



Mapping Exposure to Landslides by Means of Artificial Intelligence and UAV Aerial Imagery in the Curvature Subcarpathians, Romania

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Curvature Subcarpathians is one of Romania's most complex geological and geomorphic areas, frequently affected by landslides. The juxtaposition of snowmelt and spring rainfalls triggers significant damages to roads and buildings every few years (2018, 2021). In this context, accurately delineating the most affected areas becomes critical for evaluating landslides exposure. Aerial images have begun to be used more and more for different risk assessment phases to detect natural phenomena spread and damaged infrastructure elements. In this study, we use fully automatic detection of the landslide body and infrastructure elements (intact or collapsed buildings and roads) to support Regional Civil Protection Agencies in disaster intervention decision support. Our methodology is based on deep learning techniques for automatic detection, mapping and classification of landslide and infrastructure elements. A U-Net model was trained to detect the landslide body, and several Mask RCNN models were trained to detect the landslide features and infrastructure elements. The training accuracy for the U-Net model used for landslide body mapping is 0.86, and the validation accuracy is 0.80. The training accuracy of the Mask RCNN models is 0.76 for landslide cracks, 0.82 for roads and 0.92 for buildings. Some confusions between landslide cracks and local roads without asphalt are often seen in rural areas. The models are run on high-resolution aerial imagery collected with Unmanned Aerial Vehicles after a landslide event. The data obtained from the deep learning models are further integrated with information from various sources such as aerial/satellite imagery, online GIS resources, weather forecasts, and spatial analysis techniques for providing a helpful tool to emergency management specialists. The tools have been integrated into a GIS platform that acts as a decision support system, and it can be used from a graphical user interface without the need to have programming skills.

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