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Co-occurrence of particular meteorological elements in the region of Arctowski Station (King George Island, South Shetland Islands, in 1978*)

ABSTRACT: General meteorological conditions in the Admiralty Bay in 1978 did not deviate from those of many years. The data for 1978 were used to analyse the co-occurrence of four most perceptible meteorological parameters: temperature, air humidity, wind speed and precipitation. In summer these elements occurred simultaneously only in 1—2 intervals of values, in winter their occurrence within individual intervals was less numerous, but covered more of them.

Key words: Antarctic, meteorology, co-occurrence of meteorological elements

1. Introduction

Air temperature, wind, humidity and precipitation are the most perceptible atmospheric parameters. Of special significance is the simultaneous occurrence of specified values of these parameters. Different is the impact on man of low temperatures at calm weather than during strong winds. Other are the effects of snow falling on windless days compared to a snow storm at temperature close to 0 C. It is important to know these conditions while planning any kind of outdoor activity. This paper aims at providing such information.

The data used were checked and corrected in relation to observations described by (Nowosielski 1980) as regards meteorological conditions on the Arctowski Station in 1978.

*) The work was done during the Second and Third Polish Antarctic Expedition at the Arctowski Station as part of Project MR-II-16 granted by the Polish Academy of Sciences.

2. Data set and methods of analysis

The analysis is based on data from 1978 and the two first months of 1979. Results of standard synoptic observations made every three hours were used.

Simultaneously occurring groups of values of particular parameters were analysed:

- air temperature and relative humidity with precipitation occurring within particular wind speed ranges,
- air temperature and relative humidity,
- air temperature and wind speed,
- precipitation occurring at air temperatures within given intervals.

To avoid excessive fragmentation of the groups analysed and to avoid overgeneralization of information, the parameters under consideration were arranged in suitable intervals. The whole range of the temperatures encountered was divided into four-degree intervals; only when temperature and precipitation were considered, a different division of temperatures was applied. In the latter case

- the first group consisted of positive temperatures, far from the freezing point ($\geq 4.0^{\circ}\text{C}$),
- the second group was formed by negative temperatures far from the melting point ($\leq -4.1^{\circ}\text{C}$),
- the third group of temperatures was contained between $+3.9$ and -4.0°C , this being the interval of temperatures most frequently accompanied by mixed precipitation, both liquid and solid.

The whole range of wind speed was divided into eight intervals, every 4 or 3 $\text{m}\cdot\text{s}^{-1}$ each, the last interval covering speeds exceeding 25 $\text{m}\cdot\text{s}^{-1}$.

Relative humidity was arranged in six intervals:

- the values not exceeding 60% of relative humidity,
- range from 61 to 90% was divided into three intervals with a gradation by every 10%,
- from the last fragment in humidity scale, 91—100%, a subdivision of humidities close to saturation, 97—100% was distinguished, because of its unfavourable influence, especially at low temperatures and strong wind.

As regards precipitation, only its occurrence or lack during the observation was considered.

The frequency of total occurrence of particular values of most perceptible weather parameters was analysed separately for each season of the year. But first a general characteristic of the annual variation of decades values had been made. This characteristic was based on the data of 1978, whereas the analysis of co-occurrence was given for the period from March 1978 through February 1979. Similar methods were also applied by (Böer 1964) and (Zavjalova 1969).

3. Meteorological characteristics of 1978 based on the decade values

In order to prove that meteorological conditions in 1978 did not differ much from the average ones on King George Island, it was necessary to compare them with a period of at least several years. This was done using the data from the British station Admiralty Bay, which was functioning in the years 1948—1960 some 8 km towards NNE from the present site of the Arctowski Station. Table I and Figure 1 show air temperature in 1978 (Arctowski) as compared to the period of 1951—1960 (Admiralty Bay). Both the Table and Figure show, that the spring, summer and autumn of 1978 were slightly warmer, whereas the winter, and especially July, was cooler. This was even to the advantage of investigations performed, as conditions more extreme than the average ones were introduced.

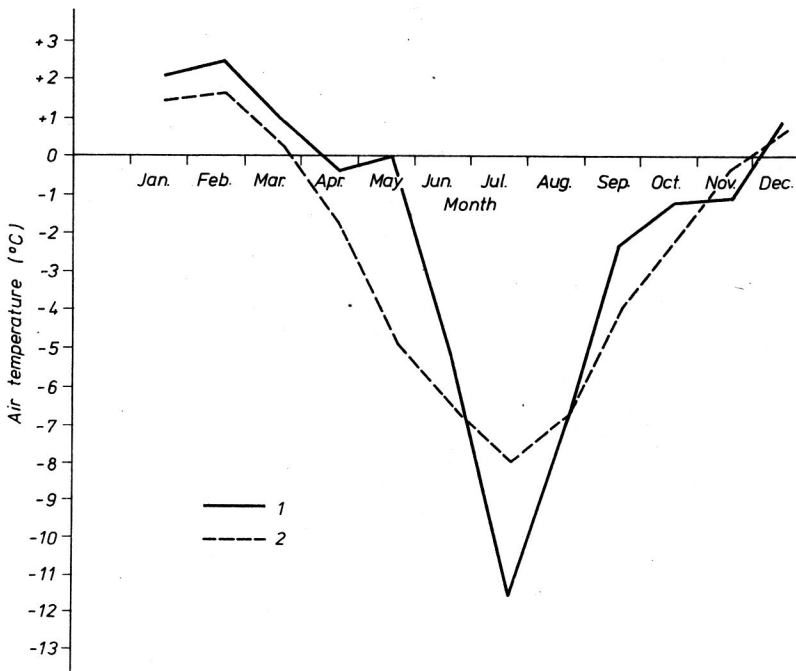


Fig. 1. Annual course of air temperature, 1978 (Arctowski Station) as compared to mean temperatures in 1951—1960 (Admiralty Bay)
1 — Arctowski Station, 2 — Admiralty Bay

3.1 Air temperature

The warmest month of 1978 was February with mean monthly temperature 2.5°C. Mean temperature of its second decade was the highest in that year (3.1°C). The first decade of January was only slightly cooler (2.7°C).

Table I.

Monthly means of air temperature and pressure in 1978 (the Arctowski Station) compared with those in 1951—1960 (Admiralty Bay, after Anonymous 1968 and Dolgin and Petrov 1977)

	Months											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Air pressure (hPa)												
Admiralty Bay 1951—1960	989.2	988.7	989.4	990.9	993.3	993.8	993.4	993.4	991.4	988.4	987.9	992.4
Arctowski St. 1978	989.0	991.0	993.4	992.6	1002.2	984.6	1002.5	984.9	993.8	984.5	993.9	987.6
Air temperature (°C)												
Admiralty Bay 1951—1960	1.4	1.6	0.2	-1.8	-4.8	-6.4	-8.0	-6.8	-4.1	-2.2	-0.4	0.6
Arctowski St. 1978	2.1	2.5	0.9	-0.4	0.0	-5.1	-11.8	-6.9	-2.3	-1.2	-1.1	1.0

The absolute maximum temperature was at the beginning of March (8.9°C). Minimum temperatures of these two warmest months in the year did not drop below -2.2°C . Mean temperatures of winter months were -5.1 , -11.8 and -6.9°C in June, July and August respectively. The lowest mean decade values fell on the two first decades of July, with temperatures -13.3 and -12.2°C . Absolute minimum temperature, -25.3°C was recorded in the first decade of August (Table II).

