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Maryland Climate Bulletin
May 2024

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DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCE
Sumant Nigam, Chair

Maryland State Climatologist Office

Summary

Statewide averages show that May 2024 was warmer and drier than normal (i.e., 1991-2020 averages). Monthly mean temperatures were in the 61−69°F range; maximum temperatures were between 70 and 79°F, and minimum temperatures were in the 49−61°F range. Monthly total precipitation was between 2.4 and 5.4 inches.

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

- The mean temperature was warmer than normal throughout the state, especially over Garrett County (around 4.5°F), the southern parts of Calvert, Saint Mary's, and Dorchester counties (3.3−3.6°F), and parts of Washington, Frederick, Carroll, Baltimore, and Harford counties (3.0−3.3°F).

- The maximum temperature was warmer than normal almost everywhere in the state, particularly in Garrett County (around 3.9°F), Allegany County (2.1−2.4°F), and portions of Carroll, Frederick, Calvert, and Saint Mary's counties (around 2.1°F). Slightly colder than normal temperatures appeared over the eastern shore in portions of Kent, Queen Anne's, and Caroline counties (−0.6°F).

- The minimum temperature was also warmer than normal everywhere in the state, especially in the southern parts of Calvert, Saint Mary's, and Dorchester counties (5.2−5.5°F), Garrett County (5.2°F), portions of Talbot and Dorchester counties (4.9−5.2), and parts of Montgomery, Frederick, Carroll, Baltimore, and Harford counties (4.0−4.3°F).

- Precipitation was below normal over most of the state. In particular, parts of Harford and Cecil counties (1.2−1.4 inches deficit), which got around 60−65% of their climatological precipitation, and parts of Caroline, Dorchester, and Wicomico counties (0.8−1.0 inches deficit) that received around 75 percent of their climatological precipitation. Above-normal precipitation occurred only over Washington and Frederick counties (0.2−0.6 inches) and parts of Allegany and Prince George's counties (inches).

- For the first time in the year, abnormally dry conditions appeared in the state over Dorchester, Wicomico, Somerset, and Worcester counties. While most of the creeks and rivers had normal streamflow, some creeks and rivers in this region also showed below-normal streamflow; some creeks and rivers over the Piedmont and western Maryland also showed below-normal streamflow.

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

- All eight climate divisions were warmer and drier than normal. While the Central Eastern Shore, Climate Division 2, was the driest (0.71 inches below normal), the Allegany Plateau, Climate Division 8, was the warmest (4.2°F above normal). Notably, anomalies in the minimum temperatures were larger than in the maximum temperatures in all Climate Divisions.

- The statewide temperature was warmer than normal for the sixth consecutive month since December 2023. The statewide precipitation anomalies remained below normal in May after a wetter-than-normal March.

Historical Context (Figure 9, Tables A1 and A2)

- Mean, maximum, and minimum statewide temperatures in May (66.1, 75.6, and 56.6°F) were above the long-term (1895-2023) averages. Except for the maximum temperature, the mean and minimum temperatures were among the 10% of the highest values on record for the month but still far from the historical maximum records of 69.3 and 58.8°F established in 2004; the warmest maximum temperature on record of 82.2°F, was set in 1991. May's statewide precipitation (3.66 inches) was just below the long-term average, far from the driest May on record of 0.82 inches in 1964.

- Mean temperatures indicate that May 2024 was the ninth warmest May in Garrett and Saint Mary's counties and the tenth in Harford County.

- Minimum temperatures show that May 2024 was the sixth warmest May statewide. Except for Wicomico, Somerset, and Worcester, the minimum temperatures in the remaining counties and Baltimore City ranked within the upper ten warmest on record. May was the fourth warmest in Harford, Calvert, Saint Mary's, and Talbot counties and the fifth warmest in Dorchester County.

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

- Statewide mean temperature, heating, and cooling degree−days in May showed significant trends: a warming trend (1.1°F/century), a decreasing trend (–20.0°FDD/century), and an increasing trend (17.1°FDD/century), respectively. Statewide precipitation also had a significant wetting trend (0.75 in/century).

- Regionally, mean temperatures in May showed significant warming trends almost everywhere. In particular, over Baltimore City (2.0°F/century), Baltimore County, and parts of Caroline, Talbot, Dorchester, Somerset, Wicomico, and Worcester counties (1.6–1.8°F/century).

- Regionally, May precipitation had significant wetting trends over the northern counties west of Bay and counties over the southern eastern shore. In particular, over areas of Garrett, Montgomery, Howard, Carol, and Baltimore counties (1.1–1.2 inches/century), and Somerset and Worcester counties (0.7−0.8 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, 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 May 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, heating degree-days, 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 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 6/18/2024.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al. 2014). It is available in a preliminary status (v1.0.0-20240606) at:

https://www.ncei.noaa.gov/pub/data/cirs/climdiv/
Data was downloaded on 6/10/2024.

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., May 2024) are the departures of the monthly value from the corresponding month's 30-year average (i.e., from the average of 30 Mays) 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 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. May 2024 Maps

A. Mean Temperatures

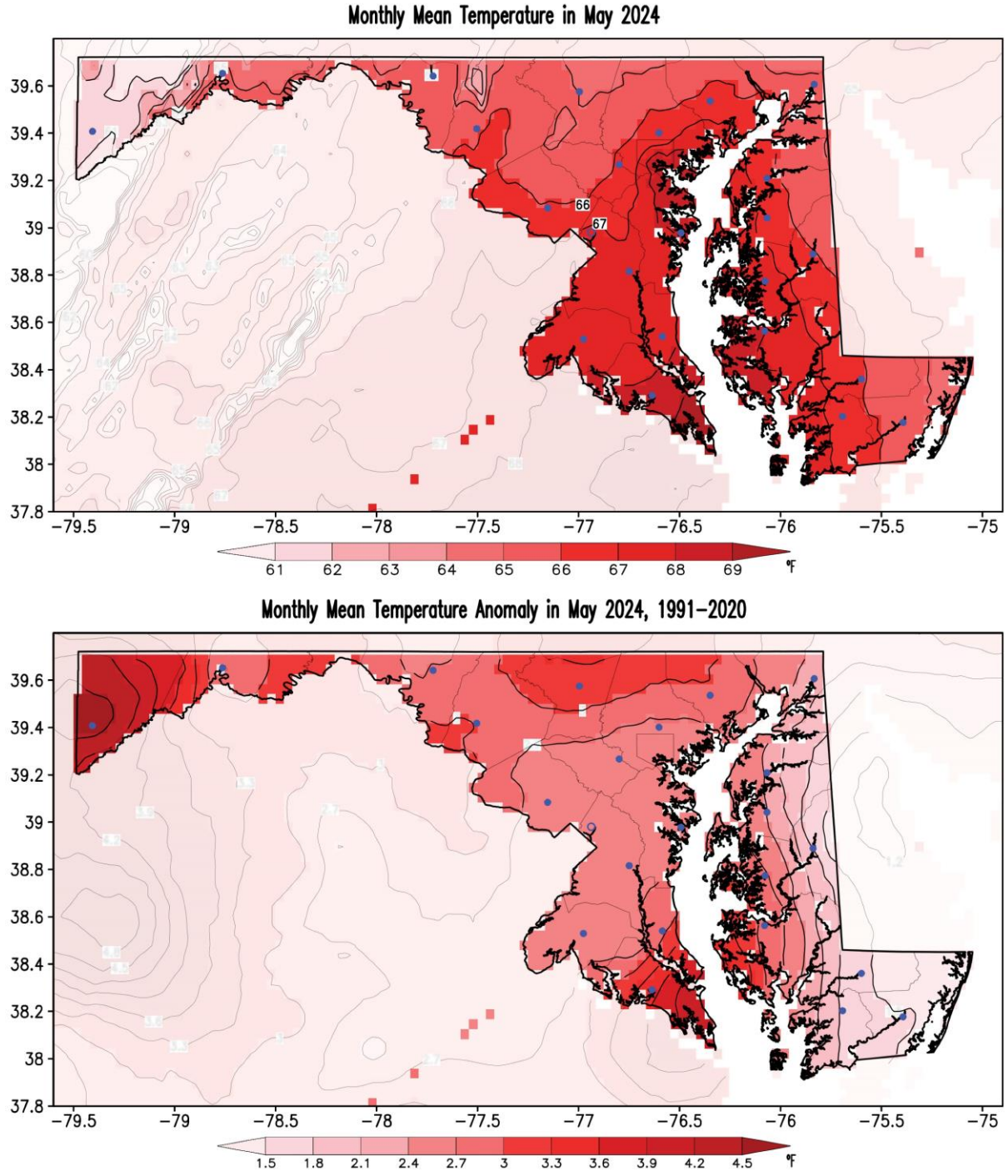

Figure 1. Monthly mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for May 2024. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been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

