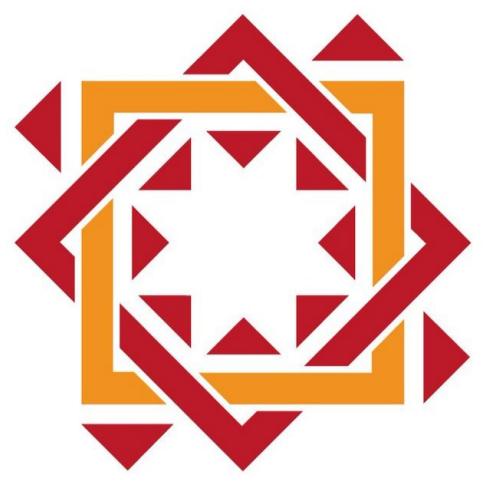
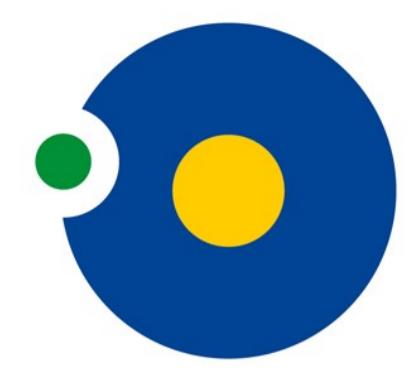


Air temperature in Novaya Zemlya Archipelago and Vaygach Island from 1832 to 1920 in the light of early instrumental data



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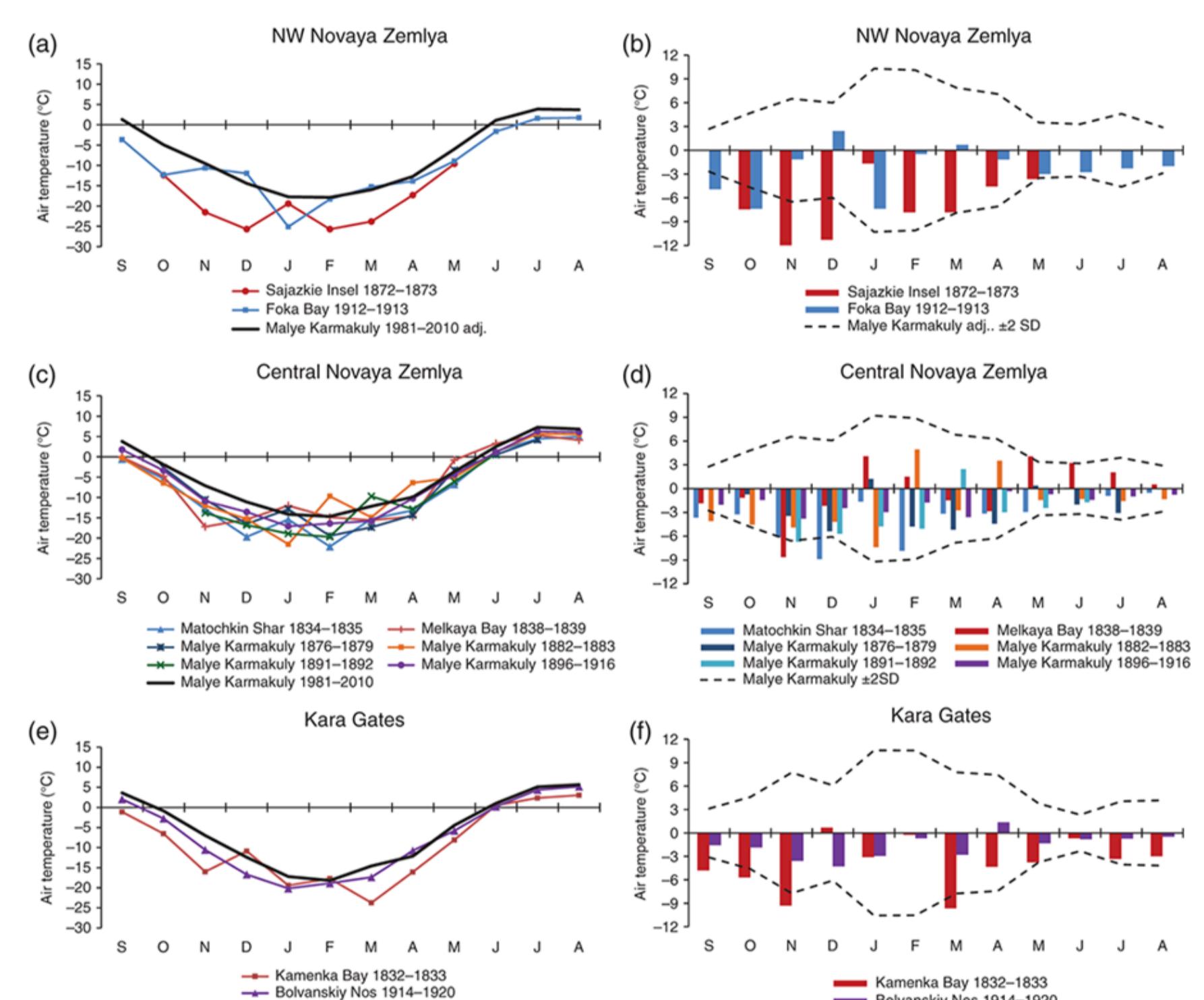
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ABSTRACT

