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Maryland Climate Bulletin
March 2024

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DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCE
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Summary

Statewide averages indicate that March 2024 was warmer and wetter than normal (i.e., 1991-2020 averages). Monthly mean temperatures were in the 41 − 51°F range; maximum temperatures were between 51 and 64°F, and minimum temperatures were in the 30 − 41°F range. Monthly total precipitation was between 3.5 and 9 inches.

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

- The mean temperature was warmer than normal everywhere, particularly over Garrett County (around 6.0°F) and portions of Montgomery and Frederick counties (around 5.2°F).

- The maximum temperature was also warmer than normal throughout the state, especially in Garrett County (around 7.0°F) and portions of Montgomery, Prince George's, and Anne Arundel counties (around 5.4°F).

- The minimum temperature was warmer than normal everywhere, too, particularly over portions of Frederick and Montgomery counties (above 5.4°F), Carroll County (around 5.2°F), Garrett, and western Allegany counties (around 4.8°F), and western Talbot, Queen Anne's, and eastern Anne Arundel counties (around 4.6°F).

- Precipitation was above normal over most of the state, especially in the southeastern counties of Wicomico, Somerset, and Worcester (above 4 in and up to double the climatological precipitation). Below-normal precipitation was found over Garrett County and portions of Allegany, Frederick, and Carroll counties.

- For the third month in a row, drought conditions were absent, and above-normal streamflow was present throughout the state at the end of March 2024.

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

- All eight climate divisions were warmer than normal, and except for the western Climate Division 8, which was drier than normal, the rest were wetter than normal this month.

- The statewide temperature anomalies were warmer than normal for a fourth consecutive month since December 2023. However, after a wetter-than-normal January and a drier-than-normal February, the statewide precipitation anomalies returned above normal in March.

Historical Context (Figure 9, Tables A1 and A2)

- Mean, maximum, and minimum statewide temperatures in March (48.2, 58.6, and 37.7°F) were above the long-term averages and among the 10% of the highest values (1895-2023) but still far from the records of 53.0, 65.2, and 41.4°F established in 1921, 1945, and 2012, respectively. March's statewide precipitation (5.67 in) was above the

long-term average and among the 10% of the largest values but still far from the historical record of 8.27 inches in 1994.

- March 2024, however, was the second wettest on record in Somerset, Wicomico, and Worcester counties, the fourth wettest in Caroline and Dorchester counties, and the fifth wettest in Calvert and Saint Mary's counties.

Freezing Days (Figure 10)

- So far this year, statewide minimum temperatures indicate the state has had 4 fewer freezing days (daily minimum temperatures less than or equal to 32°F) than normal. These fewer freezing days correspond to 1 in the light freeze range (between 29 and 32°F), 2 in the moderate freeze range (less than 29°F but greater than or equal to 25°F), and 1 in the severe freeze range (less than 25°F).

Century-Plus Trends, 1895-2024 (Figures 11, 12)

- Statewide mean temperature and heating degree days in March showed significant trends: a warming trend (2.1°F/century) and a decreasing trend (–64.6°FDD/century). Statewide precipitation had a small, non-significant wetting trend (0.08 in/century).

- Regionally, March mean temperatures showed significant warming trends everywhere except Garrett and Allegany counties. Notably, in the Piedmont, over the Montgomery−Frederick and Carroll−Howard boundaries, over Harford, Cecil, and Baltimore counties into Baltimore City, where it reaches 3°F/century. Trends larger than 2°F/century appear in the southeast along Caroline, Talbot, Dorchester, Somerset, Wicomico, and Worcester counties.

- Regionally, March precipitation had no significant trends. However, non-significant wetting trends are found over Baltimore County (0.4 in/century) and southern Worcester County (0.3 in/century); non-significant drying trends are found over western Maryland, especially Garrett County (around 0.3 in/century) and in western Charles County.

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, 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 statewide, and climate division and county-wise, 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 March 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. Freezing days are identified via statewide-averaged minimum air temperatures and displayed in Section 6. Century-plus trends in statewide air temperature, heating 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.

2. Data

Surface air temperatures, total precipitation, and heating 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 4/10/2024.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al. 2014). It is available in a preliminary status (v1.0.0-20240404) at:

https://www.ncei.noaa.gov/pub/data/cirs/climdiv/
Data was downloaded on 4/8/2024.

- NOAA Area averages of daily temperatures and precipitation dataset (NClimGrid−Daily −Durre et al. 2022, 2022a). It is available in a "scaled" status that matches the monthly values (*202403-ste-scaled.csv, v1.0.0) at:
  https://www.ncei.noaa.gov/pub/data/daily-grids/v1-0-0/
  Data was downloaded on 4/05/2024.

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 the anomalies: Anomalies for a given month (e.g., March 2024) are the departures of the monthly value from the corresponding month's 30-year average (i.e., from the average of 30 Marches) during 1991-2020; the 30-year average (or mean) is the climate normal, or just the climatology. 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 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 freezing days. Tracking freezing days is important as the growing season can be approximated as the period between the date of the last killing frost in the spring and the date of the first frost in the fall using the 32°F threshold (USEPA, 2023). A freezing day is defined as a day when the minimum surface air temperature is less than or equal to 32°F. Freezing categories are further defined and approximated depending on how low the minimum temperature reaches (USDA, 2023). A light freeze is defined when the minimum air temperature is between 29° and 32°F; tender plants are killed with little destructive effect on other vegetation. A moderate freeze is defined as when the minimum air temperature is less than 29°F but greater than or equal to 25°F; it has a widely destructive effect on most vegetation, with heavy damage to fruit blossoms and tender and semi-hardy plants. A severe freeze is defined when the minimum temperature is less than 25°F, causing heavy damage to most plants; at these temperatures, the ground freezes solid, with the frozen ground's depth dependent on the freeze's duration and severity, soil moisture, and soil type.

About heating degree-days. Degree-days are the difference between the daily mean temperature (high temperature plus low temperature divided by two) and 65°F. It gives a general idea of how much energy is required to warm 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. March 2024 Maps

A. Mean Temperatures

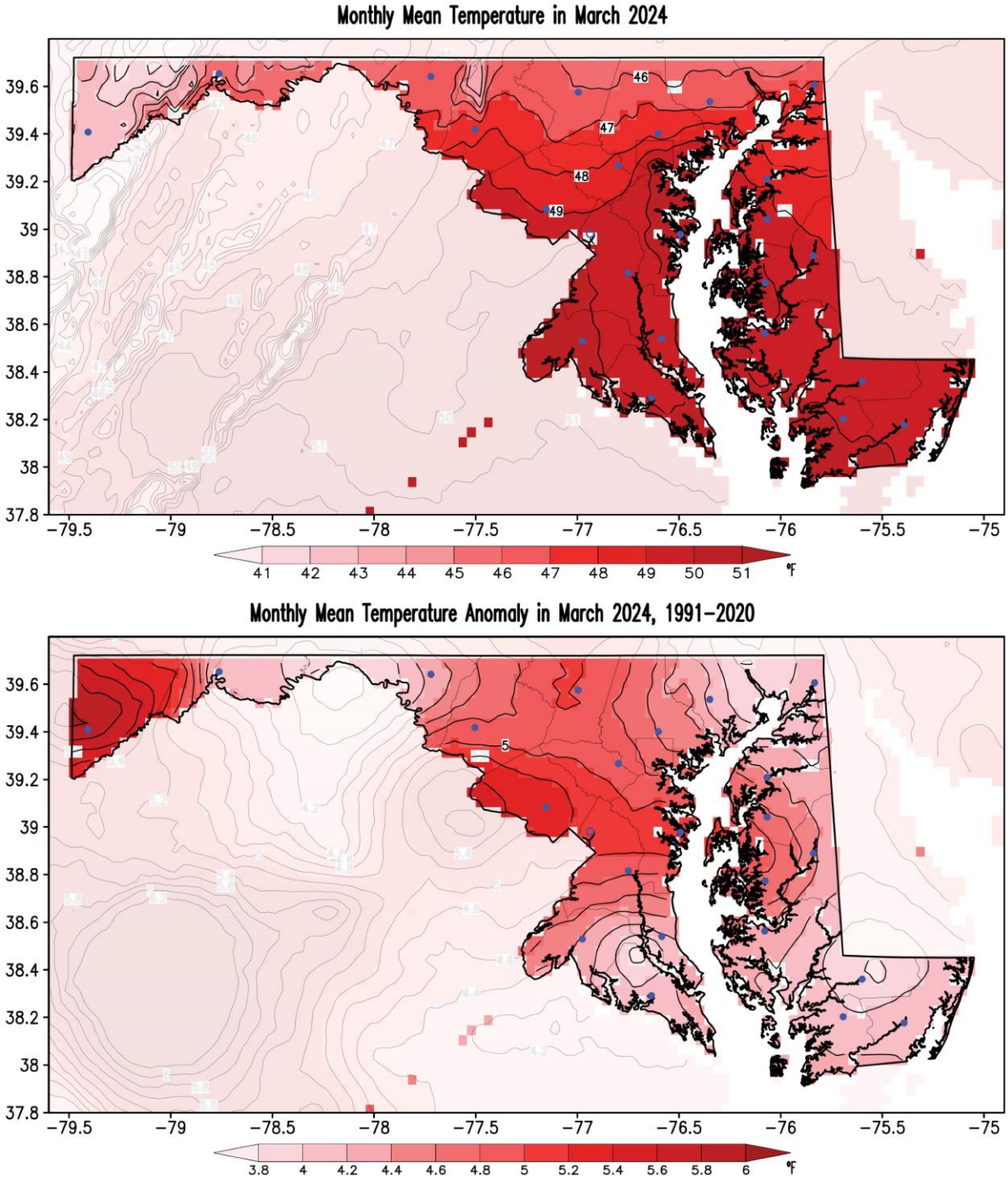

Figure 1. Monthly mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for March 2024. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been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

