

# *CEOS Disaster Risk Management*

## Proposition to the CEOS WG Disasters:

# The Geohazards Lab

CEOS WG Disasters meeting, 14-16 March 2017



# Overview of the Proposition



- ❑ **New initiative** proposed in the frame of CEOS with already 4 CEOS members intending to contribute
- ❑ Aims to **address priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030** using satellite EO
- ❑ Main goal: ***provide an EO processing & e-collaboration environment to exploit EO data to assess geohazards and their impact***
- ❑ Support and complement **CEOS WG Disasters activities (on-going pilots, follow-on activities and the RO), GEODARMA.**
- ❑ While CEOS activities focus on providing data to users, the Geohazards Lab will complement these activities with additional EO processing. The contribution of the Geohazards Lab is not required for the CEOS activities to achieve their goals.



Based on **lessons learnt from the Seismic Hazards pilot** activity some challenges have been identified:

- ✓ many users aren't aware or cannot afford EO based solutions
- ✓ 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
- ✓ the EO data and derived VA products are costly to generate for the objectives of the community (e.g. with regional/global coverage)

As a contribution from ESA to the CEOS WG Disasters (seismic, volcano and landslides) the **Geohazards Exploitation Platform** has provided an EO processing and an e-collaboration environment. It has demonstrated benefits:

- ✓ support expert users from CEOS and the GSNL with hosted processing
- ✓ support users who aren't processing experts (black boxes)
- ✓ help users in regions with limited bandwidth (EO results versus large EO data files)
- ✓ optimise impact over time with the persistency of results (on-line publication of results).

These concrete achievements from precursor platform activities are the basis for a broader joint approach with several space agencies.



The **Geohazards Lab** is a new initiative to help the user community augment the impact of the CEOS WG Disaster activities.

It is focused on geohazards (seismic, volcano, landslides) and is intended to maximise how user needs are met with hosted processing and e-collaboration by:

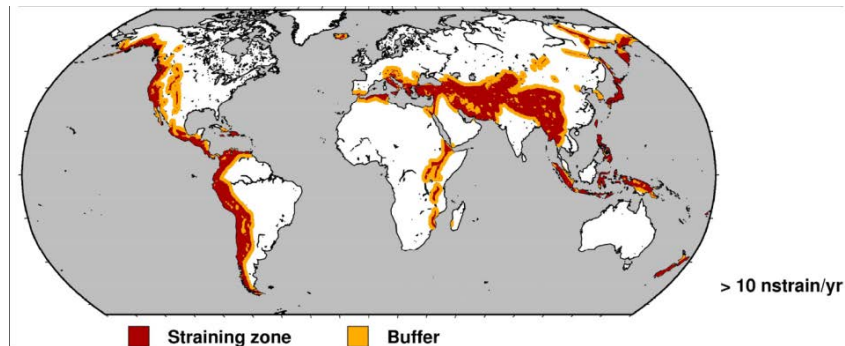
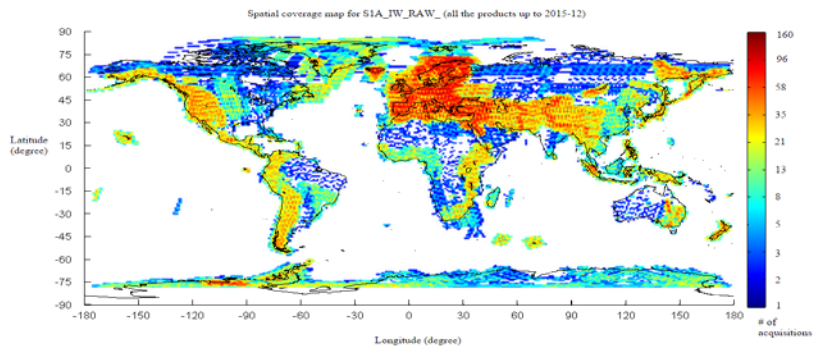
- ✓ addressing the complexity and timeliness of massive volume processing
- ✓ finding more cost effective approaches to achieve greater geographic coverage
- ✓ raising awareness and share results with geoscience centers and end users
- ✓ supporting capacity development activities with on-line solutions

