



# Water content reflectometer gives improved accuracy

A new version of the Water Content Reflectometer, the CS616, is available from Campbell Scientific. The CS616 improves upon the measurement accuracy of the CS615 while matching its resolution and precision. New features include improved electrostatic discharge protection and reduced measurement time and sensitivity to signal attenuation. The improvements come from a refined circuit design and use of new surface-mount electronic components that provide better high-frequency performance. The CS616 can be ordered with lead lengths up to 1000 feet.

Like the CS615, the CS616 consists of two 30 cm stainless steel rods that connect to an epoxy-encapsulated printed circuit board. The differentially driven rods form a transmission line with a wave propagation velocity that is dependent on the dielectric permittivity of the medium surrounding the rods. Nanosecond risetimes produce waveform reflections characteristic of an open-ended transmission line.

The return of the reflection from the rod ends triggers a logic state change that initiates propagation of a new wavefront. Since water has a dielectric permittivity significantly larger than other soil constituents, the resulting oscillation frequency is dependent upon the average water

content of the medium surrounding the rods.

The megahertz oscillation frequency is scaled down and easily read by Campbell Scientific's CR510, CR10X, CR23X or CR5000 dataloggers. The probe rods can be inserted from the surface or buried at any orientation to the surface.

Each CS616 requires a single-ended input channel along with a control port to enable the probe. Multiple probes can use a single control port. Instruction 138 has been developed to measure the CS616 with the CR510, CR10X, and CR23X; measurement time is approximately 0.5 milliseconds. The period averaging instruction, 27, can also be used with the CR510, CR10X, and CR23X dataloggers. The CR5000 uses the PortSet and PeriodAvg instructions to measure the probe. Consult our product literature for versions of PC208W, LoggerNet, and datalogger OS that support Instruction 138.

Operating specifications (VWC = volumetric water content)

- probe-to-probe variability:  $\pm 0.5\%$  VWC in dry soil,  $\pm 1.5\%$  VWC in typical saturated soil
- accuracy  $\pm 2\%$  VWC using standard calibration with bulk electrical conductivity  $\leq 0.5$  deciSiemen

meter<sup>-1</sup> in the 0% to 50% VWC measurement range

- precision 0.05% VWC
- resolution 0.1% VWC



The CS616 water content reflectometer (shown with the CR10X) improves upon the measurement accuracy of the CS615 while matching its resolution and precision.

JULY 1999 VOL. 24 NO. 7



**Executive Editor:** Claude Labine

**Managing Editors:** Jeff Goalen  
Brian Day

**Assistant Editors and Design:**  
Tracy Weber Davidson    Jared Thayne  
Tim Abel                      Carl de Leeuw

**Contributing Writers:**

Claude Labine	Clyde Best
Rachel Christensen	Betsy Dastrup
Tim Davenport	Tracy W Davidson
Bryan Dixon	Tim Jeppsen
Rick Spielmaker	Sid Stock
Michael Thurgood	Dana Whorley
Linda Worlton	

**Graphics/Photography:**

Hoa Pham	Brian Atkinson
Jared Thayne	Kevin Jeske

## Faster SC32B replaces the SC32A

The SC32B has replaced the SC32A as our Optically Isolated RS-232 Interface between a datalogger CS I/O port and a computer serial port. The SC32B ships with a 9-pin to 9-pin serial data cable and an SC12 cable. The SC32B supports data transfer rates up to 115 kbps, so you can transfer data at the highest rate possible by your datalogger.



## SDS511: Add multiple devices to a datalogger

Developed by Campbell Scientific Australia, the SDS511 is a dual port adapter. It allows customers to add multiple devices, such as a PDA and a COM210 to one datalogger. Communications are determined on a first-come-first-served basis.

The SDS511 has two ports. One port supports modem enable (ME) devices, the

other supports both synchronous devices for communication (SDC) and ME devices. Compatible SDC devices include the CR10KD keyboard display and COM300 Voice Synthesizer modem. Compatible ME devices include the CD294 DataView Display, PDA's, laptop computer, COM210 phone modem, and our CDPD digital cellular modems.

