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High Arctic IRMA (Integrated Research and Monitoring Area) automatic weather station field data 1990-91 Part 1 & 2

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HIGH ARCTIC IRMA
(INTEGRATED RESEARCH AND MONITORING AREA)
AUTOMATIC WEATHER STATION FIELD DATA
1990-91

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Geological Survey of Canada
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1991-92 report of Green Plan Program
INSTRUMENTAL MONITORING OF CLIMATE CHANGE IN THE HIGH ARCTIC

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ABSTRACT

Data for the season of 1990-91 from two field stations in the GSC High Arctic IRMA were used to develop procedures for processing automatic weather station data from remote High Arctic sites. The data obtained from the loggers were split, organized, checked for out of range values and imported into spreadsheets. Visual examination of quick plots identified periods of problem data which were removed. These cleaned data were plotted in standardized formats developed during the study. A selection of these plots are presented. Extensive appendicies provide neccessary information for the ongoing data processing efforts. User feedback is encouraged.

ACKNOWLEDGMENTS

The authors wish to thank all those who contributed to the field programs at the two field stations and to the preparation of the report. On Agassiz Ice Cap, David Fisher, Ed Waddington, Tad Pfeffer, Mike Waszkiewich, Lief Lundgaard and Jocelyne Bourgeois all contributed to setting up, digging out or maintaining the instrumentation. At Hot Weather Creek, Hock Woo, Cathy Young, Kelly Thompson and David Atkinson participated in the meteorology program in some way. Barrie Maxwell implemented the program which established the Hot Weather Automatic Weather Station. Polar Continental Shelf Project provided the flying hours for the field programs. Roger McNeely and Paul Egginton laboured to obtain funding for the data processing. Doug Hodgson provided valuable suggestions regarding the text and diagrams. David Atkinson worked on the plots and figures and Sharon Parnham prepared the final text.

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PART I

DATA REPORT AND PLOTS

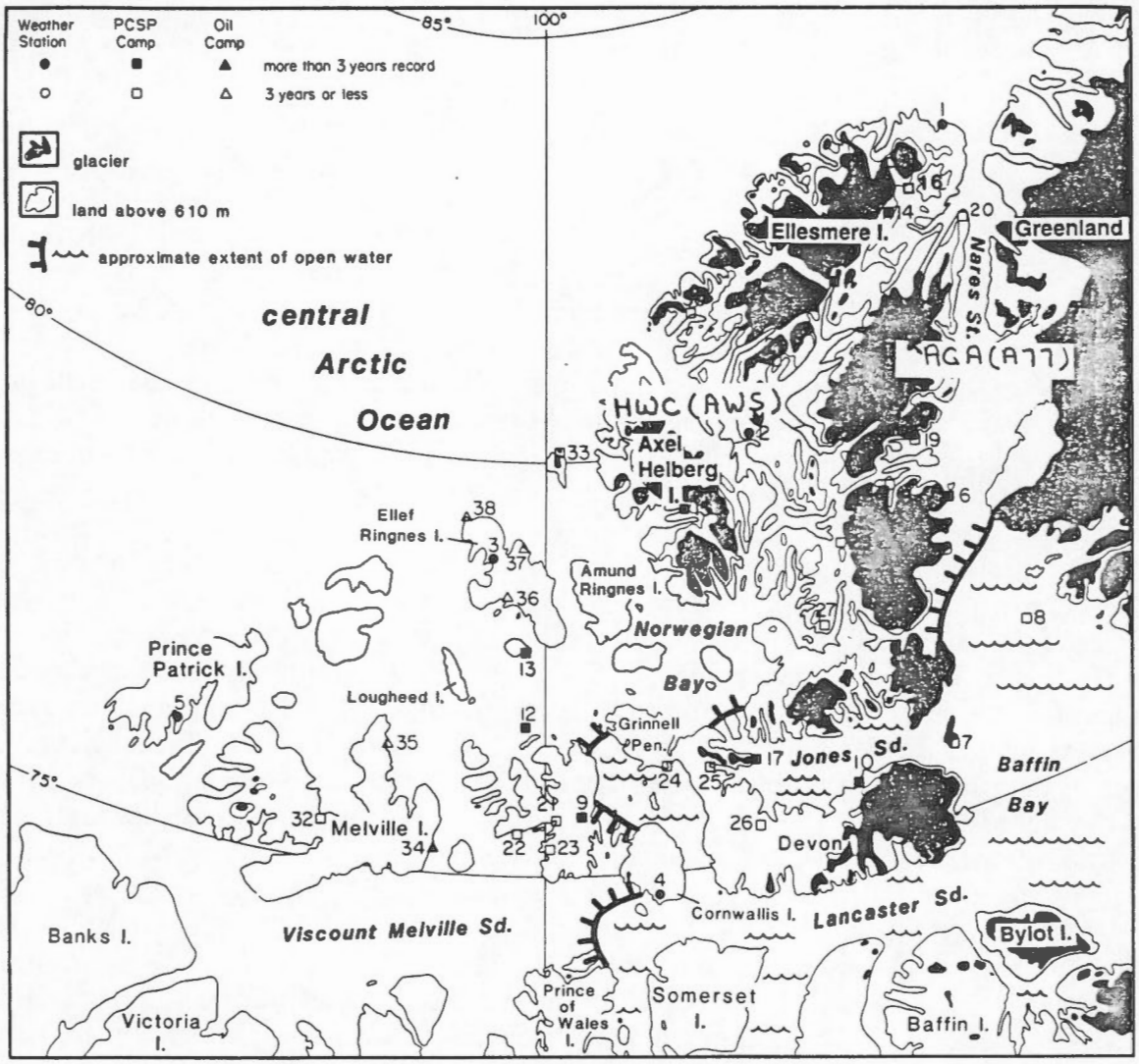
INTRODUCTION

History

Field camp instrumental records of climate in the Canadian High Arctic Islands date back to the explorers who penetrated these ice filled seas in the early nineteenth century. Permanent meteorological observing stations Joint Arctic Weather Stations (JAWS) were not established until the late 1940's and these are all in coastal locations. By the late 1950's field parties usually studying glaciology, geology or ecology (and sometimes even climate) provided valuable summer season (and the odd winter season) weather records from inland areas.

The present phase of automated instrumental monitoring of climate in the High Arctic began with the pioneer efforts of members of the North Water Project (Müller et al., 1975) and International Biological Program (Bliss, 1977 and Courtin and Labine 1977) in the early 1970's. These programs endeavoured to use digital automatic weather recording instrumentation (in addition to conventional means) to study climatic phenomena on micro, meso and regional scales over prolonged periods. By the mid 1980's the advances in automatic data logger technology made it possible to begin augmenting the very sparse coastally biased permanent meteorological station network (Figure 1) with year round automatic weather station records from field camps (Labine, 1988).

In the late 1980's members of the Terrain Sciences Division of the Geological Survey of Canada turned to automatic weather station technology to investigate two very different environments of the Canadian High Arctic. These regional scale studies were both joint ventures. In cooperation with Campbell Scientific Canada Corporation a site in the snow accumulation area of the Agassiz Ice Cap was instrumented. The Arctic Adaptation Division of the Canadian Climate Centre installed a full automatic weather station at the Hot Weather Creek site in the broad interior tundra area of the Fosheim Peninsula. Both these initial studies yielded exciting results (Alt et al., 1991; Koerner et al., 1991; Edlund et al., 1989 and 1990; Headley,1990; and Peters and Headley, 1991). They have become a fundamental part of the GSC High Arctic Integrated Research and Monitoring Area (IRMA) established in response to the aims of the Canadian Global Change Program. The multi-disciplinary, multi-agency nature of the IRMA initiative is reflected in the bibliography found in Appendix 1 which suggests the varied nature of potential users of the meteorological data from these two sites.



The Queen Elizabeth Islands: topography, modern glaciers and maximum extent of open water in a typical year (Maxwell 1982). Also shown are **Atmospheric Environment Service permanent weather stations**: 1. Alert, 2. Eureka, 3. Isachsen, 4. Resolute Bay, 5. Mould Bay; **Polar Continental Shelf Project** - supported, short-duration stations: 6. Cape Herschel, 7. Coburg Island, 8. Carey Islands, 9. Polar Bear Pass, 10. Truelove Inlet, 11. Tanquary Fiord, 12. Seymour Island, 13. King Christian Island, 14. Lake Hazen, 15. Expedition Fiord, 16. Piper Pass, 17. Cape Vera, 18. Alexandra Fiord, 19. Princess Marie Bay, 20. Judge Daly Promontory, 21. Bracebridge Inlet, 22. Bradford Island, 23. Hooker Bay, 24. Porden Point, 25. Eidsbotn Fiord, 26. Haughton River, 27. Baumann Fiord, 28. Strathcona Fiord, 29. Neil Peninsula, 30. Irish Arctic Expedition, 31. Clements Markham Inlet, 32. Nias Point, 33. Meighen North; **Oil Industry camps**: 34. Rea Point, 35. Drake Point, 36. Dome Bay, 37. Malloch Dome, 38. Cape Isachsen.

Figure 1. Location Map of Sites within the High Arctic IRMA.

Purpose of Report

The present report is the first in a series of reports resulting from a Green Plan project designed to maintain, standardize and process the data from High Arctic IRMA, regional, automatic weather stations. The aim of these reports is to make the most recent season's data available to users:

- rapidly enough to be used for analysis of the current seasons field data (as in the case of a masters degree thesis or Current Research papers)
- in a standard format year after year
- with out of range and questionable data removed
- in a graphic format (ie., plots) for initial comparative studies
- as data or spreadsheet files for use in climate and transfer function calculations and for creating publishable diagrams
- with all necessary documentation

The efforts described in this first report focused on the establishment of standardized protocols for data handling and presentation which meet all the above criteria (Appendix 3). It was a lengthy task as is reflected in the discussions which follow.

The reports will initially include data from the regionally representative sites established for long term monitoring in the GSC High Arctic IRMA. They are designed to provide this climate information for the use of all investigators working in the area. Subsidiary weather data collecting sites will be the responsibility of the individual researcher.

It must be emphasized that these are still field camp data and must be used with caution even in the cleaned format presented in the present series of reports. Some of the problems are discussed in the following but others are yet to be investigated.

Organization of Report

All the information essential to using the data plots is given in Part I. The plots are presented under a separate cover (Part III) so that they can be printed single-sided to facilitate comparison on a light table. They are grouped by station and then by file. A complete list of all these Figures is given at the beginning of the plot section (Part III).

Detailed documentation is presented in Part II (and the Appendices). This includes the information needed to use the computer files prepared for release with this report as well as documentation of each step in the data preparation process and of the logger and sensor configuration, programming and environmental conditions. This will allow users to make their own value judgement on the reliability of any piece of data before further processing is undertaken. It must be stressed that this is the users responsibility, particularly when using the ASCII files.

The Appendices contain information to be used in the preparation of subsequent reports in this series. These Appendices will be refined each year with the aim of producing a manual for processing field camp autostation data at the end of the project. In addition a bibliography of work being carried out in association with GSC High Arctic IRMA activities has been included for reference and will be updated each year.

STATIONS AND INSTRUMENTATION

The stations are discussed in alphabetical order. Their location within the High Arctic IRMA is shown in Figure 1. Further station information such as photos etc., will be included in subsequent reports. The station abreviations are in the form STN (STE) where STN is the field area (ie., AGA Agassiz Ice Cap) and STE is the instrument site (ie., A77 the 1977 borehole). See the list of abbreviations for details.

The Agassiz Ice Cap, 1977 deep bore hole site AGA(A77):

Lat 80° 47.90'N, Long 72° 54.05'W, Elev ca. 1670 m. asl

Regional Setting and Representativeness: AGA(A77)

The Agassiz Ice Cap is roughly 16 000 Km^2 in area, (Figure 2a). It has a very smooth surface topography although nunataks occur even in the highest parts. The 1977 bore hole site, AGA(A77), is located about 2030m from the top of a local dome and 1000m west of the ridge extending south from the local dome. This somewhat protected site (Figure 2b) was chosen to avoid the wind scouring effect which is experienced at the sites located on the top of the dome (Fisher et al 1983). The closest nunatak is 9 kilometres away. The ice cap slopes gently down to the southeast. Some local wind and temperature effects would be expected at this site. A subsidiary station was established at the 1984 bore hole site on the top of the local dome which will allow investigation of these meso-scale phenomena. The 1977 site was chosen as the main site as it has produced the most climatically complete core record and is thus the focus of the seasonal snow studies.

General Site and Instrumentation Information: AGA(A77)

The general instrument site area is 2 kilometres to the south of the main camp area. There are several major problems when attempting to maintain a year round autostation in the accumulation area of an ice cap (Alt et al.,1991). Although accumulation is relatively low on high arctic ice caps the snow surface on Agazziz Ice Cap rises 30 to 50 cm a year in areas with no obstructions and considerably more where drifting occurs around an obstacle. This essentially lowers the screen level more than 50 cm each season (Figure 3). For this reason the sensors must be raised by digging out and repositioning the screen each spring.

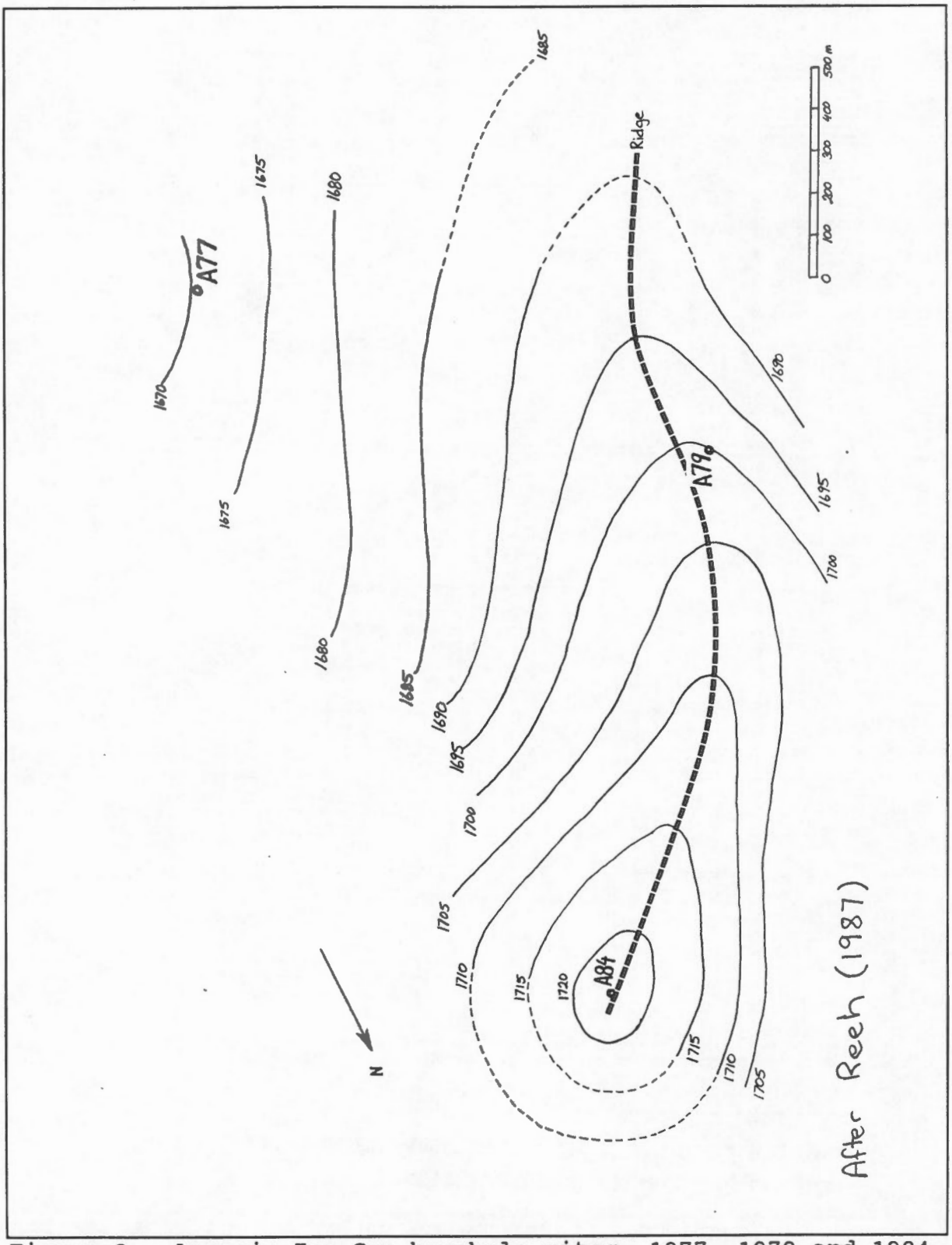
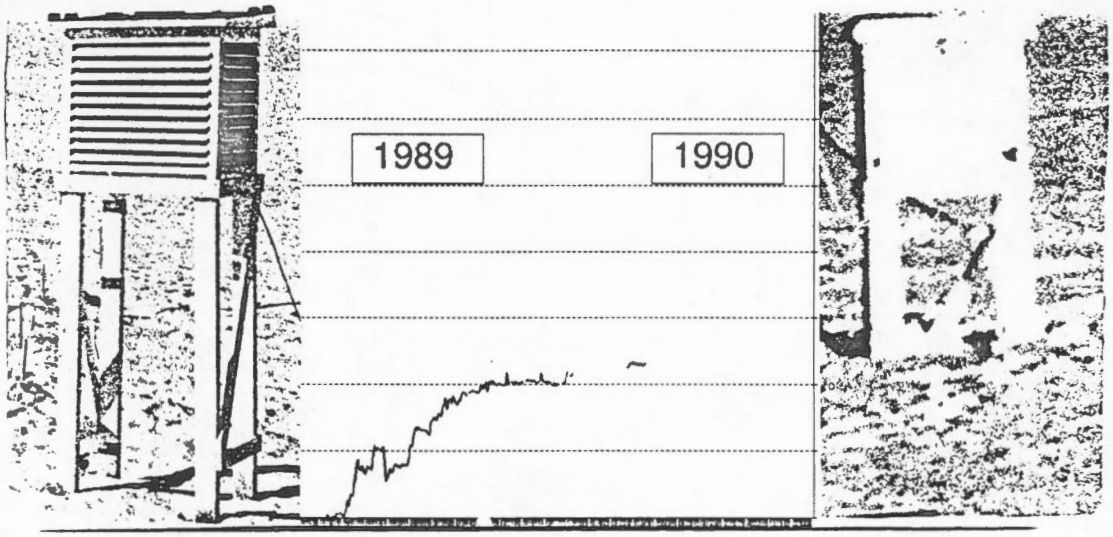
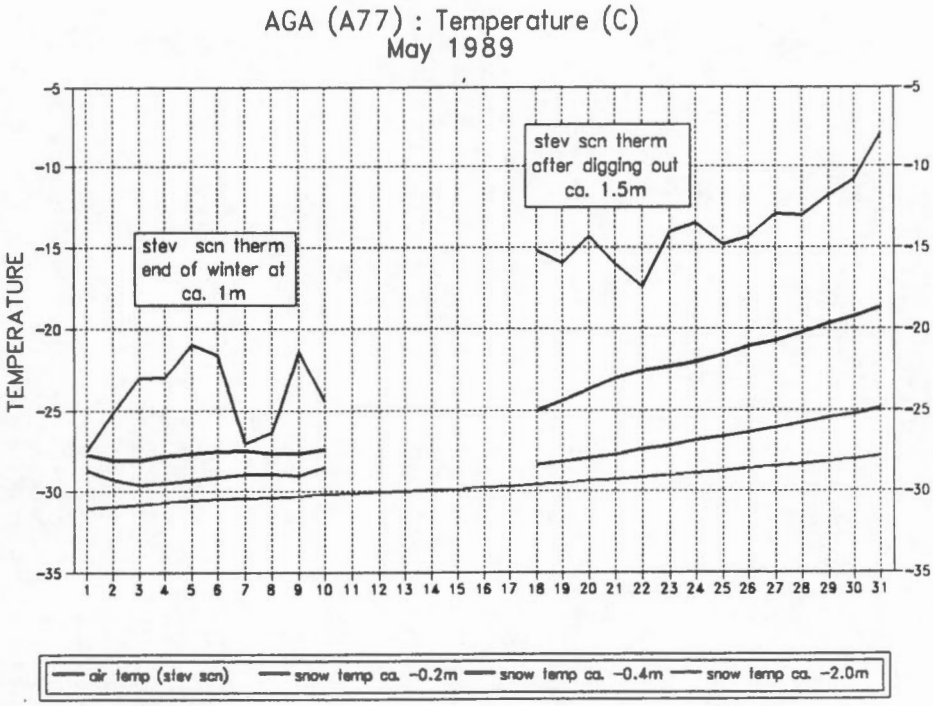


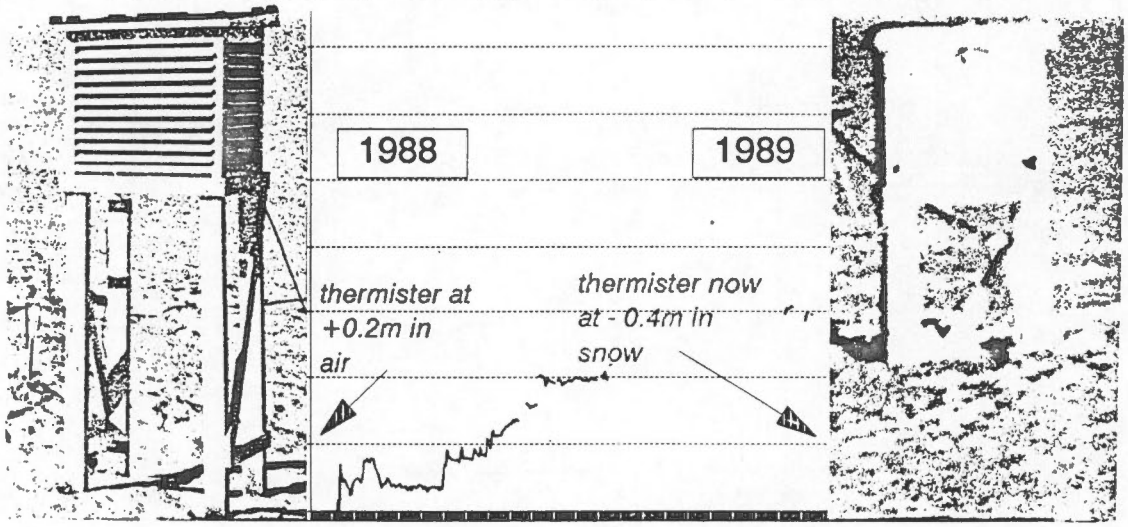
Figure 2. Agassiz Ice Cap borehole sites, 1977, 1979 and 1984.

