Società Italiana Gallerie

Italian Tunnelling Society

BEYOND A TUNNEL VISION
THE SECOND EUROPEAN CONFERENCE ON TUNNEL RENOVATION

SIG SESSION: INSPECTION, INVESTIGATION AND MONITORING
DURING SERVICE LIFE

Speaker: Paolo Mazzanti

Structural and geotechnical monitoring for infrastructural asset management: new prospective

Friday November 27th 2020 – fully digital

The speaker

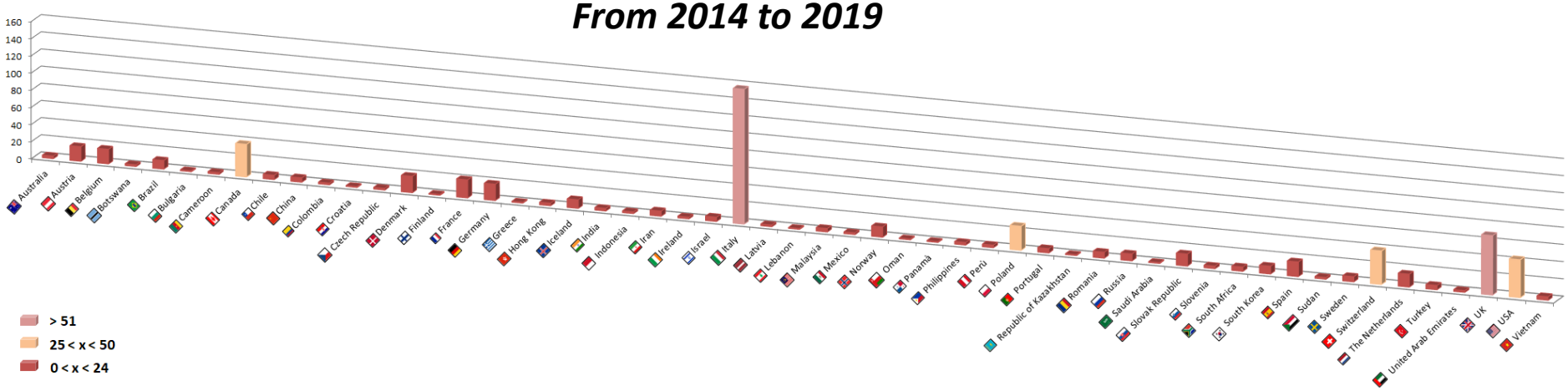
- Professor of Remote Sensing and Geological Risks at the Department of Earth Sciences of “Sapienza” University of Rome
- Member of the CERI Research Center for Prediction, Prevention and Control of Geohazards “Sapienza” University of Rome
- Member of the recently borne ISSMGE TC220 “Field Monitoring in GeoMechanics”
- Member of the Engineering geology committee of the Transportation Research Board
- Member of the technical committee 4.3 (Earthworks) of the PIARC (World Road Association)
- **Co-founder and CEO of NHAZCA S.r.l., spin-off “Sapienza” University of Rome**
- **Organizer and co-director of the annual IcGSM (International Course on Geotechnical and Structural Monitoring)**

INTERNATIONAL COURSE ON GEOTECHNICAL AND STRUCTURAL MONITORING

www.geotechnicalmonitoring.com

664 Participants x 56 countries

From 2014 to 2019



3 days ***Main Course***

2 consecutive days ***Field Trip***

12 days ***Master Classes***

ICGSM
INTERNATIONAL COURSE ON GEOTECHNICAL AND STRUCTURAL MONITORING

2021

The Company in a Nutshel

NHAZCA
WWW.NHAZCA.COM

- NHAZCA is a limited company (S.r.l.), Spin-Off of Sapienza University of Rome (Italy)
- Incubated at ESA Business Incubation Centre in 2010
- Integrated team of 30 qualified professionals, researchers and academics
- Constant huge investment in R&I
- International leader of analysis and monitoring solutions for the management and control of Land and Infrastructures/Structures
- Remote Sensing cutting edge company for engineering geology and civil engineering applications
- ISO 9001:2015 Certification

ISO 9001
BUREAU VERITAS
Certification

Why Monitoring?

1: Knowledge monitoring

(Satellite InSAR, PhotoMonitoringTM, TLS)

Design phase, operational phase, standard maintenance, risk assessment, screening after paroxysmal events

2: Control monitoring

(TInSAR, PhotoMonitoringTM)

Construction phase, operational and maintenance in critical segments, risk management; verification of high risk areas

3: Emergency monitoring

(TInSAR)

Construction phase in very high risk areas, operational phase, risk mitigation

Why Remote Sensing?

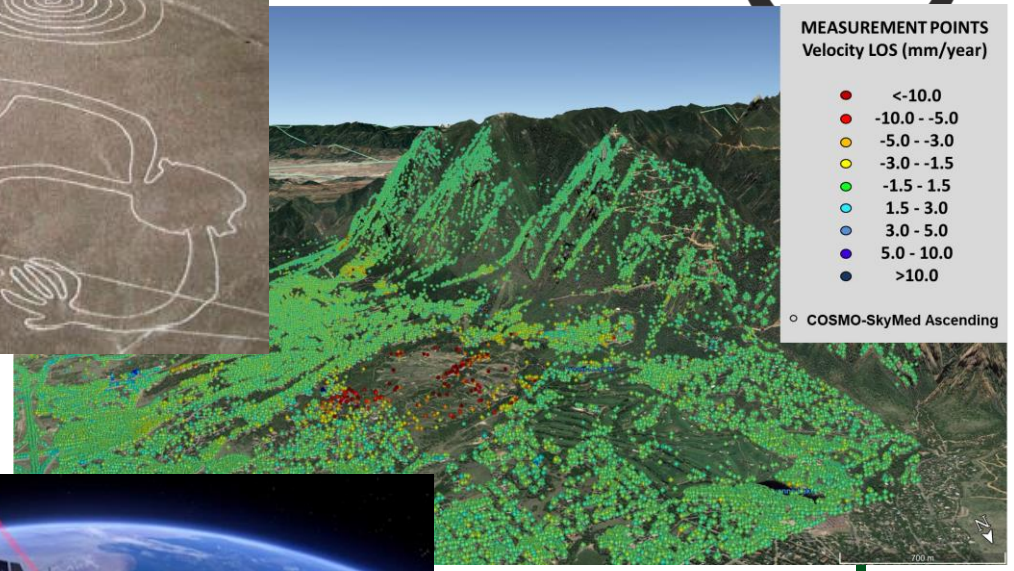
1: For achieving a panoramic view - big area analysis

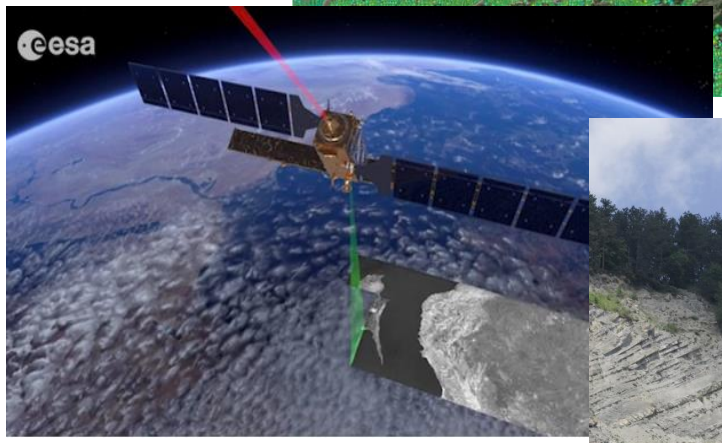
2: For increasing the spatial information density

