Supplemental Material

Supplementary Tables

Marginal Sea	OND μ	OND σ	JFM μ	JFM σ
Canadian Archipelago (CAA)	89.77	2.95	98.43	0.42
Hudson Bay (HUD)	38.21	7.31	99.05	0.85
Baffin Bay (BAF)	52.62	7.16	93.16	2.82
Labrador Sea (LAB)	7.54	2.65	35.18	6.12
Greenland Sea (GRE)	53.75	4.88	68.24	8.24
Iceland Sea (ICE)	12.38	3.97	22.02	4.83
Irminger Sea (IRM)	0.97	1.33	3.28	1.39

Table S1 Autumn (OND) and winter (JFM) mean (μ) and standard deviation (σ) of sea ice concentration (%), 1873-2013, for the seven marginal seas included in the statistical analyses.

Component (PC)	Summarized Description (Number of loaded indices per PC)	Abbreviation	r^2 (%)
1	AMO OND, JAS, AMJ (3)	$AMO_{au,su,sp}$	23.44
2	GRE SST JAS, AMJ; ICE SST JAS, AMJ (4)	$GRE\text{-}S_{su,sp}$	10.09
3	BAF ICE OND; CAA ICE OND; HUD ICE OND; LAB ICE OND (4)	$BAF\text{-}I_{au}$	7.38
4	GBI AMJ; NAO AMJ (2)	GBI_{sp}	6.11
5	CAA SST JAS, AMJ (2)	$CAA\text{-}S_{su,sp}$	5.44
6	GBI OND; NAO OND (2)	GBI_{au}	4.43
7	ICE ICE OND; IRM ICE OND (2)	$ICE\text{-}I_{au}$	4.04
8	GBI JAS; NAO JAS (2)	GBI_{su}	3.57
9	IRM SST JAS (1)	$IRM\text{-}S_{su}$	2.99
10	HUD SST JAS (1)	$HUD\text{-}S_{su}$	2.85
11	SCA AMJ (1)	SCA_{sp}	2.78
12	GRE ICE OND (1)	$GRE\text{-}I_{au}$	2.78

Table S2 Rotated principal components (PCs) calculated for autumn T2m analyses since 1873 (e.g., UPE, SMQ, ILU, SER, NAR, SMK; **Figure 4a–c**). The total dataset variance (r^2) explained by the 12 PCs is 75.90%. In summary, the PC time series are used as orthogonal predictors of T2m variability as shown in **Figures 4-5**. Commas separate each oceanic or atmospheric index by season, while semicolons separate different geophysical indices. Abbreviations for sea ice (I) and SST (S) are followed by subscripts indicating the season.

Component (PC)	Summarized Description (Number of loaded indices per PC)	Abbreviation	r^2 (%)
1	AMO OND, JAS, AMJ (3)	$AMO_{au,su,sp}$	22.84
2	BAF ICE OND; CAA ICE OND; HUD ICE OND; LAB ICE OND (4)	$BAF\text{-}I_{au}$	10.50
3	GRE SST JAS, AMJ; ICE SST JAS (3)	$GRE\text{-}S_{su,sp}$	7.55
4	GBI AMJ; NAO AMJ (2)	GBI_{sp}	6.21
5	CAA SST JAS, AMJ (2)	$CAA\text{-}S_{su,sp}$	5.89
6	ICE SST AMJ; IRM SST AMJ (2)	$ICE\text{-}I_{sp}$	4.47
7	ICE ICE OND; IRM ICE OND (2)	$ICE\text{-}I_{au}$	3.93
8	GBI OND; NAO OND (2)	GBI_{au}	3.42
9	GBI JAS; NAO JAS (2)	GBI_{su}	3.24
10	LAB SST JAS (1)	$LAB\text{-}S_{su}$	2.78
11	IRM SST JAS (1)	$IRM\text{-}S_{su}$	2.78

Table S3 As in **Table S2**, but for autumn T2m analyses since 1890 (e.g., NUK, KNS; **Figure 4d**). The cumulative explained variance (r^2) of the 11 PCs is 73.61%.

