Committee on Earth Observation Satellites

Landslide Demonstrator Working Group Presentation

"EO-based Landslide services: Paving the Way for Landslide Risk Management Products"

June 3rd, 2021

Overview

- Progress on Data Requirements per use cases and activities

- Current activities

Applications of the Demonstrator

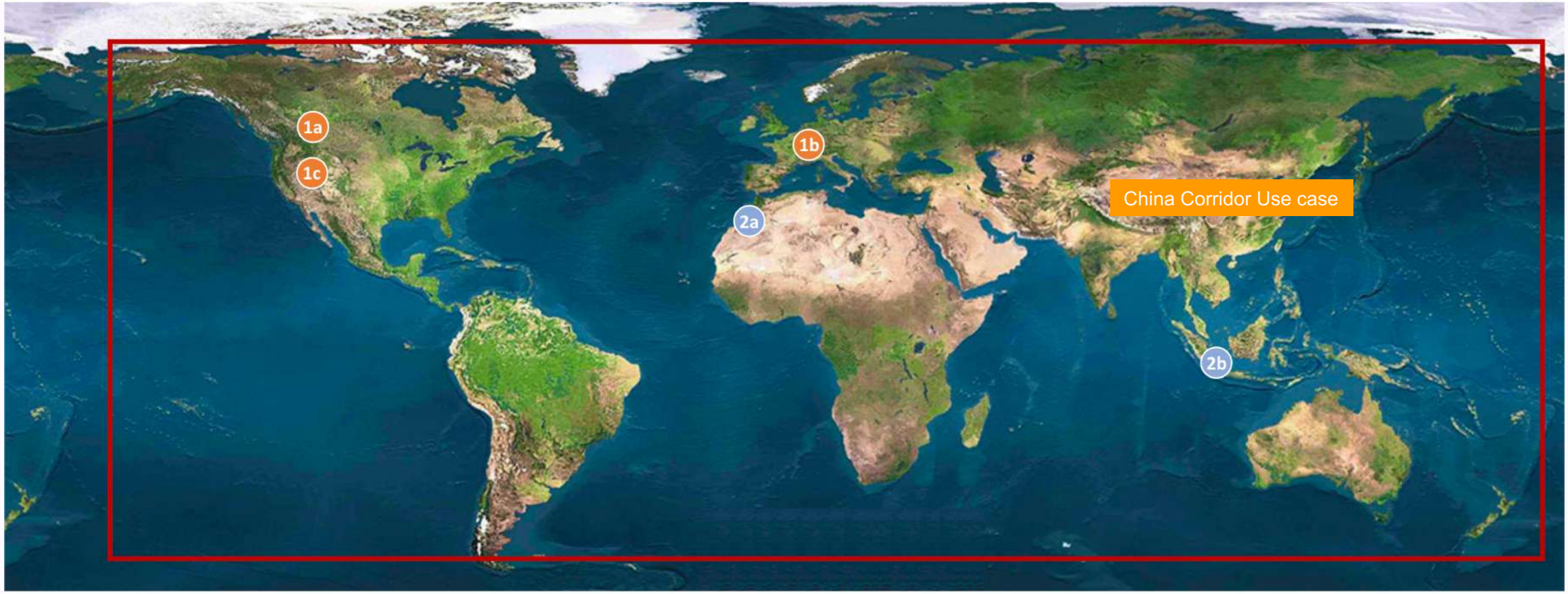
- **Application 1**: Use satellite data for landslide disaster assessment and mitigation along **transportation and pipeline corridors**, with goal of establishing local monitoring of areas of possible danger with regularity and consistency of observation, and of facilitating the assessment of the future evolution of these slopes

- **Application 2:** Use of satellite data for establishing **landslide risk financing products** (country or region risk profiles, hazard and risk maps) in full complementarity with the World Bank Disaster Risk Financing and Insurance Program (DRFIP).

- **Application 3:** Coordinate and expand the availability of landslide inventories and supporting data to advance **landslide science** at global scale, with the systematic documentation of large landslide disasters triggered by intense rainfall and/or high magnitude earthquakes in terms of standardized inventories of different complexity.

Demonstrator Leads
Jean-Philippe Malet (University of Strasbourg)
Dalia Kirschbaum (NASA)
Corey Froese (BGC Engineering)
Clément Michoud (Terranum)

