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Air temperature changes in the arctic from 1801 to 1920

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ABSTRACT: In this paper, the results of an investigation into the thermal conditions in the Arctic in the period from 1801 to 1920 are presented. For this 'early instrumental' period limited meteorological data exist. Generally, the first meteorological stations in the Arctic were established in the second half of the 19th century and almost all of them were located in the coastal parts of Greenland. In order to get at least a rough idea of thermal conditions in the Arctic in the study period, data from different land and marine expeditions were collected. A total of 118 temperature series of monthly means have been gathered. Although the area and time periods covered by the data are variable, it is still possible to describe the general character of the temperature conditions.

The results show that the areally averaged Arctic temperature in the early instrumental period was 0.8 °C lower than the next 60-year period (1861–1920). In comparison to present-day conditions, winter and autumn were significantly colder (winter by 1.6 °C and autumn by 0.9 °C) than were summer (colder by 0.4 °C) and spring (colder by only 0.2 °C). The air temperature in the real Arctic during the first International Polar Year (IPY) was, on average, colder than today by 1.0–1.5 °C. Winter was exceptionally cold with the average temperature being lower by more than 3 °C in all months except February. On the other hand, spring (March–May) was slightly warmer than today, and April was exceptionally warm (1.1 °C above present norm).

The temperature differences calculated between historical and modern mean monthly temperatures show that majority of them lie within one standard deviation (SD) from present long-term mean. Thus, it means that the climate in the early instrumental period was not as cold as some proxy data suggest. Copyright © 2009 Royal Meteorological Society

KEY WORDS Arctic; air temperature changes; early instrumental period

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1. Introduction

Our knowledge of recent air temperature changes in the Arctic (over the last 80–85 years) is, relatively speaking, fairly well developed (see e.g. Przybylak, 2002, 2003, 2007; Bobylev *et al.*, 2003; McBean *et al.*, 2005). Prior to 1920, however, regular instrumental observations were only rarely carried out. Only six records (Jakobshavn: start date 1866; Upernavik 1873; Godthåb: 1875; Ivigtut: 1875; Angmagssalik: 1894; and Malye Karmakuly: 1896) extend back to the second half of the 19th century. Recently, temperature series for some stations located in the western and southern parts of Greenland have been extended into the late 18th century by Vinther *et al.* (2006) using early observational records. Nevertheless, quite a number of large gaps exist in these series. As can be seen all stations (except Malye Karmakuly) are located in the coastal parts of Greenland. Przybylak (1996, 2002) found that temperature changes in this part of the Arctic tend to be independent of each other. As a result, the use of these data to reconstruct the temperature history of the other parts of the Arctic would be inappropriate. In the first two decades of the 20th century there were only four stations operative (Nome and Barrow in Alaska, Green Harbour in Spitsbergen and Björnöya in Björnöya Island). In the Nome and Green Harbour stations, meteorological observations started in December 1906 and 1911 respectively, whereas in the other two they began significantly later, i.e. in 1920. Therefore, any climatic data prior to 1920 – and in particular for the 19th century – are very important for an evaluation of climatic variation and change in the Arctic. Better knowledge about climate variation in the early instrumental period is also very important for determining its range, which is driven mainly by natural factors. Such data would also allow us to determine more accurately the magnitude of influence of anthropogenic factors into present Arctic climate changes. More complete information about the historical climate is also helpful for the validation of climate models. Awareness of all these facts has recently prompted some researchers to undertake a search for such data (e.g. Przybylak, 2000a; Wood and Overland, 2003, 2006; Przybylak, 2004; Lüdecke, 2005; Przybylak and Panfil, 2005; Przybylak and Vízi, 2005; Klimenko and Astrina, 2006; Vinther *et al.*, 2006; Cappellen *et al.*, 2007, and many previous Danish Meteorological Institute (DMI) Technical Reports, which can be found on: http://www.dmi.dk/dmi/dmi-publikationer.htm). For a more detailed review and a reference list of some older publications for the Canadian Arctic see Przybylak and

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Vízi (2005), and for Greenland see Vinther *et al.* (2006) and Cappellen *et al.* (2007).

In this paper we present the recent results of our investigations carried out as part of the ACEIP project (History of the Arctic Climate in the 19th Century and the Beginning of the 20th Century Based on Early Instrumental Data), which in turn is part (WP4.6) of the IPY-CARE/ASR (Climate of the Arctic and its Role for Europe/Arctic System Reanalysis) project. The climate of the Arctic in historical times (1801–1920) is compared with the contemporary climate (1961–1990).

2. Area, data and methods

In the ACEIP project various kinds of meteorological data have been collected for study purposes. In the present paper, however, analysis is limited to the main meteorological variable, i.e. air temperature. Also, so far only monthly means have been used to characterize climate for the analysed period. These data have been collected for the area of Arctic defined after Treshnikov (1985) (see Figure 1) for the period 1801–1920. The majority of meteorological measurements (Figure 2) were made during various land and sea exploratory and scientific

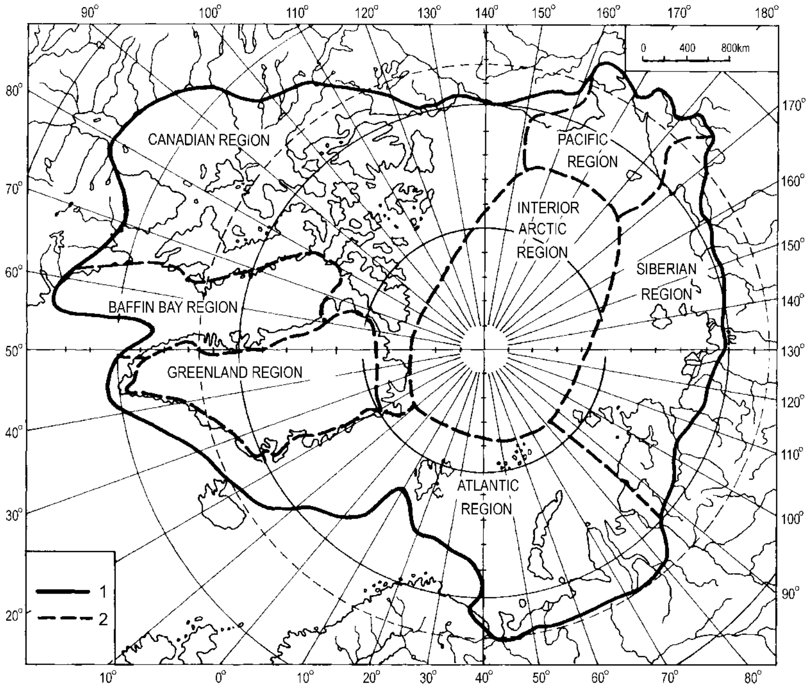

Figure 1. The real Arctic and its climatic regions (adapted from Treshnikov, 1985). The southern Arctic boundary has been delimited using mean long-term values of almost all meteorological variables. 1 – boundary of the Arctic, 2 – boundaries between climatic regions.

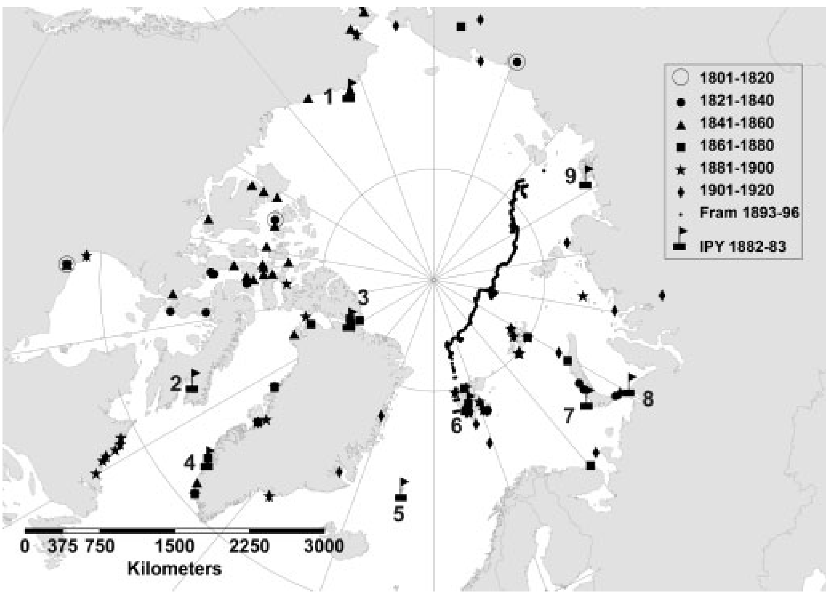

Figure 2. Location of measurement points operating in the Arctic from 1801 to 1920. First IPY stations: 1- Point Barrow, 2 – Kingua Fjord, 3 – Lady Franklin Bay, 4 – Godthåb, 5 – Jan Mayen, 6 – Kapp Thordsen, 7 – Malye Karmakuly, 8 – Kara Sea, 9 - Sagastyr.

expeditions, many of which took place following the first International Polar Year (IPY) 1882/83. As can be seen from Figure 2, expeditions were sent mainly to the western and European parts of the Arctic. As a result, a large number of temperature series were collected for these areas (Table I). On the other hand, relatively few data series exist for the Arctic Ocean, Alaska and the Siberian part of the Arctic. The number of expeditions and meteorological stations operating in the Arctic throughout the study period was variable. The majority of them were noted after 1880 (29 in 1881–1900 and 35 in 1901–1920) and between 1841 and 1860 (24), and the fewest from 1801 to 1820 (2, Figure 3). The impulse for the organisation of many expeditions in the last 40 years of the study period was the success of scientific investigations carried out during the first IPY. In turn, a large number of expeditions in the period from 1841 to 1860 were strictly connected with the lost expedition under the command of Sir John Franklin. Following the disappearance of Franklin's expedition (1845), the Royal Navy sent a great number of search expeditions to the Canadian Arctic.

Up to now, 118 historical temperature series have been collected (Table I) for the Arctic ranging in duration from 1 month to 120 years (SW Greenland reconstructed series). The majority are for Atlantic (48) and Canadian (43) regions, whereas only one series is available for the Arctic Ocean. The majority of series (77.1%) are shorter than 2 years (Figure 4). The greatest number of series are for a year (34) or less (35), whereas only four series are longer than 20 years.

Table I. Number of mean monthly temperature series for the Arctic from 1801 to 1920.

Regions*	Number of temperature series	Years
Atlantic	48	1832–1920
Siberian	5	1820–1920
Pacific	13	1848–1920
Canadian	43	1814–1910
Baffin Bay	8	1801–1920
Interior Artcic	1	1893–1896
The whole Arctic	**118**	**1801–1920**

* after Treshnikov (ed.) 1985

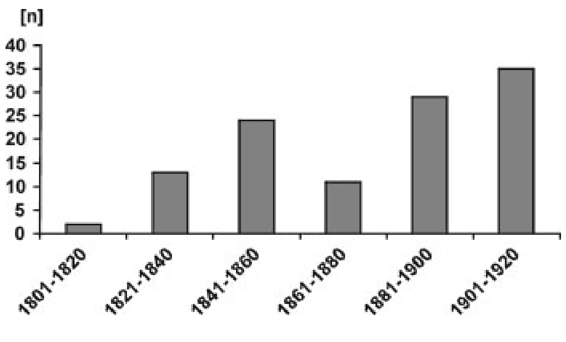

Figure 3. Number of temperature series (n) in the 20-year periods in the Arctic from 1801 to 1920.

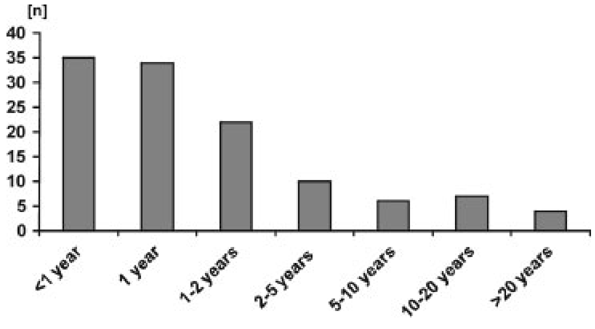

Figure 4. Number of temperature series (n) with different periods of observations in the Arctic from 1801 to 1920.

Statistics of data coverage for the study area, for all analysed 20-year periods and for the study period as a whole are presented in Table II. More details of gathered temperature series (location, duration, sources of data) are available in Appendix and at http://www.umk.pl/~vizi/Appendix.pdf. The series of mean monthly temperature data were taken directly from the various publications or have been calculated by the authors using available data of a higher resolution (e.g. daily or hourly). Taking together all the information presented in Tables I and II, Figures 2–4 and in Appendix, it is clear that information about temperature conditions for different Arctic regions and for different seasons is variable and limited. Therefore the averaged results that are presented for individual regions and for the Arctic as a whole should be treated as the best approximation of the real climate that currently exists. We are still looking for new data series in the hope that, if they exist, they will allow us to improve our knowledge in the future. Thus any assistance that readers of the current paper may offer in providing such series would be welcomed.

The second dataset includes contemporary data (1961–1990) obtained either for the historical sites or for areas located near such sites. In the first case, the locations of meteorological observations in the historical and contemporary periods are the same or, where possible, the average long-term characteristics have been calculated using mathematical interpolation (kriging) for the historical sites. The modern values obtained in this way for historical sites were compared with those from the period 1801–1920. Using this procedure, the differences resulting from different geographical locations of historical and modern observation points were removed. Sites for which this procedure was not possible (when, for example, the number of available meteorological stations located near the historical site was too small) corrections have been made based on the analysis of the spatial distribution of air temperature between the historical site and the nearby modern station.

However, the reader must be aware of the fact that some sources of errors and biases still remained. For example, such errors and biases may result from the use of different types of instruments and recording schedules (which determined the methods for calculating daily means and monthly means) and differences in

Table II. Statistics of data coverage for the Arctic and for climatic regions therein from 1801 to 1920.

