

Monthly Attribution Overview - September 2024

An analysis of how climate change boosted United States temperatures in September 2024

Using Climate Central's Climate Shift Index (CSI) tool to measure the impact of climate change on daily temperatures across the United States, as well as NOAA's Applied Climate Information System (ACIS) to find daily temperature information, we have compiled a high-level overview of how climate change has affected temperature trends in September in cities across the United States.

1. High Level Findings

- September temperature anomalies in the U.S. were elevated across much of the country: 171 out of 191 analyzed cities were warmer than normal. The highest anomalies were in the Midwest and northern Great Plains (Figure 1).
- This was the hottest September on record in 12 cities – including Denver, Minneapolis, and Phoenix – and was in the top 5 hottest Septembers for an additional 26 cities.
- The Northern Rockies and Plains, as well as the Upper Midwest showed particularly elevated September temperatures. Average temperatures across the Northern Rockies and Plains were 5.4 °F higher than normal, and 4.3 °F in the Upper Midwest.
- Climate Shift Index (CSI) values meanwhile followed a different trend: Southwest and Florida cities stood out, experiencing the highest number of days with climate change-influenced temperatures at or above CSI 3 (temperatures made at least 3x more likely because of climate change).
- On average, cities analyzed in the Southwest experienced at least 10 days with temperatures resulting in CSI values greater than or equal to 3. With the exception of the Southeast (with an average of 6 days), this was more than double the number of CSI 3 days experienced on average by cities in any other region.

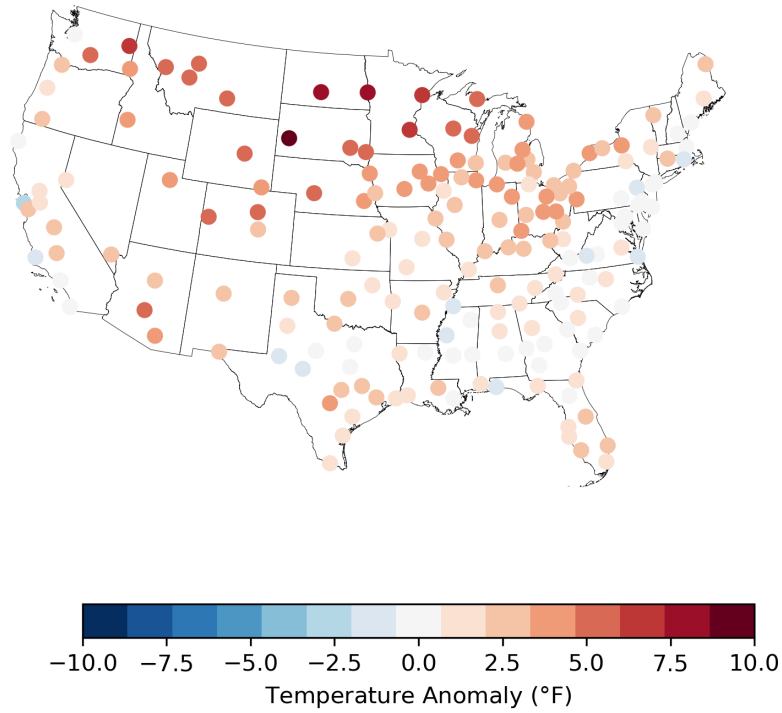


Figure 1. Threaded ACIS temperature anomalies for September 2024 relative to the 1991-2020 standard normal period. Analysis based on ACIS data.

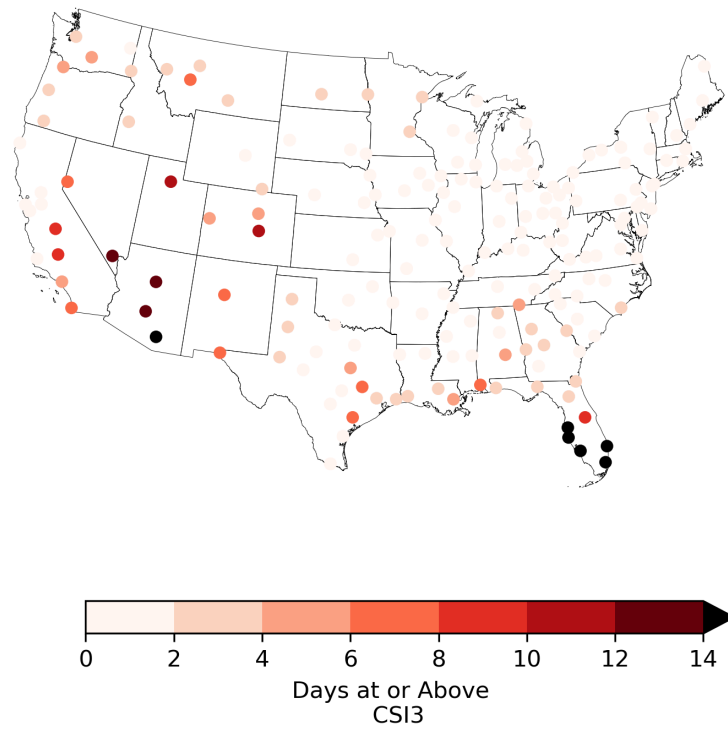


Figure 2. Days with a CSI of 3 or higher for September 2024 for ACIS threaded stations. Analysis based on ERA5 data (September 1-26) and GFS data (September 27-30).

