Maryland Climate Bulletin December 2022

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DEPARTMENT OF
ATMOSPHERIC &
OCEANIC SCIENCE
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Maryland
State
Climatologist
Office

Summary

December 2022 was colder and wetter than normal (i.e., 1991-2020 averages). Monthly temperatures didn't exceed 41°F; maximum temperatures were in the 37 to 50°F range; and minimum temperatures were between 20 to 31°F. Monthly total precipitation was in the 2.7 to 5.3 inches range.

Maryland Regional Features (Figures 1-5, C1, and D1)

- Mean temperature was colder than normal everywhere, notably in Allegany, Garrett, and Washington counties (−2.0°F).

- Maximum temperature (i.e., the monthly average of daily maximum temperature) was also colder than normal in Allegany and Garret counties (−2.0°F) but warmer than normal in southern Howard, Baltimore, and northern Anne Arundel counties, as well as Cecil and Wicomico counties (+ 0.5°F).

- Minimum temperature (i.e., the monthly average of daily minimum temperature) was colder than normal everywhere but notably in Washington and Worcester counties (−3°F), Saint Mary's and Caroline counties (−2.8°F), and Anne Arundel, Washington, and Frederick counties (−2.6°F).

- Precipitation was above normal over most of the state, especially in Washington and Frederick counties (+1.5 in), Saint Mary's County (+1.3 in), Montgomery, Howard, Baltimore, Cecil, and Dorchester counties (+1.1 in). Northwestern counties, notably Garrett, had below-normal precipitation (−0.9 in).

- No region/county of Maryland exhibited drought conditions this month. The above-normal December rainfall over the southeastern shore offset the abnormal dryness over southern Somerset and Worcester counties observed in November.

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

- All eight climate divisions were colder than normal, but not all were wetter than normal; the Allegheny Plateau (Climate Division 8) was drier than normal.
- Statewide temperature anomalies have changed signs in the past three months. Precipitation was above normal in December after two consecutive drier-than-normal months.

Historical Context (Figure 8, Tables A1 and A2)

- This month's comparison with the 1895-2021 statistics showed that mean and maximum temperatures (36.7, 46.4°F) were above normal, but minimum temperature (27.0 °F) was below normal; precipitation (4.47 in) was above normal within 25% of the largest data.
- This month was the 70th warmest and 101st wettest among the 128 Decembers in the 1895-2022 period.

Maryland State Climatologist Office – MDSCO

Contents

1.   Introduction

The Maryland Climate Bulletin is issued by the Maryland State Climatologist Office (MDSCO), which resides in the Department of Atmospheric and Oceanic Science at the University of Maryland, College Park. It documents the surface climate conditions observed across the state in a calendar month and is issued in the second week of the following month.

Maryland's geography is challenging, with the Allegheny and Blue Ridge mountains to the west, Piedmont Plateau in the center, the Chesapeake Bay, and the Atlantic Coastal Plain to the east. The range of physiographic features and the eastern placement of the state within the expansive North American continent contribute to a comparatively wide range of climatic conditions.

The bulletin seeks to document and characterize monthly surface climate conditions statewide, and climate division and county-wise, placing them in the context of regional and continental climate variability and change to help Marylanders interpret and understand recent climate conditions.

The monthly surface climate conditions for December 2022 are presented via maps of key variables, such as average surface air temperature, maximum surface air temperature, minimum surface air temperature, total precipitation, and their anomalies (i.e., departures from normal); they are complemented by drought conditions for the state, as given by the U.S. Drought Monitor (Section 3). Statewide and climate division averages for the month are compared against each other via scatter plots (Section 4). The monthly statewide averages are placed in the context of the historical record via box and whisker plots in Section 5. Ancillary statewide, climate division, and county-level information is provided via tables and plots in Appendices A-B; climatology and variability maps are in Appendices C-D.

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 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 1/12/2023.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al. 2014), which is available in a preliminary status (v1.0.0-20230106) at: https://www.ncei.noaa.gov/data/climdiv/access/ Data was downloaded on 1/12/2023.

The drought conditions are from the U.S. Drought Monitor website: https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Some definitions:

About the anomalies: Anomalies for a given month (e.g., December 2022) are the departures of the monthly value from the corresponding month's 30-year average (i.e., from the average of 30 Decembers) during 1991-2020; the 30-year average (or mean) is the climate normal, or just the climatology. When the observed monthly value exceeds its climatological value, it is referred to as above-normal (e.g., warmer than normal or wetter than normal) or a positive anomaly. In contrast, when this value is smaller than its climatological value, it is referred to as below-normal (e.g., colder than normal or dryer than normal) or negative anomaly.

About NOAA's Climate Divisions. The term "climate division" refers to one of the eight divisions within 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, 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.

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. December 2022 Maps

A. Mean Temperatures

Monthly Mean Temperature in December 2022

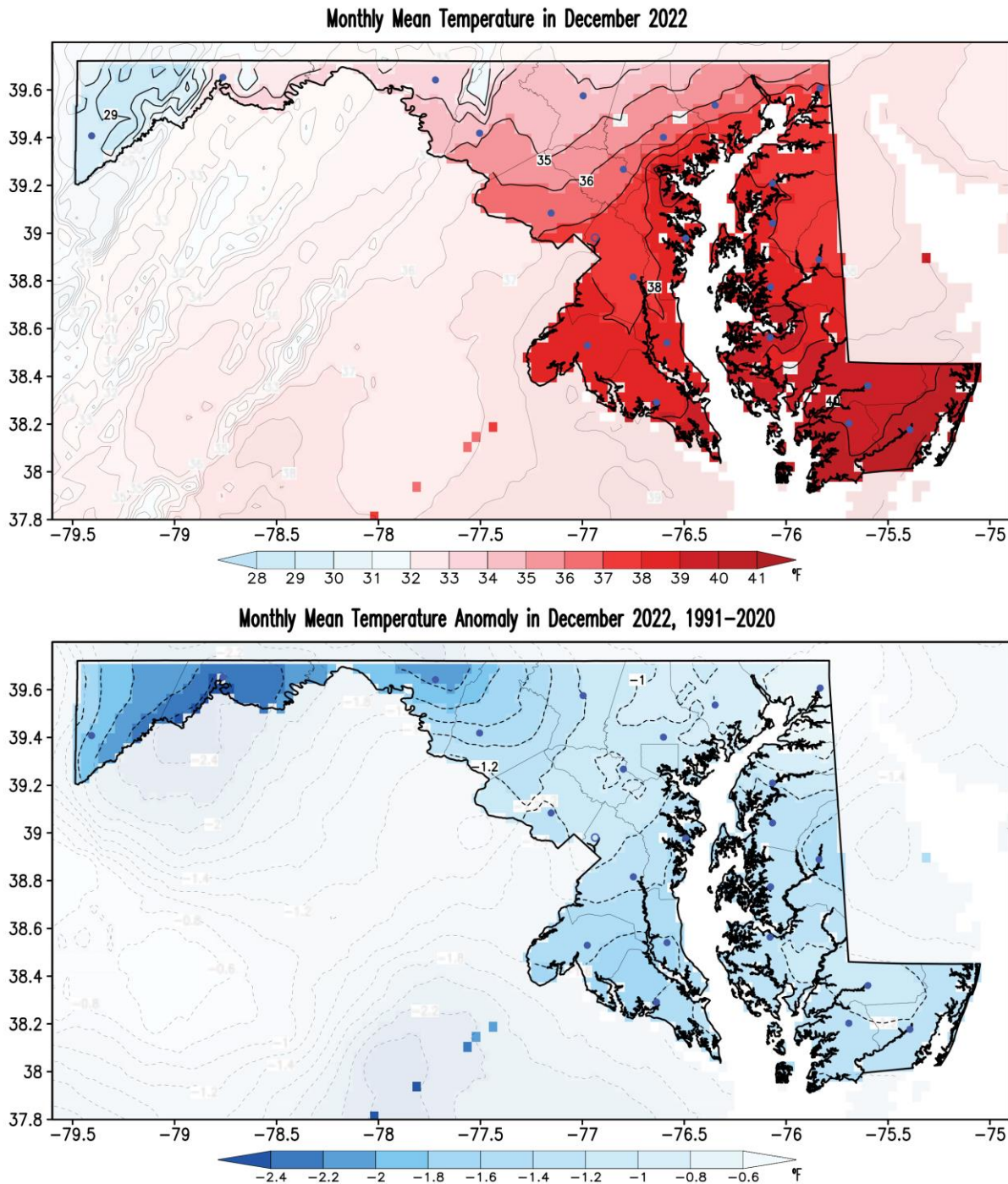**Monthly Mean Temperature Anomaly in December 2022, 1991−2020**

