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Maryland Climate Bulletin
August 2022

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DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCE

Maryland State Climatologist Office

Summary

August 2022 was warmer and drier than normal in average, when compared with the 1991-2020 climatology. These conditions appeared after an anomalously warm and wet July. Regional differences showed that temperature anomalies over the coastal plain counties along the Chesapeake Bay were larger than in other counties, especially over Dorchester, Wicomico and Cecil counties. Regional differences in precipitation showed that Harford and Cecil counties and western and northern Garrett and Allegany counties received more precipitation than other counties; these counties were wetter than normal while the rest of the state was drier than normal, especially over Montgomery and Frederick counties and Saint Mary's, Calvert, Dorchester, Wicomico, Somerset and Worcester counties. The slightest above normal precipitation over the northwestern counties alleviated the abnormally dry conditions of the previous month but the below normal precipitation over the southeastern shore counties of Dorchester, Wicomico, Somerset and Worcester seems to be behind the abnormally dry and moderate drought conditions over these counties. Statewide temperature conditions in August 2022 were well above the mean and median of the historical 1895-2021 record and within 10% of the largest of the historical data; precipitation was below the mean and median of the historical 1895-2021 record and it was short of making into to the lower 25% of the lowest precipitation data.

Contents

1. Introduction

This bulletin is issued by the Maryland State Climate Office once per month in order to indicate in a brief format the most recent monthly surface climatic conditions in the state. Maryland is a state of great geographic diversity with miles of streams and rivers, beaches, coastal flatlands and wetlands, hills, valleys and mountains. This range of physiographic features, together with the land and water distribution and the placement of the state within the continental U.S., contribute to a comparatively wide range of climatic conditions thus the importance of their monitoring. This bulletin is addressed to all Marylanders so they can stay current with the latest climate conditions impacting their lives.

The monthly surface climate conditions for August 2022 are presented via maps of a set of variables such as mean surface air temperature, maximum surface air temperature, minimum surface air temperature, total precipitation, and their anomalies, that are complemented with drought conditions for the state, as given by the U.S. Drought Monitor (Sections 3). Statewide averages in August 2022 are contrasted against the historical record via box and whisker plots and scatter plots (Sections 4). Then statewide and climate division averages for the month are contrasted against each other via scatter plots (Section 5). Ancillary information at statewide, climate divisions and county levels are given via tables and plots, and via maps in Appendices A-D.

2. Data

Surface air temperature and total precipitation data in this report are from the following sources:

- NOAA Monthly U.S. Climate Gridded Dataset at 5km horizontal resolution (NClimGrid – Vose et al. 2014), which are given in a *preliminary* status, and available at:

  https://www.ncei.noaa.gov/data/nclimgrid-monthly/access/
  Data downloaded on 9/9/2022.

- NOAA Monthly U.S. Climate Divisional Dataset (NClimDiv – Vose et al. 2014), which is available, in a *preliminary* status (v1.0.0-20220907), at:

  https://www.ncei.noaa.gov/data/climdiv/access/
  Data downloaded on 9/10/2022

The drought conditions map is from the U.S. Drought Monitor site and available at:

https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Some useful notes are the following.

About the anomalies. Anomalies for a given month (i.e. August 2022) are the difference of the monthly values with respect to the long-term mean of the 30 months (i.e. Augusts) in the period 1991-2020; this 30-year mean is known as the climate normal, or just the climatology for short. When a value exceeds its climatological value, it is usually referred as an above normal (e.g., warmer than normal or wetter than normal) anomaly, or positive anomaly, while when the value is smaller than its climatological value, it is referred as a below normal (e.g., colder than normal or dryer than normal) anomaly, or negative anomaly.

About NOAA's Climate Divisions. The term "climate division" refers to one of the 8 divisions in the state that represent climatically homogeneous regions, as determined by NOAA:

https://www.ncei.noaa.gov/access/monitoring/dyk/us-climate-divisions

These regions are the following:

- 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, and Montgomery, as well as 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.

3. August 2022 Maps

A. Mean Temperatures

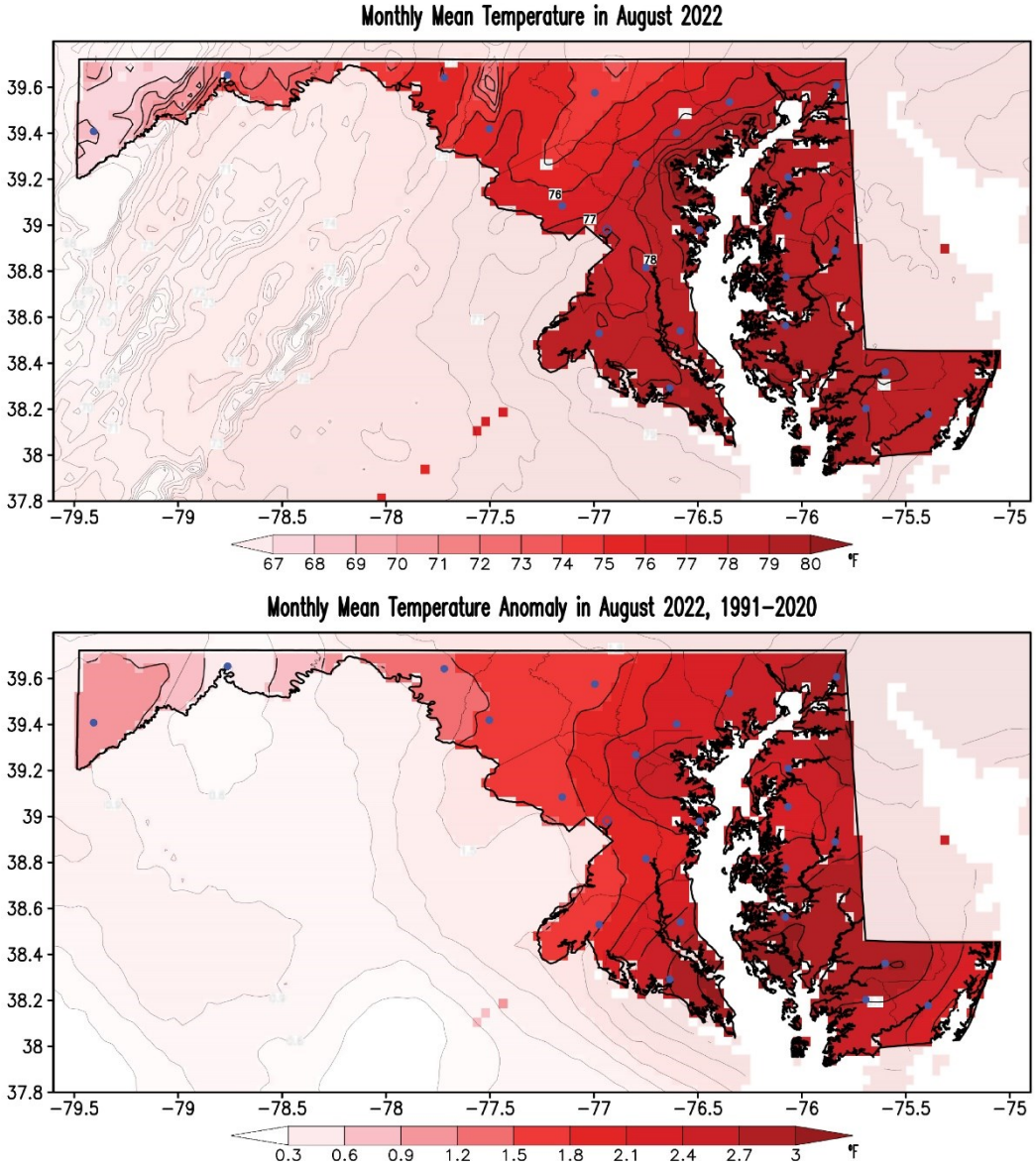

Figure 1. Mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in August 2022. Temperatures are given in °F according to the color bars. Red shading in the anomaly map shows above normal conditions. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly mean temperatures are starting to decrease slightly in August 2022. Temperatures along the coastal plains were warmer (~78-88°F) than over the North Central and Appalachian Mountains climate divisions (~72-75°F) and Garrett County (~68-69°F). The mean temperatures over the state were again warmer than normal. Anomalies over southern Saint Mary's, Calvert and western Dorchester counties reached 3.0 °F, over eastern Cecil and Kent counties reached 2.7°F and over Allegany County 0.6°F; appendices A and B show the area-averaged values. The largest anomalies reached and surpassed the regional year-to-year variability over the counties along the Chesapeake Bay (Appendix D).

