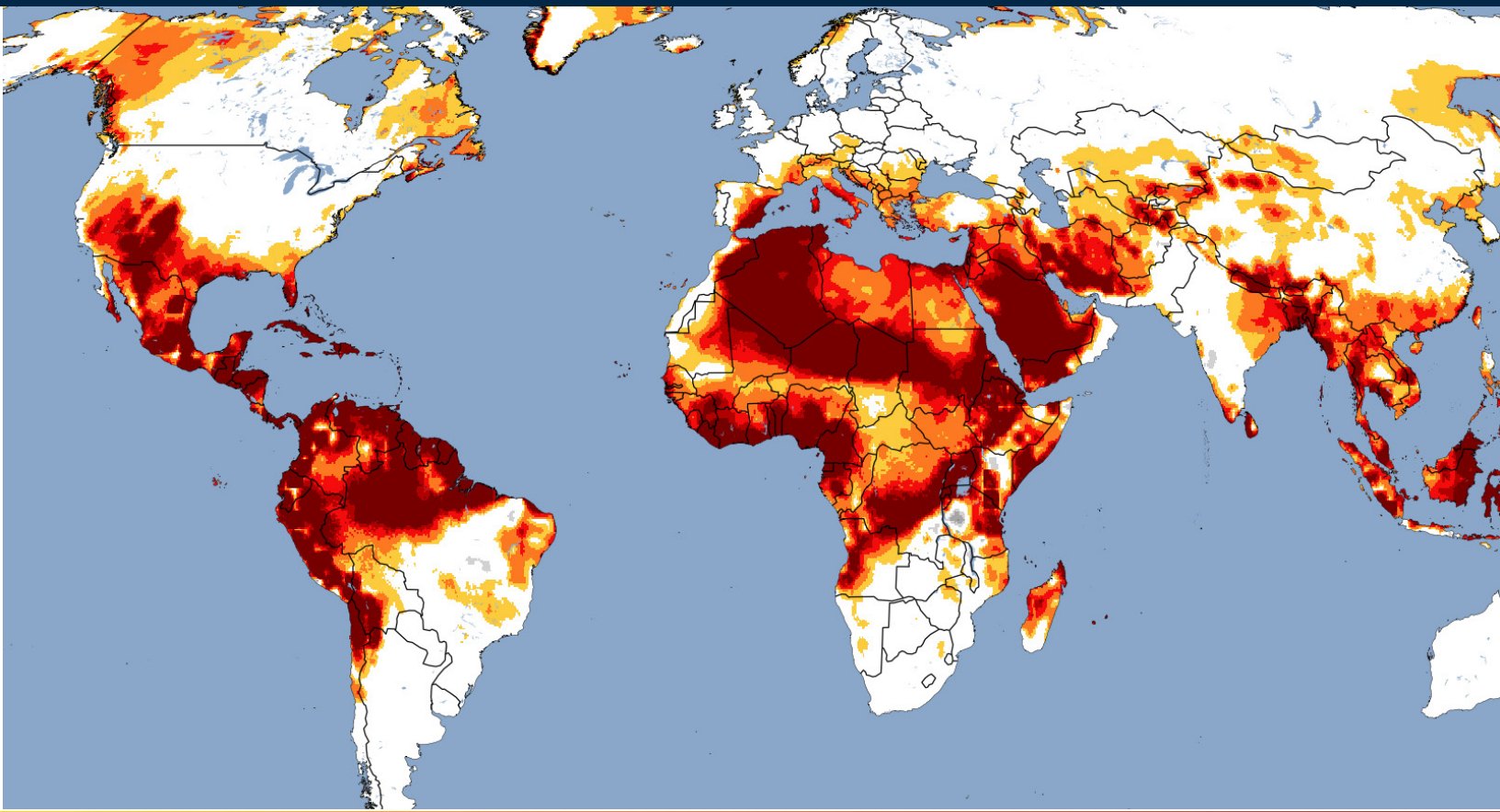


Worldwide daily fingerprints of climate change during Earth's hottest month

More than 6.5 billion people—81% of the global population—experienced climate change-attributed heat in July 2023.



August 1, 2023

CLIMATE  CENTRAL

Worldwide daily fingerprints of climate change during Earth's hottest month

Key Facts

Analysis using the [Climate Shift Index](#) (CSI), Climate Central's daily temperature attribution tool, indicates that human-caused climate change made unusually hot July 2023 temperatures far more likely across the globe. This analysis included 200 countries and 4,700 cities.

Over 6.5 billion people—81% of the global population—experienced at least one day in July with a CSI level 3 or higher. A CSI level 3 indicates that human-caused climate change made those temperatures *at least three times more likely*.

At least 2 billion people felt a very strong influence of climate change (CSI level 3 or higher) on each of the 31 days in July. Global exposure peaked on July 10, 2023, when 3.5 billion people worldwide experienced extreme heat at CSI level 3 or higher.

Well-documented July heat events include those in Mexico, the southern United States, and southern Europe. This global analysis also identifies other regions that experienced extreme July heat altered by climate change—including **Florida and the Caribbean, Central America, northern Africa, the Middle East, and parts of South and Southeast Asia**.

People living near the equator and on small islands experienced an exceptionally strong influence of human-caused climate change on July temperatures. In tropical climates, relatively small daily temperature anomalies can have a strong CSI signal.

Small island developing states—including 11 in the Caribbean—account for 16 of the 28 countries with the highest July average CSI level (5.0), indicating conditions made *at least five times more likely* due to human-caused climate change.

Some 870 cities had at least 25 July days at CSI level 3 or higher, including Alexandria, Egypt; Algiers, Algeria; Dhaka, Bangladesh; Douala, Cameroon; Guatemala City, Guatemala; Guayaquil, Ecuador; Havana, Cuba; Jeddah, Saudi Arabia; Mexico City, Mexico; Sanaa, Yemen; Santo Domingo, Dominican Republic; Tampa, United States; and Timbío, Colombia.

Thousands of people die from heat-related causes each year. Attribution science identifies conditions that are becoming more common due to human-caused climate change—and therefore require adaptation efforts such as heat action plans to reduce risk. **Heat events with CSI levels 1 through 5 will continue to become more frequent and intense as long as humans continue to burn coal, oil, and natural gas.**

➤ [Download data:](#) July 2023 Climate Shift Index (CSI) levels for 200 countries and 4,700 cities

INTRODUCTION

July 2023 was marked by record-shattering global average temperatures and widespread, simultaneous heat extremes—which are among the deadliest weather-related hazards.

