



Committee on Earth Observation Satellites

# WGDisasters Seismic Hazards Demonstrator

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Virtual Meeting

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

- Pursue **global tectonics mapping** in the long term
- Expand **active fault mapping from regional to global coverage primarily using VHR optical data** supporting supporting geomorphological and morpho-tectonics studies
- Exploit EO data to derive **advanced research products for earthquake response**: expand to target of at least 10-12 EQ per year
- **Articulate with EO disaster response capabilities** e.g. the Charter to make sure users are aware of and use it.

# 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	AOI	Number of images requested
2019-R02	<b>Approved</b>	University of Leeds	Pleiades	Central Asia	<b>2322 sq. km. in Central Asia</b>
2019-R03	<b>Approved</b>	University of Leeds	Pleiades	Indonesia	<b>316 sq.km. in Indonesia</b>
2019-R04	<b>Approved</b>	University of Leeds	Pleiades	Ecuador	approx. 3000 sq. km. in Ecuador
2019-R05	<b>Approved</b>	University of Leeds	Pleiades	Nepal	approx. 3000 sq. km. in Nepal
2019-R06	Not received	University of Leeds	Pleiades	Turkey	approx. 3000 sq. km. in Turkey
2019-R07	<b>Approved</b>	University of Leeds	Pleiades	Kenya	approx. 3000 sq. km. in Kenya
2019-R08	Not received	HUA	TerraSAR-X, Cosmo-SkyMed, Pleiades	Greece	N/A in Greece
2019-R09	Not received	HUA	TerraSAR-X, Cosmo-SkyMed, Pleiades	Iran	N/A in Iran
2019-R10	<b>Approved</b>	University of Oxford	Pleiades	Turkmenistan	3,648 (tri-stereo total)
2019-R11	<b>Approved</b>	Argans c/ESA	Cosmo-SkyMed	Durres (Albania)	
2020-R12	<b>Approved</b>	University of Leeds	Pleiades	Elazig (Turkey)	
2020-R13	<i>Rejected by DLR</i>	INGV	TanDEM-X	North Zanjan fault (Iran)	



Request no.	Request status	Prime Investigator Affiliation	Data requested	AOI	Number of images requested
2020-R14	Approved	University of Oxford	Pleiades	Dushanbe (Tajikistan)	1,500 sq. km. (tri-stereo total)
2020-R15	Approved	NOA, AUTH, DUTH	Pleiades	Samos island (Greece)	824 sq. km. (tri-stereo total)
2020-R16	Approved	University of Oxford	Pleiades	Dushanbe (Tajikistan)	1,856 sq. km. (stereo total)
<b>2021-R17</b>	Approved	University of Oxford	Pleiades	Almaty (Kazakhstan)	4,227 sq. km. (tri-stereo total)
<b>2021-R18</b>	Approved	University of Tehran	Cosmo-SkyMed	Tehran (Iran)	400 images
<b>2021-R19</b>	Approved	INGV, NOA	Cosmo-SkyMed and CSK Second Generation	Tirnavos, Thessaly (Greece)	19 images per satellite per orbit
<b>2021-R20</b>	Approved	University of Oxford	Pleiades	Shamakhi (Azerbaijan)	5,836 sq. km. (stereo total)
<b>2021-R21</b>	Approved	COMET-University of Leeds	Pleiades	Qinghai (China)	2,421 sq. km (tri-stereo total)

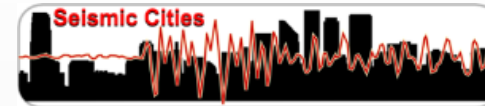
- Updated **Data Requests spreadsheet** uploaded on [www.ceos.org](http://www.ceos.org) under Document Management



## Quito, Ecuador), Nairobi (Kenya) and Kathmandu (Nepal), University of Leeds et al.

Tomorrow's Cities: **deriving models of multi-hazard risk to inform urban development planning** for four major capital cities using **Pleiades** VHR images

✓ *In progress (Quito and Kathmandu completed)*



## Qinghai, China (University of Leeds, COMET et al.)

Deriving DEMs of the **2021 May 21st Mw 7.3 Maduo earthquake** rupture using **Pleiades tri-stereo** data to **map the fault rupture zone**. This will aid field teams in mapping out the rupture in the field, as well as create remotely derived datasets against which to compare this information to improve our understanding of earthquake faulting events.