B. Maximum Temperatures

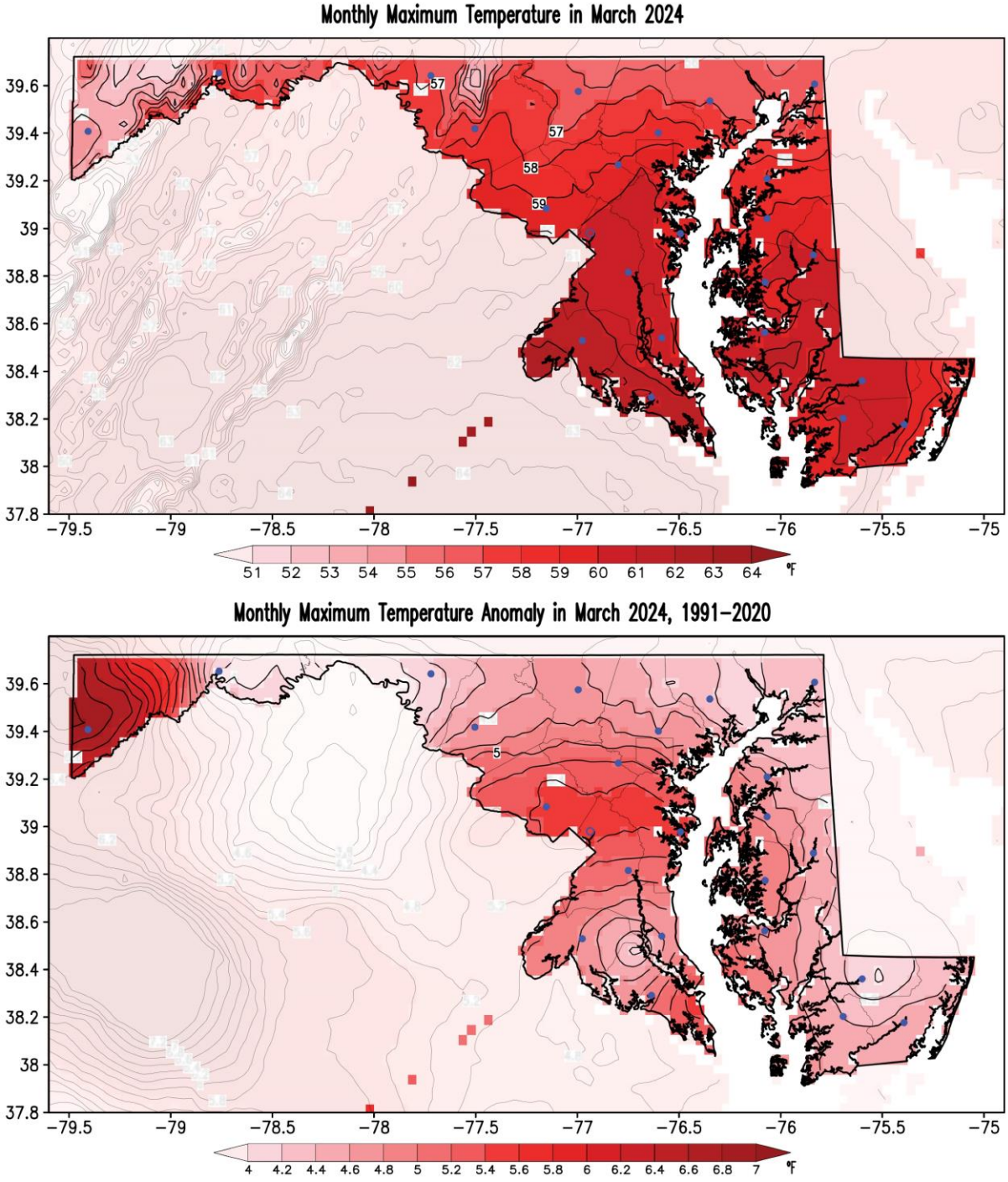

Figure 2. Monthly maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for March 2024. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has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

C. Minimum Temperatures

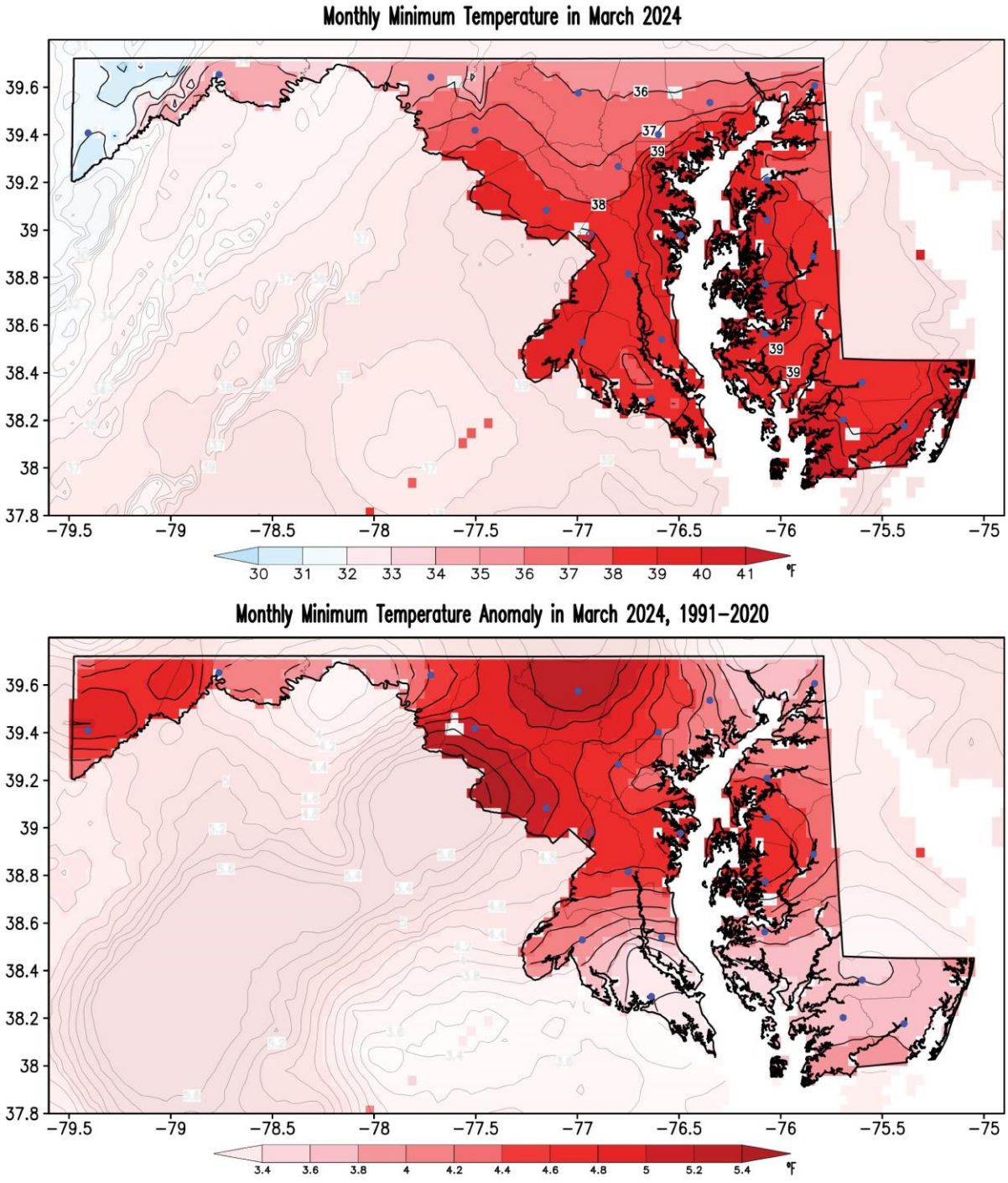

Figure 3. Monthly minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for March 2024. Temperatures are in °F following the color bar. Blue/red shading in the temperature map shows temperatures below/above 32°F, while red shading in the anomaly map marks 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

