

EXPERIMENTAL

HeatRisk

Expanding a New Heat Service to the CONUS

Updates and Impact-Based Verification

21st Annual CPASW

March 26, 2024, Tallahassee, FL

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Take a HIKE. Do it RIGHT.

More than 200 hikers annually are rescued from City of Phoenix desert and mountain parks and preserves. This simple checklist can help keep you from becoming a statistic.

Watch the Weather:
Pay attention to the weather. Heatstroke is a leading cause of death among hikers. Watch for early mornings and evenings when there's more shade.

Dress Appropriately:
Wear proper shoes, clothing, hat and sunscreen.

Bring Water:
Hydrate before you go. Have plenty of water, more than you think you need. Turn around and head back to the trailhead before you drink half of your water.

Team Up:
Hike with others. If hiking solo, tell someone your start and end times, and location.

Keep in Contact:
Carry a mobile phone.

Be Honest:
Do you have a medical condition, heart problem, diabetes, knee or back problem? If you're unsure, tell your hiking partner. They may be able to help you get out safely.

Don't Trailblaze:
Only use the Service Board's hand-cut and uncut paths. Do not create new paths. If you do, please mark them with orange flags.

Take Responsibility:
If you're the one who needs help, shouldn't have been here for health reasons or ignored safety guidelines, be the responsible hiker who takes it like an adult and says I'm Right.

A public service message from the City of Phoenix Parks & Recreation Department and Fire Department

www.phoenix.gov

Heat Warning

In Effect April - October

Hike when it's cooler, early morning or evening.

TURN AROUND BEFORE YOUR WATER IS 1/2 WAY GONE!

Each year hikers suffer serious illness or death from heat exhaustion.

www.phoenix.gov

HIKE RIGHT





Developing a Modern Heat Service



Leverage Peer Reviewed Heat-Health Science consistently:

- **Acclimation** of heat important
- Communities adapt and build to local climatology
- Everyone has differing heat tolerance
- Duration and time of year matter

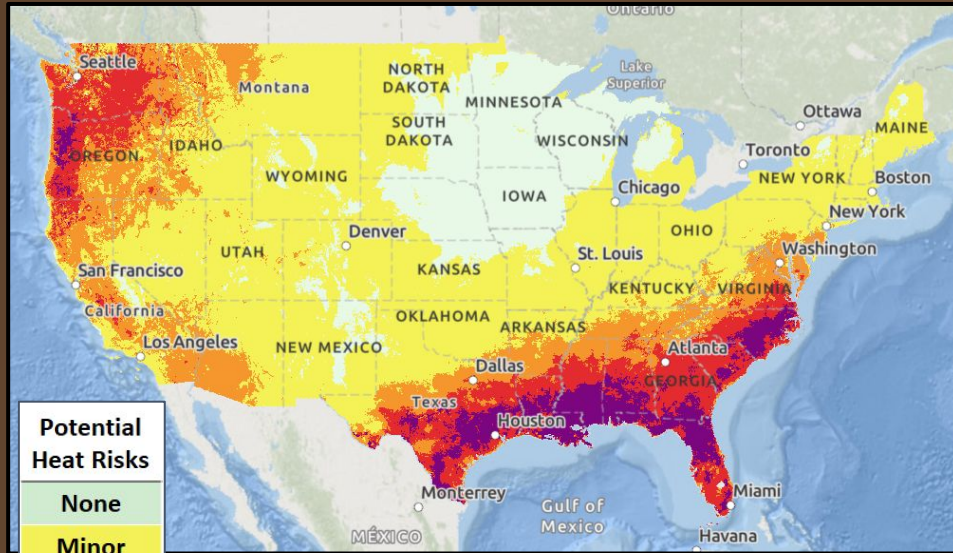
Incorporate nationally consistent CDC expert heat-health model-derived data

Heat Service should be:

- easy to understand + communicate
- available everyday at all locations
- consistent with the 7-day NWS forecast
- automated



Experimental HeatRisk



Potential Heat Risks
None
Minor
Moderate
Major
Extreme

NBM-based example forecast
Valid: Mon Aug 14 2023

Gives customers/partners a **color/numeric-based framework** to act when they need to.

Builds **national consistency and science** into our messaging efforts & legacy products.

Puts NWS forecast temperatures into a **climatological context** based on location & time of year.

Leverages NCEI 1991-2020 Normals and **CDC collaboration**.

Expanding Across CONUS April 2024!

