

# Tools for fast analysis of InSAR based displacement maps

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EGU general assembly

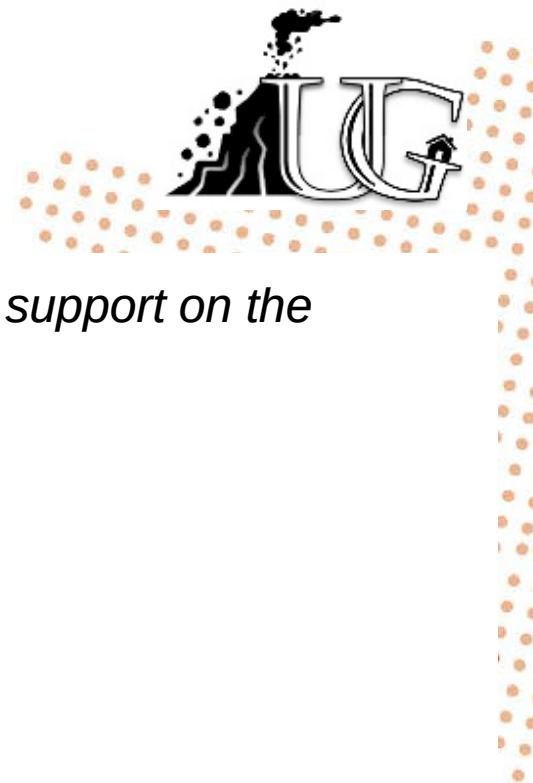
# Introduction



- This work summarizes part of the tools developed in the EU projects U-Geohaz (<http://u-geohaz.cttc.cat>), Safety (<http://Safety.cttc.cat>) and Momit and that will be updated and improved in the ongoing Project Riskcoast (SOE3/P4/E0868)
- These projects share a common goal that is to develop tools and procedures to exploit EO data to continuously assess the potential impact of active geohazards in urban areas and infrastructures.
- In this presentation we focus on tools to support the analysis of Sentinel-1 InSAR based results.
  - the main goal is to provide tools to help non-expert users on the interpretation of the standard products provided by InSAR techniques.
- We introduce two developed tools:
  - Active deformation areas tool (ADA Finder)
  - Active deformation areas classifier (ADA classifier)



# Why these tools?

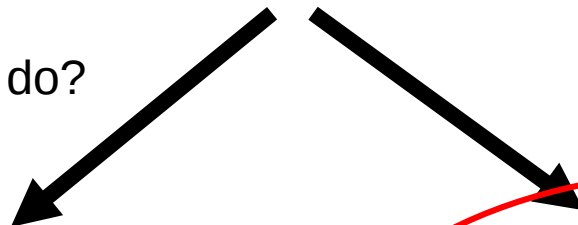


*“We want to develop tools and procedures to provide support on the management of geohazards”*



We need of operational products

What can we do?



Working at processing  
level

Post processing: provide  
simplified products for not  
expert users

Analysis and interpretation: difficult and time consuming

1. Geometric limitations of SAR acquisition

2. Spatial and temporal noise

3. Huge amount of information

Velocity  
[mm/yr]

