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Maryland Climate Bulletin
July 2024

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DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCE
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Summary

Statewide averages show that July 2024 was warmer and drier than normal (i.e., 1991-2020 averages). Monthly mean temperatures were in the 70−83°F range; maximum temperatures were between 82 and 92°F, and minimum temperatures were in the 59−74°F range. Monthly total precipitation was between 1.2 and 6.0 inches.

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

- The mean temperature was warmer than normal over most of the state, especially over a small area in Harford County (3.6°F), parts of Harford, the tri-county area among Baltimore, Howard, and Anne Arundel, western Montgomery and Frederick, and Washington counties (3.3°F), and Garrett County (around 3.0°F). Slightly colder than normal conditions appeared over Worcester County (–0.3 to –0.6°F) and portions of Somerset and Wicomico counties.

- The maximum temperature was also warmer than normal over much of the state, particularly over Washington and Allegany counties (4.8°F), Garrett County (4.0°F), the tri-county region among Baltimore, Howard, and Anne Arundel, and the northern parts of Carroll and Frederick counties (3.6°F). Slightly colder than normal conditions appeared over Worcester County (–0.1°F).

- The minimum temperature was warmer than normal over most of the state, too, especially over Harford County (3.9°F), parts of Harford and Cecil counties (3.6°F), and parts of Washington, western Frederick and Montgomery counties, parts of Baltimore, Howard and Anne Arundel counties, Kent County, portions of Queen Anne's and Cecil counties and western Charles County (3.3°F). Colder than normal conditions appeared over Worcester County (−0.6 to −0.9°F) and parts of Somerset and Wicomico counties.

- Precipitation was below normal over much of the state, particularly over Garrett County (3.0 in deficit), Allegany County (2.4 in deficit), and parts of Baltimore, Howard, Anne Arundel, Harford, Cecil, Kent, and Queen Anne's counties (2.1 in deficit). The region between eastern Garrett and Allegany counties had 40% of their monthly climatological precipitation, while western Washington County, the central and eastern Piedmont, and northern Eastern Shore counties had 60% of theirs. Above-normal precipitation occurred only over central and southern Eastern Shore counties, with a maximum over Worcester County (1.2−1.5 in).

- The drought intensified this month, even though the extension of the state under drought conditions diminished from 94% at the end of June to 67% at the end of July. The severity of the drought increased to the west of central Piedmont, reaching Severe Drought levels over eastern Garrett, Allegany, and southern Washington counties. Most of the creeks and rivers in the moderate-to-extreme drought areas had below-to-much-below-normal streamflow.

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

- All eight climate divisions were warmer than normal again. While the North Central, Climate Division 6, was the warmest (3.2°F above normal), the Southern Shore, Climate Division 1, was the least warm (0.1°F above normal). On the other hand, seven of the eight climate divisions were drier than normal. The Allegheny Plateau, Climate Division 8, was the driest (2.68 in below normal), and the Southern Shore, Climate Division 1, was the only one wetter than normal (0.96 in above normal).

- Statewide temperature was warmer than normal for the eighth month since December 2023. Statewide precipitation was below normal for the fourth month since April.

Historical Context (Figure 9, Tables A1 and A2)

- Statewide mean, maximum, and minimum temperatures in July 2024 (79.1, 89.3, 68.8°F) were above their long-term (1895-2023) mean. Except for the maximum temperature, the mean and minimum temperatures were among the 5% of the warmest on record and close to the historical records of 80.1 and 69.6°F set in 2020; the warmest maximum temperature on record of 90.6°F was established in 2011. Statewide precipitation (3.35 in) in July was below the long-term mean but still far from the record of 1.34 inches in 1983. Mean and minimum temperatures were the sixth and fourth warmest on record, respectively, while maximum temperature was the eleventh warmest.

- Mean temperatures indicated that July 2024 was among the five warmest on record for thirteen of the twenty-three counties. Carroll, Frederick, and Washington counties reached the second warmest July; Baltimore City reached its third warmest. Minimum temperatures were among the five warmest on record for fifteen counties. Cecil and Harford counties reached the warmest July, while Baltimore City has its second warmest. Maximum temperatures reached the fifth warmest in Harford and Howard counties.

- Precipitation showed that July 2024 was among the second driest on record for Garrett County and the fourth for Allegany County.

Century-Plus Trends, 1895-2024 (Figures 10, 11)

- Statewide mean temperature and cooling degree−days in July showed a significant warming trend (1.9°F/century) and an increasing cooling trend (65.2°FDD/century). Statewide precipitation had a minuscule, no significant wetting trend (0.04 in/century).

- Regionally, July temperatures showed significant warming trends everywhere except in western Maryland. The largest trend is in Baltimore City (3.0°F/century), as it has been

since March. Trends above 2.0°F/century are evident in the counties of central Piedmont and the central and southern Eastern Shore.

- Regionally, July precipitation had no significant trends. The largest no significant wet trends (around 0.7 in/century) are over Harford and Cecil counties, while the largest no significant drying trends (0.3 in/century) are over Garrett and Washington counties and counties in the central Eastern Shore.

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 eastern placement of the state 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 July 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 (Section 3). Statewide and climate division averages for the month are compared against each other via scatter plots (Section 4). The monthly statewide averages are placed in the context of the historical record via box and whisker plots in Section 5. Century-plus trends in statewide air temperature, cooling degree-days, precipitation, and state maps of air temperature and precipitation are presented in Section 6. 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

Surface air temperatures, total precipitation, and cooling 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 8/10/2024.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al. 2014). It is available in a preliminary status (v1.0.0-20240705) at:

https://www.ncei.noaa.gov/pub/data/cirs/climdiv/
Data was downloaded on 8/9/2024.

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., July 2024) are the departures of the monthly value from the corresponding month's 30-year average (i.e., from the average of 30 Julys) 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 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*.

About heating and cooling degree-days. Degree days are the difference between the daily mean temperature (high temperature plus low temperature divided by two) and a base temperature of 65°F as it is assumed that when the exterior temperature is 65°F, heating or cooling is not necessary to be comfortable. If the mean temperature is above 65°F, the base temperature of 65°F is subtracted from the mean temperature, and the difference defines cooling degree-days. If, on the other hand, the mean temperature is below 65°F, the mean temperature is subtracted from the base temperature of 65°F, and the difference defines heating degree-days. Degree-days give a general idea of how much energy is required to warm or cool buildings; because energy demand is cumulative, degree-day totals for a month are the sum of each day's degree-day total (CPC, 2023).

