GROUP ON EARTH OBSERVATIONS

Geohazard Supersites & Natural Laboratories

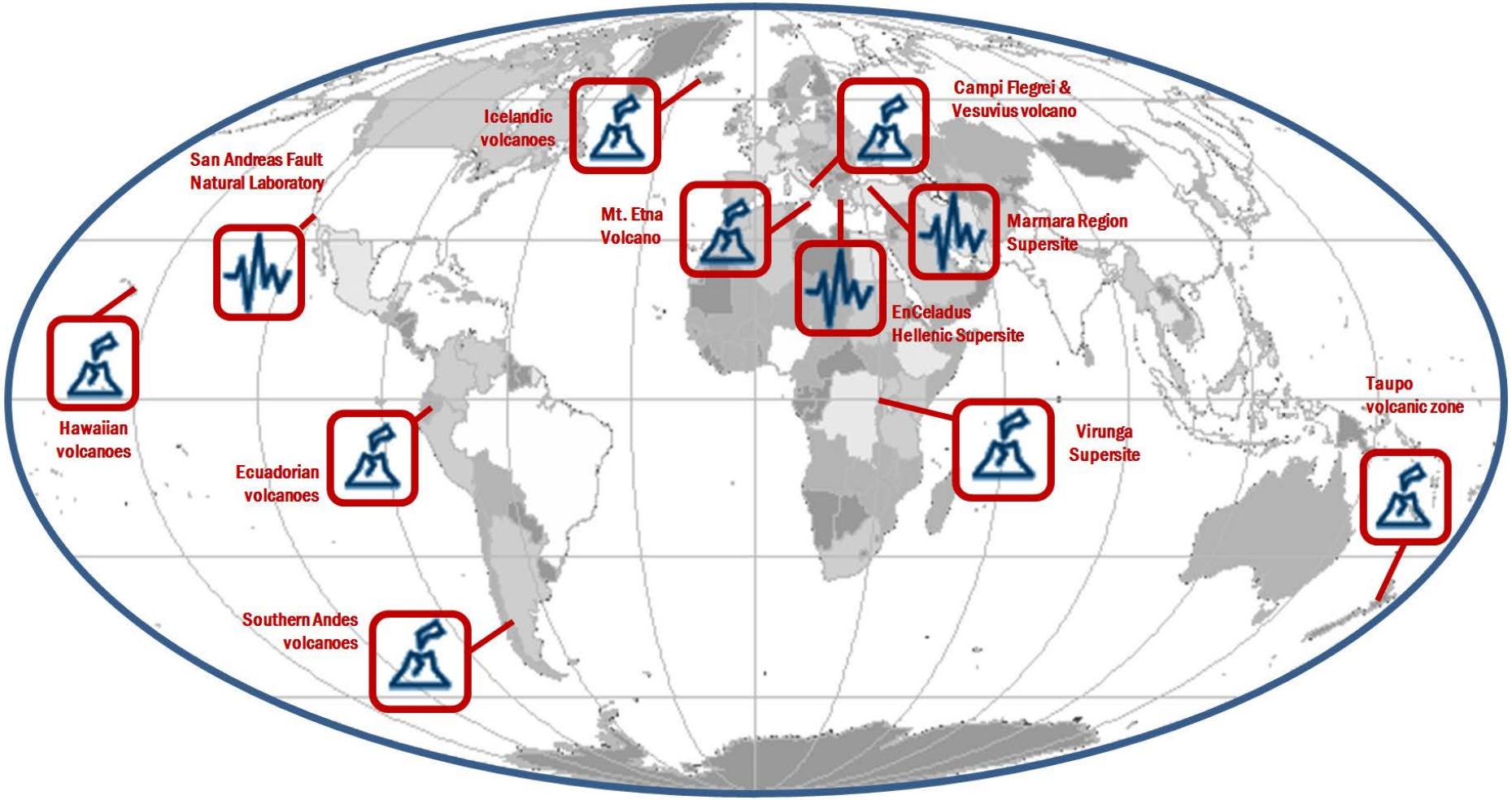
Status of the GEO-GSNL initiative

Stefano Salvi

Chair of the Supersites Advisory Committee

CEOS WG Disasters meeting #10, Naples, September 2018

The Supersite network in 2019



Permanent Supersites

	Supersite	Status	Next Biennial report
1	Hawaiian volcanoes	To be renewed at SIT 34	25-Oct-20(4th)
2	Icelandic volcanoes	Renewed at SIT 33	5-Nov-19 (3rd)
3	Etna volcano	Renewed at Plenary 32	9-Apr-20 (3rd)
4	Campi Flegrei/Vesuvius volcano	Renewed at Plenary 32	9-Apr-20 (3rd)
5	Western North Anatolian Fault	Renewed at Plenary 32	9-Apr-20 (3rd)
6	Taupo Volcano	Renewed at Plenary 31	15-Apr-19 (3rd)
7	Ecuador volcanoes	Renewed at Plenary 31	15-Apr-19 (3rd)
8	Corinth Gulf/Ionian Islands	To be renewed at SIT 34	8-Nov-20 (2nd)
9	San Andreas Fault NL	2nd year of activity	27-Apr-19 (1st)
10	Southern Andes volcanoes	1st year of activity	19-Oct-19 (1st)
11	Virunga volcanoes	1st year of activity	19-Oct-19 (1st)

Event Supersites

	Supersite	Supporting agencies	Status
1	Azgeleh earthquake, Iran-Iraq	ASI	ongoing

Outstanding issues

CNES support to Etna, Vesuvius, Marmara Supersites ended. Need to discuss CNES support to GSNL.

Issues with EO data sharing

- The DLR portal is on again but apparently only for FTP access ?
- Can Pleiades data be share through the Geohazard Exploitation Platform ?

Issues with EO data use - 1

- For some Supersites (e.g. Virunga) there have been delays due to the little experience of the Coordinator with satellite imagery. Support has been given and orders are under way.

- The same for the Enceladus Supersite, but with the additional problem of the change of Coordinator and of some misunderstandings on the actual implementation of the Open Science approach at the Supersite. This has been discussed and orders should arrive soon.

- Sometimes the coordinator waits for a clear signal of increased deformation (measured by the ground networks) before ordering data. We are making clear to all that long term time series are a fundamental component of the Supersite concept, and data must be acquired even during periods of quiescence, to guarantee the continuity of the time series for future studies.

Issues with EO data use - 2

- For some Supersites there may be private companies who want access to the data for research (e.g. they are involved in EC projects with scientific partners). Is this a problem for the agencies?

News from the Supersites

- The San Andreas Fault Natural Laboratory has eventually started activities. The Coordinator has ordered TSX and CSK data.

- Researchers of the Instituto Geofisico (Ecuador Supersite), Technical University of Aachen (Ezgeleh Event Supersite), Servicio Geologico Colombiano, and INGEMMET, are successfully doing InSAR processing using cloud resources in the EVER-EST platform.

