

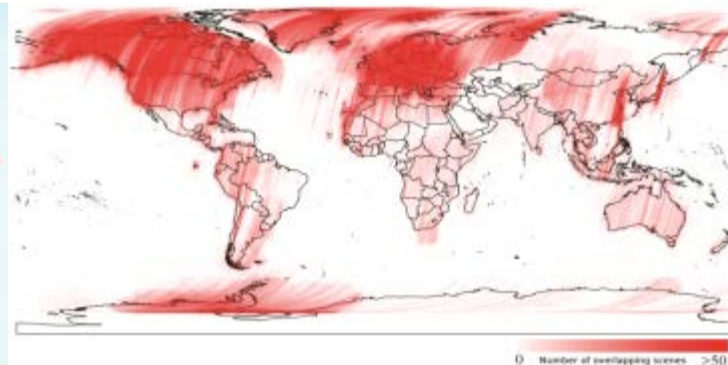
The Geohazards TEP

Philippe Bally

ESA, April 2015



THE DISASTER RISK MANAGEMENT CYCLE



Innovation in space...

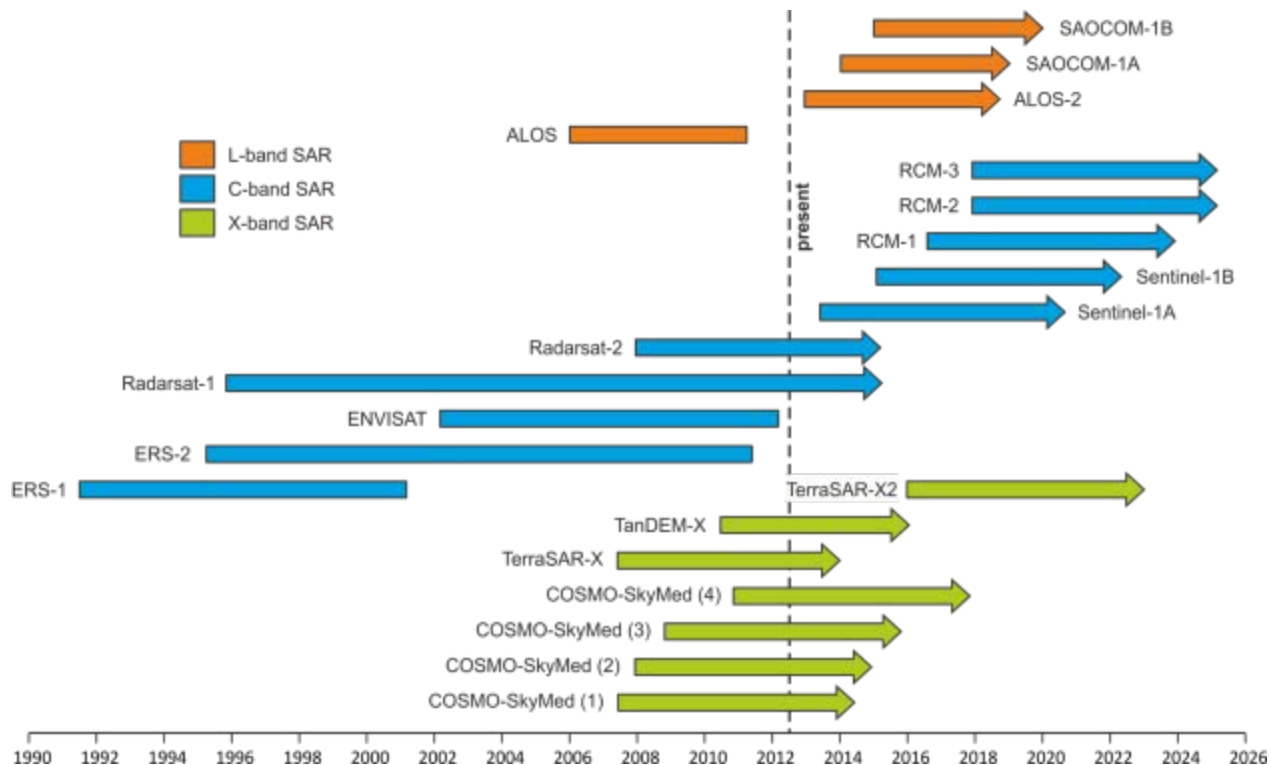


ESA is operating EO missions providing very large collections of large files

Sentinel-1: three Terabyte per day (projection: 10 Tera with S1-A & S1-B)


One year ~ 1 Petabyte

ERS & ENVISAT data over **world tectonic regions ~ 1 month** of S1-A acquisitions



EO data Supply vs Consumption

(from the Santorini conference)



Theoretical(*) volume of data acquired by Sentinel-1
(~465-700 scenes per day
i.e. 23-35 000 000 km²)

173-260 times extent of Greece

*[*assuming 17-26% duty cycle]*

Volume of production similar to Terrafirma
(~750/yr equivalent to 43 000 000 km²)

EO Supply capacity **200 - 300 times** larger than levels of exploitation of current levels of service delivery

ESA has started to apply **innovative approaches: TEPs**

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)

Objectives of the geohazards community:



- 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

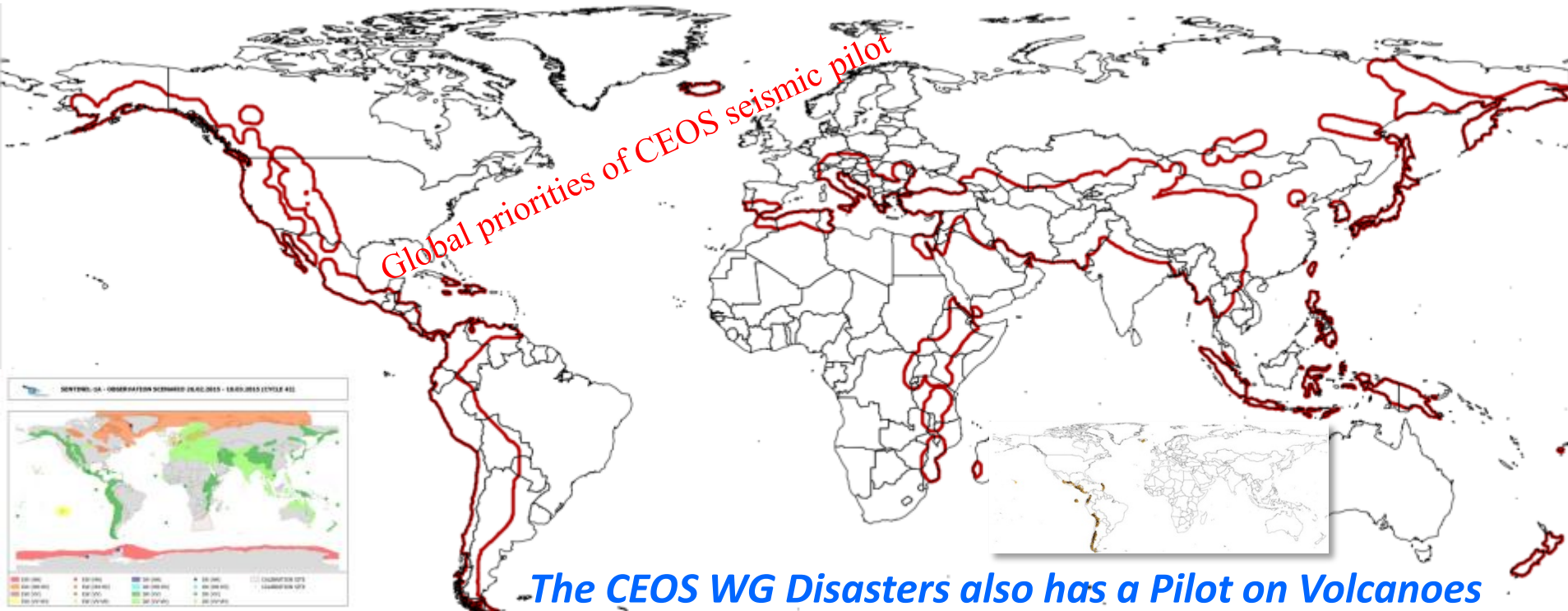
[role of EO: wide extent satellite observations]

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

[role of EO: multiple observations focused on supersites]

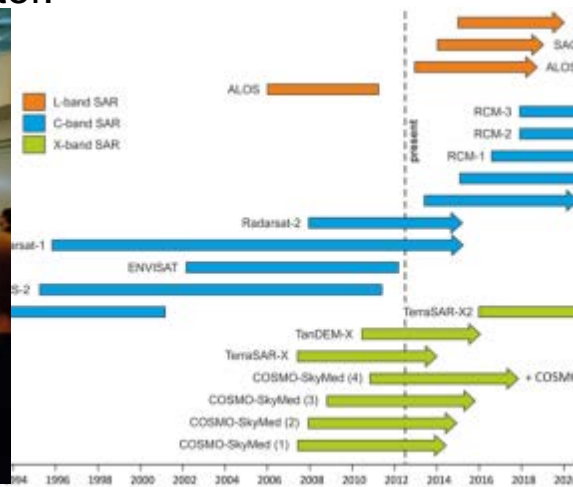
- C. Develop and demonstrate advanced science products for **rapid earthquake response**.

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



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.



GEO GROUP ON EARTH OBSERVATIONS 

→ THE INTERNATIONAL FORUM ON SATELLITE EO AND GEOHAZARDS

The Santorini Conference
Santorini, Greece, 21-23 May 2012

Ph. BALLY (Editor)
ESA/ESRIN

→ INTERNATIONAL FORUM ON SATELLITE EARTH OBSERVATION FOR GEO-HAZARD RISK MANAGEMENT
21-23 May 2012 | Santorini Convention Centre | Greece



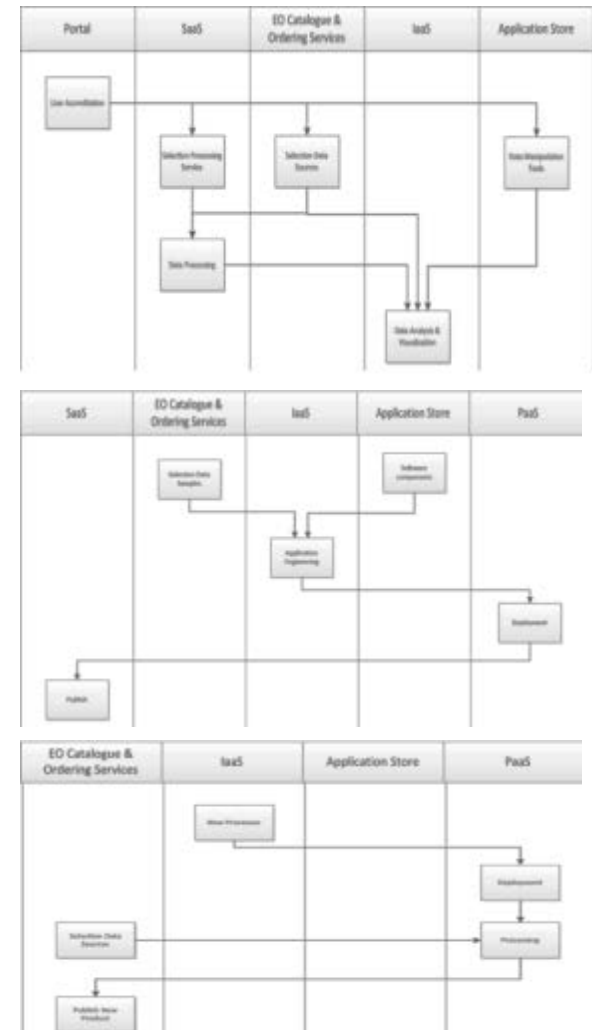
Benefits to users



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.