# Examples of challenge & opportunity:



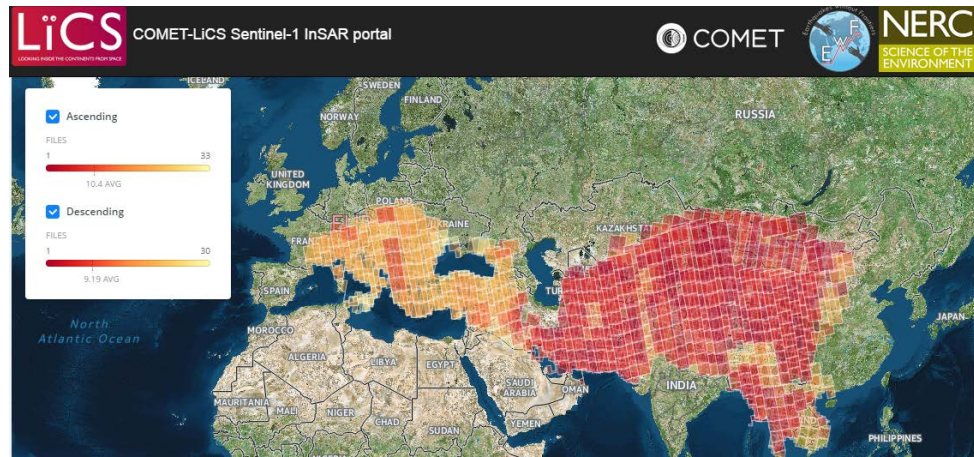
*Sentinel-1 and Sentinel-2 change the way satellite EO is exploited for DRR:*

- 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 challenge & opportunity:

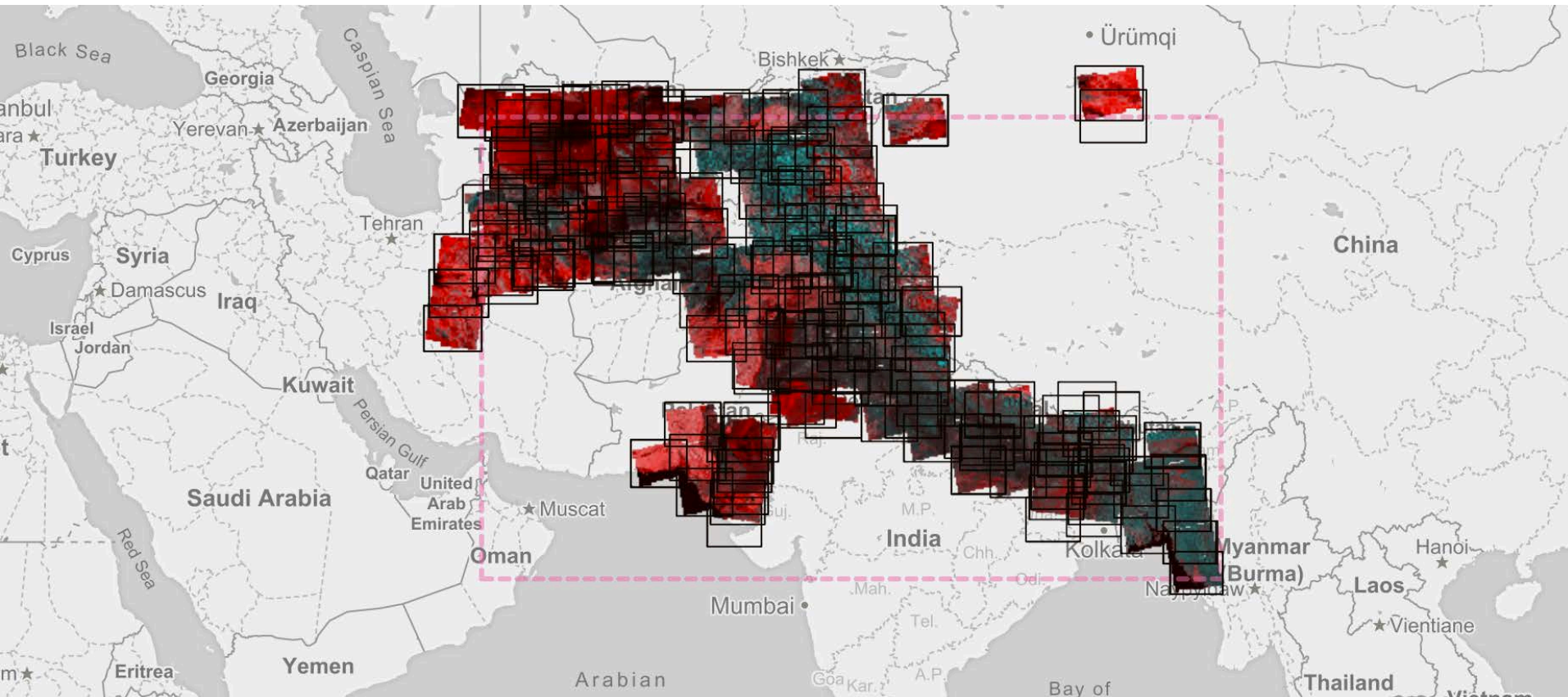


Illustration of the systematic production of the DLR InSAR Browse chain using Sentinel-1 data on the GEP. Region: Himalayas.

