MDSCO-2025-3S

Maryland Climate Bulletin
Summer 2025

Prepared by
Dr. Alfredo Ruiz-Barradas
Maryland State Climatologist

This publication is available from:
https://www.atmos.umd.edu/~climate/Bulletin/

DEPARTMENT OF
ATMOSPHERIC &
OCEANIC SCIENCE
Sumant Nigam, Chair

Maryland
State
Climatologist
Office

Summary

Summer 2025 was warmer and drier than normal (i.e., 1991-2020 averages) in Maryland, with colder and drier-than-normal conditions in August, warmer and wetter-than-normal conditions in July, and warmer and drier-than-normal conditions in June. Regionally, summer mean temperatures varied from 68 to 78°F, with maximum temperatures between 77 and 87°F, and minimum temperatures in the 58 to 70°F range. Seasonal accumulated total precipitation was between 8.5 and 15 inches.

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

- The mean temperature was warmer than normal in the entire state, especially in Garrett County (2.0−2.8°F), Somerset and Worcester counties (1.0–1.4°F), and Washington County (1.0°F).

- The maximum temperature was a mix of warmer and colder than normal temperatures. Warmer-than-normal temperatures were observed from the central Piedmont counties to the west, and over southwestern Charles County and the southernmost parts of Calvert, Saint Mary's, Dorchester, Somerset, and Worcester counties, but notably over Garrett County (2.0−2.6°F). Normal to below-normal temperatures were observed in the rest of the state, particularly in the counties of the Eastern Shore (0.2–0.4°F below).

- The minimum temperature was warmer than normal throughout the state, particularly in Garrett County (2.4−3.4°F), Somerset and Worcester counties (2.0–2.4°F), and Washington County (1.4−1.6°F).

- Precipitation was below normal over almost the entire state, particularly in Frederick, Carroll and Montgomery counties (3.2−4.0 inches deficit), Wicomico, Somerset and Dorchester counties, and the southern portions of Calver and Saint Mary's counties, and Cecil County (2.0−2.4 inches deficit), and parts of Garrett and Allegany counties (1.2−2.0 inches deficit). Among these regions, the summer precipitation over Frederick was 20 to 32% lower than its climatological seasonal precipitation, while precipitation in the other regions was between 12% and 16% lower. Above normal precipitation was found only over northern Baltimore and Harford counties, northwestern Garrett County, and Queen Anne's and Kent counties (0.4−1.2 inches), which amounted to 4 to 8% more than their normal summer precipitation.

- The partial water year 2025 (October 2024 − August 2025), except for northwestern Garrett County, was below normal everywhere else in the state, notably over Frederick, Carroll, and Montgomery counties (7−10 inches deficit), and parts of Harford, Kent, and Queen Anne's counties (7−9 inches deficit). The region over Frederick received 18−27% less than their climatological water amount, while the region over Harford got 18% less. The above-normal water amount over Garrett County (1−3 inches) received between 3 and 6% more than its climatological water amount.

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

- All eight climate divisions experienced warmer and drier-than-normal conditions during summer 2025. Climate Division 8, the Allegheny Plateau, had the largest mean temperature departure from normal (2.3°F), while Climate Division 4, Upper Southern, had the smallest (0.3°F below). Climate Division 1, the Southeastern Shore, to the east of the Bay, had the largest departure from normal precipitation (1.86 inches deficit); in contrast, Climate Division 5, Northeastern Shore, to the east of the Bay, had the smallest departure (0.57 inches deficit).

- Seasonally, statewide mean temperature anomalies in summer 2025 were warmer than normal (0.8°F), following a much warmer-than-normal spring (3.1°F), and a colder-than-normal winter 2024-25 (1.7°F below). Statewide precipitation anomalies in summer 2025 were below normal (1.41 inches deficit), after conditions were wetter than normal in spring (2.58 in), and drier than normal in winter 2024-25 (2.56 inches deficit).

Historical Context (Figure 8, Tables A1 and A2)

- Summer 2025's statewide mean, maximum, and minimum temperatures (75.3, 84.9, and 65.6°F) were above their long-term (1895-2024) averages (73.4, 83.9, and 62.9°F). Except for the maximum temperature, the others were within 25% of their warmest values on record, and even more, the minimum temperature was also within 5% of its warmest temperatures. The mean and maximum temperatures were far from their warmest records of 77.2 and 87.9°F, established in 2010, but the minimum temperature was closer to its warmest record of 66.6°F, also set in 2010. The statewide precipitation for summer 2025 (11.38 inches) was below the long-term average (12.53 inches) and far from the driest summer on record, which was 5.29 inches set in 1966.

- Statewide, mean temperature showed that summer 2025 was the seventeenth warmest summer since 1895, while the maximum temperature indicated that this was the thirty-eighth warmest summer. On the other hand, the statewide minimum temperature revealed that this was the seventh warmest summer on record.

- No counties reached mean temperatures among the ten warmest on record, except for Garrett County, which reached its third warmest summer. Similarly, no counties reached maximum temperatures among the ten or even twenty warmest since 1895. However, seventeen counties reached minimum temperatures within the ten warmest on record, and three of them within the five warmest; among these, Garrett County set a record, Somerset had its fourth warmest summer, and Worcester had its fifth warmest.

