Working Group on Disasters

An overview

WGDisasters Leads:

Andrew Eddy (Athena Global)

Laura Frulla (CONAE)

Lorant Czaran (UN-SPIDER)

DCT Lead: Antonio Montuori (ASI)

ceos.org/ourwork/workinggroups/disasters/

CEOS

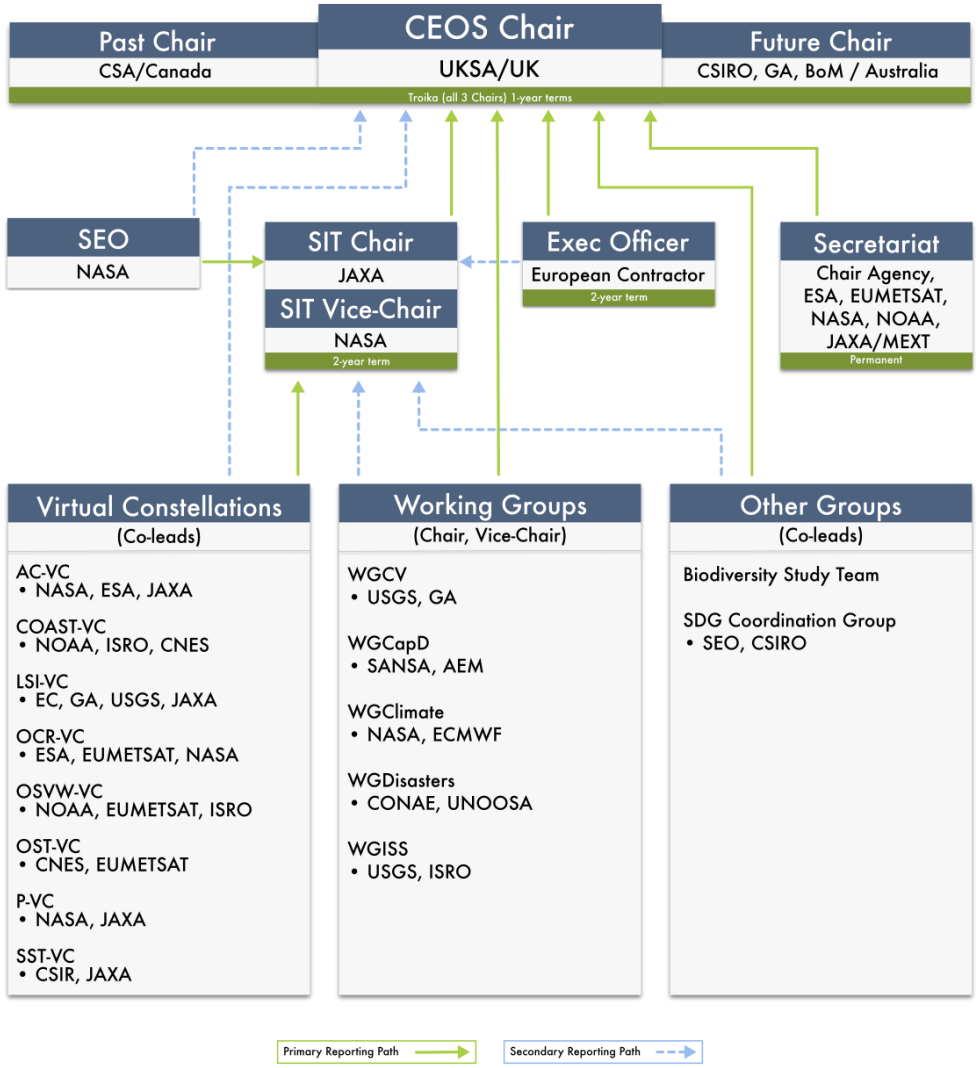
Committee on Earth Observation Satellites

CEOS fundamentals

- The **Committee on Earth Observation Satellites (CEOS)** is an international organization established in 1984 with the aim to coordinate and harmonize Earth observations to make it easier for the user community to access and use data

- As of 2023, it has 34 national space agencies as regular members and other 29 associate members.

- CEOS employs three Governing Documents that guide its work: The CEOS Strategic Guidance document, The CEOS Governance and Processes document, A three-year rolling CEOS Work Plan.

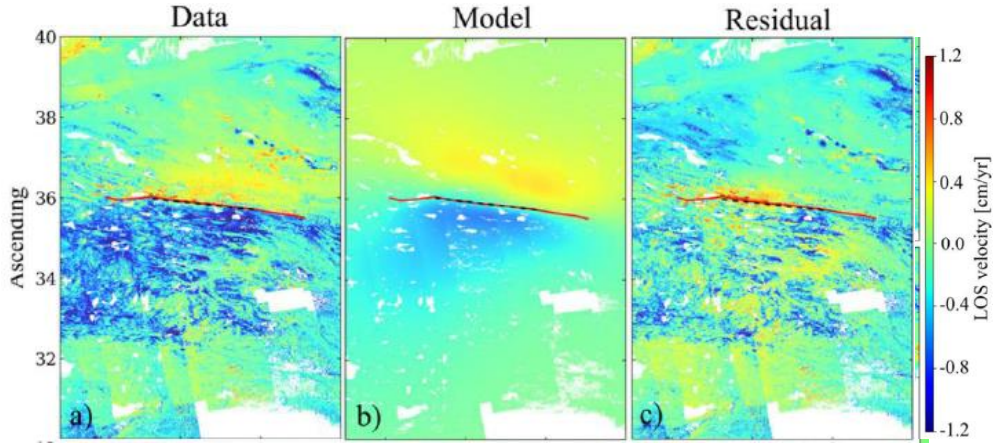


WGDisasters Objectives

- Support **Disaster Risk Management (DRM) authorities** by means of **satellite-based EO** and **science-based analyses.**
- Support the **UNDRR Sendai Framework**, (mainly Priority1 “Understanding Risk”, Priority4 “Build Back Better”).
- Support **international initiatives** such as GEO.
- Raise the **awareness of Governments, policy-makers, decision-makers, and major stakeholders** of the benefits of using satellite EO in all phases of DRM.
- Foster **increased use of EO** in support of **DRM and DRR,** and express **related EO capabilities and needs.**

WGDisasters Activities

Pilots, Demonstrators, Labs

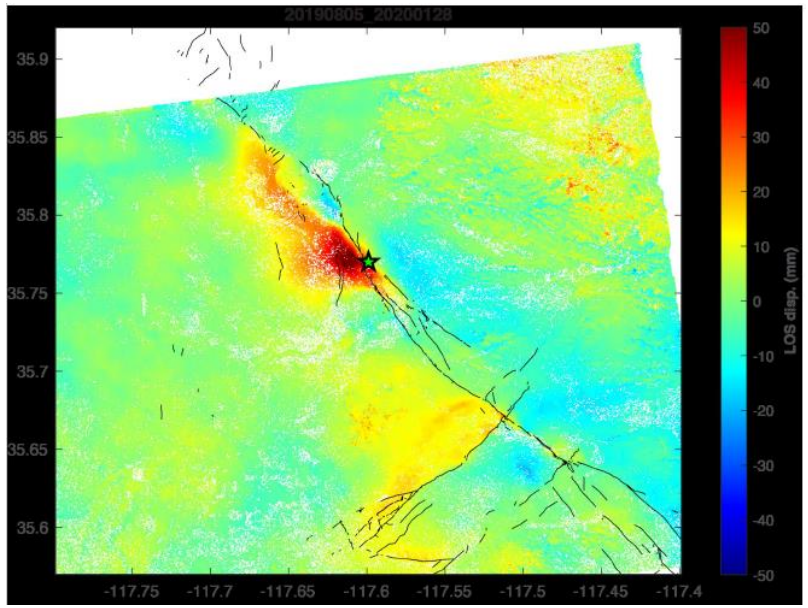


Mean velocity 2014-2021 in the area of the 2001 Kokoxili Mw7.8 earthquake (China). Comparison between Sentinel-1 and model products.

- ❖Wildfire Pilot
- ❖Flood (GEO/LEO/SAR) Pilot

- ❖Landslide Demonstrator
- ❖Volcano Demonstrator
- ❖Seismic Hazards Demonstrator
- ❖Recovery Observatory Demonstrator

Post-seismic deformation retrieved with CSK data for the 2019 Mw 7.1 Ridgecrest earthquake (San Andreas Fault).