3: For reducing interaction with monitored area

4: For monitoring back in time

5: For monitoring inaccessible areas





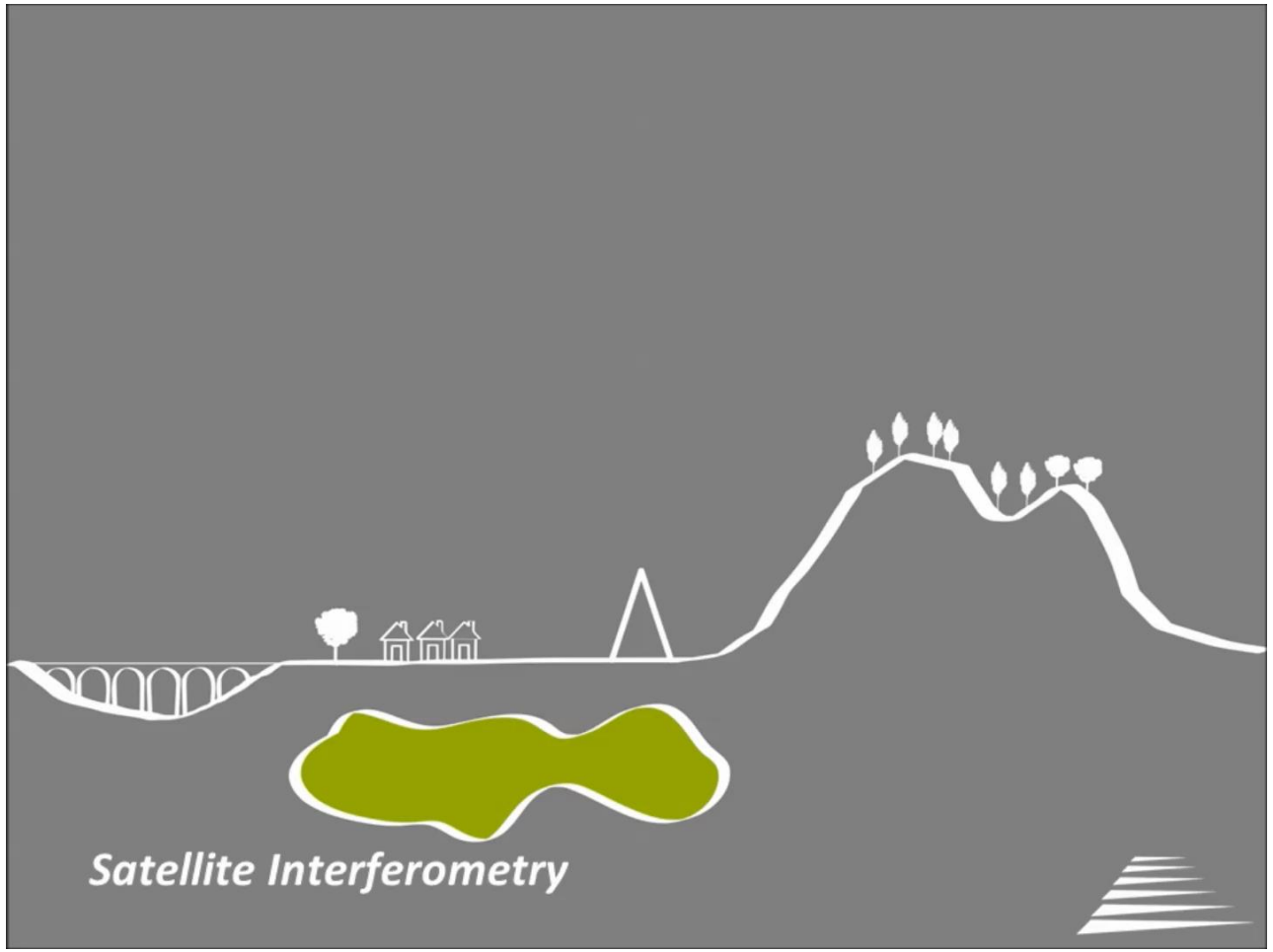
NHAZCA
NATURAL HAZARDS CONTROL AND ASSESSMENT

Remote systems for geotechnical and structural monitoring

- High precision Leveling
- Robotic Total Station
- Differential Global Navigation System
- Terrestrial Laser Scanning
- Satellite SAR Interferometry
- Terrestrial Radar Interferometry
- PhotoMonitoring™

Satellite SAR Interferometry

www.sarinterferometry.com



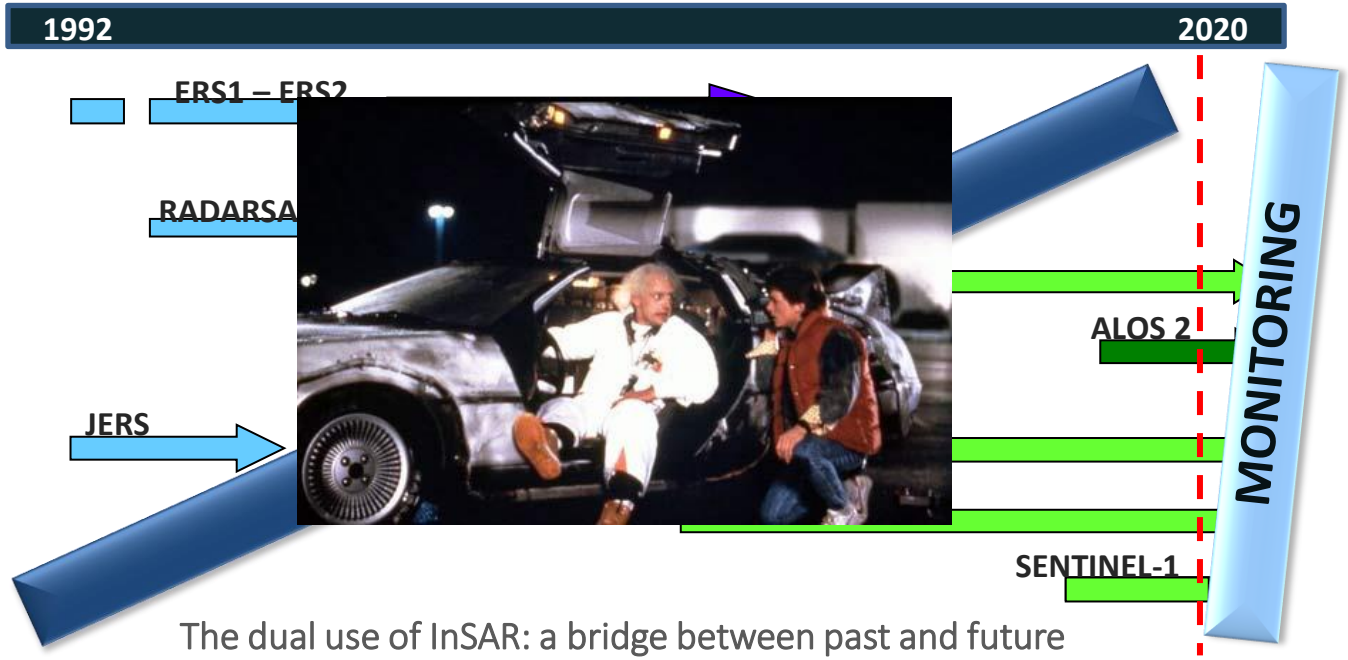
Satellite SAR Interferometry

www.sarinterferometry.com

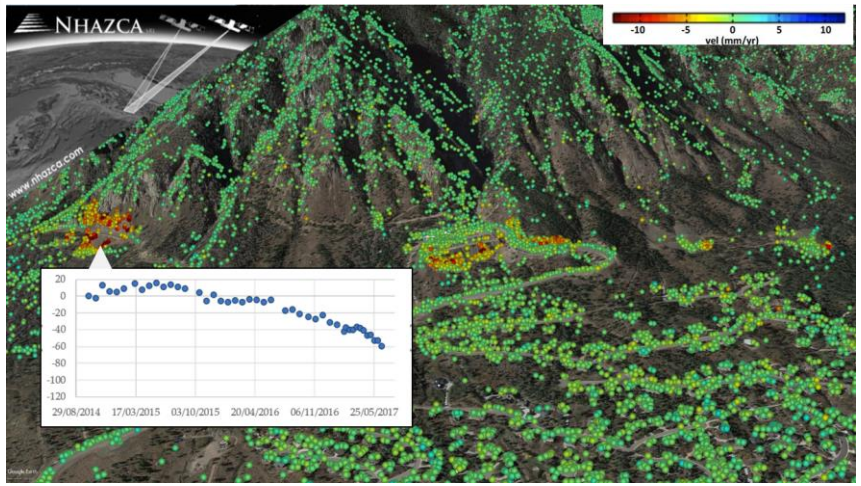
Why 'satellite' 'radar' data for engineering projects?

#1 A kind of "time machine" providing quantitative information about past (and future) deformation

A new paradigm to "monitoring" thanks to SAR (Synthetic Aperture Radar) images acquired from 1992 by several satellite sensors



The dual use of InSAR: a bridge between past and future



Spatial and temporal quantitative deformation measurement

Satellite SAR Interferometry

www.sarinterferometry.com

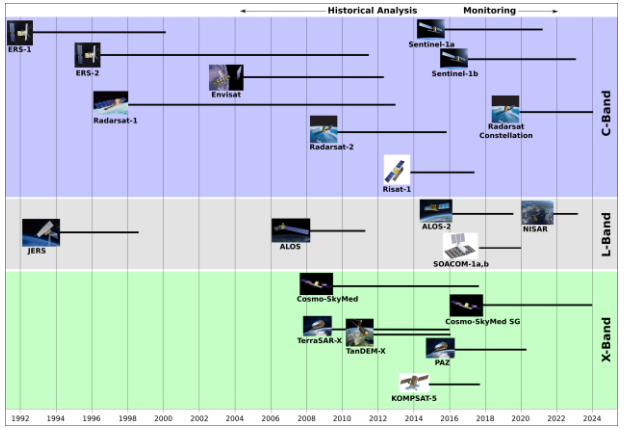
Why 'satellite' 'radar' data for engineering projects?

#2 Cost-effective

#3 Fully remote (no ground sensors)

