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Maryland Climate Bulletin
Spring 2024

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DEPARTMENT OF
ATMOSPHERIC &
OCEANIC SCIENCE
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Maryland
State
Climatologist
Office

Summary

Spring 2024 was warmer and wetter than normal (i.e., 1991-2020 averages), starting with a warmer and wetter March that turned into a warmer and drier-than-normal April and May. Seasonal mean temperatures were in the 51−60°F range, maximum temperatures were between 61 and 70°F, and minimum temperatures were in the 40−51°F range. Seasonal accumulated total precipitation was between 10 to 16 inches.

Maryland Regional Features (Figures 1-5, C1, and E1)

- Mean temperature was warmer than normal throughout the state, notably in Garrett County (around 5.1°F), parts of Saint Mary's, Calvert, and Dorchester counties (above 3.9°F), and counties on the Piedmont (above 3.3°F).

- Maximum temperature was also warmer than normal everywhere, particularly in Garrett County (above 5.1°F), parts of Saint Mary's, Calvert, and Dorchester counties (around 3.0°F), and portions of Montgomery, Frederick, Howard, Anne Arundel, Carroll, Baltimore, and Harford counties (around 2.7°F).

- Minimum temperature was warmer than normal all over the state, too, especially over the southern tip of Calvert County (5.4°F), portions of Saint Mary's, Calvert, Dorchester, and Garrett counties (around 5.1°F), areas in Montgomery, Frederick, Carroll, and Baltimore counties (above 4.2°F), and parts of the Piedmont, Queen Anne's, Talbot, and Dorchester counties (around 3.9°F).

- Precipitation was above normal over large areas in the state, notably over southern Somerset and Worcester counties (above 2.8 inches), southern Baltimore County, Baltimore City, and northern Garrett County (around 2.4 inches). These regions had around 30% and 15−20% more than their climatological spring precipitation. Montgomery County and portions of Frederick, Charles, and Caroline counties had below-normal precipitation, around 5−10% less than their climatological precipitation.

- The partial water year 2024 (October 2023−May 2024) was above normal over much of the state, especially over southern Baltimore County, parts of Anne Arundel and Kent counties (above 5 in), with a maximum over Baltimore City (around 6.5 in). These regions had around 16-22% more water than their climatological amounts at this time of the year. On the other hand, the southern tip of Garrett County, western Montgomery, Frederick, and Charles counties had around 2% less water than their climatological amounts.

Maryland Climate Divisions (Figures 6-7, B1, and B2)

- All eight climate divisions were warmer and wetter than normal. Climate division 8, the Allegheny Plateau, had the largest mean temperature departure from normal (4.6°F), while climate division 1, the Southeastern Shore, had the smallest (2.6°F). The latter also had the largest precipitation departure from normal (1.94 in), and climate division 2, the Central Eastern Shore, had the smallest precipitation departure from normal (0.52 in).

- Seasonally, statewide mean temperature anomalies have remained warmer than normal since fall 2023, with the largest anomalies in winter 2023-24 (3.7°F). Statewide precipitation anomalies changed from below normal in fall 2023 (2.82 in deficit) to above normal in winter (4.83 in) and spring (1.06 in).

Historical Context (Figure 8, Tables A1 and A2)

- Spring 2024's statewide mean, maximum, and minimum temperatures (56.9, 67.0, and 46.9°F) were above the long-term (1895-2023) averages. Except for the maximum temperature, the mean and minimum temperatures were among the 5% of the highest recorded values for the season and close to the records established in 2012 (58.2 and 47.0°F); the statewide mean temperature was the third warmest, and the minimum temperature was the second warmest since 1895. Spring's statewide precipitation (12.57 in) was above the long-term average but far from the wettest spring in 1983 (18.81 in).
- Spring 2024's mean temperatures at the county level were among the five warmest for most counties; Dorchester, Harford, Saint Mary's, Somerset, and Talbot counties had the second warmest spring, while Garrett County had the warmest spring.
- Spring 2024's minimum temperatures at the county level were among the three warmest for most counties; Calvert, Carroll, Cecil, Frederick, Garrett, Harford, Saint Mary's, Talbot, and Washington counties had the warmest spring.

Century-Plus Trends (Figures 9, 10)

- Statewide mean temperature in spring showed a significant warming trend (2.0°F/century), while heating degree-days had a significant decreasing trend (−170.6°F degree-days/century). Similarly, the statewide partial water (October 2023−May 2024) year also had a significant increasing trend (2.42 in/century). However, the statewide accumulated total precipitation had a non-significant increasing trend (0.92 in/century).
- Regionally, spring mean temperatures showed significant warming trends throughout the state. They ranged from around 0.6°F/century over Garrett County, above 2.2°F/century on the central and southern eastern shore, to around 3.0°F over Baltimore City.
- Regionally, accumulated total precipitation in spring showed statistically significant wetting trends over the Piedmont and western Maryland and the southern tip of Worcester County. Maximum increasing trends of 1.8 in/century were found over Garrett County and to the northwest of Baltimore City. A small, non-statistically significant drying trend was found on the southwestern tip of 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. This is the seasonal version of the bulletin.

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 seasonal 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 seasonal surface climate conditions for spring 2024 are presented via maps of key variables, such as average surface air temperature, maximum surface air temperature, minimum surface air temperature, accumulated total precipitation, and their anomalies (i.e., departures from normal); they are complemented by partial water year conditions for the state (Section 3). Statewide and climate division averages for the season are compared against each other via scatter plots (Section 4). The seasonal 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, accumulated total precipitation, partial water year, and state maps of air temperature and accumulated total 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-E.

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), which 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), which 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.

Water year data is calculated from the monthly total precipitation.

Some definitions:

About the seasons: Seasons are defined following the common three-month meteorological definitions as follows. Spring includes March, April, and May; summer includes June, July, and August; fall includes September, October, and November; and winter includes December, January, and February. Seasonal temperatures are obtained as the mean of the temperatures in the three months, while seasonal precipitation and degree days are obtained as the sum of their values in the three months (which in turn were obtained as the sum of their daily values).

About the anomalies: Anomalies for a given season (e.g., spring 2024) are the departures of the seasonal value from the corresponding season's 30-year average (i.e., from the average of 30 springs) during 1991-2020; the 30-year average (or mean) is the climate normal, or just the climatology. When the observed seasonal 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 dryer 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 degree days. Degree days are the difference between the *daily mean temperature* (high temperature plus low temperature divided by two) and a predefined base temperature; because energy demand is cumulative, degree-day totals are usually calculated on a daily, monthly, seasonal, and annual basis.

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

About the water year. The water year is the sum of total precipitation from the 1st of October to the 30th of September of the next year and is labeled by the year in which the measurements end; so, the water year 2024 started in October 2023 and will end in September 2024. Total precipitation in the complete water year reflects winter snow accumulation and summer rainfall. Precipitation that falls during a water year reflects how much water will contribute to actual stream flow and groundwater inputs for that year. This issue presents only the partial water year from October to May.

