

SnopViz, AN INTERACTIVE VISUALIZATION TOOL FOR BOTH SNOW-COVER MODEL OUTPUT AND OBSERVED SNOW PROFILES

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ABSTRACT: “SnopViz” is primarily a visualization tool for both observed snow profiles ([CAAML V5.0 Snow Profile IACS](#)) and simulation output of the snow-cover model SNOWPACK. The JavaScript application runs on any modern browser and does not require an active Internet connection. The latest release is available for download from [models.slf.ch](#) and examples can be run from [snopviz.org](#). While the strength of this new visualization tool lies in its interactive features, a few of which are sketched below, it also provides means to output vector graphics files (SVG) or JSON object files for easy interfacing with other applications.

KEYWORDS: snowpack, graphical user interface, CAAML-format

1. INTRODUCTION

SnopViz is an open source visualization tool for SNOWPACK simulation output as well as for observed snow profiles. It has been designed to fulfill the needs of operational services as well as to offer the flexibility required to satisfy the specific needs of researchers.

SnopViz is able to render single and multiple snow profiles, either observed or modeled, that are provided as CAAML Snow Profile V5.0 IACS compliant files, which is the international standard format for exchanging snow profile data ([caaml.org/Schemas/V5.0/Profiles/SnowProfileIACS](#)). The International Association of Cryospheric Sciences (IACS) and the CAAML WORKING GROUP support and promote this so called CAAML-format. In addition, SnopViz provides a full replacement of the current research visualization tool SN_GUI for SNOWPACK.

SnopViz is now implemented in the operational environment of the Swiss Avalanche Warning Service at the WSL Institute for Snow and Avalanche Research SLF (WSL/SLF). The latest version of SnopViz can always be run from [snopviz.org](#) where example files are provided for testing.

2. PROJECT REALIZATION

SnopViz is a JavaScript (JS) stand-alone application that does not require an active connection to either Internet or a server. It consists of two parts:

2.1 *The SnopViz library*

The SnopViz library is pure JS. It parses the provided input files, for example, a single or multiple snow profiles, timelines as natively output by SNOWPACK, or time series provided in the flexible [SMET](#) format also used by SNOWPACK. Internally the library provides classes for representing data. Moreover, the plugin architecture allows to handle JavaScript Object Notation (JSON) objects as well. Plugins for other file formats may be added easily. Output is provided either as vector graphics (SVG) or JSON.

Note that the library may also be used stand-alone, that is, without user interaction. This simplifies integration in other platforms, which, for example, only need to convert a CAAML-file into a SVG image.

2.2 *The SnopViz User Interface*

The User Interface is a browser based stand-alone interface (JS/HTML5). It runs in every modern browser, including IE, and allows user interaction with the graphs. SVG, the XML based standard for vector graphics, was chosen because of its easy interaction with JavaScript and a good software support (Adobe Illustrator, Inkscape) to manipulate graphs outside SnopViz for publication purposes.

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3. SINGLE SNOW PROFILES

For now, SnopViz provides 4 different snow profile types, two of which are shown in Figure 2 below.

