Use of EO inputs for Sustainable Development in India : *An update*

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Presentation to 58th Session of UN COPUOS, 10-19 June, 2015,Vienna

Outline

- Sustainable Development : India Facts
- Indian EO Missions : Current & Planned
- National Programs & Convergence for Sustainable Development
- EO Inputs for Sustainable Development
  - Natural Resource Census
    Emvironmental Protection
  - Decentralised Planning
  - Disaster Risk Reduction
  - Urban & Infrastructure Planning

Natural Resource Census

- Regular mapping with consistent thematic classification, input data, map output and seamless GIS layers for web access & spatial decision support

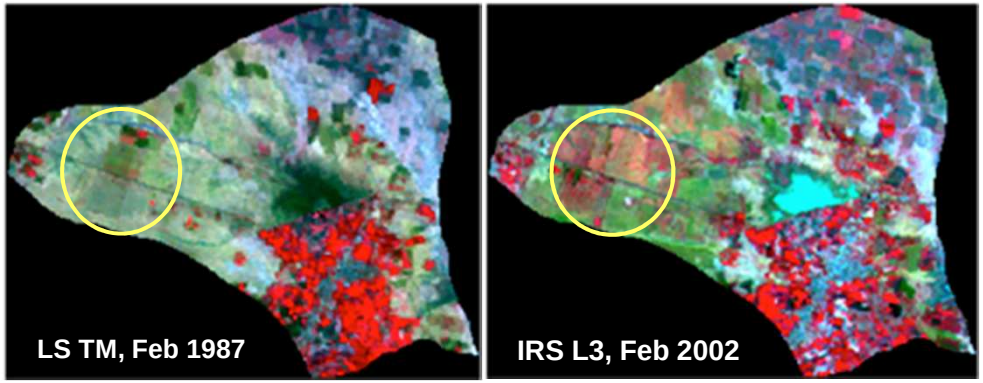
Land Use/Land Cover	• 10 cycles 250K • 02 Cycles 50K
Land Use/Land Cover	• Hot-Spot Monitoring at 10K
Land Degrad-ation (1:50K)	• Erosion Mapping 05-06) • Salinity& Waterlogging
Geomorphology & Lineament	• 1::50,000, Level 3/ 245 Classes,
Forest Cover Alert	• Pilot study

Wasteland Monitoring

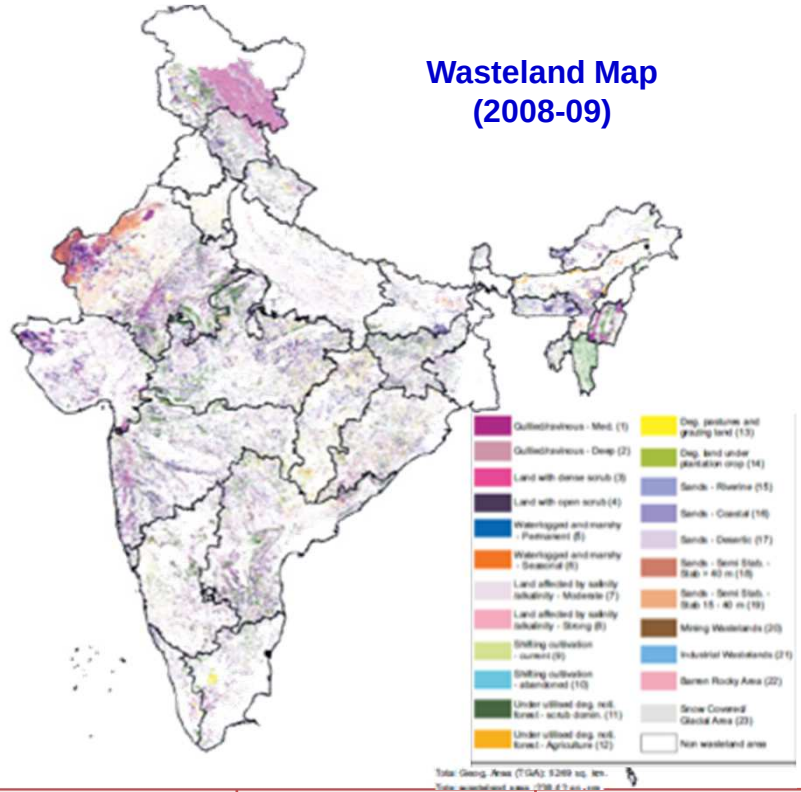
A Targeted Rural Development Programme: with village & watershed boundaries

- **Bring culturable wastelands under cultivation**
- **Enhance food grain production**
- **Bring 30% under green cover**

- National Wasteland Inventory Project (1986 - 2000)
- National Wasteland Updation Mission (2003 - 2004)
- Monitoring of the wasteland areas (2005-06)
- Wasteland Change Analysis - using three season LISS-III data of 2008-2009
- Coverage : Entire India at 1:50,000 scale
- No. of Wasteland categories : 28



Wasteland Map (2008-09)

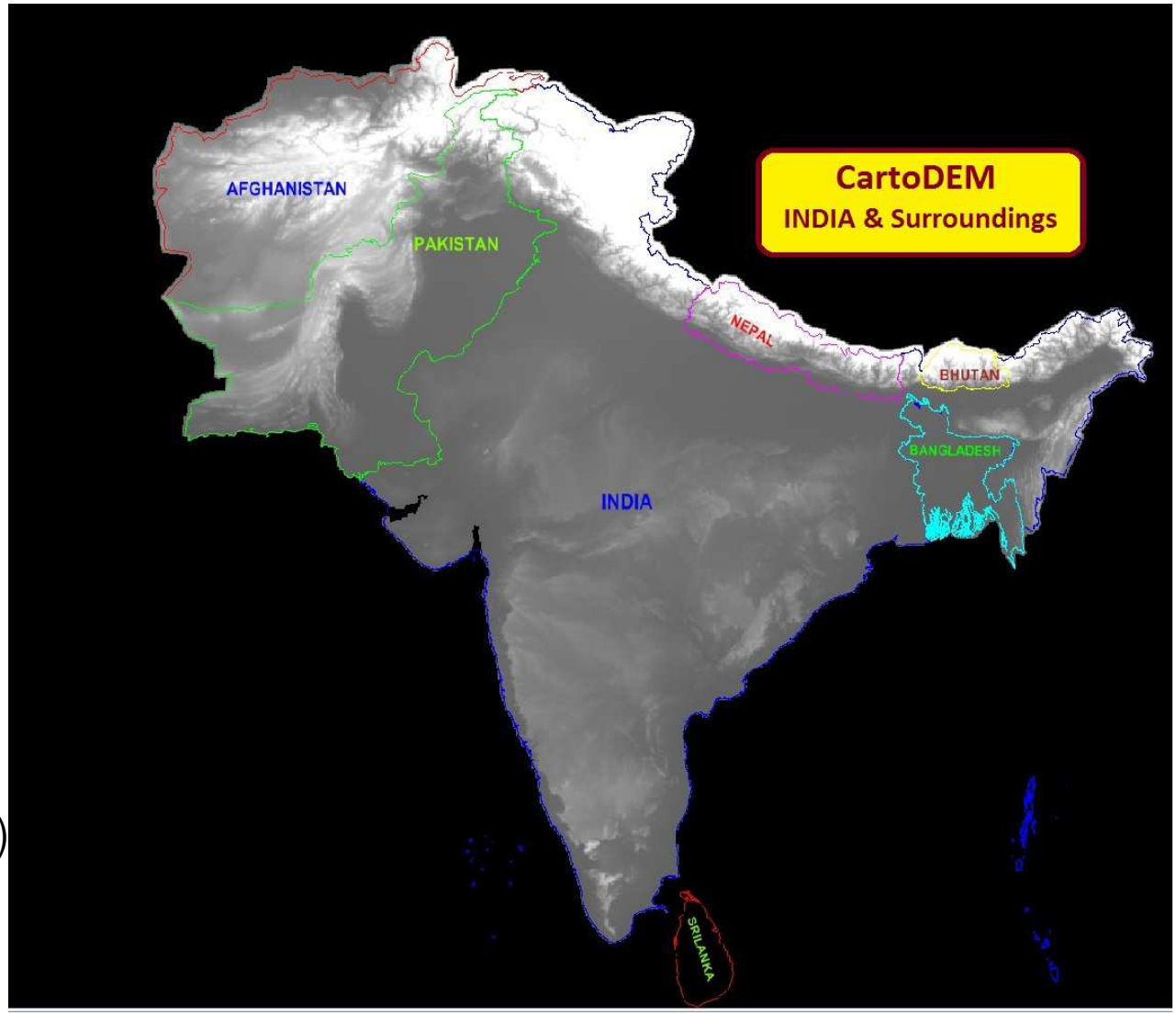


Area (Mha)	% of TGA	Year of Data
63. 85	20.17%	1986 -2000
55.27	17.45%	2003
47.22	14.91%	2005
46.73	14.76%	2009

CartoDEM (V3.0) on 10 years of Cartosat

- **Uses CARTOSAT-1**
- **DSM, WGS**
- **10m spacing**
- **(.ca. 8m absol accuracy in plains)**
- 30 m free downloa

- Water body flattening
- Gap filling with SRTM/ASTER DEM
- Separate layers prepared for (a) DEM, (b) water bodies, (c) gaps filled with SRTM/ASTER DEM
- Extended to Surrounding countries



Version 3 CartoDEM was released on 05-05-2015

Food Sustainability

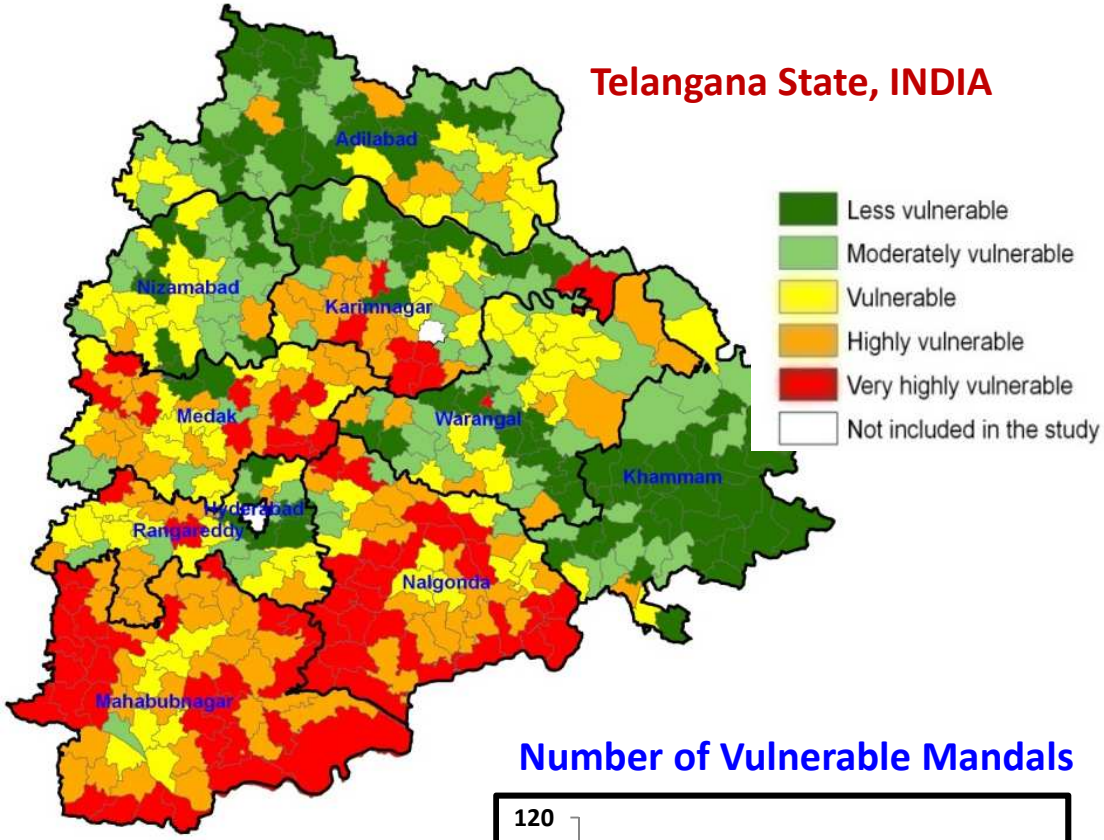
- Operational crop production forecasting (6 major crops) & Agricultural Drought Assessment by Dept of Agric.
- New Applications being developed
  - Horticulture & Plantation crops mapping, suitability analysis
  - Geomatics for pest monitoring
  - Land Resource Inventory (1:10k) for soil fertility mapping
  - Drought Vulnerability for DRR

