THE AURORA Programme

THE CLIMATE OF THE AURORA AREA

INGER HANSSEN-BAUER

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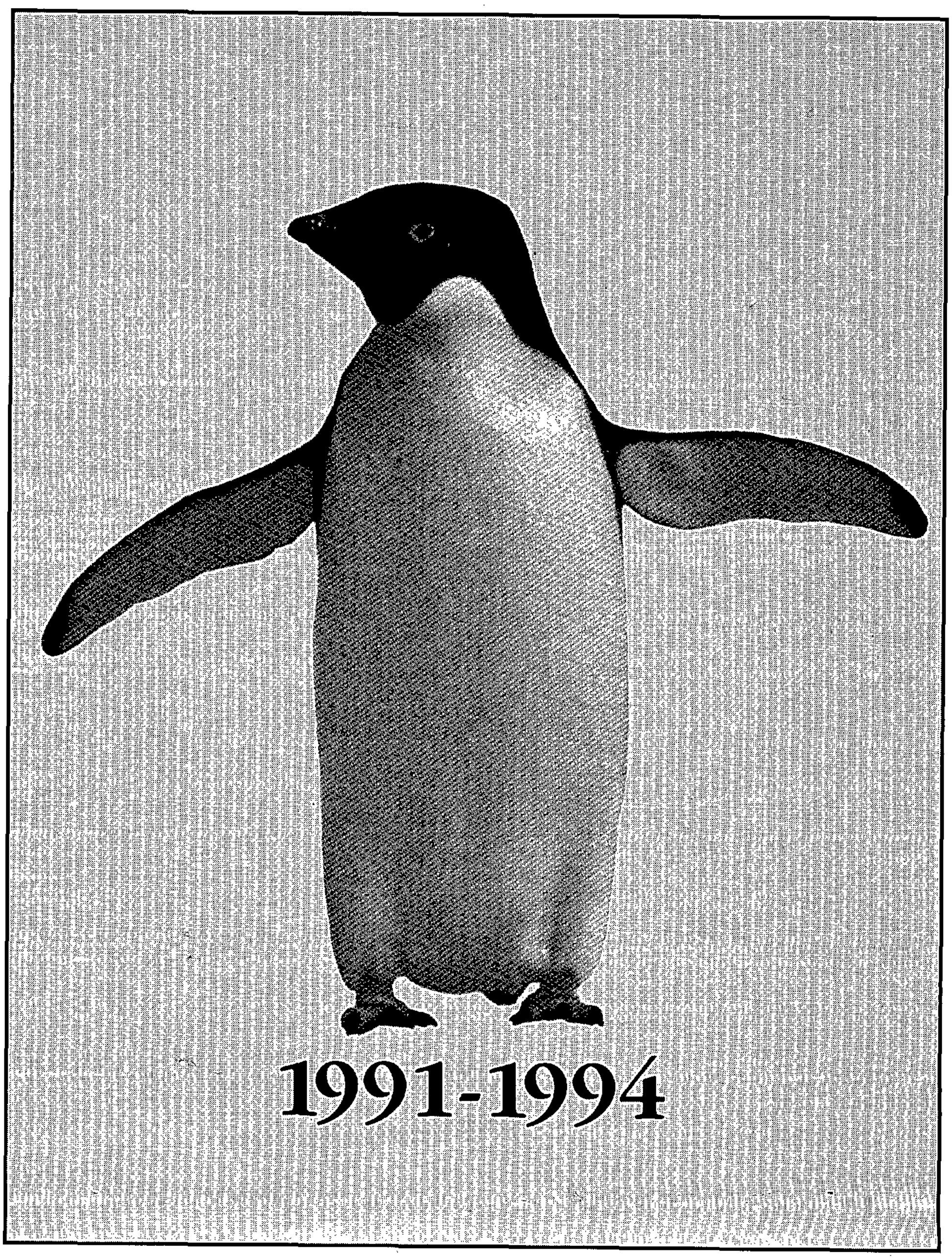

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SUMMARY

The present data report summarizes the meteorology part of the Aurora programme 1991-1994. The climate of the Aurora investigation area is described using meteorological data from the Aurora field stations "Bluefields", "New Haven", "Snowhenge" and "Theron Mountains", together with data from the reference station Halley. Results from earlier analyses were used both in order to compare with the present results, and as a supplement in areas without measurements.

Coastal parts of the Aurora area have long term mean July temperatures in the range -20 - -30°C. For the shelf areas, the mean July temperatures range from -30°C in the outer areas to -40°C in middle and inner ares. Mean July temperatures at the glaciers leading from the polar plateau to the shelf range from -50°C at the top to -40°C in the bottom, while the mountain areas between these glaciers probably are considerably milder (up to -30°C). Temperature differences are smaller during southern summer.

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THE CLIMATE OF THE AURORA AREA

Contents:

1. INTRODUCTION

The present report summarizes the meteorology part of the Aurora Programme 1991-1994 (Kristensen, 1993). Meteorological data from the Aurora investigation area (fig. 1) collected during 1992 and 1993, are used to describe the climate of the area. Halley (fig. 1), which is run by British Antarctic Survey, is chosen as the reference climatological station, as it is relatively close to the area, and has unbroken high quality observation series of more than 30 years.