HeatRisk Levels



Extreme (4)

Rare long duration and/or extreme event, extreme risk of widespread heat-related impacts (including illness and mortality) for anyone without effective cooling and/or hydration. Both min and max temps above 95th percentile for 2+ days and/or near all-time records.

Major (3)

Major risk of widespread heat-related impacts (including illness and mortality) for anyone without effective cooling and/or hydration.

Excessively warm day and nights (generally above 95th percentile).

Moderate (2)

Moderate risk of heat-related impacts, **mostly in "at risk" populations** without effective cooling and/or hydration, primarily heat-related illness. Non-zero, but low, risk of heat-related mortality expected. "Hot" during the day, "warm" at night to general population in normally cooler climates.

Minor (1)

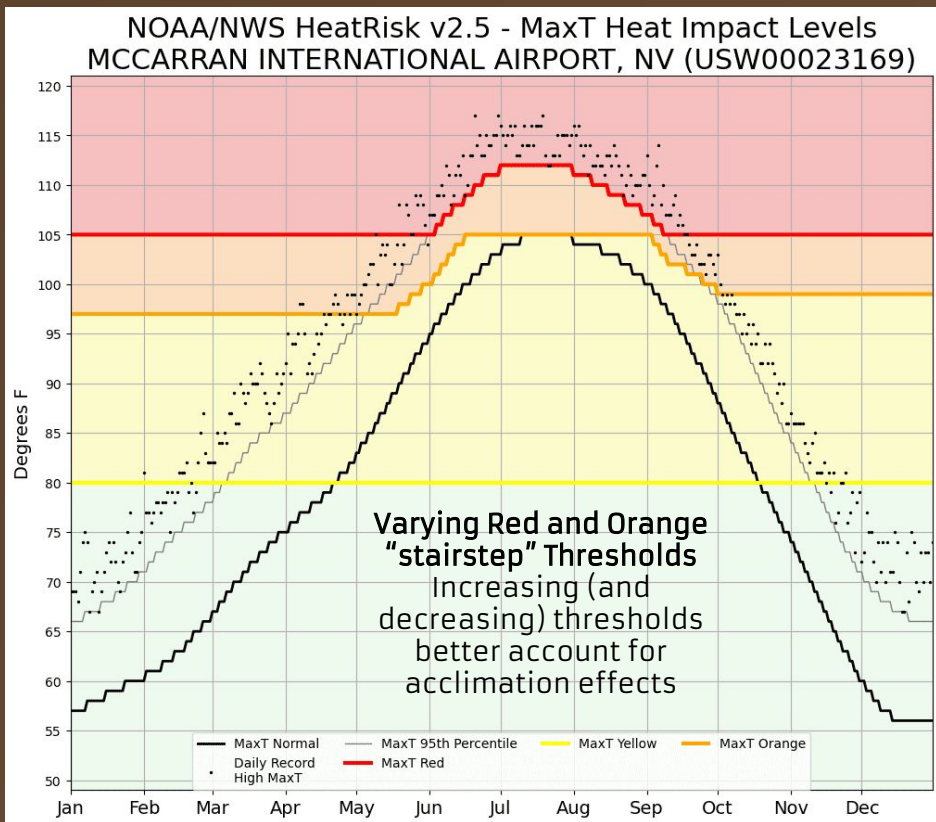
Minor risk in "at risk" populations. Minor spike in heat illness. Non-zero, but very low, risk of mortality expected.

None (0) Little to no risk from expected heat.





HeatRisk - How It Works



High (Red) Threshold

Based on temperature associated with 50th percentile of CDC heat-attributable deaths. Where applicable, increases when 95th POR temperature percentile is intersected.

Moderate (Orange) Threshold

Permutations of the Red and Yellow values, taking into account the time of year (Spring vs Fall) and CDC data, along with capping at the Red base value (where applicable) to better account for less acclimation in heat-sensitive groups.

