The Meteorological Data of the Georg-von-Neumayer-Station for 1981 and 1982

by Marianne Gube-Lenhardt
and Friedrich Obleitner

Berichte zur Polarforschung Nr. 30 / März 1986
Reports on Polar Research no. 30 / March 1986

FOREWORD

The German wintering station Georg von Neumayer in Antarctica serves as a meteorological observatory since March 1981. During the first year the instrumentation was incomplete and the measurements as well as the WMO observations had to be carried out by a single person, Mr. F. Obleitner.

In the beginning of 1982 a 15 m heigh mast - equipped with wind velocity and temperature sensors - and several other instruments were installed by the two meteorologists G. König and J Kipfstuhl, who worked at the station from the end of 1981 to the beginning of 1983.

The observational material of the years 1981 and 1982 has been processed partly by the wintering team and partly by Dr. M. Gube-Lenhardt in Bremerhaven. She has started a routine processing and analysing procedure which will be continued regularly for the following years.

The first part of this report, assembled by M. Gube-Lenhardt, contains mainly a set of data statistics for the years 1981 and 1982.

The second part, prepared by F. Obleitner, presents a more detailed review of the first year's instrumentation and the observational procedures.

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"Ocean and Atmosphere Experimental Physics"

Summary of the Meteorological Data of the Georg-von-Neumayer-Station for the Years 1981 and 1982

by Marianne Gube-Lenhardt

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CONTENTS

1. Introduction

This report describes the instrumentation at the Georg-von-Neumayer-Station (70°37'S 08°22'W) for the years 1981 and 1982, explains the data processing and archiving procedures and presents some results of the recordings taken during these two years. It is intended to continue the yearly reports in future. The data compiled in the reports may serve to describe the climatic conditions at the Georg-von-Neumayer Station.

2. Observations and Instrumentation

The meteorological observations at the Georg-von-Neumayer Station (meteorological station number 89002) have started with the first wintering season on 2 March 1981. During this first year the meteorological activities were confined to standard synoptic observations, which were also passed to the general meteorological data network GTS (Global Telecommunication System), to the recording of atmospheric surface pressure and to the registration of hourly means of air temperature, the wind vector and the global radiation (i.e. incoming diffuse and direct solar radiation. These first observations are described in more detail by F. Obleitner in the second part of this report.

In the beginning of 1982 the amount of equipment was increased: A 15 m mast was installed to measure vertical profiles of temperature, wind speed and wind direction. The vertical profile of firn temperature was recorded in six levels down to about 5-6 m depth. Radiation measurements were also expanded to include both global radiation and the reflected solar radiation as well as the total (long- and shortwave) in- and outgoing radiation fluxes. Furthermore, two humidity sensors have been installed. An improved data acquisition unit enabled us to archive 10 minute means of all data on cassette. Tables 1 and 2 give a detailed description of the instrumentation and sampling rates during 1981 and 1982.

3. Data Processing and Archiving

All meteorological data gained at the Georg-von-Neumayer Station are archived in the Alfred-Wegener-Institute, Bremerhaven. The data have first to be processed and validated. The actual sensor heights above ground were manually inserted into the meteorological mast data files. Much of this work could only be accomplished with the help of the over-wintering meteorologists F. Obleitner, G. König and J. Kipfstuhl.

Some quantities have been derived from the direct measurements, e.g. the longwave (i.e. thermal) radiation components and the total surface radiation budget. For climatological reasons hourly mean values of certain quantities were computed and archived. These are: air pressure, air-temperature (2 m), relative humidity (2m), wind vector (10m, 17m in 1981), firn temperature (1 m depth) and the radiation budget components.

Table 3 lists the current entries into the 1981-1982 archive.

4. Results

The 1981 and 1982 climatological data are subsequently portrayed with the aid of tables and figures. In particular, time series of monthly mean temperature, pressure, humidity, firn temperature and radiation data as well as monthly histrograms of cloud coverage, wind speed and direction, surface temperature inversion and surface albedo are shown.

4.1 Air Temperature (Fig. 1a and 6a)

The mean annual temperature of about -16°C remained much the same in 1981 and 1982, although it should be noted that in 1981 two summer months (January and February) are missing in the annual statistics.

The yearly amplitude amounted to 18.3°C in 1981 and to 25.8°C in 1982, again the former value is uncertain due to missing data. Lowest mean monthly temperature was reached in June, while the absolute minimum temperatures (-36.6°C in 1981, -43.6°C in 1982) were recorded in August. The air temperature rises above the freezing value several times from December to March with maxima of +2.3°C (1981) and 2.8°C (1982) in December.

4.2 Pressure (Fig. 1b and 6b)

The pressure measurements are reduced to the mean sea level under the assumption of an isothermal atmosphere. Considering the 40 m station elevation, this correction should be sufficiently good.

Practically all recorded pressure values are substantially lower than the standard sea level pressure of 1013.3 hPa. There was only one registration of a higher value (1016.4 hPa) in August 1981. The monthly pressure extremes generally reflect pressure changes caused by synoptic disturbances occuring on a temporal scale of a few days.

4.3 Humidity (Fig. 6c, only 1982)

The installation of two humidity sensors in 1982 allowed routine humidity recordings at 2 m height. Humidity measurements, however, are very difficult to perform at low ambient temperatures. The response time of the sensors increase with decreasing temperatures. Another difficulty arises from the fact that both water vapour pressure (e) and the corresponding saturation vapour pressure (E) assume rather low values, so that even small uncertainties of these quantities may lead to large misestimates of the relative humidity r ($r=100e/E$). The typical bias of the two instruments at the station amounted up to 10 % relative humidity. The derived means are averages of both instruments.

The monthly mean realtive humidity lies mostly between 80 and 90 % corresponding to a total water vapour content between 1.6 g/kg in summer and 1.7 g/kg in winter. During dry periods the relative humidity can drop down to as low as 35 %.

4.4 Firn Temperature (Fig. 6d, only 1982)

The main problem associated with the firn temperature measurements lies in the uncertainty of the actual sensor depth. Due to snow drift and snow accumulation with time the sensor depths are variable and can hardly be determined accurately. In 1982 the depth was estimated from the surface snow accumulation. Figure 6d shows the recorded temperature of the sensor which was originally at 1 m depth, but approximately at 2 m at the end of 1982.

As expected, the firn temperature reflects the annual air temperature cycle with a phase lag of one to two months. The amplitude (8.7°C) is clearly much smaller than the atmospheric one.

4.5 Cloudiness (Fig. 2 and Fig. 7)

Overcast or partly cloudy skies (greater than 5 octas) are predominant conditions. The only months showing at times less than 3 octas are May and June (1981 and 1982). However, the month to month and year to year variations are considerable, so that these two years' data are not representative for cloudiness characteristics of individual months with any statistical significance.

4.6 Wind Speed (Fig. 3 and Fig. 8)

The annual average of the wind speed was 10.9 m/s in 1981 and 9.5 m/s in 1982 (see Table 4 and Table 5). As the histograms show, the prevailing wind speed is somewhat lower than the monthly mean values and lies between 6 and 8 m/s. Higher wind speed during winter is a common fact of both years. The maximum wind speed reached 36.5 m/s in 1981 and 35.0 m/s in 1982. Such high winds are associated with severe snow storms.

4.7 Wind Direction (Fig. 4 and Fig. 9)

The two yearly histograms (Fig. 4k and Fig. 9m) show three distinct maxima for the wind directions 70-79°, 160-170° and 220-250°.

The monthly means (Table 4 and Table 5) and the histograms reveal that easterly winds are by far predominant throughout the year. This result agrees with the observation that the centre of most of the depressions passing the station lie at lower latitudes. Depressions with their core south of the station give rise to westerly winds, which occur occasionally during the Austral summer. The southerly slope winds are well represented in the data, while northerly winds are rare at the Georg-von-Neumayer Station.

4.8 Vertical Temperature Gradient, Temperature Inversion (Fig. 10, only 1982)

Since March 1982 the installation of the 15 m mast allowed the recording of surface temperature inversions which mean a strongly stable atmospheric vertical density stratification. Surface inversions are present at the Georg-von-Neumayer Station during 88 % of the total time. The atmospheric static stability becomes stronger during the winter months, when the histograms show a shift to higher temperature gradients (up to 1 K/m).

4.9 Radiation Measurements

4.9.1 Global Radiation (Fig. 5 and Fig. 11)

Both years' global radiation registrations show similar characteristics. The most striking feature is of course the large annual variation ranging between about $700 W/m^2$ at local noon in December and less than $20 W/m^2$ at local noon in May, and finally resulting in zero solar irradiance during the polar night in June and July.

The dominating process for the monthly mean values is the solar irradiance at the top of the atmosphere, giving the almost sinusoidal daily cycles. Individual values may deviate of course from the monthly mean due to the influence of clouds.

Comparison of the two years show not much year-to-year variation for the respective months. Further continuation of the global radiation programme is anticipated and will give more significant information on interannual variations.

4.9.2 Longwave Radiation Flux (Fig. 12 a, only 1982)

The two longwave (thermal) radiation budget components (L) have been computed from the total flux (F) and the shortwave flux (K) measurements:

$$L_{up,down} = F_{up,down} - K_{up,down}.$$

L_{up} is a measure of the snow or ice surface temperature. Assuming a surface emissinity of 1 (black body), the surface temperature ranges between 243 K in June and 271 K in December. The downward flux is always by about $20 W/m^2$ lower, thus resulting in a net thermal radiative loss of the surface.

4.9.3 Albedo (Fig. 13, only 1982)

The surface albedo is defined as $100 \cdot K_{up}/K_{down}$ and gives the fraction of solar radiation reflected at the Earth's surface. The snow or ice surface at the Georg-von-Neumayer Station has a very high albedo between 80 and 90 % with not much change over the year.

4.9.4 Radiation Budget (Fig. 12b, only 1982)

The difference of the downward and upward radiation fluxes is commonly referred to as the surface radiation budget

$$B = (K_{down} + L_{down}) - (K_{up} + L_{up}).$$

This figure indicates whether radiation processes form an energy source or sink of the snow surface.

The mean annual radiation budget is negative in polar regions. At the Georg-von-Neumayer Station B assumes slightly positive values during the summer months. The sign changes occur at the end of October and in February. More details on the January and Feburary radiation characteristics are be expected from the future measurements.

Table 1: Meteorological Instrumentation, 1981

(a) Synoptic Observations

Time schedule:	Three-hourly observations at 00, 03, 06, 09, 12, 15, 18, 21 UT
Coding:	According to WMO standard FM-11C SYNOP, extended by a first data group giving year and month of the observation
Included parameters:	Visibility, total cloud coverage, wind direction, wind speed, air temperature, air pressure, pressure tendency, cloud group (coverage of lowest cloud layer, types of low, medium high and high clouds)

(b) Hourly Mean Values

Wind vector:	Cup anemometer and wind vane (Thieß, Göttingen) in 17 m heigh
Air temperature:	Pt-100 together with a standard psychrometer (Lambrecht, Göttingen) in 2 m height ('Stevenson Screen)
Global radiation:	Pyranometer (Eppley Laboratories)

Registration:	Analogue; digitization was performed during the data evaluation

Table 2: Meteorological Instrumentation, 1982

(a) Synoptic Observations

Time schedule:	Three-hourly observations at 00, 03, 09, 09, 12, 15, 18, 21 UT
Coding:	According to WMO standard F12-VII SYNOP, extended by a first data group giving year and month of the observation
Included parameters:	Visibility, total cloud coverage, cloud height, wind direction, wind speed, air temperature, dew point temperature, air pressure, pressure tendency, cloud group (coverage of lowest cloud layer, types of low, medium high and high clouds), present and past weather, snowdrift

(b) Meteorological Mast

Wind vector:	Cup anemometer and wind vane (Thiess, Göttingen) wind direction: in 5 heights between 1 and 15 m wind sped: in 6 heights between 0.5 and 15 m
Air temperature:	Pt-100 (Lambrecht, Göttingen) in 6 heights between 0.5 and 15 m

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Registration 10 minute means on digital cassettes

Note: The actual sensor heights remained variable during the year due to snow accumulation beneath the mast

(c) Firn Temperature

Pt-100 (Lambrecht, Göttingen) in 6 depths between 0.25 and 6 m

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Registration:

Note: The actual sensor depths remained somewhat variable during the year due to snow accumulation; in general, an accumulation rate of about 1m/year can be assumed

(d) Surface Observations

Air pressure:	Precision barometer (aneroid) (Hartmann & Braun, Hamburg) reduced to mean sea level pressure
Humidity:	Hair hygrometer (Thieß, Göttingen) at about 2m above the level surface
Global radiation:	Pyranometer (Eppley Laboratories)

Reflected solar radiation: Pyranometer (Eppley Laboratories)
Total radiation (up and down): Pyrradiometer (Lange, Berlin)

Registration: 10 minute means on digital cassettes

Table 3: Archived meteorological data, 1981 and 1982

(a) Synoptic Observations

- Contents: Coded SYNOP messages from March 1981 to December 1982
- Archive medium: Magnetic tape
- Data amount: Approximately 24 kByte per month

(b) Meteorological Mast

- Contents: 10 minute means of temperature, firn temperature, wind speed and direction, relative humidity, air pressure (after quality control, with appropriate sensor heights included) from March 1982 to December 1982
- Archive medium: Magnetic tape
- Data amount: Approximately 1.3 MByte per month

(c) Radiation Measurements

- Contents: 10 minute means of sunshine duration, global radiation, reflected solar radiation, down- and upward going thermal radiation, resultant radiation budget (after quality control) from March 1982 to December 1982
- Archive medium: Magnetic tape
- Data amount: Approximately 0.2 MByte per month

(d) Hourly Mean Values (Climatological Archive')

- Contents: Hourly mean values of air pressure, air temperature, relative humidity, 10 m wind, 1 m firn temperature, all four radiation budgets (as computed from mast and radiation measurements)

Note: Due to the reduced instrumentation in 1981 some of the parameters are just set to default values for 1981

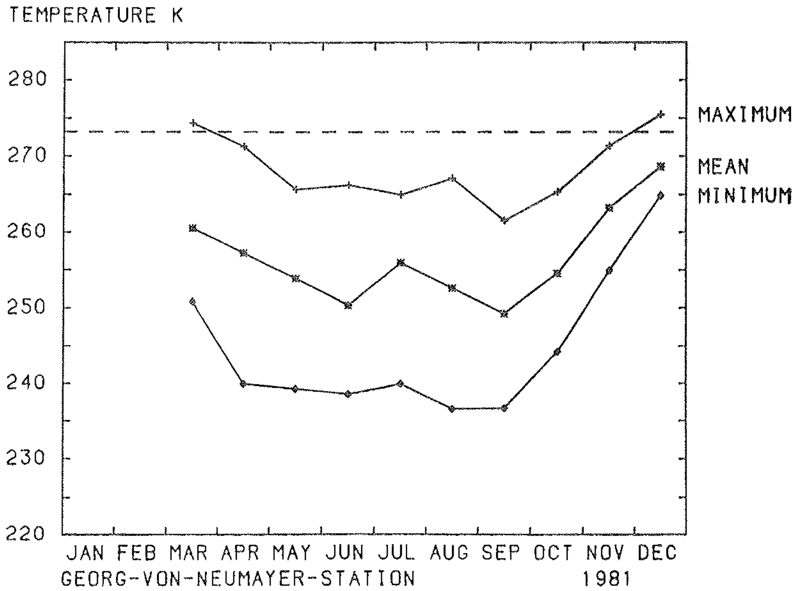
- Archive medium: Magnetic tape
- Data amount: Approximately 0.7 MByte per year

Table 4: Monthly means and extremes, 1981 (from synoptic observations)

1981 GEORG-VON-NEUMAYER 70° 37'S 08° 22'W ELEVATION 40 M	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
AVERAGE TEMPERATURE (DEG C)	---	---	-12.6	-15.9	-19.3	-22.8	-17.2	-20.6	-23.9	-18.6	-9.9	-4.5	-16.5
TEMPERATURE MAXIMUM (DEG C) (DATE)	--- (--)	--- (--)	1.2 (8)	-1.9 (12)	-7.5 (3)	-6.9 (7)	-8.2 (1)	-6.0 (17)	-11.6 (28)	-7.8 (6)	-1.8 (12)	2.3 (28)	2.3
TEMPERATURE MINIMUM (DEG C) (DATE)	--- (--)	--- (--)	-22.3 (23)	-33.2 (20)	-33.9 (20)	-34.6 (21)	-33.2 (31)	-36.6 (5)	-36.5 (18)	-28.9 (13)	-18.2 (4)	-8.3 (18)	-36.6
AVERAGE MAXIMUM TEMPERATURE (DEG C)	---	---	-10.1	-13.8	-17.6	-20.3	-16.1	-18.7	-21.6	-15.5	-7.7	-2.4	-14.4
AVERAGE MINIMUM TEMPERATURE (DEG C)	---	---	-13.4	-17.9	-20.8	-24.5	-19.3	-22.3	-25.7	-18.7	-9.9	-4.5	-17.7
AVERAGE REL. HUMIDITY (PERCENT)	---	---	---	---	---	---	---	---	---	---	---	---	---
MAXIMUM REL. HUMIDITY (DATE)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	---
MINIMUM REL. HUMIDITY (DATE)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	--- (--)	---
AVERAGE STATION PRESSURE (HPA)	---	---	989.2	986.6	983.3	983.7	979.6	987.2	982.4	978.2	978.7	976.6	982.5
MAXIMUM PRESSURE (HPA) (DATE)	--- (--)	--- (--)	998.3 (28)	1010.1 (9)	995.5 (16)	1000.8 (27)	1003.1 (4)	1016.4 (15)	998.5 (18)	993.5 (4)	989.7 (13)	989.4 (20)	1016.4
MINIMUM PRESSURE (HPA) (DATE)	--- (--)	--- (--)	977.2 (22)	965.3 (25)	966.4 (18)	949.8 (7)	953.0 (7)	964.9 (22)	951.0 (29)	950.9 (6)	964.9 (2)	947.9 (9)	947.9
PREVAILING WIND DIRECTION	---	---	095	095	095	095	095	085	085	085	085	085	085
AVERAGE WIND SPEED (M/S)	---	---	8.9	10.6	12.7	9.7	13.4	12.3	10.5	9.4	11.7	9.5	10.9
MAX. WIND VEL. (M/S) (DEG) (DATE)	--- --- (--)	--- --- (--)	22.6 110 (4)	32.9 100 (25)	29.3 100 (7)	23.1 100 (6)	35.0 090 (2)	36.5 090 (11)	29.8 100 (27)	35.0 100 (5)	26.2 090 (9)	25.7 100 (8)	36.5 090
AVERAGE SKY COVER (TENTH)	---	---	5.0	6.2	5.0	5.0	6.2	6.2	6.2	6.2	6.2	6.2	5.9
NUMBER OF CLEAR DAYS	--	--	00	04	06	03	00	02	05	03	04	02	29
NUMBER OF PARTLY CLOUDY DAYS	--	--	19	11	12	22	16	16	13	14	09	13	145
NUMBER OF CLOUDY DAYS	--	--	09	13	11	04	10	11	12	14	15	16	115
NUMBER OF DAYS WITH VISIBILITY LESS THAN 0.4 KM	--	--	04	09	11	13	04	05	10	09	12	05	82
NUMBER OF DAYS WITH MODERATE SNOWDRIFT	--	--	--	--	--	--	--	--	--	--	--	--	--
NUMBER OF DAYS WITH STRONG SNOWDRIFT	--	--	--	--	--	--	--	--	--	--	--	--	--

DASHES INDICATE: NO OBSERVATIONS

Figure 1: Time series of monthly mean temperature (a) and pressure (b) together with the respective monthly extreme values, 1981 (from synoptic observations)



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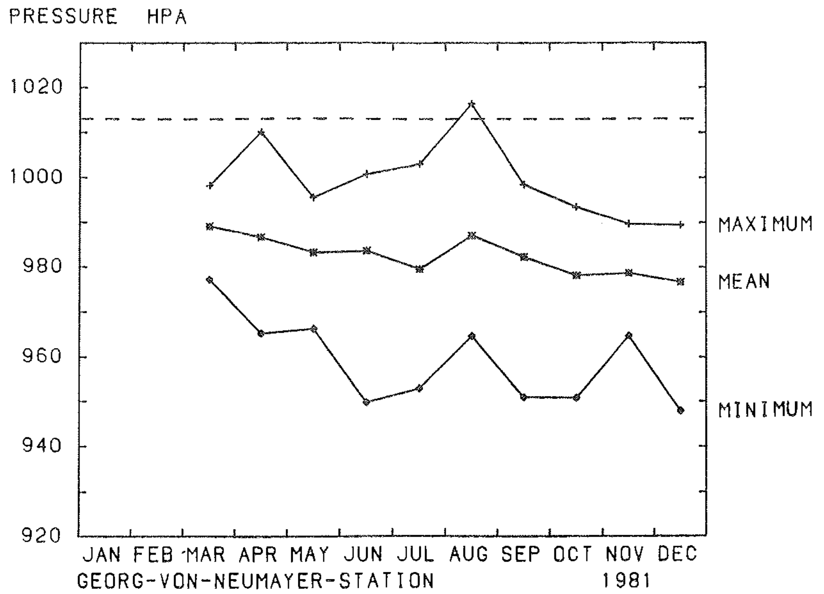
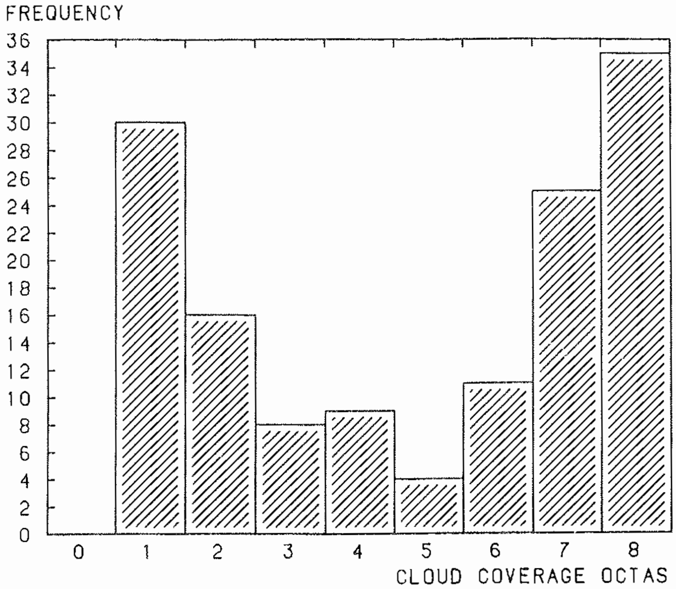


(1b)

Figure 2: Histograms of total cloud coverage, 1981 (from synoptic observations
(a) - (j): months March - December 1981
(k): entire year 1981



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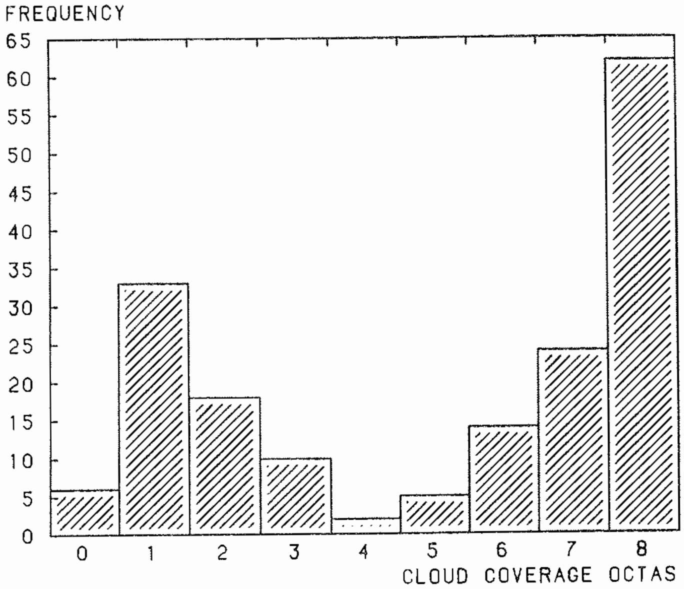

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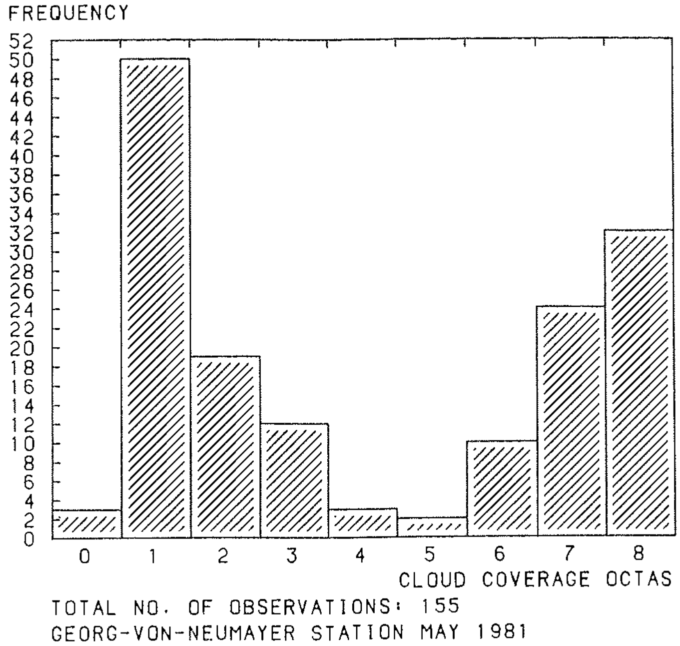
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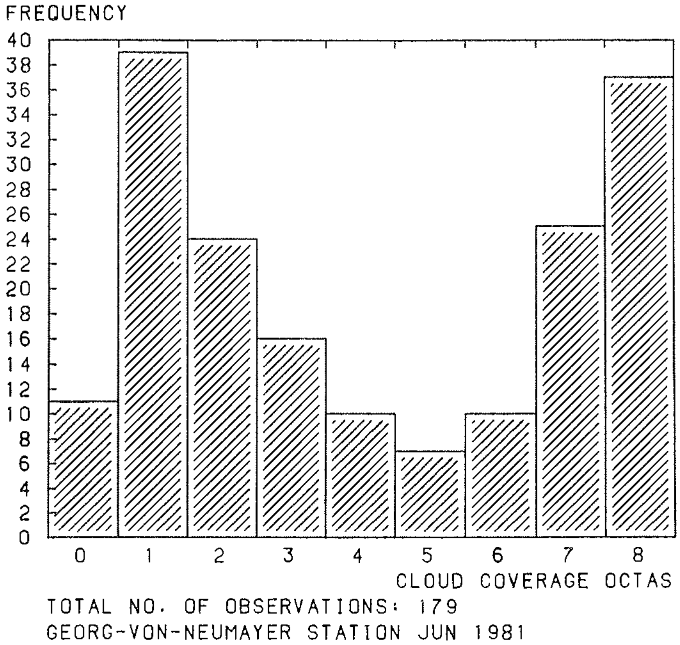
GEORG-VON-NEUMAYER STATION MAY 1981

(2c)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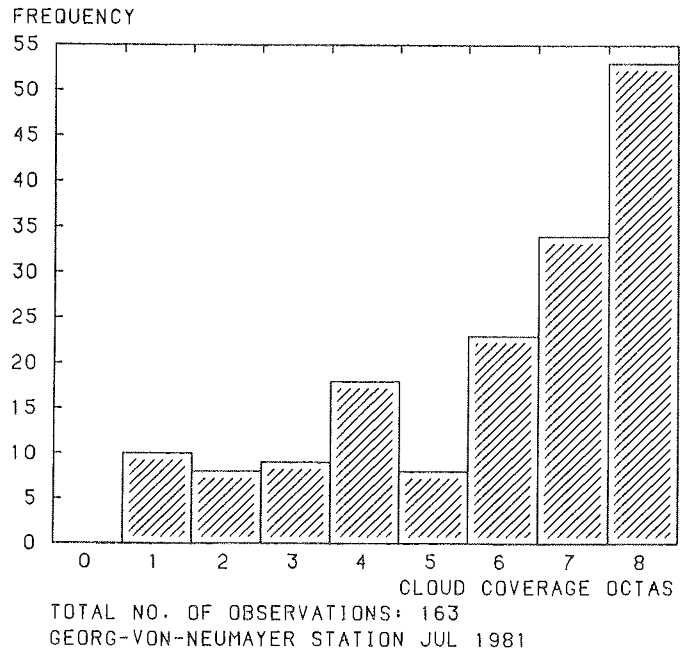
GEORG-VON-NEUMAYER STATION JUN 1981

(2d)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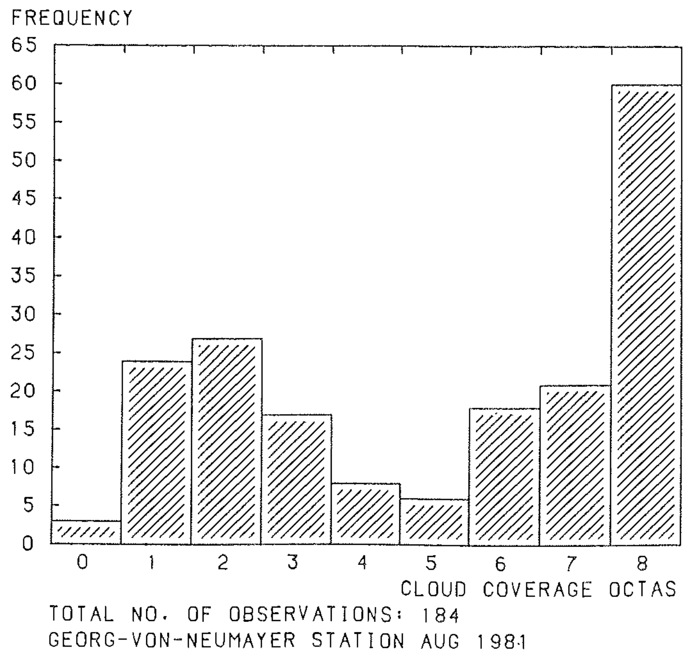
GEORG-VON-NEUMAYER STATION JUL 1981

(2e)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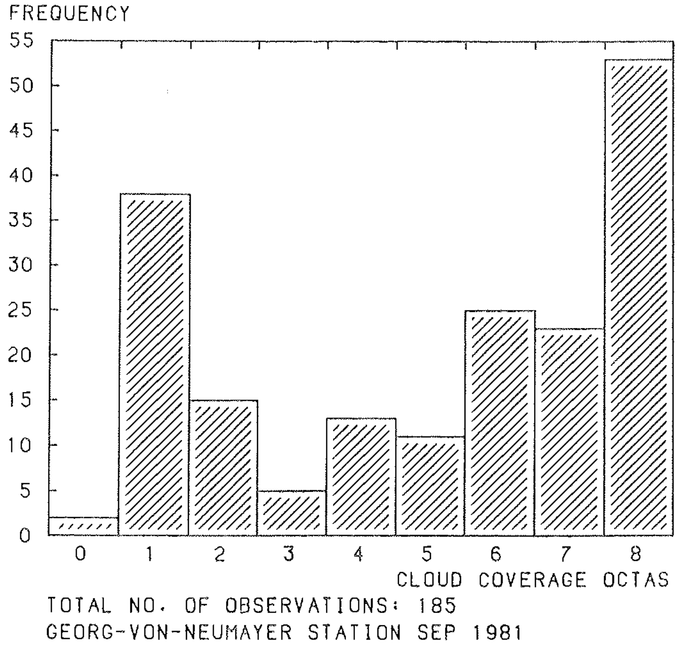
GEORG-VON-NEUMAYER STATION AUG 1981

(2f)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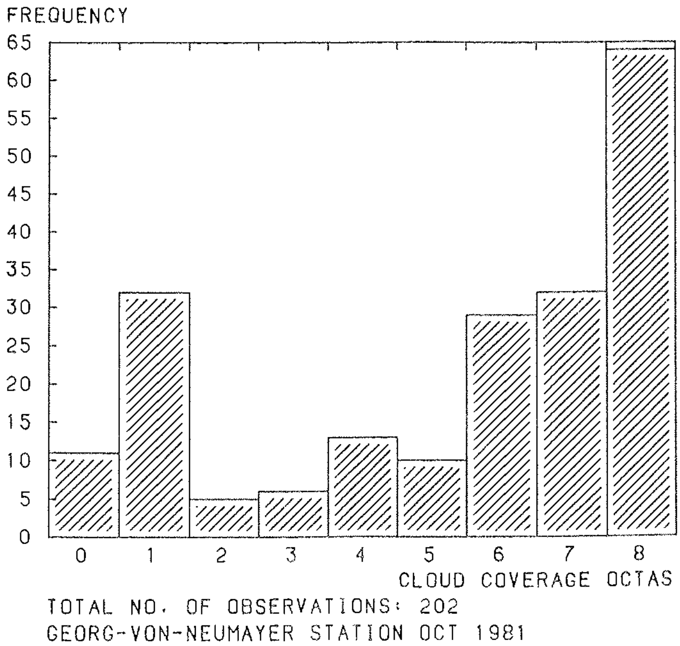
GEORG-VON-NEUMAYER STATION SEP 1981

(2g)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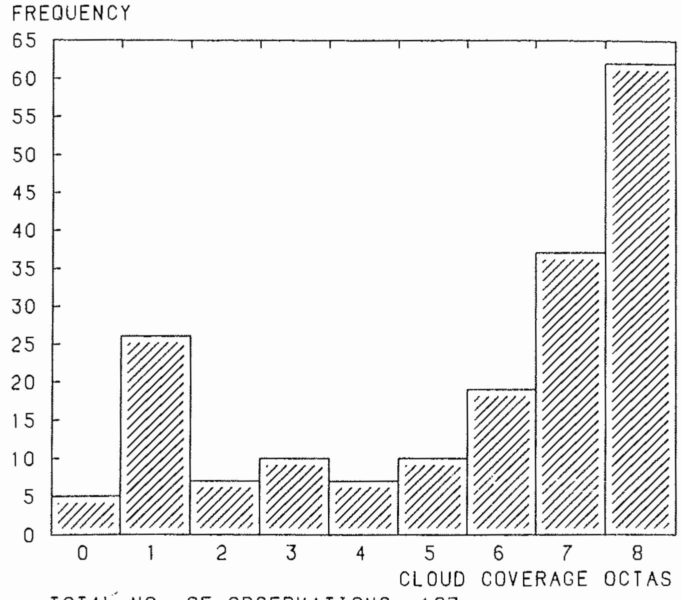
GEORG-VON-NEUMAYER STATION OCT 1981