Agricultural Drought Vulnerability Assessment for Risk Reduction

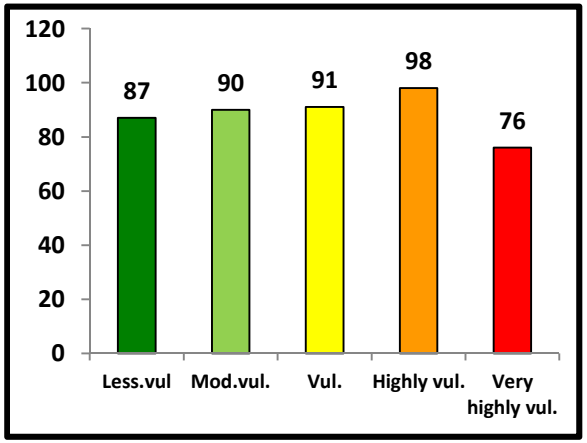
Parameters Used

A. Exposure component
1. Total season rainfall
2. Sowing period rainfall
3. Total season rainy days
4. Sowing period rainy days
B. Sensitivity component
1. Season's Integrated NDVI
2. Season's Maximum NDVI
3. August NDVI
4. Cropping pattern
C. Adaptive capacity component
1. Soil
2. Irrigation support
3. Land holdings

Agricultural Drought Vulnerability Index **ADVI = EI+SI-AI**



Number of Vulnerable Mandals



Priority: Low → High

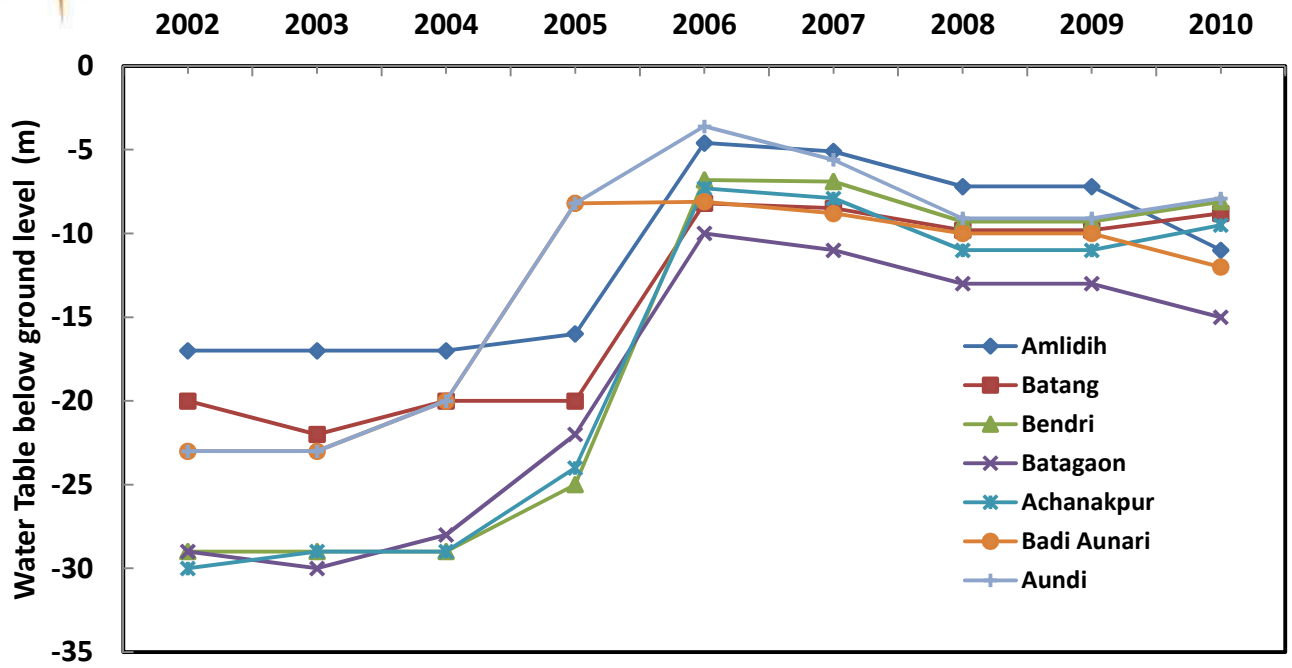
Water Sustainability

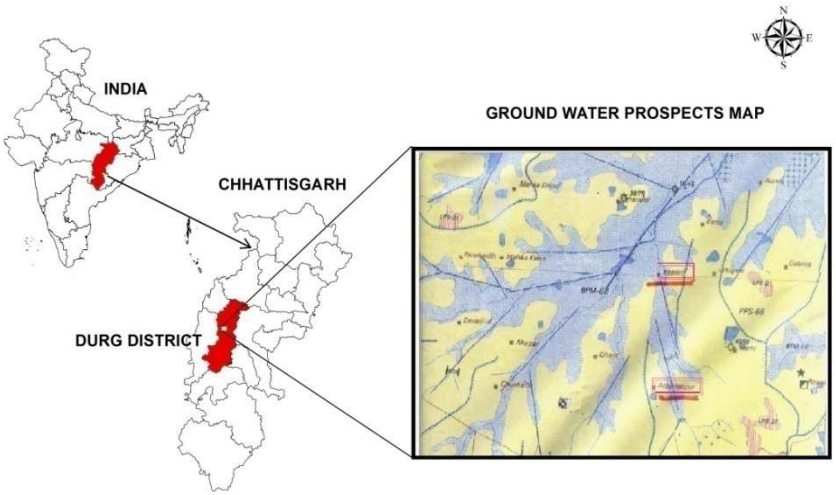
- Operational applications in area of
  - Water Resource Assessment (Cryo, Surface, ..)
  - Hydrogeology Mapping for Ground Water Potential Zone
  - Monitoring for Irrigation infrastructure, Canals, Tanks
  - Operational Distributed Hydrology Models for runoff & flood early warning
  - ….
- Information accessible through webGIS

www.wris-nrsc.gov.inv.in
www.bhuvan.nrsc.gov.in

- New sustainability applications for
  - National Aquifer mapping
  - Village level sustainability plans
  - Optimal water distribution at village scale
  - …

Use of Hydrogeology Maps - Recharge





Impact of Recharge structures on ground water sustainability

- 101 recharge structures (Masonary stop dam-23, percolation tank-12, Boulder check dam-25, Nala bund-13 and desilting of pond-28) were constructed in this sub-watershed based on the knowledge gained from RGNDWM ground water prospects maps.
- Water table has risen to a maximum of 20m at places with average rise of 15m in the area.

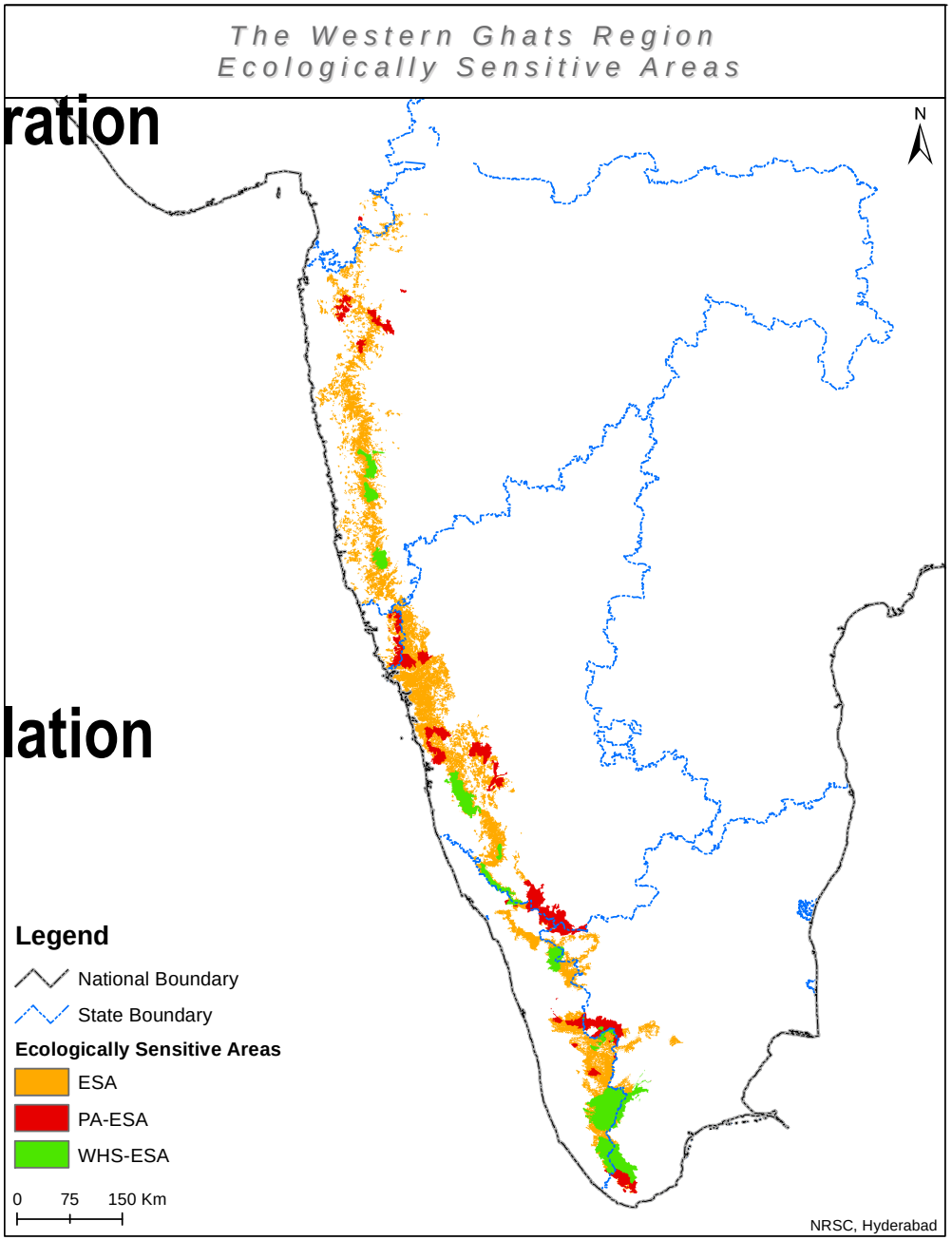
CHHATTISGARH Success story under RGNDWM project (Gajra sub-watershed, Patan Block, Durg Dist.)

