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Identifying buildings at risk and pedestrian travel times to safety areas in a debris flow worst-case scenario

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During the last two centuries, several debris flow events occurred in the upper part of the Zêzere valley, which is located in the Estrela mountain, in Central Portugal. These events were responsible for material damage as well as for the loss of lives. Given the susceptibility of this area to the occurrence of debris flows, a methodology for pedestrian evacuation modelling was implemented, in order to identify buildings at risk and pedestrian travel times to safety areas in a debris flow worst-case scenario. Starting from a dynamic run-out model, developed in previous works, the potential debris flow intensity was estimated (e.g. flow depth, velocity and run-out distance). Sequentially, the buildings potentially affected by the impact of debris flows, as well as the ones where the evacuation would take longer than the debris flows arrival, were identified. In addition, the potentially exposed population was estimated by applying a dasymetric distribution to each residential building. This population distribution took into account the identification of the older residents as the most exposed to debris flows, which is critical to develop reliable pedestrian evacuation travel time scenarios. The pedestrian evacuation modelling was performed using the Pedestrian Evacuation Analyst, a GIS tool developed by the United States Geological Survey. The evacuation modelling was based on an anisotropic approach, which considers the influence of slope direction on travel costs, thus its application is suitable in a mountainous area. The implemented methodology is a critical step towards the implementation of a reliable early warning system to debris flows that can be reproduced elsewhere.

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