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# Maryland Climate Bulletin
# August 2024

Prepared by
Dr. Alfredo Ruiz-Barradas
Maryland State Climatologist

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DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCE
*Sumant Nigam*, Chair

Maryland State Climatologist Office

# Summary

Statewide averages indicate that August 2024 was warmer and wetter than normal (i.e., 1991-2020 averages). Monthly mean temperatures were between 67 and 78°F; maximum temperatures were in the 78–88°F range, and minimum temperatures were between 56 and 68°F. Monthly total precipitation was in the 2–8 inches range.

*Maryland Regional Features* (Figures 1-6, C1, and D1)

- The mean temperature was warmer than normal over much of the state, particularly over the southern tip of Saint Mary's, Calvert, and Dorchester counties (above 1.0°F) and along the boundary of Garrett and Allegany counties (around 1.0°F). Slightly colder than normal conditions appeared over Worcester County (around –0.2°F) and portions of Wicomico and Somerset counties.

- The maximum temperature was also warmer than normal over most of the state, especially over the southern tip of Saint Mary's, Calvert, and Garrett counties (above 2.2°F). Slightly colder than normal conditions appeared over Washington County (around –0.2°F).

- The minimum temperature had patches of warmer and colder-than-normal temperatures in the state. It was warmer than normal over regions like western Montgomery and Frederick, and Charles and Saint Mary's counties (around 1.0°F), among others, on the Piedmont and northern Eastern Shore, and colder than normal over areas like Worcester, Wicomico, Somerset, and Garrett counties (around –1.0°F).

- Precipitation was above normal over a large portion of the central and northern parts of the state and drier than normal over a large portion of the Eastern Shore and southern counties to the west of the Bay. Above-normal precipitation was particularly high (above 4 in) over southern Washington, Frederick, and Carroll counties and northern Montgomery and Howard counties, which received more than double their climatological August rainfall. Other counties in the Piedmont received at least 40% more than their climatological rainfall. On the other hand, below-normal precipitation was observed over parts of Worcester, Wicomico, and Somerset counties (around 1.5–2 in deficit), accounting for around 60% less rainfall than their climatological rainfall.

- The intensity of the drought diminished this month, even though the extension of the state under drought conditions remained the same as last month, 67%. The severity of the drought diminished as the extent of the areas under moderate-to-extreme conditions diminished in the west. Extreme drought conditions were only in southwestern Garrett County. The creeks and rivers in western Garrett County had a below-normal streamflow, while the rest of the state had mostly normal streamflow. Severe drought conditions remained in the remaining Garrett and Allegany counties, while moderate drought conditions did in portions of Allegany, Washington, Frederick, and Montgomery counties. Abnormally dry conditions appeared over the entire Eastern Shore and Calvert, Saint Mary's, and Charles counties.

*Maryland Climate Divisions* (Figures 7-8, B1, and B2)

- Except for the Southeastern Shore, Climate Division 1, the other climate divisions were warmer than normal. The Lower Southern, Climate Division 3, had the warmest anomaly (0.9°F above normal), but the Southeastern Shore, Climate Division 1, had the coldest anomaly (0.1°F below normal). On the other hand, five of the eight climate divisions were wetter than normal. The Appalachian Mountains, Climate Division 7, had the wettest anomaly (2.78 in above normal), and the Southern Shore, Climate Division 1, had the driest anomaly (1.98 in below normal).

- Statewide temperature was warmer than normal for the ninth month since December 2023. Statewide precipitation was above normal for the first time since April.

*Extreme daily heat and precipitation, and growing degree days* (Figures 9-11)

- Statewide maximum and minimum daily temperatures indicated that the current number of days with extreme temperatures is larger than normal, although not the number of waves/spells. There were 7 more hot days (maximum temperature warmer than 86°F) than normal but the same number of heatwaves (8), 13 more warm days (maximum temperature warmer than 80°F) than normal but 3 less warm day spells (6 vs. 9), and 14 more warm nights (minimum temperature warmer than 68°F) than normal but the same number of warm night spells (5).

- Statewide daily total precipitation showed that the current number of days with extreme precipitation (at least 0.64 inches; the 95th percentile in 1951-2000) is larger than normal by 3 days. Still, the number of dry spells (consecutive days with daily precipitation of no more than 0.04 inches) is less than normal by 5 dry spells.

- The cumulative calendar year (until August 31) growing degree days have been greater than normal since the start of March. Modified growing degree days (base 86/50°F) reached 3256°FDD, and growing degree days (base 50°F) reached 3196°FDD by the end of August. The modified growing days were 227°FDD above normal, while the growing degree days were 293°FDD above normal.

*Historical Context* (Figure 12, Tables A1 and A2)

- Statewide mean, maximum, and minimum temperatures in August 2024 (75.2, 85.7, 64.7°F) were above their long-term (1895-2023) mean but far from their historical records of 78.0, 88.9, and 68.0°F set in 2016, 1900 and 2018, respectively. Statewide precipitation (5.08 in) in August was too above the long-term mean but still far from the record of 11.85 inches in 1955.

- Precipitation indicated that August 2024 was the fifth wettest for Washington County, the seventh wettest for Frederick County, and the tenth wettest for Carroll County.

*Century-Plus Trends, 1895-2024* (Figures 13, 14)

- Statewide mean temperature and cooling degree−days in August showed a significant warming trend (2.0°F/century) and an increasing cooling trend (69.8°FDD/century). Statewide precipitation had a non-significant drying trend (–0.28 in/century).

- Regionally, August temperatures showed significant warming trends everywhere in the state. The largest trend is in Baltimore City (3.3°F/century), as it has been since March. Trends above 2.4°F/century are evident in the counties of central Piedmont.

- Regionally, August precipitation had significant drying trends over parts of the Blue Ridge and western Piedmont. The largest drying trends appeared over Frederick and Carroll counties (–0.9 in/century).

# Contents

# 1. Introduction

The Maryland Climate Bulletin is issued by the Maryland State Climatologist Office (MDSCO), which resides in the Department of Atmospheric and Oceanic Science at the University of Maryland, College Park. It documents the surface climate conditions observed across the state in a calendar month and is issued in the second week of the following month.

Maryland's geography is challenging, with the Allegheny and Blue Ridge mountains to the west, the Piedmont Plateau in the center, the Chesapeake Bay, and the Atlantic Coastal Plain to the east. The range of physiographic features and the state's eastern placement within the expansive North American continent contribute to a comparatively wide range of climatic conditions.

The bulletin seeks to document and characterize monthly surface climate conditions in the state, placing them in the context of regional and continental climate variability and change to help Marylanders interpret and understand recent climate conditions.

The monthly surface climate conditions for August 2024 are presented via maps of key variables, such as average surface air temperature, maximum surface air temperature, minimum surface air temperature, total precipitation, and their anomalies (i.e., departures from normal); they are complemented by drought conditions for the state, as given by the U.S. Drought Monitor, and streamflow anomalies as given by the U.S. Geological Survey Water Watch in Section 3. Statewide and climate division averages for the month are compared against each other via scatter plots in Section 4. Extreme daily heat and precipitation, as well as growing degree days, are presented from the analysis of daily statewide averaged temperatures and precipitation in Section 5. The monthly statewide averages are placed in the context of the historical record via box and whisker plots in Section 6. Century-plus trends in statewide air temperature, cooling degree days, precipitation, and state maps of air temperature and precipitation are presented in Section 7. Ancillary statewide, climate division, and county-level information is provided via tables and plots in Appendices A-B; climatology and variability maps are in Appendices C-D, including the percent of normal precipitation and normalized anomalies for the month.

# 2. Data & Methods

Surface air temperatures, total precipitation, and degree-days data in this report are from the following sources:

- NOAA Monthly U.S. Climate *Gridded* Dataset at 5-km horizontal resolution (NClimGrid – Vose et al. 2014). It is available in a preliminary status at https://www.ncei.noaa.gov/data/nclimgrid-monthly/access/
  Data was downloaded on 9/11/2024.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al. 2014). It is available in a preliminary status (v1.0.0-20240906) at:

https://www.ncei.noaa.gov/pub/data/cirs/climdiv/
Data was downloaded on 9/10/2024.

- NOAA area averages of daily temperatures and precipitation dataset (nClimGrid−Daily −Durre et al. 2022). It is available in a preliminary status, v1.0.0, at: https://www.ncei.noaa.gov/products/land-based-station/nclimgrid-daily
  Data was downloaded on 9/9/2024.

Drought conditions are from the U.S. Drought Monitor website:
https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Streamflow conditions are from the U.S. Geological Survey Water Watch website:
https://waterwatch.usgs.gov/index.php

Some definitions:

*About climate and climatology*. Weather and climate are closely related, but they are not the same. Weather represents the state of the atmosphere (temperature, precipitation, etc.) at any given time. On the other hand, climate refers to the time average of the weather elements when the average is over long periods. If the average period is long enough, we can start to characterize the climate of a particular region.

It is customary to follow the World Meteorological Organization (WMO) recommendation and use 30 years for the average. The 30-year averaged weather data is traditionally known as Climate Normal (Kunkel and Court 1990), which is updated every ten years (WMO 2017). Establishing a climate normal or climatology is important as it allows one to compare a specific day, month, season, or even another normal period with the current normal. Such comparisons characterize anomalous weather and climate conditions, climate variability and change, and help define extreme weather and climate events (Arguez et al. 2012). The current climate normal, or just the climatology, is defined for 1991–2020.

*About the anomalies*: Anomalies for a given month (e.g., August 2024) are the departures of the monthly value from the corresponding month's 30-year average (i.e., from the average of 30 Augusts) during 1991-2020. When the observed monthly value exceeds its climatological value, it is referred to as above normal (e.g., warmer than normal or wetter than normal) or a positive anomaly. In contrast, when this value is smaller than its climatological value, it is referred to as below normal (e.g., colder than normal or drier than normal) or negative anomaly.

*About variability*. The monthly standard deviation of a climate variable measures its dispersion relative to its monthly mean and assesses its year-to-year, or interannual, variability. Anomalies are sometimes compared against that variability to identify extremes in the climate record. When the anomalies are divided by the standard deviation, they are named standardized anomalies.

*About hot days, warm days, and warm nights.* Extreme heat, detrimental to crops without irrigation and population lacking air conditioning, is tracked by the count of hot days, warm days and nights, and their consecutive occurrence (e.g., Tschurr et al. 2020, Barriopedro et al. 2023). A hot day is defined as one when the maximum temperature is greater than 86°F, a warm day is when the maximum temperature is greater than 80°F while a warm night is when the minimum temperature is greater than 68°F. When these conditions persist for two or more days, they are called heat waves for the hot days and warm spells for the warm days and nights. These threshold values correspond to the 89th and 75th percentiles of statewide daily maximum temperature and the 95th percentile of statewide daily minimum temperature for the period 1951-2000.

*About degree days.* Degree days are the difference between the daily mean temperature (high temperature plus low temperature divided by two) and a predefined base temperature; because energy demand is cumulative, degree-day totals are usually calculated on a daily, monthly, seasonal, and annual basis.

- *Heating and cooling degree days.* These are used to get a general idea of how much energy is required to warm or cool buildings. The base temperature used for this purpose is 65°F, considered tolerable for human comfort (CPC, 2023).

- *Growing degree days*. These estimate the growth and development of plants and insects through the calendar year or during the growing season under the idea that development will only occur if the temperature exceeds some minimum development threshold temperature or, in other words, if enough warmth is accumulated. Because the actual development will differ for different plants and insects, and the presence of weeds and precipitation can influence the development, a base temperature of 50°F is generally considered acceptable for all plants and insects (OSU 2024). However, this base temperature is best suited for the development of specific crops like corn, sweet corn, soybeans, tomatoes, and a few others.

    - *Modified growing degree days*. The modified growing degree days are obtained if base temperatures are established for the daily maximum and minimum temperatures before calculating the daily mean temperature. When the base temperature for the daily maximum temperature is set to 86°F, and the base temperature for the daily minimum temperature is set to 50°F, the growing degree days are specific to corn development as no appreciable growth is detected with temperatures lower than 50°F or greater than 86°F.

