SISTEMI, SERVIZI E APPLICAZIONI SPAZIALI A SOSTEGNO DELLE GRANDI INFRASTRUTTURE NAZIONALI:
L'ESPERIENZA DI NHAZCA E DEL CERI

Paolo Mazzanti

Agenzia Spaziale Italiana, Roma
Roma, 4-11-2021

The SPEAKER

Prof. Paolo Mazzanti, "Sapienza" University of Rome

- MSc in Geology and PhD in Earth Sciences
- Lecturer of Remote Sensing and Geologic Risks at **"Sapienza" University of Rome (Italy)**
- **CERI** (Research Center for the Forecast, Prevention and Control of Geological Risks)

- Organizer of the **"International Course on Geotechnical and Structural Monitoring"**

- Member of the **TRB (Transportation Research Board)** Engineering Geology Committee
- Member of the Executive Board of the **FMGM (Field Measurements in Geomechanics) community**

- Founder and CEO of **NHAZCA S.r.l.**, Startup of "Sapienza" University of Rome.

NHAZCA

NHAZCA is a limited company (S.r.l.), Startup of **"Sapienza" University of Rome (Italy)**

International leader of analysis and monitoring **solutions** for the **management** and **control** of **Infrastructures and Natural Hazards**

- Incubated at **European Space Agency Business Incubation Centre**
- Integrated team of 30 qualified **professionals, researchers** and **academics, 100% graduated**

- Core technologies: Satellite InSAR, Terrestrial InSAR, PhotoMonitoring™, Laser Scanner, Drones (UAV)
- Serving more than 400 customers from 40 countries
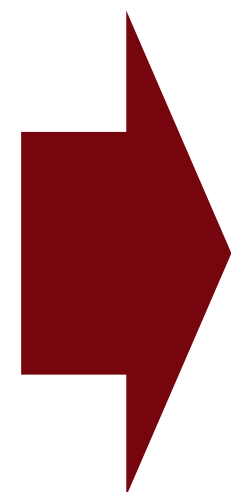
- **ISO 9001:2015** Certification

ISO 9001
BUREAU VERITAS
Certification

BUREAU VERITAS
1828

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WHY LAND AND INFRASTRUCTURE MONITORING?

Problem:

Aging infrastructures + Geohazards

Solution:
Monitoring
Predictive maintenance
Asset Management

Smart Asset Management

Taiwan (2010)

Morandi Bridge (August 2018)

Imera Viaduct (April 2015)

Albiano Viaduct (April 2020)

WHY LAND AND INFRASTRUCTURE MONITORING?

Taiwan (2010)

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Albiano Viaduct (April 2020)

Smart Asset Management based on **Earth Observation data**

- Analyses over large areas

- No interference with asset operations

- Historical analyses

- Tracking of changes and deformations

WHY LAND AND INFRASTRUCTURE MONITORING?

INSPECTION

SURVEY

MONITORING

MAINTENANCE
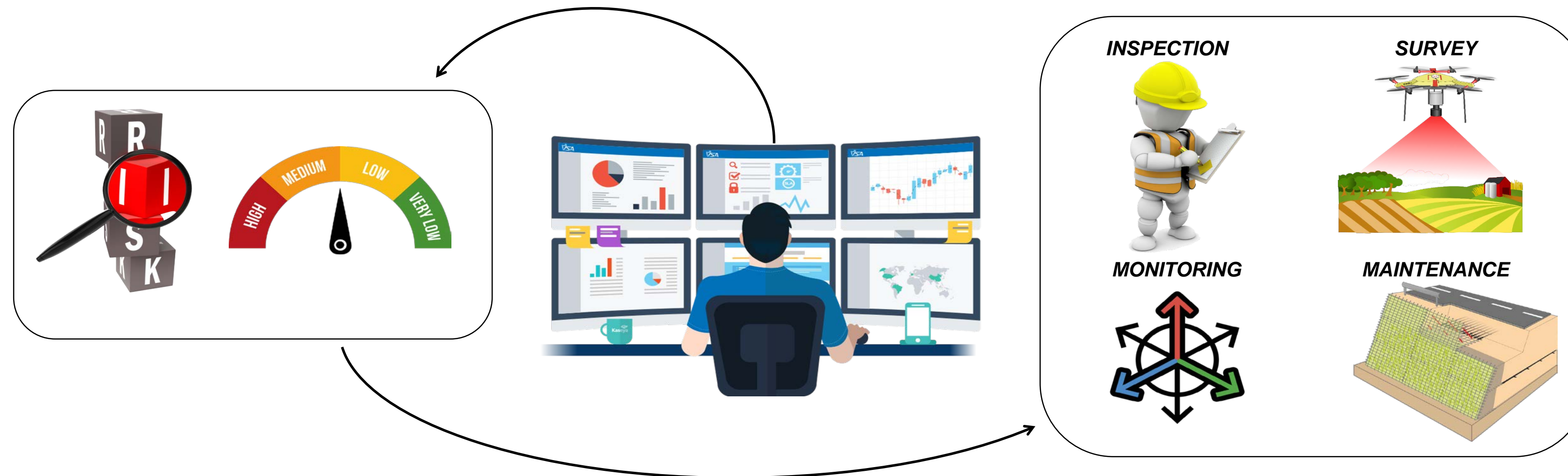
Smart Asset Management based on **powerful data analysis**

- Satellite InSAR technology

- PhotoMonitoring™

- Data interpretation and elaboration

- GeoHazard Assessment

Taiwan (2010)

Morandi Bridge (August 2018)

Imera Viaduct (April 2015)

Albiano Viaduct (April 2020)

MULTI-FREQUENCY AND MULTI-RESOLUTION EO DATA

- About 1000 satellites for Earth Observation

- Many others planned in the last few months

- Several public and private operators

- Wavelenght ranging from less than 1 micron to several decimeters

- Spatial resolution up to 15 cm

- Temporal resolution up to 1 day (potentially few hours)
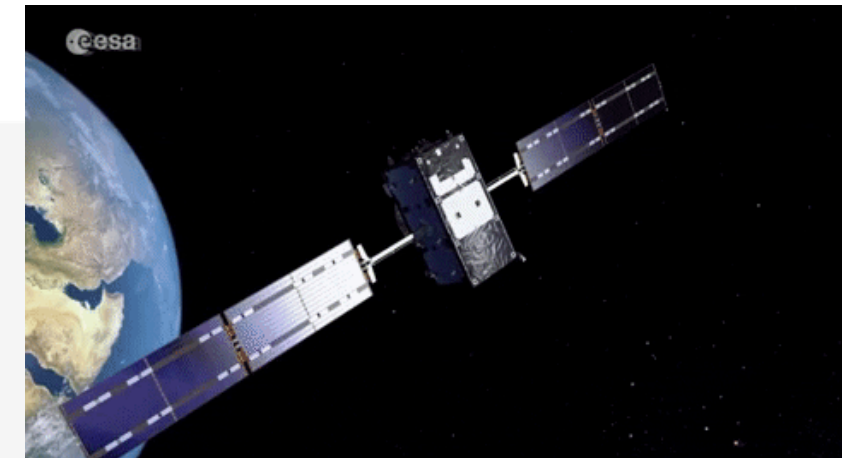
SATELLITE AND INSAR REVOLUTION

