

 ICSC
Centro Nazionale di Ricerca in HPC,
Big Data and Quantum Computing

ANNUAL MEETING

del Centro Nazionale di Ricerca in HPC,
BIG DATA AND QUANTUM COMPUTING

ISOLA D'ELBA – LA BIODOLA, 5 - 8 OTTOBRE 2025



Finanziato
dall'Unione europea
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Ministero
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PIANO NAZIONALE
DI RIPRESA E RESILIENZA



SPOKE 5

Environment & Natural Disasters

Risk Mitigation through Knowledge

Roberto Bellotti, Federica Cotecchia

Spoke 5: Environment & Natural Disasters



Ecosystem

- **8 partner** universities and research centres
leader UniBa – **co-leader** UnivAq
- **2 industrial** partners
- **Total budget: 12.2 M€**
- **Critical mass: 113**
- **Recruited personnel: 48**
including 12 RTD-A and 7 technologists
- **PhDs: 12**

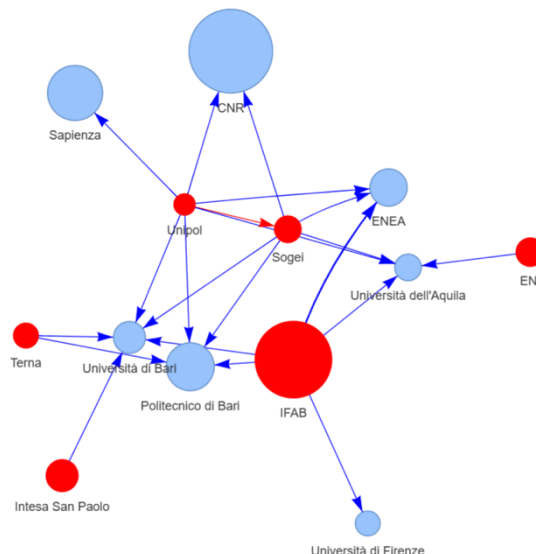
updated Dec 2024



Spoke 5: Environment & Natural Disasters Ecosystem

• Innovation Funds

- Participating to: 8
- budget: 1.1 M€
- leader of OSM



• Open Calls

- budget for public institutions: 1.4 M€
/ 3 funded projects
- budget for private companies 1.7 M€
/ 7 funded projects

updated Dec 2024

SPOKE 5 Environment & Natural Disasters

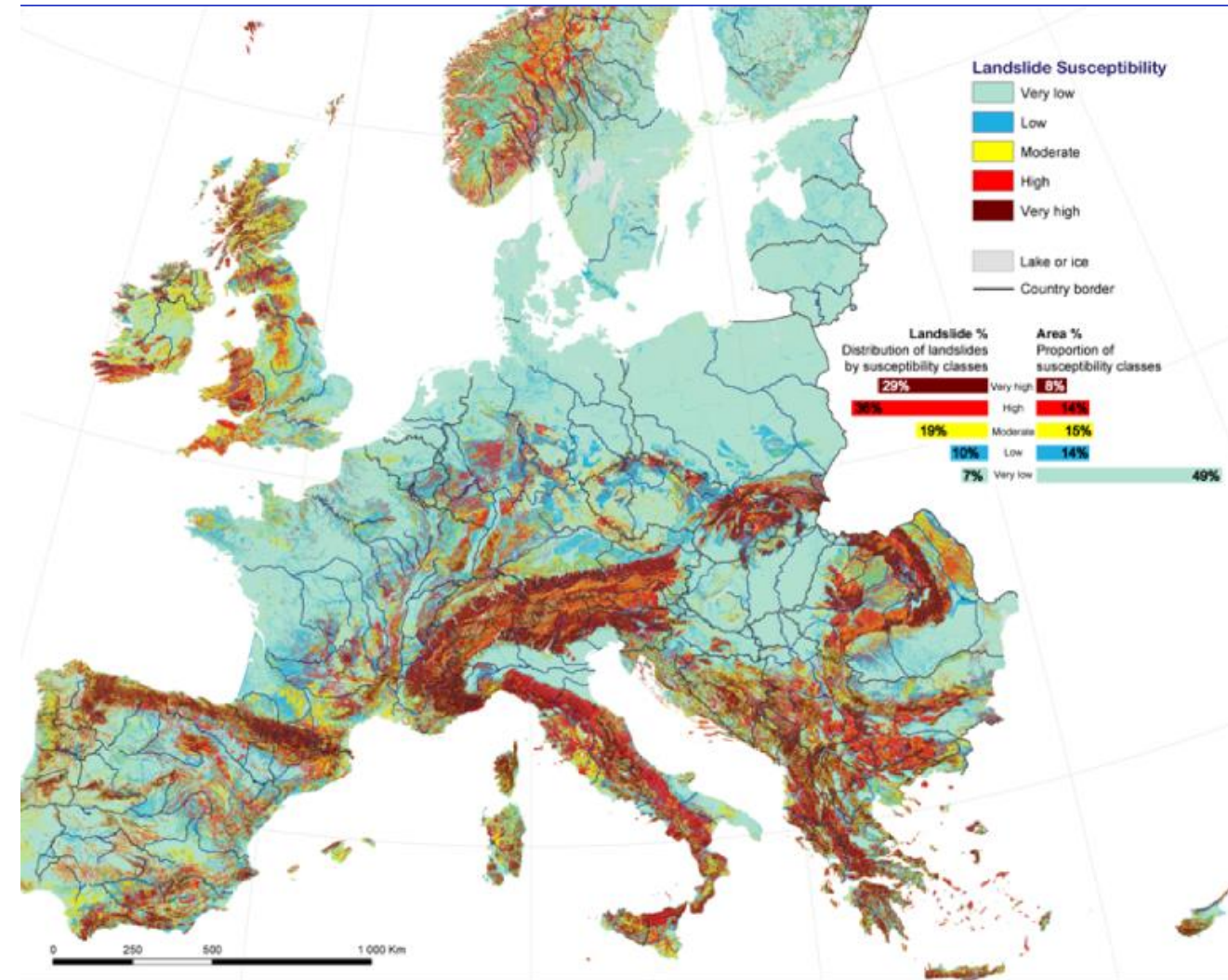


Introduction



Challenges and opportunities

- Italy is one of the **most disaster-prone countries** in Europe
- Contributing to the **UN Sendai Framework (2015–2030)** positions Italy as a European and international reference in disaster



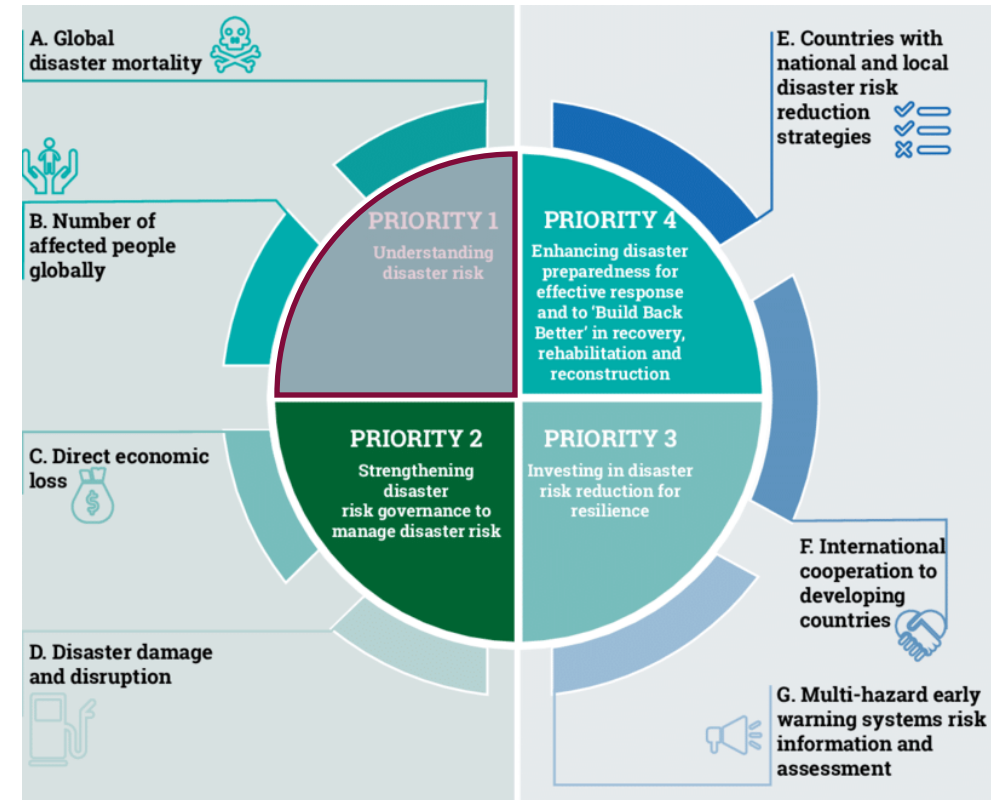
Introduction



Challenges and opportunities

- Italy is one of the **most disaster-prone countries** in Europe
- Contributing to the **UN Sendai Framework (2015–2030)** positions Italy as a reference country for disaster risk reduction at the world scale

