

ISRO DMS Programme - Overview



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Dec 04, 2019

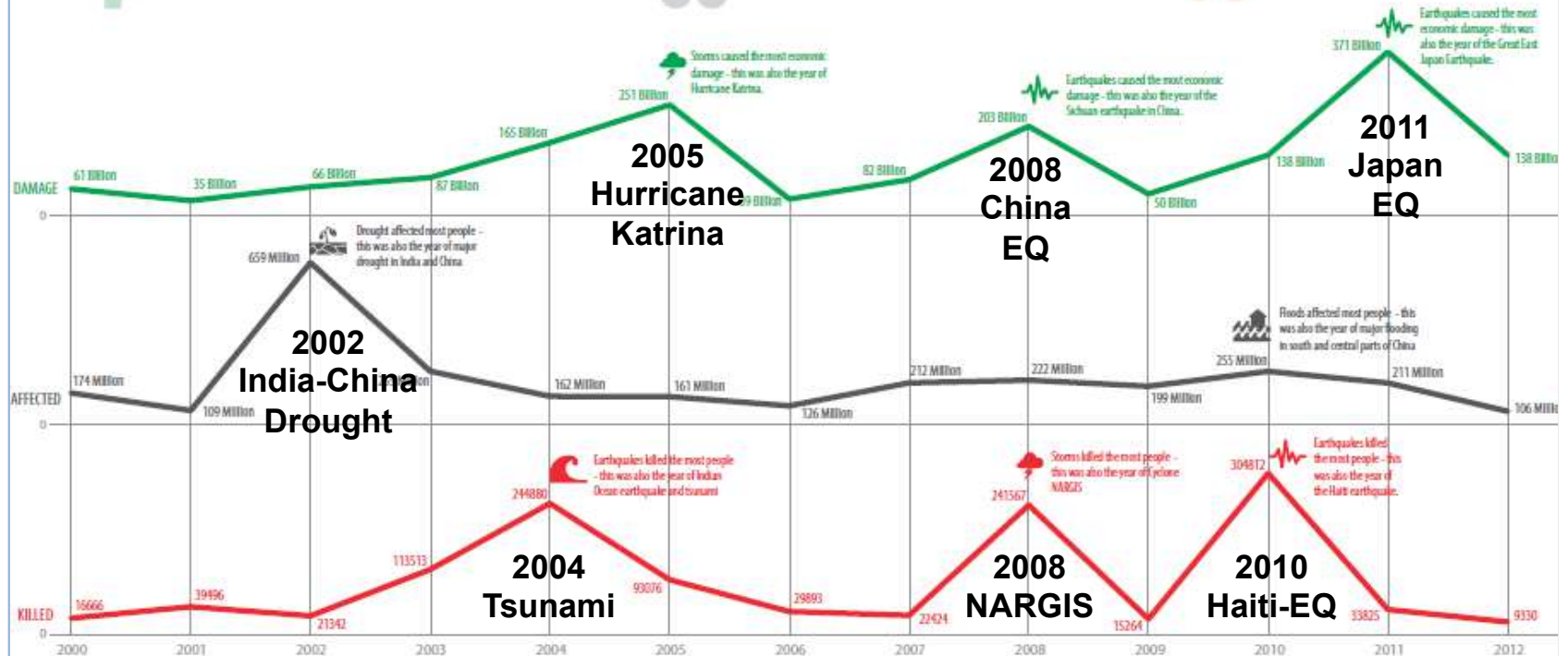


Global Disaster Scenario

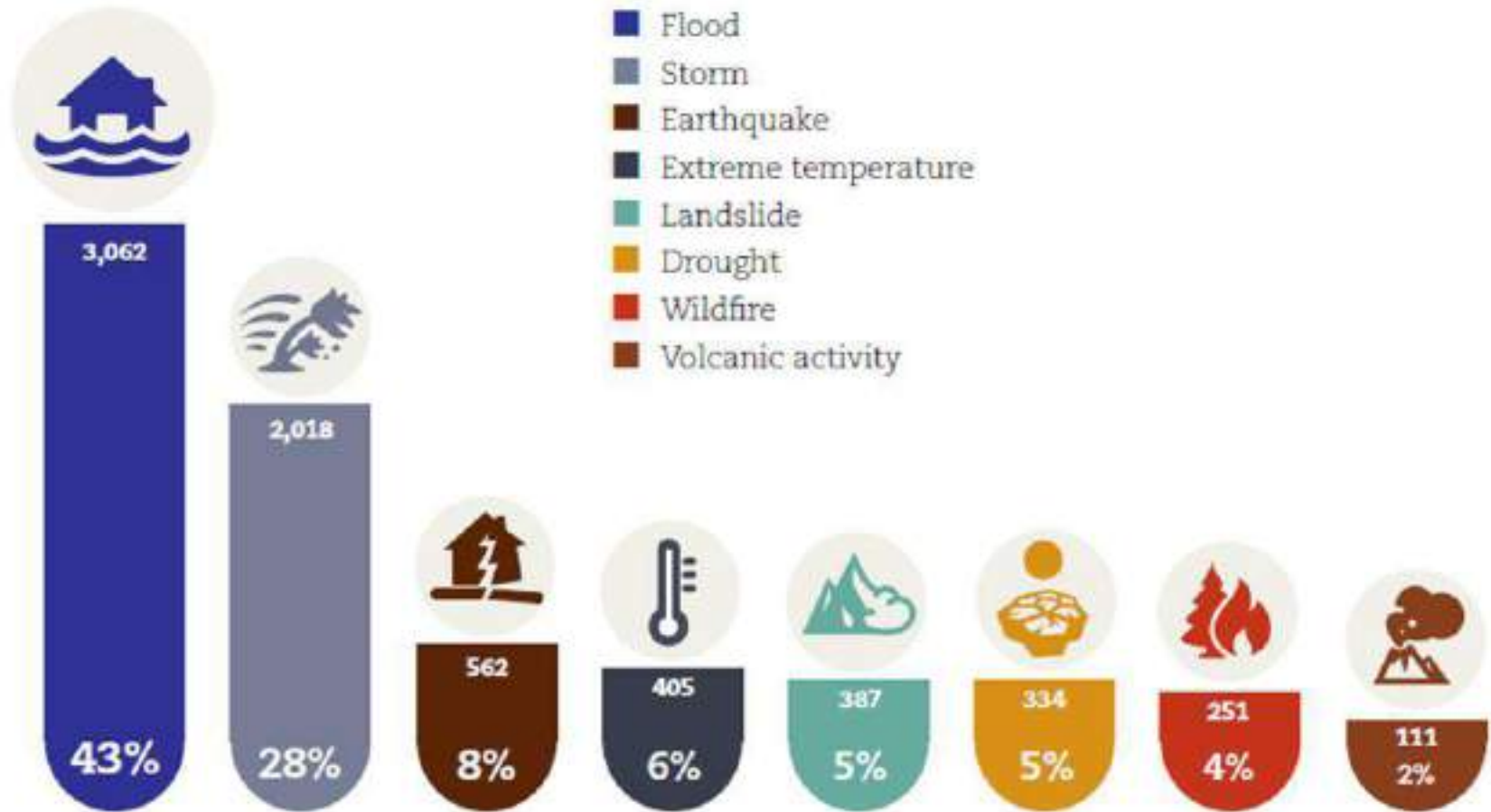


DISASTER IMPACTS / 2000-2012

*Disasters refers to drought, earthquake (seismic activity), epidemic, extreme temperature, food, insect infestation, mass movement (dry & wet), storm, volcanic, and wildfire / Data source: EM-DAT: The OFDA/CRED International Disaster Database / Data window: 12 March 2013 - v13.07
 OCIA Humanitarian Symbol (2012) <http://reliefweb.int/help/world/world-humanitarian-and-country-icons> 2012 / Find out more about UNISDR: <http://www.unisdr.org>

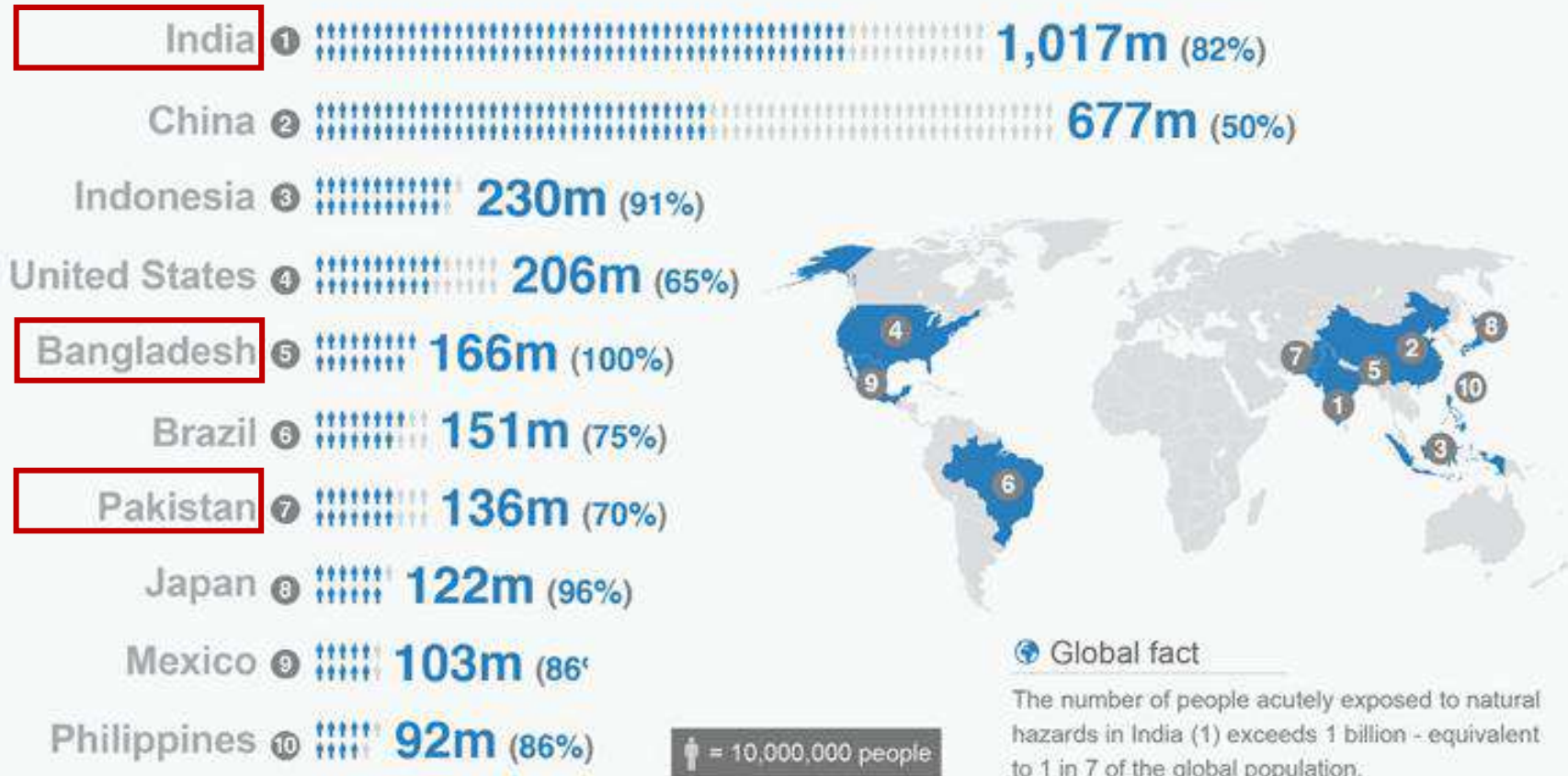


Global Disaster Events



Exposure to Natural Hazards

The 10 populations most exposed to natural hazards



Some Definitions

Hazard

potentially damaging physical event ..cause loss of life, property...



Vulnerability

conditions which increase the susceptibility to the impact of hazards



Risk

probability that a hazard will turn into a disaster

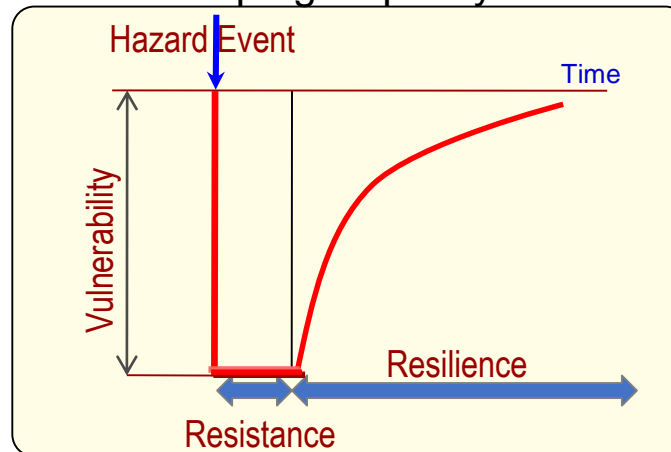


Disaster

A serious disruption causing widespread human/material/ economic/environ. losses



Resistance + Resilience =
Coping Capacity



Resilience

capacity of a system (exposed to hazards) to adapt, by resisting/ changing



Sendai Framework for DRR Geo-informatics

Post-2015 Framework Priority	Exemplary activities
1. <i>Understanding disaster risk</i>	Knowledge and information generation and management (including risk and vulnerability assessments, cost-benefit analysis, and information systems), research, innovation and technology transfer.
2. <i>Strengthening governance/ institutional arrangements/ organizational, legal and policy frameworks to manage disaster risk</i>	Institutional capacity building, planning (ex-ante and ex-post), coordination, management, policies and regulation
3. <i>Investing in disaster risk reduction for resilience</i>	Hard and soft investment, land use and water management, infrastructure conservation (including natural), construction

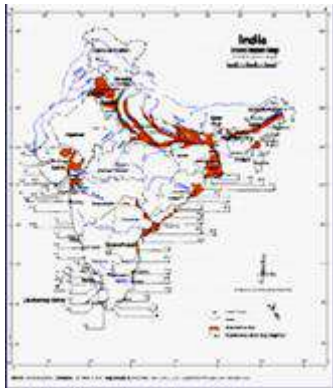
Sendai Framework recommended use of Geo-Spatial Technology for Achieving these Priorities

	social protection and basic service provision)
4. <i>Enhancing disaster preparedness for effective response, and to Build Back Better in recovery, rehabilitation and reconstruction</i>	Evacuation facilities, retrofitting schools, hospitals and other public buildings, training and contingency plans (including early warning systems)

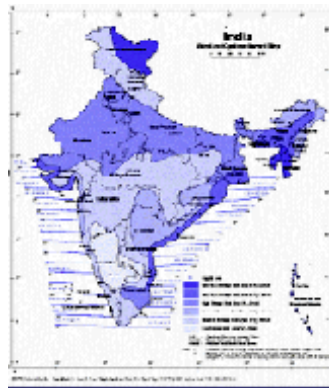
Source: see the Post-2015 Framework zero draft at http://www.wcdrr.org/documents/wcdrr/Pre-zero_draft_post2015_frmwk_for_DRR_8_August.pdf

Indian Disaster Scenario

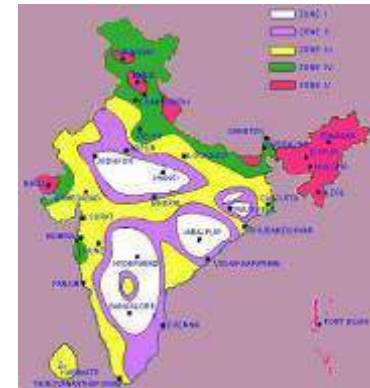
- Floods – 12% (40 Million Hectares)
- Cyclones – 8%
- Drought – 70% of cultivable land
- Earthquake – 65%
- **A Major Disaster occurs every 2-3 years**
- **50 million people affected annually**



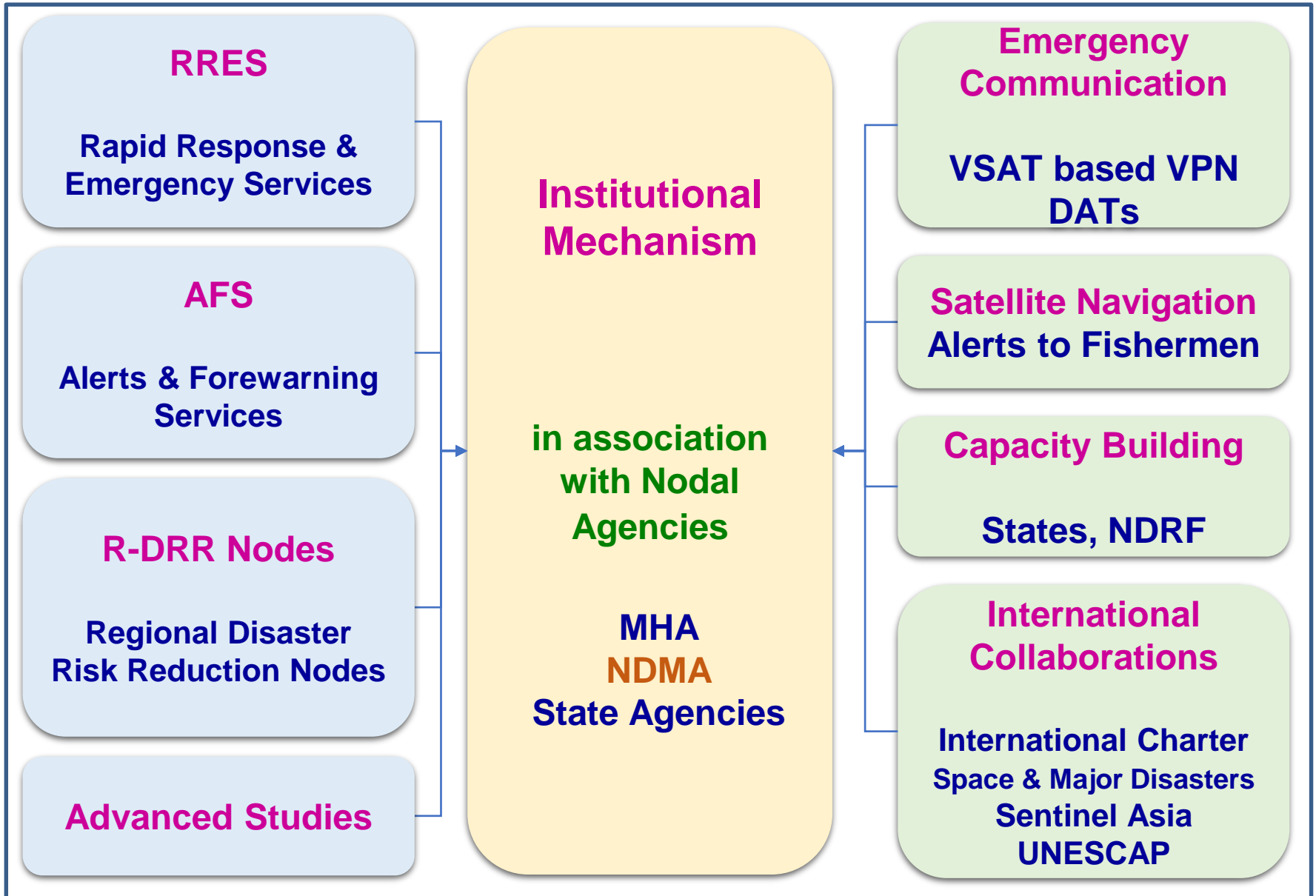
Flood Hazard



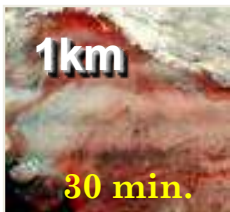
Wind Hazard



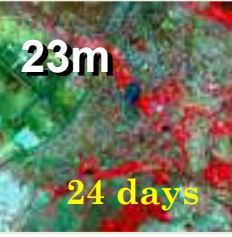
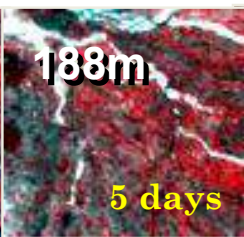
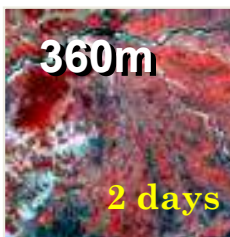
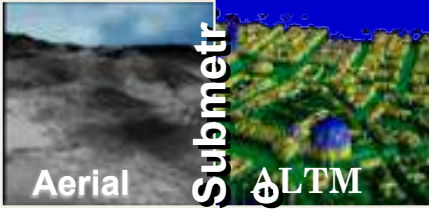
Earthquake Hazard