3. July 2024 Maps

A. Mean Temperatures

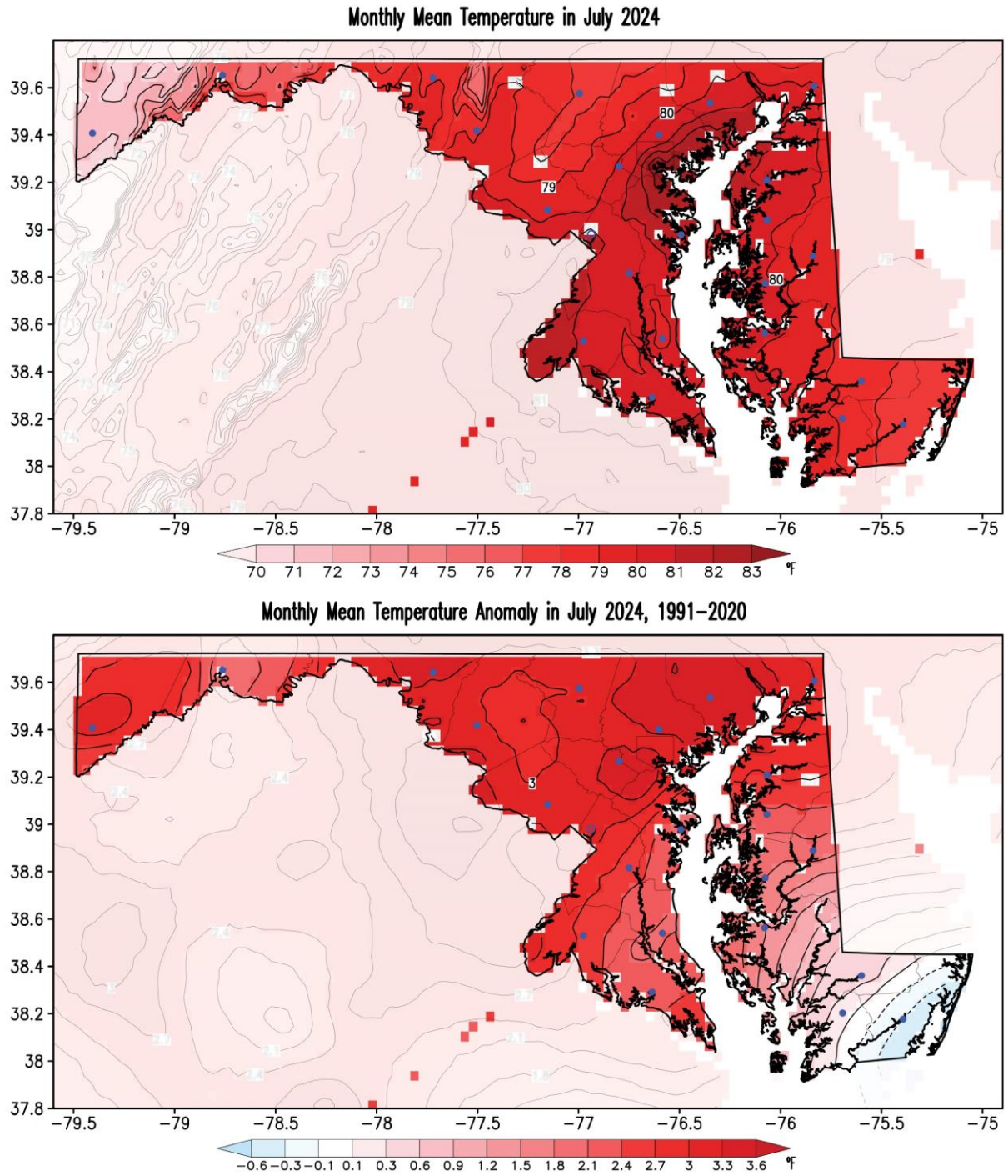

Figure 1. Monthly mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for July 2024. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the state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

B. Maximum Temperatures

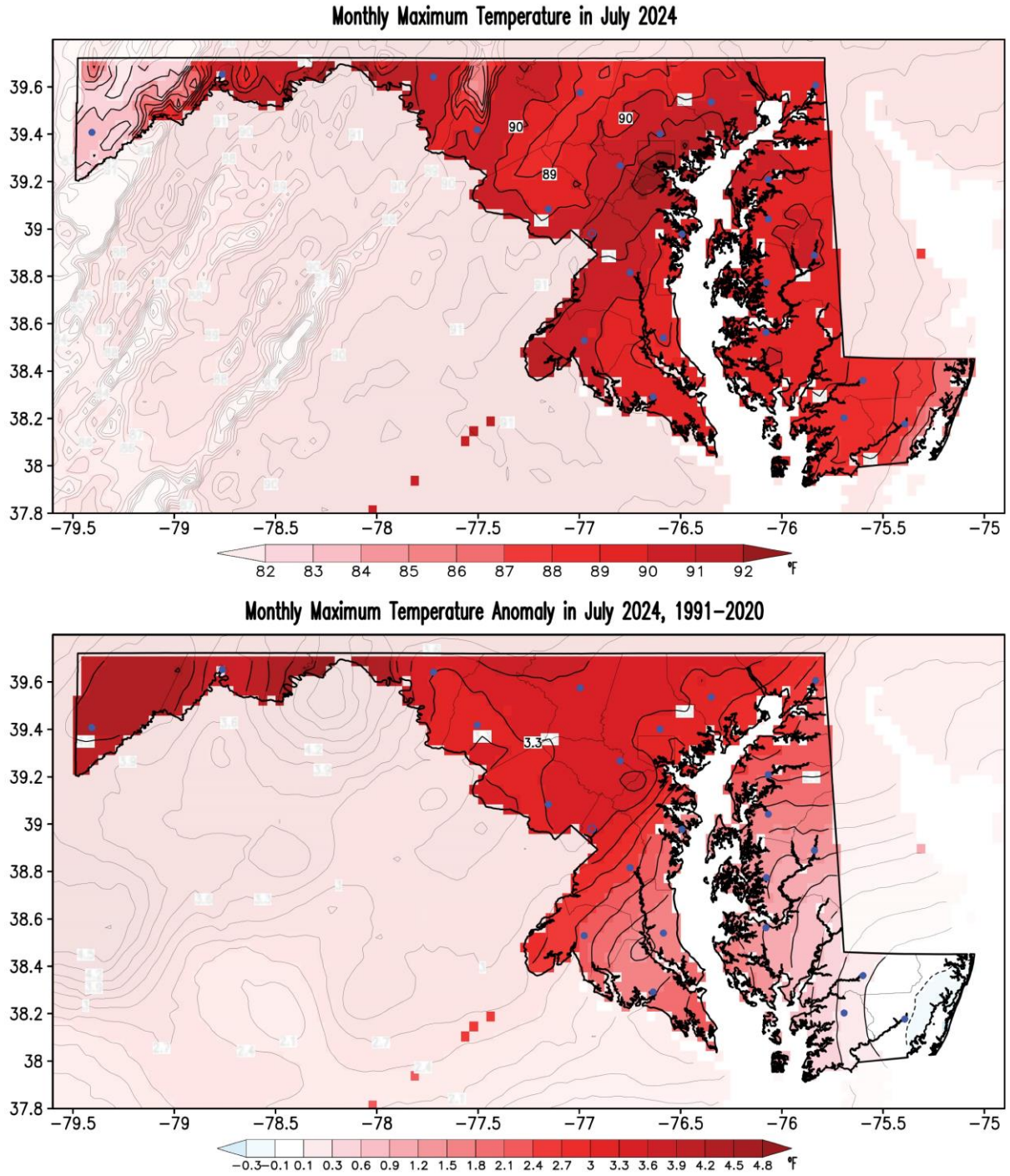

Figure 2. Monthly maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for July 2024. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the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

C. Minimum Temperatures

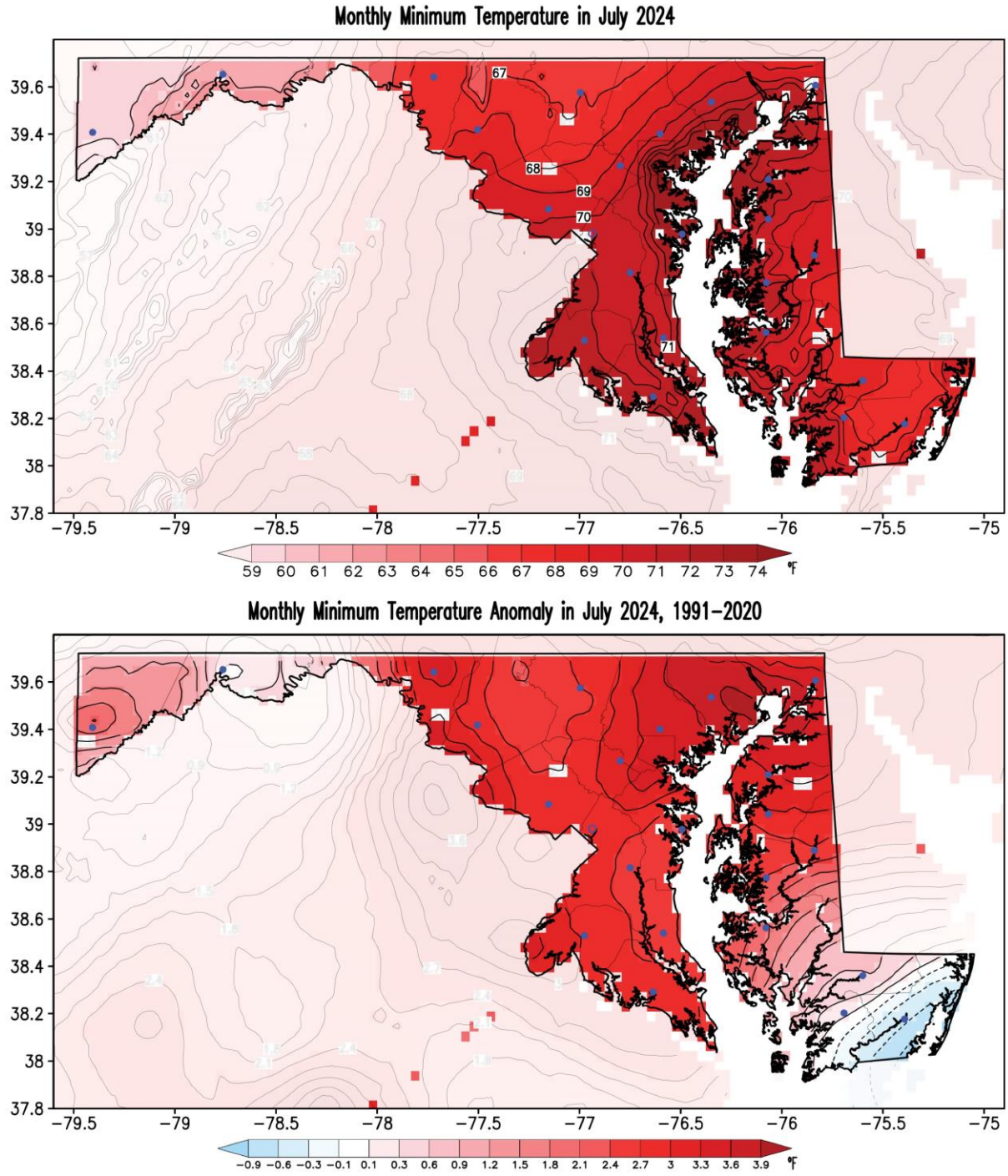

Figure 3. Monthly minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for July 2024. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the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

