (NM)	DIRECTION OF RIG FROM CYCLONE	DATE/ TIME (IST) OF OCCURRENCE	DISTANCE OF RIG FROM PATH (NM)	DIRECTION OF RIG FROM PATH	UNCERTAINTY IN PATH FORECAST (NM)	MSW (KTS)	UNCERTAINTY IN INTENSITY FORECAST (KT)	SIGNIFICANT WAVE HEIGHT (M)	STATE OF SEA
ARABIAN SEA AREA													
1.	Lakshadweep Area (LAK)-1 (08.75° N/75.67° E)	15.0°	72.7°	415	SSE	16.05.21/ 0530	415	SSE	10	< 27	5	< 4	Rough
2.	Lakshadweep Area (LAK)-2 (11.00° N/72.75° E)	15.0°	72.7°	240	S	16.05.21/ 0530	240	S	10	33	5	4-6	Very rough
3.	East Central Arabian Sea (ECA)-1 (15.33° N/72.75° E)	15.0°	72.7°	20	NNE	16.05.21/ 0830	10	E	15	65	15	>14	Phenomenal
4.	East Central Arabian Sea (ECA)-2 (18.75° N/71.33° E)	15.0°	72.7°	239	NNW	17.05.21/ 1130	20	E	50	85	10	>14	Phenomenal
5.	North East Arabian Sea (NEA) (20.50° N/70.00° E)	15.0°	72.7°	367	NNW	18.05.21/ 0230	35	W	67	63	10	10-14	Very high

Warning Dissemination Mechanism

- Telephone, Tele-fax, Mobile Phones
- VHF/HFRT/Police Wireless, Aeronautical Fixed Terminal Network
- Global telecommunication system (GTS), NAVTEX , Internet (e-mail), ftp
- Mass Media: : Radio/TV (Prasar Bharati and private broadcasters), News Papers
- Govt. (mausam.imd.gov.in) or Public Websites, Social media (Facebook, Twitter, Instagram, BLOG), Weekly & daily Weather Video
- SMS :General Public (RSMC website), Senior Level DM Officers (CDAC), Farmers (Kisaan Portal), Fishermen (INCOIS)

Twitter:: https://twitter.com/Indiametdept

Facebook:: https://www.facebook.com/India.Meteorological.Department/

Blog:: https://imdweather1875.wordpress.com/

Instagram:: https://www.instagram.com/mausam_nwfc

Youtube:: https://www.youtube.com/channel/UC_qxTReoq07UVARm87CuyQw

WARNING DISSEMINATION: MOBILE APP

E-Governance initiative of IMD:-

Information is disseminated via Mobile Apps

- Mausam app for weather information
(https://play.google.com/store/apps/details?id=com.imd.masuam)
(https://apps.apple.com/us/app/id1522893967)
- UMANG app (https://play.google.com/store/apps/details?id=in.gov.umang.negd.g2c)
(https://apps.apple.com/in/app/umang/id1236448857)
- Damini for lightning (https://play.google.com/store/apps/details?id=com.lightening.live.damini)
(https://apps.apple.com/app/id1502385645)
- Meghdoot for Agro-met services
(https://play.google.com/store/apps/details?id=com.aas.meghdoot)
(https://apps.apple.com/in/app/meghdoot/id1474048155)
- Rain alarm
(https://play.google.com/store/apps/details?id=de.mdiener.rain.usa)

MAJOR INITIATIVES WITH RESPECT TO DISSEMINATION: CAP

- **Implementation of Common Alert Protocol (CAP)**

- ✓ **IMD has started the dissemination of weather information through Common Alerting Protocol (CAP).**
- ✓ **These feeds are automatically aggregated to the WMO Alert Hub at https://cap-sources.s3.amazonaws.com/in-imd-en/rss.xml. These alerts are also disseminated to Google,AccuWeather, Global Multi-Hazard Alert System (GMAS) portal (https://gmas.asia/).**
- ✓ **IMD also participates as one of the alert generating agencies for the CAP alert project of NDMA developed by CDOT.**
- ✓ **During the cyclone 'YAAS', 7.1 cr, Tauktae 0.18 cr, Nisarga 1.98 cr and Gulab 0.32 cr messages were disseminated through CAP platform.**
- ✓ **Training of all IMD Centres for NDMA-CAP PAN India project has been completed and all the centres are using the platform to disseminate the warnings.**

MAJOR INITIATIVES IN INDIA WITH RESPECT TO DISSEMINATION

Application Programming Interface (API)

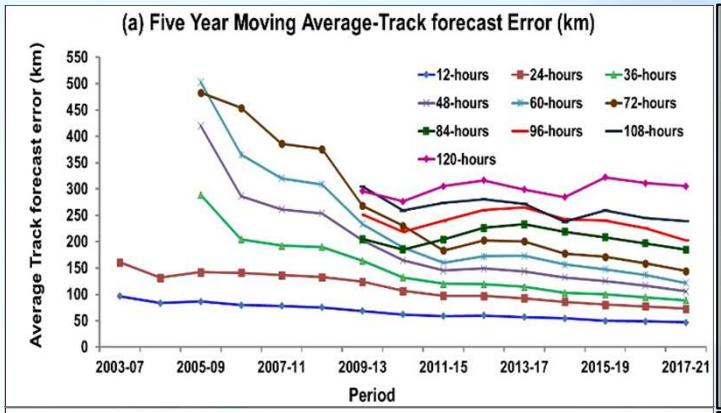
- ✓ API interface has been developed for various products like cyclones , heavy rainfall, thunder storms, heat wave etc. It is used by various stake holders within the country and outside including Global Multi-hazard Alert System (GMAS) of WMO, Google, Apple etc.

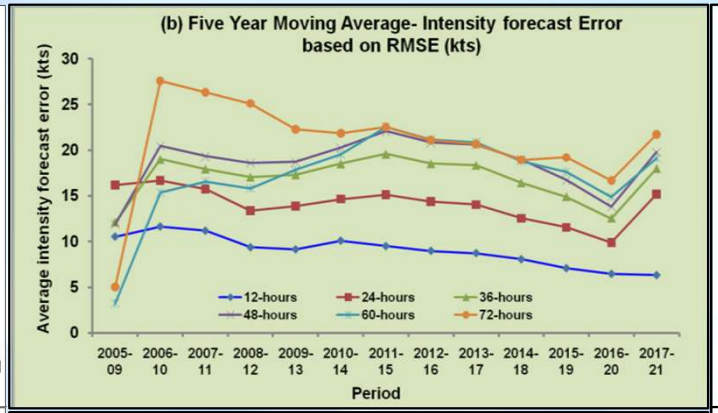
IMPLEMENTATION OF CROWD SOURCING IN IMD

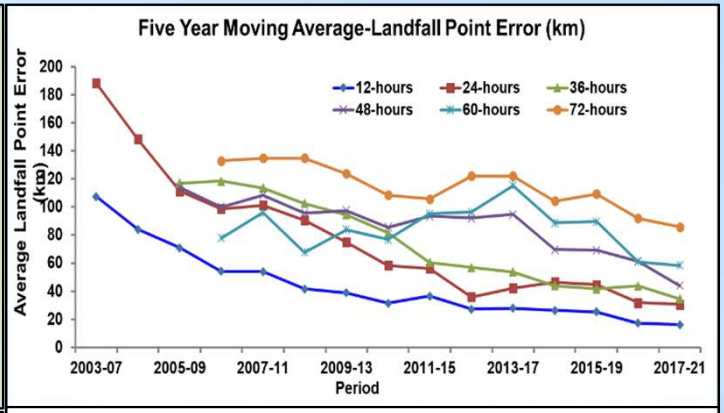
- ✓ India Meteorological Department launched its Crowd source web interface in January 2021 to allow users to make their own observations and share with service provider.
- ✓ This feature can be found in the "Public Observation" section of Mausam website of IMD (https://city.imd.gov.in/citywx/crowd/enter_th_datag.php).
- ✓ User can report their observations (textual and .png format) along with their location and time of the events.

