

Air temperature in Franz Josef Land Archipelago from 1899 to 1940

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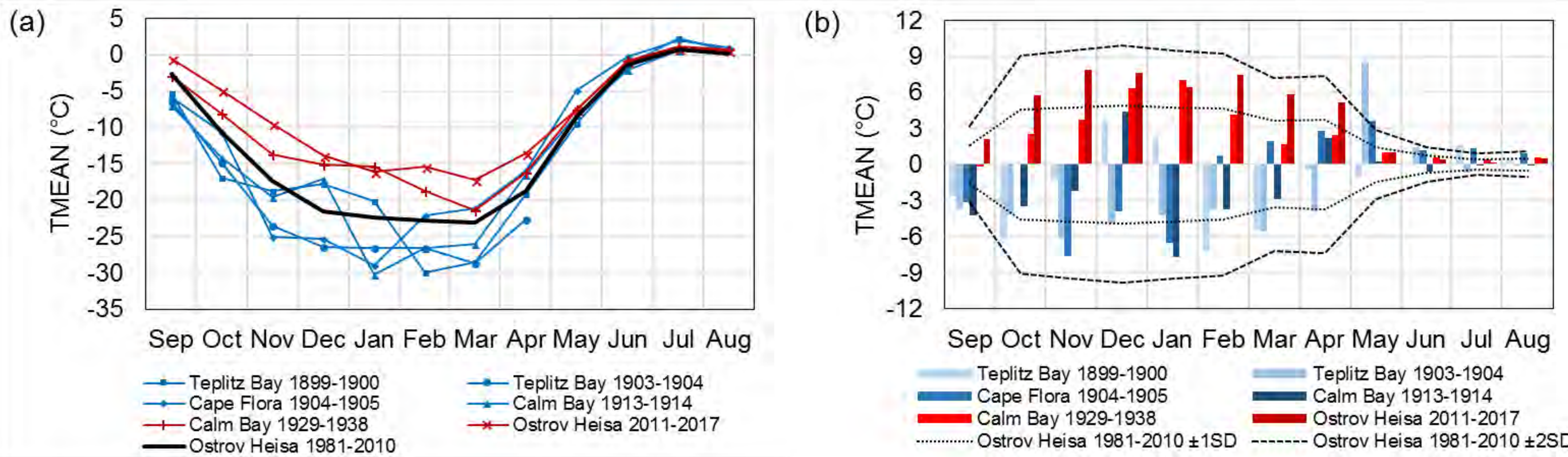
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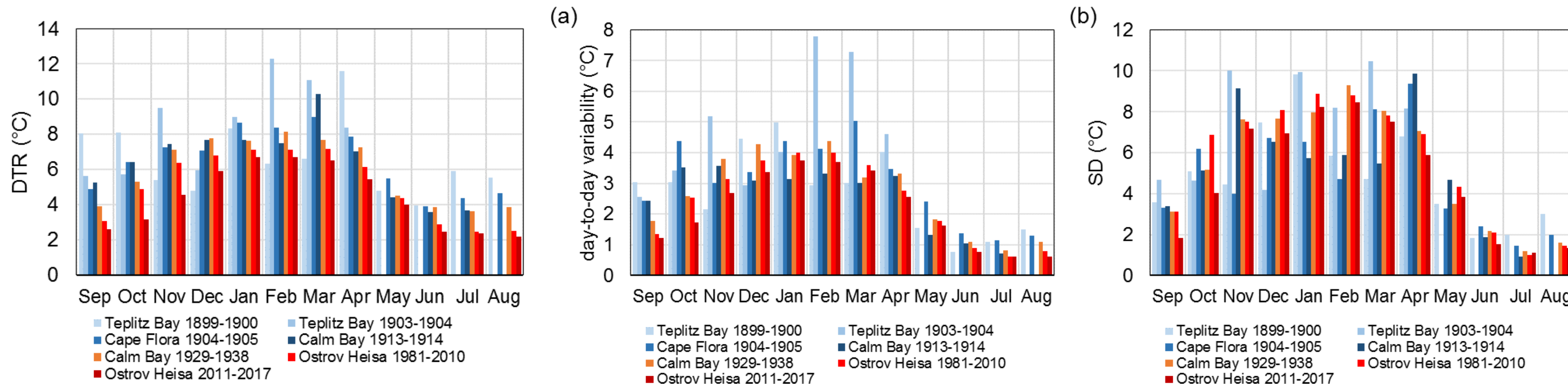
INTRODUCTION

The results of an investigation into the air temperature conditions in Franz Josef Land Archipelago (FJL) from 1899 to 1940, 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 (MAX, MEAN, MIN, DTR). Such rich sets of data allowed for more comprehensive and precise recognition of air temperature conditions in FJL. 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 diurnal temperature range. The results were compared with contemporary temperature conditions (climate normal 1981–2010) to estimate the range of their changes between historical and present times.