(2h)



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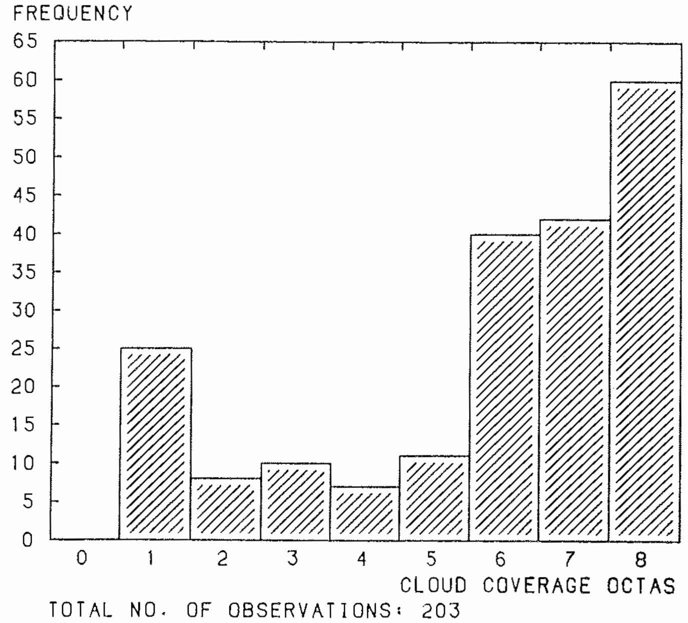

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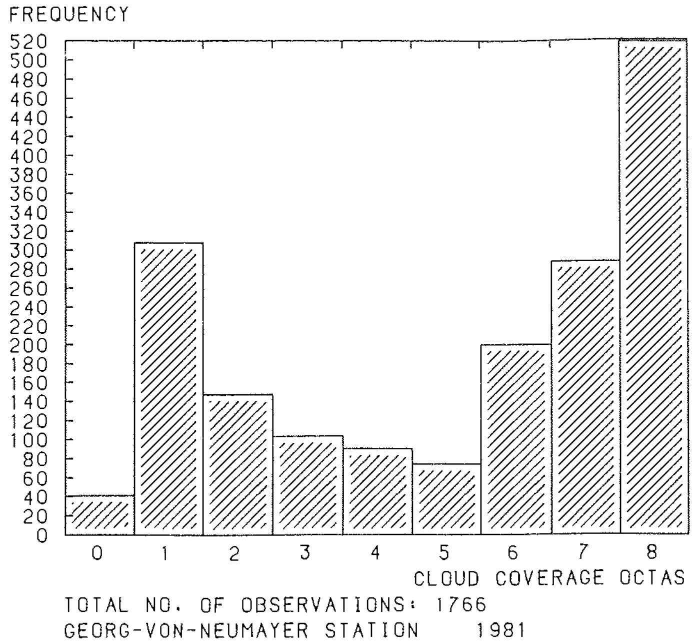
(2j)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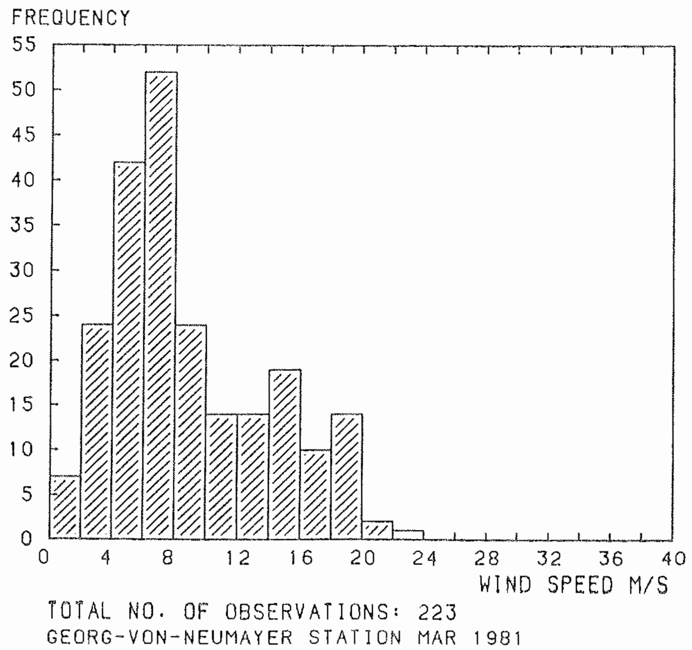
7
8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 1766
GEORG-VON-NEUMAYER STATION 1981

(2k)

Figure 3: Histograms of wind speed, 1981 (from synoptic observations
(a) - (j): months March - December 1981
(k): entire year 1981



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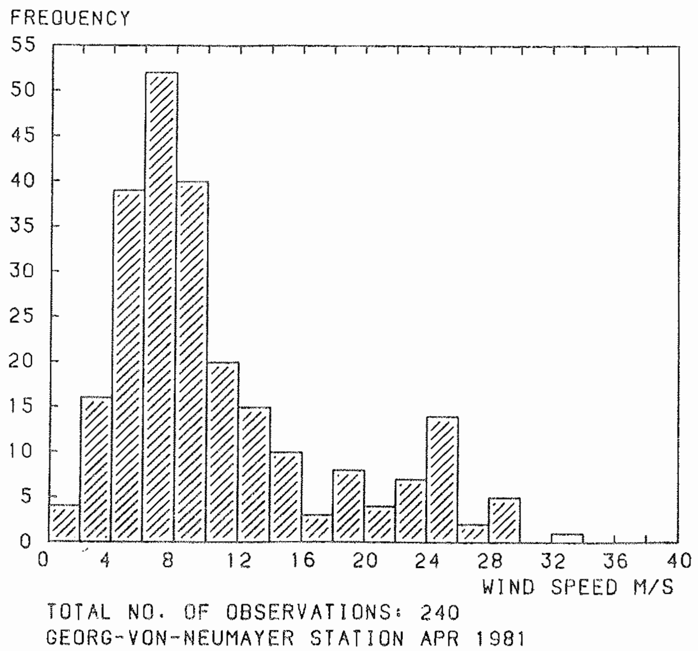
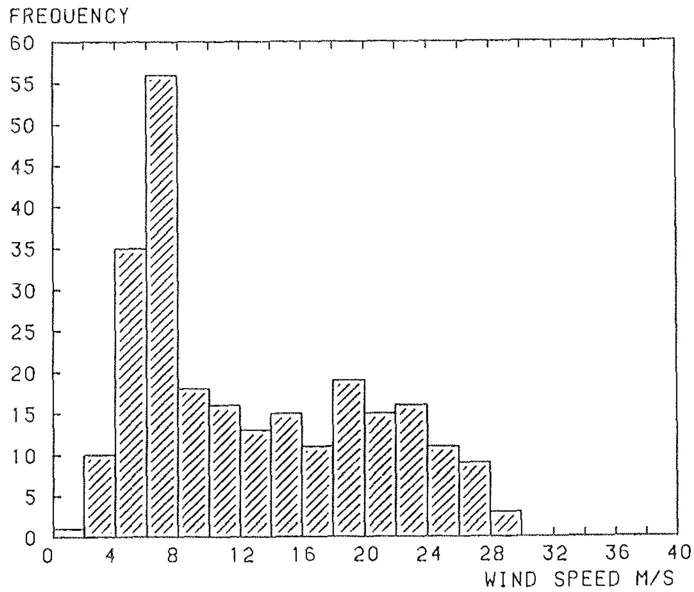
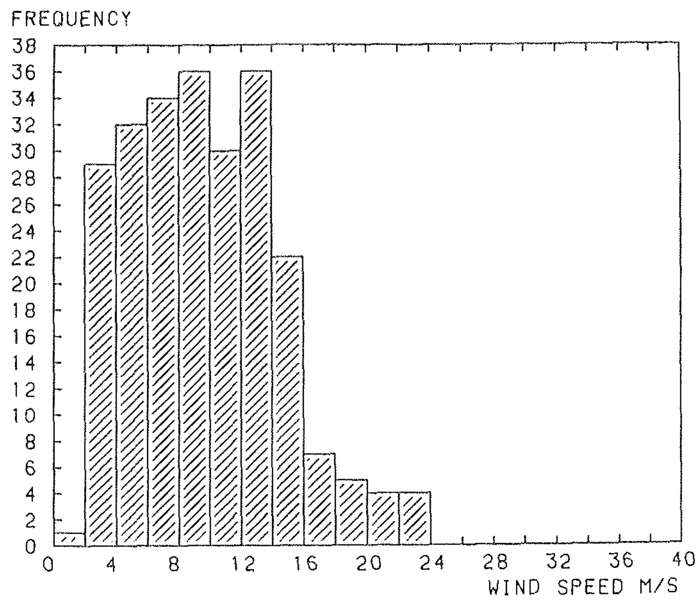


(3b)



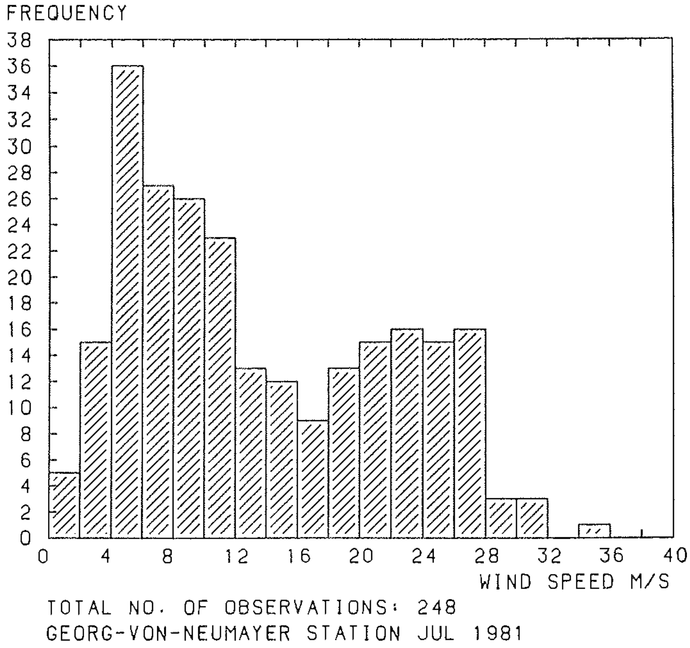
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION MAY 1981

(3c)



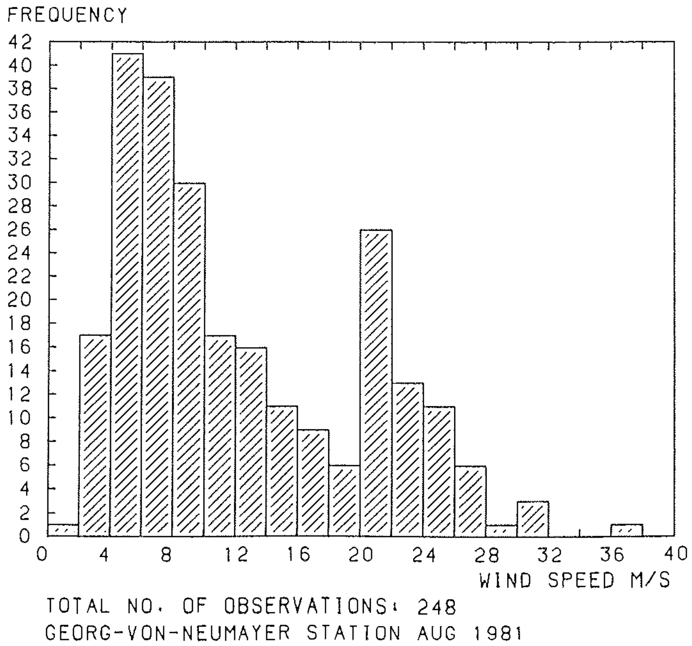
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION JUN 1981

(3d)



FREQUENCY
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION JUL 1981

(3e)



FREQUENCY
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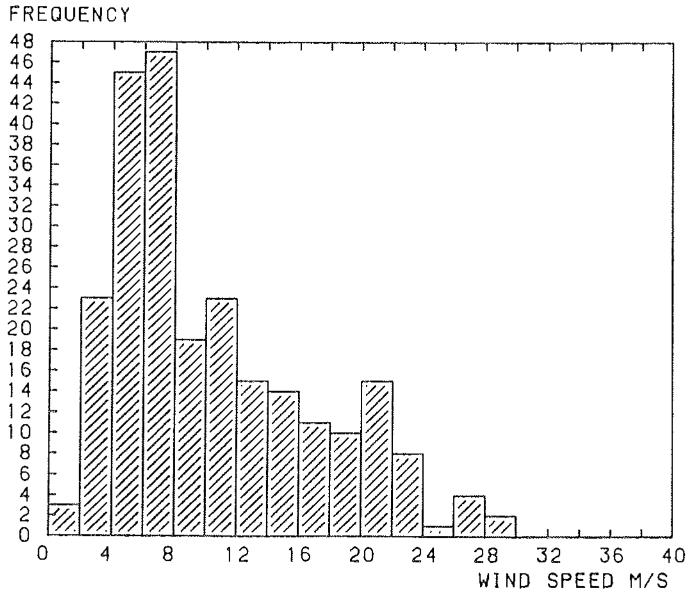
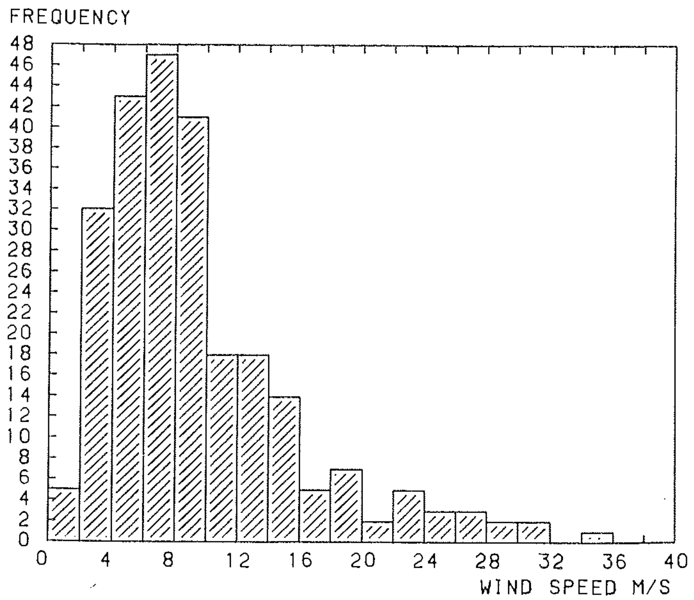
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION AUG 1981

(3f)



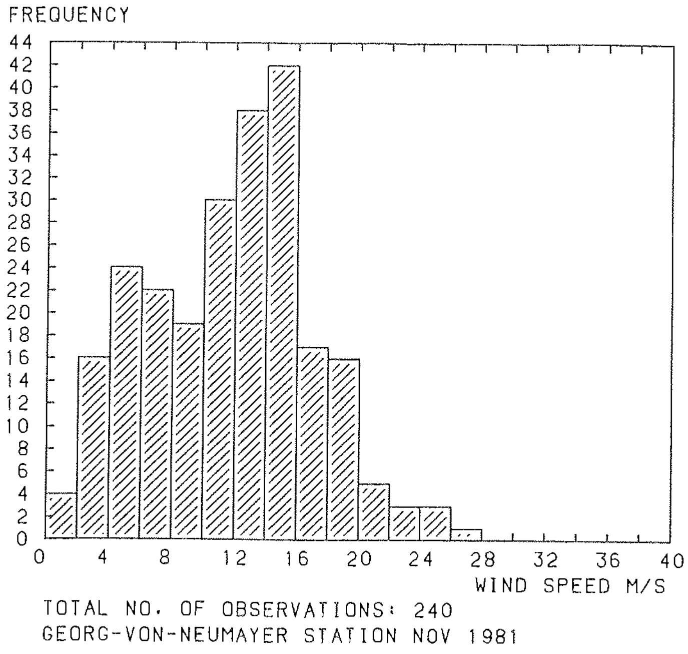
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION SEP 1981

(3a)



TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION OCT 1981

(3h)


FREQUENCY
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36
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28
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24
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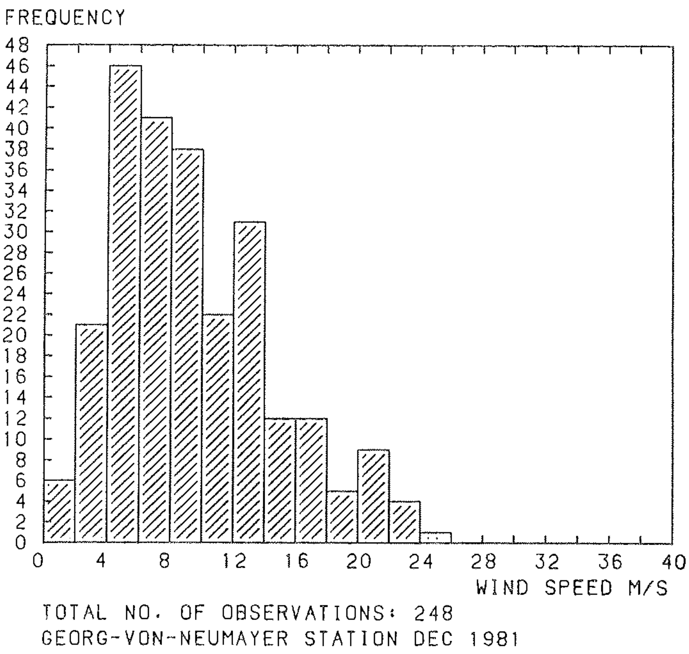
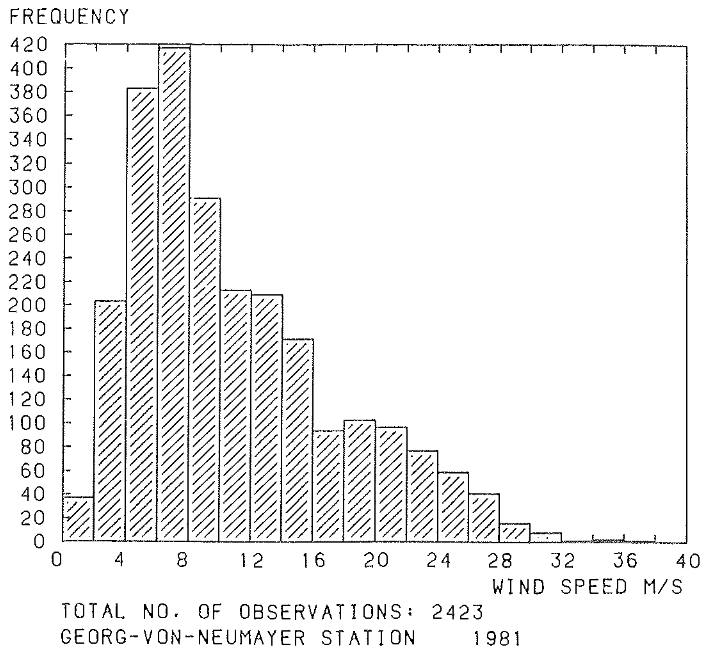
18
16
14
12
10
8
6
4
2
0
0
4
8
12
16
20
24
28
32
36
40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION NOV 1981

(3i)


FREQUENCY
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
4
8
12
16
20
24
28
32
36
40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION DEC 1981

(3j)


FREQUENCY
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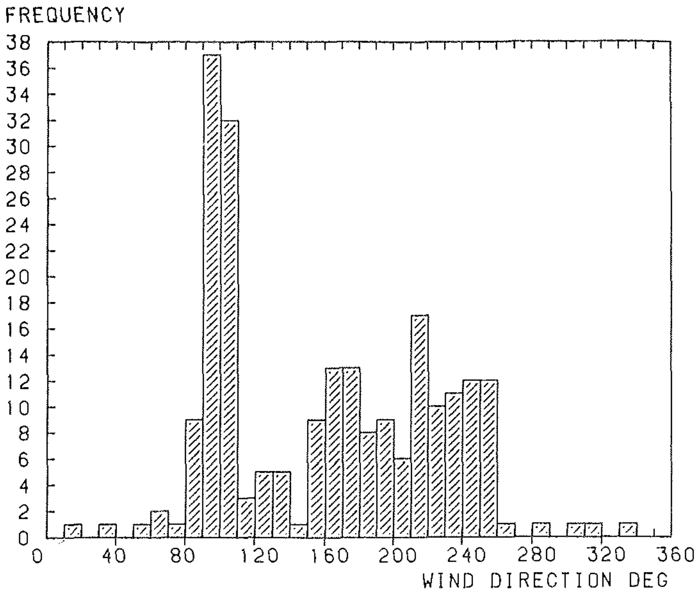
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 2423
GEORG-VON-NEUMAYER STATION 1981

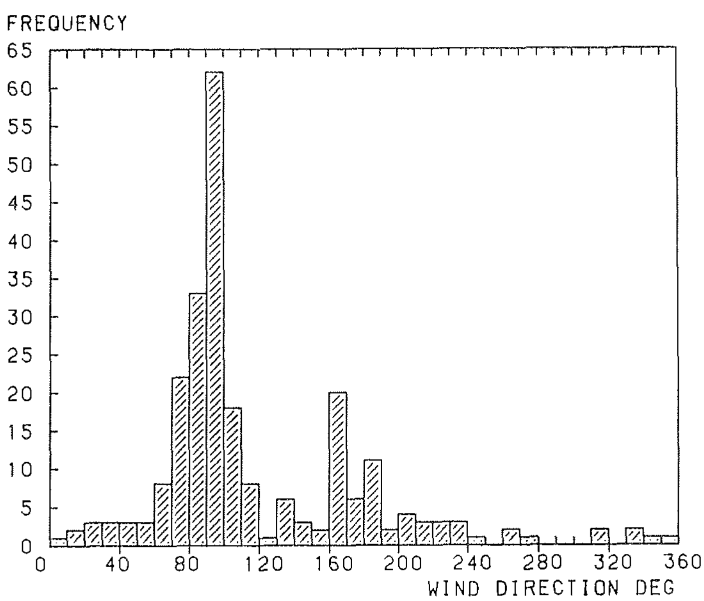
(3k)

Figure 4: Histograms of wind direction, 1981 (from synoptic observations)
(a) - (j): months March - December 1981
(k): entire year 1981



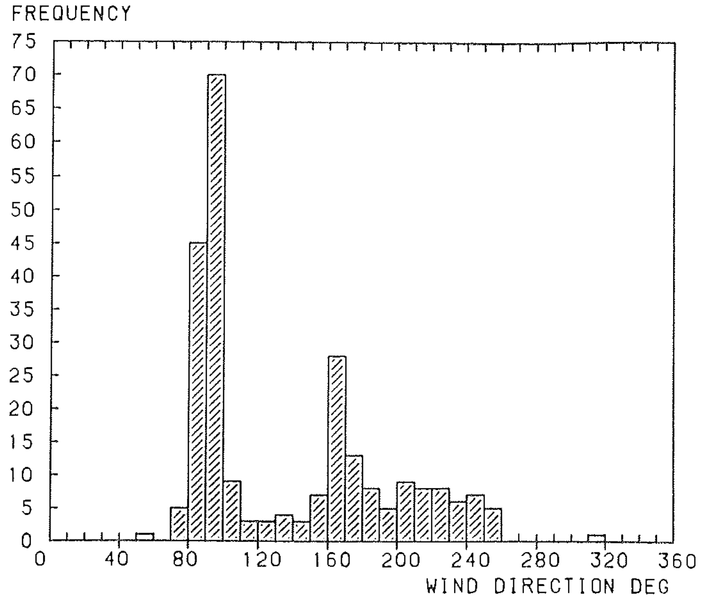
TOTAL NO. OF OBSERVATIONS: 223
GEORG-VON-NEUMAYER STATION MAR 1981

(4a)



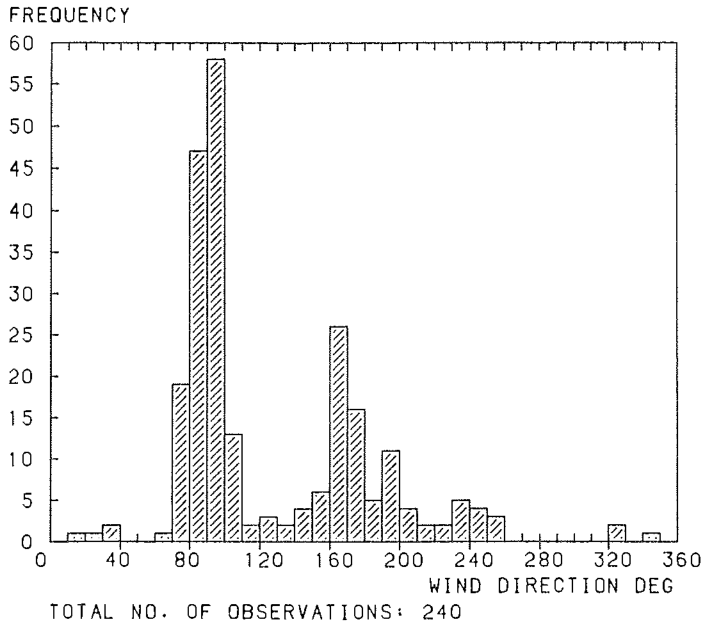
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION APR 1981

(4b)



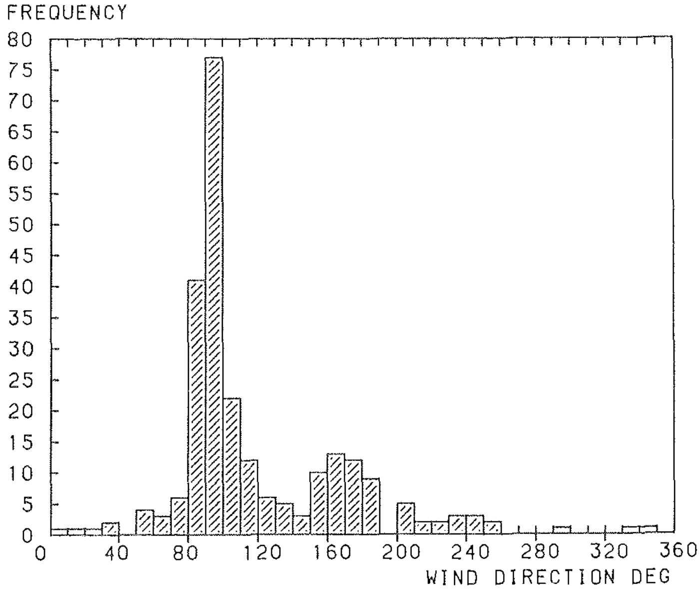
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION MAY 1981

(4c)



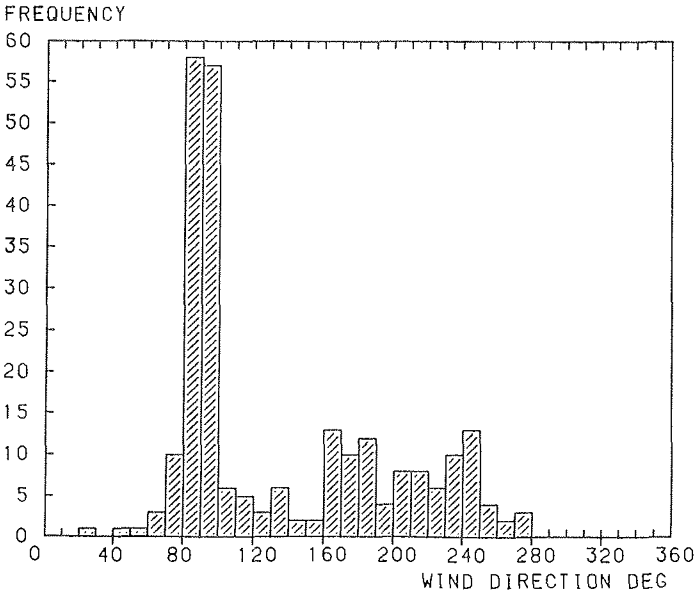
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION JUN 1981

(4d)



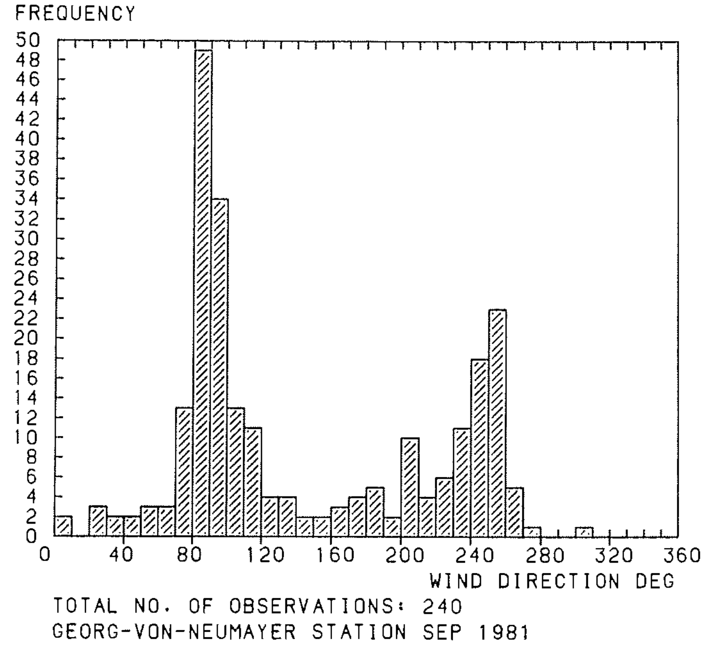
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION JUL 1981

(4e)

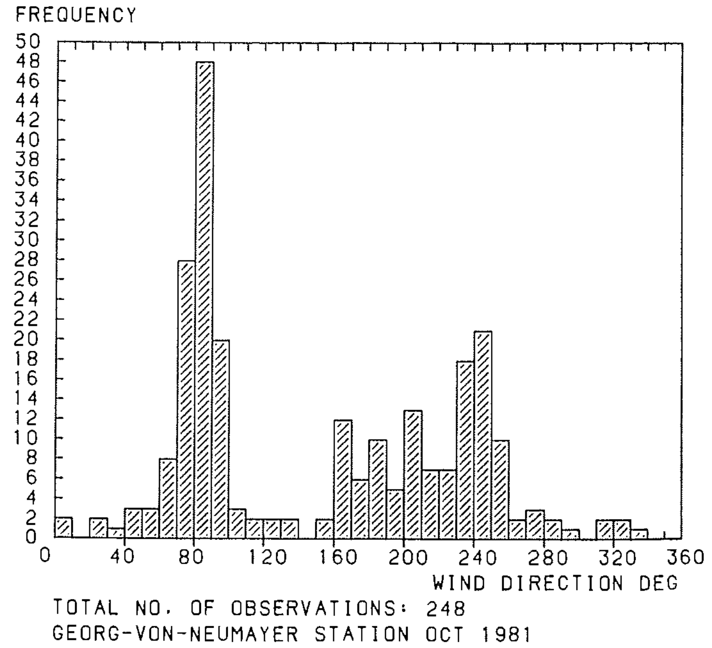


TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION AUG 1981

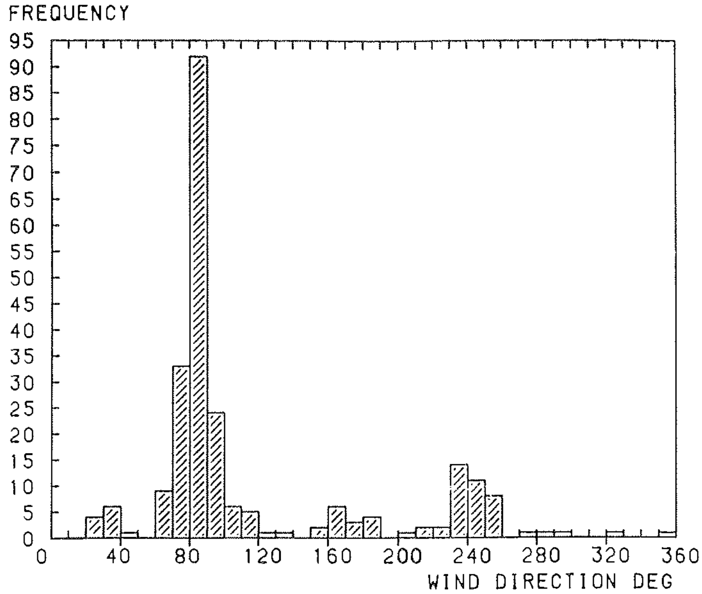
(4f)


FREQUENCY
50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
0 40 80 120 160 200 240 280 320 360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION SEP 1981

(4g)

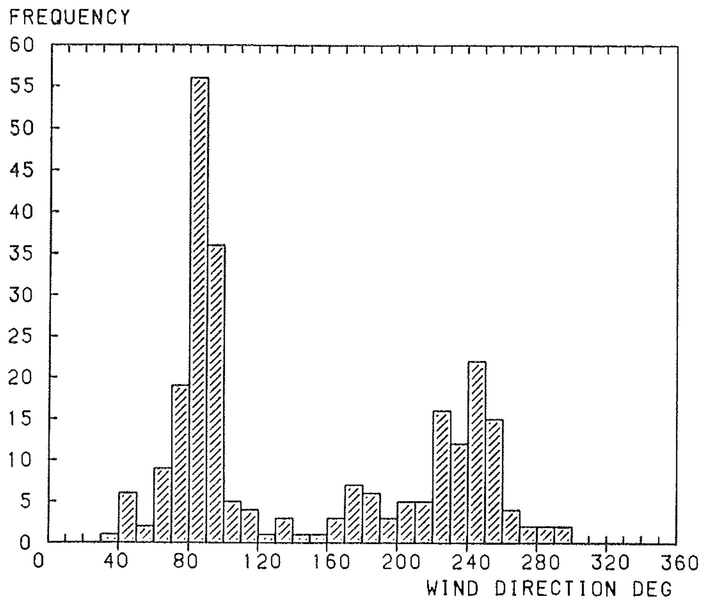

FREQUENCY
50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
0 40 80 120 160 200 240 280 320 360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION OCT 1981

(4h)