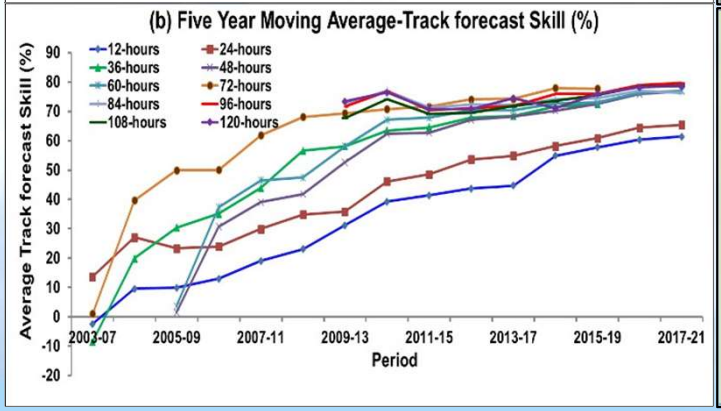
Five Year Moving Average- Track Forecast Error & Skill

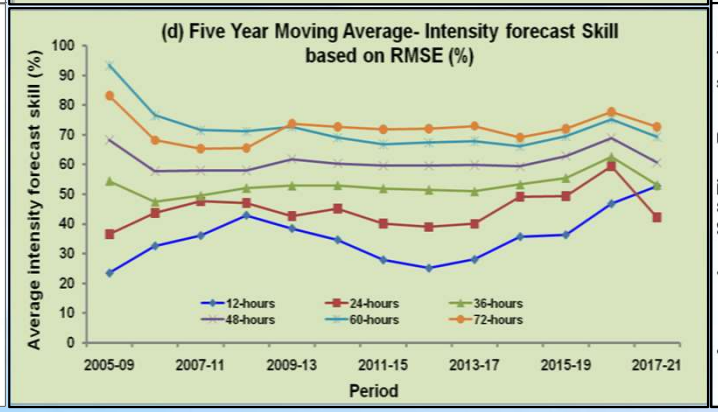
- About 25% decrease in error compared to previous five years
- At par or better than many leading centres
- Recurving and rapidly/slow moving tracks are still challenging

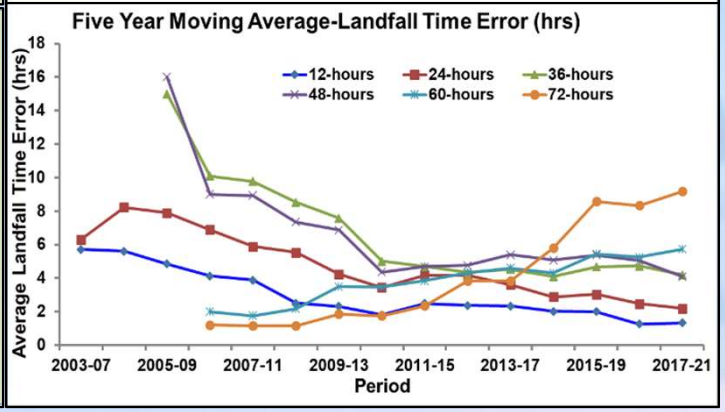












Way Ahead

- IMD under the Ministry of Earth Sciences has been continuously strengthening and upgrading Early Warning System aiming at Disaster Risk Reduction based on state of art technology which helped to minimize loss of lives.

❖ Scope for application of latest technology:

- Application of Artificial Intelligence & Machine learning
- Digital forecasting
- Include projections of Climate Change
- Develop multi-institutional mechanism to develop disaster resilient society
- Last mile connectivity
- Effective utilization via consistent data base updating of the Web DCRA-DSS tool for Dynamic impact based forecasting and risk based warning


Thank you

NRSC-Lightning Detection Sensor Network

: **Alok Taori,** Sci/Eng 'SG'

A. Suryavanshi & D. Venkatesh

Why shall we worry about Lightning

2 minute read · December 8, 2022 2:26 AM GMT+5:30 · Last Updated 3 months ago

Lightning kills 907 in India as extreme weather surges in 2022

Reuters

[1/2] A policeman jumps off a makeshift raft after wading through a flooded area of a slum on the banks of the river Yamuna in New Delhi, India, September 28, 2022. REUTERS/Anushree Fadnavis/F... Read more

Lightning strikes kill more than 100 in India

The Guardian, 26 June 2020

Bihar state records one of the highest daily tolls from lightning in recent years as monsoon begins

www.deccanherald.com › State › Top Karnataka Stories

Karnataka: 9 killed in lightning strikes | Deccan Herald

Karnataka: 9 **killed** in **lightning strikes**. **Oct** 20 **2020**, 22:42 ist. updated: **Oct** 21 **2020**, 03:41 ist.

science.thewire.in › the-sciences › india-lightning-death...

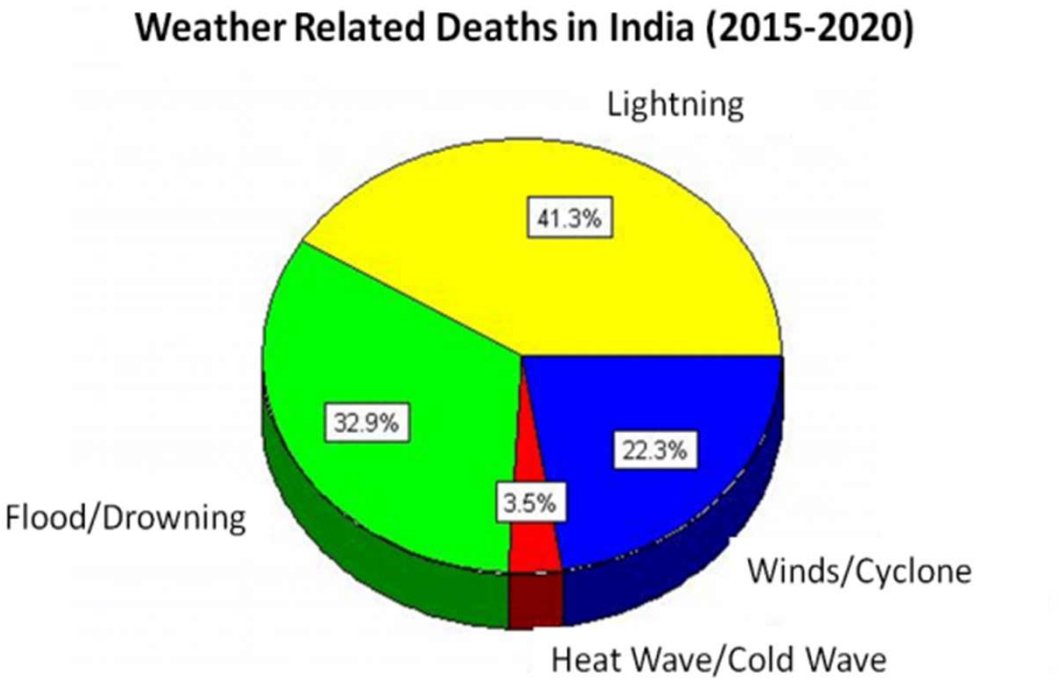
Understanding India's Lightning Patterns to Prevent India's ...

