The U-Geohaz project: Sentinel-1 to support geohazards early warning systems and impact assessment

Oriol Monserrat[1], **Anna Barra**[1],
Gerardo Herrera, Lorenzo Solari, Elena González-Alonso, Marta Béjar-Pizarro, Silvia Bianchini, Roberto Sarro, Anselmo Fernández García, Paola Reichenbach, Michele Crosetto, Filippo Catani.

[1]Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/CERCA), Division of Geomatics, Barcelona, Spain

UCPM-2017-PP-AG – 783169 U-Geohaz

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

EGU 2019, Vienna, 10 April 2019

Centre Tecnològic de Telecomunicacions de Catalunya

U-GEOHAZ Geohazard impact assessment for urban areas

UCPM-2017-PP-AG – 783169 U-Geohaz

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

01/01/2018 – 31/12/2019

- **Policy area:** Prevention
- **Priority covered:** Projects focusing on improving urban resilience by addressing cascade effects and the resilience of urban infrastructure.
- **Total Cost:** 989,504.16 € (EU contribution = 742,128.13)
- **Project Coordinator:** Oriol Monserrat, Centre Tecnològic de Telecomunicacions de Catalunya (CTTC)

https://u-geohaz.cttc.cat/

CTTC Centre Tecnològic de Telecomunicacions de Catalunya

U-GEOHAZ Geohazard impact assessment for urban areas

https://u-geohaz.cttc.cat/

MAIN TARGET

Providing maps, based on **Sentinel-1 6-days ground deformations monitoring**, to assess continuously the **potential impact of geohazard** activity to urban areas and critical infrastructures and to be used as key inputs to **support early warning**.

Sentinel-1

- Regular worldwide acquisition
- Regional Scale
- High temporal sampling (6/12 days)
- Free data

CTTC Centre Tecnològic de Telecomunicacions de Catalunya

U-GEOHAZ Geohazard impact assessment for urban areas

https://u-geohaz.cttc.cat/

MAIN TARGET

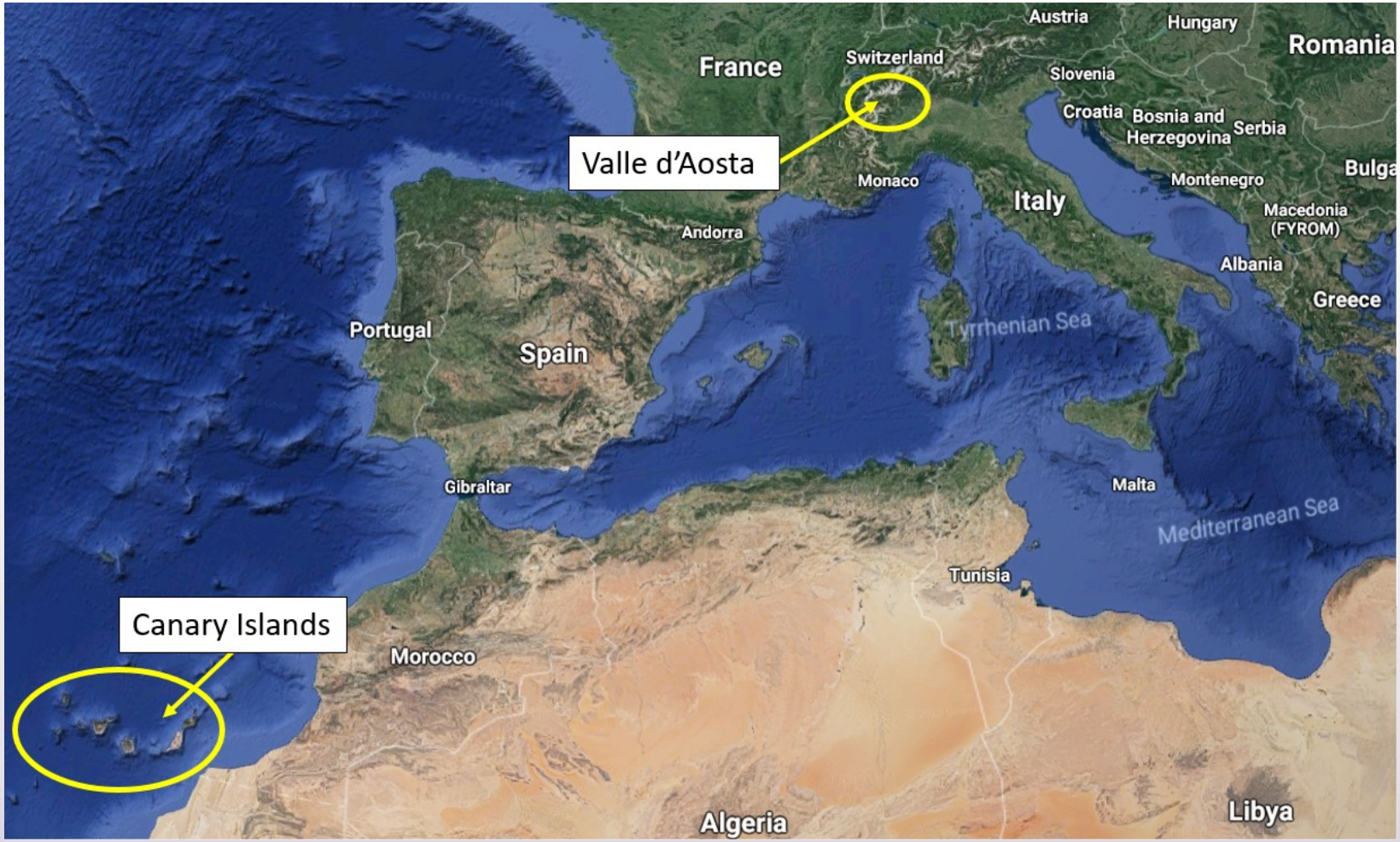
Providing maps, based on **Sentinel-1 6-days ground deformations monitoring**, to assess continuously the **potential impact of geohazard** activity to urban areas and critical infrastructures and to be used as key inputs to **support early warning**.

Sentinel-1

- Regular worldwide acquisition
- Regional Scale
- High temporal sampling (6/12 days)
- Free data

Centre
Tecnològic
de Telecomunicacions
de Catalunya

U-Geohaz test sites



Centre
Tecnològic
de Telecomunicacions
de Catalunya

U-Geohaz test sites

U-Geohaz Consortium

Number of beneficiaries: 18
11 countries - 12 Geological Surveys - 3 CPAs

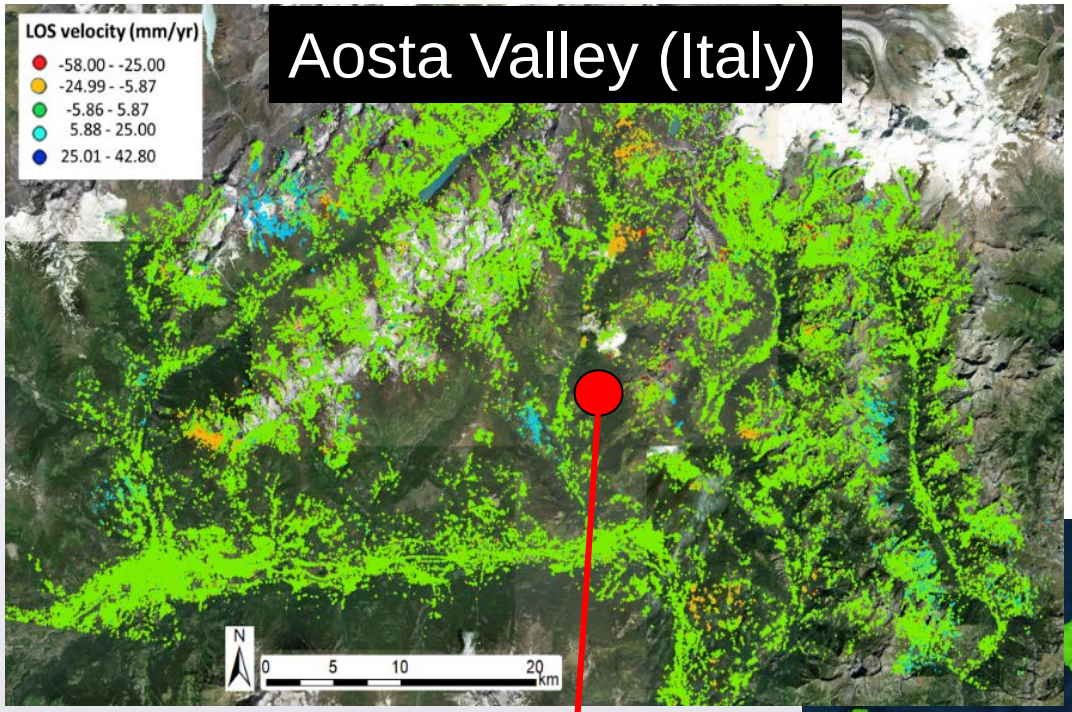
CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

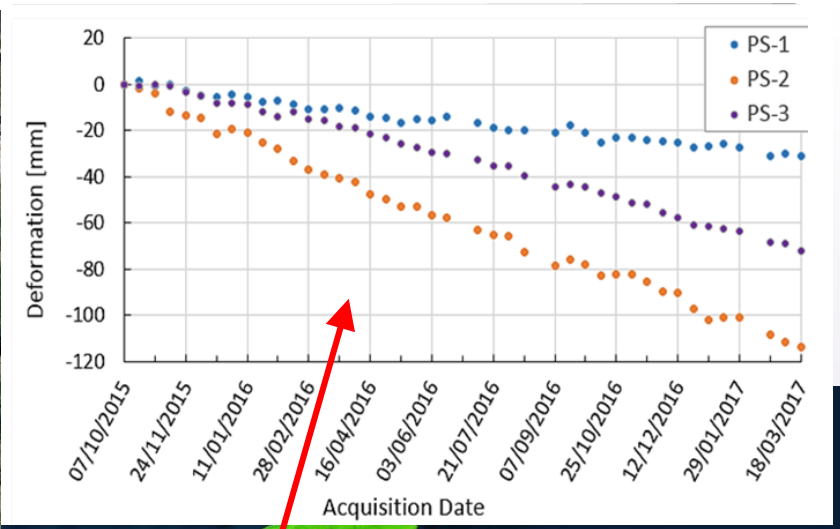
U-GEOHAZ

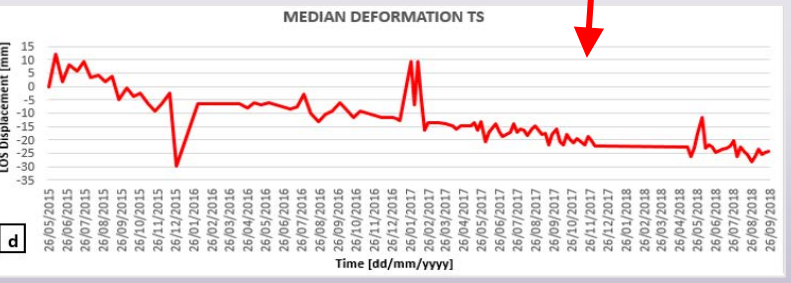
Geohazard impact assessment for urban areas

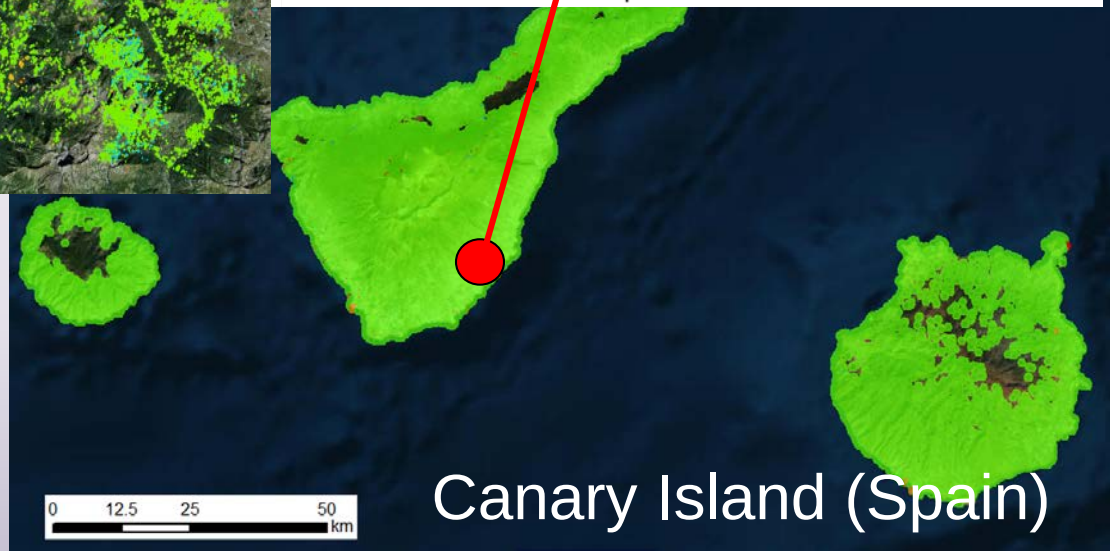
UCPM-2017-PP-AG – 783169 U-Geohaz

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







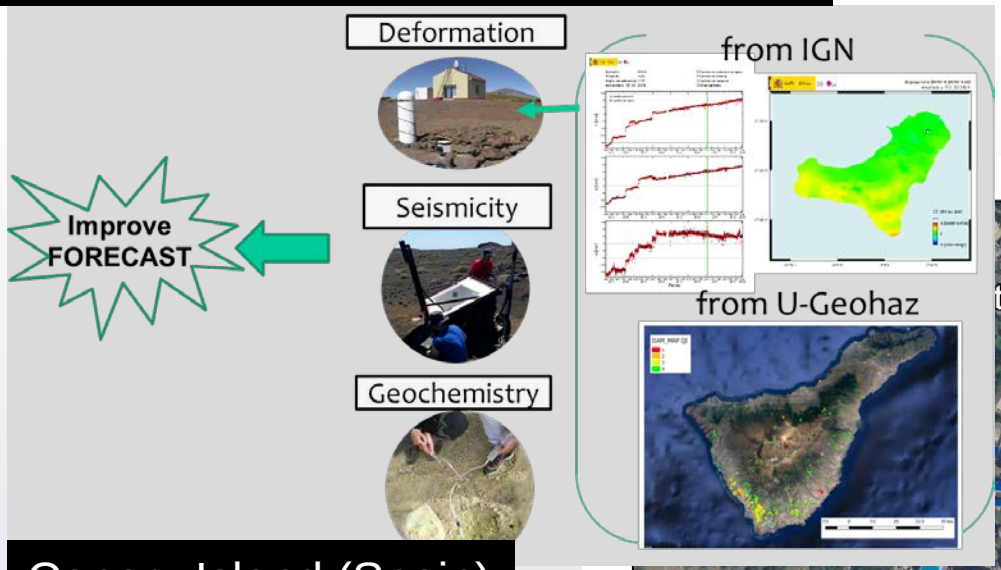


CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

U-GEOHAZ
Geohazard impact assessment for urban areas

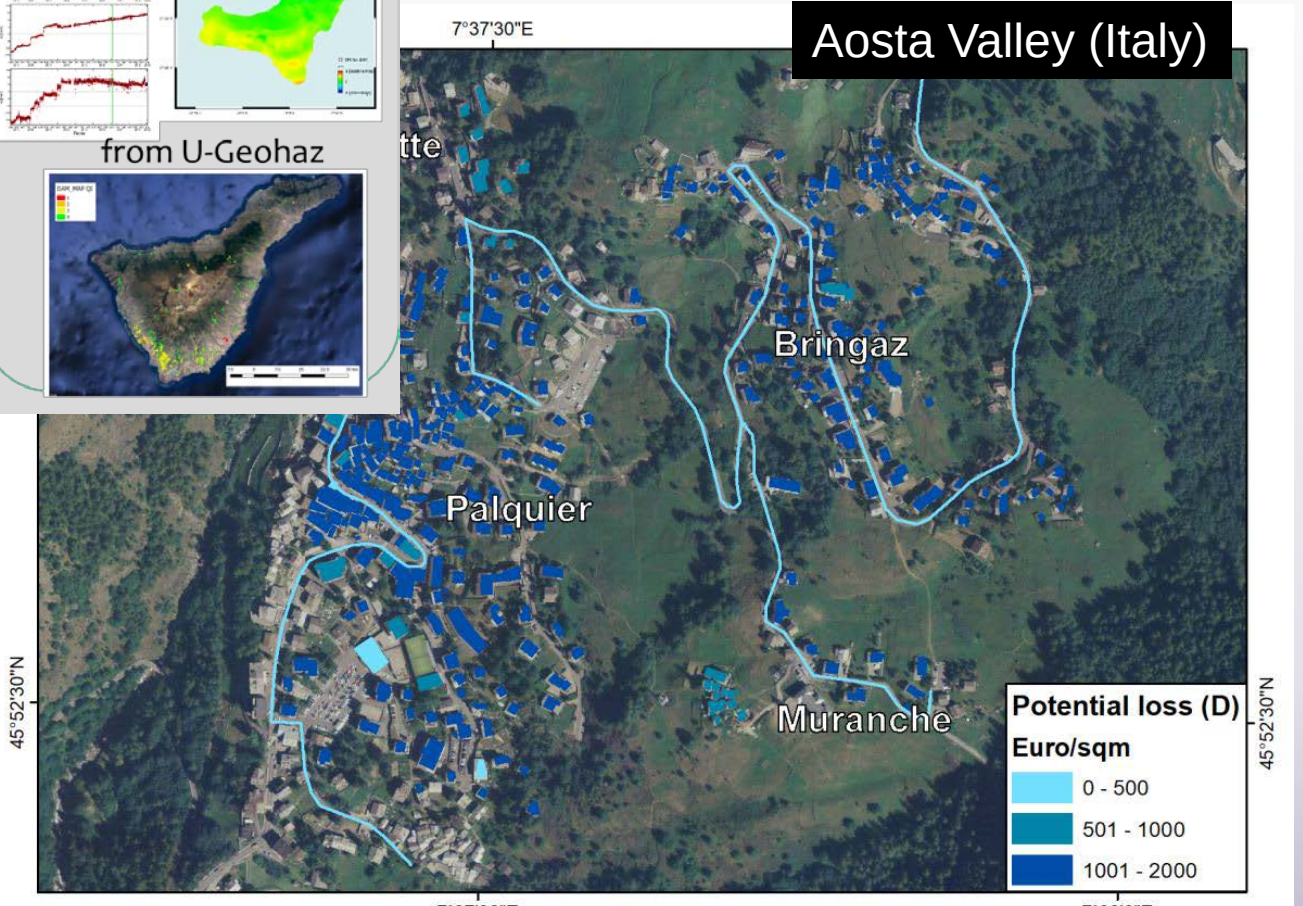
Deformation + other data → potential impact, early warning

Volcano Monitoring System and Alert



Canary Island (Spain)

Aosta Valley (Italy)



CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

Thanks for your kind attention!