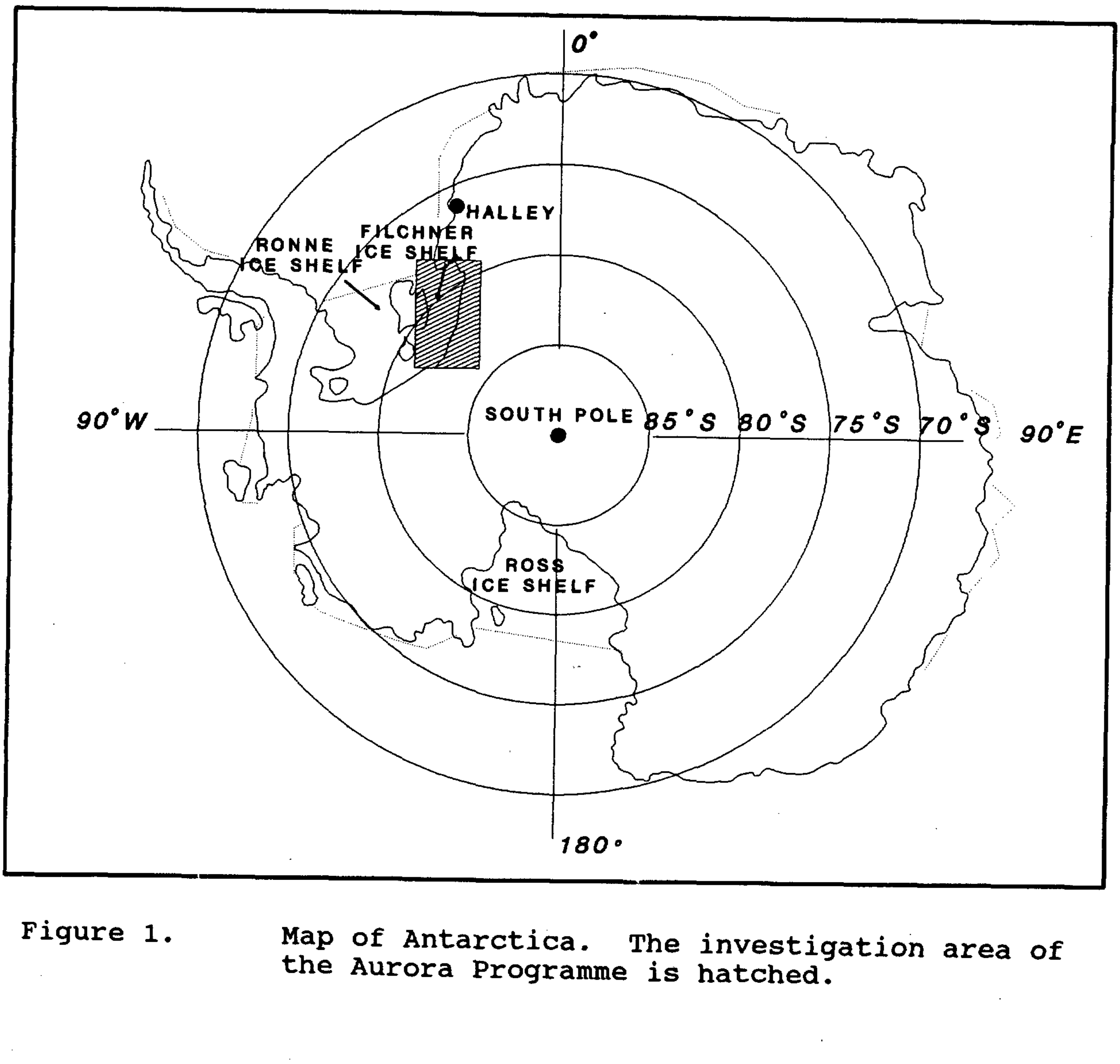

Figure 1. Map of Antarctica. The investigation area of the Aurora Programme is hatched.

2. INVESTIGATION AREA AND METEOROLOGICAL STATIONS

2.1 Investigation area.

The investigation area of the Aurora Programme (fig. 2) includes the Filchner Ice Shelf and the adjacent glaciers and mountain areas. Differences are expected in the climate from coast to inlands and also from ice shelf areas to mountain areas and glaciers. The positions of the Aurora meteorological stations Bluefields, New Haven, Snowhenge and Theron Mountain, are indicated in figure 2. Short descriptions of the stations and their instrumentation are given in the following sections. Further information was given in the meteorological data reports (Hanssen-Bauer 1992b, 1993a-b, 1995), where also data quality and data handling were described more in detail.

2.2 Meteorological instrumentation.

Two types of meteorological stations were used, the Aanderaa automatic weather station (Appendix 1), and the Icex Capsule (Appendix 2).

The Aanderaa stations recorded hourly air temperature (Ta), wind speed (F), wind direction (D) and either air pressure (p) or snow temperature below the surface (Ts). The quality of the data is generally high. The **Ta** sensors were in the range -60°C - +33°C, and they were equipped with radiation screens. The **Ta** and **p** sensors worked very well, while the **F** and **D** sensors malfunctioned during cold periods.

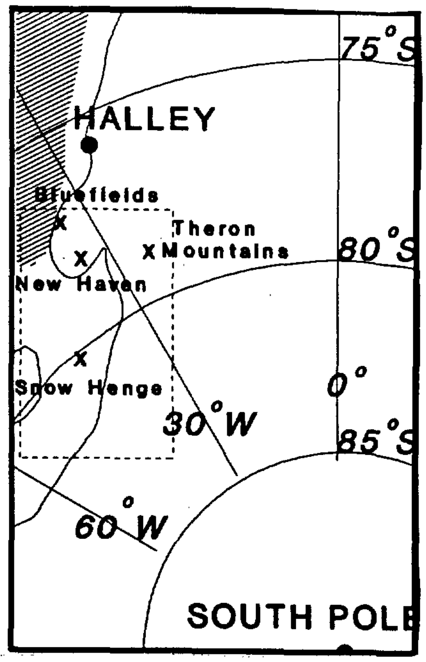

Figure 2. Map showing the Aurora stations. The dotted line enclose the investigation area.

The Icex Capsules measured internal temperature (Ti) and air pressure (p). Extreme temperatures for the previous 12 hours (Tx and Tn) were recorded every 12 hour. The quality of the controlled **p** data from the ICEX capsules is high. On the other hand, the quality of the **Ti** measurements is poor during summer, as there may be considerable radiation errors during sunny hours. The magnitude of these errors depend on local conditions, but they can apparently be several degrees during sunny periods (Hanssen-Bauer, 1995). During fall, winter and spring, the quality of the **Ti** data is reasonable. However, it should be emphasized that the sensor is within the capsule. Consequently, it measures snow temperature rather than air temperature if the capsule is buried by snow.

2.3 The Aurora stations.

Bluefields is situated 77°30'S, 34°12'W on Coats Land. The height above sea level is 375 m. The station is relatively close to the edge of the shelf, and represents the "coastal" parts of the investigation area. An Aanderaa automatic weather station was used for the meteorological measurements at this station, including sensors for **Ta**, **p**, **F** and **D** 4 m above ground level. Measurements started February 23 1992.

New Haven has coordinates 78°35'S, 34°00'W. Height above sea level is 547 m. The station is situated not far from the transition between the Bailey Ice Stream and Filchner Shelf. An Icex Capsule was measuring **p** and **Ti**, **Tx** and **Tn** from February 16 1992. Temperature measurements malfunctioned in September 1992, and the station was closed down in January 1993.

Snowhenge is situated in the middle of the Filchner Ice Shelf, 80°06'S, 42°15'W. The height above sea level is 110 m. From February 22 1992, **Ti** and **p**, **Tx** and **Tn** were measured by an Icex Capsule. However, because of the malfunctions of external sensors at the station, the capsule was replaced by an Aanderaa station in January 1993. This station has sensors for measuring **Ta**, **F**, **D** and **Ts** (snow temperature 8.1 m below the surface).

The **Theron Mountains** station is located 79°00'S, 28°06'W. The station consists of an Icex Capsule measuring **p**, **Ti** , **Tx** and **Tn**. It is situated on a flat, snow covered area about 930 m above sea level in the Theron Mountains. Measurements started on February 18 1992.

Available meteorlogical data from the Aurora stations are listed in table 1. Data from every 3[RD] hour were used in the present analyses. The data have earlier been published in data reports (Hanssen-Bauer 1992b, 1993a-b, 1995).

Table 1. Available measurements at the Aurora station in 1992 and 1993.

STATION	ELEMENT: PERIOD	Ta	Ti, Tx-n	Ts	p	F	D
BLUEFIELDS	1992 1993	X X			X X	X X	X X
NEW HAVEN	1992 1993		X		X		
SNOWHENGE	1992 1993	 X	X 	 X	X 	 X	 X
THERON MOUNTAINS	1992 1993		X X		X X		

2.4 The reference station Halley.

The Halley Station (fig. 2) is run by the British Antarctic Survey. It is situated on drifting ice 75°36'S, 26°41'W. Elevation above sea level is about 30 m. The distance to Bluefields, which is the nearest of the Aurora station is about 200 km. Halley is a full synoptic station with 8 observations a day. Climate statistics based on Halley meteorological data from the period 1957-1989 (Hanssen-Bauer, 1992a) will be used to create a climatic reference for the Aurora area.

3. CLIMATE ANALYSES

3.1 Representativity of the test period.

Table 2 shows monthly and annual means of some climate elements at Halley during 1992 and 1993 together with the corresponding values for the period 1957-1989 (Hanssen-Bauer, 1992a). For temperature, the highest and lowest monthly means during 1957-89 are also tabulated, as well as the standard deviations of the mean values for the individual months. The monthly mean temperatures are shown in figure 3 as well. August 1992 was only 0.2°C warmer than the coldest August during 1957-89, and February 1993 was 0.3°C colder than the coldest February during the same period. With these exceptions, all monthly mean temperatures 1992-93 were well within the range defined by the reference period 1957-89. The annual mean temperatures were 0.9°C and 0.8°C below the reference value, respectively. This is also well within the 1957-89 range.