*About extreme precipitation*. This is defined as the yearly number of days with statewide averaged daily total precipitation equal to or greater than 0.64 inches. This threshold value represents the 95th percentile of statewide averaged daily total precipitation for 1951-2000.

*About the dry day spells.* A dry day is defined as a day with precipitation below 0.04 inches. These conditions are named dry spells if they persist for two or more days. The number of dry spells and the longest dry spell are particularly important during the vegetation period (Tschurr et al., 2020).

*About NOAA's Climate Divisions.* The term "climate division" refers to one of the eight divisions in the state that represent climatically homogeneous regions, as determined by NOAA: https://www.ncei.noaa.gov/access/monitoring/dyk/us-climate-divisions

The eight climate divisions in Maryland are:

- Climate Division 1: Southeastern Shore. It includes the counties of Somerset, Wicomico, and Worcester.
- Climate Division 2: Central Eastern Shore. It includes the counties of Caroline, Dorchester, and Talbot.
- Climate Division 3: Lower Southern. It includes the counties of Calvert, Charles, and St. Mary's.
- Climate Division 4: Upper Southern. It includes the counties of Anne Arundel and Prince George's.
- Climate Division 5: Northeastern Shore. It includes the counties of Kent and Queen Anne's.
- Climate Division 6: North Central. It includes the counties of Baltimore, Carroll, Cecil, Frederick, Harford, Howard, Montgomery, and the city of Baltimore.
- Climate Division 7: Appalachian Mountains. It includes the counties of Allegany and Washington.
- Climate Division 8: Allegheny Plateau. It includes Garrett County.

Note that these Climate Divisions do not correspond with the *Physiographic Provinces* in the state, as the former follow county lines. Climate Division 8 follows the *Appalachian Plateau Province*, Climate Division 7 follows the *Ridge and Valley Province*; however, Climate Division 6 includes the *Blue Ridge and the Piedmont Plateau provinces*, Climate Divisions 3, 4, and a portion of 6 include the *Upper Coastal Plain Province*, and Climate Divisions 1, 2, 5, and a portion of 6 include the *Lower Coastal Plain (or Atlantic Continental Shelf) Province*.

# 3. August 2024 Maps

## A. Mean Temperatures

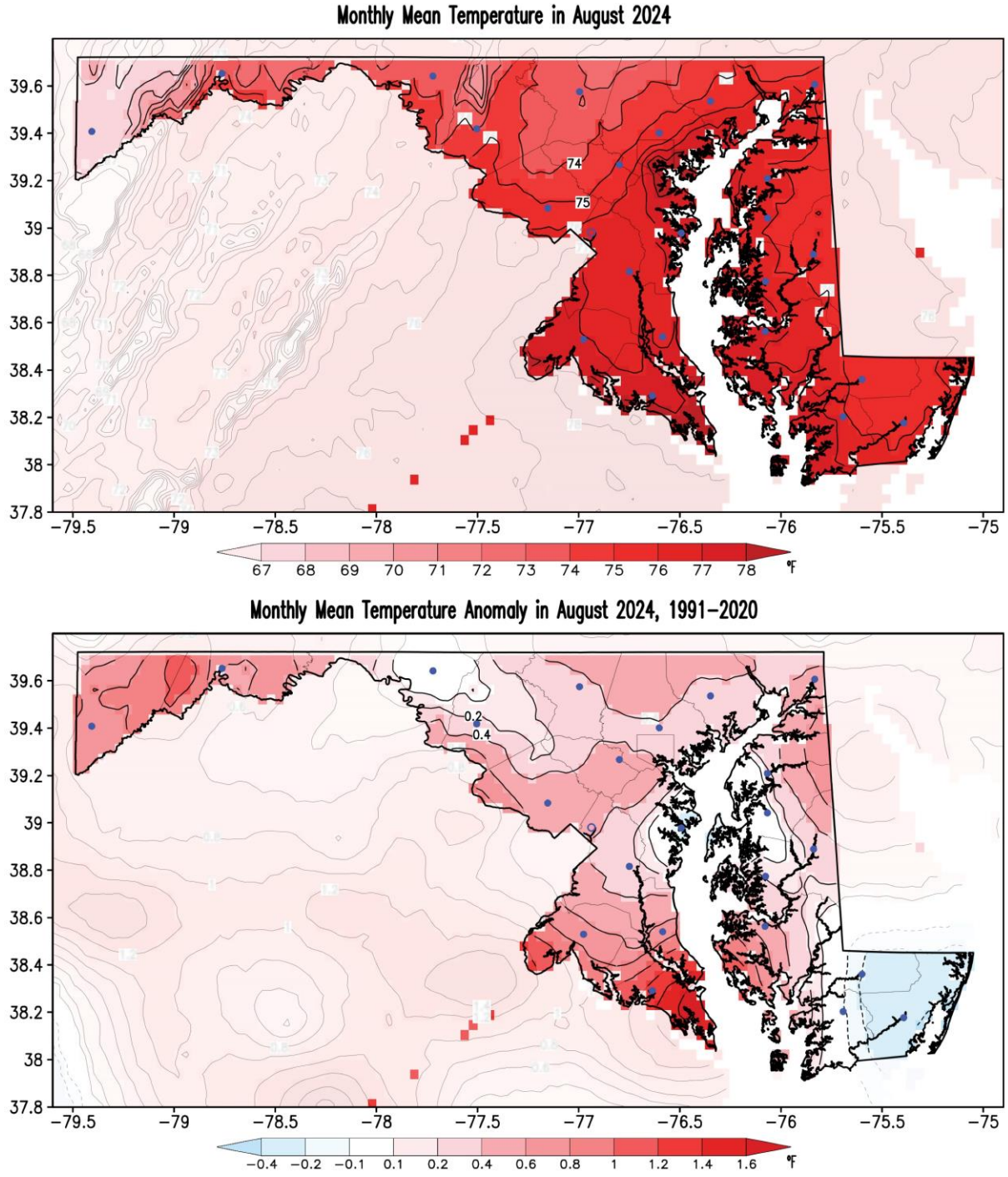


**Figure 1.** Monthly mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for August 2024. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

B. Maximum Temperatures

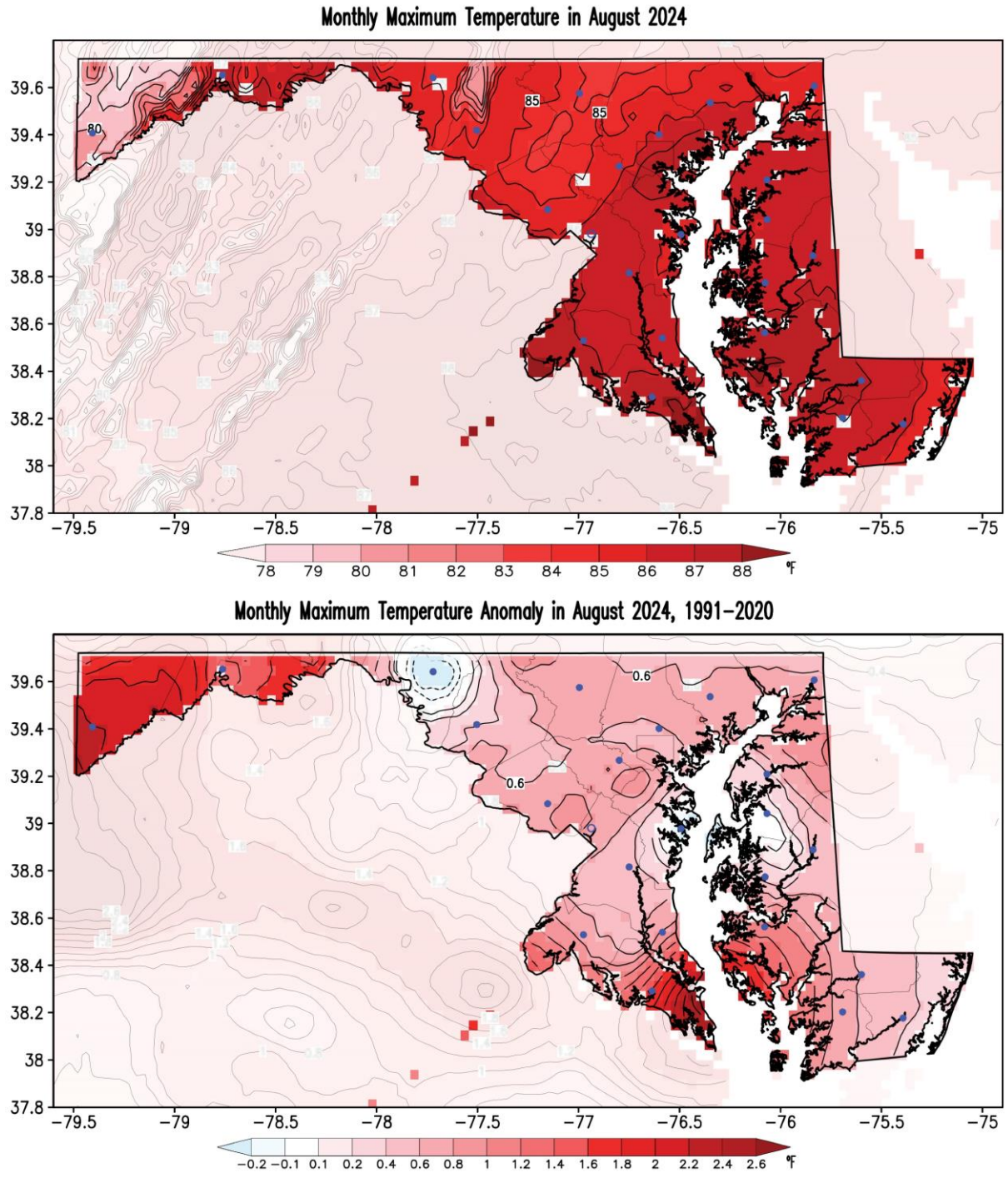


**Figure 2.** Monthly maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for August 2024. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

C. Minimum Temperatures

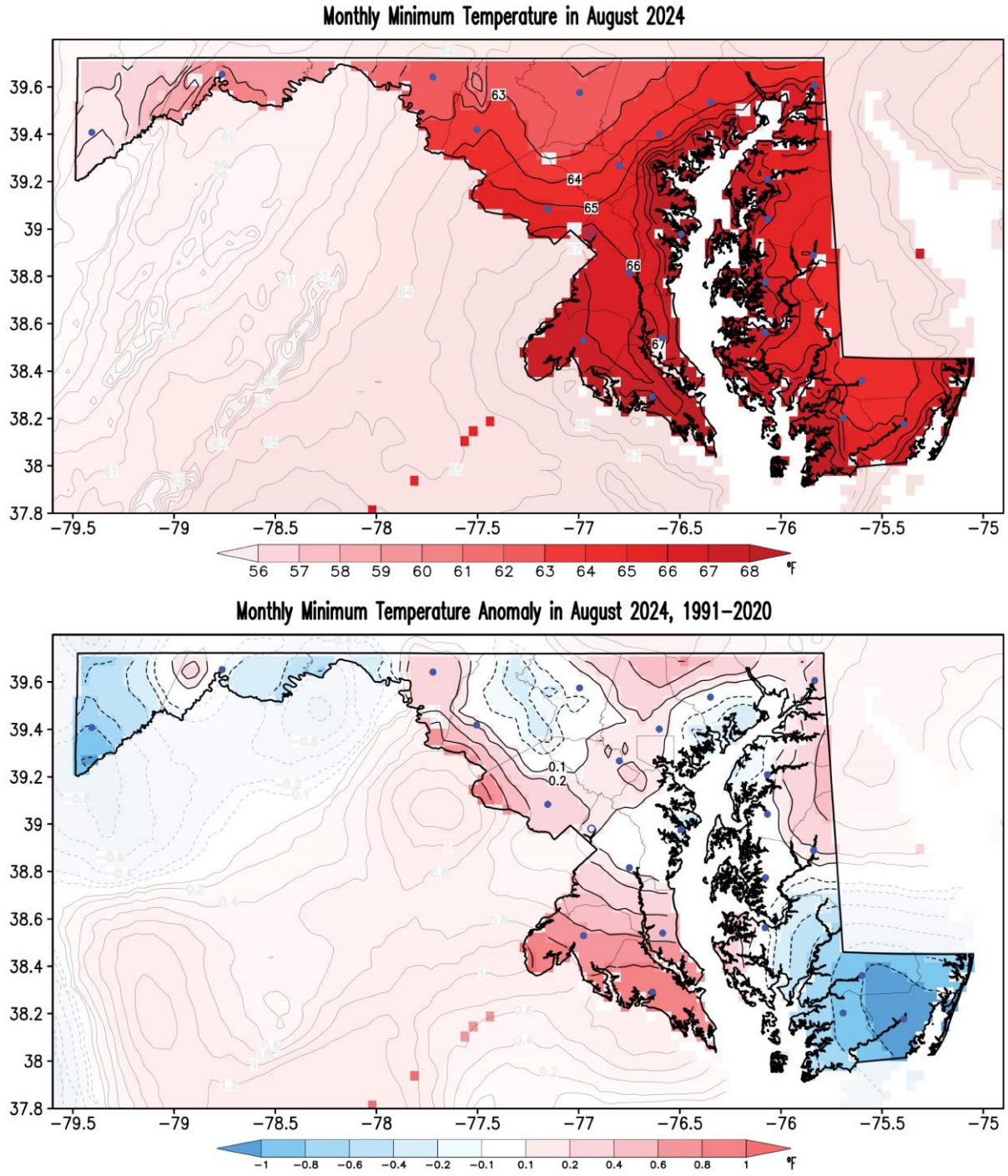


**Figure 3.** Monthly minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for August 2024. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

