List of 2025 IPL New Projects

No.	Country	Project Leader	IPL Project Proposal
1	Italy	Maria Teresa Brunetti	AI-Powered Extraction of Rainfall-Induced Landslide Information (AI-PERIL)
2	Italy	Antonella Peresan	Harmonized cross-border mass-movement susceptibility mapping for earthquake induced rockfall modeling at the Italy-Slovenia border
3	Italy	Daniele Spizzichino	The extraordinary monitoring plan for Italian cultural heritage: landslides and risk management in a context of climate change

No. 1

Date of Submission	15 July 2025

IPL Project Proposal Form 2025

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title: (2 lines maximum): **AI-Powered Extraction of Rainfall-Induced Landslide Information (AI-PERIL)**

   Select one of two below.

   (1) New project

2. Main Project Fields

   Select the suitable topics. If no suitable one, you may add new field.

   (1) Technology Development

   A. Monitoring and Early Warning

   (3) Capacity Building

   B. Collating and Disseminating Information/ Knowledge

   (4) Mitigation, Preparedness and Recovery

   B. Mitigation

3. Name of Project leader: **Maria Teresa Brunetti**

   Affiliation: **CNR IRPI – Senior Researcher**

   Contact: (postal address, fax, phone, email): **Via Madonna Alta, 126, 06128 Perugia, phone number: +39 075 5014410, email: mariateresa.brunetti@cnr.it**

   Core members of the Project

   Names/Affiliations: **Stefano Luigi Gariano (CNR IRPI – Senior Researcher)**, **Massimo Melillo (CNR IRPI –Researcher)**, **Elisabetta Napolitano (CNR IRPI – Associated Researcher)**, **Silvia Peruccacci (CNR IRPI – Senior Researcher)**

4. Objectives: (5 lines maximum; what you expect to accomplish?):

The objective of the project is to develop AI-based procedures to automatically extract accurate information on the occurrence of rainfall-induced landslides from textual sources available on the internet, including web pages and PDF documents. The information includes the location of the landslide and the date/time of its occurrence, as well as the spatial and temporal accuracy of the extracted information.

5. Background Justification: (10 lines maximum)

A reliable landslide forecast requires the collection of information on historical landslides in a structured catalogue. Using landslide catalogues that contain inaccurate spatial and temporal information leads to unreliable and uncertain operational landslide forecasting. Therefore, the availability of accurate and detailed catalogues is essential to reduce the uncertainties, which are to some extent unavoidable. To this end, for the last 15 years, many researchers from CNR IRPI have been actively involved in the compilation of ITALICA (the ITAlian rainfall-induced LandslIdes CAtalogue), which currently contains 6312 records with information on rainfall-induced landslides that have occurred on the Italian territory between

January 1996 and December 2021 (Peruccacci et al., 2023; Brunetti et al., 2025). Extracting data on the occurrence of rainfall-induced landslides manually from the main information sources (online newspapers, technical reports, blogs and social media) is extremely time-consuming and requires considerable human and financial resources. The use of AI could solve this critical issue.

6. Study Area: **World**

7. Project Duration: **Two years**

8. Resources necessary for the Project and their mobilization
   Personnel, Facilities, and Budgets

Researchers from CNR IRPI (permanent staff and research associates);
Computers and servers to manage and store data at CNR IRPI;
Budget: A financial contribution may be needed to buy subscriptions to AI tools, to optimize and speed up information extraction operations. Additional expenses are foreseen for the publication of the results.