B. Maximum Temperatures

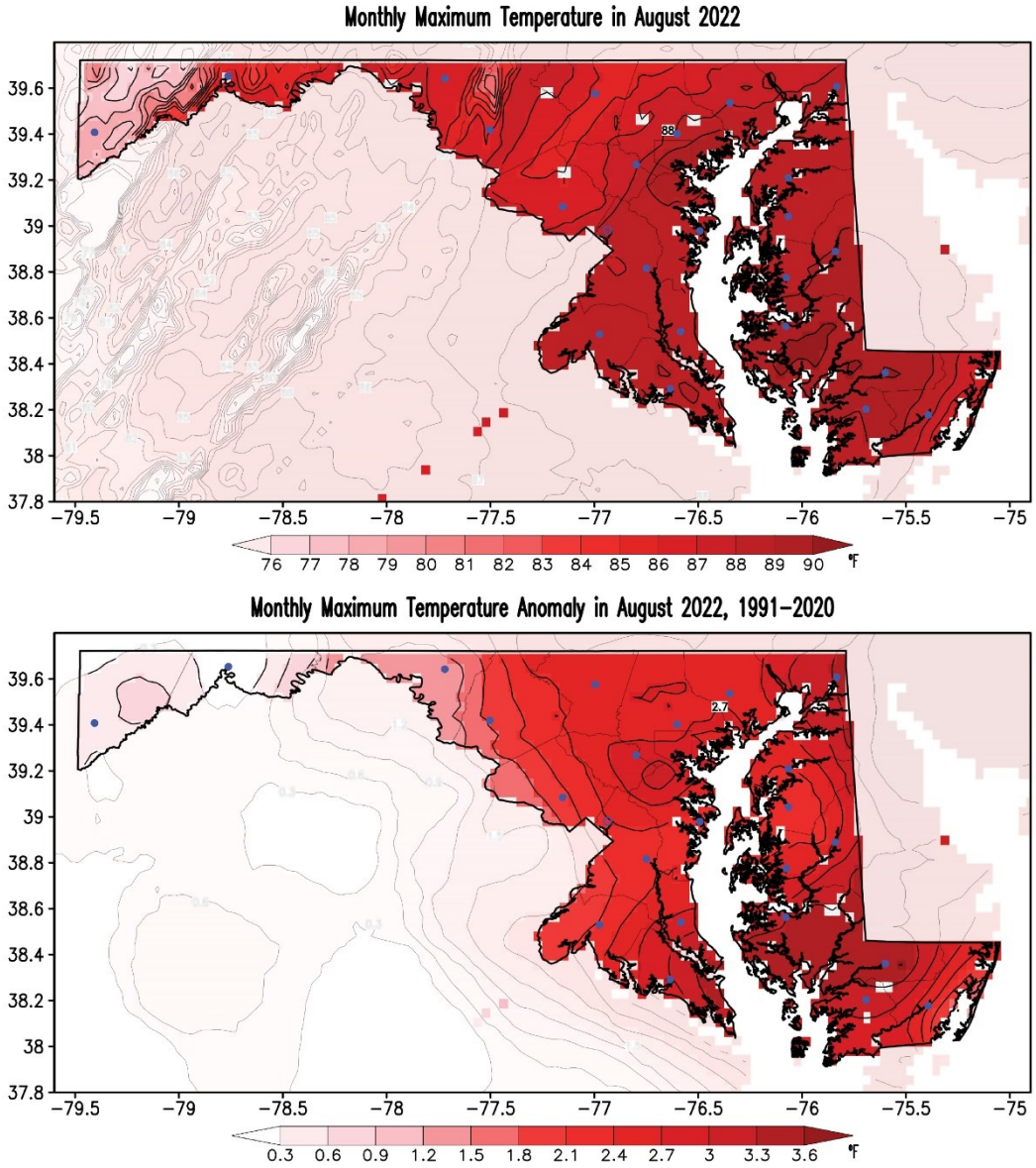

Figure 2. Maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in August 2022. Temperatures are given in °F according to the color bars. Red shading in the anomaly map shows above normal conditions. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly mean maximum temperatures in August 2022 had the same structure than the mean temperatures with maximum values over the coastal plains (~88-90°F) and minimum values over Frederick County (~82°F) and Garrett County (~76-78°F). Maximum temperatures were above normal everywhere in the state, with maximum over Dorchester, Wicomico and Cecil counties (~3.3-3.6°F) and minimum values over Allegany County (0.6°F); appendices A and B show the area-averaged values. The largest anomalies reached and surpassed the regional year-to-year variability over the counties along the Chesapeake Bay (Appendix D).