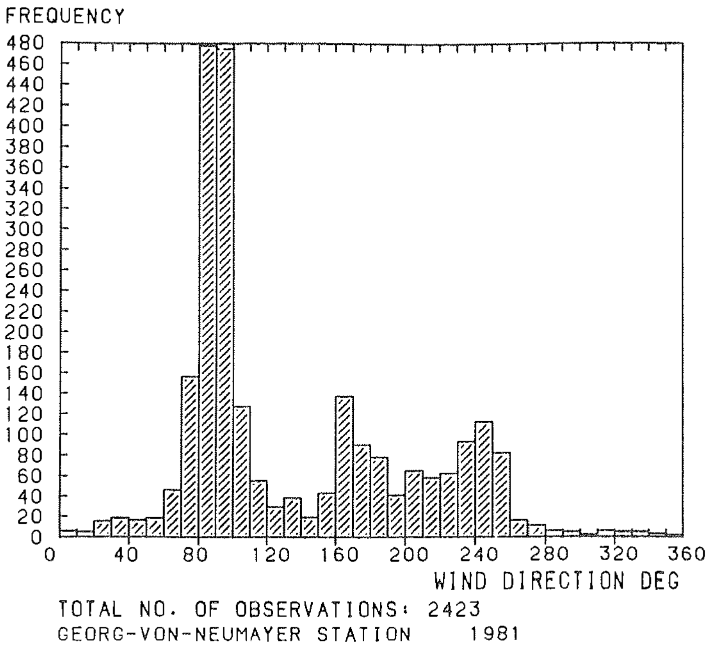
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION NOV 1981

(4i)



TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION DEC 1981

(4j)


FREQUENCY
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440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0 40 80 120 160 200 240 280 320 360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 2423
GEORG-VON-NEUMAYER STATION 1981

(4k)

Figure 5: Monthly means of daily global radiation cycle. Numbers on curves indicate respective months, 1981 (from hourly global radiation registration)

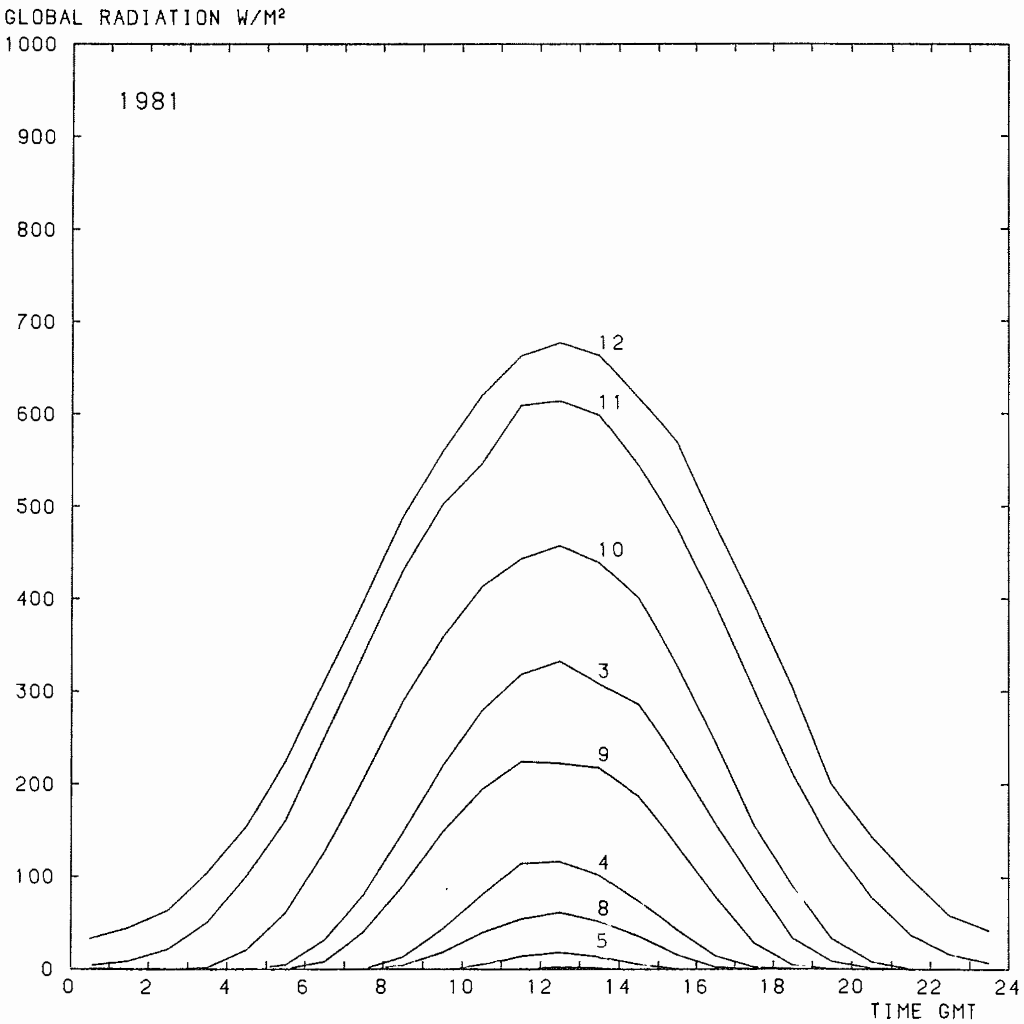
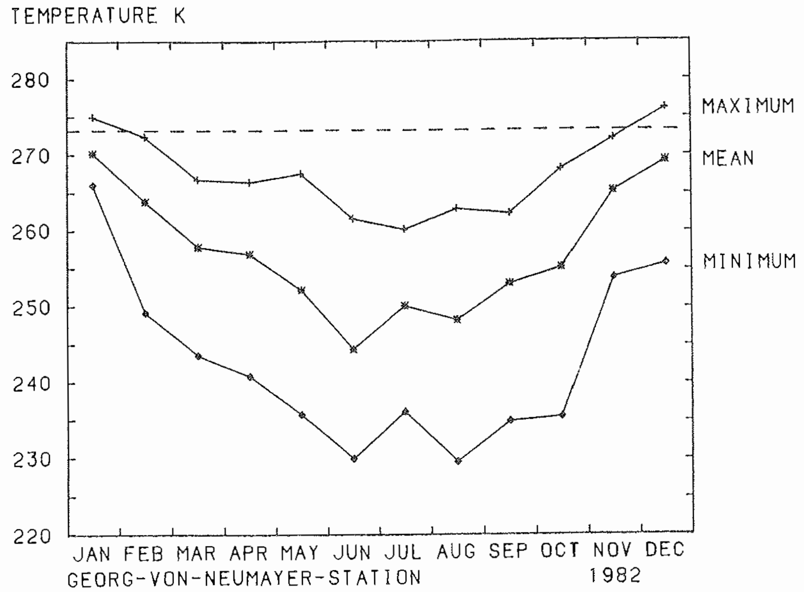


Table 5: Monthly means and extremes, 1982 (from synoptic observations)

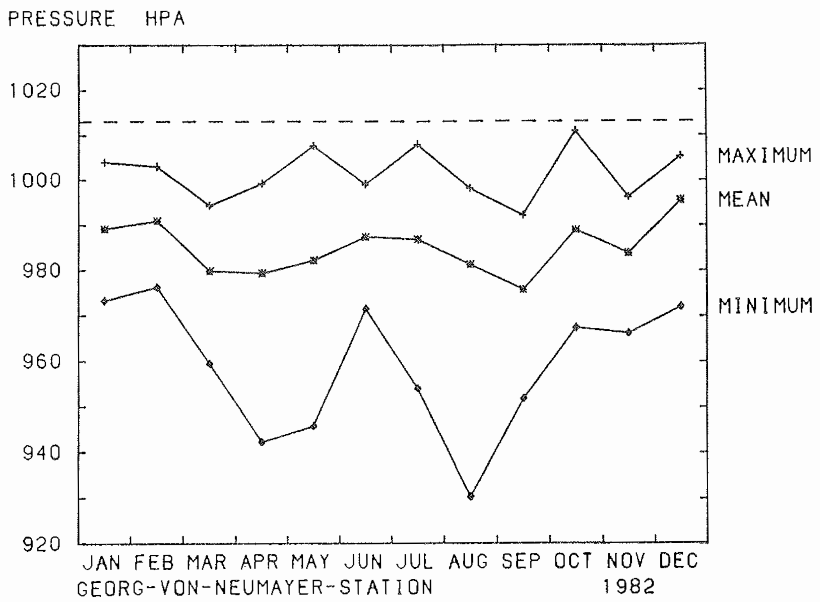
1982 GEORG-VON-NEUMAYER 70° 37'S 08° 22'W ELEVATION 40 M	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
AVERAGE TEMPERATURE (DEG C)	-2.9	-9.2	-15.2	-16.2	-20.9	-28.7	-23.0	-24.9	-20.1	-18.0	-8.0	-4.0	-15.9
TEMPERATURE MAXIMUM (DEG C) (DATE)	1.8 (2)	-0.8 (19)	-6.4 (9)	-6.8 (13)	-5.7 (7)	-11.6 (1)	-13.0 (17)	-10.3 (24)	-10.9 (15)	-5.1 (17)	-1.1 (23)	2.8 (18)	2.8
TEMPERATURE MINIMUM (DEG C) (DATE)	-7.1 (28)	-23.9 (26)	-29.5 (20)	-32.3 (7)	-37.4 (19)	-43.2 (10)	-37.0 (25)	-43.6 (15)	-38.3 (6)	-37.7 (2)	-19.4 (20)	-17.6 (1)	-43.6
AVERAGE MAXIMUM TEMPERATURE (DEG C)	-1.0	-5.9	-11.6	-13.1	-16.5	-23.7	-19.4	-20.4	-17.1	-14.4	-5.8	-1.8	-12.6
AVERAGE MINIMUM TEMPERATURE (DEG C)	-2.9	-14.5	-20.0	-20.1	-25.4	-32.6	-26.5	-29.8	-24.3	-22.5	-11.0	-7.3	-19.7
AVERAGE REL. HUMIDITY (PERCENT)	---	083	082	087	082	078	085	087	086	084	087	084	084
MAXIMUM REL. HUMIDITY (DATE)	--- (--)	099 (19)	099 (9)	097 (13)	096 (7)	094 (5)	100 (23)	096 (24)	100 (15)	100 (26)	100 (24)	098 (9)	100
MINIMUM REL. HUMIDITY (DATE)	--- (--)	058 (3)	061 (10)	040 (12)	062 (29)	056 (5)	058 (14)	069 (5)	035 (7)	056 (20)	050 (17)	055 (2)	035
AVERAGE STATION PRESSURE (HPA)	989.3	991.1	980.0	979.5	982.3	987.4	986.8	981.3	975.7	988.9	983.7	995.5	985.1
MAXIMUM PRESSURE (HPA) (DATE)	1004.0 (18)	1003.0 (10)	994.4 (22)	999.2 (16)	1007.6 (23)	999.0 (7)	1007.9 (19)	998.1 (8)	992.2 (15)	1010.9 (8)	996.2 (29)	1005.2 (14)	1010.9
MINIMUM PRESSURE (HPA) (DATE)	973.4 (27)	976.3 (18)	959.6 (24)	942.3 (9)	945.8 (7)	971.5 (30)	954.0 (31)	930.3 (24)	951.8 (8)	967.3 (1)	966.1 (8)	971.8 (10)	930.3
PREVAILING WIND DIRECTION	095	085	085	085	075	075	075	075	075	075	075	065	075
AVERAGE WIND SPEED (M/S)	8.9	7.4	7.9	11.9	8.2	6.9	11.7	10.0	11.7	10.8	12.0	6.2	9.5
MAX. WIND VEL. (M/S) (DEG) (DATE)	26.7 100 (5)	21.6 090 (17)	23.7 090 (24)	27.8 090 (8)	25.7 080 (31)	25.7 080 (1)	34.5 080 (31)	35.0 080 (24)	32.4 090 (8)	28.3 080 (8)	25.2 080 (14)	20.1 110 (9)	35.0 080
AVERAGE SKY COVER (TENTH)	7.5	5.0	5.0	6.2	5.0	2.5	6.2	6.2	6.2	5.0	7.5	6.2	5.7
NUMBER OF CLEAR DAYS	02	07	02	02	02	10	00	01	01	03	01	03	34
NUMBER OF PARTLY CLOUDY DAYS	09	11	16	12	15	15	14	13	11	12	09	13	150
NUMBER OF CLOUDY DAYS	20	10	11	14	11	05	10	13	10	13	20	15	152
NUMBER OF DAYS WITH VISIBILITY LESS THAN 0.4 KM	04	03	05	12	04	03	11	15	16	16	15	01	105
NUMBER OF DAYS WITH MODERATE SNOWDRIFT	--	06	03	05	05	04	13	06	08	13	19	02	84
NUMBER OF DAYS WITH STRONG SNOWDRIFT	--	00	01	09	04	02	15	11	16	10	08	01	77

DASHES INDICATE: NO OBSERVATIONS

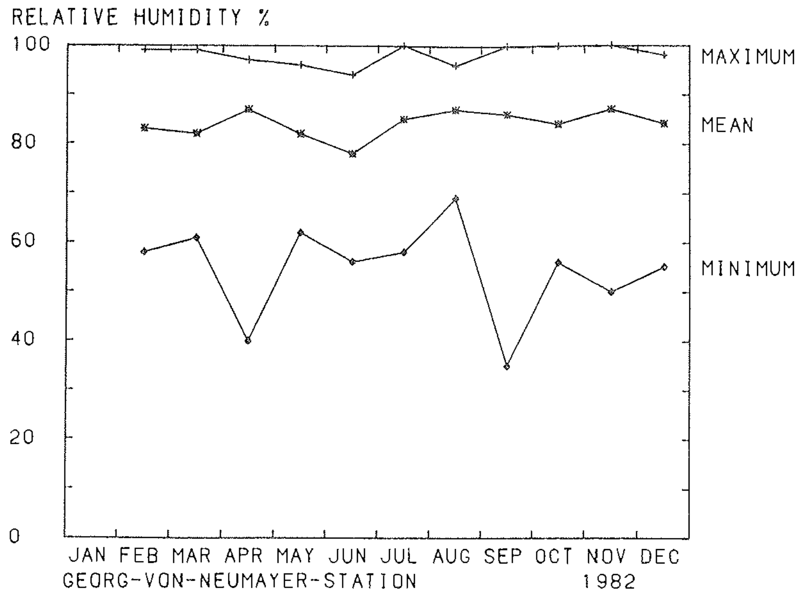
Figure 6: Time series of monthly mean temperature (a), pressure (b), relative humidity (c) and firn temperature at 1 m depth (d), 1982 (from synoptic observations; firn temperature from 10 minute means registration)



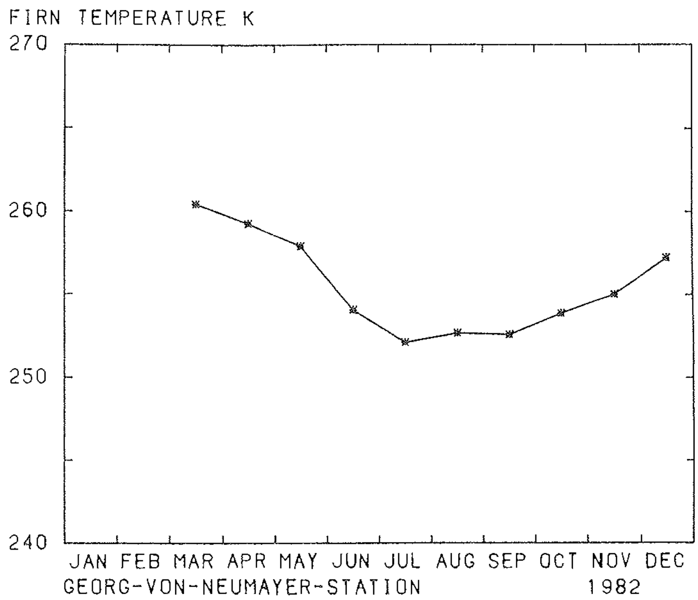
(6a)



(6b)

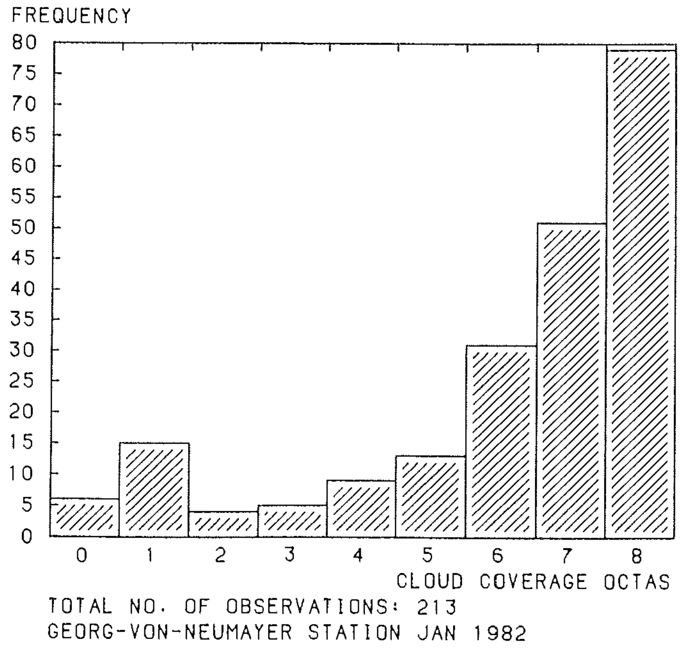

RELATIVE HUMIDITY %
100
80
60
40
20
0
MAXIMUM
MEAN
MINIMUM
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
GEORG-VON-NEUMAYER-STATION 1982

(6c)

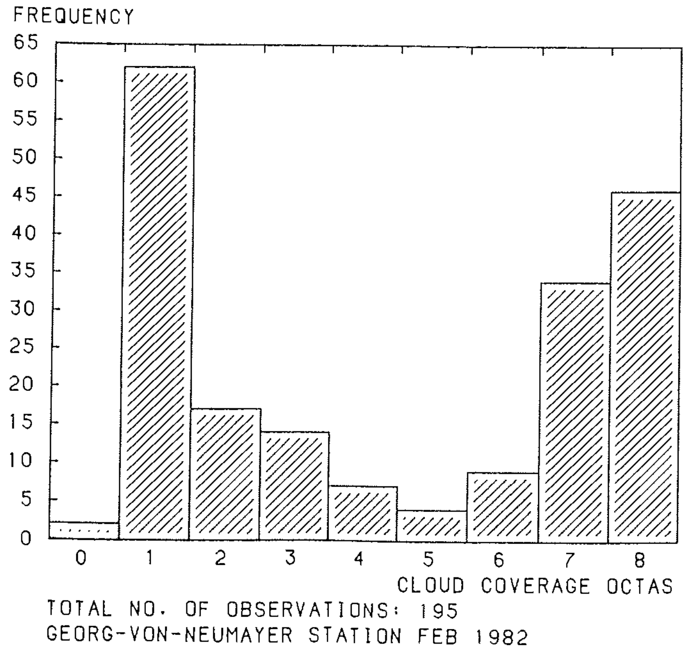

FIRN TEMPERATURE K
270
260
250
240
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
GEORG-VON-NEUMAYER-STATION 1982

(6d)

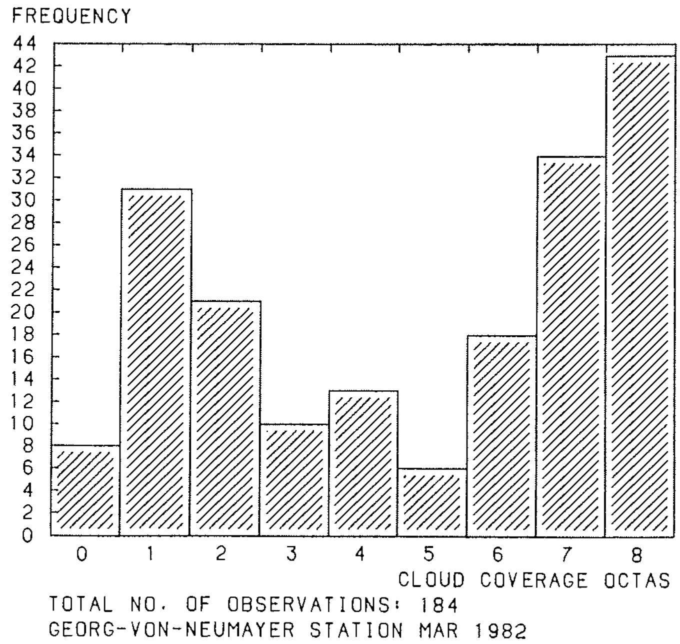
Figure 7: Histograms of total cloud coverage, 1982 (from synoptic observations)
(a) - (l): months January - December 1982
(m): entire year 1982



(7a)



(7b)


FREQUENCY
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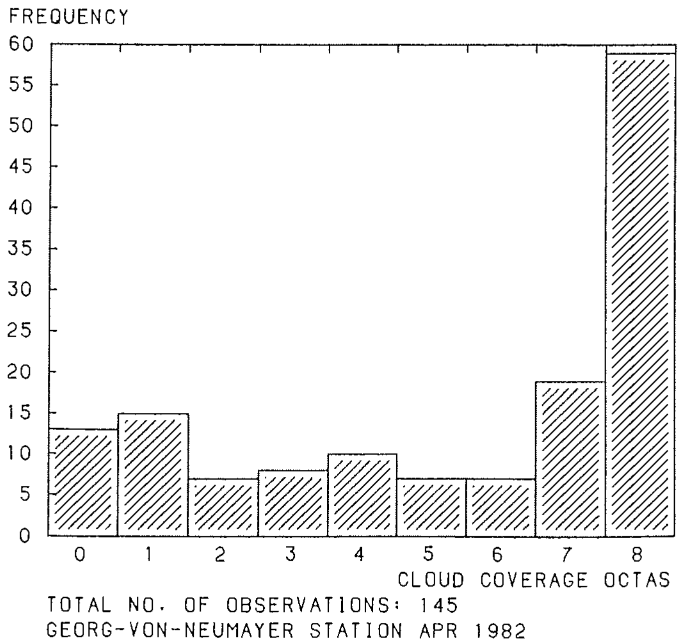
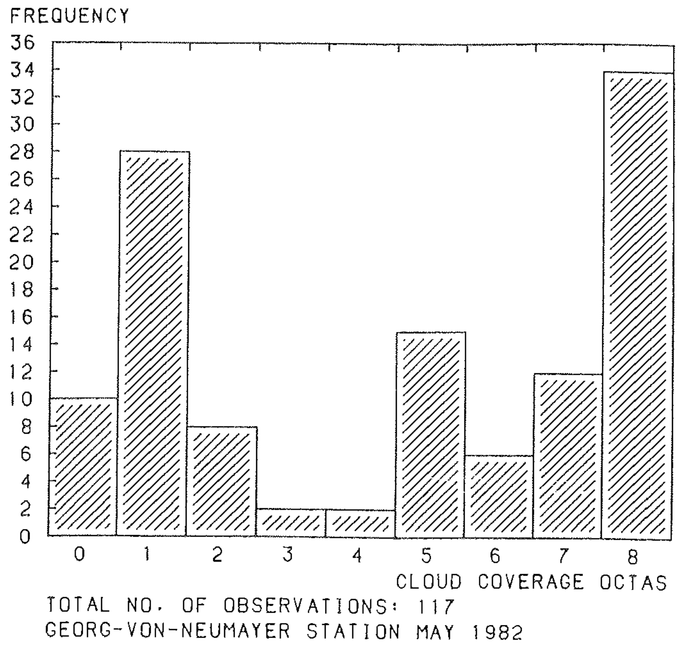
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 184
GEORG-VON-NEUMAYER STATION MAR 1982

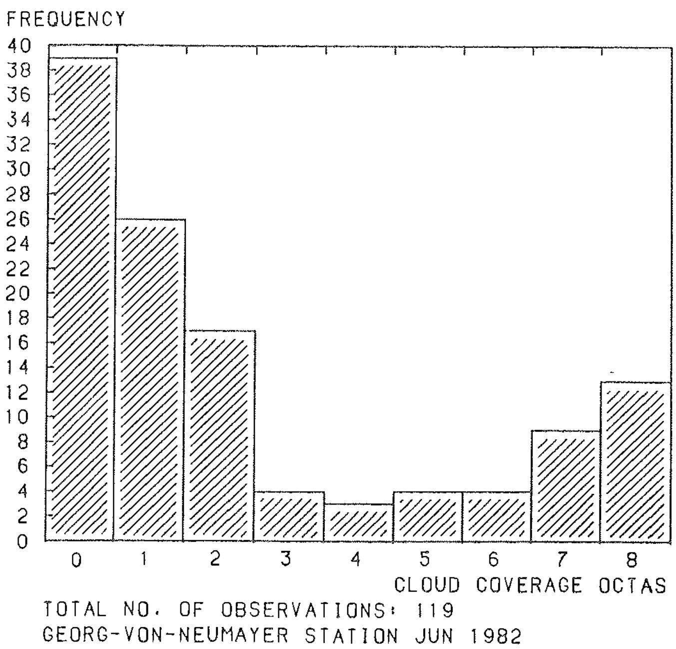
(7c)


FREQUENCY
60
55
50
45
40
35
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 145
GEORG-VON-NEUMAYER STATION APR 1982

(7d)


FREQUENCY
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 117
GEORG-VON-NEUMAYER STATION MAY 1982

(7e)


FREQUENCY
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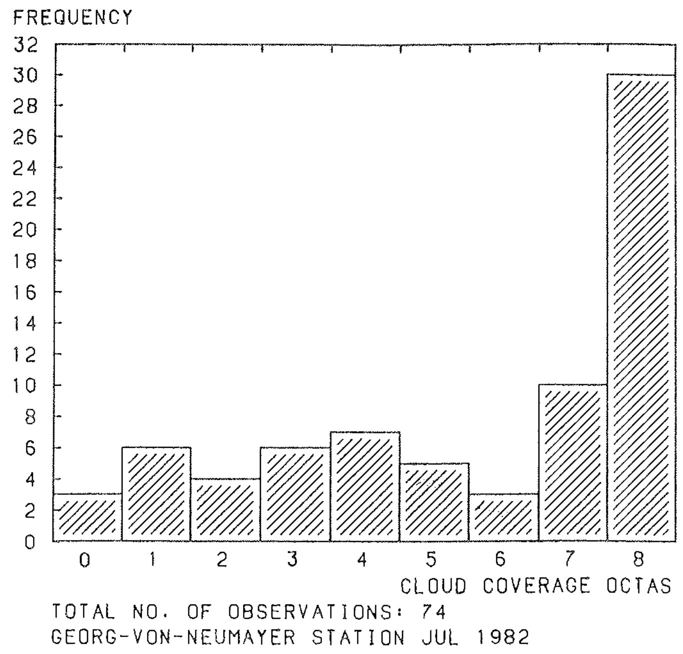
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 1 2 3 4 5 6 7 8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 119
GEORG-VON-NEUMAYER STATION JUN 1982

(7f)


FREQUENCY
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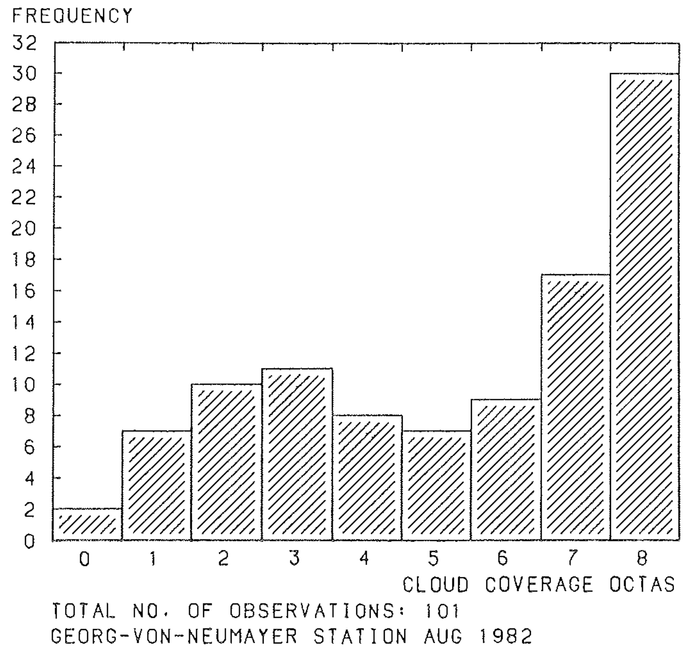
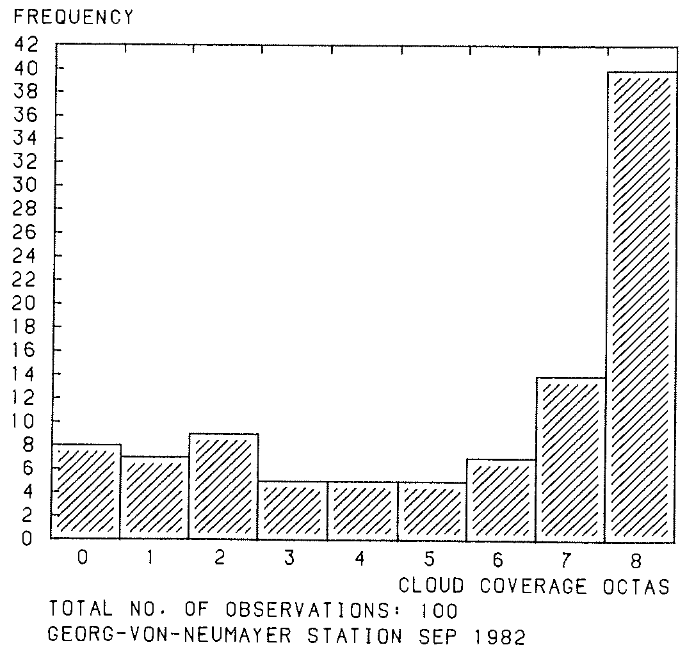
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 74
GEORG-VON-NEUMAYER STATION JUL 1982

(7g)


FREQUENCY
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 101
GEORG-VON-NEUMAYER STATION AUG 1982

(7h)


FREQUENCY
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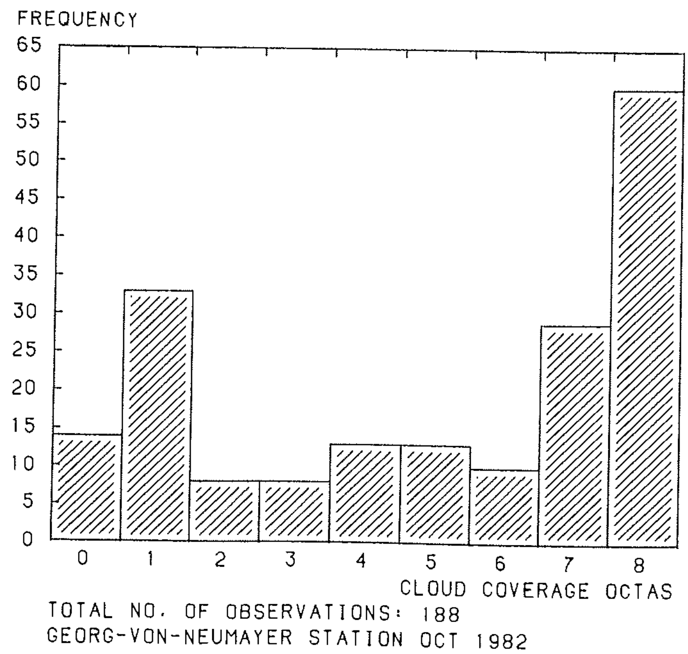
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 100
GEORG-VON-NEUMAYER STATION SEP 1982

(7i)


FREQUENCY
65
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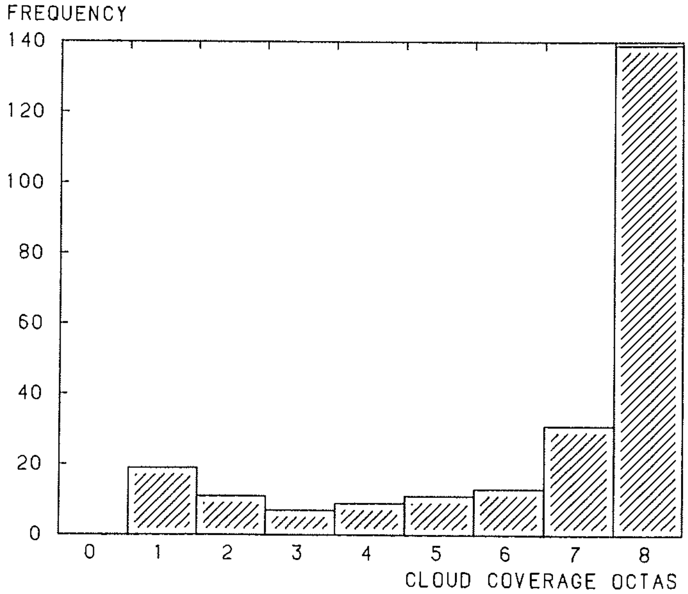
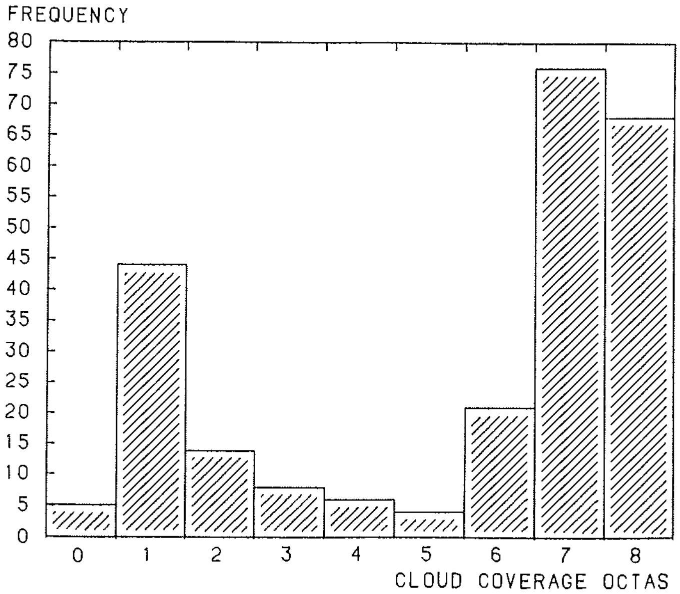
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 188
GEORG-VON-NEUMAYER STATION OCT 1982

