

Supplementary information to:

**Mid to Late Holocene sea-surface temperature variability in Northern
Newfoundland and its linkage to the North Atlantic Oscillation**

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Supplementary Information 1: Atmospheric temperature variability on Newfoundland, 1942-2010

Monthly station data from St Johns A station, Newfoundland, at 47°37'20" N and 52°44'34" W. Monthly atmospheric temperature measurements were taken from St Johns A station between 1942 and 2010. Data was accessed at: climate.weather.gc.ca (2019). Seasonal averages were calculated for the summer (JJAS) and winter (NDJF) seasons using the available monthly temperature averages.

Summer atmospheric temperatures were on average 13.3°C between 1942 and 1997, increasing to an average of 14.4°C between 1998 and 2010 (Figure S1).

Winter atmospheric temperatures showed strong inter-decadal variability through the period (Figure S2): temperatures were warmer between 1950-1970 (average -1.2°C), cooler from 1971-1995 (average -2.6°C) and warmer between 1996-2010 (average -1.2°C). This reflects to some degree the negative relationship between temperature in the Labrador Sea and the North Atlantic Oscillation. NAO variability in the corresponding periods, as shown by the updated Jones et al. (1997) dataset (Osborn, 2019), shows the NAO was on average -0.13 between 1950-1970, 0.51 between 1971-1995 and 0.1 between 1996-2010.

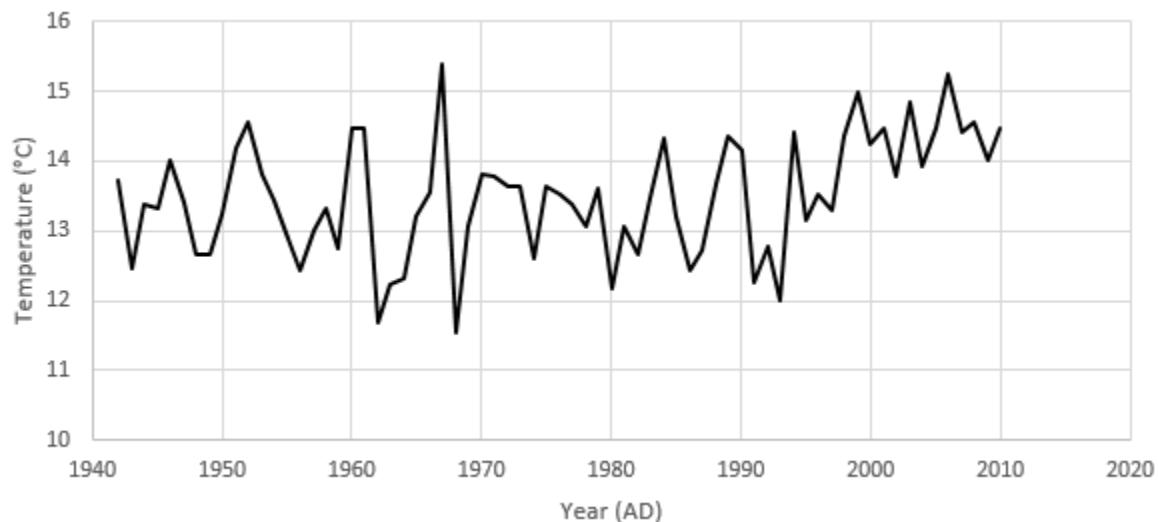


Figure S1: Annual summer temperature at St Johns A station, Newfoundland, calculated from monthly temperature averages (June - September) for the period 1942-2010.

