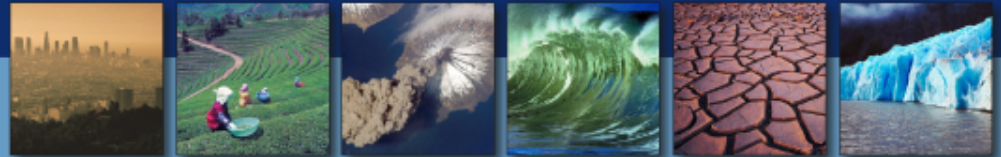


CEOS Disaster Risk Management

CEOS WG Disasters

The Geohazards Lab

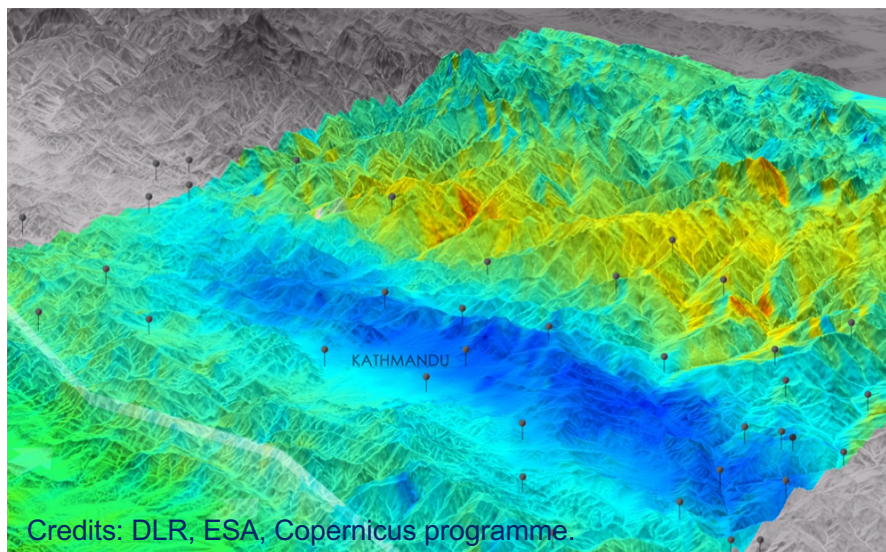
CEOS WG Disasters 9th meeting



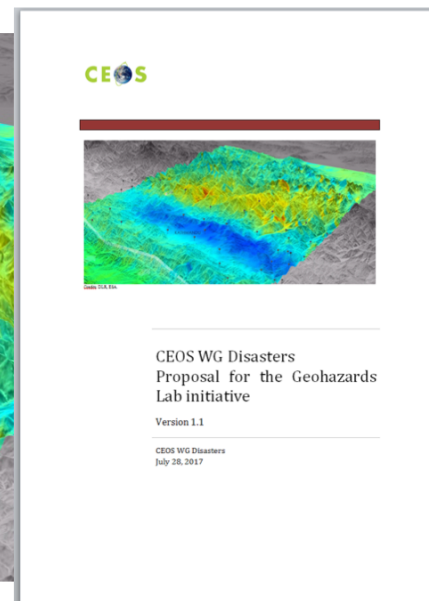
Overview:



- The only CEOS WG Disasters activity focusing on EO processing rather than data
- **Implementation Plan approved** by CEOS SIT during the CEOS Plenary in October 2017
- **Kick-off** in early 2018
- **First results already available** thanks to the on-going activities of the users from the geohazards community on GEP.



Credits: DLR, ESA, Copernicus programme.



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

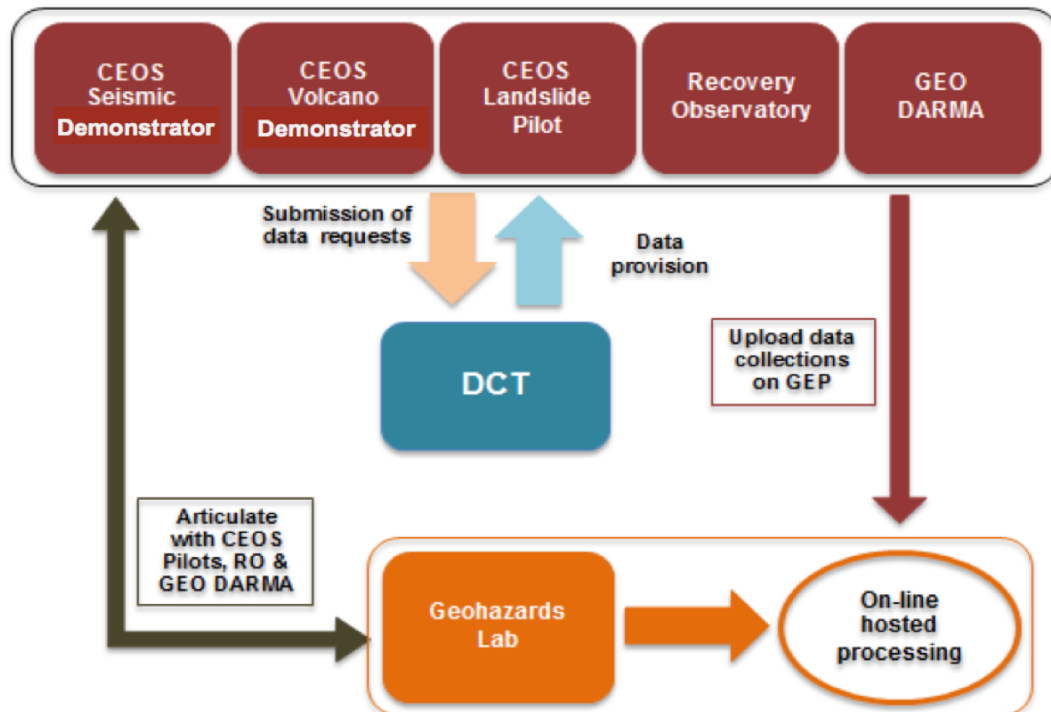
- ✓ Aims to **address priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030** using satellite EO (focus: better understanding hazards & risks)
- ✓ Supports and complements the **CEOS WG Disasters activities** (on-going pilots, follow-on activities and the RO), the **GSNL** and **GEODARMA**.