(7j)



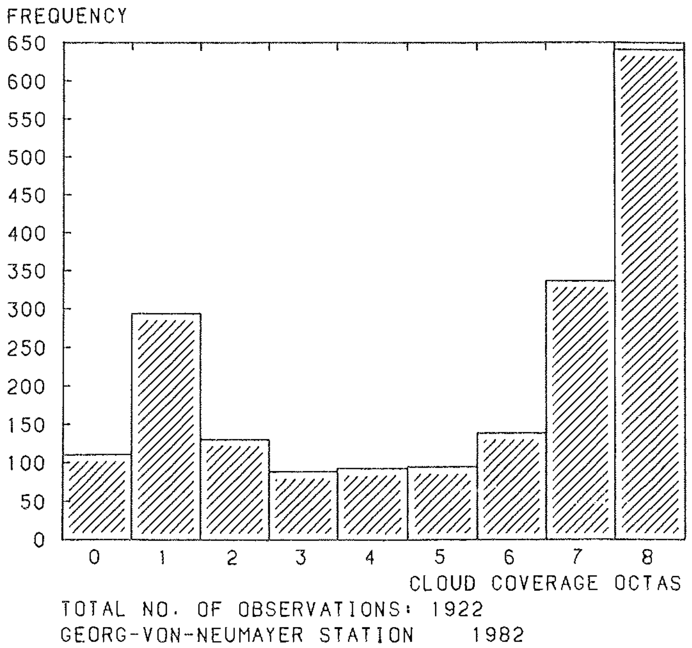
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION NOV 1982

(7k)



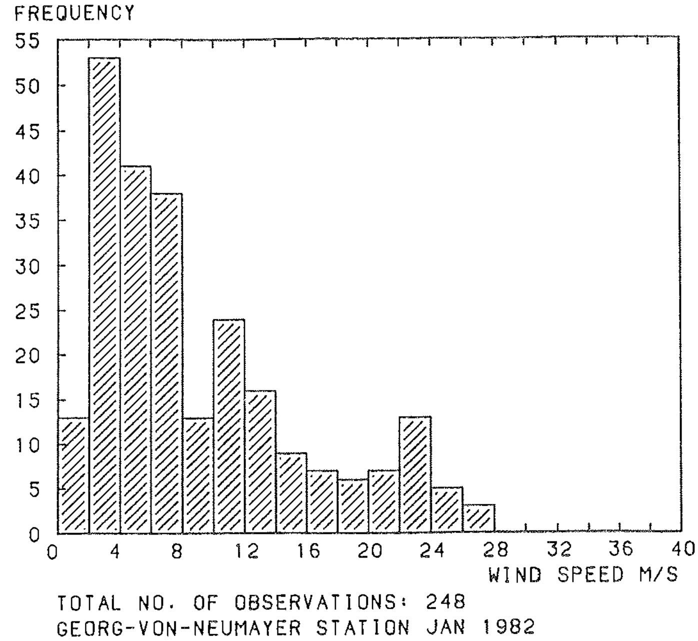
TOTAL NO. OF OBSERVATIONS: 246
GEORG-VON-NEUMAYER STATION DEC 1982

(7l)

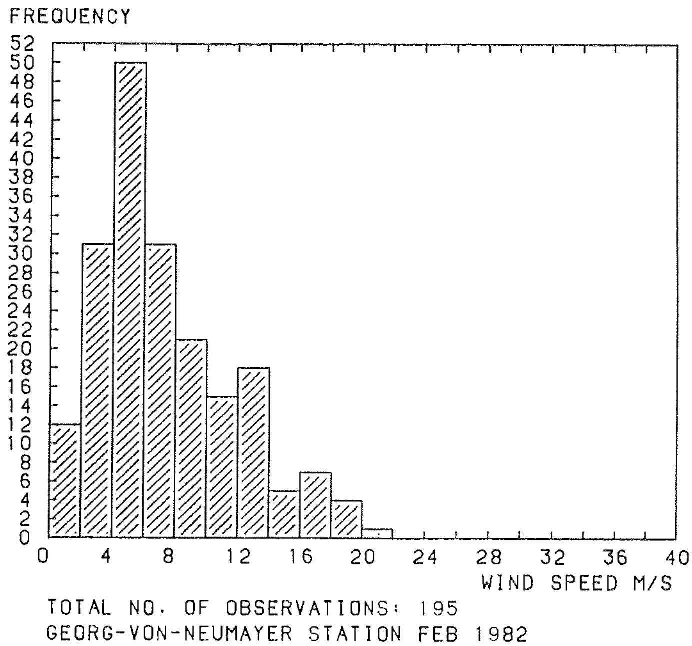

FREQUENCY
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0 1 2 3 4 5 6 7 8
CLOUD COVERAGE OCTAS
TOTAL NO. OF OBSERVATIONS: 1922
GEORG-VON-NEUMAYER STATION 1982

(7m)

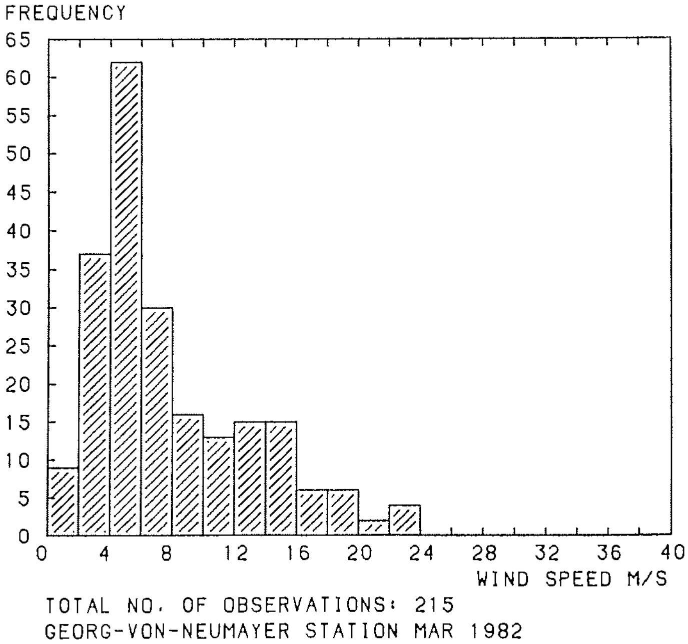
Figure 8: Histograms of wind speed, 1982 (from synoptic observations)
(a) - (l): months January - December 1982
(m): entire year 1982



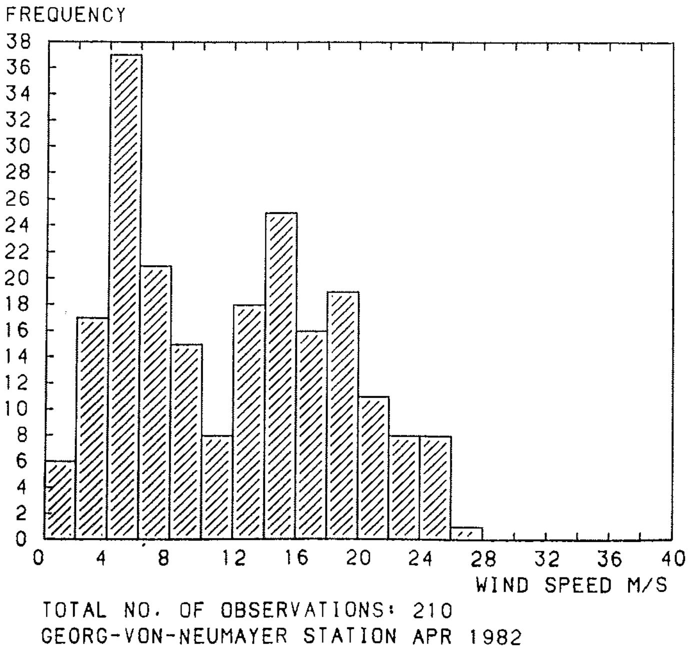
(8a)



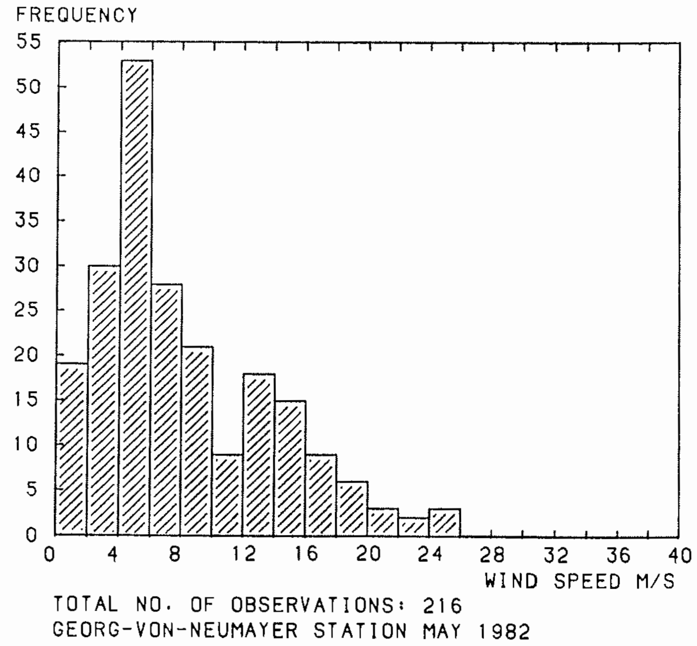
(8b)


FREQUENCY
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 215
GEORG-VON-NEUMAYER STATION MAR 1982

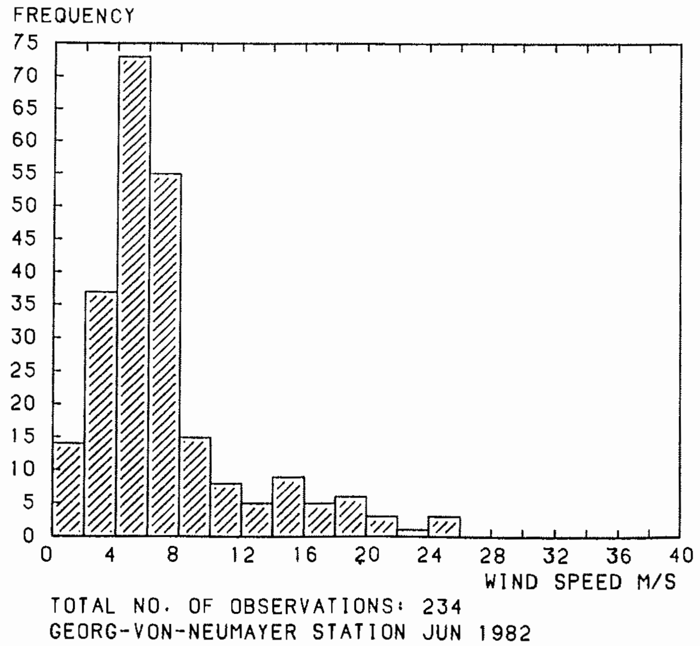
(8c)


FREQUENCY
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 210
GEORG-VON-NEUMAYER STATION APR 1982

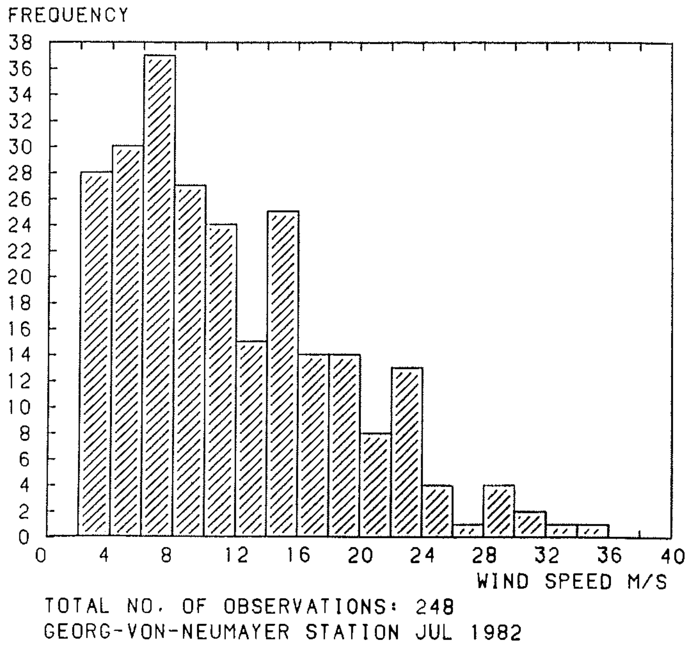
(8d)


FREQUENCY
55
50
45
40
35
30
25
20
15
10
5
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 216
GEORG-VON-NEUMAYER STATION MAY 1982

(8e)

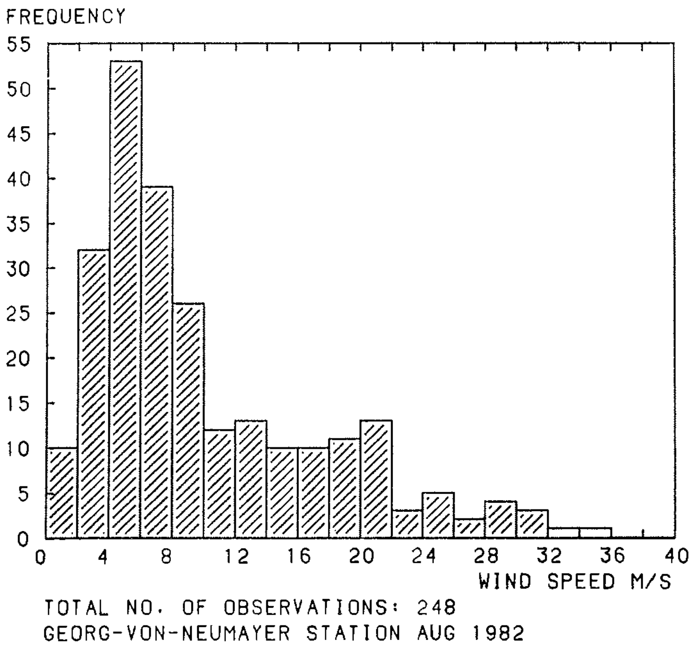

FREQUENCY
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 234
GEORG-VON-NEUMAYER STATION JUN 1982

(8f)



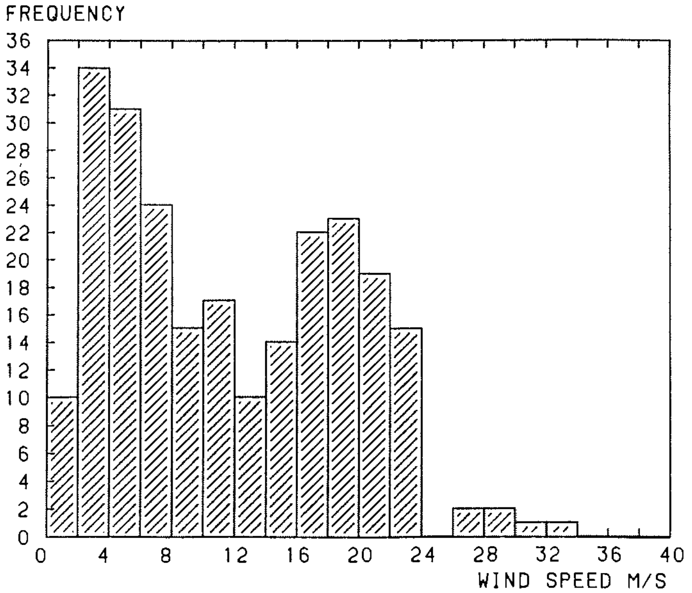
FREQUENCY
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION JUL 1982

(8g)



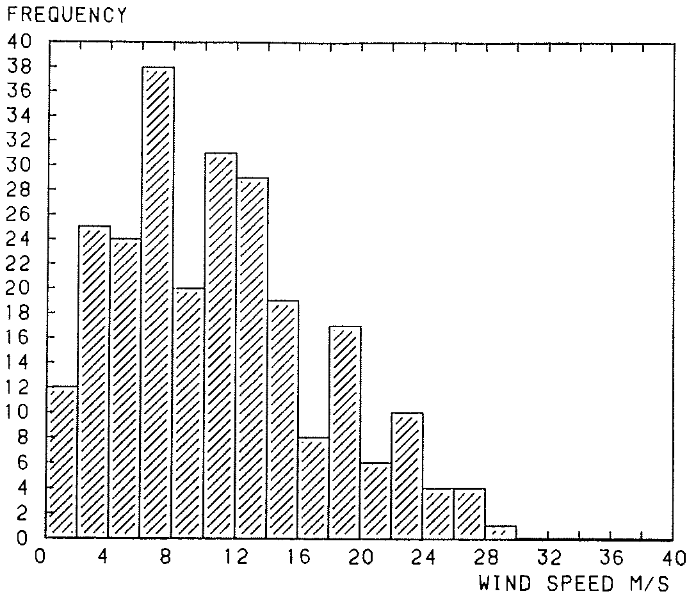
FREQUENCY
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION AUG 1982

(8h)



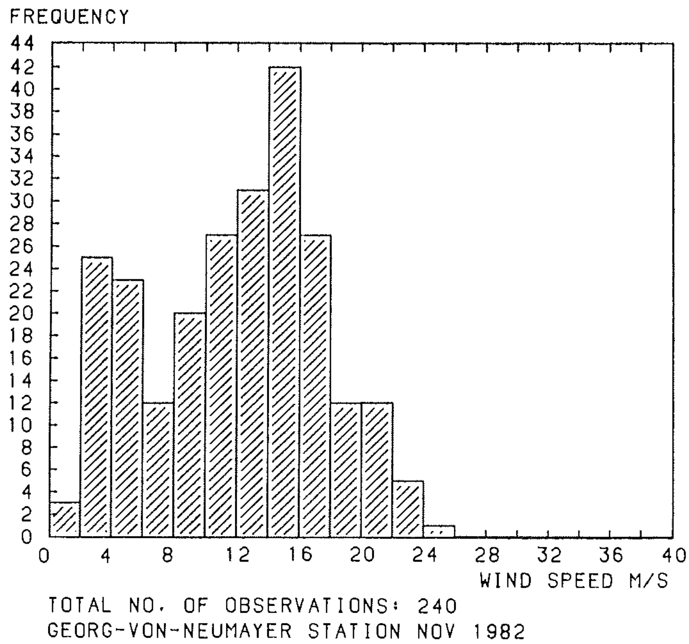
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION SEP 1982

(8i)

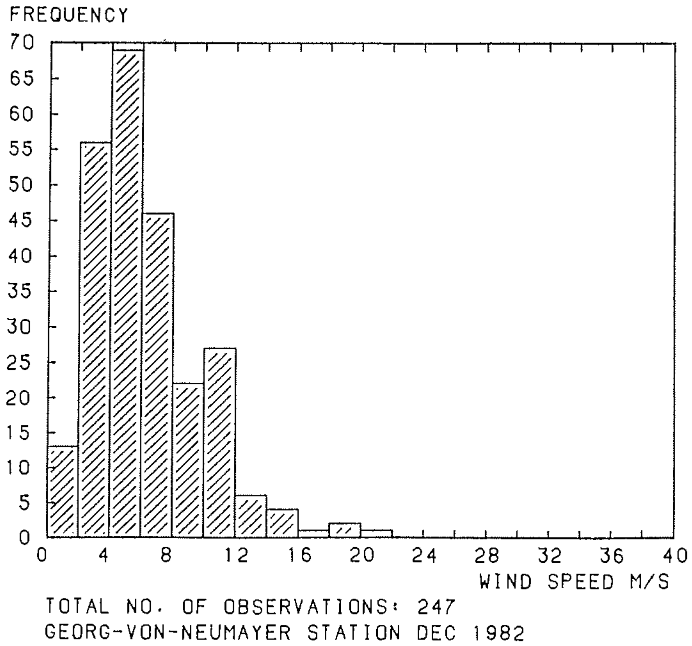


TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION OCT 1982

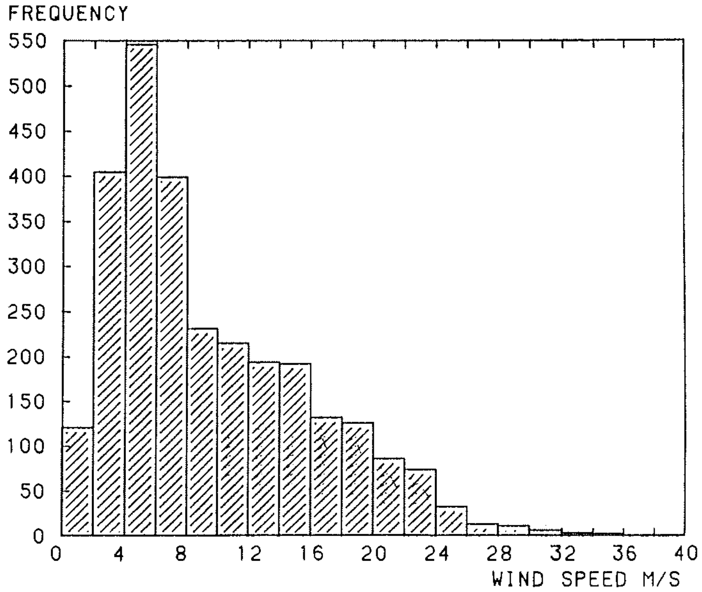
(8j)


FREQUENCY
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION NOV 1982

(8k)


FREQUENCY
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0 4 8 12 16 20 24 28 32 36 40
WIND SPEED M/S
TOTAL NO. OF OBSERVATIONS: 247
GEORG-VON-NEUMAYER STATION DEC 1982

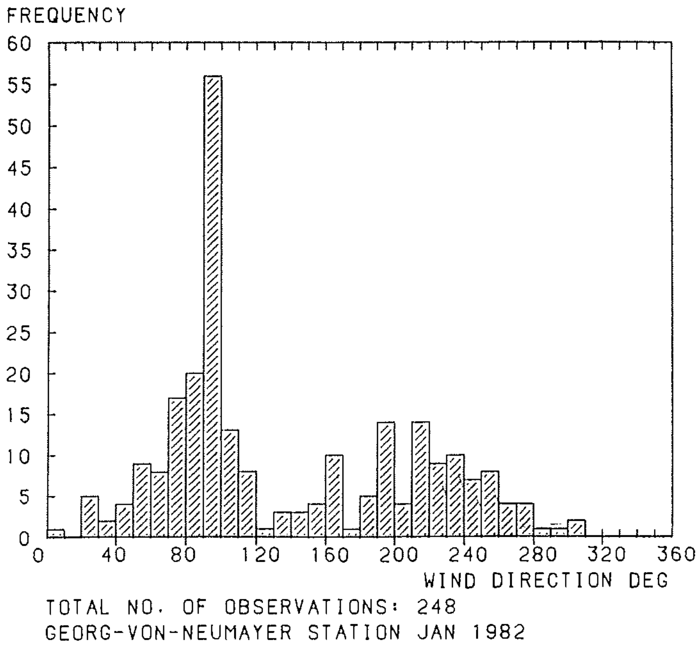
(8l)



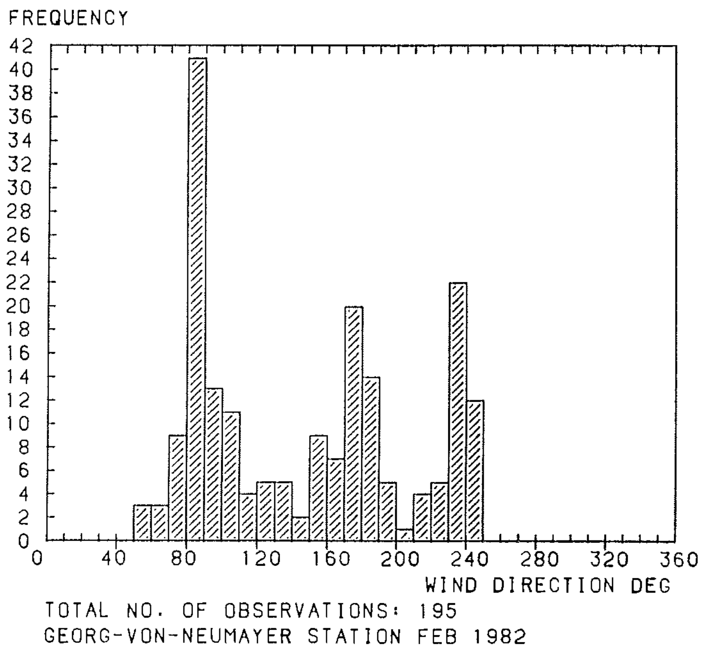
TOTAL NO. OF OBSERVATIONS: 2789
GEORG-VON-NEUMAYER STATION 1982

(8m)

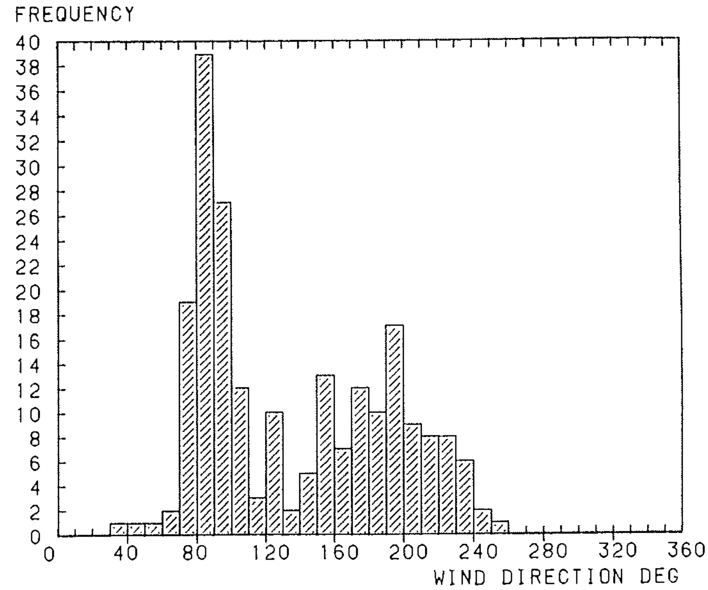
Figure 9: Histograms of wind direction, 1982 (from synoptic observations)
(a) - (l): months January - December 1982
(m): entire year 1982



(9a)

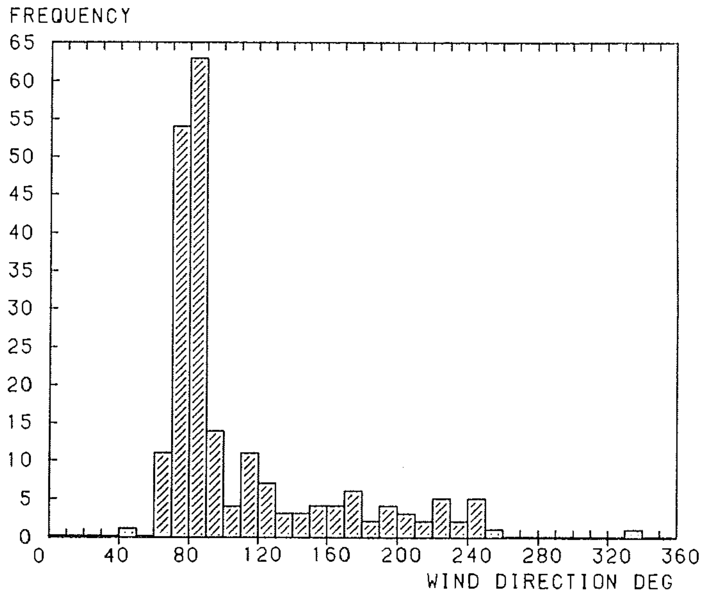


(9b)



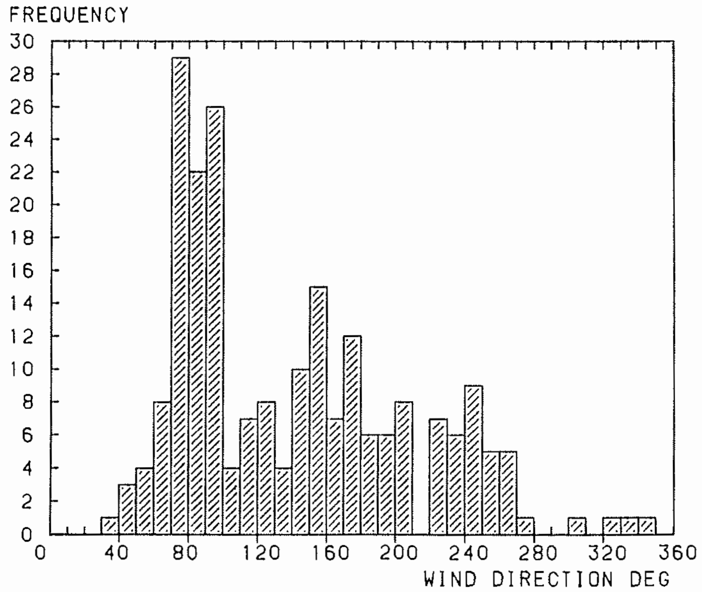
TOTAL NO. OF OBSERVATIONS: 215
GEORG-VON-NEUMAYER STATION MAR 1982

(9c)



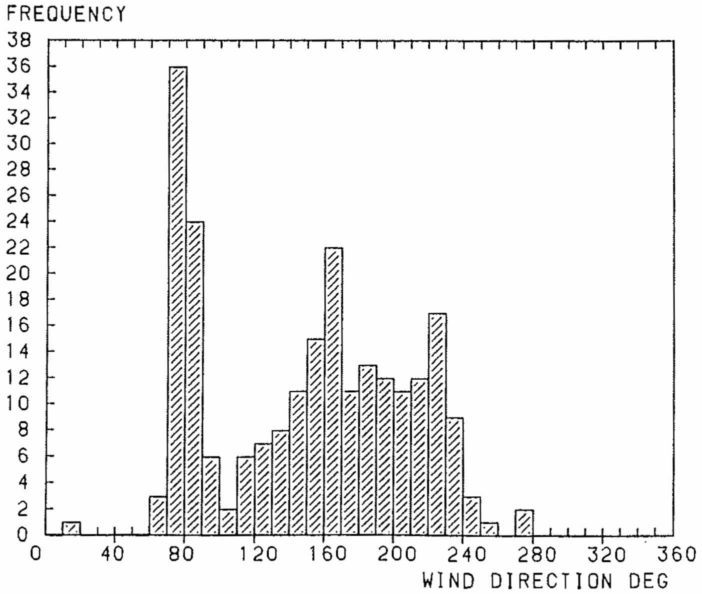
TOTAL NO. OF OBSERVATIONS: 210
GEORG-VON-NEUMAYER STATION APR 1982

(9d)



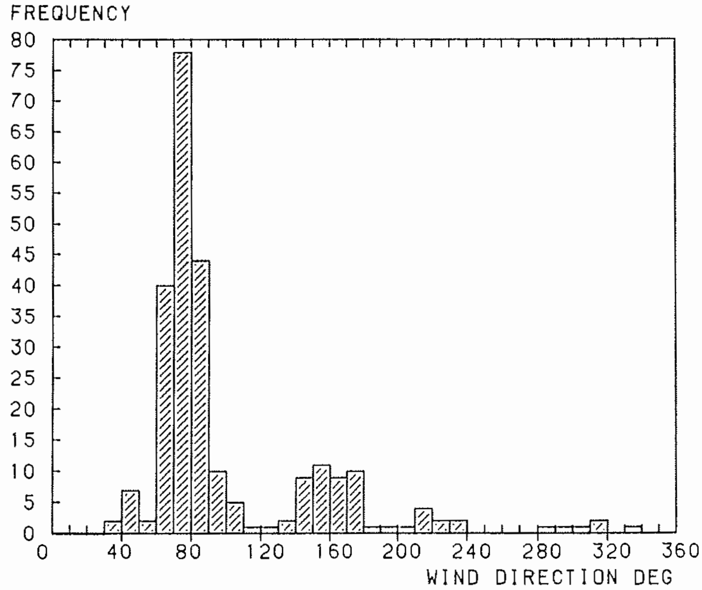
TOTAL NO. OF OBSERVATIONS: 217
GEORG-VON-NEUMAYER STATION MAY 1982

(9e)



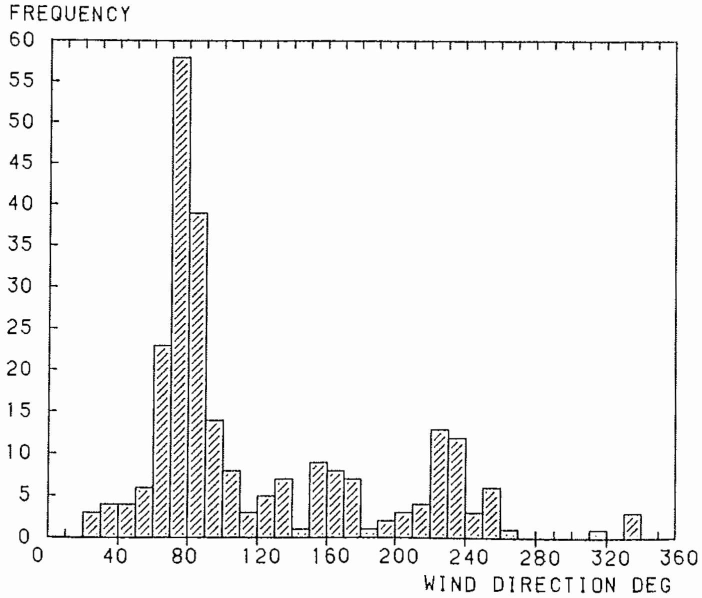
TOTAL NO. OF OBSERVATIONS: 232
GEORG-VON-NEUMAYER STATION JUN 1982

(9f)