RESULTS

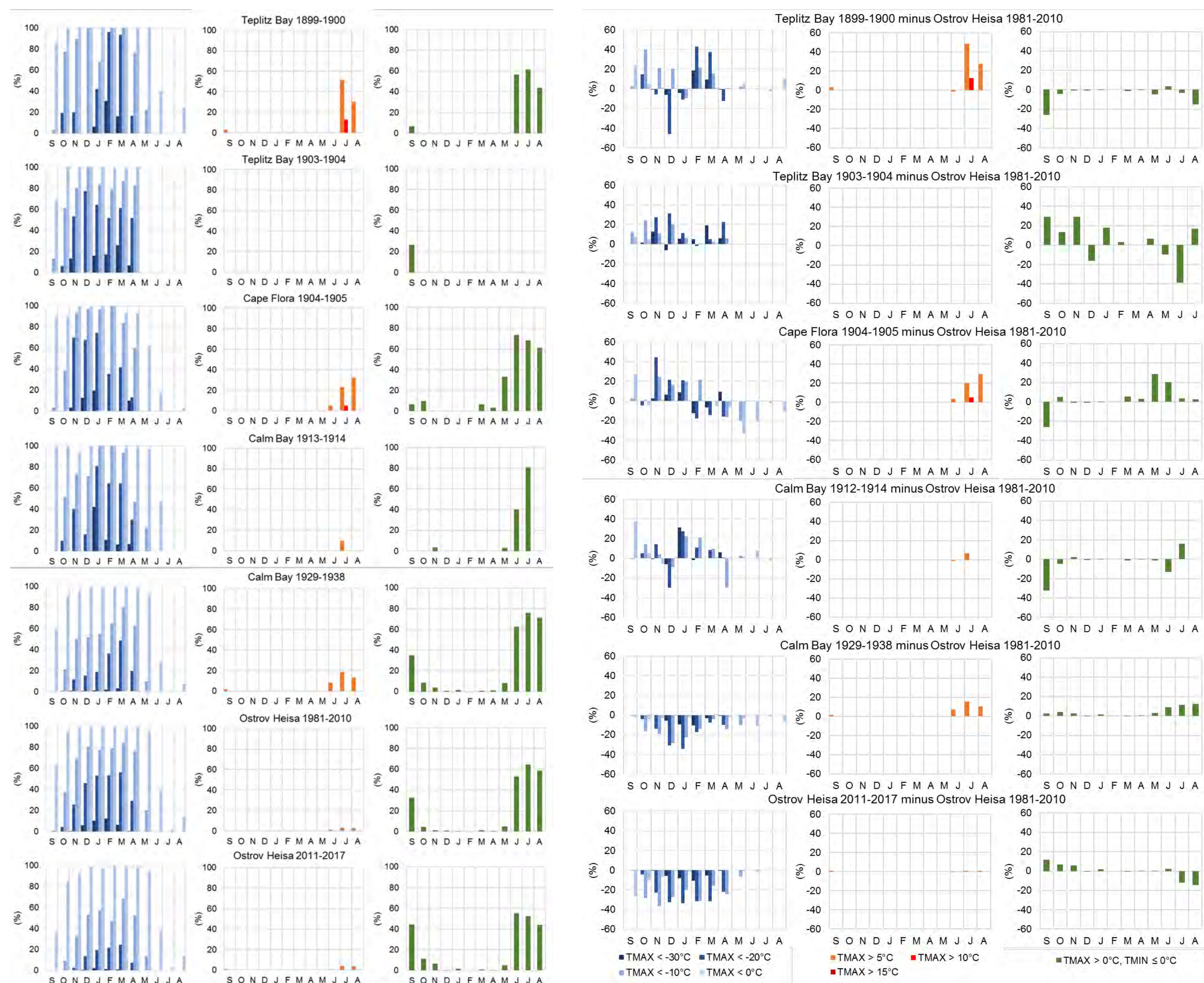


(a) Annual courses of mean monthly temperature and (b) its monthly differences between selected periods and climate normal (1981–2010). Differences were obtained by subtracting the climate normal (1981–2010) at Ostrov Heisa from analysed short-term periods. Dotted and dashed lines indicate $\pm 1SD$ and $\pm 2SD$, respectively. SDs have been calculated on the basis of present data (1981–2010) taken from Ostrov Heisa.