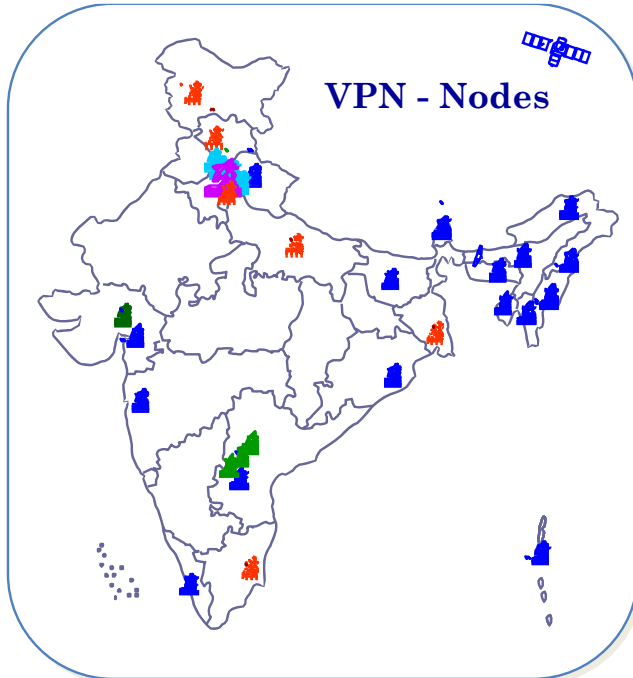
DMS – Aero-Space Infrastructure



**Aerial Laser Terrain Mapper
Digital Camera
Synthetic Aperture Radar (SAR)**

DMS – Satellite Communications



Hub



**Monitoring Nodes: PMO; MHA;
Cabinet Sectt.**



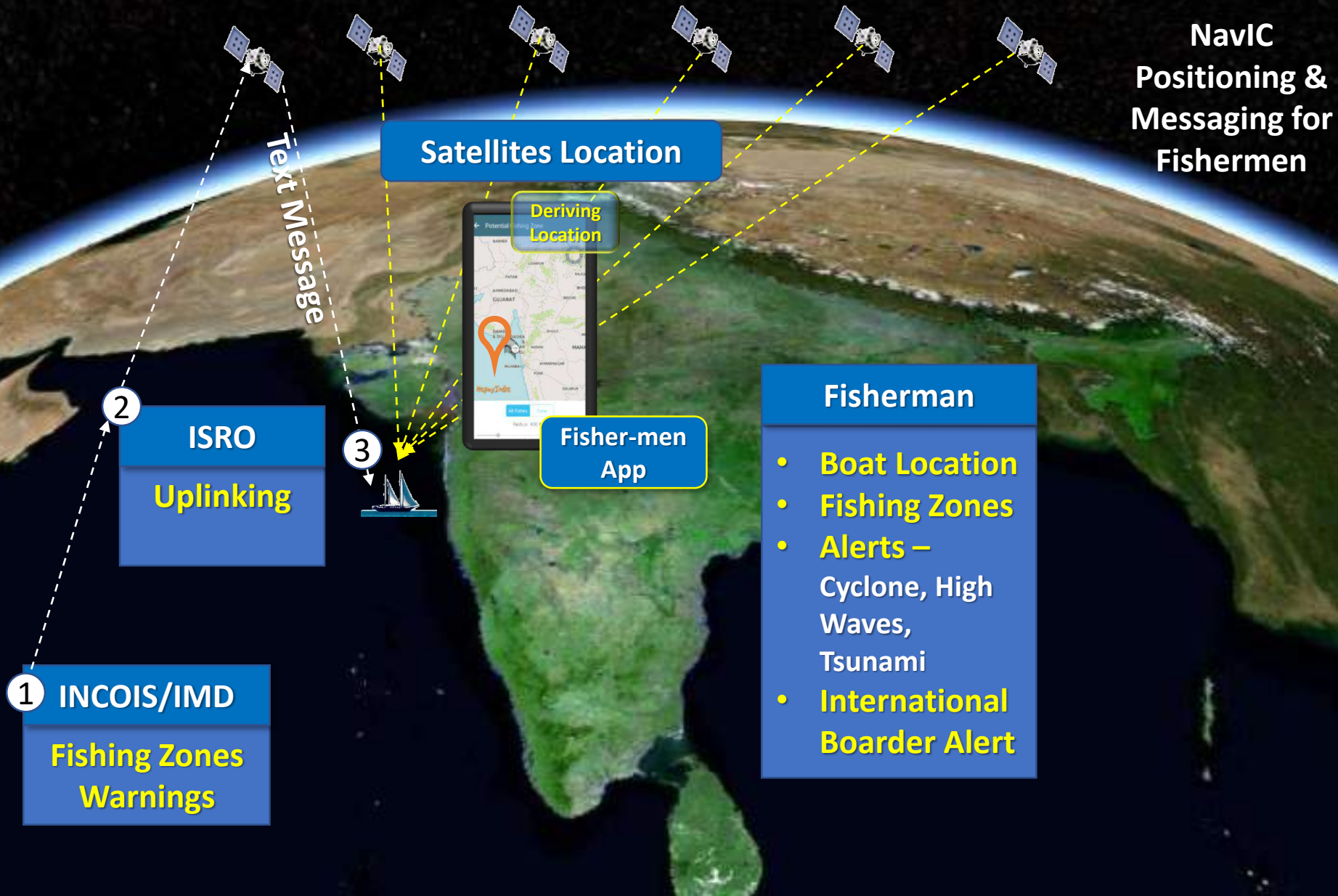
**Primary Nodes: NRSC (1+1);
INCOIS; IMD; GSI; CWC; SOI;
SAC; MCF**



State Control Rooms

- **Linking Nat'l Emergency Ops Centre with State EOCs, Knowledge Institutions, and Key Offices of Govt.**
- **Expansion to Multi-Hazard-prone Dists (240+), DM Authorities/ NDRF Units (50+)**
- **Integration with complementary networking technologies - Terrestrial, WiFi/ WiMax, ...**

DMS – Satellite Navigation – Indian NavIC



Floods



- Flood Inundation Maps
- Damage Assessment
- Hazard Zonation
- Bank Erosion Studies

Earthquake



- Damage Assessment

Cyclone



- Inundation Maps
- Recession Maps
- Damage Assessment

Landslide



- Damage Assessment
- Hazard zonation

Drought



- Monthly Agril. Drought Report
- End-of-the-Season Agril. Drought Report

MNCFC

Forest Fire

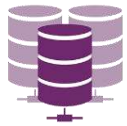


- Active Fire Detection
- Damage Assessment

National Database Emergency Management

NDEM is a **National geospatial database repository** of the entire country coupled with **Decision Support System** tools to assist the disaster management during emergency situations.

Objectives



Organization of multi-scale geospatial database for Entire country at 1:50,000 scale; for 350 districts at 1:10,000 scale; for 5 Mega-cities at 1:2,000 scale (Bangalore, Hyderabad, Mumbai, Delhi, Kolkata)



Development of Decision Support System (DSS) tools for addressing disaster/ emergency management.



Establishing computer infrastructure to facilitate network connectivity, data ingest, validation, GIS databases organization, data dissemination and services hosting.

- NRSC/ ISRO has **operationalized NDEM from 2013** onwards. The services are extended to 36 States/UTs for emergency management in active collaboration with Ministry of Home Affairs (MHA).
- **Integrated Control Room for Emergency Response (ICR-ER)**

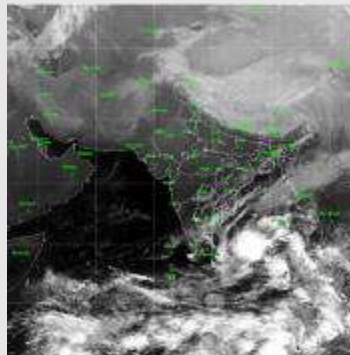


NDEM - Services

NDEM services in user friendly formats with dynamic and scale based rendering through device independent platforms.

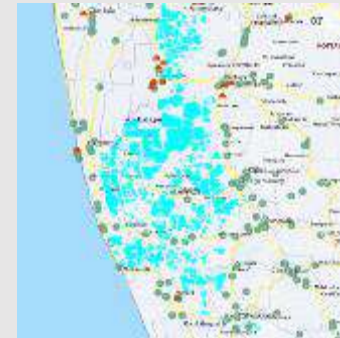


NDEM Version 3.0



Web Services

Integration of services



WMS Services

Multi-scale database



Reports/Geo-PDF

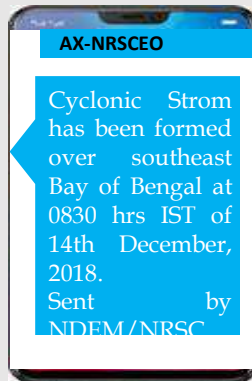
Cyclone Track, Risk Maps



Geo-Portal



NDEM Mobile



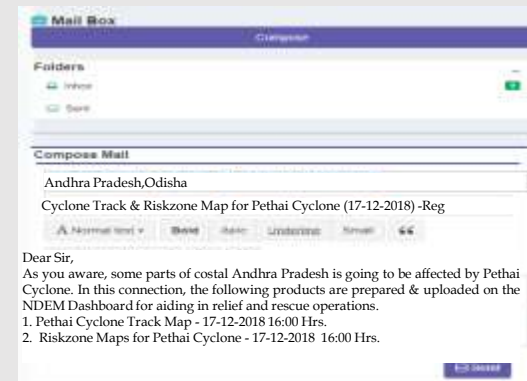
SMS

Alerts/Warnings
Message



Whatsapp

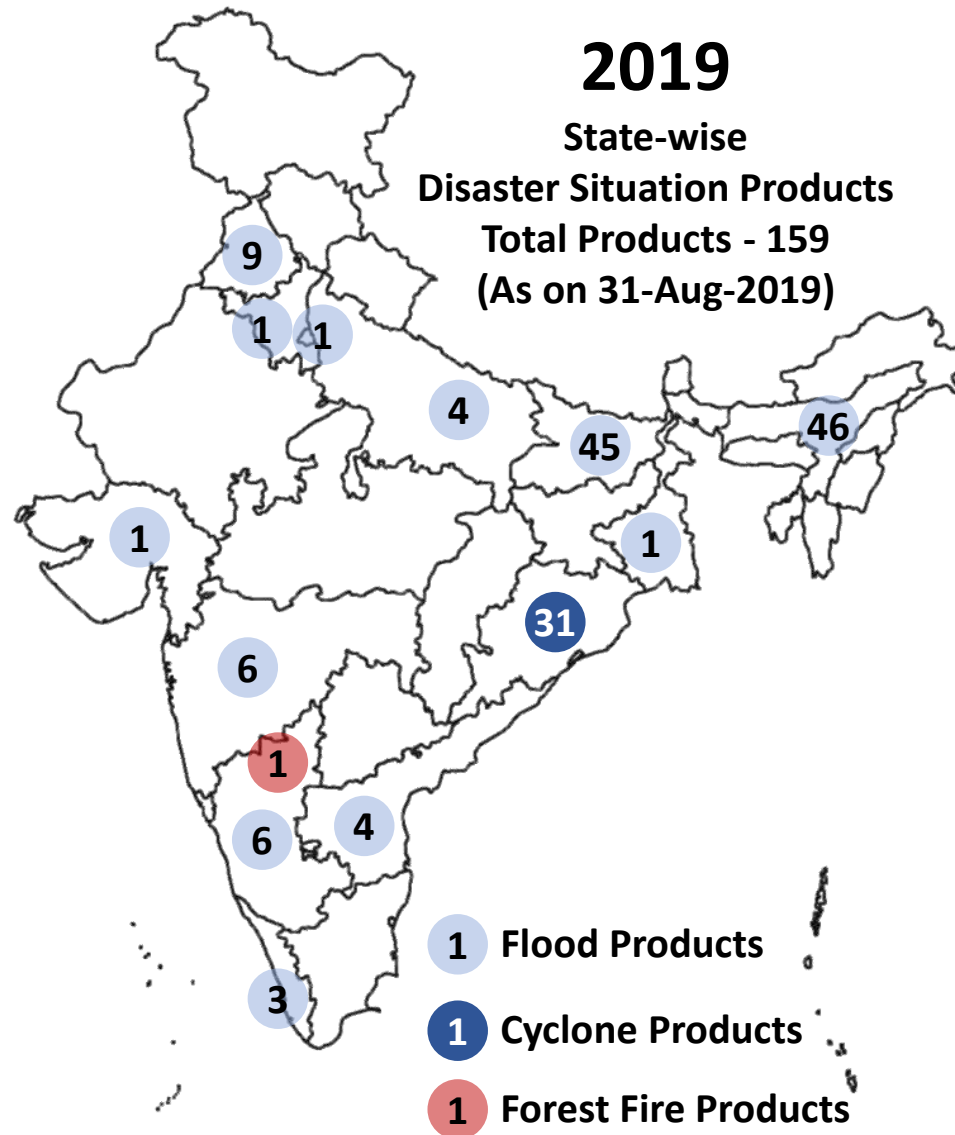
Products with
snapshots



Emails

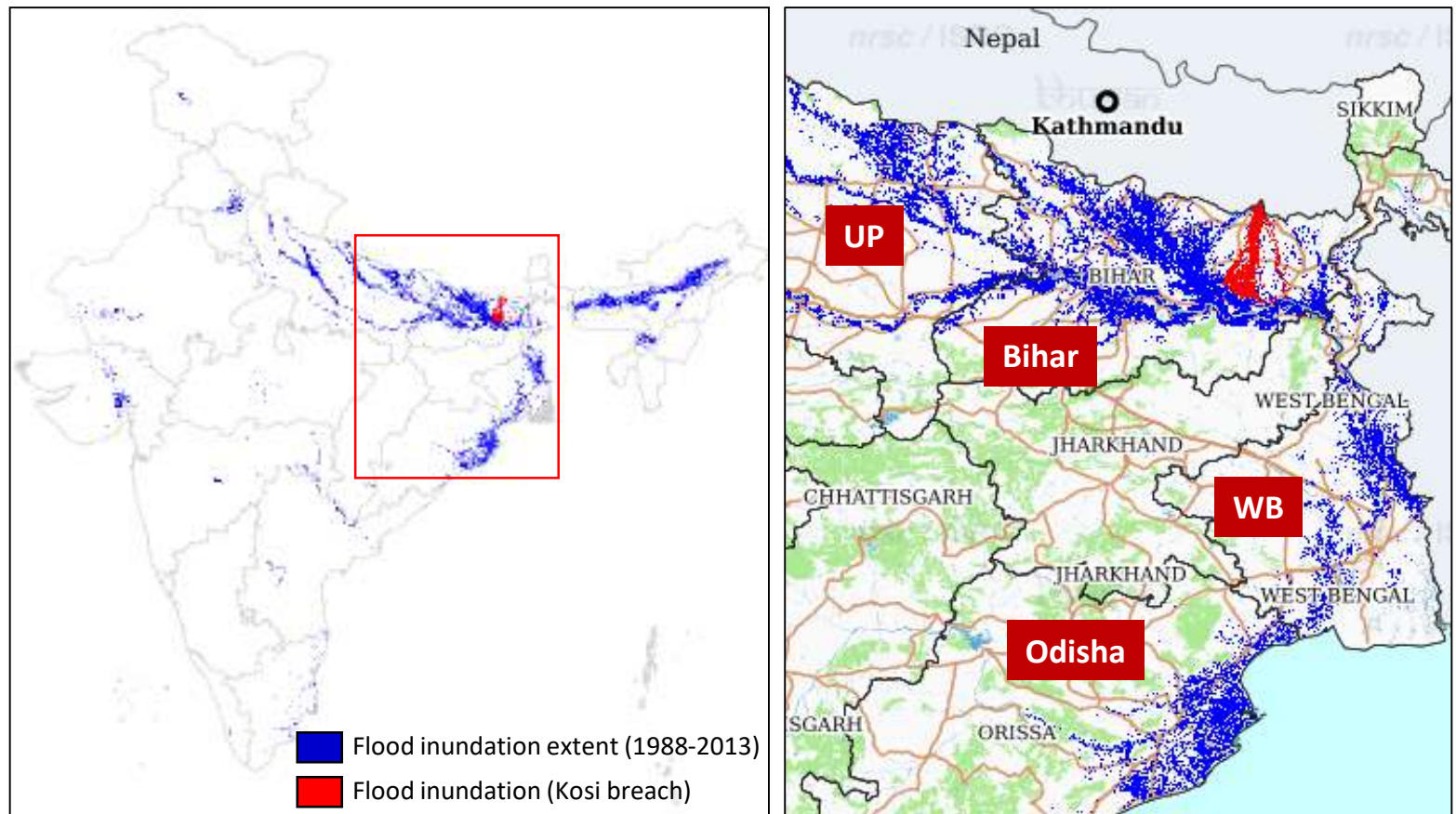
Information with
products

Disasters - 2019



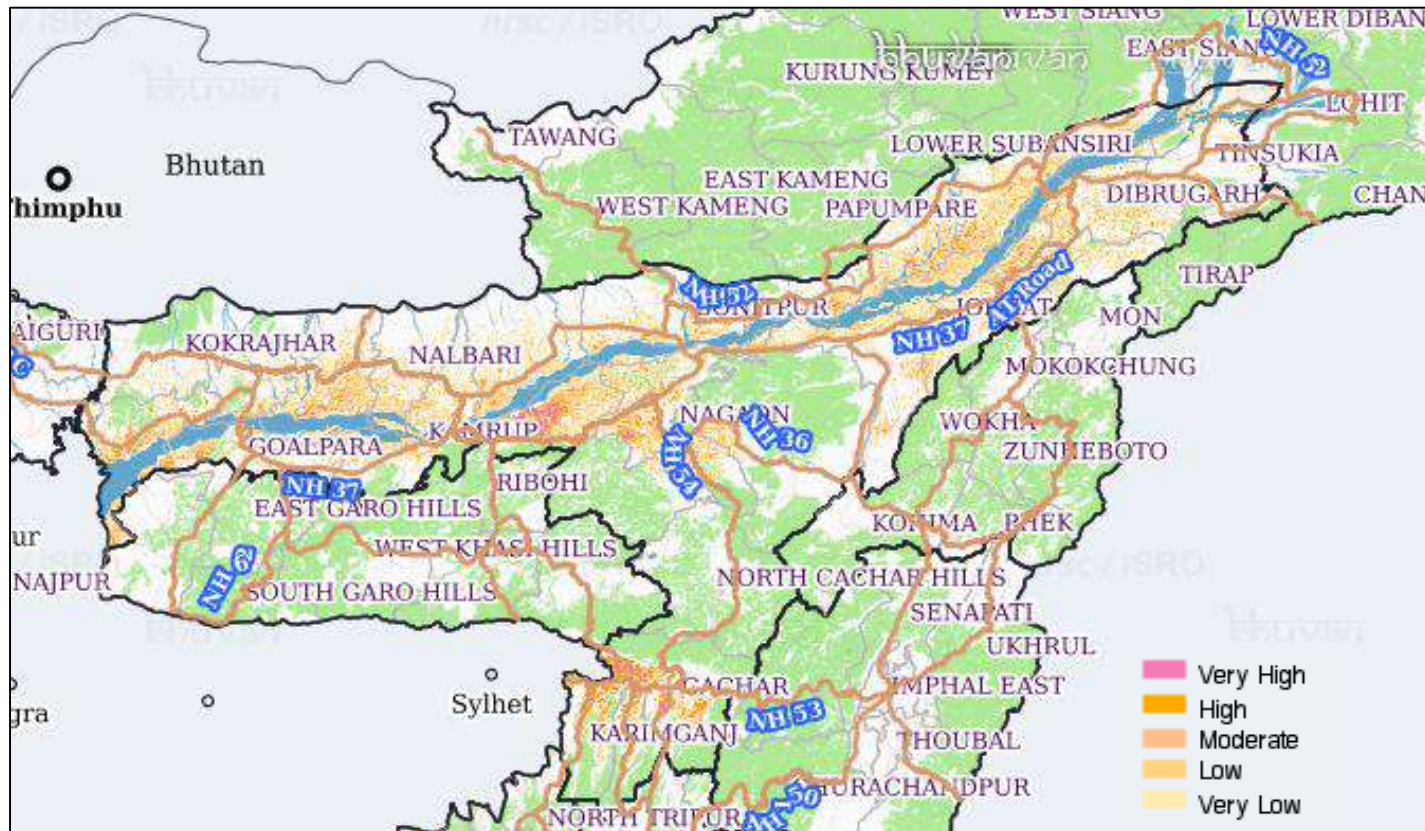
Flood Inundation Footprints-India

- Preliminary flood prone area map – Satellite data of 1988 - 2013
- Major flood events from J&K to Tamilnadu, Gujrat to Assam



Flood Hazard - Assam State

- Flood hazard map - 215 satellite datasets, - 1998-2015
- 5 Categories of Severity
- This helps in better understanding of flood severity.



