Use of Space Technology in Post Disaster Damage and Needs Assessment - Case Study of 2015 Nepal Earthquake

26 May, 2017
SAARC Disaster Management Center
Ahmedabad, India

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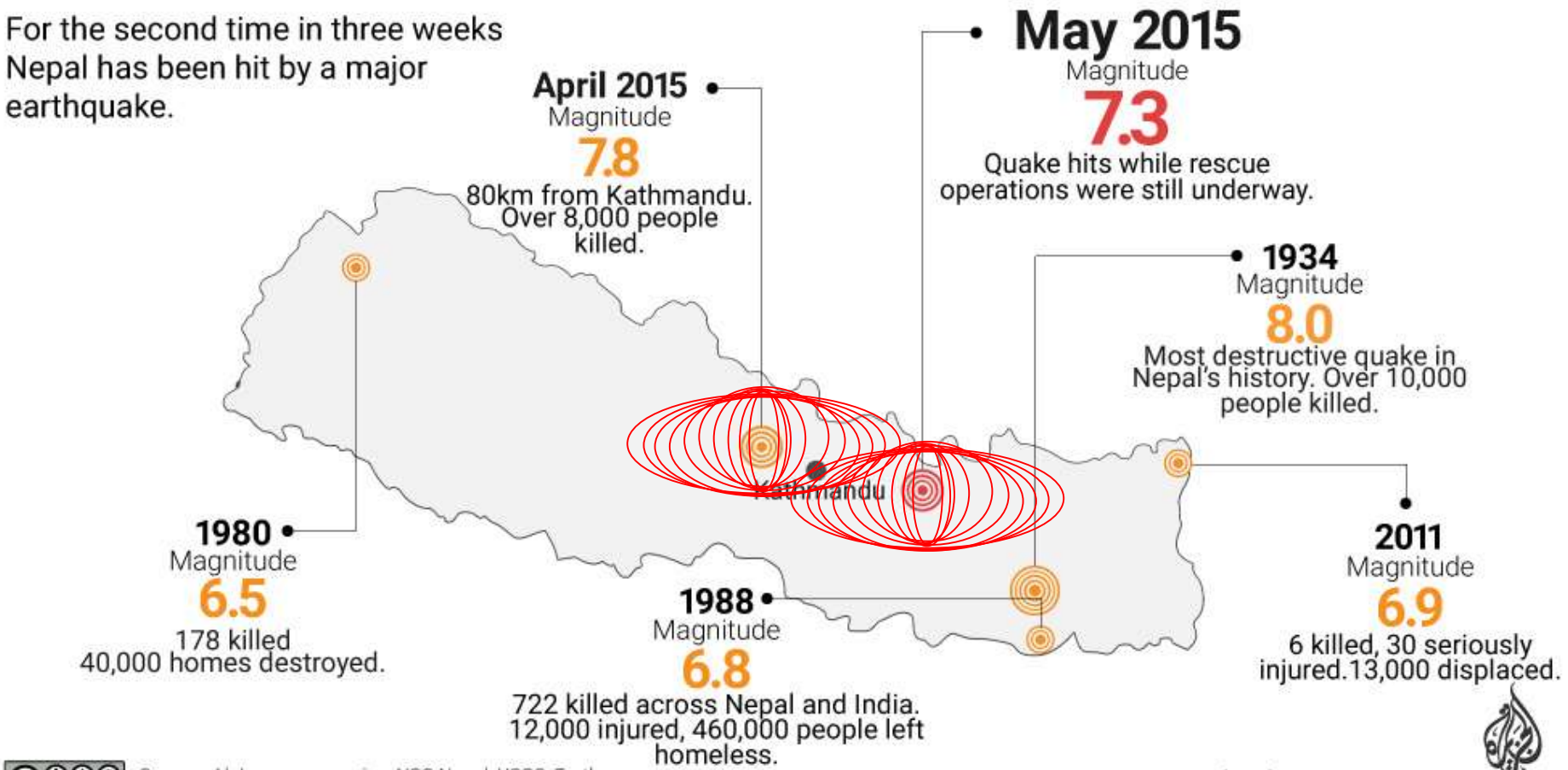
Outline of the presentation

- 2015 Nepal Earthquake
- Disaster Damage and Assessment
- Pre and Post Datasets
- Application of Space Technology
- Gaps and Challenges
- Way Forward

Nepal Major Earthquakes (1934-2015)

Timeline: Nepal earthquakes

@ajlabs

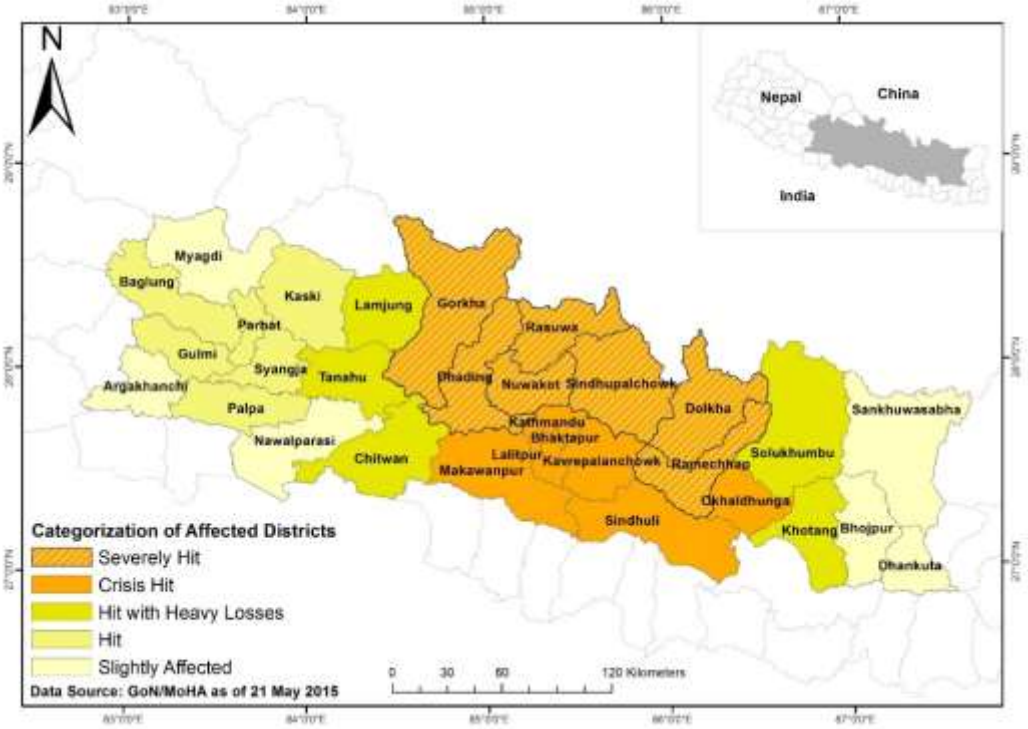


Source: Al Jazeera, agencies, NSC Nepal, USGS, Earthquaketrack, Nepal Disaster Knowledge Network

Last updated: 12 May 2015

ALJAZEERA

…Recalling 2015 Nepal Earthquake..

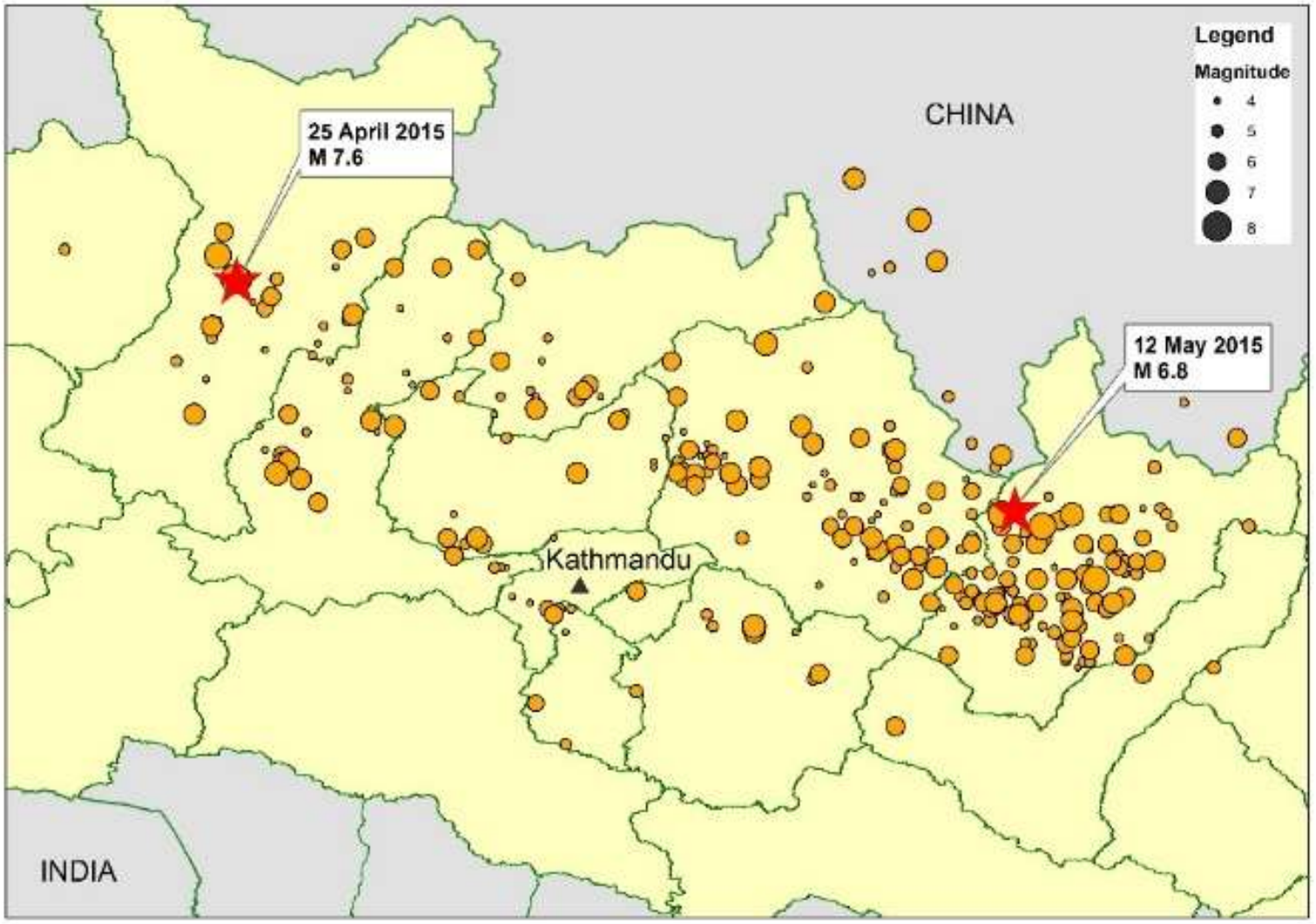


~ 8 M people affected (1/3 of the country's population)

