An Automated Procedure for Plotting Snow Stratigraphy

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ABSTRACT

Because snowpack stratigraphy influences the behavior of the pack, reports of research on snow often present illustrations of stratigraphy of the snowpack. Producing snowpack profiles by traditional manual methods is costly and time consuming. This paper describes a new, easy-to-use procedure for automatically plotting snowpack stratigraphy, either from one pit or from a series of pits, employing the software SnowPit98, our custom macro (program) and custom font for the commercially-available software, Excel97. The custom font is used to label the snow layering with the International Snow Classifications symbols. This paper describes our software, provides a user guide to its use, and shows example snow stratigraphy plots that can be generated. This software should be useful to snow physicists, hydrologists and chemists, and avalanche forecasters.

Key words: Snow, stratigraphy , plot, ICSI/IGS, computer program.

INTRODUCTION

It is well known that the stratigraphy and properties of a snow pack may change significantly over time, and that the nature of the snow pack affects the nature of runoff for hydrological forecasting and affects the timing of avalanche release. Research on snow often requires snowpack stratigraphy data to describe the nature of the pack. It is the purpose of this paper to describe SnowPit98: a new, easy-to-use procedure for automatically plotting snow pit stratigraphy with our custom macro and custom font for the commercially-available software, Excel97. This procedure allows the user to type in snow pit data and generates plots of either a single snow pit or multiple pits (in a time series, for example). Figure 1 depicts a sample plot. This paper describes our macro, provides a user guide, and

shows example snow pit plots that can be generated. Interested users can contact the second author to obtain the software.

Commercially available packages for cataloging snowpack information are available. For example, Snowpro is a package currently advertised on the Web (www.gasman.com/snowpro.htm) that is being marketed for U.S.$ 199. plus shipping, and is useful for avalanche and roadway snow data. It produces a form for one snow pit with location, date, and other identifying information at the top and profiles of hardness, crystal type, snow water equivalent, etc. Other packages similar to this have been offered commercially in the past. Snowpro (and other programs like it) are useful for cataloging data, but do not create plots of snow pit stratigraphy that are suitable for use in scientific papers.
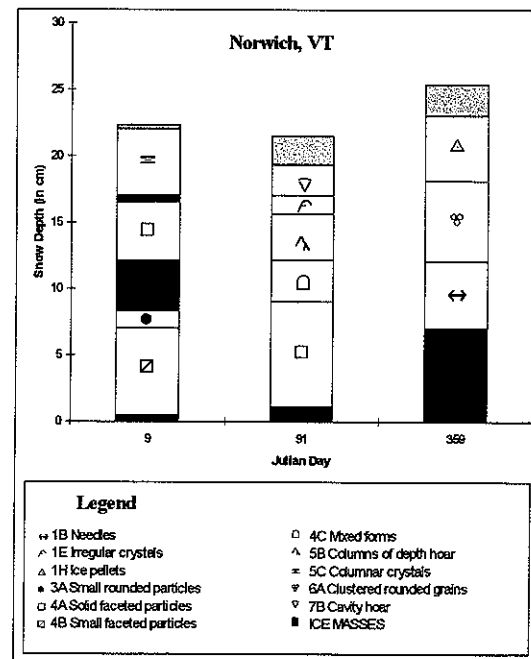

Figure 1. Example stratigraphy plot.

In our research we have found the need to produce plots of a single snowpack stratigraphy, or a sequence of stratigraphies (e.g., Albert and Hardy, 1993). In the past, these illustrations were hand-drawn and lettered, incurring both production costs and sometimes extended lead time for the graphic artist's availability. We decided to design computer software to produce plots economically and quickly.

APPROACH

The goal of this project is to design an easy-to-use snow pit plotting program that requires little startup time to learn, and that can be used on a personal computer. Because many users of personal computers are already familiar with Microsoft Windows, and may already have the Excel application available, we decided to create a Visual Basic macro to control a Microsoft Excel workbook in order to input the data and produce the plots. For the user already familiar with Excel, a built-in advantage to this approach is that the user can edit the completed plots to suit their needs. In addition to the Visual Basic Macro, we have developed a custom font, "Snow," included in this distribution, which contains all the ICSI/IGS symbols (Colbeck et al, 1990), including the conventional symbols to indicate grain shapes.

DESCRIPTION OF SNOWPIT98

SnowPit98 is our custom-designed macro (program) to plot stratigraphy that runs within Microsoft Excel97. The macro has been designed to automatically plot snowpack stratigraphy from snowpit data that has been typed into the Excel spreadsheet. SnowPit98 will produce a plot representing any number of snow pits, either data from a single snow pit or data from a time series of snow pits, for example.

