Visualizing snow profiles

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ABSTRACT: The introduction of the CAAML 5.0 Profile for IACS Snow Profiles (Haegeli et al., 2010) created the necessary foundation for facilitating the exchange of snow profiles among different applications. There are many different applications on the market to create and visualize snow profile information, all of them address slightly different needs. However, the ability exchanging profile data across different applications is currently quite limited, which considerably hinders collaborations among avalanche safety operations and researchers. The goal of this project is to provide a freely accessible web service for the visualisation of snow profile data. The functionality of web service is based on components from the SLF snow profile application and can accept snow profile data from any sources in the CAAML 5.0 snow profile format. The web service can either be used by human users via the provided user interface or by other applications via its RESTful API. Once a CAAML 5.0 file is uploaded, the web service returns a visual representation of the snow profile as an image or a PDF file. In addition to the web service, we also provide a couple of open source components written in Java to convert CAAML 5.0 snow profiles into other XML formats or a Java object model, and to render the object model into an image or a PDF file. These components will give other groups a head start for the development of other snow profile visualization functionalities and enhance to collaborative development of snow profile software for avalanche safety professionals and researchers.

KEYWORDS: Information exchange, XML, CAAML 5.0, IACS, snow profile, visualization

1 INTRODUCTION

Based on the Java code already developed for the existing proprietary SLF snow profile application, a couple of components were extracted for handling snow profile data in CAAML 5.0 format and for visualizing the data as an image or a PDF file. The extracted components include:

- a component containing a Java object model for exchanging the data between the other components.
- a Reader and Writer component for dealing with the data files,
- a Renderer component for generating images, and

Based on these components, a new web service was developed for visualizing CAAML 5.0 snow profile data and converting them into images or PDF files. The service has a user interface for human interaction and a RESTful API for use by other applications.

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2 SNOW PROFILE VISUALIZATION SERVICE

The SLF provides a web-based service for transforming snow profiles in CAAML 5.0 format in to images or PDF files, based on components from its existing proprietary snow profile application. The service provides interfaces for both human users and other applications to request the visualization of snow profile data in CAAML 5.0 format. However, both interfaces use the same components for the visualization.

2.1 Interfaces

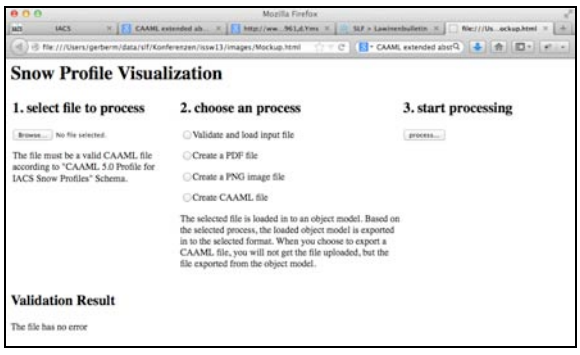

Figure 1. Screenshot of the graphical user interface of the snow profile visualization service

The graphical user interface for human users is a web page (Figure 1) where users can upload CAAML 5.0 files and gets back a visualized snow profile as an image in PNG format or as a PDF file. In addition to the visualization

functionality, the website also allows users to validate their CAAML 5.0 data with respect to the schema defined by the CAAML 5.0 Profile for IACS Snow Profiles standard.

The interface for machine-to-machine interaction is a RESTful web service that allows other applications to make a http request with a snow profile in CAAML 5.0 format. The result of the request is a visualization of the snow profile as a PNG image or a PDF file (Figure 2). This allows other applications to integrate the visualization of snow profile data with very little programming effort.

