atmosphere

Supplementary Materials: Mixed Temperature-Moisture Signal in $\delta^{18}O$ Records of Boreal Conifers from the Permafrost Zone

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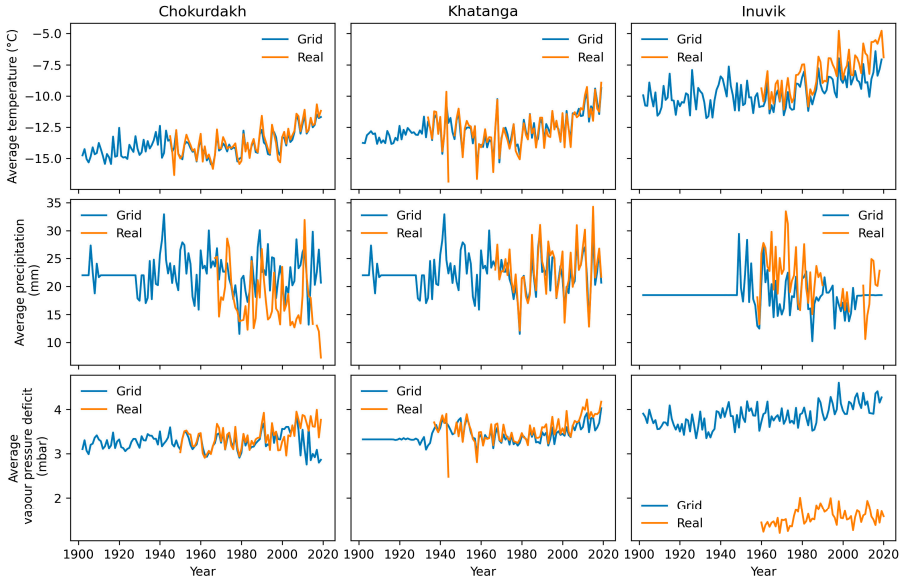

Figure S1. Annual air temperature (upper pannel), precipitation (middle pannel) and vapor pressure deficit (low pannel) data obtained from the gridded *climexp* vs. local *meteo.ru* data for Chokurdakh (left panel), Khatanga (middle panel) and Inuvik climate.weather.gc.ca, and https://climexp.knmi.nl/selectstation.cgi?id=someone@somewhere (right panel), respectively.

Table S1. Correlation coefficients (r) between annual climate data obtained from the local weather stations for different time periods and climate explore gridded data (1901–2020).

Weather station	Coordinates Local station	Coordinates KNMI Grid-data	Air temperature		Precipitation		Vapor pressure deficit	
			r	Period	r	Period	r	Period
Chokurdakh (IND, RU)	**70°37′ N, 147°53 E**	**70°–71° N, 147°–148° E**	**0.90**	1939–2019	0.22	1966–2019	**0.34**	1940–2019
Khatanga (TAY, RU)	71°59′ N, 102°28′ E	71°–72° N, 102°–103° E	**0.90**	1906–2019	**0.91**	1966–2019	**0.75**	1936–2019
Inuvik (CAN)	68°30′ N, 133°48′ W	68°–69° N, 133°–134° W	**0.93**	1959–2020	**0.65**	1957–2018	**0.32**	1959–2020

Note, *Significant *P-Value* at the level *<0.01* are marked in bold.

Table S2. Trend analysis (r) and *(p-values)* calculated based on the local weather station observations for the periods 1901-1979, 1980–2020 and 1901–2020 for annual (January–December, J-D), winter (December, January, February, DJF), spring (March, April, May, MAM), summer (June, July, August, JJA), autumn (September, October, November, SON) air temperature, precipitation and vapor pressure deficit (VPD).