Figure 1. Monthly mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for December 2022. Temperatures are in °F following the color bar. Blue shading in the temperature map shows temperatures below 32 °F, while the anomaly map marks colder 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.

B.   Maximum Temperatures

Monthly Maximum Temperature in December 2022

Monthly Maximum Temperature Anomaly in December 2022, 1991–2020

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

C.   Minimum Temperatures

Monthly Minimum Temperature in December 2022

Monthly Minimum Temperature Anomaly in December 2022, 1991−2020
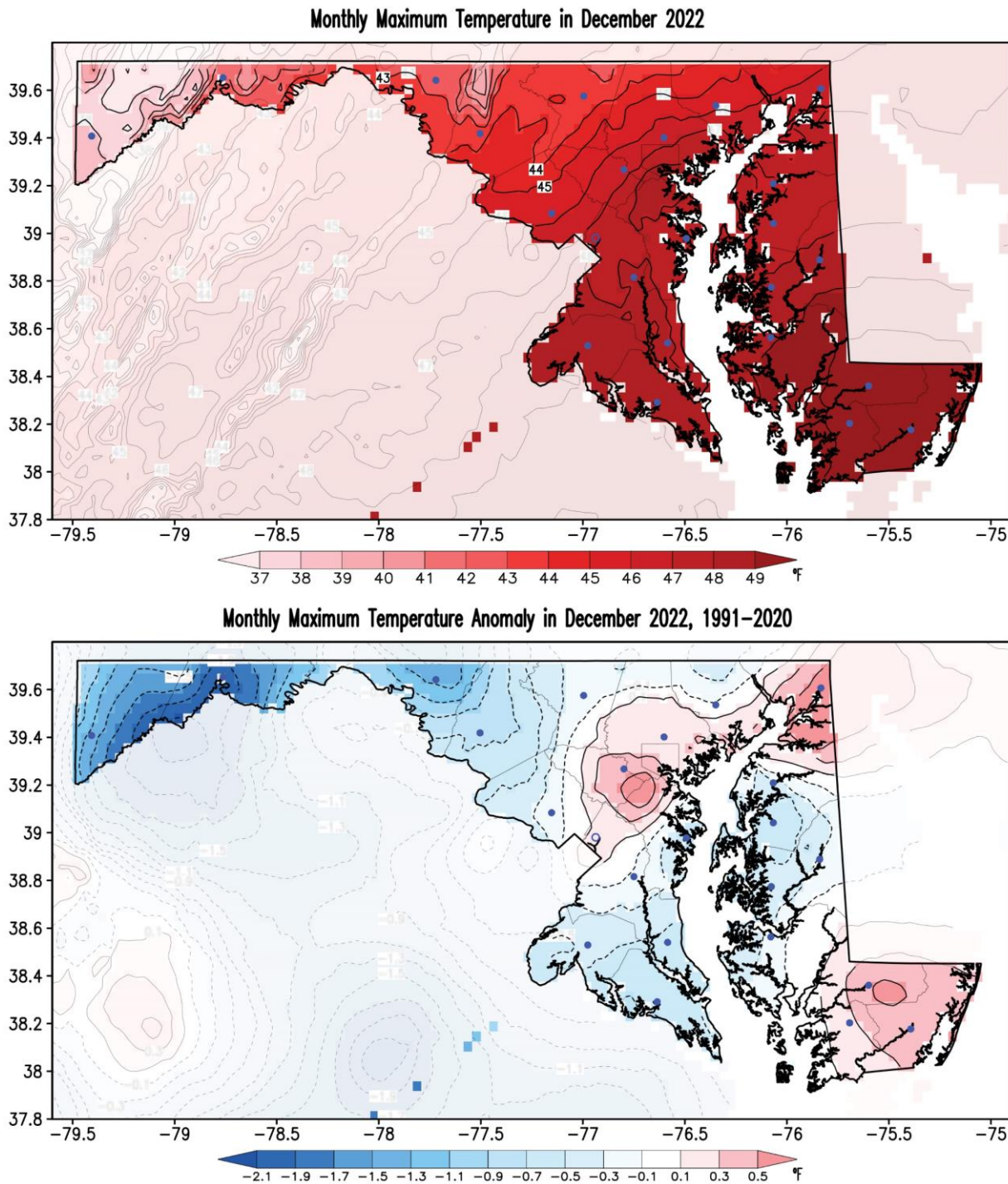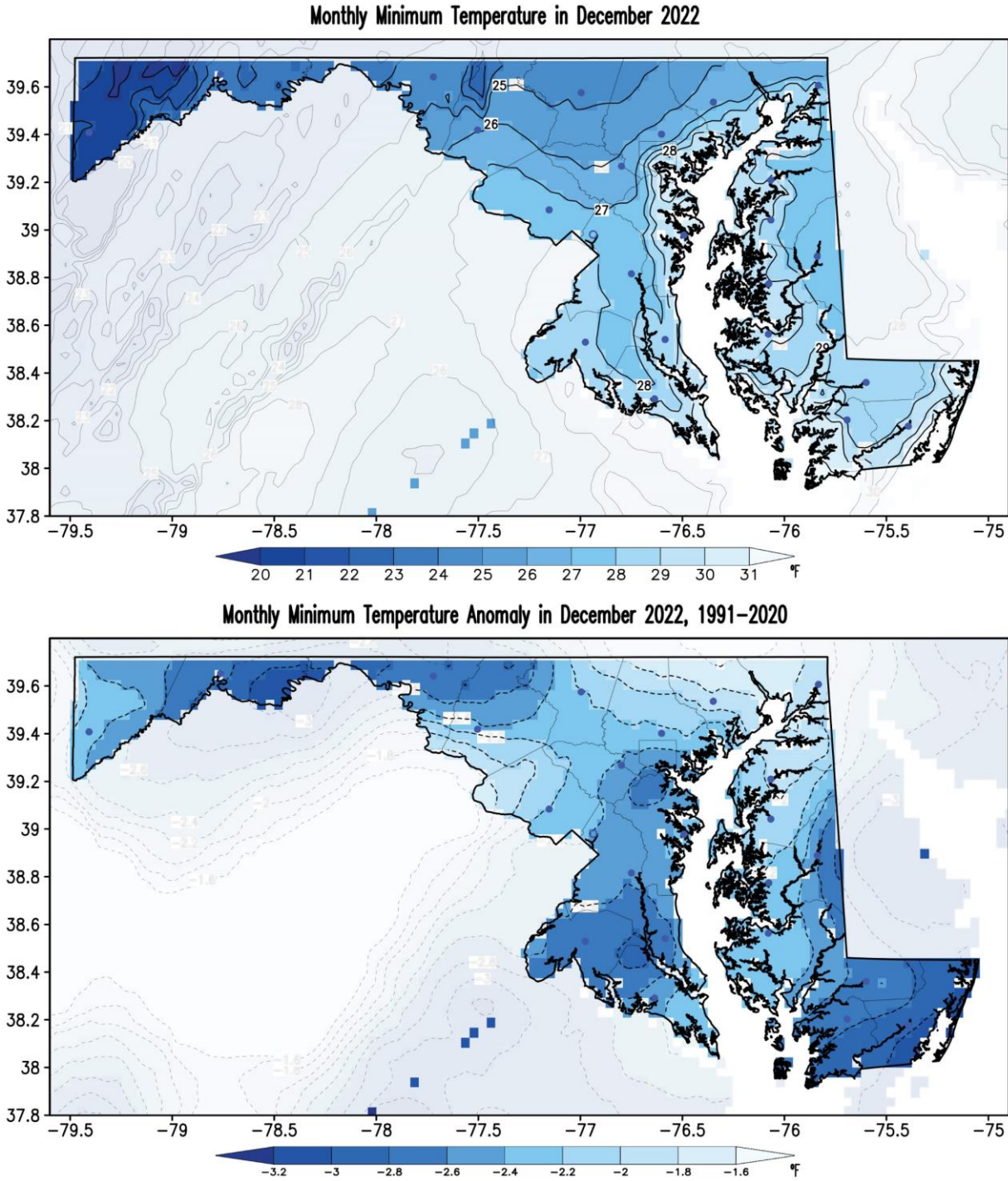