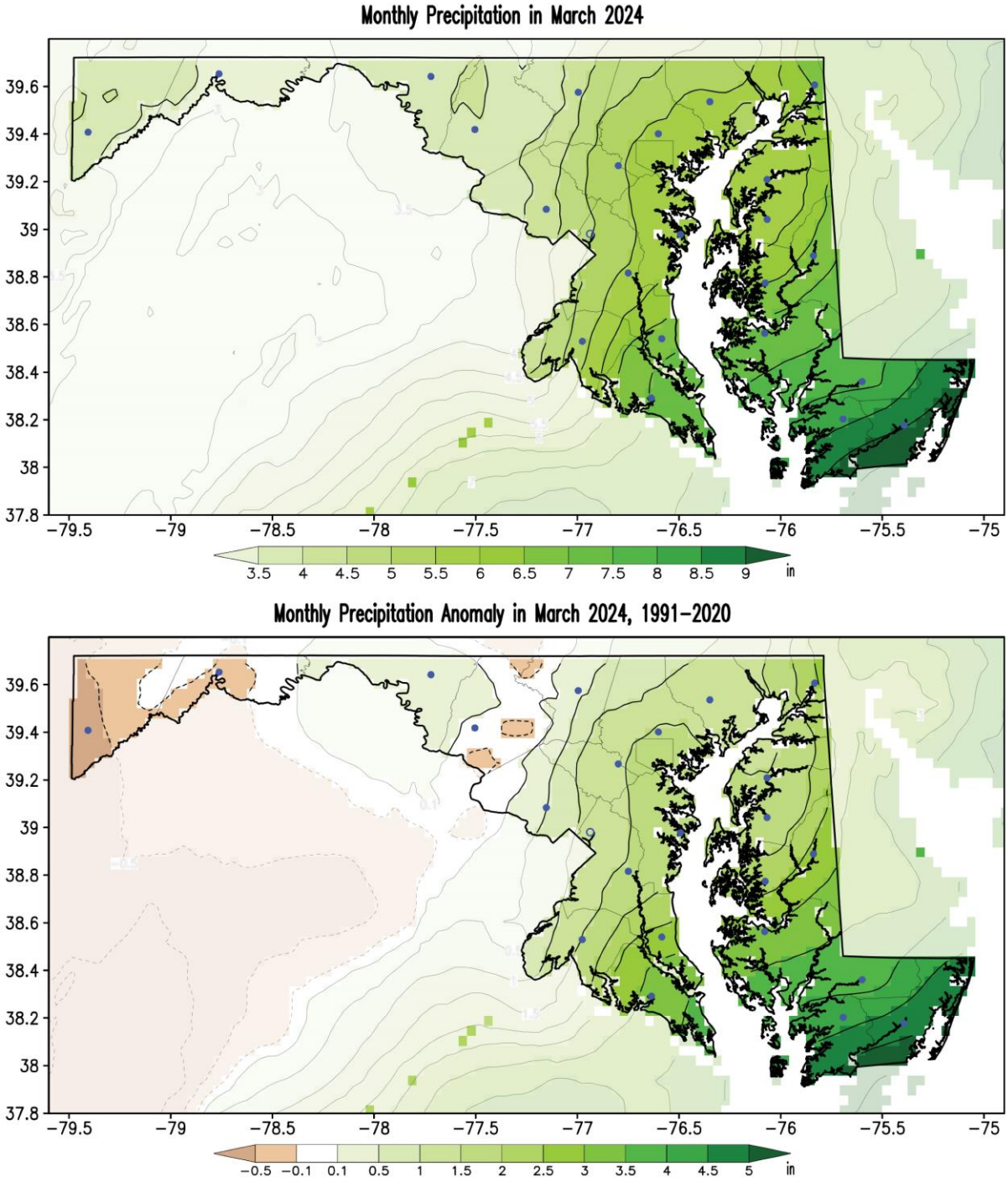

Figure 4. Monthly total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for March 2024. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside the state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

E. Drought

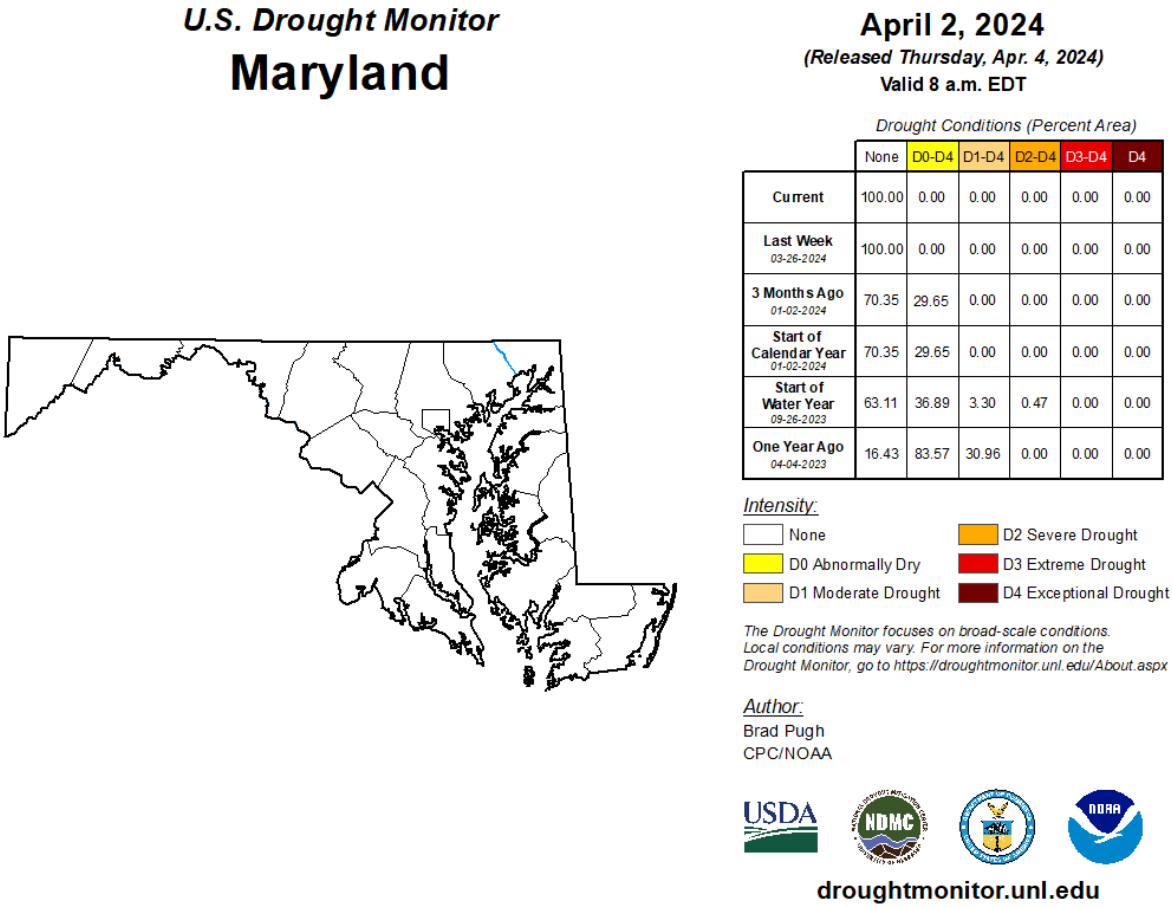

Figure 5. Drought conditions as reported by the U.S. Drought Monitor on April 2, 2024. At this time, the state is still drought-free for third month in a row.

