*Last Updated:* 9/30/2024 by Sarah U.

**Heatwave Data Documentation**

**ZCTAs and CONUS Climate Divisions**

1. Download .kmz file from NCEI: <https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc%3AC00005>
2. Download ZCTA shapefile for CONUS: <https://hub.arcgis.com/datasets/c455b5fdb90f4734b9dda689f5cdf802/explore?location=31.063496%2C-66.807855%2C4.91>
3. In ArcGIS, conduct a spatial join using ‘largest overlap’ option
4. Each ZCTA should contain a climate region
5. Write off file as a .csv
6. Filter to just NC in RStudio
7. The resulting file is: NC\_ZCTA\_Climate\_Divisions.csv (located in project\_files/calculate\_metrics)

**Percentile Threshold**

**Data:**

1. PRISM daily time series of minimum, maximum, and average temperature at the zip code tabulation (ZCTA) level for North Carolina, from 01-01-2010 to 12-31-2020. (shared\_data/raw/PRISM/**NC\_PRISM\_ZIP\_2008\_2021.parquet**).
2. File relating ZCTAs to their CONUS Climate Division: **NC\_ZCTA\_Climate\_Divisions.csv**
3. Run both files through code/**calculate\_heatwave\_duration\_percentiles.R**
4. Resulting file is shared\_data/extreme\_heat\_metrics/relative\_threshold/**NC\_ZCTA\_Heatwaves\_2010\_2020\_v3.parquet**

**Methodology**

Percentile thresholds used to define heatwave events are derived at the climate region level. Climate region data is from the NOAA Monthly U.S. Climate Divisional Database. There are eight such climate regions across NC (NOAA). The use of regionally derived thresholds rather than fixed values or thresholds calculated across the entire state better accounts for local acclimatization to climate conditions (Grundstein & Dowd, 2011).

Zip code tabulation areas (ZCTAs) were grouped by their corresponding climate region, and temperature thresholds were calculated based on daily average, minimum, and maximum temperature values across all ZCTAs within the corresponding climate region for May through September of 2010 to 2020.

The 75th, 85th, 90th, 95th, 97.5th, and 99th percentile thresholds were calculated for each climate region for average, minimum, and maximum temperature values. The resulting values are shown in the columns *tmean*\_*pct\_75, tmin\_pct\_75, tmax\_pct\_75* thru *tmax\_pct\_99*. The value of *tmean\_pct\_90* (for instance) for a given location reflects the 90th percentile average temperature threshold for the corresponding climate region that ZCTA is located within.

*above\_tmean\_pct\_75, above\_tmin\_pct\_75, above\_tmax\_pct\_75* thru *above\_tmax\_pct\_99*, denote whether the average (*tmean*), minimum (*tmin*), or maximum (*tmean*) temperature for each ZCTA for each day during 2010 to 2020 was above the corresponding temperature threshold for that climate region. A value of ‘1’ for *above\_tmean\_pct\_95* for a ZCTA on a given day means the daily average temperature was in excess of the corresponding 95th percentile temperature threshold (*tmean\_pct\_95*)value for that ZCTA.

Heatwave events are defined based on incidences of consecutive days above a specified percentile threshold. Our analysis specifies a 2, 3, and 4-day duration of heat events above the 75th, 85th, 90th, 95th, 97.5th, and 99th percentiles for average, minimum, and maximum temperatures. The final day of a given heatwave event is denoted with a ‘1’ in the corresponding column (ex. *above\_tmean\_pct\_*75\_*two\_days*).