B. Maximum Temperatures

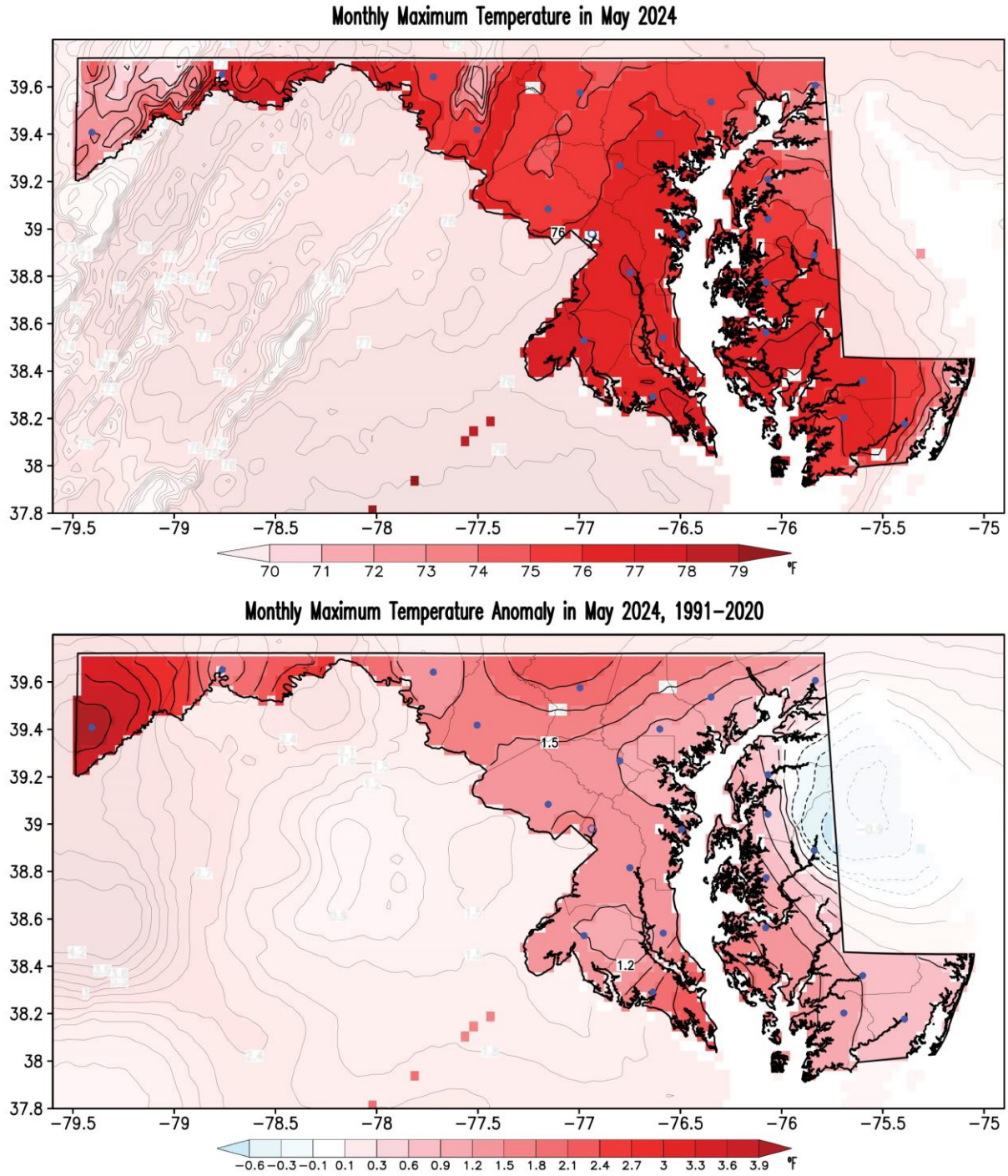

Figure 2. Monthly maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for May 2024. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the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

C. Minimum Temperatures

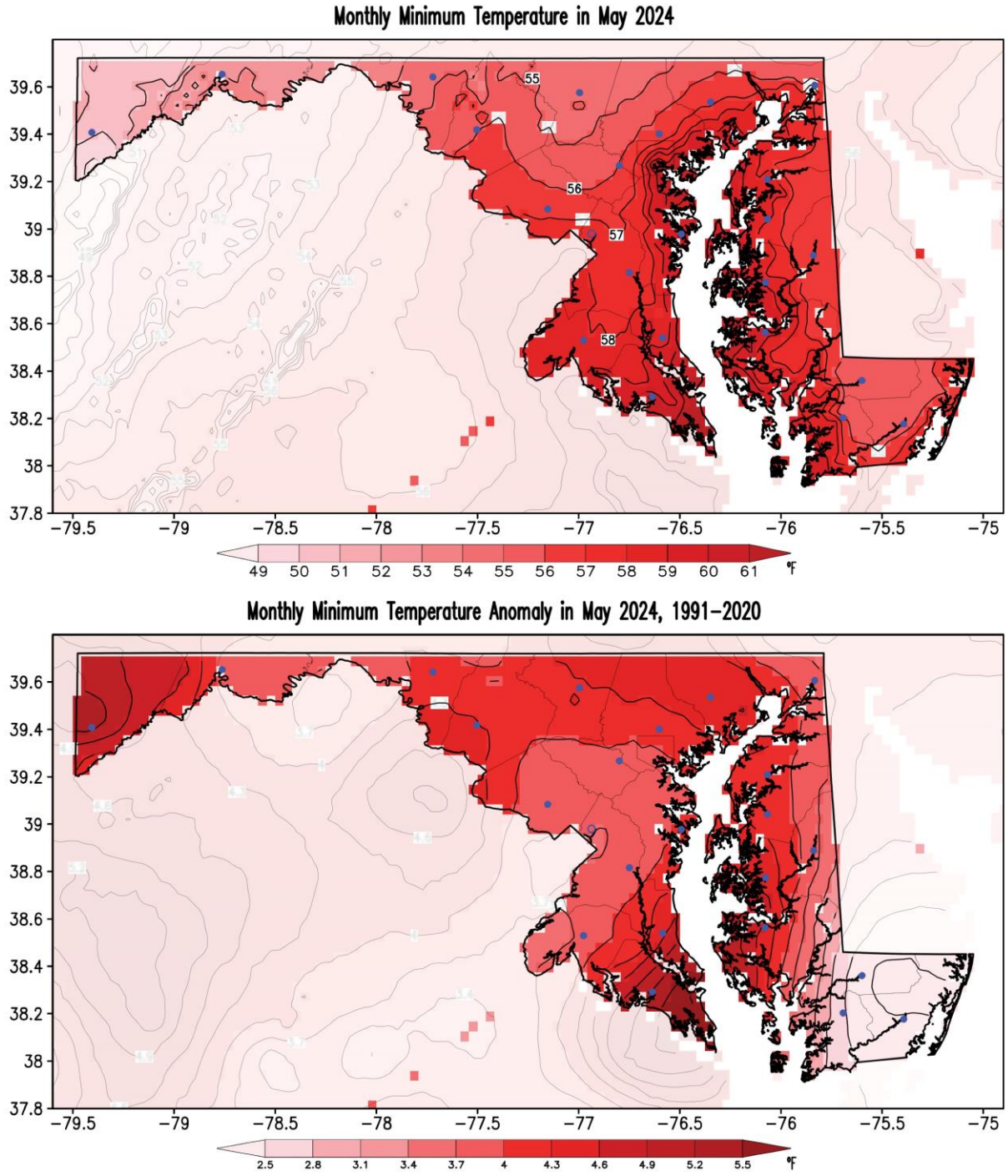

Figure 3. Monthly minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for May 2024. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been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

