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Atmospheric precipitation of the summer season in the Kaffiöyra region (North-West Spitsbergen)

ABSTRACT: Height, frequency and spatial differentiation of atmospheric precipitation of the summer season for the period 1975–1982 are presented. Results of the respective investigations are compared with atmospheric precipitation in other areas of the western coast of Spitsbergen.

KEY WORDS: Spitsbergen, climate, atmospheric precipitation.

1. Introduction

Recognition of the precipitation amont is necessary for setting up the glacier mass balance as well as the water balance of non-gliaciated areas. However, this element belongs to those recognized rather insufficiently on Spitsbergen. This follows at least from two reasons, viz.: 1) small number of the permanent weather stations, which are located exclusively at the coasts of the island, 2) considerable variability of atmospheric precipitation distribution in time and space. Therefore, every new precipitation measurements stand gives the information, unknown up to now, about value and dynamics of this meteorological element.

In the present report precipitation measurement results in the summer season performed during six Torunian Polar Expeditions to Spitsbergen (1975, 1977, 1978, 1979, 1980 and 1982), organized either exclusively by the Institute of Geography, N. Copernicus University, or at its participation. General geographic investigations (including meteorological ones) in the Oscar II Land (North-West Spitsbergen) in the region of the coastal plain of Kaffiöyra (Fig. 1) were carried out by the expeditions. The principal

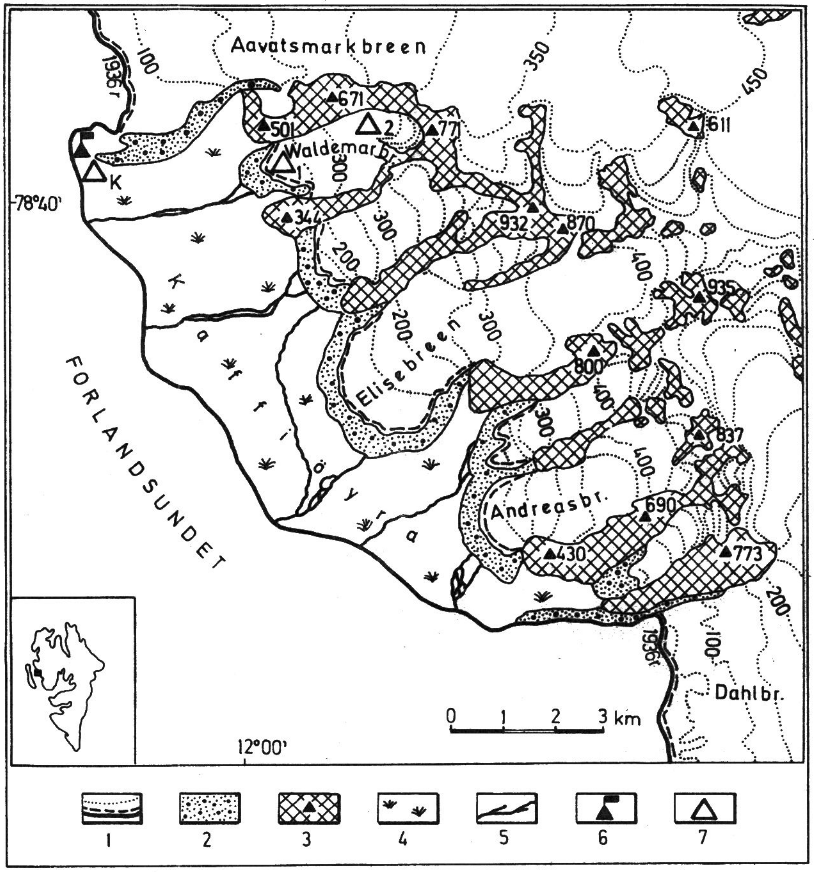

Fig. 1. Layout of measurement stands. Legend: 1 — glacier fronts with countour lines, 2 — moraines, 3 — mountain ridges with altitude points, 4 — coastal plains (tundra), 5 — main glacier rivers, 6 — base of the Torunian Polar Expeditions, 7 — meteorological measurement stands at Kaffiöyra (K), on the Waldemar glacier front (1) and on firn field on the Waldemar glacier (2)

measurement place constituted each time the weather station located at the base of expeditions in the northern part of Kaffiöyra ($\varphi = 78.41'$ N, $\lambda = 11°51'$ E, $H = 6$ m a.s.l., 200 m from the sea coast line). Moreover, in 1980 comparative measurements of the precipitation amount were performed on the Waldemar glacier at 2 stands: 1) at the glacier foot (stand I) — 129 m a.s.l., 2.7 km from the sea coast line, 2) on the firn field(stand II) — 385 m a.s.l., about 6 km from the sea coast line. A detailed description of the area investigated is to be found, among other things, in the work of Wójcik, Marciniak and Przybylak 1981.

The expeditions mentioned stayed on the area comprised with investigations usually from the first or second ten days of July to the first ten days of September. These periods were defined conventionally as summer seasons. Only for 1975 and 1980 we dispose of the data of two full summer months, i.e. of July and August.