D. Precipitation

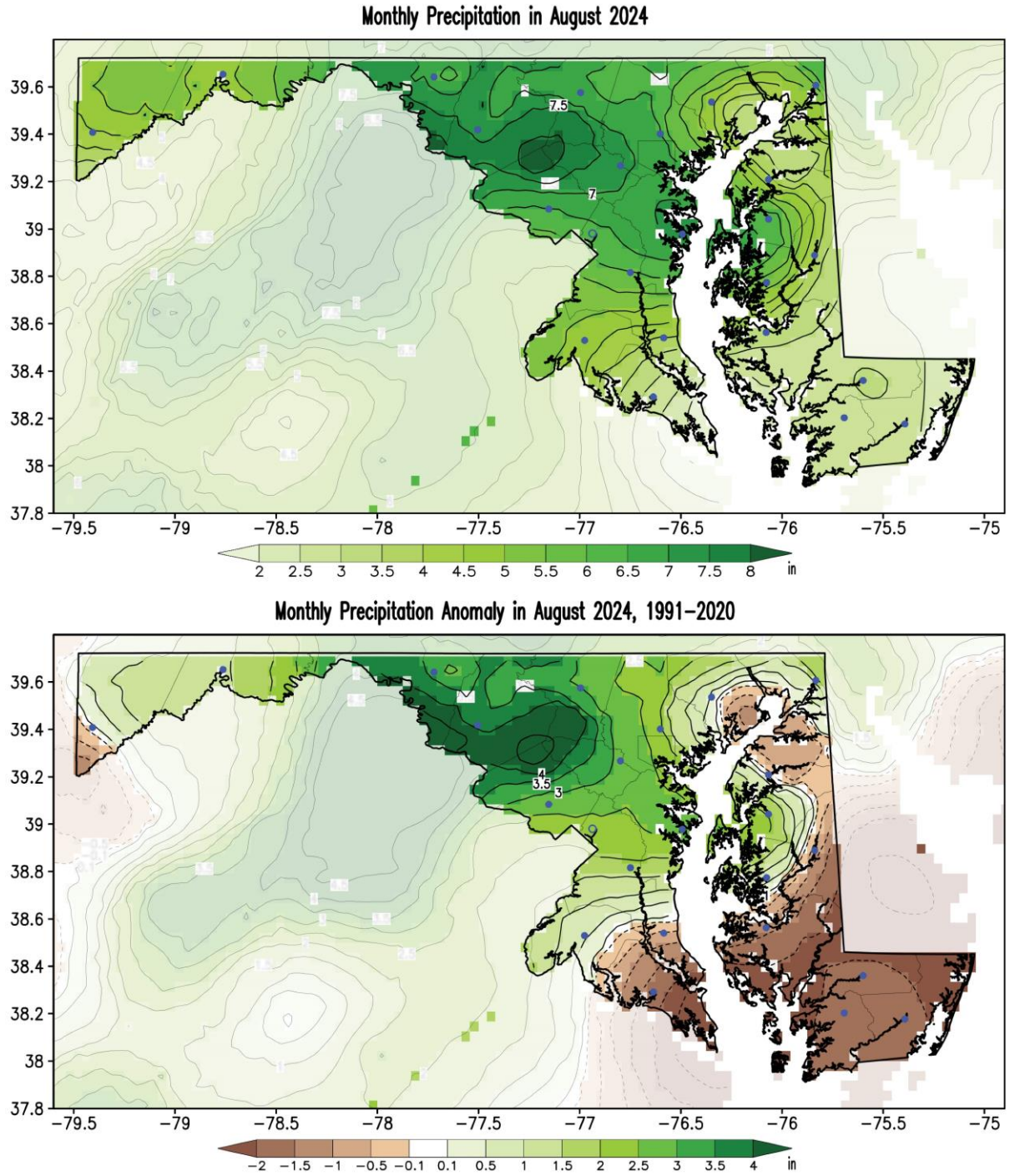


**Figure 4.** Monthly total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for August 2024. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

E. Drought

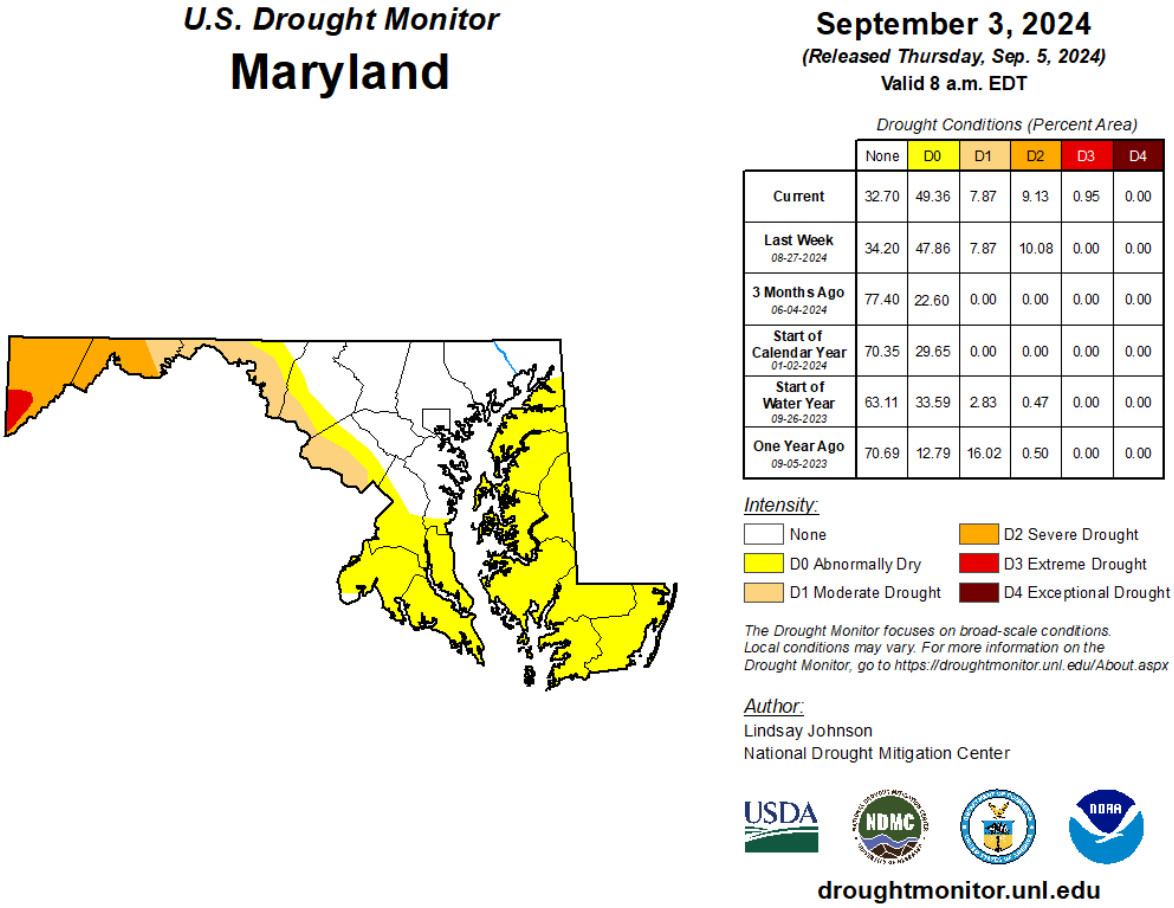


**Figure 5.** Drought conditions as reported by the U.S. Drought Monitor on September 3, 2024. At this time, around 67% of the state is under some drought category, as it was at the end of July. However, the extent of the west's moderate to extreme drought categories is less. Still, the extent of the abnormally dry conditions increased and now covers the whole Eastern Shore and southern counties to the west of the Bay. Yellow shading indicates abnormally dry regions, light orange shading shows regions under a moderate drought, darker orange marks regions under severe drought, and red shading indicates extreme drought according to the drought intensity key. Numbers in the table indicate the percentage of the state covered under the particular drought conditions at the time (in the left column). Areas shown in yellow (Abnormally Dry) indicate land that is going into or coming out of drought. Light orange areas (Moderate Drought) highlight land that may experience low water supply and damage to crops and pastures. Orange areas (Severe Drought) show land with water shortages and an increased likelihood of crop and pasture losses. Red areas (Extreme Drought) highlight land that may experience widespread water shortages and major losses of crops and pastures, with forests susceptible to fire. Current conditions can be monitored from the U. S. Drought Monitor website.

F. Streamflow

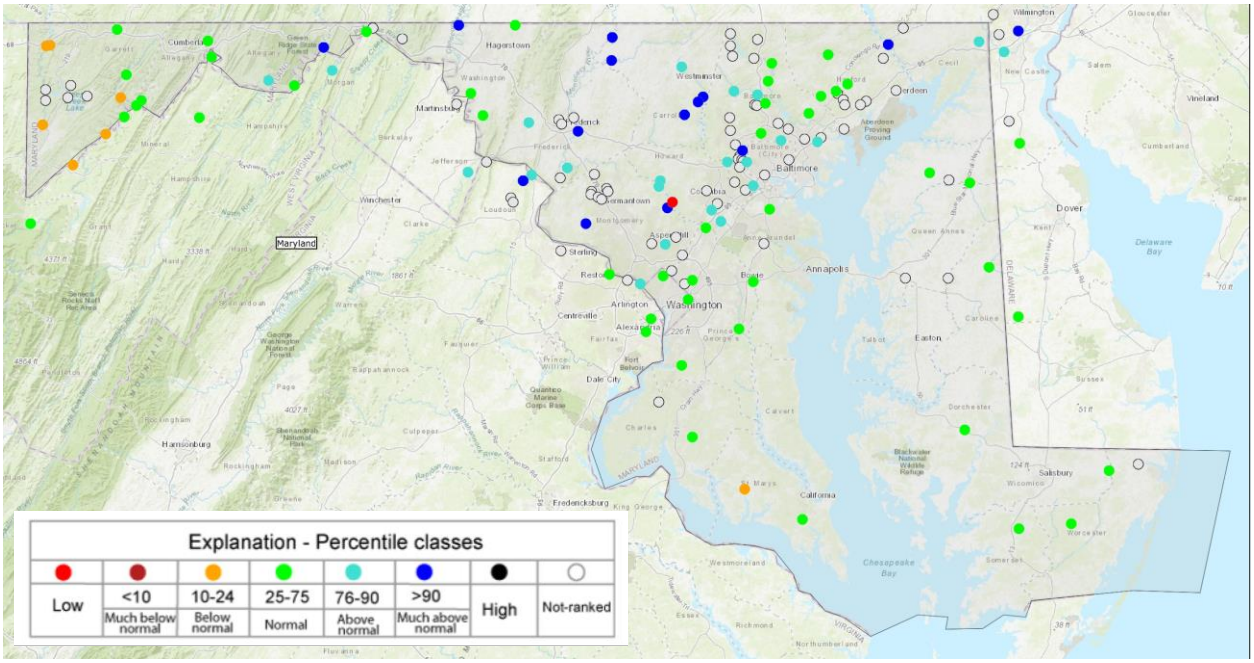


**Figure 6.** Monthly averaged streamflow class anomalies as reported by the U.S. Geological Survey (USGS) Water Watch for August 2024. Orange to red-filled circles denote below-normal streamflow conditions, cyan to black-filled circles denote above-normal streamflow conditions, and green-filled circles represent normal streamflow conditions. Springs and rivers had Below-normal streamflow in the severe to extreme drought areas in Garrett County. Current conditions can be monitored from the U. S. Geological Survey website.

