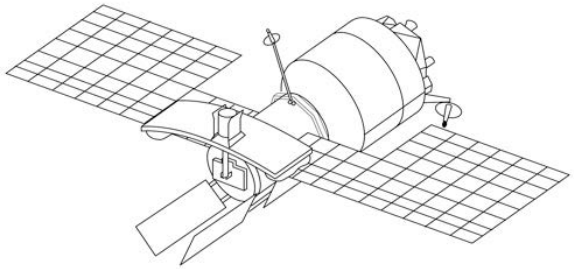
*Building Capacity for a Centre of Excellence for EO-based monitoring of Natural Disasters*

# *Spaceborne and airborne geohazard monitoring*



Ioannis Papoutsis
IAASARS
National Observatory of Athens

One Step BEYOND Workshop,
15/10/2015
ESA, Frascati

FP7-Regpot-2012-23-1

# Research Domains

*Centre of Excellence for*

*EO-based monitoring of Natural Disasters*

- Fires & Floods
- Geophysical hazards
- Atmospheric disasters
- Urban environment

# Capacities

**Data & methods tier**

Sentinel Mirror Site | NSN | ENIGMA | NOANET | In-situ

**Earth Observation -** SAR Interferometry

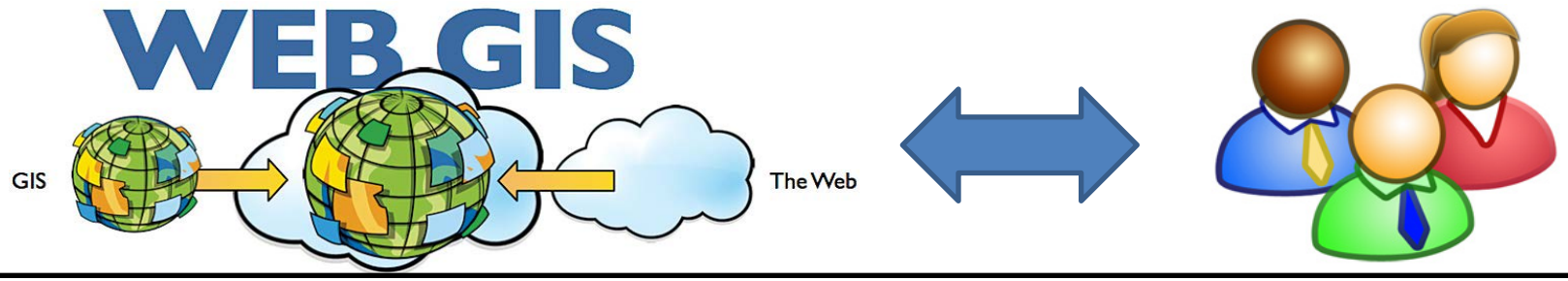
**Services tier**

Geodesy | Modeling | Hazard assessment | Large scale processing

**Applications tier**

Volcanoes | Tectonics | Landslides | Subsidence

**Users tier**



# Geohazard applications

## Earthquake deformation mapping

**Data**

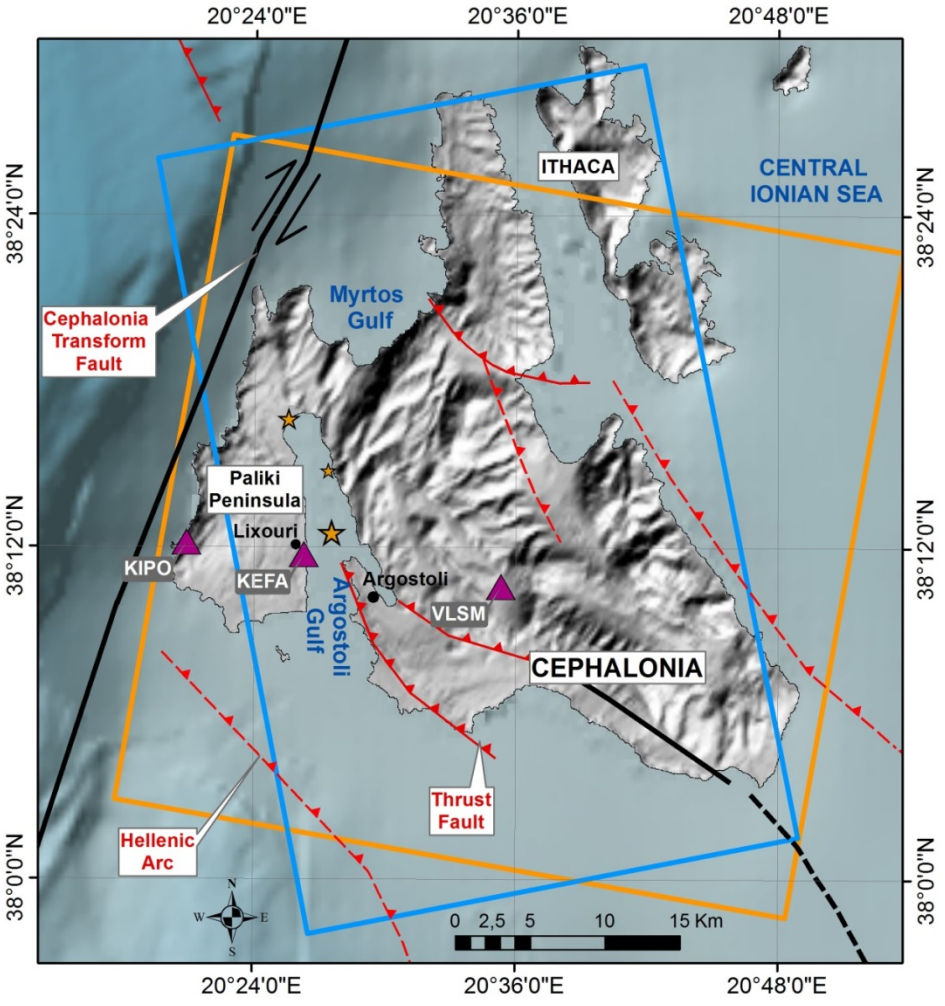
- NSN
- NOANET
- ENIGMA
- In-situ

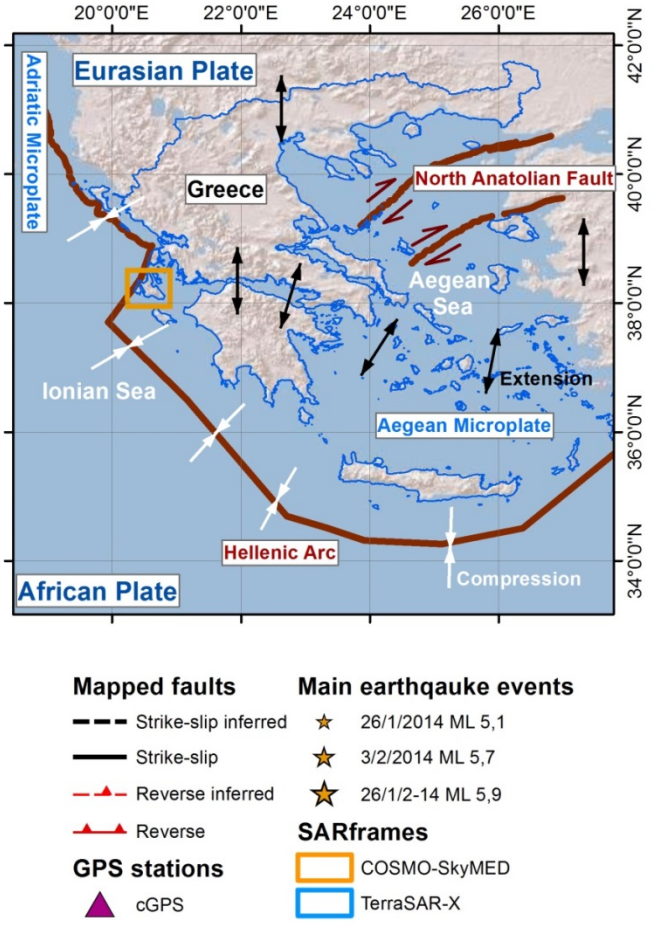
**Services**

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

**Applications**

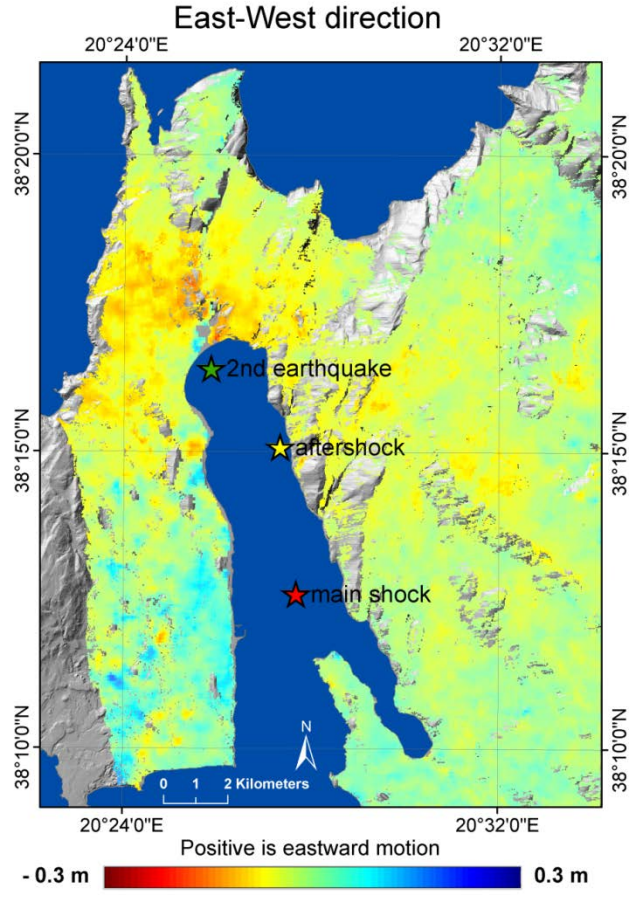
- Tectonics
- Volcanoes
- Landslides
- Subsidence