The daily sums of atmospheric precipitation from the Kaffiöyra station in summer season of 1975–1982 are quoted in the works dealing with meteorological conditions during the Torunian Polar Expeditions (Leszkiewicz 1977, Wójcik 1982, Wójcik and Marciniak 1983, Marciniak and Przybylak 1983, Marciniak and Przybylak-unpublished material, Wójcik and Przybylak — unpublished material).

Precipitation was measured with the Hellmann's ombrometer of the inlet area of 200 cm^2. In Kaffiöyra this instrument was placed at a standard height of 1 m above ground and in the Waldemar glacier at the height of 0.5 m above ice or snow surface. The precipitation measurement occurred everyday at the station near the expedition base and every 2–3 days on the glacier.

It is to stress that the measured atmospheric precipitation amounts are of the indicatory character and are less than real amounts. Among the factors allowing to reduce the number of precipitation measurements under climatic conditions of Spitsbergen plays the wind velocity. Lower losses connected with high relative humidity of air are caused by evaporation and moistening the reception surface of the ombrometer.

The precipitation measurement with the standard ombrometer makes, as a rule, impossible to record actual amount of water coming from trace falls and liquid deposit. They constitute at frequent drizzles and hazes on Spitsbergen a high per cent of the total atmospheric precipitation amounts. The atmospheric water amount measured with the use of large ombrometers with the Grunows' network (interceptic additionally liquid deposit, suspension and trace falls), which can be often several times higher than that recorded with the standard ombrometer (Liebersbach 1982).

2. Precipitation amount and frequency

The ten-day sums of atmospheric precipitation amounts in Kaffiöyra in the summer season of 1975–1982 are put together in Table 1. Also corresponding precipitation sums from neighbouring stations, i.e. Ny Ålesund ($\varphi = 78°55'$ N, $\lambda = 11°56'$ E, $H = 8$ m a.s.l.) and Barentsburg ($\varphi = 78°04'$ N, $\lambda = 15°14'$ E, $H = 22$ m a.s.l.), are presented in this Table. These data will be used in a comparative analysis performed in the further part of the work. Beside ten-day values, also precipitation sums for particular months and for the period July 21–August 31 as the longest period of joint measurements for all 6 summer seasons have been put together.

Table I

Atmospheric precipitation sums (mm) at Kaffiöyra (K) at Ny Ålesund (NA) and at Barentsburg (B) in the summer seasons of the period 1975–1982

Year	1975			1977			1978			1979			1980			1982			1975–1982		
Period	K	NA	B	K	NA	B	K	NA	B	K	NA	B	K	NA	B	K	NA	B	K	NA	B
1–10 July	5.9	–	1.7	–	11.6	15.3	–	6.5	6.8	–	1.7	6.4	0.2	1.2	0.1	–	0.0	0.4	–	4.2	5.1
11–20 July	5.3	–	11.7	–	6.8	25.4	–	2.9	0.9	7.2	5.6	13.6	0.0	0.3	1.5	–	14.6	10.6	–	6.0	10.6
21–31 July	52.6	–	19.7	22.9	6.8	21.1	22.4	4.8	6.3	1.9	7.0	0.9	15.2	28.3	30.1	23.6	20.9	12.3	23.1	13.6	15.1
1–10 Aug.	5.9	–	2.1	15.2	17.5	9.1	8.3	2.9	10.0	0.9	6.1	9.7	10.0	30.1	30.2	16.1	4.6	8.5	9.4	12.2	11.6
11–20 Aug.	1.0	–	17.4	4.0	0.3	7.2	2.1	0.6	4.5	14.9	1.3	5.8	78.8	101.1	102.4	0.9	4.3	1.0	17.0	21.5	23.0
21–31 Aug.	6.1	–	8.3	2.3	2.1	5.5	11.4	4.8	18.3	.	1.3	.	4.0	0.2	21.3	12.3	28.4	25.1	6.0	7.4	13.1
1–31 July	63.8	54.0	33.1	–	25.2	61.8	–	13.2	14.0	–	14.3	20.9	15.4	29.8	31.7	–	35.5	23.3	–	28.7	30.8
1–31 Aug.	13.0	18.0	27.8	21.5	19.9	21.8	21.8	8.3	32.8	15.8	8.7	15.5	92.8	131.4	153.9	29.3	37.3	34.6	32.4	37.3	47.7
21 July–31 Aug.	65,6	–	47.5	44.4	26.7	42.9	44.2	13.1	39.1	17.7	15.7	16.4	108.0	159.7	184.0	52.9	58.2	46.9	55.5	54.7	46.9
1 July–31 Aug.	76.8	72.0	60.9	–	45.1	83.6	–	21.5	46.8	–	23.0	36.4	108.2	161.2	185.6	–	72.6	57.9	–	66.0	78.5

* For the station Ny Ålesund (NA) mean sums were calculated for the period 1977-1982 except for mean montly sums and sums for the period 1 July 31 Aug. Data for Ny Ålesund were taken from the Norsk Meteorolosk Arbok 1975-1983. Data for Barantsburg were made accessible by the weather station in this locality.

