CEOS Disaster Risk Management

Seismic Hazards Demonstrator

CEOS WG Disasters 11th meeting

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Committee on Earth Observation Satellites

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:

  Provide satellite data to generate EO based scientific information to be shared with decision makers for seismic hazard assessment

Objectives

Not on an emergency basis

I. Pursue **global tectonics mapping** in the long term

II. Expand **active fault mapping** from regional to global coverage primarily using VHR optical data supporting supporting geomorphological and morpho-tectonics studies

III. Develop a collaborative framework with geoscience centres to promote adoption of EO-based technology by decision makers, establish a consensus methodology for research 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 research products for earthquake response**: expand to target of at least 10-12 EQ per year

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

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) /Greece**
- **BRGM /France**
- **Harokopeion University of Athens (HUA) / Greece**
- **CEO-YachayTech / Ecuador**
- **CNRS IPGP /France**

Data - Yearly quota available and requests

Agency	ASI Cosmo-SkyMed	CNES Pleiades	DLR TerraSAR-X	ESA Sentinel-1 & 2
Quota per year	650 images	20000 sq. km.	Upon request	Open

Request no.	Prime Investigator Affiliation	Secondary Investigator Affiliation	AOI (Country)	Data requested	Number of images requested	Objective
2018-R01	University of Tehran	INGV	Kerman province (Iran)	Cosmo-SkyMed	130	Observe inter- and post-seismic strain accumulation
2019-R02	University of Leeds		Central Asia	Pleiades archive and SPOT-6/7 archive	AOIs: 739 sq. km TRI-STEREO AOI: 998 sq. km TRI-STEREO	Assess the potential of SPOT-6-7 for deriving the Palu fault rupture offsets through both the urban city and rural environment
2019-R03	University of Leeds		Palu, Indonesia	Pleiades archive and SPOT-6/7 archive	AOI: 158 sq. km AOI: 567 sq. km	
Upcoming	University of Leeds	Dozens of users	Quito (Ecuador), Istanbul (Turkey), Nairobi (Kenya, Kathmandu (Nepal)	Pleiades (and SAR: TBD)	12000 sq. km	Support the GCRF Hubs : Aiming to derive models of multi-hazard risk to inform urban development planning for four major capital cities Quito (Ecuador), Istanbul (turkey), Nairobi (Kenya) and Kathmandu (Nepal)
Upcoming	HUA		Sub-urban Athens (Greece)	TerraSAR-X, Cosmo-SkyMed, Pleiades	N/A	Monitor potential deformation along the faults
Upcoming	HUA	International Institute of earthquake Engineering and Seismology	Kerend-Zahab area (Iran)	TerraSAR-X, Cosmo-SkyMed, Pleiades	N/A	Monitor potential deformation along the faults

- Data request (BRGM) sent to Charter for ALOS-2 (primarily) and TerraSAR-X data over Sulawesi, Indonesia