Jul 8, 2020 — ... **Deaths**. 08/07/**2020** ... One possibility for the apparently low rate of **deaths** due to **lightning** is the low level of reporting, especially from rural areas. ... It forms mainly in thunderstorms – or cumulonimbus clouds – in **India**. ... period from March to May, and the northeast monsoon from **October** to **December**.

www.indiatvnews.com › India

Thane lightning strikes maharashtra deaths injured casualties ...

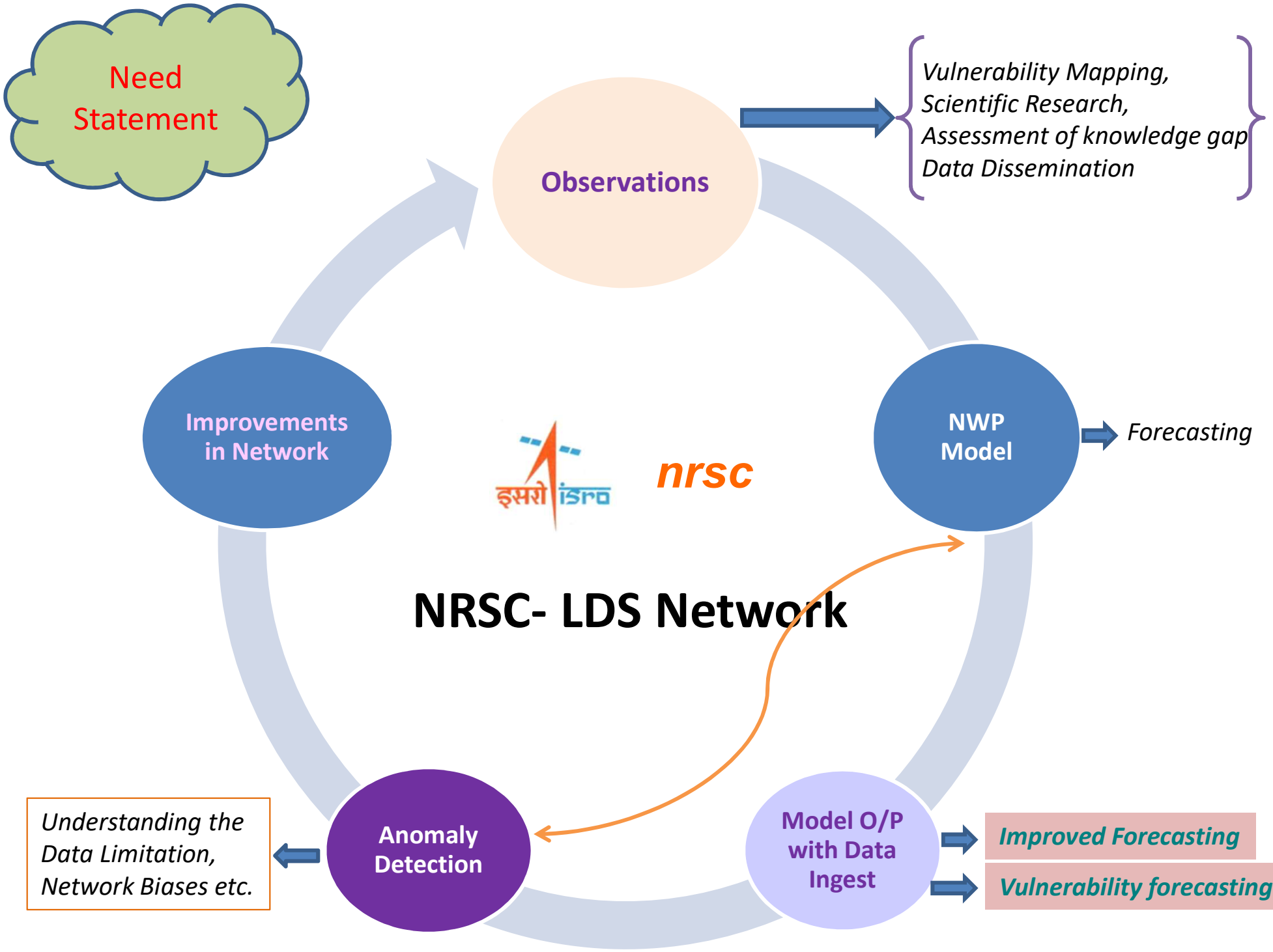
15-year-old boy dies, 26 injured as **lightning strikes** Thane in Maharashtra ... New Delhi Published on: **October** 22, **2020** 7:43 IST ... Latest **India** News.



hilly topography, deciduous monsoon jungles, low altitude clouds, rich mineral content etc., during the monsoon from June to September, especially in initial and terminal phase of monsoon, lightning causes huge loss to life and property. The reported loss of life has been highest 247 in 2007 and the death toll during the last three years and the compensation paid out of State budget for the same is as under:

Ser	Year	Deaths due to lightning (in Number)	Amount of compensation paid (in Rupees)
1.1	2011-12	139	1,47,22000
1.2	2012-13	160	2,22,24000
1.3	2013-2014	183	2,90,20550
1.4	2014-15	204	4,67,00000
1.5	2015-2016	148	3,10,00000
	Total	632	14,36,66,550

