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Maryland Climate Bulletin
Winter 2022-23

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DEPARTMENT OF
ATMOSPHERIC &
OCEANIC SCIENCE
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Maryland
State
Climatologist
Office

Summary

Winter 2022-23 was considerably warmer and drier than normal (i.e., 1991-2020 averages), after January and February 2023 were warmer and drier than normal. Seasonal mean temperatures were above freezing everywhere; maximum temperatures were in the 41 to 54°F range; minimum temperatures were between 24 to 36°F, contrary to normal below-freezing temperatures everywhere. Seasonal accumulated total precipitation was in the 7 to 11 inches range.

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

- Mean temperature was warmer than normal everywhere by at least 3°F, notably in the North Central counties of the Piedmont Province (between 4.2 o 5.2°F) and portions of Garrett, Prince George's, Charles, Saint Mary's, Calvert, Talbot, Dorchester, Wicomico, Somerset, and Worcester counties (between 4.2 to 4.6°F).

- Maximum temperature was also warmer than normal everywhere, by at least 3.8°F, especially over Montgomery, Howard, southern Carroll and Baltimore counties, northern Prince George's and Anne Arundel counties, and Baltimore City (above 5.4°F); western Garrett County, and portions of Saint Mary's, Calvert, Talbot, Dorchester, and Wicomico counties (~5.2 °F).

- Minimum temperature was warmer than normal everywhere, by at least 2.6°F, but notably in portions of Montgomery, Frederick, Carroll, and Baltimore counties (above 4.6°F), and northern Garrett, Allegany counties, and portions of Saint Mary's, Calvert, Talbot, and Dorchester counties (above 4.0°F).

- Precipitation was below normal over most of the state, especially over Garrett, eastern Prince George's, Anne Arundell, Talbot, Caroline, Dorchester, Wicomico, Somerset, and Worcester by around 1.4 in. Southern Cecil, Harford, and northern Kent had above-normal precipitation by 0.2 in.

- The partial water year (October 2022-February 2023) also shows below-normal conditions over most of the state, especially over western Garrett, western Frederick, and Montgomery counties, and southern Baltimore County and Baltimore City (−70 in). These regions have around 85% of the climatological amounts at this time of the year. Harford and Cecil counties are the only places with above-normal conditions (~20 in).

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

- All eight climate divisions were warmer by at least 3°F and drier than normal.

- Statewide warm and dry anomalies have persisted since last summer, but the warming in winter 2022-23 was around four times larger than in summer 2022.

Historical Context (Figure 8, Tables A1 and A2)

- Winter 2022-23's mean, maximum, and minimum statewide temperatures (40.5, 50.1, and 30.9°F) were all above the long-term (1896-2022) average, and close to the historical records set in 1932. Accumulated total precipitation (8.56 in) was below the long-term average but still far from the record set in 2002.
- Statewide, winter 2022-23 was the 2nd warmest and 49th driest among the128 winters in the 1896-2023 period. Maximum temperatures in seventeen counties were among the three warmest on record (e.g., Wicomico was the warmest), while minimum temperatures in nine counties were among the three warmest.

Century-Plus Trends (Figures 9, 10)

- Statewide mean temperature showed a significant 3.0°F/century warming trend, and the heating degree-days a significant −280.84°F degree-days trend. On the other hand, statewide accumulated total precipitation showed a non-significant decreasing trend (−0.12 in/century), and the partial water year had a non-significant increasing trend (1.39 in/century).
- Regionally, winter 2022-23 mean temperatures showed a significant warming trend everywhere in the state. It varies from ~2°F/century over Garrett County to ~3.0°F on the eastern shore, to ~3.4°F/century along the Montgomery−Frederick and Carroll−Howard boundaries, extending into Baltimore City, along the northern portions of Harford and Cecil counties.
- Regionally, winter 2022-23 accumulated total precipitation showed non-significant trends. The largest drying trends are in southern Anne Arundel, Kent, and Queen Anne's counties (−0.8 in/century). These drying trends decrease toward Charles and Prince George's counties to the southwest, Harford and Cecil counties to the north, and western Montgomery, Carroll, Frederick, Washington, and Allegany counties to the northwest. Increasing trends (0.1 to 0.3 in/century) are found over Garrett, Baltimore, and Howard counties, and portions of Calvert, Saint Mary's, Caroline, Somerset, and Wicomico counties.

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 winter 2022-23 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 3/10/2023.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al. 2014), which is available in a preliminary status (v1.0.0-20230308) at: https://www.ncei.noaa.gov/pub/data/cirs/climdiv/
  Data was downloaded on 3/13/2023.

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., winter 2022-23) are the departures of the seasonal value from the corresponding season's 30-year average (i.e., from the average of 30 winters) 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*.

3. Winter 2022-23 Maps

A. Mean Temperatures

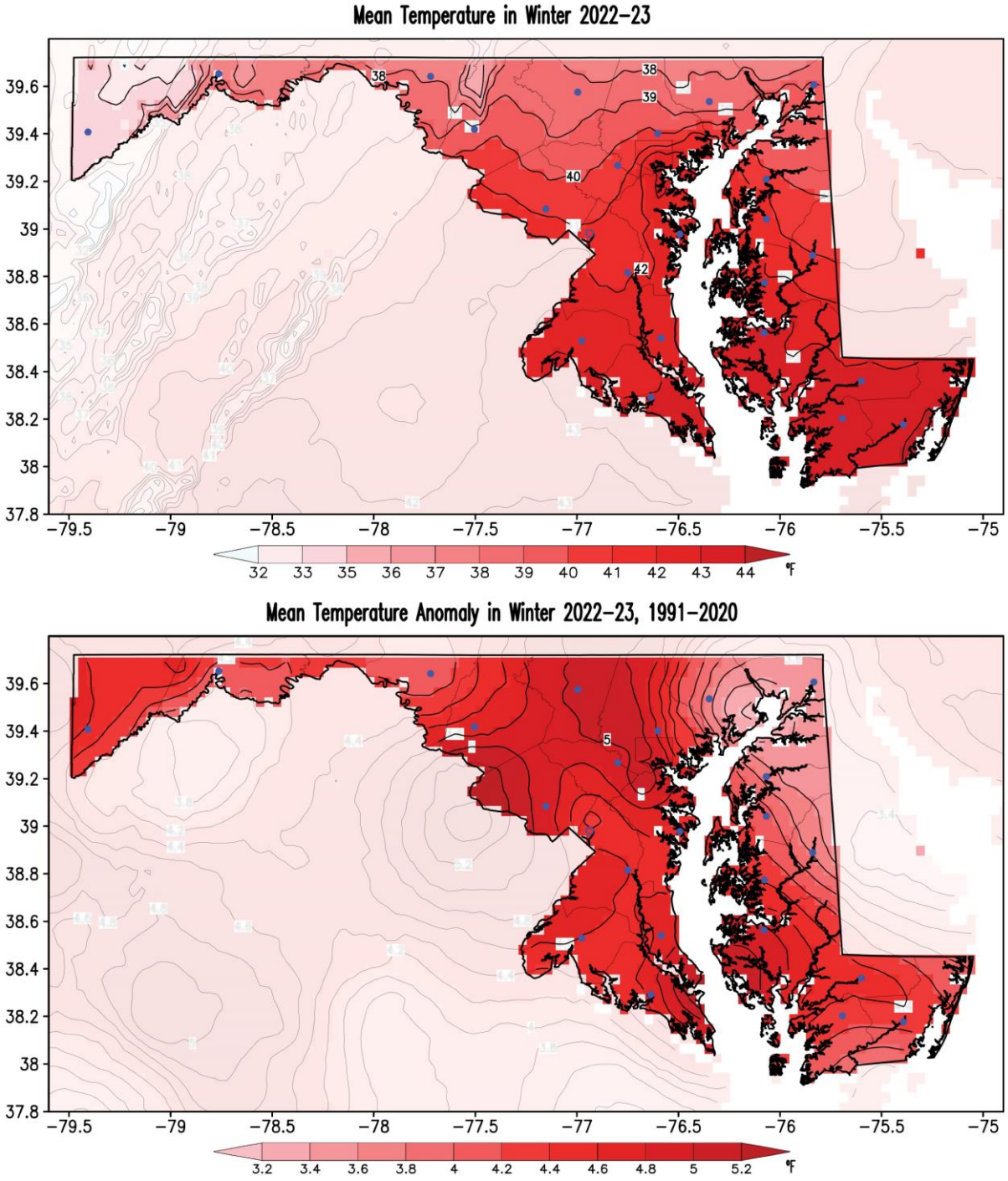

Figure 1. Seasonal mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for winter 2022-23. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