# 4. August and JJA 2024 Climate Divisions Averages

## A. August 2024 Scatter Plots

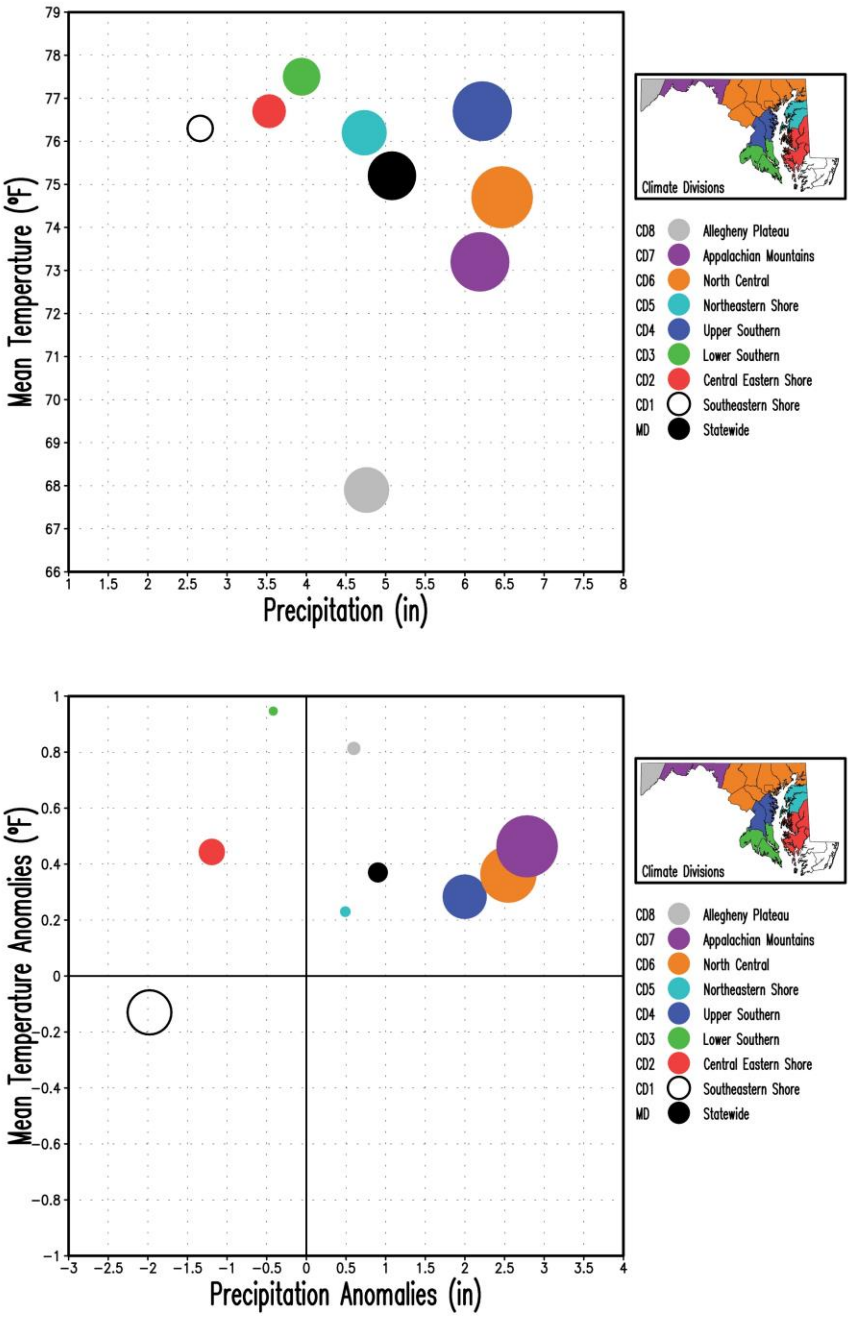


**Figure 7.** Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for August 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 climatology. Temperatures are in °F and precipitation is in inches. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (6.47 inches in CD6, top panel) and by the maximum precipitation anomaly (2.78 inches in CD7, bottom panel) among the nine regions. Note that the color of the filled circles corresponds to the color in the Climate Divisions according to the inset map.

B. June – August 2024 Scatter Plots

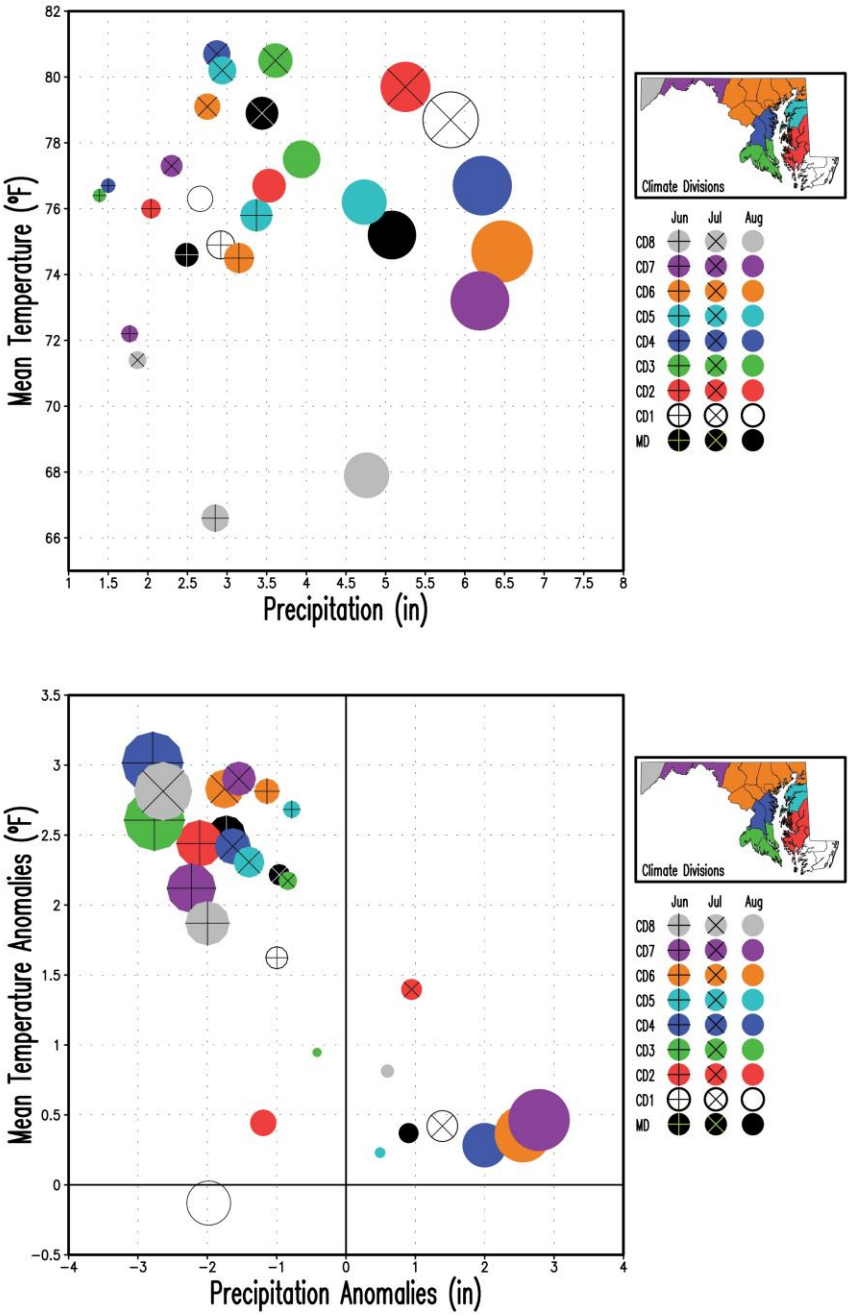


**Figure 8**. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for June, July and August 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 climatology. Temperatures are in °F, and precipitation is in inches. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (6.47 inches in CD6 in August, top panel) and by the maximum precipitation anomaly (|−2.79| inches in CD4 in June, bottom panel) among the nine regions and three months. August is displayed with filled circles only, while July and June are displayed with superposed multiplication and addition signs, respectively.