D. Precipitation

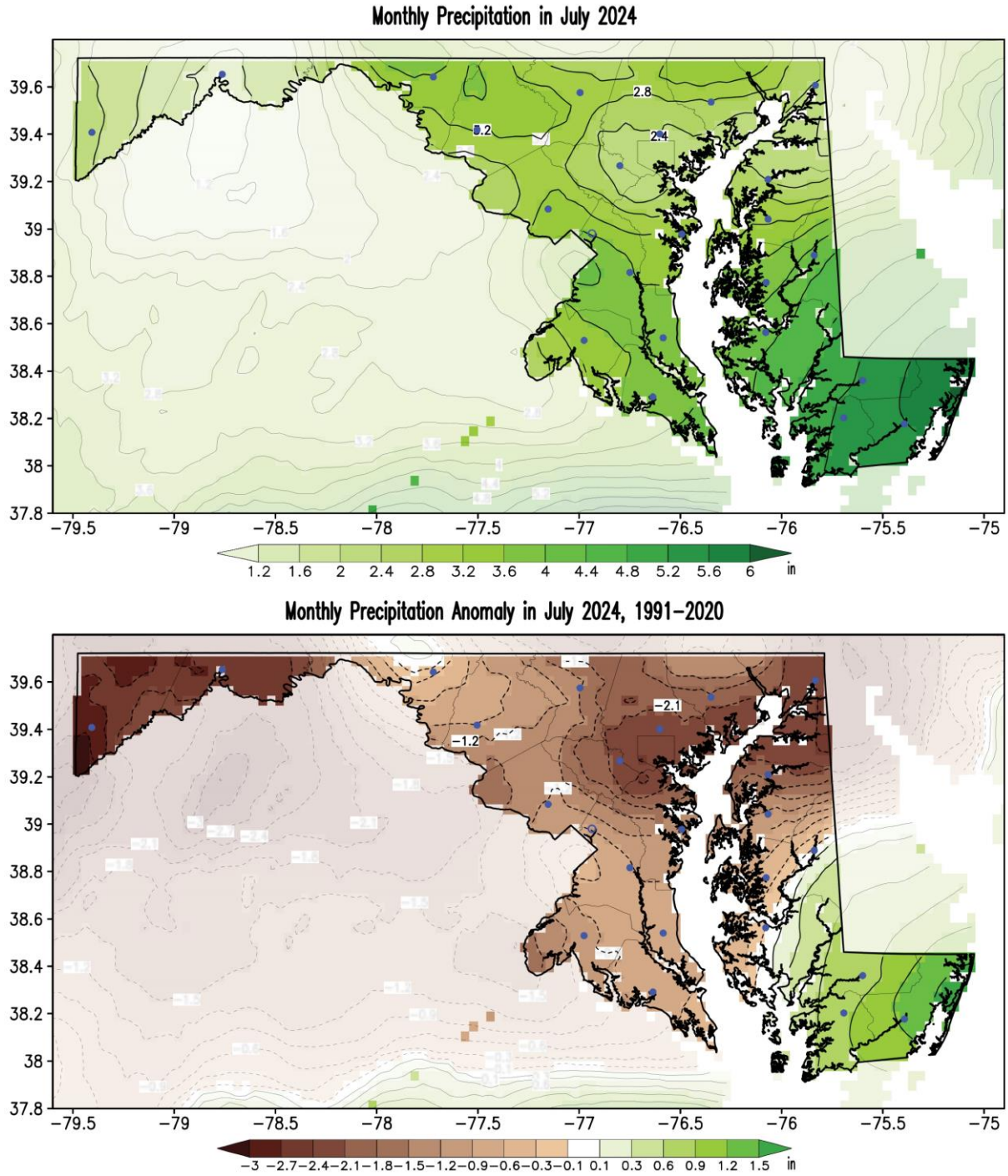

Figure 4. Monthly total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for July 2024. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside the state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

E. Drought

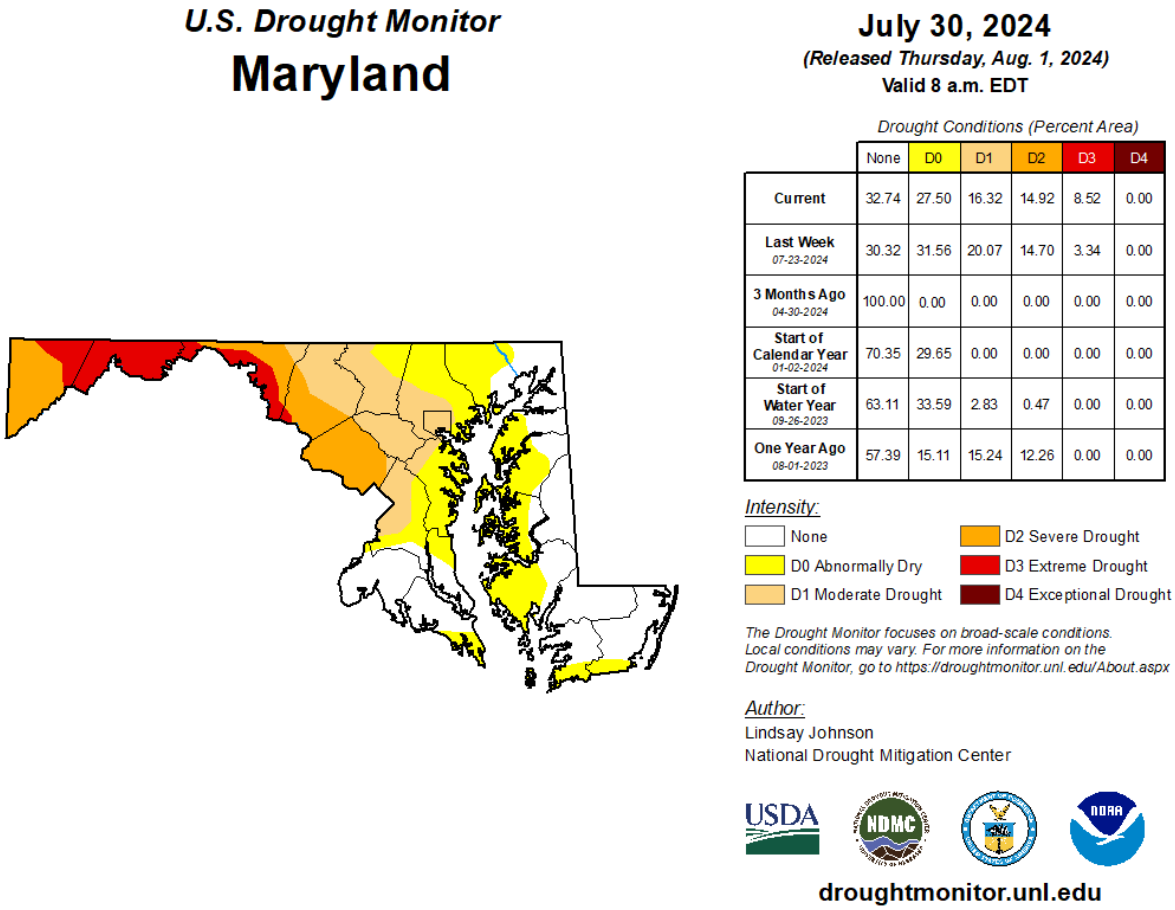

Figure 5. Drought conditions as reported by the U.S. Drought Monitor on July 30, 2024. At this time, around 67% of the state is under some drought category. Yellow shading indicates abnormally dry regions, light orange shading shows regions under a moderate drought, darker orange marks regions under 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