LOS deformation velocity
< -5   > 5
[cm/year]
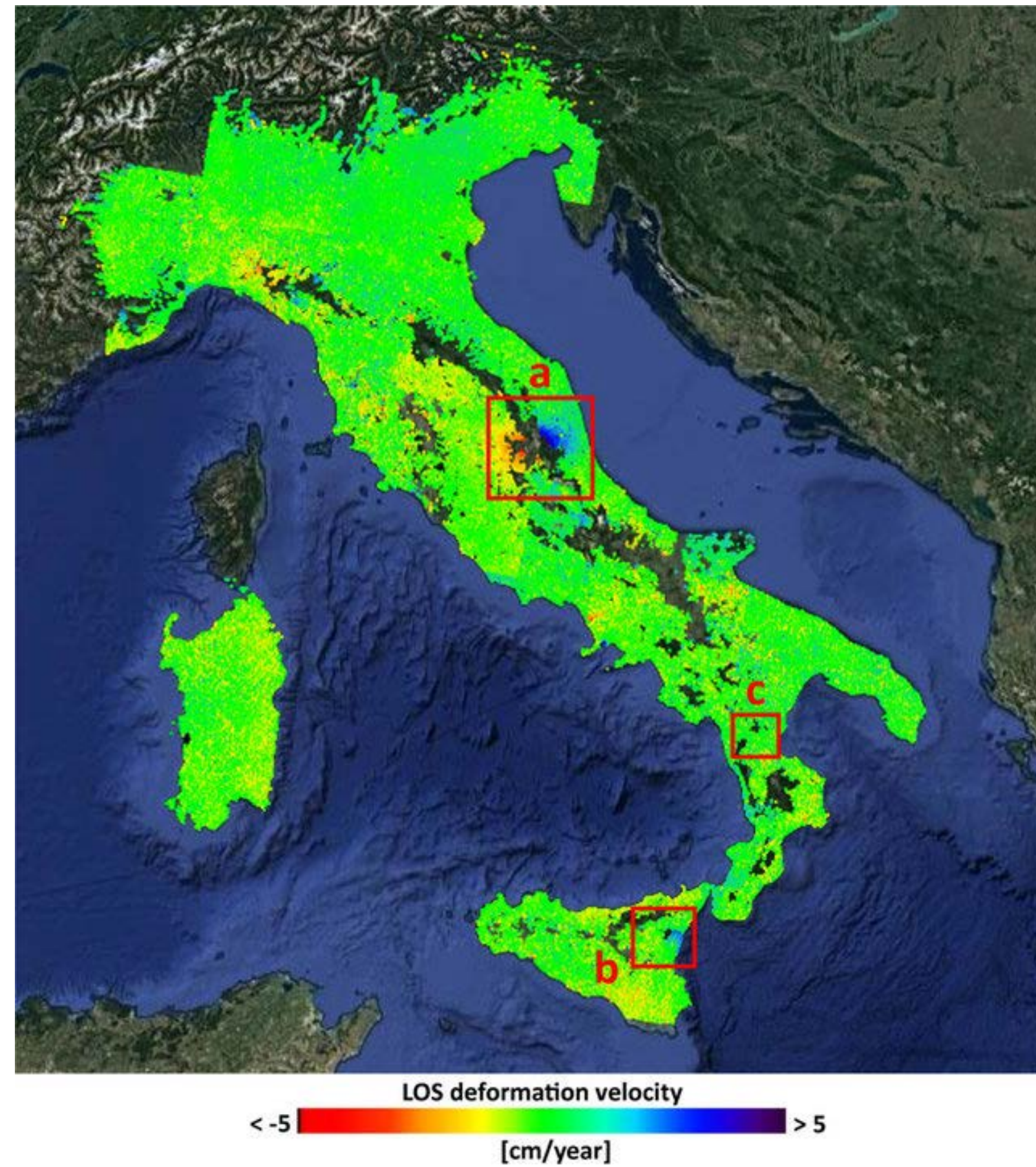
Democratizing land, infrastructures and processes!
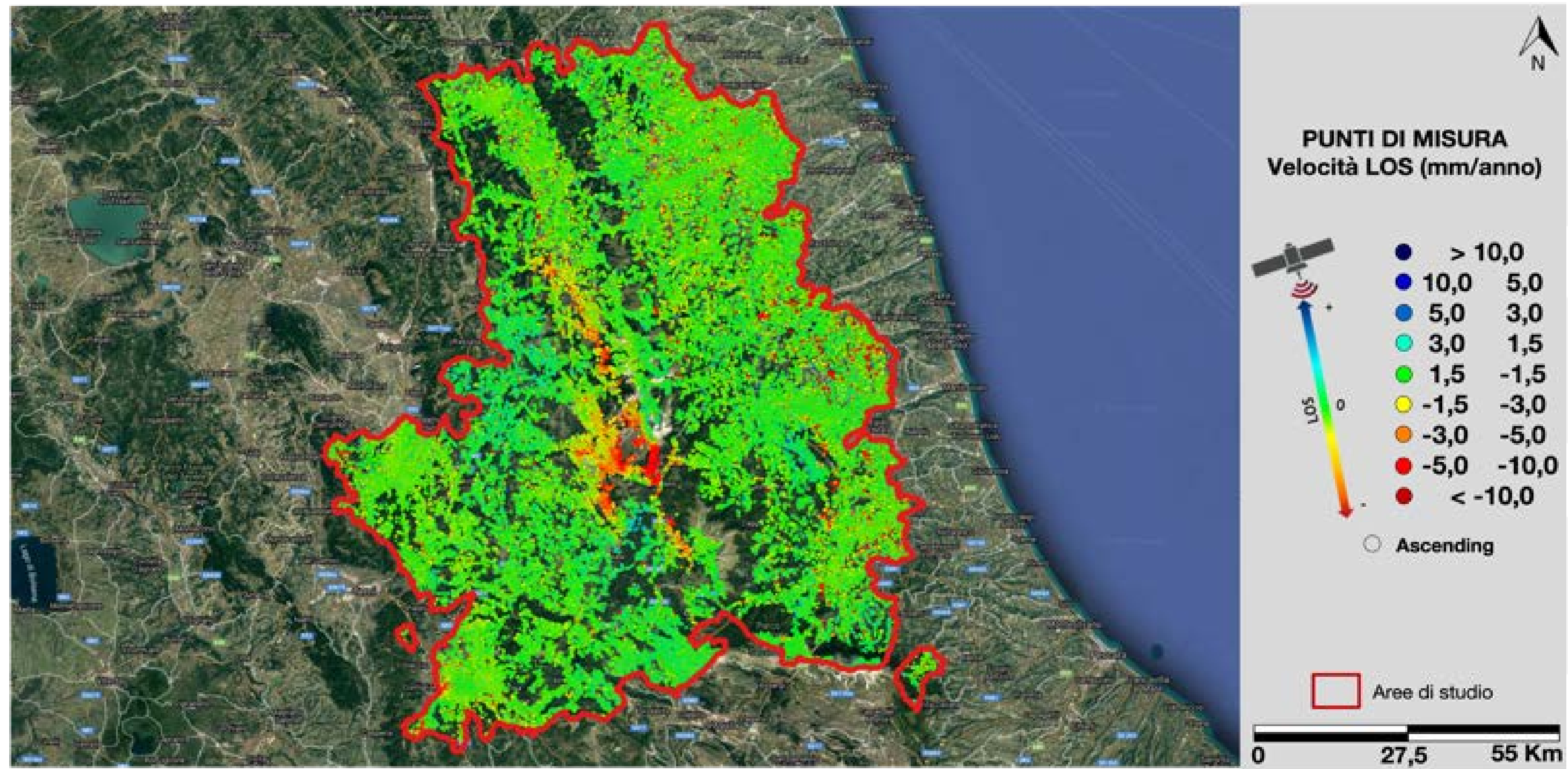
PLANNING PURPOSE