Table II

Occurrence frequency of days with atmospheric precipitation in summer seasons of the period 1975–1982

Observation period	Number of observation days	Number of days without precipitation		Number of days with precipitation 0.0		Number of days with precipitation $\geqslant 0.1$		Number of days with precipitation $\geqslant 1.0$		Number of days with precipitation $\geqslant 10.0$	
	n	n	%	n	%	n	%	n	%	n	%
July 1-Aug. 31 1975	62	31	50.0	5	8.1	26	41.9	15	24.2	2	3.2
July 21-Aug. 28. 1977	39	19	48.7	11	28.2	9	23.1	7	17.9	1	2.6
July 21-Sept. 7, 1978	49	25	51.0	9	18.4	15	30.6	13	26.5	1	2.0
July 9-Sept. 5, 1979	59	35	59.3	9	15.3	15	25.4	7	11.9	.	.
July 5-Sept. 7, 1980	65	29	44.6	11	16.9	25	38.5	14	21.5	5	7.7
July 14-Sept. 9, 1982	58	20	34.5	10	17.2	28	48.5	15	25.9	.	.
Total	332	159	47.9	53	16.6	118	35.5	71	21.4	9	2.7

The ten-day precipitation sums are characterized by a considerable variability in the same summer season and from year to year. The extreme in respect to the precipitation amounts were two neighbouring summer seasons: of 1979 with the lowest and of 1980 with the highest precipitation amounts (Table I). In the dryest among the 6 summer seasons analyzed occurred one ten-day period without any precipitation (third ten days of August 1979), the record in this respect being the second ten days of August 1980 (78.8 mm) exceeding the monthly sums in the remaining seasons. At Kaffiöyra the richest in precipitation was the third ten days of July, the poorest in this respect being two first ten days of August. In 1975, 1977 and 1978 the precipitation sums for the third ten days of July were higher than those throughout the whole August. Relatively low precipitation amounts in Hornsund in the first half of summer of 1970–1974 were recorded by Pereyma (1983).

The number of days with and without precipitation in particular 6 summer seasons is presented in Table II. In the period 1975–1982 days with precipitation constituted almost a half of all observation days (47.8), there of 16.4% constituted days with trace falls (0.0 mm). Days with the precipitation amount of ⩾0.1 mm constituted, on the average, about 1/3 measurement periods in the summer season. The number of days with precipitation and their structure according to the values of precipitation sums are very variable from year to year. They exhibit a certain connection with precipitation sums in the given summer season. Thus, e.g. in the dry season of 1979 there were no daily precipitation of ⩾10.0 mm, whereas in the wet year 1980 there were as many as 5 such days.

A more exact structure of days with precipitation according to classes are presented in Fig. 2. A decrease of the percentual share of days with the growth of precipitation sums is distinctly visible. Days with low-amount precipitation prevail. This is a characteristic feature of the climate of polar zone. Only 11.3% constituted days with higher precipitation amounts and only 5.2% of all days with precipitation constitute days with precipitation higher than 10.0 mm. The highest daily precipitation amount in Kaffiöyra (23.3 mm) was recorded on August 15, 1980.

The period with precipitation (i.e. subsequent days with precipitation) varied in Kaffiöyra within 1–10 days. Among 59 periods with precipitation occurring during observations in the summer season as many as 57.6% lasted not longer than 2 days and 13 periods (22.0%) did not exceed 3–4 days. In the precipitation-rich summer season of 1980 as many as 4 periods occurred with precipitations lasting 7 days. Similarly looks the structure of precipitationless periods. The longest precipitationless period amounting to 13 days occurred in the dry summer season of 1979.

The occurrence of precipitation or its lack is connected with the

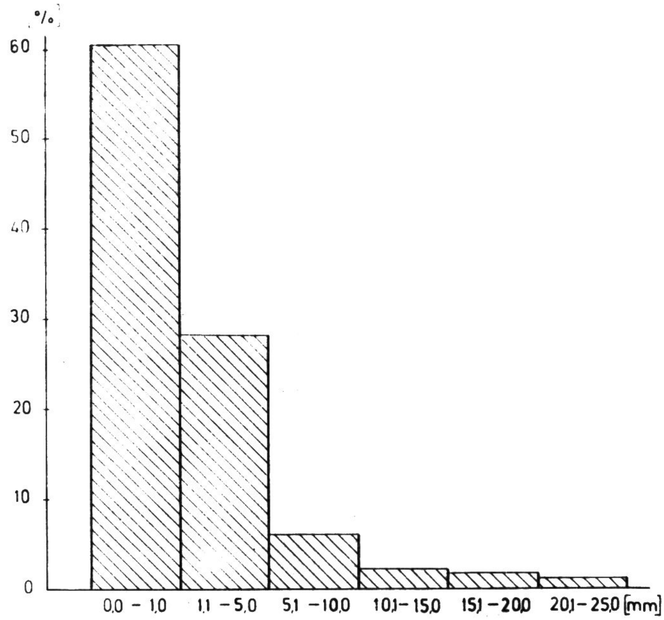

Fig. 2. Occurrence frequency of days (%) with atmospheric precipitation sums according to classes at Kaffiöyra in the period 1975–1982

atmospheric circulation type (Markin 1975), in which one of the indices can be the wind direction. In Kaffiöyra precipitation occurred most often at winds from the southern direction, which are characterized also by the highest occurrence frequency. Conditional probability of precipitation occurrence in case of these winds amonted in 1978–1980, the period for which we dispose of suitable data, to 29.2%, whereas at wind from northern sector this probability was twice less (14.1%). Other wind directions and calms occurred rarely under orographic conditions of Kaffiöyra (about 14% of all observations).