By U-GEOHAZ team

CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

U-Geohaz

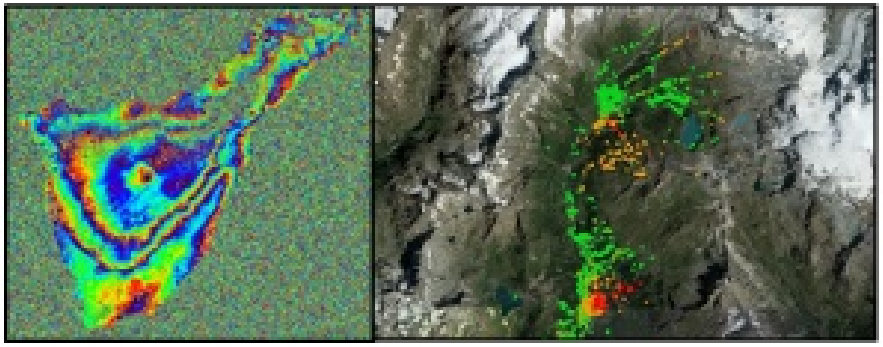
MAIN MENU

About U-Geohaz

Geohazard impact assessment for urban areas

Test-sites

Results



Centre Tecnològic de Telecomunicacions de Catalunya

U-GEOHAZ Geohazard impact assessment for urban areas

UCPM-2017-PP-AG – 783169 U-Geohaz

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

Back to Main menu

01/01/2018 – 31/12/2019

- **Policy area:** Prevention
- **Priority covered:** Projects focusing on improving urban resilience by addressing cascade effects and the resilience of urban infrastructure.
- **Total Cost:** 989,504.16 € (EU contribution = 742,128.13)
- **Project Coordinator:** Oriol Monserrat, Centre Tecnològic de Telecomunicacions de Catalunya (CTTC)

https://u-geohaz.cttc.cat/

https://u-geohaz.cttc.cat/

Back to Main menu

MAIN TARGET

Providing maps, based on **Sentinel-1 6-days ground deformations monitoring**, to assess continuously the **potential impact of geohazard** activity to urban areas and critical infrastructures and to be used as key inputs to **support early warning**.

Sentinel-1

- Regular worldwide acquisition
- Regional Scale
- High temporal sampling (6/12 days)
- Free data

U-Geohaz Consortium

Number of beneficiaries: 18
11 countries - 12 Geological surveys - 3 CPAs

U-Geohaz Background

Centre Tecnològic de Telecomunicacions de Catalunya

Safety

Sentinel-1 for Geohazard regional monitoring and forecasting

Back to Main menu

ECHO/SUB/2015/718679/Prev02-SAFETY

http://safety.cttc.cat/

01/01/2016 – 31/12/2017

U-Geohaz is the natural extension of the previous ECHO project Safety. U-Geohaz goals will be achieved by fully exploiting the results obtained in SAFETY. In particular, U-Geohaz aims to advance with respect to SAFETY. The project will provide tools to support early warning (EW) systems for landslides and rock-falls, and an EW system for volcanic geohazard.

See more about Safety

Main goals of U-Geohaz

U-Geohaz Background

Sentinel-1 for Geohazard regional monitoring and forecasting

ECHO/SUB/2015/718679/Prev02-SAFETY

http://safety.cttc.cat/

01/01/2016 – 31/12/2017

Main Target of Safety

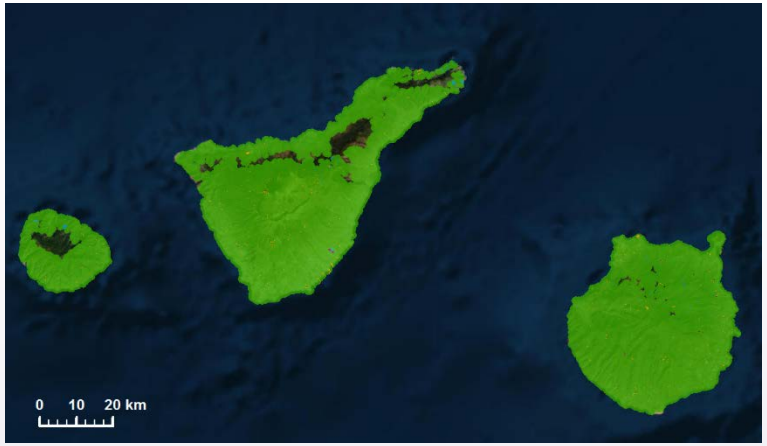
Developing and testing a procedure to provide Civil Protection Authorities (CPA) with the capability of periodically evaluating and assessing the potential impact of geohazards (volcanic activity, landslides and subsidence) on urban areas and infrastructures, over regional areas.

Safety Consortium

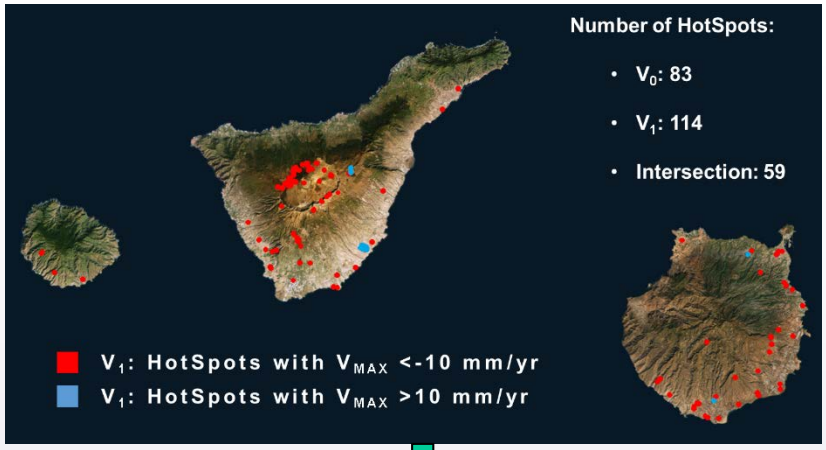
U-Geohaz Background

Safety main results

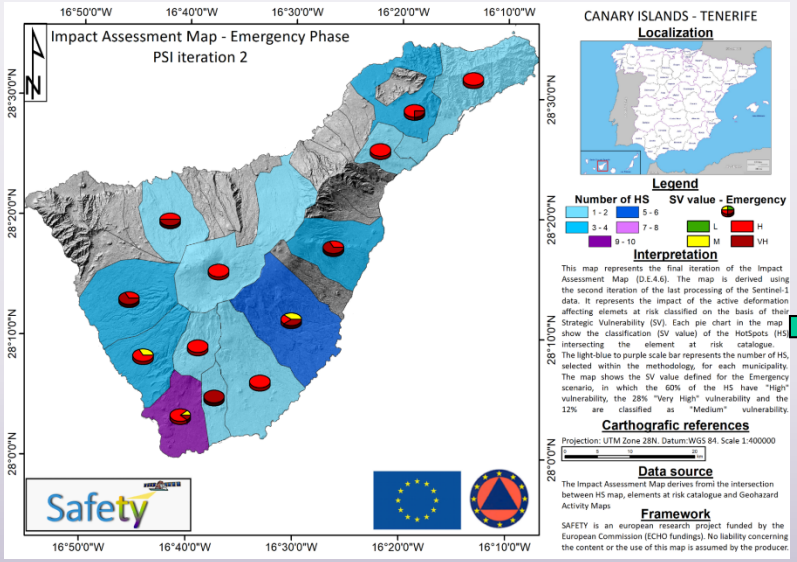
Deformation Activity Map



Active Deformation Areas map



Vulnerable Elements Activity Map



Barra A, Solari L, Béjar-Pizarro M, Monserrat O, ., ... & Moretti S. (2018). A Methodology to Detect and Update Active Deformation Areas Based on Sentinel-1 SAR Images. Remote Sens. 9:1002.

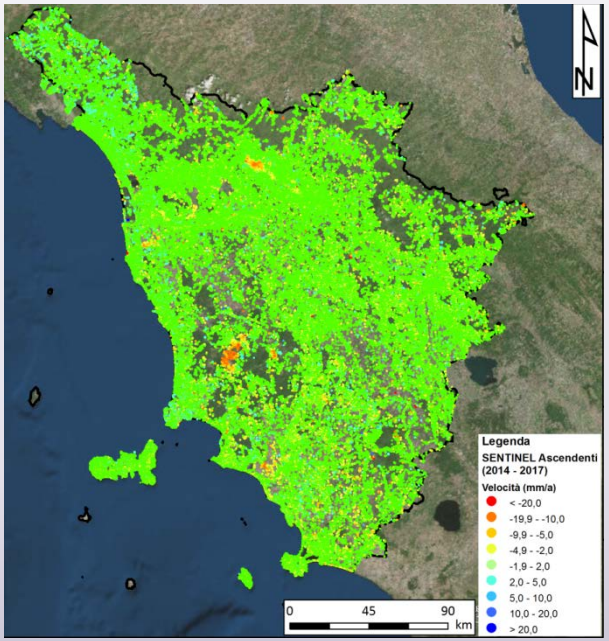
Solari, L., Barra, A., Herrera, G., Bianchini, S., Monserrat, O., Béjar-Pizarro, M., ... & Moretti, S. (2018). Fast detection of ground motions on vulnerable elements using Sentinel-1 InSAR data. Geomatics, Natural Hazards and Risk, 9(1), 152-174.

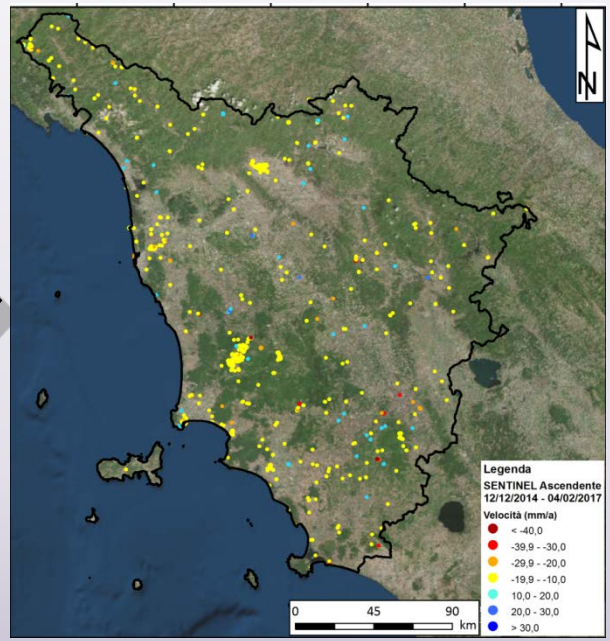
U-Geohaz Background

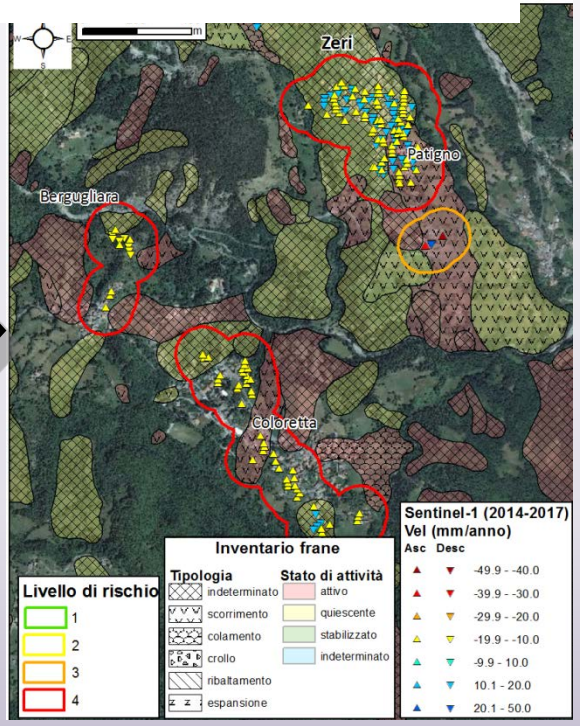
- The tools developed in Safety have been implemented in the Volcanic monitoring centre of the IGN, in charge of the Volcanic alerts in Spain.

- We have implemented the tools at the Geological Survey of Spain which has a strong interaction with Spanish CPA for landslide geohazard purposes.

- UNIFI is developing a project for the Italian CPA on Tuscany Region (Italy) based on the SAFETY approach.







Why U-Geohaz?
Goal 1

Back to Main menu

At the start of Safety:

- Sentinel-1 was not yet operational
- We had not experience with the Sentinel-1 data
- There were a lot of potentialities but also a lot of doubts

At the end of Safety:

- Sentinel-1 is fully operational
- The Sentinel-1 system have widened the range of applications of SAR interferometry.

→ from “measurement” to “monitoring”

U-Geohaz GOAL 1: to develope tools based on Sentinel-1 to support early warnings systems for landslides and volcanic activity. (WP2 and WP3)

How to reach goal 1?

U-Geohaz GOAL 1: to develope tools based on Sentinel-1 to support early warnings systems for landslides and volcanic activity. (WP2 and WP3)

- Implementing and test a procedure to fully exploit the 6 day repeatability of the Sentinel-1 constellation.

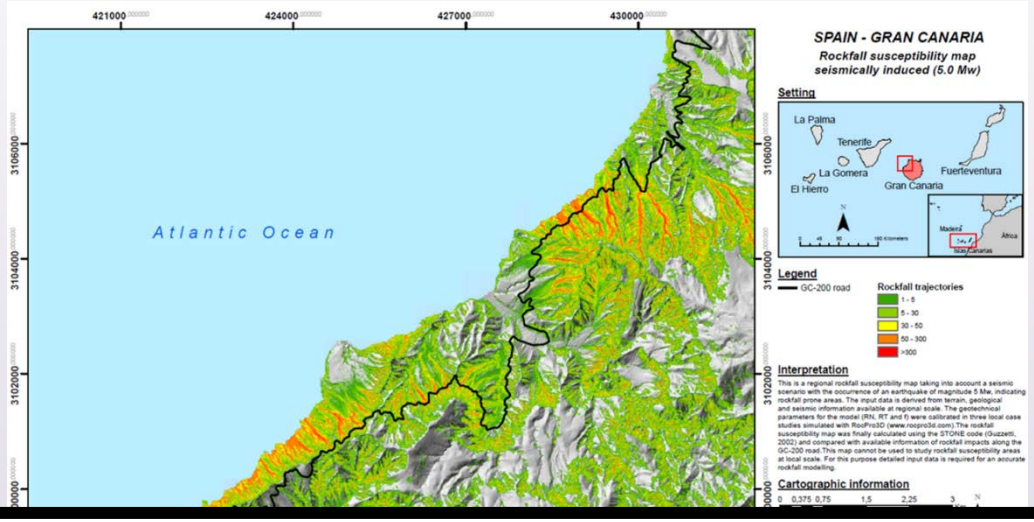
- Integrating these data with other existing data to continuously assess the potential impact of the landslide and volcanic activity.

Why U-Geohaz?

Goal 2

Safety included two main results in Rockslide applications:

- Tuning of existing free tools for susceptibility mapping and trajectory estimation.
- Implemented a protocol at Canary Island CP to collect key information for each event in order to improve the database in a reliable way.



U-Geohaz GOAL 2: to develope an early warning system for rock fall geohazard. (WP4)

How to reach goal 2?

U-Geohaz GOAL 2: to develope an Early warning system for rock fall geohazard. (WP4)

- Exploiting all the work done in Safety.
- Tailoring tools and methods developed in previous projects to address two key issues:
  - Improvement of the capability to recognize rockfall source areas.
  - Definition of empirical rainfall thresholds.

Why U-Geohaz?
Goal 3

- Safety aimed to implement the developed procedure at the CPA. But unfortunately, this was not fully achieved.

- One of the gaps detected by Safety project was related to the real capability of the CPAs to produce the developed products.

U-Geohaz GOAL 3: to strengthen the interaction between CPAs and Geological Surveys in Europe. with the aim of contributing to improve their cooperation. (WP5)

How to reach goal 3?

Back to Main menu

U-Geohaz GOAL 3: to strengthen the interaction between CPAs and Geological Surveys in Europe. with the aim of contributing to improve their cooperation. (WP5)

- To this purpose we have involved 12 geological surveys with direct relation with their corresponding CPAs.

- We are going to evaluate the integration of geohazard into urban planning to increase urban resilience in Europe.

- Provide a better understanding of the relations between GSs and the corresponding CPAs in the different European countries.

- Demonstrate the U-Geohaz products performance to the GSs and the CPAs from the participating countries.

