LO SVILUPPO DI SERVIZI SATELLITARI PER L'INGEGNERIA CIVILE

L'ESPERIENZA DEL PROGETTO I.MODI

15.02.2018

ROMA

INGEGNERIA SAN PIETRO IN VINCOLI

!MODI®
Satellite Services for Structural Monitoring

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 720121

Survey Lab

Spin off di
SAPIENZA
UNIVERSITÀ DI ROMA

IL PROGETTO I.MODI®

MARIA MARSELLA
CEO Survey Lab

ROMA - 15.02.18

I.MODI® Satellite Services for Structural Monitoring

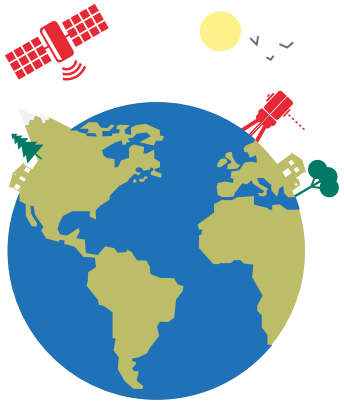
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 720121

Survey Lab

Spin off di Sapienza Università di Roma

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

Survey Lab Ltd, established in **2008**, is a **spinoff** of **Sapienza University of Rome**.
The **expertise** of the Company in the **techniques for monitoring** land, structure and infrastructure derives from the strict connection with **researchers** of the Area of Geomatics in the Department of **Civil**, **Environmental** and **Construction Engineering**.



Our **MISSION**

- Leverage DICEA's **scientific and technological knowledge** in order to capture additional **business opportunities** (otherwise not pursuable through the University)
- **Implement** and **distribute** innovative **monitoring systems** by integrating advanced **geomatic** technologies and satellite **Earth Observation** data with a focus on **natural hazards** and **built-up** environment.

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

Our **TEAM**


Fabrizio Fossati


Francisco Guerrero


Valeria Giangiacomo


Lorenzo Lugaresi


Maria Marsella


Peppe D'Aranno


Stefania Arangio


Chiara Crosti


Sara Chinnici


Silvia Scifoni


Fabrizio Spaziani

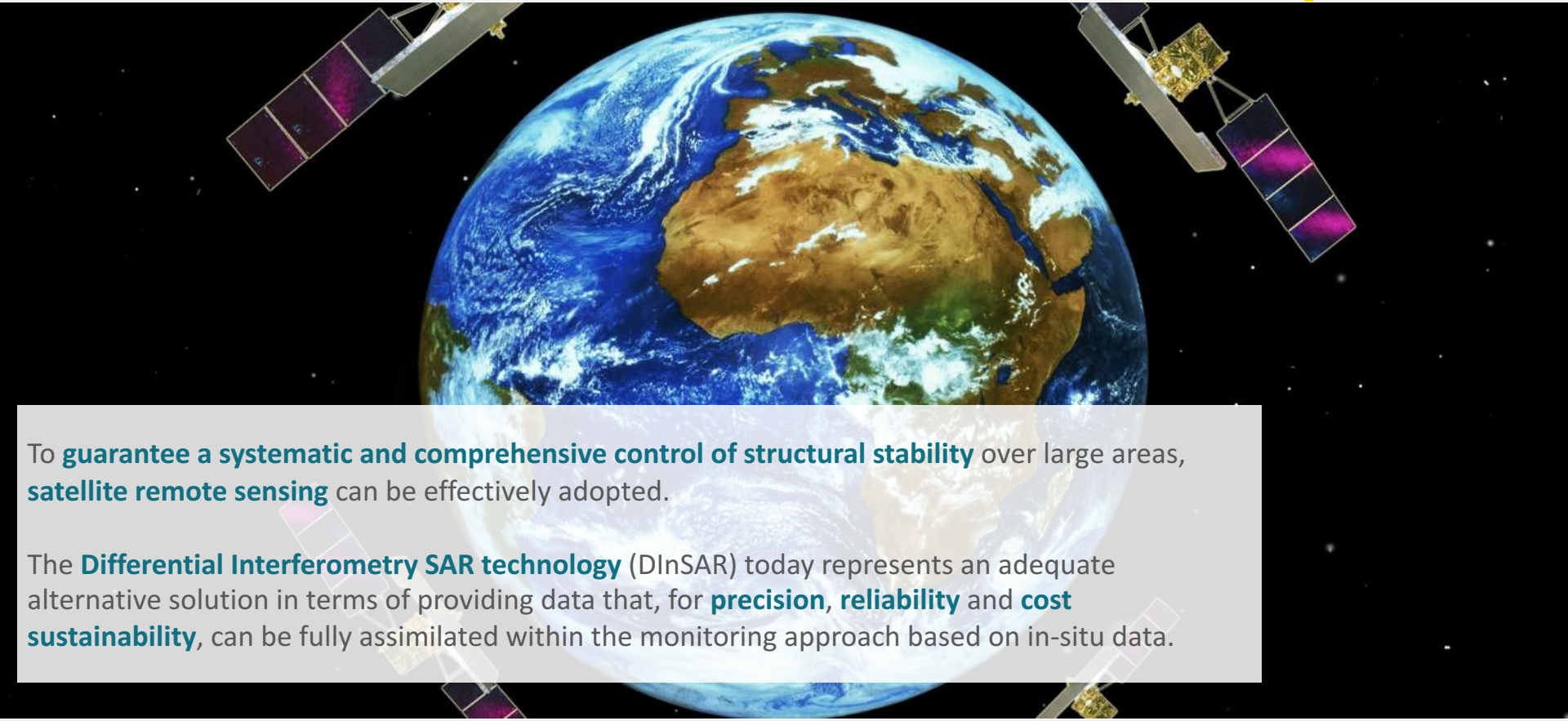

Josè Palenzuela


Angela Celauro


Marco Corsetti

Earth Observation

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

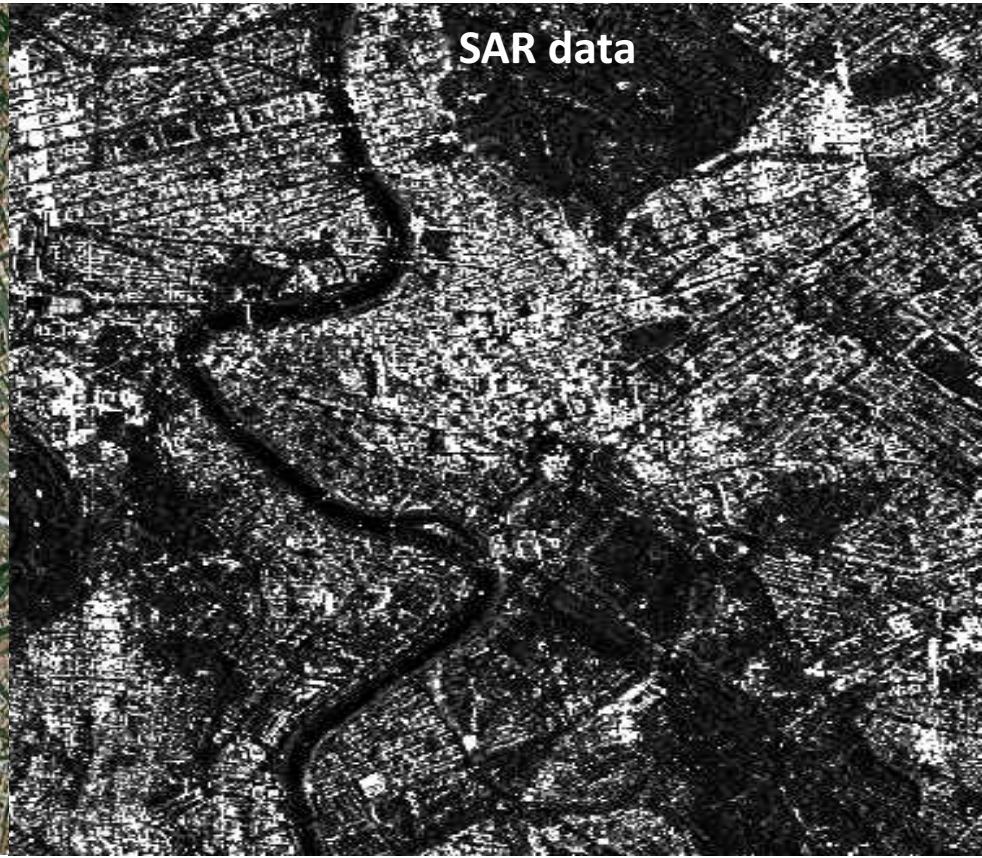


To **guarantee a systematic and comprehensive control of structural stability** over large areas, **satellite remote sensing** can be effectively adopted.

The **Differential Interferometry SAR technology** (DInSAR) today represents an adequate alternative solution in terms of providing data that, for **precision**, **reliability** and **cost sustainability**, can be fully assimilated within the monitoring approach based on in-situ data.