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.

- 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.
- Can be used to **deliver EO data** e.g. to support CEOS pilot and demonstrator 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.
- Able to deliver **VA products** elaborated by partners on the platform or generated externally (e.g. off line) and published on the platform.



CEOS Concrete objectives concerning DRR activities (1)



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 e.g. with on-line services** (*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 data delivery and 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**

CEOS Concrete objectives concerning DRR activities (2)

Committee on Earth Observation Satellites



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.

Contributions from space agencies



... 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

- ESA, CNES and BRGM committed made an **in-kind contribution by to jointly support a scientific animation activity associated to the Geohazards Lab starting to be conducted by BRGM** in France, in Q3 2017 (the effort is equally supported by these 3 contributors). For more details, see slide 10.

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**.

We welcome contribution from other CEOS agencies!

Contributions from the geohazards community



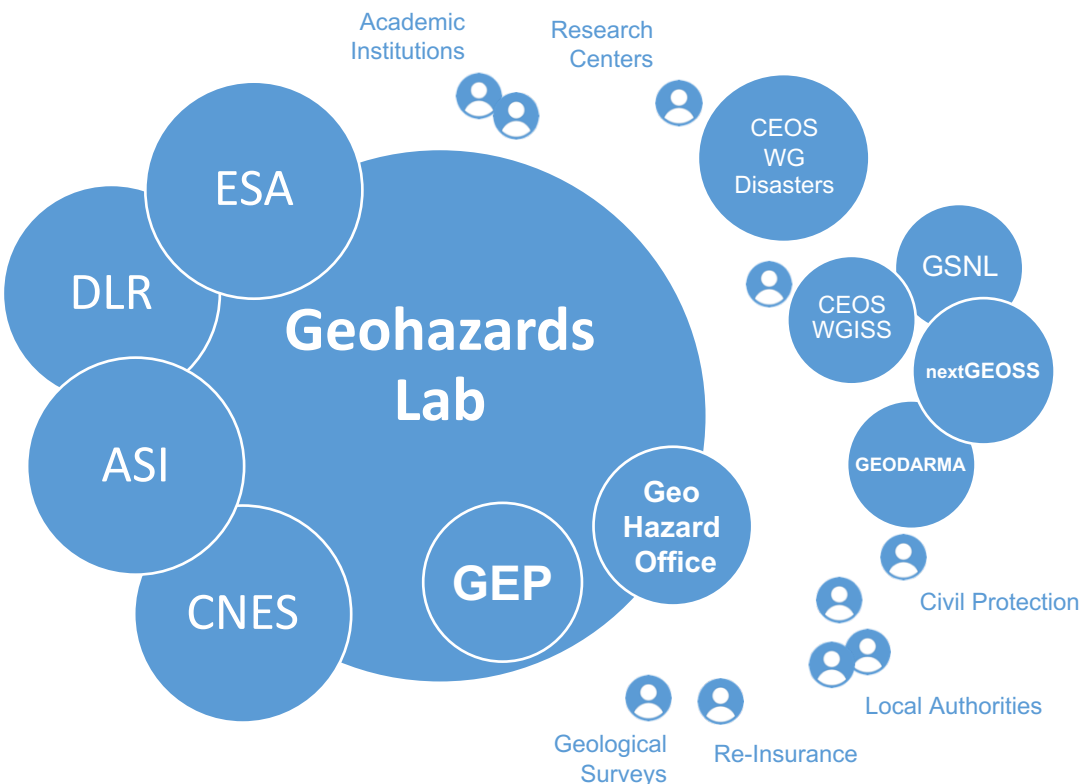
Geoscience centers with EO expertise that already have had an active role:

- **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 provides in-kind contribution (labor) to the GeoHazards Office and takes the lead role
- **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)



