A national-scale methodology for prioritizing landslide monitoring sites

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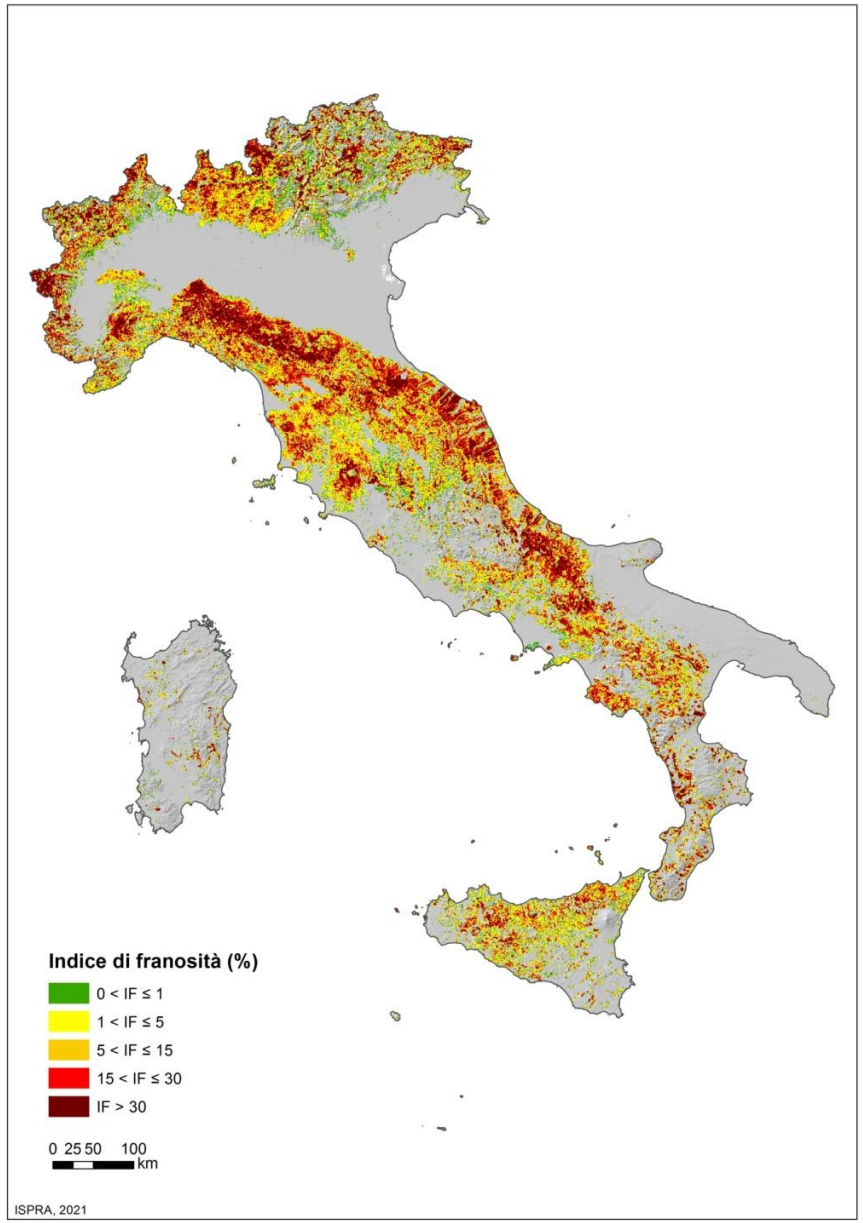
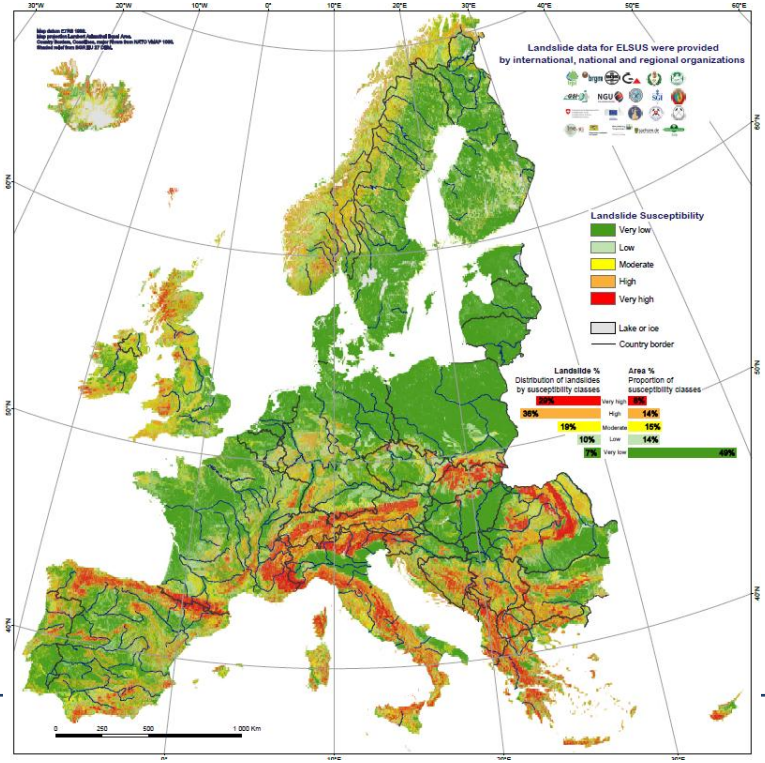
Thu, 07 May, 08:35–08:45 (CEST)

Landslides in Italy – The Italian Inventory (IFFI)