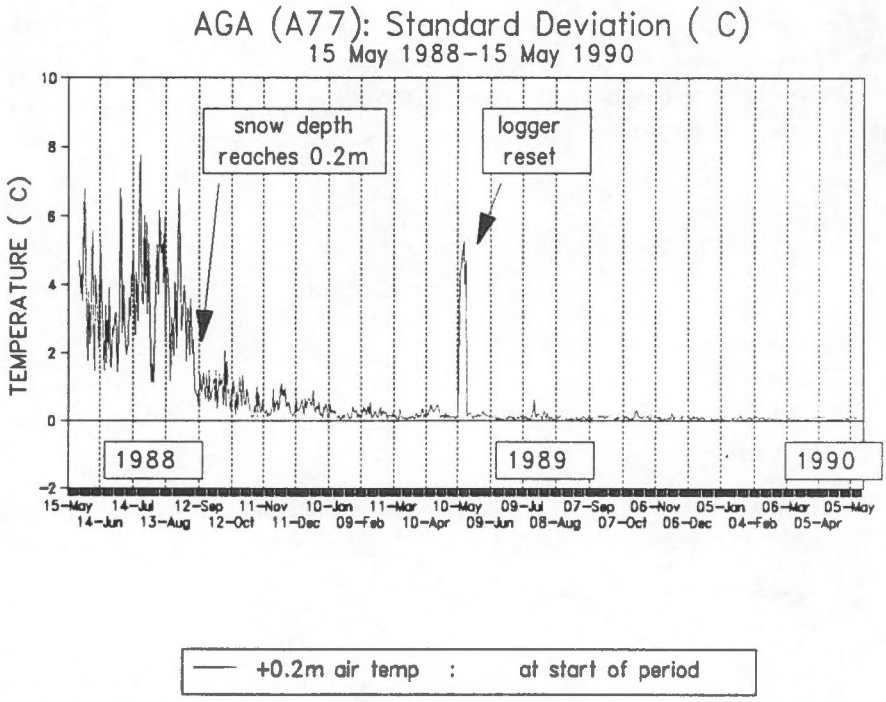




Air temperature jumps after stevenson screen is dug out and repositioned on the surface.

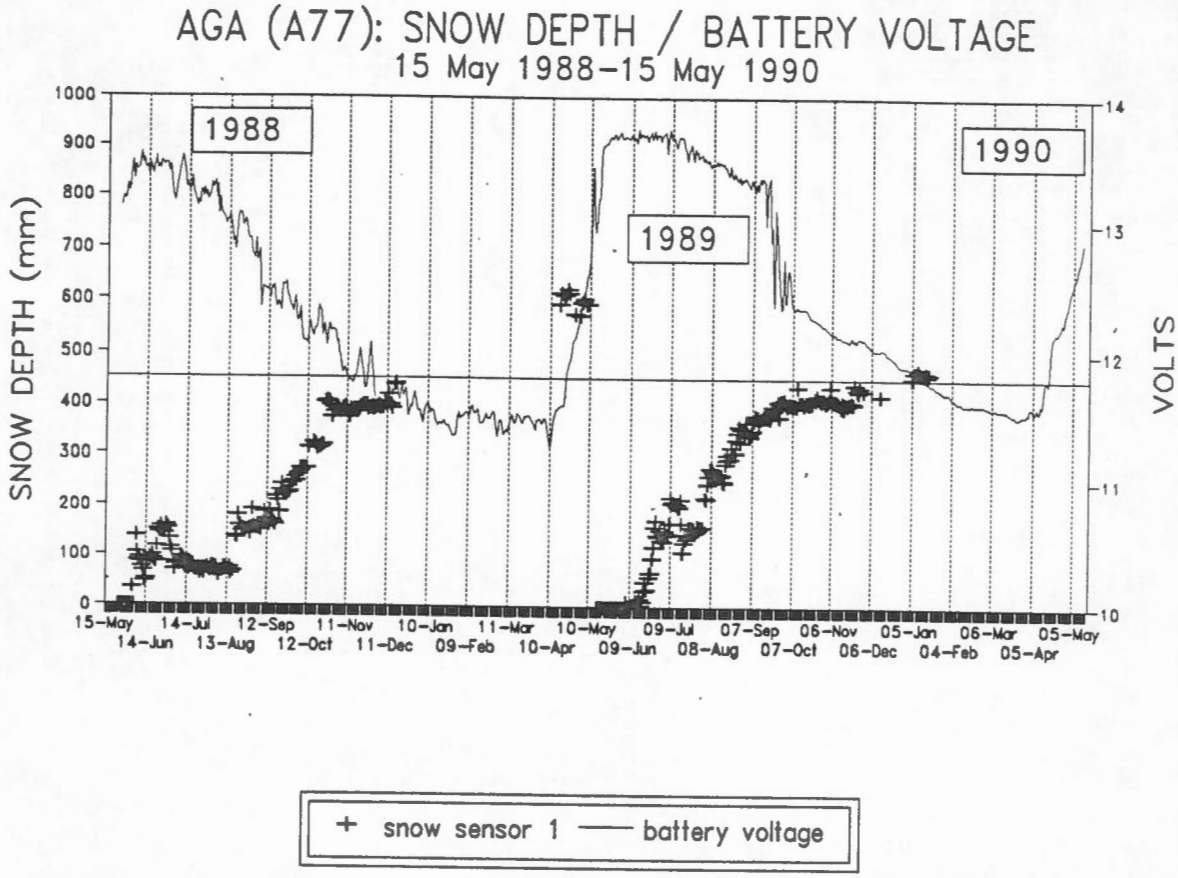
Figure 3a. Effect of snow accumulation on autostation instrumentation.





Standard deviation of temperature from the thermistor installed at +0.2m (above the surface) in May 1988 shows when it first became burried, providing a check on the snow depth sensors.

Figure 3b. RMK snow depth array: 1988-90.



Snow accumulation was much greater in summer 1989 than in the warm summer of 1988.

A new sensor design, to be tested next season on the ice cap, draws considerably less power and should eliminate loss of data at low battery voltages and cold temperatures.

Figure 3c. CSMAL snow depth sensor and battery voltage: 1988-90.

New techniques and standards must be developed for these regions. One of the aims of the joint CSCC/GSC cooperation is to develop such methods.

Two major instrumentation problems also exist. Even the best designed unventilated radiation screen experiences radiation heating due to multiple reflections from the very bright snow surface of the ice cap particularly in June. All exposed sensors are subject to accumulation of rime ice, hoar frost and ice at various times during the season. This can remain for the remainder of the season or, even more difficult to handle, it can drop off or sublimate before the station is visited in the spring giving apparently valid data. Addressing these problems is another of the aims of the CSCC/GSC cooperation.

May 1990 - May 1991: Site and Instrumentation Details, AGA(A77)

At the beginning of this period the snow depth sensors which were being tested by CSCC on Agassiz Ice Cap were removed in order to return them to CSCC for modification. The site had become very badly drifted and the whole station had to be moved to a fresh site. This entailed cutting the wires to the deep snow thermistors and moving the station 30 m to the west of the 1989-90 position. The new site was equipped with an air temperature thermister in a Stevenson Screen and a temperature/humidity probe in a 12 plate Gill screen as well as several shallow-depth/height thermisters for measuring coarse resolution snow accumulation. This latter (RMK snow depth array) gives an estimate of snow depth by recording the standard deviation of the temperature of a set of thermistors arranged at roughly 10 cm intervals above the snow surface. When a thermister becomes covered the standard deviation drops sharply (see Figure 3b Figure AGA9091. – in Part III). Further details of the instrumentation are given in Part II and the appendicies.

Hot Weather Creek, autostation site HWC(AWS):

Lat 79°57'54"N, Long 84°26'33"W, Elev 05 m. asl

Regional Setting and Representativeness

The Hot Weather Creek field camp is located on the Fosheim Peninsula 30 kilometres east of the permanent weather station at Eureka (Figure 4). The automatic weather station site is positioned about 20 metres from the western edge of the narrow strike valley cut by the north-south oriented Hot Weather Creek (Figures 4). The creek is small and ephemeral. East of the instrument site the valley slopes down over an old slump and several terraces to the creek bed 30 metres below. The creek meanders to the east just south of the instrument site. The area within a 20- to 25-kilometre radius of the site is characterized by gently rolling terrain dissected by numerous creeks. The elevation of this lowland is around 100 metres and valleys are typically 30 metres deep except to the northwest where a series of ridges rise to move them 150 metres. The site was chosen to

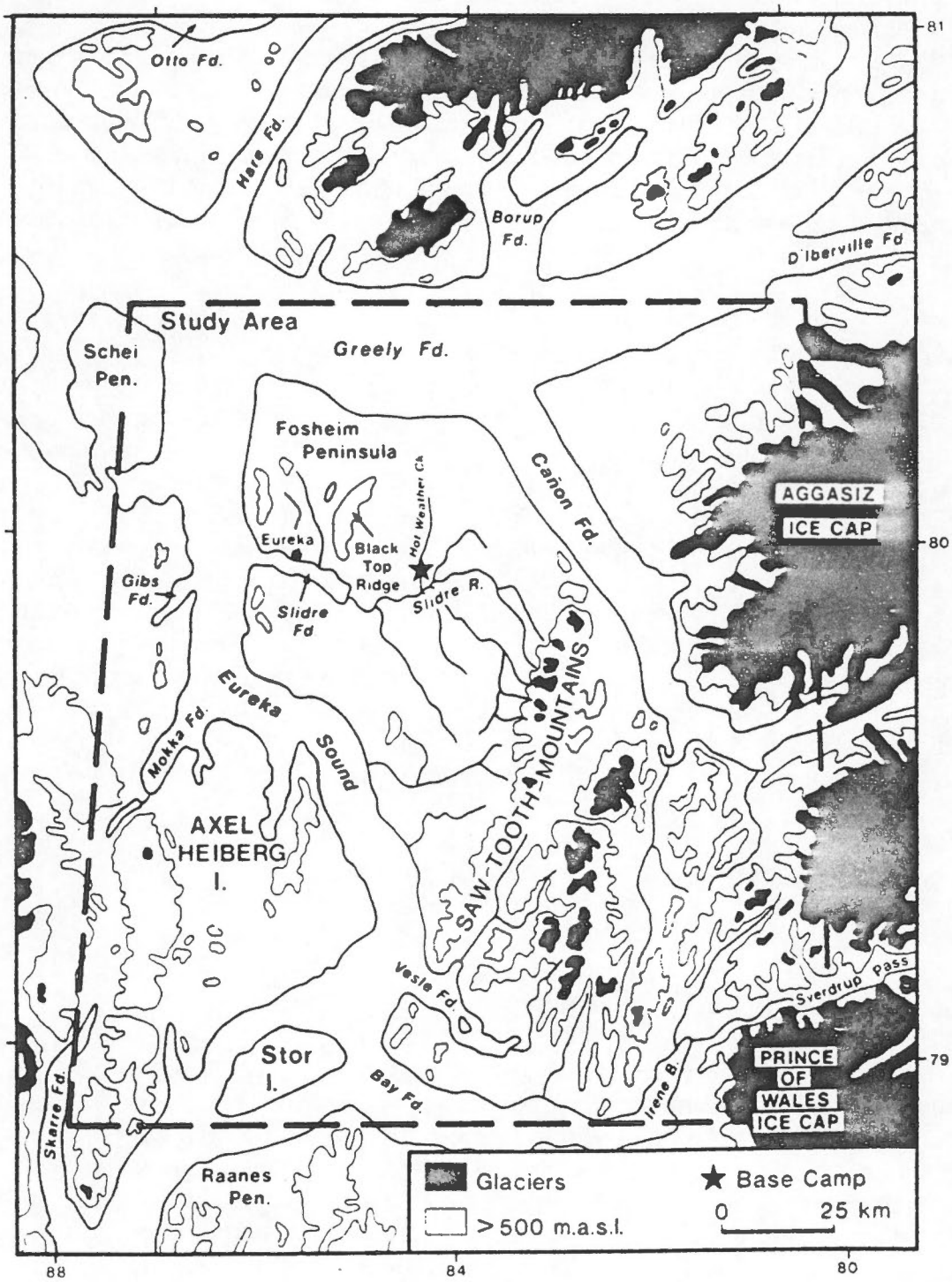


Figure 4a. Fosheim Peninsula location map.

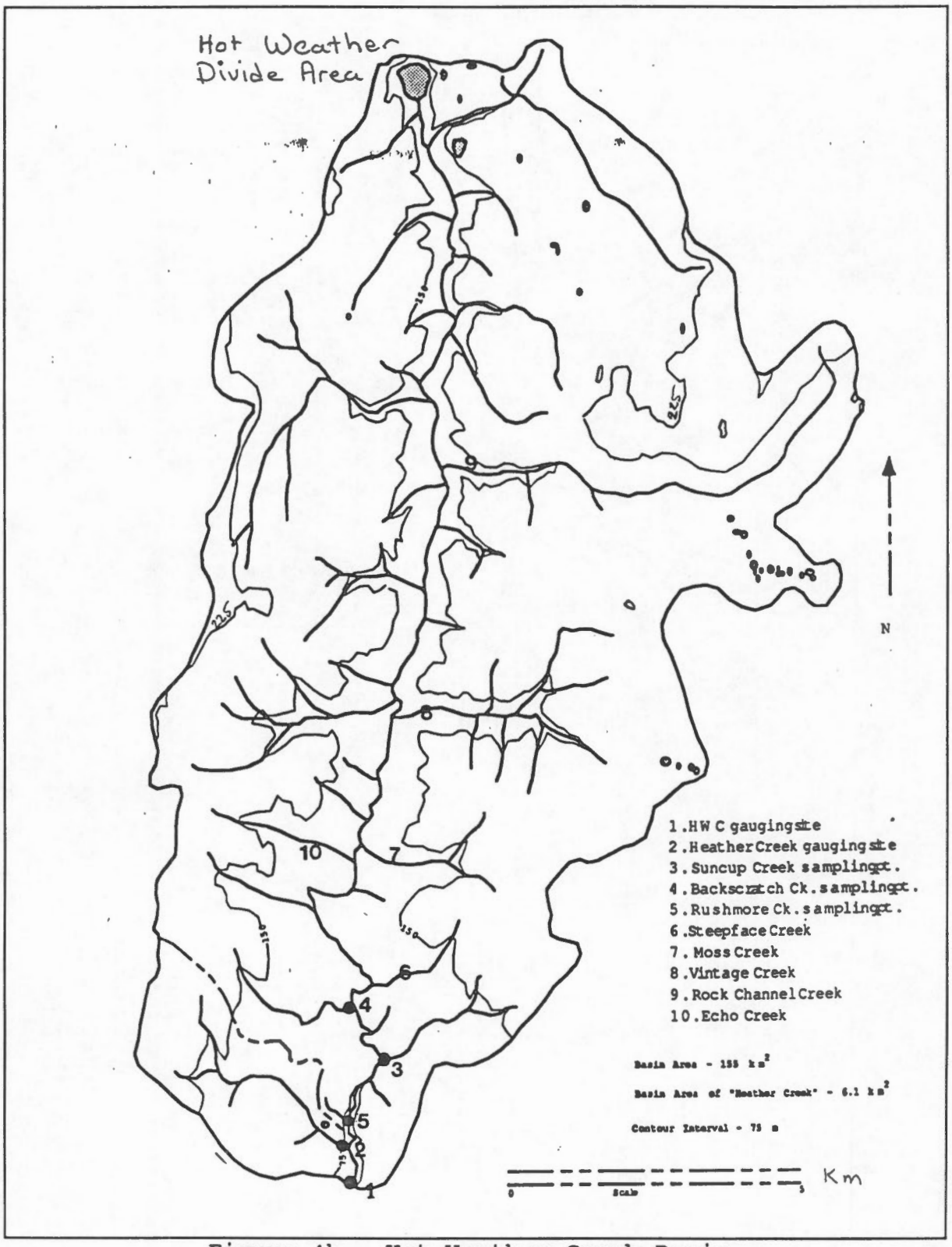


Figure 4b. Hot Weather Creek Basin.

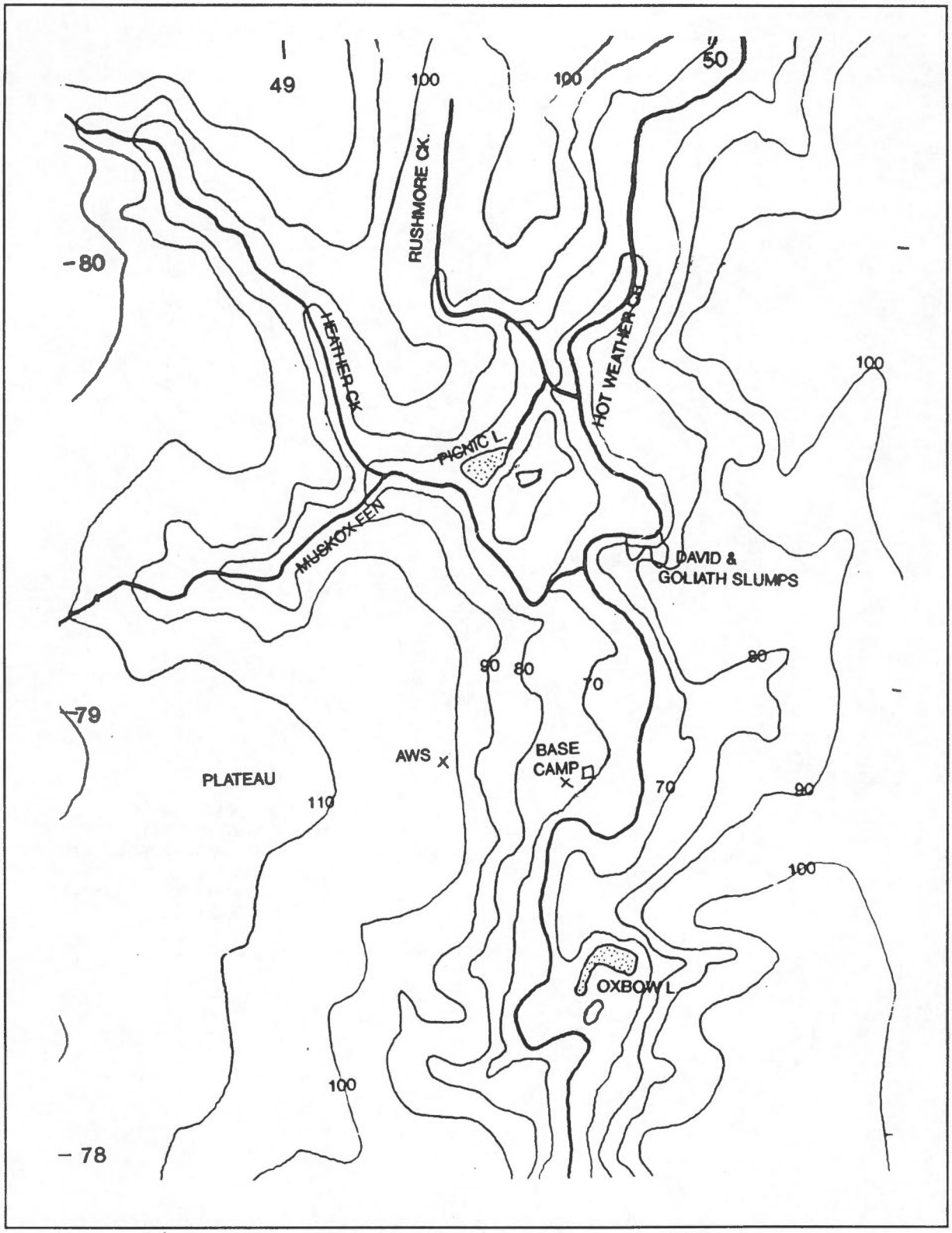


Figure 4c. Hot Weather Creek Base Camp Area.

represent this roughly 1000 square kilometre gently rolling inland lowland area. This is in contrast to the coastal fiord location of the Eureka station. There may be some minor local effects due to with the site's proximity to the edge of the creek valley and the definite north-south orientation of the valley these would be mainly in terms of altering the wind regime. The cross-section in Figure 5 illustrates the greatest relief differences in the area. Beyond the 20-kilometre radius (area ca. 1000 m^2) mountain barriers about 1000 m. high fill the central part of the NW and S quadrants and all the SE quadrant. In the remaining quadrants the terrain slopes down to ice filled fiords (Figure 1) beyond which, at a distance of 60 to 80 kilometres, mountain ranges dominate the terrain.

Regional Description by Quadrant

To the west beyond the creek valley the 100 m asl lowland continues as gently rolling terrain cut by the Slidre River and a number of creeks until it reaches the foothills of the Sawtooth Mountains 25 kilometres to the east and southeast. The Sawtooth Mountains run in a northeast-southwest direction and rise to heights of 1200 metres 35 kilometres southeast of the site. To the northeast the terrain rises gently and then falls to Canon Fiord 20 kilometres northeast of the site. Beyond that, Agassiz Ice Cap is visible on clear days.

About five kilometres northwest of the site the terrain rises to 200 metres at the top of an corrugation in the rolling terrain. These roughly 100 meter high undulations extend for 20 kilometres to the base of Black Top Ridge (ca. 770 metres). This ridge runs from due west of the site filling the northwest quadrant of the horizon. Slidre Fiord cuts 25 kilometres eastward into the Fosheim Peninsula reaching to within 15 kilometres of the site to the south of the Blacktop Ridge. Eureka the permanent AES weather station lies 30 kilometres directly to the west on Slidre Fiord (west of Black Top Ridge).