Status of activities

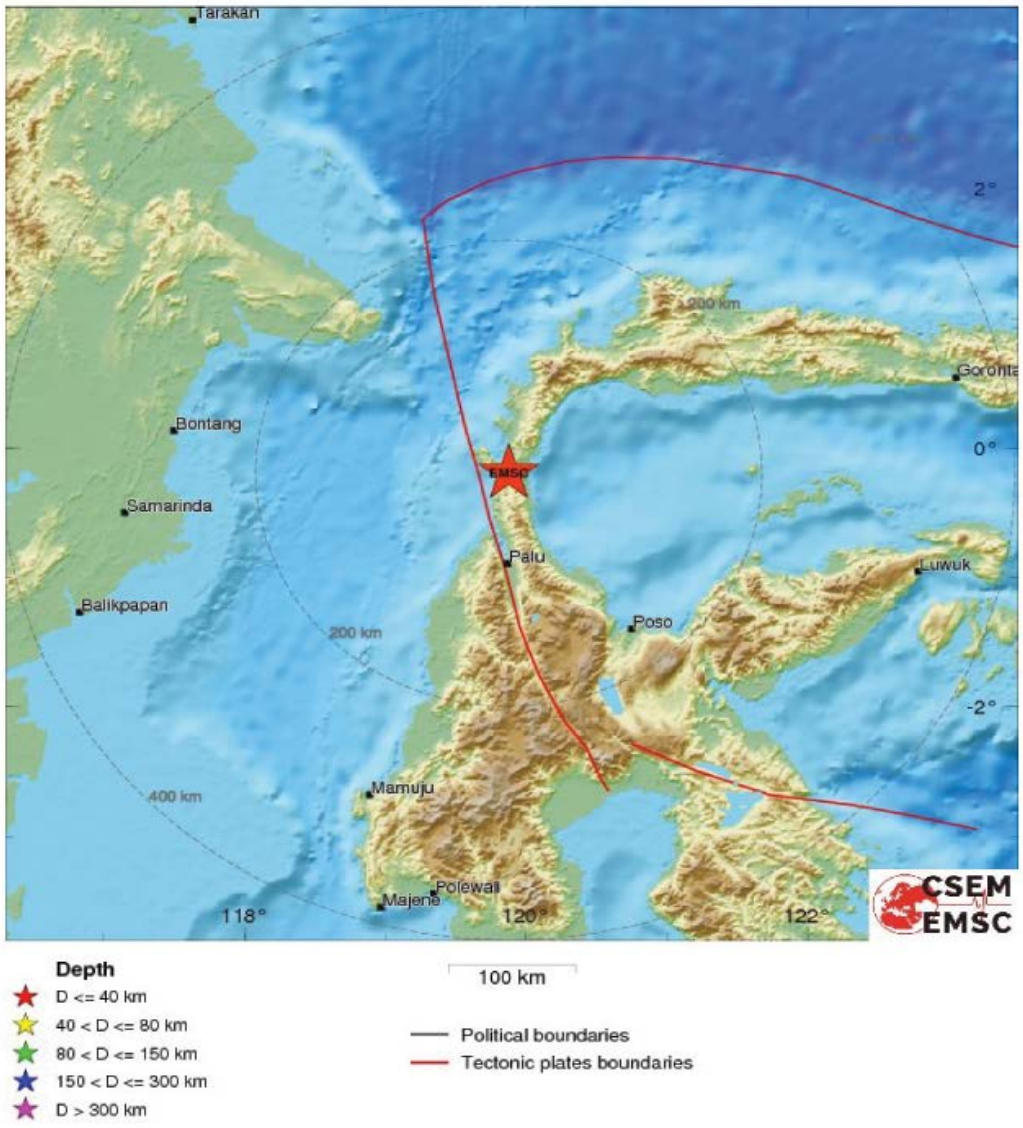
Advanced research products for earthquake response

- ✓ Sulawesi, Indonesia - September 2018 (BRGM, ESA, NOA/CRL)
- ✓ Zakynthos, Greece – October 2018 (HUA)

Articulate with EO disaster response capabilities

- ✓ Listing EO products that could be shared with the international Charter on a best effort basis (on-going).

Sulawesi, Indonesia (1)



28 September 2018

a large earthquake (**Mw 7.5**) struck the **Minahasa Peninsula, Indonesia**. The earthquake caused massive damages near **Palu city**, including onshore gravitational instabilities and a tsunami.

