multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate

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1. Technical references

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* 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

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2. ABSTRACT

This document describes the activities undertaken in the framework of Task 2.3.3: Deep Learning (DL) and machine learning (ML) for mass wasting characterization in subaerial and submarines areas.

The main goal of the work is to establish a rationale for selecting the most influential factors (predisposing-WP2, preparatory-WP3 and triggering-WP4) and the most suitable learning models to characterize ground instability phenomena, both in subaerial and submerged environments.

After an initial assessment of ML and DL methodologies and their use in ground instability assessment, a meticulous review of all available Learning Examples (LEs) was undertaken. The aim was to identify LEs incorporating ML (in its broader sense) or DL methodologies. This scrutiny led to the discernment of 22 LEs featuring learning models.

A subsequential statistical analysis of the LEs revealed comprehensive coverage of processes and control parameters of WP2 and WP3 are covered.

Landslides represent the most frequently examined form of ground instability (39.3% slow landslides and 32.1% rapid landslides), followed by subsidence (10.7%) sinkholes (10.7%) and liquefaction (7.1%).

The activity proceeded with a more in-depth description of the learning approached available for each ground instability process as the final step toward the creation of the rationales.

The rationalization phase was carried out trough the creation of LE-level toolchains related specifically to the application of ML and/or DL methods to the selected processes and environments.

The toolchains have been represented following standard block-diagram recommendations and stems derived from LEs. To adequately address the recommended conceptual and logical scheme of application of machine learning methods, blocks related to pre-processing, processing, and post-processing have been included.

A final generalization phase of the LE-based toolchain was made for each instability process, in attempt to define a framework for the implementation of ML and DL methods in ground displacement risk mitigation and assessment.

The work revealed that, from one hand, ML and DL can represents useful tools for decision makers, facilitating more informed choices in field as land-use planning, infrastructure development, and emergency response, treated by other Return Spokes with special reference to TS1, TS2, TS3.

To the other and, the analyses conducted on the LEs revealed that DL applications in the domain of ground instability still suffer some gaps in current research and tool development, even due to the complex interactions between factors that characterize ground instabilities and the paucity of data with required accuracy.

The absence of comprehensive ML/DL tools for multi-hazard assessment and runout estimation in the available dataset of LEs, as well as the building of risk scenarios, represents a critical gap in our ability to address natural hazards related to mass movements effectively and should be addressed in the next project phase.