Centre
Tecnològic
de Telecomunicacions
de Catalunya

U-Geohaz

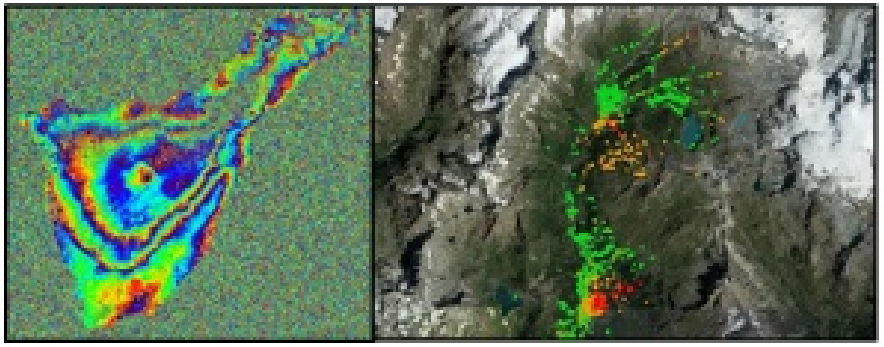
MAIN MENU

About U-Geohaz

Geohazard impact
assessment
for urban areas

Test-sites

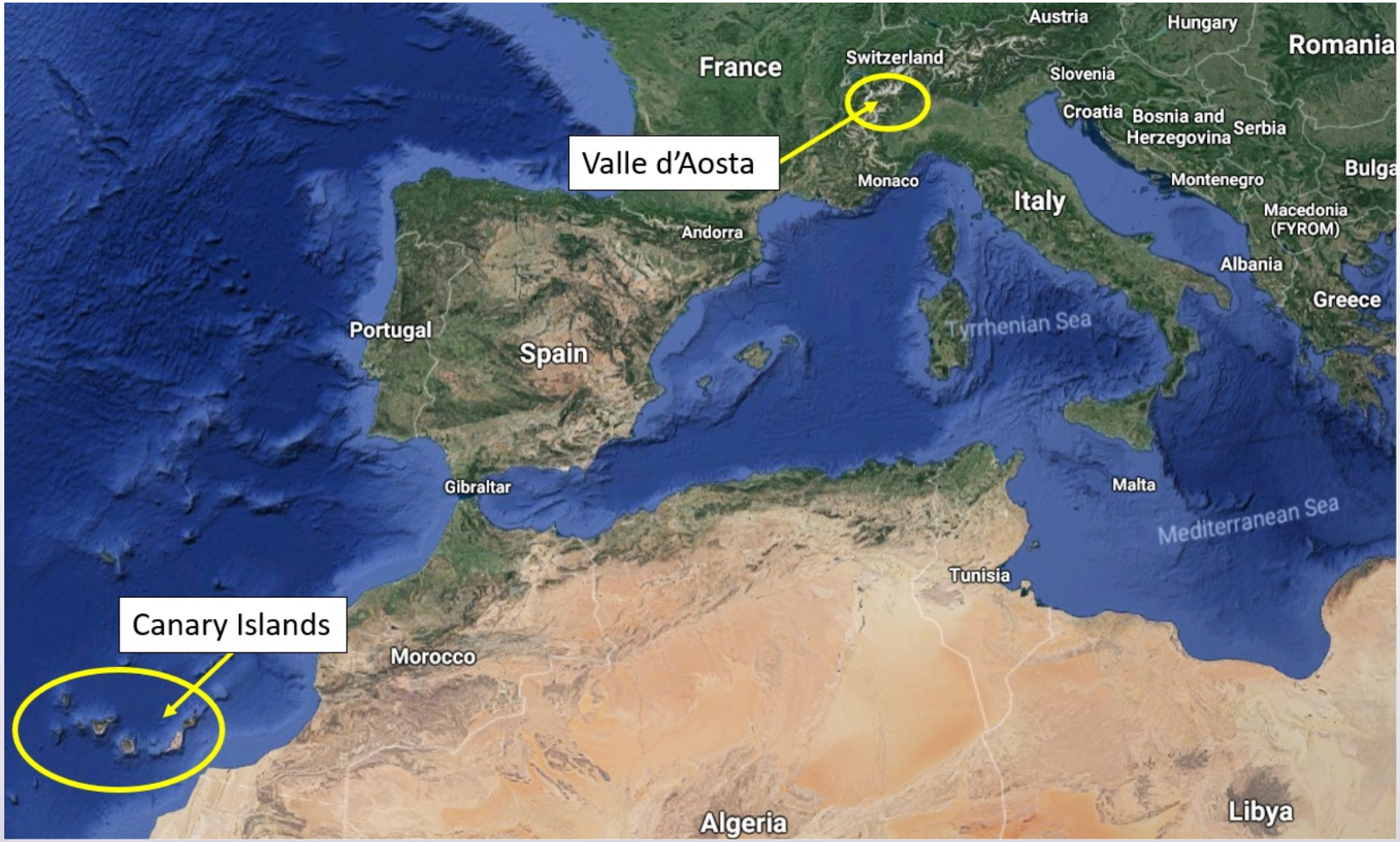
Results



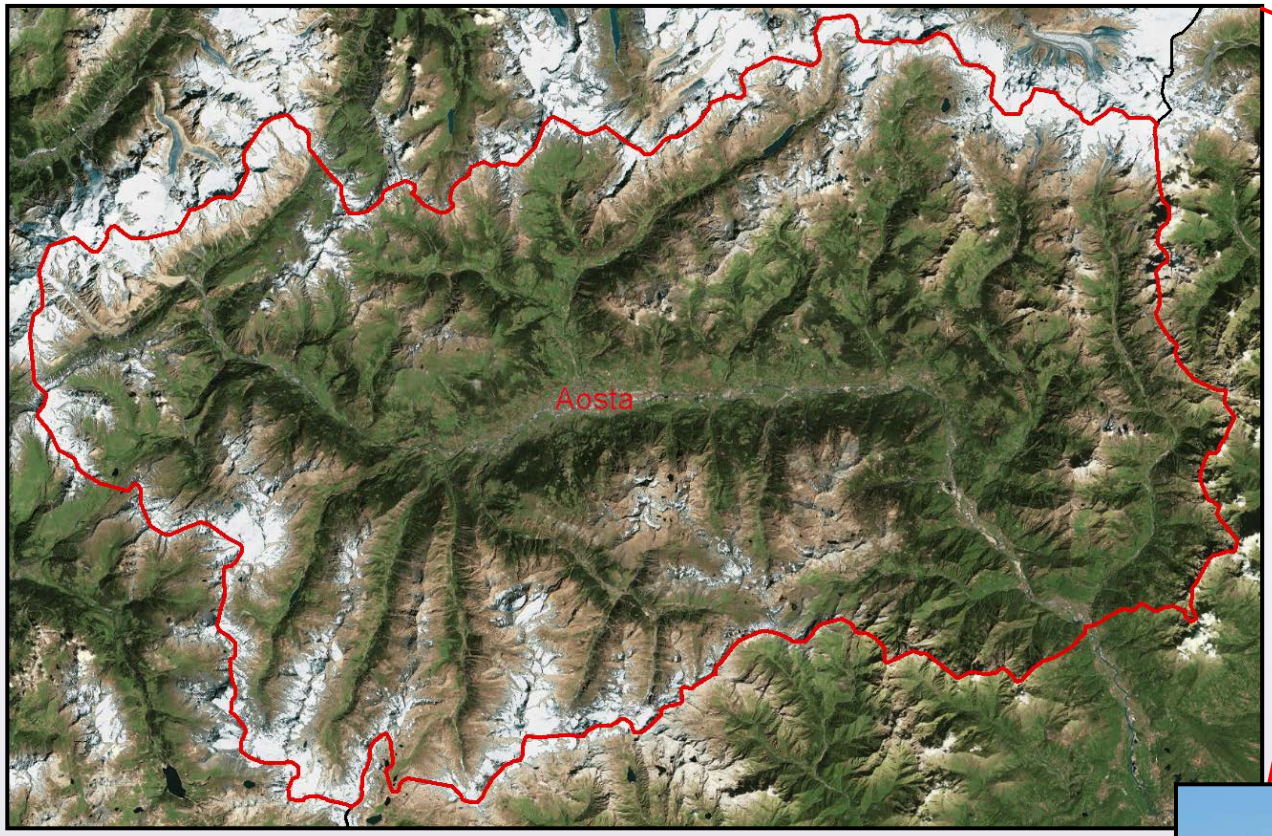
Centre
Tecnològic
de Telecomunicacions
de Catalunya

U-Geohaz test sites

Back to
Main menu



Test sites: Valle d'Aosta Region



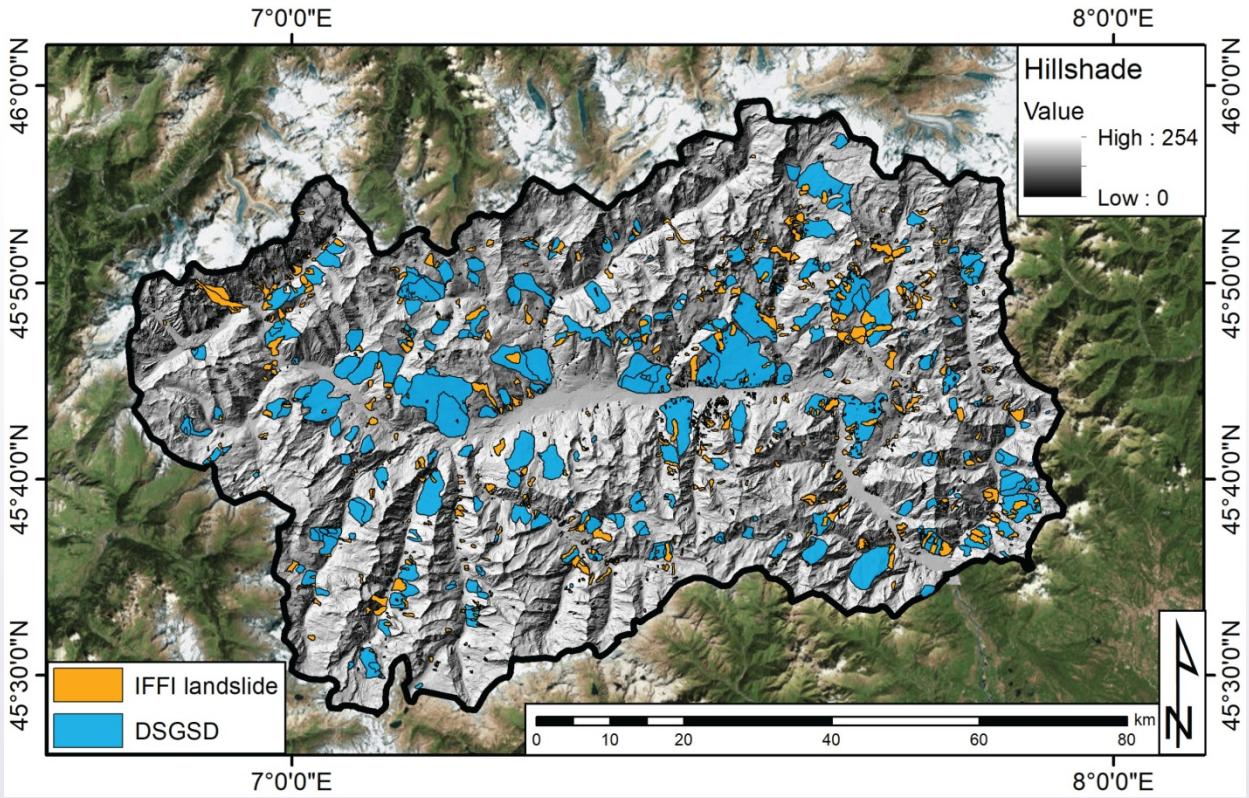
Surface = 3260 sqkm

Population = 126.687

Municipalities = 74

>50% of the territory is above 2000 m a.s.l.

Test sites: Valle d'Aosta Region
Landslide risk



"La Saxe" landslide

"Champlong" landslide

4400 landslides

134 landslides/100 sqkm

520 sqkm affected by landslides (16% of the total)

Rockfalls, complex and rotational landslides are common

Test sites: Canary Island Volcanic risk

The **volcanic risk assessment and monitoring activities** of Canary Islands, is assigned to the National Geographic Institute (Instituto Geográfico Nacional - IGN), which is also in charge of transferring information to the Civil Protection authorities in the country. The IGN Volcano Monitoring System (VMS) includes permanent geophysical and geodetic stations, temporal stations and field campaigns. Nowadays, IGN is using Sentinel-1 data.

Test sites: Canary Island Rock fall risk

Rockfalls are the most frequent and damaging landslide type in the archipielago, in the past decade the Emergency Services from Gran Canaria and Tenerife Island accumulate more than 7000 rockfall events producing damages to communication networks. In this context, a set of tools to support an early warning system for rockfalls, which is relevant for the Canary Island CP, will be developed in U-Geohaz.

Centre Tecnològic de Telecomunicacions de Catalunya

U-Geohaz

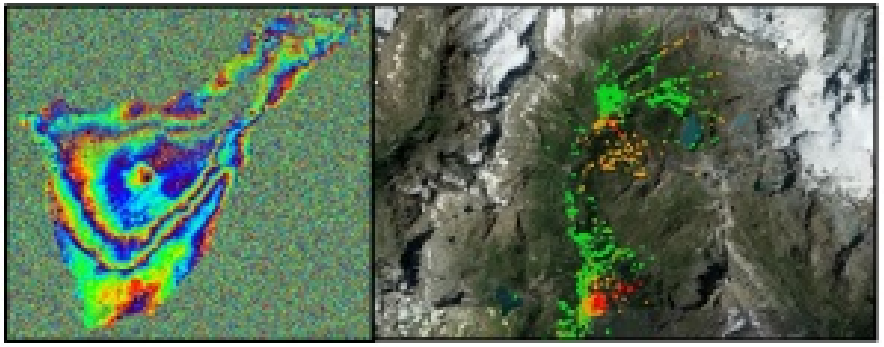
MAIN MENU

About U-Geohaz

Geohazard impact assessment for urban areas

Test-sites

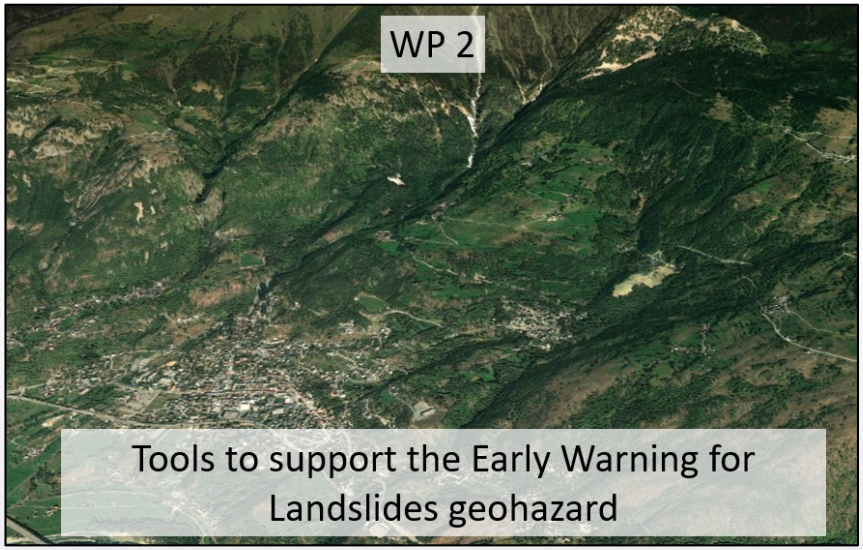
Results

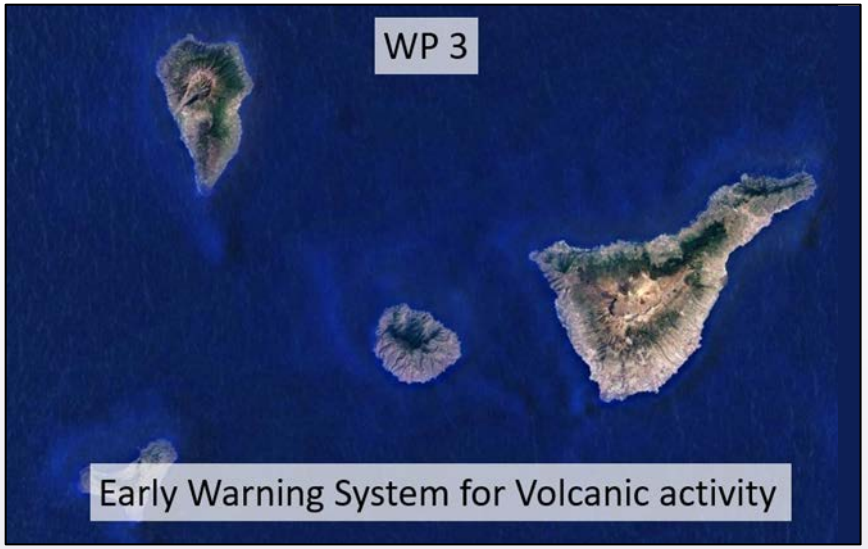


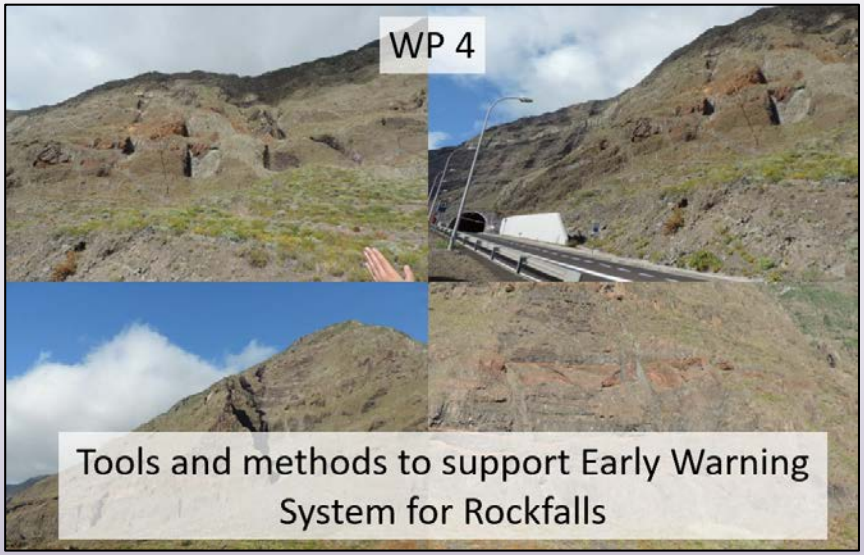
CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