Monthly means of diurnal range (DTR) in analysed stations

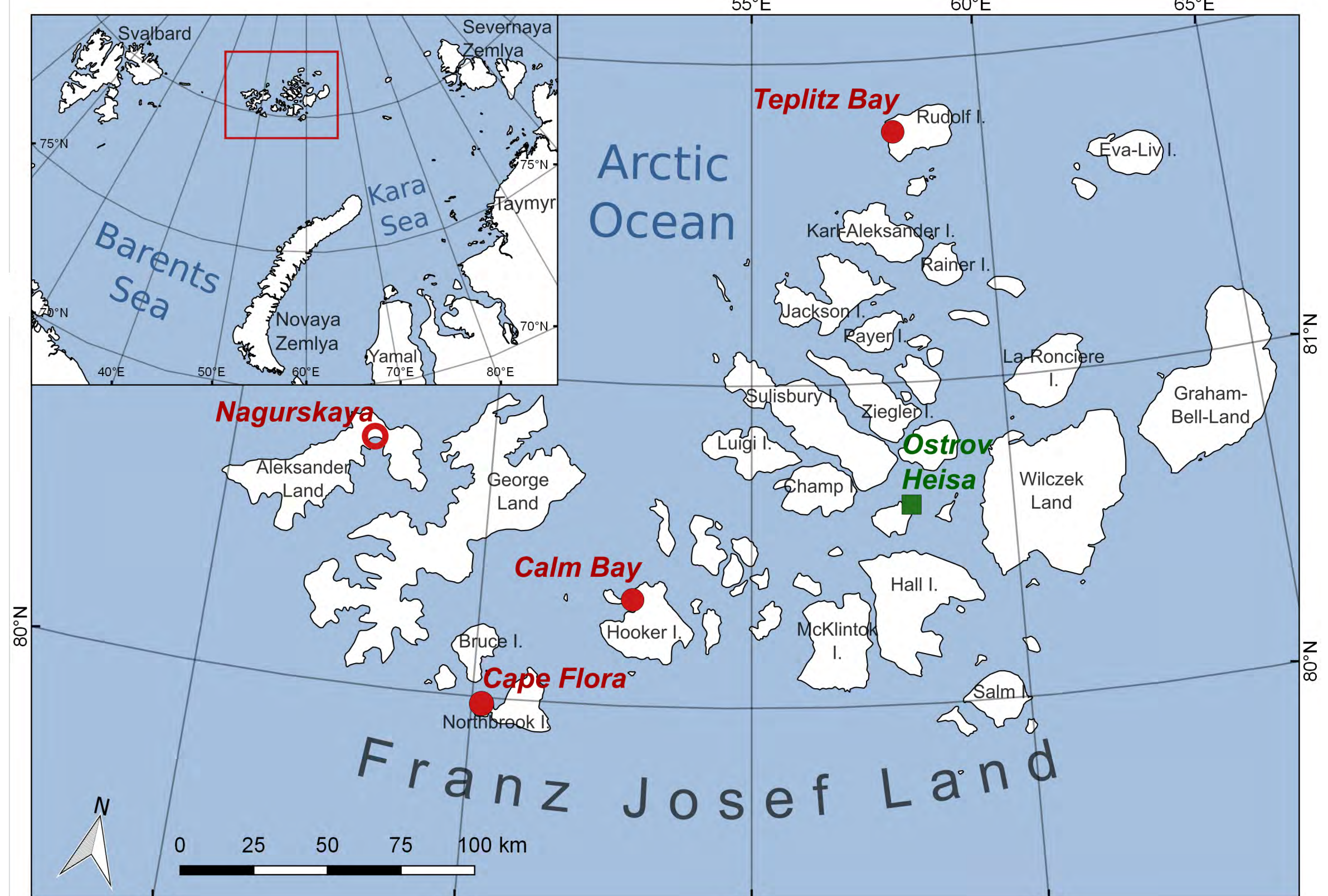
(a) Monthly means of day-to-day variability of mean daily air temperature in analysed stations. (b) The same as in (a) but shown in SD.



