Sentinel-1 for Granada coast landslides monitoring and potential damage assessment

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Dear all,

My presentation is about a work developed in the framework of the Riskcoast Project.

After a short overview of the project, you will see some results over the coastal area of Granada Municipality (in Andalucía, South of Spain), which is highly affected by slope instabilities.

This work is an example of multi scale (medium to large) application of InSAR for geohazard risk management: starting from the results obtained over a wide area of around 1100 square km, we can focus on a very local analysis. In this case, the analysis locates the areas that are most susceptible to generate damages due to local differential settlements.

Thank you for your interest.

Take care and be safe,

Anna

In the next slides

- Introduction: the Riskcoast Project
- Wide area InSAR results and Active Displacement Areas (ADA) Map
- Example of few detected ADA
- Local Analysis: the case of Los Almendros Urbanization. Identification of areas affected by differential displacement and comparison with damage map

↓

Preliminary results

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https://interreg-sudoe.eu/gbr/home

- Main goal of Riskcoast:

"*We want to develop tools and procedures to provide support on the management of geohazards related to coastal areas like for example landslides, erosion or flooding's*"

HOW?

HOW?

- By providing a review on the main geohazards risks affecting the SUDOE coasts and how they are managed (GT1).
- We will test new statistical approaches to provide tools for urban planning and management (GT2)
- By proposing green approaches for geohazard risk mitigation and recovery. (GT6)
- By addressing the geohazards at a river basin level (GT3): integrated approach.
- By using monitoring tools (GT4): "*We will use innovative approaches to exploit far-medium and short range* ***remote sensing techniques***"

RISKCOAST - Desarrollo de herramientas para prevenir y gestionar los riesgos en la costa ligados al cambio climático

Combating climate change

We are 7 partners

Areas of study

- Costal erosion
- Slope instabilities
- Beach retreatment
- Urban development at risk
- Floods

Coast and fluvial basins of GRANADA

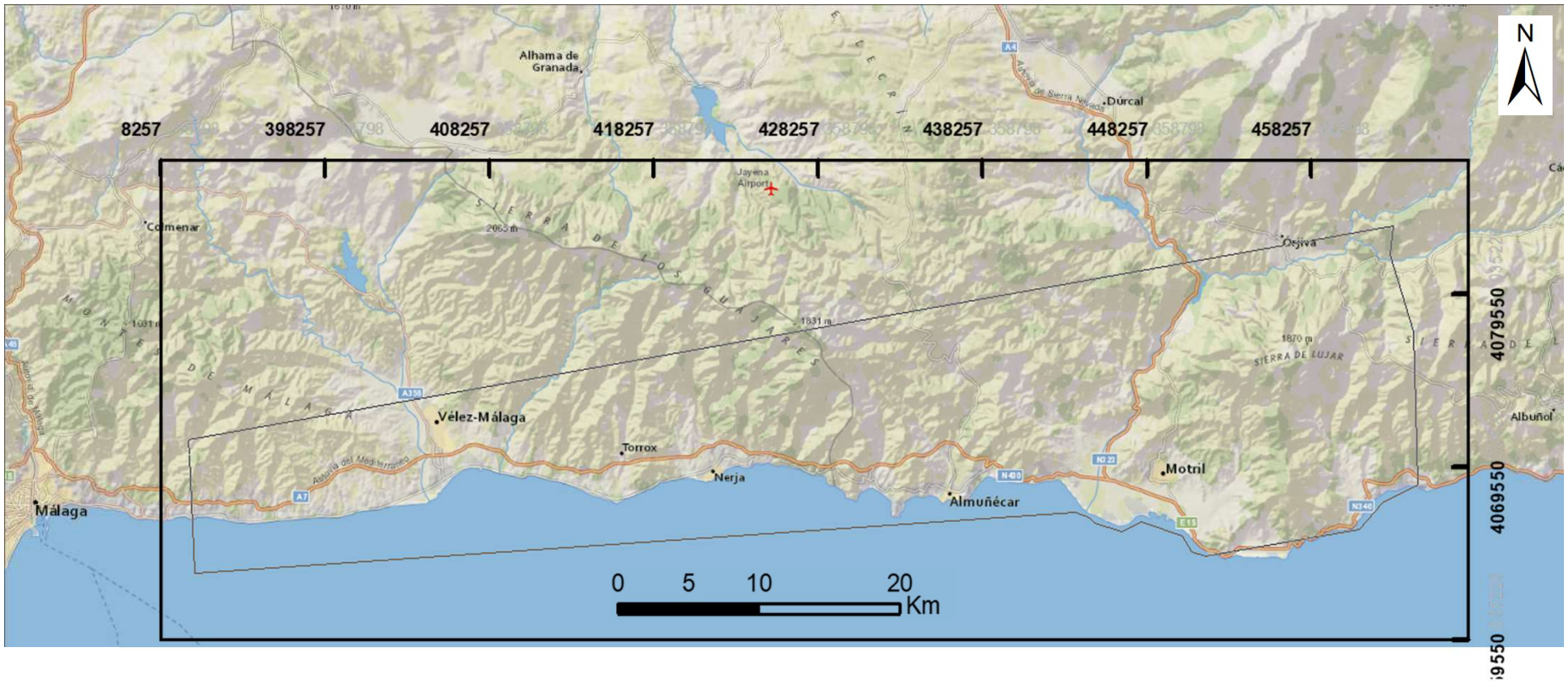
IBIZA

MALLORCA

Granada coast, Andalucía (Spain)

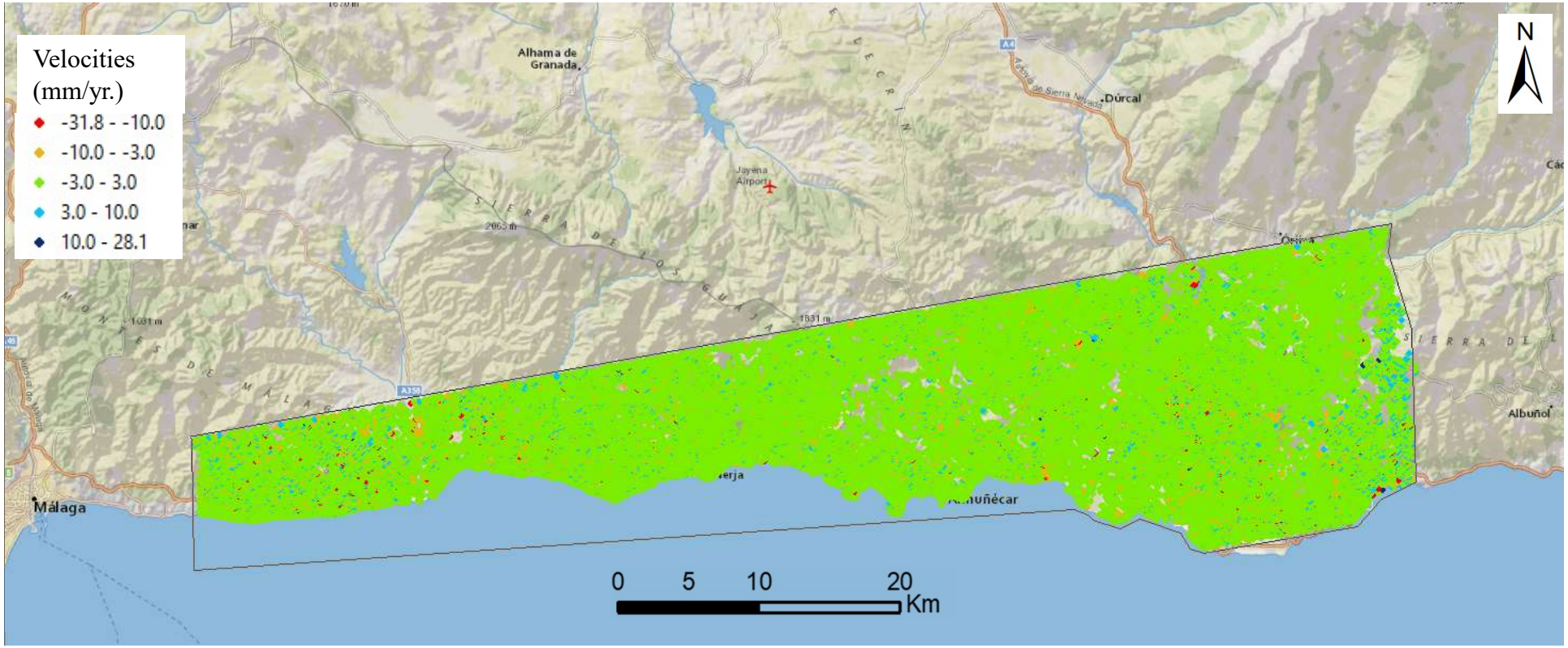
- Costal erosion
- **Slope instabilities**
- Beach retreatment
- Urban development at risk
- Floods