Earth Observation

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

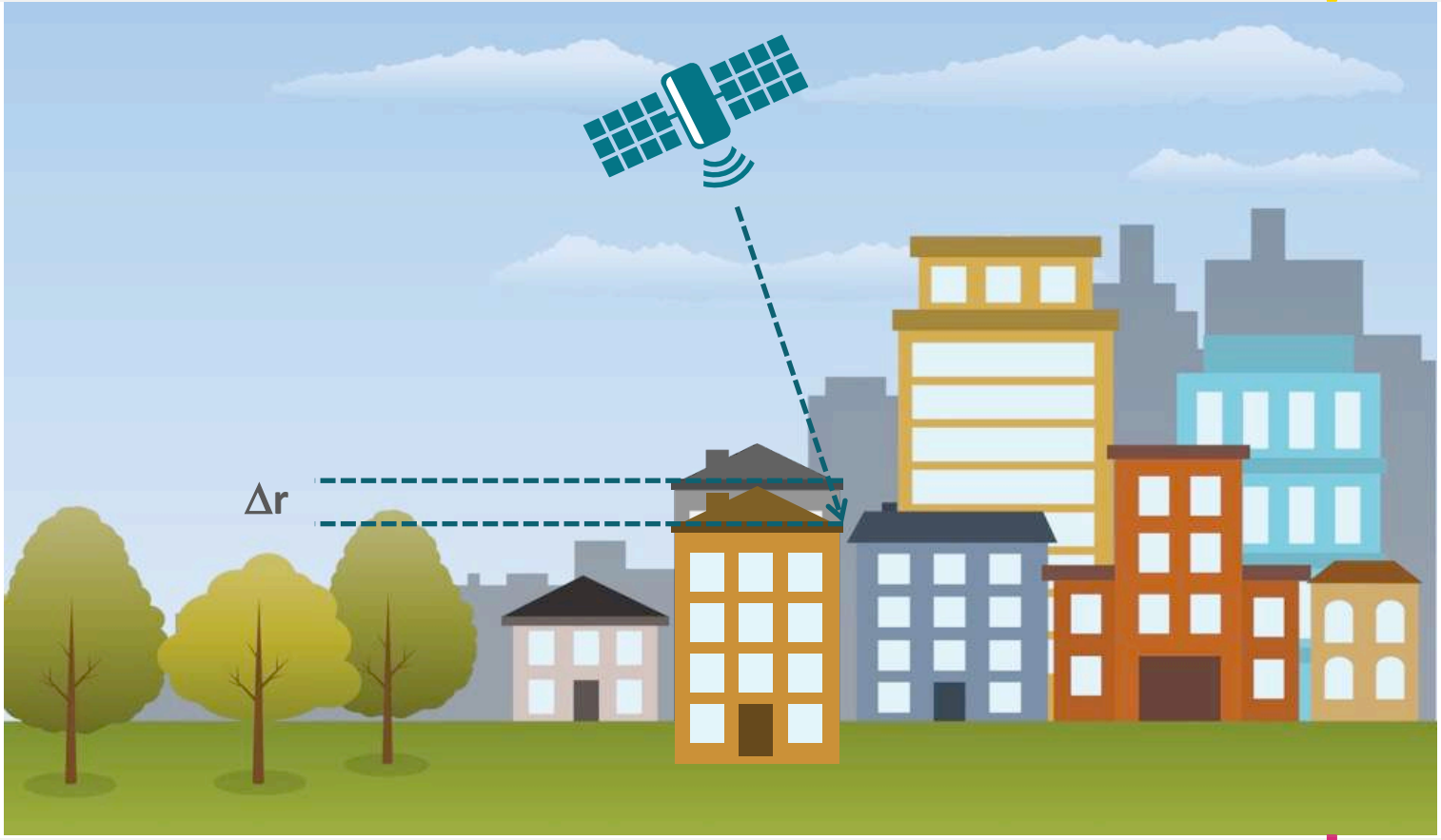


Differential Interferometry SAR

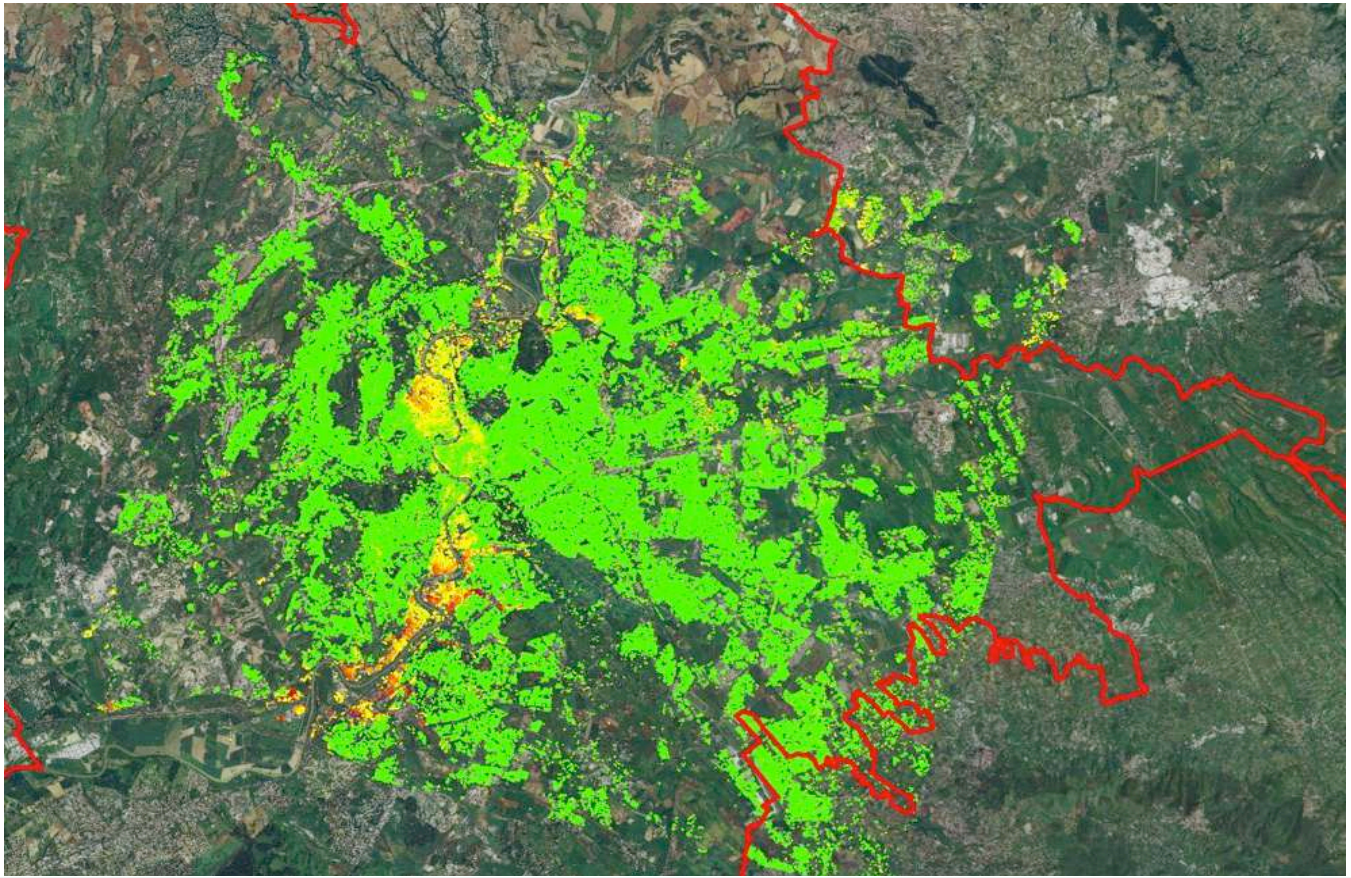
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

Differential Interferometry SAR

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

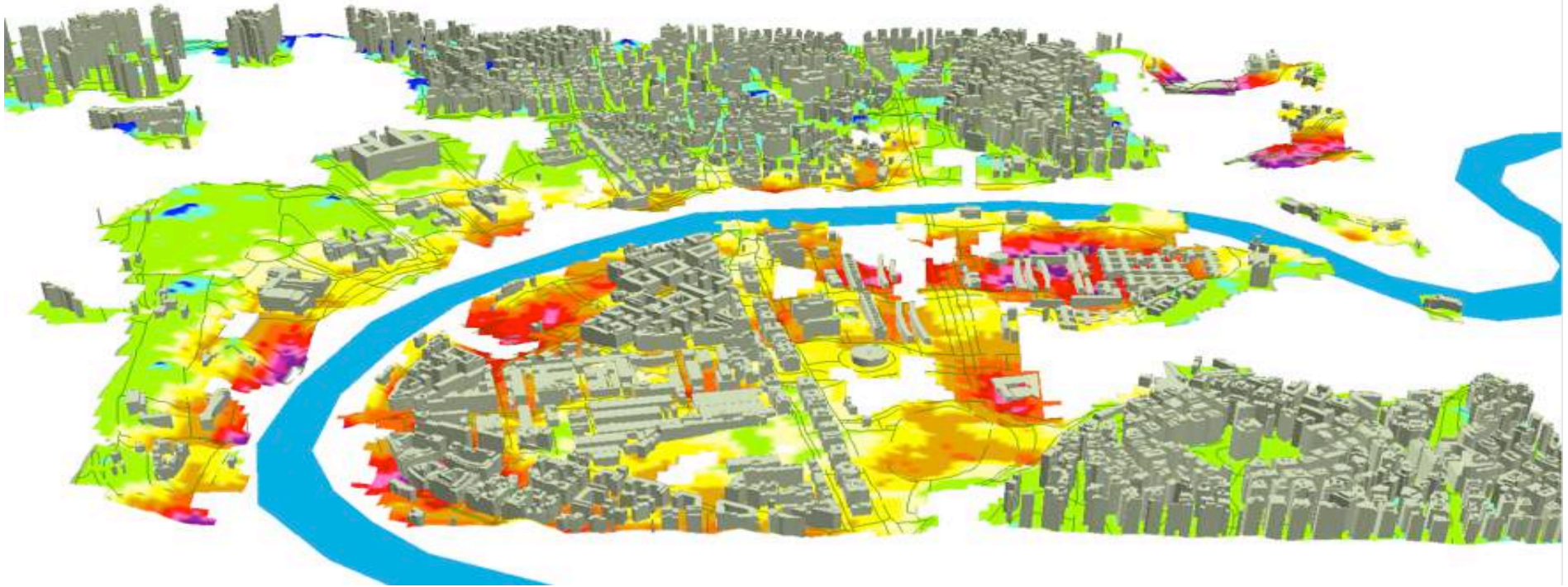


This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121



ROMA Nord

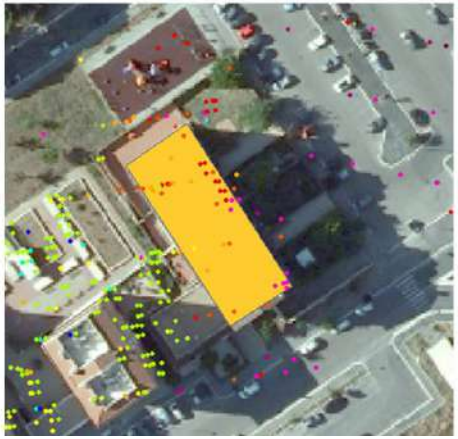
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121



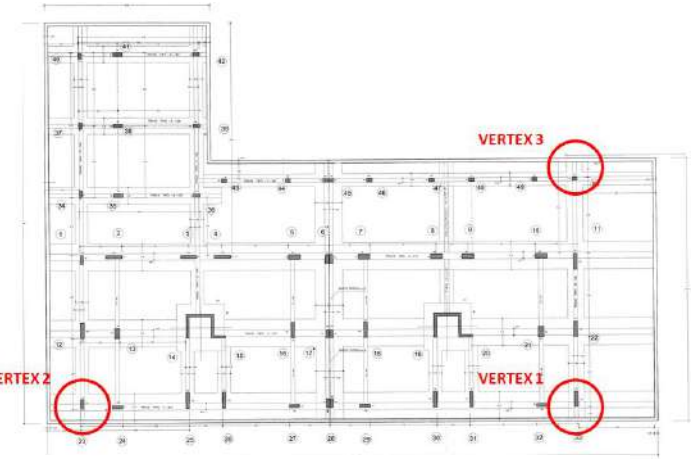
LOS displacement Time series of relevant points

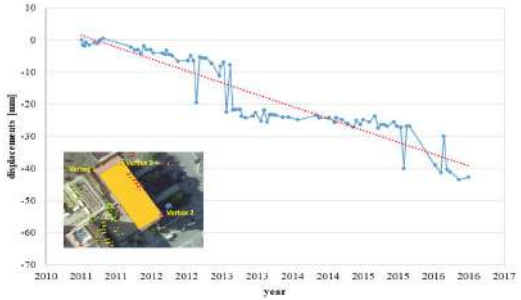
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

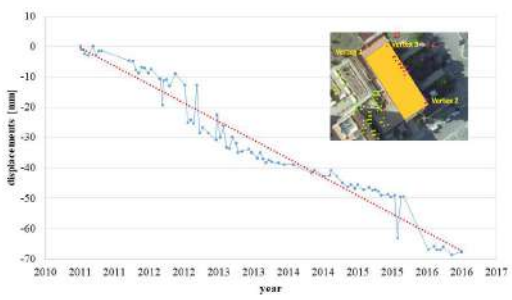
Measurement points on the analyzed building

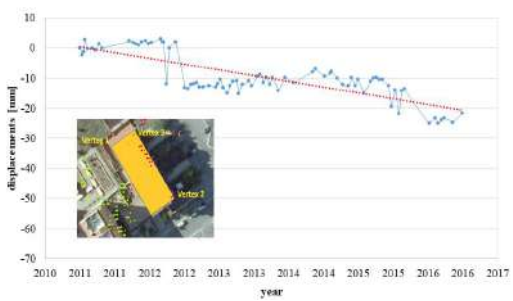


Measurement points with coherence > 0.7





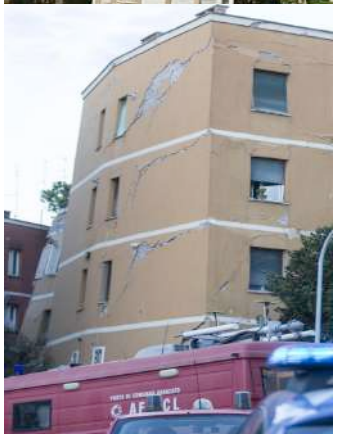




This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

The monitoring system is strictly devoted to **safeguarding the population** and has a primary role in setting up **mitigation and prevention actions**, as well in the implementation of an **alert system**.

