# Assessing Changes in Arctic Heat Waves

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# Arctic heat wave severity does not depend on sea ice regimes.

## Background

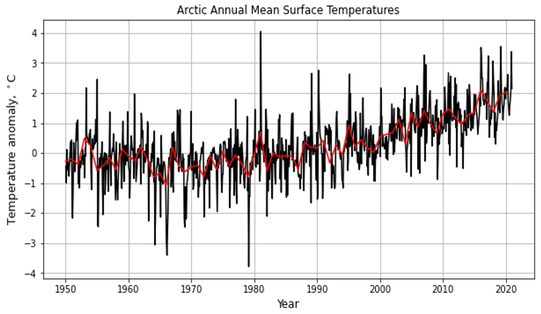



*Figure 1*:
NOAA surface temperature anomalies.
Monthly mean anomalies (**black**)
Annual mean anomalies (**red**).

## Methods

1. From CESM1, gather simulations **of daily minimum and maximum temperatures** from **Alert, Nunavut** and **Utqiagvik, Alaska** from **1920-2100**.
   - Alert has ice that does not melt out in summer.
   - Utqiagvik has ice that melts out in summer and refreezes in the winter.
2. Calculate a 90$^{th}$ percentile threshold of minimum and maximum temperatures (**CTN90pct**, **CTX90pct**) based on a 15-day window, where the window in center is the day in question.
   - **A heat wave is defined as three or more consecutive days above this 90$^{th}$ percentile threshold.**
3. Calculate yearly values of HWN, HWD, and HWF.
   - **HWD** – the length (in days) of the longest yearly event
   - **HWF** – the sum of participating heat wave days per year
   - **HWN** – the yearly number of heat waves

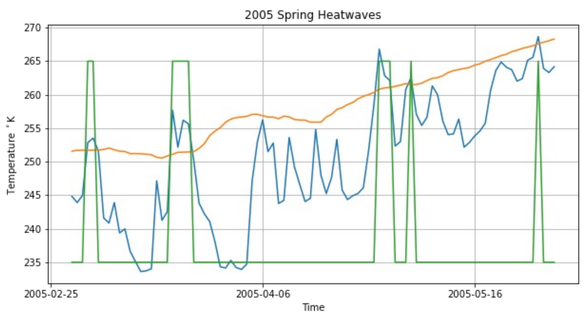
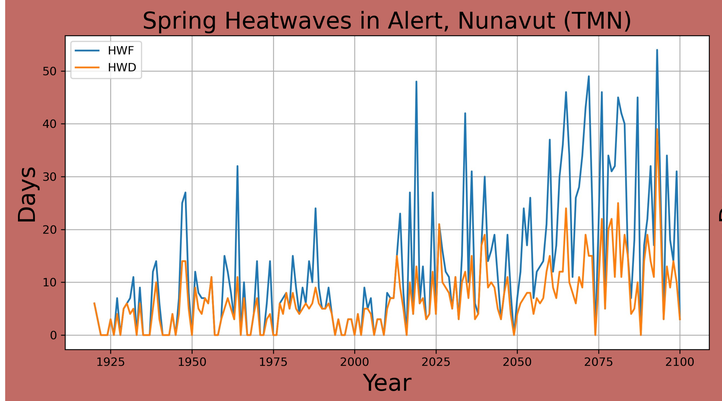


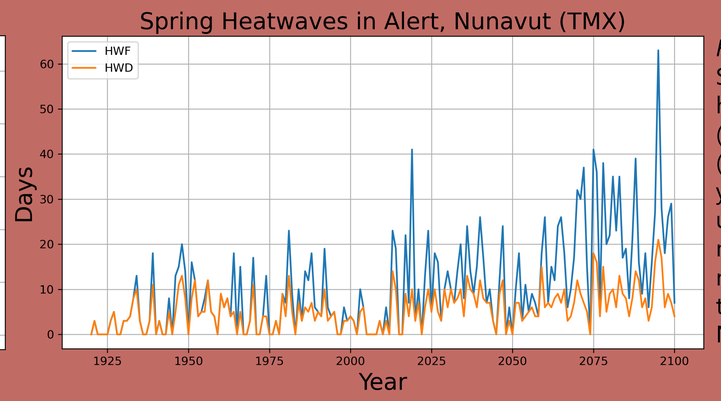

*Figure 2*:
Daily minimum temperatures (**blue**) with a 90$^{th}$ percentile threshold (**orange**) identifying heat waves in Spring 2005. Days above the threshold (**green**) make up a heat wave if three or more occur consecutively.