- Statewide precipitation indicated that summer 2025 was the fiftieth driest summer on record. No counties were closer to any record, but Frederick had its twenty-eighth driest summer, while Washington got its thirty-sixth driest summer on record.

Century-Plus Trends, 1895-2025 (Figures 9, 10)

- Statewide mean temperature and cooling degree days in summer showed a significant warming trend (1.9°F/century) and an increasing cooling trend (187.1°FDD/century), respectively. On the other hand, summer statewide accumulated total precipitation and partial water year (October−August) presented non-significant trends: a drying trend (−0.26 in/century) and an increasing water trend (1.90 in/century), respectively.

- Regionally, summer mean temperatures exhibited significant warming trends throughout the state, notably over Baltimore City and southern Baltimore County (2.6−3.2°F/century), the urban corridor from southern Montgomery and northern Prince George's counties to central Baltimore and southern Harford counties (2.2−2.4°F/century), and over the Eastern Shore (2.0− 2.2°F/century).

- Regionally, accumulated total precipitation in summer showed areas of drying and wetting trends. However, the only significant trends were drying trends between western Frederick and eastern Washington counties and over southwestern Charles County (−1.4 to −1.6 inches per century).

Chesapeake Bay Sea Surface Temperatures (Figures 11, 12, F1)

- Sea surface temperatures in the Chesapeake Bay in summer 2025 were in the 72–81°F range. Regionally, they were below their 2007-2020 mean over the majority of the Bay from the Upper Basin (1.2°F below) and the Middle Basin (0.6°F), where the anomalies largely occupied the main steam of the Bay and rivers on the Eastern Shore, to the Lower Basin where the extent of anomalies on the main steam diminished from north to south until they were confined to the waters along the Eastern Shore and rivers reaching the waters of the Tangier and Pocomoke Sounds (0.2–0.4°F below). The waters off Worcester County's Chincoteague Bay were also colder than the mean (0.2–0.4°F below). On the other hand, warmer anomalies than the 2007-2020 mean appeared along the western shore waters from the Back and Patapsco Rivers (0.8-1.2°F above) to the southern Calvert County coast, where they expanded to reach the Taylor and Hoopers Islands (0.2−0.4°F above). The current all-basin mean temperature of 79.2°F was slightly below the 19-year mean of the dataset (79.4°F) and far from the coldest summer temperature of 77.5°F, set in 2014, within the 19-year record (2007−2025).

Contents

Summary i
Contents iv
1. Introduction 1
2. Data & Methods 1
3. Summer 2025 Maps 5
A. Mean Temperatures 5
B. Maximum Temperatures 6
C. Minimum Temperatures 7
D. Precipitation 8
E. Partial Water Year (October 2024 – August 2025) 9
4. Summer 2025 and Winter 2024-25 – Summer 2025 Climate Divisions Averages 10
A. Summer 2025 Scatter Plots 10
B. Winter 2024-25 to Summer 2025 Scatter Plots 11
5. Summer 2025 Statewide Averages in the Historical Record 12
A. Box and Whisker Plots 12
6. 1895-2025 Trends 13
A. Statewide Mean Temperature, Cooling Degree-Days, Accumulated Total Precipitation, and Partial Water Year (October 2024-August 2025) 13
B. Temperature and Precipitation Maps 14
7. Chesapeake Bay's Satellite Sea Surface Temperatures 15
A. Maps 15
B. Upper, Middle, Lower, and Entire Basins 16
Appendix A. Summer 2025 Tables: Statewide, Climate Divisions, and Counties 17
A. Mean Temperature and Precipitation 17
B. Maximum and Minimum Temperatures 18
Appendix B. Summer 2025 Bar Graphs: Statewide, Climate Divisions, and Counties 19
A. Temperatures and Precipitation 19
B. Temperature and Precipitation Anomalies 20
Appendix C. Summer 1991-2020 Climatology Maps and Summer 2025 Precipitation as Percentage of Climatology 21
Appendix D: The Water Year 1991-2020 Climatology, and October 2024 – August 2025 as Percentage of Climatology 22

Appendix E. Summer Standard Deviation and Summer 2025 Standardized Anomalies Maps 22
Appendix F. 2007-2020 Mean and Standard Deviation of Sea Surface Temperatures in Summer .. 24
References 25

1. Introduction

The Maryland Climate Bulletin is issued by the Maryland State Climatologist Office (MDSCO), which resides in the Department of Atmospheric and Oceanic Science at the University of Maryland, College Park. This is the seasonal version of the bulletin.

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

The bulletin aims to document and characterize seasonal surface climate conditions, situating them within the context of regional and continental climate variability and change, to help Marylanders interpret and understand recent climate conditions.

The seasonal surface climate conditions for summer 2025 are presented via maps of key variables, such as average surface air temperature, maximum surface air temperature, minimum surface air temperature, accumulated total precipitation, and their anomalies (i.e., departures from normal); they are complemented by partial water year conditions for the state in Section 3. Statewide and climate division averages for the season are compared using scatter plots in Section 4. The seasonal statewide averages are placed in the context of the historical record via box and whisker plots in Section 5. Century-plus trends in statewide air temperature, cooling degree-days, accumulated total precipitation, partial water year, and state maps of air temperature and accumulated total precipitation are presented in Section 6. Seasonal sea surface temperatures (SST) in the Chesapeake Bay are presented in Section 7. Ancillary statewide, climate division, and county-level information is provided via tables and plots in Appendices A and B; climatology and variability maps are included in Appendices C-E; mean and variability of the sea surface temperatures in the Chesapeake Bay are displayed in Appendix F.

