BC MINISTRY OF TRANSPORTATION AND HIGHWAYS
REMOTE WEATHER STATION SYSTEM OVERVIEW

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Introduction

The British Columbia Ministry of Transportation and Highways Snow Avalanche Section currently maintains a province-wide network of 22 remote weather stations. The majority of the stations have been installed since 1984 and incorporate 'state of the art' components and software.

In any one avalanche hazard area the weather station system may consist of a series of stations. Each station contains a number of environmental sensors connected to a micrologger which manipulates, stores, and then transmits the sensor data via a radio link to a local base station. A mini computer, located in Burnaby, collects the data from all stations province-wide and then transmits the same to the mainframe computer in Victoria. The data is then archived and available for analysis and reporting.

Weather Stations

The weather stations are situated at mid-starting zone or ridgetop elevations and consist of a sensor array, micrologger (Campbell Scientific), radio package, power supply, and environmental building. Most sites are accessible by helicopter only.

Some, or all, of the following environmental parameters are measured: wind speed and direction, air temperature, relative humidity, precipitation, and snow temperatures.

The system is flexible enough to allow for a wide variety of sensor input. Snow pillow and snow glide sensors have been incorporated into some existing systems, providing data for other agencies.

The sensors measuring snow temperatures and precipitation as well as an effective anti-riming system have been adapted, developed and in part, manufactured by Snow Avalanche Section (SAS) staff.

Base Stations

The base stations are located in a local Ministry office and are composed of a standard Compaq PC (640K), Campbell Scientific Inc. (CSI) PC201 card (installed in PC) and power controller (PC203), radio package, printer, and Hayes telephone modem.

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The Campbell Scientific PC203 and PC201 card allow the base station to function unattended, calling the weather stations at pre-determined intervals. Using the (CSI.) PC205 software, we are able to manually communicate with the individual weather stations to alter programming, sampling rates, and conduct troubleshooting procedures.

We presently retrieve data hourly in normal conditions and every 10 minutes in a manually-initiated "storm mode". The data collected is stored on a floppy disk for three days and a plain-language hard copy is printed out. The 'data' disk also stores both system log and error files produced by the PC205 software to assist in system performance analysis and troubleshooting.

Communications

The radio communication for the system, including repeaters, is handled by Motorola HT90 radios modified by CSI and CSI DC95 radio frequency (RF) modems. A DC95 modem installed in a weather station can also function as a repeater for a station farther down the RF path.

All weather stations communicate via RF links. Our experience with land lines has been less than satisfactory with lengths greater than 500 metres. Problems with transient currents and damage caused by animals and lightning have made long lengths of land line a poor investment.

Computer Linking and Long-term Storage

A Northern Telcom 585 mini computer located in Burnaby is the active component in the computer linking operation. Every hour the NT 585 calls all the base stations province-wide via telephone and collects the available data.

The NT 585 then transmits the data via telephone to the IBM mainframe computer in Victoria. The data is stored in an on-line file for approximately five days and then archived where it is available for historical analysis and reporting. The NT 585 also transmits the data to the Pacific Weather Centre of the Atmospheric Environment Service (AES) for their use in weather forecast generation.

For analysis the local Avalanche Technician currently has immediate access to the three days of data stored on the base station data disk and his file of hard copy printouts. For access to further historical records a request to the Victoria office provides the data. In the near future approximately five years of data will be stored on a 20 mb disk in the technician's data entry computer.

Software

The software used to run the base stations and microloggers is a combination of programming developed by Campbell Scientific with additional features added by Ministry programmers.

Sampling Methods

Sampling methods and calculations performed by the microloggers provide us with:

Air temperature	-	present and 12-hour maximum/minimum
Wind speed	-	point observation
	-	vector magnitude and maximum speed
Wind direction	-	point observation
	-	vector magnitude and standard deviation
Precipitation	-	total (in gauge)
	-	hourly accumulation
	-	12-hourly accumulation

NOTE: All present or point observations are done on the hour or every ten minutes in 'storm' mode.

Troubleshooting

The base station software contains functions with numerous troubleshooting capabilities. From the base station the user is able to alter micrologger programming, modify telecommunication parameters, observe communication quality, etc.

Communication system troubleshooting is facilitated through the use of a compact test kit assembled by Snow Avalanche Section staff using a Radio Shack RS102 portable computer which is configured to a standard radio package. This portable system enables the user to communicate directly with any part of the RF network regardless of its location.

Conclusions

Since 1985 many hours have been spent sorting out the various 'bugs' that the installation of a new system seems to create. In general we are satisfied that the system is providing us with consistent, reliable data and records.

It appears to be the norm for high tech companies to market products which are still in the latter stages of development. It is therefore very important to work closely with the manufacturers during all phases of implementation. A company representative available on site to direct the initial installation could be invaluable in terms of learning about the new system and savings in troubleshooting dollars.