B. Maximum Temperatures

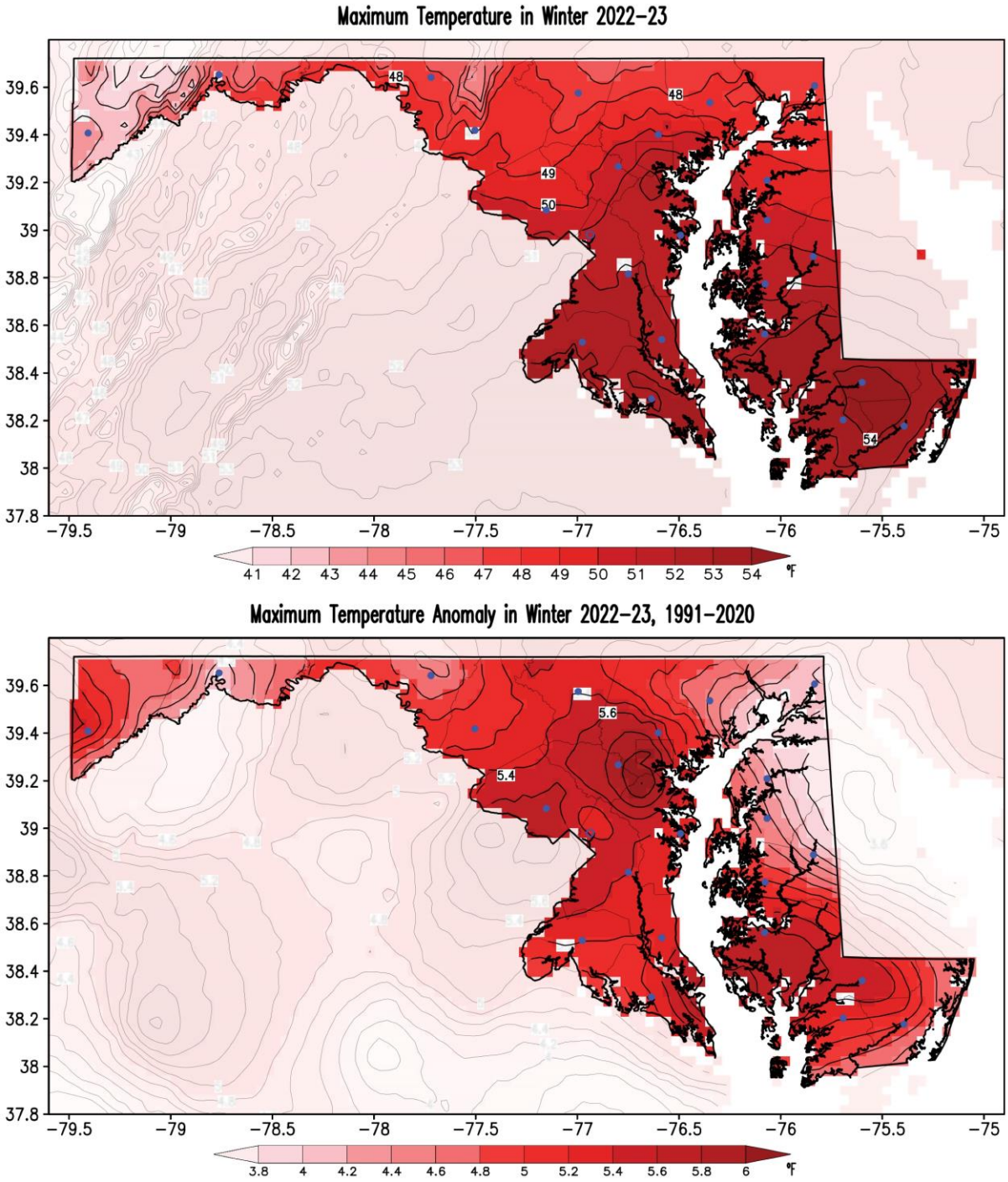

Figure 2. Seasonal maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for winter 2022-23. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

C. Minimum Temperatures

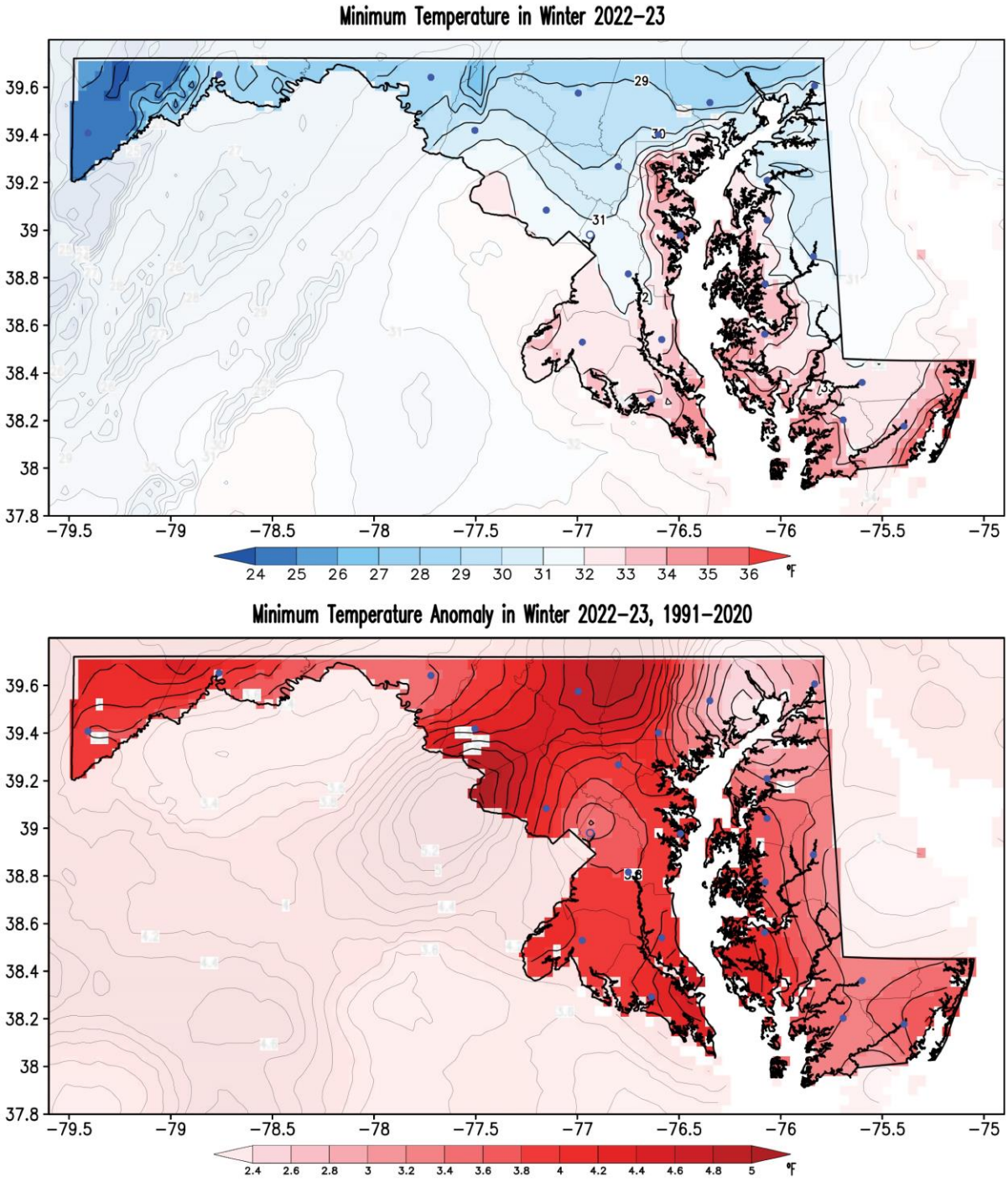

Figure 3. Seasonal minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for winter 2022-23. Temperatures are in °F following the color bar. Blue/red shading in the temperature map shows temperatures below/above 32°F, while red shading in 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