Use cases

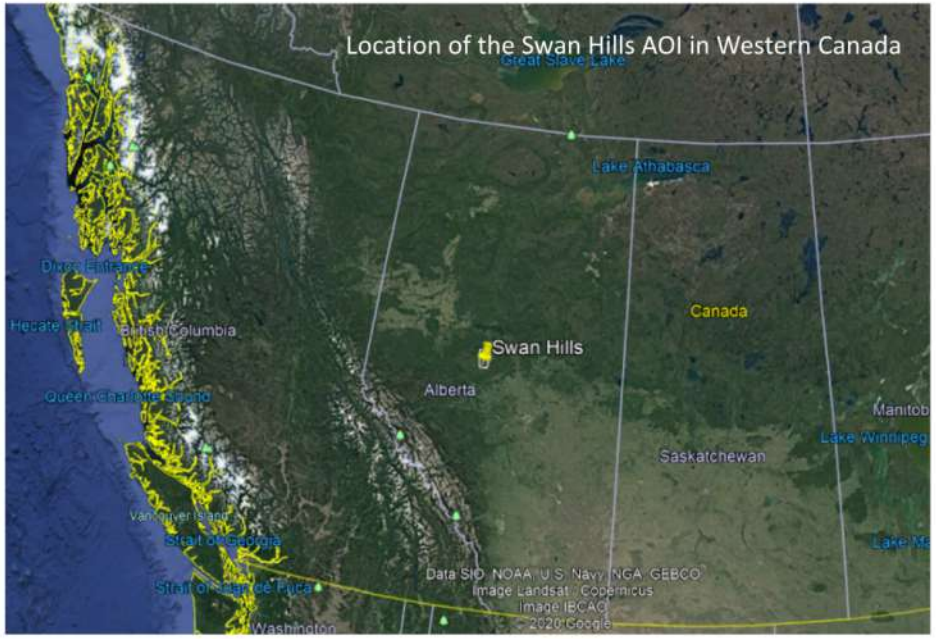


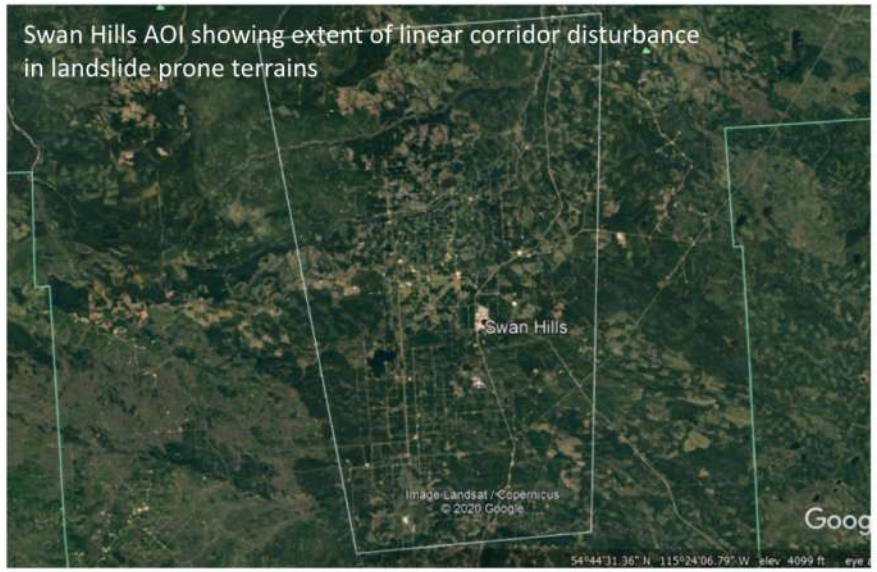
CEOS Landslide Demonstrator

- Application 1 / Corridor (1a: Canada/Alberta – Swan Hills, 1b: France-Italy-Swiss - Aosta/Wallis/Arve , 1c: US – Midwest)
- Application 2 / DRF (2a: Morocco / Rif-Tetouan-Tanger, 2b: Indonesia)
- Application 3 / Inventories

Status of Data Requirements

Application 1 – Site 1a – Canada / Alberta Swan Hills





Data provision plan

Justification of data (short explanation)

Evaluation of C-band complementarity (CSK + S1 + RCM)
Combination of C-band + L-band (SAOCOM).
The area is currently monitored by Sentinel-1 and LiDAR data. The area lends itself to testing multi-frequency acquisitions using RCM, Sentinel-1 and L-Band (SAOCOM) with relevance to linear infrastructure monitoring and Landslide Risk Management

Agency	Satellite/Sensor	Acquisition period	Frequency	Surface to cover
CSA	RCM – tasking to be supported by CCMEO	June 2021 – April 2023	72 images, 2 images/month for 3 years	50 x 30 km
CONAE	SAOCOM (StripMap, single pol, Level 1A)	June 2021 – April 2023	72 images, 2 images/month for 3 years	50 x 30 km

Status of Data Requirements

Application 1 – Site 1b – Swiss-France-Italy / Aosta-Wallis-Arve – Great St-Bernard Pass

Great Bernard Pass corridors accross 3 countries

Agency	Satellite/Sensor	Acquisition period	Frequency	Surface to cover
CNES	Pléiades	June-Aug-Oct 2021 March-June-Aug-Oct 2022 March-June-Aug-Oct 2023	3 to 4 dates/year (stereo)	ca. 1000 km2
DLR	TSX/StripMap	June-Aug-Nov 2021 March-June-Aug-Nov 2022 March-June-Aug-Nov 2023	36 image (2 images/month x 3 ½ years)	ca. 1000 km2
ASI	CSK/StripMap Himage (5 m)	June-Nov 2021 March-Nov 2022 March-Nov 2023	8 months / year	40x40 km (1600 km2)
CSA	/	/	/	/
CONAE	SAOCOM (StripMap, single pol, Level 1A)	June 2021 – April 2023	54 images, 2 images/month for 9 months per year (March-Nov) for 3 years	50 x 30 km

Justification of data (short explanation)

Combination of C-band + L-band (CSK + S1 + SAOCOM)
Very-high resolution offset-tracking : combination of TSX (SAR) + Pléiades (Optical)
3D displacement reconstruction : TSX InSAR + offset-tracking

Data provision plan

Status of Data Requirements

Application 2 – Site 2a – Morocco / Rif

Rif area Tanger-Tetouan landslide hazard areas

Justification of data (short explanation)

The site is the most landslide prone areas in Morocco. A combined hazard assessment modelling with the LHIS-P platform integrating Lhasa-Flow/R and consequance mapping is running systematically on GEP (DRFI / World Bank).

The landslide prediction need to be calibrated/validated with new observations to extend the landslide inventories

Data provision plan

Agency	Satellite/Sensor	Acquisition period	Frequency	Surface to cover
CNES	Pléiades	March-June-Oct 2022 March-June-Oct 2023	3 dates/year (stereo)	ca. 800 km2
DLR	/	/	/	/
ASI	CSK/StripMap Himage (5 m)	Jan-Dec 2022 Jan-Dec 2023	2 images / month	40x40 km (1600 km2)
CSA	/	/	/	/

Status of Data Requirements

Data requirements per use cases defined with the stakeholders

CSA: quotas discussed

DLR / CONAE : meeting week 23

ASI/CNES: meeting to plan before end of June

→ First delivery of data in September/October 2021 (and official start of Demonstrator)

Application: Landslide Risk Financing

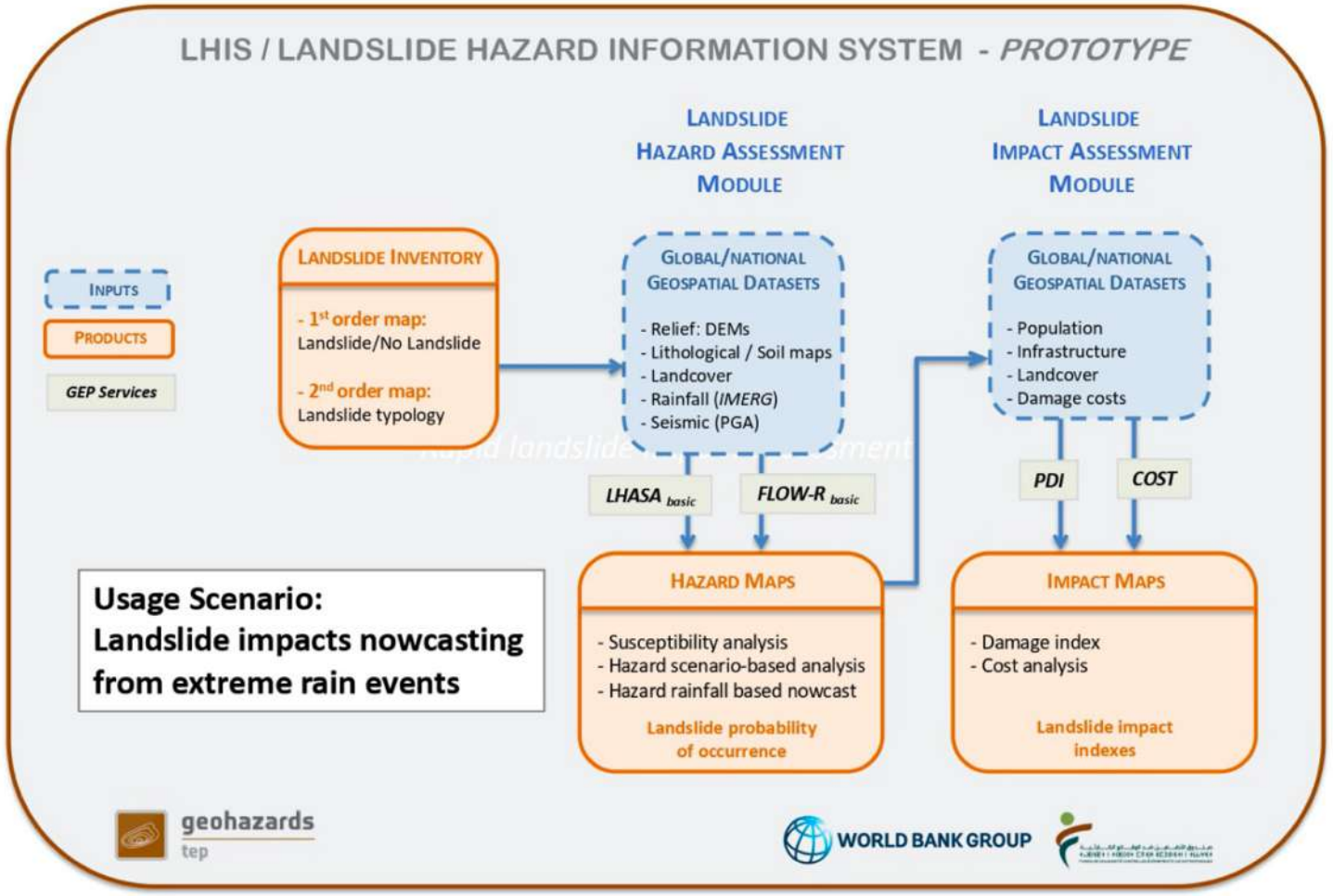
Application 2: Operational Landslide EO Products for Disaster Risk Financing and Insurance Program (World Bank)