C. Minimum Temperatures

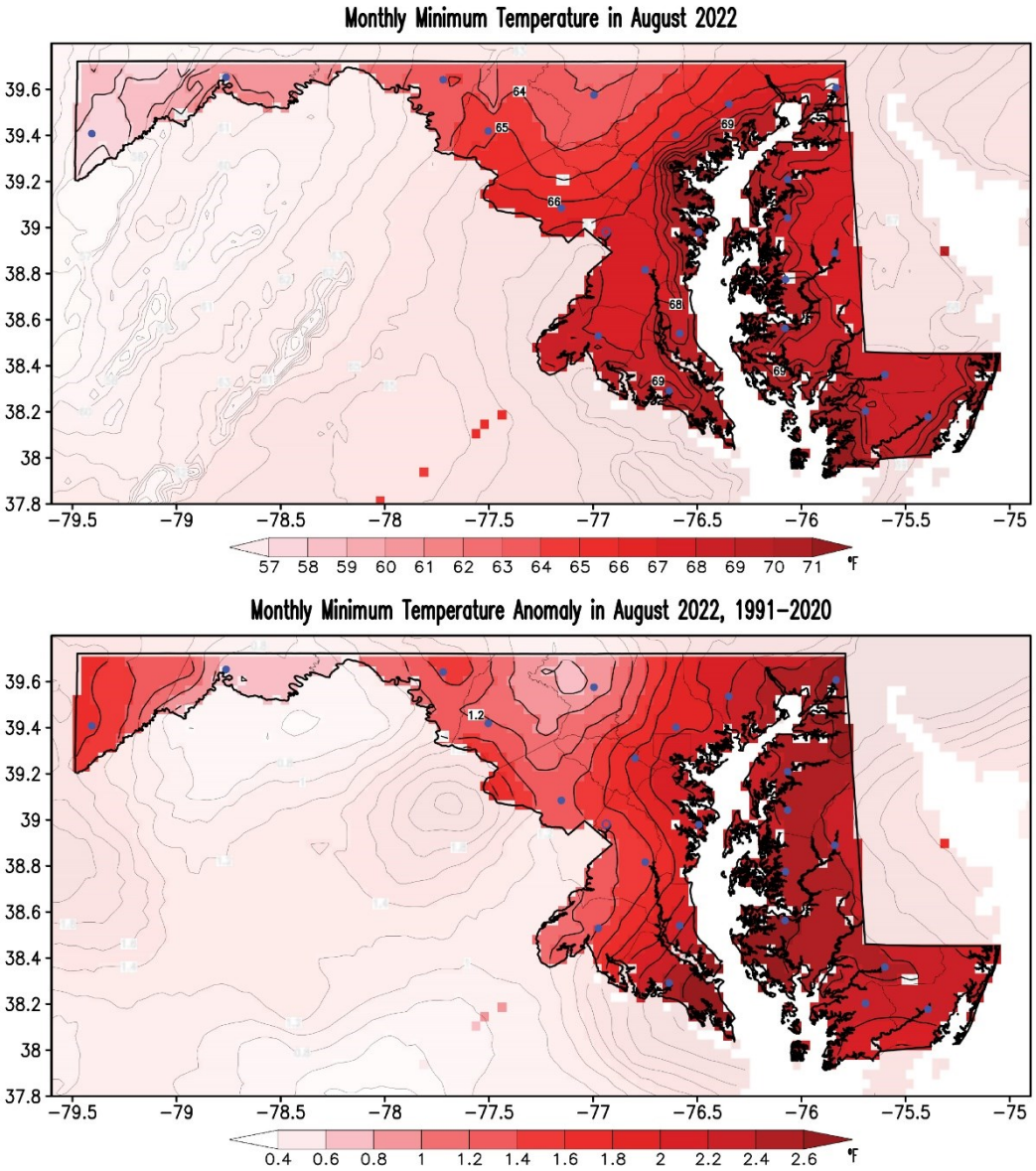

Figure 3. Minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in August 2022. Temperatures are given in °F according to the color bars. Blue/red shading in the anomaly map shows below/above normal conditions. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly mean minimum temperatures in August 2022 reached minimum values over Garrett County (~58°F) and maximum values along the coasts of the Chesapeake Bay (~68-71°F). The minimum temperatures over the majority of the state were warmer than normal too, especially over southern Saint Mary's, Calvert, Cecil and western Dorchester counties (~ 2.6°F). Anomalies over Allegany and Carroll counties reached the lowest values (~0.6°F); appendices A and B show the area-averaged values. Anomalies to the east of the Bay reached the year-to-year variability (Appendix D).

D. Precipitation

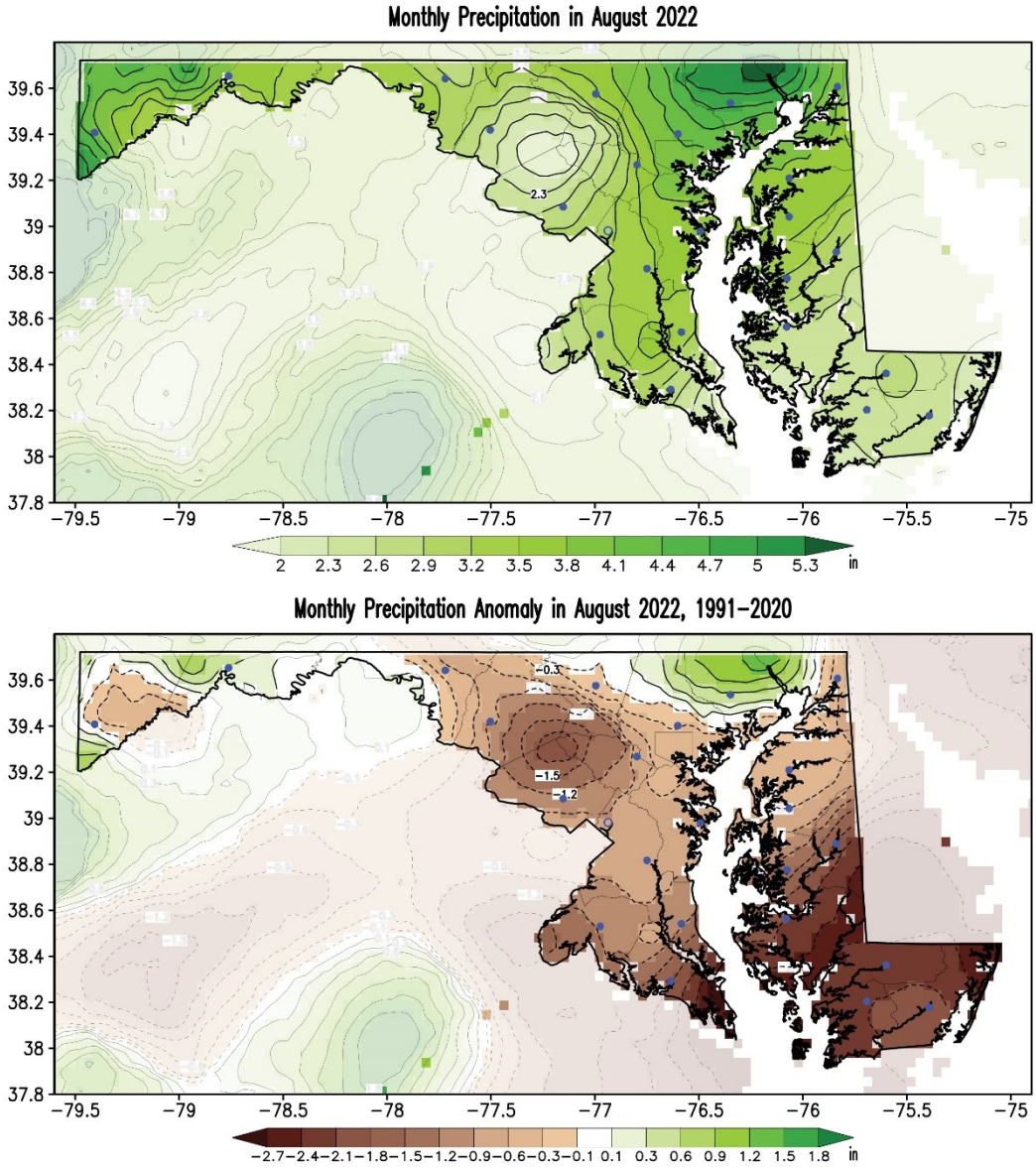

Figure 4. Precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in August 2022. Precipitation units are given as inches according to the color bars. Brown/green shading in the anomaly map shows below/above normal conditions. Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

Monthly total precipitation in August 2022 reached maximum values over a few northern counties. Precipitation was maximum over Harford and Cecil counties (~5-5.3 in) and over western and northern Garrett and Allegany counties (4.1-5 in) and it was minimum over southern coastal counties (2.0-2.6 in) and Montgomery and Frederick counties (~2.0 in). Similarly, the largest positive anomalies were over the cited northern counties, and the maximum negative anomalies were over Saint Mary's, Calvert, Dorchester, Wicomico, Somerset and Worcester counties (-2.1 to -2.7 in), and over Montgomery and Frederick counties (-1.8 in); appendices A and B show the area-averaged values. The regions of negative anomalies over Montgomery and Frederick counties exceed the year-to-year variability (Appendix D).

