

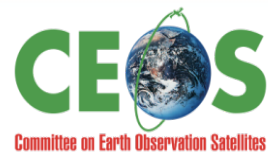
# *CEOS Disaster Risk Management*

## Seismic Hazards Demonstrator

CEOS WG Disasters 12<sup>th</sup> meeting



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# Overview and objectives



Following the precursor Seismic Hazards pilot activity, the seismic Hazards Demonstrator aims to **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** in collaboration with GLab 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.

## ***Objectives (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**
- **University of Oxford / UK**
- **CNRS IPGP /France**

# Data - Yearly quota available and requests



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

Request no.	Request status	Prime Investigator Affiliation	Data requested	Number of images requested	Objective
2019-R02	<b>Approved</b>	University of Leeds	Pleiades	<b>2322 sq. km. in Central Asia</b>	To address the UN sustainable cities and communities global challenge by improving our understanding of earthquake hazard for three major cities along the northern Tien Shan mountains in Kyrgyzstan and Kazakhstan that have been struck by huge earthquakes in the past.
2019-R03	<b>Approved</b>	University of Leeds	Pleiades	<b>316 sq.km. in Indonesia</b>	Assess the potential of Pleiades for deriving the Palu fault rupture offsets through both the urban city and rural environment
2019-R04	Received (awaiting CNES response)	University of Leeds	Pleiades	approx. 3000 sq. km. in Ecuador	Support the GSRF 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)
2019-R05	Received (awaiting CNES response)	University of Leeds	Pleiades	approx. 3000 sq. km. in Nepal	
2019-R06	Not received	University of Leeds	Pleiades	approx. 3000 sq. km. in Turkey	
2019-R07	Not received	University of Leeds	Pleiades	approx. 3000 sq. km. in Kenya	
2019-R08	Not received	HUA	TerraSAR-X, Cosmo-SkyMed, Pleiades	N/A in Greece	Monitor potential deformation along the faults
2019-R09	Not received	HUA	TerraSAR-X, Cosmo-SkyMed, Pleiades	N/A in Iran	Monitoring of active structures
2019-R10	Not received	University of Oxford	Pleiades	N/A in Turkmenistan	Studying the faulting and preserved surface ruptures from some of the more significant 20th century and older earthquakes within the interior of Asia, with a focus on several that have caused widespread damage in urban regions. An initial focus is the city of Ashgabat, Turkmenistan

# Status of activities



## **Advanced research products for earthquake response**

- ✓ Sulawesi, Indonesia - September 2018 (BRGM, NOAA/CRL), on-going work
- ✓ California, USA – October 2018 (CRL/NOA)

## **Active fault mapping with VHR optical data**

- ✓ Sulawesi, Indonesia - September 2018 (University of Leeds)
- ✓ Central Asia – October 2018 (University of Leeds)

## **Articulate with EO disaster response capabilities**

- ✓ Proposition of EO products to be shared with the International Charter on a best effort basis