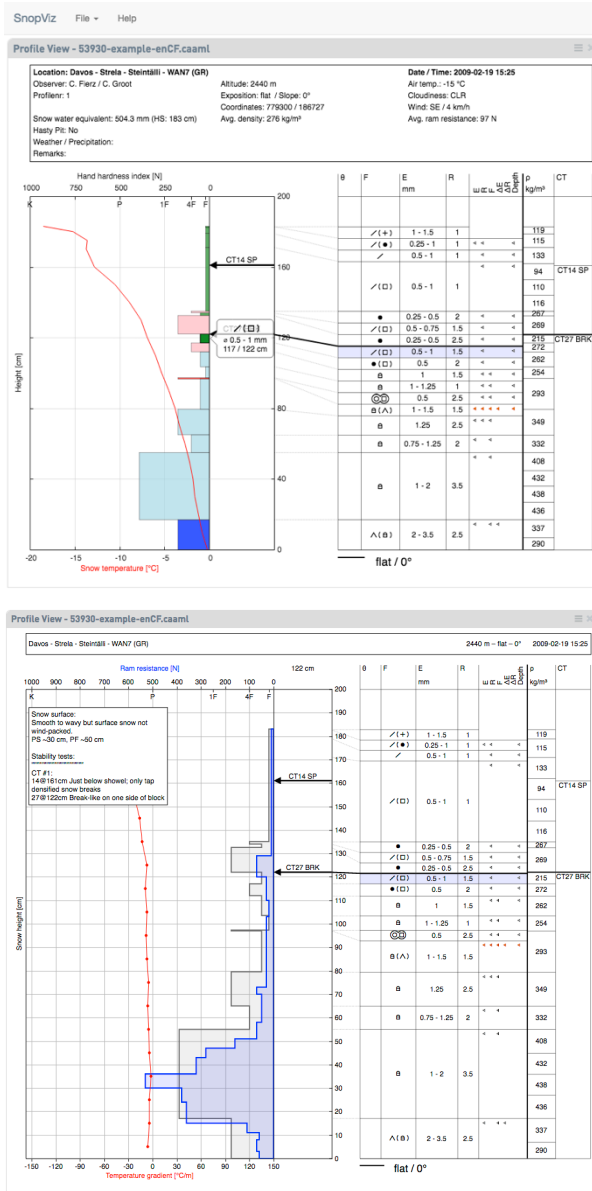


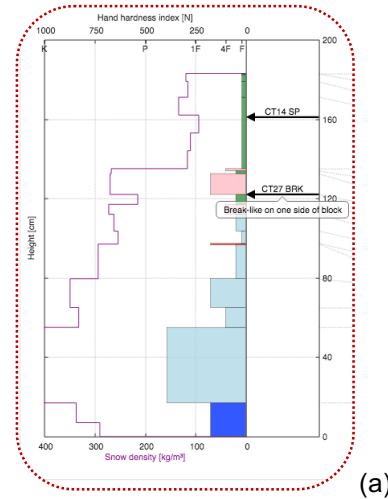
Fig. 2: Simple profile (top) and SLF-profile (bottom).

The simple profile (top in Fig. 2) is the enhanced representation of the bare simple profile used along with SNOWPACK timelines (see Section 4), while the SLF-profile is the interactive counterpart of the graph presently used at WSL/SLF. By hovering the mouse over the table, layers are highlighted, facilitating the connection of layer properties across the graph. Note also the balloon

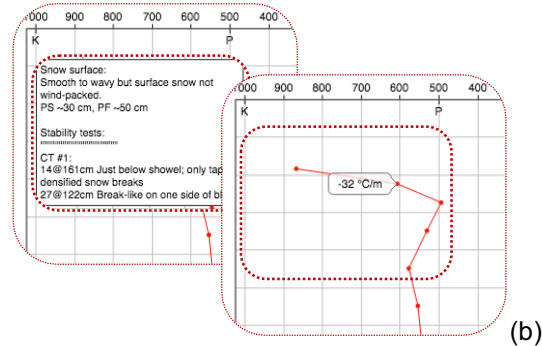
in the simple profile showing grain shape and size in detail.

3.1 Interactive features

Below are a few selected features that make the use of this interactive tool more than valuable.



(a)



(b)



(c)

Fig. 3: Interactive SnopViz features.

Using the mouse, simple snow profiles can be zoomed vertically (Fig. 3a). Clicking on the bottom axis title cycles through different property profiles such as temperature, grain size, liquid water content, density, etc. In addition, pointing at the location of a stability test opens a comment balloon. Clicking on the text box in SLF-profiles makes it disappear (Fig. 3b), revealing the profile hidden below. Here, temperature gradient was preferred to temperature by clicking on the bottom axis. Hovering over the graph displays the values at the corresponding height. Different types of headers can be chosen (Fig. 2) and hovering over the coordinates allows to link to a map service (Fig. 3c).