Democratizing land, infrastructures and processes!
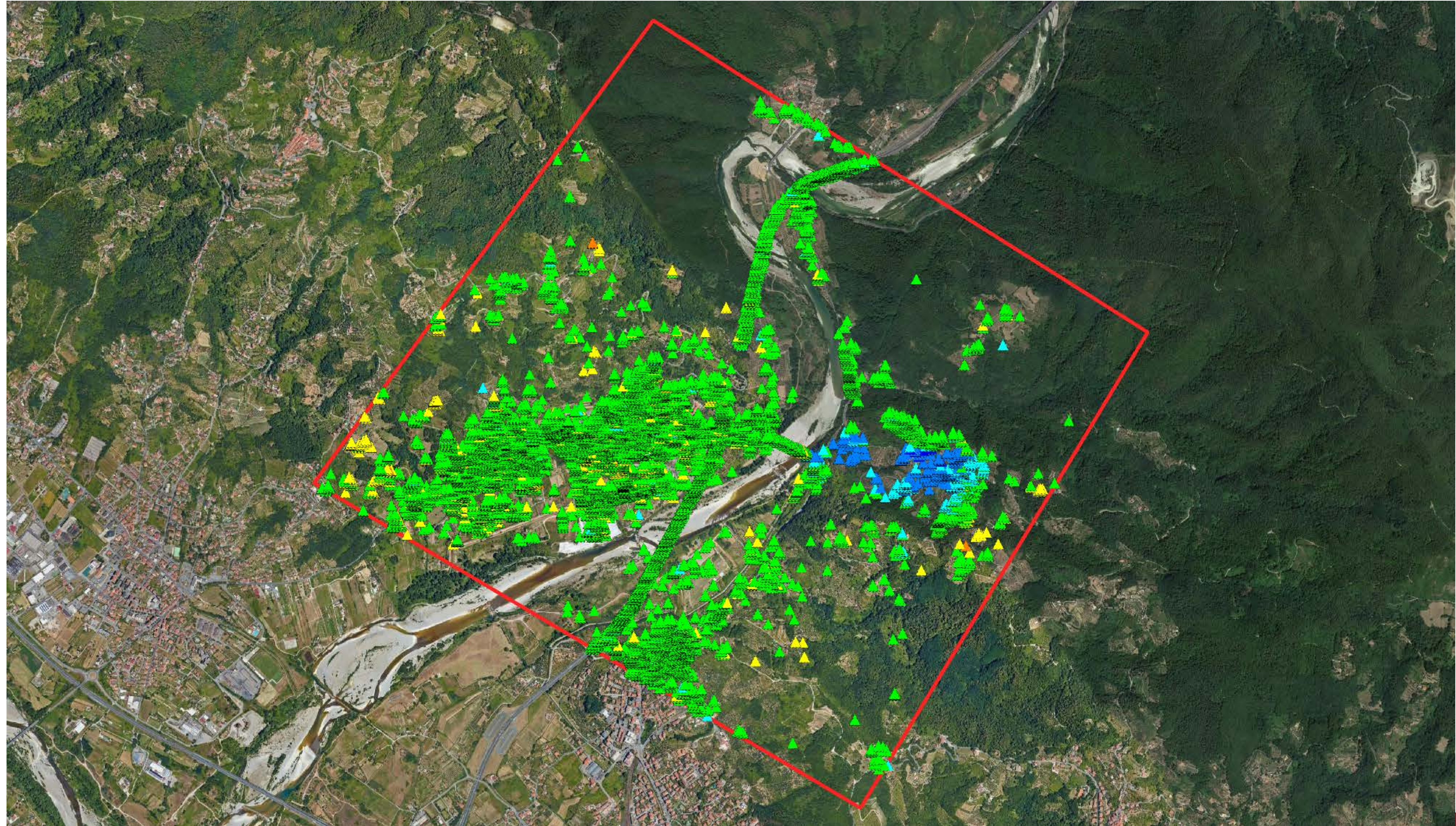
PLANNING PURPOSE