Figure 3. Monthly minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for December 2022. Temperatures are in °F following the color bar. Blue shading in the anomaly map marks colder than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

D.   Precipitation

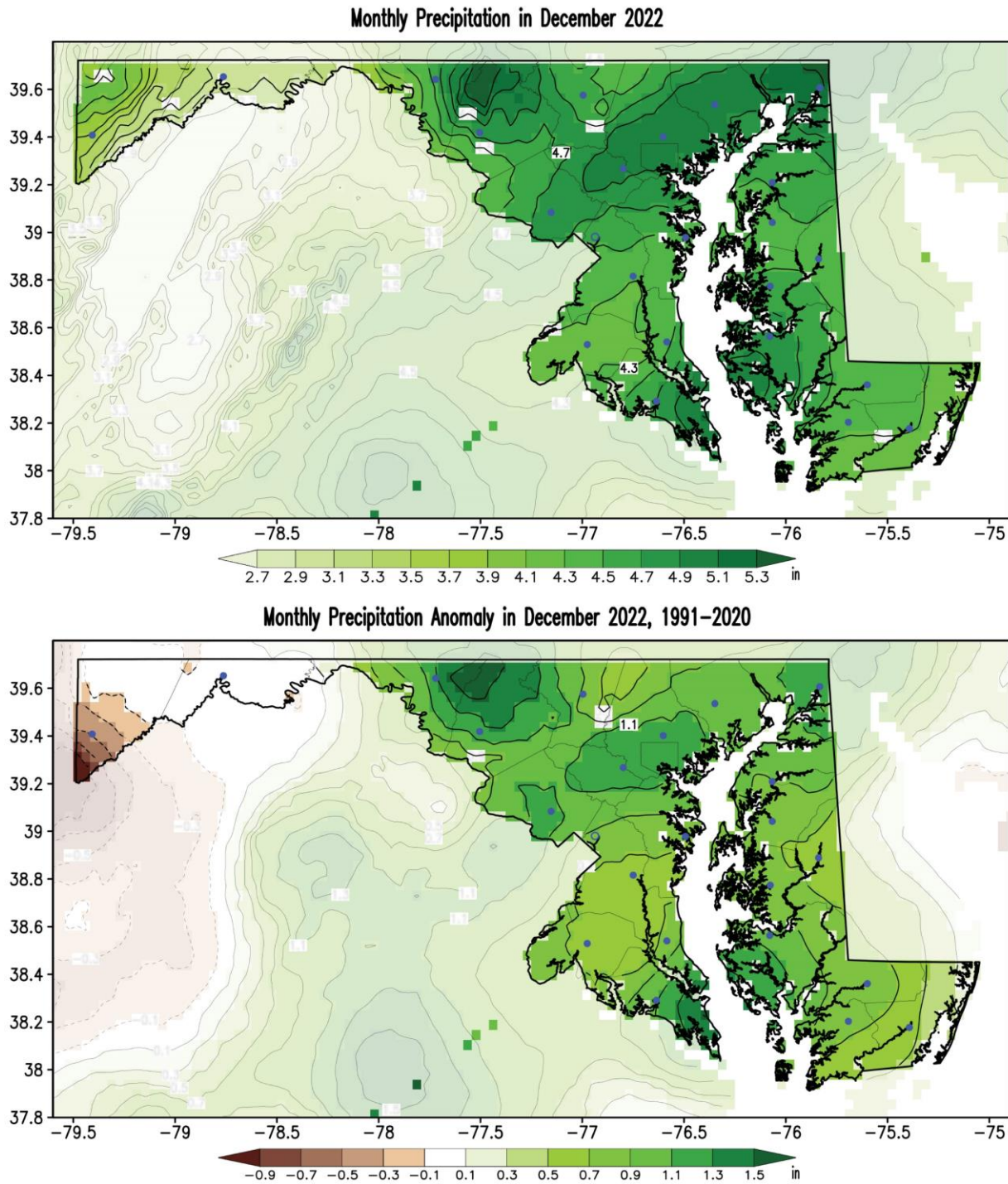**Figure 4.** Monthly total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for December 2022. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside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

