Maryland Climate Bulletin
January 2023

Prepared by
Dr. Alfredo Ruiz-Barradas
Maryland State Climatologist

DEPARTMENT OF
ATMOSPHERIC &
OCEANIC SCIENCE
Sumant Nigam, Chair

Maryland
State
Climatologist
Office

Summary

January 2023 was much warmer and drier than normal (i.e., 1991-2020 averages). Monthly mean temperatures were above freezing everywhere; maximum temperatures were in the 40 to 54 °F range; and minimum temperatures were between 26 to 38°F. Monthly total precipitation was in the 1.5 to 4.0 inches range.

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

- Mean temperature was warmer than normal everywhere by at least 7 °F, notably in Carroll, Baltimore, and portions of Saint Mary's, Calvert, and Dorchester counties (above 8.5°F).

- Maximum temperature (i.e., the monthly average of daily maximum temperature) was also warmer than normal everywhere, by at least 6 °F, especially over Baltimore City, northern Anne Arundel, Dorchester, Wicomico, and southern Saint Mary's and Calvert counties (above 8.5 °F).

- Minimum temperature (i.e., the monthly average of daily minimum temperature) was warmer than normal everywhere, by at least 6 °F, but notably in Carroll, Baltimore, Frederick, northern Montgomery, Howard, and northwestern Garrett counties (above 9°F), and portions of Saint Mary's, Calvert, Talbot, and Dorchester counties (above 8.5°F).

- Precipitation was below normal over most of the state, especially in Montgomery, Prince George's, Howard, Anne Arundel, and Talbot counties by around 1.4 in. The northwestern tip of Garrett County was the only region with above-normal precipitation (0.2 in).

- Abnormally dry conditions over Maryland reappeared this month over southern Garret and Saint Mary's counties. Since December, the below-normal rainfall over Garrett County may be behind the abnormal dryness here.

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

- All eight climate divisions were warmer by at least 7.5 °F and drier than normal by at least 0.6 in.
- Statewide anomalies have changed signs in the past three months. From anomalously warm and dry conditions in November to cold and wet conditions in December to much warmer and drier conditions in January.

Historical Context (Figure 8, Tables A1 and A2)

- This month's comparison with the 1895-2022 statistics showed that mean, maximum, and minimum temperatures (42.0, 50.4, and 33.7 °F) were well above normal within the 5% of the highest values; precipitation (2.13 in) was below normal, within 25% of the smallest values.
- This month was the 3rd warmest and 18th driest among the 129 Januaries in the 1895-2022 period.

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 January 2023 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 2/8/2023.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al. 2014), which is available in a preliminary status (v1.0.0-20230206) at: https://www.ncei.noaa.gov/data/climdiv/access/ Data was downloaded on 2/9/2023.

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., January 2023) are the departures of the monthly value from the corresponding month's 30-year average (i.e., from the average of 30 Januaries) 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.   January 2023 Maps
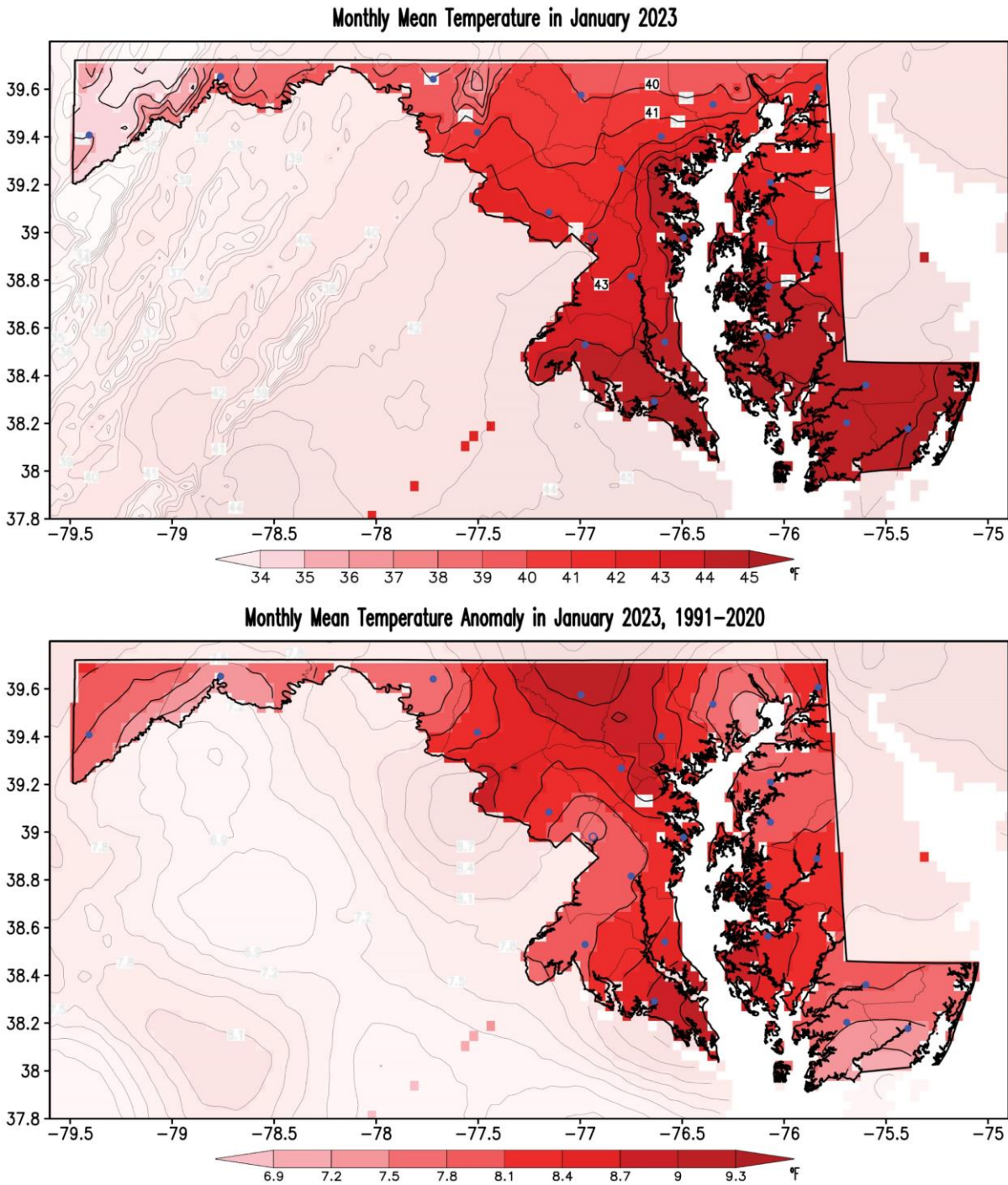
A.   Mean Temperatures