F. Streamflow

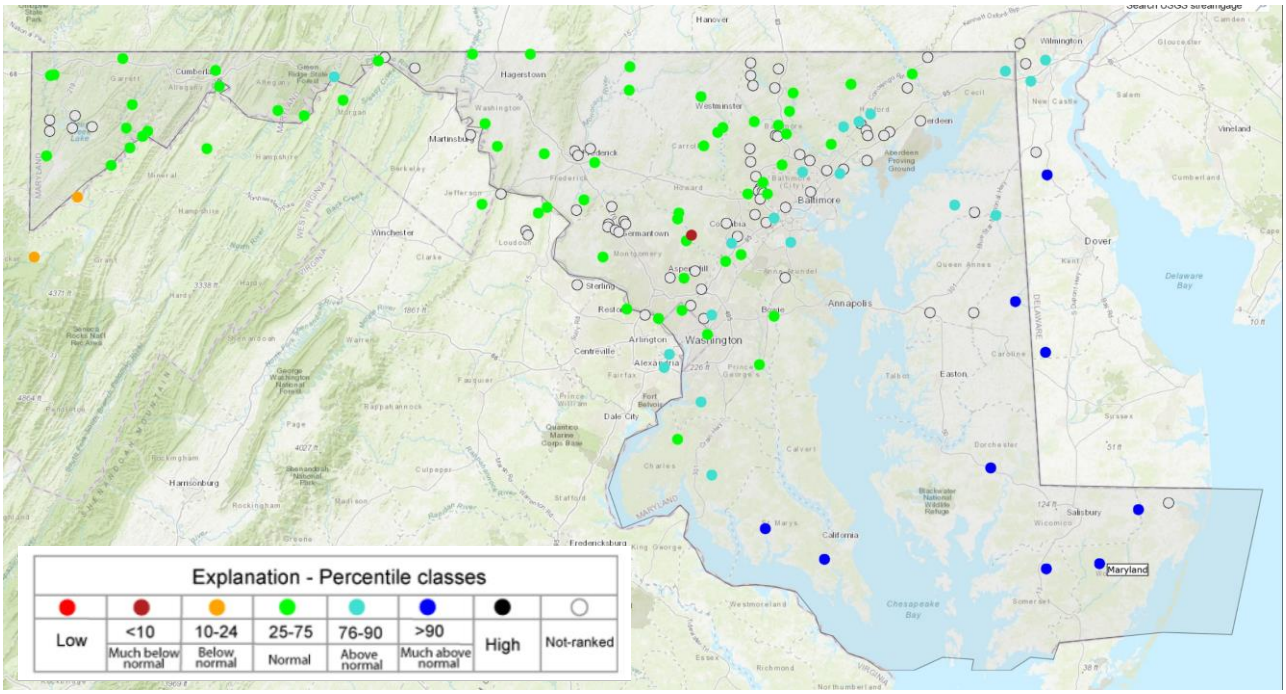

Figure 6. Monthly averaged streamflow class anomalies as reported by the U.S. Geological Survey (USGS) Water Watch for March 2024. Orange to red-filled circles denote below-normal streamflow conditions, cyan to black-filled circles denote above-normal streamflow conditions, and green-filled circles represent normal streamflow conditions .

4. March and JFM 2024 Climate Divisions Averages

A. March 2024 Scatter Plots

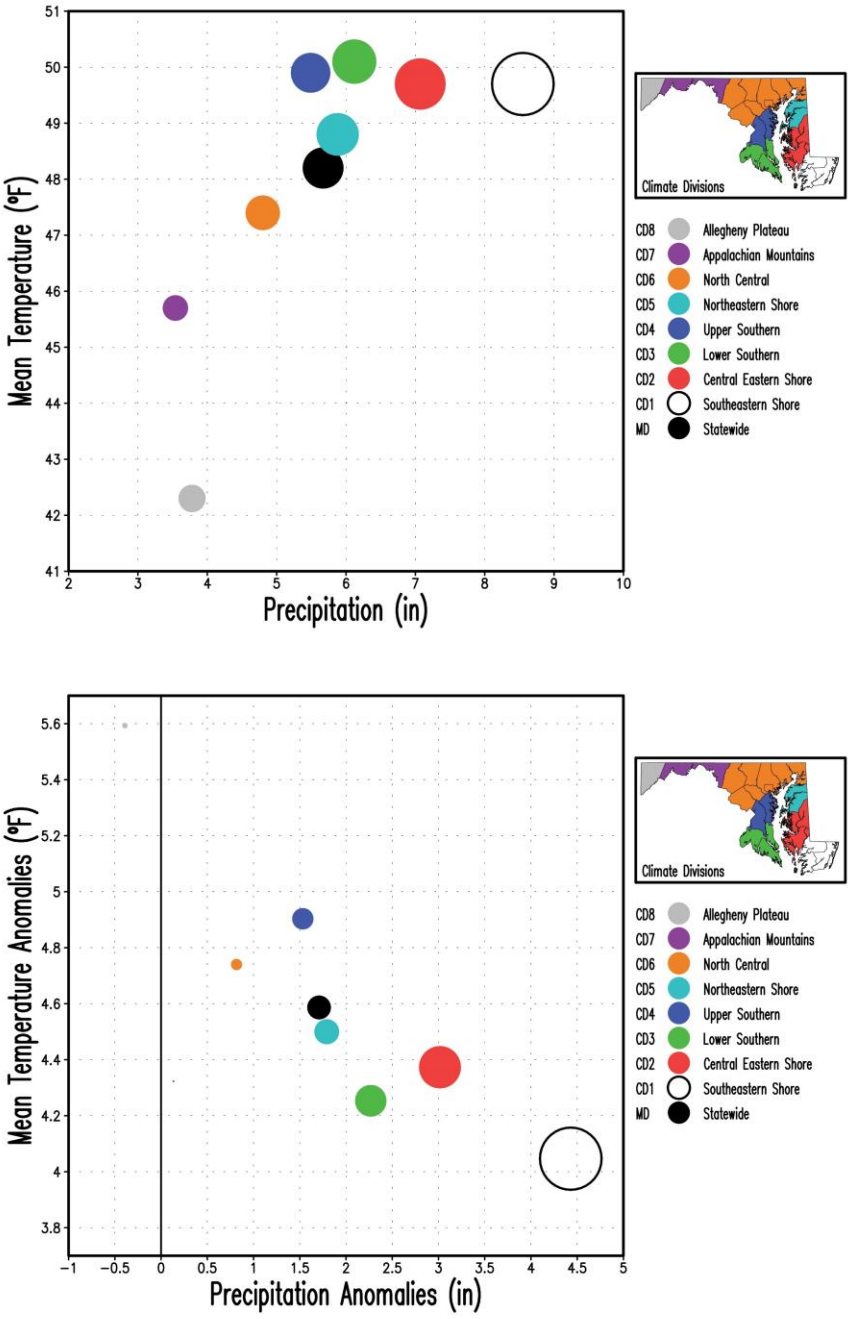

Figure 7. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for March 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 climatology. 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 (8.55 inches in CD1, top panel) and by the maximum precipitation anomaly (4.43 inches in CD1, 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. January – March 2024 Scatter Plots