Granada Coast: Area of InSAR processing



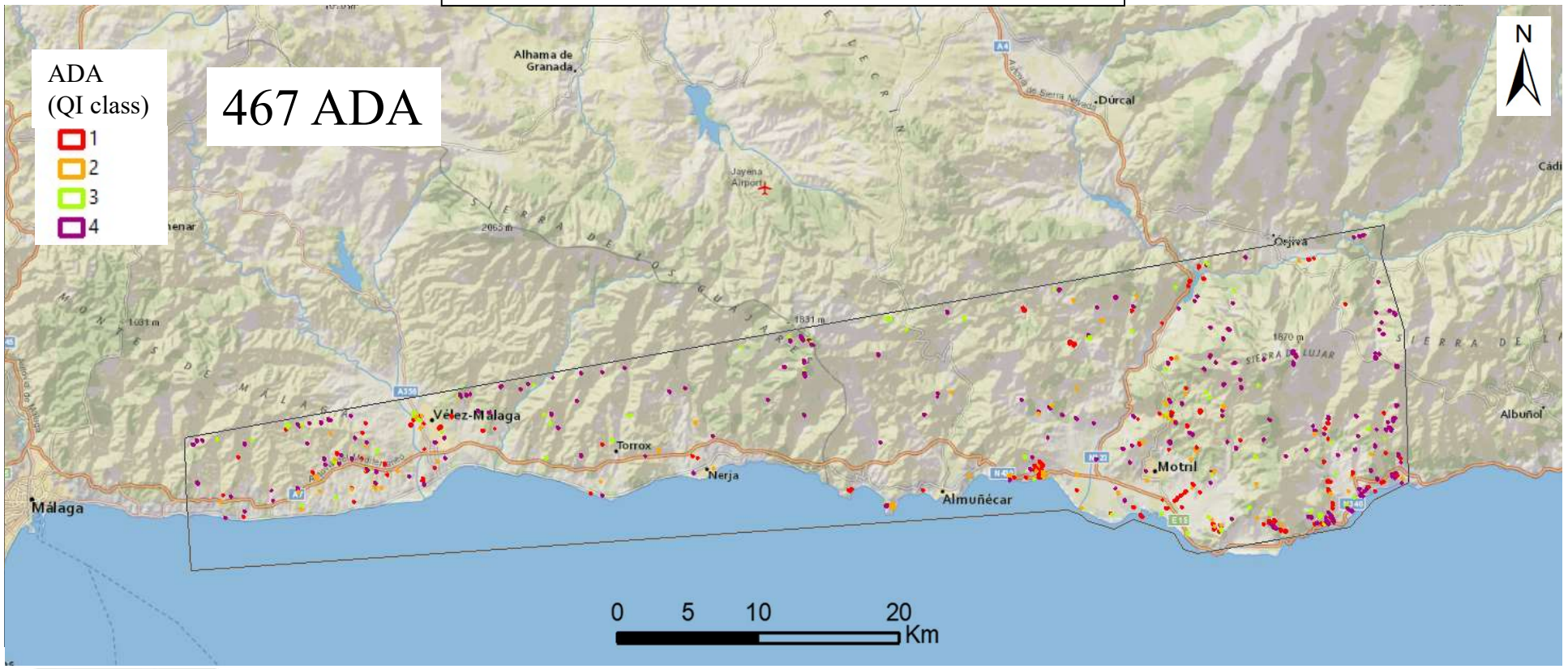
InSAR result over wide area
Velocity map

450330 points



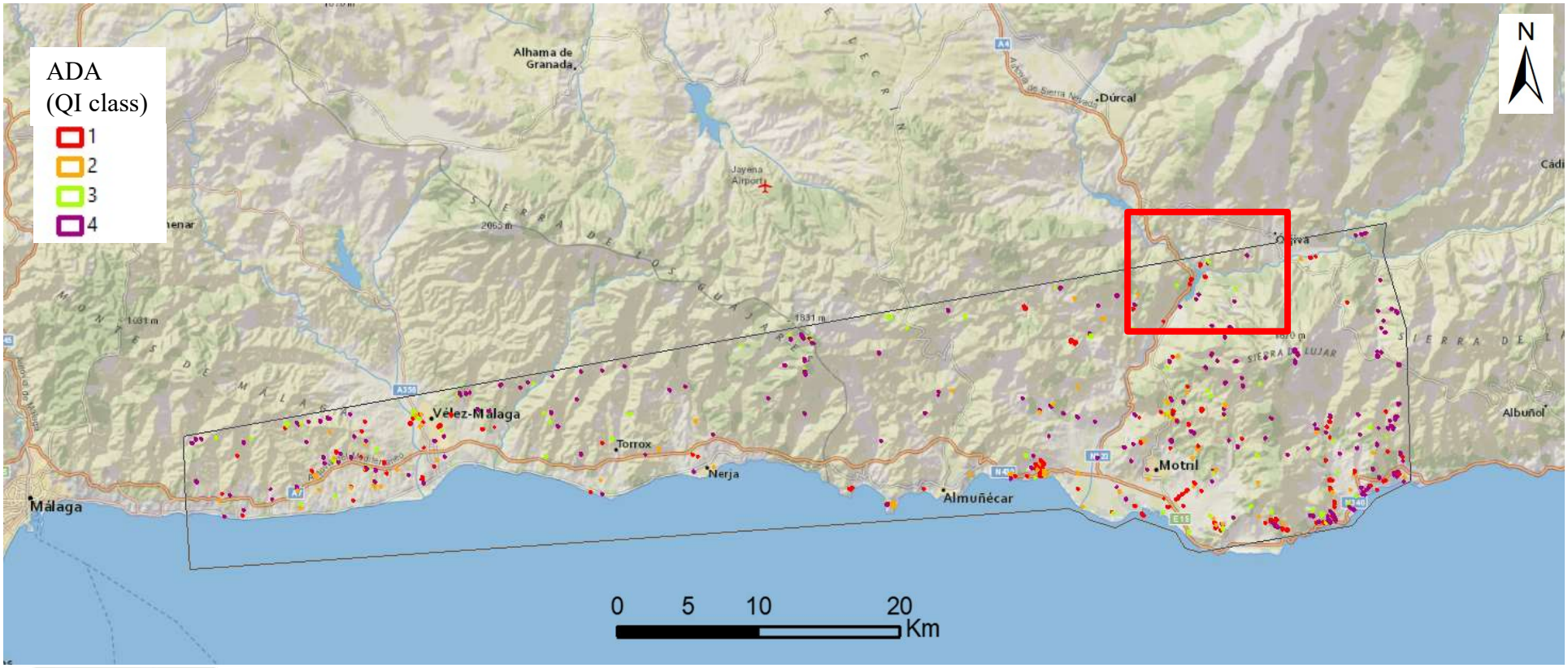
InSAR result over wide area
Active Displacement Areas Map

