



BEYOND

Building a Centre of Excellence
for EO-based monitoring of Natural Disasters



Spaceborne and airborne geohazard monitoring BEYOND GeoHUB

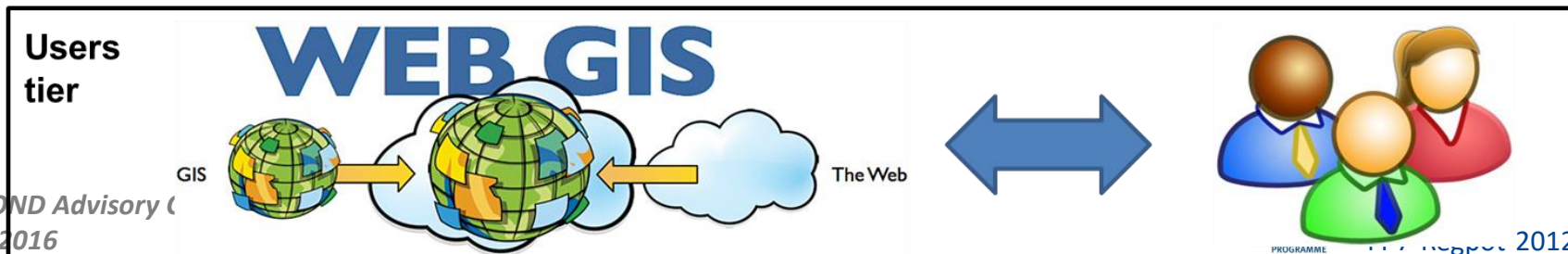
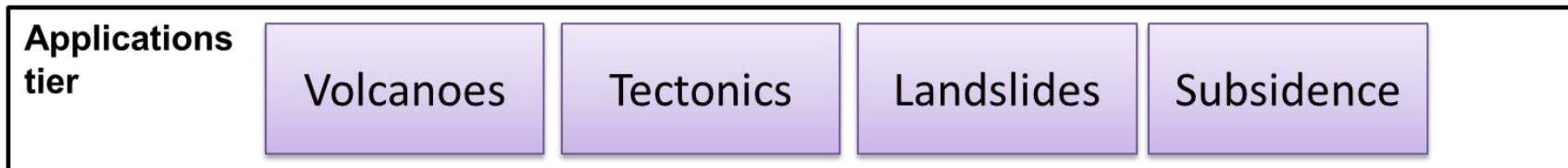
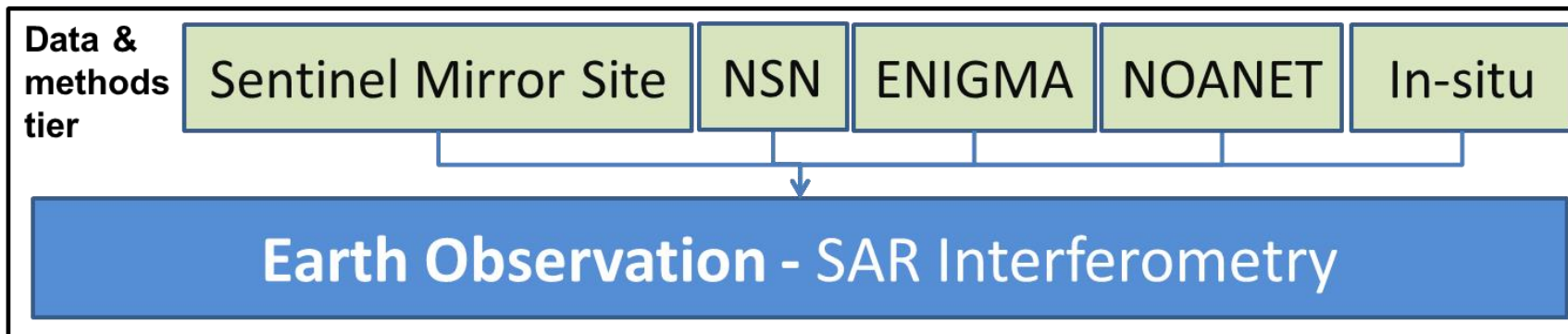
Ioannis Papoutsis

The BEYOND Advisory Committee meeting
June 24, 2016



FP7-Regpot-2012-13-1

GeoHUB



An overview

Service	Status	Input data	Scale
Mapping of large-scale ground velocities & 3D decomposition	Operational	SAR, GPS	National
Estimation of earthquake 3D crustal deformation	Operational	multi-angle SAR, GPS	Local
Seismic risk estimation	pre-operational	SAR, in-situ, GIS	Local
UAV based damage assesement	Operational	Aerial data	Local
Mapping of tectonic hazard areas in subduction zones	Research	SAR, GPS	Regional
Monitoring of volcanic activity	Operational	SAR, GPS, in-situ	Local
Monitoring dispersion of volcanic ash	pre-operational	Weather data	Regional
Detection of new landslides	Operational	SAR	Local
Update of landslide inventory maps	pre-operational	SAR, in-situ	Regional
Estimation of landslide susceptibility	pre-operational	SAR, in-situ, GIS	Regional
Detection of subsidence in urban & peri-urban areas due to manmade activities & physical processes	Operational	SAR, GPS	Regional
Monitoring of construction activities in urban environment	Operational	SAR, GPS	Local