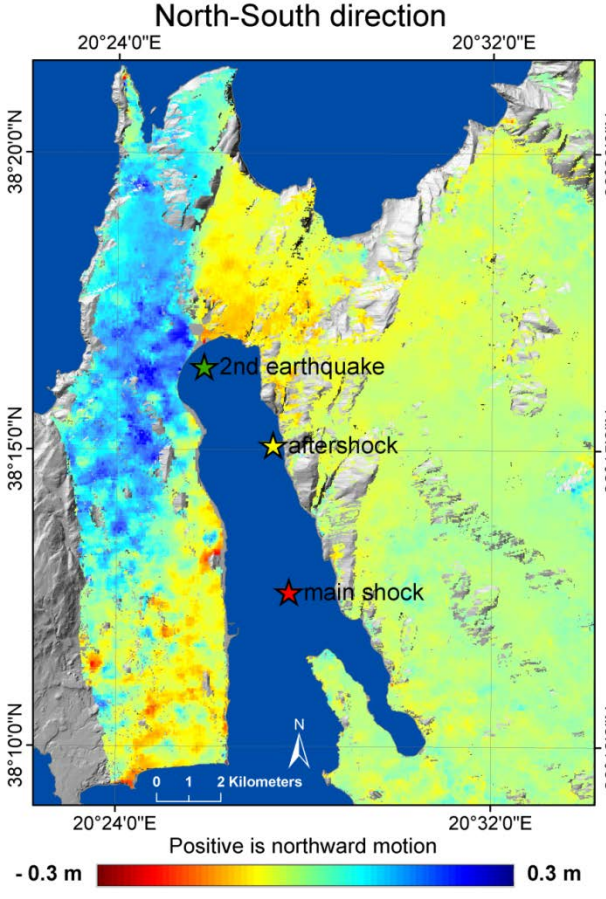


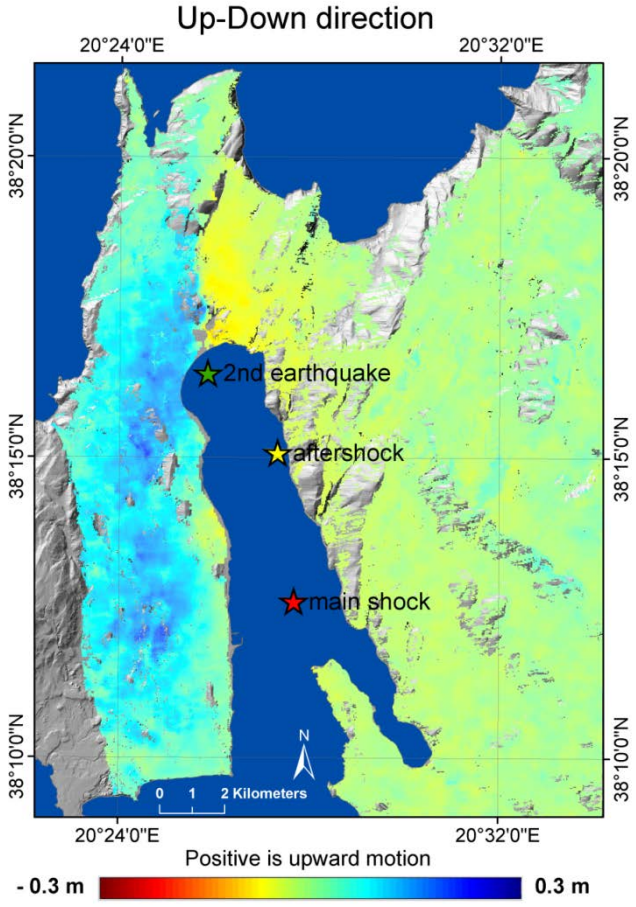



# Geohazard applications
## Earthquake deformation mapping

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



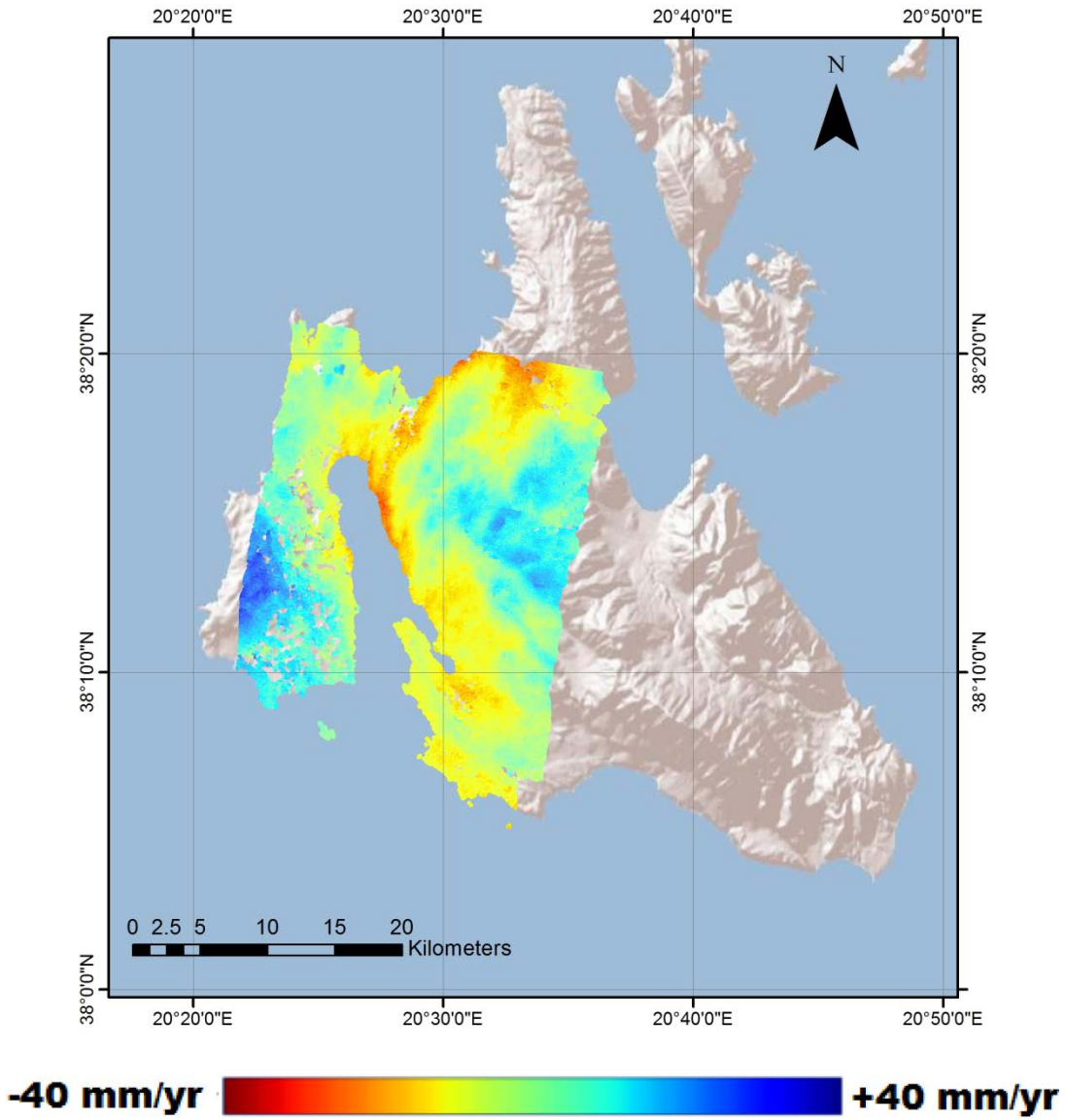




Merryman Boncori et al., SRL 2015

# Geohazard applications

## Post-seismic earthquake monitoring

Post-seismic slip, measured with COSMO-SkyMed data



# Geohazard applications

## Earthquake deformation mapping

**Data**

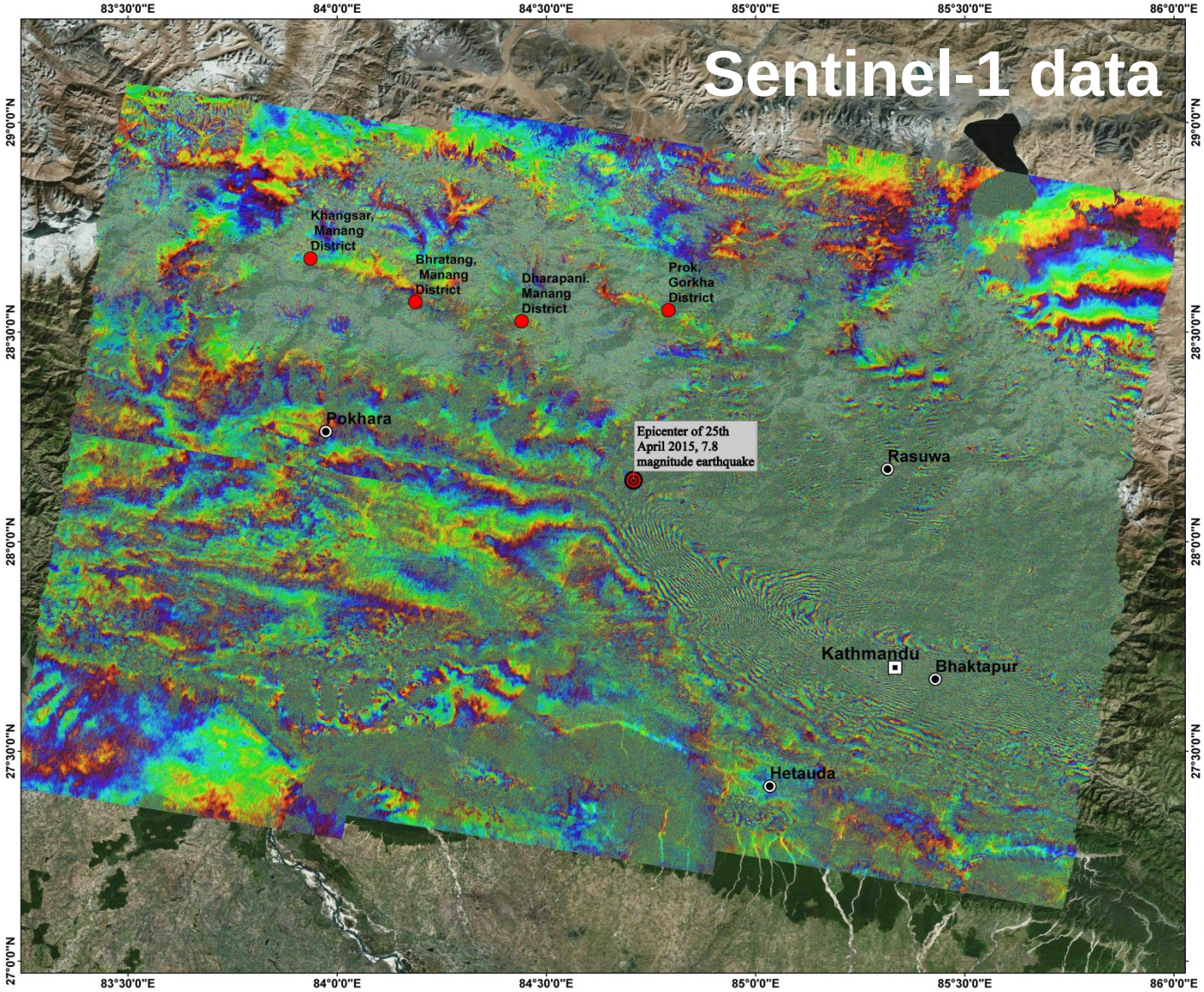