Bivariate heatwave events are defined as 2, 3, or 4 consecutive days where both the minimum and maximum daily temperature was above the respective minimum or maximum temperature threshold for that ZCTA (ex. *above\_tmin\_tmax\_pct\_90\_two\_days*).

|  |  |  |
| --- | --- | --- |
| **File:***NC\_ZCTA\_Heatwaves\_2010\_2020\_v3.parquet* | | |
| **Location:** shared\_data/extreme\_heat\_metrics/relative\_threshold | | |
| **Description:** Percentile threshold based heat events at the 2010 North Carolina ZCTA level for 2010 to 2020 | | |
| **Name** | **Type** | **Description** |
| tmin\_pct\_75 | value | Value of the 75th percentile minimum temperature threshold for the climate region that the ZCTA is located in. |
| tmax\_pct\_75 | value | Value of the 75th percentile maximum temperature threshold for the climate region that the ZCTA is located in. |
| tmean\_pct\_75 | value | Value of the 75th percentile average temperature threshold for the climate region that the ZCTA is located in. |
| tmin\_pct\_85 | value | Value of the 85th percentile minimum temperature threshold for the climate region that the ZCTA is located in. |
| tmax\_pct\_85 | value | Value of the 85th percentile maximum temperature threshold for the climate region that the ZCTA is located in. |
| tmean\_pct\_85 | value | Value of the 85th percentile average temperature threshold for the climate region that the ZCTA is located in. |
| tmin\_pct\_90 | value | Value of the 90th percentile minimum temperature threshold for the climate region that the ZCTA is located in. |
| tmax\_pct\_90 | value | Value of the 90th percentile maximum temperature threshold for the climate region that the ZCTA is located in. |
| tmean\_pct\_90 | value | Value of the 90th percentile average temperature threshold for the climate region that the ZCTA is located in. |
| tmin\_pct\_95 | value | Value of the 95th percentile minimum temperature threshold for the climate region that the ZCTA is located in. |
| tmax\_pct\_95 | value | Value of the 95th percentile maximum temperature threshold for the climate region that the ZCTA is located in. |
| tmean\_pct\_95 | value | Value of the 95th percentile average temperature threshold for the climate region that the ZCTA is located in. |
| tmin\_pct\_97.5 | value | Value of the 97.5th percentile minimum temperature threshold for the climate region that the ZCTA is located in. |
| tmax\_pct\_97.5 | value | Value of the 97.5th percentile maximum temperature threshold for the climate region that the ZCTA is located in. |
| tmean\_pct\_97.5 | value | Value of the 97.5th percentile average temperature threshold for the climate region that the ZCTA is located in. |
| tmin\_pct\_99 | value | Value of the 99th percentile minimum temperature threshold for the climate region that the ZCTA is located in. |
| tmax\_pct\_99 | value | Value of the 99th percentile maximum temperature threshold for the climate region that the ZCTA is located in. |
| tmean\_pct\_99 | value | Value of the 99th percentile average temperature threshold for the climate region that the ZCTA is located in. |
| above\_tmean\_pct\_75 | 0/1 | A value of 1 indicates the average temperature for the corresponding date and ZCTA was in excess of pct\_75. |
| above\_tmin\_pct\_75 | 0/1 | A value of 1 indicates the minimum temperature for the corresponding date and ZCTA was in excess of pct\_75. |
| above\_tmax\_pct\_75 | 0/1 | A value of 1 indicates the maximum temperature for the corresponding date and ZCTA was in excess of pct\_75. |
| above\_tmean\_pct\_85 | 0/1 | A value of 1 indicates the average temperature for the corresponding date and ZCTA was in excess of pct\_85. |
| above\_tmin\_pct\_85 | 0/1 | A value of 1 indicates the minimum temperature for the corresponding date and ZCTA was in excess of pct\_85. |
| above\_tmax\_pct\_85 | 0/1 | A value of 1 indicates the maximum temperature for the corresponding date and ZCTA was in excess of pct\_85. |
| above\_tmean\_pct\_90 | 0/1 | A value of 1 indicates the average temperature for the corresponding date and ZCTA was in excess of pct\_90. |
| above\_tmin\_pct\_90 | 0/1 | A value of 1 indicates the minimum temperature for the corresponding date and ZCTA was in excess of pct\_90. |
| above\_tmax\_pct\_90 | 0/1 | A value of 1 indicates the maximum temperature for the corresponding date and ZCTA was in excess of pct\_90. |
| above\_tmean\_pct\_95 | 0/1 | A value of 1 indicates the average temperature for the corresponding date and ZCTA was in excess of pct\_95. |
| above\_tmin\_pct\_95 | 0/1 | A value of 1 indicates the minimum temperature for the corresponding date and ZCTA was in excess of pct\_95. |
| above\_tmax\_pct\_95 | 0/1 | A value of 1 indicates the maximum temperature for the corresponding date and ZCTA was in excess of pct\_95. |
| above\_tmean\_pct\_97.5 | 0/1 | A value of 1 indicates the average temperature for the corresponding date and ZCTA was in excess of pct\_97.5. |
| above\_tmin\_pct\_97.5 | 0/1 | A value of 1 indicates the minimum temperature for the corresponding date and ZCTA was in excess of pct\_97.5. |
| above\_tmax\_pct\_97. | 0/1 | A value of 1 indicates the maximum temperature for the corresponding date and ZCTA was in excess of pct\_97.5. |
| above\_tmean\_pct\_99 | 0/1 | A value of 1 indicates the average temperature for the corresponding date and ZCTA was in excess of pct\_99. |
| above\_tmin\_pct\_99 | 0/1 | A value of 1 indicates the minimum temperature for the corresponding date and ZCTA was in excess of pct\_99. |
| above\_tmax\_pct\_99 | 0/1 | A value of 1 indicates the maximum temperature for the corresponding date and ZCTA was in excess of pct\_99. |