Low (Yellow) Threshold

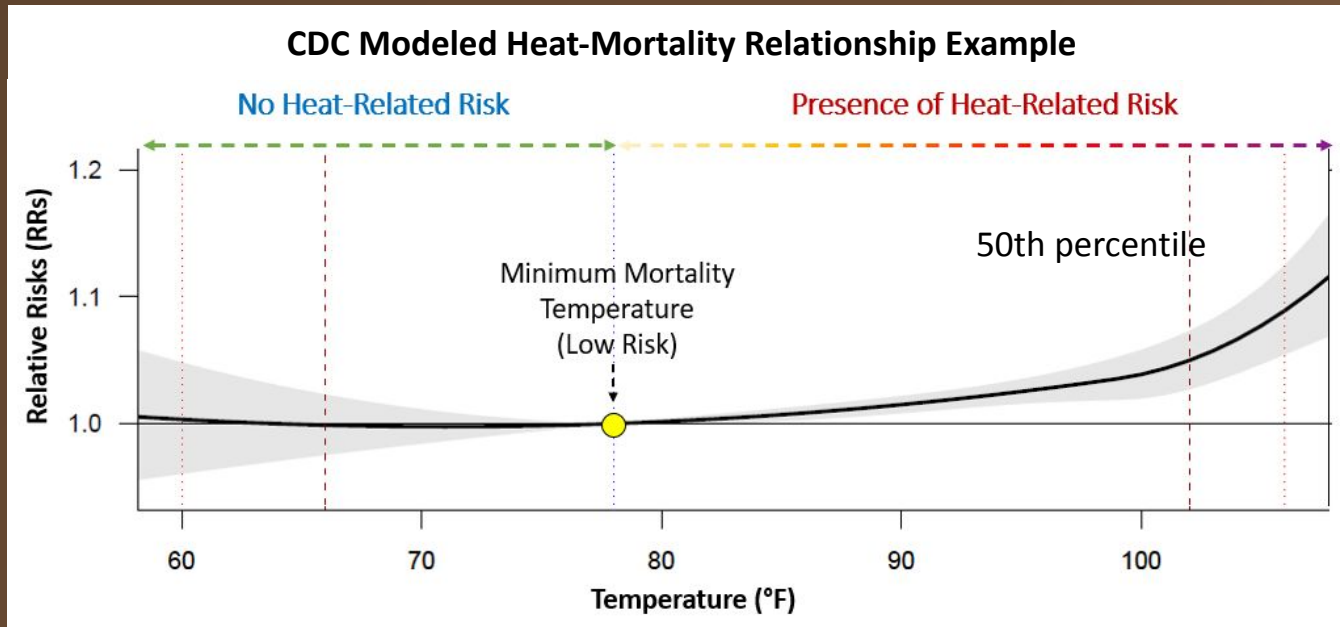
Based on CDC Minimum Mortality Temperature; nearly all heat-attributable deaths occur above this.