Monitoring structural stability in **urban areas** and **large infrastructure networks** is emerging as one of the dominant **socio-economical issues** for the safety of the population.



This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

METRO C ROMA
Monitoring of the interaction between excavations and monuments

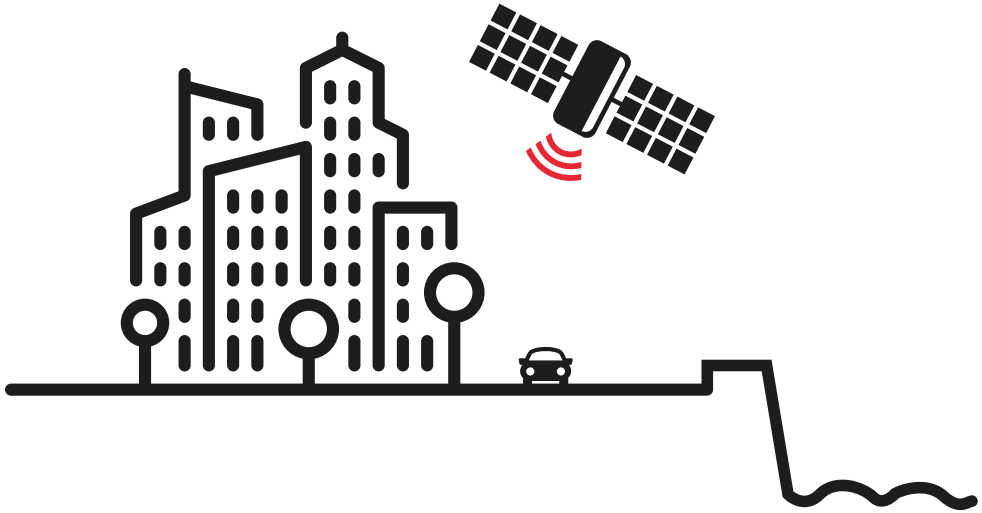
WHERE Project Call ASI PMI n.2 Earth Observation
Monitoring of the interaction between excavations and monuments

MODI
Development of innovative services for the monitoring of the state of damage to structures based on the use of techniques DInSAR

Edifice Monitoring Displacement
App aimed to monitoring the displacement of buildings in large urban areas through thematic maps obtained by the elaboration of satellite data.

Implemented monitoring system for structural displacement
Monitoring the stability of buildings and infrastructures integrating Earth Observation data processed with DInSAR technique, data acquired in situ and numerical models.

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121



DInSAR data exploitation to **monitor the stability** of buildings and infrastructures providing user friendly **damage assessment**.

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

European Commission

EASME

Executive Agency for SMEs

European Commission > EASME > Sme calls > H2020-SMEINST-2-2015

Home | About EASME | Working for EASME | News | Tenders | Communication

Our four areas of action → SME SUPPORT | ENVIRONMENT | ENERGY | MARITIME

H2020-SMEINST-2-2015

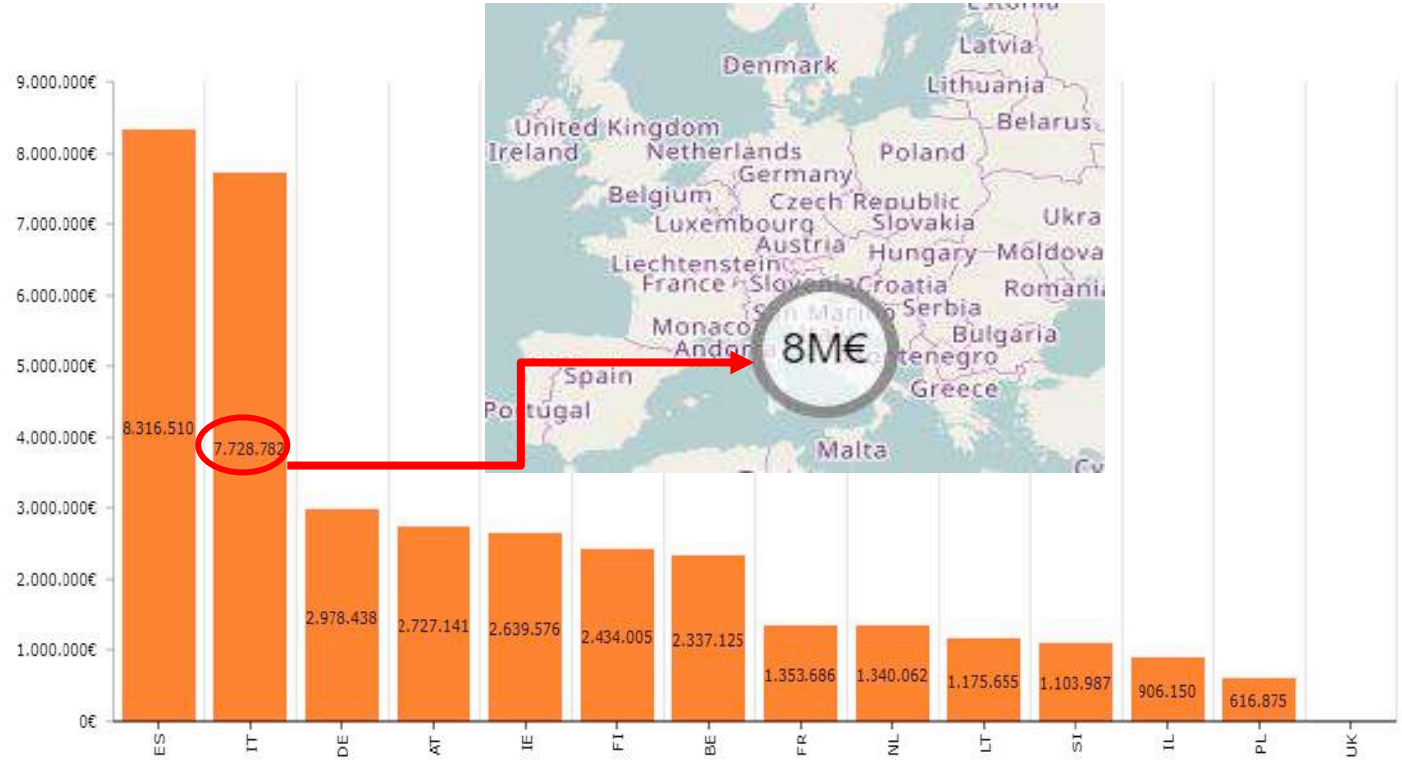
Implemented MOnitoring system for structural DIsplacement

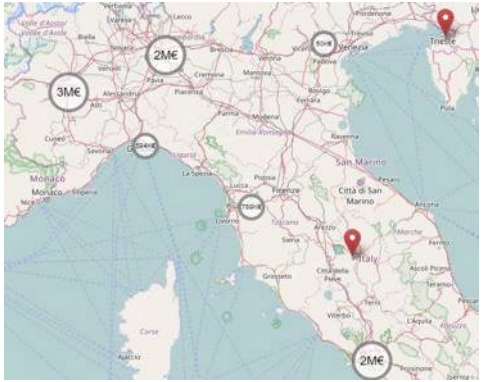
Project Acronym: I.MODI

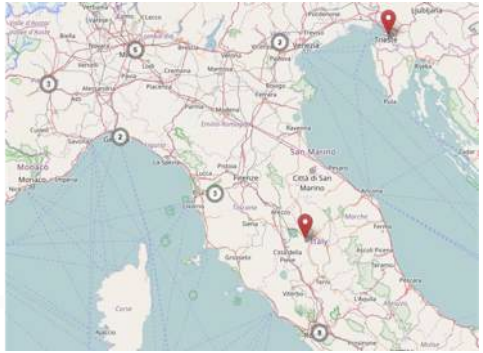
I.MODI aims at exploiting business opportunity generated by the increasing need to have a systematic monitoring system able to control stability of buildings and civil infrastructures. It focuses on the exploitation of EO data to create an added value service where the integration between EO observation (Sentinel 1/Copernicus, COSMO-SkyMed and ESA archive SAR data from ERS-1/2 and Envisat) and ground-based technologies represents the core of the system and becomes easily accessible from users.

SME PHASE 2 - Call Space

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121







HOW DOES IT WORK?

DInSAR data

In situ data

Web GIS

Wide Area Analysis

Structure Classification

Single Structure Damage Assessment

- Preliminary Analysis
- Preliminary Damage Analysis
- Quantitative Analysis

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

data provider

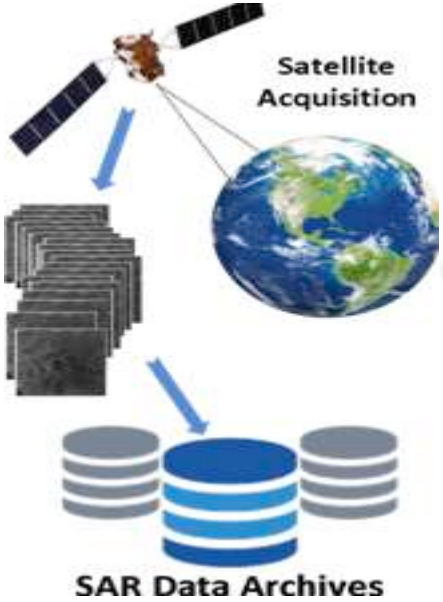
users and stakeholders

complementary SMEs

CRAS

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

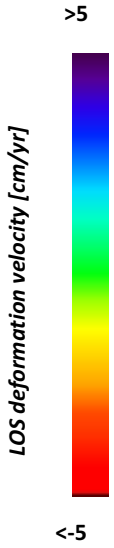
Full resolution SBAS-DInSAR analysis: a Big Data challenge

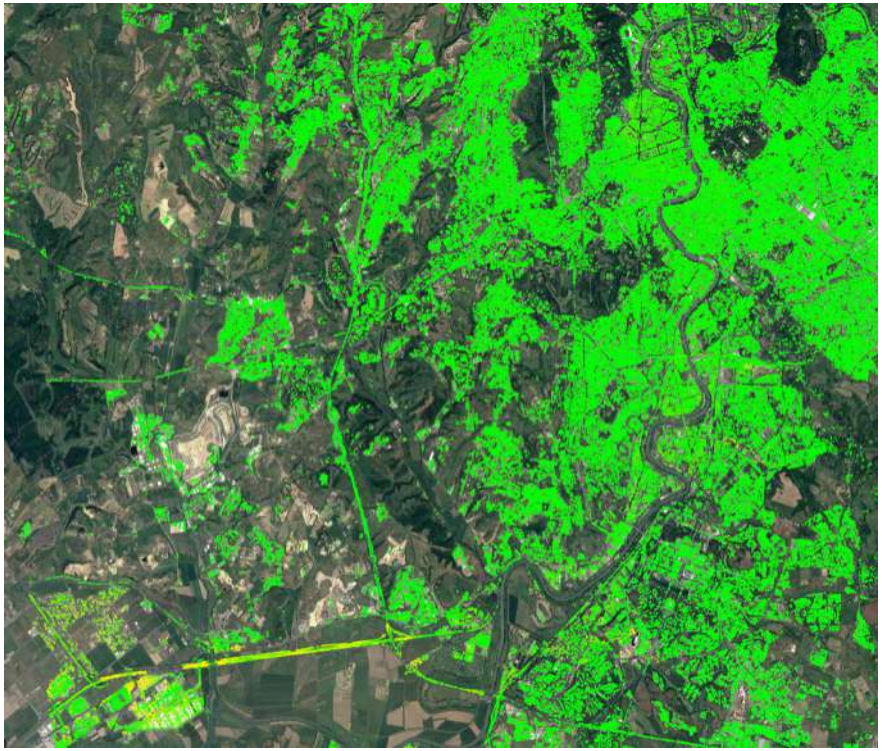


Full Resolution SBAS-DInSAR results:
MILLIONS OF POINTS TO PROCESS!!!