The rising frequency and intensity of these devastating events is consistent with [well-established scientific understanding](#) of the consequences of carbon dioxide emissions principally from burning coal, oil, and natural gas.

Climate change attribution uses statistical methods to quantify whether and to what extent human-caused climate change altered the likelihood of specific events. Attribution science identifies weather conditions that are becoming more common due to human-caused climate change. This knowledge allows us to prepare for these conditions and manage their impacts. It also emphasizes the urgent need to prevent climate-related impacts from growing worse, by reducing carbon pollution from burning coal, oil, and natural gas.

Climate Central's daily attribution tool, the [Climate Shift Index](#)®, or CSI, applies the [latest peer-reviewed methodology](#) to map the influence of climate change on temperatures across the globe, every day.

This report presents the results of a Climate Central analysis that uses the CSI to quantify the influence of human-caused climate change on daily average temperatures experienced across the globe, in 200 countries, and in 4,700 cities from July 1, 2023 to July 31, 2023.

This analysis quantifies the links between human-caused climate change and the unprecedented and even dangerous heat during July 2023. The CSI system uses similar methods to those developed by the World Weather Attribution initiative; this study complements their [recently published analysis](#) of heat waves in North America, Europe, and China by considering the whole planet and by highlighting the exposure of people to climate-driven heat.

This report has three components:

1. Global fingerprints of climate change. We map July 2023 average CSI levels to identify global hot spots of heat attributable to human-caused climate change. We also map the total number of days in July 2023 with temperatures made *at least three times more likely* due to climate change. We use population data to determine the total human exposure to days with very strong climate fingerprints during July 2023.

2. Fingerprints of climate change in 200 countries. We quantify July 2023 average CSI levels and days at CSI level 3 or higher in 200 countries, across six continents. We rank the top 10 countries in each continent in terms of the strength and duration of their CSI signal during July 2023.

3. Fingerprints of climate change on 4,700 global cities. For each city, we determine the July 2023 average CSI level, the number of days at CSI level 3 or higher, and the CSI of that city's most intense 14-day period of heat during July.

RESULTS

1. Global fingerprints of climate change

July 2023 was very likely Earth's record hottest month.

From July 3 through July 31, global daily average temperatures **were continuously hotter** than the previous record set in August 2016.

The peak of the global heat occurred on July 6, 2023 with a global average temperature of **17.08°C (62.74°F)**, 0.28°C hotter than the previous (August 2016) record.

This all-time record-breaking heat followed the **hottest June ever recorded** for the planet.

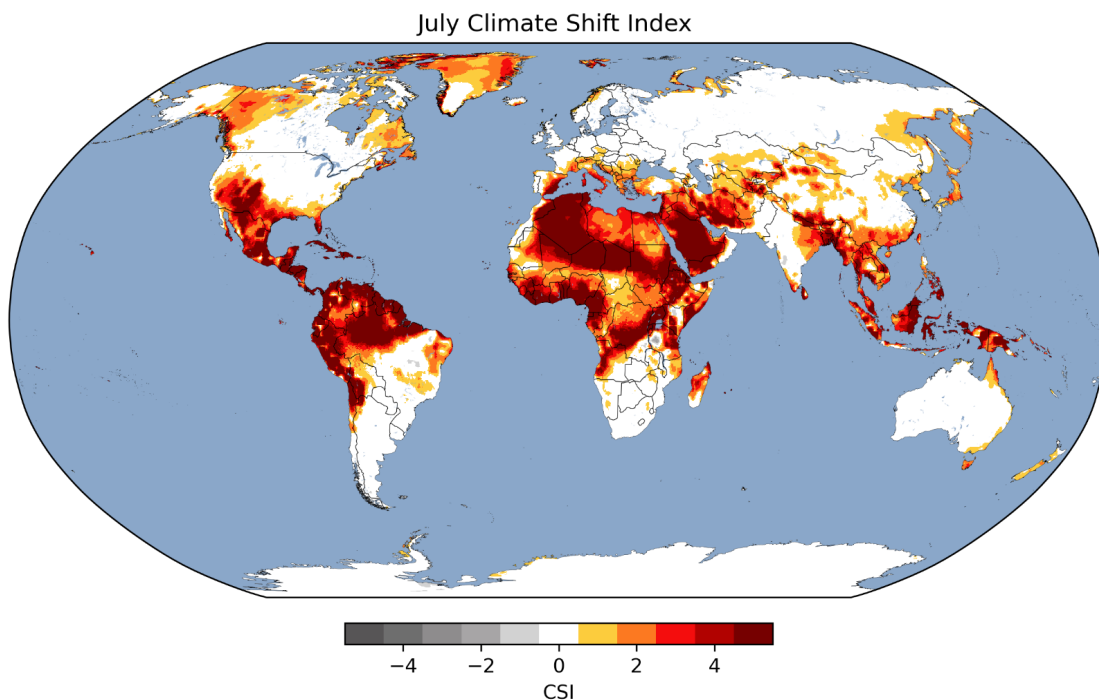


Figure 1. Daily average temperature Climate Shift Index averaged over July 1, 2023 to July 31, 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023.

Regional hot spots: July 2023 heat attributable to human-caused climate change

During July 2023, average CSI levels were especially high (CSI level 4 and 5, indicating conditions made *at least 4x and at least 5x more likely* due to climate change) in: north Africa (especially Algeria); the Gulf of Guinea coastline; parts of central Africa, the Sahel, and the Horn of Africa; the Arabian Peninsula; the Mediterranean Basin; the Malay Archipelago; parts of South and Southeast Asia; the Amazon Basin; the Andes; Central America; Mexico; the Caribbean; the southern United States; northwest Canada; and Greenland and the Canadian Arctic Archipelago.

Human-driven warming affected nearly everyone.

During July 2023, 6.5 billion people—81% of the global population—experienced at least one day at CSI 3 or higher, and 50% experienced at least 10 days at this level.

- Over the same period, 65% of people experienced at least one day at CSI 5 or higher, and 36% experienced at least 10 days at this level.
- The average person on the planet experienced 11 days at or above CSI 3 and eight days at level 5.
- From July 1 to July 31, 68% of the global land surface experienced at least one day at CSI 3 or higher, and 51% experienced CSI level 5.