North of the site the rolling terrain rises gently for 20 kilometres to the head of Hot Weather Creek at an elevation of 140m and then falls off for another 20 kilometres to ice filled Greely Fiord. Less than 5 kilometres south of the site Hot Weather Creek joins the Slidre River which drains west into Slidre Fiord. The rolling terrain continues to Eureka Fiord in the southwest, while 30 kilometres to the south an unnamed mountain rises to 700 metres. To the southeast the terrain rises to over 300 metres some 20 kilometres from the site.

General Site and Instrumentation Information

The instrument site was chosen to be representative of the vegetation and surface conditions of the broad area of gently rolling terrain (100 m asl); not of the valleys or the ridge tops. This terrain is covered by earth hummocks 10-100 cm in diameter and large networks of high-centre, frost fissure polygons 20 to 30 m in diameter. *Salix-Dryas* hummocky tundra is the most common plant community found on almost all moderately drained , neutral to moderately alkaline soils of the silty lowlands.

The automatic weather station is located near the centre of a large polygons with the typical *Salix-Dryas* broken tundra vegetation cover.

The instrumentation was installed (June 1988) and has been maintained by the Arctic Adaptation Division CCC AES with field support by GSC. It consists of a Campbell Scientific CR10 micrologger with meteorological sensors for air temperature and relative humidity, wind speed and direction, and solar incoming radiation. It also supports a ultrasonic snow depth sensor, an experimental vegetation temperature and four ground temperatures. It is powered by a 25 AH, 12 volt gel cell (a second gel cell was added in 1989) charged by a 10 watt solar panel.

The instrumentation and sampling rates do not meet those set out in the fourth draft of the AES autostation guidelines (1992 AES) due to power and storage limitations. It must therefore still be classed as a field camp autostation. Upgrades will proceed in the directions set out by the standards but some of these are unnecessary or impossible under these remote conditions. The station is carefully maintained and serviced every spring. At this time any sensors which have been damaged or have malfunctioned during the winter are replaced. In addition, each season, the wind speed and direction sensors and the pyranometer(s) are replaced so the sensors can be calibrated annually.

August,1990-August,1991: Site and Instrumentation Details, HWC(AWS)

Details of the instrumentation configuration are given in Part II. The battery power appears to have remained above the critical 11.9 volt level (found to be necessary for operation of the snow depth sensor, Alt et al., 1991) all winter as seen in Part III, Figure HWC9091D.6 The radiation sensor recalibration showed less than 0.3% drift which is within the range of the accuracy of the sensor.

DATA PROCESSING AND PRESENTATION

Based on processing the data from these two very different stations discussed above, a protocol or set of procedures were developed. These start with the data files dumped from the logger and finish with the final cleaned data files which are included with this report. (The term 'dump' has been used to signify the copying of data from a data logger or module and the time of dump refers to the last record transferred at that time). The ultimate aim of the six year project is to produce a data processing system that can be used successfully in the field camp on a portable, solar powered, field computer by computer-literate, but not necessarily extensively trained, personnel. The intermediate steps of this procedure would satisfy the need for on site validation of sensor continuity at the time of servicing. The final step would allow immediate use of the current season's data and comparisons to previous seasons. This would include presentation of these cleaned data as standardized plots for on-the-spot analysis by non-meteorologial field personnel.

As would be expected problems were encountered requiring adjustment of the original procedures a number of times. Seemingly small points, such as the treatment of missing data (blanks etc) involved consultations with software experts, computer hardware acquisitions and wedding of various software packages, all of which have a definite learning curve attached. One purpose of the Appendices of this report is to document all this information for future use. New problems will doubtless be encountered each season with the introduction of new sensors and stations. The Appendices will be updated each year to reflect the experience thus gained. The final report will, thus, contain the accumulated wisdom of the six seasons and provide the capabilities sought by users of these data. It might be noted that the AES comparable manned permanent meteorological station data are not available in case of daily maximum and minimum temperature and of radiation until several years after their collection.

AES is currently planning the next generation of its national archive, of which autostation data will form an important component. The Hot Weather Creek data (and some of the Agassiz data) should be suitable for inclusion in this archive In the meantime cleaned data which can be used with discretion by experienced field personnel will be available within the time frame required.

An important additional application of these final procedures would be to facilitate similar processing of the autostation data being collected by other field parties in the high arctic regions. These valuable data are often used for specific purposes and then put aside or are just accumulated for future reference.

For the above reasons, considerable effort has been expended to make the procedures as universal as possible and the preparation of the plots for each new data set as simple as possible. The procedure protocol is presented in Appendix 3.

Quatro Pro spreadsheet software was used as it seemed be the simplest and most universal such software to meet the aims of the processing and presentation proceedures. It makes use of extended memory, allows an unlimited number of data points in the graphs, is compatible with Lotus and Excel and can be imported into Word Perfect 5.1 and is currently used in climate spreadsheet operations by the agencies co-operating in this program.

The Data

The High Arctic loggers discussed here sample most sensors every 60 seconds. These values can be stored and used to produce hourly (or in the case of Agassiz six hourly) and daily values. These values can be mean, total, maximum, minimum, standard deviation or frequency distribution for the period in question. The actual sampled value can also be output. Power hungry sensors such as the CSMAL snow depth sensors are usually sampled only once a day. In the case of wind speed and direction the mean values are usually vector

means. For applications such as turbulence or pollution transport studies such vector means are invaluable. For comparison to data from manned stations or for study of synoptic conditions these vector values can be misleading giving a low wind speed and direction that may never have occurred for an hour during which a strong wind shifted, for example from north to south-southeast.

Hourly and three hourly observations at manned meteorological stations are the equivalent of sampled or spot observations or are observer averaged values as in the case of 5 minute wind speed and direction observations. The standards being developed by AES for co-operative climate autostations will ask for both sampled (one minute average) and one hour mean values of some parametres. Due to storage and power limitations and to additional demands on the system such as ground temperature strings or testing of multiple snow depth sensors, field autostations must modify these requirements.

The climatological day is defined for Canada as the 24-hour period ending at 0600 UCT. For the CST zone which runs through the middle of the High Arctic Islands this is 0000 (or 2400) local time. Thus for autostations, the climatological day begins with the 0100 CST hourly (or the first observation following 0100 CST, eg. 0600 CST six hourly) observation and encompasses the 24-hour period ending at 0000 CST (0600 UCT). AES maintained loggers are run on UCT as this is the WMO standard. Non-AES AWS climate loggers in the High Arctic are set to CST which simplifies data reduction as the logger day then corresponds to the above described climatological day.

Details of the quality control and organization of the 1990-91 data are given in Part II. The final cleaned data are presented as:

- six monthly files for the **daily (D)** values produced by the logger programming
- six month files for the **calculated (C)** daily values which were obtained by calculating the mean, max and min etc.,values of hourly (or six hourly) values
- one month files for the **hourly (H)** (or six hourly) values

The six month files are for the periods April to September (**summer**) and October to March (**winter**). These periods were chosen to facilitate production of the plots and to ensure files of a manageable size. These standard files of course do not correspond to the period between data dumps which differ from year to year and from station to station. In this initial data report both the **summer** files (and plots) may have missing periods of data. In subsequent reports as the data are combined with other years only one **summer** will be incomplete. These incomplete files (and plots) will however be included in the reports to ensure rapid release of the maximum quantity of data.

The Plots

As indicated above, the plots produced for this report are designed to:

- allow field personnel from other disciplines, who do not have access to computers or time to produce their own plots to analyze the meteorological data in conjunction with their own observations as soon as possible after the data is dumped

- to allow detailed examination of sensor functioning ideally before leaving the field (ie., during the servicing of the station) to identify environmental problems such as drifting and riming etc.,

- to allow comparison of daily and hourly data on the same time scale

- to allow comparison of each new season's data with past seasons without having to replot the past data

- to allow preparation of figures for posters and papers with as few changes as possible

Producing accurate, standardized, presentable plots from unprocessed data is a very time consuming process which discourages many individual researchers from undertaking it. Often they will have to be satisfied with plots for irregular periods which are good for just the immediate application or which have inconsistencies not particularly critical for that application. Other potential users of the data just do not have the time or experience to produce such plots and so do not utilize the data fully. In addition to quality control and file organization procedures discussed above, little details such as leap years and printers which give slightly different sized graphs must be considered. Each application and researcher will require somewhat different parametres and time frames. Creating a standardized labeling system within the constraints of the Quatro Pro spreadsheet package is not likely to satisfy all users. The graph titles can, however, be changed easily within the spreadsheet or by using a scanner and desktop publishing regime as long as all the pertinent information is on each graph. The following requirements were identified as essential for the plots presented in Part III of this report:

1) that the time and unit scale be compatible from graph to graph

2) that a standard labelling format give all necessary information

3) that basic parametres be plotted alone and that the plots be printed only on one side of the page and bound facing the same direction so that they can be compared to other parametres and periods on a light table

4) that background grids be provided to allow quantitative evaluations (and that these be removable for presentations)

5) that as few changes as possible are necessary to the basic graphs each time a new set of data are plotted

6) that the spreadsheet containing the graphs have the same format even when the sensors or logger programs change from season to season

7) that the same printer (ie., same size graph) be able to produce black and white diagrams for reports and publications and colour diagrams for posters

8) that hourly data be presented by month to allow study of the diurnal variations

9) that the daily and calculated data be presented by six months, **summer** and **winter**, because 12 month files are too large and do not produce adequate resolution for most parametres plotted

10) that where applicable daily and calculated data also be presented by month for comparison to the hourly data; as **Melt Season** (or in some cases **Dark Season**) for seasonal study of phenomena controlled by above freezing temperatures (or lack of solar radiation) ; or by summer field season (**May to August**) to correspond to other field observations.

Notes on Data and Plots May 1990-May 1991: AGA(A77)

The final cleaned files presented in this initial report for the Agassiz Ice Cap 1977 bore hole site contain the parametres listed in Table 1.

The general site and sensor problems (Alt et al 1991) will be treated in more detail in a paper (Koerner et al, in preparation) inspired by the condition of the station when the field party arrived at the site in late March 1992. Specifics of the problems with the 1990-91 data are discussed in Part II.

Although the Gill shield is subject to radiation heating (relative to the unventilated Stevenson screen) these data have been used in the plots to provide consistency with the previous seasons and with other automatic station data.

The relative humidity values are suspect for a number of reasons and must be treated with caution. They are included here as they are the first such readings from an ice cap station and they might inspire discussion of the problems of autostation humidity measurements at temperatures near and below freezing.

Table I. AGA(A77): Final Cleaned Data Spreadsheet Files (**.WQF**).

File: AGA9090D.WQF data from 17 May to 30 September 1990	
File: AGA9091D.WQF data from 1 October 1990 to 31 March 1991	
Column	Parameters (Abbreviations)
A	DATE(CST)
B	JULIAN
C	
D	DAY
E	MTH
F	YEAR
G	UCT
H	YEAR
I	MONTH
J	CST DAY
K	JULIAN
L	BAT
M	TM+.47m
N	TM+.34m
O	TM+.21m
P	TM+.08m
Q	SD+.47m
R	SD+.34m
S	SD+.21m
T	SD+.08m

File: AGA9090C.WQF data from 17 May to 30 September 1990	
Column	Parameters (Abbreviations)
A	DATE(CST)
B	JULIAN
C	
D	DAY
E	MTH
F	YEAR
G	UCT
H	YEAR
I	MONTH
J	CST DAY
K	JULIAN
L	TM SS
M	TM GIL
N	RHM GILL
O	TX SS
P	TX GIL
Q	RHX GIL
R	TN SS
S	TN GIL
T	RHN GIL

File: AGA90076.WQF data from July 1990	
File: AGA90056.WQF data from May 1990	
Column	Parameters (Abbreviations)
A	DATE NO.
B	YEAR
C	MONTH
D	DAY CST
E	HOUR CST
F	TAB ID
G	JULIAN &
H	HOUR UMT
I	TAIR
J	RH
K	DIR
L	SPD
M	TVEG
N	T-0.1M
O	T-0.2M
P	T-0.5M
Q	T-1M
R	RAD

The first day of data (May 17, 1991) has been removed as it was suspected, from the detailed plots, that the sensors were still adjusting to the move and reinstallation.

Comparison of the RMK snow depth array results and the CSMAL snow depth sensor results from 1989-90 showed good agreement (Alt et al, 1991). These plots for 1990-91 are a bit complex but have been included here for discussion.

Notes on Data and Plots for August 1990-August 1991: AGA(A77)

The final cleaned files presented in this initial report for the Hot Weather Creek automatic weather station contain the parametres listed in Table 2.

Details of the periods of data which are suspect are given in Part II. The periods of missing wind data are probably due to icing of the sensors. Wind data for the period February 19, 1991 to March 27, 1991 should be treated with caution. The gaps in the snow depth sensor data are the result of periods snowfall or blowing snow which produce erroneous readings. For clear days between March 24 and May 30 1991 the solar radiation data have been corrected for the effect of shading of the sensor by the wind sensor.

The Relative Humidity (RH) values over 100% have been changed to 100%. The original values are within the accuracy of the sensor.

There is a sudden jump in the 50cm soil temperature between 1700CST and 1800CST on July 22, 1991. There are a number of possible explanations for this. A first look at the winter data from 1991 suggests that the thermister returned to reasonable values several months after the jump. The 1992 annual field inspection did not produce a firm answer as to the reason for the jump.

The vegetation temperatures are not included in the plots as there is a definite problem with the shield at low sun angles and with low wind speeds. Considerably more research is needed into ways of measuring vegetation and surface temperature at remote High Arctic sites.

DISCUSSION AND FUTURE DIRECTIONS

Cautionary Notes

As is reflected in the discussions above the data presented here must be treated with care. They are in some cases largely experimental and in other cases not quite standard. They do however provide considerable information about the weather during the 1990-91 season at these two interesting sites. They also provide a basis for studying instrumentation and site problems. It is the hope of the authors that their release will inspire further study and suggestions from the users and not blind acceptance (or rejection).

TABLE 2. HWC(AWS): Final Cleaned Data Spreadsheet Files (.WQF)

File:HWC9090D.WQF data from 22 August to 30 September 1990
File:HWC9091D.WQF data from October 1990 to March 1991
File:HWC9191D.WQF data April 1991 to September 1991

Column	Parameter (abbrev.)	Parameter and source (used for legend)
A	DATE (CST)	Date no in day month format
B	CST JUL	julian day from CST date no.
C	HR	hour from CST date no.
D	DAY	day from CST date no.
E	MTH	month from CST date no.
F	YR	year from CST date no.
G	UCT JUL	julian day in UTC
H	YEAR	year from split of logger data
I	MONTH	month from logger split
J	CST DAY	day from logger split
K	UCT JUL	julian day from logger
L	UCT TIME	time to dump in UTC
M	TX AIR	Tmax air Gill
N	TIME TX	time UTC of TX
O	TN AIR	Tmin air Gill
P	TIME TH	time UTC of TN
Q	WSX	WSmax 2 minute
R	TIME ESX	time UTC of wind speed max
S	WD of WSX	WD of WSmax
T	RAD KD	KD total Eppley
U	SNDC	SND cleaned CSMAL
V	BAT	Battery Voltage
W	TM AIR	Tmeanxn air Gill
AA	ZEROS	line of 0s

File:HWC9191C.WQF data from 1 April – 30 September 1991	
Column	Parameter (abbreviation)
A	DATE (CST)
B	JULIAN
C	
D	DAY
E	MTH
F	YEAR
G	UCT
H	YEAR
I	MONTH
J	CST DAY
K	JULIAN
L	TIME
M	TM GIL
N	RHM GIL
O	WSM
P	TVEGX
Q	TGX-.1m
R	TGX-.2m
S	TGX-.5m
T	TGX-.1m
U	TVEGM
V	TGM-.1m
W	TGM-.2m
X	TGM-.5m
Y	TGM-.1m
Z	TVEGN
AA	TGN-.1m
AB	TGN-.2m

File:HWC9107H.WQF July 1991	
Column	Parameter (abbreviation)
A	DATE NO.
B	YEAR
C	MONTH
D	DAY CST
E	HOUR CST
F	
G	YEAR
H	JULIAN
I	HHMM
J	TAIR
K	RHAIR
L	WS
M	WD
N	TVEG
O	TG-.1m
P	TG-.2m
Q	TG-.5m
R	TG-1.0m
S	RAD

The Arctic Adaptation division of AES has undertaken two comparability studies of wind at Hot Weather Creek as part of their ongoing commitment to investigating the reliability of automatic weather station data (Headley, 1990 and Headley and Peters, 1991). The first compares winds at the usual field autostation height of 3 metres and WMO standard of 10 metres. The second compares winds at Hot Weather Creek with those at Eureka the closest permanent station.

Campbell Scientific Canada Corporation and the Glaciology Section of GSC are testing new sensors as they become available and investigating sensor and radiation screen development, to solve the unique problems encountered on ice caps.

Future Reports and Stations

Future reports will include relevant topics such as the history of automatic weather stations, discussion of site specific sensor problems and their solutions, data from adjacent permanent weather stations, climatic data tabulations and recommendations for the following field season. Data from previous (1988-1990) years will be added as time permitts.

Data from subsidiary or local sites collected by individual researcher or from stations operated by other agencies working in the High Arctic IRMA area could also be processed using these protocols (if funds are available). These could then be included in future reports once the results of the specific studies have been published by the individuals involved.

The last report of the series will include the final version of the protocols developed during the project, recommendations for the future of the High Arctic IRMA automatic weather station program and complete documentation and complete data files for each station from the time of its establishment to the end of the Green Plan project. (This will cover the period 1988-1996 for the two initial stations).

Due to the large year-to-year variability in summer climate in the High Arctic, investigation of the present regional climate or of climate change (Global Change) requires at least a decade of data to produce relevant results. Based on the data which will be available at the end of this Green Plan project, a field camp climatology of the Eureka Intermontane Region will be initiated jointly by AES and GSC (with possible involvement from universty groups active in the area). This unique, anomalously warm, inland area could then be compared to other regional climate areas in the High Arctic IRMA with a view to determining their relative response to environmental change such as global warming or Arctic haze.

The long-term records from the ice cap stations will initially be used for examination of seasonal variations in transport and deposition mechanisms of ice core parametres such as pollen, aerosols and oxygen isotopes and for development of oxygen isotope, pollen and ice layer transfer functions. The latter (eg., the change in melt layer percentage values

equivalent to a 1 °C change in mean July temperature) will be used in conjunction with records from other ice caps with different melt regimes (ie., Barnes and Penny Ice Caps). They will also contribute to comparisons between paleo records from tundra sites in the High Arctic IRMA and ice core records. Considerably more development work is needed before a true climatology of high arctic ice caps is possible.

Funding cuts within AES and GSC made it impossible to establish a new station planned for the Hot Weather Creek divide (Figure 4)which would be representative of the higher, possibly less protected (from cold flow off Greely Fiord), regions of the Fosheim Peninsula. Instead in 1992-93 a partial station was established on Devon Ice Cap (Figure 1) using existing instrumentation and experimental sensors provided by CSCC. It is hoped in 1993-94 to upgrade the Devon Ice Cap station and install the Hot Weather Divide station.

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PART II

COMPUTER FILE DOCUMENTATION

AGA(A77): DOCUMENTATION MAY 1990 - MAY 1991

<u>Sensor and Logger Documentation</u>

Instrumentation Description

(see Appendix 2 for technical specifications)

1) Temperature:

a) Air temperature 1 is a 107F thermistor housed in a Stevenson Screen.

b) Air temperature 2 is a 207F thermistor housed in a small Gill self-ventilating radiation sheild.

c) Snow temperatues: This profile of temperatures was established to act as a snow depth indicator. The standard deviation of the sensor would indicate whether the sensor was in or out of snow.

2) Relative Humidity:

A polysulfanated styrene chip which is part of the air (207F) temperature and humidity probe.

Output Array

The initial file is the .DAT original data file. This file, named AGA9091.DAT starts at 0600 on Julian Day 137 (May 17), 1990, and ends at 1200 on Julian Day 129 (May 9) 1991. The data string or output element arrays are as follows:

a) Six hourly outputs:

01: Table ID, 0106
02: Julian Day
03: Time (HHMM), with time set at Central Standard Time
04: Mean Air Temperature 1 (°C)

05: Mean Air Temperature 2 (°C)
06: Mean Air Relative Humidity %
07: Minimum Air Temperature 1 (°C)
08: Minimum Air Temperature 2 (°C)
09: Minimum Air Relative Humidity %
10: Maximum Air Temperature 1 (°C)
11: Maximum Air Temperature 2 (°C)
12: Maximum Air Relative Humidity %

b) Daily outputs

01: Table ID, 0111
02: Julian Day
03: Battery Voltage
04: Mean Temperature +47 cm (°C)
05: Mean Temperature +34 cm (°C)
06: Mean Temperature +21 cm (°C)
07: Mean Temperature +8 cm (°C)
08: Standard Deviation +47 cm
09: Standard Deviation +34 cm
10: Standard Deviation +21 cm
11: Standard Deviation +8 cm

Data Processing Documentation

SPLIT Parameter Files .PAR

The SPLIT process (PC208 software package) is the initial tool of the data processing which, as the name implies, splits or partitions the data but also sorts it and performs an initial filtering of any out-of-range values. The following SPLIT.PAR files were used to do an initial quality control on the data. As the filenames imply the files were used for either 1990 or 1991. The only differences between these files are the "Start" and "Stop" conditions as well as the year which is inserted into the file. When selecting elements, range delimiters were used to replace obvious "garbage data" with blanks.

