



Committee on Earth Observation Satellites

Landslide Disaster Working Group Pilot: Status Report

March 8th, 2016

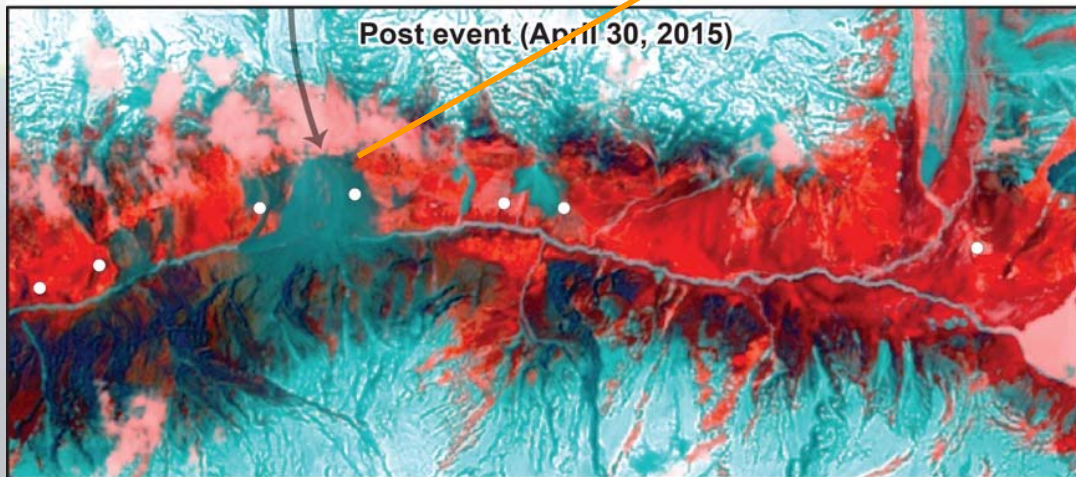
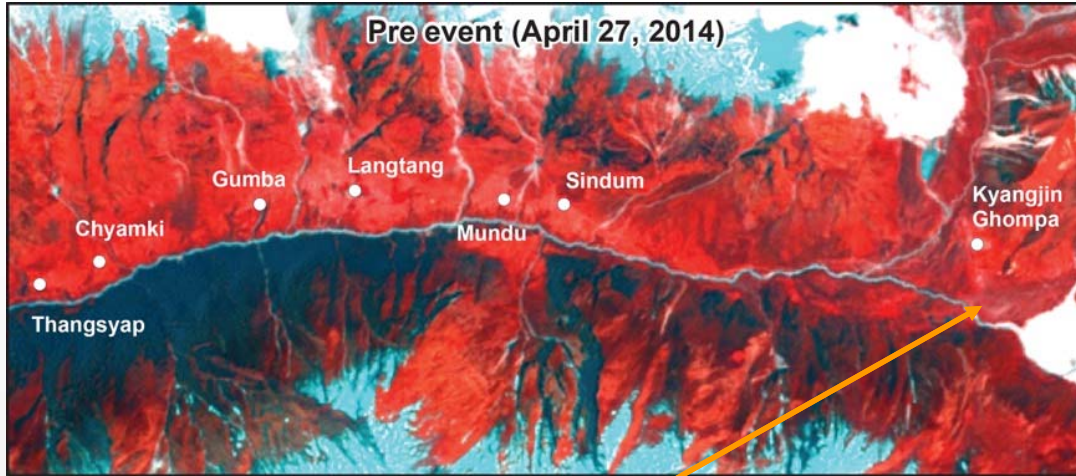




