

## *The Safety project: Sentinel-1 for Civil Protection geohazards management*



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ECHO/SUB/2015/718679/Prev02-SAFETY

**Project Co-financed by the EU-Union Civil Protection Mechanism**



## *Sentinel for Geohazards regional monitoring and forecasting*

01/01/2016 – 01/01/2018



European Commission,  
Directorate-General  
Humanitarian Aid and  
Civil Protection (ECHO)

Developing and testing a procedure to provide Civil Protection Authorities (CPA) with the capability of periodically evaluating and assessing the potential impact of geohazards (volcanic activity, landslides and subsidence) on urban areas and infrastructures, over regional areas.



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Dirección General de Seguridad  
y Emergencias



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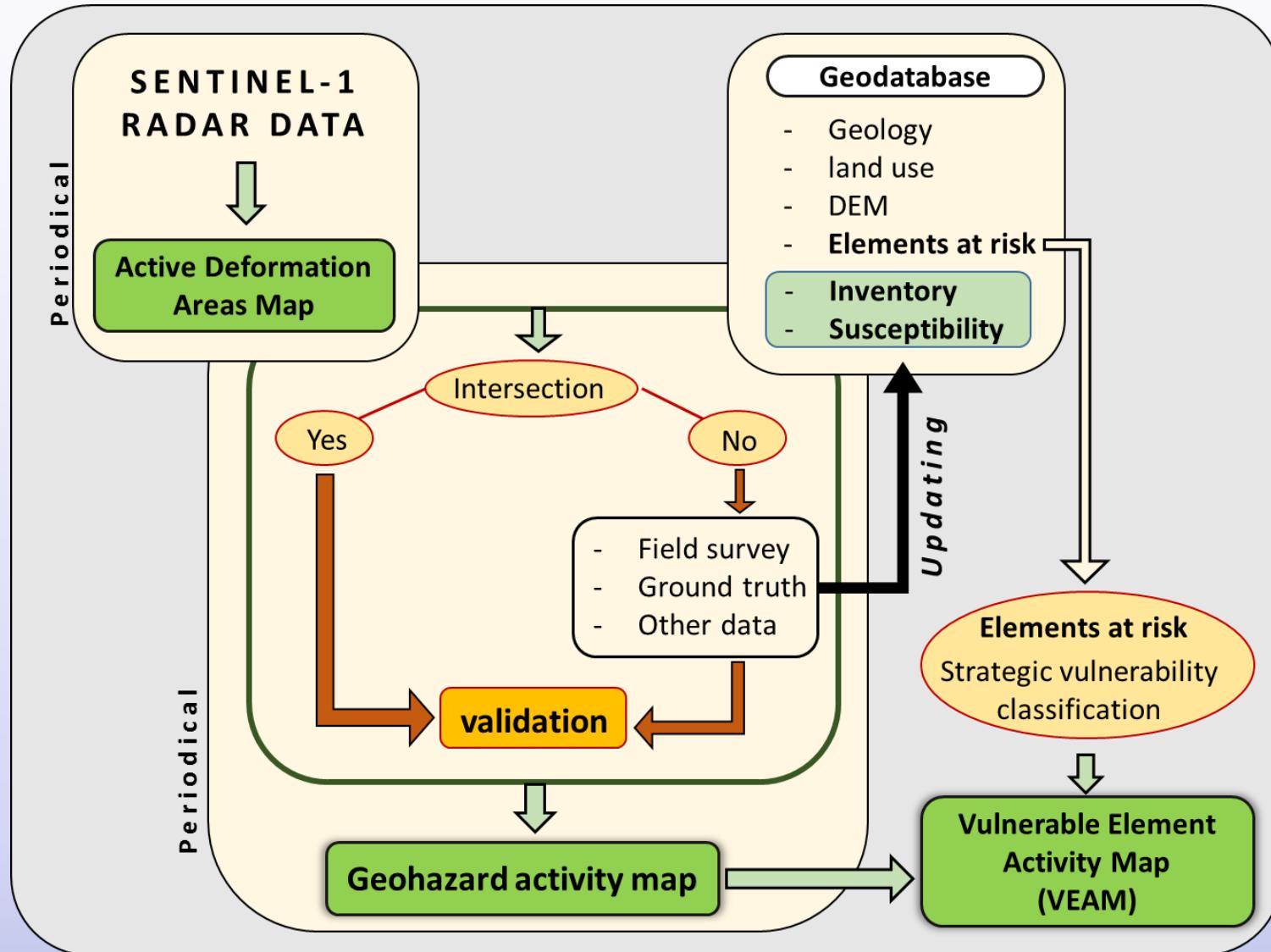


# Why Sentinel-1?

- Wide area coverage
- Regular worldwide acquisition
- High temporal sampling (6/12 days)
  - Free access
- Higher coherence (compared with other C-band satellites)