Environment Protection

- National scale Landscape-level biodiversity map
- Monitoring of National Parks & Sanctuaries
- Eco-sensitive area zonation
- Coastal Regulation Zones
- Environmental Clearance & EIA

Eco-sensitive Area mapping with EO

- Multi-thematic data integration
- Forest Cover
- Vegetation Type
- Biodiversity Map
- Protected Area
- Wetlands
- Village boundary & population



Urban Sustainability

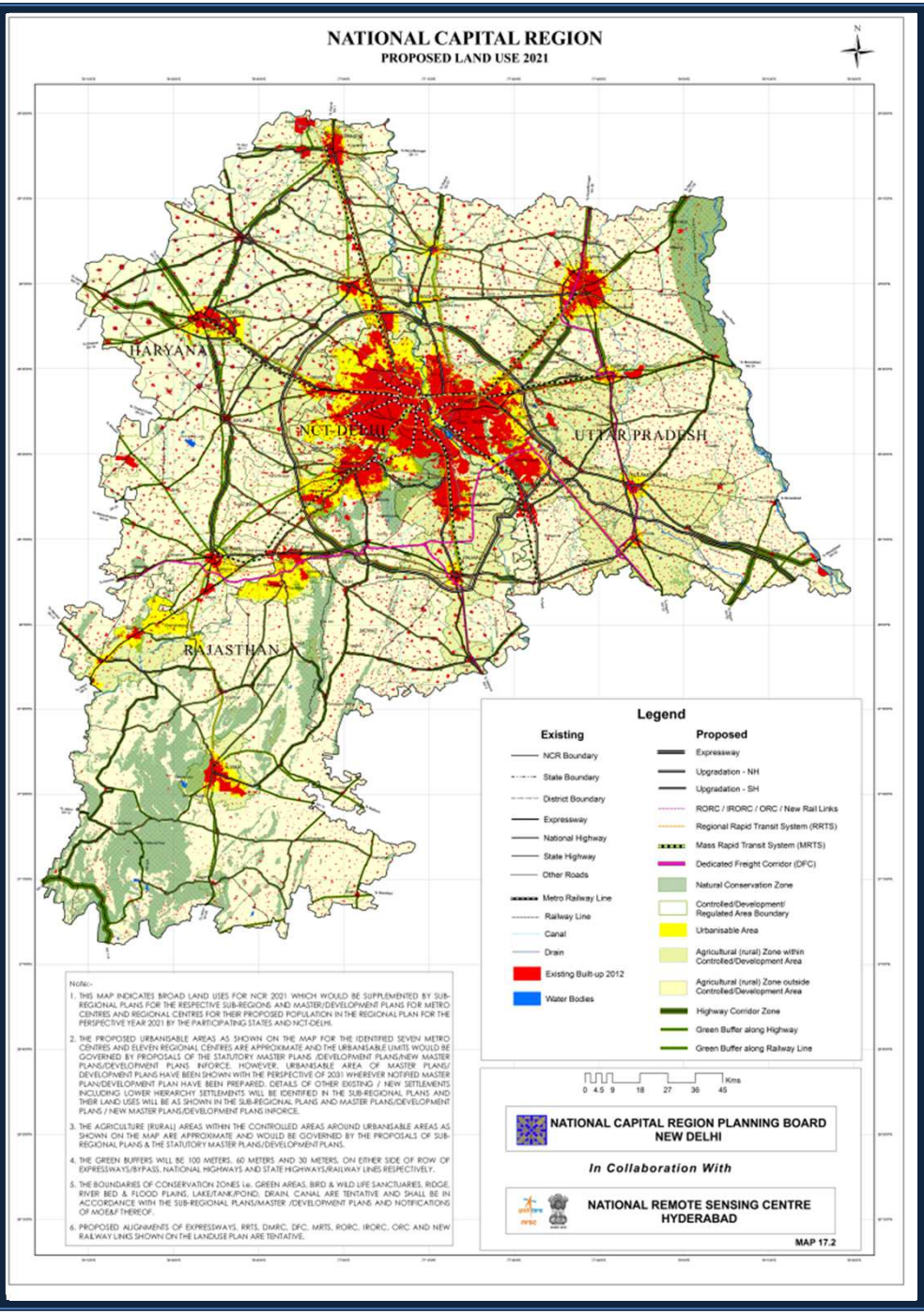
- Urban Master Plans (UMP)
  - Preparation, Mid-plan review of UMP
- National Urban Information System (NUIS)
- National Capital Region (NCR) Mid-term review
- Monitoring Urban Environment
  - Sprawl, green cover, lakes/wetlands
- High resolution EO & photogrammetry for Urban Infrastructure
  - Mapping squatter habitations, basic amenities provisions

Urban Planning

National Capital Region Regional Plan 2021 - For Sustainable Urban Development

National Capital Region covers an area of 34, 144 sq.km in NCT Delhi, Haryana, UP and Rajasthan. NCR Regional Land use has been prepared from LISS-IV 2012 data on 1:50,000 scale and Land use change analysis between 1999 & 2012 have been used for the Revision of Regional Plan – 2021 (RRP-2021).

- **Remote Sensing and GIS based Regional Plan offers spatial policy formulations for Sustainable Urban Development.**
- **Regional Plan provides Urban Planning guide lines for preparation of Sub Regional Plans (Master / Development Plans) for the City / Towns within the region .**
- **Monitoring of the Urban Growth to facilitate the Urban Local Bodies (ULB's) to enforce harmonised & Sustainable development .**
- **Enables the urban governance.**



Disaster Risk Reduction

- India is highly prone to various disasters
- EO program supports all phases of Disaster Management
- RECENT EXAMPLES
- Preparatory Phase
  - Flood Hazard Zonation
- Early Warning Phase
  - Cyclone Prediction (Phailin case study)
- Early Response & Relief
  - Flood inundation mapping

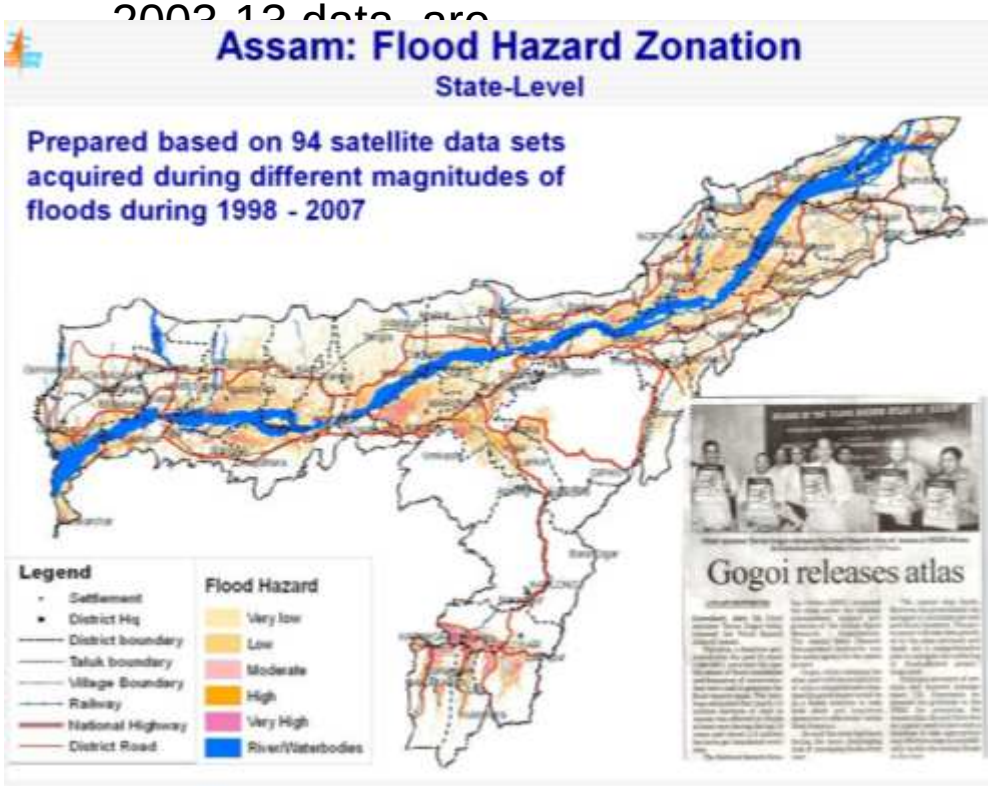
Sustainable Development through Better Preparedness

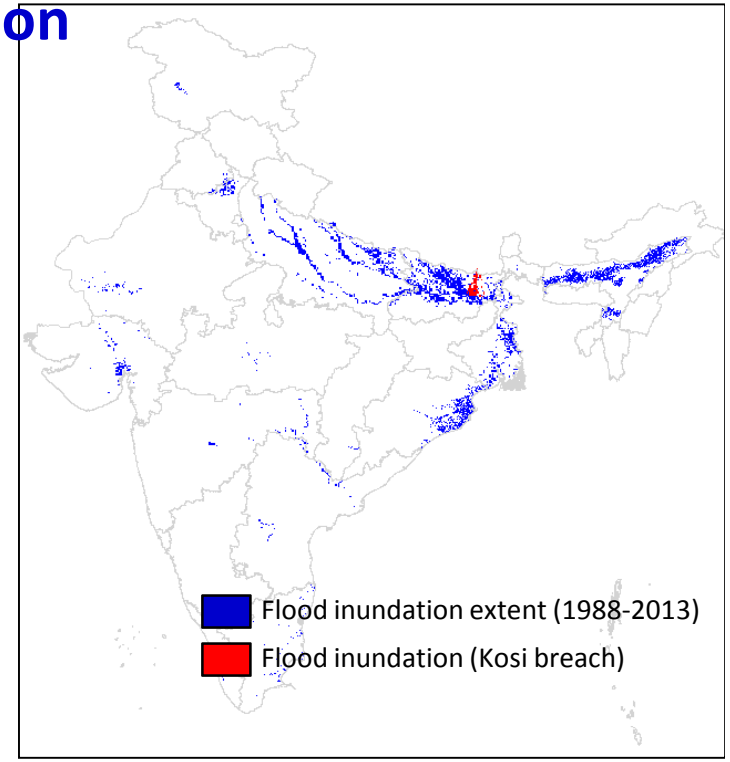
Flood Prone Area Assessment, India

Flood Hazard Zonation

Satellite Data Used:

- Satellite data corresponding to High Flood Levels (HFL) used
- Mostly during 2003-2013 (about 100 satellite datasets)
- Important events included, in addition to 2003-13 data, are





Aggregated Flood Inundation

~10.934 mHa

Historic information on floods through satellite observations helps in better preparedness