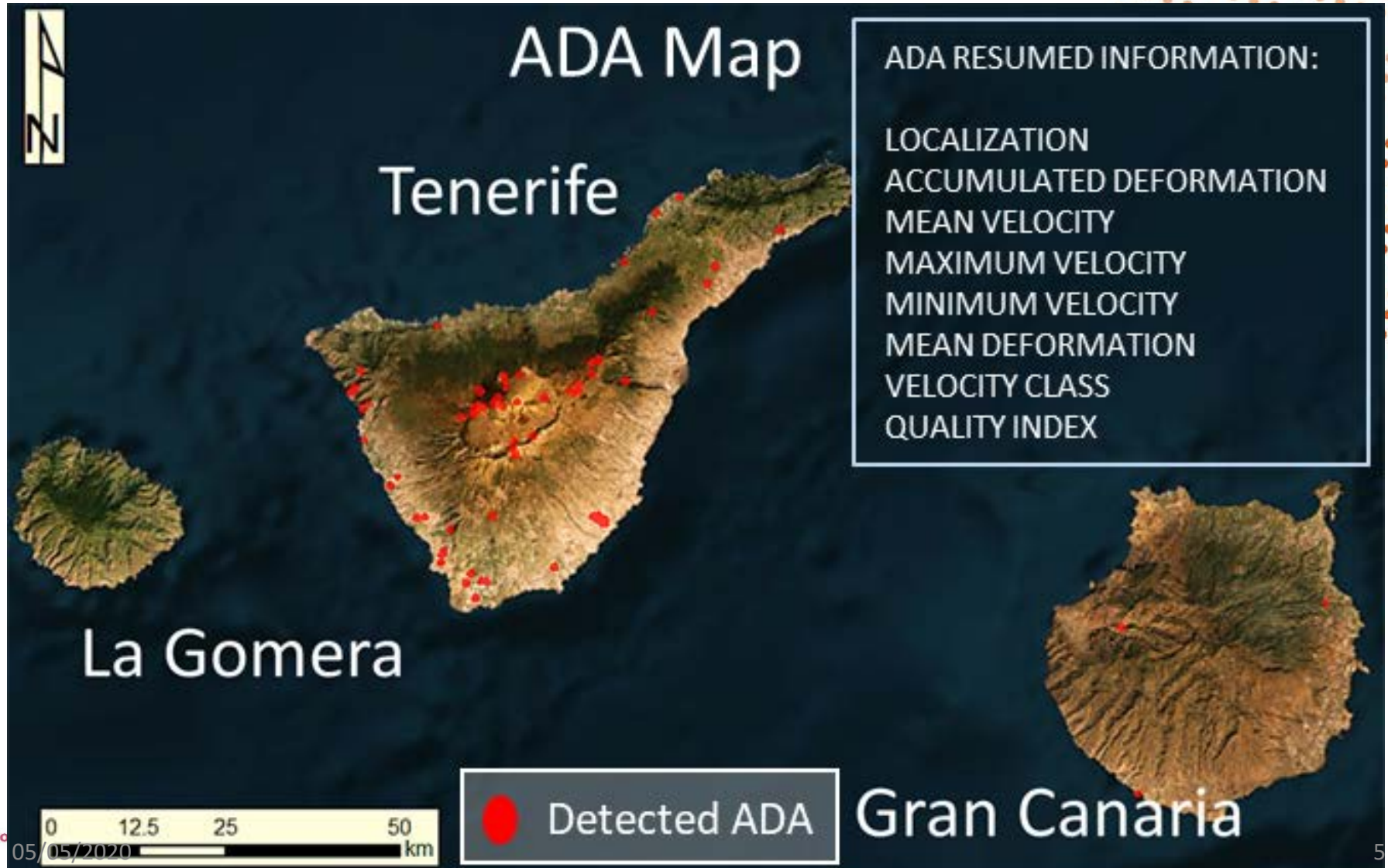


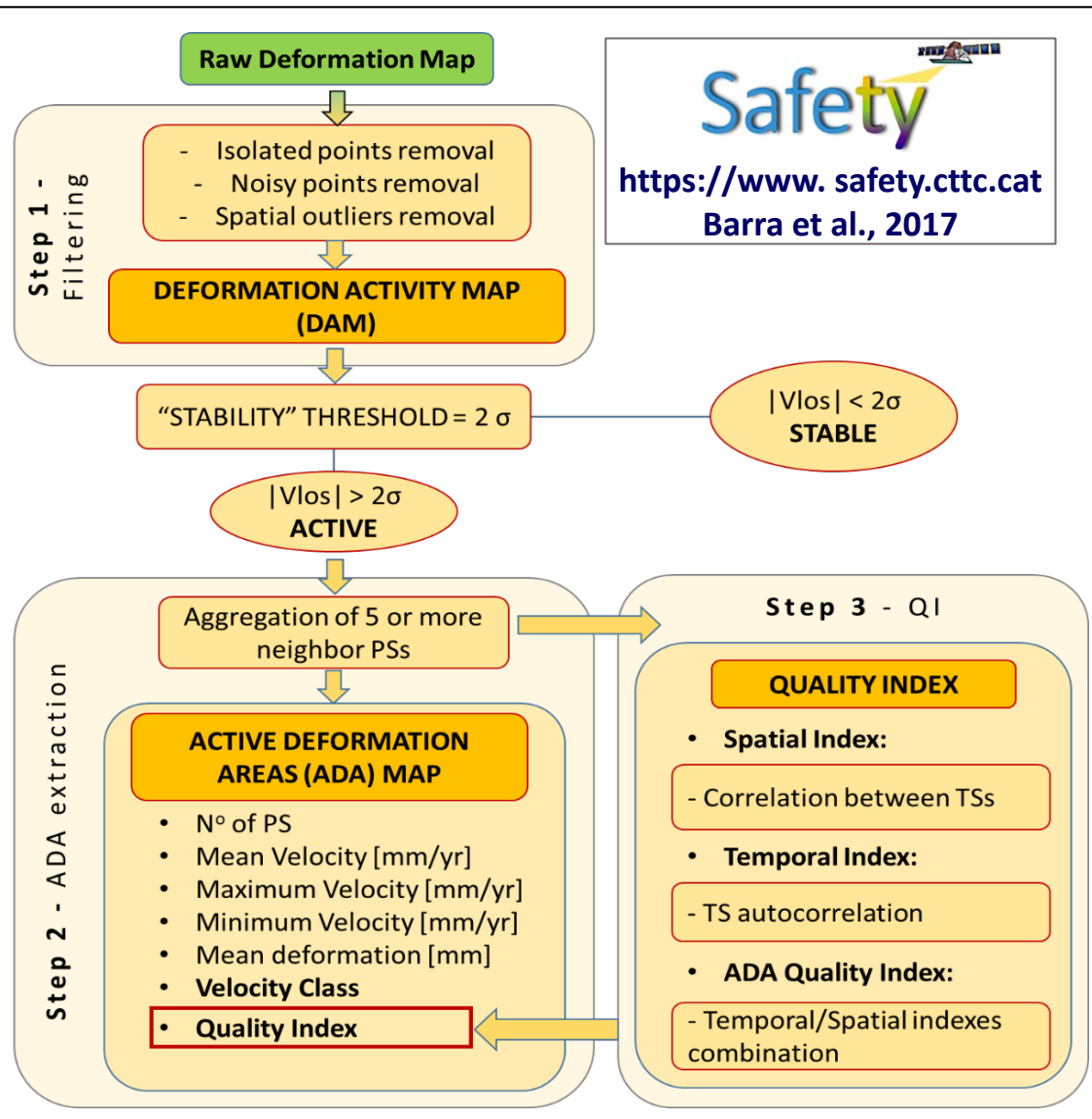
Total land area around 5.000 km<sup>2</sup>