Figure 1. Monthly mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for January 2023. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer 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 January 2023

Monthly Maximum Temperature Anomaly in January 2023, 1991−2020
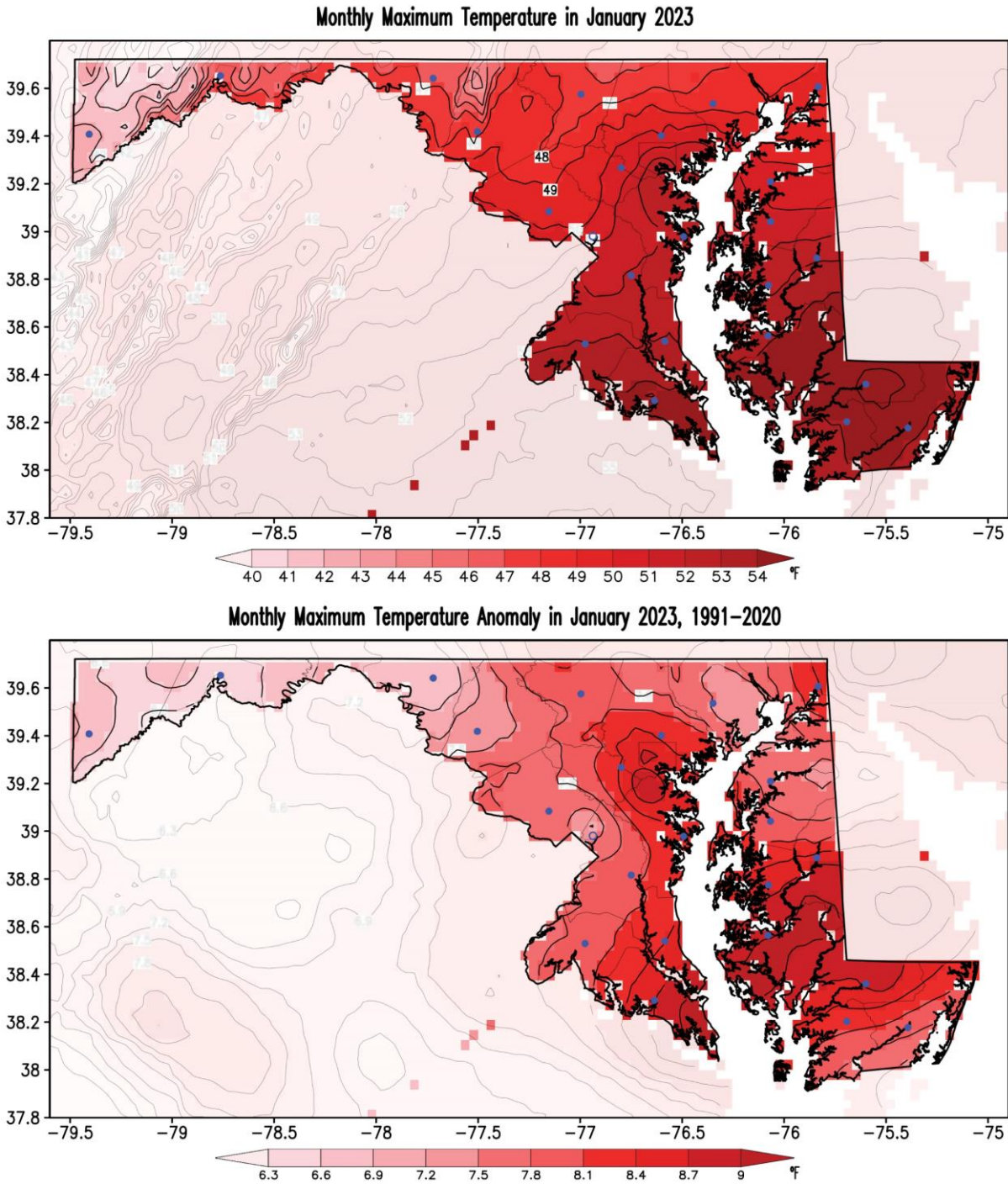

Figure 2. Monthly maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for January 2023. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.
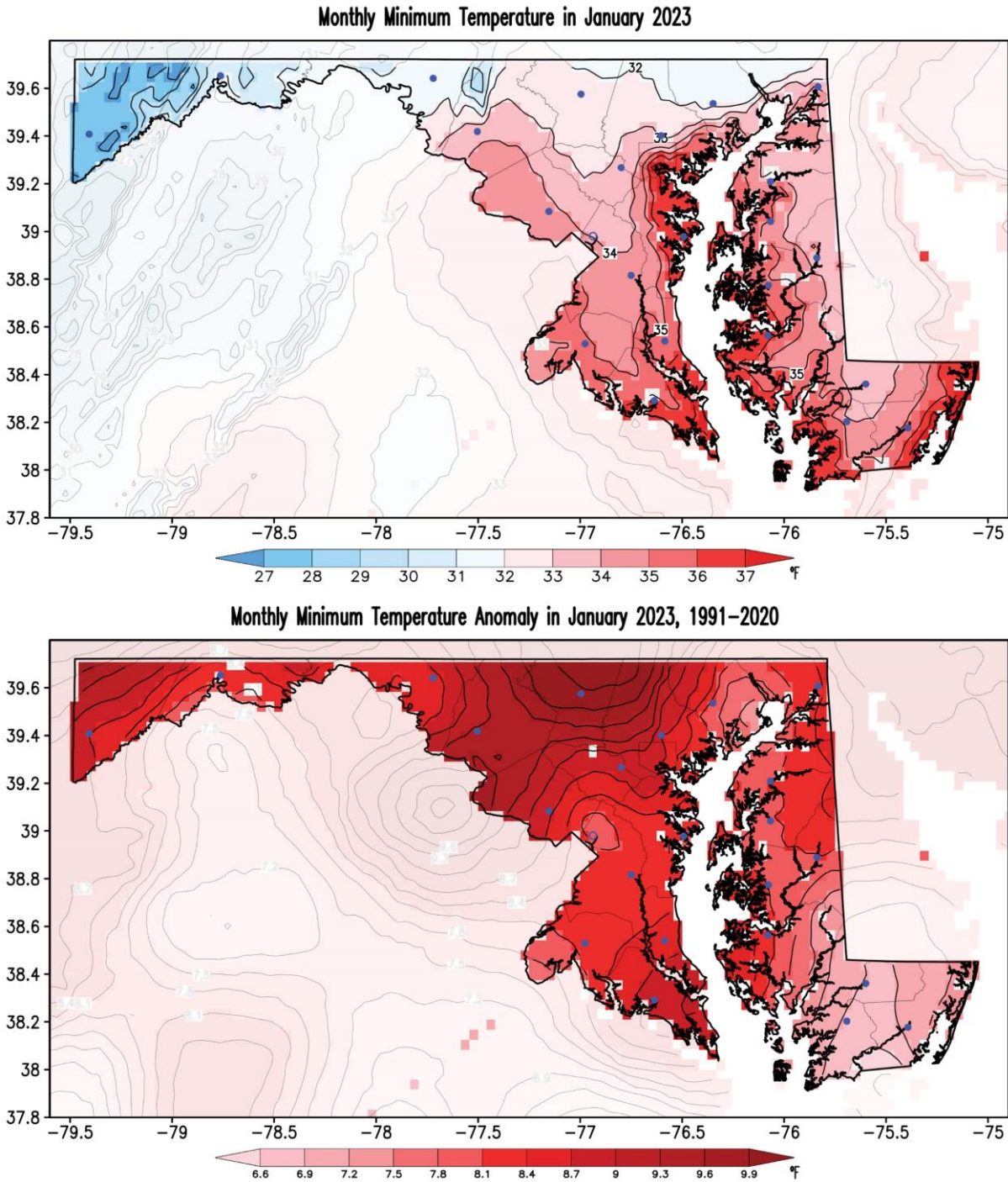
C.   Minimum Temperatures

