CEOS Disaster Risk Management

Seismic Hazards Demonstrator

CEOS WG Disasters 9th meeting

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Outline

- **Background**
  - **Precursor activity**
  - **Achievements**
  - **Success and way forward**
- **Seismic Hazards Demonstrator**
  - **Context and Overview**
  - **Objectives**
  - **Moving from the pilot to the demonstrator activity**
  - **Benefit to users**
  - **Contributions**
  - **Data volumes**
  - **Governance and meetings**
- **Conclusion**

Background

Precursor activity: Seismic Hazards pilot

With respect to the objectives derived from the Santorini report
http://esamultimedia.esa.int/docs/EarthObservation/Geohazards/esa-geo-hzrd-2012.pdf
… the **Seismic Hazards pilot** set the following objectives:

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]*

Concrete target for the Pilot: Test, validate and start production in representative priority areas.

B. **Support and continue the GSNL** *[role of EO: multiple observations focused on supersites]*

Concrete target for the Pilot: Help the GNSL access and exploit data.

C. **Develop and demonstrate advanced science products for rapid earthquake response** *[role of EO: observation of earthquakes with M>5.8]*

Concrete target for the Pilot: Generate EO based earthquake response products.

Contributions:
- 6 space agencies: ESA, NASA, ASI, CNES, DLR, JAXA
- 8 geoscience centres with EO practitioners (INGV, COMET, NASA JPL, CNR IREA, University of Miami, NOA, UNAVCO, ISTerre/IPGP)

# Major Achievements

Achievements – Objective A

The **Seismic Hazards pilot met its objectives**, in particular:

Objective 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]*

Pilot objective: Test, validate and start production in representative priority areas

Strain rate mapping:
✓The methodology is validated e.g. over Turkey by COMET (UK) and California by Univ. Miami (with EO data collections provided outside CEOS)
✓The global production **continuous: COMET started processing over the Americas and Africa.**
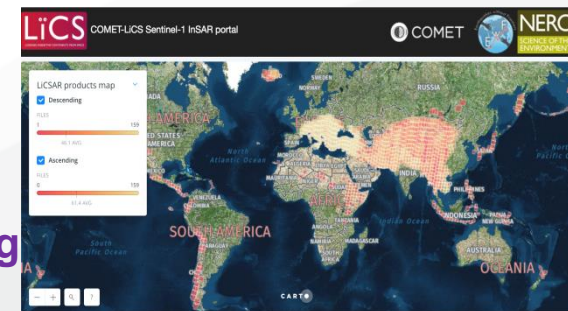
COMET's LiCSAR portal.

Active fault mapping:
✓Stereo optical data used to support fault reconnaissance mapping locally over limited areas (by University of Leeds and COMET)
✓First analysis of the need for large scale fault reconnaissance mapping
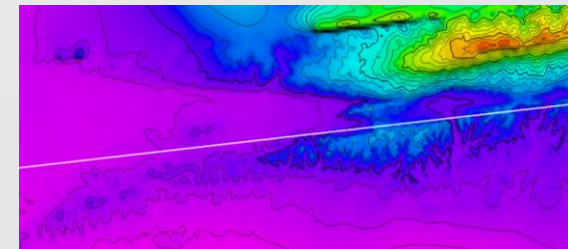

Preliminary results over the Sagaing fault in Myanmar.

Achievements – Objective B

Objective B: Support and continue the GSNL *[role of EO: multiple observations focused on supersites]*