# Digital cellular modem efficient and rugged

## Access new Redwing Modem via the Internet

We have added a new digital cellular modem/transceiver, the Redwing. Manufactured by AirLink, the Redwing is a full-duplex unit that supports telecommunications via a cellular digital packet data (CDPD) network. CDPD modems are IP based, requiring an Internet address assigned by your service provider. By using the Internet to access your modem, you can eliminate long distance charges and dial-up time, pay for data throughput instead of airtime, and realize faster data throughput. Operating costs, initial equipment investment, and current drain are lower than analog cellular systems.

The Redwing is a rugged, lightweight modem that operates over  $-30^{\circ}$  to  $+70^{\circ}\text{C}$  and 5% to 95% RH. The data transmission rate is up to 19.2 Kbps via TCP/IP. Dialing delays are not required, allowing quick response for data communication. Built-in encryption maintains security of the data while transmitting.

The Redwing is a 600 mW modem with a typical current drain of 60 mA while receiving and 280 mA during transmission. A power cable included with the modem connects to the datalogger's 12 V or switched 12 V terminal. Connection to the switched 12 V terminal allows the datalogger to switch power to the modem during scheduled transmission intervals, thereby conserving power. If this method is used, the modem can be powered with a BP12 battery and an MSX10 solar panel.

Components required are a Campbell Scientific datalogger, serial interface (SC932A), Redwing modem, antenna, power supply, environmental enclosure, and instrument mount. Two antennas are available: a compact 0 dB and an 8 dB Yagi antenna. If the site is near the edge of the CDPD coverage, you may need the Yagi. Contact your local cellular company to verify CDPD service is available at your site.

Any user of cell phone technology should be aware that the field is still very much in flux. For example, we have had some difficulty in maintaining a long term supply of analog modems. Furthermore, we are told that CDPD support will tend to disappear over the next few years and be replaced with LX. Any user who wants long term stability with cellular phone technology should be aware of the continuing evolution of the technology.



*The Redwing allows you to shift from analog to digital cellular technology.*

## CSBUOY: Floating data, minimal setup

The CSBUOY is a wireless, floating, self-contained package that can be deployed with a minimal amount of setup. It offers a fish farmer or water resource manager the ability to monitor critical water quality parameters from the convenience of their office.

The CSBUOY monitor/transmitter is housed in a protective polyurethane buoy. It is powered by a 7 Ahr, 12 Vdc rechargeable battery continuously charged by a 5 W solar panel mounted on the buoy. Deployed anywhere in the pond, the CSBUOY transmits data back to the pond-side monitoring and control system via spread spectrum radio, thus eliminating the cost and inconvenience of burying cable. In typical applications, the CSBUOY can transmit up to three miles. Where greater distances are needed, a higher gain 3 dB antenna with a clear line-of-site can transmit over 10 miles. This wireless method also allows the option of moving the buoy from pond to pond. Two CSBUOY models are available.

The CSBUOY-DT is preprogrammed and includes water temperature and dissolved oxygen probes. An agitator brush attached to the dissolved oxygen probe cleans the membrane to eliminate biological fouling.

The CSBUOY-NS is a platform without probes. A variety of water quality probes, including SDI-12 models, are compatible with this buoy. Custom programming is required.



*Completely self-contained, the CSBUOY measures water quality parameters in fresh water.*