3. Spatial differentiation of precipitation amounts

Parallel precipitation measurements over the coastal plain of Kaffiöyra (1 measuring stand) and on the Waldemar glacier (2 measuring stands), performed in 1980, showed a considerable spatial differentiation of precipitation amounts. A great spatial differentiation of precipitation between coastal plains and neighbouring glaciers prove also Kosiba (1960) and Baranowski (1968). According to these authors the monthly precipitation sums for the period 1957–1960 in the summer season on the Werenskiolda glacier at the altitude of 380 m a.s.l. were twice higher than analogic values at the Hornsund coast.

The precipitation sums recorded in the Kaffiöyra region refer significantly to the height a.s.l. of the measuring stands. On the firn field of the Waldemar glacier (stand 2 — 385 m a.s.l.) the precipitation amounts were the highest. In August 1980 they constituted 276% of the precipitation sums at Kaffiöyra and in the first ten days of this month they reached as many as 396% of precipitation sum over the plain. It follows from the above that relation between precipitation amount on the glacier and in Kaffiöyra are not constant in particular periods of the summer season. This problem was analyzed on the basis of precipitation sums for several-day periods of measurements marked with successive numbers (Table III, Fig. 3).

Table III.

Atmospheric precipitation sums (in mm) at Kaffiöyra and the Waldemar glacier (St. 1, St 2) in the summer season of 1980

No. of the period	Observation period	Kaffiöyra	St 1	St 2
1.	July 25–28	10.1	25.9	–
2.	July 29–31	3.5	4.2	–
3.	Aug. 1–10	10.0	26.0	39.4
4.	Aug. 11–12	13.7	41.6	59.4
5.	Aug. 13–14	.	.	.
6.	Aug. 15–16	41.6	72.8	112.47
7.	Aug. 17–18	10.7	11.2	16.5
8.	Aug. 19–22	13.4	14.8	18.5
9.	Aug. 23–27	.	.	.
10.	Aug. 28–31	3.1	5.5	9.6
11.	Aug. 1–10	10.0	26.0	39.4
12.	Aug. 11–20	78.8	135.1	202.4
13.	Aug. 21–31	4.0	11.2	14.7
14.	Aug. 1–31	92.8	172.3	256.5

The curve in Fig. 3 illustrating the correlation of precipitation sums between the plain and the stands on the glacier (a and b) show the course approximating the logarythmic curve. From that it can be concluded that low precipitation increments in Kaffiöyra correspond to the considerable precipitation increments on the glacier. From the course of curves deviates the position of 2 stands (Nos 7 and 8) representing precipitations for the periods August 17–18 and August 19–22, 1980. The analysis of the meteorological data has proved that precipitation amounts in these days occurred at low wind velocities (about 2 m/s). Under such conditions

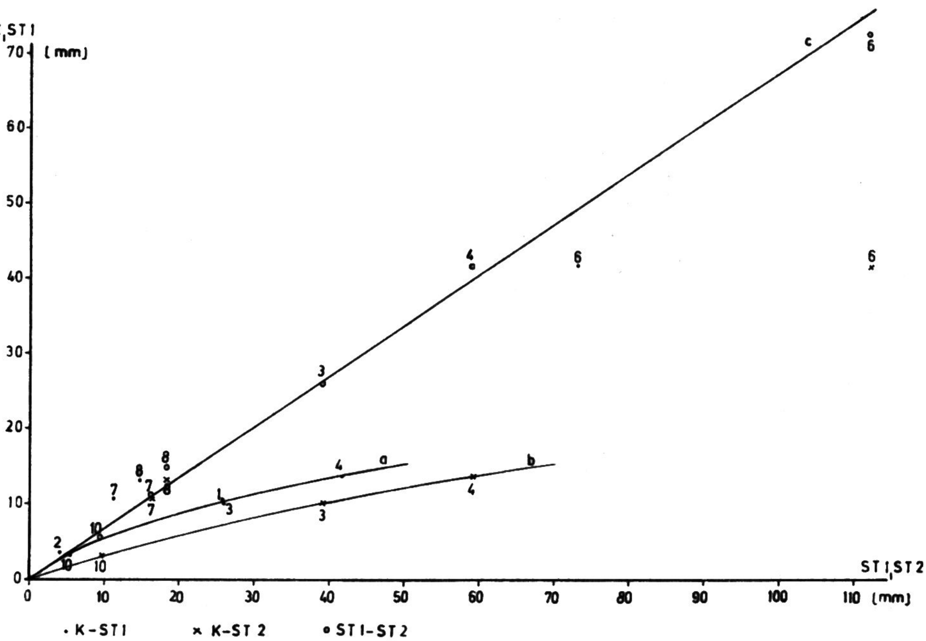

Fig. 3. Correlation of precipitation sums for the chosen periods of the summer season of 1980 between the stands: a) Kaffiöyra (K)–St. 1, b) Kaffiöyra (K)–St. 2, c) St. 1–St. 2