Demonstrator Leads: Clément Michoud (Teranum) and Jean-Philippe Malet

Industry Participant: World Bank

Goal: implement a processing platform prototype to respond to likely landslide events (in Near-Real Time, NRT) in order to provide estimates of parameters suitable to inform parametric insurance calculations.

Development and stress-tests of services and products over Morocco, but all the development will be generic to be easily transferred to other countries and risk situations (especially in SE Asia).



Landslide Hazard Information System – Prototype Project

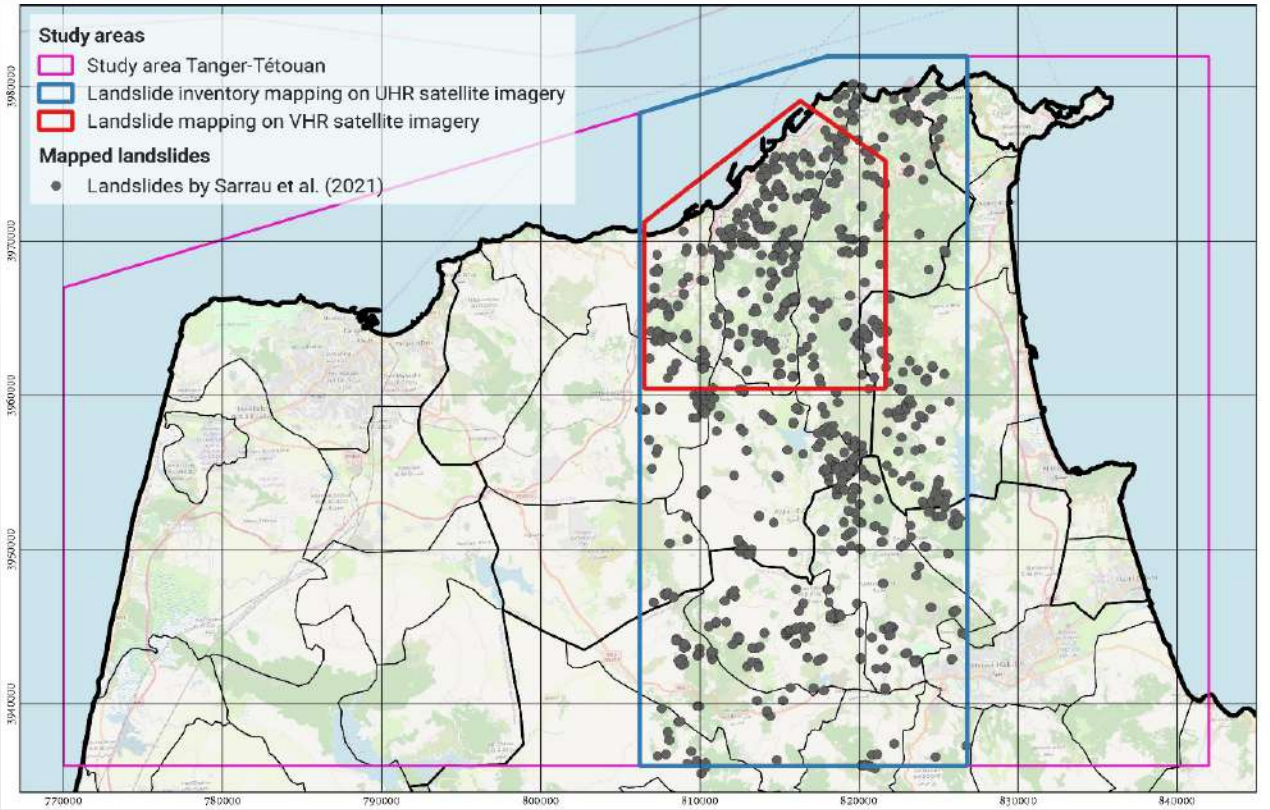
- Key Objectives:
- High resolution, automatic landslide mapping using EO data
- Landslide Hazard Assessment, suitable for generalization to other locations
- Landslide Impact Assessment, including exposure estimates and cost / impact indices.
- Collaborating groups: Terranum (Swi), Conectus CNRS EOST (France), USRA / NASA (USA), Terradue (Italy), NHAZCA (Italy)

WORLD BANK GROUP
Disaster Risk Financing and Insurance Program

صندوق التضامن ضد الوقائع الكارثية
FONDS DE SOLIDARITÉ CONTRE LES ÉVÉNEMENTS CATASTROPHIQUES

Landslide Hazard Information System – Prototype Project

- Project deliverables on track for completion in Early June
- Data collection and cataloging of relevant factors for landslide hazard and risk completed
- **High resolution local landslide inventory completed**
- Development of local susceptibility model completed for test area
- Deployment of local LHASA/FLOW-R system on University of Strasbourg HPC systems in process
- Runout and impact assessment underway