D. Precipitation

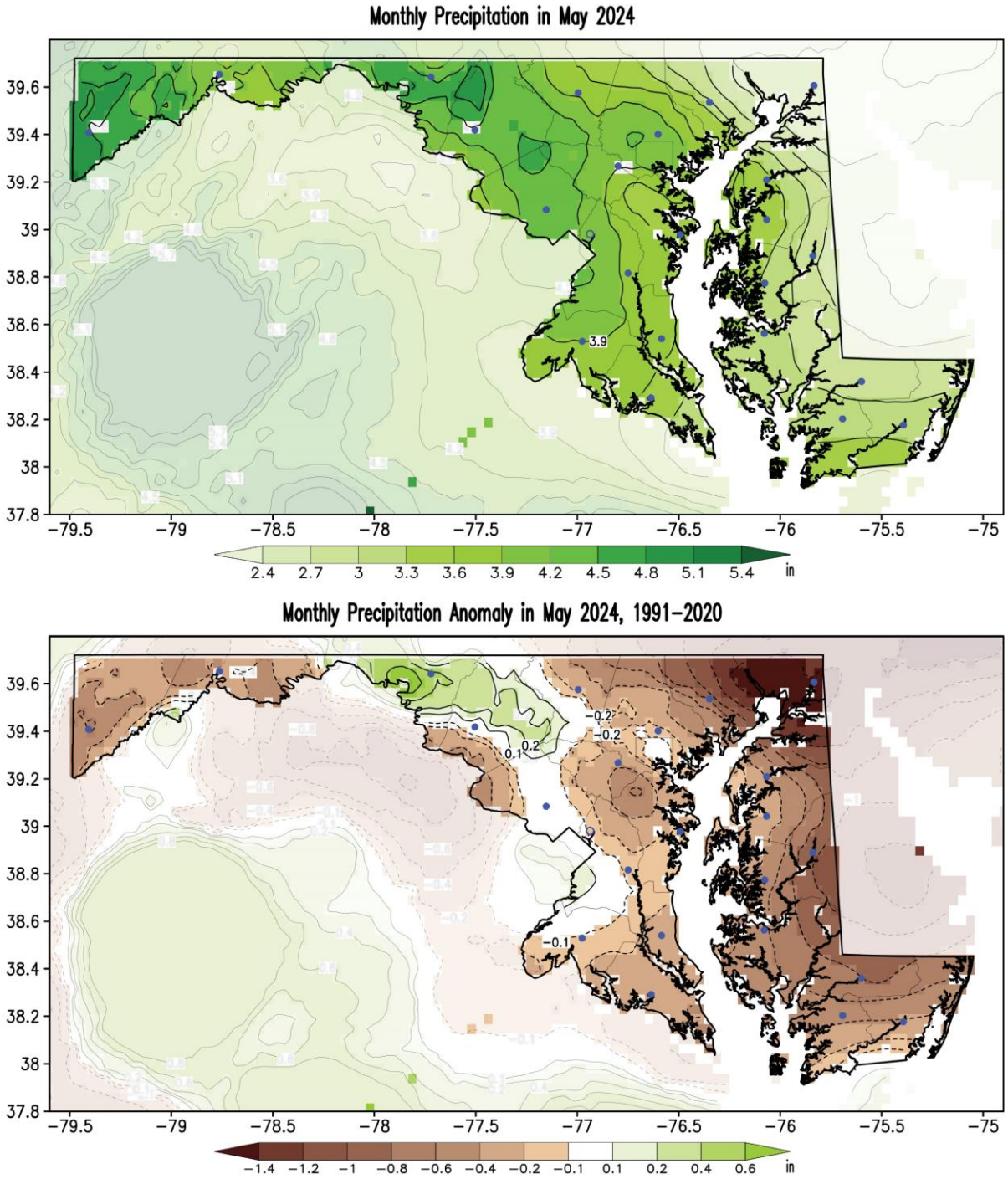

Figure 4. Monthly total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for May 2024. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside the state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

E. Drought

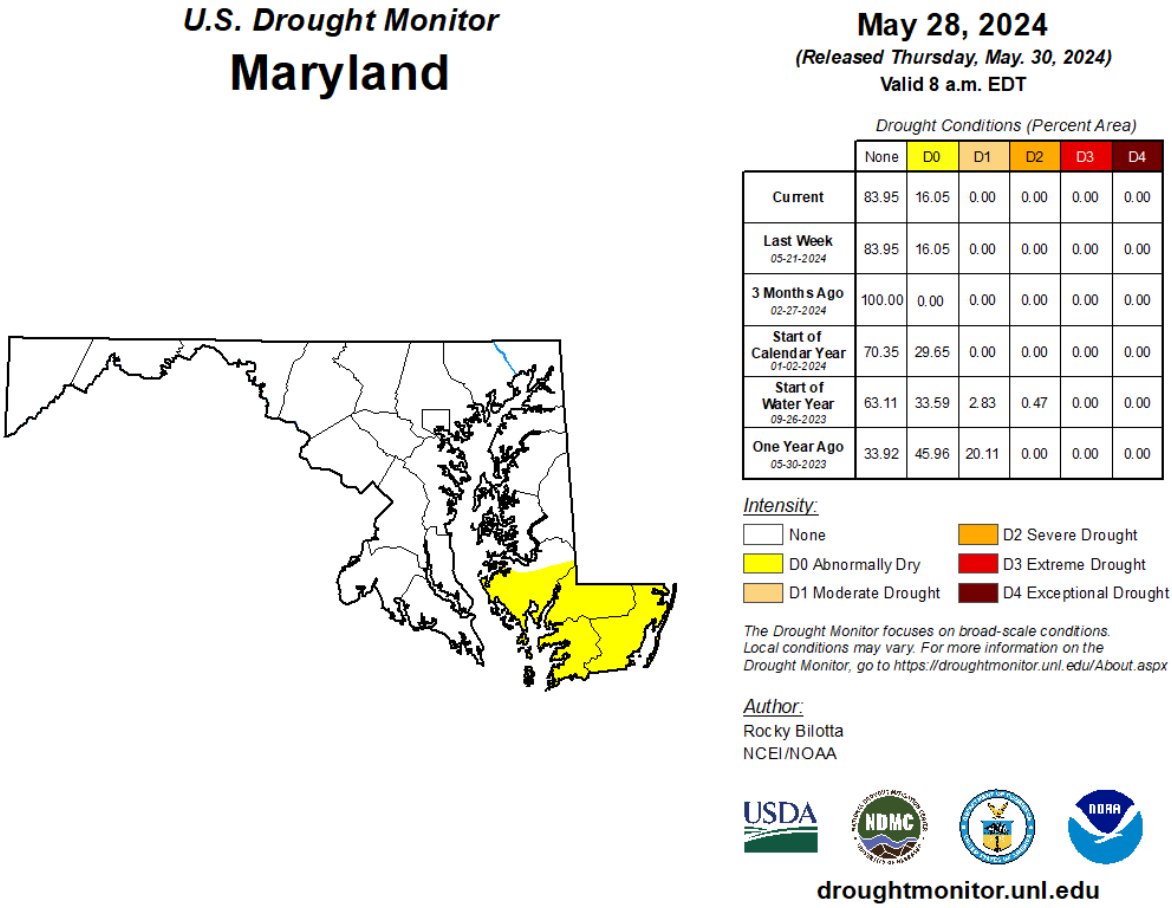

Figure 5. Drought conditions as reported by the U.S. Drought Monitor on May 28, 2024. At this time, the state has abnormally dry conditions for the first time in the year; this is the second consecutive month that the southern eastern shore has below normal precipitation.

