

# UN-India Workshop on use of EO for Disaster Management & Risk Reduction “Asian Experience”

## Space Technology in Disaster Response – Indian Scenario



PG Diwakar

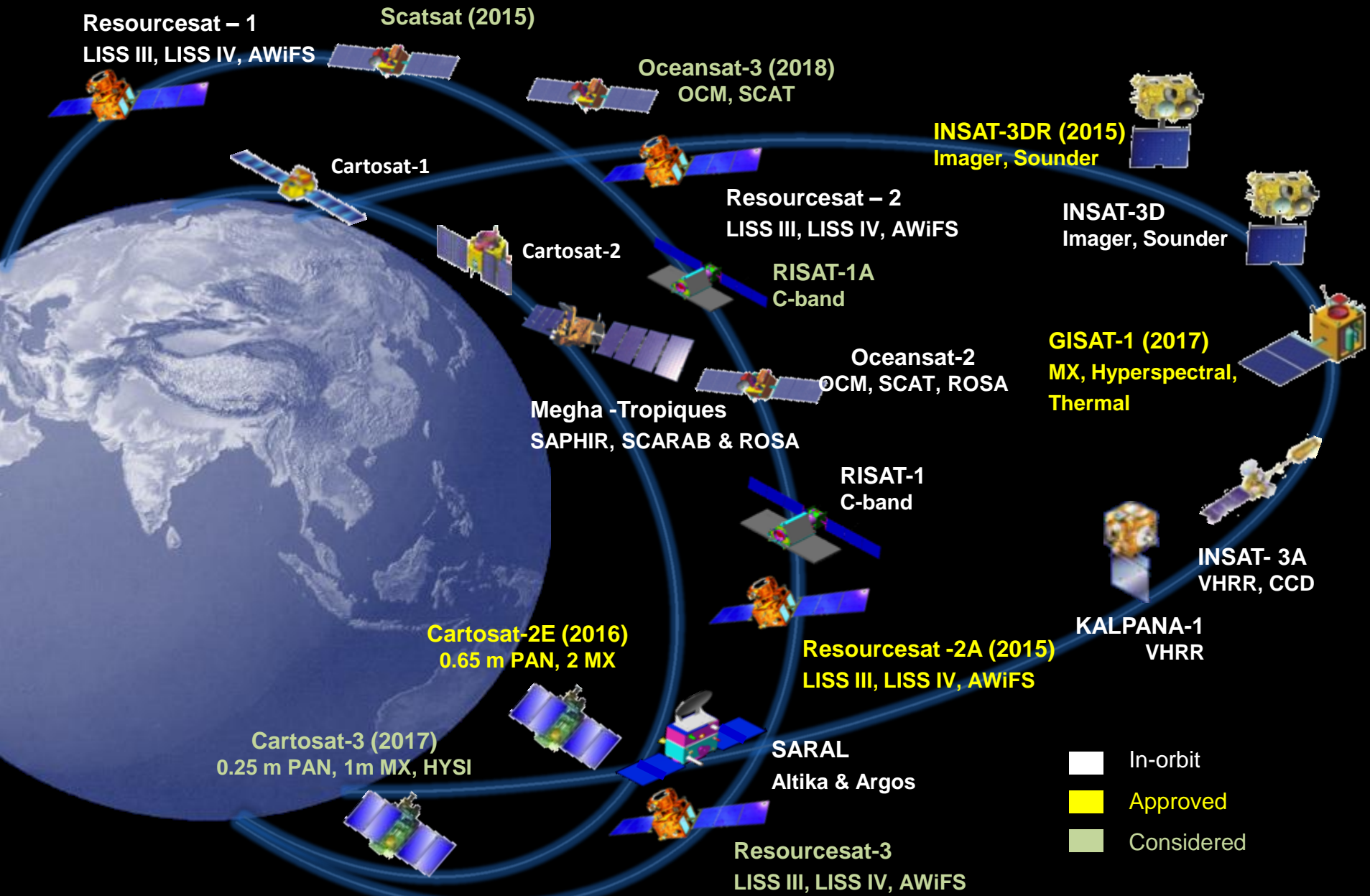
March 08, 2016



National Remote Sensing Centre  
Indian Space Research Organisation



# Indian Earth Observation in the future



# DISASTER RESPONSE

## 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

## Early Warning & Assessments



Near Real-time  
monitoring of all major  
disasters

## Forest Fire

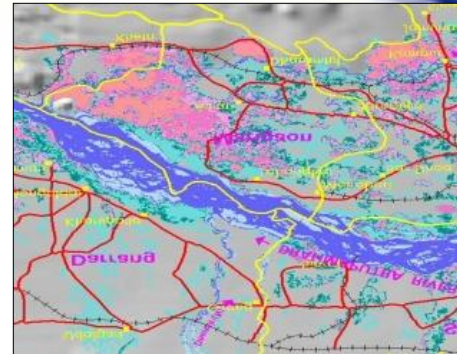


- Active Fire Detection
- Damage Assessment

# DMS – Decision support Centre

**ALERTS**  
Adv. Info.  
& near real time  
assessment

**Data Acquisition, Analysis  
& Dissemination for all  
major disasters**



Satellite Data Programming  
and Acquisition  
(NRSA Earth Station / NDC)

**Data**  
• Satellite and Aerial  
• All Resolutions  
• Optical and Microwave

ASAR /ALTM/ etc.

Flight Planning

Defense clearance

Data acquisition,  
processing and  
transfer to DSC



**Acquisition of data**

Database,  
Knowledge Banks

Ground / Ancillary  
Information

**Data Analysis**

Hardware &  
software

Customized  
Analysis Tools

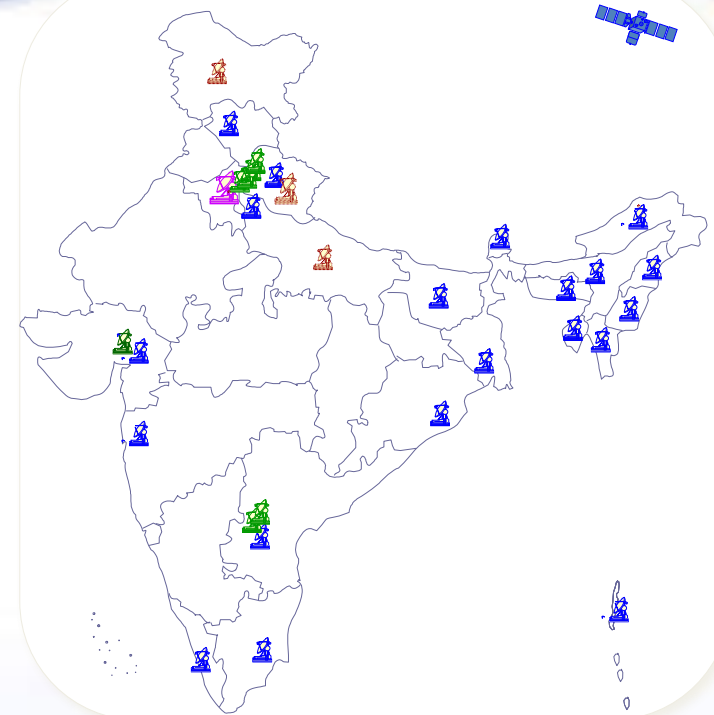


**Outputs**

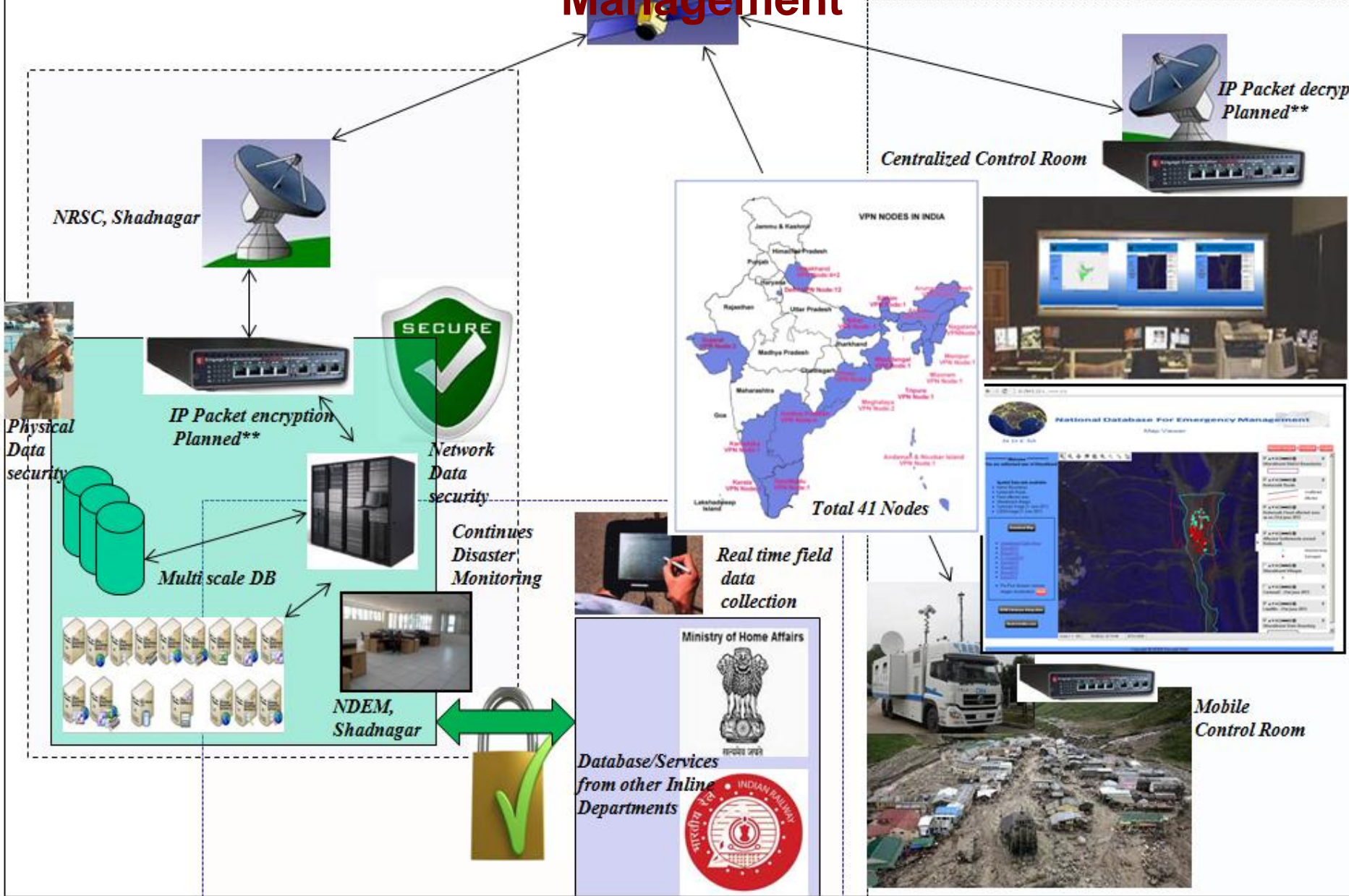
**Dissemination to Users**  
VSAT, FTP, Bhuvan, E-mail etc.

# Communication Network (VPN)

- **SATCOM based Virtual Private Network (> 40 nodes) are operational (GSAT 12)**
- **Online GIS data analysis, data download, Video conf, .....**
- **22 multihazard prone State Emergency Operation centres (10 Primary Nodes providing data CWC, IMD, INCOIS...) & 5 Monitoring nodes (CabSec, NEOC, PMO, PMR...)**
- **Expansion of the network to multi-hazard prone districts of the nation**
- **National Disaster Management Command Centre - in advanced stage of planning**



# National Database for Emergency Management



# Emergency Communication

**Several Types of Emergency communication are in place use to meet critical requirements.**

## **MSS TYPE-D Terminals – Satellite Phones**

- Portable satellite phones for emergency communication – between terminals and terminals to PSTN



## **Distress Alert Terminals (DAT) for fishermen**

- Floatable terminals which transmits messages while a boat is in danger.
- 1850 DATs provided to fishermen - India Coast Guard.



## **DTH based Disaster Warning Dissemination System**

- Disaster alerts through Set-top-Boxes
- 500 DDWS systems - IMD and Doordarshan





# Disaster Management Support

## Floods

- **Response**
  - Inundated Area, Districts & Villages submerged.
  - Frequency – 5-day, 2-day, Daily, 12-hrly, thrice a day – depending on coverage & based on severity
  - Damage to structures – Uttarakhand Floods (2013), J&K floods (2014)
- **Early Warning**
  - Info. on discharge, likely submergence (fr rainfall), water levels / discharge parameters
- **Mitigation**
  - Villages frequently flooded - Historical satellite
  - Flood Prone Areas -Historic flood inundation (10-15 yrs)
- **Information Dissemination**
  - Central & State Disaster Management Authorities – Near real-time
  - Information on Public domain through Bhuvan Platform