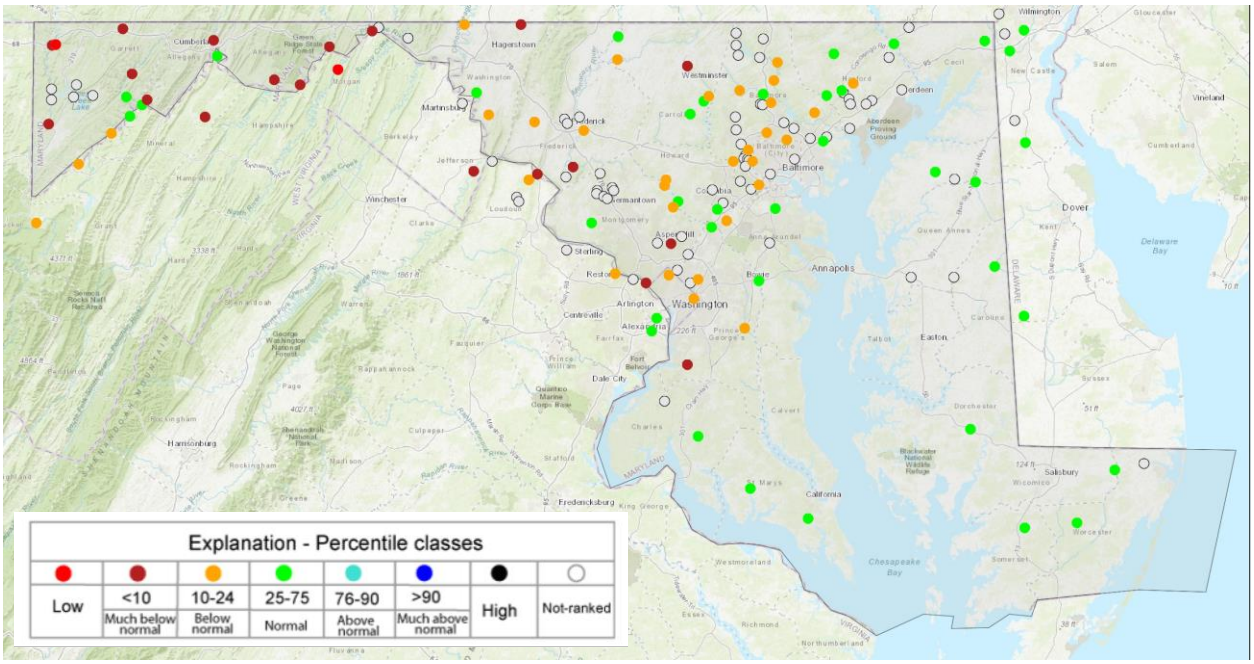

Figure 6. Monthly averaged streamflow class anomalies as reported by the U.S. Geological Survey (USGS) Water Watch for July 2024. Orange to red-filled circles denote below-normal streamflow conditions, cyan to black-filled circles denote above-normal streamflow conditions, and green-filled circles represent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

4. July and MJJ 2024 Climate Divisions Averages

A. July 2024 Scatter Plots

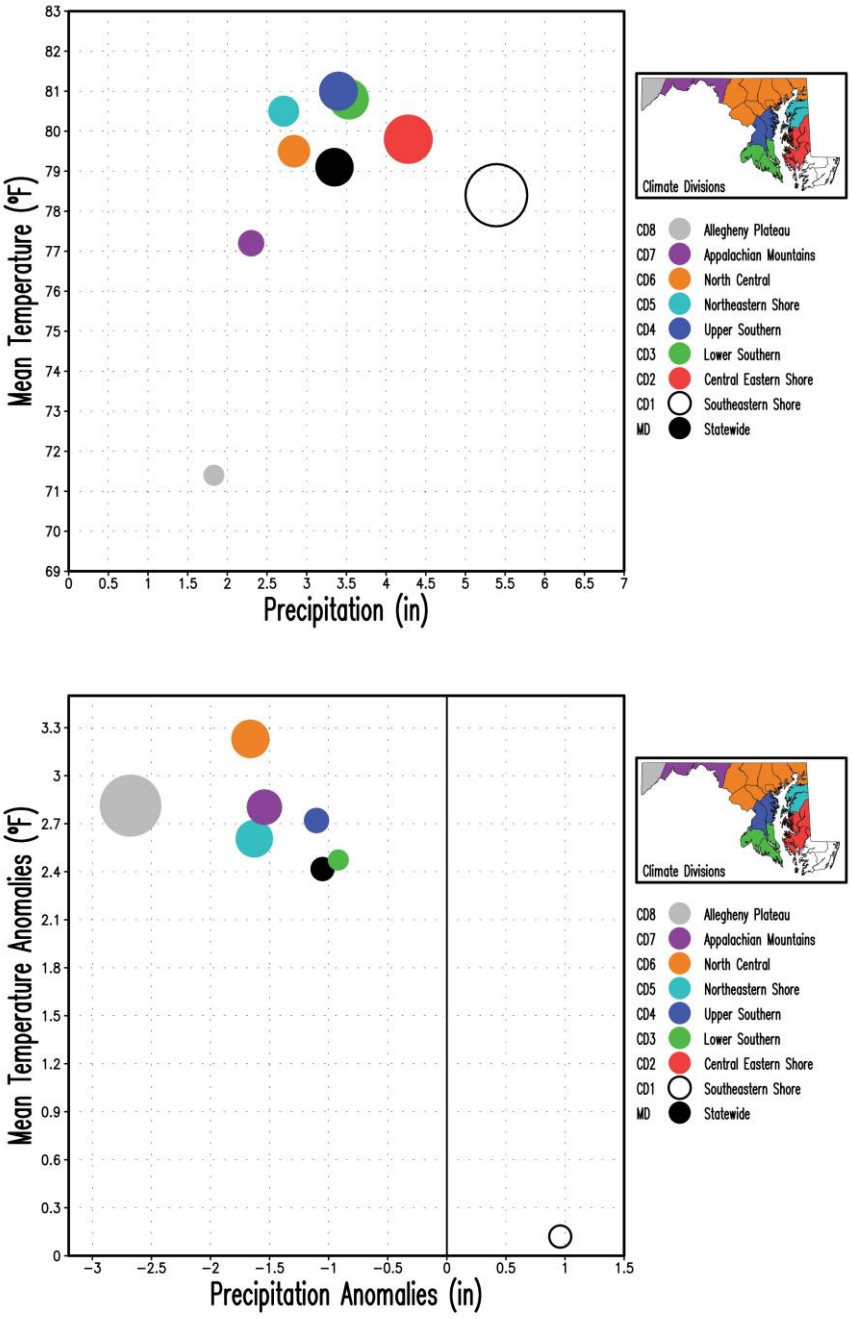

Figure 7. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for July 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 climatology. 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 (5.39 inches in CD1, top panel) and by the maximum precipitation anomaly (|−2.68| inches in CD8, 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. May – July 2024 Scatter Plots

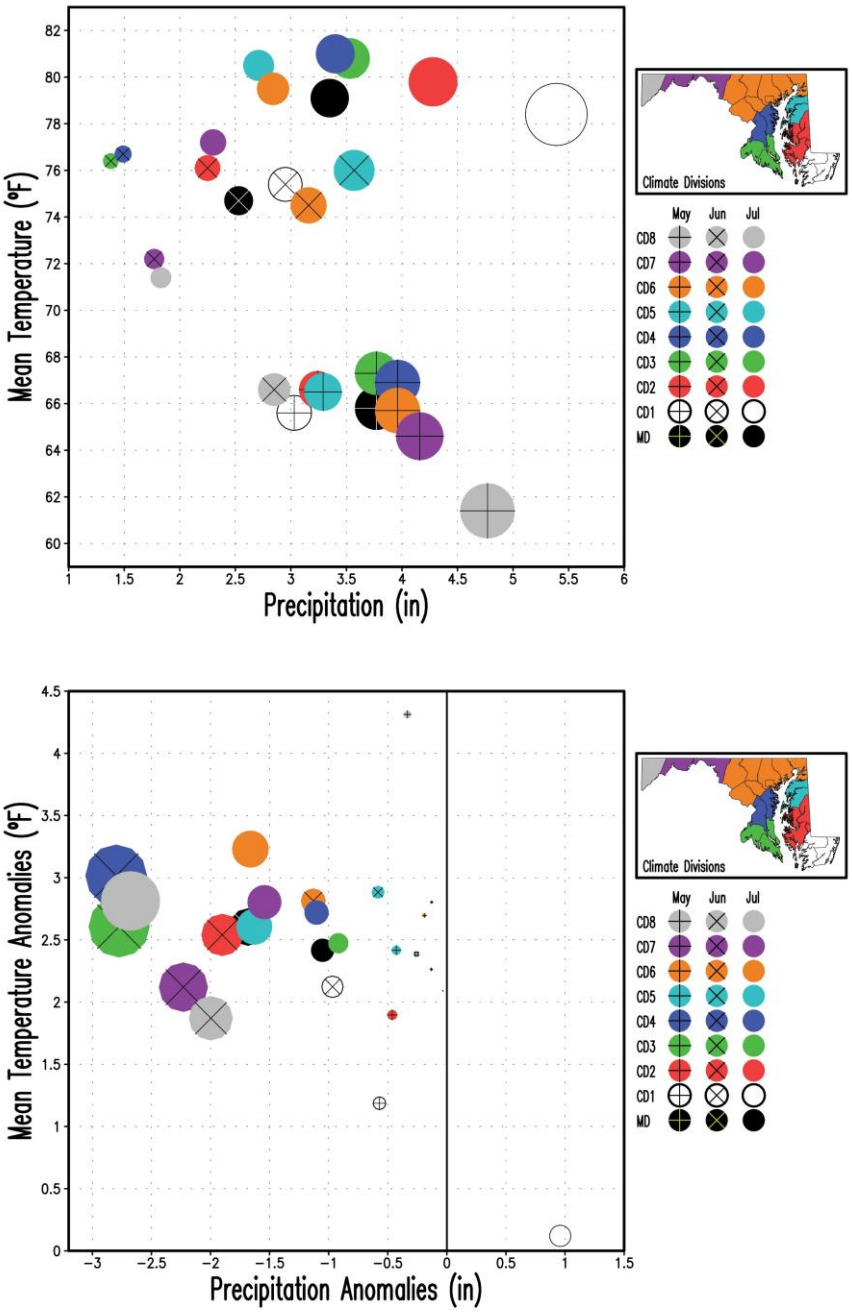

Figure 8. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for May, June and July 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 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 (5.39 inches in CD1 in July, top panel) and by the maximum precipitation anomaly (|−2.80| inches in CD4 in June, bottom panel) among the nine regions and three months. July is displayed with filled circles only, while June and May are displayed with superposed multiplication and addition signs, respectively.