Figure 3. Monthly minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for January 2023. 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.
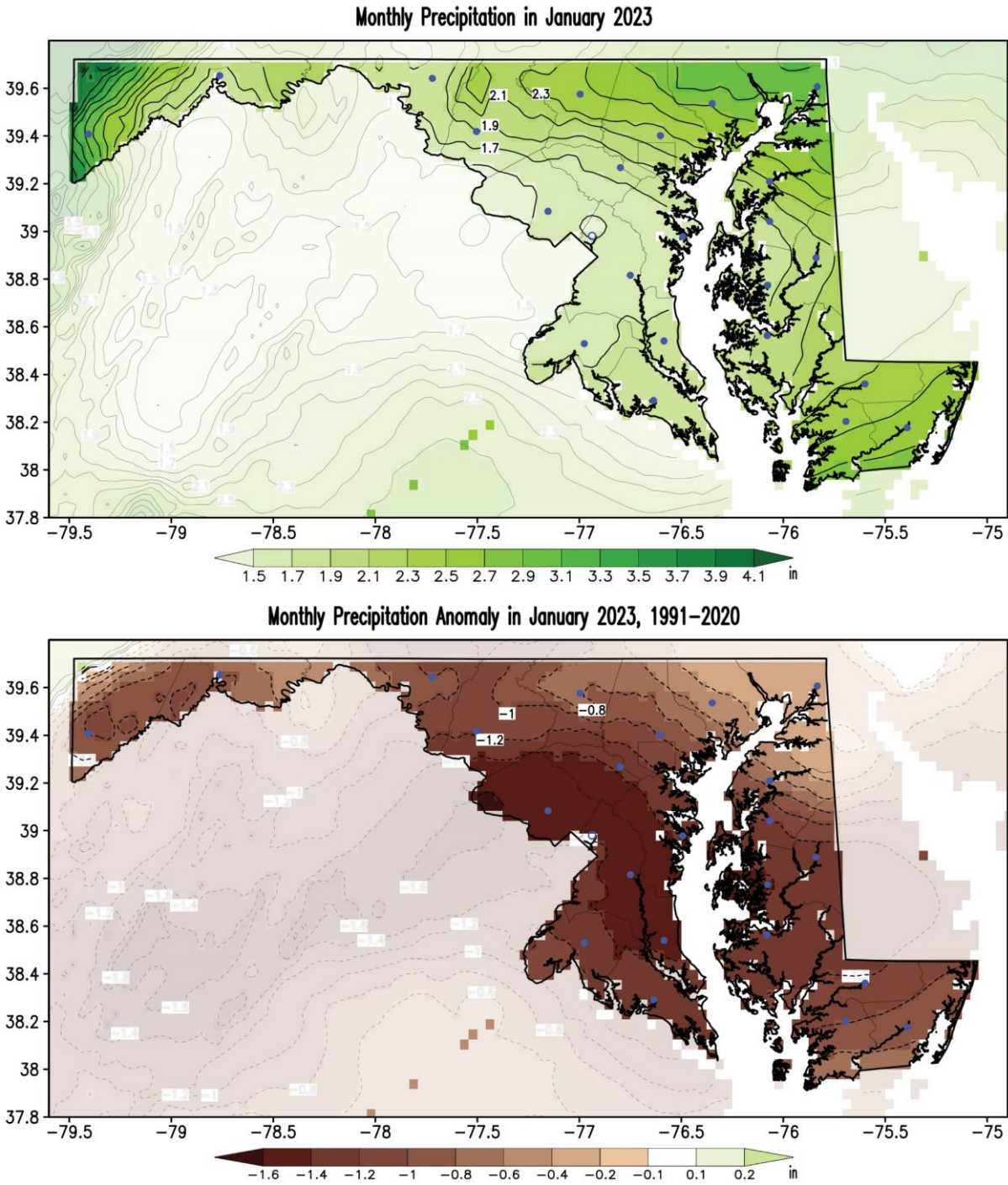
D.   Precipitation

**Figure 4.** Monthly total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for January 2023. 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
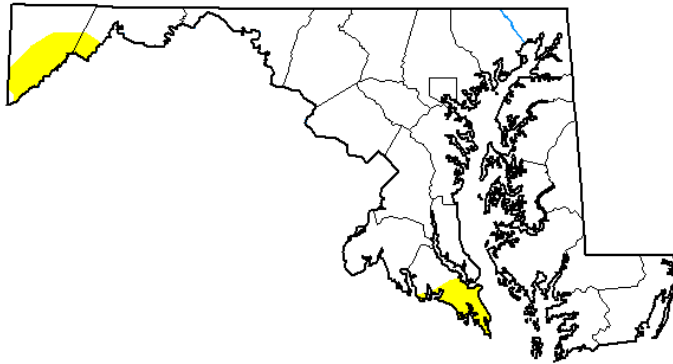
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	94.45	5.55	0.00	0.00	0.00	0.00
Last Week 01-24-2023	94.45	5.55	0.00	0.00	0.00	0.00
3 Months Ago 11-01-2022	97.16	2.84	0.00	0.00	0.00	0.00
Start of Calendar Year 01-03-2023	100.00	0.00	0.00	0.00	0.00	0.00
Start of Water Year 09-27-2022	65.82	34.18	6.75	0.00	0.00	0.00
One Year Ago 02-01-2022	97.75	2.25	0.00	0.00	0.00	0.00

Figure 5. Drought conditions as reported by the U.S. Drought Monitor on January 31, 2023.