- ❖Geohazards Supersites and Natural Laboratories (GSNL)

Wildfire Pilot

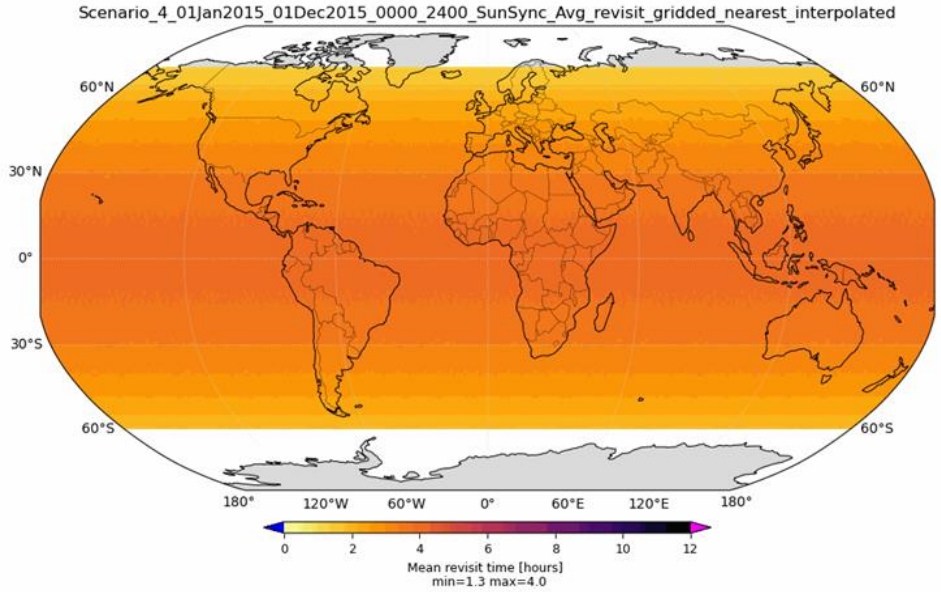
Leads: J. Johnston, M. de Jong, & C. McFayden, NRCan. D. Dufour CSA. D Morton, NASA.

❖OBJECTIVES / OUTCOMES:

- Provides inventory of EO systems suitable for active-fire monitoring.
- Explores existing gaps in wildfire EO capabilities (existing and proposed) [see bottom figure].
- Articulates global stakeholders and user requirements for active-fire remote sensing monitoring and suggest way-forward for the community.

Example fire 'hotspot' products from MODIS, VIIRS, & Landsat.

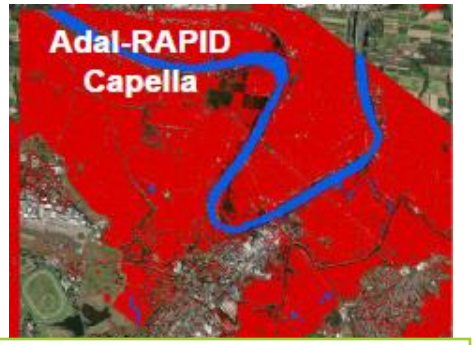
Potential changes in satellite active fire monitoring capabilities 2015-2046.



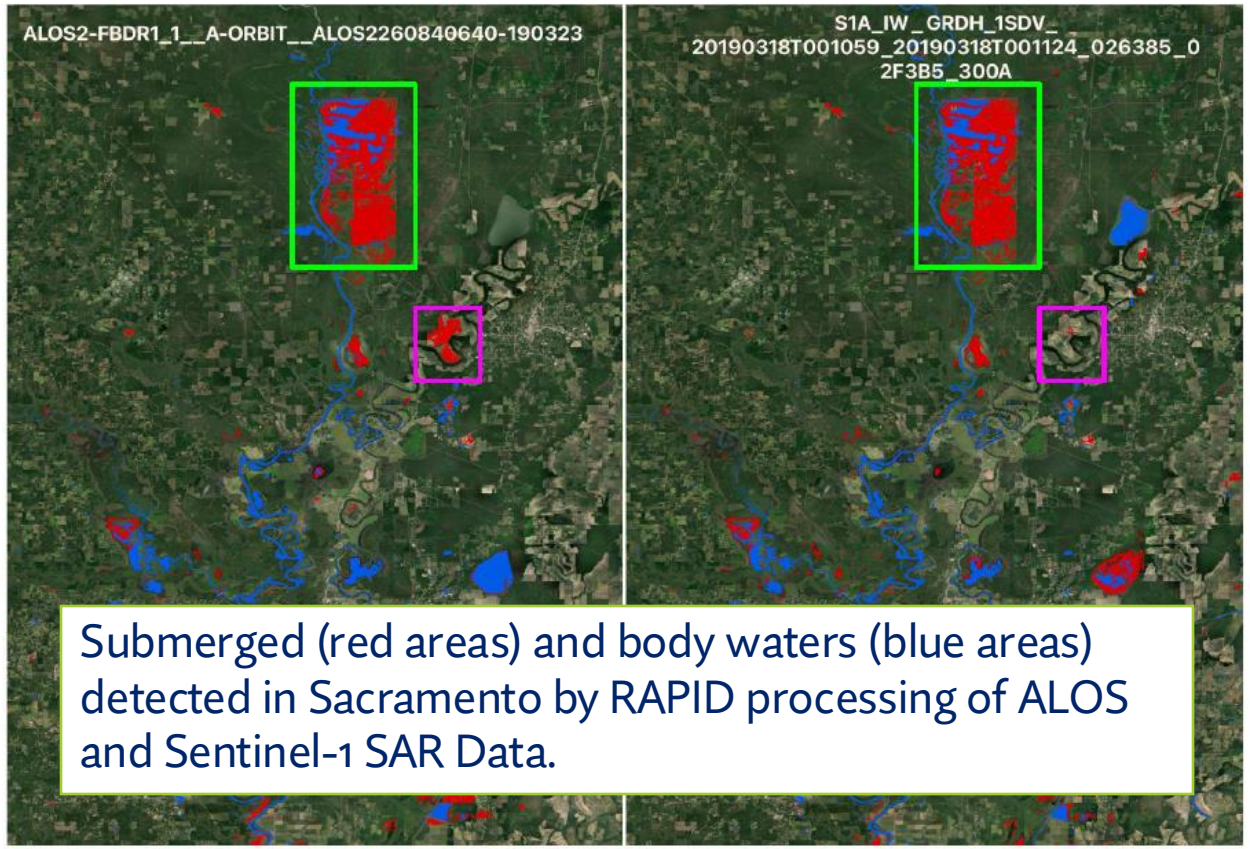
Flood Pilot

Leads: M.U. Quirno, CONAE; S. Helfrich, NOAA; G. Schumann, RSS Hydro

- **GOAL**: Explores and demonstrates best practices for combining optical and radar data to map floods and improve vulnerability, exposure and hazard information.
- **Lessons Learnt and outcomes**:
  - ML techniques for data fusion.
  - Merging GEO-LEO and SAR sources.
  - Probabilistic inundation maps, with hydrologic models and SAR products.



Submerged (red) and body waters (blue) detected in Australia (2021) with Capella SAR.



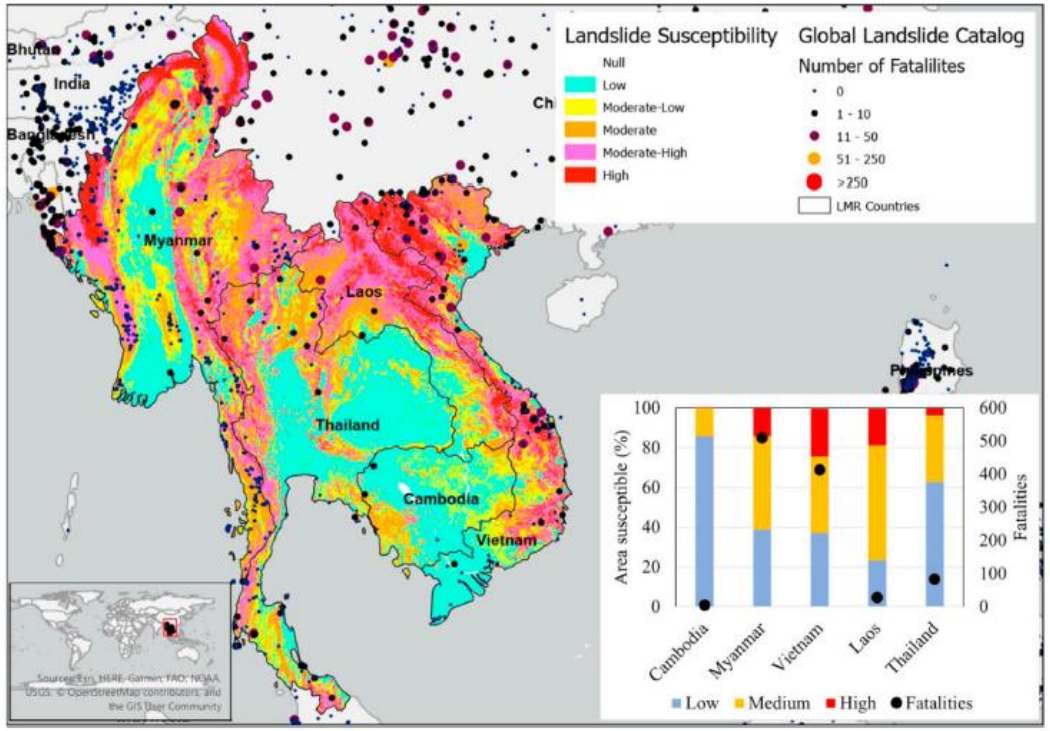
Submerged (red areas) and body waters (blue areas) detected in Sacramento by RAPID processing of ALOS and Sentinel-1 SAR Data.

