Maryland Climate Bulletin
March 2022

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DEPARTMENT OF
ATMOSPHERIC &
OCEANIC SCIENCE

Maryland
State
Climatologist
Office

Summary

Maryland's south got warmer and wetter than the north in March 2022. However, the drier and warmer than normal conditions observed in February persisted in March. Warmer than normal conditions were present statewide. Maximum surface air temperature anomalies surpassed the year-to-year variability in the southern half of the state (~southward of Baltimore City), while minimum surface air temperature anomalies did it in the southernmost counties of both shores (~southward of Prince Frederick). Precipitation, on the other hand, was only wetter than normal in the southernmost counties but it was much drier than normal in the rest of the state, with negative anomalies larger than the year-to-year variability in counties to the northwest and northeast of Baltimore City. As a consequence of this anomalously low precipitation, and previous dry conditions in February, almost the whole state (~89%) was identified by the U.S. Drought monitor as an anomalously dry region and a few regions in the north and south with moderate drought (~10%). Statewide temperatures were among the 25% of the largest temperatures in the historical 1895-2021 record, however precipitation was very close to the 25% of the smallest values in the record.

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 March 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 March 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 temperatures 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 4/20/2022

- NOAA Monthly U.S. Climate Divisional Dataset (NClimDiv – Vose et al. 2014), which are given in a *preliminary* status, and are available at:

  https://www.ncei.noaa.gov/data/climdiv/archive/
  Data downloaded on 4/6/2022

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. March 2022) are the difference of the monthly values with respect to the long-term mean of the 30 months (i.e. Marchs) 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.
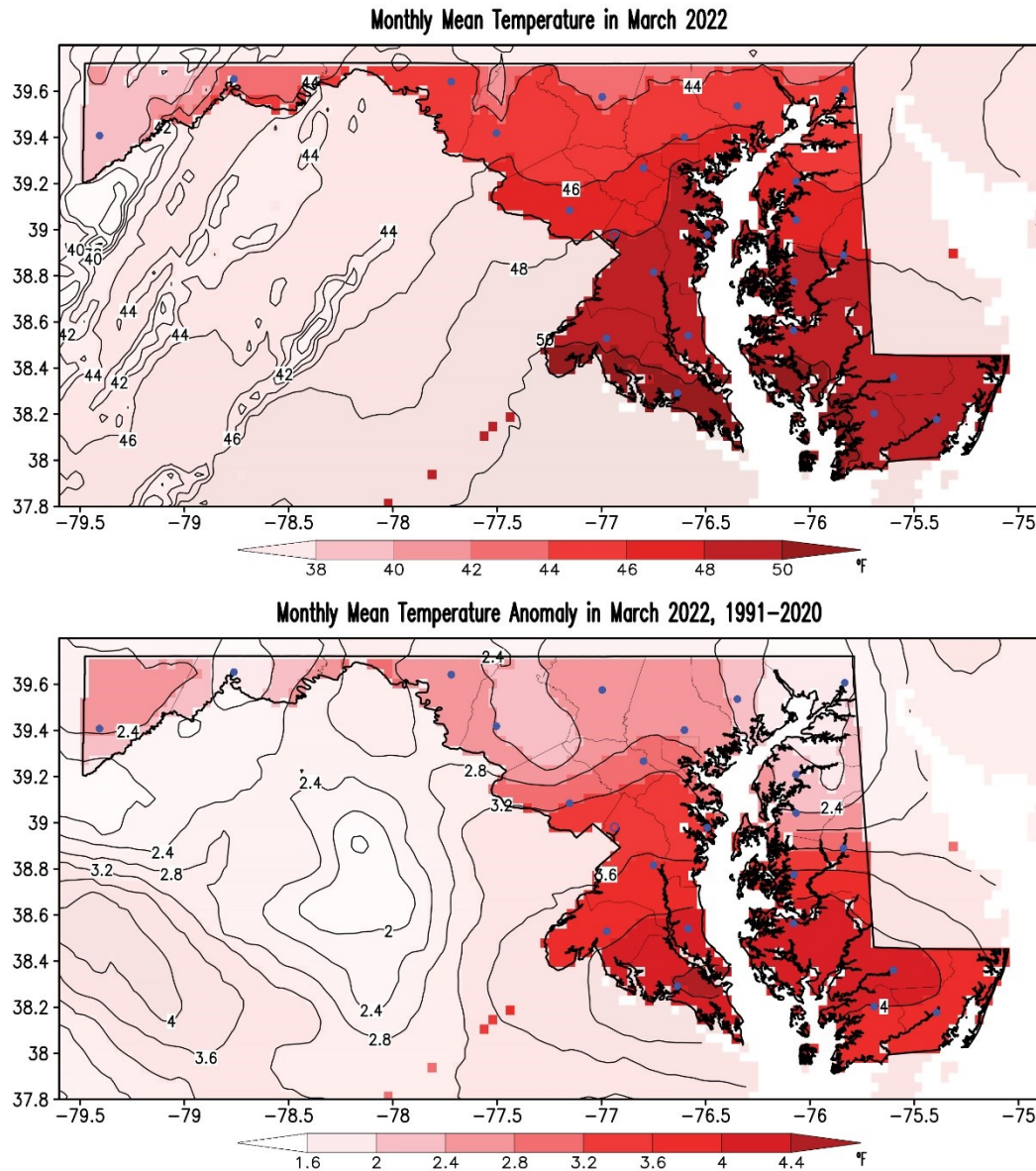
3.   March 2022 Maps