4. January and NDJ 2022/2023 Climate Divisions Averages

A. January 2023 Scatter Plots

Figure 6. Scatter plots of area-averaged Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for January 2023. 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 (2.99 inches in CD8, top panel) and by the maximum precipitation anomaly (|-1.40| inches in CD4, 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.

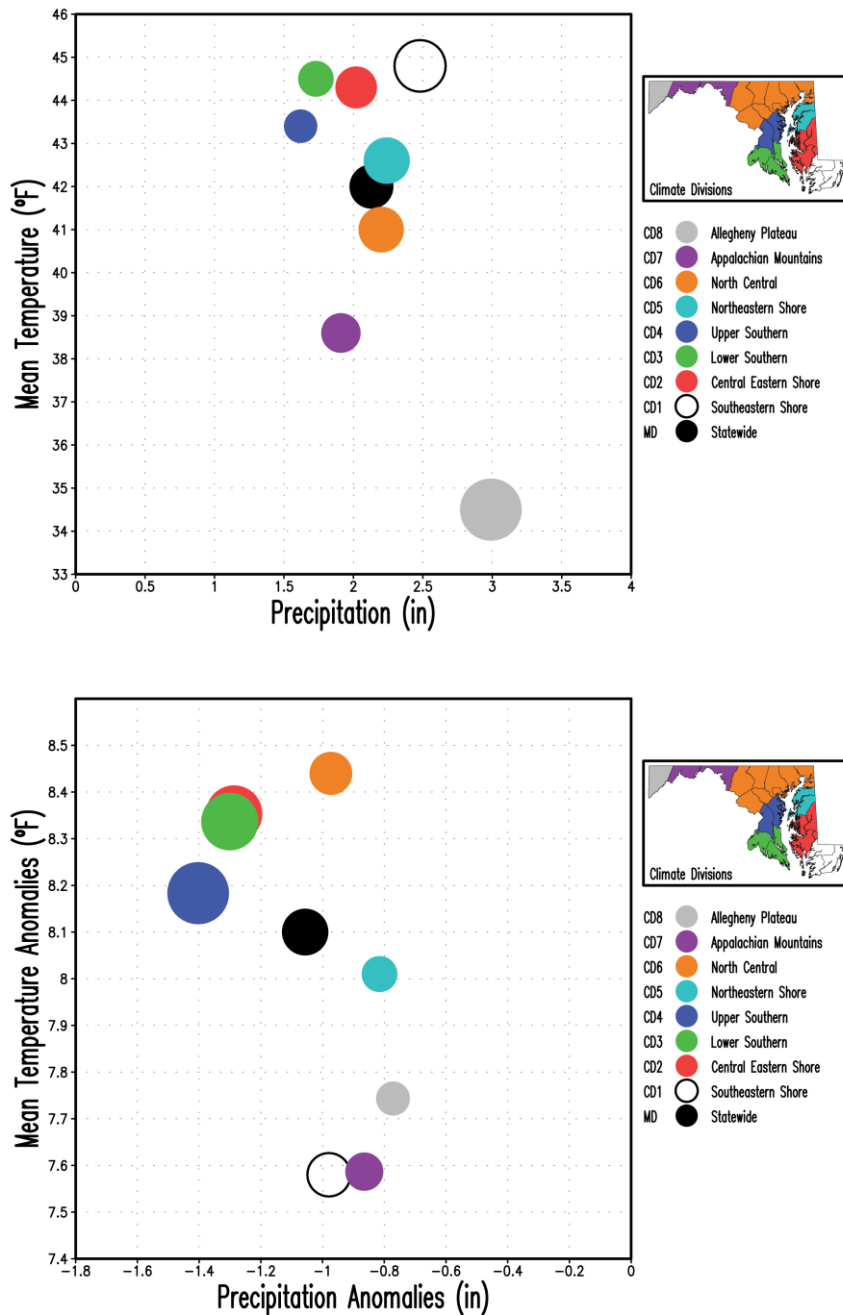B.   November-December/2022-January/2023 Scatter Plots
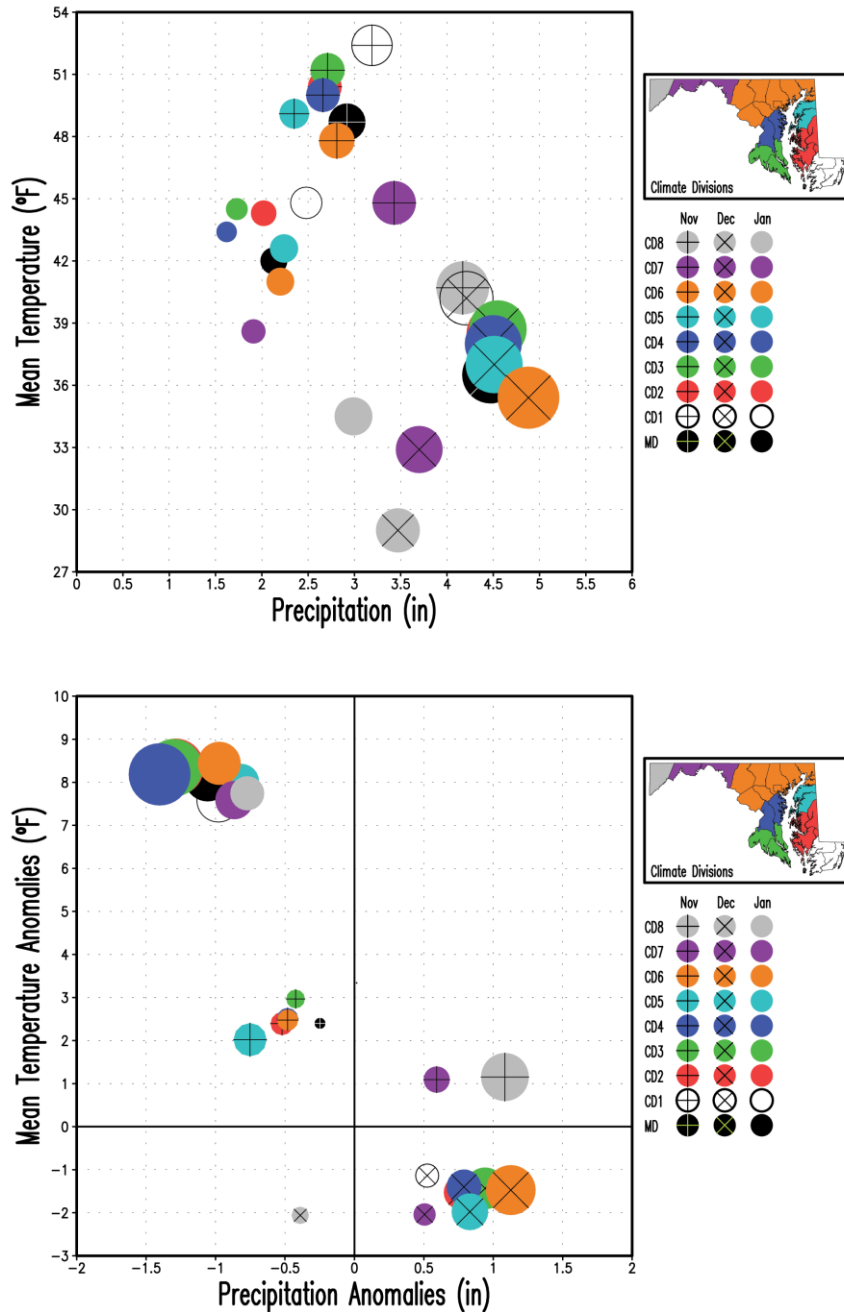
Figure 7. Scatter plots of area-averaged Maryland (statewide) and Climate Divisions (CD#) monthly mean surface air temperature vs. total precipitation for November, December 2022, and January 2023. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their 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 (4.88 inches in CD6 in December, top panel) and by the maximum precipitation anomaly (|-1.40| inches in CD4 in January, bottom panel) among the nine regions and three months. January is displayed with filled circles only, while December and November are displayed with superposed multiplication and addition signs, respectively.

