

A PRACTITIONER'S PERSPECTIVE: PROVIDING TIMELY AND RELEVANT MOUNTAIN WEATHER INFORMATION TO AVALANCHE WORKERS AT SNOWBASIN, A SUN VALLEY RESORT AND THE FOREST SERVICE UTAH AVALANCHE CENTER

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ABSTRACT: Utah's Wasatch Range is fortunate to have over 40 automated mountain weather stations, but how do you make all of these data useful to ski patrollers and backcountry avalanche forecasters in time for a morning control route or backcountry avalanche advisory? In an attempt to obtain meaningful information from this data, a program was developed to summarize data tables from Internet websites. The outcome was an easy-to-use weather summary that can be accessed from a home computer. The program has been used to improve efficiency at Snowbasin, A Sun Valley Resort and the Forest Service Utah Avalanche Center.

Keywords: meteorological data, automated weather station, graphical summary, avalanche forecasting

1. INTRODUCTION

Mountain resorts and backcountry avalanche centers use remote weather stations to collect and store various meteorological data. Displaying the data in a meaningful and timely manner for use by patrollers and forecasters can be challenging. A program, called the "Snowbasin Weather Summary" was developed to help solve this problem.

Data are collected at automated weather stations operated by ski resorts and other institutions. The data are automatically accessed by National Weather Service computers and then posted to their website for public use. The Snowbasin Weather Summary queries this website and retrieves hourly data from seven mountain weather stations for the previous 24-hour time period (see Figure 1). These data are processed, summarized and graphically displayed to show trends over the time period.

2. BACKGROUND

The program was originally written to assist two patrollers in summarizing website-posted data tables and recording daily observations. At the

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time, data columns were skimmed or totaled to obtain maximum and minimum temperatures,

average wind speeds, directions and gusts, barometric pressure, snowfall and snow water equivalents. Early versions of the program improved the efficiency of data summary and used graphs to show trends.

Within a year, the program was enhanced and adapted to meet the specific needs of the Snow Safety Department at Snowbasin. Improvements included graphs of relative humidity and percent of precipitation versus wind direction. Feedback from patrollers helped to make the graphs more user friendly. The summary is posted daily and discussed at the morning meeting. Each patroller has access to a personal copy of the program for use at home. Both the patrol and home versions are in the same format.



Figure 1: Automated weather stations at Snowbasin (▲).

A copy of the program was also provided to the Salt Lake office of the Forest Service Utah Avalanche Center. Two of the forecasters were immediately interested in using the program to assist in developing backcountry avalanche advisories. They used the basic structure of the Snowbasin Weather Summary to develop a similar tool for summarizing data from many weather stations throughout the Wasatch Range. The

program is currently used in regular forecasting operations.

3. PROCESS

The “Web Query” function in Microsoft® Excel enables the program to access and retrieve data from external sources, such as a website-posted data table. Using this function and Visual Basic programming language within Excel, the program retrieves the latest weather data from multiple web pages, inserts the data into a spreadsheet, manipulates it, runs error checks, and then summarizes the data into color-coded tables and graphs (See Figure 2).

through spreadsheets, databases and graphs. Access to this information, however, is typically unavailable to individuals unless they are at the ski area or avalanche center. Because this program is Internet-based, the summaries are readily accessible to every patroller and backcountry forecaster while away from work. It only requires a computer with Microsoft® Excel and Internet access. That means a forecaster can stay up-to-date during their days off or on a trip out of town and a ski patroller can review the summary while eating breakfast on a control morning (See Figure 3). Patrollers can also use this “early” report to begin preparing for their control route while driving to work.