3. Spring 2024 Maps

A. Mean Temperatures

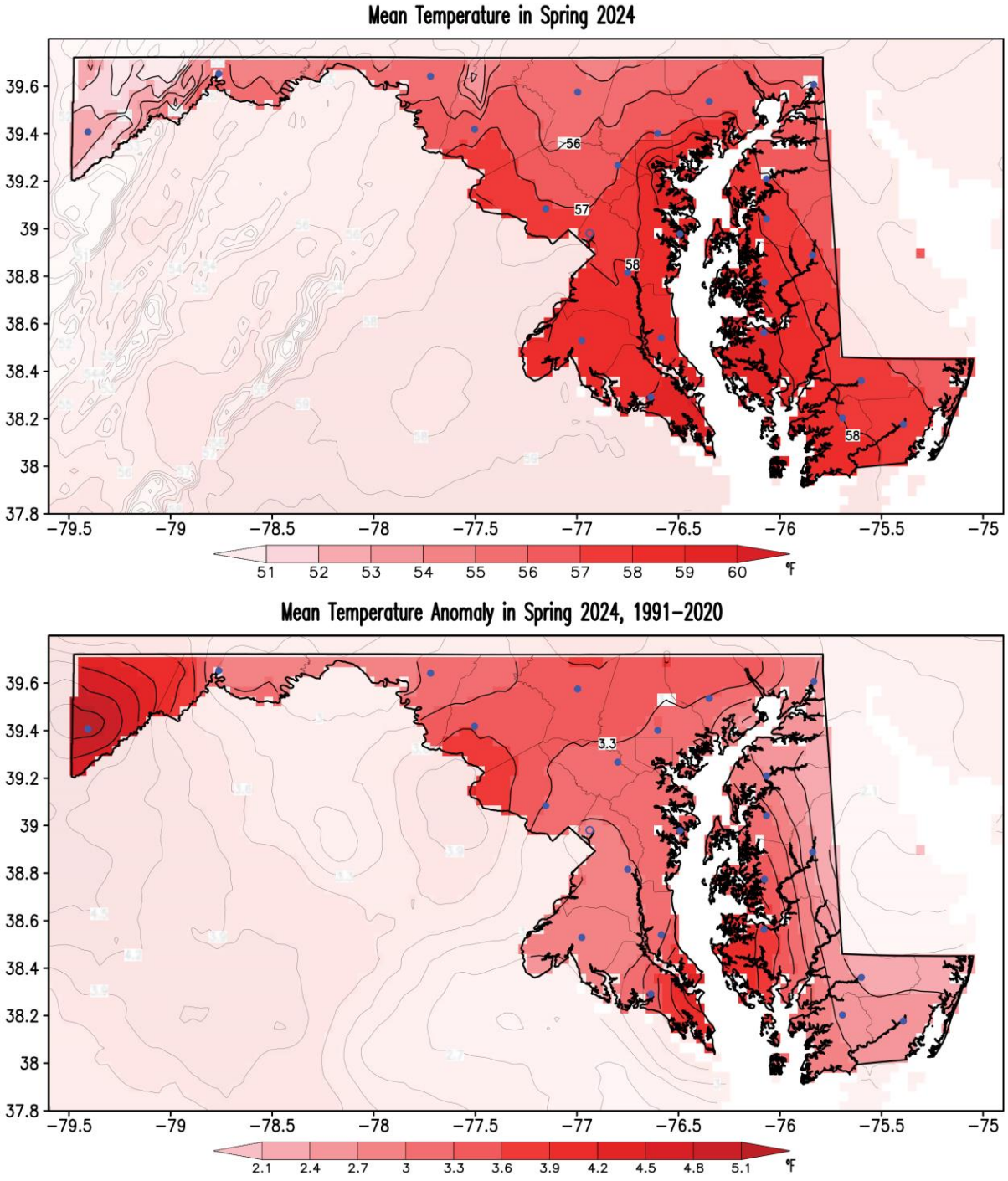

Figure 1. Seasonal mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for spring 2024. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has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

B. Maximum Temperatures

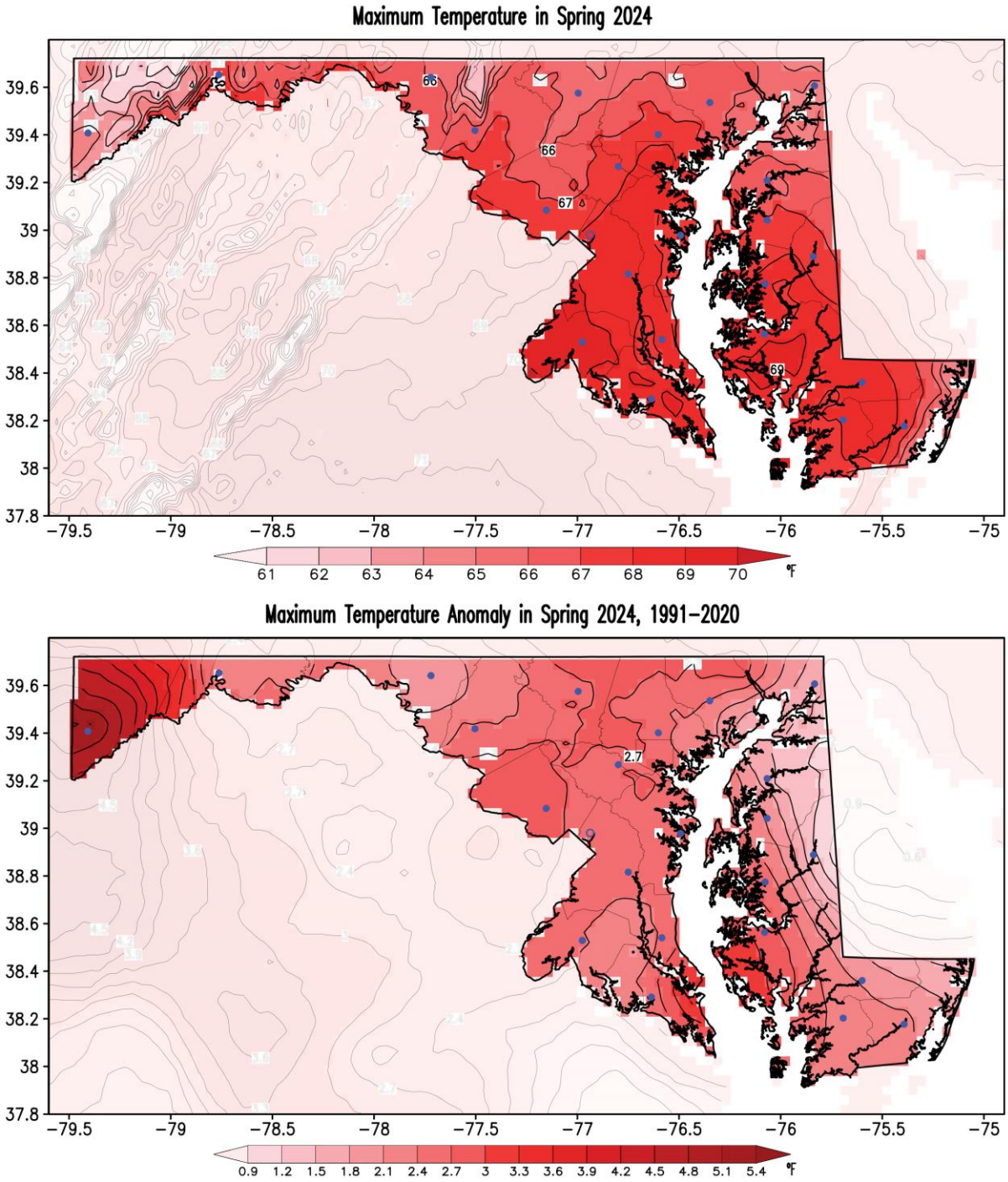

Figure 2. Seasonal maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for spring 2024. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has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

C. Minimum Temperatures

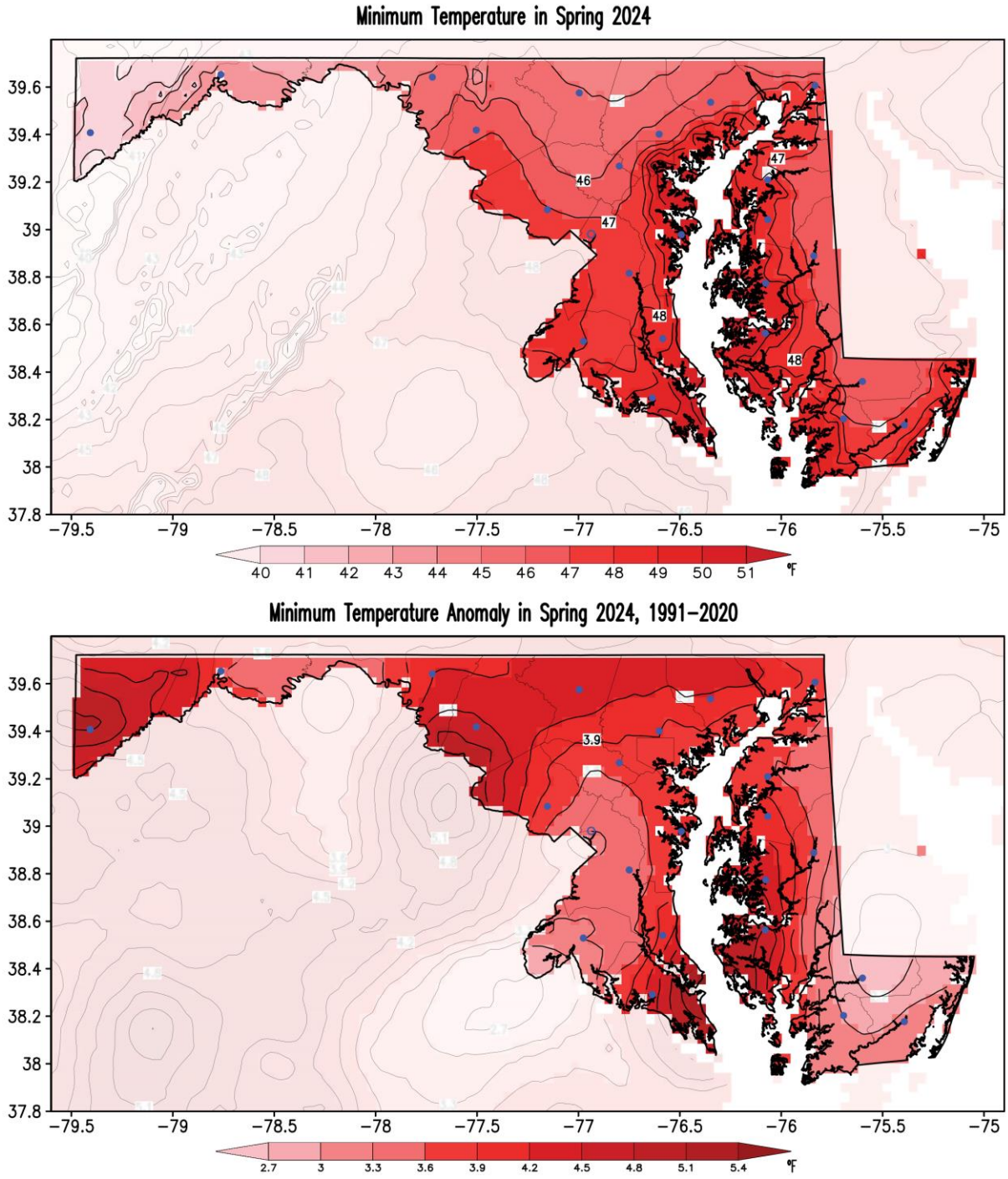

Figure 3. Seasonal minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for spring 2024. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has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