1) Six Hourly Data:

AGA90BH.PAR and AGA91AH.PAR - Used to extract six hourly data for 1990 (dump to december) and 1991 (january to dump) data respectively, insert the year into the PRN file, and perform a verification of range limits on the data: temp (-55 to +20) and humidity (0 to 100). These .PAR files initially produced IAGA906B.PRN AND IAGA916A.PRN files respectively. These I*.PRN files were imported into Quatro Pro for the initial verification of the data.

```
F1=Help  F2=Commands                Insert is Off   Param file is AGA90BH.PAR
-----------------------------------------------------------------------------------------------------------
                    Name(s) of input DATA FILES(s): AGA9091.DAT
                Name of OUTPUT FILE to generate: IAGA906B.PRN/["]
                          START reading in AGA9091.DAT:
                        STOP reading in AGA9091.DAT: 2[1.]
                         COPY from AGA9091.DAT: 1[0106]
SELECT element #(s) in AGA9091.DAT: y=1990.,y,DATE(2;1990.),2,3,4[-55..20],5
                                    [-55..20],6[0..100],7[-55..20],8[-55..20],9[0..100],
                                    10[-55..20],11[-55..20],12[0..100]
            HEADING for report: AGASSIZ 1990/1991\INTERNAL FILE
   HEADINGS for AGA9091.DAT, col. # 1:   YEAR
                          column # 2:   DATE
                          column # 3:   JULIAN\DAY
                          column # 4:   TIME\CST
                          column # 5:   MEAN\AIR\TEMP1
                          column # 6:   MEAN\AIR\TEMP2
                          column # 7:   MEAN\AIR\R.H.
                          column # 8:   MIN\AIR\TEMP1
                          column # 9:   MIN\AIR\TEMP2
                         column # 10:   MIN\AIR\R.H.
                         column # 11:   MAX\AIR\TEMP1
                         column # 12:   MAX\AIR\TEMP2
                         column # 13:   MAX\AIR\R.H.
```

```
F1=Help  F2=Commands                Insert is Off   Param file is AGA91AH.PAR
-----------------------------------------------------------------------------------------------------------
                    Name(s) of input DATA FILES(s): AGA9091.DAT
                Name of OUTPUT FILE to generate: IAGA916A.PRN/["]
                          START reading in AGA9091.DAT: 2[1.]
                        STOP reading in AGA9091.DAT:
                         COPY from AGA9091.DAT: 1[0106]
SELECT element #(s) in AGA9091.DAT: Y=1991.,Y,date(2;1991.),2,3,4[-55..20],
                                    5[-55..20],6[0..100],7[-55..20],8[-55..20],
                                    9[0..100],10[-55..20],11[-55..20],12[0..100]
            HEADING for report: AGASSIZ 1990/1991\INTERNAL FILE
   HEADINGS for AGA9091.DAT, col. # 1:   YEAR
                          column # 2:   DATE
                          column # 3:   JULIAN\DAY
                          column # 4:   TIME\CST
                          column # 5:   MEAN\AIR\TEMP1
                          column # 6:   MEAN\AIR\TEMP2
                          column # 7:   MEAN\AIR\R.H.
                          column # 8:   MIN\AIR\TEMP1
                          column # 9:   MIN\AIR\TEMP2
                         column # 10:   MIN\AIR\R.H.
                         column # 11:   MAX\AIR\TEMP1
                         column # 12:   MAX\AIR\TEMP2
                         column # 13:   MAX\AIR\TEMP3
```

2) Daily Data

AGA90BD.PAR and AGA91AD.PAR - Used to extract the daily data for 1990 and 1991 respectively, insert the year into the PRN file and perform a verification of range limits on the data as previously discussed. These .PAR files produce IAGA90DB.PRN and IAGA91DA.PRN files. These I*.PRN files were then imported into Quatro Pro for the initial verification of the data.

```
F1=Help  F2=Commands                    Insert is On   Param file is AGA90BD.PAR
-----------------------------------------------------------------------------------------------------------
                    Name(s) of input DATA FILES(s): AGA9091.DAT
                Name of OUTPUT FILE to generate: IAGA90DB.PRN/["]
                          START reading in AGA9091.DAT:
                         STOP reading in AGA9091.DAT: 2[1.]
                          COPY from AGA9091.DAT: 1[0111]
SELECT element #(s) in AGA9091.DAT: Y=1990.,Y,DATE(2;1990.),2,3,4..
                                    7[-55..20]8..11[0..13]
                HEADING for report: AGASSIZ 1990/1991 DAILY DATA
        HEADINGS for AGA9091.DAT, col. # 1:    YEAR
                              column # 2:    DATE
                              column # 3:    JULIAN\DAY
                              column # 4:    BATTERY\VOLTS
                              column # 5:    MEAN\TEMP\+47 CM
                              column # 6:    MEAN\TEMP\+34 CM
                              column # 7:    MEAN\TEMP\+21 CM
                              column # 8:    MEAN\TEMP\+8 CM
                              column # 9:    STAND\DEV\+47 CM
                             column # 10:    STAND\DEV\+34 CM
                             column # 11:    STAND\DEV\+21 CM
                             column # 12:    STAND\DEV\+8 CM

F1=Help  F2=Commands                    Insert is On   Param file is AGA91AD.PAR
-----------------------------------------------------------------------------------------------------------
                    Name(s) of input DATA FILES(s): AGA9091.DAT
                Name of OUTPUT FILE to generate: IAGA91DA.PRN/["]
                         START reading in AGA9091.DAT: 2[1.]
                          STOP reading in AGA9091.DAT:
                          COPY from AGA9091.DAT: 1[0111]
SELECT element #(s) in AGA9091.DAT: Y=1991.,Y,DATE(2;1991.),2,3,4..7[-55..20],
                                    8..11[0..13]
                HEADING for report: AGASSIZ 1990/1991 DAILY DATA
        HEADINGS for AGA9091.DAT, col. # 1:    YEAR
                              column # 2:    DATE
                              column # 3:    JULIAN\DAY
                              column # 4:    BATTERY\VOLTS
                              column # 5:    MEAN\TEMP\+47 CM
                              column # 6:    MEAN\TEMP\+34 CM
```

```
column # 7:   MEAN\TEMP\+21 CM
column # 8:   MEAN\TEMP\+8 CM
column # 9:   STAND\DEV\+47 CM
column # 10:  STAND\DEV\+34 CM
column # 11:  STAND\DEV\+21 CM
column # 12:  STAND\DEV\+8 CM
```

3) Calculated Data

AGA90BC.PAR and AGA91AC.PAR - Used to calculate the daily data from the six hourly data and insert the year into the PRN file.

```
F1=Help  F2=Commands          Insert is On   Param file is AGA90BC.PAR
-----------------------------------------------------------------------------------------------------------
                Name(s) of input DATA FILES(s): RAGA906B.PRN
              Name of OUTPUT FILE to generate: AGA90BC.PRN
                      START reading in RAGA906B.PRN:
                      STOP reading in  RAGA906B.PRN:
                        COPY from RAGA906B.PRN:
SELECT element #(s) in RAGA906B.PRN: TEMP1.PRN:
                                   SMPL(1..5;4),AVG(6..8;4),MAX(9..11;4),
                                   MIN(12..14.4)
            HEADING for report: 1990/1991\CALCULATED\DAILIES
   HEADINGS for RAGA906B.PRN, col. # 1:   YEAR
                          column # 2:   MONTH
                          column # 3:   DAY
                          column # 4:   JULIAN\DAY
                          column # 5:   TIME\CST
                          column # 6:   MEAN\TEMP1
                          column # 7:   MEAN\TEMP2
                          column # 8:   MEAN\R.H.
                          column # 9:   MAX\TEMP1
                          column # 10:  MAX\TEMP2
                          column # 11:  MAX\R.H.
                          column # 12:  MIN\TEMP1
                          column # 13:  MIN\TEMP2
                          column # 14:  MIN\R.H.

F1=Help  F2=Commands          Insert is On   Param file is AGA91AC.PAR
-----------------------------------------------------------------------------------------------------------
                Name(s) of input DATA FILES(s): RAGA916A.PRN
              Name of OUTPUT FILE to generate: AGA91AC.PRN
                      START reading in RAGA916A.PRN:
                      STOP reading in RAGA916A.PRN:
                        COPY from RAGA916A.PRN:
SELECT element #(s) in RAGA916A.PRN: SMPL(1..5;4),AVG(6..8;4),
                                   MAX(9..11;4),
                                   MIN(12..14;4)
```

HEADING for report: 1990/1991\CALCULATED\DAILIES

HEADINGS for RAGA916A.PRN, col. # 1:	YEAR
column # 2:	MONTH
column # 3:	DAY
column # 4:	JULIAN\DAY
column # 5:	TIME\CST
column # 6:	MEAN\TEMP1
column # 7:	MEAN\TEMP2
column # 8:	MEAN\R.H.
column # 9:	MAX\TEMP1
column # 10:	MAX\TEMP2
column # 11:	MAX\R.H.
column # 12:	MIN\TEMP1
column # 13:	MIN\TEMP2
column # 14:	MIN\R.H.

Six Hourly Data

The original data file, AGA9091.DAT was processed using AGA90BH and AGA91BH to produce the initial .PRN files IAGA906B.PRN and IAGA916A.PRN. These files were imported into Quatro Pro in order to produce the quick plots for data quality control. These spreadsheets, for internal use only, were kept as IAGA906B.WQ1 and IAGA916A.WQ1 and contain the saved quick plots.

With the analysis of the plots and correction of any problem data, the final cleaned files were saved as RAGA906B.WQ1 and RAGA916A.WQ1. From these cleaned files, the 6 hourly data were partionned into monthly files (Table 3).

Daily Data

The original data file, AGA9091.DAT was processed using AGA90BD.PAR and AGA91AD.PAR to produce the initial .PRN files IAGA90DB.PRN and IAGA91DA.PRN which were then imported into Quatro Pro. The spreadsheets produced IAGA90DB.WQ1 and IAGA91DA.WQ1 contained the initial quick plots for the quality control process following which the final cleaned files became RAGA90DB.WQ1 and RAGA91DA.WQ1. These files of daily data were broken down further into "summer" and "winter" periods and named BAGA90SD.WQ1, OAGA90WD.WQ1, OAGA91WD.WQ1 AND AAGA91SD.WQ1 (Table 3).

Calculated Data

The six hourly data found in the cleaned files RAGA906B.WQ1 and RAGA916A.WQ1 were printed to .PRN files RAGA906B.PRN and RAGA916A.PRN in order to be processed by SPLIT. The .PAR files used were AGA90BC.PAR and AGA91AC.PAR. The .PRN file produced were AGA90BC.PRN and AGA91AC.PRN which were then imported into the spreadsheets IAGA90BC.WQ1 AND IAGA91AC.WQ1 for quality control graphing purposes. The resulting spreadsheet files were also organized in the "summer" and "winter" periods and were called BAGA90SC.WQ1, OAGA90WC.WQ1, OAGA91WC.WQ1 and AAGA91SC.WQ1 (Table 3).

Data Quality Control Notes

The data file AGA9091.DAT does not contain any major errors or missing data. There are however two areas where the data need to be considered in light of the following information:

1) The two air temperatures show different values because of the different radiation shields used. Under high radiation loads (clear skies and highly reflective surface) and no wind, the small Gill radiation sheild will cause overheating of the sensor. By late winter, the Stevenson Screen usually has filled with drifting snow and the temperature sensor is somewhat insulated by the snow, thereby showing temperatures which are higher than the small Gill radiation sheild.

2) The relative humidity values during the July 1990 period seems to peak in the low 90's. Although this is the first continuous record of relative humidity values from an ice cap, these data could be real since the air temperature rarely rises above freezing and there are intermittent variations in readings throughout the period. These values may reflect a problem regarding the use of ice and water satuation vapour pressure by the logger calibration program.

TABLE 3. AGA(A77): Split and Organized Data Files

FILE NAME	STARTS	STOPS
RAGA906B.WQ1	0600, 137 (MAY 17) 1990	2400, 365 (DEC 31) 1990
RAGA906A.WQ1	0600,1 (JAN 1) 1991	1200, 129(MAY 9) 1991
RAGA90DB.WQ1	137 (MAY 17), 1990	365 (DEC. 31), 1990
RAGA91DA.WQ1	1 (JAN 1), 1991	128 (MAY 8), 1991
BAGA90SD.WQ1	137 (MAY 17), 1990	273 (SEPT. 30), 1990
BAGA90SC.WQ1		
OAGA90WD.WQ1	274 (OCT. 1), 1990	365 (DEC. 31), 1990
OAGA90WC.WQ1		
OAGA91WD.WQ1	1 (JAN 1), 1991	90 (MARCH 31), 1991
OAGA91WC.WQ1		
AAGA91SD.WQ1	91 (APRIL 1), 1991	128 (MAY 8), 1991
AAGA91SC.WQ1		
BAGA9005.WQ1 *	0600 137 (MAY 17), 1990	2400 151 (MAY 31), 1990
AAGA9105.WQ1 *	0600 121 (MAY 1), 1991	1200 129 (MAY 9), 1991

* These two files are the only incomplete files of the monthly files of hourly data. The rest of the monthly files are the following. They all start at 0600 on the first day of the month and end at 2400 on the last day of the month. The files are named as follows:

6AGA9006.WQ1, 6AGA9007.WQ1, 6AGA9008.WQ1, 6AGA9009.WQ1, 6AGA9010.WQ1, 6AGA9011.WQ1, 6AGA9012.WQ1, 6AGA9101.WQ1, 6AGA9102.WQ1, 6AGA9103.WQ1, and 6AGA9104.WQ1

File Formats and Periods of Record: Final Cleaned Data

Creating the Final Cleaned Data Files and Final Plots

The Final Cleaned Data files were created in two steps. First the Organized Raw Cleaned data files shown in the second part of Table 3. above were imported into the QPRO spreadsheet templates (see Appendix 3 for details of this process) which contain the named graphs used to produce the plots. The logger dates were checked against the spreadsheet generated dates and data visually examined for problems. The named graphs were then altered to reflect the new data (see Appendix 6) and the named graphs plotted using the plotting macro (Appendix 5 and file **PGRAPH.WQM**). These graphs were then examined by all field personnel involved in the data collection process and the questionable data (or graphs) removed from the spreadsheet as discussed in the final quality control notes below.

The second step was to save these spreadsheets as the final cleaned data worksheet files (**.WQF**) listed in Table 1. From these worksheets the final graphs were plotted on the Hewlett Packard Paint Jet Printer (in colour) and then photocopied for the report. The graphs plotted in this initial report are listed in Part III. The named graphs in the worksheet **.WQF** can easily be modified to produce figures for papers etc., by removing the grid and customizing the headings. A few examples of multiple parameter plots, which were not plotted for the report to avoid repetition, but were included in the worksheet might also be useful for presentations.

Next, the blanks in the spreadsheet were replaced by "-9999." and the data printed to an ASCII file (**.PR9**).

Final Quality Control Notes

The data for May 17, 1990 was removed from the AGA data as the maximum temperatures appeared too high and it was assumed that the sensors were still adjusting, to being moved. It is just possible that when the previous days data are examined (ie., the 1989-90 file is processed) that this may prove to be real data, in which case it will be added to the files when they are joined.

HWC(AWS): DOCUMENTATION AUGUST 1990 - AUGUST 1991

Sensor and Logger Documentation

Sensor Description and Conditions

See the appendices for technical specifications

1) Radiation:
   Eppley pyranometer for shortwave incoming radiation, uses a thermopile sensing element. The sensor is calibrated and replaced every year.

2) Temperature:
   a) CSCC Thermistor (207C) for air temperature housed in a small Gill self-ventilating radiation shield.

   b) CSCC Thermistors (107B) are also used for the temperature of the vegetattion and the ground temperatures.

3) Relative Humidity:
   A PhysChem polysulfanated styrene chip which is part of the air (207C) temperature and humidity probe

4) Wind Speed:
   The Met-One 013A Heavy duty three cup anemometer.

5) Wind Direction:
   A Met-One 023A Heavy Duty wind vane.

6) Snow Depth:
   An ultrasonic distance sensor, the CSMAL01. (CSCC)

Output Array Definitions

The initial data file is HWC9091.DAT which starts at 1300 on Julian Day 234 (Aug. 22), 1990, and ends at 1100 on 235 (August 23), 1991. Due to annual maintenance on the station there is a data gap from 1700 on J.D. 170 (June 19) to 1700 on 171 (June 20) 1991. The data in this file has been output as follows:

1) Hourly outputs:

   01: Table ID 0116
   02: Julian Day (NEW DAY AT 0000)
   03: Time HHMM (Set to UCT,UNIVERSAL COORDINATED TIME)

04: Sample of Air Temp (°C)
05: Sample of Relative Humidity (%)
06: 2 Minute Wind Speed Vector (KM/HR)
07: 2 Minute Wind Vector Direction (VECTOR DEGREES)
08: Sample of Vegetative Temperature (°C)
09: Sample of 10 cm Ground Temperature (°C)
10: Sample of 20 cm Ground Temperature (°C)
11: Sample of 50 cm Ground Temperature (°C)
12: Sample of 100 cm Ground Temperature (°C)
13: TOTAL RADIATION MJ/M^2

2) Daily Outputs at 0600 (UCT, 0000 LOCAL):

01: TABLE ID 0132
02: JULIAN DAY (NEW DAY AT 0000)
03: TIME (HHMM, UCT)
04: MAXIMUM AIR TEMPERATURE °C
05: TIME OF MAXIMUM
06: MINIMUM AIR TEMPERATURE °C
07: TIME OF MINIMUM
08: MAXIMUM WIND KM/HR
09: TIME OF MAXIMUM
10: SAMPLE DIRECTION OF MAXIMUM WIND DEGREES
11: TOTAL INCOMING RADIATION (MJ/M^2)
12: SAMPLE OF SNOW DEPTH MILLIMetres
13: SAMPLE OF BATTERY VOLTAGE

Loggger Wiring and Programming

Program: HOT WEATHER CREEK 1990 AND 1991
Flag Usage: 0 FOR OUTPUT AND 1 FOR SNOW DEPTH SENSOR

1) Wiring:

Input Channel Usage:
1H- AIR TEMP
1L- AIR RH
2H- WIND DIRECTION
2L- VEGETATIVE TEMPERATURE
3H- 10 CM GROUND TEMPERATURE
3L- 20 CM GROUND TEMPERATURE
4H- 50 CM GROUND TEMPERATURE

4L- 100 CM GROUND TEMPERATURE
5H- GLOBAL RADIATION (INCOMING SHORTWAVE)

Excitation Channel Usage:E1 - 207C TEMP
E2 - 207 RH AND 107B'S
E3 - WIND DIRECTION
Control Port Usage: C1 - SNOW DEPTH SENSOR
C2 - 12 VOLT RELAY DRIVER
Pulse Input Channel Usage: P1 - WIND SPEED 013A
P2 - SNOW DEPTH CSMAL01

2) Program:

```
*    1        Table 1 Programs
  01: 60      Sec. Execution Interval

01:  P3       Pulse
  01: 1       Rep
  02: 1       Pulse Input Chan
  03: 2       Switch closure
  04: 4       Loc [:WND SPD  ]
  05: .04799  Mult KM/HR
  06: 2.4142  Offset KM/HR

02:  P3       Pulse
  01: 1       Rep
  02: 2       Pulse Input Chan
  03: 0       High frequency
  04: 11      Loc [:SNW DEPTH]
  05: 1       Mult MILLIMetres
  06: 0       Offset

03:  P4       Excite,Delay,Volt(SE)
  01: 1       Rep
  02: 5       2500 mV slow Range
  03: 1       IN Chan
  04: 1       Excite all reps w/EXchan 1
  05: 0       Delay (units .01sec)
  06: 2000    mV Excitation
  07: 1       Loc [:AIR TEMP ]
  08: .09866  Mult
  09: -67.3   Offset

04:  P12      RH 207 Probe
  01: 1       Rep
  02: 2       IN Chan
  03: 2       Excite all reps w/EXchan 2
  04: 1       Temperature Loc AIR TEMP
```

```
 05: 2       Loc [:RH       ]
 06: 1       Mult
 07: 0       Offset

05:  P11      Temp 107 Probe
 01: 5       Reps
 02: 4       IN Chan
 03: 2       Excite all reps w/EXchan 2
 04: 5       Loc [:107 TEMPS]
 05: 1       Mult
 06: 0       Offset

06:  P4       Excite,Delay,Volt(SE)
 01: 1       Rep
 02: 5       2500 mV slow Range
 03: 3       IN Chan
 04: 3       Excite all reps w/EXchan 3
 05: 2       Delay (units .01sec)
 06: 900      mV Excitation
 07: 3       Loc [:WIND DIR ]
 08: .78000  Mult
 09: 0       Offset

07:  P1       Volt (SE)
 01: 1       Rep
 02: 3       25 mV slow Range
 03: 9       IN Chan
 04: 10      Loc [:MJ/M/M   ]
 05: .00582  Mult
 06: 0       Offset

08:  P89      If X<=>F
 01: 10      X Loc MJ/M/M
 02: 4       <
 03: 0       F
 04: 1       Call Subroutine 1

09:  P10      Battery Voltage
 01: 12      Loc [:BATT VOLT]

10:  P92      If time is
 01: 0       minutes into a
 02: 60      minute interval
 03: 21      Set low Flag 1

11:  P92      If time is
 01: 58      minutes into a
 02: 60      minute interval
 03: 11      Set high Flag 1

12:  P91      If Flag/Port
```

```
 01: 11     Do if flag 1 is high
 02: 30     Then Do

13: P31     Z=X
 01: 3      X Loc WIND DIR
 02: 17     Z Loc :

14: P31     Z=X
 01: 4      X Loc WND SPD
 02: 18     Z Loc :

15: P95     End

16: P92     If time is
 01: 0      minutes into a
 02: 60     minute interval
 03: 10     Set high Flag 0 (output)

17: P77     Real Time
 01: 110    Day,Hour-Minute

18: P70     Sample
 01: 2      Reps
 02: 1      Loc AIR TEMP

19: P76     Wind Vector (Pre OS10 0.1)
 01: 1      Rep
 02: 20     WS, Dir (Polar Sensor)
 03: 18     Wind Speed/East Loc
 04: 17     Wind Direction/North Loc

20: P70     Sample
 01: 5      Reps
 02: 5      Loc 107 TEMPS

21: P72     Totalize
 01: 1      Rep
 02: 10     Loc MJ/M/M

22: P92     If time is
 01: 354    minutes into a
 02: 1440   minute interval
 03: 30     Then Do

23: P86     Do
 01: 42     Set high Port 2

24: P95     End

25: P92     If time is
 01: 359    minutes into a
```

```
 02: 1440   minute interval
 03: 30     Then Do

26:  P20    Set Port(s)
 01: 9999   C8..C5=nc/nc/nc/nc
 02: 9995   C4..C1=nc/nc/nc/100ms

27:  P86    Do
 01: 71     Pulse Port 1

28:  P95    End

29:  P92    If time is
 01: 360    minutes into a
 02: 1440   minute interval
 03: 30     Then Do


30:  P86    Do
 01: 52     Set low Port 2

31:  P95    End

32:  P92    If time is
 01: 360    minutes into a
 02: 1440   minute interval
 03: 10     Set high Flag 0 (output)

33:  P77    Real Time
 01: 110    Day,Hour-Minute

34:  P73    Maximize
 01: 1      Rep
 02: 10     Value with Hr-Min
 03: 1      Loc AIR TEMP

35:  P74    Minimize
 01: 1      Rep
 02: 10     Value with Hr-Min
 03: 1      Loc AIR TEMP

36:  P73    Maximize
 01: 1      Rep
 02: 10     Value with Hr-Min
 03: 4      Loc WND SPD

37:  P79    Sample on Max or Min
 01: 1      Rep
 02: 3      Loc WIND DIR

38:  P78    Resolution
```

```
 01: 1       High Resolution

39: P72      Totalize
 01: 1       Rep
 02: 10      Loc MJ/M/M

40: P78      Resolution
 01: 0       Low Resolution

41: P70      Sample
 01: 2       Reps
 02: 11      Loc SNW DEPTH

42: P96      Serial Output
 01: 71      SM192/SM716

43: P        End Table 1

*   2        Table 2 Programs
 01: 0.0000  Sec. Execution Interval

01: P        End Table 2

*   3        Table 3 Subroutines

01: P85      Beginning of Subroutine
 01: 1       Subroutine Number

02: P37      Z=X*F
 01: 10      X Loc MJ/M/M
 02: 0       F
 03: 10      Z Loc [:MJ/M/M   ]

03: P95      End

04: P        End Table 3
```

Data Processing Documentation

SPLIT Parameter Files (.PAR)

The SPLIT process (using PC208 software package) is the initial tool of the data proessing which, as the name implies, splits or partitions the data and also sorts it and performs an initial filtering of any out-of-range values. The following SPLIT.PAR files were used to do an initial quality control on the data. As the filenames imply, the files were used for either 1990 or 1991. The only differences between these files are the "Start" and "Stop" conditions as well as the year which is inserted into the file. When selecting elements, range delimetres were used to replace obvious "bad data" with blanks.