- NSN
- NOANET
- ENIGMA
- In-situ

**Services**

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

**Applications**

- Tectonics
- Volcanoes
- Landslides
- Subsidence



# Geohazard applications

## Earthquake deformation mapping

**Data**

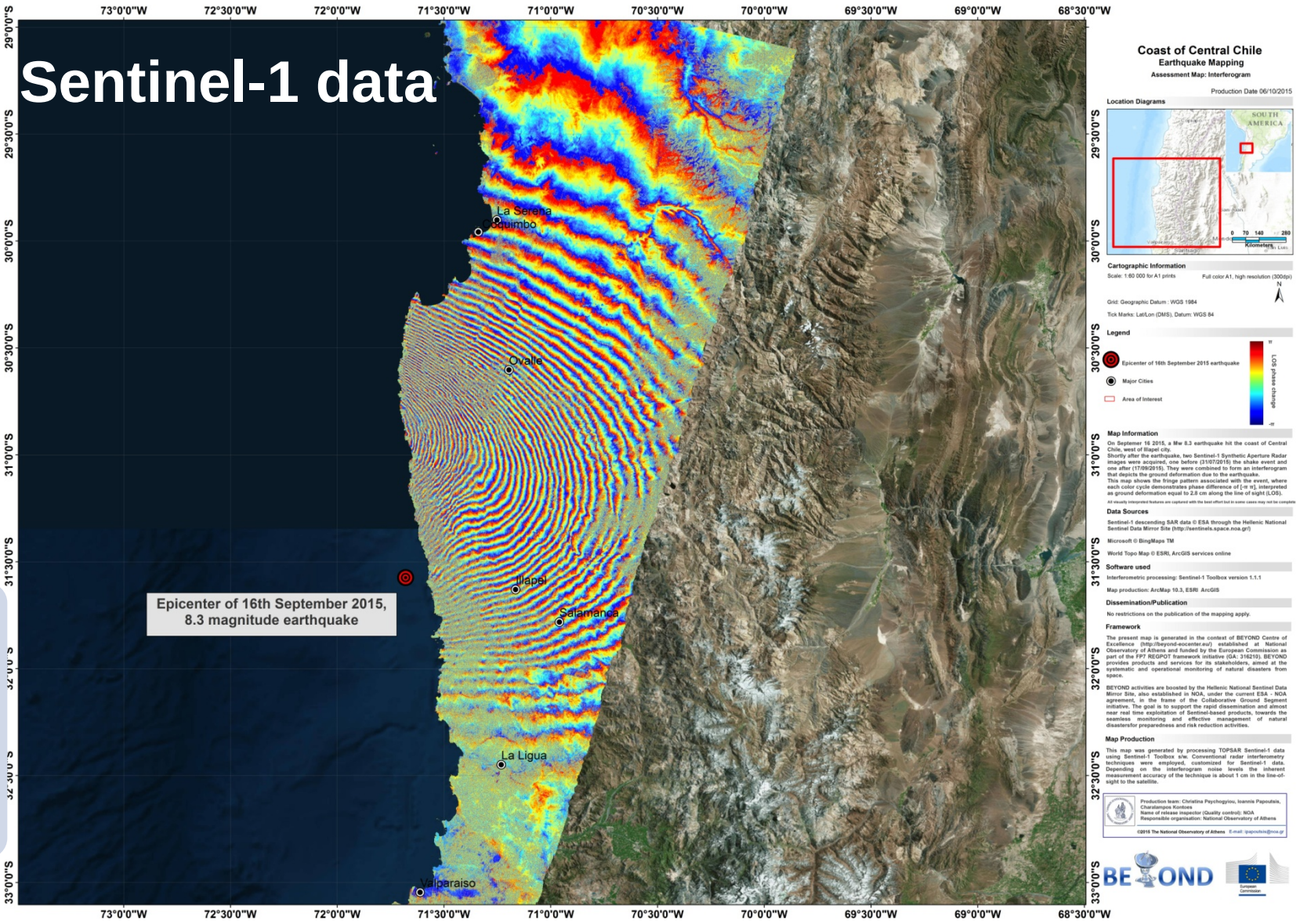
- NSN
- NOANET
- ENIGMA
- In-situ

**Services**

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

**Applications**

- Tectonics
