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The effect of wind direction and orography on air temperature at the „Arctowski" Station

ABSTRACT: The frequency of wind occurrence at sectors each 30° as well as mean air temperature at particular wind direction were accounted for the warmest and the coldest year of the investigation period 1978—1987 at Polish Antarctic „Arctowski" Station. The effect of orography on wind direction and air temperature was determined. A great rate of dependence of air temperature and wind direction upon atmospheric circulation type was found. High air temperature at the winds from 300° and 330° directions is related both to the kind of air mass and foehn phenomena.

Key words: Antarctic, South Shetland Islands, air temperature, wind direction.

Introduction

The depression activity plays the most significant role in shaping the meteorological conditions of South Shetland Islands. The low pression areas pass very often and result in quick changes of wind direction and cold and warm periods of short duration. There are considerable differences in character and rate of the atmospheric circulation during the years, so the weather conditions the same month in different years may remarkably deviate. The greatest differences occur in the cold period (Milašenko 1976, Nowosielski 1980, Stepko and Wielbińska 1981, Schwerdtfeger 1984).

At South Shetland Islands and Antarctic Peninsula the frequency of calms depends on the covering degree of the station (Kolosova 1976). The orientation of mountain chains morphological axes strongly influences the distribution of wind directions. The height of these mountain chains under certain conditions causes air temperature increase. This increase may reach 1—5 deg at Marguerite Bay (Pepper 1954, Schwerdtfeger 1975) or 2.5 deg at Admiralty Bay station (Burdecki 1957). High temperature increase (4.4 deg) as an effect of foehn winds were noted also at Ezcurra Inlet (Kowalewski and Wielbińska 1984).

The aim of this paper is to answer how the diversified relief of the surface of King George Island and the „Arctowski" Station situation influence the air temperature and wind directions distribution at this station.

Methods

It was assumed that during the year with predominant meridional atmospheric circulation higher temperatures do occur than with predominant zonal circulation (Milašenko 1976, Styszyńska 1985). From the decade 1978—1987 of our investigations at „Arctowski" Station two years were chosen: 1985 as the warmest and 1980 as the coldest one. In 1985 July, October and November had the highest mean temperatures and in 1980 April, August, September and November had the lowest mean temperatures in this decade (Fig. 1).

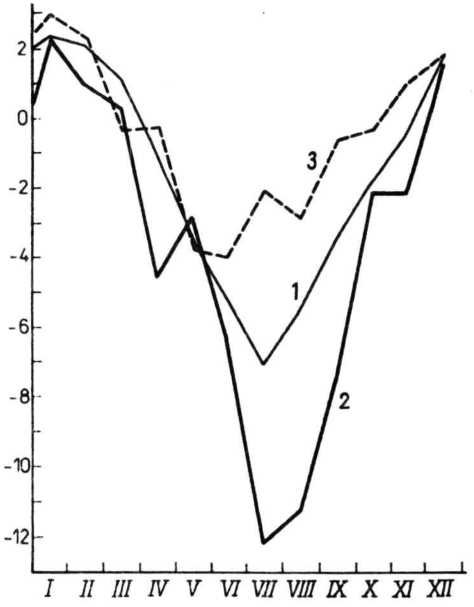


Fig. 1. Mean month's temperatures in the decade 1978—1987 (1), in 1980 (2) and in 1985 (3).

In order to illustrate the dynamics of changes of investigated parameters thermal wind roses for respective months were constructed basing on standard meteorological observations resumed every 3 hours („Arctowski" meteorological annual 1980 and 1985, unpubl. data). They show the frequency of occurrence of the wind blowing from the direction of particular sectors (each

30°) and the deviation of the air temperature measured at this particular wind direction from the mean month's temperature. Standard temperature deviations were calculated for particular wind directions. This analysis was carried out only when the frequency of wind occurrence from the particular direction was not lower than 3%. Observations of atmospheric pressure and air humidity parameters were applied to determine the effect of orography upon air temperature.

Results and discussion

1. The influence of Admiralty Bay orography upon the shaping of wind system

The „Arctowski" Station is situated on King George Island at SW coast of Admiralty Bay, at the marine terrace 3 m above sea level. The bay has a character of deep fiord, surrounded by the elevations of ice dome from 300 to 650 m above sea level.

The longer morphological axis of the island is oriented along SW — NE line. The „Arctowski" Station is situated at the intersection of two great systems of valleys. The first of them is the fiord system of Ezcurra Inlet and Martel Inlet. The valley between Arctowski Icefield and Warszawa Icefield forms its continuation in WSW direction towards Maxwell Bay. The depression between the main ice dome of the island and Kraków Icefield joins Martel Inlet with King George Bay situated in ENE direction. The second great system of valleys make Admiralty Bay and Mackellar Inlet. It is connected with Usher Glacier in the northern part of the island by the depression between the main ice dome and Kraków Icefield. The main axis of this valley is oriented along NNW — SSW line (Fig. 2). Throughout a year the South Shetland Islands region is influenced by the col formed by subtropical and antarctic high pressure ridges and the lows coming from Bellingshausen and Weddell Seas. Considering the predominant western atmospheric circulation and the winds blowing from western and northern sectors the island is an important obstacle in the air flow (Schwerdtfeger 1984, Marsz and Suszczewski 1987). In this situation the valleys are the best ways for the air flows from the tops of the ice domes. Foehn and katabatic winds occur which is observed at the Station at the N, W and SW wind directions (Kowalewski and Wielbińska 1984). These phenomena are evident also in the air flow structure (Kowalski 1985).

The hipsometric profiles for particular directions are shown in fig. 3. Winds coming from the directions 300° and 330° have to cross the highest elevations of the altitude of 600—650 m. Similar altitudes but more distant, 12—15 km from the Station, are situated in 000° and 030° directions.

In the case of humid air flow (relative humidity ≥80%) its temperature at the lee side may increase by 0.5 to 2.5 deg as a result of pseudo-adiabatic processes. The temperature increase is more apparent at the winds from the

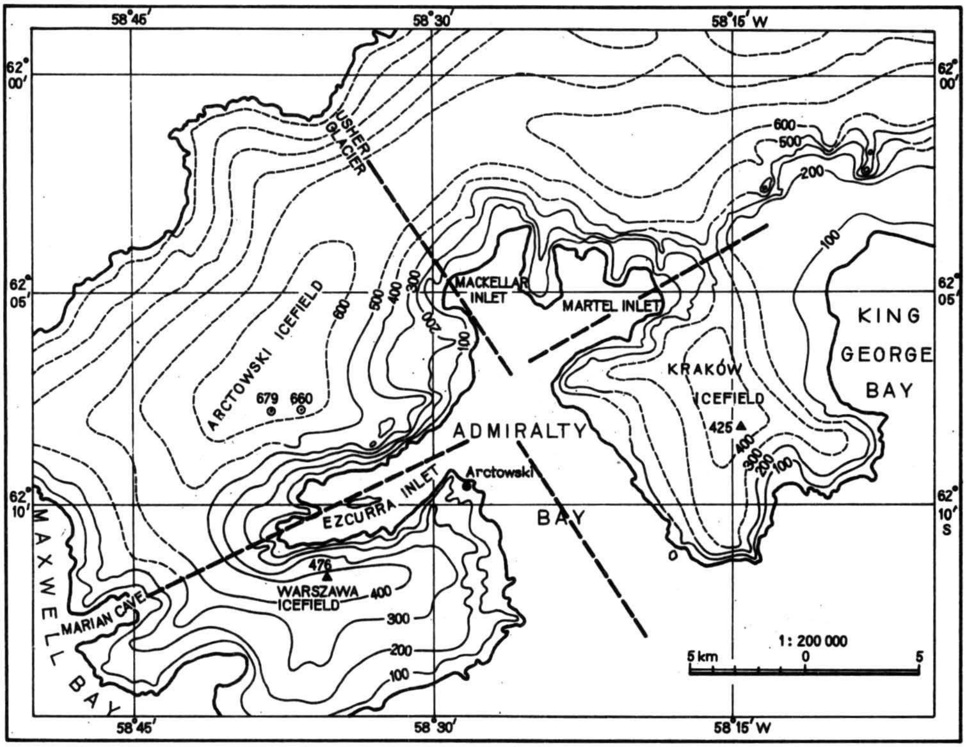


Fig. 2. The „Arctowski" Station area. The axes of principal valleys are shown.

directions 300° and 330° than 000° and 030°. In the first case the Station is separated from the steep edge of the Arctowski Icefield only by the water of Ezcurra Inlet, about 3 km wide. In the case of northern and north-eastern winds the air after passing through the central part of the island flows over the waters of Mackellar Inlet or Martel Inlet. The temperature of their waters in summer is about 1.5°C, while in winter they are covered with ice. Consequently the air previously heated through descending process often cools again after passing over the bays a distance of 10—12 km. At these wind directions at „Arctowski" Station the temperature changes caused by orography only rarely occur, whereas at Admiralty Bay station they were evident (Burdecki 1957).