*Note: the Geohazards Exploitation Platform is a pilot within the CEOS WGISS*

# Example of the Himalayas:

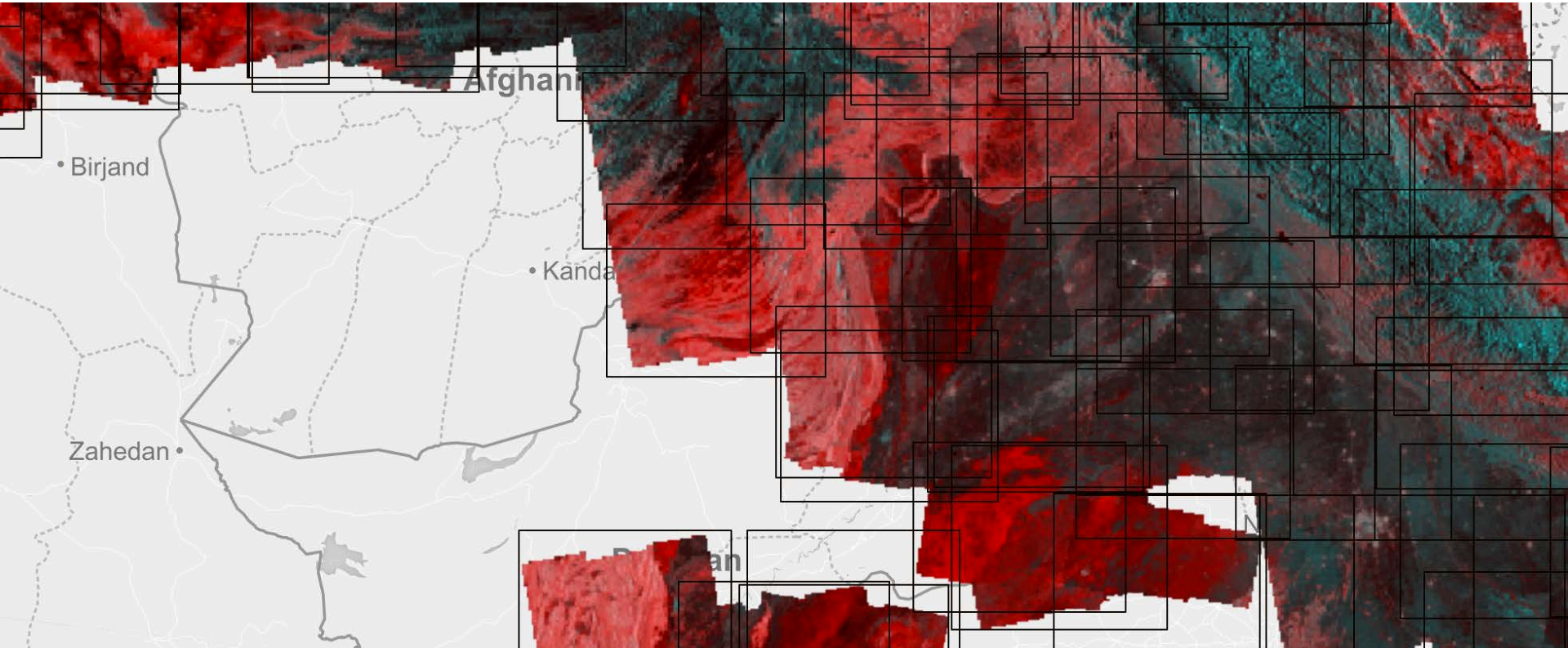


Illustration of the systematic production of the DLR InSAR Browse chain using Sentinel-1 data on the GEP.