Component (PC)	Summarized Description (Number of loaded indices per PC)	Abbreviation	r^2 (%)
1	AMO OND, JAS, AMJ (3)	$AMO_{au,su,sp}$	22.91
2	BAF ICE OND; CAA ICE OND; HUD ICE OND; LAB ICE OND (4)	$BAF\text{-}I_{au}$	10.61
3	GRE SST JAS, AMJ; ICE SST JAS, AMJ (4)	$GRE\text{-}S_{su,sp}$	7.45
4	GBI AMJ; NAO AMJ (2)	GBI_{sp}	6.22
5	GBI OND; NAO OND (2)	GBI_{au}	5.90
6	ICE ICE OND; IRM ICE OND (2)	$ICE\text{-}I_{au}$	4.53
7	LAB SST JAS; AMJ (2)	$LAB\text{-}S_{su,sp}$	3.94
8	CAA SST JAS; AMJ (2)	$CAA\text{-}S_{su,sp}$	3.43
9	IRM SST JAS (1)	$IRM\text{-}S_{su}$	3.24
10	GBI JAS; NAO JAS (2)	GBI_{su}	2.81
11	SCA AMJ (1)	SCA_{sp}	2.78
12	IRM SST AMJ (1)	$IRM\text{-}S_{sp}$	2.78

Table S4 As in **Table S2**, but for autumn T2m analyses since 1895 (e.g., TAS, HEL, CGT3, and CGLT; **Figure 4e-f**). The cumulative explained variance (r^2) of the 12 PCs is 76.60%.

Component (PC)	Summarized Description (Number of loaded indices per PC)	Abbreviation	r^2 (%)
1	GRE SST JAS; HUD SST JAS; ICE ICE OND; IRM ICE JFM, OND (5)	$GRE\text{-}S_{su}$	21.75
2	AMO JFM, OND, JAS (3)	$AMO_{wi,au,su}$	11.99
3	BAF ICE OND; CAA ICE OND; HUD ICE OND; LAB ICE OND (4)	$BAF\text{-}I_{au}$	7.57
4	GBI JFM; NAO JFM (2)	GBI_{wi}	6.52
5	GBI OND; NAO OND (2)	GBI_{au}	5.57
6	GBI JAS; NAO JAS (2)	GBI_{su}	4.98
7	BAF SST JAS; CAA SST JAS (2)	$BAF\text{-}S_{su}$	3.96
8	ICE SST JAS; IRM SST JAS (2)	$ICE\text{-}S_{au}$	3.87
9	GRE ICE JFM; ICE ICE JFM (2)	$GRE\text{-}I_{wi}$	3.38
10	GRE ICE OND (1)	$GRE\text{-}I_{au}$	3.13
11	LAB ICE JFM (1)	$LAB\text{-}I_{wi}$	2.94

Table S5 As in **Table S2**, but for winter T2m analyses since 1873 (e.g., UPE, SMQ, ILU, SER, NAR, SMK; **Figure 5a–c**). The cumulative explained variance (r^2) of the 11 PCs is 75.66%.

Component (PC)	Summarized Description (Number of loaded indices per PC)	Abbreviation	r^2 (%)
1	GRE ICE JFM; GRE SST JAS; ICE ICE JFM; IRM ICE JFM, OND (5)	GRE-I_{wi}	21.17
2	BAF ICE OND; CAA ICE OND; HUD ICE OND; LAB ICE OND (4)	BAF-I_{au}	12.34
3	GBI OND; NAO OND (2)	GBI_{au}	8.08
4	GBI JFM; NAO JFM (2)	GBI_{wi}	6.71
5	BAF SST JAS; IRM SST JAS; LAB SST JAS (3)	BAF-S_{su}	5.63
6	GBI JAS; NAO JAS (2)	GBI_{su}	5.16
7	BAF ICE JFM; LAB ICE JFM (2)	BAF-I_{wi}	4.14
8	GRE ICE OND (1)	GRE-I_{au}	3.51
9	ICE SST JAS (1)	ICE-S_{su}	3.41
10	AMO OND (1)	AMO_{au}	3.16
11	ICE ICE OND (1)	ICE-I_{wi}	3.08

Table S6 As in **Table S2**, but for winter T2m analyses since 1890 **(**e.g., NUK, KNS; **Figure 5d**). The cumulative explained variance (r^2) of the 11 PCs is 76.39%.