E. Drought

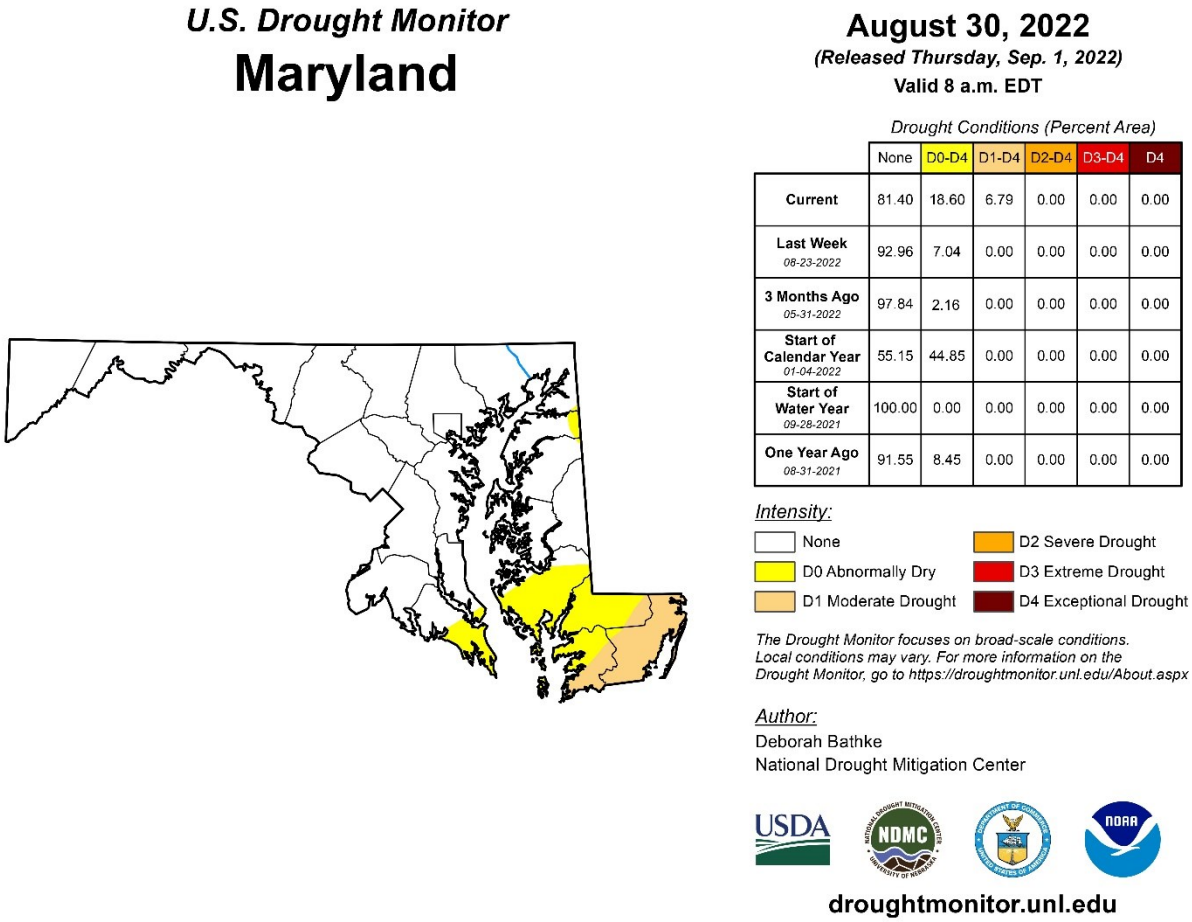

Figure 5. Drought conditions as reported by the U.S. Drought Monitor on August 30, 2022.

Drought conditions at the end of August 2022 indicate that the abnormally conditions over Garrett, Allegany and Washington counties seen in July have disappeared but abnormally dry conditions, and even a moderate drought, are present over the southeastern shore counties now. The decrease in precipitation and increased temperatures over the southeastern shore counties of Dorchester, Wicomico, Somerset and Worcester seem to be behind the observed abnormally dry and moderate drought conditions at the end of this month. While under the abnormally dry conditions surface water levels decline, crops are stunted, gardens begin to wilt and fire danger is elevated, under moderate drought conditions reservoir and lake levels are below normal capacity, trees, landscaping and fish are stressed, hay, grain yields and honey production are lower than normal or decline and irrigation use increases.

4. August 2022 Statewide Averages in the Historical Record

A. Box and Whisker Plots

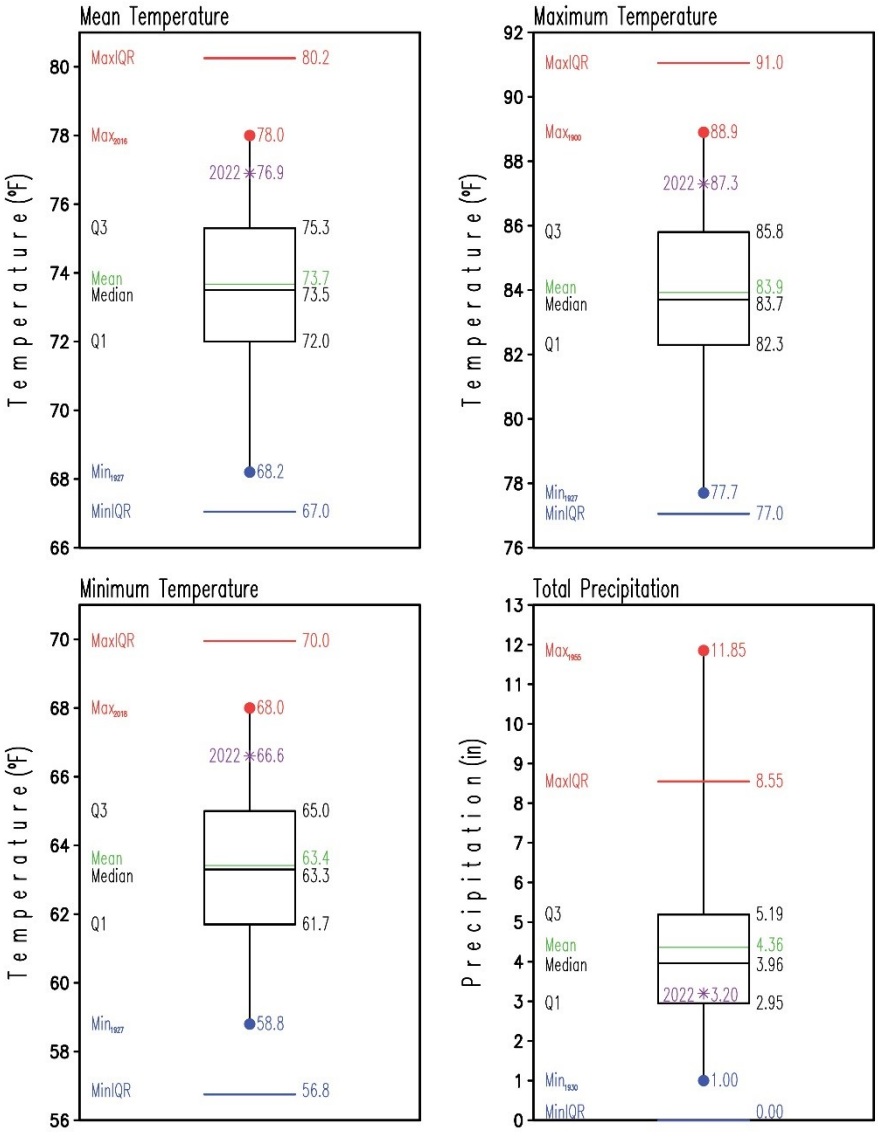

Figure 6. Box and Whisker plots of Maryland statewide mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures and total precipitation (lower right) in August for the period 1895-2021. Conditions in August 2022 are represented by the label and asterisk in purple within the boxes. Statistics for the period 1895-2021 are labeled at the left side of each box and whisker plot and their values at their right. 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 respectively, are the lower and upper horizontal black lines of the box respectively. The minimum and maximum values in the period are marked by the blue and red dots at the end of the whiskers; the year of occurrence is shown as a subscript to their labels. The blue and red horizontal lines represent extreme values defined by Q1-1.5×(Q3-Q1) and Q3+1.5×(Q3-Q1), respectively.

Statewide temperatures (76.9, 87.3, 66.6°F) in August 2022 were above the mean and median of the 1895-2021 historical record within the ~10% of the largest values, while precipitation was below the mean and median. Thus, in the historical context, August 2022 was warmer and drier.