Annual courses of relative frequency of occurrence (in %) of characteristic days in Franz Josef Land in analysed stations

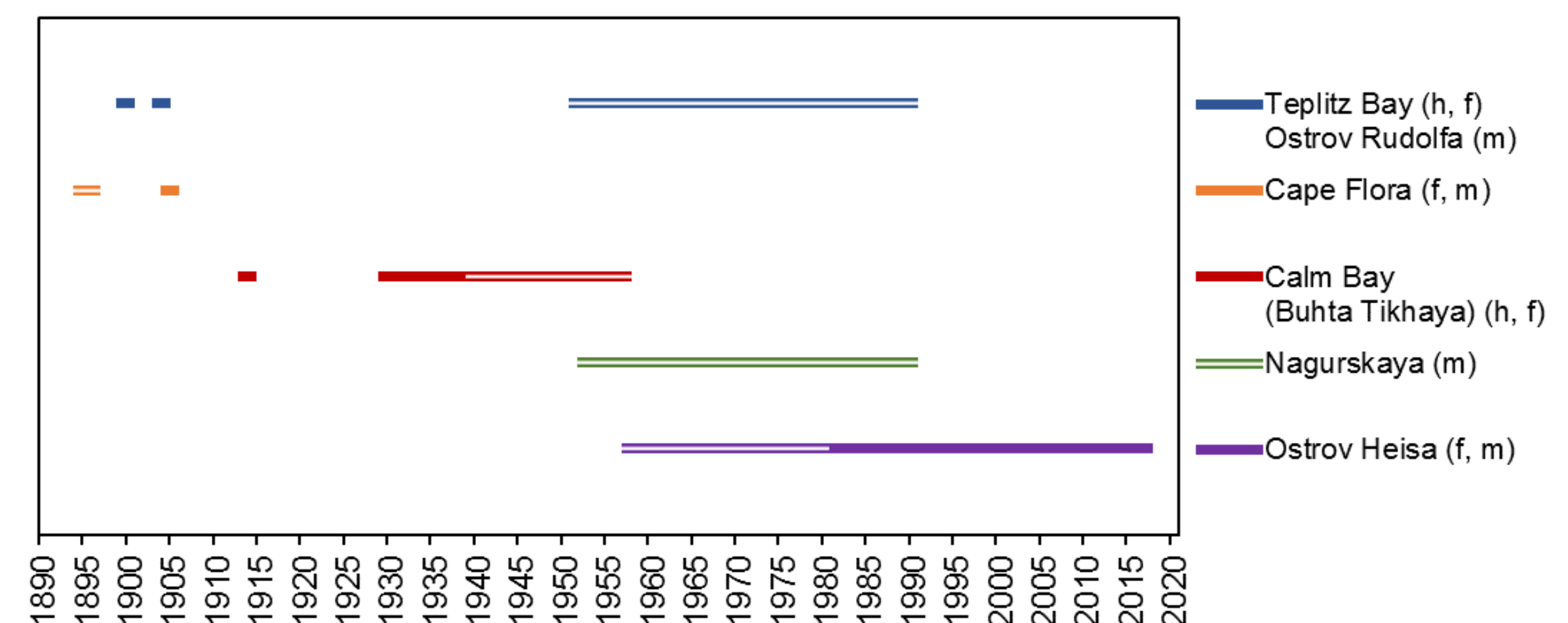
Annual courses of differences between the number of characteristic days (in %) in Franz Josef Land at analysed stations. Data from reference station Ostrov Heisa (1981–2010) were subtracted from historical and present ones.

AREA



Location of land meteorological stations in Franz Josef Land. Filled dots and square indicate historical and present stations, respectively. A blank dot indicates a station not used in the study.

DATA



Temporal distribution of the air temperature observations from meteorological land stations in Franz Josef Land.

Key: filled lines – data used, blank lines – data not used, h – hourly resolution of data, f – fixed (sub-daily, see table below), m – monthly.