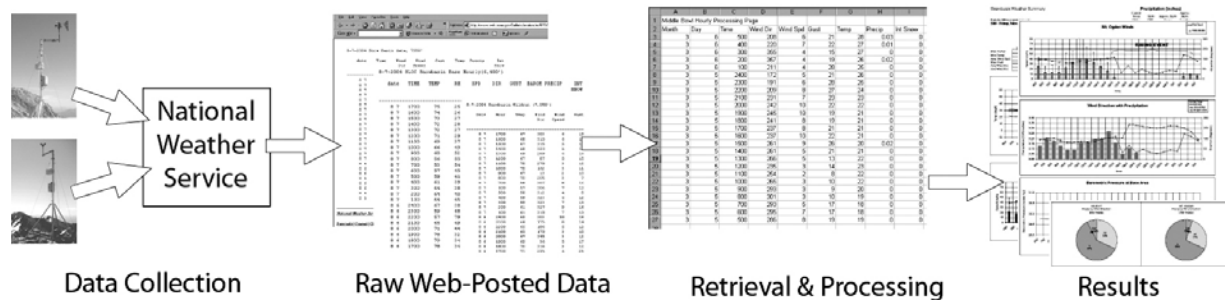


Figure 2: Process diagram for Snowbasin Weather Summary.

4. BENEFITS

Data loggers are capable of collecting enormous amounts of data. It is important that these data be summarized and presented rapidly for interpretation by avalanche workers. This program is fast, concise, easy to read, easily accessible and useful for avalanche forecasting.

The program saves time. Instead of scrolling down data tables and calculating totals to get a feel for the weather conditions, patrollers and forecasters can accomplish the same goal with one click of the mouse.

The program is concise and easy to read. By filtering out unnecessary data and clearly summarizing what is relevant, patrollers and forecasters can observe only what is important in affecting avalanche danger. This improves efficiency and ultimately leads to better decision-making. An example output is shown in Appendix A.

The weather summary is easily accessible. Many avalanche programs summarize weather data

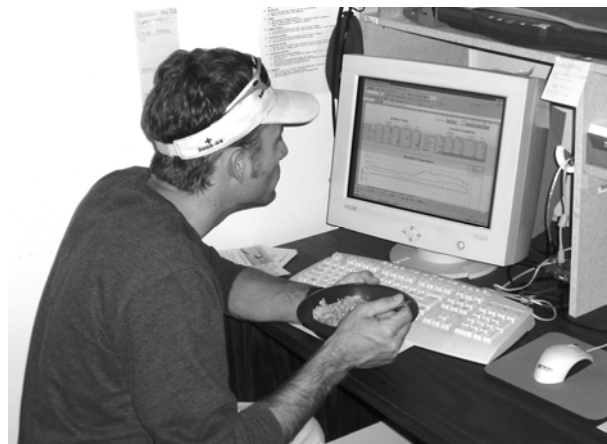


Figure 3: Accessing the weather summary from a home computer.

The weather summary can help to develop forecasting skills. Avalanche workers use weather and avalanche patterns, both spatial and historical, to assist in predicting future avalanche activity. The summary can be used to develop a hypothesis of the current conditions, which can then be tested in the field (See Figure 4). Over time, and combined with hands-on experience, the

weather summary can help patrollers and forecasters develop a graphical “memory” of these patterns to help predict future activity in their specific route or area.



Figure 4: Snowbasin Patroller reviewing weather summary before starting a control route.

The program is very flexible and could be adapted to meet the needs of other ski areas and avalanche centers, provided the desired data could be posted to a website.

5. LIMITATIONS

The program works reliably, but the output still depends on the quality of the input data. For a variety of reasons, weather stations can periodically produce erroneous data. Some of these errors can be filtered and identified with proper programming, but ultimately, it is the user's responsibility to correctly interpret the data. Rime, ice, damaged telephone lines, power problems, Internet congestion and other factors can also cause data to be completely unavailable.

6. CONCLUSIONS

The Snowbasin Weather Summary and the version used by the Forest Service Utah Avalanche Center have proven to be useful tools for patrollers and forecasters. In addition, the summaries are concise, easy to read, accessible and save time. Other ski areas and avalanche centers could use similar programs to understand and utilize weather information more efficiently.