- The Coordinator of the Greek Supersite has changed. The new coordinator is Spyros Lalechos, from EPPO.

New proposals

- The proposal for a multihazard Supersite in Peru has been submitted to CEOS DCT (more later).
- Initial discussions about a possible Supersite in Haiti.

Capacity building

- We are continuing to collaborate with USGS VDAP for training South American volcano scientists on InSAR data processing using the EVER-EST platform. A second course is happening in Peru in April 2019, also taught by a NASA/JPL scientist.
- Five Supersites are working together to further implement algorithms and processing tools in the Geohazard Exploitation Platform, to support the provision of value added services based on EO data. An H2020 project proposal is under way.

Addressing action M 9/9

Action M9/9:
Look at existing supersites list and make recommendations on which ones might be expanded to include other hazards and work on risk assessment

These Supersites are affected by further hazard types and would be very happy to include them in the Supersite, also because there are data requests from the scientific community:

- Iceland Supersite – for glacial-related hazards and landslides.
- Ecuador, Marmara, Virunga – landslides.
- Marmara, San Andreas, Campi Flegreii, Ecuador – urban subsidence

Decision needed by CEOS WGD: shall approve extension to these hazards?.

Results from the Supersites

- Hawaii
- Taupo
- Event Supersite for 2017 Iran-Iraq, Ezgeleh earthquake

Hawaii Supersite report 2017-2018

- The 2017-2018 report is dominated by the research and monitoring efforts carried out for the 2018 eruption, aleady presented at WGD meeting #10 in Naples.

- International participation has strongly increase in this period (22 researchers from US, China, Singapore, Europe).

- The monitoring and scientific information derived from the Supersite EO data have been extremely important during the crisis response, and has been provided to a number of end-users:

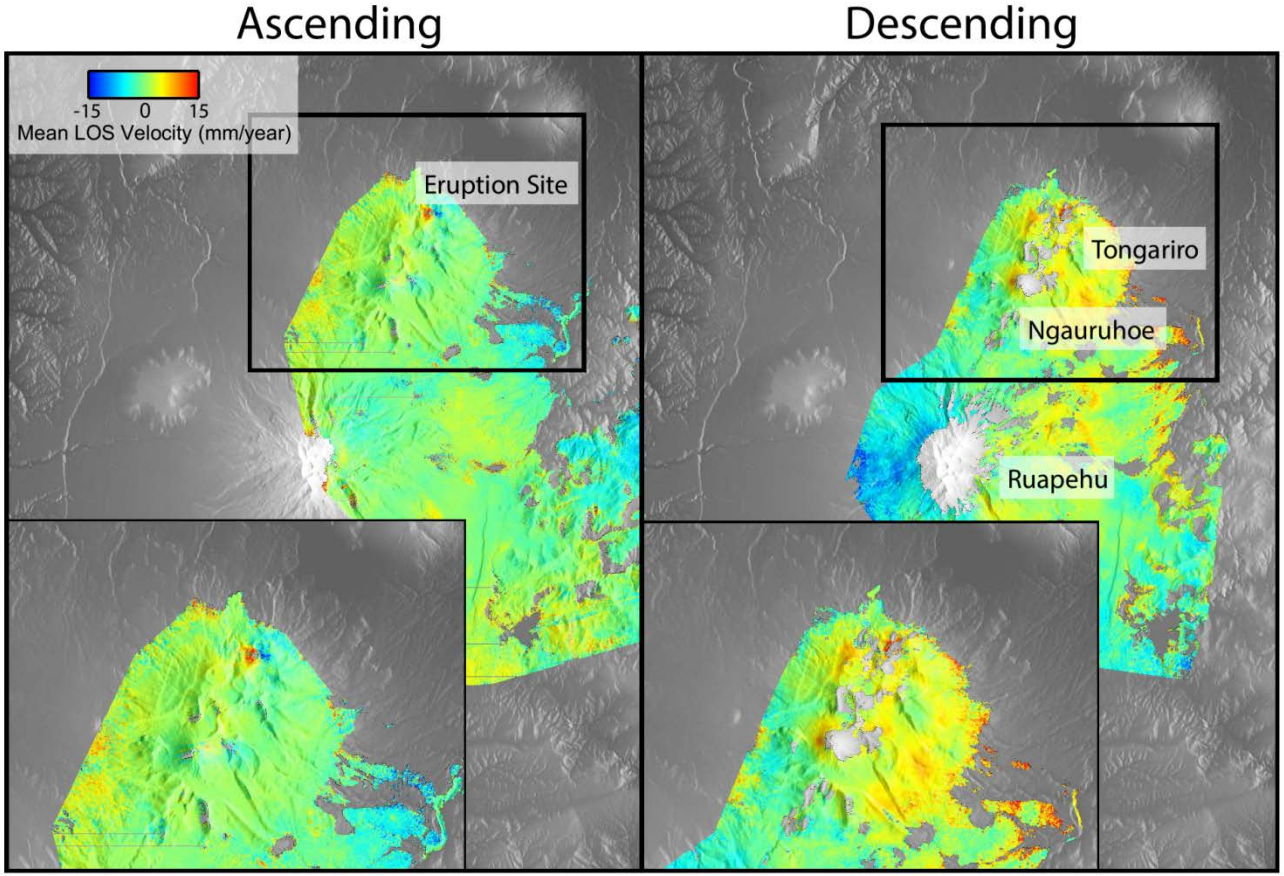
  "… Insights from Supersite data have become invaluable to stakeholders on the Island of Hawai`i, and results provide exceptional fodder for scientific exploration into how volcanoes work"

Hawaii Supersite issues

- No organized and easily accessible repository for the Pleiades data and their derived DEMs.
- A quota of Pleiades data would be needed for the next period.
- RSAT 2 quota should be reinstated, and also the archived RSAT 2 data, considering "…*their unique resolution and polarization, constitute critical value added that will not be available from any other source*".