D. Precipitation

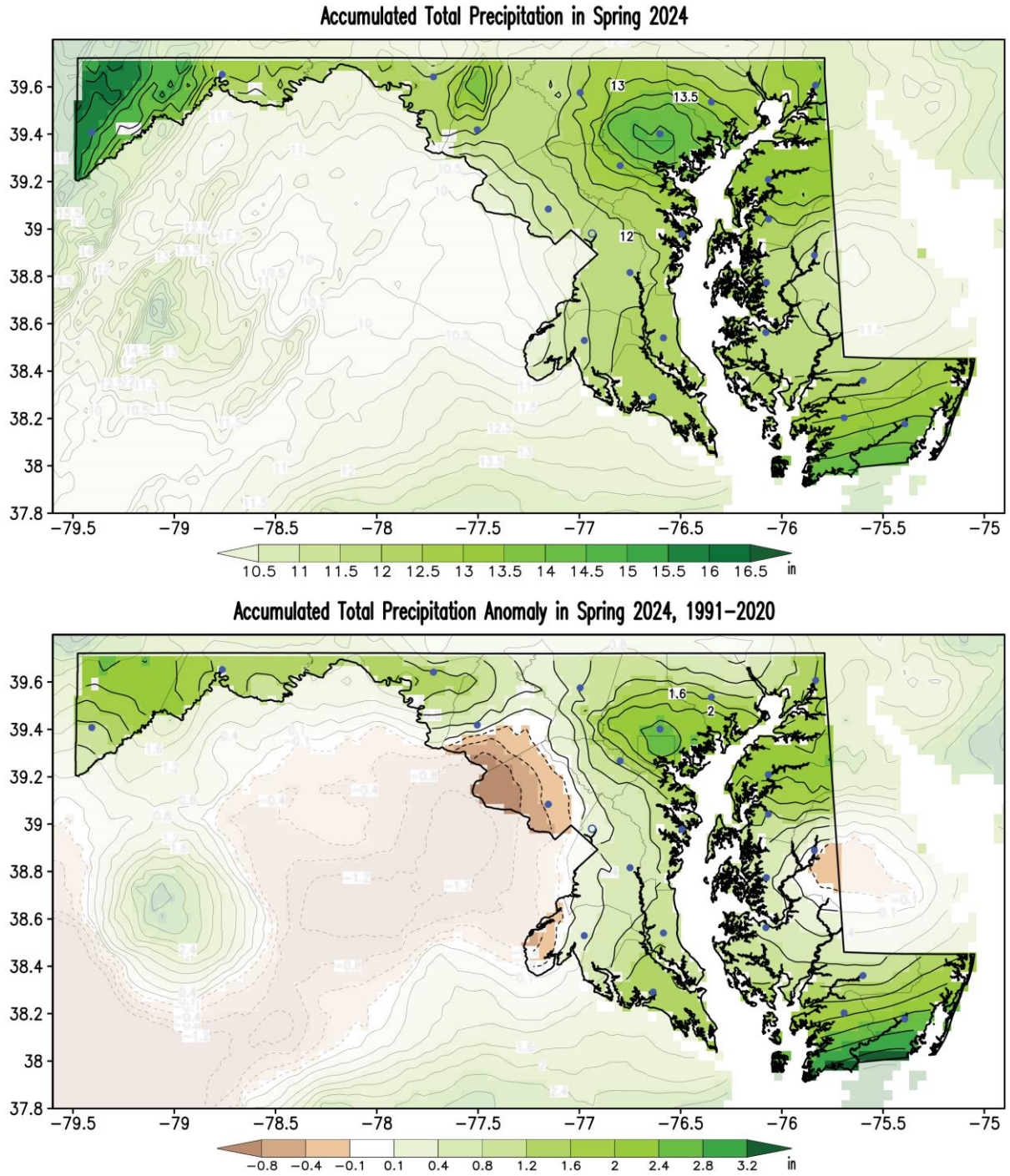

Figure 4. Seasonal accumulated total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for spring 2024. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside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

E. Partial Water Year (October 2023 – May 2024)

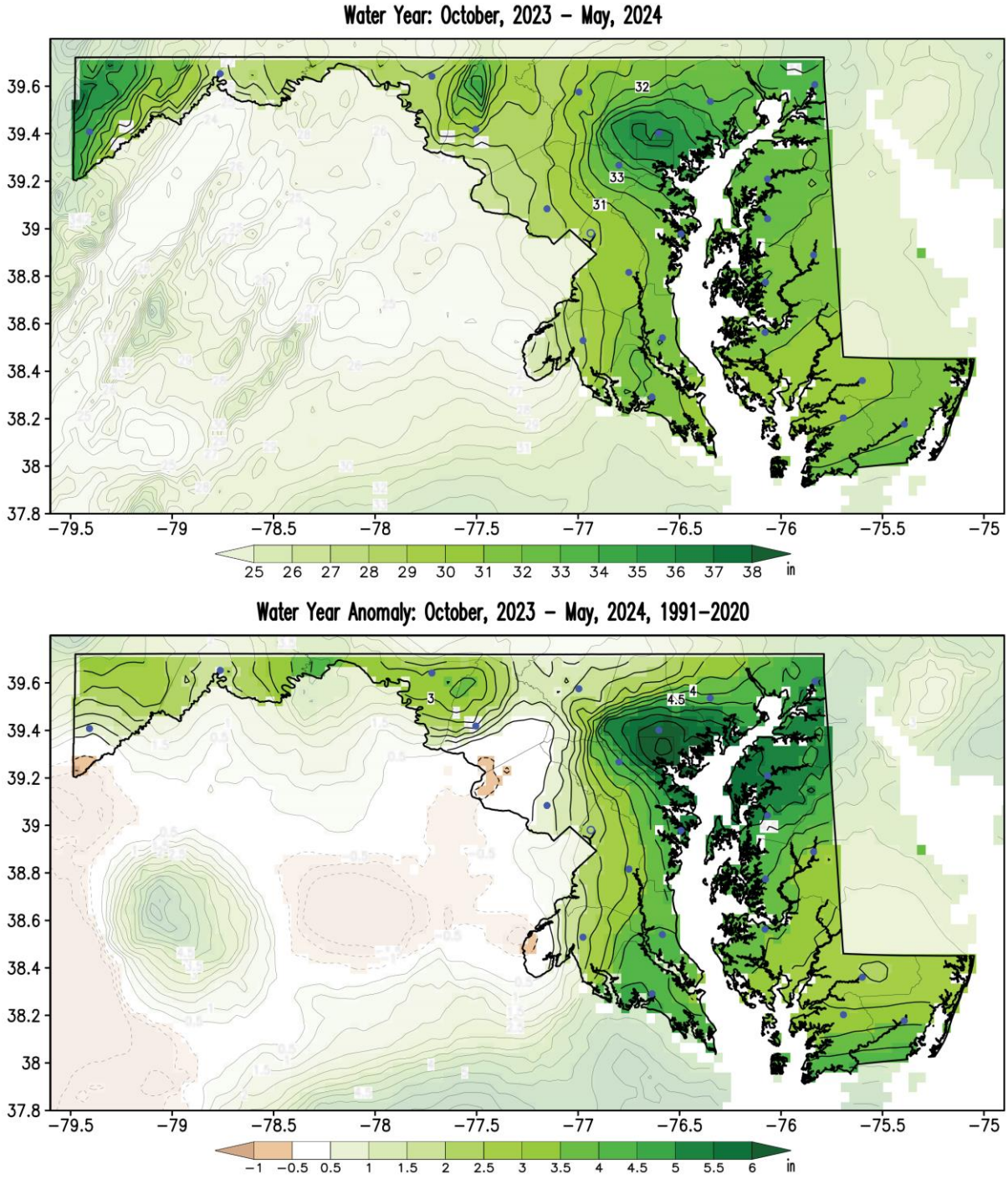

Figure 5. Partial water year until May 2024 (top panel), and its anomaly with respect to the 1991-2020 climatology (bottom panel). Water year is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. The current maps display the partial conditions from October 2023 to May 2024. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