Period	Regions*	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
		m	n	m	n	m	n	m	n	m	n	m	n	m	n	m	n	m	n	m	n	m	n	m	n
1821–1840	Atlantic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Siberian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Pacific	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Canadian	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	3	3
	Baffin Bay	16	16	16	16	16	16	16	16	15	15	14	14	13	13	13	13	13	13	13	13	15	15	15	15
	Arctic	**16**	**19**	**16**	**19**	**16**	**19**	**16**	**19**	**15**	**18**	**14**	**17**	**14**	**15**	**14**	**15**	**14**	**16**	**14**	**16**	**16**	**19**	**16**	**19**
1821–1840	Atlantic	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Siberian	1	2	1	2	1	2	1	2	1	2	1	2	0	0	1	1	1	1	1	1	1	1	1	1
	Pacific	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Canadian	14	21	14	21	14	21	14	20	13	18	12	15	12	15	10	13	10	16	13	19	13	20	13	20
	Baffin Bay	16	16	15	15	16	16	16	16	12	12	7	7	5	5	3	3	7	7	16	16	16	16	16	16
	Arctic	**20**	**42**	**20**	**41**	**20**	**42**	**20**	**41**	**19**	**35**	**18**	**27**	**16**	**23**	**14**	**20**	**16**	**27**	**20**	**39**	**20**	**40**	**20**	**40**
1841–1860	Atlantic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Siberian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pacific	5	7	5	7	5	7	5	7	5	7	5	7	4	6	2	3	4	6	5	7	5	7	5	7
	Canadian	14	30	14	30	14	30	14	30	13	27	13	27	13	27	12	23	11	27	12	28	13	30	13	30
	Baffin Bay	20	20	20	20	20	20	20	20	20	20	20	20	19	19	19	19	20	20	20	20	20	20	20	20
	Arctic	**20**	**57**	**20**	**57**	**20**	**57**	**20**	**57**	**20**	**54**	**20**	**54**	**20**	**52**	**20**	**45**	**20**	**53**	**20**	**55**	**20**	**57**	**20**	**57**
1861–1880	Atlantic	4	6	4	6	4	6	3	5	3	5	3	4	2	3	4	6	4	6	5	7	4	6	4	6
	Siberian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pacific	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1
	Canadian	8	10	8	10	8	10	8	10	8	10	6	8	6	8	7	9	6	8	7	9	8	10	9	11
	Baffin Bay	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	Arctic	**20**	**37**	**20**	**37**	**20**	**37**	**20**	**36**	**20**	**36**	**20**	**33**	**20**	**32**	**20**	**35**	**20**	**34**	**20**	**37**	**20**	**37**	**20**	**38**

1881–1900	Atlantic	10	27	10	27	10	27	10	27	10	25	9	24	8	22	9	24	10	27	10	26	11	27	11	27
	Siberian	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	2	2	2	2	2	2	2	2
	Pacific	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	8	6	9	6	9	6	9
	Canadian	14	25	14	24	14	25	14	24	14	25	14	22	13	22	14	21	13	22	14	26	14	26	14	27
	Baffin Bay	20	57	20	57	20	58	20	56	20	56	20	57	20	57	20	57	20	61	20	61	20	60	20	61
	Arctic	**20**	**118**	**20**	**117**	**20**	**119**	**20**	**116**	**20**	**115**	**20**	**112**	**20**	**109**	**20**	**110**	**20**	**120**	**20**	**124**	**20**	**124**	**20**	**126**
1901–1920	Atlantic	20	99	20	98	20	102	20	100	20	101	20	98	20	94	20	88	20	91	20	100	20	98	20	101
	Siberian	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	0	2	2	2	2	2	2
	Pacific	19	40	19	40	19	38	20	39	19	36	19	33	19	35	19	35	20	37	20	39	20	38	20	39
	Canadian	10	17	10	18	10	20	10	18	10	18	10	18	10	19	10	17	10	16	10	17	10	17	10	15
	Baffin Bay	20	44	20	44	20	45	20	44	20	45	20	46	20	45	20	43	20	40	20	44	20	45	20	44
	Arctic	**20**	**202**	**20**	**202**	**20**	**207**	**20**	**203**	**20**	**202**	**20**	**197**	**20**	**194**	**20**	**184**	**20**	**184**	**20**	**202**	**20**	**200**	**20**	**201**
1801–1920	Atlantic	37	135	37	134	37	138	36	135	36	134	35	129	33	122	36	121	37	127	38	136	38	134	38	137
	Siberian	5	6	5	6	5	6	5	6	5	6	5	6	2	2	3	3	4	4	6	6	6	6	6	6
	Pacific	30	55	30	55	30	53	31	54	30	51	30	48	29	49	26	45	29	51	32	56	32	55	32	56
	Canadian	63	106	63	106	63	109	63	105	61	101	58	93	56	93	55	85	52	91	58	101	61	106	62	106
	Baffin Bay	112	173	111	172	112	175	112	172	107	168	101	164	97	159	95	155	100	161	109	174	111	176	111	176
	Arctic	**116**	**476**	**116**	**474**	**116**	**482**	**116**	**472**	**114**	**460**	**112**	**440**	**110**	**425**	**108**	**409**	**110**	**434**	**114**	**473**	**116**	**478**	**116**	**482**

* after Treshnikov (ed.) 1985

m - number of years for which there is at least one monthly mean air temperature value in the study period

n - number of monthly mean values used for calculation of air temperature anomalies in particular 20-year periods and for the whole period (station A × number of months for which data were collected in a study period + station B × number of months for which data were collected in a study period, etc.)

thermometers' exposures. The problem is that it is impossible to estimate some of these errors because of a lack of information. Przybylak and Vízi (2004) estimated that biases connected with different methods of calculating monthly means in historical and present times are small and generally do not exceed 0.2 °C (that work also includes details about sources of data and their quality).

3. Results and discussion

3.1. The whole period

The annual courses of average temperature calculated based on all available data for the whole study period 1801–1920 and for two sub-periods, 1801–1860 and 1861–1920, are shown in Figure 5. However, to obtain more reliable results, the bias resulting from the rising quantity of data with time and changing spatial coverage was to some degree reduced by initially calculating 20-year means, and then using these as a basis for further calculations. All three curves presenting annual courses of air temperature generally reveal similar patterns of changes. Firstly, it was clear that the coldest months were February and January and the warmest were July and August. Positive average values of monthly temperature (aside from July and August) were also noted in June. Secondly, the second half of the year was warmer than the first.

A detailed comparison of the historical and modern temperature data is presented in Table III and Figures 6–8. All the data gathered confirm the very well-known fact that the Arctic in the analysed historical period was colder than at present. On average, the Arctic as a whole was colder by 0.8 °C (Table III). Atlantic, Siberian and Canadian regions were the coldest parts of it (about 1 °C), whereas the Baffin Bay region saw the least cooling (only 0.4 °C). Annual mean temperatures in all the 20-year periods and in all climatic regions were colder than today (Table III, Figure 6). Differences generally are less than 2 °C. Almost similar patterns of temperature changes between comparable periods were observed in winter and autumn. In winter all differences are negative and varied from 1 °C to 4 °C. On average, winter was colder by 1.6 °C, with a maximum (about 2 °C) in January and February (Table III, Figure 7). Negative differences clearly dominate also in autumn. Only in three 20-year periods were slight positive differences noted (Table III, Figure 6). Significantly colder autumns were observed in the period 1801–1860 in comparison with the period 1861–1920 (Figure 7). On average, this season in the Arctic throughout the whole study period was colder than the present by 0.9 °C. On the other hand, summers and especially springs were not so cold in comparison with the present thermal conditions. Their negative temperature differences averaged for the entire Arctic and the period 1801–1920 amounted to −0.4 °C and −0.2 °C, respectively (Table III, Figure 6).

Generally Vinther *et al.* (2006) found very similar results for south-western Greenland (merged Greenland temperature series). For example, the air temperature differences that they calculated between the periods 1811–1920 and 1961–1990 (using data published in their Table VIII) amounted to −1.1 °C, −2.4 °C, −0.6 °C, −0.3 °C and −0.9 °C for annual, winter, spring, summer and autumn periods, respectively. The reconstructed mean annual temperature for the Barents and the Kara seas basin by Klimenko (in press) shows only small cooling (<0.5 °C) in the study period. This cooling was not continuous throughout the study period. For example, greater warming (>0.4–0.5 °C above the 1951–1980 mean) was observed here from 1850 to 1875. Data analysis for the Canadian Arctic for the period 1819–1859 also reveals a slight cooling (0.3 °C for the annual mean) in comparison with the present-day value (Przybylak and Vízi, 2005).

For the period 1861–1920 it is possible also to compare our data with the data for the whole Arctic (60–90°N) compiled by Jones *et al.* (1999). We should remember here, however, that for this period there were only a few permanent meteorological stations operating in the real Arctic (defined after Treshnikov, 1985, see also Figure 1). Thus, in reality, the dataset mentioned describes mainly the temperature in the 60–70 °N latitude band and therefore should rather be termed 'Subarctic'. Comparison of temperature differences between periods 1861–1920 and 1961–1990, calculated based on both

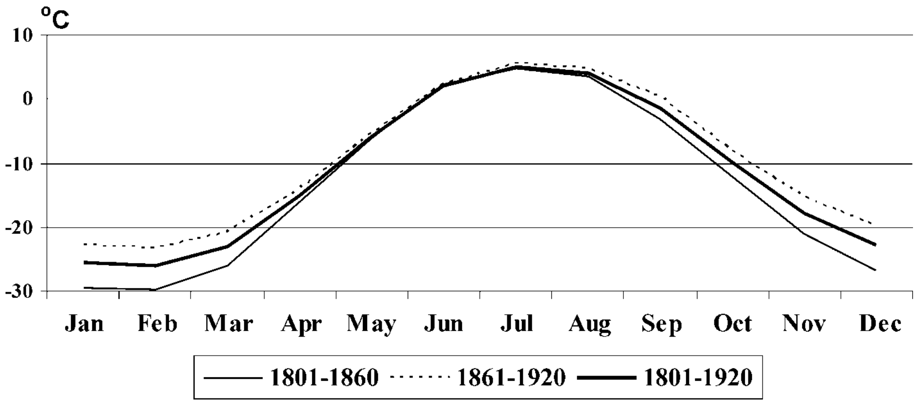

Figure 5. Average annual courses of air temperature in the Arctic in selected early instrumental periods.

Table III. Average air temperature differences (°C) between mean monthly (JAN, FEB, MAR, etc.), seasonal (DJF, MAM, etc.) and annual (YEAR) values from the historical and modern (1961–1990) periods for the regions and the whole Arctic.

Period	Regions*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DJF	MAM	JJA	SON	YEAR
1801–1820	Atlantic																	
	Siberian									**−6.9**	**−7.2**	**−4.4**	**−2.6**				**−6.2**	
	Pacific																	
	Canadian	**−2.3**	**−3.4**	**−3.3**	**−2.3**	**−0.7**	**−1.8**	*2.5*	**−1.5**	**−1.7**	**−3.0**	**−2.8**	*1.3*	**−1.5**	**−2.1**	**−0.2**	**−2.5**	**−1.6**
	Baffin Bay	**−3.3**	**−4.3**	**−3.6**	**−1.7**	**−1.8**	**−1.2**	**−1.1**	**−1.8**	**−2.7**	**−1.3**	**−1.8**	*2.4*	**−1.8**	**−2.4**	**−1.4**	**−1.9**	**−1.9**
	Arctic	**−3.2**	**−4.2**	**−3.5**	**−1.8**	**−1.6**	**−1.3**	**−0.6**	**−1.8**	**−2.9**	**−1.9**	**−2.1**	*2.0*	**−1.8**	**−2.3**	**−1.2**	**−2.3**	**−1.9**
1821–1840	Atlantic	*1.3*	**−0.6**	**−3.1**	**−2.1**	*1.3*	*2.1*	**−0.3**	**−0.6**	**−3.2**	**−3.4**	**−7.5**	**−3.5**	**−0.9**	**−1.3**	*0.4*	**−4.7**	**−1.6**
	Siberian	**−5.0**	**−1.4**	*6.3*	*6.6*	*7.6*	*5.3*		*2.0*	**−6.2**	**−10.3**	**−4.0**	**−6.7**	**−4.4**	*6.8*	*3.6*	**−6.8**	**−0.5**
	Pacific																	
	Canadian	*0.6*	**−0.7**	**−0.9**	*0.6*	**−1.0**	**−0.3**	**−0.7**	**−0.5**	**−0.7**	**−1.4**	*0.0*	*0.1*	*0.0*	**−0.4**	**−0.5**	**−0.7**	**−0.4**
	Baffin Bay	**−3.2**	**−3.5**	**−0.8**	**−0.5**	*0.0*	**−1.8**	**−0.8**	**−0.7**	**−1.7**	**−2.0**	**−2.3**	*3.0*	**−1.3**	**−0.4**	**−1.1**	**−2.0**	**−1.2**
	Arctic	**−1.1**	**−1.8**	**−0.7**	*0.2*	*0.1*	*0.0*	**−0.7**	**−0.4**	**−1.5**	**−2.0**	**−1.6**	*0.8*	**−0.7**	**−0.1**	**−0.4**	**−1.7**	**−0.7**
1841–1860	Atlantic																	
	Siberian																	
	Pacific	**−2.0**	**−1.6**	**−1.7**	**−0.3**	**−0.7**	**−2.3**	**−2.2**	**−1.8**	**−2.6**	**−5.2**	**−4.6**	**−2.1**	**−1.9**	**−0.9**	**−2.1**	**−4.1**	**−2.3**
	Canadian	**−1.7**	**−1.5**	**−0.2**	*1.5*	**−0.5**	**−0.9**	**−1.8**	**−0.9**	**−1.9**	**−2.1**	**−0.2**	**−1.9**	**−1.7**	*0.3*	**−1.2**	**−1.4**	**−1.0**
	Baffin Bay	**−2.6**	**−1.1**	*1.0*	*0.3*	*0.2*	*0.4*	**−0.1**	**−0.4**	**−0.8**	**−0.4**	**−1.2**	*3.4*	**−0.1**	*0.5*	**0.0**	**−0.8**	**−0.1**
	Arctic	**−2.1**	**−1.4**	*0.1*	*0.9*	**−0.3**	**−0.6**	**−1.2**	**−0.7**	**−1.6**	**−1.9**	**−1.1**	**−0.1**	**−1.2**	*0.2*	**−0.9**	**−1.5**	**−0.8**
1861–1880	Atlantic	*3.1*	**−4.3**	**−1.8**	**−1.5**	**−2.0**	**−0.1**	**−0.3**	**−0.6**	**−0.6**	**−4.0**	**−2.5**	**−3.6**	**−1.6**	**−1.8**	**−0.3**	**−2.4**	**−1.5**
	Siberian																	
	Pacific	**−2.4**	*0.6*	*2.5*	**−0.6**	*0.8*	**−0.8**	**−1.5**			*0.2*	**−3.7**	**−2.6**	**−1.5**	*0.9*	**−1.1**	**−1.7**	**−0.7**
	Canadian	**−3.9**	**−3.0**	**−4.1**	**−0.9**	*0.3*	*1.1*	*0.4*	**−0.3**	**−0.4**	**−2.4**	**−2.1**	**−1.4**	**−2.8**	**−1.5**	*0.4*	**−1.6**	**−1.4**
	Baffin Bay	**−3.3**	**−2.4**	**−1.0**	**−0.9**	*0.2*	**−0.3**	**−0.5**	**−0.4**	**−1.0**	**−0.7**	**0.0**	*3.0*	**−0.9**	**−0.6**	**−0.4**	**−0.6**	**−0.6**
	Arctic	**−2.4**	**−2.8**	**−1.9**	**−1.0**	**−0.1**	*0.1*	**−0.3**	**−0.4**	**−0.8**	**−1.7**	**−1.1**	*0.5*	**−1.6**	**−1.0**	**−0.2**	**−1.2**	**−1.0**

(*continued overleaf*)

Table III. (*Continued*).

