# Program and Abstracts

## 52nd International Arctic Workshop 2024

NSF INSTAAR University of Colorado Boulder EGCS Earth, Geographic, and Climate Sciences

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***Cover photo:***

Coastal Nunivak Island, City of Mekoryuk, overlooking the Bering Sea.

Photo: Julie Brigham-Grette, Sept. 2023.

# PROGRAM AND ABSTRACTS

# 52nd ANNUAL INTERNATIONAL ARCTIC WORKSHOP

# March 13th – 16th, 2024


**DEPT. OF EARTH, GEOGRAPHIC, AND CLIMATE SCIENCES**

**WCRP CLIMATE AND CRYOSPHERE PROJECT**

**SCHOOL OF EARTH AND SUSTAINABILITY**

**CLIMATE SYSTEM RESEARCH CENTER**

**University of Massachusetts, Amherst**

**Organizing Committee:**

Julie Brigham-Grette

Tim Cook

Meghan Taylor

Samantha Bombard

Catherine Britt

Raymond Bradley

# Introduction

## Overview and history

The 52nd Annual International Arctic Workshop will be in person 13-16 March, 2024 at the University of Massachusetts Amherst Campus Conference Center. The meeting is traditionally hosted by the Institute of Arctic and Alpine Research (INSTAAR). This workshop has grown out of a series of informal annual meetings started by John T. Andrews in 1970, and sponsored by INSTAAR and other academic institutions worldwide.

## Theme

*"The Legacy of Arctic Change: Looking Back but Thinking Forward"* The polar regions are undergoing rapid change, perhaps a transformation that can only be informed from our understanding of the climate system based on studies of the past, contemporary observations, and modeling of the future.

## Website

https://umass.irisregistration.com/Site/Arctic

## Program

The workshop takes place on 2.5 succeeding days, mostly from 9am to 6pm Eastern Standard Time. Time slots are 15 min, allowing for 12 min talks and a few minutes of questions and transitions. Posters should be up all day March 14 and 15 in the Campus Center Auditorium. Each is numbered and grouped. Two-hour poster sessions will be held with odd numbers on Thursday and even numbers on Friday. Lunches are served in the same room as the posters.

## NSF

The National Science Foundation's Division of Polar Programs has a long tradition of being a supporter of the Arctic Workshop. *Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.*

# CLIMATE AND BIOCLIMATE CONDITIONS IN NAIN (LABRADOR) IN THE LATE 18TH CENTURY

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This study focuses on the analysis of climate and bioclimate conditions in Nain (Labrador) in the late 18th century. For this purpose, we used invaluable instrumental meteorological observations made by Moravian Missionaries. These records were sourced from three primary archival collections: the Moravian Archives in Herrnhut (Germany) and the Moravian Archives at Muswell Hill and the Archives of the Royal Society in London (Great Britain) (Fig. 1). The 18th-century Moravian missionary observations offer a unique perspective on the climate and bioclimate of the Labrador coast, providing essential data on temperature, precipitation and wind force and direction, and short descriptions of the weather. Observations were made two, three, or four times a day from Oct 1771 until July 1786, but include two gaps: 20th Oct 1774 to 16th Sep 1775 and 12th – 30th Sep 1784. For this study, we utilized sub-daily air temperature (1771–86) measurements in Nain and wind speed (1776–85) estimates using a six-degree scale (1–6). Nain is located on the eastern coast of Labrador (j = 56°32′N, l = 61°41′W, H = 11 m a.s.l.) (Fig. 2).

All available historical data were quality controlled and converted to present units (°C and $ms^{-1}$). In the next step, the original daily air temperature means (calculated from different measurements times) were corrected to real means calculated from 24 hourly measurements. Corrections for each month were calculated based on contemporary data (1991–2010). The corrected daily means have been used to calculate monthly, seasonal and yearly means, as well as other statistics such as number of different categories of cold/warm days, growing degree days sum (GDD), air thawing index degree-days sums (ATI), positive degree-days sum (PDD) and air freezing index degree-days sum (AFI). The last four indices were calculated using definitions proposed by Nordli et al. (2020).