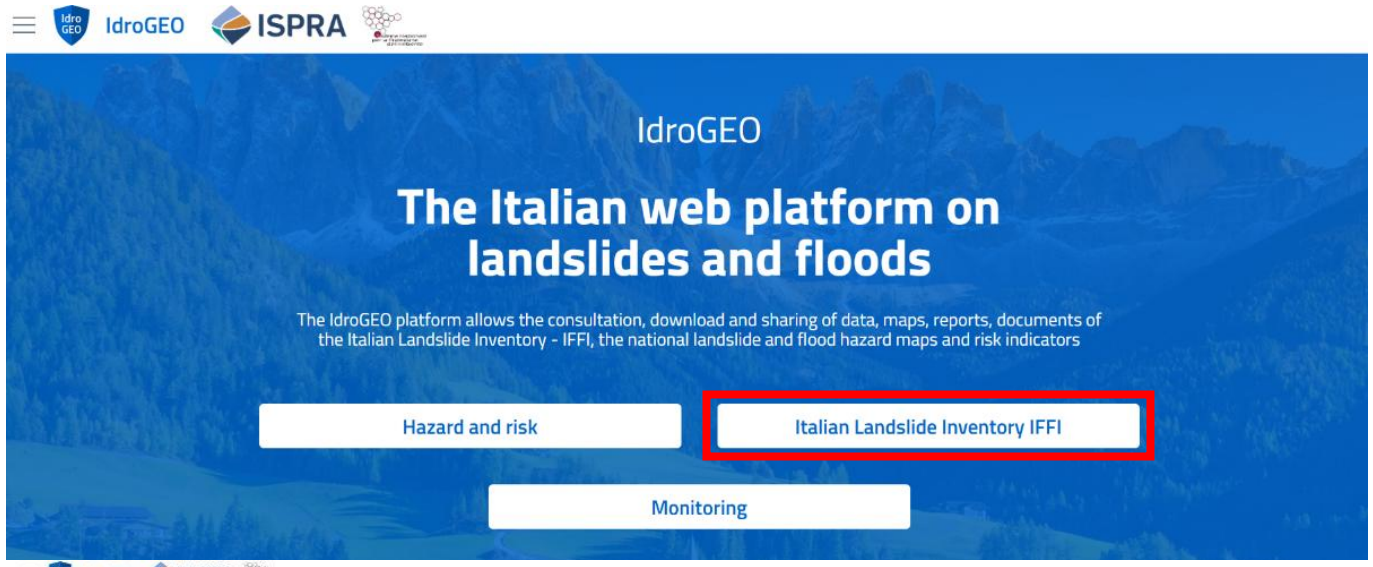


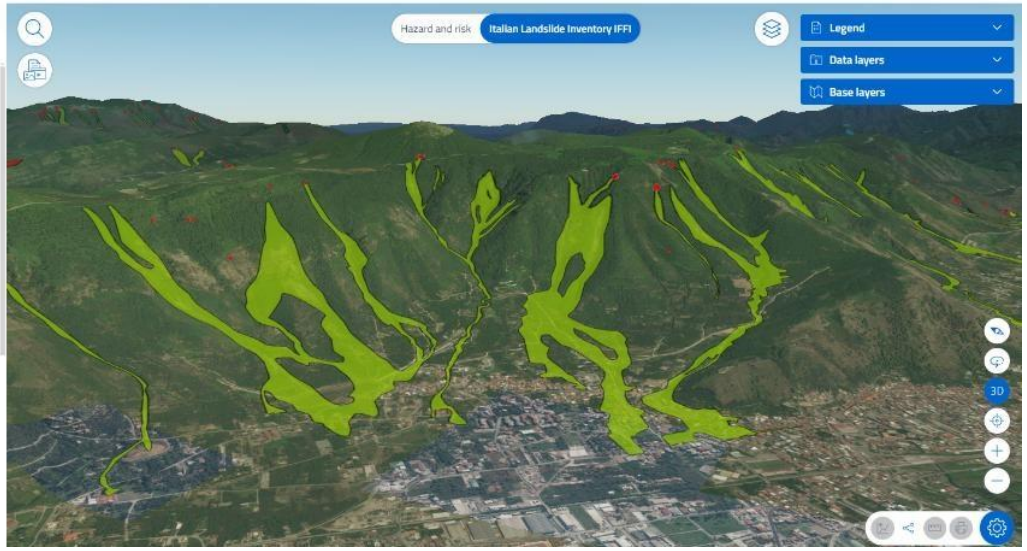
- > 680.000 landslides (reference period 1116-today)
- Area of nearly 25,000 km^2 (8.3% of the national territory)
- 2/3 of the landslides surveyed in Europe
- > 1,000 landslides each year (~100 major events)