7. ACKNOWLEDGEMENTS

G.R. Fletcher helped to develop the original program and his ideas have greatly improved the weather summary. Many individuals from the Snowbasin Ski Patrol, Snow Safety Department and the Forest Service Utah Avalanche Center contributed and offered suggestions for improvements. Snowbasin, A Sun Valley Resort and the Forest Service National Avalanche Center provided financial assistance for the presentation of this paper.

Appendix A: Example Snowbasin Weather Summary output for April 28, 2004 showing a frontal passage. The output uses U.S. Customary units. The Top of Strawberry and Strawberry Tower 2 weather stations are out of service.

Snowbasin Weather Summary

Data for 24-hour period prior to:
1800 - Wednesday, April 28, 2004

Precipitation (inches)

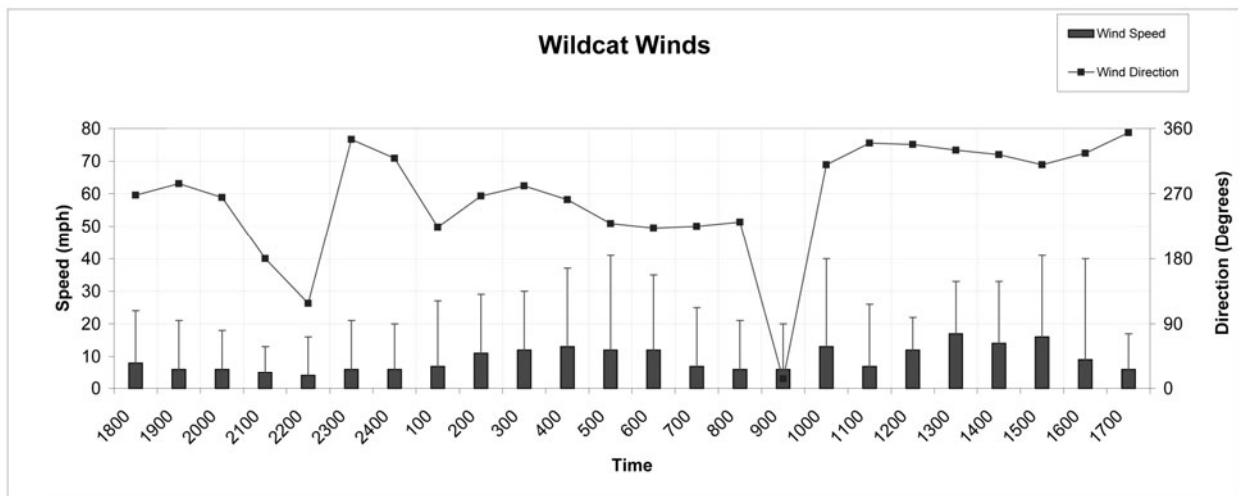
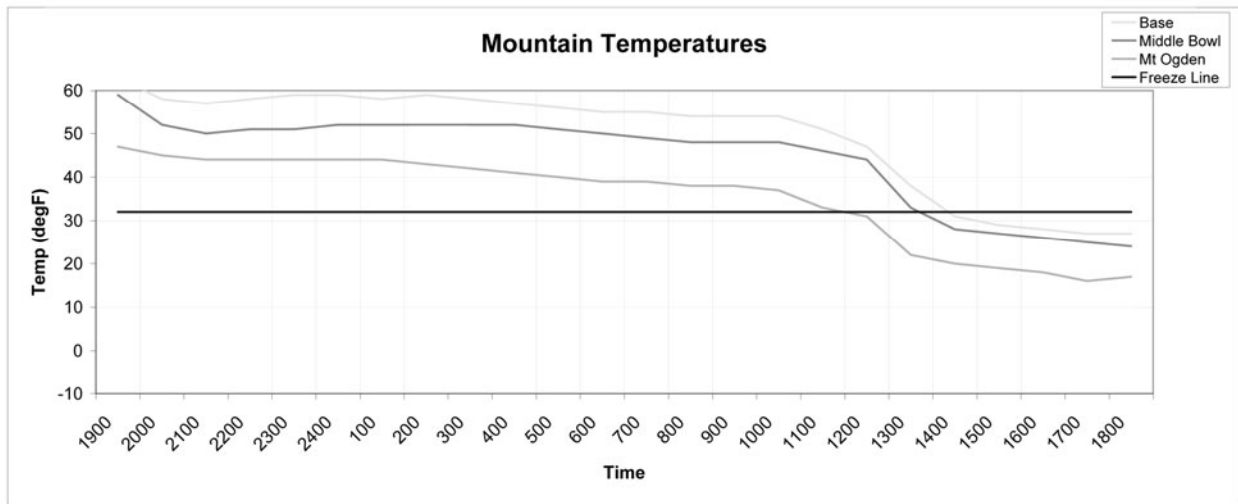
	Current Snow Stake:	24-Hr SWE:	Approx. 24-Hr Snow:	Approx. 24-Hr Density:
Middle Bowl	4	0.29	4	7%
Base	2	0.25	2	13%
Straw Twr 2		0.00		