| above\_tmean\_pct\_75\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with an average temperature in excess of tmean\_pct\_75 for the specified ZCTA. |
| above\_tmean\_pct\_75\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with an average temperature in excess of tmean\_pct\_75 for the specified ZCTA. |
| above\_tmean\_pct\_75\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with an average temperature in excess of tmean\_pct\_75 for the specified ZCTA. |
| above\_tmin\_pct\_75\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a minimum temperature in excess of tmin\_pct\_75 for the specified ZCTA. |
| above\_tmin\_pct\_75\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a minimum temperature in excess of tmin\_pct\_75 for the specified ZCTA. |
| above\_tmin\_pct\_75\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a minimum temperature in excess of tmin\_pct\_75 for the specified ZCTA. |
| above\_tmax\_pct\_75\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a maximum temperature in excess of tmean\_pct\_75 for the specified ZCTA. |
| above\_tmax\_pct\_75\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a maximum temperature in excess of tmean\_pct\_75 for the specified ZCTA. |
| above\_tmax\_pct\_75\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum temperature in excess of tmean\_pct\_75 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_75\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_75 and tmin\_pct\_75 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_75\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_75 and tmin\_pct\_75 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_75\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum and minimum temperatures in excess of tmax\_pct\_75 and tmin\_pct\_75 for the specified ZCTA. |
| above\_tmean\_pct\_85\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with an average temperature in excess of pct\_85 for the specified ZCTA. |
| above\_tmean\_pct\_85\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with an average temperature in excess of pct\_85 for the specified ZCTA. |
| above\_tmean\_pct\_85\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with an average temperature in excess of pct\_85 for the specified ZCTA. |
| above\_tmin\_pct\_85\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a minimum temperature in excess of tmin\_pct\_85 for the specified ZCTA. |
| above\_tmin\_pct\_85\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a minimum temperature in excess of tmin\_pct\_85 for the specified ZCTA. |
| above\_tmin\_pct\_85\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a minimum temperature in excess of tmin\_pct\_85 for the specified ZCTA. |
| above\_tmax\_pct\_85\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a maximum temperature in excess of tmean\_pct\_85 for the specified ZCTA. |
| above\_tmax\_pct\_85\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a maximum temperature in excess of tmean\_pct\_85 for the specified ZCTA. |
| above\_tmax\_pct\_85\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum temperature in excess of tmean\_pct\_85 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_85\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_85 and tmin\_pct\_85 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_85\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_85 and tmin\_pct\_85 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_85\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum and minimum temperatures in excess of tmax\_pct\_85 and tmin\_pct\_85 for the specified ZCTA. |
| above\_tmean\_pct\_90\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with an average temperature in excess of tmean\_pct\_90 for the specified ZCTA. |
| above\_tmean\_pct\_90\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with an average temperature in excess of tmean\_pct\_90 for the specified ZCTA. |
| above\_tmean\_pct\_90\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with an average temperature in excess of tmean\_pct\_90 for the specified ZCTA. |
| above\_tmin\_pct\_90\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a minimum temperature in excess of tmin\_pct\_90 for the specified ZCTA. |
| above\_tmin\_pct\_90\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a minimum temperature in excess of tmin\_pct\_90 for the specified ZCTA. |
| above\_tmin\_pct\_90\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a minimum temperature in excess of tmin\_pct\_90 for the specified ZCTA. |
| above\_tmax\_pct\_90\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a maximum temperature in excess of tmean\_pct\_90 for the specified ZCTA. |
| above\_tmax\_pct\_90\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a maximum temperature in excess of tmean\_pct\_90 for the specified ZCTA. |
| above\_tmax\_pct\_90\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum temperature in excess of tmean\_pct\_90 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_90\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_90 and tmin\_pct\_90 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_90\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_90 and tmin\_pct\_90 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_90\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum and minimum temperatures in excess of tmax\_pct\_90 and tmin\_pct\_90 for the specified ZCTA. |
| above\_tmean\_pct\_95\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with an average temperature in excess of tmean\_pct\_95 for the specified ZCTA. |