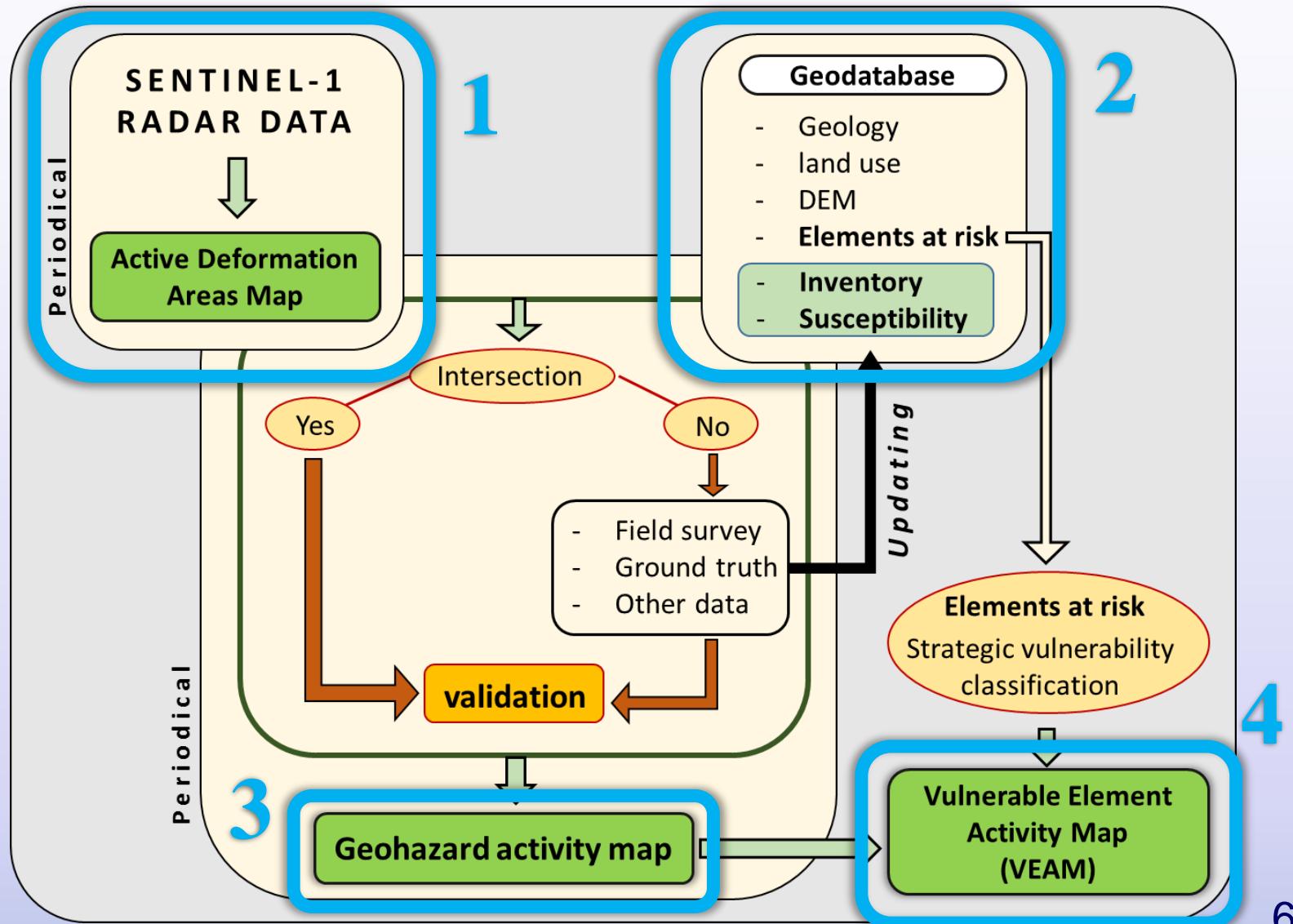
# Safety Project

## Developed procedure

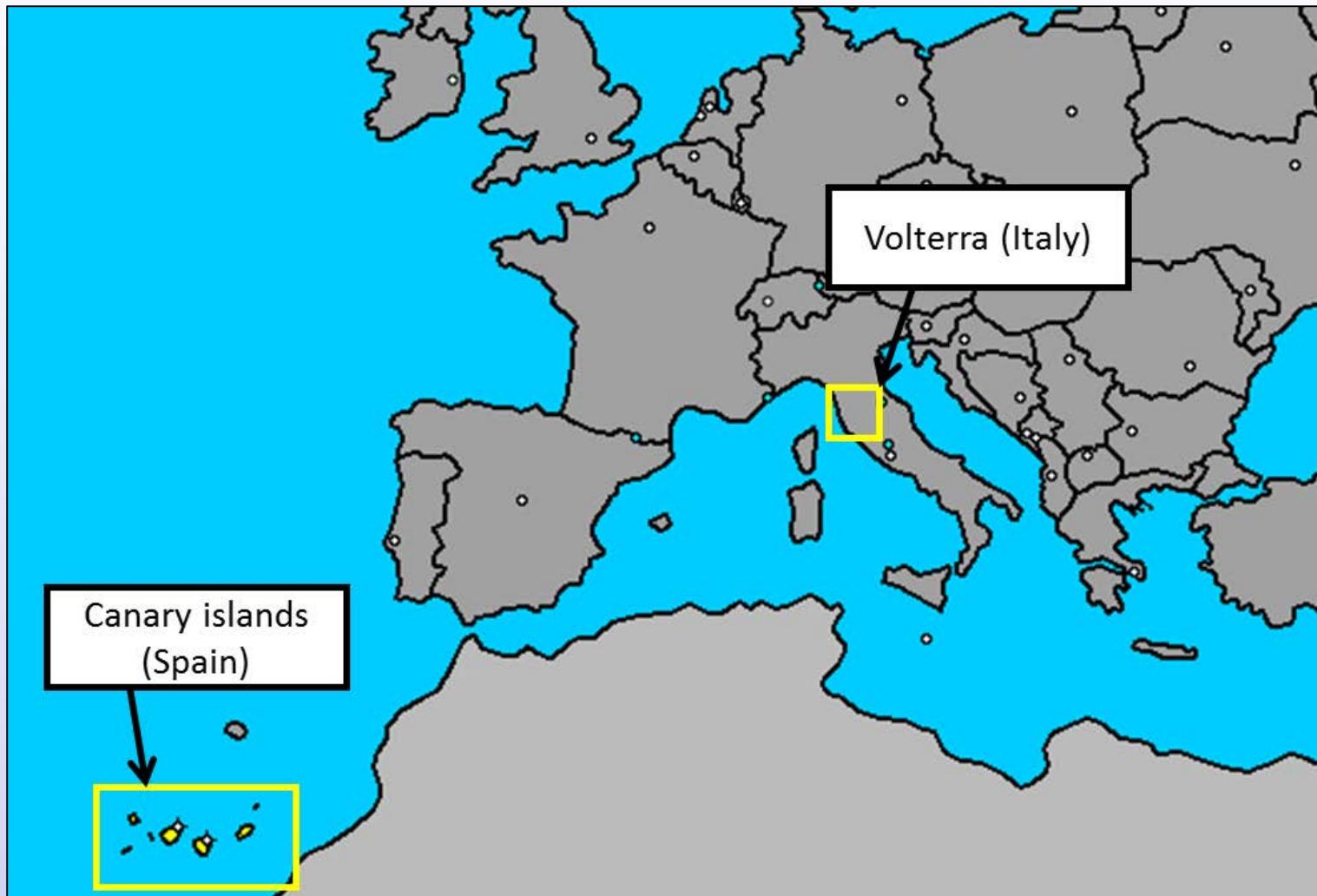


# Summary of Presentation

## Main activities and results

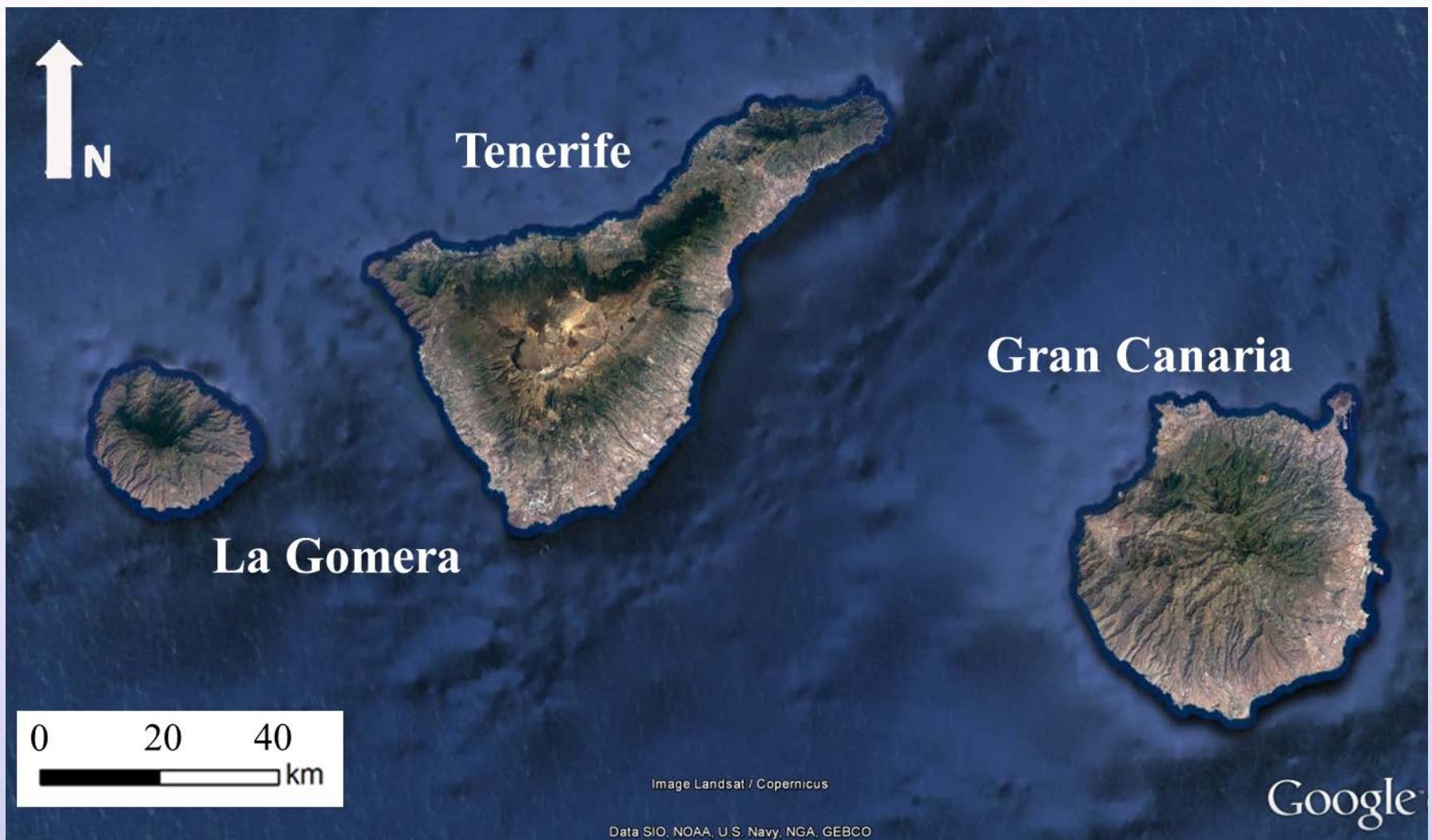


# Test Sites



# Study Areas

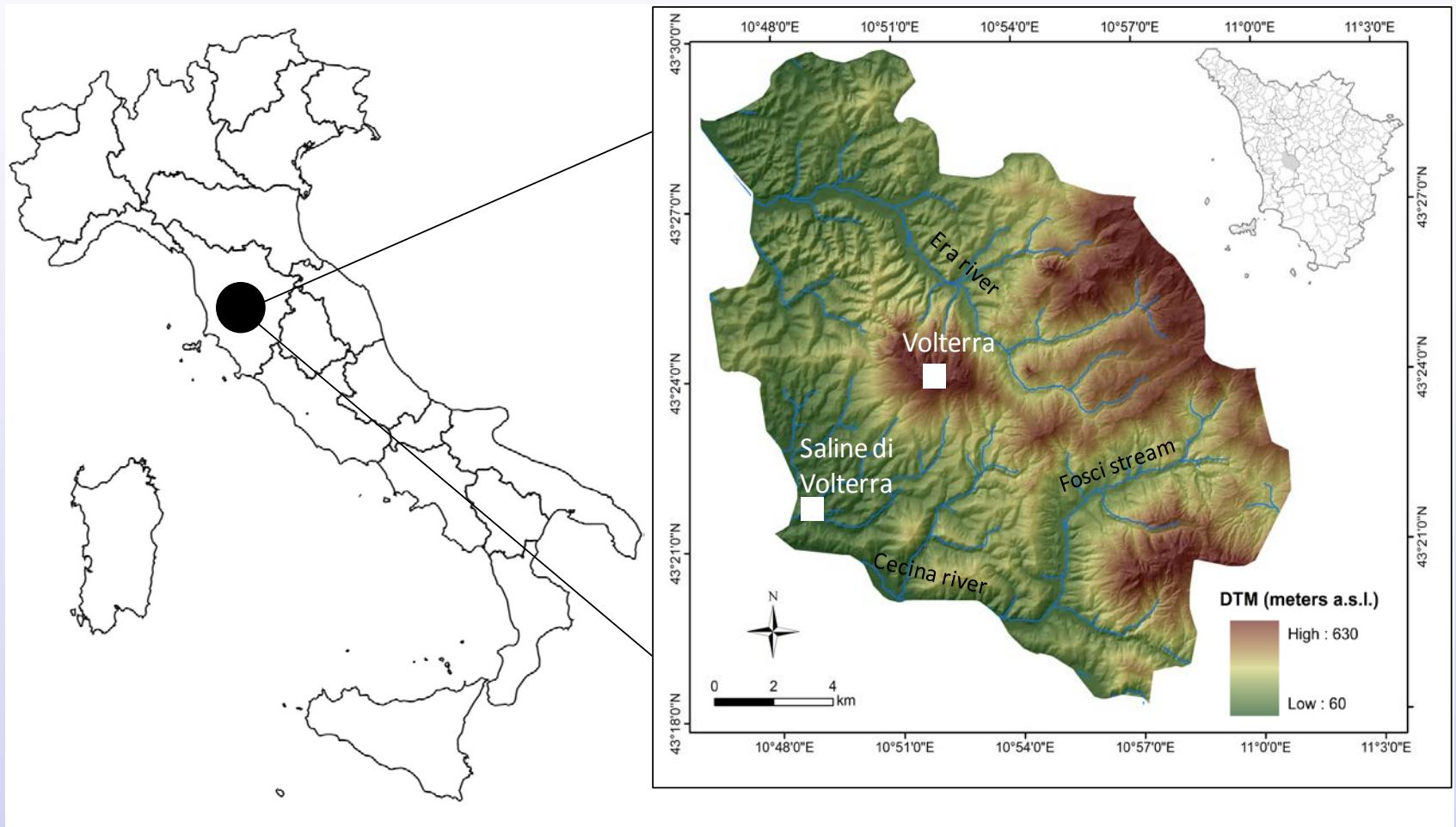
## Canary Islands



Total land area around 5.000 km<sup>2</sup>

# Study Areas

## Volterra municipality (Tuscany Region, Italy)



Municipality area of about 250 km<sup>2</sup>

# Study Areas

## *Canary Islands*

### Main Hazards

Volcanic  
Rockfall

### Main Lithologies

Lavas  
Pyroclastics

### Main Land Coverage/use

Sparse vegetation  
Bare soil/lava

### Data availability

Low

### Radar Response

High coherence

## *Volterra Municipality*

### Main Hazards

Landslide

### Main Lithologies

Clays  
Sands

### Main Land Coverage/use

Agriculture/Pasture  
Forest

### Data availability

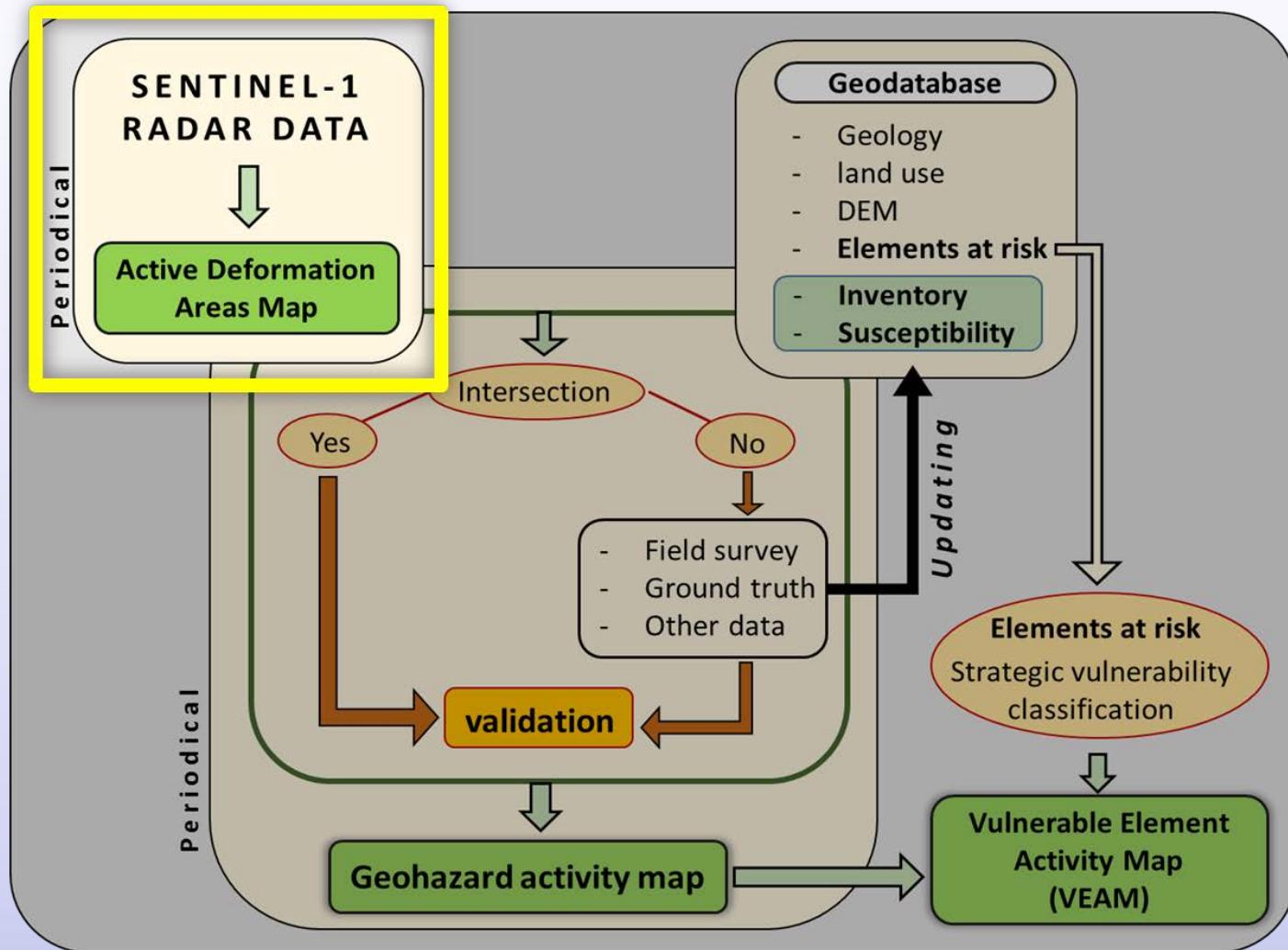
High

### Radar Response

Low coherence

# Safety Project

## Deformation Activity Map and HotSpots Map



# Challenges

- 1) Readability
- 2) Reliability
- 3) Regional scale

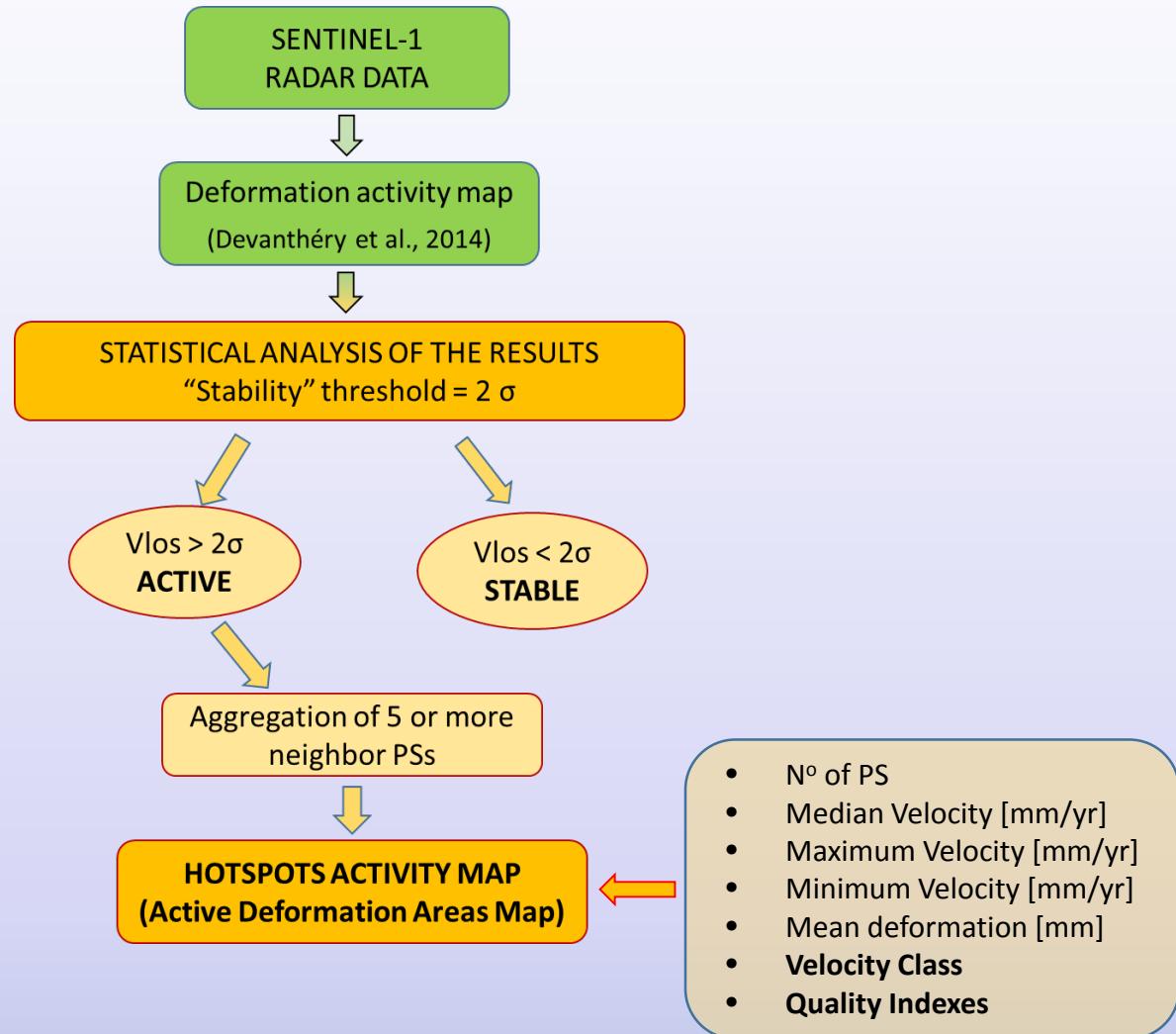
## Main constraining factors:

- 1) Spatio-temporal noise (i.e. the map sensitivity)
- 2) Huge number of information (PSs)

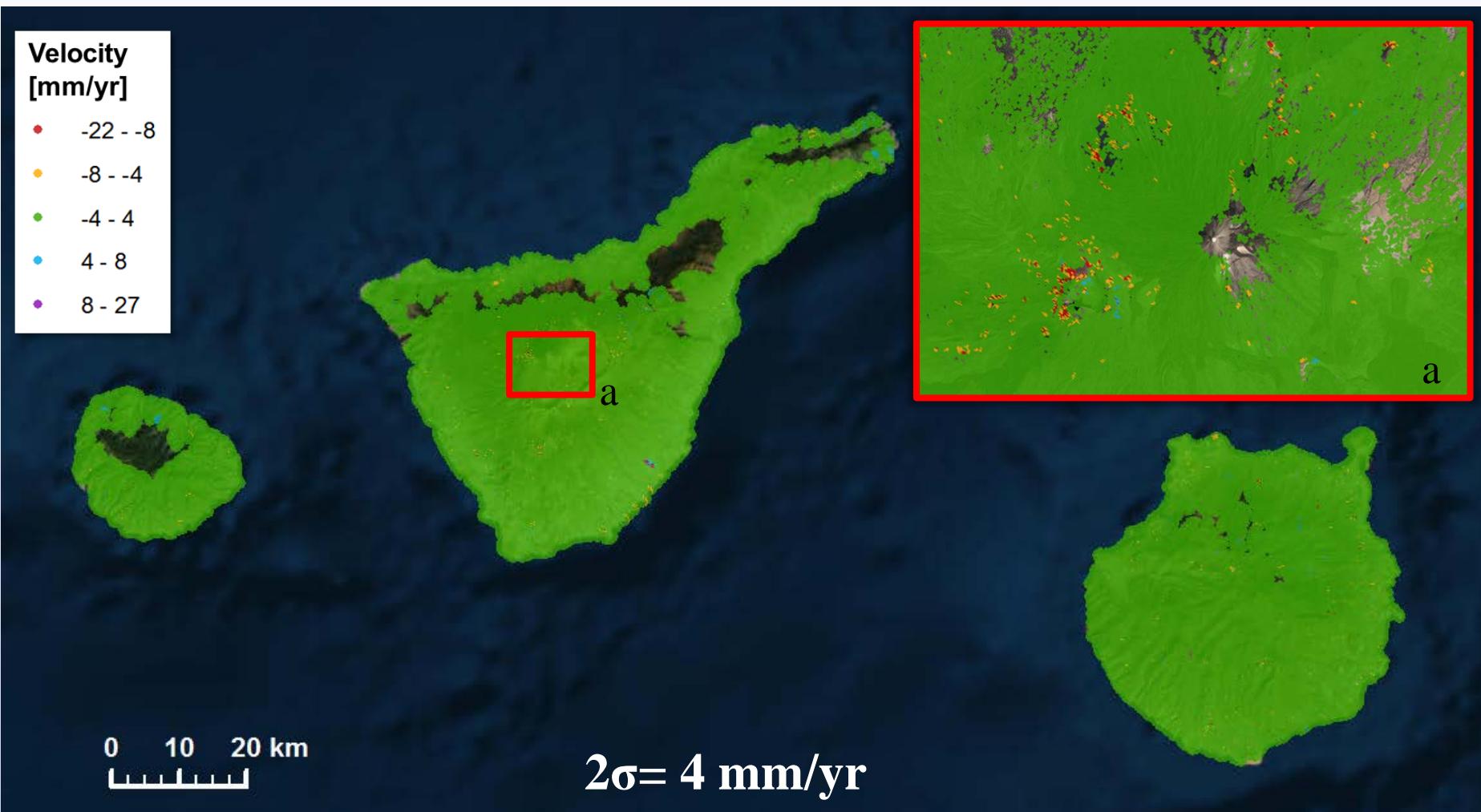


# Deformation Activity Map

## Active Areas (HotSpots) Extraction



# Deformation Activity Map Canary Islands

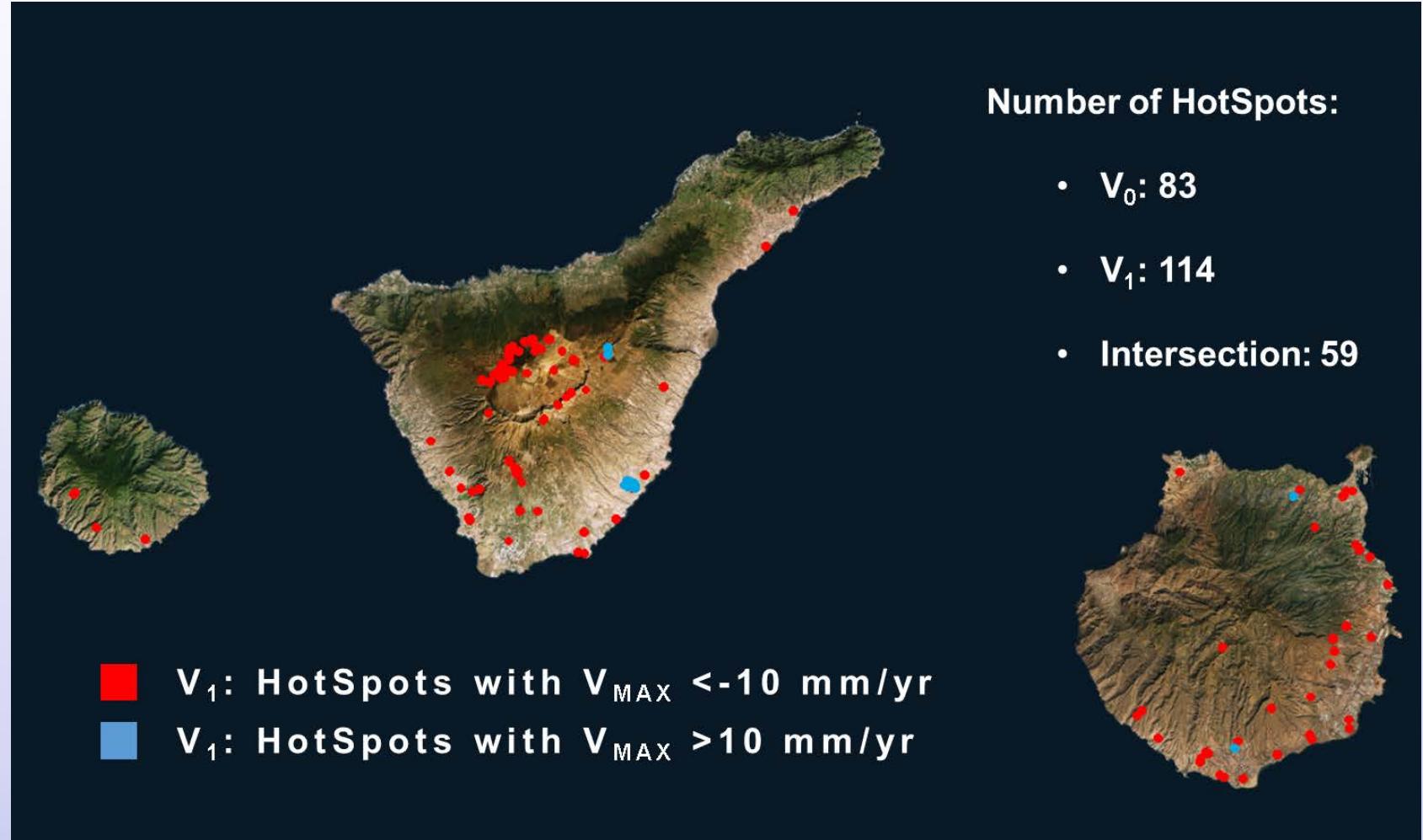




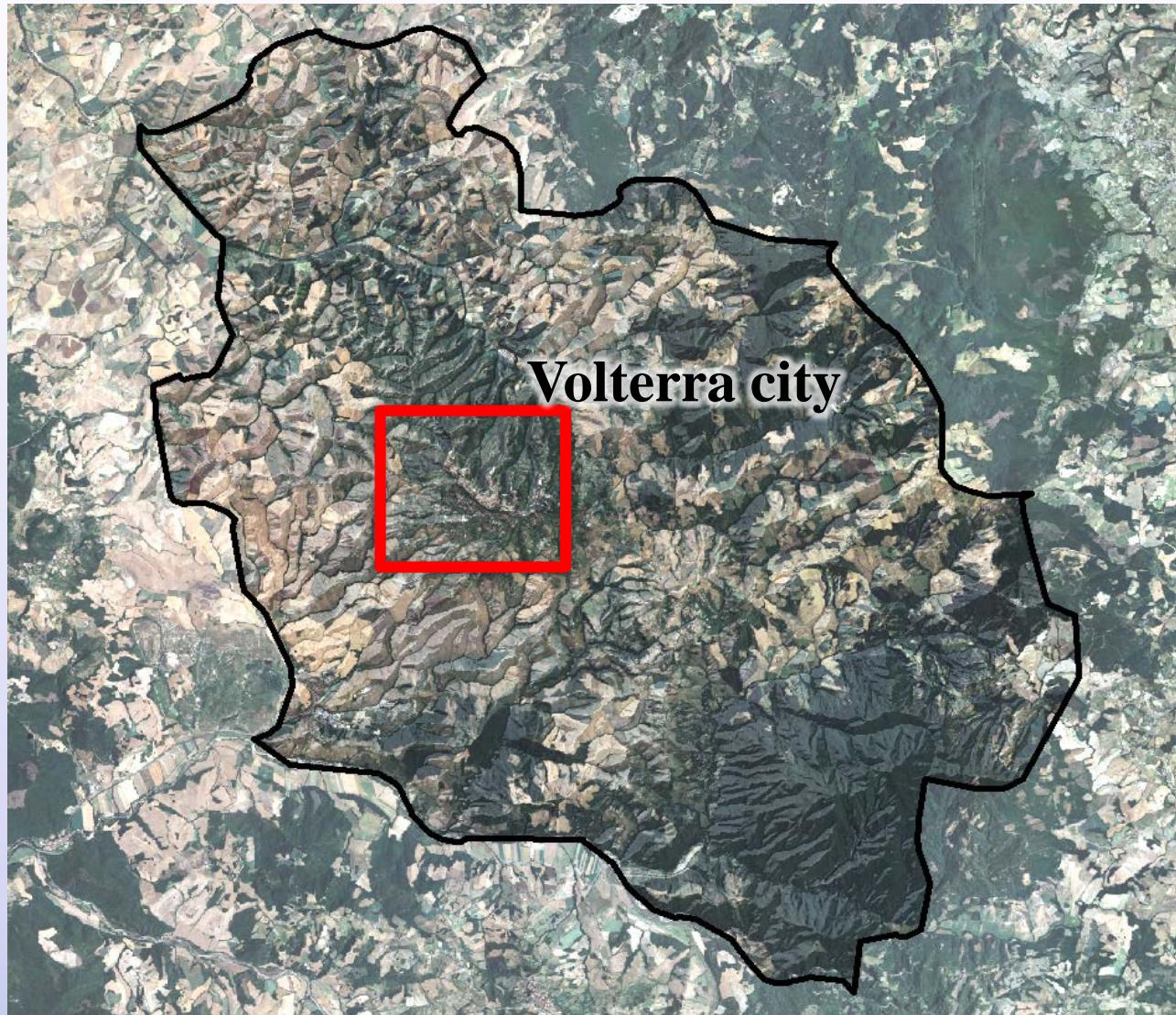
# Active Deformation Areas (HotSpot) map