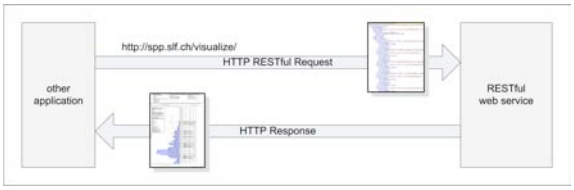

Figure 2. RESTful web service for machine interaction with visualization service

2.2 Service implementation

Both interfaces use the same components for the visualization of the data. Underneath the service wrapper, which provide the interfaces for the RESTful web service and the graphical user interface, there is a Reader component, responsible for reading the provided snow profile data in CAAML 5.0 format. The Reader produces the snow profile Java object model, which consists of Plain Old Java Objects (POJO). This is a proprietary object model that is used by the components developed at the SLF. The model is then passed to the Renderer, which produces a visualization of it (Figure 3). The resulting image or PDF file is then returned to the user of the web service.

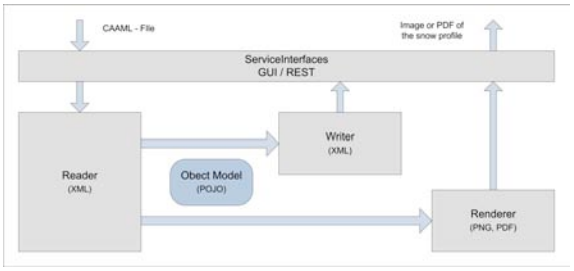

Figure 3. Implementation of snow profile visualization service

In addition, the service also contains a Writer component, which is not used in the visualisation process described above. The Writer component enables the service to return the snow profile in another format than an image. Presently, the Writer component supports the SLF XML format, the CAAML 5.0 format, and the format used by the SPPWin application. The SPPWin application is the legacy application that was used by the SLF prior to the current snow profile application.

3 SNOW PROFILE JAVA COMPONENTS

The SLF has developed of the following Java components to handle and visualize snow profile data:

- Snow Profile Java Model,
- a Reader,
- a Writer, and
- a Renderer.

All of these components are based on a proprietary internal Java object model that is part of the Snow Profile Java Model component. For reading and writing XML files, the XML-Beans Java framework is used and we provide an additional component that contains the XML-Bean classes for the SLF-specific XML and the CAAML 5.0 snow profile data format. All components depend on the Snow Profile Java Model (Figure 4).

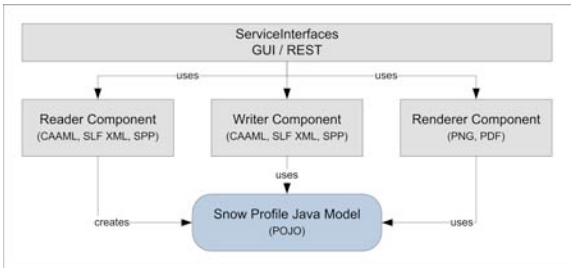

Figure 4. Dependency of the snow profile Java components

3.1 Snow profile Java model

The Snow Profile Java Model is the data structure all other components are based on. It is built out of Plain Old Java Objects (POJO), representing a snow profile and its features, starting from stratigraphic layers up to stability tests (Figure 5). The model covers all of the features currently supported by the SLF snow profile code. It is designed to be extended.