An activity of scientific animation within the Geohazards Lab



GeoHazards Office Goals:

- Full in line with the Geohazards Lab Implementation Plan
- Liaise with the geohazards community to promote their results when using the Geohazards Lab resources
- Develop collaboration with experts to harmonize and improve acceptance of platform based EO techniques
- Demonstrate and showcase hosted processing services for terrain motion mapping

GeoHazards Office

Examples of Ideas



BRGM Internal EO Workshop

Definition and collection of geoscience users requirements, Foster exploitation of platform-based EO services, Build methodological approach for communication with relevant end users



Demonstration Processing on GEP

Cloud processing on selected pilot sites, Scientific publications



CIEST initiative

Revival of the «Cellule D'intervention et d'Expertise Scientifique et Technique» collaborative framework between research institutes of forM@Ter group



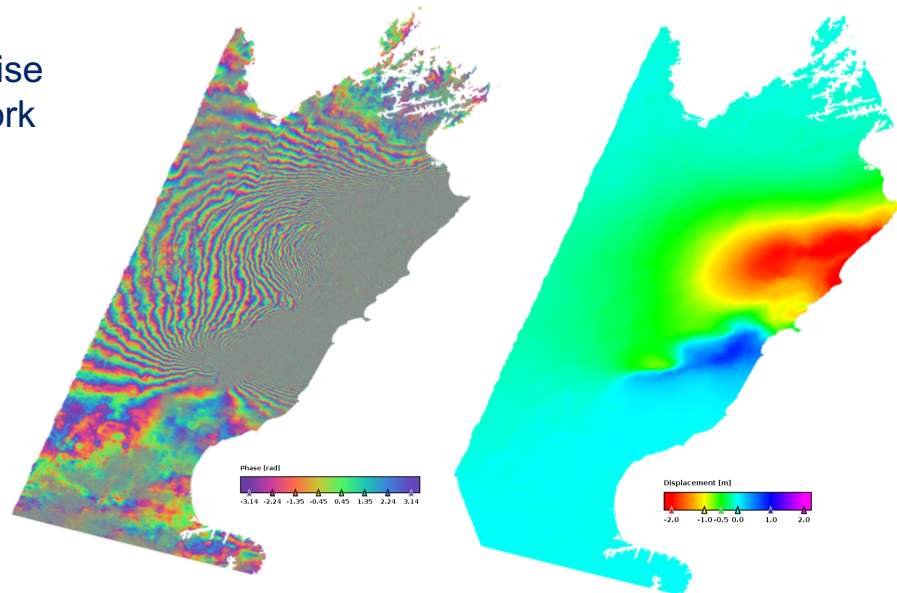
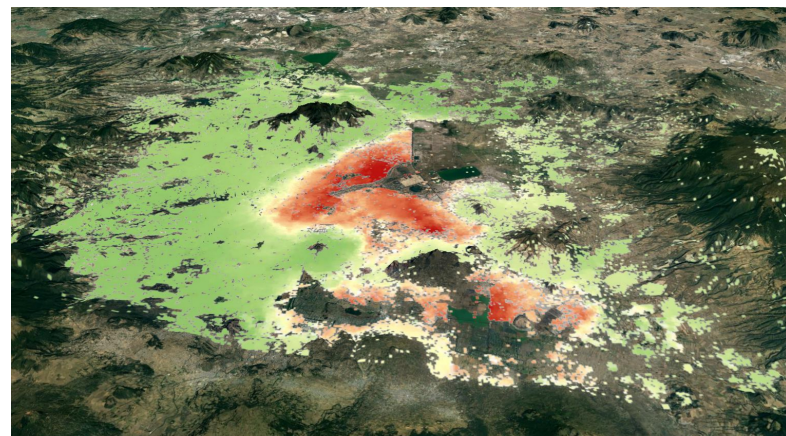
Communication

Develop a webpage in line with the CEOS portal and explore options about a Twitter account to communicate the Geohazards Lab activities



Awareness & promotion

EO4Apls (Geoscience community)
Wegener 2018 (GNSS community)
Cities on Volcanoes 2018 (IAVCEI Commission)



Planned activities for 2018-2019



Taking advantage of mutual capabilities and resources of CEOS agencies to support on-line processing within a federated environment (e.g. ESA's GEP, CNES's form@ter, DLR's InSAR processor) and of Geohazards Lab partners.

the following activities are anticipated:

- Identify opportunities for platform resources federation** (*ESA, CNES, DLR*)
- Define governance rules between the owners & operators of the underlying processing environment** (*ESA, CNES, DLR and other*)
- Set up a scientific Working Group (WG) to work on the definition and harmonization of EO techniques for terrain motion** (*e.g. ESA, CNES, BRGM, INGV, ASI*)
- Plan first meetings with the Scientific WG** (*BRGM, ESA*):
 - 1st meeting foreseen for October 2018 (possibly during the ϕ -Lab week)
 - 2nd meeting foreseen for April 2019 (possibly during EGU 2019)
- Pursue gathering of CEOS and GSNL datasets to support processing** (*ESA, ASI, DLR, CNES, INGV/GSNL*)
- Develop and feed a webpage in line with the CEOS portal and Twitter account** (*BRGM, ESA*)