F. Streamflow

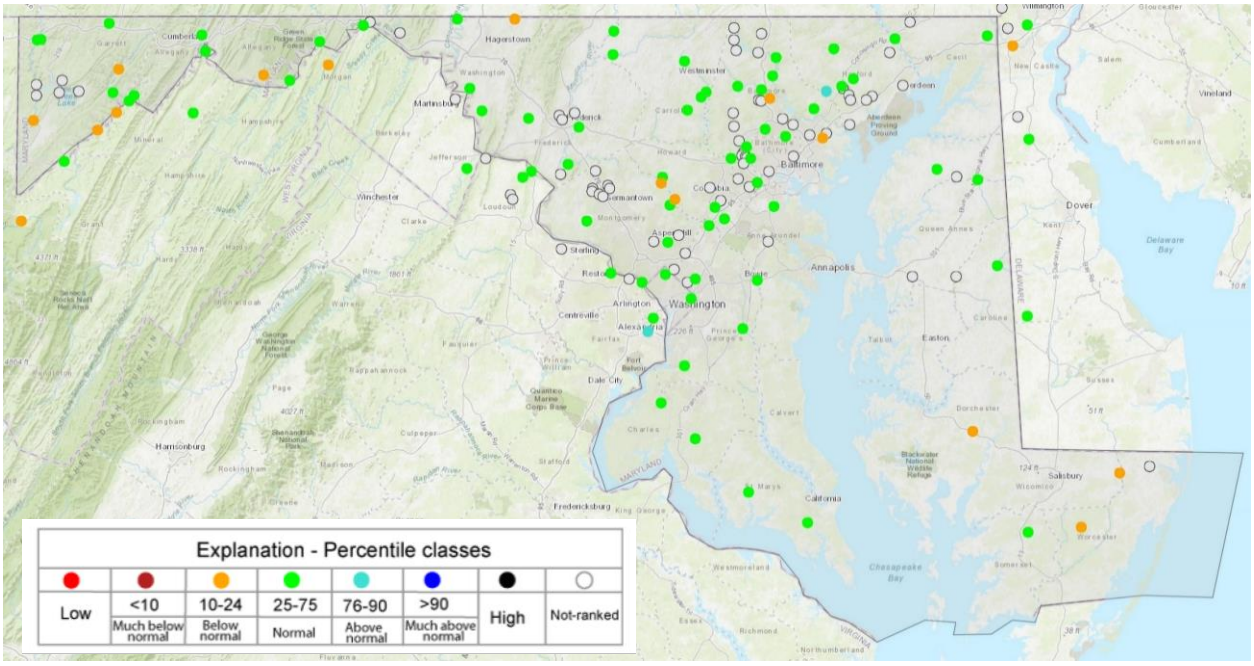

Figure 6. Monthly averaged streamflow class anomalies as reported by the U.S. Geological Survey (USGS) Water Watch for May 2024. Orange to red-filled circles denote below-normal streamflow conditions, cyan to black-filled circles denote above-normal streamflow conditions, and green-filled circles represent normal streamflow conditions. Below normal conditions are present in the state for the first time in the year; those in the southern eastern shore are within the abnormally dry conditions indicated by the US Drought monitor.

4. May and MAM 2024 Climate Divisions Averages

A. May 2024 Scatter Plots

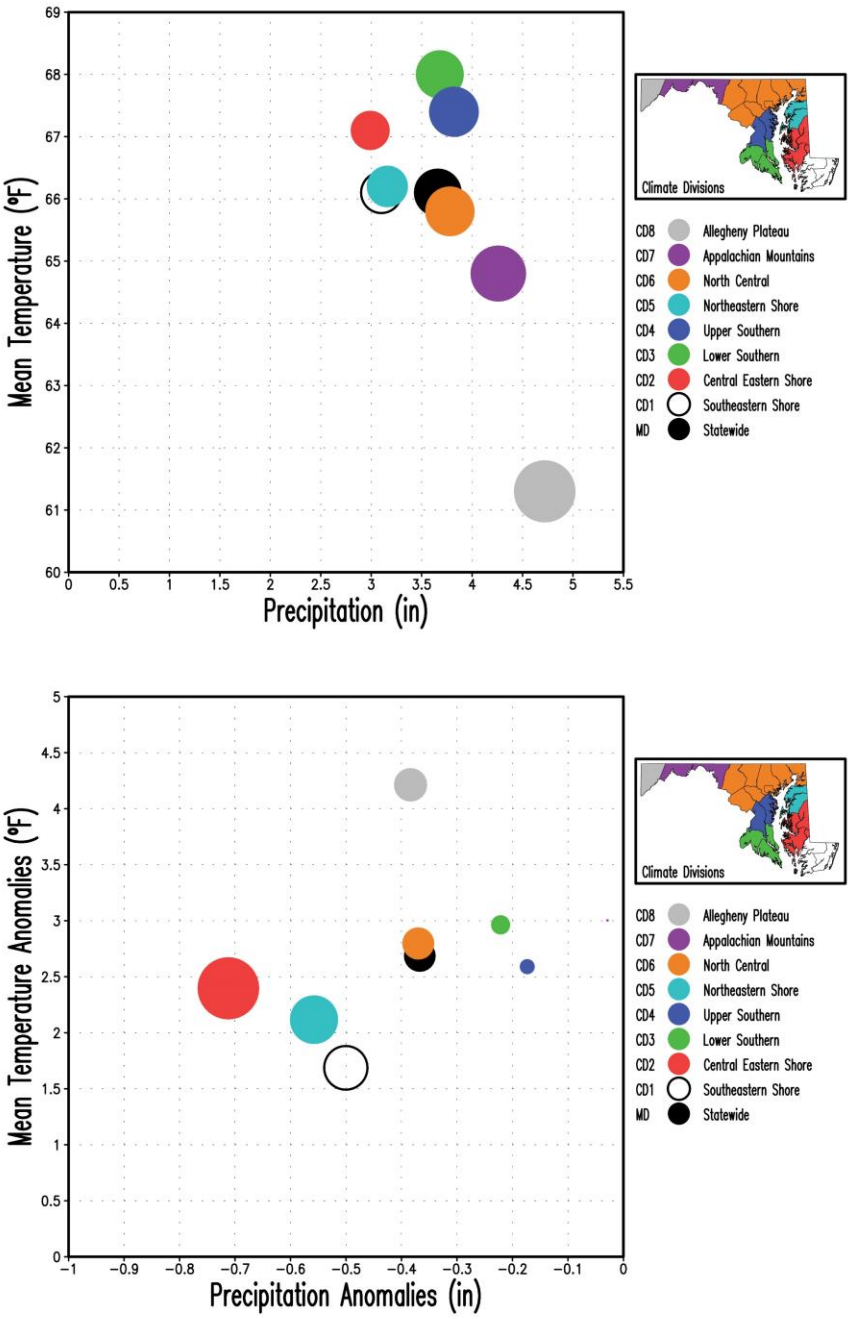

Figure 7. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for May 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 climatology. 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 (4.72 inches in CD8, top panel) and by the maximum precipitation anomaly (|−0.71| inches in CD2, 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. March – May 2024 Scatter Plots