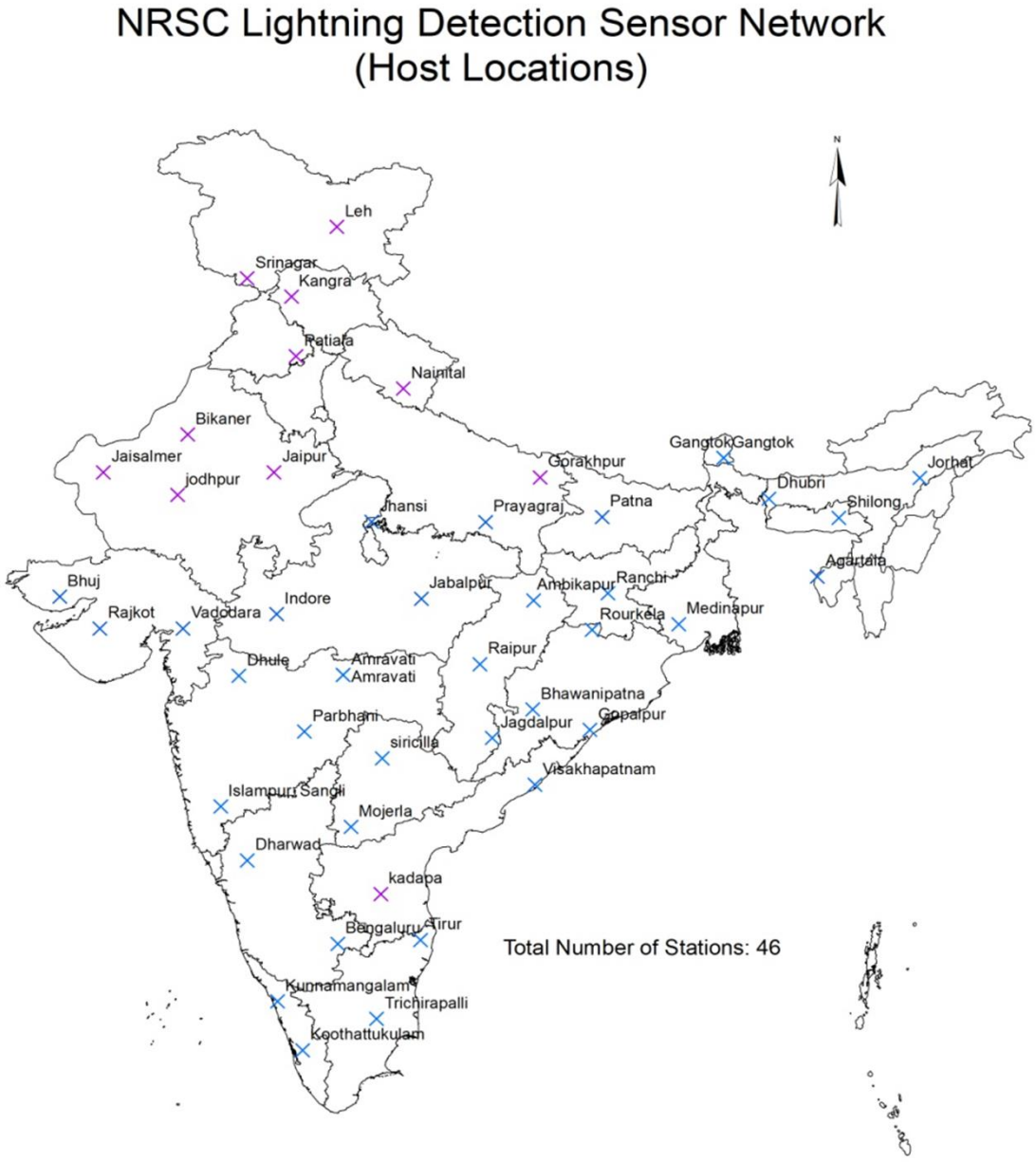
K.Joice Joseph, Karunakaran Akhildev, Asha Rose, Naveen Babu and A.P.Pradeepkumar 2017 *Proceedings of the 3rd Disaster, Risk and Vulnerability Conference (DRVC2017) 29–31 March 2017* Dept of Geology, Universityof Kerala, India ISBN9788192344980


Need Statement
Observations
Vulnerability Mapping,
Scientific Research,
Assessment of knowledge gap
Data Dissemination
NWP Model
Forecasting
Improvements in Network
nrsc
NRSC- LDS Network
Anomaly Detection
Understanding the Data Limitation, Network Biases etc.
Model O/P with Data Ingest
Improved Forecasting
Vulnerability forecasting

NRSC- Lightning Detection Sensor Network

Lightning Detector Sensing System

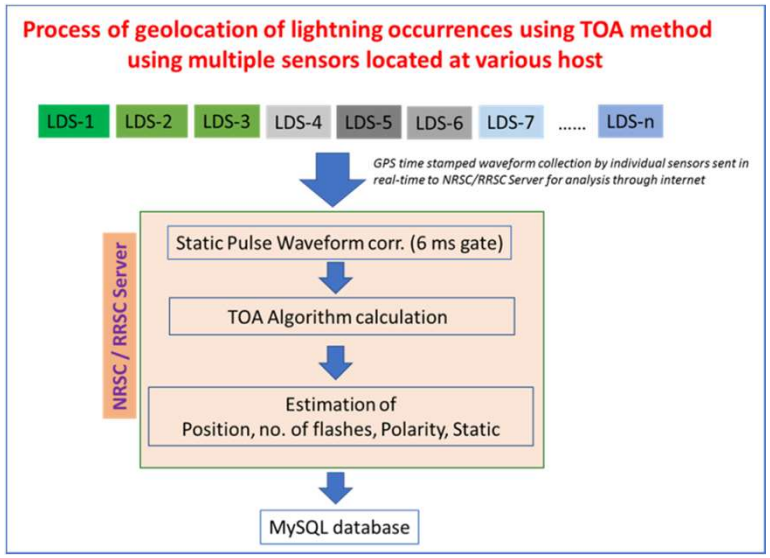
Omni-directional Antenna
Freq. Range: **1 Hz - 30 MHZ**
Detection Range:
300 km (98% confidence)
500 km (95% confidence)
Gate Time: 10 ms
Response time: 100 ns, 12 bit resolution
GPS Stamping: Trimble

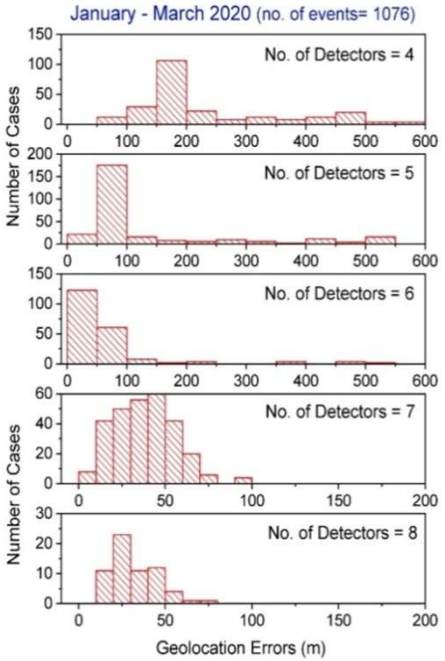


Objectives:

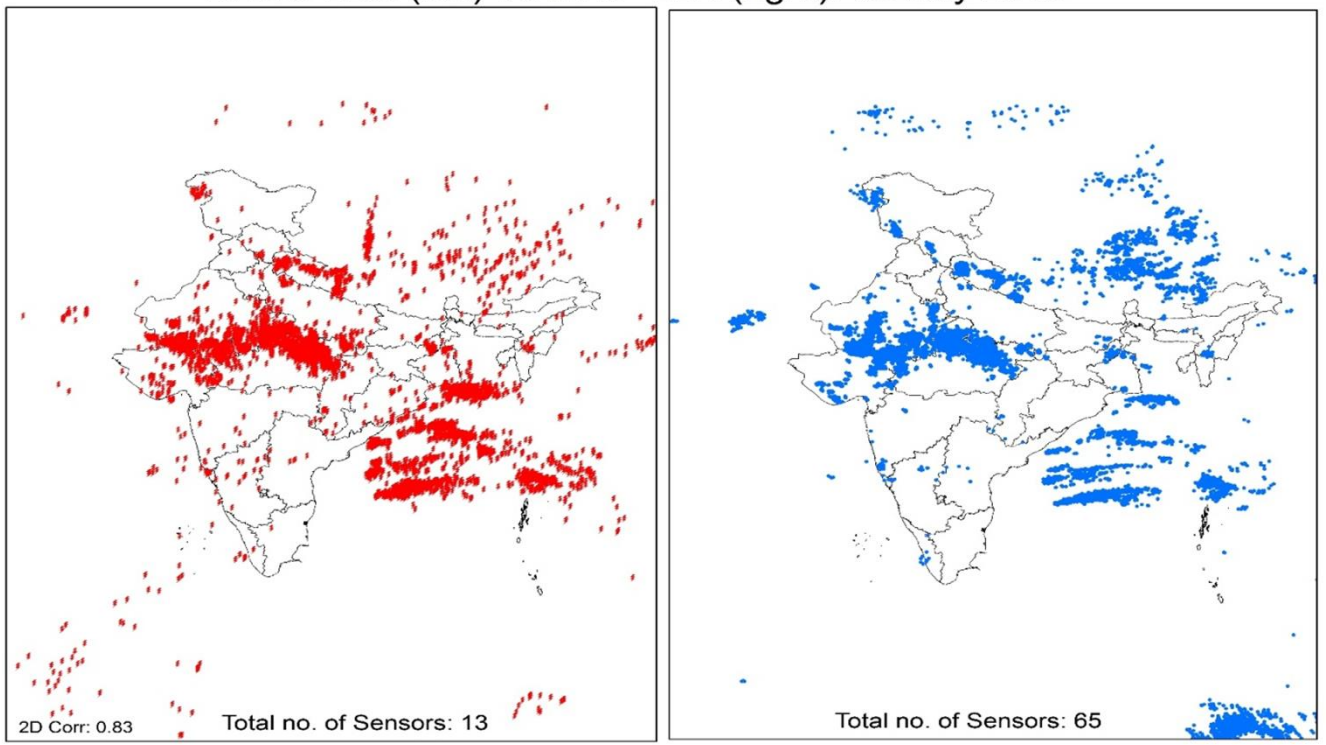
- Establishment of a lightning detection sensor network to detect the phenomena
- Generation of **Essential Climate Variable (ECV)** & its impact on the atmospheric constituents.
- Identification of potential danger zones and vulnerable area
- Investigate the usage of LDS data as input in weather forcasting models for developing a possible alert system