# Example of the Himalayas:

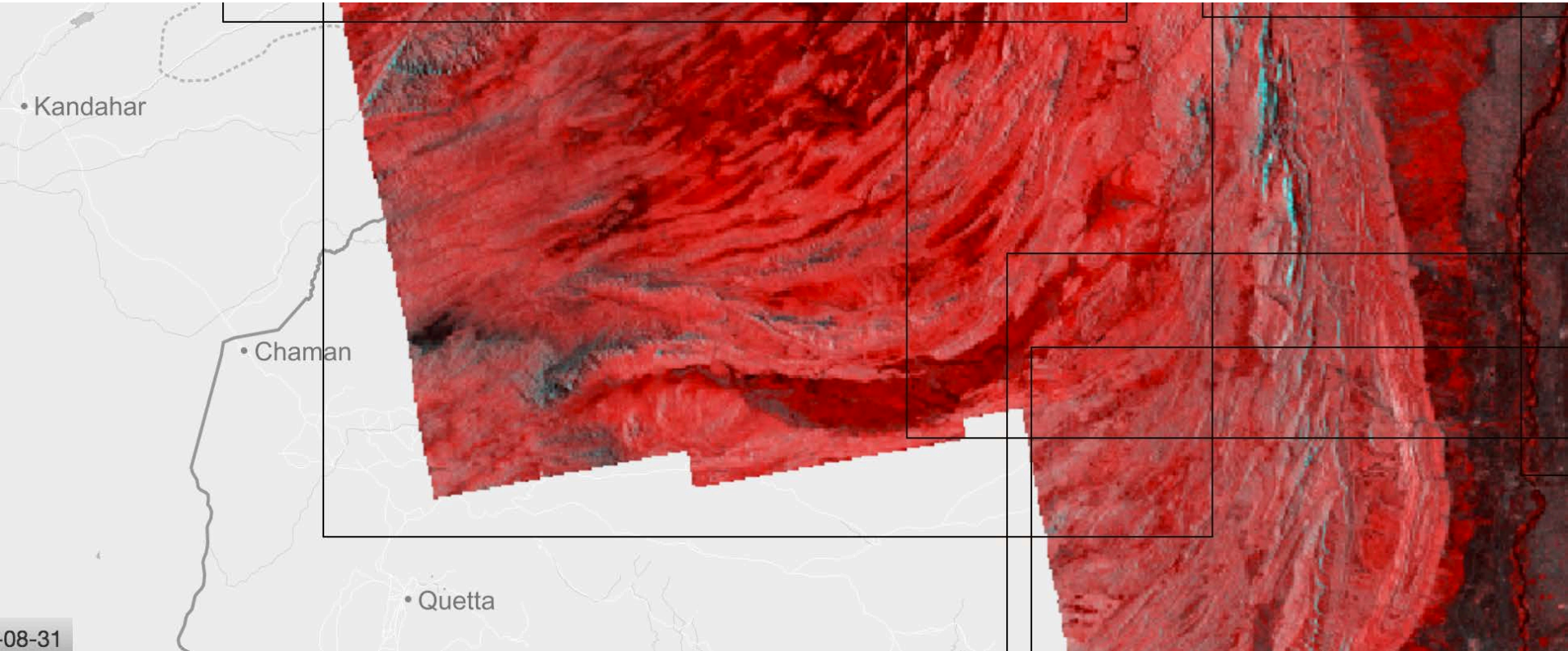


Illustration of the systematic production of the DLR InSAR Browse chain using Sentinel-1 data on the GEP.