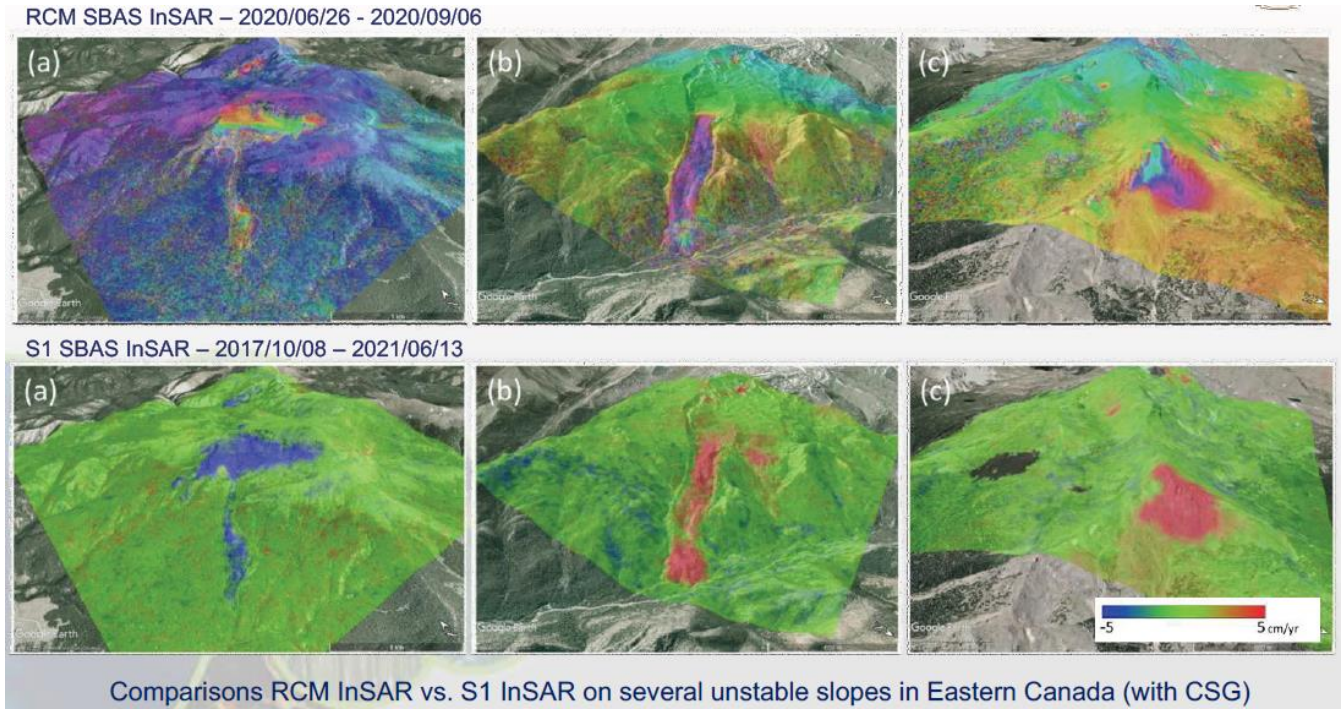
NOA/BEYOND FloodHub and FireHub services mapping over Balkan region. Flood in Feb 2021 (in blue). Sentinel-2 burnt scar mapping (in red).

Landslide Demonstrator

Leads: Pukar Amatya, NASA; Jean-Philippe Malet, UNISTRA/EOST

GOAL: demonstrate the effective exploitation of satellite EO across the full cycle of landslide disaster risk management (preparedness, response, and recovery at global, regional, and local scales), including the possibility of multi-hazard focus on cascading impacts and risk.





Comparisons RCM InSAR vs. S1 InSAR on several unstable slopes in Eastern Canada (with CSG)

Distribution of reported landslide fatalities across the Lower Mekong Region based on NASA's Global Landslide Catalog (Kirschbaum et al., 2015), with NASA's global landslide susceptibility map (Stanley and Kirschbaum, 2017).

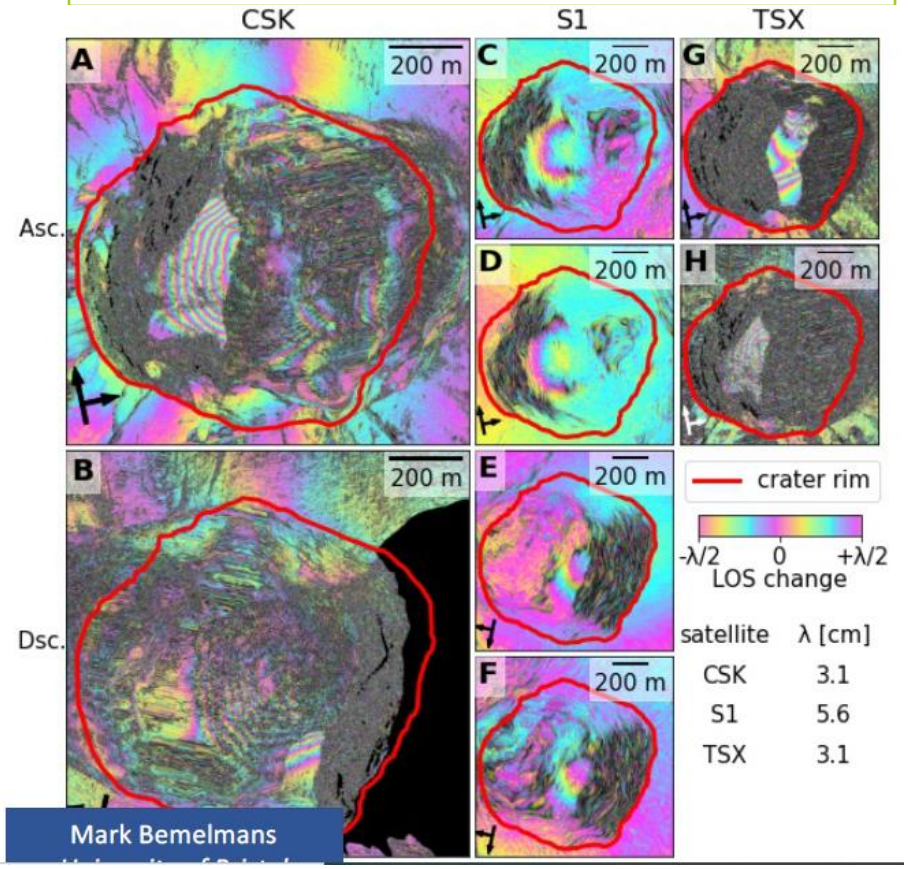
Volcano Demonstrator

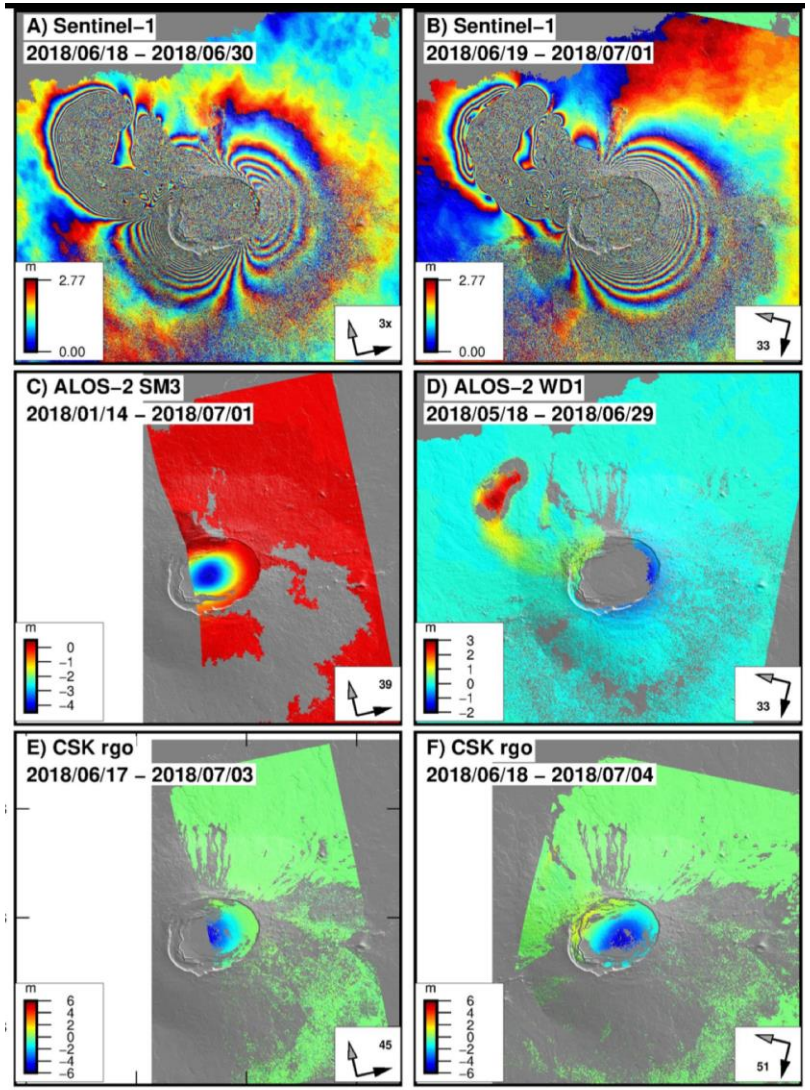
Leads: Mike Poland, USGS; Susi Ebmeier, University of Leeds.