Great temperature fluctuations were typical for the winter. The greatest decade amplitude, 28.0°C , occurred in the first ten days of August. Decade amplitudes in summer varied between 6.0 and 11.0°C .

Temperature oscillations around the freezing point are of great significance where the outdoor activity and installations are concerned. These oscillations have been observed all year round. Only in midwinter, during the two first decade of July, the temperature remained below zero. The number of such oscillations exceeded even twenty per month in autumn and spring. It should be remembered that these were oscillations around 0°C measured in the meteorological screen, i.e. 2 m above the ground. Air temperature close to the ground or close to the surface of large flat objects showed more frequent oscillations around the freezing point. The lowest temperatures measured 5 cm above the ground gives Table II. Values as low as -29.6°C and -28.5°C were recorded at the end of July and at the beginning of August.

3.2 Soil temperature

Soil temperature was measured at 4 standard depths: 5, 10, 20 and 50 cm, and from May through November also at the depth of 100 cm (Table II). The highest annual oscillations, from 17.6°C in the second decade of January to -13.0°C in July were encountered at the depth of 5 cm. At the same depth the highest decade amplitude was noted: in summer up to 18°C (the second decade of January), in winter — about 6°C only.

The annual and decade oscillations were decreasing with increasing depth and amounted only to 0.2 — 0.5°C in a decade at the depth of 100 cm. Extreme values for that level are not given, because the observations were not carried out for the whole season. The data available allow to set the minimum value of -5.3°C , which occurred at this depth in the last decade of July.

3.3 Precipitation amount and depth of snow

Precipitation totals in warm months of the year were higher than in winter and spring. The highest monthly precipitation sums were recorded in March, February and June (87.7 mm, 72.6 and 76.4 mm, respectively) and the lowest in July, August and November. Thus there were somehow three maxima of monthly precipitation: in summer, late in autumn and a smaller one — in spring. Only in one winter decade the precipitation sum did not exceed 0.1 mm and in another at the turn of winter, there was

only a trace of precipitation — 0.0 mm. Two other decades in spring had precipitation not exceeding 1.1 mm Table III.

In summer all kinds of precipitation occurred, both liquid and solid, whereas in winter the snow prevailed.

Permanent snow cover appeared not earlier than in the first decade of June and remained till the second decade of November, attaining the highest decade depth, 28 and 29 cm, in the first decades of September and at the beginning of November. At the very beginning of November the snow depth was 30 cm. Since the beginning of the year till the end of May, i.e. in summer and in autumn and then in December (at the beginning of the next summer season) the snow cover appeared only occasionally, and was 1—4 cm deep. Only on May 5 the snow depth was 7 cm and on December 14 — even 17 cm.

3.4 Humidity

Although it does not undergo diurnal variation, the relative humidity at the coasts of Admiralty Bay changes frequently, because of the katabatic winds. From the value usually oscillating between 70 and 90% it drops rapidly even below 30 to rise shortly afterwards to the former values. This phenomenon is only weakly reflected by mean values. Mean annual relative humidity is slightly higher than 80%. As regards the decade values, they were limited by 68.5% in July and 86.5% in September (Table IV).

Specific humidity stays vn the average between 4 g·kg⁻¹ in the first decade of January and 1 g·kg⁻¹ in the first decade of July.

3.5 Air pressure

South Shetland Archipelago is lying in the region of strong cyclonal activity, affecting both the variation and values of atmospheric pressure.

Dynamics of pressure changes was remarkable in 1978. In each month pressure tendencies (pressure changes within three hours) were noted exceeding 5 hPa, and the highest ones, on July 13th, reached +9.1 and +8.2 per 3 hours. In August the tendencies exceeded 5 hPa for 16 times, and the greatest drops encountered were -9.6 and -9.0 hPa per 3 hours. They were recorded on August 20, during one cycle of decreasing pressure. During 12 hours the decrease of pressure reached 30 hPa. Changes expressed by tendencies were due to advection of air density, but in a number of cases oscillations up to several hPa, of very short periods — several minutes or even less, — could be noted. They were caused by dynamic changes of pressure, due to local compression and decompression of air, connected with high turbulence of the wind.

Absolute minimum of pressure, 955.5 hPa, occurred in June, another minimum of 956.4 hPa, was recorded in August. The highest pressure, 1025.9 hPa was recorded in July. Mean monthly values stayed within the range between 984.5 hPa in October and 1002.5 hPa in July (Table III).