# Proposed solution



## ADA MAP: automatic Active Deformation Areas extraction





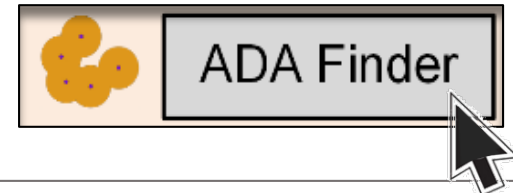
- Semi-automatic
- Repeatable
- Comparable
- Tuneable
- RAPID!



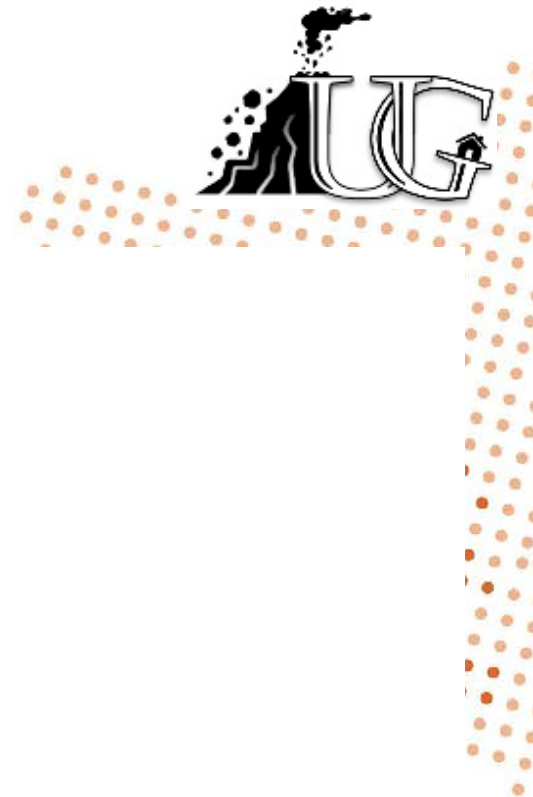
**MOMIT**  
MULTI-SCALE OBSERVATION  
AND MONITORING OF RAILWAY  
INFRASTRUCTURE THREATS