B. Scatter Plots

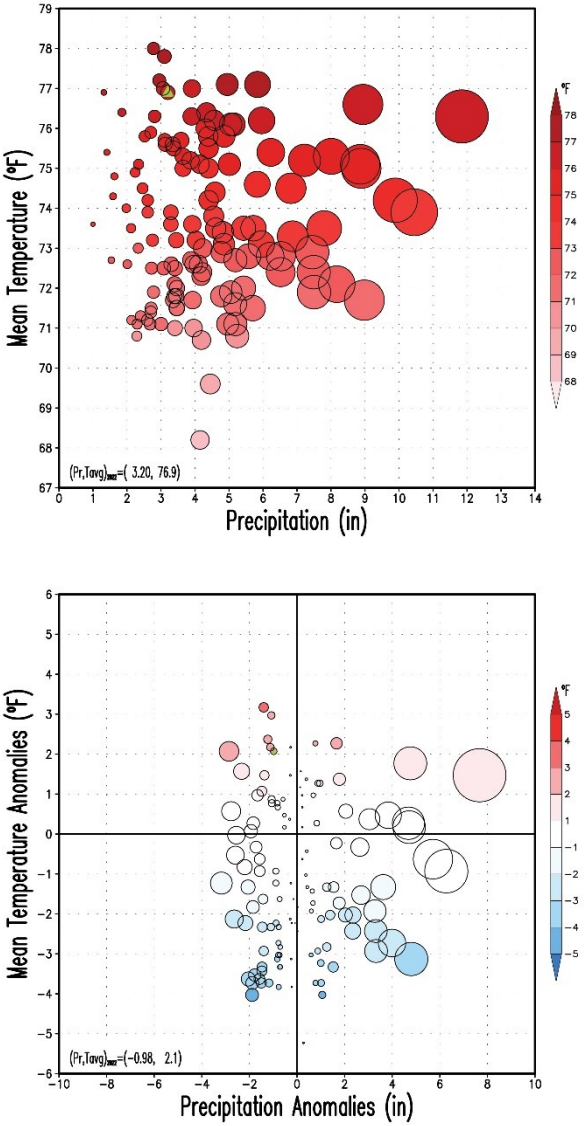

Figure 7. Scatter plot of averaged Maryland statewide mean surface air temperature vs total precipitation in August for the period 1895-2022. Upper panel shows the mean temperature and total precipitation in August, and bottom panel displays their anomalies with respect to the 1991-2020 climatology. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation on record (11.85 in in 1955, top panel) and by the maximum precipitation anomaly (7.67 in in 1955, bottom panel). The red shading of the circles in the top panel denotes temperatures above 32°F, and the blue/red shading of the circles in the bottom panel denotes below/above climatology. August 2022 is marked by the yellow/green filled triangle.

The statewide total precipitation and mean temperature of 3.20 in and 76.9°F, as also indicated by the box and whisker plots, are within the upper and left side of the data cloud in the historical record of 128 years. The statewide anomalies, with respect to the current 1991-2020 climatology, of -0.98 in and 2.1 °F also indicate an anomalous dry and very warm August 2022. The ranking of the temperatures and precipitation in August 2022 within the historical record at state, climate division and county level are displayed in the tables in Appendix A.

5. August and JJA 2022 Climate Divisions Averages

A. August 2022 Scatter Plots

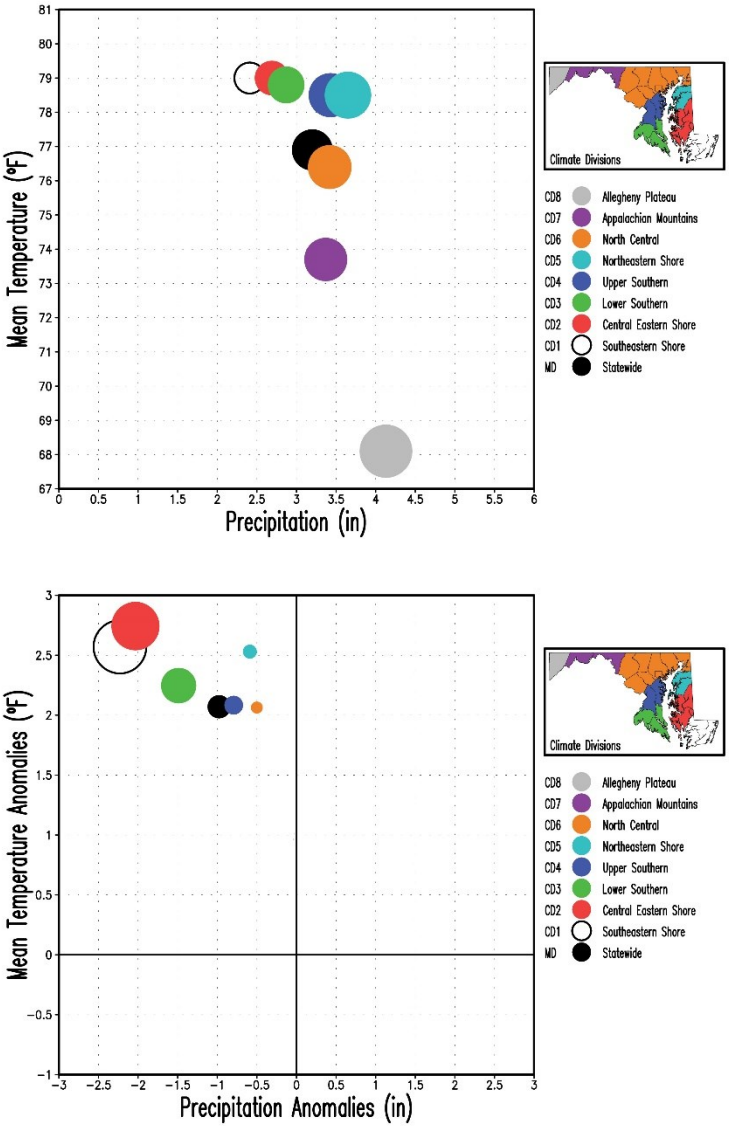

Figure 8. Scatter plot of averaged Maryland statewide and Climate Divisions (CD#) mean surface air temperature vs total precipitation for August 2022. Upper panel shows the mean temperature and total precipitation, and bottom panel displays their anomalies with respect to the 1991-2020 climatology. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (4.13 in in CD8, top panel) and by the maximum precipitation anomaly (|-2.23| in 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.

The northern climate divisions (CD6-CD8) are colder than the central and southern divisions (CD1-CD5) and the statewide mean, with CD8 been the coldest, and CD1 been the warmest among them. The driest division was CD1 and closely CD2 and CD3, while CD8 was the wettest. It is clear that all climate divisions experienced warmer and drier than normal conditions but the Southeastern Shore and Central Eastern Shore climate divisions CD1 and CD2 were the driest than normal. The values of the surface variables and their anomalies at state, climate division and county level are displayed in Appendix B bar graphs.