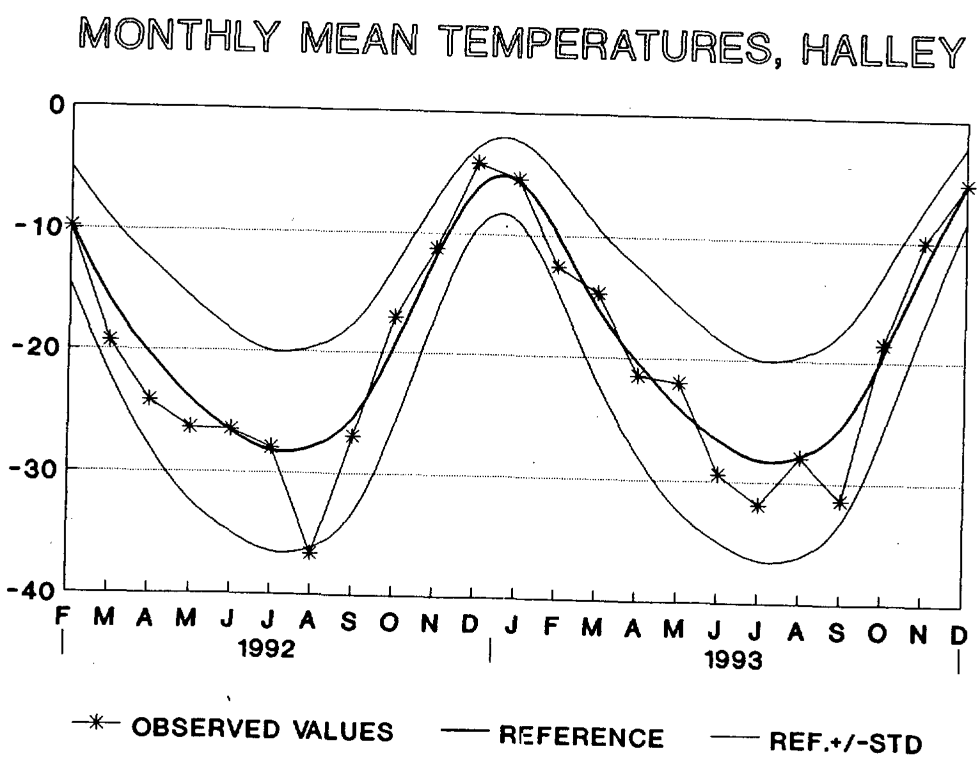

Figure 3. Monthly mean temperatures at Halley 1992 - 1993 compared to the 1957 - 1989 reference values.

Table 2. **CLIMATE AT HALLEY 1992-93 COMPARED TO STATISTICS 1957-1989**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
SEA LEVEL PRESSURE, mb, MONTHLY/ANNUAL MEAN													
Mean 1957-89	993.1	991.1	987.5	988.1	990.8	991.4	988.9	988.2	985.7	984.5	986.6	992.1	989.0
Mean 1992	991.9	995.2	984.7	992.4	997.3	999.2	985.9	986.2	988.7	988.5	982.1	989.6	990.1
Mean 1993	1000.5	989.3	988.0	988.5	984.6	987.5	986.4	985.0	985.2	981.1	988.9	987.5	987.7
AIR TEMPEARTURE, °C , MONTHLY/ANNUAL MEAN													
Mean 1957-89	-4.6	-9.7	-16.1	-20.3	-24.3	-26.7	-28.6	-28.1	-26.2	-19.7	-11.7	-5.2	-18.5
Highest 57-89	-3.0	-7.6	-10.3	-14.7	-16.3	-20.8	-22.7	-19.9	-16.7	-14.0	-9.1	-3.5	
Lowest 57-89	-6.7	-12.3	-21.6	-25.0	-32.1	-32.6	-34.2	-36.8	-33.4	-24.5	-16.0	-8.2	
Std 1957-89	3.0	4.8	6.4	7.8	8.5	8.2	8.2	8.3	8.0	6.8	4.9	3.1	
Mean 1992	-2.5	-9.8	-19.3	-24.2	-26.4	-26.4	-28.0	-36.6	-27.0	-17.1	-11.3	-4.1	-19.4
Mean 1993	-5.4	-12.6	-14.8	-21.5	-22.0	-29.4	-31.9	-28.0	-31.4	-18.6	-10.0	-5.2	-19.3
RELATIVE HUMIDITY, % , MONTHLY/ANNUAL MEAN													
Mean 1957-89	86	84	82	82	79	79	77	78	79	81	84	85	81
Mean 1992	71	87	85	83	82	81	82	71	82	87	90	94	83
Mean 1993	93	88	94	93	92	93	69	77	74	89	93	91	88
CLOUD COVER, OCTAS													
Mean 1957-89	6.0	6.0	5.6	5.6	4.9	4.5	4.6	5.1	5.4	5.8	5.8	5.8	5.4
Mean 1992	6.4	5.5	5.7	4.2	3.9	4.2	5.3	3.9	6.2	6.0	6.1	5.6	5.3
Mean 1993	4.8	4.7	7.1	5.7	5.0	4.0	3.7	5.2	4.2	6.6	6.5	6.2	5.3
WIND SPEED , KNOTS													
Mean 1957-89	10.5	11.6	13.7	14.2	13.6	13.4	13.9	14.8	14.7	14.7	12.8	10.7	13.2
Mean 1992	11.4	11.4	12.9	11.5	10.6	13.6	13.8	10.4	14.3	13.7	13.8	10.9	12.4
Mean 1993	8.0	7.8	12.9	12.3	14.0	11.6	9.9	11.4	9.3	16.6	16.2	11.6	11.8

Deviations from the reference values in mean monthly cloud cover were in the range -1.4 to +1.5 octa. Negative deviations were found for the months with mean temperatures well below the 1957-89 reference. Annual means of cloud cover were close to the refere value for both years.

Monthly means of wind speed for 1992-93 ranged from 63% to 127% of the reference values. For the months with mean temperatures well below reference values, mean wind speeds were less than 70% of the reference values. The annual means of wind speed for 1992 and 1993 were 6% and 11% below the reference value, respectively. Table 3 shows that this was caused by a relatively low frequency of winds more than 21 knots, that is strong breeze, gale and storm. On the other hand, there was an increased frequency of light winds of 1 - 6 knots. The frequency of "calm" (<1 knot) was, however, considerably lower in 1992-93 than in the reference period. It is not known if this may be caused by instrumental discrepancies between the periods or if it is real. Anyhow, the reduction in the "calm" frequency is more than compensated for by the increase in the frequency of "1 - 6 knots".

Table 3. Frequencies (%) of wind strength (Beaufort):

Beaufort number	Wind speed knots	Wind speed m/s	1957-89	1992-93
0	< 1	0 - 0.2	3.7	0.8
1 - 2	1 - 6	0.3 - 3.3	19.3	24.4
3 - 5	7 -21	3.4 -10.7	60.7	61.6
6 - 8	22 -40	10.8 -20.7	14.9	12.8
9 -11	41 -63	20.8 -62.6	1.5	0.4
12	>63	>32.7	0.0	-

All in all the period 1992-1993 is climatically representative for the reference period 1957-1989. A couple of months, though, had mean temperatures around the lowest observed during the reference period. For these months, both mean cloud cover and mean wind speed were also lower than the reference values.