14 out of 75 districts declared severely hit

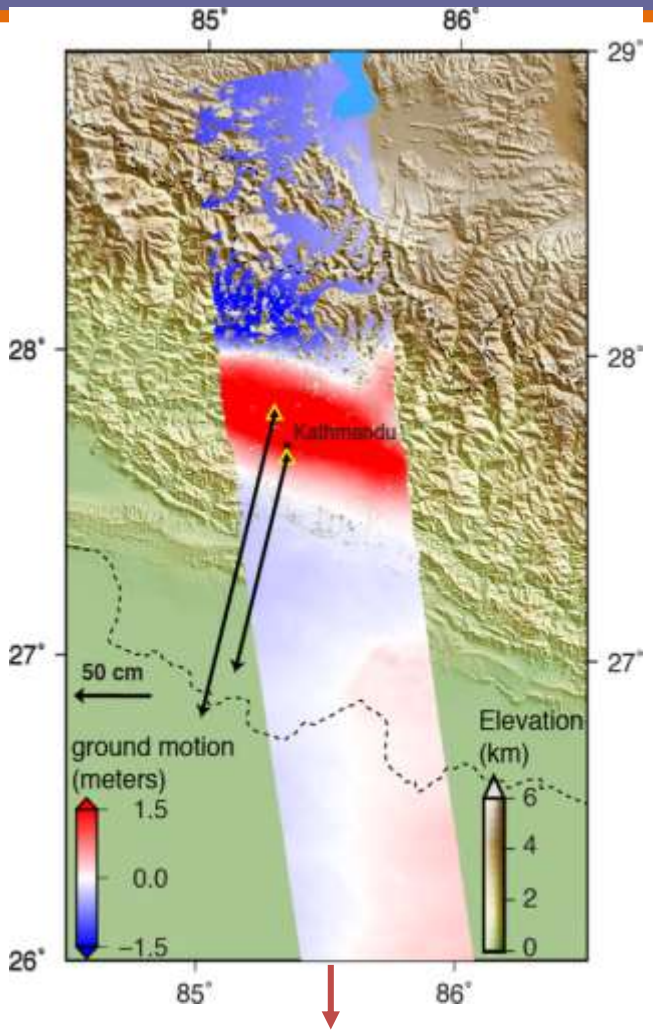
Human Loss: 9,000 death, 22,000 injured
Physical Loss: 500,000+ houses destroyed & 300,000 damaged
Financial Loss: Estimated USD 7.0 Billion (PDNA 2015)

Spatial Distribution of Aftershocks



Over 400 aftershocks (> 4 M) observed including 4 aftershocks (> 6 M, 7.3 M)

Impact of Earthquake

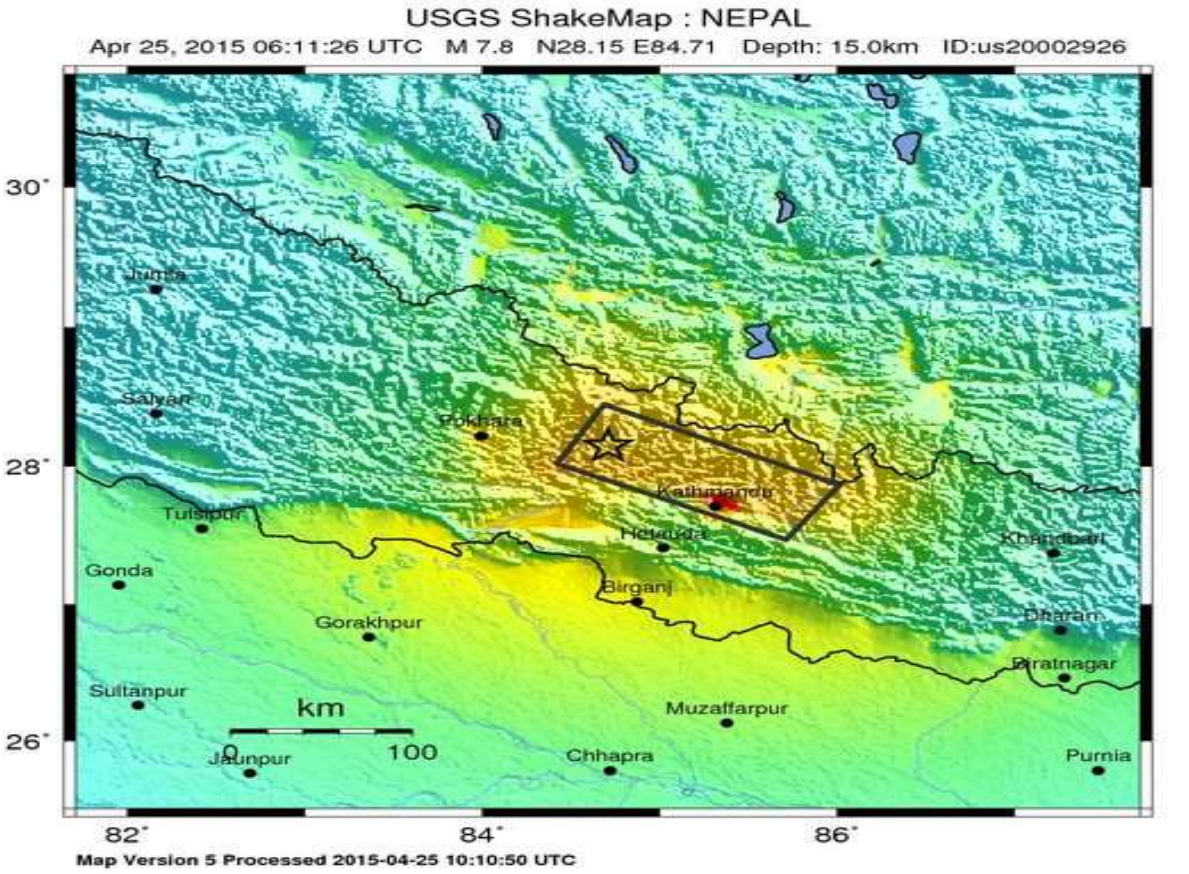


Shows Fault Rupture, Surface Movements (**Source:** NASA)

- The Kathmandu Valley shifted by 1.8 m southwestwards and raised up nearly a meter in ellipsoidal elevation (Survey Department)
- Upto 3 meter surface movement (Other Studies)

Source: USGC

ShakeMap



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

Source: USGC

Damages


Health Post


Private housing


School


Heritage


Singhadurbar


livelihood


Faultline-Gorkha


Ground Rupture


Fault rupture

Cultural Heritage (Kasthamandap)

Collapsed while blood donation camp was going on

The Guardian Photograph: Xinhua/Landov/Barcroft

Monuments (Sundhara)

Government Buildings

Urban Houses and Settlement

Assessments (PDNA to PDRF)

PDNA (June 2015)

Reconstruction Act Formation of NRA (Dec 2015)

Reconstruction and Rehabilitation Policy (Feb 2016)

PDRF (May 2016)

Rapid Damage, Loss and Need Assessment
to
Prioritized Recovery and Reconstruction Planning

Data Needs (PDNA)

PRODUCTIVE

- Agriculture
- Commerce
- Industry
- Tourism

SOCIAL

- Housing
- Education
- Health
- Culture

INFRASTRUCTURE

- Water & Sanitation
- Community infrastructure
- Energy
- Transport
- Telecommunications

CROSS-CUTTING

GENDER | GOVERNANCE | ENVIRONMENT | DISASTER RISK REDUCTION | EMPLOYMENT AND LIVELIHOODS

(Source: PDNA)

Information Needs (PDRF)

Social Sector

- Housing (rural)
- Housing (urban)
- Health
- Nutrition
- Education
- Cultural heritage
- Government buildings

Productive Sector

- Transport
- Water and sanitation
- Electricity and Renewable Energy

Infrastructure Sector

- Agriculture, livestock and irrigation
- Environment and forestry
- Tourism
- Commerce and Industry
- Financial Sector
- Communications

Cross Cutting Sector

- Gender and social inclusion
- Social protection
- Disaster risk management
- Employment and livelihoods
- Governance

Technology

Earth Observation Satellite

CrowdSourcing

Social Media

Incident Reporting Mobile Apps

Communication Satellite

Crowd Sourcing

Field Survey / Assessment

Unmanned Aerial Vehicle

Ground Observation Network

SMART Phones, Open Source, Facebook, NASA, ESRI, Google Earth, ERDAS, GPS, Research Prototypes, Others emerging tools and technology

Post Disaster Datasets

Satellite Data

- Airbus Pléiades
- Airbus SPOT 6/7
- Blackbridge RapidEye
- DigitalGlobe WV2
- DigitalGlobe WV3
- ESA Sentinel 2
- NASA MODIS
- NASA/USGS LandSat 1-3
- NASA/USGS LandSat 4-5
- NASA/USGS LandSat 7-8

OSM Data

Field Assessment Datasets

QUAKEMAP.ORG

Google

2011 Census

ekantipur.com

República

The Himalayan

Satellite Imagery

https://www.disasterscharter.org/web/guest/-/landslide-in-nep-2?redirect=https://www.disasterscharter.org/web/guest/home?p_p_id%3D101_INSTANCE_F1SeOJT57fTb%26p_p_lifecycle%3D0%26p_p_state%3Dnormal%26p_p_mode%3Dview%26p_p_col_id%3Dcolumn-1%26p_p_col_pos%3D2%26p_p_col_count%3D4

http://www.eorc.jaxa.jp/ALOS-2/en/img_up/dis_pal2_npl-eq_20150428.htm

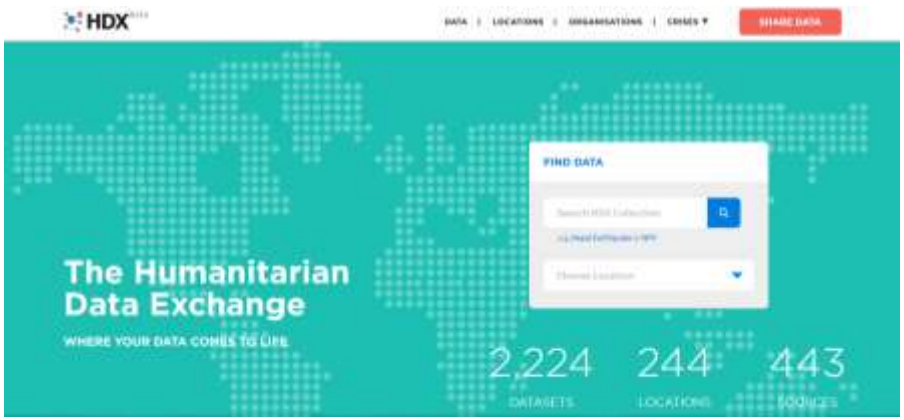
http://emergency.copernicus.eu/mapping/list-of-components/EMSR125

http://www.zki.dlr.de/article/2748

ISRO (Bhuwan)