Godavari River - Andhra Pradesh

- Spatial flood inundation is forecasted in parts of Godavari basin, in collaboration with CWC, MoWR, for next 24 hours.
- Using satellite and ground based observations on hydro-meteorological parameters, landuse / land cover, digital elevation models, flood forecasting is carried out.
- Further, using fine resolution elevation data derived from Lidar, flood inundation is simulated and integrated on to Bhuvan geo-portal for better visualisation. This information helps in better decision making for flood mitigation.



Simulated flood inundation in part of Godavari & Sabari rivers (21-Aug-2018)

Flood Inundation Modelling

Objective:

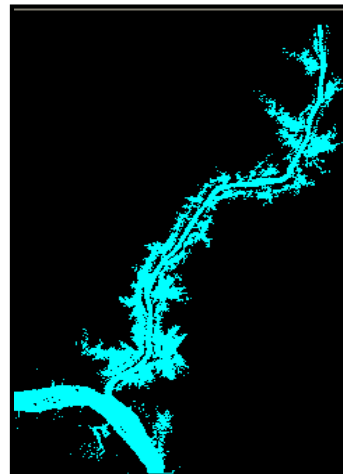
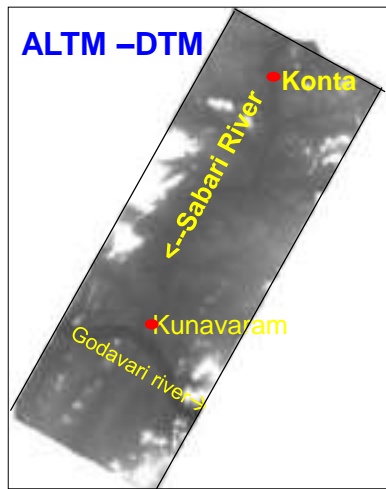
To simulate flood inundation for part of Sabari river in Godavari River basin using HEC Hydraulic model using ALTM DTM and to validate the results with Satellite data.

Input data: ALTM-DTM, Hydrological data
LU/LC data, Contour interval -0.5m

Study area : Sabari tributary from Konta to Kunavaram (35 km) stretch.

NEXT: Further, this is being extended to Devi River in Odisha State

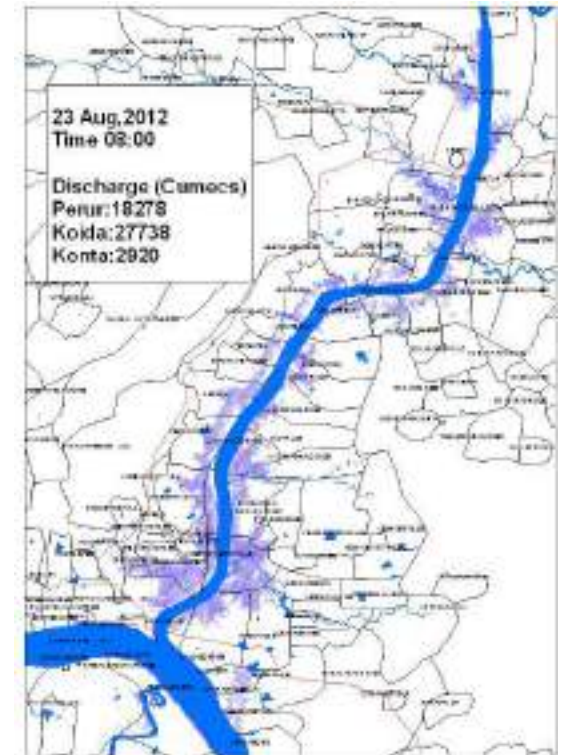
Study area



Simulation Results
23 Aug,2012
Time 06:00

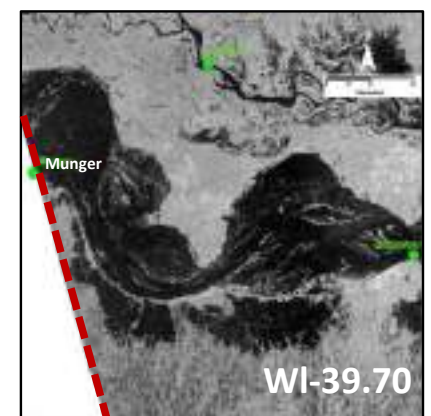
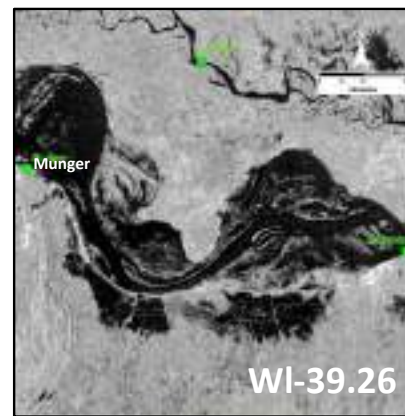
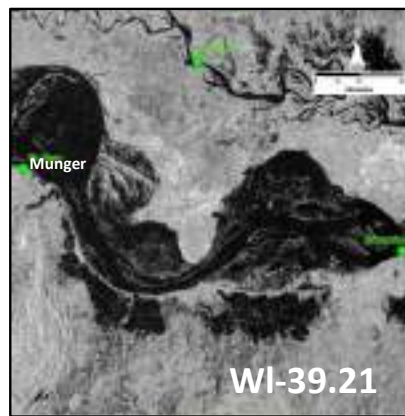
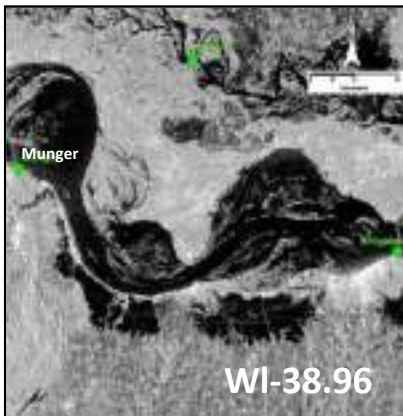
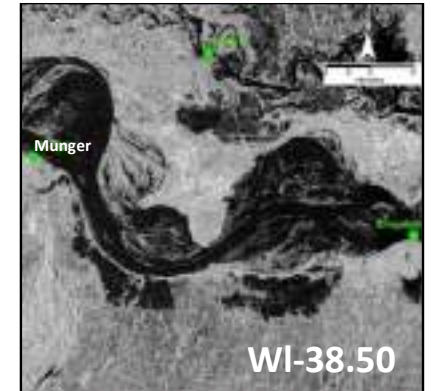
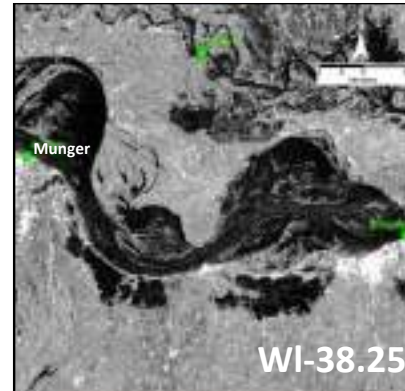
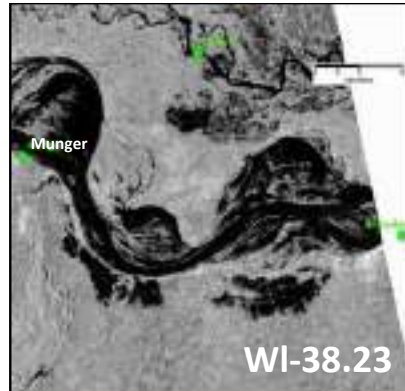
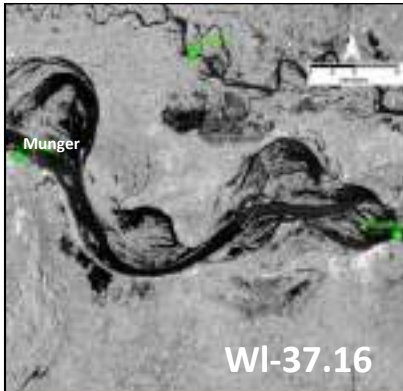


Resoursesat-2
23 Aug,2012
Time 10:30



Water Level vs Flood Inudation

River Ganga @ Munger, Bihar



Water Level vs Flood Extent

- Based on CWC Water level information, it is possible to get the flood extent with historical satellite data

Flood Inundation Viewer (Beta ver.)

State: Bihar

Base Layers:
 Pre River
 Generally Flooded Area

Time: Today Tomorrow Custom

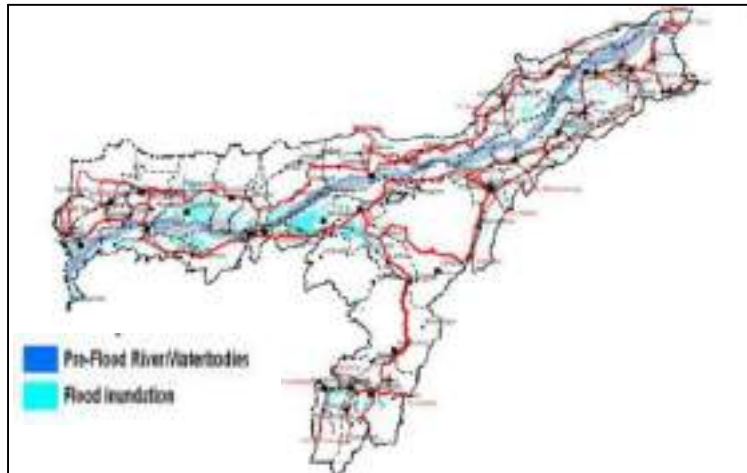
Water Level repository developed using CWC historical database

Select Station:
 Select All
 Adhwara River
 Ekmighat (45.9)
 Kambaul (85)
 Bagmati River

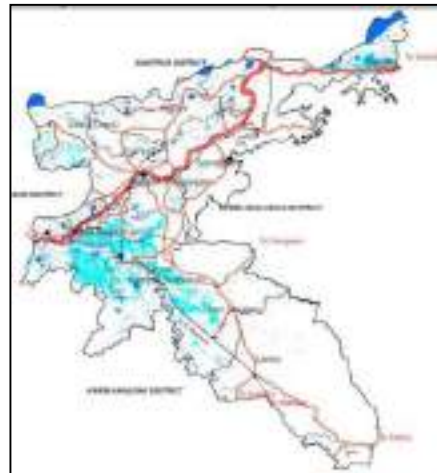
Legend

Contact us | Terms

State-Level Flood Map



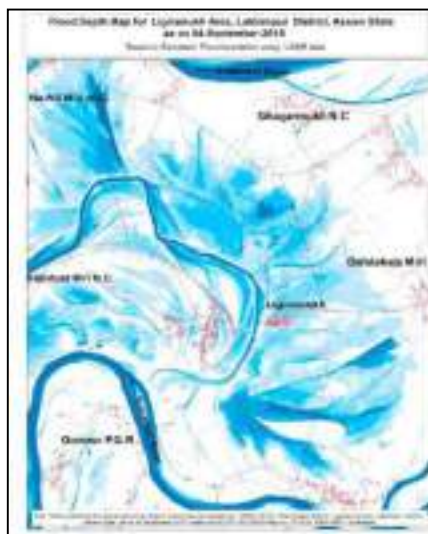
District-Level Flood Map



Detailed Flood Map



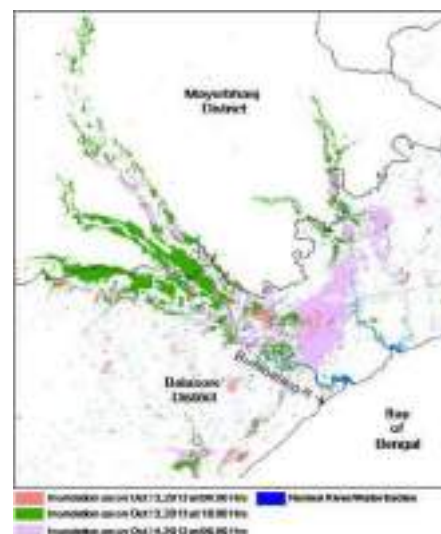
Flood Depth Maps



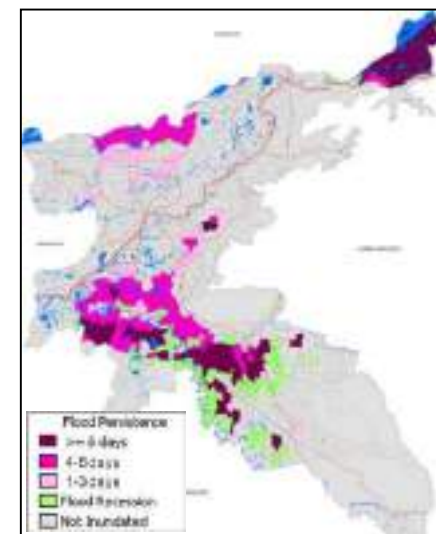
Cumulative Flood Maps



Flood Progr/Recess Maps



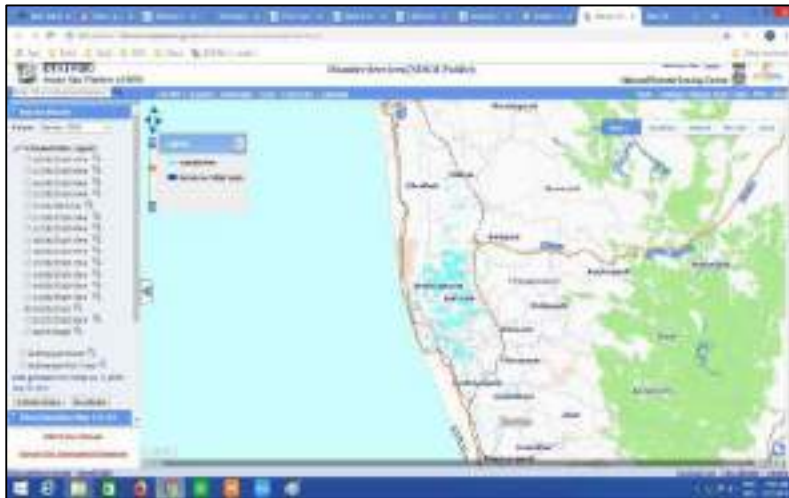
Flood Persistence Maps



Flood Inundation - Kerala State

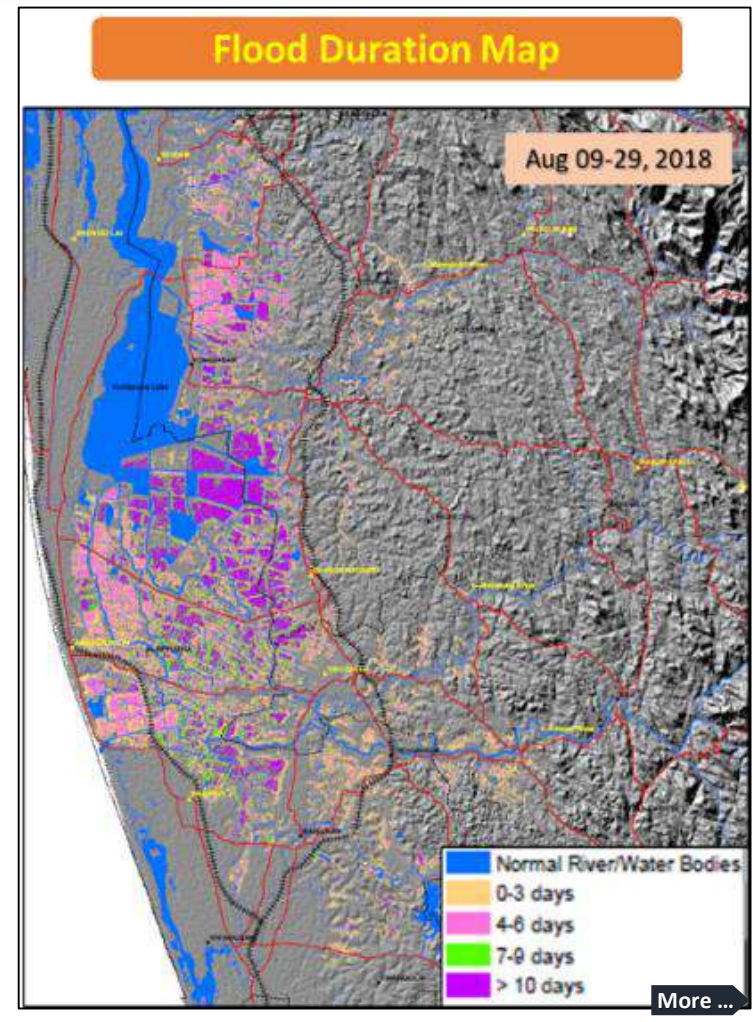
Kerala witnessed severe floods during August, 2018 due to heavy rains in the State. Considering the high intensity of the floods in Kerala, a series of satellite images were acquired and used including that the International Charter was activated for obtaining more frequent high resolution satellite datasets.

