



## Landslide inventory following the May 2023 Romagna hydrometeorological event (Northern Italian Apennines): the unavoidable requirement for laborious manual mapping

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Accurate and timely landslide inventory is crucial, particularly after large-scale disasters like earthquakes or heavy rainfalls. While remote sensing enhances mapping speed, accuracy is vital to avoid missing or falsely identifying landslides. Effective mapping depends on factors like immediate access to high-quality imagery and skilled surveyors for ground truth definition.

In May 2023, Italy's Emilia-Romagna region experienced a severe hydrogeological emergency, which triggered thousands of landslides. The landslide inventory, crucial for emergency management, faced challenges due to the high number of landslides. Initial efforts using Copernicus Emergency Management Service and national resources faced limitations in completeness and reliability. Ultimately, the official inventory was based on a detailed manual mapping from high-resolution aerial imagery.

This work presents the magnitude of the triggering event, the types of the landslides occurred with respect to the geological constraints and discusses the potential benefits and limitations of automated landslide mapping methods in such scenarios. Specifically, more than 50.000 landslides have so far been mapped over an area of around 1000 km<sup>2</sup>, which range from debris slides/avalanches to debris flows and rock block slides. The impact on infrastructures was significant especially on the road network. With respect to automatic mapping, two distinct techniques have been tested: the conventional NDVI (Normalized Difference Vegetation Index) method and the more sophisticated U-Net algorithm using different remote sensing images ranging in resolution from 10 to 0.2 m.

Results show that time-consuming creation of an extensive ground truth datasets is essential in order to evaluate the accuracy of automatic landslide mapping based on images of different resolution and quality, so to determine whether these methods can offer efficient alternatives to manual mapping in large-scale emergency situations.