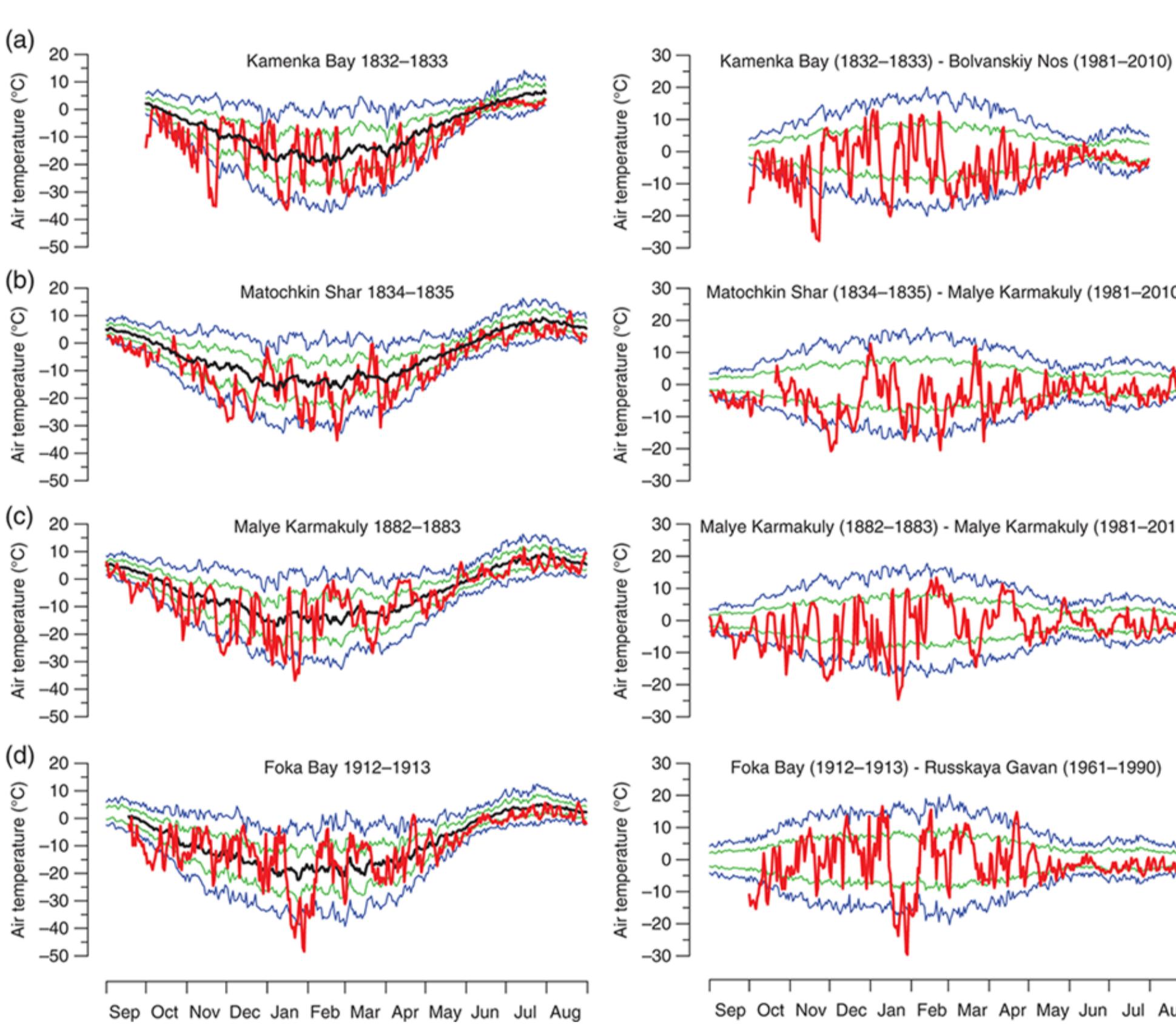
In this article, the results of an investigation into the air temperature conditions in Novaya Zemlya Archipelago and Vaygach Island (NZR) from 1832 to 1920, on the basis of all available early instrumental data gathered during exploratory and scientific expeditions, are presented. Traditional analysis based on mean monthly data was supplemented by an approach less popular in the scientific literature, i.e. the additional use of daily data. Moreover, the daily data used were not limited only to mean daily air temperature, but include also maximum daily temperature, minimum daily temperature and diurnal temperature range. Such rich sets of data allowed for more comprehensive and precise recognition of air temperature conditions in the NZR. Based on these kinds of daily data, it was also possible to calculate the number of so-called 'characteristic days' (i.e. the number of days with temperatures exceeding specified thresholds) and day-to-day temperature variability and, for the first time, to determine different characteristics of thermal seasons (duration, onset and end dates) according to Baranowski's (1968) proposition. The results were compared with contemporary temperature conditions (1981–2010) to estimate the range of their changes between historical and present times.

