Co-funded by the European Union

SAFE-LAND

Mitigating the risk of flooding and landslides via artificial intelligence with a view to extreme climate events

PROJECT RESULTS SNAPSHOT

SAFE-LAND

Mitigating the risk of flooding and landslides via artificial intelligence with a view to extreme climate events

Contracting Authority:
European Commission
(UCPM-2023-KAPP - under grant agreement No. 101140345)

Coordinator:
eCampus University (Italy)

Partners:

University of Pisa – Italy
Regional Department of Civil Protection of Medjimurje County – Croatia
Rescue And Protection Directorate of Ministry of Interior of Montenegro

Project Context & Objectives

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Mitigating the risk of flooding and landslides via artificial intelligence with a view to extreme climate events

The Climate Challenge

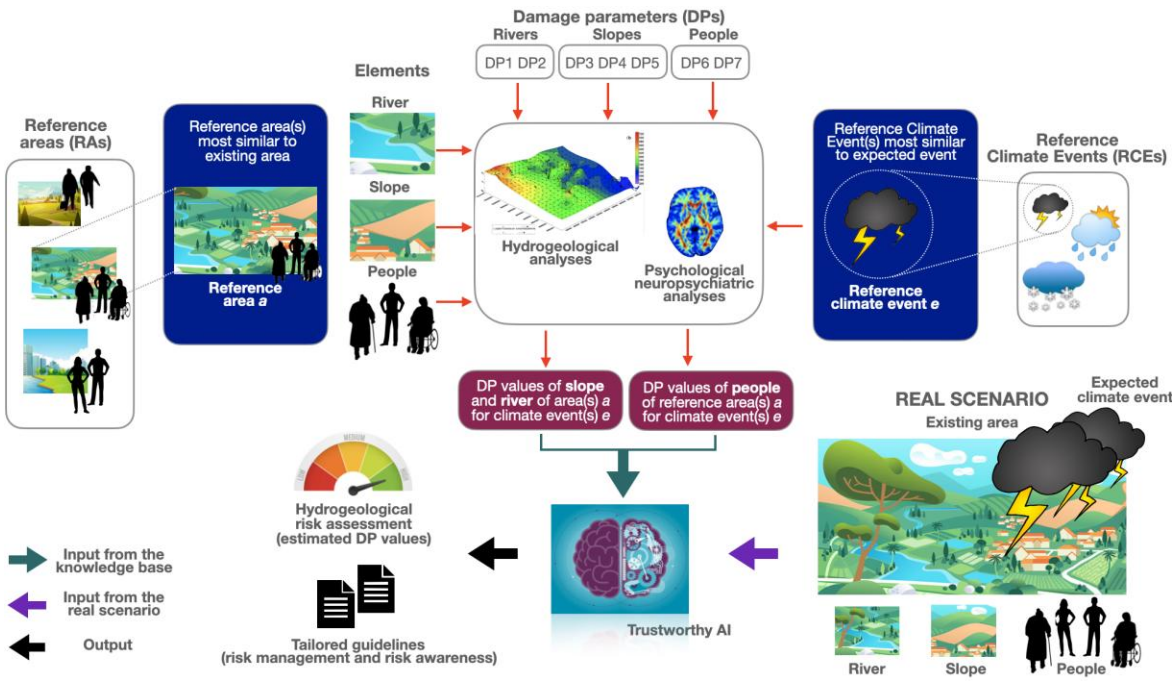
Extreme climate events are triggering an unprecedented frequency of concurrent hydrogeological hazards. These events can cause serious damage to people, buildings, and the environment. SAFELAND was created to help evaluate these risks and support authorities in protecting communities.

Application to pilot areas

Six different case studies were selected in Italy, Croatia, and Montenegro to evaluate the landslide and flooding risks. The pilot activities helped verify that the system works effectively in different environmental and social contexts.