5. July 2024 Statewide Averages in the Historical Record

A. Box and Whisker Plots

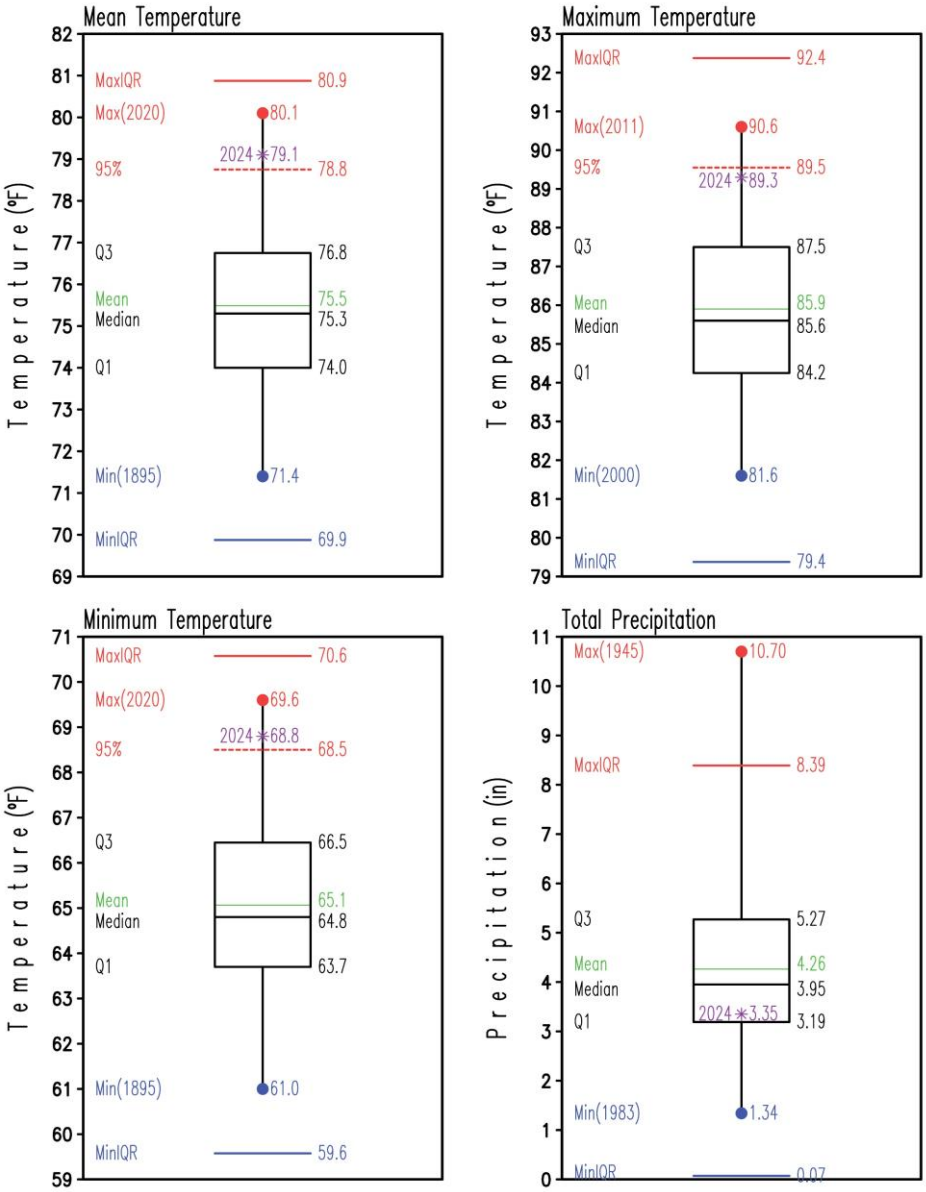

Figure 9. Box and Whisker plots of Maryland (statewide) monthly mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and total precipitation (lower right) for July for the period 1895-2023. The label and asterisk in purple represent conditions for July 2024. Statistics 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 threshold indicating the upper 5% values is marked by the dashed red line.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.

6. 1895-2024 July Trends

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

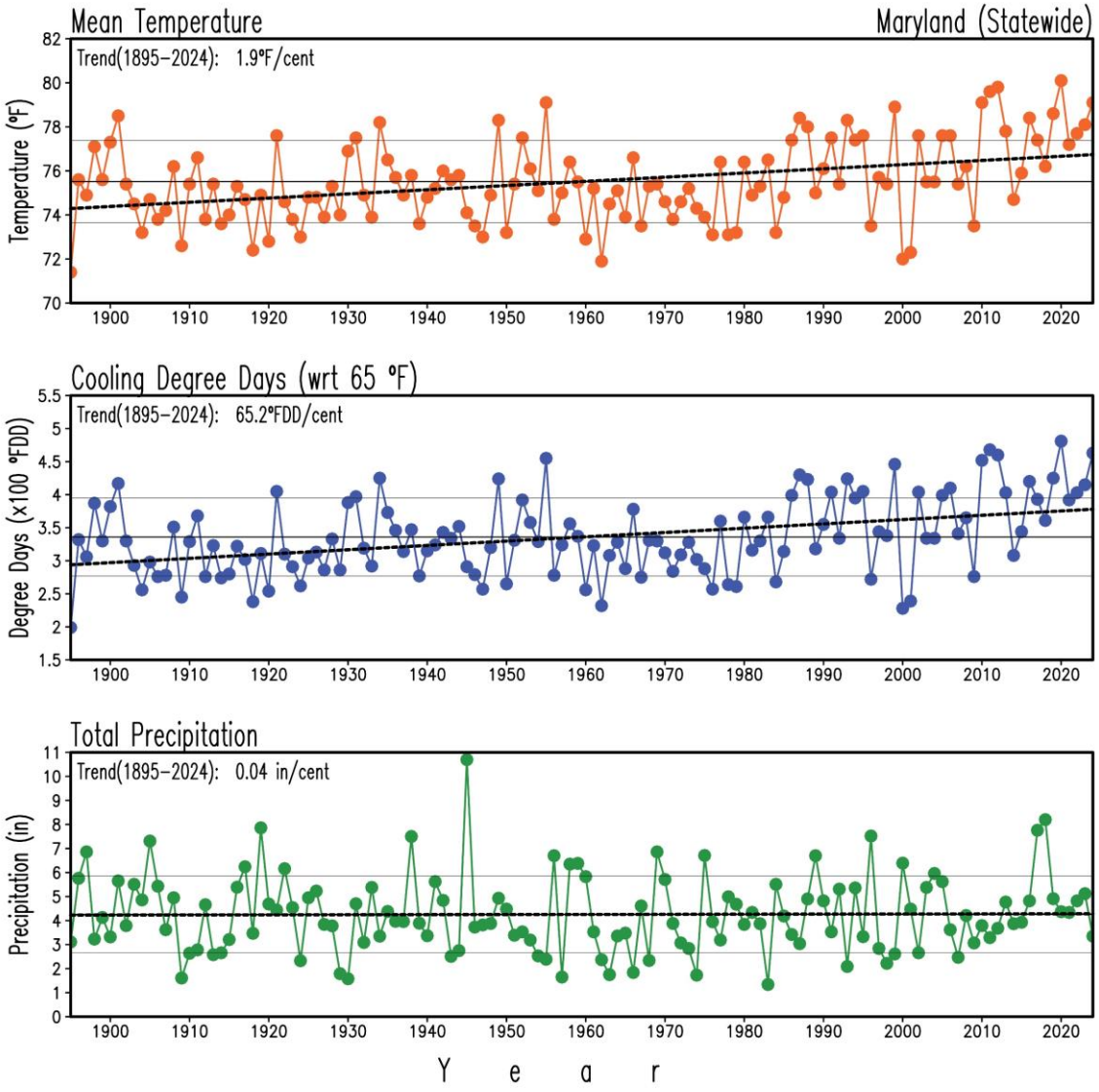

Figure 10. Maryland (statewide) mean surface air temperature, cooling degree days, and precipitation in July for the period 1895-2024. Temperature is in °F, cooling degree-days is in °F degree-days (°FDD), and precipitation is in inches. The thin, continuous black lines in each panel display the long-term means (75.5°F, 335.9°FDD and 4.26 in, 1895-2024), and the double thin, continuous gray lines indicate the standard deviation (1.9°F, 59.0°FDD and 1.60 in) above/below the long-term mean. The thick dashed black lines show the long-term linear trend. The warming temperature trend (1.9°F/century) and the increasing cooling degree-days trend (65.2°FDD/century) are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000) but no the small precipitation trend (0.04 in/century).