- Volcanoes
- Landslides
- Subsidence

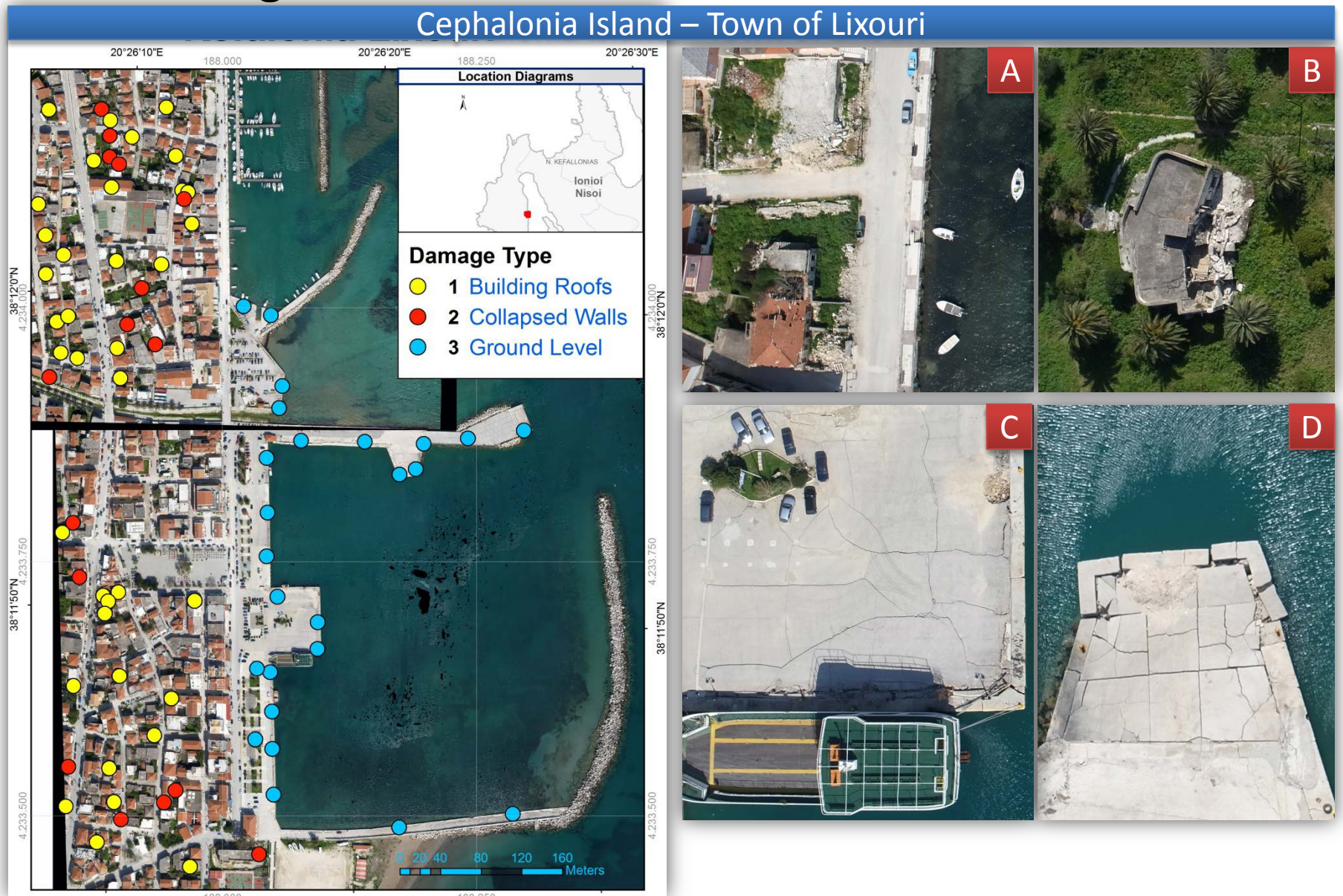


# Geohazard applications

## UAV damage assessment

# Geohazard applications

## UAV damage assessment



# Geohazard applications

UAV octocopter

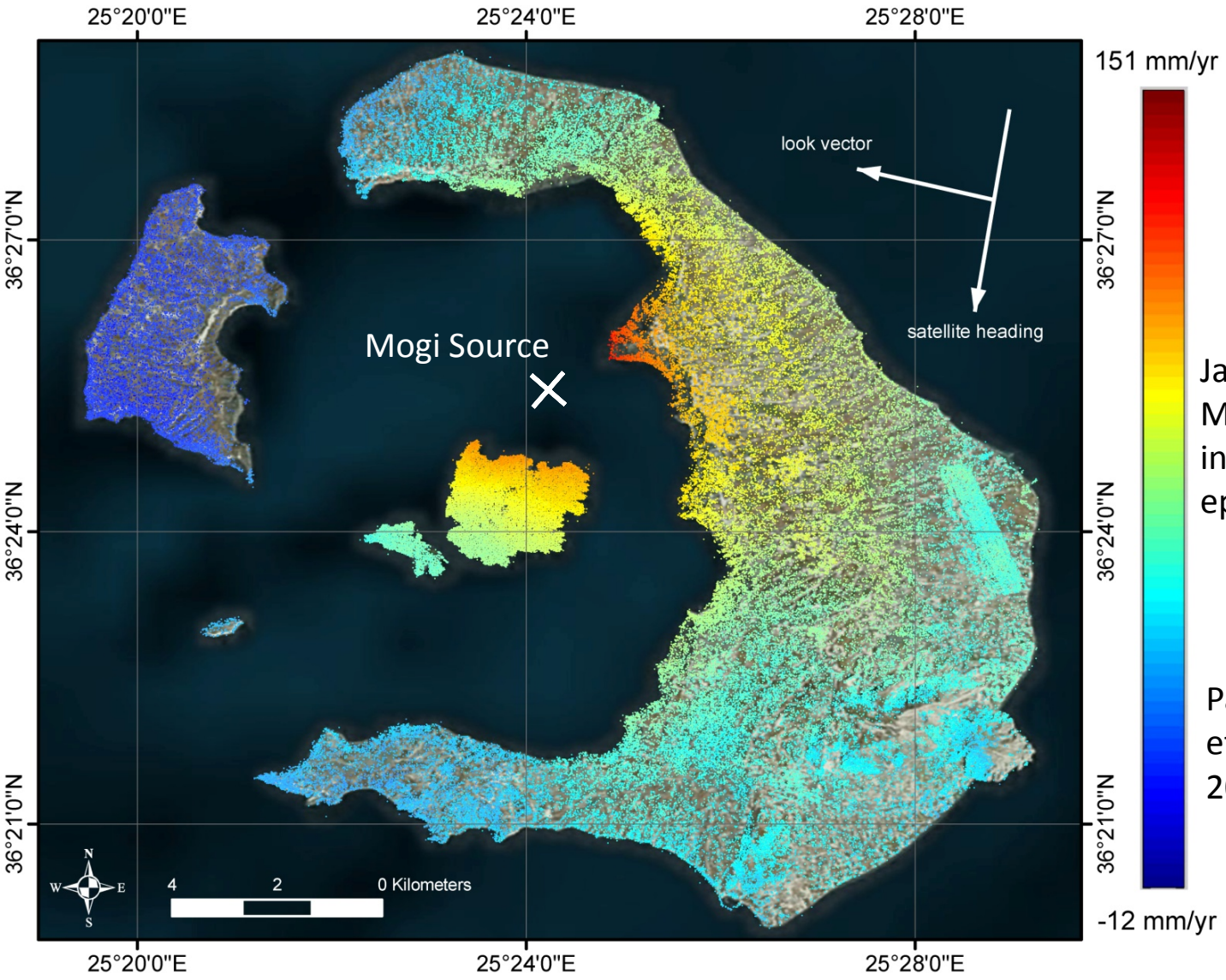
# Geohazard applications

## Monitoring volcanic activity

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

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