The SAFE-LAND Core Innovation

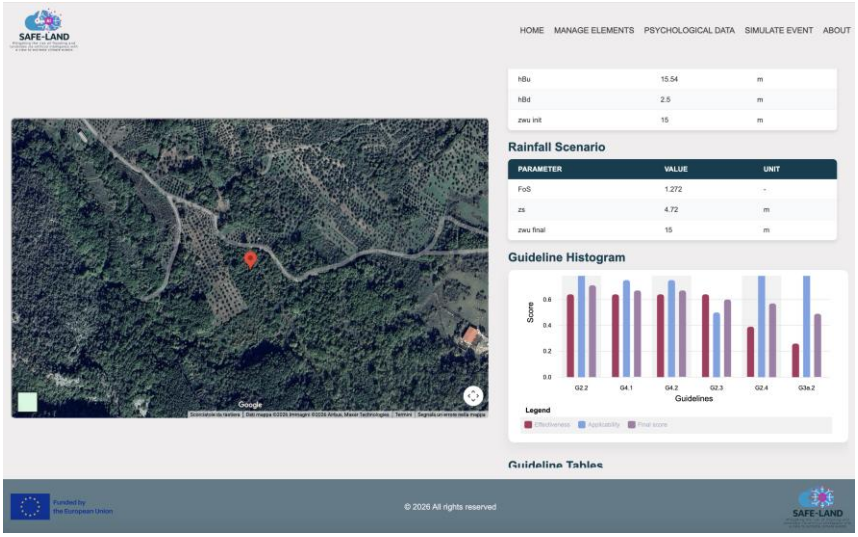
The project evaluated the landslide and flood risks for reference slopes and rivers, and analysed how people understand and react to these risks. Scientific data on slopes, rivers, climate events, and information on people's awareness were used to train an AI-based tool. This allows the system to compare real situations with known reference cases and provide useful insights for the assessment of hydrogeological risk, support the identification of risk mitigation measures, and contribute to increasing risk awareness.



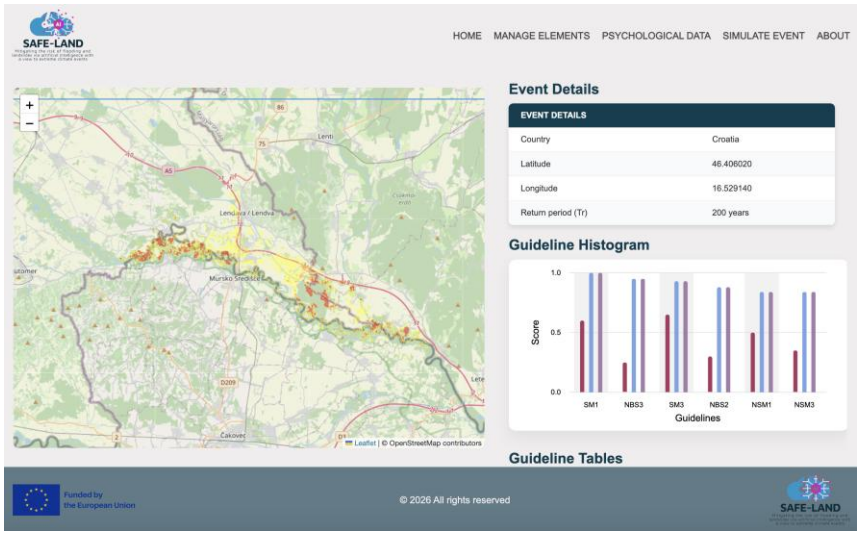
Results

SAFELAND successfully delivered an innovative decision-support tool that integrates Trustworthy Artificial Intelligence (TAI) with hydrogeological and psychological data.
The **key results** of the project include:
- The development of a knowledge-based system combining AI techniques with physically based models for the assessment of landslide and flood risks
- The capability to jointly evaluate hydrogeological risk and population risk awareness
- The generation of guidelines for risk mitigation measures and awareness-raising strategies
- The validation of the system through six pilot case studies across different countries

For a given real element (e.g. slope, river, people), the web application enables users to estimate landslide and flood risk levels, identify the most appropriate risk mitigation measures, evaluate risk awareness and suggest awareness-enhancement strategies.

