CEOS Disaster Risk Management

Proposition to the CEOS WG Disasters:

The Geohazards Lab

**CEOS WG Disasters meeting**

Overview of Proposal:

➤ **A new initiative (Jan 2017)** proposed in the frame of CEOS

➤ Initially combining processing platform activities and thematic exploitation activities (e.g. seismic/volcano/landslides Pilots and R.O.). Based on discussions during the 7th meeting in March 2017, the **CEOS WG Disasters** decided to define the Geohazards initiative as a stand alone activity and linking it to all relevant thematic activities under CEOS.

➤ **Approved** by CEOS SIT during the SIT-32 in Paris, France, 27 April 2017

Credits: DLR, ESA, Copernicus programme.

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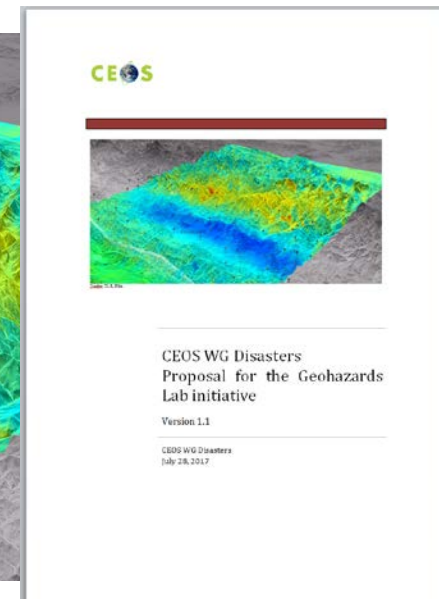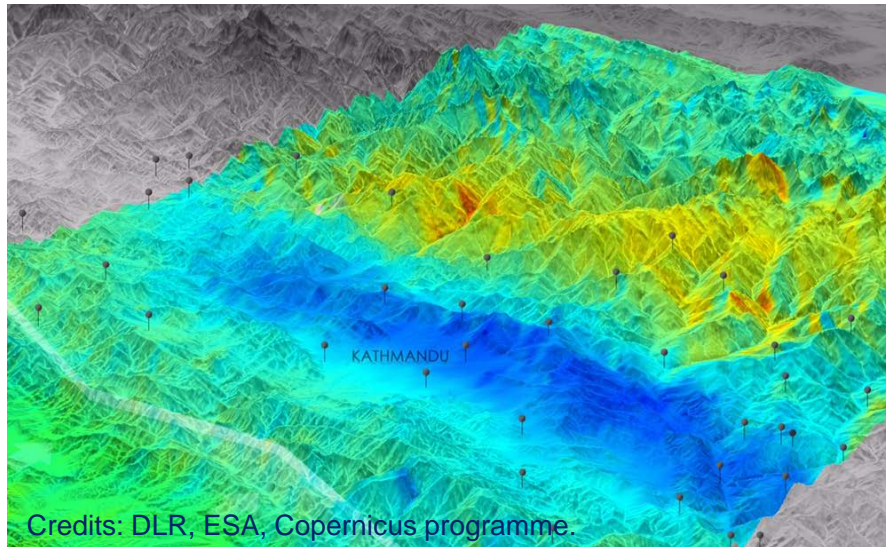
Geohazards Lab overview:

- ❑ Definition:

  **A platform with federated resources
  to access, process
  and publish satellite EO data
  and derived products**

- ❑ Goal:

  *Provide data access and a processing
  and e-collaboration environment
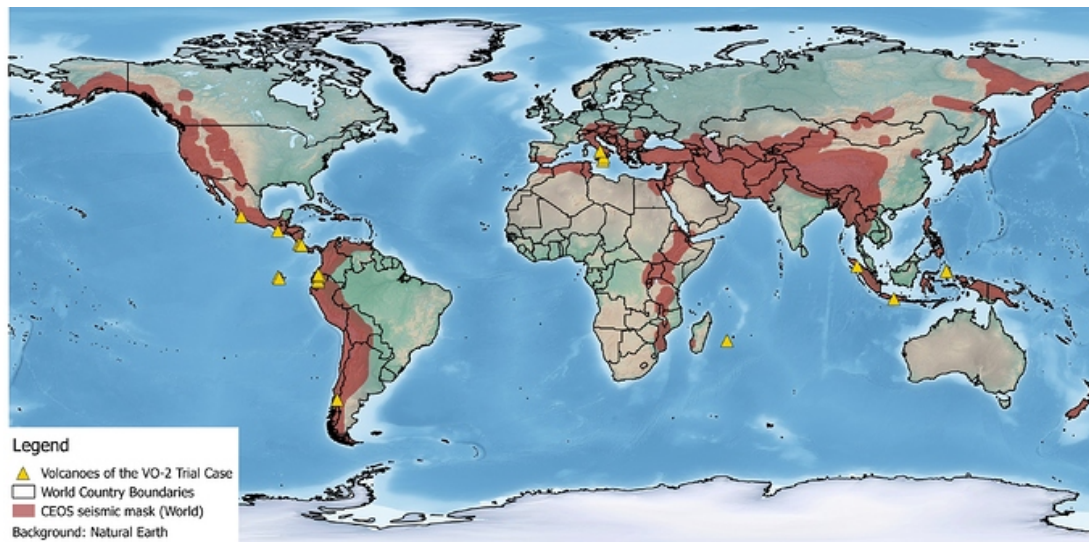 to exploit EO data to assess geohazards and their impact*

- ✓ Aims to **address priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030** using satellite EO (focus: better understanding hazards & risks)
- ✓ Supports and complements the **CEOS WG Disasters activities** (on-going pilots, follow-on activities and the RO), **the GSNL** and **GEODARMA.**

What are the Challenges?

Challenges identified in the past years:

- ✓ many users **aren't aware or cannot afford** EO based solutions
- ✓ the EO data and derived VA products are **costly to generate** for the objectives of the community (e.g. with regional/global coverage)
- ✓ EO techniques need to be **adopted by users** (standards, norms)
- ✓ some new EO missions' **data are large** in volume
- ✓ some EO applications require **complex or intensive processing**
- ✓ some EO applications require to **maintain, reprocess and compare EO based VA products**

Legend
△ Volcanoes of the VO-2 Trial Case
☐ World Country Boundaries
▨ CEOS seismic mask (World)
Background: Natural Earth

A new activity with the geohazards community:

A *new activity* to start in late 2017 with the goals to:

- Continue **supporting CEOS and GSNL users** to exploit data with hosted processing

- Work on **standards and support consensus results generation** (e-collaboration)

- achieve **awareness and acceptance** of EO based solutions with **expert users and end users** (in line with the CEOS pilots and follow-on activities, RO, GSNL and GEODARMA)

- enable EO applications with **massive volume and/or intensive processing**, such as in the case of terrain motion monitoring based on InSAR or stereo-optical data,

- reduce the **cost of EO exploitation** via the mutualization of resources (resources provisioning, processing chains)

- increase access to users in regions where it is **difficult to download large EO data products** while the results of Cloud based processing generally are much smaller files (i.e. the democratisation of space technology),

- ensure the **persistency of results** and allow to share and transform processing chains (geotagging results and publication, integration and evolution of processing chains)

Examples of challenge:
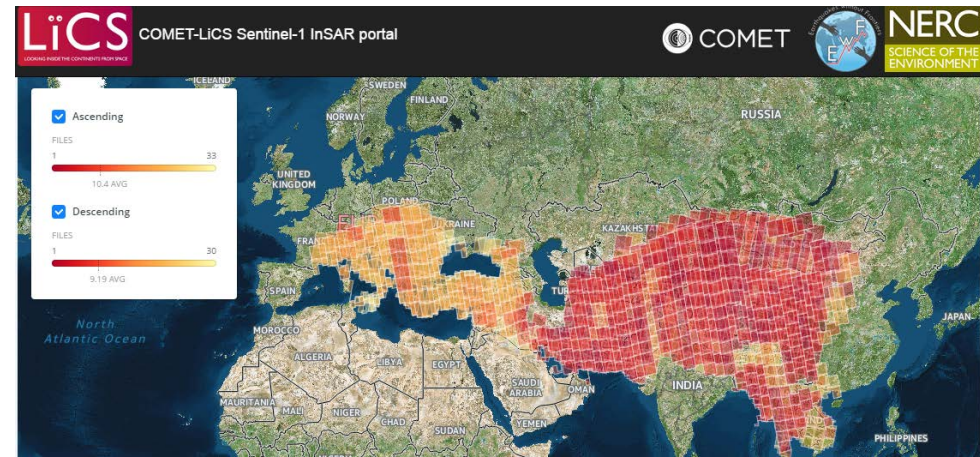
Sentinel-1 and Sentinel-2 change the way satellite EO is exploited for DRR:

- Using Sentinel-1 complex data over the world tectonic mask requires to process **200+ pairs of images every day** (2800+Giga).
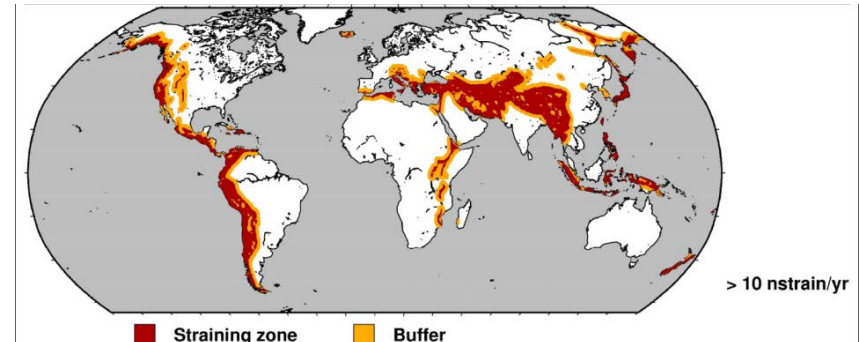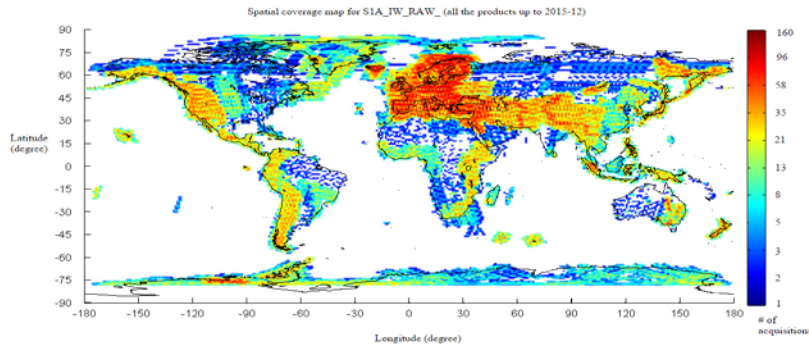
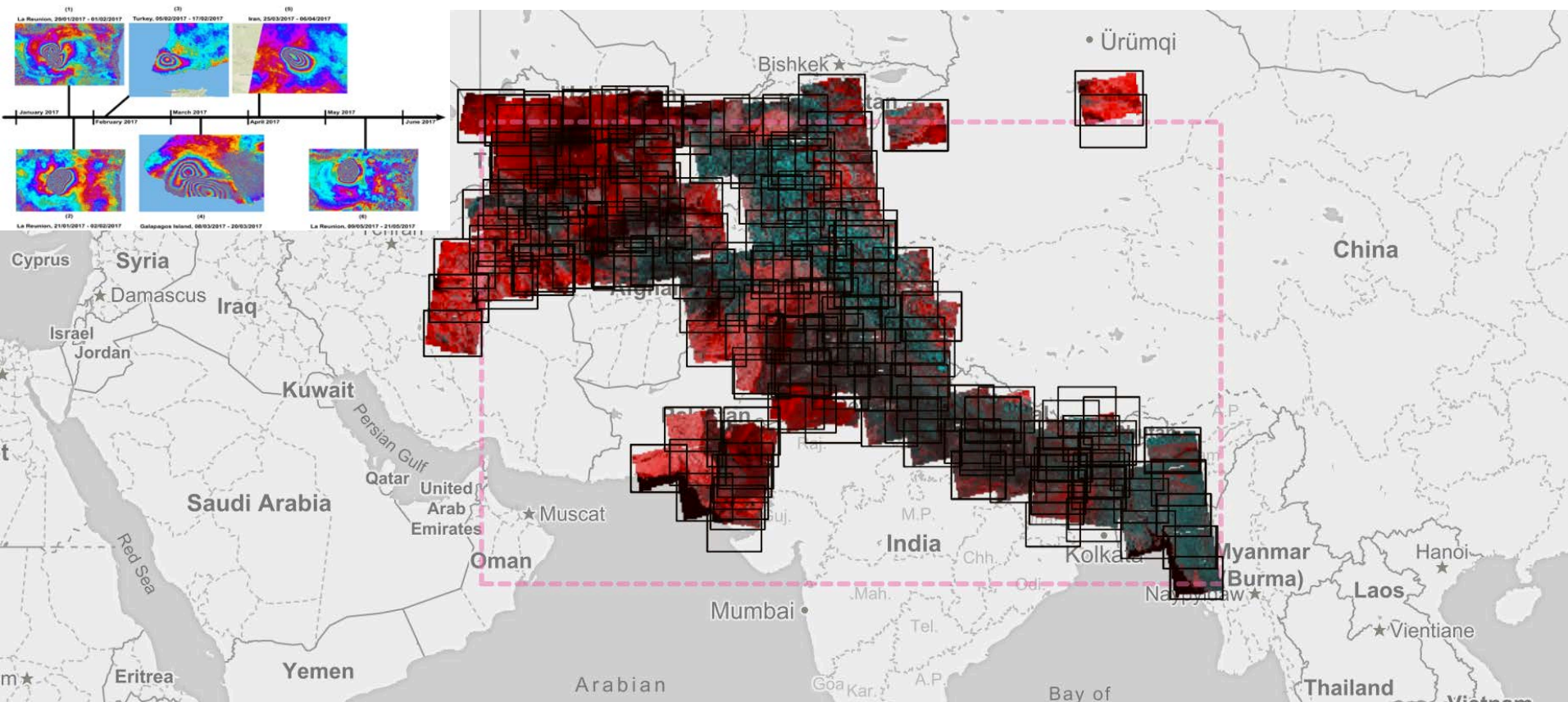- Similarly using Sentinel-2 all land surfaces of the world are covered **every 5 days (4+ Tera per day)**.