2. Local Temperature Anomaly Analysis

- The most unusually hot city in September was Rapid City, South Dakota, where it was 8.70°F hotter than normal. Septembers in Rapid City have warmed 4.2°F on average since 1970.
- Bismarck, North Dakota, stood out as the 3rd most unusually warm city (with a temperature anomaly of 7.63°F), and as the city with the 7th strongest warming trend since 1970 (an average September today is 6.7°F warmer on average than in 1970)
- 14 cities had September temperature anomalies greater than 5°F. These were in Montana (3 cities), Colorado (2), North Dakota (2), Minnesota (2), South Dakota (2), Arizona (1), Michigan (1), Washington (1), and Wisconsin (1).
- 189 out of 191 ACIS stations analyzed had positive temperature trends for September, indicating that these cities have been warming on average since 1970.
- Reno, NV had a moderately warm September (with an average daily temperature anomaly of 1.16°F), and is the fastest-warming ACIS station for September on average, warming 10.6 °F on average since 1970.

City	State	Temperature Anomaly (°F)	Average Temperature (°F)	Warming Since 1970 (°F)
Rapid City	SD	8.70	69.95	4.2
Fargo	ND	8.16	68.22	6.6
Bismarck	ND	7.63	67.28	6.7
Duluth	MN	7.09	64.35	7.4
Minneapolis	MN	6.82	70.37	7.5
Grand Junction	CO	6.32	73.42	2.4
Spokane	WA	5.59	66.70	5.5
Billings	MT	5.39	66.83	6.4
Helena	MT	5.37	64.32	8.4
Great Falls	MT	5.36	62.60	3.5

Table 1. Top 10 ACIS stations with the highest September 2024 temperature anomaly.

City	State	Warming Since 1970 (°F)	Temperature Anomaly (°F)	Average Temperature (°F)
Reno	NV	10.6	1.16	68.22
Helena	MT	8.4	5.37	64.32
Boise	ID	7.8	3.45	69.75
Minneapolis	MN	7.5	6.82	70.37
Duluth	MN	7.4	7.09	64.35
Salt Lake City	UT	7.1	4.68	73.24
Bismarck	ND	6.7	7.63	67.28
Colorado Springs	CO	6.6	3.38	66.38
Fargo	ND	6.6	8.16	68.22
Las Vegas	NV	6.6	2.55	86.20

Table 2. Top 10 ACIS stations with the fastest warming September since 1970.

3. Local Climate Shift Index Analysis

- 19 out of 191 ACIS stations analyzed had at least one week with daily CSI values greater than or equal to 3, indicating that temperatures on those days were made at least three times as likely due to climate change in those cities.
- San Juan, Puerto Rico had 30 days at CSI 5, indicating that temperatures on these days were made at least 5 times more likely to occur because of climate change.
- 5 out of the top 10 cities with the strongest climate signal were in Florida (Miami, West Palm Beach, Fort Myers, Sarasota, Tampa). Additionally, each of these cities had at least 9 days of temperatures with CSI values of 5.
- On average, cities analyzed in the Southwest experienced at least 10 days with temperatures resulting in CSI values greater than or equal to 3. With the exception of the Southeast (with an average of 6 days), this was more than double the number of CSI 3 days experienced on average by cities in any other region.

City	State	Days at CSI = 3 or higher	Days at CSI = 5	Average Temperature (°F)	Temperature Anomaly (°F)
San Juan	PR	30	30	86.05	2.70
Miami	FL	24	21	84.72	1.77
West Palm Beach	FL	23	21	84.38	2.48
Fort Myers	FL	20	18	84.43	2.28
Sarasota	FL	19	11	83.08	0.93
Tampa	FL	18	9	84.03	1.28
Honolulu	HI	17	12	82.35	0.75
Tucson	AZ	17	13	86.57	3.81
Flagstaff	AZ	14	9	60.90	2.60
Las Vegas	NV	14	9	86.20	2.55
Phoenix	AZ	14	9	94.55	5.30

Table 3. Top 10 ACIS stations with the highest number of days at or above a CSI of 3 during September 2024.

METHODS

Calculating the Climate Shift Index

All Climate Shift Index (CSI) levels reported in this brief are based on daily average temperatures and [ERA5 data](#) from September 1 to September 26, 2024, and GFS data from September 27 to September 30, 2024. See the [frequently asked questions](#) for details on computing the Climate Shift Index, including a summary of the multi-model approach described in [Gilford et al. \(2022\)](#).

City Analysis

We analyzed 191 Applied Climate Information System (ACIS) stations associated with U.S. cities. For each city, we found the CSI time series from the nearest 0.25° grid cell. We calculated the number of days at CSI levels 2, 3, 4, and 5. We used ACIS data to find the average monthly temperatures, temperature anomalies, and precipitation information, and to derive average monthly warming trends for each city.