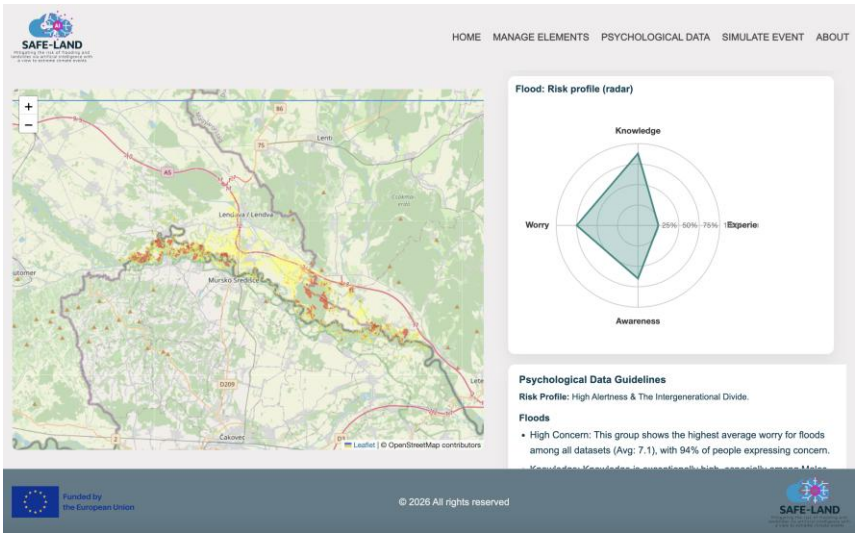


Web application: Example of graphical visualizations of the results for a real slope.
The upper panel shows the input parameters describing the slope geometry and mechanical properties, associated with the characterizing rainfall scenario. For each candidate stabilization measure identified by its code on the horizontal axis, the Guideline Histogram section shows three scores: Effectiveness (i.e., the estimated capacity of the measure to reduce the landslide risk), Applicability (i.e., the feasibility of implementing the measure given the site-specific conditions), and Final Score (i.e., the combined ranking used to prioritize the intervention). The Guideline Tables section below the histogram provide a textual description of each recommended measure, including technical characteristics and implementation notes.



Web application: Example of graphical visualizations of the results for a real river.
The map shows the river network of the study area. Each point represents a river cross-section or reach element; colors indicate the estimated flood risk level, ranging from red (high flood risk, corresponding to high water depth under the design rainfall scenario) through orange (medium flood risk) to yellow (low flood risk). The Event Details panel contains the geographic coordinates of the area and the return period of the rainfall event used for the simulation. For each candidate flood risk mitigation measure identified by a code on the horizontal axis (where SM = Structural Measures and NBS = Nature-Based Solutions), the Guideline Histogram shows three scores: Effectiveness, Applicability, and Final Score.

Web application: Continuation of the screen shown in the previous Figure (scroll down). The map on the left is the same river basin view shown in Figure 3. The right panel shows the risk awareness assessment for the exposed population of the study area. The radar chart shows the awareness profile along four psychological dimensions: Knowledge, Experience, Awareness, and Worry. The shaded area represents the average score of the surveyed population group. The Psychological Data Guidelines panel provides a textual interpretation of the awareness profile and recommends communication and preparedness strategies, focusing on the dimensions where the population shows the greatest gaps.



Dissemination

Official flyer of the KoM (Rome, Apr. 9, 2024)

Public Launch

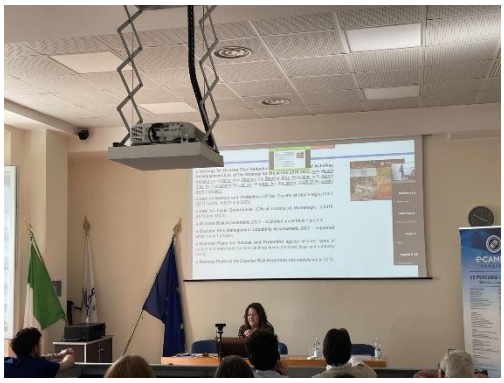
Public Kick-off Meeting (Rome, IT)

Organized by lead partner eCampus on April 9, 2024, to introduce foundational tools to public authorities. The workshop successfully registered 65 participants both in-person and online.