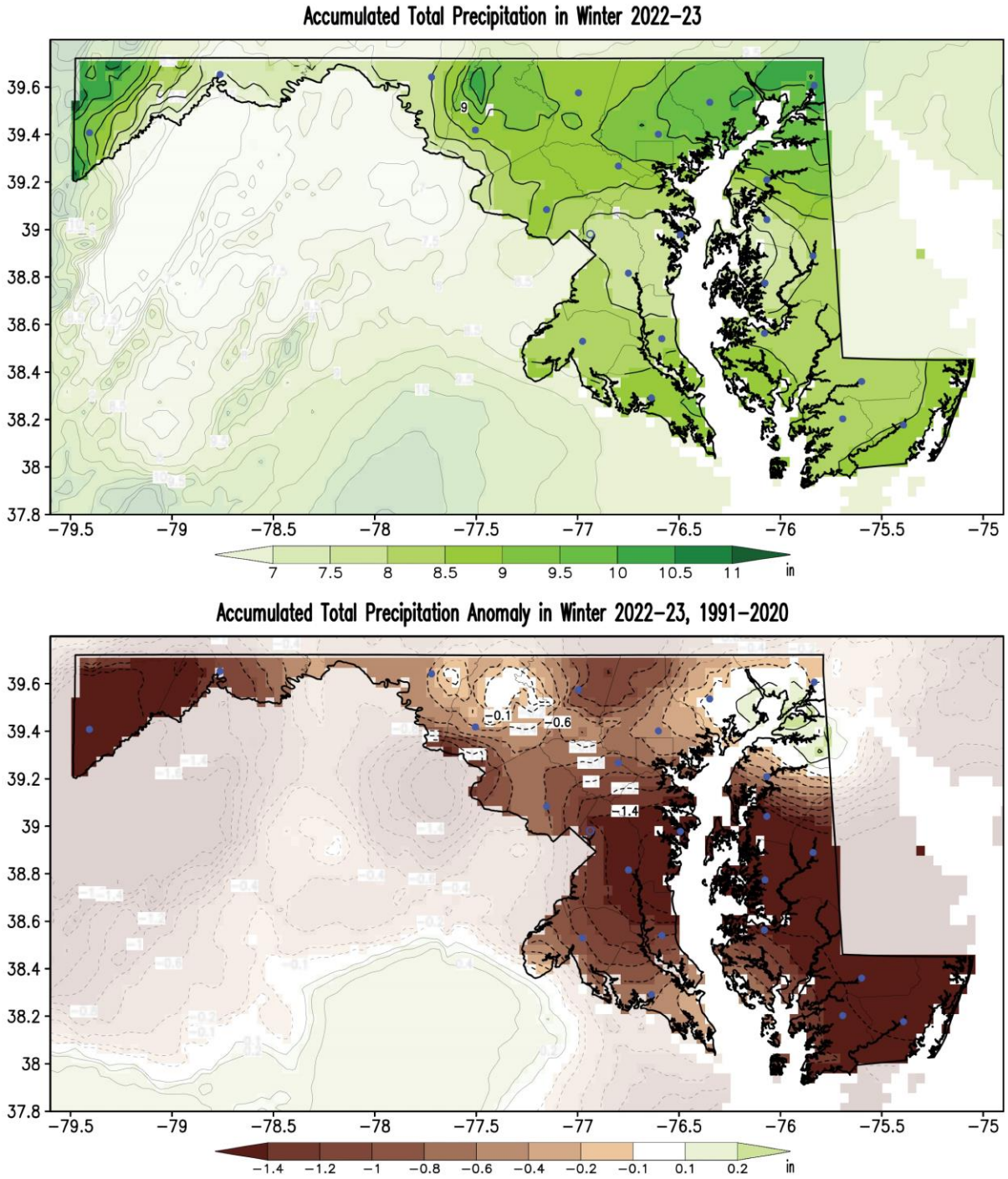

Figure 4. Seasonal accumulated total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for winter 2022-23. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

E. Partial Water Year (October 2022 – February 2023)

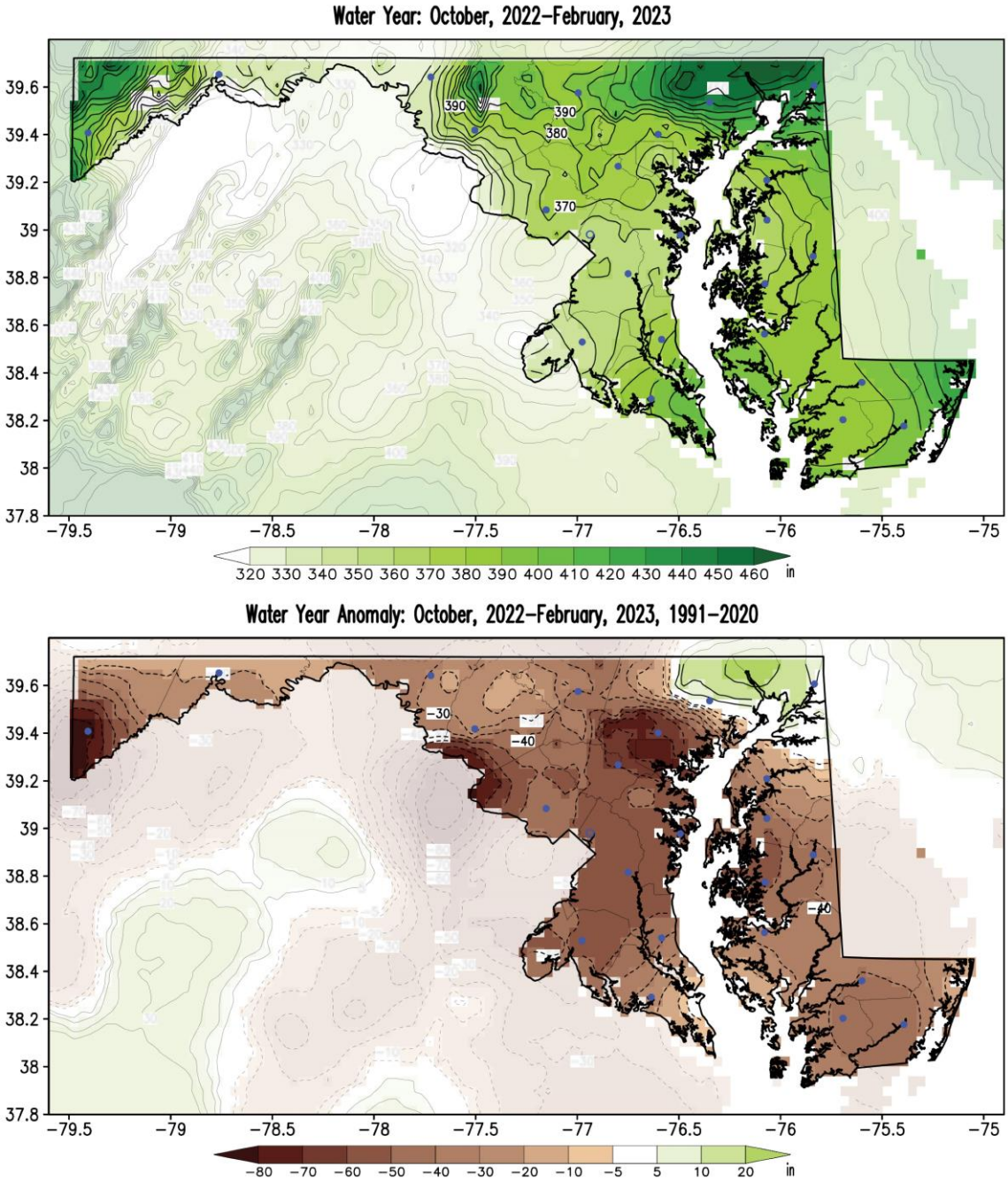

Figure 5. Partial water year until the end of winter 2022-23 (top panel), and its anomaly with respect to the 1991-2020 climatology (bottom panel). Water year is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. The current maps display the partial conditions from October 2022 to February 2023. 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; 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. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