Period	Regions*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DJF	MAM	JJA	SON	YEAR
1881–1900	Atlantic	**−0.9**	**−2.1**	**−0.5**	*0.8*	*0.3*	*0.5*	**−0.4**	**−0.9**	**−1.1**	**−2.0**	**−1.3**	**−0.9**	**−1.3**	*0.2*	**−0.3**	**−1.5**	**−0.7**
	Siberian	**−3.9**	**−5.1**	**−4.3**	*0.1*	*1.0*	*0.9*	*0.8*	**−1.0**	**−0.6**	**−4.8**	**−4.4**	**−4.9**	**−4.6**	**−1.1**	*0.2*	**−3.3**	**−2.2**
	Pacific	**−3.2**	*1.1*	*3.6*	**−0.7**	**−0.2**	**−0.7**	*0.2*	**−0.9**	**−2.2**	*0.3*	*0.5*	**−1.6**	**−1.2**	*0.9*	**−0.5**	**−0.4**	**−0.3**
	Canadian	**−5.2**	**−3.9**	**−2.1**	*0.3*	**−1.8**	*0.5*	*0.1*	**−0.6**	**−1.0**	**−2.8**	**−3.2**	**−2.4**	**−3.8**	**−1.2**	**0.0**	**−2.3**	**−1.9**
	Baffin Bay	**−2.8**	**−1.6**	*0.7*	*1.1*	*0.6*	*0.0*	**−0.6**	**−0.5**	**−0.1**	*0.8*	**−0.4**	*0.9*	**−1.2**	*0.8*	**−0.4**	*0.1*	**−0.2**
	Arctic	**−2.9**	**−2.1**	**−0.1**	*0.7*	**0.0**	*0.2*	**−0.4**	**−0.6**	**−0.6**	**−0.7**	**−1.2**	**−0.4**	**−1.8**	*0.2*	**−0.3**	**−0.8**	**−0.7**
1901–1920	Atlantic	**−1.7**	**−2.6**	**−1.8**	**−0.5**	**−0.1**	*0.3*	**−0.5**	**−0.1**	**−0.7**	**−0.6**	**−2.1**	**−2.1**	**−2.1**	**−0.8**	**−0.1**	**−1.2**	**−1.0**
	Siberian	**−0.2**	**−3.6**	**−3.5**	*4.0*	*1.6*	*1.4*	*0.4*	*2.9*		**−2.1**	**−2.2**	**−1.2**	**−1.7**	*0.7*	*1.5*	**−2.1**	**−0.2**
	Pacific	**−4.4**	*1.1*	*0.1*	**−0.2**	**−0.5**	**−0.5**	**−0.3**	**−0.2**	**−0.2**	*1.0*	**−0.5**	**−2.2**	**−1.8**	**−0.2**	**−0.3**	*0.1*	**−0.6**
	Canadian	**−2.1**	**−1.3**	*0.3*	**−0.9**	**−0.7**	**−0.6**	**−0.5**	**−0.3**	**−0.2**	**−1.0**	*0.5*	**−1.3**	**−1.6**	**−0.5**	**−0.4**	**−0.3**	**−0.7**
	Baffin Bay	**−2.2**	**−1.1**	*0.3*	*0.7*	*0.4*	**−0.8**	**−1.3**	**−0.2**	*0.3*	*0.8*	*0.9*	*1.4*	**−0.6**	*0.5*	**−0.8**	*0.7*	**−0.1**
	Arctic	**−2.4**	**−1.4**	**−0.8**	**−0.2**	**−0.1**	**−0.2**	**−0.6**	**−0.2**	**−0.4**	**−0.1**	**−0.9**	**−1.3**	**−1.7**	**−0.3**	**−0.3**	**−0.4**	**−0.7**
1801–1920	Atlantic	**−1.3**	**−2.5**	**−1.5**	**−0.3**	**0.0**	*0.4*	**−0.5**	**−0.3**	**−0.8**	**−1.1**	**−2.1**	**−1.9**	**−1.9**	**−0.6**	**−0.1**	**−1.4**	**−1.0**
	Siberian	**−3.0**	**−3.4**	**−0.5**	*3.6*	*3.4*	*2.5*	*0.6*	*1.3*	**−3.6**	**−5.2**	**−3.6**	**−3.6**	**−3.3**	*2.2*	*1.5*	**−4.1**	**−1.0**
	Pacific	**−3.9**	*0.8*	*0.3*	**−0.3**	**−0.5**	**−0.8**	**−0.5**	**−0.4**	**−0.8**	*0.1*	**−0.9**	**−2.1**	**−1.7**	**−0.2**	**−0.6**	**−0.5**	**−0.7**
	Canadian	**−2.4**	**−2.1**	**−1.1**	*0.3*	**−0.9**	**−0.3**	**−0.6**	**−0.6**	**−1.0**	**−2.0**	**−1.1**	**−1.4**	**−2.0**	**−0.6**	**−0.5**	**−1.4**	**−1.1**
	Baffin Bay	**−2.8**	**−1.9**	**−0.1**	*0.3*	*0.2*	**−0.4**	**−0.8**	**−0.5**	**−0.5**	*0.1*	**−0.4**	*1.9*	**−0.9**	*0.1*	**−0.6**	**−0.3**	**−0.4**
	Arctic	**−2.4**	**−1.8**	**−0.7**	*0.1*	**−0.1**	**−0.1**	**−0.6**	**−0.4**	**−0.8**	**−0.8**	**−1.1**	**−0.5**	**−1.6**	**−0.2**	**−0.4**	**−0.9**	**−0.8**

* after Treshnikov (ed.) 1985, bold fonts - negative anomalies

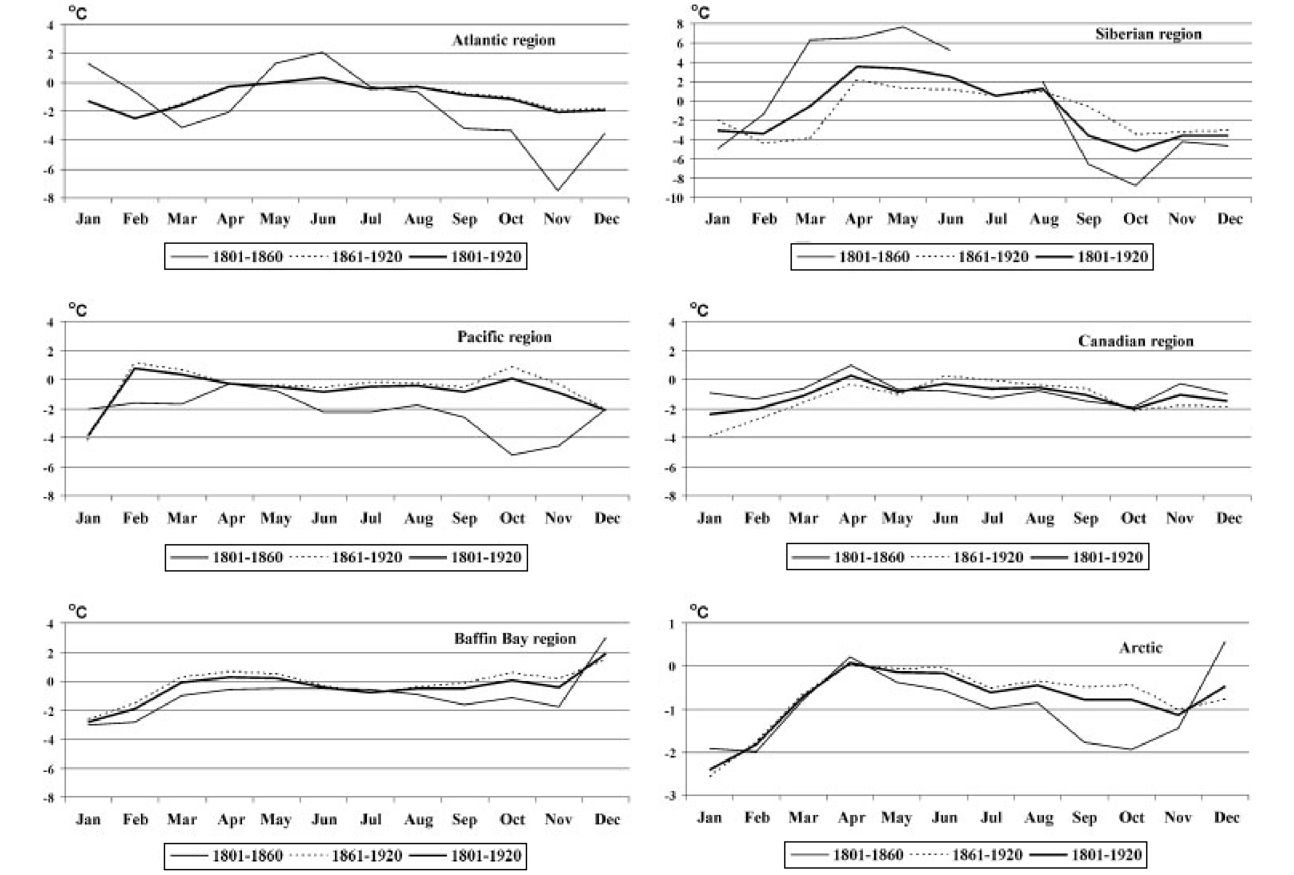

Figure 6. Air temperature differences (°C) between mean monthly values from the historical and modern (1961–1990) periods for selected climatic regions and for the whole Arctic.

of the datasets discussed, shows fairly similar results, with the exception of spring conditions. Annual values are almost the same: −0.9 °C (Jones dataset) and −0.7 °C (our dataset). In the annual course, there was significantly greater correspondence in temperature changes between the compared periods for summer (−0.6 °C and −0.3 °C, respectively) and especially for autumn (−0.8 °C and −0.7 °C). The greatest discrepancies between the real Arctic and the Subarctic occurred in spring. The former was only a little colder than it is at present (by 0.2 °C), whereas the latter experienced quite significant cooling (by 1.1 °C).

In spring, definitely the warmest month was April, which was the only month out of all the months of the year to be, on average, slightly warmer (by 0.1 °C) than today. Very high averages for April (3.6 °C above present norm), May (3.4 °C) and June (2.5 °C) were observed in the Siberian region (see Table III). However, these results are calculated based only on data from a few years (Table II) and therefore their long-term means are not particularly reliable. More trustworthy results are available for the Canadian and Baffin Bay regions, where, on average, April was warmer than today by 0.3 °C. On the other hand, negative differences (−0.3 °C, i.e. colder conditions than present) were observed in the Atlantic and Pacific regions.

Figure 7 shows annual courses of temperature differences between historical and modern times, along with their stratification into two sub-periods: 1801–1860 and 1861–1920. Generally, in almost all months, temperatures were colder in the first period. Such a pattern is particularly evident in the Atlantic, Pacific and Baffin Bay regions. For Iceland, Ogilvie and Jónsdóttir (2000) found similar results, based on the analysis of the sea-ice index. Also the analysis of merged Greenland temperatures confirms this finding (see Table VIII in Vinther *et al*., 2006). On the other hand, opposite relations are noted for the Siberian and Canadian regions.