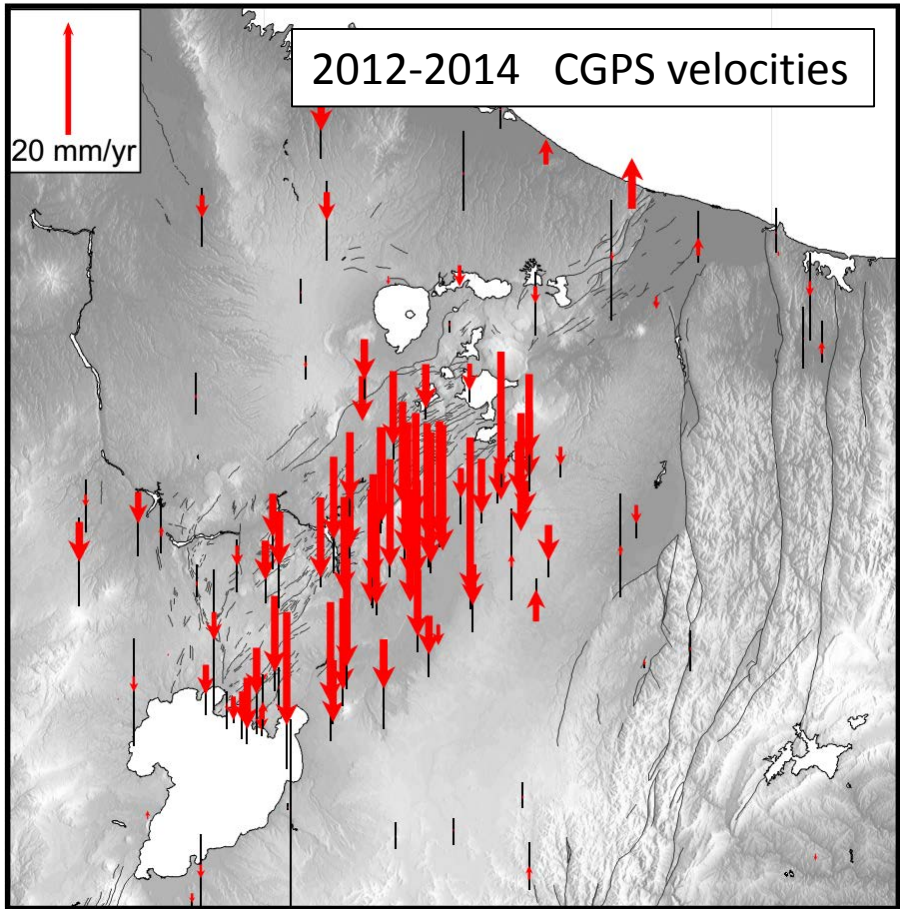
Results from Taupo Supersite: Tongariro 2012 eruption

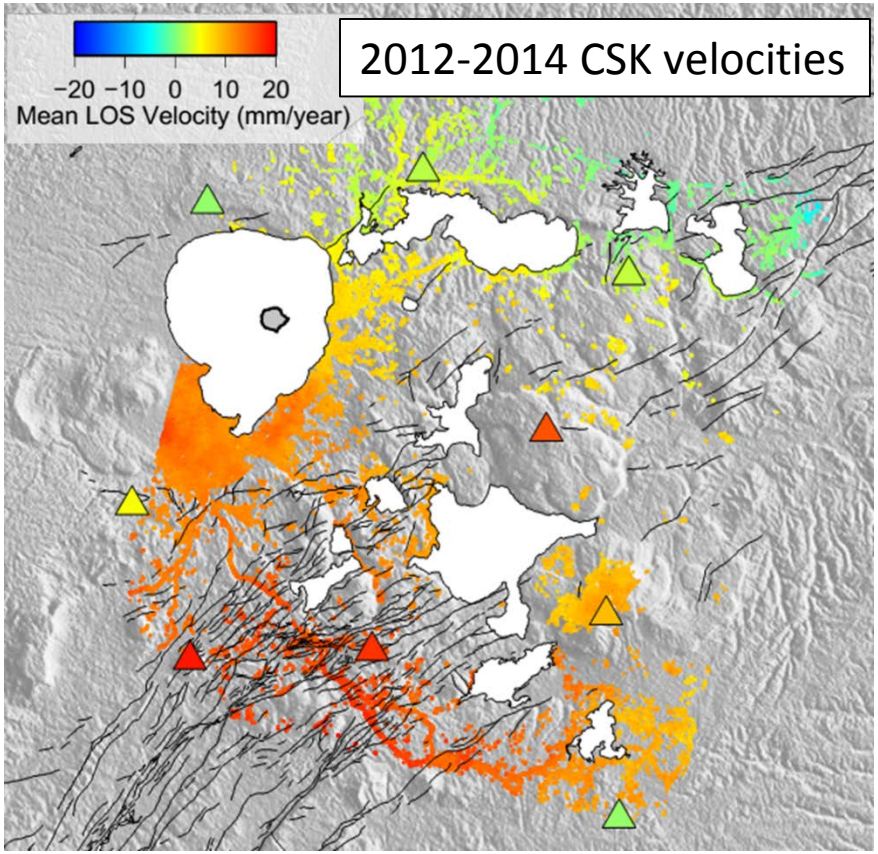
Post eruption deformation remains focused over the 2012 site with no activation of other centres. Cosmo-SkyMed and Sentinel data indicate continued subsidence of ~10 mm/yr over the main eruption site.



Results from Taupo Supersite: Okataina caldera

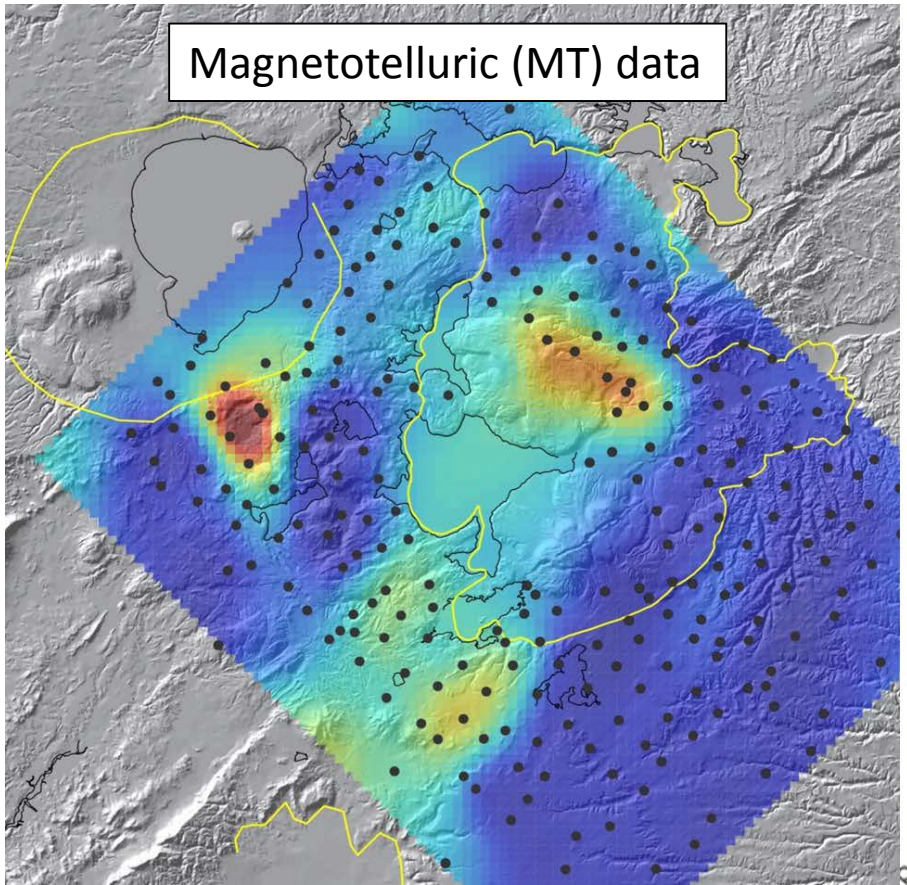
Widespread subsidence in the area is studied with InSAR, GPS, seismology and magnetotelluric data to better image the distribution of melt at depth. Constraining the inversion of geodetic data with the crustal resistivity, is providing an improved estimate of source depth of cooling magma bodies which is likely causing the subsidence .