Pilot objective: Help the GNSL access and exploit data

- ✓ The GEP successfully supported the GSNL experts for data delivery, on demand processing (mainly InSAR) and the integration of chains dedicated to GSNL activities (e.g. SISTEM by INGV Catania)
- ✓ The pilot supported the Gorkha earthquake Event Supersite, with the additional analysis of ALOS-2 data (not provided through the GSNL).
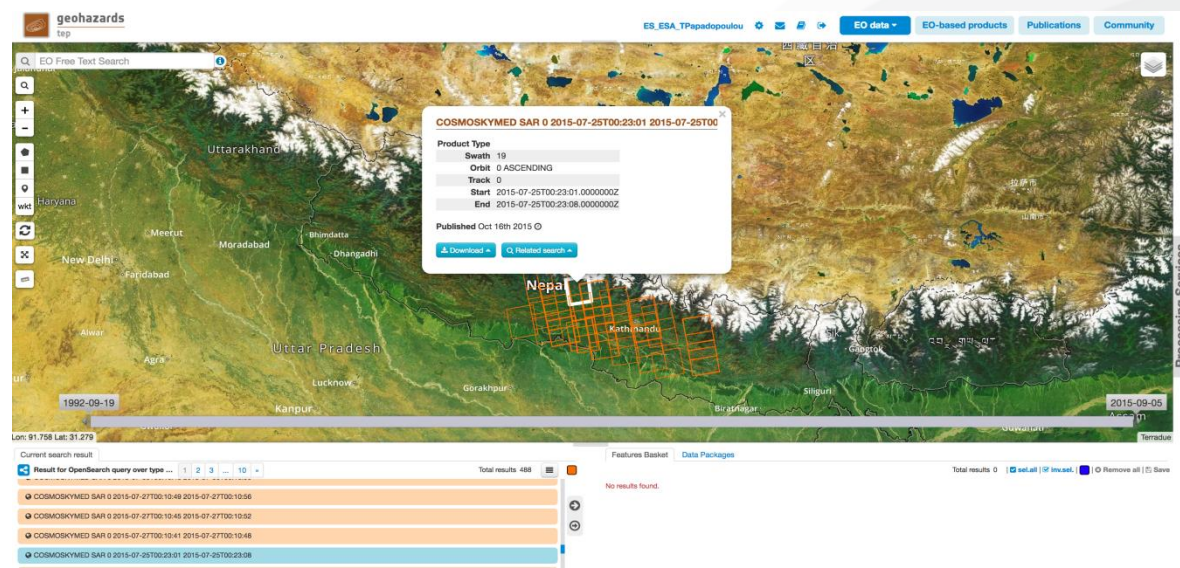
Achievements – Objective C

Objective C: **Develop and demonstrate advanced science products for rapid earthquake response** *[role of EO: observation of earthquakes with M>5.8]*

Pilot objective: Generate EO based earthquake response products

- ✓ since November 2014 the seismic pilot provided support to **8 earthquakes with magnitude > 5.8 in 5 countries worldwide**, in 5 countries: Nepal (Gorkha), Greece (Cephalonia and Lefkada), Ecuador (Muisne), New Zealand (Kaikura) and Italy (Amatrice, Visso and Norcia). Typically, users are **geoscience centres.**

- ✓ In a few cases, products derived from pilot work were **also used by end users** (e.g. Italian Civil Protection, Greek Earthquake Planning and Protection Organization (EPPO))
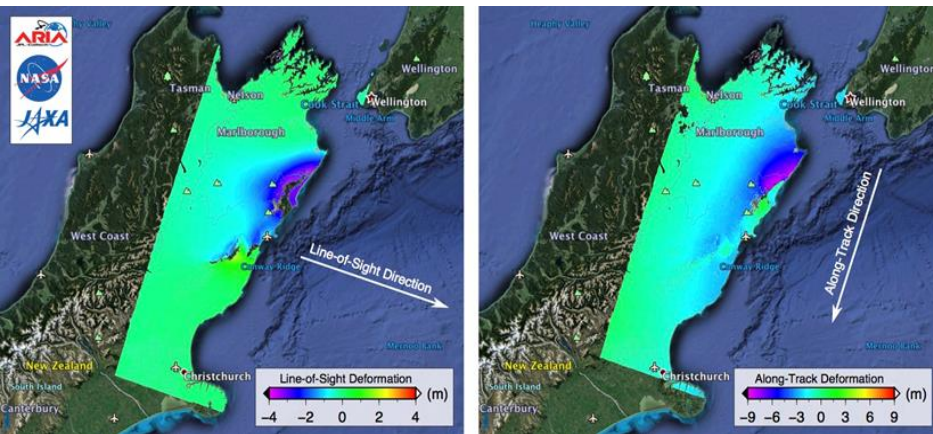
ALOS-2 interferograms showing LOS and Along Track deformation, generated by NASA JPL over Kaikura, New Zealand.
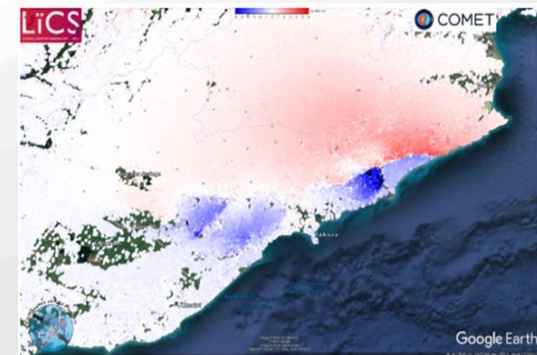
Coseismic Range Offsets from Sentinel-1 SAR data highlighting the fault trace and numerous fault segments.
**Results were online 5.5 hours after satellite acquisition.**