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:**

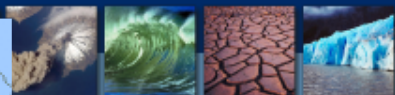
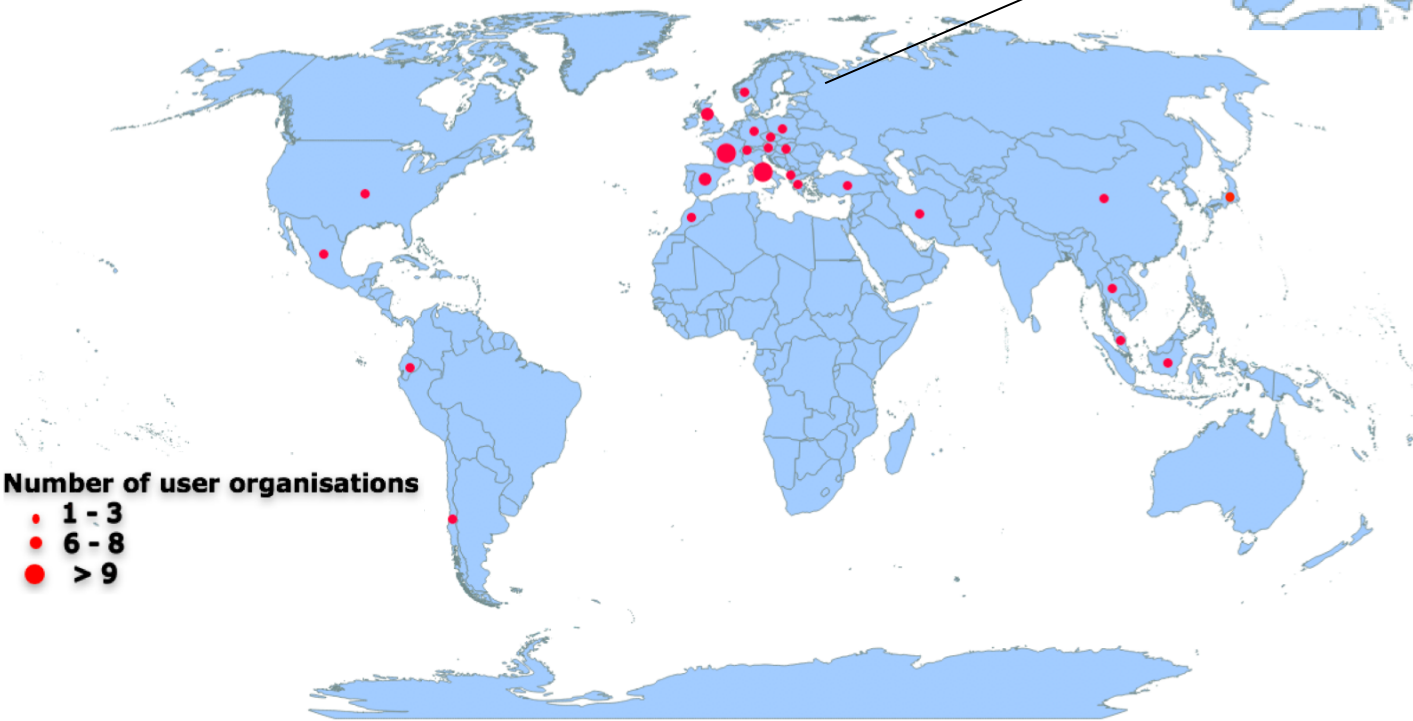
- users of **thematic activities of the CEOS WG Disasters** i.e. seismic, volcano, landslides and the R.O.
- the **GSNL users**
- other users of the **geohazards community** (the Geohazards Lab intends to support other users of the geohazards community that are not in CEOS WG Disaster activities, for 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

March 2018: 63 user organisations on-boarded (71 users)

Geographic Distribution of GEP Early Adopters



Country	Number of User organisations
FR	11
IT	10
ES	8
UK	6
GR	3
DE	2
CH	2
TR	2
US	2
AT	1
CL	1
CN	1
CZ	1
DK	1
DZ	1
EC	1
HU	1
JP	1
ID	1
IR	1
MA	1
ML	1
MX	1
NO	1
PL	1
TH	1
Total	63

- That is 21 users from the GEP Consortium and 50 users from the community via the **early adopters programme** in **26 countries**
- Mainly **European users**, but also **15 users from the rest of the world**: **Asia** (Turkey, Thailand, Indonesia, China, Malaysia, Japan & Iran), **Africa** (Morocco, Algeria), **Latin America** (Ecuador, Mexico and Chile) and **North America** (USA).