Parallel hardware architectures based on **GPU** and **multi-core** processing

IREA-CNR multi-node and multi-core HPC cluster





- CNR-IREA Full resolution CSK SBAS-DInSAR for IMODI project urban area of Rome

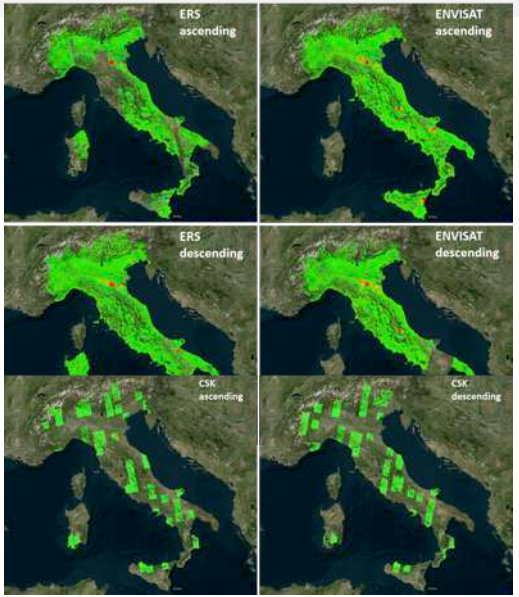
e-GEOS massive PS analysis production capabilities

e-GEOS PSP-IFSAR technology

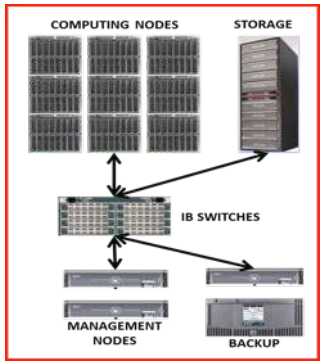
Proprietary advanced processing technology (PSP-IFSAR)

Persistent scatterer pair (PSP) method
Robust finite difference integration and phase unwrapping

PST-A
The only project at national level



e-GEOS Infrastructure



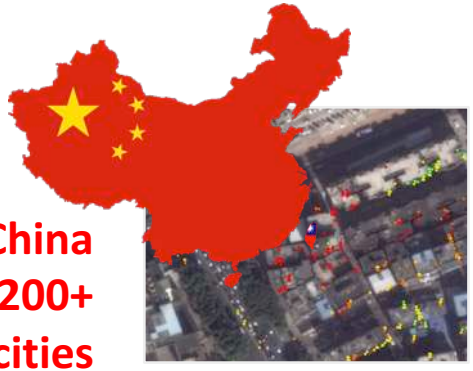
Dedicated High Performance Computing cluster for SAR data processing

- High capacity/ high performance storage
- Automatic backup system
- Modular and compact structure easily expandable

SATELLITE	GEOMETRY	TEMPORAL COVERAGE	SPATIAL COVERAGE [KM²]	# IMAGES	#PROCESSED STACK	# PS	# PS MEASUREMENTS IN THE ANALYZED TIME PERIOD
ERS	ASC/DESC	1992 - 2000	$\sim 500 \times 10^3$ (asc. + desc. geometries)	8324	138	1.4×10^7	$\sim 10^9$
ENVISAT	ASC/DESC	2003 - 2010	$\sim 500 \times 10^3$ (asc. + desc. geometries)	6642	164	2.8×10^7	$\sim 10^9$
CSK (Stripmap)	ASC/DESC	2010 - 2014	$\sim 100 \times 10^3$ (asc. + desc. geometries)	5000	100	1.3×10^8	$\sim 10^{10}$

E-GEOS is a world wide operator in Geo Information market and PS DInSAR analysis

E-GEOS is operating in China providing PS analysis over 200+ cities



Subsidence phenomena and post-works assessment due to underground water extraction and to the fast growth of cities are the main aspect to monitor

Deep Analysis at building level is needed to provide a quick and effective response to citizen

Survey Lab

!MODI

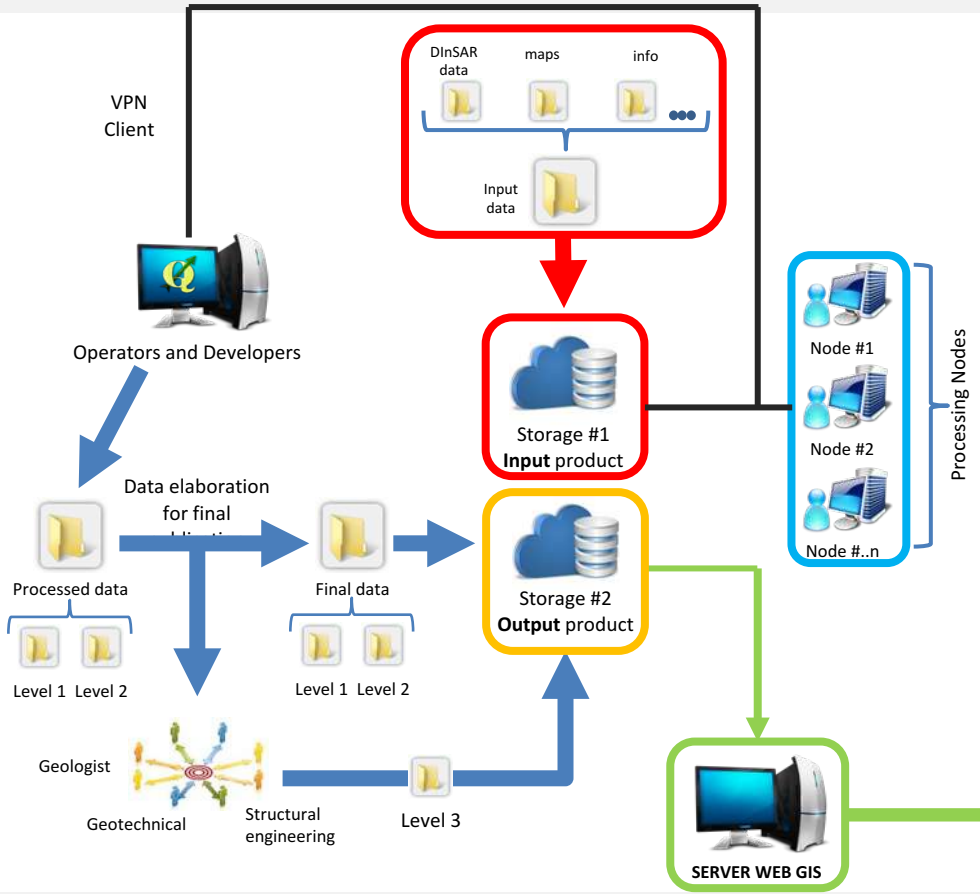
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

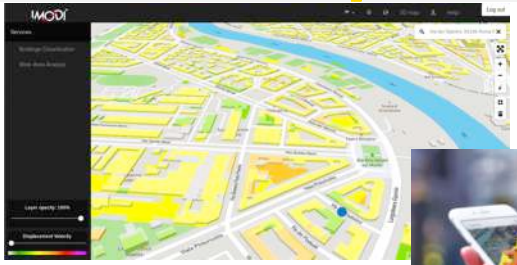
Agreement between "Protezione Civile di Roma Capitale" and the University of Rome "Sapienza" - Department of Civil Engineering, Construction and Environmental

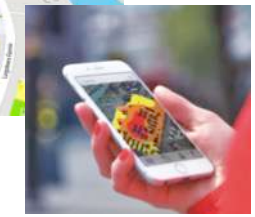
Agreement between the Ministry of Infrastructure and Transport Directorate General for dams and water and electrical infrastructure and the University of Rome "Sapienza" - Department of Civil Engineering, Construction and Environmental

Agreement between ANAS and the University of Rome "Sapienza" - Department of Civil Engineering, Construction and Environmental

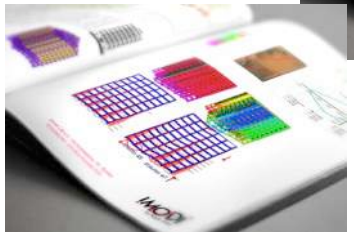
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121