# Example with a volcanic area:

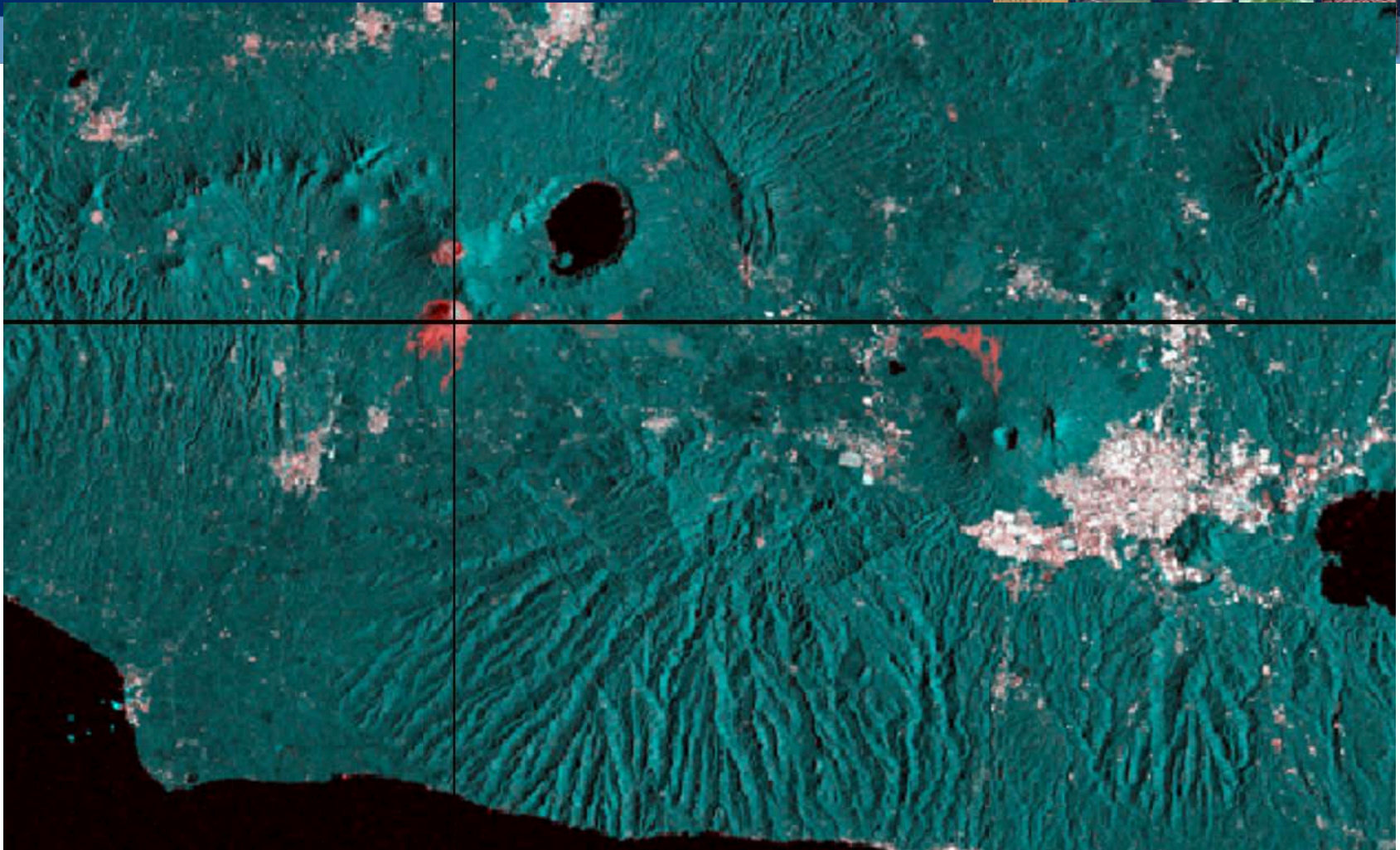


Illustration of the systematic production of the DLR InSAR Browse chain using Sentinel-1 data on the GEP. Region: El Salvador.

# A new activity with the seismic hazards community



A *new activity* is proposed with a view to start in 2017 with the goals to:

- achieve **awareness and acceptance** of EO based solutions with **expert users** (in line with the CEOS pilots, 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,
- increase access to expert users in regions where it is **difficult to download large EO data products** while the results of hosted 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)
- reduce the **cost of EO exploitation** via the mutualization of resources (resources provisioning, processing chains)

# Activities intended



## 1. Pursue & expand hosted processing following the Seismic pilot example:

- provide data access to users: Supplying data is not the priority of the Geohazards Lab
- coordinate the CEOS agencies mutual efforts in the realm of on-line processing for geohazards, enhancing complementarity and identifying possible cooperation between different parallel projects.

## 2. Unify access and exploitation of the assets provided by CEOS contributors:

- make sure that users are aware of the assets available,
- unify the method to access services,
- support common authentication framework to allow users to exploit services, tools and data with a single identity
- allow service integrators to develop algorithms and tools in a common shared environment,
- establish shared governance rules

## 3. Liaise with existing CEOS WG Disasters activities and the DCT to:

- make sure that the data delivery operations of CEOS activities is executed in a smooth fashion via the CEOS WG Disasters DCT
  - exploit complementarity with hosted processing.
- Collaboration of platforms under the Geohazards Lab to improve how users exploit EO in an on-line environment; connected to Copernicus DIAS to access EO mission data.