9. Project Description: (30 lines maximum)

Rainfall-induced landslides pose a serious geo-hydrological hazard, causing extensive damage to infrastructure and loss of life. Understanding the rainfall conditions that cause their occurrence is critical to their prediction. For large and diverse territories, the prediction of landslides is based on the definition of rainfall thresholds, which require the reconstruction of the rainfall conditions that caused the landslides. Therefore, the collection of accurate information on the spatial and temporal occurrence of past landslides is necessary so that the reconstruction of the rainfall that triggered them can be objective and reliable. The search for and selection of news from information sources is a long, complex, and repetitive procedure. CNR IRPI has invested more than a decade in information gathering and built ITALICA, the ITAlian rainfall-induced LandslIdes CAtalogue (Peruccacci et al., 2023; Brunetti et al., 2025).
Traditionally, researching and collecting accurate spatial and temporal information on rainfall-induced landslides has been time-consuming. This involves searching for news reports in newspapers and online blogs, as well as technical and scientific articles. In addition, this activity must be preferably performed by an experienced operator, since it can be prone to human errors and limited by individual processing capacity. Artificial intelligence (AI) can be a valuable support at the stage of collecting and selecting data for analysis. In fact, AI, properly trained by an experienced operator, can process and interpret large volumes of information in significantly shorter times than those required by a human operator. This, therefore, allows a greater amount of data to be collected in reasonable time, thereby reducing the uncertainty of the parameters that define rainfall thresholds.
The project aims to implement AI-based procedures for accurate reconstruction of the location and time of occurrence of landslides from online sources.
The AI-based procedures will be obtained using an iterative refinement method and natural language process (NLP) to interact with the large language model (LLM). This will enable the design of prompts that can generate structured and standardized datasets containing accurate, objective, reliable, and reproducible spatiotemporal information on rainfall-induced landslide occurrences in several areas of the world.

Language issues will also be considered. The outputs provided by AI will be validated with those of the experienced operator to optimize the prompt for information retrieval. The results, i.e. the creation of new landslide catalogues in various regions of the world and the updating of Italian rainfall-induced landslide catalogues, will be published in open-access repositories. This will allow the catalogues to be used to define, validate, and improve methods and tools for predicting landslides in space and time.

10. Work Plan/Expected Results: (30 lines maximum; work phases, milestones and publication) including the contribution plan of articles on the IPL project (progress/result) to the Open Access Book Series P-LRT in the coming few years.

The main phases of the project workflow are listed below:

1) retrieving and collecting landslide news from the internet;

2) designing, implementing and applying prompts (i.e., textual inputs provided to the AI tool) for the automatic extraction of spatiotemporal information from the collected sources;

3) verifying and validating the extracted information through manual cross-checking and

4) compiling or updating the landslide catalogues.

The workflow is scalable and adaptable: it can be applied in Italy, using textual inputs and parameters in Italian, as well as in other countries, by adapting the textual inputs to English or other local languages in which the AI has a high degree of linguistic expertise and skills.

Milestones:

M1) Collecting a sample of news articles about rainfall-induced landslides in pre-defined areas.

M2) Extracting accurate spatial and temporal information from news using the designed prompt.

The main outcomes of the project, as well as the main methodological innovations, will be summarized in an article to be submitted to the Open Access Book Series P-LRT in the coming few years.

11. Deliverables/Time Frame: **One report at the end of each year**

12. Project Beneficiaries: (5 lines maximum; who directly benefits from the work?): **The beneficiaries of the project are research institutions involved in forecasting rainfall-induced landslides and ultimately civil protection authorities.**

13. References (Optional): (6 lines maximum; i.e. relevant publications)

- Brunetti, M.T., Gariano, S.L., Melillo, M., Rossi, M., Perucacci S. (2025) An enhanced rainfall-induced landslide catalogue in Italy. Scientific Data 12, 216, https://doi.org/10.1038/s41597-025-04551-6

- Peruccacci, S., Gariano, S. L., Melillo, M., Solimano, M., Guzzetti, F., Brunetti, M. T. (2023) The ITAlian rainfall-induced LandslIdes CAtalogue, an extensive and accurate spatio-temporal catalogue of rainfall-induced landslides in Italy, Earth System Sciences Data, 15, 2863–2877, https://doi.org/10.5194/essd-15-2863-2023

Note: Please fill and submit this form by 15 August 2025 to:

KLC secretariat <klc2020@landslides.org> and ICL Network <icl-network@landslides.org>

No. 2

Date of Submission	

IPL Project Proposal Form 2025

(MAXIMUM: 3 PAGES IN LENGTH)

1. **Project Title: "Harmonized cross-border mass-movement susceptibility mapping for earthquake induced rockfall modeling at the Italy-Slovenia border"**
2. Select one of two below.
   (1) New project X
   (2) Second stage of ongoing project
3. **Main Project Fields**

   Select the suitable topics. If no suitable one, you may add new field.