At the winds from W and SW directions the air has to cross the Warszawa Icefield, which is lower (400—450 m above sea level). The orographical phenomena will occur rather rarely, unless at high air humidity ($f \geqslant 85\%$). The lee side temperature may increase by 0.5 to 1.5 deg. In this case the funnel effect of Ezcurra Inlet will increase the frequency of winds from 240° and 270° directions at „Arctowski" Station.

The air of properties unchanged flows from 120° and 150° directions from the Bransfield Strait region.

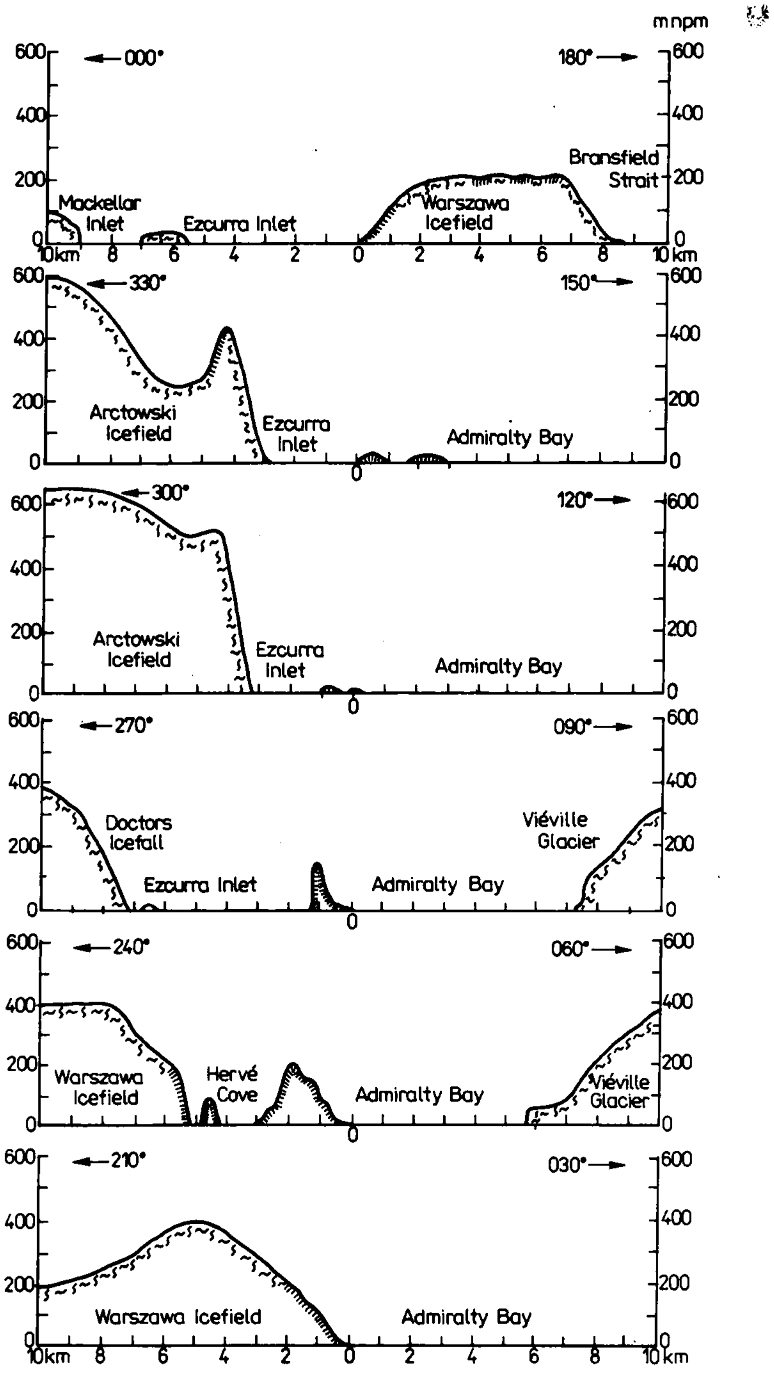


Fig. 3. Hipsometric profiles for particular wind directions. The „Arctowski" Station — 0 km.

2. Distribution of wind frequencies and directions

After reducing the wind frequecies distribution to four principal directions the predominance of western winds was noted: 1980 — 27.2% and 1985 — 10.5%, respectively. Next frequencies were: eastern winds (1980 — 25.5%, 1985 — 18.6%), northern winds (1980 — 18.3%, 1985 — 25.4%) and southern winds (1980 — 23.4%, 1985 — 15.2%). High wind frequency from E and S directions and frequency of calms in 1980 as well as remarkable wind grequency from W and N directions in 1985 is to be noticed.

In both investigated periods (1980 and 1985) winds from 230°—250° were predominant at the „Arctowski" Station reaching 15.0% and 22.6% within a year, respectively (Tab. 1). In 1985 these winds prevailed as long as 7 months, surpassing often 30% of wind frequency within the month (Tab. 2).

Within particular months of different years other wind directions may prevail than those from long-term mean direction. So during five-years period 1978—1983 in February the winds from 330° were predominant (13%) while in 1980 — 120° direction prevailed (17.5%) and in 1985 — 090° (15%). Also in September prevailing winds directions in 1980 (000° — 14.7%) and 1985 (330° — 24%) were remarkably different than five-years mean for 1978—1983 (240° — 16%).

Atmospheric circulation is mainly responsible for the distribution of wind frequency and direction. If at South Shetlands area a great number of shallow lows within the month do occur winds from 200°—250° sector prevail at „Arctowski" Station. The frequent occurrence of deep lows of Polar front origin gives the increase of the frequency of winds from the 260°—010° sector. In the case of well shaped and long-lasting highs the winds from eastern and south-eastern sectors appear to prevail and calms frequency increases as well.

The calms noticed in several consecutive observations are caused by anticyclonic weather. During the years of investigations the longest calms occurred 03—04.11.1985 (45 hours) and 24—25.07.1980 (30 hours). The noteworthy period was winter of 1980 particularly rich in calms (Tab. 1). During summers most calms were short lasting 1 or 2 observations. The calms in the mornings are connected with night heat radiation and cyclonic circulation. The calms in the nights occur mostly at highs.

3. The effect of temperature on the wind direction

The study of long-term mean values indicates that the warmest air masses come to „Arctowski" Station from NW (290°—340° sector) from the Drake Passage. In relation to mean season temperature they are warmer by 2 deg in summer up to 5 deg in winter. The coldest air masses come from 090° and 120° directions from Weddell sea. In comparison with the mean season temperature their temperatures are lower by 1.5 deg in summer up to almost 5 deg in winter (Wielbińska and Skrzypczak 1988).

Table 1

Frequency (in %) of winds from particular directions and of calms in 1980. N — number of observations; v.w. — variable winds.