Multi-platform WebGIS

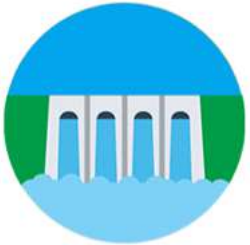


Download Technical Report

Monitoring Services

Buildings

Roads



Dams

STAY TUNED

Enter your e-mail address SUBSCRIBE

FOLLOW US

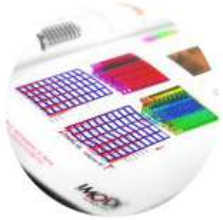
Building services

Building Classification

Displacement Analysis

Satellite Monitoring

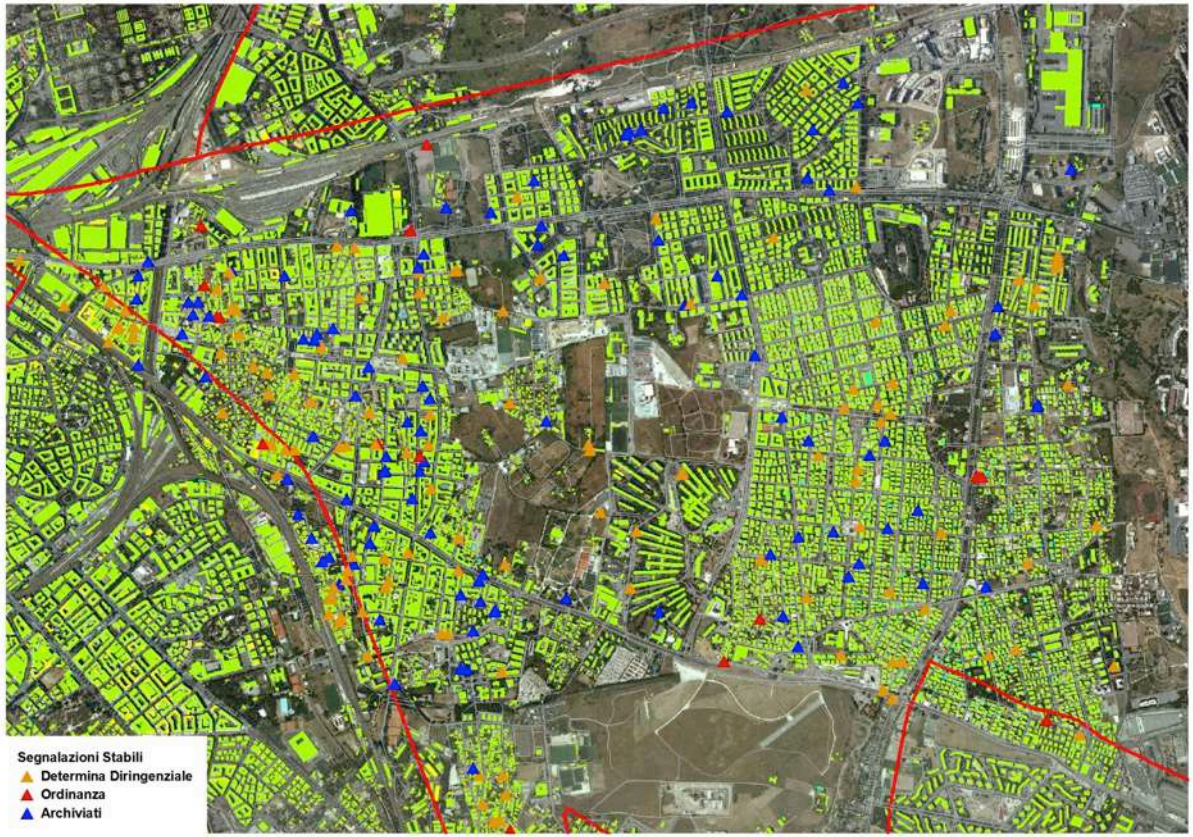
Damage Assessment



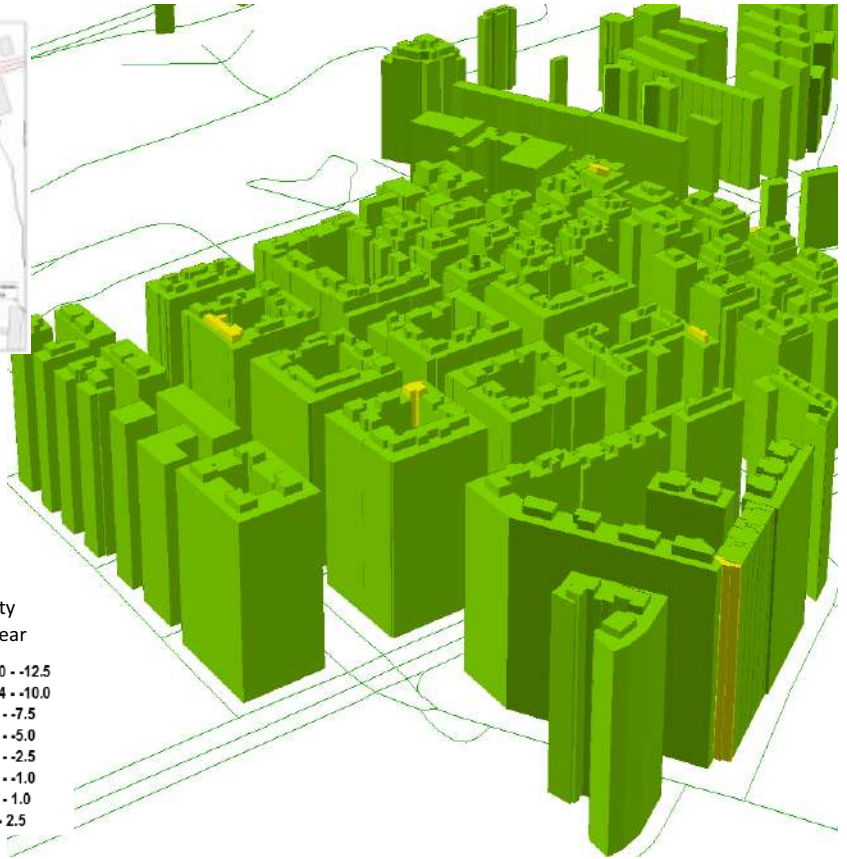
Structural Modeling

ALL SERVICES

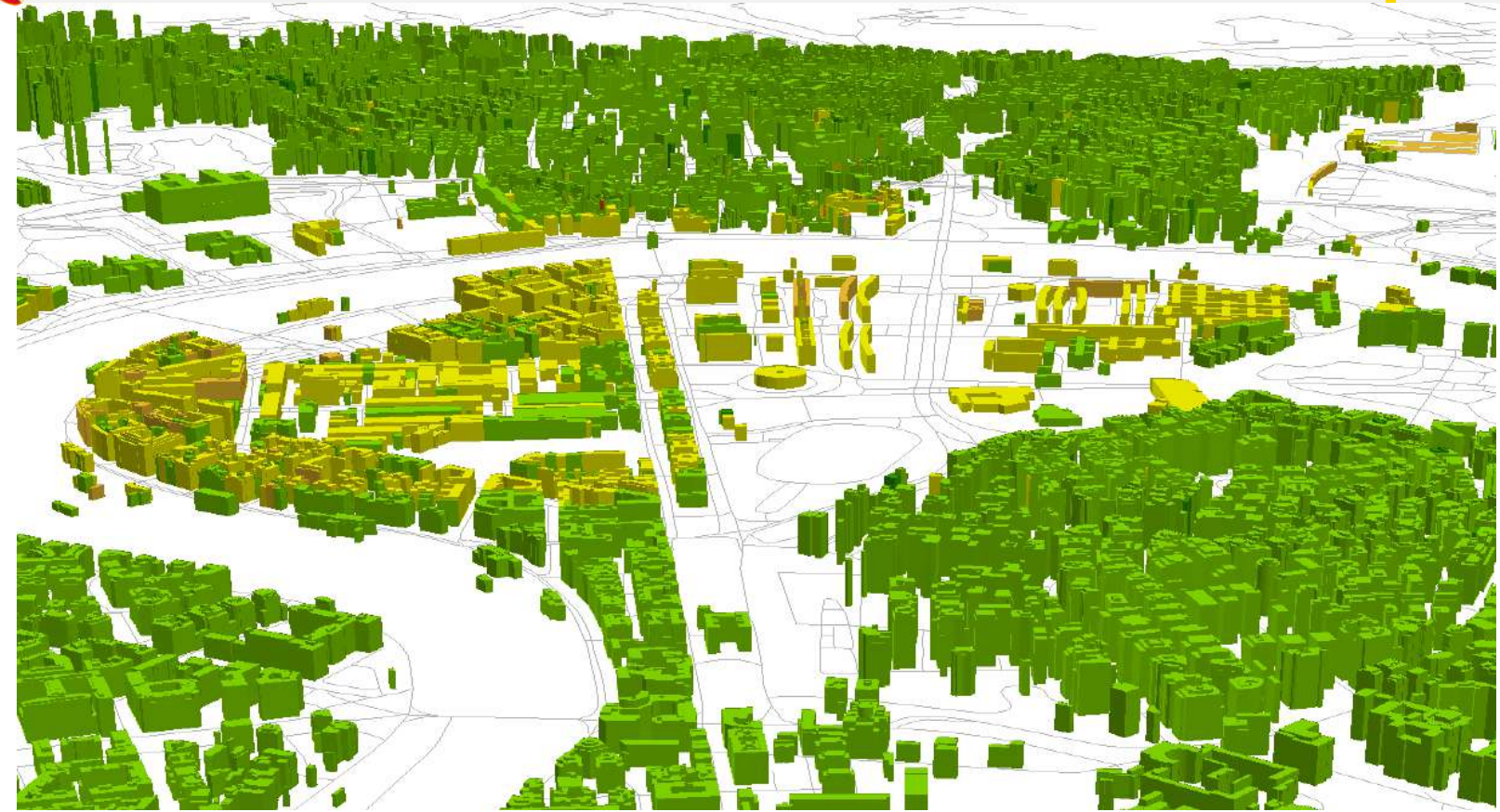
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121



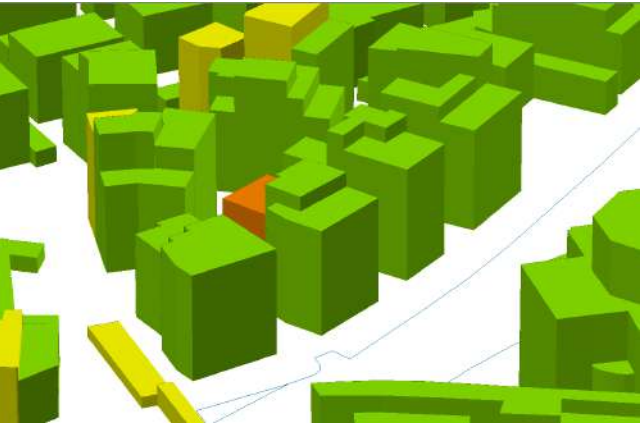
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121



This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121



This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

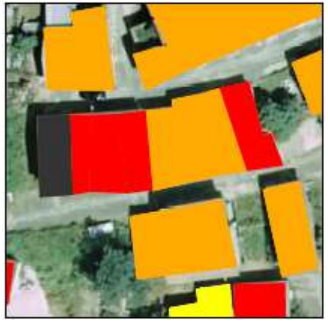


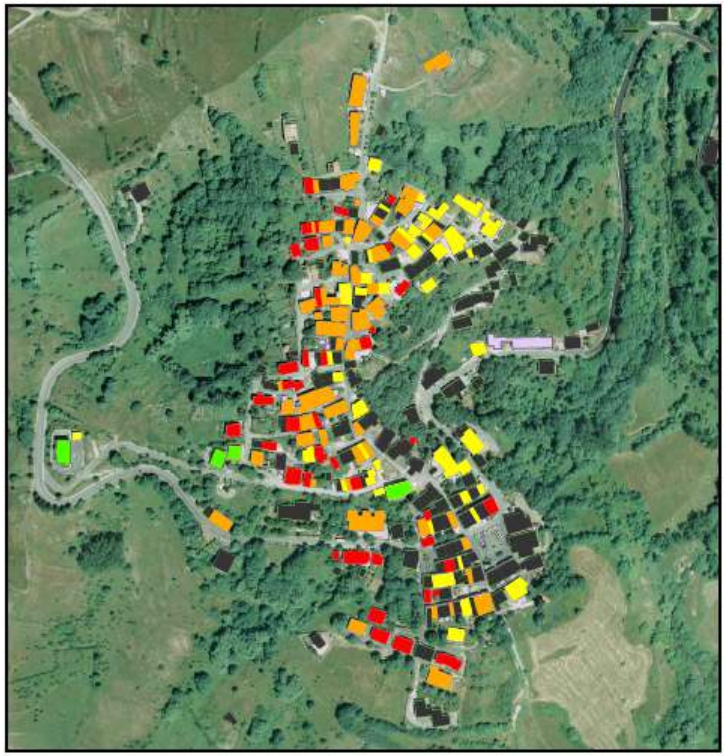
School and University

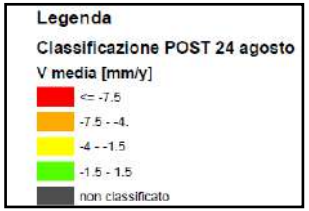
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

Post-Earthquake, Central Italy

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

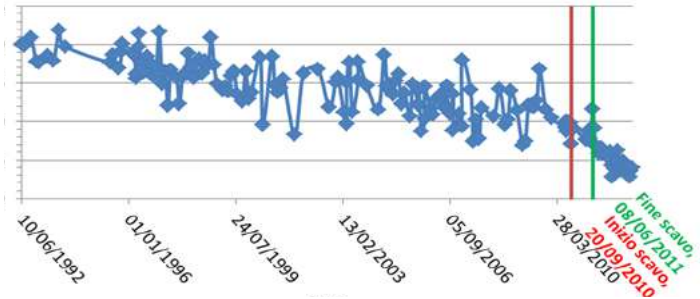






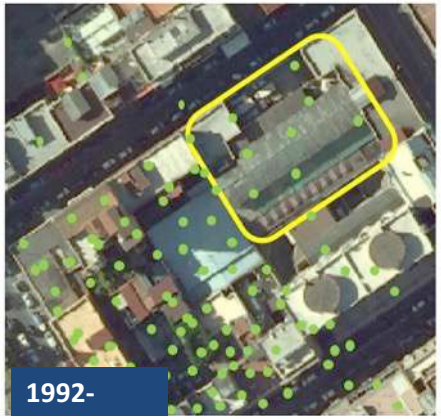
Tunnel and underground excavations

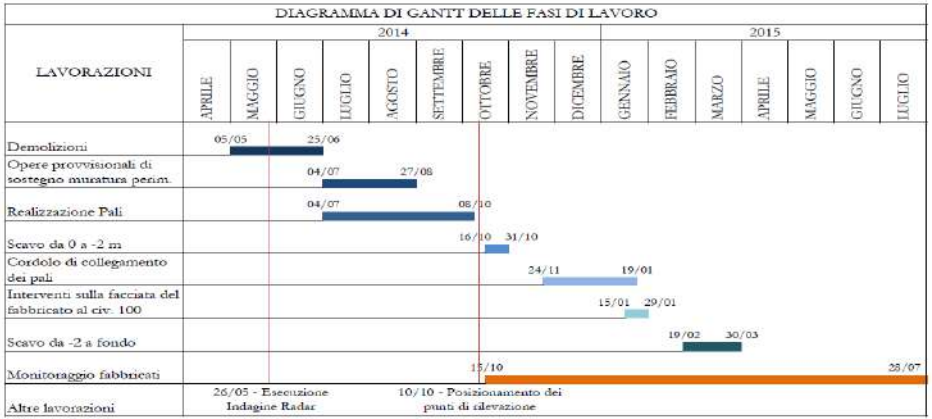
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