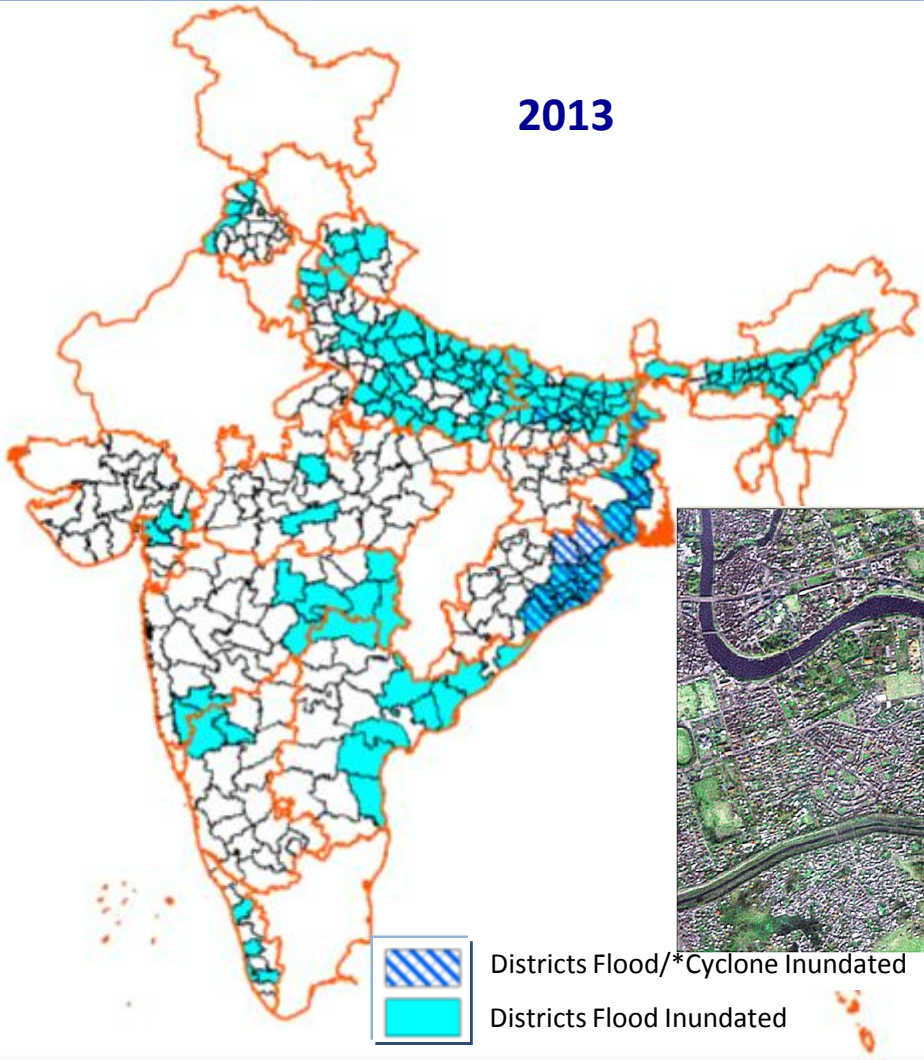




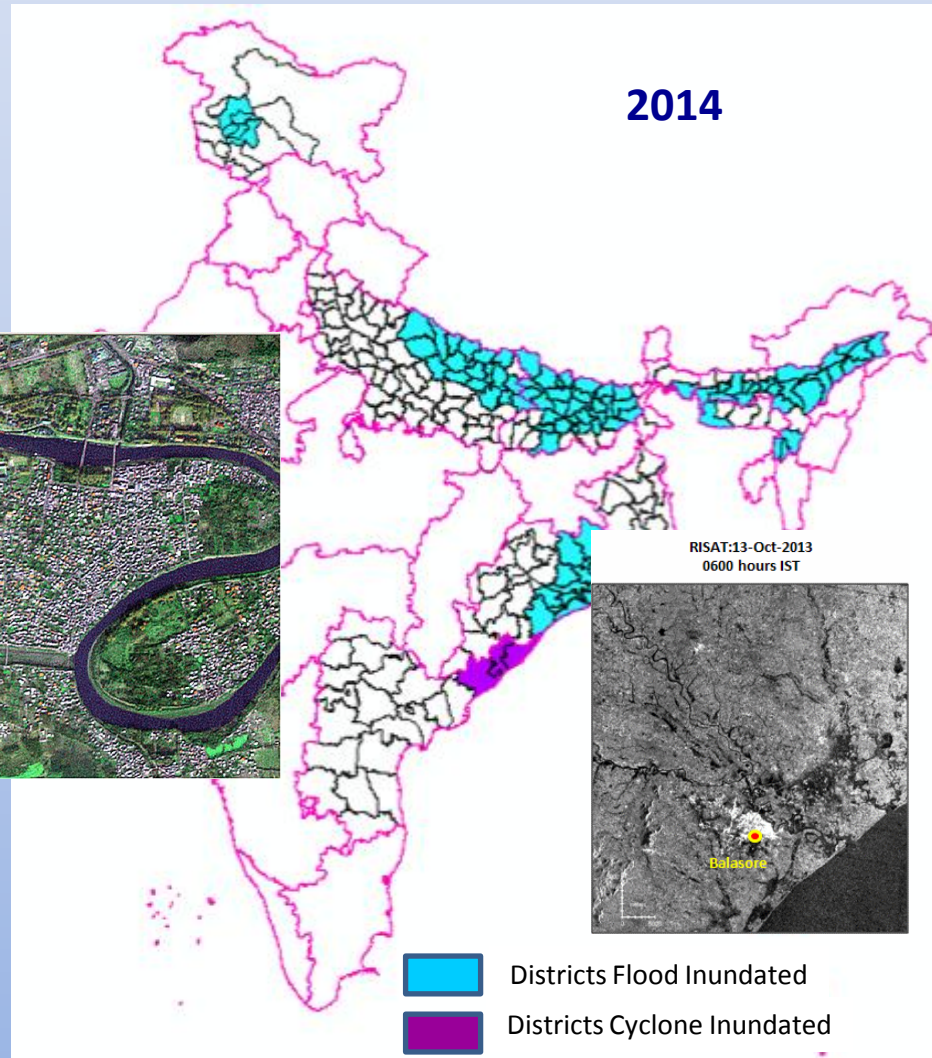
# DISASTER RESPONSE

## Major Floods & Cyclones

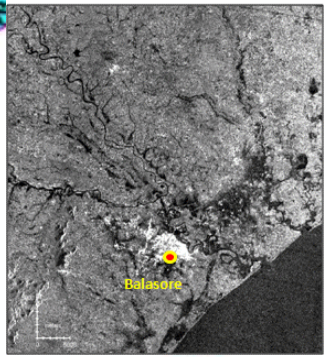
2013



2014

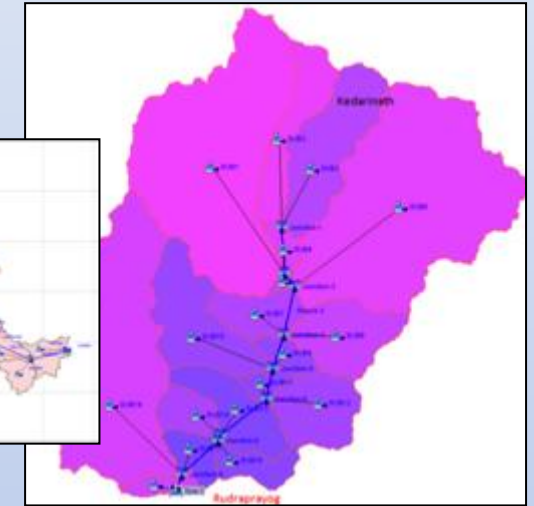
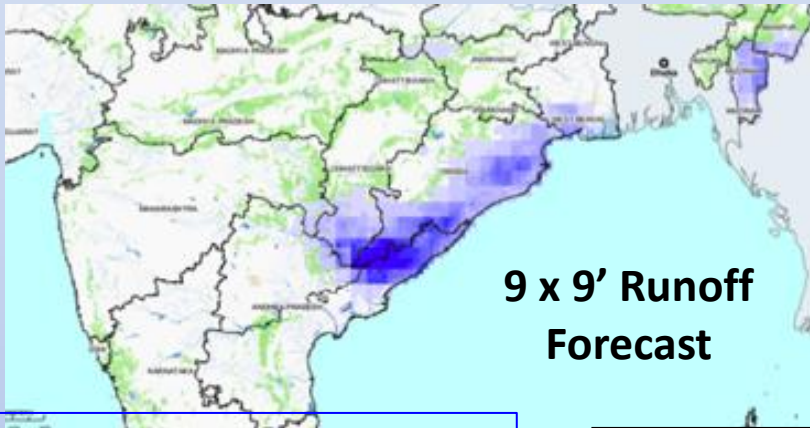


RISAT:13-Oct-2013  
0600 hours IST

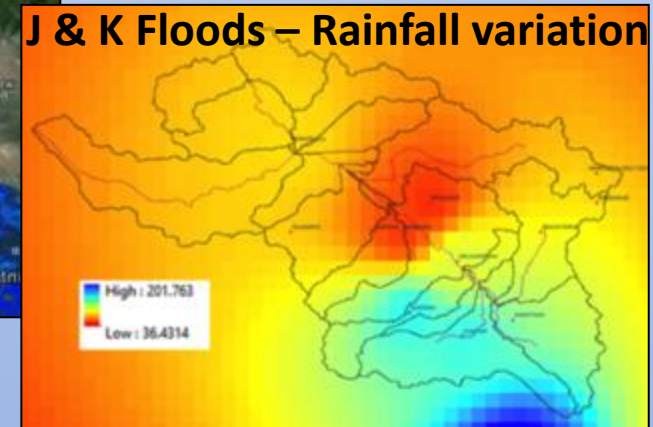


# Flood Forecast & Stream-flow simulation

Flood forecast and simulations models are used in recent events – Preparatory phase



- Experimental Surface and River Runoff forecast for Nagavali & Vamsadhara rivers



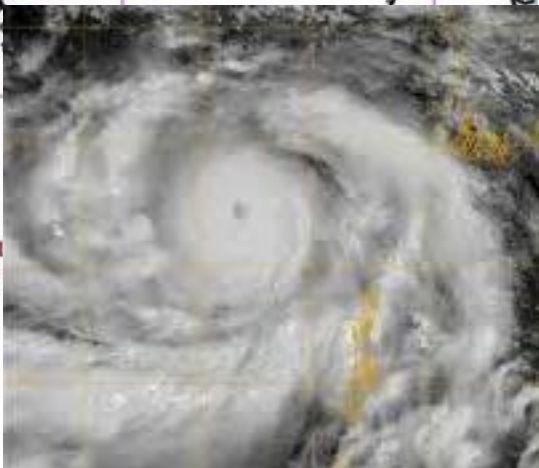
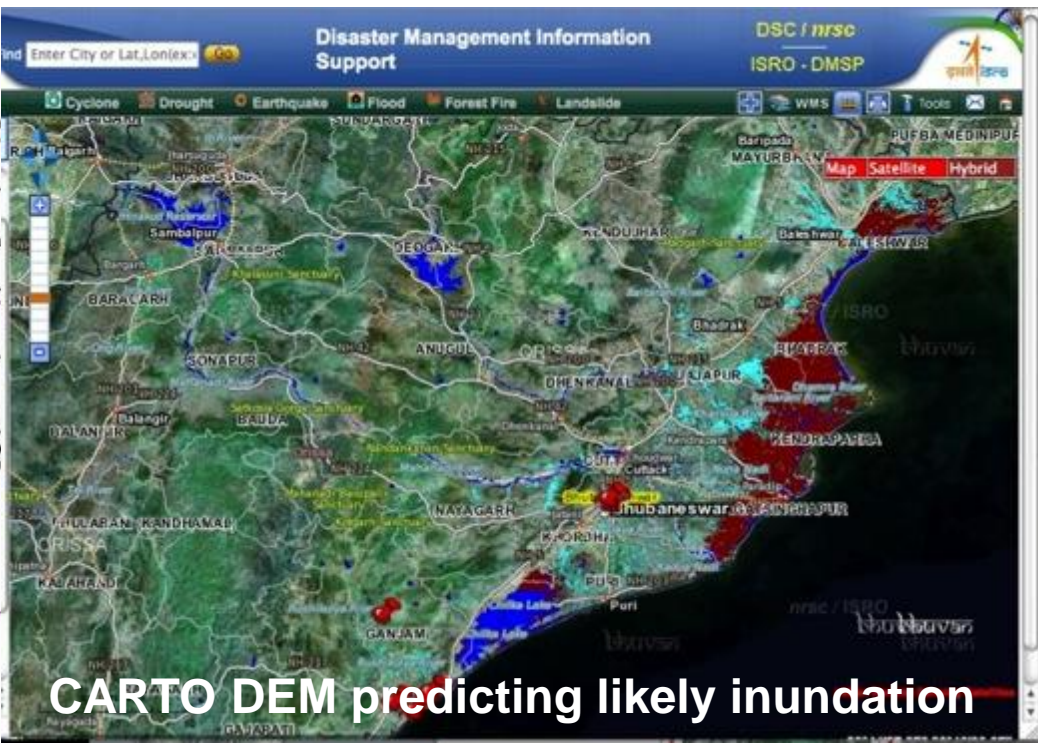
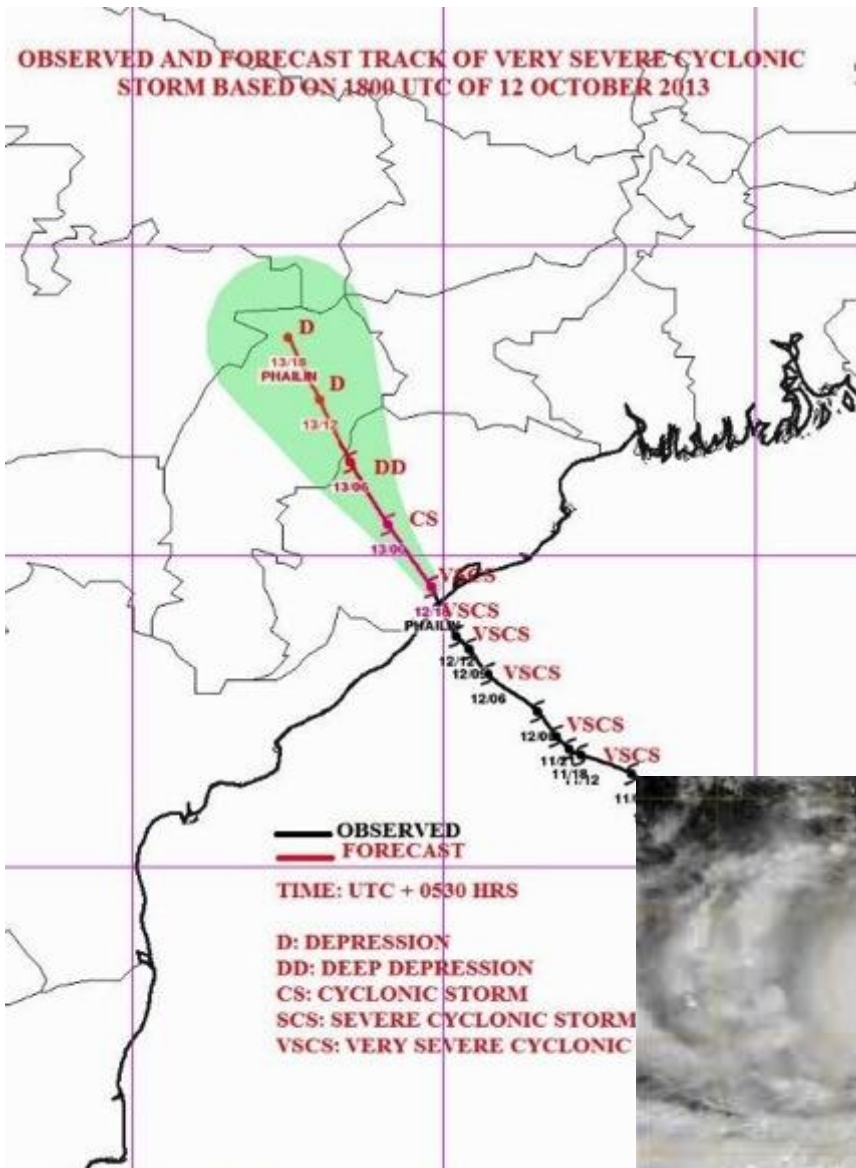


# Disaster Management Support

## Cyclones

- **Response**
  - Inundated Area - Blocks, Villages submerged
  - Frequency: Continuous Tracking; inundation: 5-day, 2-day, Daily, 12-hrly (thrice a day depending on satellite coverage)
- **Preparedness**
  - Probable inundations - historic satellite observations  
Cyclone Phailin (2013), Cyclone Hudhud (2014)
- **Mitigation**
  - Historic inundations DB due to cyclones in the country (last 10-15 years).
- **Information Dissemination**
  - MHA, NDMA, State Disaster Management Dept, CWC, IMD, and public domain

# Cyclone Phailin – online Flood inundation maps



Near real time mapping from RISAT-1 and IRS Optical images for flood inundation



# Phailin Cyclone – Info at Village level

Bhuvan | ISRO's Geoportal | Gateway to India

Welcome to Bhuvan | ISRO's Ge... | Bhuvan | ISRO's Geoportal | Gat... | +

bhuvan-noeda.nrsr.gov.in/disaster/disaster/disaster.php

**bhuvan** Deb  
Disaster Services

Find Enter City or Lat,Lon(ex: ) Go

Welcome User! Login

Disaster Management Support (DMS) Programme of ISRO More..

Recent Cyclone - Phailin

**Notify Me!!!**

**Cyclone Phailin**

- Inundation
  - 18Oct2013-1800Hr
  - 17Oct2013-1800Hr
  - Cumulative(12-16Oct2013)
  - 15Oct2013-1800Hr
  - 14Oct2013-0600Hr
  - 13Oct2013-1800Hr
  - 13Oct2013-0600Hr
  - 12Oct2013-1800Hr
- Damage Assesment
  - Ground Photo

Reference Layers

- Large Scale Maps
  - Cuttack Legend
  - Ganjam Legend
- Point Of Interest
  - Point Info
- Low lying Area
  - In Coastal Districts Legend

Disaster Management Information System (DMIS) Programme of ISRO - DMSP

Disaster Management Support (DMS) Programme of ISRO - DMSP

Recent Cyclone - Phailin

Cyclone Phailin

Reference Layers

Large Scale Maps

Point Of Interest

Low lying Area

In Coastal Districts Legend

Orissa

Mobile smart phone based Crowd-sourcing data as field data

# HudHud Cyclone

- EO based monitoring, Geospatial, UAV, IT and Crowd-Sourcing tools



Gateway to Indian Earth Observation

**Disaster Services(NDEM Public)**

**Hudhud Cyclone Android App Download**

Cyclone | Drought | Earthquake | Flood | Forest Fire | Landslide

Tools | Updates | Bhuvan Store | Help | Print | Home

**Cyclone**

Cyclone NILOFER

Cyclone HUDHUD

Track

Quick Mobile Survey

Damaged Feature

All

Remove

**Total No of Points Found:24792**

- Crop Damage
- Drinking Water/RWS
- House Damage
- Livestock/Fisheries
- Other Building Damage
- People Marooned/Require Relief
- Power
- Tanks/Canal Breach
- Tree Fallen
- Telecom
- Road

[Support for International Disasters](#)

Map | Satellite | Hybrid | Terrain | More

2014-10-20 08:32:19

18.055691099073,83.43206827813701

Place:	Ragumanda , Denkada , Vizianagaram
Created At:	Oct 20, 2014 8:32:19 PM
Category:	Kuccha_Partially Damaged,House Damage

Indian Remote Sensing Satellites

# Cyclone HUDHUD – Tracking and Online support

[bhuvan-noeda.nrsc.gov.in/disaster/disaster/disaster.php](http://bhuvan-noeda.nrsc.gov.in/disaster/disaster/disaster.php)

**Disaster Services(NDEM Public)**


 Welcome User [Login](#)

[Cyclone](#) | [Drought](#) | [Earthquake](#) | [Flood](#) | [Forest Fire](#) | [Landslide](#)

[Tools](#) | [Updates](#) | [Bhuvan Store](#) | [Help](#) | [Print](#)

**Cyclone HUDHUD Track**

IMD (12Oct14-0230IST)   
 Source: Indian Meteorological Department - IMD

JTWC (12Oct14-0230IST)   
 Source: Joint Typhoon Warning Center

Enter City or Lat, Lon(ex:chennai or 13.0823, 77.6066)

2014-10-17 09:07:05  
18.09572032,83.52130074

Place:	Relli valasa , Pusapatirega , Vizianagaram
Created At:	Oct 17, 2014 9:07:05 AM
Category:	Transformer Damaged,Power

**Quick Mobile Survey**

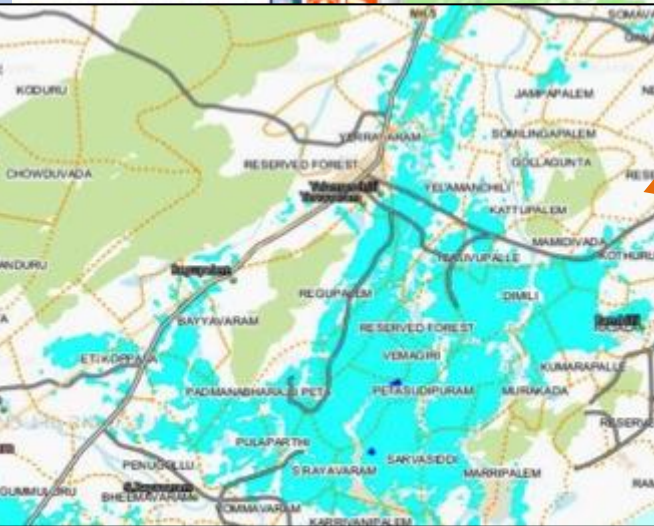
**Damaged Feature**

All

**Total No of Points Found:24792**

- Crop Damage
- Drinking Water/RWS
- House Damage
- Livestock/Fisheries
- Other Building Damage
- People Marooned/Require Relief
- Power
- Tanks/Canal Breach
- Tree Fallen
- Telecom
- Road
- Others

# Cyclone HUDHUD – Inundation Monitoring



**Vishakhapatnam, Srikakulam, Vizainagram & East Godavari were severely affected due to strong gale winds and inundation.**



# Cyclone HUDHUD- Crowd Sourcing



Public)

**Android App Download**

National Remote Sensing

*Crowd sourcing enabled to collect information from ground.*

2014-10-16 01:14:50  
17.715455622765727.82.79738453162432

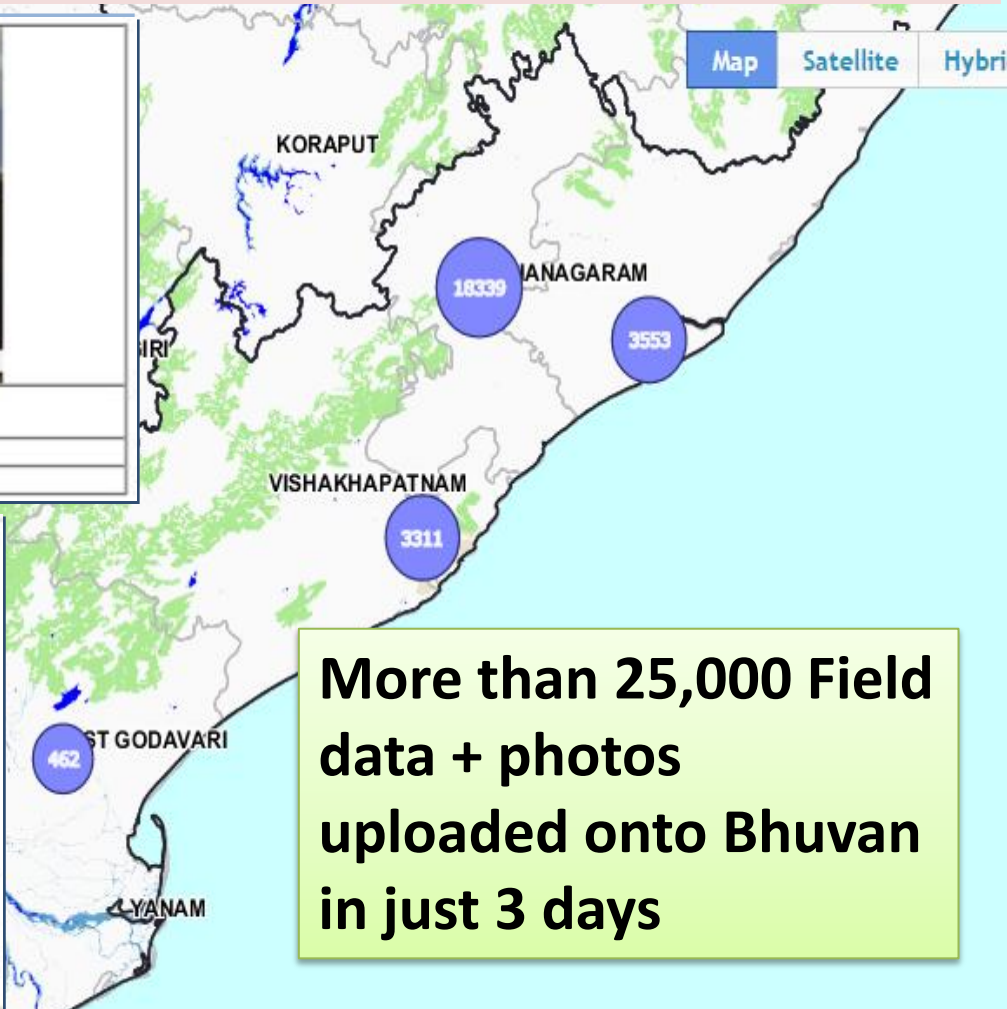
Place:	Tattaband , Ravikamatham , Visakhapatnam
Created At:	Oct 16, 2014 1:14:50 PM
Category:	Pole Fallen,Power