4. Winter and Summer-Winter 2022-23 Climate Divisions Averages

A. Winter 2022-23 Scatter Plots

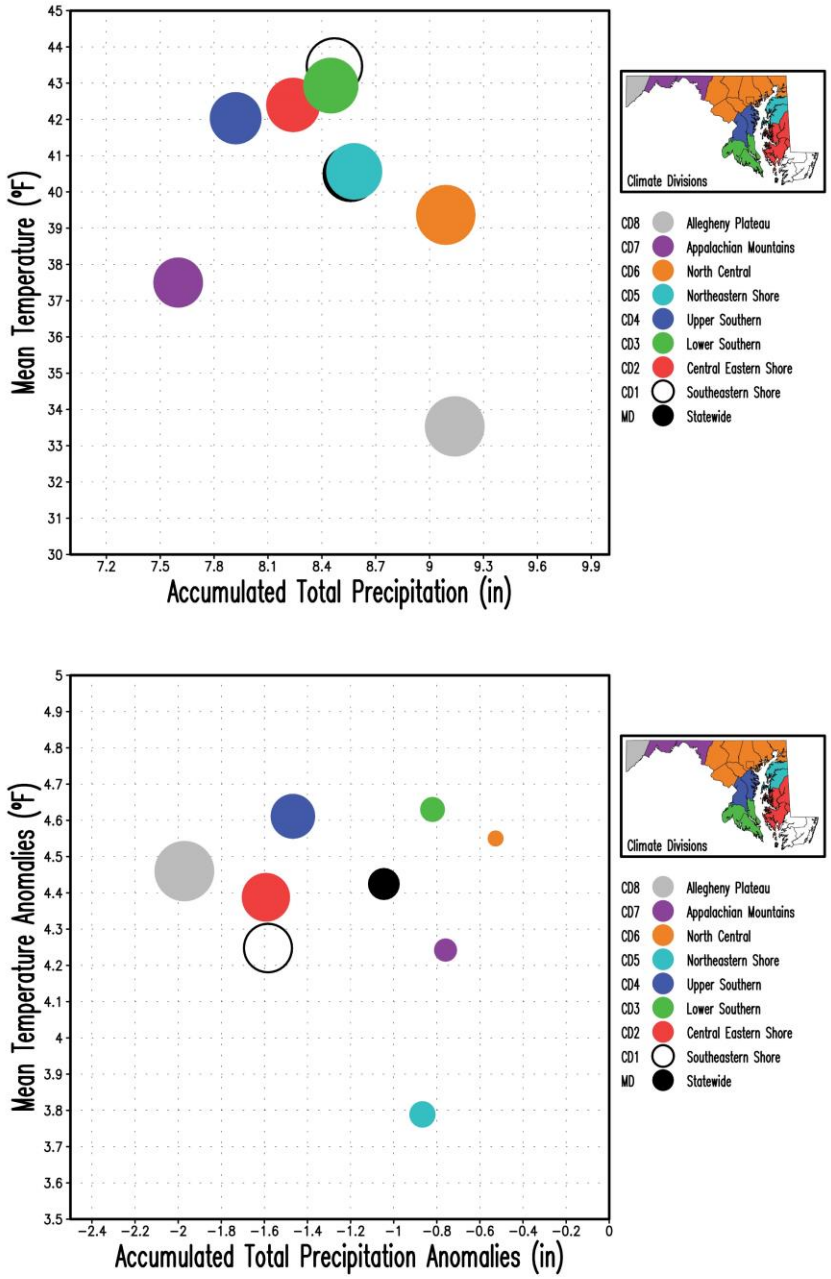

Figure 6. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) seasonal mean surface air temperature vs. accumulated total precipitation for winter 2022-23. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 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 (9.14 inches in CD8, top panel) and by the maximum precipitation anomaly (|-1.97| inches in CD8, bottom panel) among the nine regions. Note that the color of the filled circles corresponds to the color in the Climate Divisions according to the inset map.

B. Summer, Fall 2022 − Winter 2022-23 Scatter Plots

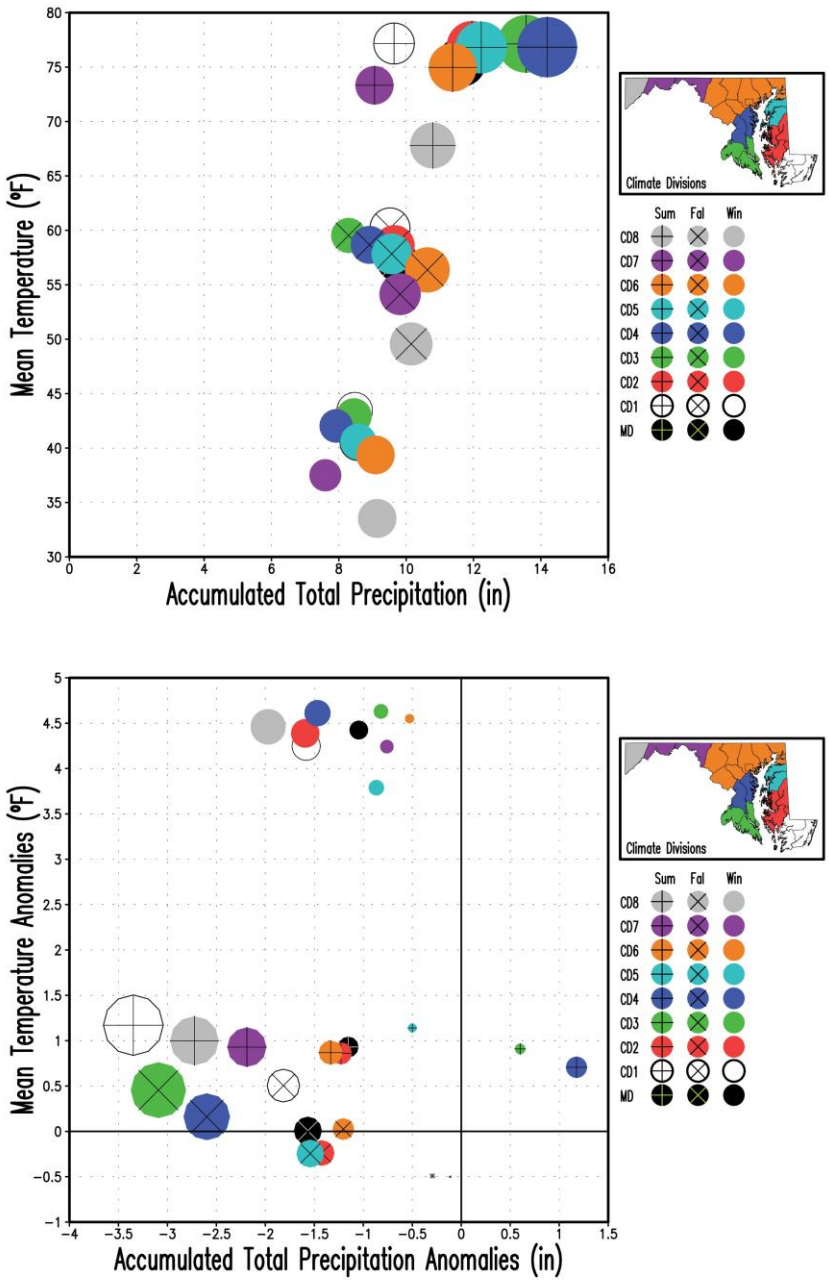

Figure 7. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) seasonal mean surface air temperature vs. accumulated total precipitation for summer, fall 2022, and winter 2022-23. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies 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 (14.19 inches in CD4 in Summer, top panel) and by the maximum precipitation anomaly (|-3.35| inches in CD1 in summer, bottom panel) among the nine regions and three months. Winter is displayed with filled circles only, while fall and summer are displayed with superposed multiplication and addition signs, respectively.