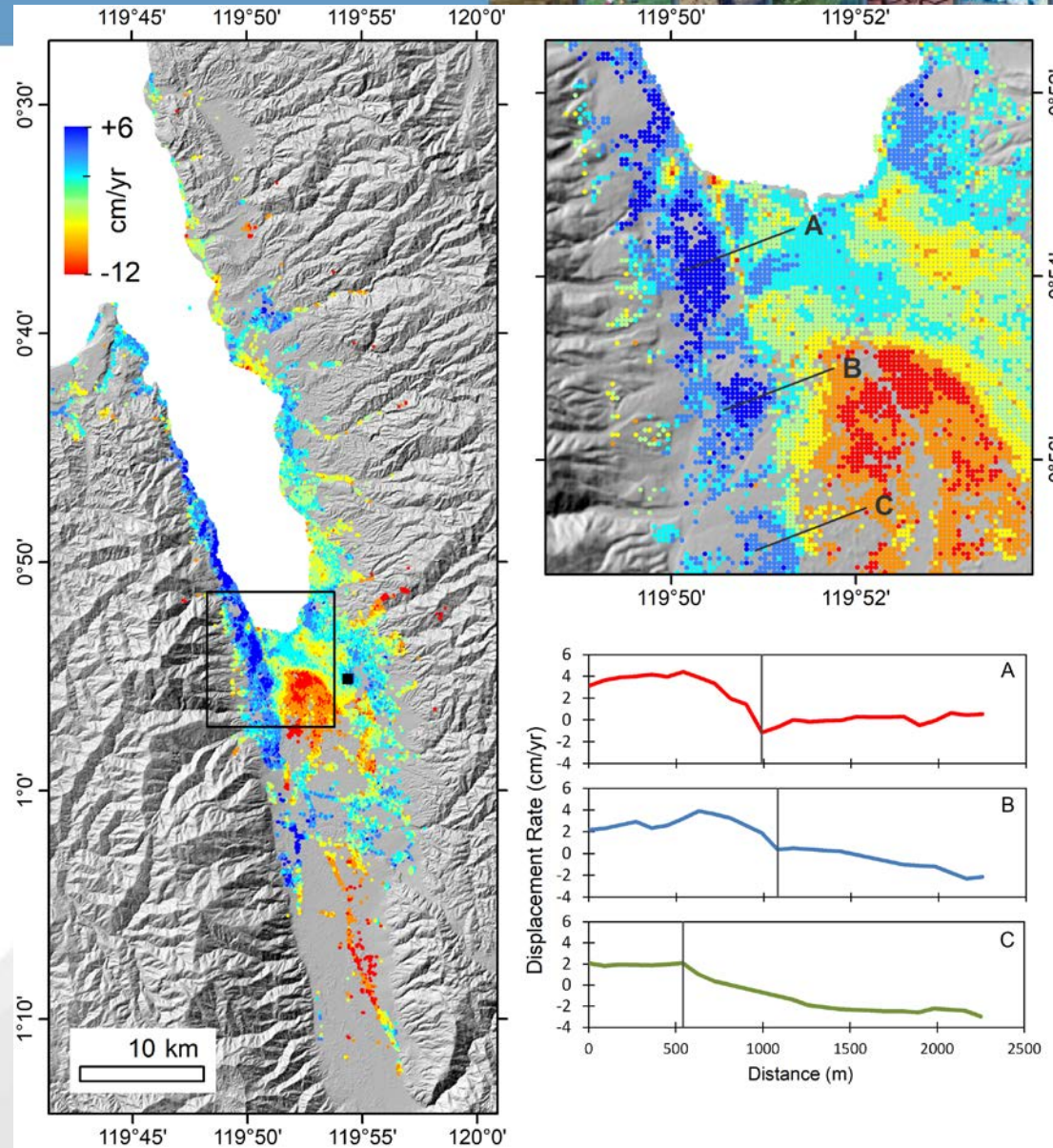
# Sulawesi, Indonesia

**28 September 2018**

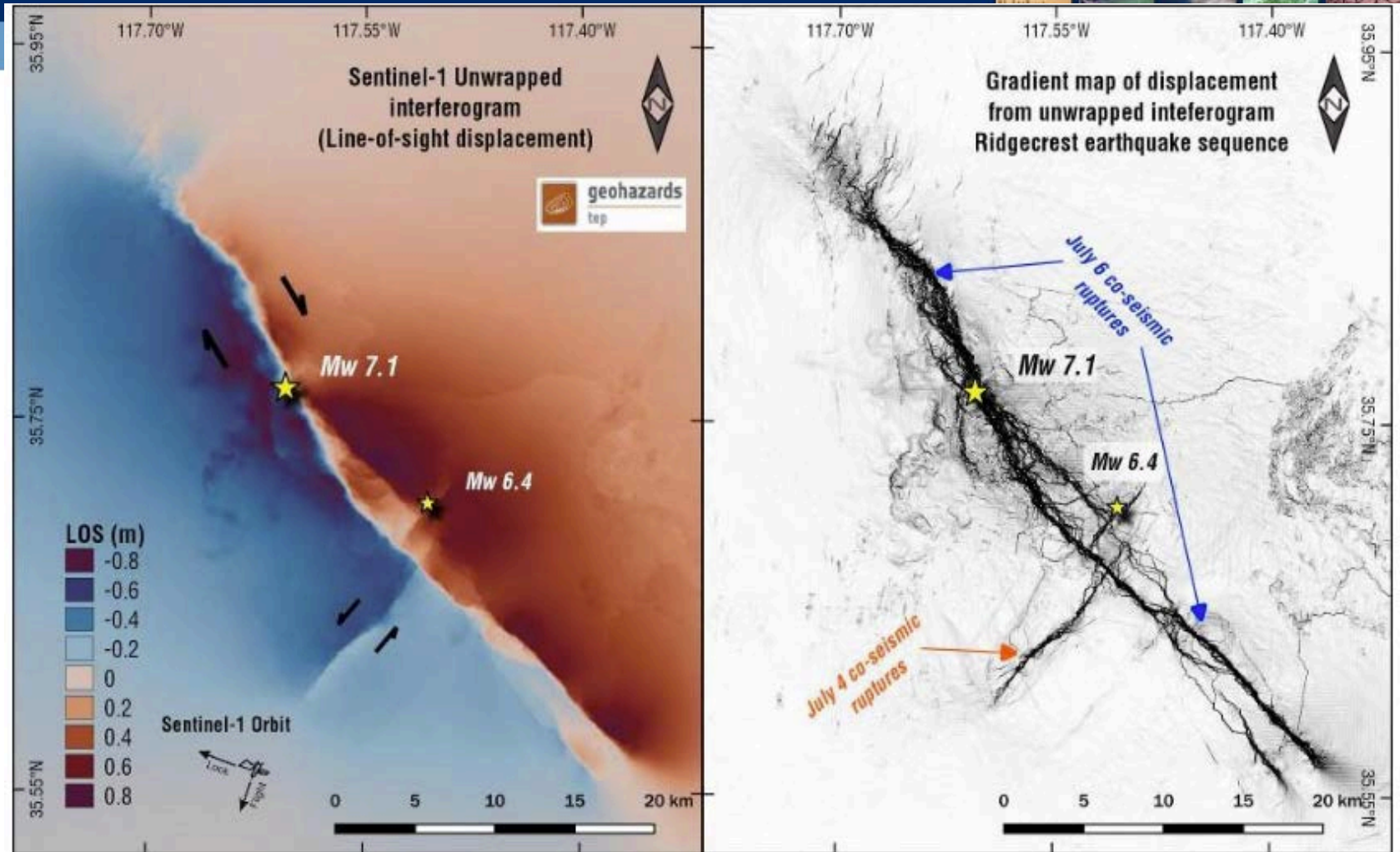
a large earthquake (**Mw 7.5**) struck the **Minahasa Peninsula, Indonesia**. The earthquake caused massive damages near **Palu city**, including onshore gravitational instabilities and a tsunami.

Post-seismic relaxation of the Sulawesi 2018 M7.5 earthquake (Indonesia) using Sentinel-1 P-SBAS service on GEP.

Credits: BRGM, CNR-IREA. Contains modified Copernicus Sentinel data.