Earthquake deformation mapping

Data

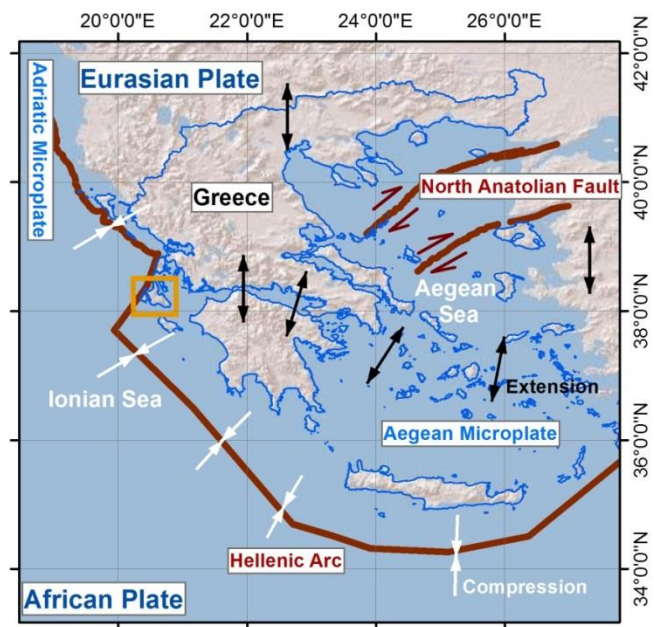
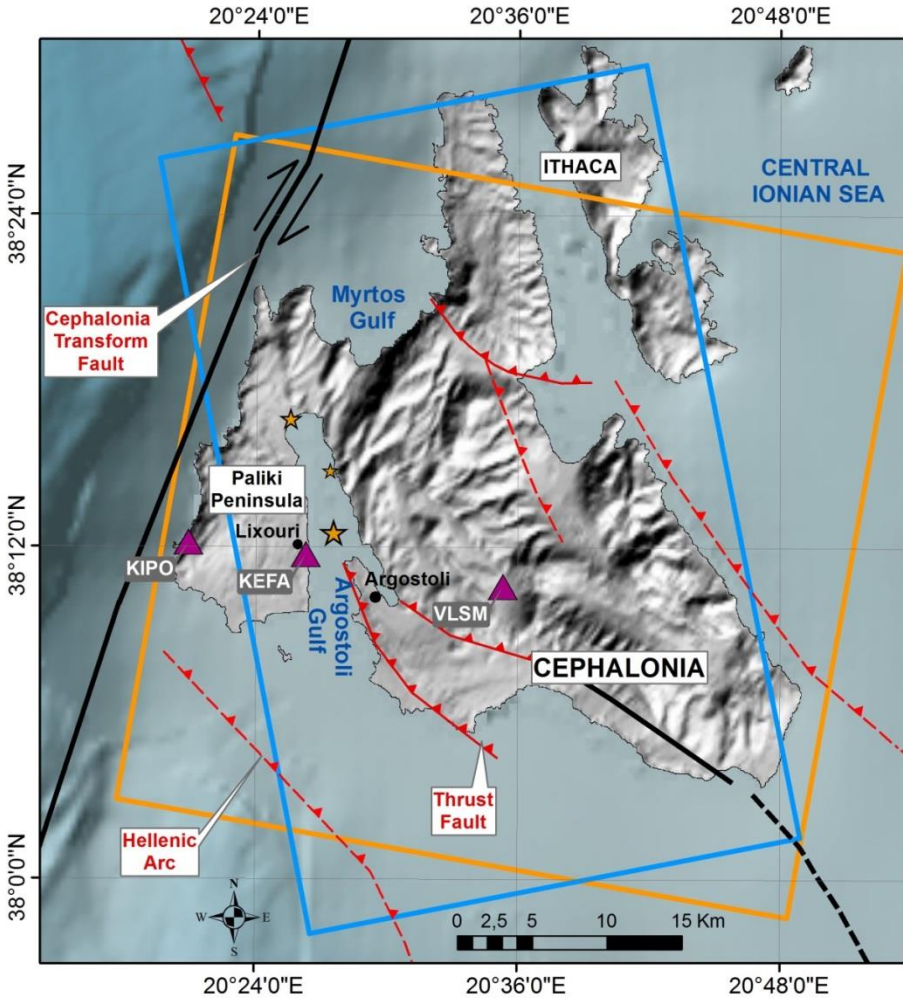
- NSN
- NOANET
- ENIGMA
- In-situ

Services

- Geodesy
- Modeling
- Hazard Ass.
- Large Proc.

Applications

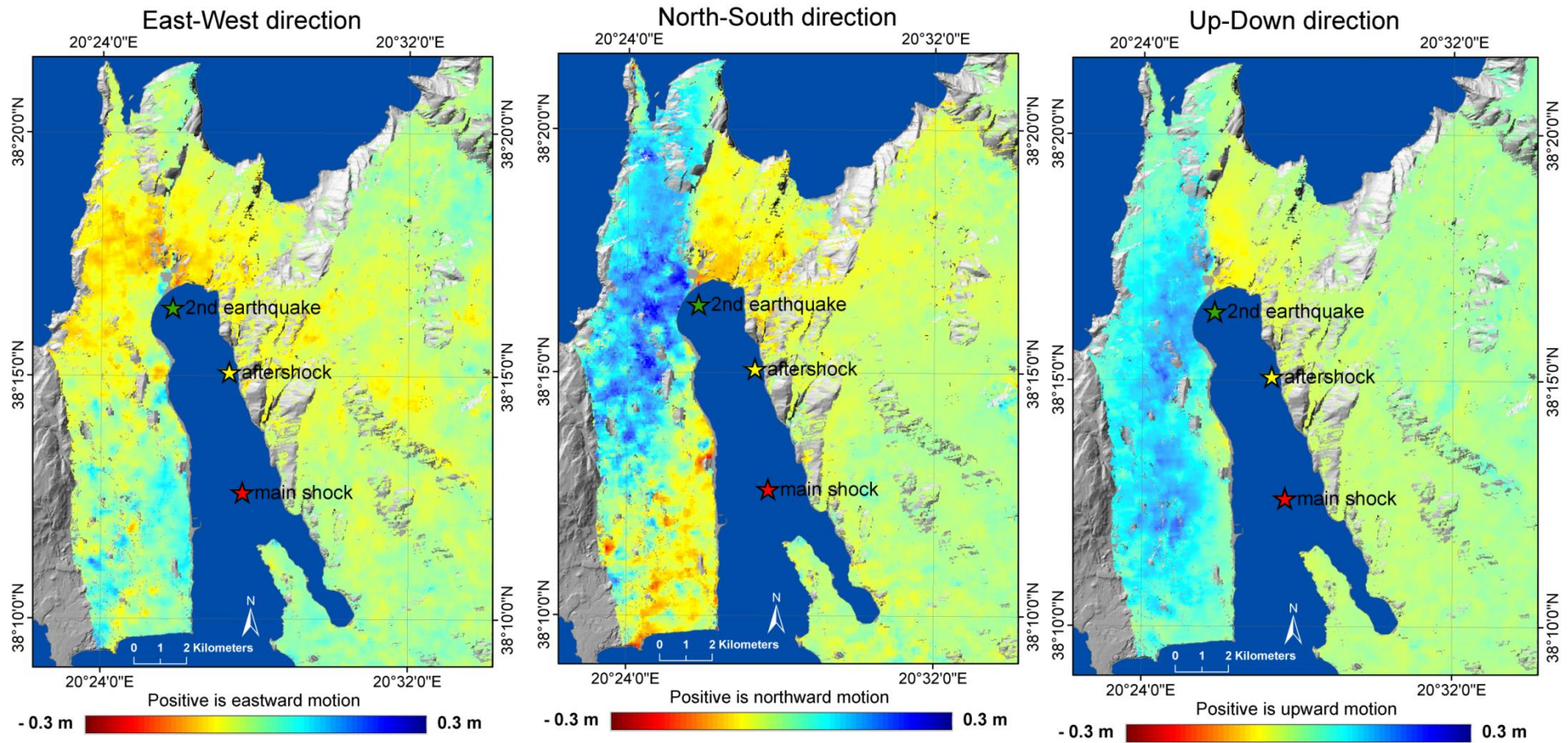
- Tectonics
- Volcanoes
- Landslides
- Subsidence