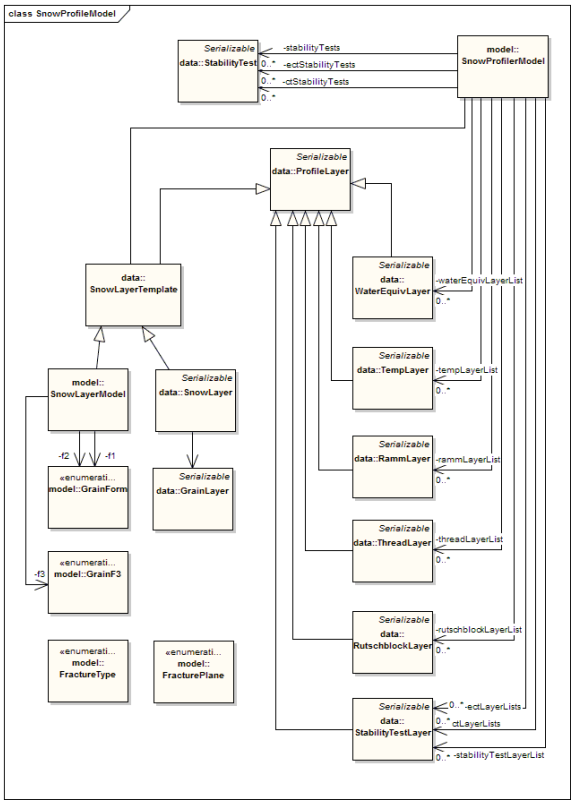

Figure 5. Class Diagram of Snow Profile Java Model

3.2 Reader component

The purpose of the Reader is to convert different file representations of snow profile data into a Snow Profile Java Model. Based on this object model, one can then either export other file-based representations of the snow profile, using the Writer component, or visualize the profile using the Renderer component. The Reader is designed in such a way that it is easy to extend it to read other file formats in the future. Presently, it supports the formats the SLF is working with, including the SPP file format (used by Matt & Sommer's snow profile application SppWin) and different XML-based formats. Internally, the Reader only uses the SLF XML format. The design is such that one can apply different XSLT-transformation style sheets to convert any XML-format into the internal SLF format. The style sheets for converting CAAML 5.0 snow profiles data into SLF XML snow profile data are directly integrated in the Reader component to support the import of CAAML 5.0 profiles into the Snow Profile Java Model for further processing in Java based applications.

The Reader component uses the XML-Beans library for reading XML. It supports the automatic generation of Java classes out of an XML schema that can be used to read, write and represent XML files. To make the other components less dependent on the XML format used to express a snow profile, the XML-Beans object model is transformed into an independent Snow Profile Java Model, used by all components described here.

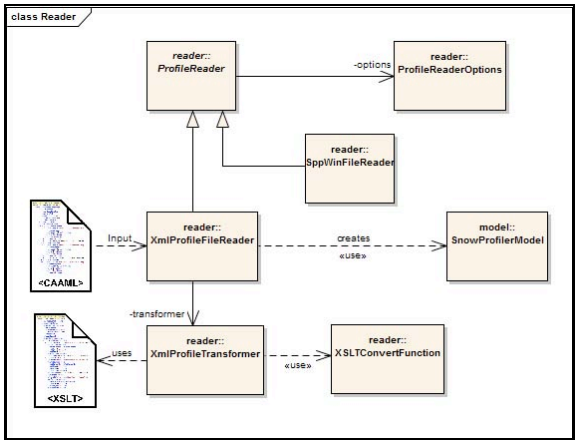

Figure 6. Schematic View of Reader Component

3.3 Writer component

The Writer component writes snow profile files, based on a given snow profile Java model. It currently supports writing snow profiles in SppWin, SLF XML and CAAML 5.0 formats. Contrary to the Reader implementation, writing different XML formats is not done by an XSLT transformation of the SLF XML format. The implemented approach is to subclass the base write functionality for each of the supported formats. However, the functionality of a generic XML write call that uses an XSLT style sheet to transform the snow profile data into different XML formats exists. Expanding this functionality to other XML format only requires the development of new XSLT files for the transformation.

3.4 Renderer component

The Renderer is responsible for visualizing snow profile data as an image or a PDF-file (Figure 7).

It operates on the Snow Profile Java Model, described above. For rendering a snow profile the JFreeChart library is used. With JFreeChart one creates an instance containing all the information used to draw the snow profile. JFreeChart then provides an operation where the information can be drawn on to any Java graphic context. This is used for rendering an image and is encapsulated in a function provided by JFreeChart.

PDF files are generated with the iText library. iText provides the graphic context that is used by JFreeChart to render the snow profile on to.

Because the SLF is located in Switzerland, a country with four official languages, the Renderer is already capable of producing visualizations

in multiple languages. Currently supported are German, French and Italian (three of the four official languages in Switzerland) as well as English for international use.