See **Barra et al., 2017**
for the ADA extraction method



InSAR result over wide area
Active Displacement Areas Map

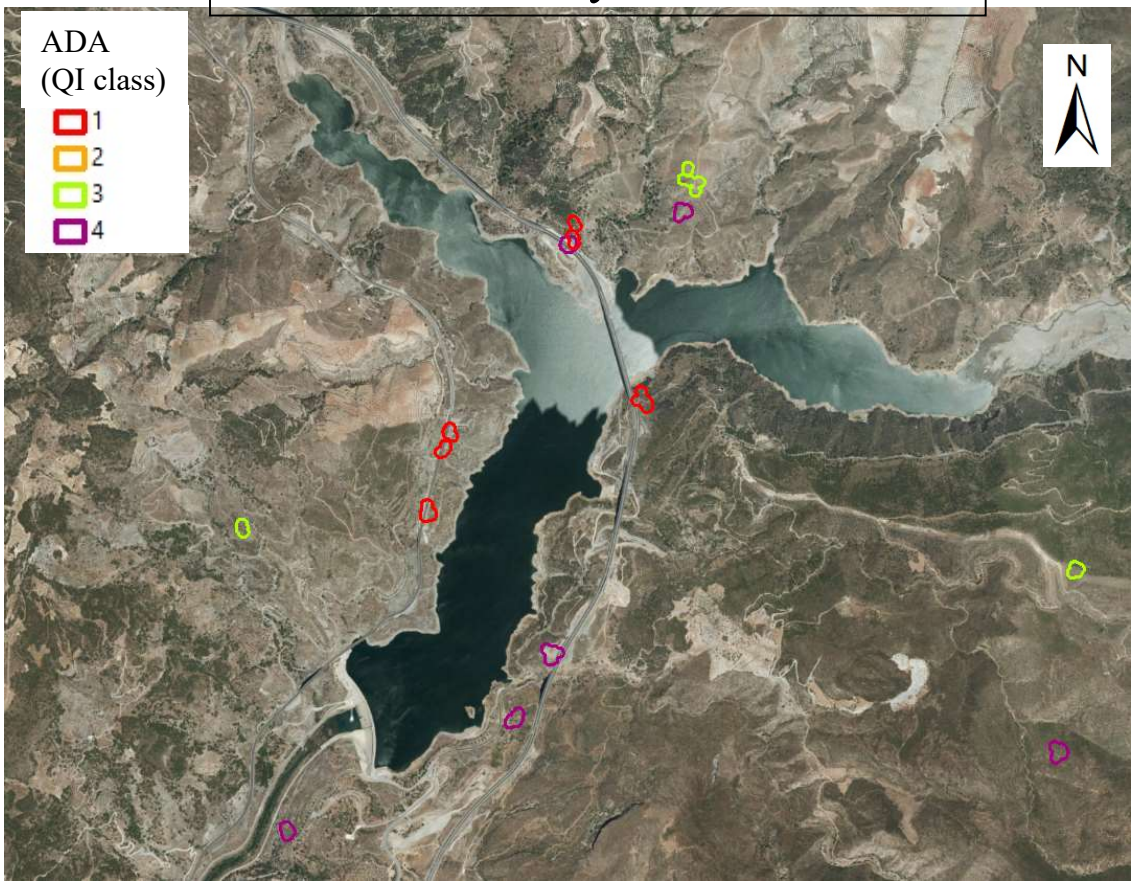
Example 1: The Rules Reservoir



InSAR result over wide area
Active Displacement Areas Map

Example 1: The Rules Reservoir

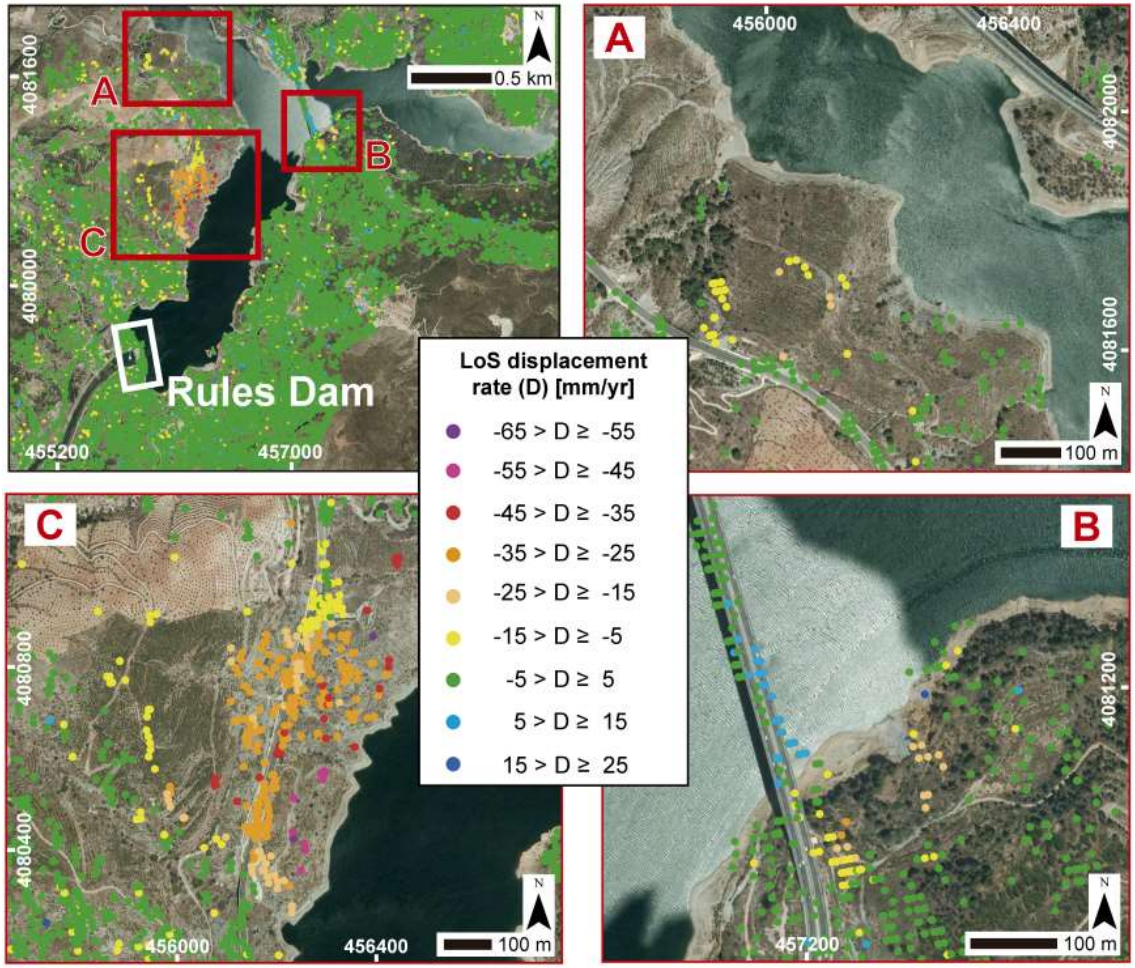
See **Reyes-Carmona et al., 2020** for the local analysis of the results