D1: LHIS-P Morocco

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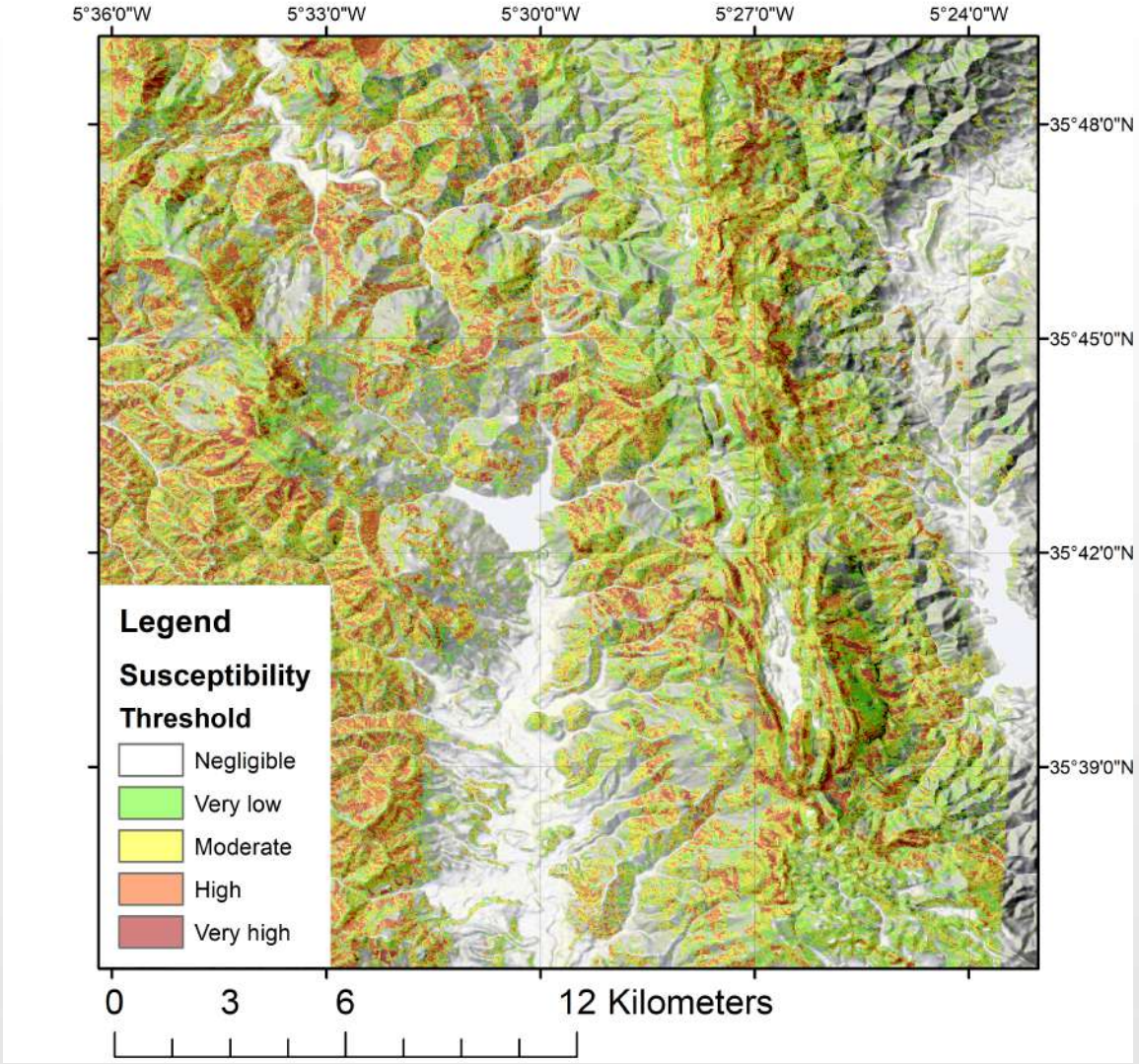

D1: LHIS-P Morocco

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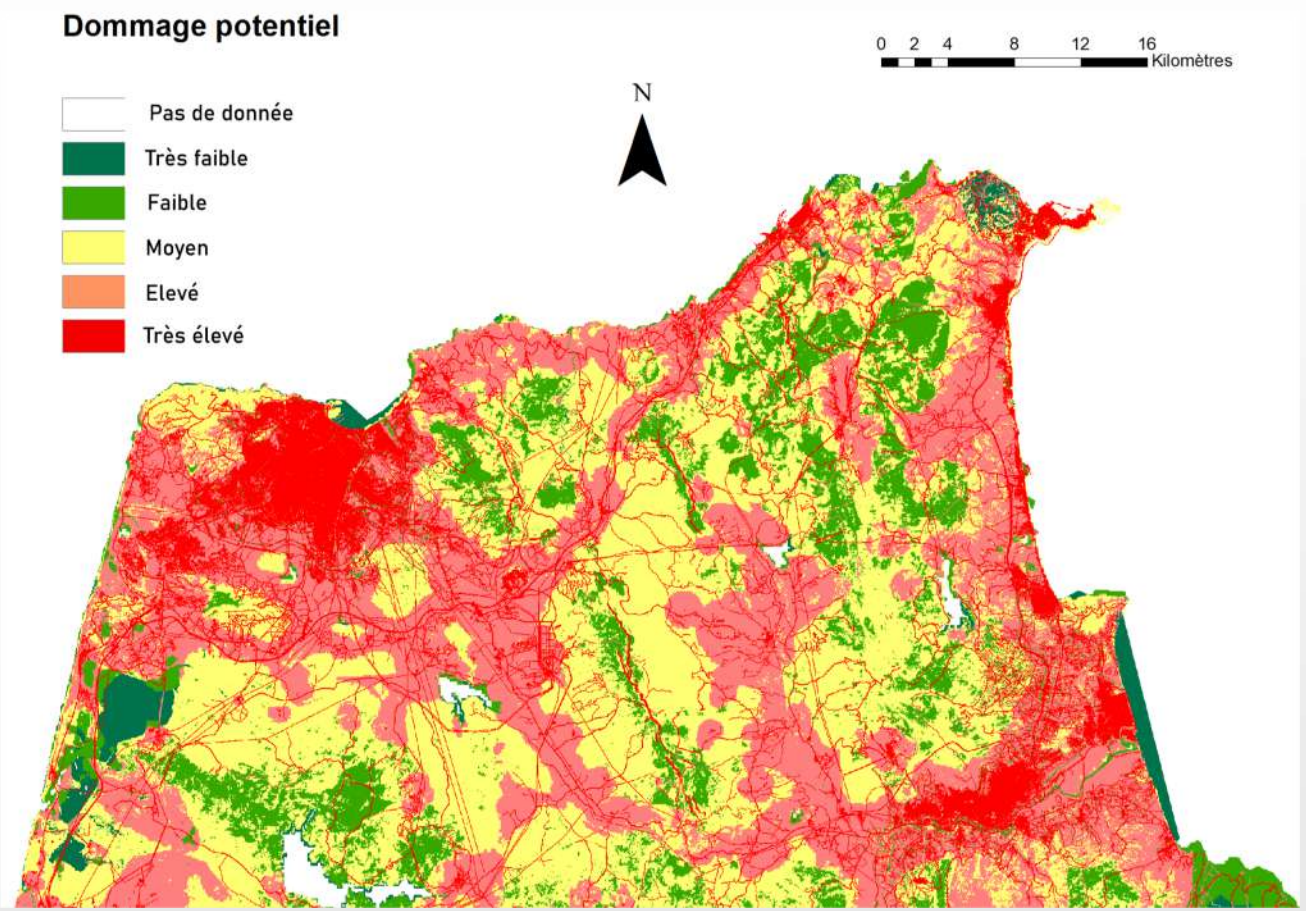


Application: Global Landslide Data

Application 3: Advancing EO-based landslide inventories for extreme forcing events (heavy rains, high-magnitude earthquakes)

The goal of this application is to coordinate and share methodologies for the establishment of landslide inventories accross different geologic and morphologic zones. In this activity we will proose standard for creating and publishing EO-based landslides inventories, with the goal of develoing an online open system to share algorithms and inventories using SAR and optical methodologies. This work will be done in coordination with the newly formed LandAware consortium's Data Working Group, with EGS (EuroGeoSurveys) and with JRC

Methodologies

Inventories

- New, open methods for SAR and optically-derived inventories. Definition of quality criteria for validating EO-based inventory and store the information, data standards
- System to store and disseminate inventories on-line

Models

- Comparison and sharing of models that provide automatic mapping capabilities and calculation of advanced statistics from the EO database.
- Establish correlation with triggers (thresholds, scaling laws) for benchmark inventories.

