

CONCEPT OF A SPATIAL DATA INFRASTRUCTURE FOR WEB-MAPPING, PROCESSING AND SERVICE PROVISION FOR GEOHAZARDS

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Introduction

Geohazards and their effects are geographically distributed over wide regions. Their effective mapping and monitoring is essential for disaster assessment and mitigation. By using satellite imagery and semi-automated methods such as object-based image analysis (OBIA) geohazards (landslides, floods, forest fires, storm damages, etc.) can be identified in a fast and efficient manner.

At the moment, several regional/national databases and platforms provide and publish data of different types of geohazards as well as web-based risk maps and decision support systems. Also, the European Commission implemented the Copernicus Emergency Management Service (EMS) in 2015 that publishes information about natural and man-made disasters and risks.

In this study we introduce the **concept of a spatial data infrastructure (SDI) for object delineation and classification, web-processing and service provision of hazard information** with the focus on user interaction in all processes. The architecture of the SDI concept is based on an existing web-based platform architecture focusing on landslides and extends it. Another aim of the web-based spatial data infrastructure is to effectively manage geographically distributed hazard datasets and to promote the interaction between various users and stakeholders.

Concept of Spatial Data Infrastructure

The term “Spatial Data Infrastructure” (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The **SDI provides a basis for spatial data discovery, evaluation, and application for users and providers** using a minimum set of standard practices, protocols, and specifications. An SDI is more than a single data set or database; an SDI hosts geographic data and attributes, sufficient documentation (metadata), a means to discover, visualize, and evaluate the data (catalogues and web mapping), and methods to provide access to the geospatial data.

At a global scale, the most prominent examples of formal SDI programs are on a national scale. Most of these are driven by the national or federal governments, e.g. the multi-national INSPIRE Initiative in Europe (Nebert, 2004*).

*Nebert, D. (Ed.). 2004. Developing Spatial Data Infrastructures: The SDI Cookbook. Global Spatial Data Infrastructure.

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1 Web-based Land@Slide platform

Regional authorities and infrastructure maintainers in almost all mountainous regions of the Earth need detailed and up-to-date inventories of natural hazards. Furthermore, hazard monitoring data are important input for decision-making systems. The project *Land@Slide* addresses these needs by developing a **web-based information extraction chain and platform for efficient mapping based on Earth observation (EO) data** with the thematic focus on landslides. Figure 1 shows the first version of the web-based *Land@Slide* platform. The prototype contains the following main functions: Segmentation, Classification, Editing Landslides, Monitoring, Validation and Infrastructure Analysis. Furthermore, the user:

- gets help and detailed information of the specific functions and tools,
- can use the platform either in English or German language,
- can select a data set in the table of content, and
- receives information about the data via an information button.

The web-based platform and its services for the mapping, processing and analysis of landslides can be extended to different types of geohazards for analysis and delineation based on EO data.

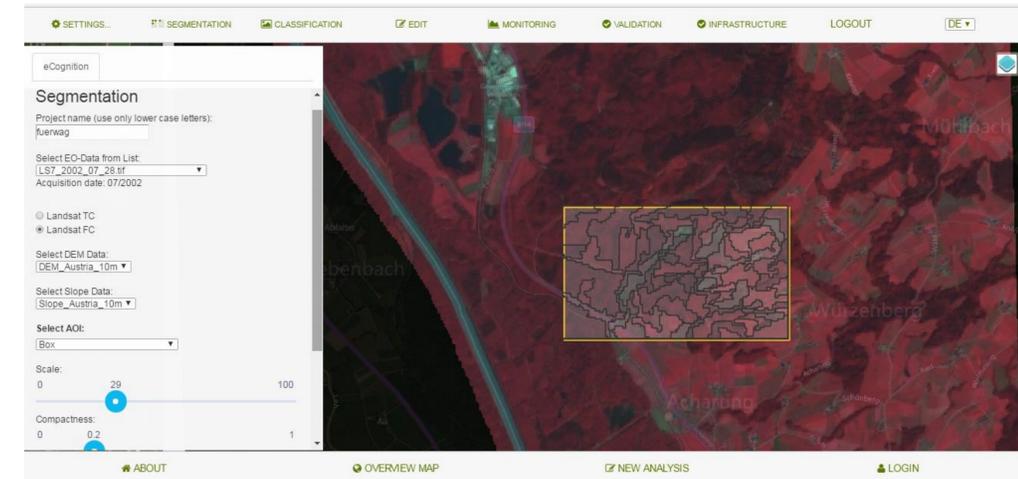
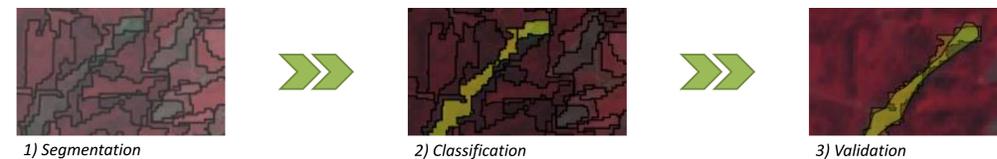