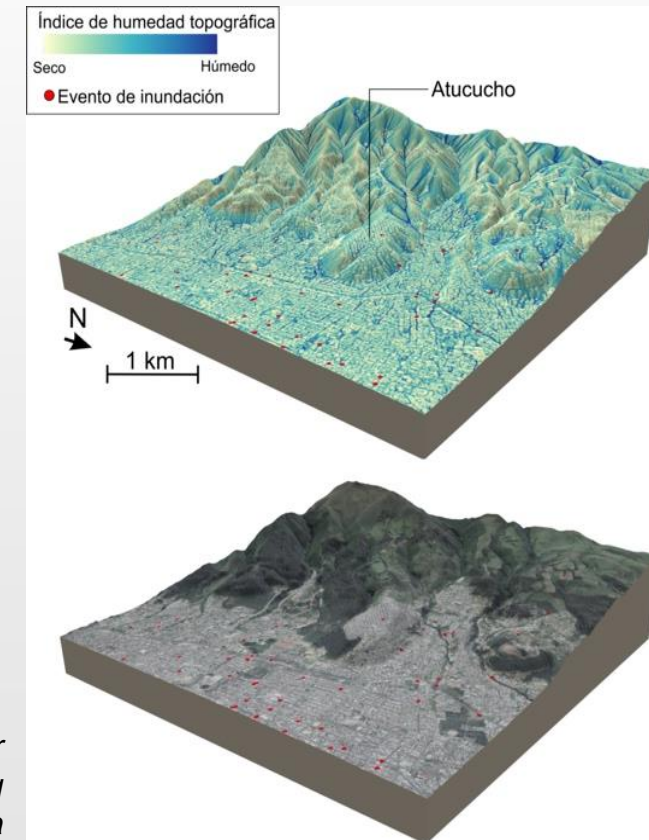
✓ *In progress (investigation of artefacts found)*

## Shamakhi, Azerbaijan (University of Oxford et al.)

Using **Pleiades stereo** data to **support active fault characterisation and palaeoseismic trenching along the edge of the Caucasus mountains and within the Kura basin**, where rapid slip is expected, but evidence of active faulting is subtle.

project co-funded through a UKRI GCRF award

✓ *In progress, fieldwork has been postponed for late 2021 - early 2022.*



*Wetness index used to show movement of water around and into the city of Quito, generated using Pleiades data*