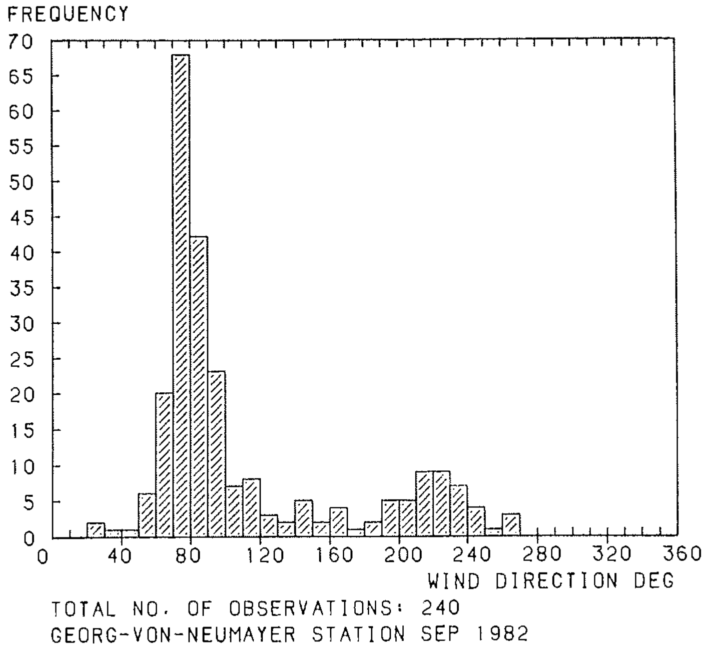
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION JUL 1982

(9g)

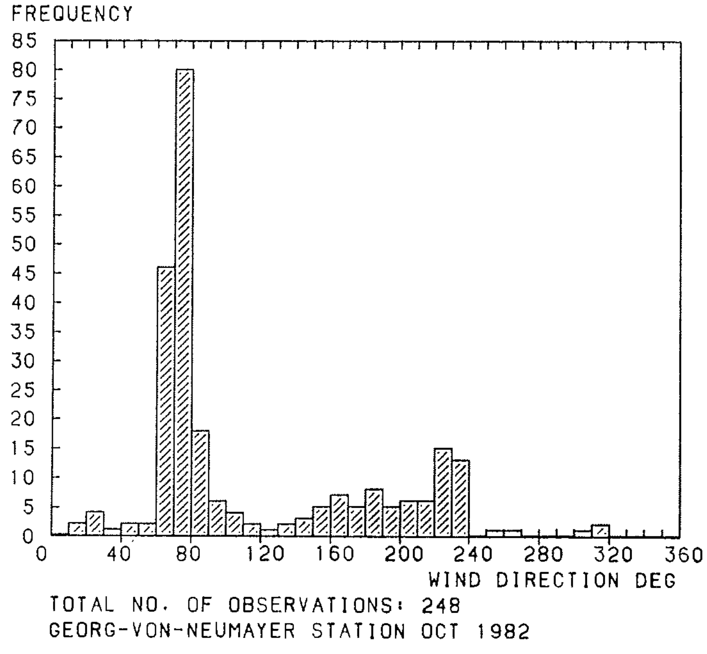


TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION AUG 1982

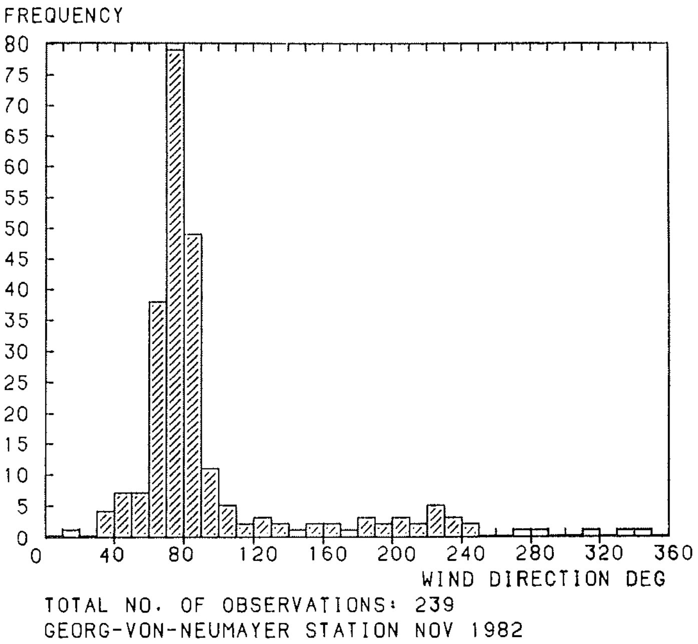
(9h)


FREQUENCY
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
40
80
120
160
200
240
280
320
360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 240
GEORG-VON-NEUMAYER STATION SEP 1982

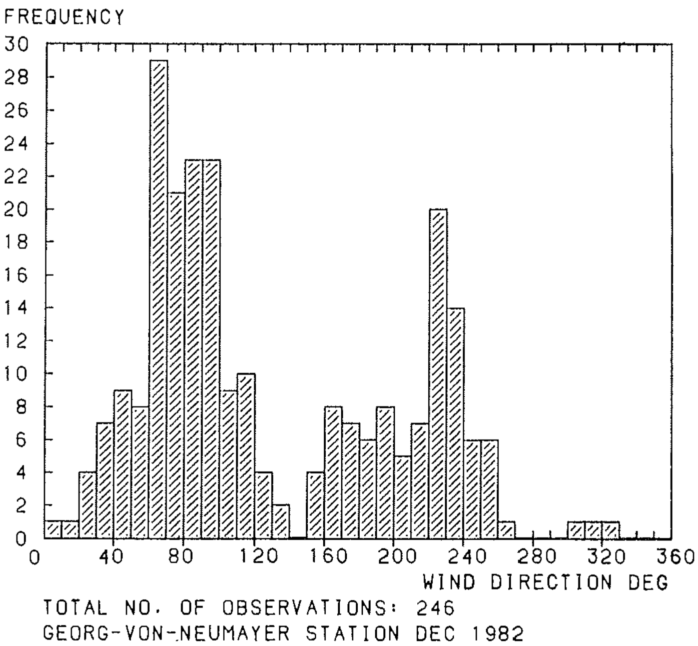
(9i)


FREQUENCY
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
40
80
120
160
200
240
280
320
360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 248
GEORG-VON-NEUMAYER STATION OCT 1982

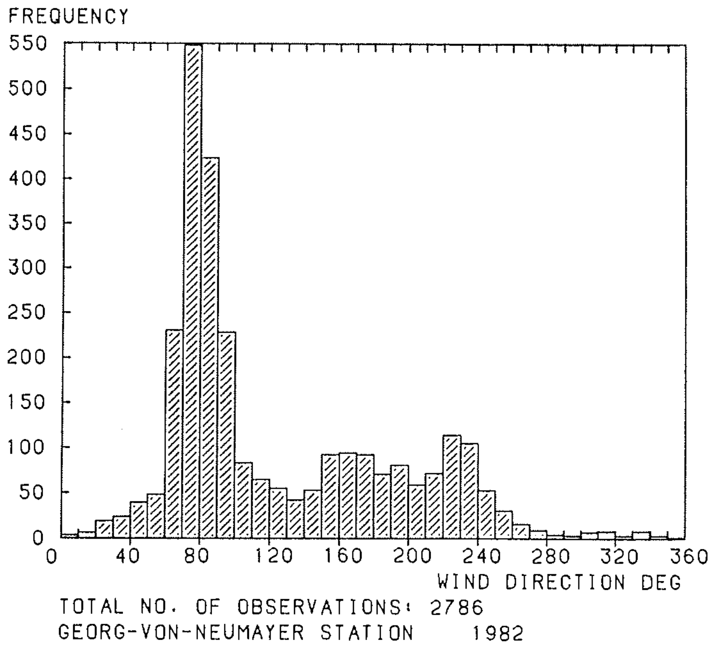
(9j)


FREQUENCY
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
40
80
120
160
200
240
280
320
360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 239
GEORG-VON-NEUMAYER STATION NOV 1982

(9k)


FREQUENCY
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
40
80
120
160
200
240
280
320
360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 246
GEORG-VON-NEUMAYER STATION DEC 1982

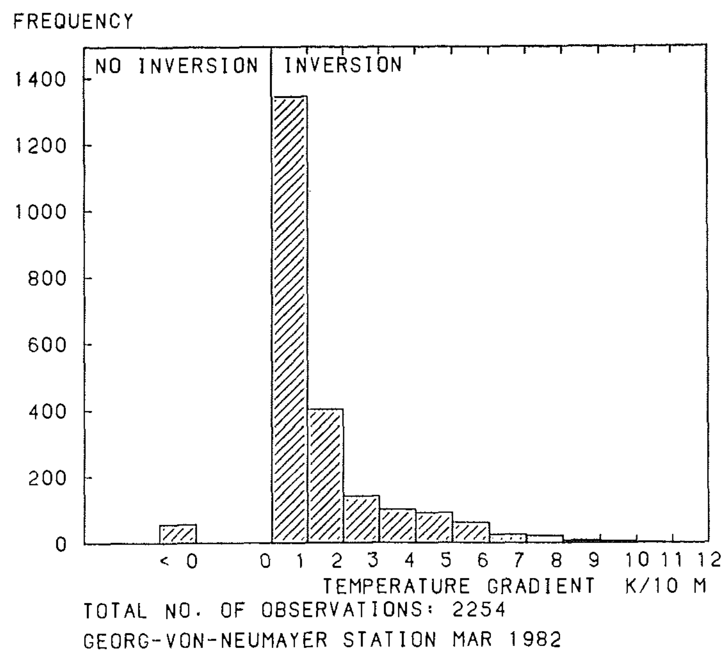
(9l)


FREQUENCY
550
500
450
400
350
300
250
200
150
100
50
0
0
40
80
120
160
200
240
280
320
360
WIND DIRECTION DEG
TOTAL NO. OF OBSERVATIONS: 2786
GEORG-VON-NEUMAYER STATION 1982

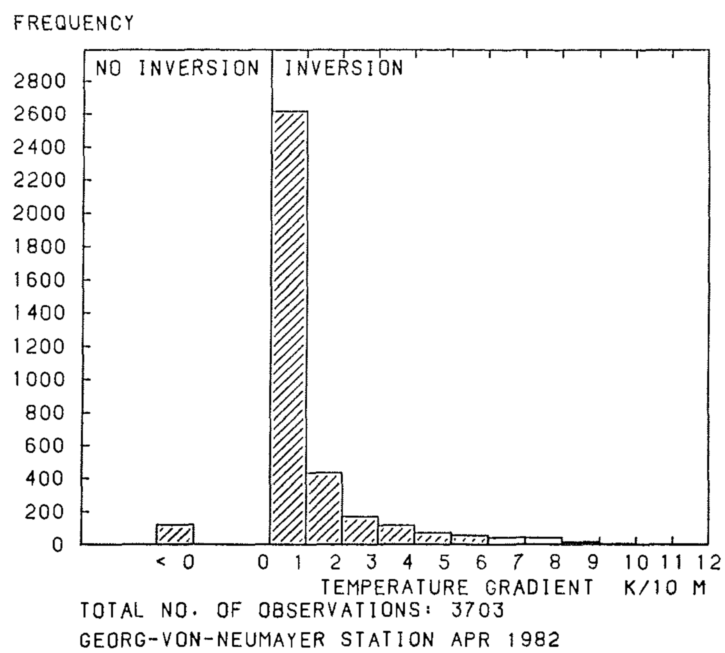
(9m)

Figure 10: Histograms of vertical temperature gradient, 1982 (from 10 minute mean registration; the temperature gradient has been computed from the temperature recordings in 15 m height and 0.5 m height)

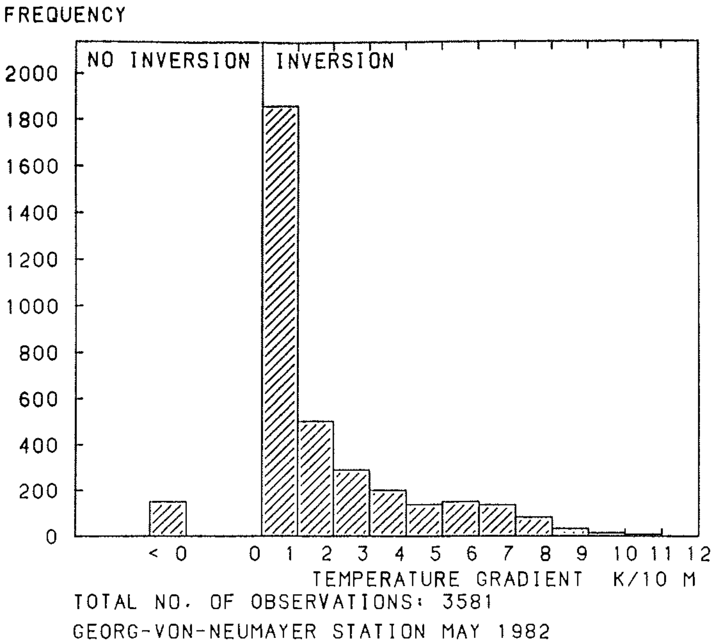
(a) - (j): months March - December 1982
(k): entire year 1982



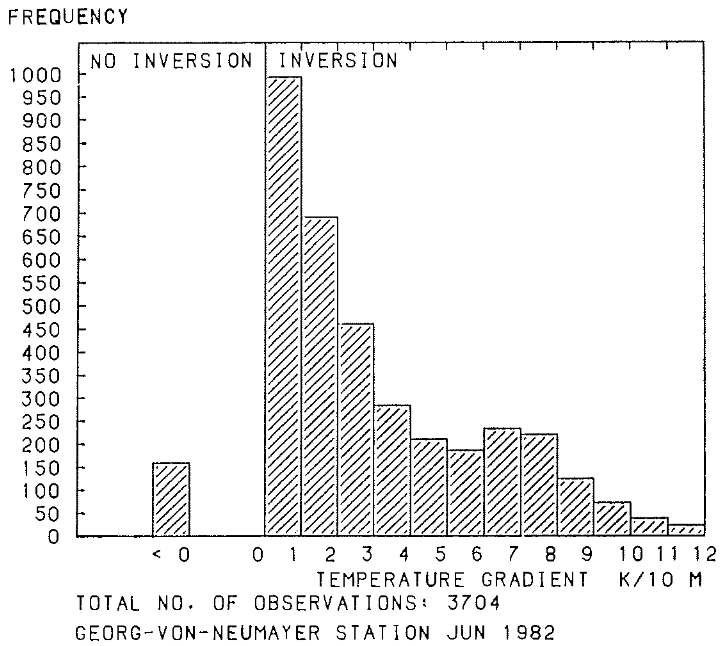
(10a)



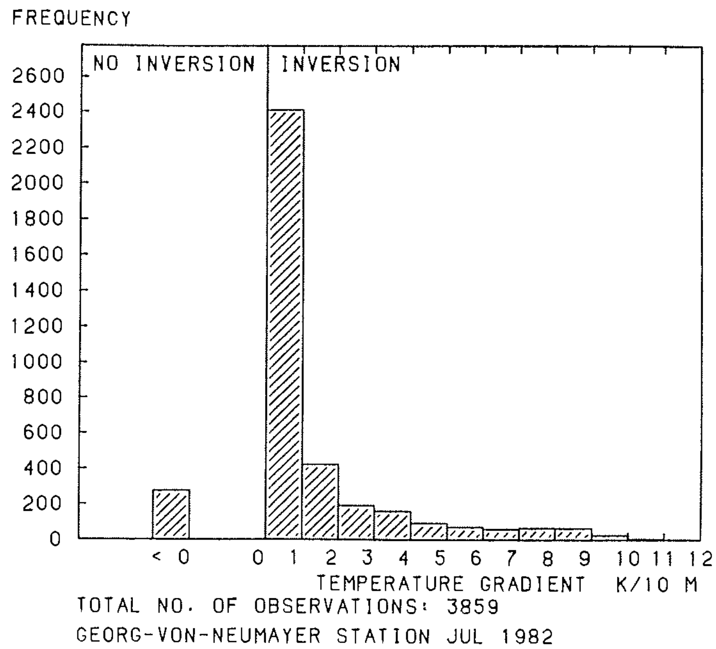
(10b)


FREQUENCY
NO INVERSION
INVERSION
2000
1800
1600
1400
1200
1000
800
600
400
200
0
< 0
0 1 2 3 4 5 6 7 8 9 10 11 12
TEMPERATURE GRADIENT K/10 M
TOTAL NO. OF OBSERVATIONS: 3581
GEORG-VON-NEUMAYER STATION MAY 1982

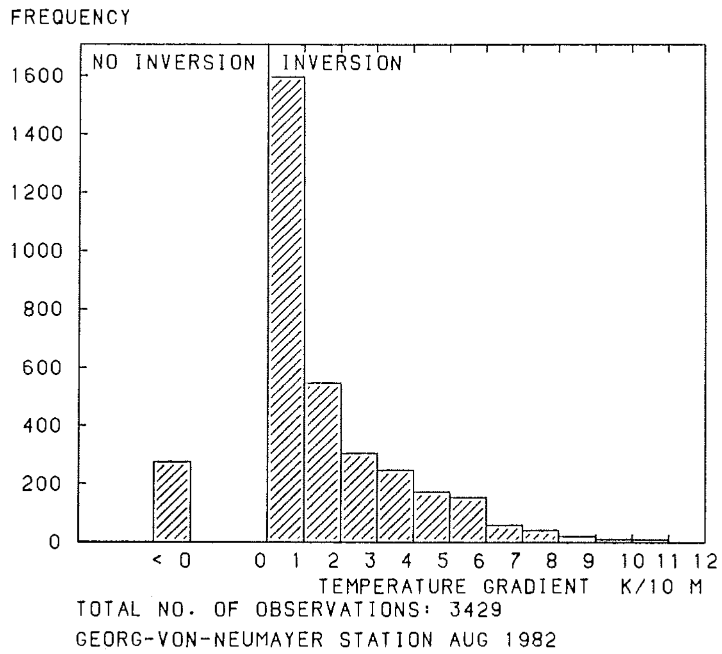
(10c)


FREQUENCY
NO INVERSION
INVERSION
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
< 0
0 1 2 3 4 5 6 7 8 9 10 11 12
TEMPERATURE GRADIENT K/10 M
TOTAL NO. OF OBSERVATIONS: 3704
GEORG-VON-NEUMAYER STATION JUN 1982

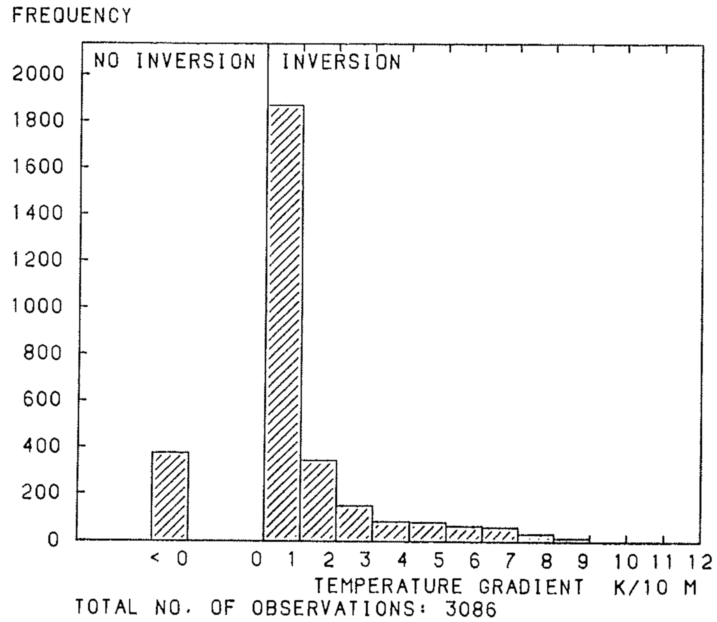
(10d)


FREQUENCY
NO INVERSION
INVERSION
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
< 0
0 1 2 3 4 5 6 7 8 9 10 11 12
TEMPERATURE GRADIENT K/10 M
TOTAL NO. OF OBSERVATIONS: 3859
GEORG-VON-NEUMAYER STATION JUL 1982

(10e)


FREQUENCY
NO INVERSION
INVERSION
1600
1400
1200
1000
800
600
400
200
0
< 0
0 1 2 3 4 5 6 7 8 9 10 11 12
TEMPERATURE GRADIENT K/10 M
TOTAL NO. OF OBSERVATIONS: 3429
GEORG-VON-NEUMAYER STATION AUG 1982

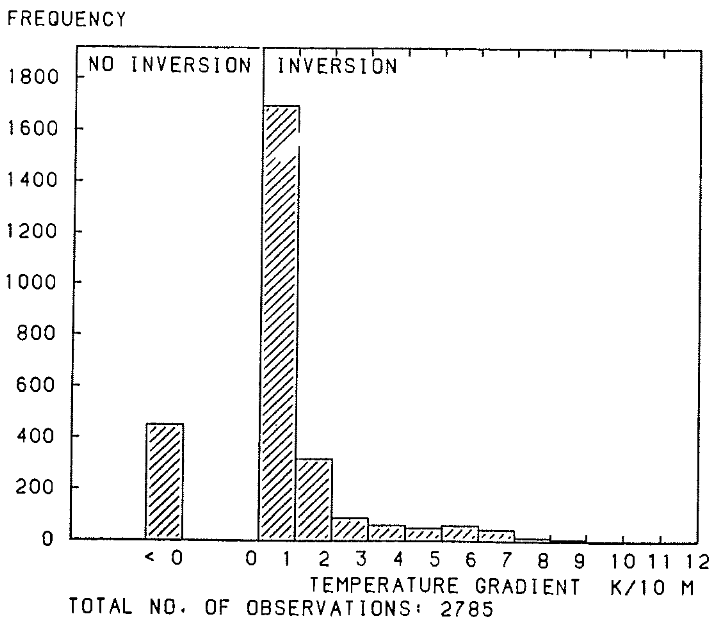
(10f)



TOTAL NO. OF OBSERVATIONS: 3086

GEORG-VON-NEUMAYER STATION SEP 1982

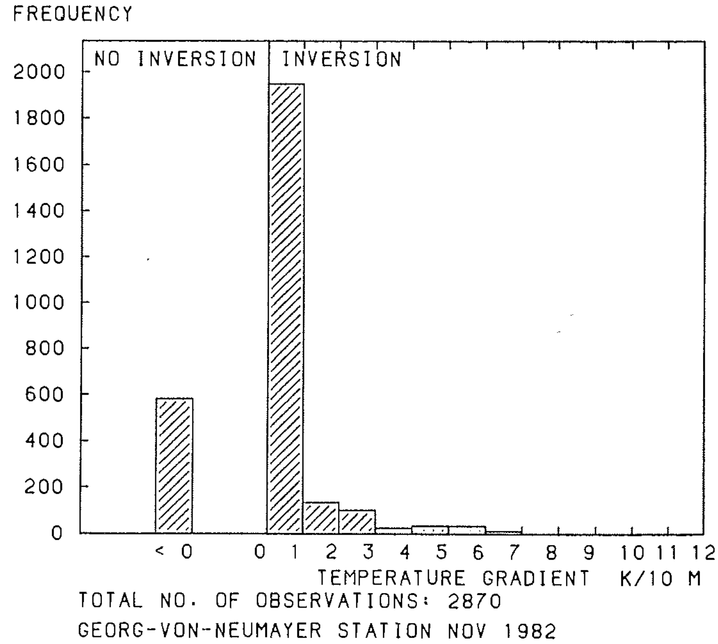
(10g)



TOTAL NO. OF OBSERVATIONS: 2785

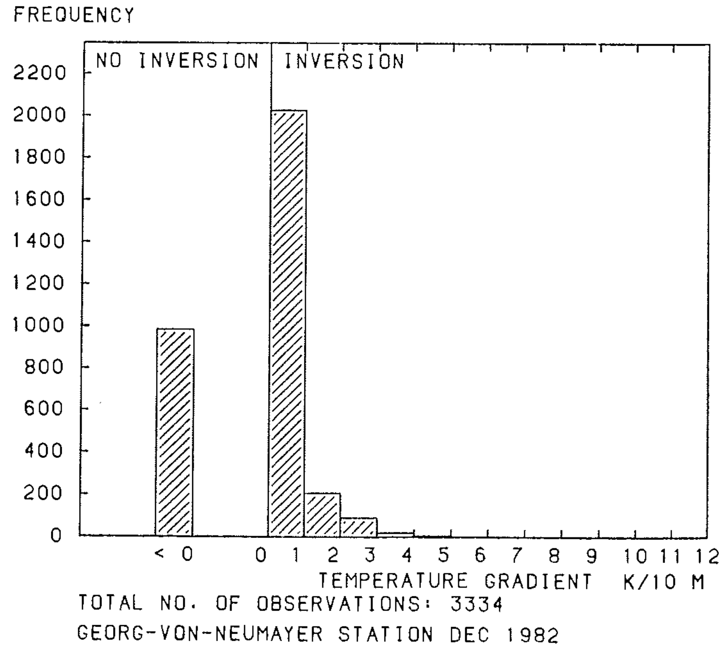
GEORG-VON-NEUMAYER STATION OCT 1982

(10h)



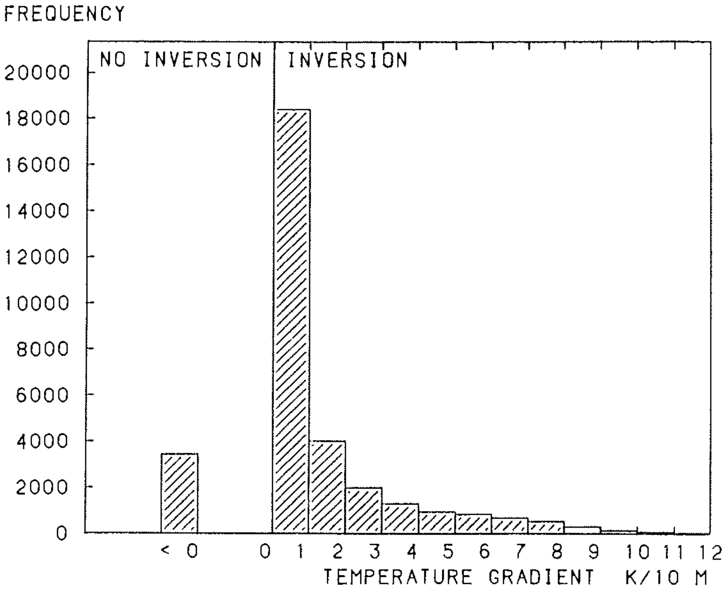
FREQUENCY
NO INVERSION
INVERSION
2000
1800
1600
1400
1200
1000
800
600
400
200
0
< 0
0 1 2 3 4 5 6 7 8 9 10 11 12
TEMPERATURE GRADIENT K/10 M
TOTAL NO. OF OBSERVATIONS: 2870
GEORG-VON-NEUMAYER STATION NOV 1982

(10i)



FREQUENCY
NO INVERSION
INVERSION
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
< 0
0 1 2 3 4 5 6 7 8 9 10 11 12
TEMPERATURE GRADIENT K/10 M
TOTAL NO. OF OBSERVATIONS: 3334
GEORG-VON-NEUMAYER STATION DEC 1982

(10j)



TOTAL NO. OF OBSERVATIONS: 32605

GEORG-VON-NEUMAYER STATION 1982

(10k)

Figure 11: Monthly means of daily global radiation cycle. Numbers on curves indicate respective months, 1982 (from hourly global radiation registration)

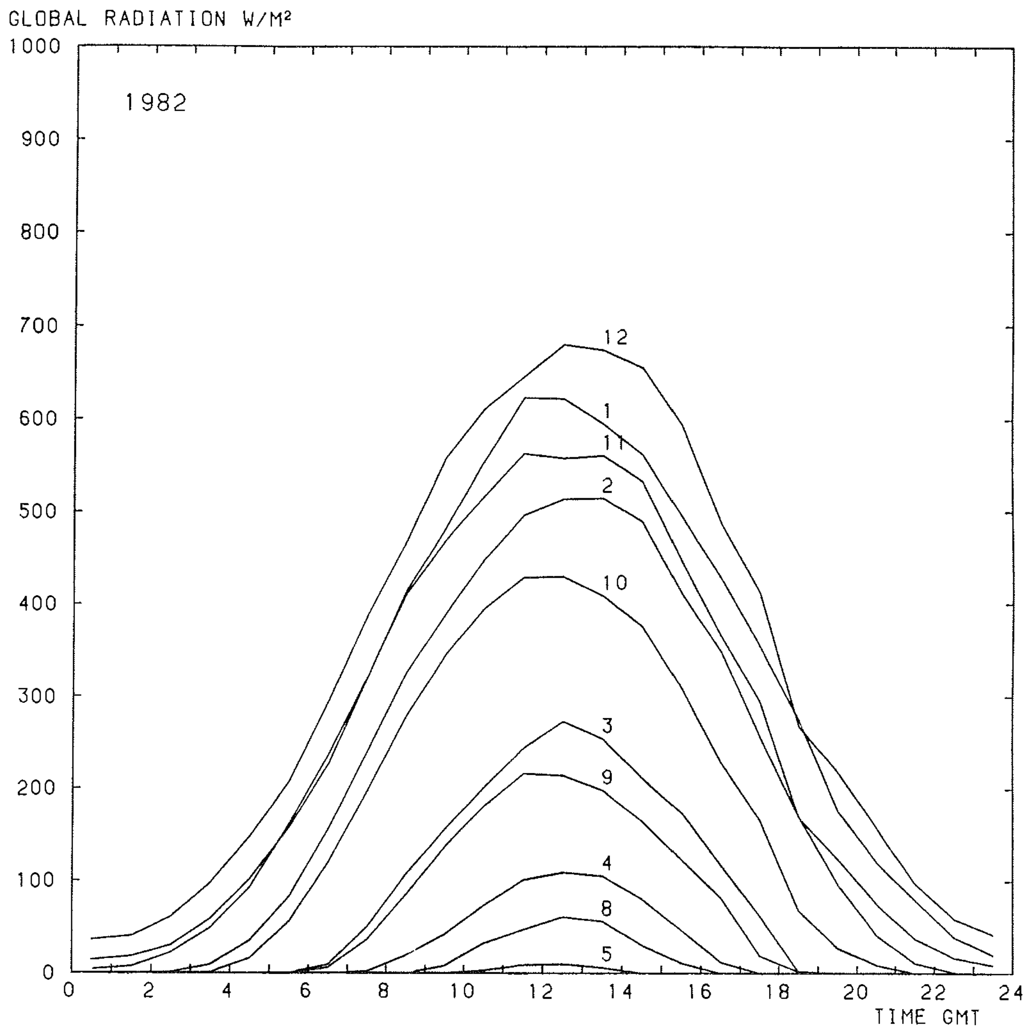
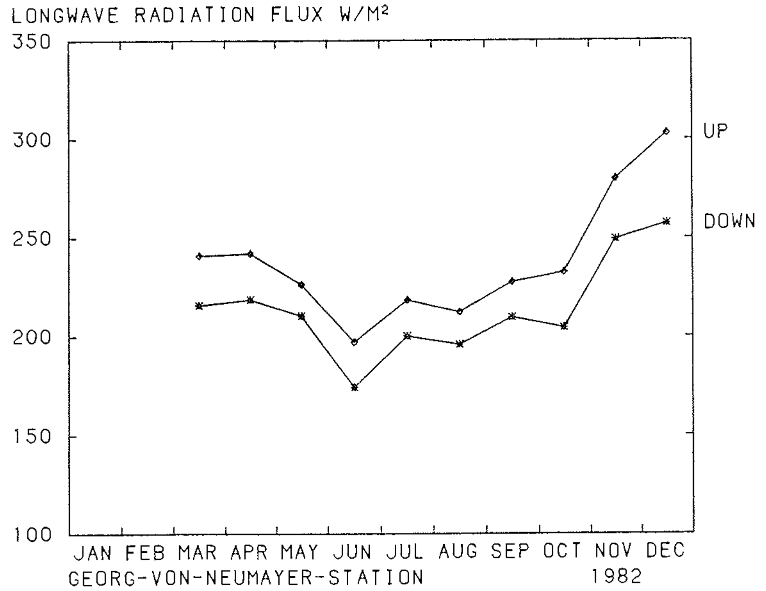


Figure 12: Time series of monthly mean longwave radiation fluxes (a) and the total surface radiation budget (b) (from 19 minute mean radiation registration)



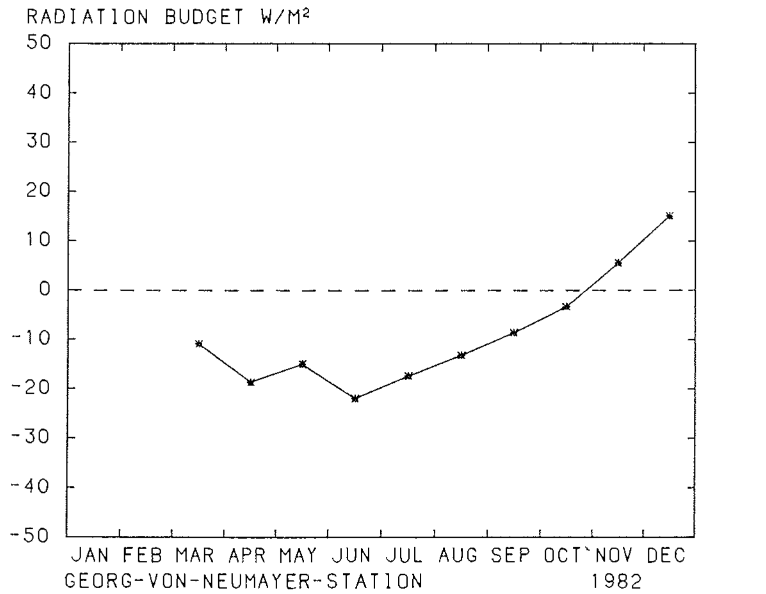
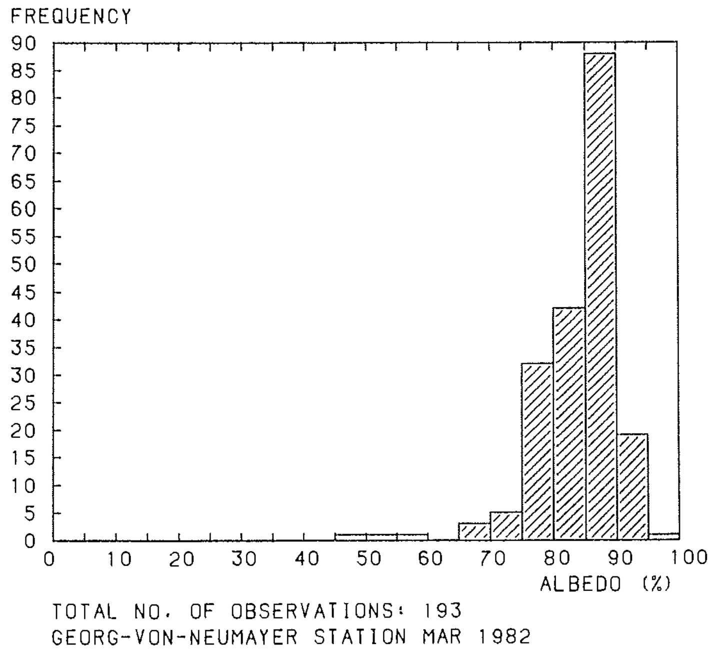
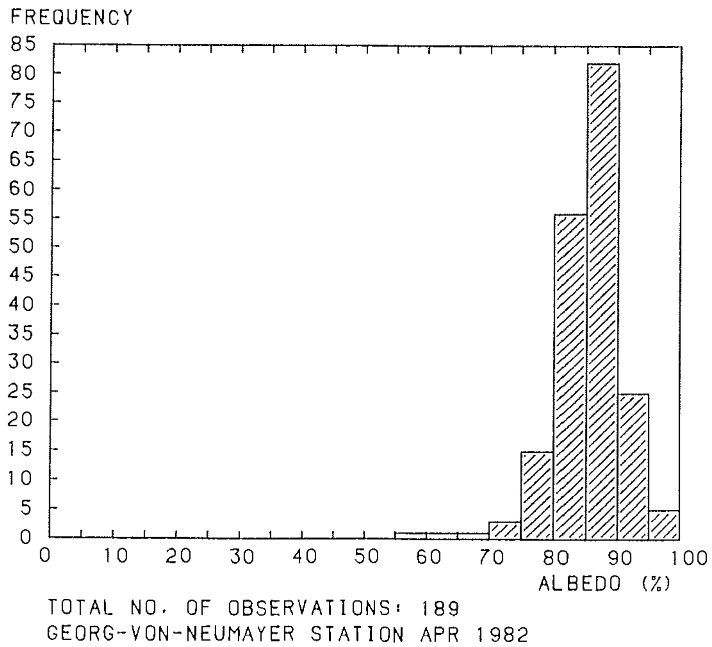