- | | |
|--------------------------|-------------------------------|
| Mapped faults | Main earthquake events |
| --- Strike-slip inferred | ★ 26/1/2014 ML 5,1 |
| — Strike-slip | ★ 3/2/2014 ML 5,7 |
| -▲ Reverse inferred | ★ 26/1/2-14 ML 5,9 |
| ▲ Reverse | |
| GPS stations | SARframes |
| ▲ cGPS | □ COSMO-SkyMED |
| | □ TerraSAR-X |

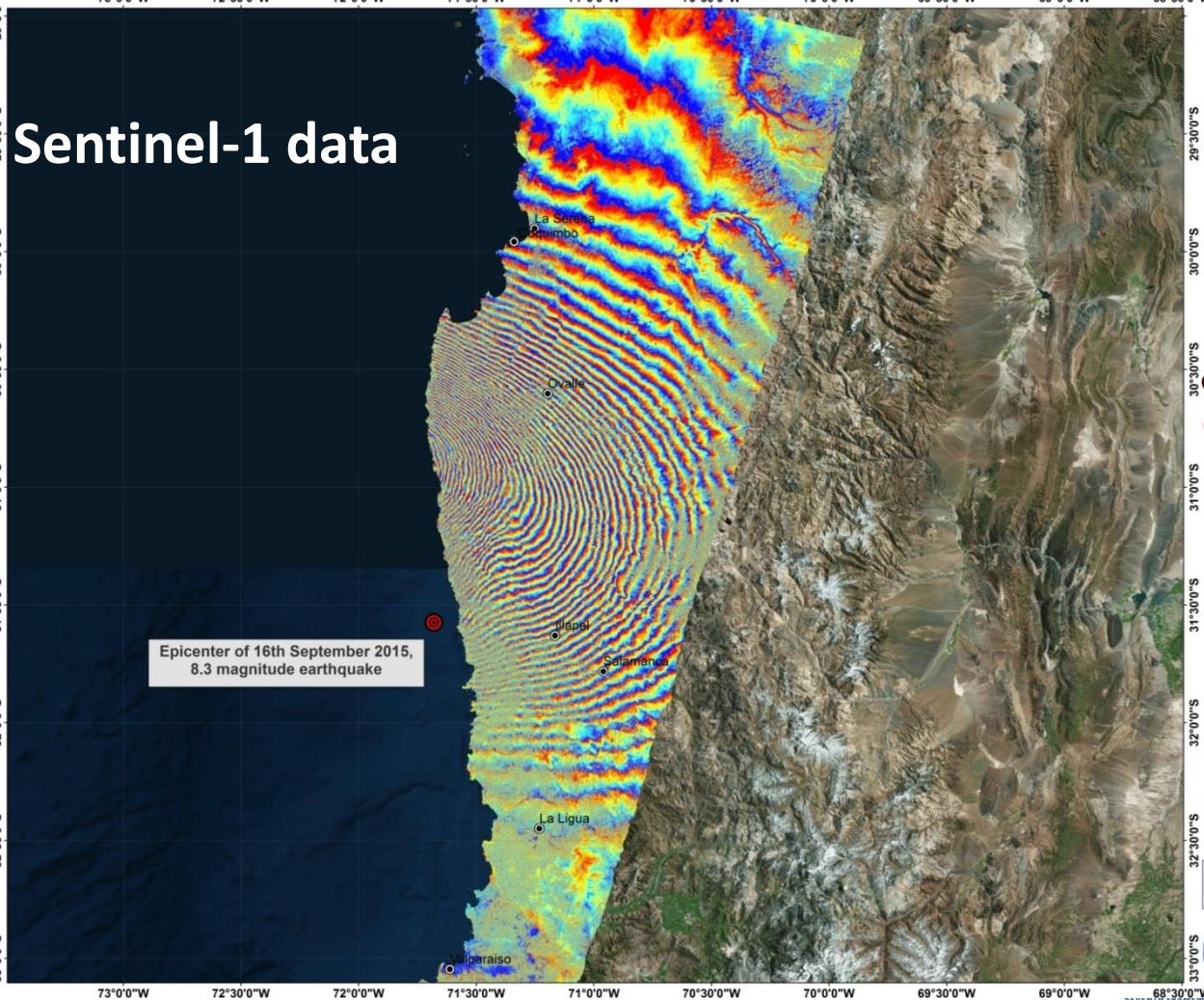
Earthquake deformation mapping

- 3D crustal deformation from TerraSAR-X & COSMO-SkyMed data
- Inversion to estimate fault parameters



Earthquake deformation mapping

- Data**
 - NSN
 - NOANET
 - ENIGMA
 - In-situ
- Services**
 - Geodesy
 - Modeling
 - Hazard Ass.
 - Large Proc.
- Applications**
 - Tectonics
 - Volcanoes
 - Landslides
 - Subsidence



Coast of Central Chile Earthquake Mapping
Assessment Map: Interferogram
Production Date 06/10/2015

Location Diagrams
A map of South America with a red box highlighting the study area on the coast of Chile.

Cartographic Information
Scale: 1:80,000 for A1 prints. Full color A1, high resolution (20000).
Grid: Geographic Datum: WGS 1984. Ticks: Meters: Lat/Lon (DMS); Datum: WGS 84.

Legend
● Epicenter of 16th September 2015 earthquake
● Major Cities
□ Area of Interest

Map Information
On September 16 2015, a Mw 8.3 earthquake hit the coast of Central Chile west of Talcahuano. Shortly after the earthquake, two Sentinel-1 Synthetic Aperture Radar images were acquired, one before (23/07/2015) the shake event and one after (17/09/2015). They were combined to form an interferogram that depicts the ground deformation due to the earthquake. This map shows the fringe pattern associated with the event, where each color cycle represents phase difference of 1 (π/2), interpreted as ground deformation equal to 2.3 cm along the line of sight (LOS). (A scale reference bar is located on the right-hand side of the map area)

Data Sources
Sentinel-1 Descending SAR data © ESA through the Helvetic National Sentinel Data Mirror Site (<http://sentinel1.eos.com>)
Microsoft © Bing/Mapbox TM
World Topo Map © ESRI, ArcGIS services online

Software used
Interferometric processing: Sentinel-1 Toolbox version 1.1.1
Map production: ArcGIS 10.1 ESRI ArcGIS

Dissemination/Publication
No restrictions on the publication of the mapping apply.