For Kerala State, about 20 flood maps & value added products were provided at different scales using 17 satellite datasets during August 9-28, 2018.



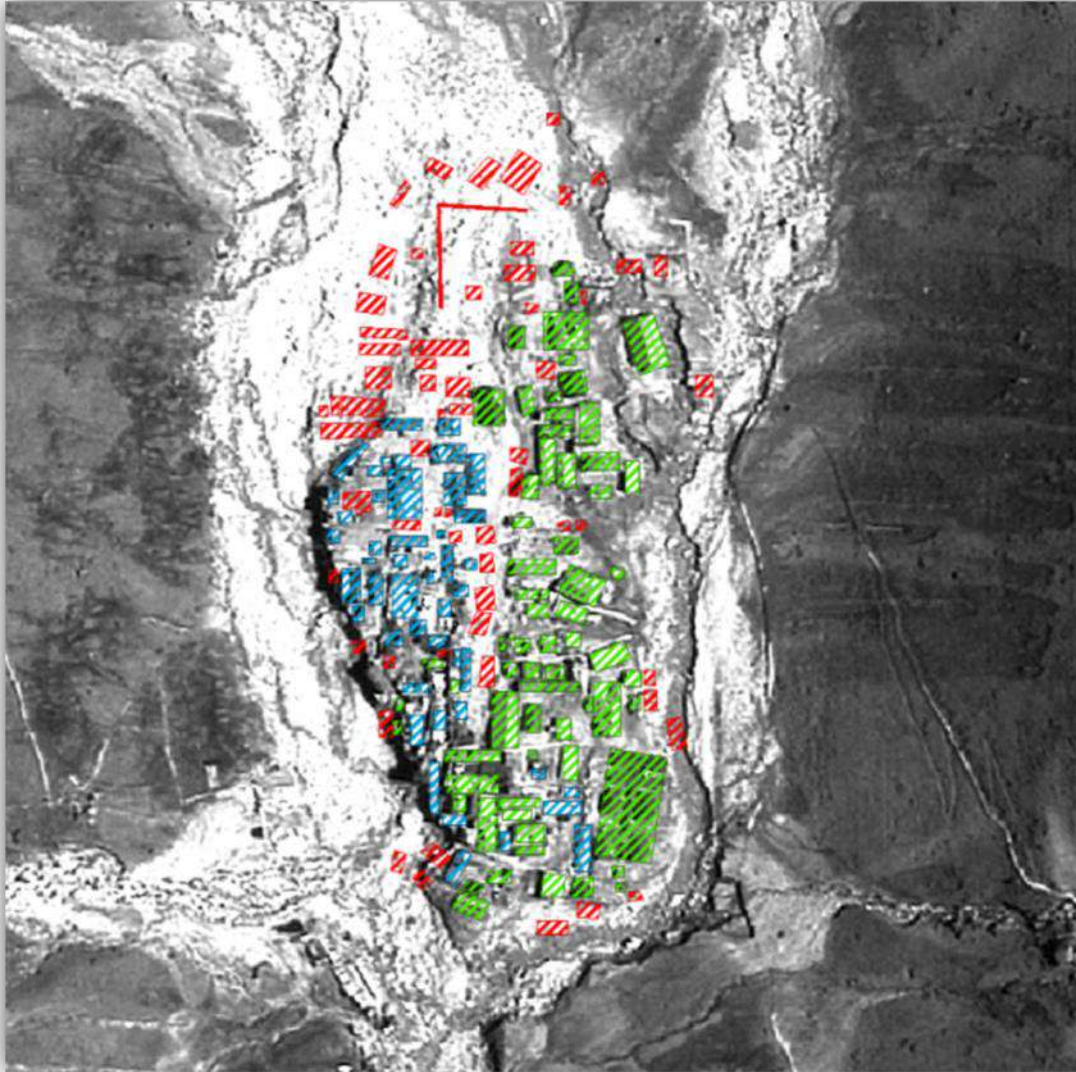
Animation of Flood Inundation observed during August 9-28, 2018

Flood Duration Map →



Damages – Case Studies

Kedarnath Floods – Jun, 2013



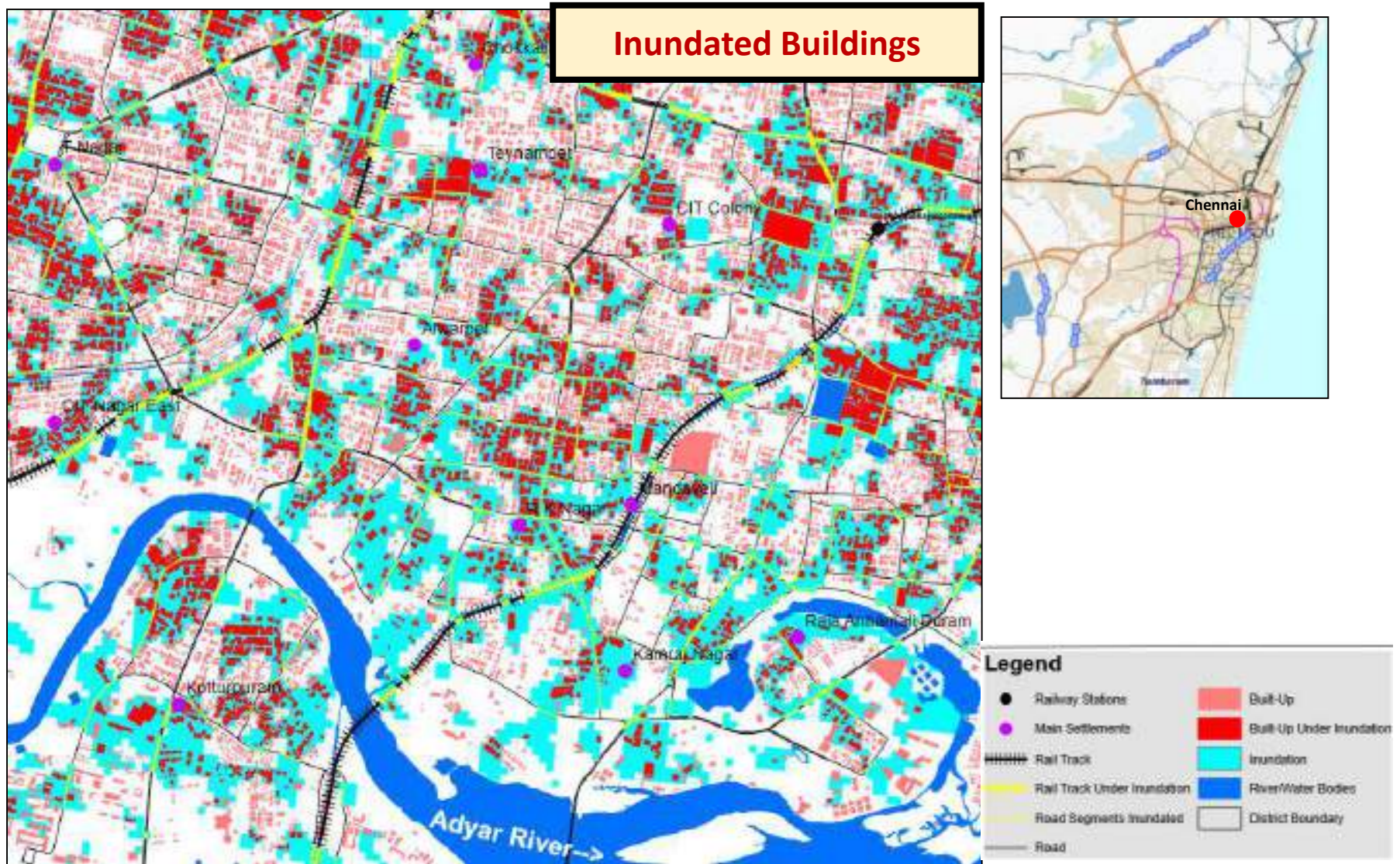
Description	Count
Structures Intact	66
Damaged	47
Washed away	63
Retaining wall (washed away)	1
Total	177

Infrastructure damage between Kedarnath and Rudraprayag

S no.	Name of Stretch	Roads damaged /locations
1	Kedarnath-Sonprayag	6 kms (at 16 locations)
2	Sonprayag-Bamsu	1.2 Kms (at 3 locations)
3	Bamsu -Pandrola	9 kms (at 14 locations)
4	Pandrola- Papdasu	5 km (at 4 locations)
5	Papdasu - Swit	0.5 Km (at 1 location)

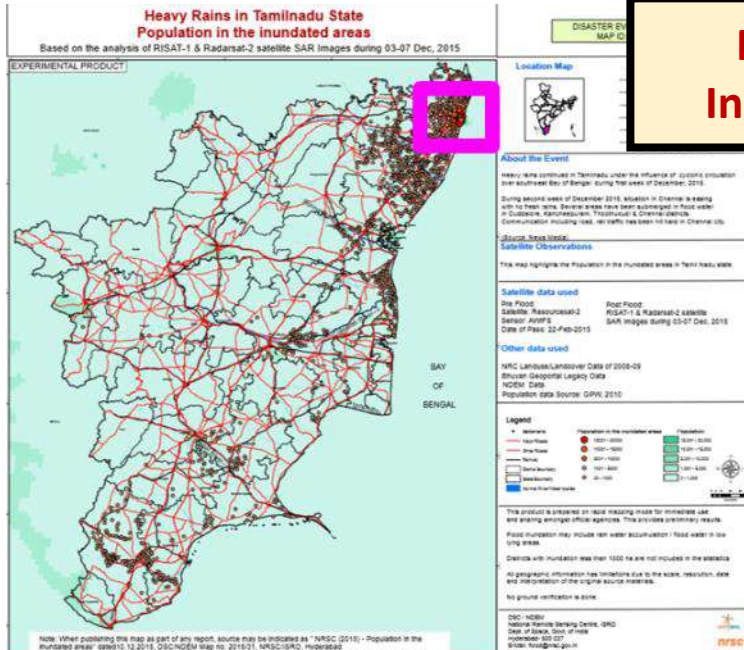
Damages – Case Studies

Chennai Floods – Dec, 2015

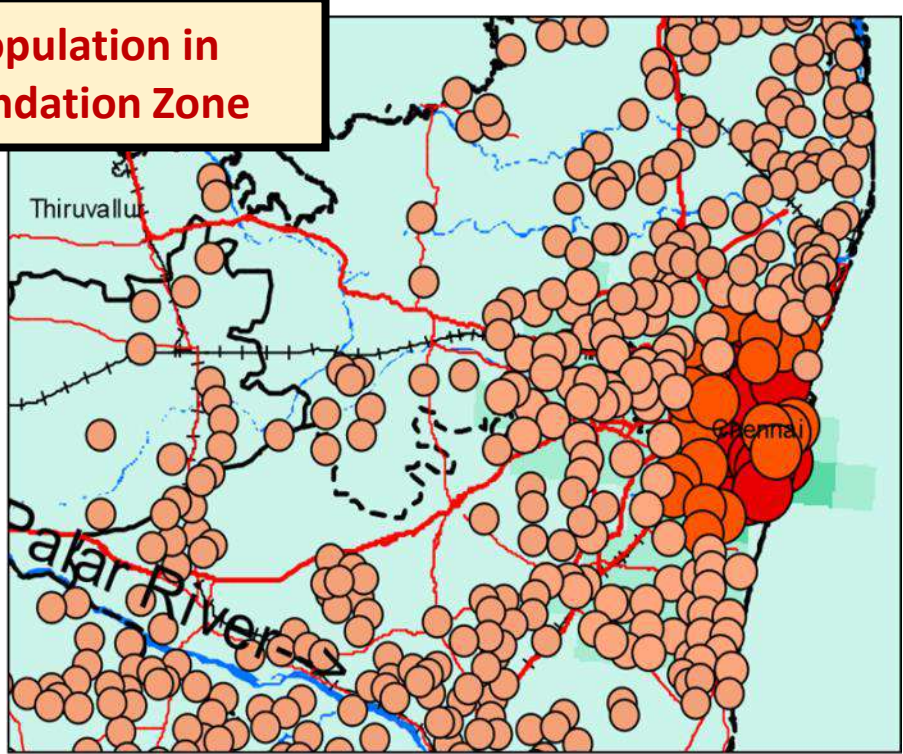


Damages – Case Studies

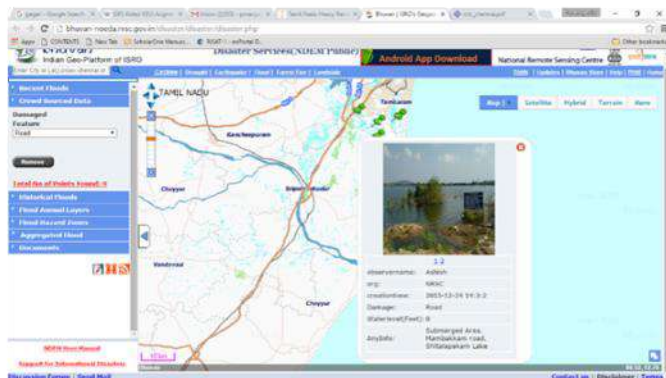
Chennai Floods – Dec, 2015



Population in Inundation Zone



Crowd sourcing on Bhuvan



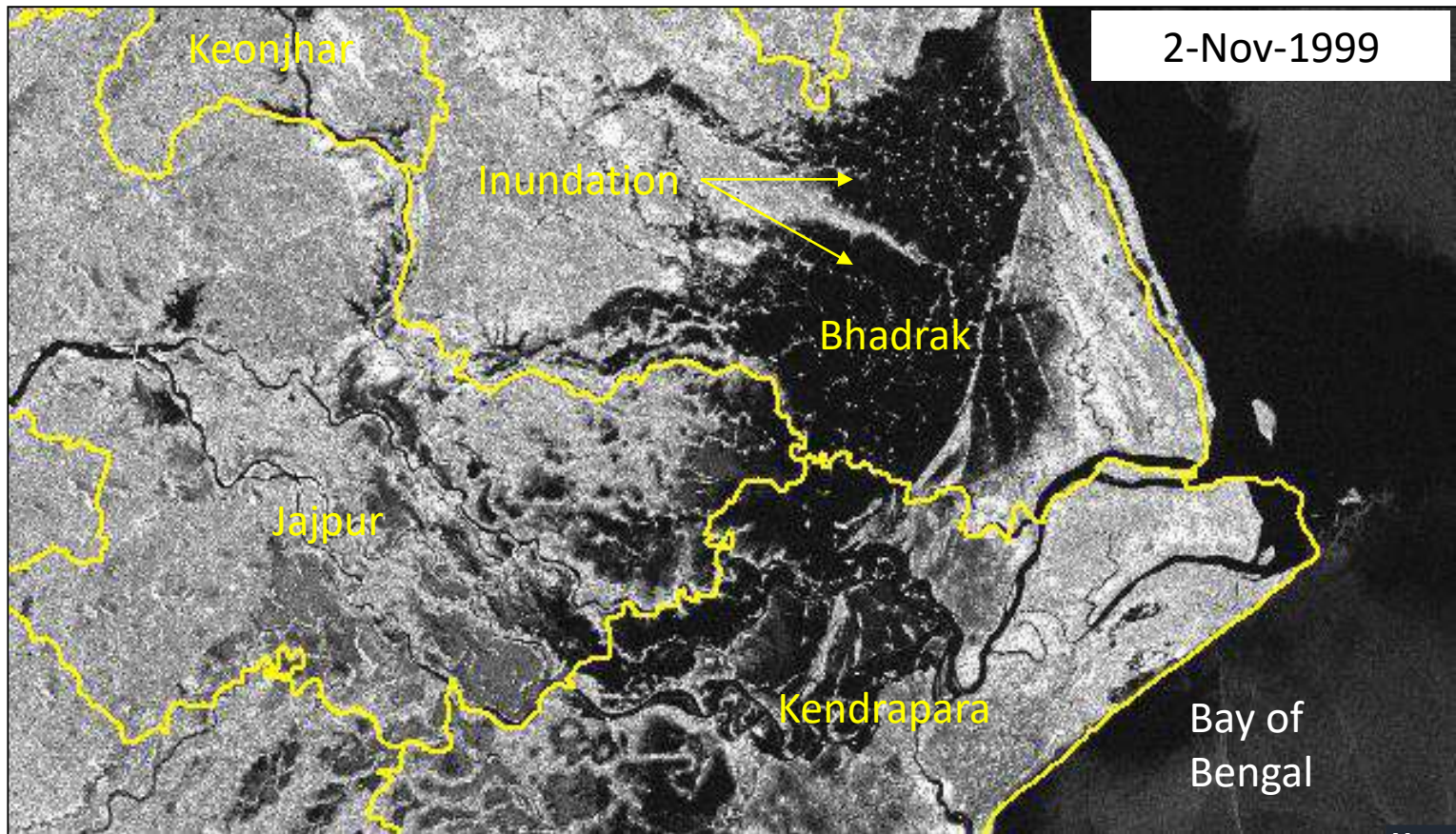
Population in the inundated areas

- Settlements
- Major Roads
- Other Roads
- ++++ Railway
- - - - District Boundary
- State Boundary
- Normal River/Water bodies

Red circle	15001 - 20000
Orange circle	10001 - 15000
Light orange circle	5001 - 10000
Lighter orange circle	1001 - 5000
Lightest orange circle	20 - 1000

Low lying areas - Odisha State

- Low lying areas (based on DEMs), historic inundations due to cyclones, etc.
- Helped Odisha Govt during 2013 Phailin Cyclone



Inundation during Odisha Super Cyclone, 1999

More ...

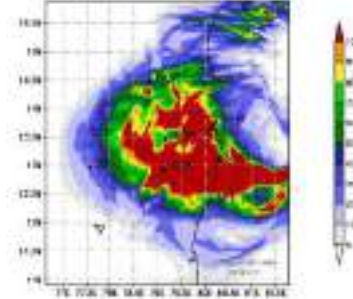
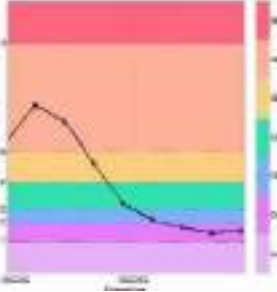
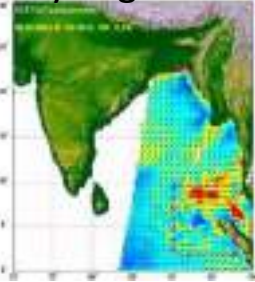
Tropical Cyclone VARDHA

Cyclogenesis

Intensity

Track

Rainfall



Dec 15 2016 : The Times of India (Mumbai)

Isro satellites saved 10,000 lives in TN

Srinivas Lakshmin

Mumbai: Two Isro satellites played a key role in saving a large number of lives mainly in Tamil Nadu when Cyclone Vardha unleashed its fury on Monday.

