GRAPHICS SYSTEM FOR SNOTEL DATA*

by

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INTRODUCTION

The Soil Conservation Service (SCS) gathers snowpack data with an automated telemetry data acquisition system called SNOTEL. Selected SCS offices, designated Data Collection Offices (DCO's), are responsible for SNOTEL maintenance, data editing, and ensuring overall data quality. As a part of the quality control procedure, a new mini-computer based graphics software package has been developed to replace an existing procedure which is of limited capability. This package provides the user with the ability to download data from the SNOTEL central computer in Portland, Oregon, and file, graphically display, edit, and upload the data back to the central computer.

The graphics package manages three basic types of data: 1) physical sensors, 2) remote maintenance parameters (RMP), and 3) ground truth. SNOTEL sensor data includes snow water equivalent, precipitation and temperature readings. RMP data are comprised of eight diagnostic parameters from each site which are used to analyze the site's telemetry equipment "health." Ground truth data includes pillow manometer, precipitation manometer, federal sampler measurements on the perimeter of the snow pillow pad, and snow course readings at an adjacent snow course, if present.

The current graphics package, called Tektronix Graphics System (TGS), is designed to run on Tektronix 4050 series computer systems and is written in BASIC. This package allows the user to download data from the SNOTEL computer system, store the data on diskettes, edit the data, plot the data, list the data, and upload the edits to the SNOTEL central computer. Downloading and uploading are accomplished through telephone communications.

TGS has many limitations. The data are stored on diskettes which hold only four site files each. Therefore, the user is constantly swapping diskettes. The 4050 series terminal has a monochrome screen, so all color plots must be done on a plotter which is extremely slow. There is no capability to manage and plot RMP data and no capability to store and display ground truth information. Because Tektronix is no longer supporting the equipment, many parts are not available and some equipment is not repairable. Therefore, a new graphics package which would replace the equipment and software needed to be developed.

3B2 GRAPHICS SYSTEM

The replacement package for TGS was designed to be hosted on an AT&T 3B2 central processing unit. A large number of these machines are being deployed at SCS field offices. The 3B2 machine has multi-user, multi-tasking capability and supports substantial peripheral disk storage. The new software was dubbed 3B2GS (for 3B2 Graphics System). It is designed for interactive processing. 3B2GS will incorporate many of the existing TGS software features and make major enhancements including additional capabilities such as dynamic editing of graphical displays, downloading (SNOTEL) directly to a database resident on a hard disk, processing and plotting RMP data, and entering and uploading ground truth data.

3B2GS will be able to drive Tektronix (TEK) 4111 color (or compatible) terminals and AT&T PC-6300 microcomputers and run in the UNIX operating system. This equipment is consistent with the SCS computer compatibility goal since PC-6300 terminals will be installed at all levels in the field.

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The 3B2GS design includes seven major processes which are: 1) download, 2) list, 3) plot, 4) edit, 5) upload edits, 6) input ground truth, and 7) upload ground truth. The following is a brief description of each process.

1. The download process receives data from the SNOTEL computer system and processes the data into files which are stored by water year on the 3B2 hard disk.

2. & 3. The list and plot processes access the 3B2 hard disk site files and output the data to reports and color plots.

4. The edit process accesses the 3B2 hard disk site files and allows the user to change the data. The user can edit via the keyboard and/or graphically with cursor control.

5. The upload edits process transfers the data edits from the 3B2 to the SNOTEL computer system. The edits are moved from the 3B2 hard disk site files into a temporary file and then transmitted up to SNOTEL.

6. The input ground truth process allows the user to locally input ground truth data from snow notes to 3B2 hard disk site files. The method of input will conform to the file structure conventions used in the Centralized Forecasting System (CFS) for performing multi-year quality assurance analysis.

7. The upload ground truth process accesses the ground truth 3B2 hard disk files and uploads the data to the CFS STAG database.

Most of the package is written in the C programming language; graphics primitives are from the Simple Graphics Package (SGP), also written in C. The use of C programming language within the UNIX operating system makes 3B2GS portable. SGP is the graphics development tool kit used to drive graphics utilities in CFS. This situation will create commonality between CFS and 3B2GS modules.

MAJOR FEATURES

The software is menu driven for easy use. Downloading and processing is done directly to a database on the 3B2. The TEK 4111 color screen has zoom capability and screen displays can be copied within two minutes. Manipulation of RMP and ground truth data and dynamic editing are features not currently available on TGS.