Framework
The present map is generated in the context of BEYOND Centre of Excellence (Interferometric monitoring), established at National Observatory of Athens and funded by the European Commission as part of the FP7 REGIOT framework initiative (GA 218715). BEYOND provides products and services for its stakeholders, aimed at the systematic and operational monitoring of natural disasters from space.
BEYOND activities are funded by the Helvetic National Sentinel Data Mirror Site, also established in NOA, under the current ESA - NOA agreement in the frame of the Collaborative Ground Segment Initiative. The goal is to support the rapid dissemination and almost real time exploitation of Sentinel-based products, towards the seamless monitoring and effective management of natural disaster preparedness and risk reduction activities.

Map Production
This map was generated by processing TOPSAR Sentinel-1 data using Sentinel-1 Toolbox and Conventional color interferometry techniques with emphasis, customized for Sentinel-1 data. Depending on the interferogram noise level, the inherent measurement accuracy of the technique is about 1 cm in the line-of-sight to the satellite.

Production team: Christine Pfyffer, Ioanna Papatou, Charalambos Karnezis
Name of software/processor: Quality control: NOA
Responsible organization: National Observatory of Athens
©2015 The National Observatory of Athens. E-mail: sentinel@noa.gr

UAV damage assessment



Data

NSN

NOANET

ENIGMA

In-situ

Services

Geodesy

Modeling

Hazard Ass.

Large Proc.

Applications

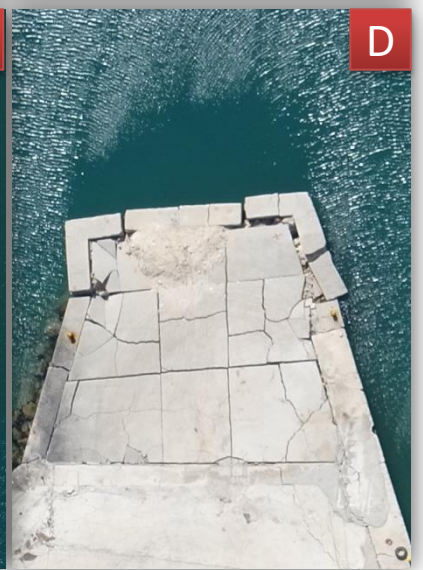
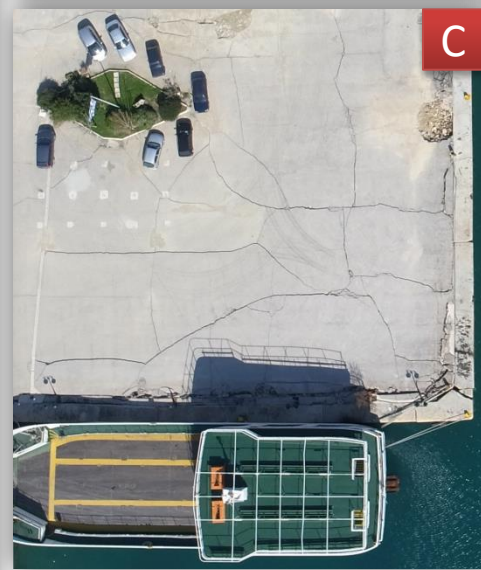
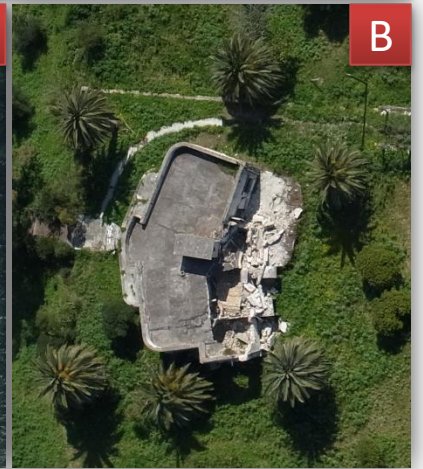
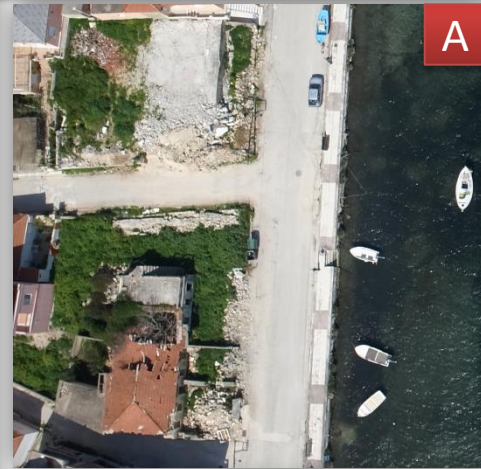
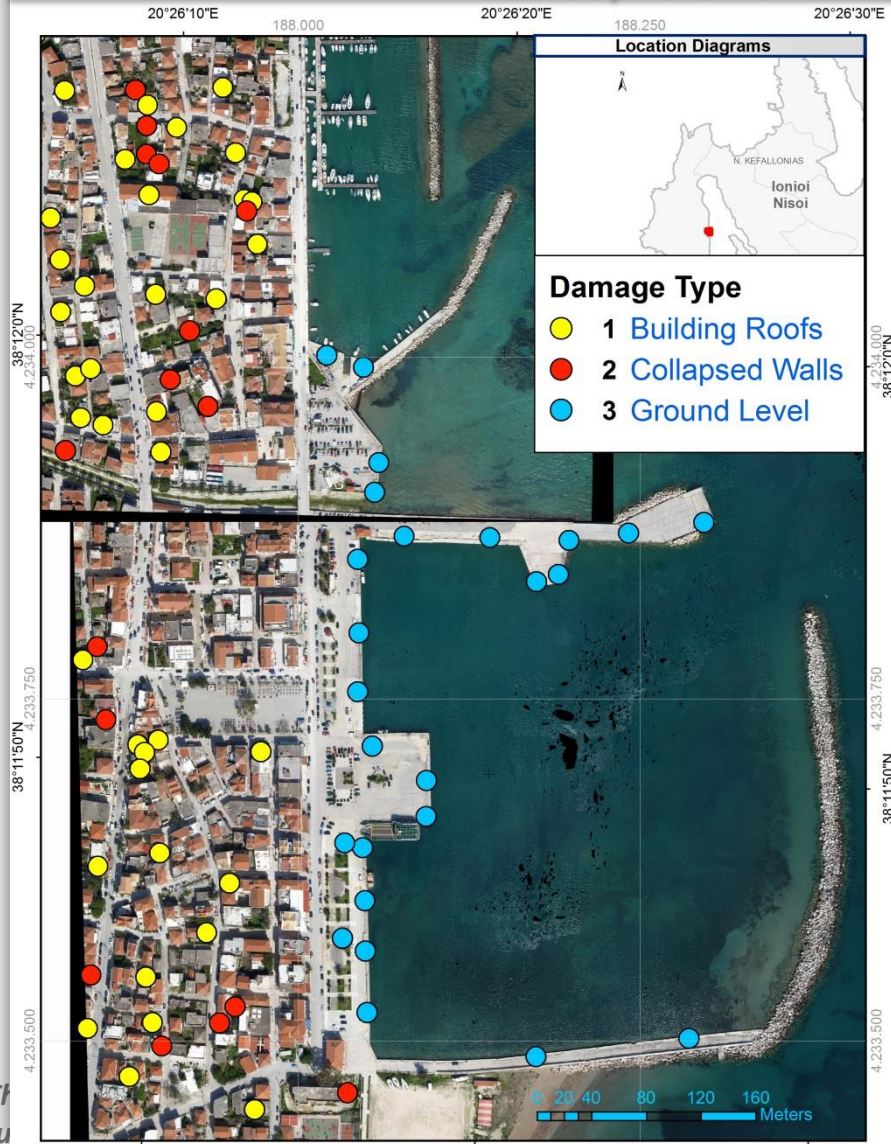
Tectonics

