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A (semi-)automated object-based approach for landslide detection based on SPOT-5 imagery and digital elevation data

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Within the framework of the research project SAFER (Services and Applications For Emergency Response, FP7), where the pre-operational version of the Emergency Response Core Service is implemented, an approach for (semi-)automated object-based landslide detection has been developed to facilitate fast localisation and classification of landslides over large areas. Geoinformation derived from Earth Observation plays a key role to cope with the effects of landslide hazards and adds to an effective preparation for potential future disasters. Innovative and (semi-)automated methods for fast and reliable detection of landslides can contribute to a more efficient monitoring and timesaving as well as cost-efficient updating of existing landslide inventories. Due to increasing availability of very high spatial resolution (VHSR) satellite imagery such methods are also gaining more importance in disaster management as they help to detect, analyse and monitor rapid landslides.

Using VHSR optical satellite data (SPOT-5 with 2.5 m GSD) and elevation data (DEM with 20 m GSD) including its derived products (e.g. slope, aspect, plan curvature, profile curvature) an approach for (semi-)automated landslide detection and classification through object-based image analysis (OBIA) has been developed for a test site in the upper Aosta Valley, Northern Italy. OBIA provides a frame for machine-based interpretation of complex classes through considering spectral, spatial, texture as well as hierarchical and context information. A rule-set for landslide detection was developed using Cognition Network Language (CNL) within the software eCognition 8. In order to objectively and (semi-)automatically select suitable scale parameters for the appropriate segmentation of landslides a statistical tool called ESP (Estimation of Scale Parameter) was used. The delineation of "meaningful" objects was further improved through split and merge functions as well as smoothing of the object boundaries by applying pixel-based resizing algorithms. The single processing steps were implemented using class modeling, a cyclic process of segmentation and classification, where objects can be addressed individually in a region-specific manner at any stage. During class modeling absolute spectral threshold values were kept to a minimum, whereas relational features (e.g. NDVI or relative differences in terrain) and spatial characteristics were used instead.

The results, showing the extracted landslides, will be validated against outcomes from other analysis, e.g. Permanent Scatterers Interferometry (PSI) measures and ground truth data. Through integration of results from various analyses the landslide monitoring service within SAFER will be implemented and consolidated. (Semi-)automated object-based methods have a high potential to monitor the evolution of landslide prone areas over time, as spectral, spatial, contextual as well as morphological parameters can be considered. The flexibility of the presented approach allows a fast and efficient adaptation to different study sites and data from different sensors, but still needs further improvement towards transferability and automation.