Wilde et al. (2018) Pan-European Landslide Susceptibility Mapping ELSUS 2.0

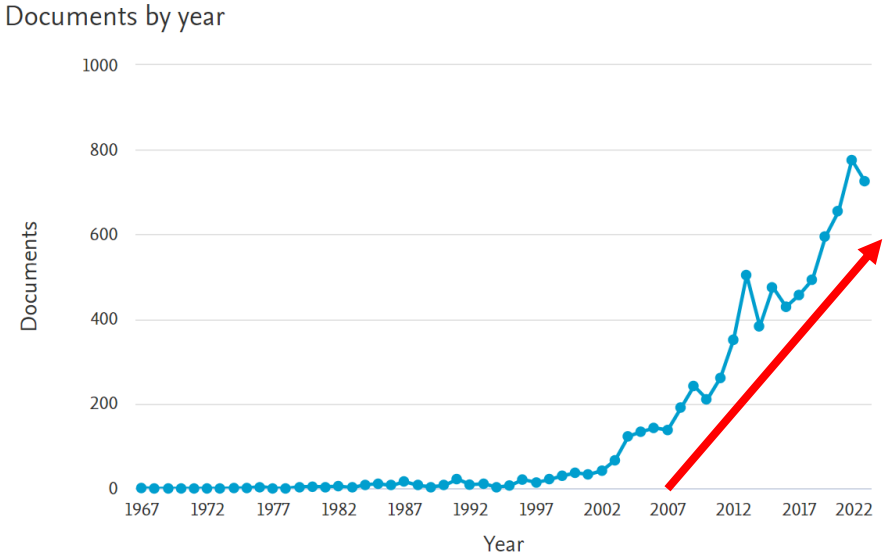
The national IdroGEO web platform

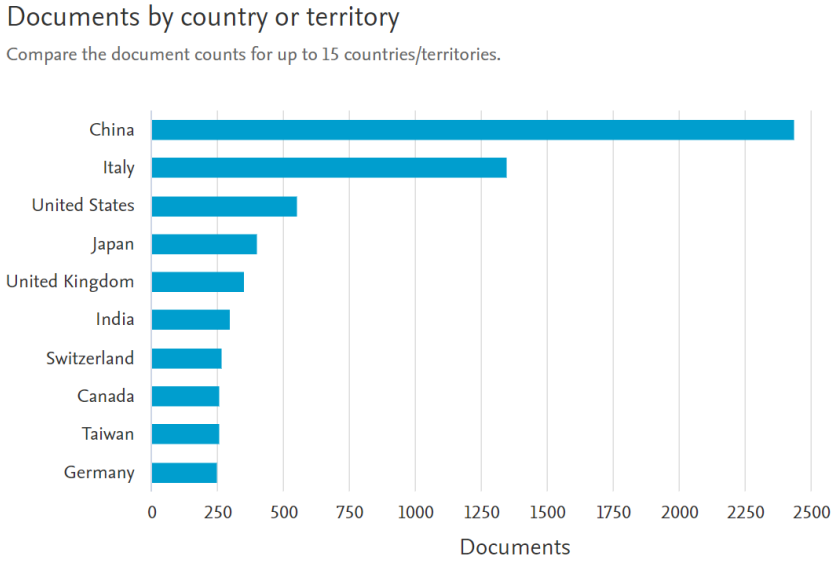




recent release: 3D view

Landslide monitoring



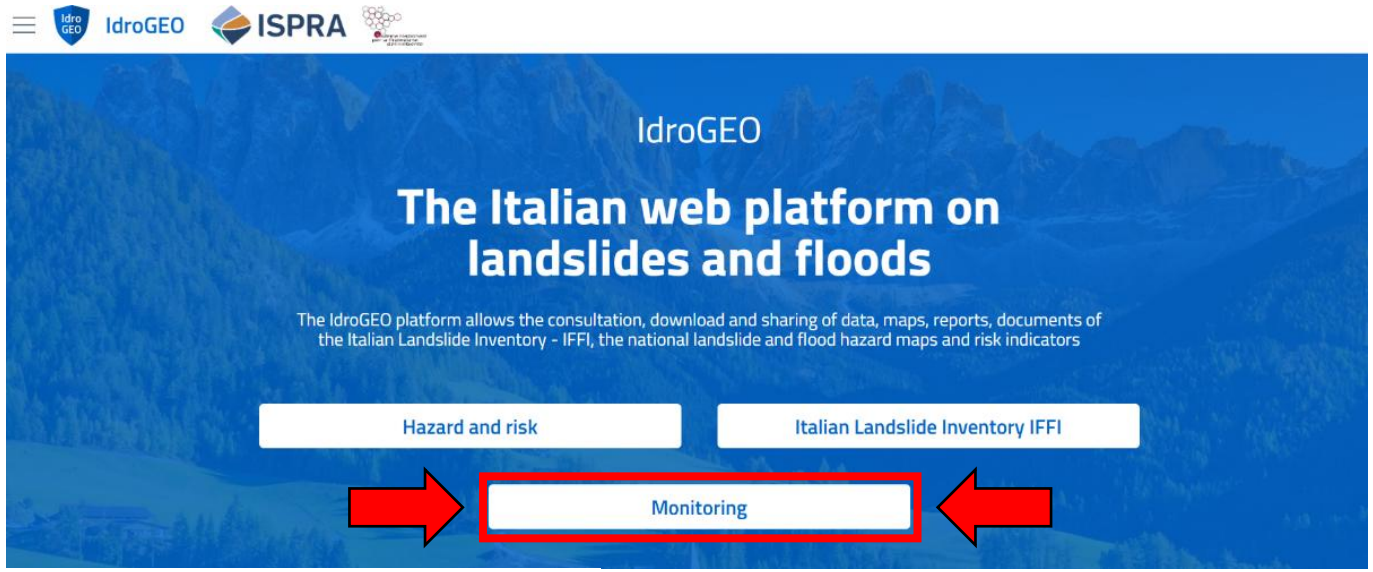


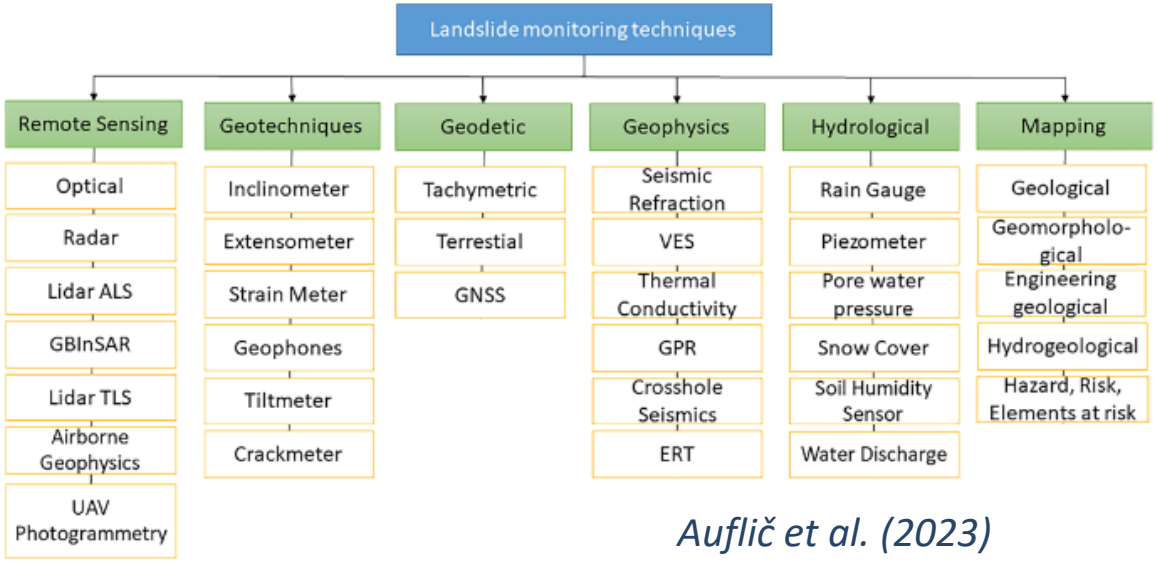
Landslide monitoring is a key (mandatory!) step in **landslide risk assessment** and **early warning services**.

Assessing landslide activity requires **multi-temporal** and **multi-scale** data on landslide conditions, including extent, kinematics, topography, hydro-geo-meteorological parameters, and failure surfaces.