Dynamic editing is the graphical process of editing data. It includes windowing (framing a specific area of the plot), zooming (enlarging the area within that window), adjusting crosshairs on the screen with thumbwheels, replacing points on the screen, redrawing of the plot with the new points, and revising the data values in the database.

SAMPLE APPLICATIONS

RMP data can be downloaded and stored to permit an entire water year to be plotted and listed at one time instead of just the thirty days currently available on the SNOTEL central computer. The eight diagnostic parameters, which reflect the previous 24 hours ending at midnight, are: 1) receive signal detection count, 2) receive synchronization (sync) detection count, 3) transmit count, 4) acknowledge count, 5) receiver detect radio frequency (RF) value, 6) normalized transmit battery voltage, 7) forward transmit voltage and 8) reverse transmit voltage. 1) Receive signal detection count is an average of the total number of times the site detected an RF signal which exceeded a predetermined strength level. 2) Receive sync detection count is an average of the total number of times the site detected a sync pattern from the master stations. 3) Transmit count is the number of times the remote transmitted data. 4) Acknowledge count is the number of acknowledgement messages the remote received from the master stations. 5) Receiver detect RF value is a measure of the RF activity seen at the site. 6) Normalized transmit battery voltage is the battery voltage measured while the site is activated. 7) Forward transmit voltage is a measure of the power driving the site antenna during the most recent transmission. 8) Reverse transmit voltage is the power reflected by the site antenna. Figure 1 is a sample of an RMP plot which demonstrates the relationship of the forward transmit voltage (FPWR) and normalized transmit battery (BAT%). As battery strength diminishes, the forward power also declines.

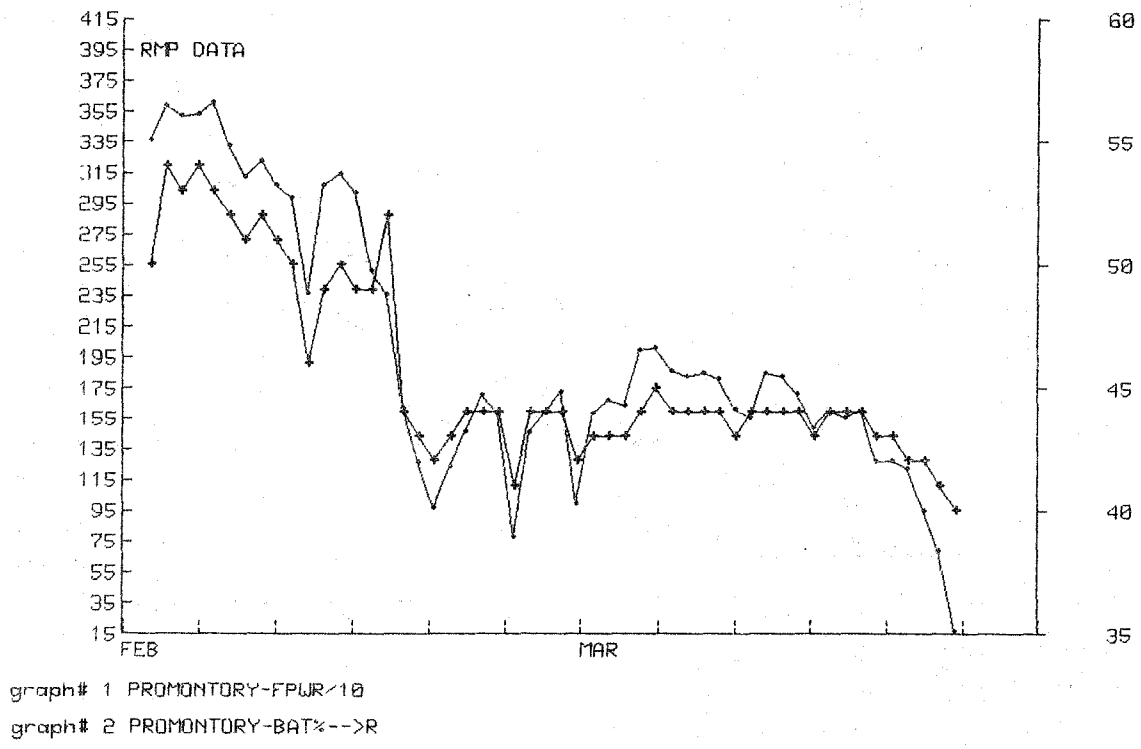

Figure 1. RMP plot demonstrates the relationship of the forward transmit voltage (FPWR) and normalized transmit battery (BAT%).