0,02 $ per monitored point in this case

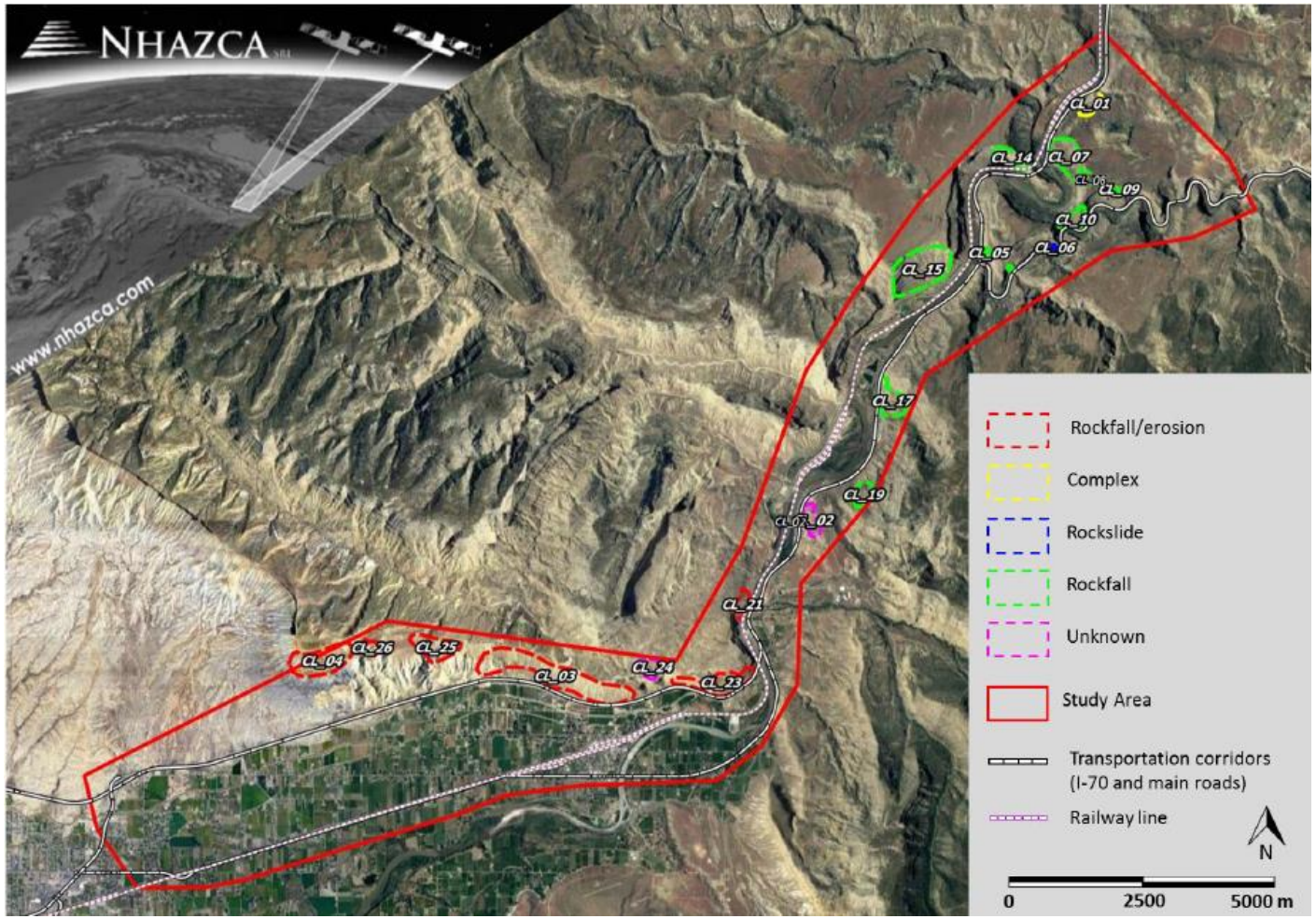
#4 Growing technology

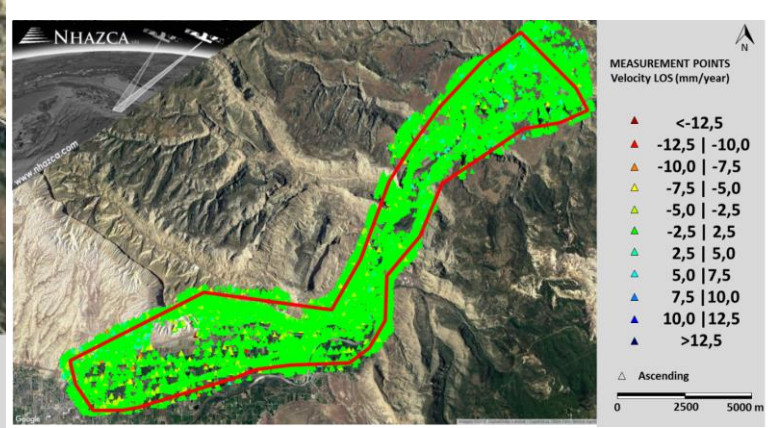


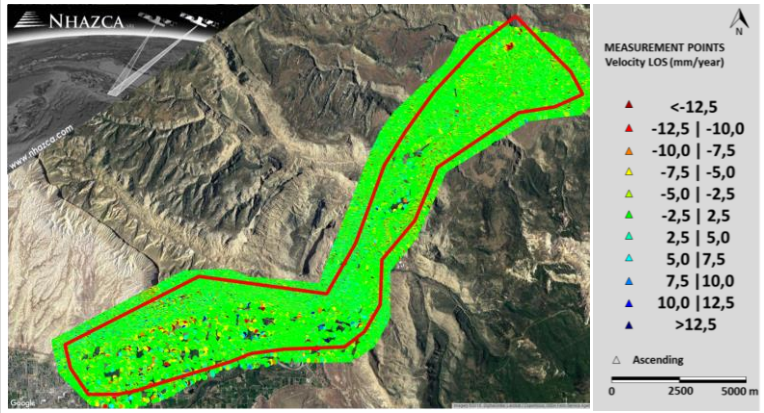
Transportation Asset Management

www.sarinterferometry.com

Historical deformation analysis for the Interstate-70 | Colorado, USA

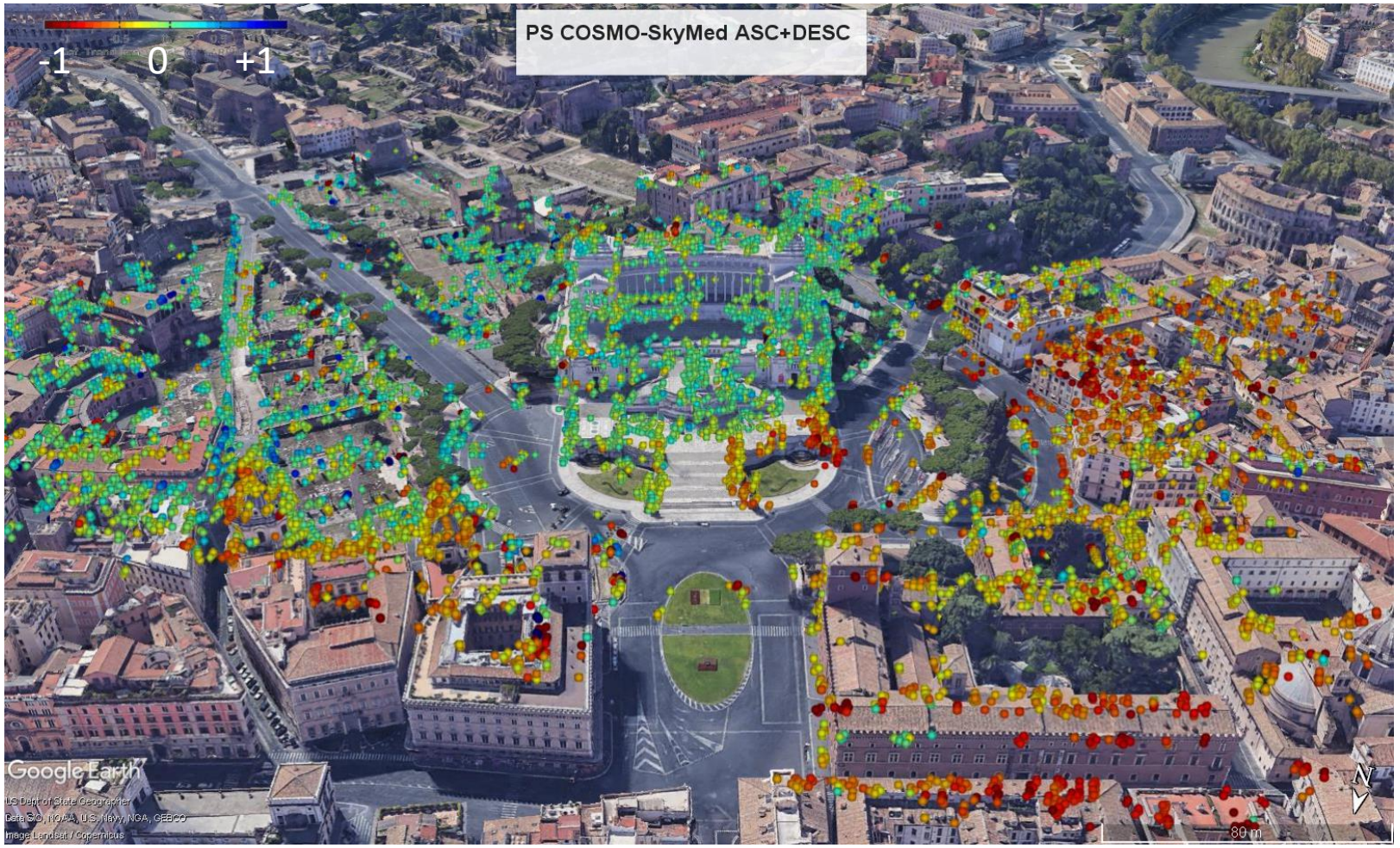






Surface deformations in the city center of Rome

www.sarinterferometry.com



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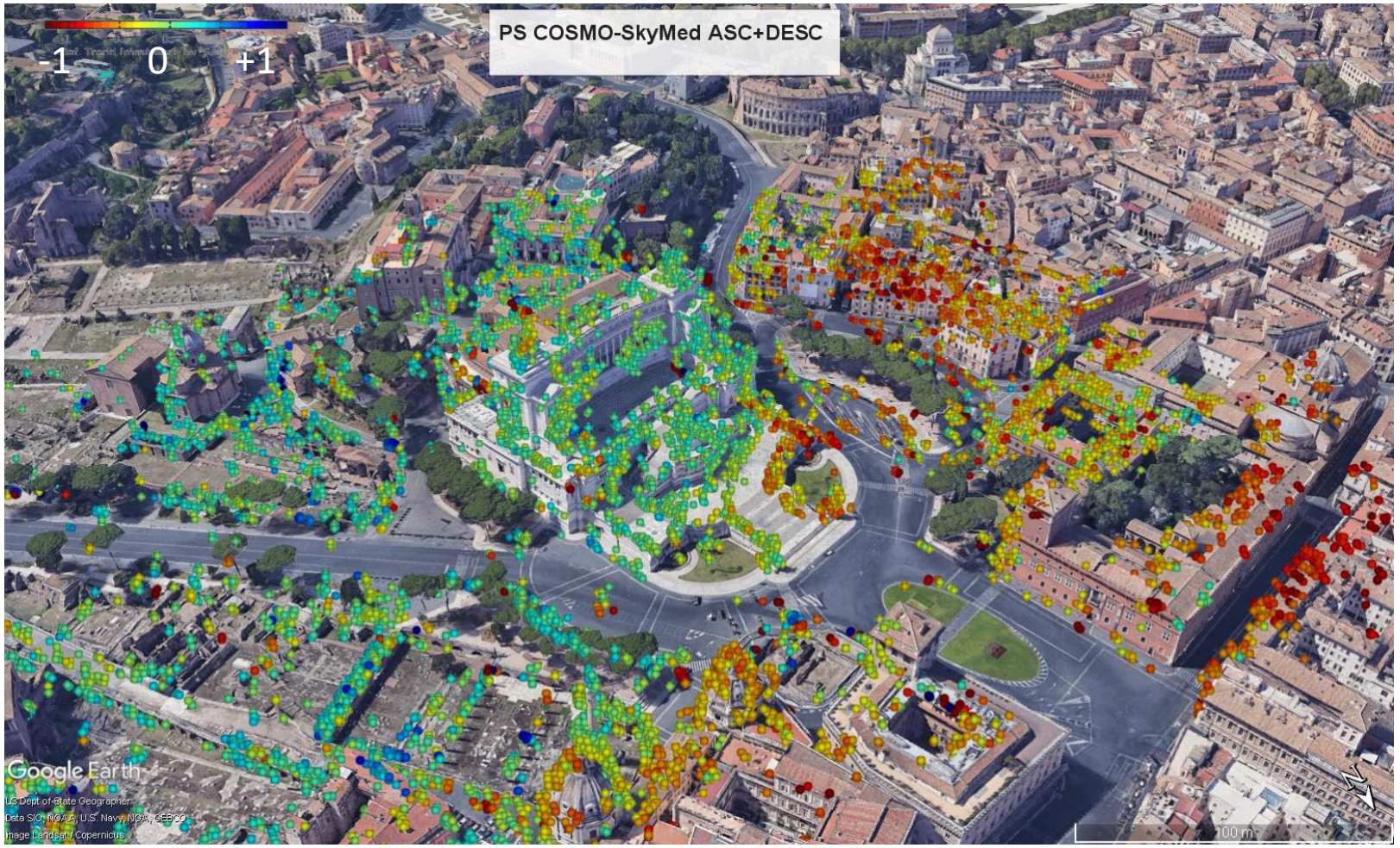