More examples of users (on GEP today)



User organisation	Areas
Ecole Normale Supérieure de Paris (France)	Etna, Italy and Corinth Rift, Greece
DLR IMF (Germany)	European tectonic mask
Altamira Information (Spain)	Test sites on landslides and 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
INGV Roma (Italy)	Marmara, East sector of NAFS
INGV Roma (Italy)	Haiti and West Java
ETH (Switzerland)	Large surface deformations caused by landslides in Bhutan Himalaya
NOA (Greece)	Geohazard sites in Greece incl. Corinth Rift
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

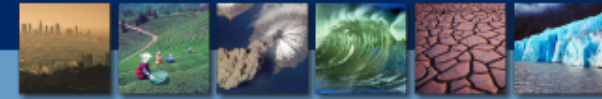
Volcanoes

Earthquakes

Landslides

Subsidence

More examples of users (on GEP today)



User organisation	Areas
CNR ISSIA (Italy)	Indonesia
IPGP (France)	Asia, N& S America, Indian Ocean
Universidad de Concepcion (Chile)	Southern Andean zone
Laboratoire de Dynamique Terrestre et Planétaire (France)	South America active volcanoes and tectonics
BRGM (France)	French coast subsidence
AIM CEA (France)	La Reunion
National Cartographic Center (Iran)	Iran
Instituto Geologico y Minero de Espana (Spain)	SouthEast Spain
USGS (USA)	Latin America volcanoes
CVGHM (Indonesia)	Indonesian and Mexican volcanoes
Yachay Tech (Ecuador)	
CNES (France)	Validation of tools for interferometric coherence over Syria and France
Istanbul Technical University (Turkey)	Deformation time series (volcanoes and faults) and mean velocity maps
Institute of Geodesy Cartography and Remote Sensing (Hungary)	Validated multi-technique of dynamics of anthropogenic ground deformations
Universitat Autònoma de Barcelona (Spain)	Identification of areas affected by wildfires, erosion and debris deposition/ ground motion due to debris deposition in Mallorca island
The Arctic University of Norway (Norway)	Analysis of deformation rates in complex landslides in Austra and Norway

Volcanoes

Earthquakes

Landslides

Subsidence

- **71** users to date
- **6** user organisations are **CEOS pilot users** (4 Seismic pilot users, 1 Volcano pilot 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).

Reporting on Capacity Building

Q4 2017-Q1 2018



Supporting training courses and workshops

- Hands-on course on Optimized computations on GEP for DEM production and the quantification of deformation through optical satellite images during MDIS form@ter workshop addressed to scientific staff and students (Clermont-Ferrand, France, October 2017)
 - Using Université de Strasbourg's MPIC-OPT software
- Training session on the Geohazards Exploitation Platform and CNES's DIAPASON software during a Radar Remote Sensing course addressed to geoscientific staff from African Geological Surveys (Bishoftu, Ethiopia, November 2017).
 - The course was given by the Geohazards InSAR laboratory and Modelling Group of the Geological Survey of Spain (<http://www.igme.es/InSARlab/>).



Although still in its Concept Phase, thanks to its precursor (GEP) and the on-going work performed by early adopters (CEOS and non-CEOS) continuously, the Geohazards Lab has started to support users from the geohazards community:

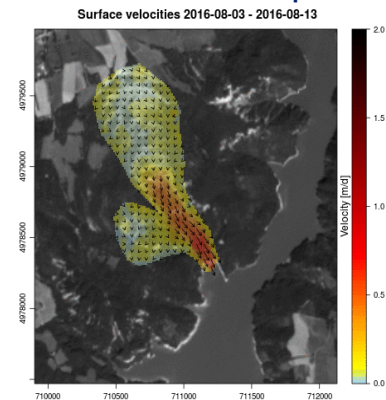
I. Support the GSNL initiative

- ✓ Cosmo-SkyMed data over Supersites have been integrated on GEP.
- ✓ INGV's SISTEM service integrated (post processing displacement maps using the SAR interferometry technique and data from the GNSS technique)
 - Discussions started with EPOS to bring European GNSS data on GEP. Other capabilities have been identified outside Europe (e.g. UNAVCO).

II. Support other CEOS Pilots that are still pursuing their activities and other demonstrator activities

- ✓ **MPIC-OPT service** (Multiple-pairwise image correlation for the monitoring of surface deformation from optical image time-series): Integration is on-going by UNISTRA/CNRS EOST (processing sensor horizontal displacements from time-series of optical satellite images)
- ✓ ESA is working closely with CNES to set up a mechanism to bring Pleiades data on GEP for on-line processing.