Priority 1: Understanding disaster risk

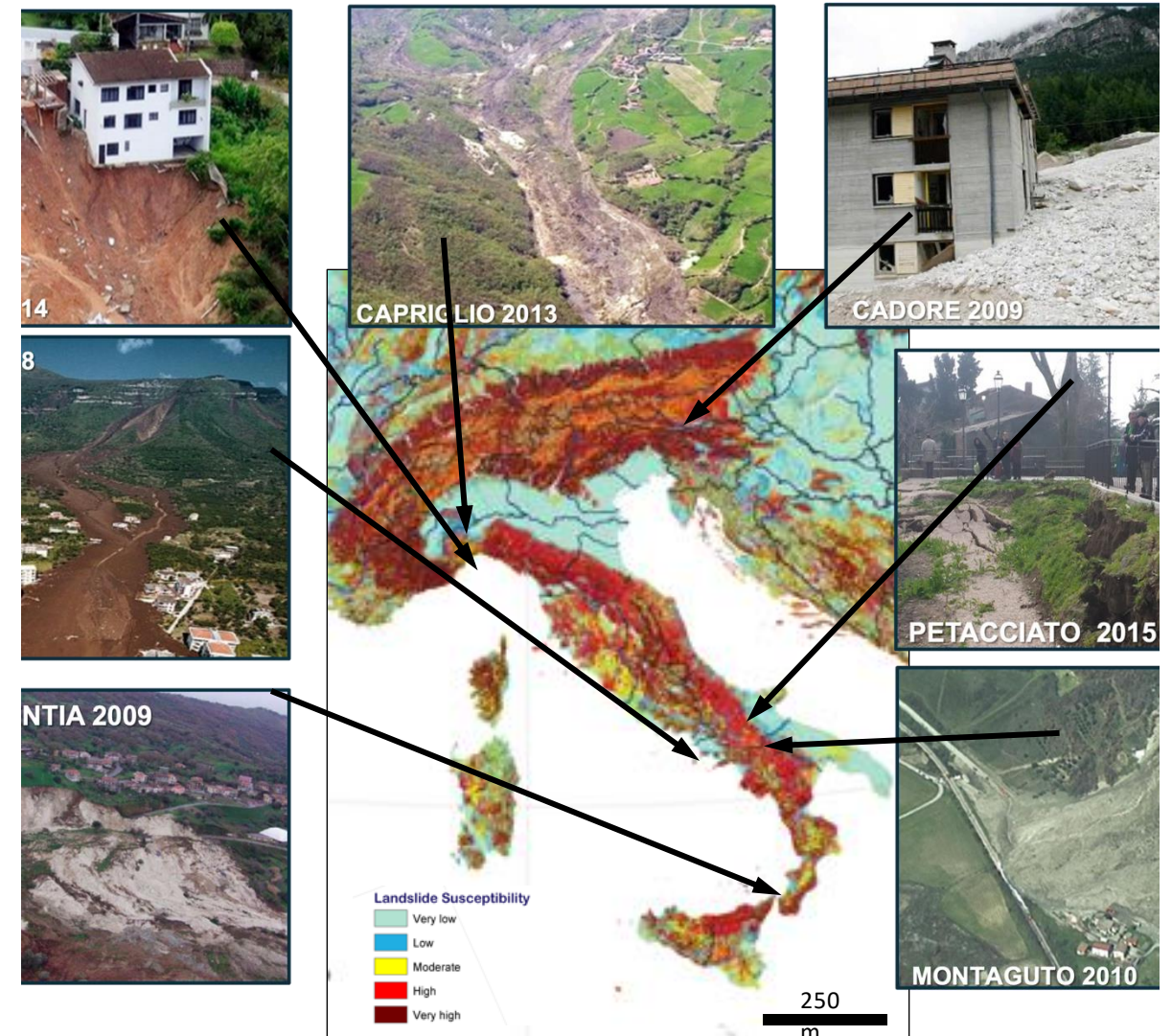


Introduction



Challenges and opportunities

- From disaster management to **natural risk prevention**

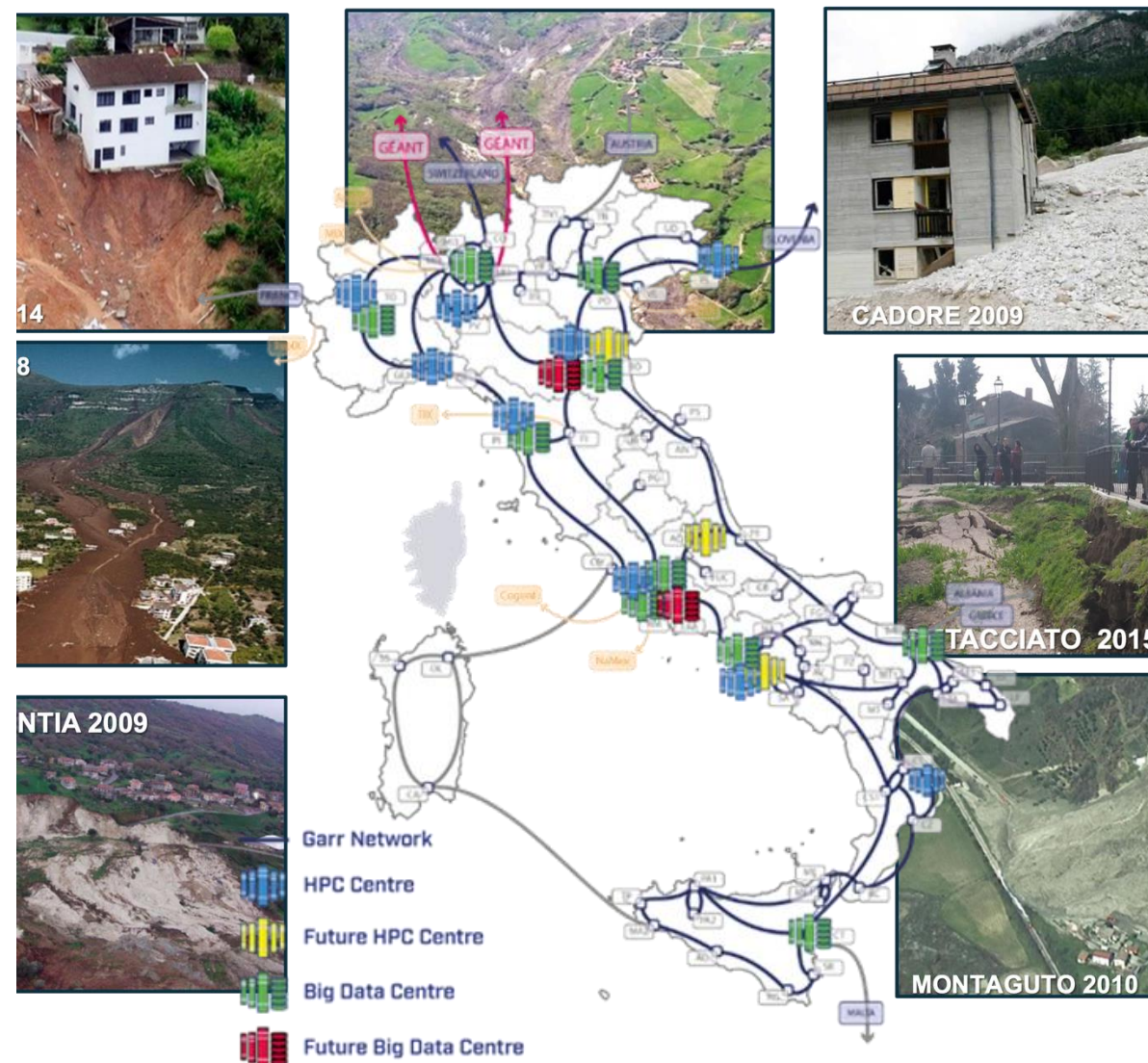


Vision



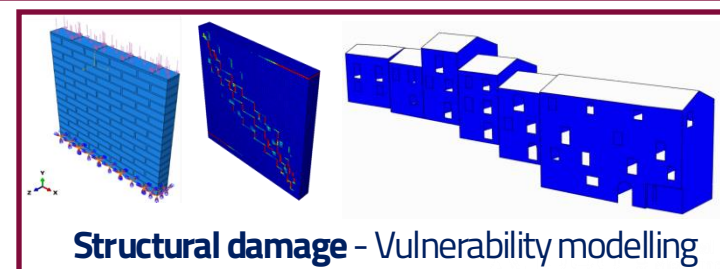
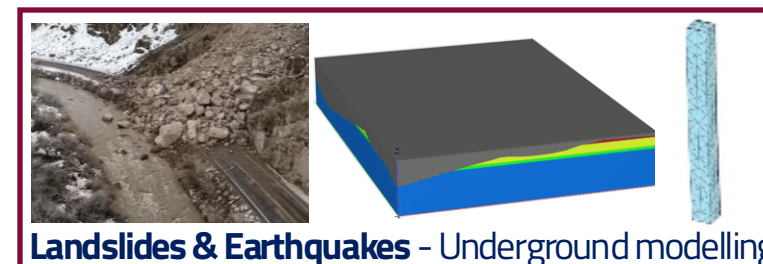
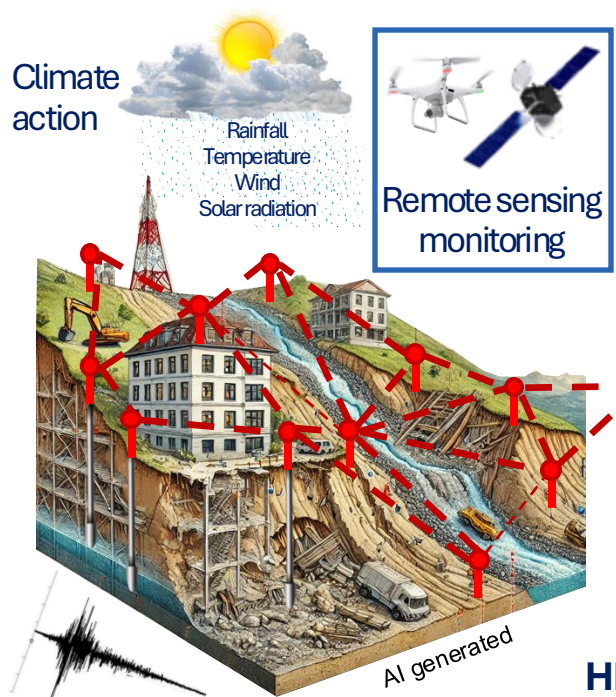
Driving Italy's Digital Revolution in Disaster Management

- From disaster management to **natural risk prevention** through **data-driven** approaches
- **Digital Infrastructure** powered by National **HPC resources**, enabling Big Data, AI & Digital Twins



Actions

Creating the Italian Digital Platform for Disaster Mitigation

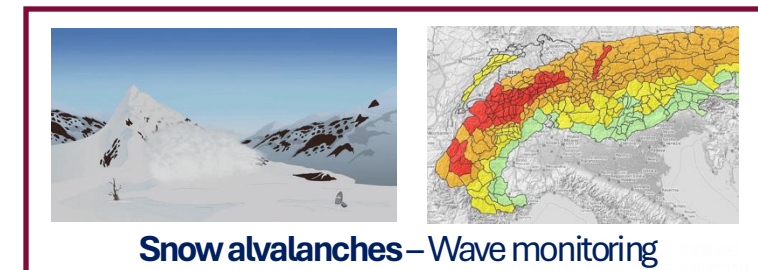
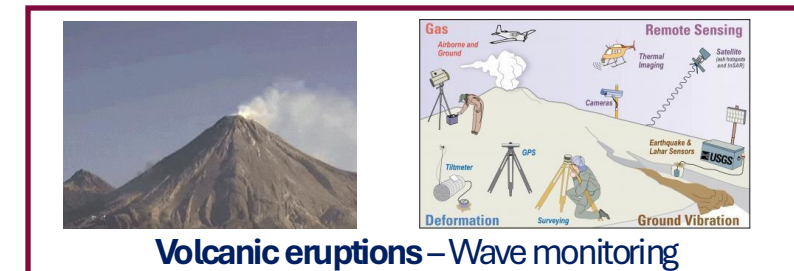
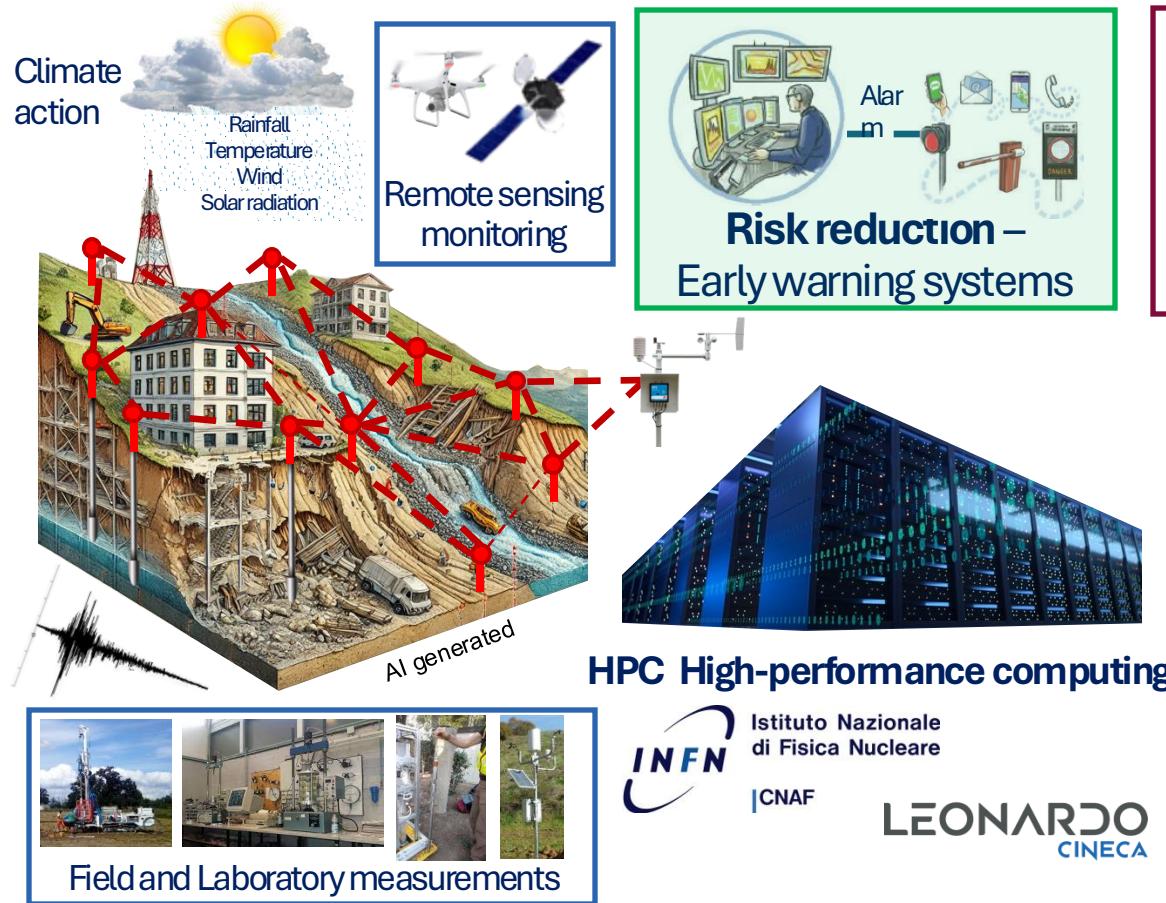


HPC High-performance computing



Actions

Creating the Italian Digital Platform for Disaster Mitigation



Actions / Mission

Creating the Italian Digital Platform for Disaster Mitigation



Harmonize & Digitalize Data

Unify data into an integrated system

Build a Shared Digital Ecosystem

Accessible to institutions and industry

Advance Predictive Modeling

Develop multi-hazard simulations powered by HPC, AI & Big Data

Enable Evidence-Based Decisions

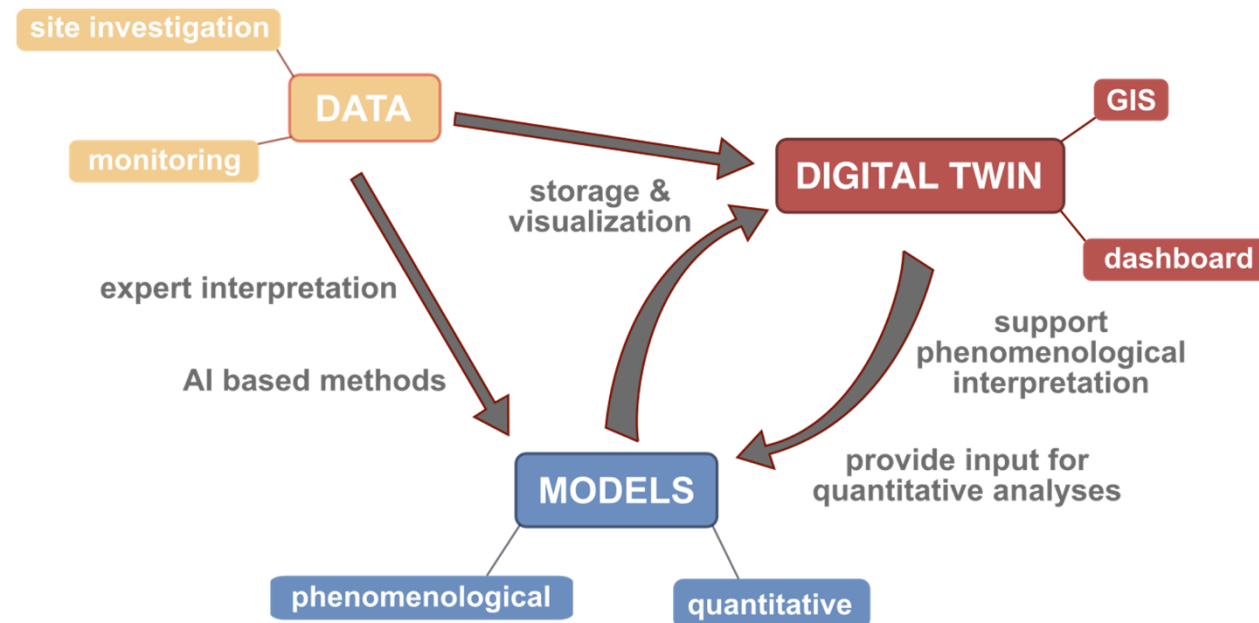
to guide prevention, planning & response

From Data to Diagnosis

Building Italy's Digital Twin for Risk Prediction and Mitigation



- **Dynamic Digital Twins:** Continuously evolving models of Italy's environment
- **Leveraging HPC, AI & Big Data** to predict, simulate, and mitigate hazard risks

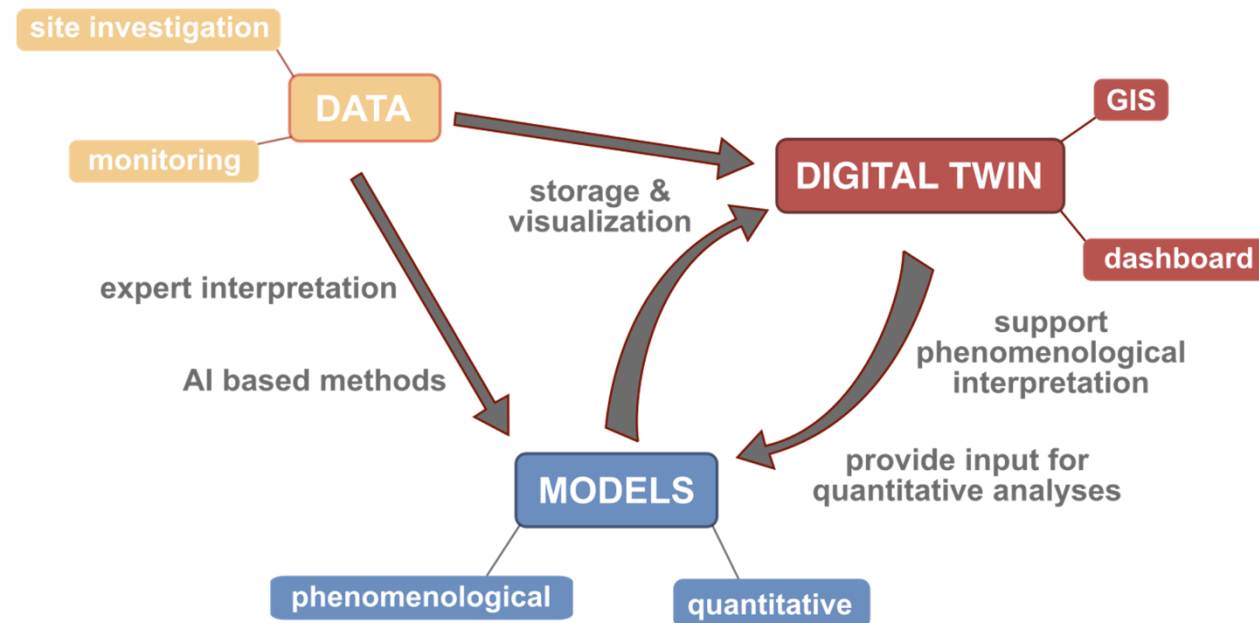
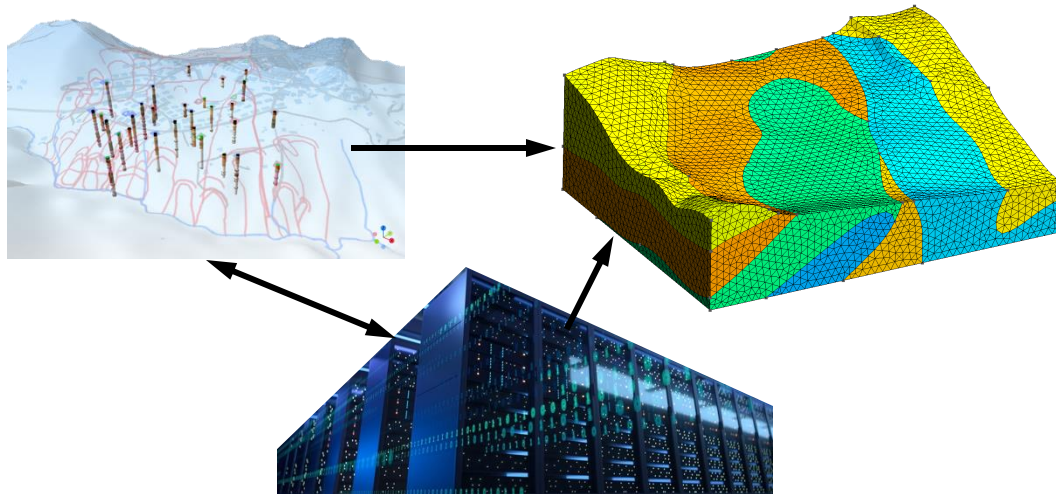