24-Hour Totals

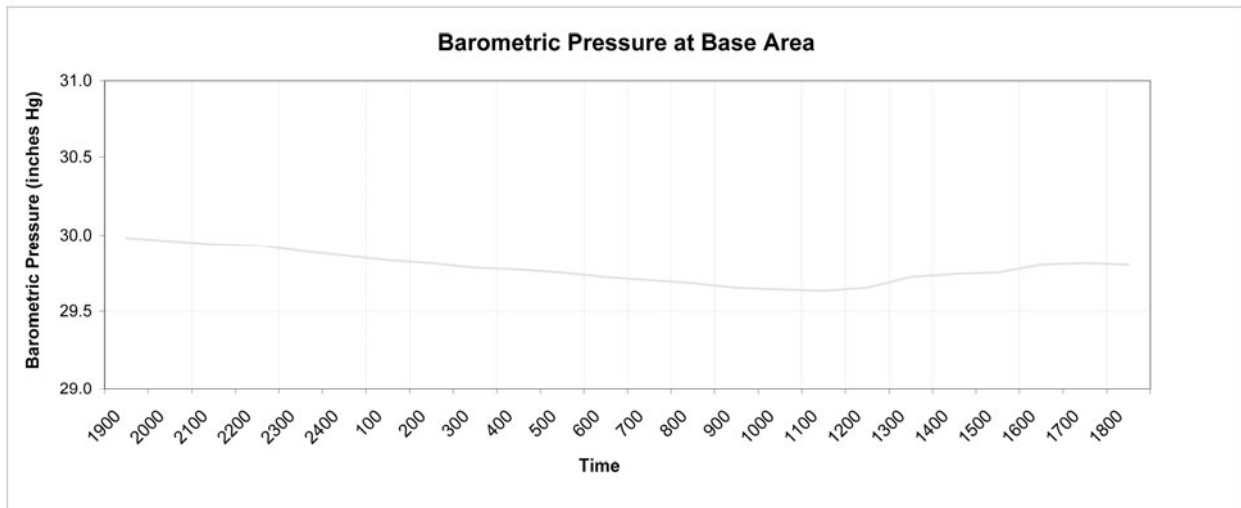
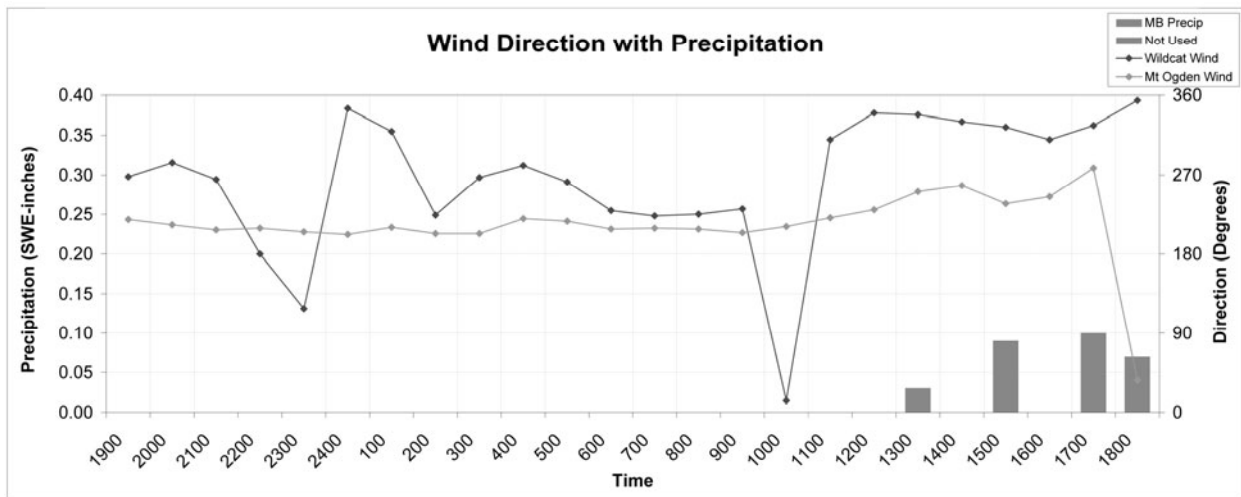
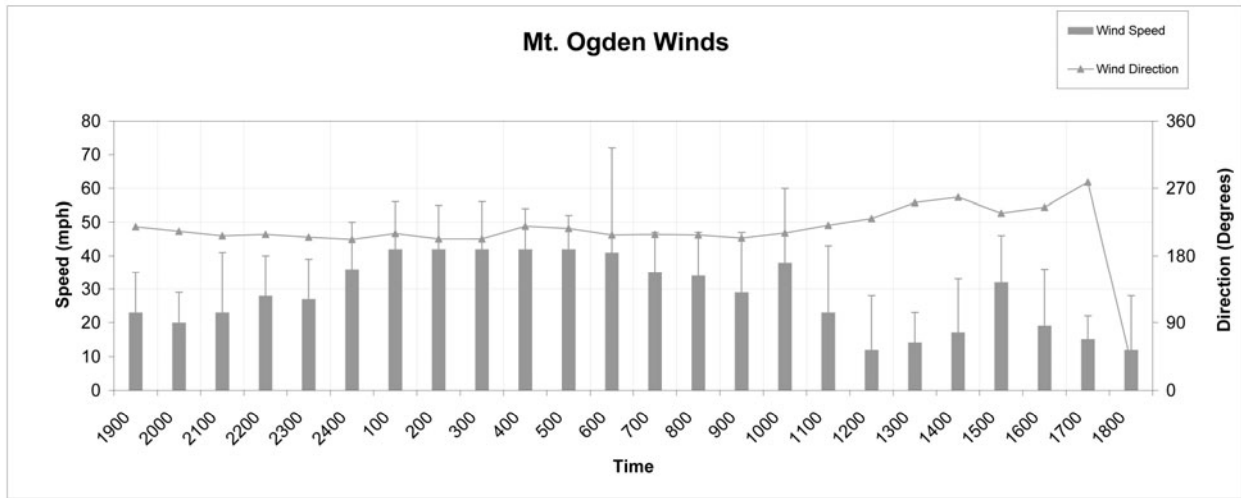
	Base	Middle Bowl	Wildcat	Top of Strawberry	Mt. Ogden
Max Temp:	63	59	55	0	47
Min Temp:	27	24	22	0	16
Ave. Wind Spd:	6	15	9	0	29
Max Gust:	28	25	41	0	72
Ave Wind Dir:	NE	SW	W	-	SSW
Ave Wind Dir:	50	217	265	0	213

Current Conditions

	Base	Middle Bowl	Wildcat	Top of Strawberry	Mt. Ogden
Last Update:	1800	1800	1700	0	1800
Temp:	27	24	22	0	17
Wind Spd:	2	1	6	0	12
Wind Dir:	S	NNW	N	-	NE
Wind Dir:	189	341	354	0	36
Barom:	29.80				



Appendix A (continued)



Appendix A (continued)