Month	N	000°	030°	060°	090°	120°	150°	180°	210°	240°	270°	300°	330°	v.w.	calm
01	241	6.6	0.8	7.1	6.2	12.0	6.2	4.6	5.4	14.1	2.9	9.1	10.0	14.9	2.8
02	211	10.9	1.9	8.5	13.3	17.5	9.5	2.8	3.8	3.8	3.3	7.1	6.6	10.9	9.1
03	225	6.2	1.8	7.6	5.8	9.8	4.4	5.3	17.8	14.7	5.8	5.8	8.0	7.1	7.8
04	214	1.9	2.3	14.5	16.8	13.1	2.8	3.3	9.3	19.6	4.2	3.7	3.7	4.7	10.8
05	222	8.1	3.6	5.4	9.0	5.4	7.2	6.8	15.7	13.0	4.1	6.8	9.0	5.9	10.5
06	229	6.1	4.4	3.5	7.4	10.9	5.7	7.9	19.7	13.5	7.0	4.4	8.7	0.9	4.6
07	170	7.6	1.2	8.8	6.5	8.8	7.1	12.4	8.2	17.6	5.3	4.7	9.4	2.4	31.5
08	199	8.0	4.5	5.0	13.7	8.5	7.5	3.0	10.6	23.1	2.0	1.5	9.5	3.0	19.8
09	194	14.7	7.9	7.4	7.9	7.4	8.9	4.7	5.3	10.0	3.2	8.4	11.0	3.2	19.2
10	223	2.2	2.2	1.8	4.9	4.5	2.2	5.4	21.5	22.0	4.5	19.3	7.2	2.2	10.1
11	234	7.7	3.0	6.4	18.4	6.4	1.7	3.0	15.4	13.2	6.0	9.8	8.1	0.9	2.5
12	223	4.5	0.4	0.4	4.0	10.8	1.8	5.8	24.2	15.7	8.1	9.0	10.8	4.5	10.1
year	2585	7.0	2.8	6.4	9.5	9.6	5.4	5.4	13.1	15.0	4.7	7.5	8.5	5.1	9.6

Table 2

Frequency (in %) of winds from particular directions and of calms in 1985. N — number of observations; v.w. — variable winds.

Month	N	000°	030°	060°	090°	120°	150°	180°	210°	240°	270°	300°	330°	v.w.	calm
01	238	9.8	8.0	1.3	9.8	8.8	10.5	8.0	3.4	13.4	8.8	5.5	11.0	1.7	4.0
02	207	11.6	5.8	2.9	15.0	14.0	8.7	4.8	3.9	12.1	11.6	3.9	5.8	—	7.6
03	207	4.8	10.1	6.3	18.4	14.0	14.0	5.3	2.4	1.9	9.2	4.8	8.7	—	16.5
04	212	16.6	4.2	2.8	5.2	6.6	6.6	3.3	4.2	15.1	10.8	5.2	19.4	—	11.7
05	226	8.4	15.0	10.6	16.4	15.0	4.0	3.1	3.1	12.8	5.8	1.8	4.0	—	8.9
06	202	4.5	3.5	1.0	2.5	9.9	8.4	3.0	10.4	36.5	10.9	4.0	5.4	—	15.8
07	240	2.9	1.7	1.2	0.8	0.8	1.7	1.7	7.5	34.2	14.6	13.3	19.2	0.4	3.2
08	218	11.0	6.4	5.5	2.8	9.6	3.2	1.8	4.6	24.8	14.2	5.5	10.1	0.5	12.1
09	230	10.0	3.9	6.5	7.4	4.3	3.5	1.7	4.8	15.7	9.1	9.1	24.0	—	4.2
10	239	5.9	4.2	2.9	2.1	3.3	3.3	1.3	6.0	32.1	13.0	9.2	16.7	—	3.6
11	201	5.5	1.5	1.0	4.5	2.5	7.0	2.0	6.0	42.2	13.8	4.0	8.5	1.5	16.3
12	220	4.5	3.6	0.4	0.4	6.8	10.9	2.2	5.5	30.8	18.6	8.2	7.7	0.4	11.3
year	2640	8.0	5.7	3.5	7.1	8.0	6.8	3.2	5.2	22.6	11.7	6.2	11.7	0.4	9.6

The air temperature plotted as the function of wind directions in 1980 and 1985 is shown as a thermal wind roses (Fig. 4). The circle denoted „0" determines the mean air temperature for particular month. The deviations in „+" and „−" are related to the differences between the mean air temperature for this direction and mean temperature for this month.

In spring and summer (XI—II) mean air temperatures at different wind directions only slightly deviate from mean month's temperature. The greatest deviations occur in winter (V—IX).

Both in 1980 and 1985 the warmest winds came from 300° and 330° directions. The comparison of the deviation values allows to determine the influence of atmospheric circulation and local topography upon the air temperature.

3.1. Winter 1980

During the coldest winter of the decade 1978—87 the warmest winds blew from 300°, 330° and 000° directions (Fig. 4 F—I). In comparison with mean month's temperature they were warmer by 2 to 9,5 deg. These winds were related to the lows created at the Polar front. Polar maritime air masses, warm (+1 ÷ +2°C) and humid (79 ÷ 96%), coming from Drake Passage and south-eastern Pacific over the central ice dome of the island were heated through pseudo-adiabatic process by 0.7 to 1.8 deg. The average influence of the orographic factor upon this air mass in winter, at winds from NW and W, amounted to +1.6 deg. Only in June at the wind from 300° direction the air temperature was by 1.6 deg lower than mean month's value (−6.5°C). It is a result of great variability of air masses coming to the „Arctowski" Station from this direction, that change from Polar maritime to Antarctic continental ones with temperatures below −20°C (standard deviation 6.3). Moreover this air mass arrived over the Arctowski Icefield entirely dry.

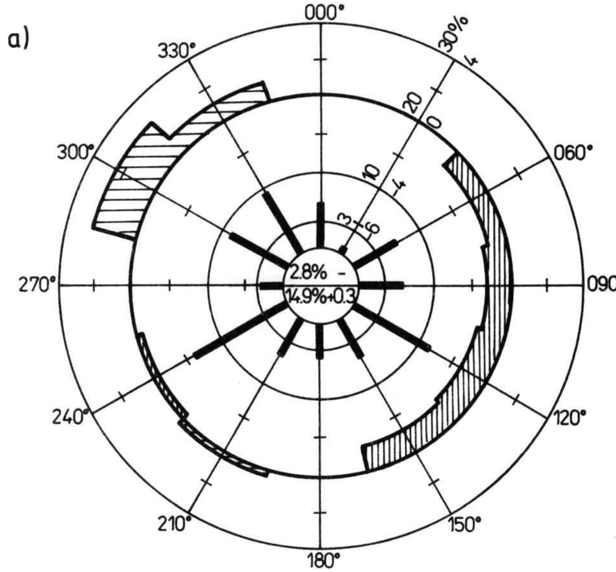
In June in South Shetland Islands area there were many shallow zonal lows arising in Antarctic air mass, that is partially transformed over the ice cover of Bellingshausen Sea. That time at „Arctowski" Station the frequency of winds from 090°—160° increased (24%) and it was accompanied by the temperature decrease by 5 to 5.9 deg in relation to mean month' temperature. The great temperature variability observed at winds from 090° and 120° directions

→

Fig. 4. Thermal wind roses a — 1980, b — 1985 (January—December): A — January, B — February, C — March, D — April, E — May, F — June, G — July, H — August, I — September, J — October, K — November, L — December

A

a)


000°
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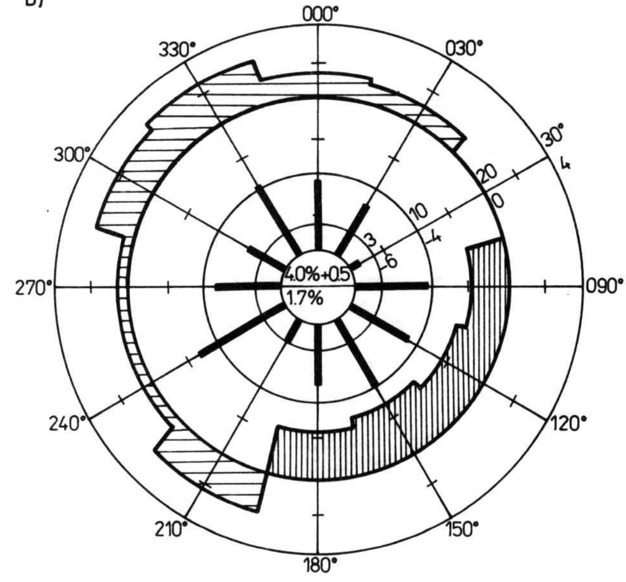
2.8% -
14.9%+0.3

b)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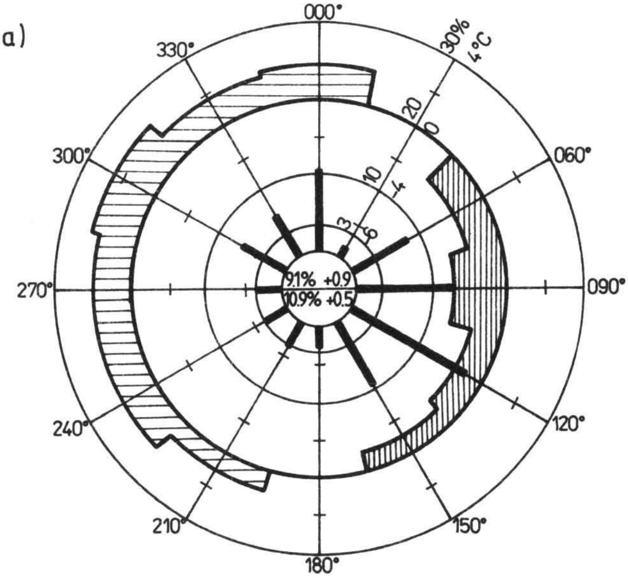
4.0%+0.5
1.7%