Demonstrator Leads: Dalia Kirschbaum, Jean-Philippe Malet (CNRS/EOST) and Olivier Dewitte (RMCA).

Industry Participants: LandAware Consortium, World Landslide Forum, USGS, EuroGeoSurveys, JRC and other geological mapping agencies

Semi-Automatic Landslide Detection (SALaD) system

Engineering Geology 282 (2021) 106000

Contents lists available at ScienceDirect

Engineering Geology

journal homepage: www.elsevier.com/locate/enggeo

Landslide mapping using object-based image analysis and open source tools

Pukar Amatya [a,b,c,*], Dalia Kirschbaum [c], Thomas Stanley [a,b,c], Hakan Tanyas [a,c,d]

[a] Universities Space Research Association, Columbia, MD, USA
[b] Goddard Earth Sciences Technology and Research, Columbia, MD, USA
[c] Hydrological Sciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA
[d] University of Twente, Faculty of Geo-Information Science and Earth Observation (ITC), Enschede, Netherlands

SALaD code is undergoing NASA's software release process and will be released as soon as it is done

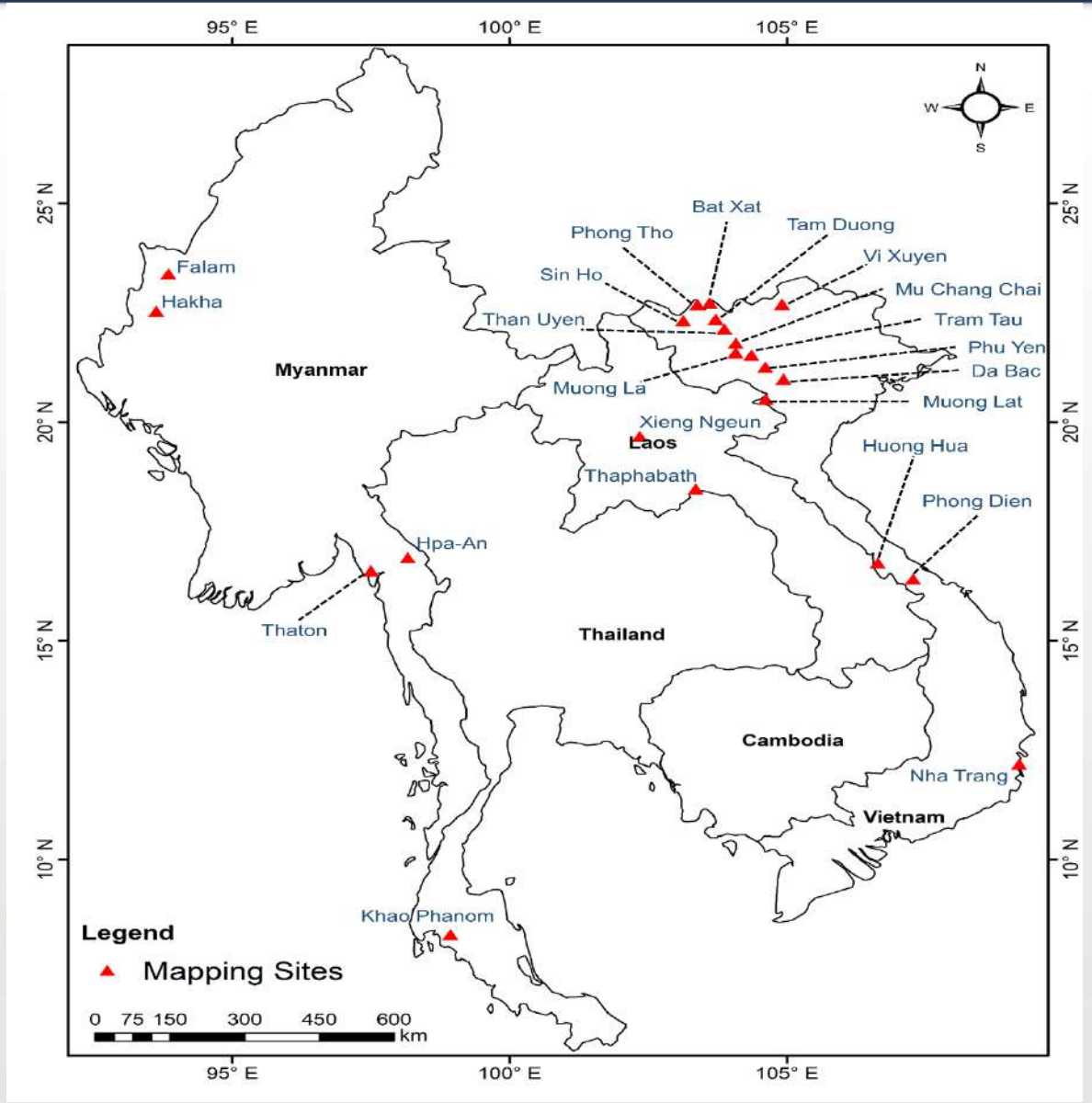
Rainfall induced landslides inventory for lower Mekong

1. Upgrade SALaD to incorporate a change detection-based approach (SALaD-CD) to create event-based landslide inventories.