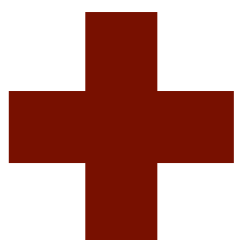# PLANNING PURPOSE
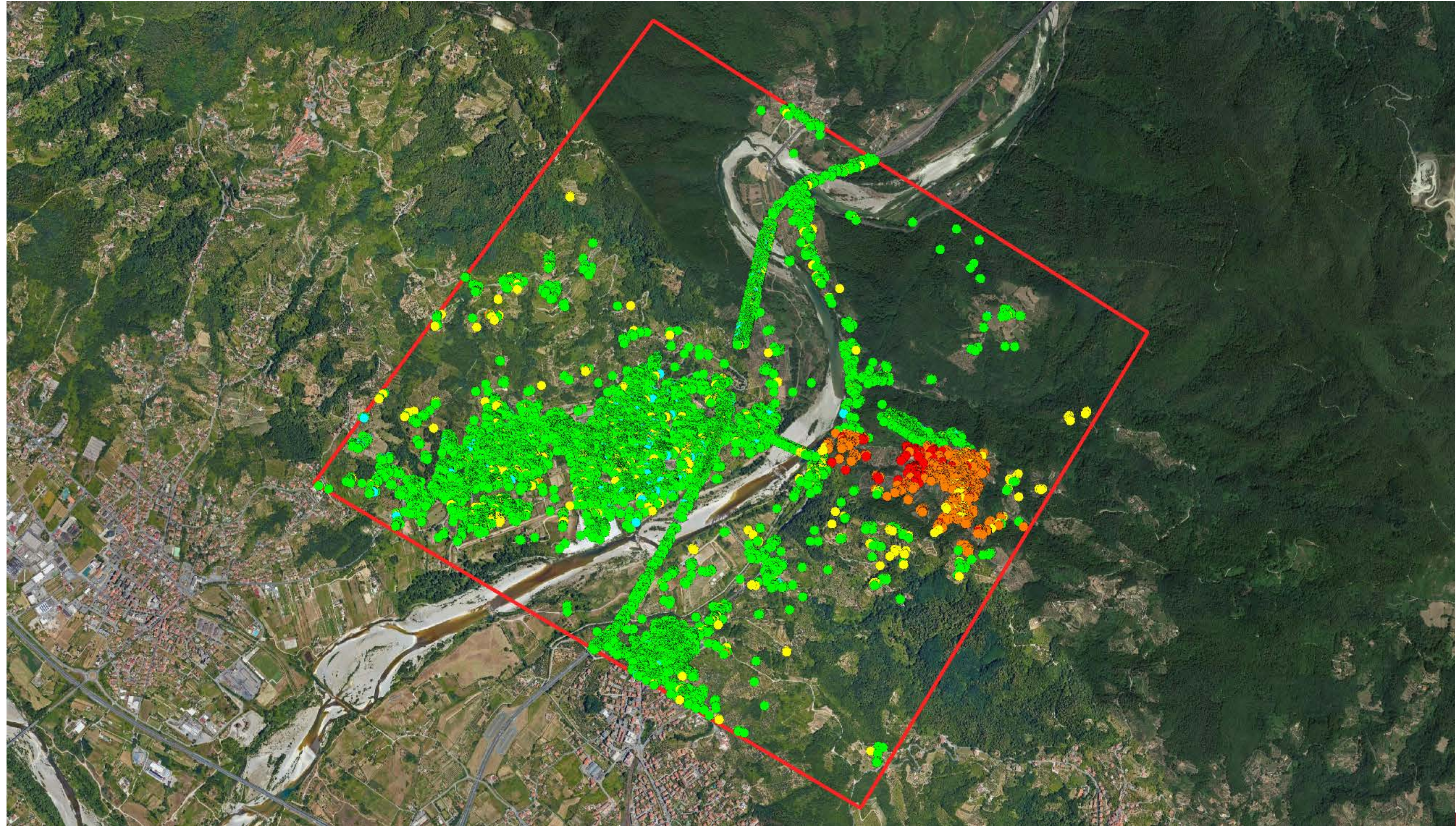
DIGITAL IMAGE MONITORING