Dekades values of air and soil temperatures on the Arctowski Station, 1978

Month	Decade	Air temperature (°C)					Soil temperature (°C)									
		max.	min.	mean	Number of oscillat. about 0°C	Grass min.	maximum			minimum						
						5 cm	10 cm	20 cm	5 cm	10 cm	20 cm	5 cm	10 cm	20 cm		
Jan.	I	8.0	-0.7	2.7	4	1.1	10.6	7.7	1.1	—	0.5	1.2	1.7	1.7	0.3	—
	II	4.6	-1.4	1.4	8	-2.1	17.6	11.5	6.9	2.3	—	0.4	0.8	0.6	0.9	—
	III	7.3	-0.8	2.2	4	-3.4	16.0	11.6	6.9	3.6	—	0.7	1.4	3.1	1.9	—
Feb.	I	6.3	-1.4	2.5	2	-1.3	10.9	7.3	4.6	0.7	—	—	0.8	1.7	1.8	—
	II	8.1	-1.5	3.1	2	-1.3	13.3	8.4	5.6	3.4	—	0.1	0.8	1.7	2.1	—
	III	5.7	-2.2	1.6	6	-2.5	10.1	6.4	4.9	3.4	—	0.2	1.2	1.7	2.6	—
Mar.	I	8.9	-3.1	1.5	9	-6.3	9.1	5.0	4.4	2.5	—	-0.5	0.6	1.1	1.5	—
	II	5.7	-6.4	-0.2	8	—	3.3	2.9	2.1	2.1	—	-0.6	-0.3	0.2	0.3	—
	III	8.1	-5.9	1.2	6	-7.9	6.9	6.9	2.6	1.7	—	-0.3	-0.1	0.2	0.3	—
Apr.	I	6.3	-6.0	0.3	8	-6.0	0.7	0.9	0.8	1.1	—	-0.8	-0.3	0.0	0.5	—
	II	5.1	-5.2	-1.4	5	-8.4	0.2	—	0.4	—	—	-3.1	—	-0.4	—	—
	III	6.5	-5.0	-0.1	9	-0.6	0.3	0.2	0.6	0.4	0.1	-2.5	-1.3	-0.5	-0.1	-0.1
May	I	7.6	-11.4	-0.4	5	—	0.3	0.3	0.2	0.5	0.1	-2.3	-2.5	-0.7	-0.2	-0.3
	II	7.1	-8.5	-1.9	5	-9.4	0.3	0.0	0.0	0.1	0.1	-5.7	-4.0	-2.8	-0.4	-0.4
	III	5.3	-3.0	2.0	5	-2.9	0.3	0.2	0.3	0.2	0.1	-2.1	-1.9	-0.8	-0.4	-0.4
Jun.	I	2.2	-11.6*)	-4.8	4	-11.9	-1.2	0.1	0.2	0.0	0.1	-6.3	-5.5	-4.7	-2.1	-0.1
	II	5.0	-11.4	-1.8	8	-10.3	-0.1	0.1	0.0	-0.1	0.1	-5.9	-4.8	-3.1	-1.7	-0.3
	III	0.4	-19.9	-8.7	2	-22.8	-1.7	-1.8	-1.8	-1.1	0.0	—	-10.3	-9.4	-4.5	-0.5
Jul.	I	-4.2	-21.9	-13.3	—	-27.3	—	—	—	—	—	—	—	—	—	—
	II	-1.9	-22.9	-12.2	—	-27.8	—	—	—	—	—	—	—	—	—	—
	III	3.2	-24.8	-9.8	6	-29.6	-5.3	-2.5	-2.7	-5.0	-4.3	—	-11.1	-10.3	-8.0	-5.3
Aug.	I	2.7	-25.3	-11.9	2	-28.5	-5.9	-5.6	-4.8	-3.6	-9.3	-9.3	-9.5	-9.0	-7.7	-4.7
	II	3.7	-17.8	-2.5	14	-18.4	-1.3	-1.7	-1.8	-3.3	-3.7	-7.5	-8.0	-8.0	-7.1	-5.0
	III	2.8	-18.5*	-6.6	4	-18.7	-1.9	-2.1	-2.7	-2.9	-3.3	-6.7	-6.5	-5.8	-4.9	-4.1
Sep.	I	3.7	-19.2*	-5.5	7	-19.9	-4.1	-3.1	-3.4	-4.0	-3.4	-6.8	-7.5	-6.2	-5.7	-4.3
	II	4.7	-10.3	-1.8	6	-14.7	-0.7	-0.7	-1.2	-2.5	-2.4	-4.1	-3.6	-3.7	-5.0	-4.2
	III	5.2	-4.0	0.3	8	-5.3	-0.2	-0.1	-0.1	-0.8	-1.9	-1.5	-0.9	-1.2	-2.2	-3.1
Oct.	I	5.4	-8.1	-0.2	10	-8.0	-0.1	0.0	0.0	-0.6	-1.1	-0.9	—	-0.3	-1.0	-2.1
	II	3.7	-6.7	-2.4	8	-12.4	-0.1	-0.1	0.0	-0.4	-1.2	-1.7	-0.5	-0.4	-0.9	-1.6
	III	4.3	-7.8	-1.1	13	-8.6	0.0	0.1	0.2	0.3	-0.8	-1.2	-0.3	-0.2	-0.6	-1.4
Nov.	I	1.4	-5.9	-2.2	4	-15.0	0.1	0.2	0.2	-0.3	-0.8	-0.9	-0.3	-0.1	-0.6	-1.1
	II	6.7	-3.6	0.6	6	-7.6	4.2	3.5	2.4	-0.1	-0.7	-0.3	0.0	0.0	-0.3	-0.8
	III	4.1	-5.3	-1.8	4	-9.6	—	3.7	2.4	0.0	-0.5	—	0.0	0.0	-0.1	-0.7
Dec.	I	4.8	-6.7	0.5	8	-7.2	—	7.3	5.0	0.4	-0.5	—	0.2	0.1	-0.1	-0.5
	II	6.6	-3.0	1.0	5	—	—	8.9	5.5	1.5	-0.4	—	0.3	0.2	0.2	-0.5
	III	8.2	-2.6	1.3	7	-1.7	—	8.5	6.7	1.9	-0.2	—	0.5	0.3	0.4	-0.5

*) lowest of the hourly values

Table III.

Decade values of wind speed, relative and specific humidity precipitation amount, depth of snow and air pressure, on the Arctowski Station, 1978

Month	Decade	Wind speed v ($m \cdot s^{-1}$)				Mean relative humidity (%)	Mean specific humidity ($g \cdot kg^{-1}$)	Precipit. amount (mm)	Depth of snow (cm)	Air pressure (hPa)		
		mean	max. (during obs. hr.)	max. (between obs. hrs)	Number of days with $v \geq 10 m \cdot s^{-1}$					monthly mean	max.	min.
Jan.	I	7.8	22	30	7	85.5	4.0	4.9	0	989.0	1004.2	972.2
	II	6.7	16	36	6	82.3	3.5	20.8	0			
	III	5.7	15	18	4	85.6	3.8	12.0	0			
Feb.	I	9.1	20	34	8	85.4	3.9	34.4	0	991.0	1013.4	971.2
	II	9.1	30	47	10	82.0	3.6	34.3	0			
	III	5.4	12	35	3	80.9	3.5	3.9	0			
Mar.	I	8.4	24	45	8	81.4	3.5	39.4	0	993.4	1017.8	966.7
	II	6.6	18	26	6	79.8	3.1	19.3	1			
	III	7.2	18	38	9	86.2	3.7	29.0	0			
Apr.	I	8.7	18	42	9	80.2	3.7	32.4	1	992.6	1014.4	963.7
	II	5.5	14	18	5	75.2	2.7	24.5	1			
	III	4.6	16	28	4	85.8	3.2	9.9	0			
May	I	6.1	12	22	7	81.7	3.2	17.0	1	1002.2	1019.9	972.8
	II	4.1	12	24	4	79.2	2.6	1.4	2			
	III	7.4	14	24	9	83.5	3.6	25.4	0			
Jun.	I	7.1	18	27	8	80.5	2.2	6.3	2	984.6	1008.4	955.5
	II	9.7	26	45	9	84.3	3.0	62.1	6			
	III	7.0	16	38	7	76.0	1.7	8.0	11			
Jul.	I	3.8	12	25	2	68.5	1.0	0.1	15	1002.5	1025.9	967.1
	II	2.2	9	10	—	80.0	1.3	2.1	16			
	III	5.7	27	50	4	79.0	1.6	12.5	17			
Aug.	I	3.8	14	—	5	76.0	1.4	3.8	18	984.9	1016.6	956.4
	II	9.6	21	43	10	78.5	2.6	4.4	18			
	III	8.9	28	40	10	76.8	2.1	7.5	17			
Sep.	I	7.1	20	30	8	74.8	2.0	0.0	28	993.8	1018.7	973.6
	II	6.2	26	37	6	86.5	2.9	39.8	22			
	III	9.7	23	47	10	83.9	3.3	7.9	13			
Oct.	I	8.2	18	34	9	80.0	3.1	15.8	11	984.5	1002.5	965.2
	II	8.4	20	37	9	74.8	2.5	3.9	12			
	III	7.5	16	28	8	82.4	3.0	15.1	16			
Nov.	I	4.2	10	—	1	78.0	2.5	1.0	29	993.9	1011.4	970.3
	II	8.3	22	36	8	79.0	3.2	1.1	14			
	III	8.1	18	32	6	71.6	2.5	9.3	0			
Dec.	I	7.0	14	25	8	79.3	3.2	3.2	0	987.6	1006.8	966.3
	II	9.1	22	40	9	82.2	3.5	35.0	2			
	III	7.2	14	30	8	77.4	3.3	16.0	0			

3.6 Wind speed

The wind on the Arctowski Station is exceptionally gusty. Light wind often rapidly changes into gale blowing several to several tens of metres per second. In 1978, during 22 decades, gusts of wind reached or exceeded $30 \text{ m}\cdot\text{s}^{-1}$, in 7 decades reached over $40 \text{ m}\cdot\text{s}^{-1}$ and the maximum gust recorded exceeded $50 \text{ m}\cdot\text{s}^{-1}$.