HWC90HB.PAR and HWC91HA.PAR - Used to extract hourly data for 1990 (data dump to december) and 1991 (january to dump) data respectively, insert the year into the PRN file, and perform a verification of range limits on the data. These .PAR files initially produced IHWC90HB.PRN and IHWC91HA.PRN. These .PRN files were then imported into Quatro Pro for the initial verification of the data.

F1=Help F2=Commands Insert is On Param file is hwc90hb.par

```
Name(s) of input DATA FILES(s): HWC9091.DAT
Name of OUTPUT FILE to generate: IHWC90HB.PRN/[""]
START reading in HWC9091.DAT:
STOP reading in HWC9091.DAT: 2[1.]:3[0700]
COPY from HWC9091.DAT: 1[0116]
SELECT element #(s) in HWC9091.DAT: y=1990.,y,2,3,4[-55..20],5[0..100],
                                    6[2.415..100],7[0..360],8..
                                    12[-50..20],13[0..40]
HEADING for report: HOT\WEATHER\1990\INTERNAL FILE
HEADINGS for HWC9091.DAT, col. # 1:   YEAR
                  column # 2:   JULIAN\DAY
                  column # 3:   TIME
                  column # 4:   SMPL\AIR\TEMP
                  column # 5:   SMPL\AIR\RH
                  column # 6:   2MIN\WIND\SPEED
                  column # 7:   2MIN\WIND\DIR
                  column # 8:   SMPL\VEG\TEMP
                  column # 9:   SMPL\10CM\GND
                  column # 10:  SMPL\20CM\GND
                  column # 11:  SMPL\50CM\GND
                  column # 12:  SMPL\100CM\GND
                  column # 13:  TOTAL\RAD\MJ/M2
```

F1=Help F2=Commands Insert is On Param file is hwc91ha.PAR

```
Name(s) of input DATA FILES(s): HWC9091.dat
Name of OUTPUT FILE to generate: IHWC91HA.PRN/[""]
START reading in HWC9091.dat: 2[1.]:3[0700.]
STOP reading in HWC9091.dat:
COPY from HWC9091.dat: 1[0116]
SELECT element #(s) in HWC9091.dat: y=1991.,y,2,3,4[-55..25],5[0..100],6[2.4
                                    15..100],7[0..360],8..12[-50..30],
                                    13[0..40]
HEADING for report: HOT\WEATHER\1991\INTERNAL FILE
HEADINGS for HWC9091.dat, col. # 1:   YEAR
                  column # 2:   JULIAN\DAY
                  column # 3:   TIME
```

```
column # 4:    SMPL\AIR\TEMP
column # 5:    SMPL\AIR\RH
column # 6:    2MIN\WIND\SPEED
column # 7:    2MIN\WIND\DIR
column # 8:    SMPL\VEG\TEMP
column # 9:    SMPL\10CM\GND
column # 10:   SMPL\20CM\GND
column # 11:   SMPL\50CM\GND
column # 12:   SMPL\100CM\GND
column # 13:   TOTRAD\MJ/M2
```

HWC90DB.PAR AND HWC91DA.PAR - Used to extract the daily data for 1990 and 1991 respectively, insert the year into the .PRN file and perform a verification of range limits on the data as previously discussed. These .PAR files produce IHWC90DB.PRN and IHWC91DA.PRN files. These I*.PRN files were then imported into Quatro Pro for the initial verification of the data.

```
F1=Help  F2=Commands                Insert is On   Param file is hwc90db.PAR
-------------------------------------------------------------------------------------------------------------------------
                    Name(s) of input DATA FILES(s): HWC9091.DAT
                Name of OUTPUT FILE to generate: IHWC90DB.PRN/["]
                          START reading in HWC9091.DAT:
                       STOP reading in HWC9091.DAT: 2[2]
                          COPY from HWC9091.DAT: 1[132]
SELECT element #(s) in HWC9091.DAT: y=1990.,y,date(2-1.;1990.),2,3,4[-50..30],
                                    5,6[-50..30],7,8[2.415..90],9,10[0..360],11[0..35],
                                    12[0..1000],13
                              HEADING for report: TEST
HEADINGS for HWC9091.DAT, col. # 1:    YEAR
                          column # 2:    DATE
                          column # 3:    JULIAN\DAY
                          column # 4:    TIME\HHMM
                          column # 5:    MAX\AIR
                          column # 6:    TIME\MAX
                          column # 7:    MIN\AIR
                          column # 8:    TIME\MIN
                          column # 9:    MAX\WIND
                          column # 10:   TIME\MAX
                          column # 11:   DIR\MAX\WIND
                          column # 12:   TOTAL\RAD
                          column # 13:   SNOW\DEPTH
                          column # 14:   BATT\VOLT
```

```
F1=Help  F2=Commands                Insert is On   Param file is hwc91da.PAR
-----------------------------------------------------------------------------------------------------------
                    Name(s) of input DATA FILES(s): HWC9091.DAT
                Name of OUTPUT FILE to generate: IHWC91DA.PRN/[""]
                    START reading in HWC9091.DAT: 2[2]
                      STOP reading in HWC9091.DAT:
                     COPY from HWC9091.DAT: 1[132]
SELECT element #(s) in HWC9091.DAT: y=1991.,y,date(2-1.;1991.),2,3,4[-55..30],
                                    5,6[-55..30],7,8[2.415..100],9,10[0..360],11[0..35],
                                    12[0..1000],13
                          HEADING for report: TEST
        HEADINGS for HWC9091.DAT, col. # 1:   YEAR
                               column # 2:   DATE
                               column # 3:   JULIAN\DAY
                               column # 4:   TIME\HHMM
                               column # 5:   MAX\AIR
                               column # 6:   TIME\MAX
                               column # 7:   MIN\AIR
                               column # 8:   TIME\MIN
                               column # 9:   MAX\WIND
                              column # 10:   TIME\MAX
                              column # 11:   DIR\MAX\WIND
                              column # 12:   TOTAL\KIN
                              column # 13:   SNOW\DEPTH
                              column # 14:   BATT\VOLT
```

HWC90BC.PAR and HWC91AC.PAR - Used to calculate daily data from the hourly data and insert the year into the PRN file.

```
F1=Help  F2=Commands                Insert is On   Param file is hwc90bc.par
-----------------------------------------------------------------------------------------------------------
                    Name(s) of input DATA FILES(s): rhwc90HB.prn
                Name of OUTPUT FILE to generate: HWC90BC.prn/[""]
                    START reading in hwc9091.dat: 2[235]:3[0700]
                      STOP reading in hwc9091.dat:
                     COPY from hwc9091.dat:
SELECT element #(s) in hwc9091.dat: y=1990.,SMPL(y;24),SMPL(date(2-1.;1990.);
                                    24),SMPL(2;24),SMPL(3;24),AVG(4[-55..35];
                                    24),AVG(5[0..100];24),AVG(6[2.415..30];24),
                                    MAX(8..12[-50..35];24),AVG(8..12[-50..35];
                                    24),MIN(8..12[-50..35];24)
                          HEADING for report: test
        HEADINGS for hwc9091.dat, col. # 1:   YEAR
                               column # 2:   DATE
                               column # 3:   JULIAN\DAY
```

```
 column # 4:   TIME\HHMM
 column # 5:   AVG\AIR TEMP
 column # 6:   AVG\RH
 column # 7:   AVG\WIND
 column # 8:   MAX\VEG\TEMP
 column # 9:   MAX\10CM
column # 10:   MAX\20CM
column # 11:   MAX\50CM
column # 12:   MAX\100CM
column # 13:   AVG\VEG\TEMP
column # 14:   AVG\10CM
column # 15:   AVG\20CM
column # 16:   AVG\50CM
column # 17:   AVG\100CM
column # 18:   MIN\VEG\TEMP
column # 19:   MIN\10CM
column # 20:   MIN\20CM
column # 21:   MIN\50CM
column # 22:   MIN\100CM

F1=Help  F2=Commands          Insert is On   Param file is hwc91ac.PAR
-------------------------------------------------------------------------------------------------------------
                Name(s) of input DATA FILES(s): rhwc91HA.prn
            Name of OUTPUT FILE to generate: HWC91AC.prn/[""]
                START reading in hwc9091.dat: 2[1]:3[0700]
                     STOP reading in hwc9091.dat:
                      COPY from hwc9091.dat:
SELECT element #(s) in hwc9091.dat: y=1991.,SMPL(y;24),SMPL(date(2-1.;1991.);
                                    24),SMPL(2;24),SMPL(3;24),AVG(4[-55..35];
                                    24),AVG(5[0..100];24),AVG(6[2.415..30];24),
                                    MAX(8..12[-50..35];24),AVG(8..12[-50..35];24),MIN(8..12[-
                                    50..35];24)
                     HEADING for report: TEST
HEADINGS for hwc9091.dat, col. # 1:   YEAR
                 column # 2:   DATE
                 column # 3:   JULIAN\DAY
                 column # 4:   TIME\HHMM
                 column # 5:   AVG\AIR
                 column # 6:   AVG\RH
                 column # 7:   AVG\WIND
                 column # 8:   MAX\VEG\TEMP
                 column # 9:   MAX\10CM
                column # 10:   MAX\20CM
                column # 11:   MAX\50CM
                column # 12:   MAX\100CM
                column # 13:   AVG\VEG\TEMP
                column # 14:   AVG\10CM
                column # 15:   AVG\20CM
                column # 16:   AVG\50CM
```

column # 17:	AVG\100CM
column # 18:	MIN\VEG\TEMP
column # 19:	MIN\10CM
column # 20:	MIN\20CM
column # 21:	MIN\50CM
column # 22:	MIN\100CM

Hourly Data

The original data file, HWC9091.DAT was processed using the SPLIT parameter files to produce the initial .PRN files IHWC90HB.PRN AND IHWC91HA.PRN. These files were imported into Quatro Pro in order to produce the quick plots for data quality control. These spreadsheets, for internal use only, were kept as IHWC90HB.WQ1 and IHWC91HA.WQ1 and contain the saved quick plots.

With the analysis of the plots and correction of any problem data, the final cleaned files were saved as RHWC90HB.WQ1 and RHWC91HA.WQ1. From these cleaned files, the hourly data were partitionned into monthly files.

Daily Data

The original data file, HWC9091.DAT was processed using HWC90BD.PAR and HWC91BA.PAR to produce the initial .PRN files IHWC90DB.PRN and IHWC91DA.PRN which were then imported into Quatro Pro. The spreadsheets produced IHWC90DB.WQ1 and IHWC91DA.WQ1 contained the initial quick plots for the quality control process following which, the final cleaned files became RHWC90DB.WQ1 and RHWC91DA.WQ1. These files of daily data were broken down into "summer" and "winter" periods and named BHWC90SD.WQ1, OHWC90WD.WQ1, OHWC91WD.WQ1 and AHWC91SD.WQ1.

Calculated Data

The hourly data found in the cleaned files RHWC90HB.WQ1 AND RHWC91HA.WQ1 were printed to .PRN files from the spreadsheet files to RHWC90HB.PRN and RHWC91HA.PRN in order to be processed by SPLIT. The .PAR files used were HWC90BC.PAR and HWC91AC.PAR. The .PRN files produced by this SPLIT run were HWC90BC.PRN and HWC91AC.PRN. which were imported into the spreadsheets IHWC90BC.WQ1 and IHWC91AC.WQ1 for quality control graphing purposes. The resulting spreadsheet files were also organized in the "summer" and "winter" periods and were named BHWC90SC.WQ1, OHWC90WC.WQ1, OHWC91WC.WQ1 and AHWC91SC.WQ1.

Data Quality Control Notes

The Hot Weather Creek data for this 1990 to 1991 period contains periods of bad data. These data are associated with the anemometer and wind vane, the ultra sonic snow depth sensor and the radiometer.

Wind Data

The main problem with the wind data occurs when the anemometer set becomes inoperative due to icing. For those periods, the wind speed and direction data were removed. These data gaps are:1600, 276 (Oct. 3) to 1600, 294 (Oct. 21) 1990
0000, 306 (Nov. 2) to 0100, 341 (Dec. 7) 1990
1300, 356 (Dec. 22) to 1000, 365 (Dec. 31) 1990
2200, 6 (Jan. 6) to 1400, 43 (Feb. 12) 1991

The wind data for the period 50 (Feb. 19) to 86 (March 27) 1991 has been kept but should be treated with caution since there is a higher frequency of calm winds and the windspeeds for that period are generally lower. Since that period usually has lower winds due to the prevailing synoptic conditions, the wind data were kept, however this cautionnary advice is issued.

Snow Data

The ultra sonic snow depth sensor will give erroneous readings when taking measurements during periods of snowfall or blowing snow. As a result, all questionnable data were removed. These gaps appear throughout the period from August 1990 to March 1991 and again briefly from May to August 1991. Please note that the snow depth data in the original data (.DAT) file from June 19 to the end of the period is consistently showing an offset of 150 mm. This offset was probably introduced in June during the annual site visit. Confirmation of the offset will be done during the 1992 site visit.

Radiation Data

Due to the nature of the installation of the pyranometer, this sensor is briefly shaded for part of the day from March 24 to May 30 1991. For clear days, the data have been corrected while for cloudy days the data are not affected because of the diffuse light.

Temperature Data

All the temperature data have passed the initial quality control with one obvious exception. On July 22 (JD 203), 1991, the 50 cm soil temperature jumps from 2.2 °C at 1700 to 5.6 °C at 1800. Although there are some possible explanations for this, the final investigation and determination will have to wait for the 1992 annual field inspection.

TABLE 4. HWC(AWS): Split and Organized Data Files

FILE NAME	STARTS	STOPS
RHWC90HB.WQ1	1300, 234 (AUG.22), 1990	0600, 1 (JAN.1), 1991
RHWC91HA.WQ1	0700, 1 (JAN.1), 1991	1100, 235 (AUG.23), 1991
RHWC90DB.WQ1	235 (AUG.23), 1990, AUG.22*	1 (JAN.1), 1991, DEC.31*
RHWC91DA.WQ1	2 (JAN.2), 1991, JAN. 1*	235 (AUG.23), 1991, AUG.22*
BHWC90SD.WQ1	235 (AUG.23), 1990, AUG.22*	274 (OCT.1), 1991, SEPT.30*
BHWC90SC.WQ1	236 (AUG.24), 1990, AUG.23*	
OHWC90WD.WQ1	275 (OCT.2), 1990, OCT.1*	1 (JAN.1), 1991, DEC.31*
OHWC90WC.WQ1		
OHWC91WD.WQ1	2 (JAN.2), 1991, JAN.1*	91 (APR.1), 1991, MAR.31*
OHWC91WC.WQ1		
AHWC91SD.WQ1	92 (APR.2), 1991, APR.1*	235 (AUG.23), 1991, AUG22*
AHWC91SC.WQ1		
BHWC9008.WQ1[2]	1300, 234 (AUG.22), 1990	0600 244 (SEP.1), 1990, AUG.31*
AHWC9108.WQ1[2]	0700, 213 (AUG.1), 1991	1100, 235 (AUG.23), 1991

* The automatic weather station's clock is set to UCT. For the daily and calculated data the station day is one day ahead of the local day. The UCT day has been converted to local day in the data set.

[2] These two files are the only incomplete files of the monthly files of hourly data. The rest of the monthly files are the following. They all start at 0700 UCT (01 local) and end at 0600 UCT. The other file names are as follows:

HHWC9008.WQ1, HHWC9009.WQ1, HHWC9010.WQ1, HHWC9011.WQ1, HHWC9012.WQ1, HHWC9101.WQ1, HHWC9102.WQ1, HHWC9103.WQ1, HHWC9104.WQ1, HHWC9105.WQ1, HHWC9106.WQ1, HHWC9107.WQ1.

File Formats and Periods of Record: Final Cleaned Data

Creating the Final Cleaned Data Files and Final Plots

The Final Cleaned Data files were created in two steps. First the Organized Raw Cleaned data files shown in the second part of Table 6. above were imported into the QPRO spreadsheet templates (see Appendix 3 for details of this process) which contain the named graphs used to produce the plots. The logger dates were checked against the spreadsheet generated dates and data visually examined for problems. The named graphs were then altered to reflect the new data (see Appendix 6) and the named graphs plotted using the plotting macro (Appendix 5 and file **PGRAPH.WQM**). These graphs were then examined by all field personnel involved in the data collection process and the questionable data (or graphs) removed from the spreadsheet as discussed in the final quality control notes below.

The second step was to save these spreadsheets as the final cleaned data worksheet files (**.WQF**) listed in Table 2. From these worksheets the final graphs were plotted on the Hewlett Packard Paint Jet Printer (in colour) and then photocopied for the report. The graphs plotted in this initial report are listed in Part III. The named graphs in the worksheet **.WQF** can easily be modified to produce figures for papers etc., by removing the grid and customizing the headings. A few examples of multiple parameter plots, which were not plotted for the report to avoid repetition, but were included in the worksheet might also be useful for presentations.

Next, the blanks in the spreadsheet were replaced by "-9999." and the data printed to an ASCII file (**.PR9**).

Final Quality Control Notes

The vegetation temperatures have been removed from the final cleaned data files as these are unreliable particularly in periods of low wind speed and low solar angles.

PART III

PLOTS

INTRODUCTION TO PLOTS: 1990-91

In the following a selection of plots from AGA(A77) and HWC(AWS) are presented for daily, calculated and hourly data. The plot spreadsheets are still under development and will be updated and refined with each subsequent report. The plots are presented by spreadsheet (HWC9090D.WQF, HWC9091D.WQF etc.,). A table listing the plots produced by the spreadsheets used in this initial report precedes each set of plots.

Creating the plot spreadsheet from which complete spreadsheet templets will be made proved to be a very legnthy process but it will allow future years (and past unprocessed years) data to be plotted with a minimum of changes. User feedback would be very much appreciated on the ese plots and on the contents and organization of the report in general.

APPENDIX 1

EXTENDED BIBLIOGRAPHY HIGH ARCTIC IRMA 1988-91

Alt, B.T.
1990: Climate; Abstract, Workshop on Arctic Observatory Sites, Geological Survey of Canada, November 1990.

A review of preliminary automatic weather station results from Hot Weather Creek and Agassiz Ice Cap.

Alt, B.T., Fisher, D.A., and Koerner, R.M.
1992: Climatic conditions for the period surrounding the Tambora Signal in ice cores from the Canadian High Arctic islands; in The Year Without a Summer? World Climate in 1816, (ed.) C.R. Harington; Canadian Museum of Nature.

Analyses core parameters (i.e., oxygen isotopes and melt layers) associated with Tambora volcanic signal and discusses synoptic analog for the period.

Alt, B.J., Labine, C., Koerner, R.M., and Fisher, D.A.
1991: Developing techniques for Global Change monitoring of High Arctic Ice Caps (abstract); in Program with abstracts, Geological Survey of Canada.

Alt, B.T. and Maxwell, B.
1990: The Queen Elizabeth Islands: A case study for Arctic climate data availability and regional climate analysis; in the Canadian Arctic Islands; Canada's missing dimension, Special Publication of National Museum of Natural Sciences, v. 1, p. 294-326.

A study of the regional climate of the Queen Elizabeth Islands defining the distinctive S-shape of the mean monthly climate patterns and identifying the intermontane region of Central Ellesmere Island. Gaps in the data network were identified. Alt carried out the climate work and prepared the manuscript.

Bourgeois, J.C.
1990: Seasonal and annual variation of pollen content in the snow of a Canadian High Arctic ice cap; Boreas, v. 19, p. 313-322.

The changes in pollen concentration in the snow of the Agassiz Ice Cap, during an eight-year period, are presented and tentatively related to climatic events during the same period.

Burn, C.R. and Lewkowicz, A.G.
1990: Canadian Landforms Examples-17: Retrogressive thaw slumps; Canadian Geographer, v. 34, no. 3, p. 273-276.

Duchesneau, M. and Jones, H.G., in press: LaCalotte de Glace Agassiz: profil physico-chimique et échange neige-atmosphere; The Musk Ox.

Edlund, S.A.
1989: Vegetation patterns assist in identifying potentially thaw-sensitive terrain on central Ellesmere Island, Arctic Canada; Abstract, in Proceedings, 40th Arctic Science Conference, Fairbanks, Alaska, 14-16 September 1989, p. 24.