The question arises of whether temperature differences between historical and present-day monthly means are significant. To check this, they were compared with year-to-year temperature variability of each month in the period 1961–1990, described using standard deviations (SDs). The results obtained for different areas (areally averaged data) and sites representing almost all climatic regions of the Arctic are presented in Figure 8. The results show that air temperatures in the Arctic from 1801 to 1920 were not as exceptionally cold as has been suggested by some analyses of proxy data (Koerner, 1977; Overpeck *et al*., 1997). This conclusion is confirmed by the fact that the majority of the mean monthly air temperatures lie within one standard deviation from the modern mean (see Figure 8), and only in a few cases do they exceed the level of two standard deviations. Calculations based on Jones's dataset for the period 1851–1920 also confirm this finding. Przybylak and Vizi (2005) noted

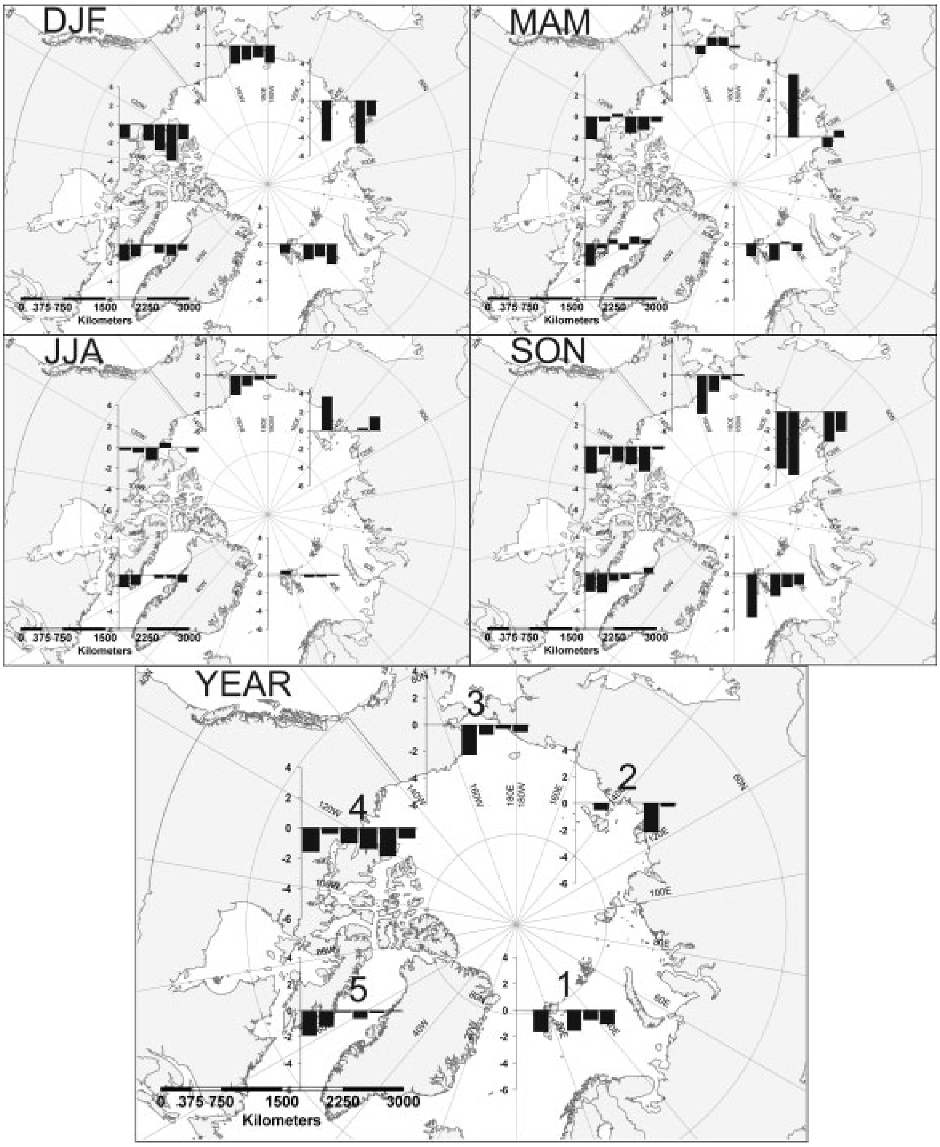

Figure 7. Air temperature differences (°C) between mean seasonal (DJF, MAM etc.) and annual (Year) values from the historical and modern (1961–1990) periods for selected climatic regions. From left to right the results are presented for the periods: 1801–1820, 1821–1840, etc. 1- Atlantic region, 2- Siberian region, 3 – Pacific region, 4 – Canadian region, 5 – Baffin Bay region.

this fact analysing temperature data (both of monthly and daily resolution) for the Canadian Arctic from 1819 to 1859.

3.2. The first International Polar Year (IPY) 1882/83

As was mentioned earlier, the greatest amount of meteorological data was collected during the periods of the so-called Franklin Era (1850s) and the first IPY. The climate of the Franklin Era is described in detail by Przybylak and Vízi (2005), and need not be reiterated here. On the other hand, the meteorological conditions during the first IPY are still not fully known, although a few papers dealing with this subject have been published recently (e.g. Lüdecke, 2004; Przybylak, 2004; Przybylak and Panfil, 2005; Wood and Overland, 2006). The reader interested in this topic may also visit a website prepared by the National Oceanic and Atmospheric Administration (NOAA) Arctic Research Office: http://www.arctic.noaa.gov/aro/ipy-1/index.htm.

During the first IPY period, nine meteorological stations were operating in the real Arctic (i.e. defined after Treshnikov, 1985; Figure 1). It is important to note that meteorological observations in all of these stations were carried out according to the same methodology and all of the measurement instruments were subject to strict calibration and control (before, during and after the expeditions). As a result, all the meteorological data that were gathered (with hourly resolution) are of good quality and are fully comparable. In spite of this, however, Wood and Overland (2006) have rightly noted that no synthesis was made of the data. The earlier listed papers, together with the present section describing some temperature characteristics for the first IPY, still analyse only small parts of the available data (mainly temperature and air pressure).

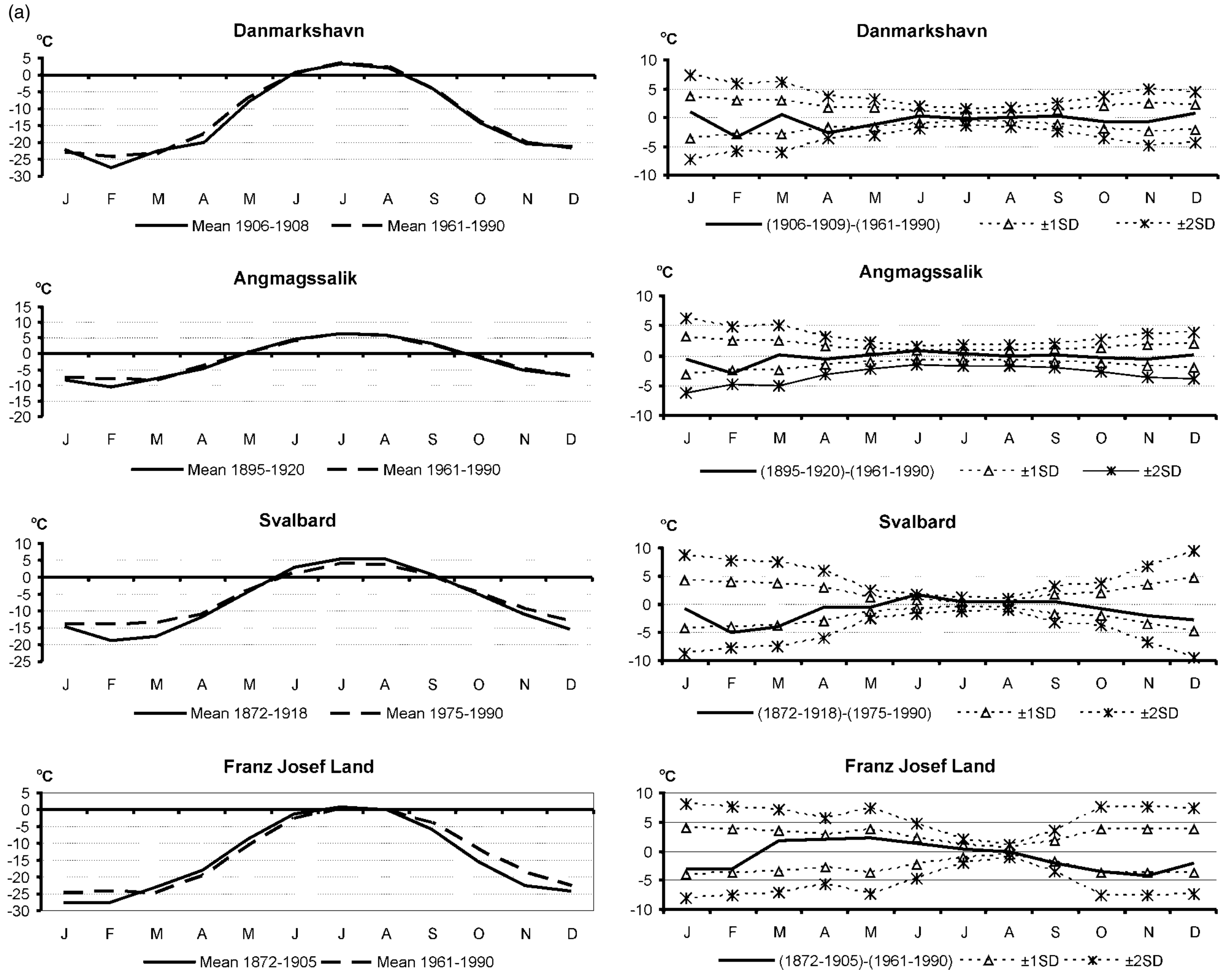

Figure 8. Annual courses of historical and modern air temperatures based on monthly means (left panels) and differences between them (right panels) in selected areas of the Arctic (a and b). Standard deviations (SDs) have been calculated on the basis of present data (1961–1990).

The rest of the meteorological variables (e.g. humidity, precipitation, wind, cloudiness) still remain to be discussed. In the Department of Climatology at the Nicolaus Copernicus University, these data are currently being digitalized and the results of their analysis will be published in the near future.

As can be seen from Figure 2, the meteorological stations operating during the first IPY in the Arctic were roughly evenly distributed and represent almost all the climatic regions that are currently distinguished in the Arctic (Figure 1). The common period of the meteorological observations (taking into account full months) in all the stations analysed lasted from October 1882 to July 1883. Similar to the present Arctic climate (Treshnikov, 1985 or Przybylak, 2002, 2003), the lowest temperature during the first IPY occurred in the north-eastern part of the Canadian Arctic (Lady Franklin Bay), where its average value amounted to −22.6 °C. In line with expectations, the second coldest region was Siberia (Sagastyr), with an average temperature equal to −18.3 °C. However, it should be added here that the lowest absolute minimum temperature was noted not in Lady Franklin Bay (−49.2 °C), but in Sagastyr (−53.2 °C).

The warmest part of the Arctic during the first IPY was the western part of the Norwegian Arctic (Jan Mayen), where the mean temperature for the common period was only −3.3 °C. However, the absolute minimum temperature was highest not here, but in the Godthåb station (−24.2 °C). The highest observed temperatures almost everywhere (except for Jan Mayen and the Kara Sea) exceed a value of 10 °C, reaching a maximum value of 15.8 °C in the Kingua Fjord. For the whole period of the first IPY, the absolute maximum temperature reached a value of 19.7 °C again in the Kingua Fjord.

In the annual course of temperature (including extreme temperatures), the coldest month in the western Arctic (except Alaska) was February (Figure 9). On the other hand, in the eastern Arctic (with the exception of the Siberian part) and Alaska, this month was the warmest of all winter months (December–March). In this area, the coldest month was December or January, although in Jan Mayen (the most maritime climate) March was coldest. The warmest month was usually July or August. From Figure 9 it can easily be seen that the clearest annual temperature courses are noted in the parts of the Arctic with the greatest degree of climate continentality

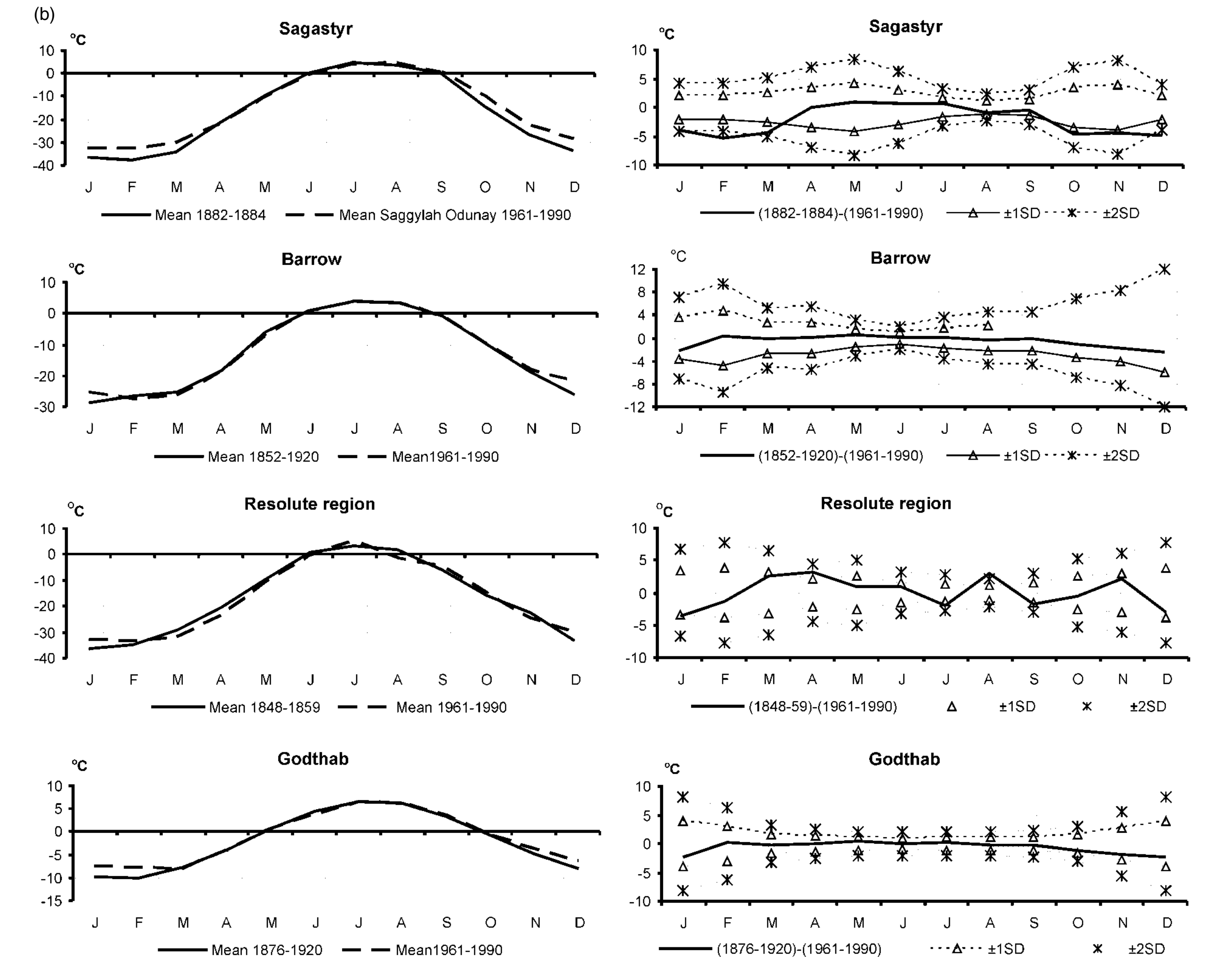

Figure 8. (*Continued*).