A. Mean Temperature

Figure 1. Mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in March 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 in March 2022 increased from south to north. Temperatures along the coastal plains of the eastern and western shore were warmer (~46-50°F) than over the North Central climate division (~44°F) and the mountainous western Maryland over Garret County (~42°F). The mean temperatures over the whole extent of the state were warmer than the climatology, especially over southern portions of the western and eastern shores with a focus over St. Mary's, Dorchester and Wicomico counties (+4°F); appendices A and B show the area-averaged values. Maximum anomalies surpassed the regional year-to-year variability not only in these counties but in counties south of ~39°N (Appendix D).
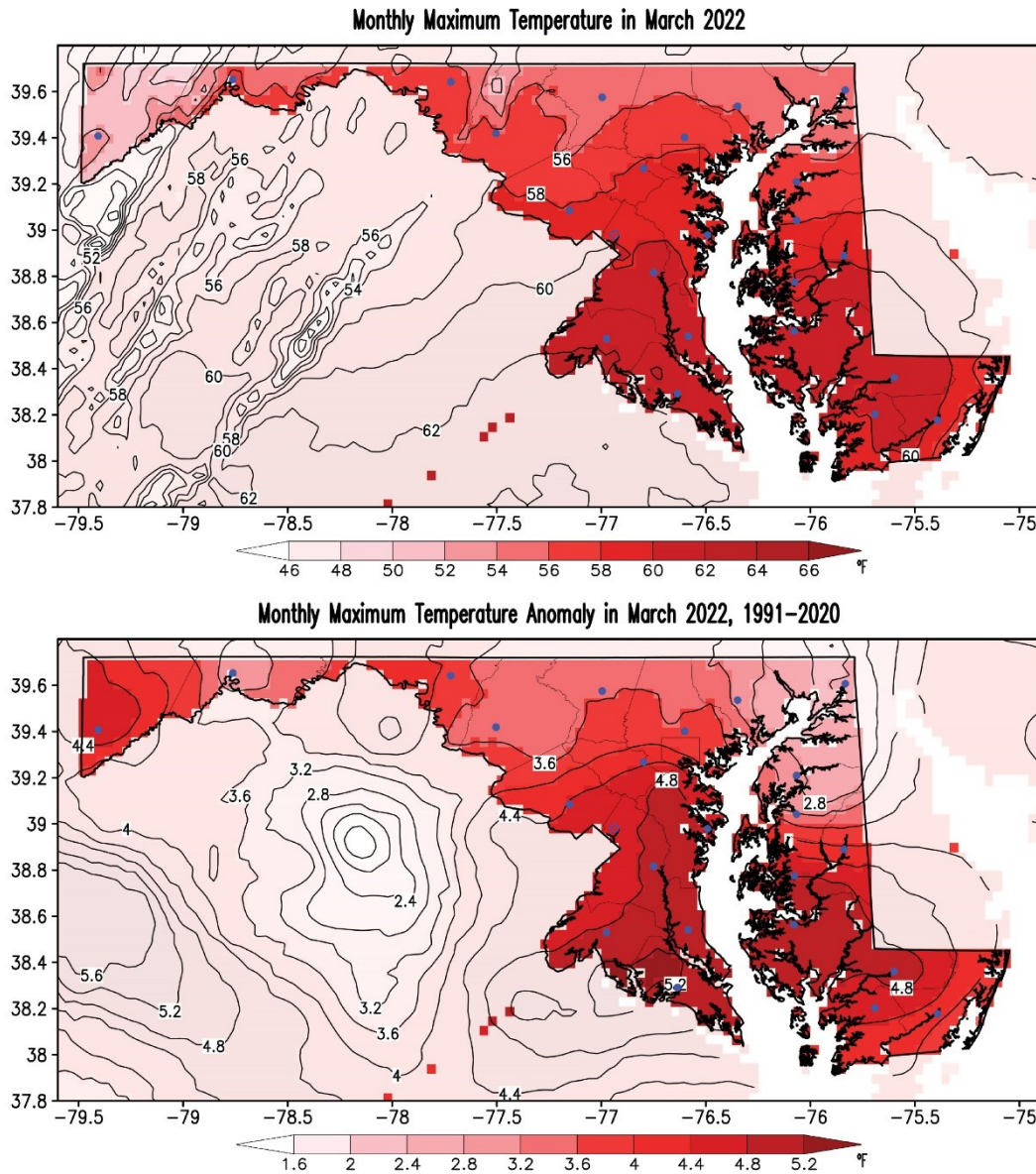
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B. Maximum Temperature

Figure 2. Maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in March 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 March 2022 follow the same structure than the mean temperatures with maximum values over the coastal plains (~62°F) and minimum values over western Maryland (~50-52°F). Maximum temperatures over the whole state were also warmer than the climatology with maximum anomalies over Saint Mary's county (+5.2°F) and the southern coastal plains over Anne Arundel, eastern Prince George's Calvert, Charles, Dorchester and Wicomico counties (+5.2°F). Maximum anomalies surpassed the year-to-year variability in these counties (Appendix D).
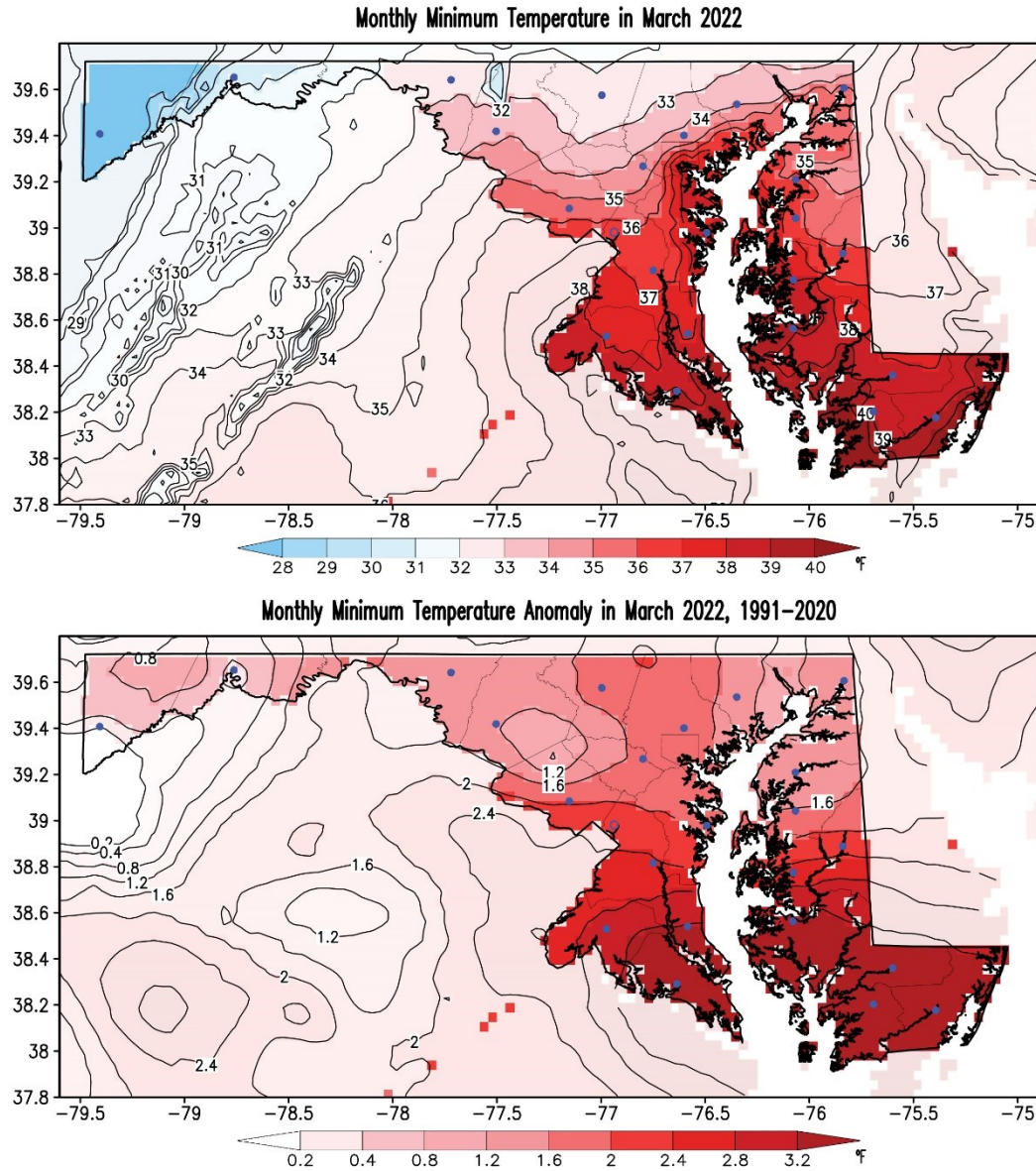
C. Minimum Temperatures

Figure 3. Minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in March 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 March 2022 were at the freezing mark or below over western Maryland (~30-32°F) over Garret and Allegany counties only. The highest values were over the coastal plains along the coasts of the Chesapeake Bay (~38°F). Minimum temperatures however, exceeded the climatological values of March everywhere in the state as it was the case for the mean and maximum temperatures. Minimum temperature anomalies were largely above normal over the coastal plains, with maximum values over Charles and St. Mary's, Dorchester, Wicomico, Somerset and Worcester counties (+2.8°F). Anomalies were larger than the year-to-year variability in the southern tips of these counties (Appendix D).