3.2 Air temperature in the Aurora area.

The correlation matrix between series of daily mean temperatures at the Aurora stations and Halley are shown in table 4a. Daily mean temperatures were used rather than single observations in order to avoid the effect of diurnal temperature variations. The series were fairly well correlated. Between stations which were run during the entire period, the correlation coefficients were all in the range 0.85 - 0.91.

Table 4b shows that correlation coefficients between monthly mean temperatures ranged from 0.94 to 0.99. The good correspondance between monthly mean temperatures at different stations is also visualized in figure 4, which shows series of monthly mean temperatures from the Aurora stations and Halley during the period March 1992 to December 1993.

Table 4a. Pearson correlation coefficients between daily mean temperatures at different stations for the period Feb.21 1992 - Dec.31 1993.

STATION	HALLEY	BLUE-FIELDS	NEW HAVEN	SNOW-HENGE	THERON MOUNT.
HALLEY	1.00	0.87	0.76*	0.85	0.89
BLUEFIELDS	0.87	1.00	0.78*	0.86	0.91
NEW HAVEN	0.76*	0.78*	1.00*	0.83*	0.92*
SNOWHENGE	0.85	0.86	0.83*	1.00	0.90
THERON MT.	0.89	0.91	0.92*	0.90	1.00

* Correlation coefficients based upon shorter period.

Table 4b. Pearson correlation coefficients between monthly mean temperatures at different stations for the period Mar. 1992 - Dec. 1993.

STATION	HALLEY	BLUE-FIELDS	NEW HAVEN	SNOW-HENGE	THERON MOUNT.
HALLEY	1.00	0.98	0.94*	0.97	0.98
BLUEFIELDS	0.98	1.00	0.95*	0.97	0.97
NEW HAVEN	0.94*	0.95*	1.00*	0.98*	0.99*
SNOWHENGE	0.97	0.97	0.98*	1.00	0.98
THERON MT.	0.98	0.97	0.99*	0.98	1.00

* Correlation coefficients based upon shorter period.

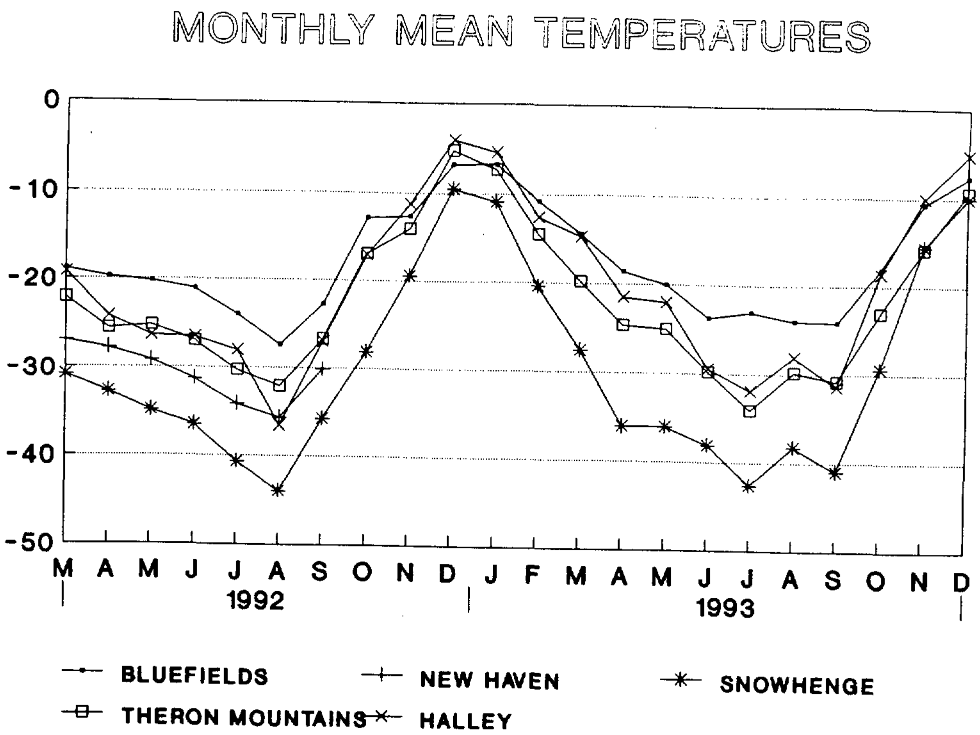

Figure 4. Monthly mean temperatures at the Aurora stations and Halley Mar 1992 - Dec 1993.

Monthly mean temperatures (TM) at the Aurora stations may thus be estimated by using a linear regression model:

$$TM(Aurora) = a + b\ TM(Halley) \quad (1)$$

Figure 5 shows scatter plots and regression lines for the 4 Aurora stations, respectively. The regression equation for each station is written above the diagram.

Reference temperatures for all months were estimated for each of the Aurora station by means of the reference temperatures from Halley (table 3) and the linear regression equation for the stations, respectively (figure 5). The results are presented in table 5. The "coastal" station Bluefields has highest reference temperature of the Aurora stations for all months. During summer (Dec-Jan-Feb), however, Halley's reference temperatures are higher. The mid shelf station Snowhenge has the lowest reference temperatures for all months. The temperature differences from the other stations are at maximum during winter, when they range from 7 to 16°C.