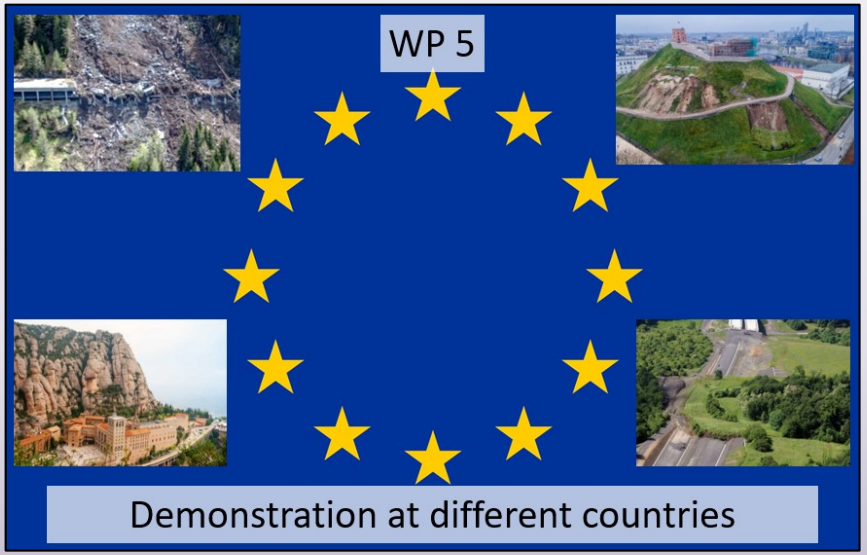
U-Geohaz Results

Back to Main menu





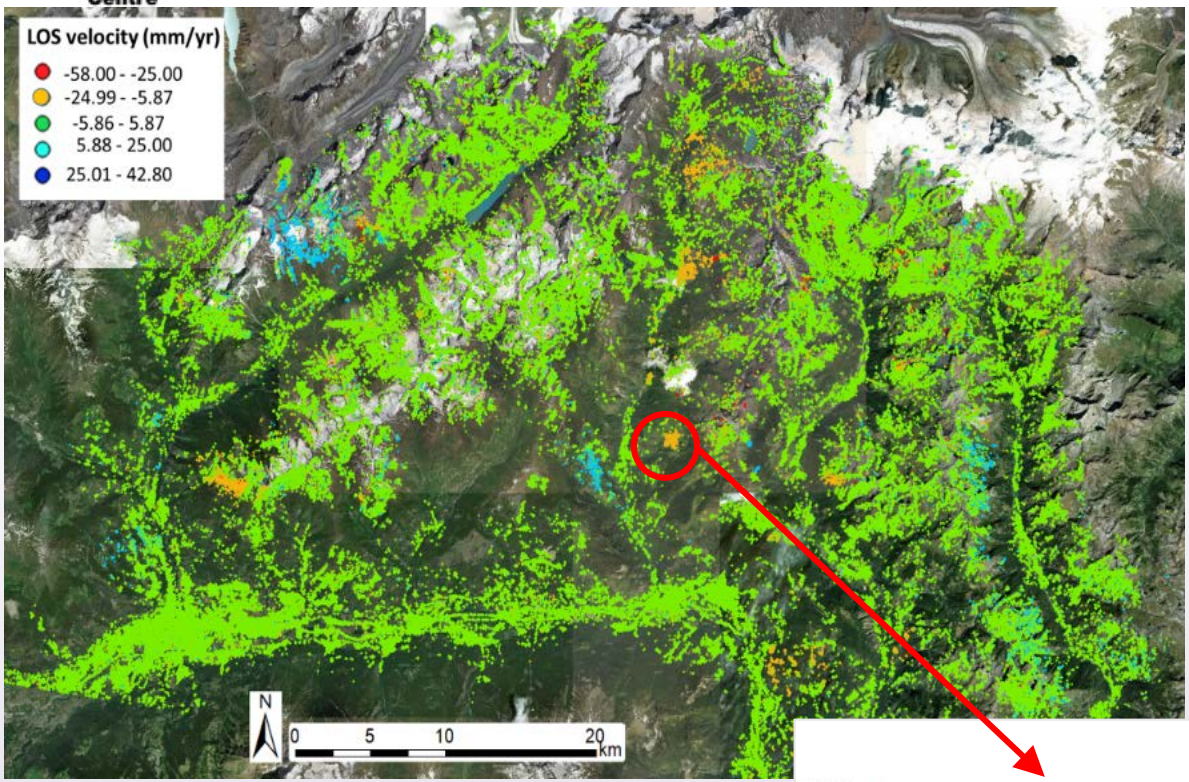




U-Geohaz Results

WP 2:Tools to support the Early Warning for Landslides geohazard

Back to Results menu

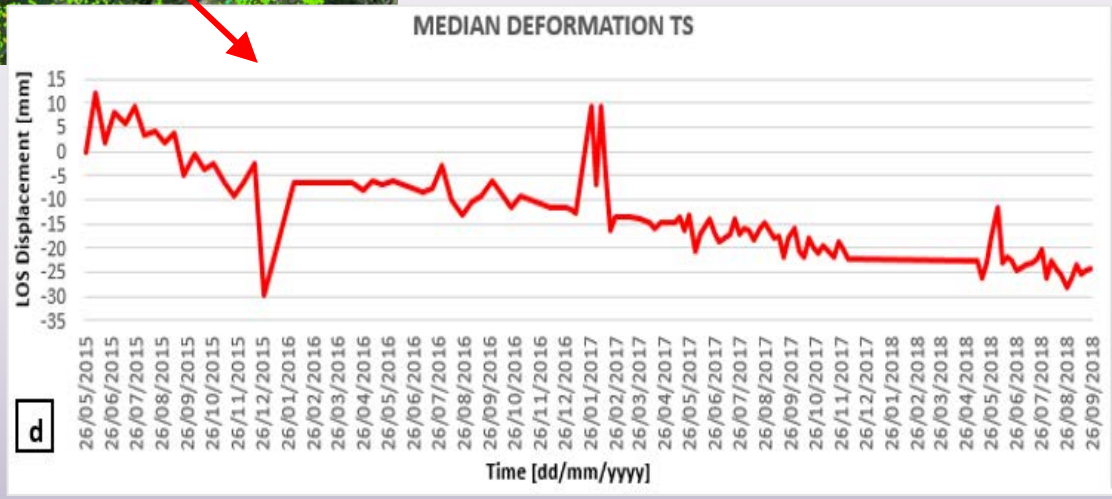


InSAR processing of Sentinel-1 images

Problematic aspects:

- Snow coverage
- Strong atmospheric component
- Phase unwrapping (aliasing)

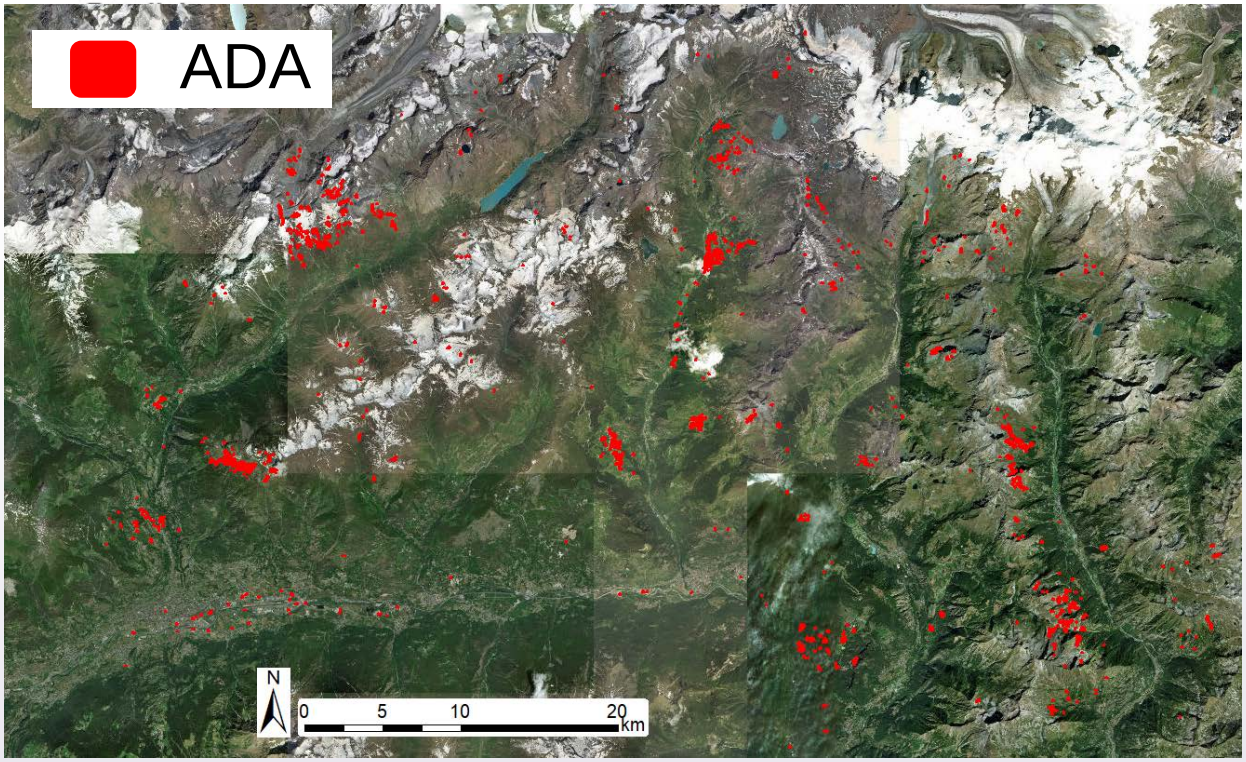
We are testing and tuning different processing approach in order to improve both the coverage and the quality of the results.



U-Geohaz Results

WP 2:Tools to support the Early Warning for Landslides geohazard

Back to Results menu



InSAR processing: derived map

ADA RESUMED INFORMATION:

LOCALIZATION
ACCUMULATED DEFORMATION
MEAN VELOCITY
MAXIMUM VELOCITY
MINIMUM VELOCITY
MEAN DEFORMATION
VELOCITY CLASS
QUALITY INDEX

ADAFinder: automatic Active Deformation Areas extraction

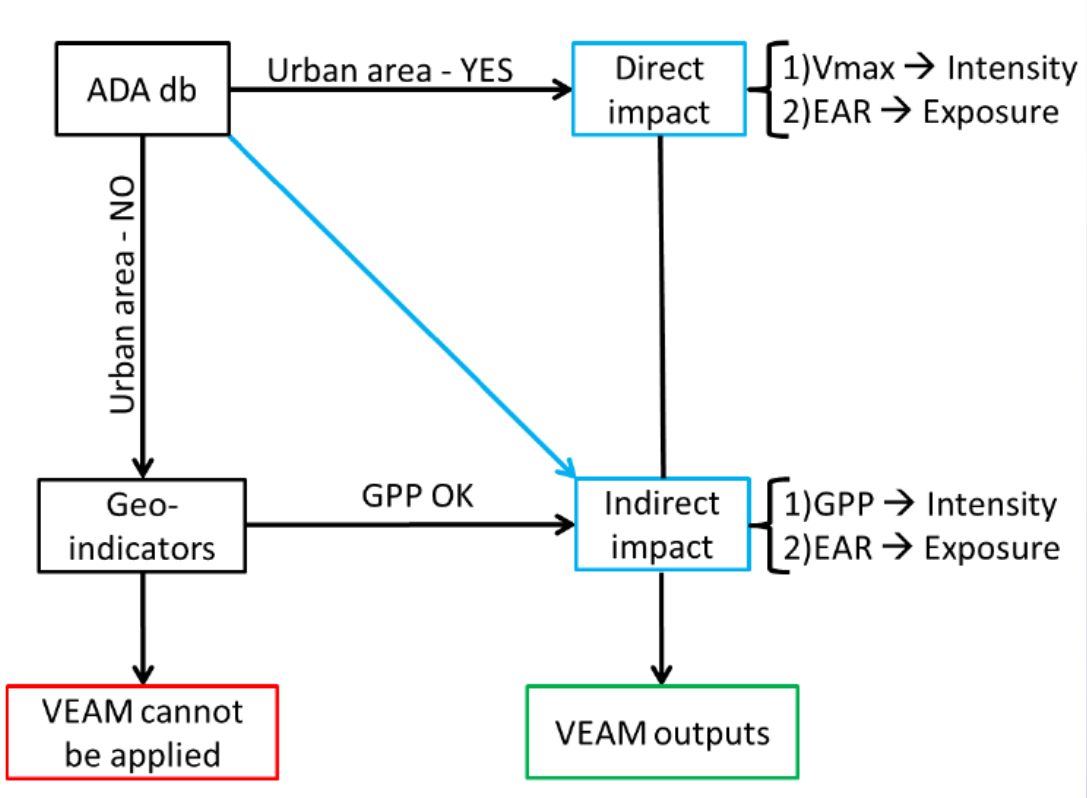
Barra A, Solari L, Béjar-Pizarro M, Monserrat O, ., ... & Moretti S. (2018). A Methodology to Detect and Update Active Deformation Areas Based on Sentinel-1 SAR Images. Remote Sens. 9:1002.

For not expert users involved in risk management:

- Simplify the readability of PSI results
- Avoid misunderstanding interpretations
- Fast focusing over the most interesting active areas

Centre Tecnològic de Telecomunicacions de Catalunya

Vulnerable Element at Risk Map (VEAM): methodology



- Vulnerability depends on Intensity & Element At Risk (EAR)
- Exposure: economic value of EAR (elements at risk) classes
- Intensity: 2 different procedures for:

→ **Direct impact** (based on ADA Vmax)

→ **Indirect impact** (based on GPP - Gravitational Process Path - model)

Centre Tecnològic de Telecomunicacions de Catalunya

Vulnerable Element at Risk Map (VEAM): methodology

Direct impact

- overlapping between ADA and EAR
- vulnerability is estimated as a value (ranging 0 - 1) as a function of intensity and building/road typology
- intensity is derived from ADA average velocity value as:
  1. average velocity < 16mm/yr
  2. 16 mm/yr < average velocity < 32 mm/yr
  3. average velocity > 32 mm/yr

Indirect impact

- no overlapping between ADA and EAR
- geo-indicators (debris cover or known debris flow)
- runout model → GPP (Gravitational Process Path)
- intensity derived from the number of trajectories, using natural breaks distribution (3 classes)

U-Geohaz Results

WP 2:Tools to support the Early Warning for Landslides geohazard

Back to Results menu

Type of building/infrastructure	Vulnerability for I=1	Vulnerability for I=2	Vulnerability for I=3	Exposure (€/m²)
Abandoned/ruined building	0.2	0.5	0.6	10
Building under construction	0.15	0.3	0.4	100
Campground/resort	0.2	0.5	0.8	100
Cemetery	0.1	0.3	0.5	80
Private house	0.2	0.35	0.6	700-4300
Hydroelectric power plant	0.1	0.2	0.5	5000
Hospital	0.2	0.5	0.7	4000
Hotel	0.15	0.3	0.5	2000
Industrial/commercial building - factory	0.1	0.2	0.5	1000
Local road	0.6	0.8	1	50
Monument	0.15	0.4	0.5	100
Power station/power substation/power shed	0.1	0.2	0.5	2000
Provincial road	0.5	0.8	1	50
Public/social/administrative building	0.1	0.3	0.6	3000
Railway/railway station	0.3	0.5	0.8	2000
Religious building	0.15	0.3	0.5	4000
School complex	0.2	0.5	0.7	4000
Shed	0.15	0.5	0.6	100
Silo	0.15	0.4	0.50	10
Sport facilities	0.1	0.25	0.5	100
Stable/barn/breeding farm	0.15	0.4	0.6	10
State highway/provincial highway	0.4	0.6	1	100
Toll road/highway	0.3	0.5	0.8	200

Vulnerability= f(intensity, EAR)

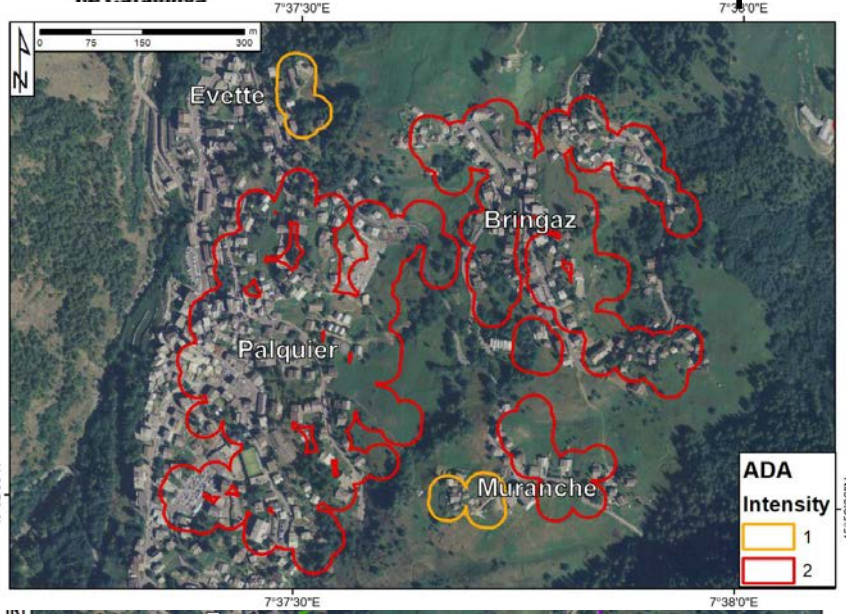
Potential worth of losses = vulnerability * exposure