Data Sharing Platform

HDX (Humanitarian Data Exchange) Portal
https://data.hdx.rwlabs.org/

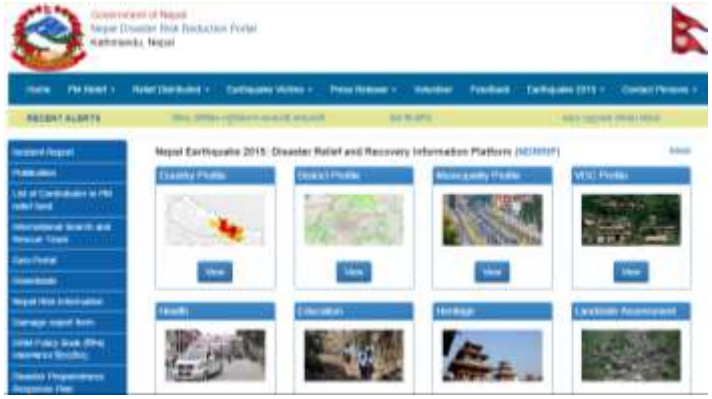


OpenStreet Map

UN Nepal Information Platform

Government Data Portal

Nepal Disaster Risk Reduction Portal
http://drr.moha.gov.np



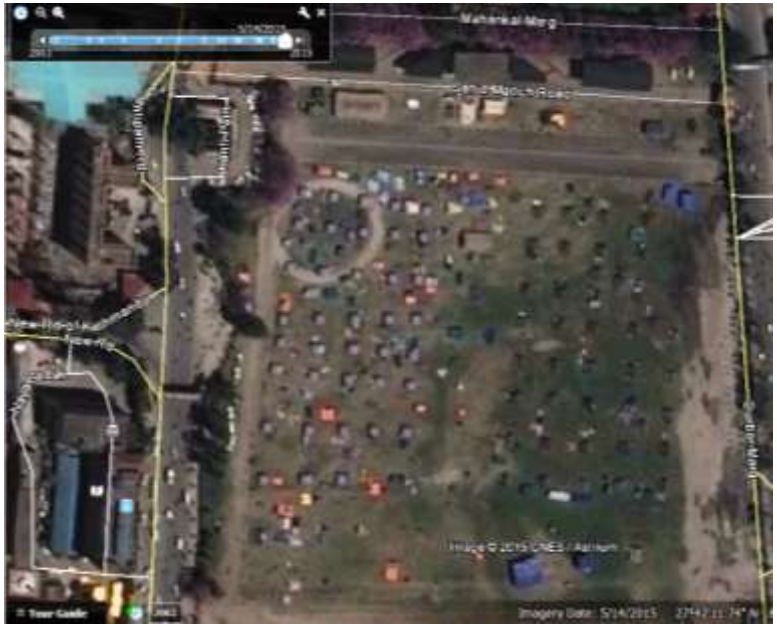
Census Beaurau of Statistics (CBS)
http://cbs.gov.np

National Geographic Information Infrastructure Project
http://www.ngiip.gov.np/

Critical Uses of Data

- Search and Rescue Operations
- Situational Analysis and Mapping
- Needs Assessment Mapping
- Post Disaster Needs Assessment (PDNA)
- Causalities and Damage
- Recovery and Reconstruction

Damage Assessment (pre and post)

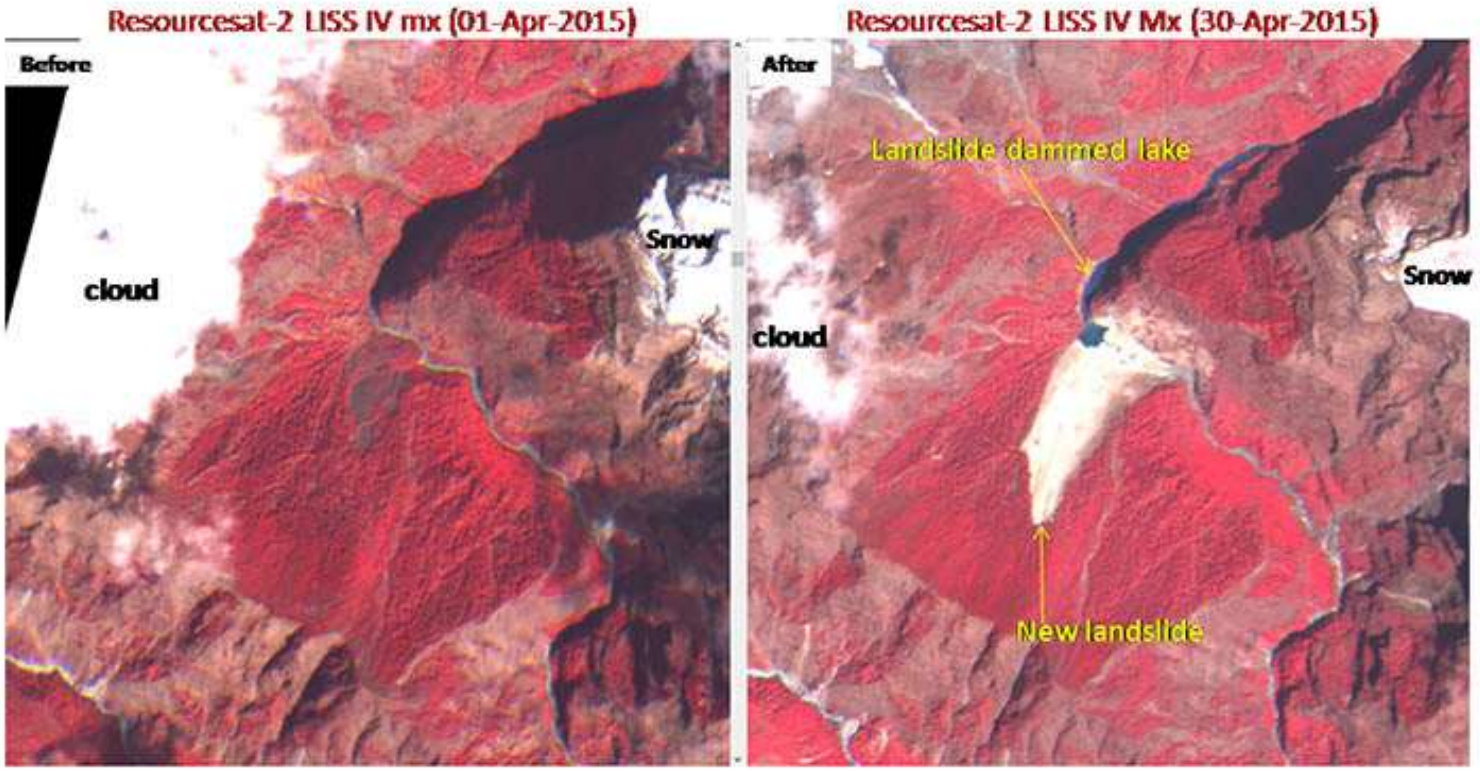


Geo Hazard Assessment (pre and post)

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

Nepal Earthquake (25-Apr-2015)

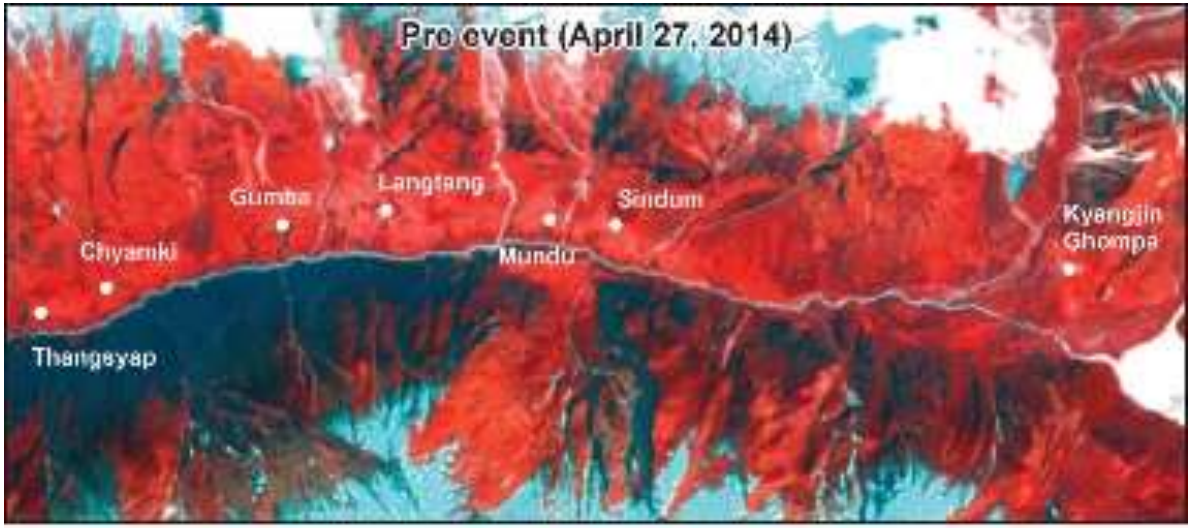
New Major landslide

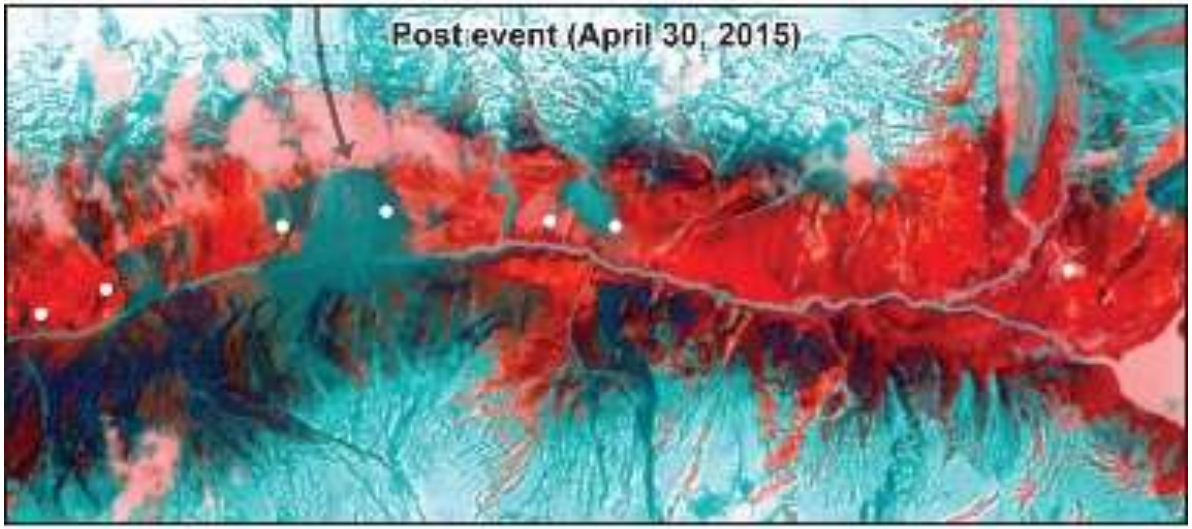


Observation: A new major landslide has blocked the valley resulting in development of a lake. Several other small new landslide are also seen.