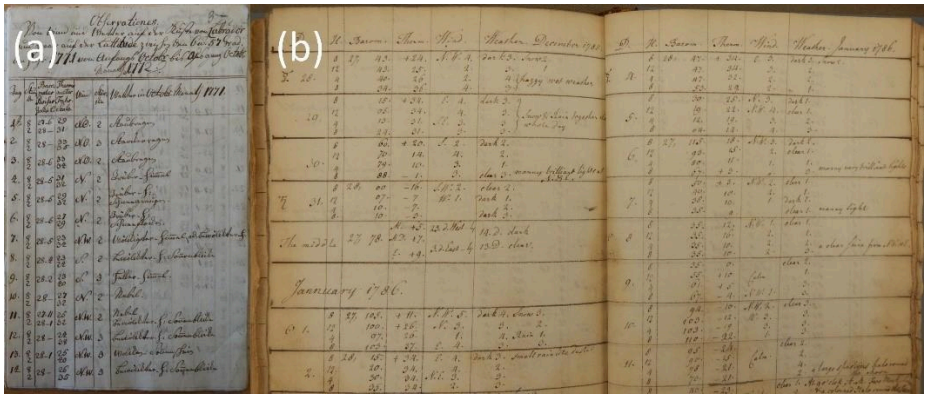


Fig. 1. Examples of manuscripts presenting meteorological observations: (a) for Nain (1 Oct 1771 to 31 July 1786), source: Unitatsarchiv MDF.1817, The Moravian Archives in Herrnhut (Germany). Data presented in the manuscript: 1 to 14 January 1771, (b) Nain, data presented in the manuscript: 28 Dec 1785 to 11 Jan 1786, Source: R.S.MA 143, The Archives of the Royal Society in London (Great Britain)

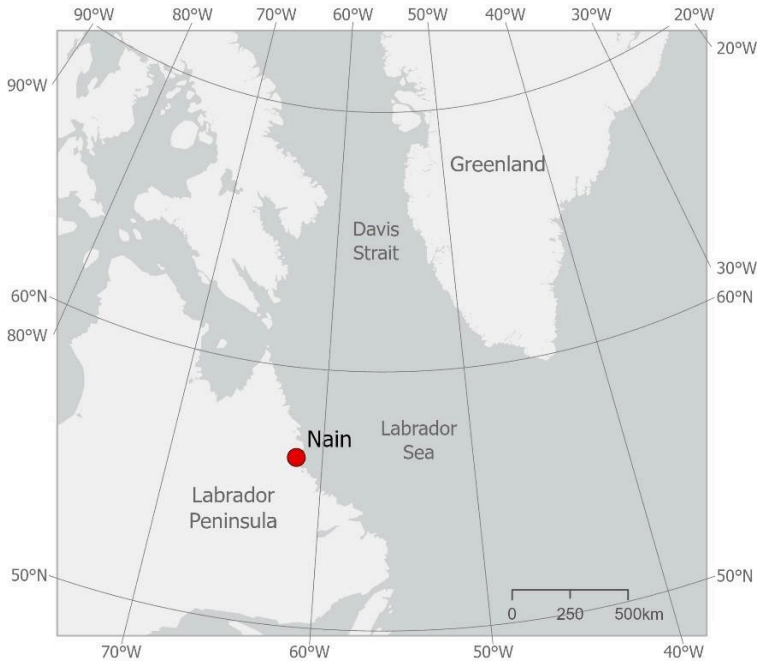


Fig. 2. Location of the study area

Bioclimatic conditions at the Nain station were estimated for a full 10 years of observations (1776–85) using three bioclimatic indices: Wind Chill Temperature (WCT), Insulation Predicted (Iclp) and Wind-Chill Index (WCI). For the calculation of the indices,

the daily meteorological measurements taken at 12:00 local time were used. In the abstract, however, we briefly present only the results of the most known WCT index, which indicates the risk of frostbite to parts of the body in specific weather conditions.

Thermal and bioclimatic conditions of the study period in the coastal part of Labrador were also compared to present-day ones.

Compared to the present day (1991–2010), the historical period of 1771–86 was colder in all months, but particularly in winter and autumn (Table 1, Fig. 3a). Mean annual air temperature was 2.4 °C colder than today. Analysis of Fig. 3a reveals that the majority of mean monthly air temperatures in historical times lie within two standard deviations of the modern mean. The average monthly GDD and ATI values in the period 1771–86 are usually very close to minimum values from 1991–2010. Most of the individual monthly values oscillate between average and minimum values from the contemporary period. The PDD during the cold season (Oct–Apr) in the period 1771–86 were noted mainly in April and October and their values were significantly lower than at present. On the other hand, the average monthly AFI values were clearly higher than the present-day norm.

Table 1. Mean monthly, seasonal and yearly differences between historical and contemporary periods of: 1) daily air temperature (T), temperature from 12h (T12), wind speed (V) and Wind Chill Temperature (WCT) index. Standard deviations (SD) were calculated using contemporary data from the reference periods.