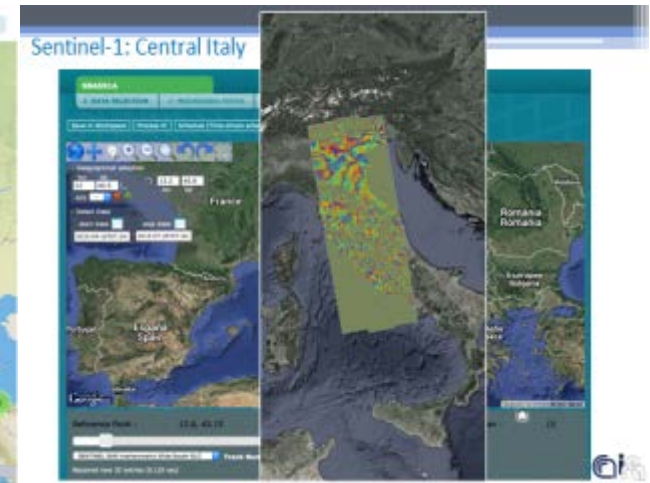
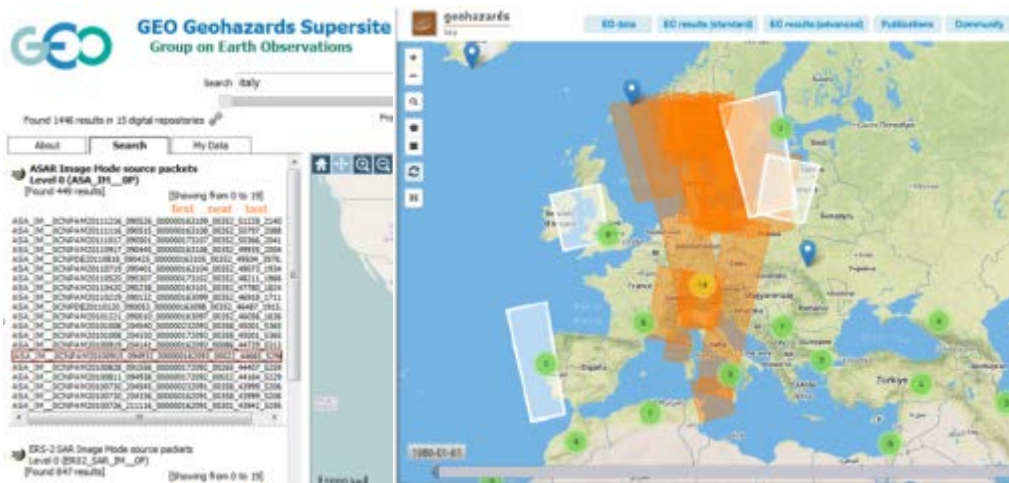
New EO Product Development, which allows a user to Authenticate; alternatively upload and deploy a new processor; discover/select data; process data and eventually publish the resulting product.



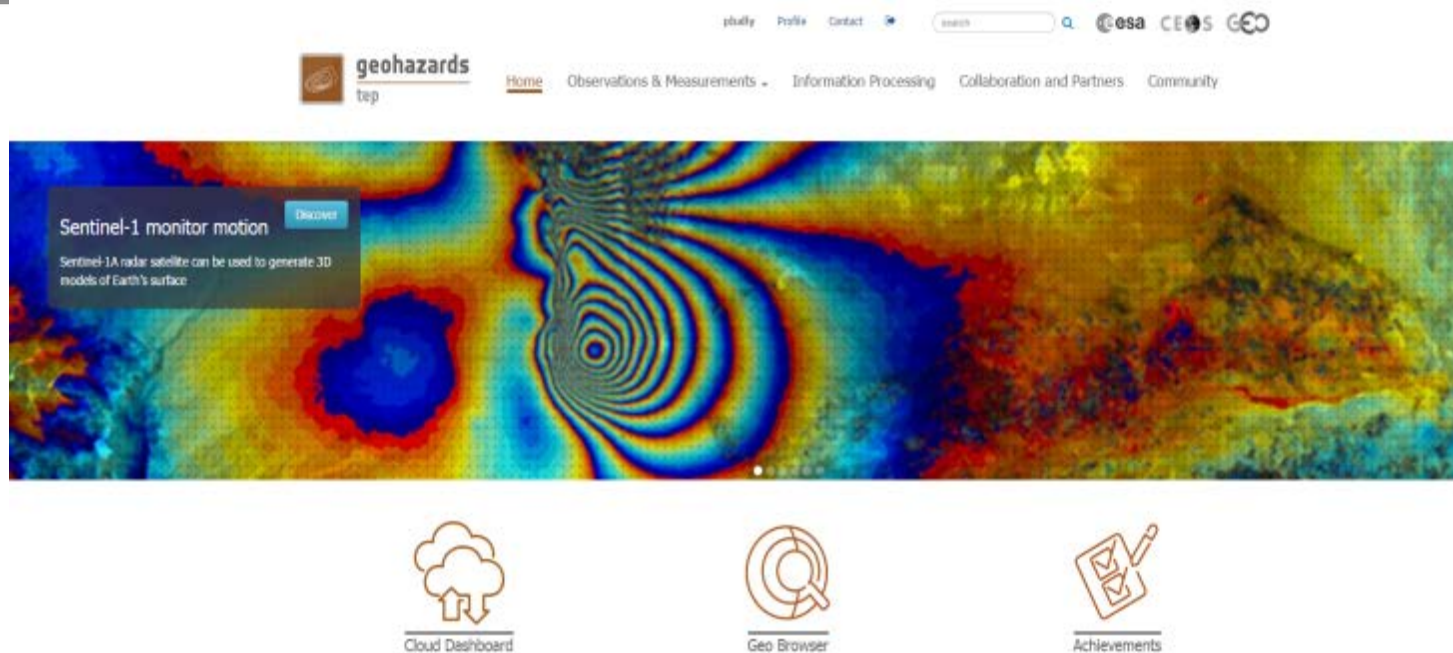
Overview of the GEP:



- ESA is developing the geohazards platform (GEP) that is based upon the **virtualization & federation of satellite EO methods** to support the geohazards community.
- An enhancement of the precursor SSEP platform (GPOD) designed to support the **Geohazard Supersites (GSNL)** and the **Geohazards community** via the CEOS WG Disasters.
- An ESA funded **R&D activity** to demonstrate the benefits of an exploitation platform for large scale hazard mapping and monitoring and to link with with large science networks.
- A **2 years Contract starting on 22 October**; Team: Terradue (IT), CNR IREA (IT), INGV (IT), DLR (DE), ALTAMIRA Information (ES), University of Strasbourg (F), ENS/CNRS (F).



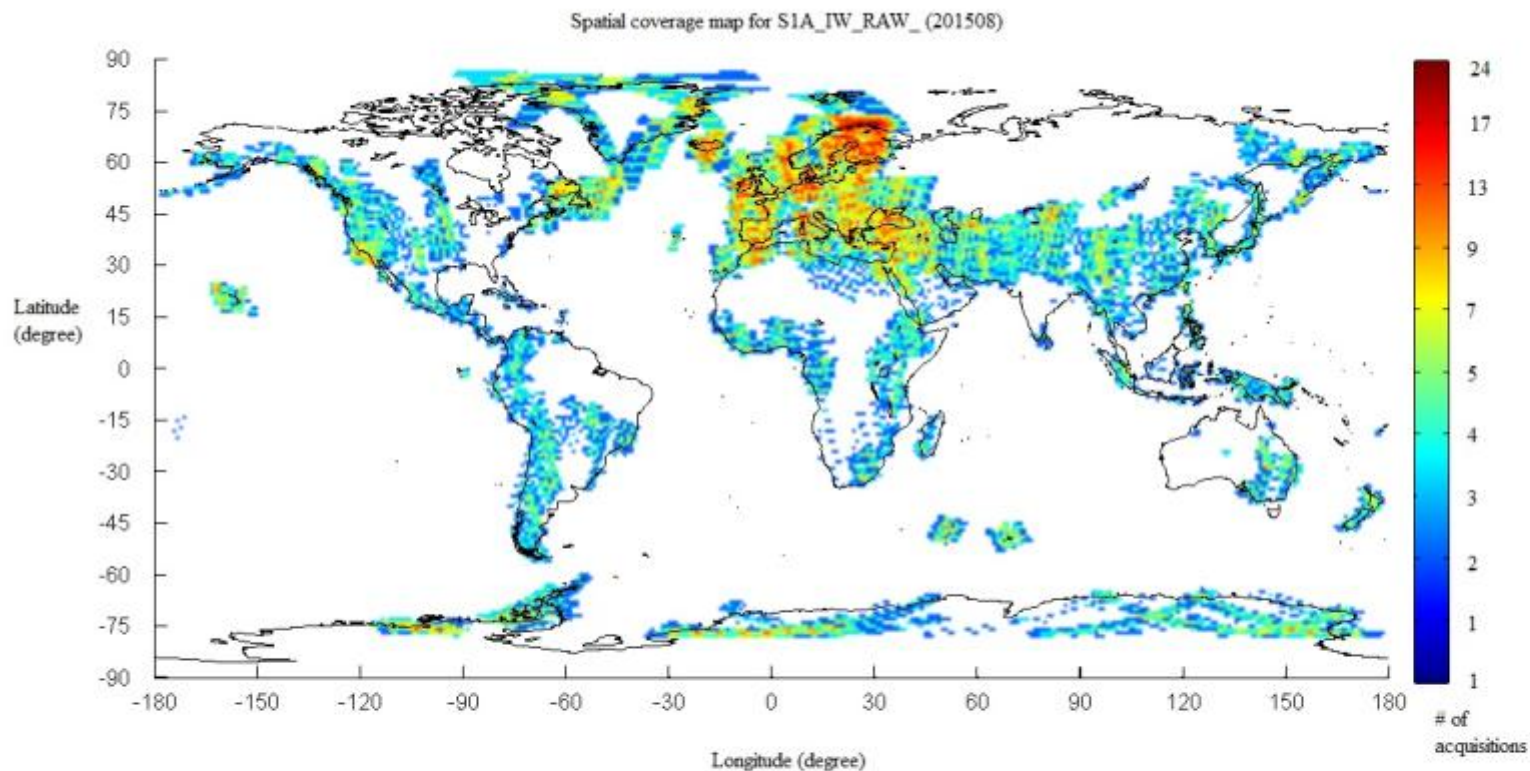
The Geohazards Exploitation Platform



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

- **EO 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 and Optical based)
- A **collaborative** work environment and scientific animation
- 2015: **22 users** on board; end 2017: **60 users**
- One of the *6 Thematic Exploitation Platforms* originated by ESA