Motivation



Langtang Valley, Nepal



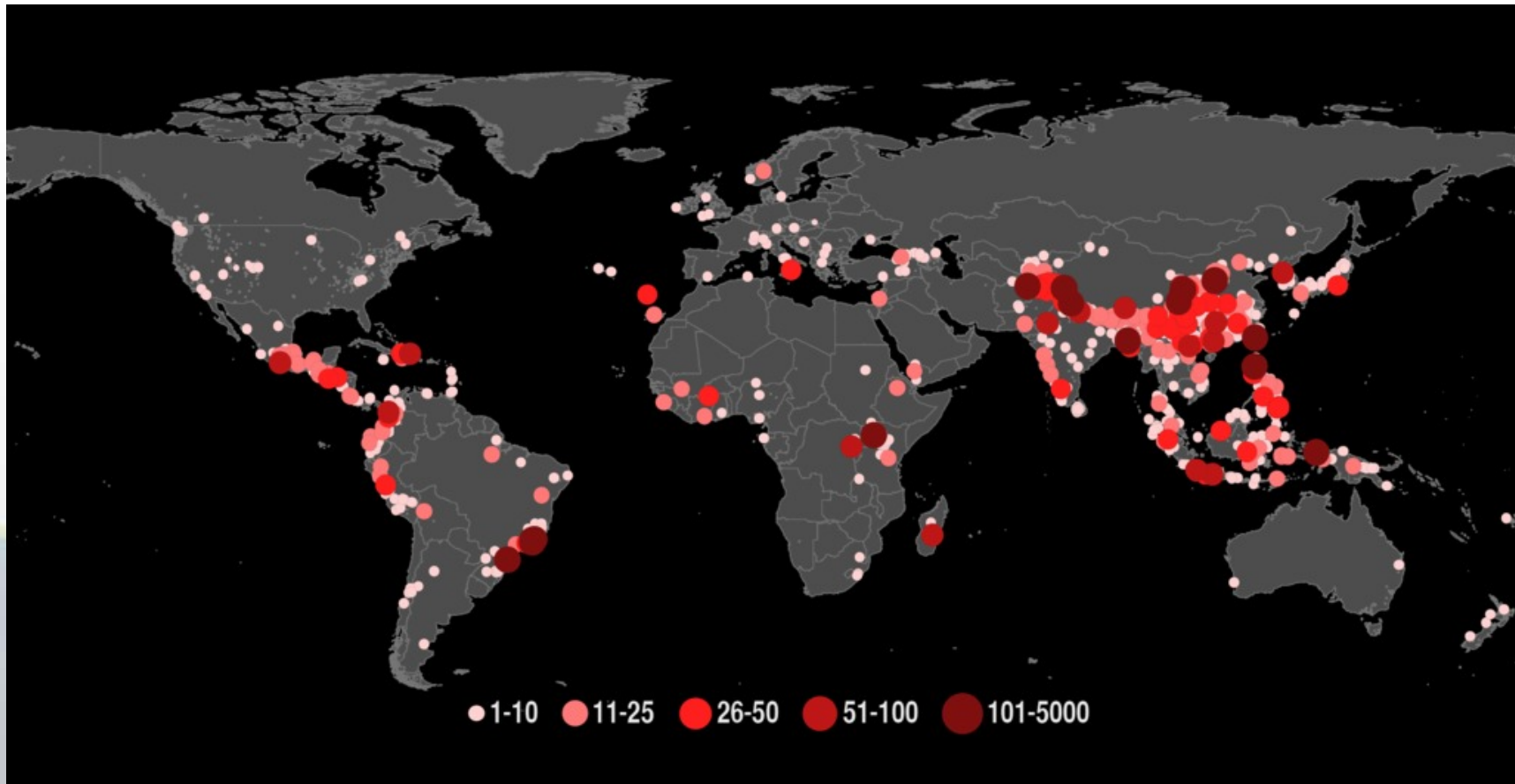
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Landsat-8 Pre and Post event views of the valley

View from the ground (Photo credit USGS)



Damage Proxy Map (DPM) from ALOS-2 Data



Landslides with fatalities from a global landslide catalog of rainfall-triggered events 2007-2013 (Kirschbaum et al. 2015)

To demonstrate the effective exploitation of Earth observations (EO) data and technologies to detect, map and monitor landslides and landslide prone hillsides, in different physiographic and climatic regions.

To apply satellite EO across the cycle of landslide disaster risk management, including preparedness, situational awareness, response and recovery with a distinct multi-hazard focus on cascading impacts and risks.



Proposed Objectives



Objective A:

Establish effective practices for merging different Earth Observation data (e.g. optical and radar) to better monitor and map landslide activity over time and space.

Objective B:

Demonstrate how landslide products, models or services can support disaster risk management for multi-hazard and cascading landslide events.

Objective C:

Exploit the experience, data, and lessons learned from ongoing pilots (i.e., seismic hazards, floods, volcanoes).

Objective D:

Engage and partner with data brokers and end users to understand user and service requirements, user expectations, and to get feedback through the activities described in objectives A-C.



Key Pilot Outputs & Deliverables



Objective A: Report on recommended practices for the combined exploitation of SAR and Optical imagery and technologies for landslide detection, mapping and monitoring”.

Objective A-C: Report on effective methodologies and strategies for considering multi-hazard and cascading aspect of landslides through multi-temporal landslide mapping from multiple triggers (leveraging information/interactions with the volcano, flood and earthquake pilots)

Objectives B-C: Landslide event inventory and activity (monitoring) maps produced using optical and SAR imagery and technologies, and their combination, for selected case studies / geographical areas.