5. Winter 2022-23 Statewide Averages in the Historical Record

A. Box and Whisker Plots

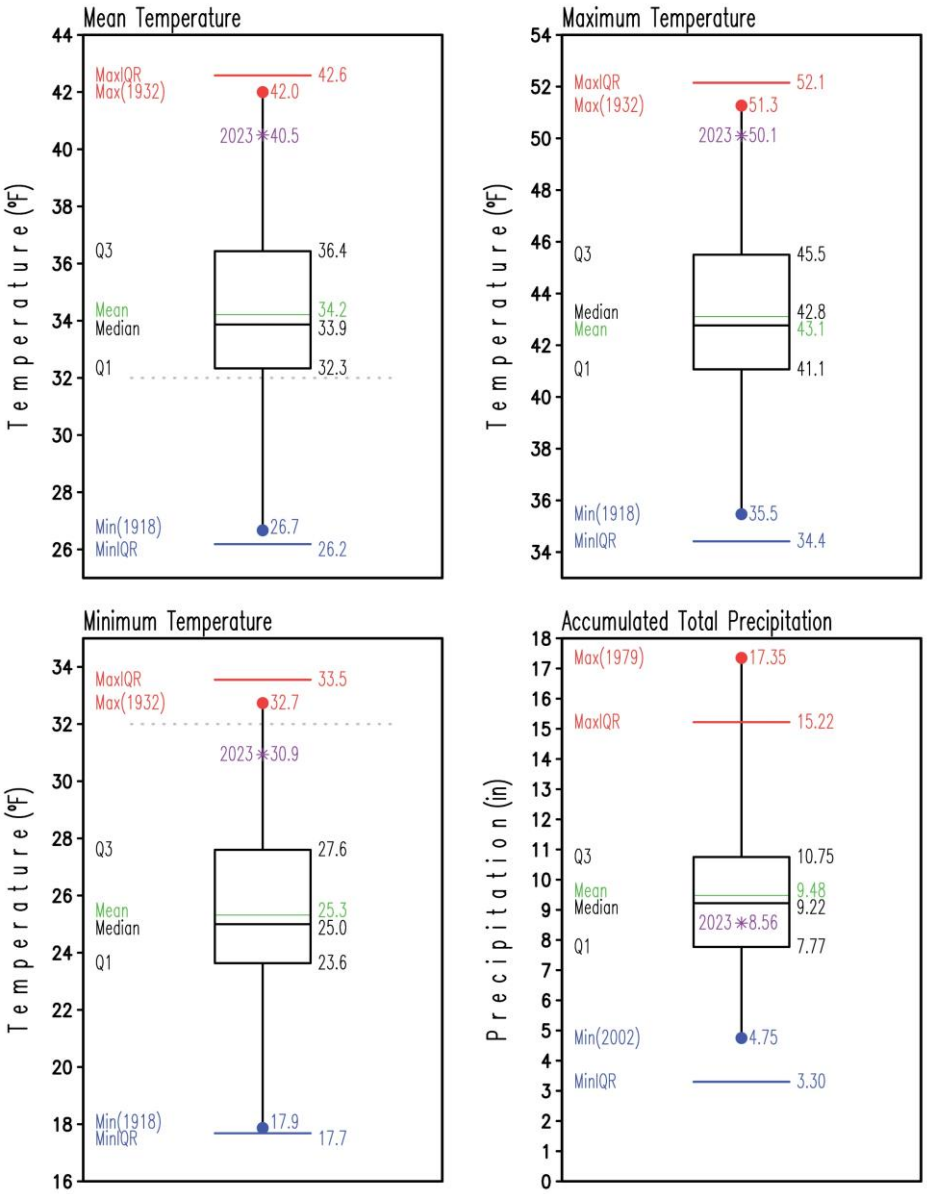

Figure 8. Box and Whisker plots of Maryland (statewide) seasonal mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and accumulated total precipitation (lower right) for winter for the period 1896-2022. The label and asterisk in purple represent conditions for winter 2022-23. Statistics for the period 1896-2022 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 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 a horizontal dotted line.

6. 1896-2023 Trends

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

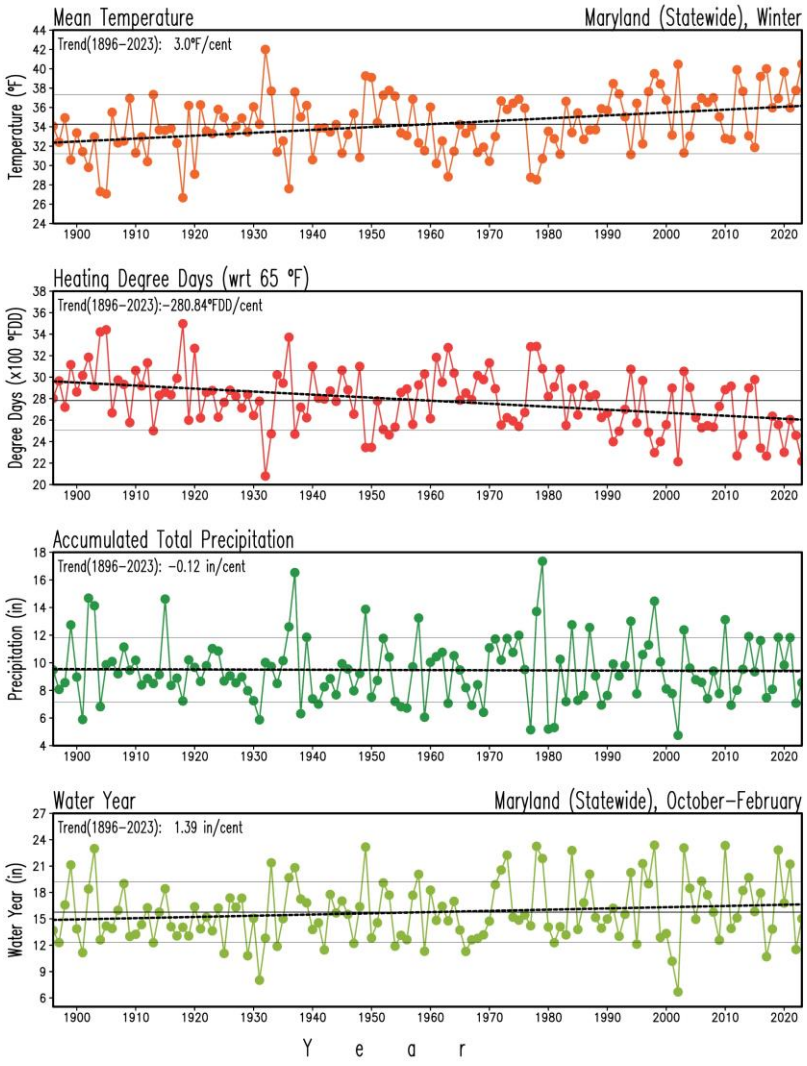

Figure 9. Maryland (statewide) mean surface air temperature, heating degree-days, accumulated total precipitation in winter, and partial (October-February) water year for the period 1896-2023. Temperature is in °F, heating degree-days is in °F degree-days (°FDD), and precipitation is in inches. The thin, continuous black lines in each panel display the long-term means (34.3°F, 2782.48°FDD, 9.47 in, and 15.76 in 1896-2023), and the double thin, continuous gray lines indicate the standard deviation (3.0°F, 276.96°FDD, 2.33 in, and 3.46 in) above/below the long-term mean. The thick dashed black lines show the long-term linear trend. 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 heat buildings; because energy demand is cumulative, degree-day totals for a season are the sum of each individual day's degree-day total (CPC, 2023). The warming temperature trend (3.0°F/century) and the decreasing heating degree-days (−280.84°FDD/century) trend are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000), but not the increasing water year (1.39 in/century) trend or precipitation (-0.12 in/century) trend.

B. Temperature and Precipitation Maps

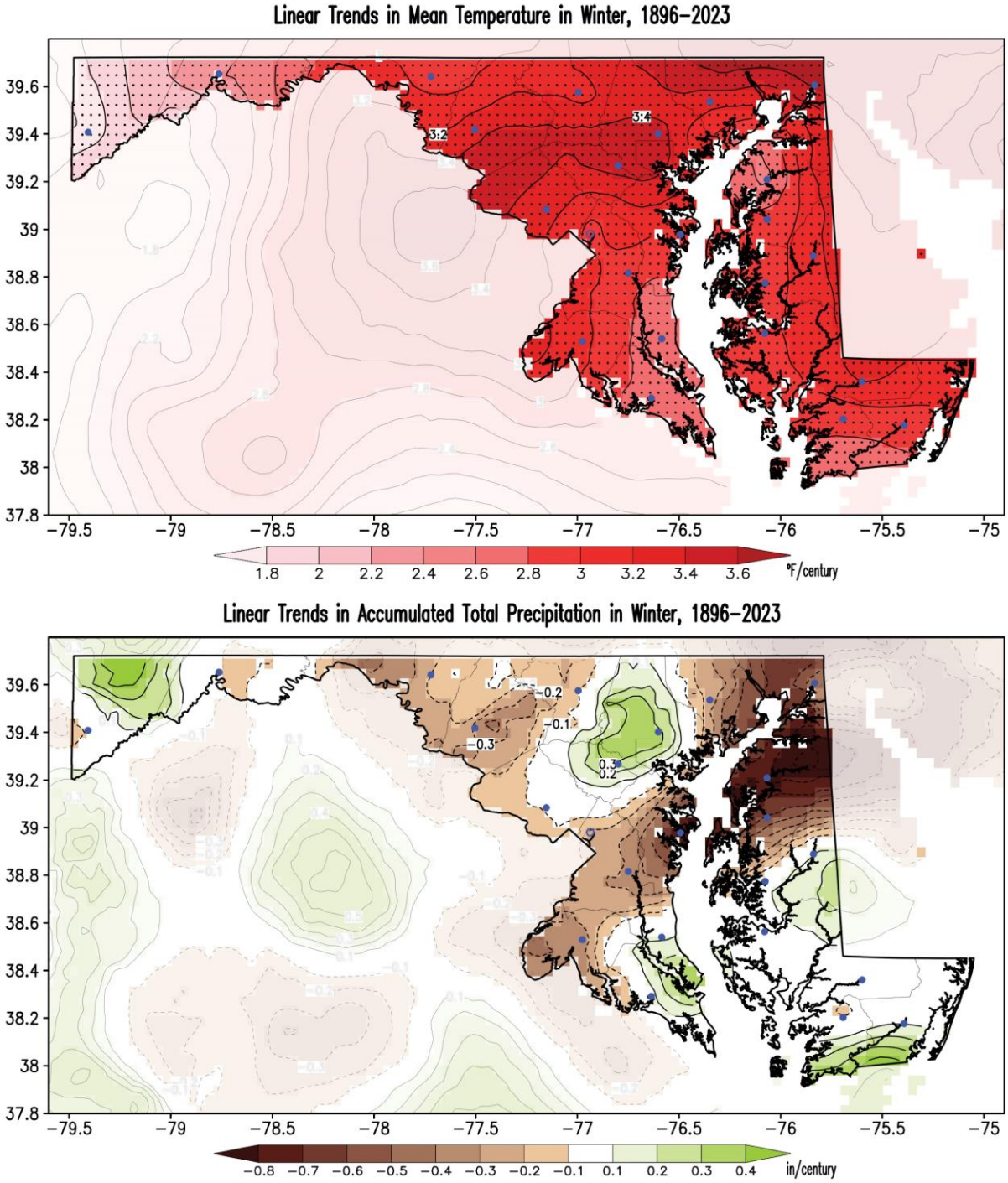

Figure 10. Linear trends in winter surface air mean temperature and accumulated total precipitation for the period 1896-2023. Temperatures are in °F/century, and precipitation is in inches/century following the color bars. Red shading in the temperature map marks warming trends. Brown/green shading in 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. Winter 2022-23 Tables: Statewide, Climate Divisions, and Counties