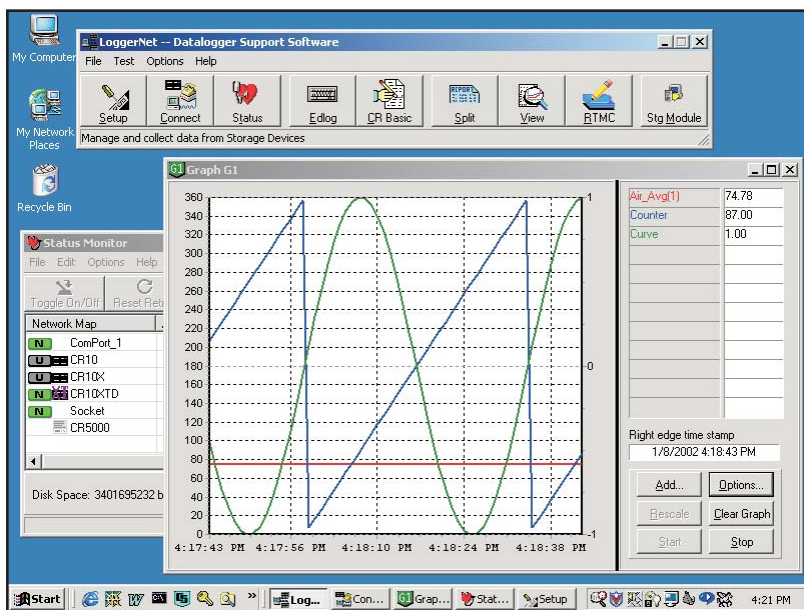
# LoggerNet 2.1 replaces PC208W

## *Array Based / Table Based Dataloggers. Loggernet handles them all!*

To date, most of our customers are using Array-based Dataloggers, including the CR500, CR510, CR10, CR10X, 21X, CR23X, and CR7X. "Array-based" describes not only the format of the data output, but it also the datalogger's operating system, underlying memory structure and the programming instructions. Although we will continue manufacturing Array-based Dataloggers for several years to come, we are migrating to new, Table-based Operating Systems, communications protocols and data formats. Although the availability of parts would eventually force us to move in this direction, the more compelling reasons are the advantages for our users. Right away, users will notice a data format that uses data labels in the first few lines of the data and standard strings for date and time, making it much easier to import data into other software. "Under the Hood", the communications with these dataloggers are packetized, which makes error-checking more robust and also makes it easier to move these packets over other communications technologies, such as TCP/IP. Several of the current dataloggers can be easily converted to this Table-based technology by simply downloading a new operating system. Newer dataloggers, including the CR200, CR5000 and CR9000 have not only adopted a Table-based technology, but are programmed in a new language, CRBASIC, which, because it's similar to other BASIC languages, is easier to use and more flexible. A new program in LoggerNet, CRBasic Editor, is used to write these programs.

We've started the conversion to Table-based technologies with existing dataloggers to ease our users' transition, but also to keep our prices lower - you can get the Table-based operating systems for CR510, CR10X and CR23X dataloggers at no charge from our WWW site.

Of course, we will continue selling, servicing and supporting Array-based loggers for many years (in fact, we're still supporting and repairing units that were sold over twenty years ago). However, we encourage new users, clients with large networks and those who want the benefits of more standard data formats, more robust communications and easier programming, to try the new Table-based technology. No matter which route you choose, however, LoggerNet can manage all of your dataloggers, and merge them seamlessly into one network.



## *Loggernet will now serve as the primary datalogger support software*

We have released LoggerNet 2.1 as our primary datalogger support software. LoggerNet is 32-bit software that provides many new features, including support for our Table-based dataloggers. We will discontinue to offer the 16-bit PC208W as of January 2003, however, we will continue to provide full technical support for many years to come.

LoggerNet 2.0 retains the significant functions of PC208W software, such as support for array-based dataloggers, telecommunications options, and scheduled data retrieval. LoggerNet includes 32-bit versions of Edlog (datalogger program editor), Split (processing data files and creating reports), View (graphing and viewing data files) and SMS (storage module support software). The files created by earlier versions of these programs are forward compatible; LoggerNet includes a software utility to convert PC208W network setups to

LoggerNet network setups. Additionally, new applications in LoggerNet, such as CRBasic Editor (CR5000 and CR9000 program editor) and RTMC (Real Time Monitoring and Control), provide new functionality. See the next page for a comparison of various display softwares available.

LoggerNet runs from a simple "PC208W-like" toolbar that controls both a server and its clients. You don't have to manage the log-ins, log-outs, and client-server communications. Most PC208W users will find LoggerNet both familiar and easy to use. You can customize the toolbar to provide easy access to the LoggerNet applications of your choice. PC208W owners can upgrade to LoggerNet for roughly 50 percent of the LoggerNet list price. Free "within-version" patches will be offered from our Web site as they are released (e.g., from LoggerNet 2.0 to 2.1).