InSAR result over wide area
Active Displacement Areas Map

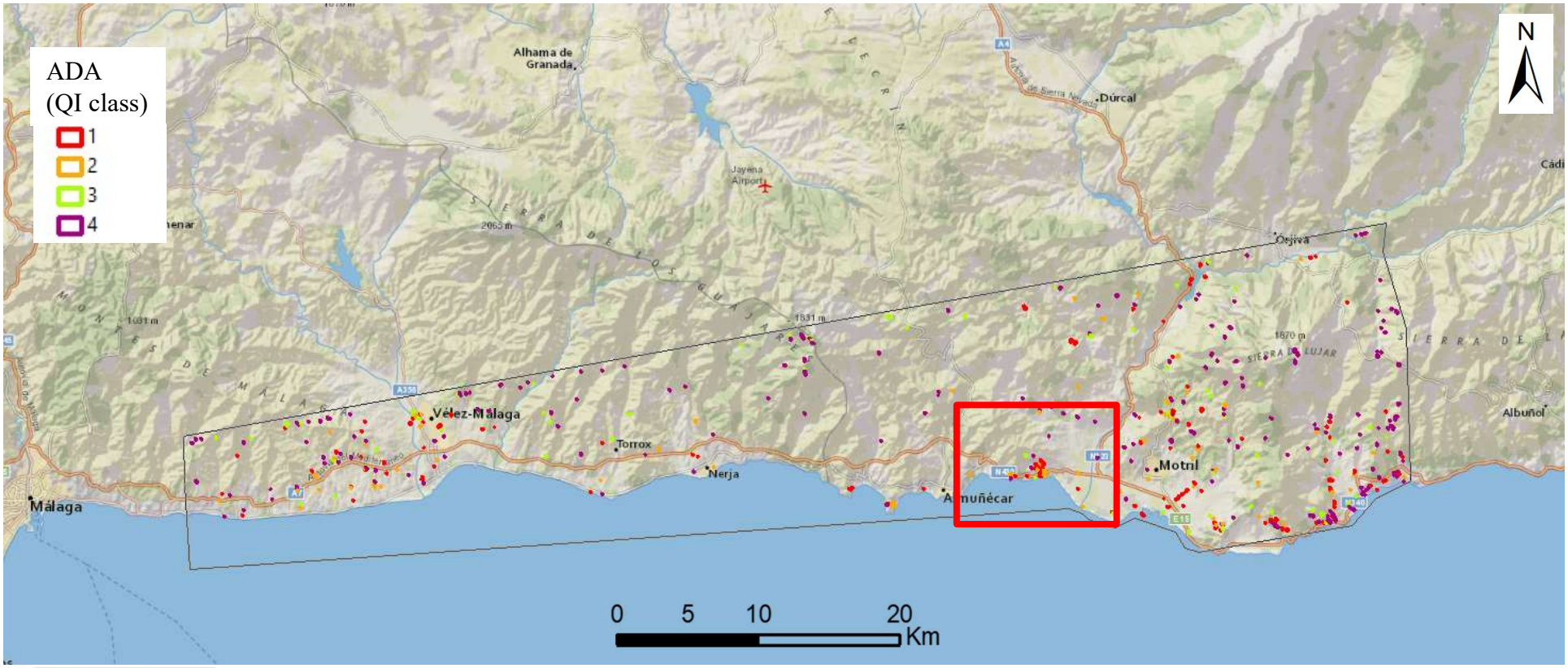
Example 1: The Rules Reservoir – Local Analysis

See **Reyes-Carmona et al., 2020**



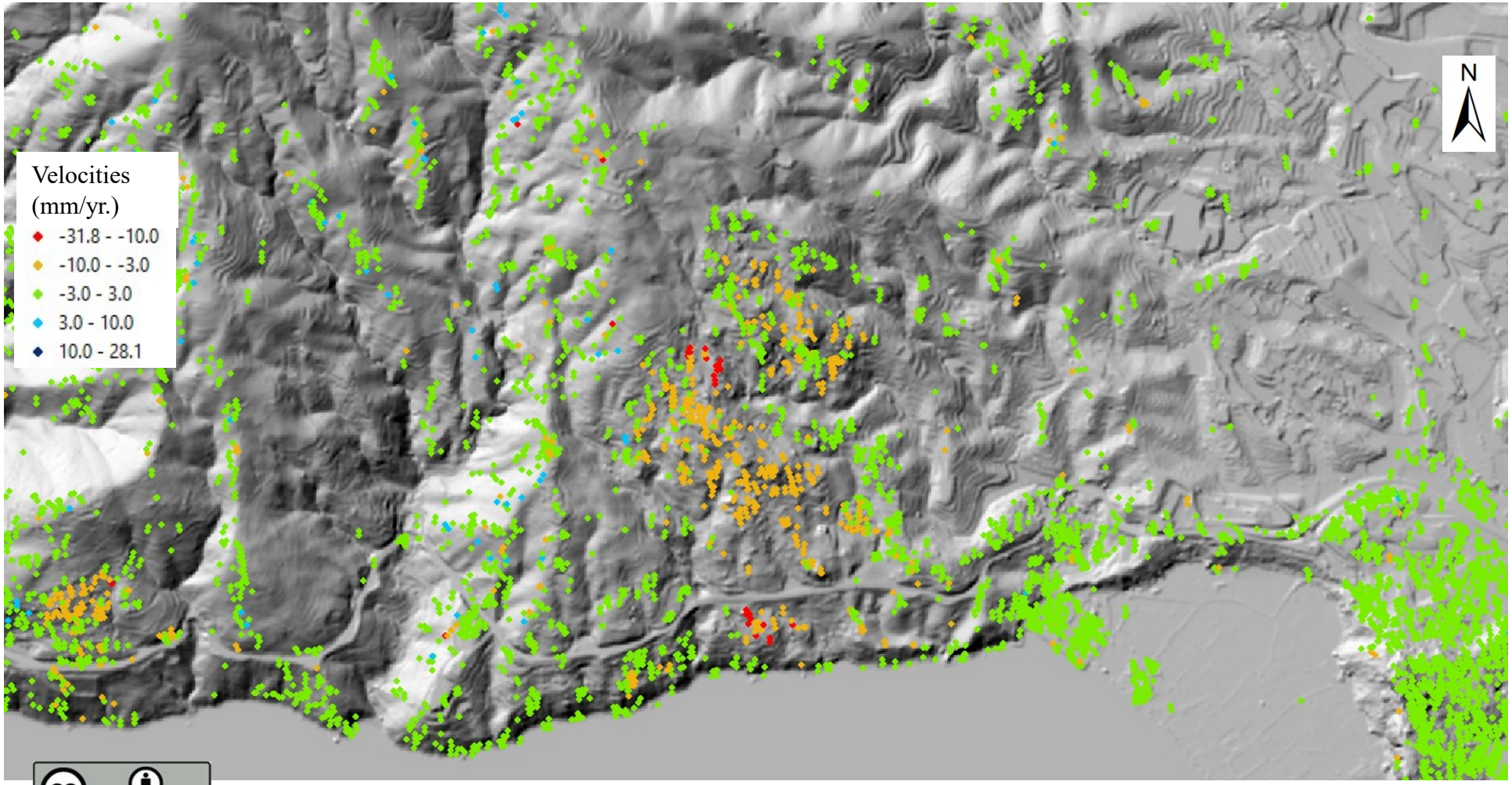
InSAR result over wide area
Active Displacement Areas Map