E.   Drought

U.S. Drought Monitor
Maryland

January 3, 2023
(Released Thursday, Jan. 5, 2023)
Valid 7 a.m. EST
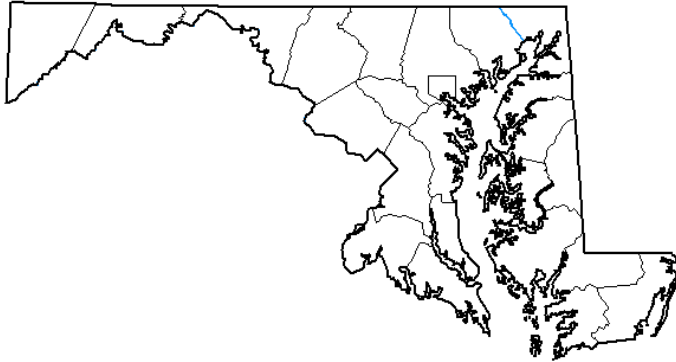
Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	100.00	0.00	0.00	0.00	0.00	0.00
Last Week 12-27-2022	100.00	0.00	0.00	0.00	0.00	0.00
3 Months Ago 10-04-2022	93.24	6.76	0.00	0.00	0.00	0.00
Start of Calendar Year 01-03-2023	100.00	0.00	0.00	0.00	0.00	0.00
Start of Water Year 09-27-2022	65.82	34.18	6.75	0.00	0.00	0.00
One Year Ago 01-04-2022	55.15	44.85	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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USDA   NDMC   NOAA

droughtmonitor.unl.edu

Figure 5. Drought conditions as reported by the U.S. Drought Monitor on January 3, 2023.

4. December and OND 2022 Climate Divisions Averages

A. December 2022 Scatter Plots

Figure 6. Scatter plots of area-averaged Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for December 2022. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 climatology. Temperatures are in °F and precipitation is in inches. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (4.83 inches in CD6, top panel) and by the maximum precipitation anomaly (1.08 inches in CD6, 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.

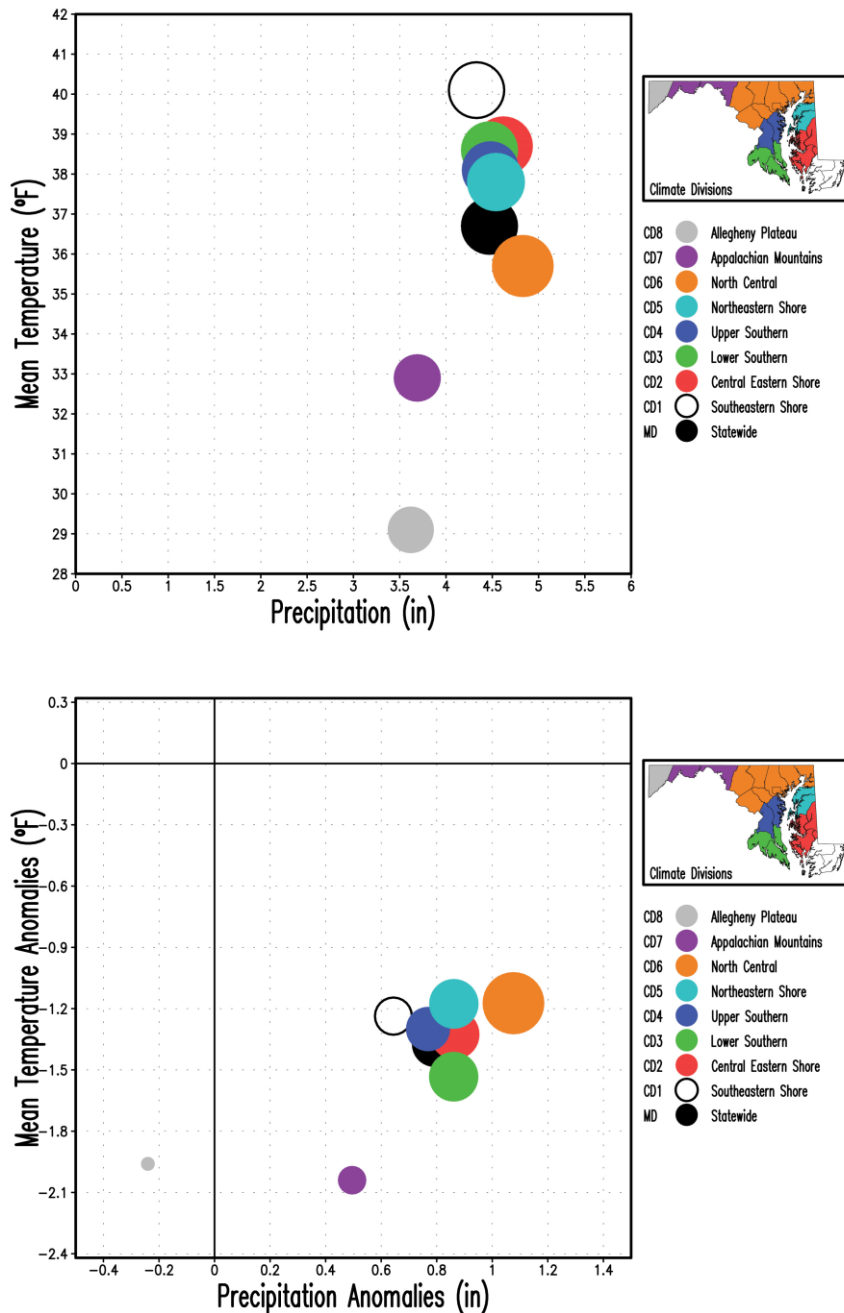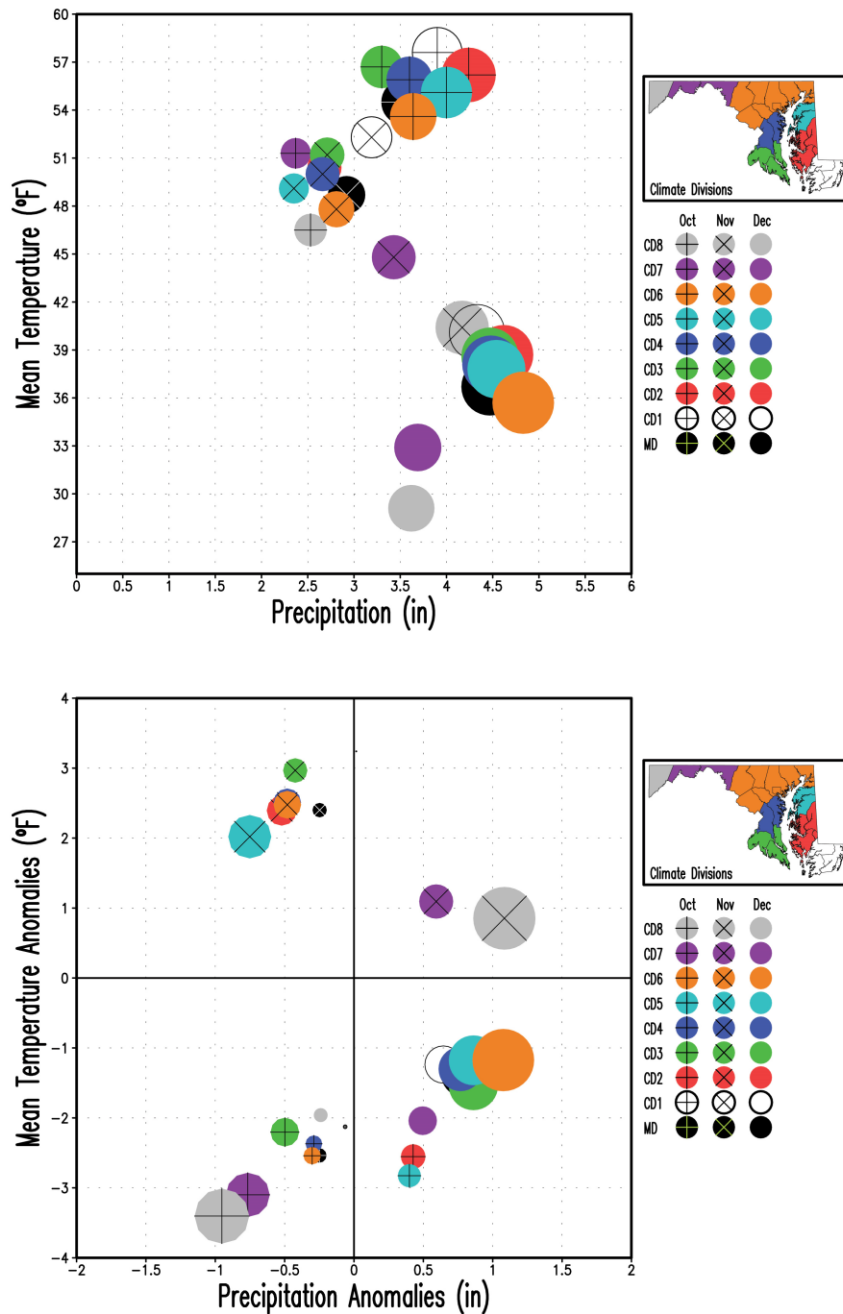B.   October-November-December 2022 Scatter Plots