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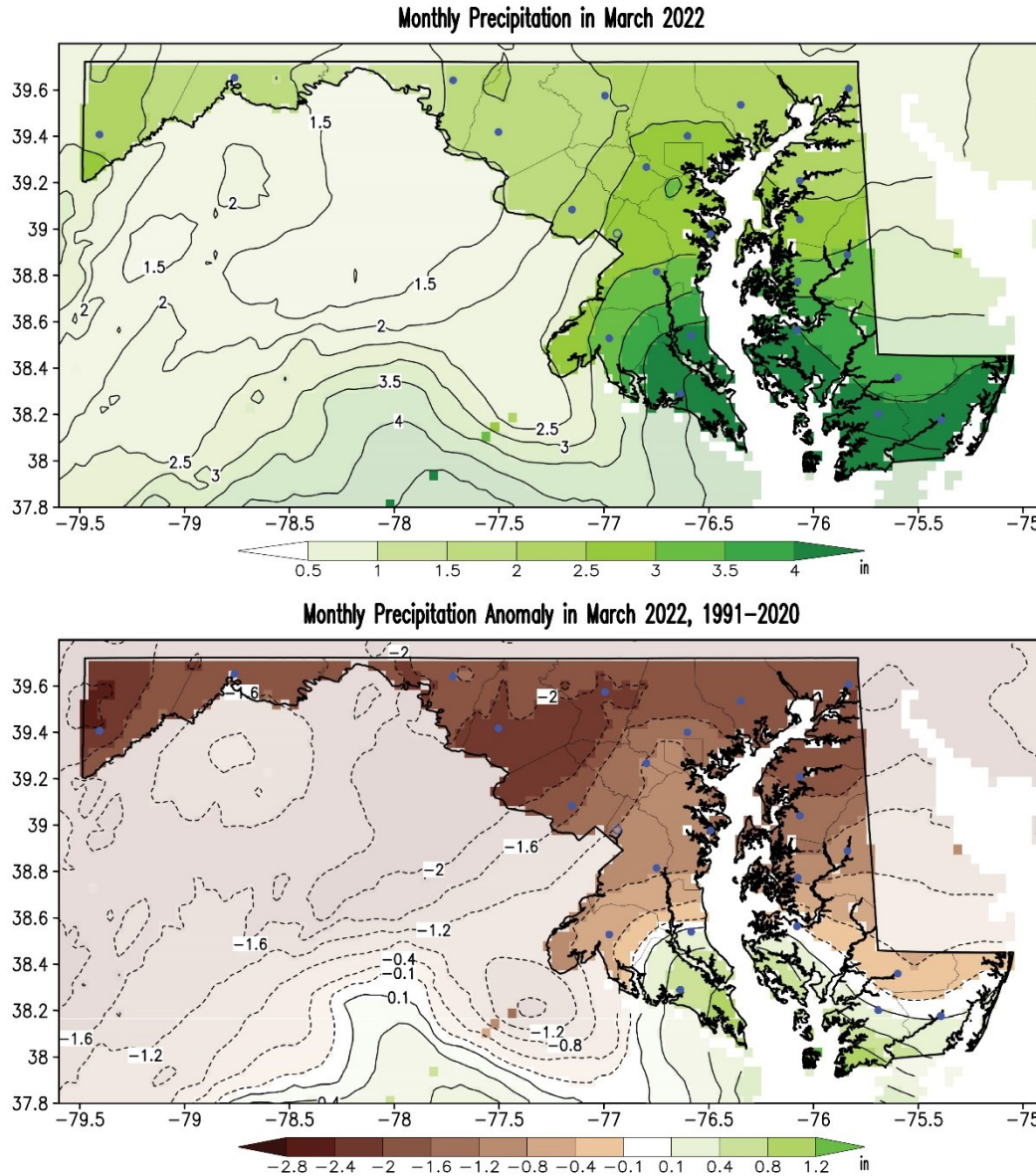
D. Precipitation

Figure 4. Precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) in March 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 March 2022 was larger than in February, especially over the western and eastern shores of the Bay. Precipitation was maximum over the southern counties of St. Mary's, Dorchester, Somerset, Wicomico and Worcester (4 in). However, precipitation was smaller than normal in large parts of the state except in the southern tips of the mentioned counties. The deficit in precipitation reached maximum values in Garrett, southern Frederic and contiguous Carroll and Montgomery counties (~-2in). Precipitation anomalies exceeded the year-to-year variability over the northern counties west of Baltimore County (Appendix D).

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E. Drought

U.S. Drought Monitor
Maryland

April 5, 2022
(Released Thursday, Apr. 7, 2022)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	11.07	88.93	9.80	0.00	0.00	0.00
Last Week 03-29-2022	11.35	88.65	5.15	0.00	0.00	0.00
3 Months Ago 01-04-2022	55.15	44.85	0.00	0.00	0.00	0.00
Start of Calendar Year 01-04-2022	55.15	44.85	0.00	0.00	0.00	0.00
Start of Water Year 09-28-2021	100.00	0.00	0.00	0.00	0.00	0.00
One Year Ago 04-06-2021	86.85	13.15	0.00	0.00	0.00	0.00

Intensity:

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

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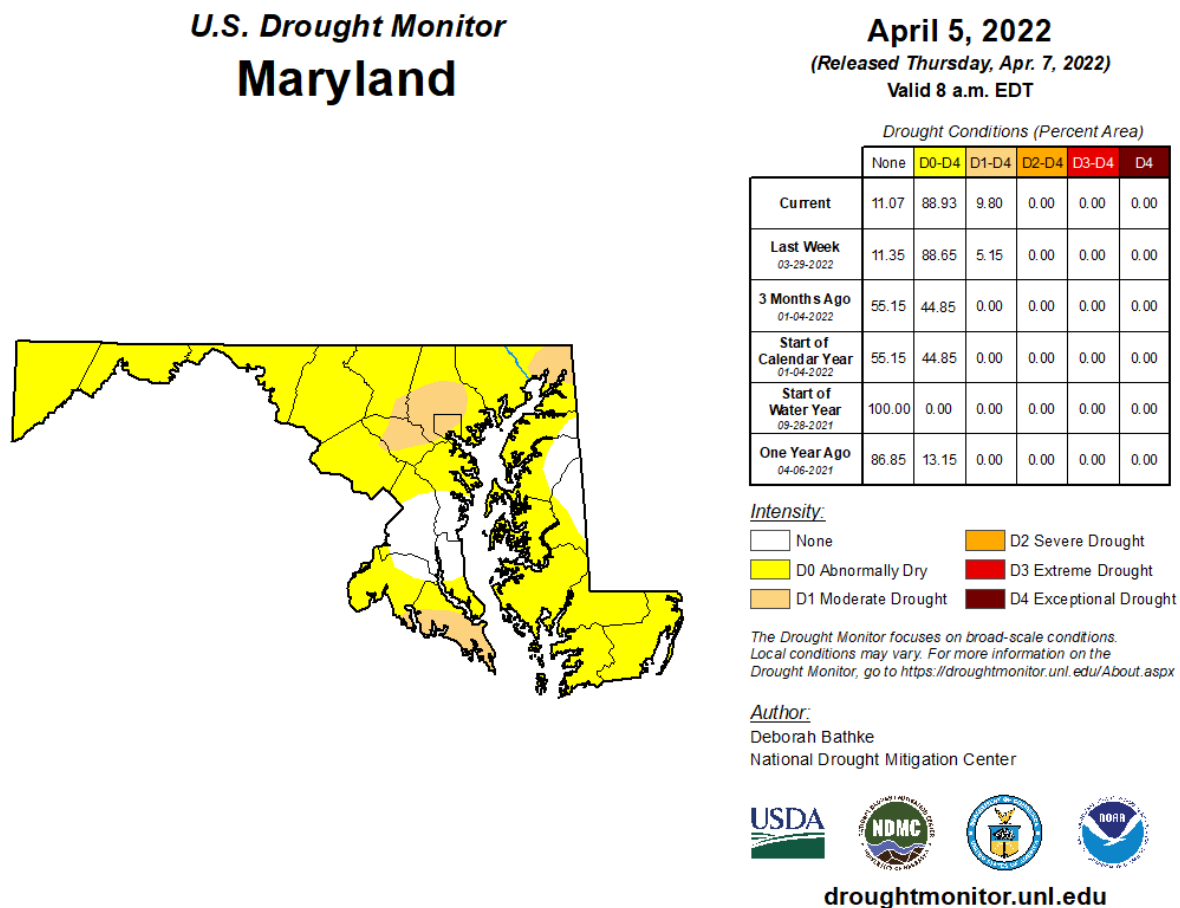National Drought Mitigation Center

droughtmonitor.unl.edu

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

Drought conditions start to show in some regions at the end of March and start of April 2022. The anomalously low precipitation in February and March 2022 are now imposing abnormally dry conditions almost statewide (~89% of the state area) where fire danger is elevated and surface water levels decline as portrayed by the drought monitor. While some regions over Prince George's, Anne Arundel, Calvert, Caroline and Queen Anne's counties show no indication of dryness (~11% of the state area), the drought monitor identifies some regions with moderate drought (~10% of the state area) over Baltimore, Howard, Cecil and Saint Mary's counties where water supplies may be low in rivers, reservoirs and wells, and some damage may occur in crops and pastures.

4. March 2022 Statewide Averages in the Historical Record
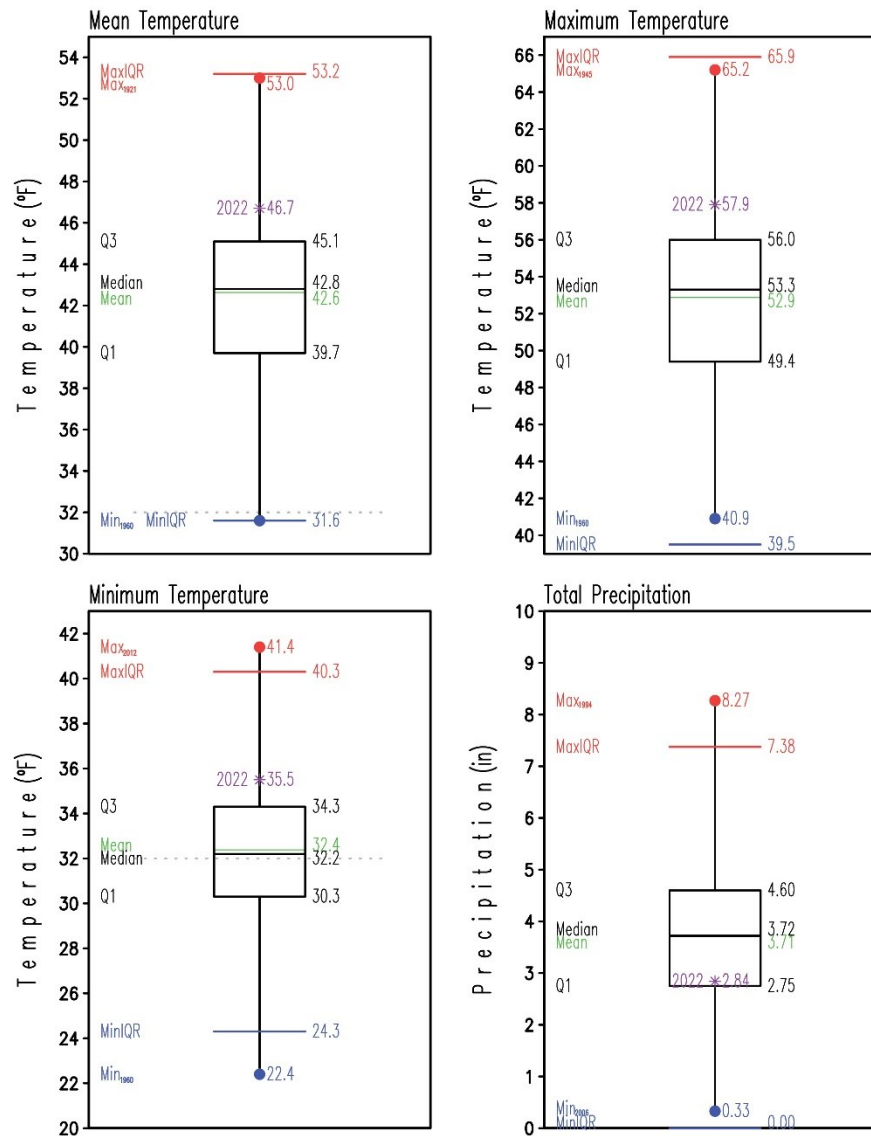
A. Box and Whisker Plots

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 March for the period 1895-2021. Conditions in March 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.