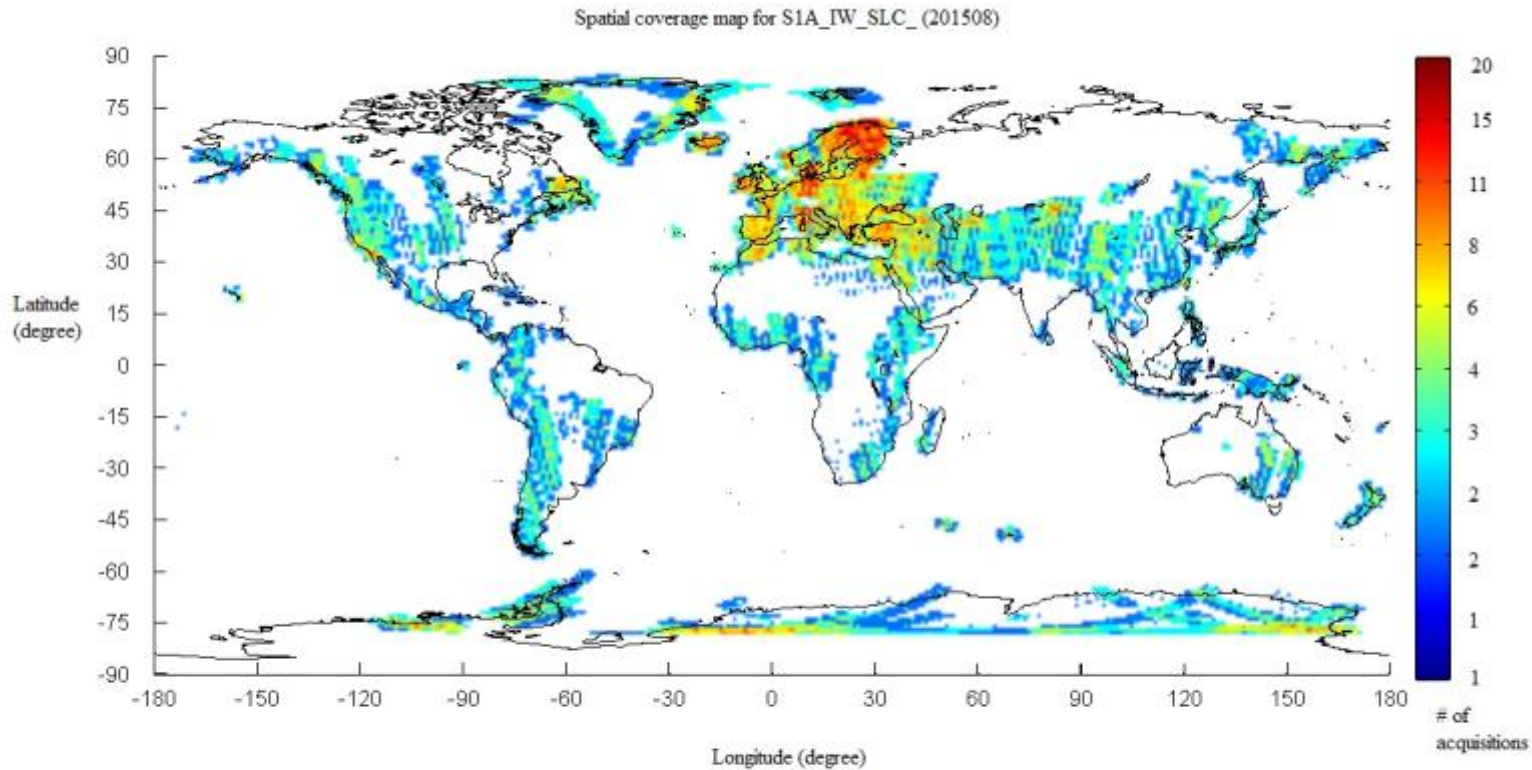
Sentinel-1A SAR RAW data, Sep 2015



Move the mouse over the image to retrieve information about the pixel

Since end Q2: 100% of acquisitions also available in SLC format

Sentinel-1A SAR SLC data, Sep 2015



Move the mouse over the image to retrieve information about the pixel

Since end Q2: 100% of acquisitions also available in SLC format

Available Sentinel-1 data



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

Portal: <https://geohazards-tep.eo.esa.int>, contact: geohazards-tep@esa.int

The screenshot displays the geohazards-tep portal interface. On the left, a map of the Mediterranean region is shown with a red box highlighting a specific area. A popup window displays the following data:

Sentinel-1 SAR-C SAR, 2015-03-19T05:04:18.242Z, IW, VV ...			
Platform Short Name	S1A	Orbit Number	
Platform Serial Identifier	0000-000A	Orbit Direction	DESCENDING
Instrument Short Name	SAR-C SAR	Start Date	2015-03-19T05:04:18.242Z
Sensor Type	IW	End Date	2015-03-19T05:04:52.084Z
Operational Mode	IW1 IW2 IW3		
Swath Identifier			
Published	Mar 20th 2015		

Below the popup, there are filter options: Time filter, Spatial filter, and Both filters.

On the right side of the interface, there is a 'Processing Services' section with a search bar and a list of 7 jobs found. Each job entry includes the service name, the user who performed it, and a 'SUCCESS' status.

Service Name	User	Status
ADORE DORIS interferometric processor	Hervé Caumont	SUCCESS
InSAR SBAS WPS	Jndiblasso	SUCCESS
InSAR SBAS WPS	Roberto Cuccu	SUCCESS
GAMMA Level-0 WPS	Enguerran Boissier	SUCCESS
GAMMA Level-0 WPS	Enguerran Boissier	SUCCESS
ADORE DORIS interferometric processor	Adrian Rose	SUCCESS
GAMMA Level-0 WPS	Roberto Cuccu	SUCCESS

At the bottom left, there is a 'Results Table' showing a list of search results with pagination (1, 2, 3, 290, Next) and a total of 14493 results. At the bottom right, there is a 'Features Basket' section showing a list of selected features with their IDs and tracks.