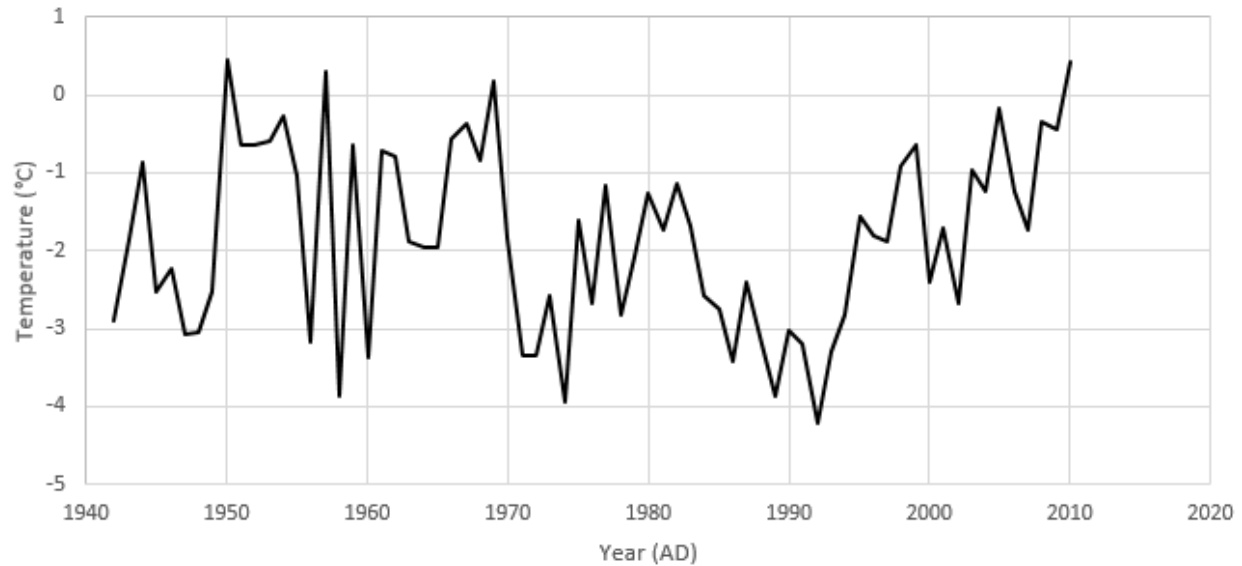


Figure S2: Annual winter temperature at St Johns A station, Newfoundland, calculated from monthly temperature averages (November - February) for the period 1942-2010.

Bibliography

Climate.weather.gc.ca (2019)

https://climate.weather.gc.ca/climate_data/monthly_data_e.html?hlyRange=1953-01-01%7C2012-03-20&dlyRange=1942-01-01%7C2012-03-19&mlyRange=1942-01-01%7C2012-03-01&StationID=6720&Prov=NL&urlExtension=_e.html&searchType=stnName&optLimit=yearRange&StartYear=1840&EndYear=2019&selRowPerPage=25&Line=2&searchMethod=contains&Month=12&Day=8&txtStationName=st-johns&timeframe=3&Year=2012 [Accessed 9/12/2019]

Osborn T (2019) North Atlantic Oscillation values. <https://crudata.uea.ac.uk/cru/data/nao/> [accessed 9/12/2019]

Jones PD, Jónsson T and Wheeler D (1997) Extension to the North Atlantic Oscillation using early instrumental pressure observations from Gibraltar and South-West Iceland. *International Journal of Climatology* 17: 1433-1450. doi: 10.1002/(SICI)1097-0088(19971115)17:13<1433::AID-JOC203>3.0.CO;2-P

Supplementary Information 2: Calculation of ocean Station 27 temperature in surface 50m

In the ocean around Newfoundland the temperature within the upper 50 m of the water column has a steep gradient with depth. As diatoms live within the upper 50 m of the water column and the diatom-based temperature reconstruction is a proxy for August temperatures, we here quantify the average temperature in this 50 m layer in August during recent decades. Measurements of temperature with depth from Ocean Station 27, offshore of Newfoundland, were made between 1999 and 2019 as part of the Atlantic Zone Monitoring Program (Fisheries and Oceans Canada, 2019). This data was accessed and the average temperature in the upper 50 m during August of each year was calculated. The results (Table S2) show that the average temperature was 6.5°C

Table S2: Average temperature of the upper 50m of the water column measured at Station 27. No measurements of August temperature were currently available for 2013, 2015 and 2017-2019.

Year	Temperature (°C)
2019	--
2018	--
2017	--
2016	6.6
2015	--
2014	5.9
2013	--
2012	6.6
2011	6.9
2010	7.8
2009	6.2
2008	6.5
2007	5.2
2006	7.7
2005	4.6
2004	5.3
2003	7.9
2002	6.8
2001	6.4
2000	6.1
1999	6.8
Average	6.5

Bibliography

Fisheries and Oceans Canada (2019) Hydrographic Data. <http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/hydro/station/multiple-eng.asp> [Accessed 10/12/2019]