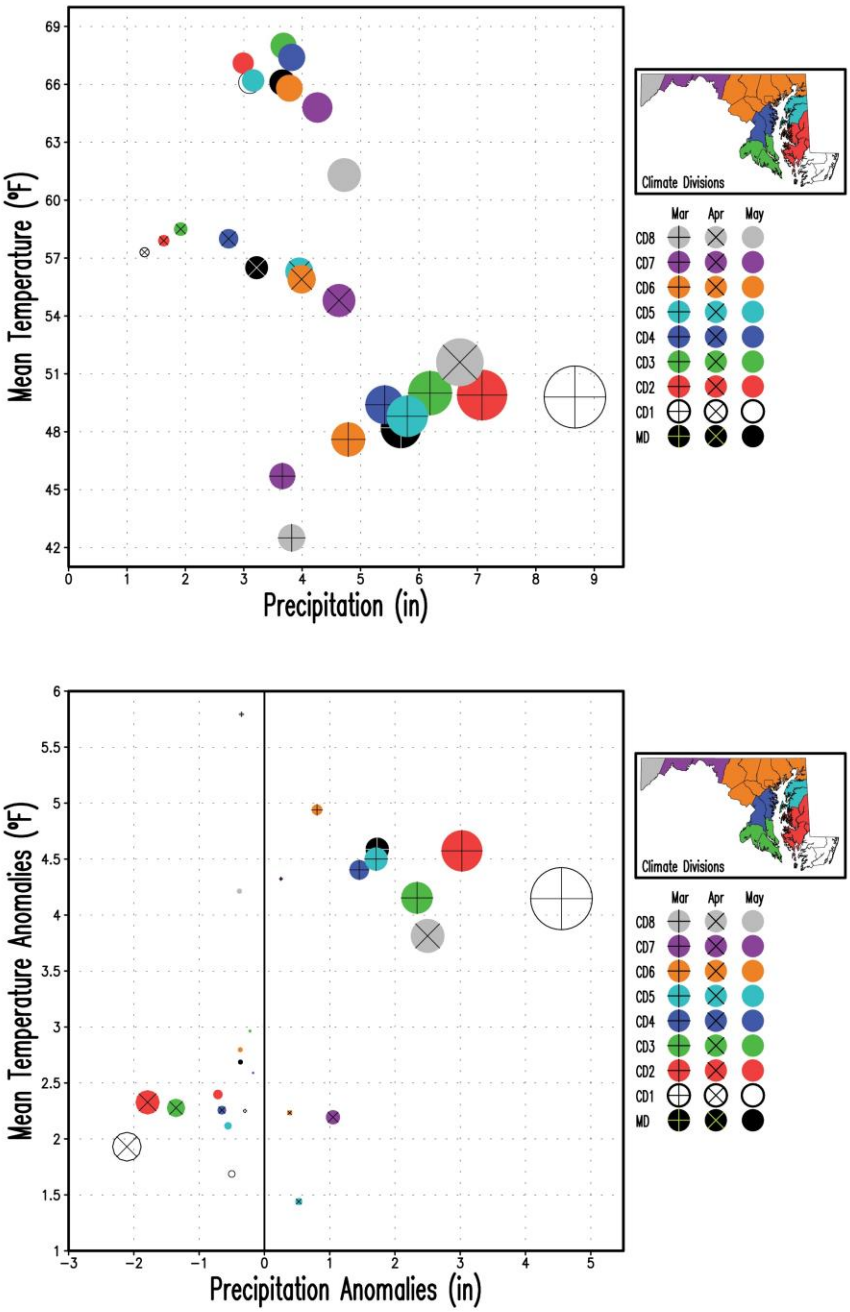

Figure 8. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for March, April and May 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 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 (8.67 inches in CD1 in March, top panel) and by the maximum precipitation anomaly (4.55 inches in CD1 in March, bottom panel) among the nine regions and three months. May is displayed with filled circles only, while April and March are displayed with superposed multiplication and addition signs, respectively.

5. May 2024 Statewide Averages in the Historical Record

A. Box and Whisker Plots

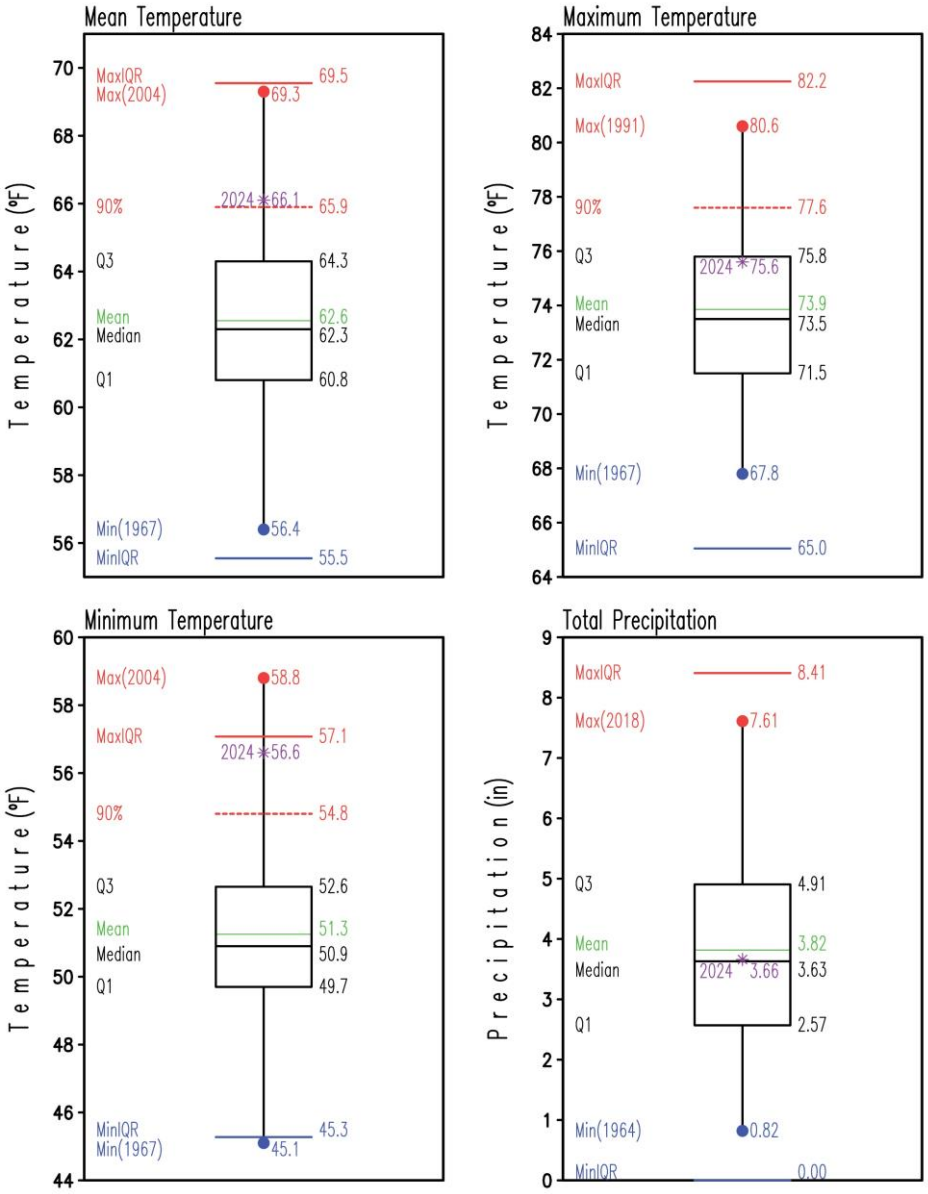

Figure 9. Box and Whisker plots of Maryland (statewide) monthly mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and total precipitation (lower right) for May for the period 1895-2023. The label and asterisk in purple represent conditions for May 2024. Statistics 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.