2014-10-16 08:36:59  
17.733716275577994.82.8583870350406

Place:	Turakalapudi , Butchayyapeta , Visakhapatnam
Created At:	Oct 16, 2014 8:36:59 PM
Category:	Pole Fallen,Power

2014-10-16 08:33:08  
17.764583942353148.82.8690708385646

Place:	Peda madina , Butchayyapeta , Visakhapatnam
Created At:	Oct 16, 2014 8:33:08 PM
Category:	Transformer Damaged,Power



**More than 25,000 Field data + photos uploaded onto Bhuvan in just 3 days**

**Total No of Points Found:25665**

- Crop Damage
- Drinking Water/RWS
- House Damage
- Livestock/Fisheries
- Other Building Damage
- People Marooned/Require Rel
- Power
- Tanks/Canal Breach
- Tree Fallen
- Telecom
- Road
- Others

**Crowdsourced Data**

**Inundation**

**Forecast**

**Support for International Disasters**

**House Damage-17192; Tree fallen-1031; Power-1636; ; Road-1078; Tank/Canal Breach-137**

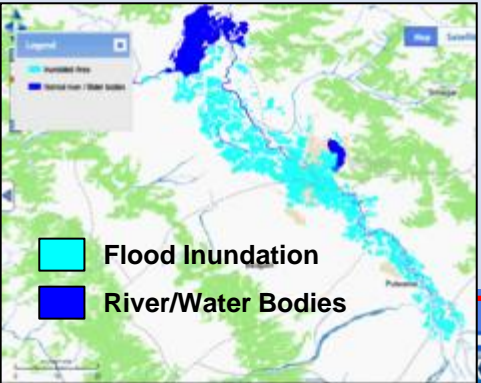
# Disaster Management Support

The screenshot shows the bhuvan website interface. At the top, it says "Disaster Services(NDEM Public)". Below this, there are navigation tabs for "Cyclone", "Drought", "Earthquake", "Flood", "Forest Fire", and "Landslide". On the left side, there is a sidebar menu with options like "Cyclone NILOFER", "Cyclone HUDHUD", "Track", "Quick Mobile Survey", "Crowdsourced Data", "Inundation", "Forecast", "Spatial Overlay", and "Additional Layers". Under "Additional Layers", there are checkboxes for "Mobile Towers Affected", "BSNL Total Mobile Towers", "Total Substations", and "Substations Affected". The main content area displays a map of Andhra Pradesh with various locations marked, including Devarapalli, Cheedikada, Jpuram, Wadaddi, Jannavaram, Rajam, Gudivada, and Madeenabagh. A scale bar at the bottom indicates 0, 4, and 8 kilometers.

The screenshot shows the HUDHUD Damage Assessment & Relief Monitoring System website. The header includes the Government of Andhra Pradesh logo and the system name. Below the header, there is a navigation menu with links like "Home", "Circulars & G.O's", "Gallery", "Downloads", "Media Releases", "Skilld Worker Tracking", "Telecom Status", "Power Status", and "Helpline Numbers". A large banner image shows a group of people, including a child, with a man in a white shirt. To the right of the banner is a "Department Login" section with fields for "Username" and "Password" and a "LOGIN" button. Below the login section is an "Updates" section with text about the Hon'ble CM's survey and relief operations. On the left side, there are buttons for "Citizen Inputs", "Maps (Bhuvan)", "CM Relief Funds", and "Gratuitous Relief Update". The "Maps (Bhuvan)" button is highlighted with a red box. To the right of the buttons is a profile picture of Sri N. Chandrababu Naidu, Hon'ble Chief Minister, Government of Andhra Pradesh. Below the profile picture is an "ABOUT HUDHUD CYCLONE" section with text describing the cyclone's impact and relief efforts.

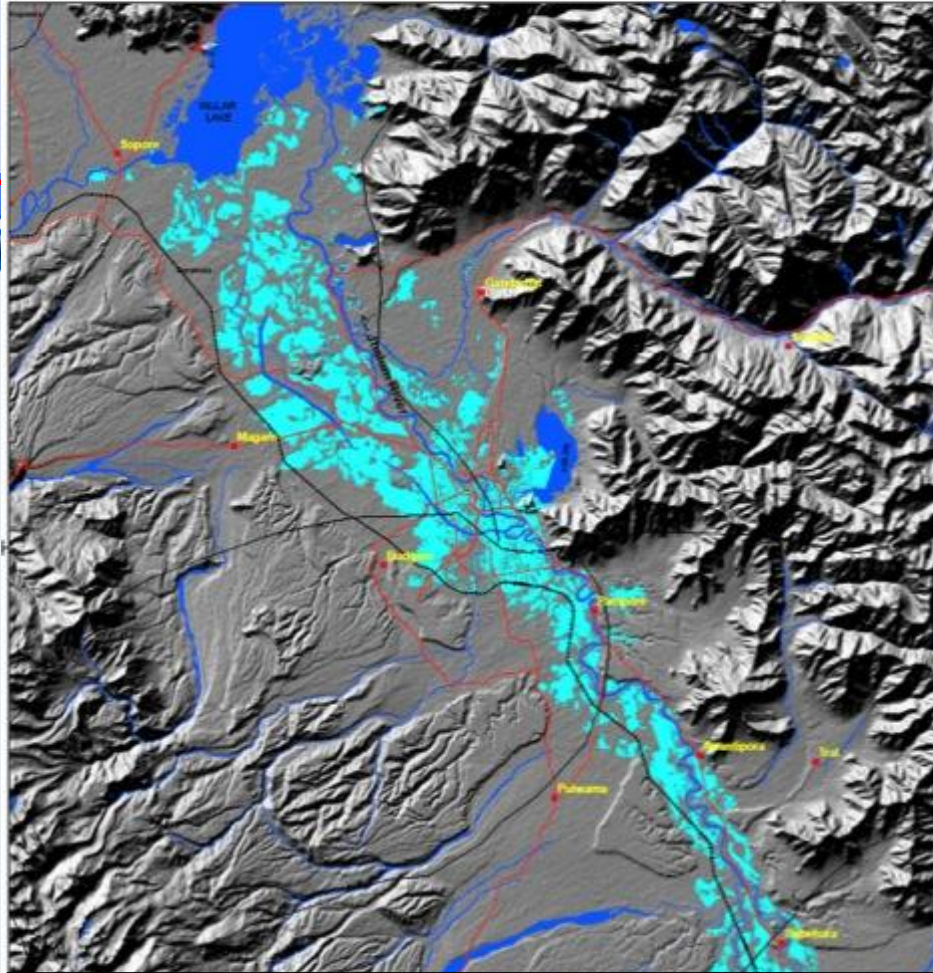
The screenshot shows a detailed map of Andhra Pradesh, India, overlaid with a network of mobile towers and substations. The map is color-coded by terrain, with green for lowlands and brown for higher elevations. Numerous blue circular markers are scattered across the map, each containing a numerical value representing the number of towers or substations at that location. The markers are densely packed in the coastal and central regions. A scale bar at the bottom indicates 0, 4, and 8 kilometers. The text "KV Transformer" is visible on the right side of the map.

# Himalayan Disasters: J&K – Sep, 2014



## Cumulative Flood Inundated Area in part of Jammu & Kashmir State

Based on the analysis of RISAT, Cartosat, Resourcesat & RADARSAT data of 08, 09, 10, 12, 15, 17, 19, 20 & 21 -September-2014

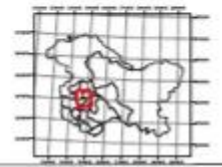


For official use

DISASTER EVENT ID: 11-FLD-2014-JK  
MAP ID: 2014/46

Date of Issue : 21.9.2014

### Location Map



### About the Event

Severe floods were reported in Jammu & Kashmir during first week of September, 2014. Heavy rains coupled with rise in the water levels of Jhelum river had led to flooding in the districts of Anantnag, Pulwama, Badgam, Baramulla & Srinagar.

(Source: New media).

### Satellite Observations

This map highlights the cumulative flood inundation observed as on 08, 09, 10, 12, 15, 17, 19, 20 & 21 September-2014 in parts of Jammu & Kashmir.

### Satellite data used

Pre Flood:  
RISAT-1 data of  
Cartosat data of  
Sensor: SAR  
Date of Pass:  
14-Aug-2014

Post Flood:	
RISAT-1 data of	08-September-2014
RISAT-1 data of	09-September-2014
Cartosat data of	09-September-2014
Radarsat-2 data of	10-September-2014
RISAT-1 data of	10-September-2014
Radarsat-2 data of	12-September-2014
RISAT-1 data of	15-September-2014
RISAT-1 data of	17-September-2014
Resourcesat data of	19-September-2014
RISAT-1 data of	20-September-2014
RISAT-1 data of	21-September-2014

### Other data used

NRC Landuse/Landcover Data of 2008-09  
Background data : Shaded Relief

### Legend

- Settlements
- Normal River/Water bodies
- Flood Inundation
- Dist Boundary
- State Boundary
- Railway
- Major Roads



This product is prepared on rapid mapping mode for immediate use and sharing amongst official agencies. This provides preliminary results. Flood inundation may include rain water accumulation / flood water in low lying areas.

All geographic information has limitations due to the scale, resolution, date and characteristics of the original source materials.

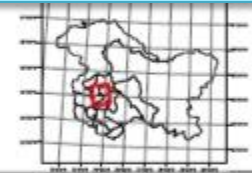
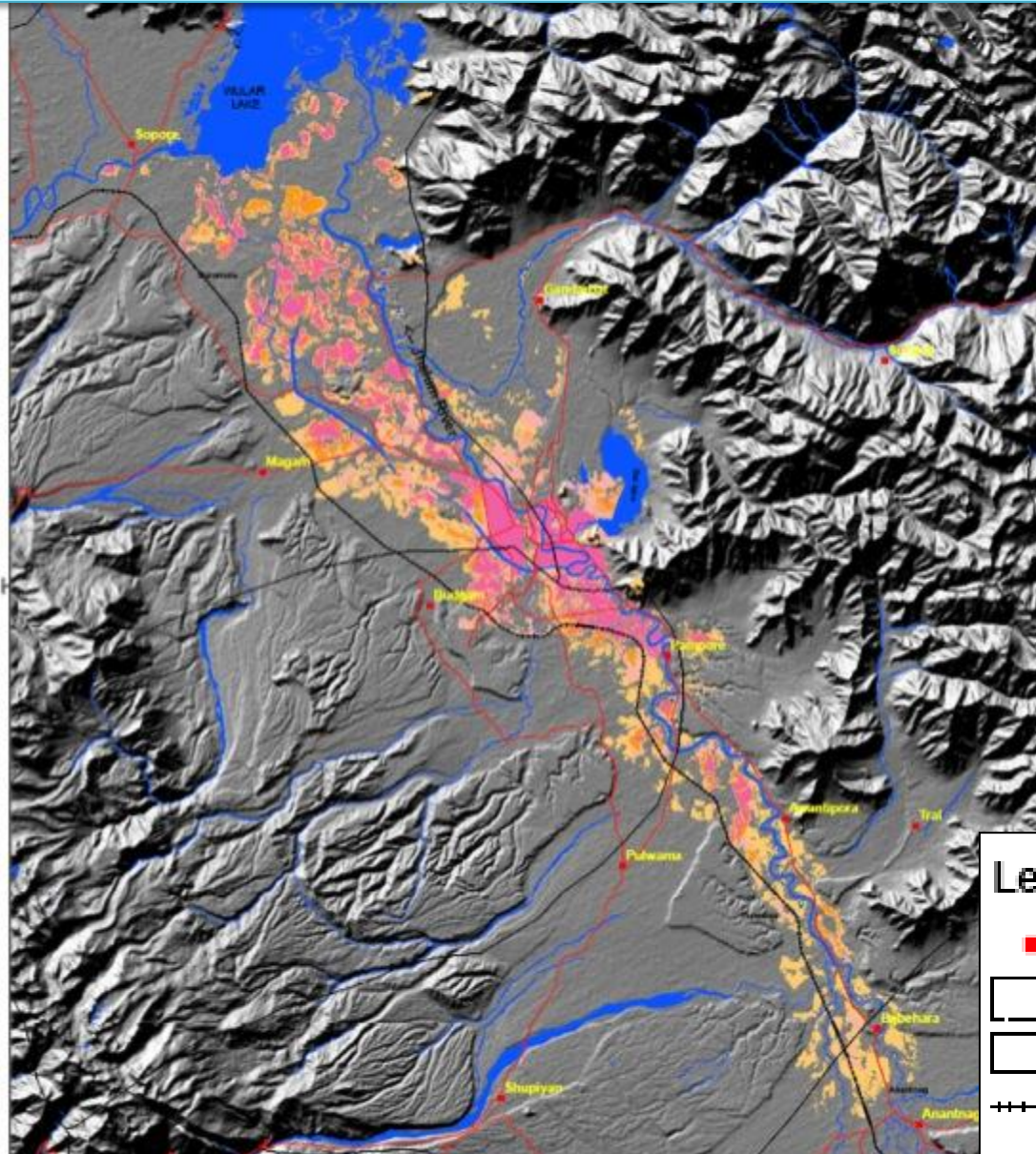
Jammu and Kashmir - 2014

### Flood Layers New

- 23/09/2014
- 22/09/2014
- 08-21/09/2014
- 21/09/2014
- 20/09/2014
- 19/09/2014
- 17/09/2014-06Hr
- 08-15/09/2014
- 15/09/2014
- 08-12/09/2014
- 10-12/09/2014
- 12/09/2014
- Cumulative 8-10th Sept
- 10/09/2014
- 09/09/2014
- Progression 8-9th Sept
- 08/09/2014-06Hr

**50 Flood inundation maps disseminated in near real time to MHA, NDMA, Govt. of J&K to help in relief and rescue operations.**

# Flood Duration Maps as a part of continuous monitoring



## About the Event

Severe floods were reported in Jammu & Kashmir during first week of September, 2014 Heavy rains coupled with rise in the water levels of Jhelum river had led to flooding in the districts of Anantnag, Pulwama, Badgam, Baramula & Srinagar.

(Source: New media).

## Satellite Observations

This map highlights the flood duration map observed as on 08, 09, 10, 12, 15, 17, 19, 20, 21 & 22 September-2014 in parts of Jammu & Kashmir.

## Satellite data used

Pre Flood:  
Satellite: RISAT-1  
Sensor: SAR  
Date of Pass:  
14-Aug-2014

Post Flood:  
RISAT-1 data of 09-September-2014  
RISAT-1 data of 09-September-2014  
Cartosat data of 09-September-2014  
Radarsat-2 data of 10-September-2014  
RISAT-1 data of 10-September-2014  
RISAT-1 data of 12-September-2014  
Radarsat-2 data of 15-September-2014  
RISAT-1 data of 17-September-2014  
Resourcesat data of 19-September-2014  
RISAT-1 data of 20-September-2014  
RISAT-1 data of 21-September-2014  
RISAT-1 data of 22-September-2014

## Other data used

NRC Landuse/Landcover Data of 2008-09  
Background data : Shaded Relief

## Legend

- Settlements
- Taluk Boundary
- State Boundary
- +++++ Railway
- Major Roads
- Normal River/Water bodies
- 0-3 days



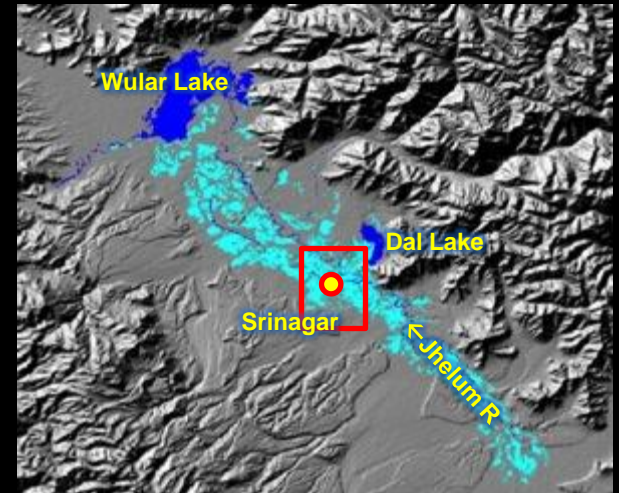
## Legend

- Settlements
- Taluk Boundary
- State Boundary
- +++++ Railway
- Major Roads
- Normal River/Water bodies
- 0-3 days
- 4-7 days
- 8-10 days
- 11-15 days

Note: When publishing this map as part of any report, source may be indicated as " NRSC (2014) - Flood Duration map for Jammu & Kashmir State (as on 08, 09, 10, 12, 15, 17, 19, 20, 21 & 22 -September-2014)" dated 23.09.2014 DSC/NDEM Map no : 2014/49, NRSC/ISRO.