Location of the landslide: 84° 47' 30" E & 28° 33' 8" N

Geo Hazard Assessment (pre and post)





Nepal: Natural Hazard Risks

OCHA Regional Office for Asia Pacific

NEPAL: Natural Hazard Risks

Issued: 01 March 2011

OCHA Regional Office for Asia-Pacific

Seismic, Volcanic and Tropical Storm Risk

CHINA

INDIA

BHUTAN

BANGLADESH

MID WESTERN

WESTERN

CENTRAL

Kathmandu

Thimphu

Legends

- OCHA office or presence
- Country capital
- Major town or city
- International boundary
- Province boundary

Earthquake Intensity

Modified Mercalli Scale

- Degree I-V
- Degree VI
- Degree VII
- Degree VIII
- Degree IX-XII

Tropical Storm Intensity

Saffir-Simpson Scale

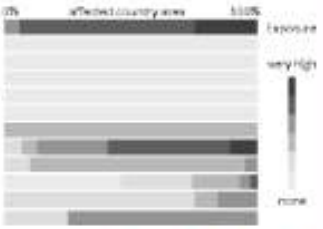
- One: 118-153 kmh
- Two: 154-177 kmh
- Three: 178-209 kmh
- Four: 210-249 kmh
- Five: 250+ kmh

Earthquake intensity zones indicate where there is a 20% probability that degrees of intensity shown on the map will be exceeded in 50 years.

Tropical storm intensity zones indicate where there is a 10% probability of a storm of this intensity striking in the next 10 years.

All Natural Hazard Risks

The bar chart shows the degree of exposure to natural hazards and the percentage of area affected (per country). The flood hazard results from river floods and torrential rain. The hazard of dryness and drought is caused by major deviations from the normal amounts of precipitation. The frost hazard depends on the elevation and the latitude.



(c) 2009, Munich Reinsurance Company, Munich Re Geo Risks Research Department

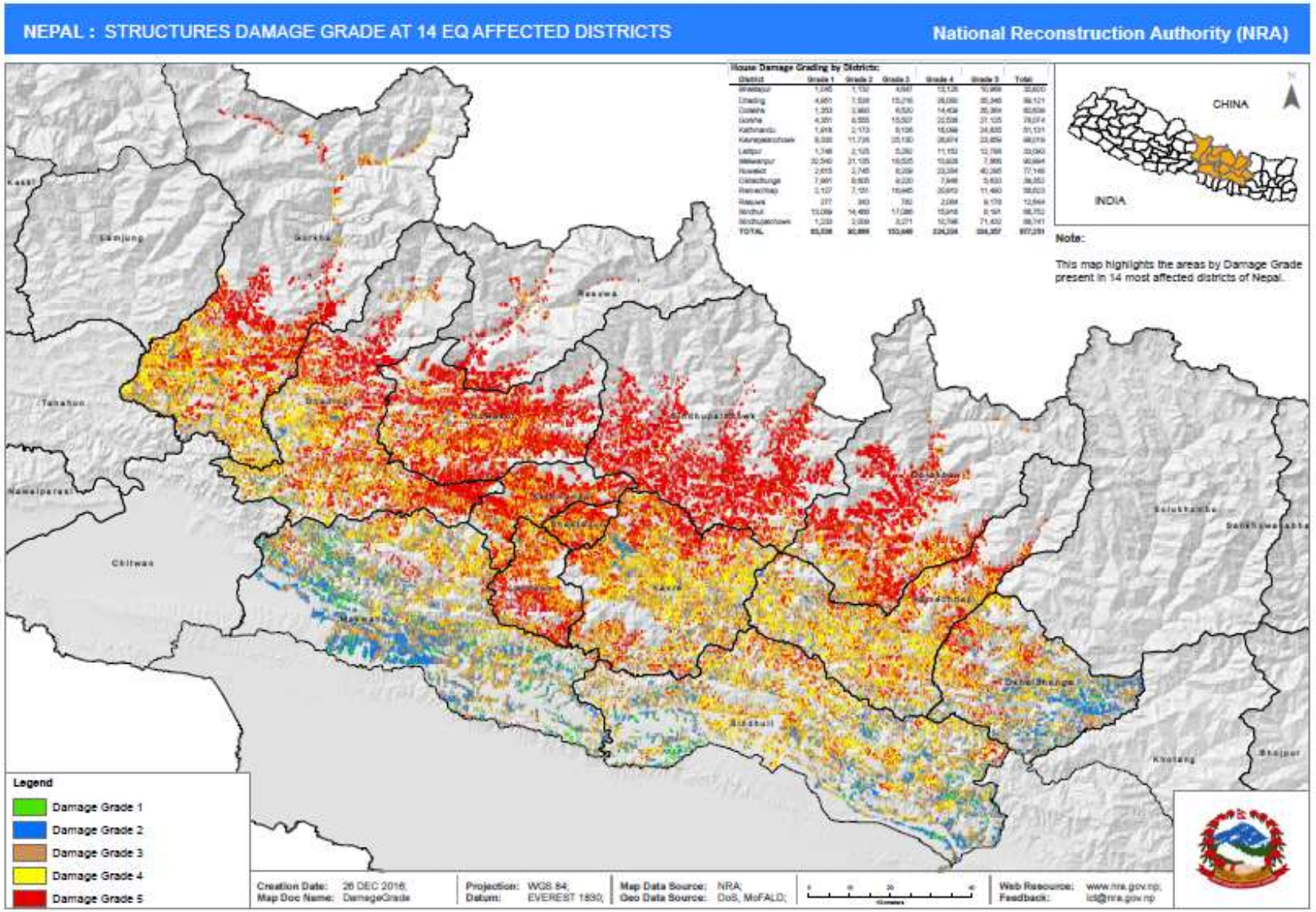
Datum: WGS84. Map data source: UN Cartographic Section, Global Discovery, FAO, Smithsonian Institute, Pacific Disaster Center, UNISYS, Munich Reinsurance Group

Map Doc Name: OCHA_NPL_Hazard_v3_110888
Creation Date: 22 March 2011
Projection/Datum: Lat/Lon WGS84
Web Resources: http://ochaonline.un.org/roap

0 50 100
Kilometers

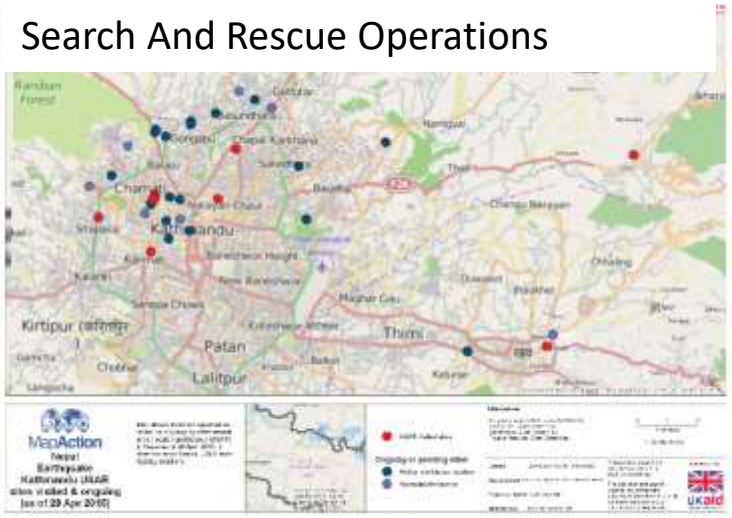
UN Office for the Coordination of Humanitarian Affairs (OCHA)
Regional Office for Asia Pacific (ROAP)
Executive Suite, 2nd Floor, UNCC Building
Rajdamnern Nok Ave, Bangkok 10200, Thailand
http://ochaonline.un.org/roap

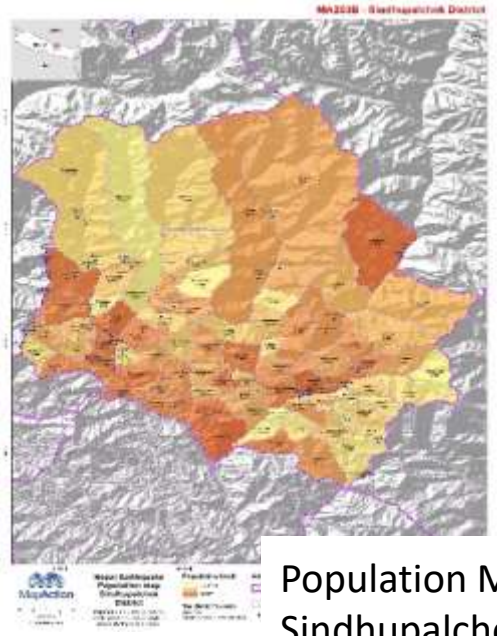
Structure Damage Grade



Humanitarian Actors, SAR, IDP

Search And Rescue Operations





Population Map of Sindhupalchowk District

Media Coverage

The Telegraph

Home Video News World Sport Finance Comment Culture Travel Life Women

USA Asia China Europe Middle East Australasia Africa South America Central Asia

Afghanistan Pakistan India North Korea South Korea Japan Kazakhstan

HOME » NEWS » WORLD NEWS » ASIA » NEPAL

Nepal earthquake: first aerial view of flattened Gurkha heartland

Quake from space

Ayesha Shakya

NEPALI Times

High-resolution satellite imagery can help the country assess hazards from landslides and save lives