| Variables | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | SON | DJF | MAM | JJA | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1771-86*** | | | | | | | | | | | | | | | | | |
| T(°C)* | -3.1 | -3.3 | -3.2 | -6.0 | -2.2 | -2.7 | -1.9 | -0.5 | -0.5 | -1.7 | -2.0 | -1.7 | -3.2 | -3.6 | -1.0 | -1.8 | -2.4 |
| 1 SD | 2.3 | 2.3 | 3.4 | 7.1 | 7.1 | 8.4 | 6.8 | 5.1 | 3.3 | 2.8 | 2.7 | 2.4 | 2.7 | 7.5 | 5.1 | 2.6 | 4.5 |
| **1776-85**** | | | | | | | | | | | | | | | | | |
| T12(°C) | -0.6 | -1.6 | -1.8 | -4.4 | -0.2 | 1.0 | 1.5 | 2.3 | 1.7 | 0.9 | 0.3 | 0.3 | -1.3 | -1.2 | 1.8 | 0.5 | -0.1 |
| 1 SD | 4.0 | 3.4 | 4.3 | 6.7 | 7.5 | 6.9 | 6.7 | 5.0 | 3.9 | 5.0 | 5.4 | 4.8 | 3.9 | 7.0 | 5.2 | 5.1 | 5.3 |
| V($m*s^{-1}$)# | -1.4 | -0.5 | -0.5 | -0.5 | 0.0 | 0.1 | -0.1 | -0.3 | -0.8 | -0.7 | -0.7 | -0.6 | -0.8 | -0.1 | -0.4 | -0.7 | -0.5 |
| 1 SD | 2.1 | 2.3 | 2.0 | 2.5 | 2.4 | 2.5 | 2.5 | 2.4 | 2.2 | 2.0 | 1.9 | 2.0 | 2.1 | 2.5 | 2.4 | 2.0 | 2.2 |
| WCT(°C) | 0.9 | -0.4 | -0.2 | -2.3 | 1.7 | 2.6 | 3.0 | 3.8 | 3.3 | 2.1 | 1.2 | 1.1 | 0.1 | 0.7 | 3.4 | 1.5 | 1.4 |
| 1 SD | 4.6 | 4.1 | 5.4 | 8.0 | 9.3 | 8.5 | 8.5 | 6.3 | 4.7 | 5.6 | 6.0 | 5.3 | 4.7 | 8.6 | 6.5 | 5.7 | 6.4 |

* – reference period 1991-2010

** – reference period 1991-2020

# – wind speed at a height of 1.2 m a.g.l.

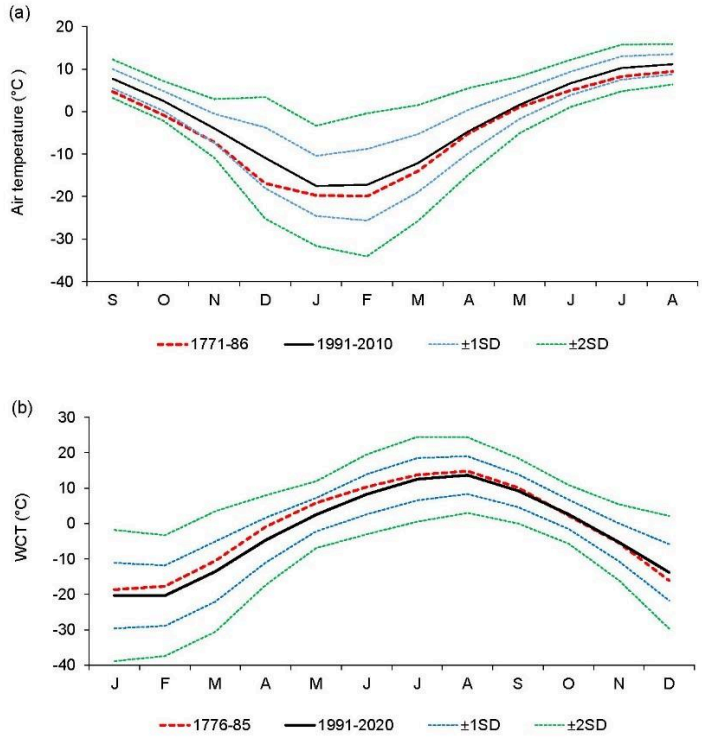


Fig. 3. Annual courses of historical and modern air temperatures (a) and WCTs (b) in Nain based on monthly means. SD calculated using present data.

Comparing the average monthly values of the WCT index at the Nain station in the historical period with the conditions prevailing there today, it is clearly visible that in the past there were more favourable bioclimatic conditions than currently, except period from October to December (Table 1, Fig. 3b). All monthly average historical values lie within the distance of one standard deviation from the present mean.

From February to June in the historical period, the monthly average conditions were much more favourable, the differences ranging from 2.1 to 3.8 °C (Table 1). From July to September, these differences were smaller (0.9–1.2 °C) but still more favourable in the historical period. Nowadays, the last three months of the year turned out to be more comfortable compared to the past, especially December, when the WCT was 2.3 °C higher than in historical times.

On the basis of this WCT index (and other indices not shown here), it follows that in the years 1776–85 in Nain, the bioclimatic conditions were more comfortable than current conditions. The main reason for this was wind conditions, i.e. smaller wind force in the historical period than at present (see Table 1).

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References:

Nordli, Ø., Wyszyński, P., Gjelten, H. M., Isaksen, K., Łupikasza, E., Niedźwiedź, T., and Przybylak, R., 2020, Revisiting the extended Svalbard Airport monthly temperature series, and the compiled corresponding daily series 1898–2018, Polar Res., 39, 3614, http://dx.doi.org/10.33265/polar.v39.3614.