# J&K Floods – Timeseries Analysis

- Extreme Flooding event
- Severe flood in last 60 years
- Near real-time Info. On Bhuvan

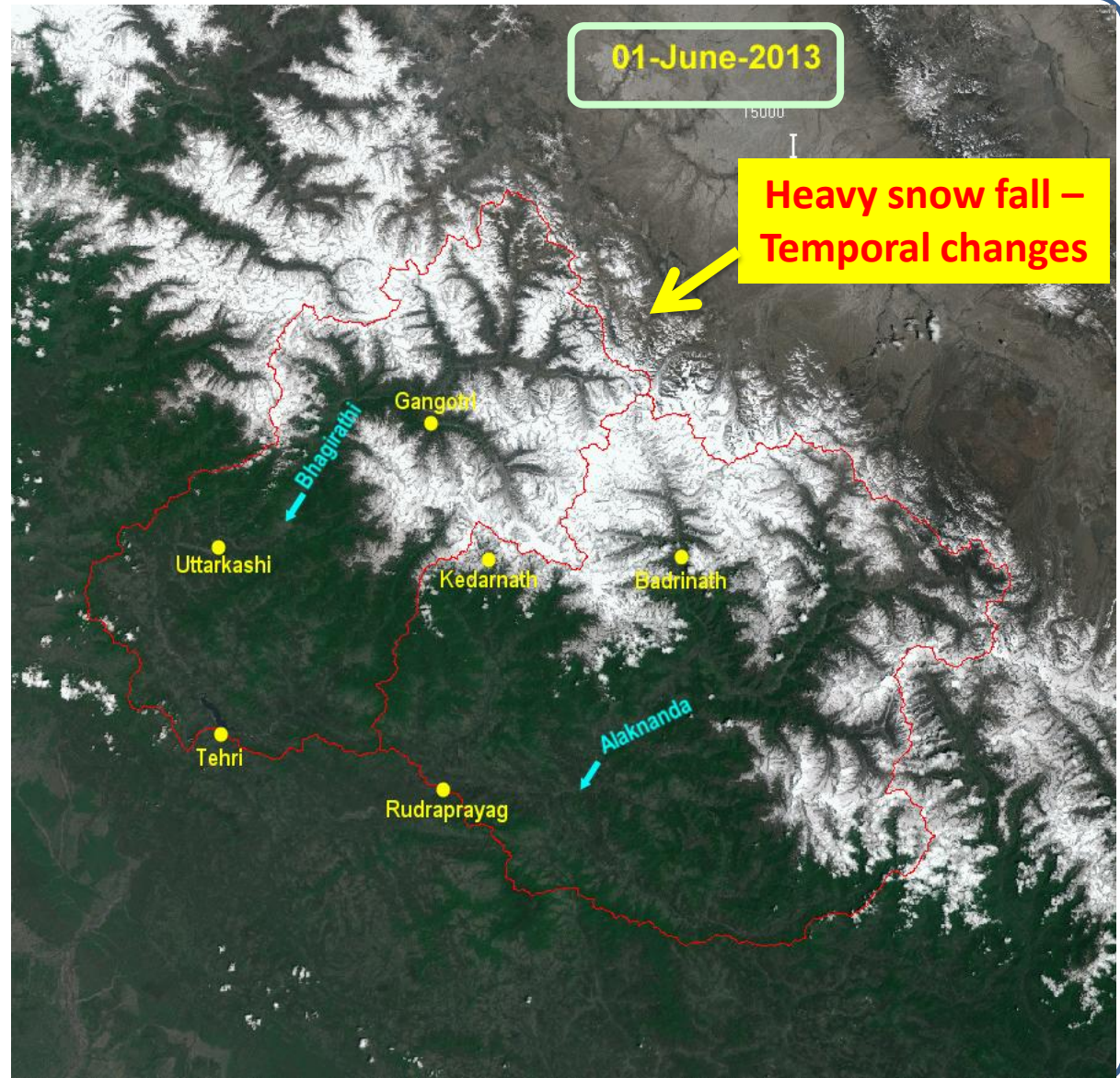
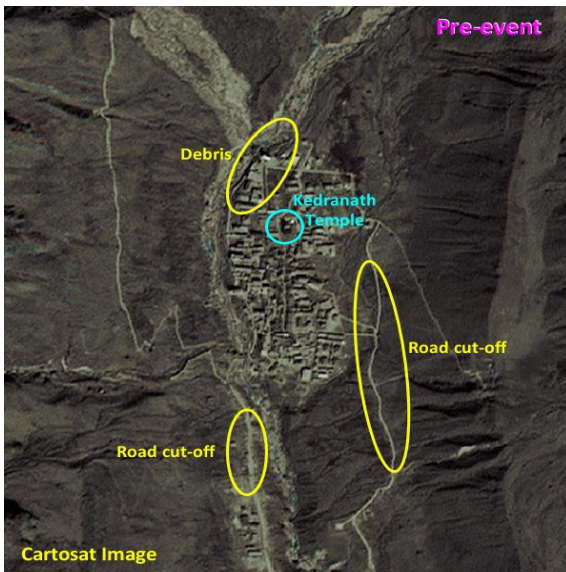


# Uttarakhand Disaster – July 2013

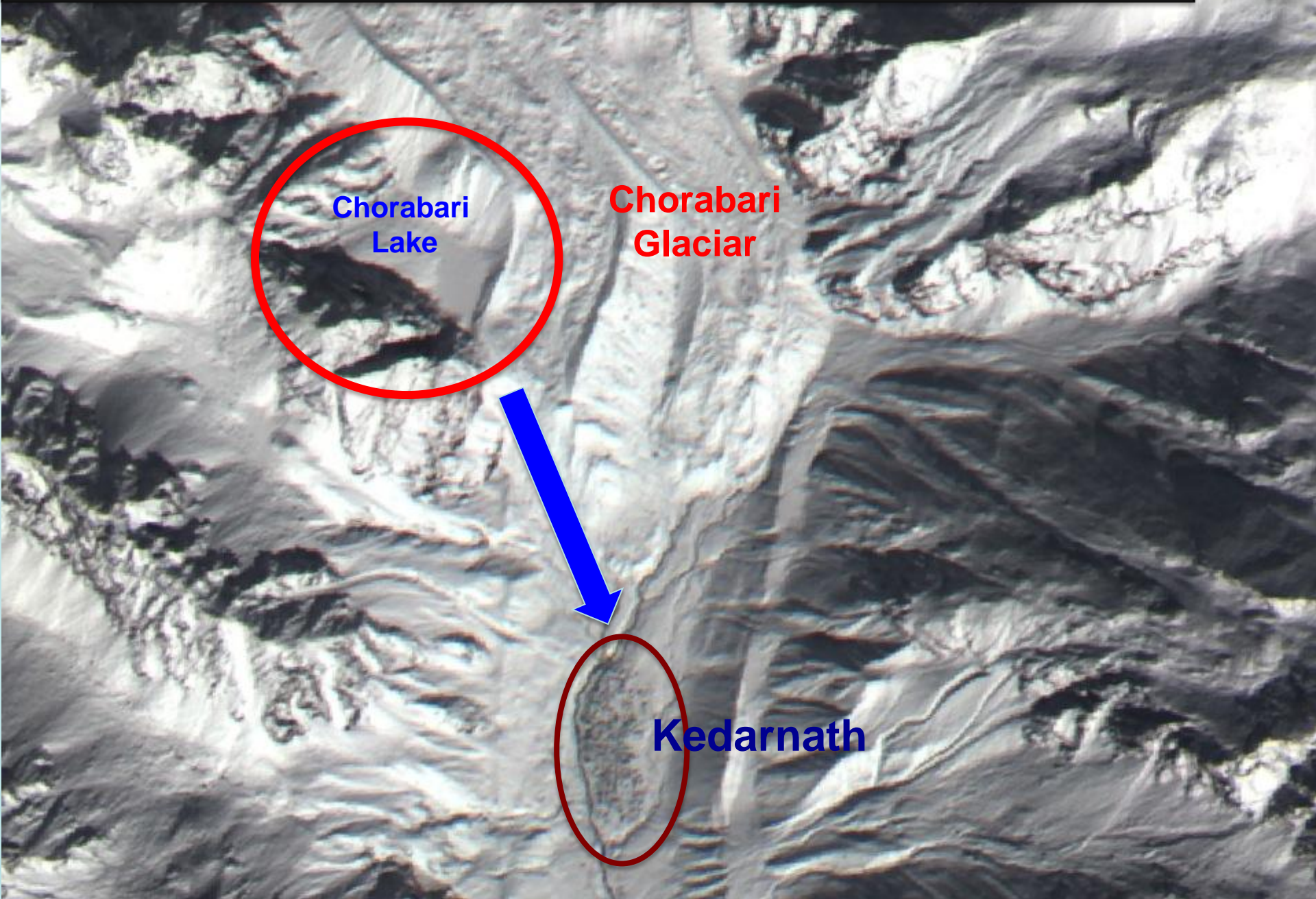


# Heavy Snowfall in upper reaches

- Heavy rainfall during 15 - 17<sup>th</sup> June, 2013 in the region, associated with heavy snowfall in upper reaches
- Sudden increase in snow cover area in **Bhagirathi, Alaknanda & Yamuna basins** - images of Resourcesat-2 AWiFS



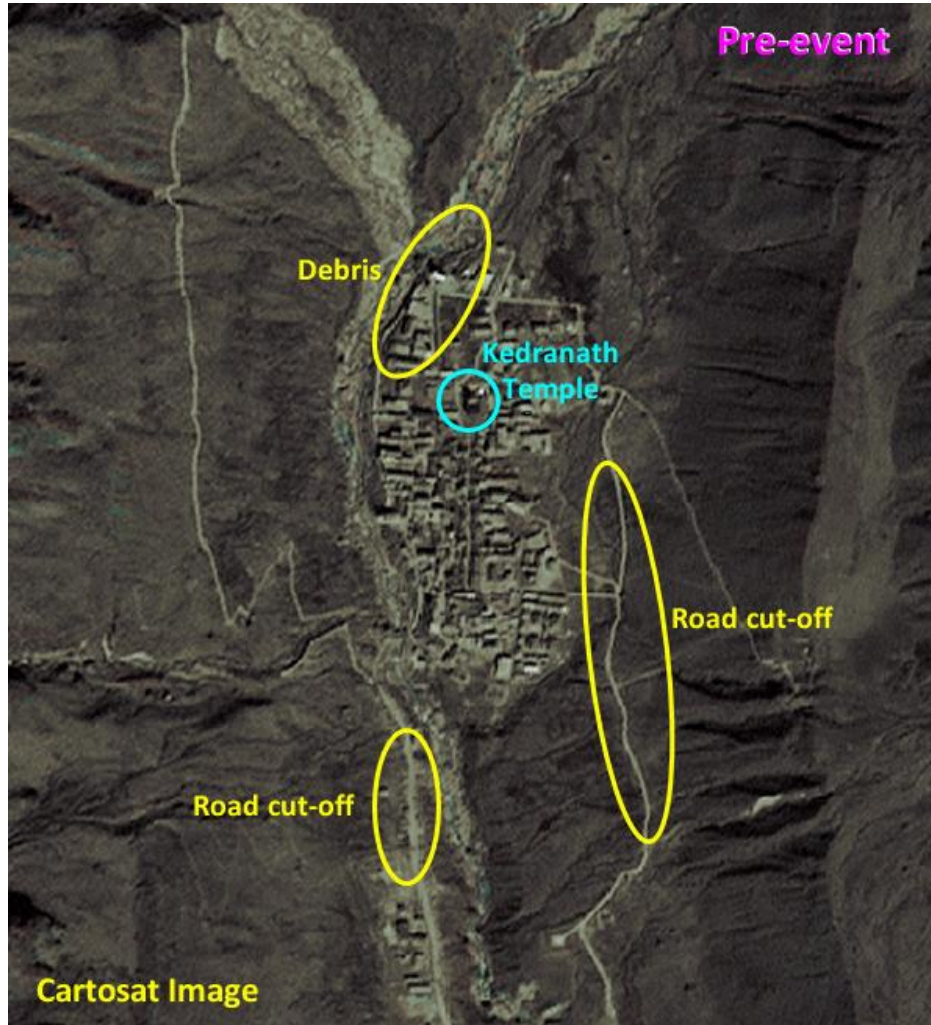
# Digital Terrain Model – Shaded Relief Maps



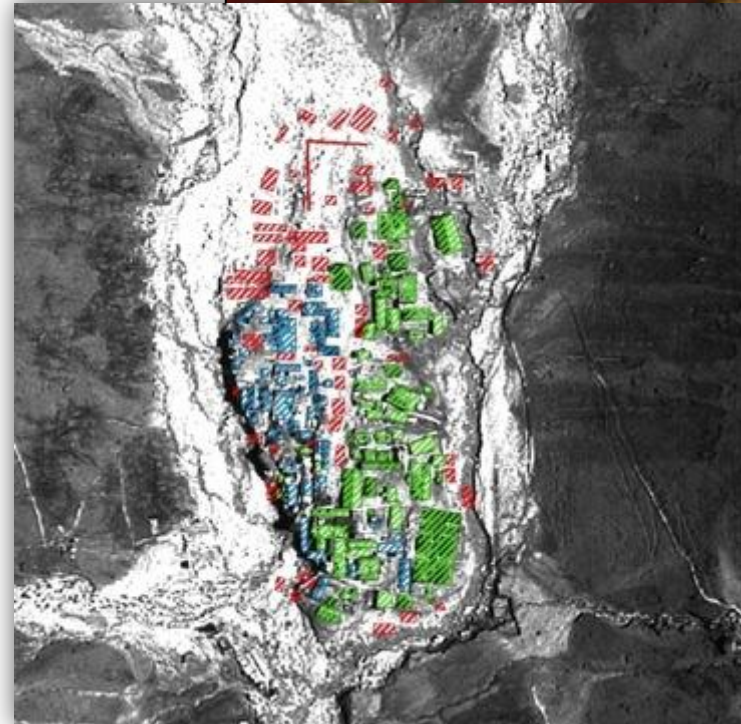
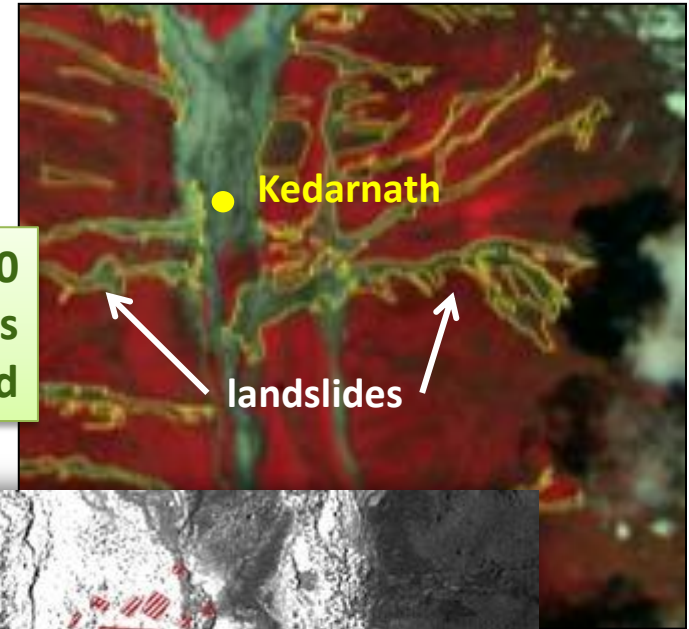


# Damage Assessment – GIS analysis

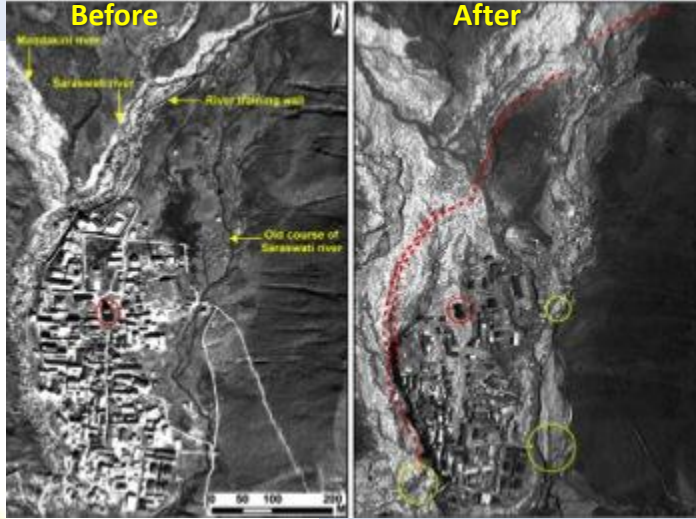
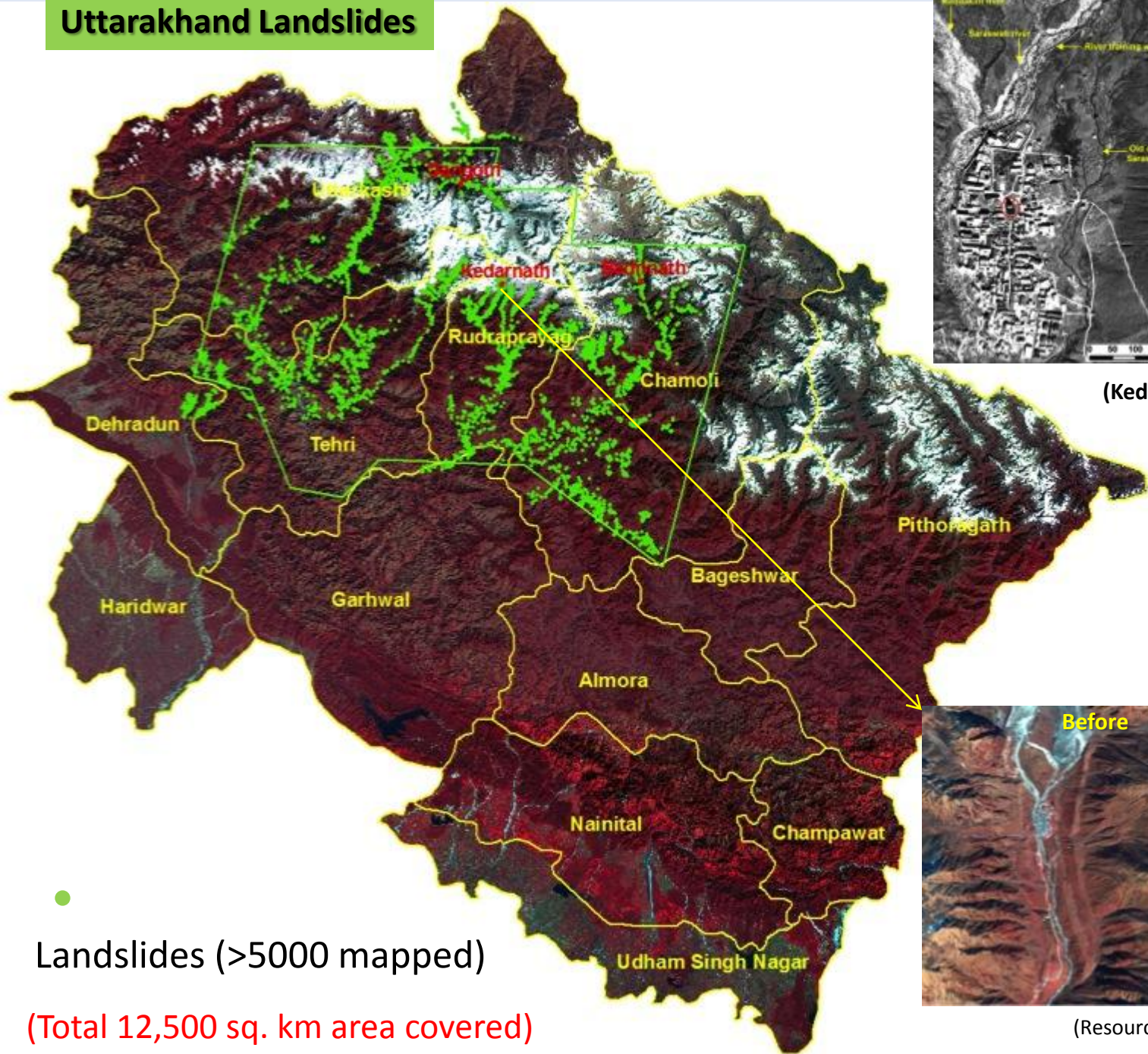
- Inundation, Damage, Landslides
- *Near real-time* info on Bhuvan Portal