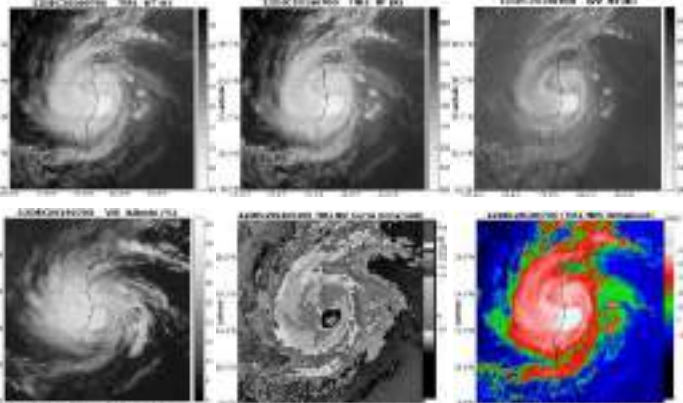
An Isro official told TOI that data from the two satelli-



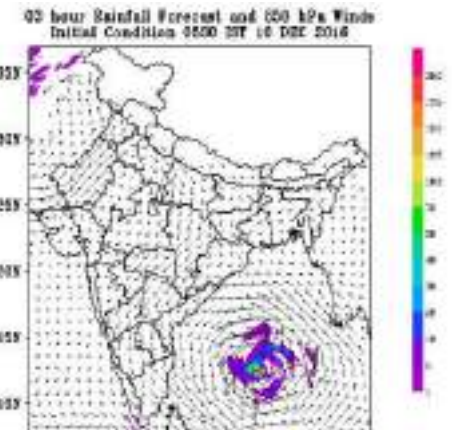
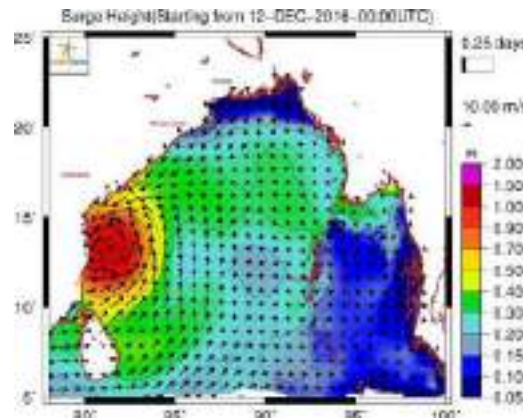
While more than 10,000 human

Cyclogenesis Prediction Time	Cyclone Formation Time
05-Dec-03 Z (3-Day lead)	08-Dec-00 Z

Cyclone Landfall Predicted (24-hr lead)	Cyclone Landfall Occurrence
12-Dec-10 Z	12-Dec-11 Z (1-hr error)
80.4 E 13.4 N	80.6 E 13.2 N (~ 35 km error)



Satellite products from different channels of INSAT-3D satellite for TC VARDHA (0700 Z 12 DEC 2016).



Inundation - Odisha State

Cyclone TITLI with Winds



Affected areas in AP, Odisha



Affected Villages in Andhra Pradesh



Affected Villages in Odisha

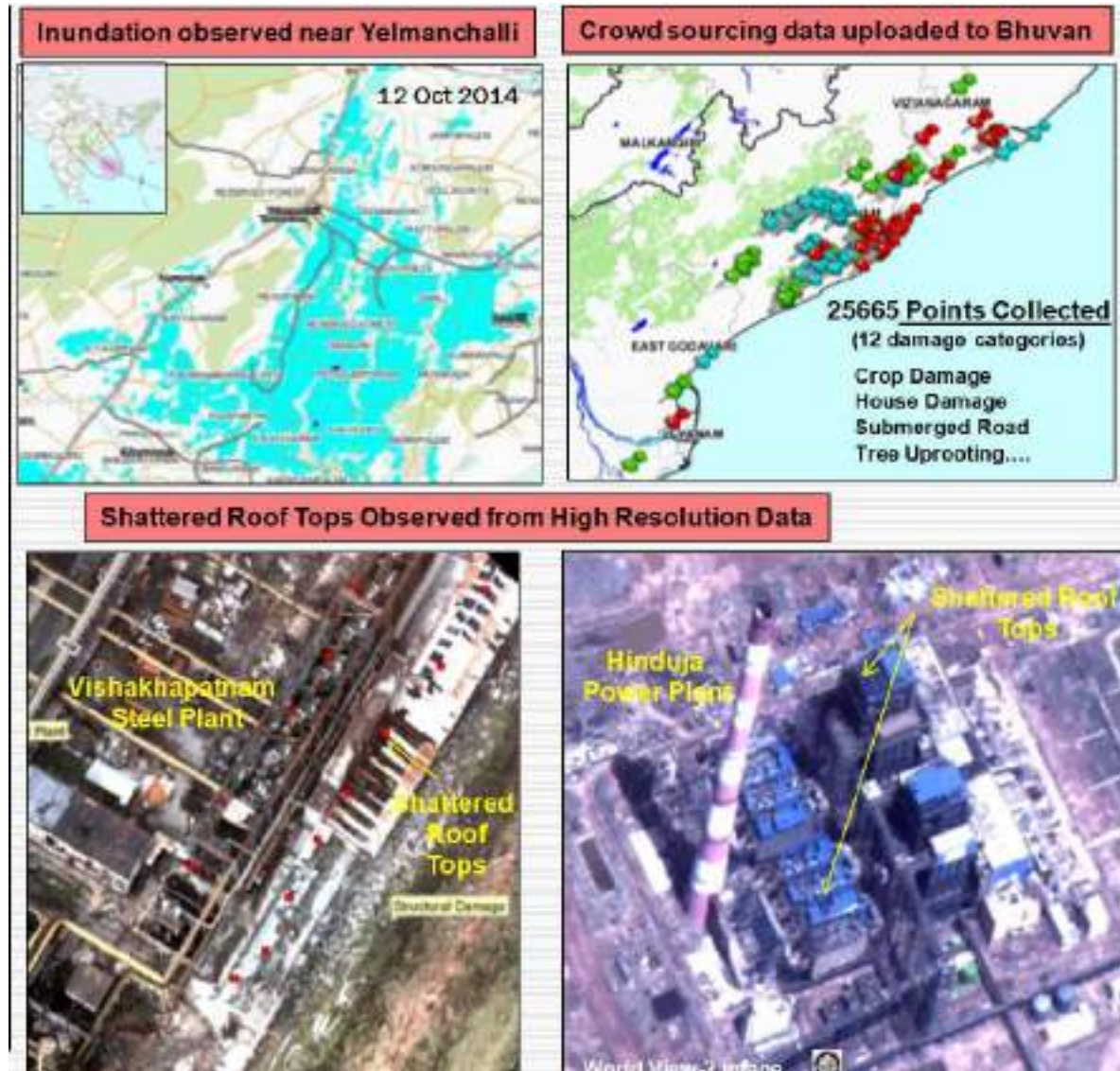


[More ...](#)

Damages – Case Studies

Cyclone HUDHUD – Oct, 2014

- Very Severe Cyclonic Storm “HUDHUD” on 12 Oct 2014 hit Vishakhapatnam, Andhra Pradesh
- International Charter was also activated.
- Inundation maps (about 22 in number) were provided in near real time to state Govt.
- Crowd sourcing was enabled to collect information from ground.



Damages – Case Studies

Cyclone FANI – May, 2019

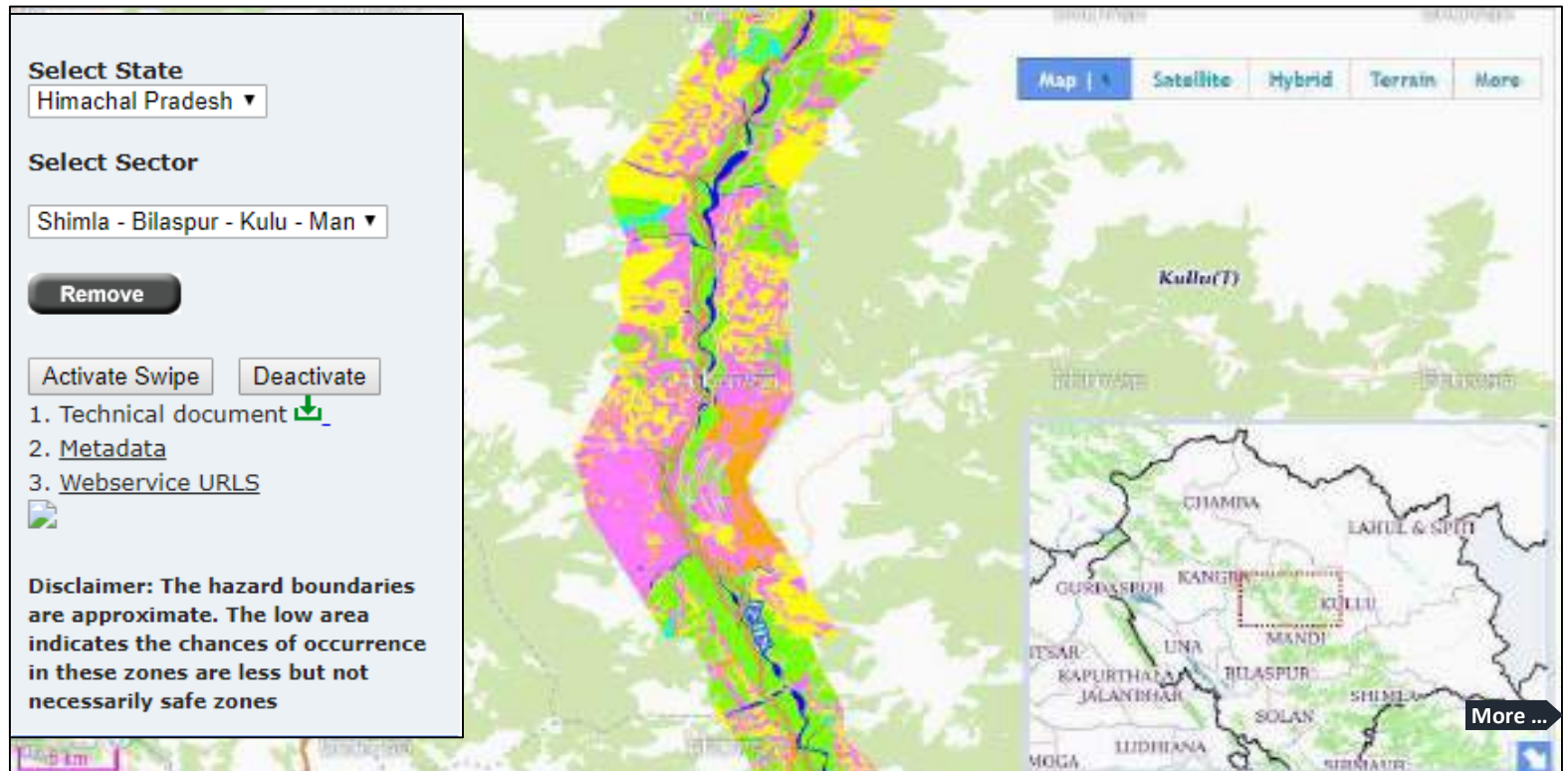
Infrastructure damage due to Cyclone FANI rains in part of Bhubaneswar City, Odisha



For more information, visit, www.nrsc.gov.in

Landslides Hazard Zones

Landslide hazard zonation maps were prepared for selected pilgrim routes in the country. These zones are delineated based on geological, topological and anthropogenic factors. These factors include lithology, soil, slope, drainage, lineament, landuse, etc. At present these maps are available for pilgrim routes in Himachal Pradesh, Uttarakhand, Meghalaya. In addition, event-based and seasonal landslide inventory is also carried out. The information on landslide inventory and hazard zones help the decision makers for better planning in these areas



Select State
Himachal Pradesh ▼

Select Sector
Shimla - Bilaspur - Kulu - Man ▼

Remove

Activate Swipe Deactivate

1. Technical document
2. Metadata
3. Webservice URLs

Disclaimer: The hazard boundaries are approximate. The low area indicates the chances of occurrence in these zones are less but not necessarily safe zones

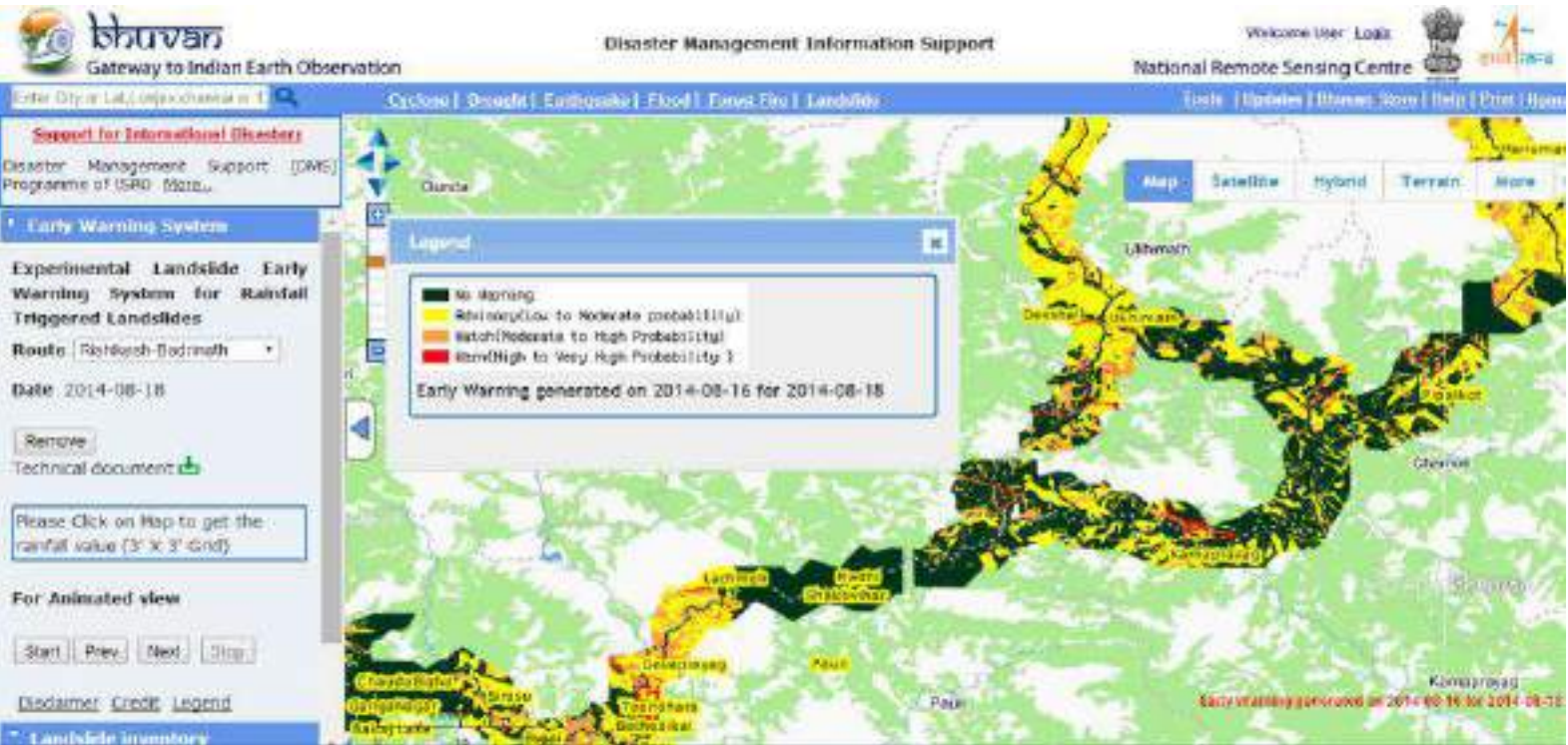
Map | Satellite | Hybrid | Terrain | More

Kullu(?)

More ...

Rishikesh-Badrinath route - Uttarakhand

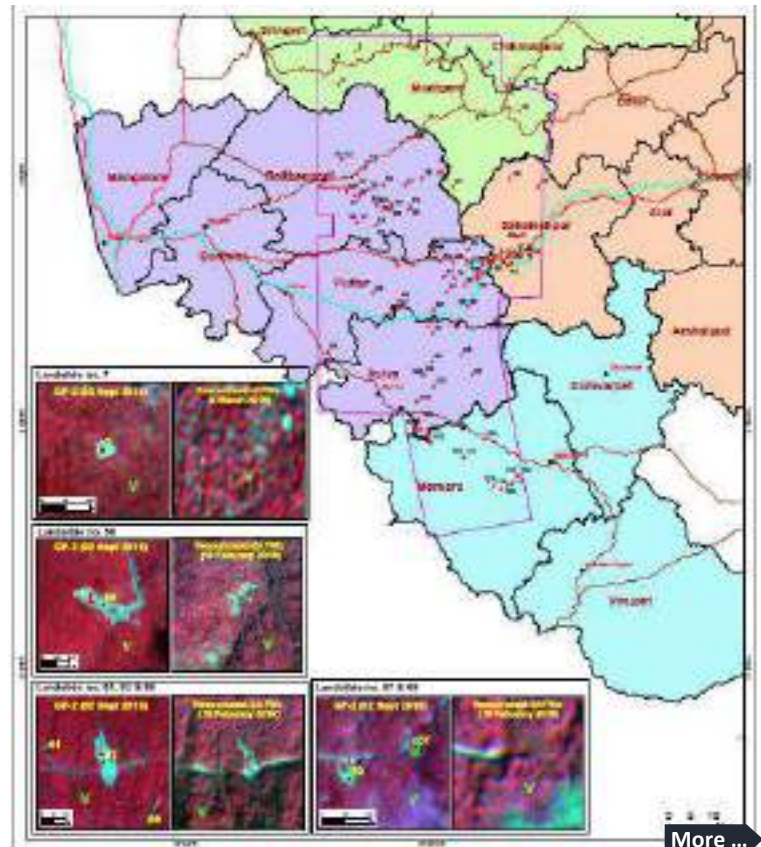
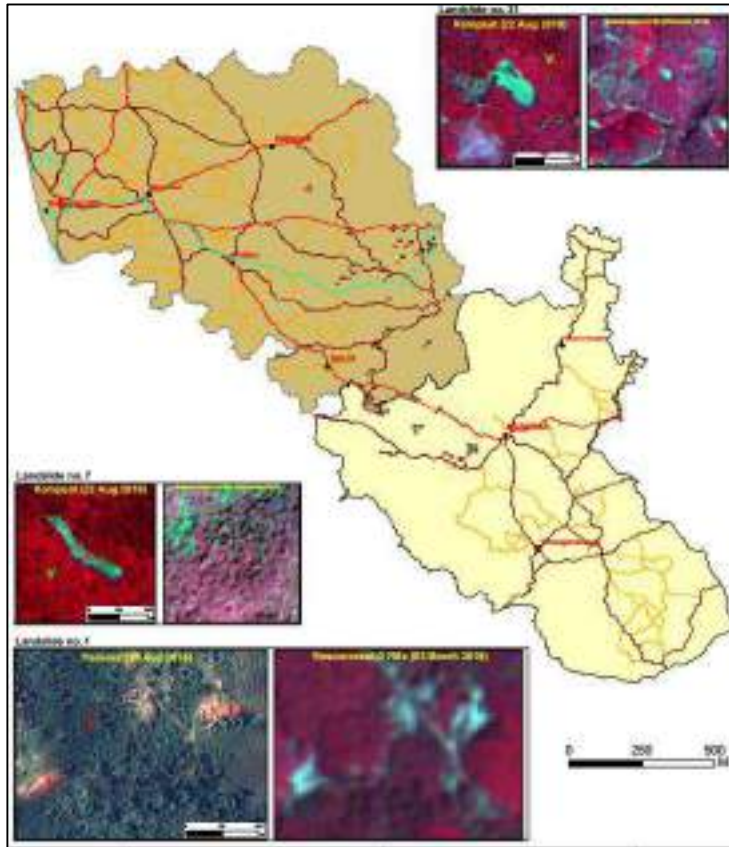
Rain induced landslide early warning system is developed for selected pilgrim routes in the country, on experimental basis. This system is designed by integrating the rainfall intensity forecast with landslide hazard zones prepared for the routes. This illustration shows the probability of occurrence of landslide along Rishikesh-Badrinath route, Uttarakhand State. In rainy season, these could be interactively used on Bhuvan Geoportal.