2. Testing and inventories creation for rainfall events in lower Mekong region in collaboration with SERVIR Mekong.

3. PlanetScope imagery available through NASA CSDA program.

4. Paper submitted to Geoscience Data Journal. Data will be available upon acceptance.

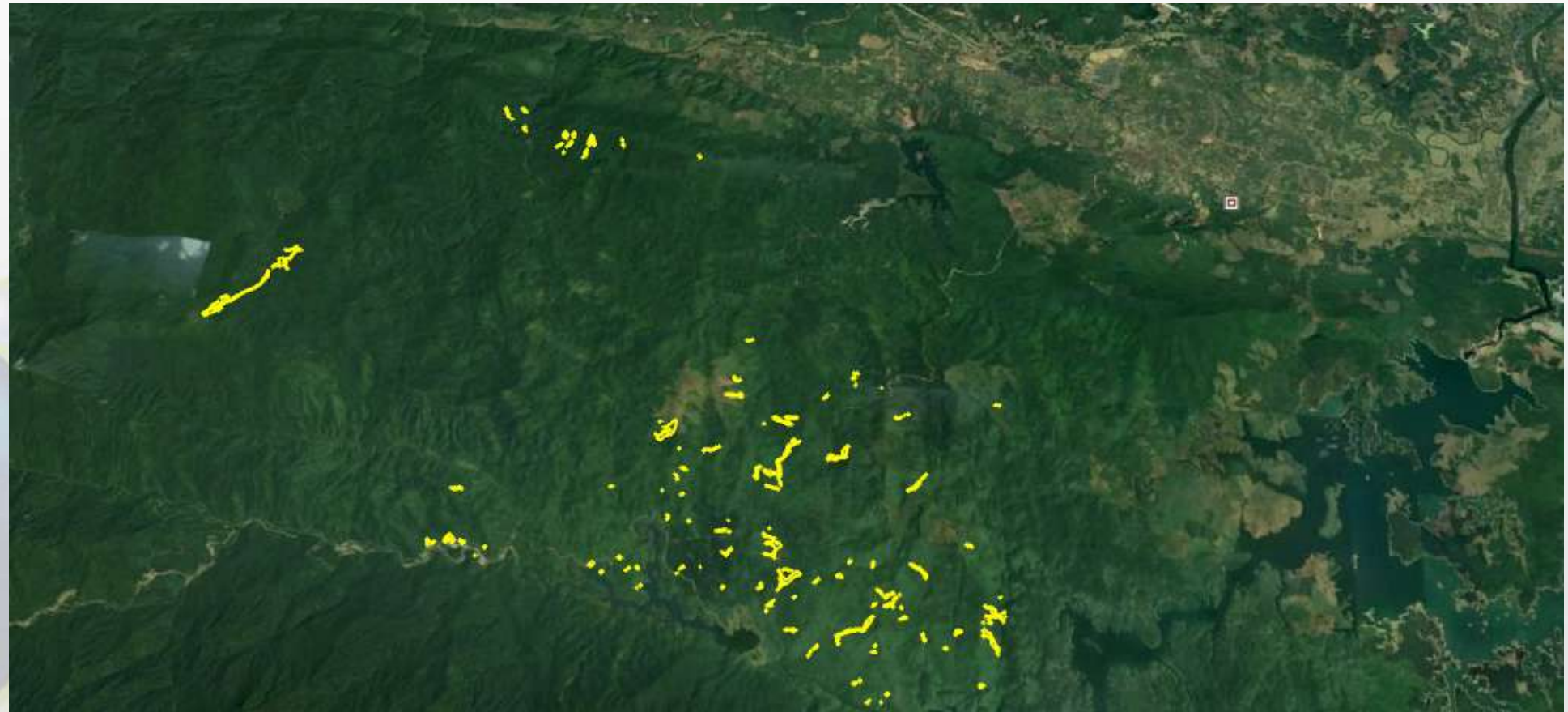


Pukar Amatya (NASA/USRA)

Phong Dien, Vietnam (October 12, 2020)

13 rescuers found dead in central Vietnam's landslides, several missing

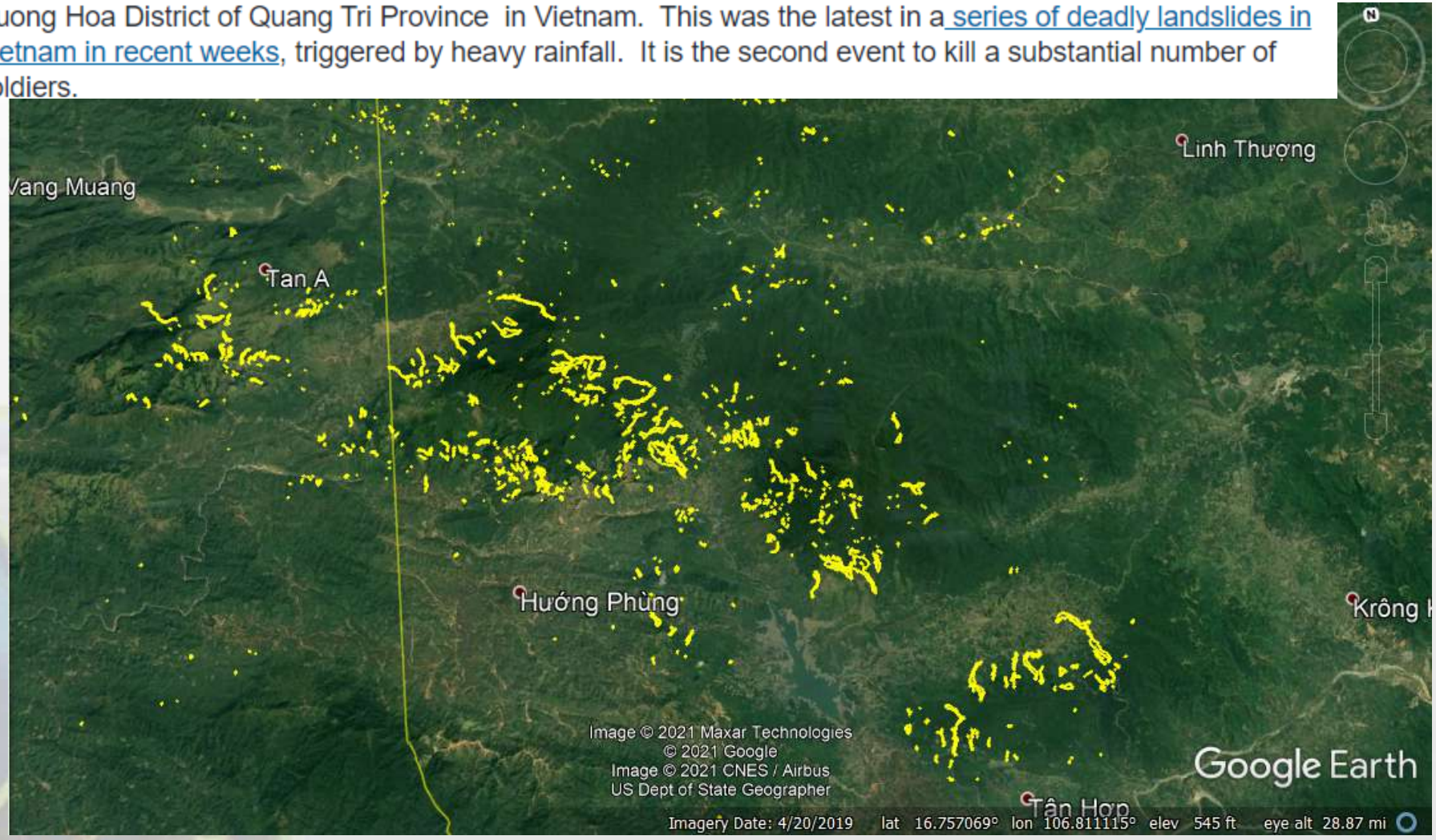
Source: Xinhua | 2020-10-15 21:51:12 | Editor: huaxia



Huong Phung, Vietnam (October 18, 2020)