<https://www.momit-project.eu/>

Navarro, J., et al, 2019



# ADA Finder tool outputs



PSI\_Row\_Deformation\_Map.shp



Filtering



Deformation\_Activity\_Map.shp

Extraction

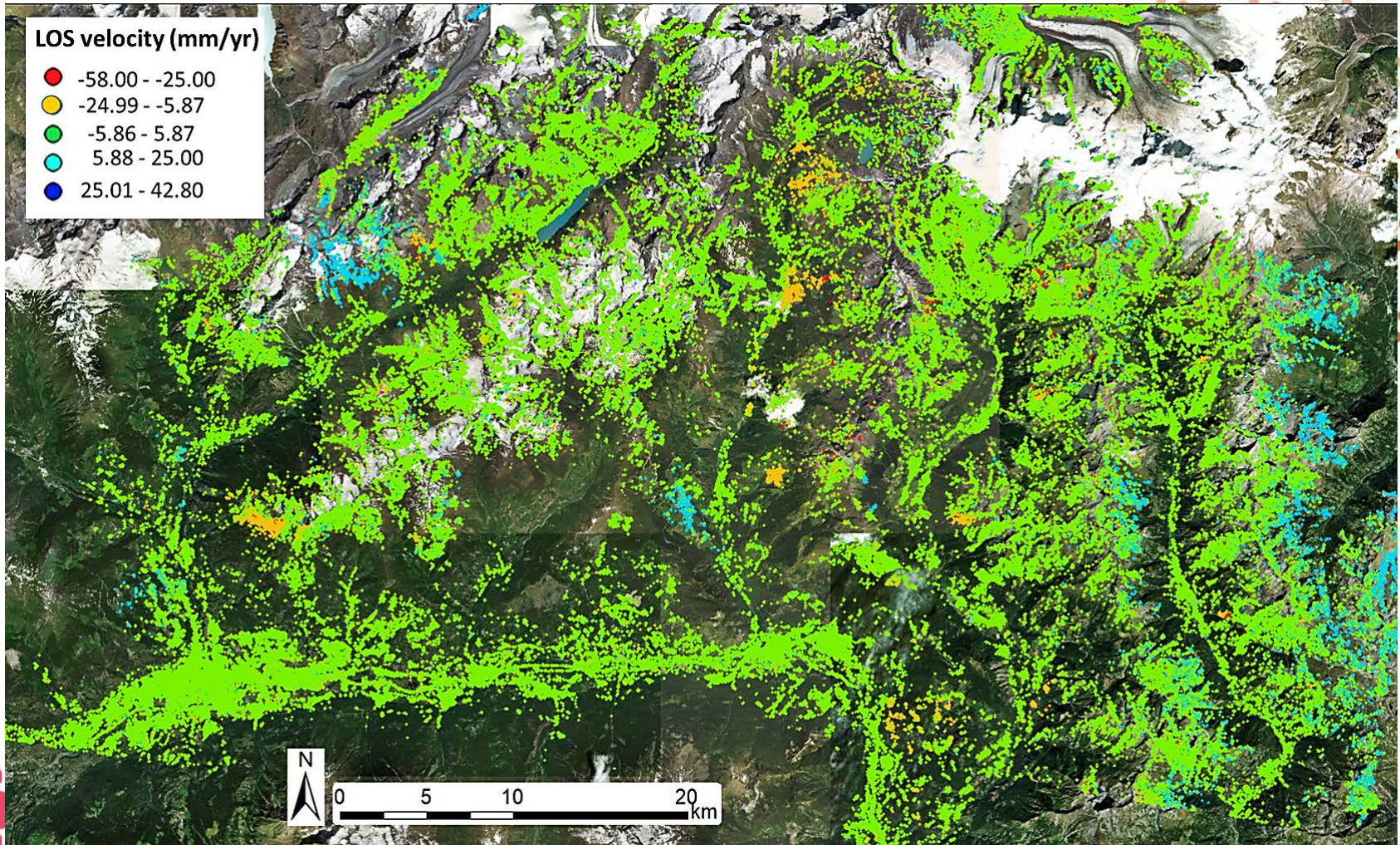


Active\_Deformation\_Areas.shp