Volcanoes

Landslides

Subsidence

Cephalonia Island – Town of Lixouri

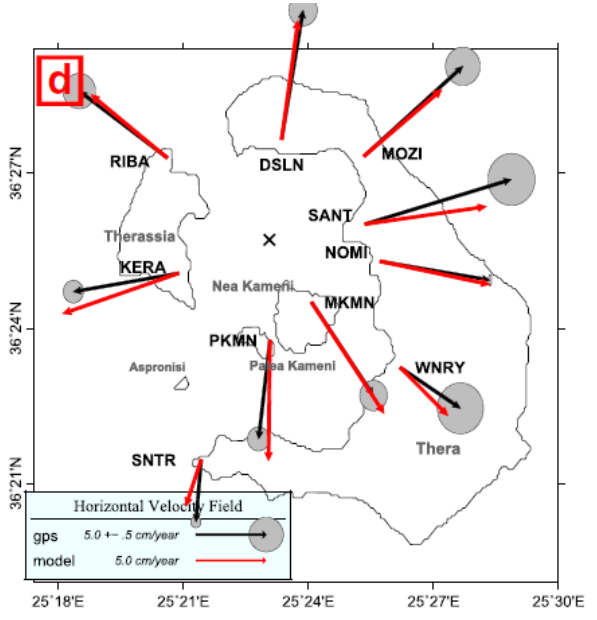
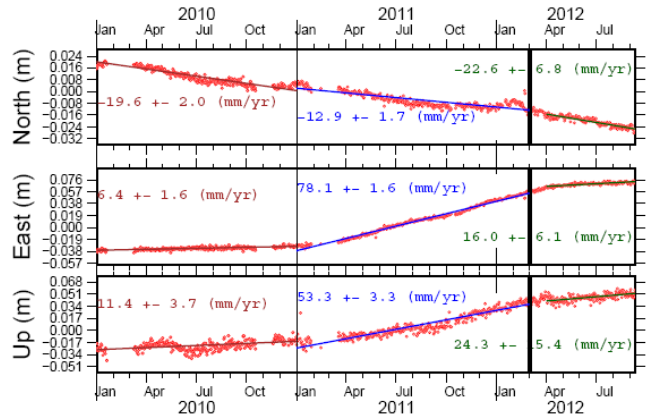


UAV octocopter

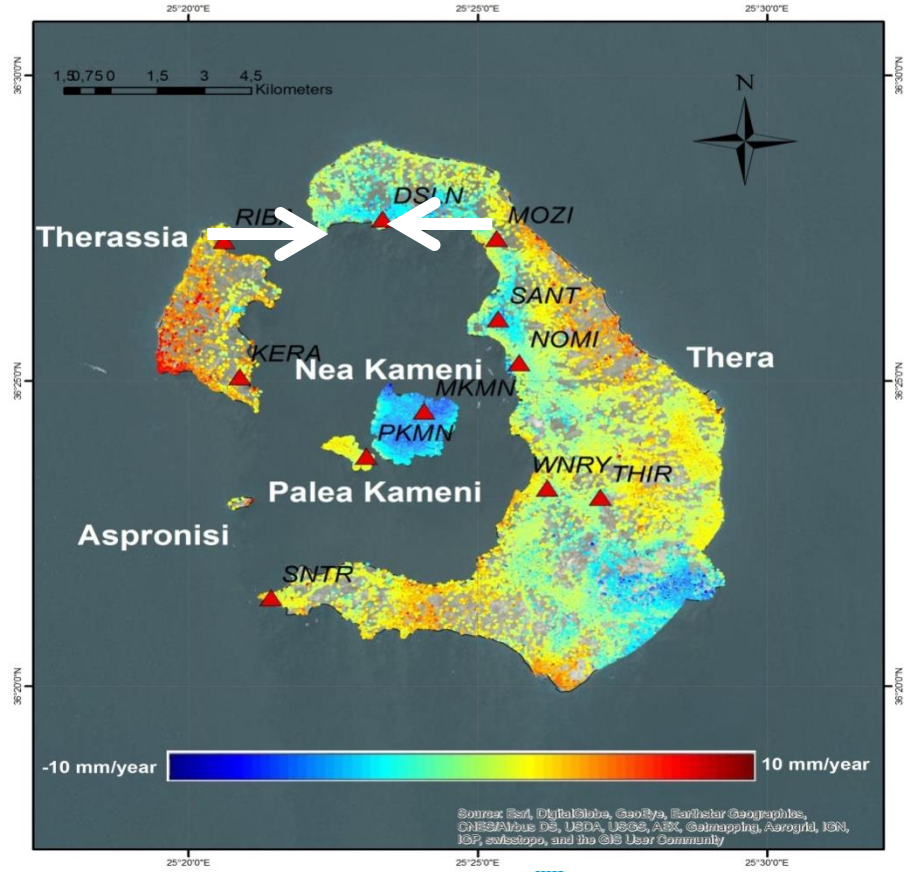


Monitoring volcanic activity

- Data
 - NSN
 - NOANET
 - ENIGMA
 - In-situ
- Services
 - Geodesy
 - Modeling
 - Hazard Ass.
 - Large Proc.
- Applications
 - Tectonics
 - Volcanoes
 - Landslides
 - Subsidence