To adress this requires
a new approach for data exploitation.

Example of opportunity:

The *Geohazards Exploitation Platform generated large volumes of measurements shared with the user community in the context of the CEOS WG Disaster since 2015.*
Note: the GEP is also a pilot within the CEOS WGISS

Overview:

The Geohazards Lab intends to enable:

- *Integration & use of tools in an on-line environment:* help the geohazard user community generate EO measurement with on line processing without downloading data.

- *Conducting e-science:* accelerate the science use of satellite EO & promote research through new mechanisms using the web (sharing results, take advantage of the persistency of EO measurements executed and stored on-line, etc.).

- *Articulate with the relevant thematic activities of the WG Disasters and help them develop the user community*: support CEOS activities, and, in parallel, develop and manage activities with other users of the geohazards community (that may not currently work in the framework of the CEOS WG Disaster).
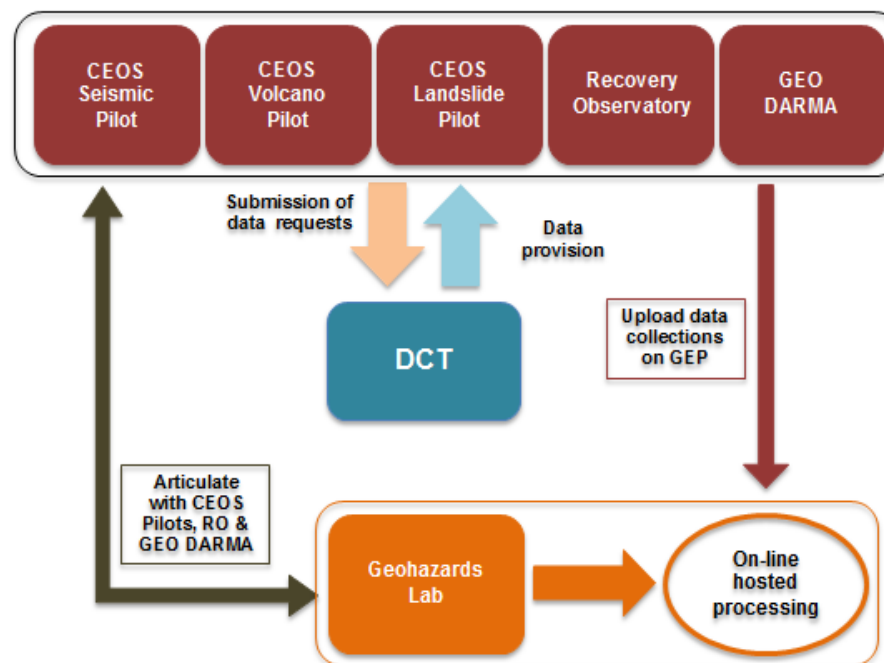
The idea of the Geohazards Lab