B

a)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9.1% +0.9
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300°
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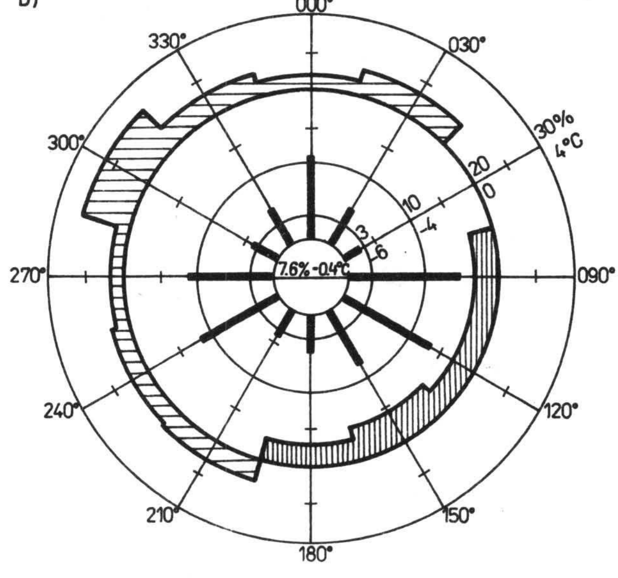
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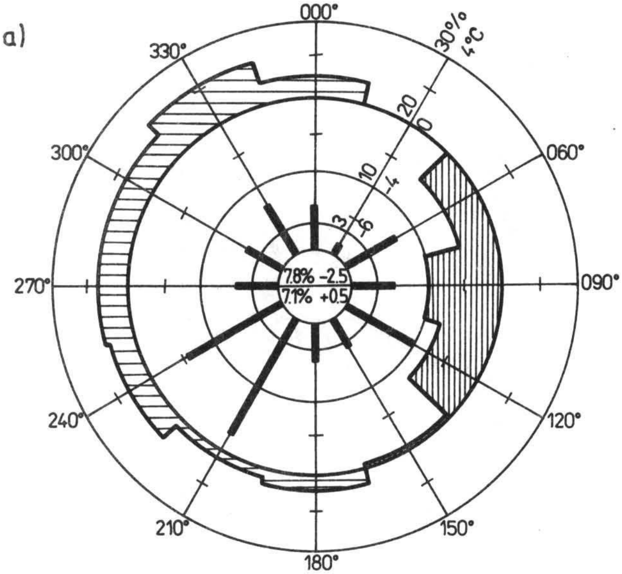
C

a)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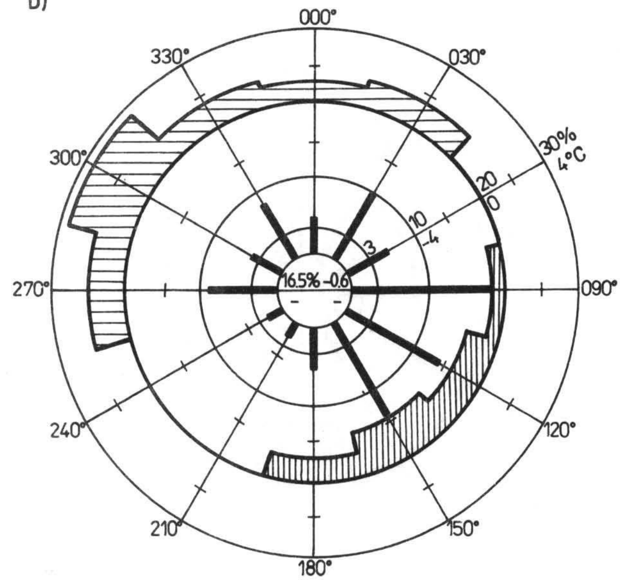
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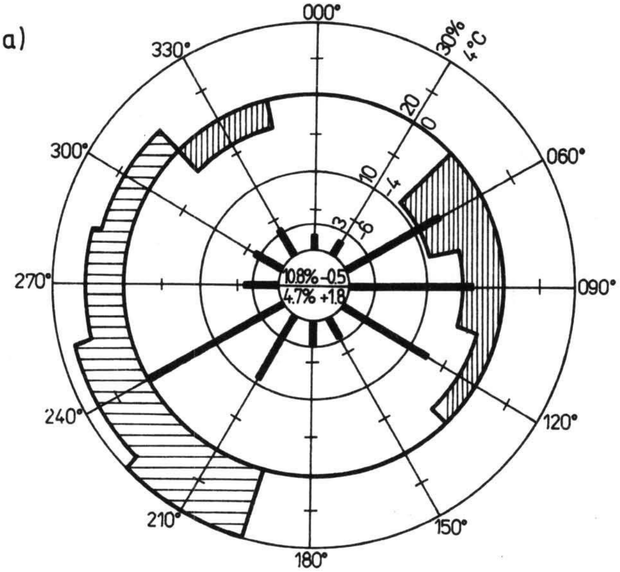
D

a)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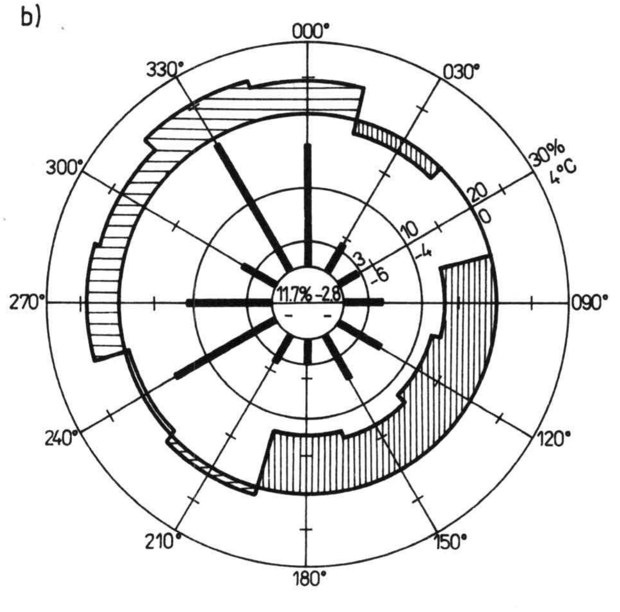
10.8% -0.5
4.7% +1.8

b)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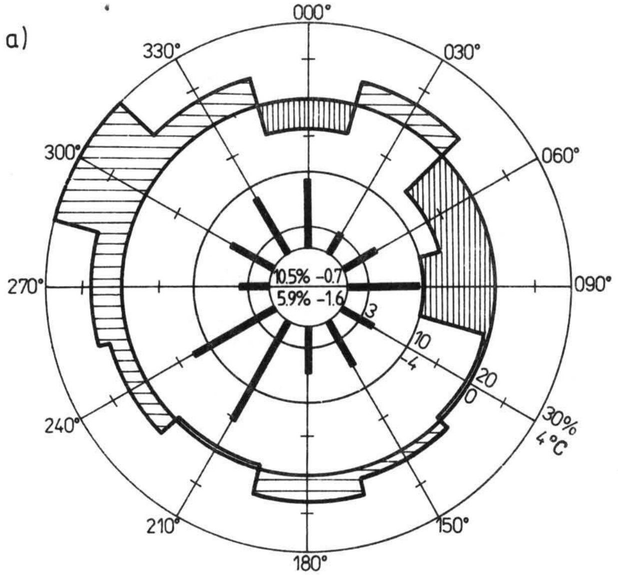
E