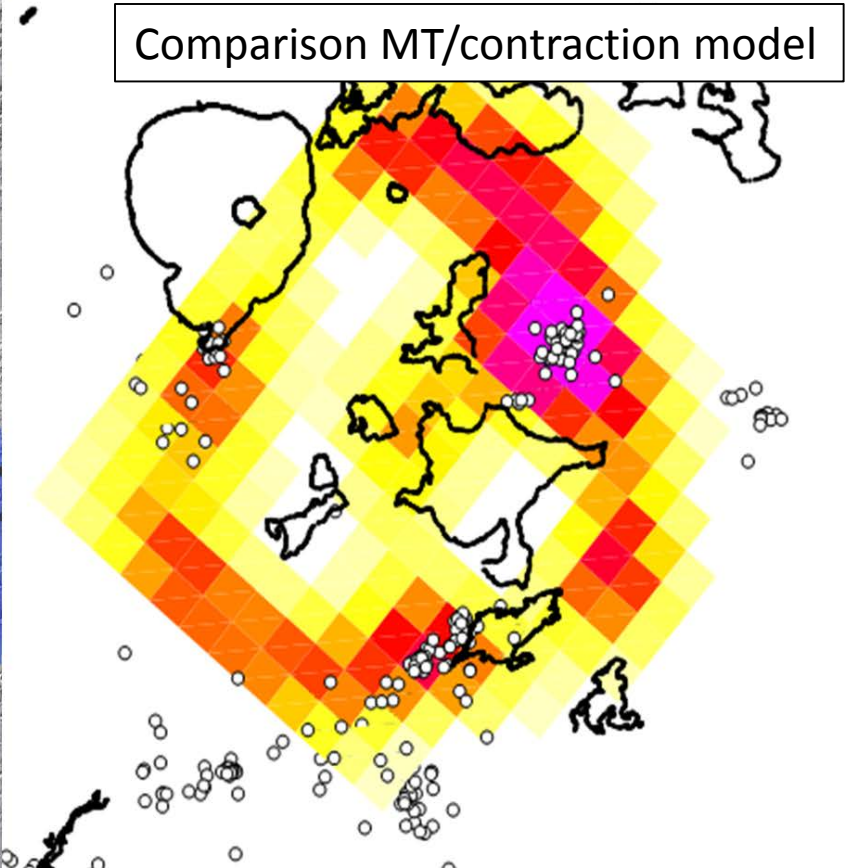




Results from Taupo Supersite: Okataina caldera

The right image shows the comparison between MT and contraction model at 5 km depth. By using the MT as a penalty function contraction is focussed into zones of low resistivity.





Use of Taupo Supersite results

Results from the Supersite are presented to a number of regional council members to inform them of ongoing activities in monitoring of volcanic hazard in New Zealand.

InSAR results, where applicable, are discussed in weekly volcanic hazard monitoring meetings to provide additional information not captured by the current ground-based systems.

Main issues from Taupo Supersite

- Limited international involvement, due to the low level of volcano activity.
- Need to reduce the latency of the TerraSAR X data to improve their effectiveness for monitoring and supporting DRM decision-making.
- RSAT 2 presently not used for long term monitoring, but quota still needed, since it may be requested for response during crises.
- ALOS 2 would be extremely important to increase coherence and deformation signal quality.

The team plans to publicize the Supersite at the 2021 IAVCEI meeting, to be held in Rotorua.

Results from Azgeleh Event Supersite

A magnitude 7.3 earthquake occurred on 12 November 2017 at 19 km depth near the Iran–Iraq border, 30 km south of the city of Halabja.

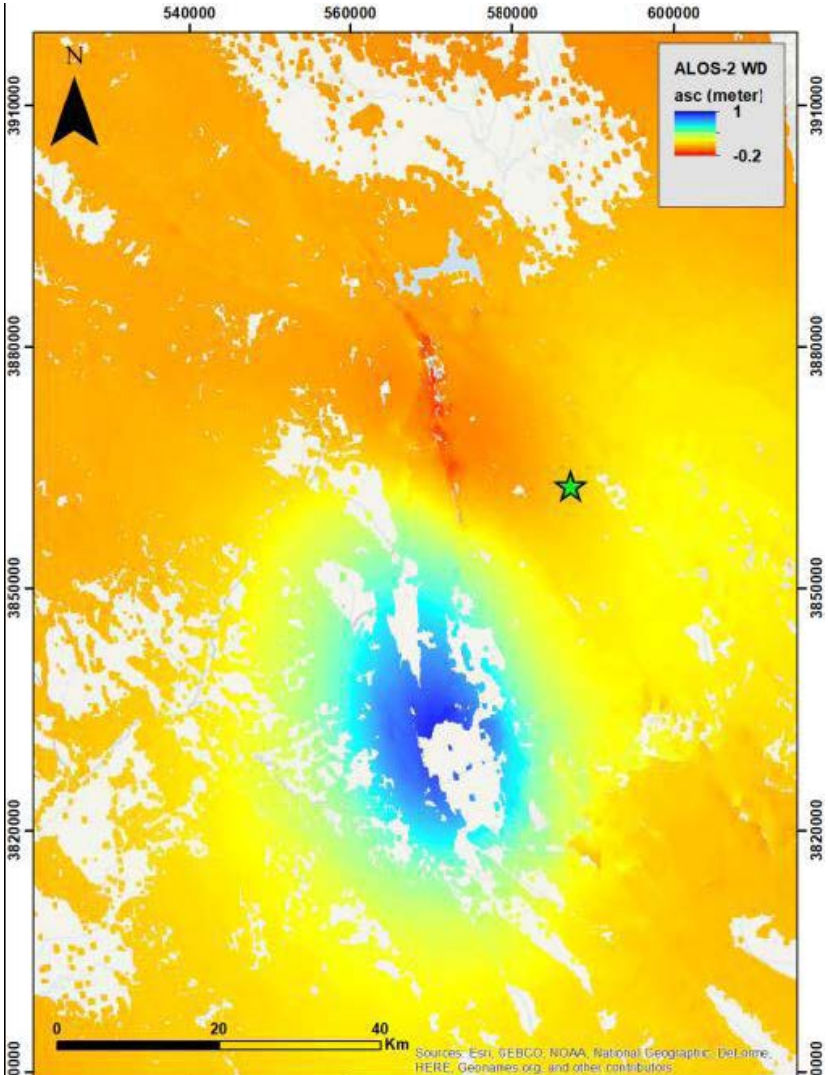
It killed 630 people, injured 8,100, and left 70.000 homeless.