This abstract covers a talk on the sensitivity of terrain underlain by massive ice bodies to periods of extended summer warmth, and suggests that vegetation patterns can help in delineating areas with such ice bodies.

Edlund, S.A.
1989: The coincidence of regional vegetation distribution patterns and summer temperatures in Arctic Canada; Abstract of Poster, in Proceedings, 40th Arctic Science Conference, Fairbanks, Alaska, 14-16 September, 1989, p. 53.

This abstract covers a poster, illustrating the detailed zonation of Canada's north that has been developed as a result of 15 years of mapping arctic vegetation. The utility of these zones for interpreting past climates from fossil plant remains was also demonstrated.

1989: Vegetation indicates potentially unstable arctic terrain; GEOS, v. 18, no. 3, p. 9-13.

This report describes the response of vegetation and geomorphic processes to warm dry summer of 1988 on Fosheim Peninsula, and suggests that some small, anomalous vegetation patterns may indicate the presence of massive ground ice, and therefore potentially unstable terrain.

Edlund, S.A.
1990: Arctic bioclimatic indicators, a key to understanding northern paleoenvironments; Abstract, GSC Forum of Activities, 1990.

This talk discusses the recently described vegetation zones in northern Canada, and how many species serve as bioclimatic indicators, and can be used to reconstruct climates from fossil records.

Edlund S.A.
1990: Woody plants as bioclimatic indicators in Arctic Canada; Abstract, in Proceedings, Symposium: Climate of Northern Latitudes: Past, Present and Future, University of Tromso, Tromso, Norway, April 2-4, 1990.

This abstract summarizes the 5 broad bioclimatic zones in Arctic Canada based on the growth form and plant community structures of tundra communities. The role of woody plants in this zonation scheme is emphasized.

Edlund, S.A., Alt, B.T., Harry, D.G., and Luckman, B.H.
1989: Plant distribution indicators of potential terrain instability (abstract); in Program with abstracts, Geological Survey of Canada, Forum 1989, Ottawa.

This presents a summary of unusual vegetation patterns which show potential at indicating the presence of regularly occurring, massive ground-ice melt. This work is based on field observations made by Edlund and Alt during summer 1988.

Edlund, S.A., Alt, B.T., Harry, D.G., and Luckman, B.H.
1989: Plant distribution indicators of potential terrain instability; Abstract, Geological Survey of Canada, Forum 1989.

This presents a summary of unusual vegetation patterns which show potential at indicating the presence of regularly occurring, massive ground ice melt.

Edlund, S.A., Alt, B.T., Harry,D.G., and Luckman, B.H.
1989: Plant distribution indicators of potential terrain instability; Abstract, Geological Survey of Canada Forum 1989.

This presents a summary of unusual vegetation patterns which show potential at indicating the presence of regularly occurring, massive ground-ice melt.

Edlund, S.A., Alt, B., Taylor, A.E., and Young, K.L.
1990: Multidisciplinary research in the intermontane zone, Ellesmere Island, N.W.T.; Poster, Geological Survey of Canada Forum 1990.

This poster describes the multidisciplinary nature of scientific work carried out at Terrain Sciences Global Change Observatory on Fosheim Peninsula.

Edlund, S.A., Alt, B.T., and Young, K.L.
1989: Interaction of climate, vegetation and soil hydrology at Hot Weather Creek, Fosheim Peninsula, Ellesmere Island, Northwest Territories; in Current Research, Geological Survey of Canada, Paper 89-D, p. 125-133.

This paper documents the preliminary findings of the first year of a multidisciplinary study initiated on Fosheim Peninsula, 80°N. An unusually warm summer led to significant ground ice melting, as manifested by the recharge of creeks and thaw ponds, surface seepage, activation of active layer detachment slides and rapid headwall retreat of ground ice slumps. This paper also describes the preliminary regional vegetation zonation.

Edlund, S.A. , Alt, B.T., and Young, K.L.
1989: Vegetation, hydrology and climate at Hot Weather Creek, Ellesmere Island, Northwest Territories; Abstract, in Program, Canadian Committee on Climate Fluctuations and Man, Annual Meeting, Ottawa, Ontario, 25-27 January 1989, CCCFM Newsletter, v. 5, p. 65.

This abstract describes the 1988 activities in the Hot Weather Creek area, including vegetation studies, local regional climate, and some surprising geomorphic processes that were triggered by a warm dry summer.

Edlund, S.A., Alt, B.T., and Young, K.L.
1990: Multidisciplinary research in the intermontaine zone of Ellesmere Island, N.W.T. (abstract); in Program with abstracts, Geological Survey of Canada, Forum 1990, Ottawa.

The abstract describes the anomalously warm, well vegetated zone of the northeastern Queen Elizabeth Islands, and describes vegetation, climate, hydrology, and geomorphic process studies underway to document the impact of climate variability on the terrain around Hot Weather Creek.

Edlund, S.A., Woo, M.-K., and Young, K.L.
1990: Climate, hydrology and vegetation patterns, Hot Weather Creek, Ellesmere Island, Arctic Canada; in The Eight International Northern Research Basins Symposium and Workshop, Abisko, Sweden, v. 1, p. 8-23.

This paper summarizes the presentation at this Symposium in which the climate, vegetation and hydrology patterns found at Hot Weather Creek are summarized. It discusses the regional anomalous vegetation patterns (rich tundra communities in an area climatically defined as polar desert and semi-desert) and suggests reasons for this anomaly.

1990: Vegetation patterns, climate and hydrology at Hot Weather Creek, Ellesmere Island, Arctic Canada; Journal of Nordic Hydrology, v. 15, no. 4.

This paper proposes the theory that there are two potential sources of moisture for major areas of Fosheim Peninsula in summer: precipitation and ground ice melt. These two sources vary in importance depending on the summer climate regime. They provide a fail-safe delivery system of moisture to vegetation on Fosheim Peninsular and permit a denser vegetation than precipitation alone could.

Edlund, S.A., Woo, M-K., Young, K.L., Alt, B.T., and Headley, A.N.
1991: Three years of environmental monitoring at GSC's Global Change Observatory, Hot Weather Creek, Ellesmere Island; Abstract, Geological Survey of Canada, Forum 1991.

This poster to demonstrates the multidisciplinary aspects of the Global Change Observatory project and the ongoing monitoring of climate and environmental responses at Hot Weather Creek, Ellesmere Island. It shows that this area is extremely sensitive to climatic change, even on a seasonal basis. Two dramatic geomorphic processes, the triggering active layer detachements slides and the rapid headwall retreat of ground ice slumps, are triggered by the very prolonged warm, dry summers when there is a deepening of the active layer sufficiently to melt the surface of buried ice bodies.

Egginton, P.A. and Hodgson, D.A.
1990: Preliminary assessment of selected drainage basins in western Fosheim Peninsula, Ellesmere Island, as sites for global change studies. in: Current Research, Part D, Geological Survey of Canada Paper 90-1D. in press.

This paper documents the depths along transects and July surface temperatures of four lakes on western Fosheim Peninsula. Holocene marine limit of western and central Fosheim Peninsula is also outlined.

Fisher, D.A. and Koerner, R.M.
1987: The effects of wind on $\delta(^{18}O)$ and accumulation give an inferred record of seasonal δ amplitude from the Agassiz Ice Cap. Ellesmere Island Canada; Bern Symposium on Ice Core Analysis, March/April 1987, Annals of Glaciology v. 10, p. 34-37.

Fyles, J.G.
1989: High terrace sediments of Neogene age, west central Ellesmere Island, Northwest Territories; In: Current Research Part D, Geological Survey of Canada, Paper 89-1D, p. 101-104.

This paper describes materials representing boreal forest to forest tundra environments from high terrace sediments. The macrofossils are compared to Kap Kobenhavn Fm. of N. Greenland and Beaufort Fm. Meighen and Prince Patrick islands.

Headley, A.
1990: A comparison of Wind speeds recorded simultaneously at three metres and ten metres above the ground, Canadian climate Centre Report No. 90-1. Atmospheric Environment Service Downsview, Ontario, 36 p.

This study examines the relationship between the wind speeds recorded at 3 metres and 10 metres, at Hot Weather Creek, Ellesmere Island. A mean variation of wind speed with height, based on a simplified form of Hellman's formula, is used to adjust the 3 m wind speeds to provide an estimate of 10 m speeds.

Hodgson, D.A.
1985: The last glaciation of west-central Ellesmere Island, Arctic Archipelago, Canada; Canadian Journal of EarthSciences v. 22, no. 3, p. 347-368.

This paper describes aspects of the late Pleistocene history of the region, and suggests that much of the Fosheim Peninsula was not glaciated during late Wisconsinan times.

Hodgson, D.A. and Edlund, S.A.
1977: Biophysical regions, western Fosheim Peninsula and eastern Axel Heiberg Island. Geological Survey of Canada Open file 501.

Koerner, R.M.
1989: Queen Elizabeth Islands glaciers; in Chapter 6 of Quaternary Geology of Canada and Greenland, (ed.) R.J. Fulton; Geological Survey of Canada, Geology of Canada, no. 1, p. 464-473.

A review of all our ice core work to date reconciled to mass balance results. Also a brief review of the various velocity rates, ice thicknesses and properties of the Canadian High Arctic ice masses.

1989: Arctic ice cores: Putting present climate into perspective; in Arctic Islands, Canada's missing dimension; Syllogeus, National Museum of Natural Sciences.

Warmth of present climate is relative: cold wrt last 10 000 years, warm wrt to last 100 000 and 2000 years.

Koerner, R.M., Alt, B.T., Bourgeois, J.C., and Fisher, D.A.
1991: Canadian polar ice caps as sources of paleoenvironmental data: advantages and disadvantages, in Proceedings of Conference on "The Role of Polar Regions in Global Change", Alaska, June 1990. (in press).

The thin ice caps (100-600 m) provide simple drilling conditions for study of ice dynamics down a flow line and long period (100,000 yr.) climatic recrods with the restriction of poor resolution in ice more than 10,000 years old.

Koerner, R.M., Bourgeois, J.C., and Fisher, D.A.
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The thin ice caps (100-600 m) provide simple drilling conditions for study of ice dynamics down a flow line and long period (100 000 yr.) climatic records with the restriction of poor resolution in ice more than 10 000 years old.

Koerner, R.M., Dubey, R., and Parnandi, P.S.N.
1989: Scientists monitor climate and pollution from ice caps and glaciers; GEOS, v. 18, no. 3, p. 33-38.

Explains how ice caps can be used to monitor both climate and pollution trends in the Arctic.

Koerner, R.M. and Fisher, D.A.
1990: Climatic warming, glaciers and sea level; Annals of Glaciology, v. 14, p. 345.

Challenges the simple relationship: warming, ice cap melting, high sea levels.

Koerner, R.M. and Fisher, D.A.
1990: A record of Holocene summer climate from a Canadian high-Arctic ice core; Nature, v. 343, no. 6259, p. 630-631.

The concentration of summer melt layers in cores from the Agassiz Ice Cap gives evidence for maximum summer warmth in the early Holocene reaching its coldest level only 150 years ago. The modern warming is unique only in terms of the last 2000 years.

Labine, C.L.

"Arctic Meteorology and Climatology, Present State and Future Direction", Canada's Missing Dimension, Science and History in the Canadian Arctic Islands, Volume 1, Ottawa, Canadian Museum of Nature, 1990.

Lewkowicz, A.G.

1989: Active-layer detachments on the Fosheim Peninsula, Ellesmere Island: the importance of the summer of 1988. Canadian Association of Geographers, Ontario Division Conference, University of Guelph, October, 1989.

1990: Frequency and magnitude of active-layer detachments on the Fosheim Peninsula, Ellesmere Island: past, present and future. Abstract. 19th Annual Arctic Workshop, Institute for Arctic and Alpine Research, University of Colorado, March 1990.

1990: Morphology, frequency and magnitude of active-layer detachment slides, Fosheim Peninsula, Ellesmere Island, N.W.T. In: Permafrost-Canada: Proceedings of the Fifth Canadian Permafrost Conference, Quebec City, June 1990, Universite Laval, Quebec. p. 111-118.

1990: Active-layer detachments, Fosheim Peninsula, Ellesmere Island. Abstract, Canadian Association of Geographers, Annual Meeting, University of Alberta, June 1990.

1990: Climatic change and permafrost slope processes. Abstract; Canadian Association of Geographers, Annual Meeting. University of Alberta, June 1990.

1992: Slope hummocks on Fosheim Peninsula, Ellesmere Island; in: Current Research, Part B; Geological Survey of Canada, Paper 92-1B. This paper describes the internal morphology of several types of slope hummocks in the Fosheim Peninsula region and attributes their origin to a combination of dessication cracking, wash processes, niveoeolian deposition and mass movement.

Luckman, B.H., Edlund, S.A., and Harry, D.G.

1988: Active-Layer detachments during late summer, 1988, Fosheim Peninsula, Ellesmere Island; CAGONT '88 Permafrost Abstracts; Programme and Abstracts, Annual meeting Canadian Association of Geographers Ontario Division, p. 13.

Abstract submitted and paper presented by Luckman. Describes the large number of geomorphic processes triggered by the unusually warm summer on Fosheim Peninsula, particularly active layer detachment slides.

Luckman, B.H., Harry, D.G., Edlund, S.A., and Alt, B.
1989: Global change, ground ice and geomorphic processes: some observations from the Fosheim Peninsula, Ellesmere Island, N.W.T., Canada; in Abstracts, 18th Annual Arctic Workshop, April 13-15, 1989, Global Environmental change and the Arctic, Lethbridge, Alberta.

This abstract summarizes work by Edlund, Alt, harry and Young on Fosheim Peninsula in 1988.

Luckman, B.H., Harry, D.G., Edlund, S.A., and Alt, B.T.
1989: Global change, ground ice and geomorphic processes: some observations from the Fosheim Peninsula, Ellesmere Island, N.W.T., Canada (abstract); in Abstracts, 18th Annual Arctic Workshop, April 13-15, 1989, Global Environmental Change and the Arctic, Lethbridge, Alberta.

This abstract summaries work by Edlund, Alt, Harry and Young on Fosheim Peninsula in 1988. Alt provided meteorological data and advice.

Peters, B. and Headley, A.
1992: A comparison of winds at Hot Weather Creek and Eureka, N.W.T. Canadian Climate Centre Report No. 92-2. Atmospheric Environment Service, Downsview, Ontario. 21 p.

Pollard, W.H.
1991: Observations on massive ground ice on Fosheim Peninsula, Ellesmere Island, Northwest Territories; in: Current Research Part E, Geological Survey of Canada, Paper 91-1E, p. 223-231.

This paper describes ground ice observations at 3 sites on Fosheim Pen. It describes some massive ice bodies and suggests that ice segregation during permafrost aggredation could be the primary process in thier formation.

Sutherland, P.D.
1984: A reassessment of Independence I: Some Observations from the Eureka Upland, High Arctic Canada.

Abstract of paper presented at the 17th Annual Meeting of the Canadian Archaeological Association, Victoria.

1989: An inventory and assessment of the Prehistoric Archaeological resources of Ellesmere Island National Park Reserve. In Press. Canadian Parks Service.

1990: A piece of the Palaeoeskimo Mosaic: Continuity and Change on Northern Ellesmere Island.

Abstract, Paper presented at the 23rd Annual Meeting of the Canadian Archaeological Association, Whitehorse, Yukon.

Waddington, E.D., Fisher, D.A., and Koerner, R.M.
In press: Microclimate at Agassiz Ice Cap Ellesmere Island, and implications for ice core studies; American Geological Union.

This paper deals with the "unusual" 10 m firn temperatures at the top of the Agassiz ice cap. Normally they reflect the mean annual air temperature but on Agassiz there is more a complexes pattern with the warmest temperatures near the top where they should be coldest. In addition to the mean annual temperature there are three possible processes at work. These are discussed and present and future automatic measuring described.

Wolfe, P.M.
1992: Suspended Sediment and Solute Transport in Hot Weather Creek, Fosheim Peninsula, Ellesmere Island, Northwest Territories, 1990-1991. B.Sc. Honours Thesis Department of Geography, Enndale College University of Toronto.

Woo, M-K., Young, K.L., and Edlund, S.A.
1990: Effects of soil, vegetation and microclimate on slope hydrology, Hot Weather Creek basin, Ellesmere Island, N.W.T.; in Current Research, Geological Survey of Canada, Paper 90-1D.

This paper describes the effects of the slightly cooler than normal and extremely west summer of 1989 had on soil hydrology and vegetation at the Hot Weather Creek site. Vegetation, site and methods descriptions written by Edlund.

Woo, M-K., Edlund, S.A., and Young, K.L.
1991: Occurrence of early snow-free zones on the lowlands of Fosheim Peninsula, Ellesmere Island, Northwest Territories; in Current Research, Geological Survey of Canada, Paper 91-1D, p. 9-14.

This paper describes the appearance of snow-free areas on Fosheim Peninsula, Ellesmere Island in early May 1990, shows how these areas are detectable on NOAA satellite imagery, and describes the monitoring of the active layer development throughout the summer in areas within and outside a major snow-free zone. Vegetation at the sites is also compared.

APPENDIX 2

INSTRUMENTATION TECHNICAL SPECIFICATIONS

MODEL 207F

TEMPERATURE AND RELATIVE HUMIDITY PROBE

1. GENERAL

The Model 207F probe contains a Phys-Chemical Research PCRC-11 RH sensor and a YSI 44002A thermistor configured for use with CSI's CR7X,21X, and CR10 dataloggers. Although both sensors are combined into one probe, separate Input/Output Instructions are used to read each sensor.

The thermistor is measured using two seperate instructions: 1) Input Instruction #4 makes a single ended measurement and 2) Instruction 55 is used to linearize the results from instruction 4. Program 55 requires the following linearization coefficients: C0=-74.143, C1=645.21, C2=-3835.8, C3=16025., C4=-33996. and C5=29763.

Input/Output Instruction #12 provides a 3V AC excitation, makes a single ended measurement, linearizes the measurement with a fifth order polynomial to obtain %RH and performs the required temperature compensation before outputting the result.

Refer to Appendix A for the programming example.

CAUTION: Never apply a DC voltage to this sensor. The RH chip will be polarized, causing irreparable damage. Do not measure the sensor resistance with a common multimeter. See the attached handling notes provided by Phys-Chemical Research Corp.

2. ACCURACY - TEMPERATURE SENSOR

The overall sensor accuracy is a combination of YSI's interchangeability specification, the precision of the bridge resistors and the linearization error. In a "worst case" example all of the errors add in one direction to yield a $\pm 0.4^{o}C$ accuracy over the range of $-55^{o}C$ to $+48^{o}C$. NOTE: It is emphasized that this is "worst case" and in CSI's experience the overall accuracy is typically better than $\pm 0.2^{o}C$.

The major error component is the $\pm 0.2^{o}C$ thermistor specification. Although the thermistor interchangeability is typically better than this, any existing error is predominantly offset and can be determined with a single point calibration. The error can then be compensated for by entering an offset which causes the

reading to match the linearization error.

The bridge resistors are 0.1% tolerance with a 10ppm temperature coefficient.

The linearization error is tabulated in Table 2-1 and also plotted on the attached graph.

Table 2-1. Thermistor Linearization Error

Range °C	Error
-59 to +55	≤1.0°C
-55 to +50	≤ .5°C
-53 to +47	<0.1°C
-51 to +13	≤0.1°C

3. ACCURACY - RH SENSOR

The overall sensor accuracy is a combination of the RH chip, the precision resistors and the linearization error. CSI's experience indicates the combined RH sensor accuracy is typically better than ±5% over the 12 to 100% RH range.

The bridge resistors are 0.1% tolerance with a 10ppm temperature coefficient.

The linearization error is tabulated in Table 3-1 and also plotted on the attached graph.

Table 3-1. RH Linearization Error

RH Range	Error, %RH
12 - 100	≤3
25 - 94	≤1

The computed RH value is temperature compensated as follows:

$$RH = RH_1 + 0.36(25-T)$$

Where: RH = Temperature compensated RH output
RH_1 = RH as computed by the linearization routine

T = Air temperature in °C at the 207 probe

INSTRUCTIONS FOR THE PROPER HANDLING AND USE OF THE PCRC-11 AND PCRC-55 HUMIDITY SENSORS

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212-924-2070

MAXIMUM CIRCUIT RATINGS

1. Only AC voltages of at least 20 cycles per second with zero D.C. component should be used with the sensor (preferably a sinusoidal waveform). Sustained operation on DC voltage or A.C. voltages with a D.C. component will result in a shift of calibration; momentary operation on DC voltage may also affect the sensor.

2. Maximum allowable current is 1 mA.

SENSOR HANDLING --- DO'S AND DON'TS

1. The surfaces of the sensor should not be touched or contaminated in any way.

2. The sensor should be held by its terminals, or by two edges.

3. The sensor should not be exposed to organic solvents and ionic-laden liquids; (any chemical compound that attacks polystyrene may affect sensor performance).

4. For removal of dust or dirt use a gentle clean (oil-free) air blast, or brush lightly with a clean soft camels hairbrush.

5. Contamination by exposure to oil or oil vapors must be avoided; calibration shift, loss of response time and sensor deterioration may result.

6. The sensor should not be subjected to liquid water immersion, and water condensation on the sensor surfaces should be avoided. While the sensor is not water soluble water condensation or immersion may affect sensor calibration.

7. The sensors are particularly susceptible to contamination by sulfur gases and sulfur compounds (Don't smoke at the sensor!).

8. It is important to remember that while this sensor is rugged, the nature of its function the sensing of water vapor precludes any type of handling that would obstruct or shield its surface from the atmosphere to be sampled.

9. If the sensor is connected to its circuit by soldering to its terminals proper heat-sink techniques must be employed to prevent the possibility of sensor overheating with resultant destruction.