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

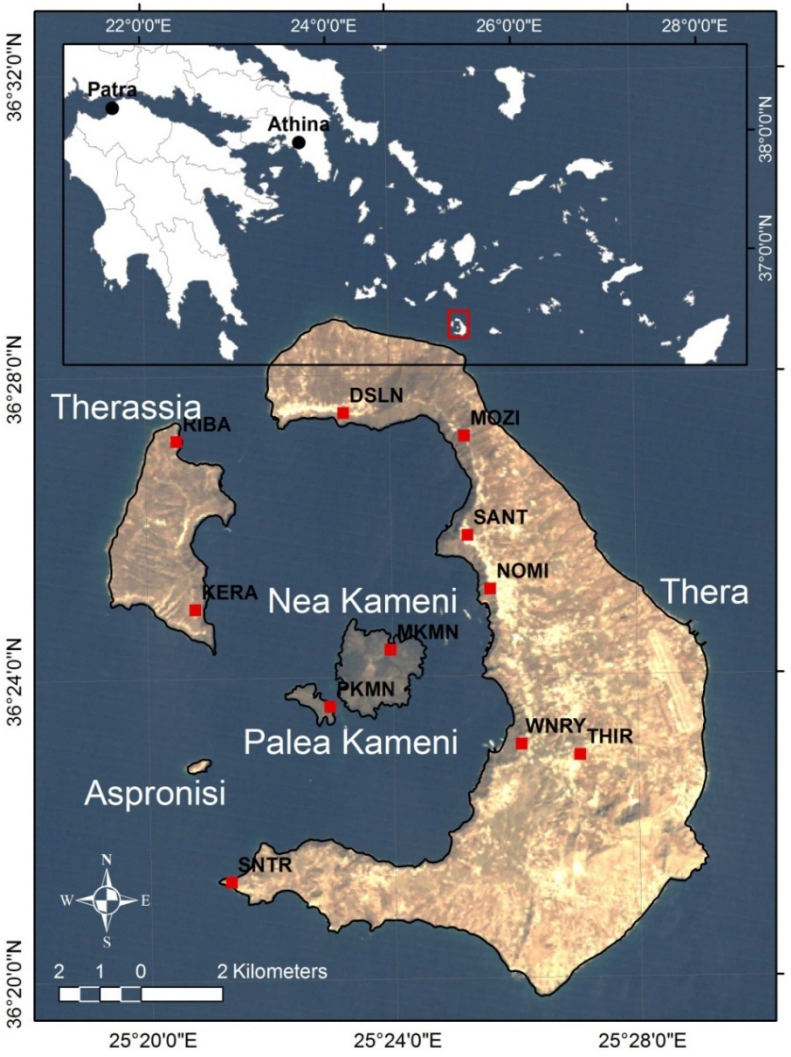



Jan. 2011 – Mar. 2012 inflation episode

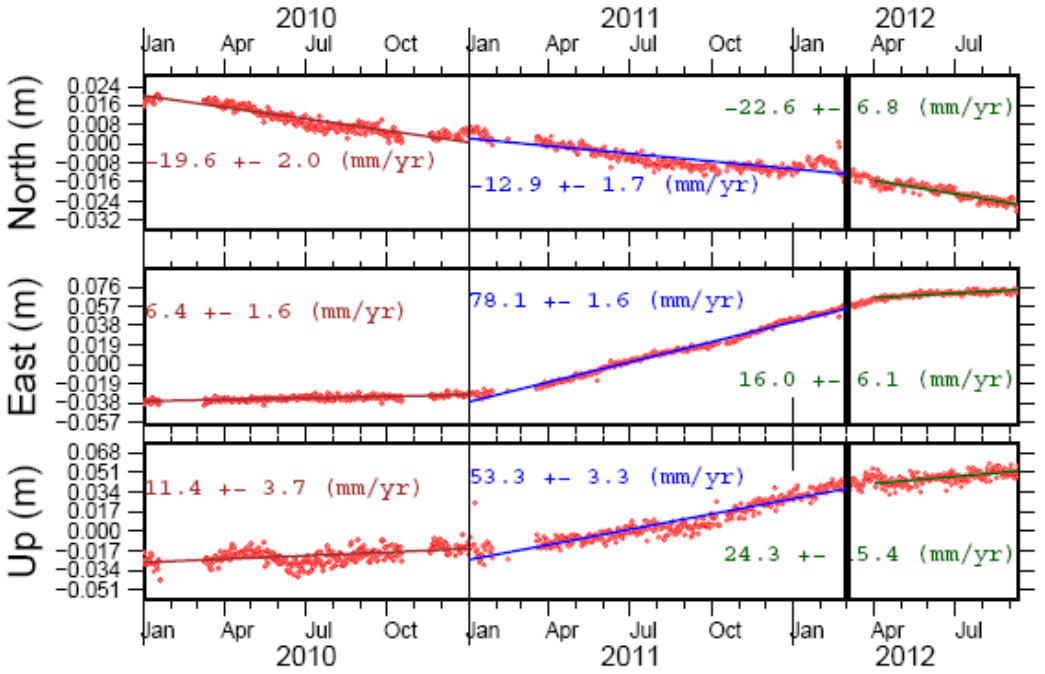
Papoutsis et al., GRL 2013

# Geohazard applications

## Monitoring volcanic activity




Time-series monitoring with in-situ GPS stations




**GPS data processing by Dionysos Satellite Observatory**

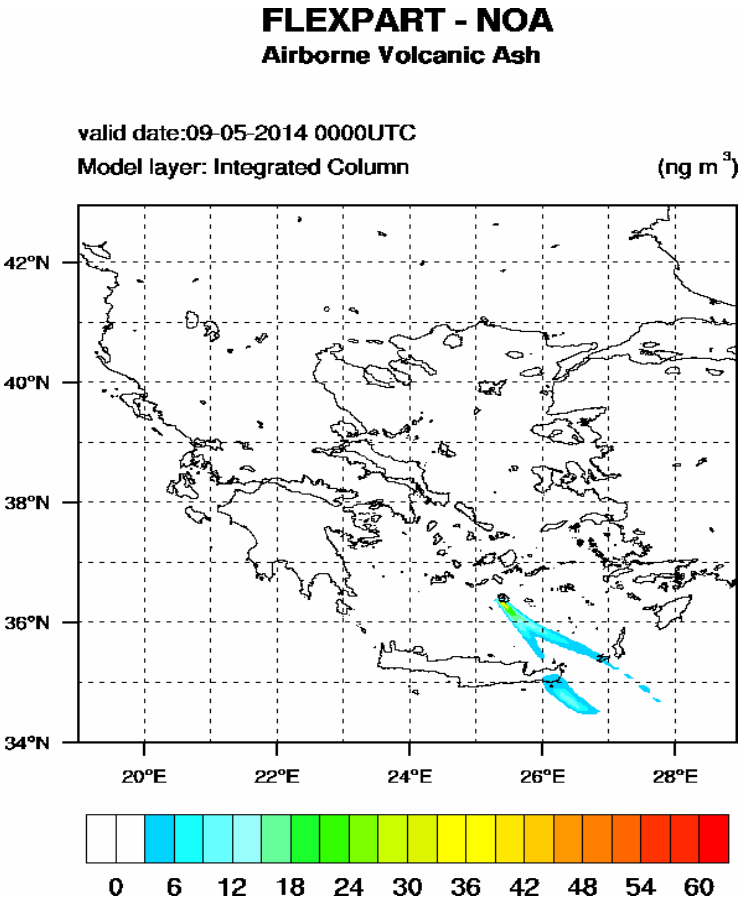
# Geohazard applications
## Dispersion of volcanic ash