Example 2: urbanization Los Almendros



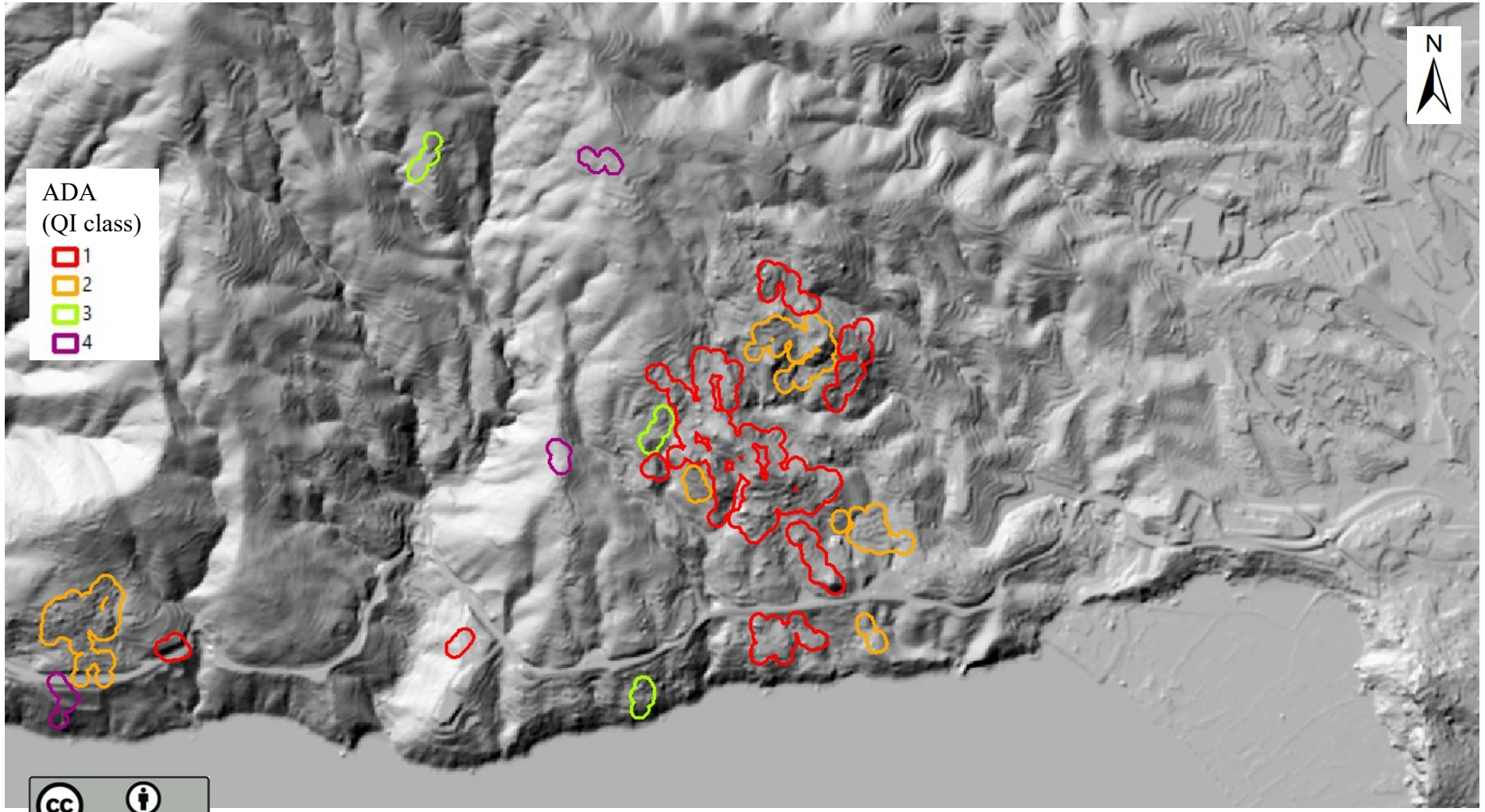
InSAR result over wide area Velocity Map