Query about "*landslide monitoring*" on Scopus database

Landslide monitoring





Auflič et al. (2023)

ISPRA Guidelines (2021) n. 32/2021

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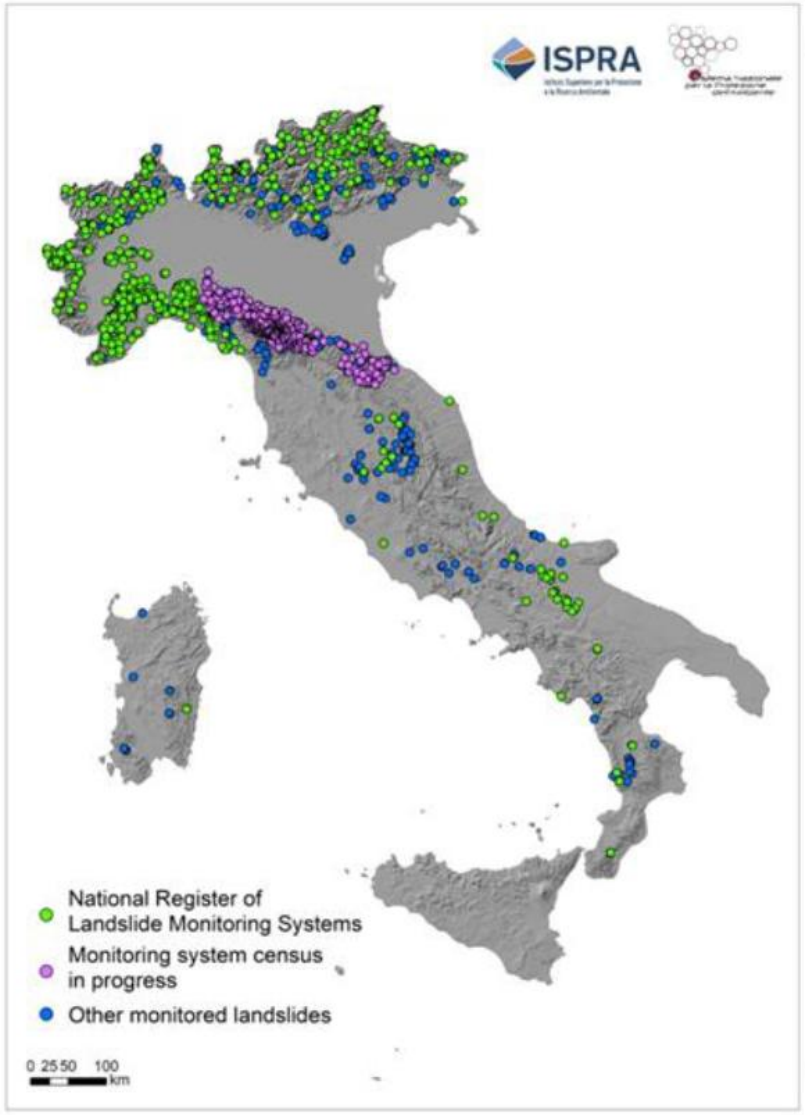
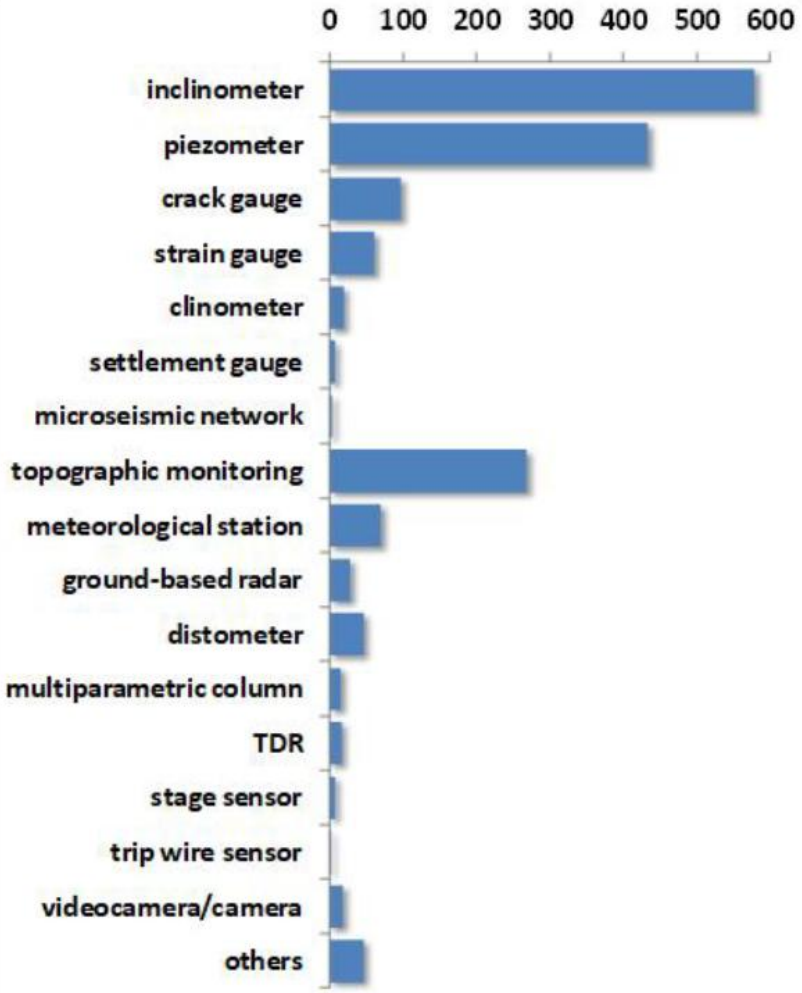
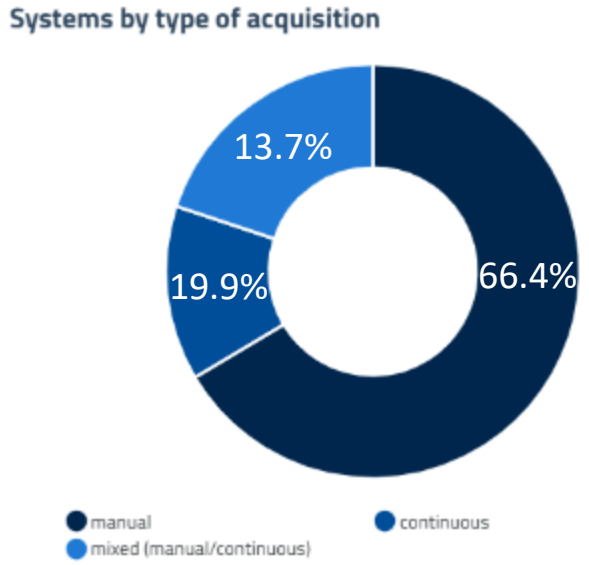
National Register of Landslide Monitoring Systems





1,040 monitoring systems currently registered.
Most of the systems (79%) have a **knowledge purpose** while other systems (21%) are or have been also used as **Early Warning Systems** (EWS).