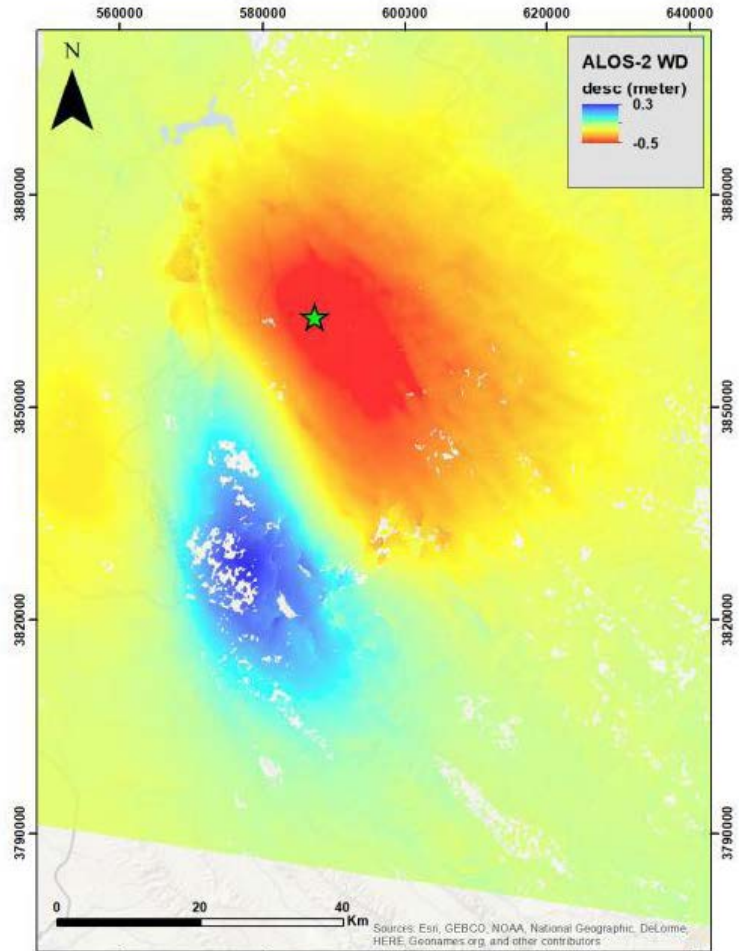
Nine months later was followed, 45 km to the south, by a M 5.9 earthquake, which killed 3 people and injured 900.

Azgeleh Coseismic Source Model

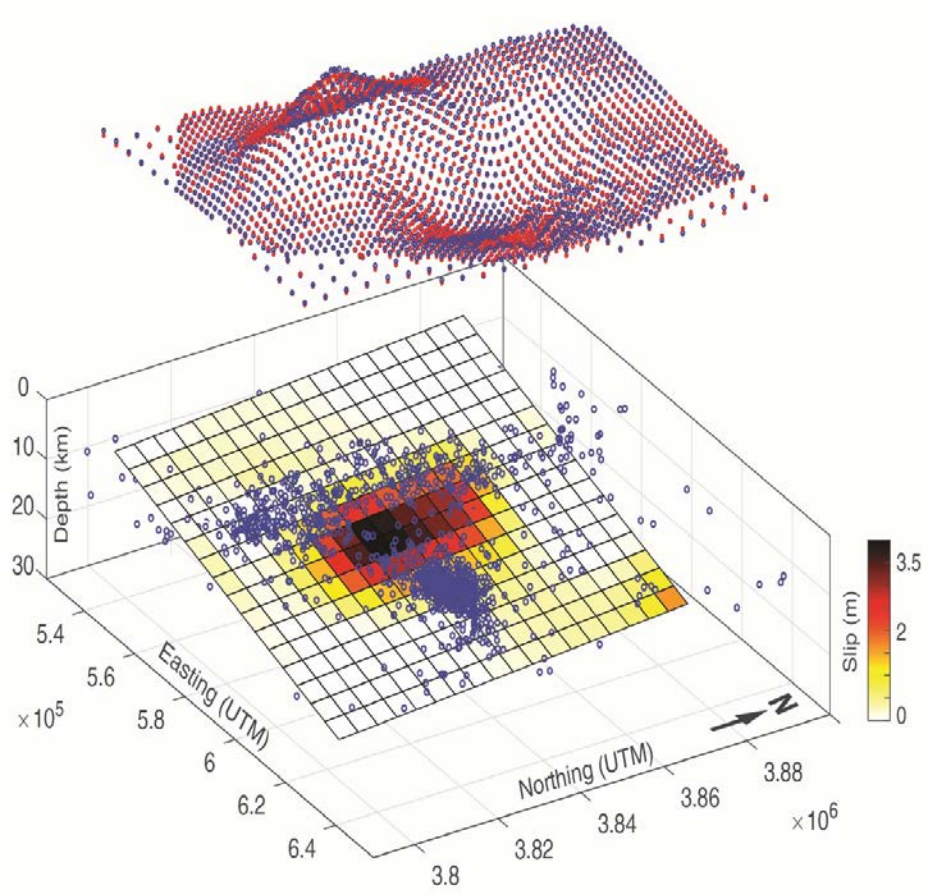
ALOS 2 Wide Swath (data not from CEOS)

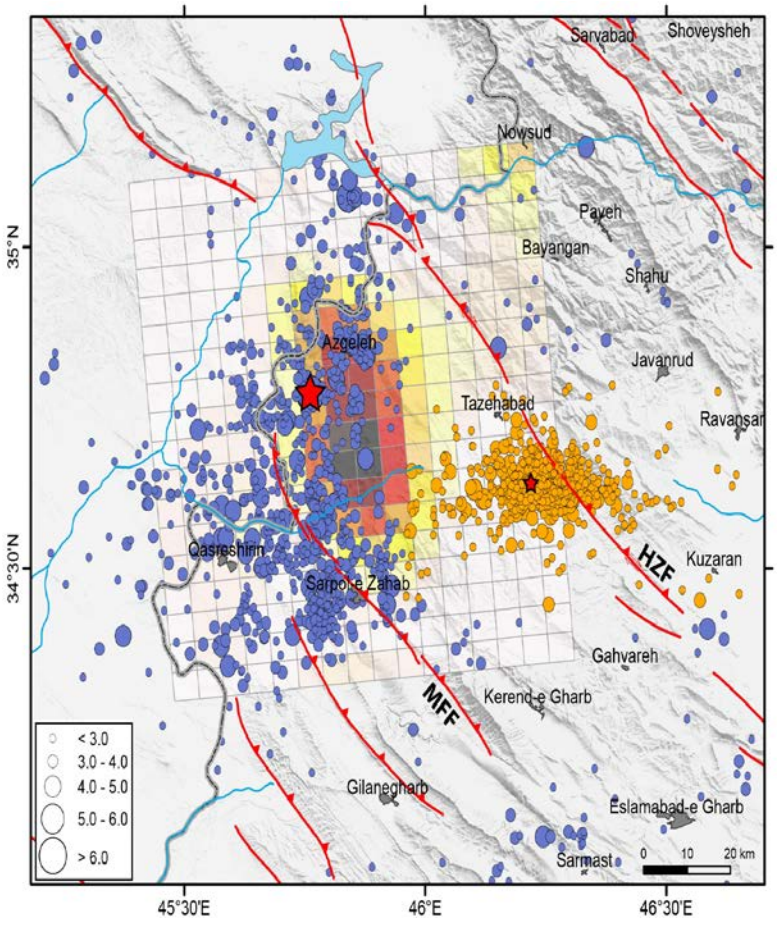
Coseismic signal > 1 m on a NNW thrust fault