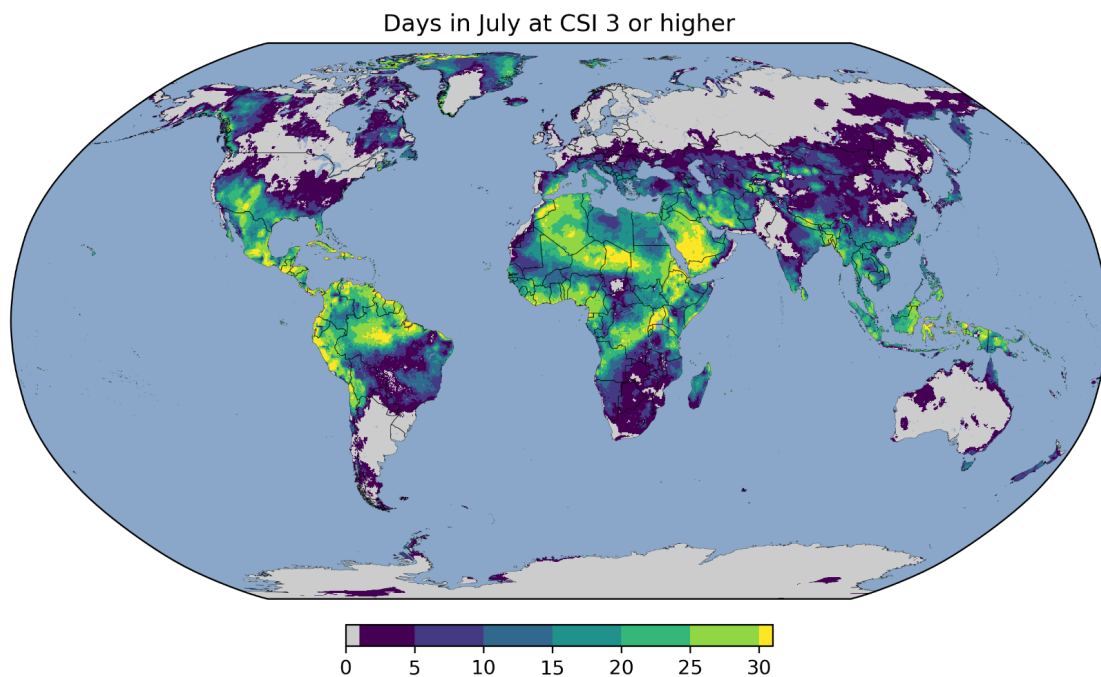


Figure 2. Total count of days in July 2023 with average temperature Climate Shift Index level of 3 or higher. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023.

Persistent July heat attributable to human-caused climate change.

Regions that experienced 20 or more days in July 2023 with temperatures made *at least three times more likely* due to climate change (CSI level 3 or higher) include: the southwestern United States, parts of Mexico, Central America, the Caribbean, northern and western South America, north Africa and the Sahel, the Horn of Africa, the Arabian Peninsula, parts of South and Southeast Asia; and the Malay Archipelago.

Billions of people were exposed to climate change daily in July 2023.

At least 2 billion people—one-quarter of the global population—felt a very strong influence of climate change (CSI level 3 or higher) on each of the 31 days in July.

Global exposure peaked on July 10, 2023, when 3.5 billion people (43% of the global population) experienced hot conditions that were made *at least three times more likely* due to human-caused climate change.

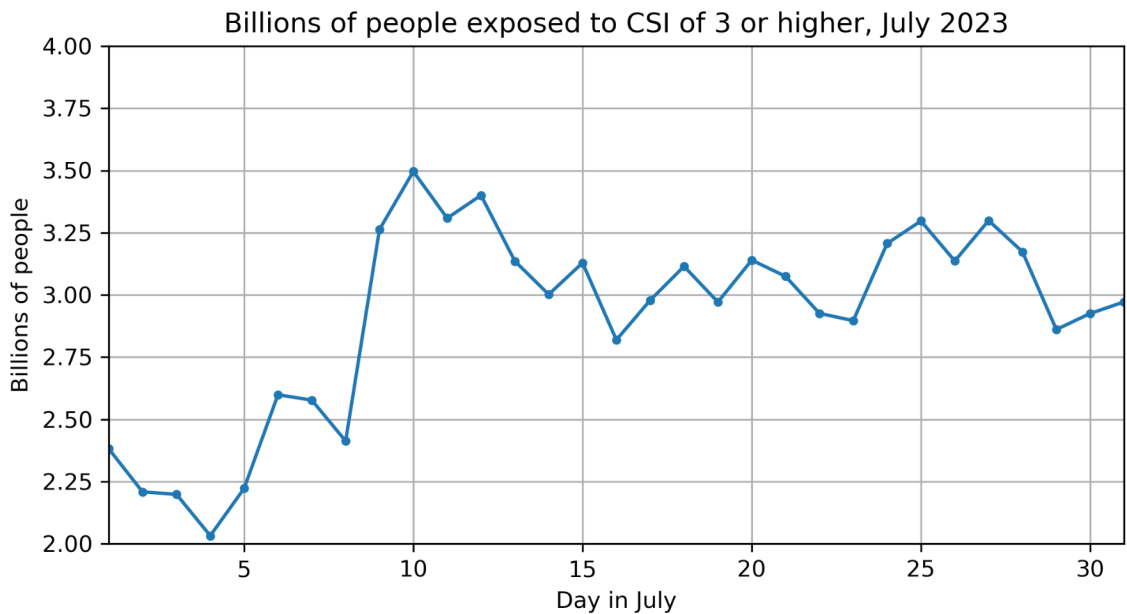


Figure 3. Daily global population exposed to Climate Shift Index level of 3 or higher in July 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023.

➤ [Download data](#): Daily global population exposed to CSI level 3 or higher and level 5

2. Fingerprints of climate change in 200 countries

We quantify July 2023 average CSI levels and days at CSI level 3 or higher in 200 countries, aggregated across six continents. We rank the top 10 countries in each continent in terms of the strength and duration of their local CSI signal during July 2023 (see Appendix Tables 1-6).

➤ [Download data](#) for all 200 countries.