GOALS:

- Aims to evaluate the utility of EO data for anticipating, detecting, and tracking volcanic eruptions.
- Supports EO applications that promote volcanic disaster risk reduction worldwide.
- Focus on high-risk volcanoes in areas where monitoring is not currently well developed (LAC, Africa, SE Asia).

Example of Multi-frequency volcanic SAR-products to study Sierra Negra, Galapagos (left panel) and Mount Augung in Indonesia (lower panel)



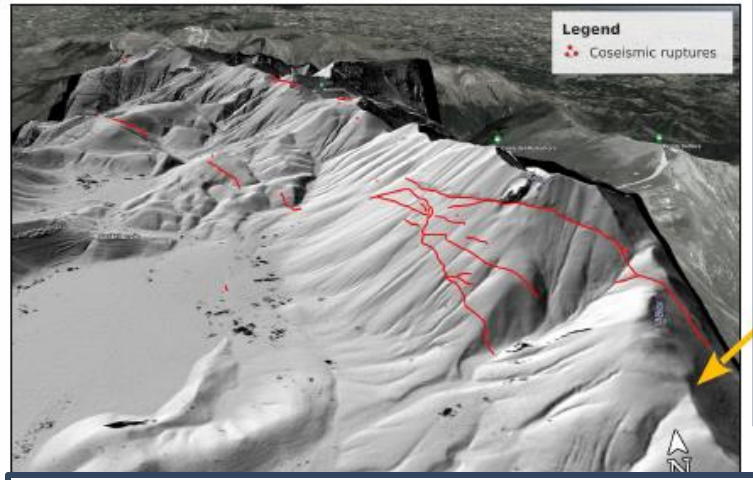


Seismic Demonstrator

Leads: Philippe Bally, ESA; Stefano Salvi, INGV

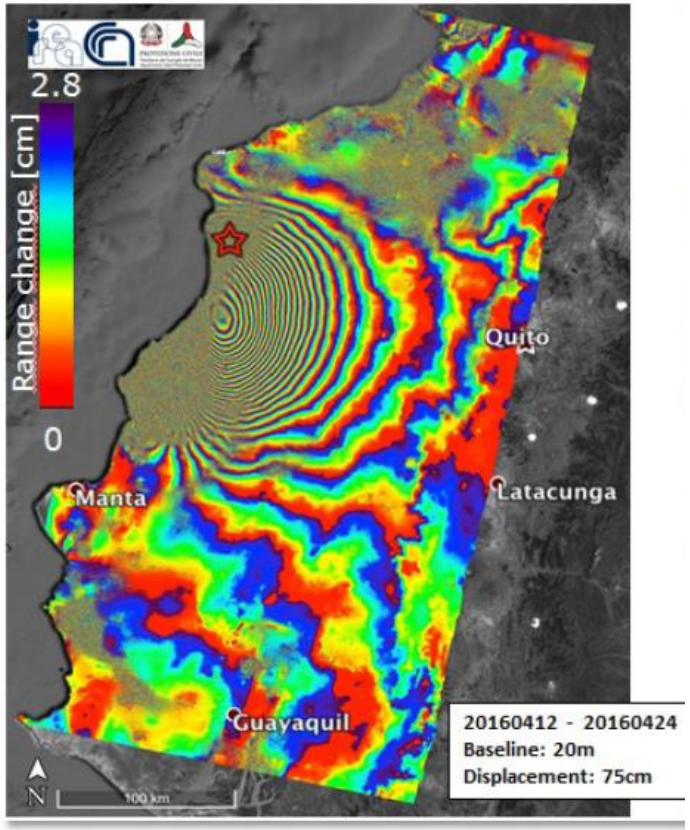
GOALS:

- Develops advanced science products for rapid earthquake response and better understanding of risk and exposure.
- Supports the uptake of these products and methodologies by WG stakeholders and users.



The Norcia earthquake (Italy, 2016, M_w 6.5)

High-resolution DEM generated using Pleiades images



Interferogram generated by CNR-IREA, exploiting two Copernicus Sentinel-1© 2016 images acquired from descending orbits (Track 40) before (12 April) and after (24 April) the Mw 7.8 event in Ecuador, whose epicentre is indicated by a red star.

The Ridgecrest earthquake sequence (California, 2019, M_w 6.4 & 7.1)

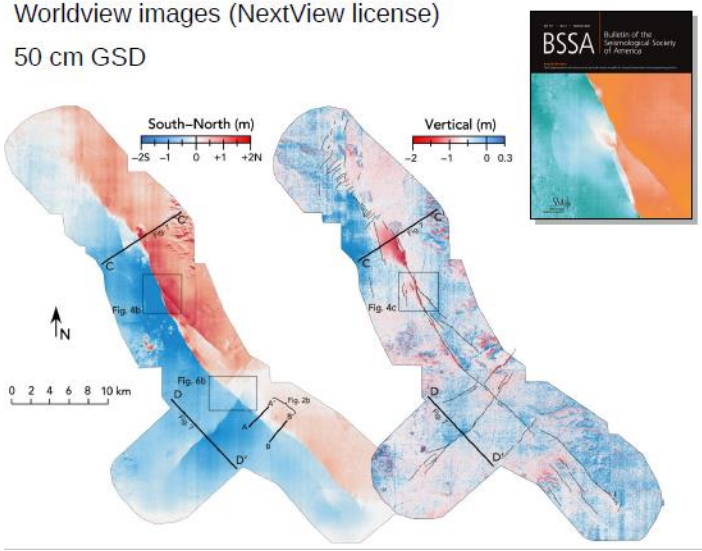
Antoine et al., 2021

Pléiades-WV multi-sensor correlation

Pléiades images (CEOS Seismic Pilot - CNES)

Worldview images (NextView license)