*Copernicus Sentinel-2
surface velocities over
the Harmaliere landslide
in French Alps*





III. Support the Recovery Observatory (RO) activity

geohazards
tep

EO data EO-based products Publications Community

EO Free Text Search

TSX-1 SSC ___SM_S SM L1B Sun, 18 Dec 2016 11:53:57 GM

Platform TSX-1
Sensor SAR
Time 2016-12-18T10:53:57.3348610Z
Product SSC___SM_S
Mode SM
Orbit 52747 DESCENDING
Swath strip_009

Published Mar 1st 2018

Download Related search

2016-10-13 2018-02-09

Lon: -66.357 Lat: 21.545

Current search result

Result for OpenSearch query over type ... Total results 49

- TSX-1 SSC ___SM_S SM L1B Sun, 18 Dec 2016 11:53:57 GMT
- TDX-1 SSC ___SM_S SM L1B Sat, 26 Nov 2016 23:54:58 GMT
- TSX-1 SSC ___SM_S SM L1B Sat, 26 Nov 2016 11:54:01 GMT
- TDX-1 SSC ___SM_S SM L1B Tue, 15 Nov 2016 23:55:00 GMT
- TDX-1 SSC ___SM_S SM L1B Tue, 15 Nov 2016 23:54:52 GMT
- TSX-1 SSC ___SM_S SM L1B Tue, 15 Nov 2016 11:54:07 GMT
- TSX-1 SSC ___SM_S SM L1B Tue, 15 Nov 2016 11:53:59 GMT

Features Basket Data Packages

Total results 50

- S2A S2MS1C INSNOBS Level1C 093 171016T092031-171016T092031
- S2A S2MS1C INSNOBS Level1C 093 171016T092031-171016T092031
- S2A S2MS1C INSNOBS Level1C 093 171016T092031-171016T092031
- S2A S2MS1C INSNOBS Level1C 093 171016T092031-171016T092031
- S2A S2MS1C INSNOBS Level1C 093 171016T092031-171016T092031
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- S2A S2MS1C INSNOBS Level1C 093 171016T092031-171016T092031
- S2A S2MS1C INSNOBS Level1C 093 171016T092031-171016T092031

Processing Services

- ✓ TerraSAR-X data over Haiti were made available to the RO users through GEP (51 scenes)
- ✓ Cosmo-SkyMed data over Haiti made available to the the RO users through GEP (111 scenes)

Reporting (3)

Q4 2017-Q1 2018

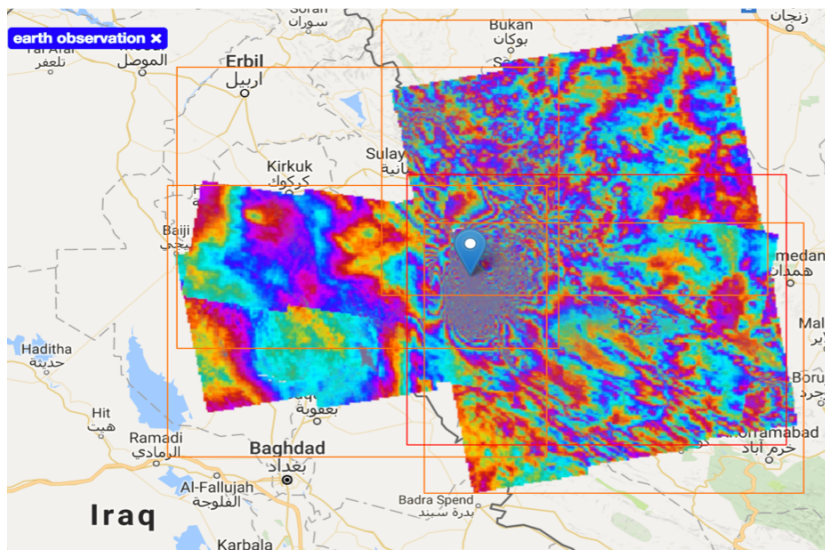


IV. Support GEO-DARMA by providing access to tools and hosted processing about geohazards in the priority areas for risk assessment

Not started yet.

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.)

- ✓ **November 2017 M 7.3 earthquake on the Iran-Iraq border:** 5 interferometric pairs of Sentinel-1 processed by DLR High Resolution InSAR browse, depicting ground deformations for the area affected by the earthquake.
- ✓ Online processing performed by the GeoHazards Office.



Deformation along the radar line-of-sight appears in interferograms as a cyclic series of fringes where each fringe corresponds to the deformation of 2.8 cm for Sentinel-1.

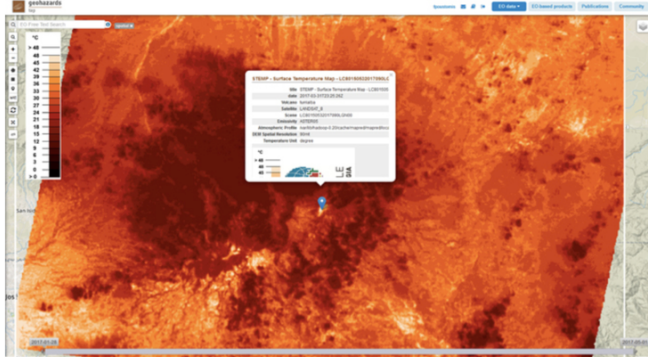
Credits: DLR InSAR Browse service.