| above\_tmean\_pct\_95\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with an average temperature in excess of tmean\_pct\_95 for the specified ZCTA. |
| above\_tmean\_pct\_95\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with an average temperature in excess of tmean\_pct\_95 for the specified ZCTA. |
| above\_tmin\_pct\_95\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a minimum temperature in excess of tmin\_pct\_95 for the specified ZCTA. |
| above\_tmin\_pct\_95\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a minimum temperature in excess of tmin\_pct\_95 for the specified ZCTA. |
| above\_tmin\_pct\_95\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a minimum temperature in excess of tmin\_pct\_95 for the specified ZCTA. |
| above\_tmax\_pct\_95\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a maximum temperature in excess of tmean\_pct\_95 for the specified ZCTA. |
| above\_tmax\_pct\_95\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a maximum temperature in excess of tmean\_pct\_95 for the specified ZCTA. |
| above\_tmax\_pct\_95\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum temperature in excess of tmean\_pct\_95 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_95\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_95 and tmin\_pct\_95 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_95\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_95 and tmin\_pct\_95 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_95\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum and minimum temperatures in excess of tmax\_pct\_95 and tmin\_pct\_95 for the specified ZCTA. |
| above\_tmean\_pct\_97.5\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with an average temperature in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| above\_tmean\_pct\_97.5\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with an average temperature in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| above\_tmean\_pct\_97.5\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with an average temperature in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| above\_tmin\_pct\_97.5\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a minimum temperature in excess of tmin\_pct\_97.5 for the specified ZCTA. |
| above\_tmin\_pct\_97.5\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a minimum temperature in excess of tmin\_pct\_97.5 for the specified ZCTA. |
| above\_tmin\_pct\_97.5\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a minimum temperature in excess of tmin\_pct\_97.5 for the specified ZCTA. |
| above\_tmax\_pct\_97.5\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a maximum temperature in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| above\_tmax\_pct\_97.5\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a maximum temperature in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| above\_tmax\_pct\_97.5\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum temperature in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_97.5\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_97.5 and tmin\_pct\_97.5 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_97.5\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_97.5 and tmin\_pct\_97.5 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_97.5\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum and minimum temperatures in excess of tmax\_pct\_97.5 and tmin\_pct\_97.5 for the specified ZCTA. |
| above\_tmean\_pct\_99\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with an average temperature in excess of tmean\_pct\_99 for the specified ZCTA. |
| above\_tmean\_pct\_99\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with an average temperature in excess of tmean\_pct\_99 for the specified ZCTA. |
| above\_tmean\_pct\_99\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with an average temperature in excess of tmean\_pct\_99 for the specified ZCTA. |
| above\_tmin\_pct\_99\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a minimum temperature in excess of tmin\_pct\_99 for the specified ZCTA. |
| above\_tmin\_pct\_99\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a minimum temperature in excess of tmin\_pct\_99 for the specified ZCTA. |
| above\_tmin\_pct\_99\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a minimum temperature in excess of tmin\_pct\_99 for the specified ZCTA. |
| above\_tmax\_pct\_99\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with a maximum temperature in excess of tmax\_pct\_99 for the specified ZCTA. |
| above\_tmax\_pct\_99\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with a maximum temperature in excess of tmax\_pct\_99 for the specified ZCTA. |
| above\_tmax\_pct\_99\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum temperature in excess of tmax\_pct\_99 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_99\_two\_days | 0/1 | A value of 1 indicates the final day of two consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_99 and tmin\_pct\_99 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_99\_three\_days | 0/1 | A value of 1 indicates the final day of three consecutive days with maximum and minimum temperatures in excess of tmax\_pct\_99 and tmin\_pct\_99 for the specified ZCTA. |
| above\_tmin\_tmax\_pct\_99\_four\_days | 0/1 | A value of 1 indicates the final day of four consecutive days with a maximum and minimum temperatures in excess of tmax\_pct\_99 and tmin\_pct\_99 for the specified ZCTA. |