   (1) Technology Development

   A. Monitoring and Early Warning, B. Hazard Mapping X, Vulnerability and Risk Assessment

   (2) Targeted Landslides: Mechanisms and Impacts

   A. Catastrophic Landslides, B. Landslides Threatening Heritage Sites

   (3) Capacity Building

   A. Enhancing Human and Institutional Capacities

   B. Collating and Disseminating Information/ Knowledge

   (4) Mitigation, Preparedness and Recovery

   A. Preparedness, B. Mitigation, C. Recovery
4. **Name of Project leader:** Antonella Peresan

   Affiliation: OGS, Senior Researcher (office and position)

   Contact: Via Treviso 55, 33100 Udine Italy, +39 0402140154 (postal address, fax, phone, email)

   Core members of the Project: National Institute of Oceanography and Applied Geophysics, OGS (Italy); Geological Survey of Slovenia (GeoZS)

   Names/Affiliations: (4 individuals maximum) Antonella Peresan (OGS - ICL deputy board member); Rachele Franceschini (OGS); Mateja Jemec Auflič (GeoZS) and Gisela Domej (GeoZS)
5. **Objectives**: To develop harmonized landslide/rockfall susceptibility maps across the Italy–Slovenia border using a shared methodology. The project aims to improve transnational hazard assessment in a multi-risk perspective, to support territorial and emergency planning, and to contribute to the identification of priority areas for real-time monitoring and civil protection interventions.
6. **Background Justification**: The Italy–Slovenia border region is highly susceptible to landslides and rockfalls due to its complex geology, steep topography, active tectonic setting and increasing climatic extremes. Currently, heterogeneous mapping methods and data standards between countries hinder coordinated risk management. A harmonized approach is essential to produce comparable susceptibility assessments, integrate seismic hazard factors, and support cross-border decision-making. The initiative addresses gaps in inventory quality, methodological alignment, and data interoperability, enhancing both prevention and response capacities in seismically active mountain areas.
7. **Study Area**: The border area between the Friuli Venezia Giulia Region (Italy) and Slovenia
8. **Project Duration**: 2 years

9. **Resources necessary for the Project and their mobilization**

Personnel, Facilities, and Budgets

Personnel: 7 persons (3 senior researchers; 3 researchers; 1 research fellow)

Facilities: OGS Seismic Network SMINO for earthquake monitoring and related earthquake data;

OGS GNSS network FREDNET for geodetic monitoring and landslides monitoring. GeoZS manages the online "Natural laboratories" monitoring system including 2 landslide and one rockfall monitoring stations.

Budgets: **140.000** € (Approximately 120.000 € is funded by the European Union within the CONCORDIA Interreg Italy-Slovenia project. Part of the funding for GeoZS in provided by the Slovenian Research and Innovation Agency (ARIS) via funding of program groups Regional Geology and Dynamic Earth).

10. **Project Description**:

The border region between Italy and Slovenia is characterized by high landslide and rockfall susceptibility due to complex geological and geomorphological conditions. The combination of heterogeneous soils, tectonic structures, and mountainous to hilly terrain makes the area particularly prone to frequent and sometimes severe slope instability events. Moderate to rather high seismicity occurred the study area, including the 1976 Friuli earthquake (M6.5), on the Italian side, and the 1998 Bovec (M5.6) earthquake, on the Slovenian side, which triggered numerous rockfalls. Human pressures further increase exposure, especially in high-risk mountain zones. Climate change exacerbates the situation through more intense and sudden rainfall, leading to rapid soil saturation, reduced slope stability, and accelerated erosion.