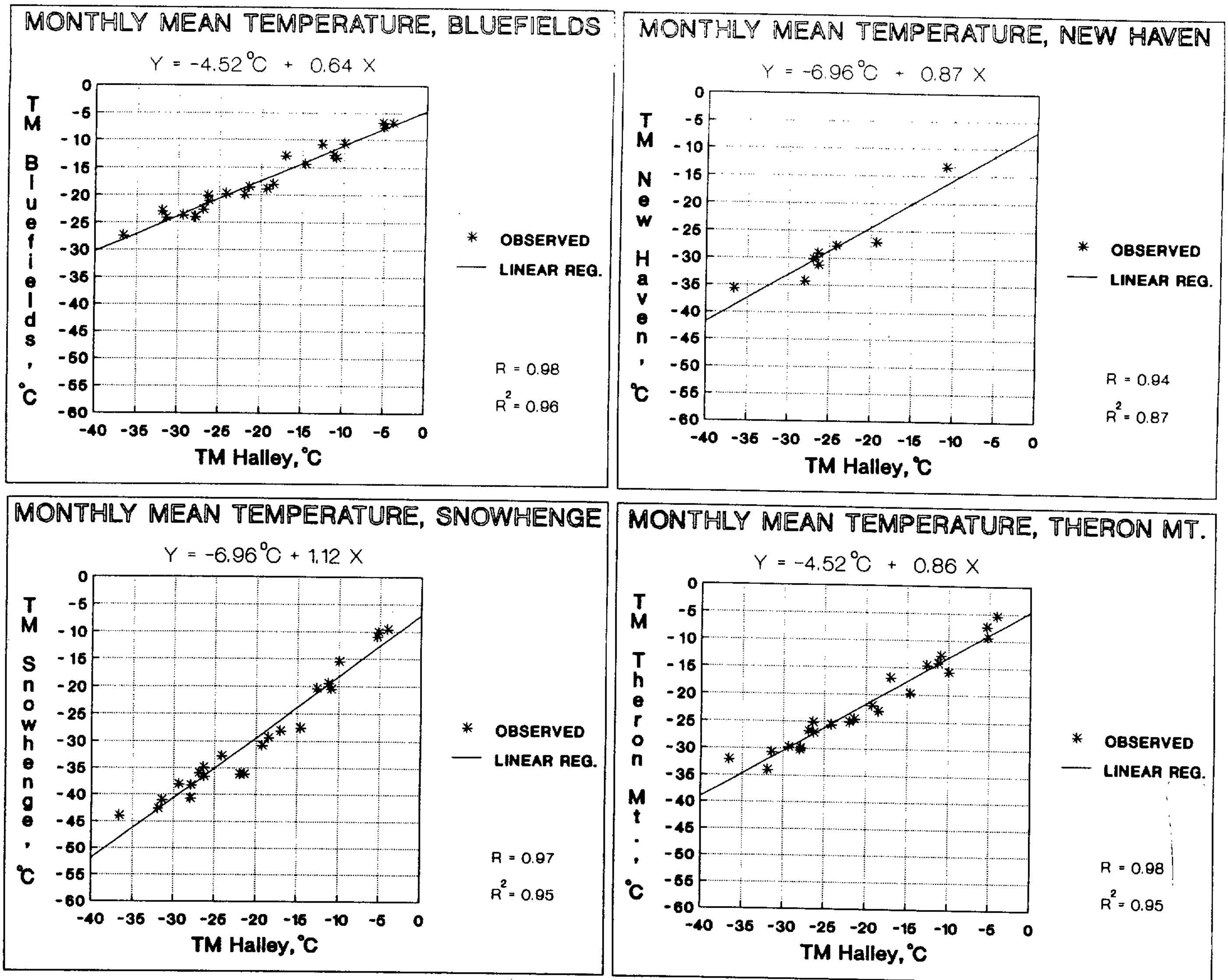

Figure 5. Scatter plots of monthly mean temperatures (TM) at the Aurora stations against TM at Halley. Regression lines (Eq. 1) are drawn. Their respective formulas are written above the diagrams.

Table 5. Monthly mean temperatures at the Aurora stations estimated from the Halley reference temperatures.

	HALLEY	Bluef.	New Haven	Snowh.	Theron Mt.
JAN	-4.6°C	-7.5°C	-11.0°C	-12.1°C	-8.5°C
FEB	-9.7°C	-10.8°C	-15.4°C	-17.9°C	-12.9°C
MAR	-16.6°C	-15.2°C	-21.4°C	-25.6°C	-18.8°C
APR	-20.3°C	-17.6°C	-24.6°C	-29.8°C	-22.0°C
MAY	-24.3°C	-20.2°C	-28.1°C	-34.3°C	-25.5°C
JUN	-26.7°C	-21.7°C	-30.1°C	-37.0°C	-27.5°C
JUL	-28.6°C	-22.9°C	-31.8°C	-39.1°C	-29.2°C
AUG	-28.1°C	-22.6°C	-31.4°C	-38.5°C	-28.7°C
SEP	-26.2°C	-21.4°C	-29.8°C	-36.4°C	-27.1°C
OCT	-19.7°C	-17.2°C	-24.1°C	-29.1°C	-21.5°C
NOV	-11.7°C	-12.1°C	-17.1°C	-20.1°C	-14.6°C
DEC	-5.2°C	-7.9°C	-11.5°C	-12.8°C	-9.0°C

The other main discrepancy between the two estimates is that Theron Mountains according to the present investigation is considerably warmer than the maps in figure 6 suggest. The 4°C differens in January may partly be caused by the radiation error which has affected the temperature measurements during sunshine hours in the summer. Some of it, may, however be caused by local heating from bare mountain sides exposed to sun radiation. The 11°C difference in July, on the other hand, is probably resulting from the fact that the mountain areas partly penetrate the temperature ground inversion, which is very strong during the winter. Temperatures in the mountain areas are thus not representative for the glaciers surrounding them, where cold air from the Polar Plateau slides downwards towards the shelf areas. The July isotherm map in figure 6 probably shows temperatures which are more representative for these glaciers than for the relatively small mountain areas.

3.3 Snow temperature at Snowhenge.

Snow temperature 8.1 m below the surface was measured at Snowhenge in 1993. Table 7 shows the monthly and annual mean temperatures compared to the similar air temperatures, and to the long term reference values. The annual mean temperature for 1993 8.1 m below the surface was slightly higher than the mean air temperature for the same period. This is not surprising, as the temperature below the surface is affected by the air temperature over a longer period, and 1993 was somewhat colder than the "reference" year. The thermal response at different depths in the snow is determined by the thermal diffusivity, κ of the snow. The temperature amplitude (MAX-MIN) at a certain depth z is given by:

$$(\text{MAX-MIN})_z = (\text{MAX-MIN})_0 \exp\{-z(\pi/\kappa P)^{1/2}\} \qquad (2)$$

Here $(\text{MAX-MIN})_0$ is the amplitude at the surface, and P is the period (e.g. Oke, 1978). Using $P = 1$ year, $z = 8$ m, and temperature amplitudes of 1.5°C and 30°C for 8 m and surface,

Table 7 Monthly and annual mean temperatures at Snowhenge, temperature difference between highest and lowest monthly mean, and time of year for these values.

Coloumn 1: Snow temperature 8.1 m below the surface in 1993.
Coloumn 2: Air temperature in 1993.
Coloumn 3: Air temperature, reference.

	Ts 8.1 m below surface, 1993	Ta , 1993	Reference air temperature
JAN	-29.0°C	-10.9°C	-12.1°C
FEB	-28.8°C	-20.4°C	-17.9°C
MAR	-28.4°C	-27.5°C	-25.6°C
APR	-28.1°C	-36.1°C	-29.8°C
MAY	-27.8°C	-36.1°C	-34.3°C
JUN	-27.7°C	-38.1°C	-37.0°C
JUL	-27.8°C	-42.6°C	-39.1°C
AUG	-28.1°C	-38.3°C	-38.5°C
SEP	-28.3°C	-41.0°C	-36.4°C
OCT	-28.7°C	-29.3°C	-29.1°C
NOV	-29.0°C	-15.5°C	-20.1°C
DEC	-29.2°C	-10.0°C	-12.8°C
ANNUAL	-28.4°C	-28.8°C	-27.8°C
MAX - MIN	1.5°C	32.6°C	27.0°C
MAX-MONTH MIN-MINTH	JUN JAN	DEC JUL	JAN JUL

respectively (see table 7), yields $\kappa = 0.7*10^{-6}m^2s^{-1}$. The same result is achieved by using the time lag $(t_z - t_0)$ of the temperature wave crest and trough from surface to depth **z**, which is given by:

$$(t_z - t_0) = (z/2)*(P/\pi\kappa)^{1/2} \quad (3)$$

In the present case, a time lag of approximately 6 months is found from the last 2 lines of table 7. Again, the estimate of the thermal diffusivity κ is $0.7*10^{-6}m^2s^{-1}$, a value which lies between the pure snow values and the pure ice values. By using this value of κ and equatins 2 and 3, temperature amplitude and time lag may now be estimated for any depth.

3.4 Air pressure in the Aurora area.

Table 8 shows the correlation matrix between air pressure at Bluefields, New-Haven, Snowhenge, Theron Mountains and Halley when using single observations (a) and monthly mean values (b). All pressure series are well correlated. The higher correlation coefficients are found between the series from Bluefields, New Haven and Theron Mountains, both for monthly values (R=0.99) and for single values (R=0.96-0.98).

The pressure values have not been reduced to mean sea level values, as the results would be rather uncertain because of the vertical temperature distribution, and because the heights of the stations are approximate. Consequently, horisontal pressure gradients have not been analysed.

Table 8a. Pearson correlation coefficients between observed air pressure at different stations for the period Feb.21 1992 - Dec.31 1993.