### **Client-Server Power**

LoggerNet consists of a server application and several client applications. The server application is the heart of LoggerNet communications. Client applications connect to the server to change its settings, use its features, and extract data. One example of client/server architecture is email. When you send email, you're working with a client application on your PC (e.g., Outlook, Eudora, Pegasus). The client application sends messages to a server. The server connects with the Internet to send and receive email messages for you and others. You can instruct your client email program to connect to the server and retrieve any email message stored on the server for you.

# Comparing ViewDAQ, RTDM and RTMC

	Design Goal	Data Source	Real-Time Updates	Alarms	Designer Tool Kit	Availability
<b>ViewDAQ</b>	Graphically appealing; fast in direct mode; easy to use	CR5000, CR9000; other table-based dataloggers via OPC Server	Yes	Real-time; Audible; Persistent, requires user acknowledgement; Multi-level alarms possible; Alarm log	Alarms, Compasses, Dials, Dual Compasses, Flag controls, Gauges, Labels, LEDs, Numerics, Potentiometer controls, Sliders, Strip charts, Switch controls, Text boxes, Thermometers	Stand-alone product (demo available)
<b>RTDM</b>	Graphically appealing; flexible; powerful; exports images to Web site	Data files or LoggerNet Server	Yes	Real-time; Audible; Persistent, requires user acknowledgement; Multi-level alarms possible; Alarm log; Launch programs	Alarms, Charts, Dials, Images, Launch buttons, Scatter plots, Set points, Sliders, Snapshots, Tables, Toggles, Web Graphics and Numeric labels, Wind meters	Stand-alone product (demo available); run-time version available for OEM applications
<b>RTMC</b>	Starter software; simple	LoggerNet Server	Yes	Real-time; Audible	Alarms, COM check, Gauges, Graphs, Images, Labels, Numerics, Set point, Sliders, Status boxes, Table display, Time, Toggles	Included in LoggerNet
<b>View</b>	Quick and simple viewer for data files	Data files	No (historic only)	None	(1) Table and (1) Graph	Included in LoggerNet

## LOGGERNET...continued...

Similarly, the LoggerNet server is the program that runs on the main PC, which uses TCP/IP to communicate with client applications. You set up the network to use phone modems, telephony devices, RF modems, TCP/IP sockets and other devices to communicate with the dataloggers. The server stores the data in ASCII files. Both client and server applications can run on the same PC providing the "one computer feel" of PC208W. Alternatively, any PC can "talk to" the server via TCP/IP allowing the client PC's to be anywhere. Client applications set or change the network, request real-time connections to dataloggers (for setting the clock, sending programs, monitoring, etc.), or create new ASCII files. For LoggerNet 2.1, this only benefits those who use RTMC to view data from another PC. In future versions, other client applications will be able to use this function.

One of LoggerNet's new applications is the Real Time Monitoring and Control Client (RTMC). RTMC allows users to configure their screens to display and set input locations, flags and ports as well as view final storage data. It provides digital, tabular, graphical, and binary data objects, and alarms. RTMC can display data from any number of dataloggers in the network and organize the data on multi-tabbed displays. It offers a variety of background graphics, but allows you to supply your own graphics to customize your screen. RTMC saves forms that can be displayed on a run-time basis.

We're excited about the versatility and power that LoggerNet 2.1 brings to our customers. Combining the functionality of PC208W, LoggerNet 1.0, and Real Time Monitoring Software (RTMS) into LoggerNet 2.1 provides the ability to mix and match dataloggers and data acquisition needs on a common software platform. LoggerNet 2.1 is poised to take advantage of the new communications protocols now available, providing easy access to TCP/IP protocols and third party software programs.