4. Spring and Fall 2023–Spring 2024 Climate Divisions Averages

A. Spring 2024 Scatter Plots

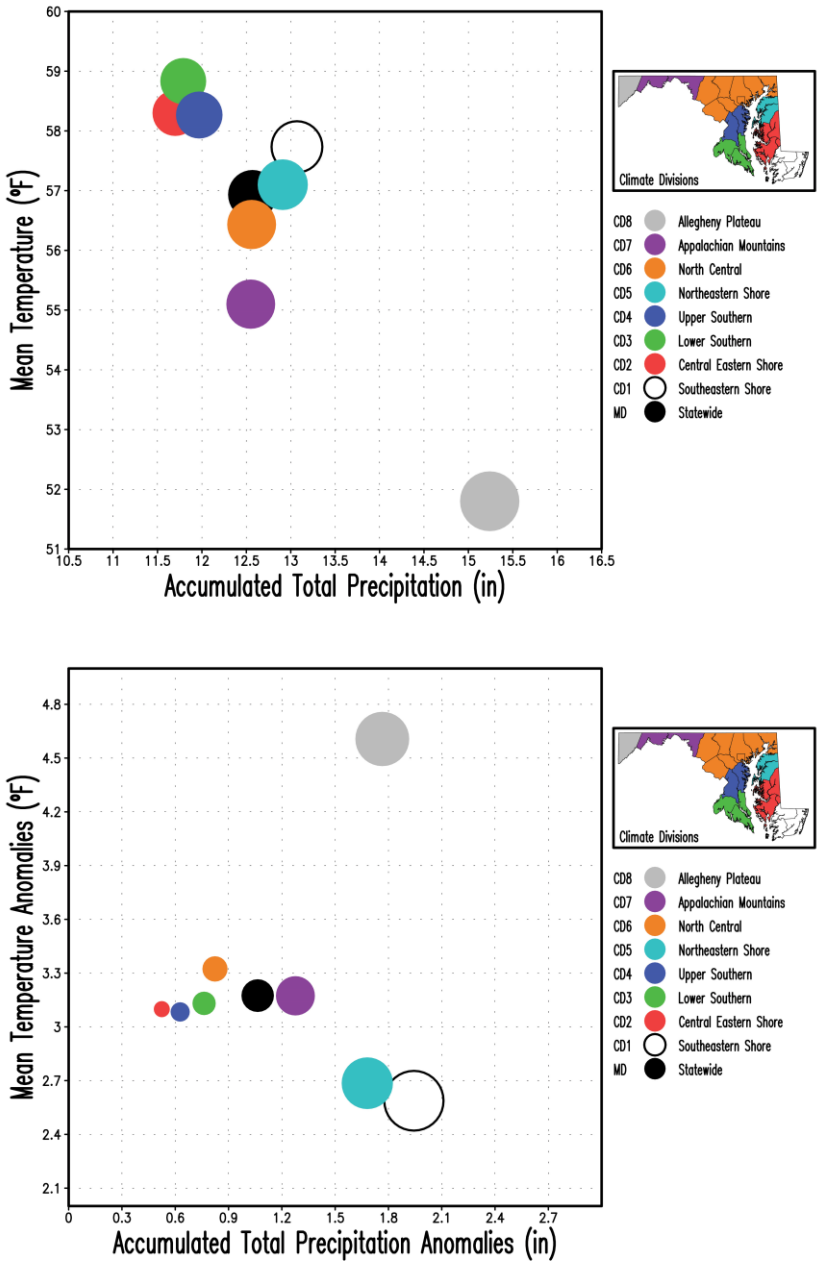

Figure 6. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) seasonal mean surface air temperature vs. accumulated total precipitation for spring 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 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 (15.24 inches in CD8, top panel) and by the maximum precipitation anomaly (1.94 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. Fall 2023, Winter, Spring 2024 Scatter Plots

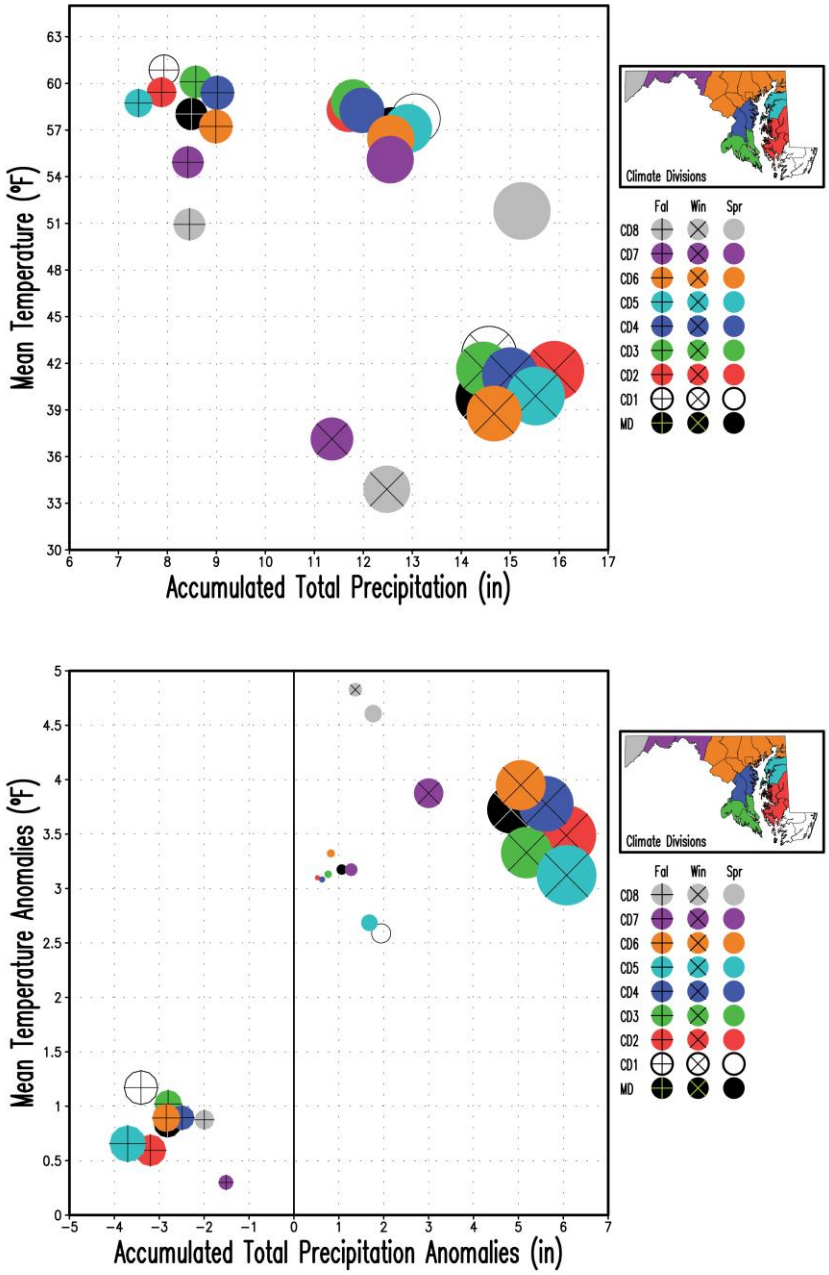

Figure 7. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) seasonal mean surface air temperature vs. accumulated total precipitation for fall 2023, winter, and spring 2024. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies 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 (15.90 inches in CD2 in winter, top panel) and by the maximum precipitation anomaly (6.07 inches in CD2 in winter, bottom panel) among the nine regions and three months. Spring is displayed with filled circles only, while winter and fall are displayed with superposed multiplication and addition signs, respectively.