50 cm GSD



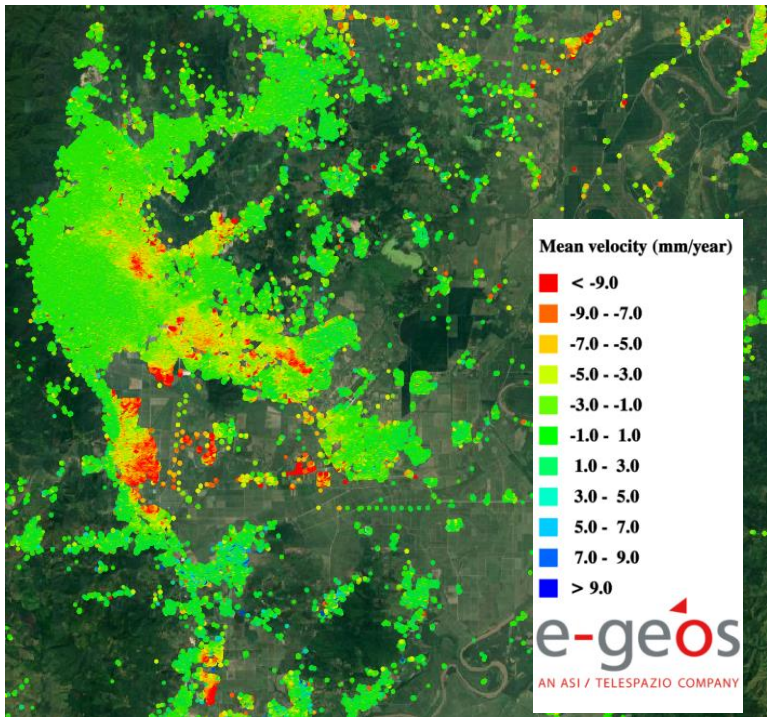
Recovery Observatory Demonstrator

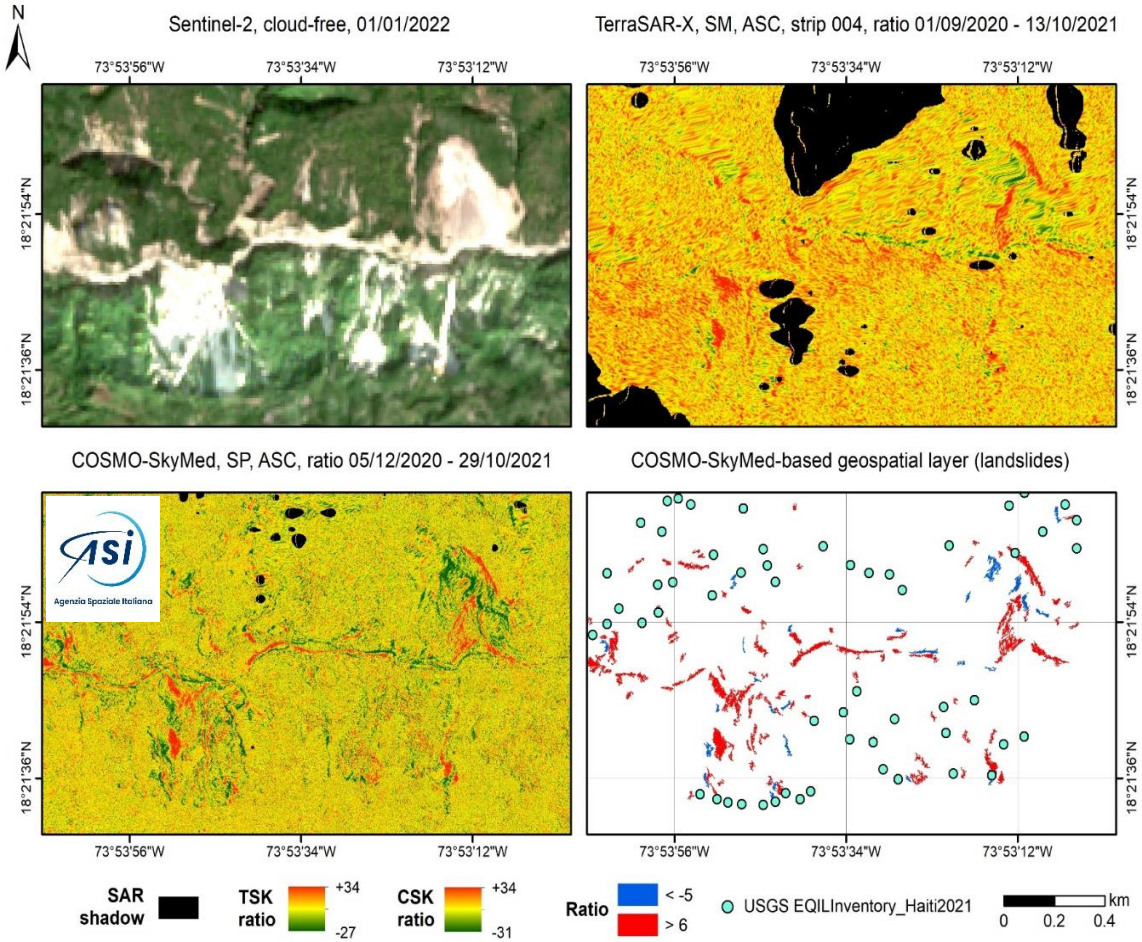
Leads: Hélène de Boissezon, CNES; Rashmin Gunasekera; World Bank

GOALs:

- Showcase contribution of satellite data and products to recovery efforts following major disaster events.
- Direct input to Post Disaster Needs Assessments and long-term contribution to Recovery Framework.

CSK-based multi-temporal DInSAR deformation maps in Honduras, for ETA-IOTA activation



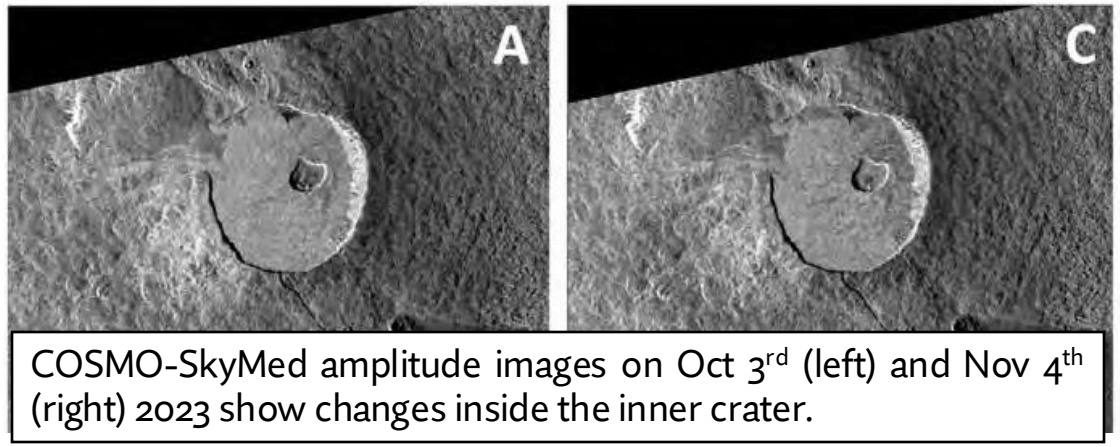


Multi-frequency SAR products relevant to the RO activation for 2021 Haiti earthquake.

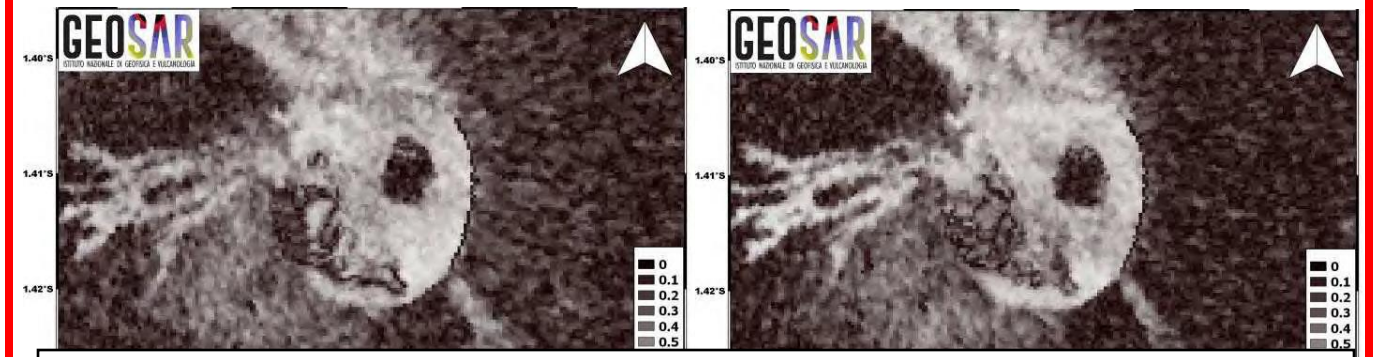
Geohazards Supersites and Natural Laboratories (GSNL)

Lead: Stefano Salvi, INGV.

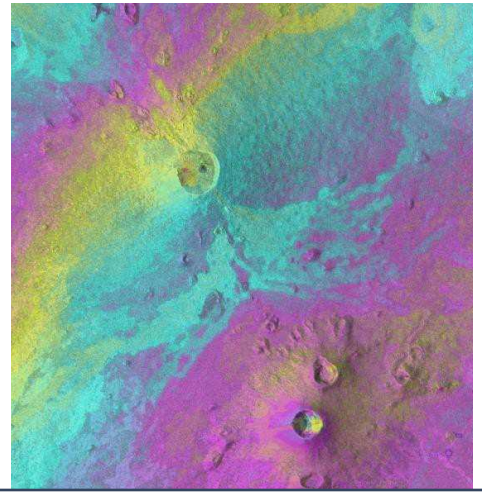
GOALS: Improve geophysical and geohazard assessment, promoting EO products uptake for societal benefits

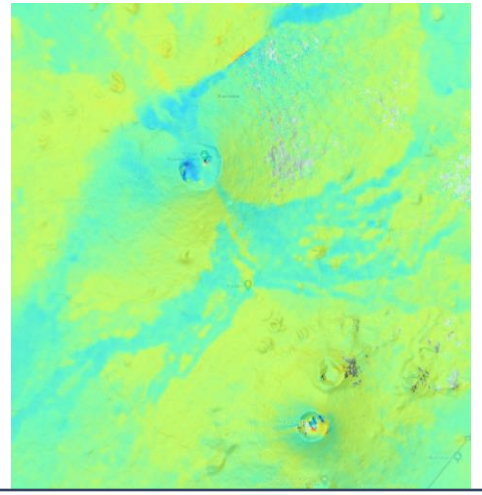


COSMO-SkyMed amplitude images on Oct 3rd (left) and Nov 4th (right) 2023 show changes inside the inner crater.