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)
Statewide	40.5	127
Climate Division 1	43.5	127
Climate Division 2	42.4	127
Climate Division 3	42.9	127
Climate Division 4	42.0	127
Climate Division 5	40.6	125
Climate Division 6	39.4	126
Climate Division 7	37.5	125
Climate Division 8	33.5	124
Allegany	36.9	125
Anne Arundel	42.3	127
Baltimore	39.6	127
Baltimore City	41.9	127
Calvert	42.7	127
Caroline	41.2	125
Carroll	38.5	127
Cecil	38.8	122
Charles	42.8	127
Dorchester	43.2	127
Fredrick	38.9	126
Garrett	33.5	124
Harford	38.7	125
Howard	40.0	127
Kent	40.3	126
Montgomery	40.7	127
Prince George's	41.8	127
Queen Anne's	40.9	125
Saint Mary's	43.2	127
Somerset	43.5	127
Talbot	42.3	126
Washington	38.1	125
Wicomico	43.2	127
Worcester	43.6	127

Region	Acc. Total Precipitation (in)	Rank (#)
Statewide	8.56	49
Climate Division 1	8.47	43
Climate Division 2	8.24	39
Climate Division 3	8.45	53
Climate Division 4	7.92	40
Climate Division 5	8.58	44
Climate Division 6	9.09	65
Climate Division 7	7.60	58
Climate Division 8	9.14	40
Allegany	7.19	53
Anne Arundel	7.92	40
Baltimore	9.23	62
Baltimore City	9.11	61
Calvert	8.32	47
Caroline	8.17	40
Carroll	8.85	66
Cecil	9.96	76
Charles	8.29	51
Dorchester	8.46	46
Fredrick	8.91	71
Garrett	9.12	40
Harford	9.73	75
Howard	8.71	59
Kent	8.95	56
Montgomery	8.41	55
Prince George's	7.96	41
Queen Anne's	8.24	38
Saint Mary's	8.71	56
Somerset	8.43	45
Talbot	7.64	26
Washington	7.98	65
Wicomico	8.37	37
Worcester	8.55	41

Table A1. Seasonal mean surface air temperature (left) and accumulated total precipitation (right) at Maryland (statewide), climate division, and county levels for winter 2022-23. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for winter 2022-23 occupies among the 128 winters after the 128 values have been arranged from the lowest to the highest in the *standard competition ranking method*. The closer to 128 the rank, the larger (i.e., warmer/wetter) the value of the surface variable is in the record.

B. Maximum and Minimum Temperatures

Region	Maximum Air Temperature (°F)	Rank (#)
Statewide	50.1	126
Climate Division 1	53.5	127
Climate Division 2	52.3	126
Climate Division 3	52.8	126
Climate Division 4	51.7	126
Climate Division 5	49.8	125
Climate Division 6	48.7	126
Climate Division 7	46.9	126
Climate Division 8	42.4	124
Allegany	46.0	125
Anne Arundel	51.7	126
Baltimore	49.2	126
Baltimore City	51.3	127
Calvert	52.3	126
Caroline	51.2	125
Carroll	47.8	126
Cecil	47.8	125
Charles	52.9	126
Dorchester	53.2	127
Fredrick	47.9	126
Garrett	42.4	124
Harford	48.2	125
Howard	49.9	126
Kent	49.4	125
Montgomery	49.8	126
Prince George's	51.8	126
Queen Anne's	50.2	125
Saint Mary's	53.0	127
Somerset	53.3	127
Talbot	51.7	126
Washington	47.7	126
Wicomico	53.8	128
Worcester	53.3	126

Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	30.9	124
Climate Division 1	33.5	123
Climate Division 2	32.5	125
Climate Division 3	33.0	127
Climate Division 4	32.4	126
Climate Division 5	31.3	123
Climate Division 6	30.1	126
Climate Division 7	28.1	123
Climate Division 8	24.7	124
Allegany	27.7	123
Anne Arundel	32.8	126
Baltimore	30.1	126
Baltimore City	32.5	126
Calvert	33.0	127
Caroline	31.2	122
Carroll	29.2	127
Cecil	29.7	122
Charles	32.8	127
Dorchester	33.1	127
Fredrick	29.9	125
Garrett	24.7	124
Harford	29.1	121
Howard	30.2	125
Kent	31.2	123
Montgomery	31.5	127
Prince George's	31.9	124
Queen Anne's	31.6	124
Saint Mary's	33.4	127
Somerset	33.8	123
Talbot	33.0	125
Washington	28.5	122
Wicomico	32.5	123
Worcester	34.0	125

Table A2. Seasonal maximum (left) and minimum (right) surface air temperatures at Maryland (statewide), climate division, and county levels for winter 2022-23. Temperatures are in °F. The rank is the order that the variable for winter 2022-23 occupies among the 128 winters after the 128 values have been arranged from the lowest to the highest using the *standard competition ranking method*. The closer to 128 the rank, the larger (i.e., the warmer) the value of the surface variable is in the record.

Appendix B. Winter 2022-23 Bar Graphs: Statewide, Climate Divisions, and Counties