Visualization of collections from CEOS members



geohazards tep

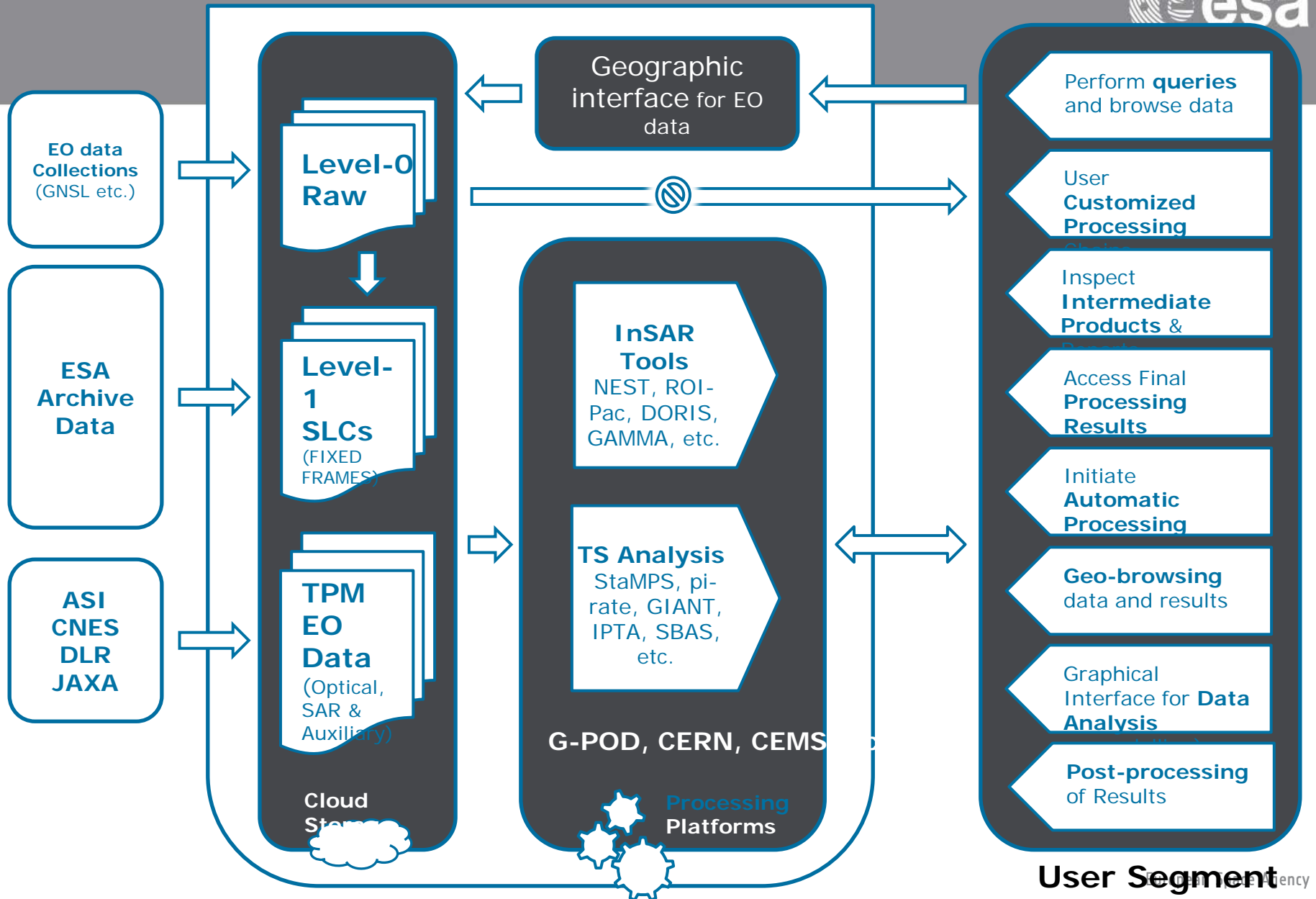
Terradue ElasticCas GeoTime GeoTimeOpenSearchable Elastic Catalogue

Search: terrasar Geo Filter

um:eoop:DLR:EOWEB:TerraSAR-X_SSC:idims_nz_pi_d...

Platform	TX01	Orbit Number	20803
Short Name		Orbit Direction	ASCENDING
Platform	1	Start Date	2011-03-16T08:03:03.961
Serial Identifier		End Date	2011-03-16T08:03:11.960
Platform Orbit Type	LEO		
Instrument	SAR		
Short Name			
Sensor Type	RADAR		
Sensor	SAR_SM_		
Operational Mode			
Swath Identifier	strip_004		
Media Type	ATOM RSS SRU		