Surface deformations in the city center of Rome

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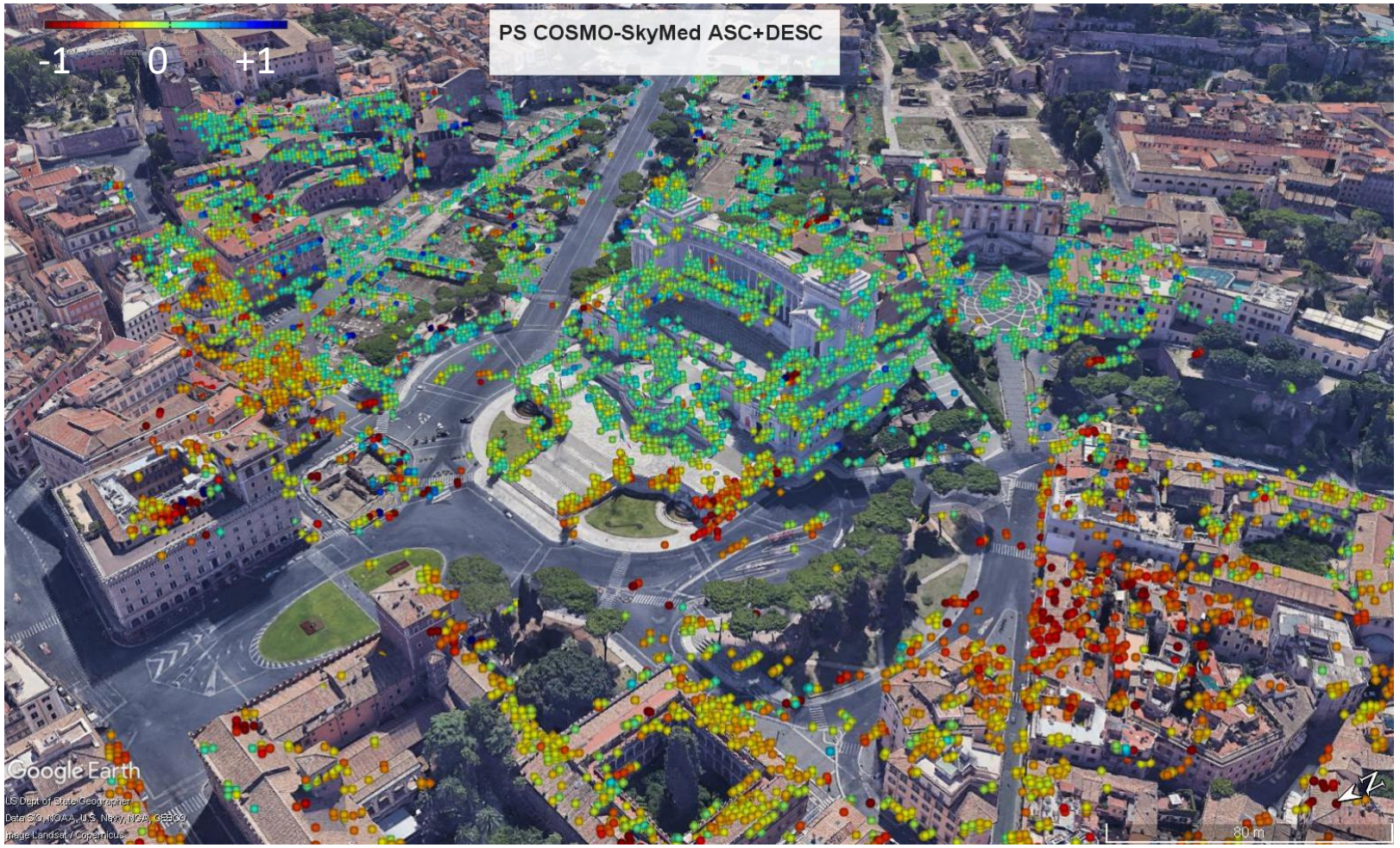
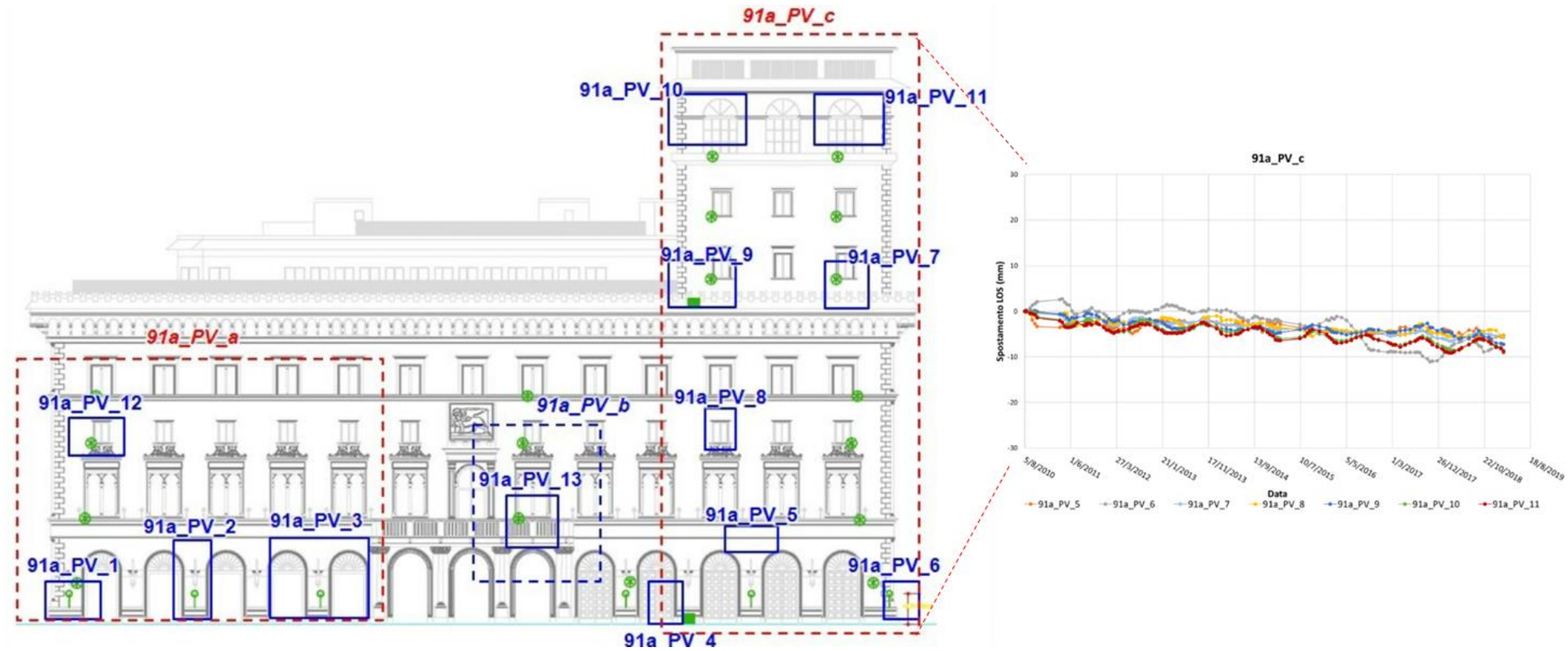


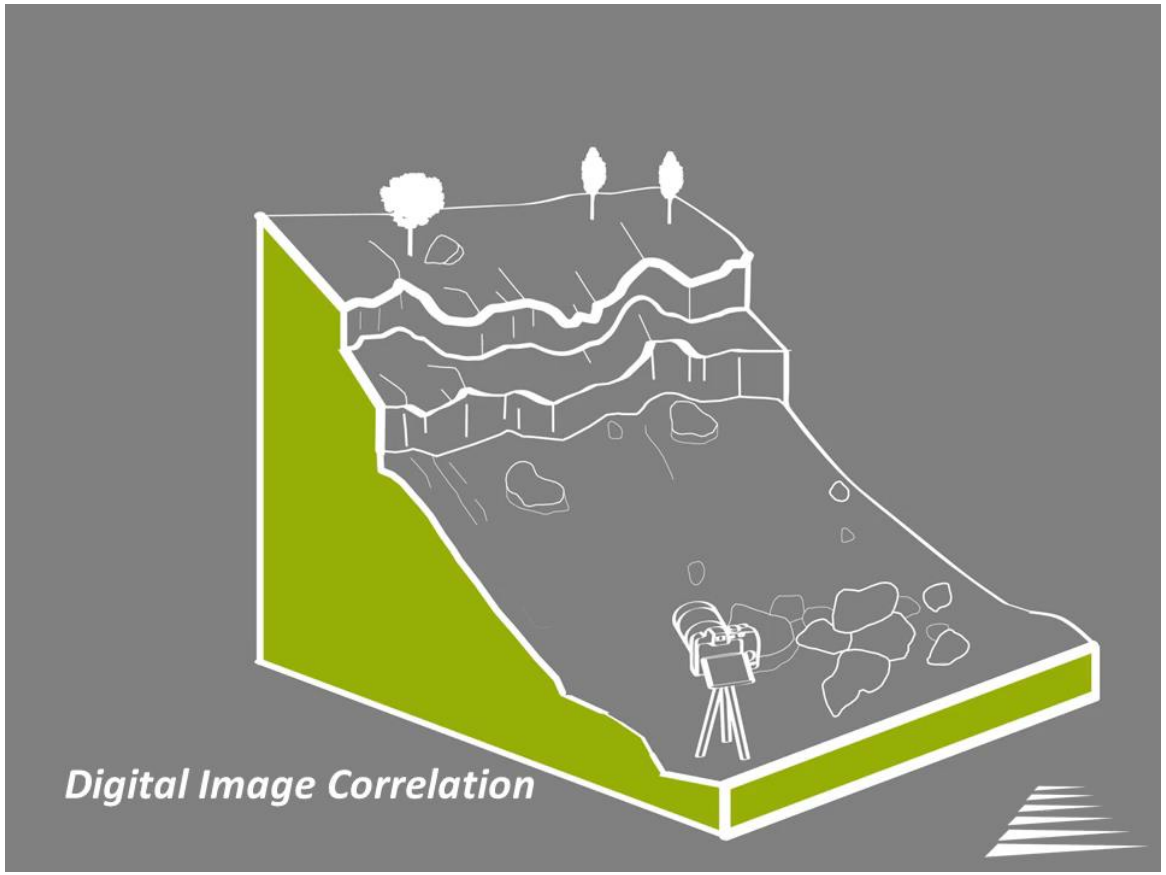
Accurate structural deformation measurements