Daily Records (POR)
95th Percentile (1970-2020)
NCEI 1991-2020 Normals

Thresholds for MinT are also generated and used



HeatRisk - How It Works

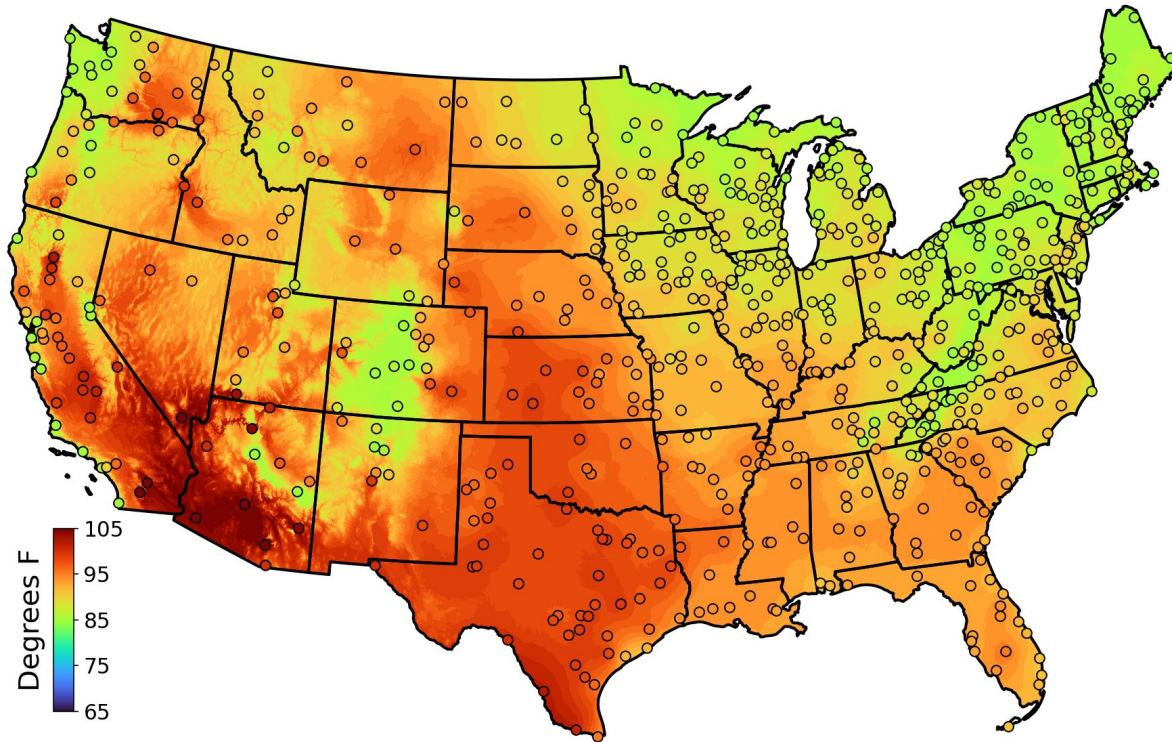


Minimum mortality temperature: The temperature value at which effect of cold is not observed and the effect of heat starts to increase.
(Source: CDC)

Temperature at the 50th Percentile of Heat Attributable Deaths

HeatRisk - How It Works

Red MaxT Base Threshold

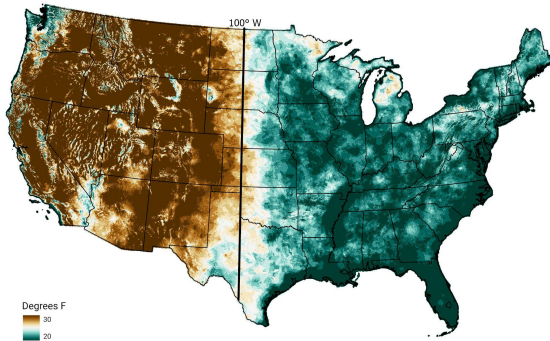


Map of the Red maximum temperature threshold across the US based on CDC-derived data for ~700 stations.

Point Data distributed using PRISM high resolution climate grids

Accounting for Humidity

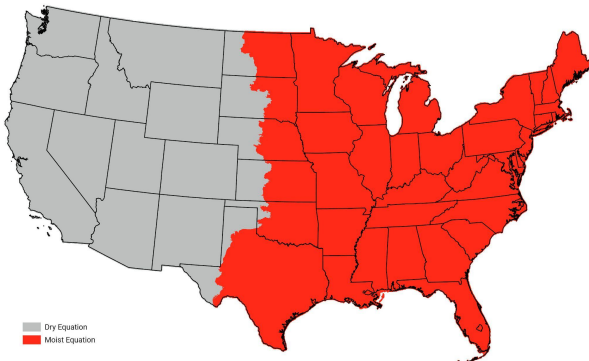
HeatRisk v2.5 - Max(Nmax)-Max(Nmin)



Locations with “humid” climates exhibit **smaller annual ranges in diurnal values** (highest daily maximum normal temperature minus the highest daily minimum normal temperature). White/Green areas are where those differences are ≤ 26 degrees.

We use this relationship to lower MinT red thresholds in moist and warm climates and raise MinT red thresholds in dry climates.

HeatRisk v2.5 - 24hr Dry vs Moist Equations



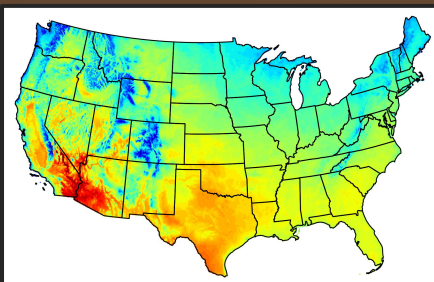
Algorithms to calculate 24 hour final values of HeatRisk also give **greater influence to minimum temperature (humidity) contributions** to estimate heat risk where this range is $\leq 26^\circ\text{F}$ and east of 104°W (red area with any “islands” filled in).



HeatRisk - How It Works

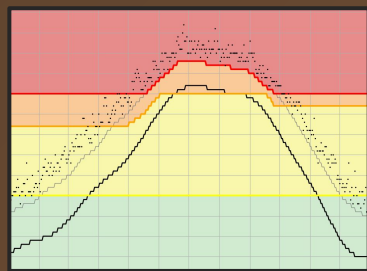
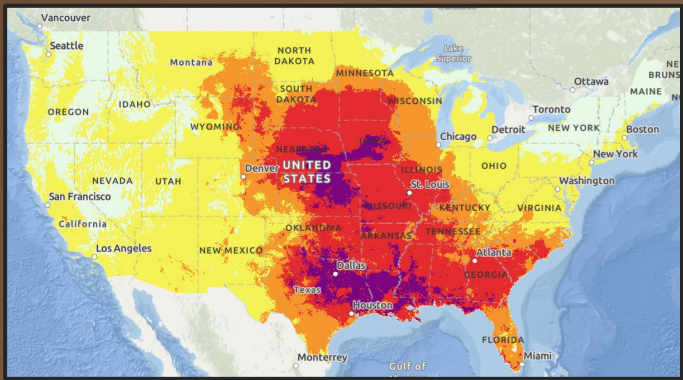


