

Actuarial Weather Extremes Series

U.S. Heat Wave: June 13-15, 2022

Authors:

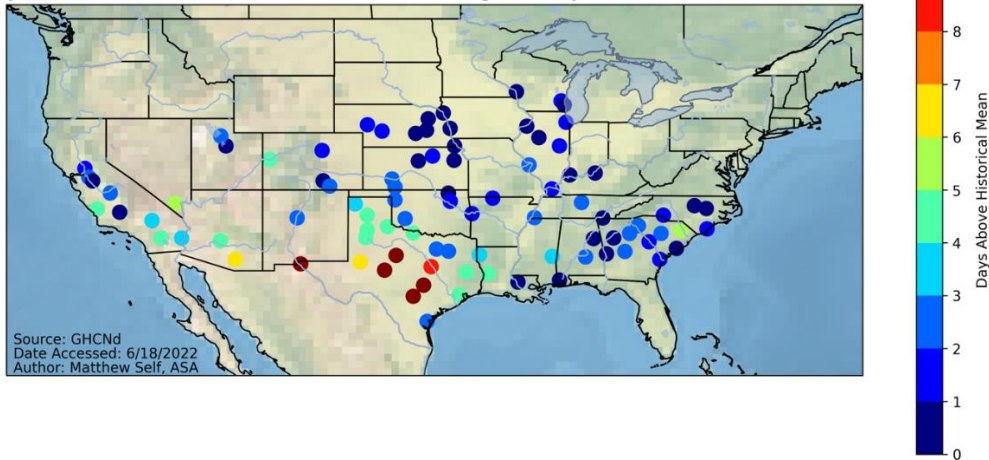
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Event Description

In the second week of June 2022, a strong heat wave hit the United States, particularly in the Midwest and South. From the Global Historical Climatology Network Daily Summaries (GHCNd), we can see that several stations recorded more days with a maximum temperature at or above 97 degrees Fahrenheit in the first two weeks of June than their historical mean, based on observations from 1950-2021 [1]. More than 125 million people were under heat advisories, with several cities breaking records¹.

June 1-15 2022 Variance from 1950-2021 Average for Days Above 97F, for 92 stations



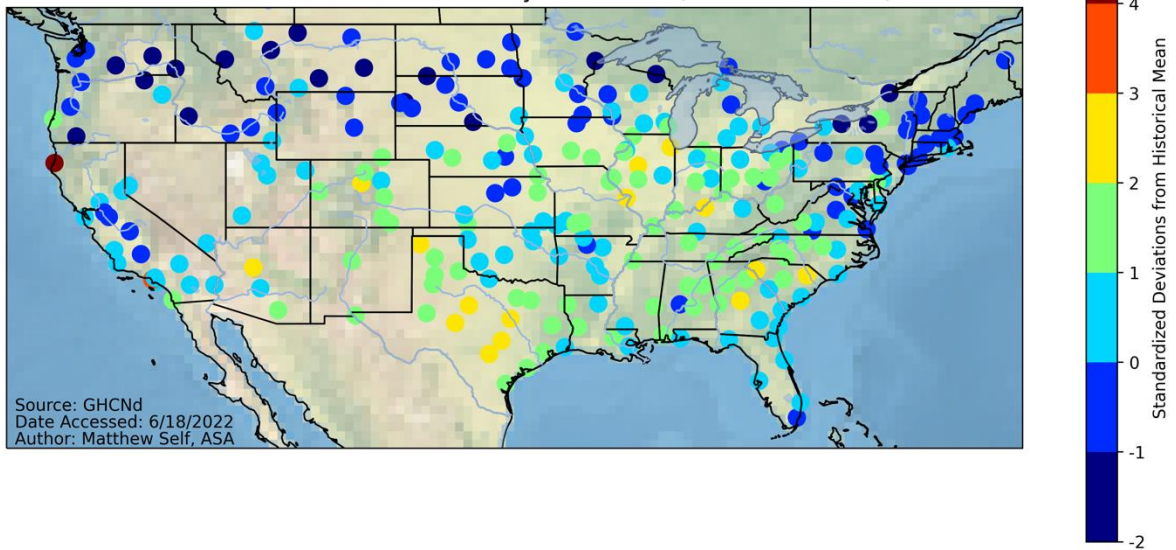
¹ CNN. June 14, 2022, [Extreme Weather Prompts Heat Warnings](#)

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In the graph below, we carried out a more complex and robust analysis. For each June 1-15 period between 1950 and 2021, we calculated the Rolling Average Three-Day Maximum Temperature and then calculated the maximum of the rolling averages; that is, we calculated the hottest “heat wave” for each June between 1950-2021. From this distribution of historical “heat waves”, we calculated the Mean and Standard Deviation and then standardized the Maximum Average Three-Day Maximum Temperature for June 2022.

June 1-15 2022 Standardized Maximum Three-Day Mean TMAX, from 1950-2021, for 270 stations



From this graph, we can see that the June 2022 Heat Wave was above to well-above normal for many stations in the Midwest and South. Heat waves can pose more of a threat to life and infrastructure than sporadic spikes in temperature because the heat is sustained and there is less time for recovery.