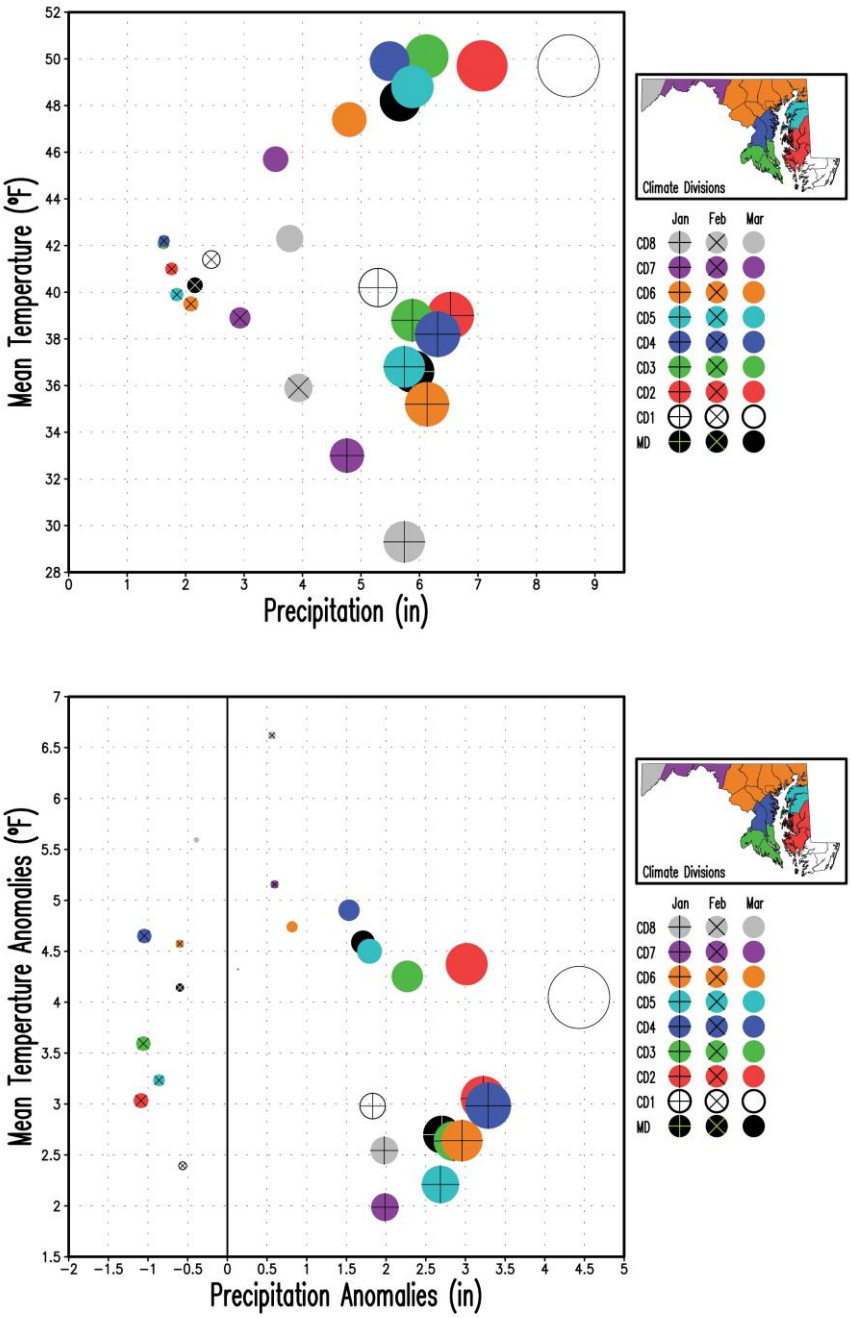

Figure 8. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for January, February and March 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect 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 (8.55 inches in CD1 in March, top panel) and by the maximum precipitation anomaly (4.43 inches in CD1 in March, bottom panel) among the nine regions and three months. March is displayed with filled circles only, while February and January are displayed with superposed multiplication and addition signs, respectively.

5. March 2024 Statewide Averages in the Historical Record

A. Box and Whisker Plots

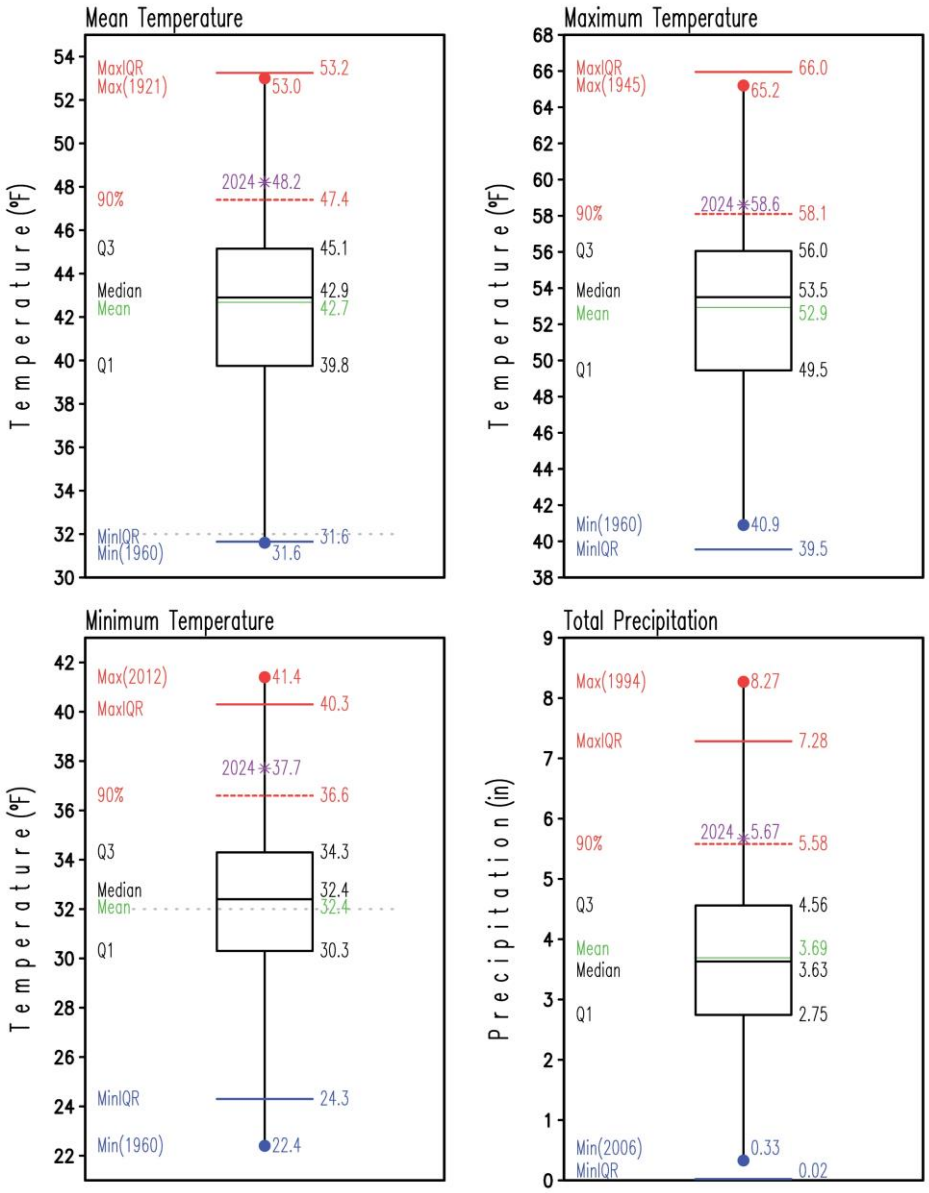

Figure 9. Box and Whisker plots of Maryland (statewide) monthly mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and total precipitation (lower right) for March for the period 1895-2023. The label and asterisk in purple represent conditions for March 2024. Statistics 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 10% 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. For reference, the 32°F temperature is displayed with an horizontal, dotted, gray line.

6. March 2024 Statewide Freezing Days

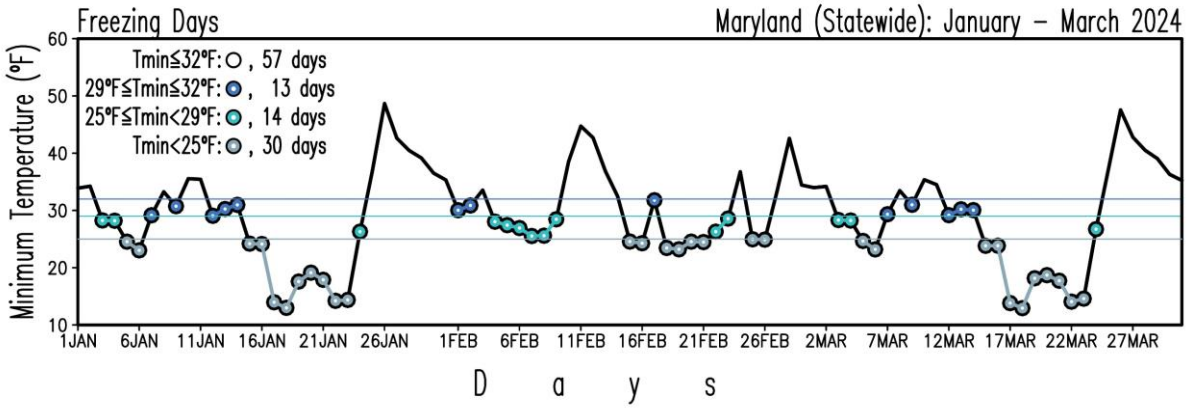

Figure 10. Maryland (statewide) daily minimum temperature and the number of freezing days at the end of March 2024. Temperature is in °F. A freezing day is defined as a day when the minimum surface air temperature is less than or equal to 32°F. The horizontal continuous lines mark the threshold temperatures of 32°, 29° and 25°F. The open circles display temperatures smaller or equal to 32°F; those filled with the darkest blue circles show the days under light freeze conditions; those filled with cyan circles display the days under moderate freeze conditions; and those filled with gray circles show the days under severe freeze conditions. By the end of the month, there were 57 freezing days in total, of which 13 days were under light freeze conditions, 14 days under moderate freeze conditions, and 30 days under severe freeze conditions; the climatological counts for the period 1991-2020 are 61 freeze days, 14 light freeze days, 16 moderate freeze days, and 31 severe freeze days.