4. TIMELINE AND TIME SERIES

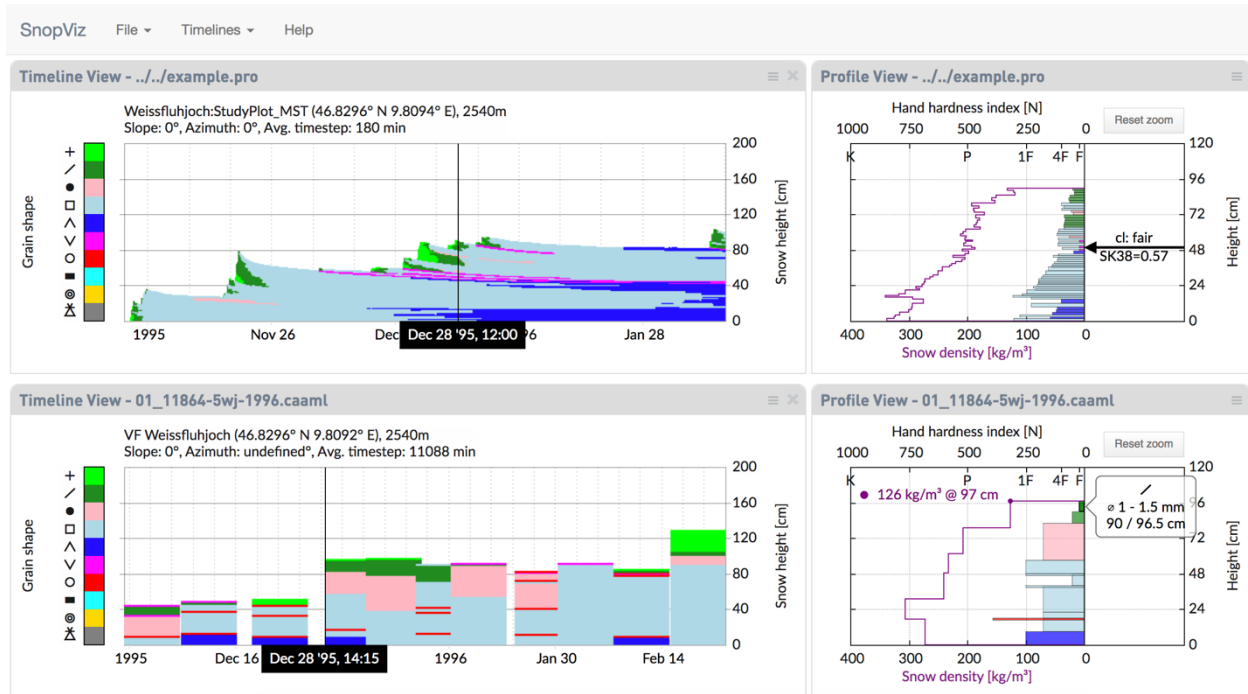


Fig. 4: Timeline of a SNOWPACK simulation (top) compared to field recorded snow profiles (bottom) for the winter 1996 at Weissfluhjoch, Davos, Switzerland.

Fig. 4 shows synchronous timelines of simulated and field recorded snow profiles. Hovering over the simulation results will hook up with the nearest observed profile in time. Clicking freezes a date as shown by the vertical cursor lines. Both profiles can then be zoomed vertically and their density and hand hardness profiles compared. Note that colours correspond to the majority

grain type as shown in the legend on the left of the timelines. The colours follow the International Classification for Seasonal Snow on the Ground (Fierz et al., 2009). More details about single layers is obtained by hovering over the bare simple profiles as seen in the balloon and displayed density value in the lower panel.

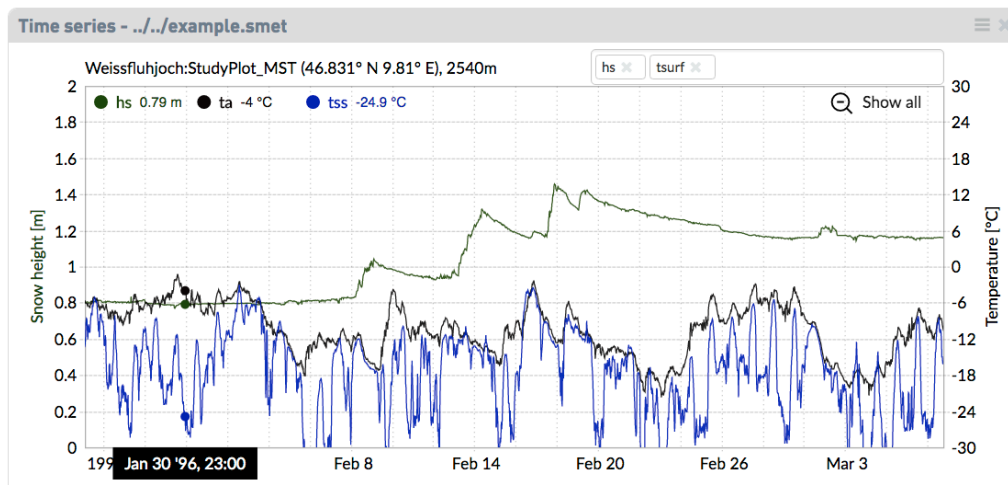


Fig. 5: Zoomed in time series for snow depth (hs), air temperature (ta), and snow surface temperature (tss) for the winter 1996 at Weissfluhjoch, Davos, Switzerland.

Time series may look very classical indeed (see Fig. 5). However, a few characteristics need particular attention. First, time series can be synchronized both among each other and with timelines. Second, entries can be grouped to facilitate the use of one common axis scale. For example, in Fig. 5, air temperature (ta) and snow surface temperature (tss) are grouped as 'tsurf' thereby referring to the same temperature axis on the right.