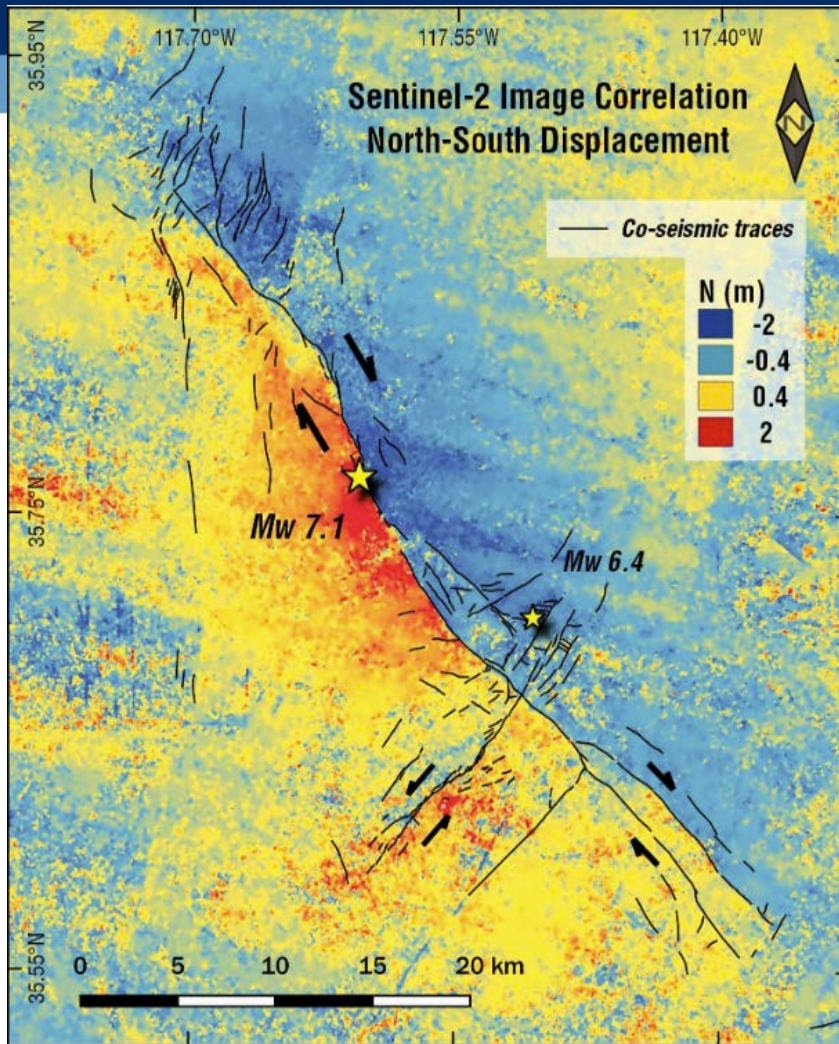


# California, USA (1)

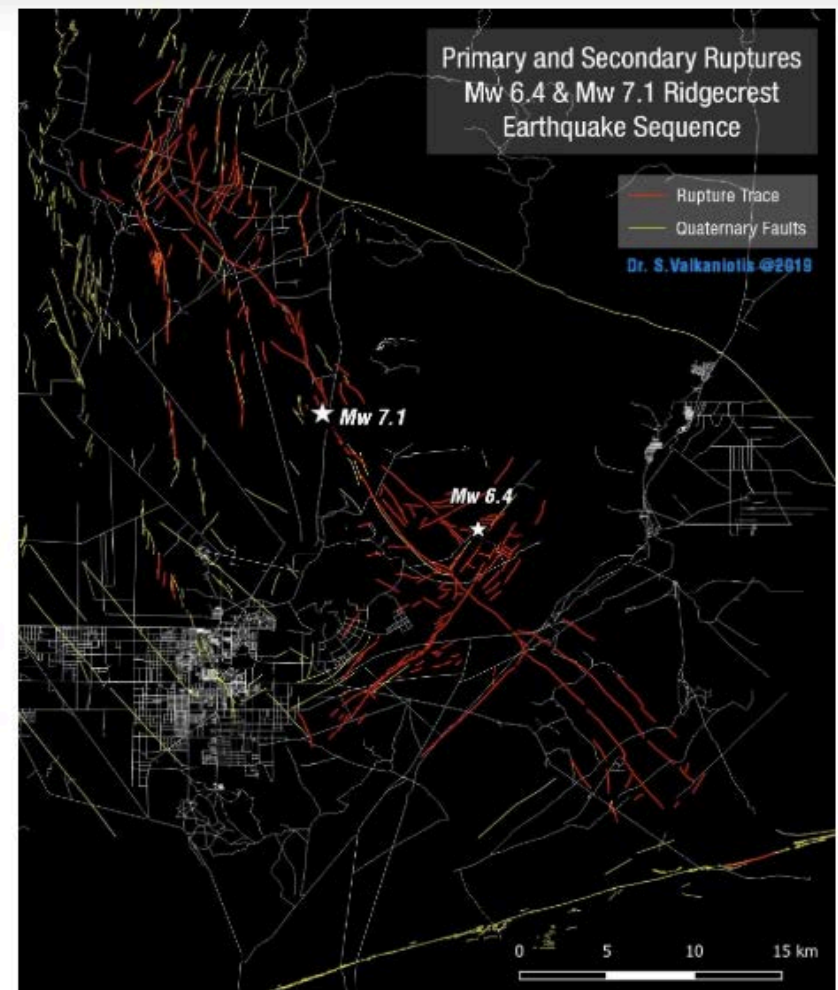


Ground displacement computed from Sentinel-1 radar images before and after the earthquakes (left) and derived displacement gradient (right). Gradient map shows major fault ruptures as thick dark lineaments. Credits: Dr. Sotiris Valkaniotis, Geodynamic Institute NOA & Corinth Rift Laboratory; Contains modified Copernicus Sentinel-1 data (2019)

# California, USA (2)



Horizontal surface displacement from image correlation, using Sentinel-2 images before and after the earthquakes. Red/yellow colors shows displacement towards north and blue towards south. Black lines are fault ruptures mapped using Sentinel-1 and Sentinel-2 images. Credits: Dr. Sotiris Valkaniotis, Geodynamic Institute NOA & Corinth Rift Laboratory; Contains modified Copernicus Sentinel-2 data (2019)



Faults activated during the 2019 Ridgecrest earthquake sequence (in red) mapped using Sentinel-1 and 2 data, superimposed with the Quaternary faults (in yellow). Most of the faults appearing after the Ridgecrest earthquakes do not appear in the Quaternary faults catalogue. Credits: Dr. Sotiris Valkaniotis, Geodynamic Institute NOA & Corinth Rift Laboratory; Contains modified Copernicus Sentinel data (2019); U.S. Geological Survey and California Geological Survey, 2006, Quaternary fault and fold database for the United States, 2019, from USGS web site: <http://earthquake.usgs.gov/hazards/qfaults/>



# Promotion and raising awareness



## Papers, Presentations, Posters:

- Paper in review: ***Contrasting seismic risk for Santiago, Chile, from near-field and distant earthquake sources*** (prepared by University of Leeds using Pleiades imagery)

## Web articles:

- <https://eo4society.esa.int/2019/07/30/mapping-the-faults-of-2019-california-earthquakes-with-sentinel-1-2/>

***We plan to prepare and circulate a short document to potential partners providing main information and explaining the procedures and commitments.***

# Conclusion



- **Data requests:** Indonesia, Central Asia, Ecuador, Nepal (GCRF Hubs), Turkey and Kenya for GSRF Hubs (upcoming)
- **Activities:** Indonesia and USA earthquakes covered (with Copernicus Sentinel-1 and 2); on-going support the GSRF Hubs with Pleiades imagery, aiming to derive models of multi-hazard risk to inform urban development planning
- **Promotion:** Web articles and paper (under review)
- **Users uptake:** University of Oxford (UK) and IPGP (France) are interested to participate in the Demonstrator



**Thank you!**