More ...

Landslides - Karnataka

Landslides occurred in Kodagu, Karnataka due to heavy rainfall in August, 2018. These events resulted in many damages to existing infrastructure in Dakshina Kannada and Kodagu districts. Over 900 landslides were identified in various taluks of Kodagu, Dakshina Kannada and other districts of Karnataka using synoptic satellite data coverages. These were made available to GSI, Karnataka State Disaster Monitoring Centre and others.



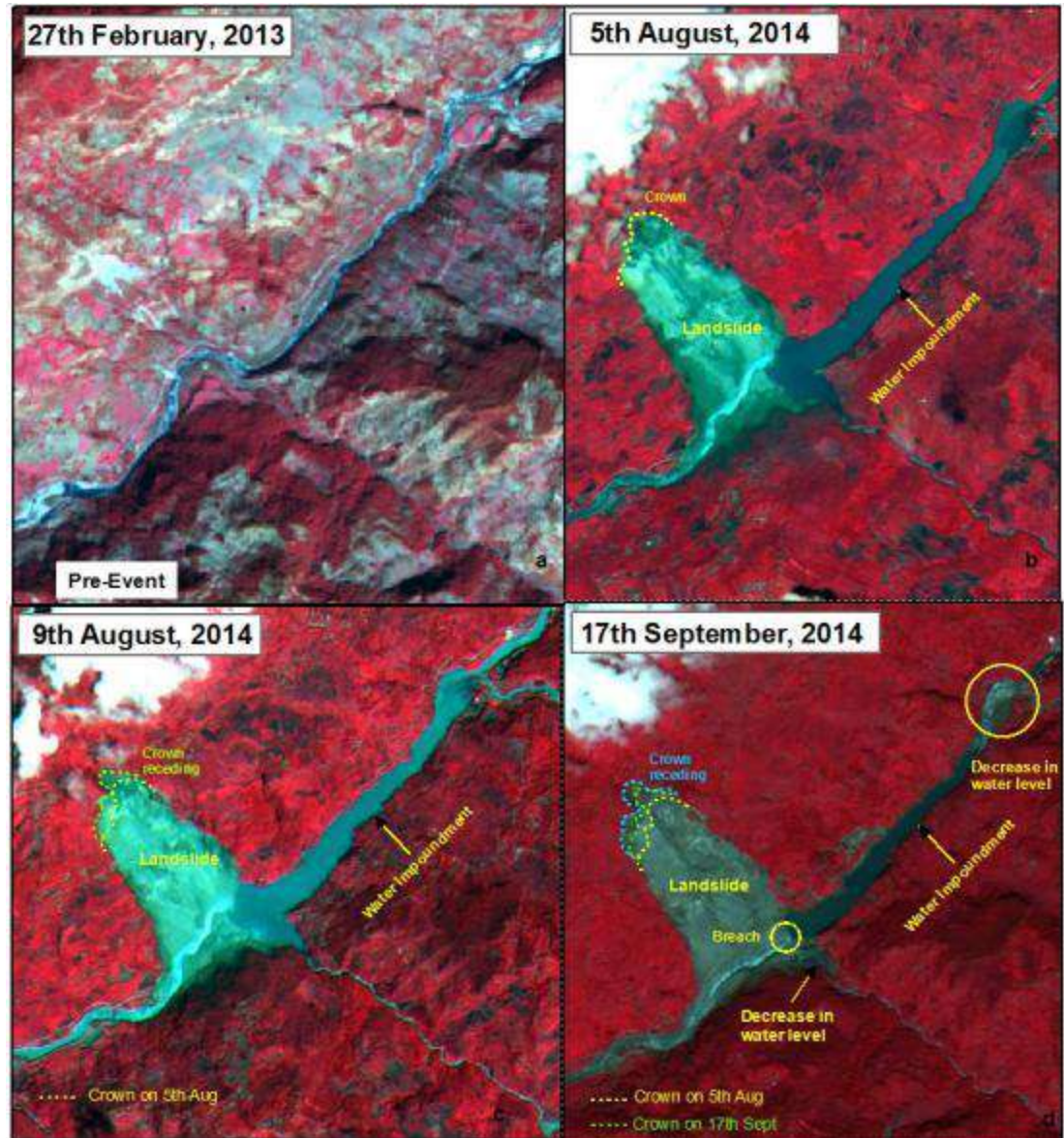
Landslides on Transboundary Rivers

Sun Koshi River in Nepal

A landslide occurred on Sun Koshi river in Nepal on 2-Aug-14

Multi-temporal satellite data analysis shows the recession of the crown of the landslide

Water Impoundment was observed initially and in September, this impoundment was reduced due to human interventions



Formation of New Roads and Channels

02-Sep-2014

Enlarged View

RESOURCESAT-2 L4-MX

Landslide
↓

NRSC/ISRO

New Road

Submerged Road

Old Road

New Road

New Channel

Damaged Road

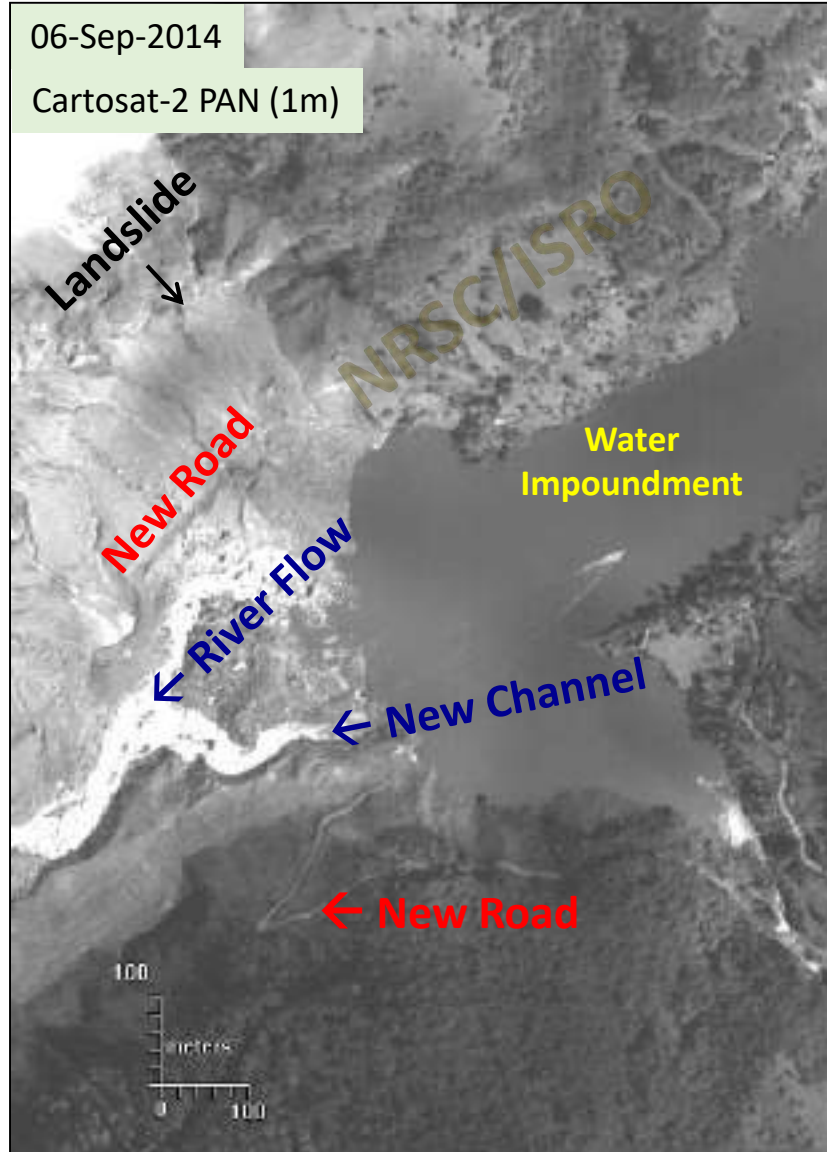
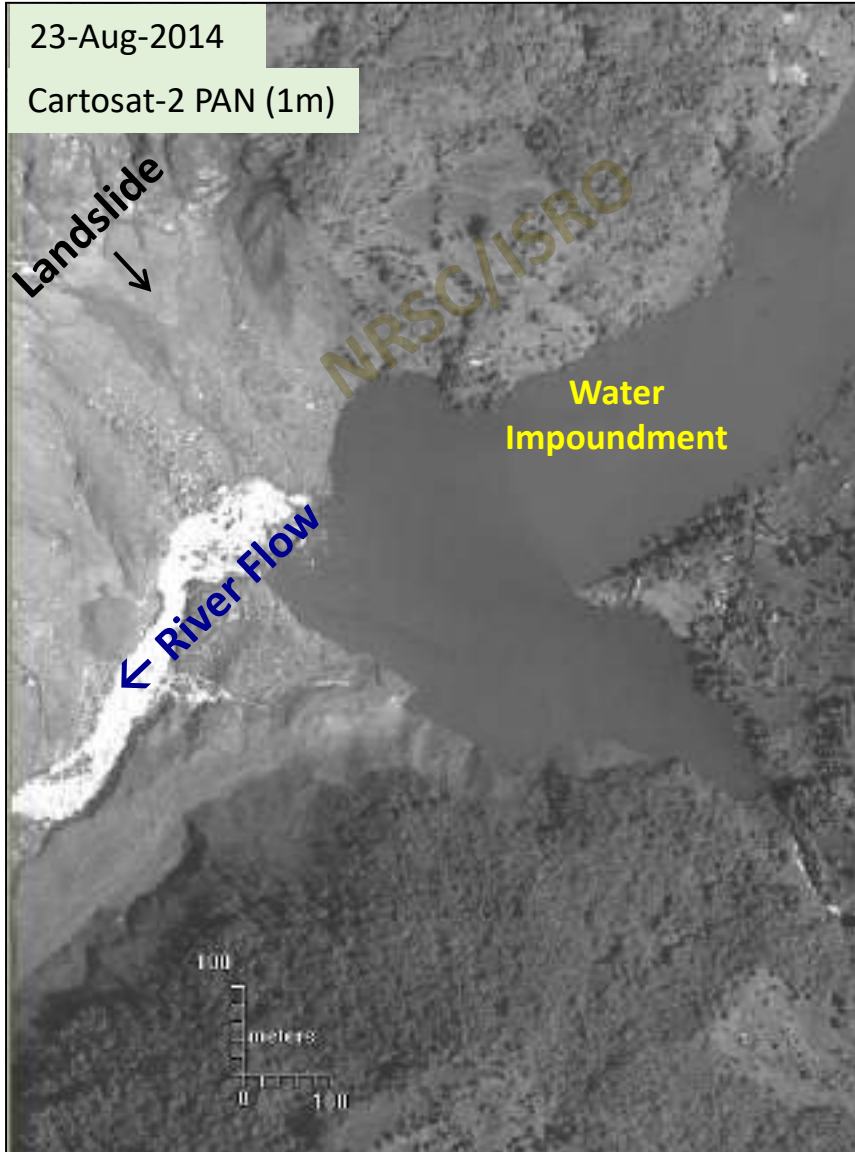
New Road

A view of these findings.



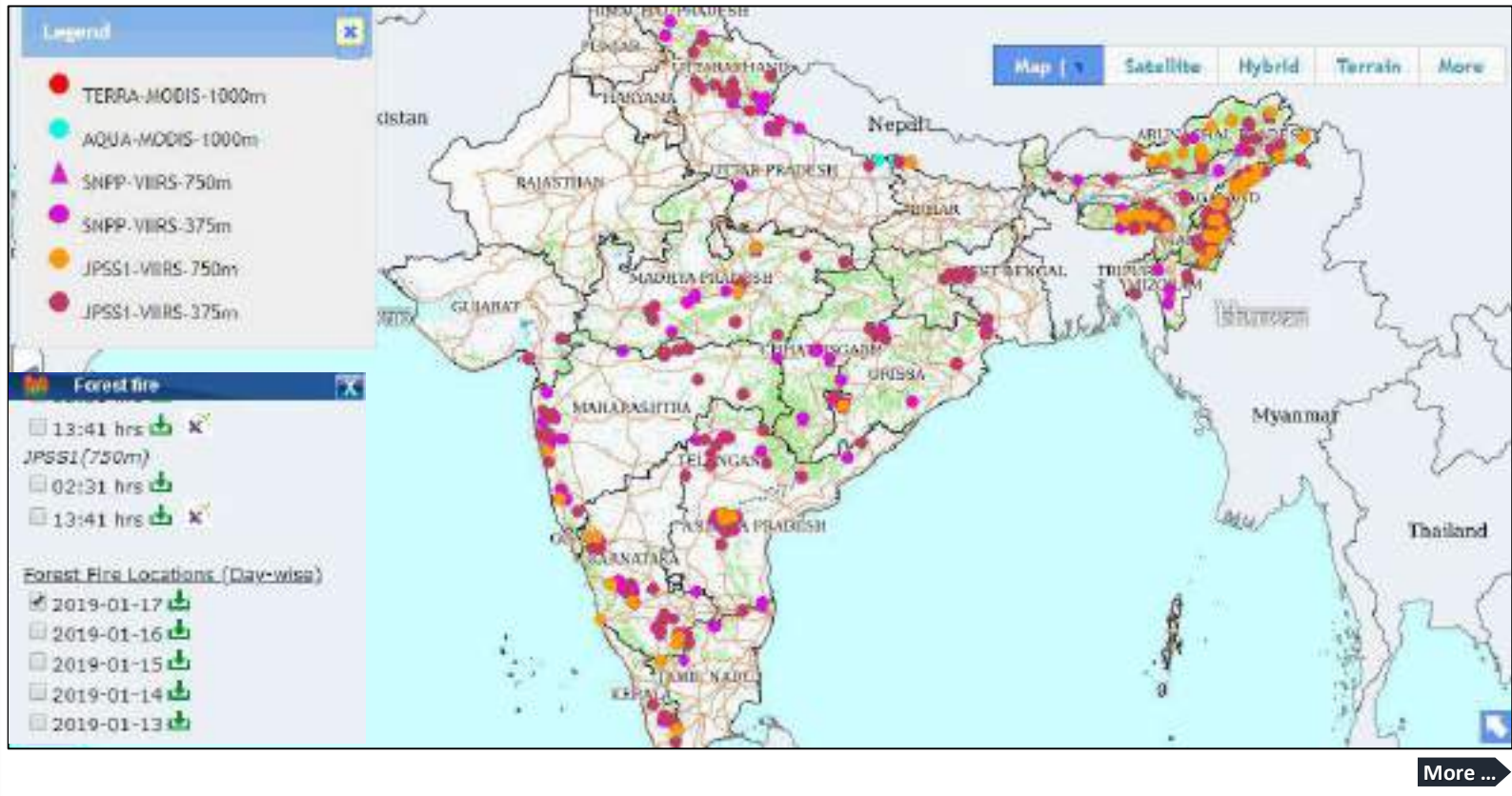
Monitoring of Landslide & Water Impoundment on Sunkoshi River, Nepal

New channel and new roads are observed in 6-Sep-2014 data when compared with 23-Aug-2014 data



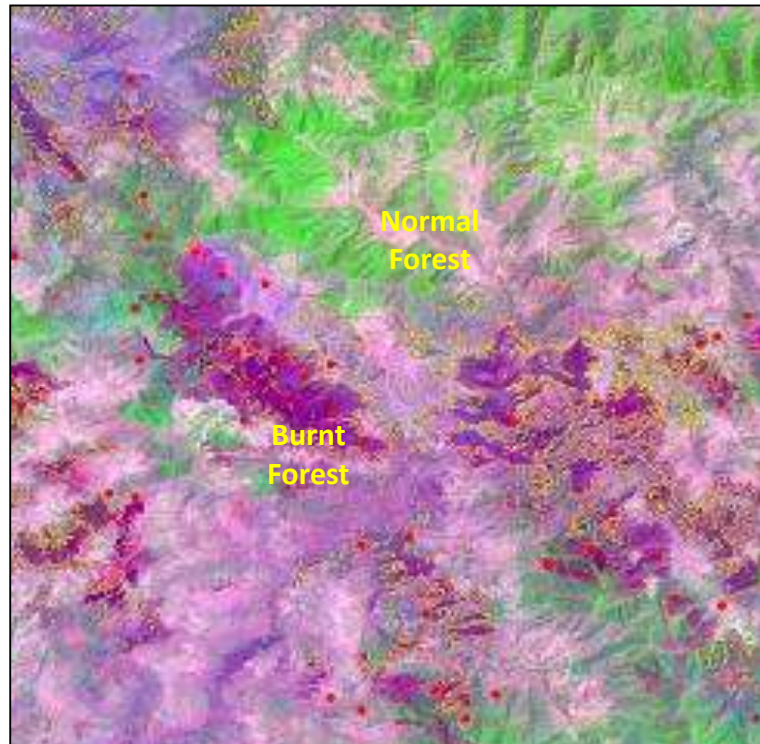
Active Forest Fire Locations in India

During fire season 2018, near real time active fire monitoring was carried out for entire Indian region. Episodic major fire events were monitored for active fires and burnt area assessment using satellite data. Information on fire events were disseminated to the user (Forest Survey of India) and the state forest departments concerned through email, SMS and Bhuvan. Following graphic shows the active forest fire locations in India as on 17-Jan-2019.

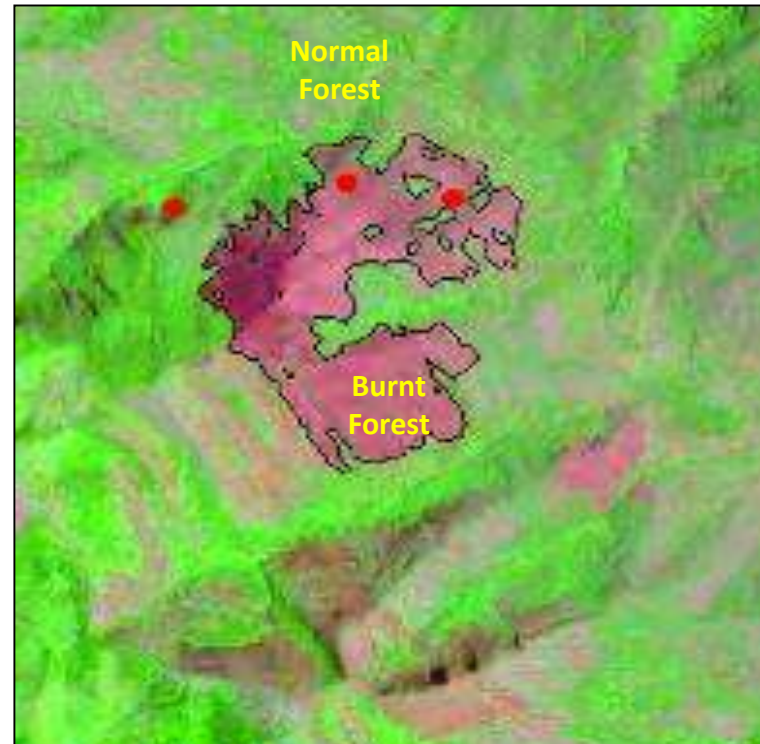


Burnt Area Assessment – Uttarakhand, Tamilnadu

During 2018, major forest fires occurred in Uttarakhand, Tamilnadu and Jammu & Kashmir. Using satellite data, the burnt area estimation was also carried out.