Achievements – Other

Other outcomes:

✓ Collaboration with mission operators to **optimize EO coverage against thematic priority areas** of the pilot: there is a high correlation between the Sentinel-1 acquisitions and target areas of the pilot community

✓ Examine gaps of the acquisition plans over high seismic risk megacities: confirmed that most sites at least partially covered by SAR data
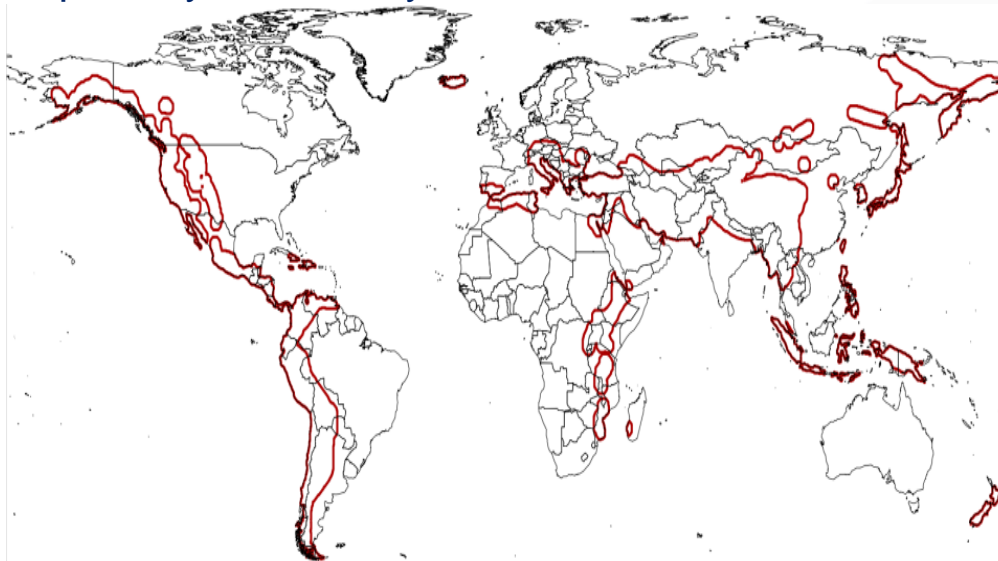
✓ **Promotion: in total 23 publications, 2 presentations, 2 posters and 10 web-stories/ articles stemmed out of pilot work.**

Success and way forward

Success and way forward

➢ Seismic Hazards pilot **successfully addressed seismic hazards** by providing:
  ❑ access to data
  ❑ access to tools & hosted processing

➢ **Primarily focused on EO practitioners from geoscience centres (expert users)** and has few end users (e.g. civil protections of Italy and Greece)

➢ **Benefit**: helped analyze the impact of the events and better elaborate scientific advice to support end users in their decision making process.

➢ **High value benefit to geoscience centres and end users**: some already expressed the need to continue the activity and expand its objectives, for instance:
  ❖ strain rate and active fault mapping to be expanded in a global basis,
  ❖ earthquake response to expand in 10-12 events per year)

➢ **Well-set example of collaboration to exploit data & tools;** makes it a good basis for a new initiative with broader goals to achieve greater impact.

The partners confirm the relevance and importance of the long-term objectives defined in Santorini and the need to continue to address them through a demonstrator activity to be started in Q2 2018.
In dialogue with the partners we defined new targets for a follow on activity.

Seismic Hazards Demonstrator

Context and Overview

- Intends to expand the precursor Seismic Hazards pilot activities

- Aims at addressing priorities of the *Sendai Framework for Disaster Risk Reduction 2015-2030* using Earth observations (EO) and in particular:
  - Priority 1 - Understanding disaster risk (hazard characteristics)
  - Priority 2 - Strengthening disaster risk governance at regional and global level.

- Main goal: to **provide data and capabilities to generate EO based scientific information to be released to decision makers for seismic hazard assessment**

- The activity is **addressing two challenges** identified in the precursor CEOS Pilots:
  - **Exposing results to decision makers**, based on a consensus methodology for product generation to avoid confusing end-users (especially, those in regions with low quality internet access and no access to processing capabilities).
  - **Broaden the use and increase acceptance of EO techniques**, aiming to educate geoscience centres and decision-makers.