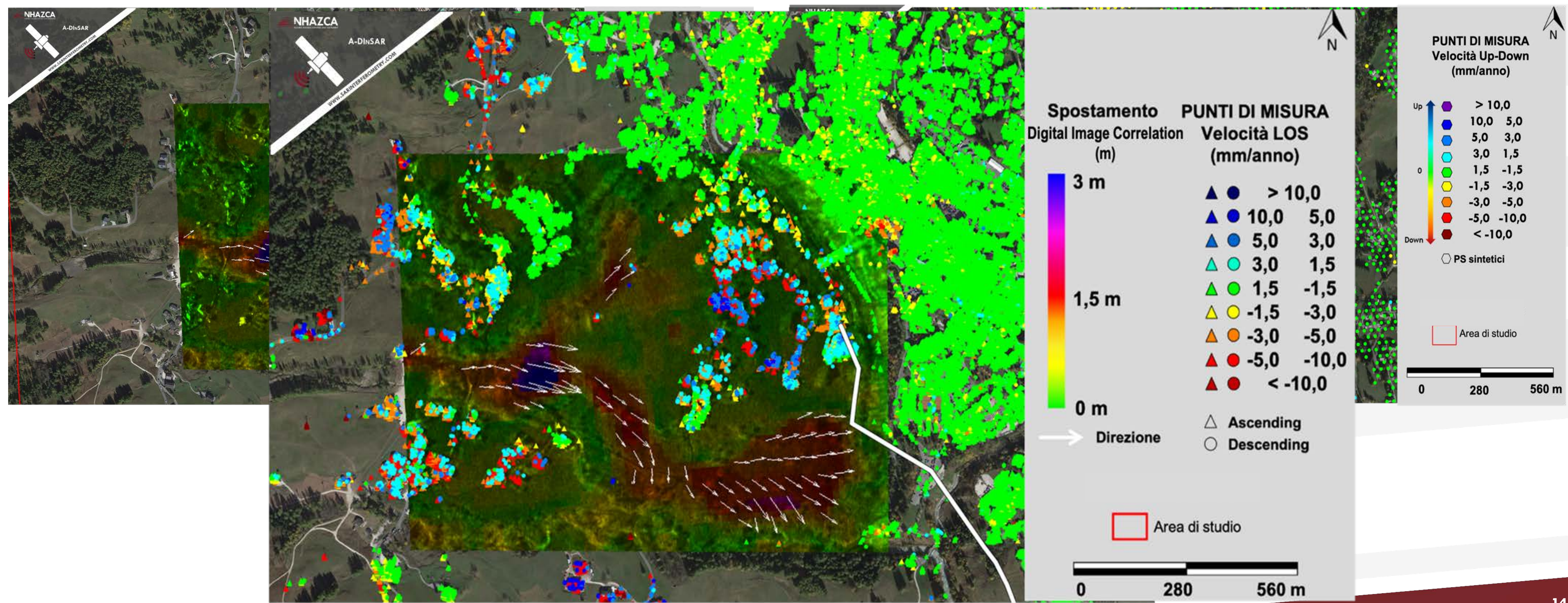
HIGH TEMPORAL FREQUENCY MONITORING
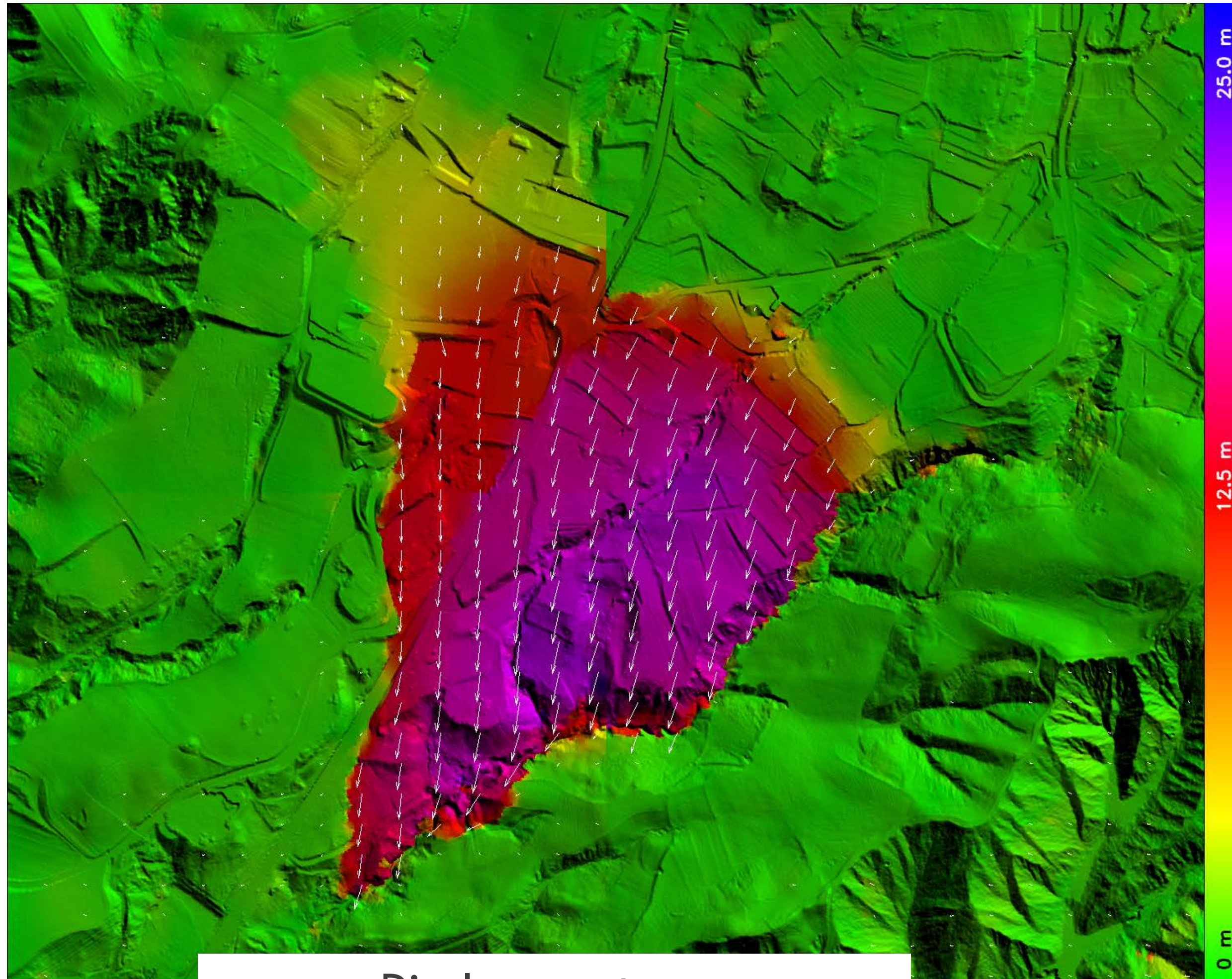
Displacement map
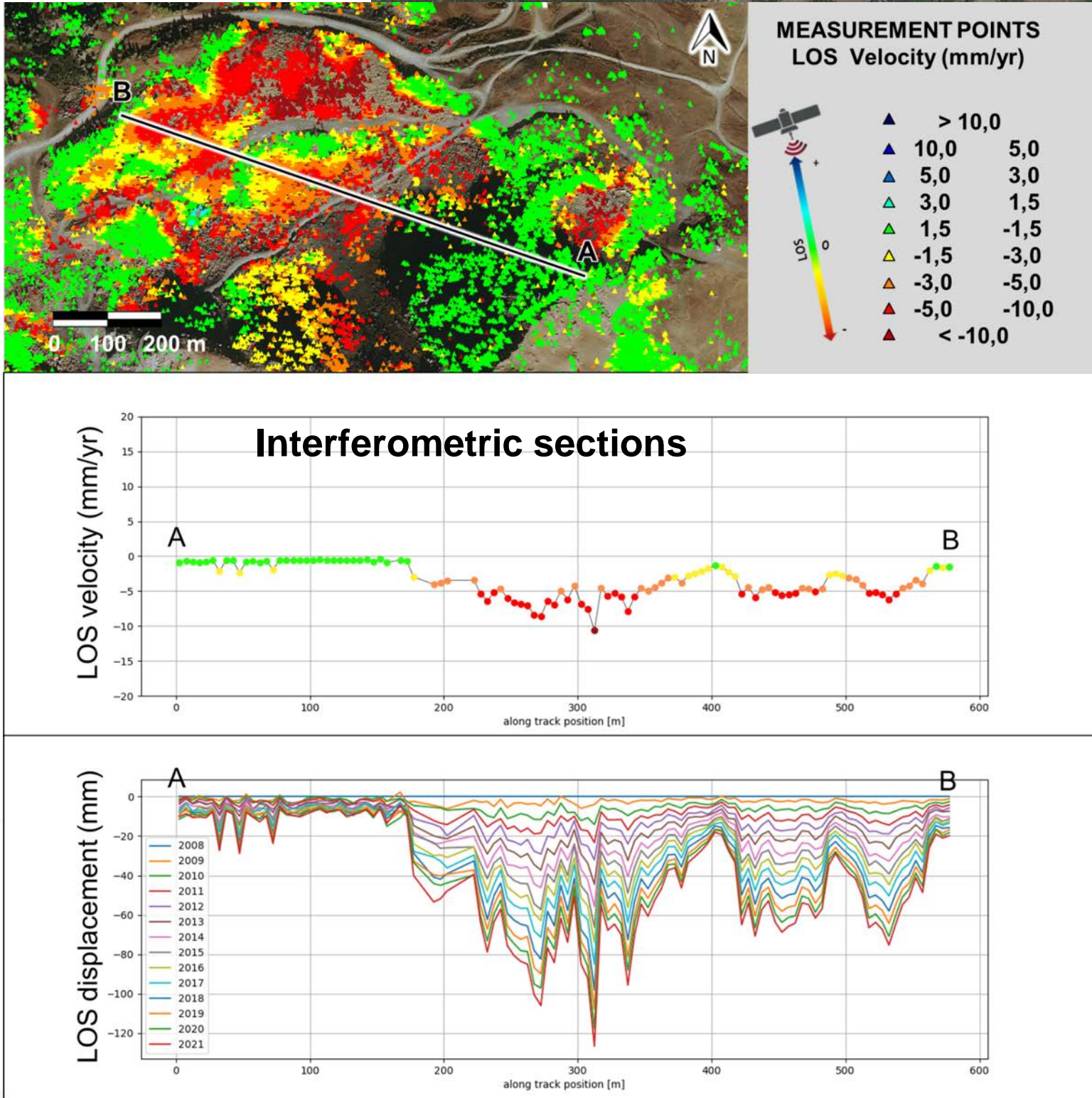