Processing of LDS data – Flow Chart



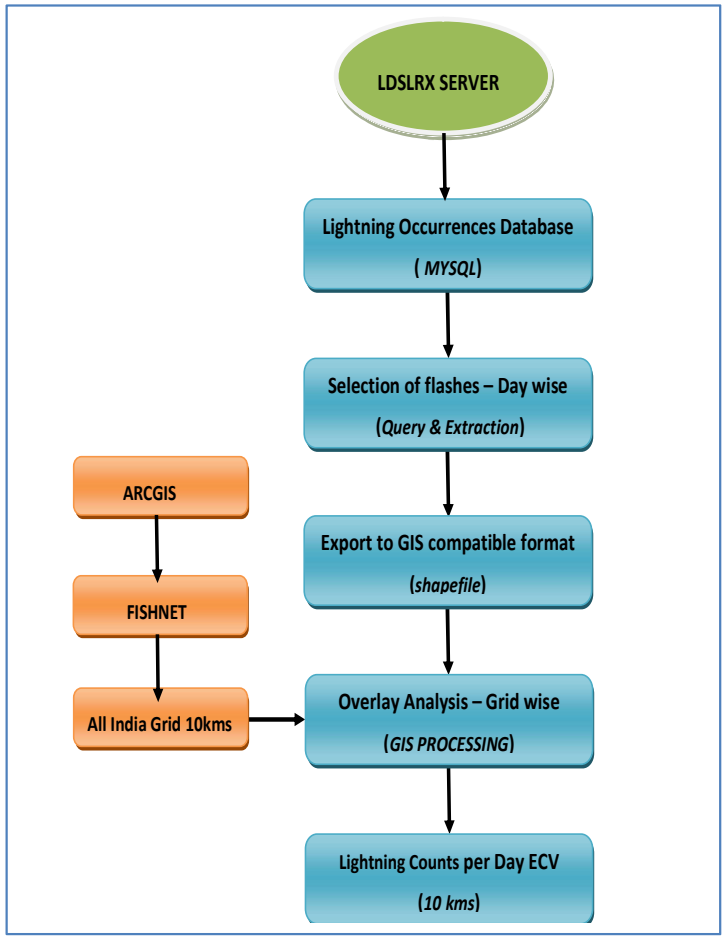


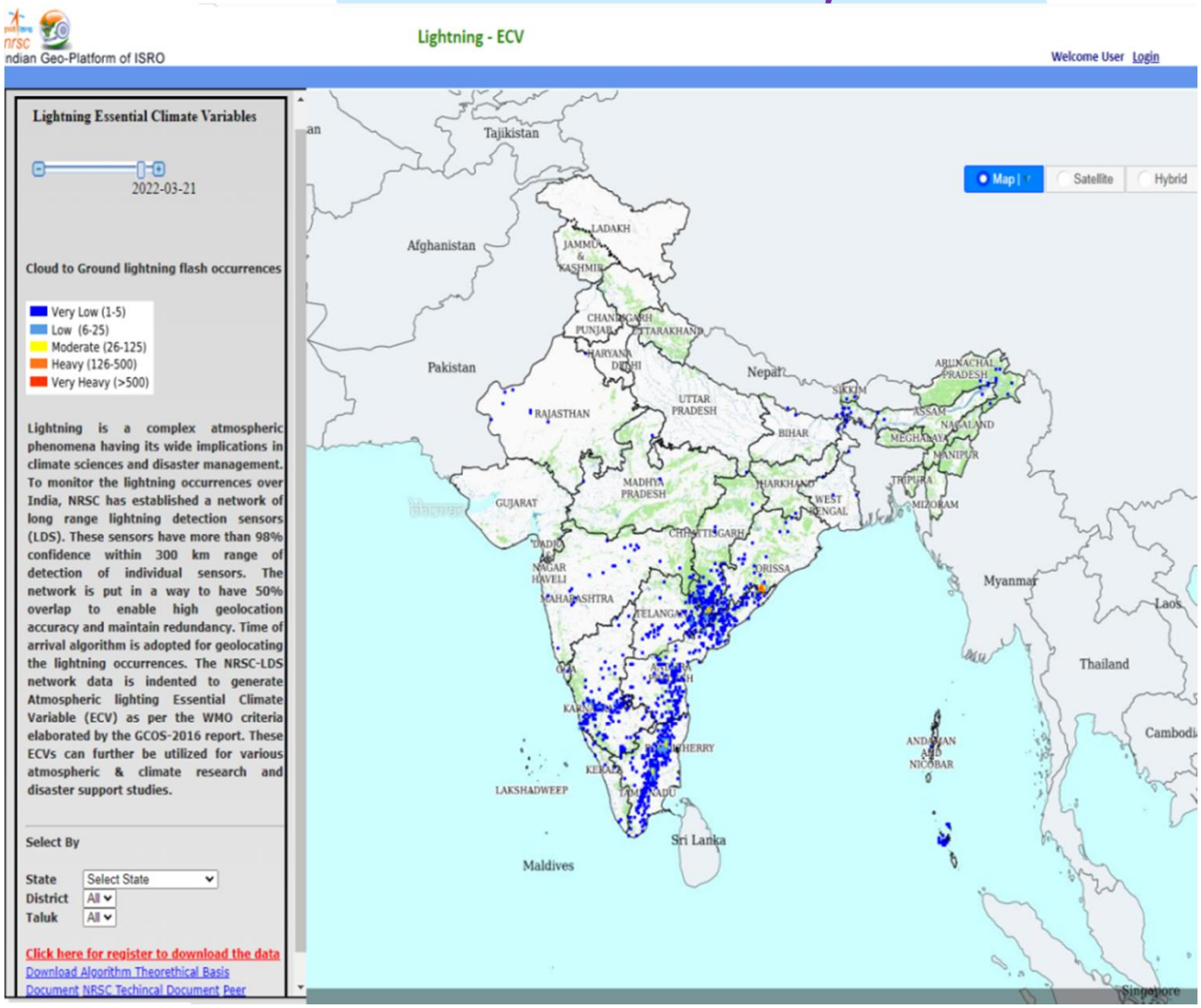
NRSC-LDS (left) Vs IITM- LLN (right): 03 July 2019