the precipitation losses caused by the wind field disturbances around the ombrometer are minimum. Subsequently, the precipitation amounts corresponding to the points on the logarythmic curve occurred at high wind velocities. For instance, on August 11–12, 1980 when the mean daily wind velocity amounted to about 9 m/s (according to measurements at Kaffiöyra) the precipitation amounts on the glacier were about 3–4 times higher. Every-hour wind velocity measurements have proved that during the most intensive rain the air movement speed reached, on the average, 14.3 m/s, exceeding in gusts 20 m/s. Similar wind velocities were recorded on August 15–16, 1980, i.e. in the days which were characterized by the highest precipitation sums for the whole period of measurements. So high wind velocities cause considerable losses of the precipitation measured, first of all, in Kaffiöyra, where orographic conditions of the glacier restra,n air flow (Fig. 1). In addition, the wind velocity effect on the precipitation measurement error on the glacier is less due to a lower position of the ombrometer above the area surface (0.5 m) as compared with Kaffiöyra (1.0 m).

The correlation between precipitation sums on both stands on the glacier is represented by the straight c (Fig. 3). This connection is more straight than the former ones, as the stands correlated differ, in fact, only with the height a.s.l. On the other hand, they are distinguished by a uniformity of substrates, lower wind velocities (in relation to those in Kaffiöyra) and by a frequent cover with the same kinds of clouds.

Mean vertical precipitation gradient between the stands Nos. 1 and 2 amounted to 33 mm/100.0 m. It is less than the mean gradient between Kaffiöyra and the Waldemar glacier (65 mm/100.0 m).

One can presume that beside atmospheric precipitation sums, also precipitation frequency would be higher on the glacier than in Kaffiöyra. The respective observations have shown, namely, that on the glacier Stratus clouds giving at lower precipitation amount occur, whereas in Kaffiöyra there is higher share of clouds of the Stratocumulus kind, which give, as a rule, no precipitation.

Summarizing, it can be concluded that the causes of the spatial differntiation of measured precipitation sums in the Kaffiöyra region are of the twofold kind: 1) physiographic conditions, 2) unequal precipitation measurement errors. To the first group of factors belong: height above sea level, distance from the sea coast, orography and substrate kind. The second group of factors comprises, first of all, the effect of wind velocity and evaporation on reduction of the amount of the measured precipitation, the influence of which is more distinctly visible in Kaffiöyra than on the glacier. This leads, apart from physiographic causes, to an increase of the differences in the measured precipitation amounts between the environments analyzed.

4. Comparison with precipitation over the areas of the western coast of Spitsbergen

The mean atmospheric precipitation amount measured in the summer season of 1975–1982 (Table I) in Kaffiöyra for the period of joint measurements (July 21-August 31) is almost identical with the precipitation sums measured at Ny Ålesund (about 30 km northwards) and somewhat higher than at Barentsburg (about 90 km SSE-wards). However, considerable differences in precipitation sums occur in particularly seasons and ten days between stations comprised with the analysis. Particularly distinctly distinguishes itself in this respect precipitation-rich season of 1980, when in Kaffiöyra lower precipitation amounts were recorded than at the remaining stations. On the other hand, in the summer season of 1975, 1977, 1978 and 1979 it was the Kaffiöyra region, which distinguished itself with high precipitation amounts or approximating those in Ny Alesund (in 1982).

The connection of precipitation sums in the Kaffiöyra region and in the neighbouring 2 stations was investigated using the correlation calculations. The correlation coefficients were calculated for daily, five- and ten-day sums for the period July 21-August 31 jointly for 6 summer seasons (Table IV). The values of these coefficients are the higher, the longer

Table IV

Values of correlation coefficients for daily (1), 5-day (2) and ten-day (3) sums of atmospheric precipitation in summer seasons of the period 1975–1982

Pair of stations	1	2	3
Kaffiöyra-Ny Alesund	0.487	0.722	0.894
Kaffiöyra-Barentsburg	0.462	0.683	0.800
Barentsburg-Ny Alesund	0.589	0.820	0.895

measurement period is related to precipitation sums (all coefficients are significant at $P = 0.001$). The correlation diagram (not quoted in this report does not prove such a close connection of precipitation sums in these three stations. In this connection calculations of correlation coefficients for the sets of data, at elimination of 2–3 highest ones, were performed. The coefficients obtained are almost twice lower, although still significant (0.41–0.49). From this it can be concluded that the possibility of estimation of even ten-day precipitation sums in one of the measurement stands on the basis of data from the neighbouring station is limited. Also Baranowski (1975), while investigating the connection between precipitation occurrence frequency in Isfjord Radio and Hornsund did not find, either, any correlation for 5-day sums, while the correlation coefficient for monthly sums between these stations amounted to 0.648.