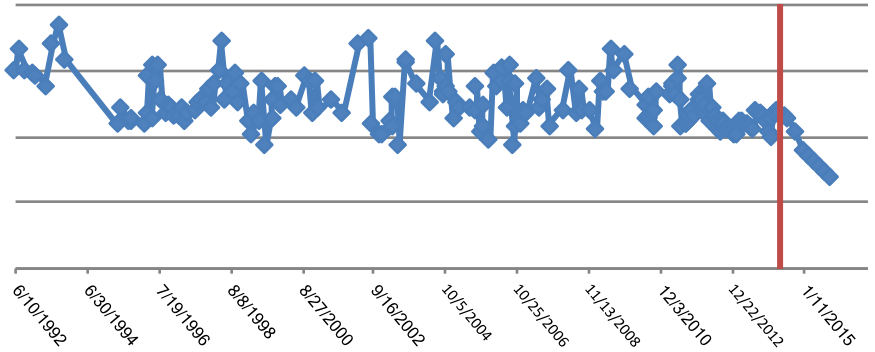


Surface excavation

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121







This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

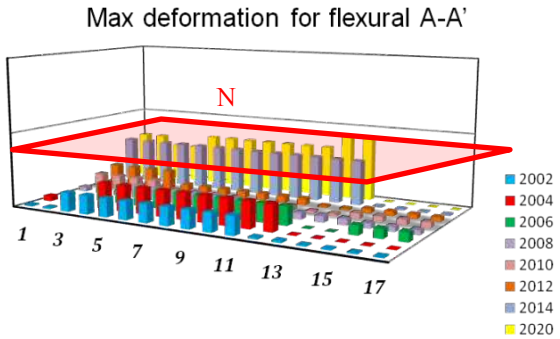
Evaluation of the bending and shear strains related to the observed deflection

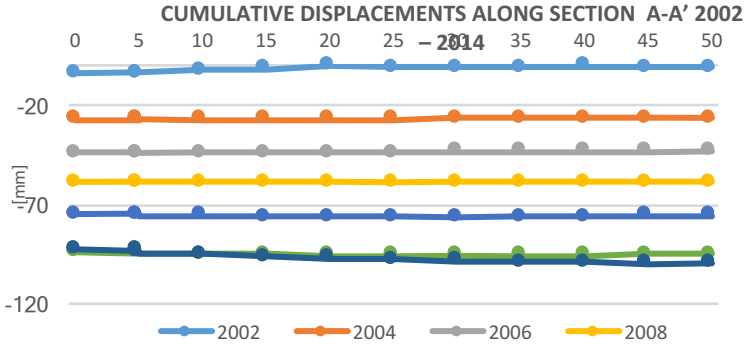
↓

Comparison of the obtained values of bending and shear strain with the critical values

e) Damage Assessment

Category of damage	Degree of severity	Limiting tensile strain
0	Negligible	0.000 – 0.050
1	Very slight	0.050 – 0.075
2	Slight	0.075 – 0.150
3	Moderate	0.150 – 0.300
4 to 5	Severe	>0.300





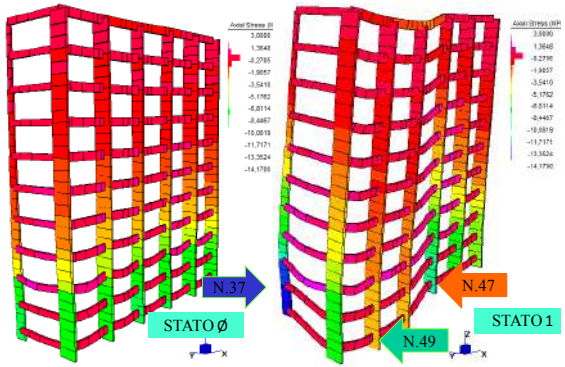
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

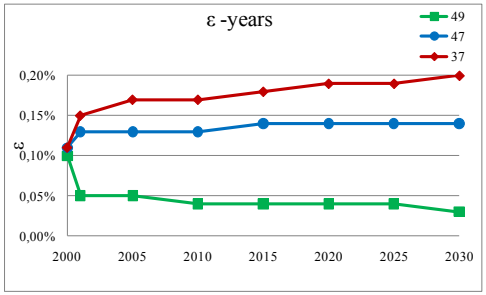
LINEAR ANALYSIS OUTPUT

- Stress and strain in the walls (bearing walls or infill walls) → Evaluation of the position and extension of cracking in the walls
- Design values of axial stress N_{Ed}, shear V_{Ed}, bending moment M_{Ed} → Ultimate limit state verification (ULS)

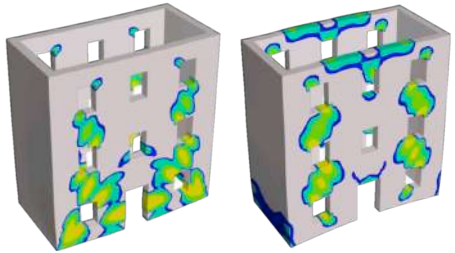
NONLINEAR ANALYSIS OUTPUT

- Ultimate values of the axial stress, shear and bending moment → Identification of the critical thresholds for the settlements
- Evolution of stress and strain in the walls → Plastic analysis (plastic hinges and mechanism of collapse)

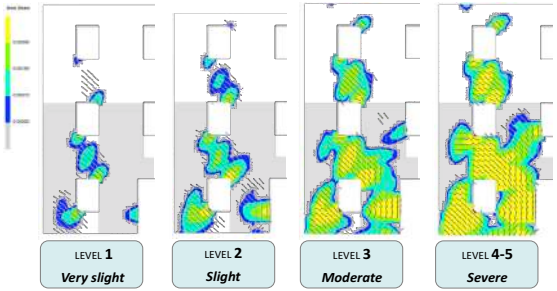




g) Assessment of the structural conditions



Output of a nonlinear analysis on a masonry structure subjected to incremental settlements



Assessment of the structural damage by observing the strain on one of the walls at different steps of the analysis, corresponding at different levels of the applied settlements.

Dam services

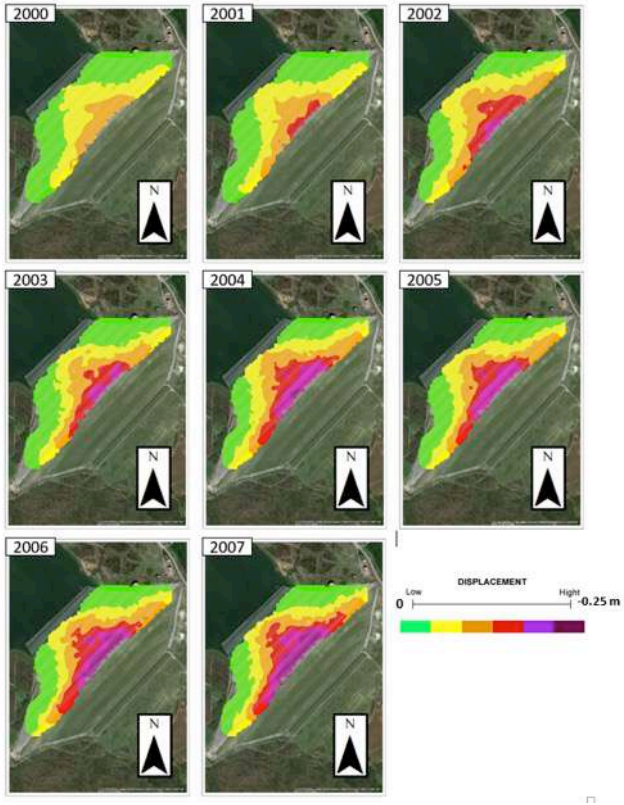
Dam Classification

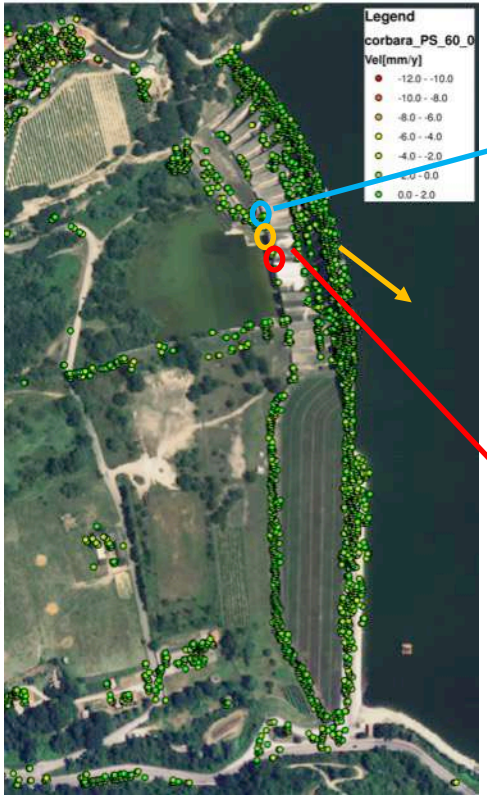
Satellite Monitoring

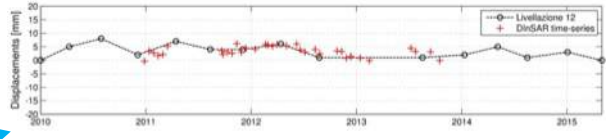
Advanced Modeling

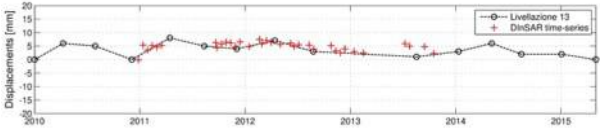
ALL SERVICES

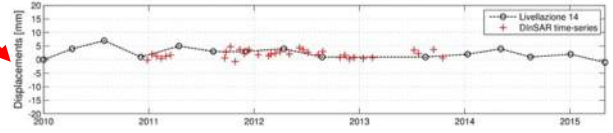
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