Analysis reveals that in 1832–1920, the NZR was markedly colder than today in all seasons. Coldest was autumn (on average by ca 5°C), and least – summer (by 1.6°C). Mean annual air temperature was colder than today by about 3°C. The majority of mean monthly air temperatures in historical times lie within two standard deviations from the modern mean. This means that values of air temperature in historical times lie within the range of contemporary air temperature variability. Different air temperature characteristics calculated on the basis of daily data for the NZR for historical/contemporary periods also confirm the occurrence of climate warming between the studied periods.

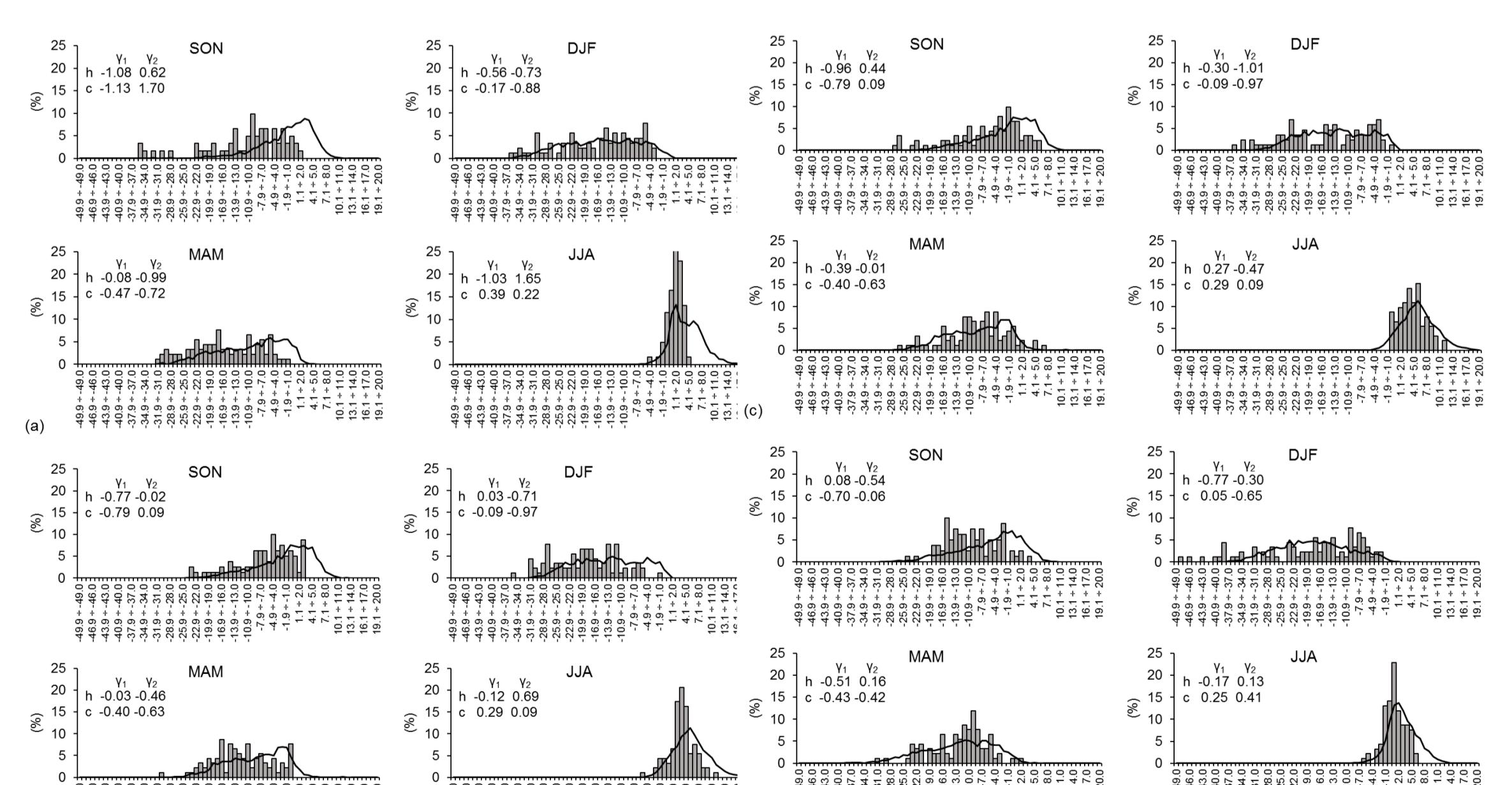
RESULTS



Annual courses of historical and modern air temperatures based on monthly means (left panels) and differences between them (right panels) in NZR. SD has been calculated on the basis of present data (1981–2010). Note: adj. – spatially adjusted to Foka Bay location.



Annual courses of MDAT in historical (red) and modern (multiyear 1981–2010 daily mean, black) sites (left panels) and their differences (red, right panels). Green and blue lines indicate ± 1 and ± 2 SD, respectively. SDs have been calculated on the basis of present data (1981–2010) taken from nearby stations. Note that for Foka Bay, due to lack of present daily data, a different reference period (1961–1990) was used.



Seasonal (September–November, December–February, etc.) relative frequencies of occurrence (in %) of MDAT in historical (bars) and modern (lines) sites located near (a) Kamenka Bay 1832–1833 and Bolvanskiy Nos 1981–2010, (b) Matochkin Shar 1834–1835 and Maty Karmakuly 1981–2010, (c) Maty Karmakuly 1882–1883 and Maty Karmakuly 1981–2010 and (d) Foka Bay 1912–1913 and Russkaya Gavan 1961–1990. Values of skewness (Y_1) and kurtosis (Y_2) for historical (h) and contemporary (c) times are also shown.

Annual courses of relative frequency of occurrence (in %) of characteristic days in NZR in historical times.

Seasonal means of air temperature in NZR in the period 1832–1920 and their differences between the historical and contemporary periods (1981–2010).