The Climate Shift Index (CSI)

Humans have caused global average temperatures to increase by [1.1°C \(2°F\)](#) since 1850. But people do not experience global average temperatures. Instead, we mainly experience climate change through shifts in the daily temperatures and weather patterns where we live.

Climate Central's [Climate Shift Index](#) (CSI) system quantifies the local influence of climate change on daily temperatures around the world.

The CSI quantifies how much human-caused climate change has shifted the odds of daily temperatures that people experience locally. The CSI tool is grounded in [peer-reviewed attribution science](#) and was launched by Climate Central in 2022. The tool is free to access.

The CSI scale is centered on zero. A CSI level of zero means that there is no detectable influence of human-caused climate change. In other words, that day's temperature is equally likely in both the modern climate and one without global warming.

Positive CSI levels 1 to 5 indicate conditions that are increasingly likely in today's climate. A CSI level of 1 means that climate change is detectable (technically, the temperature is at least 1.5x more likely). CSI levels 2 and higher correspond with the multipliers (2 = at least 2x more likely, 3 = at least 3x more likely, etc.). The CSI scale is currently capped at level 5 which means that a CSI of 5 includes higher values and thus should be read as *at least 5*. CSI level 5 events would be very difficult to encounter in a world without climate change—not impossible, but extremely unlikely.

The CSI can also be applied to temperatures that are unusually cool. For instance, a CSI level -2 means that the temperature in question is two times less likely (equivalently 1/2 as likely) due to human-caused climate change.

2.1 Africa

In July 2023, the continent recorded its all-time hottest low temperature along with local record-breaking highs. The African continent experienced its [hottest night ever recorded](#) (39.6°C; 103.3°F) on July 6 in Adrar, Algeria. On July 23, [all-time heat records](#) were set in Algiers, Algeria (48.7°C, 119.7°F) and Kairouan, Tunisia (49.0°C, 120.2°F). Egypt has experienced [prolonged heat waves](#).

- Across the 55 African countries analyzed, equally weighted, the average July CSI level was 3.0.
- Tunisia and Eritrea had the highest July temperature anomalies (3.8°C and 2.6°C, respectively).
- A total of 29 African countries had a July average CSI of 3 or higher; 17 of these countries are designated by the United Nations as [least developed countries](#).
- Eight African countries (Table 1) had a July average CSI of 5.0 (the maximum level on the CSI scale), indicating conditions that were extremely unlikely without human-caused climate change.
- Three of the top 10 African countries are [small island developing states](#); four are designated by the United Nations as [least developed countries](#) (Table 1).
- All of the top 10 African countries had at least 25 July days at CSI level 3 or higher.

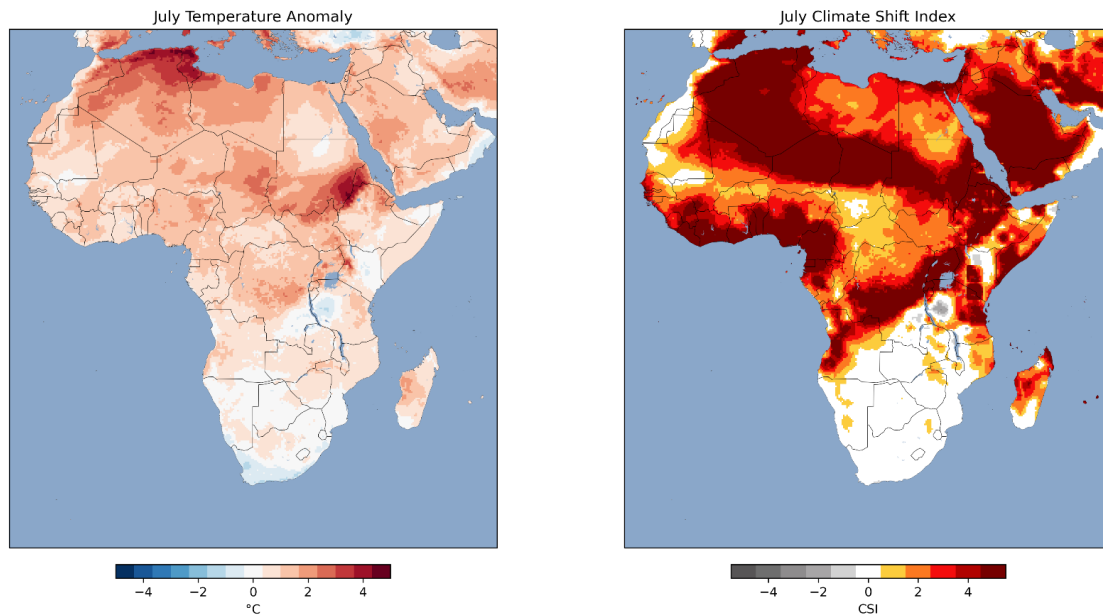


Figure 4. Daily average temperature anomaly (°C) and Climate Shift Index averaged over July 1, 2023 to July 31, 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023. Temperature anomalies from 1991-2020 normal.

2.2 Asia

Parts of Asia, including China, India and the Middle East, sweltered in record-breaking July heat. China set a [new national temperature record](#) (52.2°C; 126°F) in the western Xinjiang region on July 16, breaking its previous national record by 1.6°C. On the same date, the heat index reached [66.7°C \(152°F\)](#) at Persian Gulf International Airport on Iran's southwest coast. On July 18, the [Kuwait Times](#) reported all-time record-high power usage in the country amid extreme heat. Extreme heat [continued to affect India](#) in July after deadly heat waves in June 2023.

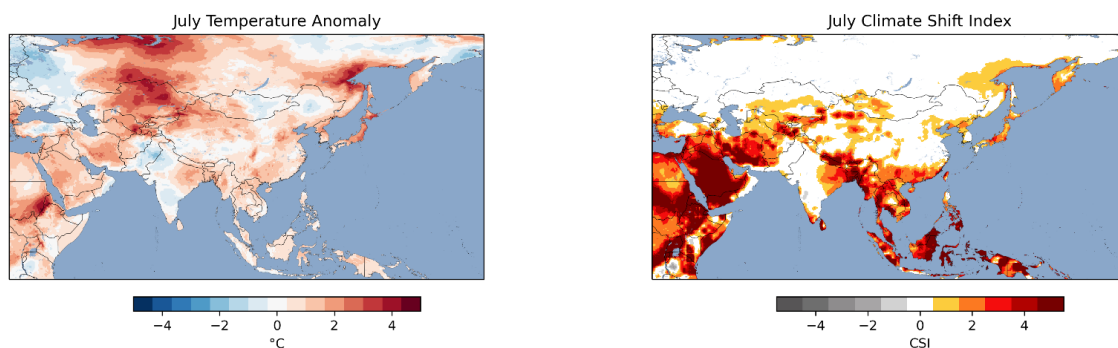


Figure 5. Daily average temperature anomaly (°C) and Climate Shift Index averaged over July 1, 2023 to July 31, 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023. Temperature anomalies from 1991-2020 normal.