The values of correlation coefficients presented in Table IV show surprisingly that the precipitation sums in Ny Ålesund and Barentsburg. i.e. in the stations situated at the longest distance, are correlated more closely with one another than with precipitation amounts in the Kaffiöyra region. One can presume that this could be caused by a certain similarity of the surroundings of the weather stations of Ny Ålesund and Barentsburg. Orographic conditions of these stations contribute to greater calmness than on the Kaffiöyra plain. This leads to highest losses of precipitation measurements in Kaffiöyra, what is evident particularly clearly in the seasons characterized by strong winds. For instance, in August 1980 the mean

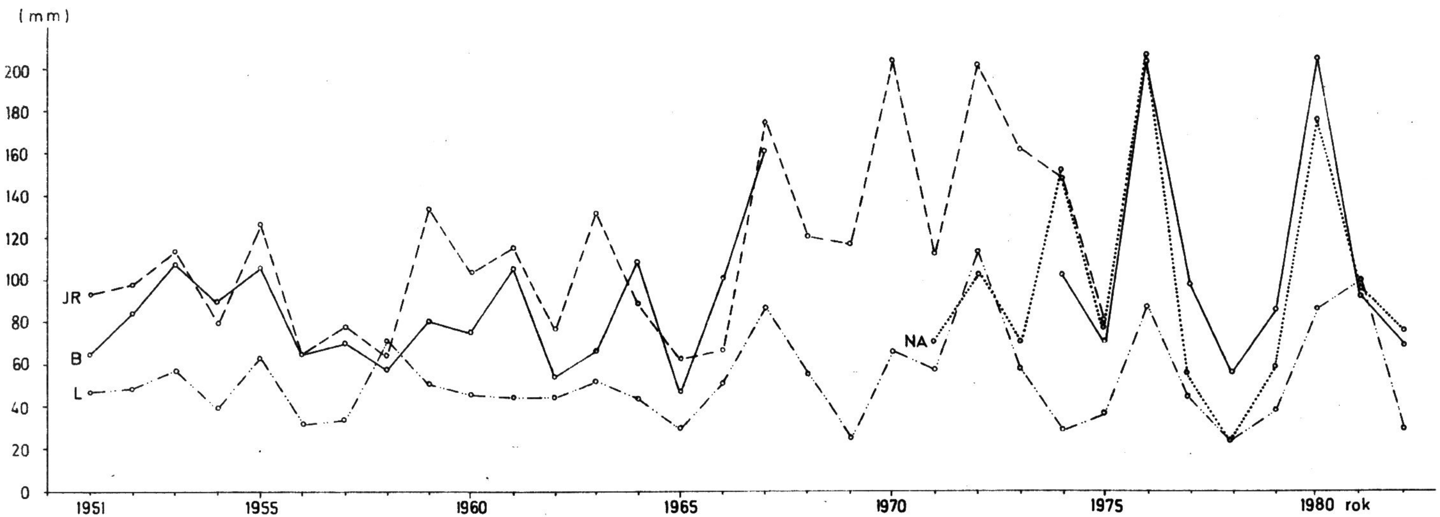

Fig. 4. Course of atmospheric precipitation sums (in mm) for the ablation season (June-August) in the period 1951–1982 at weather stations of Isfjord Radio (IR), Barentsburg (B), Longyearbyen (L) and Ny Ålesund (NA)

wind velocity in Ny Ålesund amounted to 1.9 m/s and in Kaffiöyra to 5.5 m/s.

A relatively short period of precipitation measurements in Kaffiöyra comprising 6 summer seasons requires assessment of the representability of the results obtained by comparing them with the station of a long-term series of measurements. For this purpose the data concerning precipitation for the ablation period (June-August) from 1951 to 1982 for the stations Isfjord Radio, Longyearbyen, Ny Ålesund and Barentsburg were made use of (Fig. 4 and 5). Unfortunately, the measurements performed by the