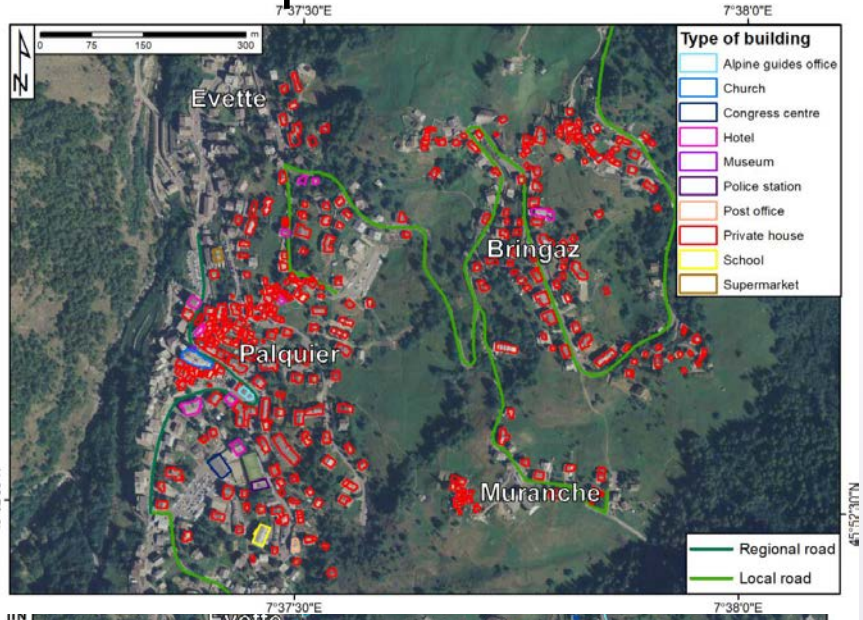
U-Geohaz Results

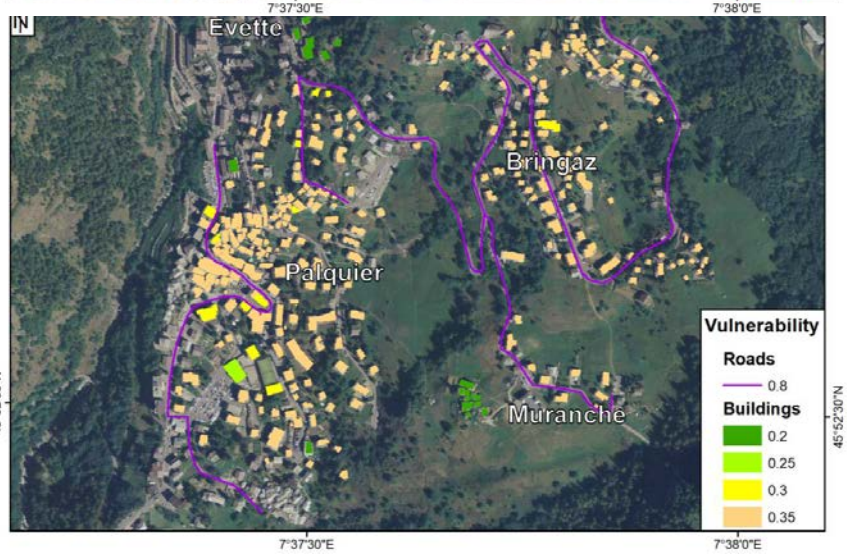
WP 2:Tools to support the Early Warning for Landslides geohazard

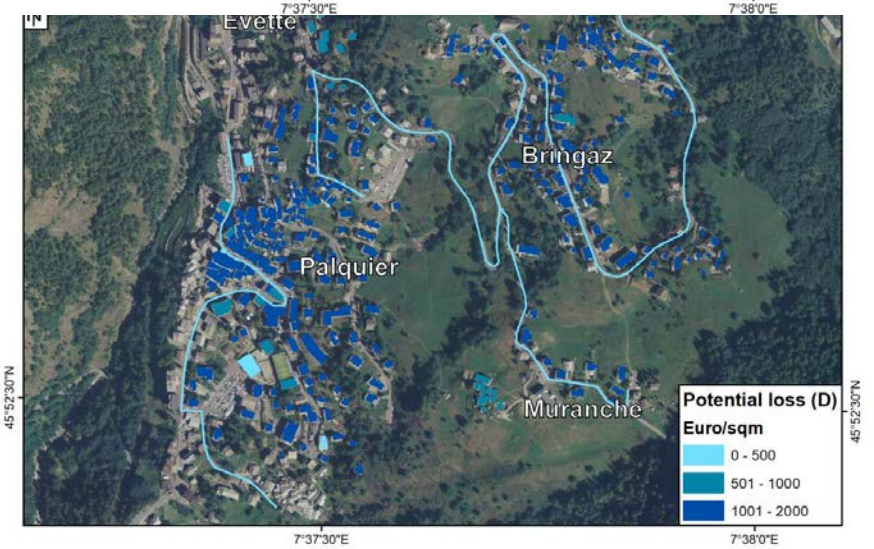
Back to Results menu

Example 1 – Direct impact









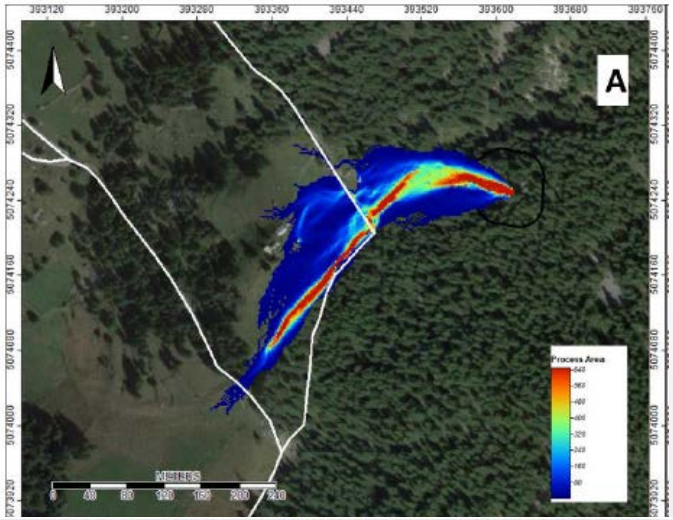
U-Geohaz Results

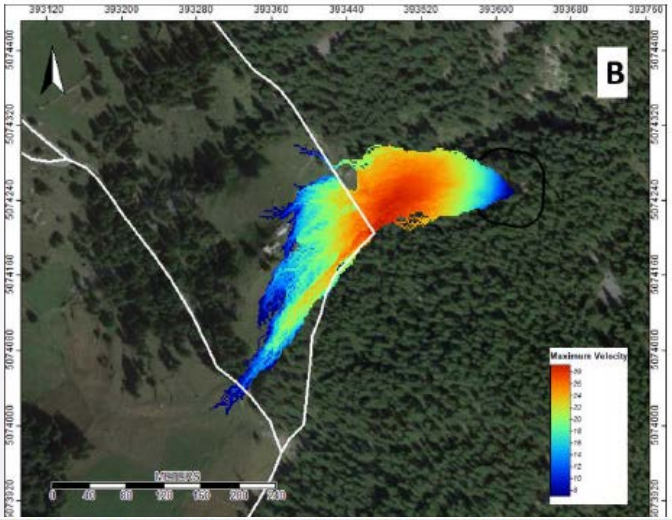
WP 2:Tools to support the Early Warning for Landslides geohazard

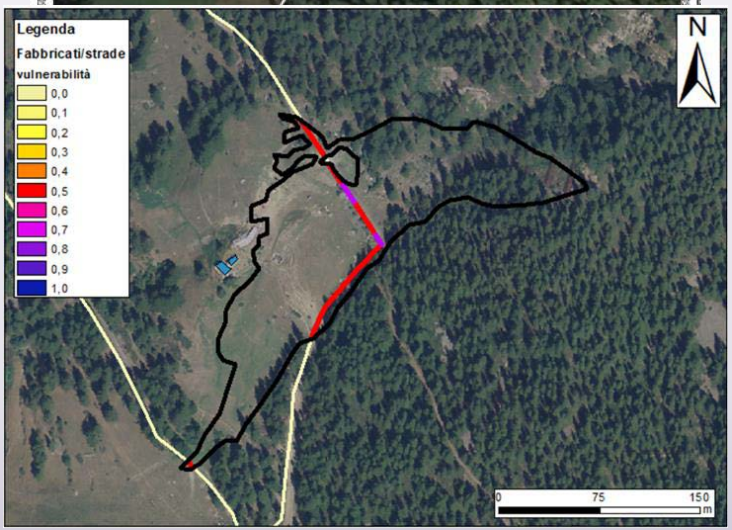
Back to Results menu

Centre Tecnològic de Telecomunicacions de Catalunya

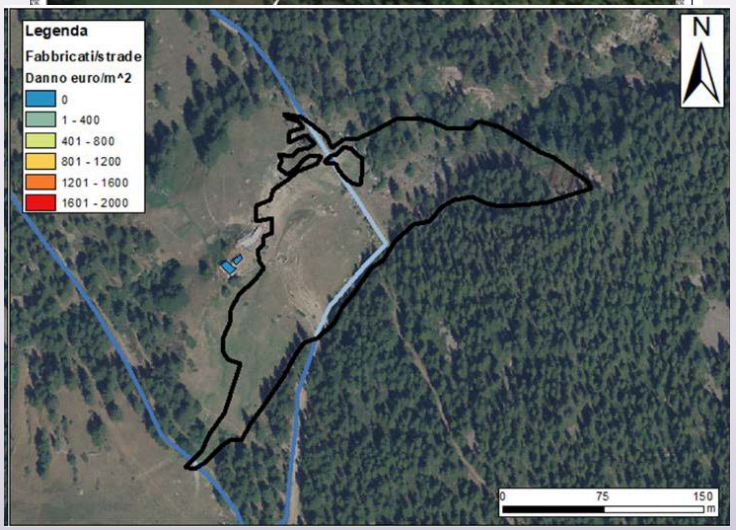
Example 2 – Indirect impact







Vulnerability map

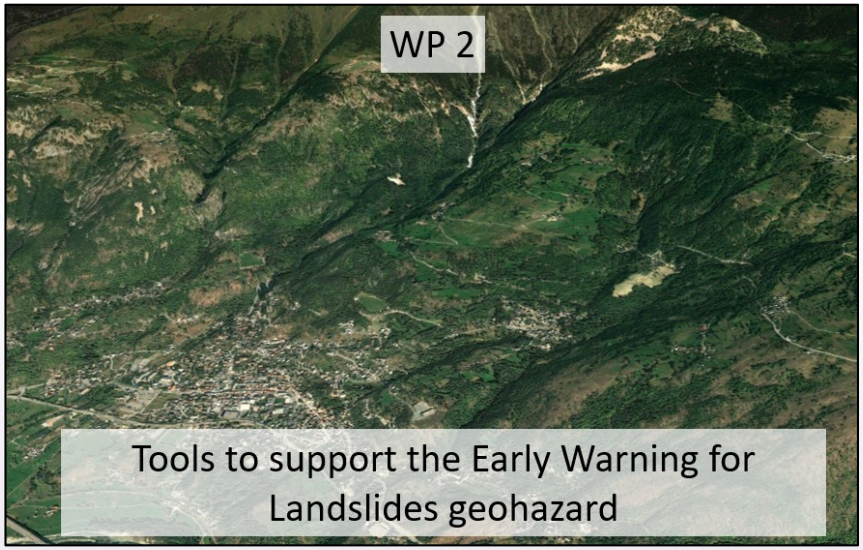


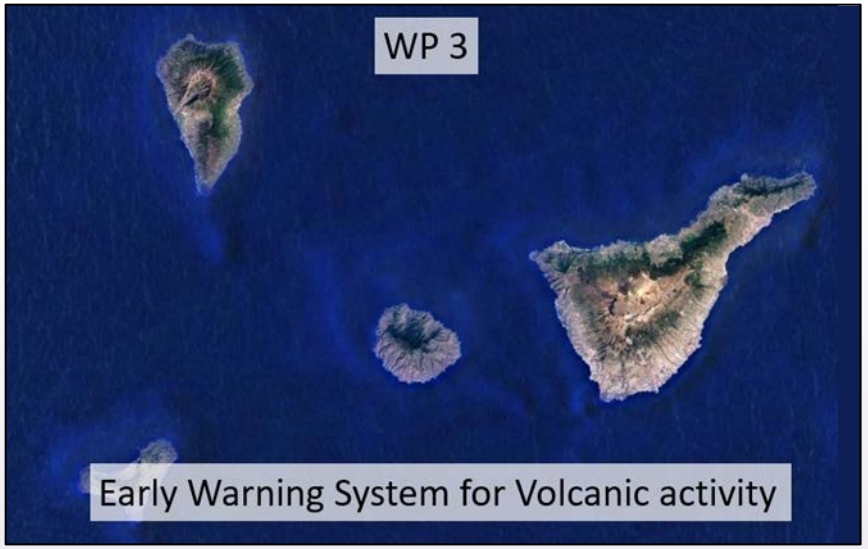
Potential worth losses map

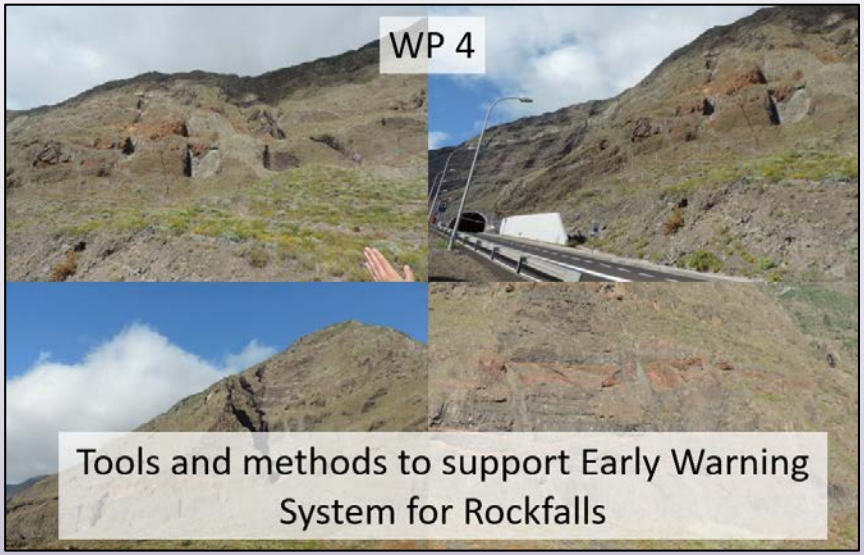
CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

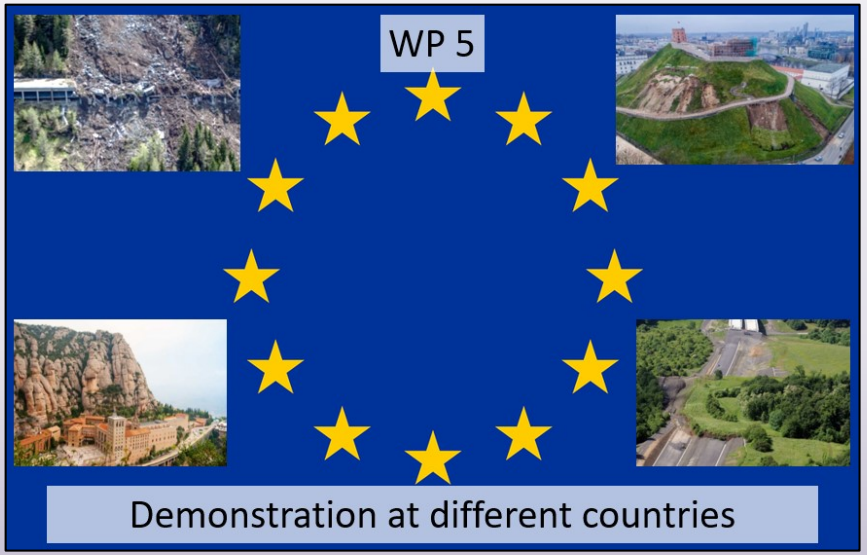
U-Geohaz Results

Back to Main menu









Centre Tecnològic de Telecomunicacions de Catalunya

WP Leader: IGN-CNIG

- Identification of user needs
- User assessment
- Deformation Activity Maps
- **Volcanic Early Warning (VEW) system implementation**
- VEW validation
- Integration of VEW in CPAS

2018 & 2019

2019

Centre Tecnològic de Telecomunicacions de Catalunya

Deformation activity maps

InSAR processing of Sentinel-1 images

The main goal of this activity is the generation of the deformation activity maps (DAM) in the Canary Islands test site with a 6-day temporal repeatability.