Francesco Pistolesi – UNIPI (on the left)

Elisabetta Cattoni, Project coordinator - eCampus

Ida Kovac and Maria Stankovic - MED

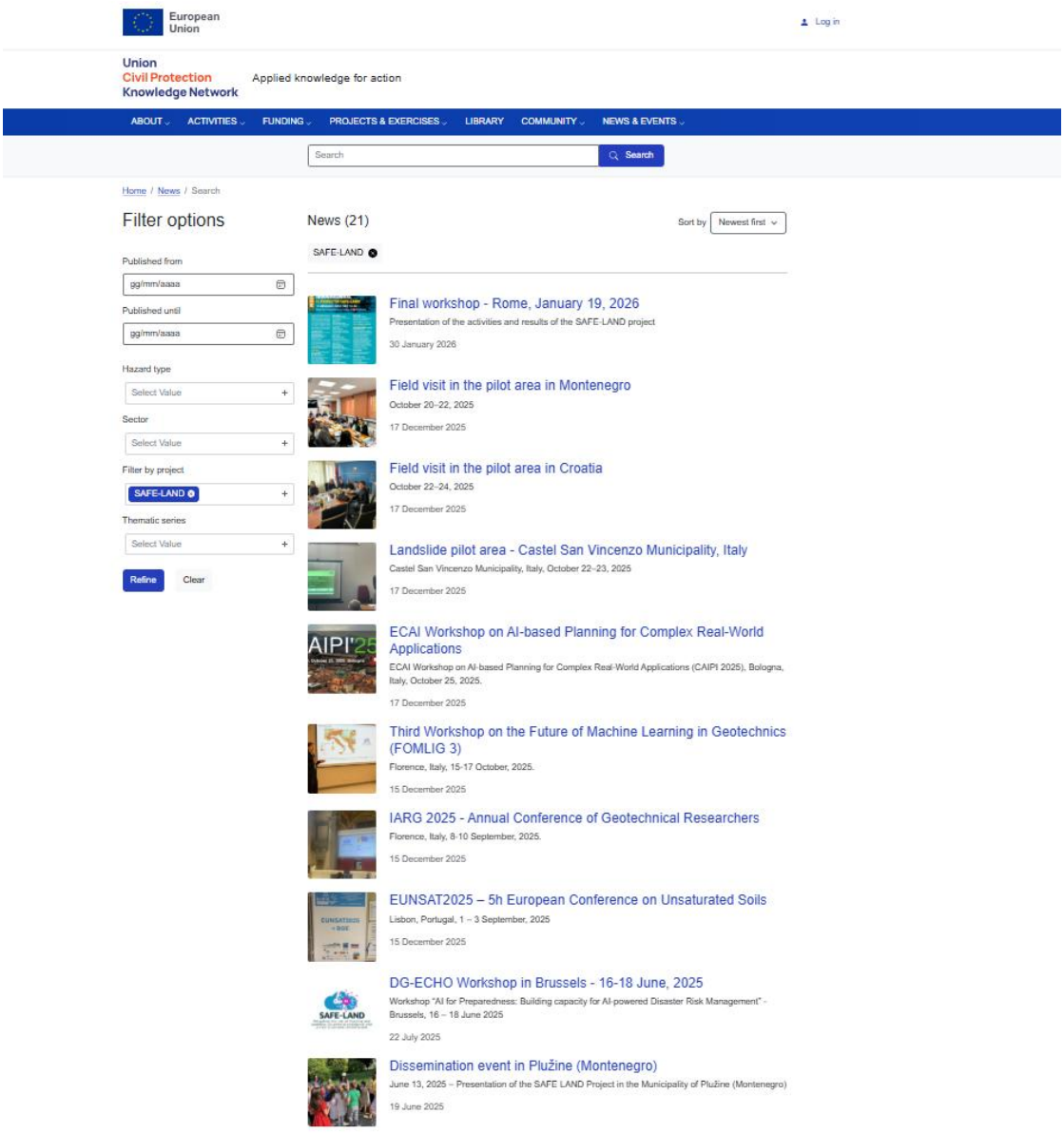


KoM: Zorica Markovic – MUP

Project web page within the UCPKN network

Platform Webpage

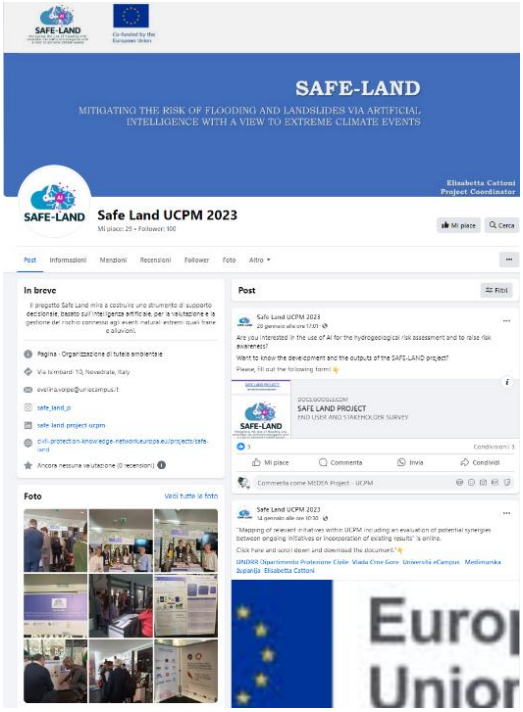
The dedicated webpage hosted inside the UCP Knowledge Network was continuously updated for disseminating the project objectives, activities and results (SAFE-LAND | UCP Knowledge Network).



Social media

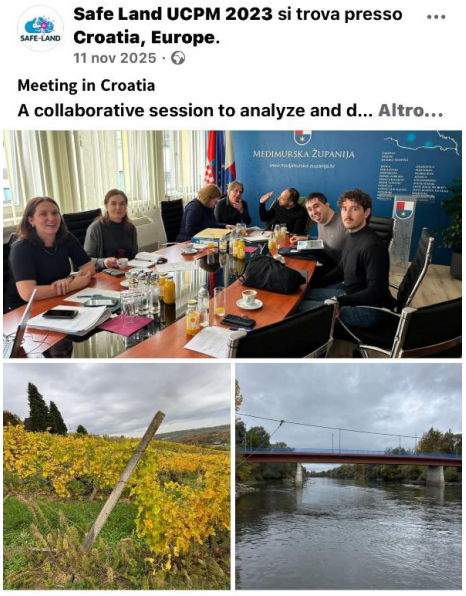
Digital Public Engagement Channels

To target general public Social network pages of SAFE-LAND project on Instagram, Facebook, and LinkedIn were created at the beginning of the project and continuously updated with information on the events, posters, programs and pictures of workshops.



https://www.facebook.com/safeland2023

https://www.instagram.com/safe_land_p/

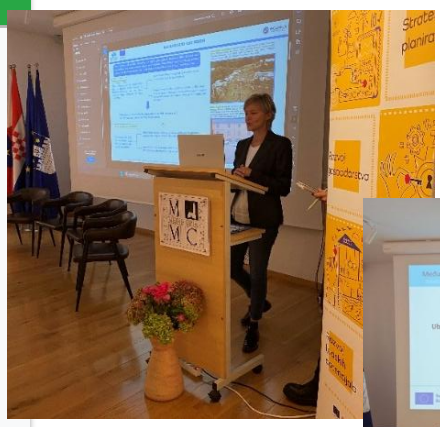


Safe Land Project UCPM | LinkedIn

Workshops and conferences

Čakovec (HR) - Oct. 3, 2024

The international conference Crisis Management and Strengthening the Civil Protection System was organized by Regional Department of Civil Protection of Medjimurje County in cooperation with the Directorate of Civil Protection of the Republic of Croatia.