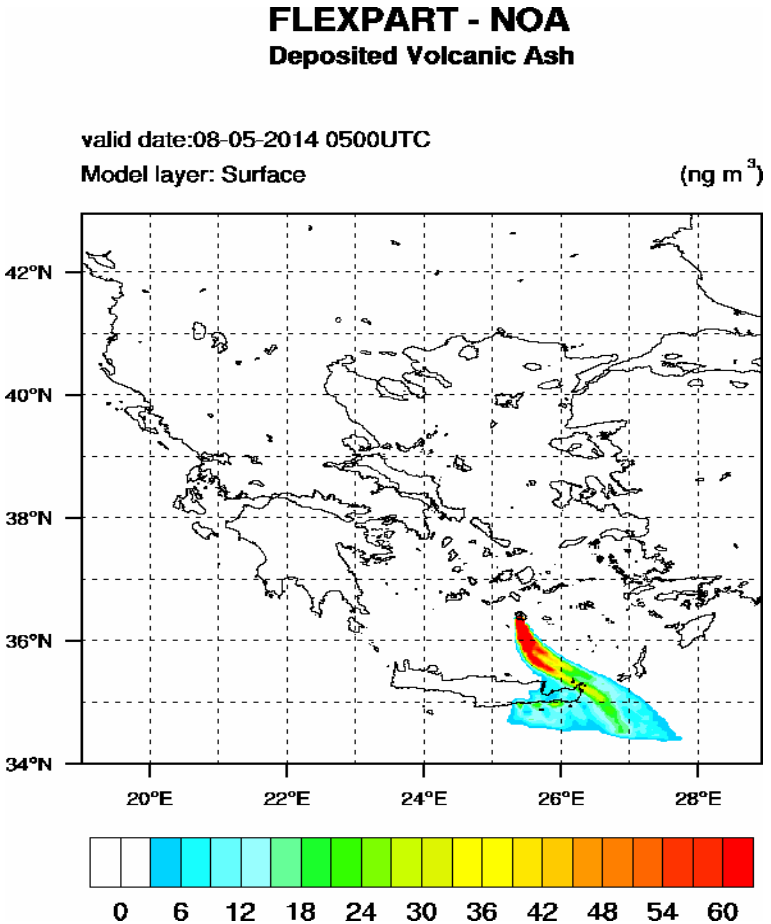
**Data**
- NSN
- NOANET
- ENIGMA
- In-situ

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

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

- Early warning system being developed in the framework of BEYOND
- The specific hypothesis assumes 60 hours of continuous emissions at 1.5 km height column