The Geohazards Lab will articulate with the **Data Coordination Team (DCT)** to make sure it does not interfere with data ordering and delivery of other CEOS WG Disasters activities.

- It provides **EO processing resources** to exploit these data. It is directly accessing **open & free data;** it is able to upload other EO data collections associated to users of CEOS WG Disasters activities (e.g. pilot, RO, etc.) **on a case by case basis provided permissions are granted** and as per the DCT procedure.

- It can also be used to **deliver EO data** e.g. to support CEOS pilots activities, the R.O. and the Geohazards Supersites (GSNL) initiative; for instance ASI confirms that GEP will be used for the GSNL concerning Cosmo data.

- In addition the Lab is able to deliver **VA products** elaborated by partners on the platform or generated externally (e.g. off line) and published on the platform.

Not on an emergency basis

Exploit commonalities across geohazards themes (tectonics, volcanoes, landslides) and need for common processing tools and systematic monitoring chains:

I. **Support the GSNL initiative with on-line services** *e.g. provide access to processing tools for GSNL users.*

II. **Support other CEOS Pilots that are still pursuing their activities and other follow-on activities**

III. **Support the Recovery Observatory (RO) activity by providing access to tools and hosted processing about geohazards related issues relevant to the RO deployed**

IV. **Support GEO-DARMA by providing access to tools and hosted processing about geohazards in the priority areas (as described in the GEO-DARMA implementation plan) for risk assessment**

Concrete objectives concerning DRR activities (2)

On an emergency basis

V. **Pursue and support the generation and distribution of advanced science products based on terrain motion mapping** e.g. advanced tectonics mapping using Sentinel-1 for earthquake response (deformation maps, source models, etc.)

VI. **Pursue and support the generation and distribution of other advanced science products** e.g. for landslide monitoring, thermal signatures of volcanic eruptions, etc.

… so far 4 space agencies …

- **ESA**
  -**access to the Geohazards Exploitation Platform** including: data storage, processing software (InSAR and stereo-optical processing chains), e-collaboration environment;
  -**man-power (staff & support under consultancy contract)**: scientific animation and promotion of information and results; support to   coordination/governance.

- **CNES** intends to provide:
  -**Processing services** developed by the French Solid Earth community within the forM@Ter data centre including systematic InSAR processing, DEM processing and optical image correlation.
  -Potential contribution to a pool of specific **human resources** dedicated to the Geohazards Lab initiative

Contributions from space agencies

… so far 4 space agencies …

- **ASI**: shall make available CEOS and GSNL Cosmo-SkyMed **collections through the GEP** (already done for the Nepal event supersite). Further details TBD.

- **DLR**: on a voluntary basis provide:
    - **higher level science products** derived from Sentinel-1 and TerraSAR-X data
    - **access** to the **automated Sentinel-1 interferometric chain**.

Contribution from other CEOS agencies :TBD

Contributions from the geohazards community

Geoscience centers with EO expertise that already have had an active role:

- **CNRS EOST** /France
- **CNRS IPGP** /France
- **COMET** /UK
- **ISTerre/Institut de Recherche pour le Développement (IRD)** /France
- **INGV** /Italy (via the responsible of the Geohazards Supersites and Natural Laboratories initiatives)
- **BRGM** /France (proposing to contribute to harmonize and improve acceptance of platform based EO techniques to support geohazards users*)*
- **CNR-IREA** /Italy (via platform federation activities about InSAR data processing)

(these thematic users are proposing to take part to the Geohazards Lab activity about platform specific issues)

Proposed work

o With CEOS agencies, the Geohazards Lab will take advantage of their mutual capabilities and resources to support on-line processing (with either interoperable but separate platforms or a federated environment, TBD).

o With community partners, it will take advantage of complementarities and identify possible cooperations between different relevant projects (e.g. some geoscience partners provide hosted processing capabilities).