- Across the 46 Asian countries analyzed, equally weighted, the average July CSI level was 2.4.
- Two Central Asian countries had the highest July temperature anomalies: Kazakhstan (2.1°C), and Uzbekistan (1.9°C).
- A total of 17 Asian countries had a July average CSI of 3 or higher.
- Six of the top 10 Asian countries had a July average CSI of 4 or higher (Table 2), indicating conditions that would be extremely rare without human-caused climate change.
- Five of the top 10 Asian countries are in the Middle East, with July average CSI of 3.9 or higher.
- All of the top 10 Asian countries had at least 21 July days at CSI level 3 or higher.

2.3 Europe

Mediterranean countries sweltered in 40°C (104°F) and higher heat, and the continent recorded its all-time hottest July temperature during the ‘Cerberus’ heat wave. Extreme heat in Greece forced the closure of the Acropolis on July 14 and fueled widespread wildfires and evacuations. Rome, Italy experienced its hottest day ever (41.8°C; 107.2°F) on July 18. On the same date, Spain's Catalonia region registered its all-time record high temperature of 45.3°C (113.5°F) in the town of Figueres. On July 24, the **temperature soared to 48.0°C (118.4°F)** in the town of Jerzu, on the Italian island of Sardinia—the all-time highest temperature ever observed in Europe during the month of July.

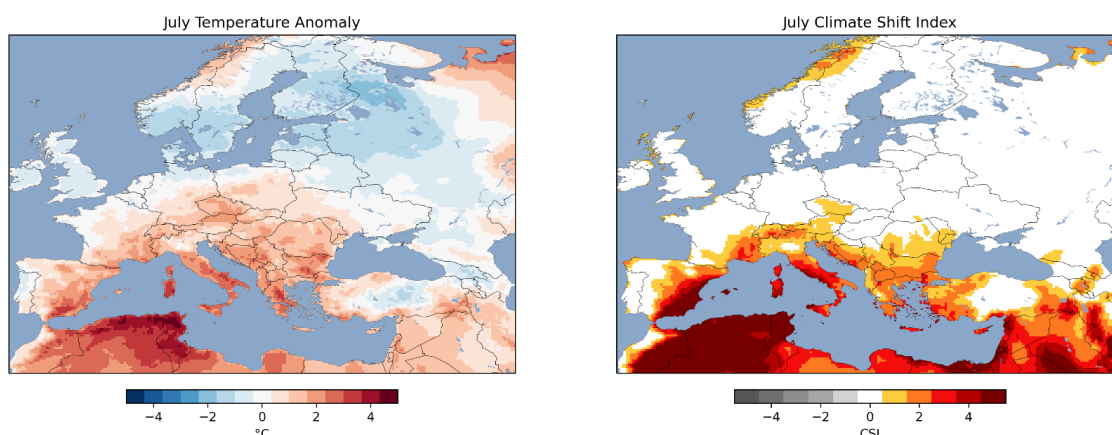


Figure 6. Daily average temperature anomaly (°C) and Climate Shift Index averaged over July 1, 2023 to July 31, 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023. Temperature anomalies from 1991-2020 normal.

- Across the 45 European countries analyzed, equally weighted, the average July CSI was 0.8.
- Seven of the top 10 July temperature anomalies (1.7°C to 2.1°C) were all in Balkan countries, with Montenegro experiencing the highest July temperature anomaly (2.1°C).
- Two countries had a July average CSI of 3 or higher: Malta (4.0) and the Canarias (3.0).
- Eight of the top 10 countries are in southern Europe, with July average CSI of 1.6-4.0 (Table 3).
- Six of the top 10 European countries had at least 14 July days at CSI level 3 or higher.
- Anomalously cool July temperatures in northern Europe had CSI levels of zero, meaning that there is no detectable influence of human-caused climate change.

2.4 North America

Prolonged extreme heat impacted the southern United States, parts of Canada, northern Mexico, and the Caribbean. From June 30 to July 30, Phoenix, Arizona experienced a record [31 consecutive days](#) with temperatures of 43.3°C (110°F) or higher, shattering the previous record of 18 days set in June 1974. Temperatures in California's Death Valley soared to 53.3°C (128°F) on July 16, close to the hottest air temperature ever recorded on Earth. Summer in the southeastern U.S. is known to be hot, but the July 2023 heat in South Florida was historic, influenced by [unprecedented ocean temperatures](#). In Miami, the heat index surpassed 37.8°C (100°F) for a record [46 straight days](#) from June 10 to July 26; the National Weather Service issued the city's first-ever [excessive heat warning](#).

Temperatures swelled to 50°C (122°F) on July 14 in Mexicali, capital city of the state of Baja California in northern Mexico. Only [16% of households](#) in Mexico have air conditioning. Following the [record warmest June](#) in the Caribbean Islands region and in [San Juan, Puerto Rico](#), extreme heat persisted in July. The Cayman Islands experienced its [all-time hottest night](#) with a minimum temperature of 29.6°C (85.3°F) recorded at Owen Roberts International Airport on July 13. [Canada's Northwest Territories](#) saw its hottest temperature ever reported (37.9°C; 100.2°F) near Fort Good Hope, this after the worst start to the country's wildfire season on record.