B. Temperature and Precipitation Maps

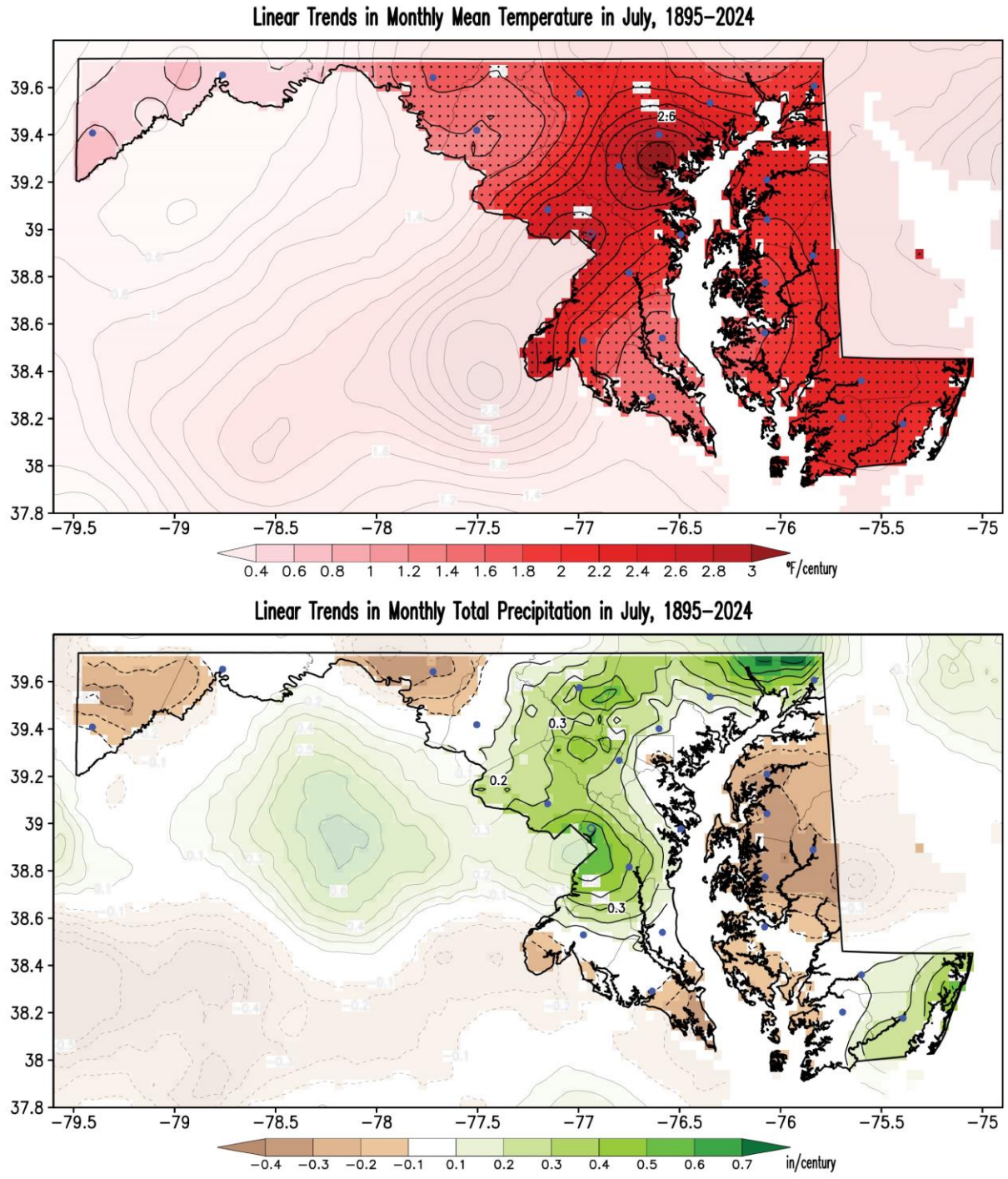

Figure 11. Linear trends in surface air mean temperature and precipitation in July for the period 1895-2024. Temperatures are in °F/century, and precipitation is in inches/century following the color bars. Blue/red shading in the temperature map marks cooling/warming trends. Brown/green shading in the 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. July 2024 Data Tables: Statewide, Climate Divisions, and Counties

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)
Statewide	79.1	125
Climate Division 1	78.4	103
Climate Division 2	79.8	118
Climate Division 3	80.8	126
Climate Division 4	81.0	127
Climate Division 5	80.5	126
Climate Division 6	79.5	129
Climate Division 7	77.2	125
Climate Division 8	71.4	124
Allegany	75.8	119
Anne Arundel	81.3	127
Baltimore	80.0	128
Baltimore City	82.1	128
Calvert	80.2	123
Caroline	79.6	123
Carroll	78.2	129
Cecil	80.1	127
Charles	81.1	128
Dorchester	79.9	116
Fredrick	78.6	129
Garrett	71.5	124
Harford	80.4	128
Howard	79.4	128
Kent	80.8	126
Montgomery	79.6	128
Prince George's	80.7	127
Queen Anne's	80.3	126
Saint Mary's	80.6	125
Somerset	79.1	104
Talbot	80.2	121
Washington	78.6	129
Wicomico	78.6	106
Worcester	77.6	96

Region	Total Precipitation (in)	Rank (#)
Statewide	3.35	39
Climate Division 1	5.39	96
Climate Division 2	4.28	67
Climate Division 3	3.53	47
Climate Division 4	3.40	43
Climate Division 5	2.71	26
Climate Division 6	2.84	30
Climate Division 7	2.30	22
Climate Division 8	1.83	2
Allegany	1.28	4
Anne Arundel	2.99	38
Baltimore	2.56	23
Baltimore City	2.26	16
Calvert	3.75	58
Caroline	4.10	66
Carroll	2.94	34
Cecil	2.55	20
Charles	3.24	37
Dorchester	4.47	69
Fredrick	3.22	47
Garrett	1.82	2
Harford	2.85	29
Howard	2.57	29
Kent	2.34	19
Montgomery	3.02	38
Prince George's	3.65	51
Queen Anne's	2.94	33
Saint Mary's	3.82	55
Somerset	5.19	96
Talbot	3.85	61
Washington	3.26	58
Wicomico	5.23	92
Worcester	5.66	105

Table A1. Monthly mean surface air temperature (left) and total precipitation (right) at Maryland (statewide), climate division, and county levels for July 2024. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for July 2024 occupies among the 130 Julys 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	89.3	120
Climate Division 1	87.9	98
Climate Division 2	89.6	114
Climate Division 3	90.0	115
Climate Division 4	90.7	121
Climate Division 5	89.9	119
Climate Division 6	89.9	124
Climate Division 7	90.1	125
Climate Division 8	83.3	123
Allegany	89.8	123
Anne Arundel	90.7	122
Baltimore	90.4	125
Baltimore City	91.8	125
Calvert	89.2	110
Caroline	89.9	115
Carroll	89.3	123
Cecil	89.5	122
Charles	90.6	116
Dorchester	89.5	113
Fredrick	89.6	123
Garrett	83.3	123
Harford	90.2	126
Howard	90.2	126
Kent	89.9	118
Montgomery	89.9	125
Prince George's	90.7	121
Queen Anne's	89.8	118
Saint Mary's	89.6	114
Somerset	88.4	106
Talbot	89.5	114
Washington	90.5	123
Wicomico	88.6	101
Worcester	87.1	94

Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	68.8	127
Climate Division 1	68.8	95
Climate Division 2	70.1	123
Climate Division 3	71.6	128
Climate Division 4	71.3	129
Climate Division 5	71.0	128
Climate Division 6	69.0	129
Climate Division 7	64.3	117
Climate Division 8	59.6	112
Allegany	61.8	97
Anne Arundel	71.9	129
Baltimore	69.5	129
Baltimore City	72.3	129
Calvert	71.3	127
Caroline	69.4	125
Carroll	67.0	129
Cecil	70.7	130
Charles	71.6	128
Dorchester	70.2	119
Fredrick	67.6	128
Garrett	59.6	112
Harford	70.6	130
Howard	68.7	129
Kent	71.6	129
Montgomery	69.3	129
Prince George's	70.7	129
Queen Anne's	70.8	128
Saint Mary's	71.7	128
Somerset	69.8	97
Talbot	71.0	124
Washington	66.6	128
Wicomico	68.6	107
Worcester	68.2	87

Table A2. Monthly maximum (left) and minimum (right) surface air temperatures at Maryland (statewide), climate division, and county levels for July 2024. Temperatures are in °F. The rank is the order that the variable for July 2024 occupies among the 130 Julys 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. July 2024 Bar Graphs: Statewide, Climate Divisions, and Counties

A. Temperatures and Precipitation

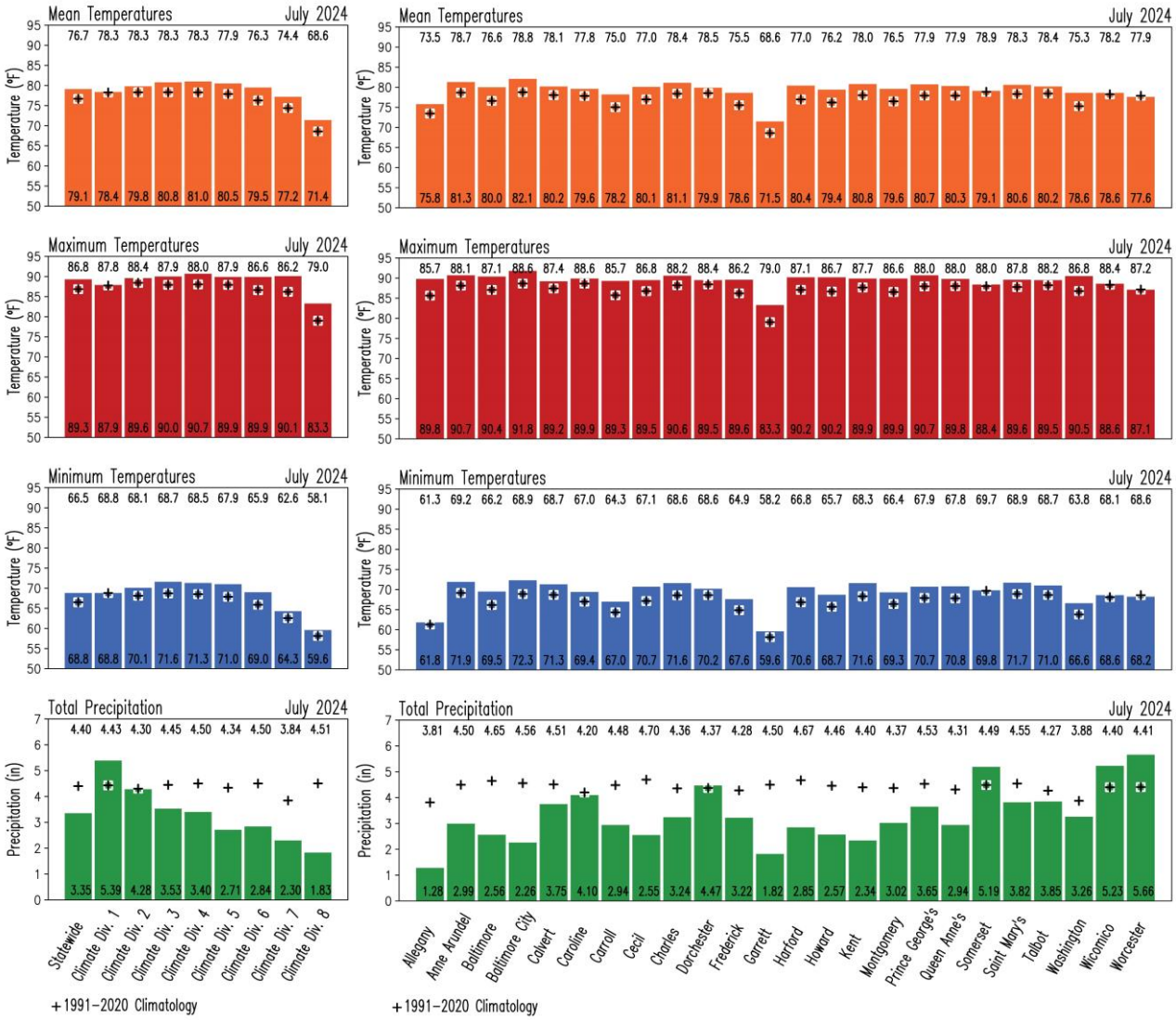

Figure B1. Monthly surface variables in Maryland for July 2024. Color bars represent the variables as follows: mean surface air temperature (orange), maximum surface air temperature (red), minimum surface air temperature (blue) and total precipitation (green) at statewide and climate division (left column), 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 July 2024. For comparison, the corresponding 1991-2020 climatological values for July are displayed as black addition signs, and their magnitudes are shown at the top of the panels.

B. Temperatures and Precipitation Anomalies

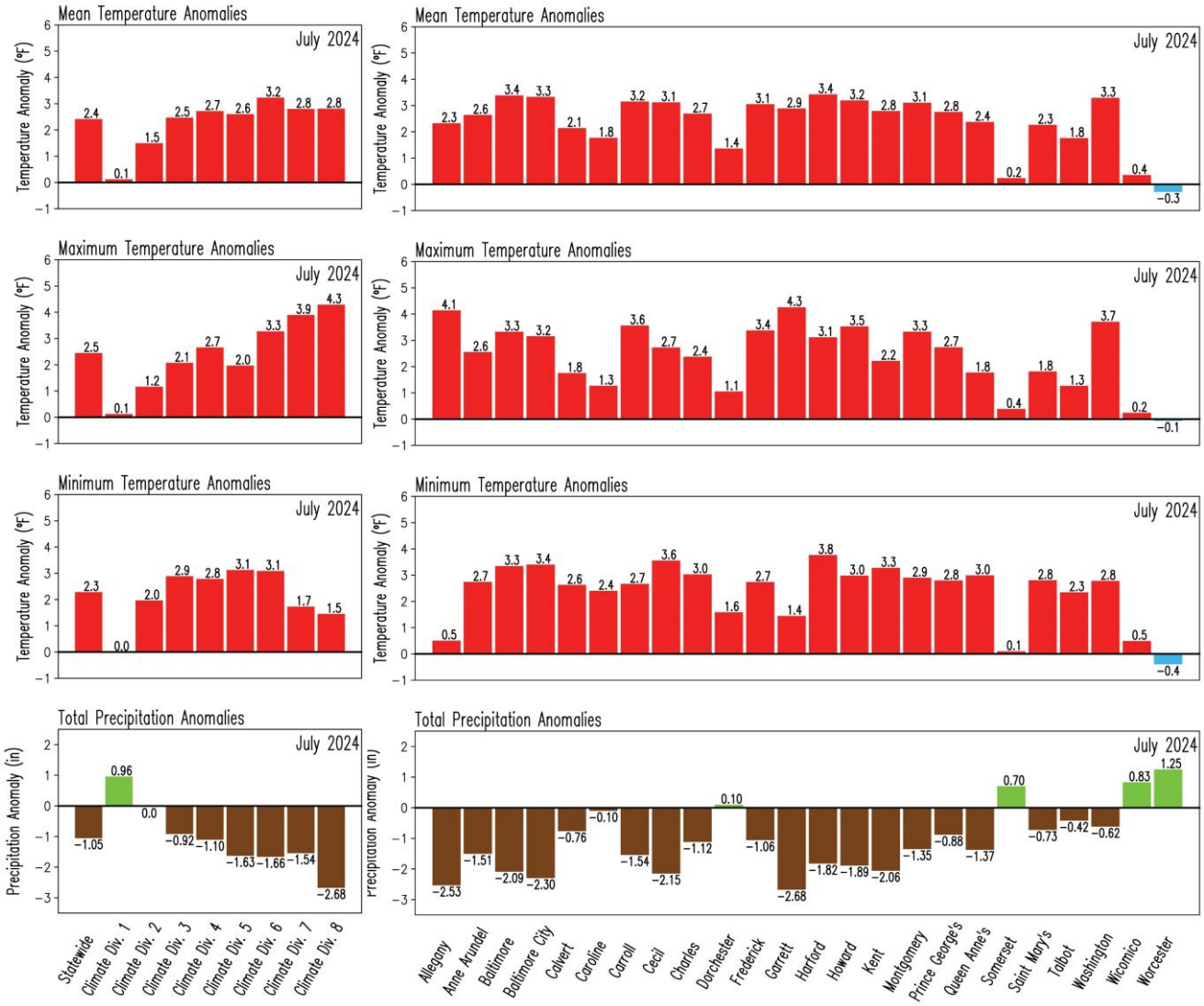

Figure B2. Anomalies of the monthly surface variables in Maryland for July, 2024. Anomalies are with respect to the 1991-2020 climatology. Red/blue color represents positive/negative (warmer/colder than normal) anomalies for mean surface air temperature (upper row), maximum surface air temperature (second 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 July 2024.