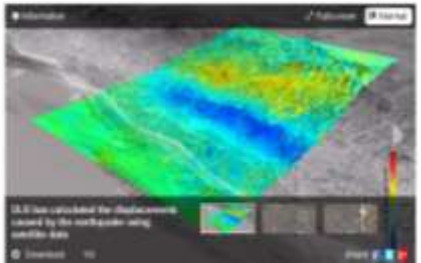
European Commission

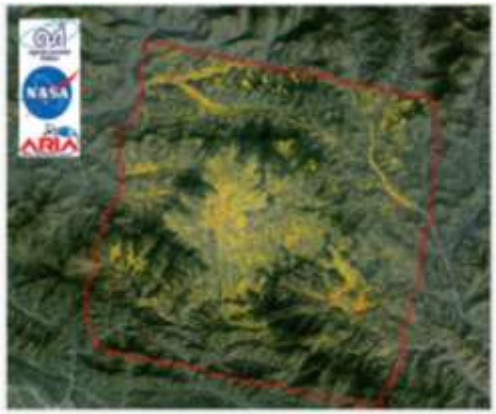
NASA Damage Maps Critical to Nepal Earthquake Response

industry tap *into news*

DLR

Update: Disaster relief – DLR provides aerial images of Kathmandu

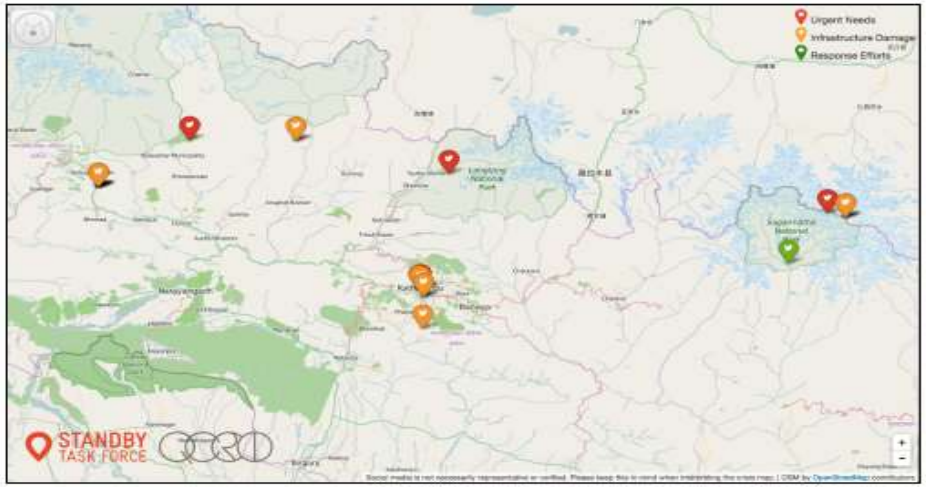




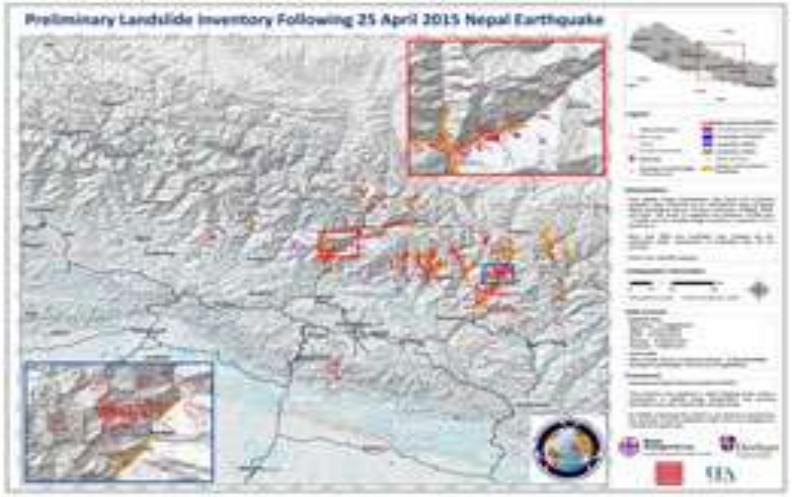
Nepal earthquake: JRC supports EU's response operations

Multiple Initiatives

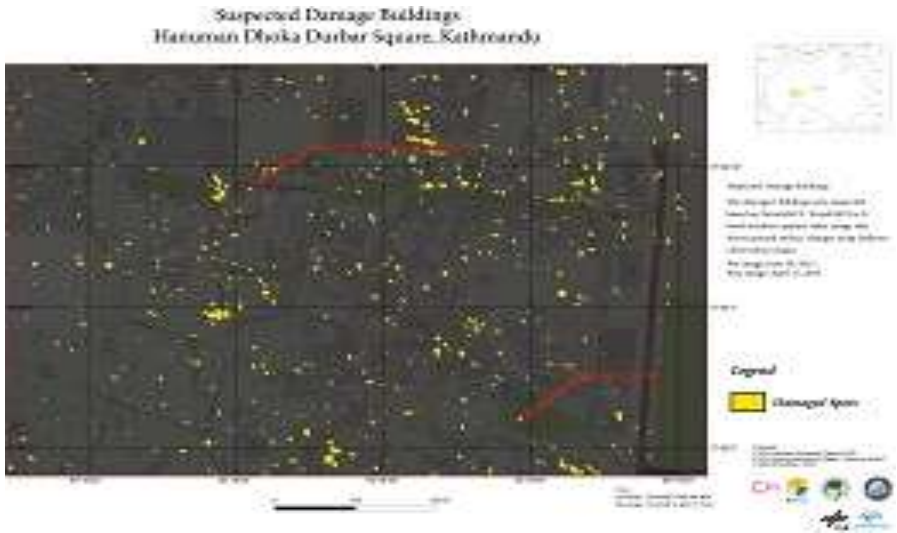
Live Crisis Map of Urgent Needs, Damage and Response Efforts posted on Twitter:



Preliminary Landslide inventory mapping after the EQ
(**Source:** British Geological Survey)



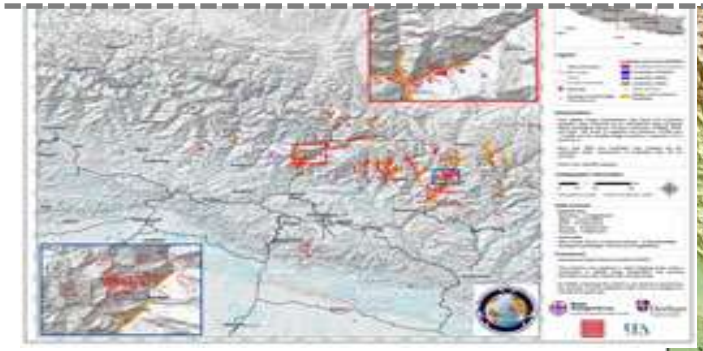
Shows suspected damage to buildings in Hanuman Dhoka Square, Kathmandu **(Source:** TerraSAR-X)

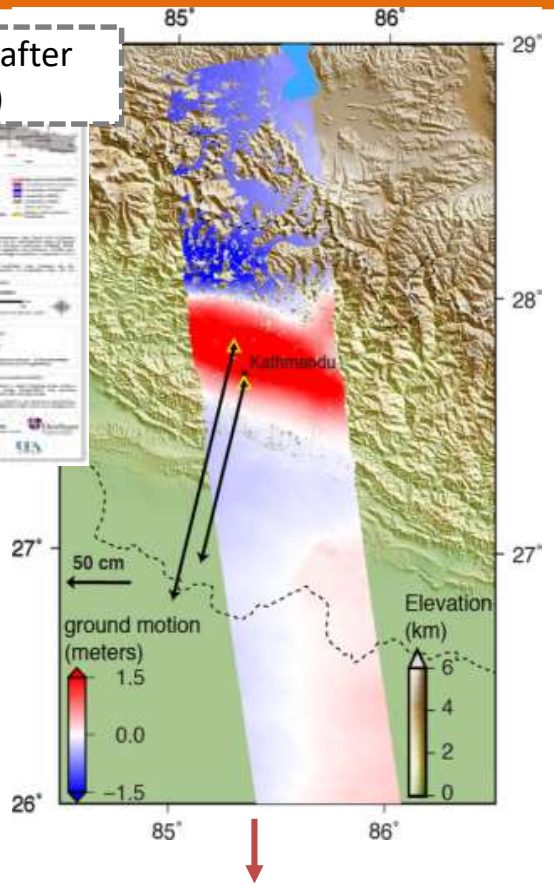


Multiple Initiatives:

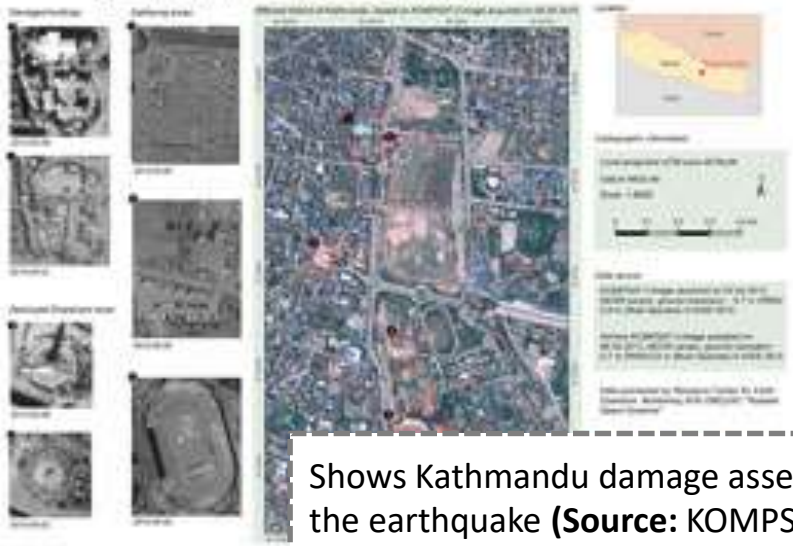
Shows before and after earthquake images of Chaku, Sindhupalchowk, (**Source:** Landsat 8 OLI / WorldView)