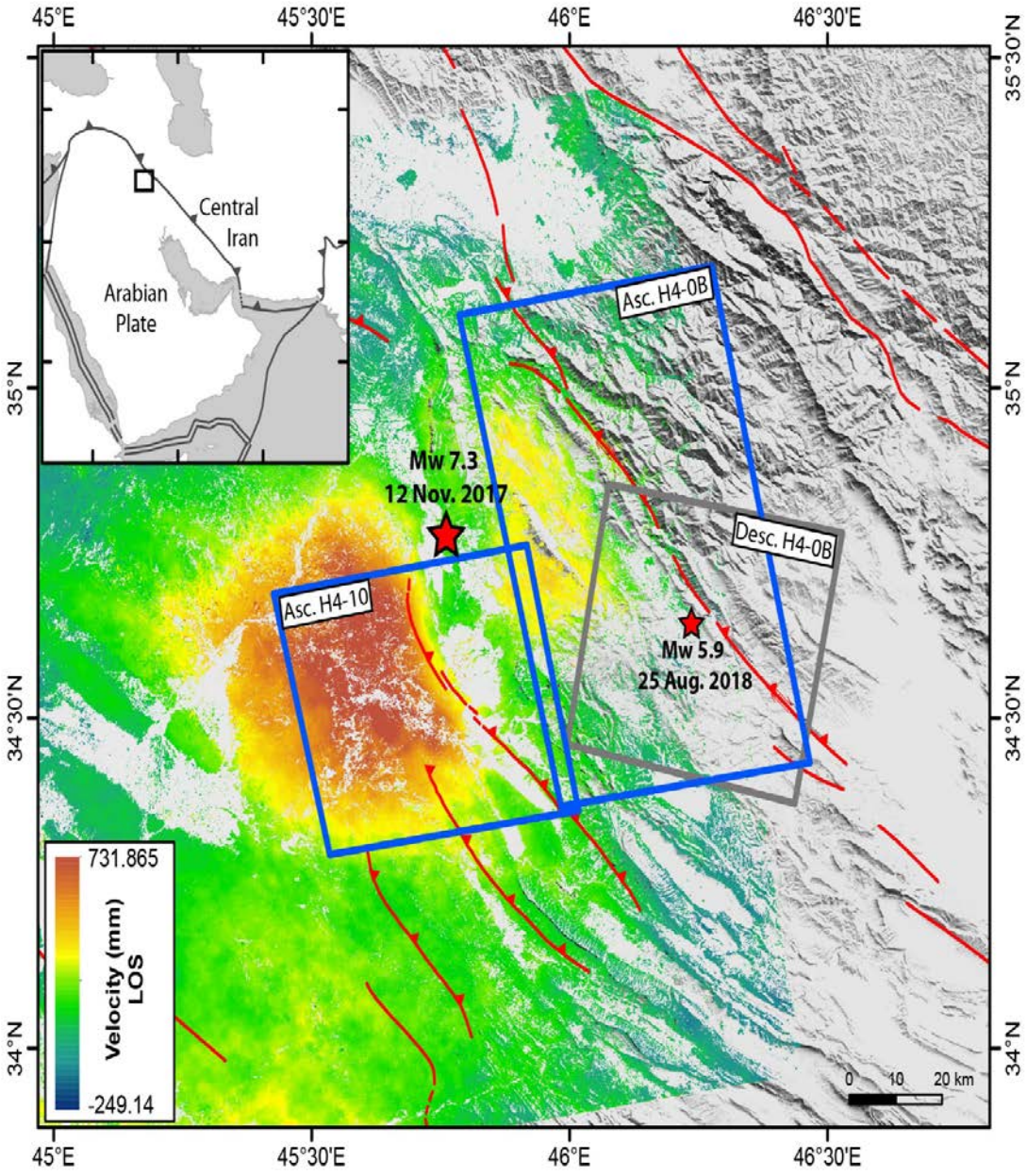


Azgeleh Coseismic Source Model





Aram et al., 2019 - Modeling the sources of the Azgeleh (12 November 2017) and Tazehabad (25 August 2018) earthquakes, Western Iran. EGU abstract