# Permafrost stations add to High Arctic Monitoring

by Daniel Riseborough and Sharon Smith, Hazards & Environmental Geology Subdivision, Department of Natural Resources Canada; with additional notes by C. Labine

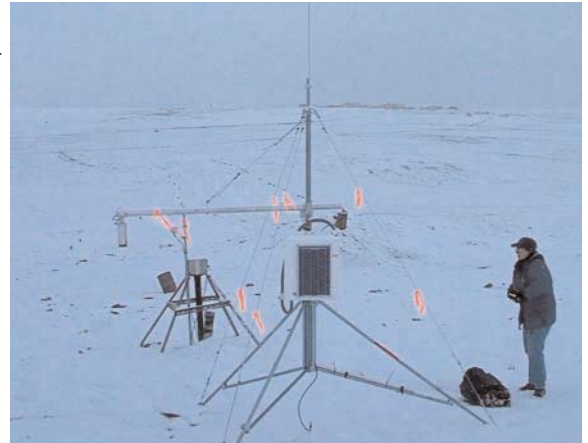
Permafrost, or permanently frozen ground, is a thermal condition. Its formation, persistence or disappearance is highly dependent on climate. Its distribution, temperature and thickness respond to natural environmental changes and anthropogenic disturbances that cause an alteration to the ground thermal regime. Changes in air temperature and/or precipitation, or surface disturbances due to clearing of vegetation, removal of insulating organic layer, forest fires, river channel migration, shoreline erosion all may produce a modification to the ground thermal regime.

The interaction between climate above the ground and climate below the ground is complex and dependent on several factors, many of which are affected by climate change. Changes in climate above the ground are most often dampened below the ground due to the insulating effects of vegetation, organic material or snow cover. There is generally a lag between a change in temperature at the ground surface and the change in permafrost at depth. For thick permafrost, this lag may be on the order of hundreds to thousands of years, for thin permafrost, years to decades.

The Geological Survey of Canada's (GSC) ongoing monitoring programs in the Mackenzie Region focus on studying the interaction between permafrost and climate. Not all permafrost in existence today is in equilibrium with the present climate. Offshore permafrost beneath the Beaufort Sea is several hundred metres thick. It was formed when the shelf was exposed to cold air temperatures during the last glaciation. This permafrost is presently in disequilibrium with Beaufort Sea water temperatures and has been slowly degrading.



*The southern edge of the Devon Island Ice Cap*



*Sharon Smith has one last look at the station before leaving Alert.*

General circulation models predict that, for a doubling of atmospheric concentrations of carbon dioxide due to anthropogenic sources, mean annual air temperature may rise up to several degrees over much of the Arctic. In the discontinuous permafrost region, where ground temperatures are within 1-2 degrees of melting, permafrost will likely ultimately disappear as a result of ground thermal changes associated with global climate warming. Where ground ice contents are high, this permafrost degradation will have associated physical impacts. Of greatest concern are soils with the potential for instability upon thaw (thaw settlement, creep or slope failure). Such instabilities may have implications for the landscape, ecosystems, and infrastructure. An assessment of the impact of climate change on permafrost is necessary in order to determine whether adaptation measures will be required.