Sources of air temperature series for Franz Josef Land

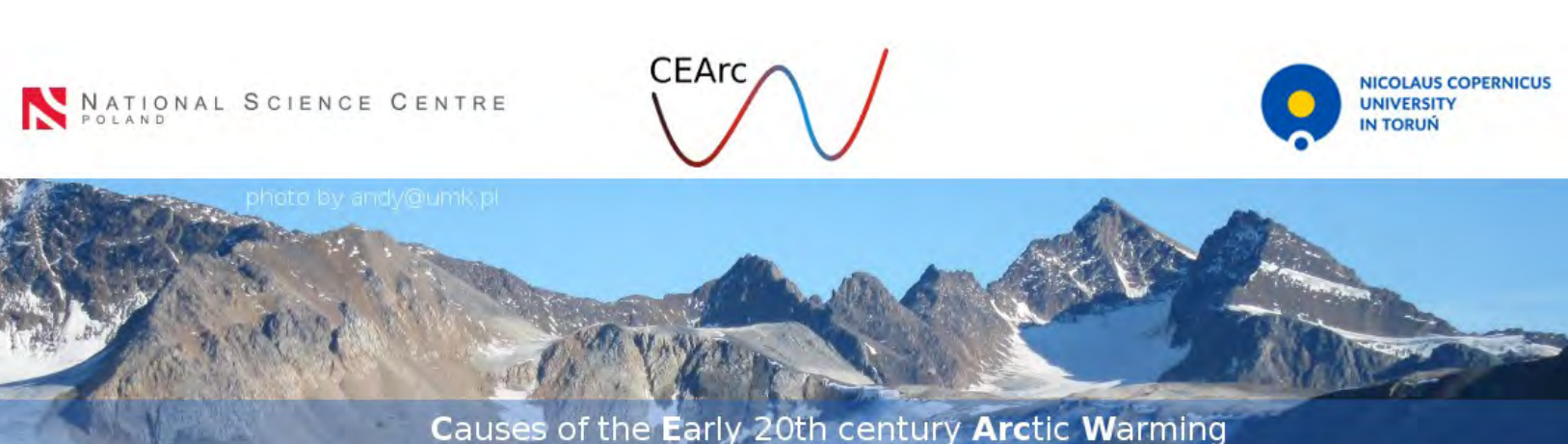
No.	Station	ϕ	λ	Station elevation (m a.s.l.)	Temporal data usage	Resolution of data	Source of data
1	Teplitz Bay	81.78°N	58.07°E	4.1	1899.08-1900.08	h	Cagni 1903
2	Teplitz Bay	81.78°N	58.07°E	9.3	1903.09-1904.04	8, 12, 20 LMT	Peters and Fleming 1907
3	Cape Flora	79.95°N	49.98°N	14.0	1894.10-1896.10	m	Hann 1904
4	Cape Flora	79.95°N	49.98°N	14.0	1904.05-1905.05	8, 12, 20 LMT	Peters and Fleming 1907
5	Calm Bay (Buhta Tikhaya)	80.32°N	52.80°E	5.9	1913.09-1914.07	h	Vise 1933
6	Calm Bay (Buhta Tikhaya)	80.32°N	52.80°E	5.9	09.1929-1931.07	h	Vise 1933, Lvov 1933
					1933.09-1934.08	7, 13, 21 LMT	Tihomirov 1938
					1935.09-12	7, 13, 21 LMT	Tihomirov 1939a
7	Nagurskaaya	80.80°N	47.63°E	15.0	1952.06-1990.12	m	Fetterer and Radionov 2000
					1936.01-1938.06	1, 7, 13, 19 LMT	Tihomirov 1939 a,b, Tihomirov 1940
8	Ostrov Rudolfa	81.80°N	57.97°E	51.0	1951.01-1990.12	m	Fetterer and Radionov 2000
9	Ostrov Heisa	80.62°N	58.05°E	20.0	1981.01-2017.12	t	RIHMI-WDC, http://meteo.ru

Key: m – monthly, h – hourly, t – six times a day (0, 3, 6, 9, 12, 15, 18, 21 LMT), LMT – local mean time, RIHMI-WDC – All-Russia Research Institute of Hydrometeorological Information – World Data Centre

Note: T_{max} and T_{min} were taken from extreme thermometers in all stations

HIGHLIGHTS

- As expected, temperatures during the end of the Little Ice Age (LIA) in FJL were generally lower (except spring/summer months) than today, but their differences did not exceed $\pm 2SD$ of present temperature variability.
- Interestingly, the Early Twentieth Century Warming (ETCW) period in FJL had a similar magnitude of positive temperature differences in winter and summer months as the recent Arctic warming. Today, a great warming of the area of FJL also occurs in autumn and spring.
- A decrease in the DTR between historical and present-time values has been noted.
- Day-to-day variability of mean daily temperature generally did not change markedly between historical and present periods.
- As expected, the number of characteristic days changed from the LIA and ETCW to present times, in agreement with temperature changes, i.e. the numbers of instances of the different categories of cold/warm days significantly decreased/increased.



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