Despite the shared risks, landslide susceptibility maps and hazard assessments remain fragmented across the border, with differences in scale, methodology, and data coverage. This lack of harmonization undermines effective cross-border planning and emergency response. The project aims to address these gaps by developing unified susceptibility maps based on a harmonized methodology and by integrating geophysical parameters to enhance hazard modelling. The OGS contributes through its expertise in seismic hazard assessment and geophysical monitoring, supporting the integration of dynamic seismic parameters into landslide susceptibility models. GeoZS contributes through its expertise in mass-movement susceptibility assessment. Key activities include:

- forward modelling of earthquake ground shaking and rockfall/landslide scenarios;
- analysis of correlations between ground shaking and rockfalls triggering;
- assessment of aftershock influence on rockfall hazard as a time-dependent process.

The project also includes rockfall run-out modelling and the generation of impact maps showing the likelihood of road damage following seismic events. These tools will directly support civil protection agencies in identifying safe intervention routes and optimizing emergency response strategies.

By addressing current methodological gaps and strengthening data and operational integration, the project will contribute to reducing landslide risk and building resilience to both climatic and seismic hazards in this transborder region.

11. **Work Plan/Expected Results**:

The main objective is to create harmonized cross-border susceptibility maps for landslides and rockfalls in the Italy–Slovenia region, based on a common methodology that improves comparability and supports disaster risk management and planning.

Phase 1 (Months 1–9):

Led by OGS and partners, the project will review national mapping approaches, identify key geological and

cartographic datasets, define relevant susceptibility parameters (e.g., lithology, slope, tectonic features), and assess data gaps. This phase sets the groundwork for a harmonized mapping strategy.

Phase 2 (Months 10–15):

OGS and GeoZS will contribute to building a shared inventory of validated landslides and rockfalls by integrating regional and national databases. A minimum set of common attributes, quality criteria, and metadata standards will be established, ensuring consistency across borders.

Phase 3 (Months 16–24):

A harmonized susceptibility mapping methodology will be implemented, with a key innovation being the integration of seismic shaking parameters (Alvioli et al., 2023: Peresan et al., 2025). Historical seismic events—such as the 1976 Friuli and 1998/2004 Bovec earthquakes—will support calibration and case studies. Maps will be validated against the compiled inventory and refined accordingly. Final deliverables include a current overview report, harmonized susceptibility maps, and a methodological report.

12. **Deliverables/Time Frame**:

    D.3.1.1 (Months 9): Comparative report on national methodologies, mapping parameters, and available geological/cartographic datasets.

    D.3.1.2 (Months 15): Joint inventory of landslides and rockfalls, including agreed attribute sets, metadata standards, and data quality requirements.

    D.3.1.3 (Months 24): Final report on harmonized cross-border susceptibility mapping methodology, with integration of seismic shaking parameters and validated map outputs.

    All deliverables that may contribute to support transnational risk management and will be made available for publication and possible use by relevant stakeholders.

13. **Project Beneficiaries**:

    Project beneficiaries include local, regional, and national public authorities responsible for civil protection and land management, higher education and research institutions involved in geohazard studies, sectoral agencies monitoring natural hazards, and the general public who benefit from improved safety and risk awareness.

14. **References (Optional):**

    1) Alvioli, M., Poggi, V., Peresan, A., Scaini, C., Tamaro, A., Guzzetti, F. (2023). A scenario–based approach for immediate post–earthquake rockfall impact assessment. Landslides 21, 1–16 (2024). https://doi.org/10.1007/s10346-023-02127-2
    2) Peresan, A., Alvioli, M., Zuccolo, E., Vaccari, F., & Badreldin, H. (2025). An approach to rockfall hazard scenarios based on earthquake ground motion. Progress in Landslide Research and Technology, Volume 3 Issue 2, 2024 (pp. 107-117). Cham: Springer Nature Switzerland.
    3) Šegina E., Jemec Auflič M., Mikoš M., Bezak N. (2024). A preliminary investigation of the small rockfall triggering conditions along a road network in Slovenia. Landslides 22, 739-751. DOI: 10.1007/s10346-024-02302-z
    4) Jemec Auflič M, Bezak N, Šegina E, Frantar P., Gariano SL, Medved A., Peternel T. (2023). Climate change increases the number of landslides at the juncture of the Alpine, Pannonian and Mediterranean regions. *Scientific reports*, vol. 13, 14 p. https://doi.org/10.1038/s41598-023-50314-x.