Figure 7. Scatter plots of area-averaged Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for October, November, and December 2022. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 1991-2020 climatology. Temperatures are in °F and precipitation is in inches. The size of the circles is proportional to the total precipitation scaled down by the maximum precipitation (4.83 inches in CD6 in December, top panel) and by the maximum precipitation anomaly (1.08 inches in CD6 in December, bottom panel) among the nine regions and three months. December is displayed with filled circles only, while November and October are displayed with superposed multiplication and addition signs, respectively.

5. December 2022 Statewide Averages in the Historical Record
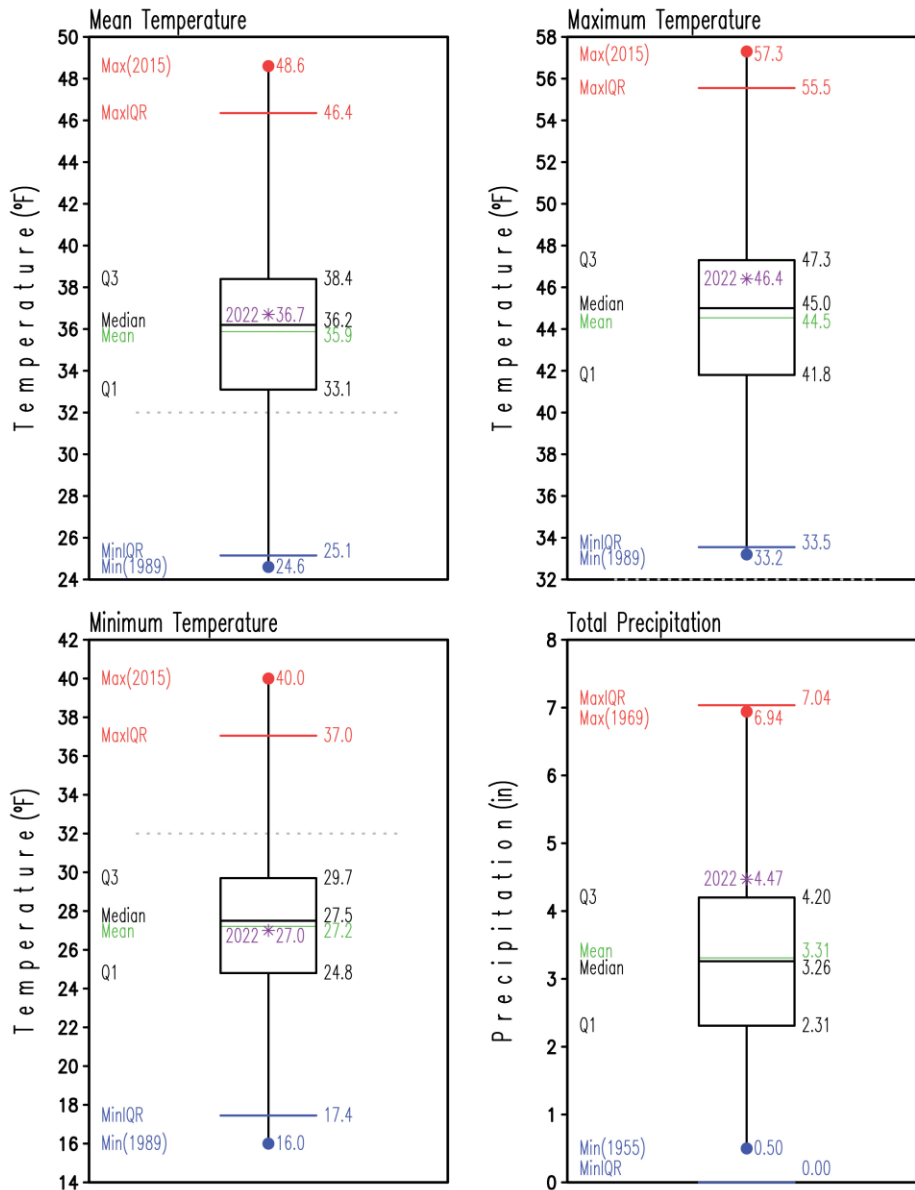
A. Box and Whisker Plots

Figure 8. Box and Whisker plots of area-averaged Maryland (statewide) monthly mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and total precipitation (lower right) for December for the period 1895-2021. The label and asterisk in purple represent conditions for December 2022. Statistics for the period 1895-2021 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.