Preliminary Landslide inventory mapping after the EQ (**Source:** British Geological Survey)



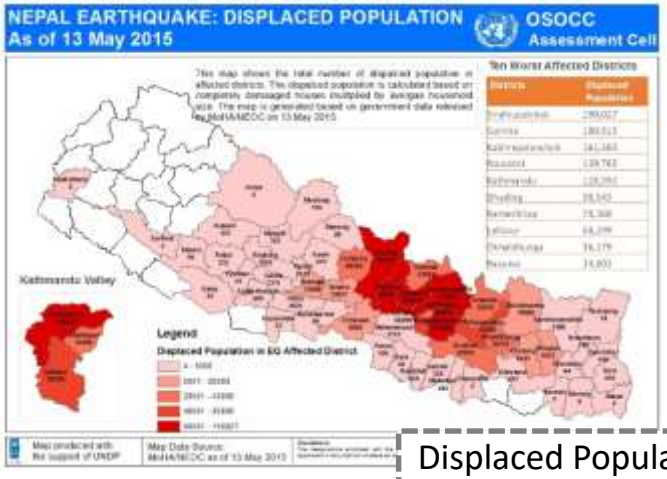


Shows Fault Rupture, Surface Movements (**Source:** NASA)

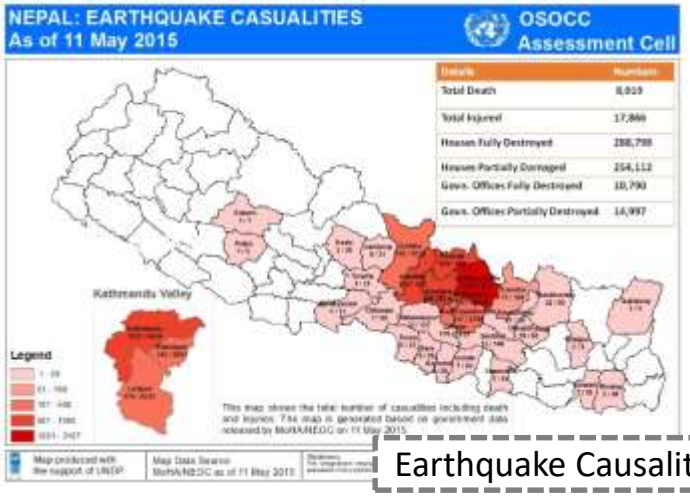


Shows Kathmandu damage assessment after the earthquake **(Source:** KOMPSAT-3 – AEISS)

Causalities and Damage Mapping

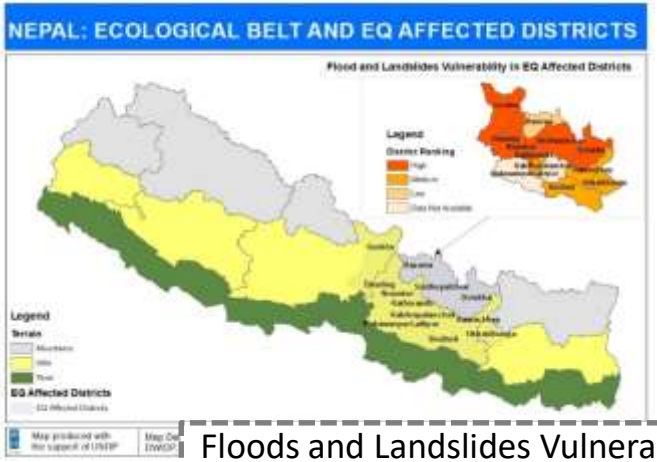


Displaced Population



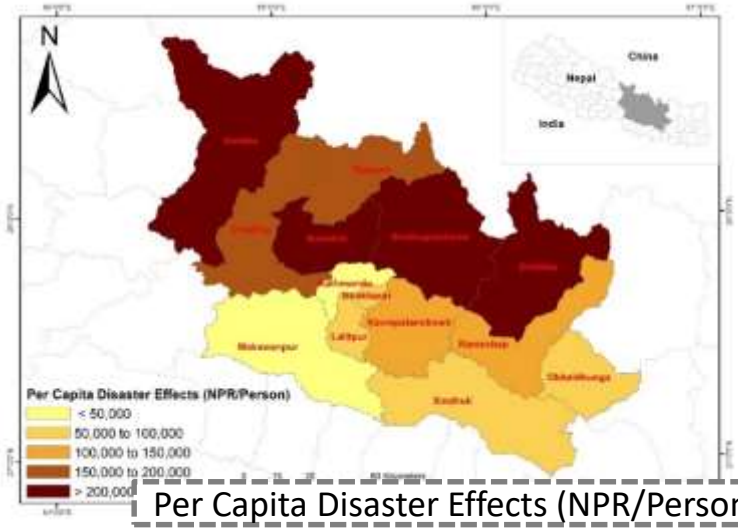
Earthquake Causalities

Destroyed Community Infrastructure

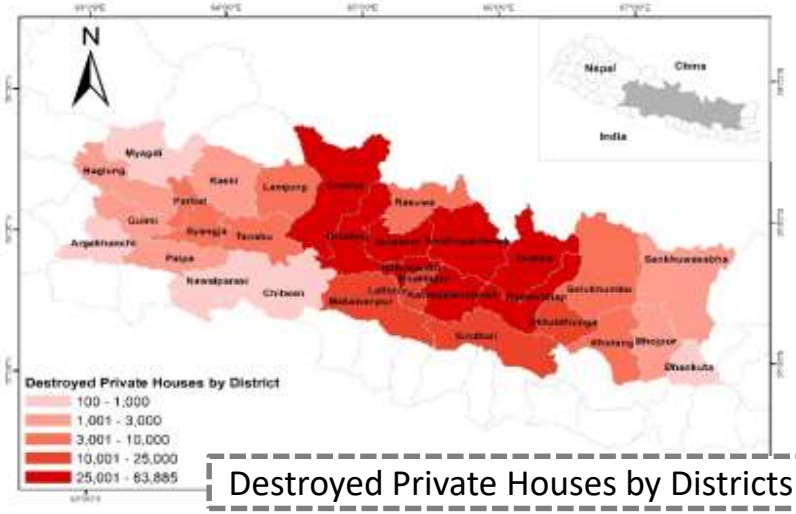


Floods and Landslides Vulnerability

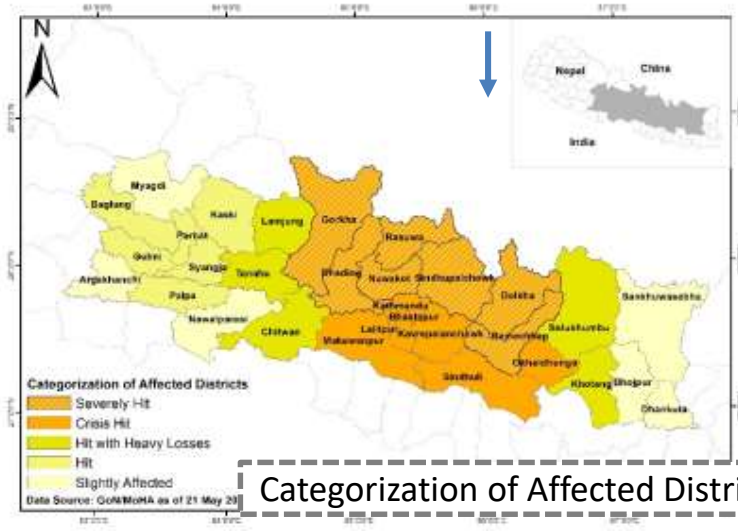
Post Disaster Needs Assessment (PDNA)



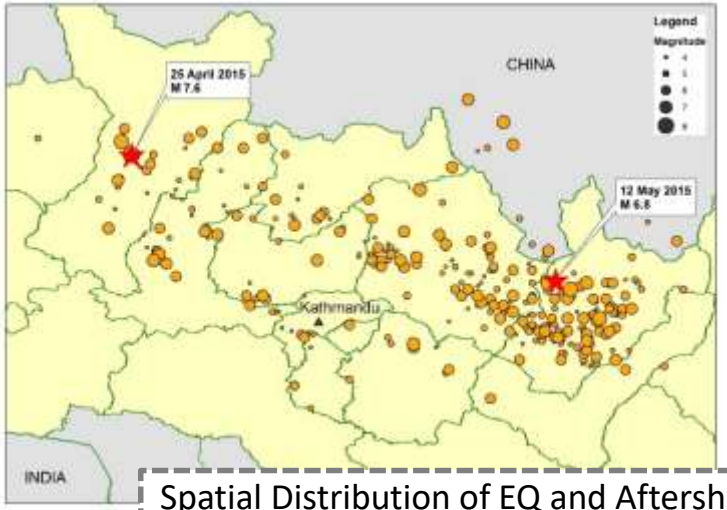
Per Capita Disaster Effects (NPR/Person)