# ADAFinder example: Aosta Valley

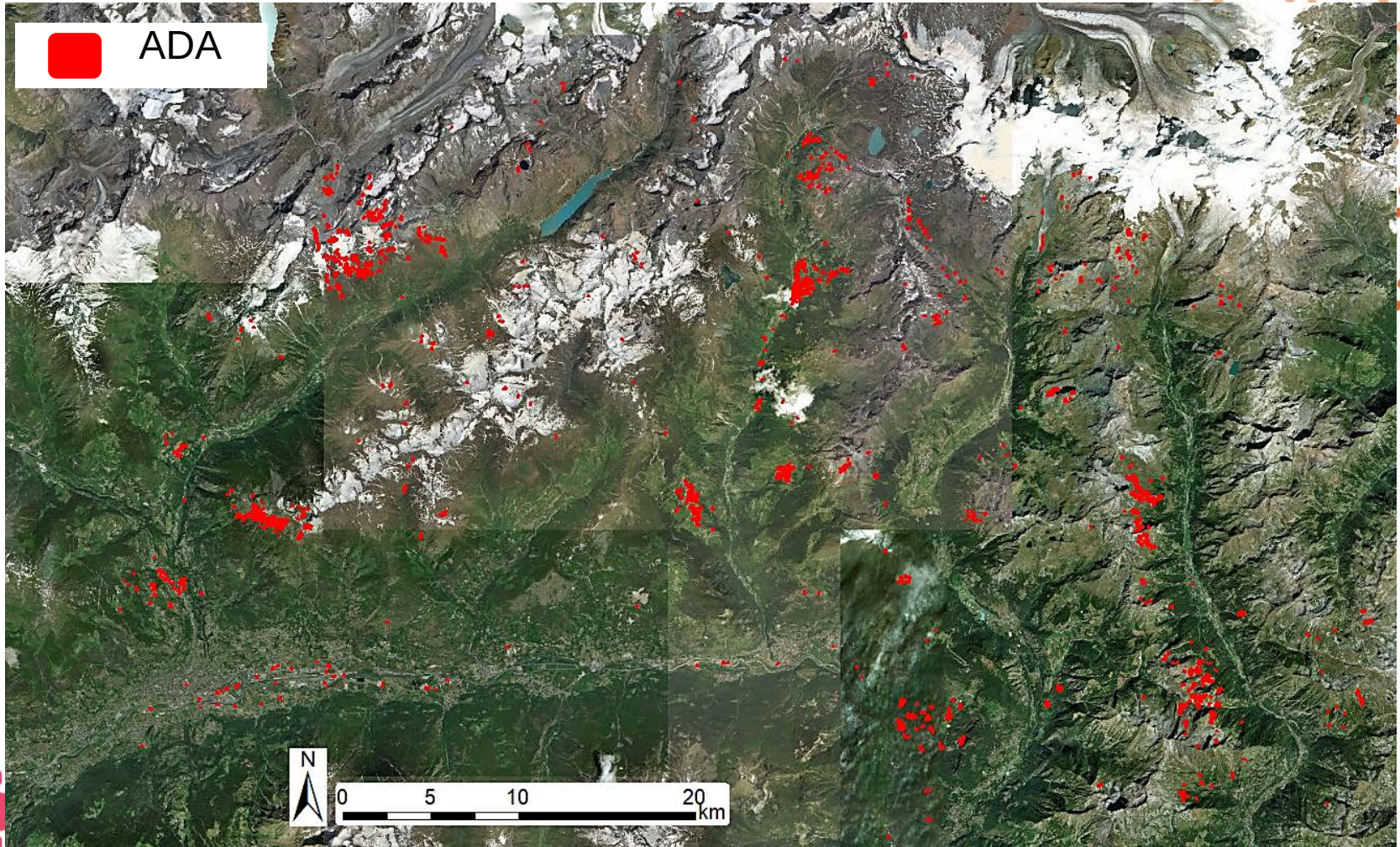


## ADA MAP: automatic Active Deformation Areas extraction



# ADAFinder output shapefile

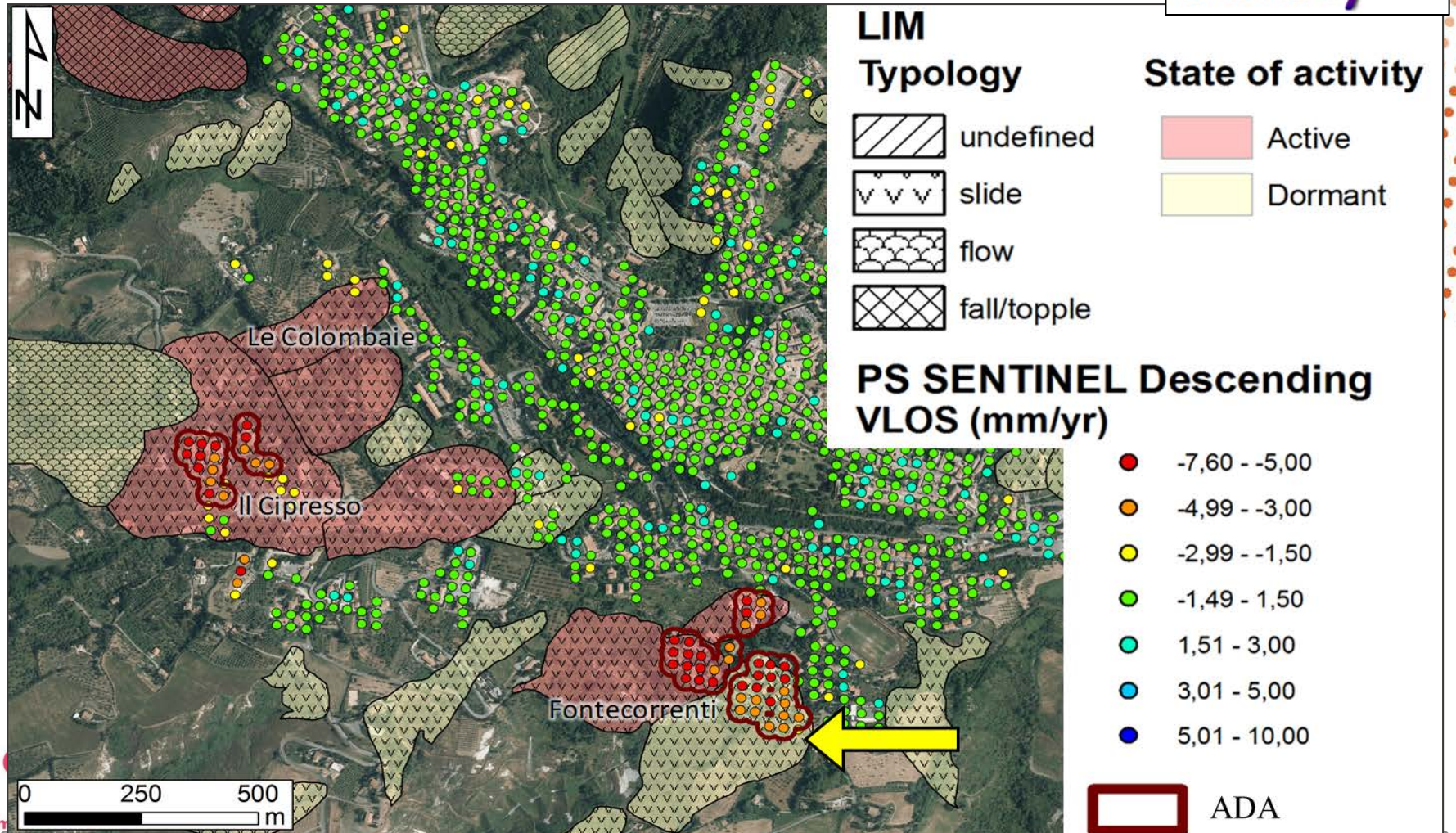
**ADA MAP: automatic Active Deformation Areas extraction**