While the warm temperatures are not extreme, they are among the 25% of the largest temperatures in the historical 1895-2021 record. Precipitation however, is almost among the 25% of the smallest values in the record.
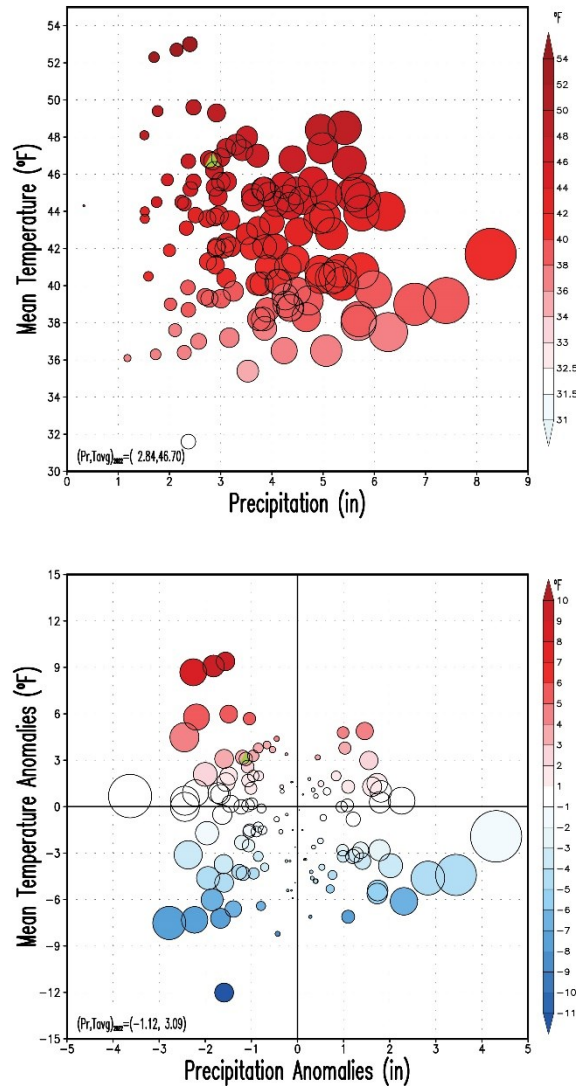
Figure 7. Scatter plots of averaged Maryland statewide mean surface air temperature vs total precipitation for the period 1895-2022. Upper panel shows the March mean temperature and total precipitation, and bottom panel displays their anomalies with respect to the 1991-2020 climatology. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation on record (8.27 in in 1994, top panel) and by the maximum precipitation anomaly (4.31 in in 1994, bottom panel). The blue/red shading of the circles denotes temperatures below/above 32°F in the top panel and below/above climatology in the bottom anomaly panel. March 2022 is marked by the yellow/green filled triangle.

The statewide total precipitation and mean temperature of 2.84 in and 46.7°F cannot be considered extreme conditions when put in context of the historical record of 128 years. The statewide precipitation and mean temperature anomalies of -1.12 in and 3.09 °F indicate that March was even drier and warmer than February 2022 (-0.61 in, 2.44 °F; updated). The ranking of the temperatures and precipitation in March 2022 within the historical record at state, climate division and county level are displayed in the tables in Appendix A.

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5.   March and JFM 2022 Climate Divisions Averages
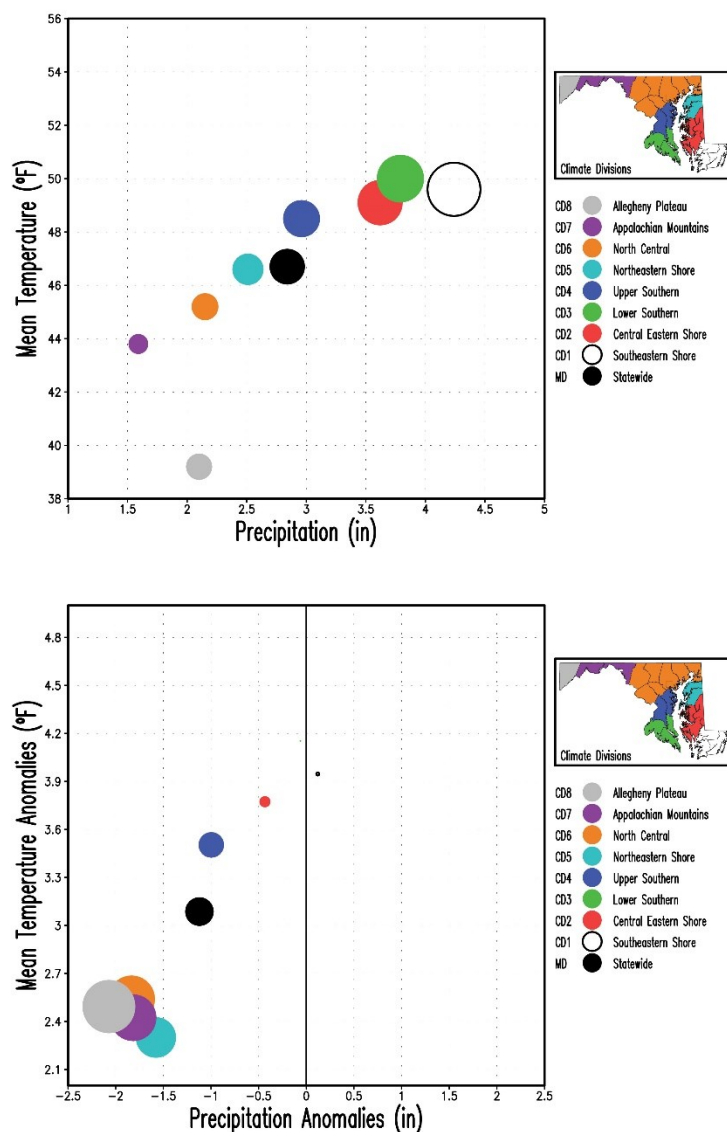
A. March 2022 Scatter Plots

Figure 8. Scatter plot of averaged Maryland statewide and Climate Divisions (CD#) mean surface air temperature vs total precipitation for March 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 (4.24 in in CD1, top panel) and by the maximum precipitation anomaly (|-2.07| in 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.

The farther to the north in the state, the drier and colder was March 2022 (as opposed to the wetter and colder conditions of February). As mentioned in the anomaly maps, the whole state was warmer than normal and almost the whole state was below normal precipitation, except for the Southeastern Shore division (CD1). The values of the surface variables and their anomalies at state, climate division and county level are displayed in Appendix B bar graphs.
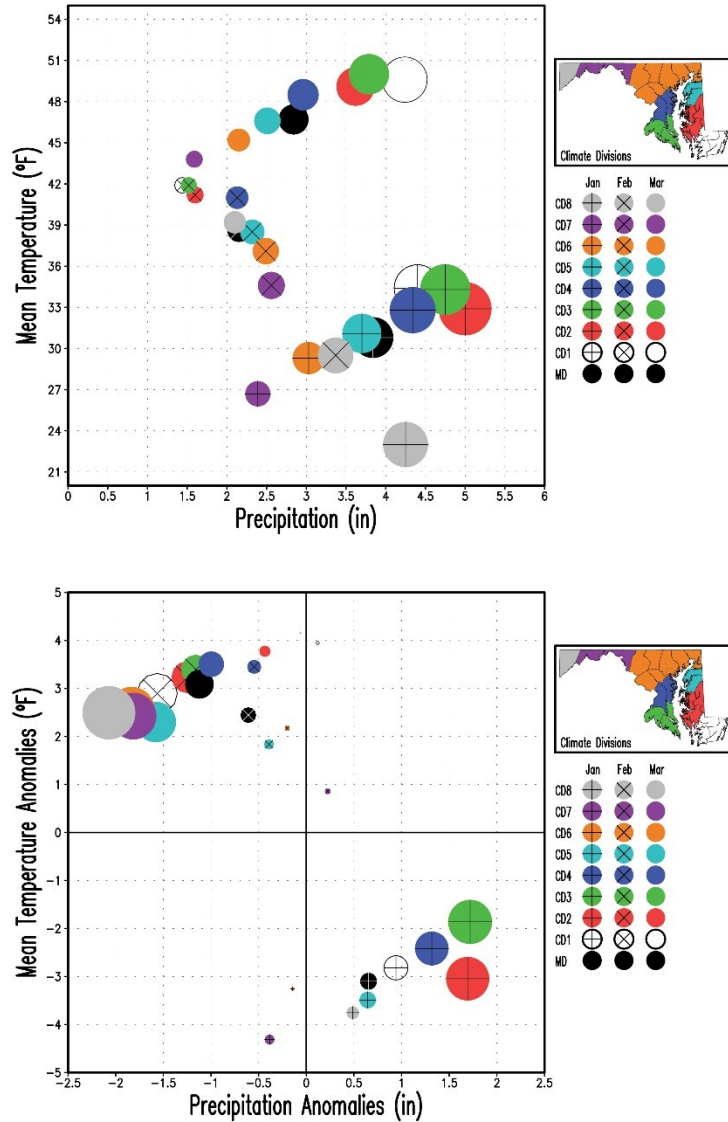
B. January-February-March 2022 Scatter Plots