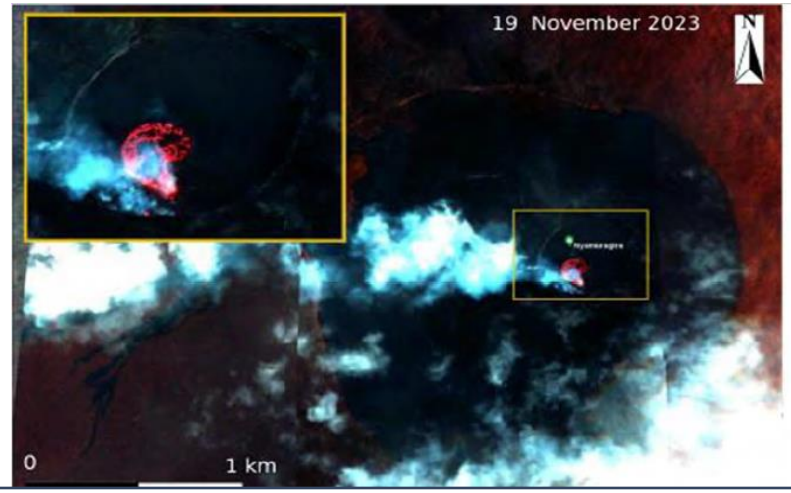


Sentinel 1 InSAR coherence does not show changes from Oct 20th - Nov 1st (left) to Nov 1st-13th (right) 2023





SAOCOM interferogram (left) and deformation map (right), for the period Oct 13th - Nov 6th 2023, inside the calderas of Nyamuragira and Nyiragongo volcanoes.



Skysat false colour image shows high temperature (molten lava) in the inner crater.

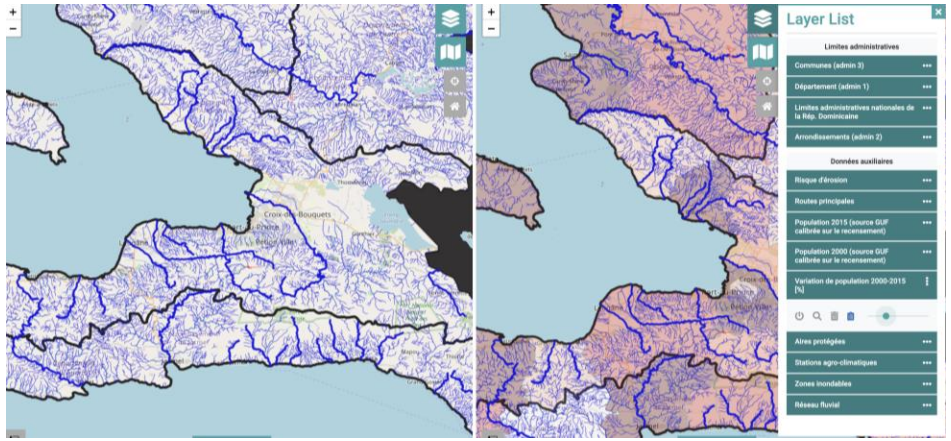
Multi-missions EO results gathered for Nyamulaghira Eruption in 2023 for Virunga Supersites

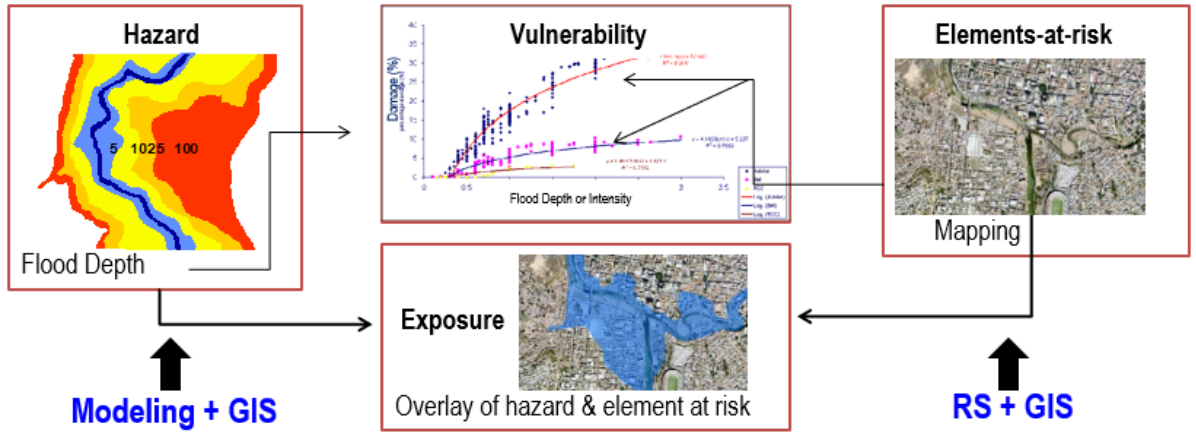
CEOS WGDisasters New Activities (1/4)

Tonga Preparedness Pilot (2024)

Lead: Ofa Masiwawa (NEMO) Lorant Czaran (UNOOSA/UN-SPIDER), Andrew Eddy (Athena Global)

- Support Tonga for improved preparedness and demonstrate usefulness of satellite EO and derived products for EW4All in "big ocean" states (SIDS)
- Leverage Tonga chairmanship of PIF to showcase innovation in Tonga, scalable to other big ocean states



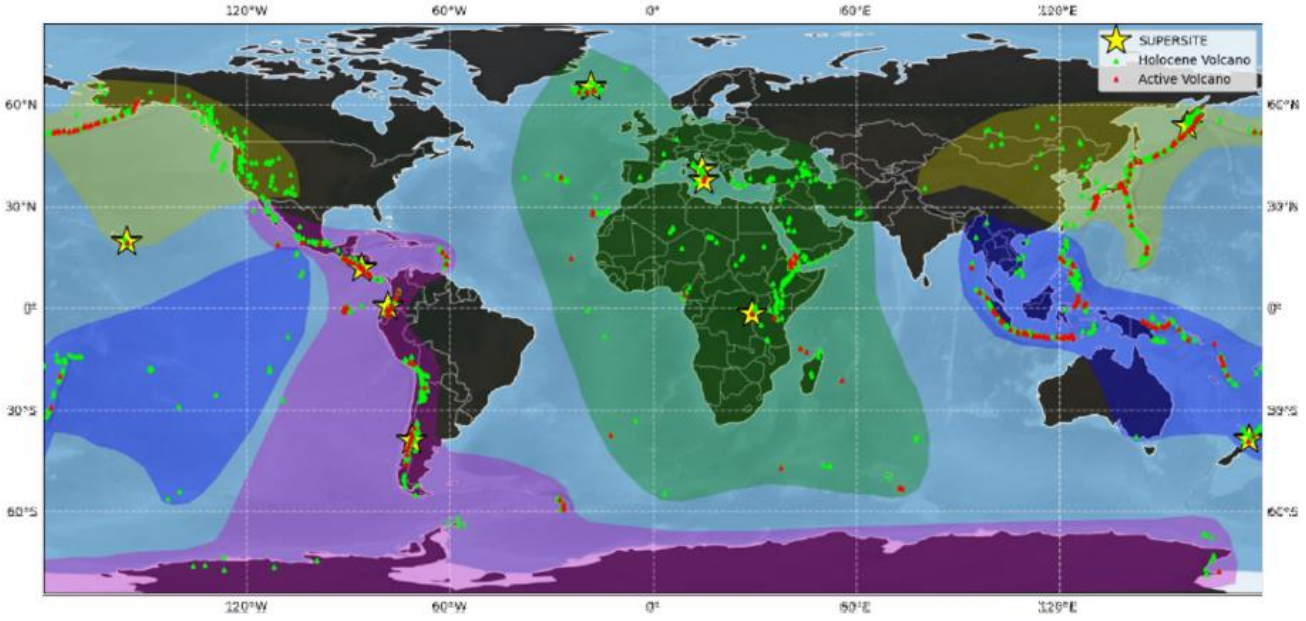


CEOS WGDisasters New Activities (2/4)

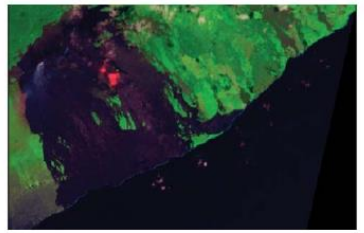
G-VEWERS

Lead: Mike Poland (USGS), Susanna Ebmeier (Leeds Univ.)