Contains modified Copernicus Sentinel data



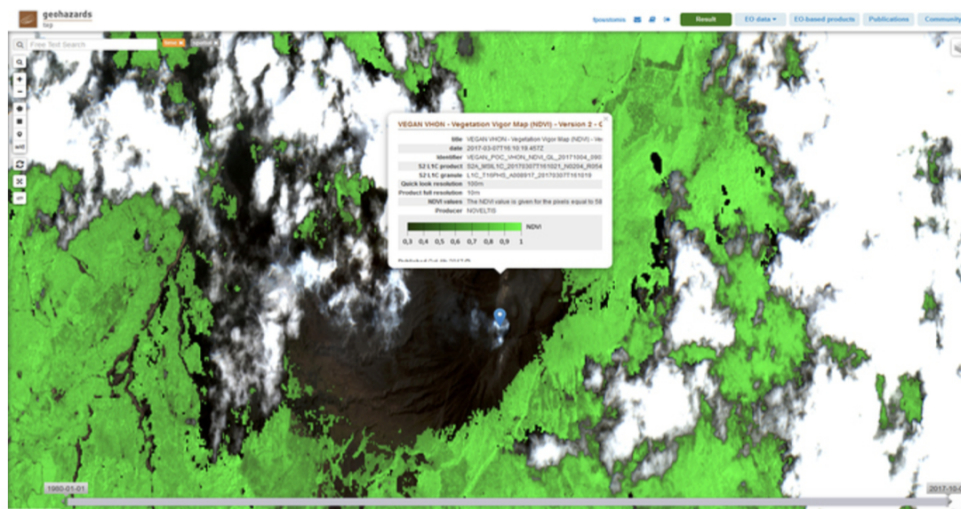
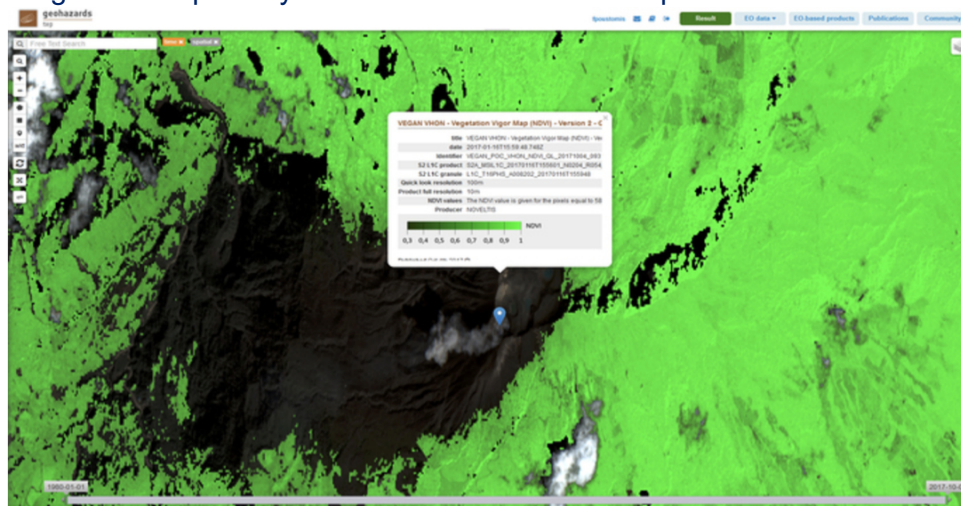
VI. Pursue and support the generation and distribution of other advanced science products e.g. for landslide monitoring, thermal signatures of volcanic eruptions, etc.

- ✓ VEGAN (Noveltis and INGV) products available:
 - ✓ **Hot Spots Detection Maps** for monitoring active eruptions and burnt areas as lava flow, lava lakes or fires during and after the eruptions
 - ✓ **Vegetation Vigor Maps** systematically derived from Sentinel-2 at high resolution (10 meters) over the monitored regions. Surface temperature maps
 - ✓ **Surface Temperature Maps (STEMP)** before, during and after a crisis.



STEMP generated' surface temperatures using Landsat 8 data. Credits: INGV

The figure below shows the impact of the eruption of Turrialba volcano in January 2017 on the vegetation at the West. Two months later, the vegetation is partially back. Contains modified Copernicus Sentinel data.





Promotion and Capacity Building

Presentations and posters

- ISTerre presented the use of GEP and the VO-2 Trial Case on Volcanoes at **MDIS 2017** in the poster entitled "Integration of Sentinel data into volcano monitoring devices: example of Merapi volcano, Indonesia" by V. Pinel, F. Beauducel, Raditya Putra, A. Budi Santoso, R. Grandin, M.-P. Doin, P. Bascou.
- ESA presented the GEP in the **1st Workshop of the Remote Sensing and Space Applications Committee** in Greece.

Papers

- [The scientific journal "Remote Sensing" have published a paper about the GEP's SBAS InSAR Service](#)

Training

- [GEP Training for the African Geological Surveys](#)

Web articles and social media



- [Operational monitoring on GEP of volcanic eruptions and their impact on agriculture and vegetation](#)
- [The scientific journal "Remote Sensing" have published a paper about the GEP's SBAS InSAR Service](#)
- [Interferograms processed by the DLR's High Resolution InSAR browse depict deformations after the November 12, 2017 M 7.3 earthquake at the Iran-Iraq border](#)
- Social media: Continue to advertise the evolutions of the platform, the participation to events/conferences, availability of new results produced on the GEP on Twitter and prepare posts about GEP v2 functionalities and services.