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

A.   Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)	Region	Total Precipitation (in)	Rank (#)
Statewide	36.7	70	Statewide	4.47	101
Climate Division 1	40.1	70	Climate Division 1	4.33	102
Climate Division 2	38.7	71	Climate Division 2	4.62	104
Climate Division 3	38.6	67	Climate Division 3	4.47	103
Climate Division 4	38.1	71	Climate Division 4	4.48	99
Climate Division 5	37.8	72	Climate Division 5	4.54	99
Climate Division 6	35.7	76	Climate Division 6	4.83	106
Climate Division 7	32.9	58	Climate Division 7	3.69	97
Climate Division 8	29.1	58	Climate Division 8	3.62	77
Allegany	32.0	54	Allegany	2.98	81
Anne Arundel	38.4	71	Anne Arundel	4.56	101
Baltimore	36.1	75	Baltimore	4.84	103
Baltimore City	38.0	75	Baltimore City	4.96	106
Calvert	38.4	65	Calvert	4.56	103
Caroline	38.0	72	Caroline	4.46	100
Carroll	34.4	74	Carroll	4.66	106
Cecil	37.0	86	Cecil	5.09	104
Charles	38.4	68	Charles	4.27	101
Dorchester	39.2	70	Dorchester	4.74	107
Fredrick	34.4	73	Fredrick	4.84	108
Garrett	29.1	58	Garrett	3.62	77
Harford	36.3	79	Harford	4.92	102
Howard	36.1	77	Howard	4.85	107
Kent	37.8	71	Kent	4.59	98
Montgomery	36.3	76	Montgomery	4.65	104
Prince George's	37.8	72	Prince George's	4.42	97
Queen Anne's	37.9	72	Queen Anne's	4.49	99
Saint Mary's	38.8	62	Saint Mary's	4.68	109
Somerset	40.1	69	Somerset	4.31	103
Talbot	38.7	72	Talbot	4.57	100
Washington	33.7	64	Washington	4.35	109
Wicomico	39.6	74	Wicomico	4.46	104
Worcester	40.4	69	Worcester	4.25	95

Table A1. Area-averaged monthly mean surface air temperature (left) and total precipitation (right) at Maryland (statewide), climate division, and county levels for December 2022. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for December 2022 occupies among the 128 Decembers 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 (#)	Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	46.4	83	Statewide	27.0	56
Climate Division 1	50.6	91	Climate Division 1	29.5	57
Climate Division 2	48.8	87	Climate Division 2	28.6	58
Climate Division 3	48.5	80	Climate Division 3	28.6	53
Climate Division 4	47.8	82	Climate Division 4	28.4	56
Climate Division 5	47.4	83	Climate Division 5	28.2	64
Climate Division 6	45.1	85	Climate Division 6	26.4	66
Climate Division 7	42.0	62	Climate Division 7	23.7	54
Climate Division 8	37.5	60	Climate Division 8	20.7	58
Allegany	41.1	57	Allegany	23.0	49
Anne Arundel	47.9	84	Anne Arundel	28.8	59
Baltimore	45.8	90	Baltimore	26.4	64
Baltimore City	47.6	98	Baltimore City	28.4	58
Calvert	48.1	79	Calvert	28.7	54
Caroline	48.4	86	Caroline	27.6	61
Carroll	43.9	82	Carroll	24.9	63
Cecil	46.3	99	Cecil	27.6	68
Charles	48.5	82	Charles	28.3	54
Dorchester	49.3	88	Dorchester	29.0	57
Fredrick	43.5	82	Fredrick	25.4	57
Garrett	37.6	61	Garrett	20.7	58
Harford	45.6	93	Harford	27.0	69
Howard	46.0	89	Howard	26.2	61
Kent	47.2	87	Kent	28.4	64
Montgomery	45.5	85	Montgomery	27.2	63
Prince George's	47.9	84	Prince George's	27.8	55
Queen Anne's	47.4	82	Queen Anne's	28.3	65
Saint Mary's	48.7	80	Saint Mary's	29.0	55
Somerset	50.3	88	Somerset	29.9	57
Talbot	48.2	85	Talbot	29.3	59
Washington	43.0	74	Washington	24.5	58
Wicomico	50.6	92	Wicomico	28.7	58
Worcester	50.9	91	Worcester	29.8	57

Table A2. Area-averaged monthly maximum (left) and minimum (right) surface air temperatures at Maryland (statewide), climate division, and county levels for December 2022. Temperatures are in °F. The rank is the order that the variable for December 2022 occupies among the 128 Decembers 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. December 2022 Bar Graphs: Statewide, Climate Divisions, and Counties