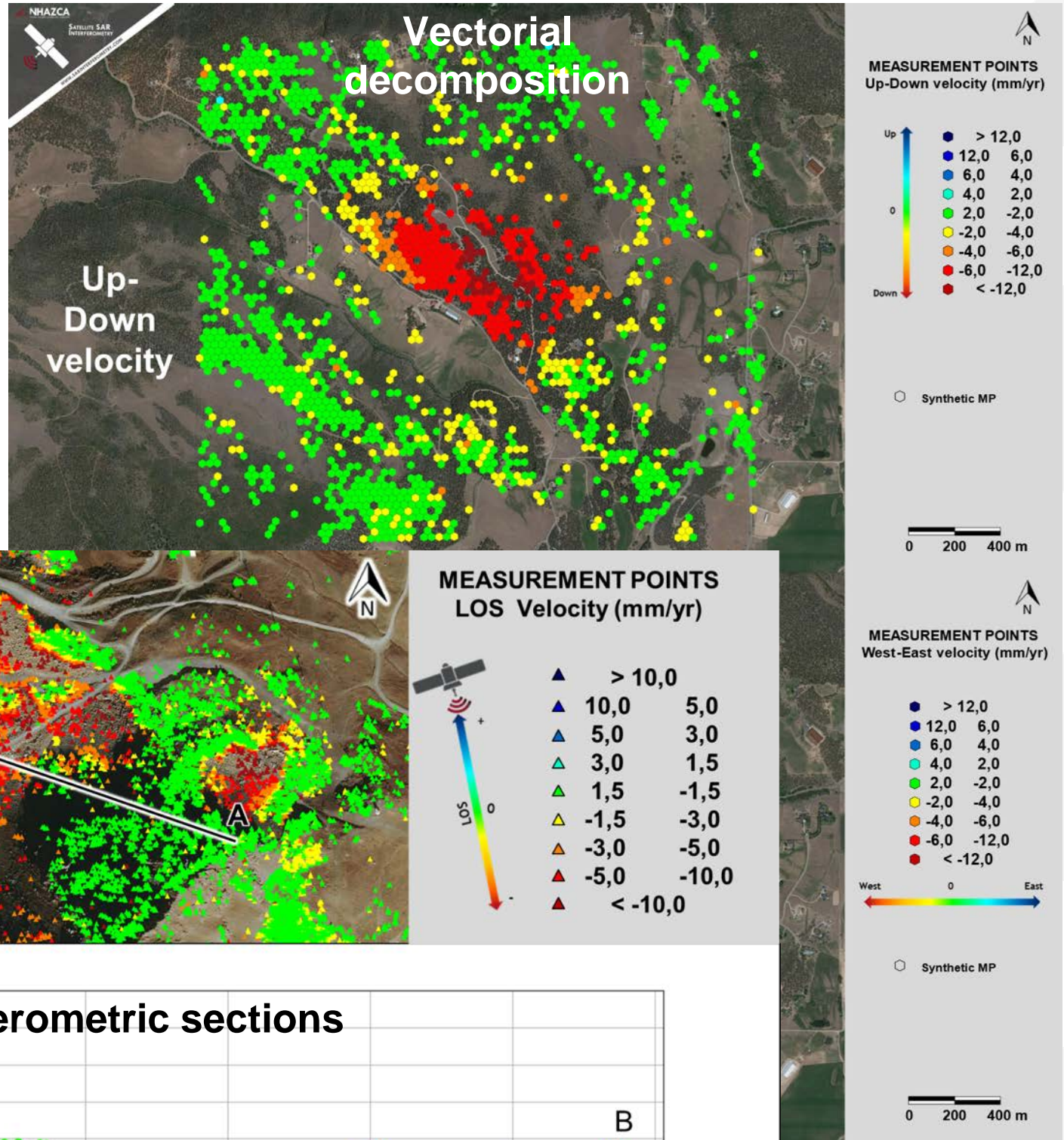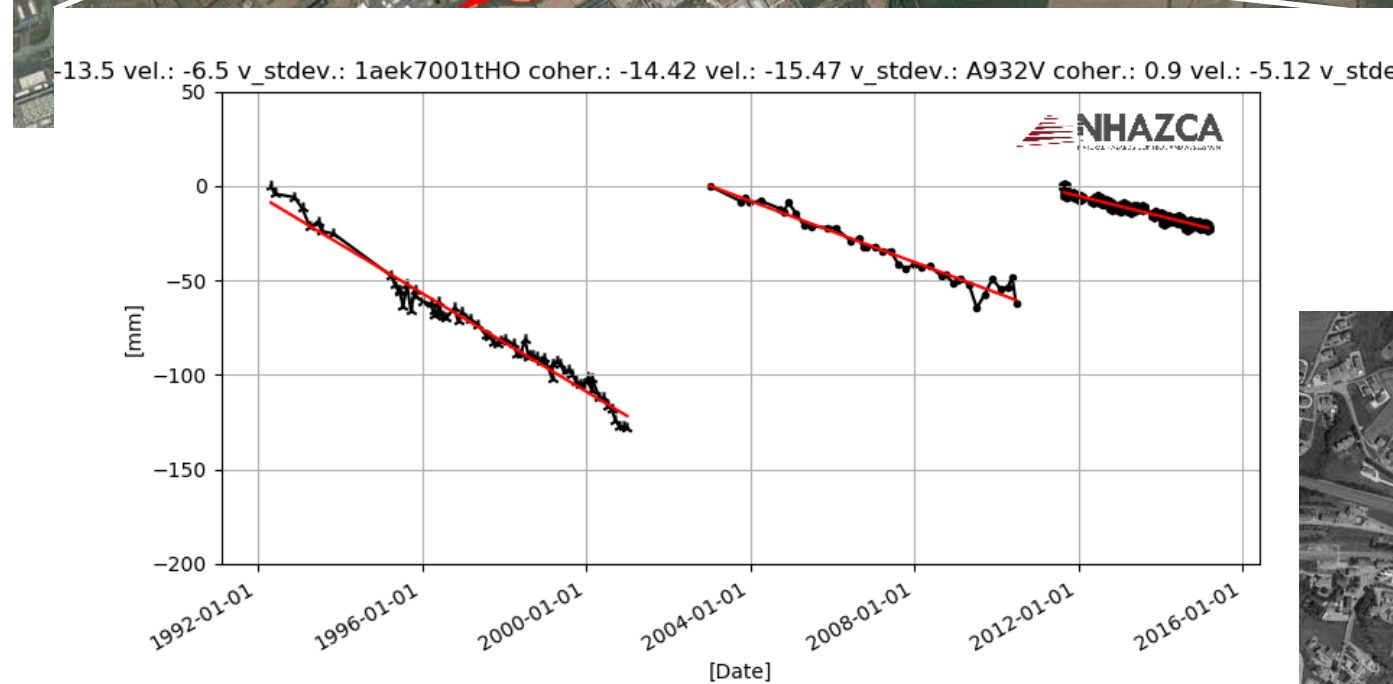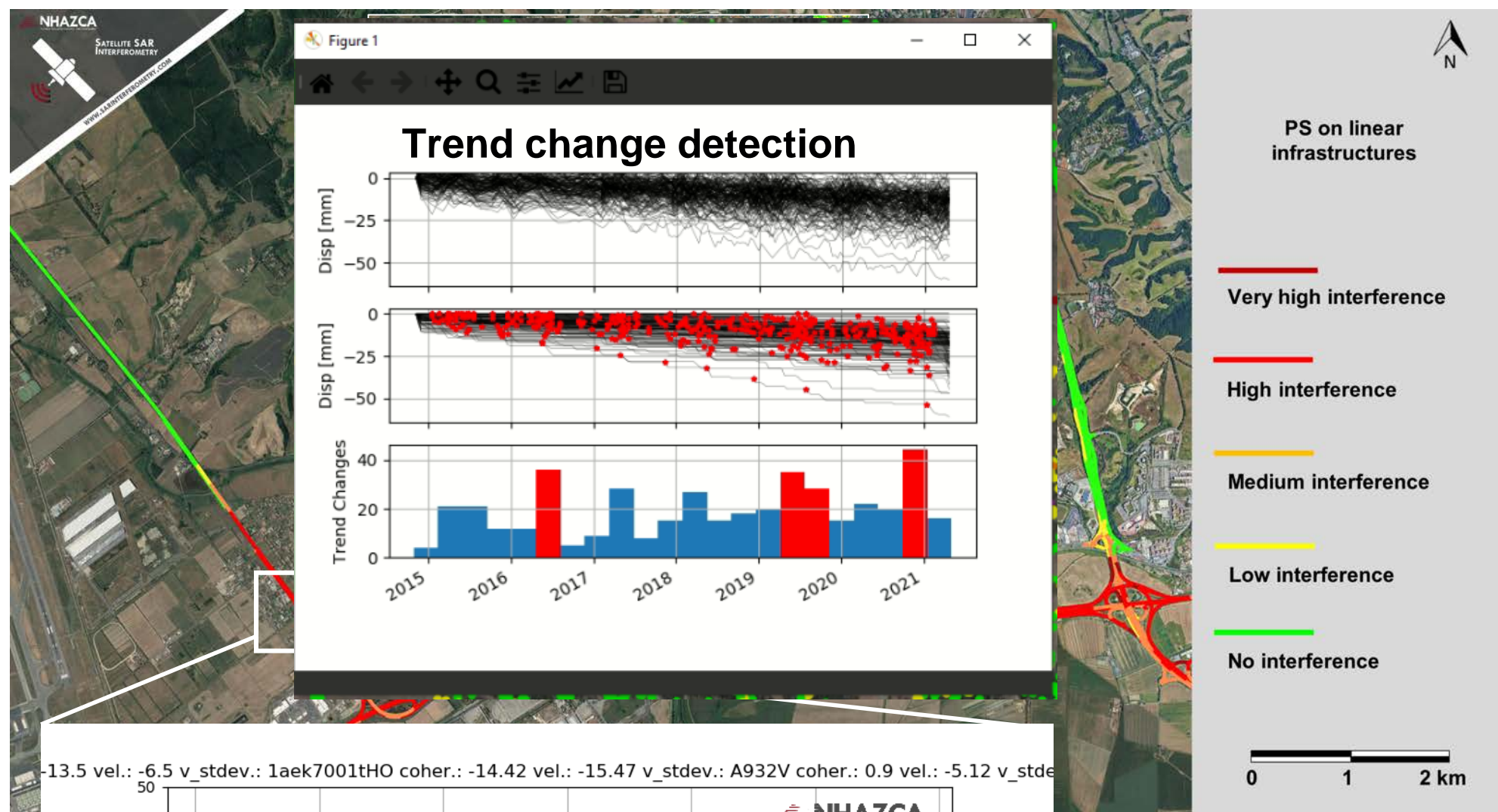