From Data to Diagnosis

Building Italy's Digital Twin for Risk Prediction and Mitigation

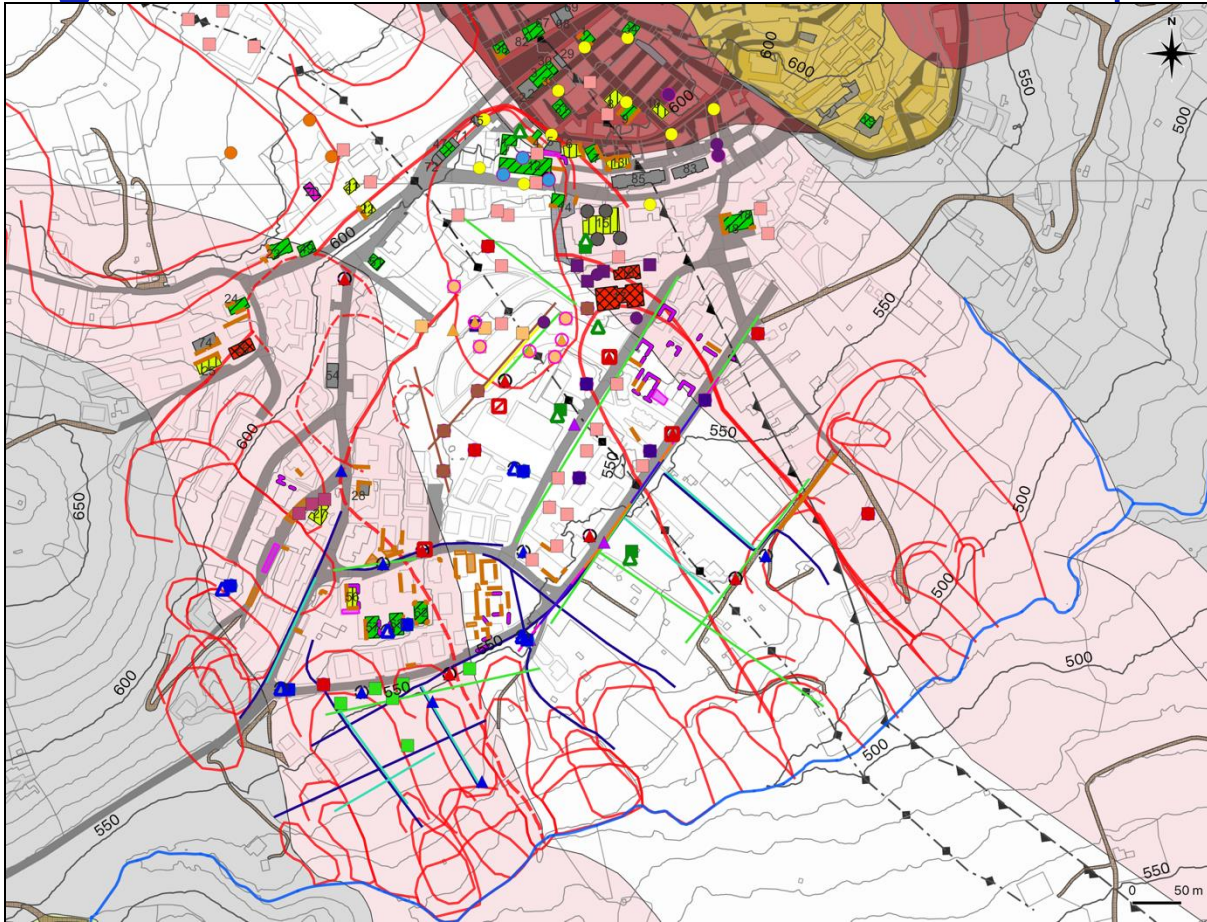


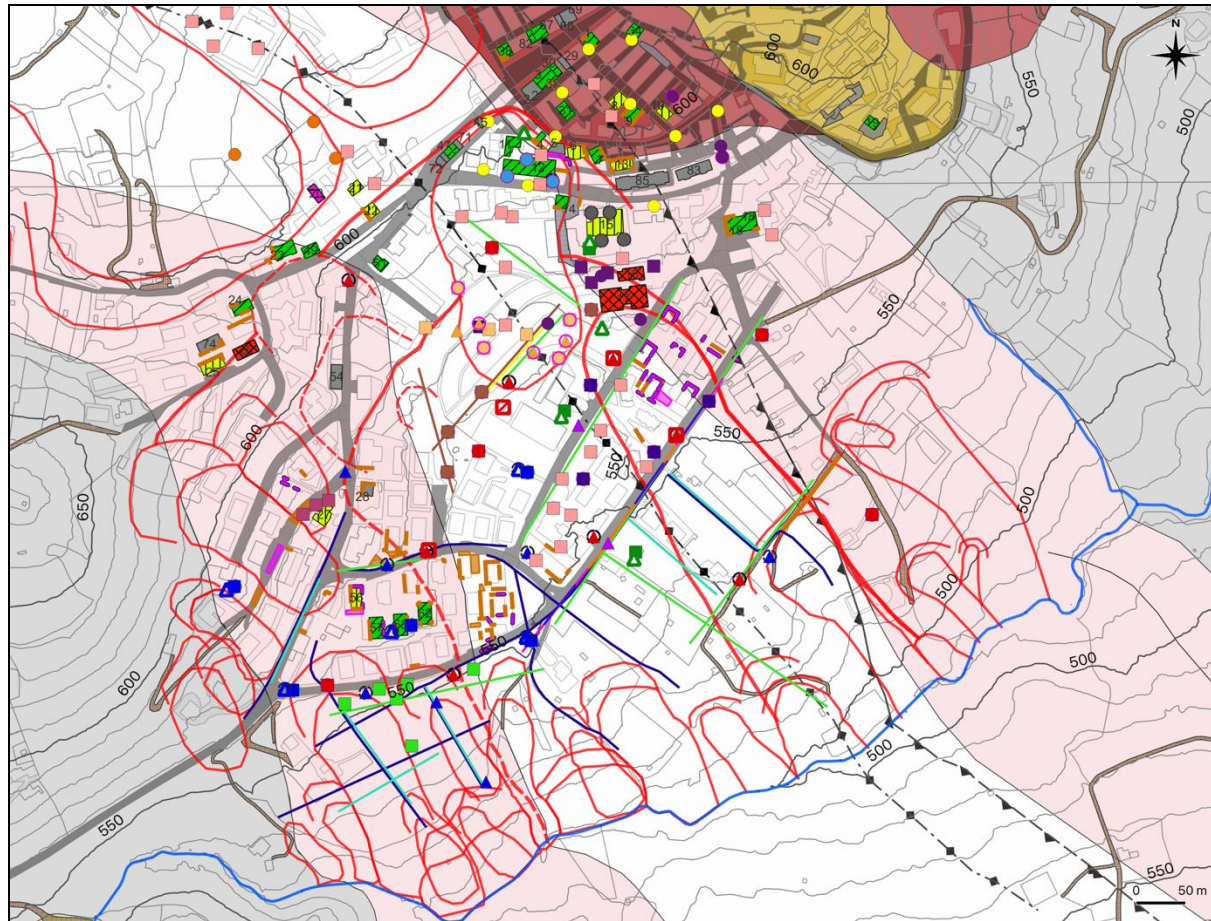
- **Dynamic Digital Twins:** Continuously evolving models of Italy's environment
- **Leveraging HPC, AI & Big Data** to predict, simulate, and mitigate hazard risks

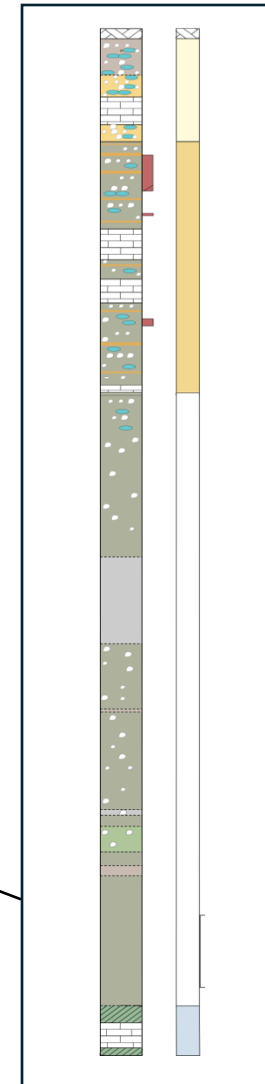
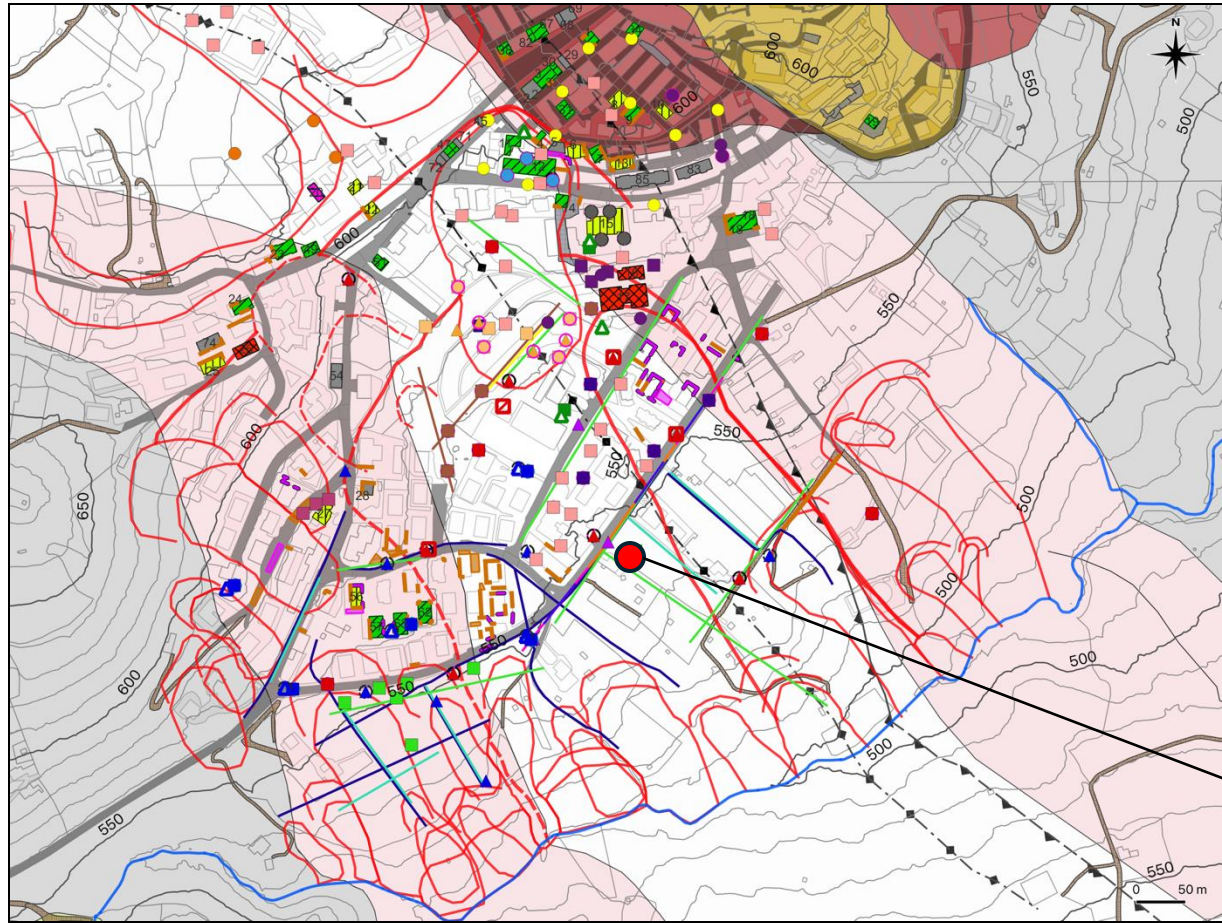