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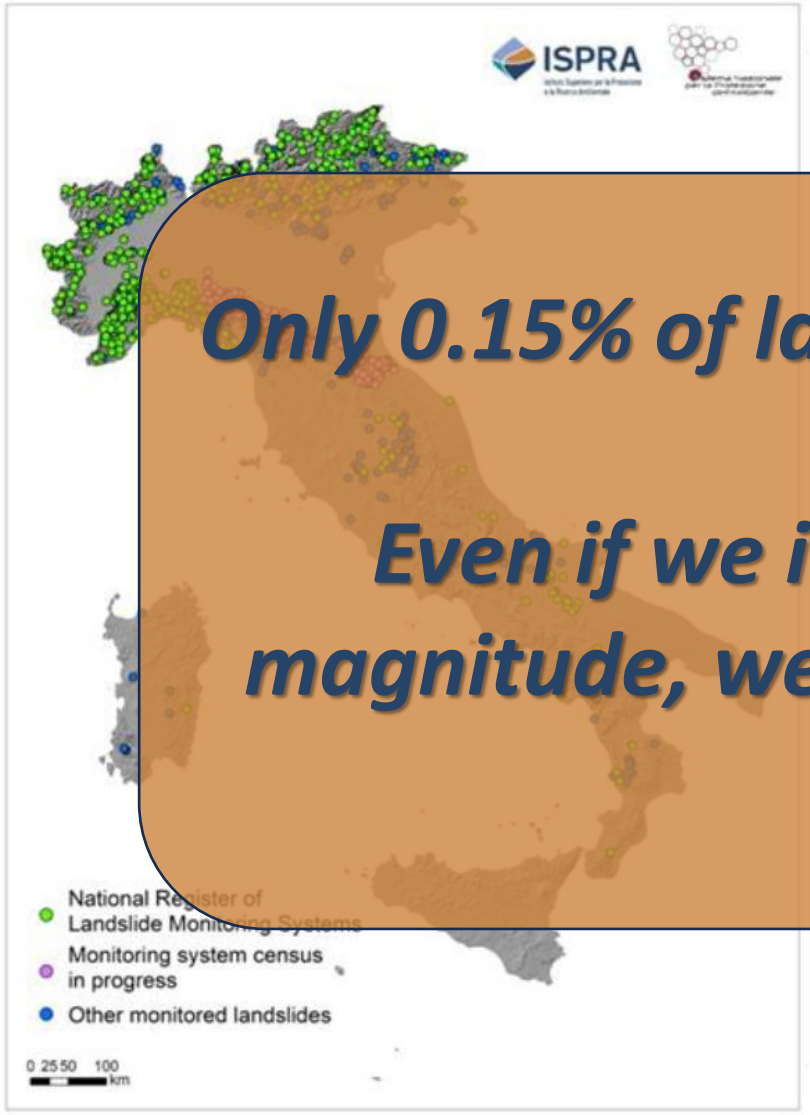
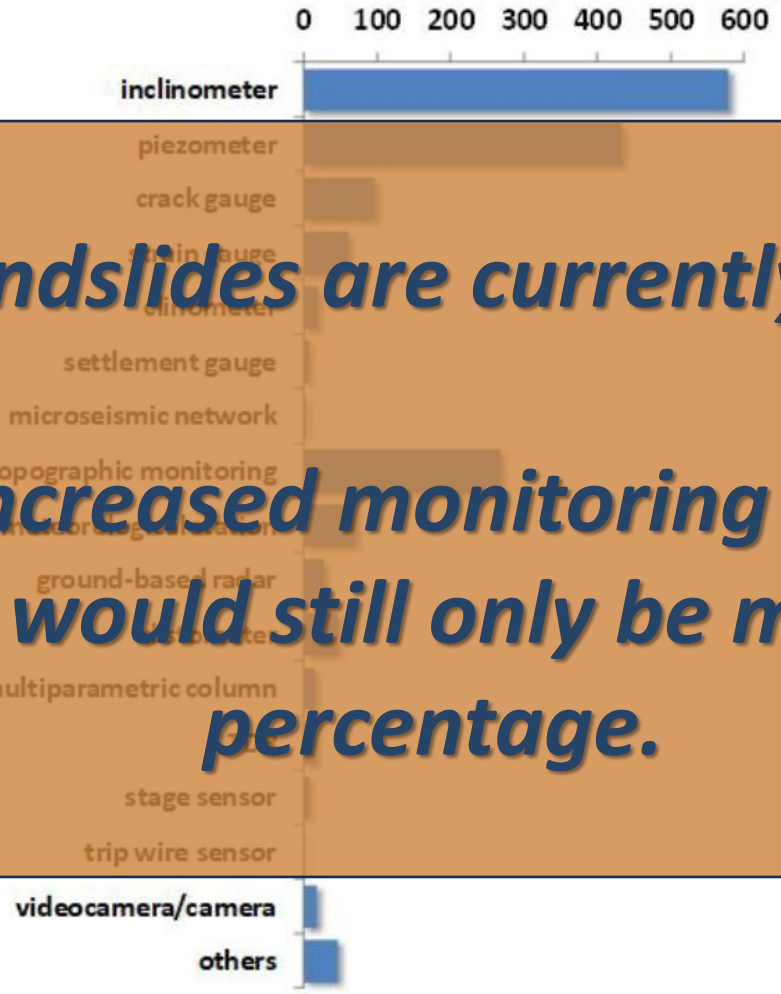


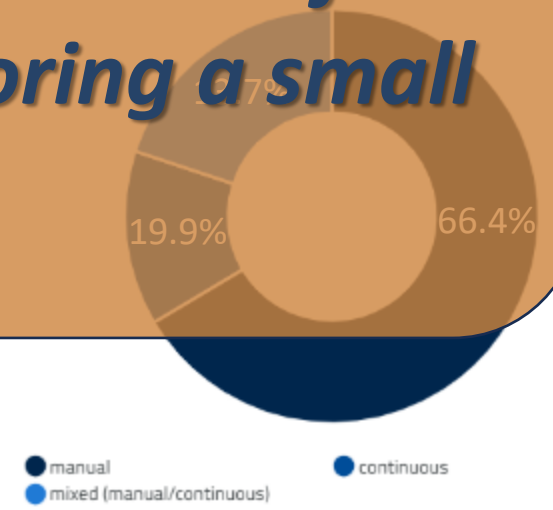


1,040 monitoring systems currently registered.