Objective D: Report on end user engagement strategies and characterize enablers, challenges, barriers to effective transfer of information, knowledge and technologies.

Past Activities

- Developed an initial plan with objectives and overarching goals
- Held 2 meetings (December 2015 and February 2016) each with approximately 35 participants
- Participant Survey was prepared and sent to pilot contributors in early January to solicit details from team members for refining Pilot objectives

Upcoming activities

- Finalize Landslide Pilot objectives and define regional focus areas
- Hold a meeting on April 20th at the EGU Meeting in Vienna, Austria
- Identify 1-2 additional co-leads for the Landslide Pilot
- Establish the Landslide Pilot web presence on CEOS.ORG with a summary of goals, objectives and participants



1. What is your area(s) of expertise or operational authority or responsibility (e.g. research focus or disaster response and recovery)?
2. In what geographic region(s) do you primarily work or have responsibility (e.g. Global, national, regional)?
3. Please rate your interest the proposed Pilot Objectives from Very important to not relevant
4. Please provide feedback on current objectives in terms of your proposed contribution and suggest ways to modify the objectives to better accommodate your expertise or the group's collective expertise.
5. What Earth Observation data are you most interested in acquiring as part of this pilot?
6. What specific aspects of this activity do you expect to participate in for the duration of the pilot?
7. The CEOS Landslide Pilot is in the scoping state. Who should be added to this discussion?
8. Please recommend others who you currently work with or who may be interested in this activity and include organization, point-of-contact name, affiliation, and email contact information.

28 Responses

Current Landslide Pilot Members (50)



Country	Number of participants	Organizations
USA	18	NASA, USGS, FEMA, GFDRR (World Bank), Southern Methodist University, U. of Oregon, U. of Washington, U. of Colorado
China	10	Academy of Opto-Electronics, CAS, China Earthquake Administration, Institute of Water Resources and Hydropower Research, Institute of Crustal Dynamics, CEA
Italy	7	CNR IRPI, ESA, EURAC, INGV, Università degli Studi di Firenze
France	6	CEA AIM, CNRS, UJF Grenoble, UNESCO, University of Strasbourg
Germany	2	GFZ German Research Centre for Geosciences
UK	4	University of Leeds, NERC COMET, University of Durham
Norway	2	Norut, Geological Survey of Norway
Kenya	1	RCMRD
EU	1	European Commission
Nepal	1	ICIMOD
India	1	ISRO
Barbados	2	CIMH
Sri Lanka	1	IWMI
Canada	1	NRCan
Taiwan	1	National Central University of Taiwan



Roles	Research	Disaster Response	Imagery Type
Researcher	Landslide hazard mapping	National Landslide Hazard Program	InSAR for landslide mapping and monitoring
Disaster Response Coordinator	gradual landslide motion in mountain	Disaster Preparedness, Post disaster impact assessments	optical and radar satellite remote sensing for improved landslide process understanding
Manager for disaster preparedness and impact assessment	Initiation processes and early warning	Support to the Government for emergency management as centre of competence for civil protection	Satellite radar interferometry (InSAR) for landslides.
Regional Science Coordination Office	image analysis for automatic event landslide detection	Operational monitoring of landslides	satellite radar for measuring ground deformation
Scientific Advisor for National Civil Protection	optical and radar satellite remote sensing for improved landslide process understanding	Earthquake disaster emergency response and relief	Optical remote sensing with a particular focus on landslide mapping and monitoring
	forecasting, monitoring and assessment of hydrometeorological related hazards		airborne lidar analysis, landslide mechanics
	debris flow inundation hazard modeling		

Global**Regional**

- Caribbean
- South Asia
- Asia
- Mediterranean
- Tibetan Plateau
- Central America

National

- US
- Western US, Appalachian States, California, Colorado
- France
- Norway
- Nepal
- Italy
- China
- Kyrgyzstan
- Iran

**Local/sub-national efforts
(catchment scale)**

- Taiwan, Korea, Japan
- Southwest China

	<i>Objective A</i>	<i>Objective B</i>	<i>Objective C</i>	<i>Objective D</i>
<i>1 - Very Important</i>	85%	60%	15%	21%
<i>2- Moderately</i>	10%	35%	60%	52%
<i>3 - Neutral</i>	5%	5%	25%	21%
<i>4 - Not Important</i>	0%	0%	0%	5%

Objective A:

Establish effective practices for merging different Earth Observation data (e.g. optical and radar) to better manage landslide detection, mapping, and monitoring.

