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Mapping landslide source and transport areas in VHR images with Object-Based Analysis and Support Vector Machines

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Visual interpretation of satellite imagery remains extremely demanding in terms of resources and time, especially when dealing with numerous multi-scale landslides affecting wide areas, such as is the case of rainfall-induced shallow landslides. Applying automated methods can contribute to more efficient landslide mapping and updating of existing inventories, and in recent years the number and variety of approaches is rapidly increasing. Very High Resolution (VHR) images, acquired by space-borne sensors with sub-metric precision, such as Ikonos, Quickbird, Geoeye and Worldview, are increasingly being considered as the best option for landslide mapping, but these new levels of spatial detail also present new challenges to state of the art image analysis tools, asking for automated methods specifically suited to map landslide events on VHR optical images. In this work we develop and test a methodology for semi-automatic landslide recognition and mapping of landslide source and transport areas. The method combines object-based image analysis and a Support Vector Machine supervised learning algorithm, and was tested using a GeoEye-1 multispectral image, sensed 3 days after a damaging landslide event in Madeira Island, together with a pre-event LiDAR DEM. Our approach has proved successful in the recognition of landslides on a 15 Km2-wide study area, with 81 out of 85 landslides detected in its validation regions. The classifier also showed reasonable performance (false positive rate 60% and false positive rate below 36% in both validation regions) in the internal mapping of landslide source and transport areas, in particular in the sunnier east-facing slopes. In the less illuminated areas the classifier is still able to accurately map the source areas, but performs poorly in the mapping of landslide transport areas.