Figure 9. Scatter plot of averaged Maryland statewide and Climate Divisions (CD#) mean surface air temperature vs total precipitation for January to March 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 (5.00 in in CD2 in January, top panel) and by the maximum precipitation anomaly (|-2.07| in in CD8 in March, bottom panel) among the nine regions. Note that March 2022 is displayed with filled circles only, while February and January are displayed with superposed multiplication and addition signs respectively.

As expected, March 2022 was warmer than February and January however it was wetter than February but drier than January. Among these three months, anomalous conditions shifted from colder and wetter than normal in January to drier and warmer than normal in February and March.

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

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)	Region	Total Precipitation (in)	Rank (#)
Statewide	46.7	109	Statewide	2.84	35
Climate Division 1	49.6	121	Climate Division 1	4.24	84
Climate Division 2	49.1	118	Climate Division 2	3.62	62
Climate Division 3	50.0	119	Climate Division 3	3.79	77
Climate Division 4	48.5	113	Climate Division 4	2.96	48
Climate Division 5	46.6	105	Climate Division 5	2.51	29
Climate Division 6	45.2	108	Climate Division 6	2.15	18
Climate Division 7	43.8	100	Climate Division 7	1.59	12
Climate Division 8	39.2	101	Climate Division 8	2.10	8
Allegany	42.9	98	Allegany	1.60	11
Anne Arundel	48.4	113	Anne Arundel	2.90	45
Baltimore	45.4	108	Baltimore	2.40	26
Baltimore City	47.5	113	Baltimore City	2.80	45
Calvert	49.5	119	Calvert	4.10	85
Caroline	48.1	113	Caroline	3.00	47
Carroll	44.1	107	Carroll	1.90	14
Cecil	44.7	101	Cecil	2.30	26
Charles	49.9	114	Charles	3.10	56
Dorchester	49.8	120	Dorchester	4.00	76
Fredrick	44.6	105	Fredrick	1.70	11
Garrett	39.2	101	Garrett	2.10	8
Harford	44.8	105	Harford	2.30	26
Howard	45.9	108	Howard	2.40	30
Kent	46.3	105	Kent	2.30	26
Montgomery	46.6	108	Montgomery	1.90	17
Prince George's	48.5	111	Prince George's	3.00	54
Queen Anne's	47.0	108	Queen Anne's	2.60	31
Saint Mary's	50.2	120	Saint Mary's	4.40	89
Somerset	49.9	121	Somerset	4.50	85
Talbot	49.0	116	Talbot	3.30	52
Washington	44.6	106	Washington	1.50	9
Wicomico	49.7	121	Wicomico	3.80	66
Worcester	49.2	120	Worcester	4.20	83

Table A1. Mean surface air temperature (left) and total precipitation (right) at statewide, climate division and county levels in March 2022. Temperature is given in °F and precipitation in in. The rank is the order that the variable in March 2022 occupies among the 128 Marchs 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 (#)	Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	57.9	114	**Statewide**	35.5	106
Climate Division 1	59.9	120	**Climate Division 1**	39.2	117
Climate Division 2	60.3	121	**Climate Division 2**	38.0	114
Climate Division 3	61.4	121	**Climate Division 3**	38.5	113
Climate Division 4	59.9	117	**Climate Division 4**	37.1	107
Climate Division 5	57.3	104	**Climate Division 5**	36.0	105
Climate Division 6	56.4	109	**Climate Division 6**	34.0	103
Climate Division 7	55.8	103	**Climate Division 7**	31.7	96
Climate Division 8	51.3	106	**Climate Division 8**	27.0	87
Allegany	55.2	99	**Allegany**	30.6	87
Anne Arundel	59.6	116	**Anne Arundel**	37.3	107
Baltimore	56.8	111	**Baltimore**	34.1	104
Baltimore City	58.4	115	**Baltimore City**	36.5	104
Calvert	60.6	120	**Calvert**	38.3	115
Caroline	59.7	117	**Caroline**	36.4	107
Carroll	55.5	103	**Carroll**	32.6	103
Cecil	54.8	99	**Cecil**	34.6	103
Charles	61.7	119	**Charles**	38.1	111
Dorchester	60.8	121	**Dorchester**	38.9	117
Fredrick	56.0	106	**Fredrick**	33.2	94
Garrett	51.3	106	**Garrett**	27.0	86
Harford	55.5	102	**Harford**	34.1	102
Howard	57.7	113	**Howard**	34.1	104
Kent	56.6	103	**Kent**	35.9	103
Montgomery	58.0	112	**Montgomery**	35.1	103
Prince George's	60.2	116	**Prince George's**	36.8	108
Queen Anne's	57.8	107	**Queen Anne's**	36.1	105
Saint Mary's	61.4	122	**Saint Mary's**	39.0	118
Somerset	60.1	121	**Somerset**	39.8	118
Talbot	59.8	121	**Talbot**	38.1	110
Washington	56.5	108	**Washington**	32.7	100
Wicomico	60.8	121	**Wicomico**	38.5	117
Worcester	59.1	120	**Worcester**	39.4	118

Table A2. Maximum (left) and minimum (right) surface air temperatures at statewide, climate division and county levels in March 2022. Temperature is given in °F. The rank is the order that the variable in March 2022 occupies among the 128 Marchs 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. March 2022 Bar Graphs: Statewide, Climate Divisions and Counties