> 5000  
landslides  
mapped



# Uttarakhand Landslides



(Kedarnath town)



(Resourcesat-2 LISS IVMx)

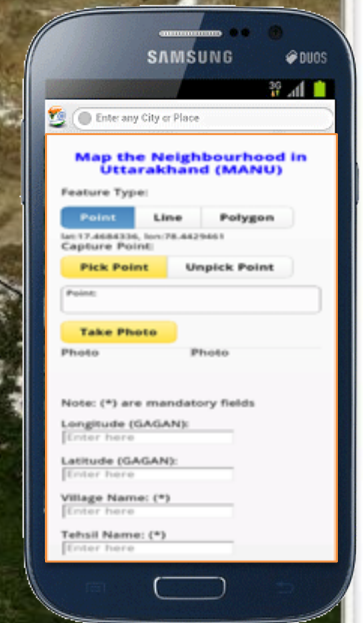
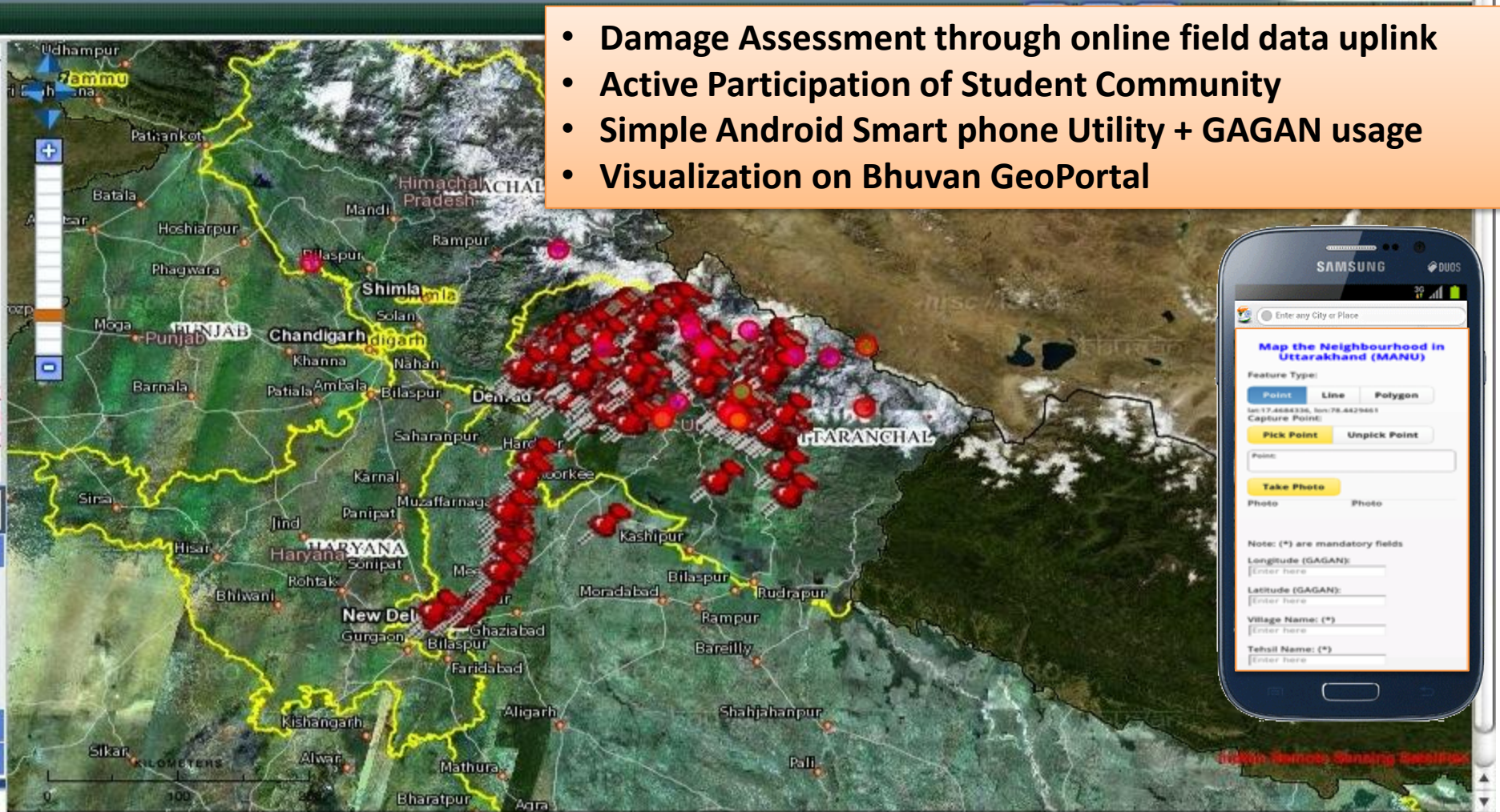
● Landslides (>5000 mapped)

(Total 12,500 sq. km area covered)

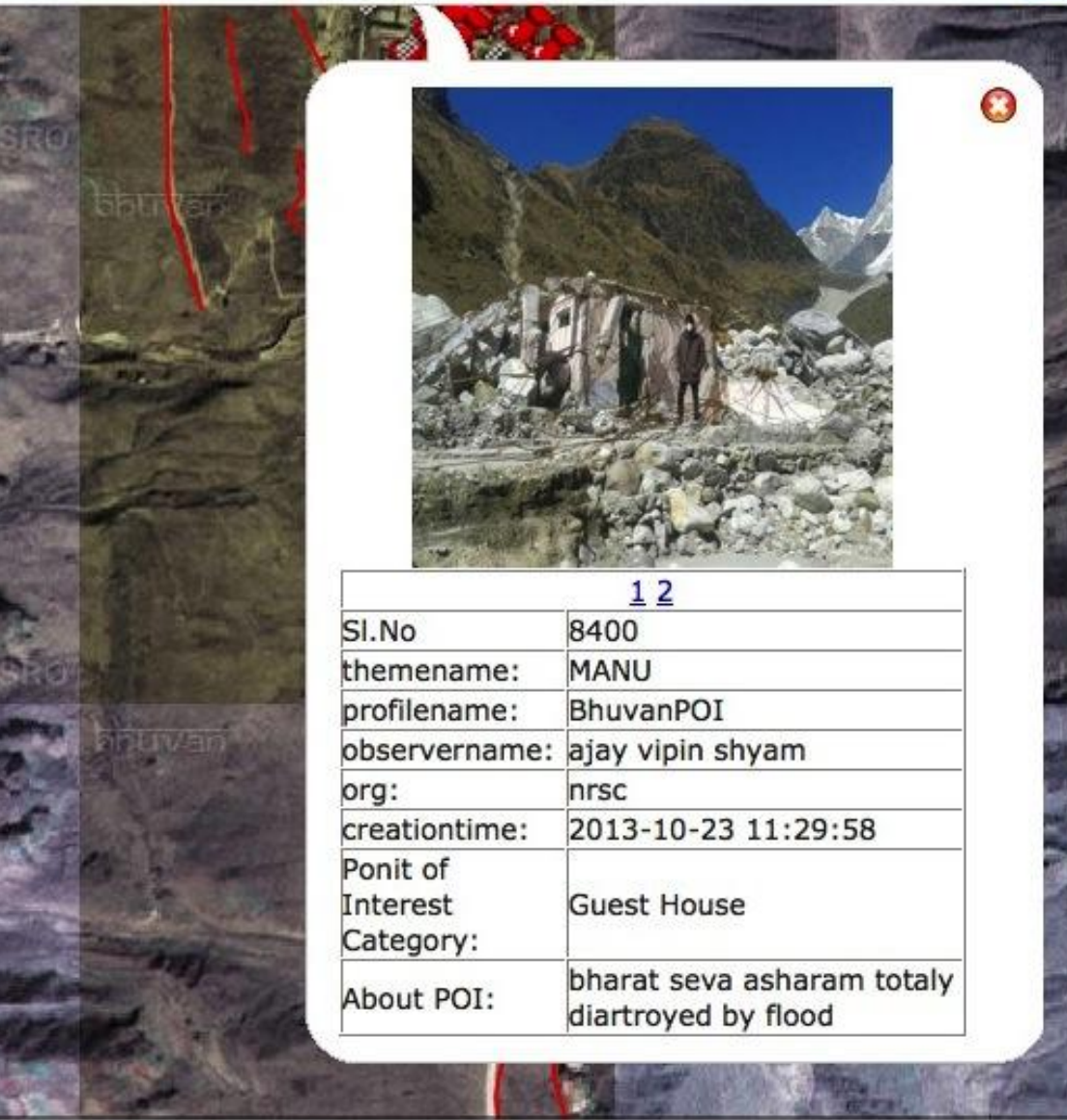
# Map the Neighbourhood in Uttarakhand (MANU) Mobile SmartPhones for Crowd-Sourcing



- Damage Assessment through online field data uplink
- Active Participation of Student Community
- Simple Android Smart phone Utility + GAGAN usage
- Visualization on Bhuvan GeoPortal



# Mapping the Neighbourhood in Uttarakhand (MANU)



1 2

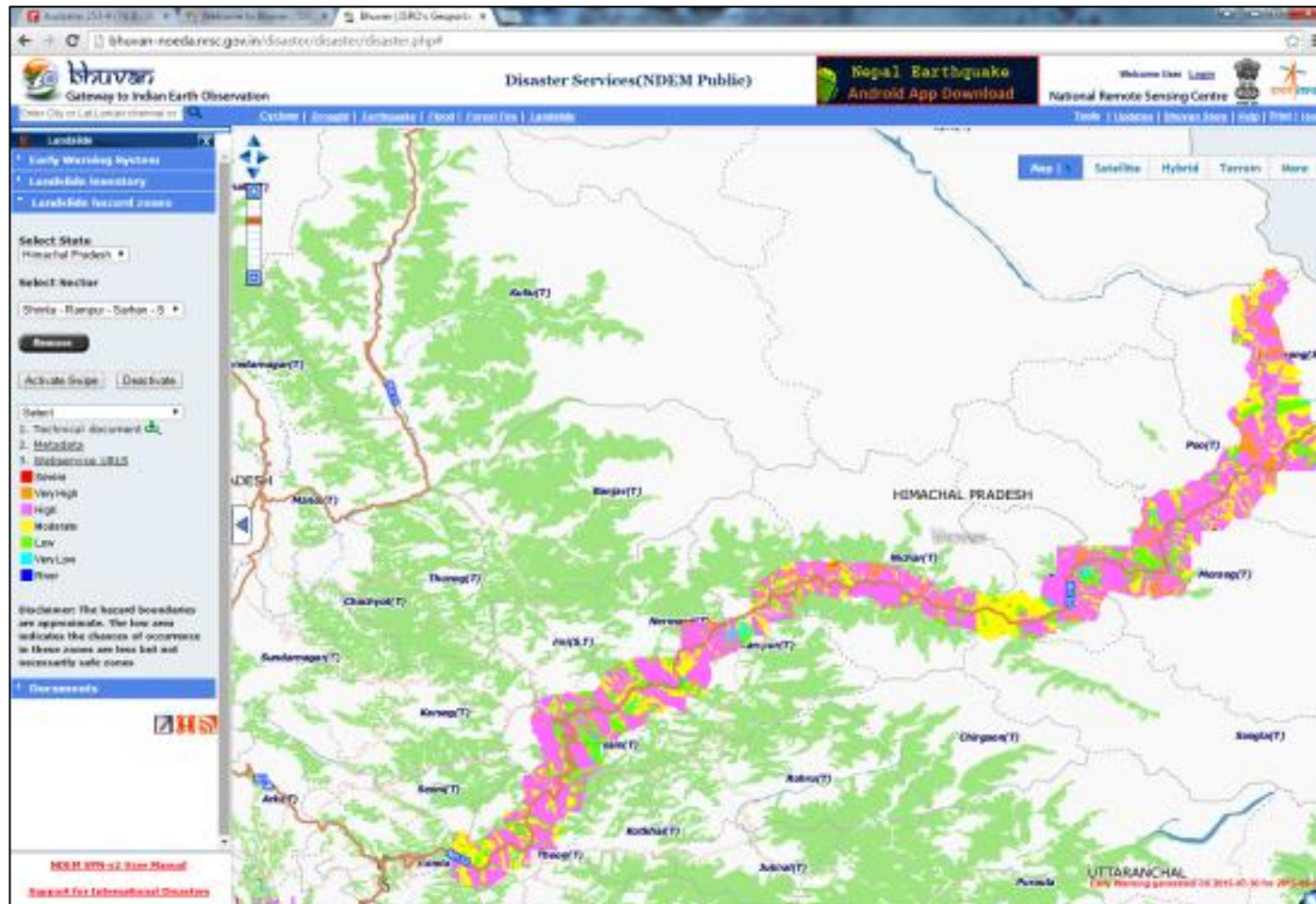
SI.No	8400
thename:	MANU
profilename:	BhuvanPOI
observername:	ajay vipin shyam
org:	nrsc
creationtime:	2013-10-23 11:29:58
Ponit of Interest Category:	Guest House
About POI:	bharat seva asharam totaly diartroyed by flood



1 2

SI.No	8406
thename:	MANU
profilename:	RiverBankErosion
observername:	ajay vipin shyam
org:	nrsc
creationtime:	2013-10-23 12:55:36
Longitude (GAGAN):	79.067920
Latitude (GAGAN):	30.735302
Village Name:	kedarnath
Tehsil Name:	ukhimath
River or Stream Name:	mandakini river
Affected Feature:	Settlement,
Type of Erosion:	Toe
Direction of Bank or River:	Left
Remarks:	destroyed after flooding flood makes tributary which suppose to damaged this lodge

# Landslide Hazard Zonation Maps



## Uttarakhand

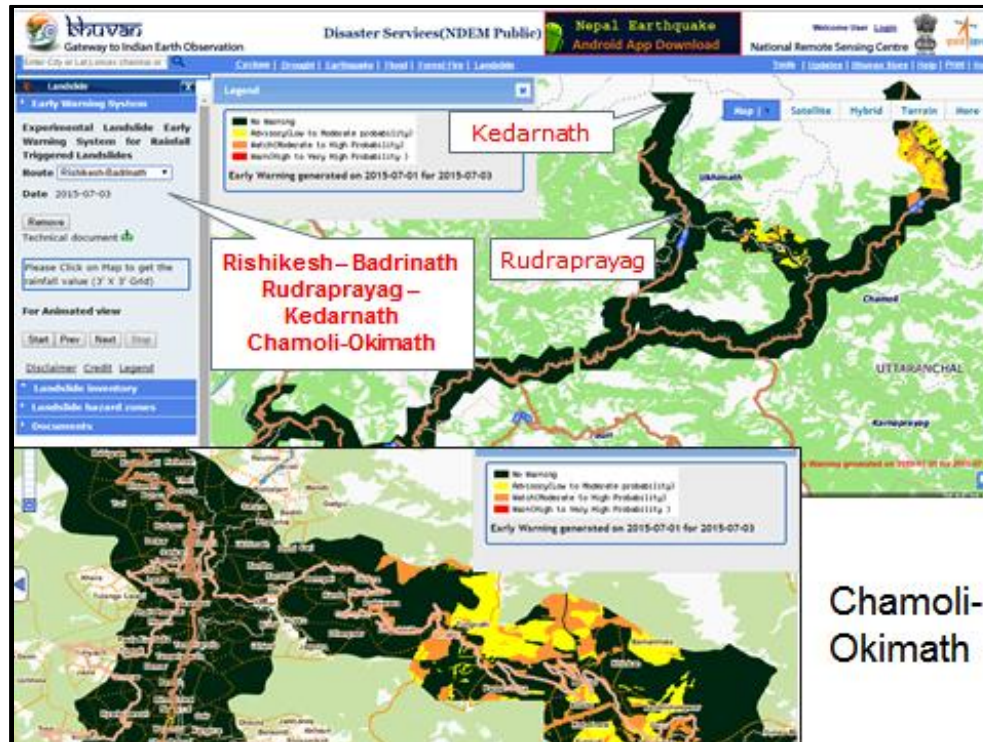
- Rishikesh-Uttarkashi-Gangotri-Gaumukh
- Rudraprayag-Okhimath-Kedarnath
- Rishikesh-Rudraprayag-Chamili-Badrinath
- Pithoragarh-Khela-Malpa

## Himachal Pradesh

- Chamoli-Usara-Okhimath
- Dalhousie-Chamba-Brahmaur
- Shimla-Rampur-Sarhan-Sumdo
- Shimla-Bilaspur-Kulu-Manali

# Landslides - Early warning system

- Spatial (geology, morphology & terrain), temporal triggering factors & controls of slope failure
- Rainfall (a trigger) for slope failure initiation
- Logistic Regression model using long term data on rainfall-landslide initiation



**Rishikesh-Badrinath-Rudraprayag-Kedarnath-Chamoli-Okimath area.**

# Forest Fire Alerts



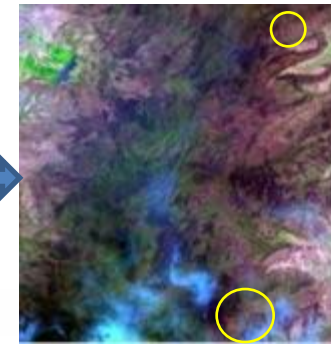
Daily acquisition of  
TERRA/AQUA  
MODIS data