Component (PC)	Summarized Description (Number of loaded indices per PC)	Abbreviation	r^2 (%)
1	GRE SST JAS; ICE ICE JFM, OND; IRM ICE JFM, OND (5)	GRE-S_{su}	21.32
2	BAF ICE JFM, OND; CAA ICE OND; HUD ICE OND; LAB ICE JFM, OND (6)	BAF-$I_{wi,au}$	12.40
3	AMO JFM, OND, JAS (3)	$AMO_{wi, au, su}$	8.09
4	GBI JFM; NAO JFM (2)	GBI_{wi}	6.65
5	GBI OND; NAO OND (2)	GBI_{au}	5.59
6	IRM SST JAS; LAB SST JAS (2)	IRM-S_{su}	5.22
7	GBI JAS; NAO JAS (2)	GBI_{su}	4.10
8	GRE ICE OND; HUD ICE OND (2)	GRE-I_{au}	3.54
9	GRE ICE JFM (1)	GRE-I_{wi}	3.29
10	BAF SST JAS; CAA SST JAS (2)	BAF-S_{su}	3.16
11	ICE SST JAS (1)	ICE-S_{su}	3.09

Table S7 As in **Table S2**, but for winter T2m analyses since 1895 (e.g., TAS, HEL, CGT3, and CGLT; **Figure 5e-f**). The cumulative explained variance (r^2) of the 11 PCs is 76.45%.

Supplementary Figures

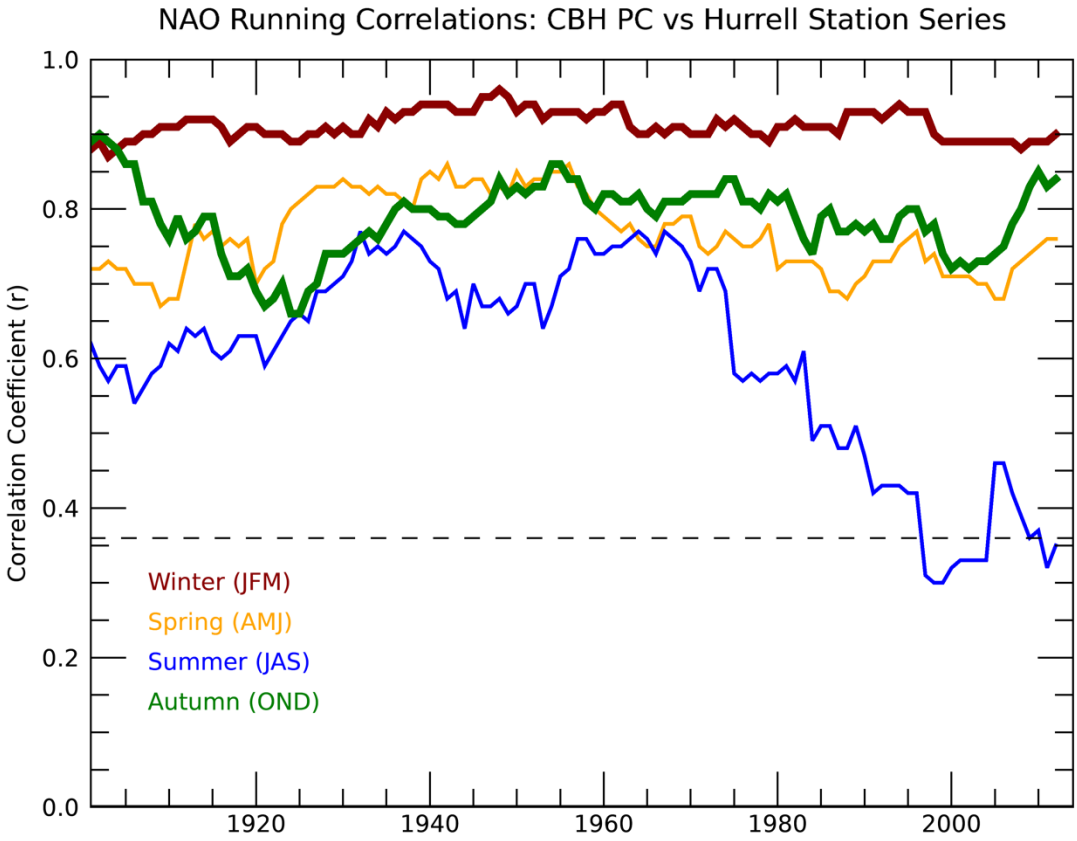

Figure S1 Thirty-year running seasonal correlations (i.e., 1873–1902, 1874–1903,…1984–2013) between the Comas-Bru and Hernández (CBH) PC-derived and Hurrell station-based NAO series. Winter and autumn series emphasized in this paper are shown in bold. All data are linearly detrended prior to calculating the correlation coefficients. The dashed line represents a threshold above which, $r>0.36$, relationships between the time series are statistically significant ($p\leq0.05$) for n-2 degrees of freedom.