Example 2: urbanization Los Almendros

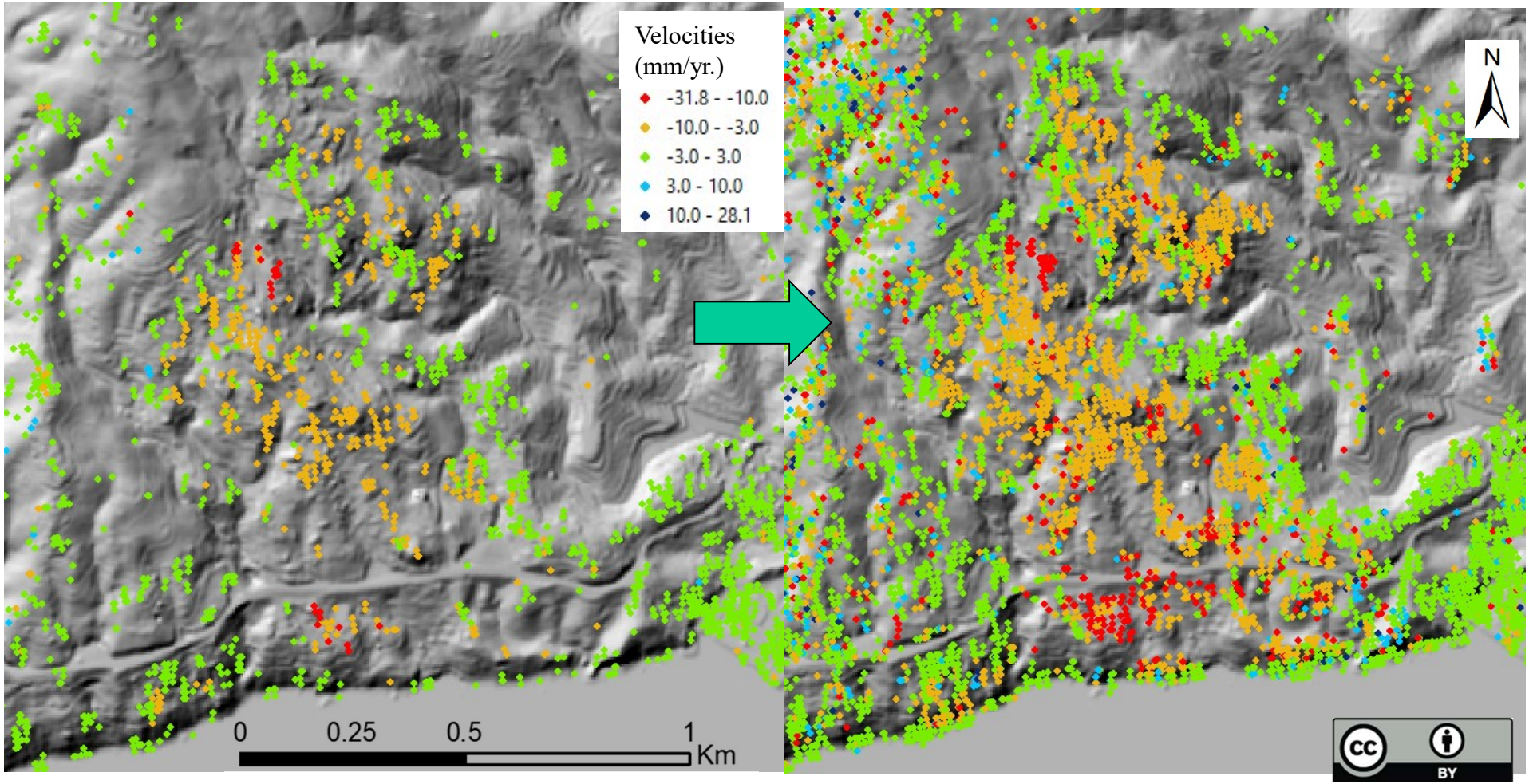


InSAR result over wide area
Active Displacement Areas Map

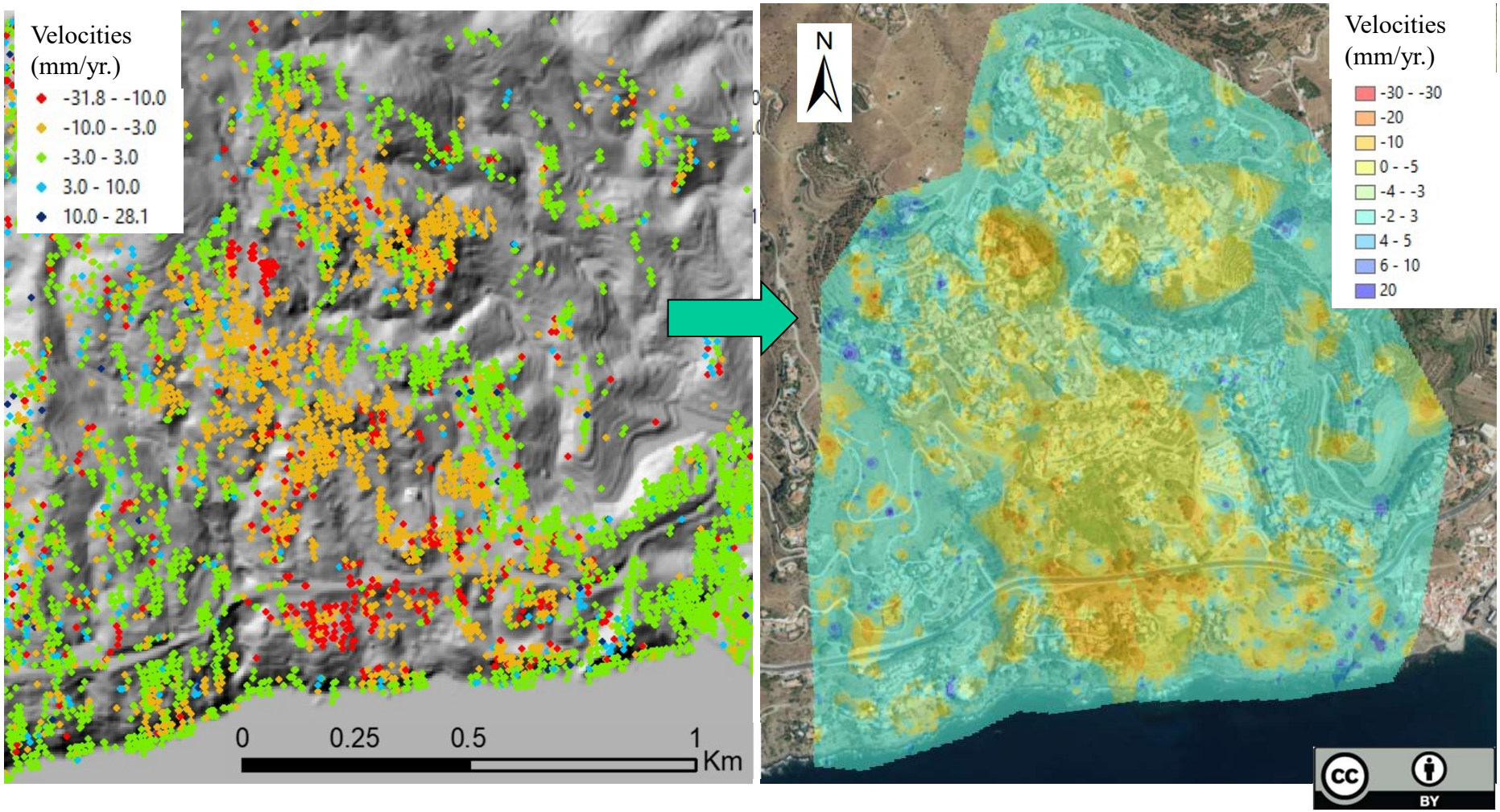
Example 2: urbanization Los Almendros



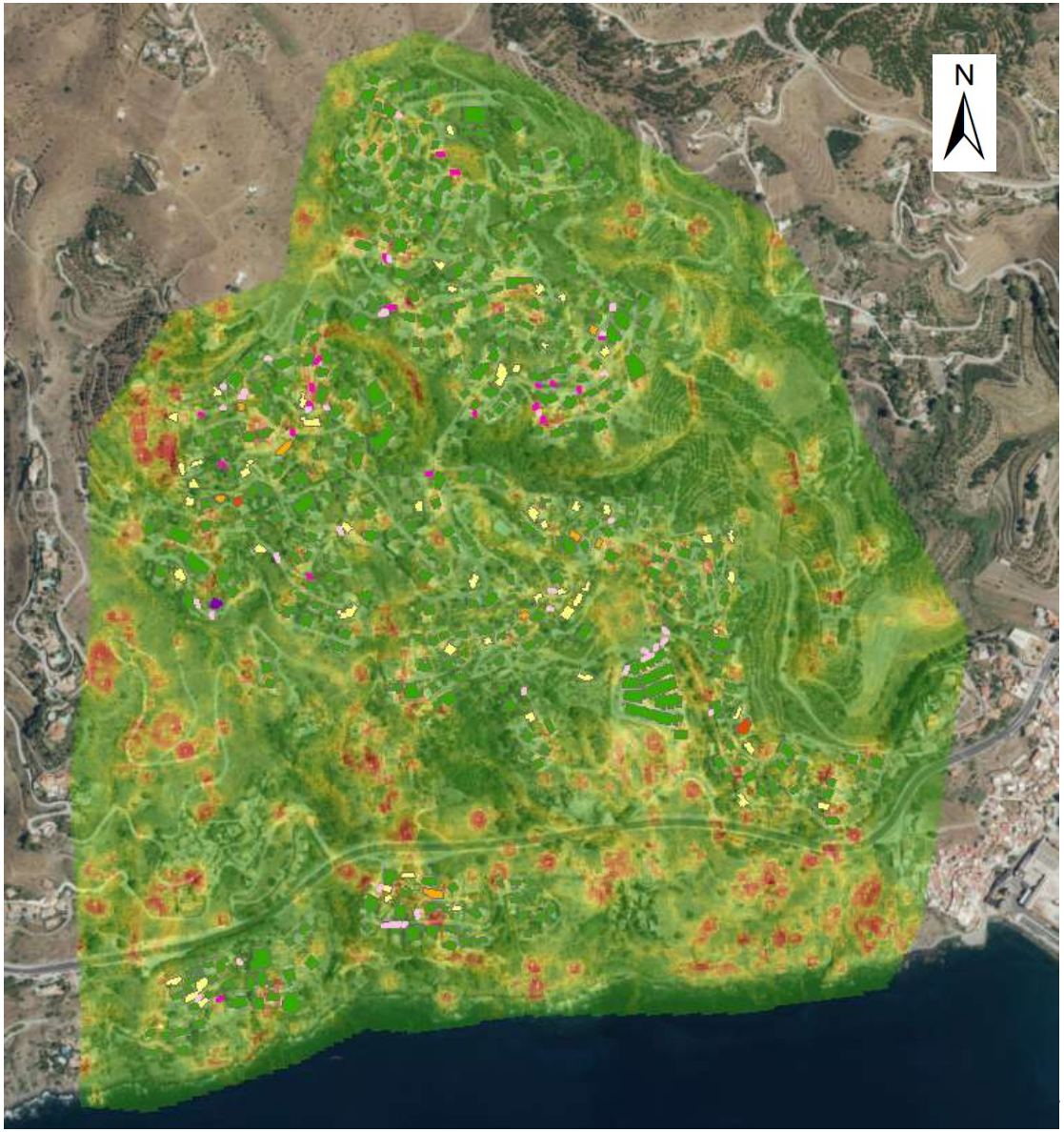
Los Almendros: local processing Velocity map (improving the points coverage)