Sentinel-1 Post-seismic Velocity

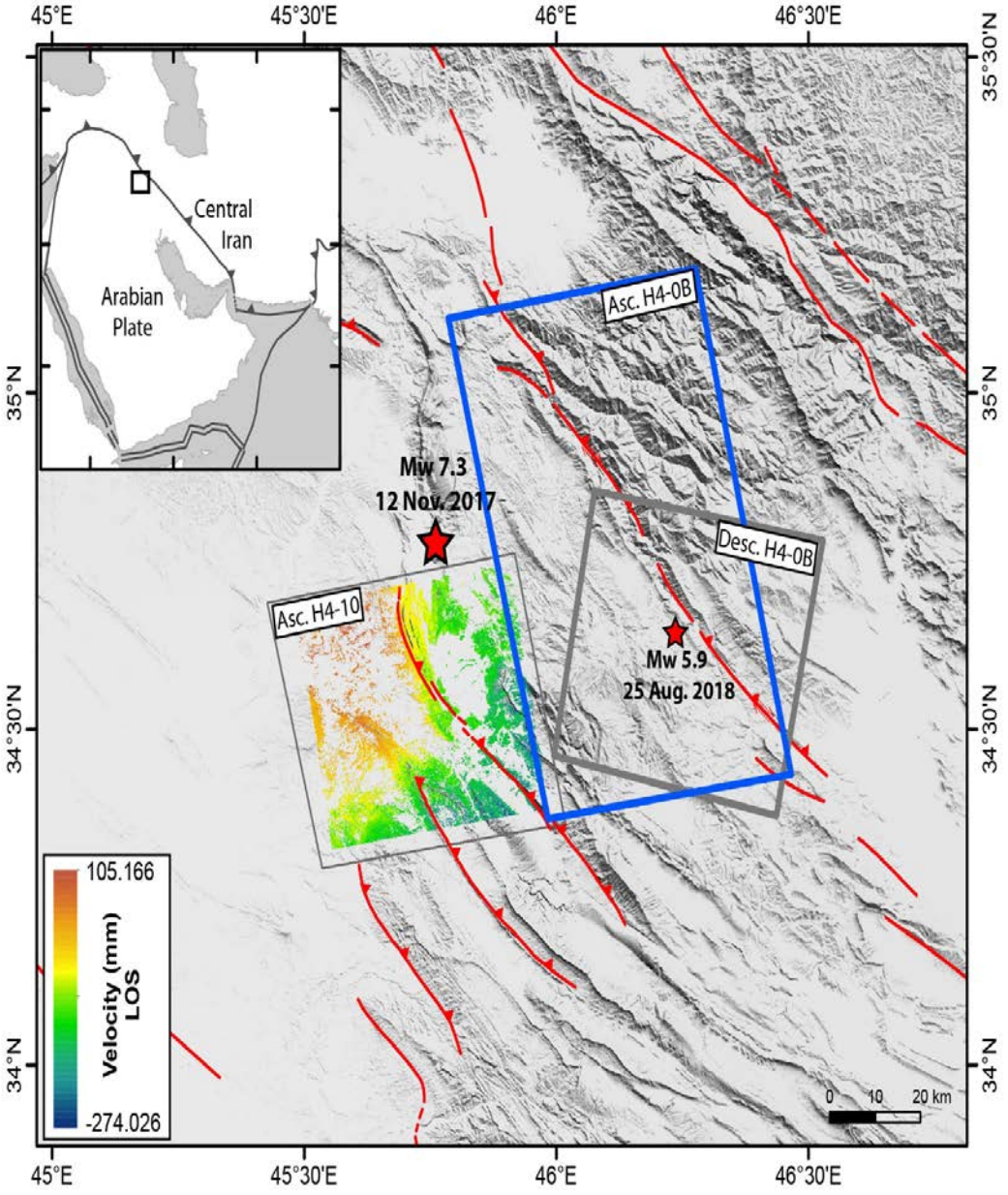
Time series InSAR using SBAS

18 Sentinel-1 images

87 interferograms

Strong post-seismic signal:

Max 70 cm/yr



CSK Post-seismic Mean Velocity Map

Time series InSAR using SBAS

26 CSK images

97 interferograms

Post-seismic signal: max 50 cm/yr

(consistent with S-1 results)

Azgeleh Event Supersite

German-Italian-Iranian team

In situ data: Hi Res relocated earthquakes, field observations

Local end-users: Iranian Geological Survey, Institute of Engineering Seismology, Iranian Civil Protection

ALOS 2 data unfortunately not from CEOS

Proposal for a multi-hazard Supersite in Peru

Proposed by:

- Observatorio Volcanologico del Ingemmet – Instituto Geológico Minero y Metalúrgico (INGEMMET)
- Instituto Nacional de Investigación en Glaciares y Ecosistemas de Montaña (INAIGEM)
- Instituto Geofísico del Perú (IGP)

International scientists

Paul Lundgren	*Research scientist - Geodesy*	*JPL-NASA - USA*	*Paul.R.Lundgren@jpl.nasa.gov*
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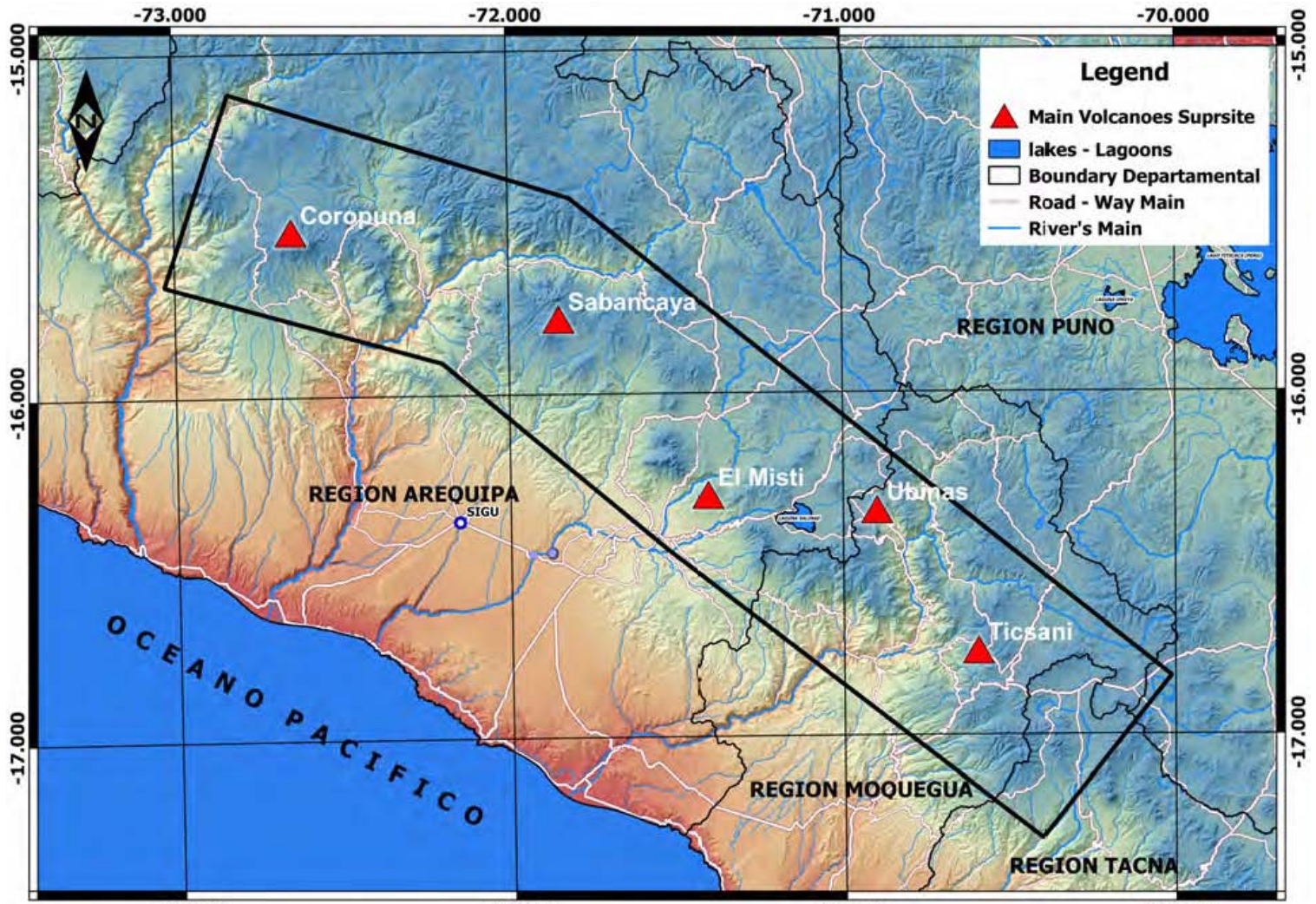
Pascal Lacroix	*Institut de Recherche Pour le Developpement*	*UMR ISTerre - Francia*	*Pascal.lacroix@ird.fr*