## Canary Islands

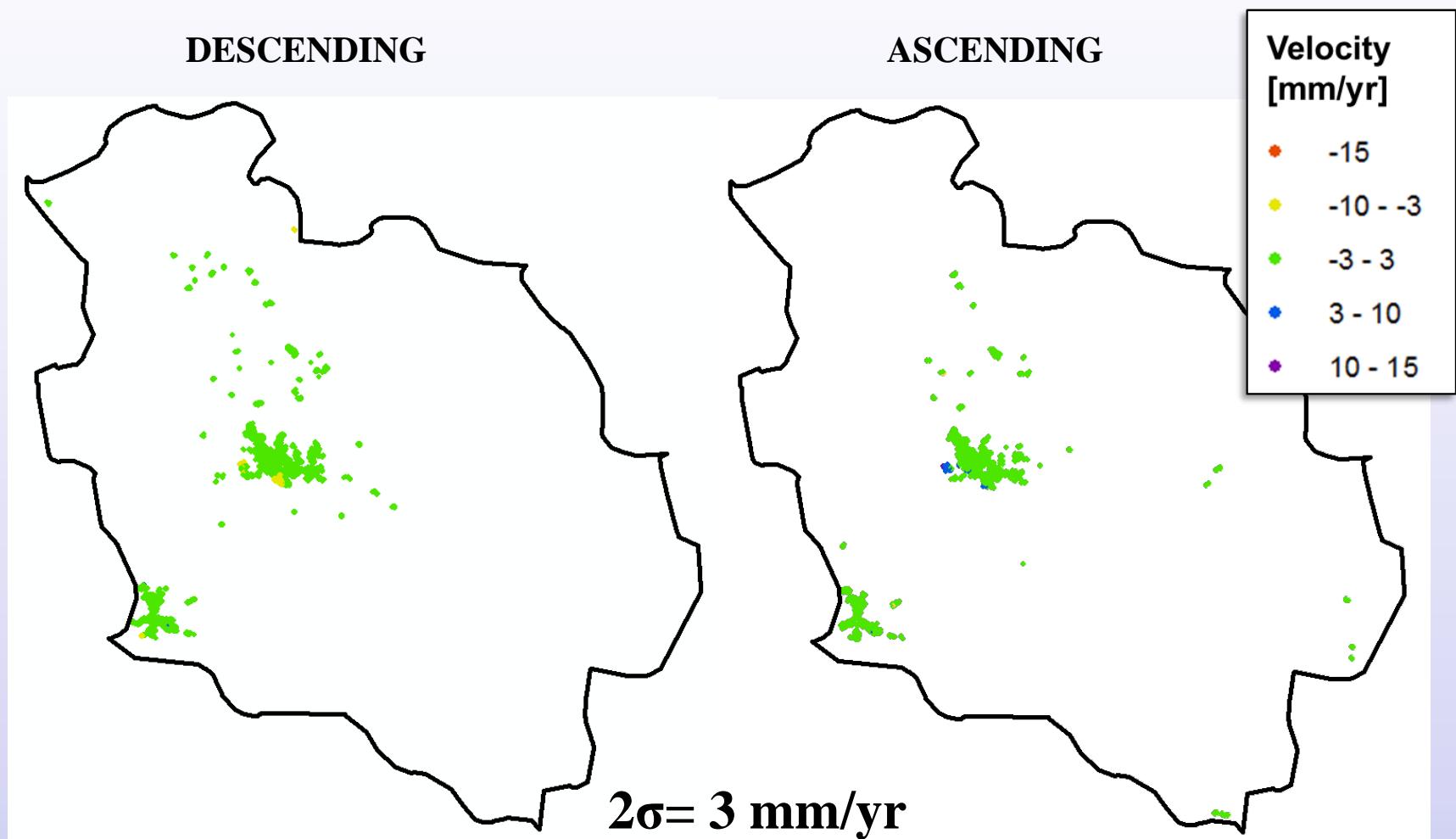


# *Deformation Activity Map Volterra*

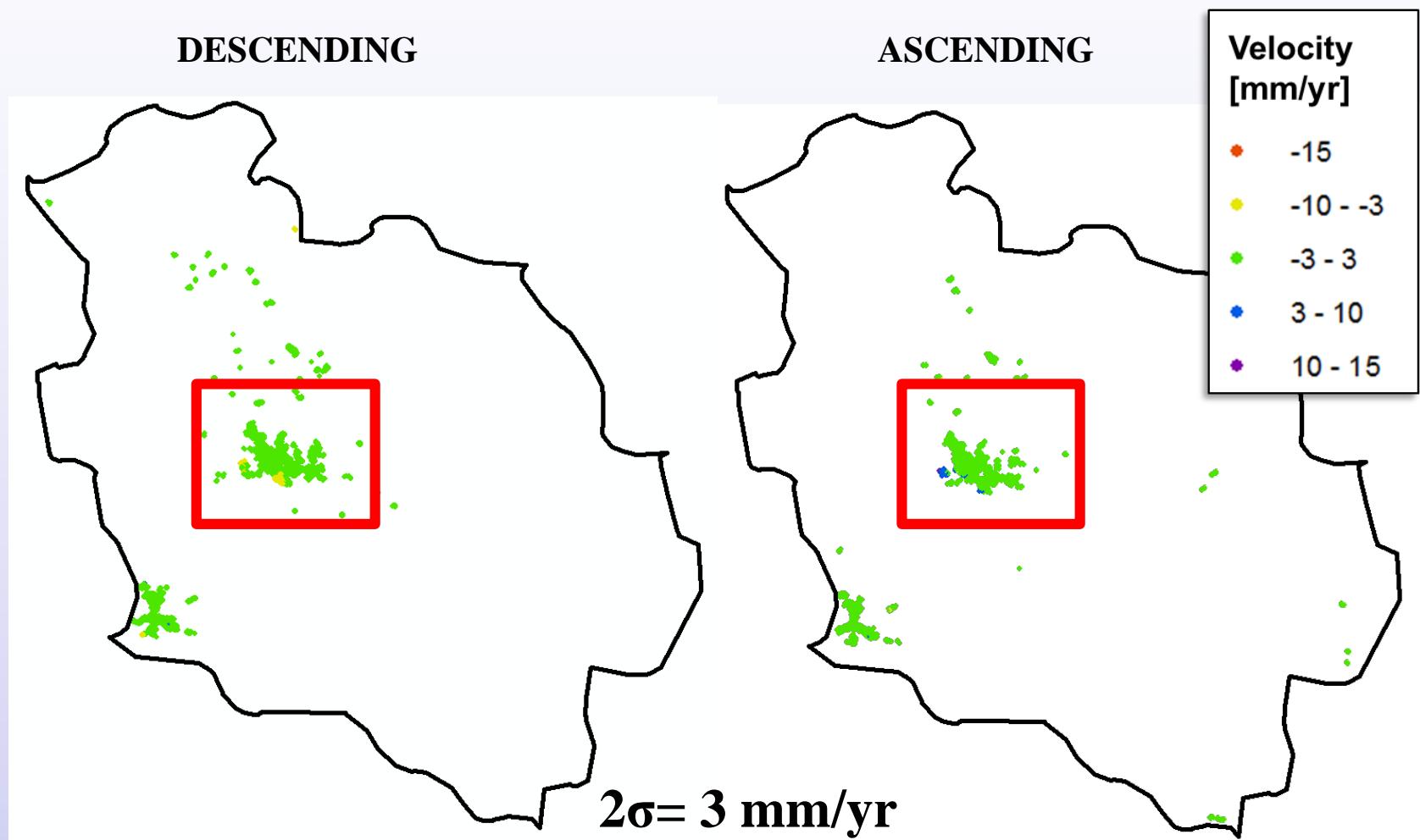


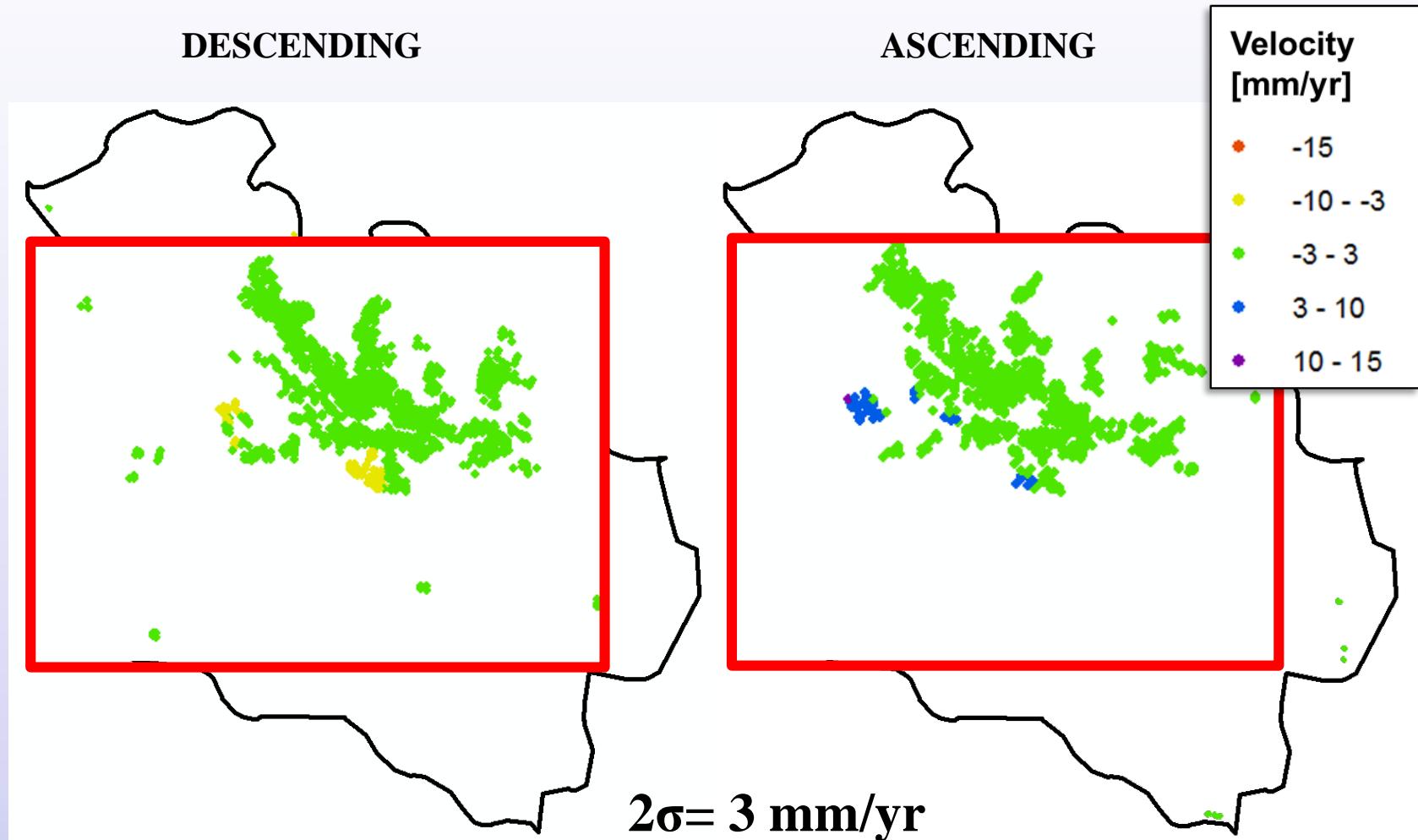
Volterra city

# Deformation Activity Map Volterra



# Deformation Activity Map Volterra

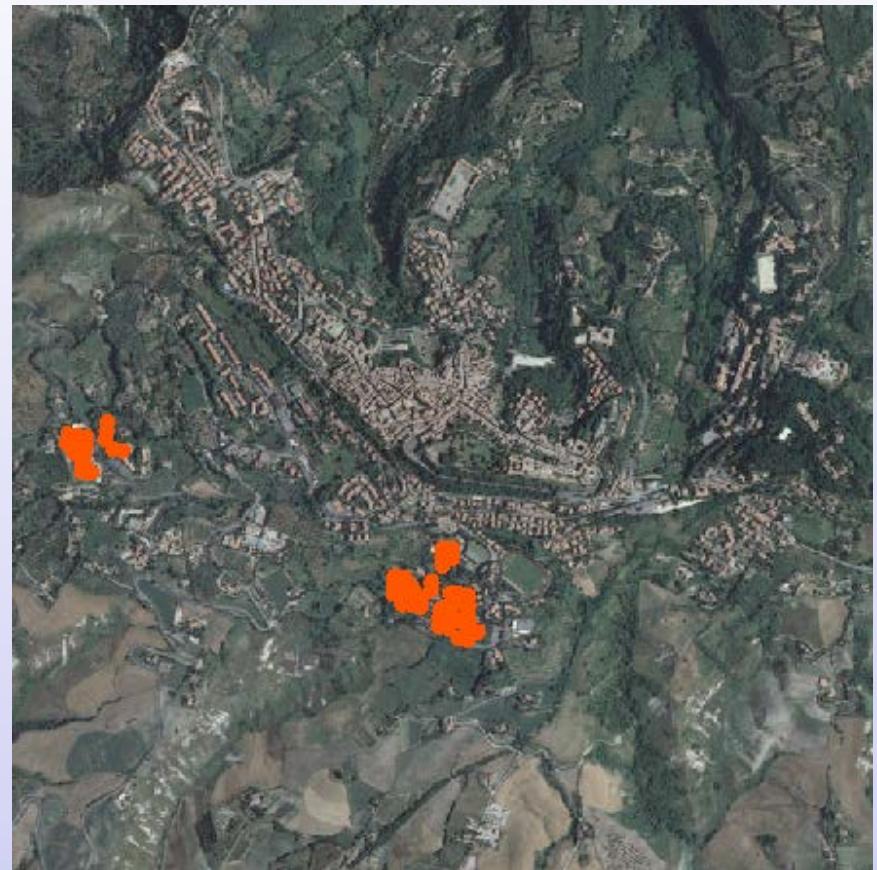
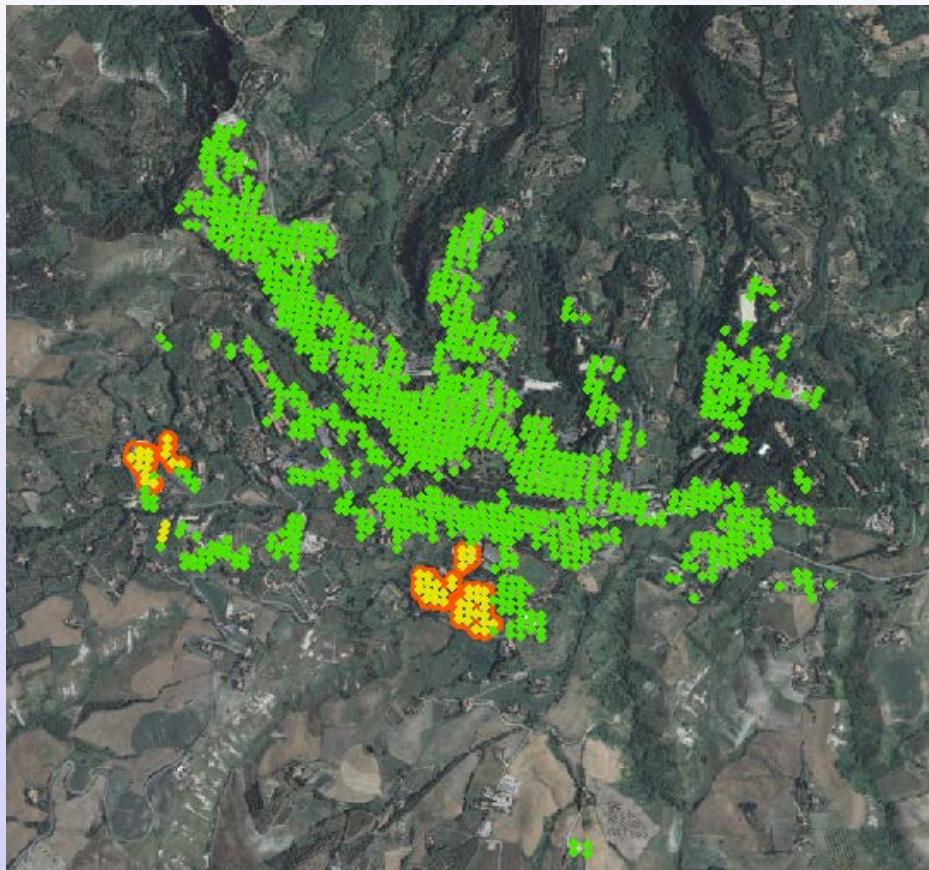