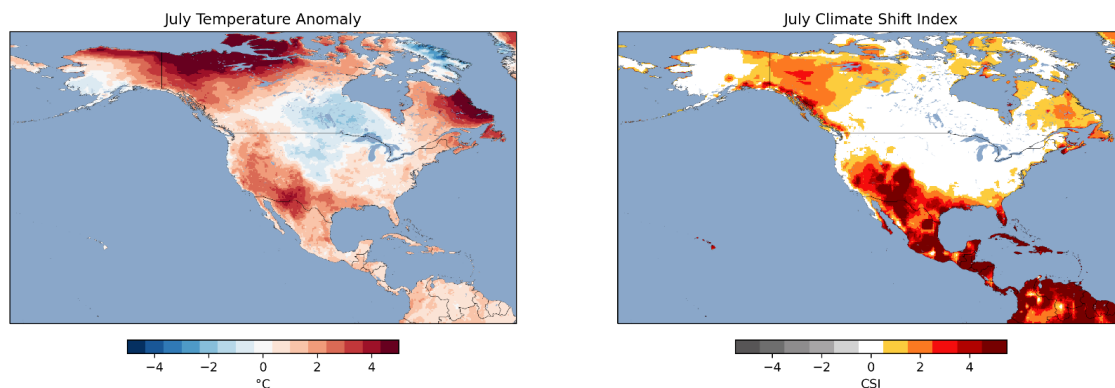


Figure 7. Daily average temperature anomaly (°C) and Climate Shift Index averaged over July 1, 2023 to July 31, 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023. Temperature anomalies from 1991-2020 normal.

- Across the 25 North American countries analyzed, equally weighted, the average July CSI level was 4.3.
- The highest July temperature anomalies were in: Greenland (2.0°C), Canada (1.7°C), and El Salvador (1.7°C).
- A total of 14 North American countries (Table 4) had a July 2023 CSI of 5.0 (the maximum level on the CSI scale), indicating conditions that would be extremely unlikely without human-caused climate change.
- Eleven of the top 14 North American countries are [small island developing states](#) (Table 4).
- A total of 17 North American countries had at least 28 July days at CSI level 3 or higher.

2.5 Oceania

Warm winter temperatures were observed in Oceania. Enhanced by the influence of El Niño, ocean temperatures in the South Pacific around New Zealand continue to run **1 to 3°C above** the long-term normal. Experts in Australia are predicting a catastrophic wildfire season due to anticipated extreme heat and drought conditions fueled by El Niño, the **largest cause of drought** globally.

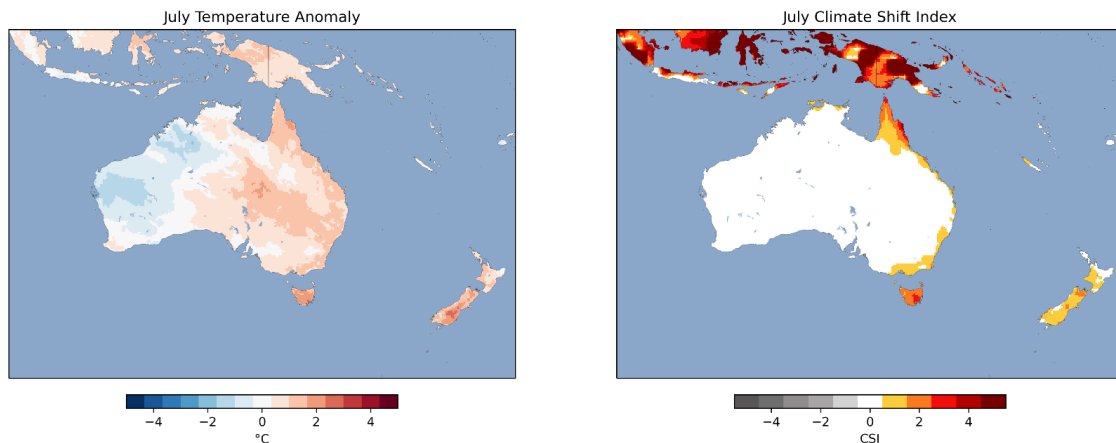


Figure 8. Daily average temperature anomaly (°C) and Climate Shift Index averaged over July 1, 2023 to July 31, 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023. Temperature anomalies from 1991-2020 normal.

- Across the 14 Oceanian countries analyzed, equally weighted, the average July CSI level was 2.2.
- The highest July temperature anomaly was in New Zealand (1.2°C).
- Seven countries had a July average CSI of 3 or higher: Kiribati, Marshall Islands, Samoa, French Polynesia, Papua New Guinea, Solomon Islands, and Guam.
- Three of the top 10 Oceanian countries (Table 5) had a July 2023 CSI of 5.0 (the maximum level on the CSI scale), indicating conditions that would be extremely unlikely without human-caused climate change.
- Eight of the top 10 Oceanian countries are **small island developing states** (Table 5).
- Five of the top 10 Oceanian countries had at least 21 July days at CSI level 3 or higher.

2.6 South America

High heat impacted parts of South America during the Southern Hemisphere's winter. In July, Lima, Peru reported its [hottest winter day](#) since records began (27.2°C; 81.0°F). A winter heat wave across much of South America resulted in [very warm nights above 20°C](#) (68°F) in many countries. Land surface heating in response to extreme drought exacerbated high winter heat in Uruguay.

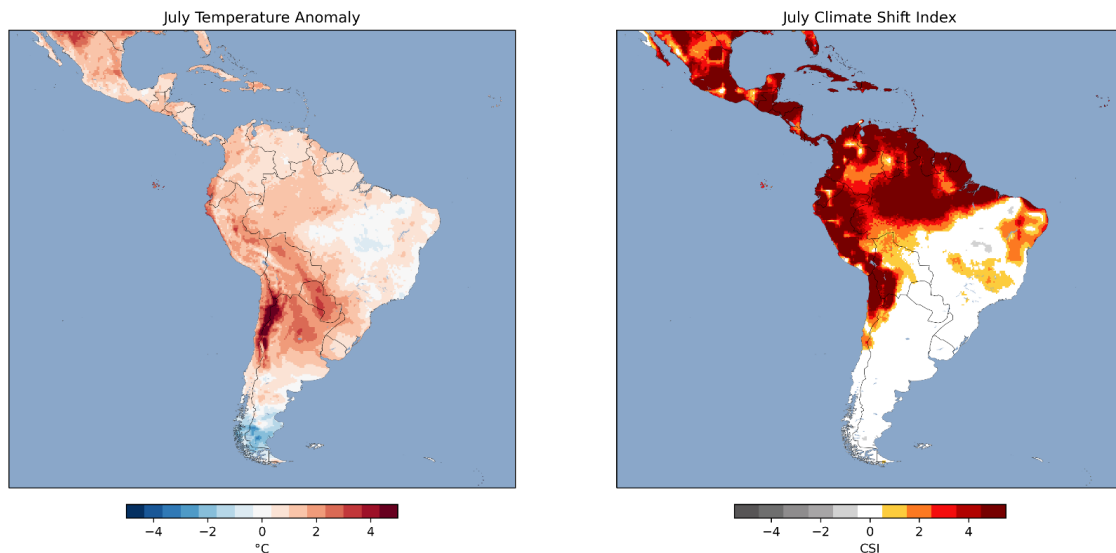


Figure 9. Daily average temperature anomaly (°C) and Climate Shift Index averaged over July 1, 2023 to July 31, 2023. Analysis based on ECMWF ERA5 and NOAA GFS. Produced August 1, 2023. Temperature anomalies from 1991-2020 normal.