a)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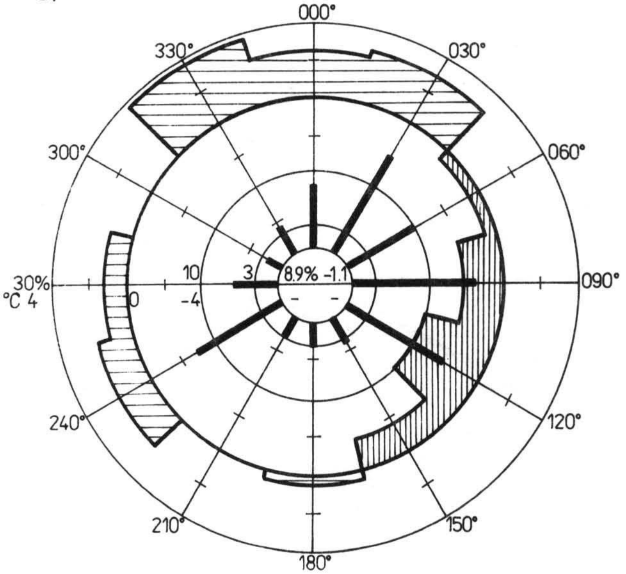
b)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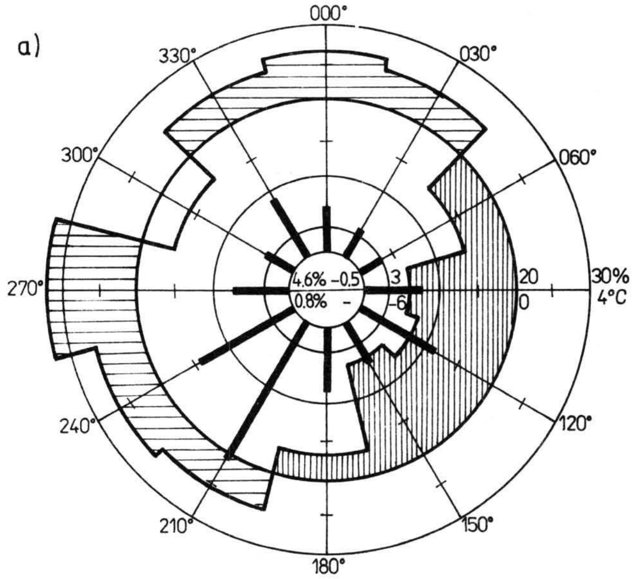
F

a)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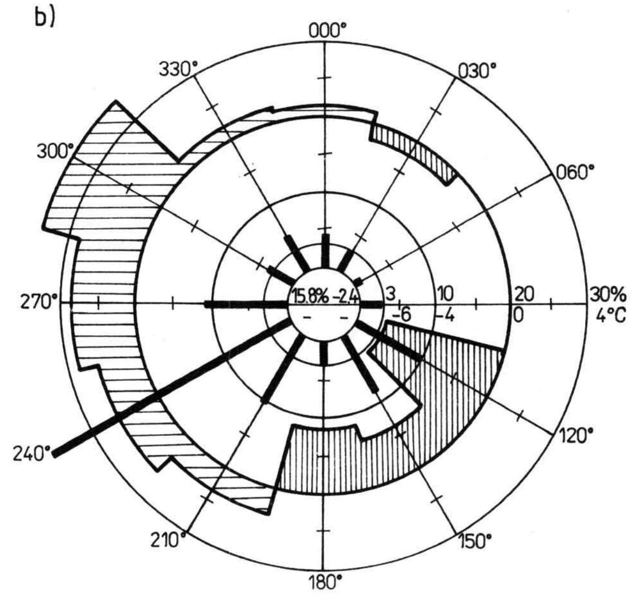
b)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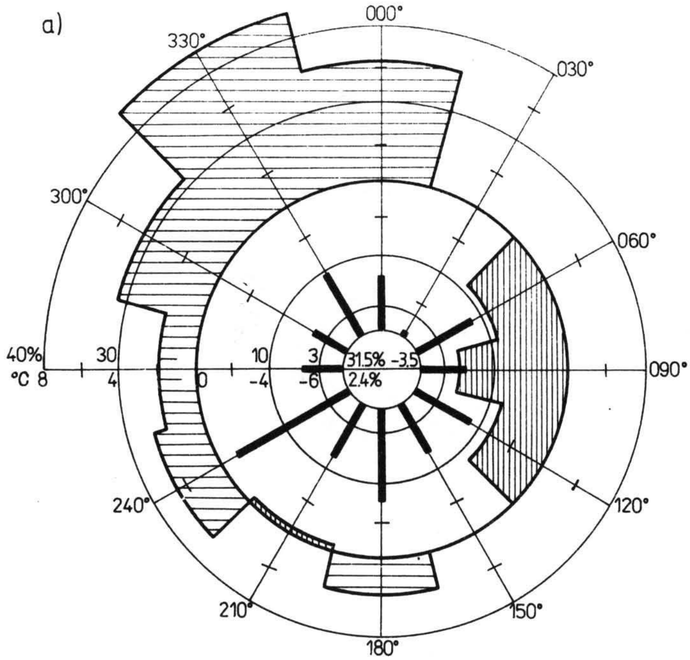
G

a)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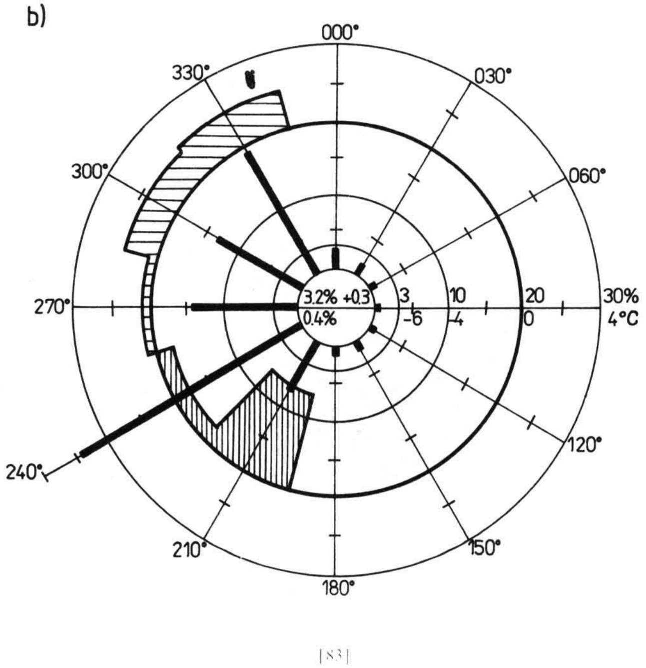
31.5% -3.5
2.4%

b)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3.2% +0.3
0.4%
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-6
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20
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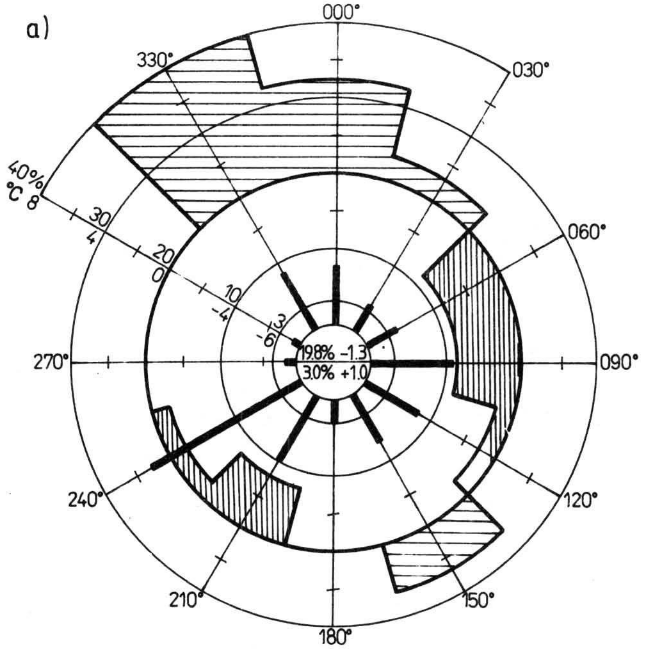
30%
4°C