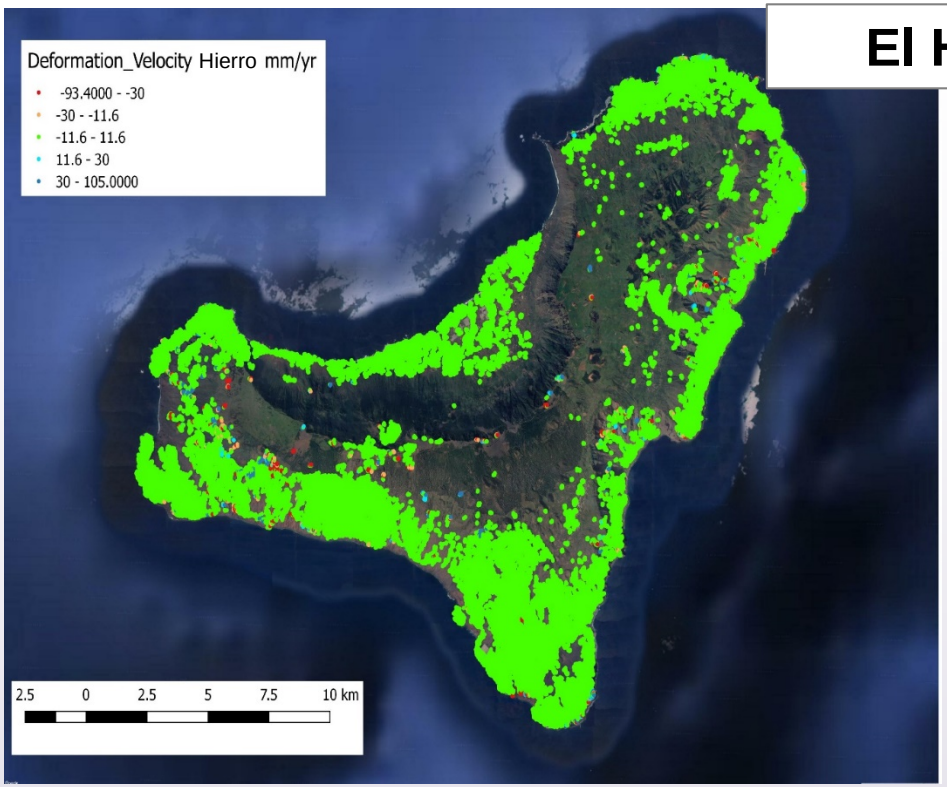
→ We want to provide an approach able to produce a reliable deformation activity map each 6 days.

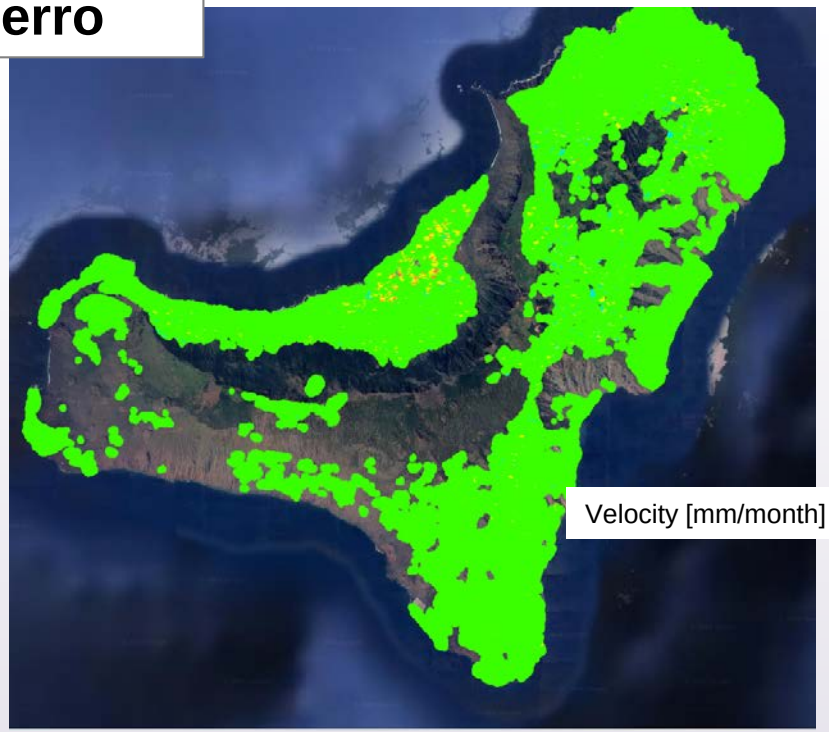
The main output of this action will be a 6-day updated ADA over the Canary Islands test site, during 12 months.

Centre Tecnològic de Telecomunicacions de Catalunya

InSAR processing of Sentinel-1 images

El Hierro





First approach

Second approach

We are testing and tuning different processing approach in order to improve both the coverage and the quality of the results.

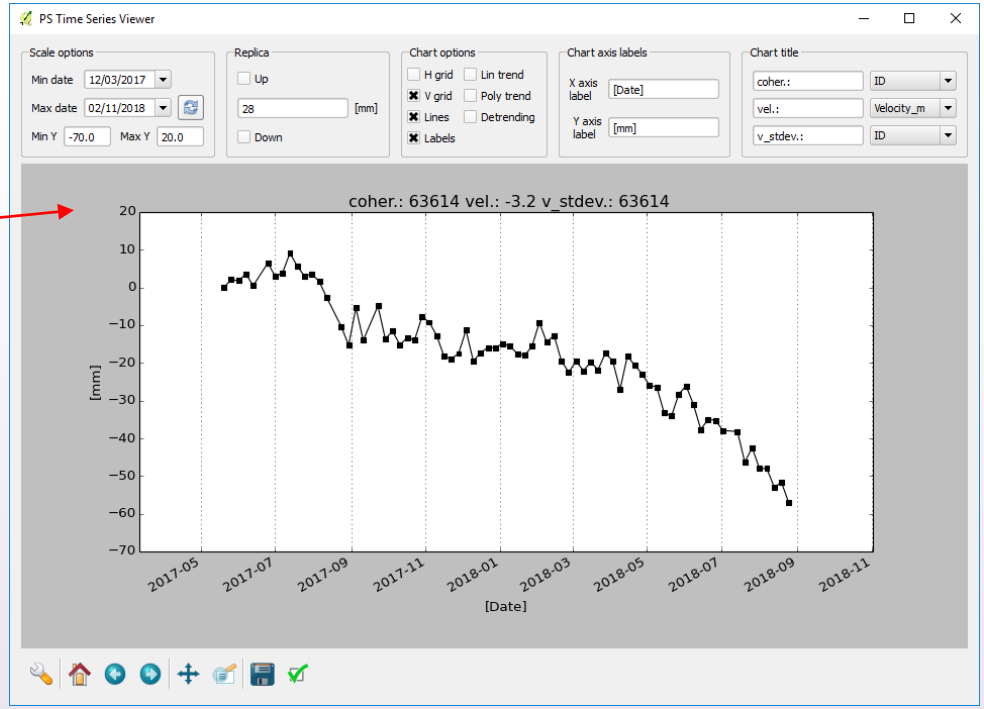
U-Geohaz Results

WP 3: Early Warning System for Volcanic activity

Back to Results menu

Centre Tecnològic de Telecomunicacions de Catalunya

InSAR processing of Sentinel-1 images



Second approach:

- We have developed the Direct integration algorithm.
- It has been tested with relative success but….
- Some critical issues raised up: “false” trends, APS filtering

The next steps: Improve pixel selection in order to discriminate “good” from “bad points”; Test different approaches to remove the APS; Validation for potential false trends; Extend the analysis to La Palma and Tenerife (ongoing); Develop a tool to automatically update the dataset (ongoing)

Centre Tecnològic de Telecomunicacions de Catalunya

IGN Volcano Monitoring System and Alert

IGN

IGN 24h/7d automatic and manual recognition of signs of volcanic activity and alarm generation

Communication of scientific alert and dissemination

Civil Protection

Emergency Plans
Local, Regional (PEVOLCA), Nacional

Scientific Commitee (Regional, Nacional)

ALERT LEVELS

Normal → Local
Pre-emergency → Regional
Emergency → Regional y National

FORECAST

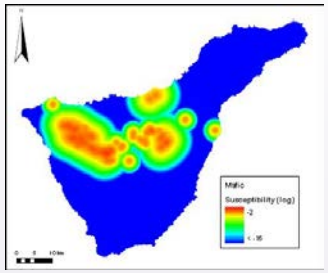
Centre Tecnològic de Telecomunicacions de Catalunya

IGN Volcano Monitoring System and Alert

Event Tree

how? *(typology)*

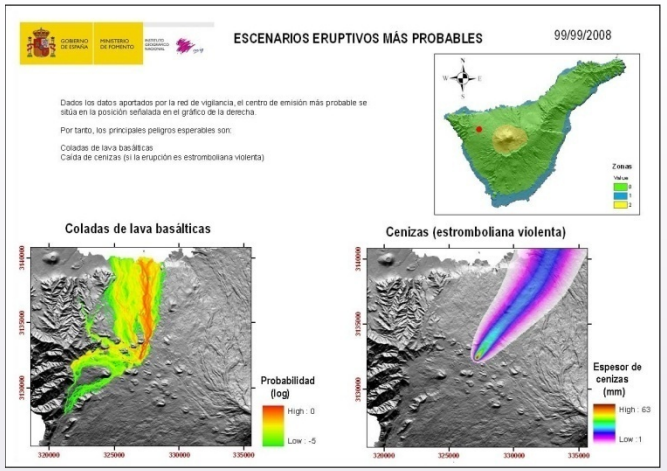
Susceptibility



where?

FORECAST

Scenarios



how? *(area affected)*

when? where? how?

Deformation

Seismicity

Geochemistry

GPS

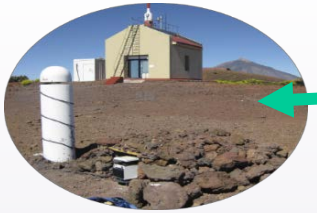
InSAR

Monitoring Networks

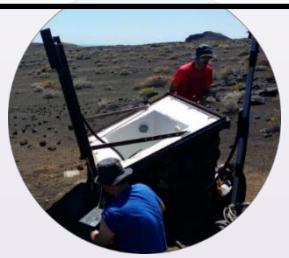
Centre Tecnològic de Telecomunicacions de Catalunya

IGN Volcano Monitoring System and Alert

Deformation



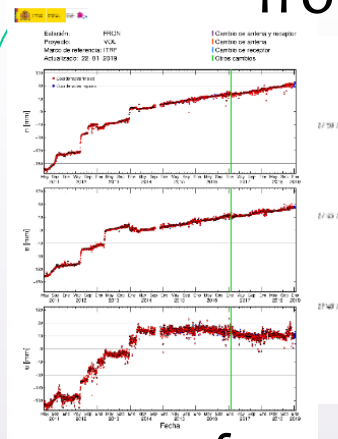
Seismicity

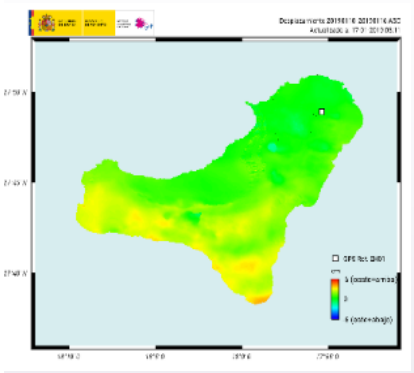


Geochemistry

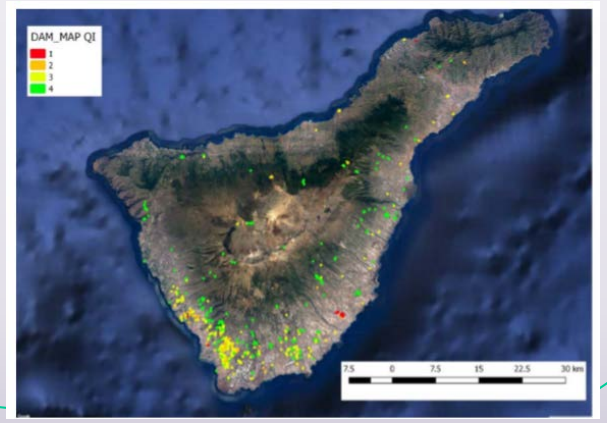
Improve FORECAST

from IGN





from U-Geohaz

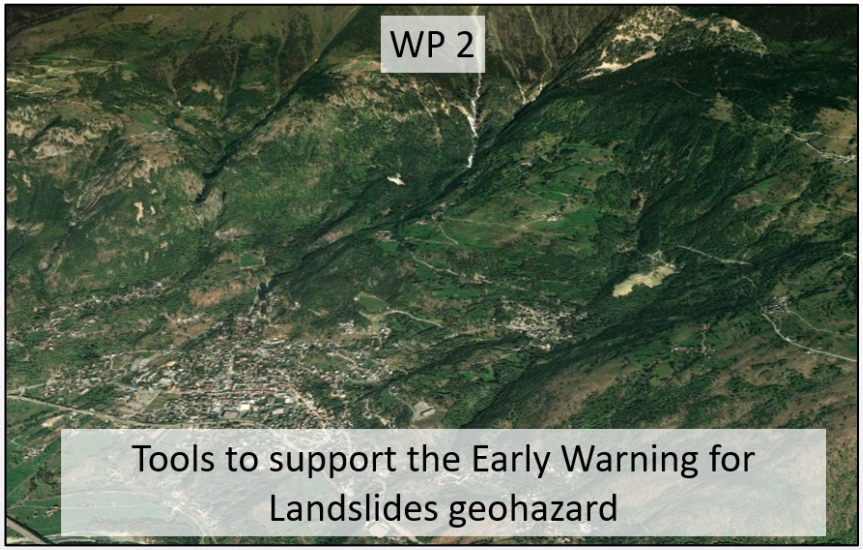


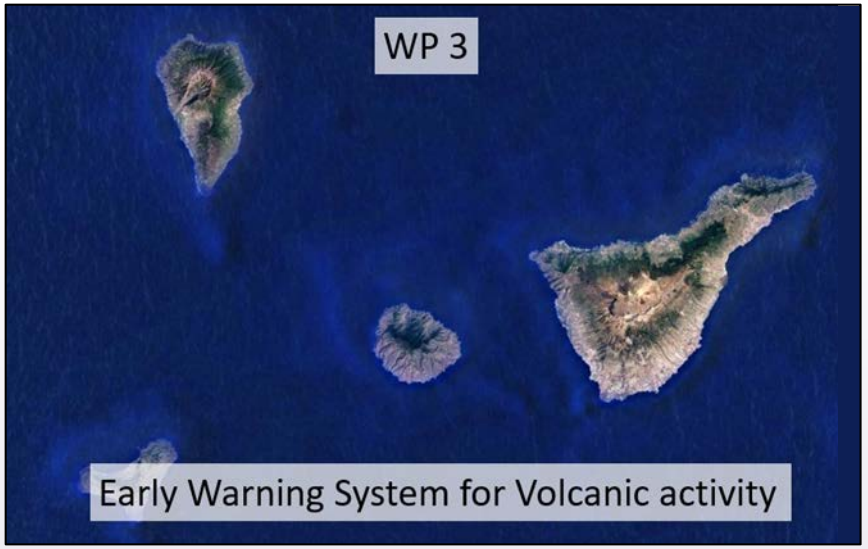
Implemented: a methodology and data model necessary to integrate IGN deformation data with InSAR DAM and ADA

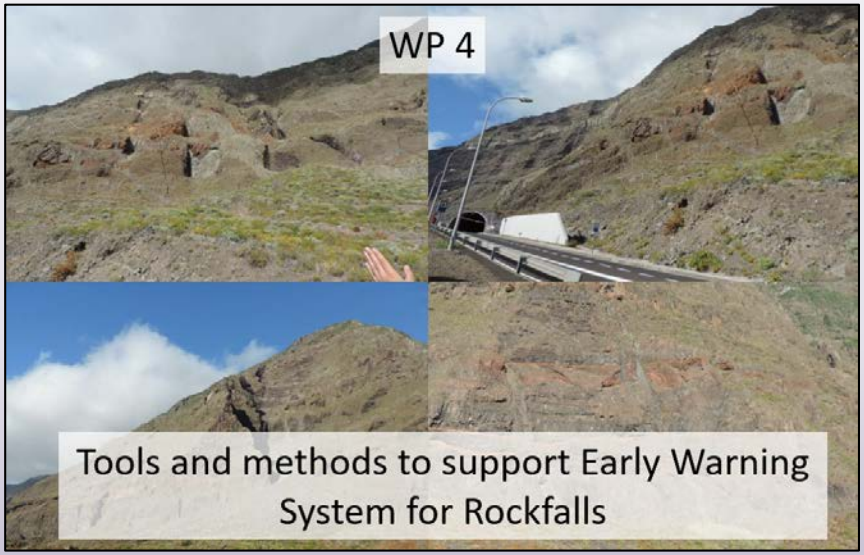
CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

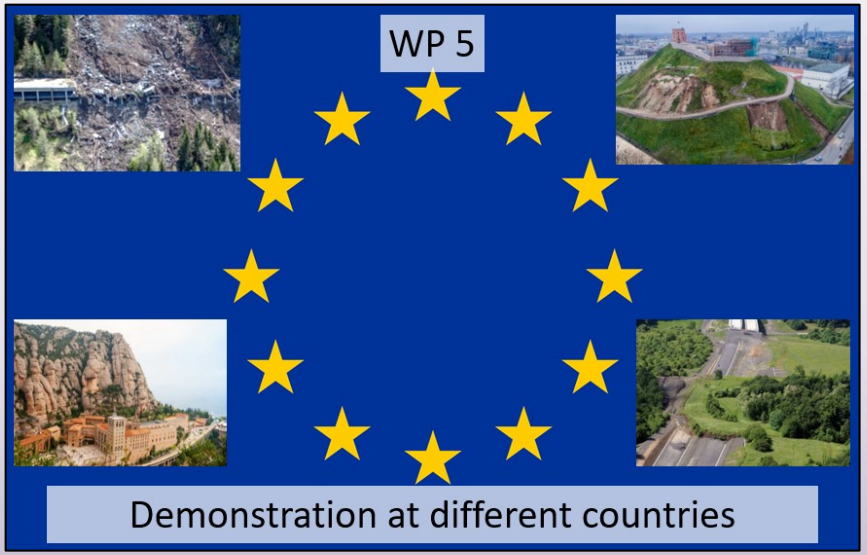
U-Geohaz Results

Back to Main menu









Centre Tecnològic de Telecomunicacions de Catalunya

WP 4: Tools and methods to support Early Warning System for Rockfall

The main goal of WP4 is to tailor tools and methods to generate information **to support early warning systems for rock falls**. Information and methods will be implemented starting from the results of LAMPRE and SAFETY projects.