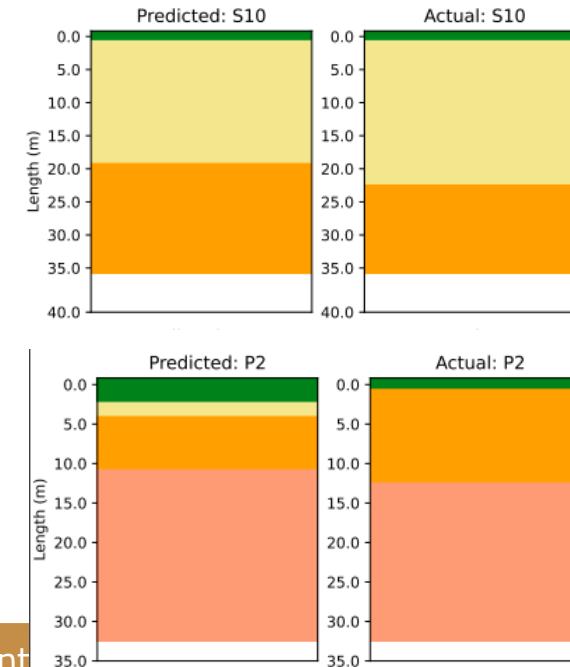
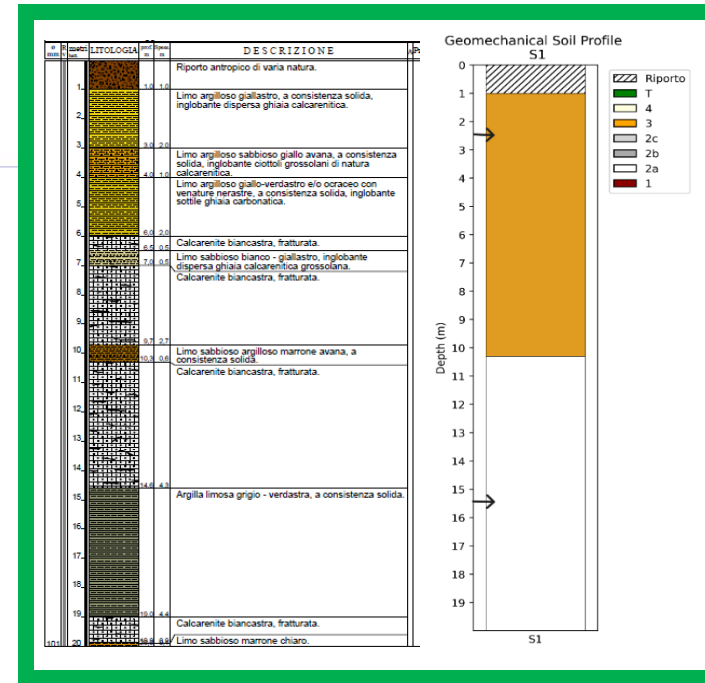
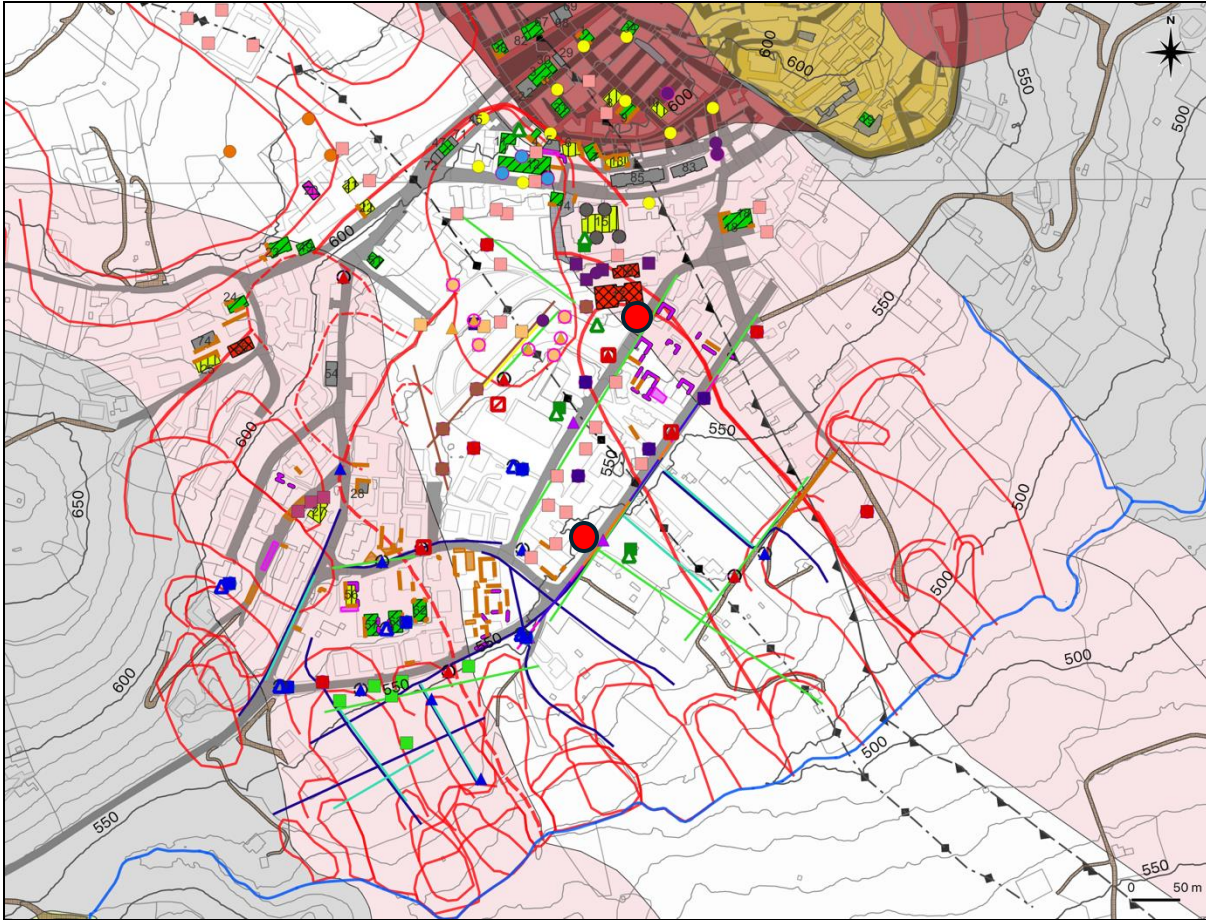
Products

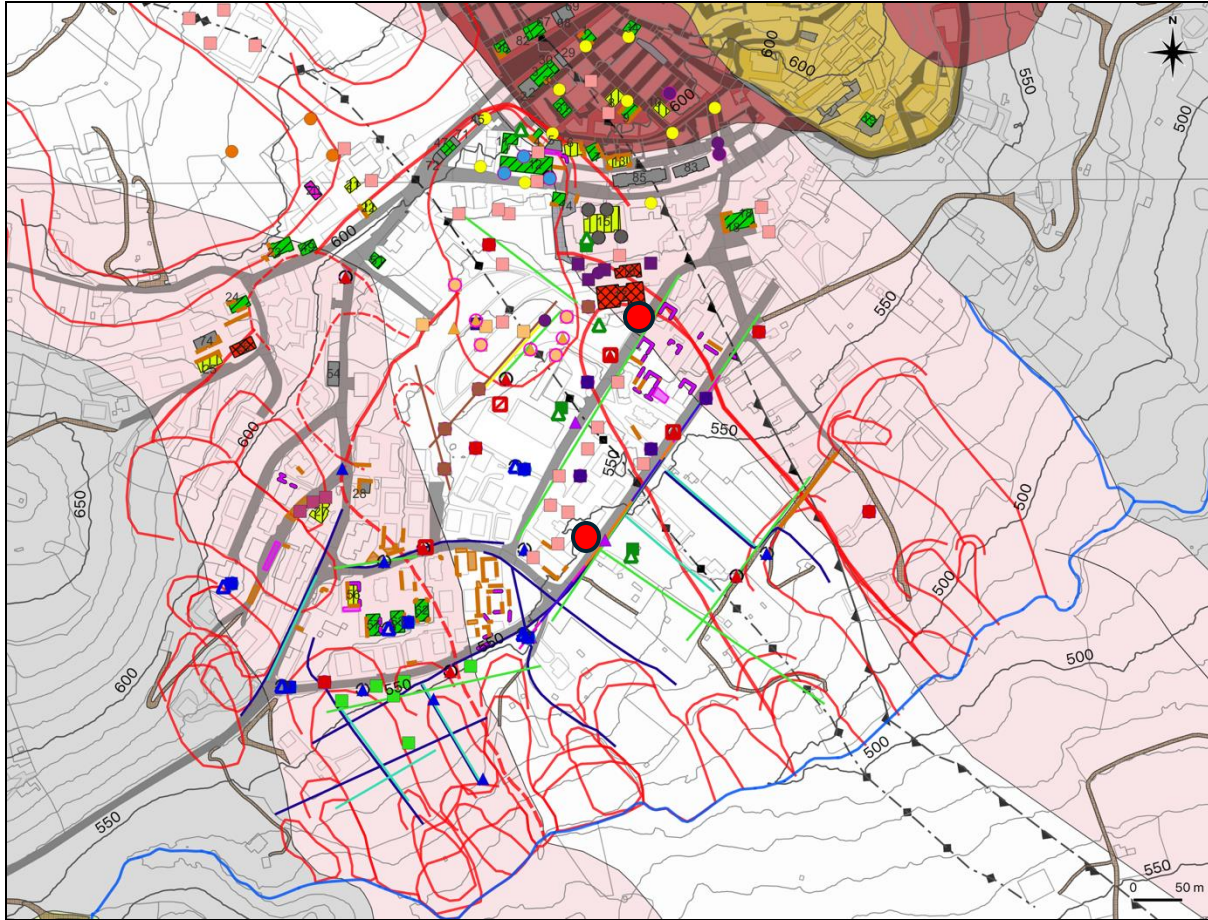
Digital twin of a landslide-affected hillslope





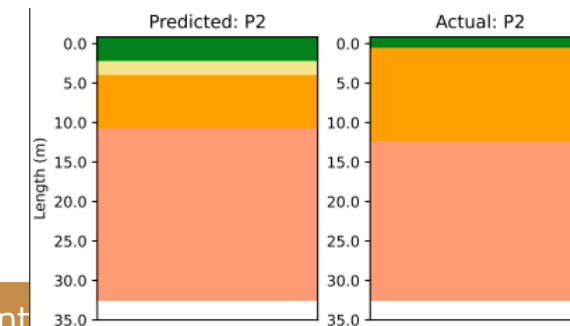
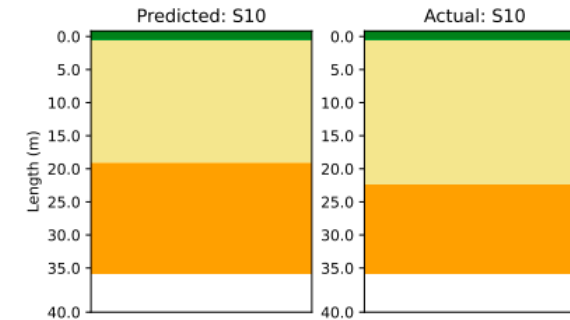


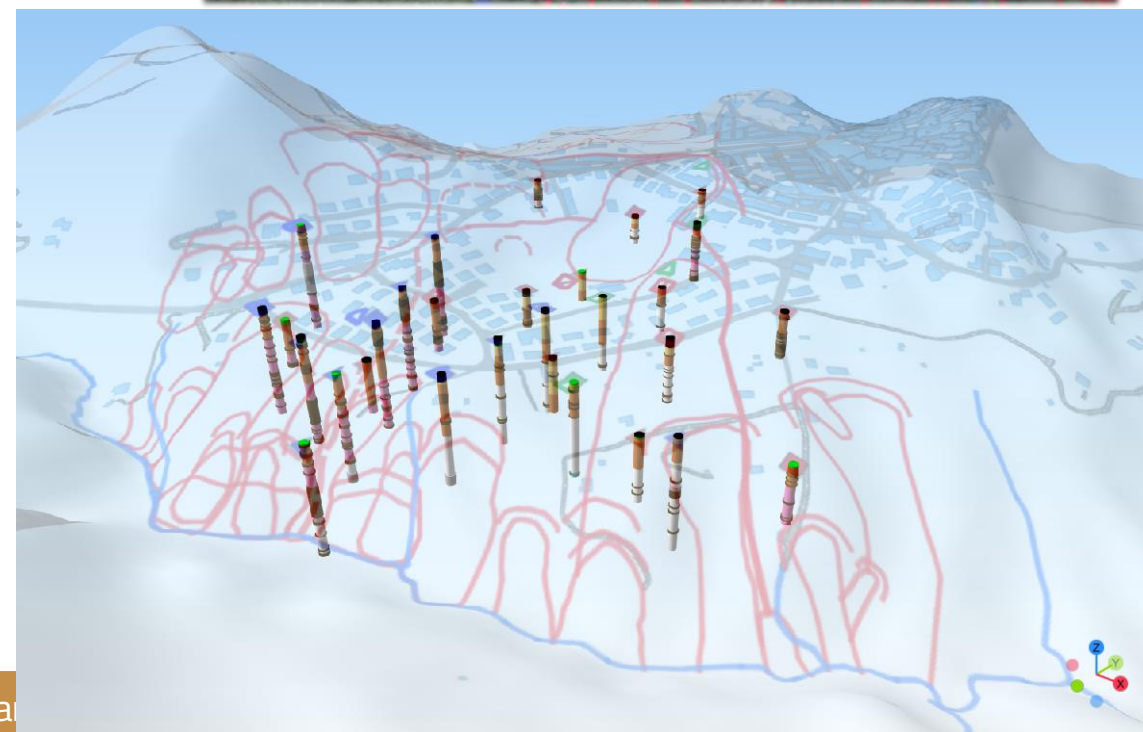
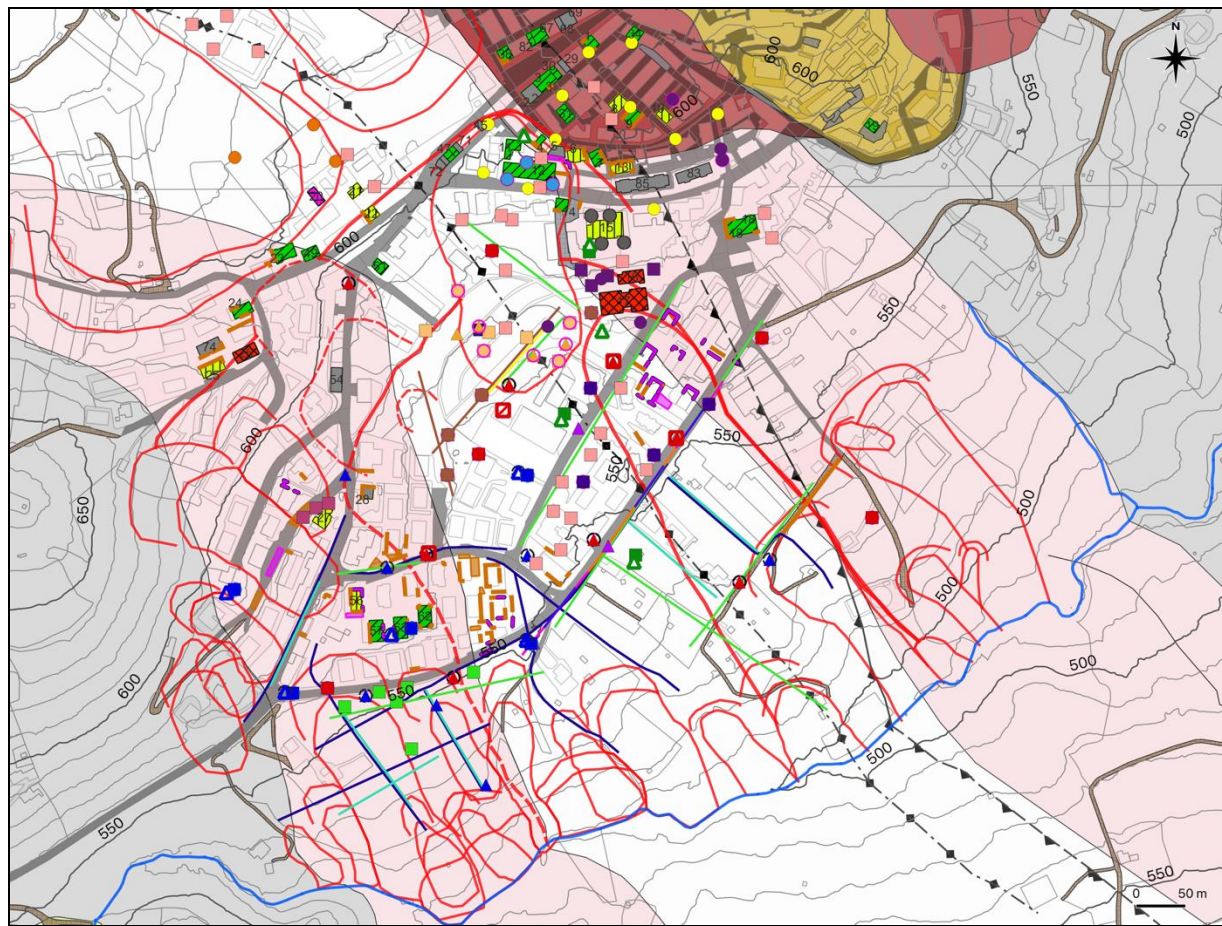