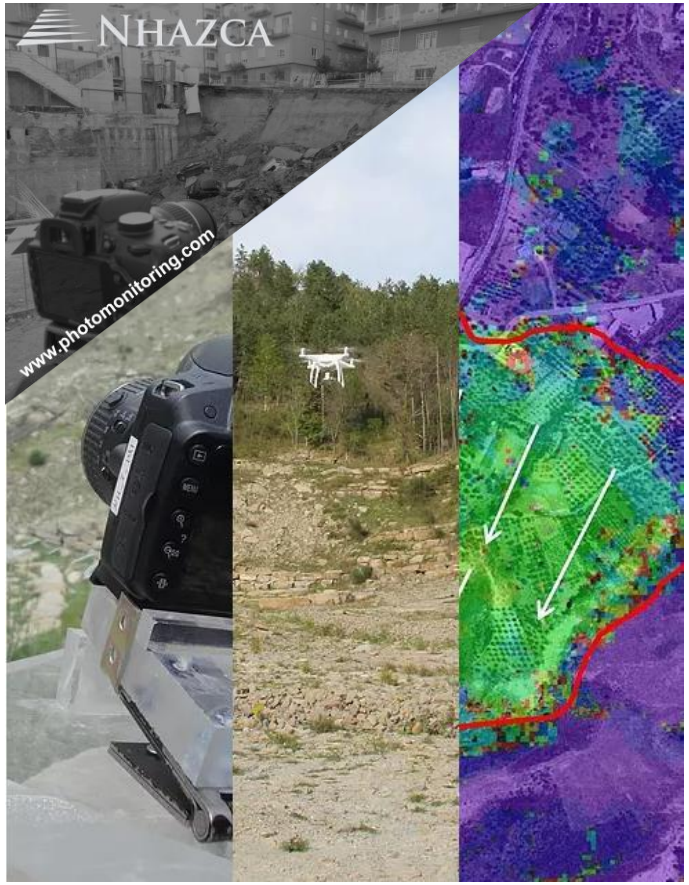
www.sarinterferometry.com



PhotoMonitoring™

www.photomonitoring.com





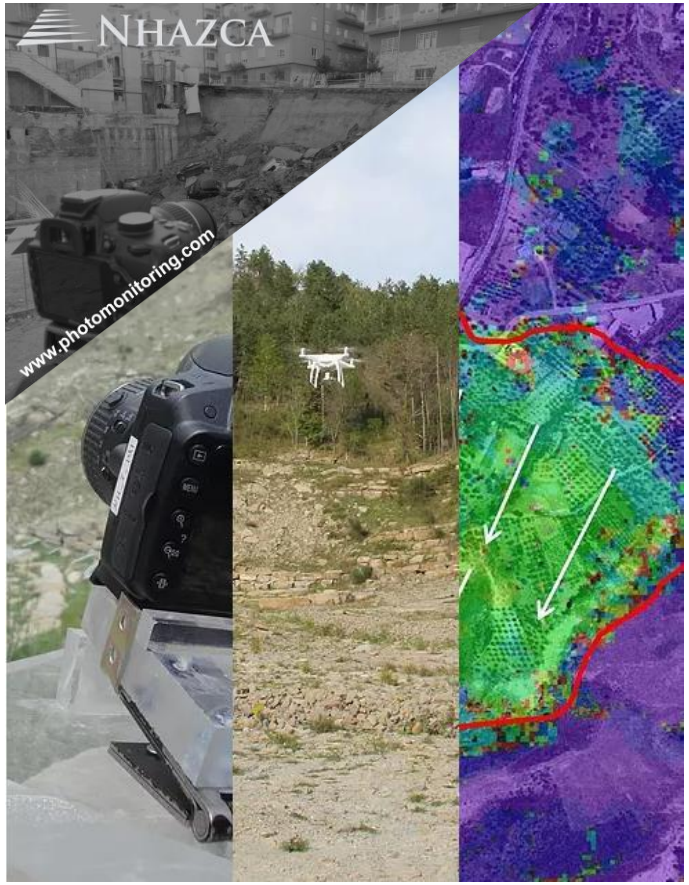
PhotoMonitoring™

www.photomonitoring.com

PhotoMonitoring™ is a new monitoring solution that takes advantage of the widespread availability of optical/multispectral sensors and images in order to achieve information about the change/displacement of the terrain by applying suitable image processing tools.

PhotoMonitoring™ works at different temporal and spatial scale, thus representing an ideal tool for investigating and monitoring different landslides processes and answering to a variety of different needs in terms of landslide hazards assessment and management.

*PhotoMonitoring™ combines advanced image-processing tools such as "Change Detection", "Digital Image Correlation", allowing to obtain **change and displacement maps**, thus creating an adaptive environment able to answer a wide spectrum of monitoring needs.*



PhotoMonitoring™ (Satellite-based)

www.photomonitoring.com

Arequipa landslide displacement analysis (Perù)

MULTI-TEMPORAL DISPLACEMENT ANALYSIS (11/2017 – 08/2019)

Planetscope: optical satellite images

Resolution: 3 meters

PhotoMonitoring™ (Satellite-based)

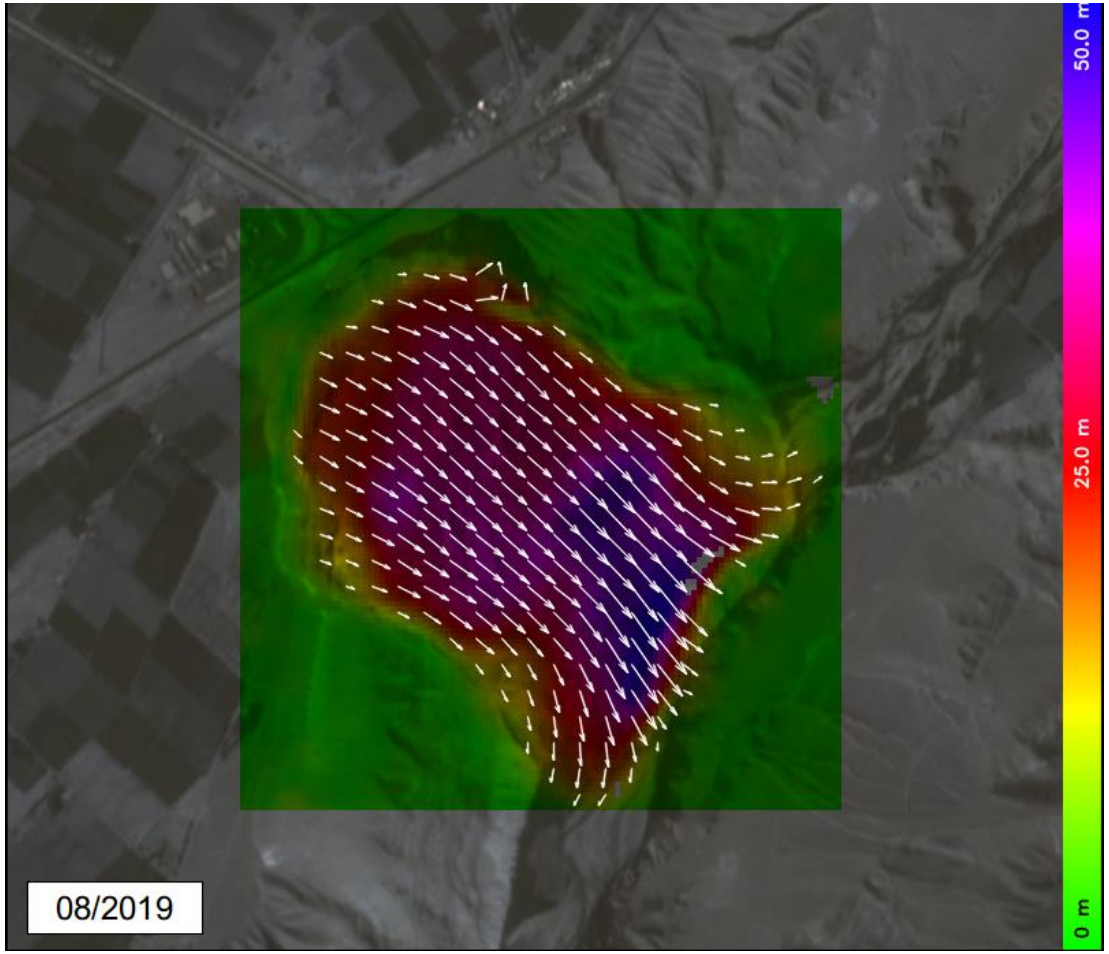
www.photomonitoring.com

Arequipa landslide displacement analysis (Perù)

Displacement map
(11/2017 – 08/2019)