10. The upper temperature limit of the sensor is approximately 200 ^{o}F.

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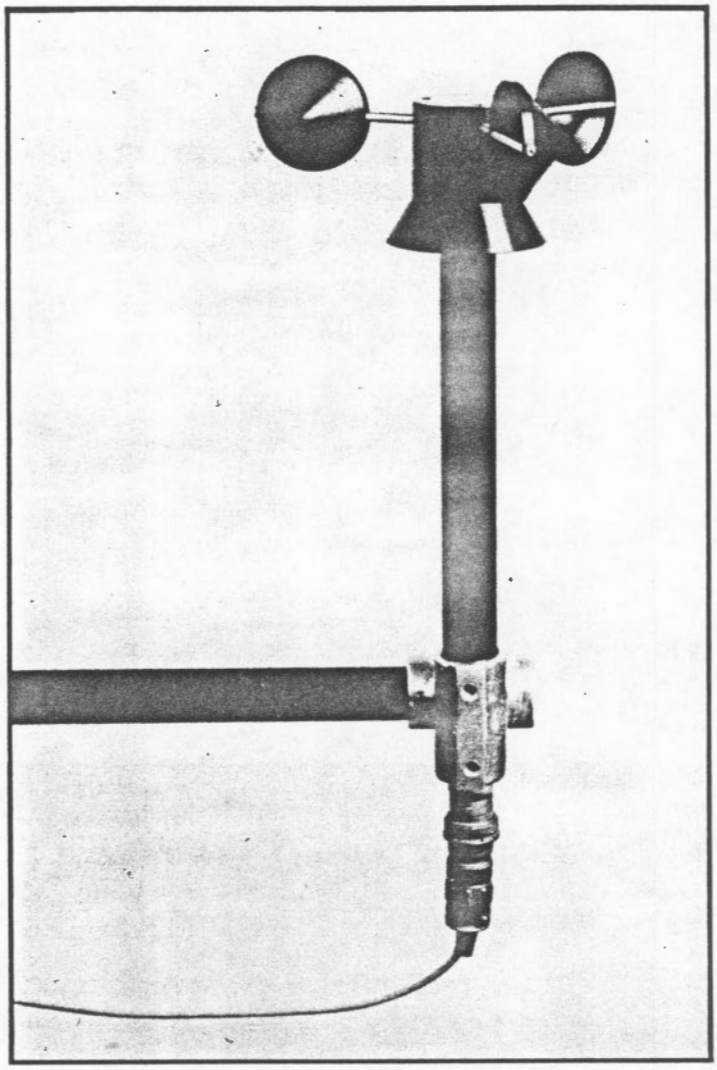
Met One

013 Wind Speed Sensor



Features

- Accuracy of 2%
- Temperature operating range of –50°C to +70°C
- Stainless steel ball bearings for greatest accuracy and operating life
- Starting threshold of 1.2 mph

The Model 013 Wind Speed Sensor has been specifically designed to accurately and reliably measure wind velocity under the most adverse environmental conditions. The Model 013 is particularly useful in remote, unattended monitoring applications where the sensor is likely to encounter high winds and heavy icing conditions. The sensor has a range of 0-150 mph with an accuracy of 2%, and a starting threshold of 1.5 mph. A unique feature of the Model 013 is a built-in ice skirt which allows sensor operation with a 2" ice load. The sensor is normally supplied with an extremely robust aluminum cup assembly which has a distance constant of less than 15 feet. Maximum operational reliability is ensured by the use of a sealed magnetic reed switch which produces a series of contact closures at a rate proportional to wind speed. The pulsed output of the sensor lends itself to applications involving both digital and analog measurement systems. Met One's Wind Speed Translator Module converts the signal into standardized analog voltage/current output.

Construction

The construction of the sensor reflects the requirement for reliability and durability. Only the best corrosion resistant material, such as stainless steel and anodized aluminum are used. The 013 sensor uses a quick-connect sensor cable. Cable length may extend hundreds of feet without affecting measurement performance.

Specifications

Range:	0-150 mph
Starting Threshold:	1½ mph
Accuracy:	± .25 mph or 2%
Distance Constant:	Less than 15 feet
Temperature Operating Range:	–50°C to +70°C
Ice Load:	2 inches
Weight:	14 ounces
Contact Rating:	10 ma maximum
Mounting:	Model 191 Mounting Arm
Sensor Cable:	A1805-xx Cable Assembly, Quick-connect connector with vinyl jacketed, shielded cable. Cable length is given in -xx feet.

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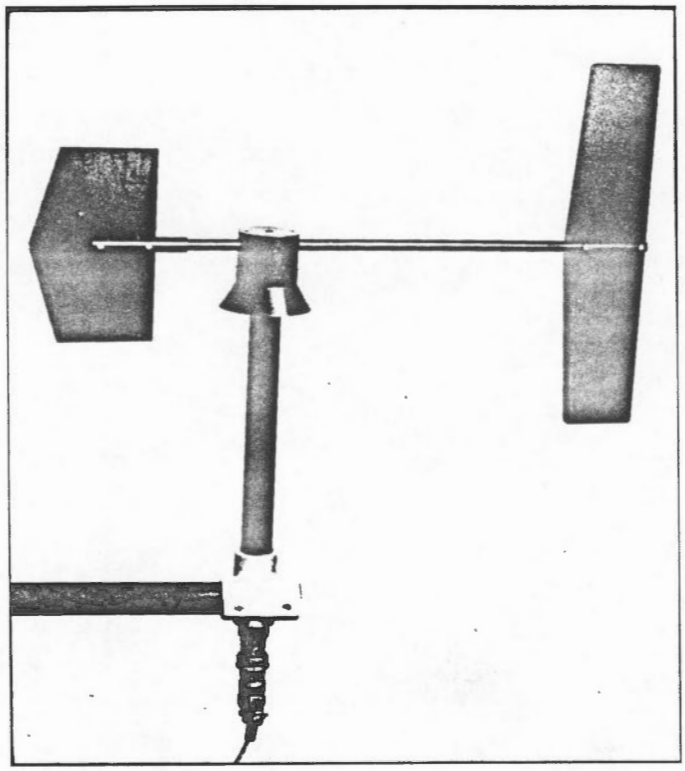
Met One 023 Wind Direction Sensor

Features

- Low starting threshold of 1½ mph
- Unique Met One "Mechanical Average System" reduces sensor wear
- Built in alignment and calibration fixture
- Operates in winds of 150 mph and ice loads of 2″



The Model 023 Wind Direction Sensor is a rugged sensor that accurately and reliably measures wind direction under the most adverse environmental conditions. The Model 023 has been specifically designed for use in remote, unattended monitoring applications where the sensor is likely to encounter high winds and heavy icing conditions. The sensor has a starting threshold of 1.5 mph and will operate in winds up to 150 mph, additionally the sensor has a built-in ice skirt which allows operation with up to a 2″ ice load.

The two part wind vane is connected by a unique ±10 slotted shaft coupler to a precision wire wound potentiometer. The sensor output is an accurate MECHANICAL AVERAGE of the wind direction. An additional benefit of the slotted shaft coupler is decreased potentiometer wear and greatly increased sensor life. The Model 023 includes an orientation fixture which facilitates accurate field alignment.

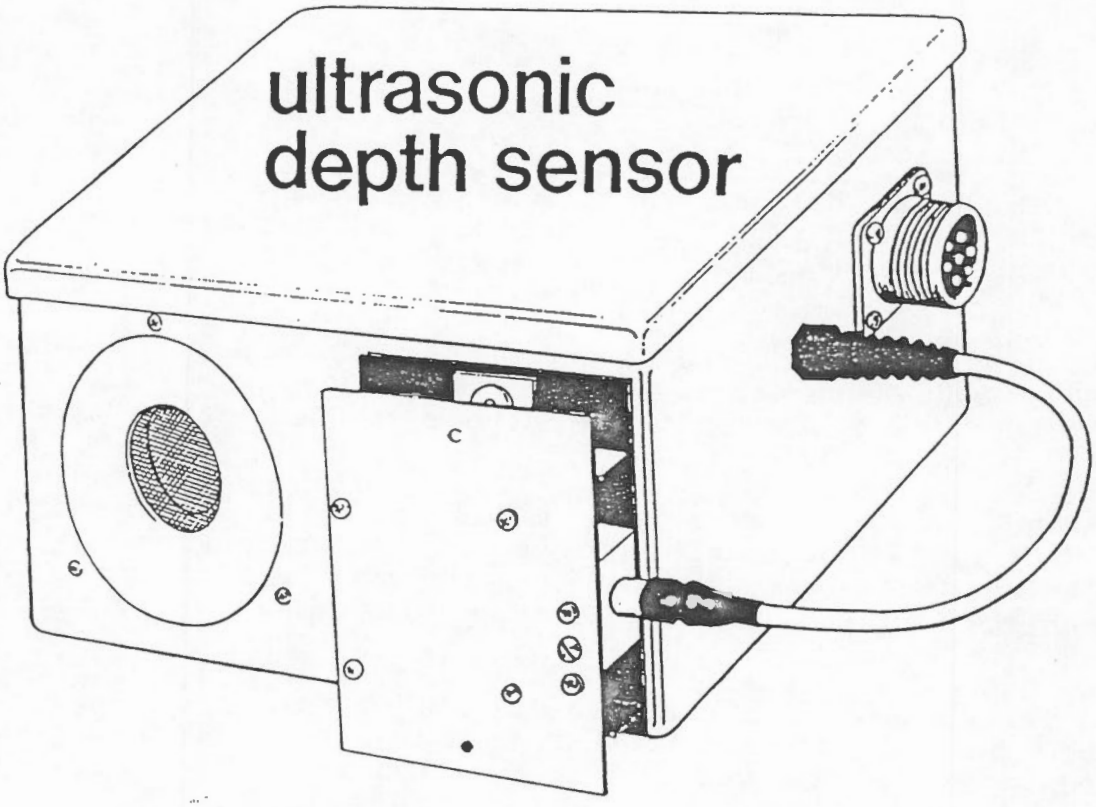
Construction

The construction of the Model 023 Sensor reflects the requirement for reliability and durability. Only the best corrosion resistant materials, such as stainless steel and anodized aluminum are used. The Model 023 is used with a quick connect shielded sensor cable.

Specifications

Electrical Range:	0–360° (0–540° when used with 540° Translator Module)
Threshold:	1½ mph
Maximum Wind Speed:	150 mph
Accuracy:	±10° standard, others on request
Ice Load:	2 inches
Delay Distance:	15 feet
Damping Ratio:	.3
Potentiometer Specifications:	
Sand, Dust, and Fungus:	MIL-E-5272
Salt Spray:	MIL-E-12934
Resistance Value:	10K ohms, others on request
Temperature Range:	−50°C to +70°C

ultrasonic depth sensor



POWER REQUIREMENTS.....+12VDC

ENVIRONMENTAL OPERATING RANGE.....-25°C to +50°C

AVAILABLE AT ADDITIONAL COST....-40°C to +50°C

MEASUREMENT.....AVERAGE OF 16 SAMPLES

TEMPERATURE CORRECTED

EFFECTIVE MEASUREMENT WINDOW.....0 CM to 1000 CM

MINIMUM DISTANCE TO TARGET.....60 CM

ACCURACY.....± 1 CM OR 0.4 % OF DISTANCE TO TARGET

(whichever is greater)

PULSE OUTPUT..... 0 to +5V TRANSMIT BURST

TEMPERATURE SENSOR

NATURAL SEMICONDUCTOR SOLID STATE

TEMPERATURE RANGE.....-50°C to +50°C

ACCURACY.....±1°C

FAILSAFE OSCILLATOR

WATCH - DOG TIMER FOR AUTOMATIC RECOVERY

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MODEL 107 TEMPERATURE PROBE

1.0 GENERAL

For use in air or soil, the 107 and 107B Temperature Probes incorporate the Fenwal Electronics UUT51J1 Thermistor in a water-resistant probe with standard 10 foot leads. Extra lead lengths are available. Do not extend lead lengths by adding wire to the pigtail (connection) end because measurement errors will result.

The 107 Temperature Probe is designed for measuring air temperature. The 107B Temperature Probe is electrically identical, but is physically more rugged for burial applications.

2.0 ACCURACY

The overall probe accuracy is a combination of Fenwal's interchangeability specification, the precision of the bridge resistors and the polynomial error. In a "worst case" example all of the errors add in one direction to yield accuracy of ±0.4°C over the range of -33°C to +48°C. The error is typically less than the specification. The major error component is the ±0.2°C (±0.5°C at -40°C) interchangeablility specification of the thermistor from 0 to 60°C. The interchangeability error is predominantly offset and can be determined with a single point calibration. The error can then be compensated for with the offset entered in the measurement instruction.

The bridge resistors are 0.1% tolerance with a 10ppm temperature coefficient.

Polynomial errors are tabulated in Table 1 and also plotted in Figure 1.

Table 1. Polynomial Error

RANGE °C	ERROR
-40 to +56	<1.0°C
-36 to +53	<0.5°C
-33 to +48	<0.1°C

3.0 PHYSICAL CONNECTIONS

The 107 schematic is shown in Figure 2. The 107 uses a single ended analog channel, the red lead "HI" can be inserted into either a HI or LO input.

The black lead connects to any excitation channel. One excitation channel will drive several hundred 107 probes. Thus, the number of 107 probes per excitation channel is physically limited by the number of lead wires that can be inserted into a single excitation terminal (approximately 10).

The purple lead connects to Analog Ground. Analog Ground, labeled "AG" on the CR10, is the same as Ground for the 21X and CR7.

The clear lead is the shield which connects to Ground (G) on the datalogger.

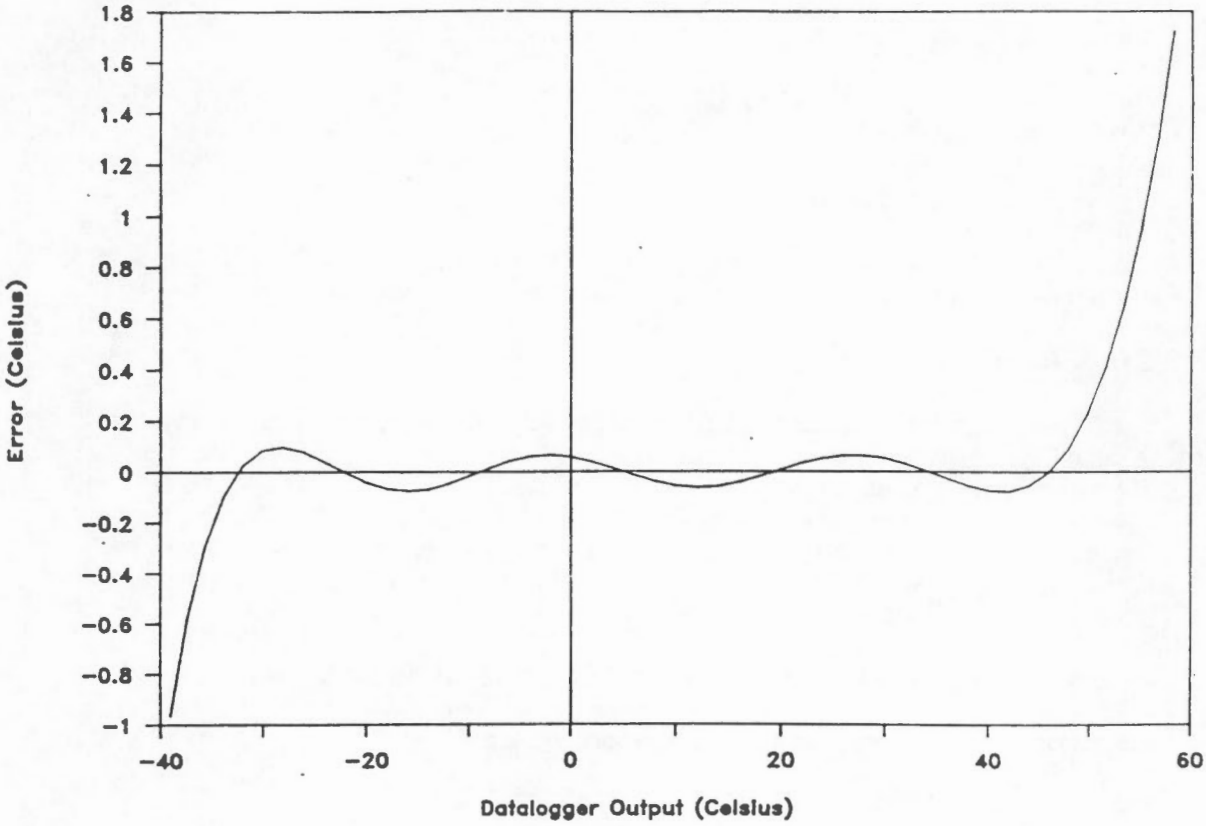

FIGURE 1. 107 Probe Polynomial Error Curve

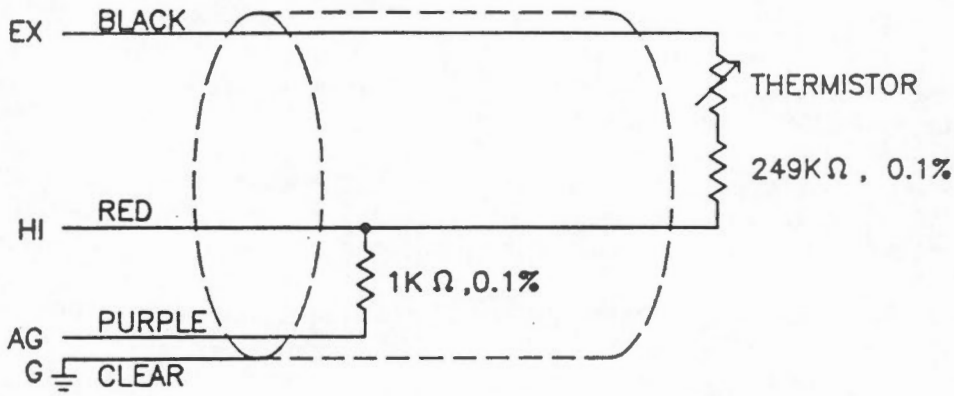

FIGURE 2. 107 Probe Schematic

4.0 PROGRAMMING

Instruction 11 is used to measure the 107 Probe. This instruction provides AC excitation, makes a single ended voltage measurement, and calculates the temperature in degrees Celsius with a fifth order polynomial.

Output in Celsius is obtained with a multiplier of 1 and an offset of 0. Fahrenheit can be obtained with a multiplier of 1.8 and an offset of 32.

5.0 INSTRUCTION 11 DETAILS

Reading this section is not necessary for general operation of the 107 Probe with Campbell Scientific's dataloggers.

Instruction 11 outputs a precise 4V AC excitation (2V with the CR10) and measures the voltage drop due to the sensor resistance. The thermistor resistance changes with temperature. Instruction 11 calculates the ratio of voltage measured to voltage excitation (V_S/V_X) which is a direct function of resistance, as shown below.

$$V_S/V_X = f(R_S) = R_f/(R_S+R_f) = 1000/(R_S+250000)$$

where, V_S/V_X = ratio of measured to excitation voltage,
R_f = fixed resistance,
and, R_S = sensor resistance.

Instruction 11 then calculates temperature using a fifth order polynomial equation developed by correlating V_S/V_X with temperature. The polynomial coefficients are given in Table 2; input to this equation is (V_S/V_X)*8000.

Table 2. Polynomial Coefficients

Coefficient	Value
C_0	-53.4601
C_1	9.08067
C_2	-8.32519×10^{-01}
C_3	5.22829×10^{-02}
C_4	-1.67234×10^{-03}
C_5	2.21098×10^{-05}

Table 3 displays resistance and datalogger output at several sensor temperatures.

TABLE 3. Temperature, Resistance, and Datalogger Output

TEMPERATURE °C	RESISTANCE OHMS	OUTPUT °C
-40.0	4015500	-39.0
-38.0	3503500	-37.4
-36.0	3062000	-35.7
-34.0	2680400	-33.9
-32.0	2350200	-32.0
-30.0	2064000	-30.1
-28.0	1815500	-28.1
-26.0	1599400	-26.1
-24.0	1411100	-24.0
-22.0	1246900	-22.0
-20.0	1103400	-20.0
-18.0	977910	-17.9
-16.0	867910	-15.9
-14.0	771370	-13.9
-12.0	686530	-12.0
-10.0	611870	-10.0
-8.0	546070	-8.0
-6.0	488000	-6.0
-4.0	436680	-4.1
-2.0	391270	-2.1
0.0	351020	-0.1
2.0	315320	2.0
4.0	283600	4.0
6.0	255390	6.0
8.0	230260	8.0
10.0	207850	10.1
12.0	187840	12.1
14.0	169950	14.1
16.0	153950	16.0
18.0	139610	18.0
20.0	126740	20.0
22.0	115190	22.0
24.0	104800	23.9
26.0	95447	25.9
28.0	87022	27.9
30.0	79422	29.9
32.0	72560	32.0
34.0	66356	34.0
36.0	60743	36.0
38.0	55658	38.1
40.0	51048	40.1
42.0	46863	42.1
44.0	43062	44.1
46.0	39605	46.0
48.0	36458	47.9
50.0	33591	49.8
52.0	30976	51.6
54.0	28590	53.4
56.0	26409	55.1
58.0	24415	56.7
60.0	22590	58.3

APPENDIX 3

PROCEDURES FOR DATA REDUCTION

revised May 1992

1) Continued development of procedures for quality control, documentation and presentation of data in cooperation with GSC TSD and AES as well as university and industry users

Revise procedures for the cleaning and organizing of the High Arctic IRMA field camp Automatic Weather Station (AWS) data to reflect new problems, techniques and other insights gained during processing of the current years field data. The final version of this report will serve as documentation of the field protocol for high arctic field camp AWS data processing.

NOTE: These protocols are not to be considered official AES quality control techniques but rather a first step in making the logger data available to field camp users. Official AES Quality Control procedures will be developed by AES CCC to be applied to the data before it is incorporated into the Canadian Meteorological Data Archive.

CAUTION and field camp common sense must be applied to all data produced by the following procedures.

Output: Report
File: **APROMMYY.RPT**
Use: Protocol for Field Camp AWS Data Processing

2) Documentation of logger programs, logger output aray elements, sensors, sensor deployemt, station description, Split .PAR files, data quality problems, data file names, data and plot file formats, QPRO macros and all other usefull information.

.DST

Give complete station description following guide lines set out by AES where possible. Note availability of photos.