Most of the systems (79%) have a **knowledge purpose** while other systems [illegible] used as **Early Warning Systems** (EWS).

Only 0.15% of landslides are currently being monitored.

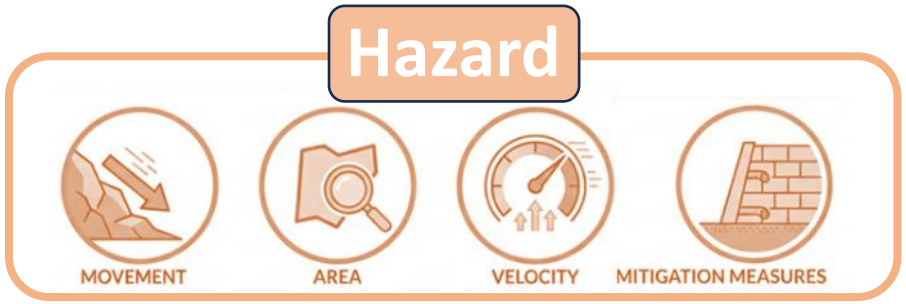
Even if we increased monitoring by an order of magnitude, we would still only be monitoring a small percentage.



National-scale methodology for prioritizing landslide monitoring sites

In the framework of the **RESILIENT** research Project "***Risk Evaluation and Smart Implementation of Landslide monItoring by citizen Engagement and New Technologies***".

National-scale methodology for prioritizing landslide monitoring sites



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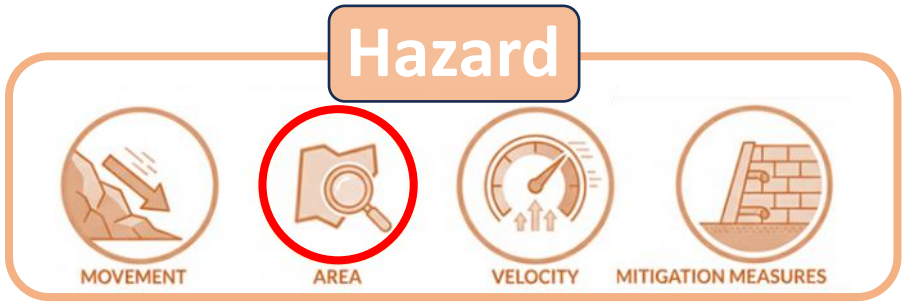
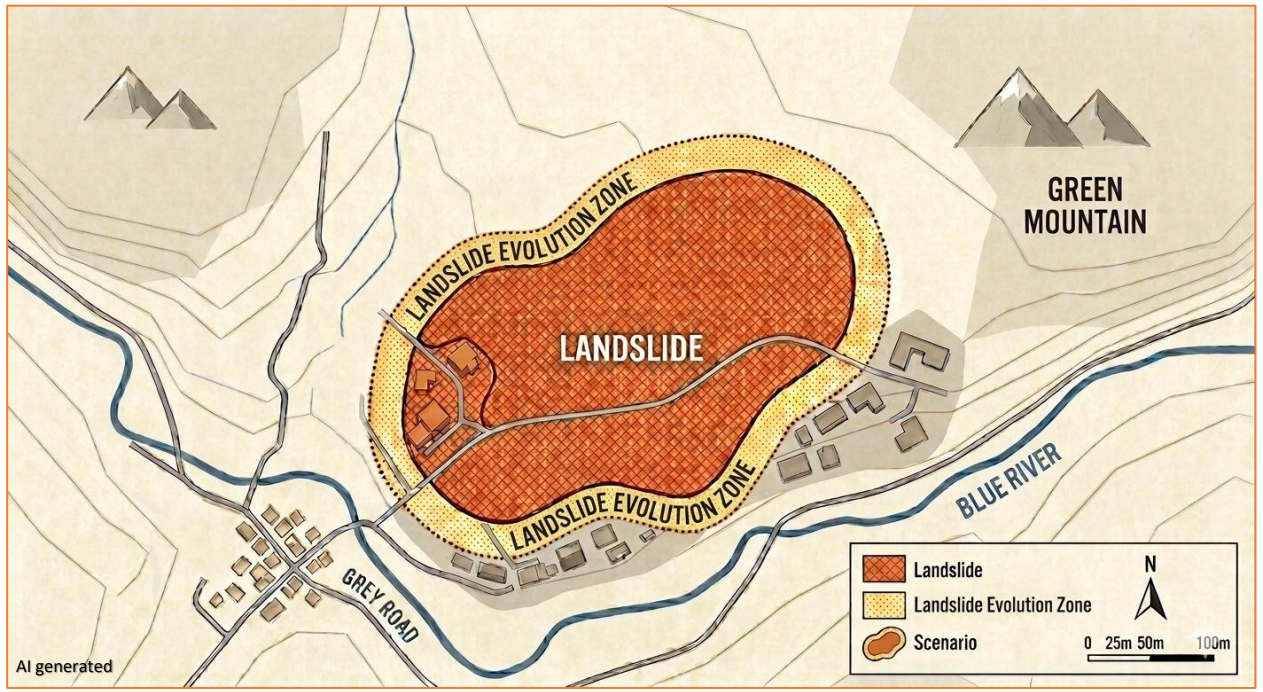


Definition of *Landslide, landslide evolution zone & Scenario*



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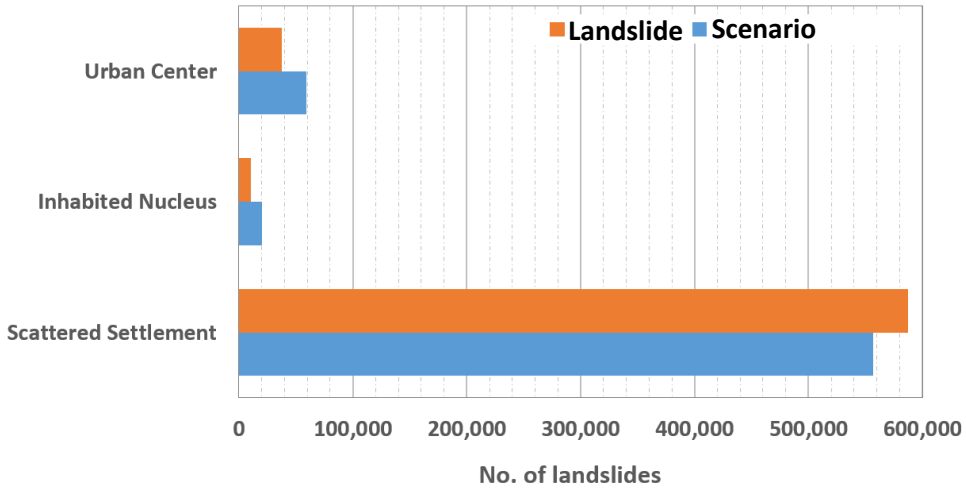
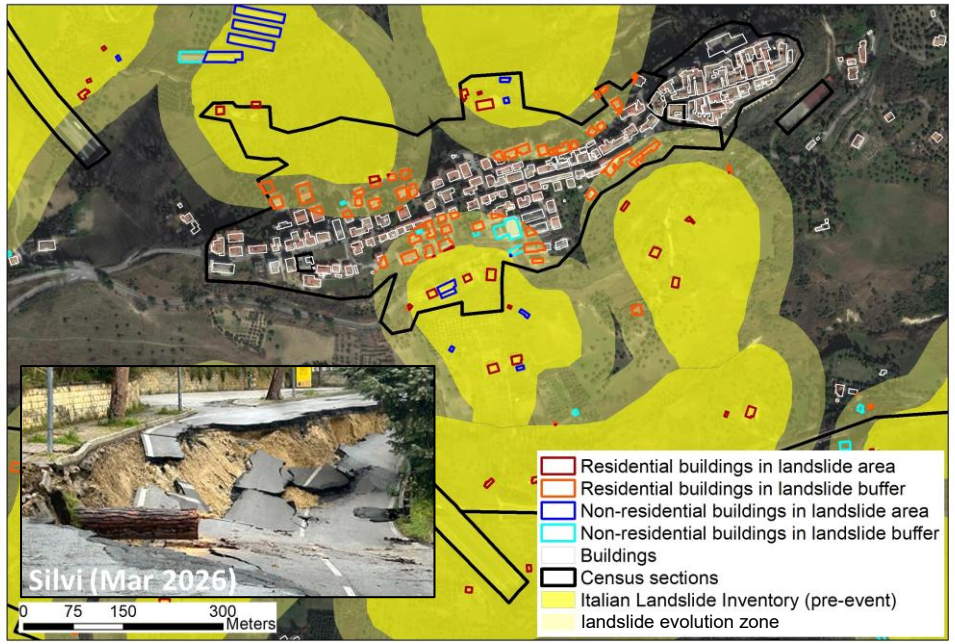
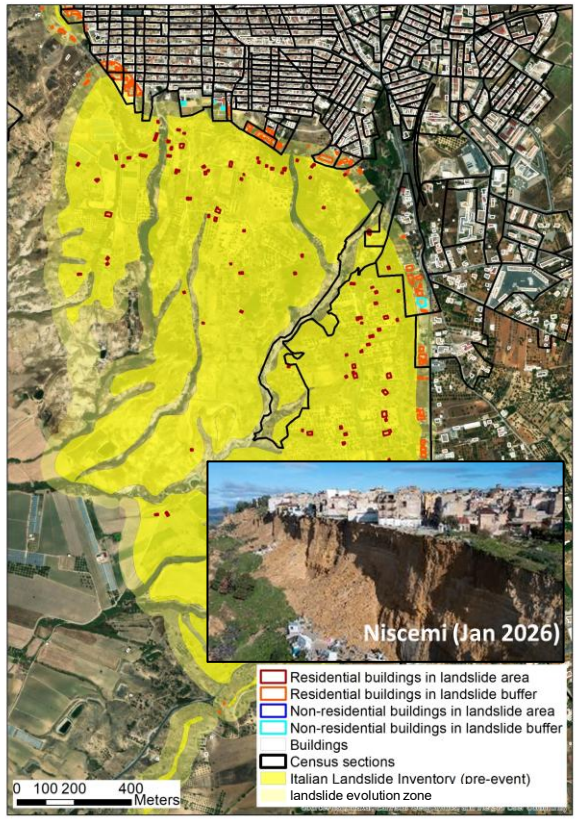
Definition of building types (e.g. residential) located in different types of sites (e.g. urban center)







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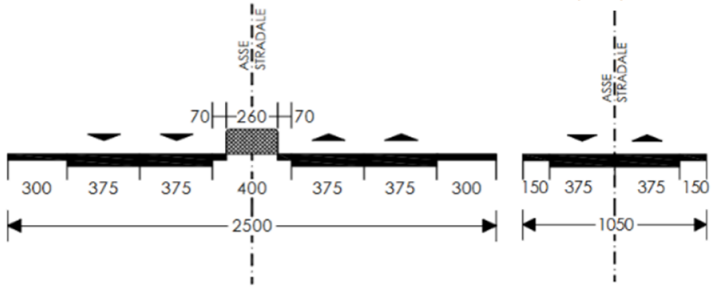
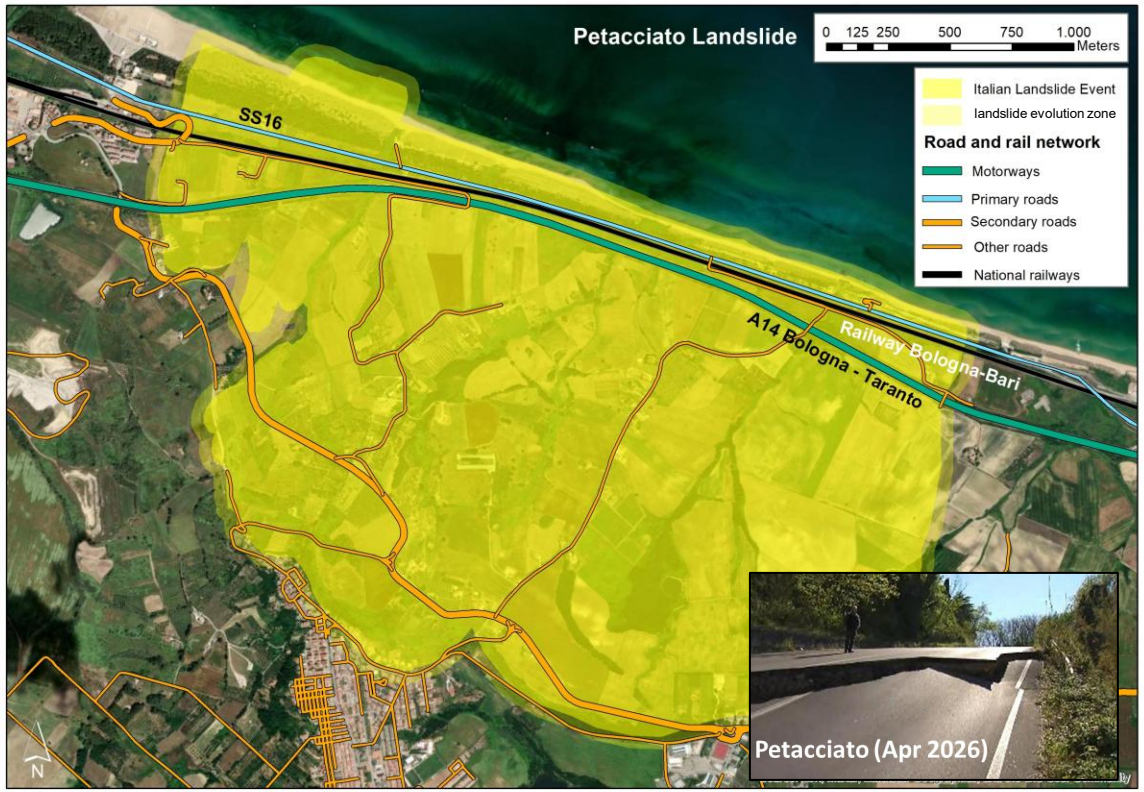
Buffer source: Ministerial Decree n. 6792 of 05/11/2001