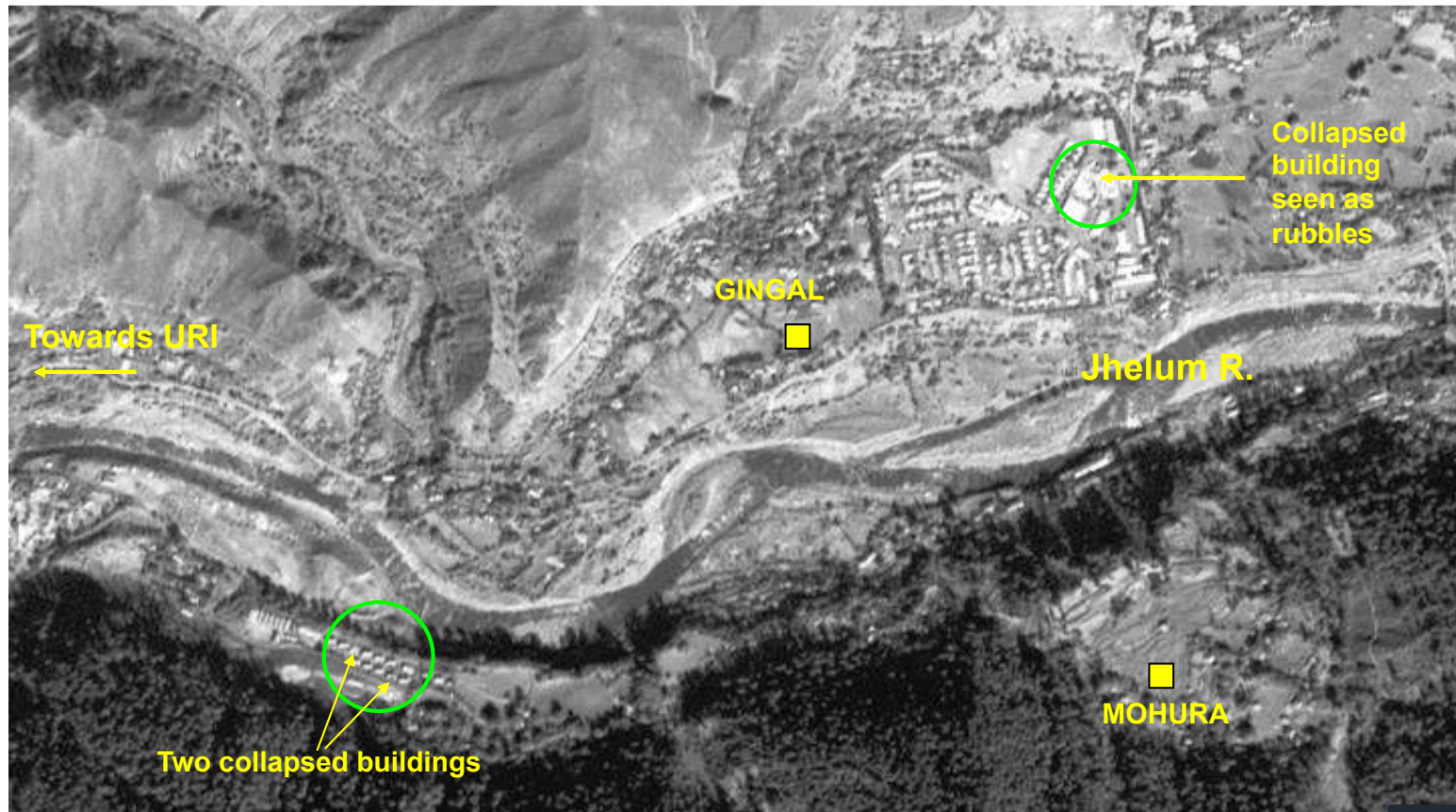
Garhwal district, Uttarakhand
Forest Fire during 20th to 24th May 2018.



Karungani Hills, Tamilnadu
Forest Fire during March 2018.

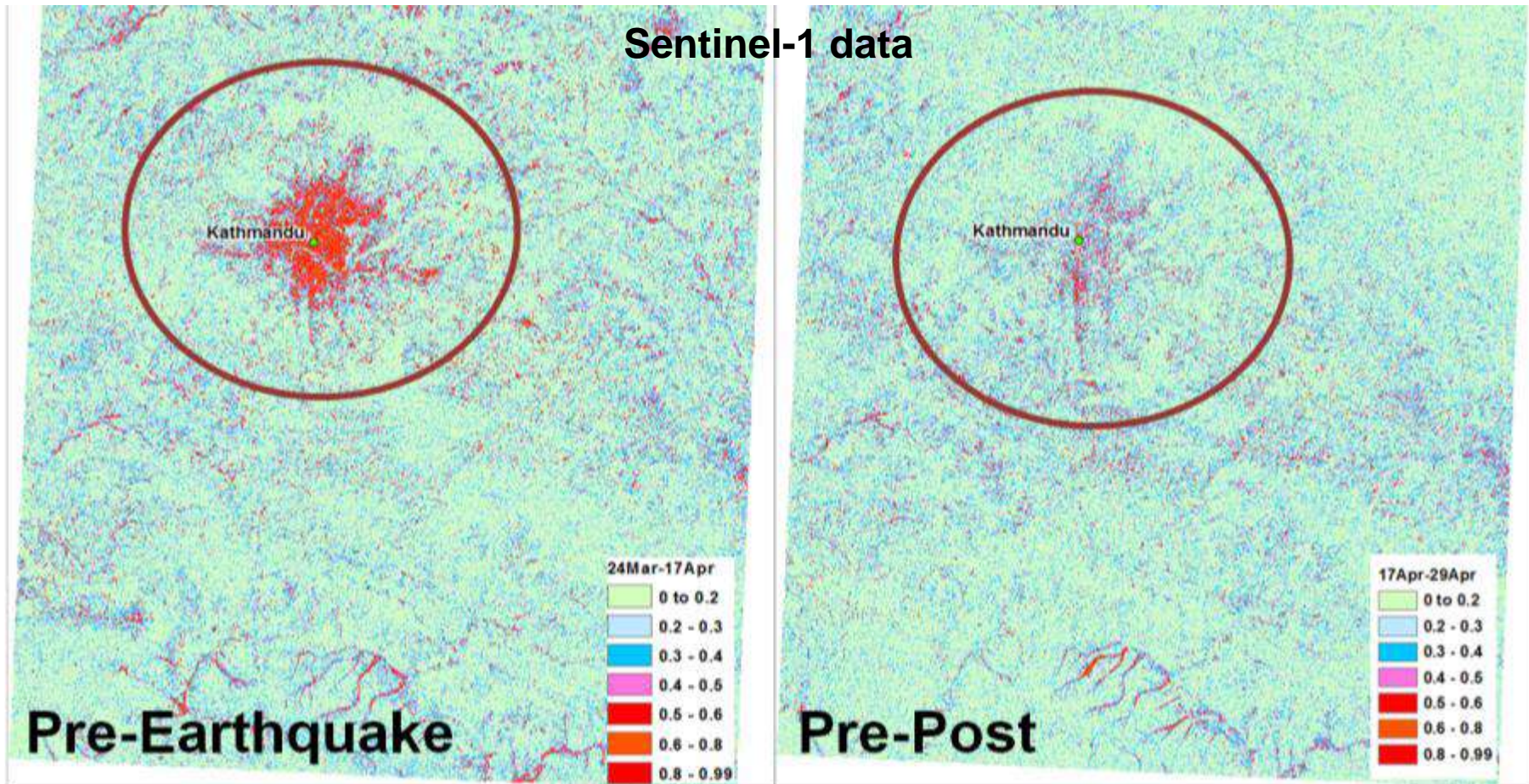
Earthquake – Jammu & Kashmir

On 8th October, 2005, a major earthquake with magnitude 7.6 jolted Jammu & Kashmir. Using high resolution stereo data from Cartosat-1, ISRO provided details of damages. Following picture shows the details.



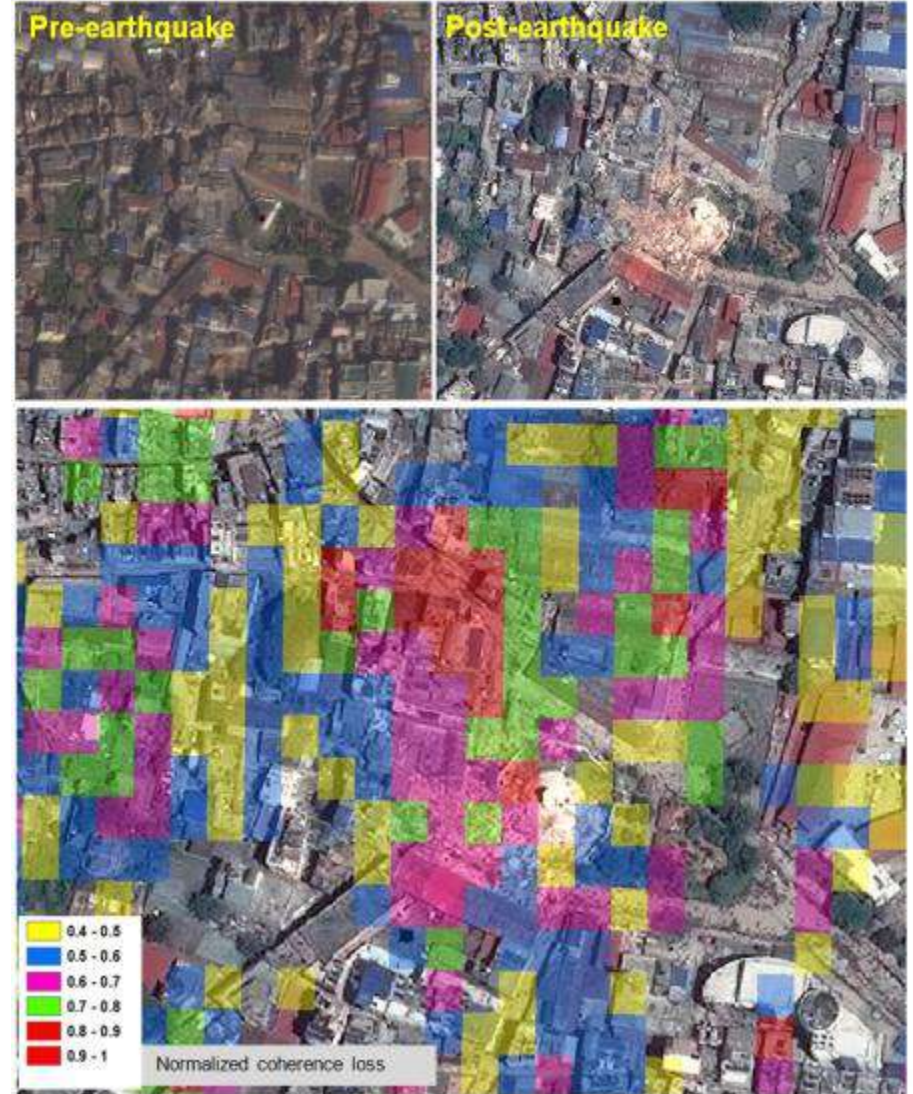
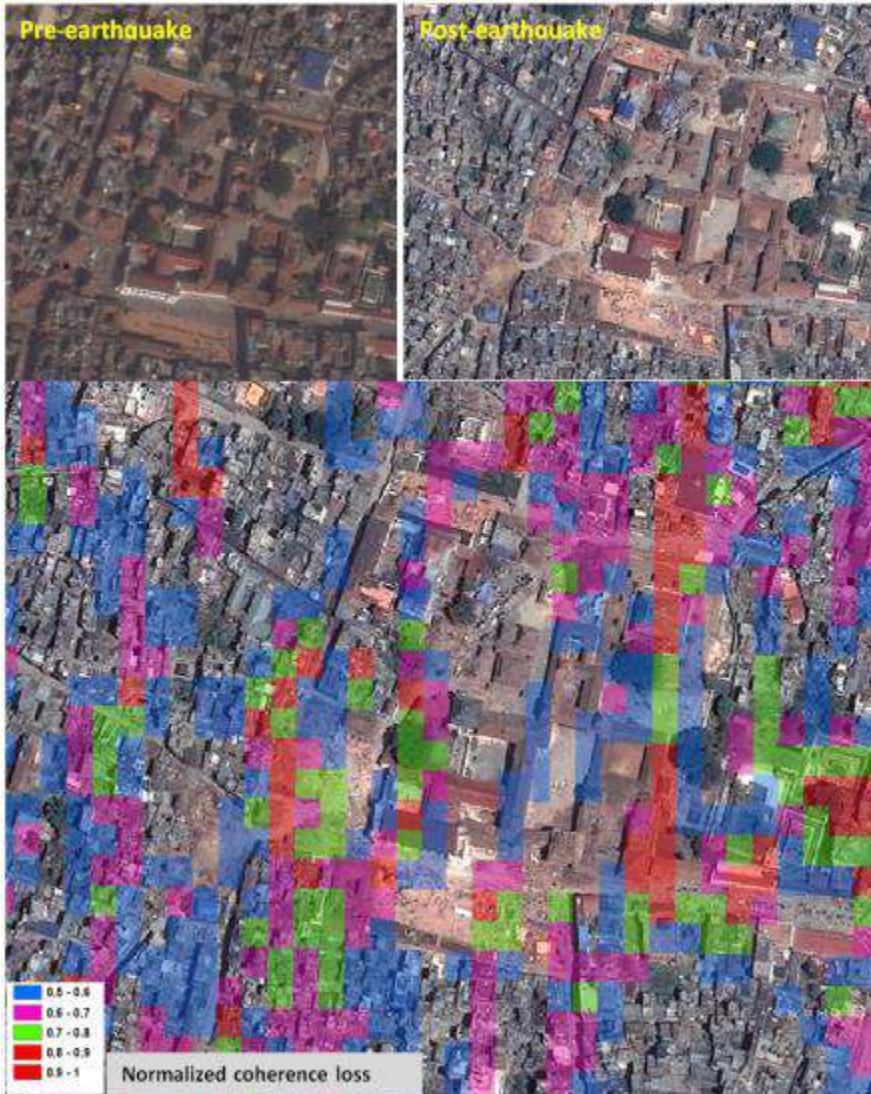
More ...

- SAR data allows quick and broad identification of damaged areas



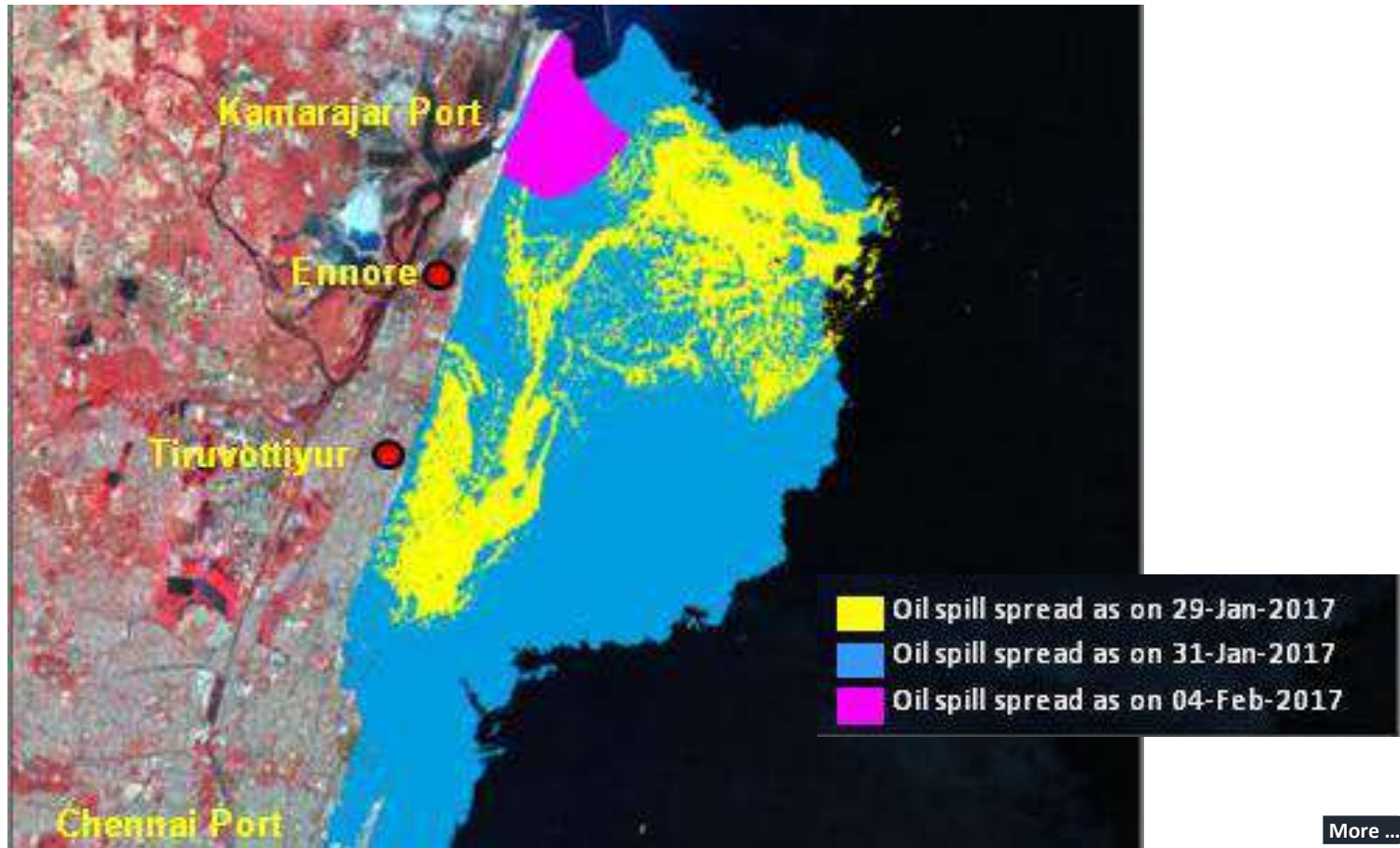
Classified Interferometric coherence for the image pair 24March-17April and for the image pair 17April-29April