Sustainable Development through Early Warning
Godavari River, Andhra Pradesh

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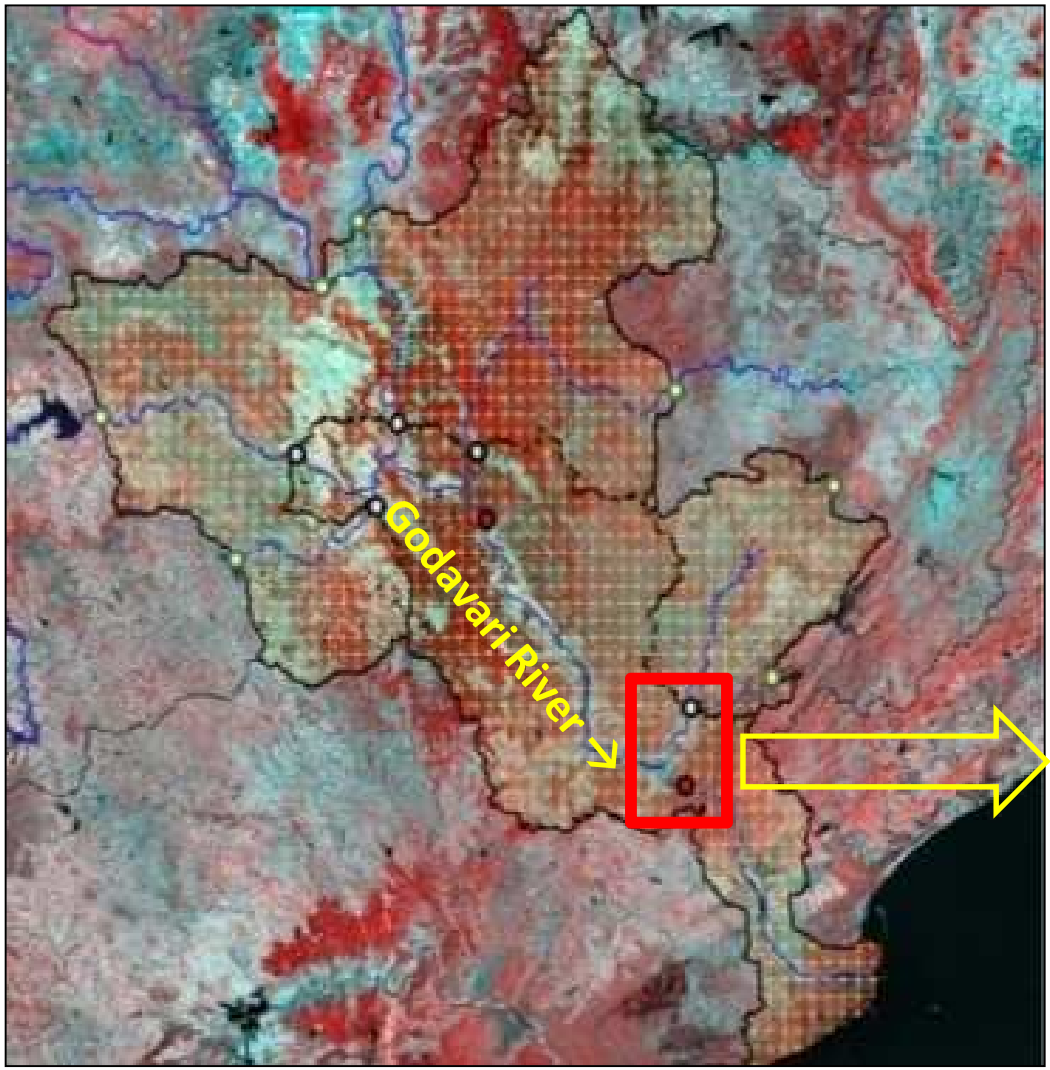
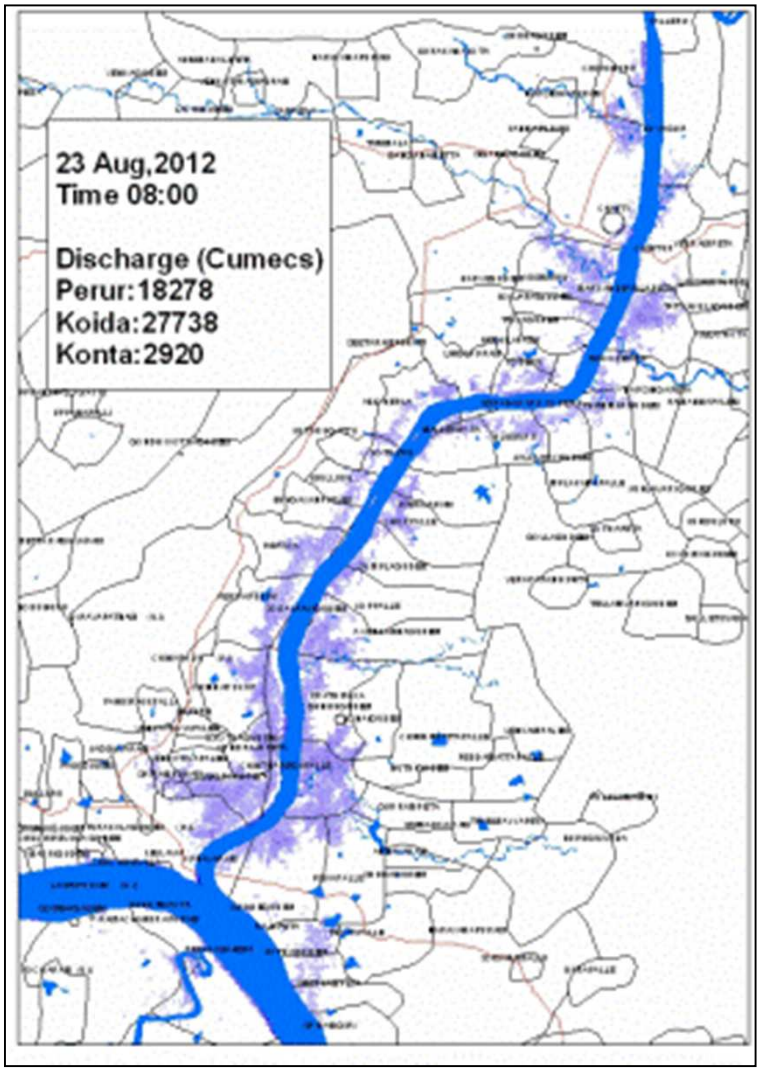
Flood Forecasting and Inundation Simulations for Godavari River, India

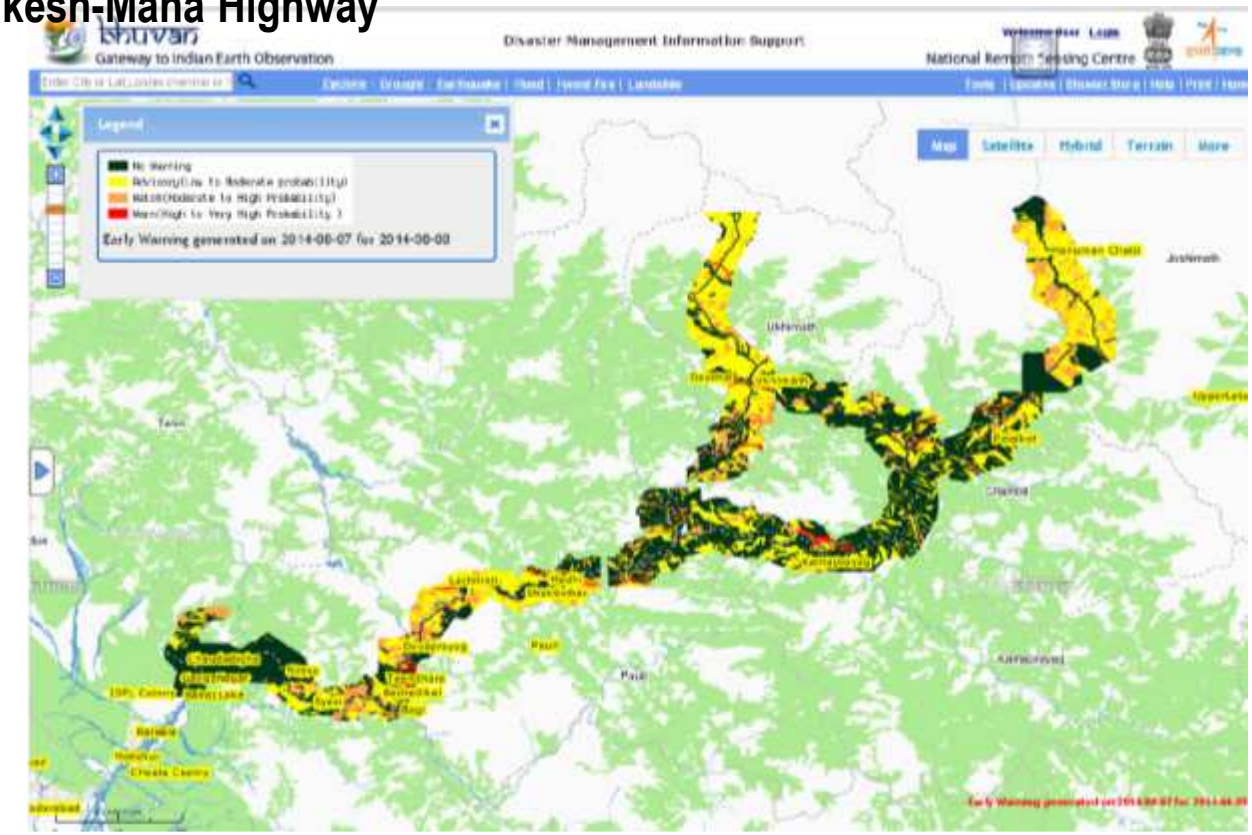




Experimental Landslide Early Warning System

Badrinath and Kedarnath Corridors in Uttarakhand

- Spatial (geological, morphological and terrain factors) and temporal (triggering factors) controls of slope failure
- Rainfall has been used as a trigger for slope failure initiation
- Logistic Regression based model developed using long term data on rainfall-landslide initiation along Rishikesh-Mana Highway



FLOOD RESPONSE - 2014
Mapping of Major Floods/Cyclones

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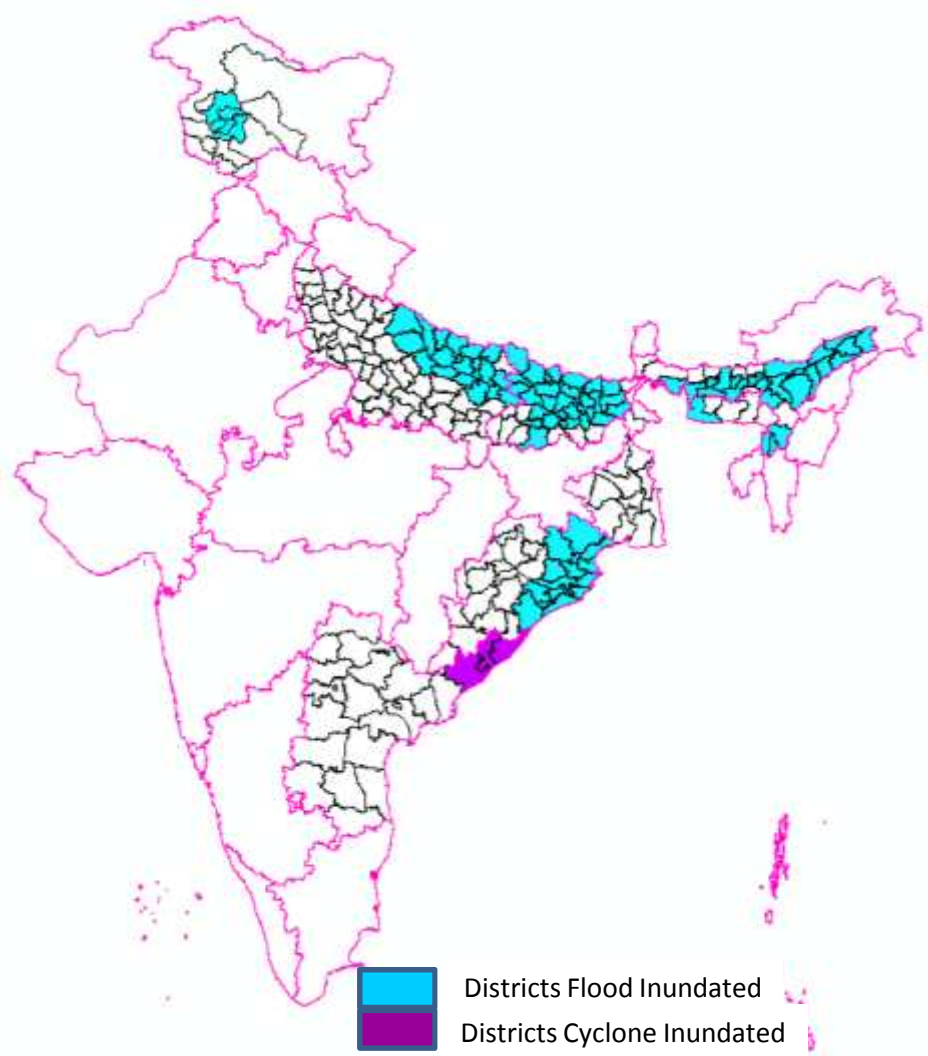