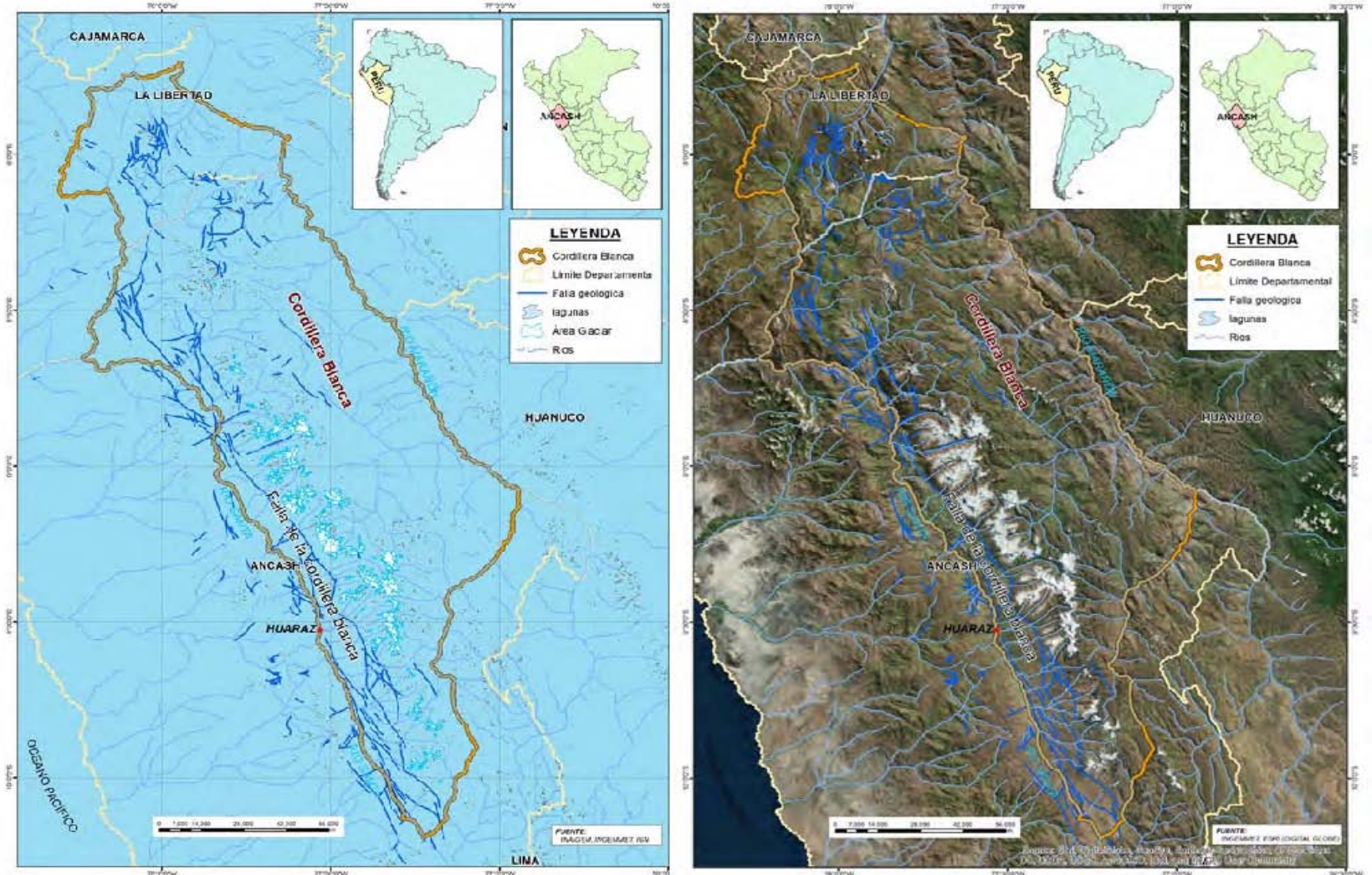
Peru Supersite proposal: AoI #1

Five active volcanoes, and their glacial environments, in Southern Peru



Peru Supersite proposal: AoI #2

The seismically active and heavily glaciated area of the Cordillera Blanca

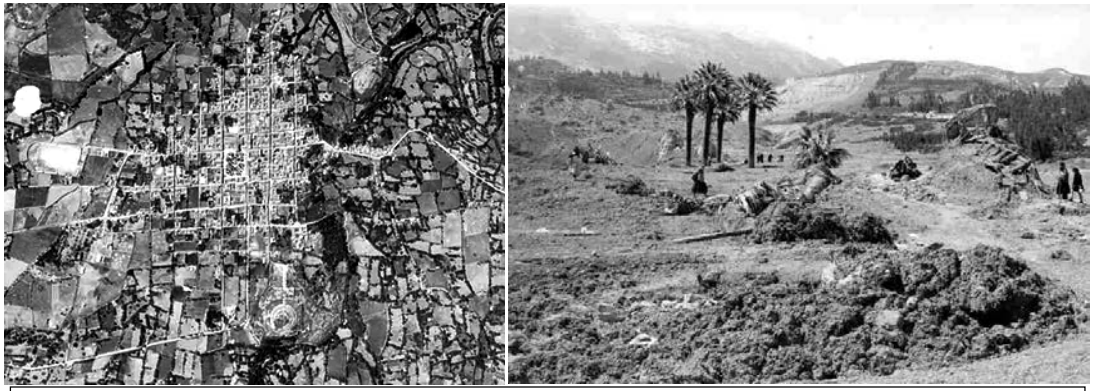


Peru Supersite proposal

High geohazard levels: strong earthquakes, eruptions, landslides, avalanches and glacial lake outburst flood (GLOF) occur every few tens of years, often associated with each other.

The most important were:

- 1941 - GLOF on the city of Huaraz, destroying a third of the city (about 4000 deaths);
- 1962 - avalanche of the Nevado Huascarán Norte (6654 m a.s.l.) destroying Ranrahirca (>4000 deaths);
- 1970 - earthquake-triggered avalanche and GLOF over Yungay and Ranrahirca completely erasing them (>18000 deaths). The earthquake caused > 70000 deaths in total.



City of Yungay, Peru: Before and after the earthquake of May 31, 1970.

Proposal for a Supersite in Peru

Objectives:

- Improve volcano monitoring through the use of high resolution SAR satellite images;
- Improve the monitoring capacity of seismicity/deformation and evaluate their influence on the stability of the hanging glaciers;
- Improve scientific research in glacial areas related to internal and external geodynamics;
- Establish a regional geological model of the fault tectonics;
- Establish and integrate with EO data an Early Warning System for lahars and avalanches in the sub-basins of glacial origin

Proposal for a Supersite in Peru

EO data requests

- TSK: all archive data + 150 images/year
- CSK: entire archive (1000 images) + 450 images/year
- RSAT2: 150 images/year
- Sentinel 1: request to increase revisit to 6 days