Change map

DATA FUSION

PhotoMonitoring™ **➕** **InSAR analysis**

DECISION MAKING BASED ON RELIABLE INFORMATION

DECISION MAKING BASED ON RELIABLE INFORMATION

PS on linear infrastructures

Very high interference

High interference

Medium interference

Low interference

No interference

0 1 2 km

NHAZCA InSAR Toolbox!

PLANNING PURPOSE….AND DECISION MAKING

Data Processing

Automatic Process Classification

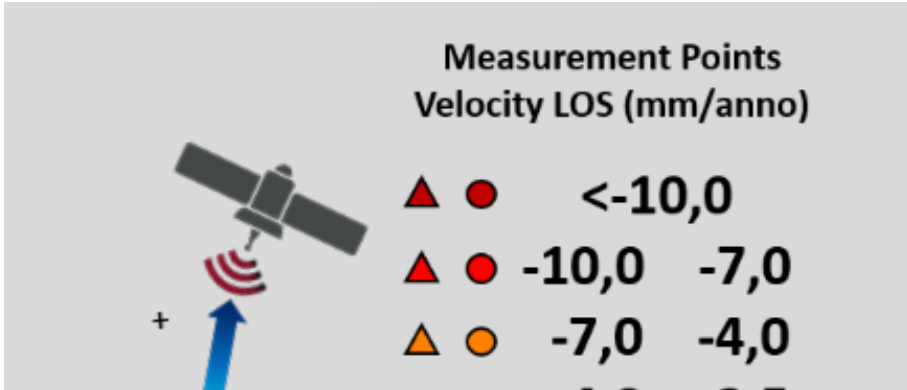*Interference Analysis*

Democratizing of InSAR for asset managers by translating data into information!
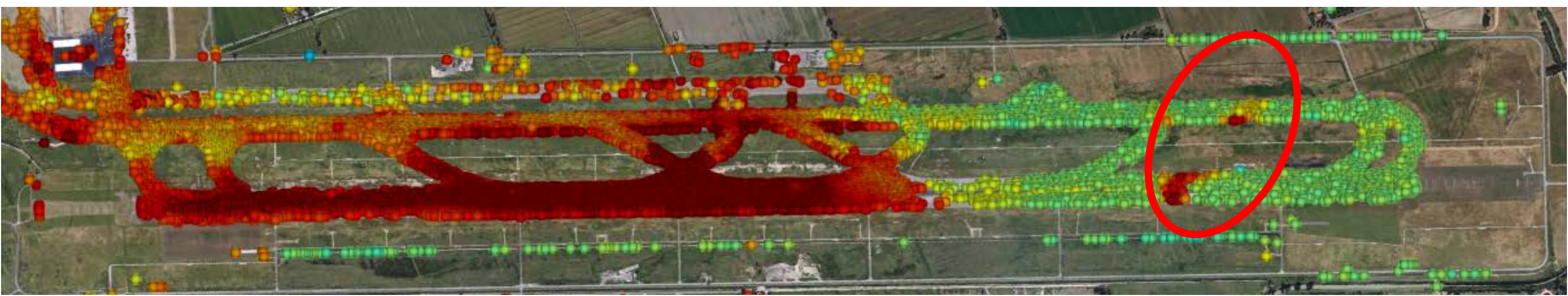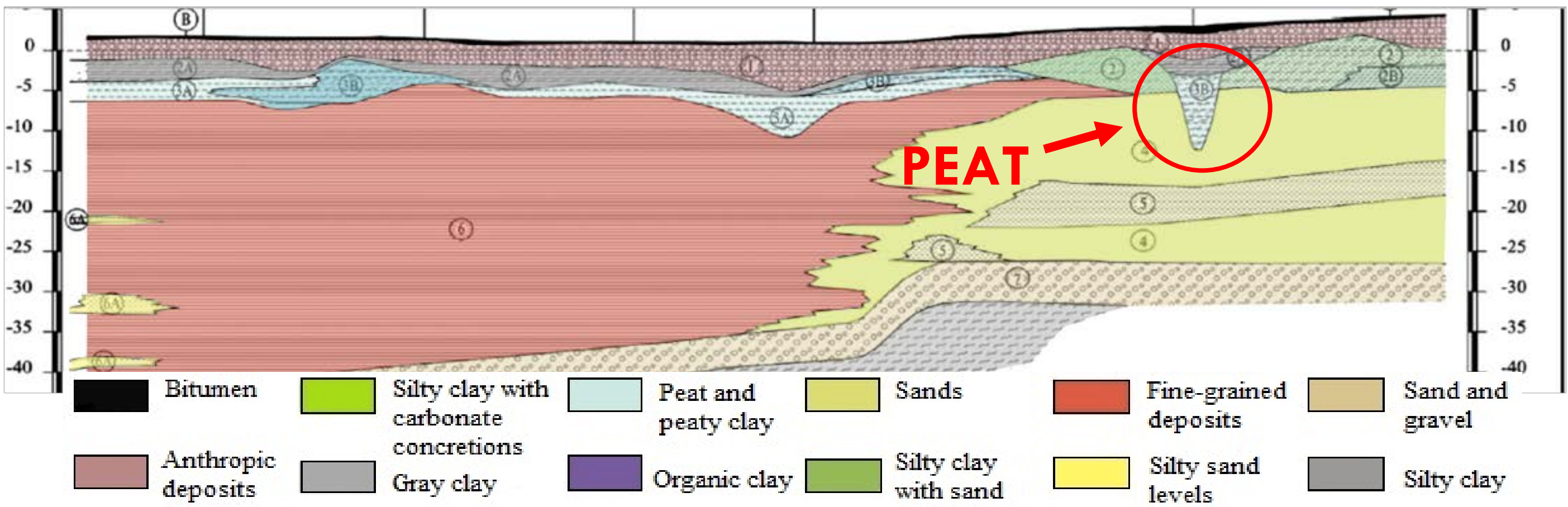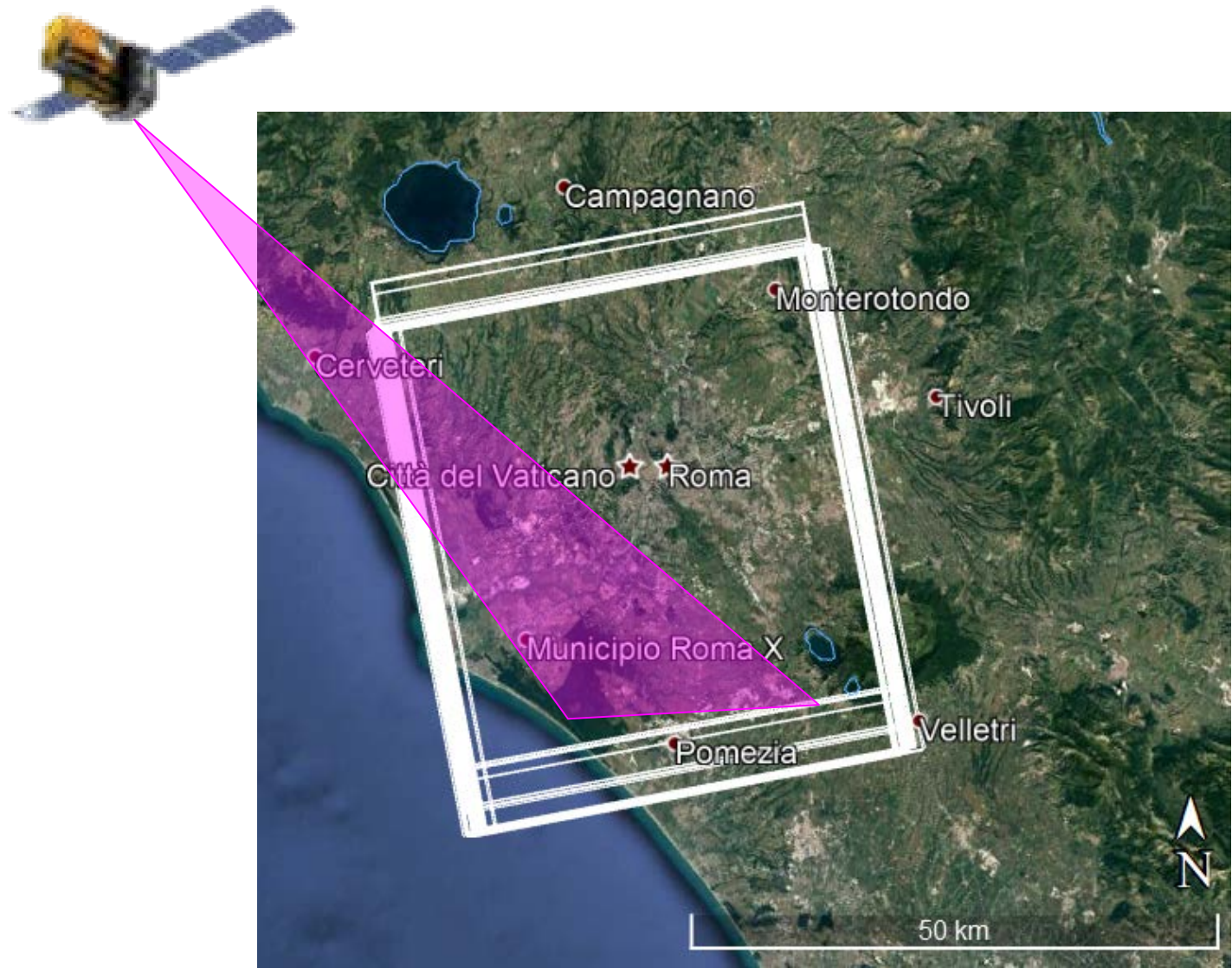
CLASSIFICATION + INTERPRETATION = UNDERSTANDING & PREDICTION

COSMO-SkyMed

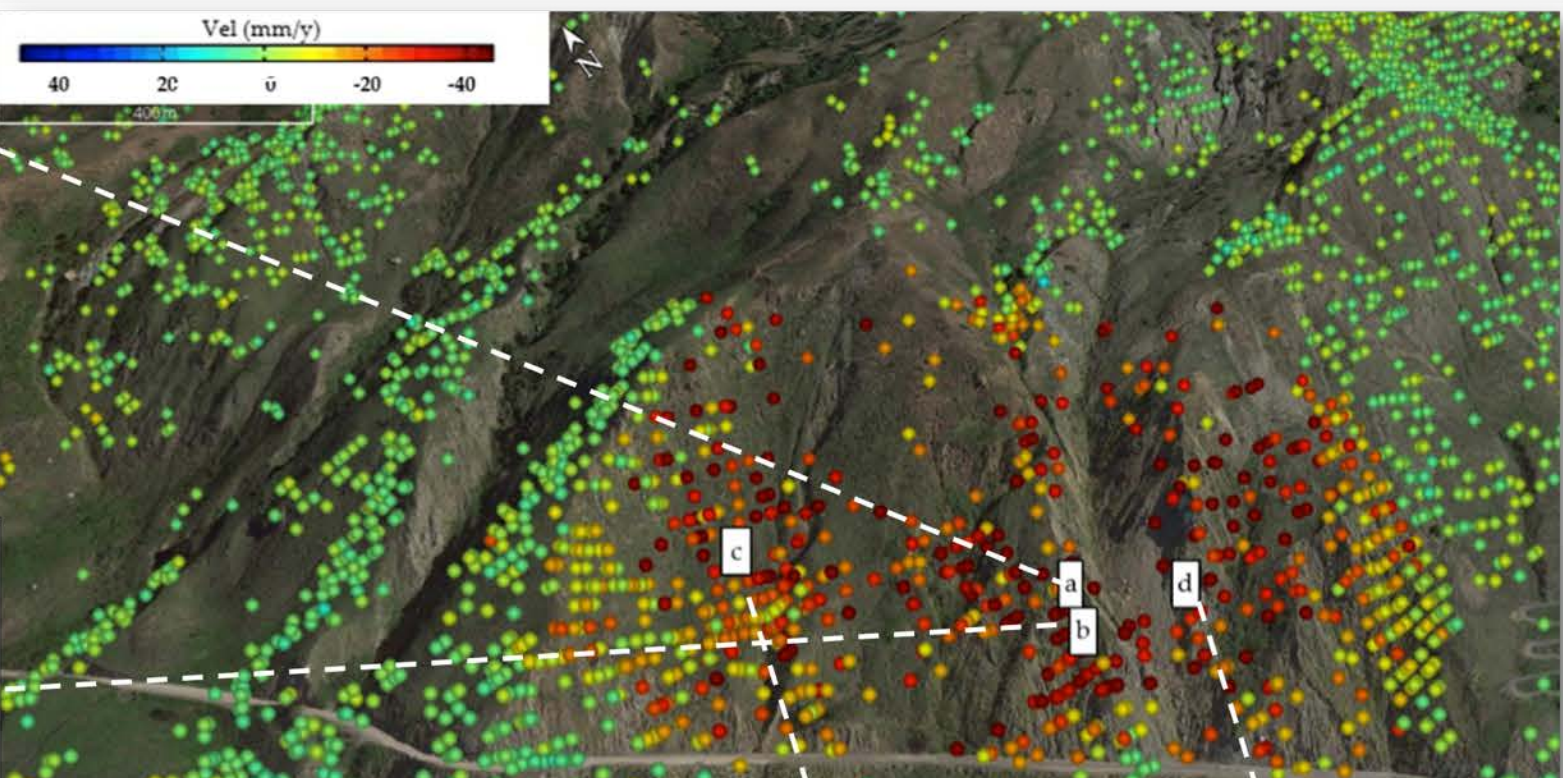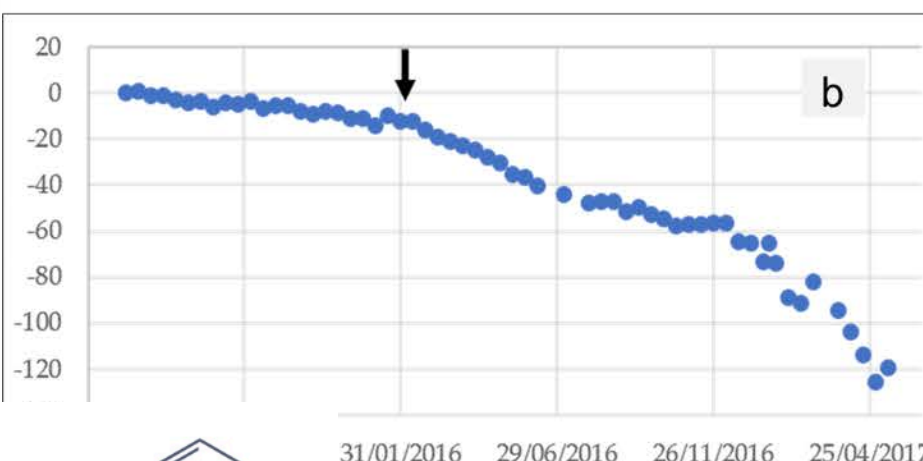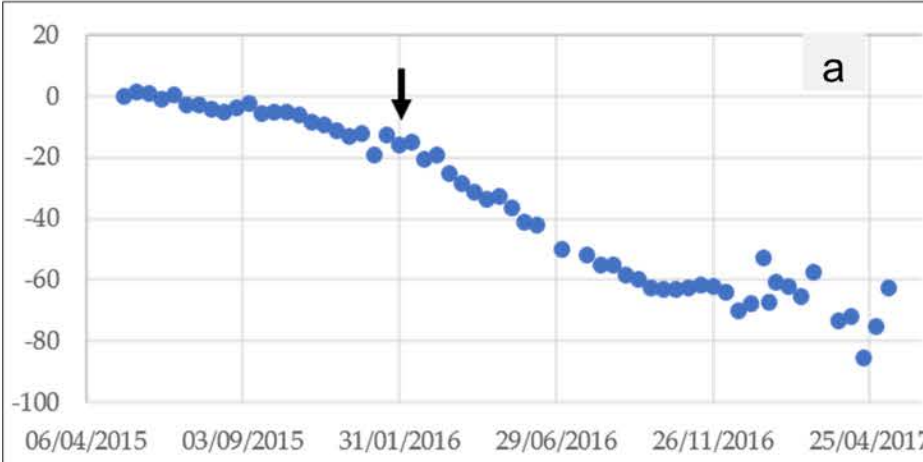- Period: Feb 2011 – Dec 2015
- **X** Band
- Resolution: **3x3 m**