Status and milestones for 2018



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

Although, Implementation Phase has not started, some first results are available.

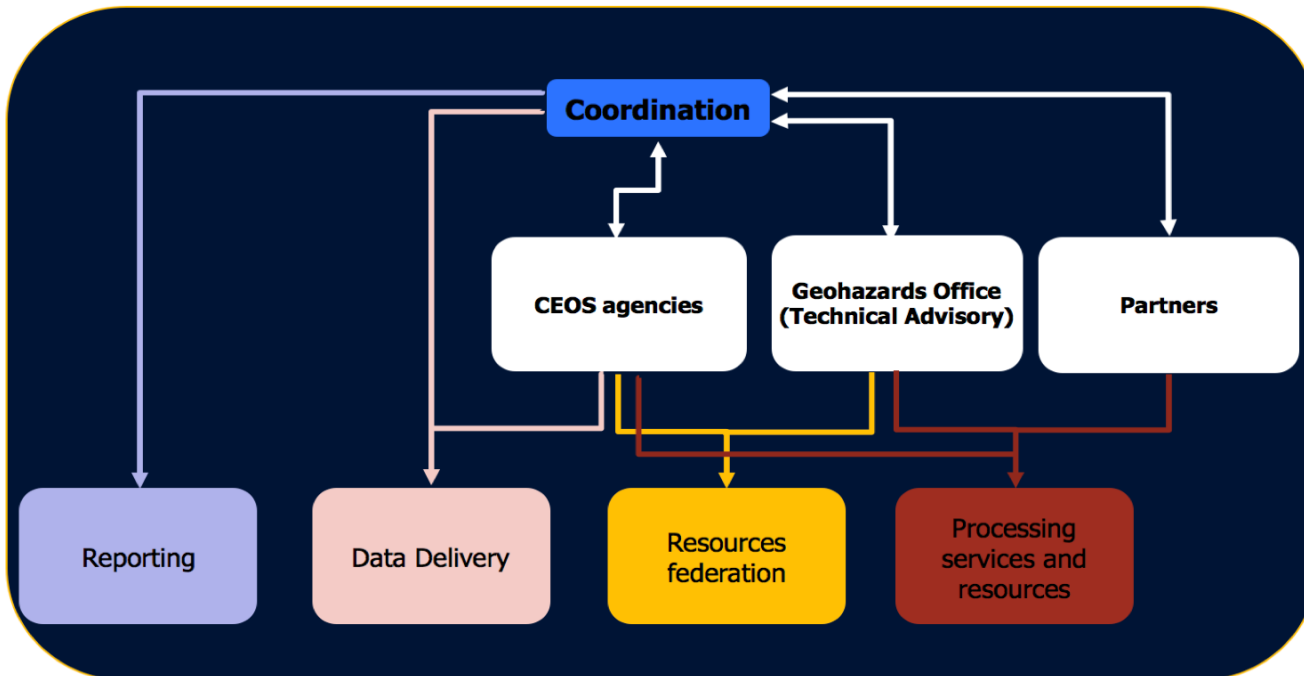
Milestones of Year 1 of the Implementation Phase	Status
Expand integration of services and tools to better meet community needs	Started
Document procedures to access and use processing chains	Not started
Define protocol with CEOS agencies that contribute to the Geohazards Lab. As a baseline ESA will provide access to the GEP	Not started
Enhance procedure to make data available in a timely fashion	Not started
Develop a Website/Webpage	Started
Start promoting hosted processing and raising awareness (capacity building, training courses, workshops)	Started
Analyse geohazards community requirements	To start shortly

Governance approach



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

- ❑ Coordination: ESA (Philippe Bally, Dorella Papadopoulou)
- ❑ Technical Advisory/Support: provides in-kind contribution (labor) to the GeoHazards Office and takes the lead role (Michael Fournelis, BRGM)
- ❑ Reporting: ESA (Philippe Bally, Dorella Papadopoulou)
- ❑ Data delivery: Data delivery procedures in collaboration with the Geohazards Lab coordinators; 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.





- **Kick off** in Q1 2018.
- **Concept Phase** continuous until Q2 2018
- **Contributions gathered:** 4 CEOS spaces agencies and 8 partners
- Further **contributions are welcome** if other CEOS space agencies and partners are interested (NASA, CSA, JAXA, European Commission) and in particular on:
 - Sharing their data through GEP
 - Integration of services
 - Capacity building support
- Concrete discussion started with CNES, DLR and ASI about **accessing or processing the EO missions** they provide on GEP
- The scientific animation lead (BRGM) will propose a **roadmap to be shared** before the next WG Disasters teleconference
- **Tools and services:** integration started
- Promotion, awareness raising and capacity building: first activities started
- Webpage (on <http://ceos.org/>) under preparation



Thank you

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