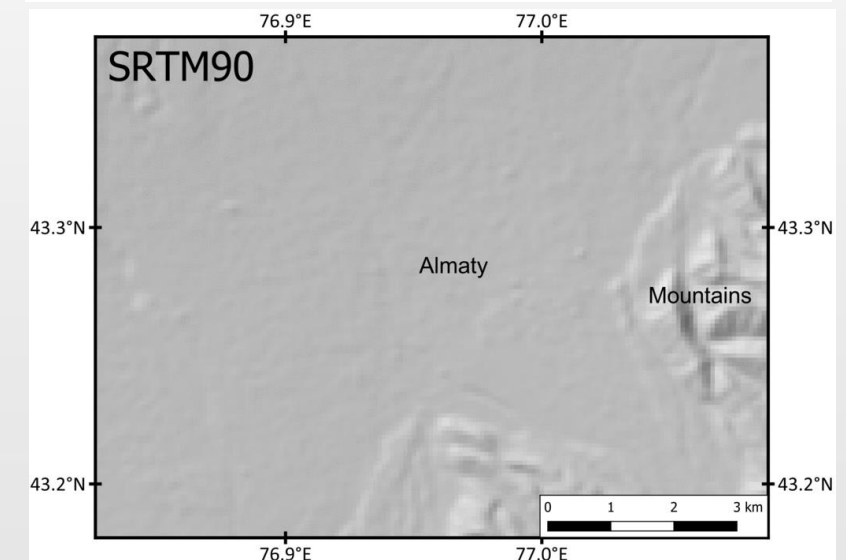
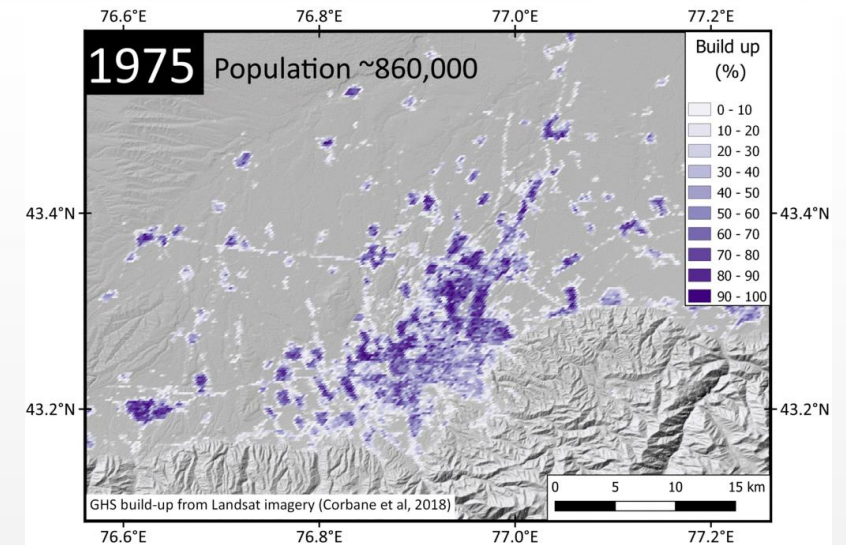
## Almaty, Kazakhstan (University of Oxford, University of Leeds, COMET, BGS, GEM Foundation et al.)

Active faulting using **Pleiades stereo** data to identify and characterise active fault scarps in urban regions along the Zailisky range front in Kazakhstan, including the city of Almaty (2M population) and various other large towns (including Bishkek, Kyrgyzstan).

✓ *In progress, DEM analysis combined with a successful palaeo-seismic survey, suggested occasional large earthquakes over the last 10,000 years. (project completion foreseen Q2 2022, results to support further detailed work and interactions with policy makers)*

## Dushanbe, Tajikistan (University of Oxford)

✓ *In progress (presentation follows)*





### Ashgabat, Turkmenistan (University of Oxford):

Examine the landscape for signs of **faulting within urban Ashgabat associated with the destructive 1948 earthquake**, and to undertake reconnaissance in support of further palaeo-seismic trenching studies.

- ✓ *Ongoing with the analysis, completion of the 1948 study foreseen in summer 2022. Fieldwork in Turkmenistan is postponed (for 2023).*

### Pamir, Tajikistan (University of Oxford):

Undertake **pilot investigations of earthquake rupture associated with the destructive 1911 and 1949 earthquakes at Sarez and Khait** and investigate **past earthquake behaviour on the major Darwaz fault**, for which no historical earthquakes are reported. This project consists of three small polygons of stereo Pleiades data.

