multi-Risk sciEnce for resilienT commUnities undeR a changiNgclimate

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1. Technical references

Project Acronym	RETURN
Project Title	multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate
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Task	T2.2.3 - Spatial analysis of proneness to ground instabilities: statistical and deterministic approaches
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Contributing beneficiary/ies	UNIFI, UNIBA.

* PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

Version	Date	Lead contributor	Description
0.1	22.11.2023	Matteo Berti (UNIBO) Riccardo Fanti (UNIFI) Mario Parise (UNIBA)	First draft (General structure)
0.2	23.11.2023	Giuseppe Ciccarese (UNIBO)	Draft of Chapter 5
0.3	24.11.2023	Riccardo Fanti (UNIFI)	Draft of Chapter 4
0.4	24.11.2023	Matteo Berti (UNIBO)	Chapters 1-3, Review and Proofreading of Chapters 4 and 5, Chapter 6
0.5	27.11.2023	Salvatore Martino, Francesca Bozzano (UniRoma1); Domenico Calcaterra, Diego Di Martire (UniNapoli), Riccardo Fanti (UniFI)	Edits for approval
1.0	28.11.2023	Participants to TK2.2.3	Final version

2. ABSTRACT

This Deliverable, part of Milestone 2.2 of Spoke 2 in the Extended Partnership RETURN Project, deals with the theme "Identification of impact-oriented indicators" as outlined in the Executive Work Plan – Milestone 2.1. It summarizes the scientific research activities conducted from January to November 2023 by Task 2.2.3 ("Spatial analysis of proneness to ground instabilities: statistical and deterministic approaches") of Work Package 2.2 ("State of the art and knowledge base to define impact-oriented hazard indicators"). This task is a component of the vertical spoke VS2, "Ground Instabilities", and involves 57 researchers from various institutions.

The focus of WP2 is on detecting and analysing predisposing factors to ground instabilities, while WP3 and WP4 concentrate on preparatory factors, and triggering and multiple geohazards cascading scenarios (MULTI-HAZARD), respectively. These work packages collectively aim to quantify ground instabilities' effects on territories, buildings, and communities, and to develop an IT platform for the spatial and temporal analysis of these instabilities.

A significant phase within Task 2.2.3 involved defining Ground Instability categories, which were categorized initially into landslides, subsidence, liquefaction, and sinkholes. A more detailed differentiation was later made, particularly distinguishing between slow and fast types of ground instability in subaerial phenomena. These categories are detailed in Table 4.1 and have been fundamental in guiding the project's direction.

The methodological approach for weighting predisposing factors, crucial for assessing ground instability susceptibility, is outlined in Figure 5.1. This process, led by the Task T2.2.3 leader and the RTDa PNRR team, started with insights from prior work package outputs and learning examples from partners. It evolved into the creation of an initial list of weighting methods, which was refined and finalized through expert panel discussions. This list is categorized into expert-based, data-driven, and physically-based methods.

Expert-based methods, while transparent and reproducible, were excluded from the Proof Of Concept due to their high subjectivity. Physically-based methods, although detailed, were also set aside because of their extensive data requirements and limited scalability. The focus, therefore, shifted to data-driven methods, known for their ability to handle large datasets and provide insights where physical parameters are less understood. The selection of a specific data-driven method was recognized as dependent on various factors, such as the type of ground instability, data availability, and study objectives.

To support the Proof of Concept phase, a "popularity index" was developed to assess the prevalence of different methods in addressing ground instability processes. This index was derived from an analysis of scholarly databases. The results, presented in Tables 5.1 and 5.2, show a notable preference for methods like Logistic Regression and Artificial Neural Networks.

The Deliverable also addresses the connections to WP3 and WP4, emphasizing the critical role of this work in the broader project framework. It lays the foundation for subsequent analyses and risk mitigation strategies by identifying susceptible areas, which then lead to the examination of preparatory processes in WP3 and triggering mechanisms in WP4. This comprehensive and systematic approach ensures effective management and mitigation strategies for ground instability risks.