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KLC secretariat <klc2020@landslides.org> and ICL Network <icl-network@landslides.org>

No. 3

Date of Submission	

IPL Project Proposal Form 2025

(MAXIMUM: 3 PAGES IN LENGTH)

1. Project Title:

The extraordinary monitoring plan for Italian cultural heritage: landslides and risk management in a context of climate change

Select one of the two below.

(1) New project

2. Main Project Fields

(1) Technology Development

A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment

3. Name of Project leader

Daniele Spizzichino

Affiliation: ISPRA Geological Survey of Italy

Contact: Via V. Brancati 00144 Roma, +39 06 50074087; +39 3386192214; daniele.spizzichino@isprambiente.it

Core members of the Project

Veronica Tofani UNIFI, UNESCO Chair on Prevention and Sustainable Management of Geo-hydrological hazards, University of Florence

Silvia Bianchini, UNESCO Chair on Prevention and Sustainable Management of Geo-hydrological hazards, University of Florence

Gabriele Leoni ISPRA

4. Objectives: (5 lines maximum; what you expect to accomplish?)

The project's main objective is to assess the current potential of satellite radar interferometry combined with ground monitoring systems for the evaluation of risk conditions, both natural and anthropogenic, that threaten Italy's natural and cultural heritage sites.

5. Background Justification: (10 lines maximum)

In recent years, the assessment of ground deformations (and their interaction with heritage structures) through satellite radar interferometry has become one of the most widely used remote and low-impact technique worldwide. Along with satellite imagery with increasingly higher spatial-temporal resolution, processing techniques capable of defining millimetric displacements over decades have been refined.

This technique allows for continuous and preventive monitoring of the immense natural and cultural heritage for the purpose of preventive management and maintenance policies.

The staff of the UNESCO Chair, involved in the proposal, has extensively worked in recent years in projects related to the protection and conservation of cultural heritage sites affected by natural and anthropogenic hazards, also through projects in collaboration with UNESCO headquarters.

6. Study Area: (2 lines maximum; where will the project be conducted/applied?)

The natural and cultural heritage study areas are selected across the entire national territory based on their typology, exposure to natural and anthropogenic hazards, site relevance, availability of remote and in situ monitoring data, and the extent of the deformations measured.

7. Project Duration: (1 line maximum)

To fully accomplish the proposed objective, the expected duration of the project is of 36 months

Resources necessary for the Project and their mobilization

Personnel, Facilities, and Budgets

The two - year project was initially funded by the Italian Ministry of Culture, with a budget of approximately €350,000. This specific satellite monitoring of cultural heritage from landslides involved a research team from the University of Florence and a team from the Italian Geological Survey of Ispra.

8. Project Description: (30 lines maximum)

The project involves the selection of dozens of sites throughout the country based on their type, exposure to natural and anthropogenic hazards, site significance, and availability of active or previous in-situ monitoring data. For this IPL project, we have selected only those subject to landslides and geohazards (landslide, seismic, and volcanic hazards). Specifically, we have chosen the following case studies: the Morgantina Archaeological Park and Villa Romana del Casale in Piazza Armerina (EN); the Roman Baths and the underwater park of Baia (Campi Flegrei); the historic center of Civita di Bagnoregio (VT); the Paestum and Velia Archaeological Park (SA); the historic center of Volterra (PI); the Baratti and Populonia Archaeological Park (LI); the historic center of Rieti; and the historic center of Pienza. A landslide risk analysis is planned for all sites, supported by satellite interferometric techniques, aimed at defining the activity of potential and ongoing phenomena and their interaction with the natural and cultural heritage structures.

