The Geohazards Exploitation Platform (GEP)

Philippe Bally¹ & Salvatore Pinto²

¹: European Space Agency, ²: Rhea c/ ESRIN

23–27 March 2015 | ESA–ESRIN | Frascati (Rome), Italy
Seismic Hazards: a key theme of the CEOS WG Disasters

- **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]

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

Available:
- (evolving) EO Data Exploitation
- (evolving) New EO Service 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
Sentinel-1A based change image of Villarrica eruption (Chile) using pre-event (20/02/2015) and post-event (04/03/2015) acquisitions.

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

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

**Science network #1**

**Science network #2**

**European Plate Observing System (EPOS) [H2020]**

**Geohazards Exploitation Platform**
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)