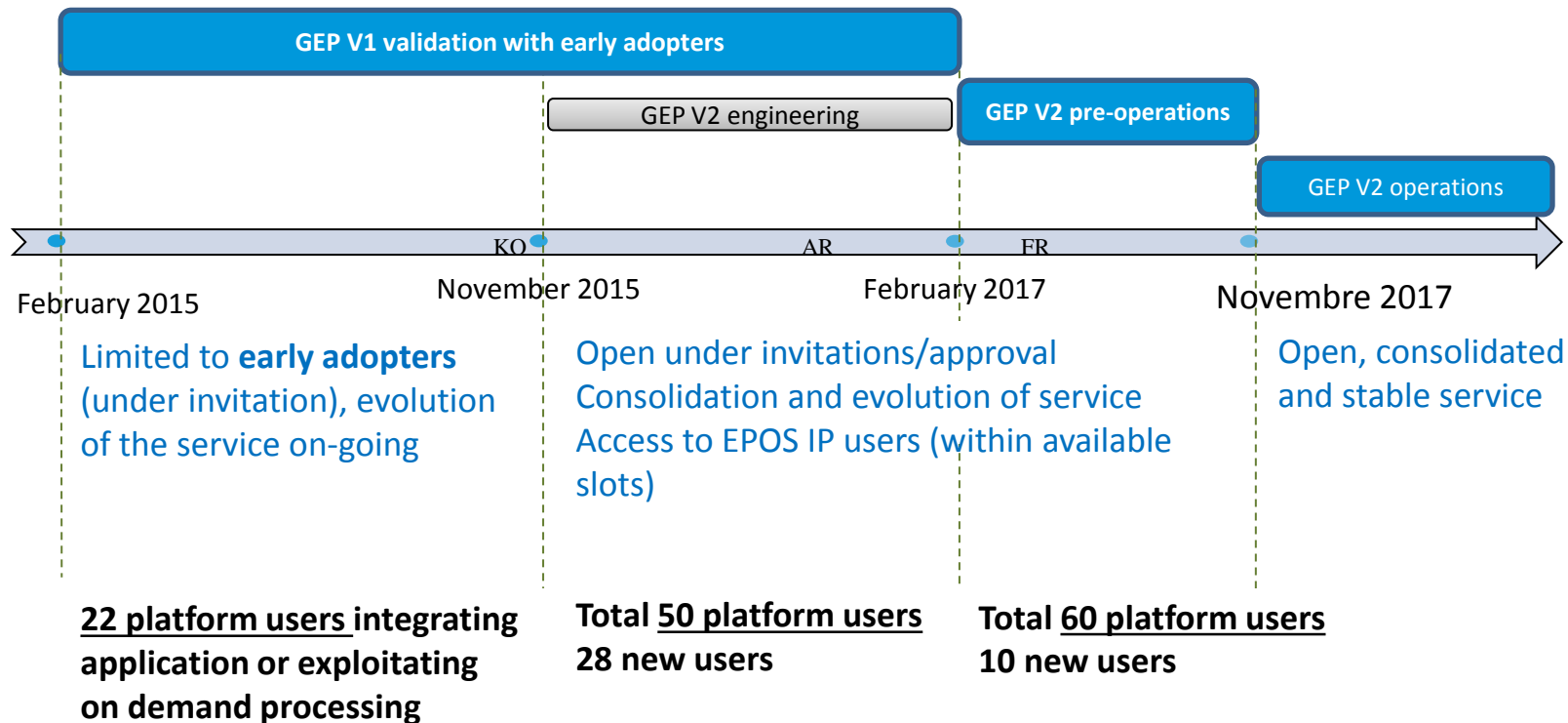
Exploitation Platform Overview



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)**.

Roadmap of the Geohazards TEP:

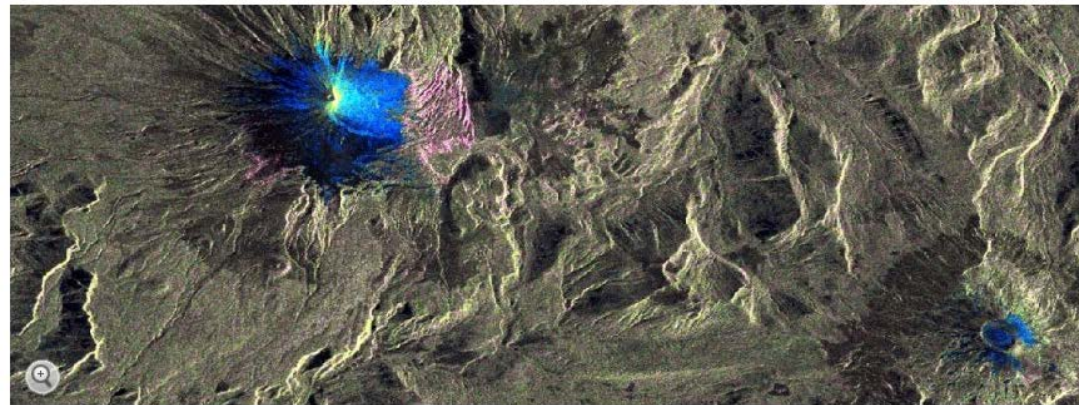


Want to apply as early adopters of the GEP (limited slots)? geohazards-tep@esa.int

GEP Validation started March 3rd:

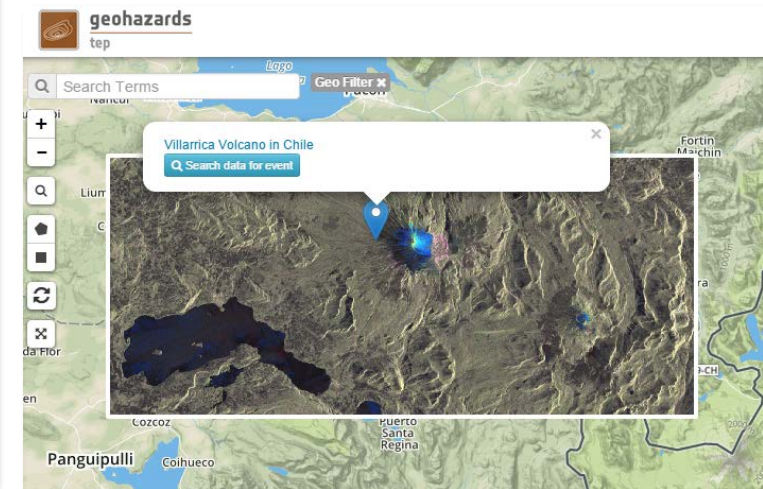


Satellitenbild der Woche: Geschüttelter Vulkan



Vulkan Villarrica: Explosion mit Folgen

Unter großem Donner spuckte der Vulkan Villarrica im Süden Chiles diese Woche Lava und Asche - Tausende mussten fliehen. Ein Satellitenbild zeigt: Die Explosion hat den Berg zerrüttet.



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 Disasters 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).