B. June-July-August 2022 Scatter Plots

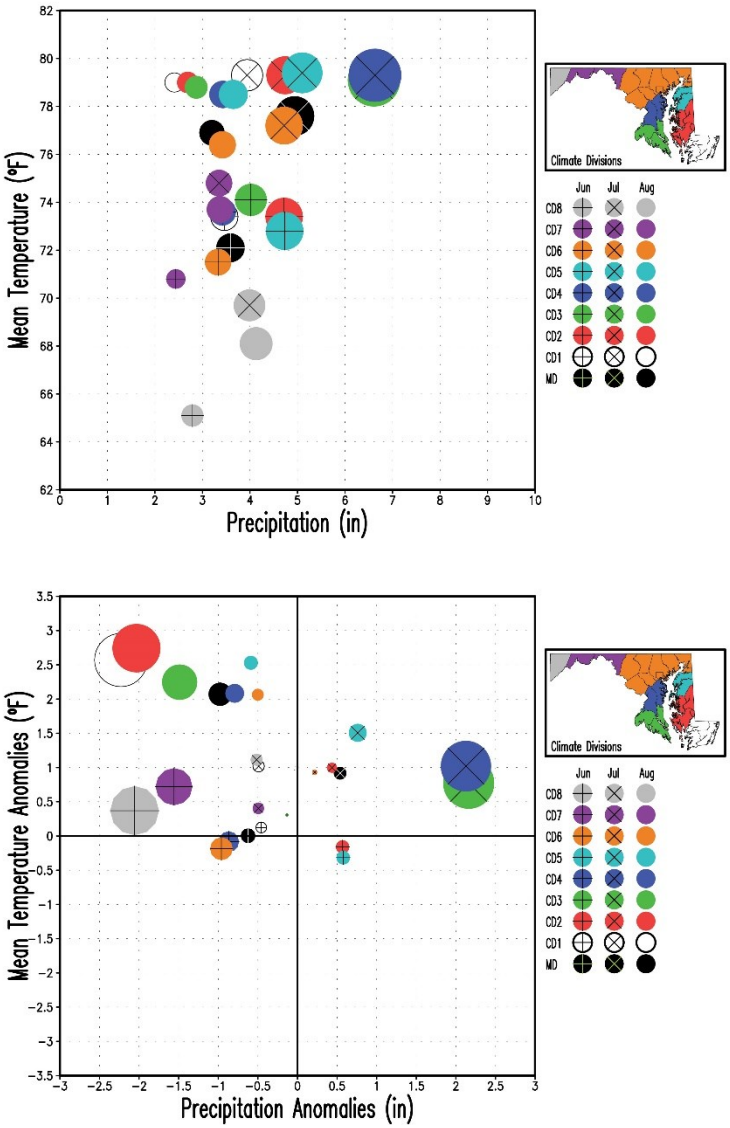

Figure 9. Scatter plot of averaged Maryland statewide and Climate Divisions (CD#) mean surface air temperature vs total precipitation for June, July and August 2022. Upper panel shows the mean temperature and total precipitation, and bottom panel displays their anomalies with respect to the 1991-2020 climatology. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (6.63 in in CD4 in July, top panel) and by the maximum precipitation anomaly (|-2.23| in in CD1 in August, bottom panel) among the nine regions and months. Note that August is displayed with filled circles only, while July and June are displayed with superposed multiplication and addition signs respectively.

Mean temperatures and precipitation, after peaking in July, decreased statewide in August 2022. Mean temperatures were above normal in the past three months, but anomalies in August doubled those in July. While the state was drier than normal in June and recovered with a wetter than normal July, especially over CD3 and CD4 climate divisions, the state was drier than normal in August, particularly over the southeastern climate divisions CD1 and CD2 which may explain the observed abnormal dryness and moderate drought conditions in these divisions.

Appendix A. August 2022 Tables: Statewide, Climate Divisions and Counties

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)
Statewide	76.9	120
Climate Division 1	79.0	125
Climate Division 2	79.0	124
Climate Division 3	78.8	123
Climate Division 4	78.5	122
Climate Division 5	78.5	124
Climate Division 6	76.4	121
Climate Division 7	73.7	99
Climate Division 8	68.1	96
Allegany	72.6	95
Anne Arundel	79.0	122
Baltimore	76.8	121
Baltimore City	79.1	123
Calvert	78.9	124
Caroline	78.3	124
Carroll	74.8	115
Cecil	78.0	128
Charles	78.4	119
Dorchester	79.5	125
Fredrick	75.2	108
Garrett	68.1	95
Harford	77.5	126
Howard	76.3	122
Kent	78.7	125
Montgomery	76.3	118
Prince George's	78.0	120
Queen Anne's	78.4	124
Saint Mary's	79.2	124
Somerset	79.5	125
Talbot	79.0	124
Washington	74.8	103
Wicomico	79.1	125
Worcester	78.6	124

Region	Total Precipitation (in)	Rank (#)
Statewide	3.20	39
Climate Division 1	2.41	21
Climate Division 2	2.69	28
Climate Division 3	2.87	33
Climate Division 4	3.43	53
Climate Division 5	3.65	57
Climate Division 6	3.42	51
Climate Division 7	3.37	66
Climate Division 8	4.13	75
Allegany	3.60	76
Anne Arundel	3.60	58
Baltimore	4.00	66
Baltimore City	3.90	65
Calvert	3.10	42
Caroline	2.80	40
Carroll	3.10	47
Cecil	4.30	78
Charles	2.90	37
Dorchester	2.40	23
Fredrick	2.50	30
Garrett	4.10	74
Harford	4.70	88
Howard	2.80	36
Kent	3.70	58
Montgomery	2.40	27
Prince George's	3.30	53
Queen Anne's	3.60	56
Saint Mary's	2.70	35
Somerset	2.30	16
Talbot	3.10	45
Washington	3.10	55
Wicomico	2.50	23
Worcester	2.30	18

Tables A1. Mean surface air temperature (left) and total precipitation (right) at statewide, climate division and county levels in August 2022. Temperature is given in °F and precipitation in in. The rank is the order that the variable in August 2022 occupies among the 128 Augusts after the 128 values have been arranged from the lowest to the highest value by using the standard competition ranking method. The closer to 128 is the rank, the larger the value of the surface variable is in the record.

B. Maximum and Minimum Temperatures

Region	Maximum Air Temperature (°F)	Rank (#)
Statewide	87.3	120
Climate Division 1	88.8	127
Climate Division 2	89.4	125
Climate Division 3	88.7	120
Climate Division 4	88.4	120
Climate Division 5	88.5	124
Climate Division 6	87.1	119
Climate Division 7	85.5	94
Climate Division 8	78.2	75
Allegany	84.5	81
Anne Arundel	88.6	121
Baltimore	87.6	122
Baltimore City	89.1	123
Calvert	88.5	123
Caroline	89.2	125
Carroll	86.2	114
Cecil	88.1	127
Charles	88.6	115
Dorchester	89.7	125
Fredrick	86.2	112
Garrett	78.2	75
Harford	87.8	124
Howard	87.2	119
Kent	88.5	124
Montgomery	86.6	115
Prince George's	88.3	119
Queen Anne's	88.4	124
Saint Mary's	88.8	121
Somerset	89.0	127
Talbot	88.8	123
Washington	86.4	101
Wicomico	89.6	126
Worcester	87.9	125

Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	66.6	116
Climate Division 1	69.3	116
Climate Division 2	68.7	121
Climate Division 3	68.9	116
Climate Division 4	68.5	115
Climate Division 5	68.4	122
Climate Division 6	65.7	113
Climate Division 7	61.9	100
Climate Division 8	58.0	107
Allegany	60.6	94
Anne Arundel	69.4	121
Baltimore	66.1	120
Baltimore City	69.1	120
Calvert	69.2	119
Caroline	67.4	118
Carroll	63.3	107
Cecil	67.9	121
Charles	68.3	112
Dorchester	69.3	121
Fredrick	64.2	102
Garrett	58.0	106
Harford	67.2	120
Howard	65.4	113
Kent	68.9	124
Montgomery	66.0	109
Prince George's	67.7	112
Queen Anne's	68.4	122
Saint Mary's	69.6	120
Somerset	70.0	117
Talbot	69.3	121
Washington	63.2	106
Wicomico	68.6	117
Worcester	69.3	116

Tables A2. Maximum (left) and minimum (right) surface air temperatures at statewide, climate division and county levels in August 2022. Temperature is given in °F. The rank is the order that the variable in August 2022 occupies among the 128 Augusts after the 128 values have been arranged from the lowest to the highest value by using the standard competition ranking method. The closer to 128 is the rank, the larger the value of the surface variable is in the record.