**Excess Heat Factor (EHF)**

**Data:**

1. PRISM daily time series of minimum, maximum, and average temperature at the zip code tabulation (ZCTA) level for North Carolina, from 01-01-2010 to 12-31-2020. (shared\_data/raw/PRISM/**NC\_PRISM\_ZIP\_2008\_2021.parquet**).
2. Run file through code/**calculate-ehf.R**
3. Resulting file is shared\_data/extreme\_heat\_metrics/ehf/ **EHF\_Heatwave\_Metrics\_NC\_ZCTA\_2010\_2020.parquet**

To calculate the EHF:

First, the Excessive Heat Index (EHI) is determined, which is the value of the 3 day temperature average subtracted from the 95th percentile of heat.

* EHI <- (3 Day temperature average) - 95th temperature percentile

**EHI\_accl** is the value of the 3 day average subtracted from the previous 30 day average temperature

* EHI\_accl <- (3 Day temperature average) - (previous 30 day temperature average)

**EHI\_sig** is when the EHI is positive

* EHI\_sig <- fifelse(EHI < 0, 0, EHI)

**EHF** is the product of a positive EHI\_sig multiplied by which ever is greater, 1, or the EHI\_accl

* EHF <- EHI\_sig \* max(1, EHI\_accl)

**No\_Heatwave** = (daynum - Heatwave\_condition)

* Daynum is a value of 1 and is subtracted from the a column indicating if there was a heatwave or not, meaning a value of 1 is a day of no heatwave

**Heatwave\_days** = (Heatwave\_condition)

* This is a renaming of the column Heatwave\_condition, which receives a value of 1 for that day when the 3 day average that that day is within is above the 95th percentile for temperature, as well as the previous 30 day average being less then the 3 day average.

**Severe\_Heatwaves** = (ifelse(EHF >= EHF85, 1, 0))

* This receives a value of 1 if the EHF for that day is equal to or greater than the 85th percentile of all EHF for that area.

**Extreme\_Heatwaves** = (ifelse(EHF >= (3 \* EHF85), 1, 0))

* This receives a value of 1 if the EHF for that day is equal to or greater than 3 times the 85th percentile of all EHF for that area.

**low\_intensity** = (ifelse(EHF > 0 & EHF < 1, 1, 0))

* This receives a value of 1 if the EHF for that day is greater than 0 and less than 1.