# Examples of users



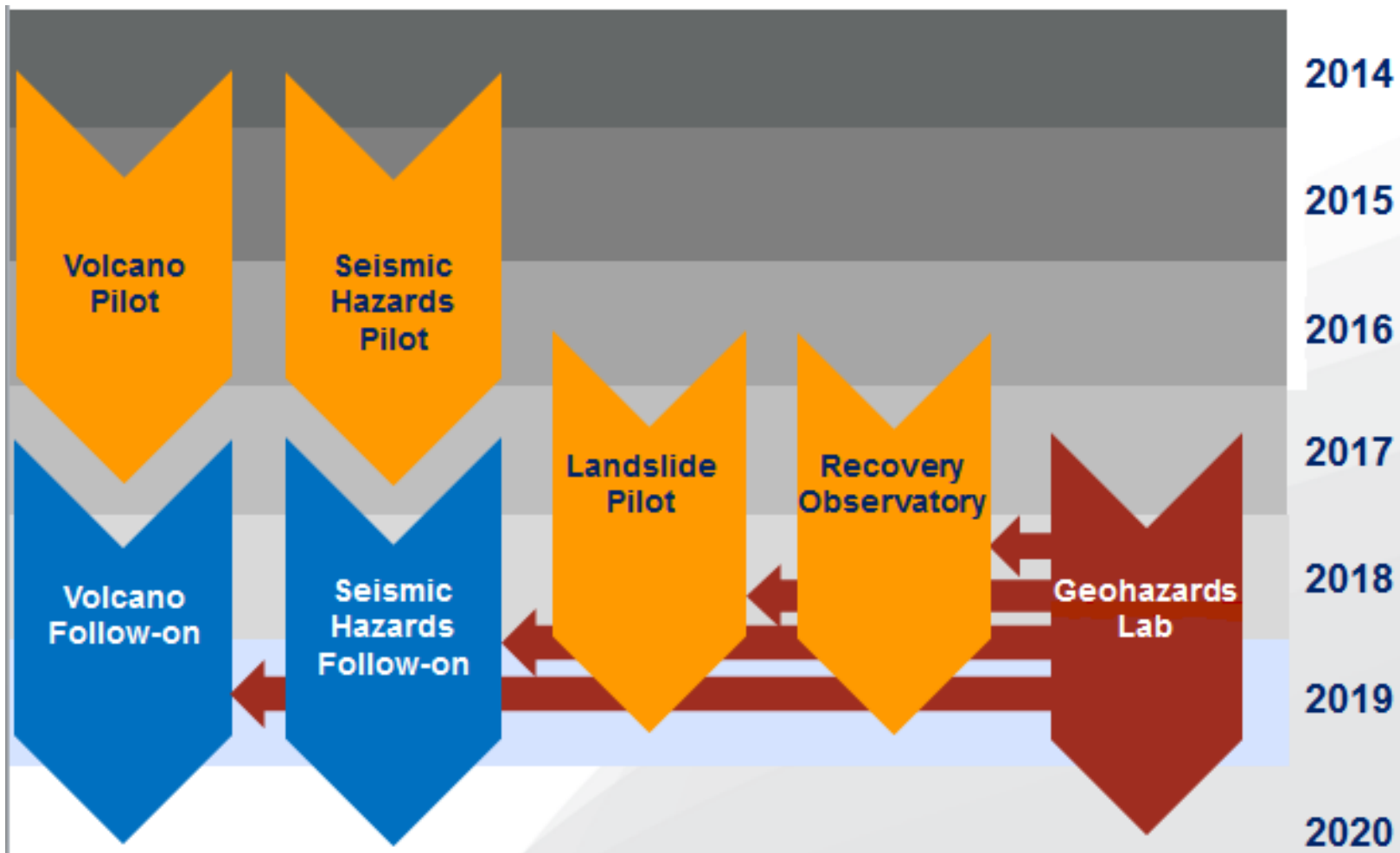
| User                       | Affiliation  | Country | Expert user processing data | End user (not doing processing) | Engaged in precursor pilot? |
|----------------------------|--|---------|-----------------------------|---------------------------------|-----------------------------|
| Stefano Salvi              | 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'École normale supérieure)                              | FR      | Expert user                 |                                 | No                          |
| Paul Arellano              | School of Geological Sciences and Engineering<br>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.**

# The idea of the Geohazards Lab



Support CEOS, GSNL and GEODARMA activities with **data delivery & thematic exploitation, hosted processing** (also available to other geohazards users):





## Not on an emergency basis

- **Processing for hazard and risk assessment** across geohazards themes (tectonics, volcanoes, landslides):
  - support other CEOS Pilots, follow-on activities and the Recovery Observatory
    - common processing tools used and systematic monitoring chains
  - support GSNL (earthquake & volcano supersites)
  - support GEODARMA

## On an emergency basis

- Support the generation of **advanced tectonic products for earthquake response**
- Support **other EO based advanced processing products** e.g. for landslide monitoring, thermal signatures of volcanic eruptions, etc.