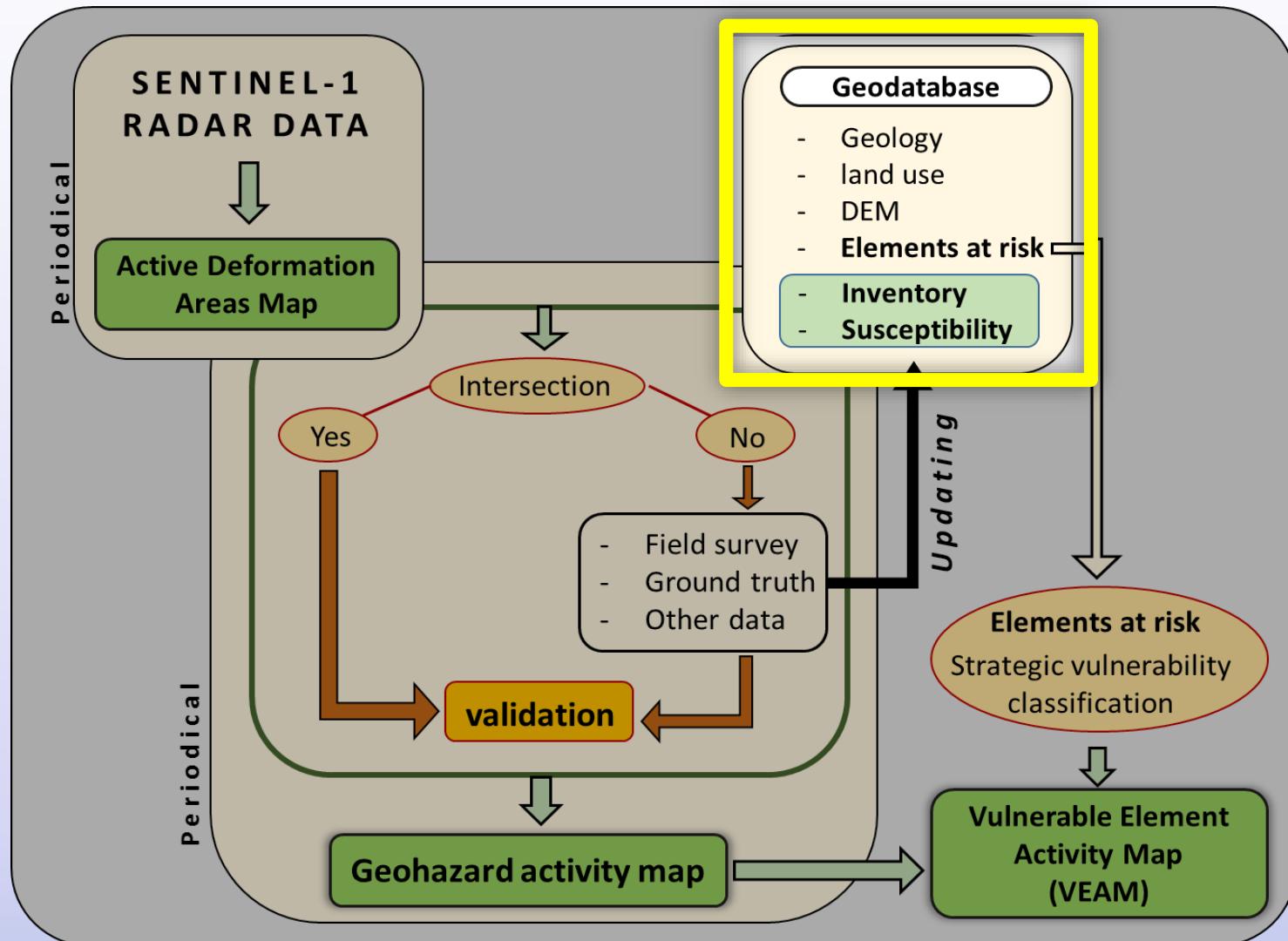
# Active Deformation Areas (HotSpot) map

*Volterra*

DESCENDING

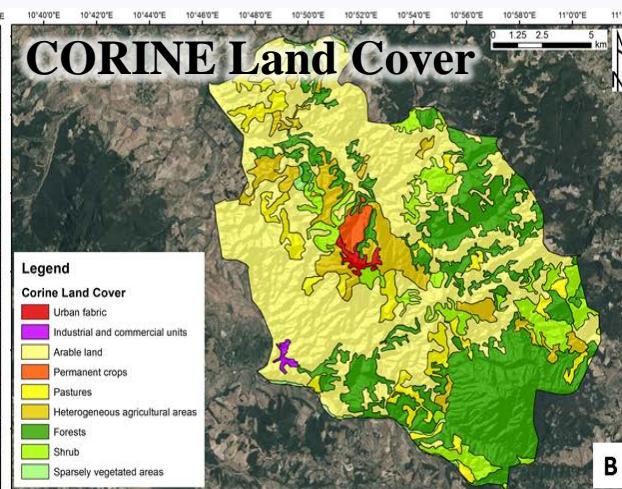
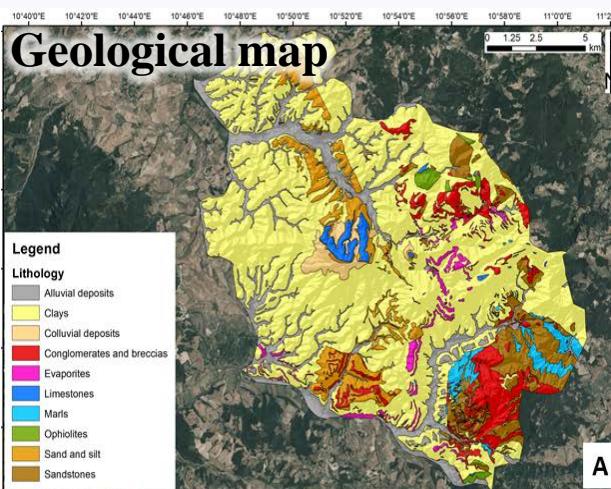
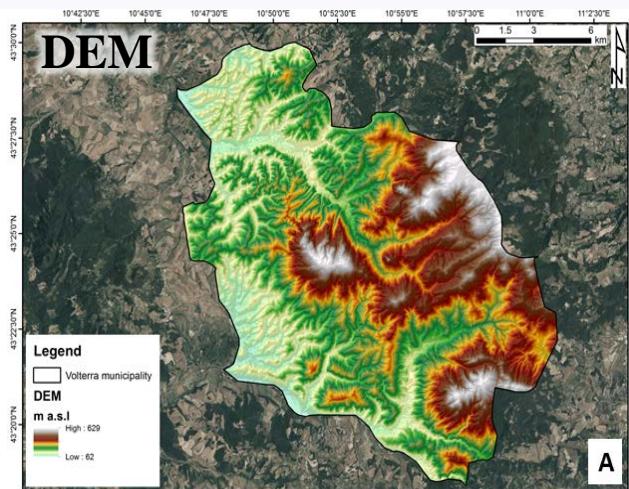


## Geodatabase and Susceptibility Analysis

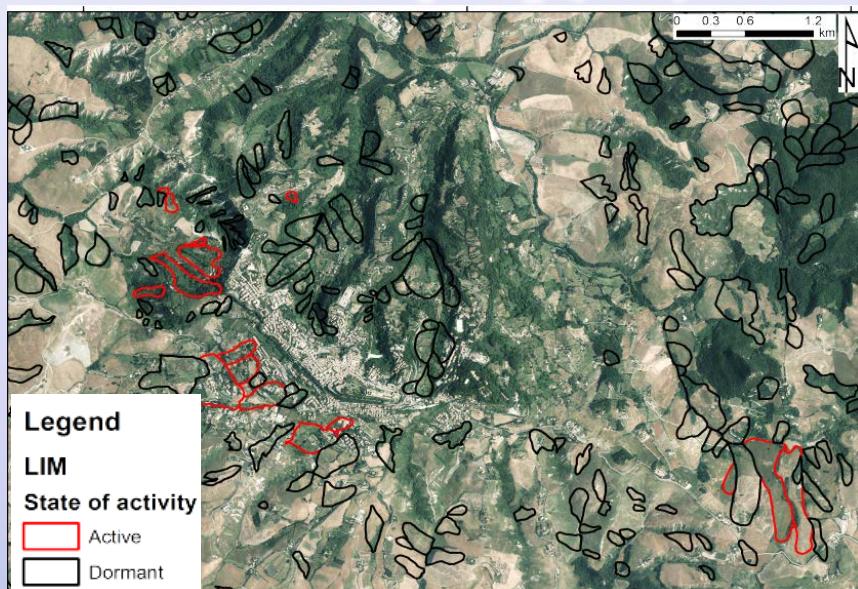


# Geodatabase

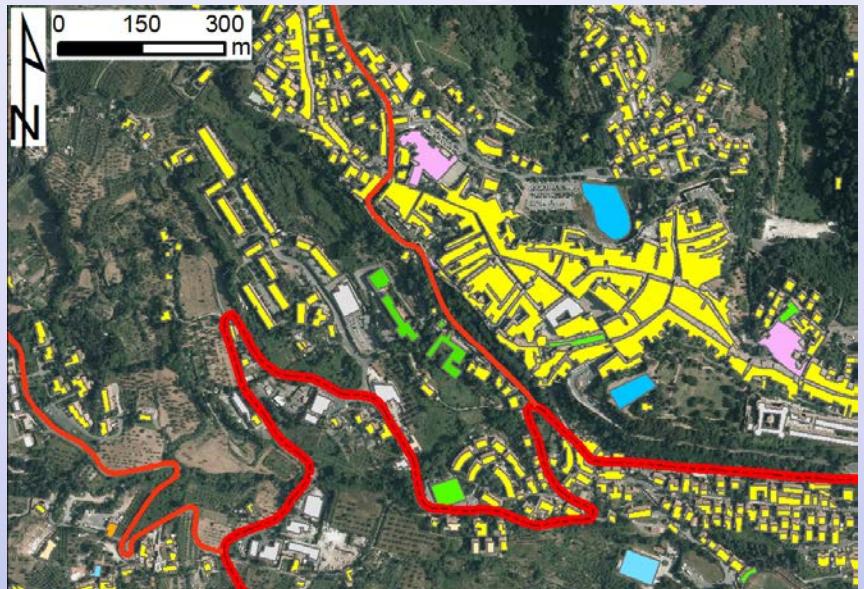
## Volterra



**Landslide Inventory Map (LIM)**



**Elements at risk catalogue**



# Landslide Susceptibility Map

## Volterra

Pixel based → LAND-SE

Geosci. Model Dev., 9, 3533–3543, 2016  
www.geosci-model-dev.net/9/3533/2016/  
doi:10.5194/gmd-9-3533-2016  
© Author(s) 2016. CC Attribution 3.0 License.