Weighted sum of for each *Landslide and landslide evolution zone*

$$Landslide, landslide\ evolution\ zone = \sum_{i=1}^{n} w_i x_i$$

Landslide, landslide evolution zone =
(motorways × 8) + (primary roads × 6) + (secondary roads × 4) + (other roads × 2) + (national railways × 8) + (other railways × 4)

$$Scenario = (Landslide \times 1.00) + (landslide\ evolution\ zone \times 0.75)$$

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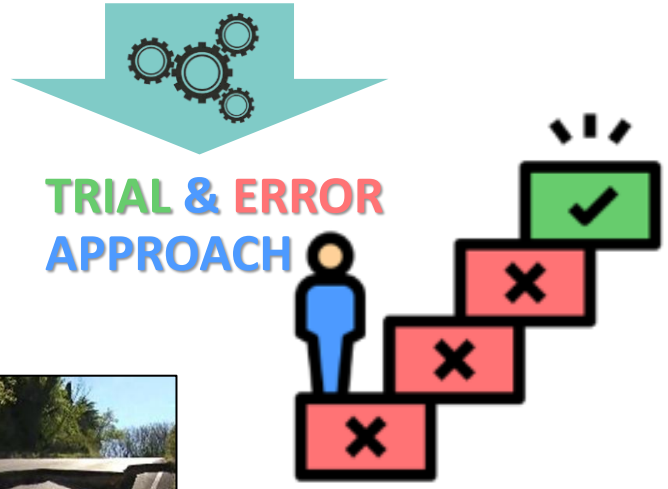
Multiple-Criteria Decision Analysis (MCDA)



Validation using occurred landslides (too many!)

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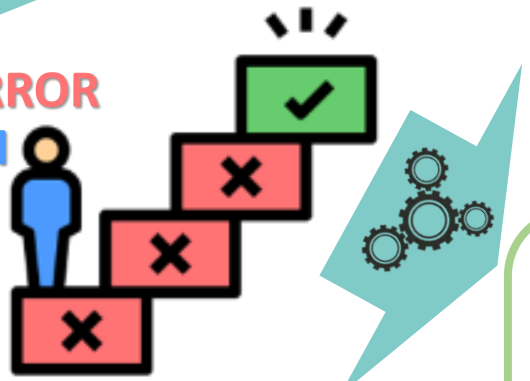
Hazard

Potential impact

Multiple-Criteria Decision Analysis (MCDA)

TRIAL & ERROR APPROACH



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Ranking and siting

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Data	Parameter	Reference	Source
IFFI - Italian Landslide Inventory	Hazard - Movement - Area - Velocity	ISPRA - Italian Institute for Environmental Protection and Research (2026)	https://www.progettoiffi.isprambiente.it/?lang=en
European Ground Motion Service Sentinel-1 InSAR data	Hazard - Velocity	EEA - European Environment Agency (2024)	https://land.copernicus.eu/en/products/european-ground-motion-service
ReNDiS - National Repertory of mitigation measures	Hazard - Mitigation measures	ISPRA - Italian Institute for Environmental Protection and Research (2026)	https://www.rendis.isprambiente.it/rendisweb/
Permanent census of population and housing	Potential impact - Buildings & urban areas - Population	ISTAT - Italian National Institute of Statistics (2021)	https://www.istat.it/en/statistical-themes/censuses/permanent-census-of-population-and-housing/
National Synthesis DataBase (geographic DB)	Potential impact - Buildings & urban areas - Population	IGMI - Italian Army's geographic supporting office (2025)	https://www.igmi.org/en/dbsn-database-di-sintesi-nazionale
Local units of the Statistical register of active enterprises ASIA	Potential impact - Business	ISTAT - Italian National Institute of Statistics (2022)	https://www.istat.it/scheda-qualita/registro-statistico-delle-unita-locali-asia-ul/
OMI - Italian Real Estate Market Observatory	Potential impact - Buildings & urban areas	The Revenue Agency (2026)	https://www.agenziaentrate.gov.it/portale/web/english/real-estate-market-observatory
Road and railway network	Potential impact - Road & railway network	OSM - OpenStreetMap (2026)	https://www.openstreetmap.org/
Cultural heritage VIR database	Potential impact - Cultural heritage	ICR - Central Institute for Restoration (2026)	https://vincoliinrete.beniculturali.it/

Conclusion

This approach is not merely an academic exercise but has practical and public policy implications; therefore, it must be shared with institutional stakeholders.

- To develop a nationwide methodology, it was necessary to consider only data that was **consistent and complete across the entire national territory**. This inevitably led to the underestimation/overestimation of certain elements (variables).
- Priority rankings must be established at least on a **regional basis** to account for the relevant geo-environmental context.
- The **monitoring systems** currently surveyed are **limited** and likely insufficient to **validate** our approach.
- As a decision-support tool, the final selection of landslides warranting a monitoring system should also integrate **expert judgment** and **social considerations**.

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