# 5. Extremes and Growing Degree Days

## A. Hot Days, Warm Days and Warm Nights

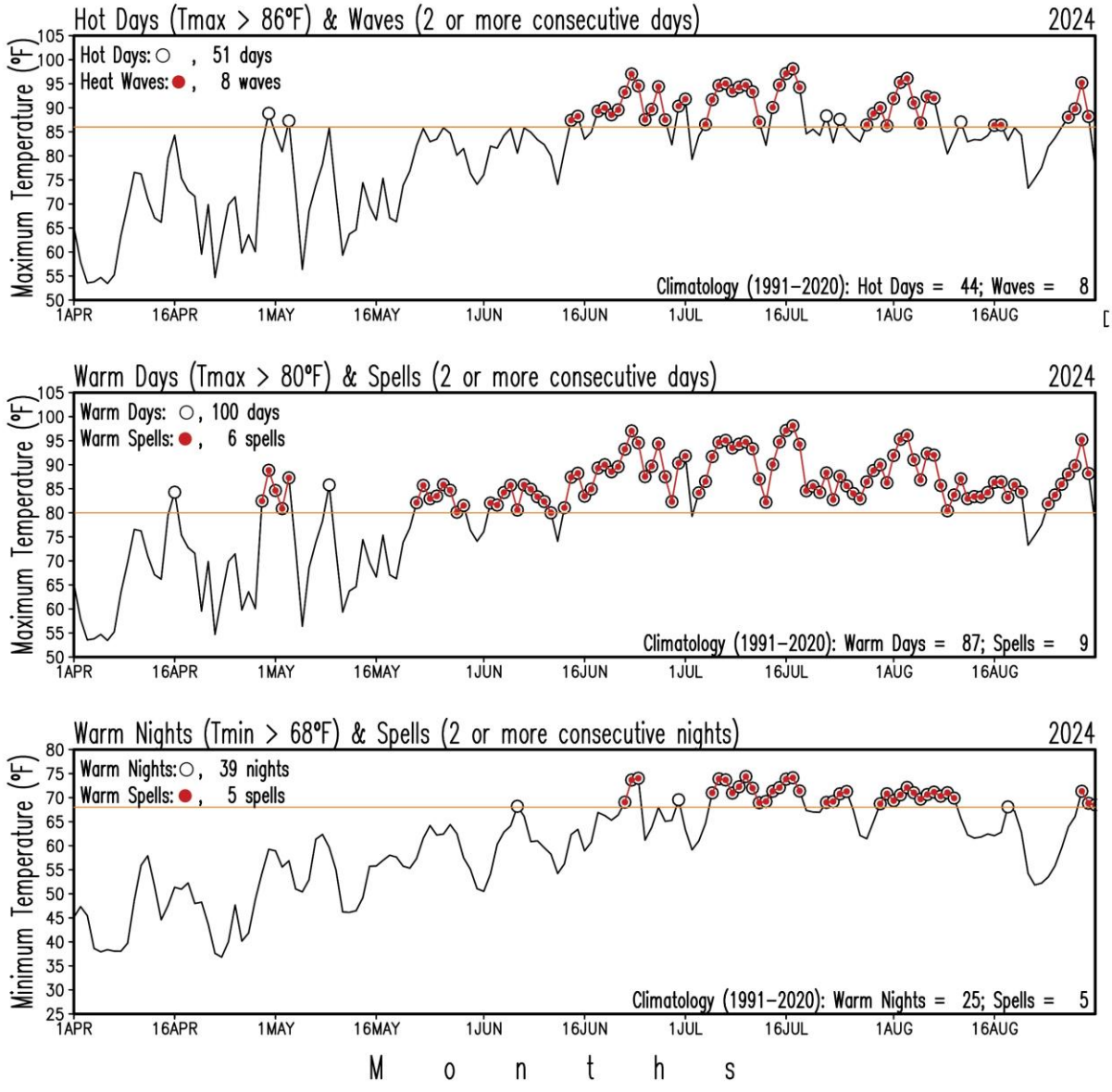


**Figure 9.** Maryland (statewide) number of hot days, warm days, warm nights, and their consecutive occurrence for the period January 1 - August 31, 2024. The upper panel shows hot days in open circles and heat waves in red-filled circles from statewide daily maximum temperatures. The middle panel shows warm days in open circles and warm day spells in red-filled circles from statewide daily maximum temperatures. Lower panel shows warm nights in open circles and warm night spells in red-filled circles from statewide daily minimum temperatures. The orange line in each panel marks the threshold temperatures of 86°F, 80°F and 68°F for each case. Figures at the county and climate division level and summary tables can be found at the MDSCO website.

B. Extreme Precipitation and Dry Spells

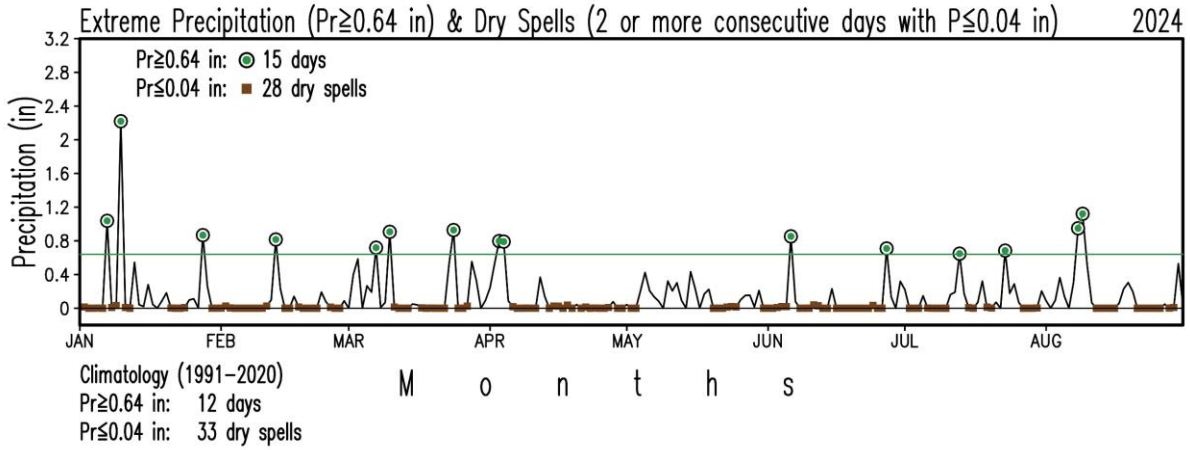


**Figure 10.** Maryland (statewide) number of days with extreme precipitation and dry day spells for the period January 1 - August 31, 2024. Extreme precipitation days (precipitation equal to or larger than 0.64 in) are identified by the green-filled circles. Dry spells (consecutive days with daily total precipitation less than or equal to 0.04 in) are shown by brown-filled squares. Both extremes are identified from the statewide area-averaged total daily precipitation. Figures at the county and climate division level and summary tables can be found at MDSCO website.

## C. Modified Growing Degree Days

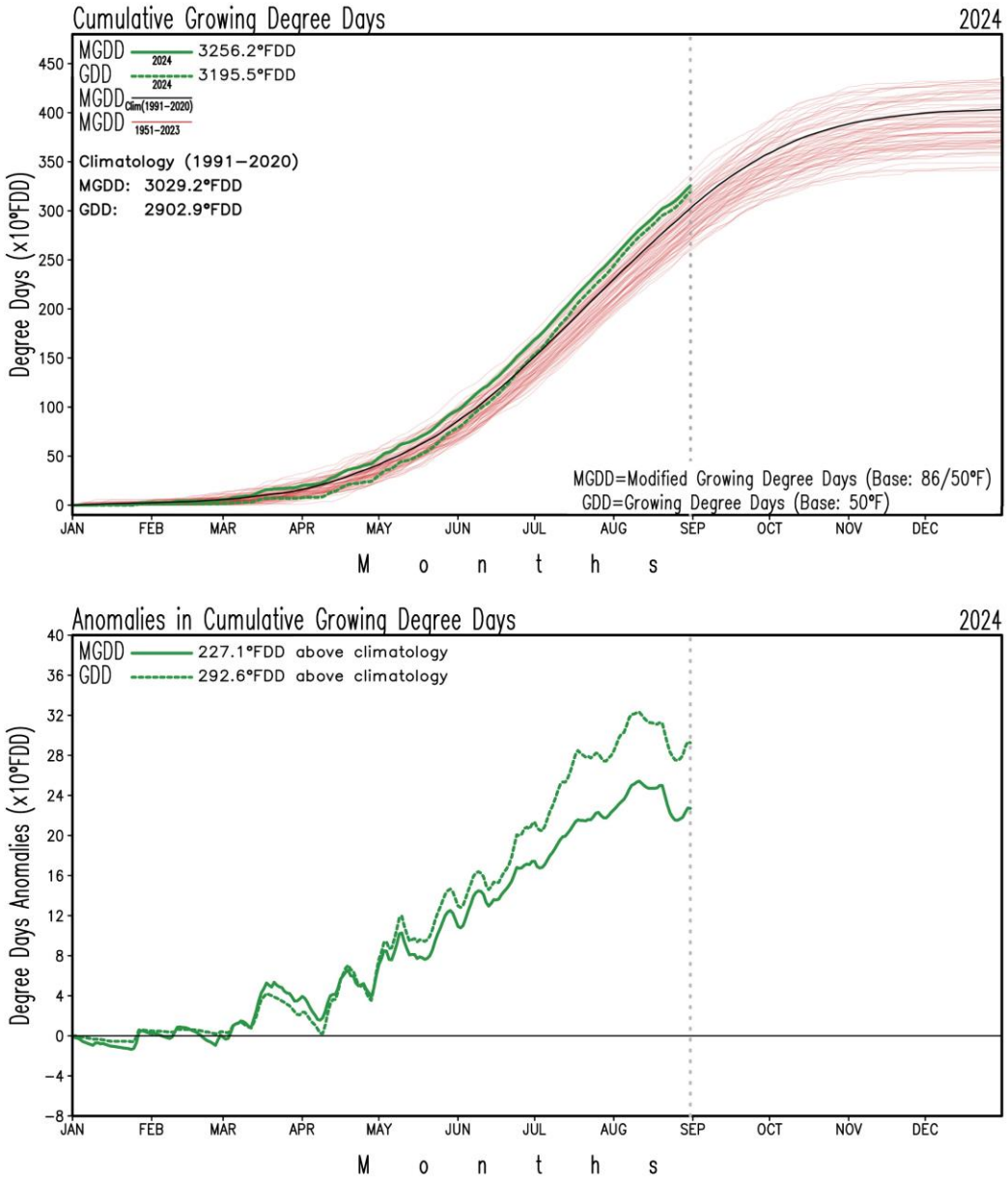


**Figure 11.** Maryland (statewide) cumulative growing degree days (upper panel) and its anomalies with respect to the 1991-2020 climatology (bottom panel) during the calendar year period January 1 to August 31, 2024. The cumulative modified growing degree days are displayed with the continuous green line, while the growing degree days are shown with the dashed green line; the black line in the upper panel shows the 1991- 2020 climatological cumulative modified growing degree days, and the thin red lines display the cumulative modified growing degree days every year from 1951 to 2023. Figures at the county and climate division level and summary tables can be found at the MDSCO website..

# 6. August 2024 Statewide Averages in the Historical Record

## A. Box and Whisker Plots

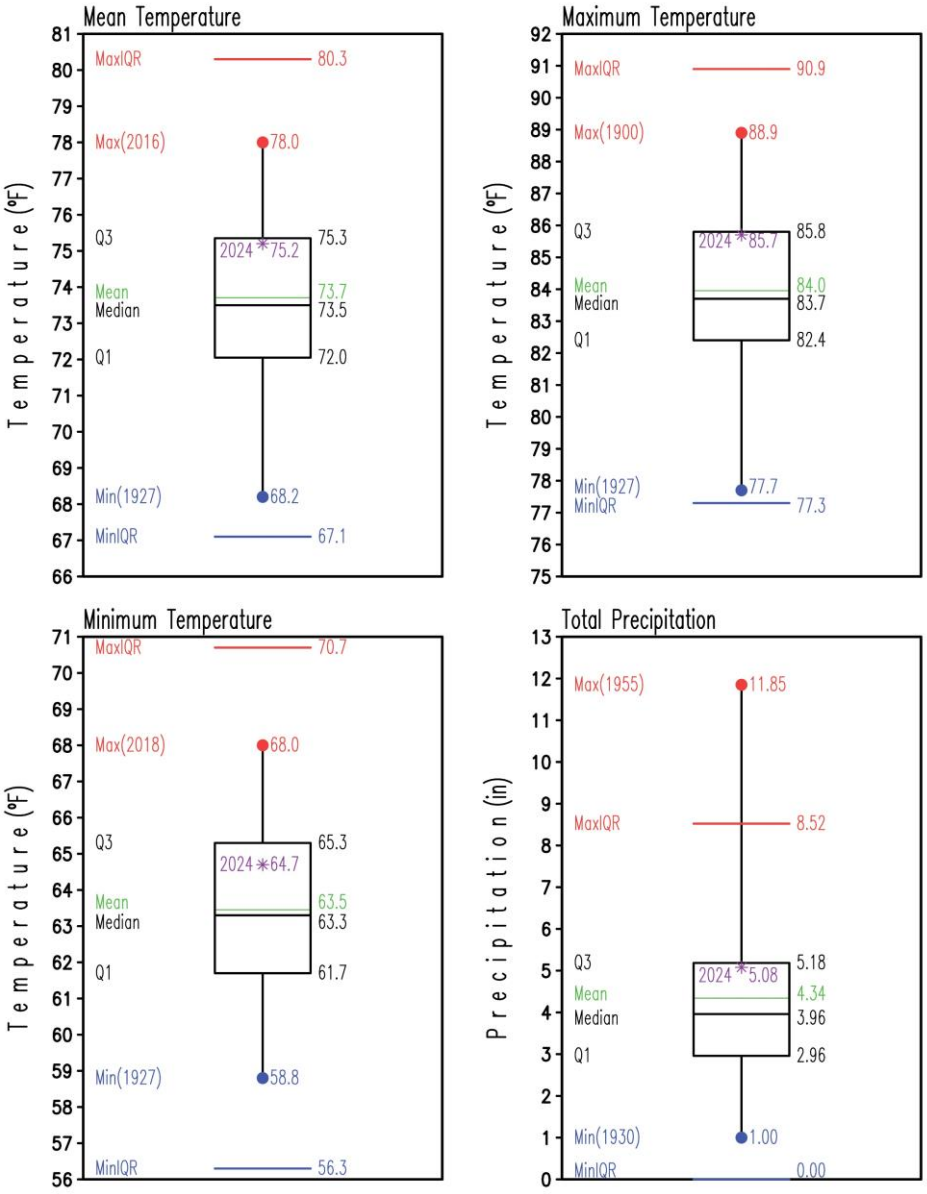


**Figure 12.** Box and Whisker plots of Maryland (statewide) monthly mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and total precipitation (lower right) for August for the period 1895-2023. The label and asterisk in purple represent conditions for August 2024. Statistics for the period 1895-2023 are labeled at the left side of each box and whisker plot and their values at their right. Temperatures are in °F, and precipitation is in inches. The mean is the green line within the box, while the median is the black line within the box. The lower (Q1) and upper (Q3) quartiles, indicating the values of the variable that separate 25% of the smallest and largest values, are the lower and upper horizontal black lines of the box, respectively. The blue and red dots mark the minimum and maximum values in the period at the end of the whiskers; the year of occurrence is shown in parenthesis. The blue and red horizontal lines represent extreme values defined by Q1-1.5×(Q3-Q1) and Q3+1.5×(Q3-Q1), respectively.