~3100 Stations

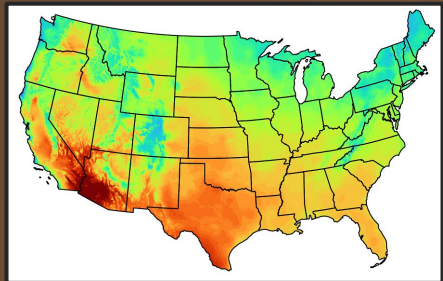


OSU PRISM Normals

Daily 24-hr Experimental HeatRisk



Climate & ~700 CDC Point Thresholds



MaxT/MinT HIL Gridded Daily Thresholds

General Information

NDFD
NWS National Digital Forecast Database



MaxT HIL Values (today)

MinT HIL Values (today/tomorrow)

Magenta - Two or three consecutive days and nights are all \geq 95th percentile, and/or highs are near or above all time records



HeatRisk Web Service (WR)

National Weather Service
National Oceanic and Atmospheric Administration

NWS Experimental HeatRisk
Identifying Potential Heat Risks in the Seven Day Forecast

Mon 8/21 Tue 8/22 Wed 8/23 Thu 8/24 Fri 8/25 Sat 8/26 Sun 8/27

Click map for potential heat risks and NWS forecast for a location.

The NWS Experimental HeatRisk is a color-numeric-based index that provides a forecast risk of heat-related impacts to occur over a 24-hour period. HeatRisk takes into consideration:

- How unusual the heat is for the time of the year
- The duration of the heat including both daytime and nighttime temperatures
- If those temperatures pose an elevated risk of heat-related impacts based on data from the CDC

This index is supplementary to official NWS heat products and is meant to provide risk guidance for those decision makers and heat-sensitive populations who need to take actions at levels that may be below current NWS heat product levels.

Category	Risk of Heat-Related Impacts
Green 0	Little to no risk from expected heat.
Yellow 1	Minor - This level of heat affects primarily those individuals extremely sensitive to heat, especially when outdoors without effective cooling and/or adequate hydration.
Orange 2	Moderate - This level of heat affects most individuals sensitive to heat, especially those without effective cooling and/or adequate hydration. Impacts possible in some health systems and in heat-sensitive industries.
Red 3	Major - This level of heat affects anyone without effective cooling and/or adequate hydration. Impacts likely in some health systems, heat-sensitive industries and infrastructure.
Magenta 4	Extreme - This level of rare and/or long-duration extreme heat with little to no overnight relief affects anyone without effective cooling and/or adequate hydration. Impacts likely in most health systems, heat-sensitive industries and infrastructure.

Comments? Questions? Please Contact Us.

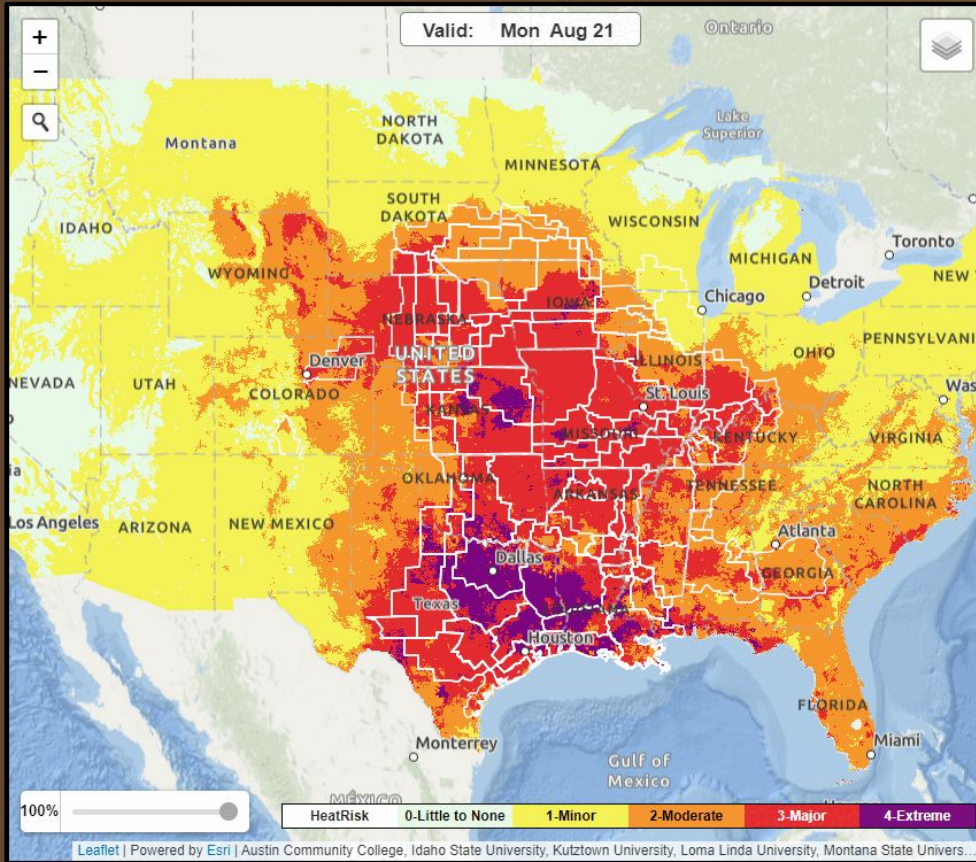
Map Overview What's in HeatRisk? Understanding HeatRisk CDC-NWS Collaboration Verification Looking for Resources?