9. Work Plan/Expected Results: (30 lines maximum; work phases, milestones and publication) including the contribution plan of articles on the IPL project (progress/result) to the Open Access Book Series P-LRT in the coming few years.

The project includes the following work plan:

Work Package 1 – Satellite Data Processing and Hazard Mapping (Year 1)

During the first year, all available satellite datasets covering the selected sites will be collected, harmonized, and processed using advanced remote sensing techniques. The primary objective is to generate high-resolution, multi-temporal datasets capable of detecting ground deformation, slope instabilities, and other surface changes. The main outputs will consist of:

- Detailed deformation maps showing both the extent and rate of ground movement.
- Potential displacement maps to identify areas at risk of future instability.
- Comprehensive landslide activity maps highlighting spatial patterns, temporal trends, and degrees of activity.

These products will establish a robust baseline for subsequent hazard and risk analyses, ensuring a scientifically sound foundation for decision-making.

Work Package 2 – Integrated Risk Assessment (Year 2)

The second year will focus on the integrated risk assessment of the selected study sites. This will involve:

- Combining the hazard data produced in Work Package 1 with information on the vulnerability and exposure of built-up areas, infrastructure, and populations.
- Applying quantitative and qualitative risk assessment methodologies to identify priority zones where risks are highest.
- Producing risk maps and reports that clearly communicate the likelihood and potential impact of slope failures and other ground movements.

This stage will provide a decision-support framework that links physical hazards with socio-economic

consequences, ensuring a holistic understanding of risks.

Work Package 3 – Mitigation Strategies and Monitoring (Year 3)

The third year will also focus on the development of tailored mitigation measures for the most critical areas. This will include:

- Proposing structural and non-structural measures aimed at reducing vulnerability and exposure.
- Designing and implementing in-situ monitoring plans to complement the satellite-based observations, enabling near-real-time tracking of ground movements.
- Recommending policy and planning tools to integrate the findings into local and regional risk management strategies.

The goal is to provide practical, evidence-based measures that enhance the resilience of communities and infrastructure to ground deformation and landslide hazards.

The results of the activities carried out in the WPs will be published in the Open Access Book Series P-LRT as well as presented during the yearly ICL/KLC conferences. Yearly reports on activities will be submitted to ICL secretariat.

10. Project Beneficiaries: (5 lines maximum; who directly benefits from the work?)

The beneficiaries of this IPL project will undoubtedly be all communities that manage cultural heritage sites, both nationally and internationally. The examples produced can serve as guidelines and references for all IPL community experts addressing the protection, conservation, management, and preventative maintenance of heritage sites threatened by landslides.

11. References (Optional): (6 lines maximum; i.e. relevant publications)

- Iadanza C., Leoni G., Spizzichino D., Trigila A., Margottini C., Osanna M., de Nigris B., Martellone A., Costantini M., Francioni E., Trillo F., Minati F. Instability Processes and SAR Data Analysis in the Pompeii Archeological Park. In: El-Qady, G.M., Margottini, C. (eds) Sustainable Conservation of UNESCO and Other Heritage Sites Through Proactive Geosciences. Springer Geology. Springer, Cham. https://doi.org/10.1007/978-3-031-13810-2_31.
- Russo, A., Giovampaola, I.D., Spizzichino, D., Leoni, G., Coletta, A., Virelli, M. (2023). The Project of Parco Archeologico Del Colosseo and the Italian Network of Archaeological Parks: From Satellite Monitoring to Conservation and Preventive Maintenance Policies. In: El-Qady, G.M., Margottini, C. (eds) Sustainable Conservation of UNESCO and Other Heritage Sites Through Proactive Geosciences. Springer Geology. Springer, Cham. https://doi.org/10.1007/978-3-031-13810-2_34.

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