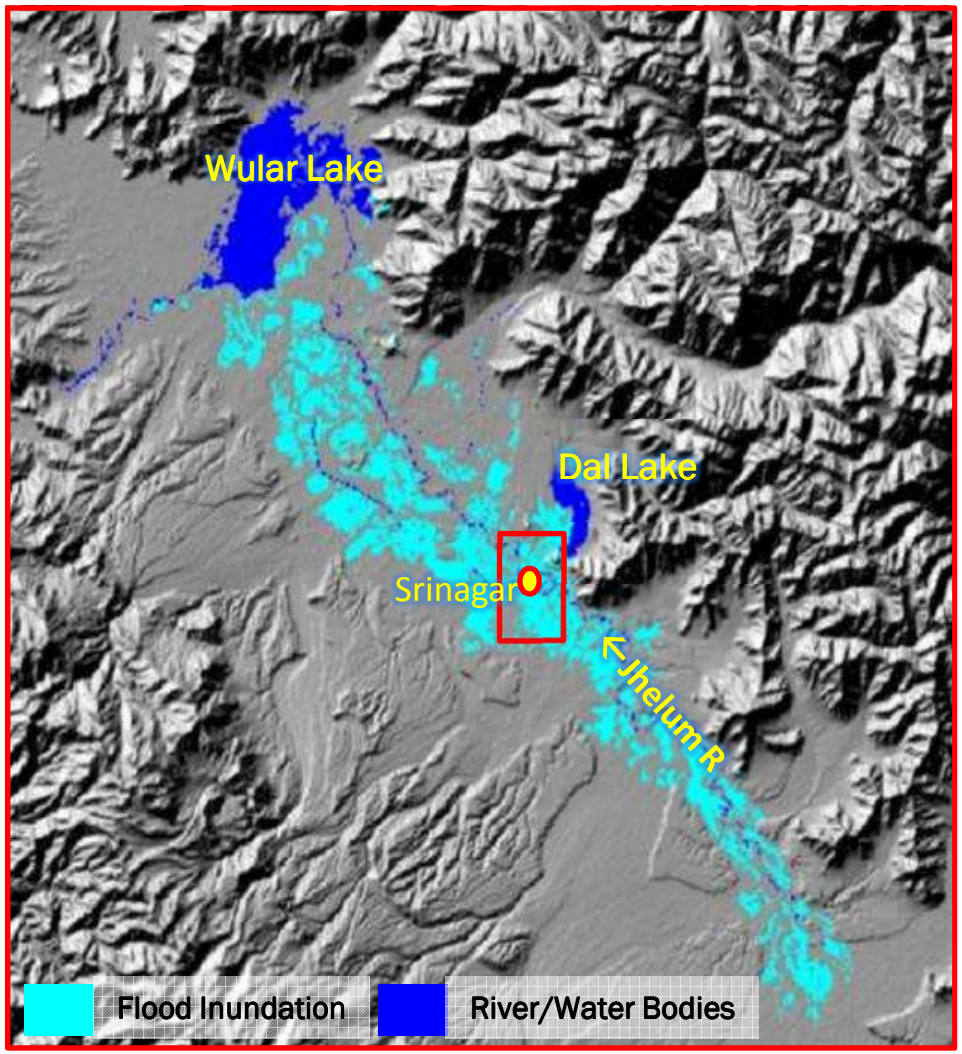
Highlights:
States Affected: 8
Flood Maps Sent: 112
(as on 30-Oct-2014)

Major Events:
Severe Floods – Jammu & Kashmir
Cyclone HUDHUD- Andhra Pradesh

Data Used:
RISAT-1, CARTOSAT-2, RESOURCESAT-2
RADARSAT-2, WORLDVIEW, PLEIADES,
RESURS-P, TERRA-SAR-X, etc

Users:
Ministry of Home Affairs (MHA)
State Relief Commissioners
NDMA, IMD, CWC

Jammu & Kashmir, Floods - 2014



- Jammu & Kashmir experienced one of the worst floods in the past 60 years, during September 2014.
- NRSC closely monitored the floods and inundation information was disseminated in near real time to State Govt. and also uploaded to Bhuvan geo portal.

End Use

- Used by state agencies for relief operations.

Ministry Info

- MHA, NDMA & Govt. of J & K

Location Info

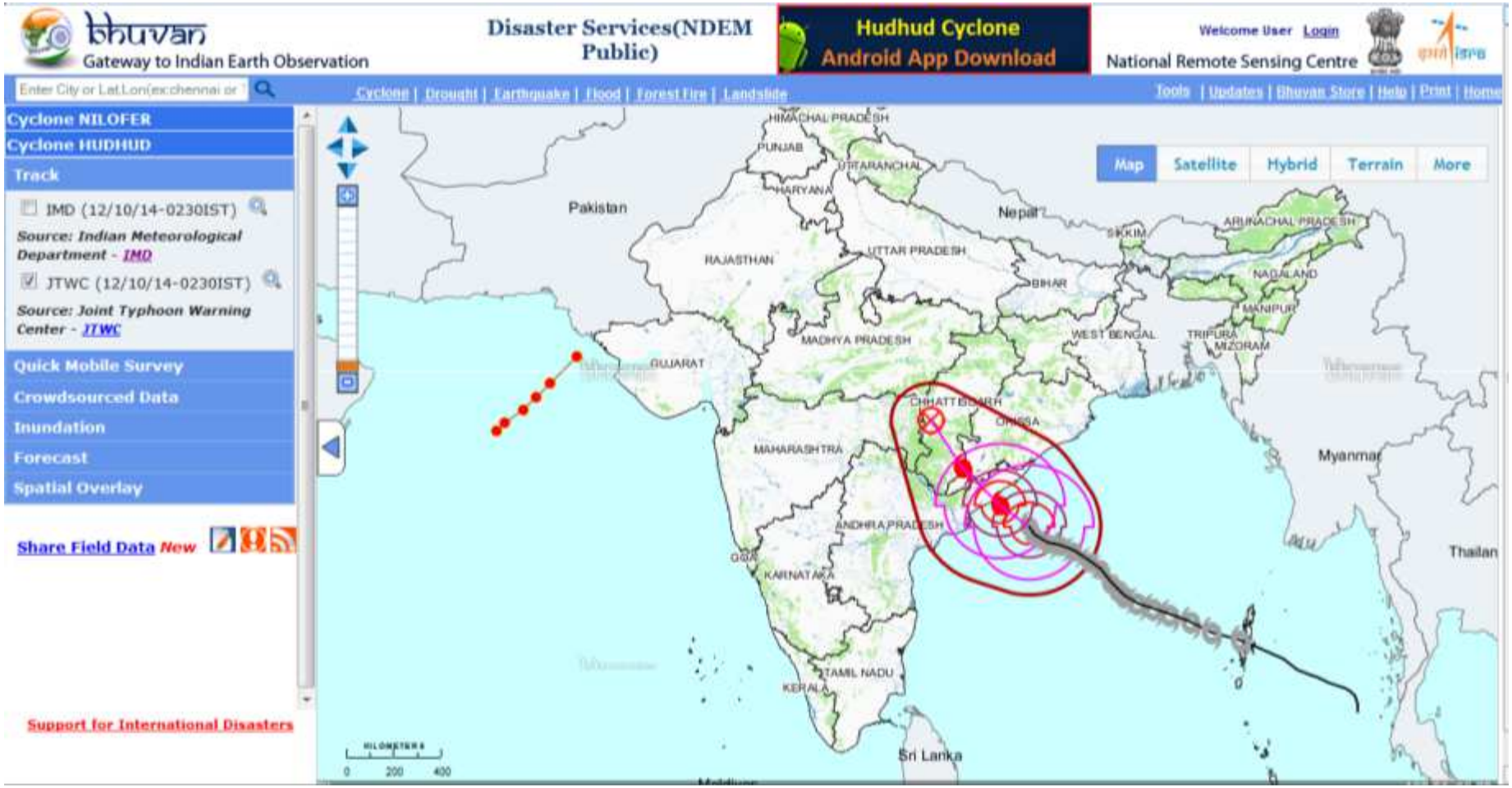
- Jammu & Kashmir

Sensor Info

- RISAT-1, Resourcesat-2, Cartosat-2, Pleaides

Cyclone HUDHUD - 2014
Cyclone Track

The very severe Cyclonic Storm ‘HUDHUD’ over west central Bay of Bengal made landfall at Andhra Pradesh coast on 12th October 2014 causing heavy damage to Vishakhapatnam city , including the airport, a number of buildings, electrical and telecommunication supplies and roads



Cyclone HUDHUD - 2014
Damages

Very Severe Cyclonic Storm "HUDHUD" on 12 Oct 2014 hit Vishakhapatnam, Andhra Pradesh between 1200 and 1300 hours IST.

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

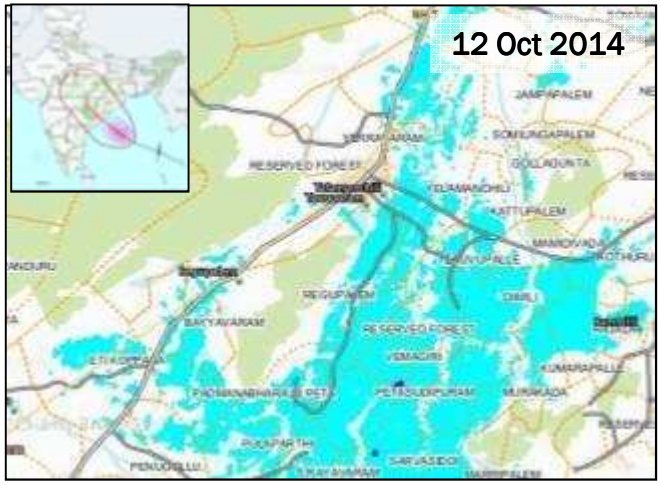
Aerial survey was carried out for detailed investigation.

Crowd sourcing was enabled to collect information from ground.

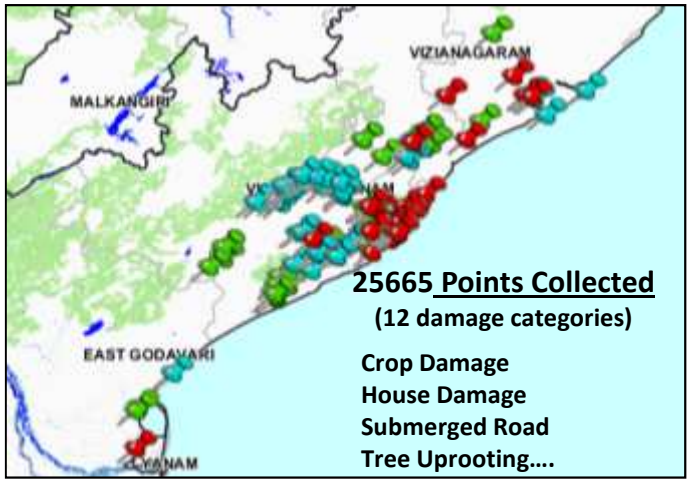
International Charter was also activated.

Inundation maps (about 22 in number) were provided in near real time to state Govt.