A. Temperatures and Precipitation

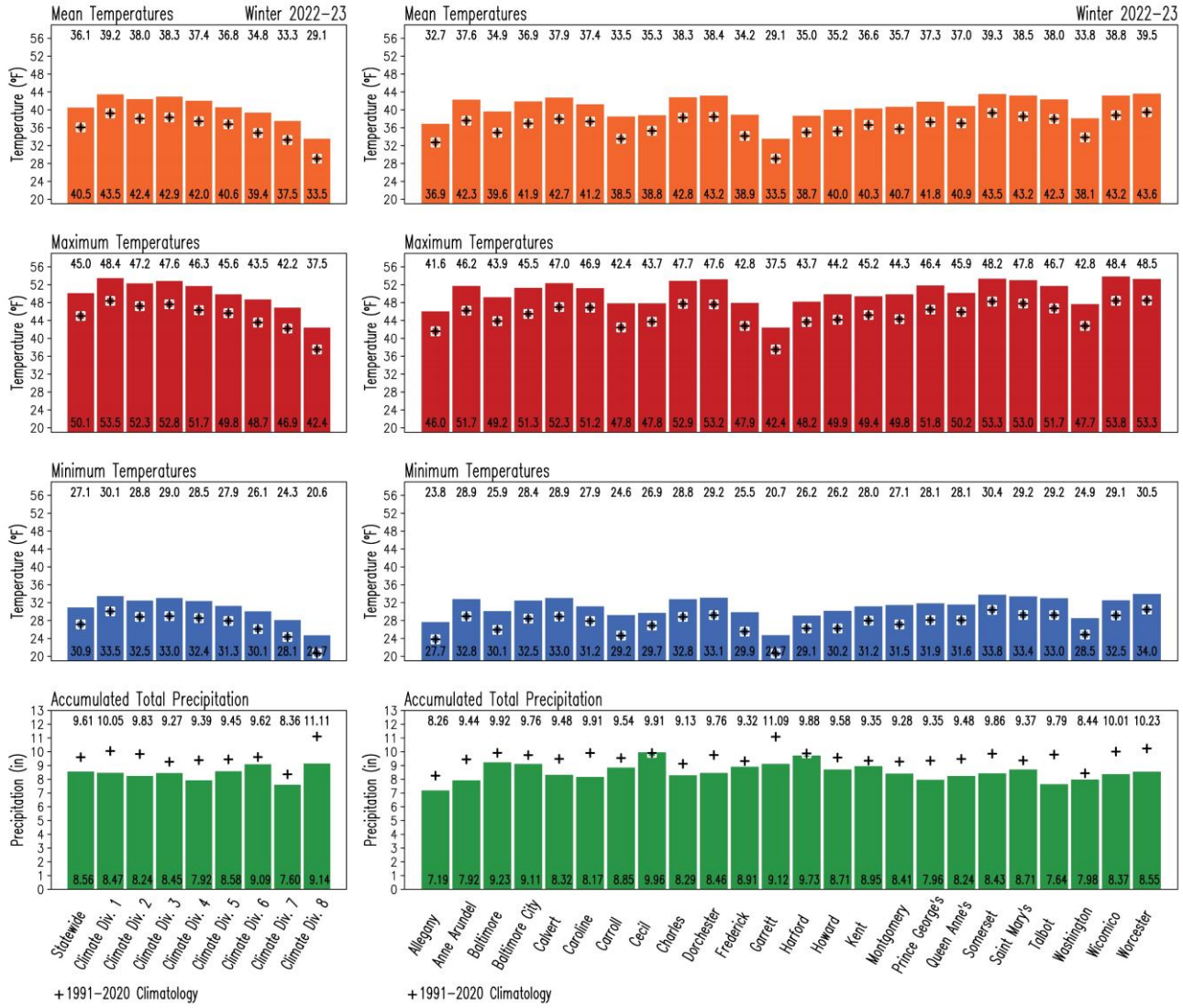

Figure B1. Seasonal surface variables in Maryland for winter 2022-23. Color bars represent the variables as follows: mean surface air temperature (orange), maximum surface air temperature (red), minimum surface air temperature (blue) and accumulated total precipitation (green) at statewide and climate 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 winter 2022-23. For comparison, the corresponding 1991-2020 climatological values for winter are displayed as black addition signs, and their magnitudes are shown at the top of the panels.

B. Temperature and Precipitation Anomalies

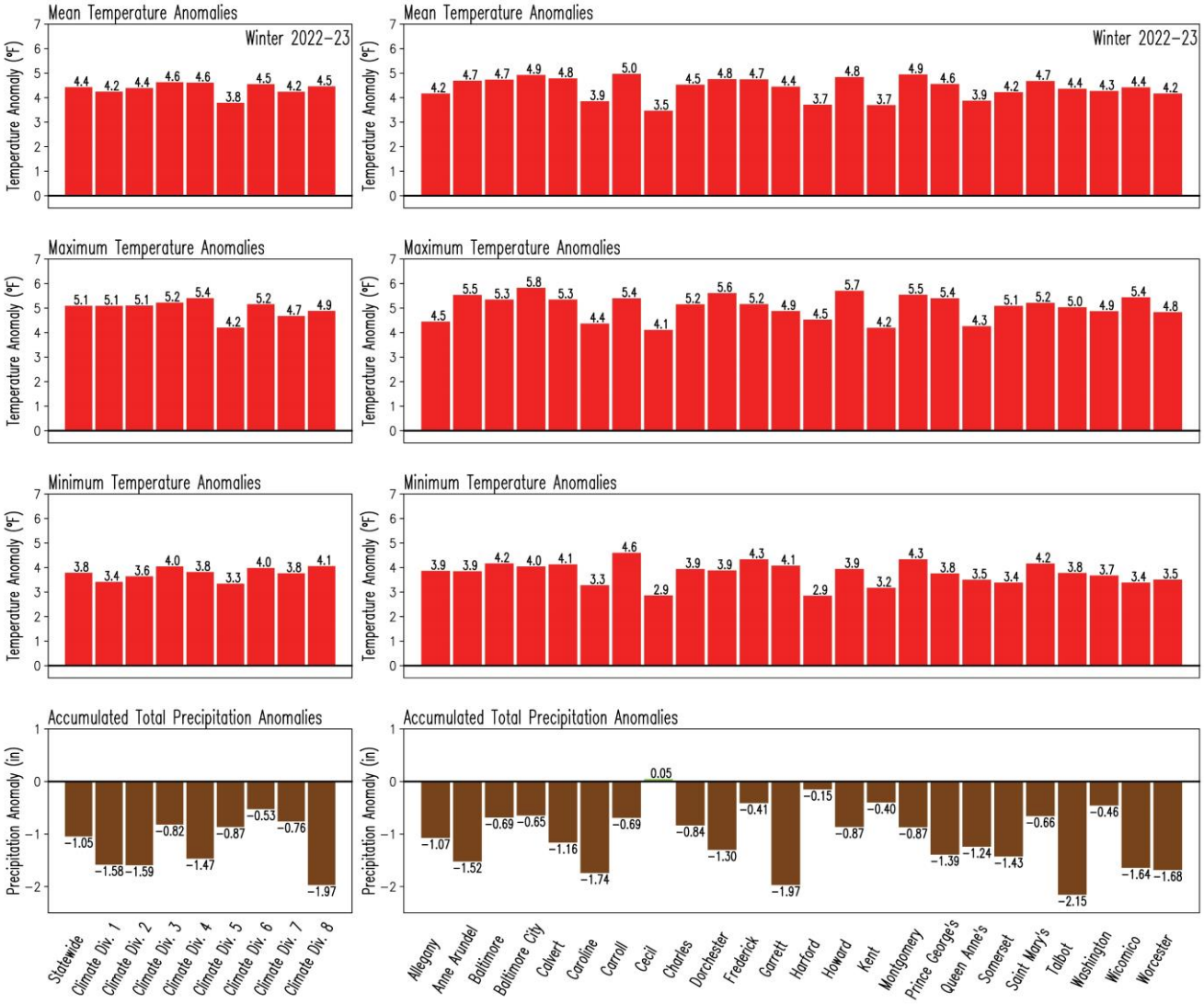

Figure B2. Anomalies of the seasonal surface variables in Maryland for winter 2022-23. Anomalies are with respect to the 1991-2020 climatology. Red color represents positive anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top), and minimum surface air temperature (third row from top) while brown/green 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 of the bars indicate the magnitude of the anomaly for winter 2022-23.

Appendix C. Winter 1991-2020 Climatology Maps

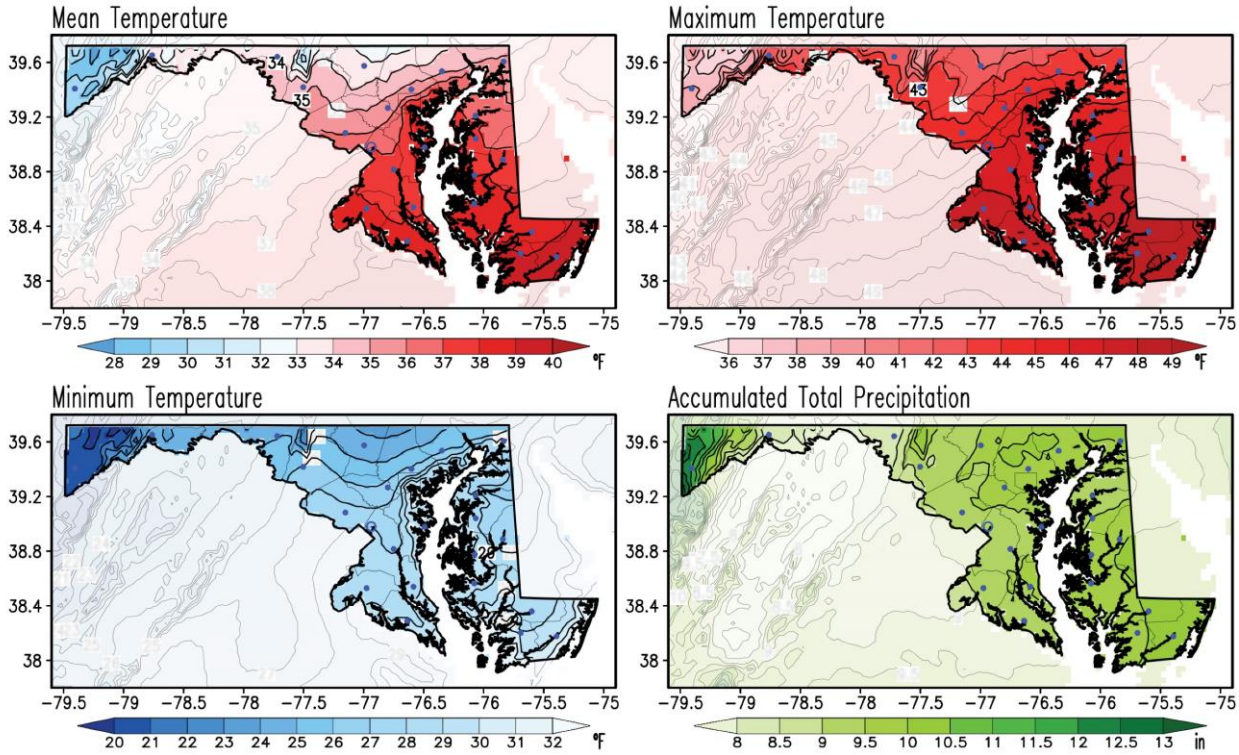

Figure C1. Winter climatology of the seasonal mean, maximum and minimum surface air temperatures, and accumulated total precipitation for the period 1991-2020. Temperatures are in °F, and precipitation is in inches according to the color bars. This is the current climate normal against which the winter 2022-23 conditions are compared to obtain the winter 2022-23 anomalies. 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, humidity, wind, sunshine, cloudiness, 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 averaging 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 2022 – February 2023 as Percentage of Climatology