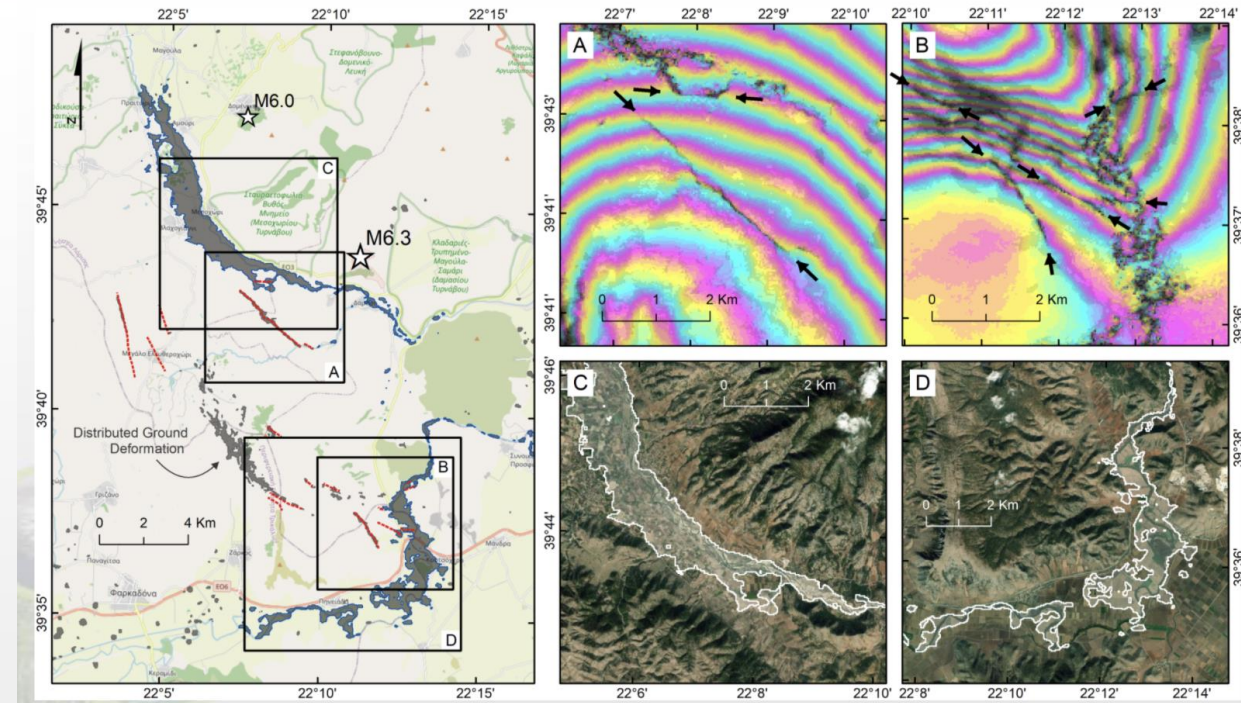
- ✓ *Khait polygon is **progressing well**, completion foreseen by the end of 2021. 30 cm Worldview-3 data used to provide additional details of some subtle features.*
- ✓ *Sarez and Darwaz is currently **on hold** (unable to organise the field components of the work, postponed for 2022).*



## Thessaly, Greece (INGV and AUTH)

INGV and AUTH started collaboration on joint analysis processing **Sentinel-1** and **CosmoSkyMed** for the **Thessaly M6.3** in **March 2021** for post seismic relaxation of the area. GEP services are also used.

✓ *In progress (further details under the Geohazards Lab presentation)*



Contains modified Copernicus Sentinel-1 data (2015-2020), processed by AUTH

*Composite map of decorrelated areas. Regions suffered extended liquefactions collocate with riverbeds. Contains Copernicus Sentinel-1 modified data.*

## Tehran, Iran (University of Tehran)

Mapping interseismic strain accumulation over the urban area of Tehran.