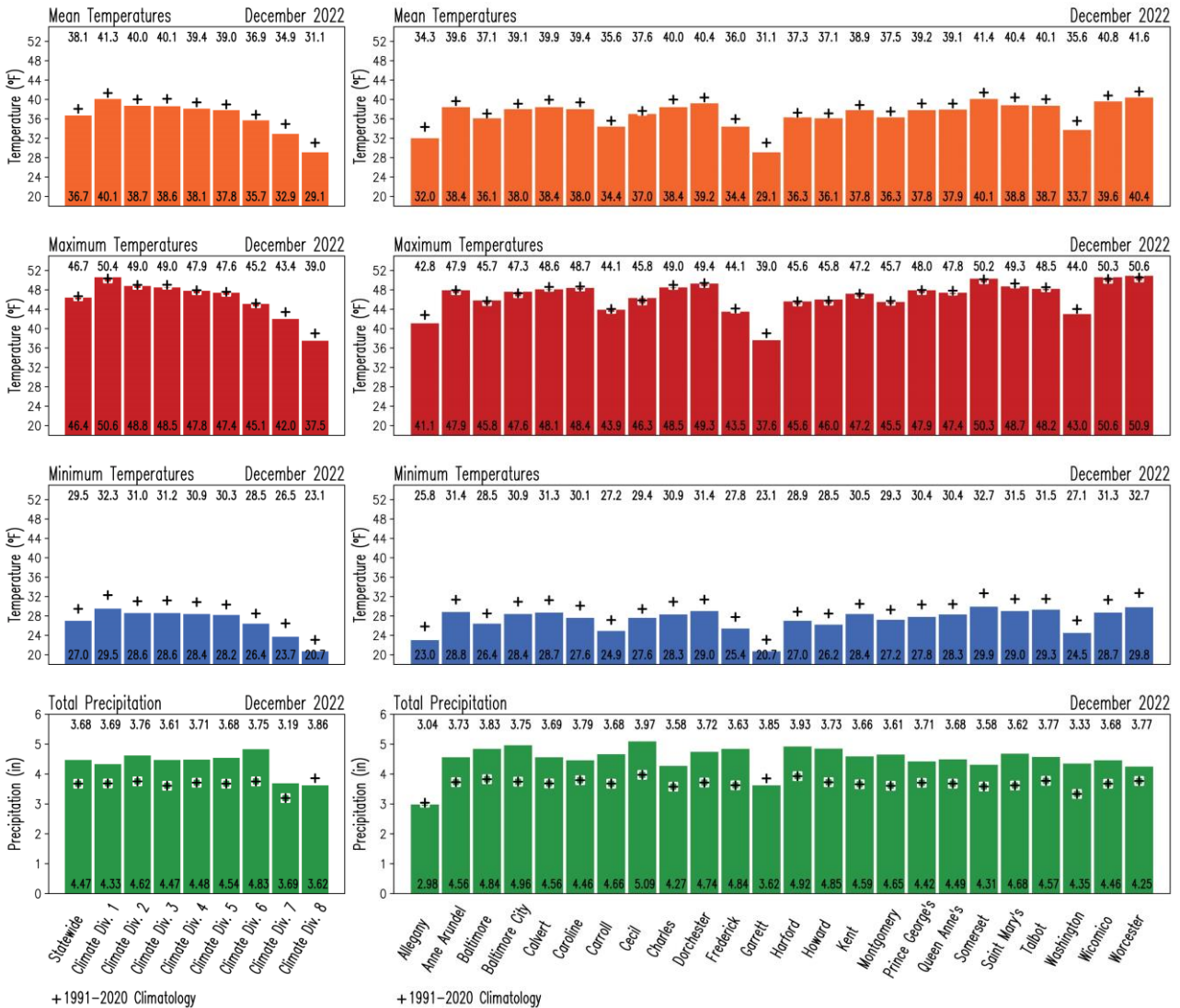## A. Temperatures and Precipitation

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

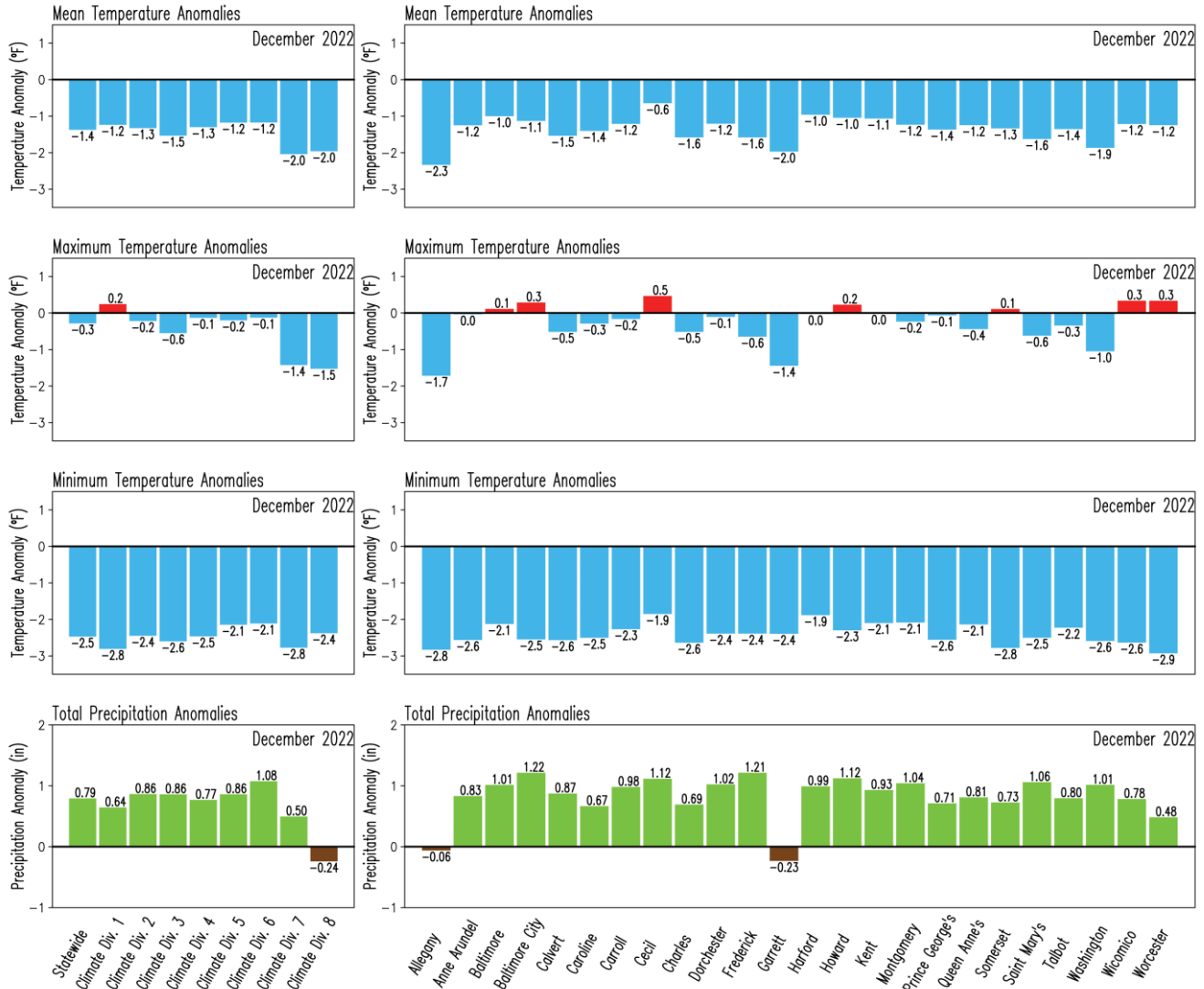B.   Temperature and Precipitation Anomalies

Figure B2. Area-averaged anomalies of the monthly surface variables in Maryland for December 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 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 December 2022.