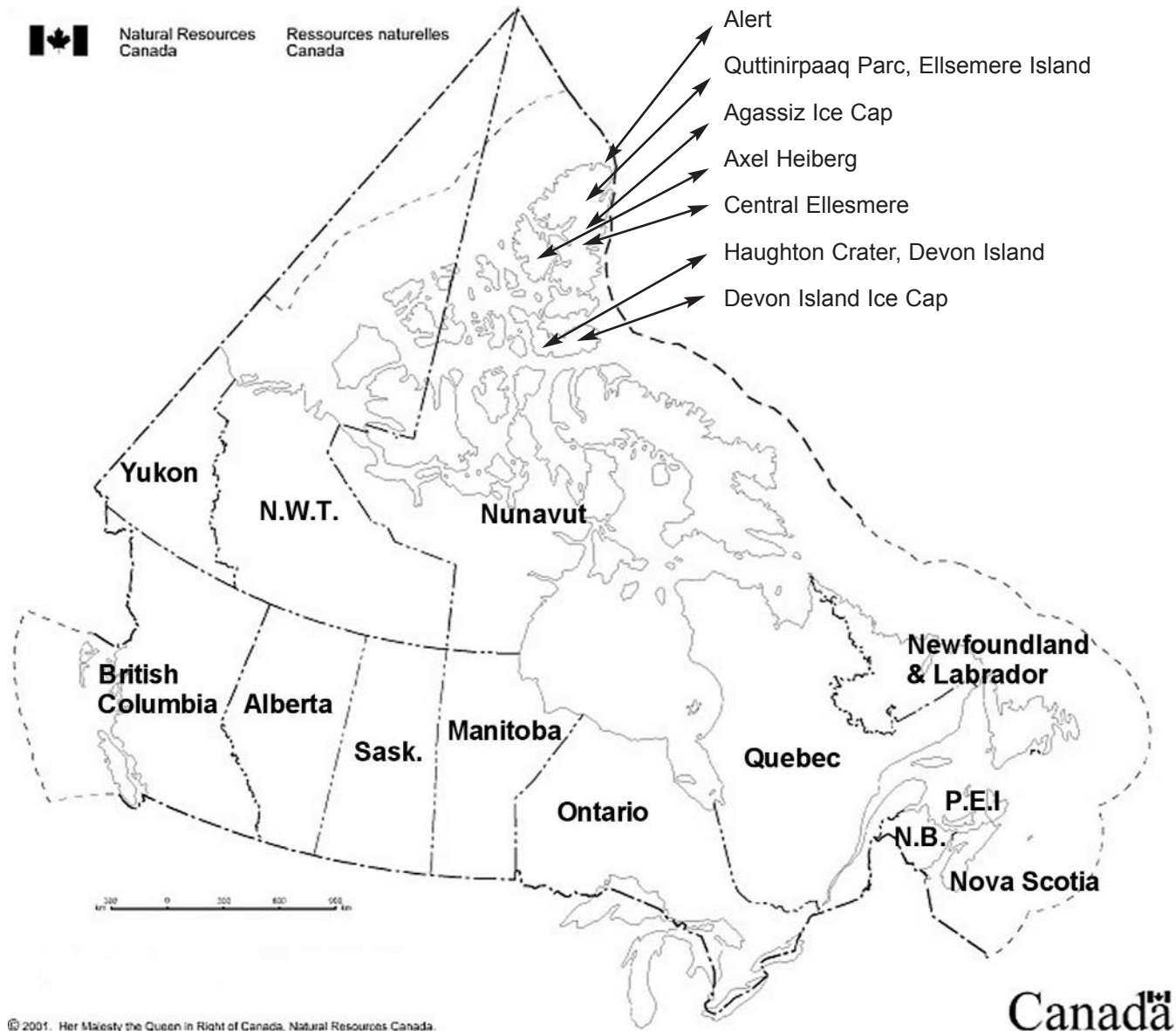
The Canadian Permafrost Monitoring Network provides long-term field observations of active layer and permafrost thermal state. The observations are essential for understanding the present permafrost conditions and the detection of the terrestrial

climate signal in permafrost and its temporal and spatial variability. This network contributes to the Global Terrestrial Network for Permafrost and Canada's obligations to provide systematic cryospheric observations under the World Meteorological Organization's Global Climate Observing System. The GSC is responsible for coordinating and implementing the framework and infrastructure for the network. About 75 thermal monitoring sites are operated by government and University scientists.

The GSC maintains a network of over 20 thermal monitoring sites. The boreholes are generally up to 20 m deep. They were established in the mid 1980's in the Mackenzie Valley and Delta, some of which are operated in collaboration with Environment Canada and Agriculture Canada. The GSC also operates a network of 60 active layer monitoring sites in the Mackenzie region using thaw tubes. The GSC maintains a network of High Arctic permafrost temperature observatories, including five boreholes at Canadian Forces Station (CFS) Alert.

In the late 1970's, five permafrost ground temperature boreholes were instrumented at Canadian Forces Station Alert (82.5°N, 62.4°W), on the northern tip of Ellesmere Island, Nunavut. Permafrost ground temperatures at depths of up to 60 m have been measured manually at these sites since 1978. These boreholes, maintained collaboratively by the Department of National Defence (DND) and the Geological Survey of Canada, represent the most northerly permafrost thermal monitoring site in the

*High Arctic Monitoring continued...Page 7*



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### *High Arctic Monitoring continued....*

world and are an important contribution to the recently established Global Terrestrial Network for permafrost (<http://sts.gsc.nrcan.gc.ca/permafrost/index.html>). The 23-year data set is one of the longest records of permafrost temperatures in Canada.