Los Almendros: spatial interpolation of the Velocity map



Los Almendros: slope of the interpolated velocity map (maximum spatial velocity gradient)



Slope of Velocity interpolation (°)

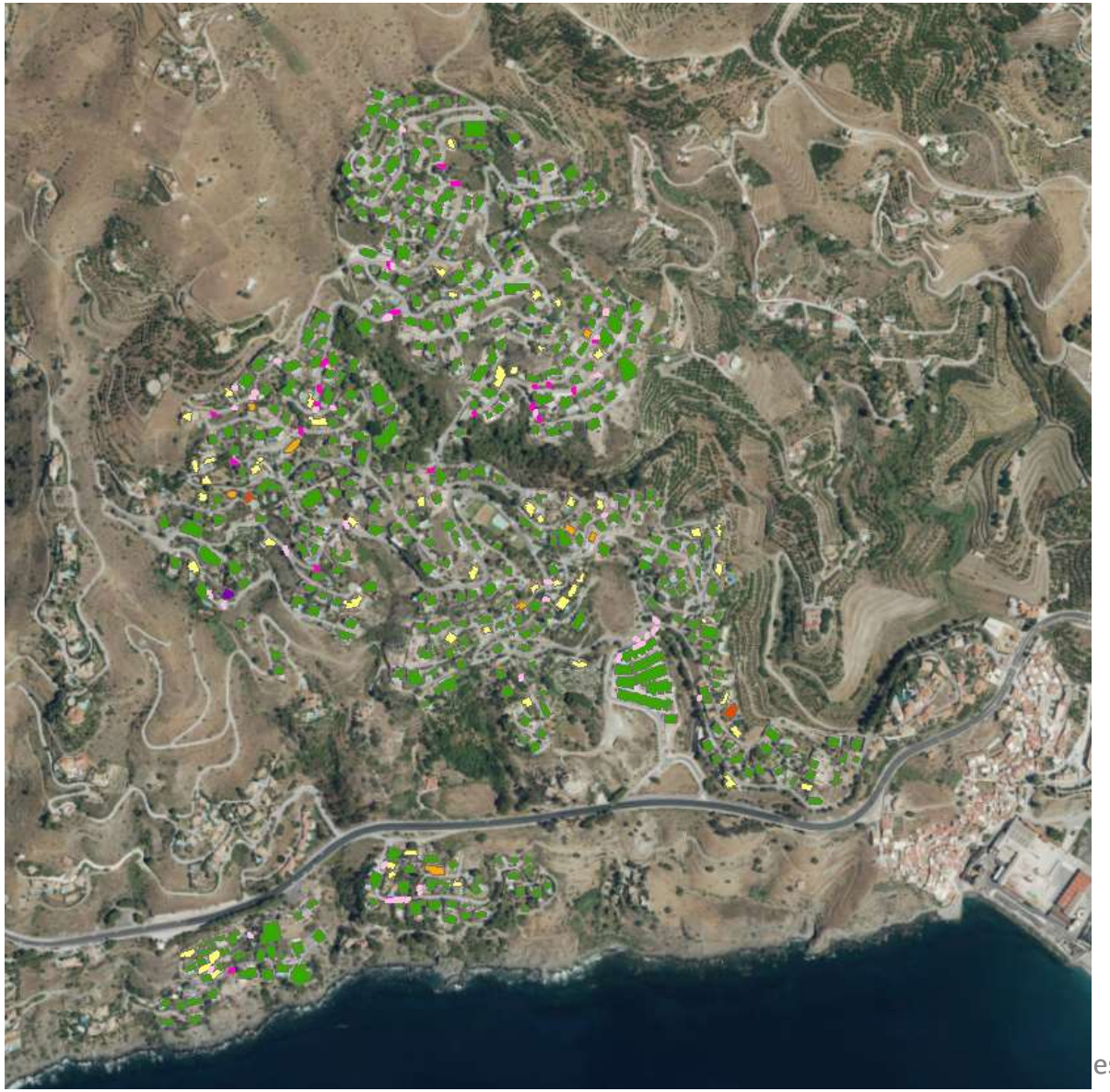
- 0 - 2
- 3 - 5
- 6 - 9
- 10 - 10
- 20 - 20
- 30 - 20
- 30 - 30
- 40 - 30