Huong Phung: another deadly landslide in Vietnam

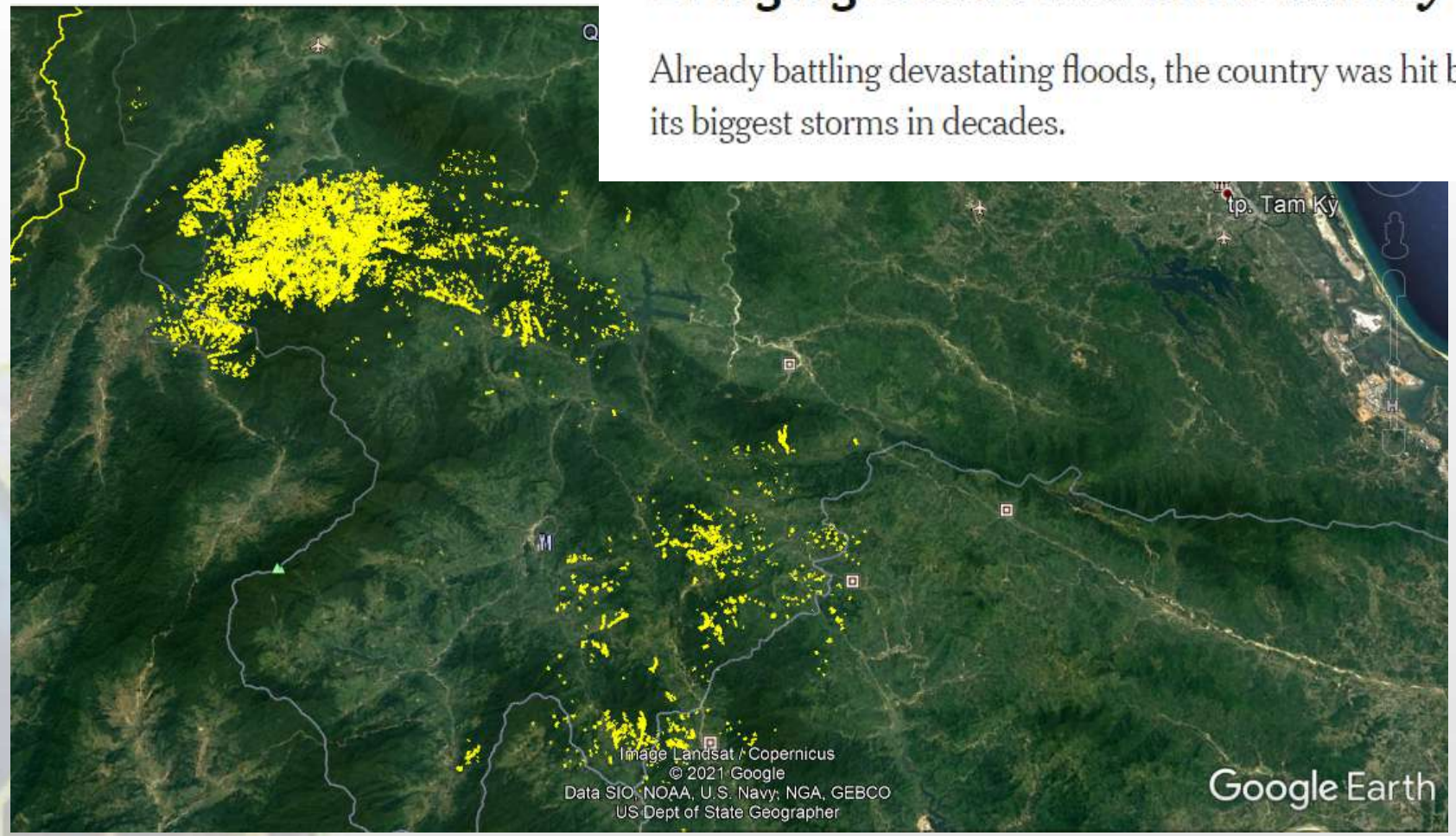
Early on Sunday 18 October 2020 a large landslide struck an army barracks in Huong Phung commune in Huong Hoa District of Quang Tri Province in Vietnam. This was the latest in a series of deadly landslides in Vietnam in recent weeks, triggered by heavy rainfall. It is the second event to kill a substantial number of soldiers.



Quang Nam, Vietnam (October 28, 2020)

Typhoon Molave Slams Into Vietnam, Bringing Death and More Misery

Already battling devastating floods, the country was hit by one of its biggest storms in decades.

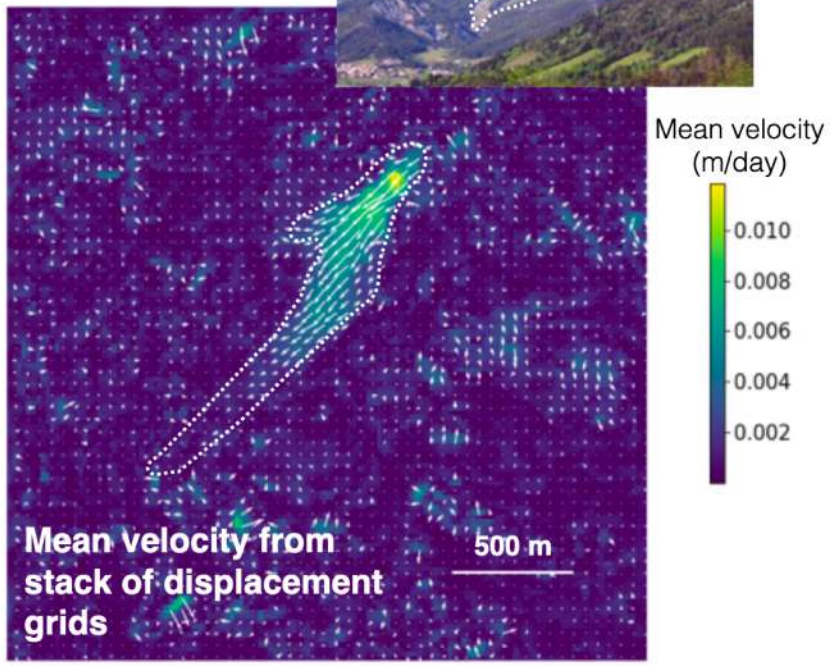


New physical approaches to map landslides from time series of deformation measurements

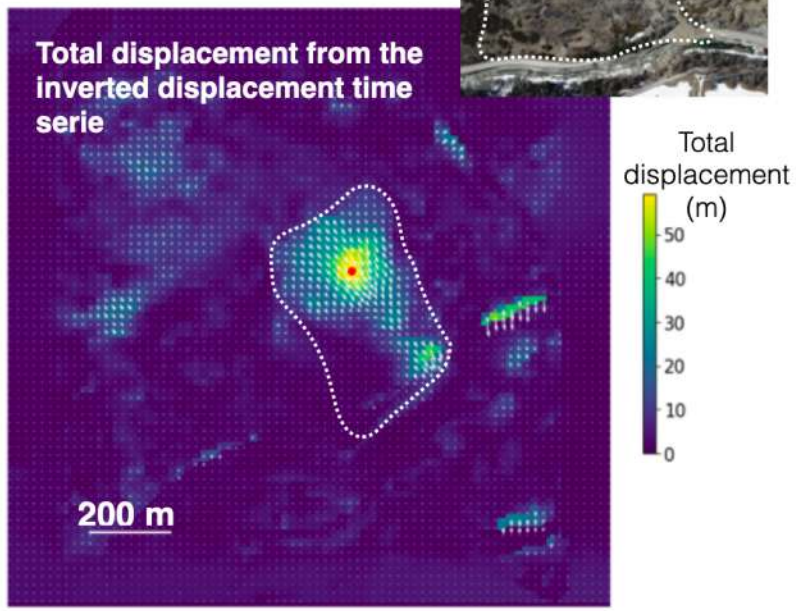
Landslide detection and classification using ICA/PCA and machine learning approaches