7. 1895-2024 March Trends

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

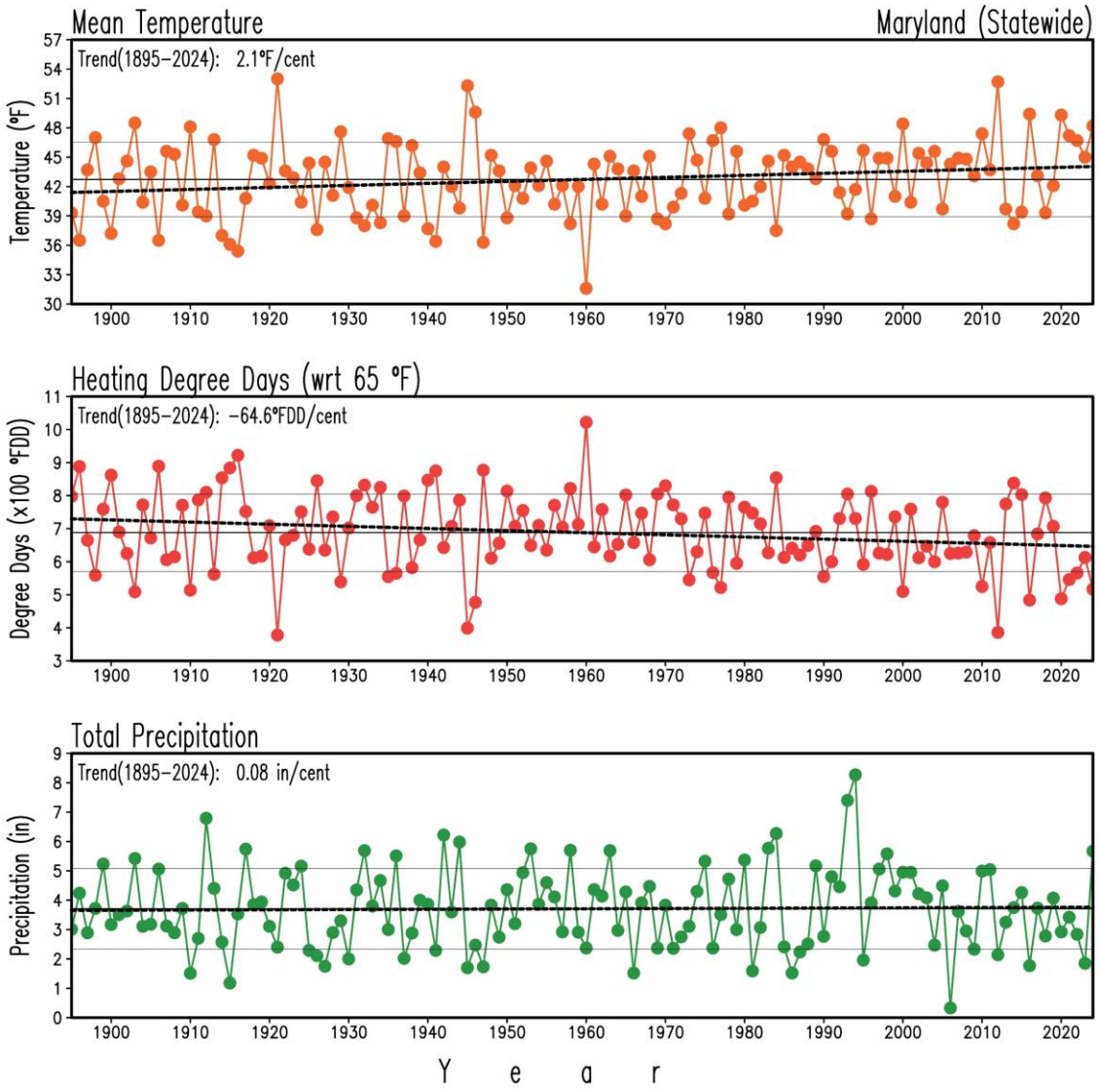

Figure 11. Maryland (statewide) mean surface air temperature, heating degree-days, and precipitation in March for the period 1895-2024. Temperature is in °F, heating degree-days is in °F degree-days (°FDD), and precipitation is in inches. The thin, continuous black lines in each panel display the long-term means (42.7°F, 688.1°FDD, and 3.71 in, 1895-2024), and the double thin, continuous gray lines indicate the standard deviation (3.8°F, 117.3°FDD, and 1.37 in) above/below the long-term mean. The thick dashed black lines show the long-term linear trend. The warming temperature trend (2.1°F/century), and the decreasing heating degree-days trend (−64.6°FDD/century) are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000) but not the small precipitation wetting trend (0.08 in/century).

B. Temperature and Precipitation Maps

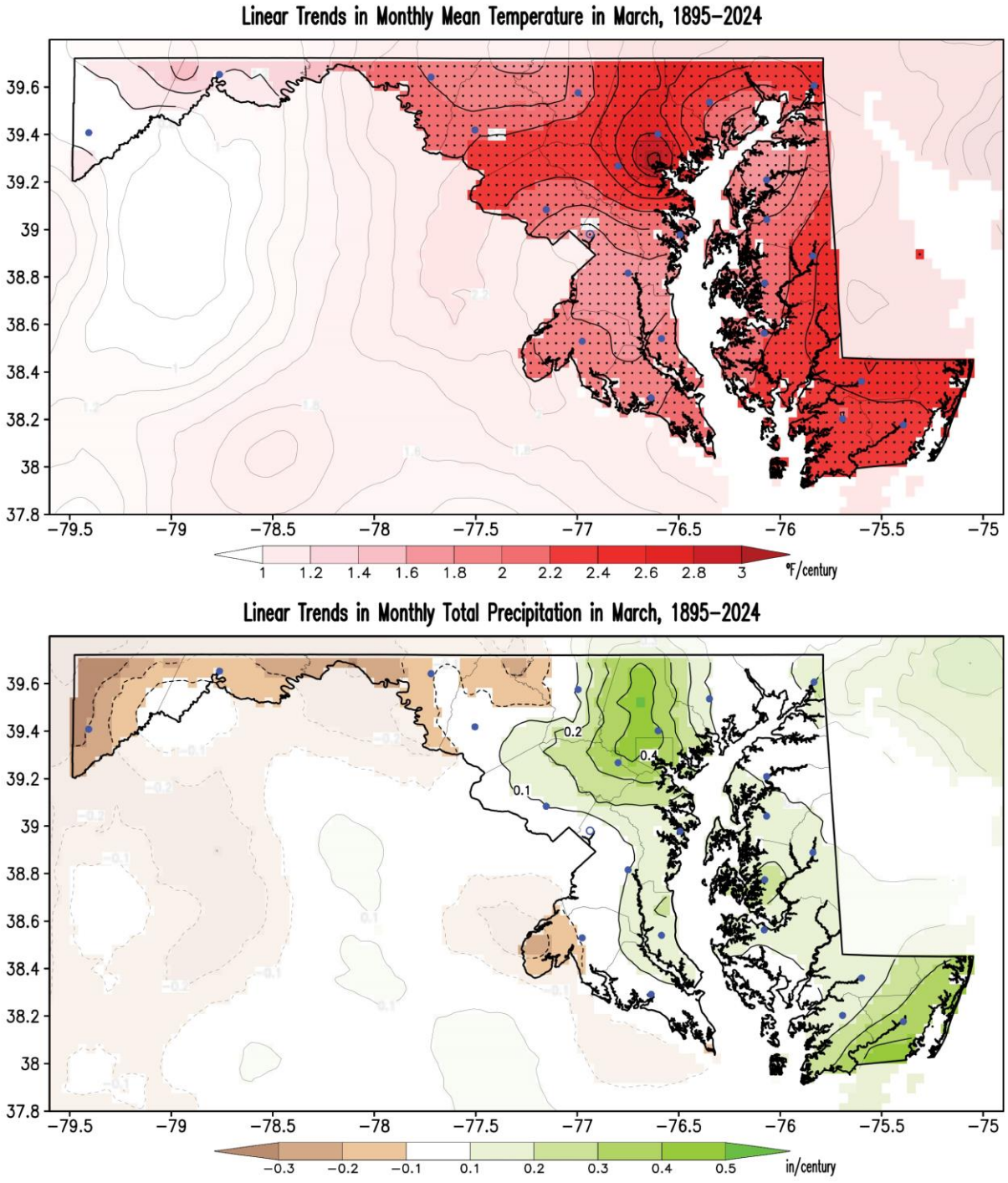

Figure 12. Linear trends in surface air mean temperature and precipitation in March for the period 1895-2024. Temperatures are in °F/century, and precipitation is in inches/century following the color bars. Red shading in the temperature map marks warming trends. Brown/green shading in the precipitation 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. March 2024 Data Tables: Statewide, Climate Divisions, and Counties

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)
Statewide	48.2	122
Climate Division 1	49.7	123
Climate Division 2	49.7	122
Climate Division 3	50.1	121
Climate Division 4	49.9	123
Climate Division 5	48.8	121
Climate Division 6	47.4	120
Climate Division 7	45.7	118
Climate Division 8	42.3	121
Allegany	45.2	117
Anne Arundel	50.0	124
Baltimore	47.4	120
Baltimore City	49.3	123
Calvert	49.6	121
Caroline	49.2	122
Carroll	46.4	120
Cecil	46.9	119
Charles	50.4	121
Dorchester	49.9	122
Fredrick	47.1	120
Garrett	42.3	121
Harford	46.8	118
Howard	48.0	121
Kent	48.5	120
Montgomery	48.8	123
Prince George's	49.8	122
Queen Anne's	49.1	122
Saint Mary's	50.0	122
Somerset	50.1	124
Talbot	50.0	124
Washington	46.2	117
Wicomico	49.5	123
Worcester	49.6	123