HeatRisk 0-Little to None 1-Minor 2-Moderate 3-Major 4-Extreme

Real-time HeatRisk output is now available anywhere in the CONUS.

Available information includes daily interactive maps with active WWA and social vulnerability layers, point-based forecasts, overview of HeatRisk including a definition of each level, static images, KML and GeoTIFF files.

Legacy Products



Example of Daily HeatRisk (colors) and NWS heat products (white outlined polygons) during a significant heat event in August 2023. Note the general connection between high values of HeatRisk and legacy heat products issued using Heat Index criteria.

For a Weather-Ready Nation, we strive to provide risk-oriented and actionable heat-related information to a wide spectrum of users.

While HeatRisk provides the framework for a continuum of heat services, we recognize that there is still a place for legacy WWA products. The internal HeatRisk process (GFE) provides information to assist meteorologists in making heat alert decisions.

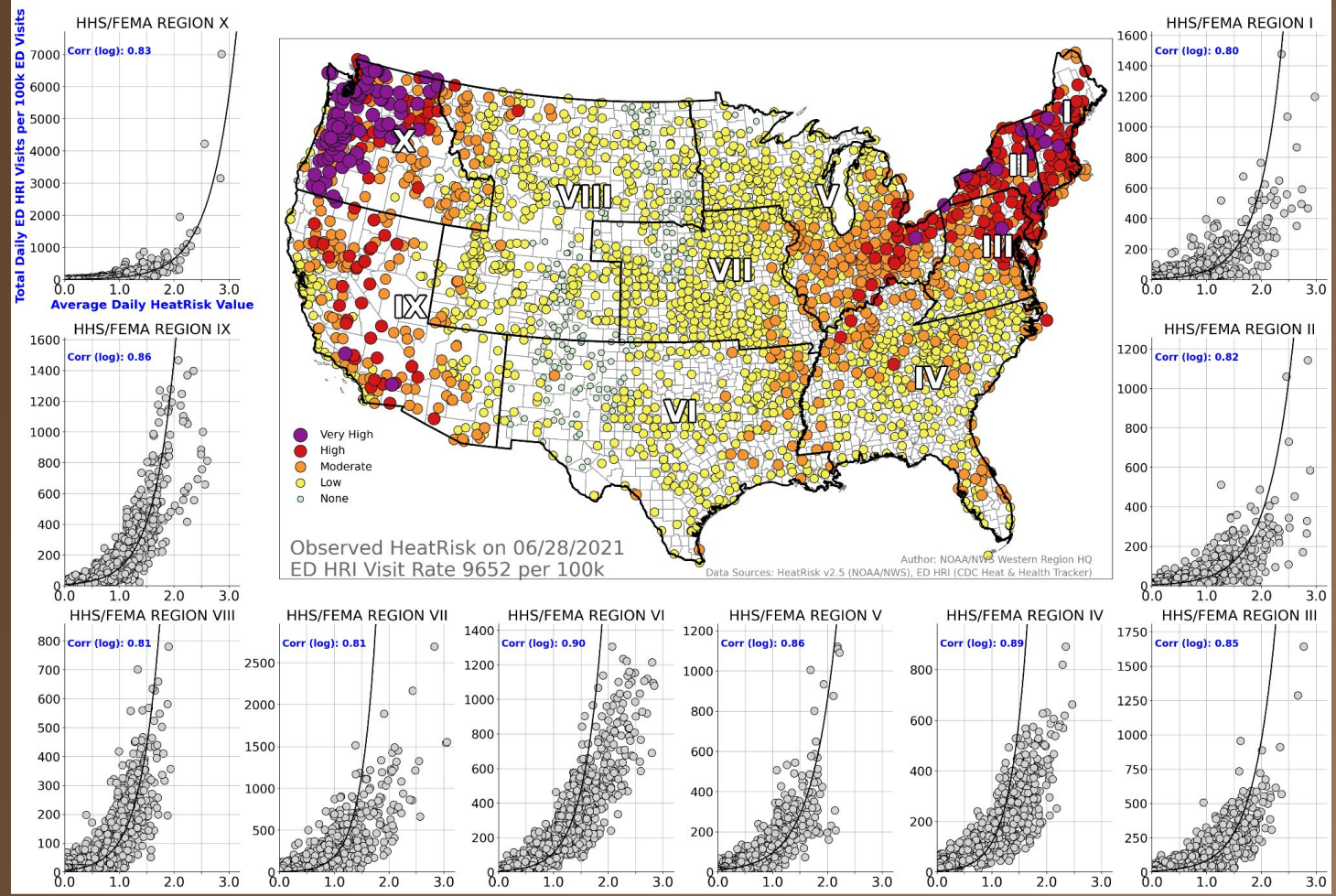
Having the HeatRisk forecast to 7 days allows partners to identify upcoming heat ahead of our heat WWA for a more seamless forecast.