Mean wind speed in particular decades ranged from $2.2 \text{ m}\cdot\text{s}^{-1}$ in July to $9.7 \text{ m}\cdot\text{s}^{-1}$ in June and September. The most frequent mean decade speeds were of $7-8 \text{ m}\cdot\text{s}^{-1}$.

4. Co-occurrence of specified values of meteorological parameters

According to the method in chapter 2 there is a possibility of combining observational results of the above parameters into several hundreds of groups, covering the whole range of conditions, from extremely severe to quite mild ones. In this study, the actual number of groups varied — depending on the season of the year — from 120 to about 200. Some of them covered a high percent of observations, whereas some other contained only a few number of cases. Such a detailed division is difficult to discuss, so in the first attempt the co-occurrence of pairs of particular parameters is considered.

4.1 Temperature and relative humidity

The co-occurrence of specified values of these two elements is given in Table V. It shows that humidities below 60% were comparatively seldom. In summer they hardly reached a frequency of 1.1% and were distributed over the whole range of temperatures. In winter these lowest humidities reached a frequency of 7.6%. Otherwise than in summer, they accompanied mainly the temperature values of the middle intervals.

An annual variation of humidities close to saturation (97—100%) could be noticed as regards their co-occurrence with determined temperature intervals: in summer, with frequency of only 1.0% they were encountered mainly in the intervals of lowest summer temperatures (3.9 to -4.0°C); in autumn their frequency rose to 3.3% and they were limited to accompany the middle intervals of temperature of this season; in winter and spring they were mainly recorded together with the highest temperatures of these seasons (Table IV).

Most frequent were the following groups of jointly observed temperature and humidity values:

- in summer — humidities 71—80% and 81—90% within temperature interval 0.0 to 3.9°C , with frequencies 19.8 and 23.1% respectively (Fig. 2A);
- in autumn — humidity 71—80% within temperature intervals 3.9 to 0.0°C and -0.1 to -4.0°C with frequencies 11.8 and 10.6% respectively;

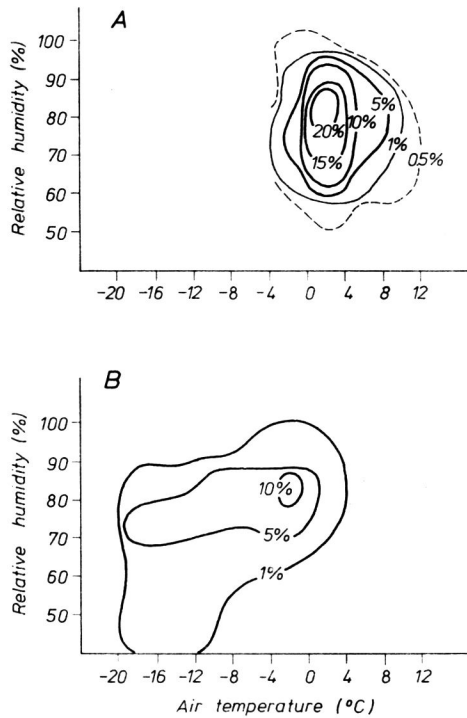


Fig. 2. Distribution of simultaneous occurrence of air temperature and relative humidity, Arctowski Station, 1978
 A — summer months B — winter months

within the same temperature intervals humidity of 81—90% occurred with frequencies 27.1 and 12.6% respectively;

- in winter — humidity of 81—90% within the temperature interval 0.1 to -4.0°C with a frequency of 10.0%, whereas within the intervals -4.1 to 8.0 and -8.1 to -12.0°C — with frequencies of about 7% each. Humidities of 71—80% in this season were slightly more frequent than 5% in each of the four-degree temperature intervals between -0.1 and -20.0°C (Fig. 2B); in spring — most frequent were the humidities 81—90%, which cumulated within the temperature interval 3.9 to 0.0°C with the frequency 18.7% and within the interval -0.1 to -4.0°C with a frequency 12.8%; humidity 71—80% occurred in 14.9% of cases together with temperatures between -0.1 to -4.0°C .

4.2 Air temperature and wind speed

In summer moderate winds prevailed. Speeds of 4—7 and 8—10 $\text{m}\cdot\text{s}^{-1}$ covered together 69.7%. They were occurring mostly at temperatures between 3.9 and 0.0°C . The second group as regards the frequency of occurrence were the light winds, 0—3 $\text{m}\cdot\text{s}^{-1}$, covering 20.9%, which also occurred most frequently at temperatures 3.0— 0.0°C . Winds of speeds exceeding

$10 \text{ m}\cdot\text{s}^{-1}$ covered 9.4%, of which 7.2% were accompanied by positive temperatures, and only 2.2% — by negative temperature values. Extremely strong winds were recorded at temperatures 3.9 to 0.0°C and -0.1 to -4.0°C (Table VI). This distribution is illustrated in Fig. 3A: highest frequencies of simultaneous occurrences of wind speed and temperature values were cumulating within specific intervals, whereas other groups of values had only few cases each.

In winter the most numerous observations, jointly 35.6%, were for the light winds ($0-3 \text{ m}\cdot\text{s}^{-1}$). They occurred for the whole range of winter temperatures but for the highest; in the four most frequent temperature intervals, contained between -4.1 and -20.0°C , they covered 5 to 9% of observations. Within the same temperature range, extended towards higher temperatures to -0.1°C , the second most numerous group of wind speeds was that of $4-7 \text{ m}\cdot\text{s}^{-1}$. Out of 25% of their total frequency, 23.3% stayed in these five temperature intervals. As regards winds of speeds $8-10 \text{ m}\cdot\text{s}^{-1}$ (total frequency 18.4%, covering mainly the temperature ranges from $+3.9$ to -16.0°C), the majority of them, 6.2%, occurred at temperatures between -0.1 and -4.0°C .

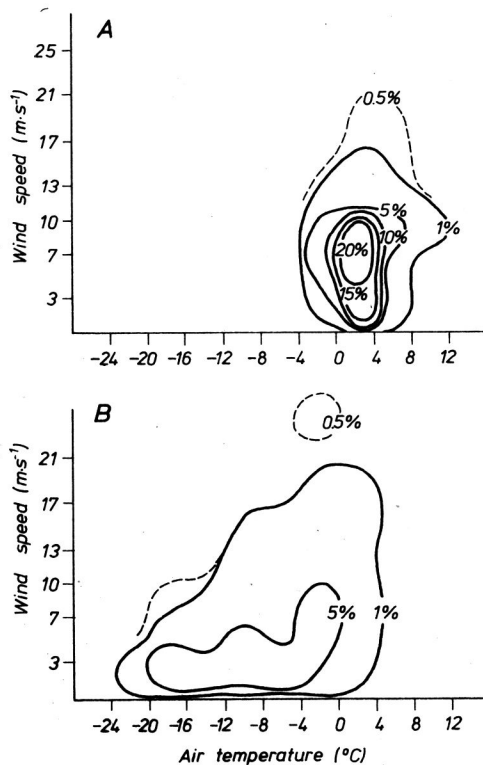


Fig. 3. Distribution of simultaneous occurrence of air temperature and wind speed, Arctowski Station, 1978

A — summer months B — winter months

Generally it can be said that the stronger the wind the more frequently it occurs at higher air temperatures, whereas the lightest winds accompany the lowest temperatures, between -20.0 and -28.0°C . (Table V). The distribution of wind frequencies within definite temperature intervals is much more dispersed than it was in summer, containing more groups of similar frequency of simultaneously occurring values of wind speeds and air temperatures (Fig. 3B).