# Geohazard applications

## Urban subsidence & uplift tracking

**Data**

- NSN
- NOANET
- ENIGMA
- In-situ

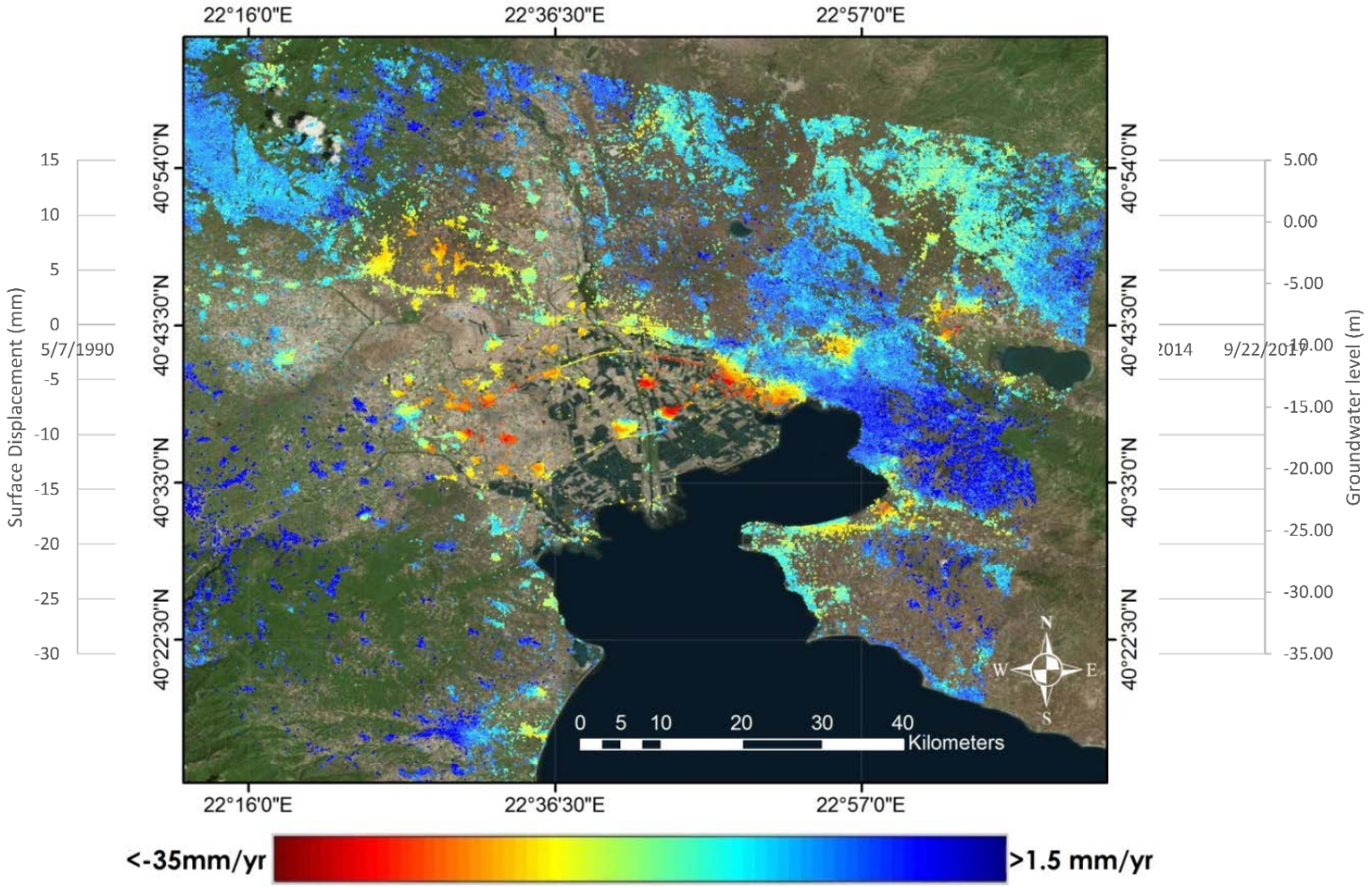
**Services**

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

**Applications**

- Tectonics
- Volcanoes
- Landslides
- Subsidence

**Thessaloniki (1992 - 2001, 2002 - 2010)**




Driver: water over-pumping, Svigkas et al., Nat. Haz. submitted

# Geohazard applications

## Seismic risk estimation

**Data**

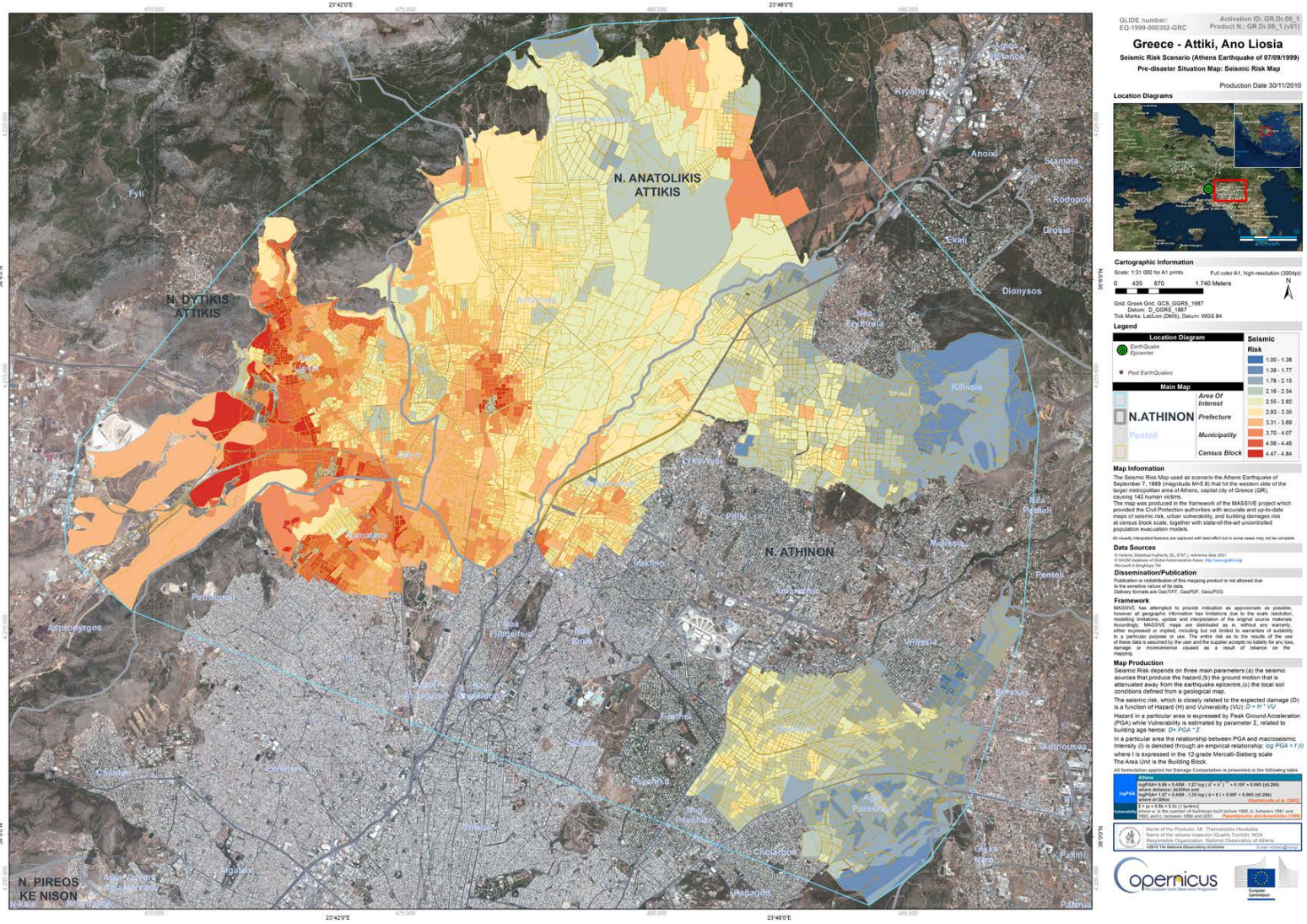
- NSN
- NOANET
- ENIGMA
- In-situ

**Services**

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

**Applications**

- Tectonics
- Volcanoes
- Landslides
- Subsidence



# Geohazard applications

## Large scale ground velocity estimation

**Data**

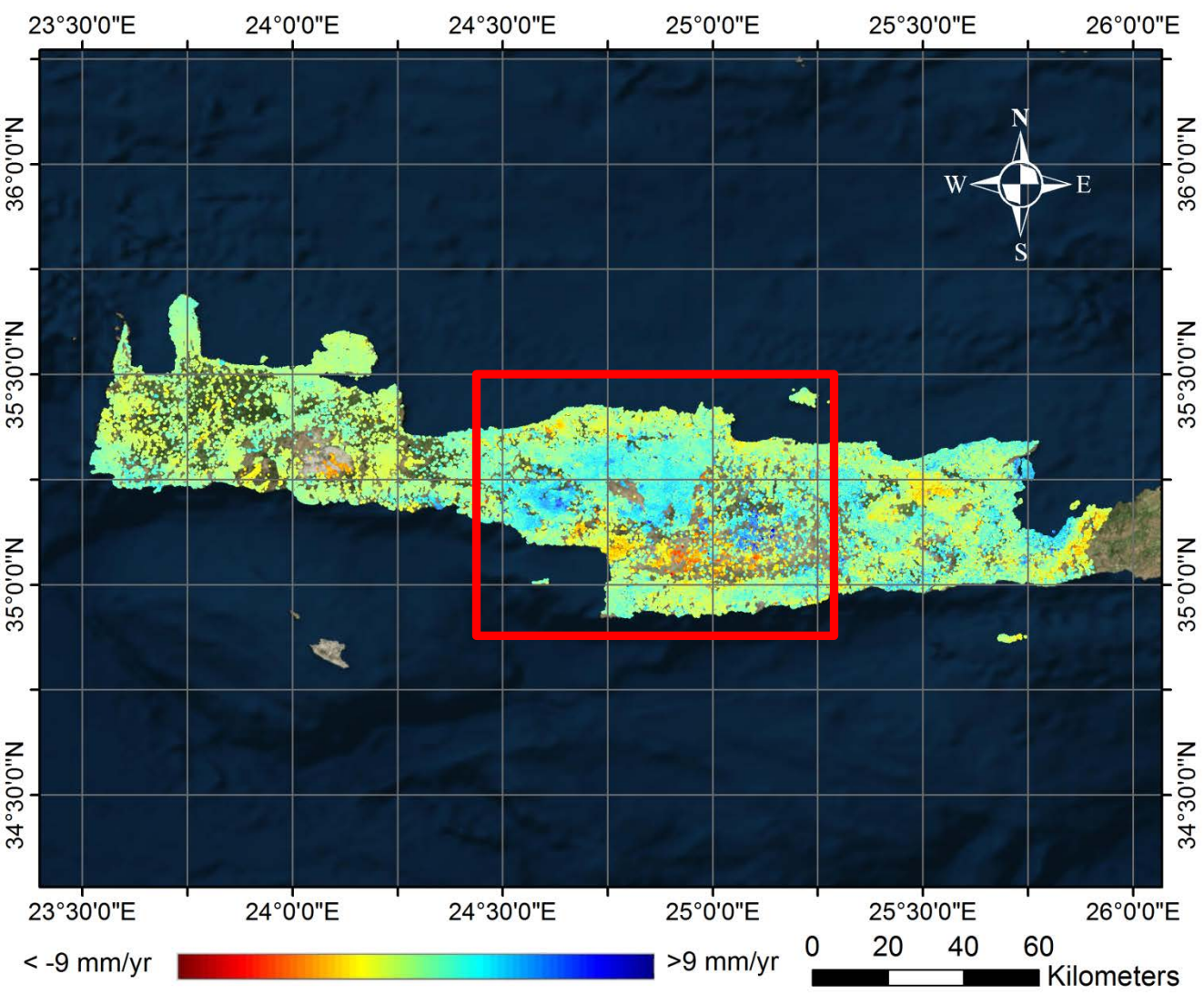
- NSN
- NOANET
- ENIGMA
- In-situ

**Services**

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

**Applications**

- Tectonics
- Volcanoes
- Landslides
- Subsidence



# Geohazard applications

## Regional landslide hazard assessment

BE-OND

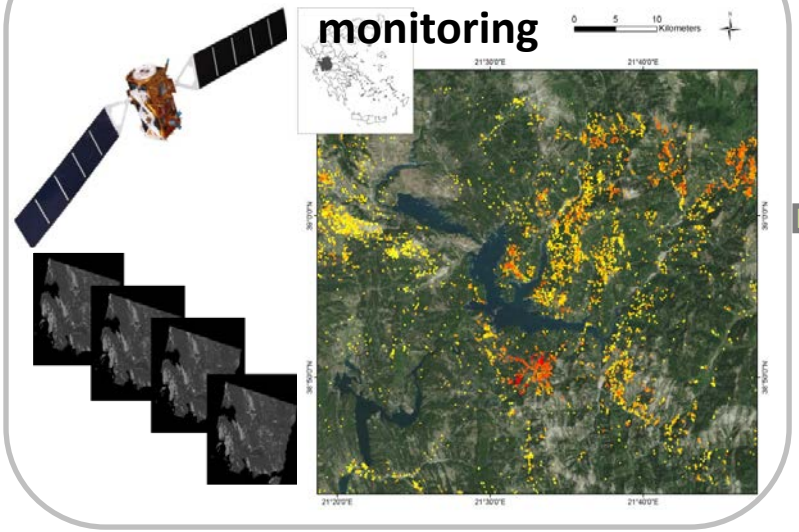
### Hazard scale characterization of slow-moving landslides