H

a)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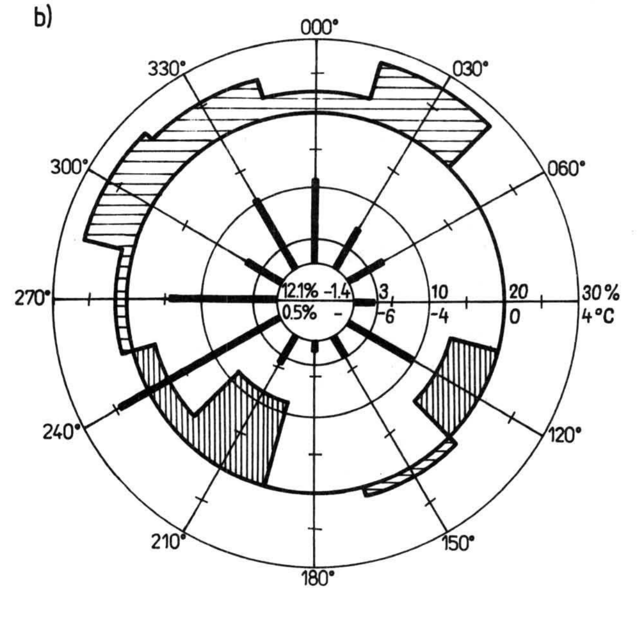
19.8% -1.3
3.0% +1.0

b)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12.1% -1.4
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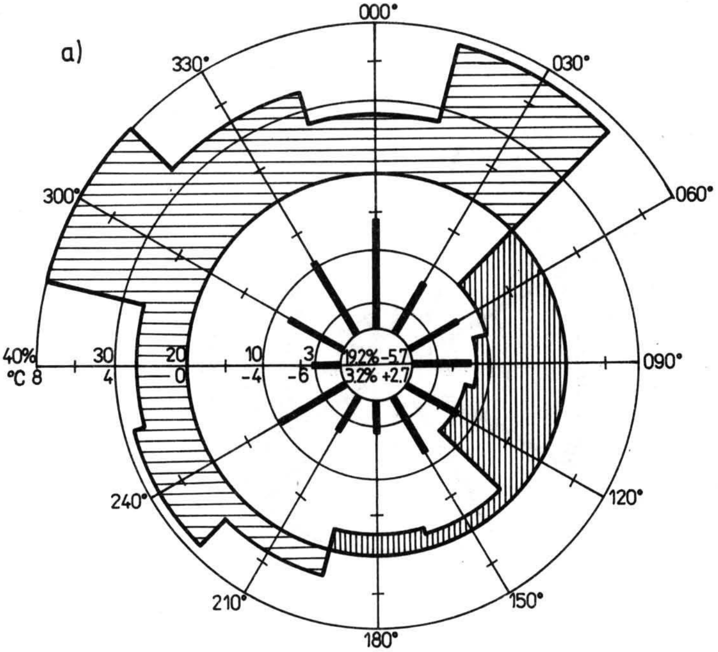
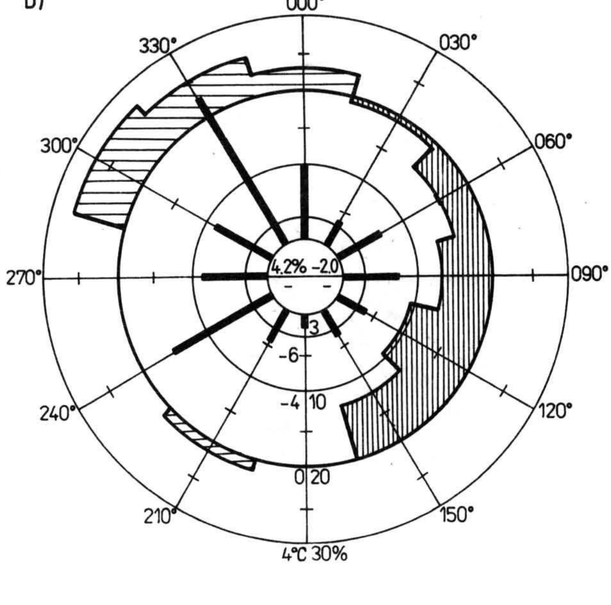
20
0
30%
4°C

I

a)

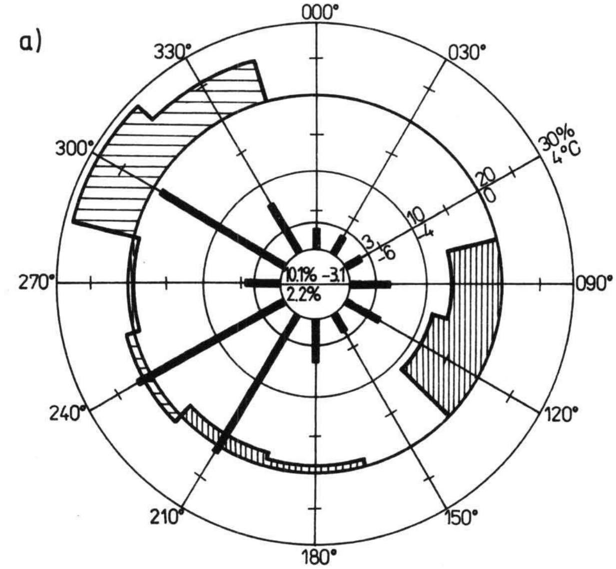

000°
030°
060°
090°
120°
150°
180°
210°
240°
300°
330°
40%
°C 8
30
4
20
0
10
-4
3
-6
19.2% -5.7
3.2% +2.7

b)

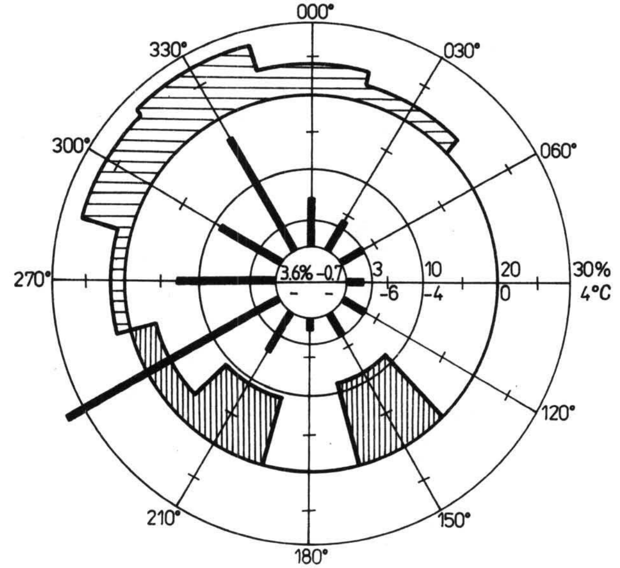

000°
030°
060°
090°
120°
150°
210°
240°
270°
300°
330°
4.2% -2.0
3
-6
-4 10
0 20
4°C 30%

J

a)