## Locations

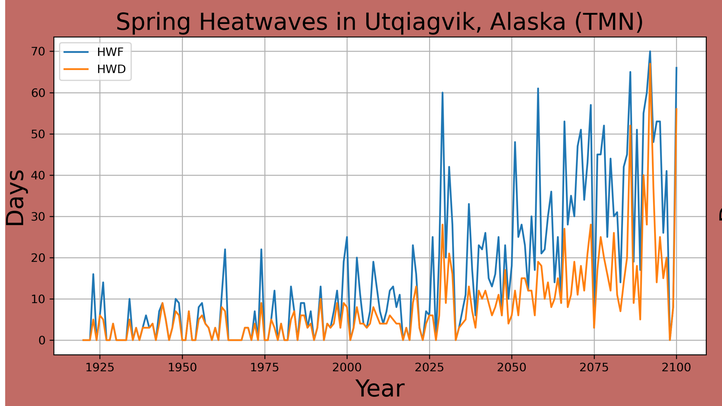

**Alert, Nunavut**
- Lat: 82.4977° N
- Long: -62.3559° W

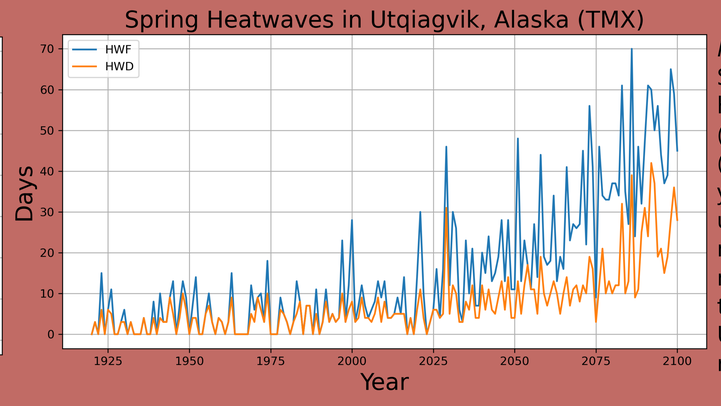
**Utqiagvik, Alaska**
- Lat: 71.2888° N
- Long: -156.7923° W




*Figures 3/4:*
Sum of participating heat wave days per year (**HWF**) and the length (in days) of the longest yearly event (**HWD**) using spring daily minimum (**TMN**) and maximum (**TMX**) temperatures in Alert, Nunavut, respectively.




*Figures 5/6:*
Sum of participating heat wave days per year (**HWF**) and the length (in days) of the longest yearly event (**HWD**) using spring daily minimum (**TMN**) and maximum (**TMX**) temperatures in Utqiagvik, Alaska, respectively.

## Key Points

- Regardless of location-specific thresholds, as the climate warms, heat waves increase.
- Maximum spring temperatures approach 0°C near the end of the 21st century, increasing the likelihood of a heat wave initiating sea ice melt.

## Future work

- Detect heat waves across the Arctic and quantify changing heat wave intensity.
- Use an absolute temperature threshold to calculate heat wave metrics (HWF, HWD, HWN): How does the frequency of these extreme events change?

***References***

1. Perkins, S. E., and L. V. Alexander, On the Measurement of Heat Waves, Journal of Climate, 26 (13), 4500–4517.
2. Stroeve, J. C., T. Markus, L. Boisvert, J. Miller, and A. Barrett, Changes in Arctic melt season and implications for sea ice loss, Geophysical Research Letters, 41 (4), 1216–1225.

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