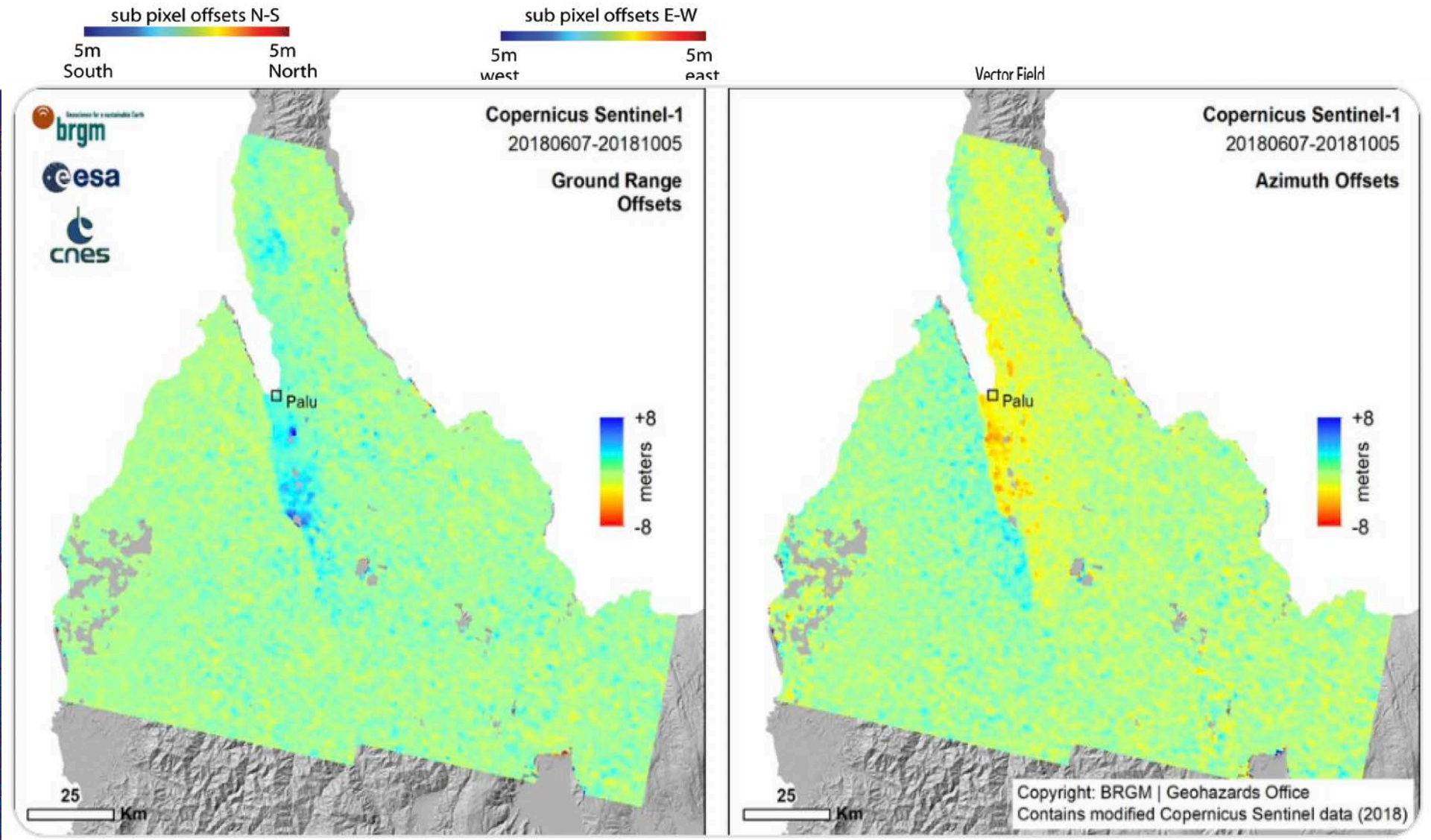
Sulawesi, Indonesia (2)

Animation derived from Copernicus Sentinel-2 data shows land movement along the fault line at Palu, Indonesia.

Map generated by ESA using Copernicus Sentinel-2 data.