Weather station	Local station, coordinates	Season	Temperature			Precipitation			Vapor pressure deficit		
			1901–1979	1980–2020	1901–2020	1901–1979	1980–2020	1901–2020	1901–1979	1980–2020	1901–2020
Chokur-dakh (RU)	70° 37' N, 147° 53' E	Annual J-D	0.03 (p=0.88)	**0.69 (p=0.00)**	**0.63 (p=0.00)**	0.42 (p=0.15)	0.14 (p=0.41)	**0.32 (p=0.02)**	0.09 (p=0.64)	**0.54 (p=0.00)**	**0.51 (p=0.00)**
		Winter DJF	0.14 (p=0.42)	**0.49 (p=0.00)**	**0.31 (p=0.01)**	**0.6 (p=0.03)**	0.26 (p=0.10)	0.07 (p=0.63)	0.05 (p=0.80)	**0.44 (p=0.01)**	**0.34 (p=0.00)**
		Spring MAM	0.09 (p=0.60)	**0.36 (p=0.02)**	**0.27 (p=0.02)**	0.07 (p=0.83)	**0.49 (p=0.00)**	**0.46 (p=0.00)**	0.03 (p=0.87)	0.29 (p=0.07)	**0.25 (p=0.04)**
		Summer JJA	0.02 (p=0.89)	**0.69 (p=0.00)**	**0.56 (p=0.00)**	0.38 (p=0.20)	**0.4 (p=0.01)**	0.12 (p=0.41)	0.0 (p=1.00)	**0.61 (p=0.00)**	**0.58 (p=0.00)**
		Autumn SON	0.19 (p=0.25)	0.22 (p=0.16)	**0.33 (p=0.00)**	0.35 (p=0.24)	0.12 (p=0.46)	0.17 (p=0.22)	0.24 (p=0.19)	0.09 (p=0.57)	0.15 (p=0.20)
Khatanga (RU)	71°59' N, 102°28' E	Annual J-D	0.2 (p=0.17)	**0.64 (p=0.00)**	**0.38 (p=0.00)**	**0.67 (p=0.01)**	0.13 (p=0.41)	0.14 (p=0.31)	0.29 (p=0.06)	**0.77 (p=0.00)**	**0.4 (p=0.00)**
		Winter DJF	0.03 (p=0.83)	**0.58 (p=0.00)**	**0.44 (p=0.00)**	0.41 (p=0.17)	0.29 (p=0.07)	0.05 (p=0.71)	**0.33 (p=0.04)**	**0.6 (p=0.00)**	**0.36 (p=0.00)**
		Spring MAM	0.01 (p=0.94)	**0.53 (p=0.00)**	**0.28 (p=0.01)**	**0.59 (p=0.03)**	0.09 (p=0.59)	0.15 (p=0.27)	0.06 (p=0.71)	**0.63 (p=0.00)**	**0.35 (p=0.00)**
		Summer JJA	0.27 (p=0.07)	**0.41 (p=0.01)**	0.15 (p=0.18)	0.23 (p=0.45)	0.19 (p=0.23)	0.05 (p=0.74)	**0.33 (p=0.03)**	**0.38 (p=0.02)**	0.09 (p=0.42)
		Autumn SON	0.34 (p=0.02)	0.12 (p=0.47)	0.03 (p=0.78)	0.39 (p=0.19)	0.23 (p=0.15)	0.09 (p=0.50)	**0.44 (p=0.00)**	0.13 (p=0.42)	0.03 (p=0.78)
Inuvik (CAN)	68°30' N, 133°48' W	Annual J-D	0.26 (p=0.27)	**0.67 (p=0.00)**	**0.77 (p=0.00)**	0.04 (p=0.85)	0.17 (p=0.41)	**0.36 (p=0.01)**	**0.58 (p=0.01)**	0.08 (p=0.61)	**0.35 (p=0.01)**
		Winter DJF	0.06 (p=0.82)	**0.42 (p=0.01)**	**0.52 (p=0.00)**	0.28 (p=0.21)	0.2 (p=0.33)	0.24 (p=0.10)	**0.52 (p=0.02)**	**0.44 (p=0.00)**	**0.62 (p=0.00)**
		Spring MAM	0.06 (p=0.81)	0.01 (p=0.97)	0.23 (p=0.08)	0.03 (p=0.89)	**0.42 (p=0.04)**	0.05 (p=0.73)	0.42 (p=0.07)	**0.32 (p=0.04)**	0.07 (p=0.62)
		Summer JJA	0.24 (p=0.31)	**0.53 (p=0.00)**	**0.54 (p=0.00)**	0.24 (p=0.28)	0.32 (p=0.12)	0.27 (p=0.06)	**0.51 (p=0.02)**	0.01 (p=0.95)	**0.25 (p=0.05)**
		Autumn SON	0.2 (p=0.41)	**0.52 (p=0.00)**	**0.65 (p=0.00)**	0.24 (p=0.29)	**0.64 (p=0.00)**	**0.54 (p=0.00)**	**0.55 (p=0.01)**	0.26 (p=0.11)	**0.69 (p=0.00)**

Table S3. Pearson correlation coefficients (**r**) and *p-values* (**p**) calculated between monthly from January until December (1–12) and seasonal (spring 3–5, summer 6–8, autumn 9-11 and winter 12–2) air temperature (Tem.) (**a**), precipitation (Prec.) (**b**) and vapor pressure deficit (VPD) (**c**) versus $\delta^{18}O$ in tree-ring cellulose ($\delta^{18}O_{cel}l$) chronologies obtained from northeastern Yakutia (YAK), eastern Taimyr (TAY) and Mackenzie Delta from Canada (CAN) over the period from 1966–2004.