# ADA + other data: assessment and interpretation

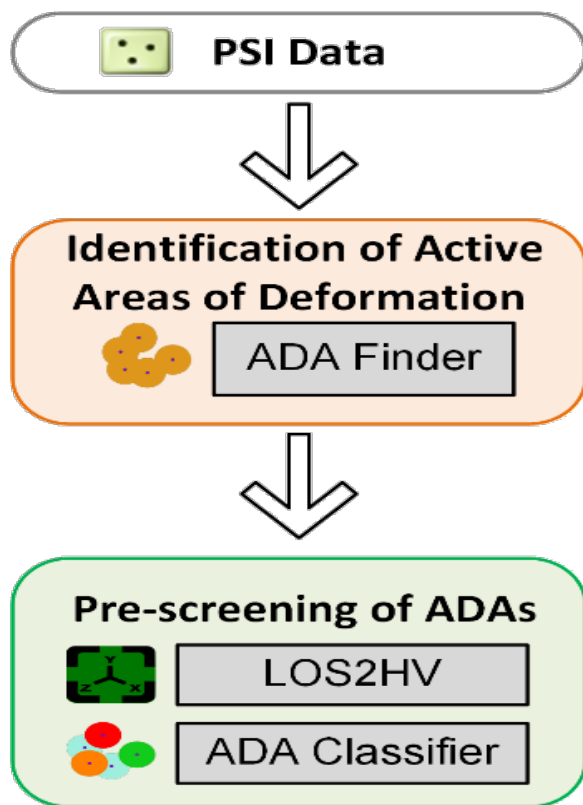
Example 1: Landslide inventory map

Volterra (Italy)



# ADA Classifier:

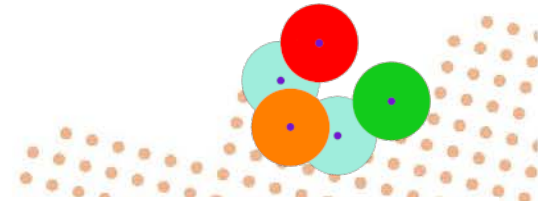
*Automatic preliminar assessment of the phenomena*



## Other data

DTM + inventories  
(landslides, sinkholes, land  
subsidences, infrastructures)  
+ geologic map

# ADA classifier tool

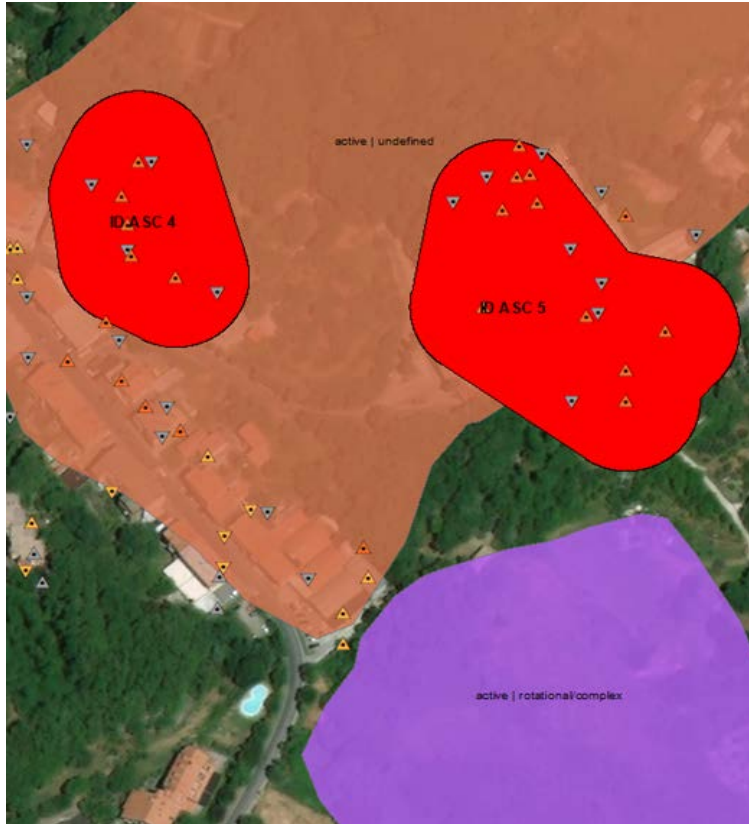


## Target

Classify the ADAs. Up to 6 phenomena:  
**landslide, sinkhole, subsidence, constructive settlements, expansive soils & temperature effects.**