5. January 2023 Statewide Averages in the Historical Record

A. Box and Whisker Plots

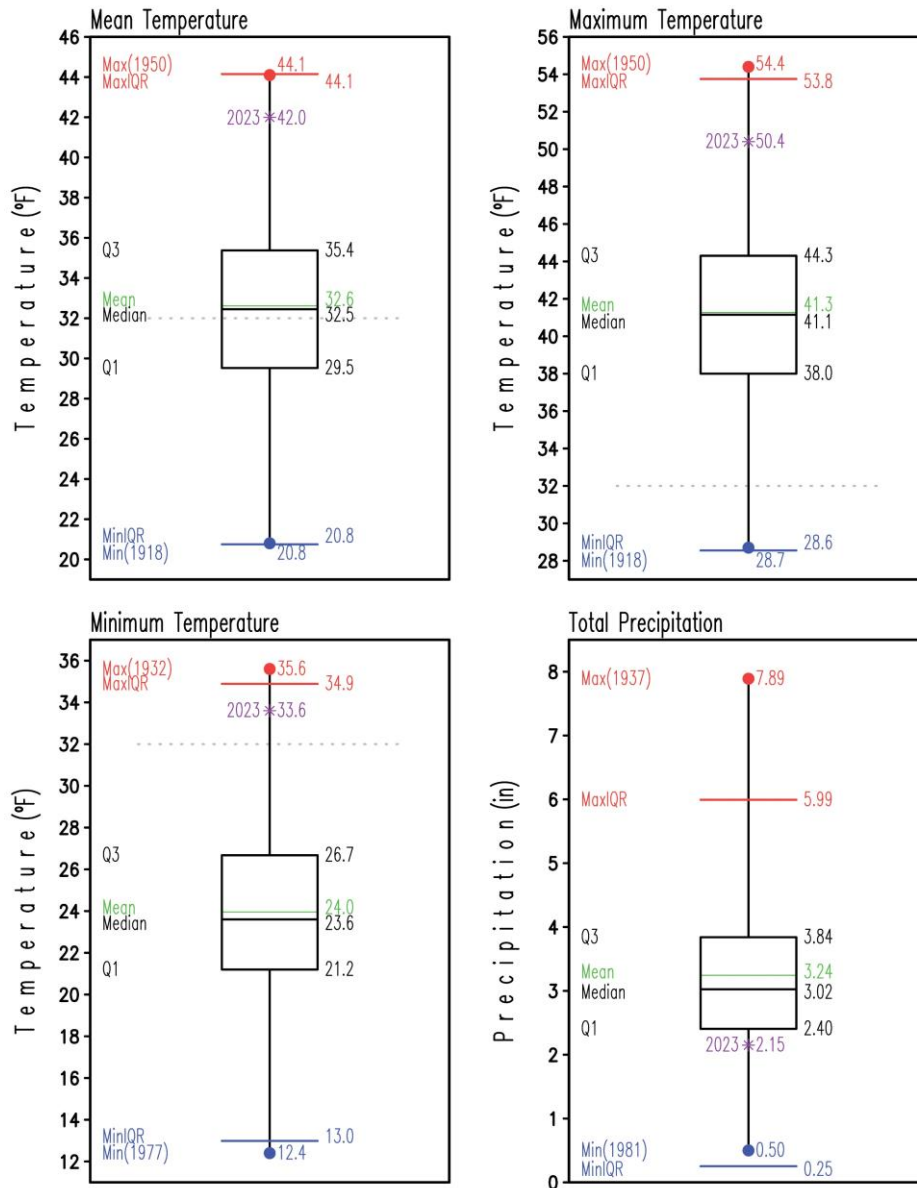**Figure 8.** Box and Whisker plots of area-averaged Maryland (statewide) monthly mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and total precipitation (lower right) for January for the period 1895-2022. The label and asterisk in purple represent conditions for January 2023. Statistics for the period 1895-2022 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.