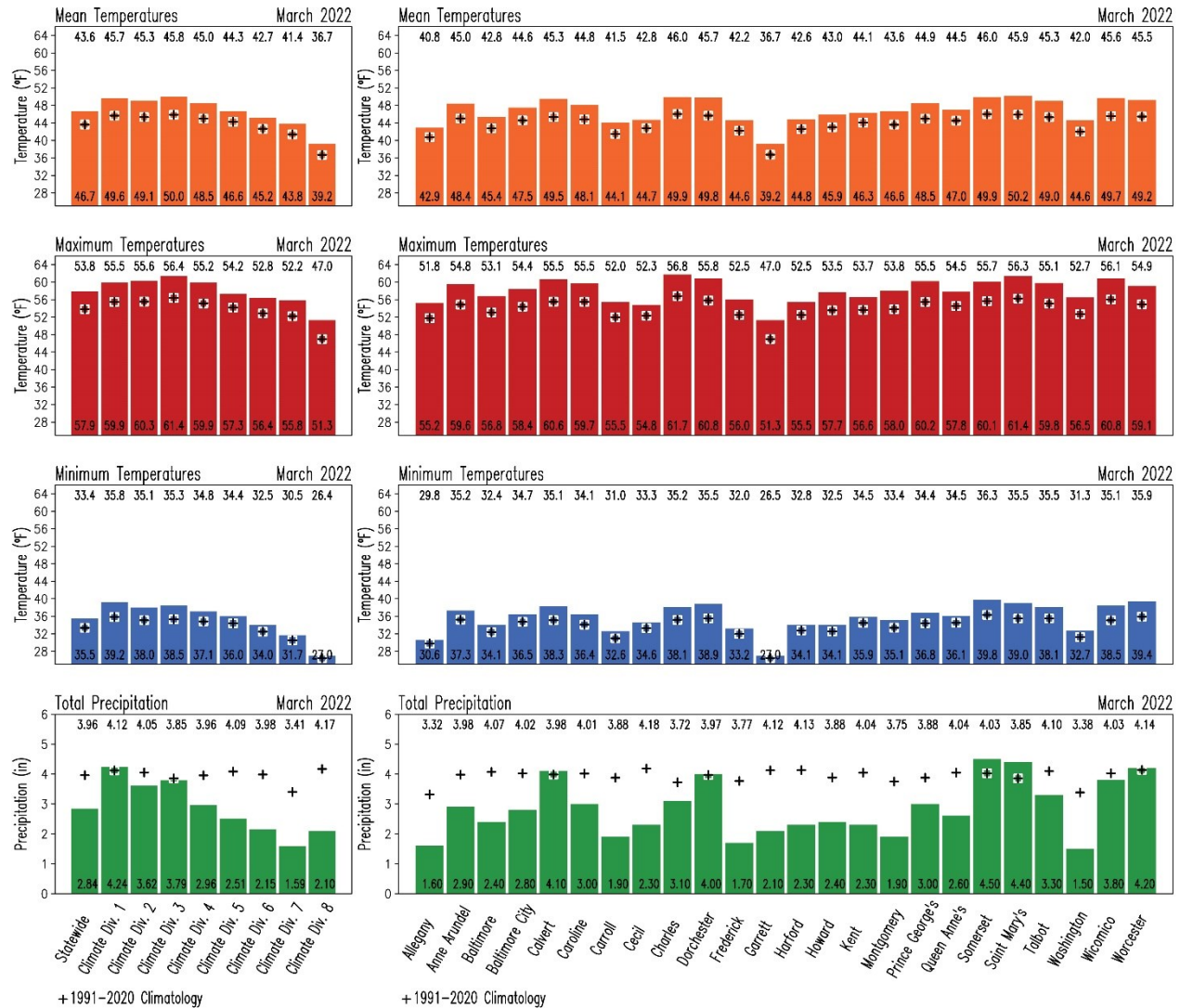## A.　　Temperatures and Precipitation

Figure B1. Area-averaged surface variables in Maryland in March 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 March 2022. For comparison, the corresponding 1991-2020 climatological values for March are displayed as black addition signs, and their magnitude are shown at the top of the panels.

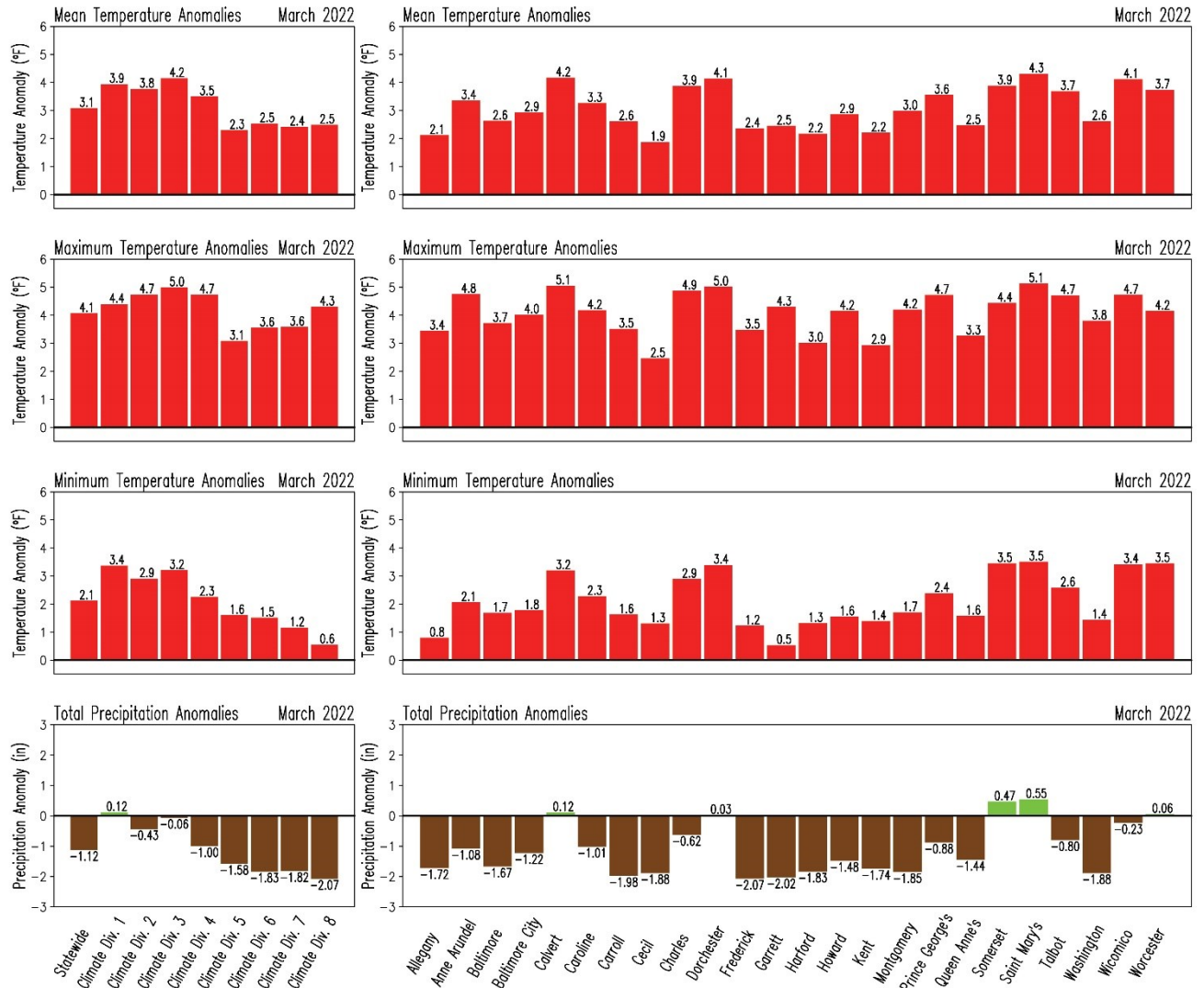## B. Temperature and Precipitation Anomalies

Figure B2. Area-averaged anomalies of the surface variables in Maryland in March 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 March 2022. Units are °F for the temperatures and in for precipitation.