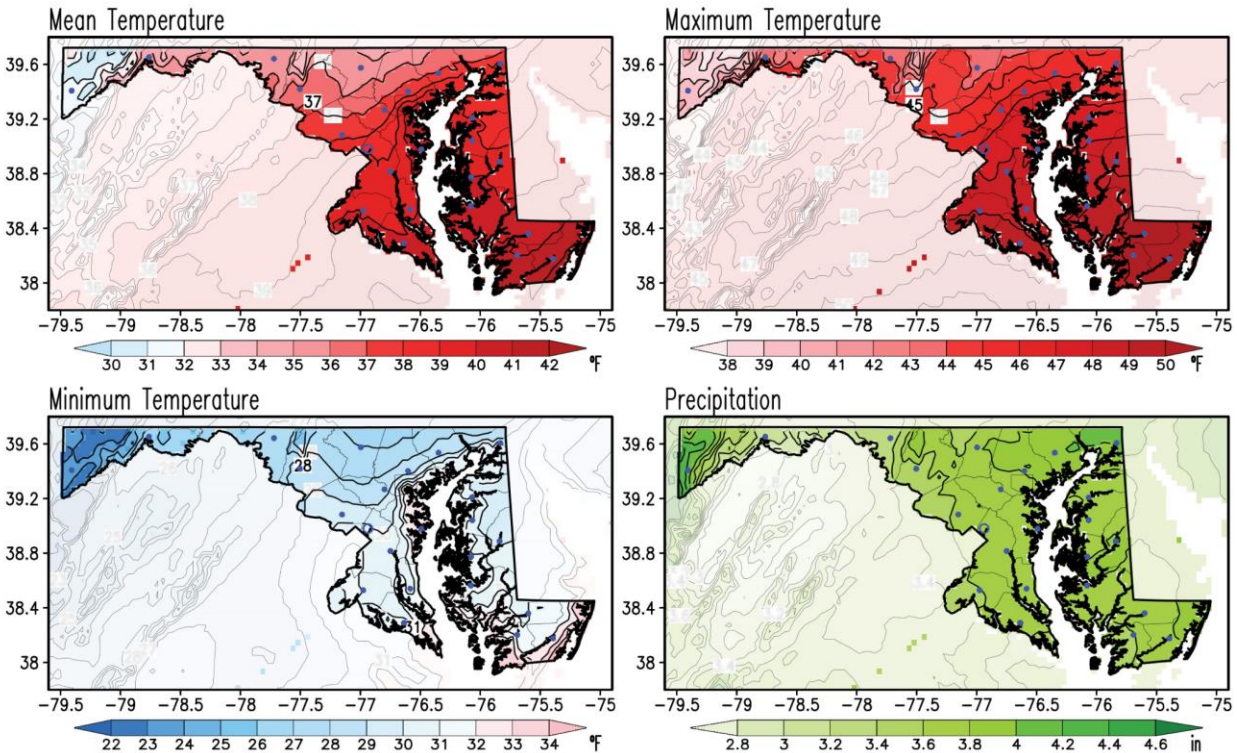# Appendix C. December 1991-2020 Climatology Maps

Figure C1. December climatology of the monthly mean, maximum and minimum surface air temperatures, and 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 December 2022 conditions are compared to obtain the December 2022 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. December Standard Deviation and December 2022 Standardized Anomalies Maps
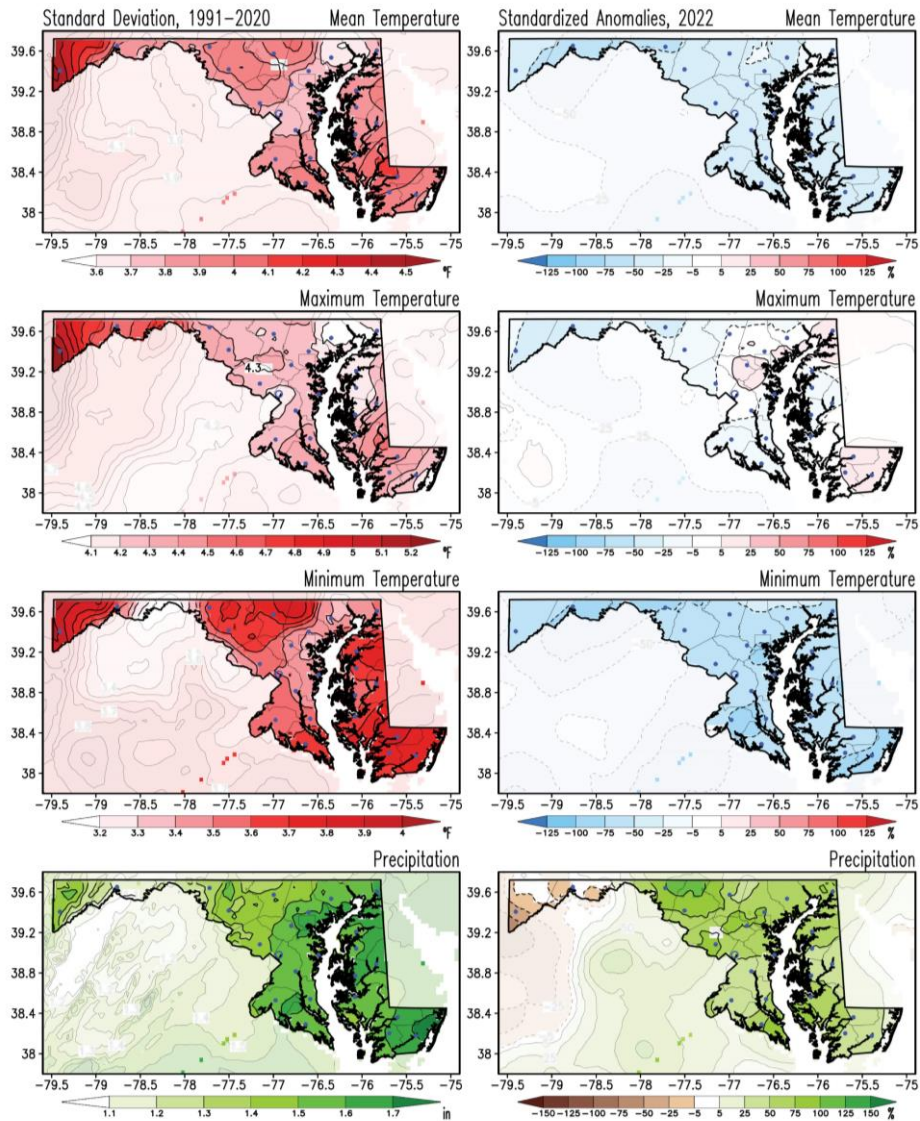

Figure D1. Standard deviation for December and standardized anomalies of temperatures and precipitation for December 2022. Standard deviations for monthly mean, maximum, and minimum surface air temperatures and total precipitation were obtained for the 1991-2020 period (left column). Anomalies for December 2022 (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 monthly standard deviation measures a climate variable's year-to-year, or interannual, variability. Anomalies are sometimes compared against that variability to identify extremes in the climate record. When the anomalies are divided by the standard deviation, they are named *standardized anomalies*.

References

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

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