5. Spring 2024 Statewide Averages in the Historical Record

A. Box and Whisker Plots

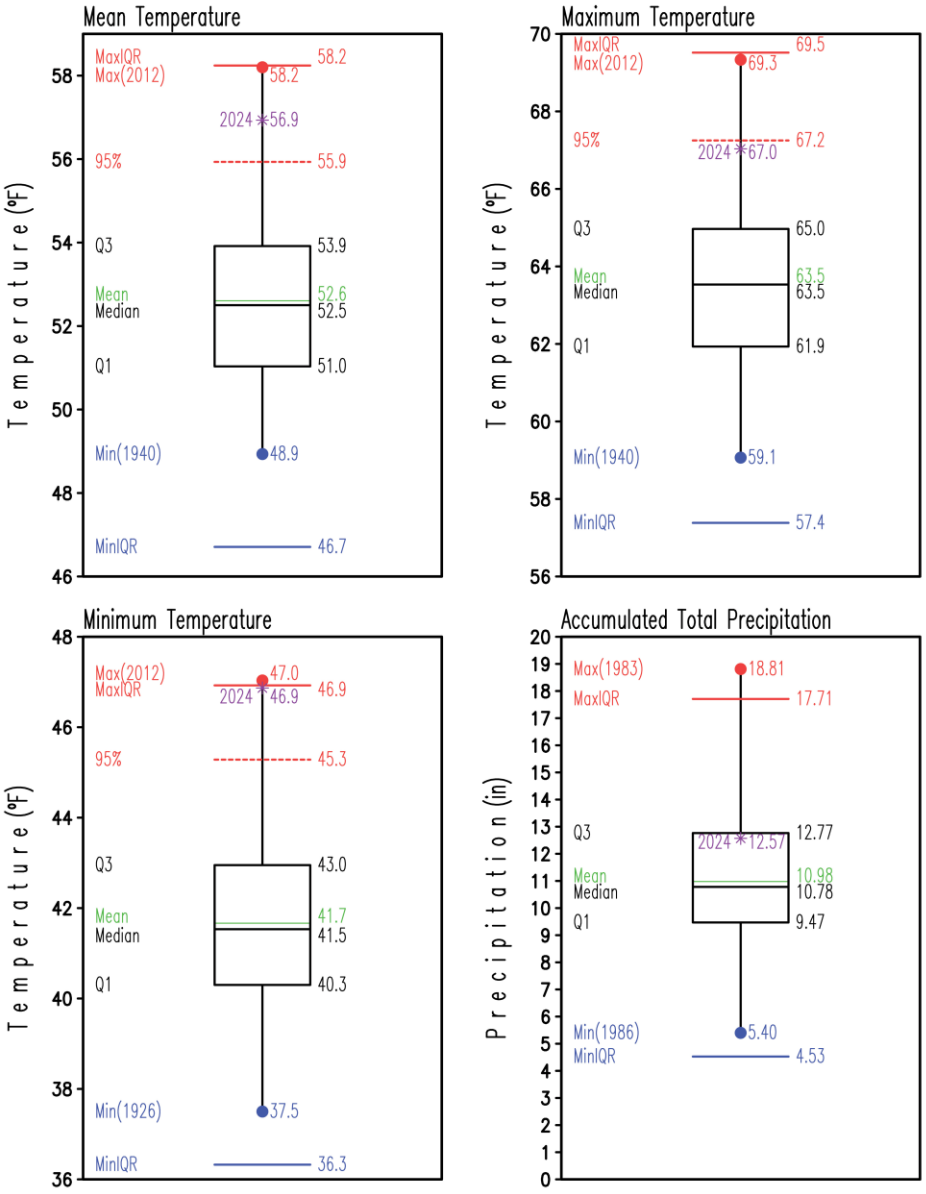

Figure 8. Box and Whisker plots of Maryland (statewide) seasonal mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and accumulated total precipitation (lower right) for spring for the period 1895-2023. The label and asterisk in purple represent conditions for spring 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 smaller and larger 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 Trends

A. Statewide Mean Temperature, Heating Degree-Days, Accumulated Total Precipitation, and Partial (October-May) Water Year

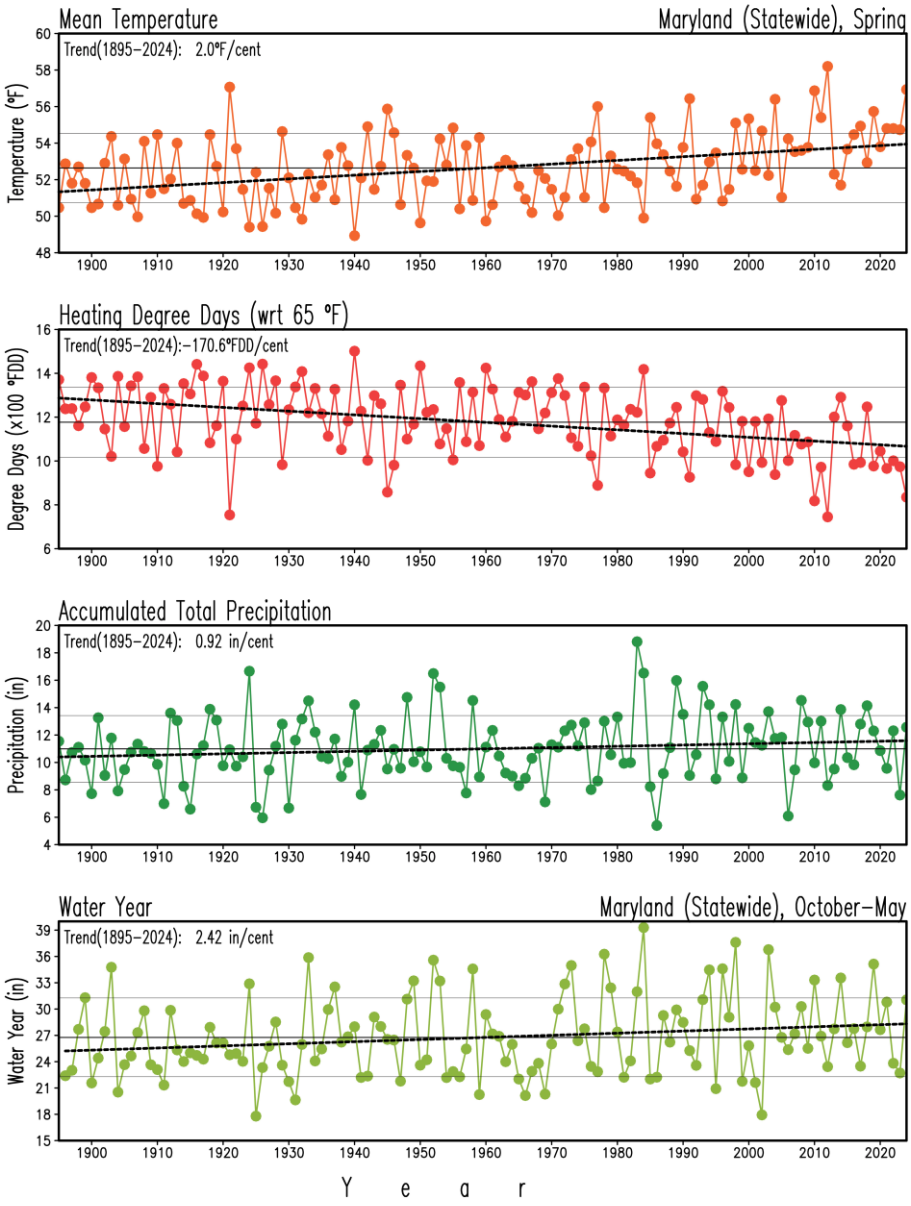

Figure 9. Maryland (statewide) mean surface air temperature, heating degree-days, accumulated total precipitation in spring, and partial (October-May) water year for the period 1895-2024. Temperature is in °F, heating degree-days is in °F degree-days (°FDD), and precipitation is in inches. The thin, continuous black lines in each panel display the long-term means (52.6°F, 1177.1°FDD, 10.99 in, and 26.77 in, 1895-2024), and the double thin, continuous gray lines indicate the standard deviation (1.9°F, 159.8°FDD, 2.43 in, and 4.49 in) above/below the long-term mean. The thick dashed black lines show the long-term linear trend. The warming temperature trend (2.0°F/century), the decreasing heating degree-days trend (−170.6°FDD/century), and the increasing water year trend (2.42 in/century) are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000), but not the increasing precipitation trend (0.92 in/century).