Discussion on new objective

Based on lessons learnt from the Seismic Hazards Pilot:

- **Pre-existing relationship** between the providers of the scientific information and the local decision-makers is fundamental.
- Important to provide local users/decision makers with results generated with a consensus method when there is **limited capacity to interpret EO based measurements**.

➢ Discussion started on new objective:

Support local capacity building in coordination with GSNL to broaden the use and acceptance of advanced EO products by geoscience centres and academia and facilitate end users with their interpretation.

❖ Need to identify resources/funding to organise on-site courses/seminars and webinars:
  - Possible funding solutions: Erasmus+, Transnational scientific funding
  - Possible webinar facilitator: CEOS WGCapD
  - COMET will provide training courses and access to InSAR training material
  - Discussion started with HUA to support webinars and on-site seminars as instructor.
  - Potential interest for participation: Yachay Tech and ESPOL (Escuela Superior Politécnica del Litoral) in Ecuador
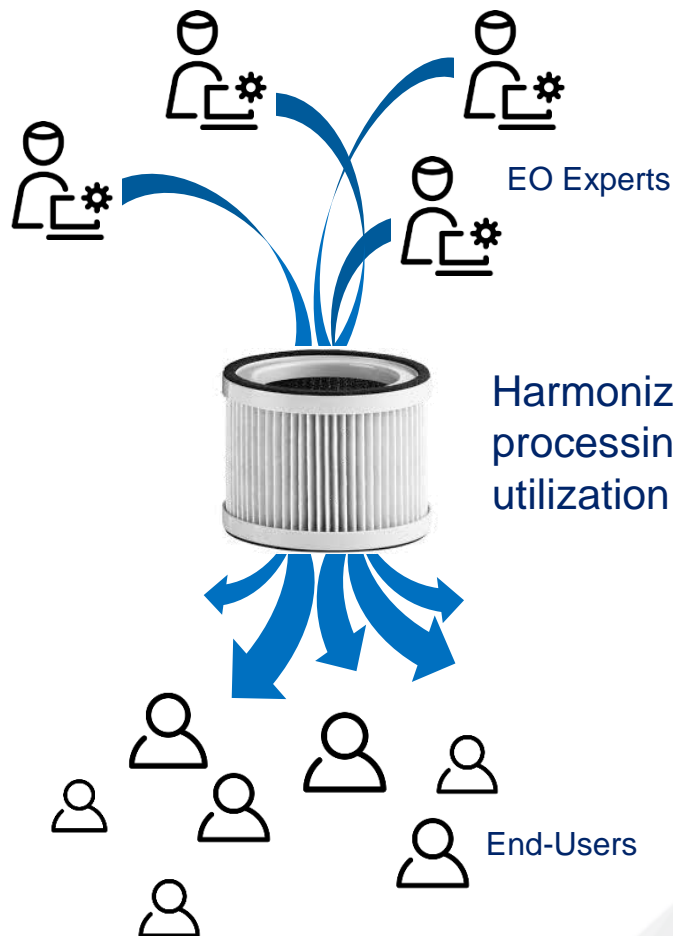
Objectives

Not on an emergency basis

I. Pursue **global tectonics mapping** that is a long process

II. Expand **active fault mapping** from <u>regional to global coverage</u> primarily with VHRO for fault reconnaissance mapping

III. ~~Pursue support to the GSNL~~ *(performed by the Geohazards Lab)*

III. **Develop a collaborative framework with geoscience centres** to achieve adoption of technology by decision makers, establish a consensus methodology for product generation and dissemination to decision makers

IV. **Support local capacity building in coordination with GSNL** and other initiatives to broaden the use and acceptance of advanced EO products by geoscience centres and academia and facilitate end users with their interpretation.

On an emergency basis

V. Exploit EO data to derive **advanced tectonic products for earthquake response**: expand to target of <u>at least 10-12 EQ per year</u>

VI. **Articulate with EO disaster response capabilities** e.g. the Charter to make sure users are aware of and use it.

Objective III – The idea

EO Experts

Harmonize presentation of independent processing results for enhanced assessment and utilization by end-users and practitioners

End-Users

- Definition and description measurements
- Dissemination templates, contents, colour scales etc.
- Type and level of auxiliary information

Mapping of targets against Santorini objectives

The 6 concrete targets defined are addressing the 3 high level objectives formulated in the Santorini report:

Santorini objective	Concrete Target of the Consolidation activity
A	I. Global strain rate mapping that is a long process
A	II. Active fault mapping from regional to global coverage primarily with VHRO for fault reconnaissance mapping
New	III. Develop a collaborative framework with geoscience centres
New	IV. Support local capacity building in coordination with GSNL
C	V. Advanced tectonic products for earthquake response: expand to target of at least 10-12 EQ per year
New	VI. Articulate with EO disaster response capabilities e.g. the Charter to make sure users are aware of and use it.