(Siberia and the Canadian Arctic). The annual range of temperature (i.e. the difference between the warmest month and the coldest month) exceeds 40 °C in three stations: Sagastyr (46.9 °C), Kingua Fjord (43.2 °C) and Lady Franklin Bay (42.3 °C). On the other hand, smaller temperature variations in the annual course were observed in Jan Mayen and Godthåb, where the annual ranges amounted to 13.8 °C and 20.9 °C, respectively (Figure 9). The greatest changes in temperature in all stations were noted from April to June (rise) and from September to November or December (fall). In summer and winter months, a stabilization of temperature was noted.

Absolute temperature range (ATR) and diurnal temperature range (DTR) also provide good characterisations of meteorological and climate conditions, and these values are shown in Figure 10. The highest monthly average DTRs in the western Arctic were noted most often in March or April. In March, the highest DTRs also occurred in the central part of Spitsbergen. On the other hand, in the rest of stations, where cyclonic activity is very common (particularly in the cold half year), the highest DTRs were observed in winter months. In the common analysed period (October–July), the highest average DTRs occurred in Kingua Fjord (7.5 °C), the Kara Sea (7.0 °C) and Sagastyr (6.3 °C), whereas the lowest ones were in Godthåb (4.2 °C) and Jan Mayen (4.4 °C) – Figure 10. This spatial pattern of the DTR during the first IPY is roughly similar to the observed pattern in the present period (Przybylak, 2000b).

Spatial distribution of the ATR occurring in particular months, and especially in the whole study period, is similar to the spatial pattern of average DTR, described earlier. The main difference is the fact that in Sagastyr and Kingua Fjord, where the highest ATRs are noted during the common period, their monthly values were not the highest (except for June and September in Sagastyr). The highest monthly ATRs were most frequently noted in the Kara Sea and in Alaska. On the other hand, the lowest values of these two temperature characteristics show a very close correspondence both in temporal and spatial analyses. They are always the lowest (except for July) in Jan Mayen and Godthåb (Figure 10).

The air temperature during the first IPY period was, on average, colder by 1.0–1.5 °C than today. Winter was exceptionally cold, with average temperature being lower by more than 3 °C in December and January. Summer 1883 was also colder but only by about 1 °C (Table IV). On the other hand, spring (March–May) was slightly

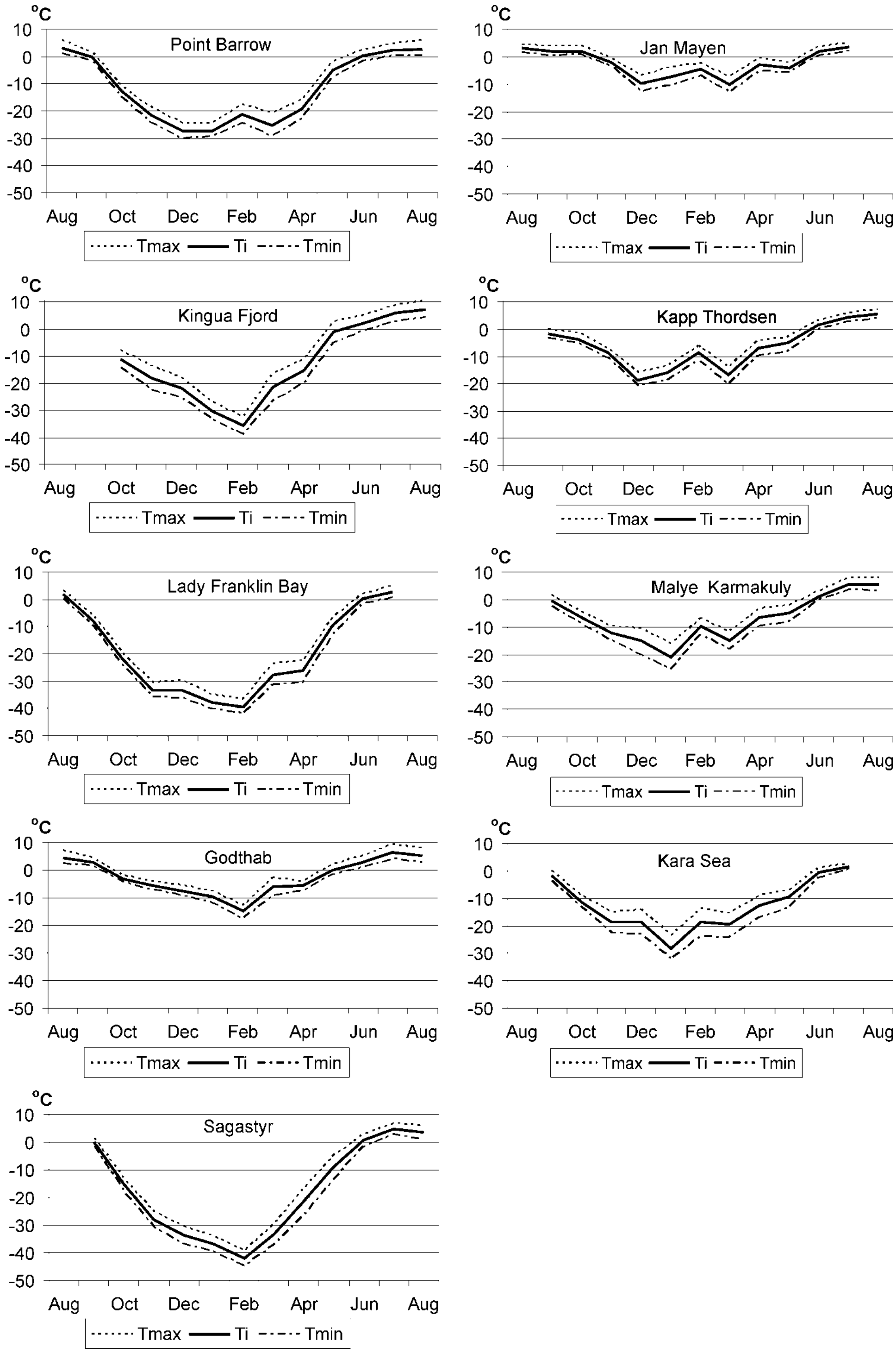

Figure 9. Annual courses of air temperature in the Arctic during the first International Polar Year 1882/83 according to monthly means. Explanations: T_i – mean daily temperature, T_{max} – daily maximum temperature, T_{min} – daily minimum temperature.

warmer than today, and April was exceptionally warm (1.1 °C above the present norm). In every month (except January) both positive and negative differences (anomalies) were observed (Table IV), when all stations are analysed. However, the predominance of negative anomalies is very clear. Roughly speaking, similar anomalies to those described earlier were calculated for the latitude band 60–90 °N (Table IV). On the other hand, the Northern Hemisphere shows negative temperature anomalies in each month during the first IPY. Thus, it can be concluded that the Arctic, in comparison with the lower latitudes, was relatively warmer at this time.

4. Conclusions and final remarks

(1) It would appear that our search for early instrumental meteorological data for the Arctic is yielding promising results. Quite a large database has

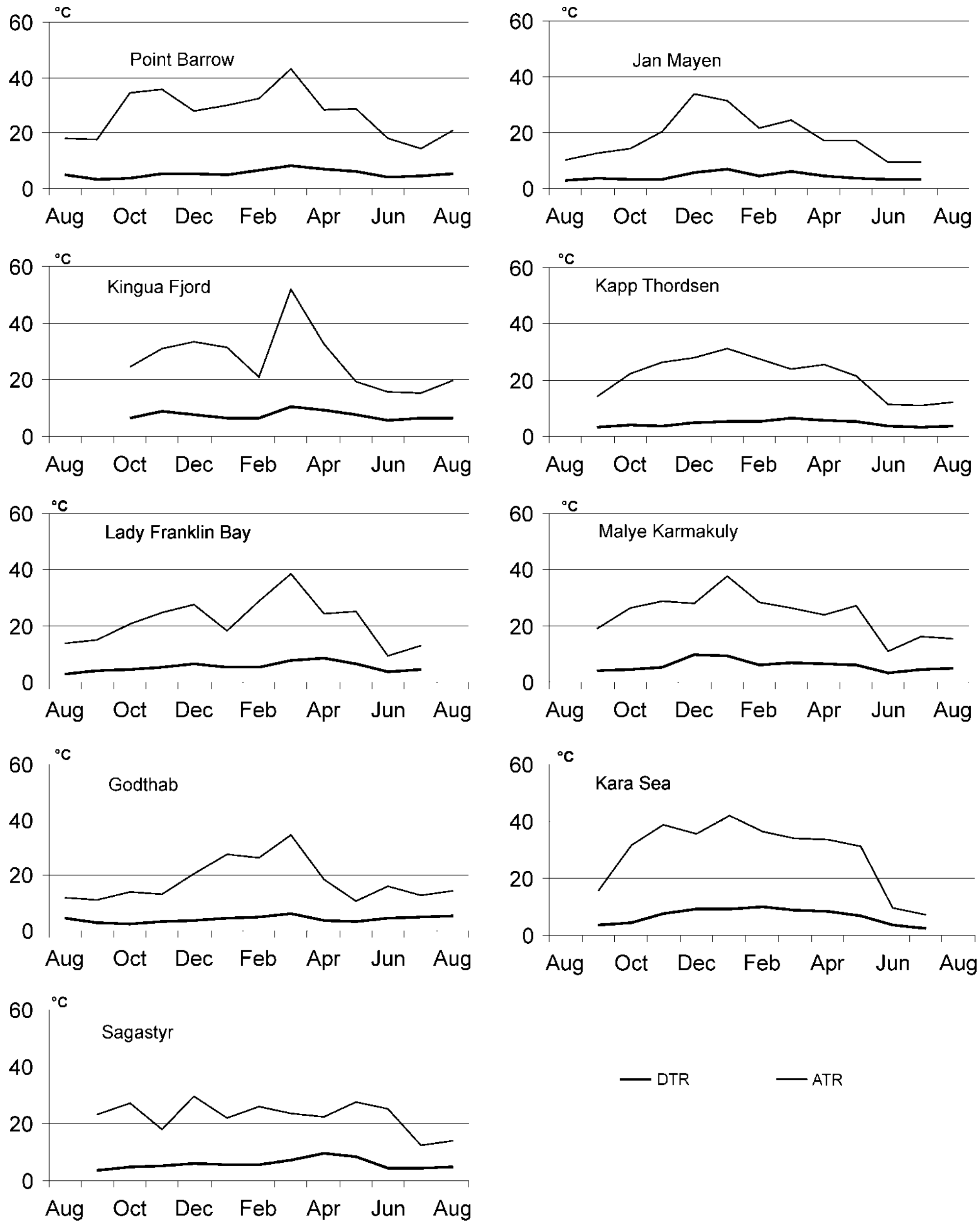

Figure 10. Annual courses of diurnal temperature range (DTR) and absolute temperature range (ATR) in the Arctic during the first International Polar Year 1882/83 according to monthly means.

been established in the Department of Climatology at the Nicolaus Copernicus University, although the process of collecting data is obviously not finished. We hope that there are still many data series available, e.g. in different libraries, archives and private collections, which we can include in future research. Again, we would welcome any help from readers in finding new meteorological data not listed in our database (Appendix and http://www.umk.pl/∼vizi/Appendix.pdf).

(2) The temperature data gathered for the whole Arctic for the period 1801–1920 clearly indicate that this period was colder than today, but the average annual temperature was only about 0.8 °C lower in comparison with the present-day (1961–1990) value. Annual mean temperatures in all the 20-year periods and in all climatic regions were also colder than modern values. It seems probable that, on average, the first 60-year sub-period (1801–1860) was colder in the Arctic by about 0.3 °C than the second 60-year sub-period (1861–1920). Cooler conditions were mainly seen from May to November. However, in the Canadian and Siberian regions the relationship was opposite, i.e. the second sub-period was colder than the first one.

(3) In the annual course, the greatest differences between historical and present-day periods occurred in winter (1.6 °C) and autumn (0.9 °C), whereas the lowest was in spring (only 0.2 °C).

(4) Throughout the whole study period, the majority of mean monthly temperatures lie within one SD from the modern mean.

Table IV. Temperature differences (°C) between mean monthly values from the first International Polar Year (1882/1883) and modern period (1961–1990)*. Negative and 0.0 values are shown in bold font.

Station/Region	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Point Barrow	**−0.2**	0.4	**−3.2**	**−3.8**	**−5.4**	**−2.0**	6.0	1.0	**−0.5**	2.1	**−0.9**	**−1.8**	
Kingua-Fjord			**−5.9**	**−5.3**	0.5	**−4.6**	**−8.9**	2.4	**−0.4**	3.4	**−1.0**	**−1.8**	0.6
Lady Franklin Bay	0.8	2.1	**−2.5**	**−6.2**	**−3.5**	**−5.7**	**−5.7**	5.5	**−0.8**	2.2	1.3	**−0.5**	
Godthåb	**−1.5**	**−0.7**	**−2.4**	**−1.9**	**−1.3**	**−2.3**	**−6.8**	2.0	**−1.7**	**−0.5**	**−1.2**	**−0.2**	**−1.0**
Jan Mayen	**−1.9**	**−0.9**	2.0	1.4	**−4.4**	**−1.6**	1.7	**−4.2**	1.2	**−3.3**	**−0.2**	**−0.7**	
Kapp Thordsen		**−2.1**	1.8	0.4	**−5.9**	**−1.3**	6.9	**−3.1**	4.3	**−1.3**	**−0.5**	**−1.8**	
Malye Karmakuly		**−3.6**	**−3.7**	**−3.3**	**−3.3**	**−5.8**	5.8	**−1.4**	4.6	**−0.5**	**−0.3**	**−1.7**	**−1.0**
Kara Sea		**−4.4**	**−5.2**	**−4.3**	0.1	**−4.9**	5.6	1.6	3.0	**−2.2**	**−0.9**	**−3.8**	
Sagastyr		**−0.3**	**−4.2**	**−4.1**	**−4.2**	**−3.9**	**−9.2**	**−3.8**	**−0.1**	0.4	0.6	0.4	**−1.0**
Mean		**−1.4**	**−2.6**	**−3.0**	**−3.0**	**−3.6**	**−0.5**	**0.0**	1.1	**0.0**	**−0.3**	**−1.3**	
Arctic (60–90°N)**	**−1.1**	**−0.4**	**−0.3**	**−3.9**	**−3.6**	**−0.6**	0.7	1.8	1.2	**−1.1**	**−0.3**	**−0.2**	**−1.3**
N. Hemisphere***	**−0.2**	**−0.2**	**−0.5**	**−0.5**	**−0.6**	**−0.7**	**−0.6**	**−0.6**	**−0.3**	**−0.3**	**−0.1**	**−0.2**	**−0.2**

* - data from the following modern stations located nearest the historical stations have been used: Point Barrow, lqaluit A, Alert, Godthåb, Jan Mayen, Svalbard Lufthavn, Malye Karmakuly, Mys Kharasavey, and Sagyllah Ary and Ostrov Dunay, respectively
** - after Jones *et al*. (1999)
*** - land + sea after Jones *et al*. (1999)

(5) During the first IPY 1882/83 the spatial patterns of mean temperature, DTR and some other thermal characteristics in the real Arctic were roughly similar to the present ones.
(6) The air temperature in the real Arctic during the first IPY period was generally colder by 1.0–1.5 °C than today. Winter was exceptionally cold with average temperature being lower in December and January by more than 3 °C. On the other hand, spring (March–May) was slightly warmer than today, and April was exceptionally warm (1.1 °C above the present norm).