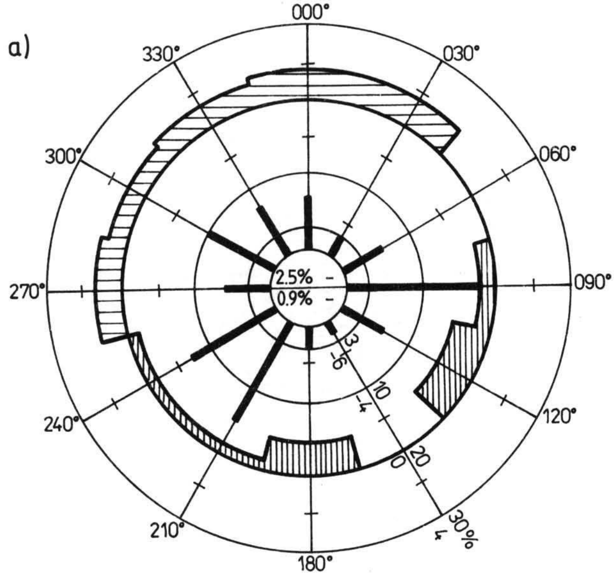

000°
030°
330°
300°
30%
4°C
20
0
10
-4
3
-6
10.1% -3.1
2.2%
270°
090°
240°
120°
210°
150°
180°

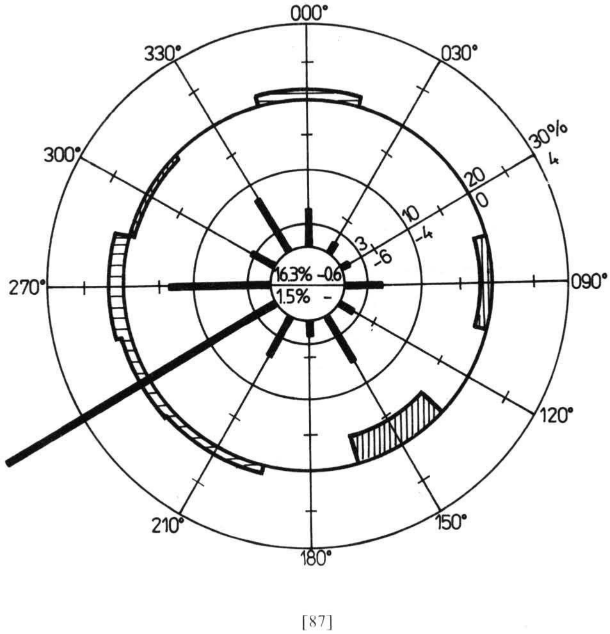
b)


000°
330°
030°
300°
060°
3.6% -0.7
3
10
20
30%
-6
-4
0
4°C
270°
120°
210°
150°
180°

K

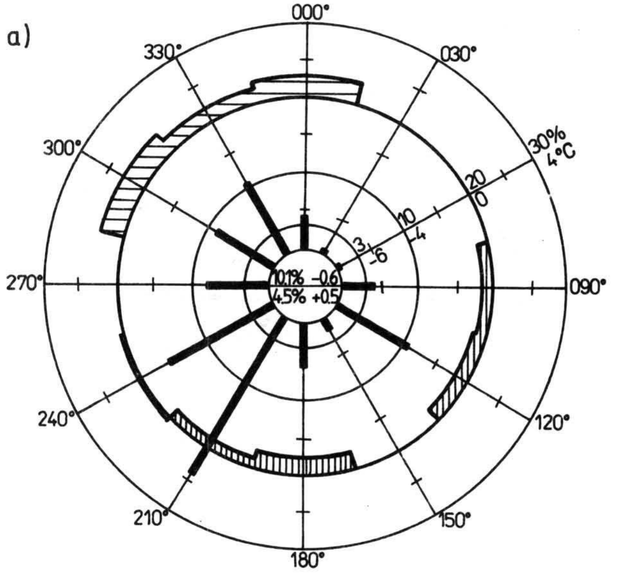
a)


000°
030°
060°
090°
120°
180°
210°
240°
270°
300°
330°
2.5% –
0.9% –
3
6
10
4
20
0
30%
4

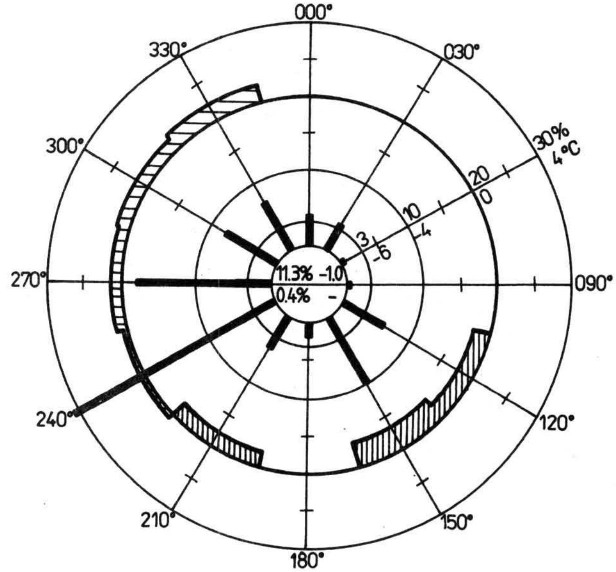

000°
030°
30%
4
20
0
10
4
3
6
16.3% -0.6
1.5% –
090°
120°
150°
180°
210°
270°
300°
330°

L

a)


000°
030°
30%
4°C
090°
120°
150°
180°
210°
240°
270°
300°
330°
20
0
10
-4
3
-6
10.1% -0.6
4.5% +0.5

b)


000°
030°
30%
4°C
090°
120°
150°
180°
210°
240°
270°
300°
330°
20
0
10
-4
3
-6
11.3% -1.0
0.4% -

(standard deviation of 5.6—6.2) becomes remarkably smaller at the winds from 150° (standard deviation 2.9) (Tab. 3a).

In winter the Antarctic maritime air mass flowing over the Warszawa Icefield was dry. Only 8 not fully developed foehns occurred. They were accompanied by 0.3 to 1.1 deg temperature increase.

During other winter months (VII—IX) fully developed and long lasting highs prevailed, and calms occurred very often (from 19.2% in IX to 31.5% in VII), with the temperature decrease below $-20°C$. August and September 1980 were the coldest months of the decade, and July had the average temperature only by 1 deg higher than the coldest July in 1987 ($-13.2°C$).

3.2. Winter 1985

Similarly to the coldest winter of the decade during the warmest one the highest temperatures were observed at the winds from 300° and 330° directions; they were by 0.8 to 5.4 deg higher than mean month's temperature. These winds were related to the frequent deep lows and they transported the polar maritime air masses (small standard deviation). Their frequency was remarkable especially in July (32.5%) and September (33.1%). This was reflected by the mean month's temperature of the air. For July the highest mean temperature of the decade ($-2.1°C$) was noted, for September $-0.7°C$. Mean temperature increase related to the pseudo-adiabatic processes while crossing a terrain obstacle was the same as in 1980 reaching 2.5 deg.

In winter 1985 the most frequent wind directions observed were 240° (from 15.7% to 36.5%) and 270° (from 10.9% to 14.6%) (Fig. 4 F—I). Only in June they were evidently warm winds. In other months the temperatures fluctuated near mean temperature (-0.9 deg, $+0.6$ deg). The air temperature variability at these winds was small (standard deviation 2.2—3.3).

The 240° and 270° directions provided to the „Arctowski" Station mainly the Antarctic air, partially transformed over Bellingshausen Sea and Bransfield Strait covered with ice. In winter these air masses occurred in 35—52% cases of wind from 240° direction and 61—90% cases from 210°. This air flows over the Warszawa Icefield always dry, of relative humidity no more than 75%. At such conditions foehn phenomena occur very rarely — only in the case of very humid polar air flow (on the average 1—3 cases per month from the 240° direction and 6—10 cases from 270°). These foehns caused only small increase of air temperature by 0.5 to 1.2 deg.

4. The dependence of air temperature upon orography

Considering the theory one can conclude that the greatest influence of orography over the air temperature at the „Arctowski" Station should take place in summer and in autumn. In this period there exist most favourable conditions for the occurrence of both foehn phenomena and katabatic winds.