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

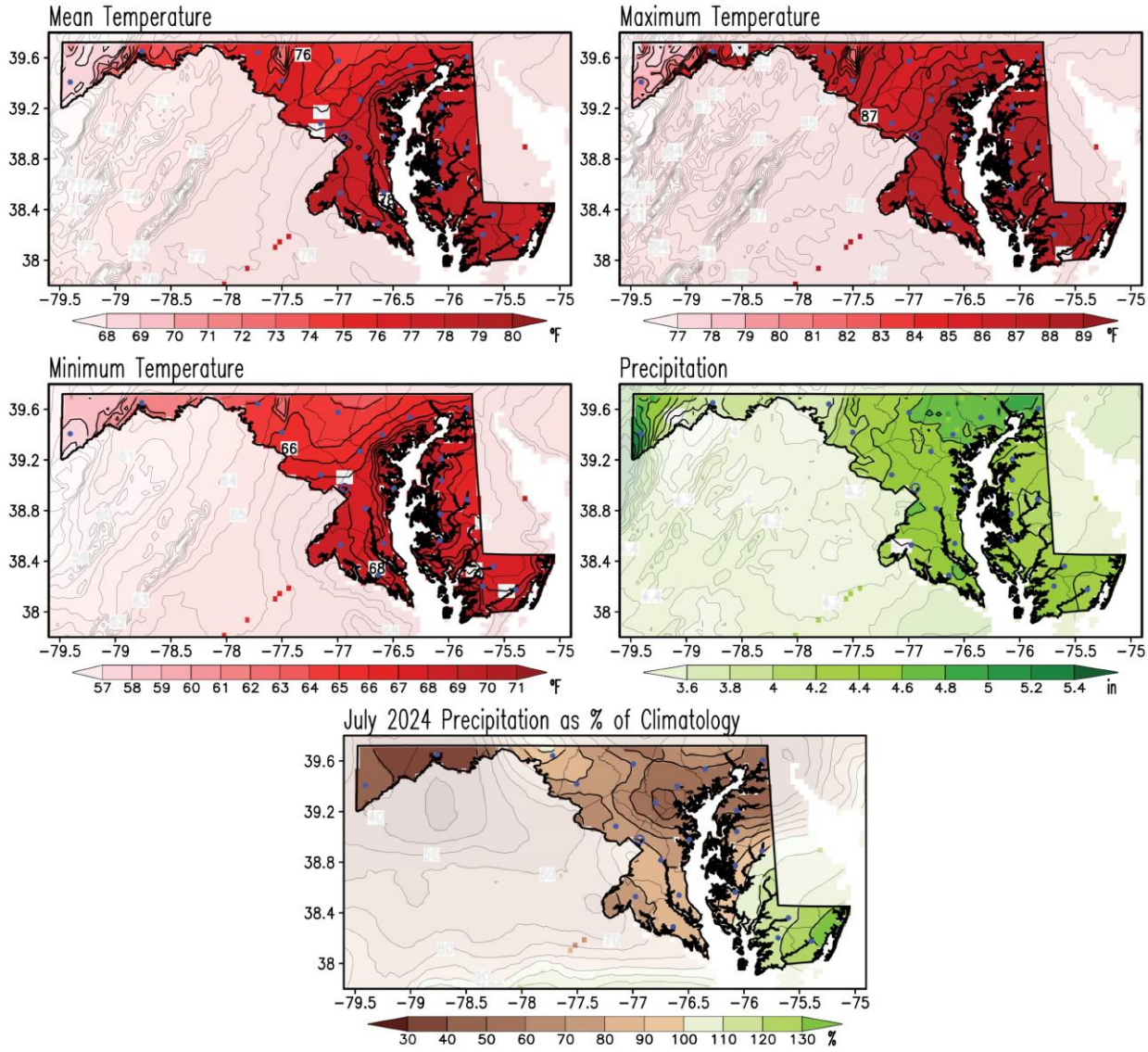

Figure C1. July climatology of the monthly mean, maximum and minimum surface air temperatures, and total precipitation for the period 1991-2020 (upper and middle rows), and precipitation in July 2024 as a percentage of climatology (bottom row). Temperatures are in °F, and precipitation is in inches according to the color bars. This is the current climate normal against which the July 2024 conditions are compared to obtain the July 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. July Standard Deviation and July 2024 Standardized Anomalies Maps

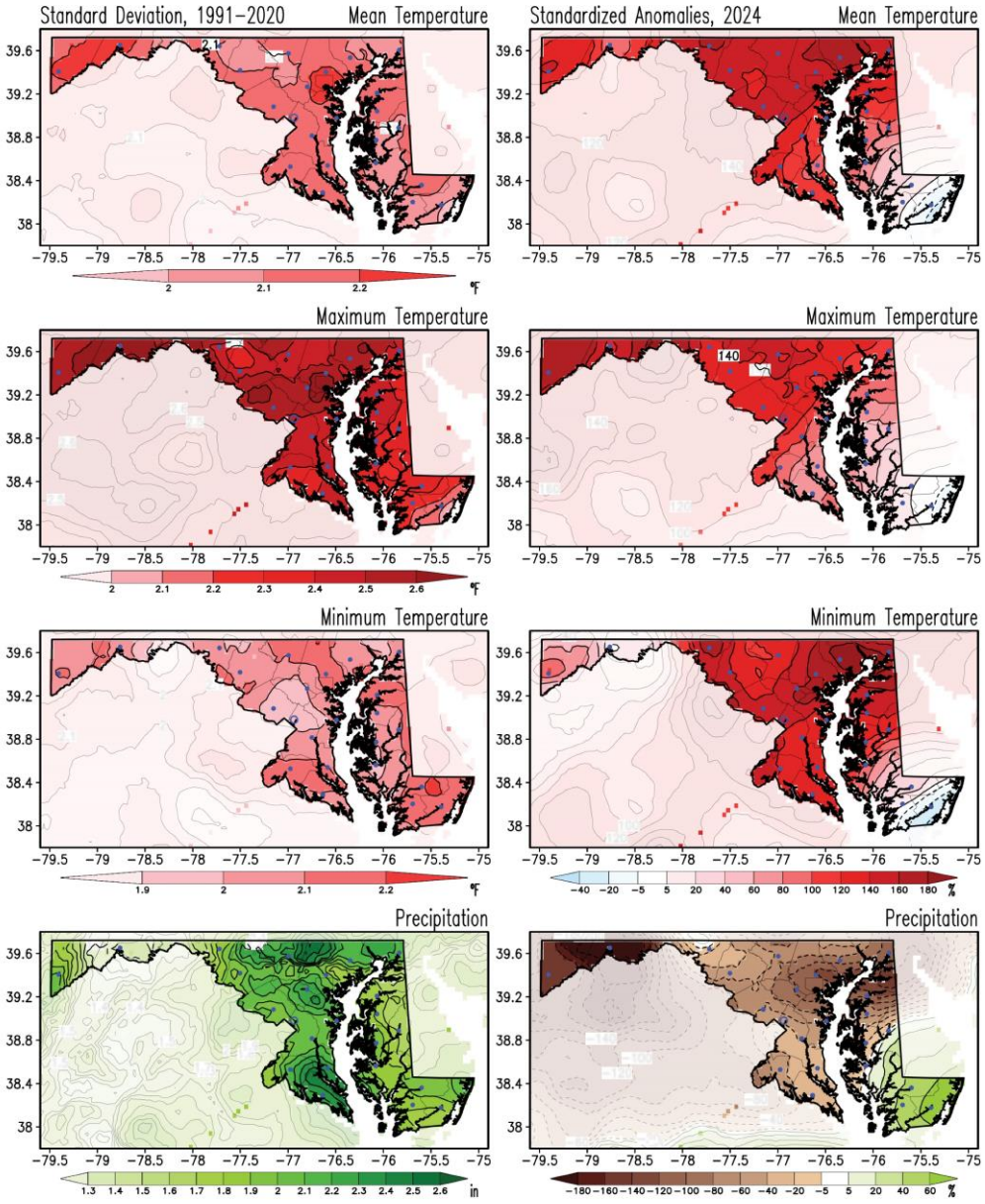

Figure D1. Standard deviation for July and standardized anomalies of temperatures and precipitation for July 2024. Standard deviations for monthly mean, maximum, and minimum surface air temperatures and total precipitation were obtained for the 1991-2020 period (left column). Anomalies for July 2024 (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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