More detailed data on the discussed co-occurrence of air temperatures and wind speeds in summer and winter, and the data for the two other seasons of 1978 are contained in Table V. The quoted numbers are based on observations of one year only and must be supplemented by further data in the course of time, to prove their reliability. A preliminary comparison with observations of 1979 showed, for example, remarkable differences in the frequency of particular wind speeds in both years. In 1979 the percentage of strong and near gale winds was about 8% higher, whereas moderate and light winds were less frequent than in 1978.

4.3 Precipitation and wind speed at definite temperatures

The values in Table VII, VIII are arranged to emphasize the frequency of cases in which falling precipitation, if any, is accompanied by temperatures close to freezing (or melting) point and if it is driven by strong winds or falls undisturbed. This information is essential in structure designing and field work planning. It is the more essential that the temperatures in the interval close to the freezing point are the most frequent ones on the Arctowski Station.

Precipitation occurred in about 30% of observations throughout the year. When we consider the seasons of the year separately, it can be seen that at the temperature interval from 3.9 to -4.0°C its frequency was 25% in summer and in autumn, then decreased to 12% in winter to increase again in spring to almost 20%.

Precipitation rarely accompanied light winds, occurring mostly with wind speeds $8-10\text{ m}\cdot\text{s}^{-1}$. Winds exceeding $10\text{ m}\cdot\text{s}^{-1}$ were accompanied by precipitation in 6.0% of cases in summer up to 8.1% in winter, occurring most frequently at temperatures 3.9 to -4.0°C .

It should be said that precipitation was not very frequent in 1978. Preliminary analysis for 1979 showed higher precipitation frequency in winter and spring than in analogous seasons of 1978. For example, in winter of 1979 there were 60% of observations with precipitation, whereas in 1978 only 32%; similarly in spring of 1979 there were 50% of observations with precipitation, and in 1978 — hardly 30%. Considerable increase in the frequency of precipitation (from 30% of cases in 1978 to 45% in 1979) was not accompanied by similar increase in annual amount of precipitation, which in 1978 was 554 mm and in 1979—591 mm.

4.4. Air temperature, humidity and precipitation at determined wind speeds

Detailed information on the frequency of groups of weather parameters occurring together within particular intervals of values is contained in Tables V—X. As already mentioned, for particular seasons of the year 120 to 200 groups were formed. Let us consider the most significant ones.

For example, in summer (Table IX, X) two groups of observations had the frequencies of 6.4 and 6.9%. These were cases when no precipitation occurred and the intervals of temperature and humidity (3.9—0.0°C and 71—80% respectively) were identical for both groups, but the wind speeds — different, namely 4—7 and 8—10 m·s⁻¹.

Cases of maximum frequency of observations with precipitation formed a group at temperatures 3.9 to 0.0°C, at wind speeds 8—10 m·s⁻¹ and at relative humidity of 81—90%.

In winter, because of the wider temperature range, it had to be divided into a greater number of observation groups, and so each contained a smaller number of observations. The highest frequencies were only 2.9 and 2.7%, both referring to the same wind speed 0—3 m·s⁻¹, relative humidity 71—80% and no precipitation during observation. Only the temperature intervals were different: frequency 2.9% referred to the interval -12.1 to -16.0°C, and 2.7% — to the interval -16.1 to -20°C.

5. Conclusions

The analysis for 1978 revealed a number of regularities:

— In summer air temperatures stayed mainly within intervals 3.9 to 0.0 and -0.1 to -4.0°C. They were accompanied by most numerous appearing values of the other parameters, as humidities of 71—80 and 81—90% and wind speeds of 4—7 and 8—10 m·s⁻¹. Within the same two temperature intervals the highest precipitation frequency was observed (precipitation amount was not considered). Out of the many theoretically possible situations only few occurred with remarkable frequencies. They concentrate in few adjacent intervals, as shown in Figs. 2A and 3A.

— The range of winter temperatures is much wider extended towards the low values. This results in more evenly distributed frequencies in the whole range of this parameter than in summer, when they were cumulated close to only few intervals of values. In winter each of the co-occurring parameters may have a similar frequency, both at high, middle and low temperatures of the season. For instance, the wind speeds of the interval 0—3 m·s⁻¹, which are pretty common in winter, were co-occurring with temperatures -0.1 to -20.0°C with frequencies exceeding or close to 4% in each of the four degree intervals. The same may be said as regards the relative humidity of 71—80 and 81—90%. More even distribution of these frequencies in particular groups of parameter values in winter is illustrated in Figures 2B and 3B.

Table VII.

Air temperature, humidity, wind speed and precipitation. Frequency (%) of simultaneous occurrences within given intervals, on the Arctowski Station
Summer (Dec. 1978, Jan., Feb.) 1979

Wind speed (m·s ⁻¹)	Relative humidity (%)	Temperature (°C)				Summa
		11.9 to 0.0 p. no p.	7.9 to 4.0 p. no p.	3.9 to 0.0 p. no p.	-0.1 to -4.0 p. no p.	
0—3	≤60		0.1	0.3		0.4
	61—70		0.1	2.6	0.1	2.8
	71—80	0.1	0.6	0.3 4.1	0.1 1.1	6.3
	81—90		0.3 1.3	1.5 3.3	0.3 0.4	7.1
	91—96			1.9 1.4	0.1 0.1	3.5
	97—100			0.4 0.1	0.3	0.8
4—7	≤60			0.3	0.1	0.2
	61—70		0.3	3.4	0.1 1.4	5.2
	71—80	0.1	0.3 1.7	0.7 6.4	0.1 1.7	11.0
	81—90		0.8 0.8	1.7 4.8	1.1 0.1	9.3
	91—96		0.3	2.1 1.5	0.8	4.7
	97—100				0.1	0.1
8—10	≤60	0.3		0.1		0.4
	61—70	0.4	0.4 0.4	4.4	0.1 1.6	7.3
	71—80	0.3	1.1 1.5	1.1 6.9	0.1 1.5	12.5
	81—90		1.7 2.4	4.4 4.7	0.8 0.6	14.6
	91—96		0.1 0.1	2.6 0.6	1.0	4.4
	97—100					
11—13	≤60	0.1		0.1		0.2
	61—70		0.1 0.1	0.1	0.1 0.1	0.5
	71—80		1.2 0.6	0.8 0.6	0.4 0.4	4.0
	81—90			0.3	0.4	0.7
	91—96				0.1	0.1
	97—100					
14—17	≤60			0.1		0.1
	61—70			0.1	0.1 0.1	0.4
	71—80		0.1 0.1	0.4 0.4	0.1	1.1
	81—90		0.6	0.1	0.1	0.8
	91—96					
	97—100					
18—21	≤60	0.1				0.1
	61—70					
	71—80		0.1 0.1		0.1	0.3
	81—90		0.1 0.1	0.4 0.1		0.7
	91—96		0.1		0.1	0.2
	97—100					
22—25	≤60			0.1		0.1
	61—70					
	71—80					
	81—90					
	91—96				0.1	0.1
	97—100					
≥26	≤60					
	61—70					
	71—80					
	81—90					
	91—96					
	97—100					
Summa	p.		7.0	18.8	6.3	100.0
	np p.	1.4	10.7	46.2	9.6	

p — percentage of observations with precipitation, no p — percentage of observations without precipitation