# The Geohazards Lab and users



The CEOS WGD Pilots and Recovery Observatory perform EO exploitation activities with these users:

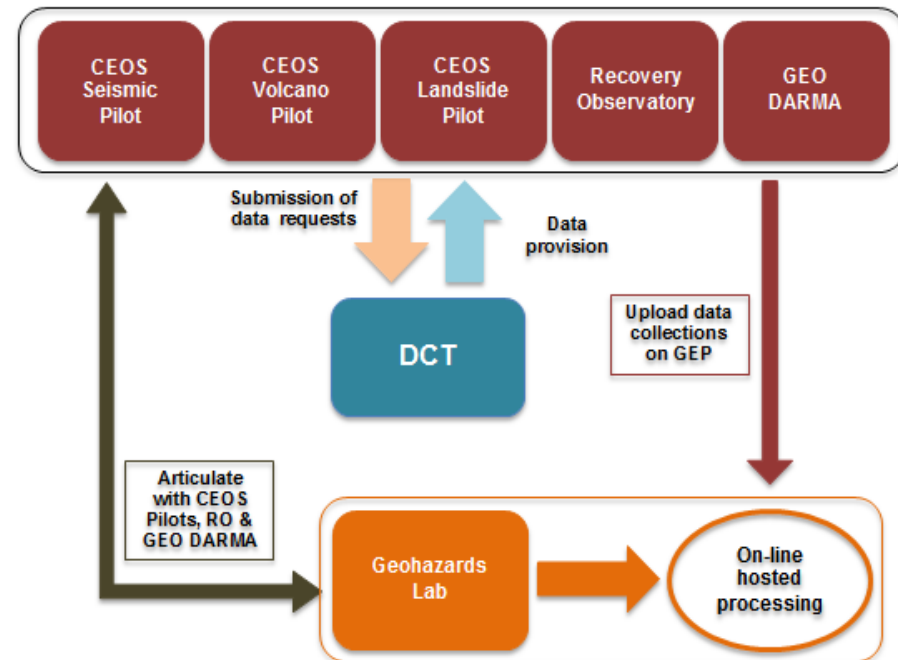
- academia/universities
- geoscience centres & volcano observatories, in some cases EO experts

The Geohazards Lab has the goal to complement them with an additional processing environment. As a baseline the Geohazards Lab intends to support users of WGD Pilots and Recovery Observatory, on a best effort basis provided resources are available. The Lab is also able to support other DRM users not in CEOS

# 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.
- **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.





# 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.
- **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.**

# 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.
- **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

*Contribution from other CEOS agencies :TBD*

# User organisations that expressed interest



## Geoscience centers with EO expertise that have already provided their contribution

- **CNRS-EOST** /France
- **IPGP** /France
- **COMET** /UK
- **ISTerre/Institut de Recherche pour le Développement (IRD)** /France
- **CEO-YachayTech** / Ecuador

## Geoscience centers with EO expertise that might contribute (TBC)

- **NASA JPL** /USA
- **INGV** /Italy
- **CNR-IREA** /Italy
- **HUA** /Greece
- **University of Miami** /USA

# Next steps



- **Identify contributors and users.**
- **Continue identifying resources for oversight/coordination incl. :**
  - manage links with other WG Disasters activities
  - make available the EO processing chains (more than 10+ available in the precursor GEP)
  - organise governance of resources to support hosted processing
  - define a 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)
  - liaise with expert users about data exploitation

This approach will be presented by the CEOS chair in the CEOS meetings in Q2-Q3 2017.



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

Philippe Bally, ESA [Philippe.Bally@esa.int](mailto:Philippe.Bally@esa.int)

Theodora Papadopoulou, ARGANS c/o ESA [Tpapadopoulou@argans.co.uk](mailto:Tpapadopoulou@argans.co.uk)