It seems that the results presented in the paper can be treated as a reliable source of information about weather and climate variation and change in the early instrumental period of observations in the Arctic. The search for meteorological data measured during different land and marine expeditions to the Arctic reveals that they are quite numerous, significantly greater than we expected to find. As we demonstrated in our previous papers (Przybylak and Vízi, 2004, 2005) the quality of the data is also quite good. This means that a significant improvement in our knowledge about the Arctic climate in the 19th and the beginning of 20th centuries is possible and depends mainly on a number of still undiscovered data sources. The ACEIP project, within which this work has been carried out, is still not finished and investigations will be continued throughout the 4th International Polar Year. Certainly, within a few years we will be able to present more results, e.g. for other meteorological elements. The use of daily and hourly data, available for some parts of the Arctic, permits a more precise insight into different aspects of weather and climate characteristics, e.g. daily and annual cycles, day-to-day variation and DTRs (for more details see Przybylak and Vízi, 2005).

The development of a historical meteorological database for the Arctic is important for the study of environmental changes in this region and for determining the existing relations between different elements of the environment. Such a database will also be crucial in estimating whether constant relationships between the climate of the Arctic and that of the rest of the world exist for long-term stretches of time. A majority of climatologists are now aware of the importance of data from reanalysis (NCEP/NCAR reanalysis, ECMWF reanalysis) for climate studies. Recently it has been suggested that these datasets be extended to include the 19th century (Allan, 2007). As such, it is clear that historical meteorological data from the Arctic will be indispensable in carrying out such a project, and for numerous other purposes as well.

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Appendix

No.	Region*	Location	φ	λ	Ship/ station	Captain/ Observer	Years	No. of months	Resolution of observations	Comparable station	φ	λ	Period	Sources of historical data
1	Atlantic (southern)	Akseløy, Belsund Spitsbergen	77°42'N	14°50'E	station		1898.09-1905.06$^{\#}$	41	m$^+$	Hornsund	77°00'N	15°33'E	1979-95	Birkeland B. J. 1920. Spitsbergens klima [in:] „Illustrert maanedsskrift for populear naturvidenskap". Naturen, 44, „Utgit av Bergens Museum".
2		Akseløy, Belsund Spitsbergen	77°43'N	14°10'E	station		1910.09-1911.05	9	m$^+$	Jan Mayen	72°00'N	9°24'W	1961-90	
3		Björnöya	74°31'N	19°01'E	station		1920.01-12	12	m$^+$	Björnöya	74°31'N	19°01'E	1961-90	Norwegian Meteorological Institute
4		Björnöya	74°31'N	19°01'E	station		1910.09-1911.05	9	m$^+$	Björnöya	74°31'N	19°01'E	1961-90	
5		Isfjord Radio	78°06'N	13°36'E	station		1912.01-1920.12$^{\#}$	103	m$^+$	Isfjord Radio	78°06'N	13°36'E	1961-90	http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=634010050010&data_set=1&num_neighbors=1
6		Jan Mayen	71°00'N	8°28'W	station	Lt. Emil von Wohlgemuth	1882.08.01-1883.07.30	12	h	Jan Mayen	71°00'N	8°24'W	1961-90	Wohlgemuth, E.E. Von. 1886. Österreichische Polarexpedition nach Jan Mayen. Beobachtungs-Ergebnisse. Wien: Der Kaiserliche-Königliche Hof -und Staatsdruckerei. 2 vols. **III**.Theil, 1 Abtheilung Meteorolgie bearbeitet von Adolf Sobieczky
7		Kanin Nos	68°42'N	43°18'E	station		1915.12-1920.12$^{\#}$	42	m$^+$	Kanin Nos	68°42'N	43°18'E	1961-90	http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=638221650004&data_set=1&num_neighbors=1
8		Maiak Cwjatoi Nos (Leuchtthurn von Swjatoi Noss)	68°09'N	39°79'E	station		1863.08-1865.06$^{\#}$	17	m$^+$	Murmansk	69°00'N	33°06'E	1961-90	Edlund O. 1928. Meteorologische und aerologische beobachtungen der Norwegischen Nowaja Semlja Expedition im Sommer 1921. pp. 55 [in:] Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlya 1921. No. 39, Det Norske Videnskaps. Akademi i Oslo, Oslo, 1928. [after:] Wild G. 1882. O temperatur vozduha v Rossiyskoy Imperiy. Tipografiya Imperatorskoy Akadamiy Nauk, Sanktpetersburg.
9		Malye Karmakuly Novaya Zemlya	72°23'N	52°36'E	station	Lt. K. P. Andreyev	1882.09-1883.08	12	h	Malye Karmakuly	72°23'N	52°44'E	1961-90	Lenz R. (ed.). 1886. Beobachtungen der Russischen Polarstation auf Nowaya Semlja. Expedition der Kaiserl. Russischen Geographischen Gesellschaft. 2 vols. in 1.
10		Malye Karmakuly Novaya Zemlya	72°33'N	52°42'E	station		1891.11-1892.06	8	m$^+$	Malye Karmakuly	72°23'N	52°44'E	1961-90	Kirch R. 1966. Temperaturverhältnisse in der Arktis während der letzen 50 Jahre. Meteorologische abhandlungen, Band LXIX, Haft 3. Instytut für Meteorologie und Geophisik der Freien Universität Berlin, verlag von Dietrich Reimer in Berlin.
11		Malye Karmakuly Novaya Zemlya	72°33'N	52°42'E	station		1897.01-1920.07$^{\#}$	210	m$^+$	Malye Karmakuly	72°23'N	52°44'E	1961-90	period VII-XII 1896: Kirch R. 1966. Temperaturverhältnisse in der Arktis während der letzen 50 Jahre. Meteorologische abhandlungen, Band LXIX, Haft 3. Instytut für Meteorologie und Geophisik der Freien Universität Berlin, verlag von Dietrich Reimer in Berlin; and period 1897-1920: The Arctic Climatology Project, Arctic Meteorology and Climate Atlas 2000
12		Melkaya Bay (Seichte Bai), Novaya Zemlya	73°57'N	54°48'E	station	Zivolka	1838.08.27-1839.08.22	12	m$^+$	Malye Karmakuly	72°23'N	52°44'E	1961-90	Edlund O. 1928. Meteorologische und aerologische beobachtungen der Norwegischen Nowaja Semlja Expedition im Sommer 1921. pp. 55 [in:] Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlya 1921. No. 39, Det Norske Videnskaps. Akademi i Oslo, Oslo, 1928. [after:] Wild G. 1882. O temperatur vozduha v Rossiyskoy Imperiy. Tipografiya Imperatorskoy Akadamiy Nauk, Sanktpetersburg.
13		Sajazkie Insel (Haseninsel), Novaya Zemlya	75°55'N	59°00'E	station	Sievert Tobiesen	1872.10.01-1873.05.18	8	m$^+$	Russkaya Gavan	76°11'N	63°34'E	1961-90	
14		St. Phokas Bay, Novaya Zemlya	76°59'N	59°55'E	station	Sedoff	1912.09.26-1913.09.03	11	m$^+$	Russkaya Gavan	76°11'N	63°34'E	1961-90	Edlund O. 1928. Meteorologische und aerologische beobachtungen der Norwegischen Nowaja Semlja Expedition im Sommer 1921. pp. 55 [in:] Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlya 1921. No. 39, Det Norske Videnskaps. Akademi i Oslo, Oslo, 1928
15		Storøy, Sydkap Spitsbergen	76°30'N	16°30'E	station		1908.09-1909.07	11	m$^+$	Hornsund	77°00'N	15°33'E	1979-95	Birkeland B. J. 1920. Spitsbergens klima [in:] „Illustrert maanedsskrift for populear naturvidenskap". Naturen, 44, „Utgit av Bergens Museum".
16		Storøy, Sydkap Spitsbergen	76°30'N	16°30'E	station		1911.08-1912.07	12	m$^+$	Hornsund	77°00'N	15°33'E	1979-95	
17		Storøy, Sydkap Spitsbergen	76°30'N	16°30'E	station		1914.09-1915.09	13	m$^+$	Hornsund	77°00'N	15°33'E	1979-95	
18	Atlantic (northern)	Adventbai Spitsbergen	78°13'N	15°38'E	station		1916.11-1917.09	11	m$^+$	Svalbard Lufthavn	78°18'N	15°30'E	1961-90	Birkeland B. J. 1920. Spitsbergens klima [in:] „Illustrert maanedsskrift for populear naturvidenskap". Naturen, 44, „Utgit av Bergens Museum".
19		Andersonsøy Spitsbergen	78°20'N	20°44'E	station		1894.09-1895.05	9	m$^+$	Svalbard Lufthavn	78°18'N	15°30'E	1961-90	
20		Cape Flora, Franz Josef Land	79°56'N	49°30'E	station	Mr. Leigh Smith	1881.10-1882.05	7	m$^+$	Nagurskaya	80°48'N	47°38'E	1961-90	Hann J. Einige. 1904. Ergebnisse der meteorologischen Beobachtungen auf Franz Josefs-Land zwischen 1872 und 1900. Aus: Meteorologische Zeitschrift, p. 547-555 [after:] Second Voyage of the 'Eira' to Franz-Josef Land [in:] Proceedings of the Royal Geographical Society and Monthly Record of Geography, vol. 1883, No. 4, pp. 204-228.
21		Cape Flora, Franz Josef Land	79°50'N	49°41'E	"Elmwood Hous" station, ship "Windward"	Jackson-Harmsworth Polar Expedition/ Albert B. Armitage (obs.)	1894.10-1896.10	25	every 2 hours	Nagurskaya	80°48'N	47°38'E	1961-90	Hann J. Einige. 1904. Ergebnisse der meteorologischen Beobachtungen auf Franz Josefs-Land zwischen 1872 und 1900. Aus: Meteorologische Zeitschrift, p. 547-555 [after:] Some results of meteorological observations made at Cape Flora, Franz Josef Land. By Mr. Strachan, Meteorological Office, London. [in:] Jackson, Frederick George. A thousand days in the Arctic. With a preface by Admiral Sir Francis Leopold McClintock. London and New York: Harper and Brothers, 1899. 2 vols.