Table VIII.
Air temperature, humidity, wind speed and precipitation. Frequency (%)
of simultaneous occurrences within given intervals, on the Arctowski
Station
Autumn (Mar., Apr., May) 1978

Wind speed (m·s ⁻¹)	Relative humidity (%)	Temperature (°C)										Summa		
		11.9 to 8.0		7.9 to 4.0		3.9 to 0.0		-0.1 to -4.0		-4.1 to -8.0			-8.1 to -12.0	
		p.	no p.	p.	no p.	p.	no p.	p.	no p.	p.	no p.		p.	no p.
0—3	≤ 60							1.0		0.4			1.4	
	61—70						0.1	1.8		0.5			2.4	
	71—80					1.0	0.1	3.5		0.3	0.2		5.1	
	81—90			0.2	0.5	3.1	0.4	5.7		0.4	0.1		10.4	
	91—96				0.5	0.5		1.9		0.4			3.3	
	97—100					0.3		0.7		0.4			1.4	
4—7	≤ 60			0.1				0.1					0.2	
	61—70			0.1	0.1	0.5	0.3	3.7		0.1		0.1	4.9	
	71—80			0.5	0.5	4.2	0.5	3.1					8.8	
	81—90			0.3	0.3	3.8	6.7	1.2	2.9	0.3	0.3	0.1	15.9	
	91—96			0.2	1.2	1.2	0.7	0.3					3.6	
	97—100					0.4	0.2	0.3					0.9	
8—10	≤ 60			0.1				0.7					0.8	
	61—70					0.7	0.1	1.5	0.1	0.3			2.7	
	71—80			0.3	1.1	1.0	3.8	0.8	2.4	0.4			9.8	
	81—90			0.3	0.1	3.7	5.7	1.4	0.4	0.4	0.1	0.3	12.4	
	91—96			0.2		1.5	0.8	1.1	0.1	0.2			3.9	
	97—100					0.5		0.3	0.2				1.0	
11—13	≤ 60							0.1		0.1			0.2	
	61—70					0.1		0.3					0.4	
	71—80			0.1	0.2	1.1		0.1					1.5	
	81—90			0.4	0.4	1.0	1.8	0.5					4.1	
	91—96					1.0	0.3	0.3					1.6	
	97—100													
14—17	≤ 60													
	61—70													
	71—80					0.2	0.1						0.3	
	81—90				0.1	0.5		0.1					0.7	
	91—96					0.3	0.1	0.2					0.6	
	97—100													
18—21	≤ 60													
	61—70													
	71—80													
	81—90			0.5		0.3							0.8	
	91—96					0.3		0.1					0.4	
	97—100													
22—25	≤ 60													
	61—70													
	71—80	0.3		0.1									0.4	
	81—90			0.1									0.1	
	91—96													
	97—100													
≥26	≤ 60													
	61—70													
	71—80													
	81—90													
	91—96													
	97—100													
Summa	p. no p.	0.3	2.3	3.4	16.7	32.5	8.5	30.8	1.4	3.3	0.7	0.1	100.0	

p — percentage of observations with precipitation, no p — percentage of observations without precipitation

Table IX.
Air temperature, humidity, wind speed and precipitation. Frequency (%)
of simultaneous occurrences within given intervals, on the Arctowski
Station
Winter (June, July, Aug.) 1978

Wind speed (m·s ⁻¹)	Relat. humid. (%)	Temperature (°C)																Summa		
		7.9 to 4.0		3.9 to 0.0		-0.1 to -4.0		-4.1 to -8.0		-8.1 to -12.0		-12.1 to -16.0		-16.1 to -20.0		-20.1 to -24.0			-24.1 to -28.0	
		p.	no p.	p.	no p.	p.	no p.	p.	no p.	p.	no p.	p.	no p.	p.	no p.	p.	no p.		p.	no p.
0-3	≤ 60					0.1	0.1			0.5	2.2		0.7							3.6
	60-70					0.1	0.1	0.1	1.0	0.2	1.2	0.1	1.5		1.9	0.3	0.3			6.7
	71-80					0.1	1.1	0.3	1.9	1.1	1.6	0.5	2.9	0.3	2.7		0.4			12.9
	81-90		0.3	0.4		0.8	0.7	0.7	1.0	1.0	1.0	0.3	1.2		1.9		0.4			9.7
	91-96		0.3	0.7		0.5		0.1	0.4	0.1			0.1							2.2
	97-100		0.3			0.2	0.1											0.1		0.5
4-7	≤ 60					0.3		0.1	0.1	1.0		0.4		0.5						2.4
	61-70			0.1		0.1	0.5		0.2	0.3	0.5	0.4	0.8	0.3	1.8					6.0
	71-80		0.3	0.1		0.1	1.8	0.3	0.4	0.7	0.8	0.5	0.7	1.0	0.8		0.3			7.8
	81-90		0.3	0.2		0.7	1.2	1.4	0.1	1.4	0.4	0.1	0.2	0.3	0.1					6.4
	91-96		0.1	0.1		1.1	0.1	0.5	0.1		0.2									2.2
	97-100		0.2																	0.2
8-10	≤ 60					0.5		0.4		0.5		0.1								1.5
	61-70					0.2	0.4	0.2	0.4		0.8		0.4		0.1					2.5
	71-80		0.1	0.8		0.4	1.9	0.1	0.7	0.5	0.4		0.8		0.2					5.9
	81-90		0.3	1.0		0.8	1.6	1.5	0.4	0.7	0.3	0.1	0.1	0.3						7.1
	91-96		0.1	0.3		0.1		0.4		0.2										1.1
	97-100					0.3														0.3
11-13	≤ 60																			0.1
	61-70			0.1		0.1				0.3										0.5
	71-80		0.2	0.4		0.2		0.1	0.8	0.3	0.1				0.1					2.2
	81-90		0.1	0.4		0.7	1.4		0.7	0.7					0.3					4.3
	91-96		0.1	0.2		0.3	0.1					0.1			0.1					0.8
	97-100			0.1		0.4														0.5
14-17	≤ 60								0.1											0.1
	61-70					0.5			0.3											0.8
	71-80			0.7					0.4			0.1								1.7
	81-90		0.4	0.5		0.4	0.5	0.3	0.3	0.8				0.2	0.4					3.8
	91-96		0.3	0.1		0.4			0.2	0.1										1.1
	97-100					0.1														0.1
18-21	≤ 60																			0.1
	61-70																			0.1
	71-80								0.1											0.1
	81-90		0.5	0.5		0.2	0.5	0.3		0.1	0.2									2.3
	91-96		0.3				0.1													0.4
	97-100		0.2	0.2		0.3														0.7
22-25	≤ 60																			0.1
	61-70			0.1																0.1
	71-80																			0.1
	81-90								0.1											0.1
	91-96		0.3					0.1												0.4
	97-100																			0.4
≥26	≤ 60																			0.4
	61-70																			0.4
	71-80		0.2					0.2												0.5
	81-90							0.5												0.5
	91-96																			0.1
	97-100			0.1																0.1
Summa	p.		4.5		7.5		6.4		8.3		2.1		2.9		0.3					100.0
	no p.	0.2		7.6		15.2		10.2		10.9		11.6		10.8		1.4				

p—percentage of observations with precipitation, no p—percentage of observations without precipitation