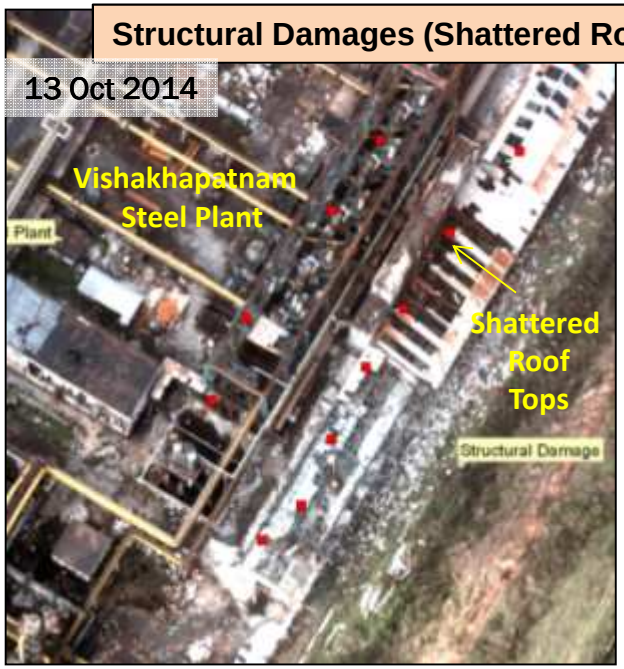
Inundation observed near Yelmanchalli

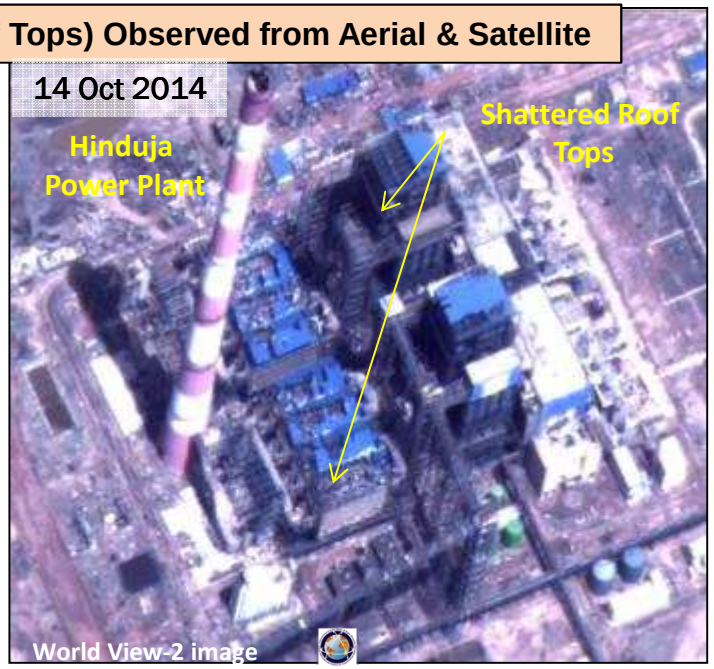


Crowd sourcing data uploaded to Bhuvan



Structural Damages (Shattered Roof Tops) Observed from Aerial & Satellite





Landslides on Transboundary Rivers

Sun Koshi River in Nepal

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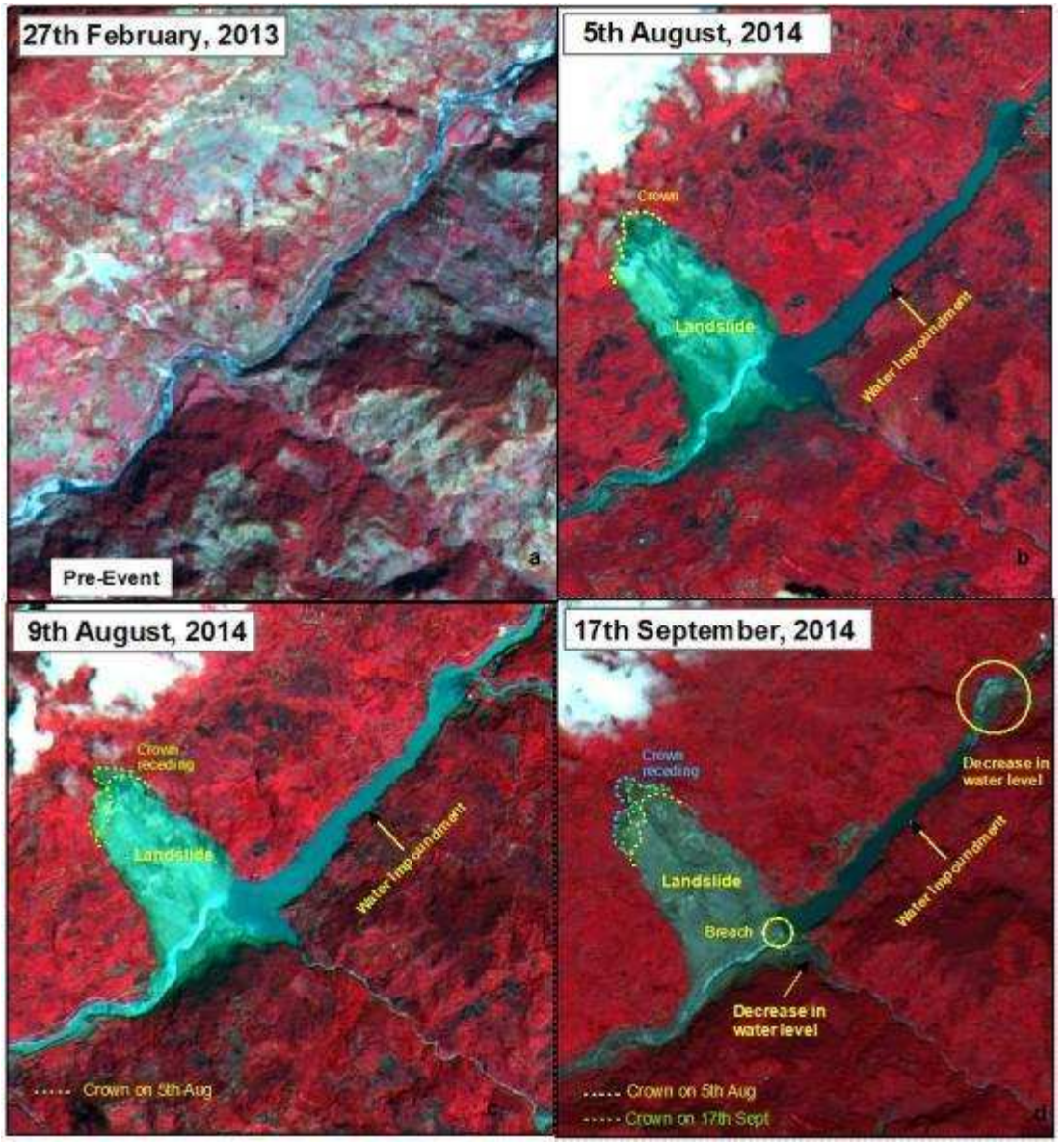
A landslide occurred on Sun Koshi river in Nepal on 2-Aug-14

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

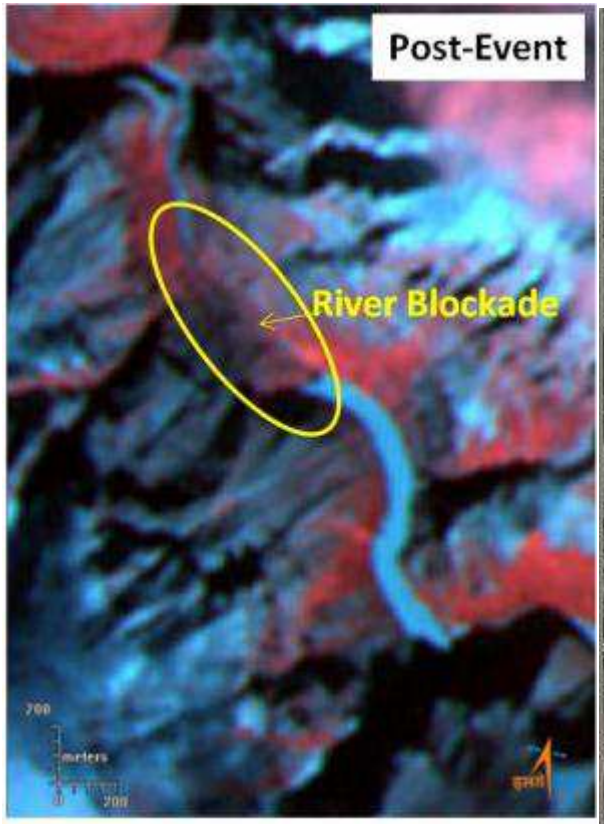


River Blockade in J&K

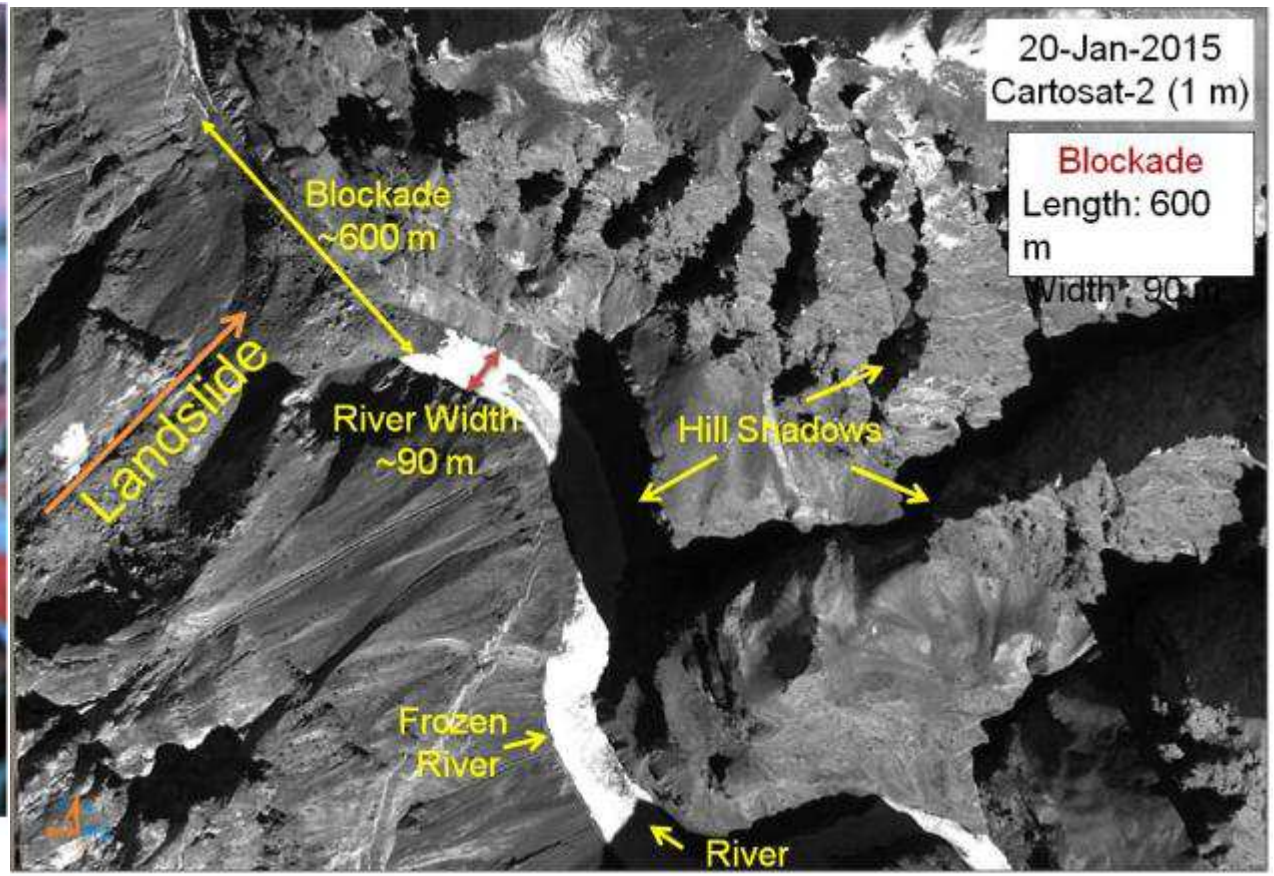
Phuktal River in Zanshkar Region

River Phuktal was blocked due to landslide in Zanshkar Region, J&K, India during Jan, 2015