## Input

ADAs (from ADAfinder) + DTM + inventories for landslides, sinkholes, land subsidences, infrastructures + geologic map + horizontal displacement map (los2hv).



# ADA classifier tool

6 different algorithms, one per phenomenon to test

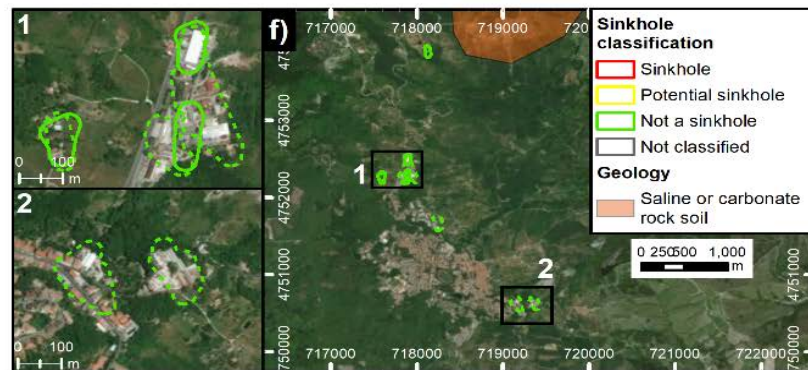
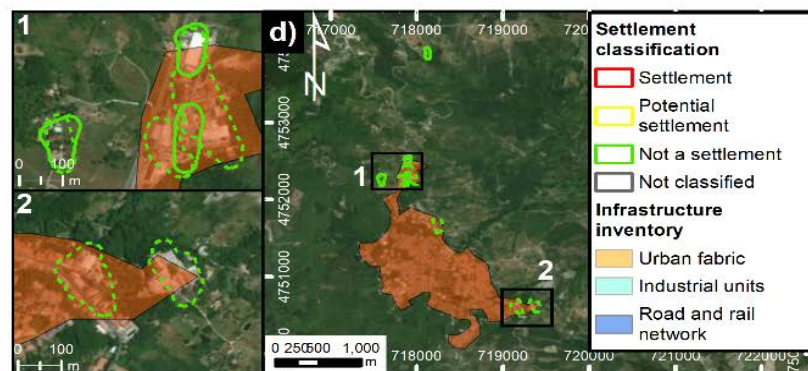
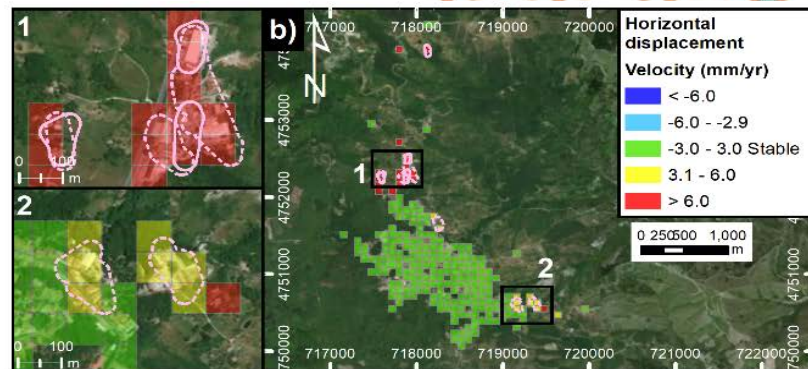
Examples for Landslide and sinkhole

## ID type 1 (Landslide)

|                                                                                         |     |                     |                                       |     |                                |
|-----------------------------------------------------------------------------------------|-----|---------------------|---------------------------------------|-----|--------------------------------|
| Is the percentage of intersection of the ADA with the landslide inventory > <b>Th1?</b> | Yes | <b>Landslide</b>    |                                       |     |                                |
|                                                                                         | No  | Slope > <b>Th2</b>  |                                       | Yes | <b>Potential new landslide</b> |
|                                                                                         |     |                     | Horizontal displacement > <b>Th3?</b> | No  | <b>Not a landslide</b>         |
|                                                                                         |     | Slope < <b>Th2?</b> | <b>Not a landslide</b>                |     |                                |