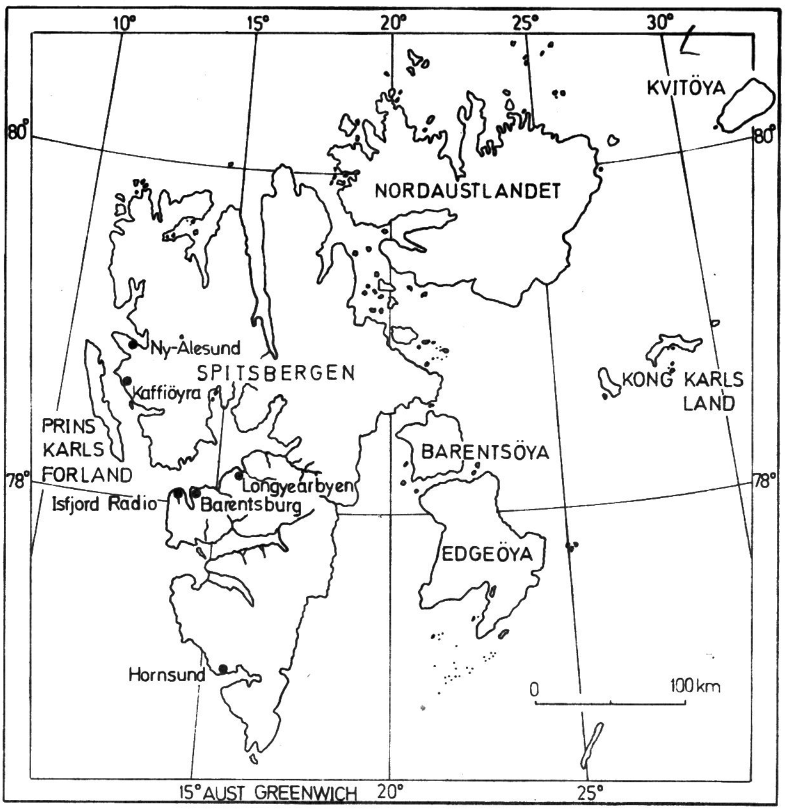

Fig. 5. Location of the stations of atmospheric precipitation measurements on Spitsbergen, the material of which was made use of in the present work

weather station Isfjord Radio, situated similarly as Kaffiöyra, have been discontinued in mid 1970ies. We dispose not, either, of the data concerning precipitation for the station Barentsburg for the period 1968–1973.

It follows from Fig. 4 that the variability of precipitation from year to year are mutually correlated at all the stations mentioned, irrespective of the precipitation amounts (low precipitation amounts at Longyearbyen situated inside the island can be distinguished here). One can estimate on this basis the formation of precipitation sums in the past 30 years in the Kaffiöyra region.

The course of the long-term precipitation sums in the ablation period shows a general growing tendency, what was also observed among others by Markin (1975). Moreover, a growing variability of precipitation sums from year to year, particularly after 1965, is distinctly marked.

High precipitation amounts occurring in 1980 belonged to the highest in the period after 1951. Exceptionally high precipitation amounts were recorded in that year, beside the stations already analyzed, also in the southern part of the western coastal zone of Spitsbergen (Szczepankiewicz-Szmyrka 1981). Only precipitation amounts in the ablation season of 1976 were equal to them. Previously high precipitation sums were recorded in 1972, 1967, 1963, 1959 and 1955. The occurrence frequency of high precipitation amounts took place, on the average, every 4 years.

5. Conclusions and final remarks

5.1. Precipitation sums in summer seasons in the Kaffiöyra region are characterized by considerable variability from year to year, similarly as in the whole coastal region of Spitsbergen.

5.2. There occurs mostly low-amount precipitation — 60.5% constitute days with the precipitation of $\leqslant 1.0$ mm, what is a characteristic feature of the polar climate.

5.3. A considerable spatial differentiation of precipitation amounts occurs in a narrow coastal belt, between the coastal plains and the glaciers adjoining them. Consequently there is a limited possibility of making use of the measurement data of the stations situated on this belt for setting up the glacier mass balance and the balance of the glacier catchment areas.

5.4. The Kaffiöyra region, similarly as the whole western coast of Spitsbergen, is characterized by the highest precipitation amounts as compared with other coastal belts of the island.

5.5 Precipitation measurement results on Spitsbergen performed with the use of standard ombrometers, are encumbered with high errors caused mainly by the wind velocity. It is connected with a high windiness and frequent occurrence of trace falls and precipitation of low amounts as well as of liquid deposits and atmospheric suspensions.

6. Резюме

Настоящая работа была выполнена в первую очередь на основании результатов измерений атмосферных осадков, проводимых в летних сезонах 1975—1982 гг. шестью

торуньскими полярными экспедициями в районе приморской низменности Каффиера, расположенной в юго-западной части Шпицбергена (рис. 1).

Суммы осадков десятидневные, месачные и за общий для всех экспедиций период 21 июля — 31 августа представлено в таблице I. В ней приводятся также соответствущие суммы осадков из станиций смежных с Каффиерой: Ню Олесунд (около 30 км северу) и Баренцбург (около 90 км к юго-востоку). Суммы осадков характеризуются значительной изменчивостью как в данном летнем сезоне, так и из года в год. Их величина в сезоне с найболее обильными осадками (1980 г.) была 6-кратно выше в сравнении с самым засушливым сезоном (1979 г). В Каффнёре в среднем наиболее богатая осадками была третья декада июля, а наиболее бедная в этом отношении были две первые декады июля и третья декада августа. Подобной значительной изменчивостью из года в год характеризовались количества дней с осадками и без осадков (табл. II). Преобладают дни с незначительными осадками — 60,5% составляют дни с осадком ≤ 1,0 мм. (Рис. 2).

Установлена значительная пространственная дифференциация величины осадков в узкой прибрежной полосе, между приморскими низменностями и смежными с ними ледниками. Сумма осадков на ледниках была 2—4 раза выше в отдельных декадах летнего сезона 1980 г., в котором проводились сравнительные измерения (табл. III, рис. 3). В связи с этим представляется, как кажется, ограниченной возможность использования результатов измерений осадков проводимых станциями расположенными в указанной приморской полосе как элемента бюджета массы ледников или баланса ледниковых водосборов.