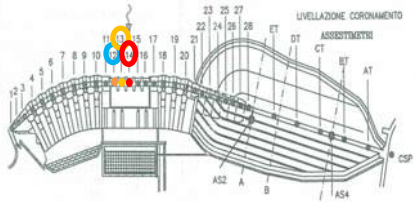




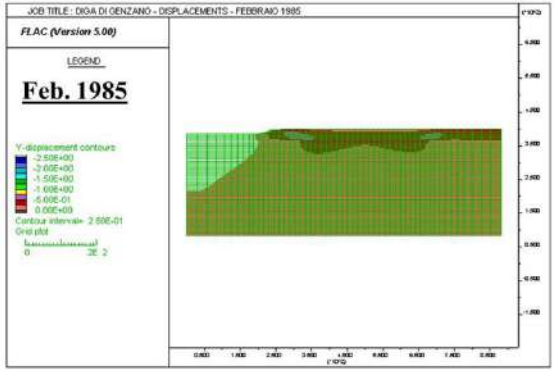


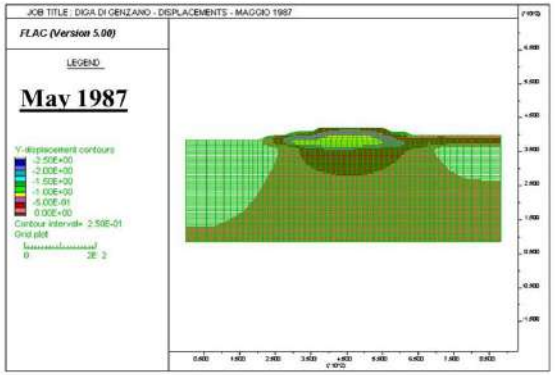


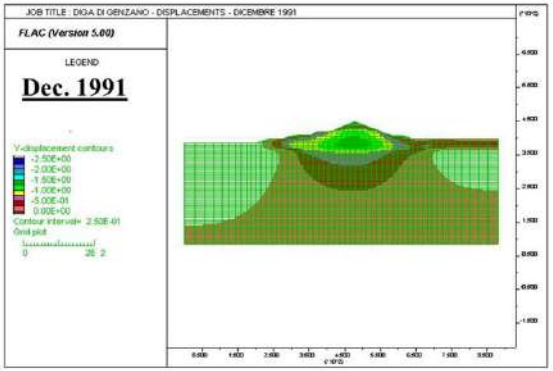


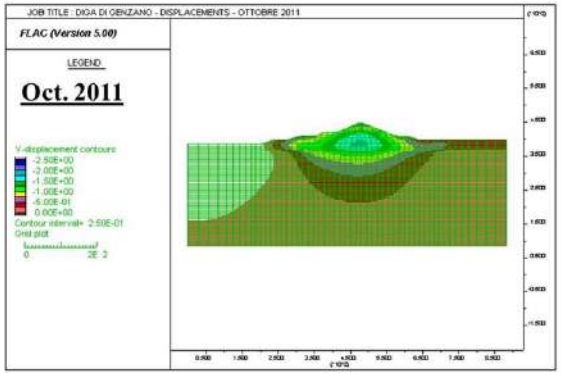


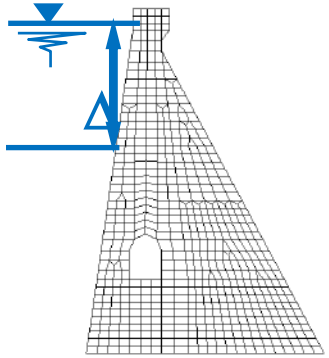
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

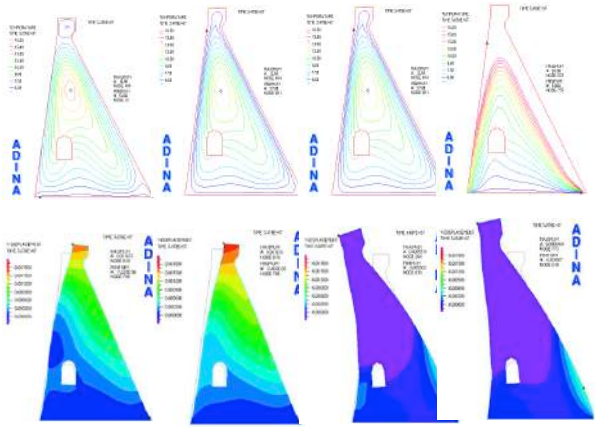












Road services

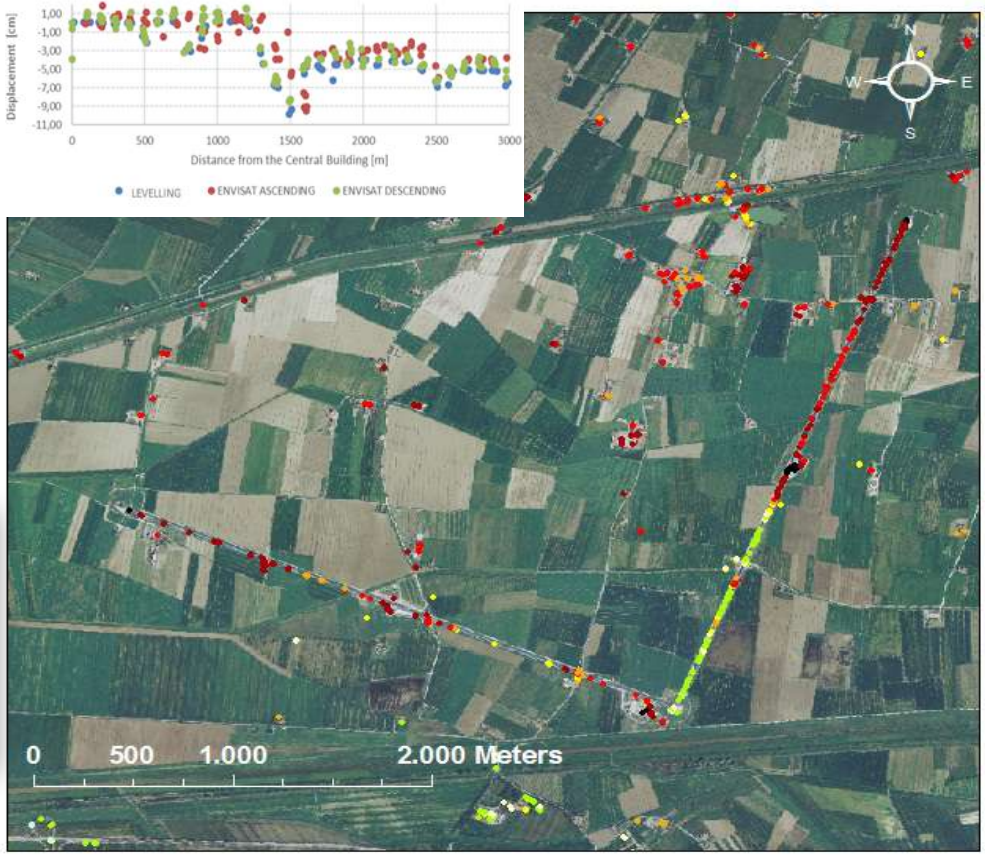
Road Classification

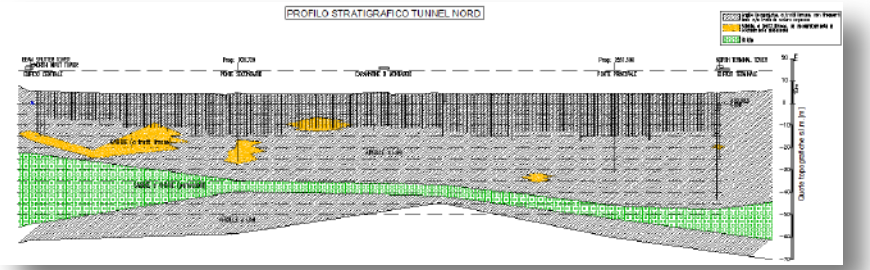
Satellite Monitoring

Advanced Modeling

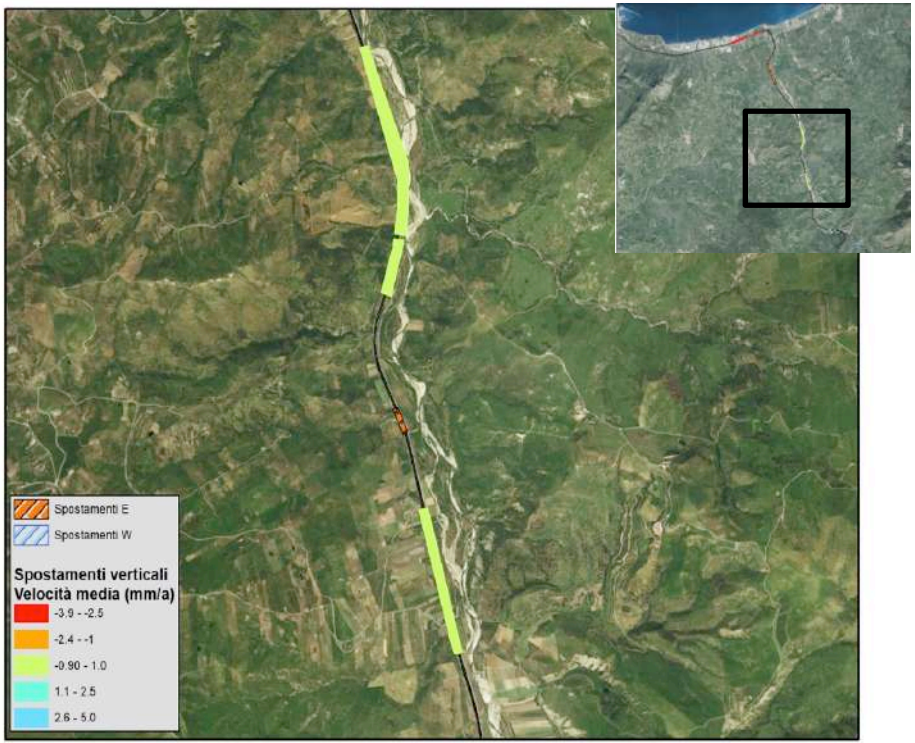
ALL SERVICES

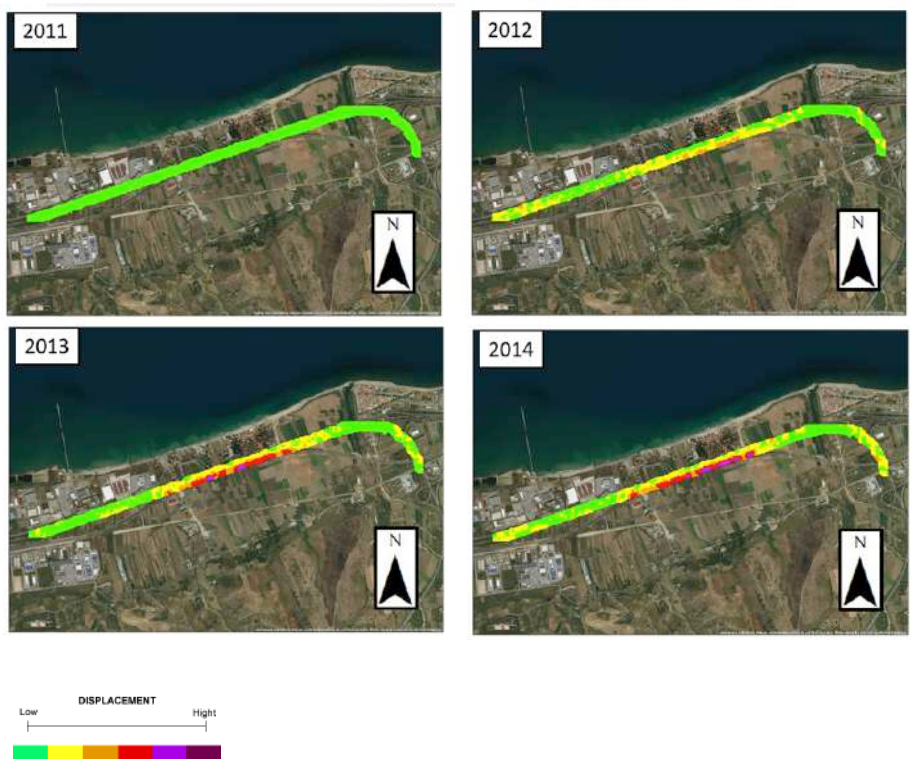
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

