Seismic Hazards: a key theme of the CEOS WG Disasters

Earthquake-induced landslides, Sichuan Province, China, May 12, 2008. Photograph courtesy of Dr. Yin Yueping, China Geological Survey, Ministry of Land and Resources, China.

- *WHY?* Most devastating global disaster – large number of events and largest number of fatalities (large events); EO can support increased understanding of risk. EO also supports response and other phases (c.f. International Charter).

- *WHAT'S MISSING?* Large data collects over seismic strain belt (15% earth surface) to improve scientific knowledge of seismic hazard; partners to analyse data to generate surface strain model based on interferometric SAR analysis. GSNL provide EO data for improved scientific understanding but only over limited areas. Science products for EQ response (M>5.8 not covered by GSNL, data types for science not covered by Charter).

Objectives of the CEOS Seismic Pilot led by ESA & DLR:

A. Support the generation of **globally self-consistent strain rate estimates** and the mapping of **active faults** at the global scale by providing EO InSAR and optical data and processing capacities to existing initiatives, such as the iGSRM

   [role of EO: wide extent satellite observations]

B. **Support and continue the GSNL** for seismic hazards and volcanoes

   [role of EO: multiple observations focused on supersites]

C. Develop and demonstrate advanced science products for **rapid earthquake response**.

   [role of EO: observation of earthquakes with M>5.8]

Global priorities of CEOS seismic pilot

The CEOS WG Disasters also has a Pilot on Volcanoes

The "Santorini Conference" organised by ESA and GEO:

- **140+ participants from 20 countries** including European countries, the US, Canada, Japan and China.
- **70+ organisations**: international organisations, public institutes, space agencies, universities & private sector.

The Thematic Exploitation Platforms (TEP)

ESA has started **Thematic Exploitation Platforms** initiative covering six thematic areas: hydrology, polar, coastal, forestry, urban & geohazards.

The **Thematic Exploitation Platforms goals** are:

→ **Facilitate use** & processing of large datasets (including non-space data) by a large number of users (science and non-science)

→ Processing services, software (e.g. toolboxes, etc.) and computing resources

→ Provide an **environment for services development**, integration and exploitation

→ Federate user communities around common scientific & thematic objectives

→ Promote **shared science objectives** & better use of satellite EO

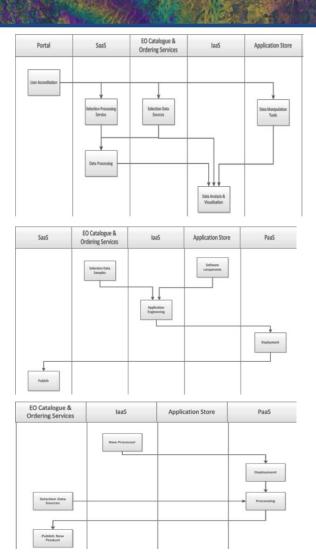→ Collaboration tools (e.g. knowledge base, open publications, social networking)

Benefits to users

EO Data Exploitation which allows a user to discover/select data and pre-existing processing service and **process data**; and visualize/analyse or select and apply data manipulation tools to the result

New EO Service Development which allows a user to discover/select a data sample and software components; **engineer (or upload) & validate an application (e.g. a processor) and deploy it on the platform** for use also by other users.
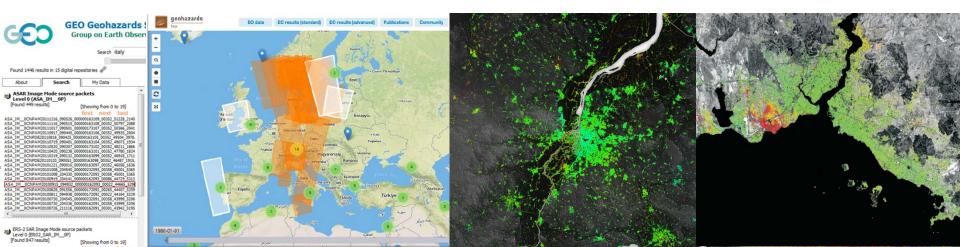
New EO Product Development, which allows a user to Authenticate; alternatively upload and deploy a new processor; discover/select data; **process data and eventually publish the resulting product**.
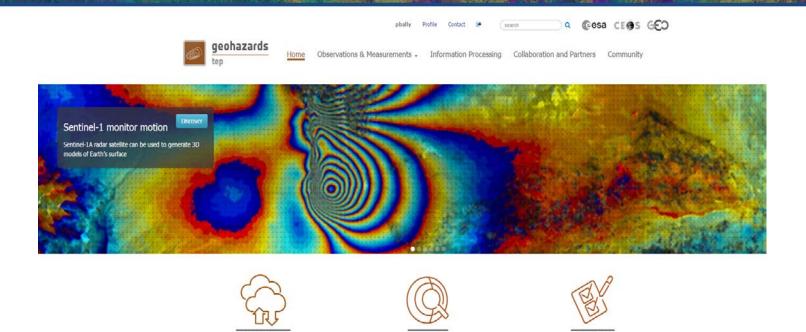
The Geohazards Exploitation Platform