2. Data & Methods

Surface air temperatures, total precipitation, and cooling degree-days data in this report are from the following sources:

- NOAA Monthly U.S. Climate *Gridded* Dataset at 5-km horizontal resolution (NClimGrid – Vose et al., 2014). It is available in a preliminary status from 1895 to the present at: https://www.ncei.noaa.gov/data/nclimgrid-monthly/access/
  Data was downloaded on September 18, 2025.

- NOAA Monthly U.S. Climate *Divisional* Dataset (NClimDiv – Vose et al., 2014). It is available in a preliminary status from 1895 to the present (v1.0.0-20250905) at: https://www.ncei.noaa.gov/pub/data/cirs/climdiv/
  Data was downloaded on September 10, 2025.

Data and sources for the Chesapeake Bay are the following:

- Satellite-based sea surface temperatures from NOAA's CoastWatch Program. The data was made available by the Program's East Coast Node. This satellite-based sea surface temperature data uses data from the Advanced Very High Resolution Radiometer (AVHRR) on the European MetOp satellites, and the Visible Infrared Imaging Radiometer Suite (VIIRS) on the U.S. SNPP and NOAA JPSS satellites. In creating this product, nighttime overpasses for the U.S. East Coast are used, thereby avoiding daytime solar heating of the ocean surface and the associated warm bias in the data. In particular, the product acquired is the monthly sea surface temperatures for the Chesapeake and Delaware Bays, which have a nominal horizontal resolution of 750 km. Please be advised that although a seasonal resolution version of the data set exists at the East Coast Node, for consistency with the analysis of surface atmospheric parameters in this Bulletin, the monthly version was preferred to derive the seasonal version of the data set in-house, as the seasonal resolution of the data at the East Coast Node was obtained from daily resolution data. It is available from 2007 to the present at:
  https://eastcoast.coastwatch.noaa.gov/data/avhrr-viirs/sst-ngt
  Data was downloaded on September 2, 2025.

- A shapefile of watersheds for the state from the Maryland Department of the Environment and the Department of Natural Resources: the Maryland Watersheds – 8 Digit Watersheds. It contains 138 separate watersheds, identified with an 8-digit numeric code from which three are on the main steam of the Chesapeake Bay: the Upper Chesapeake Bay (code: 02139996; from the mouth of the Susquehanna River to northern side of the mouth of the Gunpowder River), the Middle Chesapeake Bay (code: 02139997; from the Gunpowder River to the mouth of the Chester River), and the Lower Chesapeake Bay (code: 02139998; from the south side of the mouth of the Chester River to the mouth of the Potomac River), which in turn are used to create a one-watershed shapefile for the entire basin. These four watersheds are used to create area-averaged sea surface temperatures for the Bay. It is available at:
  https://data.imap.maryland.gov/datasets/maryland::maryland-watersheds-8-digit-watersheds/about

Some definitions:

About the seasons: Seasons are defined following the common three-month meteorological definitions. Spring includes March, April, and May; summer includes June, July, and August; fall includes September, October, and November; and winter includes December, January, and February. Seasonal temperatures are calculated as the mean of the temperatures in the three months, while seasonal precipitation and degree days are calculated as the sum of their values in the three months, which in turn were obtained by summing their daily values.

About climate and climatology. Weather and climate are closely related, but they are not the same. Weather represents the state of the atmosphere (temperature, precipitation, etc.) at any given time. On the other hand, climate refers to the time average of weather elements when the average is over long periods. If the average period is sufficiently long, we can begin 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). The current climate normal, or simply the climatology, is defined for the period 1991–2020.

It should be noted that the satellite-based sea surface temperature data set has a short temporal coverage of 19 years, from 2007 to the present, which prevents the calculation of its current climate normal (1991-2020). In this case, a 2007-2020 mean is used as a base of comparison in the calculation of anomalies. This will be referred to as the 2007-2020 mean and not as a climatology.

About the anomalies: Anomalies for a given season (e.g., summer 2025) are the departures of the seasonal value from the corresponding climatology; in this case, the 1991-2020 climatology. When the observed seasonal value exceeds its climatological value, it is referred to as above normal (e.g., warmer than normal or wetter than normal) or a positive anomaly. In contrast, when this value is smaller than its climatological value, it is referred to as below normal (e.g., colder than normal or drier than normal) or a negative anomaly.

About variability. The seasonal standard deviation of a climate variable measures its dispersion relative to its seasonal mean and assesses its year-to-year, or interannual, variability. Anomalies are sometimes compared against that variability to identify extremes in the climate record. When anomalies are divided by the standard deviation, they are referred to as standardized anomalies.

About degree days. Degree days are the difference between the daily mean temperature (calculated by averaging the high and low temperatures) and a predefined base temperature. Since energy demand is cumulative, degree-day totals are typically calculated on a daily, monthly, seasonal, and annual basis.

- *Heating and cooling degree days.* These are used to obtain a general idea of the energy required to warm or cool buildings. The base temperature used for this purpose is 65°F, which is considered tolerable for human comfort (CPC, 2023).