Table X.
Air temperature, humidity, wind speed and precipitation. Frequency (%)
of simultaneous occurrences within given intervals, on the Arctowski
Station
Spring (Sept., Oct., Nov.) 1978

Wind speed (m·s ⁻¹)	Relative Humidity (%)	Temperature (°C)												Summa		
		7.9 to 4.0		3.9 to 0.0		-0.1 to -4.0		-4.1 to 8.0		-8.1 to -12.0		-12.1 to -16.0			-16.1 to -20.0	
		p.	no p.	p.	no p.	p.	no p.	p.	no p.	p.	no p.	p.	no p.		p.	no p.
0—3	≤ 60					0.7									0.7	
	61—70					1.5		1.1							2.6	
	71—80				1.0	2.9	0.1	1.2		0.3			0.4	0.1	6.0	
	81—90			0.1	1.5	0.8	2.5	0.3	0.8		0.5				6.5	
	91—96			0.1	0.1	0.3	0.5	0.7	0.5		0.4				2.6	
	97—100															
4—7	≤ 60					0.2	0.2	1.5		0.1			0.1		2.1	
	61—70					0.7	0.1	4.0		1.1				0.1	6.0	
	71—80	0.1				2.7	0.3	5.1	0.3	1.0		0.1	0.7		10.3	
	81—90			1.4	4.5	1.1	1.9	0.3	0.3		0.2				9.7	
	91—96			0.8	0.7	0.7	0.3								2.5	
	97—100							0.1							0.1	
8—10	≤ 60							0.4		0.2					0.6	
	61—70		0.3		1.0	0.3	2.6			1.1		0.1			5.4	
	71—80	0.3		0.3	3.7	0.5	4.4			0.3					9.5	
	81—90		0.3	1.4	4.5	1.5	2.5	0.3	0.3						10.8	
	91—96			1.1	1.1	1.1	-0.5	0.1							3.9	
	97—100			0.4											0.4	
11—13	≤ 60							0.4							0.4	
	61—70				0.2	0.4		0.7		0.7					2.0	
	71—80		0.3	0.1	0.4	0.2	1.0					0.3		0.1	2.4	
	81—90			1.2	1.4	0.4	1.1	0.2	0.5						4.8	
	91—96			0.4	0.3	1.0									1.7	
	97—100			0.1											0.1	
14—17	≤ 60							0.2							0.2	
	61—70		0.3					0.4		0.4					1.1	
	71—80	0.1			0.5		0.5				0.3				1.4	
	81—90	0.2		0.4	1.4	0.5	0.5	0.1							3.1	
	91—96					0.3		0.3							0.6	
	97—100					0.1									0.1	
18—21	≤ 60						0.1								0.1	
	61—70									0.1					0.2	
	71—80			0.4	0.1										0.5	
	81—90			0.7		0.3									1.0	
	91—96															
	97—100															
22—25	≤ 60															
	61—70															
	71—80															
	81—90				0.3										0.3	
	91—96															
	97—100				0.2										0.2	
≥26	≤ 60															
	61—70															
	71—80															
	81—90				0.1										0.1	
	91—96															
	97—100															
Summa	p.		0.7	9.7	9.9	2.7	0.1		0.4							
	no p.		1.2	26.3	36.1	9.7	2.8		0.1	0.3					100.0	

p — percentage of observations with precipitation, no p — percentage of observations without precipitation

— Most unfavourable conditions, i.e. very strong wind accompanying very low temperatures (as recorded on the Station) and humidity close to saturation at extremely low temperature are a phenomenon of small probability. Nevertheless, winds of speeds exceeding $10 \text{ m}\cdot\text{s}^{-1}$ accompanying negative temperatures, were common beyond the summer season; similarly, humidity close to saturation happened at negative temperatures in all seasons of the year, although it was not very frequent.

6. Summary

Using the meteorological observations of the year 1978 from the Arctowski Station the co-occurrence of four most perceptible parameters was analysed, i.e. air temperature, wind speed, relative humidity and precipitation. Analysis of their frequencies was preceded by a discussion of general meteorological conditions during the year. These conditions were consistent with the long-term observations both when the variation of pressure and of air temperatures was considered, although the latter were below the average in winter and higher in the remaining season of the year (Table I, Fig. 1). Precipitation did not depart from normal, although its frequency of occurrence was slightly lower. Thus the conditions in 1978 could be considered as representative for the coasts of Admiralty Bay.

The presented study shows some characteristic features of weather conditions on the Arctowski Station in 1978. Common were high oscillations of air pressure and temperature even within one decade, especially in the cool season of the year; extreme pressure values were 955.5 and 1025.5 hPa and the annual mean — 992 hPa (Table III); temperature changed within the limits of 8.1 to -25.3°C , while its annual mean was -2.7°C .

Air temperature oscillations around 0°C were common even in the warmest months. Oscillations of soil temperature were considerable. At the depth of 5 cm they varied between 18°C in summer and -14°C in winter. At the depth of 100 cm the temperature varied probably from 3° to -6°C , the exact value being not known due to disturbances in measurements (Table II).

Frequency analysis of the co-occurring groups of values of most important parameters revealed that in summer the air temperatures cumulated mainly in two intervals close to 0°C , i.e. 3.9 to 0.0°C and -0.1 to -4.0°C (Figs. 2A and 3A). Within these temperatures maximum frequencies of relative humidities from the intervals 71–80 and 81–90% were contained (Table IV, Fig. 2A), the same referring to the wind speeds of 4–7 and 8–10 $\text{m}\cdot\text{s}^{-1}$ (Table V, Fig. 3A). Precipitation was most frequently recorded within the same temperature intervals.

In winter, due to temperatures extending towards negative values down to -26.0°C the frequencies of simultaneous occurrence of other parameters together with particular temperatures were lower and were distributed over a greater number of intervals. For example, the frequent in winter light winds, 0–3 $\text{m}\cdot\text{s}^{-1}$, occurred with temperatures from between -0.1 and -20.0°C with frequencies between 4 and 8% in each of the four degree intervals (Table V, Fig. 3B).

In each season of the year a slight percent of humidities close to saturation point occurred at air temperatures below zero. Wind speeds exceeding $10 \text{ m}\cdot\text{s}^{-1}$ at negative temperatures were also oppressing and they occurred, with the exception of summer, quite frequently. Still the extreme conditions, i.e. very strong winds at very low temperatures and humidities close to saturation at very low temperatures did not occur in 1978 and there is but little probability that those phenomena should be encountered together.

7. Резюме

На основании данных из 1978 г. из Станции Арцтовского совершенно анализ одновременного выступления четырёх метеорологических параметров какими являются: температура воздуха, скорость ветра, относительная влажность и осадки. Перед анализом представлено общие метеорологические условия всего года.

Эти условия были согласны с многолетними по отношению величины и хода давления а также температур воздуха, хотя эти последние ниже средних в период зимы а выше в остальные времена года (таблица I, рис. 1). Также уровень осадков был в норме, хотя их повторяемость несколько меньше. Затем можно условия 1978 г. принять как средние для побережья Залива Адмиралты.

Разработка основана на измерительных данных этого года доказала больше колебания величины давления и температуры воздуха, даже в рамках одного 10-ти дневного периода, особенно в холодное время года. Крайние величины давления выражены числами 955,5 hPa для минимум и 1025,5 hPa для максимум, при средней годовой 992 hPa (таблица III), а температура колебалась от 8,1 до $-25,3^{\circ}\text{C}$ при средней годовой равной $-2,7^{\circ}\text{C}$.

Количество переходов температуры воздуха через 0°C достигала от десяти до двадцати случаев, даже в тёплые месяцы. Колебания температура почвы были значительными и на глубине 5 см достигали от 18°C летом до около -14°C зимой. На глубине 100 см выступали в пределах от $+3^{\circ}\text{C}$ до около -6°C . Приведение более подробных данных в это время является невозможным из-за перерывов какие выступали в измерениях на этом уровне (таблица III).

Анализ одновременного частотного выступления отдельных комплектов величин самых главных параметров доказал, что летом температуры воздуха сосредоточены прежде всего в двух пределах в близи точки замерзания, т.е. $3,9$ до $0,0^{\circ}\text{C}$ а также $-0,1$ до $-4,0^{\circ}\text{C}$ (рис. 2A и 3A). В рамках пределов этих температур выступают максимальная повторяемость относительной влажности в $71-80\%$ и $81-90\%$ (таблица V рис. 3A) а также скорость ветра $4-7$ и $8-10 \text{ м}\cdot\text{с}^{-1}$ (таблица IV, рис. 3A). При тех же температурах чаще всего выступают осадки.

Зато зимой, из-за выступления температур из предела расширенного до -26 C частоты одновременного выступления с отдельными величинами меньше, раскладываются на значительно больше пределов, чем летом.

Например часто выступающий зимой слабый ветер ($0-3 \text{ м}\cdot\text{с}^{-1}$) появляется вместе с температурами пяти пределов содержащихся между $-0,1$ до $-20,0^{\circ}\text{C}$ с частотами между 4 и 8% (таблица V, рис. 3B).

В каждое время года случаются, в невеликом проценте влажности близкие насыщения при отрицательных температурах. Зато экстремальные условия, т.е. сильный ветер при низких температурах и влажности близкой насыщения при крайне низкой температуре в 1978 году не встретились и являются мало вероятным явлением.

8. Streszczenie

Na podstawie danych z roku 1978 ze Stacji Arctowskiego dokonano analizy współwystępowania czterech najbardziej bezpośrednio odczuwalnych parametrów meteorologicznych, jakimi są: temperatura powietrza, prędkość wiatru, wilgotność względna i opad. Analizę tę poprzedzono omówieniem ogólnych warunków meteorologicznych całego roku

Warunki te były zgodne z wieloletnimi pod względem wartości i przebiegu ciśnienia a także temperatur powietrza, choć te ostatnie były niższe, niż przeciętnie, w okresie zimy, a wyższe w pozostałych porach roku (tabela I, rys. 1). Również wysokość opadu mieściła się w normie, choć częstość jego występowania była nieco mniejsza. Można więc warunki roku 1978 uznać za przeciętne dla wybrzeży Zatoki Admiralicji.

Opracowanie oparte na danych pomiarowych tego roku wykazało bardzo duże wahania wartości ciśnienia i temperatury powietrza, nawet w ramach jednego okresu 10-dniowego, zwłaszcza w chłodnej porze roku. Skrajne wartości ciśnienia wyraziły się liczbami 955,5 hPa dla minimum i 1025,5 hPa dla maksimum, przy średniej rocznej 992 hPa (tabela III), a wartości temperatury zmieniały się od 8,1 do $-25,3^{\circ}\text{C}$, przy średniej rocznej $-2,7^{\circ}\text{C}$.

Ilość przejść temperatury powietrza przez 0°C sięgała kilkunastu przypadków, nawet w najcieplejszych miesiącach.

Wahania temperatury gruntu były znaczne i na głębokości 5 cm wynosiły od około 18°C latem do około -14°C zimą. Na głębokości 100 cm zawierały się w przybliżeniu od $+3^{\circ}\text{C}$ do około -6°C . Podanie dokładniejszych wartości nie jest w tej chwili możliwe ze względu na przerwy, jakie wystąpiły w pomiarach na tym poziomie. (tabela II).

Analiza częstości jednoczesnego występowania poszczególnych zespołów wartości najważniejszych parametrów wykazała, że latem temperatury powietrza skupiają się głównie w dwóch przedziałach bliskich punktowi zamarzania, to jest $3,9$ do $0,0^{\circ}\text{C}$ oraz $-0,1$ do $-4,0^{\circ}\text{C}$ (rys. 2A i 3A). W ramach tych przedziałów temperatur mieszczą się maksymalne częstości występowania wilgotności względnej w zakresie 71—80% (tabela IV, rys. 2A) oraz prędkości wiatru w zakresie $4-7$ i $8-10\text{ m}\cdot\text{s}^{-1}$ (tabela V, rys. 3A).

Przy tych samych temperaturach również najczęściej występuje opad.

Zimą natomiast, na skutek występowania temperatur z zakresu poszerzonego o wartości ujemne aż do -26°C , częstości współwystępowania z poszczególnymi wartościami temperatur są mniejsze, rozkładając się na znacznie więcej jej przedziałów, niż latem. Bardzo na przykład częsty zimą wiatr słaby ($0-3\text{ m}\cdot\text{s}^{-1}$) występuje z temperaturami z pięciu przedziałów, zawartych między $-0,1$ do $-20,0^{\circ}\text{C}$, z częstościami między 4 a 8% (tabela V, rys. 3B).

O każdej porze roku zdarzają się, aczkolwiek w niewielkim procencie, wilgotności bliskie nasycenia przy temperaturach ujemnych. Zjawiskiem równie przykrym, aczkolwiek znacznie częstszym, są — poza porą letnią — wiatry o prędkościach przekraczających $10\text{ m}\cdot\text{s}^{-1}$ przy temperaturach ujemnych. Natomiast warunki ekstremalne, to jest bardzo silny wiatr przy bardzo niskich temperaturach oraz wilgotności bliskie nasycenia przy skrajnie niskiej temperaturze w roku 1978 nie wystąpiły i są zjawiskiem bardzo mało prawdopodobnym.

9. References

1. Anonymous 1968 — World Weather Records 1951—1960 — Washington, D. C. U. S. Department of Commerce, ESSA, Environmental Data Service, 6, 605 pp.
2. Böer W., 1964 — Technische Meteorologie — B.G. Teubner Verlagsges., Leipzig, 232 pp.
3. Dolgin I. M., Petrov L. S. 1977 — Spravocnik po klimatu Antarktidy — Gidrometeoizdat, Leningrad, 2, 493 pp.
4. Nowosielski L. 1980 — Meteorological conditions at Arctowski Station in 1978 (King George Island, South Shetland Islands) — Pol. Polar Res. — 1: 83—94.
5. Zavalova I. N. 1969 — O temperaturno-vlaznostnykh karakteristikakh klimata za letnij period v Arktike dlja uceta ich pri stroitelstve — Trudy AANII 287: 81—97.

Paper received 1 October 1980

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