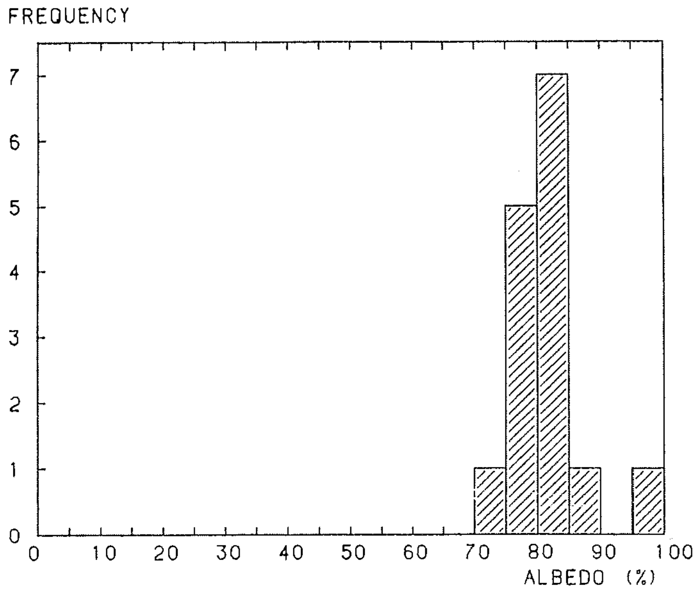
Figure 13: Histograms of surface albedo, 1982 (from hourly radiation registration)
(a) - (h): months March - December 1982 without June and July
(i): entire year 1982



(13a)

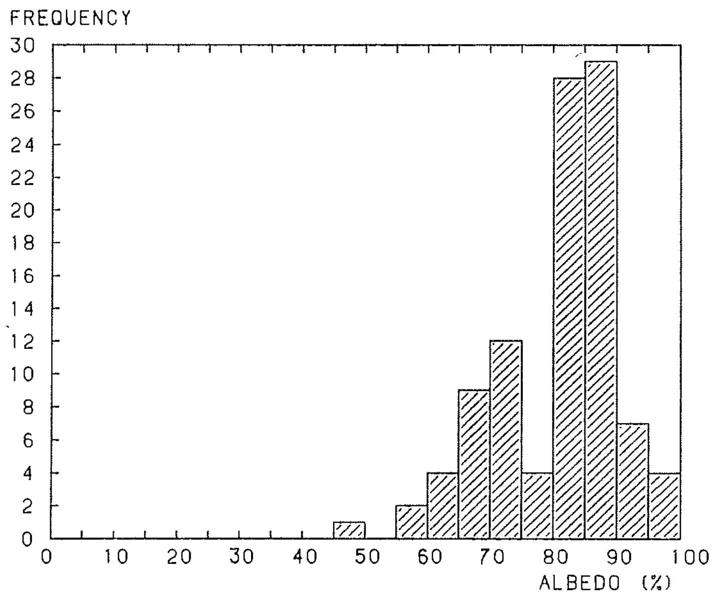


(13b)



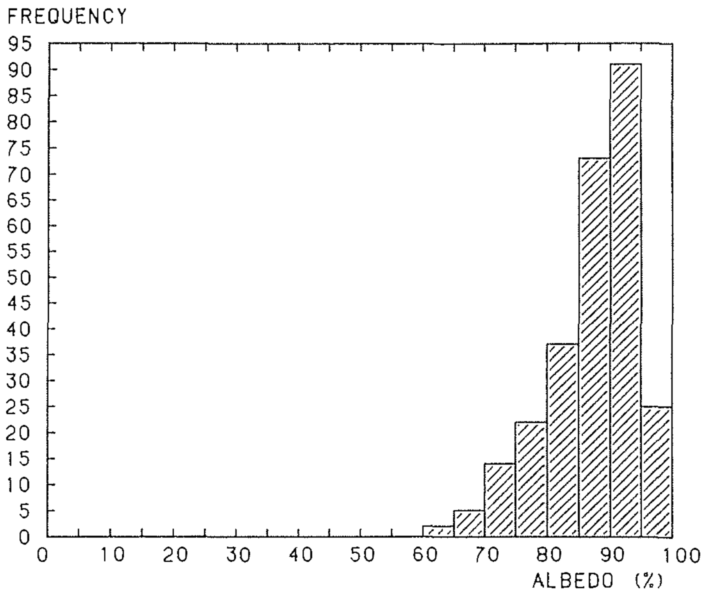
TOTAL NO. OF OBSERVATIONS: 15
GEORG-VON-NEUMAYER STATION MAY 1982

(13c)



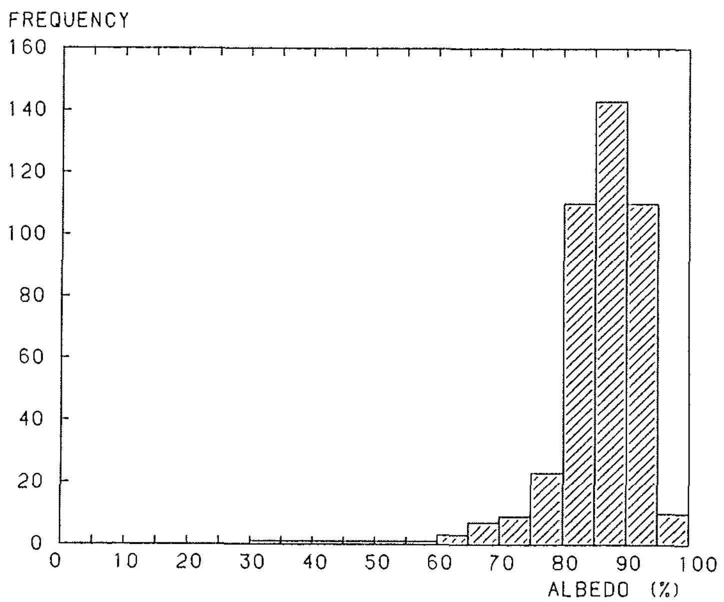
TOTAL NO. OF OBSERVATIONS: 100
GEORG-VON-NEUMAYER STATION AUG 1982

(13d)



TOTAL NO. OF OBSERVATIONS: 269
GEORG-VON-NEUMAYER STATION SEP 1982

(13e)



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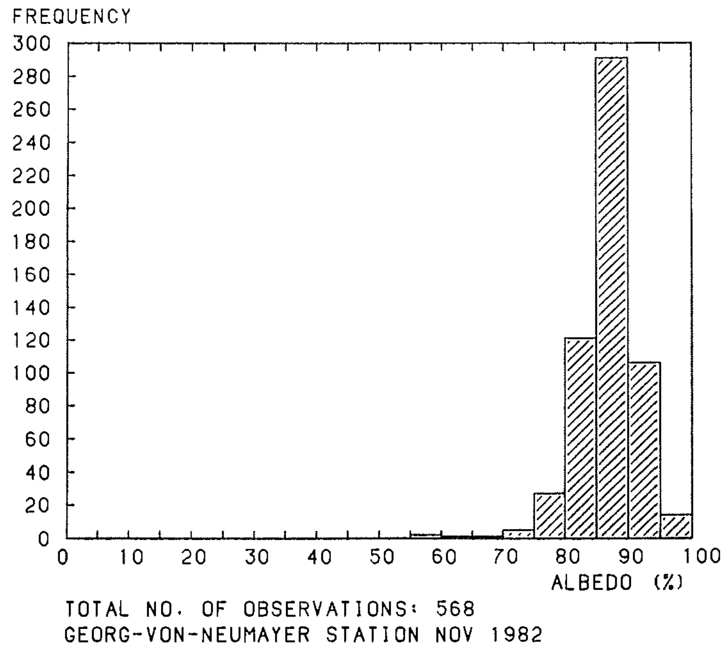
GEORG-VON-NEUMAYER STATION OCT 1982

(13f)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ALBEDO (%)
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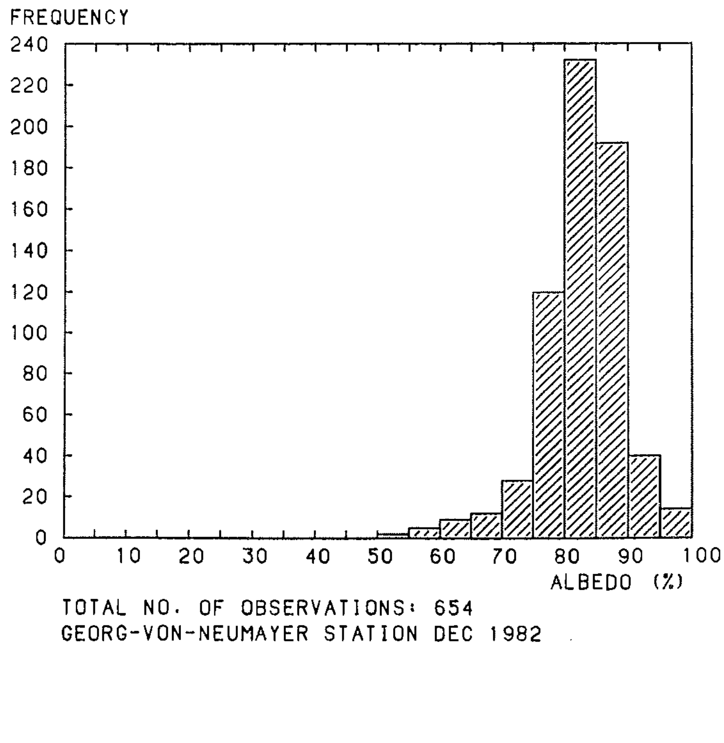
GEORG-VON-NEUMAYER STATION NOV 1982

(13g)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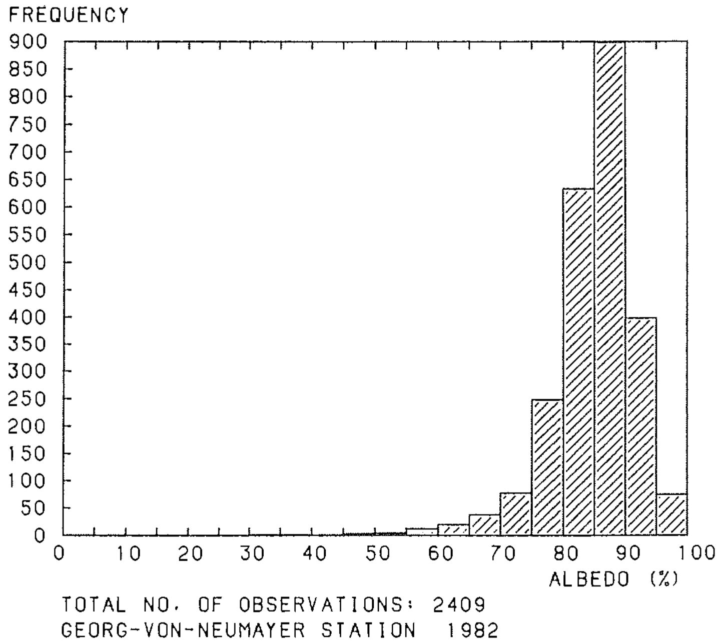
(13h)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50
0
0 10 20 30 40 50 60 70 80 90 100
ALBEDO (%)
TOTAL NO. OF OBSERVATIONS: 2409
GEORG-VON-NEUMAYER STATION 1982

(13i)

The first Year's Meteorological Observations at the Georg-von-Neumayer-Station

A Review by Friedrich Obleitner

Berichte zur Polarforschung Nr. 30 / März 1986
Reports on Polar Research no. 30 / March 1986

CONTENTS

1. Surface meteorological observations

1.1 Synoptic meteorological observations

1.1.1 Introduction

From March 1981 to February 1982 three-hourly meteorological routine observations were carried out at GvN to provide real-time meteorological information for other Antarctic stations and meteorological data centres, to present background information for special research programmes and to describe synoptic and climatological conditions at GvN for the planning of further research programmes.

1.1.2 Observation period and coding

Synoptic observations at GvN are available since February 1981 on a six-hourly basis. Since 5 April 1981 the routine observations have been extended to 00, 06, 09, 12, 15, 18 and 21 GMT. Under WMO station number 89002 the coded observations were broadcasted to the British Antarctic Survey data centre at Grytviken at 00, 12 and 18 GMT. A somewhat modified FM-11C SYNOP code was used until February 1982, when a new code was introducted by the MWO. On the average, the synoptic observation procedure was started 25 minutes before the full hour with the sequence recommended by the WMO.

1.1.3 The measuring site

With regard to prevailing winds from east and south, the meteorological mast was mounted on top of the south-easterly access tower of the wintering base. For logistic reasons, the meteorological screen had to be installed about 40 metres to the north of the base.

1.1.4 Temperature measurements

Temperature measurements were read off a normal psychrometer, maximum and minimum thermometers (W. Lambrecht KG, Göttingen), a thermohygrograph (Thieß Klima, Göttingen) and several Pt-100 resistance thermometers. These standard instruments were placed at 1.8 m above snow in a Stevenson screen, which had been modified for severe weather conditions by the British Antarctic Survey.

Under normal weather conditions the instruments proved to be sufficiently ventilated and protected against radiation and drifting snow. However, during periods with moderate, continuous snow drift, the instruments were frequently covered with snow. At very high wind speeds the screen remained generally free of snow. Cleaning of the instruments during severe weather was sometimes problematic, but the temperature readings do not seem to be seriously falsified in general.

Occasionally, the screen was packed with snow, so that the thermohygrograph was critically perturbed. Readings of the maximum and minimum thermometers were generally strongly affected by screen vibrations even at lower wind speeds. Also the humidity measurements by means of hygro- and psychrometers failed during severe snow drift.

Most of the malfunctions could not be eliminated by repeated rearrangement of the instruments within the screen. The only instrument that remained free of snow was an adjustably mounted, bare Pt-100 sensor, whose readings were recorded every two minutes within the station with a compensated analogue printer of type STDB 63 (Schenk, Wien). After careful calibrations with these recordings, reliable replenishment of deficit data, especially of maximum and minimum temperatues, was possible.

All thermometers were provided with laboratory calibration certificates and they were subjected to repeated "ice point checks" during the observation period; absolute calibrations were provided by standard thermometers.

1.1.5 Humidity measurements

Humidity measurements with conventional instruments met great principal difficulties due to the prevailing weather conditions. Besides the above mentioned problems during drift periods, at temperatures below -20°C the hygrometers responded only very slowly to changes in relative humidity, at -40°C the lag became almost infinite, making the instruments practically useless. This trend is strongly reflected in comparisons of summer and winter hygrograms, the latter showing frequently a more or less straight line during colder periods.

With these experiences, the evaluation of relative humidity within the synoptic work was confined to periods with temperatues above -20°C and no snow drift.

1.1.6 Wind measurements

As far as local topography is concerned, the site of the base is nearly ideal, the nearest hills with very gentle slopes being about 5 km to the northwest and southeast. Thus, the wind observations should be representative for a fairly large area.

The anemometer and the wind vane (Thieß Klima, Göttingen) gave analogue recordings of actual and 10 minute mean values of wind speed up to 40 m/s and of wind directions. Wind speed was measured with a 3-cup anemometer of type No. 43303 with opto-electronic signal transmission and onset velocity of 0.3 m/s at ideal conditions. The direction of the vane (type No. 43120.12) was transmitted by resistor sensors. Both instruments were heated and mounted at the top of the meteorological mast 10 m above the highest obstacle in the vicinity, corresponding to a height of 18 m (March 1981) and 17 m (February 1982) above the level snow surface surrounding the base. Additionally, the wind vector was recorded at a height of 10 m (March 1981) with a mechanical device of type "Woelfle" (Lambrecht KG, Göttingen).

For the greatest part of the observational period, the wind instruments worked satisfactorily, though for some shorter periods operational difficulties arose mainly due to severe weather conditions. Especially the "Woelfle" showed to be rather sensitive to icing by fine drift snow particles penetrating to the inner moving parts, causing the vane and the rotor to stop when the wind weakened after such periods. Severe rime and hoar frost formation caused additional malfunctions. Missing data due to failure of the electric system in the base, interference by radio signals and service of the instruments could be successfully replenished by the mechanical recordings.

The influence of the near complex of the base on the presented wind data is difficult to estimate, but is considered to be of minor importance for climatological investigations, since the position of the meteorological mast with regard to the prevailing wind directions is quite favourable. The snow accumulation beneath the mast was negligible, so that the height of the wind sensors remained nearly constant, until the extension of the access shafts of the base on 19 January 1982 yielded a new instrument height of 19 m above the level snow surface.

1.1.7 Pressure messurements

For routine pressure measurements a precision metal aneroid, used as station barometer, as well as an ordinary barograph and microbarograph (all Lambrecht KG, Göttingen) were available . The synoptic data as well as daily pressure extremes and three-hourly tendencies were based on the recording of the microbarograph, whose reliability was ensured by regular control readings with the standard aneroid. Final comparisons between the used standard aneroid and the recently calibrated barometers and hypsometers confirmed the consistency and the corrections applied, respectively. All instruments were mounted in a tempera-ted container inside the base. The altitude of the instruments amounted to approximately 40 m above sea level (B. Ritter, Braunschweig pers. communication). The pressure was reduced to mean sea level under the assumption of an isothermal atmosphere. This should be sufficiently accurate for mean pressure values, as due to the low elevation of the station the influence of an error in the mean temperature of the air column will be very small.

1.1.8 Visibility estimates

Observations of visibility according to the recommendations issued by the WMO were often practically impossible. Most hindering were the lack of visibility marks and unfavourable light or atmospheric conditions during the greater part of the year. For distances up to 700 m instrument huts, stakes, drums or other objects belonging to the station could be used as marks. Further away, the only marks were a line of empty drums along the route to the coast and some marked features of the landscape like the easily recognizable tongue of the ice shelf towards the east and the north, as well as icebergs and the profiles of ice hills to the southeast and northwest of the base. Refraction effects caused additional problems. With snow drift and/or darkness two spotlights mounted at the base were the only clues for visibility estimates. Evidently, under these circumstances the quality of the observations depends very much on the ability of the observer to estimate visibility from the "general transparency" of the atmopshere, taking into consideration the clearness of visible objects.

1.1.9 Observation of cloudiness

Similar observational difficulties were met with the observation of cloud amount and cloud type.

The typical "Antarctic" problem to decide whether the sky should be judged to be clear or covered by a very thin, transparent cirrostratus, is of minor importance at GvN, as such conditions only rarely occurred and were judged uniformally with 0 octas. Because of missing clues routine estimations of the cloud base height cannot be very reliable and have been omitted.

1.1.10 Evaluation and coding of the synoptic data

The presented data for temperature, wind and air pressure were re-evaluated together with mean hourly and daily extreme values from 00 to 24 GMT. These data are not necessarily identical with the routine synoptic data, as they are based on a full hour time scale (00, 03,...,21 GMT) contrary to the original observations starting on the average 25 minutes before. Clearly this time shift induces some difference, which, however, is assumed to be of minor importance for climatological investigations due to their statistical nature. Synoptic observations concerning cloudiness and visibility are reported according to the original routine observations.

All synoptic observations were coded according to recommendations issued by the WMO.

1.2 Measurement and evaluation of mean hourly meteorological data

From 29 January 1981 to 27 February 1981 air temperature, wind speed and direction as well as global radiation and albedo were monitored at the field camp, which had been established during construction time about 700 m southeast of the wintering base. Temperature was measured at 1.8 m height above the snow surface using ventilated platinum resistance thermometers, protected with double radiation shelters (A. Trawoeger, Innsbruck). Wind speed and wind direction were recorded at 3.1 m height with a cup anemometer of type DWR 202 (Didcot Instruments, Abingdon; reed contacts, onset velocity 0.2 m/s) and with a vane of type DWD 102 (16 by reed contacts switchable resistors, yielding 32 gradations). Radiation instruments will be described in section 2 of this report in detail.

5 and 2 minute data were continuously recorded with a digital monitoring system Microdata M200U, M200L (Microdata Ltd., Radlett) except for the periods 22 February 1981 and 27 February 1981 to 1 March 1981, when the system broke down due to difficulties with the energy supply.

When the wintering station had been completed at 2 March 1981, this meteorological field station was partly transferred and integrated into the deseribed meteorological station at the base. Evaluation of mean hourly values during the overwintering year was performed by graphical methods applied to the analogue recordings.

1.3 Summary of climatological features

1.3.1 Temperature

The daily temperature maximum mostly falls into the period 12 to 18 GMT during the sunlight season. With the sun's influence vanishing during the dark season, the more large-scale temperature fluctuations cause a tendency for the daily temperature maximum occurring at the time of transition from one day to the next, which is partly reflected even in monthly means of three hourly temperatures as illustrated in Figure 1. Additionally, this figure shows monthly means of daily variations up to 5°C to be confined to the sunlight season.

Figure 2 (lower part) presents the annual course of the daily mean temperature. It clearly shows the great temperature variability during the winter half year and the seasonal temperature change. Extreme interdiurnal temperature variations of more than 18°C are not uncommon during the winter months. Both the smaller interdiurnal change and its reduced variability in summer are most likely linked to the dominating role of the yearly solar irradiance cycle.

Figure 3 shows seasonal and yearly temperature histograms. Except for the central summer months, the decrease of the observed frequencies towards lower temperatures is very slow and irregular. The skewness of the summer distribution is well pronounced. This property may be associated with a "temperature barrier" at 0°C which is typically created by extensive snow fields.

A correlation of mean temperature and wind direction clearly reflects the dominant role of easterly winds throughout the year (Figure 4). The mean annual temperature is more or less the temperature associated with easterly winds. During winter, south winds determine the minimum temperatures (especially the absolute minima). Summer minimum temperatures are more or less governed by west wind conditions. Maximum temperatures never occurred with southerly winds, as especially during the winter months only east winds may be strong enough to break up the strong surface inversion. This may explain the strong correlation between high wind speeds and high temperatures, too.

Figure 4 suggests the division into a "maritime" and a "continental" sector by the ENE-WSW running coast line within the GvN region.

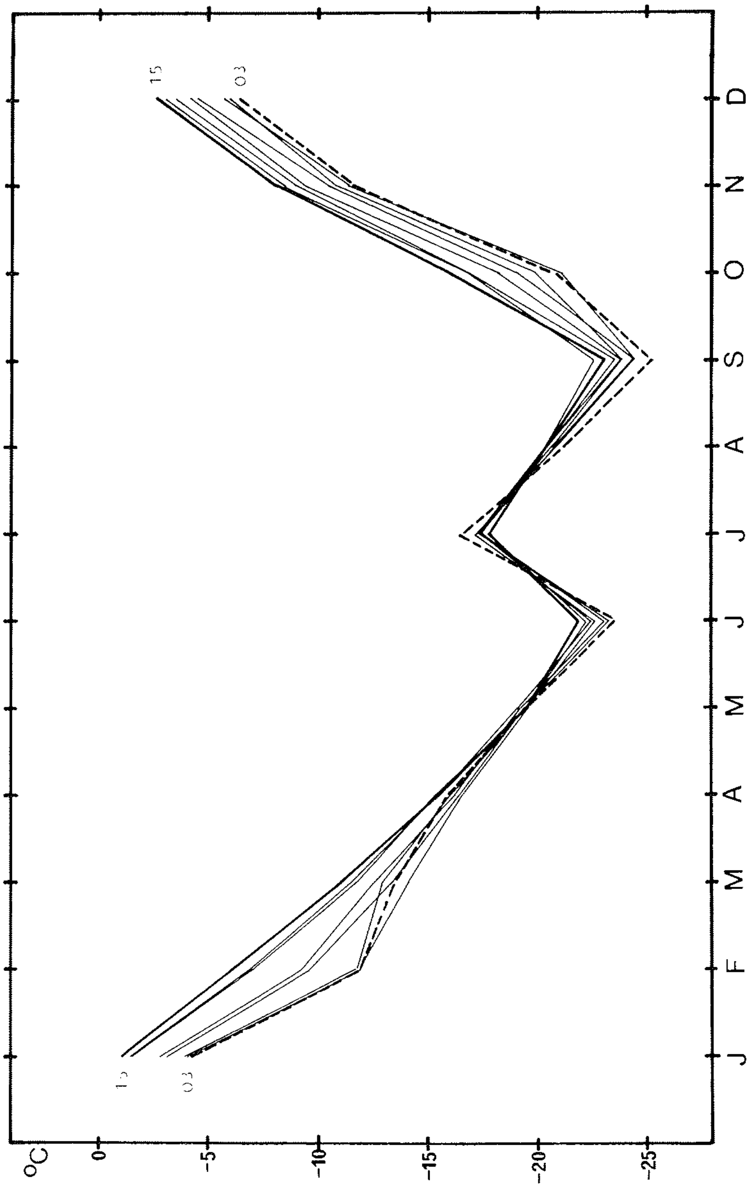

Figure 1: Monthly means of 3-hourly temperatures

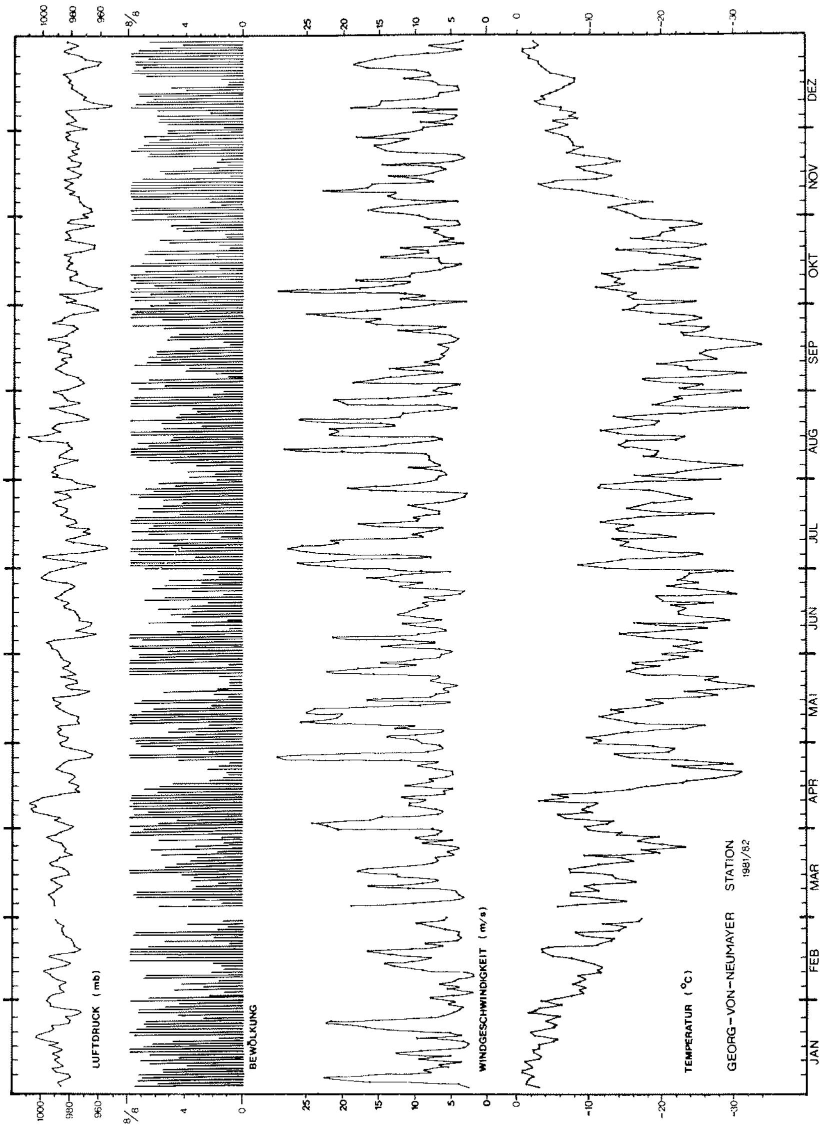

Figure 2: Climatic elements at GvN Station during 1981/82

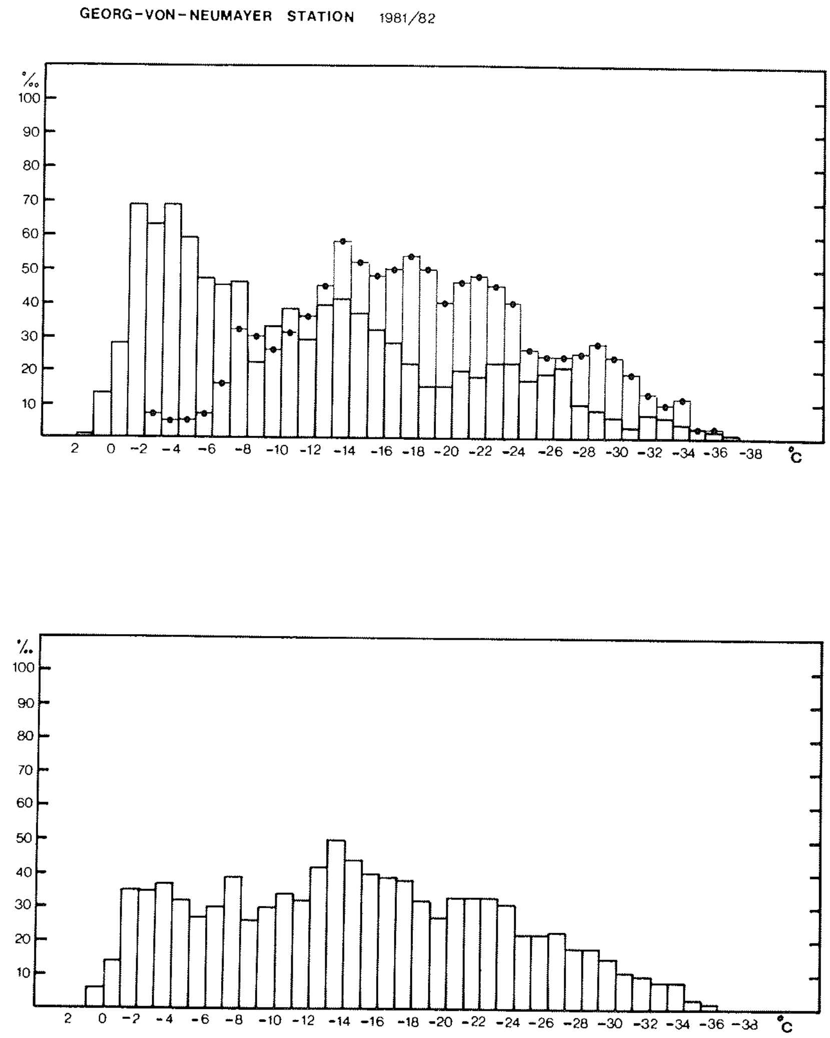

Figure 3: Yearly and seasonal histogram of temperature.
Mar. 81 - Aug. 81, Sep. 81 - Feb. 82;
lower fig.: Mar. 81 - Feb. 82

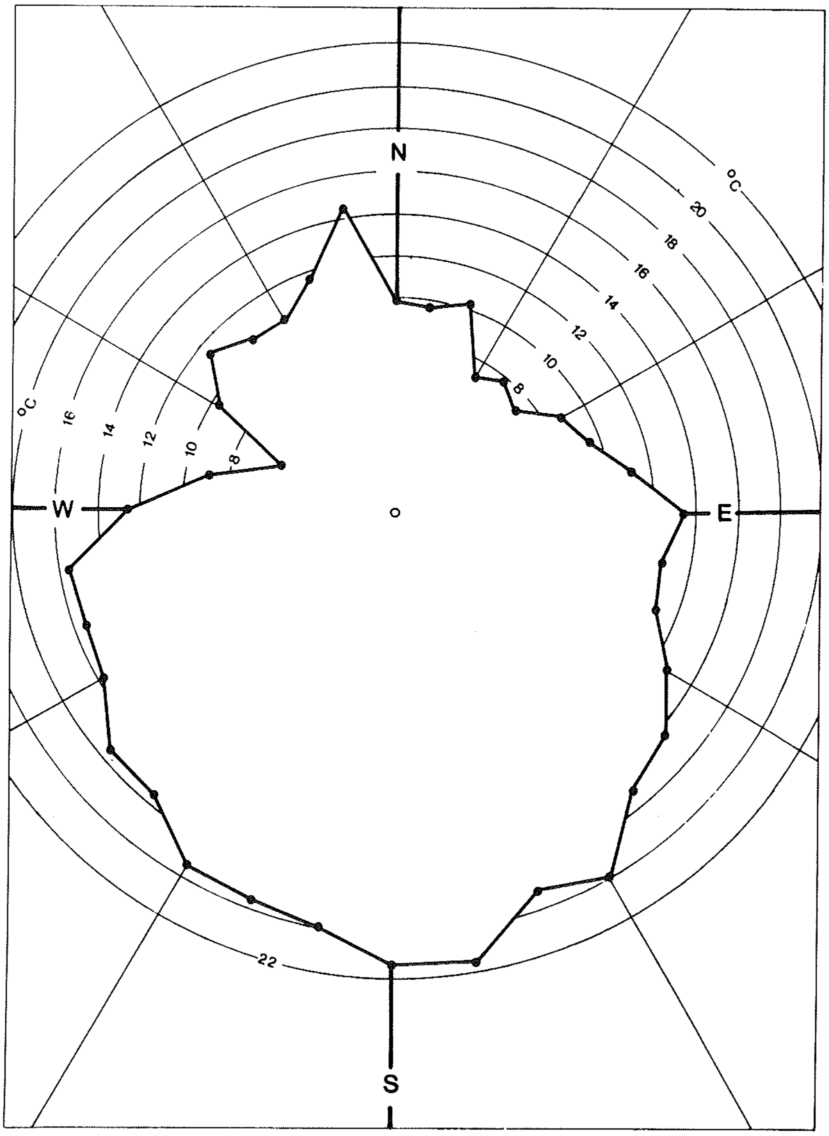

Figure 4: Mean air temperature for different wind directions

Comparison of the annual course of monthly mean temperatures at GvN with the neighbouring Antarctic coastal stations (Figure 5) shows again the extreme "corelessness" of the 1981 winter at GvN with extraordinarily high July and August temperatures. Future continuation of the observations will smooth that picture to a certain degree. As far as mean annual temperatures are concerned comparison with Maudheim and Sanae or with the GvN record 1982-1985 indicates that the 1981/82 period had been an extraordinarily warm one (Schwerdtfeger, 1970, G. Koenig, 1983 and J. Schug, 1985, pers. communication).