B. Temperature and Precipitation Maps

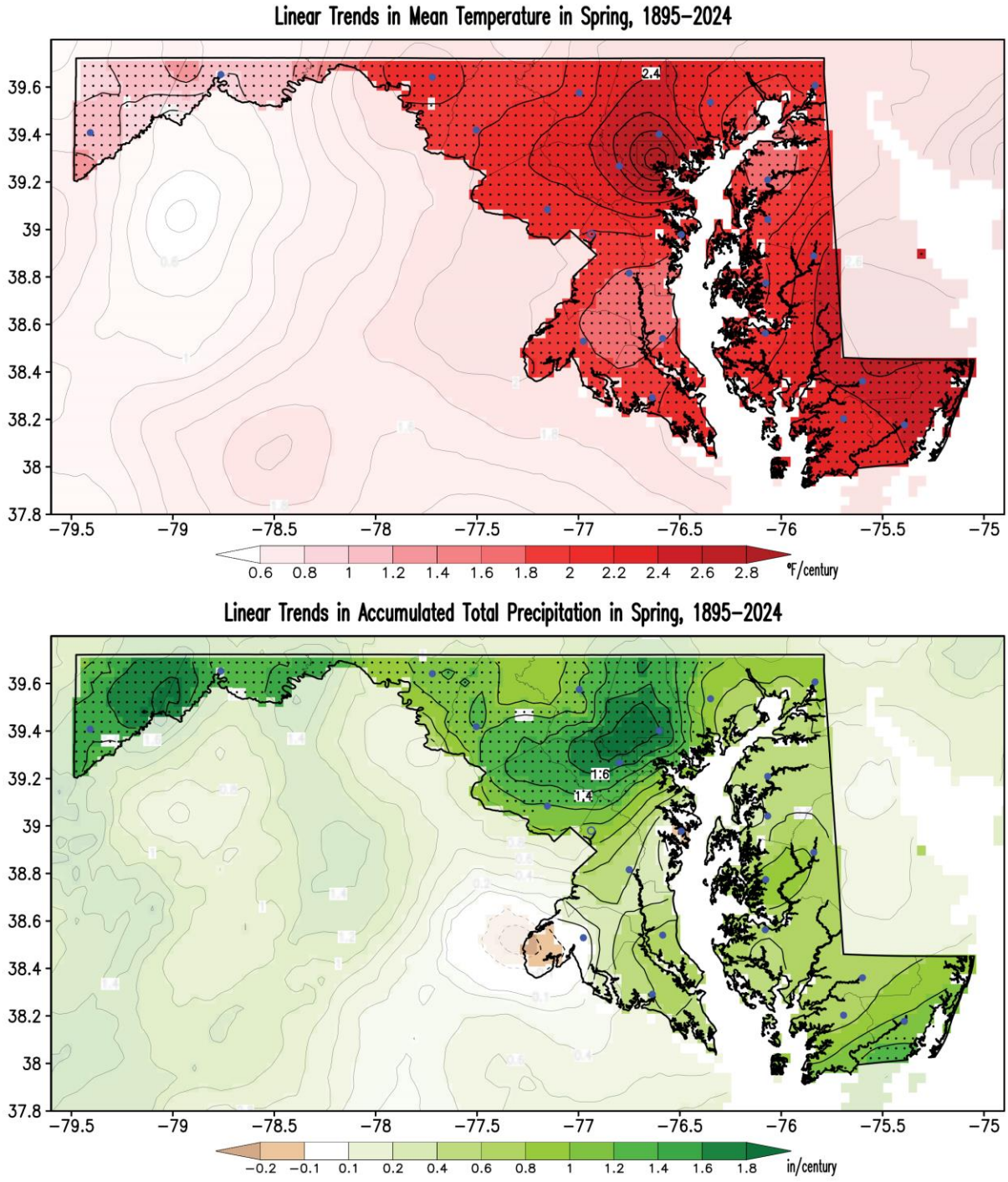

Figure 10. Linear trends in spring surface air mean temperature and accumulated total precipitation for the period 1895-2024. Temperatures are in °F/century, and precipitation is in inches/century following the color bars. Red shading in the temperature map marks warming trends. Brown/green shading in 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. Spring 2024 Tables: Statewide, Climate Divisions, and Counties

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)
Statewide	56.9	128
Climate Division 1	57.7	127
Climate Division 2	58.3	127
Climate Division 3	58.8	128
Climate Division 4	58.3	127
Climate Division 5	57.1	125
Climate Division 6	56.4	127
Climate Division 7	55.1	127
Climate Division 8	51.8	130
Allegany	54.6	127
Anne Arundel	58.5	127
Baltimore	56.6	128
Baltimore City	58.4	128
Calvert	58.7	128
Caroline	57.2	126
Carroll	55.5	127
Cecil	56.0	126
Charles	58.7	128
Dorchester	58.9	129
Fredrick	56.2	127
Garrett	51.8	130
Harford	56.5	129
Howard	56.6	127
Kent	57.0	125
Montgomery	57.2	127
Prince George's	58.0	127
Queen Anne's	57.4	126
Saint Mary's	59.2	129
Somerset	58.4	129
Talbot	58.7	129
Washington	55.6	127
Wicomico	57.6	126
Worcester	57.2	126

Region	Acc. Total Precipitation (in)	Rank (#)
Statewide	12.57	97
Climate Division 1	13.07	110
Climate Division 2	11.70	86
Climate Division 3	11.79	86
Climate Division 4	11.97	92
Climate Division 5	12.91	102
Climate Division 6	12.56	95
Climate Division 7	12.55	103
Climate Division 8	15.24	108
Allegany	12.86	107
Anne Arundel	12.26	91
Baltimore	13.77	109
Baltimore City	14.23	114
Calvert	12.24	93
Caroline	11.46	79
Carroll	12.32	92
Cecil	12.98	101
Charles	11.28	76
Dorchester	11.84	89
Fredrick	12.00	89
Garrett	15.23	108
Harford	12.86	101
Howard	12.55	98
Kent	13.20	106
Montgomery	11.19	77
Prince George's	11.82	86
Queen Anne's	12.75	98
Saint Mary's	12.27	96
Somerset	13.47	114
Talbot	11.91	88
Washington	12.24	101
Wicomico	12.20	95
Worcester	13.40	112

Table A1. Seasonal mean surface air temperature (left) and accumulated total precipitation (right) at Maryland (statewide), climate division, and county levels for spring 2024. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for spring 2024 occupies among the 130 springs 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, the larger (i.e., 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	67.0	123
Climate Division 1	67.5	123
Climate Division 2	68.2	124
Climate Division 3	68.9	123
Climate Division 4	68.3	123
Climate Division 5	66.6	117
Climate Division 6	66.4	124
Climate Division 7	66.1	120
Climate Division 8	63.0	127
Allegany	66.1	120
Anne Arundel	68.2	123
Baltimore	66.9	124
Baltimore City	68.2	124
Calvert	68.3	123
Caroline	67.5	115
Carroll	65.9	123
Cecil	65.2	117
Charles	69.3	124
Dorchester	68.8	125
Fredrick	66.1	123
Garrett	63.0	127
Harford	66.2	123
Howard	67.1	124
Kent	66.1	114
Montgomery	67.3	124
Prince George's	68.5	123
Queen Anne's	67.0	120
Saint Mary's	68.7	123
Somerset	68.1	124
Talbot	68.1	124
Washington	66.2	120
Wicomico	68.2	121
Worcester	66.6	121

Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	46.9	129
Climate Division 1	47.9	128
Climate Division 2	48.3	129
Climate Division 3	48.8	129
Climate Division 4	48.2	129
Climate Division 5	47.6	128
Climate Division 6	46.4	130
Climate Division 7	44.0	129
Climate Division 8	40.7	130
Allegany	43.0	129
Anne Arundel	48.8	129
Baltimore	46.3	129
Baltimore City	48.5	129
Calvert	49.1	130
Caroline	46.9	129
Carroll	45.1	130
Cecil	46.8	130
Charles	48.1	129
Dorchester	49.0	129
Fredrick	46.2	130
Garrett	40.7	130
Harford	46.7	130
Howard	46.0	129
Kent	47.8	128
Montgomery	47.1	129
Prince George's	47.6	128
Queen Anne's	47.8	128
Saint Mary's	49.6	130
Somerset	48.8	129
Talbot	49.2	130
Washington	44.9	130
Wicomico	47.0	127
Worcester	47.8	128