ICA/PCA decomposition for landslide studies

Test site 1: Lavalette landslide



Test site 2: Aiguilles landslide



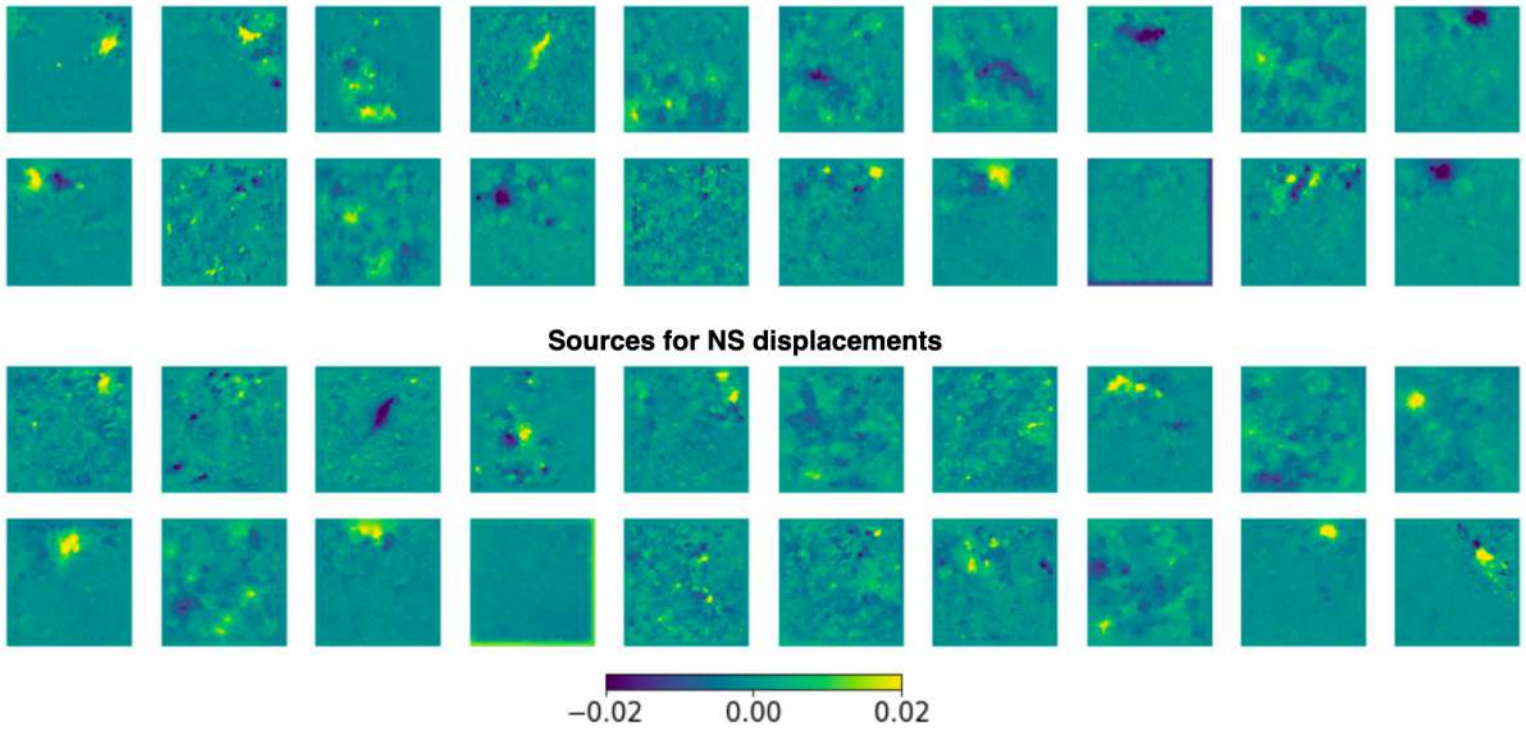
New physical approaches to map landslides from time series of deformation measurements

Landslide detection and classification using ICA/ PCA and machine learning approaches

Number of sources: 20 to set for the ICA decomposition
Number of displacement grids: 1612
Number of acquisition dates: 87

Sources for EW displacements

Sources for NS displacements



Landslide Early Warning System Network – LandAware

LandAware held a 24-hour meeting on 19-20 May that welcomed an international community to discuss a variety of topics on landslide early warning systems, supporting data and stakeholder engagement

A LEWS Data WG has convened 2 meetings this year with the goals of identifying available data to serve as benchmarks for mapping activities, identifying best practices for a white paper, and discussion of a portal for centralizing LEWS data and information

https://www.landaware.org/

LandAware
the international network
on Landslide Early Warning Systems

MayDay

'round-the-clock conference

A 24-hour event, online, diversified and engaging event

19-20 May 2021 Starting time 2:00 PM CEST

	Times in CEST	Session
19 May	14:00 – 15:00	Welcome session and Honor lecture
	15:00 – 16:00	Presentation of photo contest – Contribution from ICL president – Interviews to LEWS experts
	16:00 – 17:00	Discussion: National and local LEWS: similarities, differences and interaction (I)
	17:00 – 18:00	Discussion: Live interactive educational experiences on disaster preparedness
	18:00 – 19:00	Examples of current innovations for LEWS
	19:00 – 20:00	Panel discussion on new projects relating to landslide inventories and data gathering methods
	20:00 – 21:00	Communicating and engaging with stakeholders: Questionnaire outcomes and open discussion
	21:00 – 22:00	Early-career fellows and students' panel
	22:00 – 23:00	Contribution from Brazilian National Center for Alert Monitoring and Natural Disasters
	23:00 – 24:00	Discussion: National and local LEWS: similarities, differences and interaction (II)
20 May	00:00 – 01:00	Contribution from São Paulo State University, Brazil
	01:00 – 02:00	Ignite talks on new research and data to support LEWS
	02:00 – 03:00	Presentation of preliminary glossary for LEWS
	03:00 – 04:00	Taiwanese experiences in LEWS
	04:00 – 05:00	Streaming of pre-recorded interviews: "Meet the LandAware experts"
	05:00 – 06:00	Streaming of pre-recorded comments/interviews
	06:00 – 07:00	Interviews at LEWS experts/managers
	07:00 – 08:00	Discussion: operators' perspective on innovations
	08:00 – 09:00	Cooperative project: Let's create a «single-slide fact sheet» about the Hong Kong LEWS
	09:00 – 10:00	Live feed from the Norwegian national LEWS
	10:00 – 11:00	Lessons and best practice: communication and stakeholder engagement for LEWS
	11:00 – 12:00	LEWS experiences in Hong Kong and Japan
	12:00 – 14:00	Celebration of photo contest. Open discussion of future collaborations within LandAware. Outlook and Closure