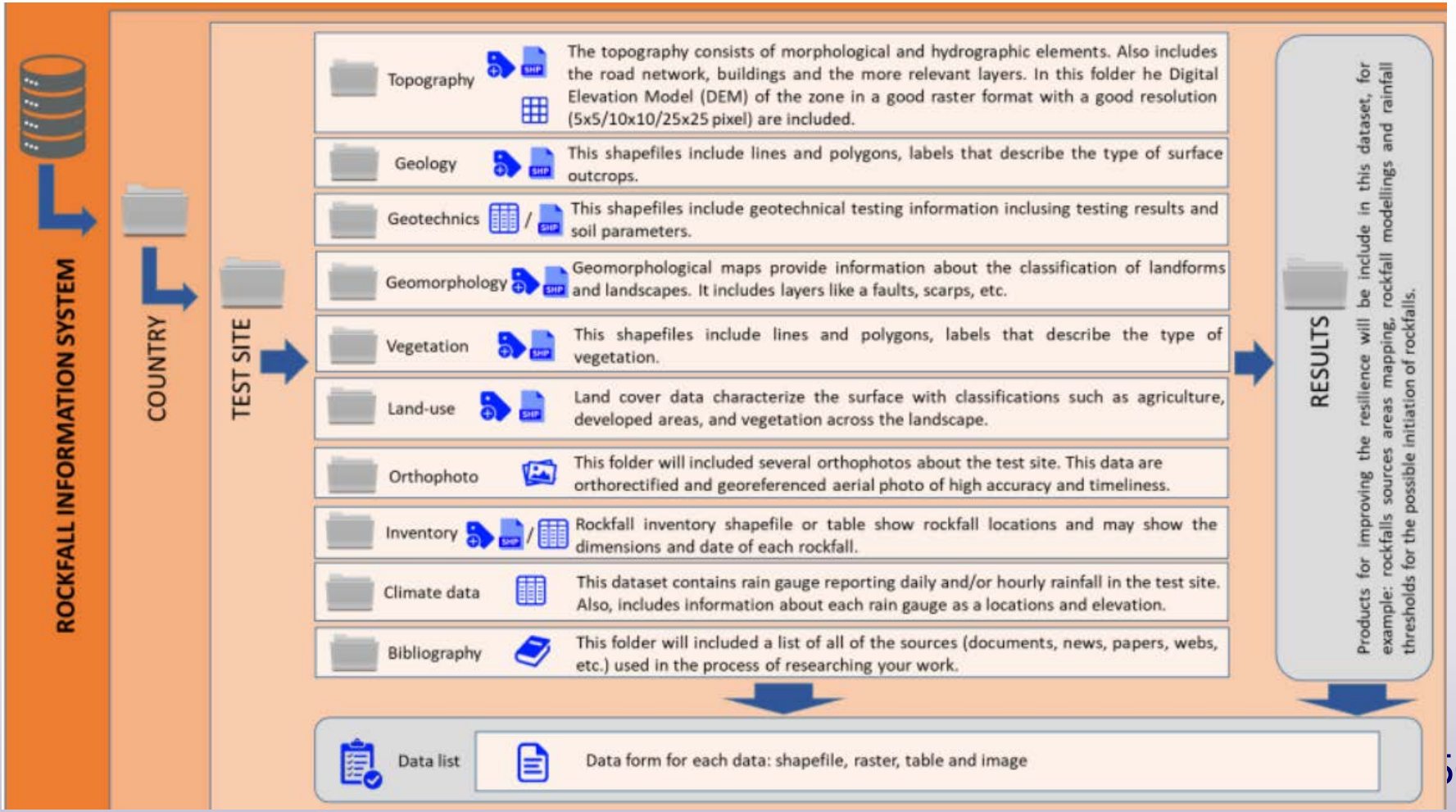
The activities are mainly focus to:

i) Implement a Data Collection System
ii) Improve the capability to recognize rock fall source areas
iii) Improve the definition of empirical rainfall thresholds for the possible initiation of rock falls.

CTTC Centre Tecnològic de Telecomunicacions de Catalunya

WP 4: Tools and methods to support Early Warning System for Rockfall

Implemented a data collection system: it will permit to collect and update the necessary input information in order to enable the periodic assessment of rockfall hazard.



ROCKFALL MODELLING: source areas identification

For the probabilistic identification of rockfalls source areas, we have used a combination of multiple statistical models. The proposed approach requires

1) a map of the observed source areas as dependent variable

2) a set of independent thematic information (e.g., morphometric indicators derived from DTM, lithological information that explicitly consider the mechanical behavior of the rocks, vegetation information).

The resulting map describing the probability of a pixel being a source areas will be the input for the rockfall modelling (i.e., STONE).

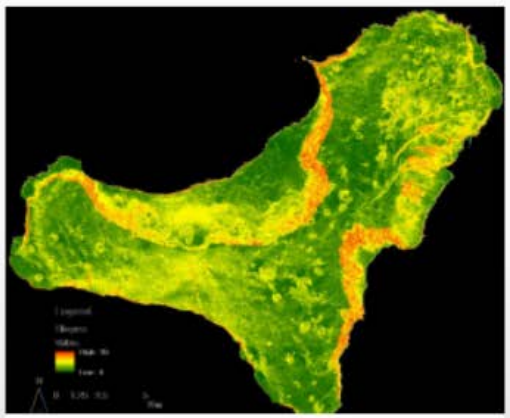
CTTC Centre Tecnològic de Telecomunicacions de Catalunya

WP 4: Tools and methods to support Early Warning System for Rockfall

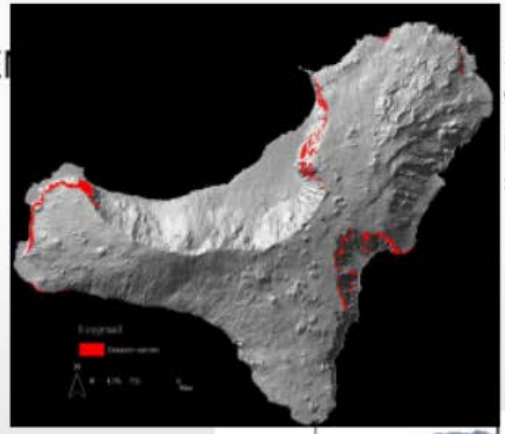
ROCKFALL MODELLING: source areas identification

Rockfall modelling – Test site data

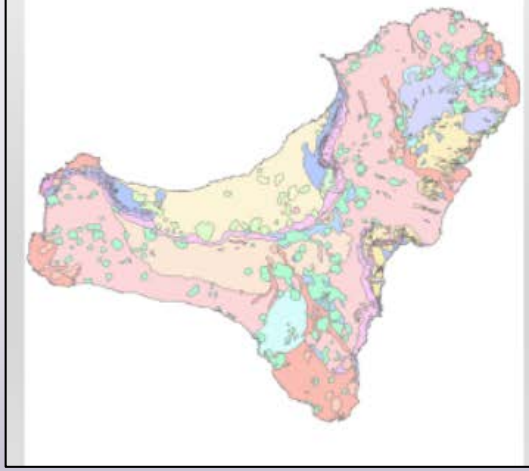
El Hierro



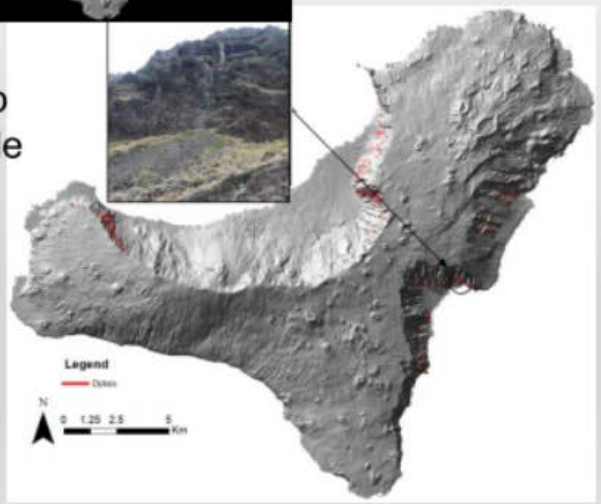
DEM



Source areas obtained with orthophotos interpretation and field surveys



Geological map at 1:25000 scale



CTTC Centre Tecnològic de Telecomunicacions de Catalunya

WP 4: Tools and methods to support Early Warning System for Rockfall

ROCKFALL MODELLING: source areas identification

To evaluate the spatial probability of rockfall source areas, we used **LAND-SUITE** selecting pixels as mapping units. We proceeded stepwise.

1. we identified the dependent variable from the observed locations of rockfall source areas. We then derived the independent variables from slope, curvature, density of dykes and lithology maps.

2. we set up **LAND-SIP** to produce a balanced (equal number of 1/0) training map with an equal number of pixels with/without source areas information and a validation map corresponding to the whole island

3. we evaluated the training dataset with **LAND-SVA** to estimate:
   i) pair-wised correlation analysis of the input variables;
   ii) multi-collinearity test of the input variables.

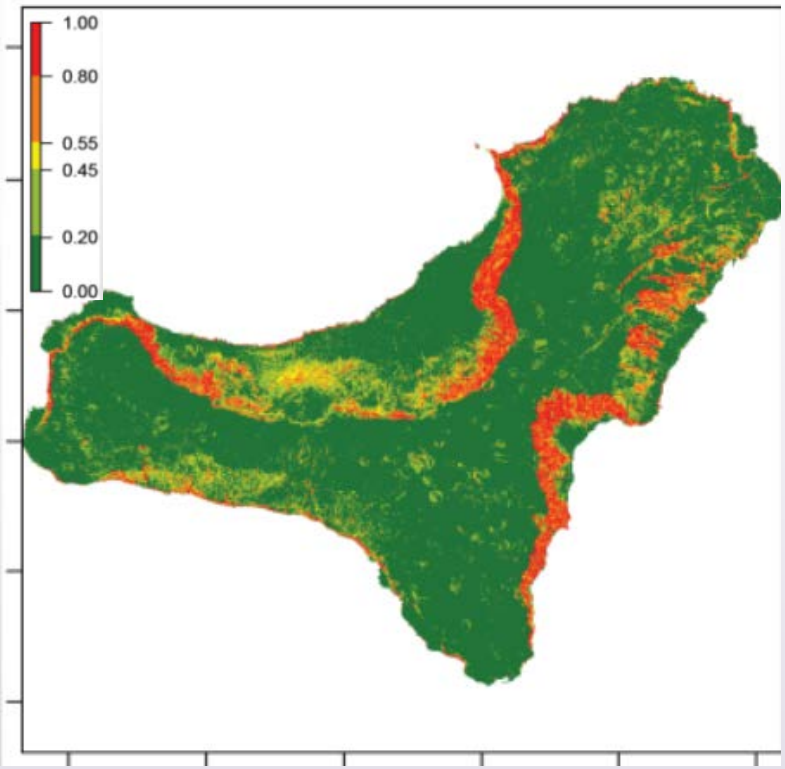
4. we applied **LAND-SE** selecting a logistic regression approach, to obtain the probabilistic map of source areas.

WP 4: Tools and methods to support Early Warning System for Rockfall

ROCKFALL MODELLING: source areas identification

To evaluate the spatial probability of rockfall source areas, we used **LAND-SUITE** selecting pixels as mapping units. We proceeded stepwise.

1. we identified the dependent variable from the observed locations of rockfall source areas. We then derived the independent variables from slope, curvature, density of dykes and lithology maps.
2. we set up **LAND-SIP** to produce a balanced (equal number of 1/0) training map with an equal number of pixels with/without source areas information and a validation map corresponding to the whole island
3. we evaluated the training dataset with **LAND-SVA** to estimate:
   i) pair-wised correlation analysis of the input variables;
   ii) multi-collinearity test of the input variables.
4. we applied **LAND-SE** selecting a logistic regression approach, to obtain the probabilistic map of source areas.



Map of the probabilistic rockfall source areas

CTTC Centre Tecnològic de Telecomunicacions de Catalunya

WP 4: Tools and methods to support Early Warning System for Rockfall

ROCKFALL MODELLING: Simulated trajectories

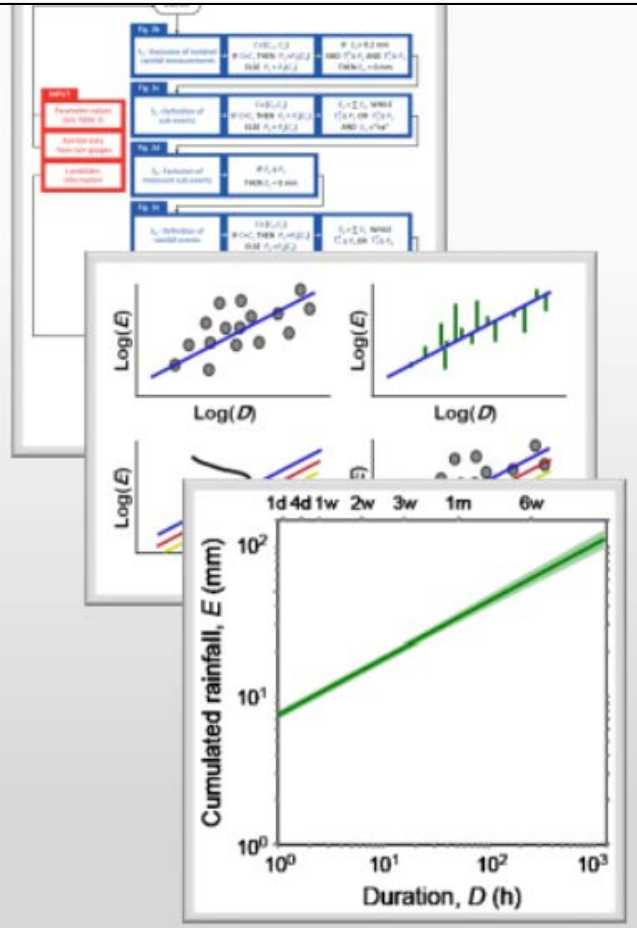
Centre Tecnològic de Telecomunicacions de Catalunya

WP 4: Tools and methods to support Early Warning System for Rockfall

RAINFALL THRESHOLD

Define empirical rainfall thresholds for the possible initiation of rock falls

- Definition of **rainfall events** with **landslide**
- Definition of reproducible **rainfall thresholds**
- Evaluation of the **uncertainty** of the **thresholds**



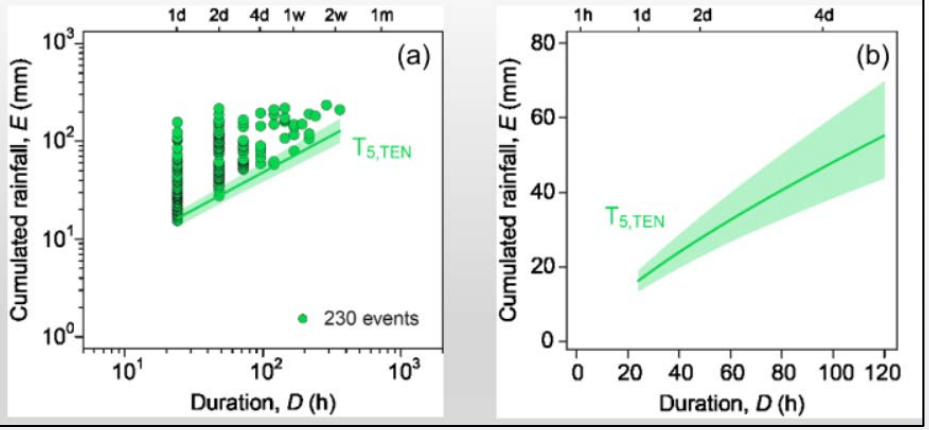
CTTC Centre Tecnològic de Telecomunicacions de Catalunya

WP 4: Tools and methods to support Early Warning System for Rockfall

RAINFALL THRESHOLD: preliminary results

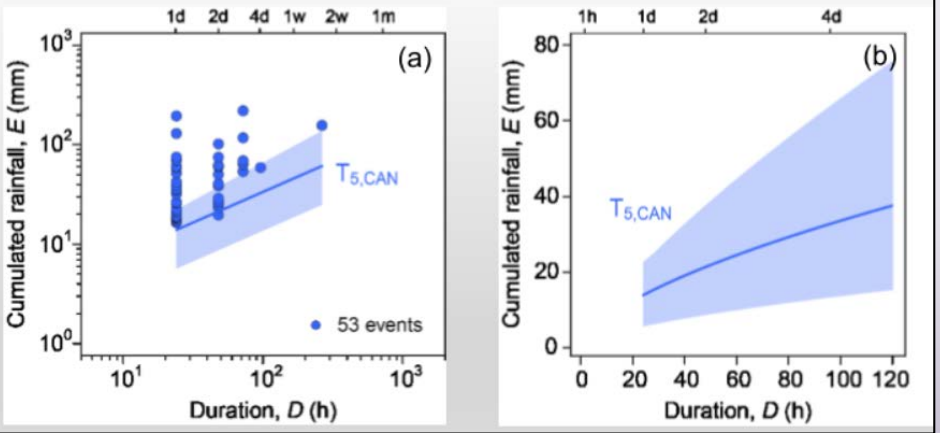
Rainfall thresholds in bi-logarithmic (a) and linear (b) coordinates. The green shaded area is the uncertainty associated with the threshold.