We also developed the custom True Type font called "Snow" to run in Microsoft Excel 97. The symbols of this font are the ICSI symbols for the various snow types. The "Snow" font allows the macro to add the ICSI/IGS symbols properly. Not only does this font allow the macro to function properly; it will also allow the user to easily use these symbols in other programs (Word, Power Point, etc.). The finished plots can easily be pasted in other programs such as Word, or can be printed out.

USER INSTRUCTIONS

The first thing one needs to do is to enter the data into the Excel spreadsheet. The data should include the depths and may include the type of each layer. Do this on the "Dataentery" worksheet (the tab

in the lower left corner shows the worksheet name) (see Figure 2). For each snowpit there are two columns that one must enter data onto, the left (columns C, E, G...) and the right (D, F, H...). In the left column, enter the starting or stopping depth of each layer (in cm). In the right column, enter the correct numerical ICSI/IGS code for the grain shape (unrecognized grain shapes will result in a "?" on plots with symbols). For example in the sample data depicted in Figure 2, on Julian Day 9, there is a snow pit that starts out with a half a centimeter of basal ice (8c), layered below small faceted particles (4b). When the macro is run, layer thicknesses are calculated by the differences in the "stopping depth," so a "start depth" is not required, but it is recommended since it may help to keep the data organized. When entering data, there are several things to be aware of. The labels that will eventually appear below each pit in the plot along the x-axis, are in the cells above the snow type (cells D2, F2, H2...). The cells just to the left of each of those (C2, E2...) are not used by the macro, and can be used for notes, etc. (In this example, that space is used to track the date).

Figure 2. Data entry worksheet area.

After the data is entered, you can run the macro. To do this, select "Macros..." from the Macro sub menu from the Tools menu (see Figure 3). After selecting "Macros..."a dialog box will appear. From this dialog box, run the "SnowPit" macro.

Figure 4 depicts the form that appears after running the "SnowPit" macro. On the "General" tab of the form, replace the text box "Title of Graph" with the title that will appear on the plot. Use the two scroll bars to set the width and height of the plot. Alternatively, if you wish to select a standard width for putting the plot into one column of a
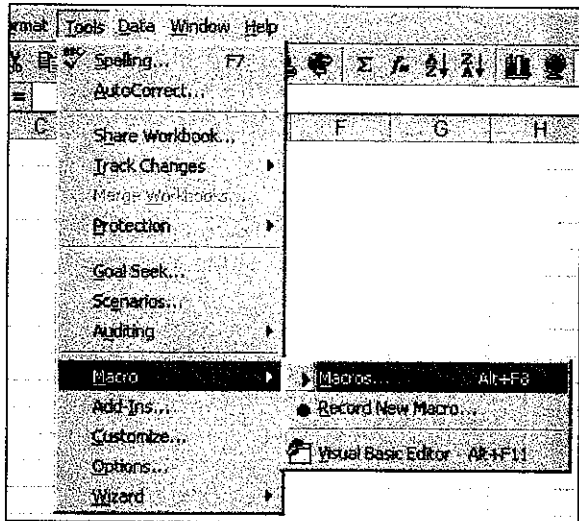
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Figure 3. Selecting "Macros..." from the Tools menu.

double column report, push the "1 column" button. Or, if you wish to select a standard width for putting the plot the whole way across the printed page, then push the "full column" button. Now choose the
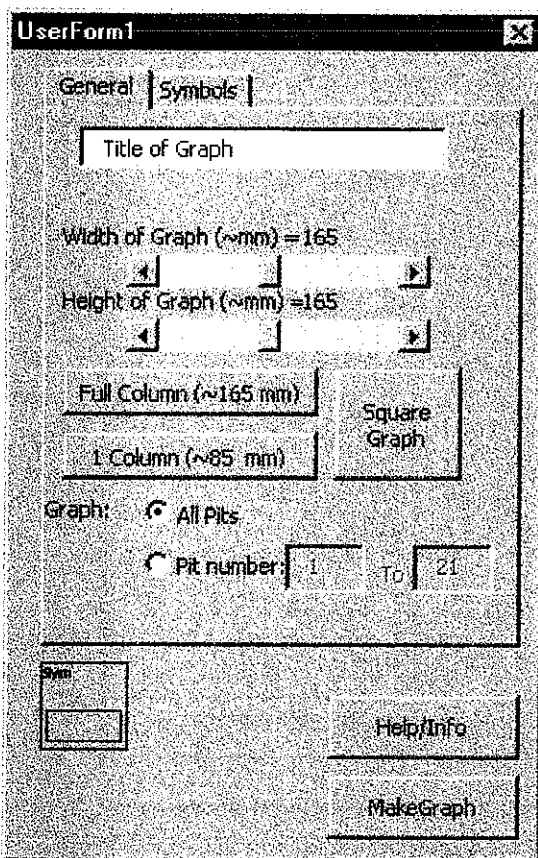