The Geohazards Lab intends to perform the following tasks:

- Unify the method to access services, be it with separate platforms or a federated environment
- Support a common authentication and authorization framework
- Allow users developing EO based services to integrate algorithms & tools in a common shared environment
- Ensure storage and processing resources are available to support on demand processing as requested by users
- Define shared governance rules between the owners & operators of the underlying processing environment
- Make sure the system capabilities enable EO services to be consistent across user groups and in time

Overall the collaboration of platforms under the Geohazards Lab will improve how users exploit EO in an on-line environment.

Examples:

ESA
The GEP will continue to be available for processing: it will be connected to Copernicus DIAS to access EO mission data from EO missions such as for instance Sentinel missions.

DLR
DLR intend to pursue & expand their InSAR Browse service on GEP (confirmed) and are studying the possibility of a new on-line processing capability using TerraSAR-X run be DLR (TBC) and connected to GEP.

CNES and ESA
Work with users from the Form@ter network and GEP users to establish a methodology about the generation of deformation data using InSAR and Optical data (TBC). This will support historical analysis and back analysis using hosted processing with different EO sources.

Users of the Geohazards Lab:

Type of users: typically geoscience centres in particular geohazard experts with skills in satellite EO that process, analyze, validate, integrate data to generate products for DRM purposes to be used by decision-makers (End Users).
End Users aren't intended to be direct users of the Geohazards Lab.

Users come *from several groups:*
- users of   thematic activities of the CEOS WG Disasters i.e. seismic, volcano, landslides and the R.O.
- the GSNL users
- other users of the geohazards community (the Geohazards Lab itends to support other users of the geohazards community that are not in CEOS WG Disaster activities, for instance 60+ geohazards users in the GEP today).

Several scenarios:
- A user runs on demand processing
- A user downloads measurements generated systematically or on request
- A user integrates a new processing chain or or modifies an on line processing chains
- A user runs a chain globally to generate a new derived product

Examples of users

User	Affiliation	Country	Expert user processing data	End user (not doing processing)	Engaged in precursor pilot?
Stefano Salvi	INGV	IT	Expert user		Directly
Christian Bignami	INGV	IT	Expert user		Directly
Cristiano Tolomei	INGV	IT	Expert user		Directly
Haris Kontoes	NOA	GR	Expert user		Directly
Tim Wright	University of Leeds/COMET	UK	Expert user		Directly
Barry Parsons	University of Oxford/COMET	UK	Expert user		Yes
Francesco Casu	CNR IREA	IT	Expert user		Yes
Eric Fielding	NASA JPL	USA	Expert user		Yes
Falk Amelung	University of Miami	USA	Expert user		Yes
Erwan Pathier	ISTERRE / University of Grenoble-Alpes	FR	Expert user		Yes
Marie-Pierre Doin	ISTERRE / University of Grenoble-Alpes	FR	Expert user		Yes
N/A	DPC	IT		End user	No
Issak Parcharidis	HUA	GR	Expert user		No
N/A	OASP	GR		End user	No
Pierre Briole	ENS (Laboratoire de Géologie de l'Ecole normale supérieure)	FR	Expert user		No
Paul Arellano	School of Geological Sciences and Engineering Hacienda San José s/n - Proyecto Yachay	ECU	Expert user		No
Abdelilah Tahayt	University of Rabat	MA	Expert user		No
Fabio Bovenga	CNR ISSIA, GAP srl / Polytechnic and University of Bari	IT	Expert user		No
Tom Ingleby	University of Leeds	UK	Expert user		No
Raphael Grandin	Institut de Physique du Globe de Paris (IPGP)	FR	Expert user		No
Dominique Rémy	Laboratoire de Dynamique Terrestre et Planétaire	FR	Expert user		No
Morteza Sedighi	National Cartographic Center, Tehran – Iran	IR	Expert user		No
Pablo Jose Gonzalez Mendez	University of Liverpool	UK	Expert user		No

Example of users from the Seismic hazards community already using the GEP and potentially interested on the Geohazards Lab, some of them being Seismic pilot users. The Geohazards Lab will support the CEOS, GSNL and GEODARMA users and is open to users from the wide geohazards community.