Region	SON	DJF	MAM	JJA	SEP-AUG	Region	SON	DJF	MAM	JJA	SEP-AUG
Air temperature means (°C)						Differences of air temperature (°C) from the ref. mean 1981–2010					
NW Novaya Zemlya (1872–73, 1912–13)	-10.7	-21.0	-14.8	0.6	-11.5	NW Novaya Zemlya (1872–73, 1912–13)	-6.3	-4.4	-3.3	-2.3	-4.1
Central Novaya Zemlya (1834–35, 1838–39, 1876–79, 1882–83, 1891–92, 1896–1916)	-5.7	-16.5	-10.4	3.9	-7.2	Central Novaya Zemlya (1834–35, 1838–39, 1876–79, 1882–83, 1891–92, 1896–1916)	-4.0	-3.2	-1.7	-0.9	-2.5
Kara Gates (1832–33, 1914–20)	-5.8	-17.3	-13.6	2.6	-8.5	Kara Gates (1832–33, 1914–20)	-4.5	-1.8	-3.4	-1.5	-2.8
NZR (1832–1920)	-7.4	-18.3	-12.9	2.4	-9.1	NZR (1832–1920)	-4.9	-3.1	-2.8	-1.6	-3.1

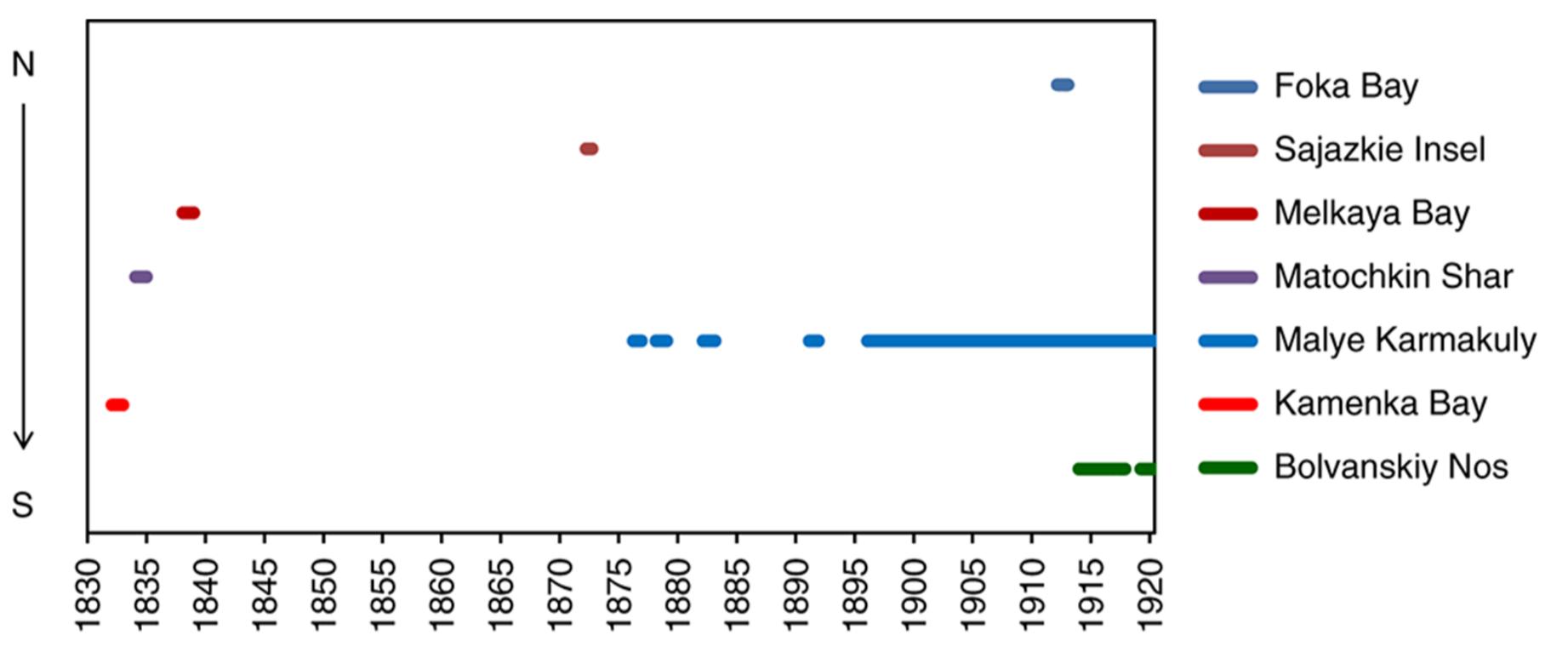
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AREA