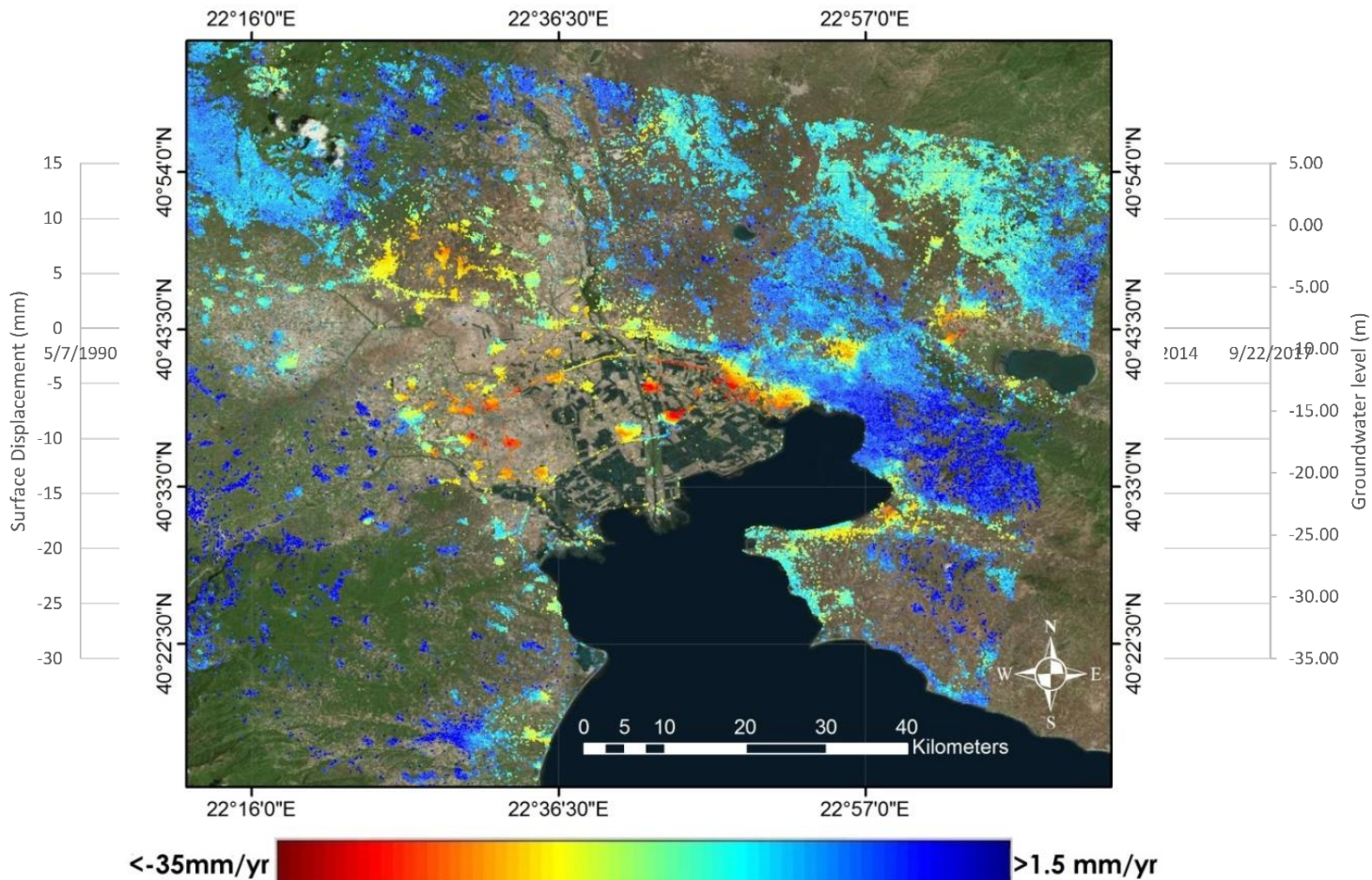


Post-inflation monitoring



Kaskara et al., LPS 2016

Urban subsidence monitoring & uplift tracking



Driver: water over-pumping, Svigkas et al., Engineering Geology, 2016

Data

NSN

NOANET

ENIGMA

In-situ

Services

Geodesy

Modeling

Hazard Ass.

Large Proc.