Destroyed Private Houses by Districts

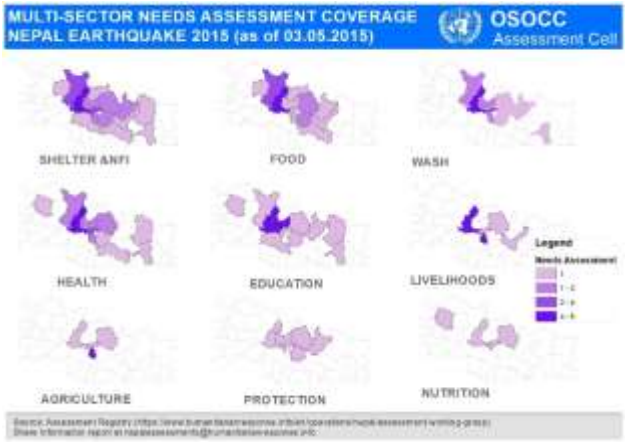


Categorization of Affected Districts

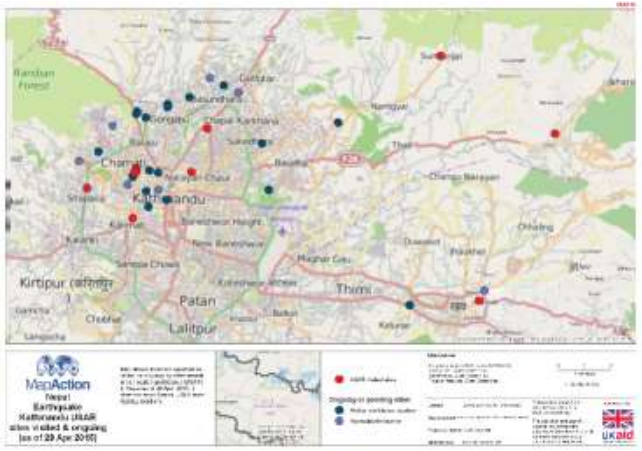


Spatial Distribution of EQ and Aftershocks

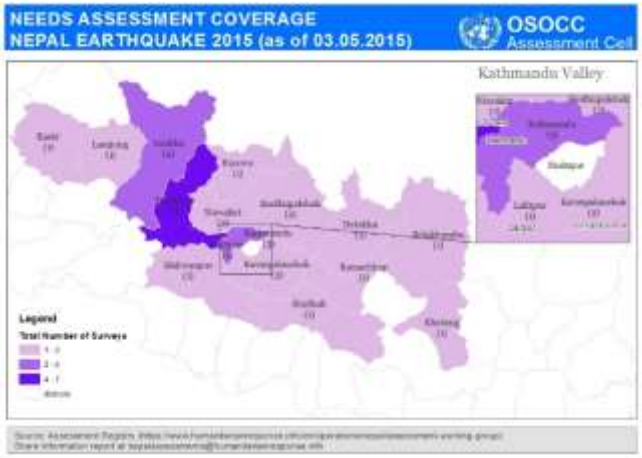
Needs Assessment



Multi-Sector Needs Assessment



Search And Rescue Operations

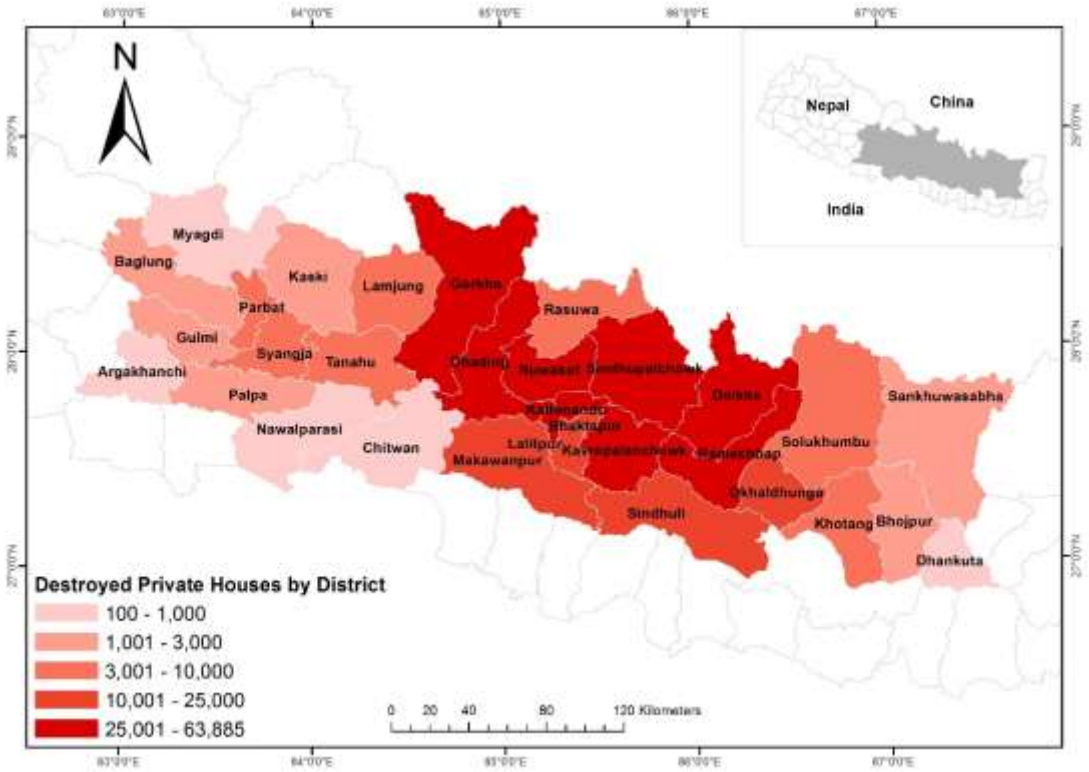


Needs Assessment Coverage

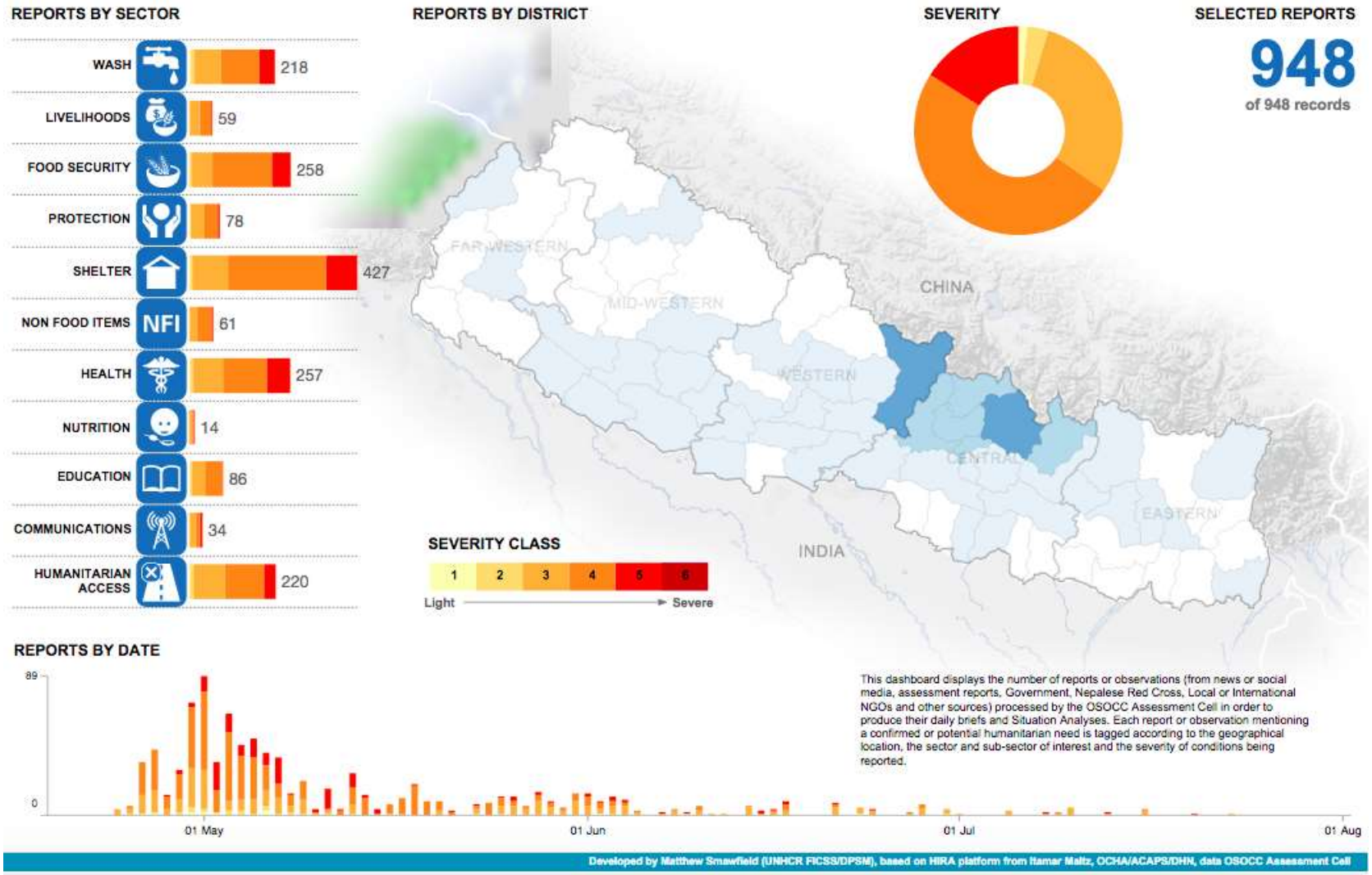
Population Map of Sindhupalchowk District

Data on destroyed houses

District	DIST_CODE	DIST_NAME	HH	Population	Dead Male	Dead Female	Dead Unknown	Dead	Injured	GovHFD	GovHPD	PriHFD	PriHPD
Sindhupalchowk	524 2 05 23	Sindhupalchok	66688	287798	1497	1943	0	3440	1573	710	37	63885	2751
Kathmandu	524 2 05 27	Kathmandu	436344	1744240	621	601	1	1223	7949	85	277	36973	50753
Nuwakot	524 2 05 28	Nuwakot	59215	277471	462	639	0	1101	1051	15	14	57943	4200
Dhading	524 2 05 30	Dhading	73851	336067	340	393	0	733	1218	93	58	43741	18720
RASUWA	524 2 05 29	Rasuwa	9778	43300	312	344	4	660	771	8	4	7040	2410
Gorkha	524 3 07 36	Gorkha	66506	271061	215	233	0	448	952	227	36	41833	4567



Humanitarian Information Review and Analysis



Gaps and Challenges

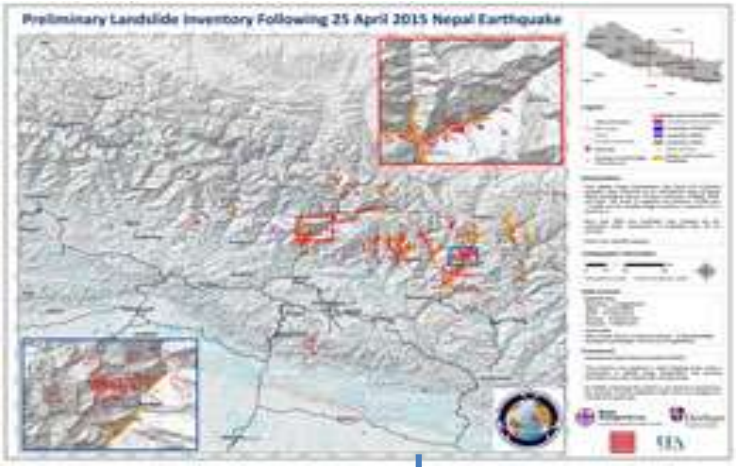
- Tested methodology or national framework for effective use of space technology in the aftermath of disaster
- Dedicated operational humanitarian data and technology platform (global, regional and national level) for harmonization, exchange and timely availability of satellite derived dataset in emergency response and recovery
- Data preparedness: lack of upto date