Moving from the Pilot to the Demonstrator activity

Why pursuing the activity about seismic hazards?

In comparison with the Pilot activity:

- Expand coverage (larger AOI's, response to a higher number of events)
- Expand the user base to achieve more impact:
  - Continue working with the Pilot team
  - Take on board new EO practitioners and other (non-expert) geoscience centres with strong links to End users
  - Reach End users through geoscience centres.

New concepts:

- Develop a collaborative framework with geoscience centres to achieve adoption of new EO approaches by decision makers: more cost effective solutions, establish a consensus methodology for product generation
- Support capacity building: expand the use and acceptance of EO products by geoscience centres and decision makers, facilitate end users to interpret EO products.

Intended benefits to users

It is needed to better address the different segments of the user base:

A. *Academia:* able to access data for scientific research.

B. *Expert users from geoscience centers (e.g. those from the Seismic pilot activity):* will be able to:
   a) access EO data that many wouldn't afford to procure
   b) provide accurate information to support end users

C. *Geoscience centers doing research or operations (e.g. with a mandate to provide technical advice to national Disaster Response authorities)* will retrieve advanced science products from expert users (*B*) to **analyse the events and the impact** and **better support the decision making process**.

D. *Decision makers (e.g. Civil Protection agencies)* that typically would receive results (e.g. scientific advice & reports) from the CEOS activity without necessarily being formally engaged.

Contributions

Space agencies:

- **ESA**
- **ASI**
- **DLR**
- **CNES**

Partners from the community:

- **COMET /UK**
- **University of Leeds /UK**
- **CNR-IREA /Italy**
- **INGV /Italy**
- **ISTerre/Institut de Recherche pour le Développement (IRD) /France**
- **National Observatory of Athens (NOA) /Athens**
- Interest expressed: **NASA JPL/USA**
- **BRGM /France**
- **Harokopeion University of Athens (HUA) / Greece**
- **CEO-YachayTech / Ecuador**
- **CNRS IPGP /France**

Proposed data volumes

Agency	ASI Cosmo-SkyMed	CNES Pleiades	CSA RADARSAT	DLR TerraSAR-X	ESA Sentinel-1 & 2	JAXA ALOS-2
Number of Images <u>per year</u> for Seismic Hazards	200-400	50-100	50-100	60-120	open	60-120

- **Other EO data collections (SAR and Optical including VHRO) to be exploited with processing without download (EO data are accessed by the processing environment but the user can only download the value adding product).**

Comparison with Quota provided to the Seismic Hazards Pilot:

Agency	ASI	CNES Pleiades	CSA	DLR	ESA	JAXA ALOS-2
Number of Images per year for Seismic Hazards	300	50	2	on request	open	100

Governance and meetings

The Seismic Hazards Demonstrator activity shall be managed by three co-leads that oversees its implementation.

Activity	Responsible
Supervision of the activity, Coordination with partners, Articulation with EO disaster response activities	ESA (Philippe Bally)
Scientific Advisory, Supervision of the activity, Coordination with GSNL	INGV (Stefano Salvi)
Coordination with partners and user communities, Reporting, Meetings/Teleconferences, Website, Promotion	ESA (Dorella Papadopoulou)

❖ 1 meeting per year with contributing partners (probably during the EGU conference in April)
❖ 1-2 teleconferences per year

Conclusion

➢ New Seismic Hazards Demonstrator activity **endorsed** by CEOS SIT in October 2017
  - o   A Draft was circulated on 30 August
  - o   Final version of the proposition to be circulated shortly

➢ **Implementation Plan** under preparation

➢ **New objective** discussed: Capacity building through technical and scientific training to local geoscience centres (expertise) and end-users (interpretation)
  - o   Resources/funding need to be identified

➢ Seismic Hazards CEOS **webpage**: work on-going (currently only a link with the Seismic Hazards Pilot Final report has been added)

Thank you!