6. 1895-2024 May Trends

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

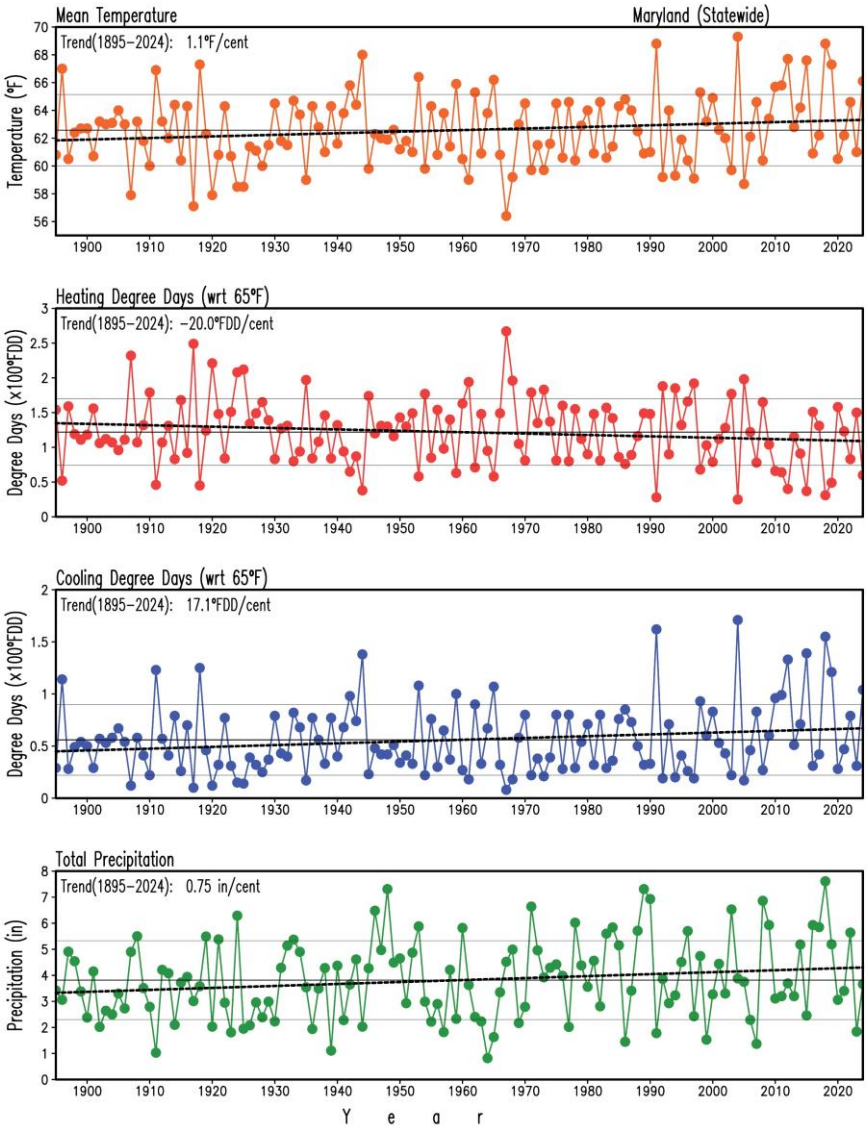

Figure 11. Maryland (statewide) mean surface air temperature, heating degree-days, cooling degree days, and precipitation in May for the period 1895-2024. Temperature is in °F, heating/cooling degree-days is in °F degree-days (°FDD), and precipitation is in inches. The thin, continuous black lines in each panel display the long-term means (62.6°F, 121.9°FDD, 56.0°FDD and 3.81 in, 1895-2024), and the double thin, continuous gray lines indicate the standard deviation (2.6°F, 47.9°FDD, 34.0°FDD and 1.51 in) above/below the long-term mean. The thick dashed black lines show the long-term linear trend. The warming temperature trend (1.1°F/century), the decreasing heating degree-days trend (−20.0°FDD/century), the increasing cooling degree-days trend (17.1°FDD/century), and the increasing precipitation trend (0.75 in/century) are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000).

B. Temperature and Precipitation Maps

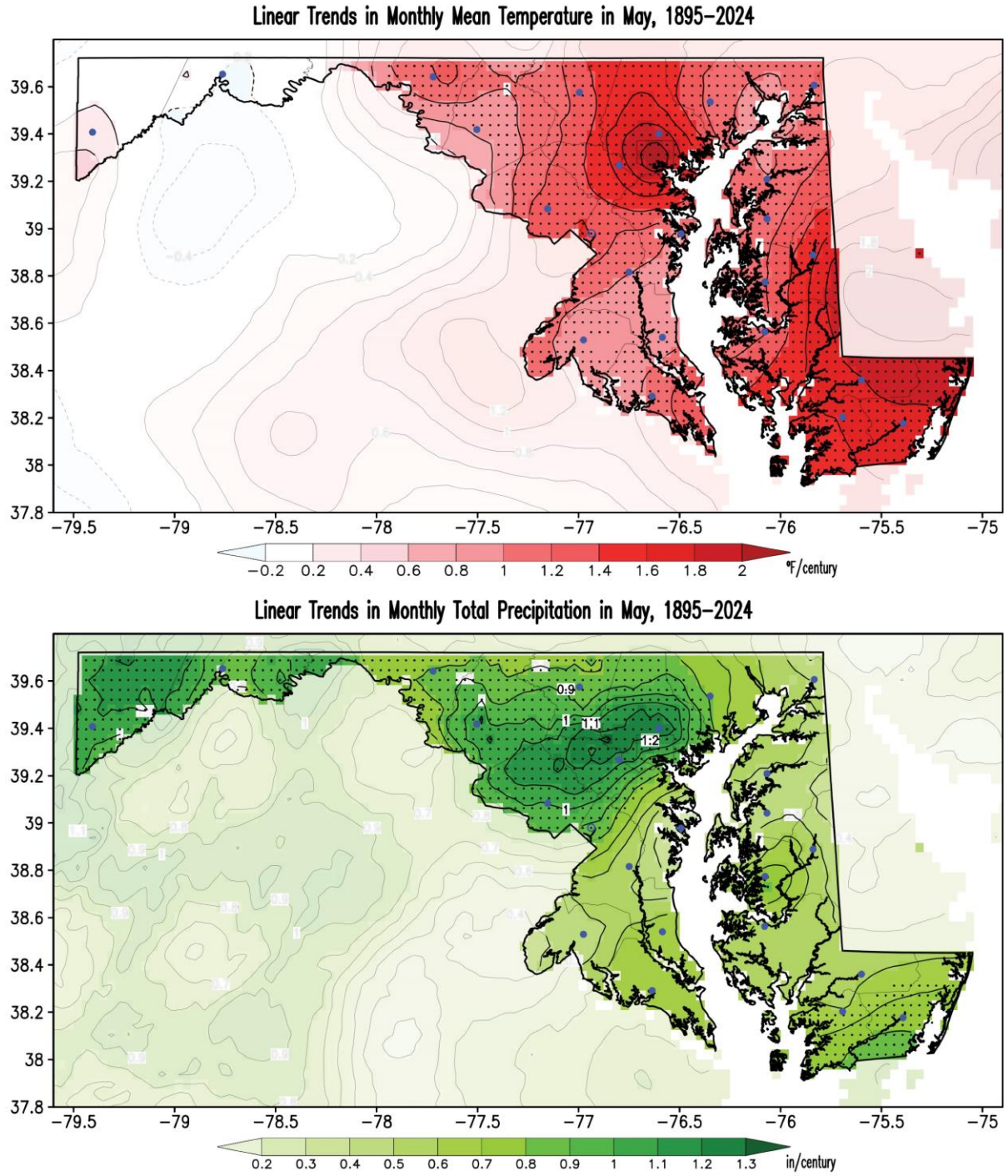

Figure 12. Linear trends in surface air mean temperature and precipitation in May for the period 1895-2024. Temperatures are in °F/century, and precipitation is in inches/century following the color bars. Blue/red shading in the temperature map marks cooling/warming trends. Green shading in the precipitation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

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)
Statewide	66.1	118
Climate Division 1	66.1	113
Climate Division 2	67.1	115
Climate Division 3	68.0	119
Climate Division 4	67.4	116
Climate Division 5	66.2	115
Climate Division 6	65.8	119
Climate Division 7	64.8	117
Climate Division 8	61.3	122
Allegany	64.4	115
Anne Arundel	67.6	116
Baltimore	66.1	120
Baltimore City	67.6	117
Calvert	67.8	119
Caroline	66.1	113
Carroll	65.1	119
Cecil	65.4	116
Charles	67.8	116
Dorchester	67.7	119
Fredrick	65.5	118
Garrett	61.3	122
Harford	66.2	121
Howard	65.7	117
Kent	66.3	116
Montgomery	66.1	118
Prince George's	67.2	116
Queen Anne's	66.4	115
Saint Mary's	68.5	122
Somerset	66.9	113
Talbot	67.5	117
Washington	65.2	117
Wicomico	66.2	112
Worcester	65.4	112

Region	Total Precipitation (in)	Rank (#)
Statewide	3.66	67
Climate Division 1	3.10	63
Climate Division 2	2.99	51
Climate Division 3	3.68	65
Climate Division 4	3.82	72
Climate Division 5	3.16	51
Climate Division 6	3.78	69
Climate Division 7	4.26	77
Climate Division 8	4.72	74
Allegany	4.05	73
Anne Arundel	3.61	68
Baltimore	3.81	71
Baltimore City	4.08	78
Calvert	3.61	60
Caroline	2.81	45
Carroll	3.95	74
Cecil	2.32	26
Charles	3.86	70
Dorchester	3.05	58
Fredrick	4.41	80
Garrett	4.72	74
Harford	2.91	45
Howard	4.10	74
Kent	3.11	51
Montgomery	4.27	79
Prince George's	3.98	75
Queen Anne's	3.25	58
Saint Mary's	3.48	64
Somerset	3.27	73
Talbot	3.27	62
Washington	4.46	84
Wicomico	2.90	48
Worcester	3.12	65

Table A1. Monthly mean surface air temperature (left) and total precipitation (right) at Maryland (statewide), climate division, and county levels for May 2024. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for May 2024 occupies among the 130 Mays 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	75.6	93
Climate Division 1	75.5	96
Climate Division 2	76.3	91
Climate Division 3	76.9	101
Climate Division 4	76.6	88
Climate Division 5	75.0	72
Climate Division 6	75.4	92
Climate Division 7	76.0	91
Climate Division 8	72.1	103
Allegany	76.1	95
Anne Arundel	76.5	89
Baltimore	75.9	94
Baltimore City	76.7	88
Calvert	76.2	94
Caroline	75.7	75
Carroll	75.4	99
Cecil	74.1	80
Charles	77.1	89
Dorchester	76.8	96
Fredrick	75.4	99
Garrett	72.1	103
Harford	75.3	87
Howard	75.8	95
Kent	74.7	72
Montgomery	75.6	93
Prince George's	76.8	88
Queen Anne's	75.1	72
Saint Mary's	76.9	102
Somerset	76.1	98
Talbot	76.1	92
Washington	75.9	90
Wicomico	76.4	96
Worcester	74.5	95

Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	56.6	125
Climate Division 1	56.7	119
Climate Division 2	57.9	126
Climate Division 3	59.2	126
Climate Division 4	58.2	124
Climate Division 5	57.6	125
Climate Division 6	56.1	124
Climate Division 7	53.6	123
Climate Division 8	50.6	125
Allegany	52.6	122
Anne Arundel	58.7	124
Baltimore	56.3	124
Baltimore City	58.6	125
Calvert	59.3	127
Caroline	56.5	125
Carroll	54.8	124
Cecil	56.6	125
Charles	58.4	123
Dorchester	58.5	126
Fredrick	55.6	125
Garrett	50.6	125
Harford	57.0	127
Howard	55.7	125
Kent	57.9	125
Montgomery	56.5	123
Prince George's	57.6	123
Queen Anne's	57.6	125
Saint Mary's	60.1	127
Somerset	57.8	120
Talbot	58.8	127
Washington	54.5	123
Wicomico	56.1	120
Worcester	56.2	118

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

A. Temperatures and Precipitation

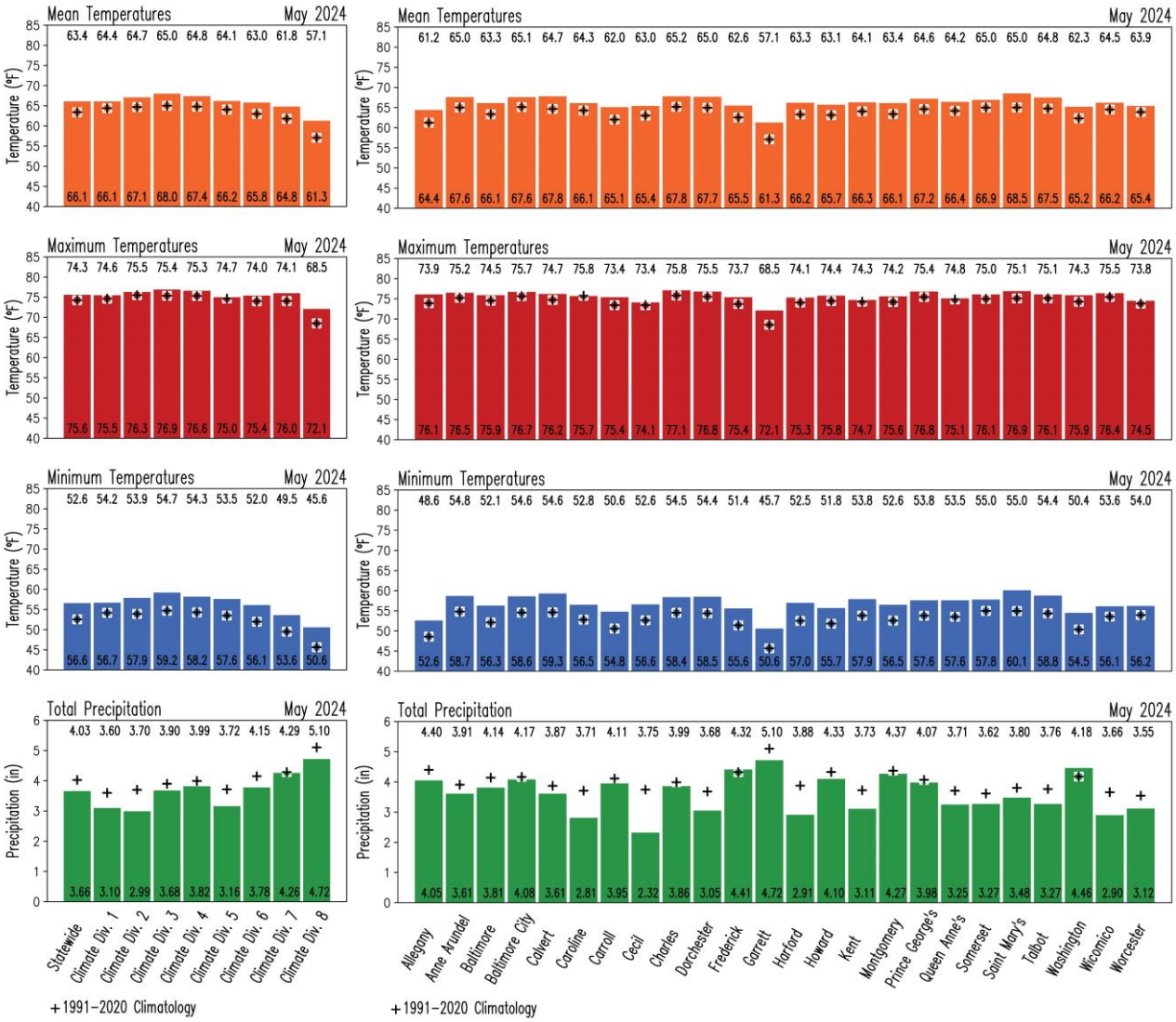

Figure B1. Monthly surface variables in Maryland for May 2024. Color bars represent the variables as follows: mean surface air temperature (orange), maximum surface air temperature (red), minimum surface air temperature (blue) and total precipitation (green) at statewide and climate division (left column),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

B. Temperatures and Precipitation Anomalies

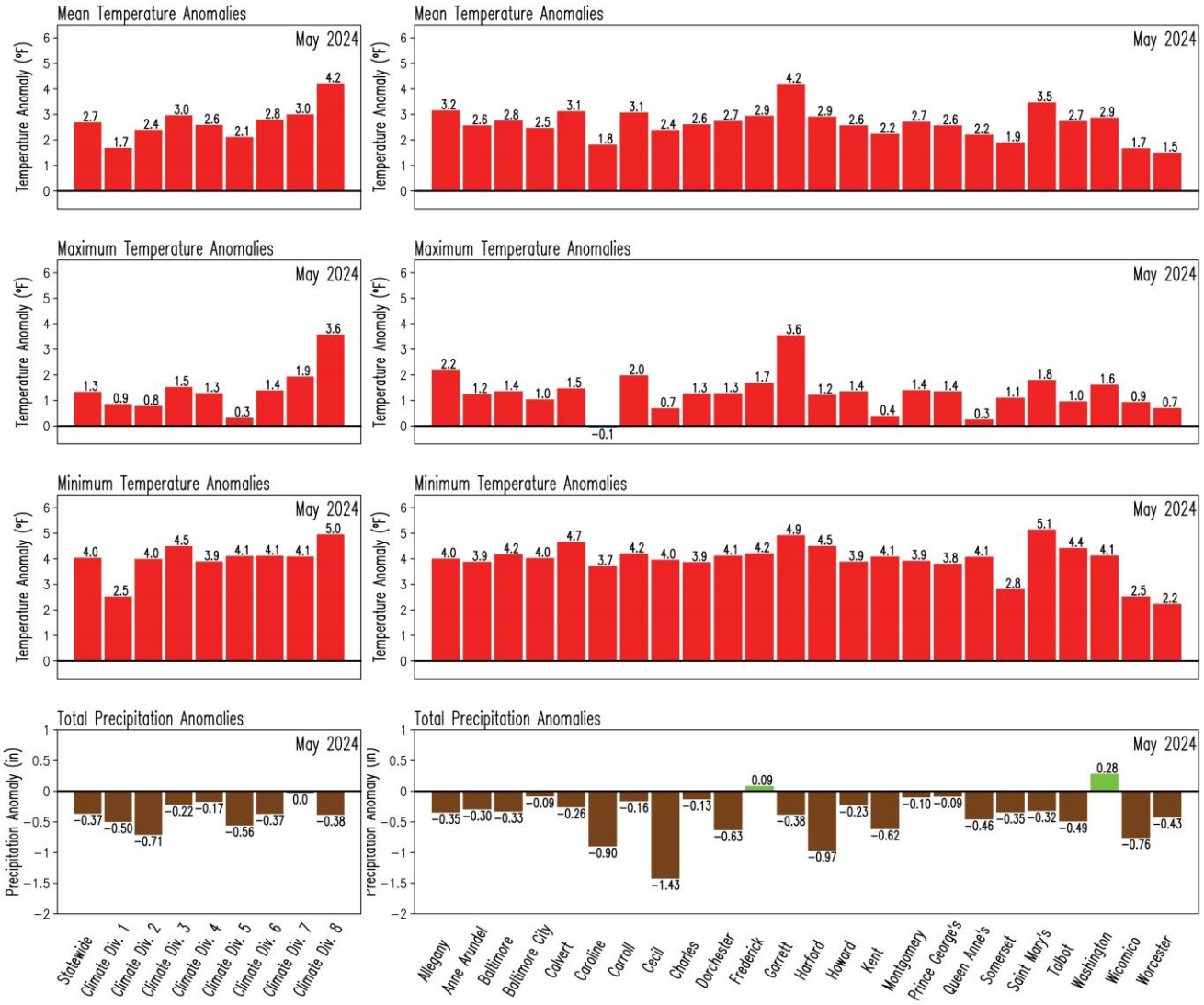

Figure B2. Anomalies of the monthly surface variables in Maryland for May, 2024. Anomalies are with respect to the 1991-2020 climatology. Red color represents positive (warmer than normal) anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top), and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