This August, three of the borehole sites were added to a network of Arctic Climate/Permafrost monitoring stations operated by the Meteorological Service of Canada (MSC), with the addition of air temperature, wind speed and snow depth measurements using Campbell Scientific weather stations.

The stations were pre-assembled at the MSC research station in Saskatoon, and shipped to the Alert weather office via DND Hercules transport. Sharon Smith and Dan Riseborough of the GSC travelled on the weekly scheduled Hercules flight to Alert in late August for their installation. The stations have the CR510 datalogger and they measure air temperature, wind speed, and snow depth. An external SM4M storage module is used for additional data storage since the stations will be visited infrequently. Power is supplied by a 26 amp/hr. battery charged by a 10 Watt solar panel. The high storage capacity of the battery is required to ensure operation through the long polar night.

The climate at Alert is typical of the cold polar desert climate seen throughout most of the High Arctic Islands. It is cold and dry with a mean annual air temperature of  $-18.1^{\circ}\text{C}$  and mean annual ground surface temperatures are about  $-16^{\circ}\text{C}$ . The 30 year normals for precipitation show 16.2mm of rainfall, with total mean annual precipitation at 153.6 mm. Permafrost is over 600 m thick.

Although snow cover is generally thin to absent in this area, it exhibits high spatial and temporal variability and is an important factor influencing the response of shallow permafrost temperatures to changes in air temperature. The data collected with the new stations will contribute to analyses of the role of local microclimate in influencing the permafrost response to changes in air temperature.



*Greely Fiord, Ellesmere Island*

### *High Arctic Monitoring continued....*

These stations join several other Campbell Scientific networks within the High Arctic Island. The accompanying map shows the sites of some of the projects with one or more stations. The Meteorological Service of Canada, the weather and climate branch of Environment Canada, operate dataloggers at all three of the main weather stations: Alert, Eureka on Ellesmere Island, and Resolute on Cornwallis Island. They have also installed our equipment at the old abandoned stations of Isachsen, Rae Point and Mould Bay all in the western Arctic Islands. Parks Canada have a network of four stations within the *Quttinirpaaq Parc* on northern Ellesmere Island. Some of the stations were installed in 1988 and the network expanded in 1992. Another government agency that Campbell Scientific Canada has been collaborating with is the glaciology group within the Geological Survey of Canada of Natural Resources Canada. We started with one station at the Agassiz Ice Cap on Ellesmere in 1987 and since then, stations have been added from the summit to some of the outflow glaciers on Agassiz, the Devon Island Ice Cap, Melville Island and Meighen Island Ice Caps. Most of the ice cap stations are limited to air temperature and snow depth; the data is used to correlate to the annual mass balance values

([http://thrust\\_2.tripod.com/glaciology/one.html](http://thrust_2.tripod.com/glaciology/one.html))

The data recovery rate from all these stations are quite high especially given the conditions the stations are subjected to. The MSC stations are the only ones with real time links. These stations are at the limit of the GOES satellites and probably represents the most northerly GOES sites. Mention of the various research groups does not imply their approval or promotion of Campbell Scientific Canada equipment. If you have permanent arctic stations and would like to share your research with us, please contact the editor.

## Thoughts from the President

*by Claude Labine*



This year will mark the 25th anniversary of Campbell Scientific Canada. When I originally set out on my first trek across Canada to present Campbell Scientific equipment to various groups, my plans were very far from what the company has become. Originally, I thought I would do this for a few years, saturate the market, and pursue a research career. Twenty five years later, we are still expanding our market, the research continues and the best part is that I am not alone.