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

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

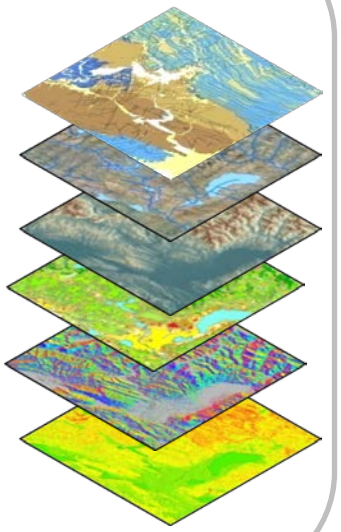
**Applications**
- Tectonics
- Volcanoes
- Landslides
- Subsidence

**Multi temporal monitoring**



**Geospatial layers**

Elevation
Slope angle
Slope aspect
Geology
Soil properties
LU/LC
Hydrology
Faults
Precipitation



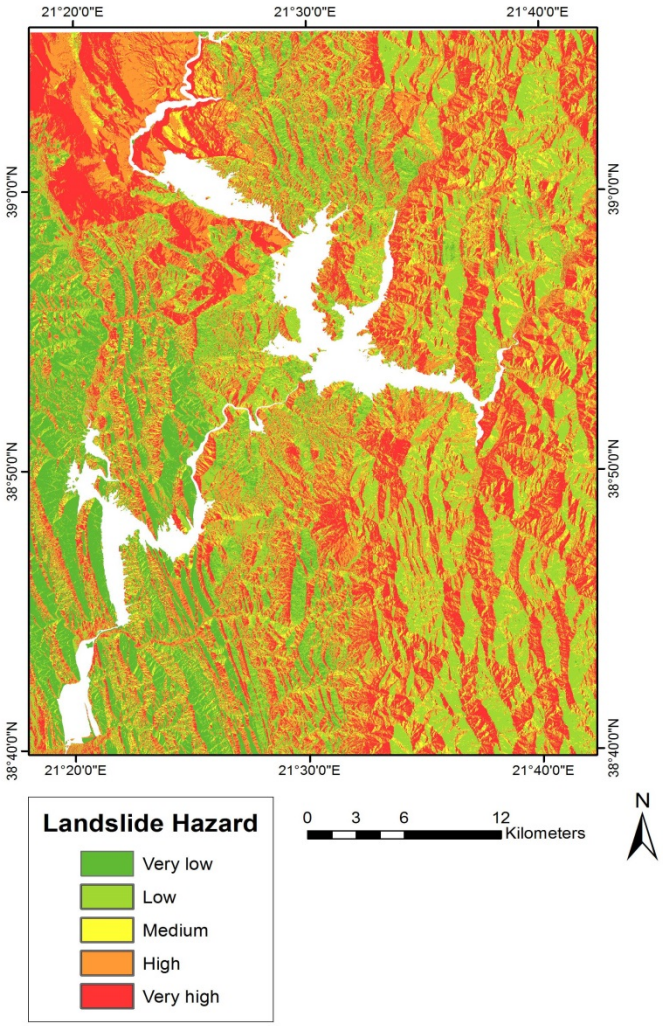
**GIS-Statistical processing**

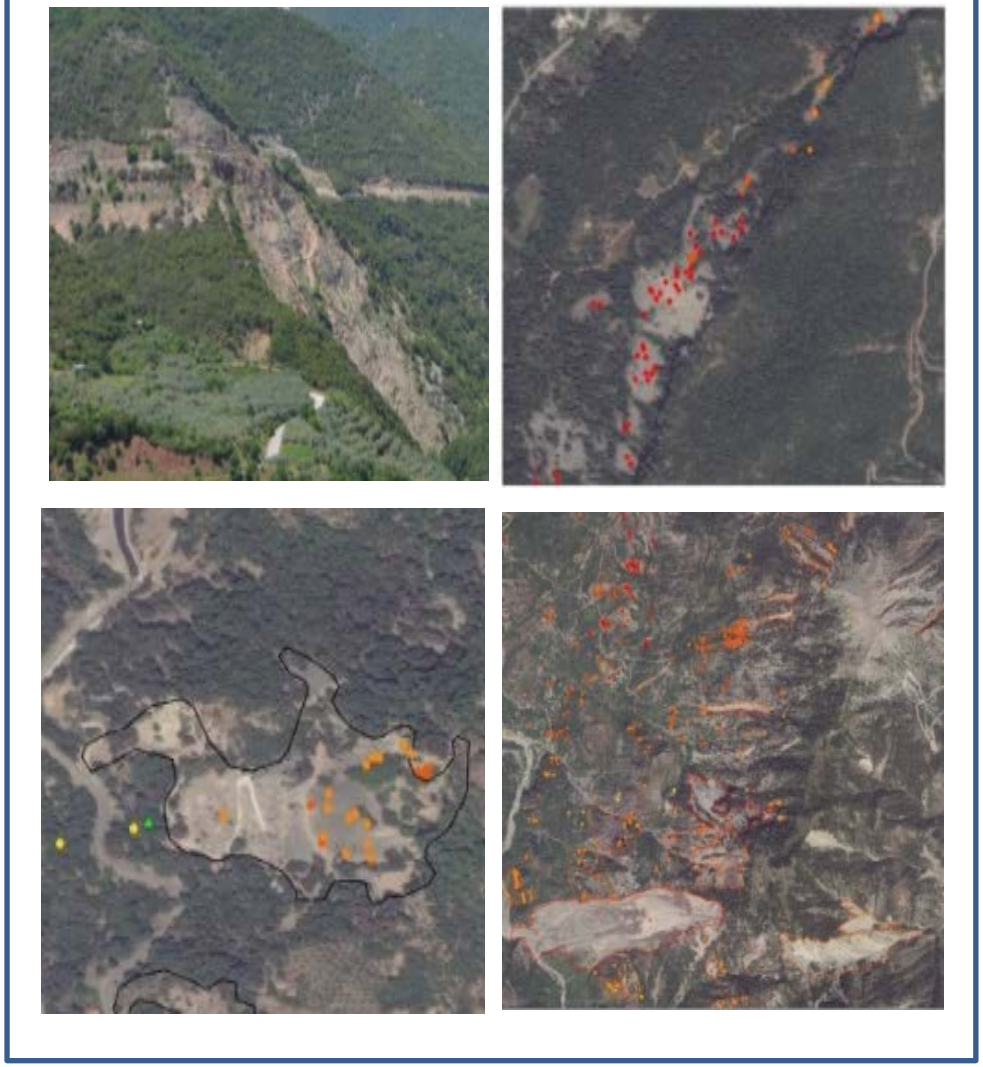
**Probability models**
- Weights of evidence
- Logistic regression
- Neural networks

# Geohazard applications

## Regional landslide hazard assessment

### Landslide Hazard map



# Geohazard services

## An overview

| Service | Status | Input data | Scale |
|---|---|---|---|
| Mapping of large-scale ground velocities & 3D decomposition | Operational | SAR, GPS | National |
| Estimation of earthquke 3D crustal deformation | Operational | multi-angle SAR, GPS | Local |
| Seismic risk estimation | pre-operational | SAR, in-situ, GIS | Local |
| UAV based damage assessement | 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 |

# Geohazard services
## Outlook

NOA hosts a Sentinel Collaborative Ground Segment

- Adaptation of existing services, deployment of new services
- Dynamic ingestion of Sentinel data for real-time applications
- Big data management, exploitation of high revisit times
- Databases of geodetic observations

# Questions?

**Thank you!**

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