More examples of users (on GEP today)

User organisation	Areas	
Ecole Normale Supérieure de Paris (France)	Etna, Italy and Corinth Rift, Greece	Volcanoes
DLR IMF (Germany)	European tectonic mask	
Altamira Information (Spain)	Test sites on landslides and earthquakes	Earthquakes
ISTerre / Institut de Physique du Globe de Paris (France)	Subduction zones of Latin America, the NAFZ and Tibet.	
INGV Roma (Italy)	Alto Tiberina Fault and Fogo Cape Verde	Landslides
INGV Roma (Italy)	Marmara, East sector of NAFS	
INGV Roma (Italy)	Haiti and West Java	Subsidence
ETH (Switzerland)	Large surface deformations caused by landslides in Bhutan Himalaya	
NOA (Greece)	Geohazard sites in Greece	
SATIM (Poland)	Silesia & Warsaw (Poland)	
Obs. Physique du Globe de Clermont-Ferrand (France)	Piton de la Fournaise in La Réunion, Cordon del Azufre / Lastarria in Chile–Argentina	
INGV Catania (Italy)	Etna & Campi Flegrei / Vesuvius	
British Geological Survey (UK)	Urban areas of Great Britain	
University of Leeds (UK)	Active deformation in the Alpine-Himalayan belt	
ESA	Over calibration sites: Rain forest, Germany (DLR targets), Australia Milan, Chicago, Sao Paulo	
ESA(Progressive Systems SLR)	Greater Cairo, South Rayan dune field, Middle Egypt province and Aswan province	
CNR IREA (Italy)	Tests on Italian volcanoes and Hawaiian and Japanese volcanic and seismic areas	
Universita De L' Aquila (Italy)	Abruzzo region: L' Aquila and Teramo for post-seismic ground displacements	
University College of London (UK)	UK landslides	
University of Rabat(Morocco)	Morocco seismic activity	

More examples of users (on GEP today)

User organisation	Areas	
CNR ISSIA (Italy)	Indonesia	Volcanoes
IPGP (France)	Asia, N& S America, Indian Ocean	
Universidad de Concepcion (Chile)	Southern Andean zone	Earthquakes
Laboratoire de Dynamique Terrestre et Planétaire (France)	South America active volcanoes and tectonics	
BRGM (France)	French coast subsidence	Landslides
AIM CEA (France)	La Reunion	
National Cartographic Center (Iran)	Iran	Subsidence
Instituto Geologico y Minero de Espana (Spain)	SouthEast Spain	
USGS (USA)	Latin America volcanoes	
CVGHM (Indonesia)	Indonesian and Mexican volcanoes	

- ➢ **61** users to date
- ➢ **5** user organisations are **CEOS pilot users** (4 Seismic pilot users and 1 Volcano pilot)
- ➢ Mainly **European users,** but also 11 users from **Asia** (Indonesia, Thailand, Malaysia and Iran), **Africa** (Algeria, Morocco), **South America** (Chile, Mexico) and **North America** (USA).

Collaborations

- **GEODARMA:** provide access to data, tools and processing resources (on a best effort basis) to GEODARMA.

- **GSNL:** support the GSNL objectives by providing access to a processing environment. Host scientific products generated by Supersites and integrate collaboration and scientific processing services being developed for the GSNL community under the EVER-EST project.

- **Other CEOS WG Disasters activities:**
  - ✓ fully articulate with current and follow-on CEOS activities
  - ✓ provide a mechanism to access data and a scientific processing and e-collaboration environment.

- **CEOS WGISS activities:** collaborate to support the realisation of a WGISS pilot; identified contribution: the GEP. A workplan has been written to prepare the pilot exercise.

- **nextGEOSS:** on-going discussions to include the Geohazards Lab and its services within the GEOSS Common Infrastructure.