1.3.2 Wind

As shown by Figure 6, monthly means of wind speed varied during 1981/82 between 7.3 m/s (February 1982) and 13.4 m/s (July 1981), the mean annual wind speed reached 10.4 m/s, which is far above corresponding values observed at the neighbouring coastal stations Sanae or Halley Bay (Schwerdtfeger, 1970). The yearly mean and the yearly variations are best comparable to conditions at Novolazarevskaya (70°46'S 11°49'E). During severe winter storms wind speed often exceeded 40 m/s, on the average at 17 days per month more than 15 m/s were reached.

Mean wind speeds for each direction sector and different periods are shown in Figure 7. Amounting to about 15 m/s, highest mean winds occurred throuhout the year with ESE winds, followed by WSW winds of 10 m/s on the average. Southerly winds reached typically about 6 m/s; regarding the directions from west to north, the number of cases is so small, that the means here may deviate substantially from their typical values. Judging by the available data, the mean winds are relatively low for these directions.

Yearly and seasonal frequency distributions of wind speed are presented in Figure 8. The GvN distribution is very similar to that of Maudheim, so that both may be judged to be of the "cyclonic" type.

The wind distribution may be divided into three groups: easterly, southerly and westerly winds. This general picture is suggested by Figure 9, showing relative frequencies of wind directions as observed during 1981/82. Throughout the year maximum frequencies are associated with easterly winds in front of approaching low pressure systems which underlines their dominant role for air transport over GvN, as highest mean velocities also occur within this sector.As has already been shown in the temperature observations, Figure 9 clearly demonstrates the increase of westerly winds in the summer half year.

As fas as can be judged from the few synoptic data, persistent southerly winds seem to be closely connected with a high pressure area over the Eastern Weddell Sea and adjacent regions of the continent. Certainly an "ice-sea" circulation system and katabatic wind components are of importance in this context.

The very rare northerly winds at GvN, are commonly associated with high precipitation and intensive advection of warm air masses.

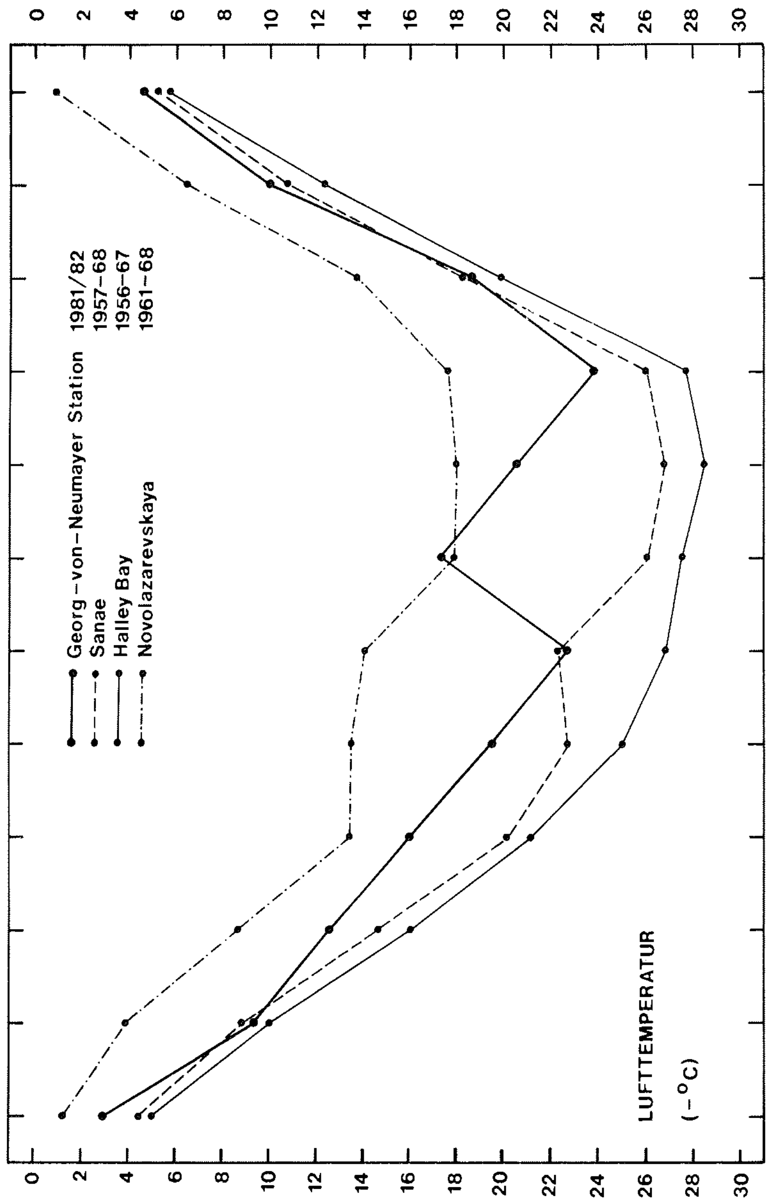

Figure 5: Monthly mean air temperatures at selected Antarctic coastal stations

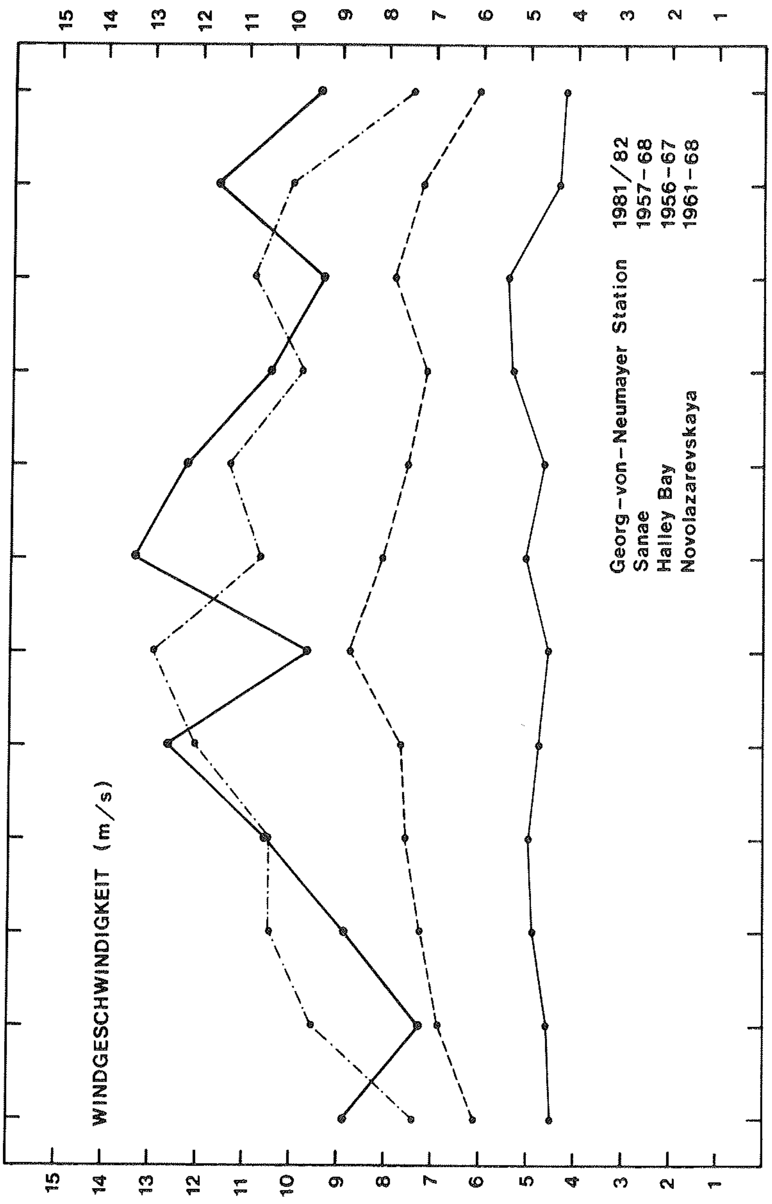

Figure 6: Monthly mean wind speeds at selected Antarctic coastal stations

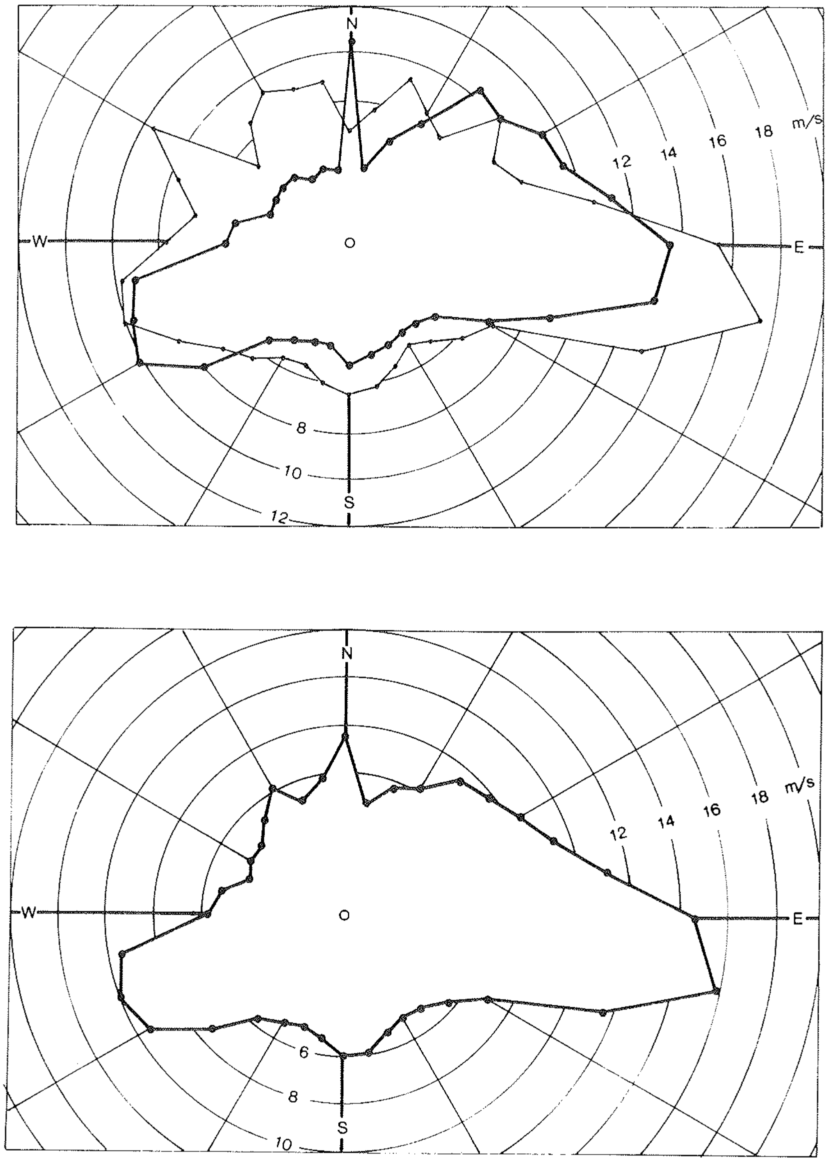

Figure 7: Mean annual and seasonal wind speeds for different direction sectors

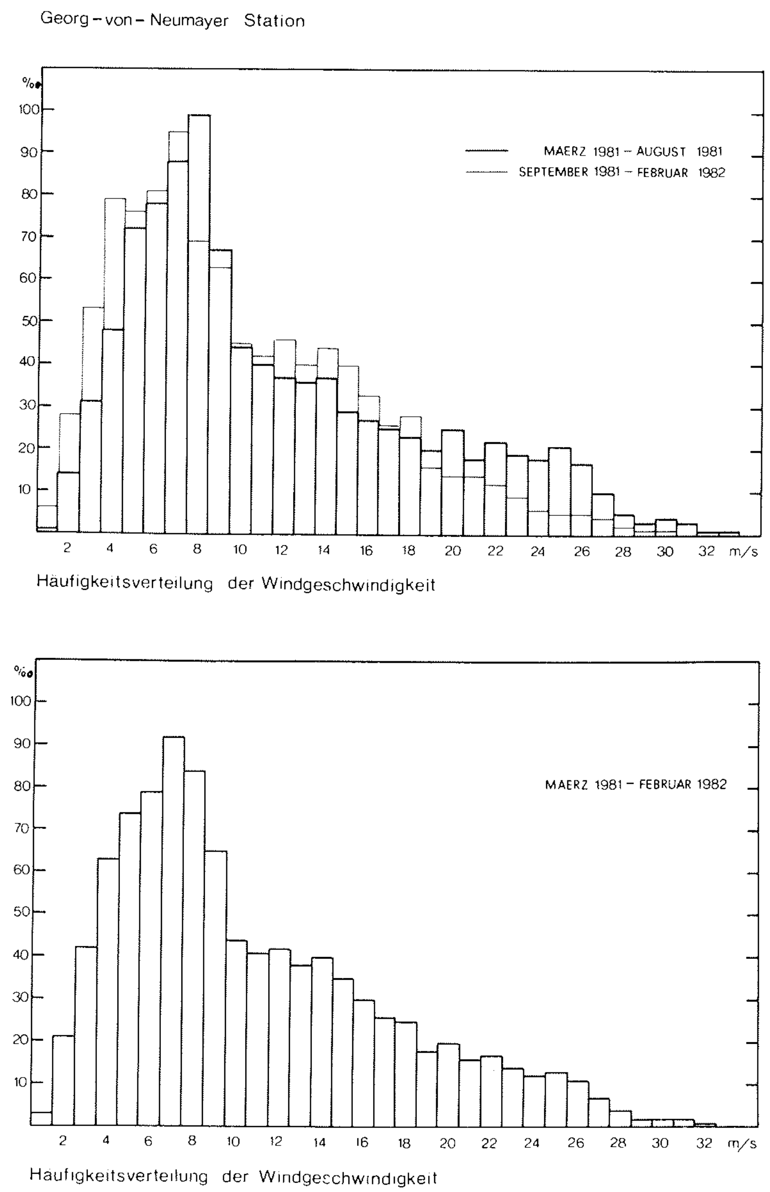

Figure 8: Yearly and seasonal frequency distributions of wind speed

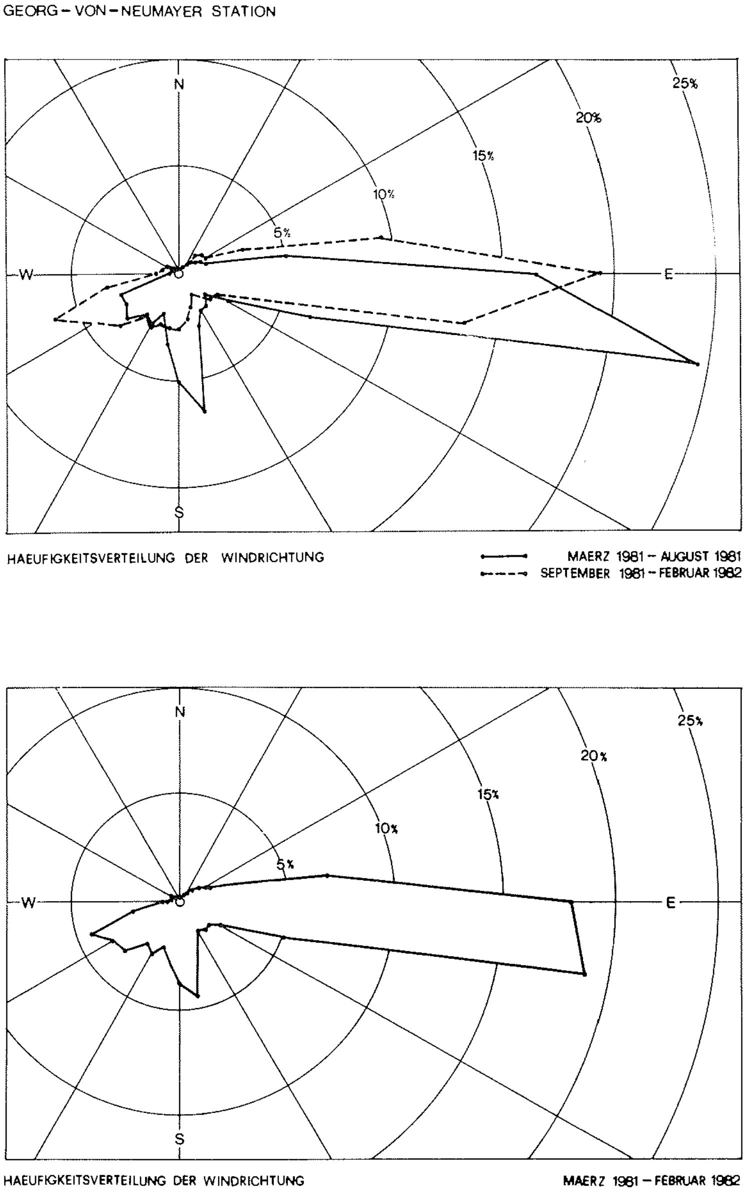

Figure 9: Yearly and seasonal frequency distributions of wind directions

During 1981/82 on 186 (49) days drifting snow from the east (west) has been observed, yielding together 235 days per year with drifting snow (Figure 10). This is an extremly high figure even for Antarctic coastal conditions (Schwerdtfeger, 1970). Easterly drifts most frequently occur during winter and spring months, whereas maximum frequencies of the generally weaker westerly drifts were observed during summer. Drifting snow is a common phenomenon for wind speeds exceeding some 8 to 14 m/s.

1.3.3 Pressure

The absolute maximum of mean sea level pressure during the 1981/82 period occurred at the end of a short intermediate high pressure period, reaching 1016.5 hPa on 15 August 1981. The absolute minimum of 946.9 hPa was observed, when the centre of an intensive south-migrating depression passed GvN directly on 9 December 1981. As shown in Figure 11, mean monthly sea level (MSL) pressure varied between 979.7 hPa (December) and 989.4 hPa (January), yielding an annual mean pressure of 983.5 hPa. Monthly means are subject to rather large month to month variations compared to the pressure recordings of neighbouring stations. This is certainly due to the dominating influence of synoptic processes on air pressure and the short observational period, both limiting the significance of the presented results.

1.3.4 Cloudiness

With a maximum of 6.4 octas and a minimum of 4.3 octas, the annual variation of the mean cloud amount at GvN is not very great. For the summer period, this one year record reflects the general picture at neighbouring coastal stations quite well, winter values remain relatively high with fairly irregular variations. The frequency distribution of cloud amounts is of "U"-shape (Figure 12), therefore cloud amounts near the mean values are not very suitable as a climatological characteristic. Considering daily variations of the mean cloud amount at GvN, only slight systematic changes during the sunlight season can be found. The total cloud amount (as well as the amount of low clouds) tends to be smaller with the generally weak southerly winds than with strong easterly and, particularly, with weak northerly winds. These facts are easily explained in terms of the characteristic changes of wind and cloudiness that occur, when frontal systems pass the GvN region. Accordingly, westerly winds are often connected with clear sky conditions. The dominating influence of the cloud cover on the radiation conditions will be dealt with by a detailed discussion of global radiation in the next section.

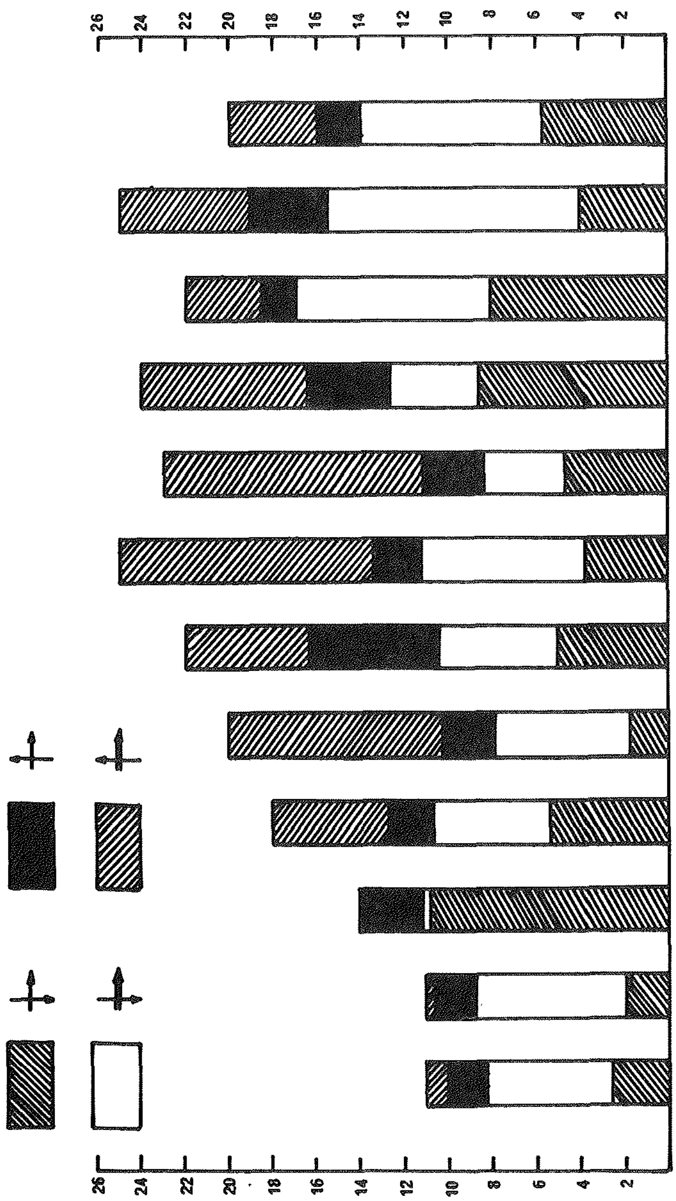

Figure 10: Number of days (N) with observed drifting snow and percentage shares of different snow drift weak to moderate (near surface), strong (near surface weak to moderate (high reaching), strong (high reaching)

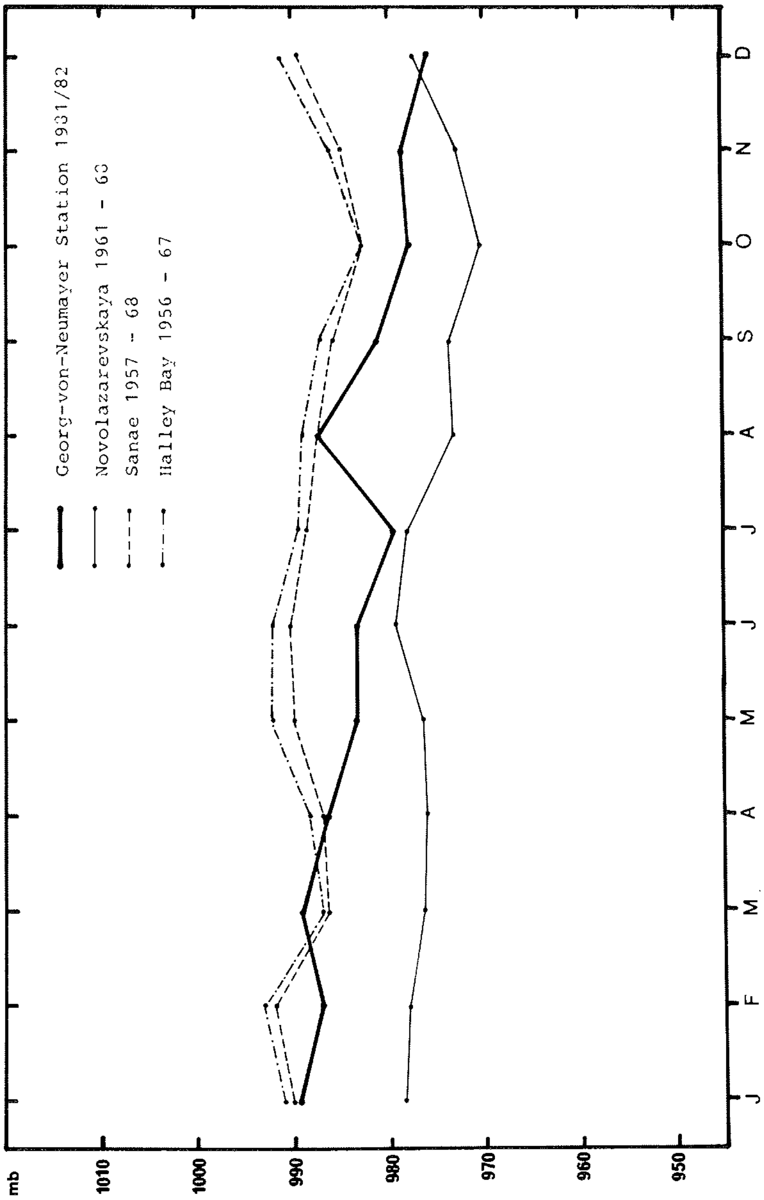

Figure 11: Monthly MSL air pressure at selected Antarctic coastal stations

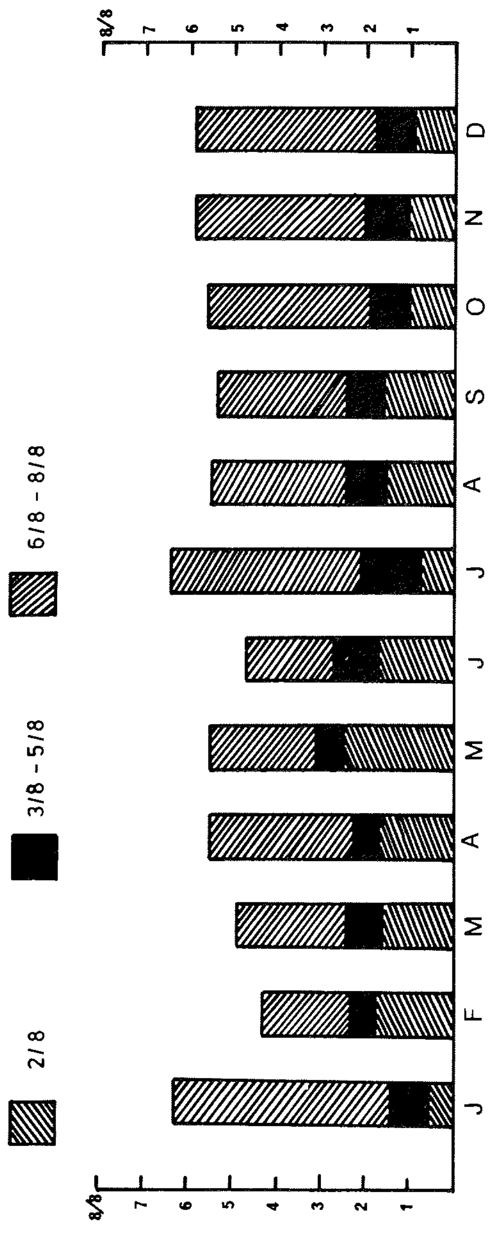

Figure 12: Mean monthly cloud amount (ordinate) and percentage shares for different classes of cloud cover (total column is 100 % each)

2. Global radiation

2.1 Introduction

2.1.1 Measurement period

Shortwave radiation fluxes were recorded at GvN as part of the meteorological programme. Continuous data were obtained from March 1981 to February 1982; the measurements were continued and extended by the following overwintering team (G. König, J. Kipfstuhl). The data set is nearly continuous except for gaps due to building operations at the base during 19 and 20 January 1981.

2.1.2 The measuring site

The radiometers were mounted at the meteorological mast situated at the southeast corner of the base. The corresponding height of the instruments was 2 m above the foot of the mast, i.e. 4 m above the ridge of the tube and 9 m above the undisturbed snow surface in the vicinity of the base. The extension of the access shafts in January 1982 led to a new instrument height of 11 m above the surface. Errors in measurement of global radiation caused by partial shading of the instruments through the mast could be easily identified and safely corrected by interpolation, as they never lasted more than a few minutes.

2.1.3 Units

Calibration of the used instruments and evaluation of the recordings were performed in terms of SI-units following the recommendations of the International Pyrheliometer Comparisons (IPC IV) in Davos, 1975 (Froehlich, 1977, Bolle, 1982). The mean value of the solar constant was taken as 1370 W/m^2 (Bolle, 1982).

2.1.4 Astronomical conditions

Solar altitudes, maximum posible sunshine duration and extraterrestrial solar irradiance were calculated for the geographical coordinates of GvN (70°37'S 8°22'W). Influences of atmospheric refraction were considered to be small and have been neglected. Hourly and daily sums of extraterrestrial insolation at actual solar elevation have been calculated using the Milankovitch formula.

The most striking astronomical features at GvN are summarized as follows:

- maximum solar altitude: 42.7° at local noon of 22 December
- minimum solar altitude: -4.2° at local noon of 21 June
- sun stays above the horizon from 19 November to 24 January
- sun stays below the horizon from 17 May to 27 July
- maximum daily sum of extraterrestrial insolation:
  45.0 MJ/m^2 on 22 December

The isopleth diagram in Figure 13 gives an idea of the light conditions in different seasons at GvN.

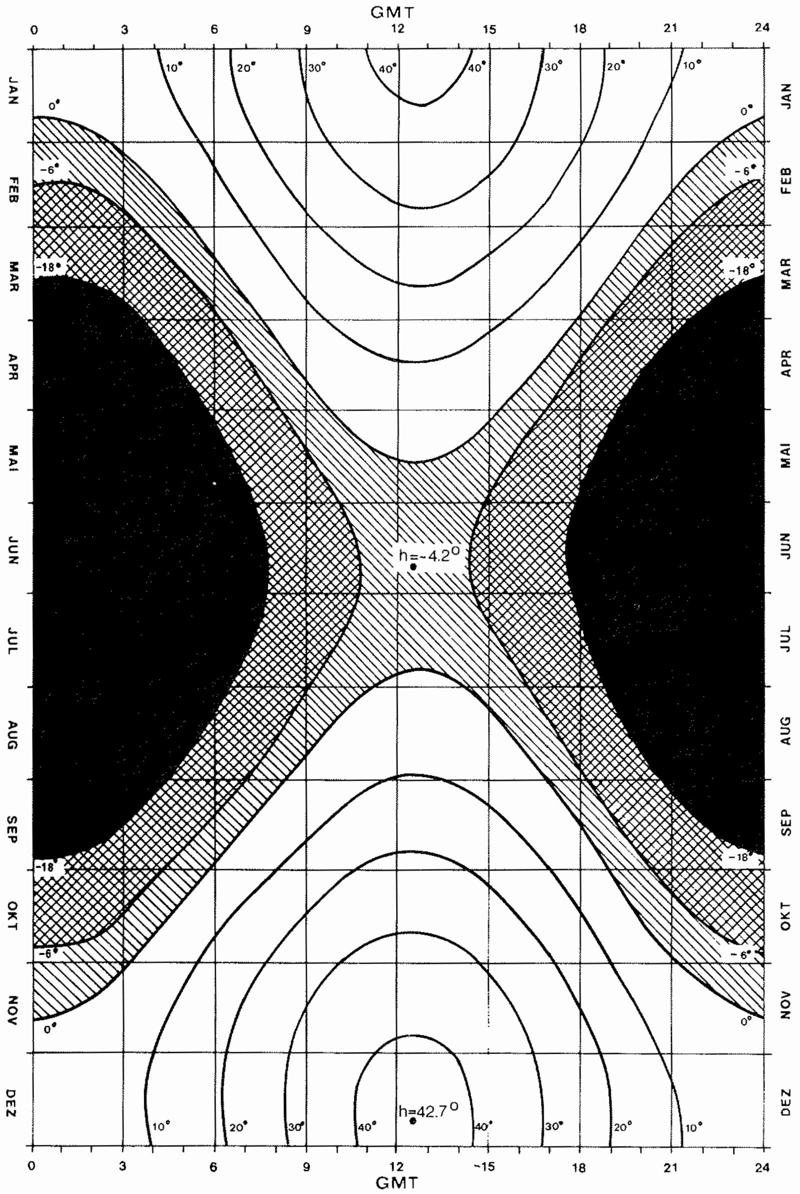

Figure 13: Solar elevations at GvN (without refraction)

2.2 Instrumentation, calibration and evaluation procedure

2.2.1 Instruments

Global radiation was measured with an Eppley pyranometer of type PSP No. 20313 F3. The recording device, a compensated analogue printer STDB 63 (Schenk, Wien) was installed within the base, a recording interval of 2 minutes per scan was chosen. Actinometric measurements for calibrations of the pyranometers and for calculation of the direct solar and diffuse radiation components were performed with a Linke-Feussner Panzeraktinometer (Kipp & Zonen, cCM1 No. 660133) and monitored with an adapted needle galvanometer (Gossen No. 267-631) and with a digital multimeter (Philips).