~4 daytime  
passes per day



Generation of 2  
daily Active  
Fire Alerts

Special  
contextual Fire  
Algorithm-  
Deployed



Value additions  
•Forest Mask  
•Forest  
Admin.  
overlay

Disaster Management Support  
Programme

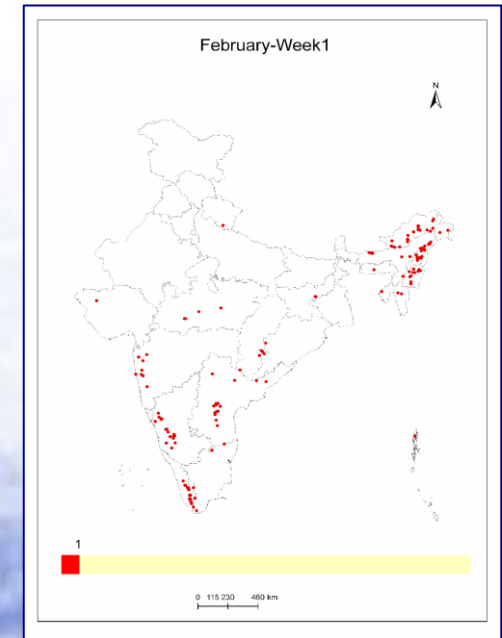
Decision Support  
Center

Indian Forest Fire Response  
and Assessment System  
(INFFRAS)

Feedba  
ck



Fire map  
Visualization  
through  
BHUVAN



Email  
Dissemination  
to ~400 nodal  
officers

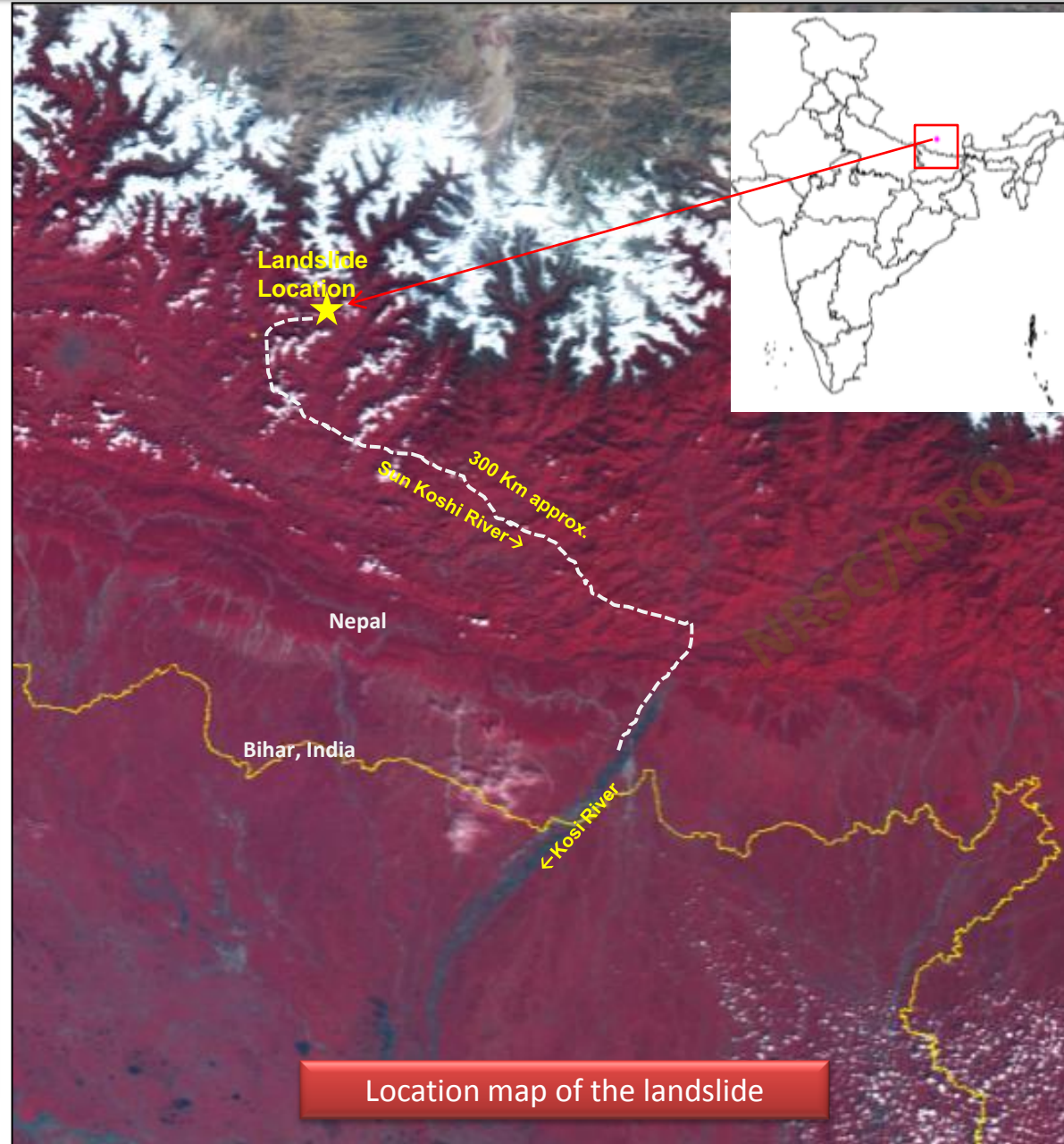
Turn-around time  
of less than 1 hr  
from satellite  
overpass

Information to  
ground  
personnel for  
fire mitigation



# Nepal – Landslide on River Sun Koshi

- A massive landslide blocked Sun Koshi river in Northern Nepal on 02-Aug-2014
- Possible formation of a lake.
- Flood threat for several villages downstream in Bihar, India.





# Landslides on Transboundary Rivers

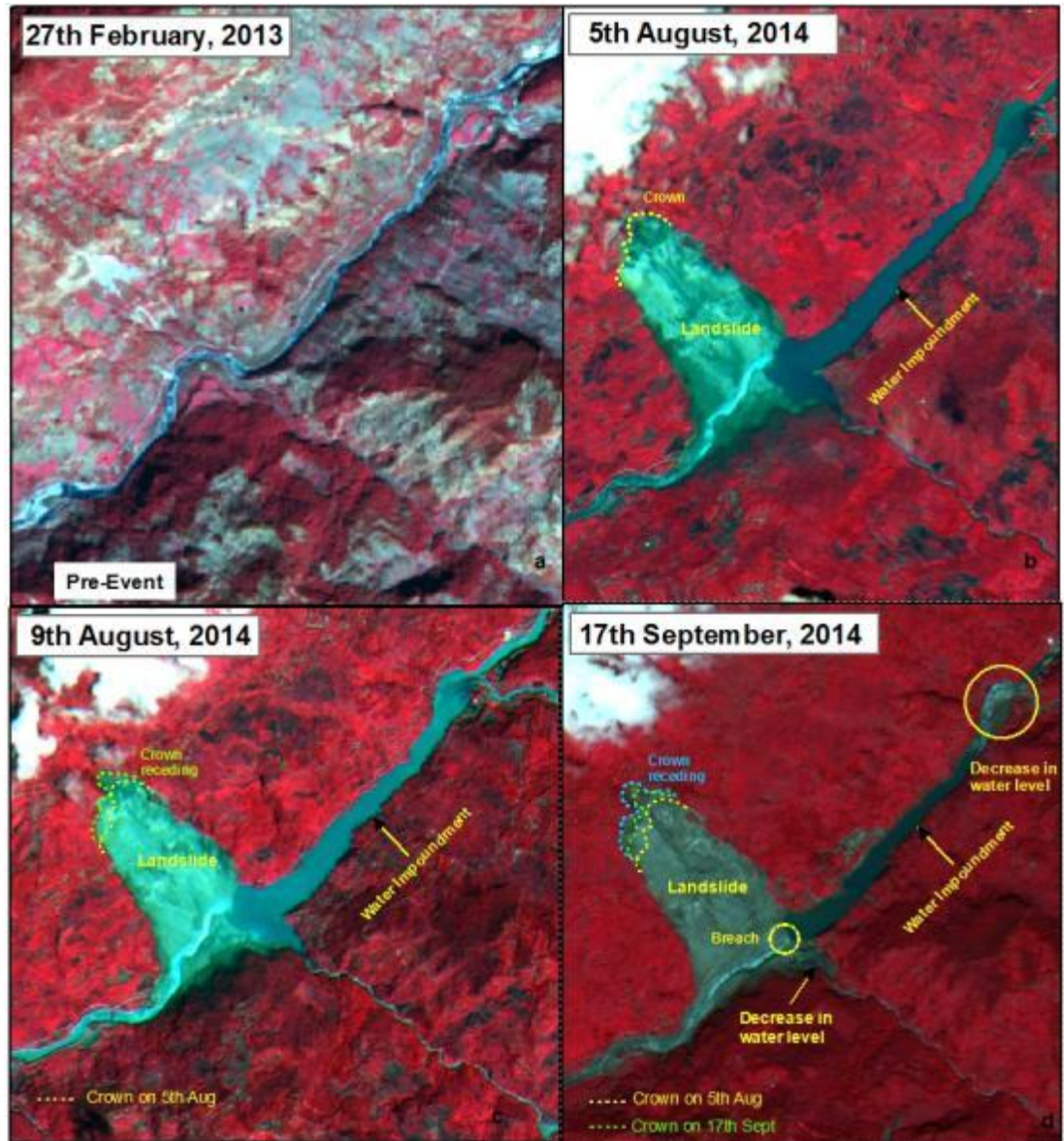
## Sun Koshi River in Nepal

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 through controlled blastings

Data helped Indian Govt. to work with Nepal Govt. in coordination/ avoiding major disaster in Bihar

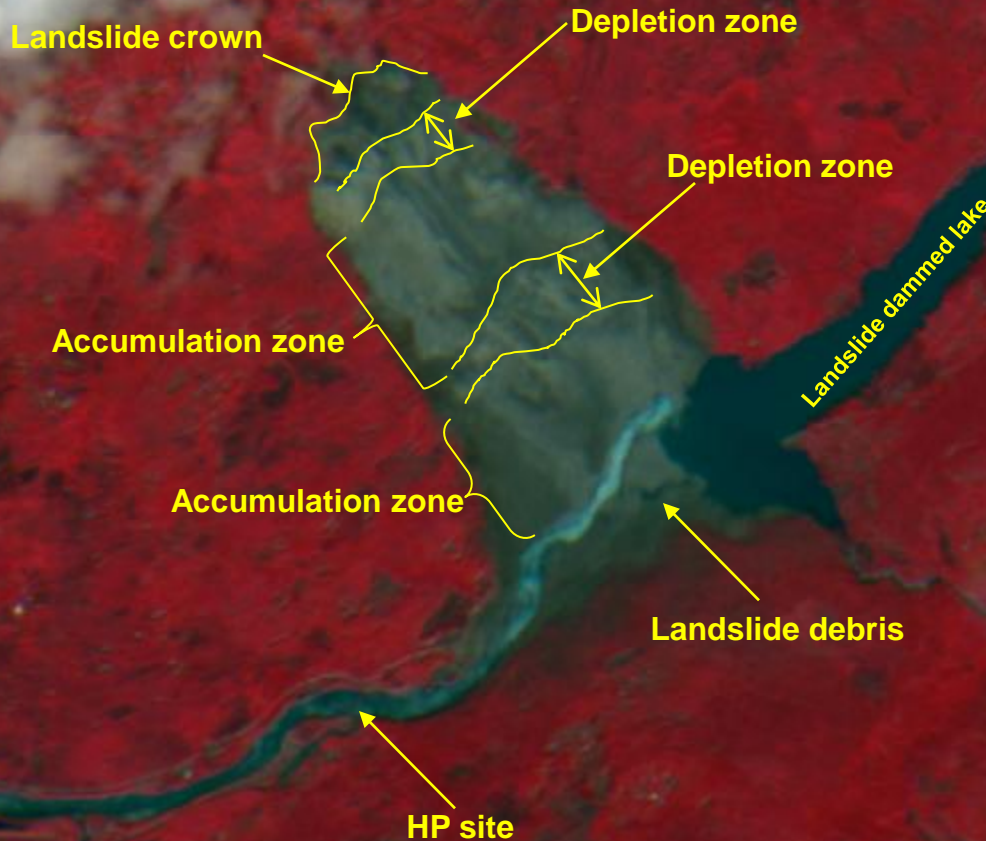


# Landslide on Sunkoshi river, Nepal

(As seen from Resourcesat-2 LISS IV MX acquired on 5 Aug 2014)

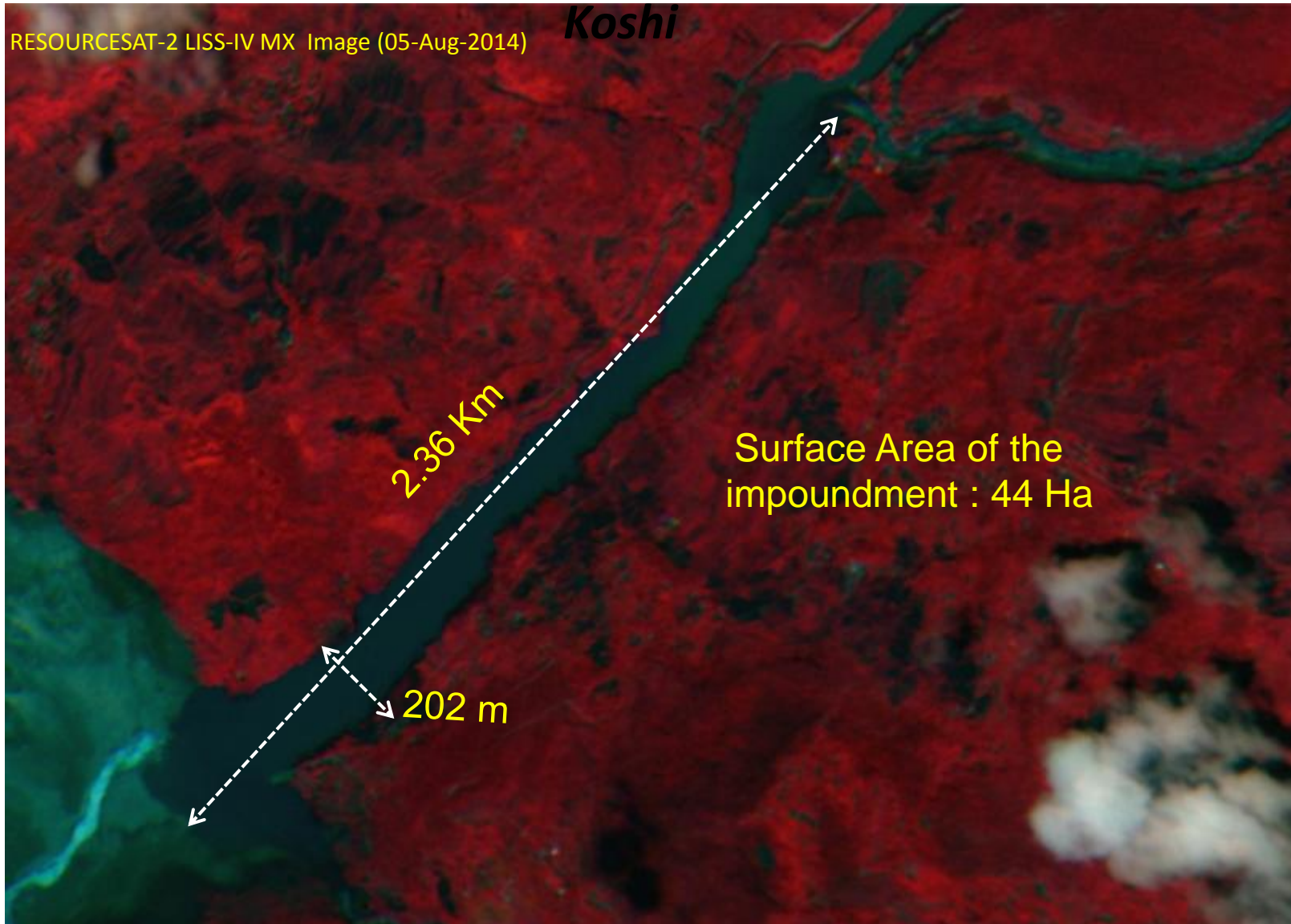


- The landslide that blocked the Sunkoshi river, is a deep seated rockslide (length 1.3 km and width 0.652 km) resulting in formation of a dammed lake
- The debris and boulders has blocked the river and moved onto the river terrace on the opposite bank.
- Analysis of historical imagery shows that it is an unstable zone with existence of small landslides.