Expected outcomes:

- ➢ Increase access to **hosted processing**
- ➢ Increase **number of users** that access on-line tools to support DRM
- ➢ Increase **type of users** in the different segments of the user base; in particular address more types of hazards; keep focus on EO specialists from these user organisations (the thematic activities of the WG Disasters work with EO experts and end users/decision makers while in the short term the Geohazards Lab is intended to help EO specialists)
- ➢ **Increase awareness/promotion** about satellite EO and DRM for different relevant themes (landslides, seismic hazards, volcanoes): if requested help Pilot Leads of other thematic activities of the WG Disasters to promote results (e.g. publish geospatial results on the Geohazards Lab).

Evaluating achievements:

Criteria	Min. effort
Number of EO processing chains available to the users by the end of the activity	15 chains
Type of EO data available through the Geohazards Lab's on-line platforms	3 SAR and 1 VHR Optical data source
Volume of EO data available through the Geohazards Lab's on-line platforms	100 scenes per data source
Number and quality of products generated on-line	30 products per year
Number of users and practitioners using the Geohazards Lab	30 users
Number and quality of peer reviewed papers based on the work accomplished by the Geohazards Lab	5 papers per year
Success in raising awareness (a) within the scientific community (e.g. through capacity building) and (b) the end users/decision makers (when these are recipients of information products and reports based on the the interpretation of Geohazards Lab's products)	(a) Training courses, workshops and (b) positive feedback from end users, benefit etc.

Milestones and schedule:

Concept Phase: April 2017- Q1 2018

Currently: process of elaboration and discussion between CEOS agencies and other partners of the Geohazards Lab to better define the activities and key outcomes.

Implementation Phase: Q2 2018 – Q1 2021
Year 1:
1. Expand integration of services and tools to better meet community needs
2. Document procedures to access and use processing chains.
3. Define **protocol with CEOS agencies that contribute to the Geohazards Lab**. As a baseline ESA will provide access to the GEP. This protocol is to develop collaboration with agencies willing to contribute to the processing environment (e.g. platform resources federation).
4. Enhance procedure to make data available in a timely fashion.
5. Develop a Web site
6. Start promoting hosted processing and raising awareness (capacity building, training courses, workshops)
7. Analyse geohazards community requirements

Year 2:
1. Develop collaborative framework with geoscience centres and other initiatives to define common standards/methodologies
   (example: agree rules to present terrain motion measurements irrespectively of the processing chain)
1. Start harmonization and improvement of EO results
2. Continue integration of services and tools
3. Validation and use of services and tools
4. Finalize definition of procedures to access and use processing chains.

Year 3:
1. Complete validation and full scale demonstration of services and tools
2. Summarize lessons learnt.
3. Complete implementation of geohazards community requirements
4. Complete harmonization and improvement of EO results

Governance approach

The Geohazards Lab shall be organized according to CEOS WG Disasters rules:

- ❑ **Coordination:** ESA is proposing to play a role (Philippe Bally, Dorella Papadopoulou).
- ❑ **Data access:** Data delivery procedures in collaboration with the Geohazards Lab coordinators; CEOS pilot/follow-on leads, GSNL PoC and GEODARMA PoC shall manage data requests.
  - ➢ the Geohazards Lab does not intend to request EO data (apart from open & free sources).
- ❑ **Processing chains & processing resources** from different infrastructures contributing in the Geohazards Lab will be provided on a voluntary basis by CEOS space agencies and partners.
- ❑ **Platform resources federation**: governance to be defined among the CEOS agencies willing to contribute to the Geohazards Lab.

- ➢ **Proposition of the Geohazards Lab approved** by the SIT in April 2017.
- ➢ **Contributions gathered**: 4 CEOS spaces agencies and 8 partners.

Further contributions are welcome if other CEOS space agencies or partners are interested.

- ➢ A **draft Implementation Plan** was circulated on 30 August (WGDisasters_Geohazards_Lab-ImplementationPlan)
- ➢ The **Geohazards Lab** is aiming for the **approval of its Implementation Plan** in the next CEOS Plenary (October 2017).
- ➢ Aiming to **kick off in early 2018**.

Thank you

For further information: *Geohazards Lab initiative* proposal:

http://esamultimedia.esa.int/docs/EarthObservation/Geohazards/2017-03-13_The_Geohazards_Lab_initiative_Draft_2.0.pdf

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