Elisabetta Cattoni

Ida Kovač

Budva, Montenegro, 6 - 8 November 2024

The SAFE-LAND project at the Marketplace Exhibition at the "Europe and Central Asia Regional Platform for Disaster Risk Reduction" in Budva, Montenegro, from 6 to 8 November 2024 (2024 Europe and Central Asia Regional Platform for Disaster Risk Reduction).

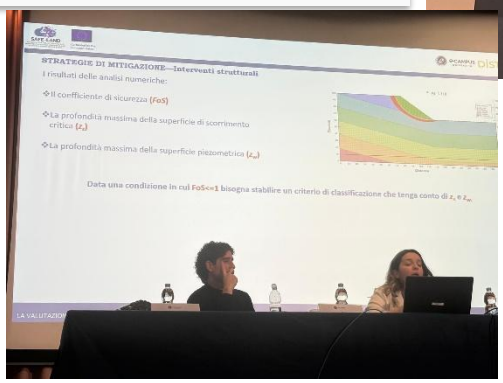
eCampus: Elisabetta Cattoni and Francesco Focacci
MUP: Zorica Markovic, Nada Srdanovic, and Methija Kuburovic

Rome – 19 January, 2026

The final national workshop was organized by eCampus and took place in Rome (IT), at the headquarter of the eCampus University, on Jan. 19, 2026. The event brought together academic experts and professional stakeholders to discuss extreme rainfall phenomena, landslide and flood risk, and the role of Artificial Intelligence in rapid risk assessment. This workshop was successfully, with 1141 participants (in presence/online)The presentation of the speakers can be downloaded at the following Link: National Workshop - Rome - 19 January 2026.

Elisabetta Cattoni (eCampus)

Francesco Pistolesi (UNIPI)

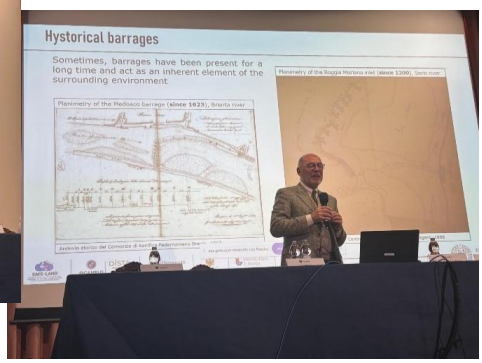


Ignacio Giomi and Evelina Volpe (eCampus)

Invited speakers

Prof. Tania Moretta (eCampus University)

Prof. Francesca Casini (University of Tor Vergata - IT)



Prof. Paolo Salandin (University of Padova- IT)

Campaigns organized by the Rescue And Protection Directorate of Ministry of Interior of Montenegro (MUP)

Five different campaigns were organized by MUP team to present the SAFE-LAND project to the students, teaching staff and school management, citizens, local media

Campaign in Nikšić - 15 and 16 May 2025

Campaign in Šavnik - 20 May 2025

Campaign in Berane – 4 June 2025

Campaign in Herceg Novi - 20 May 2025

Campaign in Plužine – 13 June, 2025

Practical excercise organized by the Regional Department of Civil Protection of Medjimurje County – Croatia (MED)

Tactical Demonstration Exercise "Water Against Water" + workshop (2 civil protection EU projects, SAFE LAND and ODZIV) – 13 November 2025 in Štrigova and Sveti Martin na Muri (Medjimurje County) - This joint exercise was organized by the Regional Department of Civil Protection of Medjimurje County and tested the operational readiness of civil protection systems in flood scenarios and demonstrated solutions developed within the SAFE-LAND project. The accompanying workshop facilitated knowledge exchange between project partners and practitioners, contributing to improved preparedness and response capacities.

13 November 2025 – Štrigova, Medjimurje County, Croatia.

Safety and Prevention Fair 2025 – Čakovec, 19 September 2025

The event was organized by the Regional Department of Civil Protection of Medjimurje County – Croatia to promote the SAFE-LAND project to the general public and professionals, with a focus on increasing awareness of natural hazards and prevention measures.