- Across the 15 South American countries analyzed, equally weighted, the average July CSI level was 2.4.
- The highest July temperature anomalies were in Paraguay (2.5°C) and Bolivia (1.9°C).
- Seven countries had a July average CSI of 3 or higher.
- Three neighboring equatorial countries had the highest July 2023 average CSI levels (Table 6): French Guiana (5.0), Guyana (4.9), and Suriname (4.7).
- Two of the top 10 South American countries are [small island developing states](#) (Table 6).
- Seven of the top 10 South American countries had at least 21 July days at CSI level 3 or higher.

3. Fingerprints of climate change in 4,700 global cities

For each city, we determine the July 2023 average CSI level, the number of days at CSI level 3 or higher, and the CSI of that city's most intense 14-day period of heat during July.

- [Download data](#) for all 4,700 cities.

Cities with the strongest fingerprints of climate change during July 2023:

There were 768 cities with an average CSI exceeding 4.0 and 870 that had 25 days or more at CSI 3 or higher. Notable cities in these groups include:

City	Country	Days at CSI = 3 or higher	Climate Shift Index	Temperature anomaly (°C)
Jeddah	Saudi Arabia	31	4.9	1.2
Sanaa	Yemen	31	4.8	1.8
Guatemala City	Guatemala	30	4.8	1.1
Havana	Cuba	30	4.8	1.4
Chattogram	Bangladesh	30	4.6	1.1
Ibadan	Nigeria	29	4.6	1.4
Douala	Cameroon	29	4.5	1.3
Monterrey	Mexico	28	4.3	1.4
Alexandria	Egypt	27	4.4	1.2
Santo Domingo	Dominican Republic	27	4.4	1.2
Cali	Colombia	26	4.3	1.3
Miami	United States	25	4.1	1.1

Climate change fingerprints on the most extreme heat events:

A total of 624 cities had CSI levels of 5 (the maximum on the scale) during their most intense 14-day heat event in July 2023. A CSI level of 5 indicates these conditions were extremely unlikely without human-caused climate change.

The following cities all had CSI levels of 5 during the most intense 14-day heat events in July 2023:

City	Country	Temperature anomaly (°C) during event
Tunis	Tunisia	5.8
Palermo	Italy	5.6
Kassala	Sudan	5.0
Chihuahua	Mexico	4.3
Málaga	Spain	4.2
Mesa	United States	4.0
Oran	Algeria	3.4
Guayaquil	Ecuador	3.3
Shubrā al Khaymah	Egypt	3.2
Amman	Jordan	3.1

CSI: Tools, Data, Custom Maps, and Local Alerts

Here are four ways to use this attribution analysis from Climate Central:

1. **Use the tools.** Climate Central's [Climate Shift Index map tool](#) shows which parts of the world are experiencing high CSI levels, every day. Explore the global CSI map for today, tomorrow, and any day during July.
2. **Download the data.** Summary data from this report are available to [download](#) and explore in more detail how human-caused climate change has affected people around the world in July 2023.
3. **Create custom CSI maps.** The Climate Shift Index is now available in KML format. [Fill out this form](#) to join our pilot project, receive the KML links, and start creating custom CSI maps.
4. **Sign up for alerts.** [Sign up here](#) to receive custom email alerts when strong CSI levels are detected in your local area.

CONCLUSIONS

July 2023 was Earth's hottest month on record. People do not experience the global average temperature, however—they experience the day-to-day changes in temperature and weather patterns where they live. The Climate Shift Index (CSI) bridges the gap between global climate change and people's everyday experience with daily temperature attribution.

Climate Central's analysis of each day in July 2023 through the lens of the CSI reveals that the influence of human-caused climate change was detectable in the daily lives of the majority of people on the planet during this unprecedented month. This experience was not evenly distributed in space or time, however.

People living near the equator or on islands surrounded by heat-storing ocean water are already experiencing more days with strong climate fingerprints. Global ocean surface temperature hit a record high in June 2023—the third-consecutive month with record-breaking ocean surface temperatures. Although temperature anomalies are smaller in the tropics relative to higher latitudes, the low daily variability in these regions makes the signal of climate change easier to detect.

The CSI reveals that during the record-hottest month on Earth, people living in places that have contributed least to the global carbon problem—especially [small island developing states](#)—have experienced more days altered by carbon pollution than anywhere else on the planet.

The widespread CSI signal on the locally lived experience of billions around the globe in July 2023 is not only an indication of conditions made more likely due to human-caused climate change. Positive CSI levels associated with anomalous and record-shattering July 2023 heat also indicate that we can expect these kinds of conditions to occur more often in a world with continued carbon pollution. Without effective and equitable measures to adapt to this altered climate, more people will be at risk from heat and other extreme weather events more often.

As the climate continues to warm, these impacts will almost certainly intensify. In the near-term, extreme heat is likely to continue as El Niño conditions continue and strengthen. In the long-term, global and local temperature records are certain to be broken again and again in future years until greenhouse gas emissions are cut to zero.

The rising frequency and intensity of extreme and record-breaking temperatures is consistent with [well-established scientific consensus](#) on the effects of unprecedented levels of greenhouse gas emissions on the occurrence of extreme heat.

Findings of Climate Central's analysis are consistent with a [July 25 analysis from the World Weather Attribution initiative](#), which found that maximum temperatures during July heat waves in the southwestern U.S. and Mexico, southern Europe, and the Chinese lowlands were made much more likely by climate change. The World Weather Attribution study was able to use special statistical methods to conclude that these events would be nearly impossible without climate change. While the automated approach used in the Climate Shift Index system is currently limited to level 5 (5x or more likely), this Climate Shift Index analysis identifies the same locations and highlights additional places where the influence of climate change in July was very intense.