Applications

Tectonics

Volcanoes

Landslides

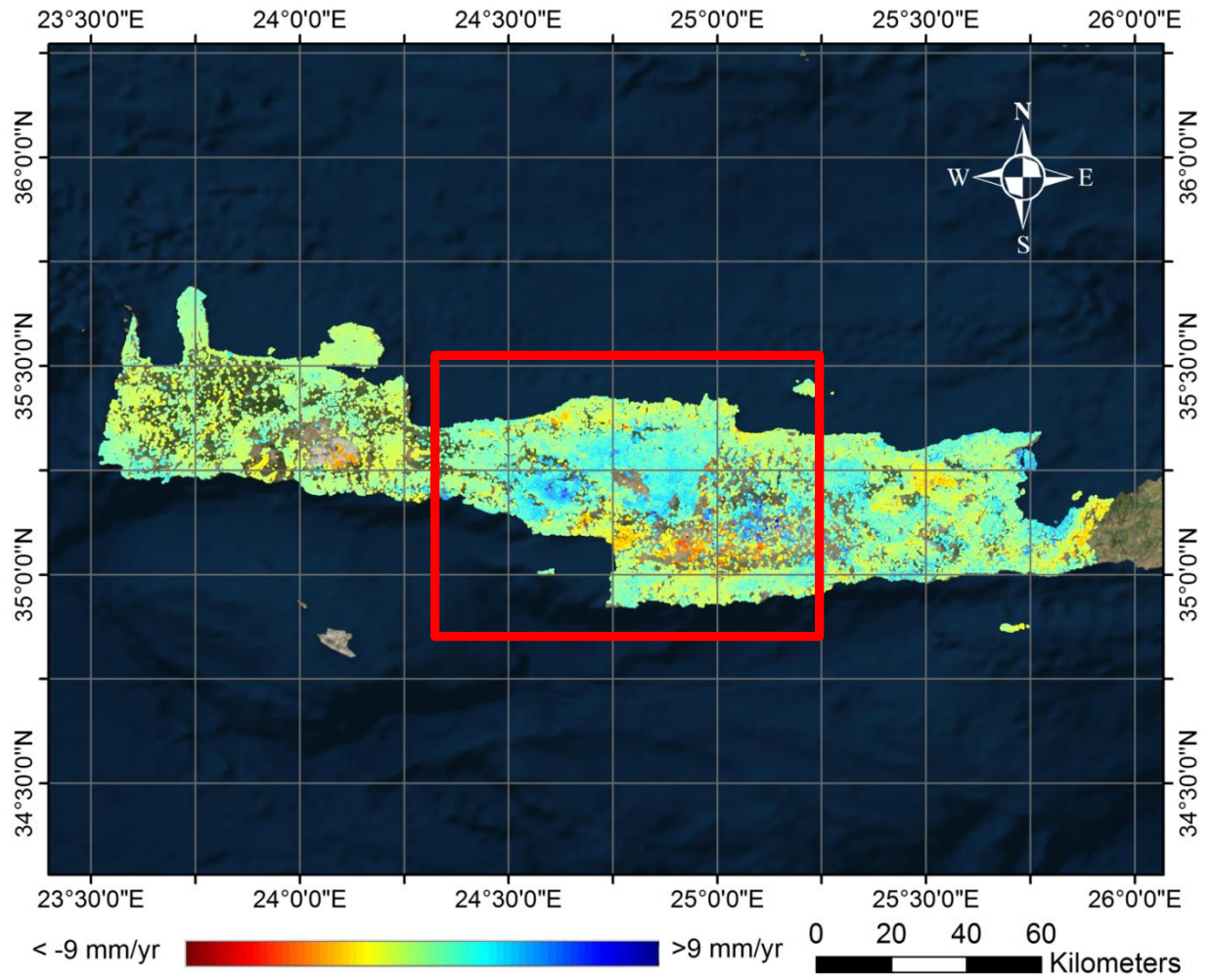
Subsidence

Large scale ground velocity estimation

- Data**
- NSN
 - NOANET
 - ENIGMA
 - In-situ

- Services**
- Geodesy
 - Modeling
 - Hazard Ass.
 - Large Proc.

- Applications**
- Tectonics
 - Volcanoes
 - Landslides
 - Subsidence

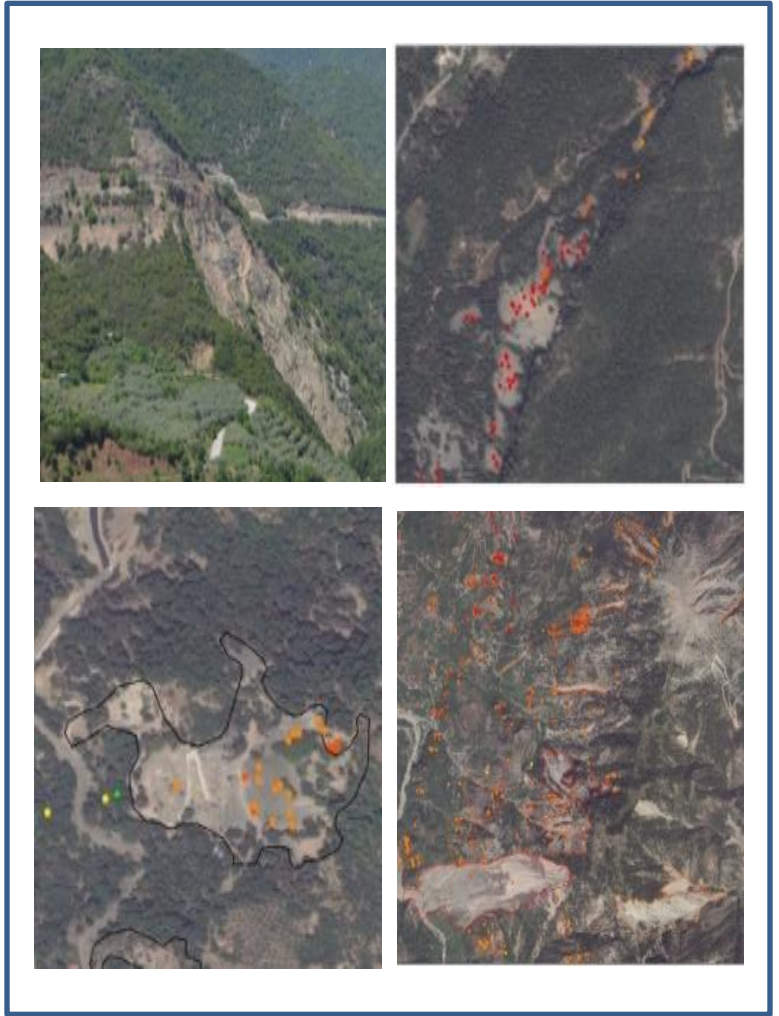
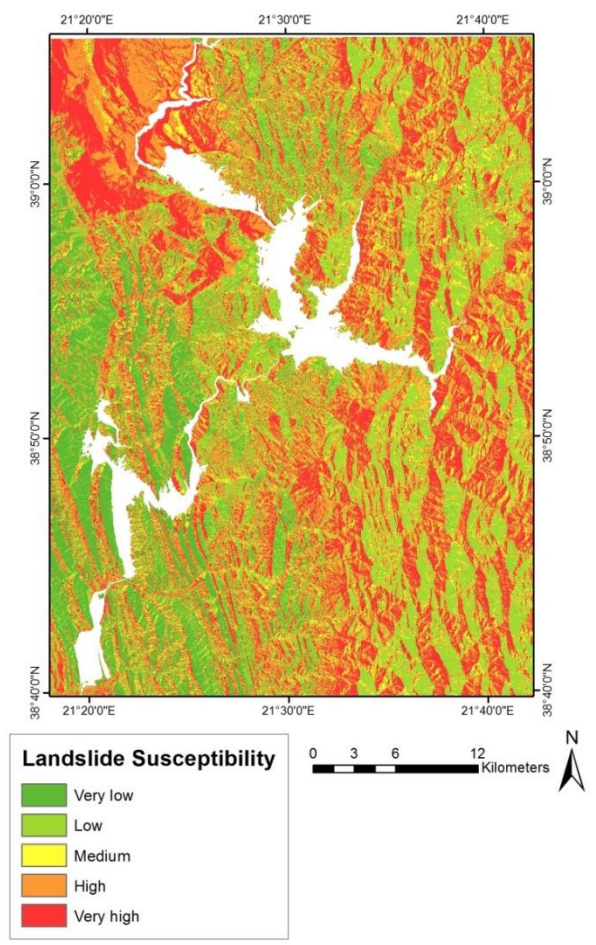


Regional landslide hazard assessment

- Data**
- NSN
 - NOANET
 - ENIGMA
 - In-situ

- Services**
- Geodesy
 - Modeling
 - Hazard Ass.
 - Large Proc.