About the water year. The water year is the sum of total precipitation from October 1st to September 30th of the following year and is labeled by the year in which the measurements end. Therefore, the water year 2025 started in October 2024 and will end in September 2025. Total precipitation for the entire water year reflects both winter snow accumulation and summer rainfall. Precipitation that falls during a water year reflects the amount of water that will contribute to actual stream flow and groundwater inputs for that year. This Bulletin presents only the partial water year from October 2024 to August 2025, based on the total monthly precipitation data for that period.

About NOAA's Climate Divisions. The term "climate division" refers to one of the eight divisions in the state that represent climatically homogeneous regions, as determined by NOAA: https://www.ncei.noaa.gov/access/monitoring/dyk/us-climate-divisions

The eight climate divisions in Maryland are:

- Climate Division 1: Southeastern Shore. It includes the counties of Somerset, Wicomico, and Worcester.
- Climate Division 2: Central Eastern Shore. It includes the counties of Caroline, Dorchester, and Talbot.
- Climate Division 3: Lower Southern. It includes the counties of Calvert, Charles, and St. Mary's.
- Climate Division 4: Upper Southern. It includes the counties of Anne Arundel and Prince George's.
- Climate Division 5: Northeastern Shore. It includes the counties of Kent and Queen Anne's.
- Climate Division 6: North Central. It includes the counties of Baltimore, Carroll, Cecil, Frederick, Harford, Howard, Montgomery, and the city of Baltimore.
- Climate Division 7: Appalachian Mountains. It includes the counties of Allegany and Washington.
- Climate Division 8: Allegheny Plateau. It includes Garrett County.

Note that these Climate Divisions do not correspond with the *Physiographic Provinces* in the state, as the former follow county lines. Climate Division 8 follows the *Appalachian Plateau Province*, Climate Division 7 follows the *Ridge and Valley Province*; however, Climate Division 6 includes the *Blue Ridge and the Piedmont Plateau provinces,* Climate Divisions 3, 4, and a portion of 6 include the *Upper Coastal Plain Province*, and Climate Divisions 1, 2, 5, and a portion of 6 include the *Lower Coastal Plain (or Atlantic Continental Shelf) Province*.