Data interpretation
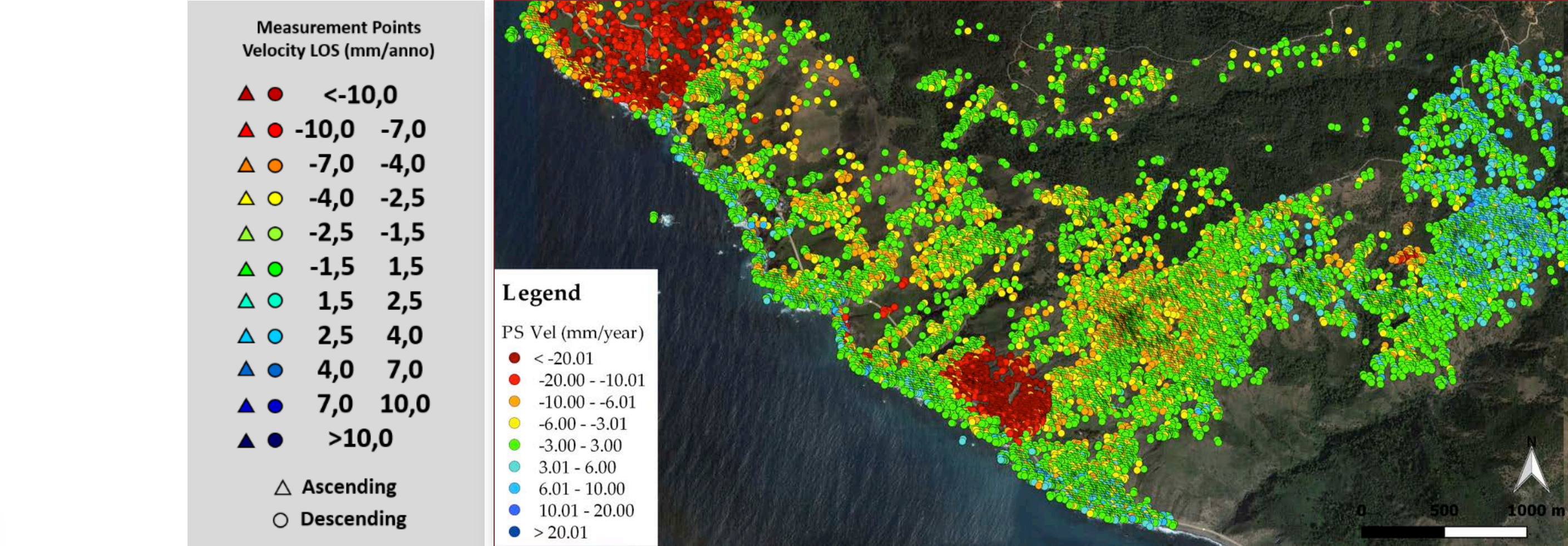
PREDICTION?

Sentinel-1

- Period: May 2015 – May 2017
- **C** Band
- Resolution: **5x20 m**

remote sensing

Article

The Role of Satellite InSAR for Landslide Forecasting: Limitations and Openings

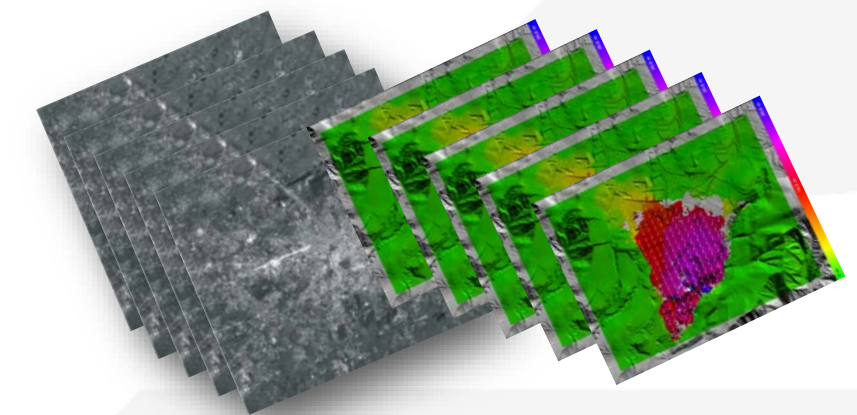Serena Moretto [1,2,*], Francesca Bozzano [1,2] and Paolo Mazzanti [1,2]

NHAZCA EFFORT SUPPORTED BY

- **MUSAR**

Data Fusion & Smart Automatic Classification of Satellite Multisensor/Multiband SAR and Optical Data

Partly financed by _ASI – Italian Space Agency_

- **SGAM**

Smart Geotechnical Asset Management

Partly financed by _ESA – European Space Agency_

- **EGMS**

European Ground Motion Service

Member of the consortium ORIGINAL (OpeRatIonal Ground motion INsar Alliance)

CONCLUSION

Images are necessary …. but not sufficient

Data derived from images are necessary …but not sufficient

Fusion of data derived from different sources is necessary… but not sufficient

Translation of data into information is necessary ….but not sufficient

Translation of information into «actions» could be enough!!

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TOWARDS THE FUTURE