Using Multi-date Satellite data, ISRO provided necessary information on the landslide to the Government



15-Jan-2014 ResourceSat-2 L3



River Blockade in J&K

Phuktal River in Zanshkar Region – After Breach

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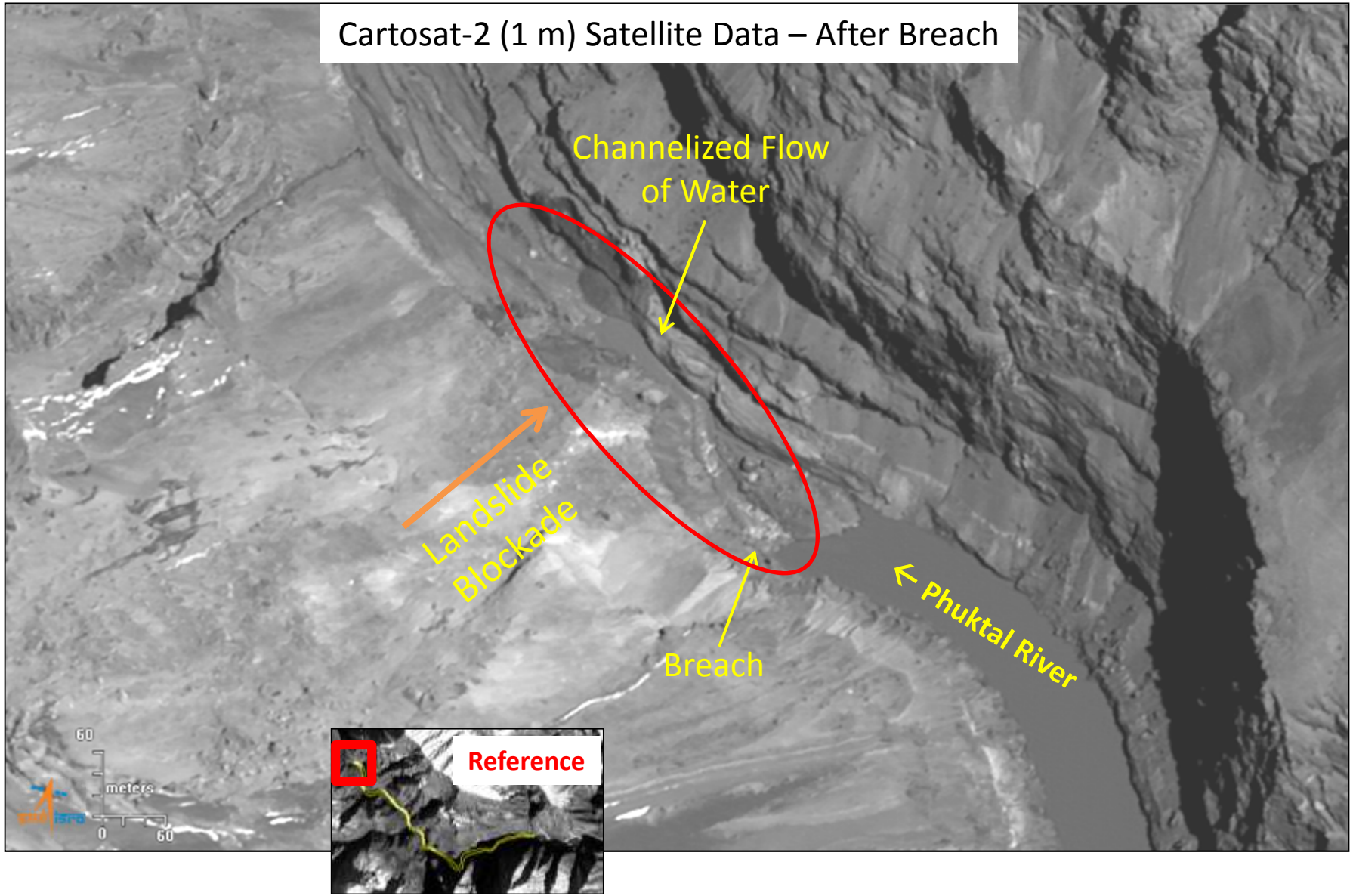
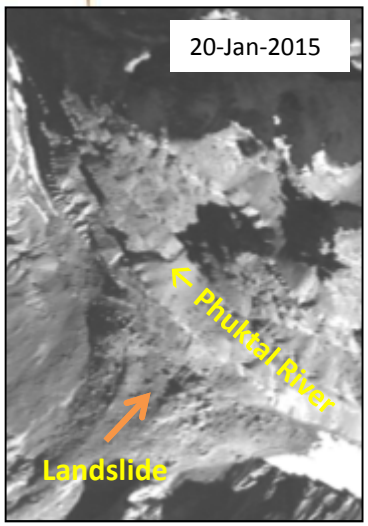
This image shows the Channelised flow over the blockade, after the breach

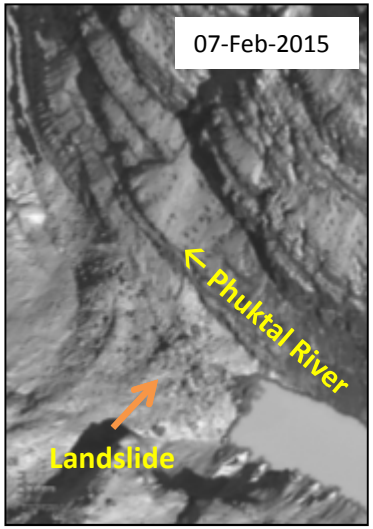


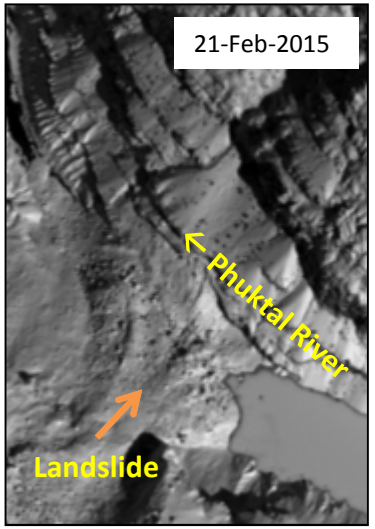
Task No: JK/LS/2015/01

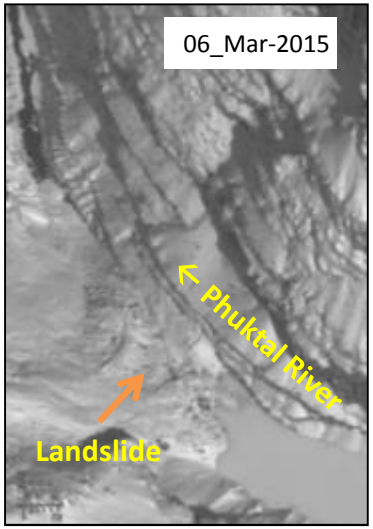
Plate No: Apr/45

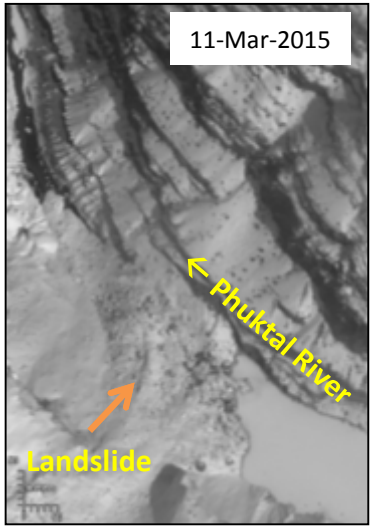
Phuktal River Blockade, J&K

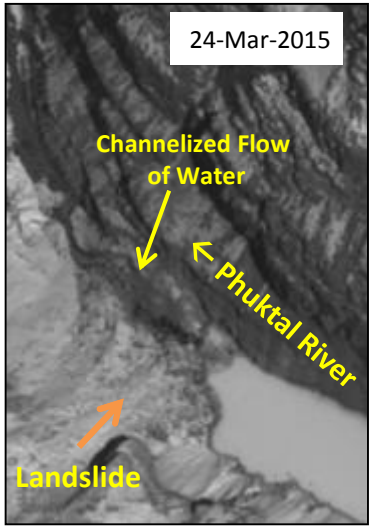


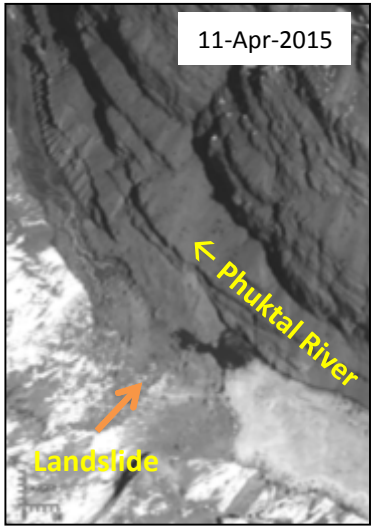


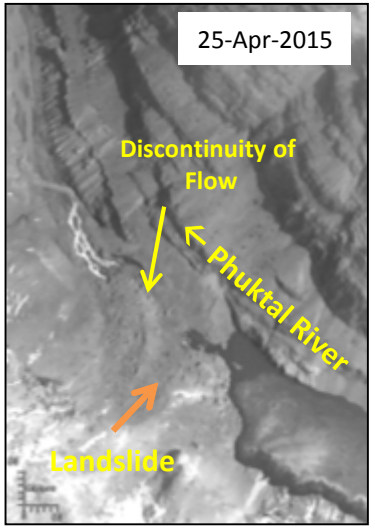


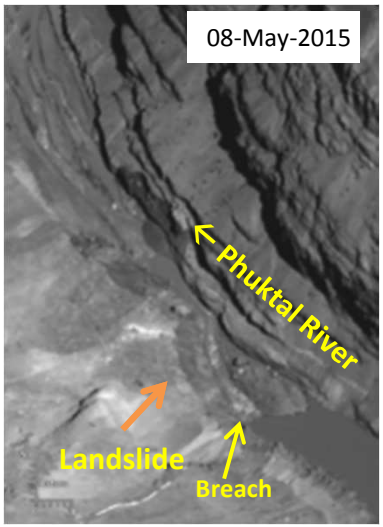












- Cartosat-2 data showing the changes at blockade area from Jan 20, 2015 to May 08, 2015

Scale

0 metres 100

Nepal Earthquake – April, 2015

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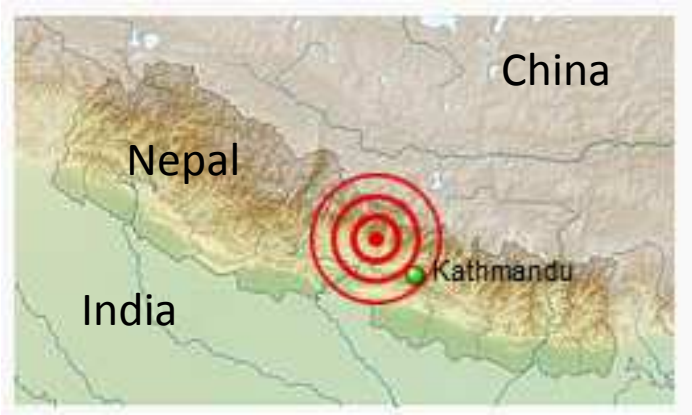


- Date: 25-Apr-2015, 11:48 IST
- Magnitude – 7.9, Depth – 15 km
- Epicenter – Lamjung, Nepal
- Effect: Nepal, India, China, Bangladesh (~10,000 deaths)

International Charter Activities

- 3 Activations for Nepal Earthquake – ISRO, CNSA & UNOSAT
- CNSA to analyse Chinese Area
- ISRO to analyse Indian & Nepal Area (merging activation of UNOSAT with ISRO)
- UNOSAT to act as Value Adder