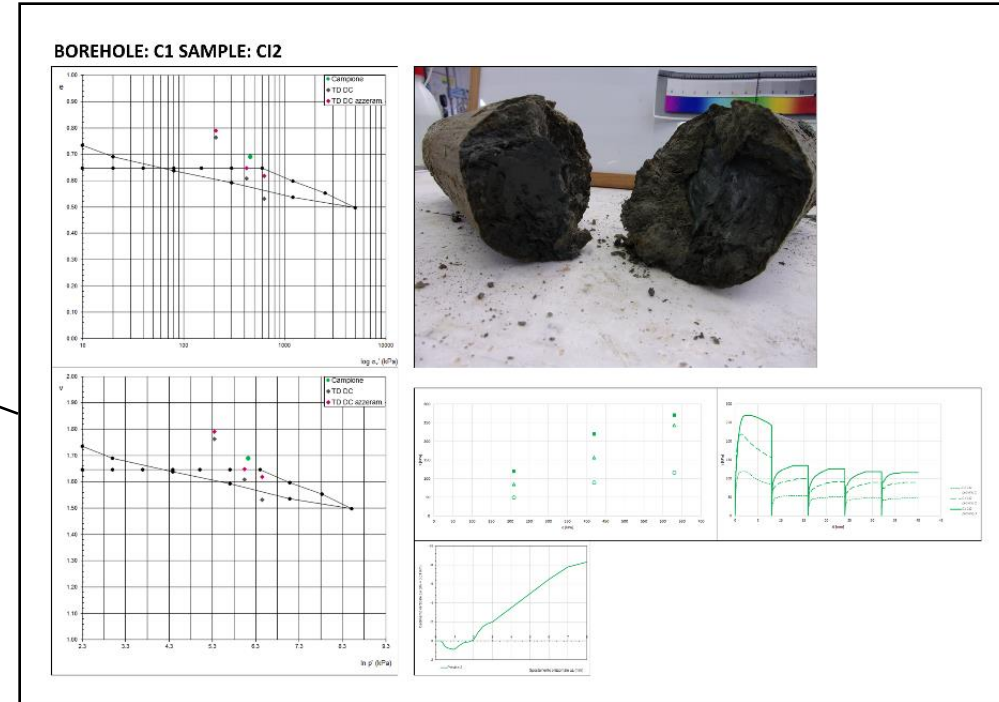
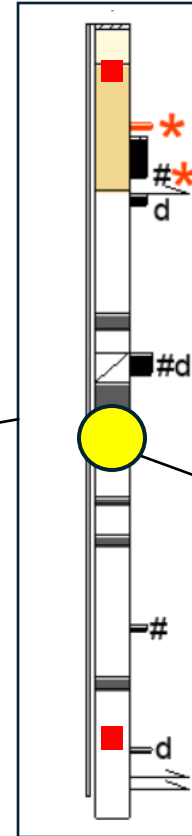
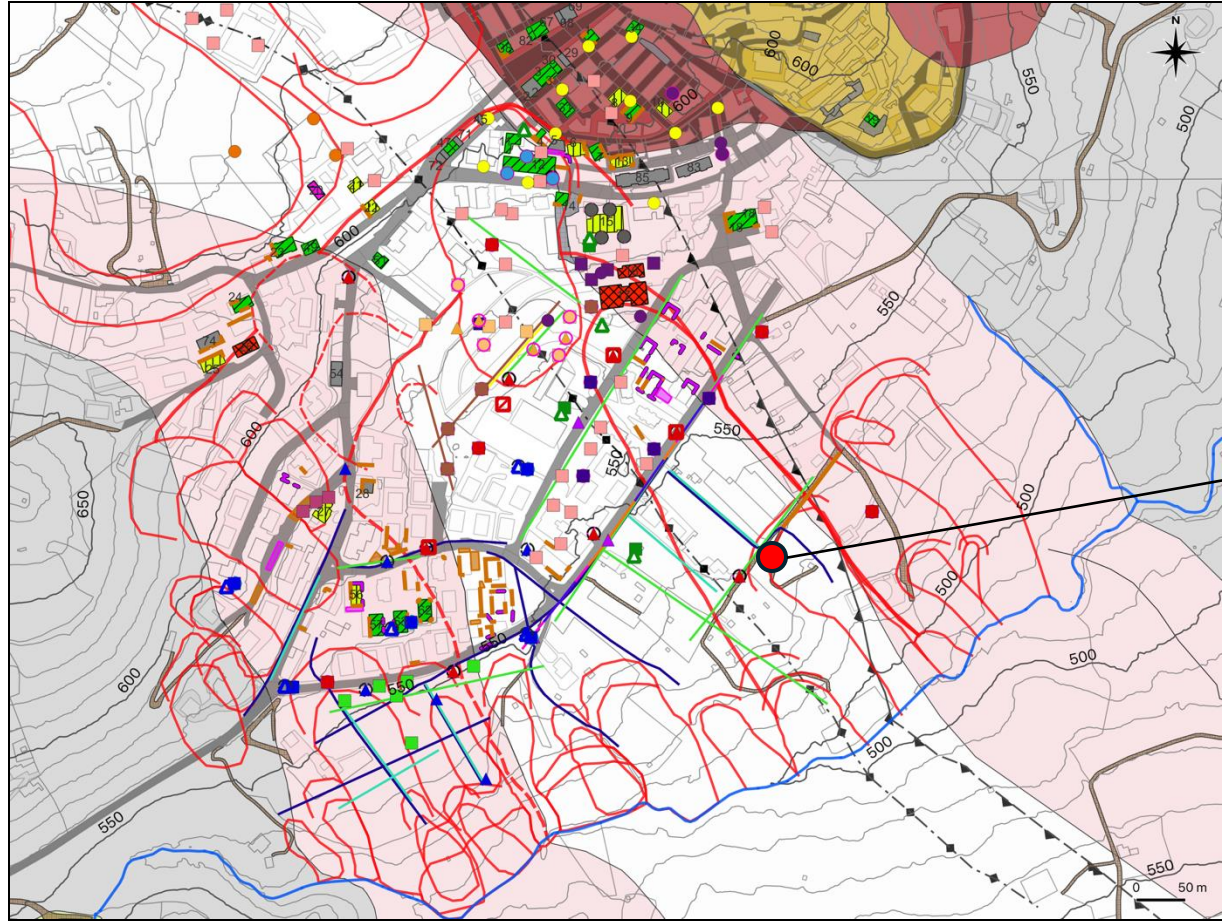


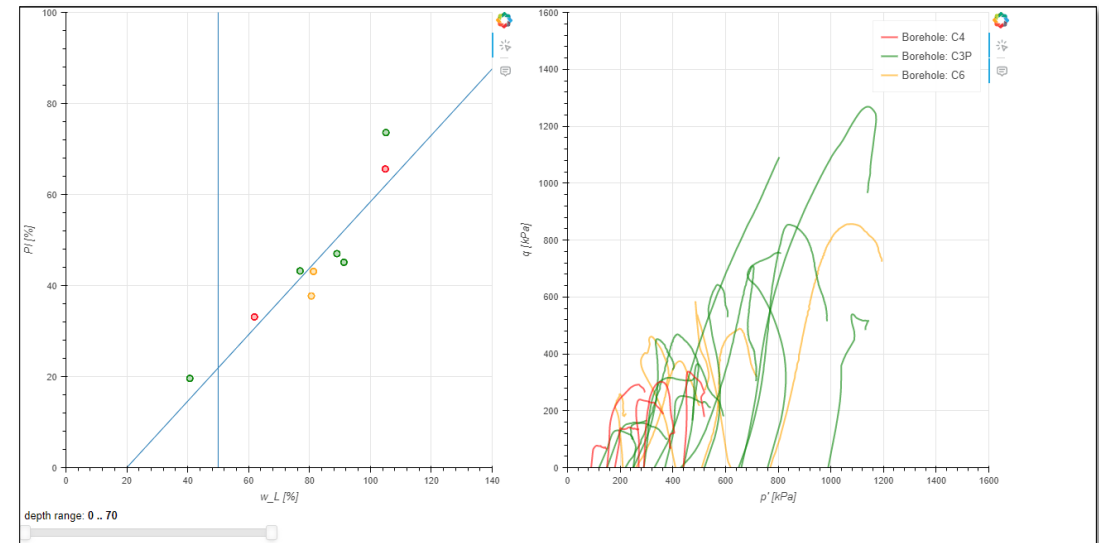
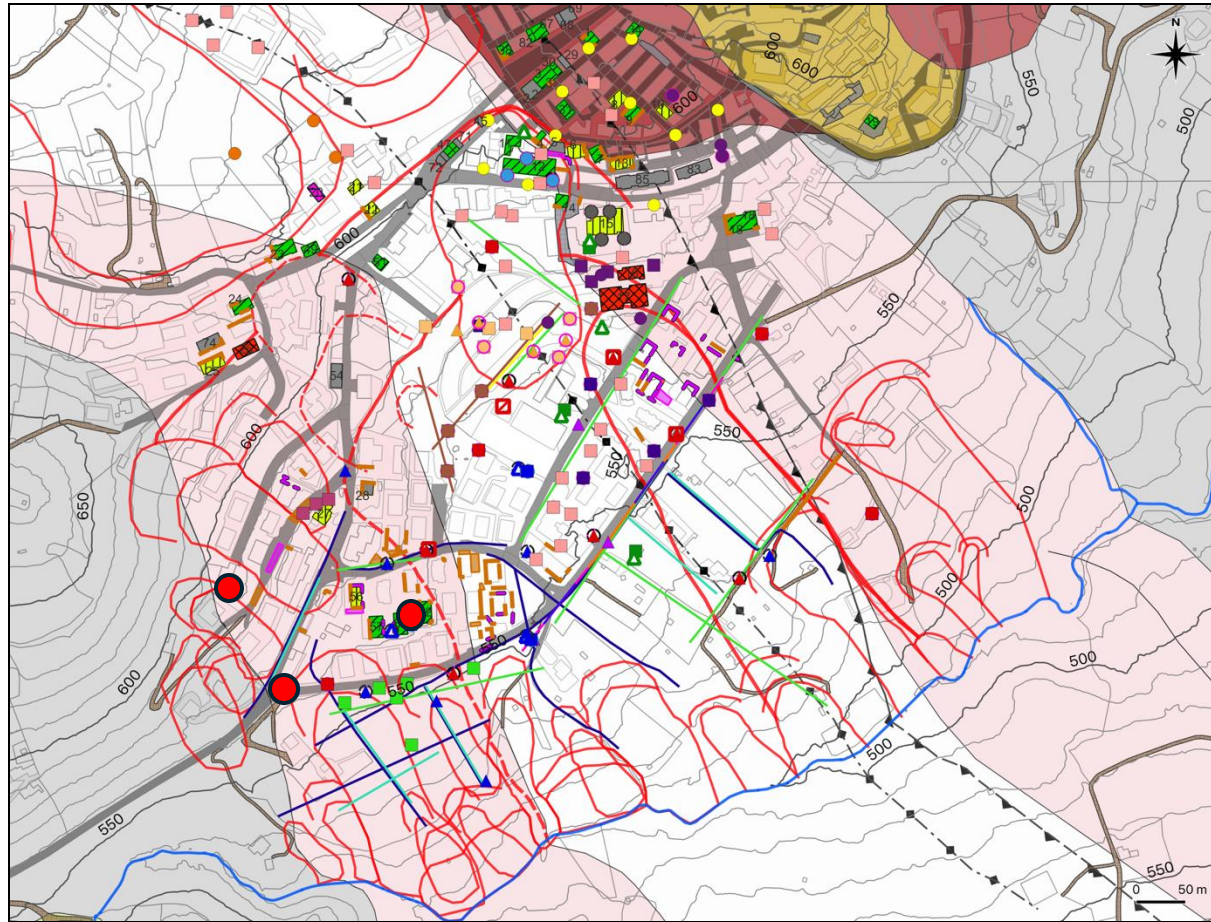
Confusion Matrix - Row-wise Normalization