- Developing / testing / benchmarking / sharing tools for high-frequency monitoring and rapid mapping of landslides with satellite EO data
- Leverage revisit time of multiple sensors (e.g. the Sentinel constellation (S1, S2) to use EO satellite images as a real source of information for the monitoring of landslide displacement/deformation at high frequency.
- Processing stacks of Optical and SAR images to create horizontal displacement maps over time
- Improve the efficiency in processing remote sensing data for emergency response
- Establishment of benchmark datasets to test available semi-automatic techniques

Objective B:

Create integrated products & services for practices or activities, such as landslide inventories, to support disaster risk management for multi-hazard and cascading landslide events.

- Further develop operational services leveraging existing projects on landslide inventory mapping, landslide monitoring and early warning, landslide modeling and interpretation
- Demonstrate the rapid emergency response landslide mapping during major disasters in coordination with end users
- Create closer links between remote sensing analysis and the needs for hazard and risk analysis
- Use the longest available time series of remote sensing data to create systematic spatiotemporal assessment of landslide activity

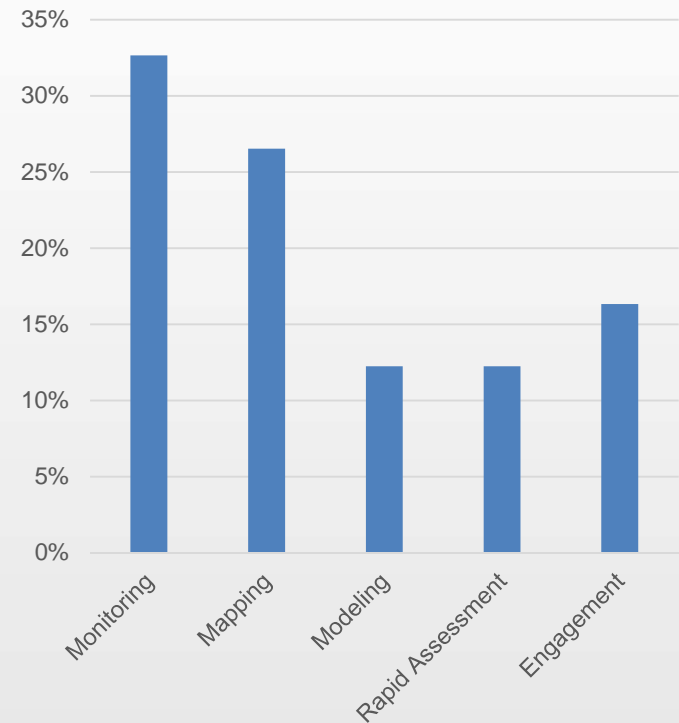


	<i>SAR</i>	<i>Optical</i>	<i>DEMS</i>	<i>Soil Moisture & rainfall</i>	<i>land use/soils</i>	<i>landslide inventories</i>	<i>LiDAR</i>
<i>Number interested</i>	15	17	5	3	3	3	2
<i>Percent</i>	58%	65%	19%	12%	12%	12%	8%
<i>Source</i>	<i>Sentinel-1 and 2, RADARSAT-2, COSMO-SkyMed, ALOS-1 and 2, TerraSAR-X, RISAT</i>	<i>Landsat, IRS, Worldview, Pleiades, SPOT5, SPOT-6/7, QuickBird, GF2, RapidEye, Sentinel-1, Sentinel-2, Venus</i>	<i>TanDEM-X</i>	<i>rainfall (weather data)</i>		<i>landslide catalogs</i>	<i>LiDAR</i>
<i>Resolution</i>		<i>1m-10m</i>	<i><10m</i>				
<i>Notes</i>	<i>Polarimetric SAR (amplitude), better if HR/VHR; need the ability to target over specific sites of interest (supersites, Nepal), <u>time series important</u></i>	<i>Multispectral (VHR better, GSD < 1 m); hyperspectral; <u>time series needed</u></i>			<i>soil erosion, regolith depth, exposed bedrock for unconsolidated deposits</i>	<i>landslide maps (specifically after earthquakes) susceptibility maps</i>	<i>Time series would be best</i>



- 1. Monitoring:** Develop/advance/communicate monitoring capabilities leveraging and integrating Optical and SAR data (**Obj A**)
- 2. Mapping:** Develop methodologies for multi-temporal image processing over select region to improve/expand landslide mapping/inventories (**Obj A**)
- 3. Hazard assessment/modeling:** Demonstrating how EO data (DEMs, hydrological information, and imagery/SAR) can advance landslide modeling/hazard assessment at a regional scale (**Obj B**)
- 4. Rapid Assessment:** Demonstration of how EO data can be rapidly processed for informed decision making (**Obj A & D**)
- 5. User/Pilot Engagement:** Need to leverage existing connections and those from other pilots to turn products into actionable information (**Obj C & D**)