Disaster event id: 03-EQ-2015-Others(Nepal)

Nepal Earthquake (25-Apr-2015)

Dharahara Tower, Kathmandu

Cartosat-2 (05-Jan-2015)

Cartosat-2 (27-Apr-2015)

Disaster event id: 03-EQ-2015-Others(Nepal)

Nepal Earthquake (25-Apr-2015)

Balkhu Suburb, Kathmandu

Cartosat-2 (05-Jan-2015)

Cartosat-2 (27-Apr-2015)

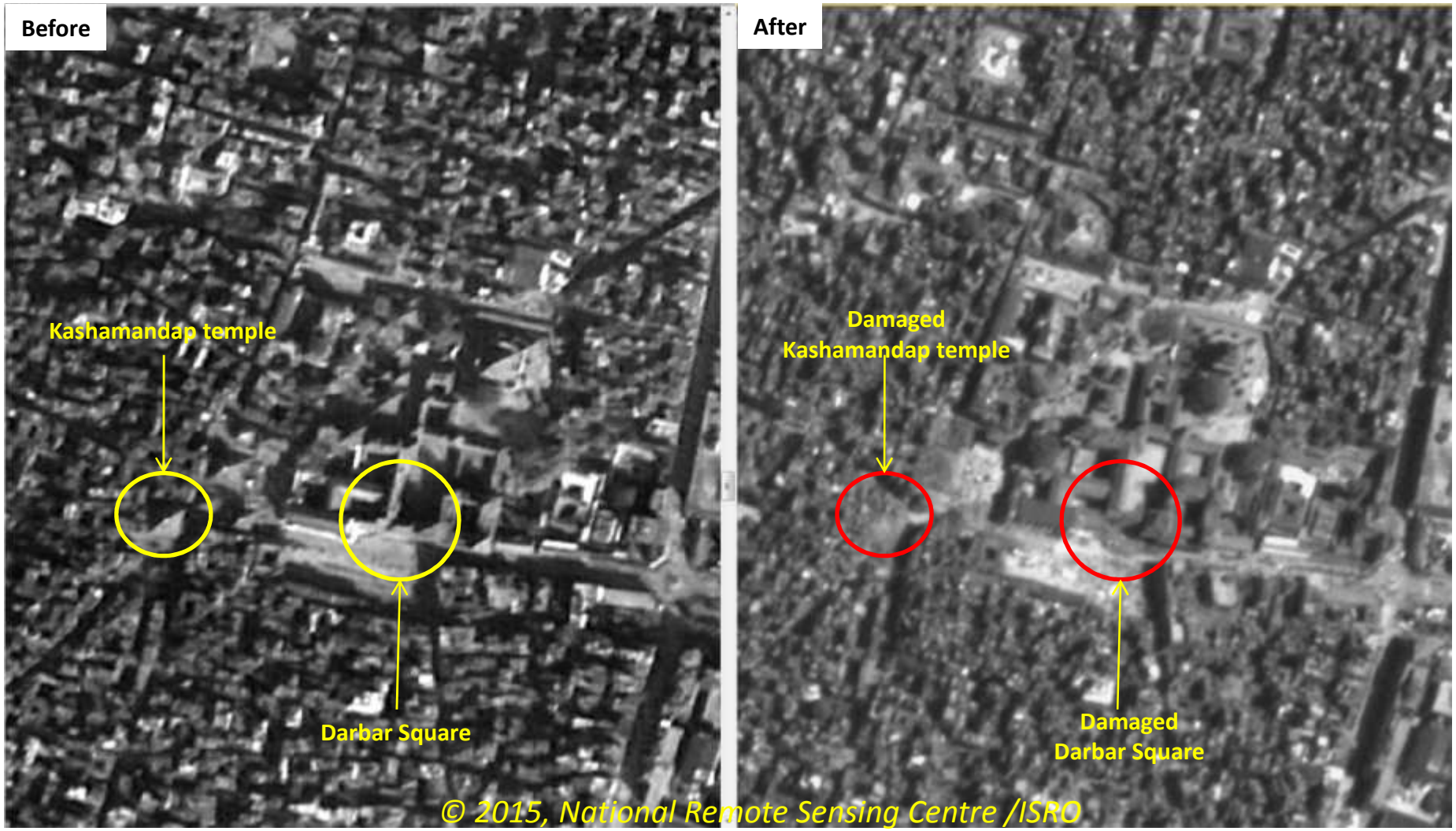
Disaster event id: 03-EQ-2015-Others(Nepal)

Nepal Earthquake (25-Apr-2015)

Darbar Square, Kathmandu

Cartosat-2 (05-Jan-2015)

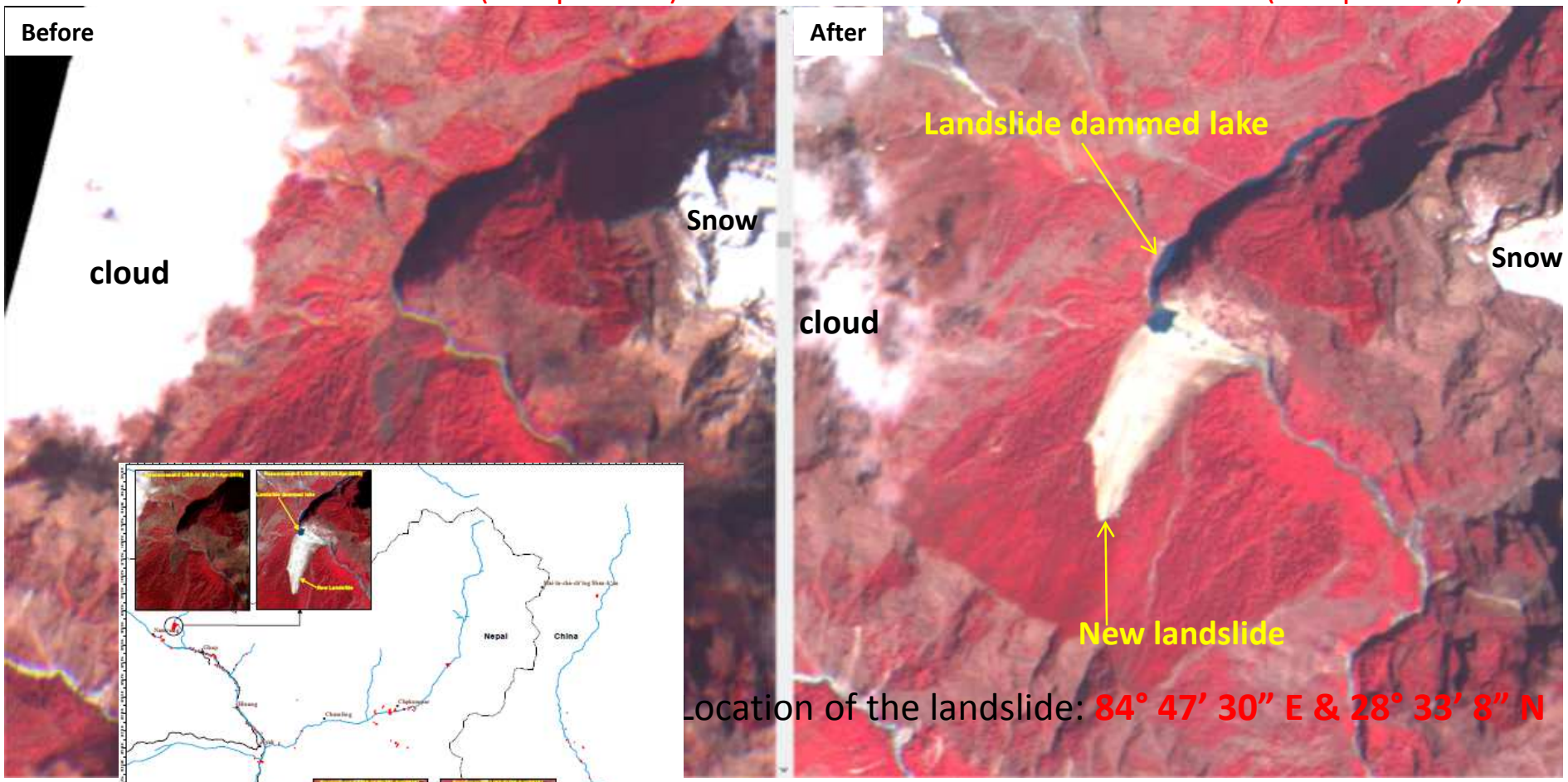
Cartosat-2 (27-Apr-2015)



Nepal Earthquake (Apr 2015) : Landslide

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

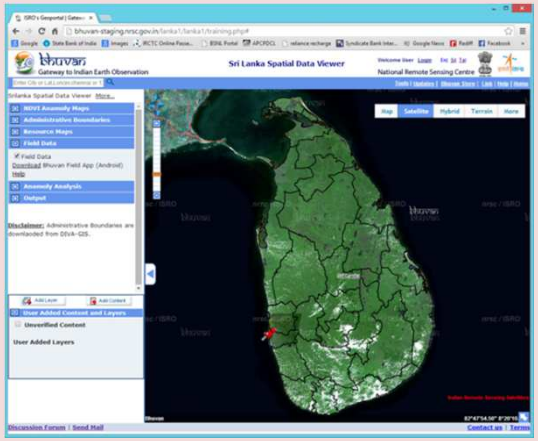
Resourcesat-2 LISS IV Mx (30-Apr-2015)



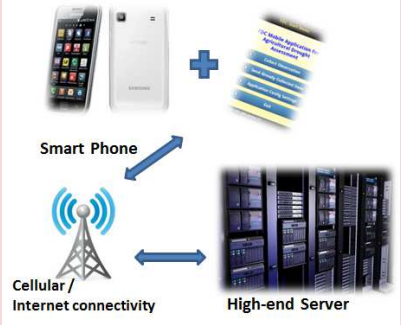
Location of the landslide: **84° 47’ 30” E & 28° 33’ 8” N**

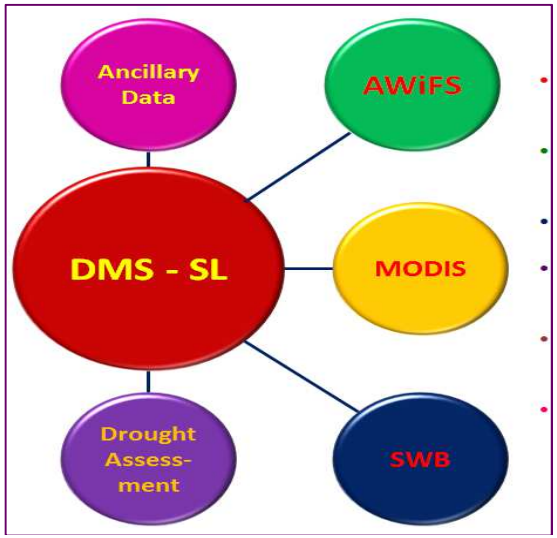
UN ESCAP-ISRO Initiative: Sri Lanka Drought

Sri Lanka Data Viewer in Bhuvan



Field Data Collection using Smart Phone for Sri Lanka





- Under Regional Cooperative Mechanism of UN-ESCAP, India offered services to provide technical support
- Drought monitoring and assessment was carried out at NRSC for Yala 2014 and Maha 2014-15 cropping seasons and forwarded to Sri Lankan
- A dedicated software called Drought Monitoring System-Sri Lanka (DMS-SL) was developed
- A mobile based Field data collection system and an exclusive Sri Lanka data viewer in Bhuvan was developed and transferred.
- Two training program was organized, one at NRSC, from 28 July to 1st August 2014 and the second at Colombo from 24-25th February, 2015.
- Plans to extend to Nepal, Myanmar and Cambodia through UNESCAP from India.
- Continuous up gradation of DMS- SL software

Thank You

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