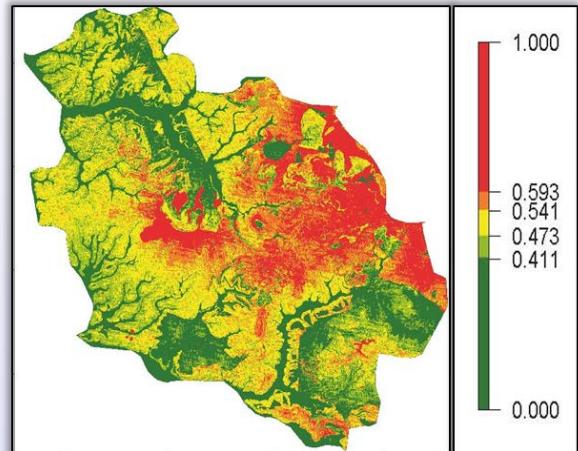
Geoscientific  
Model Development  
Open Access  
EGU

**LAND-SE: a software for statistically based landslide susceptibility zonation, version 1.0**

Mauro Rossi and Paola Reichenbach

CNR IRPI, via Madonna Alta 126, 06128 Perugia, Italy

Susceptibility maps



Polygon based → r.slopeunits

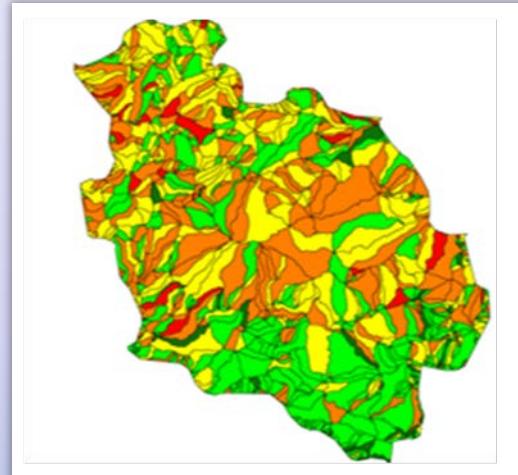
Geosci. Model Dev., 9, 3975–3991, 2016  
www.geosci-model-dev.net/9/3975/2016/  
doi:10.5194/gmd-9-3975-2016  
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Geoscientific  
Model Development  
Open Access  
EGU

**Automatic delineation of geomorphological slope units with r.slopeunits v1.0 and their optimization for landslide susceptibility modeling**

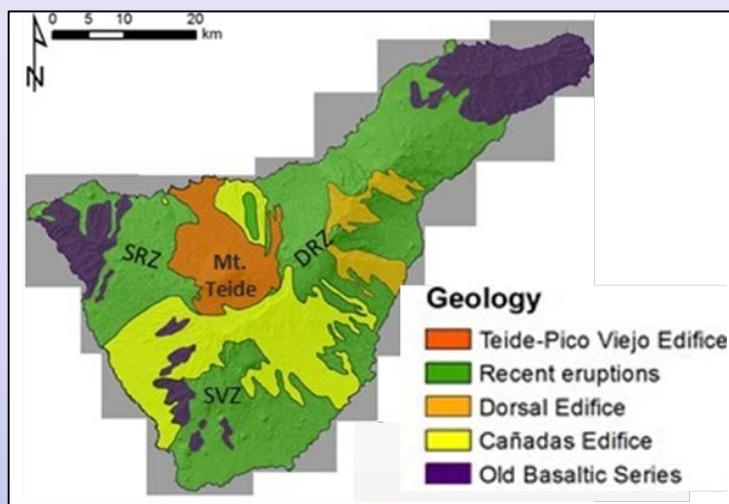
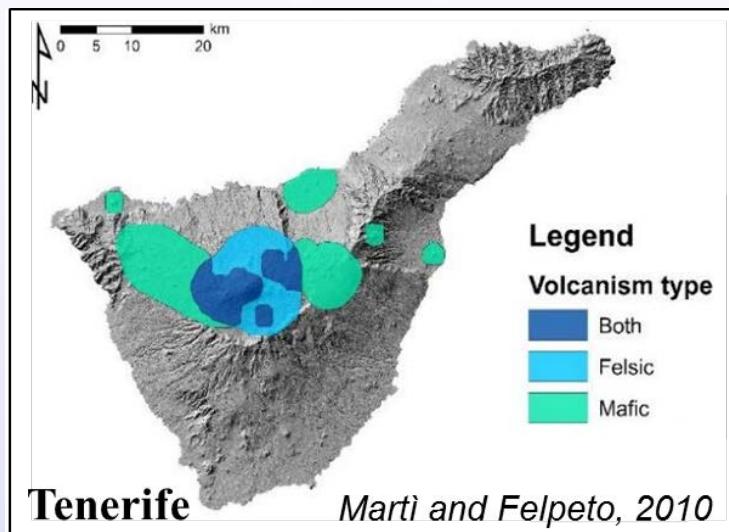
Massimiliano Alvioli, Ivan Marchesini, Paola Reichenbach, Mauro Rossi, Francesca Ardizzone, Federica Fiorucci, and Fausto Guzzetti



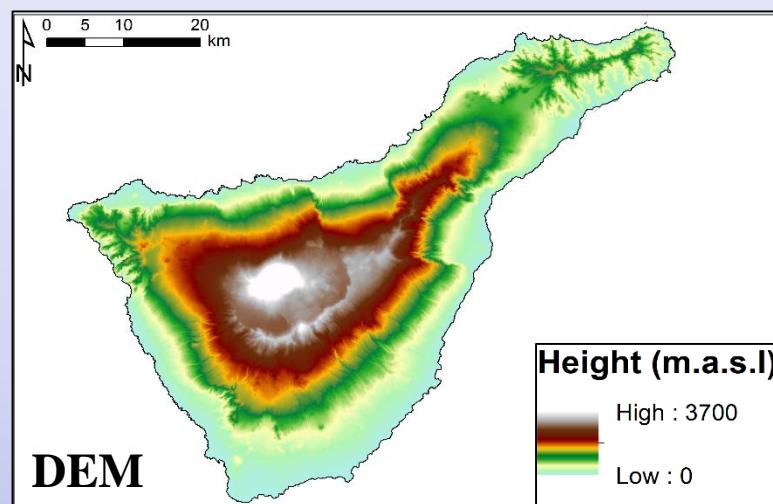
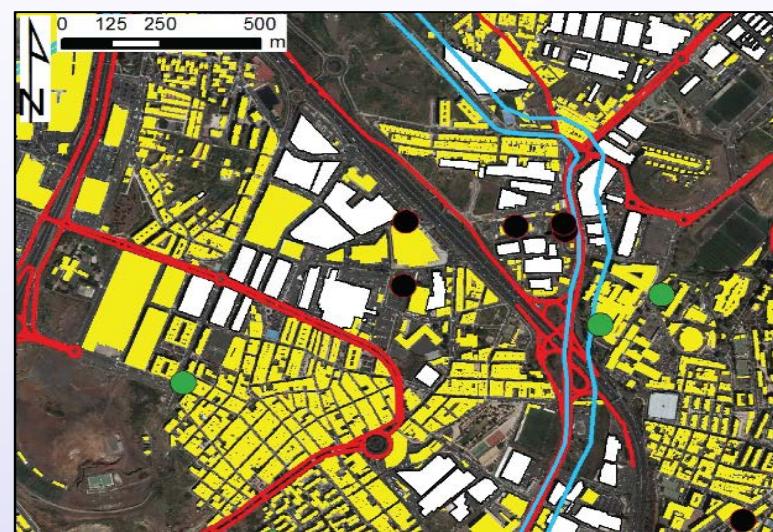
# Geodatabase