(a)

Parameter	Statistics	Tem. 1	Tem. 2	Tem. 3	Tem. 4	Tem. 5	Tem. 6	Tem. 7	Tem. 8	Tem. 9	Tem. 10	Tem. 11	Tem. 12	Tem. 3-5	Tem. 6-8	Tem. 9-11	Tem. 12-2
$\delta^{18}O_{cell}$	r	0.14	0.22	-0.07	0.15	0.07	-0.02	**0.49**	0.18	0.06	0.21	0.16	-0.03	0.06	**0.32**	0.15	0.21
YAK	*p-value*	0.28	0.09	0.59	0.25	0.59	0.89	**0.00**	0.17	0.67	0.10	0.21	0.80	0.65	**0.01**	0.26	0.11
$\delta^{18}O_{cell}$	r	0.06	-0.07	0.22	-0.07	0.12	0.17	**0.23**	0.15	-0.13	0.11	0.19	-0.03	0.13	**0.27**	0.13	-0.02
TAY	*p-value*	0.61	0.56	0.06	0.58	0.31	0.15	**0.04**	0.21	0.27	0.33	0.11	0.78	0.25	**0.02**	0.25	0.86
$\delta^{18}O_{cell-}$	r	0.19	0.09	0.26	**0.36**	0.22	0.25	**0.32**	0.05	0.25	0.10	0.05	0.26	**0.37**	0.28	0.17	0.27
CAN	*p-value*	0.24	0.56	0.10	**0.02**	0.16	0.11	**0.04**	0.75	0.11	0.53	0.74	0.10	**0.02**	0.07	0.28	0.08

(b)

Parameter	Statistics	Prec 1	Prec 2	Prec 3	Prec 4	Prec 5	Prec 6	Prec 7	Prec 8	Prec 9	Prec 10	Prec 11	Prec 12	Prec 3-5	Prec 6-8	Prec 9-11	Prec 12-2
$\delta^{18}O_{cell}$	r	−0.27	−0.05	−0.04	−0.03	−0.07	0.27	**−0.37**	−0.06	−0.03	0.04	−0.02	−0.16	−0.08	−0.12	−0.03	−0.24
YAK	*p-value*	0.10	0.77	0.81	0.84	0.69	0.11	**0.02**	0.71	0.85	0.83	0.89	0.34	0.64	0.46	0.88	0.15
$\delta^{18}O_{cell}$	r	0.05	−0.10	0.14	−0.16	−0.11	0.00	0.07	−0.11	0.05	−0.12	0.17	0.04	−0.06	−0.03	0.01	0.02
TAY	*p-value*	0.76	0.53	0.39	0.32	0.49	0.99	0.66	0.50	0.77	0.43	0.30	0.81	0.70	0.85	0.97	0.90
$\delta^{18}O_{cell}$	r	−0.13	0.15	−0.03	−0.24	−0.02	−0.28	−0.29	0.03	−0.01	−0.13	−0.06	−0.05	−0.12	−0.27	−0.05	−0.07
CAN	*p-value*	0.44	0.38	0.85	0.17	0.93	0.11	0.09	0.85	0.97	0.46	0.71	0.78	0.48	0.11	0.77	0.70

(c)

Parameter	Statistics	VPD 1	VPD 2	VPD 3	VPD 4	VPD 5	VPD 6	VPD 7	VPD 8	VPD 9	VPD 10	VPD 11	VPD 12	VPD 3-5	VPD 6-8	VPD 9-11	VPD 12-2
$\delta^{18}O_{cell}$	r	0.08	0.16	−0.04	−0.03	−0.03	0.01	**0.31**	0.17	−0.02	0.06	0.13	−0.12	−0.03	0.24	0.04	0.08
YAK	*p-value*	0.57	0.23	0.76	0.85	0.81	0.95	**0.02**	0.22	0.88	0.64	0.34	0.39	0.85	0.08	0.78	0.56
$\delta^{18}O_{cell}$	r	0.01	−0.14	**0.26**	−0.08	0.11	0.13	0.16	0.05	−0.20	0.10	0.15	−0.09	0.10	0.19	−0.02	−0.11
TAY	*p-value*	0.95	0.25	**0.03**	0.49	0.37	0.28	0.18	0.71	0.09	0.40	0.20	0.46	0.43	0.10	0.85	0.38
$\delta^{18}O_{cell}$	r	**0.37**	0.24	**0.36**	**0.50**	**0.45**	**0.36**	**0.41**	0.07	0.17	−0.07	0.05	**0.32**	**0.54**	**0.44**	0.11	**0.37**
CAN	*p-value*	**0.01**	0.12	**0.02**	**0.00**	**0.00**	**0.02**	**0.01**	0.65	0.29	0.66	0.76	**0.04**	**0.00**	**0.00**	0.49	**0.02**

Note: Significant correlation coefficients are selected in bold.