Figure 4. Form to control the graph size.

number of snow pits to be plotted. This is done by using the radial buttons (the small round spaces on the form, see Figure 4). If you select the "Pit number" option, then enter the range corresponding to the order that they were entered to the "dataentery" worksheet, not actual pit numbers or date range.

Under the "Symbols" tab, one has several options to control the use of symbols in the plot (see Figure 5). The check boxes next to "Symbols" can be used to turn the symbols for grain shape on or off. If symbols are "on," the user has the option of
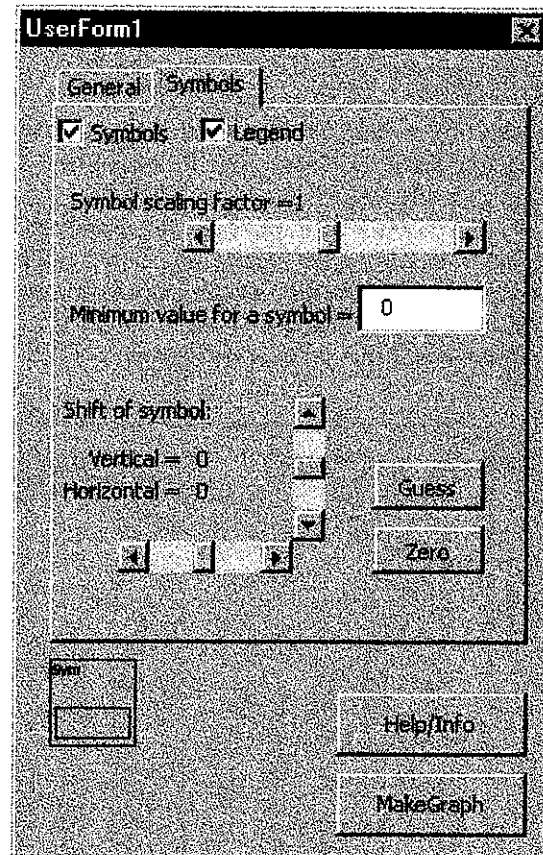

Figure 5. Form to control symbols on the graph.

displaying a legend. The legend check box turns the legend on or off. The "Symbol scaling factor" slide bar gives the user control over the size of the symbols on the plot. Ice layers (8a, 8b, 8c) are colored in black, while the crust layers (9a, 9b, 9c, 9d, 9e) are shaded in gray. Because on plots with lots of thin layers, the symbols tend to print over one another, there is a "minimum value for a symbol" option. When a number is entered in here, all layers smaller than that number will not have a symbol (ice

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and crust layers will still be black and gray respectively). When making plots, Excel has a tendency not to line things up predictably. This affects the symbol alignment. To compensate for this there is a "Shift of symbol" option. Most of the time pressing the "guess" button will get good results, but because there are so many variables, it may be necessary at times to adjust the shift using the scroll bars on this form.

Notice that as one makes changes, they will affect the box in the lower left corner of the user form. This box provides quick feedback about the size and shape of the plot, and whether the symbols and a legend are turned on. If everything looks good, then you are ready to continue. To allow the macro to finish and produce the plot, press the "Make graph button". After several seconds (to several minutes depending on hardware and number of plots) the snow pit profile will appear on the spreadsheet. One may now edit the plot as desired.

There are several important things to keep in mind when editing the graphs. The most significant is that currently SnowPit 98 can support only one plot per Excel97workbook. Therefore it is recommended that the user makes copies of the
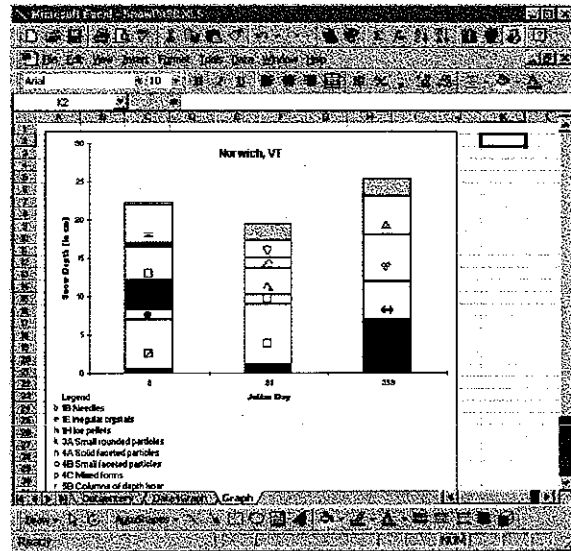