✓ *Approved, awaiting feedback*





Examples of processed satellite EO products

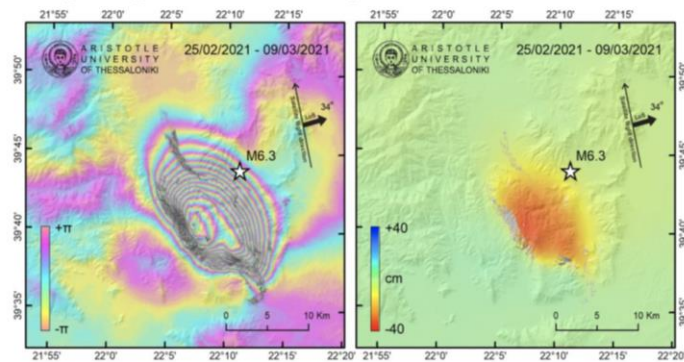


Figure 8. Example of co-seismic differential interferogram (left image) using Copernicus Sentinel-1 pre-event (25/02/2021) and post-event (09/03/2021) data, corresponding to the ground motion map (right image) of the Tirnavos (Greece) M6.3 earthquake on 03/03/2021. The ground motion map shows a maximum displacement at -38cm. No rupture reached the surface. Contains modified Copernicus Sentinel data (2021), processed by Aristotle University of Thessaloniki (AUTh).

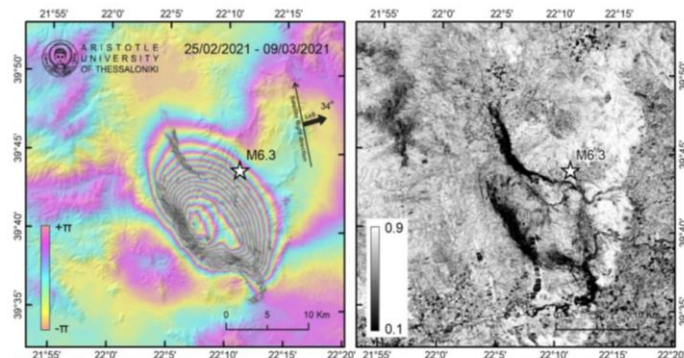


Figure 9. Example of co-seismic differential interferogram (left image) and interferometric coherence map (right image) of the M6.3 earthquake in Tirnavos (Greece), using Copernicus Sentinel-1 pre-event (25/02/2021) and post-event (09/03/2021) data. Wide-spread liquefactions along river basins and distributed surface deformation are depicted by patterns of low coherence (areas in black) nearby the epicentral area. Contains modified Copernicus Sentinel data (2021), processed online on the Geohazards Exploitation Platform (GEP) by Aristotle University of Thessaloniki (AUTh).

## Papers, Presentations, Posters:

### ➤ Paper **to be submitted**

**Improving urban risk estimates for Bishkek, Kyrgyzstan, from improved geological knowledge of hazards** (Ruth M.J. Amey, John R. Elliott, C. Scott Watson, Richard Walker, Marco Pagani, Vitor Silva, Ekbal Hussain, Kanatbek E. Abdrakhmatov, Sultan Baikulov, Gulkaiyr tilek Kyzy)

### ➤ Paper **published** (**American Geophysical Journal**)

**Significant Seismic Risk Potential from Buried Faults Beneath Almaty City, Kazakhstan, revealed from high-resolution satellite DEMs** (Ruth M.J. Amey, John R. Elliott, Ekbal Hussain, Richard Walker, MarcoPagani, Vitor Silva, Kanatbek E. Abdrakhmatov, C. Scott Watson)

## Web page, articles and Twitter:

- Seismic Demonstrator web page updated
- Several tweets published



A discussion on the future of the Seismic Demonstrator is scheduled for next week:

- how **user needs** and **EO data requirements have evolved**
  - > *with support from the Review Process of the Santorini Report*
- is there a **need to continue the Demonstrator**:
  - > *extend the activity until Q2 2022 (most of studies will have been completed by then) or*
  - > *evolve to a follow on activity*
- how to **reshape the strategy of the Demonstrator** to better address the user/community needs
  - > *SWOT analysis could be performed to facilitate the process*
- make sure there is **no interruption in data provision for on-going projects**



Thank you

**Geohazards Lab:**

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