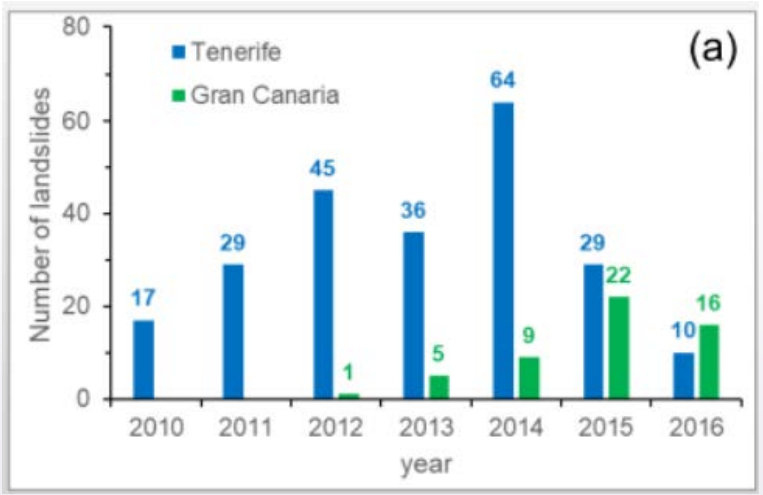
Tenerife

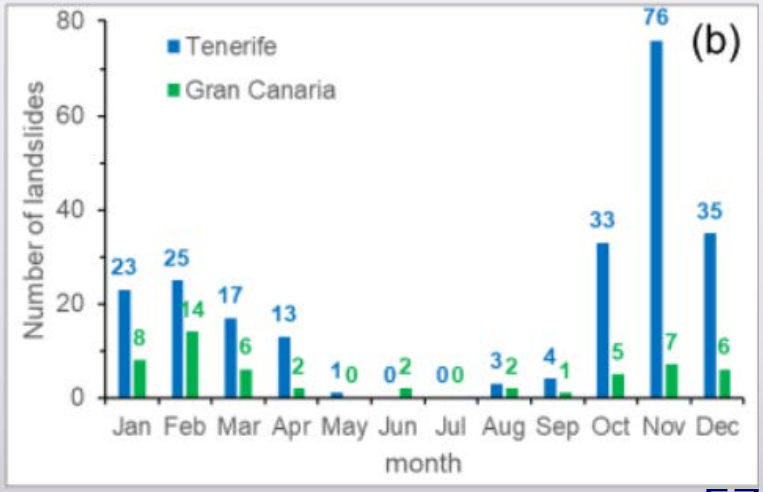


Rainfall thresholds in bi-logarithmic (a) and linear (b) coordinates. The blue shaded area is the uncertainty associated with the threshold.

Gran Canaria



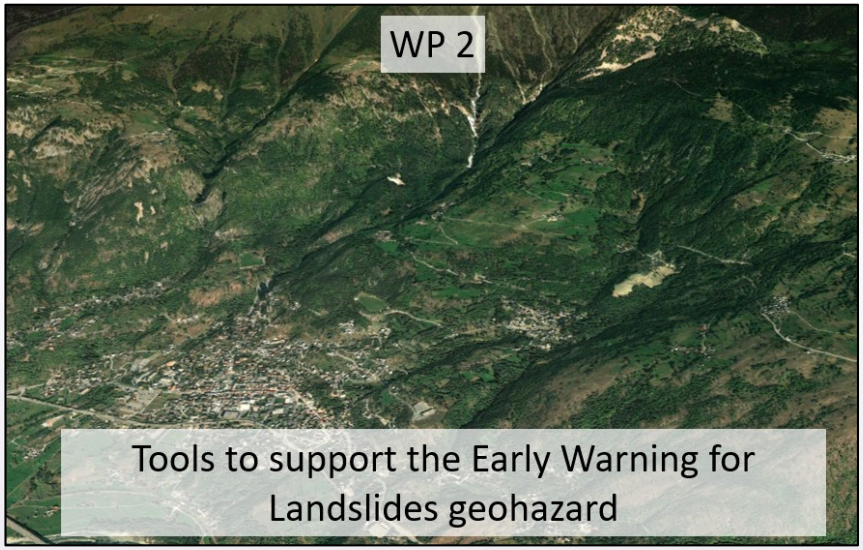


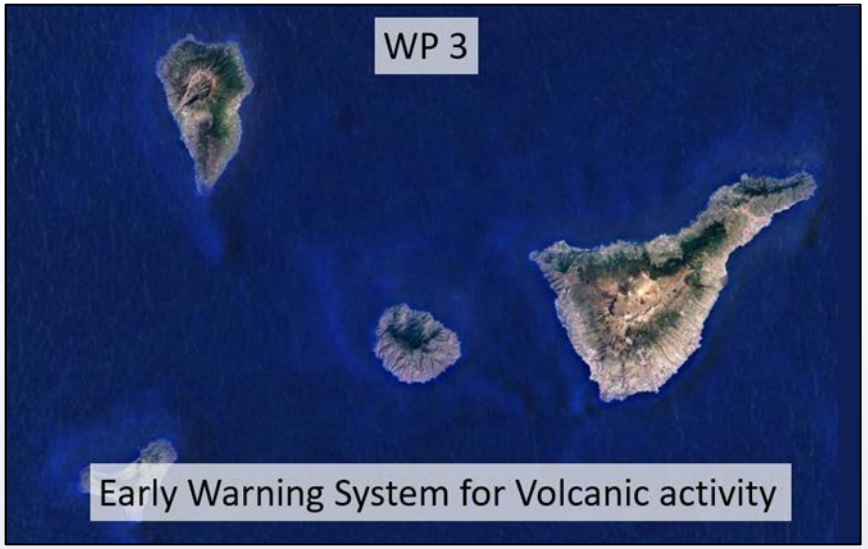


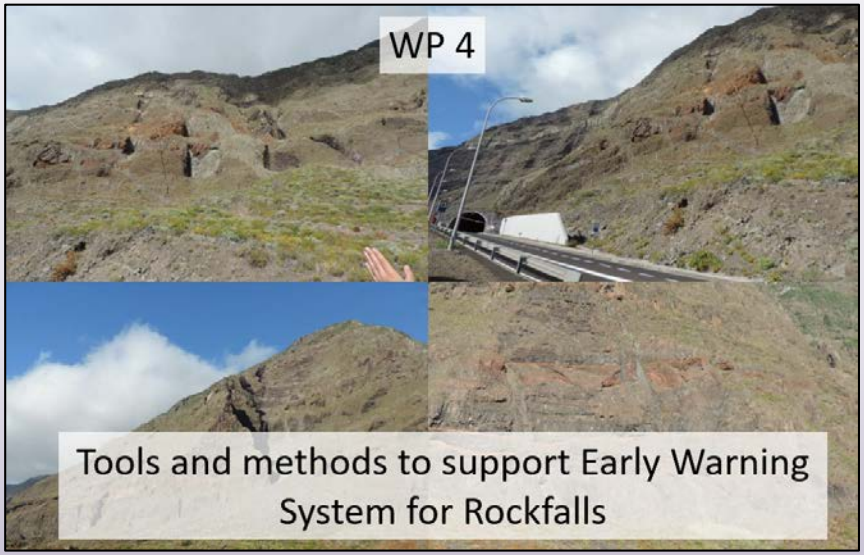
CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

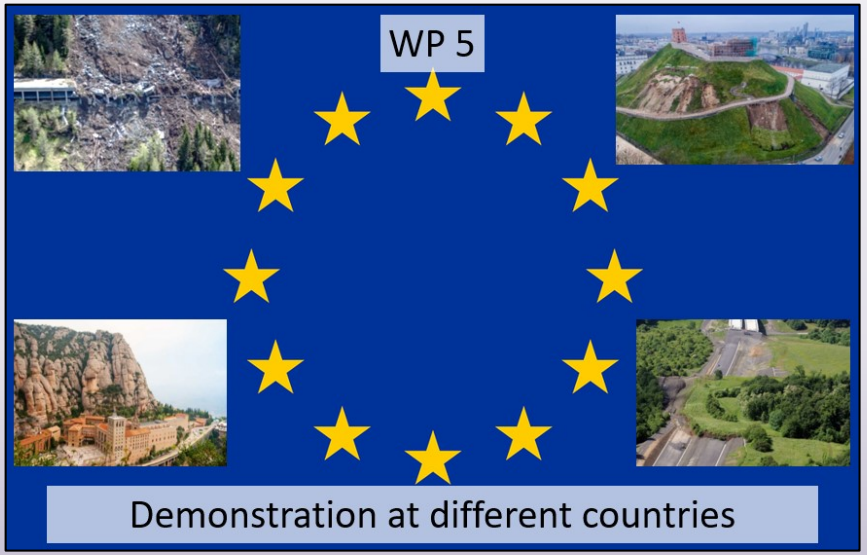
U-Geohaz Results

Back to Main menu









CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

WP 5: Demonstration at different countries

Main tasks:

- Evaluate the integration of geohazard into urban planning to increase urban resilience in Europe.

- Provide a better understanding of the relations between GSs and the corresponding CPAs in the different European countries.

- Demonstrate the U-Geohaz products performance to the GSs and the CPAs from the participating countries.

How?

The consosrtium includes 12 geological surveys with direct relation with their corresponding CPAs.

METHOD: THE EOEG QUESTIONNAIRE

Within the framework of the European Geological Surveys (EGS), the Earth Observation and Geohazards Expert Group (EOEG) has carried out a survey at the beginning of 2018 through a questionnaire that was circulated among its members. Twenty one National Geological Surveys have participated:

Austria, Croatia, Cyprus, Czech Republic, Denmark, France, Greece, Ireland, Italy, Lithuania, Norway, Poland, Portugal, Republic of Srpska, Bosnia and Herzegovina, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden and United Kingdom, as well as six regional Geological Surveys: Baden-Württemberg, Bavaria, Hessen, Lower Saxony and Saxony Anhalt in Germany, and Catalonia in Spain.

METHOD: THE EOEG QUESTIONNAIRE

The questionnaire contains a list of 30 questions divided into 4 main sections:

1. The impact of landslides in the country
2. Landslides in the Geological Surveys (GSs) of Europe.
3. Landslides in the legislation.
4. Landslide awareness and preparedness

In a fifth stage, a participatory exercise was developed to analyze in detail cases of bad urban practices on landslide prone zones across Europe. Nine countries have reported calamitous examples: Spain, Cyprus, Greece, Italy, Serbia, Slovenia, Slovakia, Poland and Romania. Every case was discussed to determine what failed and why?

WP 5: Demonstration at different countries

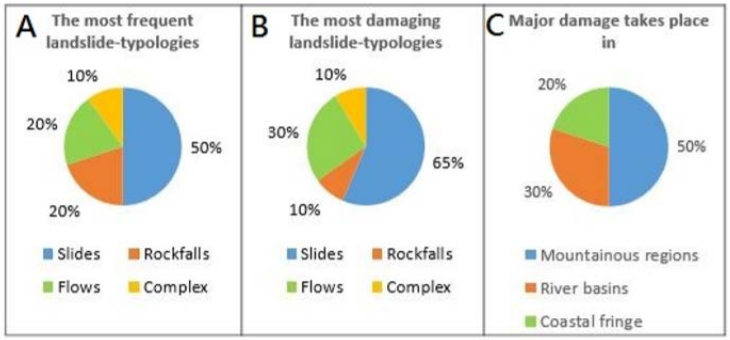


Figure 2 Statistical diagrams referring to section 1: impact of landslides in Europe: A) Frequency of landslide typologies; B) the most damaging landslide typologies and C) where major damage takes place

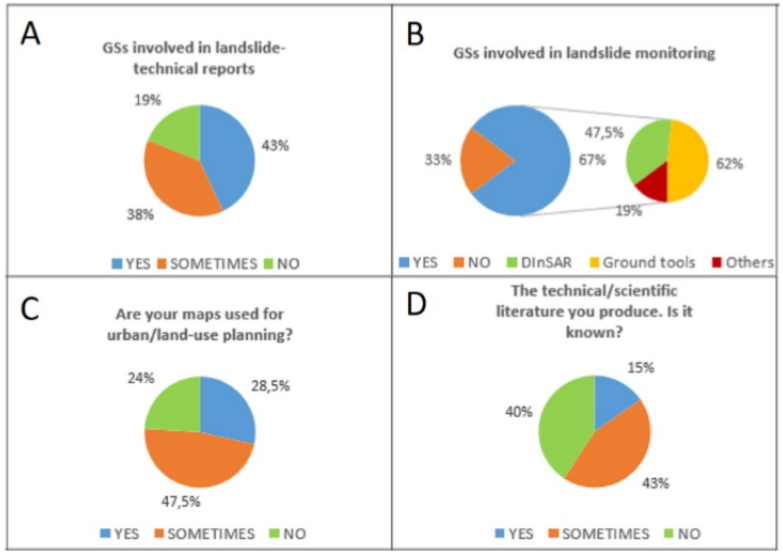


Figure 6 Statistical diagrams referring to section 2: landslides in the EGs: A) percentage of GSs involved in the elaboration of technical reports; B) percentage of GSs involved in landslide monitoring (types); C) the use of the maps elaborated by GSs for urban/land-use planning and D) the social knowledge of the technical/scientific literature generates by the GSs

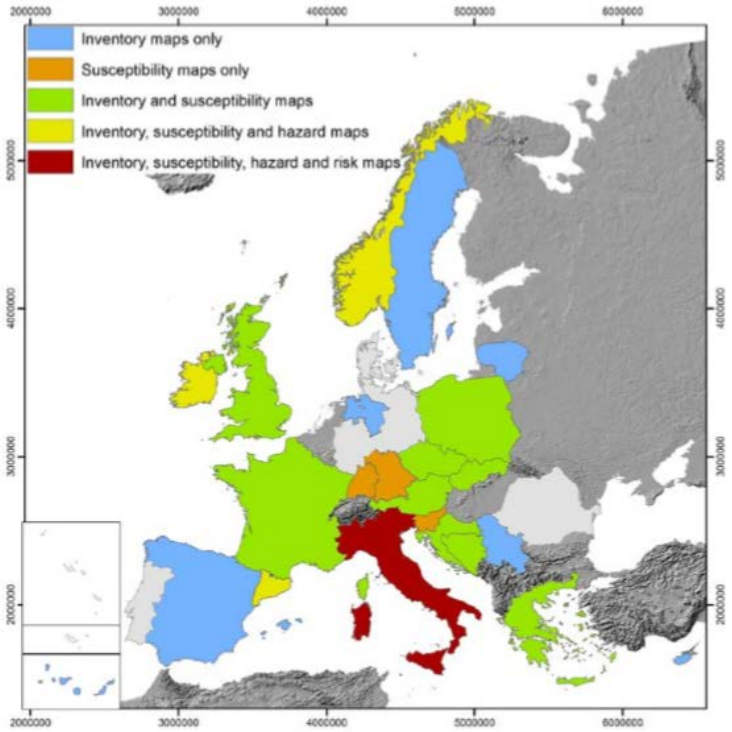


Figure 5 Types of landslide maps produced by the participant National and regional Geological Surveys

U-Geohaz Results

Back to Results menu

WP 5: Demonstration at different countries

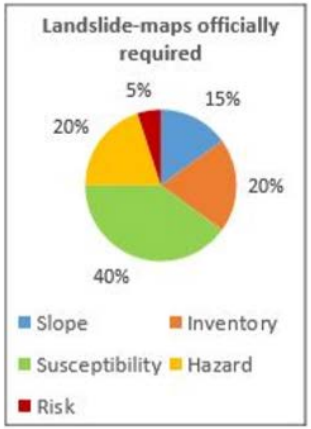


Figure 8 Landslide maps officially required by the legislations in force. 55% of the countries only required slope/susceptibility maps

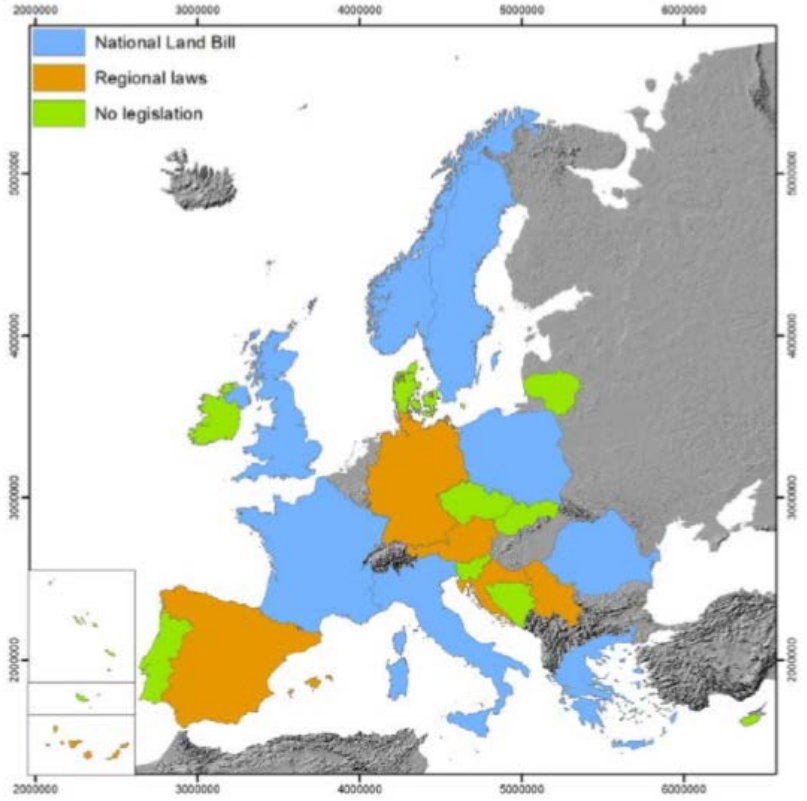


Figure 7 Legislation: how landslides are integrated into urban/land-use planning. 43% of the countries currently have no legal measures at all

See more here:
https://u-geohaz.cttc.cat/

CTTC
Centre Tecnològic de Telecomunicacions de Catalunya

WP 5: Demonstration at different countries

The **U-Geohaz Training** will be held the 3th and 4th of June in Athens. The training event is aimed at delivering the U-Geohaz tools and methods and transferring the basic knowledge to the Geological Susvays (GSs) in order to make them able to develop the U-Geohaz products and to provide them to the Civil Protection Authorities (CPAs). The training will be addressed to the 13 national and regional Geological Survays of 12 EU countries, which are included in the consortium.