**moderate\_intensity** = (ifelse(EHF >= 1 & EHF < 2, 1, 0))

* This receives a value of 1 if the EHF for that day is greater than or equal to 1 and less than 2.

**high\_intensity** = (ifelse(EHF >= 2, 1, 0)),

* This receives a value of 2 if the EHF is greater than or equal to 2.

**Heat Index**

**Data:**

1. PRISM daily time series of relative humidity and minimum, maximum, and average temperature at the zip code tabulation (ZCTA) level for North Carolina, from 01-01-2010 to 12-31-2020. (shared\_data/raw/PRISM/**Heatwave\_Metrics.parquet**).
2. File relating ZCTAs to their CONUS Climate Division: **NC\_ZCTA\_Climate\_Divisions.csv**
3. Run both files through code/**calculate-heat-index.R**
4. Resulting file is shared\_data/extreme\_heat\_metrics/heat-index/ **heatwaves\_heat\_index\_nc\_zcta\_2010\_2020\_v2.parquet**

**Methodology**

Heatwaves are defined using heat index-based percentile thresholds at the climate region level.

Climate region data is from the NOAA Monthly U.S. Climate Divisional Database. There are eight such climate regions across NC (NOAA). The use of regionally derived heat index thresholds rather than fixed values or thresholds calculated across the entire state better accounts for local acclimatization to climate conditions (Grundstein & Dowd, 2011).

Zip code tabulation areas (ZCTAs) were grouped by their corresponding climate region, and heat index thresholds were calculated based on daily average temperature and relative humidity values across all ZCTAs within the corresponding climate region for May through September of 2010 to 2020.

The 75th, 85th, 90th, 95th, 97.5th, and 99th percentile heat index thresholds were calculated for each climate region. The resulting values are shown in the columns *HI\_pct\_75* thru *HI\_pct\_99*.

*above\_HI\_pct\_75* thru *above\_HI\_pct\_99*, denote whether the heat index (*HI*) for each ZCTA for each day during 2010 to 2020 was above the corresponding threshold for that climate region. A value of ‘1’ for *above\_HI\_pct\_95* for a ZCTA on a given day means the daily heat index was in excess of the corresponding 95th percentile temperature threshold (*HI\_pct\_95*)value for that ZCTA.

Heatwave events are defined based on incidences of consecutive days above a specified percentile threshold. Our analysis specifies a 2, 3, and 4-day duration of heat events above the 75th, 85th, 90th, 95th, 97.5th, and 99th heat index percentiles. The final day of a given heatwave event is denoted with a ‘1’ in the corresponding column (ex. *two\_HI\_days\_90*).