## ID type 2 (Sinkhole)

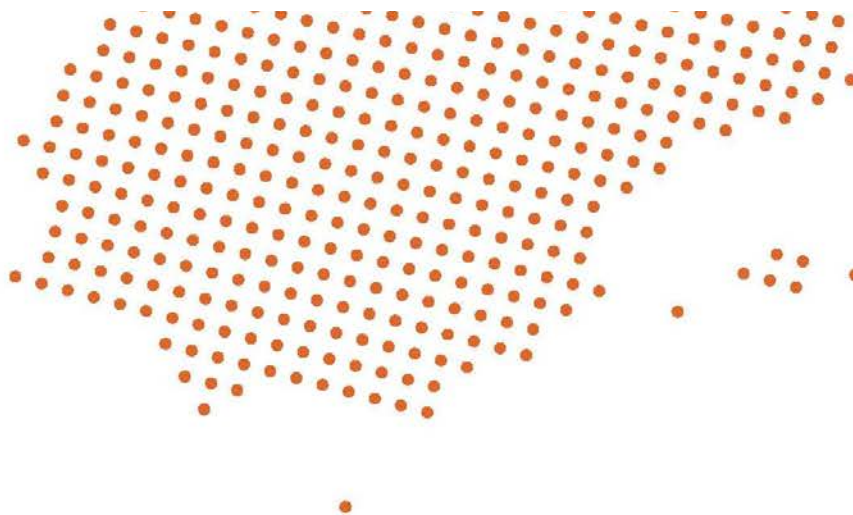
|                                                                                        |     |                                              |                                       |     |                       |
|----------------------------------------------------------------------------------------|-----|----------------------------------------------|---------------------------------------|-----|-----------------------|
| Is the percentage of intersection of the ADA with the sinkhole inventory > <b>Th4?</b> | Yes | <b>Sinkhole</b>                              |                                       |     |                       |
|                                                                                        | No  | Saline carbonate rock/soil > <b>Th13(1).</b> | Horizontal displacement > <b>Th5?</b> | Yes | <b>Not a sinkhole</b> |
|                                                                                        |     | Other lithologies                            | <b>Not a sinkhole</b>                 |     |                       |



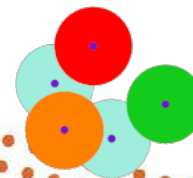
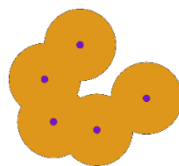
# Summary



- ADA finder and ADA tools are available under a license agreement.
- We are working on providing more advanced products (see for example Solari et al. 2020).



# Thank you!!



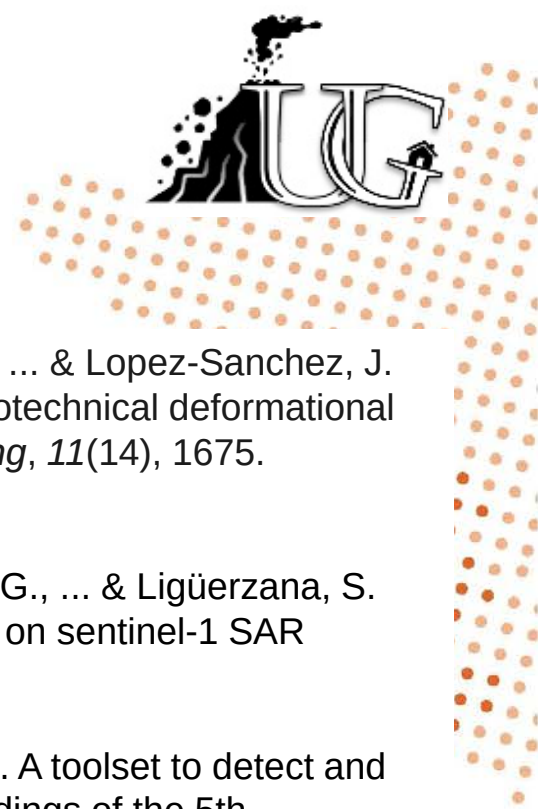
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INFRASTRUCTURE THREATS



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# References



Tomás, R., Pagán, J. I., Navarro, J. A., Cano, M., Pastor, J. L., Riquelme, A., ... & Lopez-Sanchez, J. M. (2019). Semi-automatic identification and pre-screening of geological–geotechnical deformational processes using persistent scatterer interferometry datasets. *Remote Sensing*, 11(14), 1675.

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Navarro, J. A., Cuevas, M., Tomás, R., Barra, A., & Crosetto, M. (2019, May). A toolset to detect and classify Active Deformation Areas using interferometric SAR data. In Proceedings of the 5th International Conference on Geographical Information Systems Theory, Applications and Management, Heraklion, Crete, Greece (pp. 3-5).

Solari, L., Bianchini, S., Franceschini, R., Barra, A., Monserrat, O., Thuegaz, P., ... & Catani, F. (2020). Satellite interferometric data for landslide intensity evaluation in mountainous regions. *International Journal of Applied Earth Observation and Geoinformation*, 87, 102028.