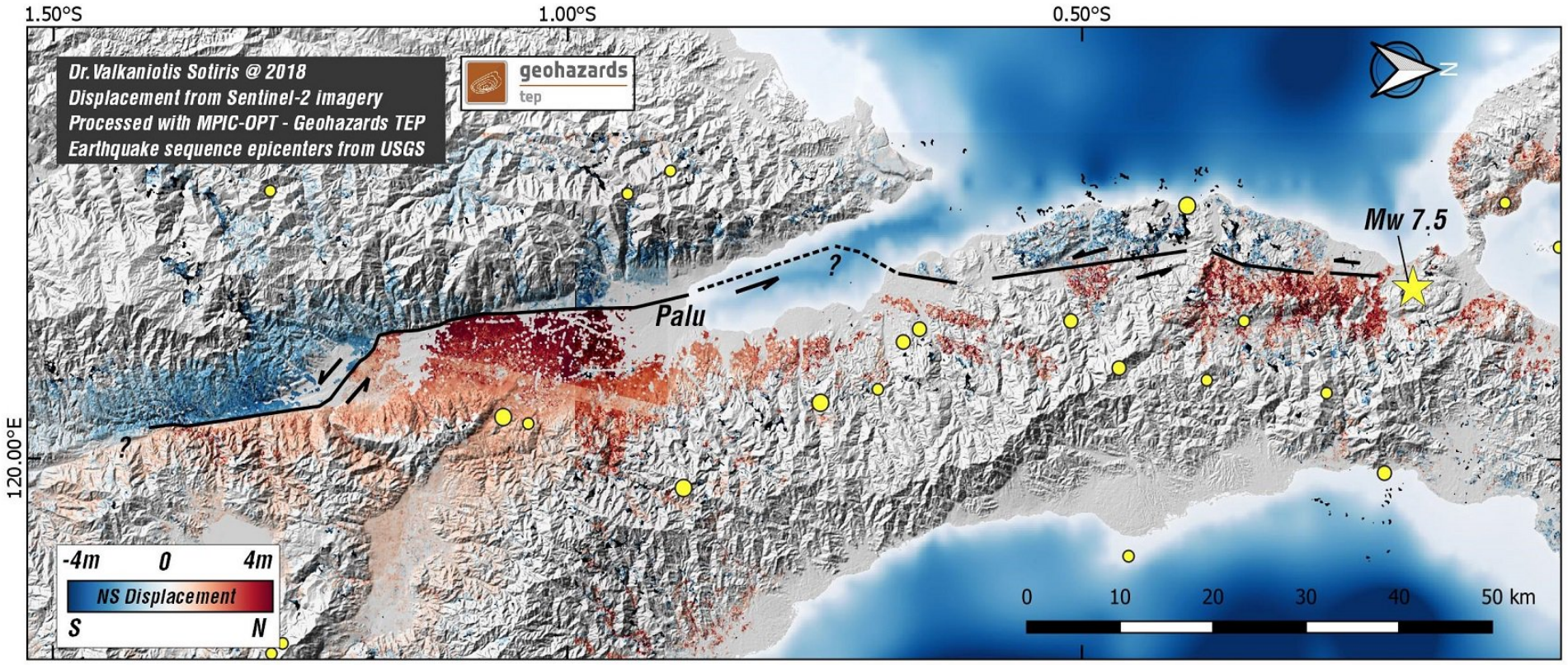
Sulawesi, Indonesia (3)

Sentinel-2 derived displacement field of the 2018-09-28 Mw 7.5 MINAHASA, SULAWESI, INDONESIA earthquake



Copernicus Sentinel-1 data processed by BRGM using GAMMA chain to measure ground displacement

Sulawesi, Indonesia (4)

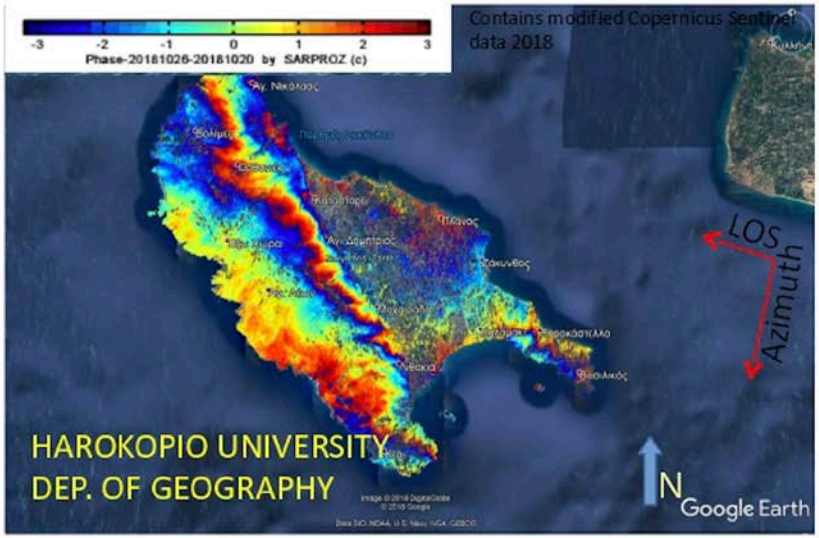


Map generated by CRL on GEP by processing Copernicus Sentinel-2 data with CNRS-EOST's MPIC-OPT chain.