- As part of the Thematic Exploitation Platform initiative, ESA is developing the Geohazards Exploitation Platform (GEP) to bring the **User closer to the data** for new services and products generation

- An ESA funded activity **on technological innovation** to demonstrate the benefits of an exploitation platform for large scale hazard mapping.

- An enhancement and harmonization of the precursor **SuperSite Exploitation Platform** (SSEP) and the **ESA EO Virtual Archive** designed to support the **Geohazards Supersites and National Laboratories** (GSNL).

- The GEP takes into account the broader needs of users engaged in the **CEOS WGDisasters** Pilots on seismic hazards and volcanoes and other user groups.

The Geohazards Exploitation Platform

An Exploitation Platform under development and validation that is sourced with **data and processing** relevant to the GeoHazards theme:

- Data **storage** concerning wide extent tectonic analysis for which large data stacks are needed (typically 1000+ and 5000+ scenes and larger)

- Access to **advanced processing tools** (e.g. InSAR)

- A **collaborative** work environment and scientific animation

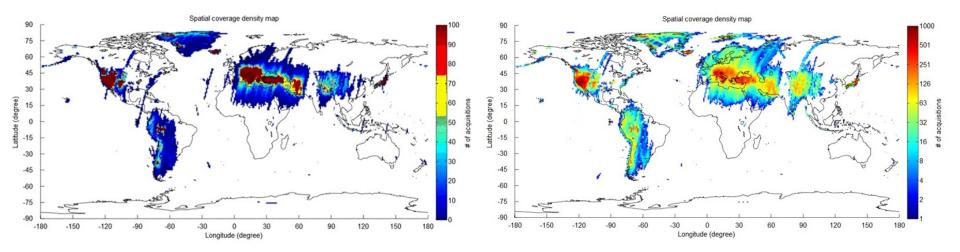- Current developer: **Terradue (IT)**; partnership with **CNR-IREA (IT)**

Available ERS, Envisat & Sentinel-1A SAR data

Sentinel-1 made available starting with CEOS Pilot targets and with the goal to gradually cover large community targets within 2016.

ERS & Envisat SAR data:

- Current ENVISAT ASAR IM Level-0 Data : > 60200 products (~30TB)

- Current ERS SAR IM Level-0 Data : > 56500 products (~28TB)