- Applications**
- Tectonics
 - Volcanoes
 - Landslides
 - Subsidence





BEYOND

Building a Centre of Excellence for EO-based monitoring of Natural Disasters



A new geomagnetic data service

Data

- NSN
- NOANET
- ENIGMA**
- In-situ

Services

- Geodesy
- Modeling**
- Hazard Ass.
- Large Proc.

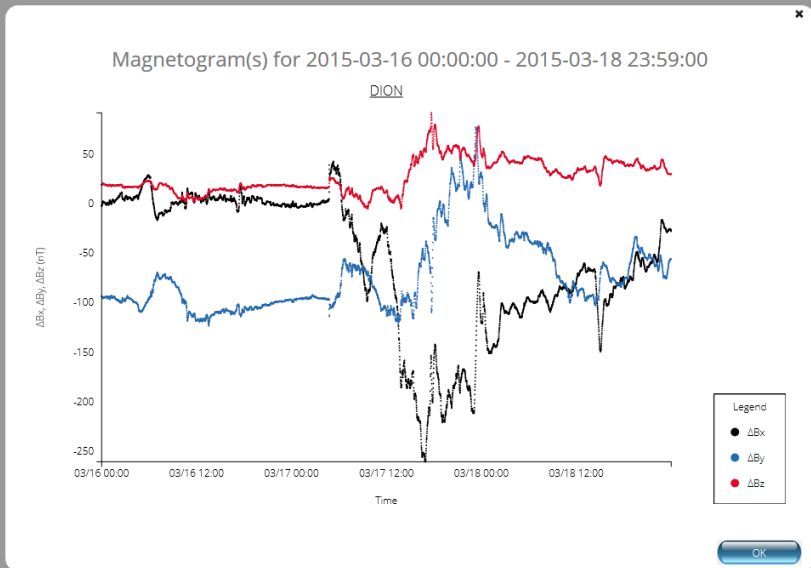
Applications

- Tectonics**
- Volcanoes
- Landslides
- Subsidence

IAASARS
Hellenic GeoMagnetic Array
ENIGMA
 Space Research & Technology Group

- HOME
- ABOUT US
- SCIENTIFIC INFO
- ENIGMA STATIONS
- ENIGMA DATA AND PRODUCTS**
- OUR TEAM

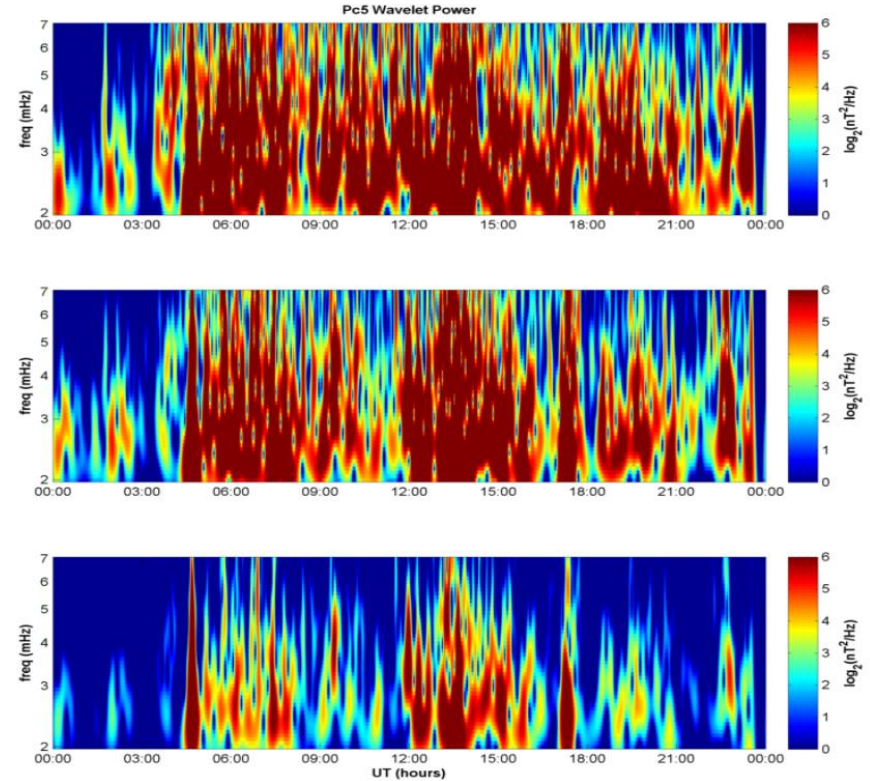
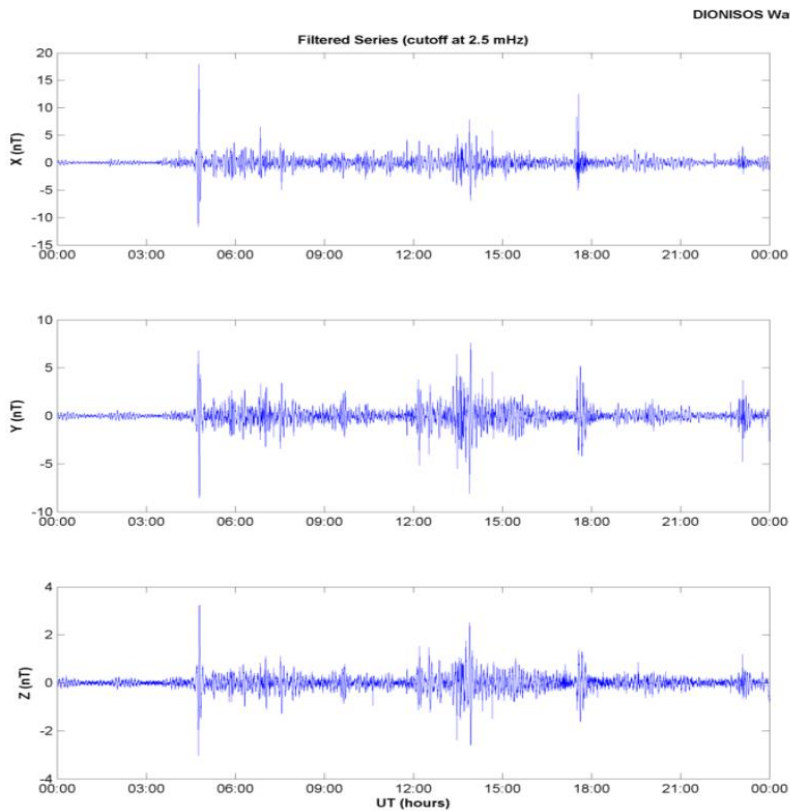
ENIGMA DATA AND PRODUCTS



DAILY WAVELET SPECTRA



A new geomagnetic data service



x

The future: BEYOND GeoHUB