# 7. 1895-2024 August Trends

## A. Statewide Mean Temperature, Cooling Degree-Days, and Precipitation

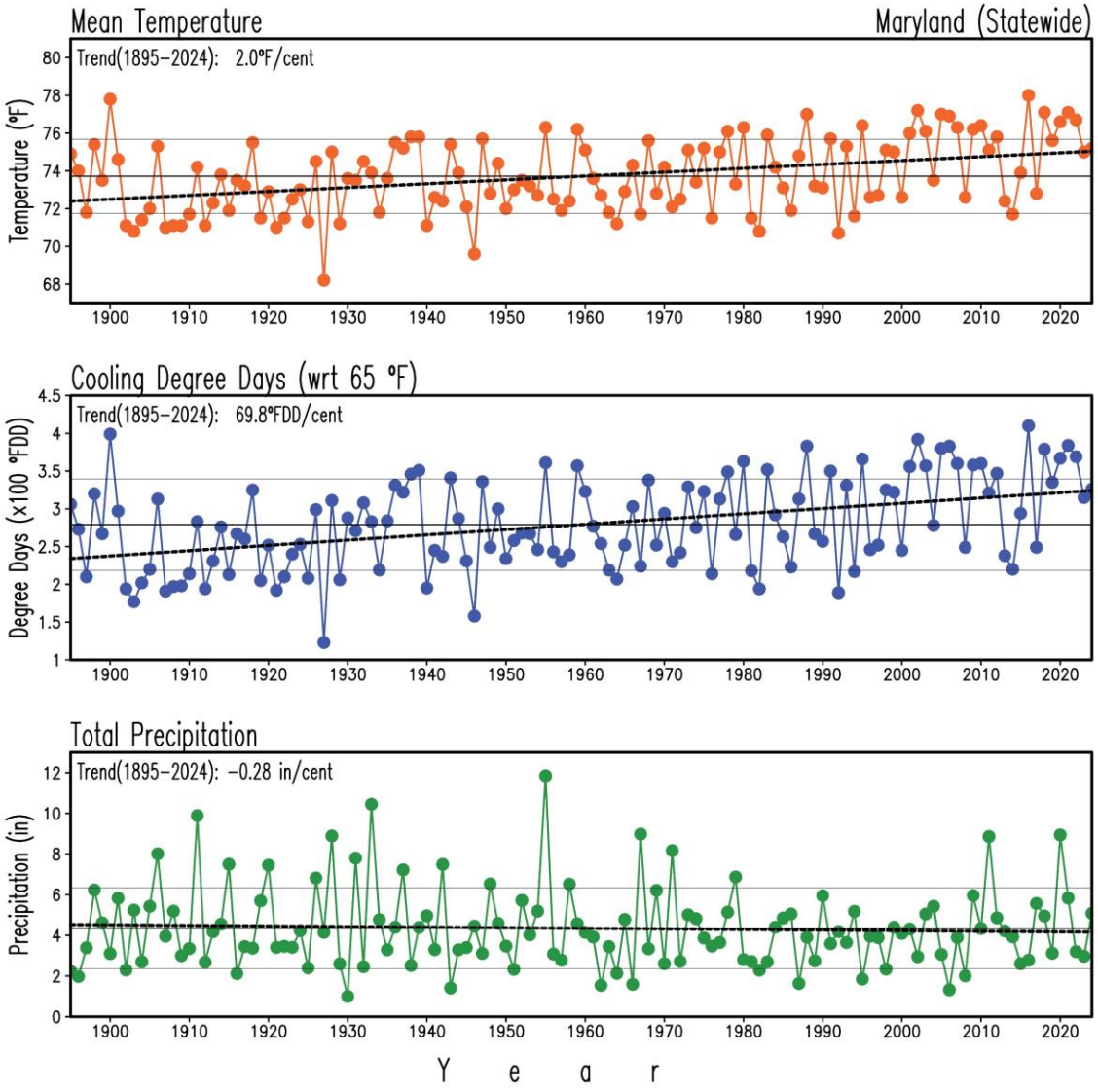


**Figure 13.** Maryland (statewide) mean surface air temperature, cooling degree days, and precipitation in August for the period 1895-2024. Temperature is in °F, cooling degree-days is in °F degree-days (°FDD), and precipitation is in inches. The thin, continuous black lines in each panel display the long-term means (73.7°F, 279.2°FDD and 4.35 in, 1895-2024), and the double thin, continuous gray lines indicate the standard deviation (2.0°F, 60.6°FDD and 1.99 in) above/below the long-term mean. The thick dashed black lines show the long-term linear trend. The warming temperature trend (2.0°F/century) and the increasing cooling degree-days trend (69.8°FDD/century) are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000) but no the precipitation drying trend (–0.28 in/century).

B. Temperature and Precipitation Maps

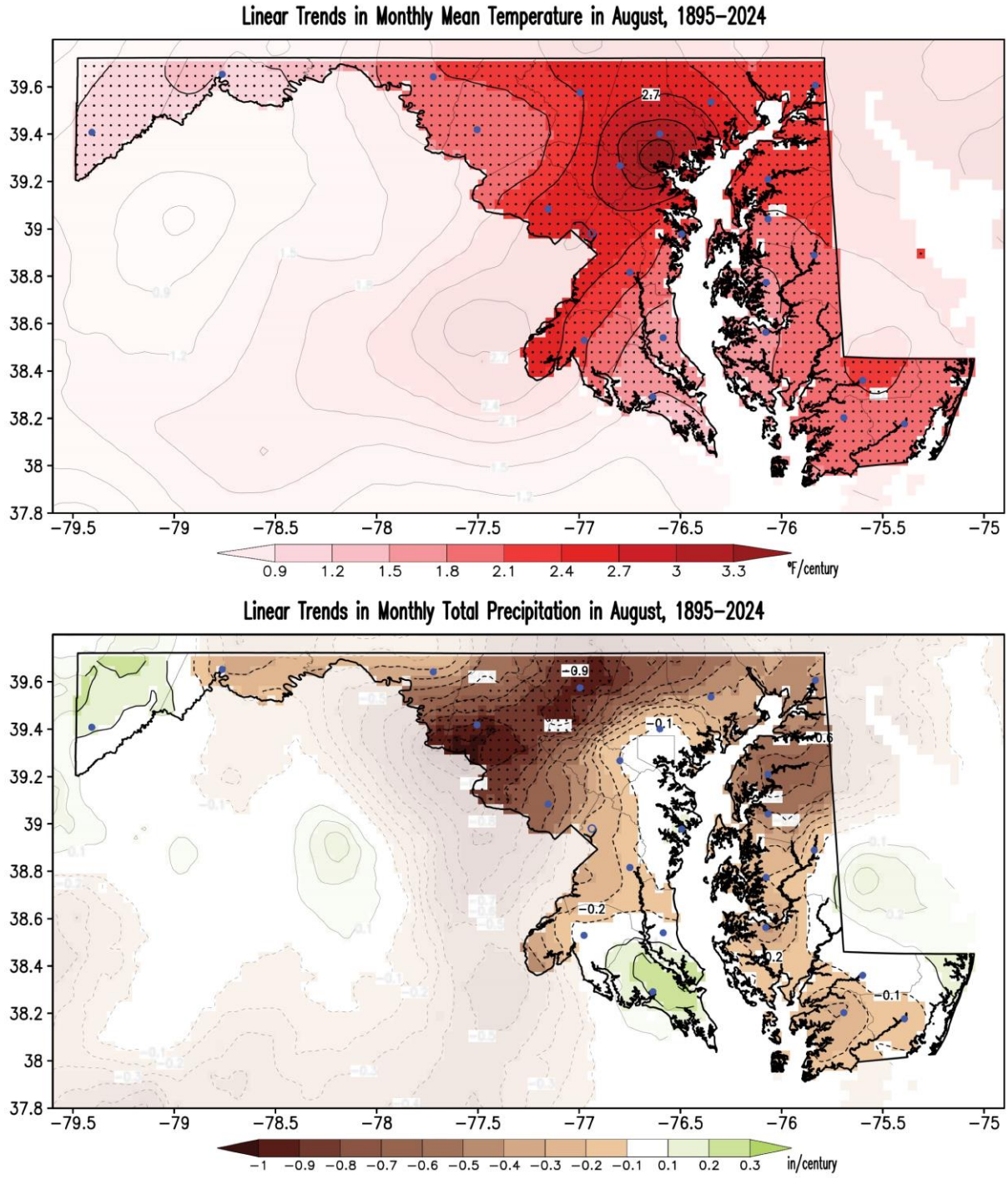


**Figure 14.** Linear trends in surface air mean temperature and precipitation in August for the period 1895-2024. Temperatures are in °F/century, and precipitation is in inches/century following the color bars. Red shading in the temperature map marks warming trends. Brown/green shading in the precipitation map shows drying/wetting trends. Stippling in the maps shows regions where trends are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000). Note that shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

# Appendix A. August 2024 Data Tables: Statewide, Climate Divisions, and Counties

A. Mean Temperature and Precipitation

| Region | Mean Air Temperature (°F) | Rank (#) |
|---|---|---|
| **Statewide** | 75.2 | 94 |
| **Climate Division 1** | 76.3 | 83 |
| **Climate Division 2** | 76.7 | 96 |
| **Climate Division 3** | 77.5 | 105 |
| **Climate Division 4** | 76.7 | 95 |
| **Climate Division 5** | 76.2 | 92 |
| **Climate Division 6** | 74.7 | 98 |
| **Climate Division 7** | 73.2 | 98 |
| **Climate Division 8** | 67.9 | 94 |
| **Allegany** | 72.7 | 97 |
| **Anne Arundel** | 77.0 | 95 |
| **Baltimore** | 75.0 | 98 |
| **Baltimore City** | 77.1 | 101 |
| **Calvert** | 77.1 | 99 |
| **Caroline** | 76.0 | 92 |
| **Carroll** | 73.4 | 94 |
| **Cecil** | 75.6 | 98 |
| **Charles** | 77.4 | 104 |
| **Dorchester** | 77.0 | 96 |
| **Fredrick** | 73.9 | 93 |
| **Garrett** | 67.9 | 94 |
| **Harford** | 75.5 | 98 |
| **Howard** | 74.6 | 97 |
| **Kent** | 76.4 | 94 |
| **Montgomery** | 75.1 | 98 |
| **Prince George's** | 76.5 | 98 |
| **Queen Anne's** | 76.2 | 90 |
| **Saint Mary's** | 77.8 | 108 |
| **Somerset** | 76.9 | 86 |
| **Talbot** | 76.7 | 85 |
| **Washington** | 73.6 | 86 |
| **Wicomico** | 76.1 | 84 |
| **Worcester** | 75.9 | 79 |

| Region | Total Precipitation (in) | Rank (#) |
|---|---|---|
| **Statewide** | 5.08 | 96 |
| **Climate Division 1** | 2.66 | 32 |
| **Climate Division 2** | 3.53 | 55 |
| **Climate Division 3** | 3.94 | 61 |
| **Climate Division 4** | 6.22 | 108 |
| **Climate Division 5** | 4.73 | 88 |
| **Climate Division 6** | 6.47 | 114 |
| **Climate Division 7** | 6.19 | 122 |
| **Climate Division 8** | 4.76 | 91 |
| **Allegany** | 5.16 | 108 |
| **Anne Arundel** | 6.72 | 111 |
| **Baltimore** | 6.36 | 112 |
| **Baltimore City** | 6.82 | 114 |
| **Calvert** | 3.92 | 64 |
| **Caroline** | 3.86 | 58 |
| **Carroll** | 7.01 | 121 |
| **Cecil** | 4.75 | 90 |
| **Charles** | 4.77 | 87 |
| **Dorchester** | 2.92 | 36 |
| **Fredrick** | 7.42 | 124 |
| **Garrett** | 4.76 | 91 |
| **Harford** | 4.80 | 91 |
| **Howard** | 7.41 | 117 |
| **Kent** | 4.28 | 72 |
| **Montgomery** | 6.95 | 116 |
| **Prince George's** | 5.84 | 103 |
| **Queen Anne's** | 5.26 | 95 |
| **Saint Mary's** | 2.82 | 38 |
| **Somerset** | 2.65 | 31 |
| **Talbot** | 5.13 | 83 |
| **Washington** | 7.16 | 126 |
| **Wicomico** | 2.86 | 34 |
| **Worcester** | 2.52 | 25 |