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| **File:***heatwaves\_heat\_index\_nc\_zcta\_2010\_2020\_v2.parquet* | | |
| **Location:** shared\_data/extreme\_heat\_metrics/heat-index | | |
| **Description:** Heat Index based heatwave events at the 2010 North Carolina ZCTA level for 2010 to 2020 | | |
| **Name** | **Type** | **Description** |
| RH | Value | Daily relative humidity value |
| HI | value | Daily Heat Index value |
| HI\_pct\_75 | value | Value of the 75th percentile heat index threshold for the climate region that the ZCTA is located in. |
| HI\_pct\_85 | value | Value of the 85th percentile heat index threshold for the climate region that the ZCTA is located in. |
| HI\_pct\_90 | value | Value of the 90th percentile heat index threshold for the climate region that the ZCTA is located in. |
| HI\_pct\_95 | value | Value of the 95th percentile heat index threshold for the climate region that the ZCTA is located in. |
| HI\_pct\_97.5 | value | Value of the 97.5th percentile heat index threshold for the climate region that the ZCTA is located in. |
| HI\_pct\_99 | value | Value of the 99th percentile heat index threshold for the climate region that the ZCTA is located in. |
| above\_HI\_pct\_75 | 0/1 | A value of 1 indicates the heat index for the corresponding date and ZCTA was in excess of pct\_75. |
| above\_HI\_pct\_85 | 0/1 | A value of 1 indicates the heat index for the corresponding date and ZCTA was in excess of pct\_85. |
| above\_HI\_pct\_90 | 0/1 | A value of 1 indicates the heat index for the corresponding date and ZCTA was in excess of pct\_90. |
| above\_HI\_pct\_95 | 0/1 | A value of 1 indicates the heat index for the corresponding date and ZCTA was in excess of pct\_95. |
| above\_HI\_pct\_97.5 | 0/1 | A value of 1 indicates the heat index for the corresponding date and ZCTA was in excess of pct\_97.5. |
| above\_HI\_pct\_99 | 0/1 | A value of 1 indicates the heat index for the corresponding date and ZCTA was in excess of pct\_99. |
| two\_HI\_days\_75 | 0/1 | A value of 1 indicates the final day of two consecutive days with heat index in excess of tmean\_pct\_75 for the specified ZCTA. |
| three\_HI\_days\_75 | 0/1 | A value of 1 indicates the final day of three consecutive days with a heat index in excess of tmean\_pct\_75 for the specified ZCTA. |
| four\_HI\_days\_75 | 0/1 | A value of 1 indicates the final day of four consecutive days with a heat index in excess of tmean\_pct\_75 for the specified ZCTA. |
| two\_HI\_days\_85 | 0/1 | A value of 1 indicates the final day of two consecutive days with heat index in excess of tmean\_pct\_85 for the specified ZCTA. |
| three\_HI\_days\_85 | 0/1 | A value of 1 indicates the final day of three consecutive days with a heat index in excess of tmean\_pct\_85 for the specified ZCTA. |
| four\_HI\_days\_85 | 0/1 | A value of 1 indicates the final day of four consecutive days with a heat index in excess of tmean\_pct\_85 for the specified ZCTA. |
| two\_HI\_days\_90 | 0/1 | A value of 1 indicates the final day of two consecutive days with heat index in excess of tmean\_pct\_90 for the specified ZCTA. |
| three\_HI\_days\_90 | 0/1 | A value of 1 indicates the final day of three consecutive days with a heat index in excess of tmean\_pct\_90 for the specified ZCTA. |
| four\_HI\_days\_90 | 0/1 | A value of 1 indicates the final day of four consecutive days with a heat index in excess of tmean\_pct\_90 for the specified ZCTA. |
| two\_HI\_days\_95 | 0/1 | A value of 1 indicates the final day of two consecutive days with heat index in excess of tmean\_pct\_95 for the specified ZCTA. |
| three\_HI\_days\_95 | 0/1 | A value of 1 indicates the final day of three consecutive days with a heat index in excess of tmean\_pct\_95 for the specified ZCTA. |
| four\_HI\_days\_95 | 0/1 | A value of 1 indicates the final day of four consecutive days with a heat index in excess of tmean\_pct\_95 for the specified ZCTA. |
| two\_HI\_days\_97.5 | 0/1 | A value of 1 indicates the final day of two consecutive days with heat index in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| three\_HI\_days\_97.5 | 0/1 | A value of 1 indicates the final day of three consecutive days with a heat index in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| four\_HI\_days\_97.5 | 0/1 | A value of 1 indicates the final day of four consecutive days with a heat index in excess of tmean\_pct\_97.5 for the specified ZCTA. |
| two\_HI\_days\_99 | 0/1 | A value of 1 indicates the final day of two consecutive days with heat index in excess of tmean\_pct\_99 for the specified ZCTA. |
| three\_HI\_days\_99 | 0/1 | A value of 1 indicates the final day of three consecutive days with a heat index in excess of tmean\_pct\_99 for the specified ZCTA. |
| four\_HI\_days\_99 | 0/1 | A value of 1 indicates the final day of four consecutive days with a heat index in excess of tmean\_pct\_99 for the specified ZCTA. |