Coherence Loss in Urban Area During Nepal Earthquake Using Sentinel-1 data

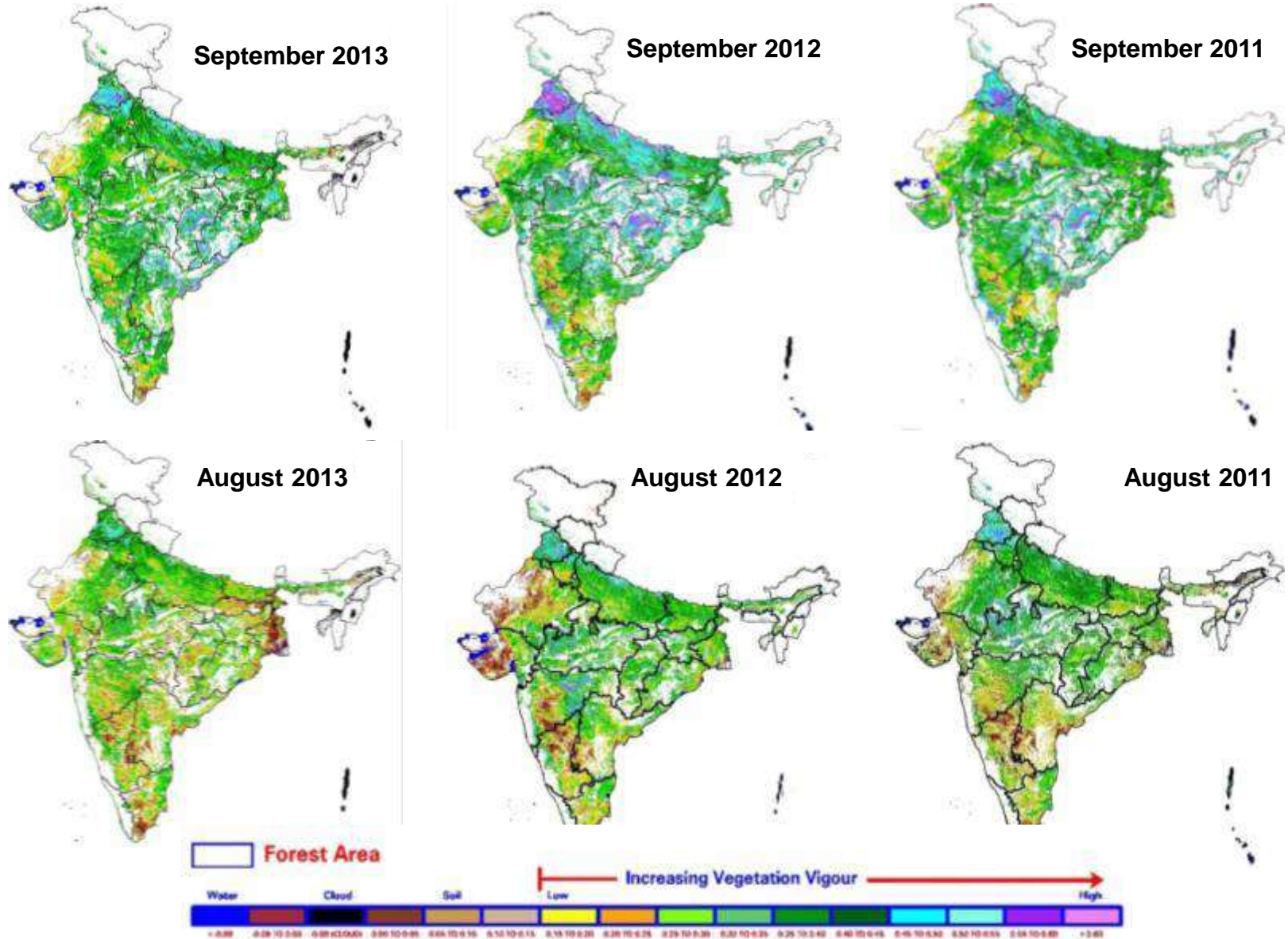


Oil Spill - Tamilnadu

Oil spills are monitored using satellite data and the probable oil spill movement is also modelled. A typical oil spill that was mapped from space in Tamil Nadu during January 2017.



Drought Monitoring



NDVI- Normalized Difference Vegetation Index



Sri Lanka - Drought Monitoring

- Support to Sri Lanka Drought Monitoring Activities
- Satellite Data Support – ResourceSat Data
- Analysis Software Support
- Capacity Building - 2019

ISRO Centres for DMS Services



1. **Hyderabad - NRSC**
2. **Shillong - NESAC**
3. **Kolkata - RC-East**
4. **Jodhpur - RC-West**
5. **New Delhi - RC-North**
6. **Bengaluru - RC-South**
7. **Nagpur - RC-Central**
8. **Dehradun - IIRS**

Info Dissemination to Central & State Departments

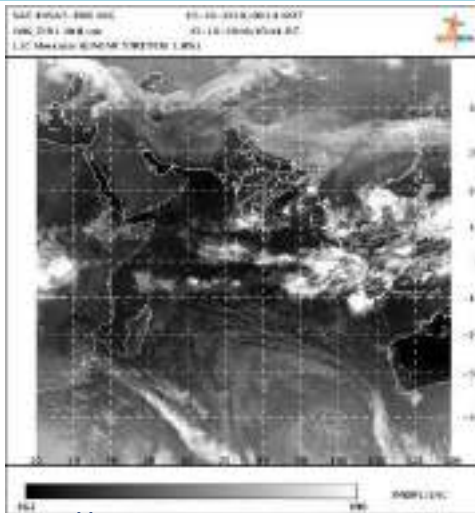
- MHA - Ministry of Home Affairs
- NDMA - National Disaster Management Authority
- NDRF - National Disaster Response Force
- Concerned Central Govt Agencies
- State DMD / SDMA – State Disaster Management Dept. /
Authority

ISRO Portals

M O S D A C

Indian Storehouse for Space based Weather and Ocean Data

- Multi Mission Met. and Ocean Satellite Data Repository
- In situ Data, Weather and Ocean State Forecast
- Met and Ocean Applications, Research and Training



<https://www.mosdac.gov.in>

Bhuvan

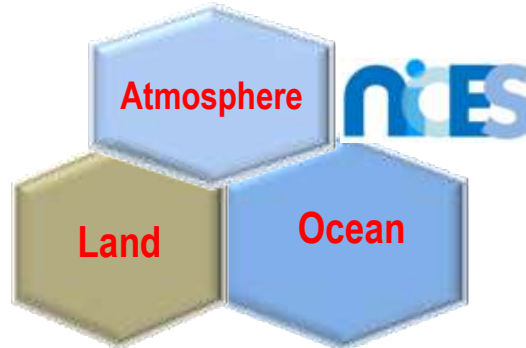


Visualisation, Free Download, Web and Mobile Applications, Maps & OGC Services, Crowd Sourcing

<https://www.bhuvan.nrsc.gov.in>



> 1.5 lakh users, 20 Nodes, Yearly Updation of Images



Climate / Environment Database & Inf. System

<https://www.bhuvan.nrsc.gov.in/nices>



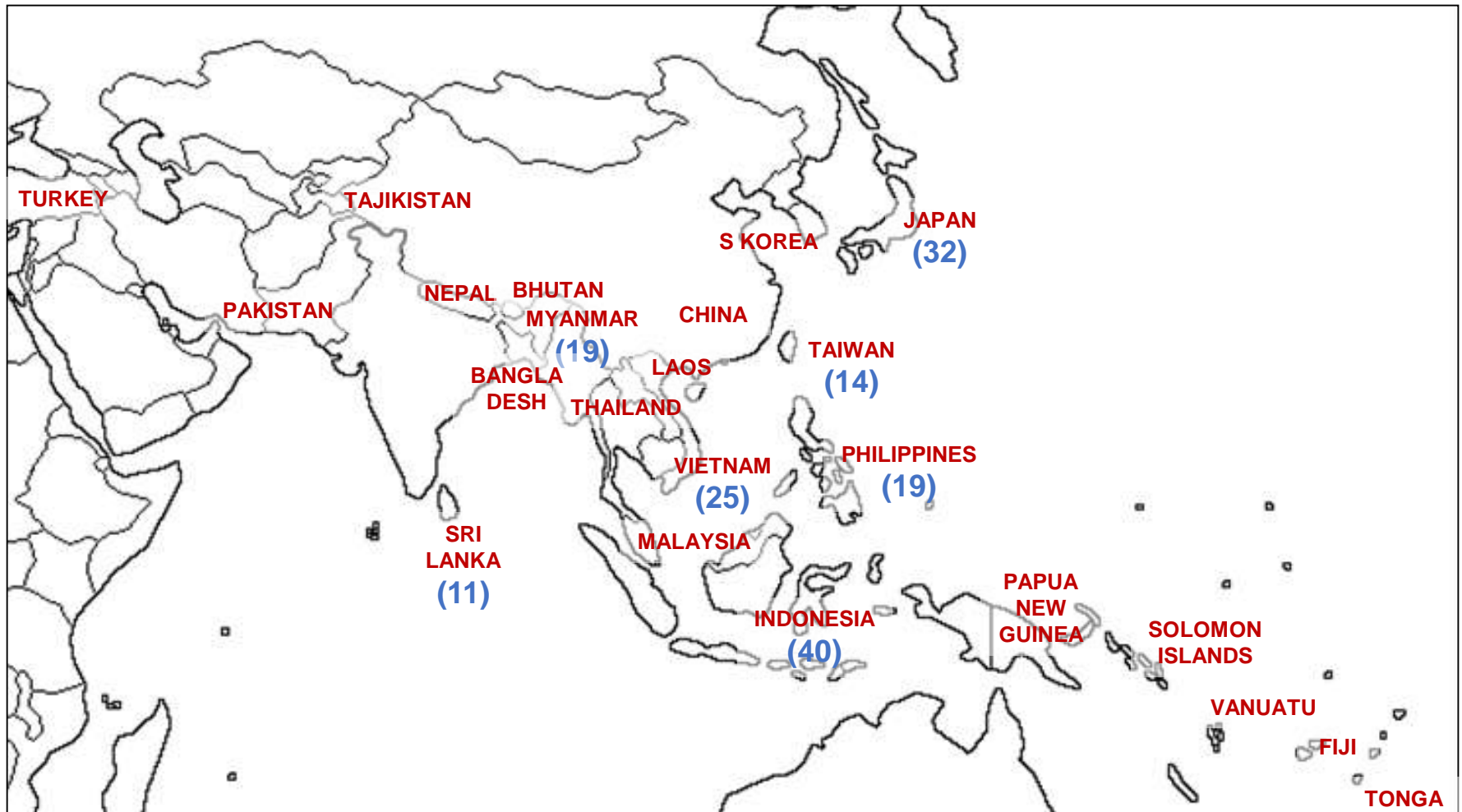
Platform for Research & Training to Academia

<https://vedas.sac.gov.in/vedas>

NDEM

Sentinel Asia – 2014-19

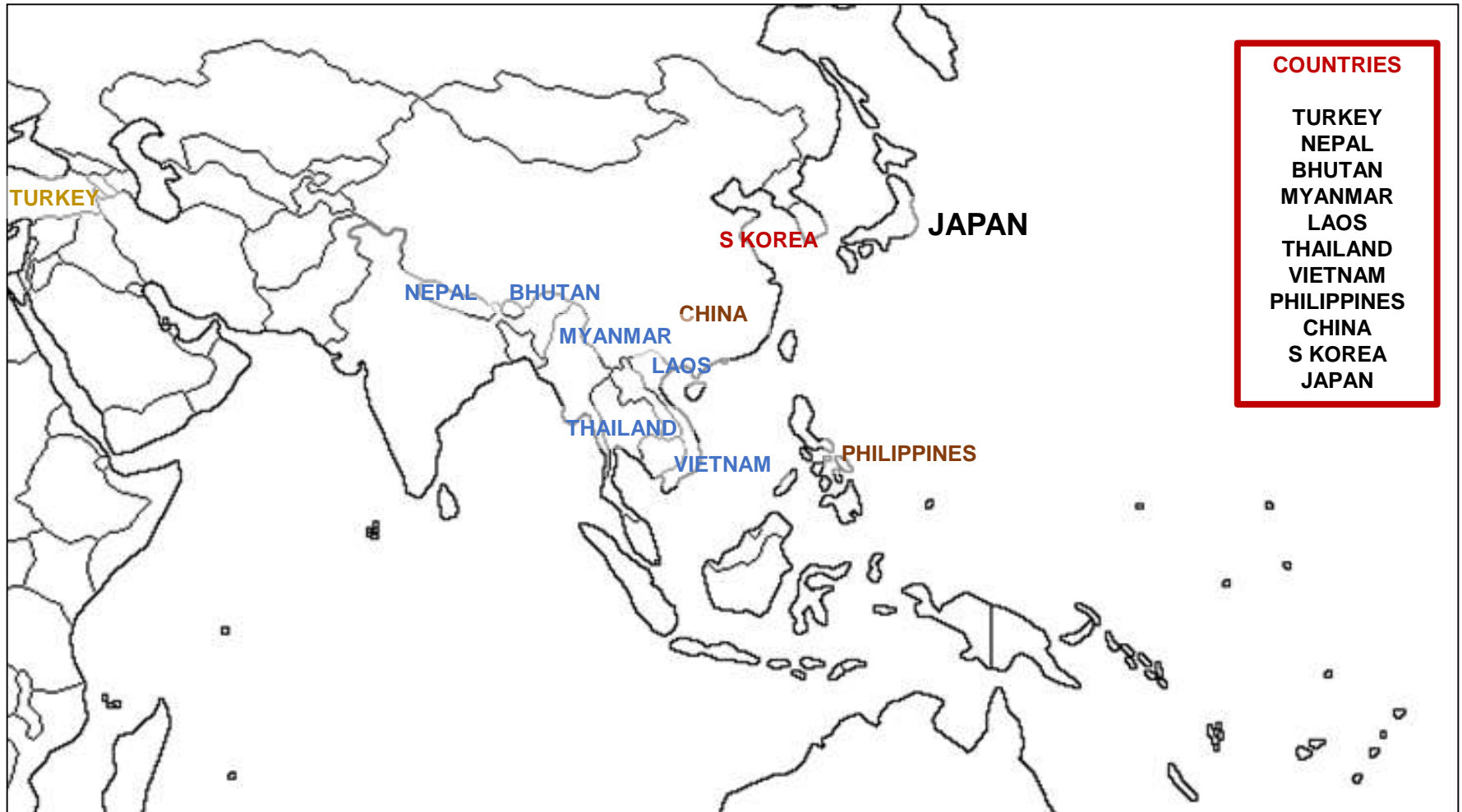
- Data support extended to **23** countries / **107** Disaster Events



- Datasets less than 10 are not mentioned

Sentinel Asia – 2019

- Data support extended to **11** countries / **15** Disaster Events



FLOODS

LANDSLIDES

EARTHQUAKES

FOREST FIRES

MULTIPLE DISASTERS

Sentinel Asia – 2017-19

- Last 3 years about 102 IRS datasets provided to 18 countries through Sentinel Asia

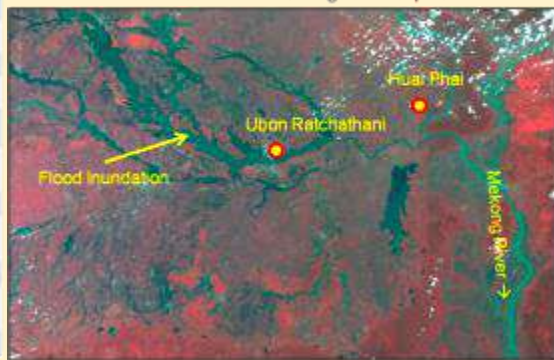
Emergency requests supported - 2019



Country	No. of Disasters	No. of Satellite datasets
Japan	3	5
Nepal	1	1
Korea	1	2
Turkey	1	1
Bhutan	1	1
Vietnam	2	2
China	1	1
Myanmar	1	2
LAOS	1	2
Thailand	1	1
Total	13	18

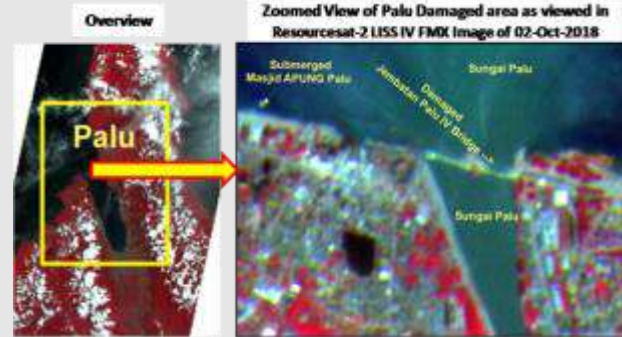
THAILAND FLOODS – SEP 2019

Resourcesat-2A WIFS Image of 24-Sep-19



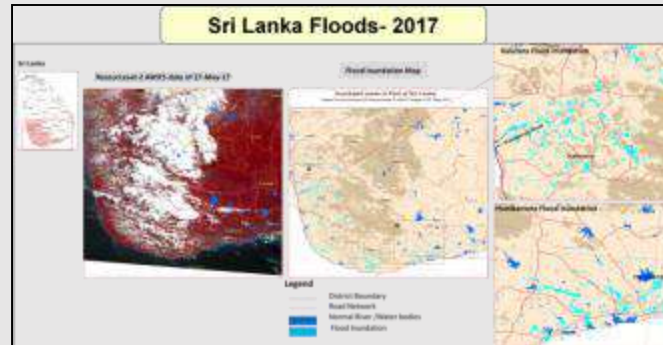
Emergency requests supported - 2018

Indonesia Earthquake, Sep, 2018



Country	No. of Disasters	No. of Satellite datasets
Japan	2	15
Philippine	2	2
Papua New Guinea	1	1
Tonga	1	1
Sri Lanka	1	5
Vietnam	4	4
Thailand	2	2
LAOS	1	1
Myanmar	2	2
Indonesia	3	20
Taiwan	2	2
Korea	1	1
Total	22	56

Emergency requests supported – 2017



Country	No. of Disasters	No. of Satellite datasets
Indonesia	2	3
Nepal	3	3
Sri Lanka	1	3
Taiwan	2	2
Bangladesh	2	2
China	2	4
Vietnam	5	7
Philippines	1	1
Myanmar	2	2
Korea	1	1
Total	22	28

Processing Platform: International Charter Space and Major Disasters

Ex: Bihar Floods – Sep, 2019




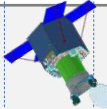

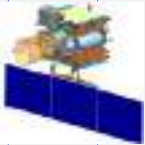
Final Product

Availability of more and more satellites

The screenshot displays the ISRO Processing Platform interface. At the top, it shows the title 'Processing Platform: International Charter Space and Major Disasters' and the user 'pm_623'. The main map area shows a satellite view of Bihar, India, with a red overlay indicating flood areas. A red circle highlights a search control panel on the right side of the map, which includes options for 'Optical', 'SAR', and 'Ext Download', along with search filters and buttons for 'Data' and 'Satellite'. Below the main map, a 'Reference Layers' panel is visible, listing 'OSM Map', 'DEM Hillshade', 'Disaster Area', 'Bing Map', and 'DEM Colored'. A 'Workspace Name: ISRO1' is also shown. In the bottom left, a 'Final Product' window displays a detailed map titled 'Map showing floods in part of Bihar' with a legend and various data layers. On the right, a 'Satellite' panel lists available satellite data, including 'KANOPUS_V,MISS_PSS,O' and 'SENTINEL_1A,SAR_ESA,S'. A text box at the bottom right states 'Availability of more and more satellites'.

14 Missions

Future EO Satellite Missions

	2019				2020				2021				2022			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
LAND & WATER	Wide Swath imaging with improved spatial resolution				RESOURCESAT – 3				RESOURCESAT – 3A							
	Advanced stereo PAN & MX ; HR DEM				RESOURCESAT – 3S				RESOURCESAT – 3SA							
	RISAT-1A (Continuity to Risat-1)				RISAT-1B				NISAR (L& S Band SAR)							
					CARTOSAT- 3 : Very High resolution PAN & High resolution MX				HRSAT (3) – Phased in Orbit for daily revisit of AOI							
					OCEANSAT - 3 Ocean Color & Wind vector – <i>Continuity</i> + SST				OCEANSAT – 3A							
GEO					GISAT-1 (Observation from GEO)											

Thanks