Planetscope: optical satellite images

Resolution: 3 meters



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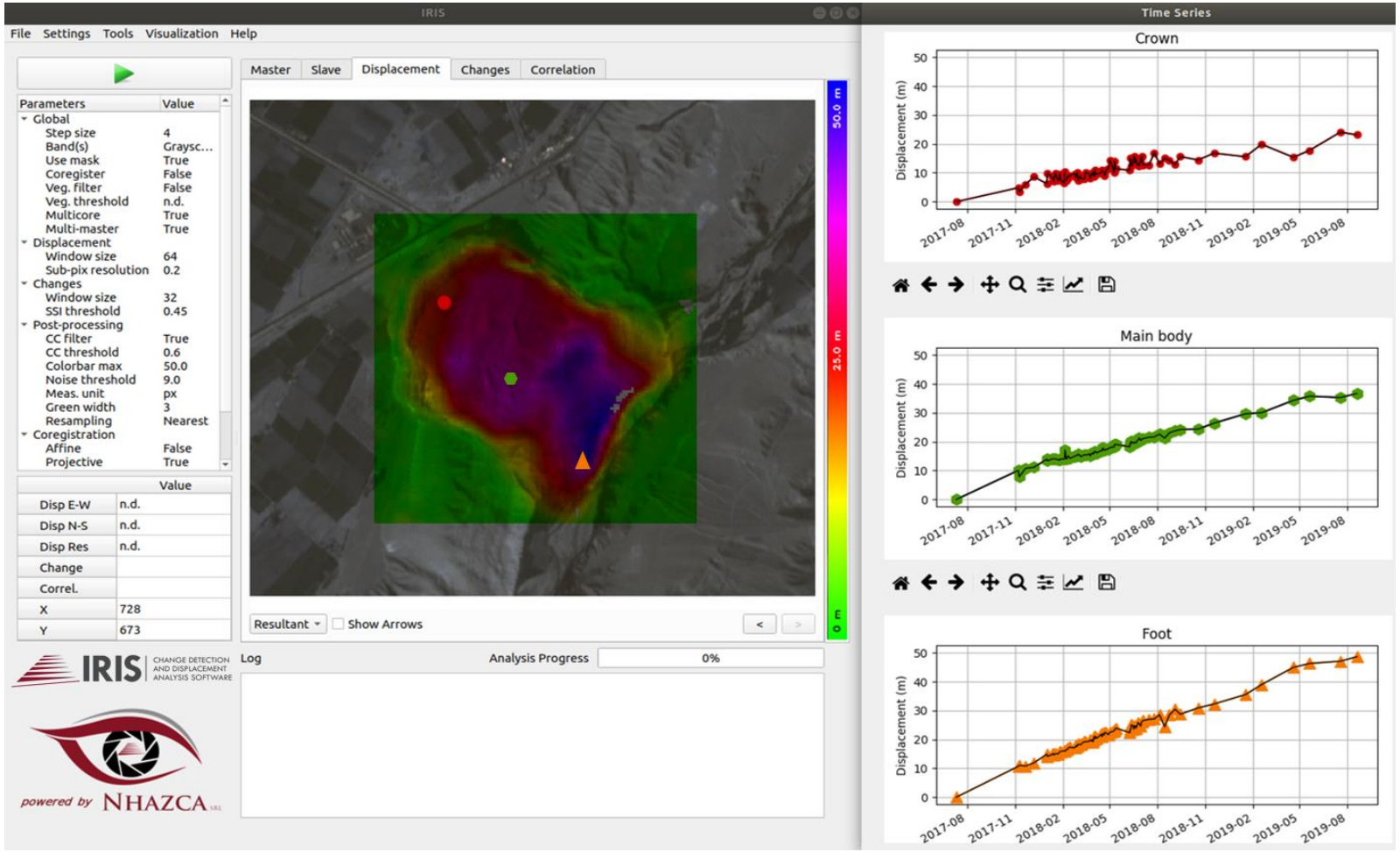


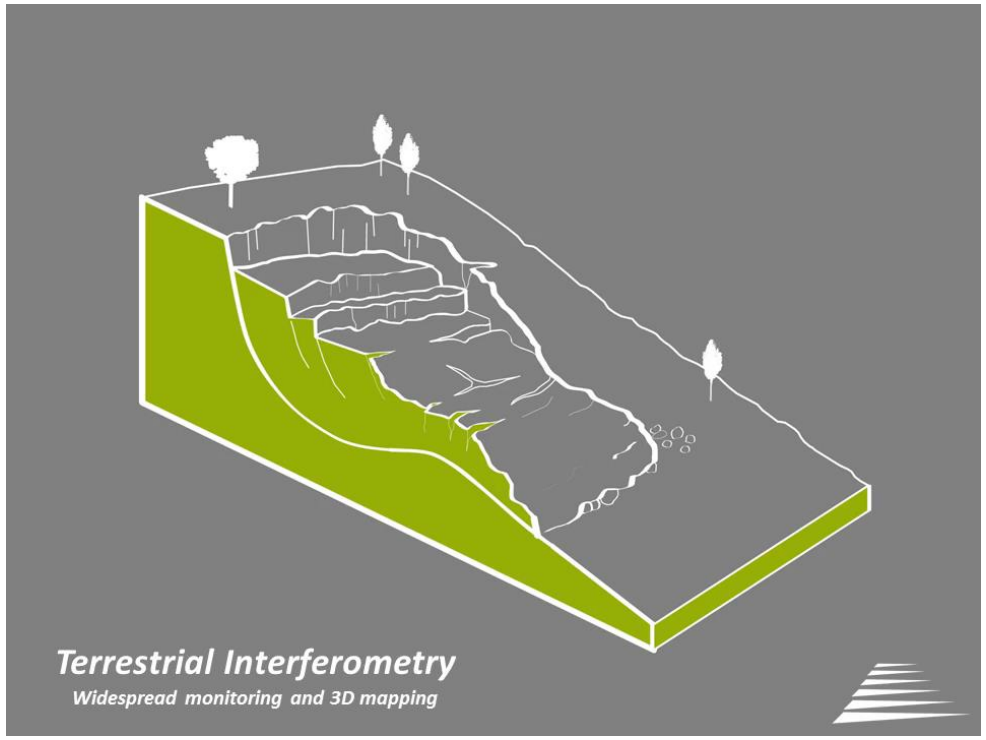
Photomonitoring (Ground-based)