Methods

Calculating the Climate Shift Index

Calculating the CSI begins with high-resolution daily temperatures (high, low, and daily average). For this report, we use [ERA5 data](#) from July 1-26 and fill in the remaining days of the month using NOAA's Global Forecast System (GFS). The GFS has been calibrated to ERA5 using a common reference period of 2019-2022. We estimate how often the temperature at a particular location is likely to occur in the current climate using both historical observations (ERA5) and 24 climate models. We also estimate the likelihood in a climate without human-caused climate change. The CSI is built from the ratio of these two likelihoods. For this report, we focus on daily average temperatures from July 1, 2023 to July 31, 2023.

Based on the multi-model approach described in [Gilford et al. \(2022\)](#), the CSI combines several different techniques for estimating the frequency of a given temperature occurring in the current climate and in a climate without human-caused climate change. Two of the techniques use 70 years of historical temperature reconstructions. The other technique uses 24 state-of-the-art global climate models run with and without carbon dioxide emitted by human activities over the historical period.

Country and Continent Analysis

The country-level analysis includes 201 countries and territories. It excludes entities that are smaller than 0.25°, the size of a grid cell. The continent level analysis includes six continents: Africa, Asia, Europe, North America, Oceania, and South America.

For this analysis, we found the mean CSI and temperature anomaly over the month of July and the number of days above CSI level 3 and 5. For each country and continent, we then selected the data within its geographical boundary and spatially averaged the mean CSI and temperature anomaly for July, as well as the number of days above CSI levels 3 and 5.

City Analysis

We analyzed more than 4,700 cities from around the world. These cities are either a national or administrative capital or have a population of more than 300,000 people. For each city, we found the CSI and temperature anomaly time series from the nearest 0.25° grid cell. We then computed the mean CSI and anomaly over the month of July and the number of days above CSI levels 3 and 5. We also found the 14-day period with the highest average temperature anomaly. We recorded the start date of this event and characterized its intensity by the mean temperature anomaly and CSI. The entire list of cities and their statistics is available for [download](#).

The cities identified in the text above were selected based on the intensity of the particular statistic as well as their population. We also only allowed a country to have a single city on the list.

Appendix

Table 1. Top 10 CSI countries in Africa, July 1 to 31, 2023

Country	Average CSI	Days at CSI = 3 or higher	Days at CSI = 5 or higher
*Mauritius	5.0	28	24
Equatorial Guinea	5.0	30	29
Mayotte	5.0	27	20
Rwanda (LDC)	5.0	31	29
Réunion	5.0	30	19
*Comoros (LDC)	5.0	29	27
Djibouti (LDC)	5.0	27	26
Liberia (LDC)	5.0	27	23
Algeria	4.9	25	22
*Cabo Verde	4.8	28	20

*Indicates [Small Island Developing State](#) and Associate Members of United Nations Regional Commissions. LDC = United Nations designated [least developed countries](#).

Table 2. Top 10 CSI countries in Asia, July 1 to 31, 2023

Country	Average CSI	Days at CSI = 3 or higher	Days at CSI = 5 or higher
Palestinian territories	4.9	23	18
Saudi Arabia	4.6	27	23
Israel	4.4	21	17
Brunei Darussalam	4.4	22	19
Bangladesh (LDC)	4.4	26	19
Yemen (LDC)	4.2	25	21
Malaysia	3.9	22	18
Kuwait	3.9	23	14
Nepal (LDC)	3.8	22	16
Sri Lanka	3.8	23	19

LDC = United Nations designated [least developed countries](#).

Table 3. Top 10 CSI countries in Europe, July 1 to 31, 2023

Country	Average CSI	Days at CSI = 3 or higher	Days at CSI = 5 or higher
Malta	4.0	22	14
Canarias	3.0	17	7
Svalbard	2.6	17	10
Italy	2.3	14	10
Greece	2.2	15	10
Isle of Man	2.0	8	2
North Macedonia	2.0	15	11
Montenegro	2.0	14	11
Spain	1.9	11	7
Bulgaria	1.6	12	5

Table 4. Top CSI countries in North America, July 1 to 31, 2023

Country	Average CSI	Days at CSI = 3 or higher	Days at CSI = 5 or higher
*Jamaica	5.0	31	31
*Puerto Rico	5.0	31	29
*Haiti (LDC)	5.0	30	29
*Curacao	5.0	30	28
*Grenada	5.0	30	29
*Guadeloupe	5.0	30	28
Panama	5.0	29	27
Honduras	5.0	29	28
*Trinidad and Tobago	5.0	29	28
*Bahamas	5.0	29	26
*Barbados	5.0	28	26
*Dominica	5.0	28	27
El Salvador	5.0	28	26
*Martinique	5.0	28	27

*Indicates [Small Island Developing State](#) and Associate Members of United Nations Regional Commissions. LDC = United Nations designated [least developed countries](#).

Table 5. Top 10 CSI countries in Oceania, July 1 to 31, 2023

Country	Average CSI	Days at CSI = 3 or higher	Days at CSI = 5 or higher
*Kiribati (LDC)	5.0	23	21
*Marshall Islands	5.0	28	23
*Samoa	5.0	25	19
*French Polynesia	4.3	25	21
*Papua New Guinea	3.4	19	15
*Solomon Islands (LDC)	3.1	20	16
*Guam	3.0	21	16
New Zealand	0.7	6	1
*New Caledonia	0.5	2	0
Australia	0.1	1	0

*Indicates [Small Island Developing State](#) and Associate Members of United Nations Regional Commissions. LDC = United Nations designated [least developed countries](#).

Table 6. Top 10 CSI countries in South America, July 1 to 31, 2023

Country	Average CSI	Days at CSI = 3 or higher	Days at CSI = 5 or higher
French Guiana	5.0	28	26
*Guyana	4.9	26	24
*Suriname	4.7	26	24
Ecuador	4.3	25	21
Peru	4.2	24	19
Venezuela	4.2	24	20
Colombia	3.6	21	17
Brazil	1.9	13	9
Bolivia	1.9	12	8
Chile	1.2	7	5

*Indicates [Small Island Developing State](#) and Associate Members of United Nations Regional Commissions.

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