SNOTEL data can be plotted with multiple sites, multiple sensors, and one or two Y axes. The maximum limit of plot lines per graph is eight giving the user extensive flexibility in site and sensor selection. Comparisons such as snow water equivalent (SWE) versus precipitation on one or more sites and SWE or precipitation on multiple sites will aid in data editing and verification. The addition of the right Y axis scale allows the user to plot data with large differences in values to obtain the best spread of points for each sensor. For example, a double Y axis graph could plot SWE and precipitation scaled to the left axis and temperature scaled to the right axis (see figure 2).

SUMMARY

The 3B2GS graphics package is the TGS graphics software replacement and is currently under development. Completion of the 3B2GS prototype is targeted for June 1987. An implementation plan for equipment procurement, equipment distribution, and software distribution to SCS field offices will be developed by September 1987. The operational 3B2GS software package will be available for SCS Snow Survey Offices by September 1988. 3B2GS features will significantly enhance many tasks such as equipment maintenance, data editing, and data analysis which are all part of quality control.

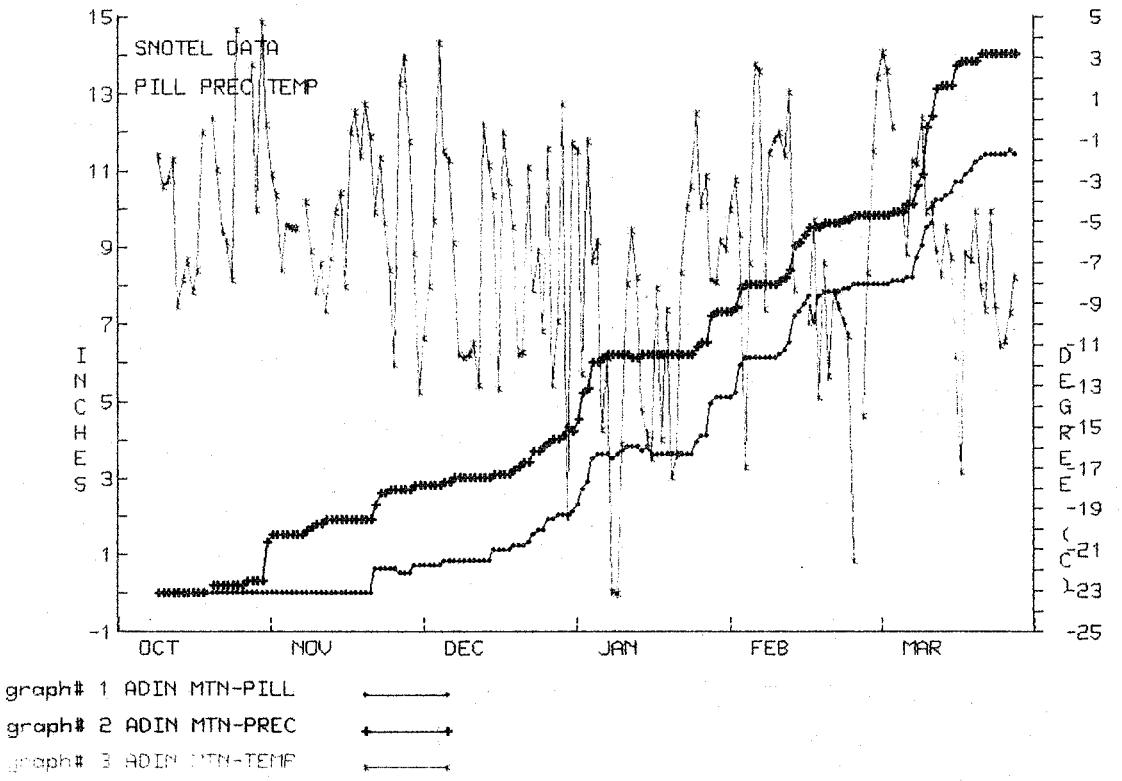

Figure 2. SNOTEL data plot which scales SWE (PILL) and precipitation (PREC) to the left axis and scales temperature (TEMP) to the right axis.

REFERENCES

Crook, A. G. and D. E. Johnson (1987) Characteristics Of The SNOTEL Data Acquisition System.