2D correlation between the two observations. NRSC-LDS network 13 sensors active sensors on this day 65 sensors of IITM were active. **Comparison has been done for 120 days of observations.**

NRSC-LDS ECV on NICES/BHUVAN

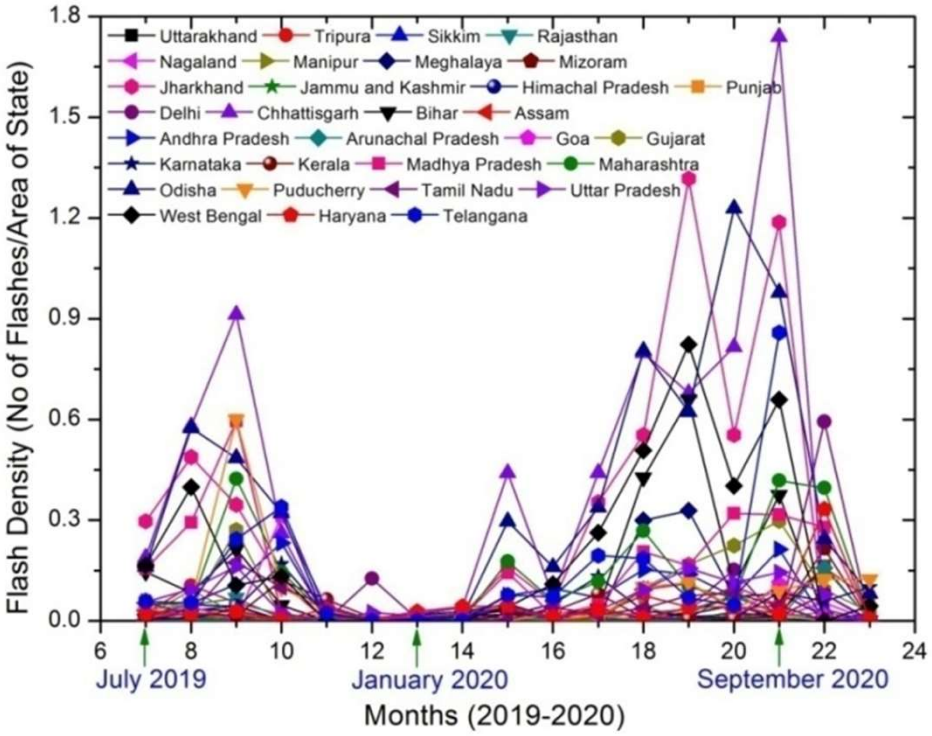


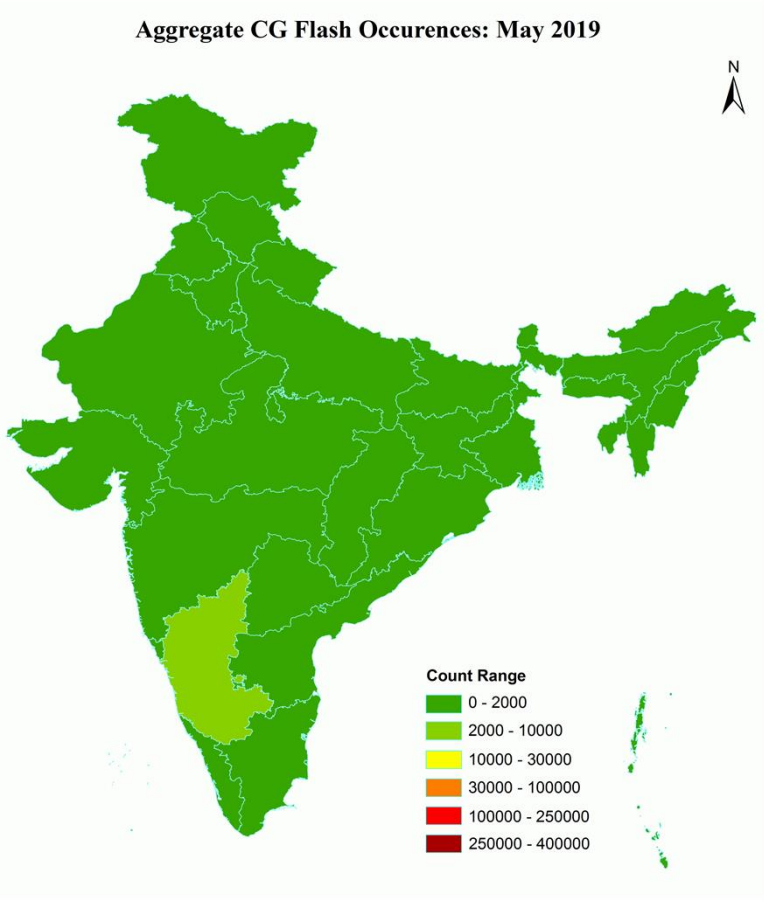


GCOS suggested lightning ECV

Product	Definition	Frequency	Resolution	Req. Uncer.	Stab.	Standard/ References
Number of Lightnings	Total number of detected flashes in the corresponding time interval and the space unit. Space unit should be equal to the horizontal resolution and the accumulation time to the observing cycle	1 day	10 km	-	-	MTGEURD[1]