Displacement map using Copernicus Sentinel-2 acquisitions from 17 September and 2 October, showing the impact of the 7.5-magnitude earthquake that hit Indonesia on 28 September 2018. The use of the Cloud processing platform GEP demonstrates the ability to rapidly provide automated measurements.

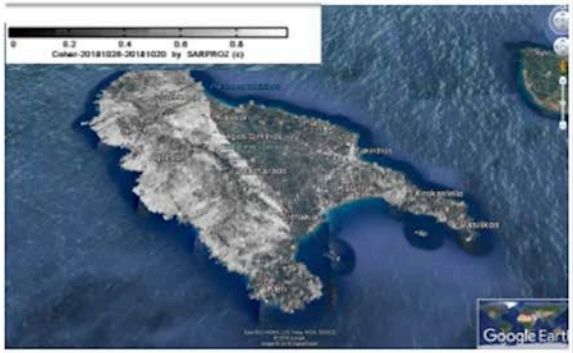
Zakynthos, Greece (1)

25th October 2018: A Mw 6.8 earthquake struck offshore, SW of Zakynthos, at a depth of 14 km.

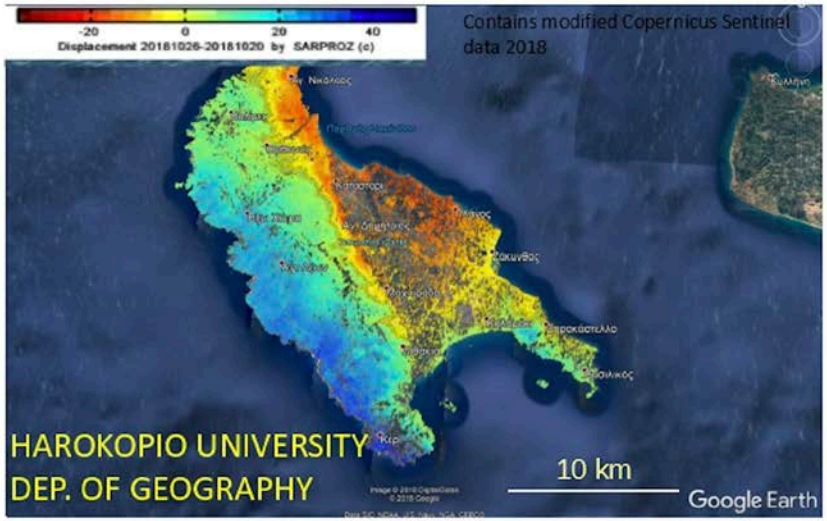


Wrapped Interferogram
Phase 2018-10-20/2018-10-26
Descending SAR scenes of
Sentinel 1 Copernicus satellite.

Interferogram and displacement map generated by HUA using Copernicus Sentinel-1 descending scenes from 20 and 26 October 2018.