Appendix B. August 2022 Bar Graphs: Statewide, Climate Divisions and Counties

A. Temperatures and Precipitation

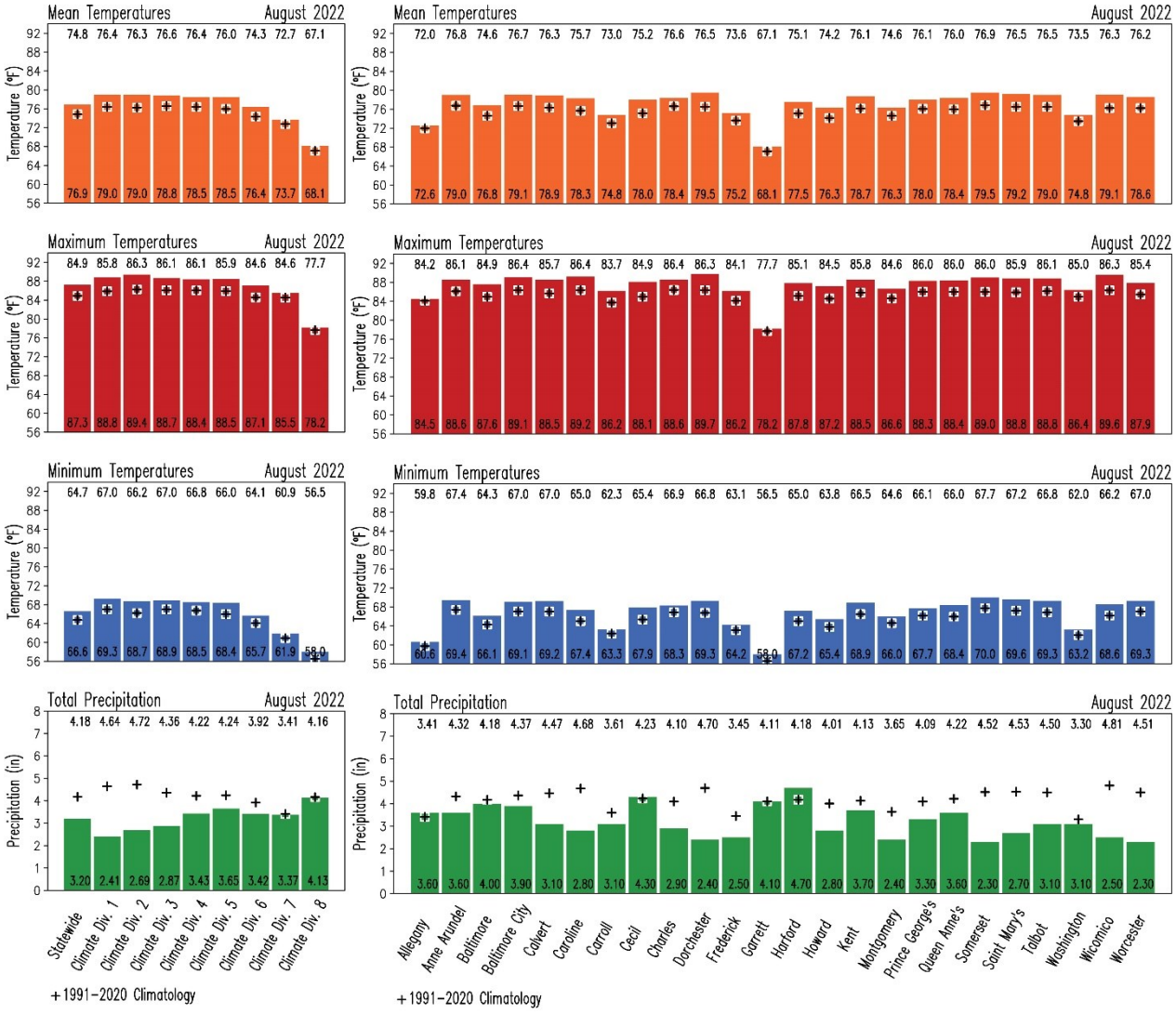

Figure B1. Area-averaged surface variables in Maryland in August 2022. Color bars represent the variables as follows: mean surface air temperature (orange, °F), maximum surface air temperature (red, °F), minimum surface air temperature (blue, °F) and total precipitation (green, in) at statewide and climate divisions (left column), and at county (right column) level. The numbers at the base of the bars indicate the magnitude of the variable in August 2022. For comparison, the corresponding 1991-2020 climatological values for August are displayed as black addition signs, and their magnitude are shown at the top of the panels.

B. Temperature and Precipitation Anomalies

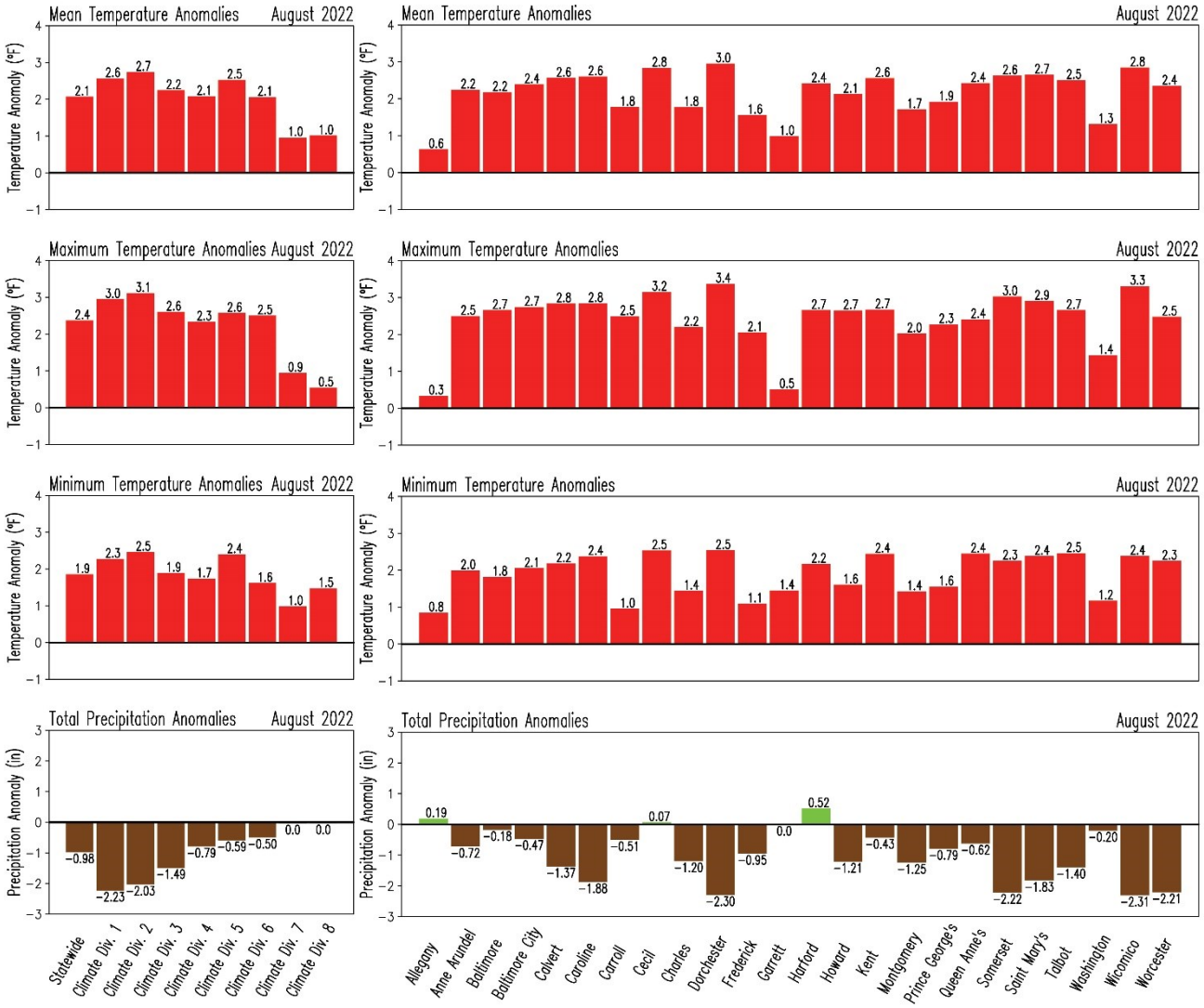

Figure B2. Area-averaged anomalies of the surface variables in Maryland in August 2022. Anomalies are with respect to the 1991-2020 climatology. Red and blue colors represent positive and negative anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top), and minimum surface air temperature (third row from top) while green and brown colors indicate positive and negative anomalies in total precipitation (bottom row) at statewide and climate divisions (left column), and at county (right column) level. The numbers outside of the bars indicate the magnitude of the anomaly in August 2022. Units are °F for the temperatures and in for precipitation.