Appendix A. January 2023 Tables: Statewide, Climate Divisions, and Counties

A.   Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)	Region	Total Precipitation (in)	Rank (#)
Statewide	42.0	127	Statewide	2.13	18
Climate Division 1	44.8	126	Climate Division 1	2.48	29
Climate Division 2	44.3	127	Climate Division 2	2.02	21
Climate Division 3	44.5	127	Climate Division 3	1.73	11
Climate Division 4	43.4	127	Climate Division 4	1.62	10
Climate Division 5	42.6	127	Climate Division 5	2.24	26
Climate Division 6	41.0	127	Climate Division 6	2.20	29
Climate Division 7	38.6	126	Climate Division 7	1.91	36
Climate Division 8	34.5	123	Climate Division 8	2.99	47
Allegany	37.9	124	Allegany	1.98	42
Anne Arundel	43.8	127	Anne Arundel	1.65	13
Baltimore	41.3	127	Baltimore	2.36	31
Baltimore City	43.5	127	Baltimore City	2.00	22
Calvert	44.4	127	Calvert	1.73	12
Caroline	43.4	127	Caroline	2.09	22
Carroll	40.2	127	Carroll	2.30	35
Cecil	41.1	127	Cecil	2.93	54
Charles	44.1	127	Charles	1.69	9
Dorchester	44.8	127	Dorchester	2.02	22
Fredrick	40.4	127	Fredrick	1.97	31
Garrett	34.5	123	Garrett	2.98	46
Harford	40.5	126	Harford	2.80	52
Howard	41.4	127	Howard	1.71	14
Kent	42.3	127	Kent	2.37	34
Montgomery	41.9	127	Montgomery	1.52	8
Prince George's	43.0	126	Prince George's	1.59	10
Queen Anne's	42.8	127	Queen Anne's	2.11	22
Saint Mary's	45.1	127	Saint Mary's	1.79	17
Somerset	44.8	125	Somerset	2.52	32
Talbot	44.3	127	Talbot	1.85	16
Washington	39.4	126	Washington	1.85	33
Wicomico	44.6	126	Wicomico	2.31	26
Worcester	45.0	125	Worcester	2.58	31

Table A1. Area-averaged monthly mean surface air temperature (left) and total precipitation (right) at Maryland (statewide), climate division, and county levels for January 2023. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for January 2023 occupies among the 129 Januaries after the 129 values have been arranged from the lowest to the highest in the *standard competition ranking method*. The closer to 129 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	50.4	125	Statewide	33.7	126
Climate Division 1	54.4	126	Climate Division 1	35.3	126
Climate Division 2	53.6	127	Climate Division 2	35.0	126
Climate Division 3	53.6	127	Climate Division 3	35.5	126
Climate Division 4	51.8	125	Climate Division 4	34.9	126
Climate Division 5	50.8	125	Climate Division 5	34.3	128
Climate Division 6	48.8	125	Climate Division 6	33.1	128
Climate Division 7	46.3	122	Climate Division 7	30.9	128
Climate Division 8	41.4	118	Climate Division 8	27.6	127
Allegany	45.5	119	Allegany	30.2	128
Anne Arundel	52.1	126	Anne Arundel	35.4	127
Baltimore	49.4	125	Baltimore	33.2	128
Baltimore City	51.6	126	Baltimore City	35.4	128
Calvert	53.1	127	Calvert	35.6	126
Caroline	52.8	126	Caroline	34.0	126
Carroll	47.9	124	Carroll	32.5	128
Cecil	49.2	125	Cecil	33.1	127
Charles	53.2	127	Charles	35.0	126
Dorchester	54.2	128	Dorchester	35.4	126
Fredrick	47.8	124	Fredrick	33.0	128
Garrett	41.4	118	Garrett	27.6	127
Harford	48.6	125	Harford	32.3	128
Howard	49.7	124	Howard	33.1	128
Kent	50.4	125	Kent	34.3	128
Montgomery	49.5	124	Montgomery	34.2	127
Prince George's	51.7	126	Prince George's	34.3	126
Queen Anne's	51.2	125	Queen Anne's	34.4	127
Saint Mary's	54.2	127	Saint Mary's	36.1	126
Somerset	54.1	126	Somerset	35.5	126
Talbot	52.9	127	Talbot	35.6	126
Washington	47.2	123	Washington	31.6	128
Wicomico	54.8	128	Wicomico	34.4	126
Worcester	54.3	126	Worcester	35.7	126

Table A2. Area-averaged monthly maximum (left) and minimum (right) surface air temperatures at Maryland (statewide), climate division, and county levels for January 2023. Temperatures are in °F. The rank is the order that the variable for January 2023 occupies among the 129 Januaries after the 129 values have been arranged from the lowest to the highest using the *standard competition ranking method*. The closer to 129 the rank, the larger (i.e., the warmer) the value of the surface variable is in the record.