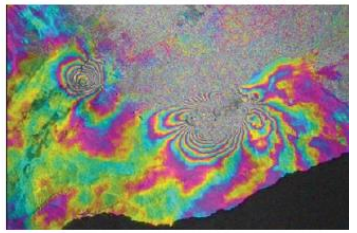
- Global volcano observation via SAR and optical satellite data
- Provide eruption response and early warning capabilities
- Assist local capacity for EO data analysis
- Train scientist at volcano observatories



Thermal

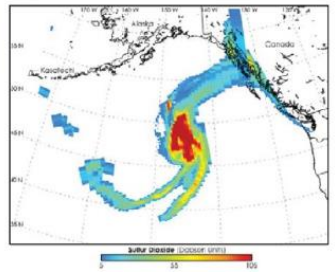


Deformation



Ash

Gas



Marapi – Indonesia (Dec. 2023)

23 deaths

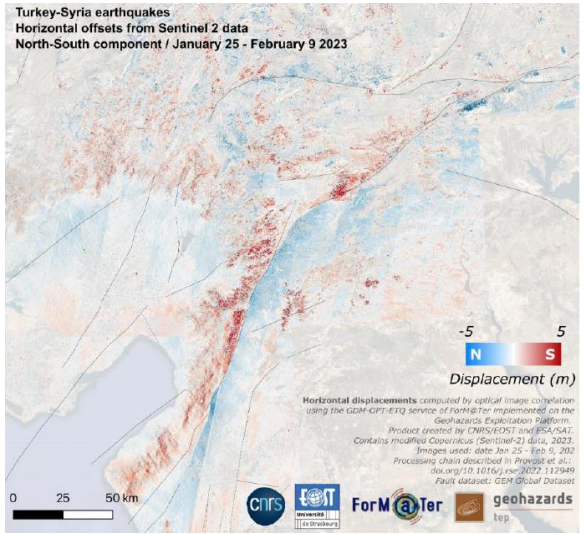
Reykjanes Peninsula - Iceland

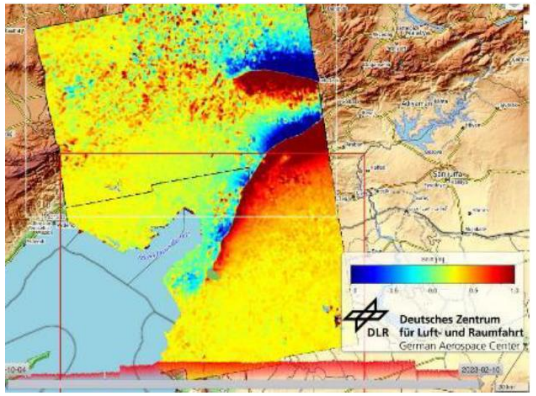
(March 2024)

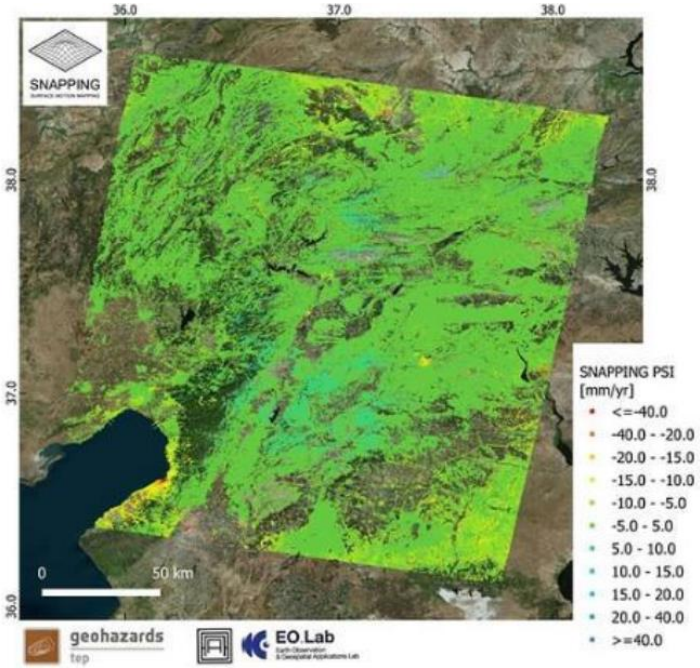
CEOS WGDisasters New Activities (3/4)

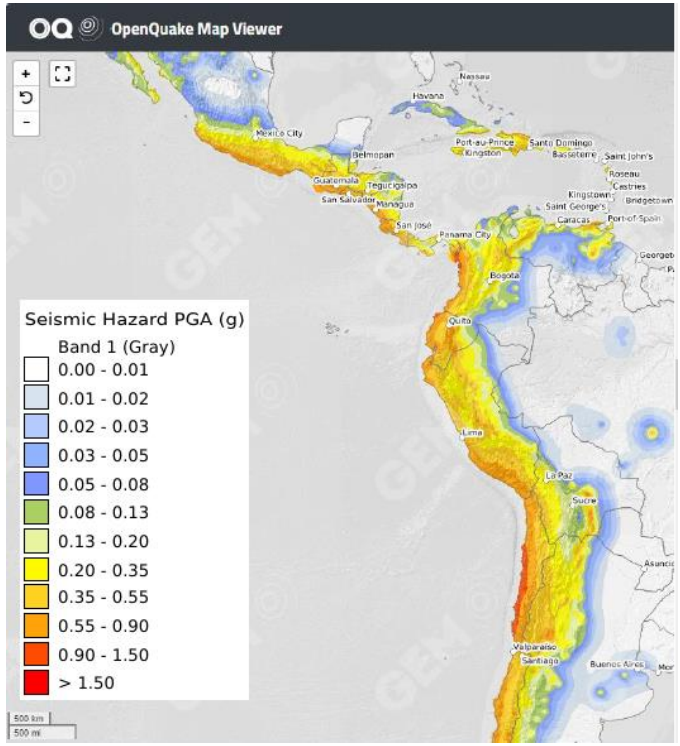
New Seismic Hazards Demonstrator

- Develop and demonstrate advanced science products for rapid earthquake response.
- Support active faults mapping with EO satellite data.
- Articulate relationship with International Charter.
- Support seismic exposure mapping.
- Focus on Latin Amertica and Carribean (LAC).









Examples of displacement map retrieved for 2023 Turkey-Syria earthquake with TSX (lower-right), Sentinel-1 (lower-left and upper-left) created on the Geohazards Exploitation Platform (GEP).

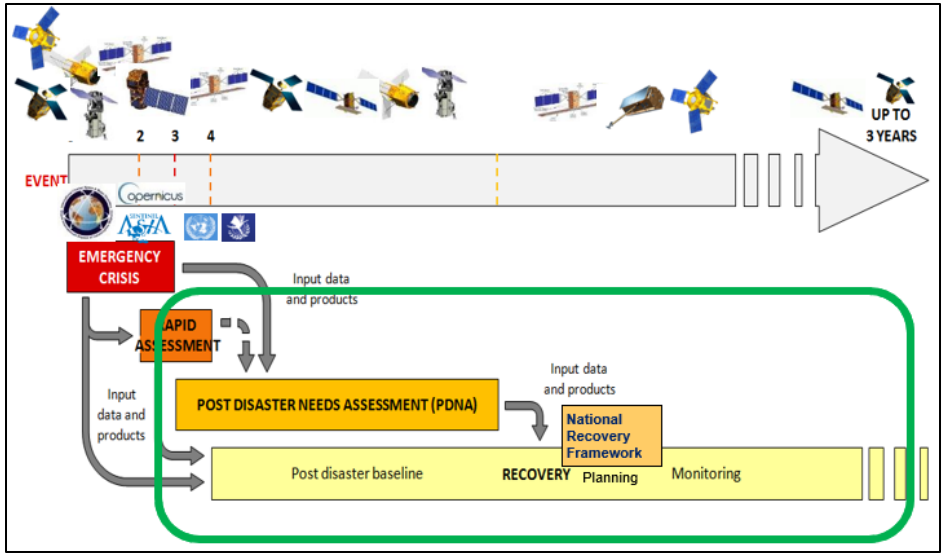
Lead: Philippe Bally (ESA), Stefano Salvi (INGV), Zach Foltz (ARGANS)

CEOS WGDisasters New Activities (4/4)

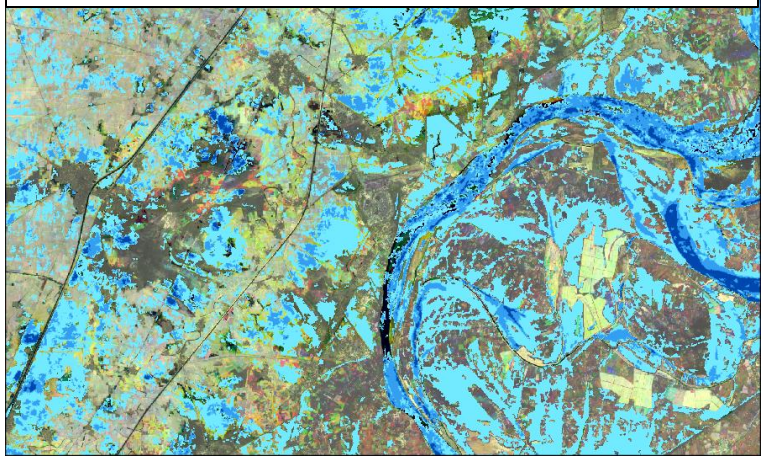
Pre-operational Recovery Observatory

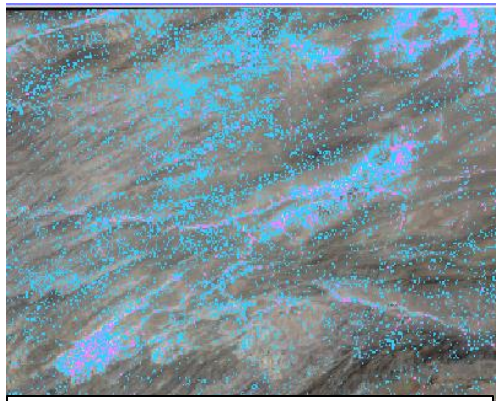
- ❖Integrated Awareness to support recovery.
- ❖Inform PDNA.
- ❖Provide Pre and post disaster protocols.
- ❖Ensure medium term monitoring.
- ❖Support Capacity Building assessment & plan.