3. Summer 2025 Maps

A. Mean Temperatures

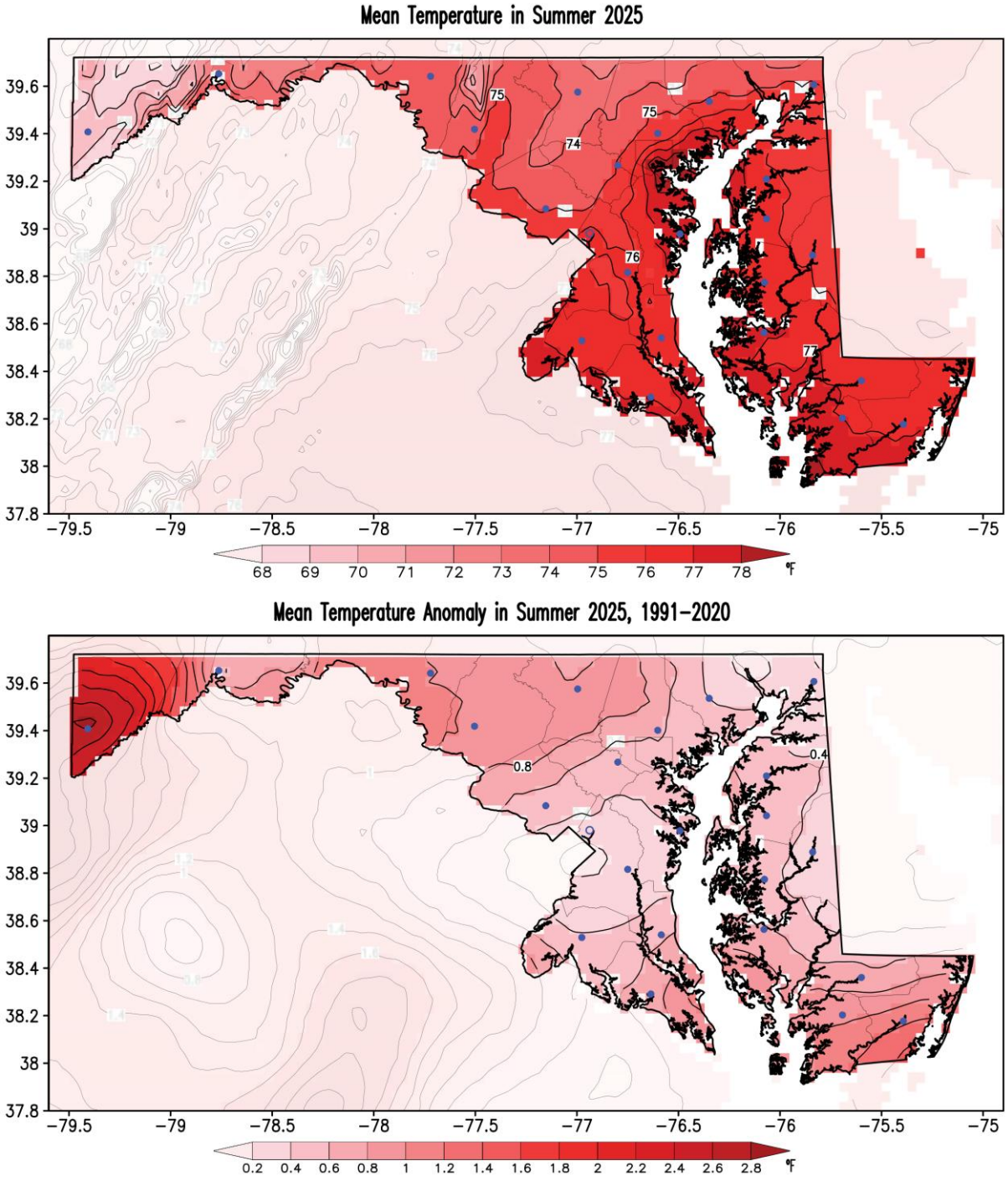

Figure 1. Seasonal mean surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for summer 2025. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

B. Maximum Temperatures

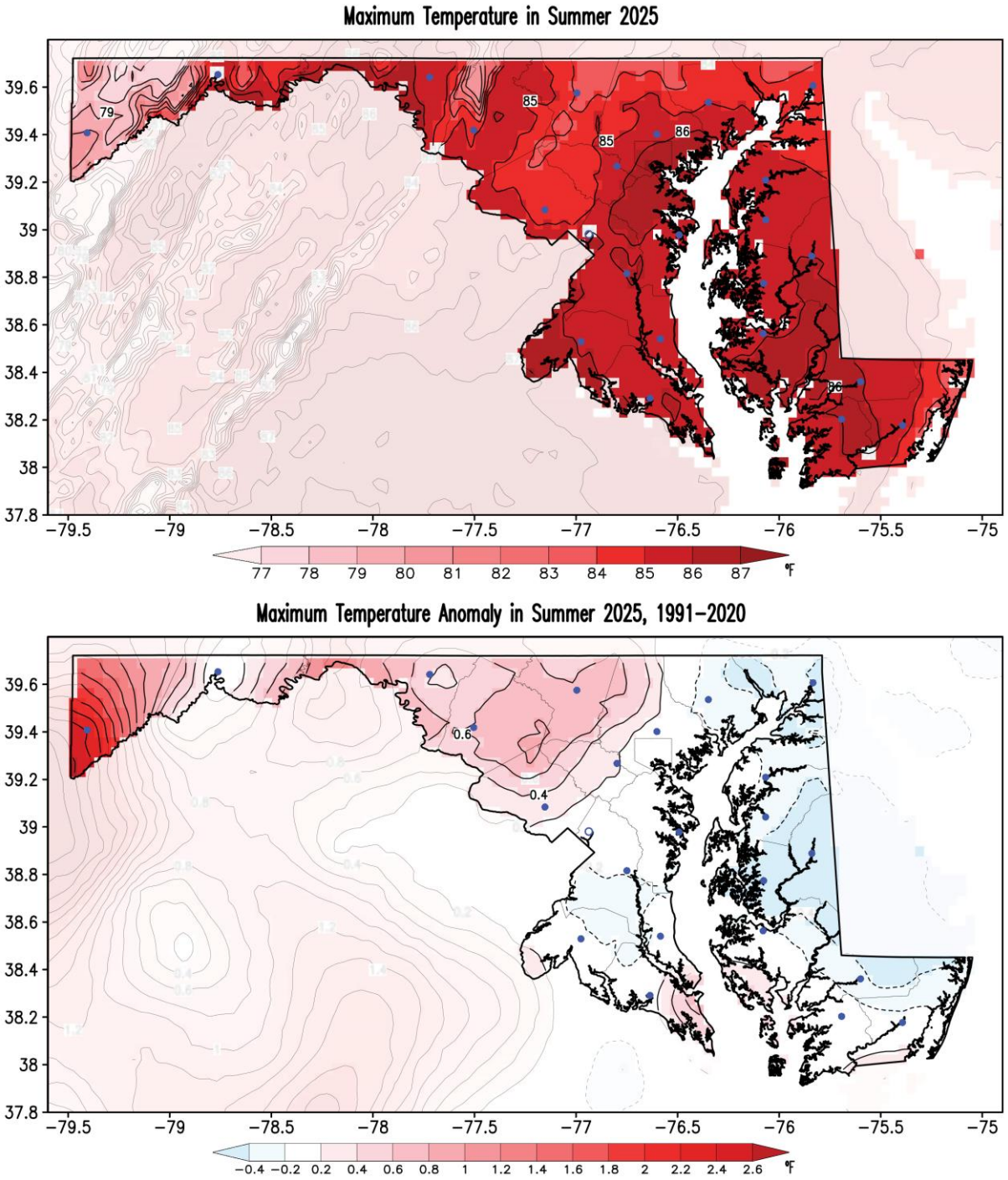

Figure 2. Seasonal maximum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for summer 2025. Temperatures are in °F following the color bar. Blue/red shading in the anomaly map marks colder/warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