STATION	HALLEY	BLUE-FIELDS	NEW HAVEN	SNOW-HENGE	THERON MOUNT.
HALLEY	1.00	0.94	0.90*	0.84	0.89
BLUEFIELDS	0.94	1.00	0.98*	0.92	0.96
NEW HAVEN	0.90*	0.98*	1.00*	0.95*	0.98*
SNOWHENGE	0.84	0.92	0.95*	1.00	0.90
THERON MT.	0.89	0.96	0.98*	0.90	1.00

* Correlation coefficients based upon shorter period.

Table 8b. Pearson correlation coefficients between monthly mean air pressure at different stations for the period Mar. 1992 - Dec. 1993.

STATION	HALLEY	BLUE-FIELDS	NEW HAVEN	SNOW-HENGE	THERON MOUNT.
HALLEY	1.00	0.97	0.96*	0.97	0.93
BLUEFIELDS	0.97	1.00	0.99*	0.94	0.99
NEW HAVEN	0.96*	0.99*	1.00*	0.96*	0.99*
SNOWHENGE	0.97	0.94	0.96*	1.00	0.91
THERON MT.	0.93	0.99	0.99*	0.91	1.00

* Correlation coefficients based upon shorter period.

3.5 Wind conditions in the Aurora area.

Table 9 shows the correlation matrix between wind speed at Bluefields, Snowhenge and Halley when using single observations (a) and monthly mean values (b). In (b), the Bluefields - Halley correlation is the only one which is significant, even on the 5% level. In (a), all correlations are significant on the 1% level because of the high number of observations. However, the correlation is very poor between Snowhenge and the other stations, indicating that the station is in a different wind regime.

Table 9. Correlation coefficients between wind speed at different stations during Feb.21 1992 - Dec.31 1993.
a) Single observations. b) Monthly means.

a)

STATION	HALLEY	BLUE-FIELDS	SNOW-HENGE
HALLEY	1.00	0.46	0.10
BLUEFIELDS	0.46	1.00	0.15
SNOWHENGE	0.10	0.15	1.00

b)

HALLEY	BLUE-FIELDS	SNOW-HENGE
1.00	0.55	-0.07
0.55	1.00	-0.35
-0.07	-0.35	1.00

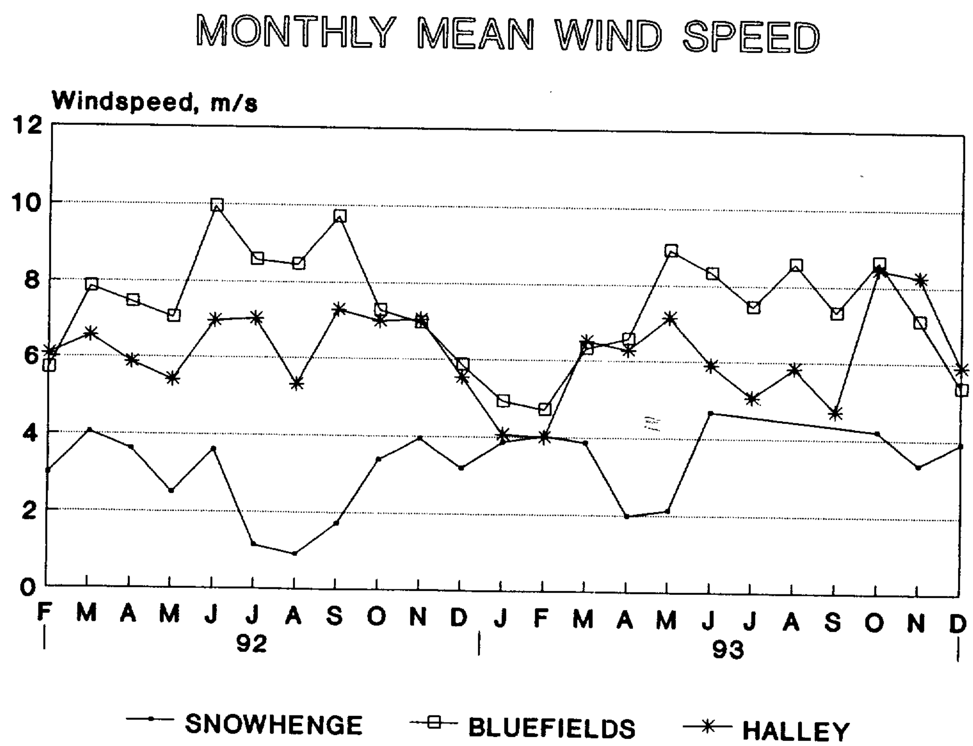

Figure 7. Monthly mean wind speed at Snowhenge, Bluefields and Halley during the Aurora period.

The same is illustrated by figure 7, which shows time series of monthly mean wind speed at the 3 stations. Note that wind speeds from Bluefields and Snowhenge were measured at 4 m above the ground, and should be multiplied by approximately 1.1 to yield the 10 m value.

The differences in wind conditions between Snowhenge and the other stations are also seen from figure 8, showing the frequency distribution of wind directions during the period Feb. 21. 1992 - Dec 31. 1993. The distribution at Halley shows that easterly winds are dominating. The wind direction was within the 90° sector E+SE almost 60% of the time. However, there is a secondary maximum for southwesterly winds, and wind direction was in the sector SW+W more than 25% of the time. This is mainly in agreement with the analyses for the reference period 1957-89 (Hanssen-Bauer 1992a). The easterly winds,

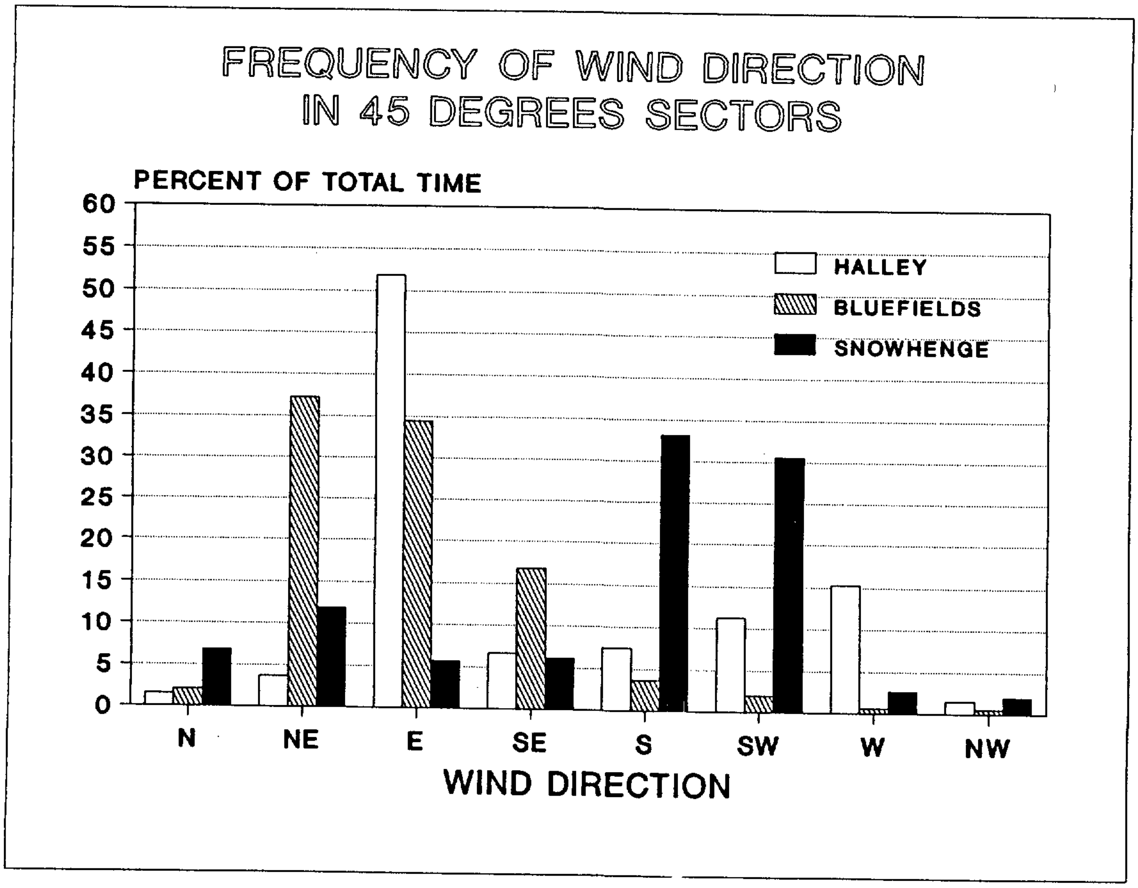

Figure 8. Distribution of wind directions at Snowhenge, Bluefields and Halley during the Aurora period. The frequencies are given for 45° sectors.