Building damage class

- 0
- 1
- 2
- 3
- 4

- Road Baches
- Road Cracks

Los Almendros: damage map based on field surveys



Building damage class*

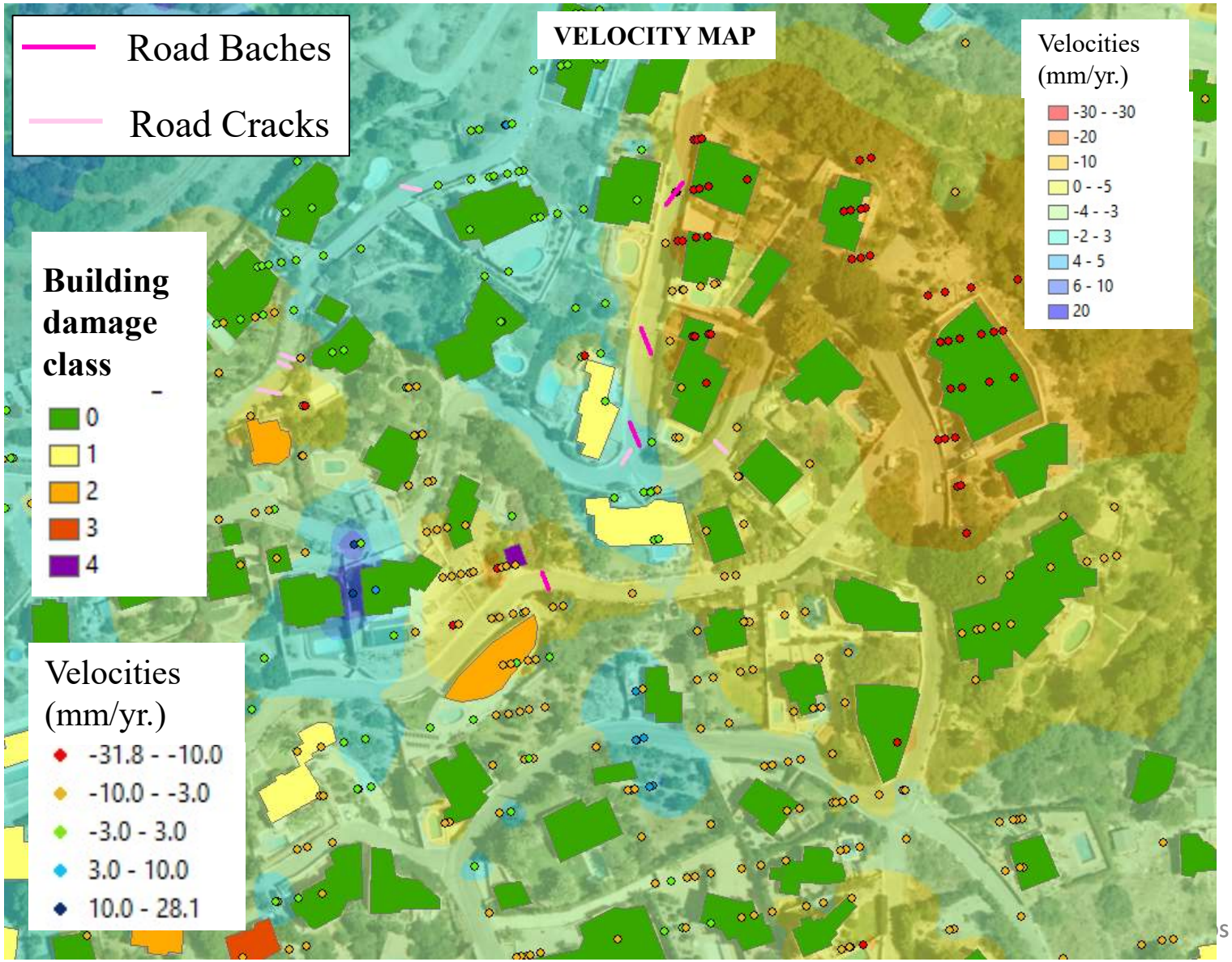
- 0
- 1
- 2
- 3
- 4

Road Baches

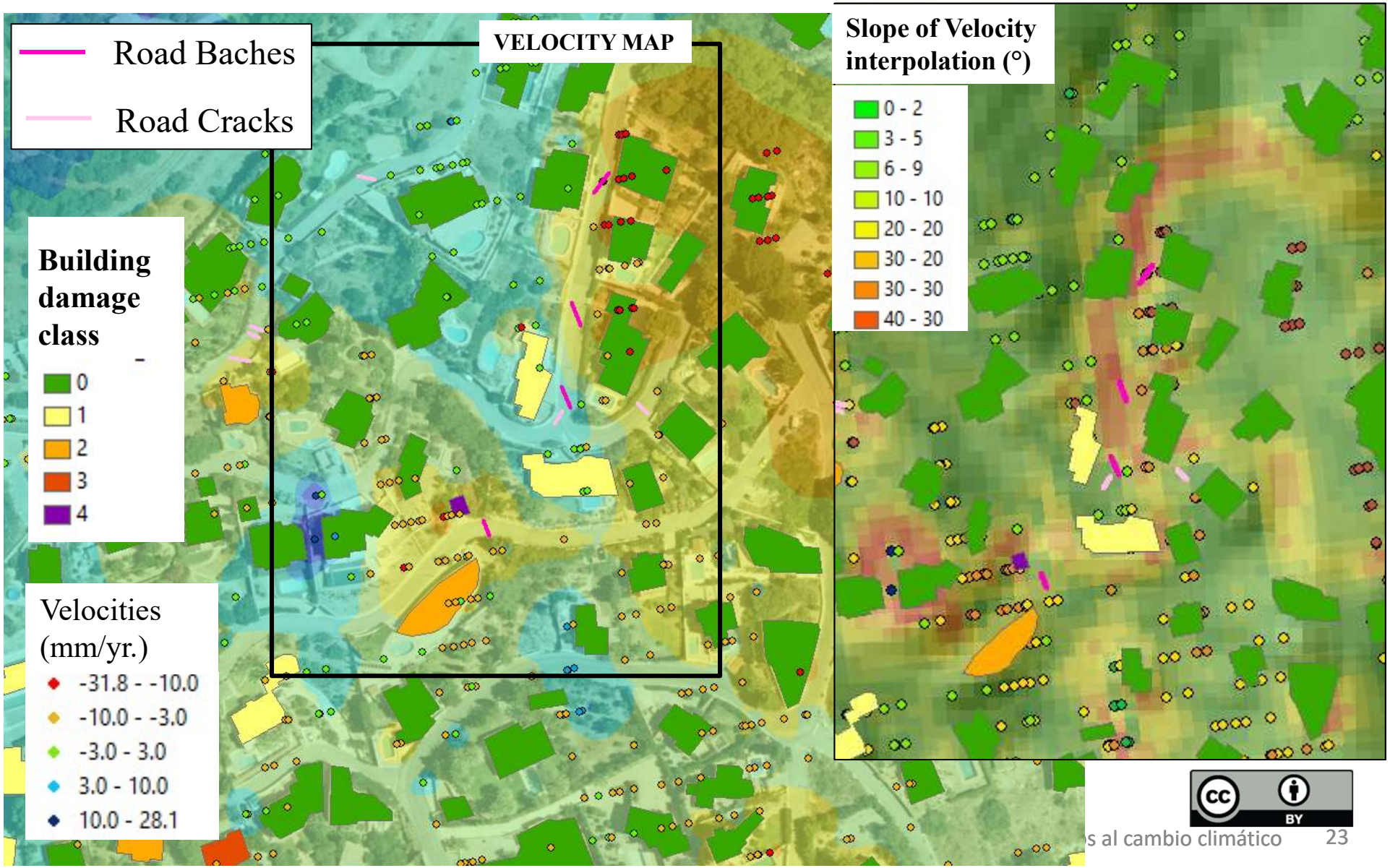
Road Cracks

***Cooper, 2008**

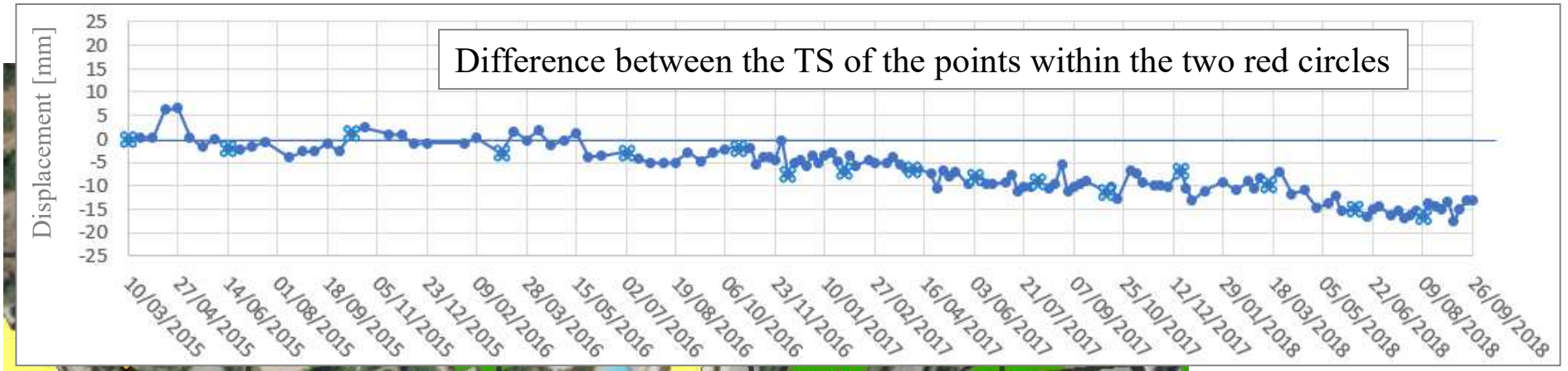
Example of mapped damages corresponding to high local variation of the displacement velocities (spatial gradient)



Example of mapped damages corresponding to high local variation of the displacement velocities (spatial gradient)



Example of local Differential Displacement Time Series (TS) were damages have been mapped



Velocities (mm/yr.)
- -31.8 - -10.0
- -10.0 - -3.0
- -3.0 - 3.0
- 3.0 - 10.0
- 10.0 - 28.1

Road Baches

Road Cracks

Thank you for reading!!!

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References

- Barra, A., Solari, L., Béjar-Pizarro, M., Monserrat, O., Bianchini, S., Herrera, G., ... & Ligüerzana, S. (2017). A methodology to detect and update active deformation areas based on sentinel-1 SAR images. Remote sensing, 9(10), 1002.
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- Cooper, A. H. (2008). The classification, recording, databasing and use of information about building damage caused by subsidence and landslides. *Quarterly Journal of Engineering Geology and Hydrogeology*, *41*(3), 409-424.