Variability in the monthly CG Lightning Occurrences

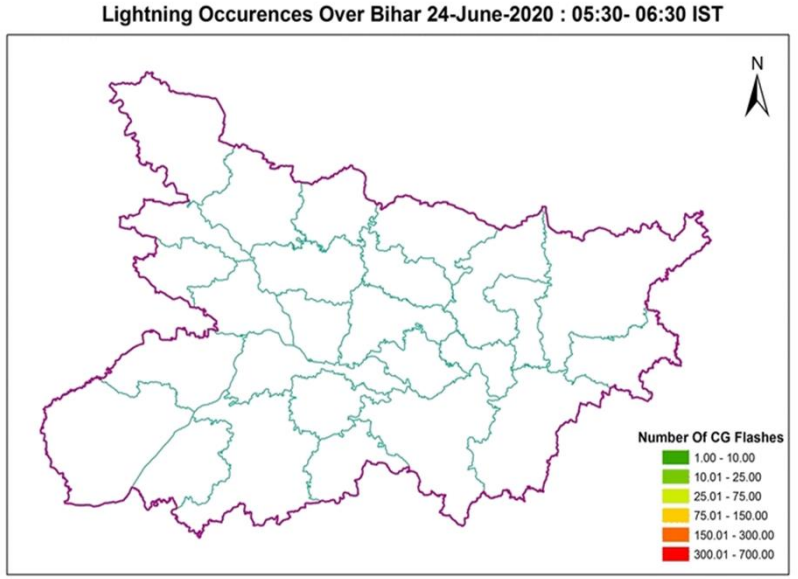


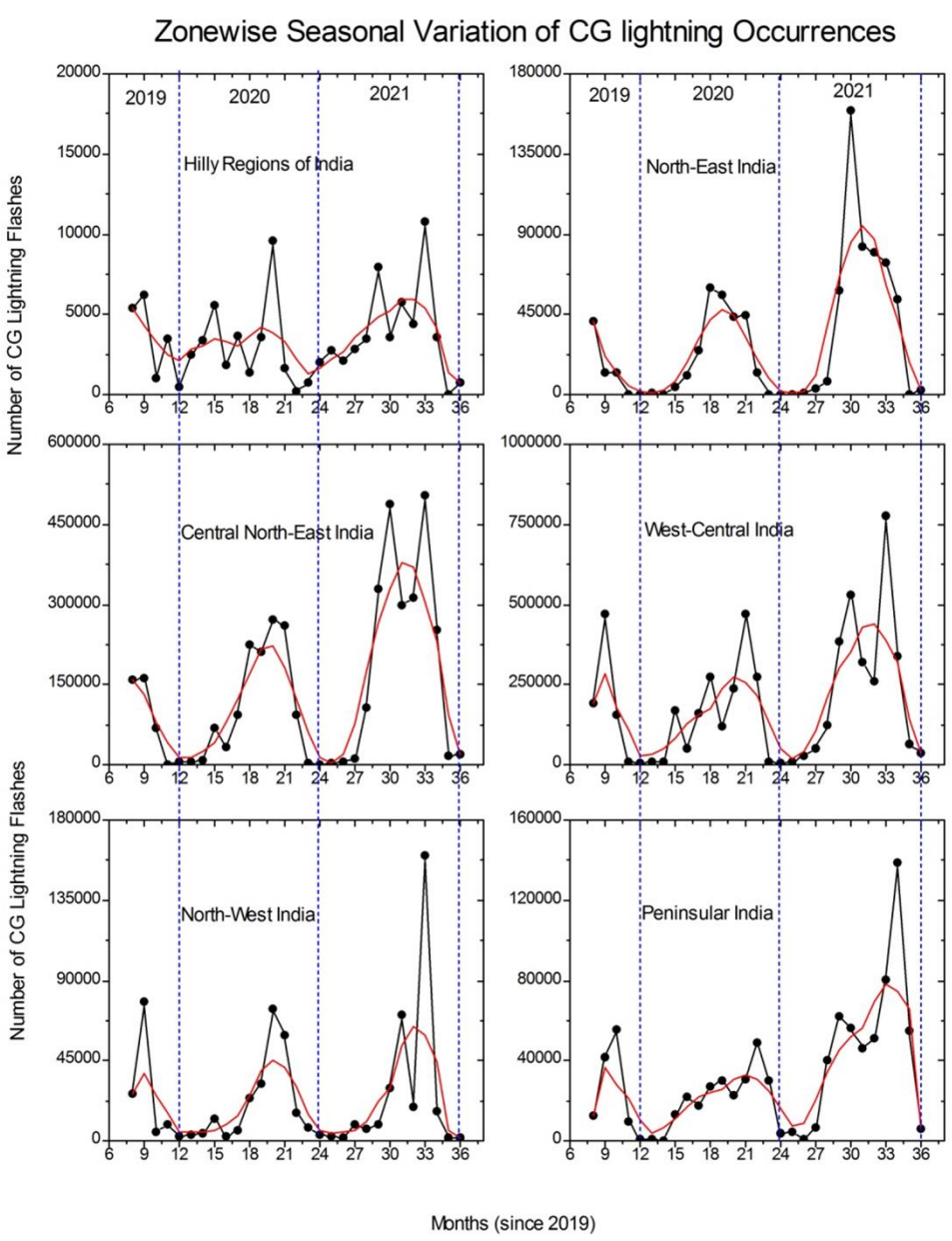


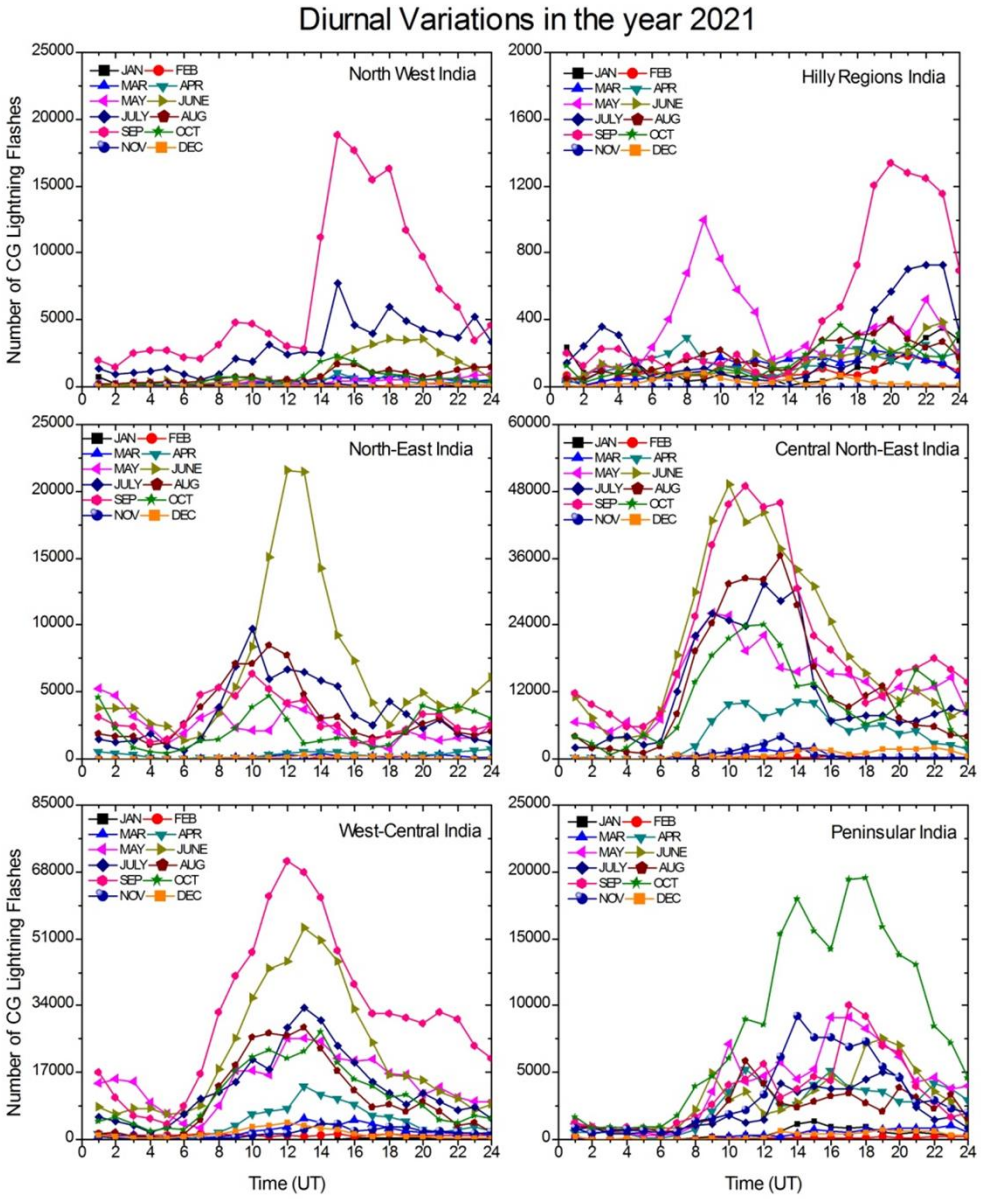
Key Highlights:

- NRSC/ISRO is ***the the first agency in the world*** to make the **Lightning ECV available**
- Odisha, Jharkhand, and, Chhattisgarh are found more affected states than **generally claimed** north-east states
- Peak time of occurrence vary from one region to the other.