which are also found in the average pattern of surface winds (Mather and Miller, 1967), had an average speed of 8 m/s. The southwesterly winds, on the other hand, had an average wind speed of about 5 m/s. The latter were frequently accompanied by low temperatures. These winds are probably a part of the cold air stream flowing down the glaciers from the Polar Plateau to the shelf and further out against the coast.

At Bluefields, the wind came from NE or E more than 70% of the time, showing that the coastal wind systems are even more dominating here than at Halley. There was no secondary maximum for southerly winds, though southeasterly winds were rather frequent. Bluefields thus seems to be less affected by the cold air drainage out from the shelf than Halley is. This may be because Bluefields is situated higher above sea level than Halley is, or because Bluefields is better sheltered against the drainage winds. Anyway, it explains why the monthly mean temperatures were higher at Bluefields than at Halley, except during summer (table 5). Average wind speed for the esterly and northeasterly winds at Bluefields was about 9 m/s, while mean wind speed for the southerly and southeasterly winds was about 5 m/s.

At Snowhenge, the stream of cold air from the Polar Plateau is the dominating wind. The wind was from S or SW about 65% of the time, and the average wind speed for these winds was about 4 m/s. There is a secondary maximum for northeasterly winds, showing that, occationally, the coastal winds reaches in to the middle of the shelf. The average speed of these winds was also about 4 m/s, which is roughly half the avarage speed of northeasterly winds at Bluefields. The norteasterly winds at Snowhenge are usually accompanied by a rise in the temperature of more than 10°C.

4. SUMMARY AND CONCLUSIONS

The Aurora investigation area may coarsly be divided into a "coastal zone" (a), "shelf areas" (b), "glaciers" (c), and "mountain areas" (d). Such a classification is suggested in figure 9. Reference climates of these different areas were deduced from comparing the Aurora observations with simultanous observations at Halley, and with the Halley reference series from 1957-1989. Some additional information from Schwerdtfeger (1970) was used as well.

a) The "coastal zone" is represented by the station Bluefields, showing monthly reference temperatures of -5°C - -10°C in mid-summer (Dec-Jan) and -20°C - -25°C in winter (Jul-Aug). Bluefields, however, is probably less affected by the cold winds draining out from the Filchner Shelf than the eastern parts of the coastal zone. Lower winter temperatures (monthly mean temperatures of -25°C - -30°C) may thus be expected in the western parts of this zone. The most frequent wind directions in the coastal zone are NE and E. In eastern parts of the zone, these directions may be expected around 70% of the time, while winds with a southerly component are expected about 25% of the time. In western parts of the zone, the frequency of NE and E winds is probably somewhat lower, while the frequency of winds from SE, S or SW is higher. The higher wind speeds are connected to the northeasterly winds (at average 7-10 m/s), while the southerly winds are weaker (at average 3-5 m/s).

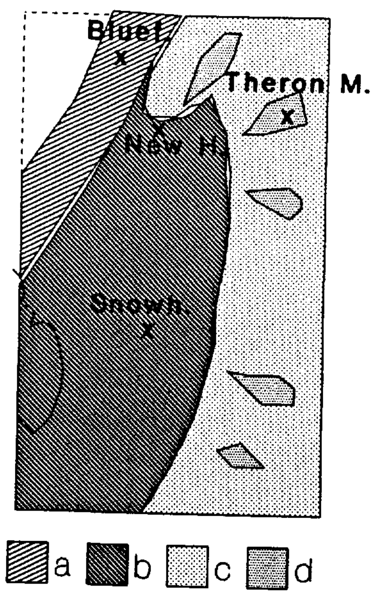

Figure 9. Sketch showing suggested borders between coastal zone (a), shelf(b), glaciers (c) and mountain areas (d). Positions of mountain areas are approximate.

b) The shelf areas are represented by the stations Snowhenge (middle and inner shelf) and New-Haven (outer shelf). In the shelf areas, the monthly reference temperatures during summer (Dec-Jan) are in the range -10 - -15°C. In winter (Jul-Aug), monthly reference temperatures in outer shelf areas are in the range -30°C to -35°C, while they are in the range -35°C - -40°C in middle and inner parts of the shelf. The air flow leading cold air from the Polar Plateau against the coast is the prevailing wind, the frequency being 60-70%. The average speed of this windflow is about 4 m/s. Occationally, however, milder air comes in from the coastal areas with northeasterly winds. At Snowhenge, the reference frequency of wind direction N or NE is 15-20%. Average wind speed is 4 m/s also for these winds.

c) The glaciers leading from the Polar Plateau to the shelf are not represented by any of the Aurora stations. However, the climate of the glaciers may to some extent be deduced from the shelf climate, as winds from the glaciers are dominating at the shelf most of the time. The glaciers are at average expected to be somewhat colder than than the shelf area, both because the northerly coastal winds more seldom would reach the glaciers, and because the cold winds from the Polar Plateau are warming adiabatically on its way down the glaciers. The monthly reference temperatures in the mid summer are thus expected to be around -20°C, while monthly reference temperatures for July and August are expected to be -40°C - -50°C. The lower temperatures are expected in the upper parts of the glaciers, while the lower parts would be more similar to the inner shelf areas. This is in accordance with figure 6. The wind is supposed to blow down the glaciers more than 70% of the time.

d) The mountain areas are represented by the station Theron Mountains. Here, the reference climate is considerably warmer than at the surrounding glaciers. In mid-summer, the monthly reference temperatures are around -10°C, while the reference temperatures for July-August are around -30°C. The difference from the glacier reference climate in summer is probably caused mainly by the locally improved radiation budget of bare mountain areas relatively to the snow surfaces. The difference in winter, on the other hand, is probably resulting from the fact that the mountain areas partly penetrate the temperature inversions, which are very strong during the winter. It is not known if the Theron Mountain measurements are representative for other mountain areas like Shackleton Range or Argentina Range, or even if they are representative for the entire Theron Mountains area. Larger local differences would be expected in the mountain areas than in more homogeneous areas (e.g. the shelf). However, a certain improvement of the temperature climate in the mountains relatively to the glaciers seems reasonable, at least in mountain slopes facing the shelf areas.