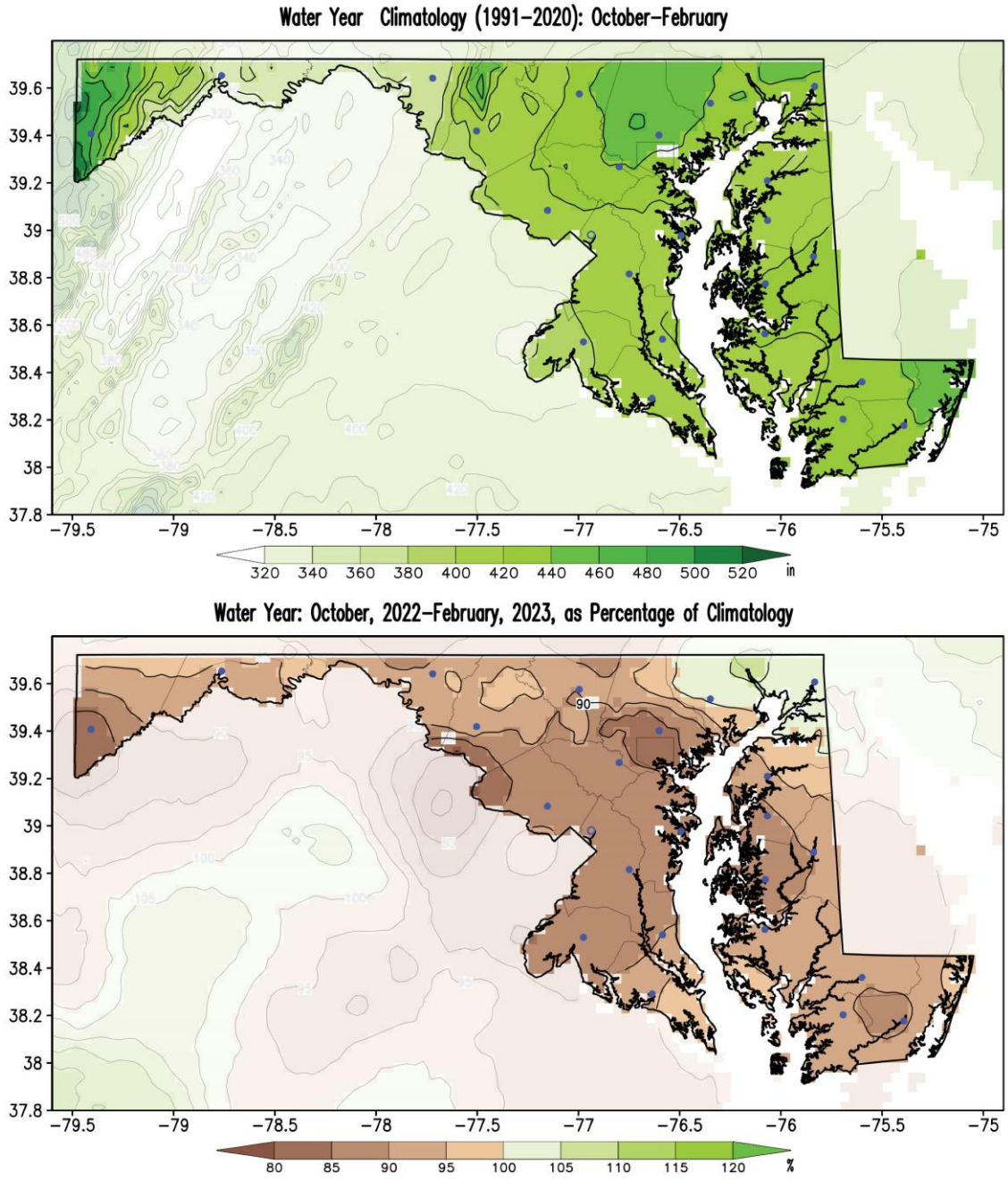

Figure D1. Climatology of the partial water year (October-February, top panel), and current partial water year (October 2022 – February 2023) as a percentage of the climatology (bottom panel). Climatology is for the period 1991-2020. The water year climatology is in inches following the color bar. The 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. Winter Standard Deviation and Winter 2022-23 Standardized Anomalies Maps

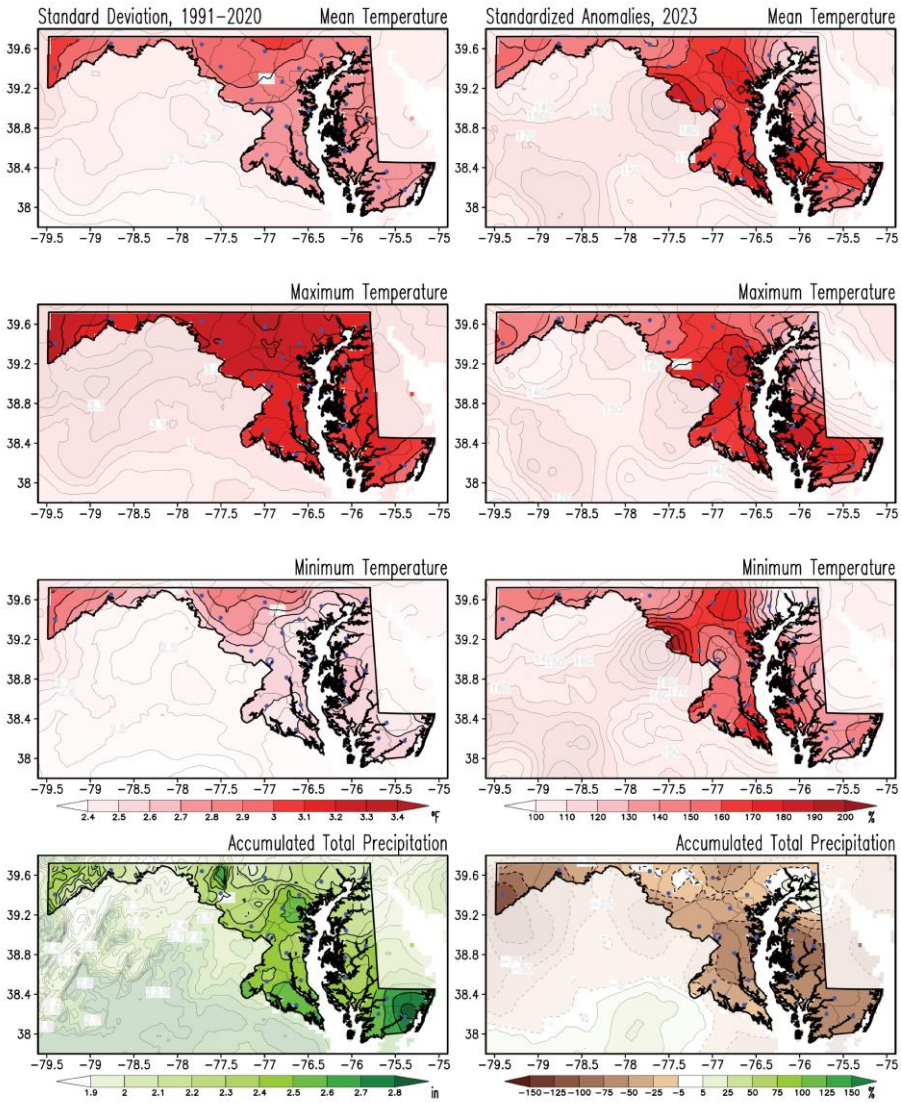

Figure E1. Standard deviation for winter and standardized anomalies of temperatures and precipitation for winter 2022-23. Standard deviations for seasonal mean, maximum, and minimum surface air temperatures and accumulated total precipitation were obtained for the 1991-2020 period (left column). Anomalies for winter 2022-23 (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. 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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