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Aftereffects

It’s still a bit too early to get adequate reliable data on Emergency Room (ER) visits and mortality experienced but many counties have reported a significant uptick in the number of calls Emergency Medical services (EMS) received for heat-related illnesses (HRI). For instance, in Indianapolis the medics respond on average to 0 to 3 heat related calls per day but for the week of June 13 medics responded to around 4 times the usual frequency². Similar experience was reported in the media for parts of Oklahoma³, North Carolina’s Piedmont, and Coastal regions⁴ and for Greenville, South Carolina⁵.

To put in context and tying it up with the analysis shown in the two graphs above corroborating with EMSs’ experience, we pulled values of some key metrics for some of the stations in the above-mentioned states for the period of June 1 – 15, 2022. Once again, the underlying data used is the GHCNd summaries [1] recorded at several stations and the analysis can be accessed on the tab ‘June 2022 Data’ in the Excel file published with this report.

Stations	States	Current Month (June 1-15, 2022)				Historical (1950-2021)	
		Max	Min	Three Day Mean Max	Days > 97°F	Avg of Three Day Mean Max	Mean Days > 97°F
Indianapolis	IN	93	76	92	-	87	-
Oklahoma City Will Rogers AP	OK	96	76	92	-	91	-
Tulsa Intl AP	OK	98	79	94	2	91	-
Hugoton	KS	108	66	99	3	95	2
Austin-Camp Marby	TX	105	92	103	12	95	1

**Historical implies the metric is based on the temperature data for the first 15 days of the month of June for period 1950-2021*

Interestingly, the SOA Research Institute (SOA) published an attribution study in 2021 “Determining the Role of Anthropogenic Climate Change on Human Health Outcomes: A Case Study on Heat Related Illness Attribution”, authored by a team at the University of Nebraska-Medical Center led by Dr. Jesse Bell. [Determining the Role of Anthropogenic Climate Change on Human Health Outcomes: A Case Study on Heat Related Illness Attribution | SOA](#) This research project had three objectives – understand the relationship between extreme temperature and HRI ER visits, a sensitivity analysis on 28 heatwave definitions available from the literature, and a climate attribution analysis which includes morbidity and healthcare cost analysis.

In that report, a case study was conducted for the state of North Carolina, where extreme temperatures (over 95°F) were compared to local emergency room visits, with results focusing on Coastal plains and Piedmont region, while the Mountain regions was dropped due to data limitations. Using the HRI ER visit data from 2011-2016 and the annual average medical expenditure spent towards HRI ER visits in 2019 based on Medicaid claims for the cost values, the study indicated that *over 25% of heat-related illness (HRI) emergency room visits were able to be attributed to anthropogenic climate change*. This is the difference between what would have occurred under natural forcings (involving no-extraction of fossil fuels beginning in 1750) and what was observed.

The overarching goal here was to use North Carolina data as a template to develop a framework and demonstrate a methodology that could be applied and replicated for other states, time periods and even for other fields.

² Wrtv.com. June 16, 2022. [IEMS responds to more than 30 heat-related calls \(wrtv.com\)](#)

³ Newson6.com. June 13, 2022. [Heat Related Calls Spike, EMSA Warns Oklahomans About Heat Related Illnesses \(newson6.com\)](#)

⁴ ncdhhs.gov. June 13, 2022. [NCDHHS Advises Caution to Prevent Heat-Related Illnesses and Death as Temperatures Rise for the Summer | NCDHHS](#)

⁵ Wspa.com. June 17, 2022 [Upstate ER’s, urgent cares see more patients with heat-related illnesses \(wspa.com\)](#)

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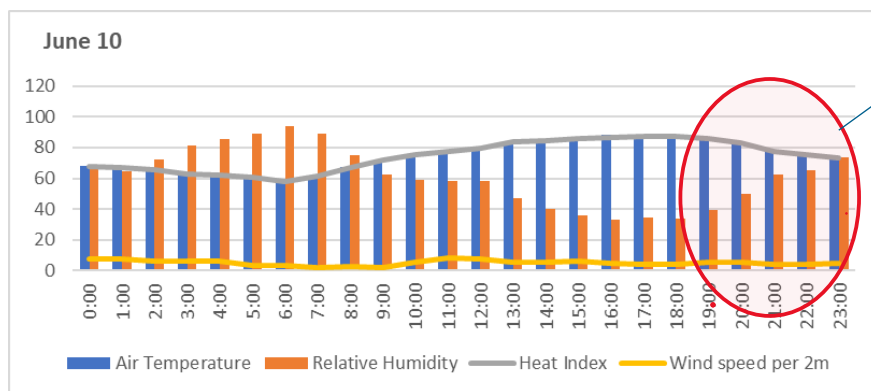
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The other news that caught our attention was [“Cattle in Kansas die by the thousands during a brutal heat wave”](#). The reported 2000 cattle deaths, reflect only the losses at farms that asked the Kansas Department of Health and Environment agency (KDHE) for help in disposing of carcasses. As reported, these numbers are expected to rise as more feedlots report losses.^{6 7 8} In addition, while exact numbers are not known, it was reported that thousands of cattle did die from heat stress across an area near Ulysses, Grant County in south-western Kansas⁹.