C. Minimum Temperatures

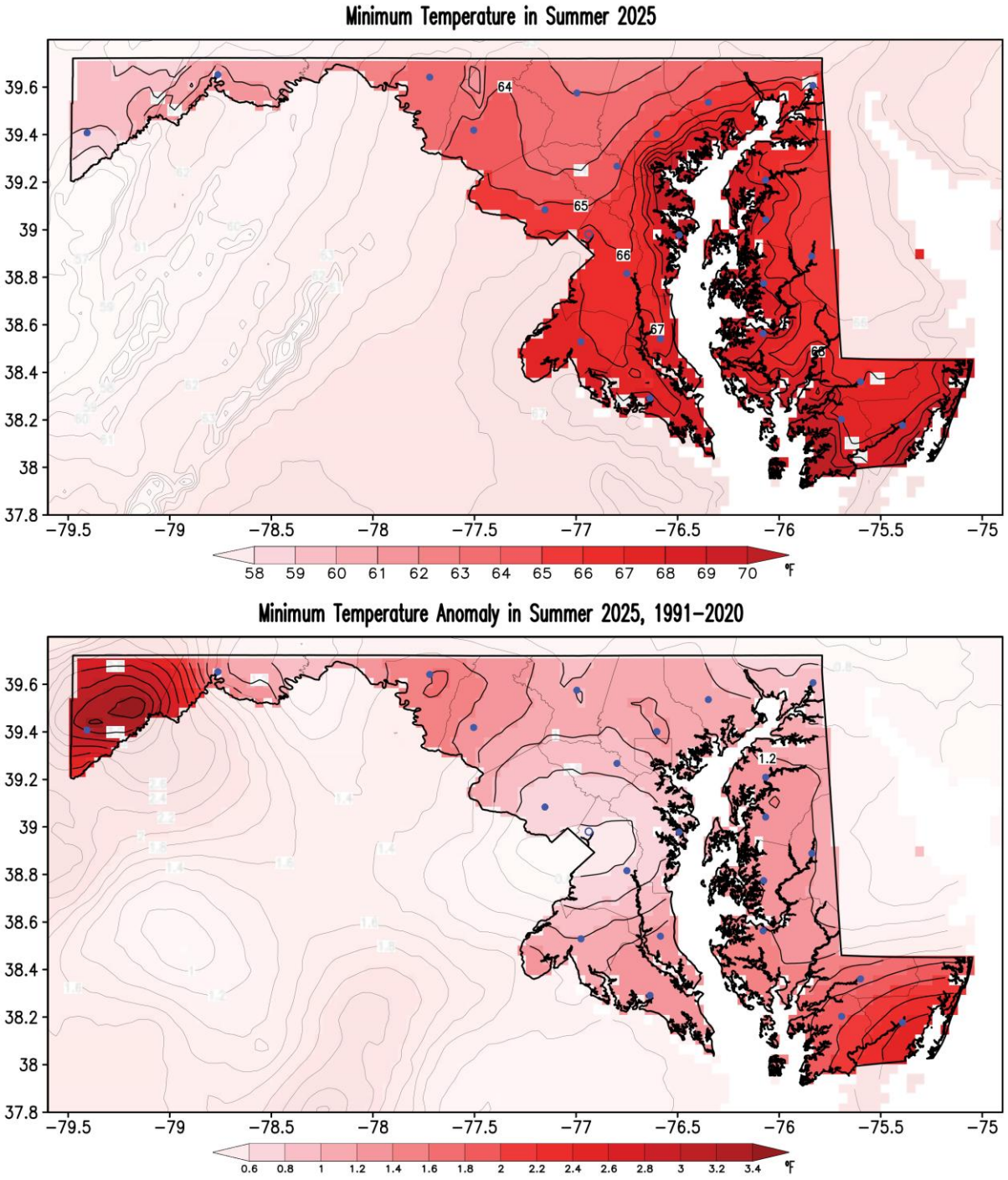

Figure 3. Seasonal minimum surface air temperature (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for summer 2025. Temperatures are in °F following the color bar. Red shading in the anomaly map marks warmer than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