Lead: Aurélien Sacotte (CNES), Dominique Blariaux (EU FPI), Andrew Eddy (Athena Global)



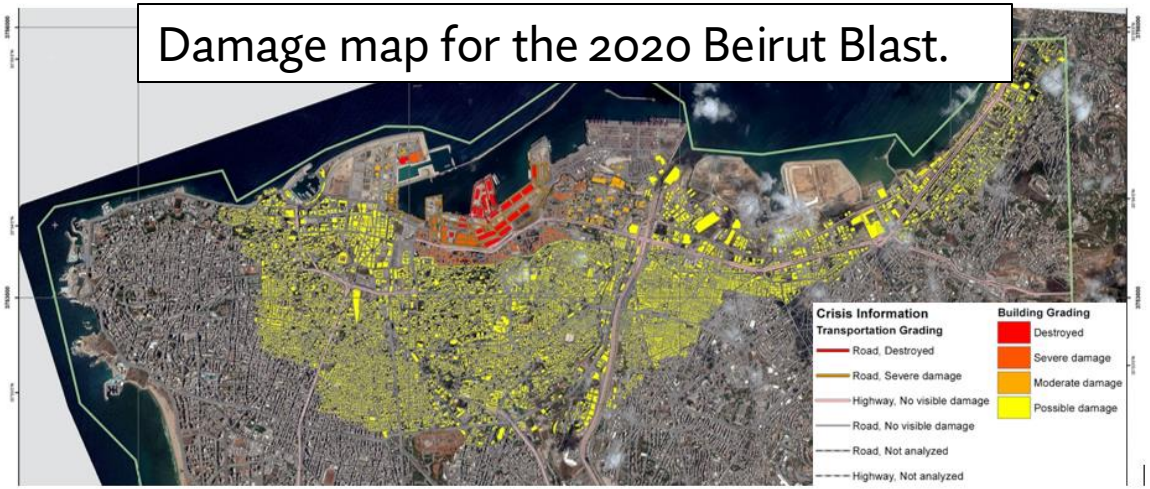
Flood map over Pakistan in 2022.





Landslides map over Balochistan Province.

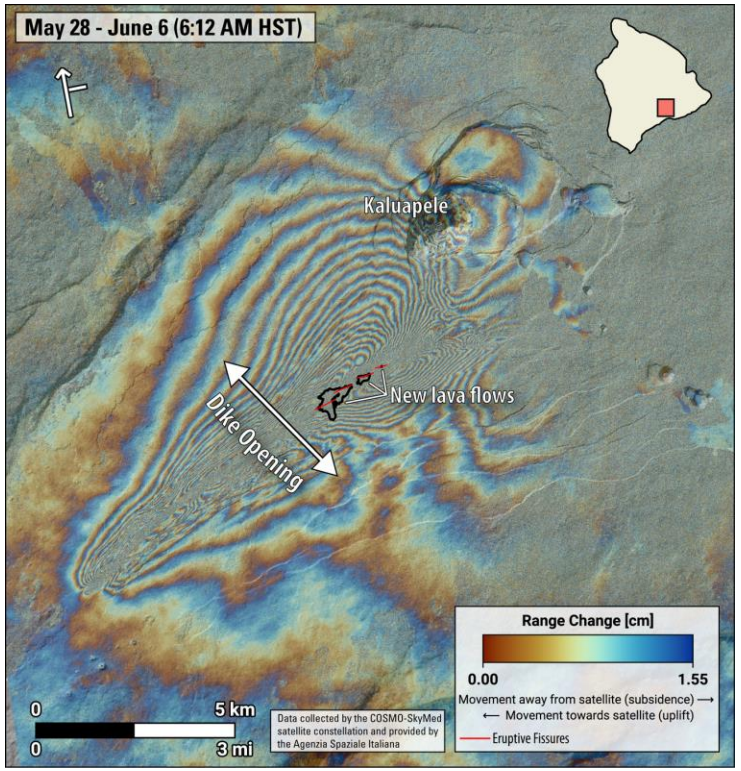
Damage map for the 2020 Beirut Blast.

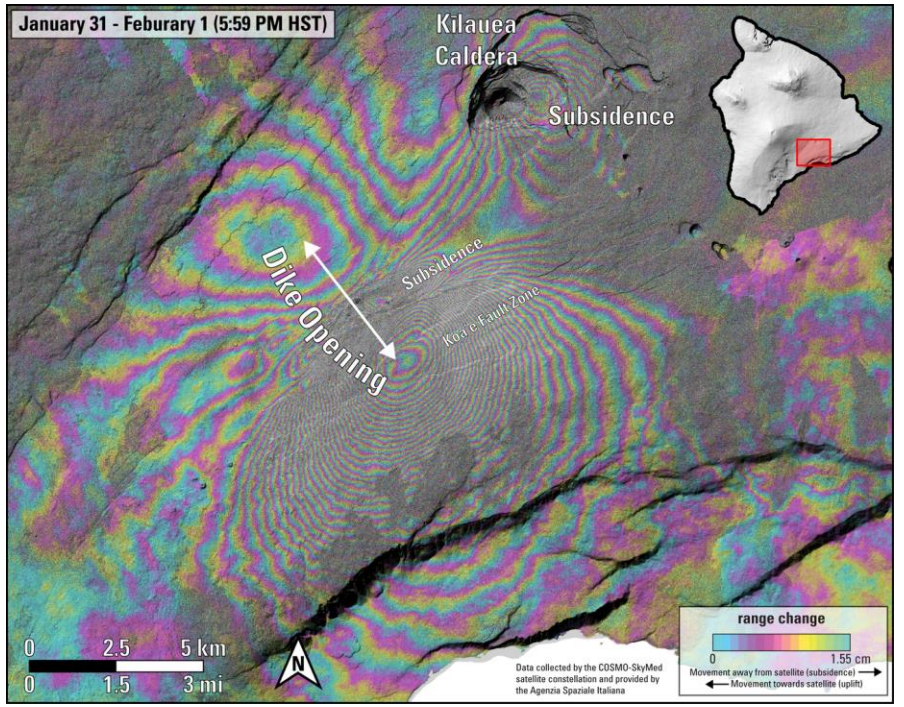


ASI Contribution to CEOS Activities

Leads: A. Montuori, D. Tapete, L. D'Amato, M. Virelli, G. Pari, L. Dini, G. Spinelli

- Since 1986 ASI is supporting CEOS initiatives.
- Since 2012 ASI joins GEO GSNL, CEOS DRM and Recovery Observatory (RO) projects, providing COSMO-SkyMed data and scientific research.
- About 20.000 COSMO-SkyMed images have been delivered for all CEOS activities and 6000 are going to be provided in the next year.
- Since 20 July 2021, ASI has been started the provision of SAOCOM data within the ASI ZoE.





CSK interferograms over Kilauea volcano show ground deformation during the intrusive activity at Kīlauea volcano. They indicate subsidence caused by depressurization of shallow magma chamber, dike intrusion and new lava flows.

ASI Contribution to CEOS Activities : Perspective for new activity

Leads: A. Montuori, D. Tapete, L. D'Amato, M. Virelli, G. Pari, L. Dini, G. Spinelli

ASI is exploring the idea of:

- proposing a new CEOS WG **Landslide activity**, that will build upon the results achieved by the previous demonstrator and moving forward
- Joining a new CEOS WG **Drought Pilot** activity, promoted by CONAE within WGDisasters

Current status:

- Investigating the feasibility
- Collecting interest, starting from the national scientific community and then internationally

Possible topics (initial ideas only, TBC):

- Multi-sensor data-based approaches
- Impact on environments, ecosystems and infrastructure

Working Group on Disasters

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DCT Lead: Antonio Montuori (ASI)

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