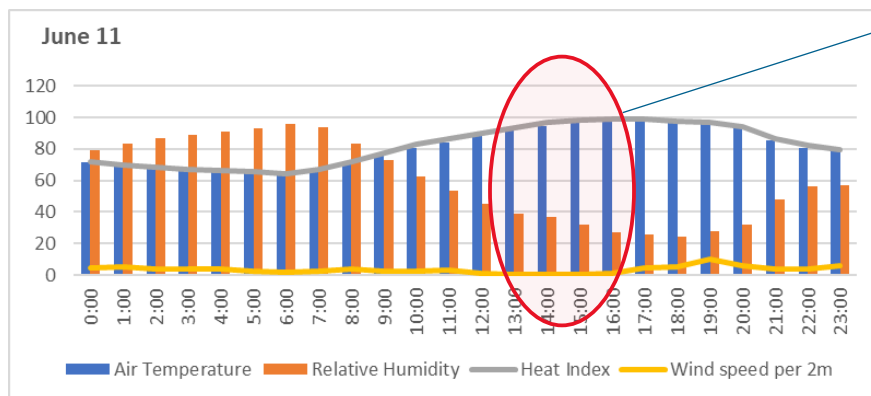
As of 2019, Kansas is the third-largest cattle state in the U.S. after Texas and Nebraska¹⁰ and is known to have climate that is conducive to cattle. Heat stress at this time of the year is quite common and the Cattle feeders have mitigation protocols in place to keep their cattle healthy and safe.

What happened during June 10-11, 2022 was unusual - the confluence of high temperatures, high humidity and drop in wind speed exacerbated the Heat stress. During this time, temperatures jumped up by 10 -14 Degrees Fahrenheit. The wind died down, and humidity kept the heat index high enough that cattle could not cool down overnight.

Hourly Data for Grant County, Kansas for June 10-11, 2022 [2]



High temperature and increasing humidity provided no time for cool down overnight.



High temperatures with increasing heat index and almost no wind increased the heat stress for cattle.

⁶ CNN. June 16, 2022. [At least 2,000 cattle deaths reported due to heat, humidity in southwest Kansas - CNN](#)
⁷ The Guardian. June 16, 2022. [Thousands of cattle dead due to heatwave in Kansas | US news | The Guardian](#)
⁸ AP News. June 16, 2022. [Heat stress blamed for thousands of cattle deaths in Kansas | AP News](#)
⁹ KAKE.com. June 15, 2022. [Thousands of cattle die from heat stress in southwest Kansas - KAKE](#)
¹⁰ WorldAtlas.com. October 24, 2019. [US States With the Most Cattle - WorldAtlas](#)

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The livestock owners/producers looking for financial support are required to file a notice of loss with the Farm Service Agency within 30 days of the loss along with the documentation of temperatures, heat, and humidity before and during the loss period¹¹. As reported, these cattle as market-ready animals would have a value of around \$2000 per head^{12 13}. This implies that many of the cattle lost, appear to have been on the heavier side and ready to be shipped for processing.

The USDA Indemnity program helps support the cattle feeders to recoup 75% of their losses and uses 100% market value to estimate the amount. As per the USDA Commercial Indemnity Table for 2022, non-adult (400 – 799 lbs.) steers and heifers market value range from \$825.07 to \$1042.41, adult beef cattle market value can range anywhere from \$841.60 to \$1710.77 and non-age specific, feeder steers or heifers above 800+ lbs. costs \$1469.60 per head¹⁴. If these were the ‘ready for processing’ cattle as widely reported, then it would be safe to assume that the indemnity payments will exceed \$1.5 million.

Sources

- [1] Source: Global Historical Climatology Network
 - <https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00203096/detail>
 - Date Accessed: 6/18/2022
 - Data: Daily Maximum Temperatures in June from 1950-2022
- [2] Source: Kansas State University- Kansas Mesonet, 2022: Kansas Mesonet Historical Data.
 - <http://mesonet.k-state.edu/weather/historical>
 - Date Accessed: 06/22/2022
 - Data: Hourly data for Grant County, Kansas for June 10-11, 2022

¹¹ Kansas Livestock Association. June 13, 2022. [Livestock Indemnity Program Available To Those Impacted By Extreme Temperatures \(kla.org\)](https://www.kla.org/livestock-indemnity-program-available-to-those-impacted-by-extreme-temperatures)

¹² KAKE.com. June 15, 2022. [Thousands of cattle die from heat stress in southwest Kansas - KAKE](https://www.kake.com/news/thousands-of-cattle-die-from-heat-stress-in-southwest-kansas)

¹³ PBS News Hour. June 17, 2022. [Heat stress blamed for thousands of cattle deaths in Kansas | PBS NewsHour](https://www.pbs.org/newshour/heat-stress-blamed-for-thousands-of-cattle-deaths-in-kansas)

¹⁴ United States Department of Agriculture. February 2022. [USDA Indemnity Values for 2022: Commercial Table](https://www.fsa.usda.gov/indemnity-values)

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