D. Precipitation

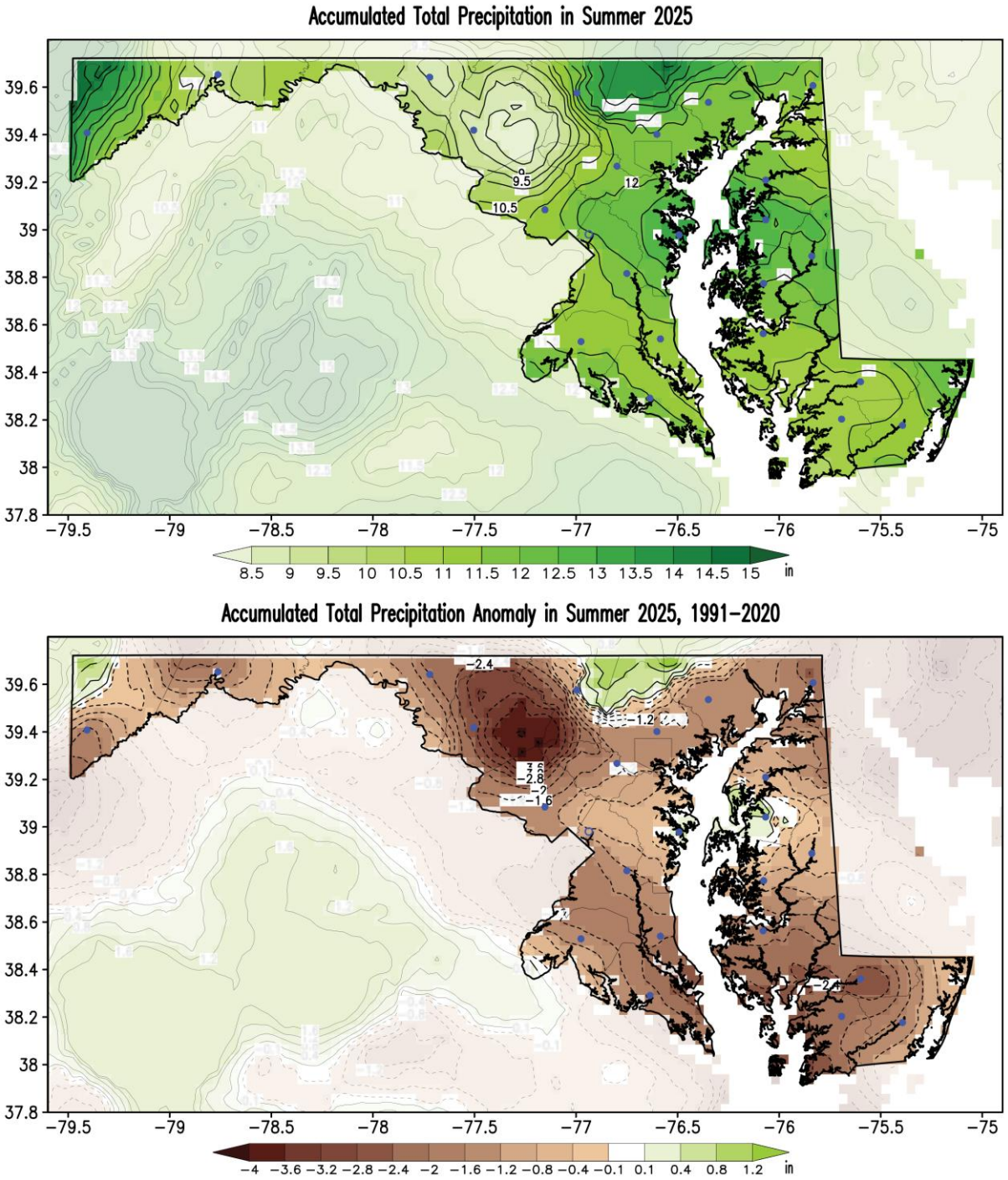

Figure 4. Seasonal accumulated total precipitation (top panel) and its anomaly with respect to the 1991-2020 climatology (bottom panel) for summer 2025. Precipitation is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