Appendix C. August 1991-2020 Climatology Maps

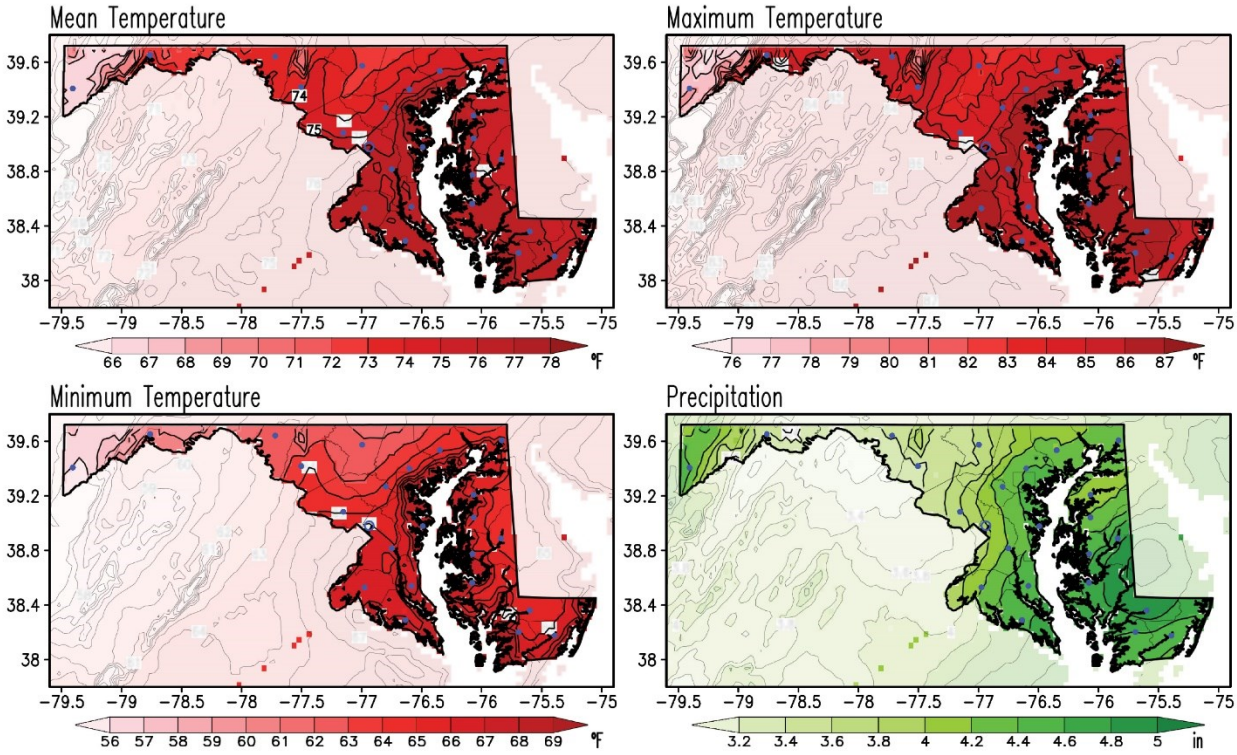

Figure C1. August climatology of the mean, maximum and minimum surface air temperatures and total precipitation for the period 1991-2020. Temperatures are given in °F and precipitation is in inches according to the color bars. This is the current climate normal against which the August 2022 conditions are compared with to obtain the August 2022 anomalies. Note that shading outside the state has been washed out for clarity purposes. 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.) and ocean (sea-level, sea surface temperature, etc.) at any given time, while 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 a 30-year period 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). The establishment of a climate normal or climatology is important as it allows one to compare a specific day, month, season, or even another period normal 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. August Standard Deviation and August 2022 Standardized Anomalies Maps

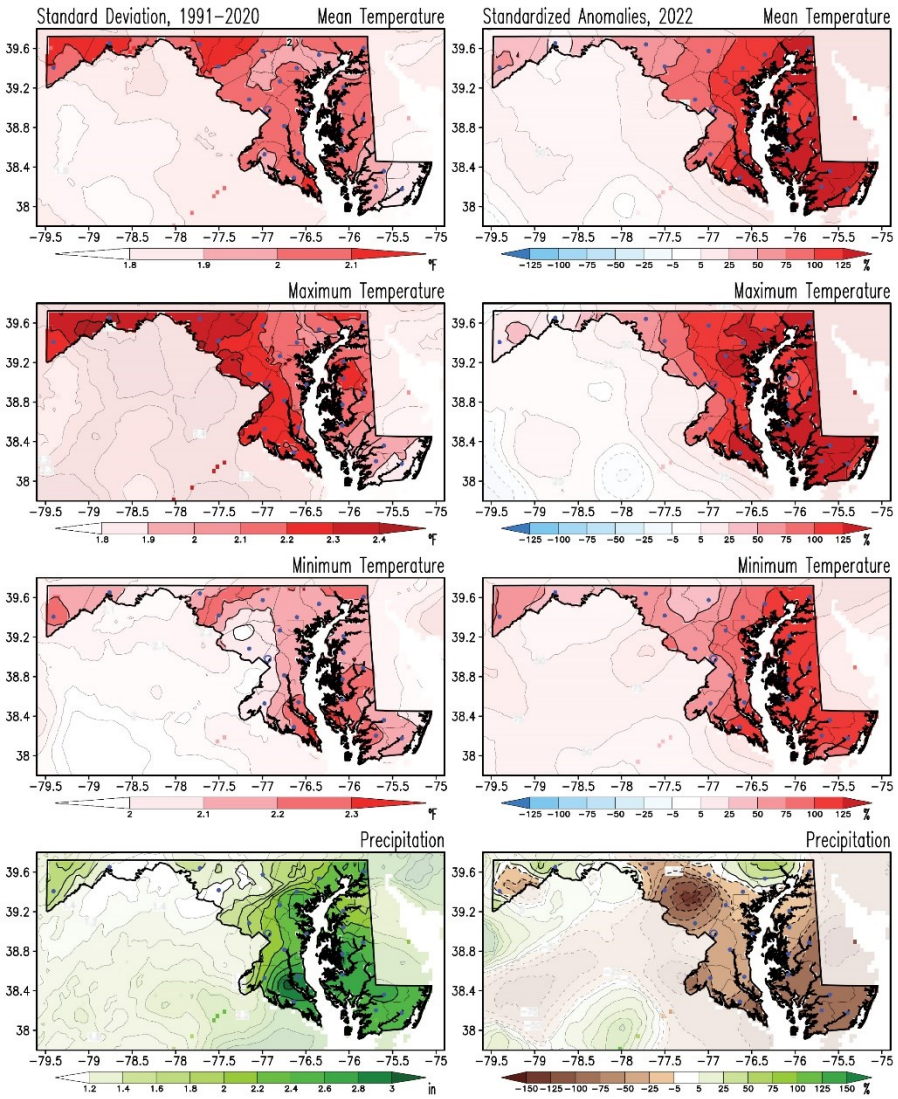

Figure D1. Standard deviation in August and standardized anomalies of temperatures and precipitation in August 2022. Standard deviations for mean, maximum and minimum surface air temperatures and precipitation are obtained for the period 1991-2020 (left column). Anomalies in August 2022 (right column) are obtained as percentage of the standard deviations. The standard deviations in temperatures are given 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, so units are in percent (%). Note that shading outside the state has been washed out for clarity purposes. Filled blue circles mark the county seats.

The standard deviation is a measure of the year-to-year, or interannual, variability of a climate variable. In this case the standard deviation is calculated for the same period as the climatology. Anomalies sometimes are compared against that variability in order to identity extremes in the climate record. When the anomalies are divided by the standard deviation they are named *standardized anomalies*.

References

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