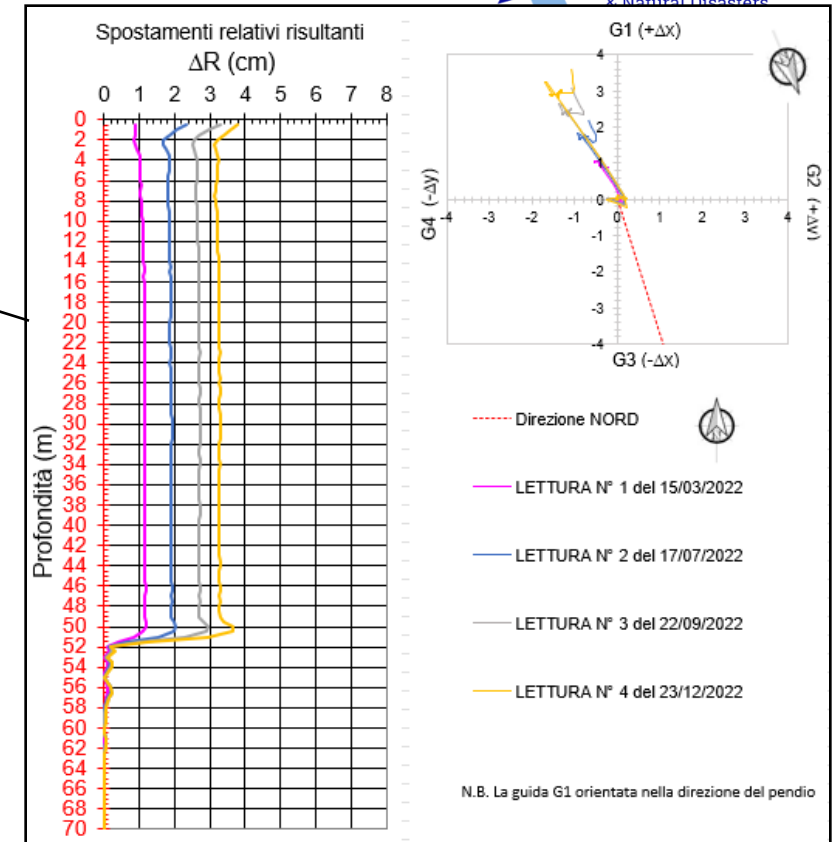
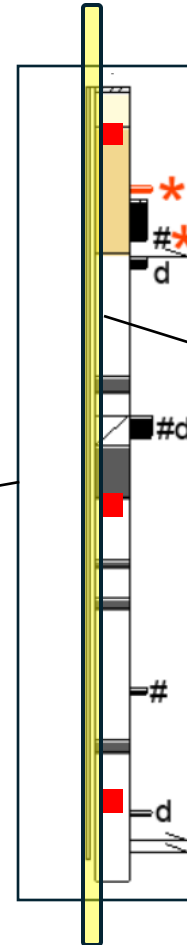
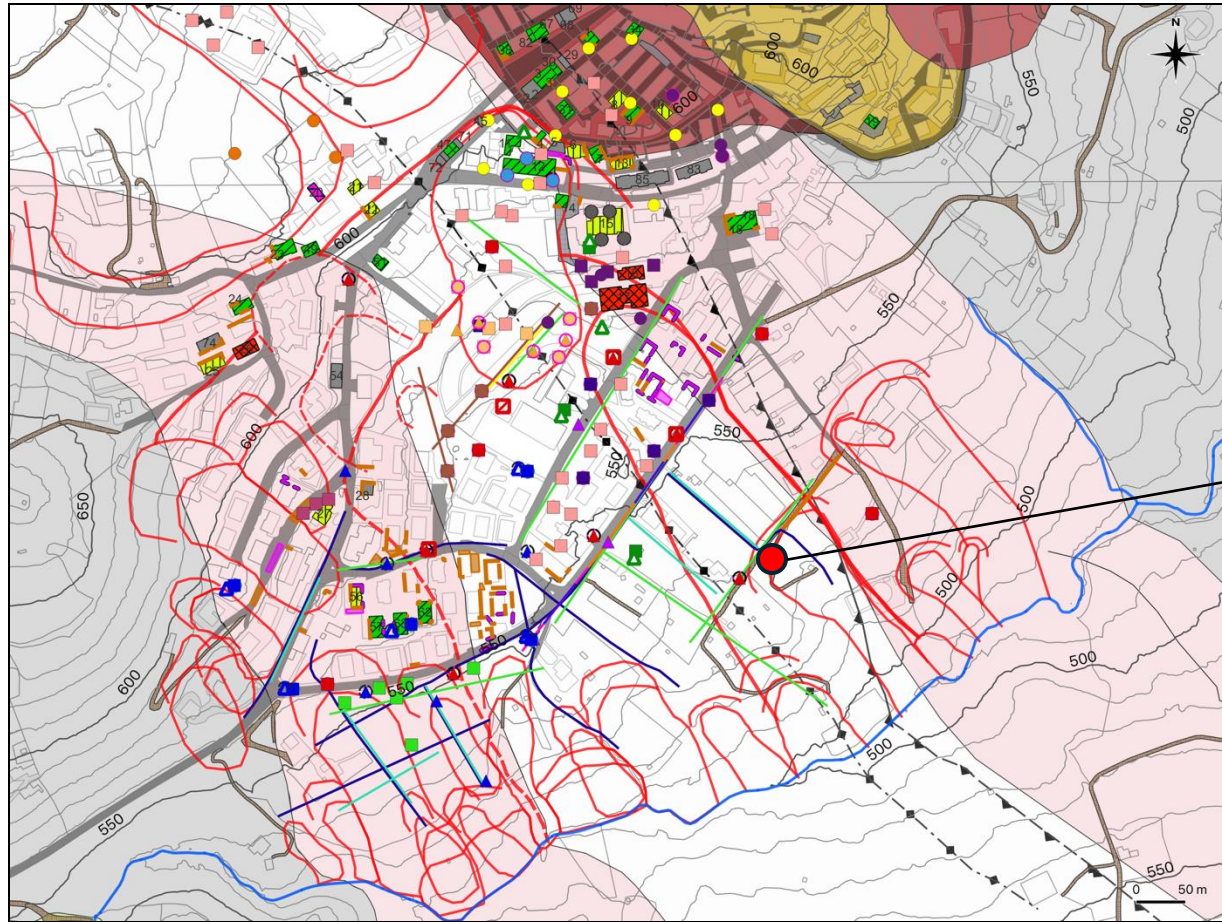
True label \ Predicted label	T	4	3	2a	2b	2c
T	82	11	6.2	0	1.5	0
4	3.1	50	33	0.6	13	0.3
3	1	8.9	70	13	4.7	2.3
2a	0	0.5	3.8	66	29	0
2b	0	0.9	7.8	13	64	14
2c	0	0	2.2	0.5	41	56











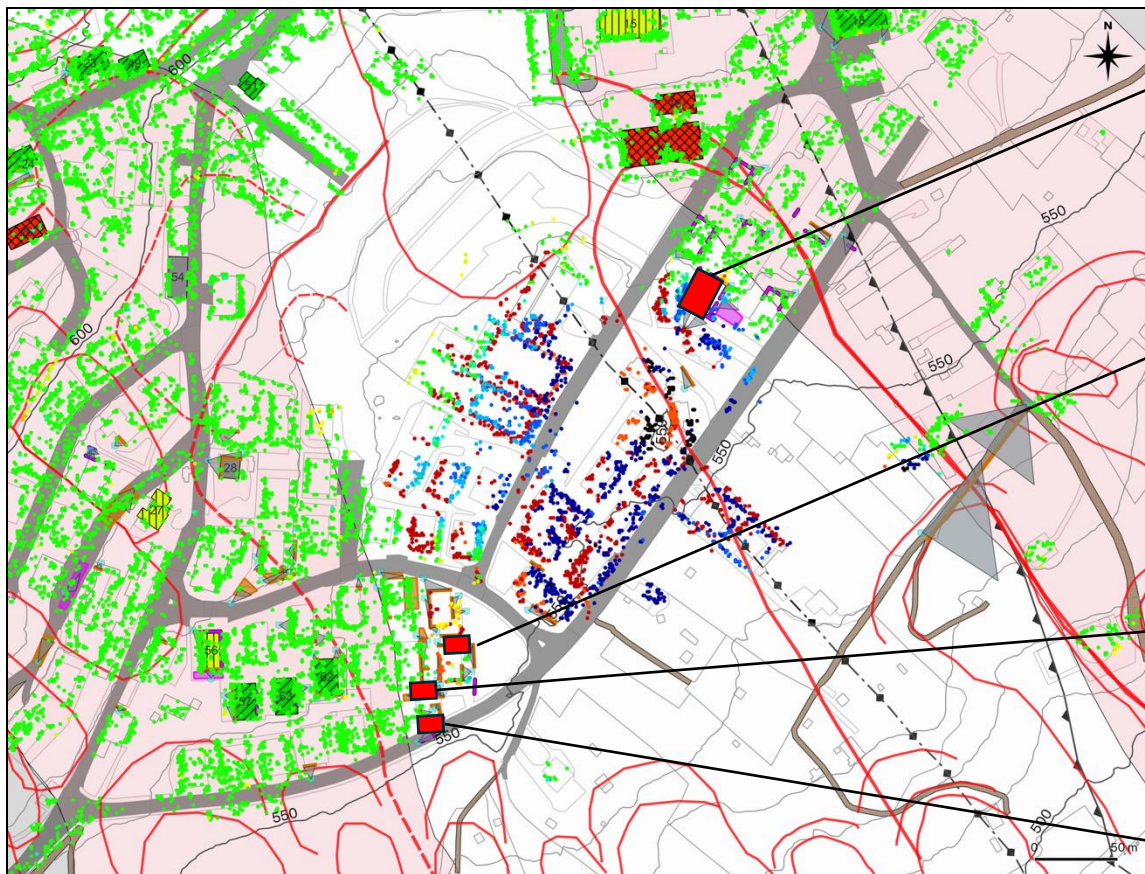




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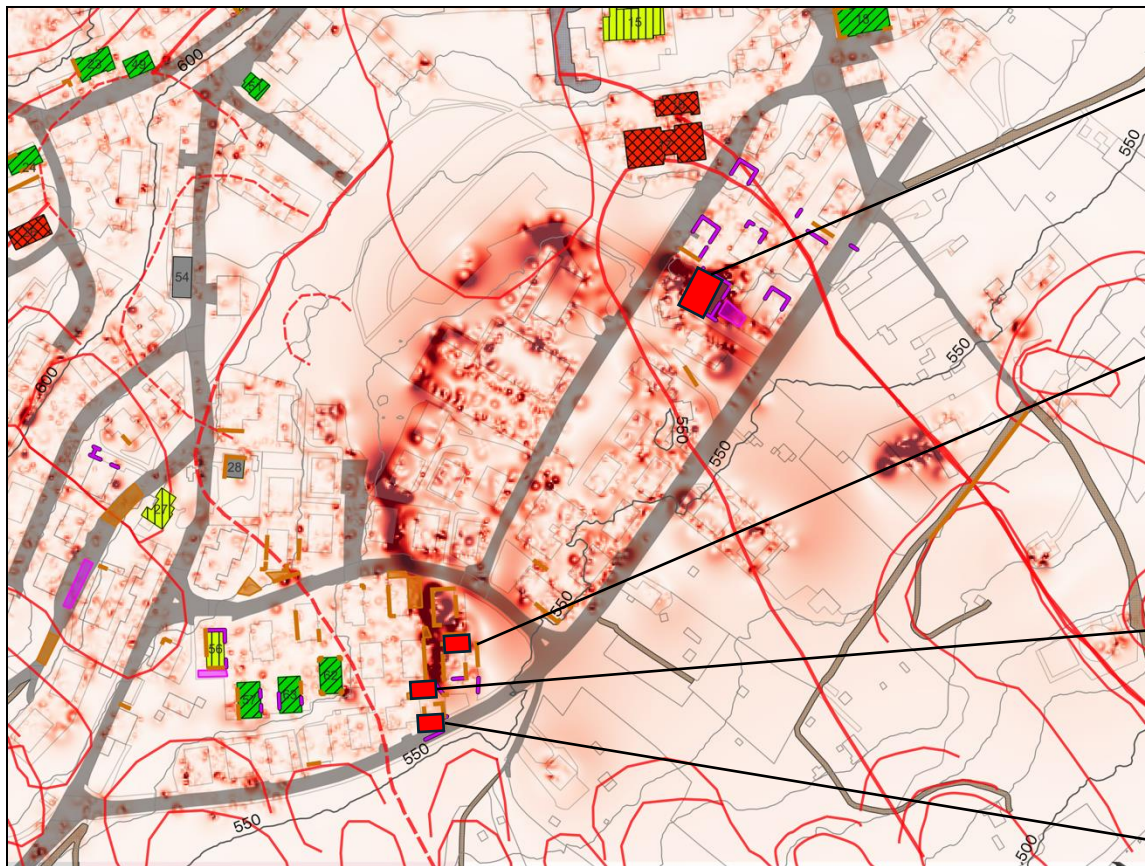
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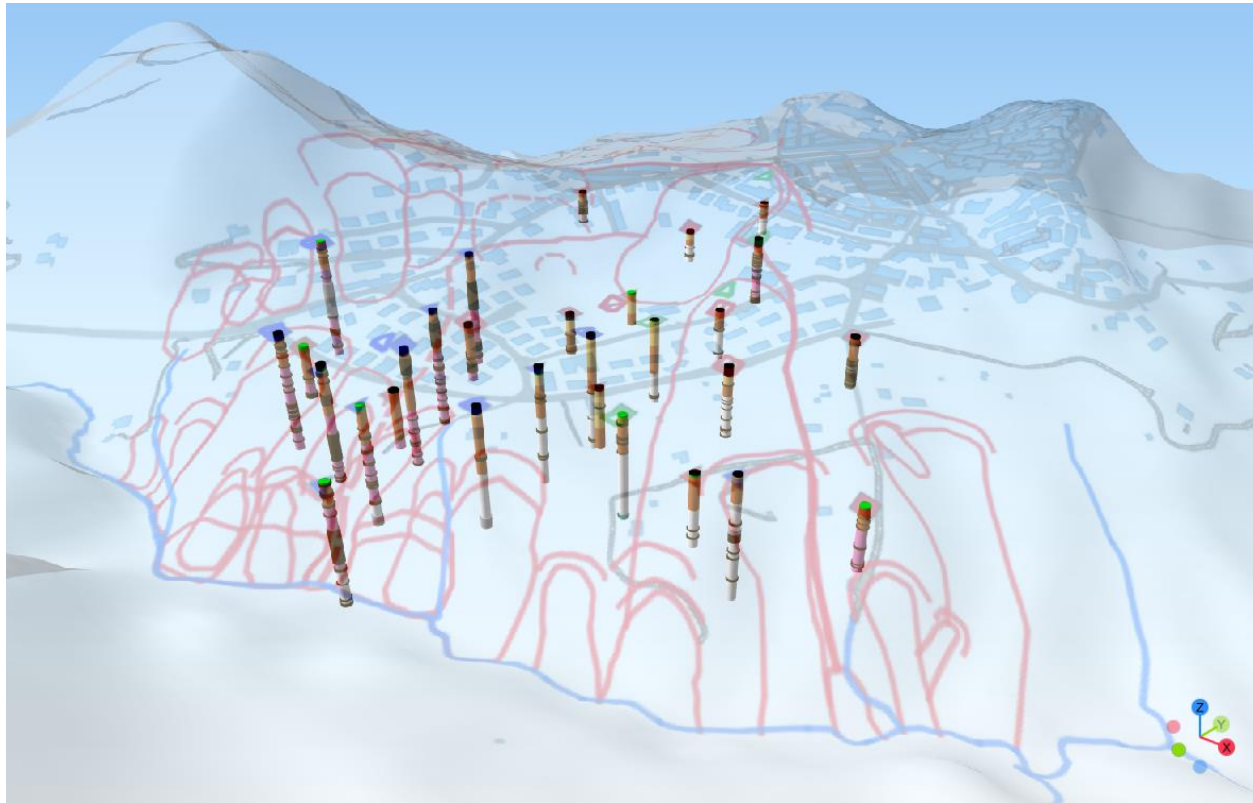