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

A. Temperatures and Precipitation

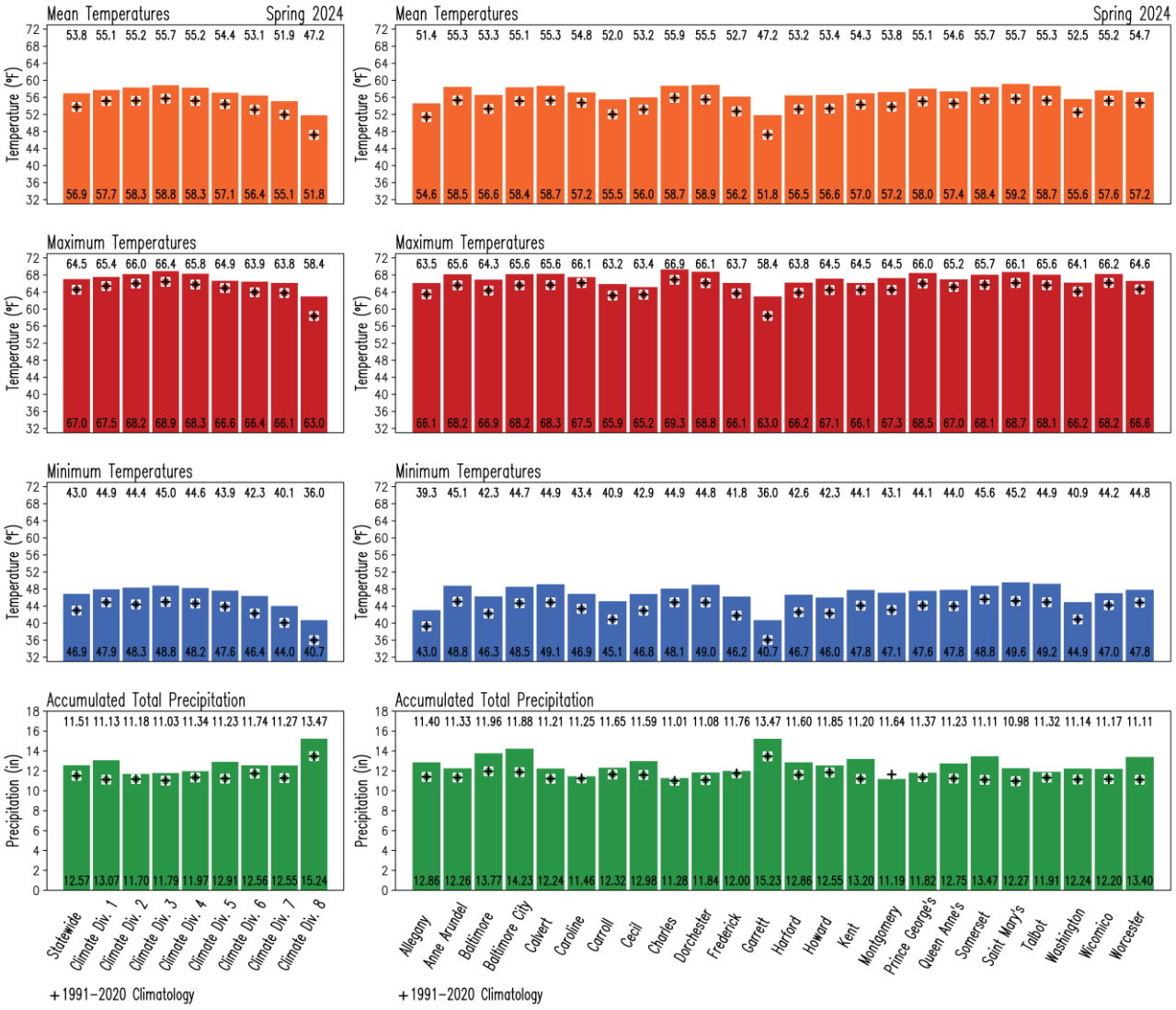

Figure B1. Seasonal surface variables in Maryland for spring 2024. Color bars represent the variables as follows: mean surface air temperature (orange), maximum surface air temperature (red), minimum surface air temperature (blue) and accumulated total precipitation (green) at statewide and climate division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

B. Temperature and Precipitation Anomalies

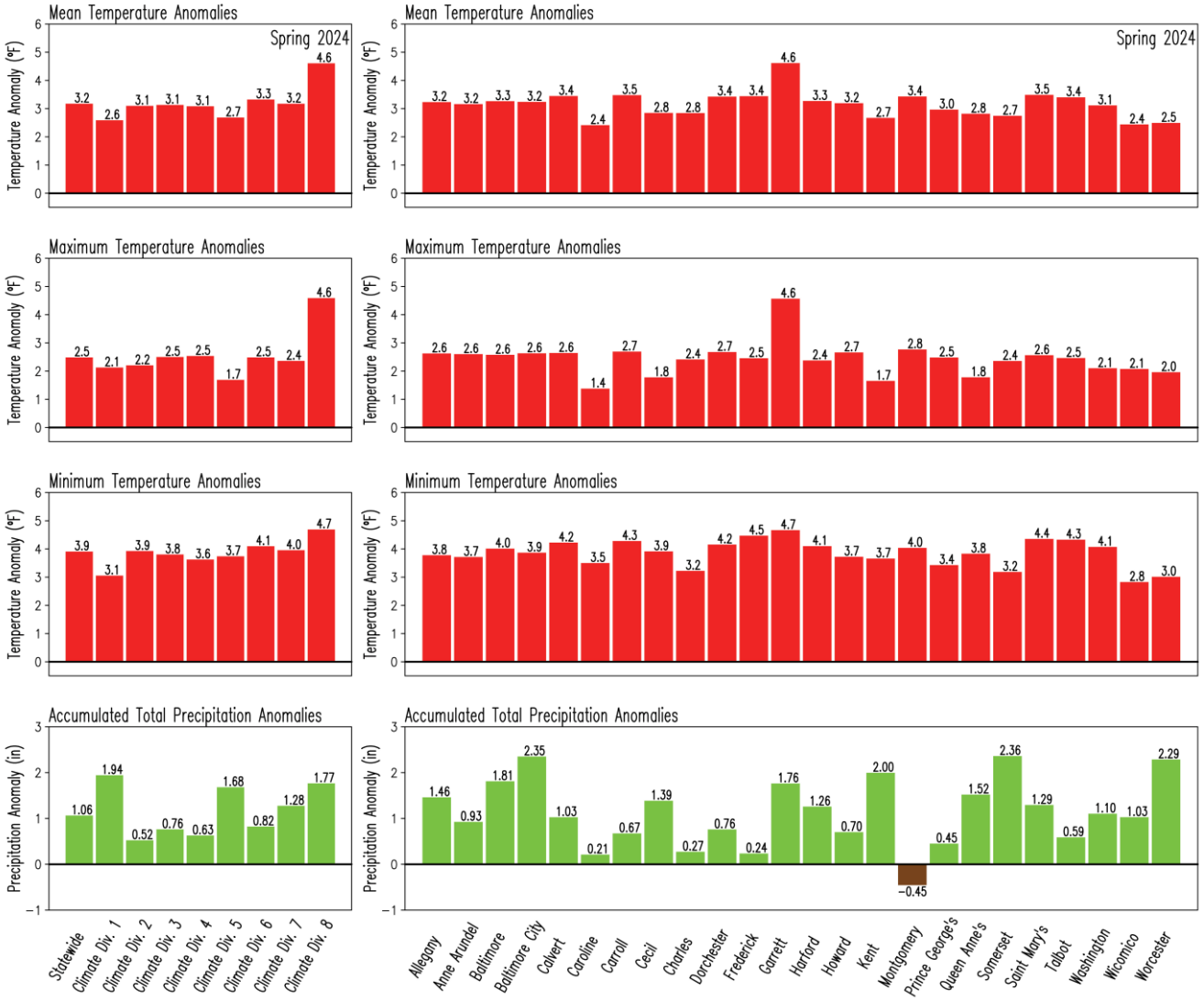

Figure B2. Anomalies of the seasonal surface variables in Maryland for spring 2024. Anomalies are with respect to the 1991-2020 climatology. The red color represents positive anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top), and minimum surface air temperature (third row from top), while the green/brown color indicates negative/positive anomalies in accumulated 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 the bars indicate the magnitude of the anomaly for spring 2024.

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

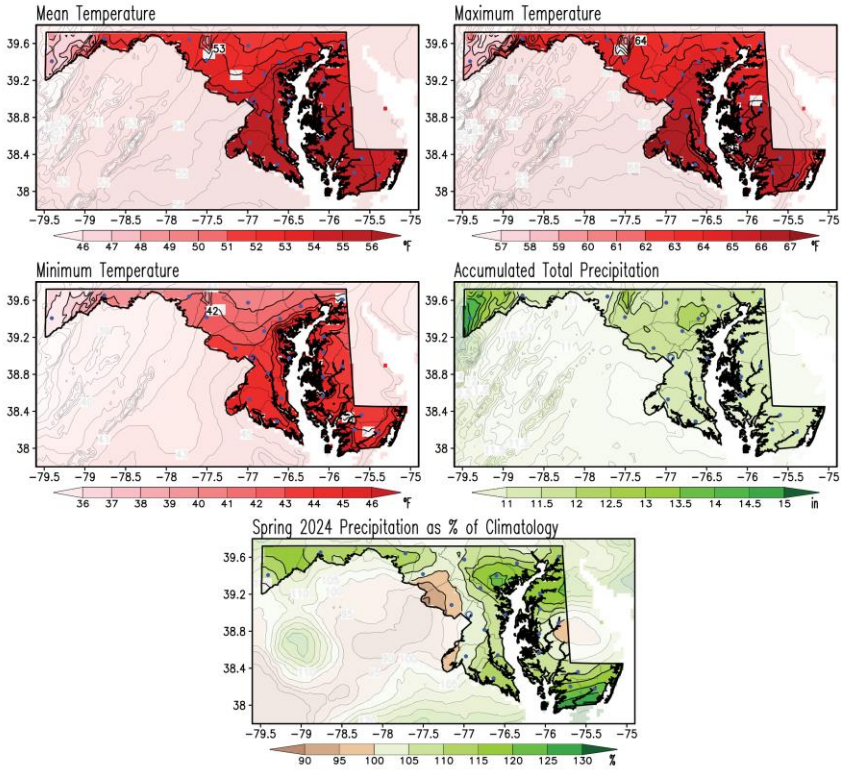

Figure C1. Spring climatology of the seasonal mean, maximum and minimum surface air temperatures, and accumulated total precipitation for the period 1991-2020 (upper and middle rows), and precipitation in spring 2024 as a percentage of climatology (bottom row). Temperatures are in °F, and precipitation is in inches according to the color bars. This is the current climate normal against which the spring 2024 conditions are compared to obtain the spring 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: The Water Year 1991-2020 Climatology, and October 2023 – May 2024 as Percentage of Climatology