22		Cape Flora Northbrook Island Franz Josef Land	79°57'N	50°05'E	"Elmwood Hous" station	W. J. Peters F. Long	1904.05.21-1905.07.30	14	8,12,20	Nagurskaya	80°48'N	47°38'E	1961-90	Krzysztof Rososiński. Stosunki termiczno-opadowe w Cape Flora na Ziemi Franciszka Józefa w okresie 21.05.1904 – 30.07.1905. praca mgr 2006 (in Polish) [after:] Fleming John A. (ed.). The Ziegler Polar expedition 1903-05. Scientific results obtained under the direction of William J. Peters.Washington: National Geographic Society, 1907. 630p., data: p. 369-487, Section C: Meteorological Observations and Compilations by W. J. Peters and J.A. Fleming.
23		Franz Josef Land	79°43'N 79°51'N	59°33'E 58°56'E	Tagetthoff	Karl Weyprecht	1872.08-1874.04	21	m*	O. Heisa	80°37'E	58°03'E	1961-90	Hann, J. Einige. 1904. Ergebnisse der meteorologischen Beobachtungen auf Franz Josefs-Land zwischen 1872 und 1900. Aus: Meteorologische Zeitschrift, p. 547-555 [after:] Wullerstorf-Urbair, Bernard von. Die meteorologischen Beobachtungen und die Ananlyse des Schiffcurses Wahrend der Polarexpedition unter Weyprecht und Payer, 1872-74. Kaiserliche Akademire der Wissenschafteb, Denkschriften. Mathematisch-naturwissenschaftlisch Classe, 1878. Band 35, p. 1-25.
24		Halvmaanesøy Spitsbergen	77°17'N	23°05'E	station		1906.10-1907.08	11	m*	Hopen	76°30'N	25°06'E	1961-90	Birkeland B. J. 1920. Spitsbergens klima. [in:] „Illustrert maanedsskrift for populear naturvidenskap". Naturen, 44, „Utgit av Bergens Museum".
25		Harmsworth Hous Cape Tegethoff Franz Josef Land	80°06'N	58°52'E	station Harmsworth Hous	Wellmann	1898.08-1899.07	12	every 2 hours	O. Heisa	80°37'E	58°03'E	1961-90	Hann, J. Einige. 1904. Ergebnisse der meteorologischen Beobachtungen auf Franz Josefs-Land zwischen 1872 und 1900. Aus: Meteorologische Zeitschrift, p. 547-555 [after:] Met. Obser. of the socond Wellmann Expedition by Evelyn B. Baldwin, Observer Weather Bereau, Report of the Chief of the Weather Bareau 1889-1900. Part VII, Washington 1901. p. 349-436
26		Hvalfiskpynt Spitsbergen	77°30'N	21°00'E	station		1904.11-1909.07#	29	m*	Hopen	76°30'N	25°06'E	1961-90	
27		Hvalfiskpynt Spitsbergen	77°30'N	20°55'E	station		1894.09-1895.06	10	m*	Hopen	76°30'N	25°06'E	1961-90	Birkeland B. J. 1920. Spitsbergens klima [in:] „Illustrert maanedsskrift for populear naturvidenskap". Naturen, 44, „Utgit av Bergens Museum".
28		Kap Lee, Spitsbergen	78°06'N	20°55'E	station		1904.09-1905.08	12	m*	Svalbard Lufthavn	78°18'N	15°30'E	1961-90	
29	Atlantic (northern)	Kapp Thordsen Spitsbergen	78°28'N	15°42'E	station	Prof. Nils Ekholm	1882.08.15-1883.08.23	13	h	Svalbard Lufthavn	78°18'N	15°30'E	1961-90	Ekholm N.G. 1890. Observations faites au Cap Thorsden, Spitzberg, par l'expédition suédoise. Stockholm: Kongl. Boktryckeriet. P.A. Norstedt & Söner. 2 vols.
30		Kapp Thordsen Spitsbergen	78°28'N	15°43'E	station		1872.10-1873.03	6	m*	Svalbard Lufthavn	78°18'N	15°30'E	1961-90	Birkeland B. J. 1920. Spitsbergens klima [in:] „Illustrert maanedsskrift for populear naturvidenskap". Naturen, 44, „Utgit av Bergens Museum".
31		Mosselbai Spitsbergen	79°53'N	16°04'E	station		1872.08-1873.09	14	m*	Ny Ålesund	78°56'N	11°56'E	1975-95	
32		Nansen's Winter Hous, Franz Josef Land	81°13'N	55°02'E	station	Fridthjof Nansen	1895.09-1896.07	11	m*	O. Rudolfa	81°48'E	57°58'E	1961-90	Hann, J. Einige. 1904. Ergebnisse der meteorologischen Beobachtungen auf Franz Josefs-Land zwischen 1872 und 1900. Aus: Meteorologische Zeitschrift, p. 547-555. Überwinterung von Fridthjof Nansen im nördlichen Teile von Frany Josefs-Land 1894-95. Die Temperatulmittel und Extreme sind migeteilt in Nansen's Werke In Nacht und Eis, Bd. II. Hr. Prof. Mohn, hatte, wie shon oben bemerkt, die Gü, mir alle Beobachtungsergebnise mitzuteilen.
33		Svalbard Lufthavn (homogenized data) Spitsbergen	78°18'N	15°30'E	station		1911.12-1920.12	109	m*	Svalbard Lufthavn	78°18'N	15°30'E	1961-90	Norwegian Meteorological Institute
34		Teplitz Bay, Rudolph Island, Franz Josef Land	81°47'N	57°56'E	station	Umberto Cagni	1899.08.11-1900.08.12	13	h	O. Rudolfa	81°48'E	57°58'E	1961-90	Tomasz Uzarski. Stosunki termiczne i nefologiczne w Teplitz Bay (Wyspa Rudolfa, Ziemia Franciszka Józefa) w okresach 11.08 1899 – 12.08 1900 i 1.09 1903 – 30.04 1904. praca mgr 2006 (in Polish) [after:] Umberto Cagni and Luigi Amedeo di Savoia. Osservazioni Scientifiche eseguite durante La Spedizone Polare di S.A.R. Luigi Amedeo di Savoia, Duca degli Abruzzi, 1899-1900 (Italian). Milano: Ulrico Hoepli, 1903. 723p., Data: p. 223-415, Relazione sulle osservazioni meteorologiche falta dal Prof. Giovanni Battista Rizzo w: Osservazioni scientifiche eseguite durante La Spedizone Polare di S.A.R. Luigi Amedeo di Savoia, Duca Degli Abruzzi, 1899-1900
35		Teplitz Bay, Rudolph Island, Franz Josef Land	81°47'N	57°56'E	station	W.J. Peters F. Long	1903.09.01-1904.04.30	8	h	O. Rudolfa	81°48'E	57°58'E	1961-90	Tomasz Uzarski. Stosunki termiczne i nefologiczne w Teplitz Bay (Wyspa Rudolfa, Ziemia Franciszka Józefa) w okresach 11.08 1899 – 12.08 1900 i 1.09 1903 – 30.04 1904. praca mgr 2006 (in Polish) [after:] Fleming, John A. (ed.). The Ziegler Polar expedition 1903-05. Scientific results obtained under the direction of William J. Peters, Washington: National Geographic Society, 1907. data: p. 369-487, Section C: Meteorological Observations and Compilations by W. J. Peters and J.A. Fleming.

36	Atlantic (northern)	Treurenberg Spitsbergen	79°55'N	16°51'E	station	Jaderin Edvard	1899.08.01-1900.0 8.15	13	h	Ny Ålesund	78°56'N	11°56'E	1975-95	Jacek Dzierżawski Stosunki termiczno-wilgotnościowe w Zatoce Treurenberg i na Masywie Olimp (NE Spitsbergen) w okresie 1.08.1899 – 15.08.1900. praca mgr 2004 (in Polish) [after:] Westman J. 1904. Physique terrestre. Meteorologie. Histoire naturelle. 8ieme section. Meterologie. A. Observations a la station d'hivernage. Observations meterologiques faites en 1889-1901 a la Baie de Treurenberg, Spitzberg [in:] Jaderin, Edvard, leader. Missions scientifiques pour la mesure d'un arc de meridien au Spitzberg enterprises en 1889-1900 sous les auspices des gouvernements russe et suedois: Mission suedoise. T.2. Physique terrestre, meterologie, historie naturelle. Sect. 7-8. Stockholm: Aktiebolaget Centraltryckeriet, 2 (8A): ss. 218
37		Waigatz	70°24'N	58°48'E	station		1914.08-1920.12[a]	62	m*	Bolvanskiy Nos	70°27'E	59°04'E	1961-90	http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=222230220010&data_set=1&num_neighbors=1
38		Zieglerøy Spitsbergen	77°20'N	22°02'E	station		1904.10-1905.06	9	m*	Hopen	76°30'N	25°06'E	1961-90	Birkeland B. J. 1920. Spitsbergens klima [in:] „Illustrert maanedsskrift for populear naturvidenskap". Naturen, 44, „Utgit av Bergens Museum".
39	Atlantic (western)	Angmagksalik Greenland	65°37'N	37°16'W	station		1895.01-1920.12	312	m*	Angmag-ssalik	65°37'N	37°16'W	1961-90	World Weather Records
40		Angmagksalik Greenland	65°37'N	37°16'W	station		1884.10-1885.05	8	every 2 hours	Angmag-ssalik	65°37'N	37°16'W	1961-90	L'Institut Météorologique de Danemark.1889-1893. Exploration Internationale des Régions Arctiques, 1882-1883. Expédition danoise. Observations faits à Godthaab. København: Chez G.E.C. Gad, Librarie de L'Université. 2 vols.
41		Danmarks-Havn Greenland	76°46'W	18°41'W	station		1906.08.17-1908.0 5.31	21	h	Danmarks-havn	76°42' N	18°54'W	1961-90	hourly data: Brand W., 1912, Stündliche Werte des Luftdrucks und der Temperatur am Danmarks-Havn, Meddelelser om Grønland, 14(5), København 1914, 357-445. fixed data: Wegener A. 1911. Meteorologische Terminbeobachtungen am Danmarks-Havn, Meddelelser om Grønland, 14(4), København 1914, 125-355.
42		Pustervig, Greenland	76°57'N	21°01'W	station		1908.10-1909.05[a]	7	h	Danmarks-havn	76°42' N	18°54'W	1961-90	Brand W., Wegener A., 1912, Meteorologische Beobachtungen der Station Pustervig [in:] Meddelelser om Grønland, 42(6), København 1914, 447-562.
43	Atlantic (eastern)	Dudinka	69°24'N	86°12'E	station		1906.08-1920.12[a]	171	m*	Dudinka	69°24'N	86°12'E	1961-90	http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=222230740000&data_set=1&num_neighbors=1
44		Kamenka Bay (Felsenbei), Novaya Zemlya	70°37'N	57°31'E	station	Pakhtusov	1832.08.23-1833.0 7.23	12	every 2 hours	Bolvanskiy Nos	70°27'E	59°04'E	1961-90	Jaapjan Zeeberg. 2001. Climate and glacial history of the Novaya Zemla Archipelago, Russian Arctic with notes on the region's history of explorations, Rozenberg Publisher [after:] Wild G. 1882. O temperatur vozduha v Rossiyskoy Imperiy. Tipografiya Imperatorskoy Akadamiy Nauk, Sanktpetersburg
45		Kara Sea	drift		"Varna"	Dr Maurits Snellen	1882.08.01-1883.0 8.25	12	every 4 h, h	Mys Kharasavey	71°08 N	66°45'E	1961-87	Snellen M., Ekama H. 1910. Rapport sur l'Expédition Néerlandaise qui a hiverné dans la Mer de Kara en 1882/83. Utrecht: J. Van Boekhoven.
46		Kara Sea	drift		"Dijmphna"		1882.08.04-1883.1 0.30	14	every 4 h, h	Mys Kharasavey	71°08 N	66°45'E	1961-87	
47		Matochkin Shar Novaya Zemlya	73°19'N	56°00'E	station	Pakhtusov, Zivolka	1834.09.08-1835.0 9.02	12	every 2 hours	Bolvanskiy Nos	70°27'E	59°04'E	1961-90	Jaapjan Zeeberg. 2001. Climate and glacial history of the Novaya Zemla Archipelago, Russian Arctic with notes on the region's history of explorations, Rozenberg Publisher [after:] Wild G. 1882. O temperatur vozduha v Rossiyskoy Imperiy. Tipografiya Imperatorskoy Akadamiy Nauk, Sanktpetersburg
48		Ostrov Dikson	73°30'N	8°24'E			1916.09-1920.08	48	m*	Ostrov Dickson	73°30'N	8°24'E	1961-90	http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=222206740006&data_set=1&num_neighbors=1
49	Siberian	Cape Cheluskin	77°32'N	105°40'E	"Maud"	H. U. Sverdrup	1918.09-1919.09	11	8,14,20	Mys Cheluskin	77°43'N	104°18'E	1961-90	Sverdrup H. U. 1930. Meteorology, Part II, Tables [in:] The Norwegian North Polar Expedition with the "Maud" 1918-1925. Scientific results, Vol. III, Part II. Published by: Geofysisk Institutt, Bergen, in co-operation with other institutions. Bergen, A.S. John Griegs Boktrykkeri.
50		Ayon Island	69°52'N	167°52'E	"Maud"	H. U. Sverdrup	1919.09-1920.06	9	8,14,20	Ayon	69°56'N	167°52'E	1961-90	
51		Nijni-Kolymsk	69°N	159°E	station		1820~1824 (exact period is unknown)	10	m*	Bukhta Ambarchik	69°38'N	160°18'E	1961-90	F. v. Wrangel. 1839. Reise längst der Nordküste von Siberien und auf dem Eismeere in den Jahren 1820-24. Berlin [after:] Hildebradsson, H. Hildebrand. Observations Meteorogiques faites par l'expedition de la Vega du Cap Nord a Yokohama par le Detroit Behring. Stockholm, 1882? Extrait des 'Vega-expeditionesns vetenskapliga iakttagelsar', vol. 1. Stockholm 1882. p. 578-579
52		Sagastyr	73°22'N	124°05'E	station	Lt. N. Jourgens	1882.09.01-1884.0 6.30	22	h	Sagyllah Ary O. Dunay	73°09'N 73°56'N	128°54'E 124°30'E	1962-90 1961-88	Lenz R. (ed.). 1886. Beobachtungen der Russischen Polarstation an der Lenamündung. Expedition der Kaiserl. Russischen Geographischen Gesellschaft. 3 vols. in 1. II. Theil. Meteorologische Beobachtungen bearbeitet von A. Eigner
53		Oustiansk	71°N	135°N	station		1820~24 (exact period is unknown)	11	m*	Kazachie	70°45'N	136°13'E	1961-90	F. v. Wrangel. 1839. Reise längst der Nordküste von Siberien und auf dem Eismeere in den Jahren 1820-24. Berlin After: Hildebradsson, H. Hildebrand. Observations Meteorogiques faites par l'expedition de la Vega du Cap Nord a Yokohama par le Detroit Behring. Stockholm, 1882? Extrait des 'Vega-expeditionesns vetenskapliga iakttagelsar', vol. 1. Stockholm 1882. s. 578-579