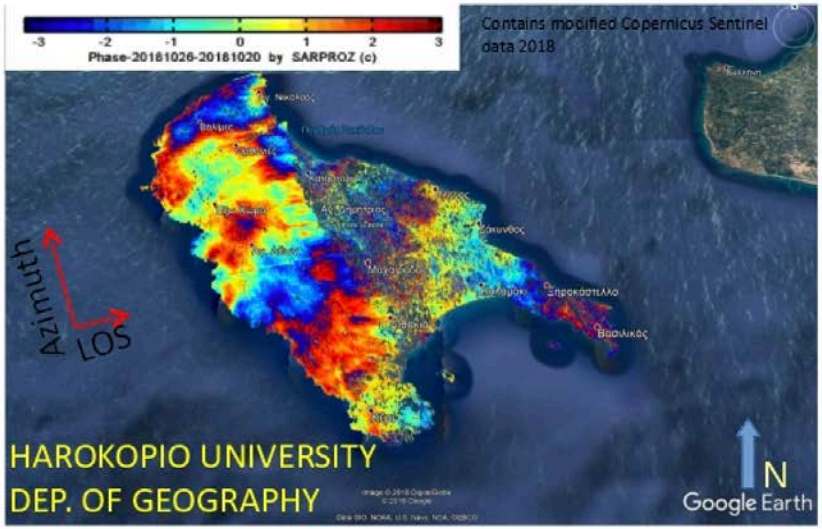


Coherence image

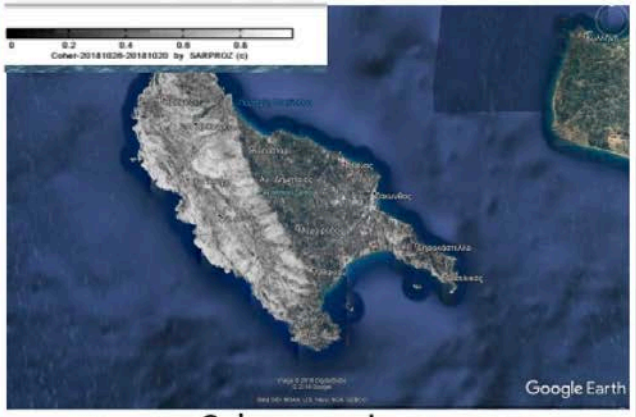


Displacement map

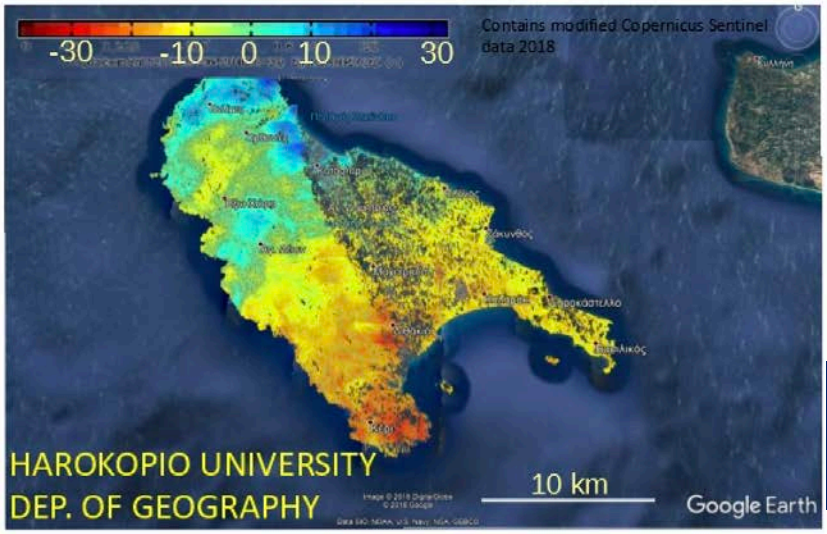
Zakynthos, Greece (2)



Wrapped Interferogram
Phase 2018-10-20/2018-10-26
Ascending SAR scenes of Sentinel 1 Copernicus satellite.



Coherence image



Interferogram and displacement map generated by HUA using Copernicus Sentinel-1 ascending scenes from 20 and 26 October 2018.

Promotion and raising awareness

Papers, Presentations, Posters:

- Poster accepted: ***CEOS activities to support the seismic hazards community***, LPS 2019
- Paper under review: ***Contrasting seismic risk for Santiago, Chile, from near-field and distant earthquake sources*** (prepared by University of Leeds using Pleiades imagery)

Web articles:

- http://www.esa.int/spaceinimages/Images/2018/10/Fault_line_land_movement_in_Indonesia
- http://www.esa.int/spaceinimages/Images/2018/10/Indonesia_earthquake_displacement_map

Twitter:

Conclusion

- **Data requests:** Iran (still under review by Demonstrator leads), **Indonesia, Central Asia, Ecuador - Turkey - Kenya - Nepal (GCRF Hubs)**, Iran (upcoming), Greece (upcoming)

- **Activities:** Earthquakes in Indonesia and Greece (with Copernicus Sentinel-1 and 2)

- **Promotion:** Webpage updated, web articles and twits published, poster for LPS 2019 under preparation

Thank you!