Impact-Based Verification

Comparing regional observed HeatRisk values (FEMA regions) against emergency dept. (ED) heat-related illness (HRI) for the combined 2019-2023 heat seasons found a **strong** correlation (0.80-0.90).

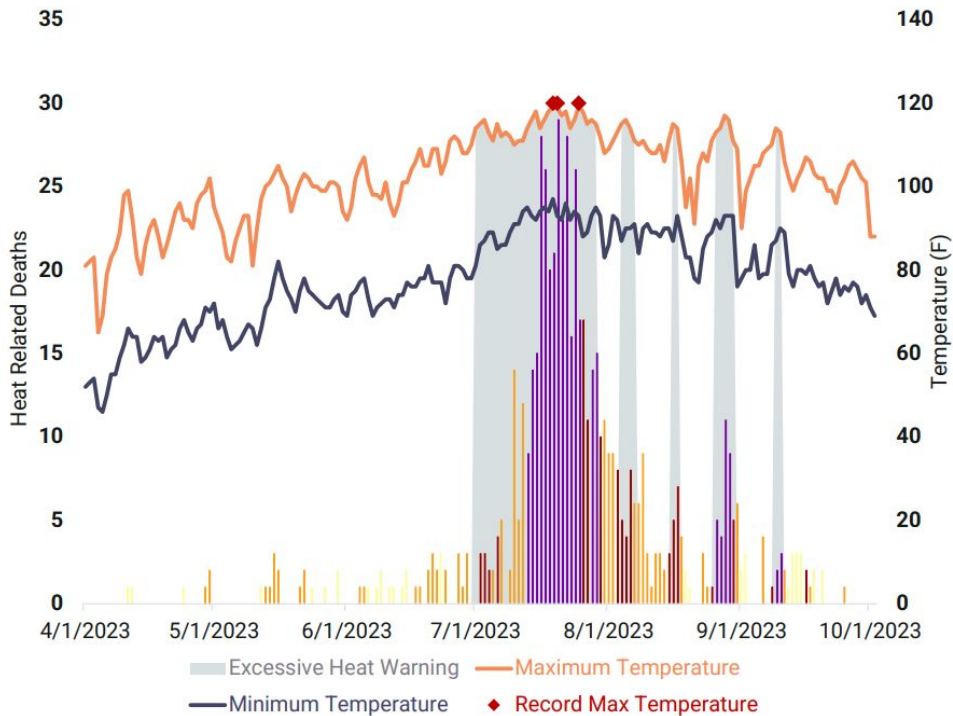
Analysis of Daily HeatRisk Values and Emergency Department Heat-Related Injury Visits for Apr 1st through Oct 31st from 2019 to 2023





Impact-Based Verification Examples

Daily temperatures were not below 91 degrees from July 10th – July 25th. **During these two weeks, 303 deaths occurred.** A new top 5 record-breaking hottest temperatures of 119 occurred on July 19th, 20th, and 25th in Maricopa County.