Appendix B. January 2023 Bar Graphs: Statewide, Climate Divisions, and Counties

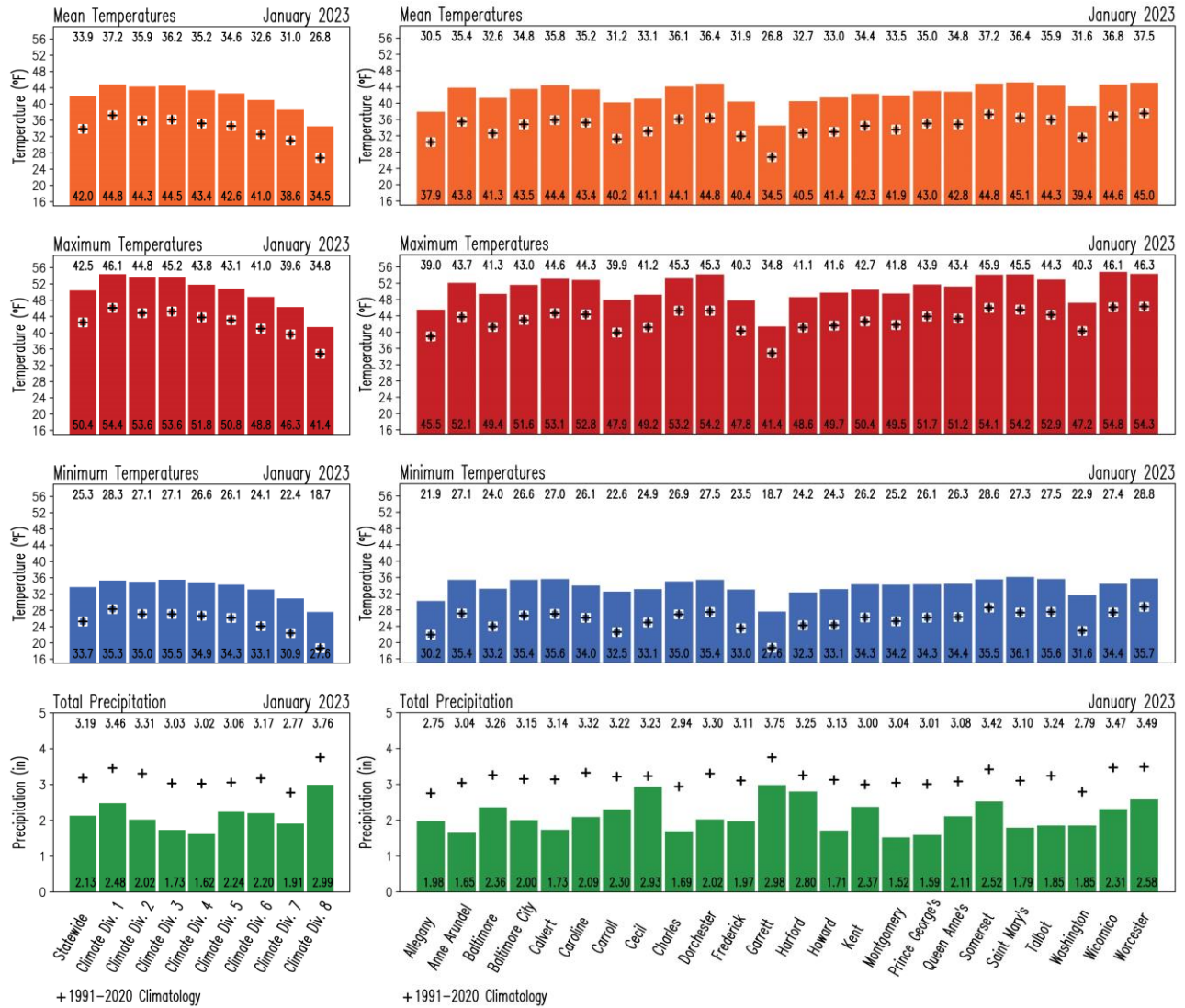A. Temperatures and Precipitation

Figure B1. Area-averaged monthly surface variables in Maryland for January 2023. 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 January 2023. For comparison, the corresponding 1991-2020 climatological values for January are displayed as black addition signs, and their magnitude are shown at the top of the panels.
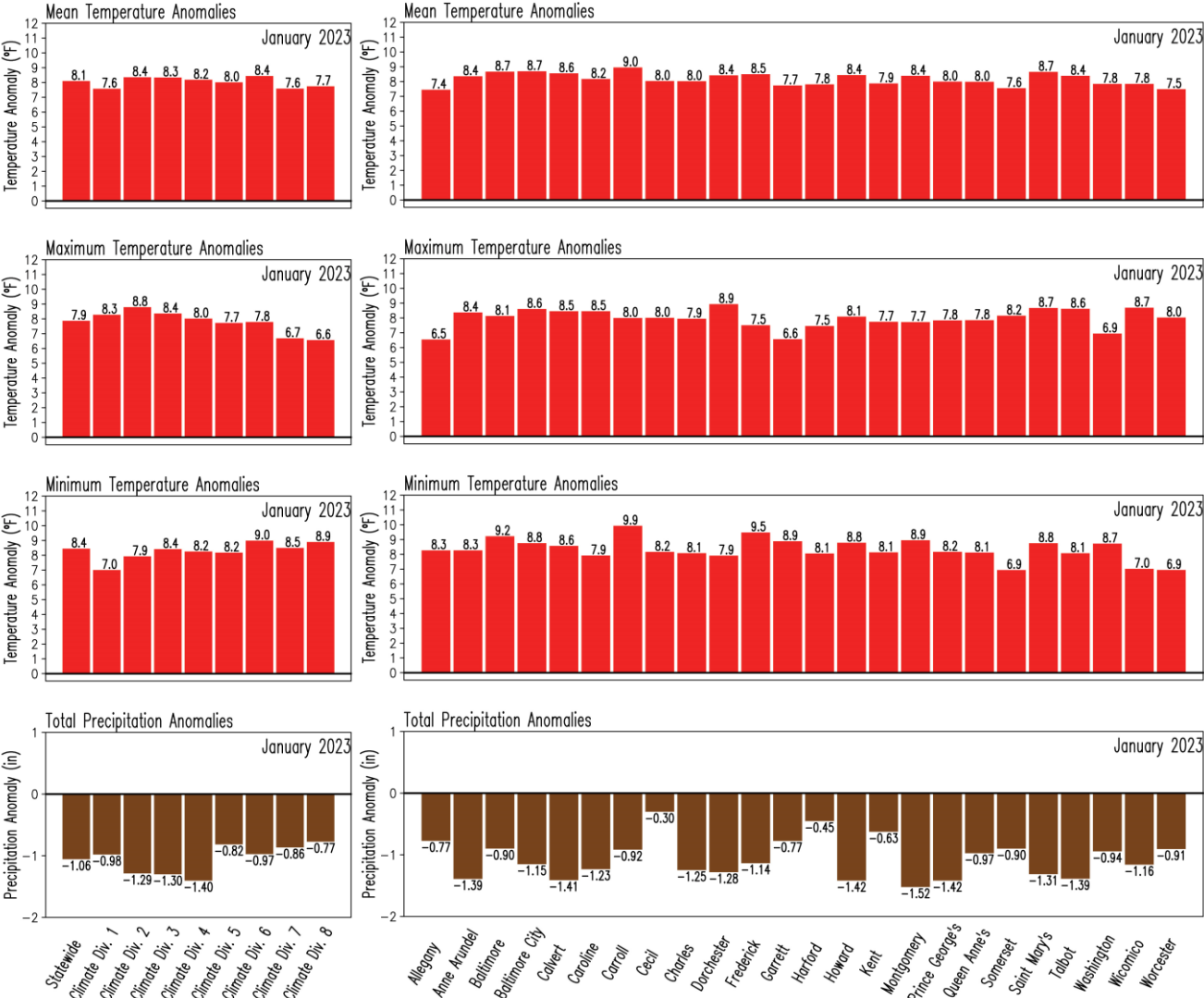
B.   Temperature and Precipitation Anomalies

Figure B2. Area-averaged anomalies of the monthly surface variables in Maryland for January 2023. 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 color indicates 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 January 2023.