2.2.2 Calibration

Sensitivity as well as temperature dependence of the used actinometer have been last determined in 1969 in Davos. Repeated comparisons at the Meteorological Institute in Innsbruck during winter 1983 with the recently at Davos recalibrated Panzeraktinometer CM1-78 showed that the sensitivity of the CM1-66 should be corrected by 2.9%. Reasons for this correction are ageing of the thermopile and of the filters. Temperature dependence remained unchanges within this period.

Evaluation of the presented data was performed with a sensitivity of 19.89 V/Wm^{-2} at 0°C and a temperature dependence of -0.13%/°C. For measurements with the Gossen millivoltmeter, a sensitivity of 11.65 V/Wm^{-2} at 0°C was assumed by taking intrinsic resistance into account.

For the Eppley pyranometer the manufacturer gave a sensitivity of 10.97 V/Wm^{-2}, which should be nearly independent of temperature due to suitable combination of temperature dependent intrinsic resistors. Careful field calibrations during 1981 at GvN using the shading method at different solar altitudes, azimuths and instrument temperatures indicated that the sensitivty specified by the manufacturer had to be corrected by 17.4 % for solar elevations greater than 15°. Significant influences of instrument temperature or orientation were not found.

Calculation of several radiation components, e.g. the remarkably constant relation of global clear sky radiation to extra-terrestrial insolation on the basis of hourly and daily values, was used as a first test of this correction. These calculations confirmed the new calibration factor gained by the shading method. With these experiences the evaluation of the presented data was performed using a corrected sensivity of the PSP 20313 F3 of 9.06 V/Wm^{-2} independent of solar position and instrument temperature.

2.2.3 Evaluation of radiation data

Evaluation of mean hourly global radiation was done by graphic integration of the 2 minute recordings, which first had to be corrected for disturbances caused by radio signals and by snow and rime deposition on the glass hemisphere of the pyranometer. Thin layers of hoar frost or rime seem to increase the signal by increasing the diffuse scattering of the direct radiation. The diffuse sky radiation, however, is normally decreased in the presence of frost or rime (Liljequist, 1956, Hoinkes, 1970). Extreme falsifications of the signal were observed at clear sky conditions with prevailing south wind producing hoar frost only at the windward side of glass hemisphere, which gave rise to additional reflection of the direct solar radiation to the sensor.

Similar conditions were observed during weak west drift with bright sunshine and corresponding snow and rime deposition at the westerly portion of the glass hemisphere, typically producing greatest errors during morning hours. During periods of heavy driftless snowfall or during snow storms no substantial deposition of snow or rime was observed. The instruments were checked several times a day, and hoar frost and rime were carefully removed.

2.3 Results

2.3.1 Global radiation extremes

Extreme values were recorded on days with broken cloud coverage, clearly reflecting the great influence of increased diffuse sky radiation due to multiple reflection between the snow surface and the cloud base (Haurwitz, 1948,Deirmendjan and Sekara, 1954, Liljequist, 1956, Möller, 1965, Kuhn, 1973). Maximum daily sums of global radiation were strongly correlated with clear sky conditions. Extremely high daily sums of global radiation were observed on days with westerly winds, clear sky and weak snow drift, which might also be an indication for changed turbidity conditions connected with such an air mass. Extremely low values of global radiation occurred on days with overcast sky (As op, Ns), strong easterly snow drift and snow fall (Figure 14, Figure 15).

2.3.2 Global radiation and cloudiness

The amount of radiation below a cloud is mainly determined by the high albedo of the latter, but also by the absorption of radiation within the cloud. Reflection as well as absorption depend on the cloud's thickness, liquid water content and dropsize distribution. Additional multiple reflection within the cloud and between the cloud base and the snow surface complicate the problem. In most cases the reduction of global radiation by clouds cannot be predicted unambiguously. Figure 14 and 15 show the rather large scatter of data points for the dependance of global radiation from cloud coverage.

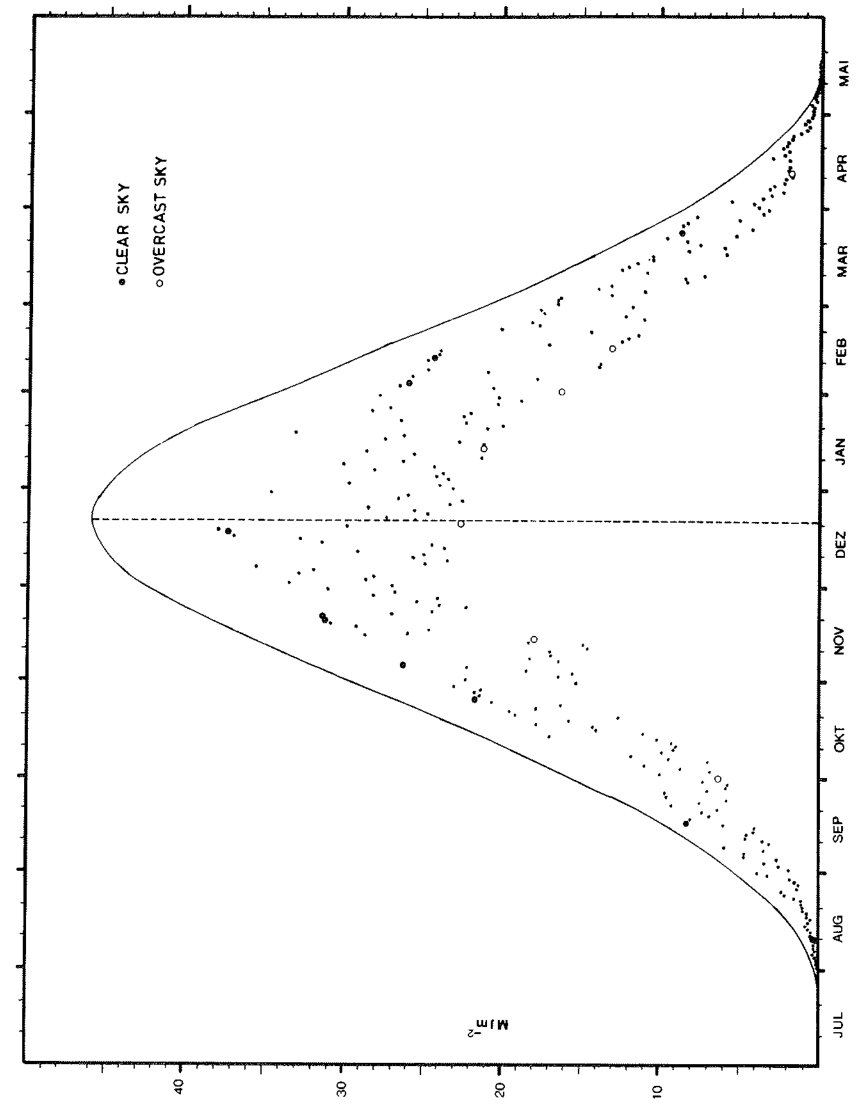

Figure 14: Daily totals of extraterr. insolation resp. global radiation at GvN

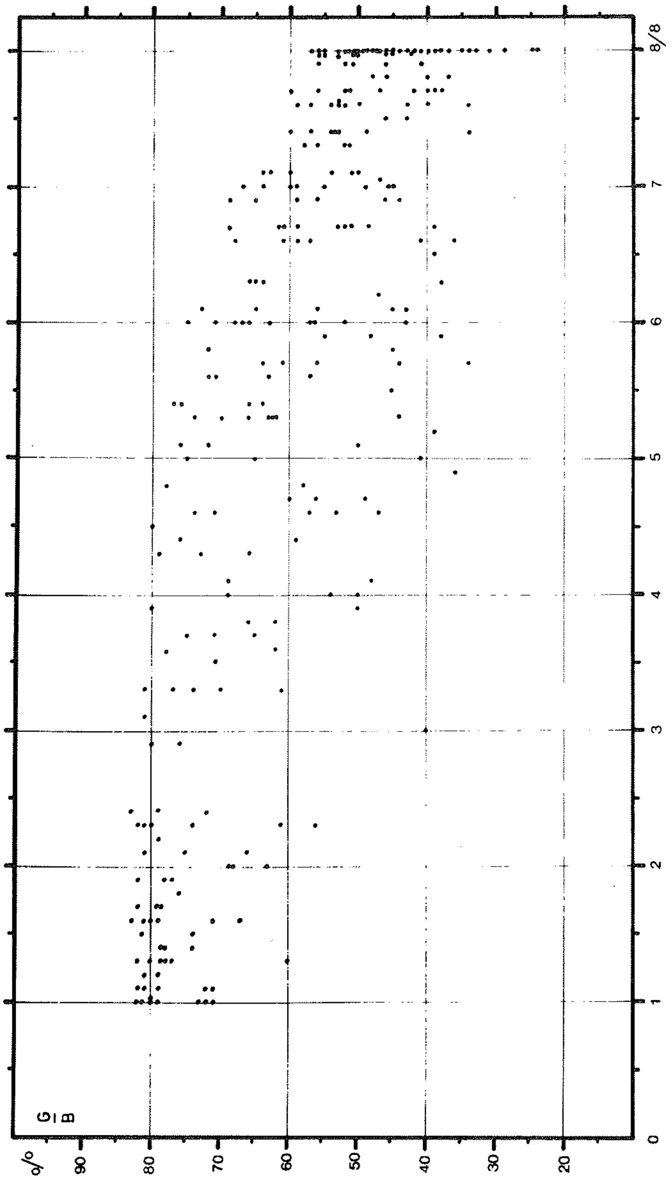

Figure 15: Ratio of global radiation to extraterr. insolation
(G/B) versus cloudiness, based on mean daily values

Except in early spring and late autumn, the clear sky global radiation typically reaches 80 to 83 % of the daily extraterrestrial insolation (Figure 16). For the entire sunlight period 81 % is a representative value. Liljequist (1956), Weller (1957) and Kuhn (1975) report corresponding relations for other Antarctic stations, showing that G/B seems to vary comparatively little with latitude.

Considering the global radiation at days with overcast sky in Figure 16, the ration G_8/B shows summer maxima around 50 %, decreasing to 30 % for spring and autumn. On the average, G_8 reaches 58 % of the assumed intensity with clear sky conditions. Similar relations G_8/G_0 have been reported from the Maudheim region by Liljequist (1956). Daily variations for selected periods at GvN are given in Figure 17.

Global radiation with a dense overcast is almost three times greater over an extensive snow field in polar region than over dark ground or open sea. Natural manifestations are two features, which are well known to every polar traveller - the dark sky off the coast and the feared polar white-out.

2.3.3 Yearly variation of global radiation

Figure 18 shows the variation of the ratio of extraterrestrial insolation to the measured global radiation throughout the year. The monthly means reach maximum values around 65 % in spring and autumn. This may be explained by the increased transparency of the atmosphere in spring due to decreased vapour and aerosol concentration, when the distance to the open sea is greatest. The autumn maximum seems to be caused by the decreased cloudiness in February and March, representing the climax of the calm summer climate. This general trend is reflected in other climate parameters, too: February and March have lowest average wind speeds and more sunshine intensive west-weather periods, which are connected with a marked decline of persistent heavy snow drifts from the east.

Mean monthly diurnal variations of the global radiation are given by Figure 19. Comparison of GvN data with those from Maudheim shows good agreement of monthly totals with the exception of somewhat lower November and December values. These spring values are responsible for the lower yearly total at GvN, amounting to 3.89 GJ/m^2, although the extraterrestrial insolation at GvN is higher than at Maudheim. The radiation conditions at GvN are more comparable to those of Novolazarevskaja (70°46'S 11°49'E) (Schwerdtfeger, 1970). This somewhat more "maritime" position (in a synoptic sense) as compared to Maudheim and neighbouring Antarctic coastal stations seems to be evident also from radiation measurements reflecting local cloudiness and turbidity conditions.

According to Kuhn et al. (1977), for coastal stations north of 72°S monthly total of December represent about 22 % of the yearly total of global radiation. With 23 % this relation is found to be true also for conditions at GvN.

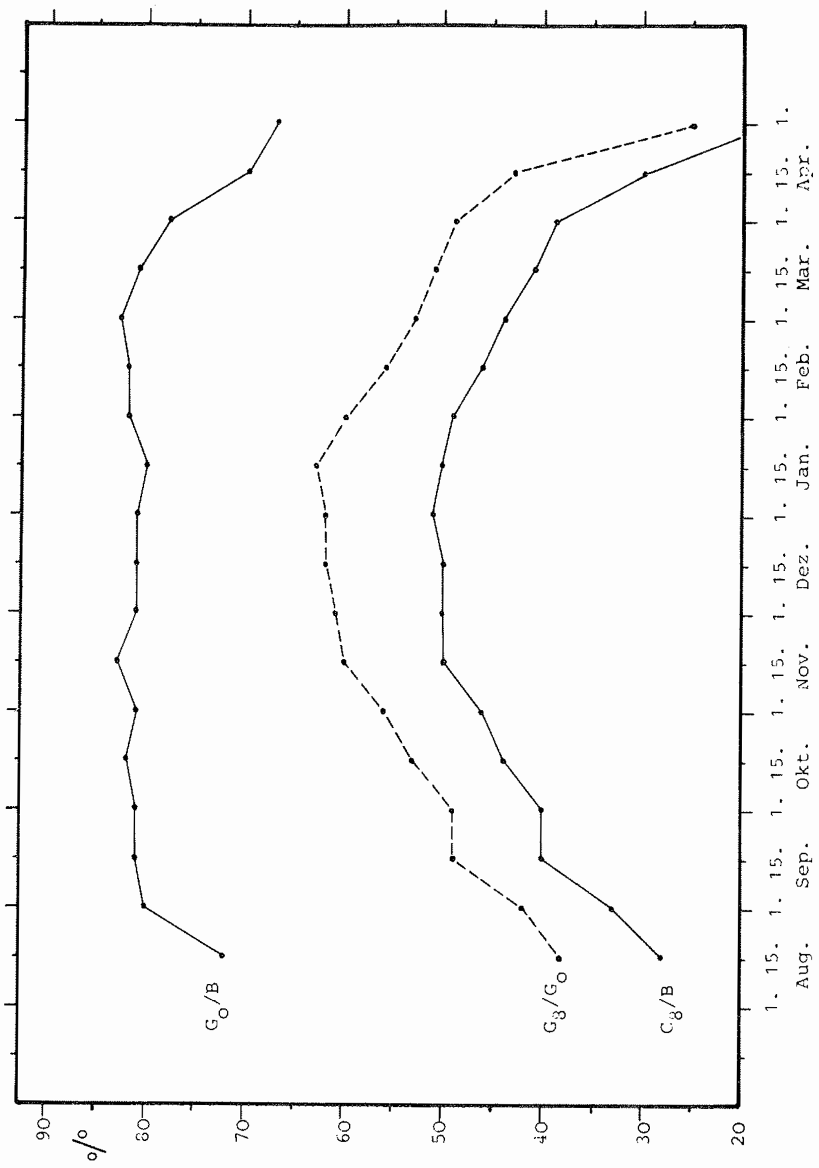

Figure 16: Bimontly values of relations between global radiation on clear days (G_o), global radiation on overcast days (G_8) and extraterr. insolation (B) based on 'normal values' (i.e. ideal values recorded in the absence of snowfall or snow drift)

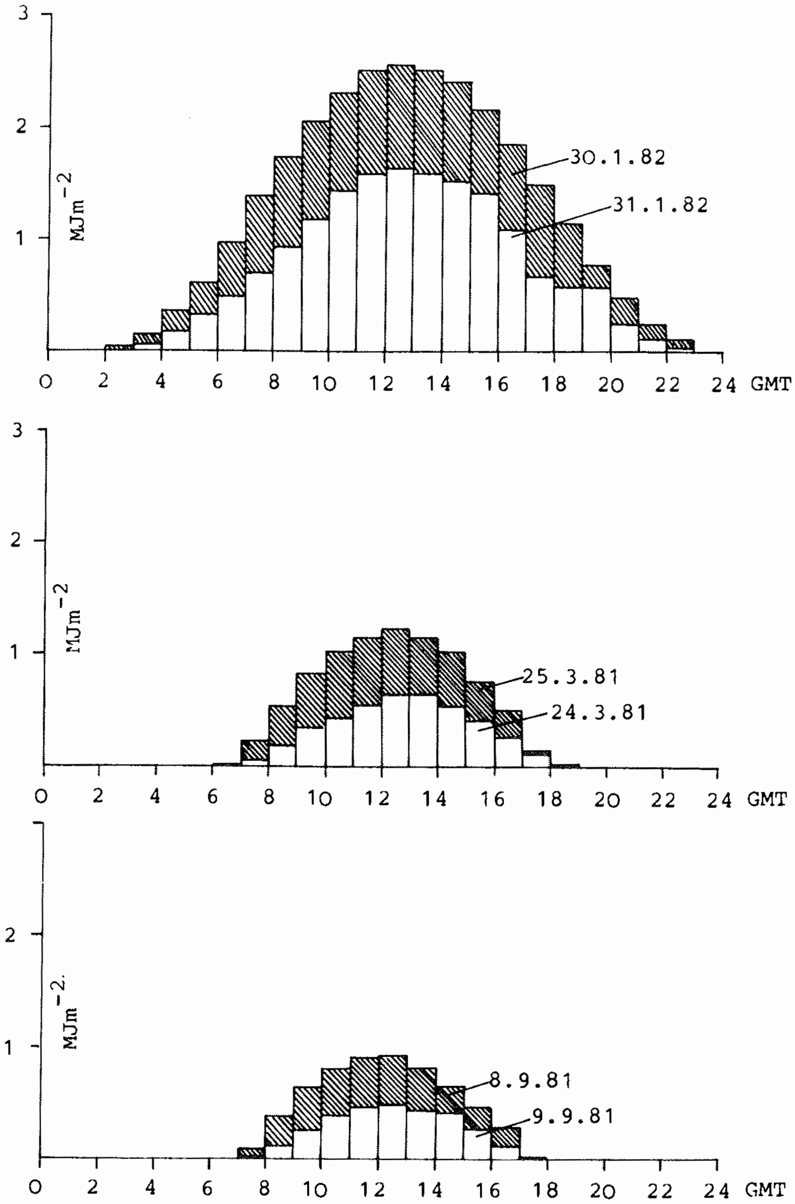

Figure 17: Daily variation of global radiation on successive clear and overcast days

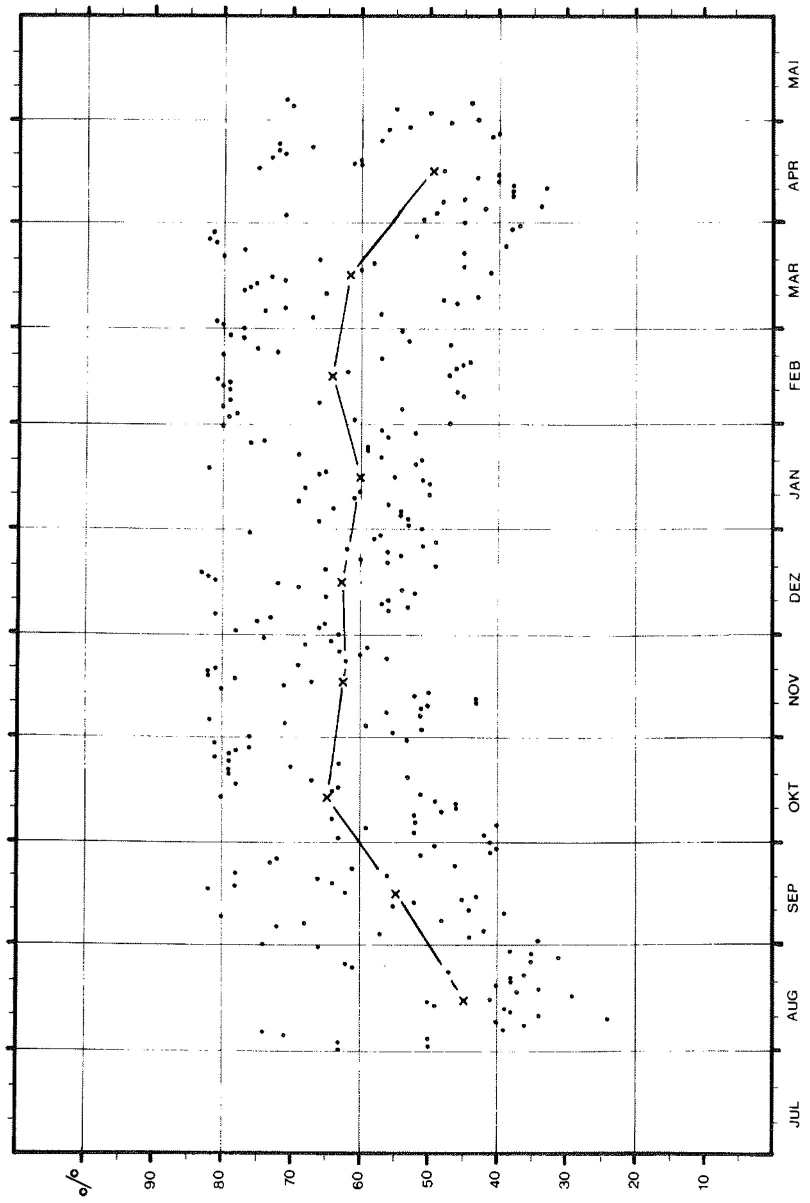

Figure 18: Annual course of the ratio global radiation (G) to extraterrestrial insolation (B)
crosses: monthly mean values

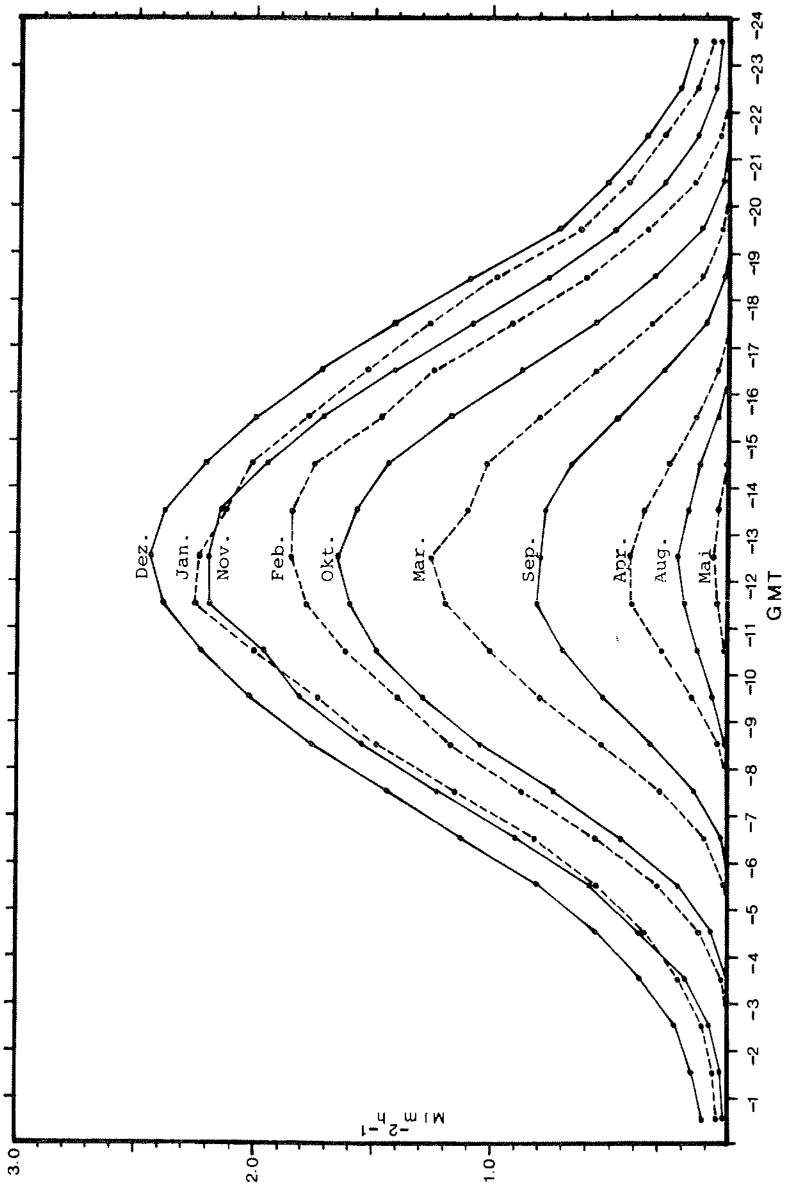

Figure 19: Mean daily variation of global radiation

2.3.4 Diffuse clear sky radiation

By screening the pyranometer from direct solar radiation, a great number of readings of diffuse clear sky radiation was obtained for different solar altitudes and turbidity conditions. Typical diurnal variations are demonstrated for 3 February 1982 in Figure 20. Noon values amount to 97.1 W/m^2, corresponding to 14 % of the measured global radiation. Concerning daily totals, the diffuse radiation D amounts to 17 % of the global radiation G on the average.

The dependence of the ratio D/G on solar altitude h is shown in Figure 21. The increasing contribution of diffuse radiation to global radiation at larger relative air masses m may be represented fairly well by a linear regression of the following form:

$$D/G = 0.1 + 0.029\, m \quad , m = \sec \zeta \quad , \zeta \text{ : solar zenith angle}$$

This implies that at m = 31.0 (=88.2°) all incident radiation is diffuse.

Comparisons with other Antarctic stations (Figure 22) confirm the supposition that at GvN as a coastal station the fraction of diffuse sky radiation is higher than at inland stations (Kuhn et al., 1977). This is essentially due to a higher aerosol concentration and to an increased Rayleigh scattering, which is proportional to surface pressure. Moreover, the value of 14 % for the ratio D/G may be noted as a further indication for the mentioned "maritime" position of GvN. The agreement of GvN and Maudheim data is remarkable, the latter showing typical summer values of 17 % for D/G. The conformity of the presented data is also shown by comparison with Rusin's (1961) summary, revealing that at most Antarctic coastal stations 12 - 15 % of the clear sky global radiation are diffuse sky radiation. Similar figures were reported for Arctic stations by Diamond and Gerdel (1956), Holmgren (1971) and Ambach (1963), Ambach and Markl (1983).

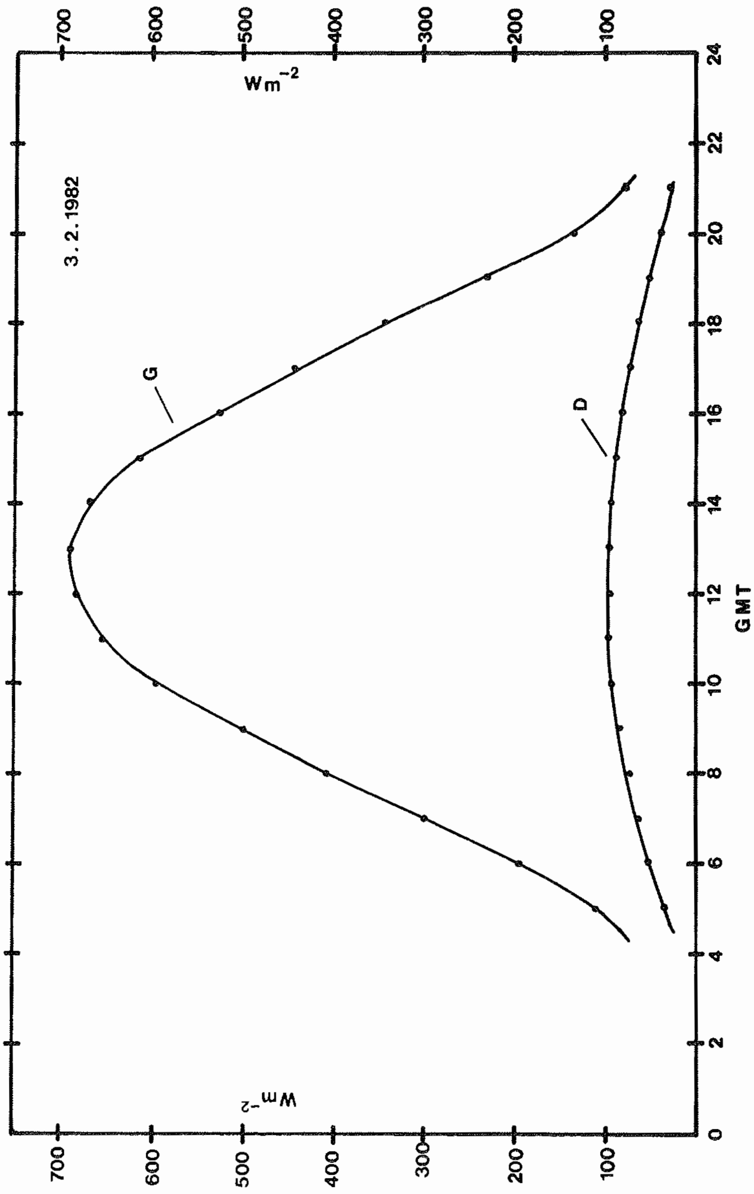

Figure 20: Daily variation of diffuse clear sky radiation D resp. global radiation G as shown by mean hourly values from 3 February 1982

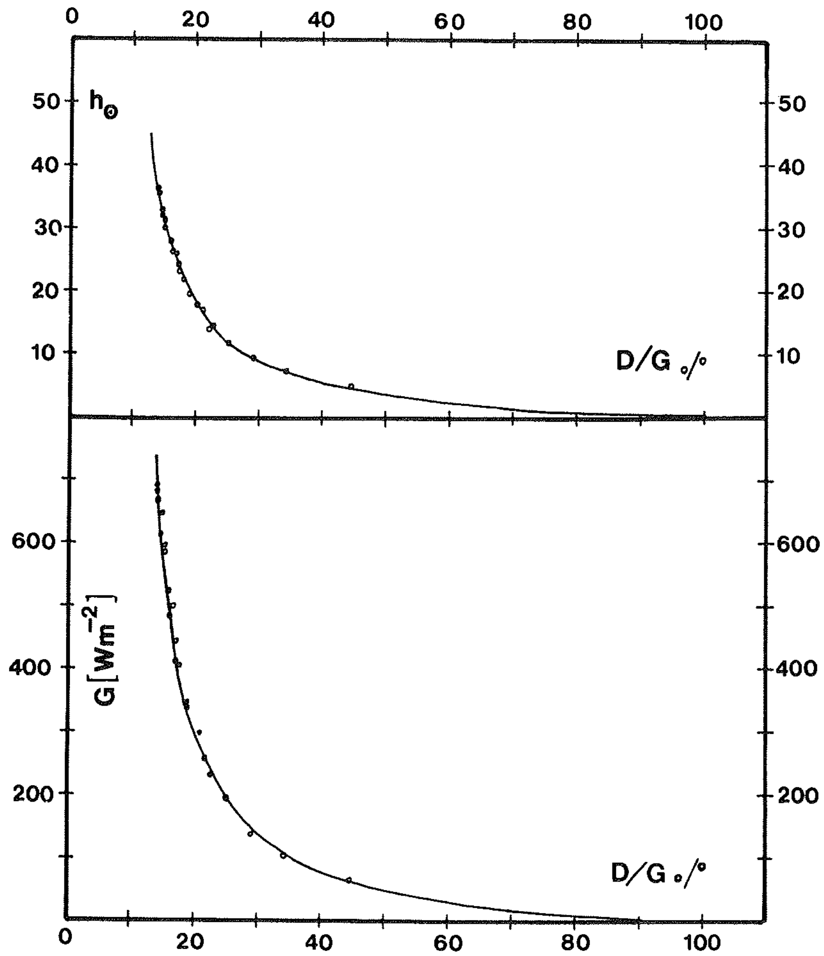

Figure 21: Ratio of diffuse clear sky radiation D to global radiation G versus global radiation G resp. solar elevation h

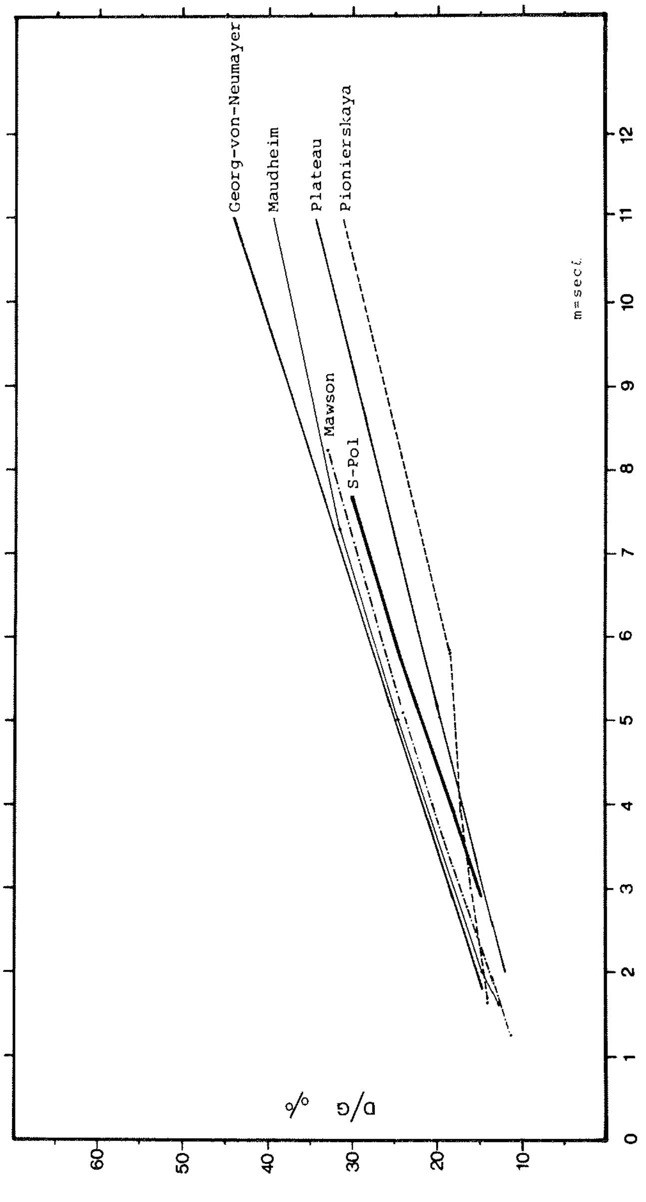

Figure 22: Ratio of diffuse clear sky radiation D to global radiation G versus relative air mass ṁ at selected Antarctic stations

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