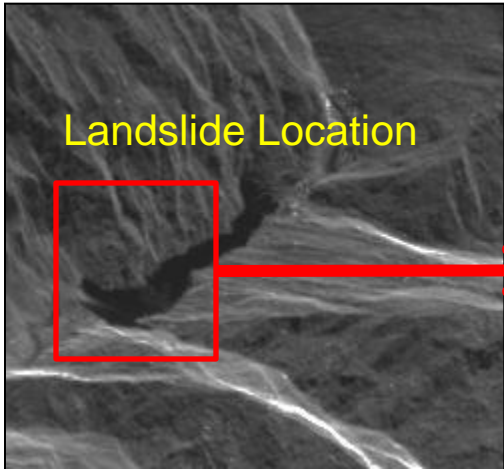


# Nepal – Landslide on River Sun Koshi

## *Details of the Impoundment on River Sun*

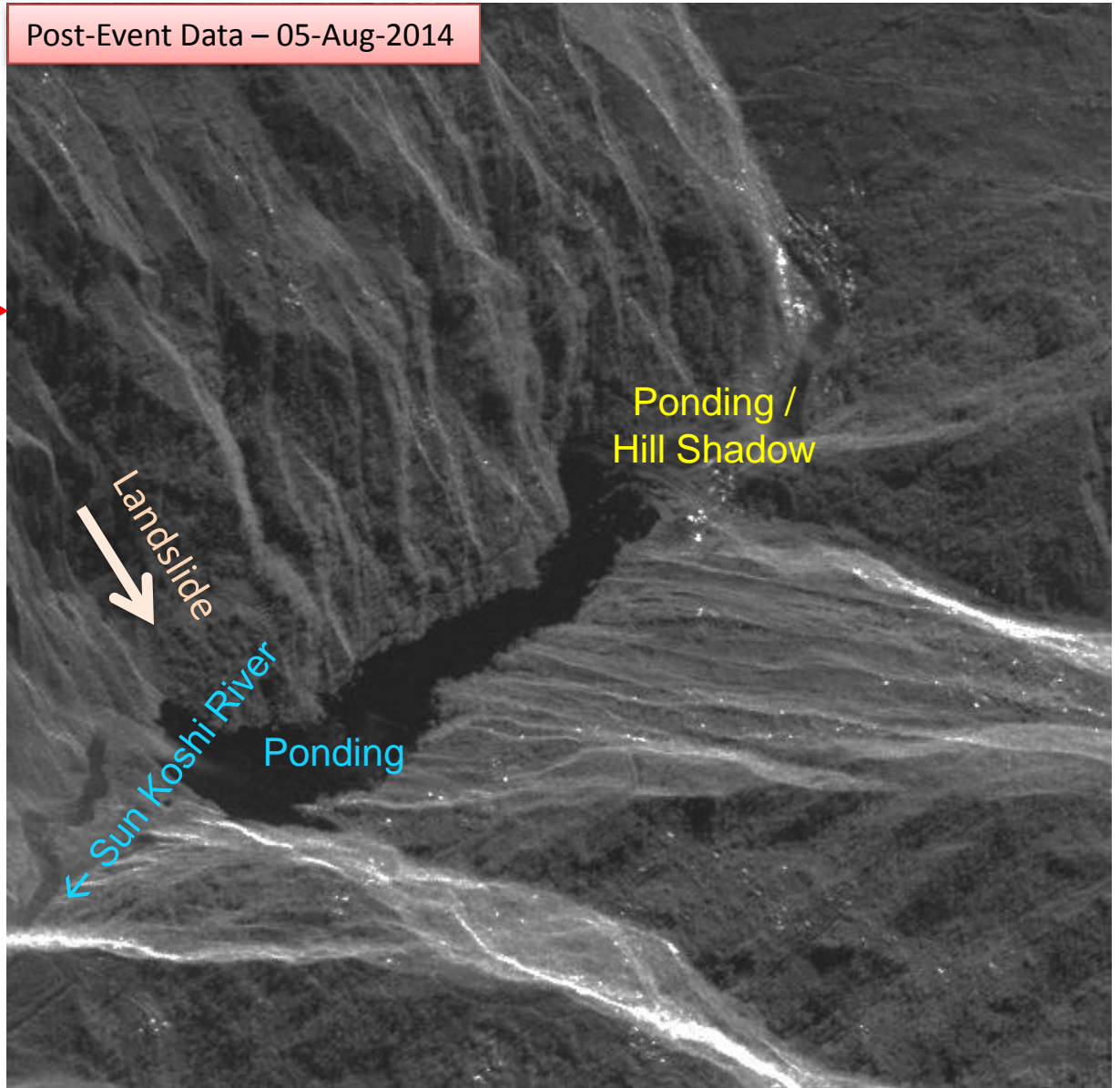


# RISAT-2 Image showing Landslide on River Sun Koshi



RISAT-2 SAR data

Image depicts a clear view of the landslide and water impounded due to blockade



\* Due to undulations, the layover, fore-shortening and hill-shadows affects are observed

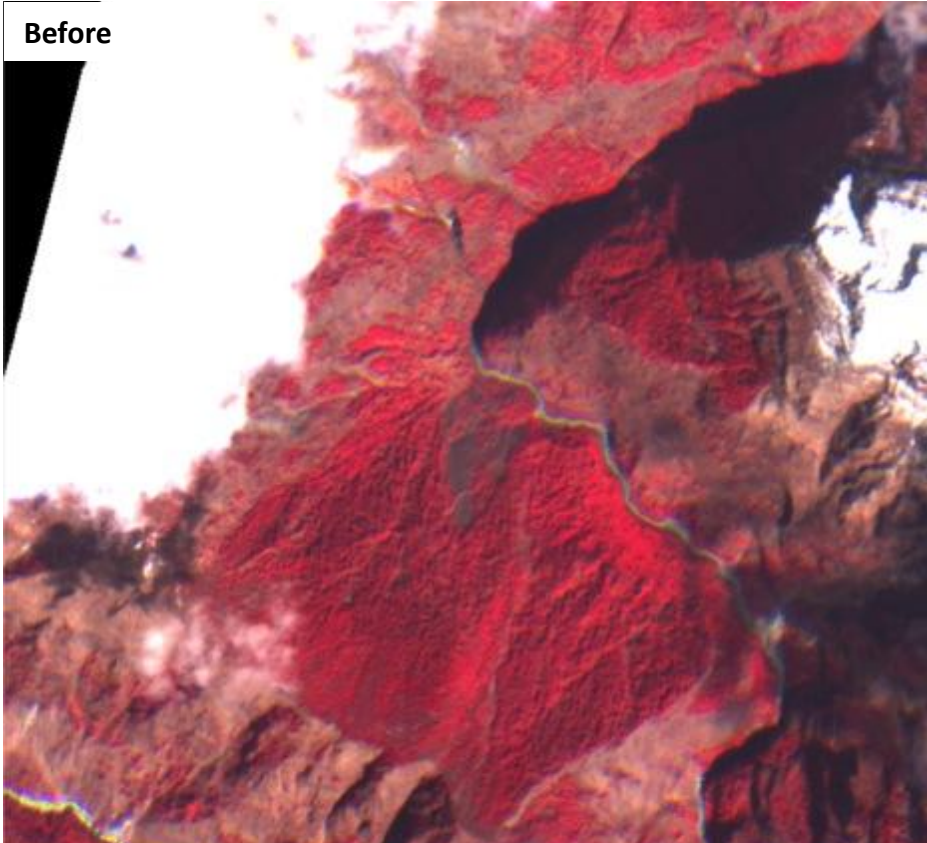
# Artificial Lake formation

## *Landslide Blocking the Valley*

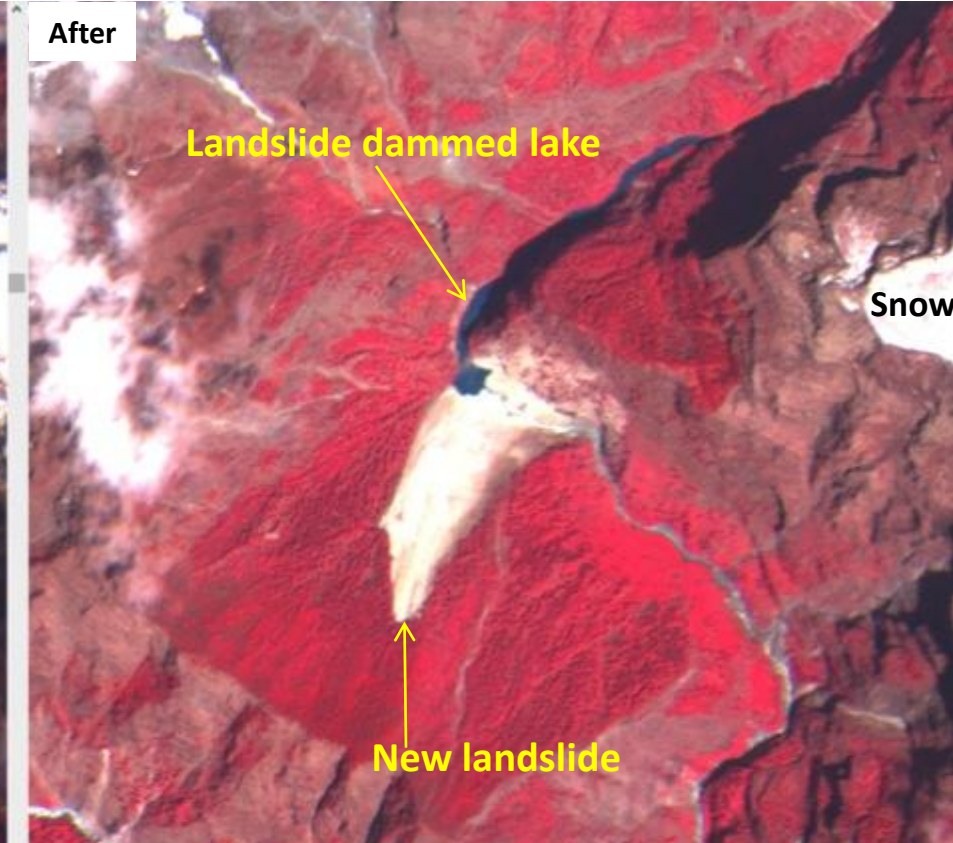
Resourcesat-2 LISS IV mx (01-Apr-2015)

Resourcesat-2 LISS IV Mx (30-Apr-2015)

Before

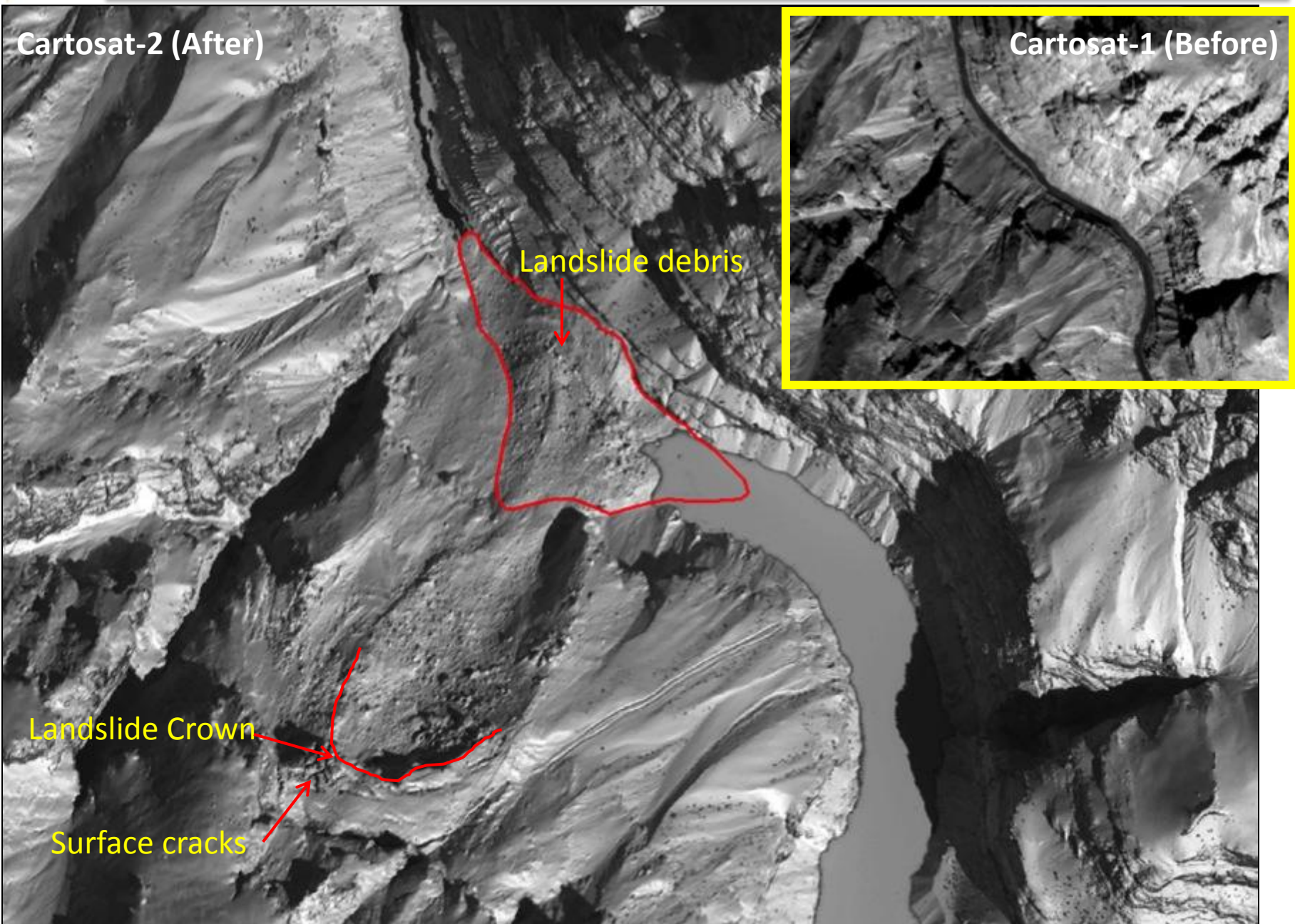


After



Observation: A new major landslide has blocked the valley resulting in development of a lake. Several other small new landslide are also seen.

# Phuktal River Landslide, Lake formation..



Cartosat-2 (After)

Cartosat-1 (Before)

Landslide debris

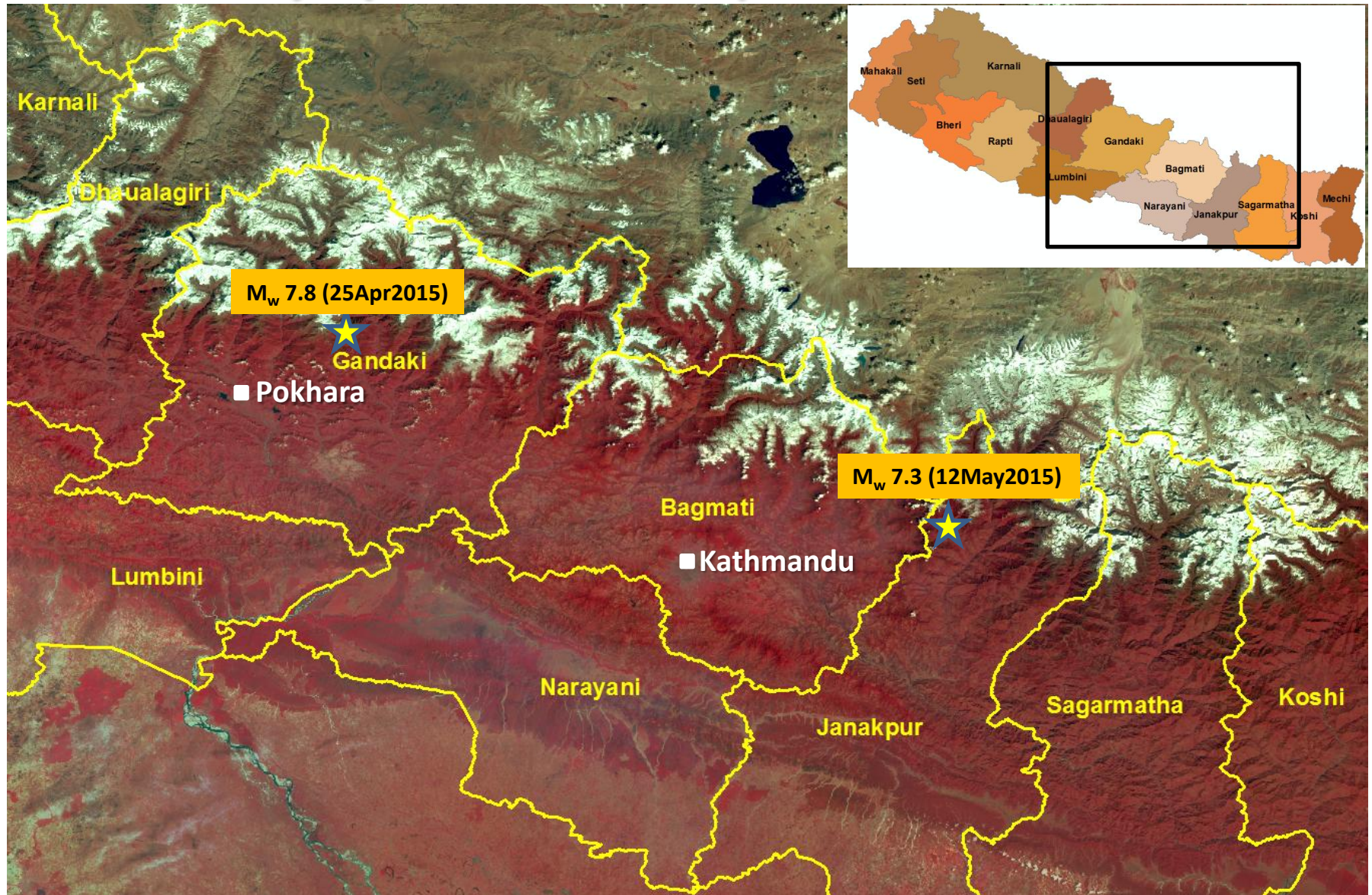
Landslide Crown

Surface cracks



# Nepal Earthquake – April, 2015

## Synoptic View of Earthquake affected area



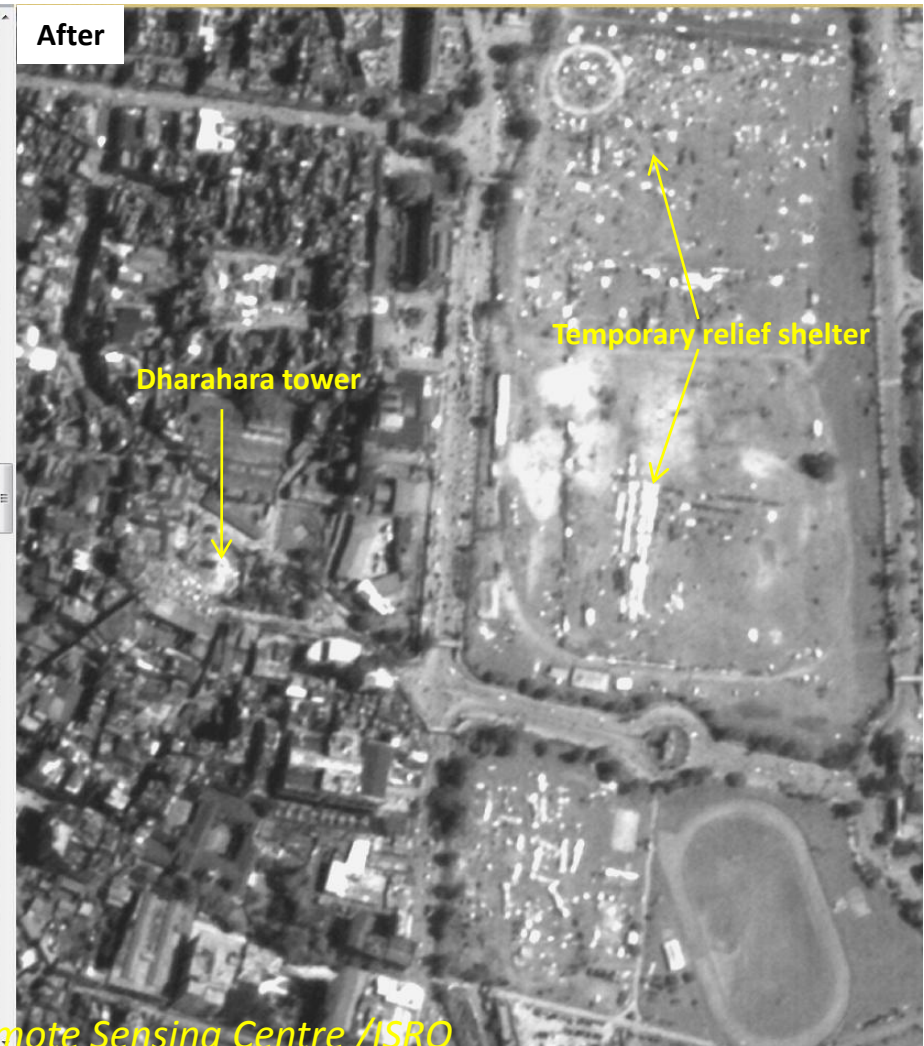


# Nepal Earthquake – April, 2015

## Dharahara Tower, Kathmandu

Cartosat-2 (05-Jan-2015)

Cartosat-2 (27-Apr-2015)





# Nepal Earthquake – Damage Assessment



The screenshot displays the National Remote Sensing Centre (NRSC) website interface. At the top, there is a header with the logo of the Government of India and the text "Gateway to Indian Earth Observation". The main navigation bar includes "Disaster Services (NDEM Public)", a "Nepal Earthquake Android App Download" button, and a "Welcome User" section with a "Logout" link. The NRSC logo and name are also present in the top right corner.

