TOWARDS AN EO-BASED LANDSLIDE WEB MAPPING AND MONITORING SERVICE

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Introduction

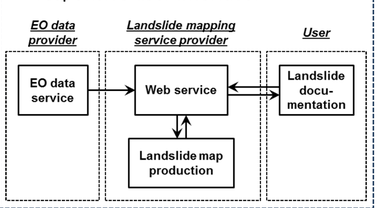
National and regional authorities and infrastructure maintainers in mountainous regions require accurate knowledge of the location and spatial extent of landslides for hazard and risk management. Information on landslides is often collected by a combination of ground surveying and manual image interpretation following landslide triggering events. However, the high workload and limited time for data acquisition result in a trade-off between completeness, accuracy and detail.

Earth Observation (EO) data offers great potential for mapping and monitoring landslides in a fast and efficient manner. While facing an increased availability of EO data and new computational methods, however, there is still a lack in science-policy interaction and in providing tools and methods that can easily be used by stakeholders and users to support their daily work.

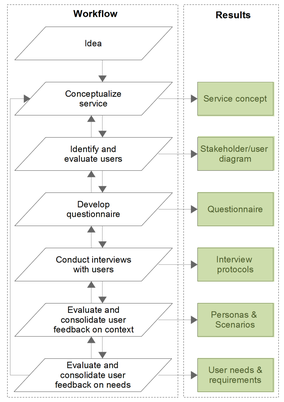
Service Concept

We introduce an innovative and user-oriented EO-based web service for landslide mapping and monitoring. Three central design components of the service are presented:

(1) the user requirements definition,
(2) the semi-automated image analysis methods for landslide mapping implemented in the service, and
(3) the web mapping application with its responsive user interface.



1 User Requirements Assessment



User requirements were gathered during semi-structured interviews with regional authorities. The potential users were asked if and how they employ remote sensing data for landslide investigation and what their expectations to a landslide web mapping service regarding reliability and usability are.

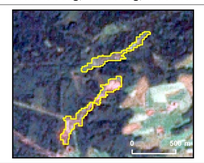
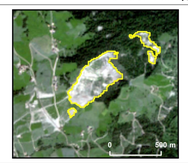
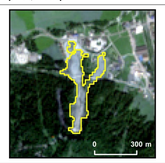
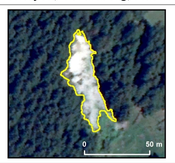
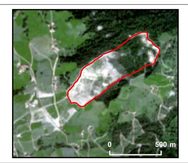
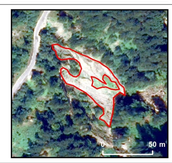
The interviews revealed the capability of our service for landslide documentation and mapping as well as monitoring of selected landslide sites, for example to complete and update landslide inventory maps. In addition, the users see a considerable potential for landslide rapid mapping. The user requirements analysis served as basis for the service concept definition.

2 Semi-automated Landslide Mapping

Optical satellite imagery from different high resolution (HR) and very high resolution (VHR) sensors, e.g. Landsat 7, Sentinel-2, SPOT-5, WorldView-2/3, was acquired for different study areas in the Alps. Object-based image analysis (OBIA) methods were used for semi-automated mapping of landslides. Image objects were created by image segmentation. Knowledge-based and statistical classification methods were used for the mapping of landslide-affected areas. The Normalized Difference Vegetation Index (NDVI) and the slope information were most useful for the detection of landslides. Further parameters (e.g. brightness, length/width ratio, relation to neighboring objects) were used additionally or in combination with each other.

For assessing the classification accuracy, the semi-automated OBIA results have been compared to the results from visual landslide interpretation conducted by a landslide expert based on the same input data.

Satellite image & DEM → Segmentation → Classification → Landslides

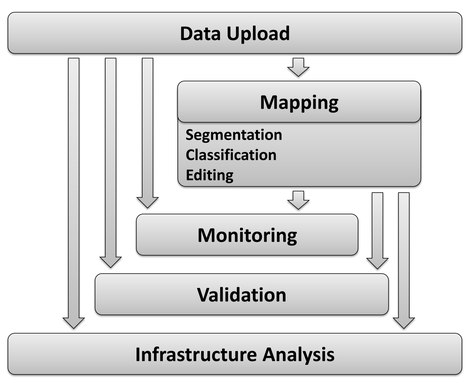
	Landsat 7 *(15 m; 28/07/2002) Haunsberg, Salzburg, Austria*	**Sentinel-2** *(10 m; 27/08/2016) Gader Valley, South Tyrol, Italy*		**WorldView-2** *(0.5 m; 29/08/2015) Montafon, Vorarlberg, Austria*	**WorldView-3** *(0.5 m; 13/08/2015) Bregenzerwald, Vorarlberg, Austria*
OBIA mapping					
Manual mapping					

3 Web Mapping Service

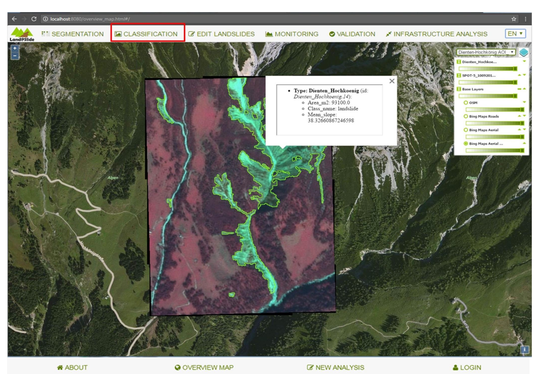
Selected mapping routines and results, including a step-by-step guidance, are integrated in the service by means of a web processing chain. This allows the user to gain insights into the service concept, the potential of semi-automated mapping methods, and the applicability of various satellite data for landslide mapping tasks.

An easy-to use and guided classification workflow, which includes image segmentation, statistical classification and manual editing options, enables the user to perform his/her own analyses. For validation, the classification results can be downloaded or compared against uploaded reference data using the implemented tools. Furthermore, users can compare the classification results to freely available data such as OpenStreetMap to identify landslide-affected infrastructure (e.g. roads, buildings). They also can upload infrastructure data available at their organization for specific assessments or monitor the evolution of selected landslides over time.

Validation of the service is done together with stakeholders, decision makers and experts, which is essential to produce landslide information products that can assist the targeted management of natural hazards, and the evaluation of the potential towards the development of an operational Copernicus Downstream Service.



Overview of the landslide web mapping and monitoring service modules



User interface of the landslide web mapping and monitoring service

Acknowledgements

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Land@Slide http://landslide.sbg.ac.at

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