Čakovec, 19 September 2025 – Informative booth

Workshop and roundtable with the stakeholders - Castel San Vincenzo, 23 October, 2025.

National workshop and roundtable with the stakeholders organized by eCampus. Presentation of the methodology and results to stakeholders and discussion about the case studies in Italy.

Castel San Vincenzo, 23 October 2025

Roundtable with the stakeholders - Podgorica (Montenegro). 22 October, 2025.

Roundtable on application to pilot areas. eCampus team participated in person at the roundtable along with representatives of the Ministry of Interior of Montenegro, Ministry of Agriculture, Forestry and Water Management, Geological Institute, and Nikšić Municipality

Podgorica (Montenegro). Oct.22, 2025

OPEN Scientific papers and workshop contributions

ECAI Workshop on AI-based Planning for Complex Real-World Applications, October 25, 2025, Bologna, IT)

Baldassini M., Pistolesi F., Giomi I., Volpe E., Cattoni E., 2025. *AI-based simulation surrogates for planning rainfall-induced landslide mitigation*. ECAI Workshop on AI-based Planning for Complex Real-World Applications, October 25, 2025, Bologna, IT

IARG 2025 Geotechnical Conference, Florence, Italy, September 10-12, 2025

Volpe E., Giomi I., Peiro Y., Baldassini M., Pistolesi F., Cattoni E. (2025). *Modelli fisicamente basati e intelligenza artificiale per la valutazione speditiva delle condizioni di stabilità dei versanti*. Incontro Annuale dei Ricercatori di Geotecnica 2025 - IARG 2025 - Firenze, 10-12 September 2025.

Third Workshop on the Future of Machine Learning in Geotechnics, Florence, Italy, October 15-17, 2025

Giomi I., Volpe E., Peiro Y., Baldassini M., Pistolesi F., Cattoni E., 2025. *A Dataset For Landslide Prediction Through Artificial Intelligence With Potential Applications*. Third Workshop on the Future of Machine Learning in Geotechnics Florence, Italy October 15-17, 2025.

Peiro Y., Ciabatta L., Giomi I., Volpe E., Cattoni E., 2025. *Integrating slope units with remote-sensed hydrological data for Landslide susceptibility mapping using machine learning*. Third Workshop on the Future of Machine Learning in Geotechnics Florence, Italy October 15-17, 2025.

A high-tier journal paper is currently under submission to *Computers and Geotechnics*

Giomi I., Baldassini M., Pistolesi F., Cattoni E. *Explainable artificial intelligence for slope stability assessment.*

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Informative material

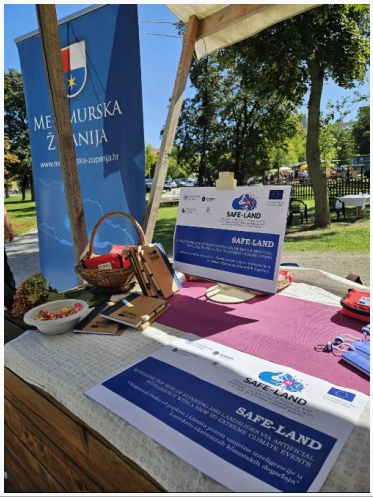
Budva: Nov, 6-8, 2024. Poster at the Marketplace Exhibition

Budva: Nov, 6-8, 2024. Flyers at the Marketplace Exhibition

Budva: Nov, 6-8, 2024. Visibility material at the Marketplace Exhibition

Castel San Vincenzo Municipality (Italy). Oct.23, 2025. Visibility material

Čakovec, 19 September 2025. Informative booth



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Contact & Links

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email: elisabetta.cattoni@uniecampus.it

Resources:

SAFE-LAND web application: https://safeland.unipi.it

SAFE-LAND on UCPKN: SAFE-LAND | UCP Knowledge Network

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Instagram: @safe_land_p