**Table A1.** Monthly mean surface air temperature (left) and total precipitation (right) at Maryland (statewide), climate division, and county levels for August 2024. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for August 2024 occupies among the 130 Augusts after the 130 values have been arranged from the lowest to the highest in the *standard competition ranking method*. The closer to 130 the rank is, the larger (i.e., the warmer/wetter) the value of the surface variable is in the record; similarly, the closer to 1 the rank is, the smaller (i.e., the colder/drier) the value of the surface variable is in the record.

B. Maximum and Minimum Temperatures

| Region | Maximum Air Temperature (°F) | Rank (#) |
|---|---|---|
| **Statewide** | 85.7 | 94 |
| **Climate Division 1** | 86.4 | 101 |
| **Climate Division 2** | 87.1 | 104 |
| **Climate Division 3** | 87.3 | 106 |
| **Climate Division 4** | 86.5 | 93 |
| **Climate Division 5** | 86.4 | 92 |
| **Climate Division 6** | 85.2 | 94 |
| **Climate Division 7** | 85.4 | 93 |
| **Climate Division 8** | 79.7 | 110 |
| **Allegany** | 85.8 | 104 |
| **Anne Arundel** | 86.4 | 91 |
| **Baltimore** | 85.6 | 93 |
| **Baltimore City** | 87.0 | 103 |
| **Calvert** | 86.7 | 102 |
| **Caroline** | 86.8 | 98 |
| **Carroll** | 84.4 | 94 |
| **Cecil** | 85.7 | 99 |
| **Charles** | 87.3 | 97 |
| **Dorchester** | 87.5 | 110 |
| **Fredrick** | 84.6 | 91 |
| **Garrett** | 79.8 | 110 |
| **Harford** | 85.8 | 94 |
| **Howard** | 85.2 | 94 |
| **Kent** | 86.4 | 94 |
| **Montgomery** | 85.3 | 96 |
| **Prince George's** | 86.6 | 94 |
| **Queen Anne's** | 86.3 | 90 |
| **Saint Mary's** | 87.5 | 114 |
| **Somerset** | 86.8 | 101 |
| **Talbot** | 86.5 | 96 |
| **Washington** | 85.1 | 82 |
| **Wicomico** | 86.9 | 102 |
| **Worcester** | 85.8 | 96 |

| Region | Minimum Air Temperature (°F) | Rank (#) |
|---|---|---|
| **Statewide** | 64.7 | 91 |
| **Climate Division 1** | 66.2 | 65 |
| **Climate Division 2** | 66.2 | 88 |
| **Climate Division 3** | 67.8 | 107 |
| **Climate Division 4** | 66.9 | 97 |
| **Climate Division 5** | 66.1 | 94 |
| **Climate Division 6** | 64.2 | 93 |
| **Climate Division 7** | 60.9 | 85 |
| **Climate Division 8** | 56.0 | 77 |
| **Allegany** | 59.6 | 82 |
| **Anne Arundel** | 67.4 | 97 |
| **Baltimore** | 64.4 | 99 |
| **Baltimore City** | 67.2 | 101 |
| **Calvert** | 67.5 | 101 |
| **Caroline** | 65.1 | 89 |
| **Carroll** | 62.3 | 87 |
| **Cecil** | 65.5 | 93 |
| **Charles** | 67.6 | 107 |
| **Dorchester** | 66.6 | 88 |
| **Fredrick** | 63.1 | 83 |
| **Garrett** | 56.0 | 76 |
| **Harford** | 65.1 | 94 |
| **Howard** | 63.9 | 96 |
| **Kent** | 66.5 | 93 |
| **Montgomery** | 64.9 | 96 |
| **Prince George's** | 66.3 | 98 |
| **Queen Anne's** | 66.1 | 94 |
| **Saint Mary's** | 68.0 | 105 |
| **Somerset** | 67.0 | 70 |
| **Talbot** | 66.9 | 89 |
| **Washington** | 62.2 | 91 |
| **Wicomico** | 65.3 | 67 |
| **Worcester** | 66.1 | 60 |

**Table A2**. Monthly maximum (left) and minimum (right) surface air temperatures at Maryland (statewide), climate division, and county levels for August 2024. Temperatures are in °F. The rank is the order that the variable for August 2024 occupies among the 130 Augusts after the 130 values have been arranged from the lowest to the highest using the *standard competition ranking method*. The closer to 130 the rank is, the larger (i.e., the warmer) the value of the surface variable is in the record; similarly, the closer to 1 the rank is, the smaller (i.e., the colder) the value of the surface variable is in the record.

# Appendix B. August 2024 Bar Graphs: Statewide, Climate Divisions, and Counties

## A. Temperatures and Precipitation

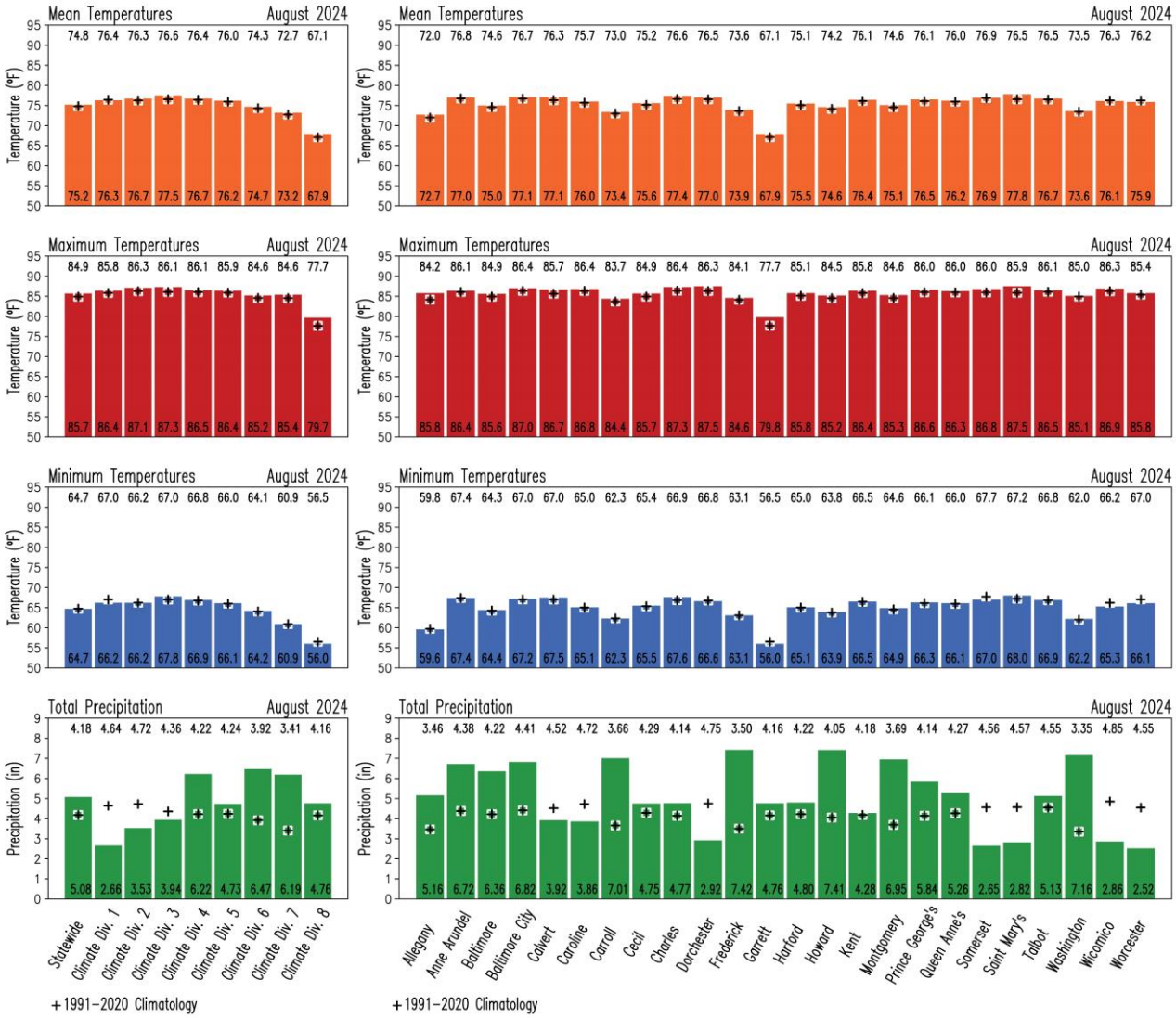


**Figure B1.** Monthly surface variables in Maryland for August 2024. Color bars represent the variables as follows: mean surface air temperature (orange), maximum surface air temperature (red), minimum surface air temperature (blue) and total precipitation (green) at statewide and climate division (left column), and at county (right column) levels. Temperatures are in °F and precipitation is in inches. The numbers at the base of the bars indicate the magnitude of the variable for August 2024. For comparison, the corresponding 1991-2020 climatological values for August are displayed as black addition signs, and their magnitudes are shown at the top of the panels.