## Canary Islands

Volcanic susceptibility contours

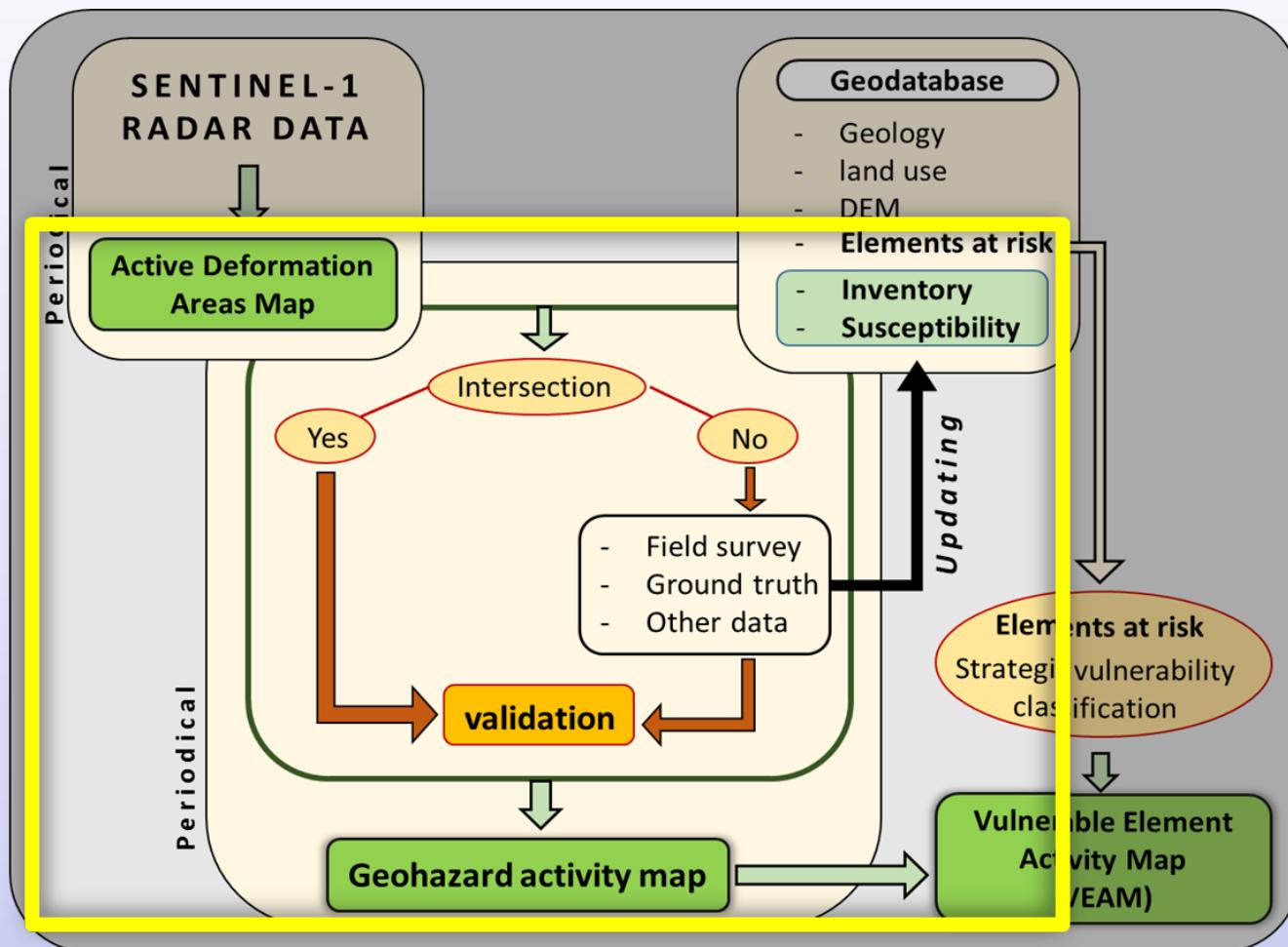


Elements at risk catalogue



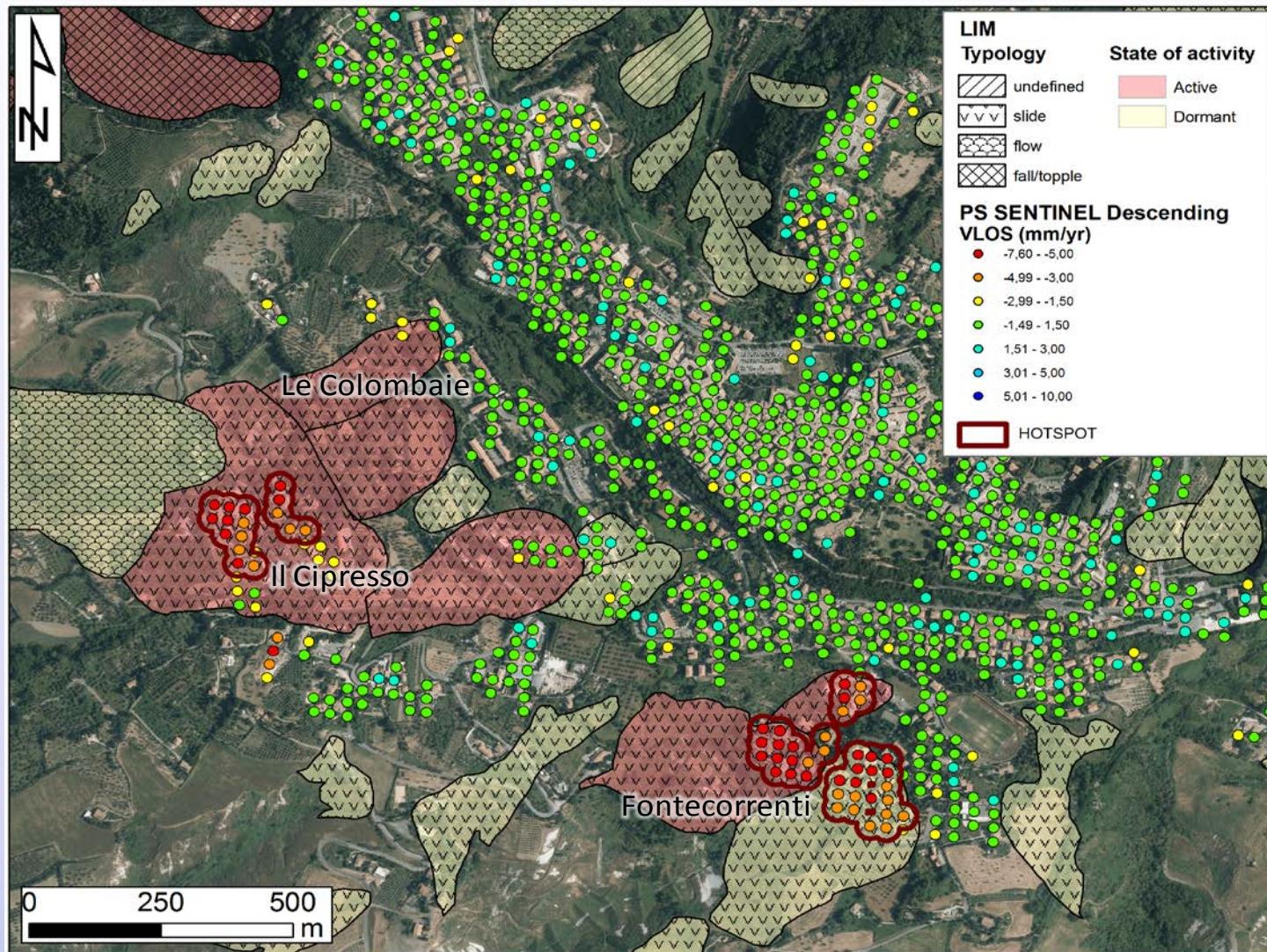
# Safety Project

## Geohazard Activity Map: HotSpots + Geohazard inventory



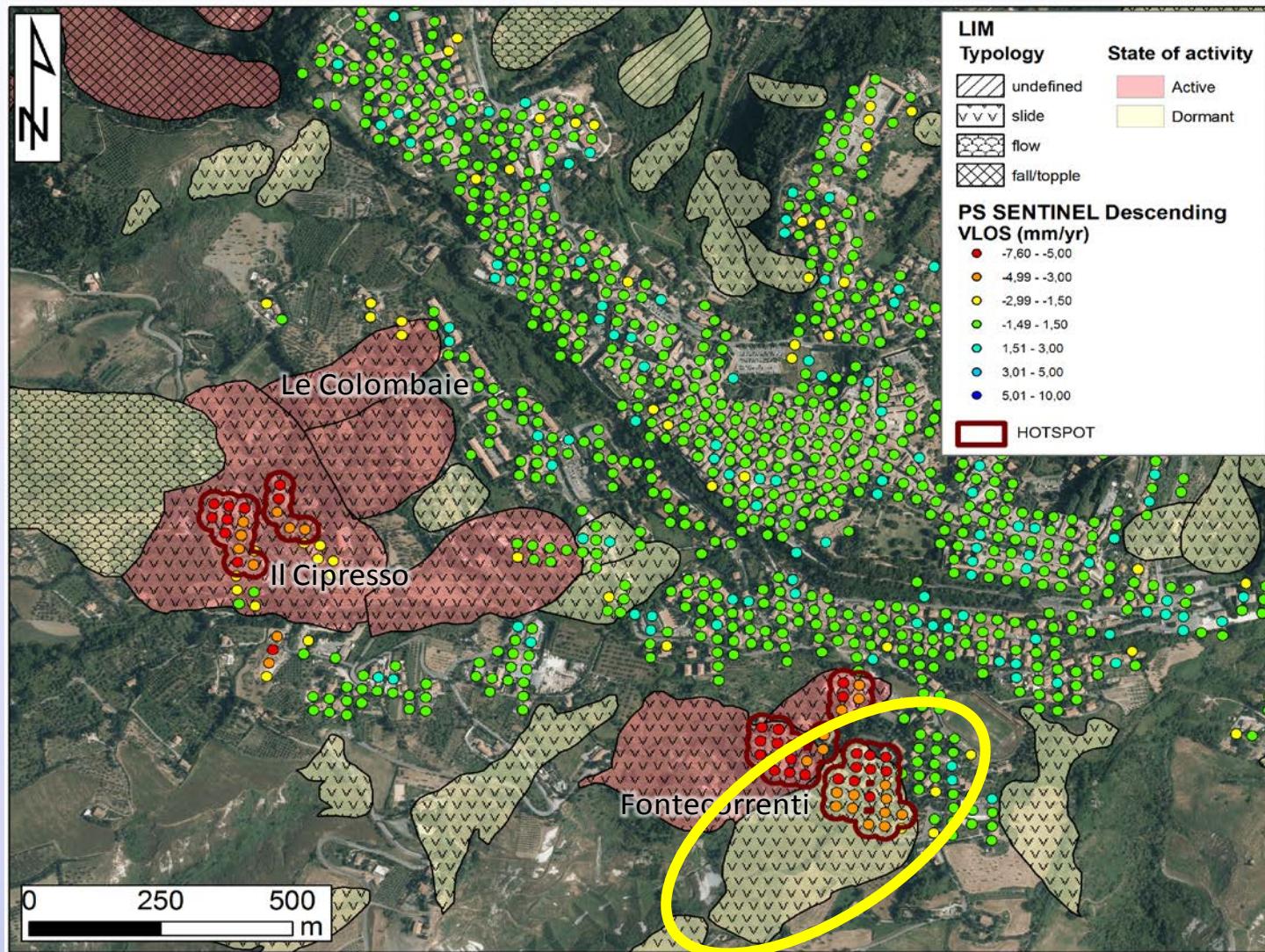
# Geohazard activity map: HotSpots + Landslide Inventory (LIM)

## Volterra - Landslide



# Geohazard activity map: HotSpots + Landslide Inventory (LIM)

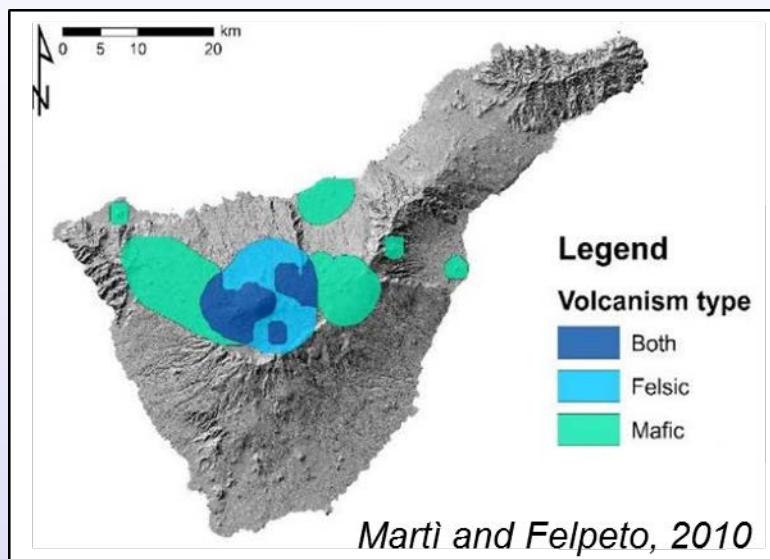
## Volterra - Landslide



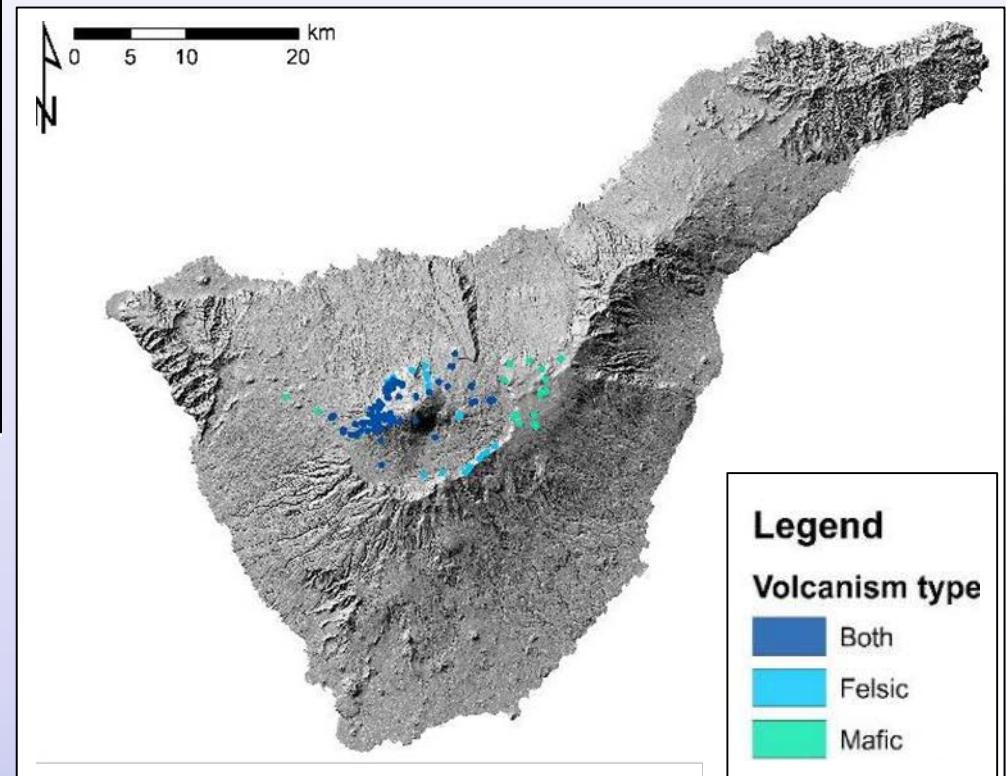
# Geohazard activity map: HotSpots + Vulcanic susceptibility

## Tenerife - Vulcanic

Spatial probability of hosting a volcanic vent



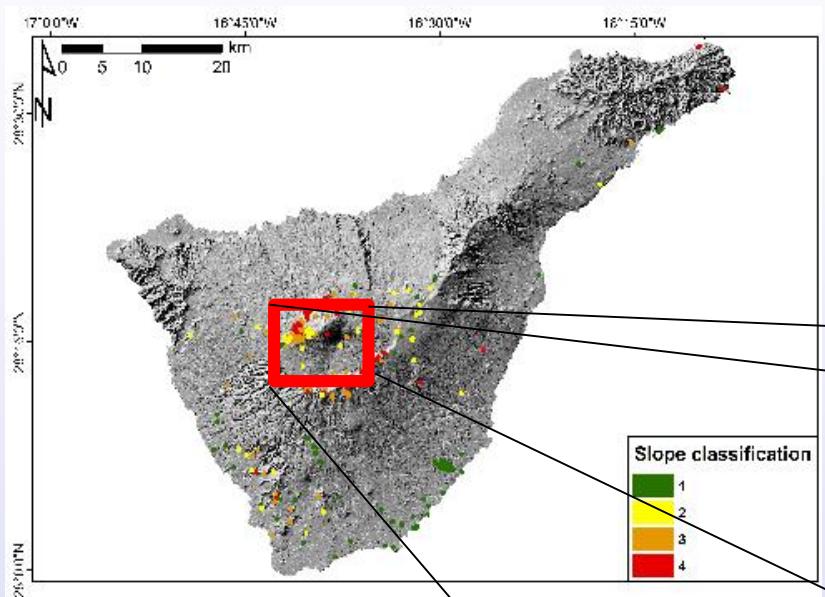
Geohazard Activity Map



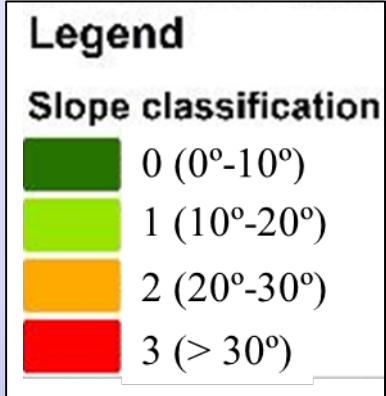
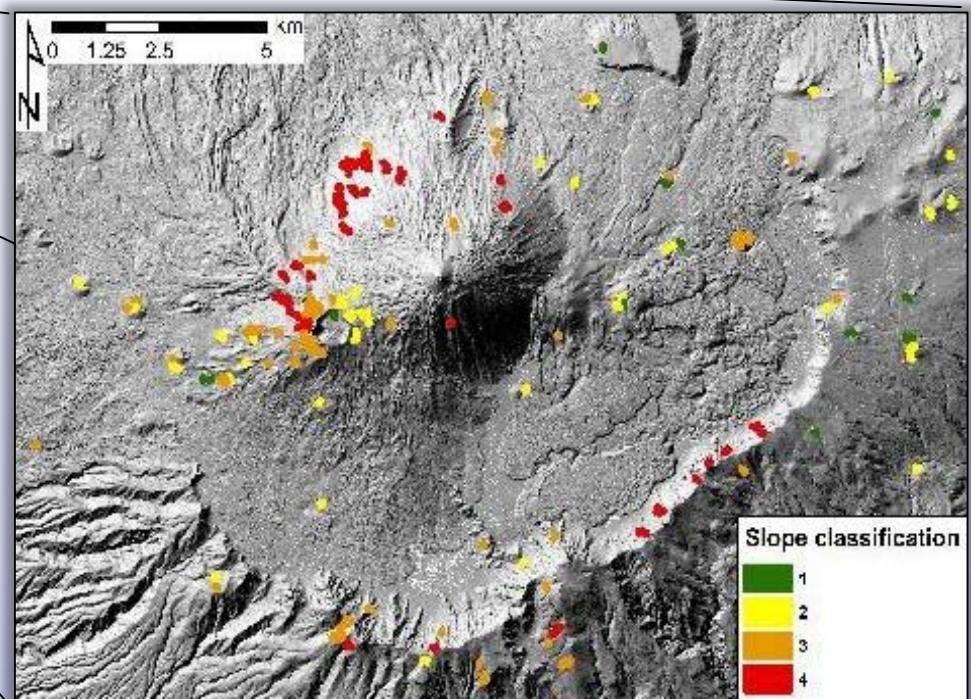
**Legend**  
**Volcanism type**