ERS & ENVISAT Level-0 data available as of **September 2014**

ERS & ENVISAT Level-0 data available as of **March 2015**
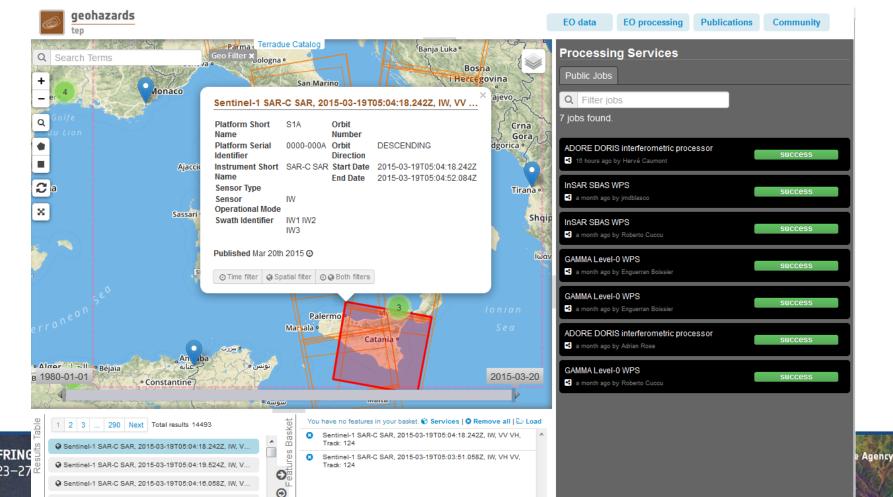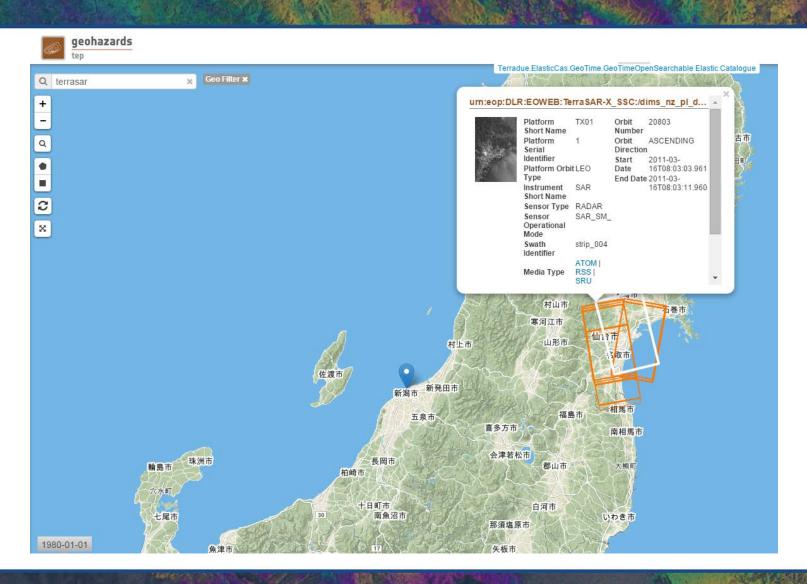
Available Sentinel-1 data

Sentinel-1 data **(same coverage as SciHub)** is directly available in GEP for launching **EO processing** services (no dissemination)

Contact: https://geohazards-tep.eo.esa.int, contact: geohazards-tep@esa.int

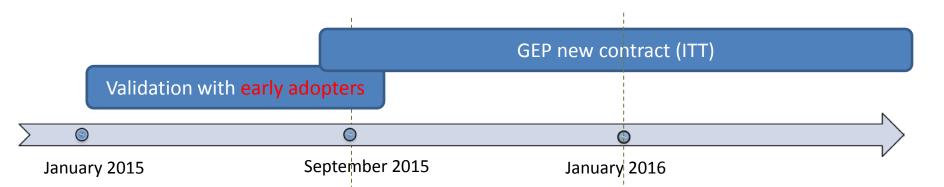# Visualization of collections from CEOS members

At this stage the Geohazard Exploitation Platform:

• Provides a **geobrowser** able to search & map data collections from platform repository and from repositories of CEOS partners contributing data from outside the platform

• Allows using **Cloud appliances** (on demand processing) and have the test data available (as if on an external drive)

• Allows use of a **Developer Sandbox** to develop and integrate new scientific applications and subsequently exploit them against larger sets of data & computing resources

• Allows the users to **consume** via the geobrowser **Web Processing Services** exposed by the user's processing appliance as a Platform as a Service (PaaS) model.

• Exploits third party Web Processing Services such as **G-POD services**.

• Exposes appliances with **SBAS, Gamma Toolbox, ROI-PAC, StaMPS, Doris , GMTSAR, PF-ASAR, Basic SSEP Toolbox, MATLAB and IDL**.

• Processors currently under integration: **Sentinel-1 Toolbox, DIAPASON, NSBAS, S-1 INSAR QL Processor (DLR)**.

GEP Roadmap:

GEP new contract (ITT)

Validation with early adopters

January 2015 — September 2015 — January 2016

Limited to early adopters (under invitation), evolution of the service on-going

Available:
- (evolving) EO Data Exploitation
- (evolving) New EO Service Development

Open under approval, consolidation and limited evolution of the service

Available:
- EO Data Exploitation
- New EO Service Development
- (limited) New EO Product Development

Open, consolidated and stable service

Available:
- EO Data Exploitation
- New EO Service Development
- New EO Product Development

Aim of validation phase:
i) to test the first version of GEP (QW)
ii) get user feedback & further tune the solution to user's needs

GEP Validation started March 3rd:

Sentinel-1A based change image of Villarrica eruption (Chile) using pre-event (20/02/2015) and post-event (04/03/2015) acquisitions.
International Charter Space & Major Dissaters activated on 3 April by ONEMI (Chile).
Blue: increase of the radar backscatter (melting of snow and ice)
Cyan: surface roughness increase (melting of snow and the accumulation of volcanic material (volcanic ash, lava flows and tephra)
Work performed by DLR on 5 March in the framework of the ASAPTERRA project originated by ESA (R&D action).

Platform *Early Adopters,*
Validation Phase started in March 2015
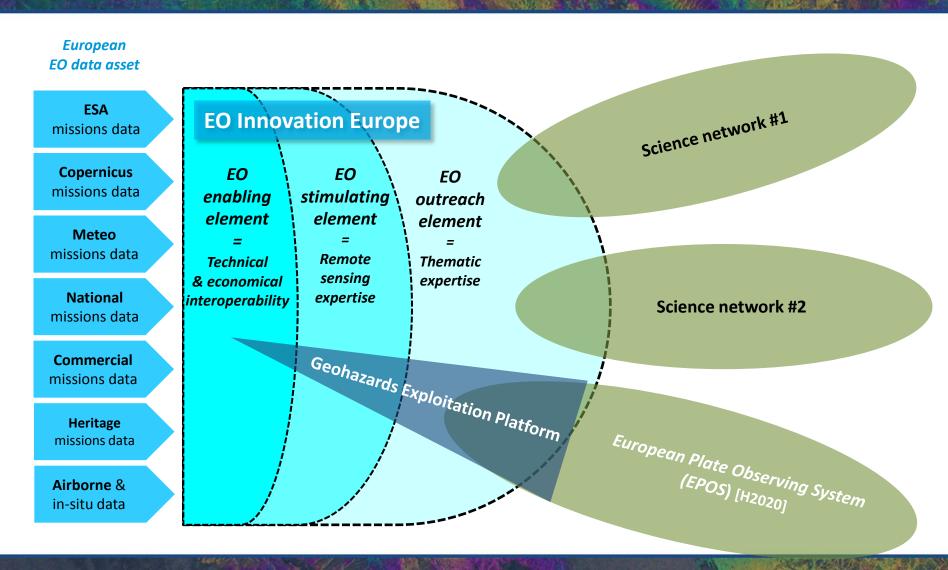
User organisation	Processors	Areas
Ecole Normale Supérieure de Paris	TBD	Etna, Italy and Corinth Rift, Greece
DLR IMF	S-1 INSAR QL	European tectonic mask
Altamira Information	DIAPASON	Test sites on landslides and earthquakes
ISTerre / Institut de Physique du Globe de Paris	NSBAS	Subduction zones of Latin America, the NAFZ and Tibet.
INGV Roma	SBAS	Alto Tiberina Fault and Fogo Cape Verde
INGV Roma	GAMMA	Marmara, East sector of NAFS
INGV Roma	SBAS	Haiti and West Java
CNR IRPI Torino	SBAS	Muliple sites volcanoes, earthquakes, landslides
NOA (Greece)	ROI_pac, DORIS, Stamps, SBAS	Geohazard sites in Greece
SATIM	DORIS , ADORE, StaMPS	Silesia & Warsaw (Poland)
Obs. Physique du Globe de Clermont-Ferrand	DIAPASON	Piton de la Fournaise in La Réunion, Cordon del Azufre / Lastarria in Chile–Argentina
INGV Catania	StaMPS, GAMMA, SBAS	Etna & Campi Flegrei / Vesuvius
British Geological Survey	SBAS	urban areas of Great Britain

Want to apply for the early adopters phase (limited slots)? geohazards-tep@esa.int

Exploitation platforms within *EO Innovation Europe*
→ linked with large science networks and ecosystems

European EO data asset

- ESA missions data
- Copernicus missions data
- Meteo missions data
- National missions data
- Commercial missions data
- Heritage missions data
- Airborne & in-situ data

EO Innovation Europe

EO enabling element = Technical & economical interoperability

EO stimulating element = Remote sensing expertise

EO outreach element = Thematic expertise

Geohazards Exploitation Platform

Science network #1

Science network #2

European Plate Observing System (EPOS) [H2020]

Two young boys look at parts of the city previously devastated by the 2004 Boxing Day earthquake and tsunami on December 23, 2009 in Banda Aceh, Indonesia. (Ulet Ifansasti/Getty Images) #