Region	Total Precipitation (in)	Rank (#)
Statewide	5.67	118
Climate Division 1	8.55	129
Climate Division 2	7.07	127
Climate Division 3	6.12	120
Climate Division 4	5.49	116
Climate Division 5	5.88	120
Climate Division 6	4.80	106
Climate Division 7	3.54	70
Climate Division 8	3.78	61
Allegany	3.30	69
Anne Arundel	5.69	119
Baltimore	5.35	115
Baltimore City	5.65	116
Calvert	6.72	126
Caroline	6.76	127
Carroll	4.29	90
Cecil	6.11	123
Charles	5.23	112
Dorchester	7.39	127
Fredrick	3.84	75
Garrett	3.77	61
Harford	5.46	115
Howard	5.00	110
Kent	5.75	118
Montgomery	4.18	95
Prince George's	5.39	115
Queen Anne's	5.93	118
Saint Mary's	7.03	126
Somerset	8.58	129
Talbot	6.50	124
Washington	3.77	78
Wicomico	7.98	129
Worcester	8.93	129

Table A1. Monthly mean surface air temperature (left) and total precipitation (right) at Maryland (statewide), climate division, and county levels for March 2024. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for March 2024 occupies among the 130 Marches 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	58.6	119
Climate Division 1	59.9	121
Climate Division 2	60.2	123
Climate Division 3	61.2	122
Climate Division 4	60.4	120
Climate Division 5	58.8	117
Climate Division 6	57.6	118
Climate Division 7	56.5	111
Climate Division 8	53.5	118
Allegany	56.1	109
Anne Arundel	60.2	120
Baltimore	57.7	117
Baltimore City	59.4	120
Calvert	60.4	122
Caroline	60.0	120
Carroll	56.7	115
Cecil	56.6	113
Charles	61.6	119
Dorchester	60.5	123
Fredrick	57.2	117
Garrett	53.5	118
Harford	56.7	114
Howard	58.8	121
Kent	58.2	116
Montgomery	59.1	121
Prince George's	60.6	120
Queen Anne's	59.2	118
Saint Mary's	61.2	122
Somerset	60.2	122
Talbot	60.0	123
Washington	56.8	114
Wicomico	60.3	121
Worcester	59.4	121

Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	37.7	122
Climate Division 1	39.5	121
Climate Division 2	39.1	121
Climate Division 3	39.0	120
Climate Division 4	39.5	122
Climate Division 5	38.8	124
Climate Division 6	37.2	123
Climate Division 7	34.9	121
Climate Division 8	31.2	122
Allegany	34.2	120
Anne Arundel	39.9	122
Baltimore	37.1	122
Baltimore City	39.2	122
Calvert	38.8	119
Caroline	38.4	123
Carroll	36.2	124
Cecil	37.1	120
Charles	39.2	120
Dorchester	39.2	121
Fredrick	37.0	123
Garrett	31.2	122
Harford	36.8	120
Howard	37.3	123
Kent	38.8	122
Montgomery	38.6	123
Prince George's	39.0	121
Queen Anne's	39.0	124
Saint Mary's	38.8	117
Somerset	40.1	122
Talbot	40.0	123
Washington	35.6	119
Wicomico	38.7	120
Worcester	39.7	120

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

A. Temperatures and Precipitation

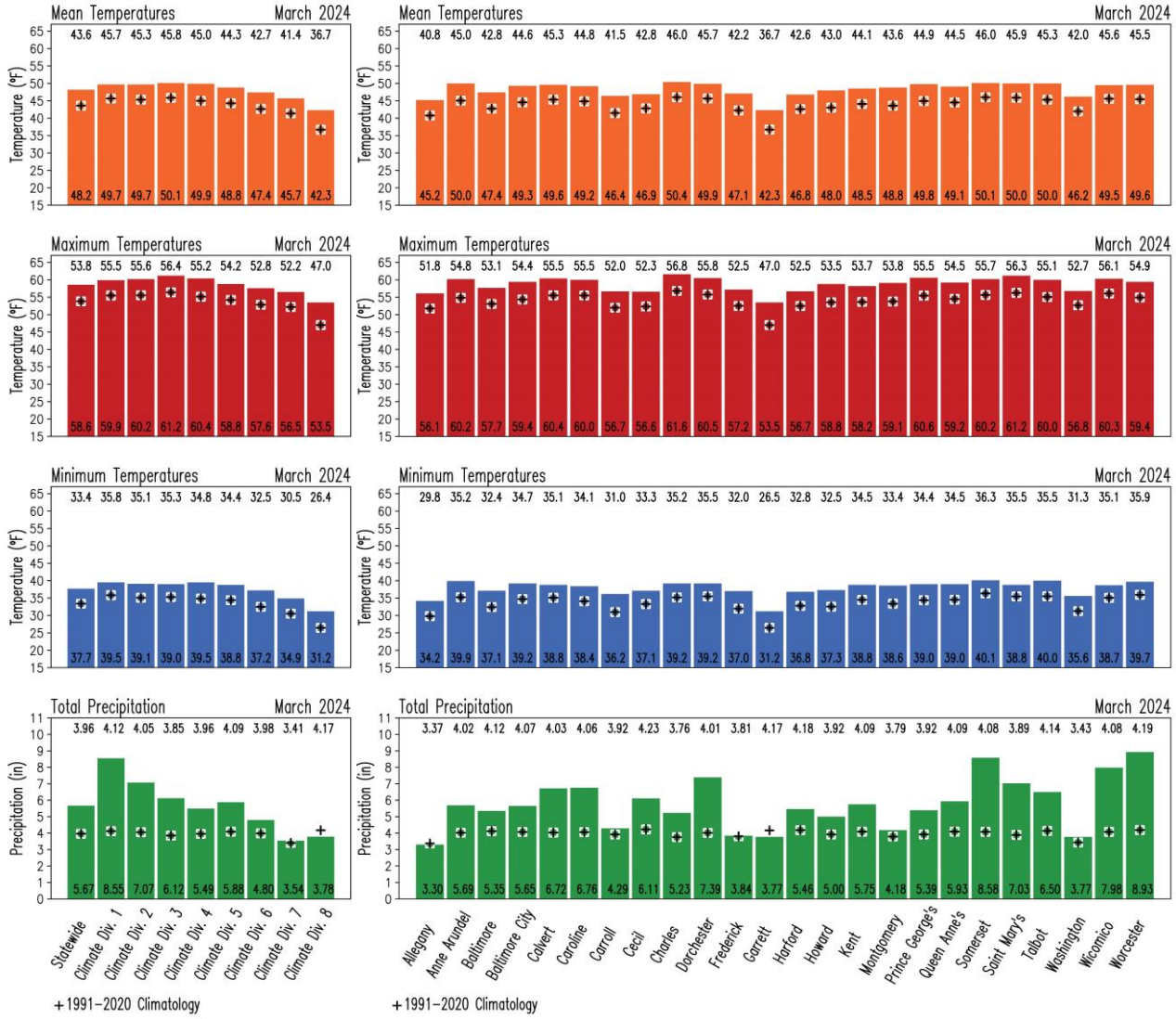

Figure B1. Monthly surface variables in Maryland for March 2024. Color bars represent the variables as follows: mean surface air temperature (orange), maximum surface air temperature (red), minimum surface air temperature (blue) and total precipitation (green) at statewide and climate division (left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