Over half of all heat related deaths in 2023 occurred on days where heat risk was calculated as extreme. There were 21 days in 2023 where the NWS calculated an extreme heat risk.

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For more information: National Weather Service <https://www.weather.gov/psr/heat>

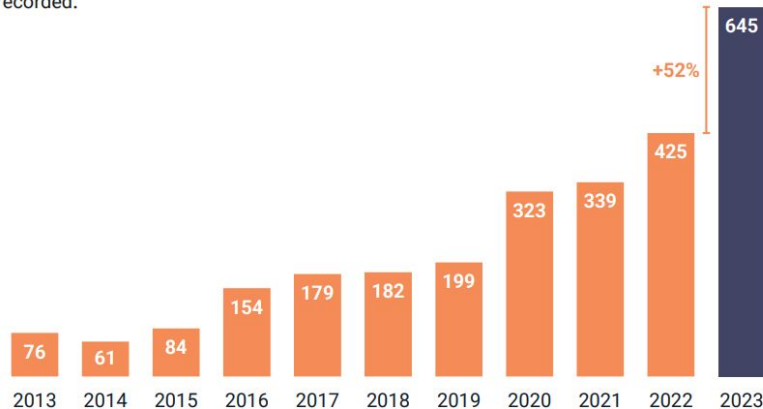
None	Minor	Moderate	Major	Extreme
No risk.	Risk to those extremely sensitive to heat.	Risk to those sensitive to heat.	Risk to most people.	Risk to everyone.
7%	24%	15%	52%	

Heat Related Deaths Over Time

Deaths by Year

Maricopa County identified a total of 645 heat related deaths occurring in 2023.

This represents a 52 percent increase from last year and the most heat related deaths ever recorded.



* 1 death that occurred in September of 2023 is pending a cause of death

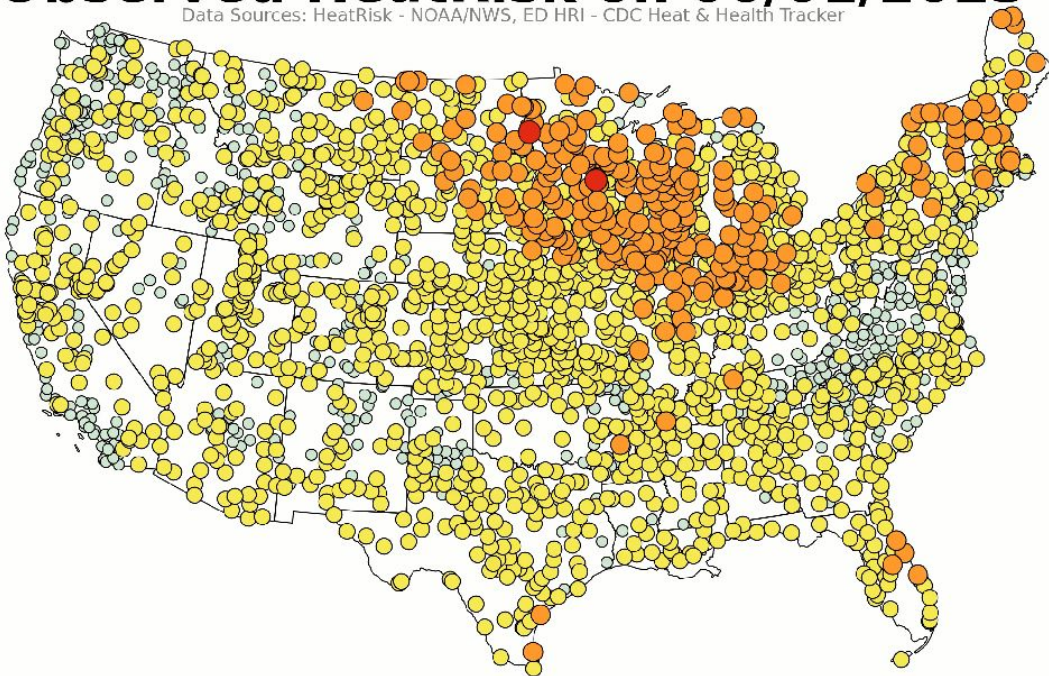


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HeatRisk

Observed HeatRisk on 06/01/2023

Data Sources: HeatRisk - NOAA/NWS, ED HRI - CDC Heat & Health Tracker



Next Steps

- Point-based Probabilistic HeatRisk Service
- Historical data delivery

THANK YOU!

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