The main content area features a search bar with the text "Enter City or Lat/Lon/lon Chennai or". Below the search bar, there are navigation tabs for "Cyclone", "Drought", "Earthquake", "Flood", "Forest Fire", and "Landslide". On the right side of the main content area, there are links for "Tools", "Updates", "Screen Store", "Help", "Print", and "Home".

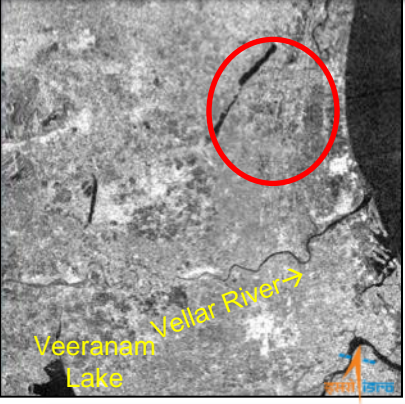
The central part of the page shows a satellite map of a city area in Nepal. A legend window is open, indicating the damage status of buildings: red for "Fully Damaged" and yellow for "Partially Damaged". The legend also lists the data sources: "Source: Cartosat-2(27Apr15), Pleiades(27Apr15) and Open Street Map(OSM)".

On the left side, there is a sidebar titled "Earthquake" with a "Recent Seismicity" section. It lists the "Nepal Earthquake New" event, dated "25 - 27 Apr 2015; Source : USGS". Below this, there are sections for "Kathmandu", "Pokhara", "Budhi Gandaki river valley", and "Sikkim", each with "Pre Event" and "Post Event" sub-sections. The "Post Event" sections list satellite imagery from "Cartosat-2" and "RS2-LISS III" or "RS2-LISS VI" with their respective dates.

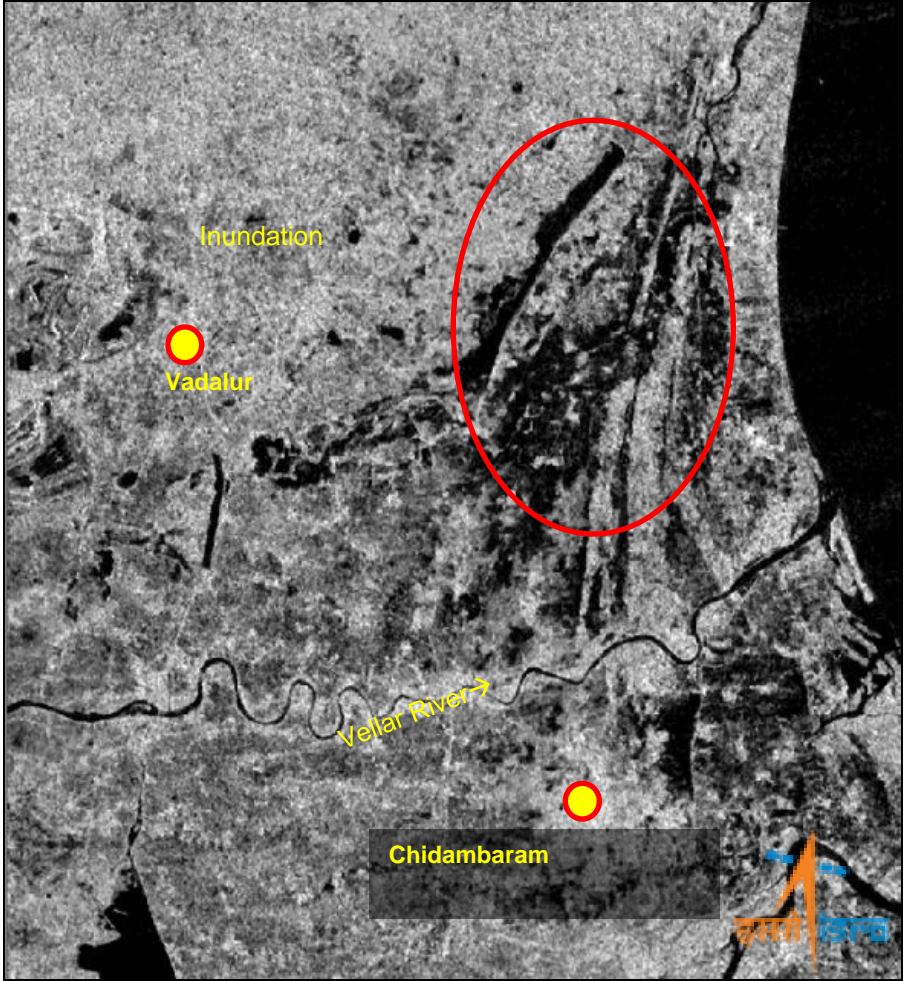
At the bottom of the map area, there are navigation controls including a vertical scale bar and a "Map" button with a dropdown menu showing "Satellite", "Hybrid", "Terrain", and "More" options.

# Chennai Flood Event

Before Event -RISAT-1 image



After Event- RISAT-1 image of 14-Nov-2015 (1800 Hrs)

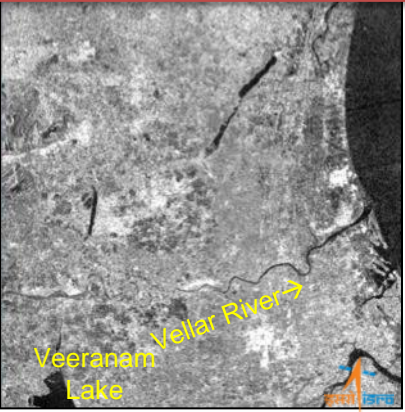


After Event- RADARSAT -2 image of 11-Nov-2015 (0600)

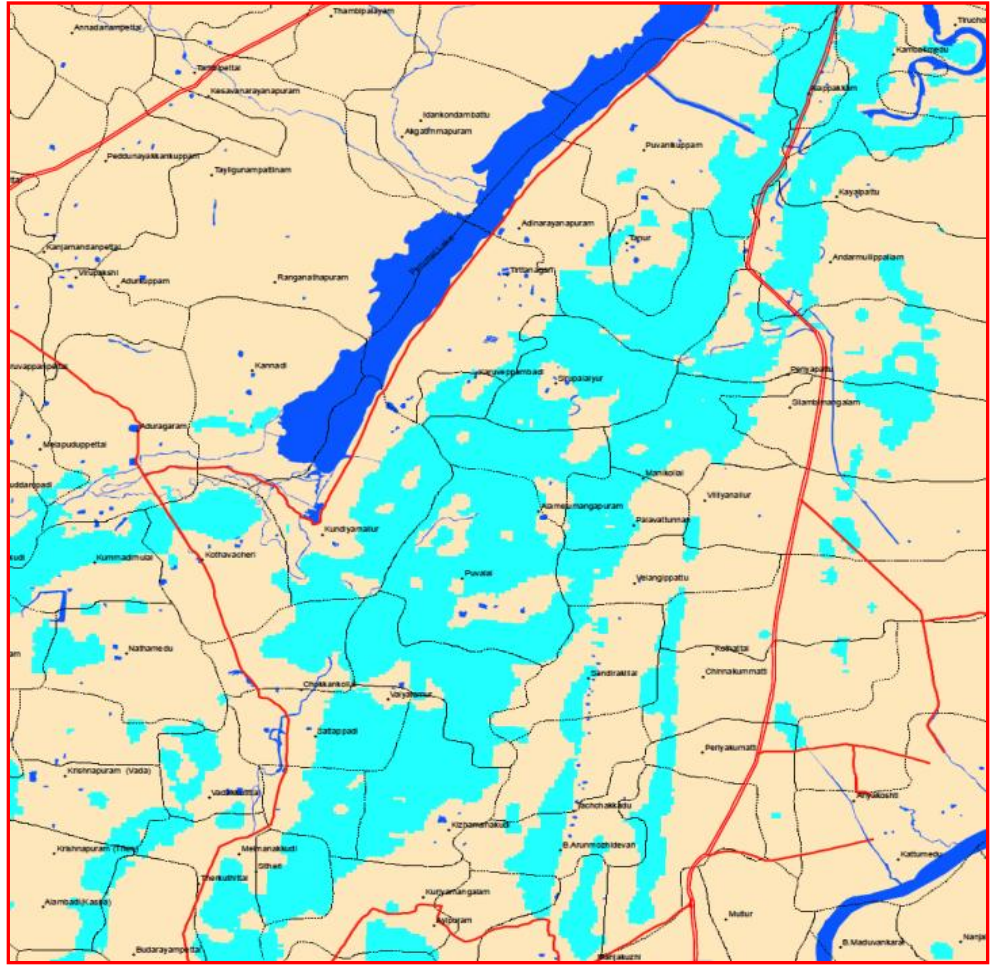


# Flood maps Disseminated in near real-time

Before Event -RISAT-1 image



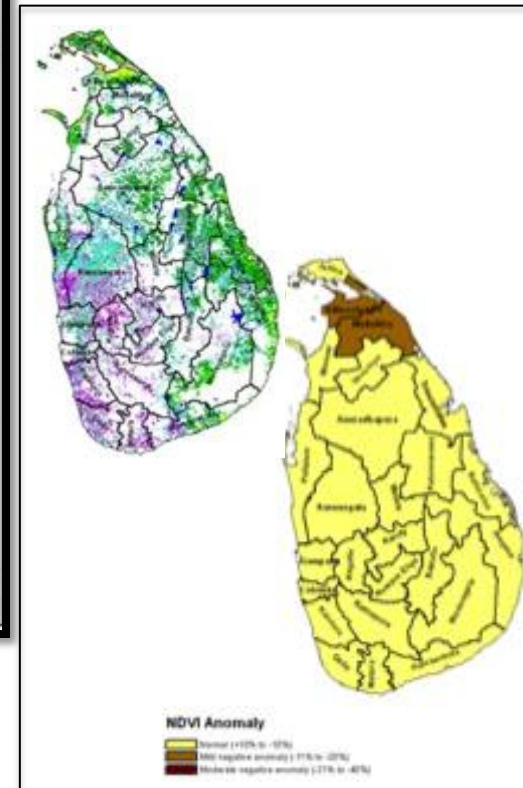
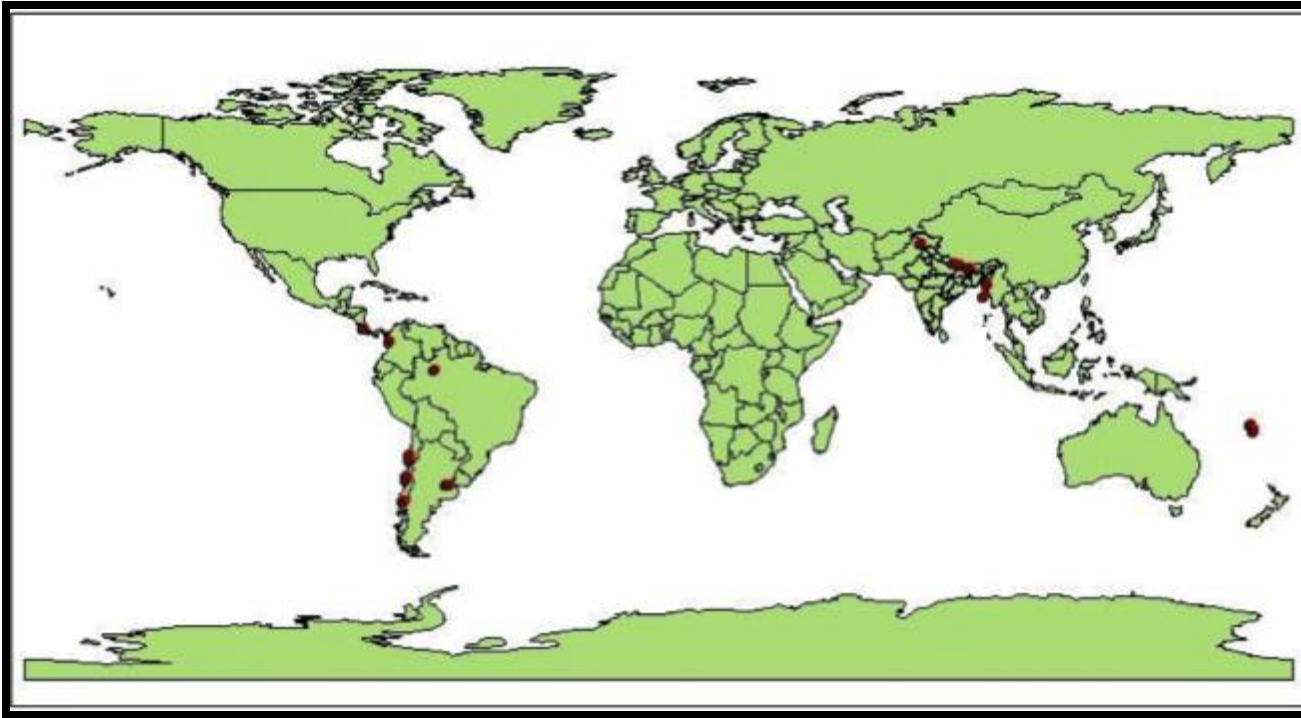
Flood map derived from Satellite data



After Event- RADARSAT -2 image of 11-Nov-2015 (0600)



## International Charter – ISRO provided leadership during Apr – Oct 2015



### ISRO's Support - 2015-16

- **Int'l Charter** – > 142 Scenes
- **Sentinel Asia** – > 30+ Scenes
- **UNESCAP** – Drought: **Srilanka** all season support; **Nepal** feasibility study done
- **UN-SPIDER** – International Workshop on DRR in Mar 2016

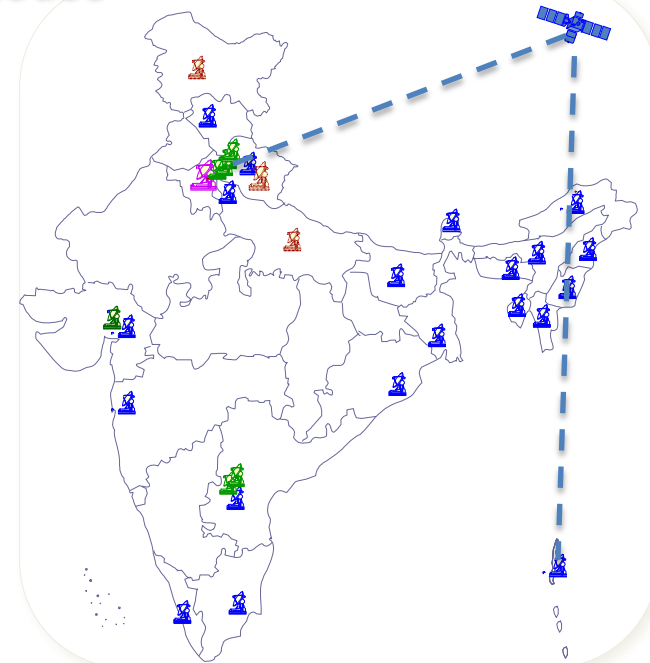
# National Level Disaster Management – Way Ahead

**NDEM: Serving Multi-scale Data on major disasters, DSS tools**

**NDEM to serve all nodes at National level through Sat. communication and geospatial technologies to address all Major Disasters in the country**

- Fail-safe Connectivity (Terrestrial & SATCOM)
- Geospatial services for near real-time Images/Maps
- State of the art Control Room in Delhi with DSS
- State/ District level connectivity + Disaster Hotspot

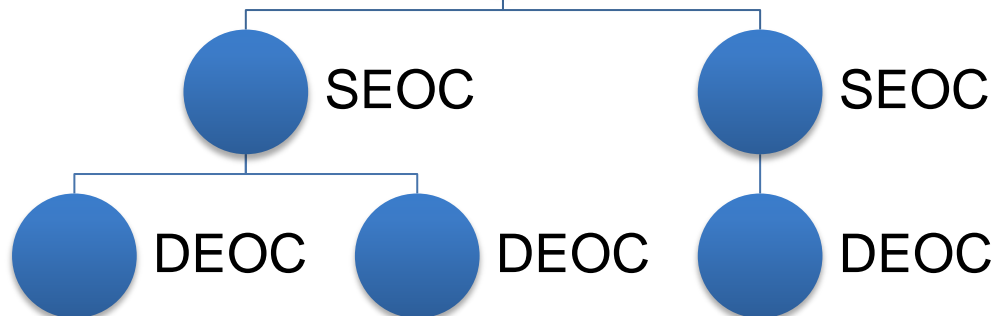
VPN Nodes with over 40 nodes – connecting 20 State nodes



**Emergency Operations**

**Centres**

**Control Centre**

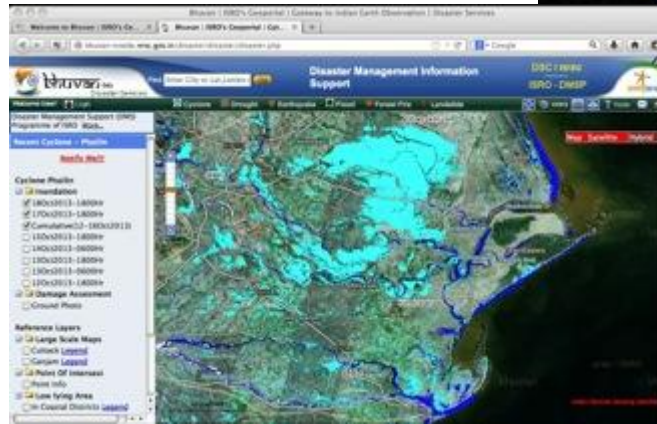


Web Site: [www.nrsc.gov.in](http://www.nrsc.gov.in)

Geoportal: <http://bhuvan.nrsc.gov.in>



terrain view with  
S data and  
lement locations



# Thank You