B. Temperatures and Precipitation Anomalies

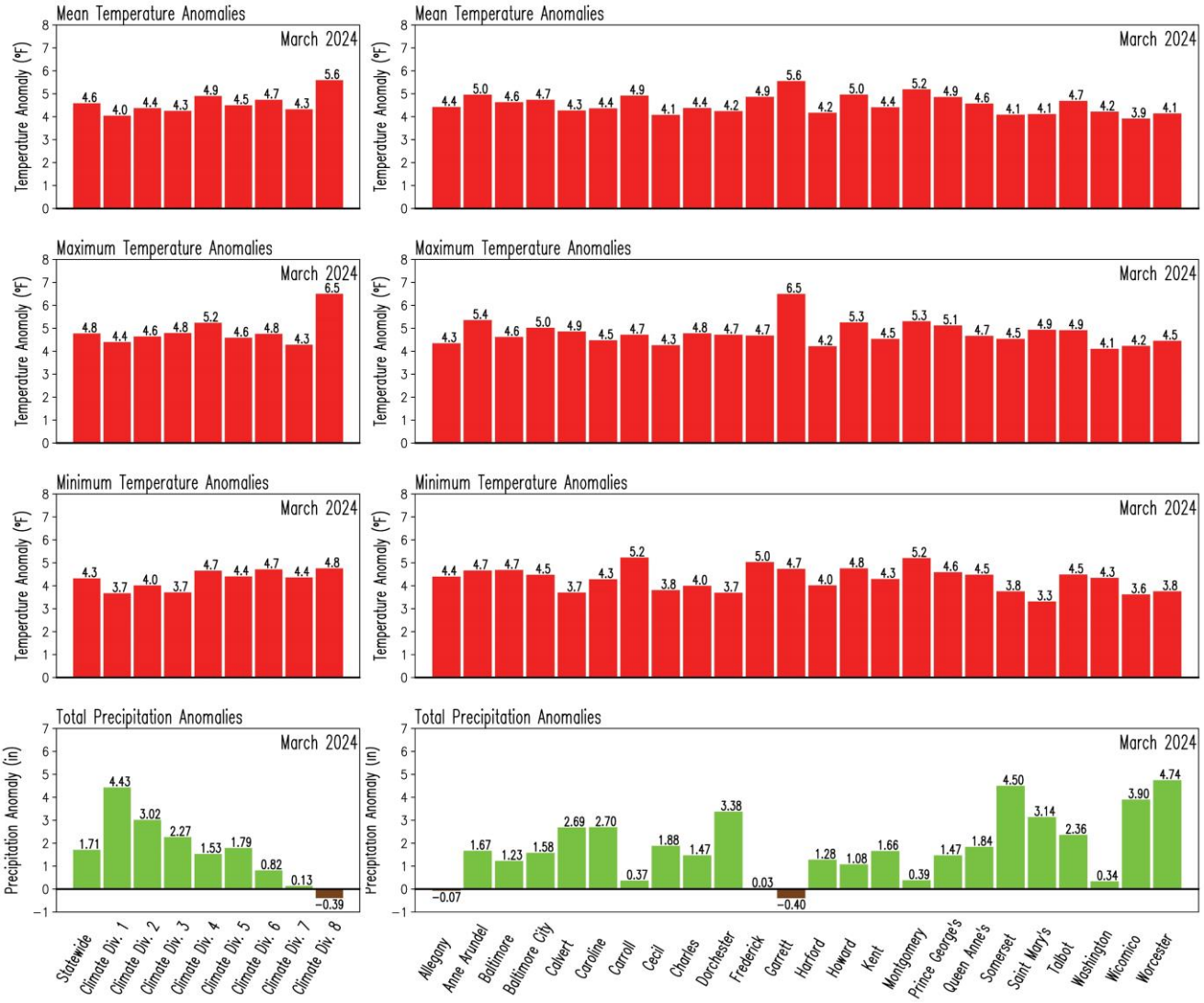

Figure B2. Anomalies of the monthly surface variables in Maryland for March 2024. Anomalies are with respect to the 1991-2020 climatology. Red color represents positive (warmer than normal) anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top),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

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

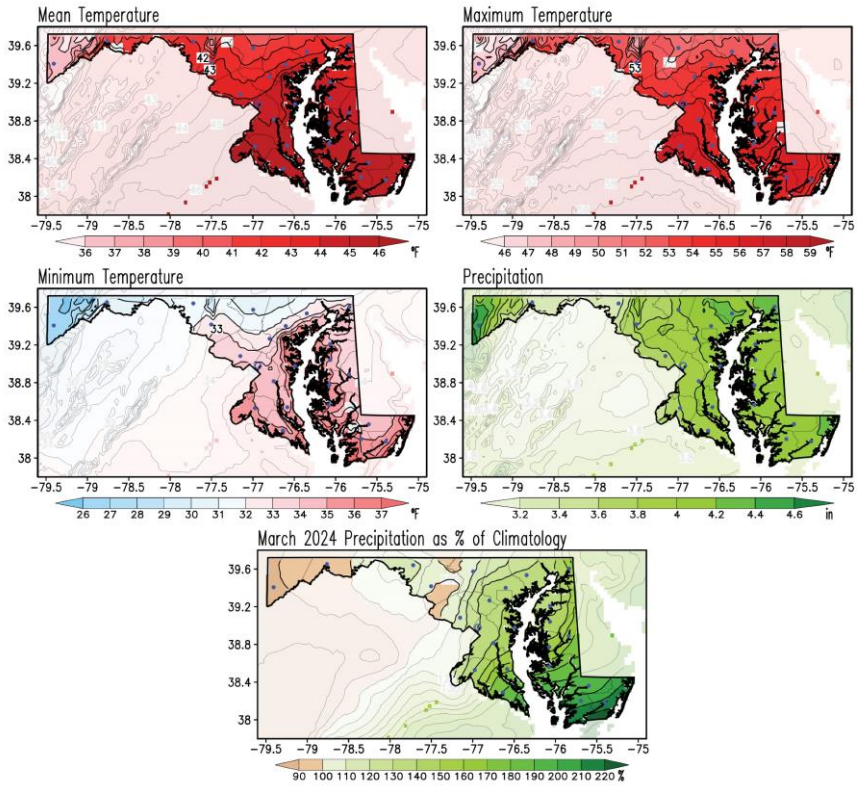

Figure C1. March climatology of the monthly mean, maximum and minimum surface air temperatures, and total precipitation for the period 1991-2020 (upper and middle rows), and precipitation in March 2024 as a percentage of climatology (bottom row). Temperatures are in °F, and precipitation is in inches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

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).

Appendix D. March Standard Deviation and March 2024 Standardized Anomalies Maps

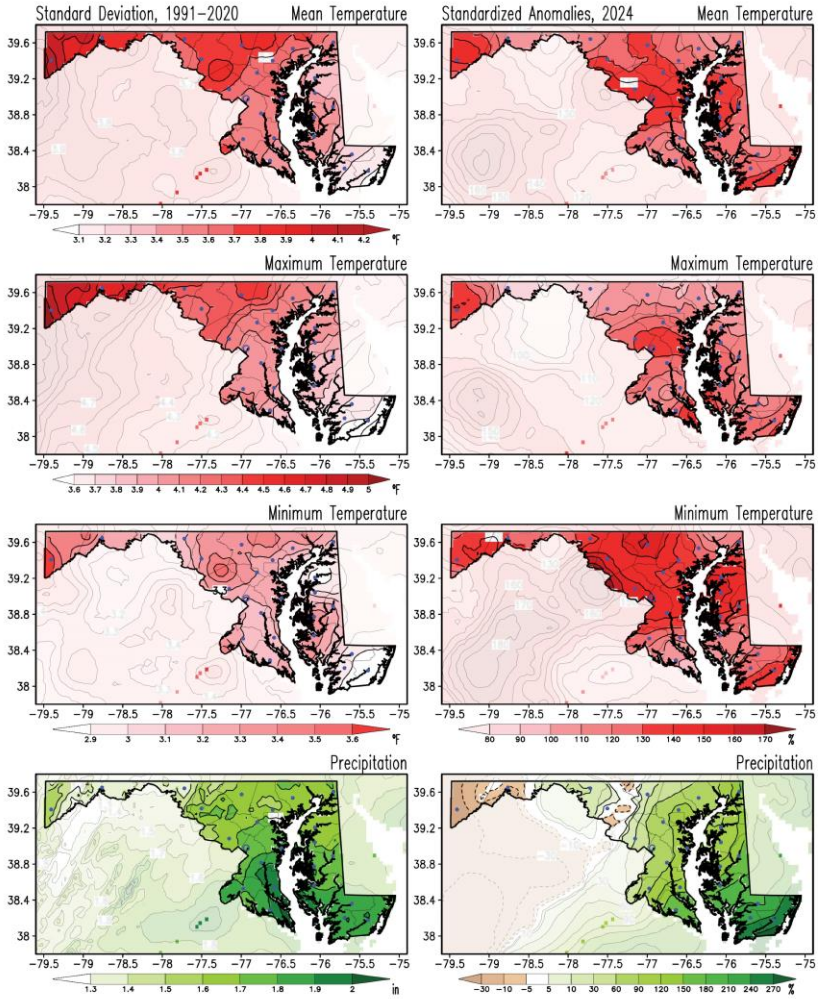

Figure D1. Standard deviation for March and standardized anomalies of temperatures and precipitation for March 2024. Standard deviations for monthly mean, maximum, and minimum surface air temperatures and total precipitation were obtained for the 1991-2020 period (left column). Anomalies for March 2024 (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. Red shading in the anomaly temperature maps marks 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.

The monthly standard deviation measures a climate variable's 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*.

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