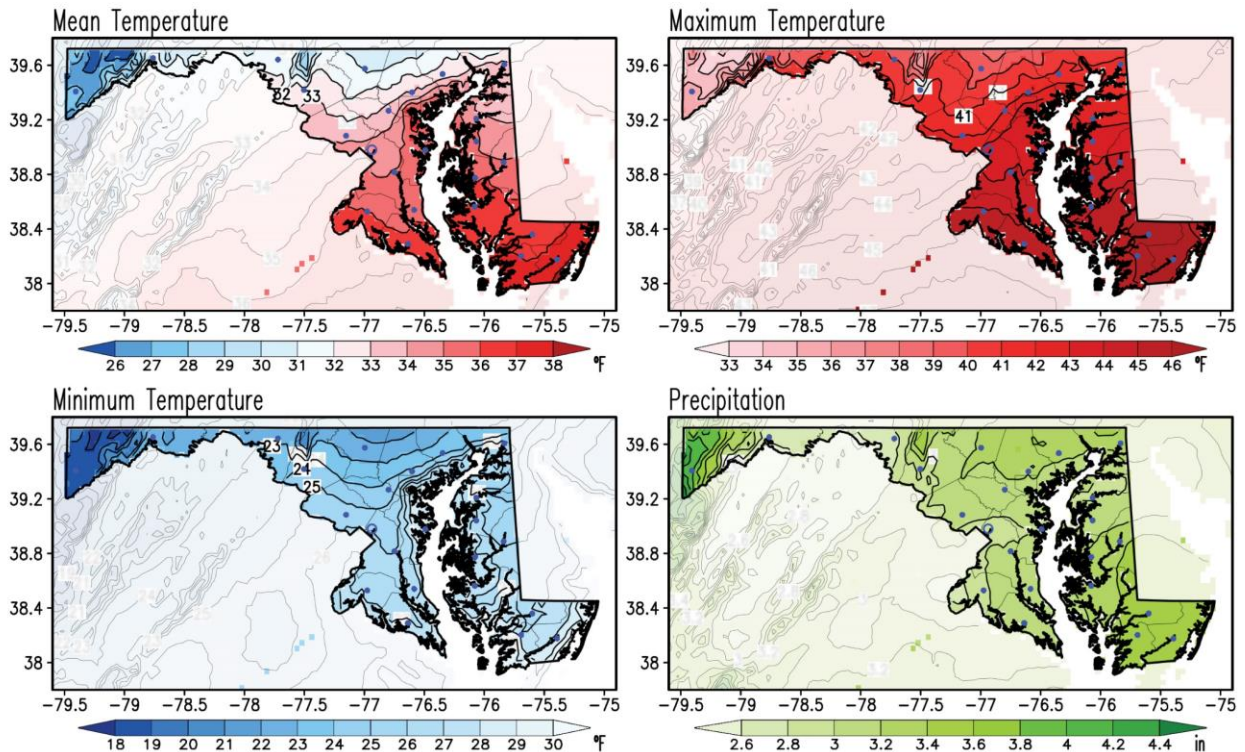# Appendix C. January 1991-2020 Climatology Maps

Figure C1. January 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 January 20223 conditions are compared to obtain the January 2023 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. January Standard Deviation and January 2023 Standardized Anomalies Maps
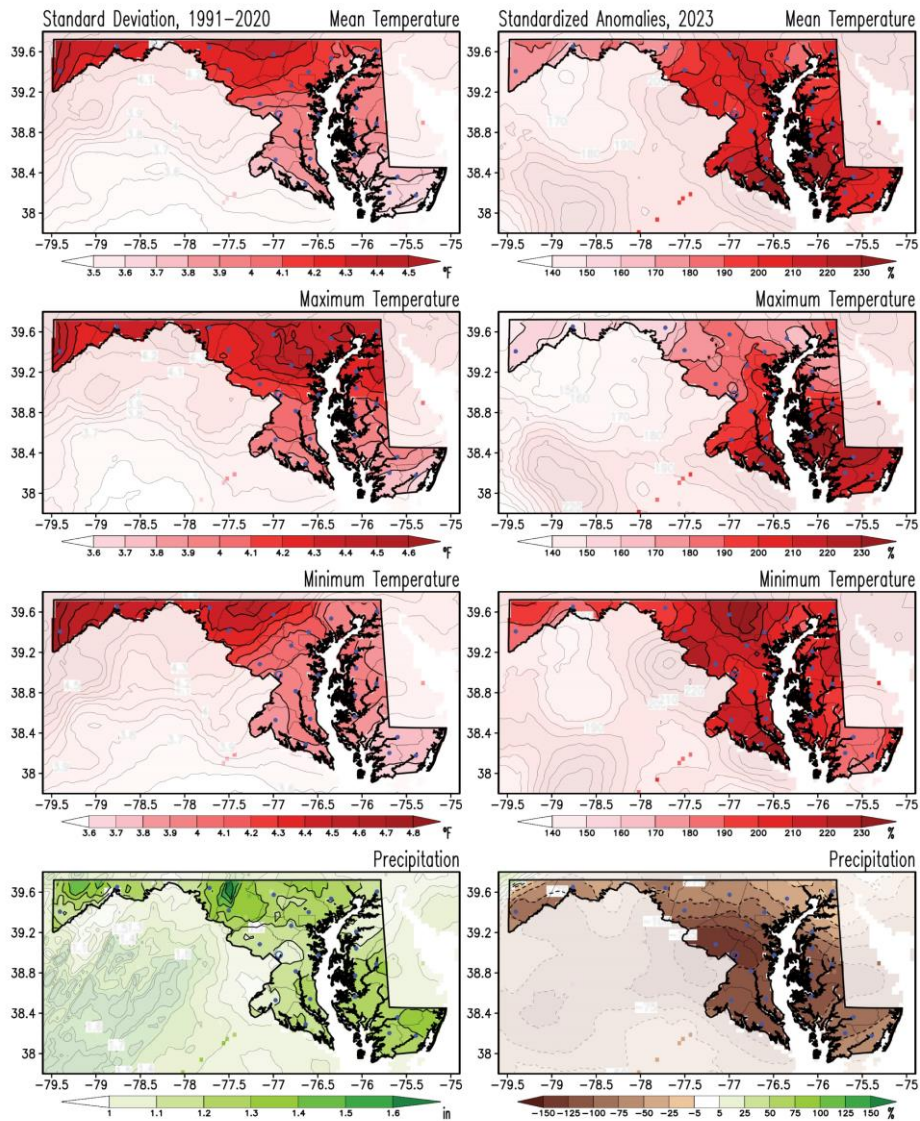

Figure D1. Standard deviation for January and standardized anomalies of temperatures and precipitation for January 2023. Standard deviations for monthly mean, maximum, and minimum surface air temperatures and total precipitation were obtained for the 1991-2020 period (left column). Anomalies for January 2023 (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.

Kunkel, K. E., and A. Court, 1990. Climatic Means and Normals—A Statement of the American Association of State Climatologists (AASC), Bulletin of the American Meteorological Society, 71(2), 201-204. Retrieved Aug 20, 2022, from https://journals.ametsoc.org/view/journals/bams/71/2/1520-0477-71_2_201.xml

Vose and co-authors, 2014. NOAA Monthly U.S. Climate Gridded Dataset (NClimGrid), Version 3. NOAA National Centers for Environmental Information. DOI:10.7289/V5SX6B56 [access March 28, 2022].

WMO, 2017. WMO Guidelines on the Calculation of Climate Normals. WMO-No. 1203, Series. 29pp. https://library.wmo.int/doc_num.php?explnum_id=4166.