54	Pacific	Anadyr	64°48'N	177°36'E	station		1898.09-1920.12#	215	m+	Modern data (1961-1990) for historical sites have been interpolated (kriging method) based on temperature data taken from adjacent meteorological stations.	http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=222255630007&data_set=1&num_neighbors=1
55		Barrow	71°21'N	156°17'W	station	Commander Rochfort Maguire	1852.09-1854.07	22	h		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
56		Barrow	71°17'N	156°40'W	station	Lt. P. Henry Ray	1881.11.01-1883.08.27	24	h		Ray P.H. 1885. Report of the International Polar Expedition to Point Barrow, Alaska. Washington, D.C., Government Printing Office.
57		Barrow	71°23'N	156°17'W	station		1901.09-1904.04	32	m+		World Weather Records 1934
58		Barrow	71°23N	156°17'W	station		1910.09-1911.12	16	m+		
59		Barrow	71°23'N	156°17'W	station		1915.12-1920.12#	19	m+		
60		Chamiso Island, Emma Harbour	66°13'N	161°46'W	station	T.E.L. Moore	1849.08-1850.07	12	h		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
61		Kotzebue	66°52'N	162°38'W	station		1897.09-1904.11#	67	m+		http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=425701330000&data_set=1&num_neighbors=1
62		Mys Uelen	66°12'N	169°48'W	station		1918.10-11	2	m+		http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=222253990002&data_set=1&num_neighbors=1
63		Nome	64°30'N	165°26'W	station		1906.12-1920.12#	168	m+		http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=425702000000&data_set=1&num_neighbors=1
64		Pitlekaie, Tchukotka Peninsula	67°05'N	173°23'W	station	Nordenskiold	1878.10.01-1879.07.17	10	every 4 h, h		Hildebradsson, H. Hildebrand. 1882?. Observations Meteorogiques faites par l'expedition de la Vega du Cap Nord a Yokohama par le Detroit Behring. Stockholm. [after:] Nordenskiold, Nils Adolf Erik, ed 'Vega-expeditionesns vetenskapliga iakttagelsar', vol. 1. Stockholm 1882. p. 578-579. Stockholm: F. & G. Beijers forlag, 1882-87. 5 vols.
65		Port Clarence	65°05'N	165°30'W	station	T.E.L. Moore	1850.09-1851.07	33	h		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
66		Port Providence	64°26'N	173°00'W	station	T.E.L. Moore	1848.10-1849.06	9	h		
67	Canadian (southern)	Churchill	58°44'N	94°04'W	station		1884.10-1890.12#	74	m+		http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=403719130006&data_set=1&num_neighbors=1
68		Churchill	58°44'N	94°04'W	station		1895.01-1910.12#	143	m+		
69		Fort Hope, Repulse Bay	66°32'N	86°56'W	station	Dr. John Rae	1846.09-1847.07	11	6,12,18		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
70		Fort Hope, Repulse Bay	66°32'N	86°56'W	station	Dr. John Rae	1853.09-1854.07	11	8,14,20		
71		Hudson Strait	drift		"Terror"	Sir George Back	1836.08-1837.07	12	every 2 hours		
72		Kingua Fjord Baffin Island	66°36'N	67°19'W	station	Dr W. Giese	1882.10.16-1883.10.10	13	h		Neumayer G., Börgen. 1886. Die Beobachtungs-Ergebnisse der Deutschen Stationen. Berlin: Verlag von A. Asher & Co. 2 vols. Band I. Kingua-Fjord und die meteorologischen Stationen II. Ordnung in Labrador: Hebron, Okak, Nain, Zoar, Hoffenthal, Rama, sowie die magnetischen Observationen in Breslau und Göttingen.
73		Winter Island	66°11'N	83°10'W	"Hecla" "Fury"	Sir W.E. Parry	1821.08-1822.07	12	every 2 hours		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
74		York Factory	57°00'N	92°26'W	station		1814.10-1816.06#	12	m+		Blodet L. 1875. Climatology of the United States and of the Temperate Latitude of the North American Continent, J. B. Lippinott, Philadelphia.
75		York Factory	57°00'N	92°26'W	station		1821.11-1832.05#	13	m+		
76		York Factory	57°00'N	92°26'W	station		1838.01-1852.08#	144	m+		ftp://ftp.ncdc.noaa.gov/pub/data/ghcn/v2
77		York Factory	57°00'N	92°26'W	station		1874.10-1883.05#	99	m+		http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=403719120031&data_set=1&num_neighbors=1
78		York Factory	57°00'N	92°26'W	station		1885.10-1889.07#	42	m+		
79		York Factory	57°00'N	92°26'W	station		1898.09-1910.05#	135	m+		
80	Canadian (northern)	Camden Bay	70°08'N	145°29'W	"Enterpise"	Sir Richard Collison	1853.09.15-1854.07.31	11	every 4 hours		Strachan, R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888)
81		Rice Strait	78°46'N	74°57'W	"Fram"	Otto Sverdrup	1898.10.01-1899.07.24	10	every 2 hours		Mohn H. 1907. Meteorology [in:] Report of the second Arctic Expedition in the "Fram" 1898-1904. No. 4. Videnskabsselskabet i Kristiana.

82	Canadian (northern)	Assistance Bay	74°40'N	94°16'W	"Sophia"	Alex Stewart	1850.09-1851.08	12	4,12,20	Modern data (1961-1990) for historical sites have been interpolated (kriging method) based on temperature data taken from adjacent meteorological stations.	Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
83		Batty Bay	73°12'N	91°10'W	"Prince Albert"	W. Kennedy	1851.09-1852.04	8	8,12,16, 20		
84		Beechey Island	74°43'N	91°54'W	"North Star"	J.W.S. Pullen	1852.08.09-1854.0 8.27	25	h		
85		Cambridge Bay	69°03'N	105°12'W	"Enterpise"	Sir Richard Collison	1852.09.23-1853.1 4.08	12	every 4 hours		
86		Dealy Island	74°56'N	108°49'W	"Resolute", "Intrepid"	Sir Henry Kellett, F.L. McClintock	1852.09-1853.07, 1852.11-1853.07	12	every 2 hours		
87		Discovery Bay	81°44'N	65°03'W	"Discovery"	Sir George S. Nares	1875.08-1876.07	12	h		Results Derived from the Arctic Expedition, 1875-1876, I.- Physical Observations by Captain sir George Nares, R.N., and Captain Feilden, &c. [in:] Accounts and Papers: 39 (8) Arctic Expedition, Session 17 January-16 August1878, Vol. LII., London, Printed by G. E. Eyre and M. Sptiswoode, Printers to the Queen's Most Exellent Majesty. For Her Majesty's stationery Office. 1878. http://www.umanitoba.ca/libraries/units/archives/collections/subject/arcticstudies/arcticbb/viewbb.php?t=1878&p=i1
88		Felix Harbour Gulf of Boothia	69°59'N	92°01'W	"Victory"	Sir John Ross	1829.09-1830.08	10	h		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
89		Floeberg Beach	82°27'N	61°22'W	"Alert"	Sir George S. Nares	1875.08-1876.07	12	h		Results Derived from the Arctic Expedition, 1875-1876, I.- Physical Observations by Captain sir George Nares, R.N., and Captain Feilden, &c. [in:], Accounts and Papers: 39 (8) Arctic Expedition, Session 17 January-16 August 1878, Vol. LII., London, Printed by G. E. Eyre and M. Sptiswoode, Printers to the Queen's Most Exellent Majesty. For Her Majesty's stationery Office. 1878. http://www.umanitoba.ca/libraries/units/archives/collections/subject/arcticstudies/arcticbb/viewbb.php?t=1878&p=i1
90		Fort Conger, Lady Franklin Bay, Ellesmere Island	81°44'N	64°45'W	station	Adolphus W. Greely	1881.08.05-1883.0 8.08	24	h		Greely A.W. 1886. Report on the Proceedings of the United States expedition to Lady Franklin Bay, Grinnell Land. Washington, D.C.: Government Printing Office. 2 vols.
91		Gaasefjord	76°49'N	88°40'W	"Fram"	Otto Sverdrup	1900.10.01-1902.0 7.20	22	every 2 hours		Mohn H. 1907. Meteorology [in:] Report of the second Arctic Expedition in the "Fram" 1898-1904. No. 4. Videnskabsselskabet i Kristiana.
92		Griffith Island	74°34'N	95°20'W	"Resolute"	Sir Horatio T. Austin	1850.09.12-1851.0 8.10	12	h		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
93		Havnefjord	76°29'N	84°04'W	"Fram"	Otto Sverdrup	1899.11.01-1900.0 7.31	9	every 2 hours		Mohn H. 1907. Meteorology [in:] Report of the second Arctic Expedition in the "Fram" 1898-1904. No. 4. Videnskabsselskabet i Kristiana.
94		Igloolik	69°21'N	81°53'W	"Fury"	Sir W.E. Parry	1822.08-1823.07	12	every 2 hours		Strachan, R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
95		Melville Sound	74°42'N	101°22'W	"Resolute", "Intrepid"	Sir Henry Kellett, Sir F.L. McClintock	1853.09-1854.05	9	every 2 hours		
96		Mercy Bay	74°06'N	117°55'W	"Investigator"	Sir Robert J. McClure	1851.08-1853.07	20	every 2 hours		
97		Mundy Harbour Gulf of Boothia	70°18'N	91°35'W	"Victory"	Sir John Ross	1831.09-1832.05	8	h		
98		Northumberland Sound	76°52'N	97°00'W	"Assistance"	Sir Edward Belcher	1852.09-1853.08	12	every 2 hours		
99		Polaris Bay Greenland	81°36'N	62°15'W	station	C.F. Hall	1871.12.01-1872.0 8.31	9	h		Bessels E. 1876. Scientific results of the United States Arctic expedition, steamer Polaris, C.F. Hall commanding. Vol. 1. Physical observations. Washington, DC: Government Printing Office.
100		Polaris House Greenland	78°18'N	70°15'W	station	C.F. Hall	1872.11.01-1873.0 5.31	7	h		
101		Port Bowen	73°13'N	88°55'W	"Hecla" "Fury"	Sir W.E. Parry, H.P. Hoppner	1824.09-1825.08	12	every 2 hours		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
102		Port Kennedy	72°01'N	94°14'W	"Fox"	Sir F.L. McClintock	1858.09-1859.08	12	every 2 hours, every 4 hours		

103	Canadian (northern)	Port Leopold	73°50'N	90°12'W	"Enterprise", "Investigator"	Sir James Clark Ross, E.J. Bird	1848.09-1849.08	12	every 2 hours	Modern data (1961-1990) for historical sites have been interpolated (kriging method) based on temperature data taken from adjacent meteorological stations.	Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
104		Princess Royal Islands	72°47'N	117°35'W	"Investigator"	Sir Robert J. McClure	1850.09-1851.08	12	every 4 hours		
105		Victoria Harbour Gulf of Boothia	70°08'N	91°35'W	"Victory"	Sir John Ross	1830.09-1831.08	12	h		
106		Walker Bay	71°35'N	117°39'W	"Enterpise"	Sir Richard Collison	1851.09-1852.08	12	h		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
107		Wellington Channel	75°31'N	92°10'W	"Assistance"	Sir Edward Belcher	1853.09-1854.08	12	every 2 hours		
108		Winter Harbour Melville Island	74°47'N	110°48'W	"Hecla, "Griper"	Sir W.E. Parry	1819.09-1820.08	12	every 2 hours		
109		Wolstenholm Sound	76°34'N	68°45'W	"North Star"	James Saunders	1849.08-1850.07	12	every 4 hours		
110	Baffin Bay	Baffin Bay	drift		"Fox"	Sir F.L. McClintock	1857-1858	13	every 4 hours		Strachan R. Contributions to Our Knowledge of the Meteorology of the Arctic Regions. Authority of the Meteorology: London; Part I (1879), Part II (1880), Part III (1882), Part IV (1885), Part V (1888).
111		Hebron, Labrador	58°12'N	62°21'W	station		1882.09.12-1918.07#	366	8,14,20 and m+		Neumayer G., Börgen. 1886. Die Beobachtungs-Ergebnisse der Deutschen Stationen. Berlin: Verlag von A. Asher & Co. 2 vols. Band I. Kingua-Fjord und die meteorologischen Stationen II. Ordnung in Labrador: Hebron, Okak, Nain, Zoar, Hoffenthal, Rama, sowie die magnetischen Observationen in Breslau und Göttingen and http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=403719020020&data_set=1&num_neighbors=1
112		Hoffenthal, Labrador	55°2'N	60°12'W	station		1882.09.01-1883.08.31	12	8,14,20		Neumayer G., Börgen. 1886. Die Beobachtungs-Ergebnisse der Deutschen Stationen. Berlin: Verlag von A. Asher & Co. 2 vols. Band I. Kingua-Fjord und die meteorologischen Stationen II. Ordnung in Labrador: Hebron, Okak, Nain, Zoar, Hoffenthal, Rama, sowie die magnetischen Observationen in Breslau und Göttingen.
113		Nain, Labrador	56°33'N	61°41'W	station		1882.09.01-1912.12#	335	8,14,20 and m+		Neumayer G., Börgen. 1886. Die Beobachtungs-Ergebnisse der Deutschen Stationen. Berlin: Verlag von A. Asher & Co. 2 vols. Band I. Kingua-Fjord und die meteorologischen Stationen II. Ordnung in Labrador: Hebron, Okak, Nain, Zoar, Hoffenthal, Rama, sowie die magnetischen Observationen in Breslau und Göttingen and http://data.giss.nasa.gov/cgi-bin/gistemp/gistemp_station.py?id=403719020010&data_set=1&num_neighbors=1
114		Okak, Labrador	57°34'N	61°56'W	station		1882.09.18-1883.09.14	13	8,14,20		Neumayer G., Börgen. 1886. Die Beobachtungs-Ergebnisse der Deutschen Stationen. Berlin: Verlag von A. Asher & Co. 2 vols. Band I. Kingua-Fjord und die meteorologischen Stationen II. Ordnung in Labrador: Hebron, Okak, Nain, Zoar, Hoffenthal, Rama, sowie die magnetischen Observationen in Breslau und Göttingen.
115		Rama, Labrador	58°33'N	63°15'W	station		1882.09.07-1883.08.29	12	8,14,20		
116		SW Greenland					1801-1920#	1272	m+		B. M. Vinther, K. K. Andersen, P. D. Jones, K. R. Briffa, and J. Cappelen, 2006, Extending Greenland temperature records into the late eighteenth century, Journal of Geophysical Research, Vol. 111, D11105
117		Zoar, Labrador	56°7'N	61°22'W	station		1882.09.01-1883.08.31	12	8,14,20		Neumayer G., Börgen. 1886. Die Beobachtungs-Ergebnisse der Deutschen Stationen. Berlin: Verlag von A. Asher & Co. 2 vols. Band I. Kingua-Fjord und die meteorologischen Stationen II. Ordnung in Labrador: Hebron, Okak, Nain, Zoar, Hoffenthal, Rama, sowie die magnetischen Observationen in Breslau und Göttingen.
118	Interior Arctic	"Fram"	drift		"Fram"	Fridthjof Nansen	1893.09.20-1896.08.16	32	h		Arctic Climatology Project. 2000. Environmental Working Group Arctic Meteorology and Climate Atlas. Edited by F. Fetterer and V. Radionov. Boulder, CO: National Snow and Ice Data Center. CD-ROM

* after Treshnikov (ed.) 1985
\# - with gaps
\+ - resolution of available data (the resolution of observations is unkown)

Resolution of observations:
h - hourly
d - daily
m - monthly

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