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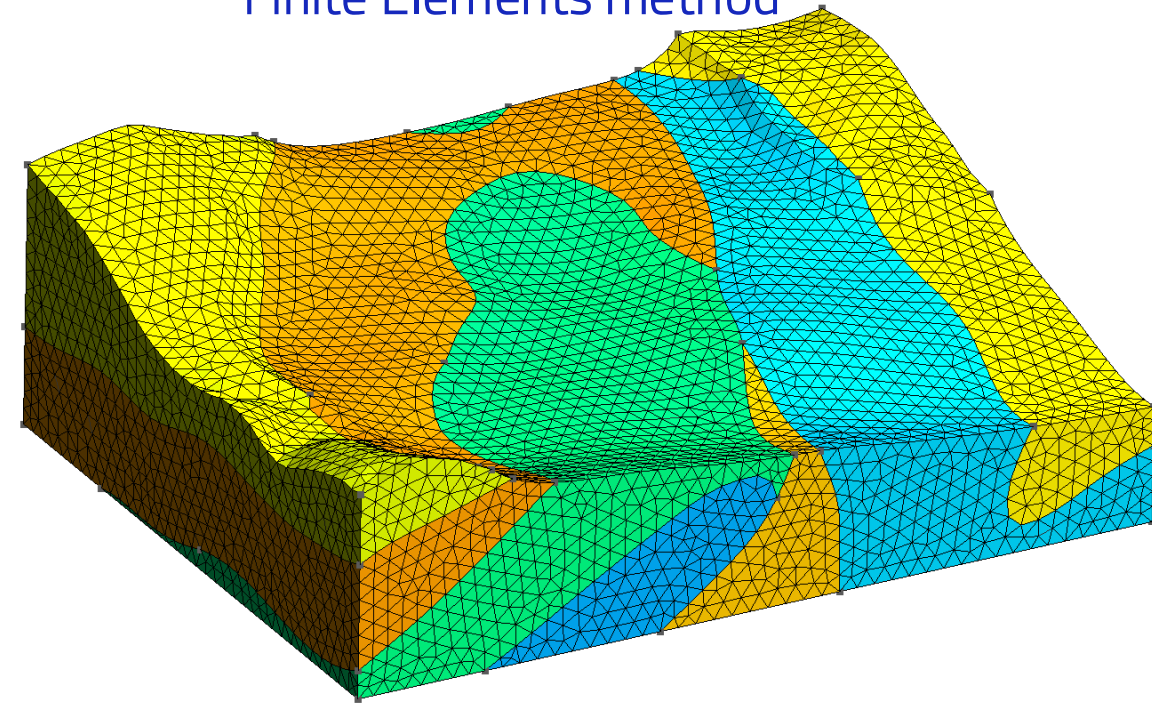


Products

Numerical modelling for the prediction of the displacement fields



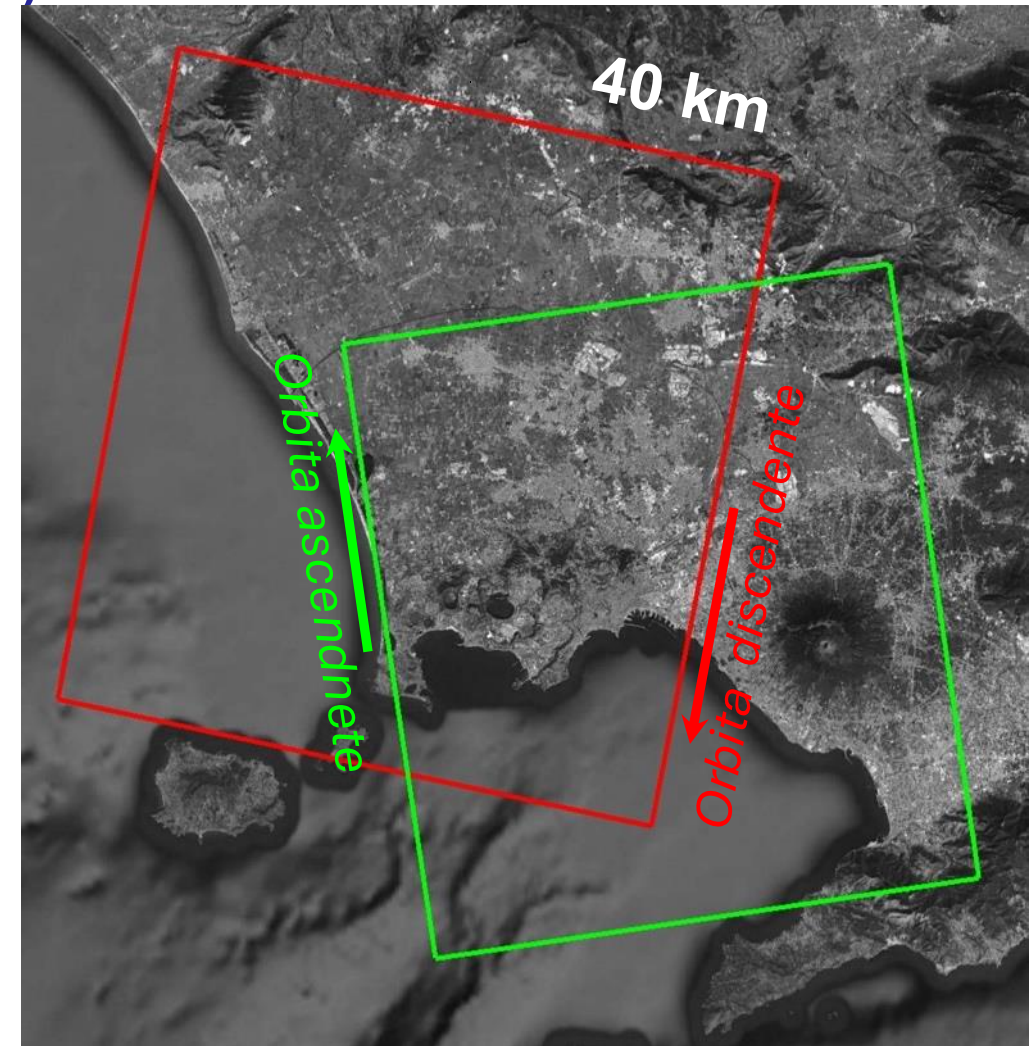
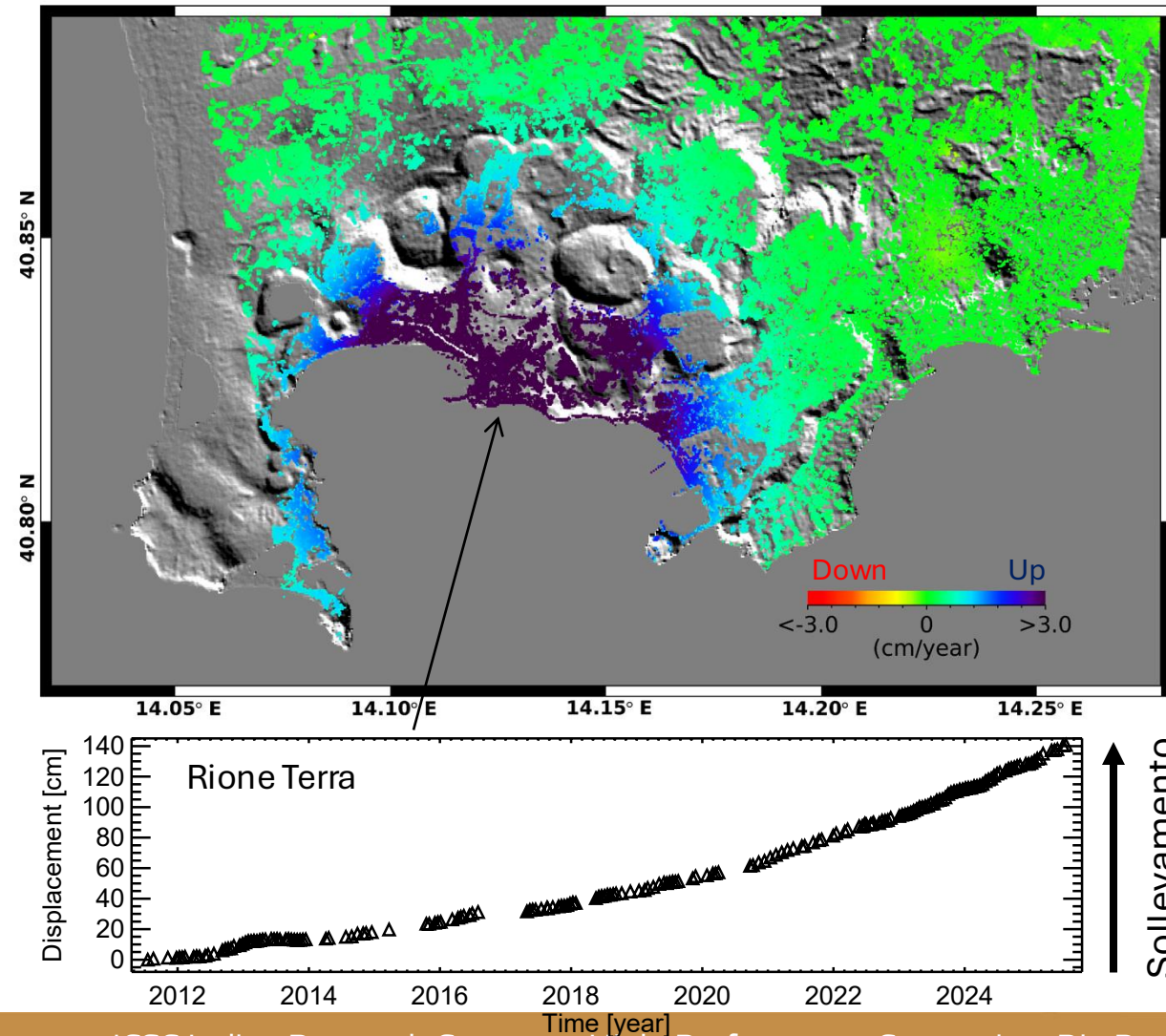
Finite Elements method



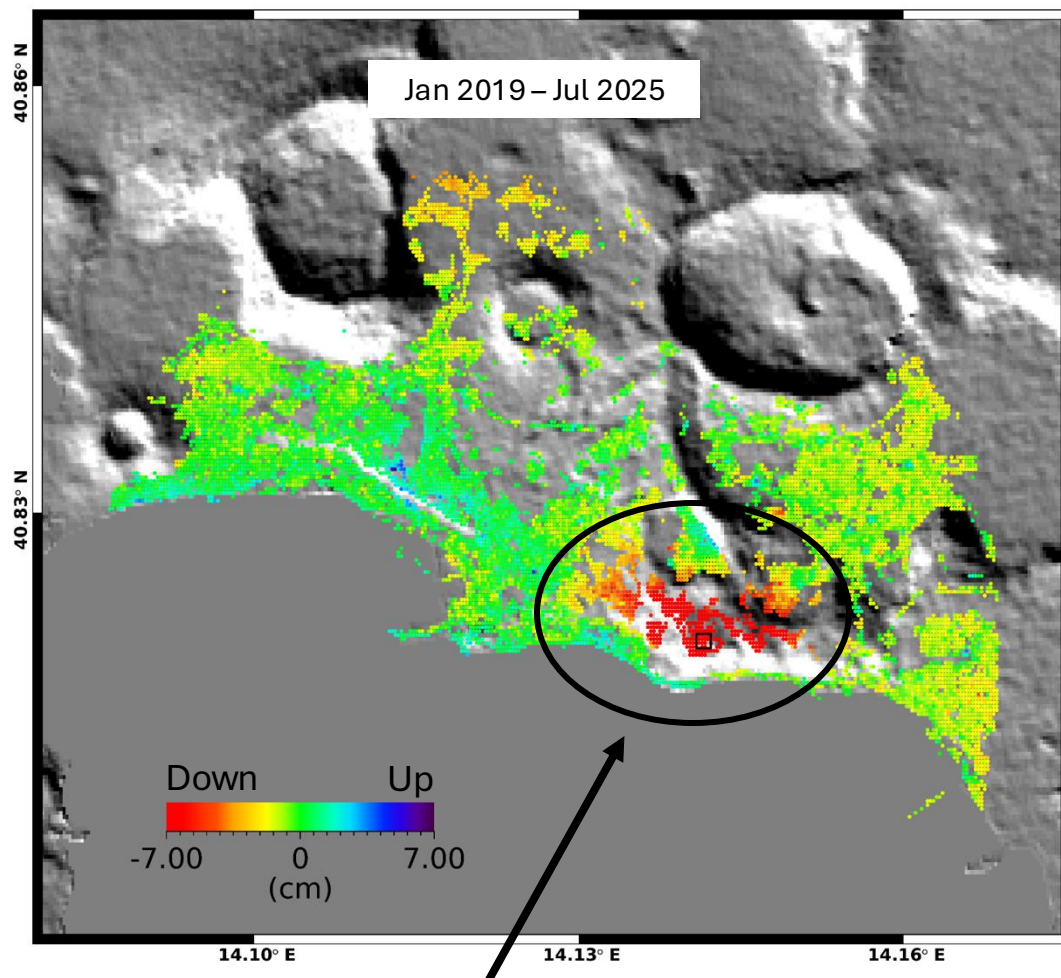
Caldera dei Campi Flegrei: rilievo radar satellitare degli spostamenti mediante dati COSMO-SkyMed

Velocità media di spostamento verticale

(2011-2025)



Caldera dei Campi Flegrei: rilievo radar satellitare degli spostamenti mediante dati COSMO-SkyMed (2011-2025)



Anomalia (deficit) dello spostamento verticale

nature communications



Article

<https://doi.org/10.1038/s41467-025-56723-y>

Burst-like swarms in the Campi Flegrei caldera accelerating unrest from 2021 to 2024

Received: 8 July 2024

Accepted: 29 January 2025

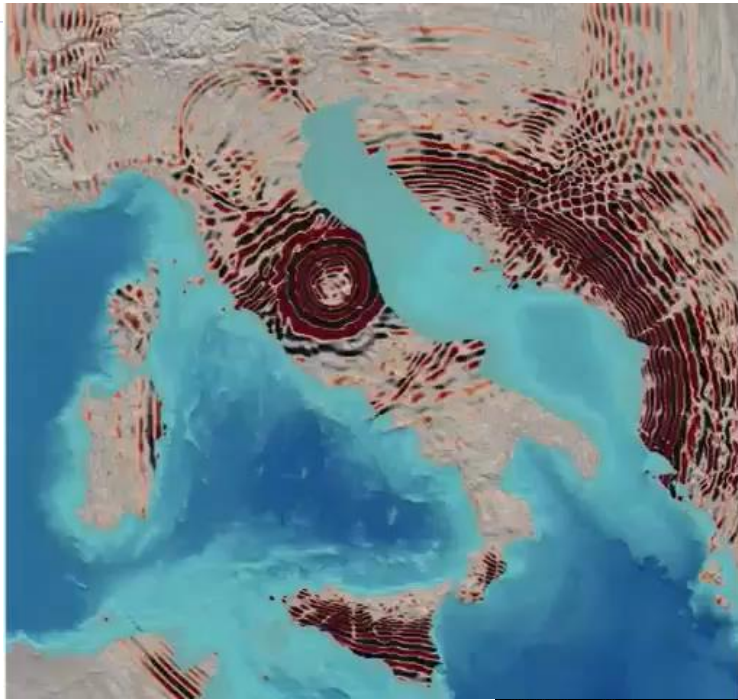
Published online: 11 February 2025

Check for updates

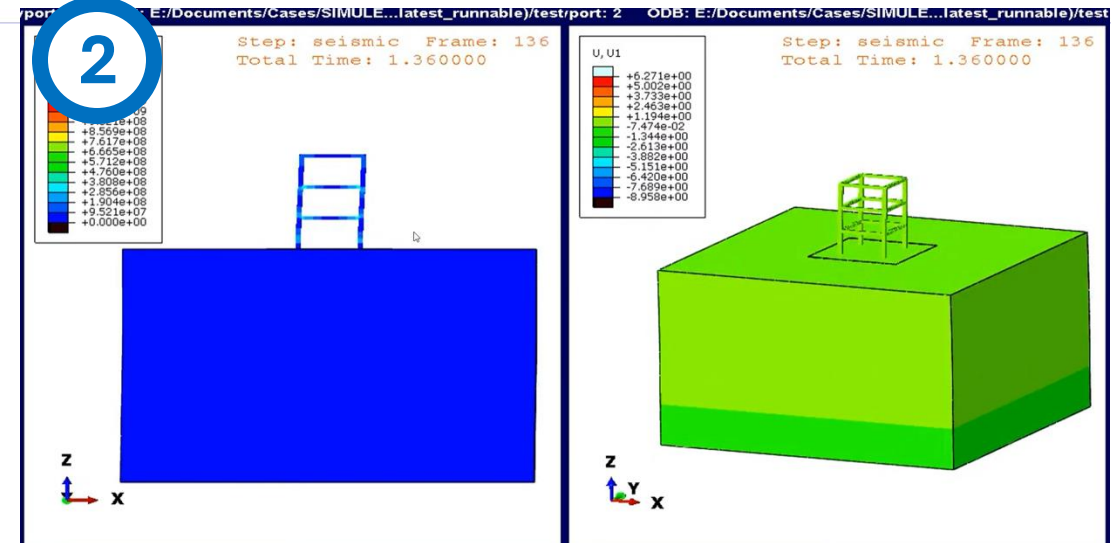
Flora Giudicepietro^{1,2}, Rosario Avino¹, Eliana Bellucci Sessa¹,
Andrea Bevilacqua³, Manuela Bonano², Stefano Caliro¹, Francesco Casu²,
Walter De Cesare¹, Claudio De Luca², Prospero De Martino^{1,2},
Federico Di Traglia^{1,2}, Mauro A. Di Vito¹, Mario Dolce¹, Antonietta M. Esposito¹,
Riccardo Lanari², Giovanni Macedonio^{1,2}✉, Michele Manunta²,
Carmine Minopoli¹, Fernando Monterroso², Augusto Neri³,
Patrizia Ricciolino¹, Francesco Rufino¹, Alessandro Santi¹, Giovanni Scarpato¹,
Pasquale Striano², Anna Tramelli¹ & Giovanni Chiodini¹



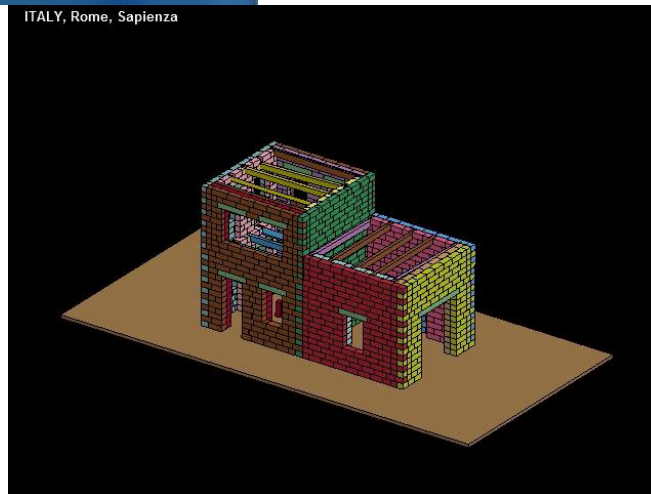
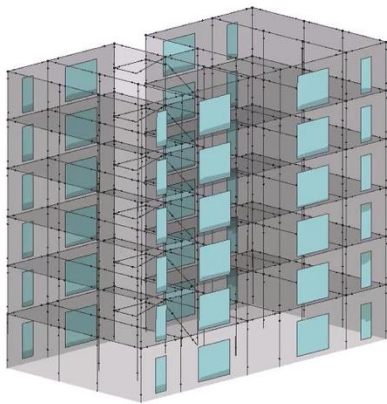
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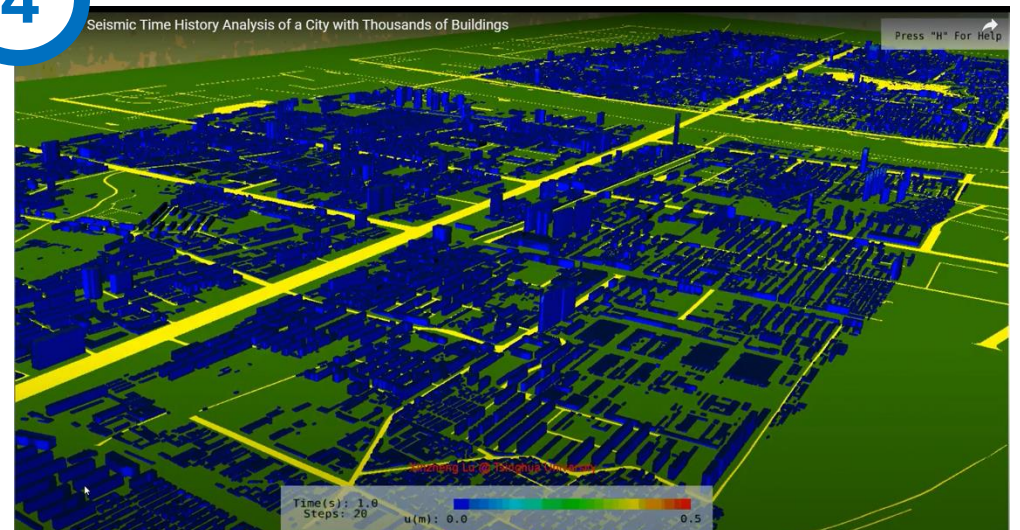


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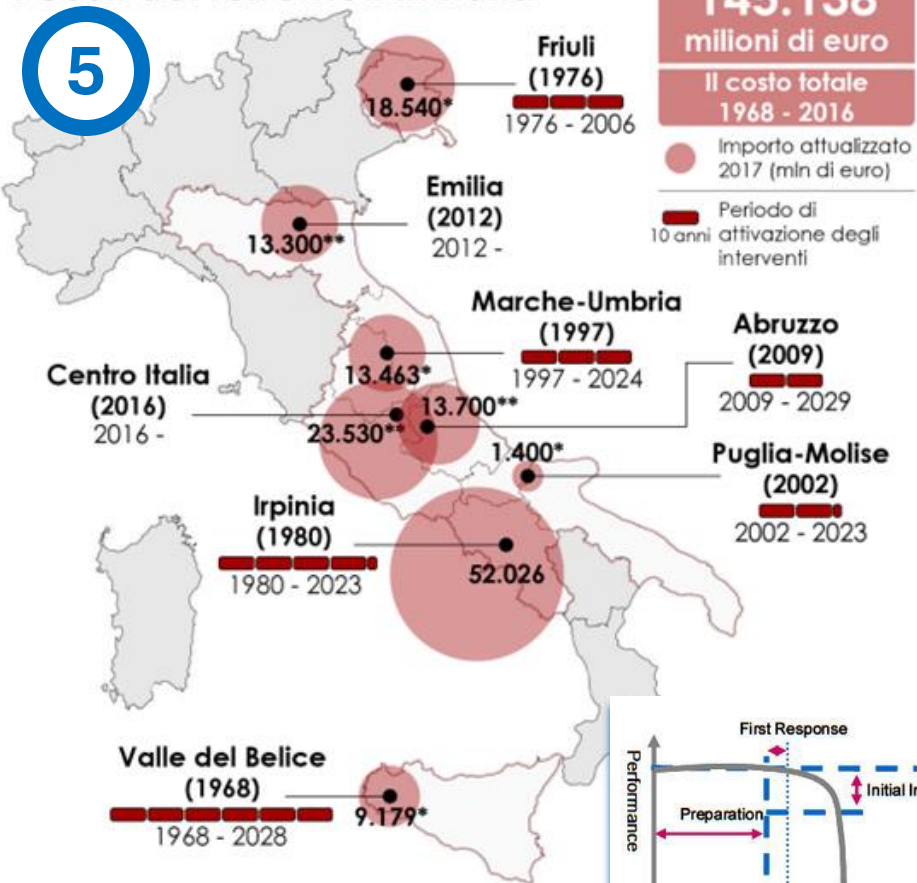


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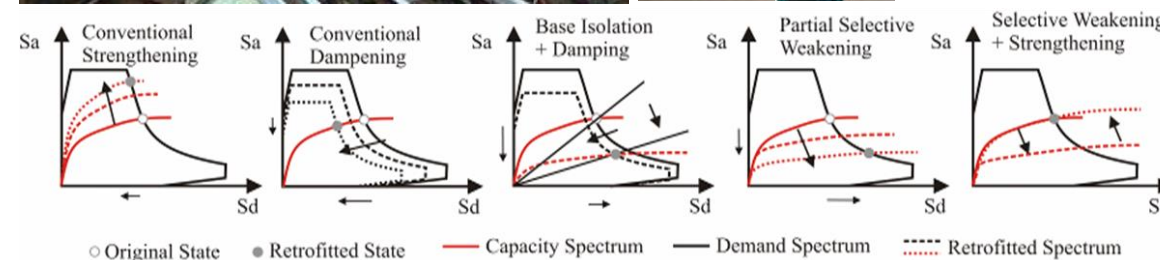
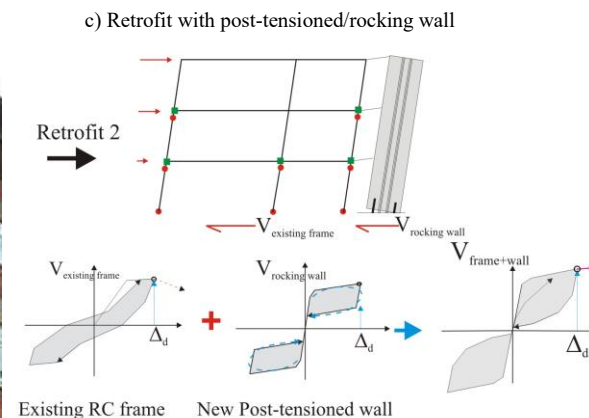
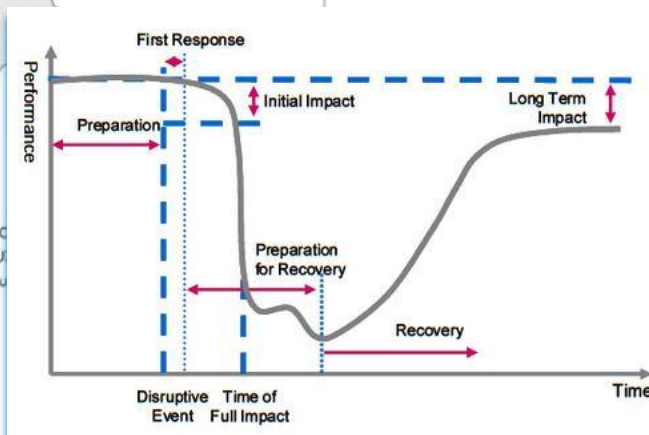
(source: <https://www.youtube.com/watch?v=xwrZmmUkFvY&t=1s>)



I costi dei terremoti in Italia



* Dati a consuntivo sulle risorse effettivamente stanziati dalla
** Previsioni di spesa delle autorità locali preposte alla ricostruzione
Fonte: Centro studi





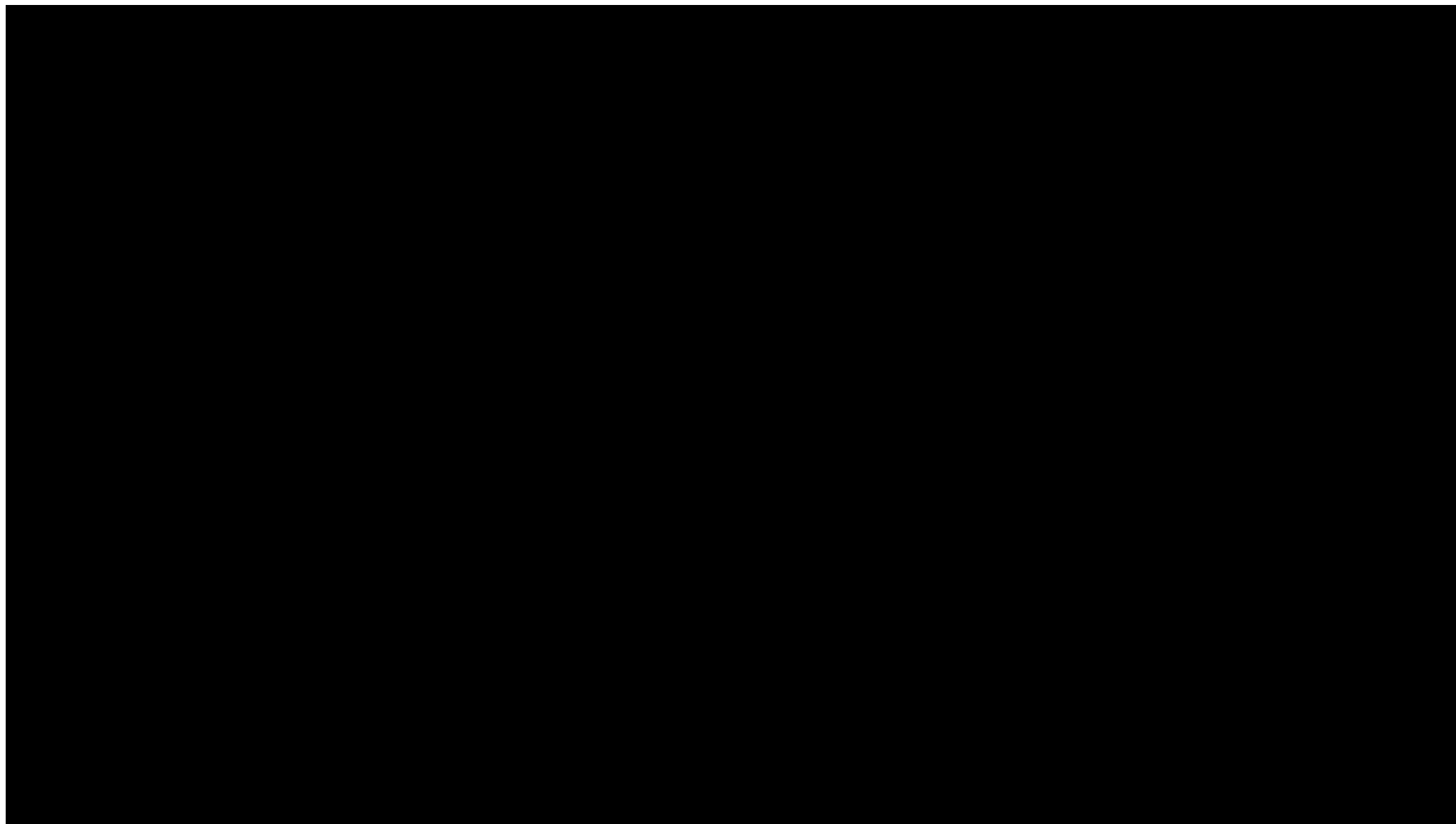
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Grazie per il vostro lavoro.

<https://www.supercomputing-icsc.it/>