Ref: *Taori et al., Natural Hazards, doi:* 10.1007/s11069-021-05042-8, *2022 , Taori et al.,* doi:10.20944/preprints202112.0183.v1, *2021.*

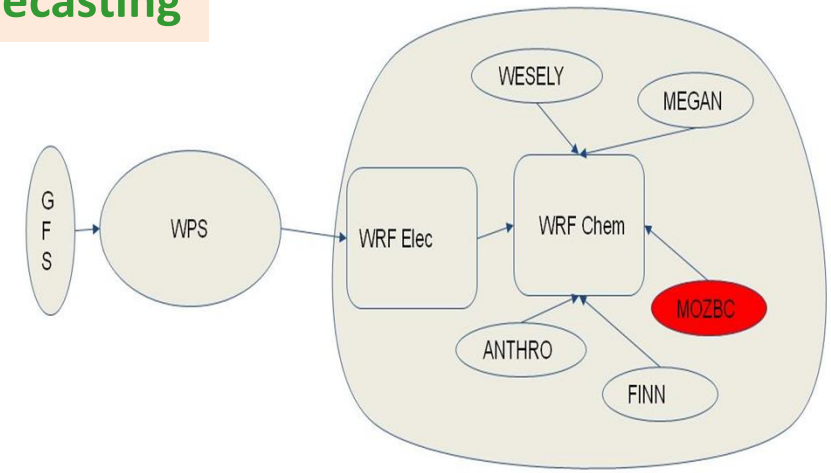


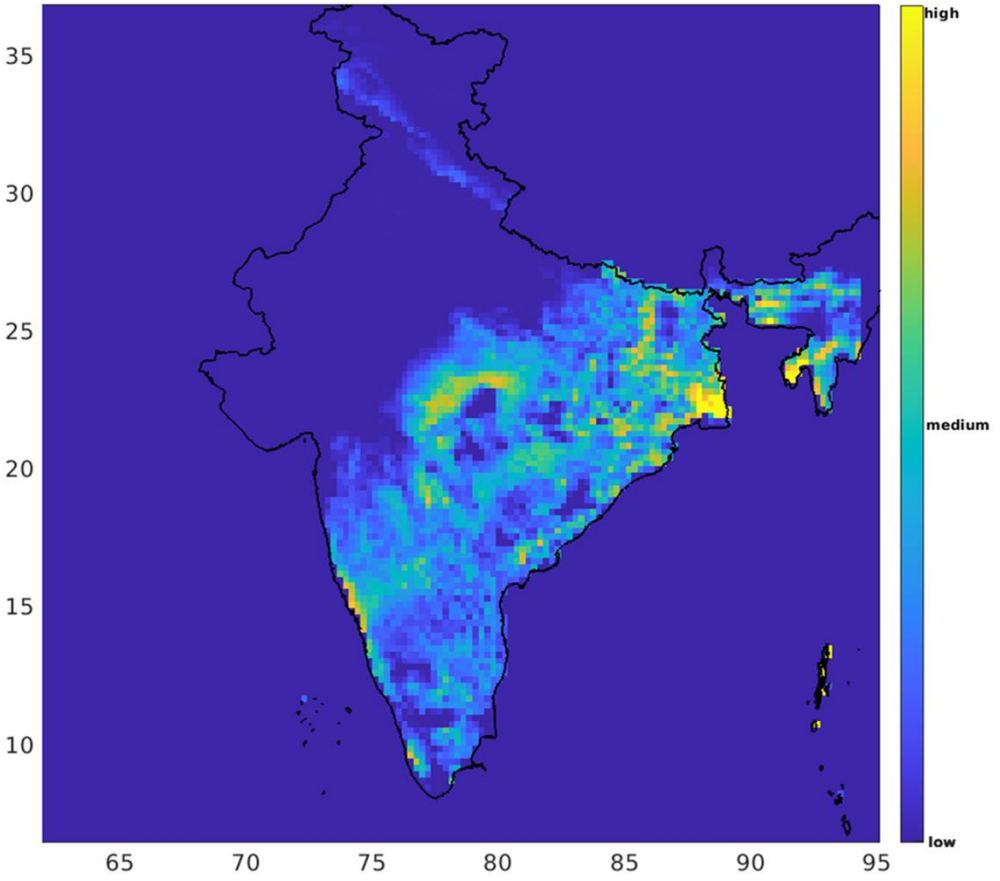




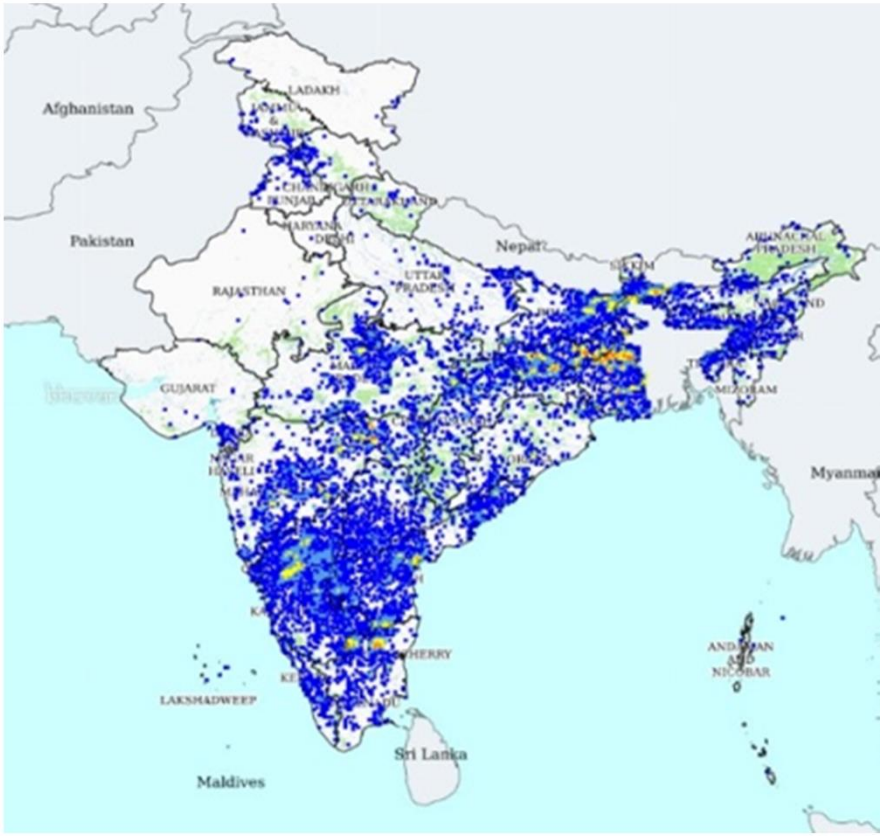
Zones in India	States
North-East	West Bengal, Assam, Meghalaya, Nagaland, Manipur, Mizoram, Tripura, Sikkim
Central North-East	Odisha, Jharkhand, Bihar, Uttar Pradesh
North-West	Haryana, Chandigarh, Delhi, Punjab, Rajasthan, Gujarat
West-Central	Madhya Pradesh, Goa, Maharashtra, Chhattisgarh, Telangana
Peninsular	Kerala, Karnataka, Andhra Pradesh, Tamilnadu, Puduchery
Hilly region	Uttarakhand, Himanchal Pradesh, Jammu & Kashmir, Arunchal Pradesh

NRSC Efforts on the Forecasting





Forecast result of T+1(5th Sept 2022) on 4th Sept 2022



Data hosted by LDS network on 5th Sept 2022

Thanks....