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

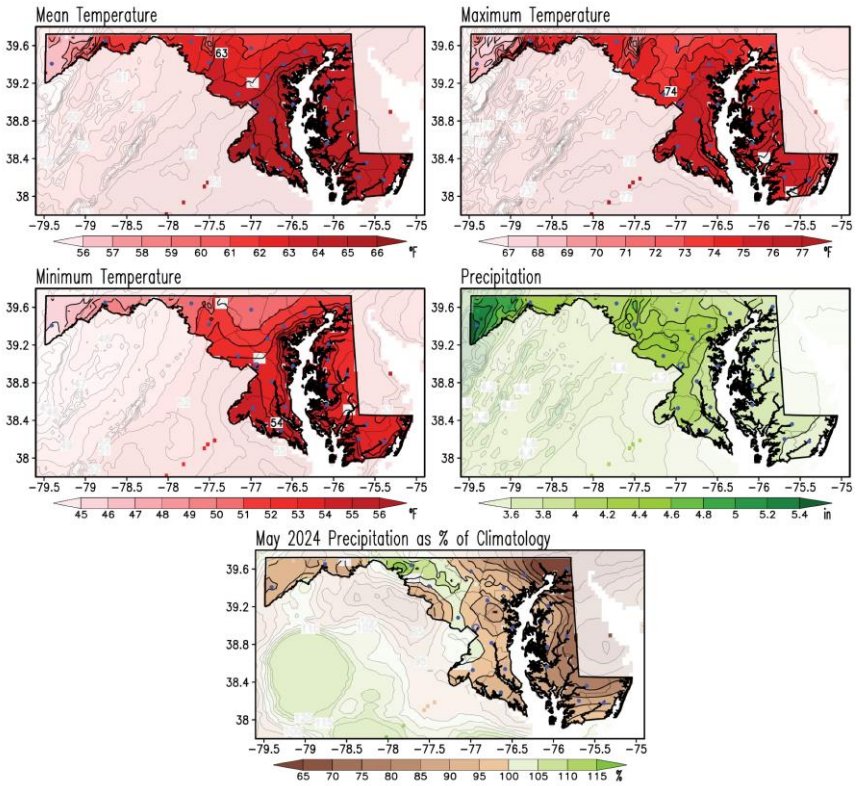

Figure C1. May climatology of the monthly mean, maximum and minimum surface air temperatures, and total precipitation for the period 1991-2020 (upper and middle rows), and precipitation in May 2024 as a percentage of climatology (bottom row). Temperatures are in °F, and precipitation is in inches according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

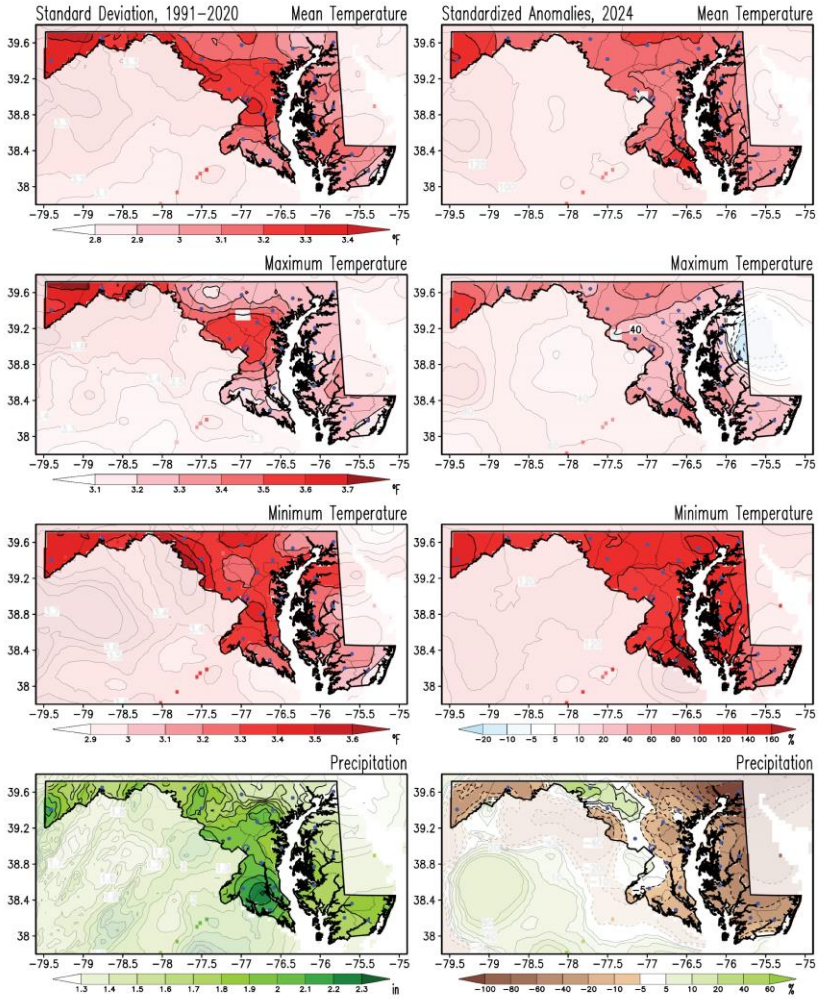

Figure D1. Standard deviation for May and standardized anomalies of temperatures and precipitation for May 2024. Standard deviations for monthly mean, maximum, and minimum surface air temperatures and total precipitation were obtained for the 1991-2020 period (left column). Anomalies for May 2024 (right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

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*.

References

Arguez A., I. Durre, S. Applequist, R. S. Vose, M. F. Squires, X. Yin, R. R. Heim Jr, and T. W. Owen, 2012. NOAA's 1981-2010 U. S. Climate Normals. An Overview. *Bulletin of the American Meteorological Society*. 93, 1687-1697, doi:10.1175/BAMS-D-11-00197.1 https://www1.ncdc.noaa.gov/pub/data/normals/1981-2010/documentation/1981-2010-normals-overview.pdf.

CPC, Climate Prediction Center, 2023. Degree Days Explanation. https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/degree_days/ddayexp.shtml

Kunkel, K. E., and A. Court, 1990. Climatic Means and Normals—A Statement of the American Association of State Climatologists (AASC), *Bulletin of the American Meteorological Society*, 71(2), 201-204. Retrieved Aug 20, 2022, from https://journals.ametsoc.org/view/journals/bams/71/2/1520-0477-71_2_201.xml

Santer, B. D., and co-authors, 2000: Statistical significance of trends and trend differences in layer-averaged atmospheric temperature time series. *J. Geophys. Res.*, 105, 7337–7356, doi:10.1029/1999JD901105.

USDA, U.S. Department of Agriculture, 2023. Growing Season Dates and Length. https://www.nrcs.usda.gov/wps/portal/wcc/home/climateSupport/wetlandsClimateTables/growingSeasonDatesLength

USEPA, U.S. Environmental Protection Agency. Climate Change Indicators in the United States. The growing season, 2023. https://www.epa.gov/climate-indicators

Vose and co-authors, 2014. NOAA Monthly U.S. Climate Gridded Dataset (NClimGrid), Version 3. *NOAA National Centers for Environmental Information*. DOI:10.7289/V5SX6B56.

WMO, 2017. WMO Guidelines on the Calculation of Climate Normals. WMO-No. 1203, Series. 29pp. https://library.wmo.int/doc_num.php?explnum_id=4166.