Table 3

Standard deviations of the average air temperature for particular wind directions in 1980 (a) and in 1985 (b).

a)

month	000°	030°	060°	090°	120°	150°	180°	210°	240°	270°	300°	330°	calm
01	1.7	—	1.3	1.3	1.8	1.1	1.5	1.5	1.9	—	1.3	1.3	—
02	1.4	—	1.2	1.6	1.9	1.1	—	2.2	1.6	1.2	1.9	1.7	1.6
03	1.9	—	1.8	1.1	2.7	3.2	3.7	2.0	2.3	2.8	2.5	2.4	2.0
04	—	—	4.9	4.1	3.2	—	—	2.4	3.6	4.0	3.8	3.5	4.4
05	5.9	4.6	5.0	4.9	3.9	3.0	3.7	2.5	3.0	3.7	3.8	5.0	2.4
06	3.4	4.1	6.0	5.6	6.2	2.9	4.8	3.3	3.6	2.6	6.3	3.7	6.4
07	7.7	—	2.9	1.3	3.8	3.8	5.3	3.6	4.6	6.4	6.1	7.2	3.1
08	6.5	7.1	4.2	5.7	5.3	3.4	—	4.6	5.7	—	—	4.7	4.9
09	7.3	5.0	4.6	3.5	4.3	6.3	8.0	5.8	5.0	—	2.2	6.5	6.4
10	—	—	—	2.1	3.5	—	2.9	3.8	3.4	3.7	1.9	2.3	3.8
11	1.6	—	1.7	1.4	1.6	—	—	2.0	2.1	0.9	2.3	2.4	—
12	1.4	—	—	2.6	1.6	—	2.0	2.3	2.1	2.7	2.1	1.6	1.7

b)

month	000°	030°	060°	090°	120°	150°	180°	210°	240°	270°	300°	330°	calm
01	1.8	1.5	1.6	1.4	1.7	1.8	2.5	2.7	1.8	2.4	1.4	2.0	2.1
02	0.9	1.8	2.0	1.3	1.8	1.6	1.5	2.1	1.4	1.3	1.2	0.9	2.0
03	3.0	2.2	2.0	1.8	1.9	1.6	2.0	—	—	2.2	1.7	3.2	1.9
04	2.0	3.2	—	1.7	2.3	1.6	—	2.5	2.2	2.0	2.4	2.5	2.9
05	3.7	3.4	3.3	3.7	3.2	1.9	—	—	2.0	2.2	—	3.5	3.3
06	4.7	—	—	—	4.2	5.1	—	3.4	2.6	2.5	2.3	3.8	4.2
07	—	—	—	—	—	—	—	3.3	2.7	2.6	2.3	1.9	0.9
08	2.0	1.9	3.2	—	3.2	—	—	2.2	3.3	2.7	2.0	2.2	2.6
09	1.8	3.3	4.2	3.3	3.2	2.4	—	2.7	2.2	2.8	1.0	1.2	2.4
10	1.8	2.9	—	—	3.7	2.3	—	3.3	2.2	2.2	2.5	1.7	3.1
11	1.8	—	—	1.6	—	1.5	—	1.6	1.0	1.6	1.2	1.6	1.3
12	0.8	1.0	—	—	0.7	0.9	—	1.6	1.3	1.6	1.2	1.3	1.2

The precondition for foehn phenomena is the flow of warm and very humid air from the directions related to high terrain obstacles. Therefore the foehn phenomena (temperature increase, humidity decrease) will accompany the flow of Polar maritime air and more rarely Antarctic maritime air from NW, N, more rarely from W, SW and NE directions.

Katabatic winds of bora type occur at a considerable thermal contrast between relatively warm water surface of Admiralty Bay and air masses cooled in consequence of radiation, occurring over ice domes at the anticyclonic weather.

In summer 1980 the temperature increase related to pseudo-adiabatic processes reached on the average 2—2.5 deg at winds from NW and N as well as 1.0—1.5 deg at winds from W and SW.

The analysis of meteorological data from 1985, especially from spring and summer (X—XII), suggest some doubts. The part of these data is certainly inconsistent. The cases of very high temperatures (+5.4°C, +10.2°C) at very low relative humidity (64, 61%) are questionable considering the fact that because of the condensation level the air had to flow over the obstacle as a dry one. In the same time considerable cloud cover was noted (N=6) as well as a cloud base level below the terrain obstacles. If the observations were correct the question arises what is the air mass of such unusual properties in these geographical conditions. Because of these doubts the determination of the influence of orography over temperature changes is here limited to winter period.

Conclusions

1. The course of main elevation of the island induces the predominance of winds from 240° direction at the „Arctowski" Station.

2. The air temperature distribution at the „Arctowski" Station is subject, above all, to the type of atmospheric circulation. At the displacement of subtropical high pressure zone to the south the cyclo-genesis area at Polar front is situated in South Shetland Islands region. At the station area warm air masses of Polar maritime and Antarctic maritime origin prevail. Air temperatures, even in winter, only rarely decrease below −10°C. Antarctic maritime air, of relatively low humidity, flows over the island beeing dry — without temperature changes. Winds from 230°—240° sectors are predominant. This type of atmospheric circulation prevailed in 1985. High mean month's temperatures were noted. At the displacement of subtropical high pressure zone to the north South Shetland Islands region becomes the cyclo-genesis area related to the Antarctic front. Shallow zonal lows formed in Antarctic air prevail; they are thermically poorly diversified. Ridges of Antarctic high pressure develop frequently and remain for many days. The

frequency of calms increases as well. Winds from 170°—250° and 070°—130° are predominant. The air temperature decreases often below −20°C. That was the prevailing type of atmospheric circulation in 1980.

3. The warmest winds are from 300° and 330° as well as 000° and 270° directions.

4. In the case of warm and humid polar maritime flow (relative humidity ⩾80%) air temperature increase occurs at lee side through pseudo-adiabatic processes, if at its way any terrain obstacle is situated. This increase at the „Arctowski" Station equals 2—2.5 deg in summer and 1.6 deg in winter at the winds from 300° and 330° directions. These changes are accompanied by air relative humidity decrease by 10 to 15%. At the winds from 270° and 240° directions the temperature increase related to foehn phenomena is slightly lower (average 1.0—1.5 deg in summer and 0.5—1.2 deg in winter). „Arctowski" Station is separated from lee side of main ice dome of the island by cold or frozen waters of Mackellar Inlet and Martel Inlet, therefore at the winds from 000° and 030° the foehn phenomena rarely occur. Considering other air masses arriving to „Arctowski" Station only Antarctic maritime air mass in summer strongly transformed (subantarctic) may be accompanied with foehn phenomena, at winds from 300° and 330° directions.

5. The greatest deviations of mean temperature for particular wind direction from mean month's temperature occur in winter. Positive deviations reached 9.5 deg in 1980 and 5.4 deg in 1985, and negative −5.9 and −6.4, respectively.

6. The lowest diversity of air temperature in relation to the wind direction occurs in summer (XI—I) and reaches 2.7 deg.

7. The variability of air temperature at particular wind direction in summer is relatively small — the standard deviations are from 1.1 to 2.6 in summer 1980 and 0.7 to 2.7 in 1985. This variability remarkably increases in winter, when standard deviations reached 8.0 in 1980 and 5.1 in 1985.

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Streszczenie

Na podstawie przeprowadzonej analizy kierunków wiatru i temperatury powietrza na Stacji Arctowskiego w najchłodniejszym (1980) i najcieplejszym (1985) roku z dziesięciolecia 1978—87 (rys. 1) stwierdzono duży wpływ orografii wyspy i rodzaju cyrkulacji atmosferycznej na przebieg badanych elementów.

Przeważają wiatry zgodne z osiami dużych obniżeń terenowych (rys. 2). Dominującym jest wiatr z sektora 230°—250° (tab. 1 i 2). Najcieplejsze są wiatry z kierunków 300° i 330° oraz z 000° i 270° (rys. 4). Maksymalne odchylenia temperatury powietrza przy tych kierunkach wiatru od średniej miesięcznej osiągają w 1980 roku +9.5 deg., a w 1985 r. +5.4 deg. Najzimniejsze wiatry występują z kierunków 090°, 120° i 150°. Przy napływie wilgotnego powietrza ($f \geq 80\%$) głównie z kierunków 300° i 330° występują wiatry fenowe. Przy innych kierunkach wiatru, ze względu albo na mniejsze wysokości przeszkód albo na większe oddalenie Stacji Arctowskiego od ich zawietrznej (rys. 3) zjawiska fenowe na Stacji notowane są rzadziej. Wynikający z procesów pseudoadiabatycznych wzrost temperatury osiąga średnio 1.5—2.5 deg w lecie i 0.5—1.6 deg w zimie. W zimie każdemu kierunkowi wiatru towarzyszy duża zmienność temperatury (tab. 3).