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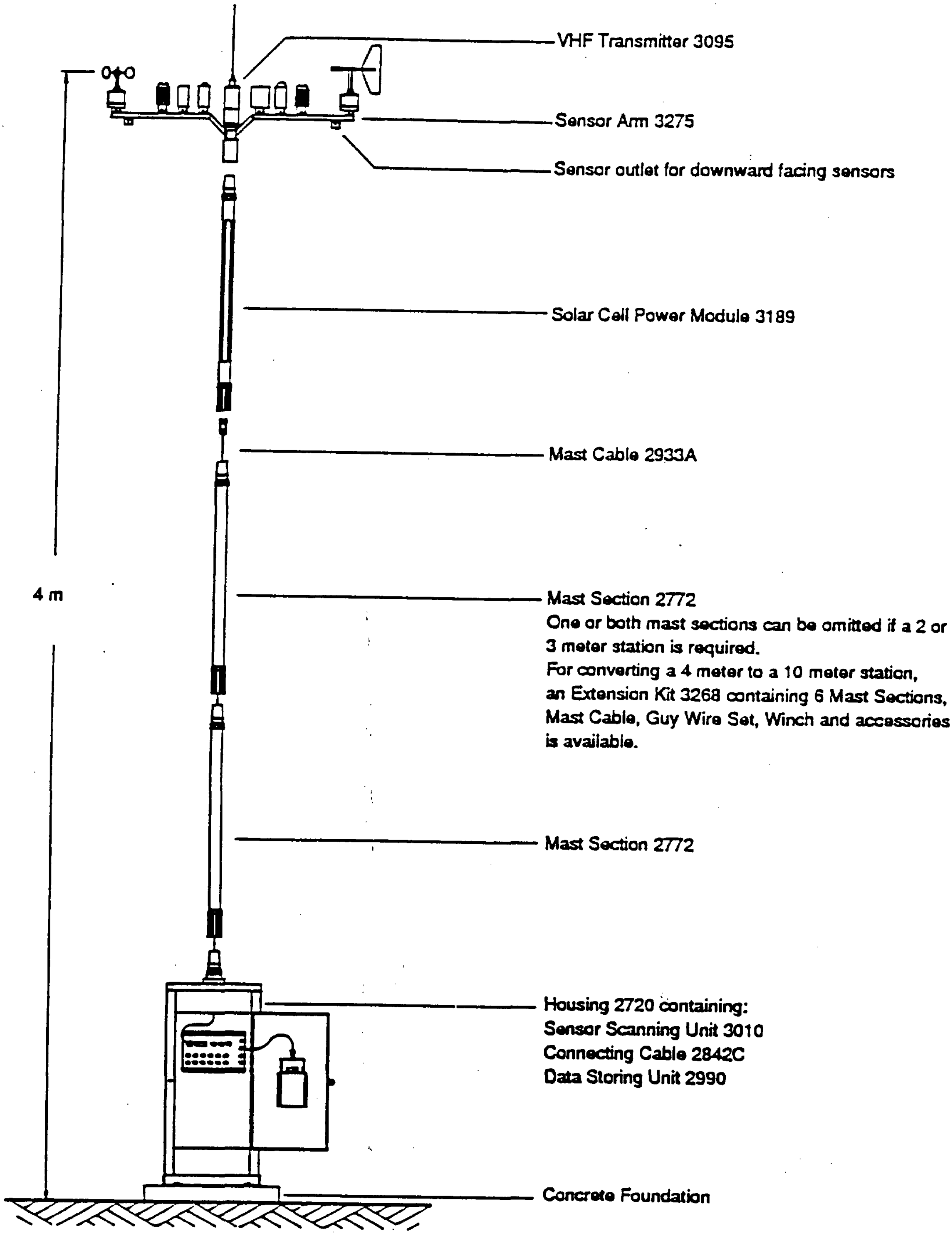
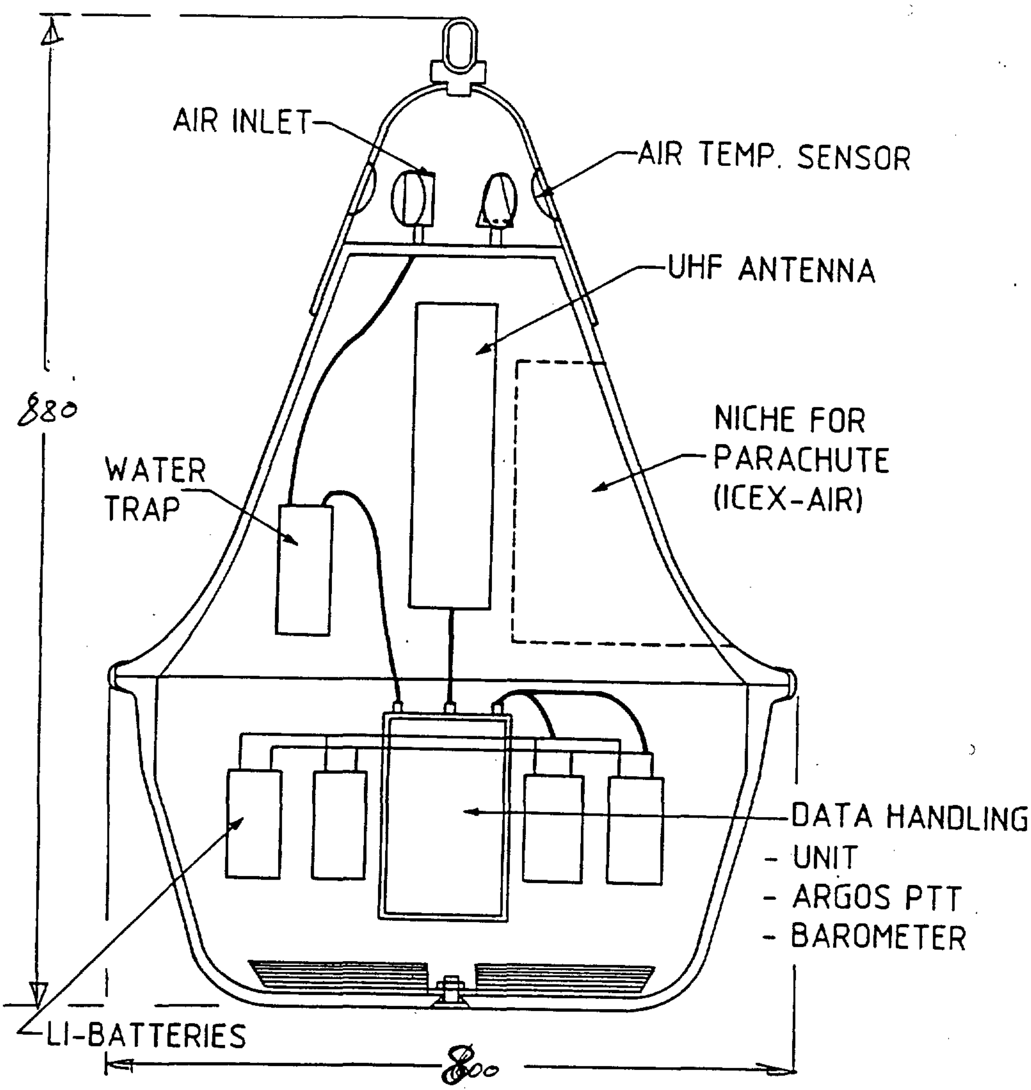
Appendix 1

AUTOMATIC WEATHER STATION 2700



Appendix 2



Sensors:	
Air pressure:	Paroscientific Digiquartz 215 A or 216 B pressure transducer.
Range:	920 - 1060 HPa.
Resolution:	0.13 HPa.
Air temperature	CMI air thermometer, based on Fenwall UUA 32J3. thermistor.
Range:	.-60 - +30 °C
Resolution:	0.1 °C
Surface temperature:	CMI thermometer, based on Fenwall UUA 32J3 thermistor.
Range:	.-2 - +23 °C
Resolution:	0.1 °C
Range may be modified if required, other sensors may be utilized.	