Volcanism type	Color
Both	Dark Blue
Felsic	Cyan
Mafic	Light Green

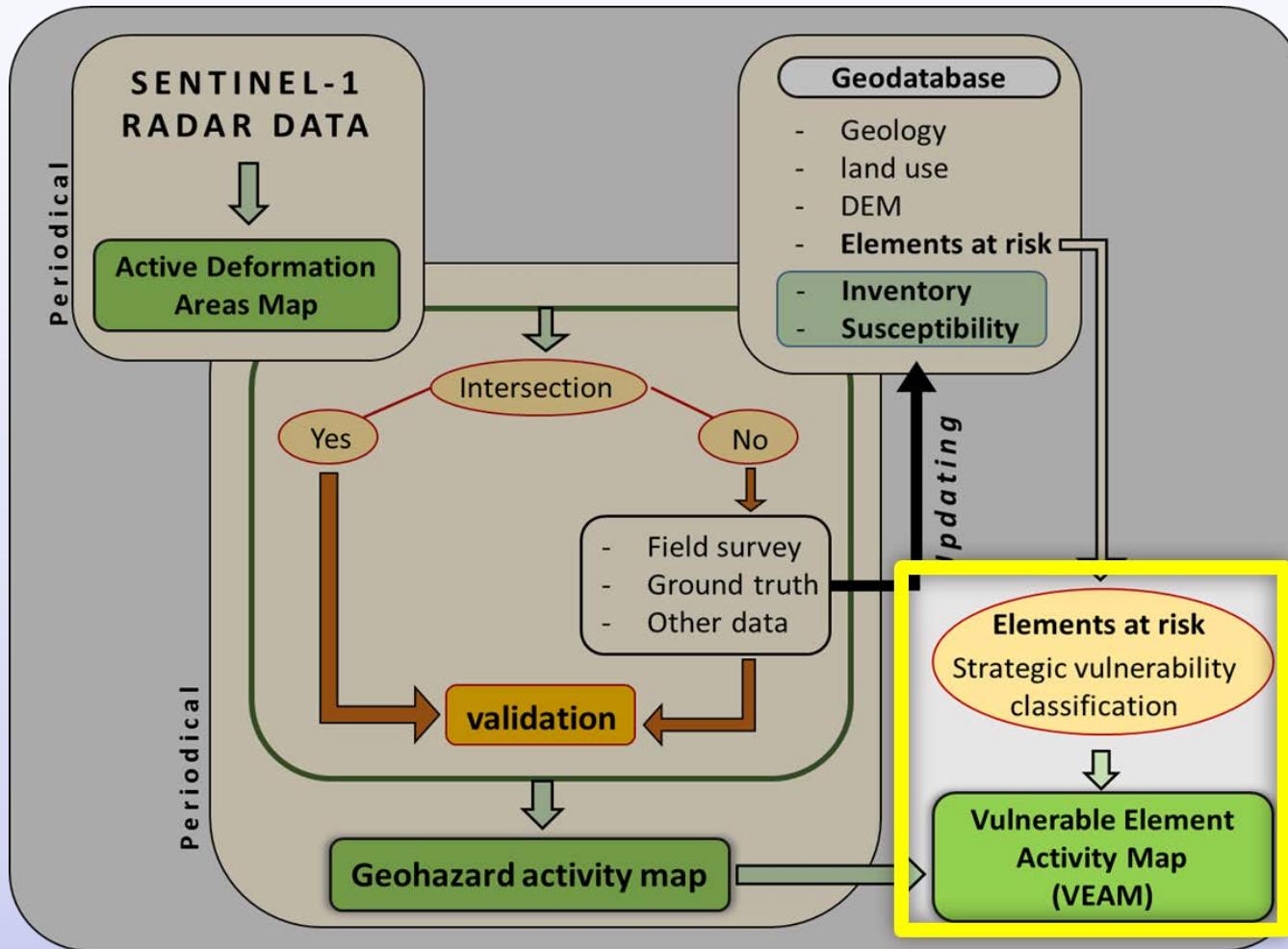
# Geohazard activity map:

  
*HotSpots + Slope classification*  
**Tenerife - Landslide**

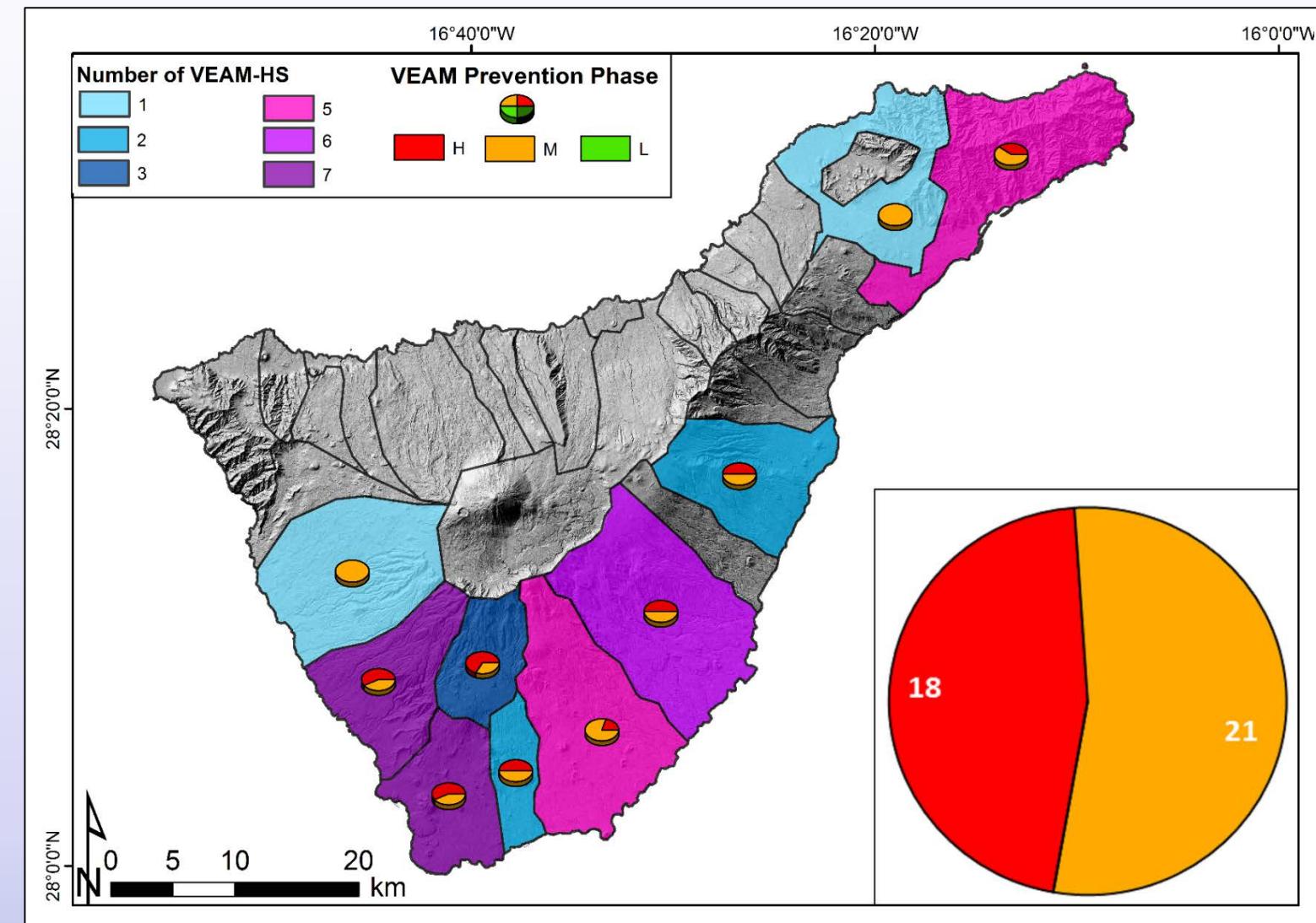
Teide and Pico Viejo



## Vulnerable Element Activity Map: HotSpots map + Vulnerability map



# Vulnerable Element Activity Map: VEAM - Prevention

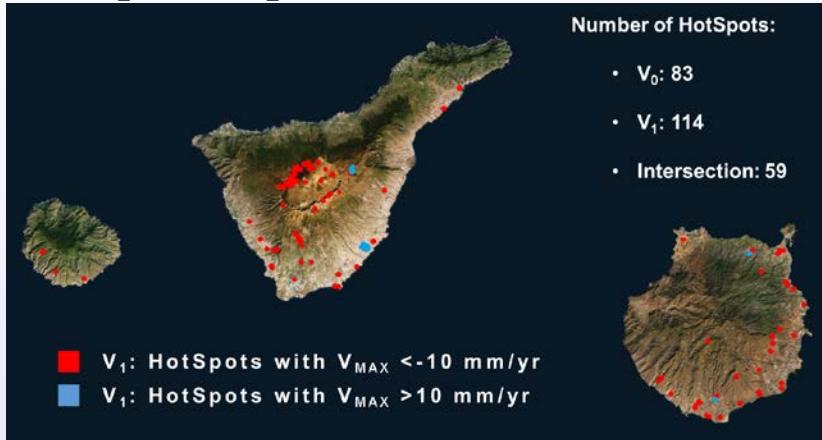


# Summary &... work in progress

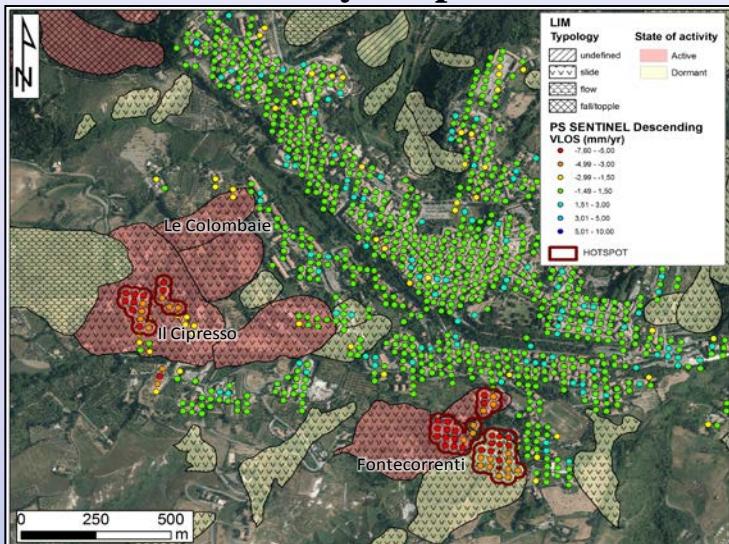
## Deformation Activity Map



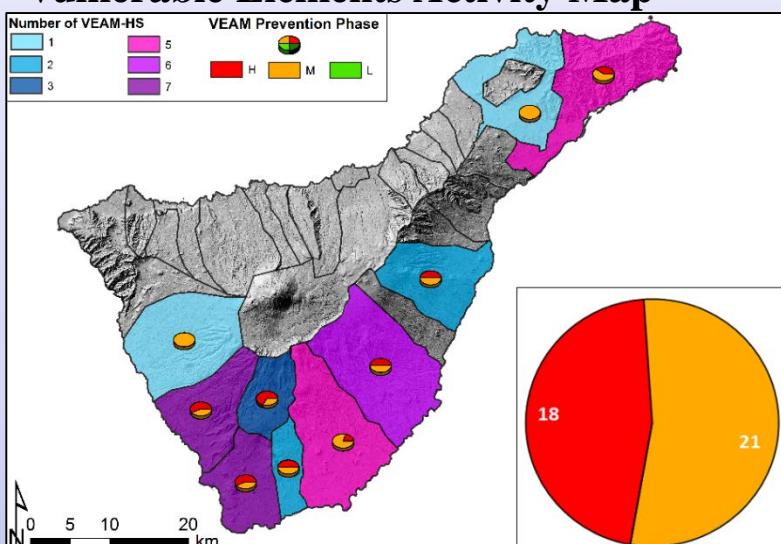
## HotSpots Map



## Geohazard Activity Map



## Vulnerable Elements Activity Map





Contact: Anna Barra, E-mail: anna.barra@cttc.cat, Tel.: (+34) 93 645 2900

## SAFETY TRAINING

- 27 – 28 November 2017
- Escuela Nacional de Protección Civil,  
Madrid (Spain)

## SAFETY WORKSHOP

- 29 November 2017
- Instituto Geográfico Nacional,  
Madrid (Spain)

### Paper under preparation:

Barra, A., Solari, L., Bejar, M., Monserrat, M., Bianchini, S., Herrera, G., Crosetto, M., González-Alonso, E., Mateos, R. M.. Geohazard activity map generation based on Sentinel 1 images



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*Thanks for your kind attention!*





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- Free fees

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# Safety training: Sentinel for Geohazards regional monitoring and forecasting

## Context and overview

The main objective of the Safety project is providing Civil Protection Authorities (CPAs) with the capability of periodically evaluating and assessing the potential impact of geohazards (volcanic activity, earthquakes, landslides and subsidence) on urban areas. This goal includes the implementation of a procedure involving new free accessible tools and methods that can produce periodically updated geohazard activity maps and impact assessment maps on infrastructure networks and built-up areas.

The produced maps are based on deformation activity maps derived from Satellite SAR interferometry techniques (InSAR), like Persistent Scatterer Interferometry (PSI). The PSI based deformation activity maps are usually not a standard type of input for CPAs. For this reason, a proper interpretation requires a full understanding of the whole production process, as well as a well understanding of how must be used. Moreover, its integration with different layers, like geohazard inventories or critical infrastructures, provides the capability of generating periodically geohazard activity maps and vulnerability elements at risk. The main goal of the training is to help the potential final users of the Safety products with the knowledge to properly interpret and use them.

## Audience

The main target group of the training is represented by Civil Protection Authorities technicians of the different EU countries which deals with geohazard maps in prevention activities. This group will have priority during the inscription period. It is also expected the attendance of different organizations like geological surveys that usually works with regional and national authorities.

## Course material

Copies of the presentations and other materials presented during the course.

## Modules

- Basic introduction to InSAR and PSI.
- Discussion of some key aspects of PSI: main PSI features, e.g. Persistent Scatterers, Line-of-sight, linear model, etc.; main advantages and limitations of PSI data; hints to exploit the data; examples and counter-examples.
- Generation and use of the deformation activity maps: main procedure; hints for interpretation and discussion of the two test sites of the project.
- Generation and use of the susceptibility maps: main procedure, hints for interpretation, discussion of the two test sites of the project.
- Generation and use of the geohazard activity maps: main procedure; hints for interpretation and discussion of the two test sites of the project.
- Generation and use of the vulnerability elements at risk maps: procedure; hints for interpretation and discussion of the two test sites of the project.

## Lecturers

The lectures will be delivered by experts of the Safety Consortium, with long experience in the different fields covered by project: SAR remote sensing and geohazard mapping and monitoring. The Safety Consortium is formed by seven independent partners: the Technological Centre of Telecommunications of Catalonia (CTTC), the Instituto Geológico Minero de España (IGME), the Università di Firenze (UniFi), the Consiglio Nazionale delle Ricerche (CNR), Centro Nacional de Información Geográfica and the Instituto Geográfico Nacional CNIG (CNIG-IGN) and the Italian and the Canarian CPAs (IDCP and CDCP).

### Course details:

Monday – Tuesday  
27 – 28 November 2017

### Venue:

Escuela Nacional de Protección Civil  
Autovía A-3 Madrid-Valencia Km. 19  
Camino Salmedina - 28529 Rivas-Vaciamadrid, Madrid (España)

### Language of the course:

English

### Contact:

Anna Barra  
E-mail: anna.barra@cttc.cat  
Tel.: (+34) 93 645 2900

### Training fees:

Free

### Organizers:

