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Lucjan NOWOSIELSKI

Institute of Meteorology and Water Management, Warszawa

Meteorological conditions at Arctowski Station in 1978 (King George Island, South Shetland Islands)*)

ABSTRACT: Results from measurements and basic observations of meteorological elements carried out in 1978, at Arctowski Station situated on King George Island (South Shetland Islands) are presented

Key words: Antarctic, meteorology

1. Introduction

Meteorological measurements and observations in the region Admiralty Bay were conducted between 1949—1960 at the British Station "Admiralty Bay" located at Kellar Peninsula. Meteorological measurements at Arctowski Station were started in 1977 (Zubek, in press). The presented results comprise the data from the second year of continuous measurements at Arctowski Station.

2. Methods

Measurements and observations at the Meteorological Station operating within the area of Arctowski Station. Base were made by means of a standard equipment conventionally used by meteorological stations working for weather forecasting services.

The Meteorological Station (62°10′S, 58°28′7″W) is registered in the W.M.O. registry at No. 89052. The Station works throughout day and night, regular observations are made every 3 hours from 0000 to 2400 G.M.T.

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Atmospheric pressure was measured until January 18, 1978, by means of an aneroid, then, from January 19 with a mercury barometer (N.B. the height of barometer was 3.2 m above M.S.L.) and the readings of pressure values were reduced to mean sea level. Monthly, seasonal and annual mean values were calculated on the basis of regular observations made every 3 hours.

Air temperatures were measured with a mercury termometer placed at a height of 200 cm above ground level in a meteorological shutter — screen (Polish type). Measurements of the minimum temperatures were made by means of tuluole minimum thermometer, the maximum temperatures were measured with a mercury maximum thermometer kept in a meteorologic screen. Mean values were calculated on the basis of observations made every 3 hours.

Wind direction and speed were measured with an electrical cup anemometer, its transmitting part was fixed at a free — standing pole at a height of 11 m above ground level. Mean values were calculated on the basis of the every three hours observations.

Humidity was evaluated by means of an August psychrometer kept in a meteorological screen. Relative humidity (expressed as a percentage) actual vapour pressure, saturation vapour pressure and dew point, at the dry bulb temperature were calculated. Means were calculated from every three hours observation.

Cloud amounts were determined in oktas — eight parts of sky covered with clouds. Visual observations were every three hours and on this basis means were calculated.

Height of cloud base was determined visually. The base of low clouds was evaluated by comparison with the known heights of the local elevations of the ground. The calculations of the number of days with clouds bases below 200 m were based on all observations.

Visibility observations were made using visual methods based on repers to which the distance is known. Regular observations were made every 3 hours, moreover cases of reduced visibility due to fog were noted.

Amount of precipitation was measured using a Holmann raingauge, the inlet (area = 200 cm^2) was at a height of 100 cm above ground level, The measurements were made four times a day: 0000, 0600, 1200, 1800 G.M.T. The number of days with precipitation was calculated on the basis of the frequency of precipitation throughout a day (24 h). The number of days with fog was calculated on the basis of recordings of the occurrence of fog throughout a day (24 h). The number of days with blowing snow was calculated analogically.

The number of days with snow covering more than a half of the area were calculated on the basis of daily observations evaluating visually snow covered ground around the meteorological screen (meteorological garden).

The term "summer" is used to derine a six — month period including the following months: October, November, December, January, February, March, the term "winter" includes the remaining months: April, May, June, July, August, September.

A day with a phenomenon is counted when it occurs in a given day, no matter how long it lasts. If in the same day several phenomena occur simultaneously (fog. drizzle, rain, etc) such a day is counted separately for each of them.

3. Results

Results from the measurements of pressure are given in Table I. Changes of pressure in the region of the Station are quite remarkable due to frequent and quick movement of deep depressions in the area of the South Shetlands. The greatest changes of pressure, calculated from the three hours observations in 1978, were fall 12.8 mb (August 23), rise 7.3 mb (August 26). The highest value of atmospheric pressure (1025.9 mb) was recorded July 17, the lowest value 955.5 mb — July 27, 1978. Annual amplitude of pressure in 1978 was 70.4 mb. The mean annual pressure, claculated from the records of a 13- year series of measurements at the British Admiralty Bay Station conducting observations between 1948–1960, was 991 mb, whereas at Arctowski Station the mean annual pressure for 1978 was 9.5 mb higher. The mean pressure for six summer months was almost equal to the values for the same months of the period 1948–1960, whereas the means pressure for six winter months was 20 mb higher than the values for the same period at Admiralty Bay Station (1948–1960).

Results from the measurements of air temperature are given in Table I. In 1978, temperatures below as well as above 0°C occuned in every month throughout the whole year. This is due to high cyclonic activity over this region and frequent alternation of cold air masses brought in from the Antarctic Continent and warm oceanic air masses from lower geographical latitudes. In 1978 February was the warmest month — the mean monthly temperature 2.5°C and July was the coldest — 11.6°C. The annual amplitude of the mean montjhy temperatures was 14.1°C.

In 1978 monthly amplitudes of extreme temperatures ranged in the summer season from 9.4°C to 15.3°C, in the winter from 12.5°C to 28°C.

The comparison of mean temperatures of the warmest and the coldest month of 1978 with mean temperatures of July — 10.0°C and January + 3.0°C, calculated for the South Shetlands from isotherms chart, shows that at Arctowski Station these two months has temperatures below normal the highest temperature of the year 8.9°C in March 1978 was lower than the absolute maximum temperature 11°C at Admiralty Bay in the period 1948–1960. The lowest temperature of the year −25.3°C in August 1978 was higher than the absolute minimum temperature noted at Admiralty Bay −32.0°C.

Results from the measurements of wind direction and speed are given in Table II, III and in Fig. 1. The mean wind speed for the year 1978 calculated from 2920 observations was 7.0 m/s (for summer — 7.4, for winter — 6.5). The highest mean monthly wind speed 8.0 m/s was noted in February and October, the lowest 3.6 m/s in July, 1978. The mean wind speed calculated for the period of six summer months was nearly 1 m/s higher than in the winter season. In 1978 winds with mean velo-

Table I.

Pressure (mb), temperatures (°C) and wind velocity (m/s) in 1978

Elements compared		Month											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Pressure	Mean	988.6	991.0	993.4	992.6	1003.4	984.5	1002.5	984.9	993.8	984.8	993.9	987.6
	Maximum variation of pressure	+3.0	5.1	4.9	4.9	6.3	6.7	6.4	7.3	5.3	5.1	4.0	3.4
		−5.2	6.6	6.3	5.7	5.0	7.4	8.2	12.8	6.1	4.8	4.3	7.8
Temperature	Mean	2.1	2.5	0.8	−0.4	−0.1	−5.1	−11.6	−7.1	−2.3	−1.2	−1.1	1.0
	Minimum	−1.4	−2.2	−6.4	−6.0	−11.4	−19.9	−24.8	−25.3	−23.5	−8.1	−5.9	−6.7
	Maximum	8.0	8.1	8.9	6.5	7.6	5.0	3.2	3.7	5.2	5.4	5.5	8.2
	Monthly amplitude	9.4	10.3	15.3	12.5	19.0	24.9	28.0	29.0	28.7	13.5	11.4	14.9
Wind speed	Mean	6.7	8.0	7.4	6.3	5.9	7.8	3.6	7.4	7.6	8.0	6.9	7.7
	Maximum	36	47	45	42	24	45	50	43	47	37	36	40

+ rise of pressure, — fall of pressure

Mean annual pressure — 981.5

Mean (summer months) pressure seasonal — 989.9

Mean (winter months) pressure seasonal — 973.2

Table II

Number of days mean wind speed ⩾ 15 m/s and gusts speed ⩾ 25 m/s in 1978

	Month														
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Summer	Winter	Year
wind speed ⩾ 15 m/s	3	6	8	3	0	10	4	9	9	9	4	4	34	35	69
gusts speed > 25 m/s	4	9	8	4	0	10	5	16	12	12	6	9	48	47	95

Table III

Frequence of wind direction and ranges of wind speed (m/s) in 1978

Wind speed	Wind direction																		
	C	VRB	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM
0	287	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	287
1—5	.	9	67	42	58	34	50	36	62	52	58	69	60	109	64	38	43	42	893
6—10	.	.	83	50	28	41	55	42	32	25	44	82	167	268	127	60	67	88	1259
11—17	.	.	39	17	7	5	8	11	26	12	1	24	47	50	22	24	49	50	392
18—28	.	.	8	1	1	.	1	.	3	7	1	.	1	4	2	13	20	26	88
29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1
Total	287	9	197	110	94	80	114	89	123	96	104	175	275	431	215	135	179	207	2920

C — calm
VRB — variable
. observations missing

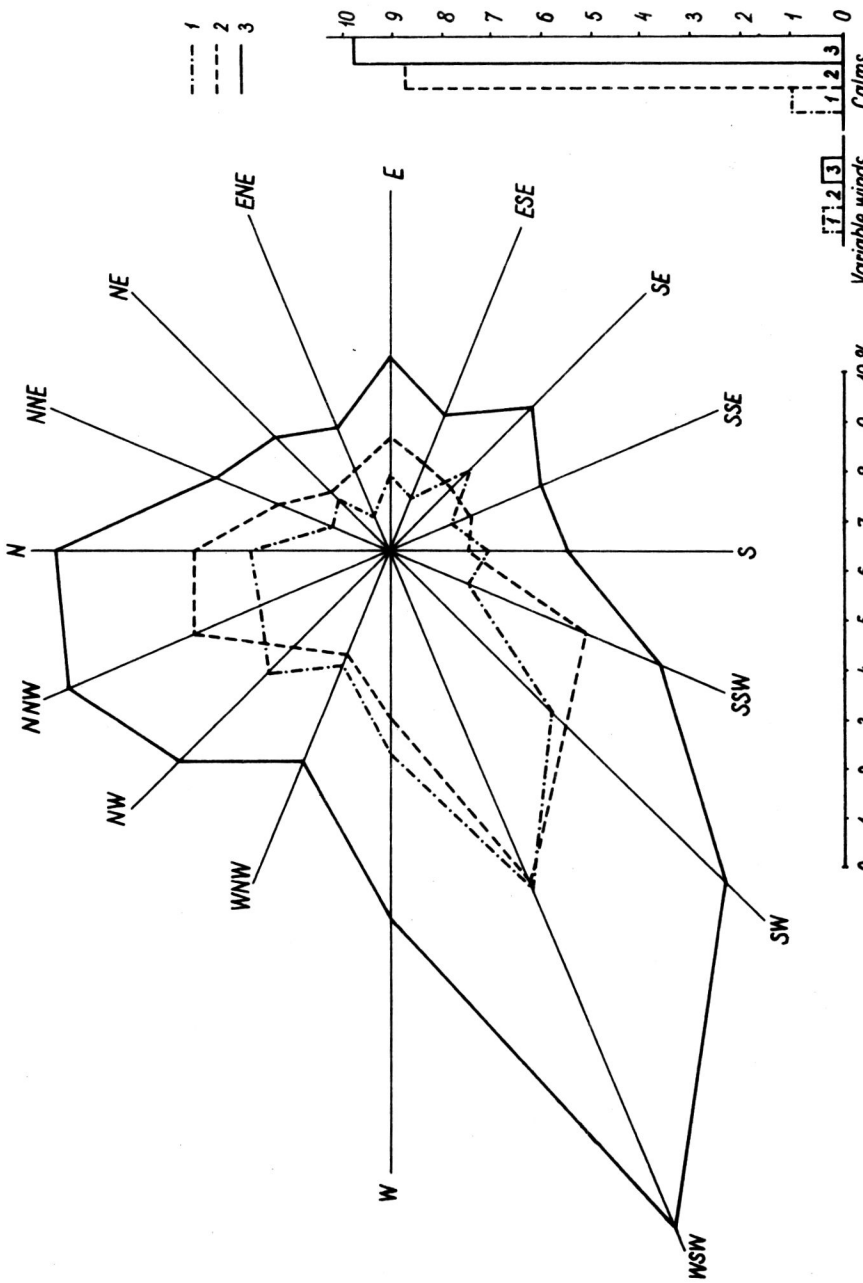

Fig. 1. Frequency of wind directions at Arctowski Station in 1978
1 — summer, 2 — winter, 3 — year.

city reaching or exeeceding 15 m/s occured during 69 days, Gusts reaching or exeeceding 25 m/s were recorded during 95 days. The highest gust reaching 50 m/s occuned in July 1978. The annual mean wind speed for 1978 is similar to the annual mean speed at Admiralty Bay Station — 6.5 m/s, calculated from the 13-year series of observations (1948–1960). In 1978 the prevalent winds were from WSW 14.8%, SW 9.5%, W 7.5%, NNW 7.1%, N 6.8%, NW 6.1% (Fig. 1).

The loast frequently occurring wind directions were: S, SSE, SEE, ESE, E, ENE, NE, NNE. The observed wind distribution is due to the prevailing in the region west zone circulation, between latitudes 40°S and 60°S affected also by orographic effects of King George Island. Ezcurra Inlet and Admiralty Bay. The differences in the distribution of winds between the "summer" and the "winter" months were inconsiderable. Predominance of wind directions NNW, N and SSW in the summer season may be attributed to the katabatic effects more frequent in the warmer part of the year. The colder air from the glacier cap flows towards comparatively warmer Admiralty Bay and the neighbouring region, which is snowfree and strongly heated.

Mean annual relative humidity in 1978 was 80%. Mean montly relative humidity was higher in summer 81% than in winter 79%. These values are 3–4% lower than at Admiralty Bay. Mean annual saturation vapour pressure was 4.6 mb and mean annual dew point was — 4.9°C. The results are given in Table IV.

Cloud observations are presented in Table V and VI. The maximum of total cloud amount occurred in the summer months. In winter the values of cloud amount were lower. Throughout the year 1978 the annual means were higher than 6/8. As results from cloud observations the region of Arctowski Station has an advantage over the neighbouring regions as regards cloud amounts. Very often totally overcast skies were observed over King George Island and the surrounding waters whereas at Admiralty Bay the total cloud amount was in the range of 3/8–6/8. Westerly winds and orographic effects of the region of Admiralty Bay favour the forming of strong air currents descending from the ice-cap of King George Island and dissipation of low clouds in the area around the Station. In 1978 as many as 168 days were recorded, in which the height of cloud bases was 200 m or lower (Table VI). The maximum frequency of cloud heights 200 m or less at the occurred in June, the minimum in November. Only these cases were taken under consideration, where low cloud amounts were 4/8 or higher.

In 1978 the number of days when visibility was 1 km. or less was much higher during the winter (38) than in the summer (11). Altogether in 1978 there were 49 days, when visibility was 1000 m or lower (Table VI). Only on about 30% of these occasions visibility was reduced due to fog, the most frequent cause of the reduced visibility was snow or blowing snow.

In 1978 the annual total of precipitation was 554.8 mm (Table V). During the summer months the total of precipitation was higher (304.5 mm) than in the winter months (250.3 mm). The maximum occurred in March (88.0 mm), the minimum in November (11.5 mm). The highest daily

Table IV

Mean monthly relative humidity (%) vapour pressures (mb) and temperature (°C) of dew points in 1978

	Month												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Relative humidity	85	83	83	80	82	80	76	77	82	79	76	79	80
Vapour pressure	6.0	6.1	5.5	4.8	5.1	3.6	2.1	3.2	4.4	4.5	4.4	5.3	4.6
Temperature of dew point	—0.4	—0.2	—1.8	—3.5	—2.9	—8.0	—15.2	—10.4	—5.1	—4.5	—4.9	—1.8	—4.9

Table V

Total clouds amounts and total amount of precipitation in 1978

	Month														
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Summer	Winter	Year
Cloudiness in oktas	6.7	6.6	7.4	6.2	5.6	6.8	5.5	5.7	5.6	6.1	6.4	6.8	6.5	5.9	6.2
Total amount precipitation (mm)	37.7	79.2	88.0	58.6	43.2	70.5	14.6	15.7	47.7	33.7	11.5	54.4	304.5	250.3	554.8

*) oktas — eigt parts of skies overcast (1/8, 2/8. . . . . 8/8)

Table VI.

Number of days visibility ⩽ 1000 m, precipization, fog, blizzards snow cover and low clouds bases ⩽ 200 m in 1978

Elements compared	Month														
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Summer	Winter	Year
Number of days:															
visibility ⩾ 1000 m	3	·	3	3	4	17	5	7	2	4	·	1	11	38	49
precipitation	29	24	26	20	24	24	20	23	22	25	15	28	147	133	280
rainfall	17	18	18	10	12	3	·	2	8	8	5	14	80	35	115
drizzle	2	2	1	1	3	·	·	1	1	·	·	·	5	6	11
snowfall	19	14	19	17	15	24	20	23	21	22	11	23	108	120	228
fog	3	·	1	3	3	·	2	1	2	·	·	·	4	11	15
blowing snow	·	1	2	·	1	17	10	20	14	10	1	1	15	62	77
snow cover	2	3	11	12	11	25	31	31	30	31	19	5	71	140	211
low cloud bases ⩾ 200 m	12	14	20	12	12	24	17	18	11	11	3	14	74	94	168

precipitation was recorded in September 26.7 mm/24 hrs and the maximum amount in 6 hours in June and September 16.6 and 16.5 mm. The greatest number of days of precipitation occurred in January (29 days), the smallest in November (15 days). The total number of days of precipitation in 1978 was high (280 days), (Table VI). Rain and snow occurred throughout the year, rain did not fall in July only, as snow occurred in all the months in the winter and the summer. Fog did not occur frequently in 1978. Throughout the year there were only 15 days of fog. (Table VI). Fog occurred more frequently during the winter months (11 days) than in the summer months (4 days). Frequent snowfall and high speeds cause the formation of blowing snow. In 1978 there were 77 days of blowing snow which occurred mainly during the winter months (62 days), but were observed also on the summer (15 days) (Table VI). Blowing snow besides snowfall were the main cause of reduced visibility.

Snow cover prevailed in the region of the Station during 211 days, extending over more than a half of the surface area of the ground (Table VI). Permanent snow cover overling the ground completely was observed from June 19 to November 18.

4. Summary

Results of measurements and observations of basic meteorological elements, carried out in 1978 by the Meteorological Station at Arctowski Station (62 10'S, 58 28'7''W), situated at Admiralty Bay on King George Island in the South Shetland Islands, are presented.

Meteorological conditions in the investigated region are extremely variable, rapid and violent changes in atmospheric pressure occur frequently associated with strong and gusty winds. The number of days of winds reaching gale speed is very large throughout the year. Air temperatures below and above 0 C occur in every month of the year. Humidity and cloudiness are high throughout the year, but the region of Admiralty Bay is privileged, as compared to the surrounding regions, due to the local orographic and fohn effects. Low cloud bases below 200 m occur very frequently. Winds blowing from WSW prevailed. Snow and rain occur in every (almost) months of the year. Fog is infrequent. The main cause of reduced visibility are snowfall and blowing snow. Snow cover occurred during all the months of the year, whereas permanent snow cover was observed during five months from mid-June to mid-November.

5. Резюме

Представлено итоги исследований и наблюдений основных метереологических элементов в 1978 г., выполненных на Метереологической Станции, Станции Арцтовского (62'10' S, 58'28'7 W). Станция расположена на острове Кинг Джорж, в архипелаге Южных Шетландов.

Метереологические условия в исследованном районе непостоянные. Часто выступают быстрые изменения давления вместе и сильными и штормовыми ветрами. В течение года количество дней с ветрами достигающими штормовых скоростей — большое. Каждый месяц выступают минусовые и плюсовые температуры воздуха. Влажность воздуха и облачность весь год большие. Однако местность залива Адмиральты привилегирована по отношению к окружающему району. Причиной этого является орография

и феновые эффекты. Часто выступают низкие облака, ниже 200 м. Преобладающие ветры дуют из WSW. Почти каждый месяц наблюдаются осадки дождя и снега. Главной причиной уменьшения видимости являются осадки и метела а туманы являются редко. Снежный покров выступает в течение всего года а постаянно удерживается 5 месяцев с половины июля до половины ноября.

6. Streszczenie

Przedstawiono wyniki pomiarów i obserwacji podstawowych elementów meteorologicznych za rok 1978 wykonanych przez Stację Meteorologiczną w Stacji Arctowskiego (62 10′S, 58 28′7″W) położoną nad Zatoką Admiralicji na wyspie Króla Jerzego w Archipelagu Południowych Szetlandów.

Warunki meteorologiczne w badanym rejonie są bardzo zmienne, występują szybkie i częste zmiany ciśnienia, którym towarzyszą silne i porywiste wiatry. Ilość dni z wiatrami osiągającymi sztormowe prędkości w ciągu roku jest bardzo duża. We wszystkich miesiącach roku występują temperatury powietrza zarówno ujemne jak i dodatnie. Wilgotność powietrza i zachmurzenie przez cały rok jest duże, lecz rejon Zatoki Admiralicji jest uprzywilejowany względem obszarów otaczających, czego przyczyną jest orografia i efekty fenowe. Bardzo często występują niskie chmury o podstawie poniżej 200 m. Przeważające wiatry wieją z WSW. Opady deszczu i śniegu występują prawie we wszystkich miesiącach roku. Mgły są zjawiskiem rzadkim, główną przyczyną zmniejszenia widzialności są opady i zamiecie śnieżne. Pokrywa śnieżna występowała w ciągu wszystkich miesięcy roku a trwała pokrywa utrzymywała się przez 5 miesięcy, od połowy czerwca do połowy listopada.

7. References

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AUTHOR'S ADDRESS:

Mgr Lucjan Nowosielski
Instytut Meteorologii i Gospodarki Wodnej
Podleśna 61
01-673 Warszawa, Poland