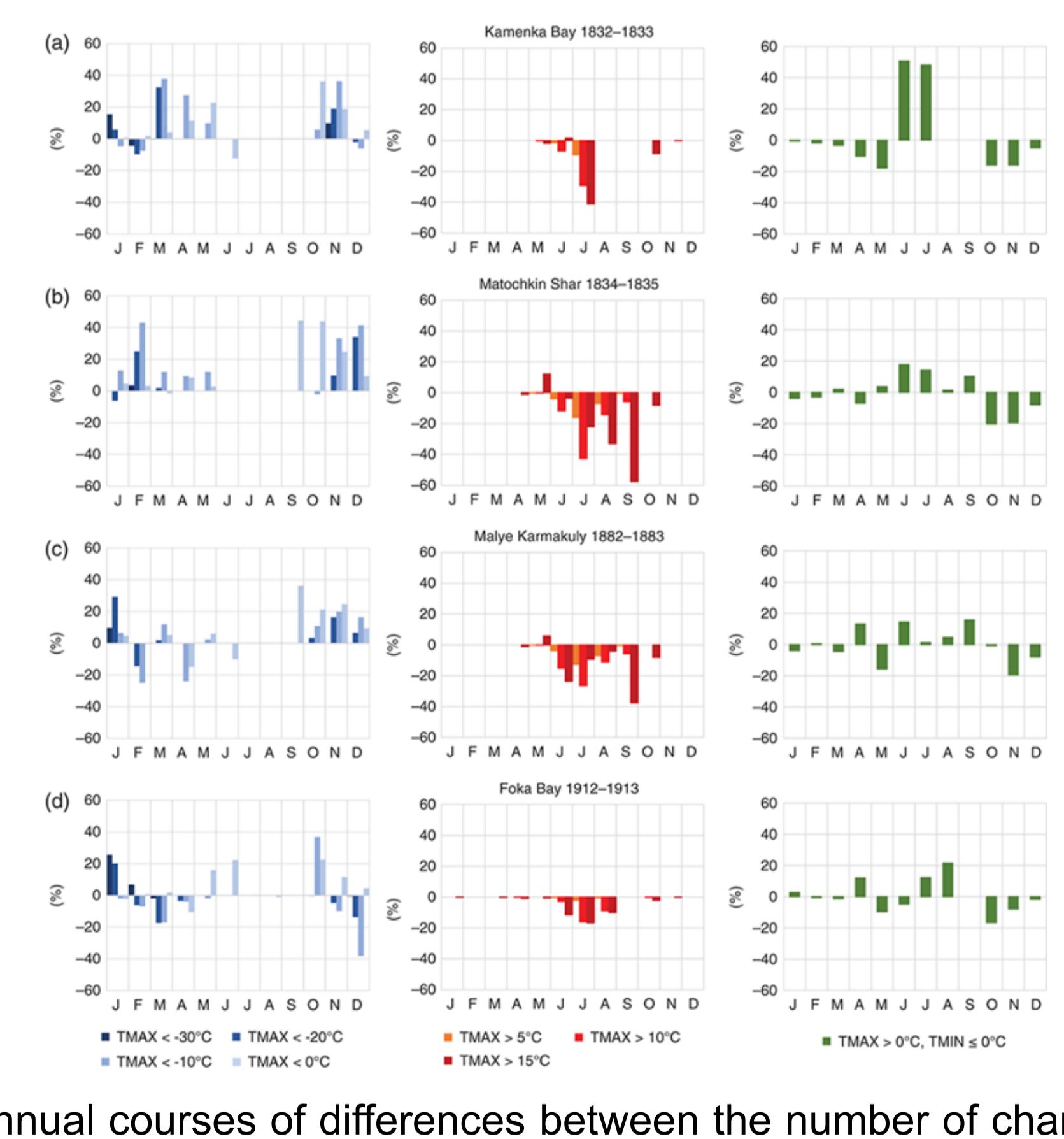


Location of historical (dots) and modern (triangles) land meteorological stations in NZR.

DATA



Temporal distribution of the air temperature observations from meteorological land stations used in the study of the NZR from 1832 to 1920.



Annual courses of differences between the number of characteristic days (in %) in NZR in historical times and modern period (1981–2010). Note that for Foka Bay, due to lack of present daily data, a different reference period (1961–1990) was used. The differences were obtained by subtracting the modern values from the historical ones.