Gaps and Challenges

- Data preparedness: lack of upto date national spatial and non-spatial data

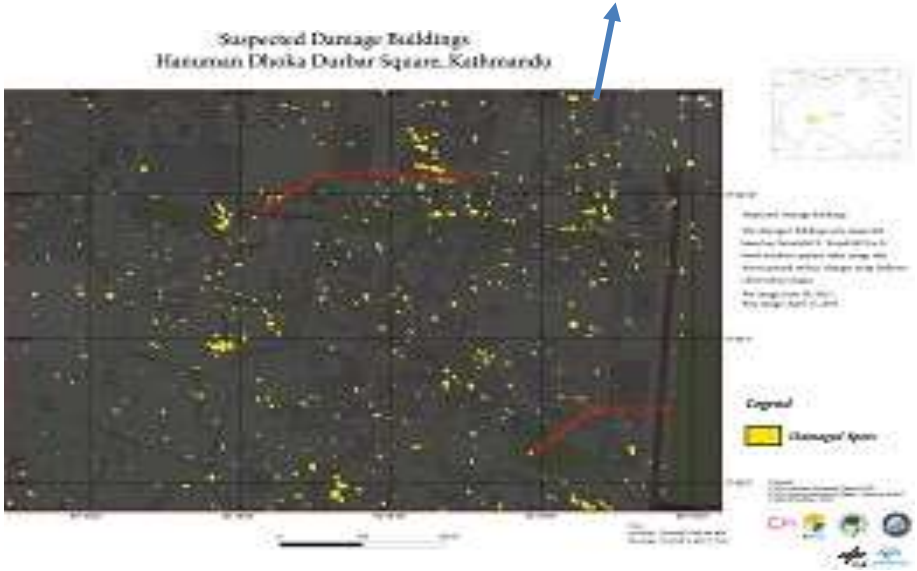
- Limited use of space technology in holistic damage and assessment process. In-spite of multiple initiatives from different sources, the use of Satellite Images in development process of both PDNA and PDRF process

Multiple Initiatives (Contd.):



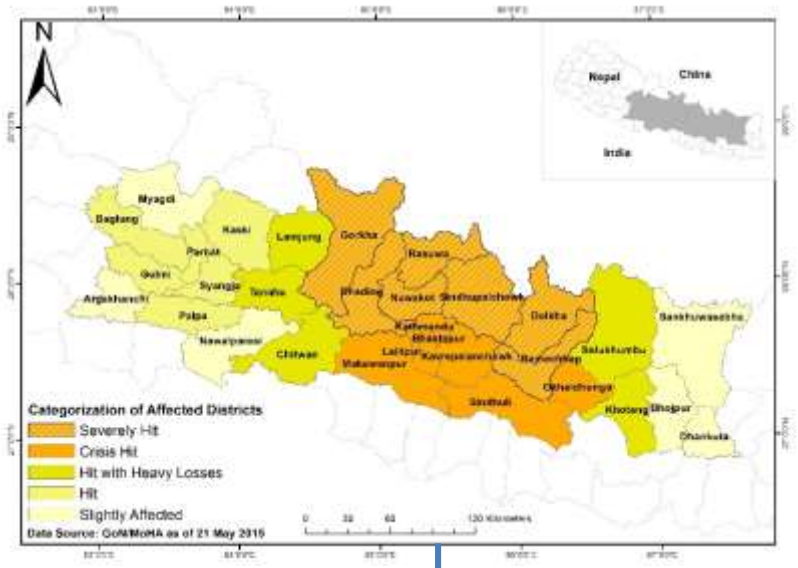
Preliminary Landslide inventory mapping after the EQ (**Source:** British Geological Survey)

Shows suspected damage to buildings in Hanuman Dhoka Square, Kathmandu **(Source:** TerraSAR-X)



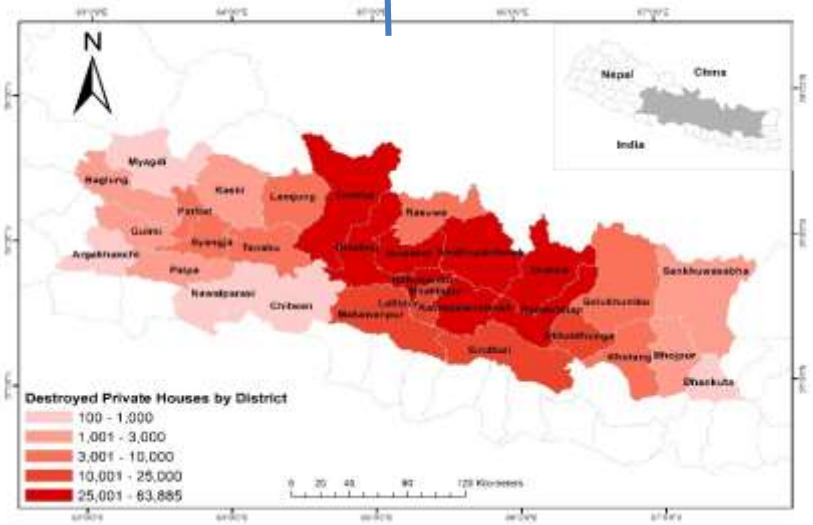
- **Random Pockets were Identified and Mapped.**
- **Lacked Coordination with Government Plans and Priorities.**
- **No Scale-up to Cover National Perspective of Earthquake Gorkha 2015.**
- **Lacked Sector-wide Satellite-based Mapping and Analysis.**

PDNA Mapping Examples:



Categorization of Affected Districts (**Source**: GoN)

Destroyed Private Houses by Districts (**Source:** GoN)

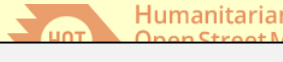


- **PDNA Process confined to limited use of GIS-based Mapping and Analysis.**
- **Attempt of use in Sectoral Analysis was also in Constrained Form.**

Data Availability and Access

National Actors

International Actors



Data Acquisition, Availability and Harmonization Issues

Japan Aerospace Exploration Agency

|Sentinel Asia

National Remote Sensing Centre

bhuvan
Gateway to Indian Earth Observation

Possible Way Forward

- Development of humanitarian data and space technology framework for emergency response and recovery phase
- Upscale use of latest data and technology in rapid assessment process (PDNA, PDRF, Needs Assement)
- Unified and Integrated Approach “In-Country Dedicated Common Platform”
- Emergency Data Preparedness: National Geodatabase
- Institutional linkages and strengthening of national actors
- Updating of National Spatial Data Infrastructure

Data Collection

Post Disaster

Primary Datasets

Spatial Analysis and Geospatial tools for field data collection

Secondary Datasets

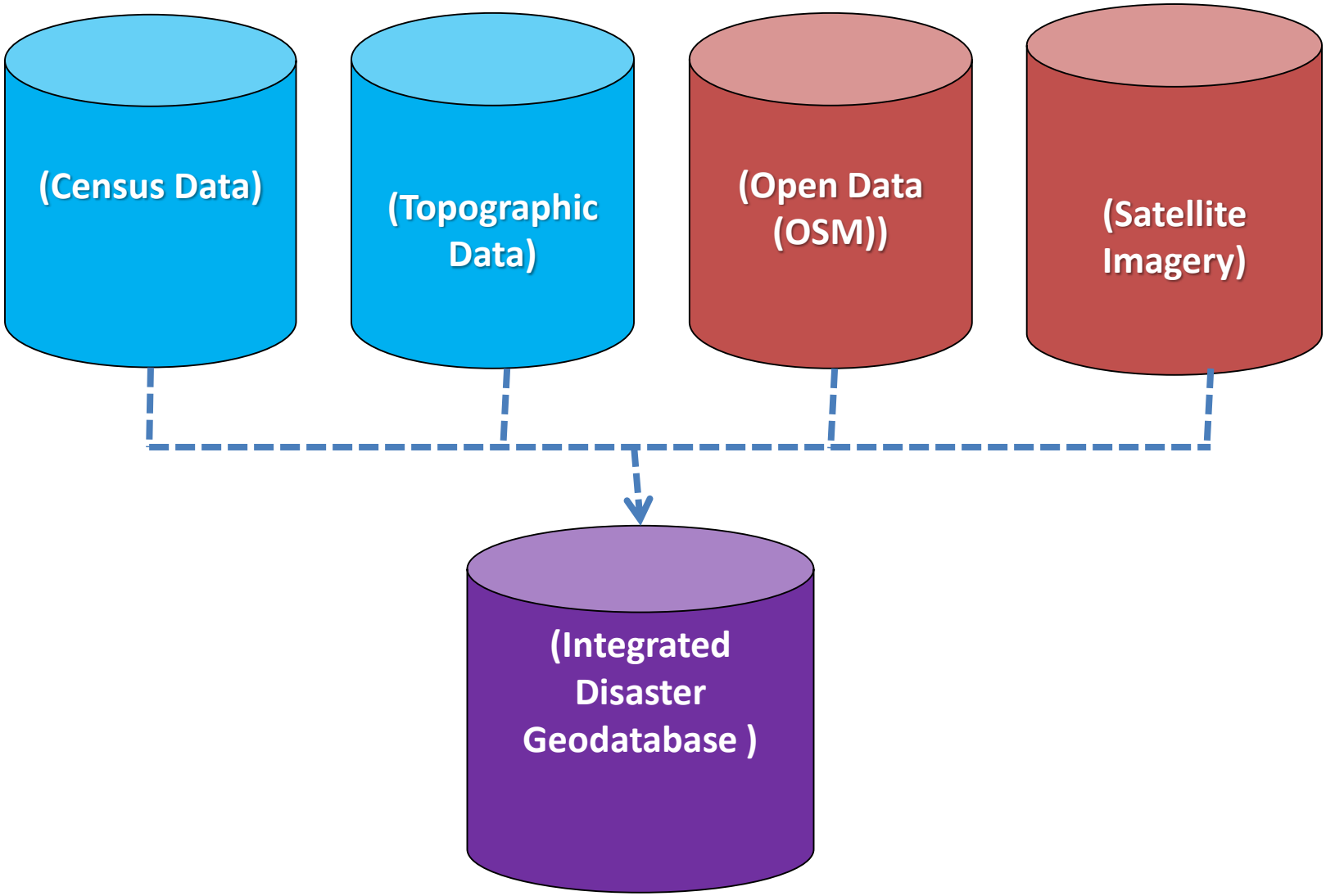
Post Disaster Satellite Data and government line agencies datasets

Pre Disaster

Baseline Datasets

Population, Demographics, Administrative Boundaries etc

Integrated Geodatabase



Thank You !