www.photomonitoring.com

Structural monitoring of engineering structures

Terrestrial SAR Interferometry

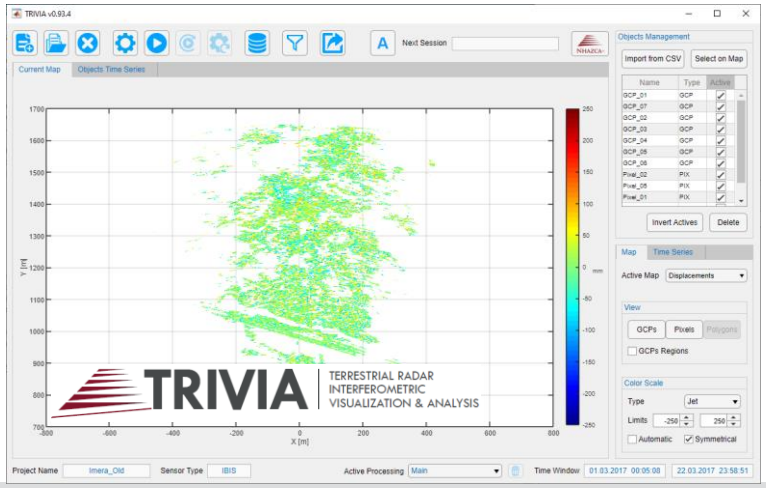
www.sarinterferometry.com

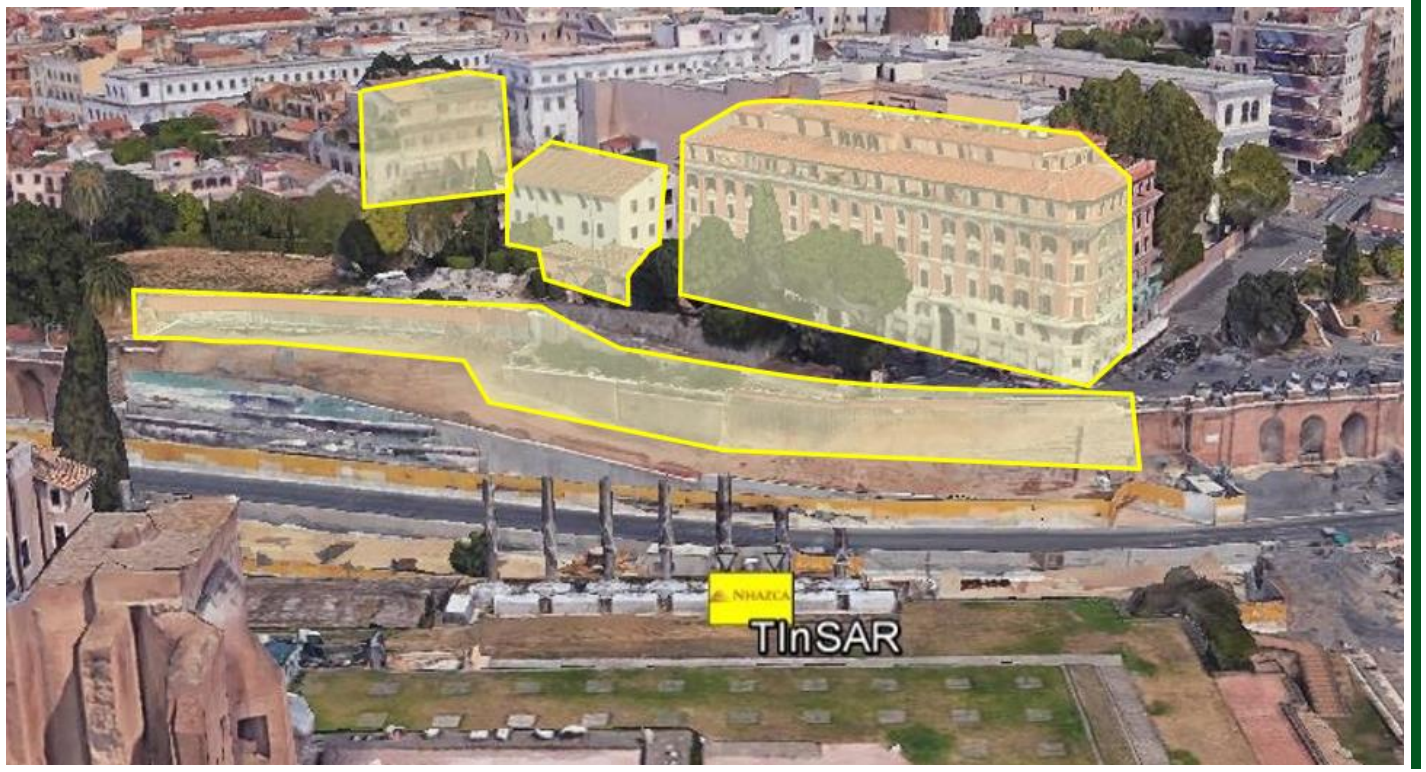


TInSAR monitoring of the Metro C tunnel in Rome

www.sarinterferometry.com

Terrestrial InSAR monitoring of an anchored wall





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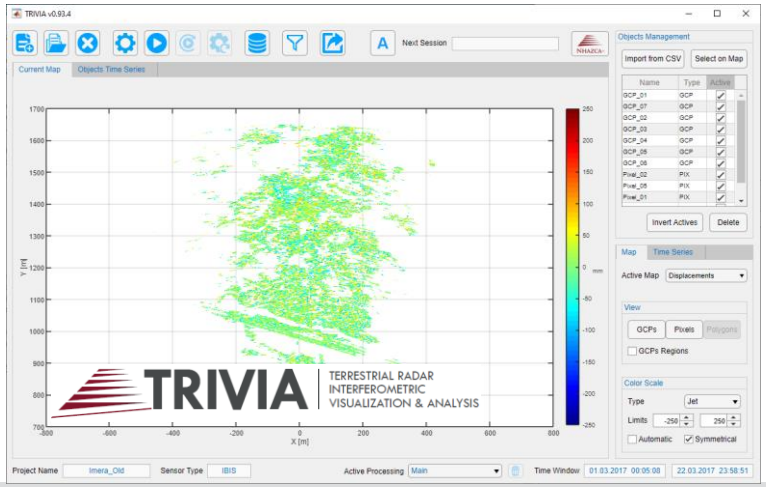
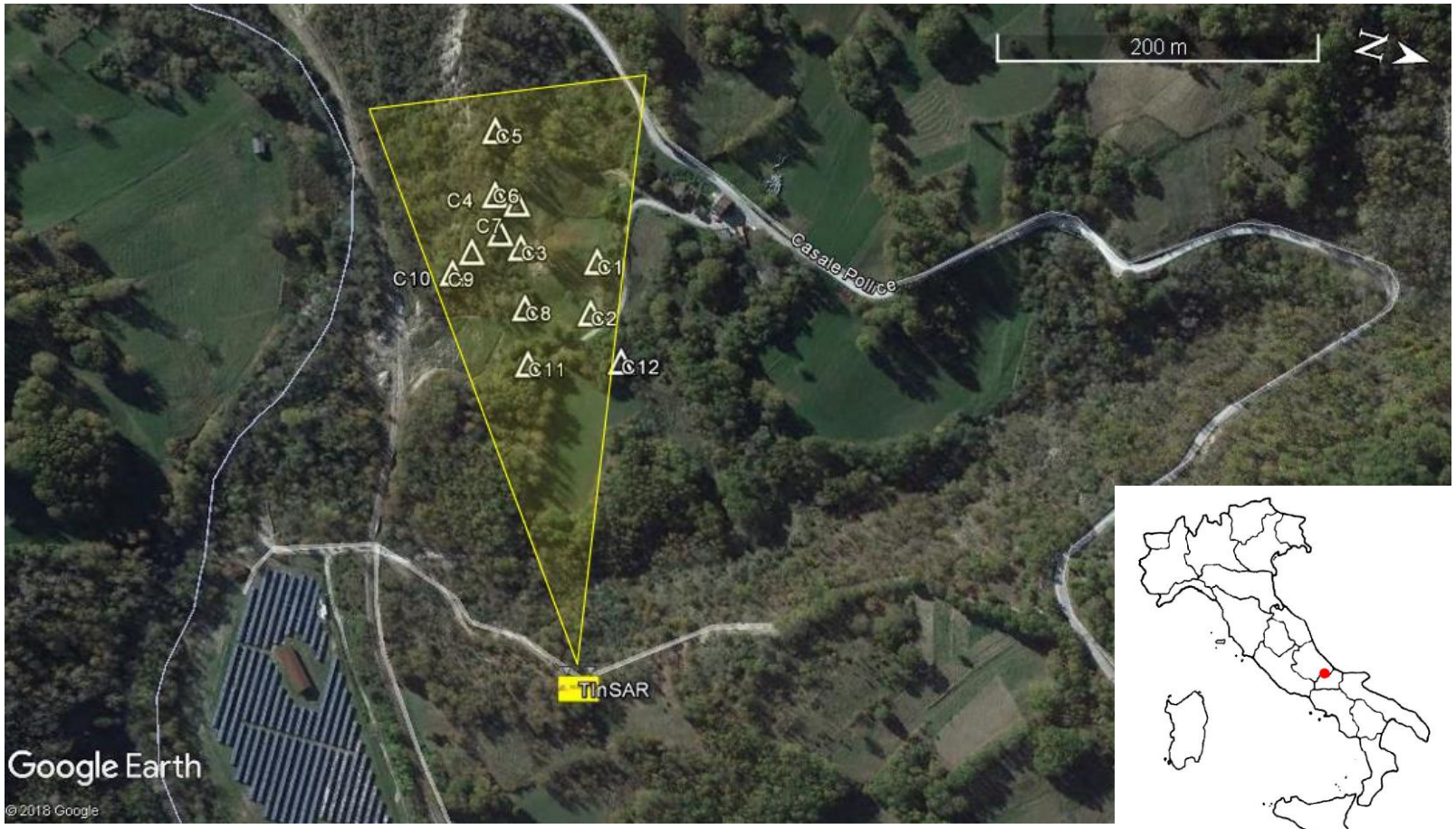


TInSAR monitoring a landslide facing a new tunnel

www.sarinterferometry.com

Objective: *Monitoring the deformational behaviour of the Malincolavilla Landslide interfering with the construction of a National Road* ***Cantiere ANAS "SS652 Fondo valle Sangro"***



TInSAR monitoring a landslide facing a new tunnel

www.sarinterferometry.com

Cantiere ANAS "SS652 Fondo valle Sangro"

Installation site

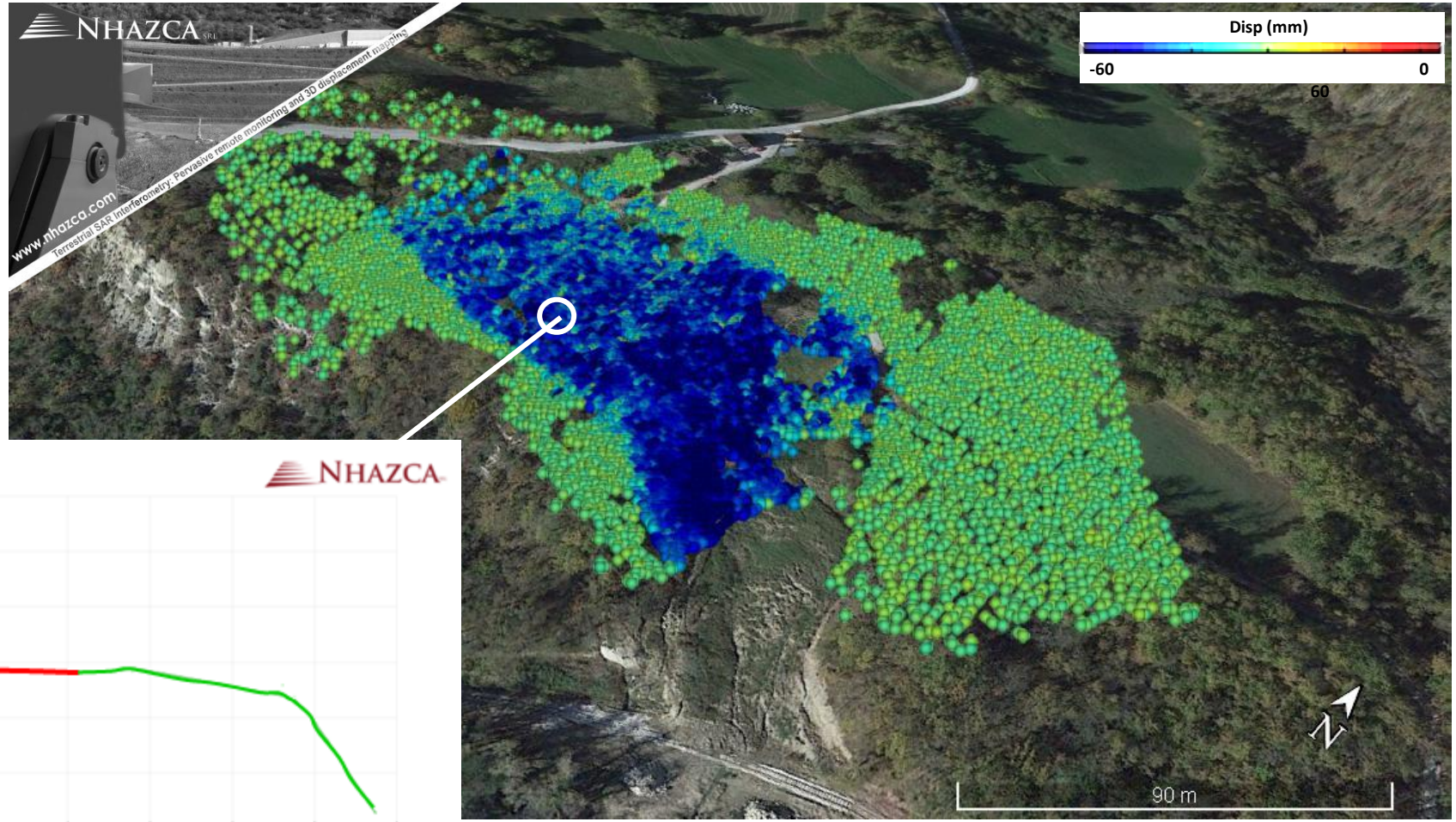
- IBIS-L TInSAR
- Proprietary Photovoltaic panels for power supply (RAPS)
- 10 Corner Reflectors
- Laser Scanner survey

Installation site

- Difficult environmental conditions

TInSAR monitoring a landslide facing a new tunnel

www.sarinterferometry.com



Photomonitoring or TInSAR?

www.sarinterferometry.com

Monitoring slope stability during the San Giovanni tunneling excavation

V= 10,000 m^3

Bozzano F., C. I. (2011). Displacement patterns of a landslide affected by human activities: insights from ground-based InSAR monitoring. *Nat Hazards 59(3):1377–1396. doi:10.007/s11069-011-9840-6*

Mazzanti P., B. F. (2014). New insights into the temporal prediction of landslides by a terrestrial SAR interferometry monitoring case study. Landslides – Springer.