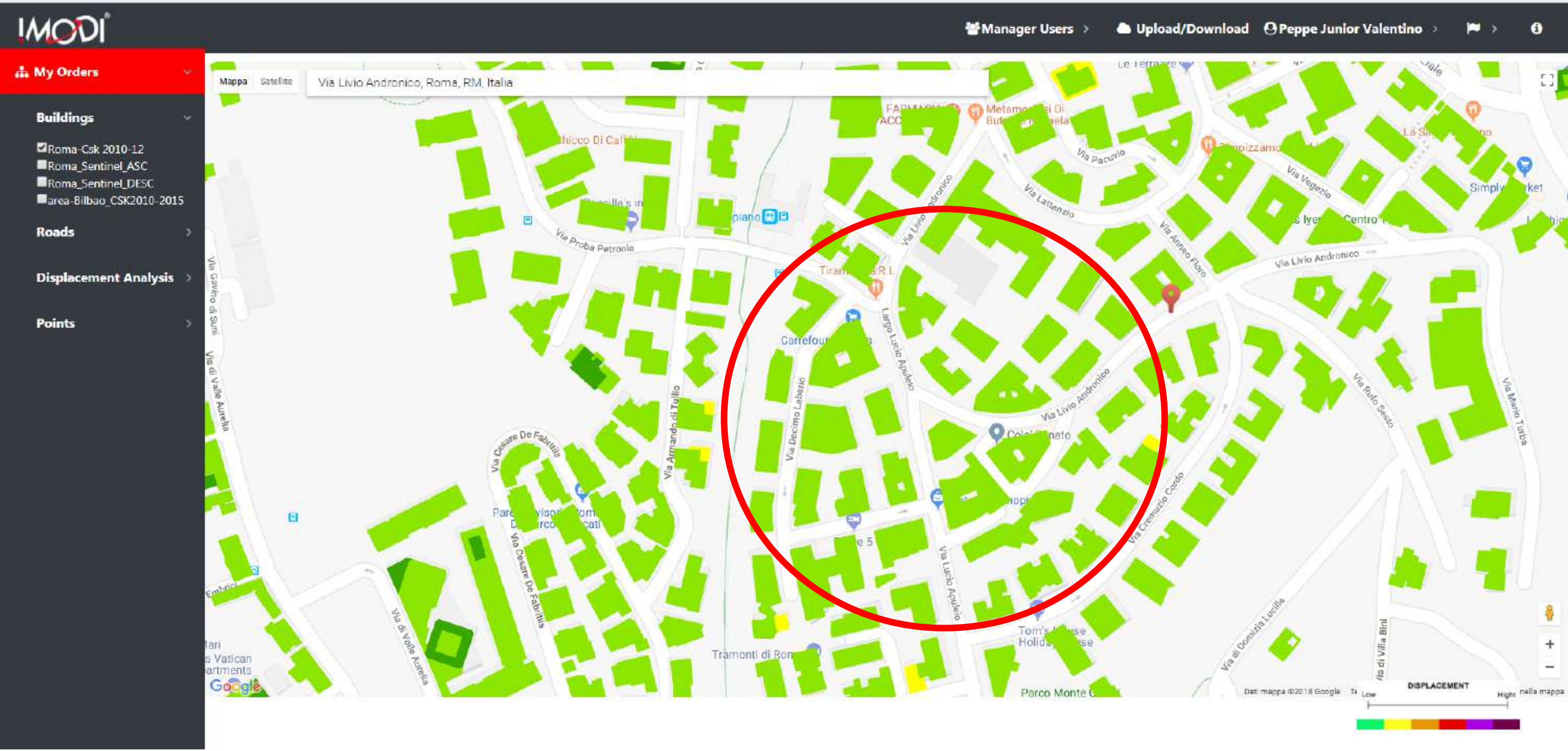




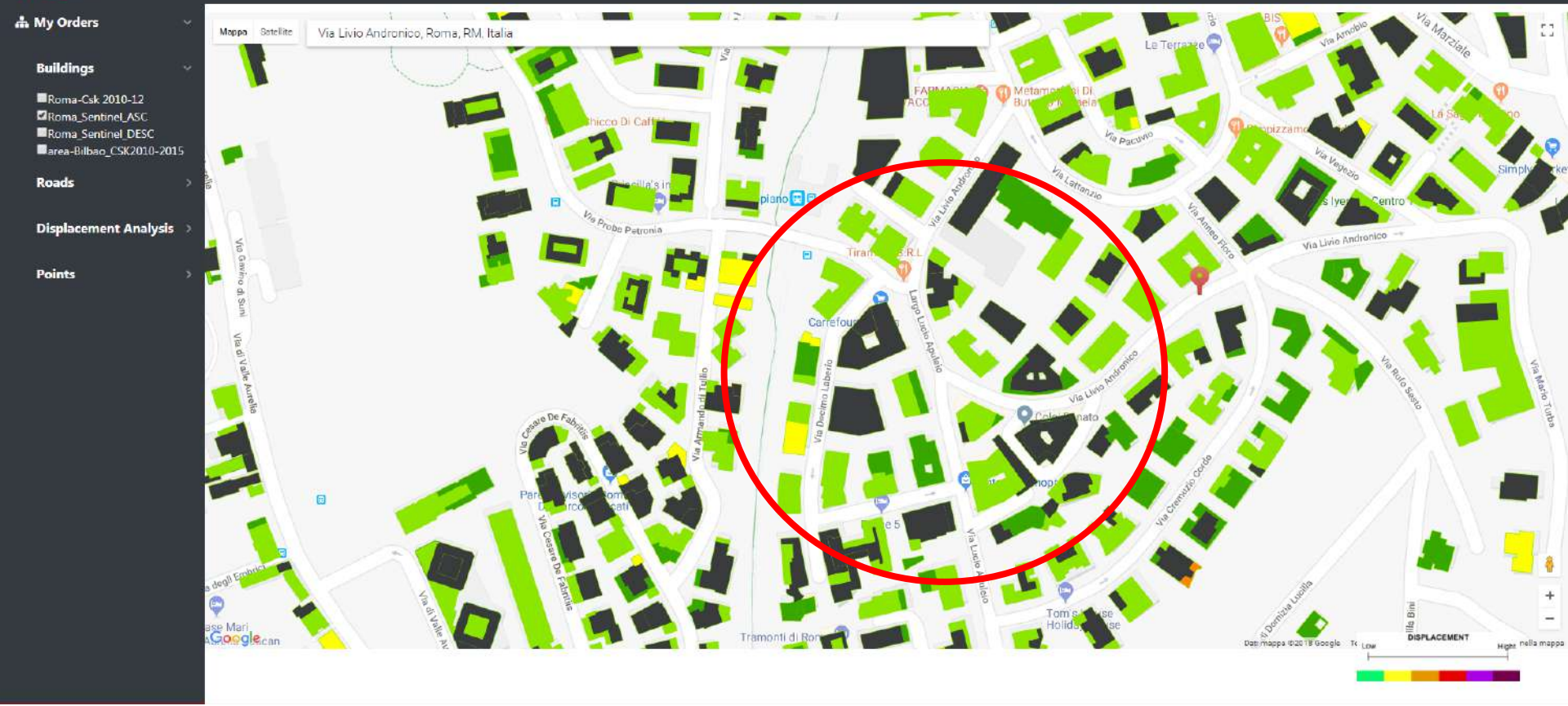
This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

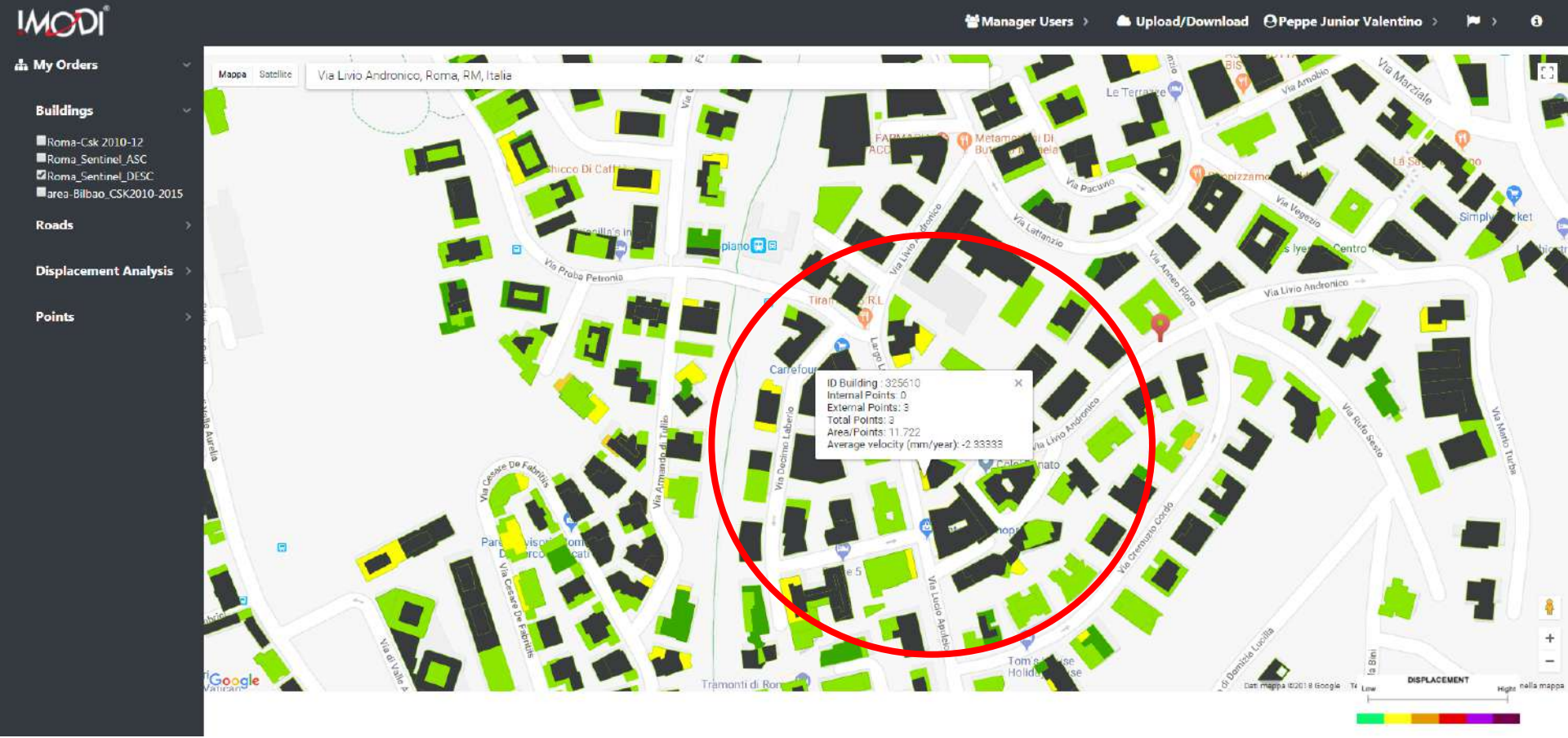






Manager Users
Upload/Download
Peppe Junior Valentino
My Orders
Buildings
Roma-Csk 2010-12
Roma_Sentinel_ASC
Roma_Sentinel_DESC
area-Bilbao_CSK2010-2015
Roads
Displacement Analysis
Points
Mappa
Satellite
Via Livio Andronico, Roma, RM, Italia
Via Livio Andronico
Via Decimo Laberio
Largo Lucio Apuleio
Via Lucio Apuleio
Via Cremuzio Cordo
Via Rufo Sesto
Via Anneo Floro
Via Lattanzio
Via Pacuvio
Via Vegezio
Via Proba Petronia
Via Armando di Tullio
Via Cesare De Fabritiis
Via di Valle Aurelia
Via Gavino di Suni
Via Mario Turba
Via di Villa Bini
Via di Domizia Lucilla
Carrefour
Tramonti di Roma
DISPLACEMENT
Low
High


My Orders
Buildings
Roma-Csk 2010-12
Roma_Sentinel_ASC
Roma_Sentinel_DESC
area-Bilbao_CSK2010-2015
Roads
Displacement Analysis
Points
Mappa
Satellite
Via Livio Andronico, Roma, RM, Italia
DISPLACEMENT
Low
Higher


Manager Users
Upload/Download
Peppe Junior Valentino
My Orders
Buildings
Roma-Csk 2010-12
Roma_Sentinel_ASC
Roma_Sentinel_DESC
area-Bilbao_CSK2010-2015
Roads
Displacement Analysis
Points
Mappa
Satellite
Via Livio Andronico, Roma, RM, Italia
ID Building : 325610
Internal Points: 0
External Points: 3
Total Points: 3
Area/Points: 11.722
Average velocity (mm/year): -2.33333
DISPLACEMENT

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 720121

Innovazione, sostantivo femminile

THANK YOU!

imodi.info

info@imodi.info

Keep Following us!