Interest in Thematic Topics





Suggested regional study areas



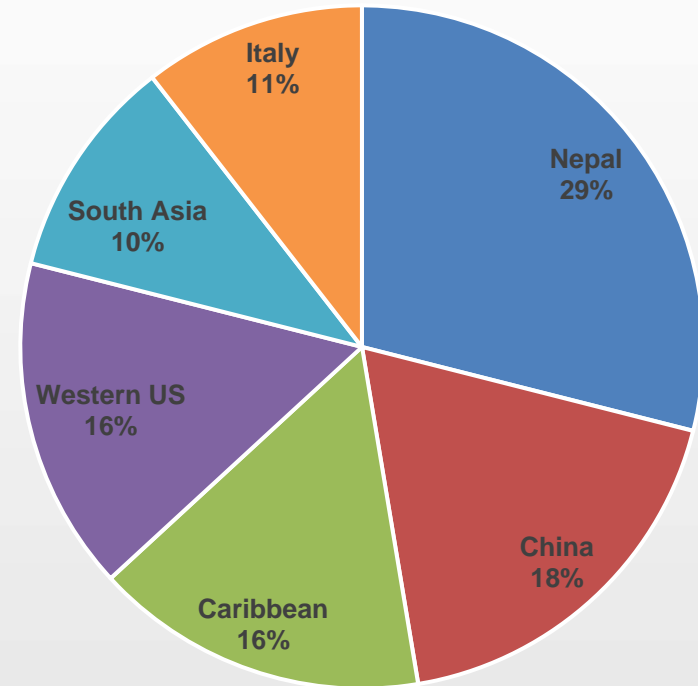
1. Nepal

2. Pacific Northwest, U.S. (Oregon, Washington)

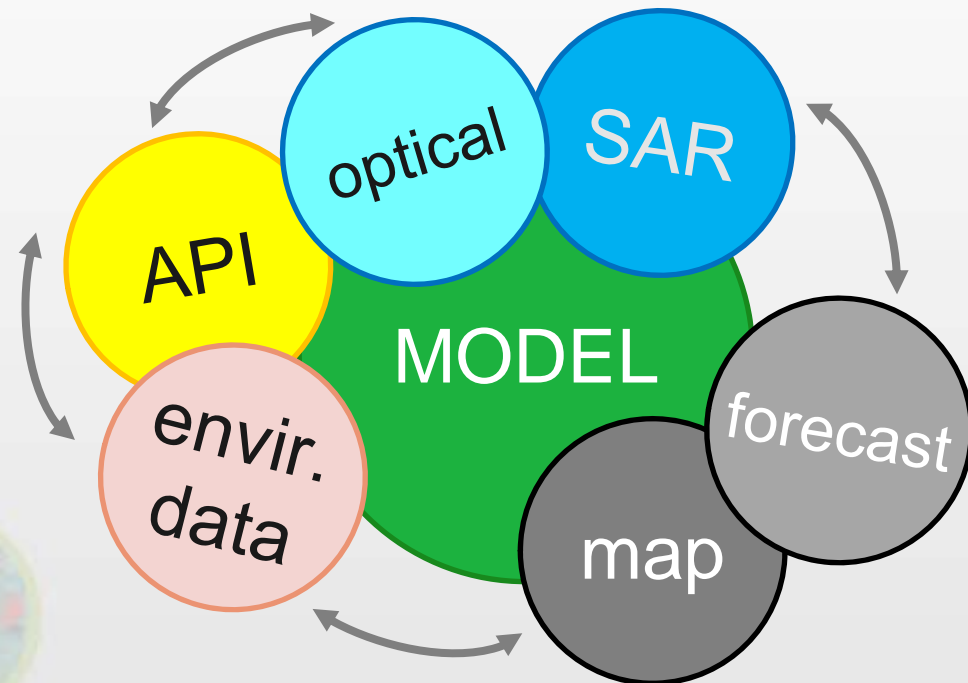
3. China (southwestern area)

4. Caribbean (focus area TBD)

Regional Expertise of Group



Advanced **landslide modelling tools** capable of **assimilating remote sensing data** and products for model initialization and validation.





- **Clear need in the community:** Landslide hazards are pervasive and research activities related to application of EO data are often not well-coordinated between regions
- **Landslide Pilot is still forming:** we are still seeking new participants
- **Open to suggestions and guidance:** particularly from other pilots



Questions/Comments



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