Photomonitoring or TInSAR?

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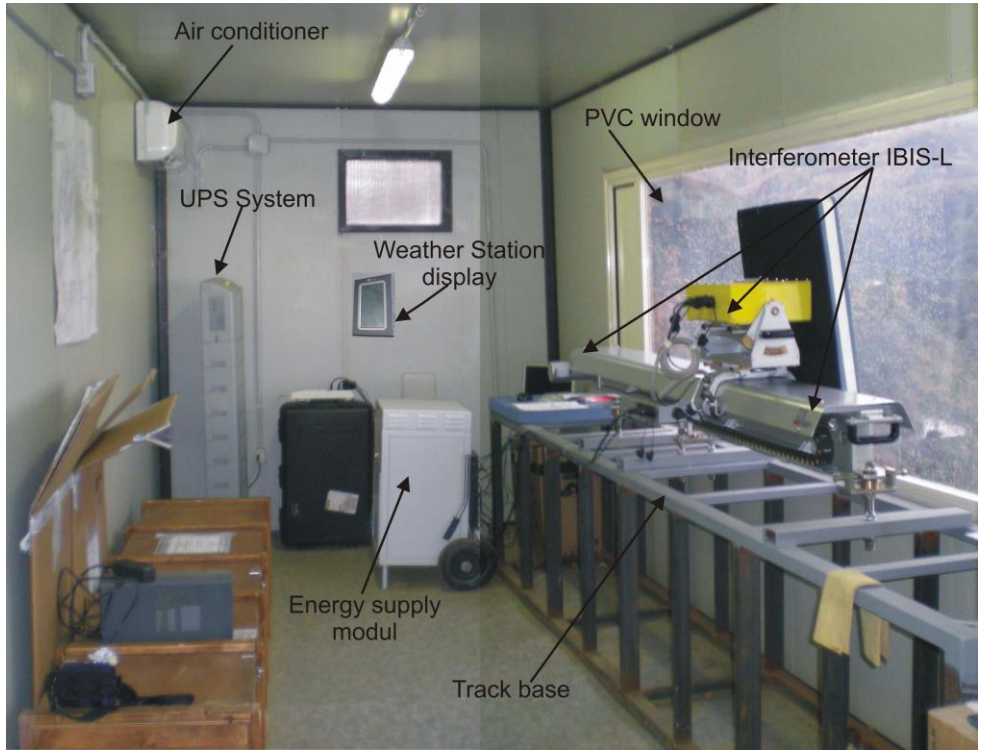
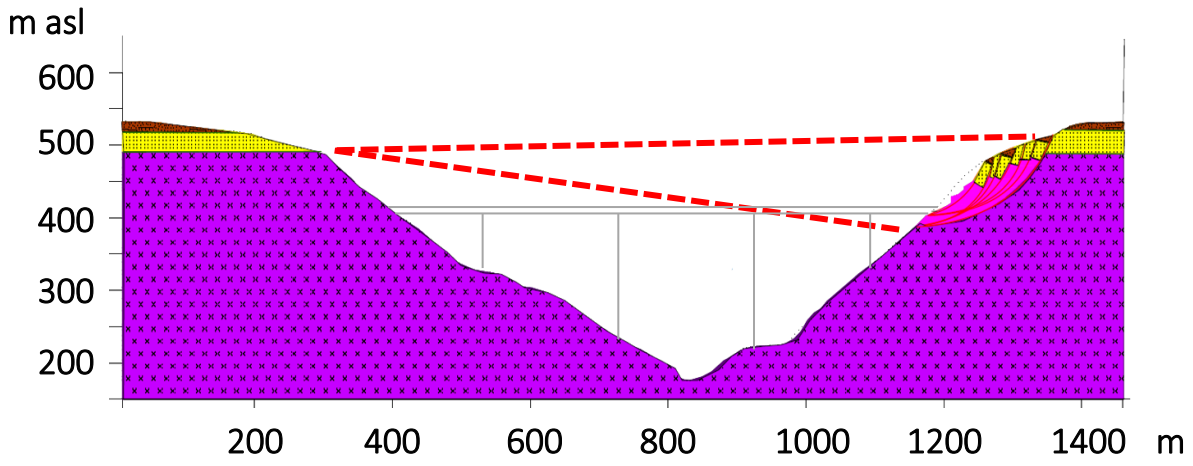
Monitoring slope stability during the San Giovanni tunneling excavation

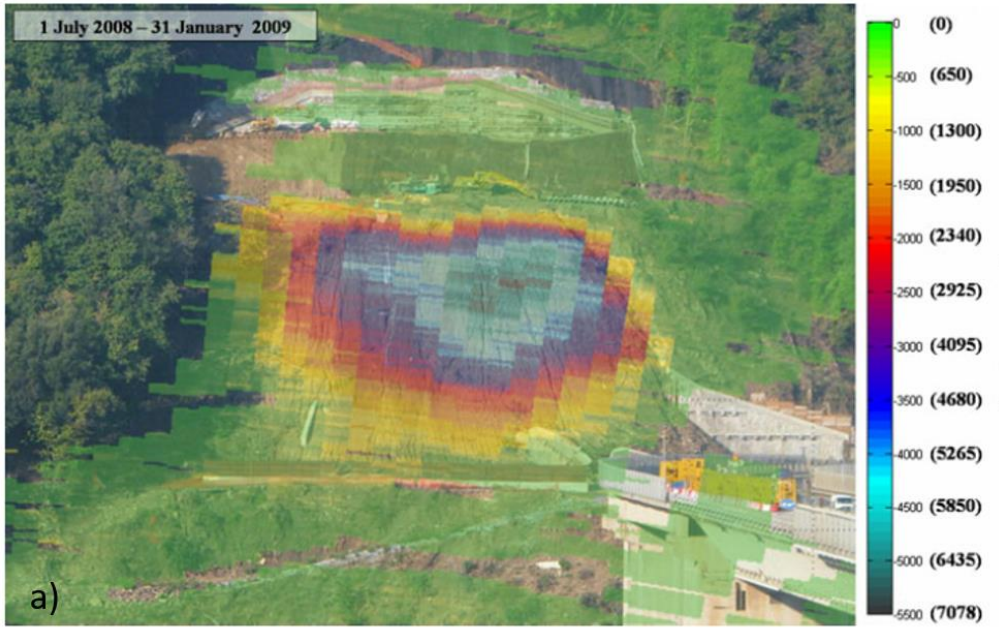


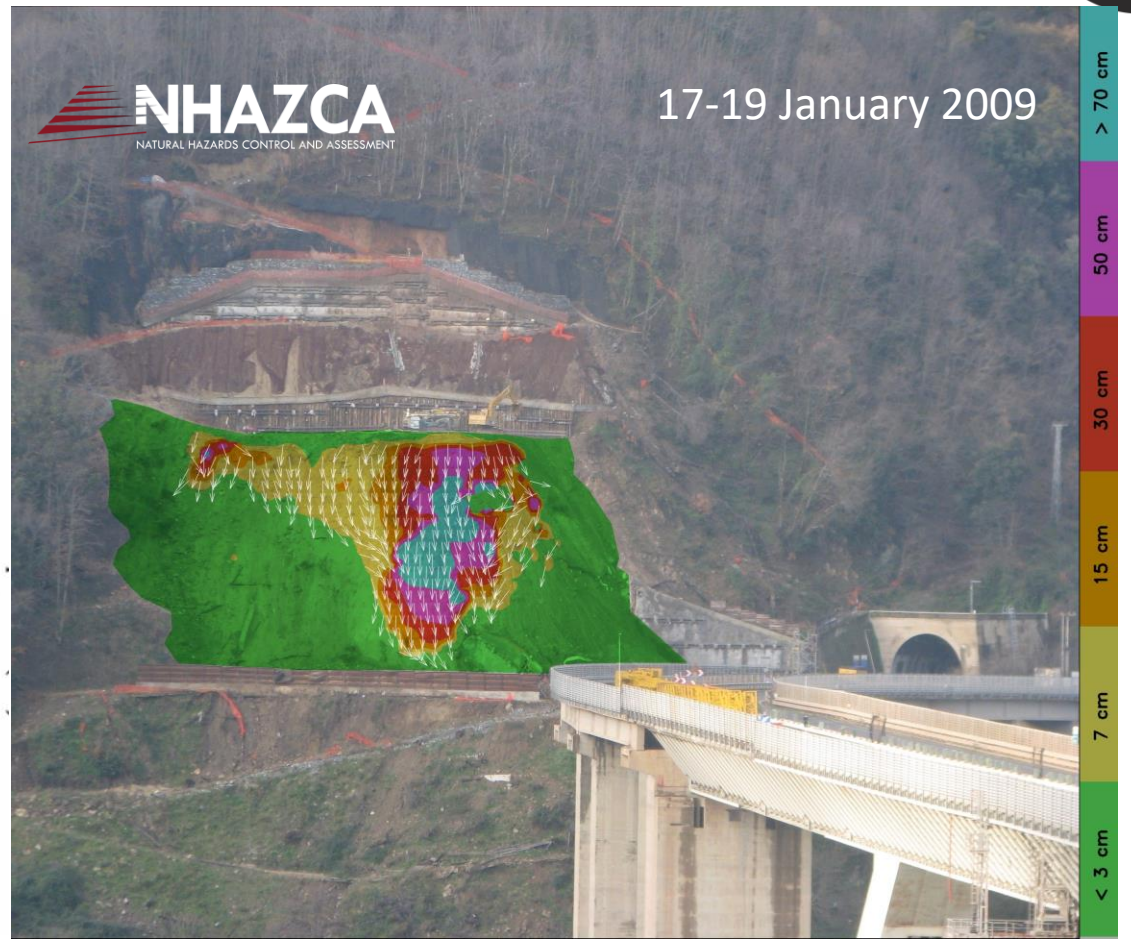


Photomonitoring or TInSAR?

Monitoring slope stability during the San Giovanni tunneling excavation

PhotoMonitoringTM:
https://www.photomonitoring.com/





THANK YOU!

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www.sarinterferometry.com

www.photomonitoring.com

SPIN OFF DI SAPIENZA UNIVERSITÀ DI ROMA

NHAZCA

NATURAL HAZARDS CONTROL AND ASSESSMENT

TOWARDS THE FUTURE