.DOC

a) Assemble and print **.DLD** files from beginning of dump period (ie., from previous season's field documentation - Y1) and where these do not exist recreate them as far as possible.

b) Compare **.DLD** file dumped at time of data dump (Y2) to that in a) above and to the dumped data as it appears in **.DAT** file. Record any inconsistencies.

c) Add any visual comments on condition of instrumentation or site before data dump (ie., sensor icing, drifting around instrumentation or obvious damage). Note also availability of photos of site conditions etc.

d) .....add here a list of all the things put into the .doc file using that file as a guide.....

.DFL

a) List files created during data processing as they are stored on master disketts. Use the file naming protocol detailed in Appendix II.

b) Give Split, ASCII, and spread sheet formats of final cleaned data.

.DQM

List QPRO data handling and plot macros as stored on LIBRARY diskett giving a brief description of use.

Output: Documentation Files
File: **STNYY.DST, STNYY.DOC, STNYY.DFL and QPRO.DMO**
Use: Appendix of data report and to accompany data file release

3) Inital documentation and consolidation of data dumped from remote tundra and ice cap stations.

From Module or Logger .DAT files

a) Consolidate the various **.DAT** files into one file for the whole period since the last normal (major) data dump (using Word Star or other applicable editor which does

not add any characters or change the **.DAT** file). There should be only one **.DAT** file between maintance visits (ie., the time at which changes are made to logger program or sensors) regardless of how often the data has been dumped during that period.

b) Document in **.DOC** file the beginning and end dates (YY,DD,HHMM) of each **.DAT** file. These files will permanentlty as the origional logger data.

Output: Consolidated logger data files
Files: **STNY1Y2.DAT**
Use: For split into manageable files and for reference to origional logger data condition.

4) Split, initial cleaning, calibration and standardization of data format of consolidated logger .DAT files to produce initial .PAR files for import into QPRO spreadsheet.

From Consolidated logger data files

Using the SPLIT **.PAR** files given in the **.DOC** Appendix and file.

a) Split into hourly/six hourly (**h**) and daily (**D**) files by calendar year (see NOTE: SMALL RAM). Months begin on the first day (eg., 1 January) at 0700 UMT which is 0100 CST and end at 0600 UMT or 0000(2400) CST (or when data ends).

b) Split into calendar years.

c) Add year and translate logger julian day into MM/DD in CST. Leave logger julian day and HHMM in logger time (eg., for HWC that is UMT and for AGA it is CST). See NOTE: TIME for table of local and universal times.

?.....MMYY not in h files

d) Put YY/MM/DD(CST)/JJJ(logger)(/HHMM)/ and blanks where observations are missing (see NOTE: BLANKS) and document missing periods in **.DOC**.

e) Check for out of range values and replace with blanks (see NOTE: Blanks). Document in **.DOC**.

?.....MMDD not in hourly file should they be for consisency?

f) Organize the parameters into the following format:
"YY/MM/DD/JJJ/(HHHH)" then the parameters in the order they appear in the 1990-91 record with additional parameters added to the file as needed and blanks entred in the columns of parameters no longer recorded. Thus the number of columns will increase each time a new season's data is processed (this will not necessarily be in chronological order). The format of the parameters will be different for each station (STN). The format for each station will be updated in the **STNYY.DOC** file each year (see 2 above).

g) Apply any calibration factors not included in logger programming (eg.,correction for misaligned wind vane, conversion to standard units; °C, KM/HR,mm,etc)

add.....

h) Capture **.PAR** file using WINDOWS .....check ....so that it can be incorporated into the **.DOC** file along with comments on missing and out of range values, corrections and conversions and any other changes or problems..

?....is this right

i) Call these files Initial .PRN files **ISTNYYhx.PRN** and **ISTNYYDx.PRN** where **x=A** indicates the start of the calendar year, Jan-dump, and **B** indicates the end of the year, dump-Dec. **D** indicates daily data and **h** indicates hourly data where **H** = one hourly, **6** = six hourly, **3** = three hourly and **Z** = twelve hourly. (For computers with RAM less than 4MB see NOTE: Small RAM).

Output: **Initial Raw Split Data** (by dump and year)
Files: **ISTNYYhx.PRN and STNYYDx.PRN**
Use: internal only, and to be used in next step

5) <u>Further cleaning and organization</u> of data: From quick plots, identification and elimination of obvious periods of sensor malfunction and environmental problems such as icing, animal damage and snow accumulation. From this cleaned hourly data, calculation of daily values.
Production of files for final data examination and plotting.

From Initial Raw Split Data .PRN files

a) Import these **h** and **D** file into QPRO spreadsheet and for each spreadsheet:

i) Replace all "?" by real blanks.

ii) Do a quick plot of each parameter to look for obvious instrument problems.

iii) Replace sections of obviously questionable data with blanks and document in **.DOC**. See APPENDIX for guide lines on what problems to look for.

iv) Where possible correct data by hand based on knowledge of specific problems such shading of pyranometer at low sun angle by annemometer, etc.

v) Document changes in detail in **.DOC** file.

b) For **D**aily data: from the cleaned daily spreadsheets eXtract files by six month seasons (s) and calendar year (**YY**). The six month seasons are summer (s = **S**) defined as April to September and winter (s = **W**) defined as October to March. This will give the following files for data dumped in the spring or summer:

dump - September
October - January
January - March
April - dump

These organized spreadsheet files **oSTNYYsD.WQ1** where **o= O** for complete periods and **A** or **B** for partial periods will be used to ceaate six month spreadsheets for plotting and final data examination.

c) For **H**ourly data: eXtract the hourlies (6 hourlies) as months **hSTNYYMM.PRN** where **h= (H,6,3,z)** for whole months and **A** or **B** for partial months.

d) To produce **C**alculated daily values from hourly (six hourly) data:

i) Search and replace the blanks in the cleaned hourly spreadsheets with ""

ii) Print to File the hourly (six hourly) spreadsheet as **RSTNYYhx.PRN**

iii) Run Split to calculate mean, total, max and min values of the hourly (6 hourly) values (where appropriate) and put these into files **ISTNYYxC.PRN**. Capture Split **.PAR** file and document in **.DOC**.

iv) Import these **C**alculated **.PRN** files into a QPRO spreadsheet and eXtract to six month season files as in b) above.

e) Save these cleaned organized spreadsheets **RSTNYYhx.WQ1, RSTNYYxC.WQ1** and **RSTNYYDx.WQ1** until the final plots and data examination has been done after which they can be deleted.

f) Save the hard copy of the quick plots.

Output: **Organized Raw Cleaned Data**
Files: **OSTNYYsn.WQ1, xSTNYYsn.WQ1,** where **n= D** or **C** ;
and **hSTNYYMM.WQ1, xSTNYYMM.WQ1**
Use: internal only for import into final spreadsheet

6) Final data check and preliminary plots of the organized raw cleaned data by incorporation into monthly templets of h hourly and six month season templets of D daily and C calculated spreadsheet files.

From Organized Raw Cleaned Data

a) Start with the HOURLY spreadsheet templet, **STNYYMMh.WQ1,** created at the end of the previous years data processing. Bring in the data spreadsheet **hSTNYYMM.WQ1** to create a working spreadsheet for draft plots and further data examination through the following steps.

i) Change "date number" as explained at top of spreadsheet templet.

ii) Modify the templet to include new parameters added in the current year. This may involve moving the columns of 0, 180 used as base lines in the plots to make room additional data columns.

iii) Combine the data spreadsheet into the templet spreadsheet. In the case of partial months the combined data file must be positioned in exactly the correct cell. It can not be moved after combining as this will mess up the graphs. Rather, erase the whole combined data portion of the file (being careful to get it all but not the baselines) and recombine in the correct location. Partial months from previous dump are to be combined at this stage to make full a month. Where part of a monthh is not available leave blank.

iv) Check that the templet days (from "date Number") match the logger dates being aware of what is in CST and what is in UCT.

v) Prepare the label file using **STNWINTh.WQL** changing all the relevent parameters in the shaded area of the spread sheet. Extract the **.WQL** spreadsheet as values and save as **STNYYMMH.WQL.** Copy cells A1..U100 from **.WQL** into A300 of the data spreadsheet.

vi) Extract the data spreadsheet as values and save under the name **STNYYMMh.WQ1** where all the variables are defined (eg., AGA90076.WQ1). This makes the file easier to work with as the formulas in the day, month,year columns take alot of space.

vii) Create graphs for new parameters being careful to start with the appropriate existing graph as a base to ensure size, scale and title compatibility. Add new graphs to A200 and A300 blocks in the data spreadsheet.

viii) Plot draft graphs in landscape orientation on printer with same scaling as the Glaciology Section HP Paint Jet Printer (such as the Fujitsu dot matrix printer in Epson FX80/100 mode).

ix) Examine graphs for data problems such as screen heating, stabilizing of newly installed thermisters (snow or ground), testing and dig out periods not identified by first data validity check.

b) Start with DAILY and CALCULATED spreadsheet templets **STNY1Y2n.WQ1** from the previous years data processing. Change "date no." and add new parameters. Into these six month spreadsheet templets (April-September and October- March), combine the data spreadsheets **oSTNYYsn.WQ1.** At least two data spreadsheets will be combined into summer six month templet. Follow the same steps as in a) above. Be sure to account for leap years when comparing julian dates.

c) Compare plots of **h, D** and **C** files. Circulate to field camp personnell (ie., Koerner, Edlund and Headley etc) for comment on plot format, data reliability, and other problems. Keep these graphs for internal use and future reference. Save these working spreadsheets as **STNYYNNh.WQP and STNY1Y2n.WQP** for internal use.

d) Create spreadsheet of final cleaned field camp data by the following steps. These data cannot be viewed as AES quality controlled data but can be used with care and common sense by field researchers.

i) Elimimate all questionable data based on careful examination and oncomments from circulating draft plots as in c) above. Be over cautious. Replace with blanks.

ii) Do not use average vector wind directions except as 2 minute spot readings.

iii) Eliminate vegetation temperatures from HWC final spreadsheet until screen problems are solved. Use Gill Screen air temperatures to ensure standardization (even though other screens may indicate lower radiation heating).

iv) Document snow temperatures which are at changing depth. Document decreasing height of screen temperatures on ice caps due to snow accumulation. If can not accurately document remove from final spreedsheet.

v) Document snow depth measurements problems. Remove further data if neccessary.

vi) Other questionable data such as RH values which follow the TEMP exactly or mirror it exactly should be discussed in the Data Report.

e) Document everything in **STNY1Y2.DOC** file.

f) Save these final cleaned spreadsheets as **STNY1Y2n.WQF** and **STNYYMMh.WQF.** Document file formats in .DFL.

?...decide what to do with totally blank columns... i think we will have to leave them in... .

g) Replace blanks with "" and Print to file the data portion of the final spreadsheets to get a **.PRN** file for use in future SPLIT runs. Document file format in **.DFL.**

h) Replace blanks with -9999 and print to file the data portion of the final spreadsheets to get a completely numeric ASCII file for use in FORTRAN and PASCAL programs. Document file formats in **.DFL.**

Output: **Final Cleaned Data**

Files: **STNY1Y2n.WQF, .PRN &.PR9** and **STNYYMMh.WQF, .PRN & .PR9.** (**.WQP** files saved for internal use only)

Use: For release along with open file report containing documentation and caveats. Data with **.DOC** and **.DFL** can be released prior to completion of.... reviewed open file Data Report...??.... to people having a connection with the project. Draft plots could be used as is for analysis or be prettied up for quick publications or Forum posters.

7)<u>Presentation of Final Cleaned Data</u> as plots for analysis by users.

From Final Cleaned Data

a) From **D, C** and **h .QWF** files plot basic single parameter graphs on the following time scales. Ensure that both vertical and horizontal graph dimensions and scale intervals match within a time scale (although the ranges of the y-axis may have to vary from station to station and month to month). This will allow visual comparison of plots on a light table. Plot only on one side of the paper. Bind plots along the top of the graph (printed in landscape). Use Dot Matrix EPSON FX80/100 printer or HP Paint Jet printer.

   i) **D,C** six month time series (with comparison to AES stations where apropriate)

   ii) **D,C** melt season time series (including multiple station plots where apropriate)

   iii) **D,C** monthly time series (each month for at least May - August) and **h** monthly time series (each month of year)

Output: **Figures of final cleaned data** at various time scales
Files: on **.WQF** spreadsheets
Use: Data Report and release to users along with QPRO spread sheets so that they can be prettied up for use in publications (with appropriate reference to GSC open file)

8) <u>Climate calculations</u> on final cleaned data ; including basic diurnal, monthly and annual mean and deviations from long term normals for closest AES permenant station

From Final cleaned SPLIT .PRN files

a) Calculate monthly diurnal means, monthly means and totals and annual means and put into file **STNCn.PRN**. Use format YY/12 monthly means (totals) /annual means (totals). In each subsequent season add to this file in chronological order (beginning in 1988).

b) Put **STNCn.PRN** into **MEAN** templet and plot time series of monthly and annual values

Output: **Climate Data (by station and n)**
Files: **STNCn.PRN**
Use: Presentation as tables and graphs

9) <u>Preparation of field camp data report</u> including station descriptions, lists of available data parameters and data files, documentation of all steps in data processing, graphical presentation of data, tables of climate calculations, update of procedure report and recomendations for following field season servicing and sensor replacment. Where appropriate comments on the data plots can also be included.

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SMALL RAM: if a full season dump is being processed on a field computer with less than 5MB RAM the **h** file will have to be further split to avoid a file too big to import into the spreadsheet in the next step. This split should be along the lines: dump-Sept (**A**), Oct-Dec (**AA**), Jan-Mar (**BB**) and Apr-dump (**B**).

BLANKS: When blanks are entred from SPLIT they appear in the **.PRN** file as" " when TYPEd or looked at in Word Star or other word processing program. When inported into a QPRO spread sheet they look like blanks in the body of the spread sheet but are actually a single quote"". This "" is plotted as a blank but it is counted as zero not as missing in functions such as @AVG giving an incorrect answer. These "" s must be replaced in the spread sheet file. They have to remain in the **.PRN** file however because otherwise it is imported all crocked (ie. everything moves over into the blanks). Before exporting the final files to final cleaned **.PRN** the blanks must be replaced with "". Before exporting the files to ASCII **.PR9** files for use in FORTRAN , PASCAL or other languages the blanks must be replaced by a number like -9999.

APPENDIX 4

HIGH ARCTIC IRMA 1988-91

FILES

	example
1)PROCEDURES DEVELOPMENT	
APROMMYY.APX	APRO0592.APX
FILEMMYY.APX	FILE0592.APX
2)DOCUMENTATION	
STNY1Y2.DLD	AGA9091.DLD
STNY1Y2.DOC	AGA9091.DOC
3)LOGGER DUMP DATA	
By Dump	
STNY1Y2.DAT	HWC9091.DAT, HWC9191A.DAT*

*"A" or "B" at the end would denote part of a normal dump period such as a second summer dump or changes made to programmind within a normal dump period.

4)INITAL RAW SPLIT DATA	
By Year	
ISTNYYhx.PRN	IAGA906B.PRN, IAGA916A.PRN
ISTNYYDx.PRN	IAGA90DB.PRN, IAGA91DA.PRN

5)ORGANIZED RAW CLEANED DATA

By Year

RSTNYYhx.PRN from RSTNYYhx.WQ1
ISTNYYCx.PRN calculated from RSTNYYhx.PRN

RSTNYYhx.WQ1	RAGA906B.WQ1, RAGA916A.WQ1
RSTHYYDx.WQ1	RAGA90DB.WQ1, RAGA91DA.WQ1
RSTNYYCx.WQ1	RAGA90CB.WQ1, RAGA91CA.WQ1

By Six Month

daily

BSTNY1SD.WQ1**	BAGA90SD.WQ1	(dump-sep)
OSTNY1WD.WQ1**	OAGA90WD.WQ1	(oct-dec)
OSTNY2WD.WQ1**	OAGA91WD.WQ1	(jan-mar)
ASTNY2SD.WQ1**	AAGA91SD.WQ1	(apr-dump)

**will be combined into six month files in the final spreadsheet

calculated

BSTNY1SC.WQ1**	BAGA90SC.WQ1	(dump-sep)
OSTNY1WC.WQ1**	OAGA90WC.WQ1	(oct-dec)
OSTNY2WC.WQ1**	OAGA91WC.WQ1	(jan-mar)
ASTNY2SC.WQ1**	AAGA91SC.WQ1	(apr-dump)

**will be combined into six month in final spreadsheet

By Month

hourly

hSTNYYMM.WQ1	6AGA9001.WQ1,.....	(whole month)
xSTNYYMM.WQ1***	BAGA9001.WQ1,....	(partial month)

***this allows only one type of hourly data per station - that which the logger records. If a special split is done (ie. to match HWC hourlies to AGA 6 hourlies or HWC and AGA to PCSP stations) this would be done on the final cleaned data (STN.....PRN) so the "x" or "h" at the beginning would

not be neccessary. The resulting STNYYMMh.PRN file with " ' " for blanks would then be imported into a spread sheet and the " ' " replaced by blanks using search and replace producing a STNYYMMh.WQF file.

6)FINAL CLEANED DATA

WORKSHEET (with blanks for missing data: for plotting)****

STNY1Y2D.WQF	AGA9091D.WQF
STNY1Y2C.WQF	AGA9091C.WQF
STNYYMMh.WQF	AGA90076.WQF,etc....

**** will be ....WQ1 during development stages and .WQP before final elimination of all suspect data (for internal use only)

SPLIT (with ' for missing data: for use in split)

STNY1Y2D.PRN	AGA9091D.PRN
STNY1Y2C.PRN	AGA9091C.PRN
STNYYMMh.PRN	AGA90046.PRN,etc....

ASCII (with -9999 for missing data: for use in fortran or pascal)

STNY1Y2D.PR9	AGA9091D.PR9
STNY1Y2C.PR9	AGA9091C.PR9
STNYYMMh.PR9	AGA90076.PR9

7)CLIMATE CALCULATIONS

STNCn.WQF	AGACD.WQF, AGACC.WQF, AGAC6.WQF
STNCn.PR9	AGACD.PR9, AGACC.PR9, AGAC6.PR9

8)DATA REPORT

Y1Y2DATA.RPT	9091DATA.RPT	
Y1Y2RECC.RPT	9091RECC.RPT	(recommendations)

APPENDIX 5

QPRO Macros and Techniques

PRODUCT	:	Quattro Pro	NUMBER	:	129
VERSION	:	All			
OS	:	DOS			
DATE	:	September 11, 1991	PAGE	:	1/3
TITLE	:	A Macro For Printing a Block of Named Graphs			

The Graph Print macro allows you to automatically print a batch of named graphs located in the current spreadsheet.

To use Graph Print:

1. Enter the macro as it is listed on page 3 into your macro library spreadsheet. If you do not have a macro library sheet already in use, perform the following steps:

   a. Open a blank spreadsheet.
   b. Type in the macro.
   c. Select: /Tools | Macro | Library | Yes.
   d. Save the new spreadsheet with a .WQ1 extension.

2. Open the file containing the Graph Print Macro.

3. Open the file containing the graphs you wish to print.

4. Enter the names of the graphs you wish to print in the current sheet as labels into a block of cells.

   Use /Graph | Name | Create to define the names of the graphs.

5. Select: /Tools | Macro | Execute.

6. Type: GRAPH_PRINT, and press [Enter].

   If you wish to assign a hotkey to the macro, use /Edit | Names | Create and enter a backslash (\) followed by a letter on the keyboard (e.g., \G assigns Alt-G as the hotkey). Designate cell B11 to take the name. If a hotkey is assigned to the macro, steps 5 and 6 listed above can be skipped and simply press Alt-G to execute the macro.

7. The macro will then ask you to highlight the block containing the names of the graphs you wish to print. Highlight the block, and press [Enter].

8. Graph Print will then step through the graphs and print to the default printer automatically.

PRODUCT : Quattro Pro NUMBER : 129
VERSION : All
OS : DOS
DATE : September 11, 1991 PAGE : 2/3

TITLE : A Macro For Printing a Block of Named Graphs

The Graph Print Macro
(As Displayed)

```
PROMPT          Enter
                Block
                  of
               Named
               Graphs
                 to
                Print

COUNTER
COUNTER2
Graph_Print     {MESSAGE PROMPT,0,0,0}
                {/ Name;Create}_GRAPHS~
                {?}~{/ GraphPrint;DestIsPtr}
                {FOR COUNTER,0,@ROWS([]_GRAPHS)-1,1,print_row}
                {/ Name;Delete}_graphs~{QUIT}

print_row       {FOR COUNTER2,0,@cols([]_graphs)-1,1,output_graph}
output_graph    {IF @CELLINDEX("type",[]_graphs,counter2,counter)<>"1"}
                  {RETURN}
                {LET gph,@CELLINDEX("contents",[]_graphs,counter2,
                  counter)&"~"}
                {/ GraphPrint;Use}
gph             GRAPH1~
                {/ GraphPrint;Go}
```

This is an "L"

TITLE : A Macro For Printing a Block of Named Graphs

The Graph Print Macro
(Cell-Formula)

```
 A1: 'PROMPT
 A9: 'COUNTER
A10: 'COUNTER2
A11: 'Graph_Print
A17: 'print_row
A19: 'output_graph
A22: 'gph
 B1: ^Enter
 B2: ^Block
 B3: ^of
 B4: ^Named
 B5: ^Graphs
 B6: ^to
 B7: ^Print
B11: '{MESSAGE PROMPT,0,0,0}
B12: '{/ Name;Create}_GRAPHS~
B13: '{?}~{/ GraphPrint;DestIsPtr}
B14: '{FOR COUNTER,0,@ROWS([]_GRAPHS)-1,1,print_row}
B15: '{/ Name;Delete}_graphs~{QUIT}
B17: '{FOR COUNTER2,0,@COLS([]_graphs)-1,1,output_graph}
B19: '{IF @CELLINDEX("type",[]_graphs,counter2,counter)<>"l"}{RETURN}
B20: '{LET gph,@CELLINDEX("contents",[]_graphs,counter2,counter)&"~"}
B21: '{/ GraphPrint;Use}
B22: 'GRAPH1~
B23: '{/ GraphPrint;Go}
```

This is an "L"

After entering in the macro, select /Edit | Names | Labels | Right. Define the range A1..A22 when prompted and press [Enter]. This will create all named blocks necessary to execute the macro.

Finally, select /Edit | Names | Create and assign the name PROMPT to block B1..B7. This named block is used to display the message defined in cell B11.