An anniversary is an appropriate time to reflect on the events of years past. I think my proudest accomplishment is the team of people that has grown over the years and the reputation that our company enjoys. In the world of electronic technology, it is unusual to see a company supporting product which has lasted over twenty years. Of all the agencies and groups we support, I am most proud of the support we give to universities and colleges. Depending on when some of the departments first bought our equipment, we generally are dealing with the fifth or sixth generation of new graduate students. These newcomers are given the equipment (usually with no manuals since they are long gone), and invariably we are dealing with them to help them start their monitoring program. We give this continued free support even though the original sale was many years ago. It is our way of contributing to the next generations of researchers and engineers. We also contribute to higher learning through the educational discount we offer to universities and colleges and through the student prizes we have established. The original student prize was for the best student paper at the Canadian Society of Agrometeorology. Since then two other student prizes have been established: one with the Canadian Geophysical Union (hydrometeorology) and one with the Canadian Meteorological and Oceanographic Society. In the past two years we have been involved with many CFI (Canadian Foundation for Innovation) grants and have contributed to these by way of extra discounts or increased in-kind contributions.

Part of an anniversary also means looking ahead. This past year we have created a core of an engineering group in order to be more active in research and development of new products. We are appreciative of those of you who have contacted us in the past to offer to participate in technology development and now we are in a better position to accept these offers.

We look forward to continued collaborations and challenges from you and to another twenty five years of monitoring progress and if you would like to share your research with us, please contact the editor.



## New Staff



James Rogoza

**James** is back! He was with us from 1991 to 1996 and had left to work with Micralyne (formerly Alberta Microelectronic Centre). With our increased need for in-house design, we were able to have him return. James originally graduated from the BSc Electrical Engineering Cooperative Program at the University of Alberta, in 1991. James still plays part time farmer by helping out at the family farm near Smoky Lake. He enjoys country music and the outdoors. Both he and his wife Heather enjoy camping, hiking and country music festivals.



Jessica Smith

**Jessica** graduated from the University of Alberta with a specialization degree in Environmental Biology. She focused her studies on aquatic ecology and spent a year studying at the Bamfield Marine Station and a summer studying Alpine Lakes in Banff National Park. In her spare time Jessica enjoys Karate, photography and painting.



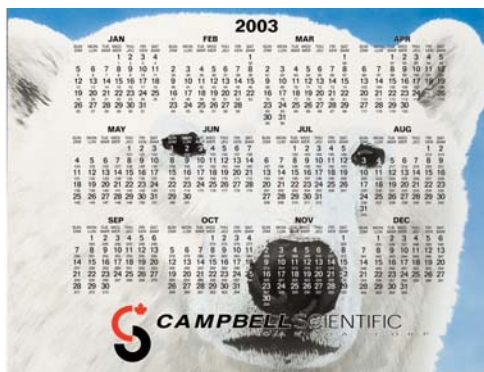
Jan Hall

**Jan** graduated from the University of Alberta in 1998, with a degree in Biology and a minor in Geology. In the summer of 1999 he moved to Alaska to work as a Fisheries Biologist in the Alaskan commercial fishery. He returned to Edmonton (his hometown) two years later, and shortly after joined the Campbell Scientific family. He enjoys outdoor activities in both summer and winter, and traveling to distant corners of the world.



Jared Giesbrecht

**Jared** began working with Campbell Scientific in May of 2002, after earning his Bachelor's degree in Electronics Systems Engineering from the University of Regina. His previous work experience includes 12 months as an engineering assistant with Nortel Networks in Ottawa and Calgary. Jared provides technical support to customers, applications staff, and production/repair staff. His interests include golf, photography and attempting to cheer the Saskatchewan Roughriders to victory.



*Happy New Year*

To mark our twenty-fifth anniversary, we have chosen the polar bear. This animal was used in the very first consecutive-day calendar we issued back in 1982. Given our involvement in northern research, we thought it was a good symbol of our activities.

## Meet Campbell Scientific Canada at:

<u>Date</u>	<u>Exhibit/Meeting</u>	<u>Location</u>
<b>Feb</b> 9-13	American Met. Society 83rd Annual Meet.	Long Beach, CA
<b>April</b> 24-25	In House Training Course	Edmonton, Alberta
<b>May</b> 10-14	Canadian Geophysical Union	Banff, Alberta
<b>June</b> 2-5	Canadian Meteorological and Oceanographic Society Conference	Ottawa, Ontario
16-20	Congress IGB on Large Dams	Montreal, Québec
<b>September</b> 23-27	XII World Forestry Congress	Québec, Québec
<b>October</b>	Canadian Wind Energy Conference	Pincher Creek, AB