Figure 6. A sample plot in Microsoft Excel.

original workbook, and use those to make various plots. Also keep in mind that if one runs the macro a second time after modify the original, the original will be lost when the new plot replaces the old plot. A dialog box will remind the user of this, but
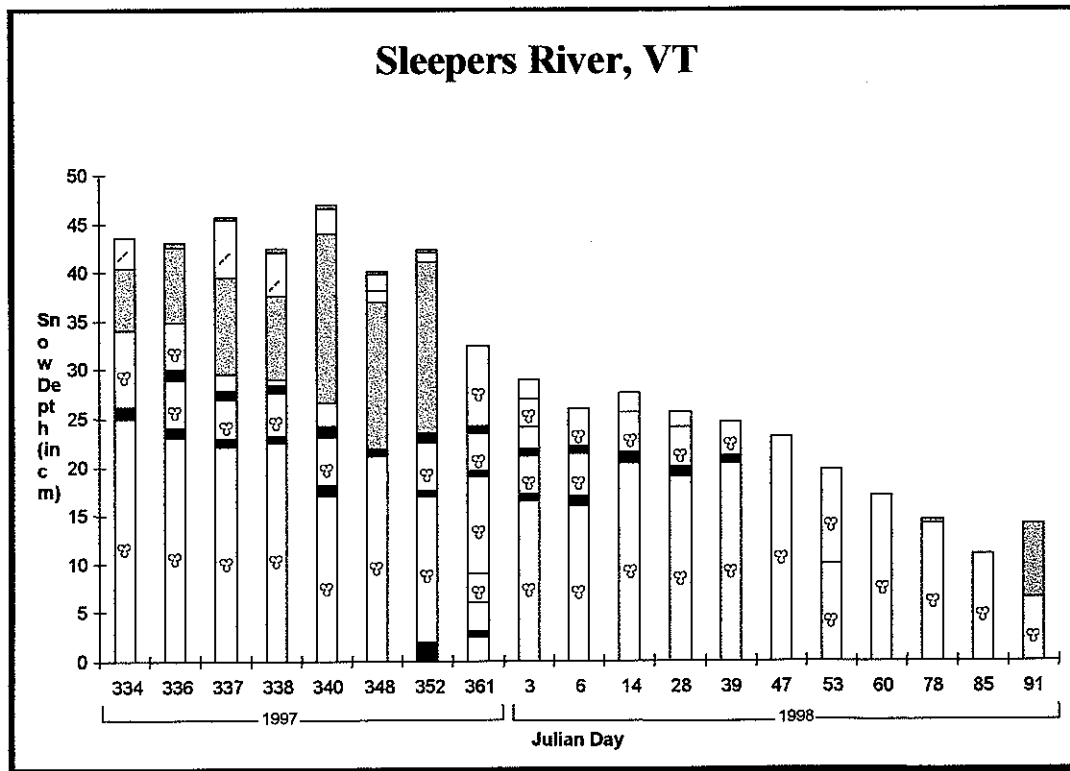

Figure 7. A sample time series of snow pits are plotted.

unfortunately in the current version there is no way to abort.

Because SnowPit 98 uses a custom font ("Snow"), this font must be included with the plots if they are given to another user for post production work.

Figure 6 depicts a sample plot as it appears on the screen. This plot can be edited in the same manner as other Excel charts (plots) are edited. For example, the user could now edit the text along the axis.

Figure 7 shows a sample final plot. In this example we have plotted three snow pits, but there could be as few as one, or as many as desired.

CONCLUSION

In this paper we have presented SnowPit98, a new macro for plotting snowpack stratigraphy, and a custom font, "Snow," for snow symbols. Both SnowPit98 and Snow are designed for use within Microsoft Excel97. SnowPit98 will enable those working with snow pit data to easily portray their results. Because of its ease of use, and fast results, this macro should eliminate the need for extensive pre-production work. This will increase quality of the investigator's output, while decreasing production times and cost. Future improvements include units that are the choice of user (depth and label), the ability to plot snow density, wetness and hardness, the ability to put multiple plots in one workbook, alterations so that ice and crusts don't need to be black and gray, and the ability to abort so that old plots aren't destroyed.

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