Figure 1: User interface of the Land@Slide platform – (visualisation of the segmentation service)

2 SDI concept for web-mapping, processing and data provision for geohazards

The conceptual architecture of the web-based platform of the *Land@Slide* project comprises of three tiers. The **data tier** consists of a file storage system and the spatial data catalogue for the management of EO data, other geospatial data on landslides, as well as descriptions and protocols for data processing and analysis. An interface to allow the data integration from external sources (e.g. Sentinel data hub) is planned supporting rapid mapping. The **logic tier** consists of java based web and GIS server. Sub and main modules are part of the logic tier and are published as service (**presentation tier**). Six main services are designed and developed:

- (1) a web-mapping service (including image segmentation and classification approaches),
- (2) a monitoring service to monitor changes over time,
- (3) a validation service to analyze landslide delineations from different sources,
- (4) an infrastructure service to identify affected infrastructure,
- (5) a data upload service to integrate external data for web-based data analysis and provision and
- (6) a data management module.

The main services use and combine parts of the sub services. Sub services are for example map services, feature editing services, geometry services and geoprocessing services. For (meta)data provision and to support data interoperability, web standards of the OGC and the REST interface is used. Furthermore, a series of client applications based on new technology standards use the data and services offered by the SDI.

To extend the existing concept and transfer it to an comprehensive **multi-geohazard SDI solution** the data catalog is upgraded. The hazard data and information, which are stored in the spatial database, is directly connected to the map server and the metadata server to publish this information through 1) a map viewer and a 2) geocatalogue to search and explore geospatial data.

The *Land@Slide* platform is developed mainly based on a range of free and open source technologies and based on widely used open standards (e.g. from the Open Geospatial Consortium). Only for image segmentation the commercial software eCognition is used. The multi-geohazard SDI solution will be entirely developed using open source technologies to ensure interoperability among and between components and to reduce costs.

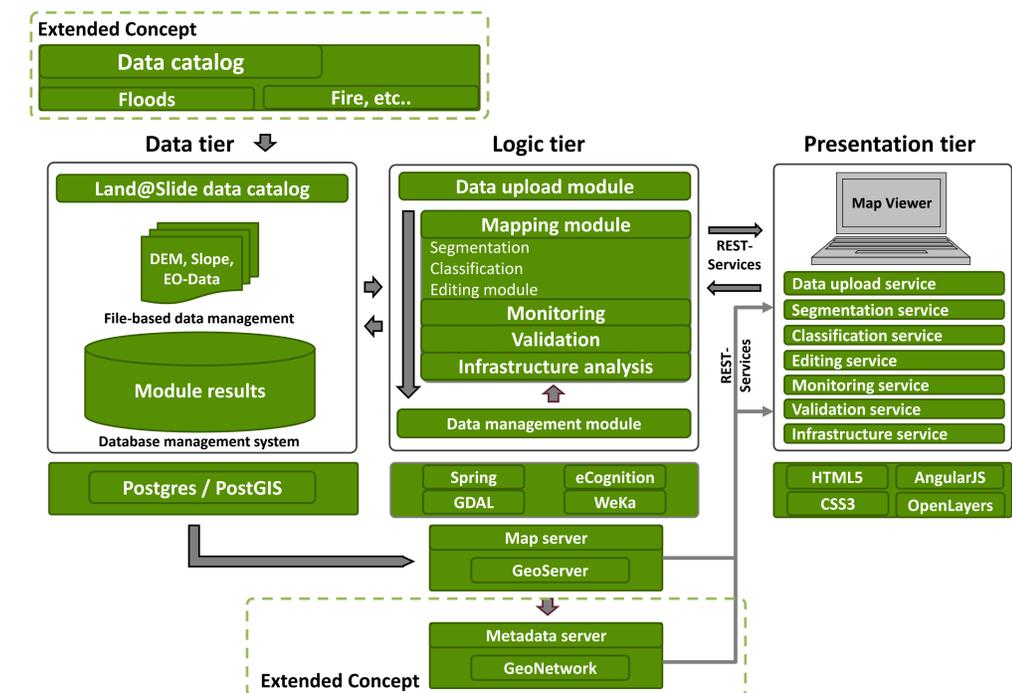


Figure 2: SDI architecture