The Renderer uses some configuration properties to customize visualization. They are encapsulated in a class, and can be read from a file or configured directly using Java.

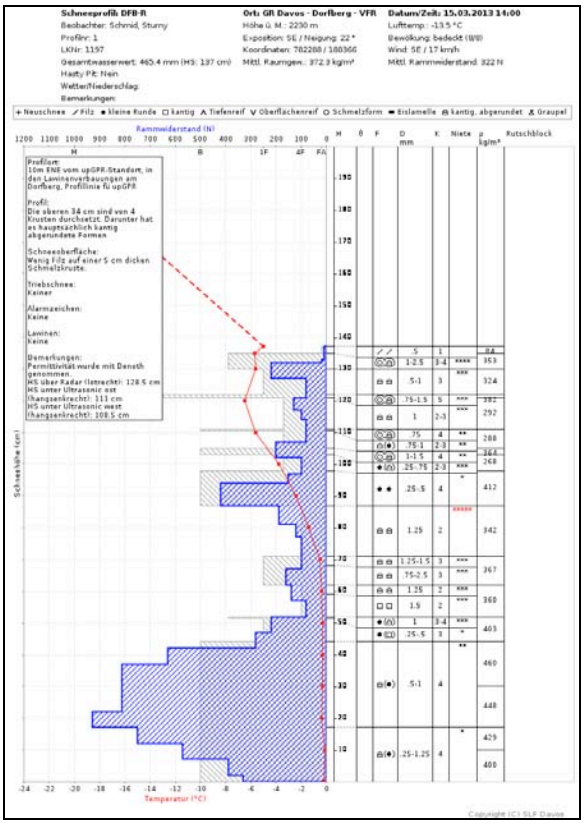

Figure 7. Snow Profile Image created by Renderer Component

4 CONCLUSIONS

With the new components for handling and visualization snow profile data, it is now possible to extend existing or new snow profile applications with CAAML 5.0 support and visualization, without having to develop them from scratch. The available web service allows users to quickly validate snow profiles available in CAAML 5.0 format and to create images from them. Applications can call the service to get snow profile images for their CAAML 5.0 data, instead of rendering them by themself. For example, an application modeling snow stratigraphy can produce CAAML 5.0 snow profile output files and get them visualized, using this service. This will improve productivity in developing solutions for dealing with snow profiles and increase the ability to exchange snow profile data among applications, agencies and research groups.

5 OUTLOOK

The current version oft the service is producing a default visualization of the profile. However, the Renderer is capable to use configuration information to customize the visualization. A future version of the service may thus contain options to configure the Renderer prior to get the profile data visualized.

Furthermore, we envision the development of an additional Renderer, based on the provided Reader and Model components, that produce different visualizations and/or different output formats. One requirement may be to create a vector based output format that can be used for further editing with standard tools like Adobe Illustrator—possibly based on SVG files.

6 USEFUL LINKS

CAAML
http://www.caaml.org

IACS Classification for Seasonal Snow on the Ground:
http://www.cryosphericsciences.org/snowClassification.html

RESTful Web Service
http://en.wikipedia.org/wiki/Representational_state_transfer

JFreeChart Librabry
http://www.jfree.org/jfreechart/

iText Library
http://itextpdf.com/

REFERENCES

Fierz, C., Armstrong, R.L., Durand , Y., Etchevers, P., Greene, E., McClung, D.M., Nishimura, K., Satyawali, P.K. and Sokratov, S.A., 2009. The International Classification for Seasonal Snow on the Ground. HP-VII Technical Documents in Hydrology, 83. UNESCO-IHP, Paris, France, 90 pp.

Haegeli, P., Atkins, R., Gerber, M., Hörtnagl, J., Fierz, C., Kelly, J., Morin, S., Nairz, P. and Tomm, I., 2010. An international standard for the exchange of snow profile information an example for a domain specific application of CAAML 5.0, International Snow Science Workshop ISSW, Lake Tahoe CA, U.S.A., 17-22 October 2010, 415-416.