## B. Temperatures and Precipitation Anomalies

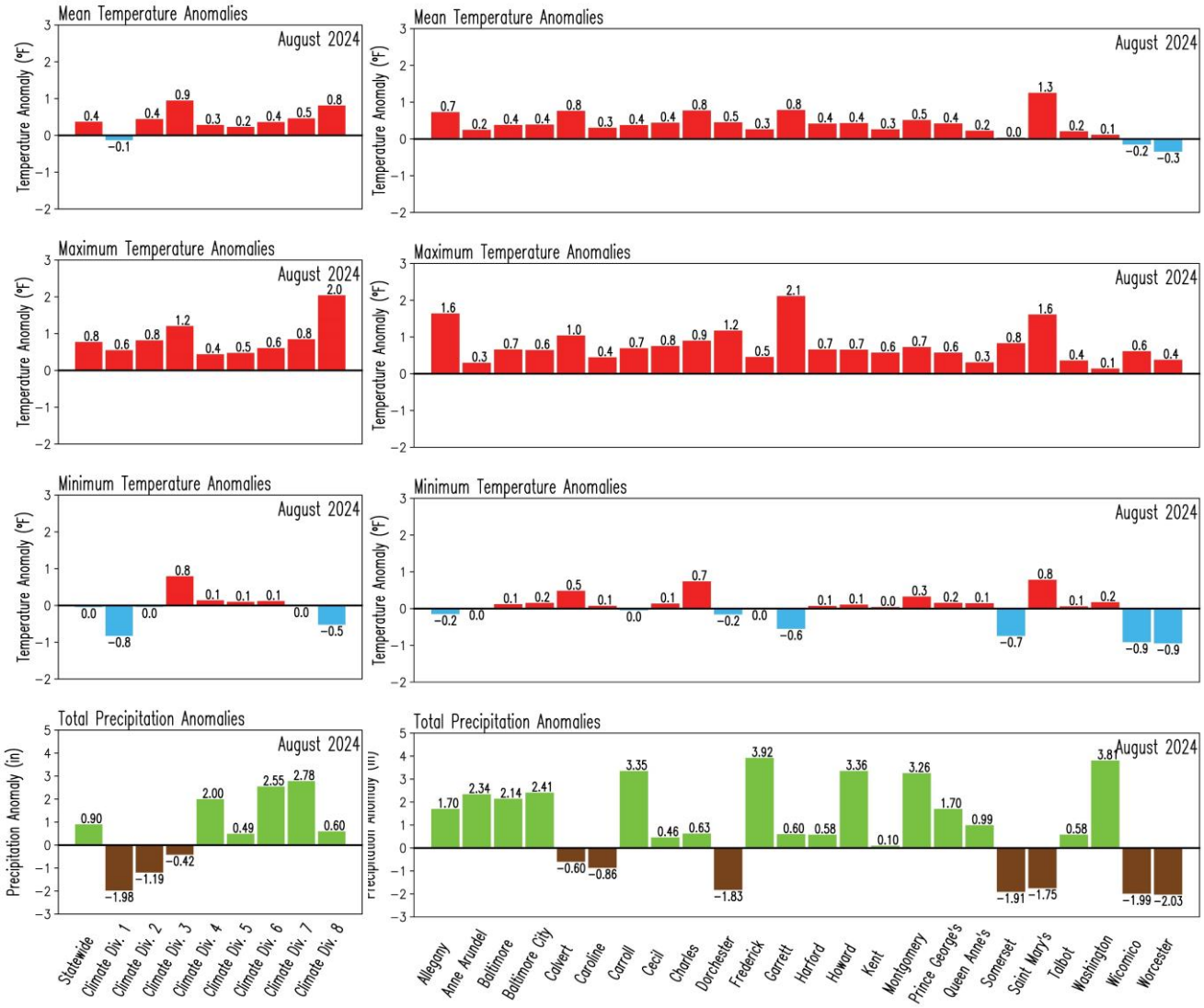


**Figure B2.** Anomalies of the monthly surface variables in Maryland for August 2024. Anomalies are with respect to the 1991-2020 climatology. Red/blue color represents positive/negative (warmer/colder than normal) anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top), and minimum surface air temperature (third row from top), while green/brown color indicates positive/negative (wetter/drier than normal) anomalies in total precipitation (bottom row) at statewide and climate division (left column), and at county (right column) levels. Temperatures are in °F, and precipitation is in inches. The numbers outside of the bars indicate the magnitude of the anomaly for August 2024.

# Appendix C. August 1991-2020 Climatology Maps and August 2024 Precipitation as Percentage of Climatology

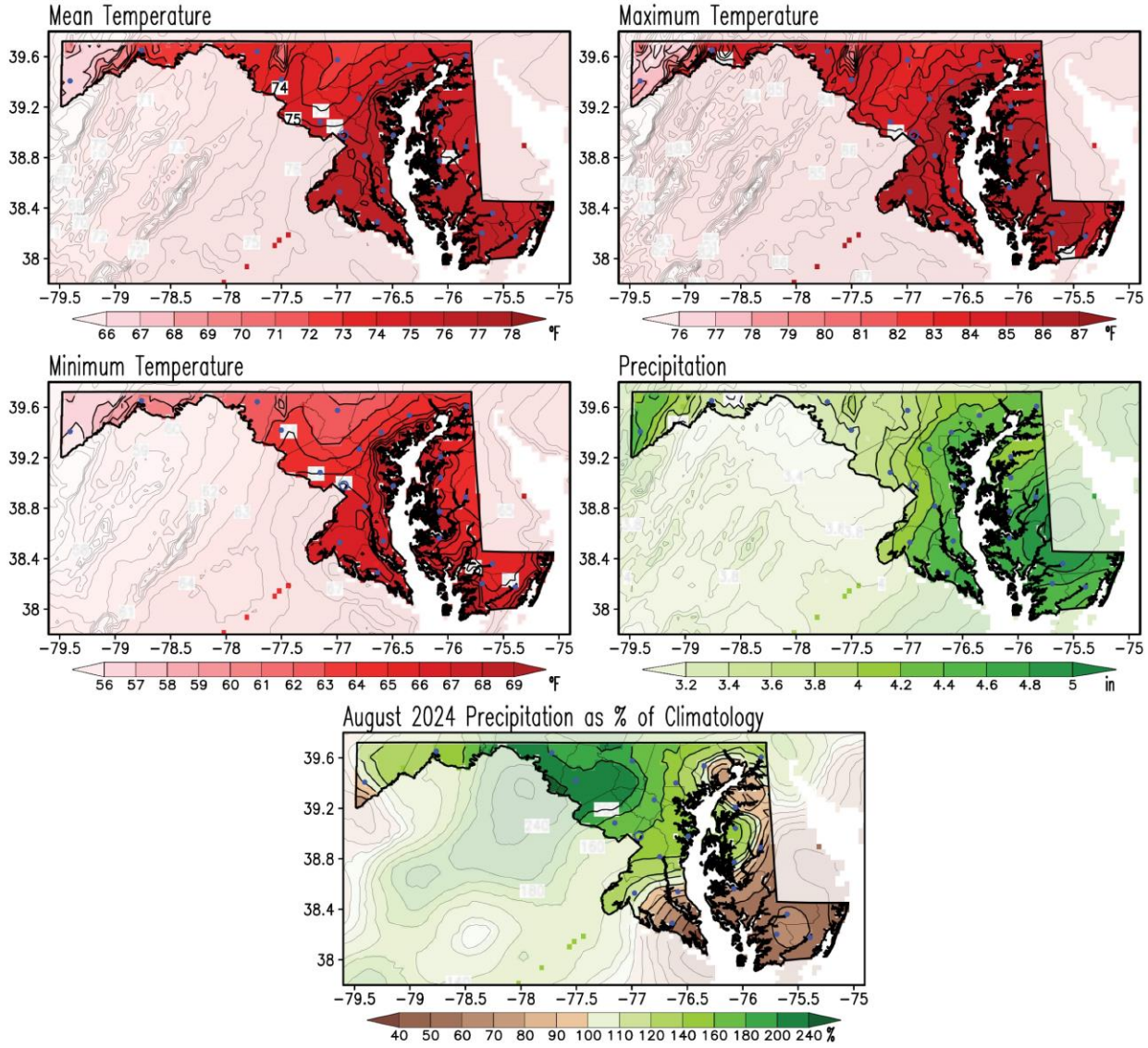


**Figure C1.** August climatology of the monthly mean, maximum and minimum surface air temperatures, and total precipitation for the period 1991-2020 (upper and middle rows), and precipitation in August 2024 as a percentage of climatology (bottom row). Temperatures are in °F, and precipitation is in inches according to the color bars. This is the current climate normal against which the August 2024 conditions are compared to obtain the August 2024 anomalies (from Figure 1 to 4). The precipitation as a percentage is obtained by dividing the total precipitation (from Figure 4) by the climatology (from the middle right panel) and multiplying that ratio by 100 so units are in percent of climatology (%); brown/green shading in this map shows drier/wetter than normal conditions. Note that shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

# Appendix D. August Standard Deviation and August 2024 Standardized Anomalies Maps

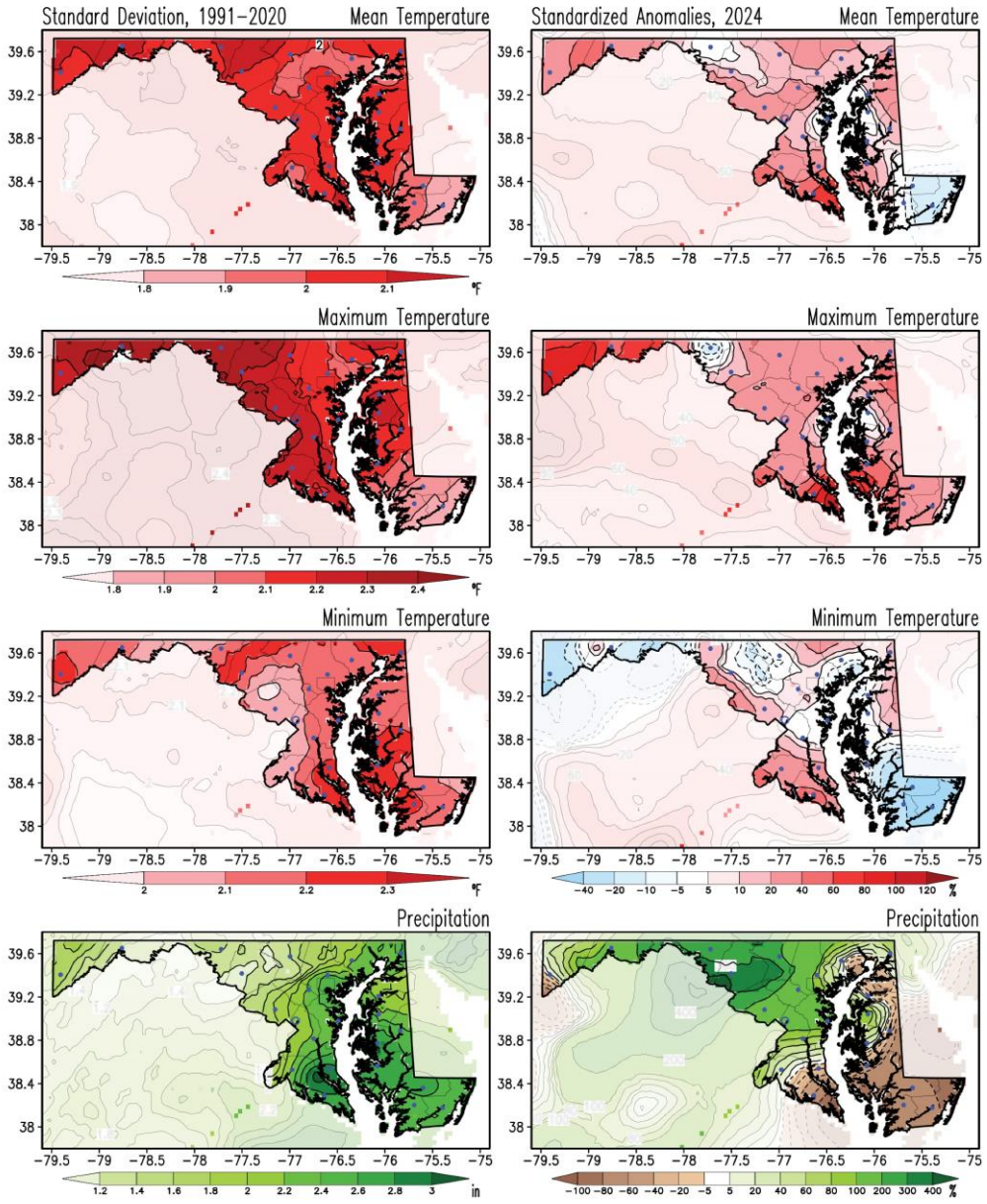


**Figure D1.** Standard deviation for August and standardized anomalies of temperatures and precipitation for August 2024. Standard deviations for monthly mean, maximum, and minimum surface air temperatures and total precipitation were obtained for the 1991-2020 period (left column). Anomalies for August 2024 (right column) are obtained as a percentage of the standard deviations. The standard deviations in temperatures are in °F, and those in precipitation are in inches according to the color bars. Blue/red shading in the anomaly temperature maps marks colder/warmer than normal conditions; brown/green shading in the anomaly precipitation map marks drier/wetter than normal conditions. The standardized anomalies are obtained by dividing the raw anomalies (from Figures 1 to 4) by the standard deviation (from left column panels) and multiplying that ratio by 100; hence, units are in percent (%). Note that shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

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