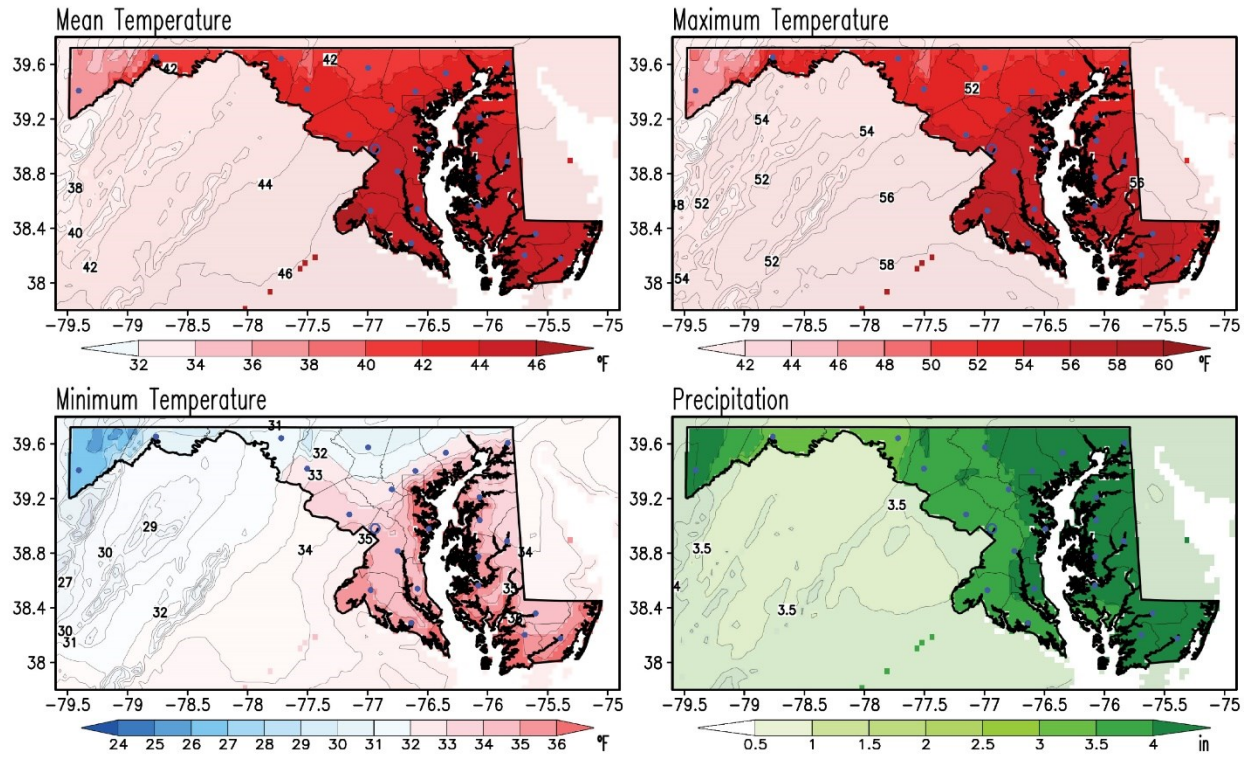# Appendix C. March 1991-2020 Climatology Maps

Figure 10. March climatology of the mean, maximum and minimum temperatures and 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 the March 2022 are compared with to obtain the March 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. March Standard Deviation and March 2022 Standardized Anomalies Maps
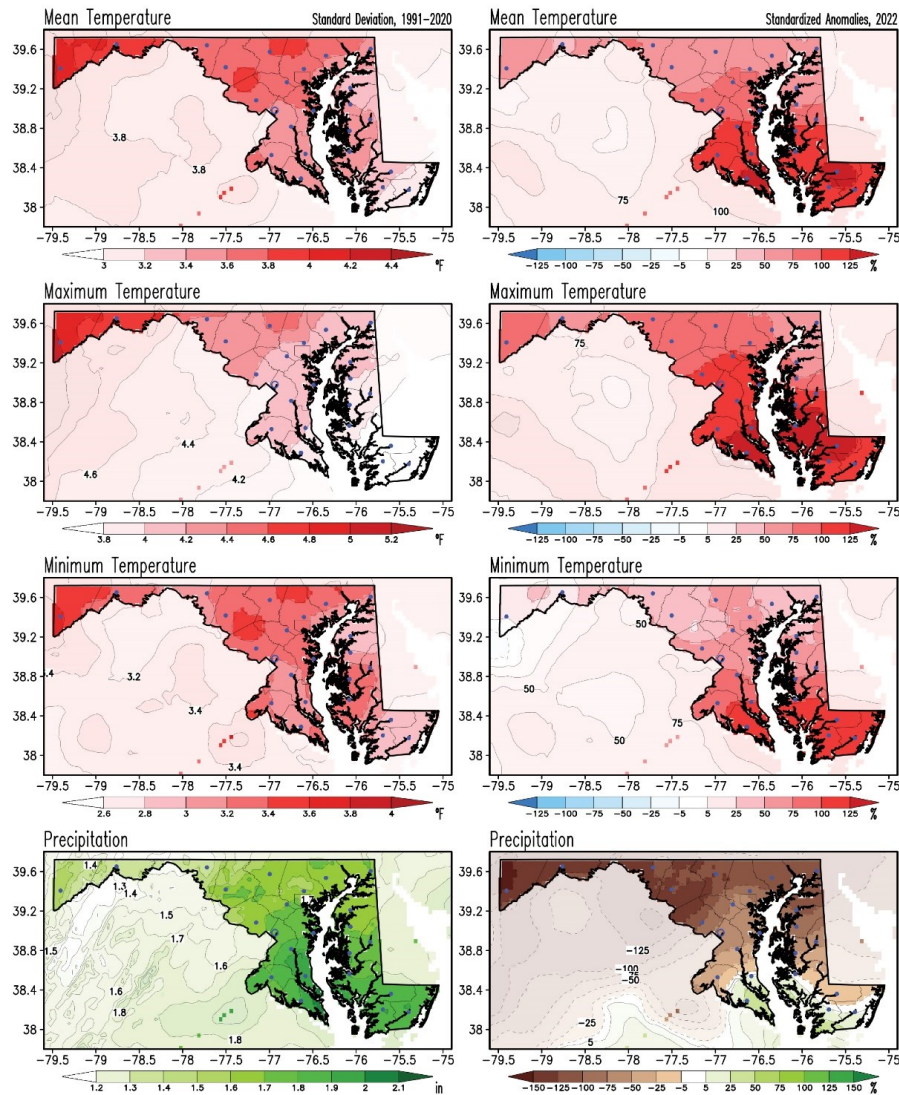

Figure D1. Standard deviation in March and standardized anomalies in March 2022. Standard deviations for mean, maximum and minimum surface air temperatures and precipitation are obtained for the period 1991-2020 (left column). Anomalies in March 2022 are obtained as percentage of the standard deviations (right column). The standard deviations in temperatures are given in °F and those in precipitation are in inches according to the color bars. Standard deviation is a measure of the year-to-year variability. 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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