Software tools developed for the Swiss avalanche warning service - a system overview
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ABSTRACT: Today, highly specialized software is required to produce the public avalanche bulletin and complementary snow information. Numerous data sources contribute to the information pool analysed by the avalanche warning service. The database includes measurements, observations, and model data. These data are retrieved through a SQL-based data access component as JSON feature service and analysed in an interactive GIS system as well as automatically processed to SVG maps and image files for the internet and other end user devices. The in-house developed Java based GIS components gistools are essential in the automatic map production process. Optimized for performance and low memory consumption the gistools library is widely used in the dissemination and communication of avalanche danger and snow information. The individual components of these software tools are illustrated and the technical implementation is described.

KEYWORDS: GeoServices, GIS, Java, JSON

1 INTRODUCTION
Starting in the early 1990s the WSL Institute for Snow and Avalanche Research SLF has developed a wide variety of GIS-based tools to support avalanche forecasters. In 1996 the project Avalanche Warning Switzerland 2000 (Russe et al., 1998) introduced “computer-aided avalanche forecasting” in order to cope with the increasing demand for more detailed avalanche forecasts. The traditional SLF observer network was complemented with a network of high Alpine automatic weather and snow measurement stations (Lehning et al., 1998). A GIS application framework (Stoffel, 2001) was developed at the SLF to improve spatial data visualization and analysis for the avalanche warning service and to disseminate map products to the public. Over a decade later at the start of the winter 2012-2013 the format of the avalanche bulletin was revised and optimized for internet and smartphone users (Winkler et al., this issue). In this context the spatial data visualization and analysis tools were renewed. Based on a modern software framework the actual tools consist of three software components (Data Access Component, Aktuell++ and Gistools). This paper gives an overview on the individual components and their technical implementation.

2 SOFTWARE TOOLS

2.1 Data access component
Numerous data sources contribute to the information pool analysed by the avalanche warning service. Measurements, observations and model data are collected in the database. These data are retrieved through a SQL-based data access component (DAC) as JavaScript Object Notation (JSON) feature service following the GeoServices Representational State Transfer (REST) Specification. The JSON is a lightweight plain text format for data interchange and GeoService is its specialization for geographic content. Different clients can execute queries to get features from the DAC.

The DAC allows time efficient single or multiple value queries for a given date and time over all database entries as well as the calculation of basic operations (sum and difference) and basic statistics (minimum, maximum and mean).

2.2 Aktuell++
To visualize the large amount of data compiled in the snow and avalanche database Aktuell++ a GIS-based interactive application was developed. It supports the forecaster in getting a quick overview over the current and past weather, snow and avalanche conditions in the Swiss Alps.

The Aktuell++ custom application is developed as ArcGIS for Desktop add-in to ArcMap. Aktuell++ is built in C# based on ArcObjects. The application is targeted to high-performance data display and hence it is making use of in-memory data handling and ArcGIS geopro-
cessing tools. ArcGIS for Desktop add-ins are easy to install and share. Aktuell++ enables the user to configure the DAC queries over an intuitive menu and to visualize the resulting JSON features on a map. Multiple measurement values may be combined in specific symbols. An example is given in Figure 1 showing a map of avalanche observations.

Figure 1. Spatial visualization of avalanche observations

Spatial interpolation is available for quantitative data to calculate a continuous distribution from sampled point values like new snow depth, etc. (Figure 2).

Figure 2. Spatial interpolation of new snow depth

2.3 Gistools

The in-house developed Java based GIS components gistools are essential in the automatic map production process. The resulting scalar vector graphics (SVG) maps also contain the logic statements required to render the various specifications of the map as image files for the internet and other end user devices. This logic is implemented in JavaScript and allows the map to be displayed in a variety of ways by means of different configurations. An example of the automatic map production is given in Figure 3.

Figure 3. Four-panel time series plot of wind speed and direction

3 CONCLUSIONS

The actual suite of software tools developed for the Swiss avalanche service is based on industry standards like GeoServices, Java and SVG. High-performance data access and highly customized spatial visualizations are essential to analyse the wealth of information required to produce the daily avalanche bulletins.

4 REFERENCES