5. TOOL BAR MENUS

5.1 Settings

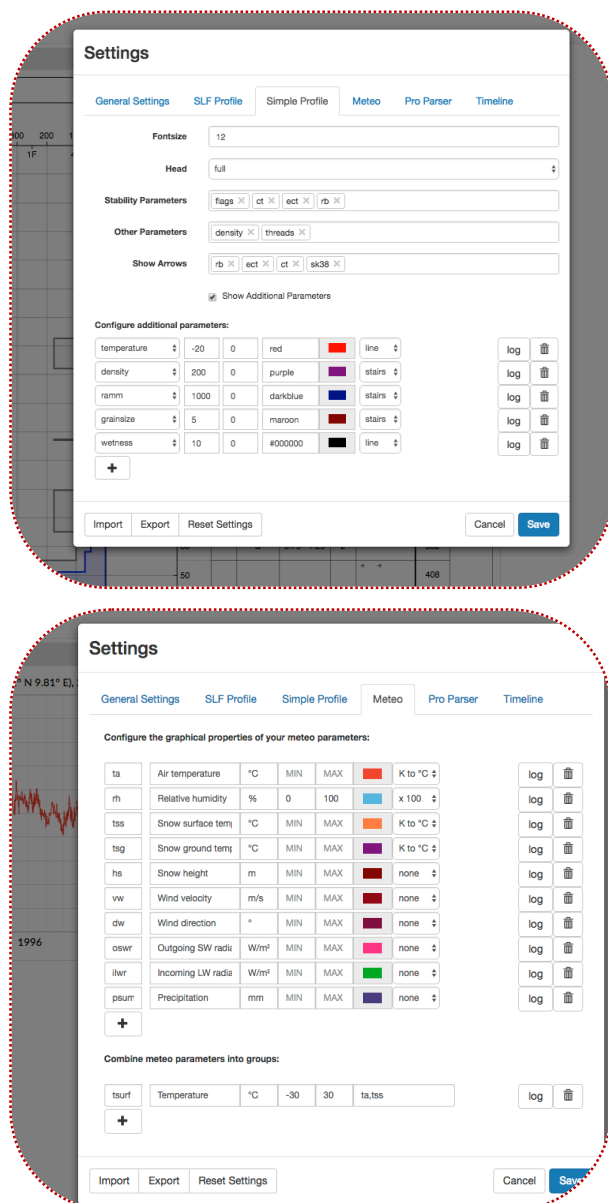


Fig. 6: Settings for simple profiles (top) and time series (bottom).

The 'File'-tab on the tool bar of SnopViz allows to open the settings tool. Fig. 6 show examples for setting simple profile and time series behaviour. Settings are stored in the browser and can be exported as JSON for later use.

As shown in Fig. 2, stability tests are also included in the profile table. Which tests are shown and in what order is set in the top panel of Fig. 6. Currently, rutschblock (rb), compression (ct), and extended column tests (ect) are implemented, but more could be added if either standard CAAML elements (shear frame and propagation saw test) or custom data are written in the profile file. At present, this is not the case at WSL/SLF.

In addition, however, the threshold sum approach (flags) of Schweizer and Jamieson (2007) is implemented as in the existing snow profile application SnowProfiler of WSL/SLF and can also be toggled on and off.

5.2 Burger menus



Fig. 7: Burger menu for profiles (left) and for time series (right).

In addition, graph specific burger menus are available. For example, while viewing snow profiles, one can quickly switch from SLF to simple profile or print/export the graph in various formats (left panel in Fig. 7). The menu shown in the right panel of Fig. 7 allows to jump from one snow property to another in a timeline. Other properties can be added by configuring properly the settings. Also, the menu provides entries to add synchronous time series or to maximize either the timeline or the bare simple profile. The latter feature is convenient to export graphs in SVG format.

6. CONCLUSIONS AND OUTLOOK

SnopViz is a robust JS/HTML5 application to render both observed snow profiles and SNOWPACK simulation output. The successful development of SnopViz was only possible through the continued exchange between all partners at SLF and the developers at Egger Consulting. SnopViz is now operational at WSL/SLF and the latest version can always be tested on snopviz.org. Moreover, the latest release of the open source code is available for download on the forge models.slf.ch.

The next step would be to implement a snow profile recording module, which is currently under discussion. As SNOWPACK will soon be able to import and export model output in CAAML-format, such a module would also allow to manipulate initial profiles for simulations, for example, if a surface hoar layer is missing due to not accurate input data.

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