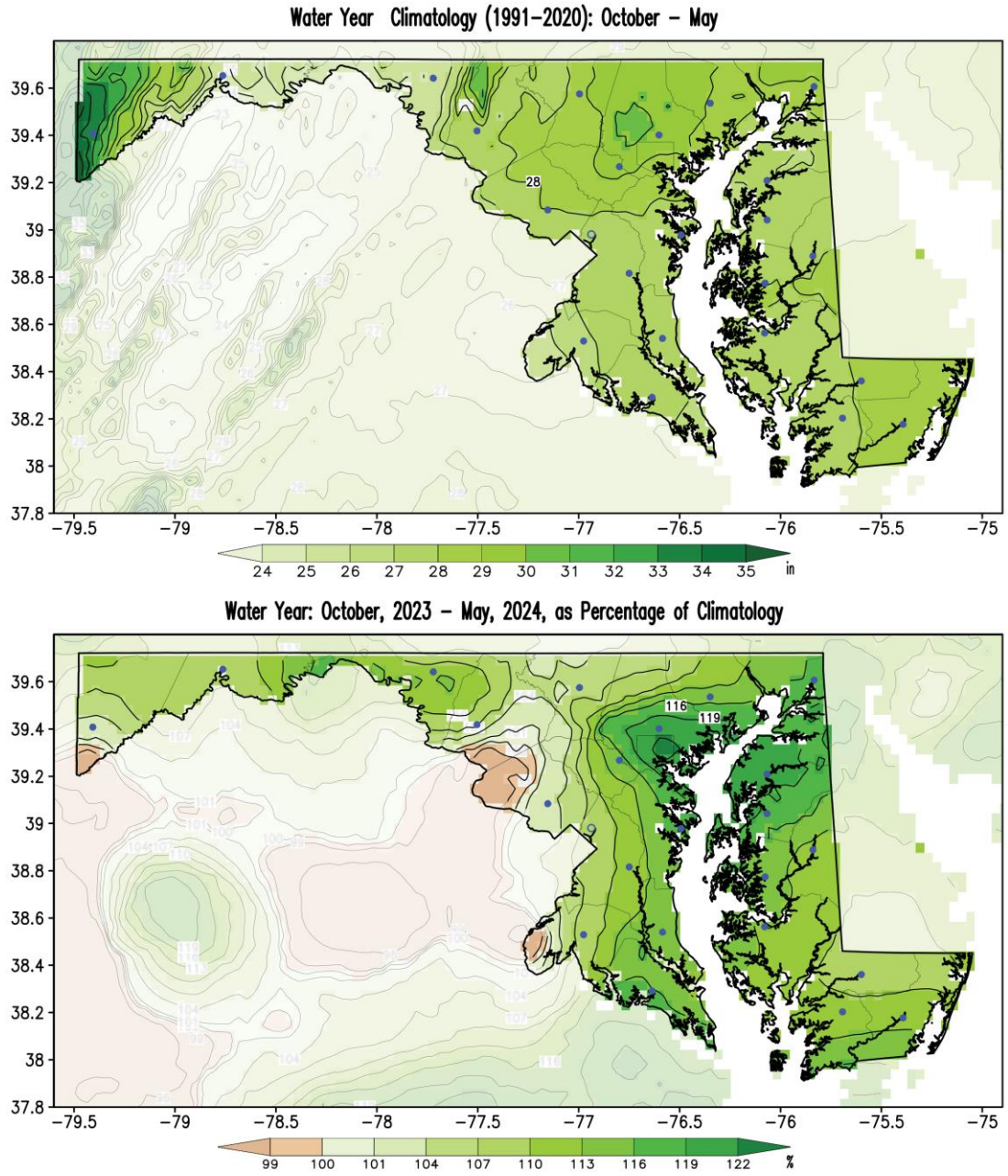

Figure D1. Climatology of the partial water year (October-May, top panel), and current partial water year (October 2023 – May 2024) as a percentage of the climatology (bottom panel). Climatology is for the period 1991-2020. The water year climatology is in inches following the color bar. The current water year as a percentage of climatology is obtained by dividing the current water year (Figure 5 upper panel) by the climatology (upper panel) and multiplying the ratio by 100; hence units are in percent (%). Brown/green shading in the percentage map highlights regions where the current water year is smaller/larger than normal. Note that shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

Appendix E. Spring Standard Deviation and Spring 2024 Standardized Anomalies Maps

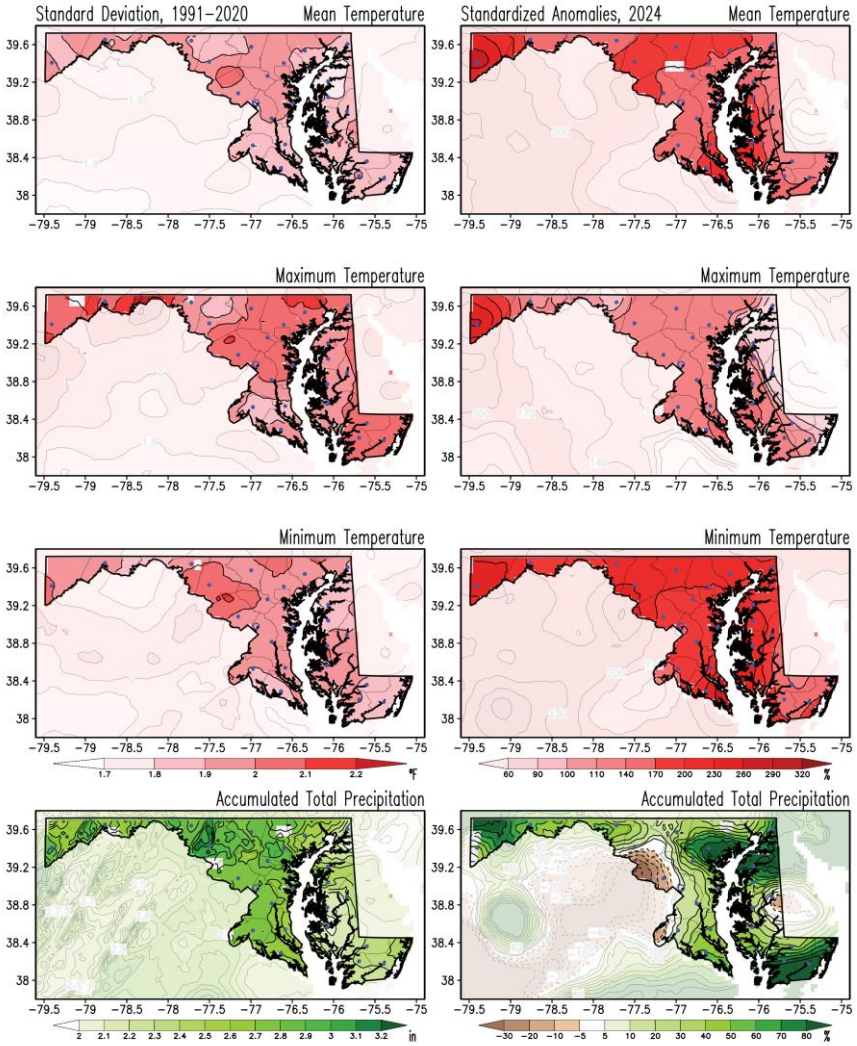

Figure E1. Standard deviation for spring and standardized anomalies of temperatures and precipitation for spring 2024. Standard deviations for seasonal mean, maximum, and minimum surface air temperatures and accumulated total precipitation were obtained for the 1991-2020 period (left column). Anomalies for spring 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 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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