Examples of *Early Adopters*



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
SATIM (Poland)	Silesia & Warsaw (Poland)
Obs. Physique du Globe de Clermont-Ferrand Univ. Blaise Pascal (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
ICTP (Italy)	Morocco seismic activity

Volcanoes

Earthquakes

Landslides

PoC for applications: geohazards-tep@esa.int

Since March 2015 the GEP already registered 21 projects



GEP inherits from the precursor TEP-QuickWin Validation phase, 21 User Registration Forms (projects) where:

➤ 14 projects focused on processing using applications already integrated:

- SBAS
- ROI_PAC
- GAMMA
- DORIS
- DIAPASON

➤ 4 projects integrate processors or new services:

- New services based on SBAS (CNR-IREA)
- NSBAS (ISTERRE)
- New services based on DIAPASON (Altamira Information)
- Sentinel-1 InSAR-QuickLook (DLR)

➤ 3 projects will concentrate on large scale or systematic production

- Country wide measurements using SBAS
- Systematic processing InSAR-QuickLook

Country	Number of Users per Country
DE	1
ES	1
FR	4
GR	1
IT	7
MA	1
PL	1
UK	3
US	1
Total	22

This corresponds to 22 users from 19 organisations and 9 countries

Over 2016-2017 the GEP will have 10-20 new projects



Since October 2015 the GEP includes six new partnerships that bring new applications and new end-users:

- ALTAMIRA Information with SPN processing services (free and commercial products)
- CNR-IREA with SBAS based Sentinel-1 Surveillance service
- DLR with InSAR-QuickLook products generation
- UNI. STRASBOURG with MICMAC based optical data processing
- ENS/CNRS with the validation of the platform services to serve the CRL
- INGV for optical data pre-processing for volcanoes monitoring

Each will bring 1 user and the GEP will identify 25 new users during the project execution.

Two ESA GSP projects on Innovation in the area of Disaster Risk Reduction will bring 7 additional users: Altamira Information, CNR IRPI, INGV, IGME, NKUA, e-geos, Deimos Space and NOA.

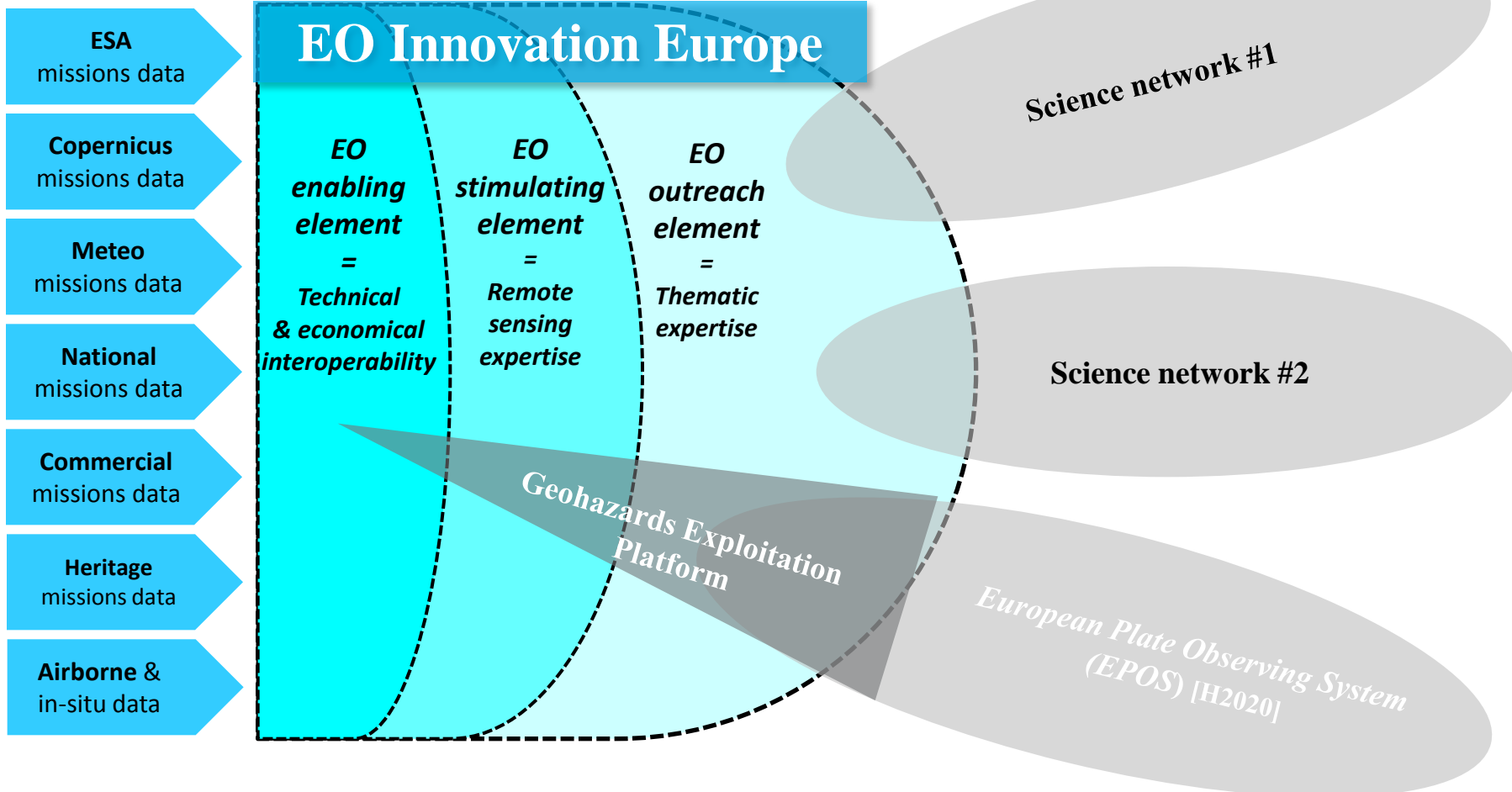
– **This will make 60 users in end 2017**

Exploitation platforms within *EO Innovation Europe*

→ linked with large science networks and ecosystems



*European
EO data asset*



Thank you



18 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) #