Рейон Каффиеры, подобно как все западное побережье Шпицбергена, характеризуется наивысшей величиной осадков в сравнении с остальными побережьями этого острова. Средняя величина осадков измеряемых в летнем сезоне 1975—1982 гг. в этом районе за общий период 21 июля — 31 августа является почти идентичной с суммами осадков измеренных в Ню Олесунд и несколько выше, чем в Баренцбурге (Табл. I). Однако возможность оценки суммы осадков в районе Каффиеры для более коротких периодов (сутки, пентада, декада) в отдельных сезонах на основании данных из соседних станций ограничена, несмотря на то, что для этих сумм и станций имеются сравнительно высокие коэффициенты корреляции (табл. IV). Они, в частности, представляют собой результат нескольких крайне высоких сумм осадков для 1975 г., а особенно для 1980 г.

Многолетний ход сумм осадков в период аблияции (июнь-август) для 1951 г. на станциях Исфиорд Радио, Баренцбург и Лонгиербюен показывает в общем возрастающую тенденцию (рис. 4 и 5). Сверх того обозначается растущая изменчивость сумм осадков, особенно после 1965 г.

Результаты измерений осадков на Шпицбергене проведенных стандартными дождемерами обременены значительной неточностью вызванной в первую очередь скоростью ветра. Это связано с сильной ветренностью, частыми следовыми осадками и осадками небольшой величины, а также с атмосферными отложениями и суспензиями.

7. Streszczenie

Opracowanie wykonano głównie na podstawie wyników pomiarów opadów atmosferycznych wykonanych w sezonach letnich 1975–1982 przez 6 Toruńskich Wypraw Polarnych w regionie nadmorskiej niziny Kaffiöyra położonej w północno-zachodniej części Spitsbergenu (rys. 1).

Dekadowe, miesięczne i za wspólny dla wszystkich wypraw okres 21.07–31.08. sumy opadów przedstawia tab. I. W tablicy tej zamieszczono także odpowiednie sumy opadów ze stacji sąsiadujących z Kaffiöyrą — Ny Ålesund (około 30 km na N) i Barentsburg (około

90 km na SSE). Sumy opadów wykazują dużą zmienność zarówno w ramach tego samego sezonu letniego jak i z roku na rok. Wysokość opadów w sezonie najobfitszym w opady (1980 r.) była 6-krotnie wyższa od sezonu najsuchszego (1979 r.). Na Kaffiöyrze średnio najobfitsza w opady była trzecia dekada lipca, natomiast najuboższe pod względem ilości opadów były dwie pierwsze dekady lipca i trzecia dekada sierpnia. Podobnie dużą zmiennością z roku na rok odznaczają się liczby dni z opadami i bez opadów (tab. II). Przeważają dni z opadem o małej wydajności — 60.5% stanowią dni z opadem ≤ 1.0 mm (rys. 2).

Stwierdzono duże zróżnicowanie przestrzenne wysokości opadów występujące w wąskim pasie wybrzeży — między nizinami nadmorskimi i przylegającymi doń lodowcami. Sumy opadów na lodowcach były 2–4 razy wyższe w poszczególnych dekadach sezonu letniego 1980 r. w którym wykonano pomiary porównawcze (tab. III, rys. 3). Z tego względu, jak się wydaje, ograniczona jest możliwość wykorzystania wyników pomiarów opadów ze stacji brzegowych jako elementu bilansu masy lodowców lub bilansu zlewni lodowcowych.

Region Kaffiöyry, podobnie jak całe zachodnie wybrzeże Spitsbergenu otrzymuje największą ilość opadów w porównaniu z pozostałymi wybrzeżami tej wyspy. Srednia wysokość opadów zmierzonych w sezonach letnich 1975–1982 w tym regionie za wspólny okres 21.07.–31.08. jest niemal identyczna z sumami zmierzonymi w Ny Ålesund i nieco wyższa niż w Barentsburgu (tab. I). Jednakże możliwość szacowania sum opadów w regionie Kaffiöyra za krótsze okresy (doba, pentada, dekada) w poszczególnych sezonach na podstawie danych ze stacji sąsiednich jest ograniczona, pomimo iż otrzymano dla tych sum i stacji stosunkowo duże współczynniki korelacji (tab. IV). Są one bowiem przede wszystkim rezultatem kilku skrajnie wysokich sum opadów z roku 1975, a w szczególności z r. 1980.

Przebieg wieloletni sum opadów w okresie ablacji (czerwiec-sierpień) od 1951 r. na stacjach: Isfjord Radio, Barentsburg, Longyearbyen wykazuje ogólną tendencję wzrostową. (rys. 4 i 5). Ponadto zaznacza się rosnąca zmienność sum opadów, szczególnie po 1965 r.

Wyniki pomiarów opadów na Spitsbergenie wykonywane standardowymi deszczomierzami obarczone są znacznymi błędami spowodowanymi głównie prędkością wiatru. Wynika to z dużej wietrzności, występowania częstych opadów śladowych i o małej wydajności, a także osadów i zawiesin atmosferycznych.

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