E. Partial Water Year (October 2024 – August 2025)

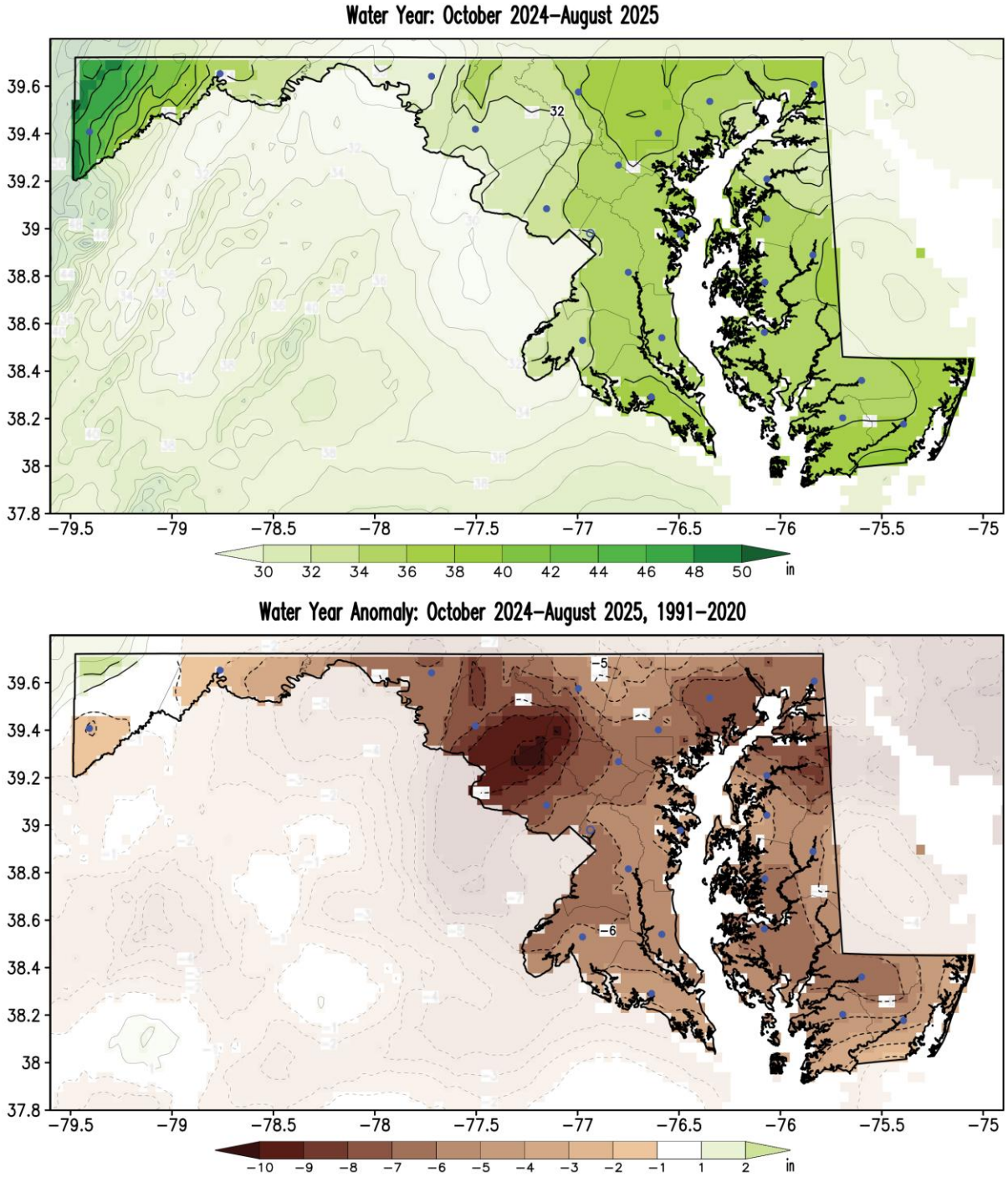

Figure 5. Partial water year until August 2025 (top panel), and its anomaly with respect to the 1991-2020 climatology (bottom panel). Water year is in inches following the color bar. Brown/green shading in the anomaly map marks drier/wetter than normal conditions. The current maps display the partial conditions from October 2024 to August 2025. Note shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

4. Summer 2025 and Winter 2024-25 – Summer 2025 Climate Divisions Averages

A. Summer 2025 Scatter Plots

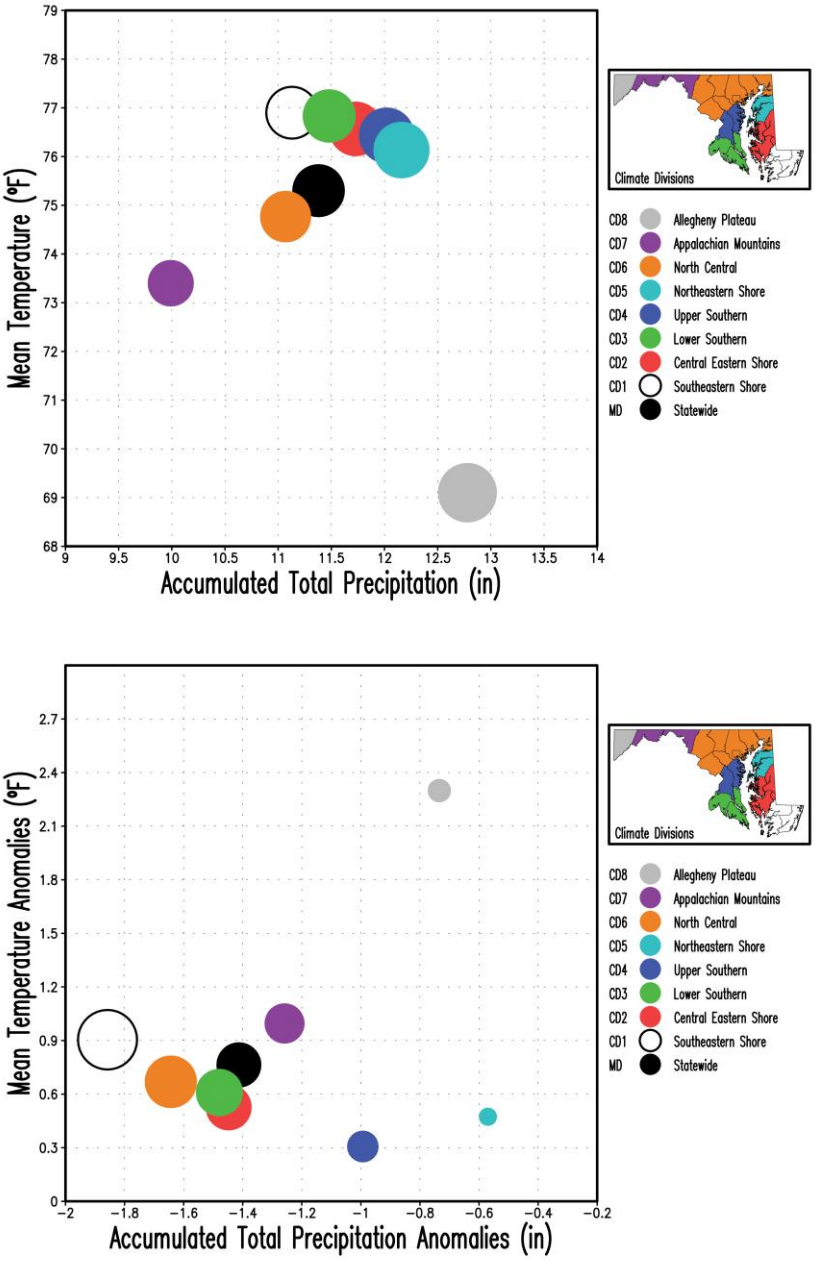

Figure 6. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) seasonal mean surface air temperature vs. accumulated total precipitation for summer 2025. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies with respect to the 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 (12.78 inches in CD8, top panel) and by the maximum precipitation anomaly (|−1.86| inches 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.

B. Winter 2024-25 to Summer 2025 Scatter Plots

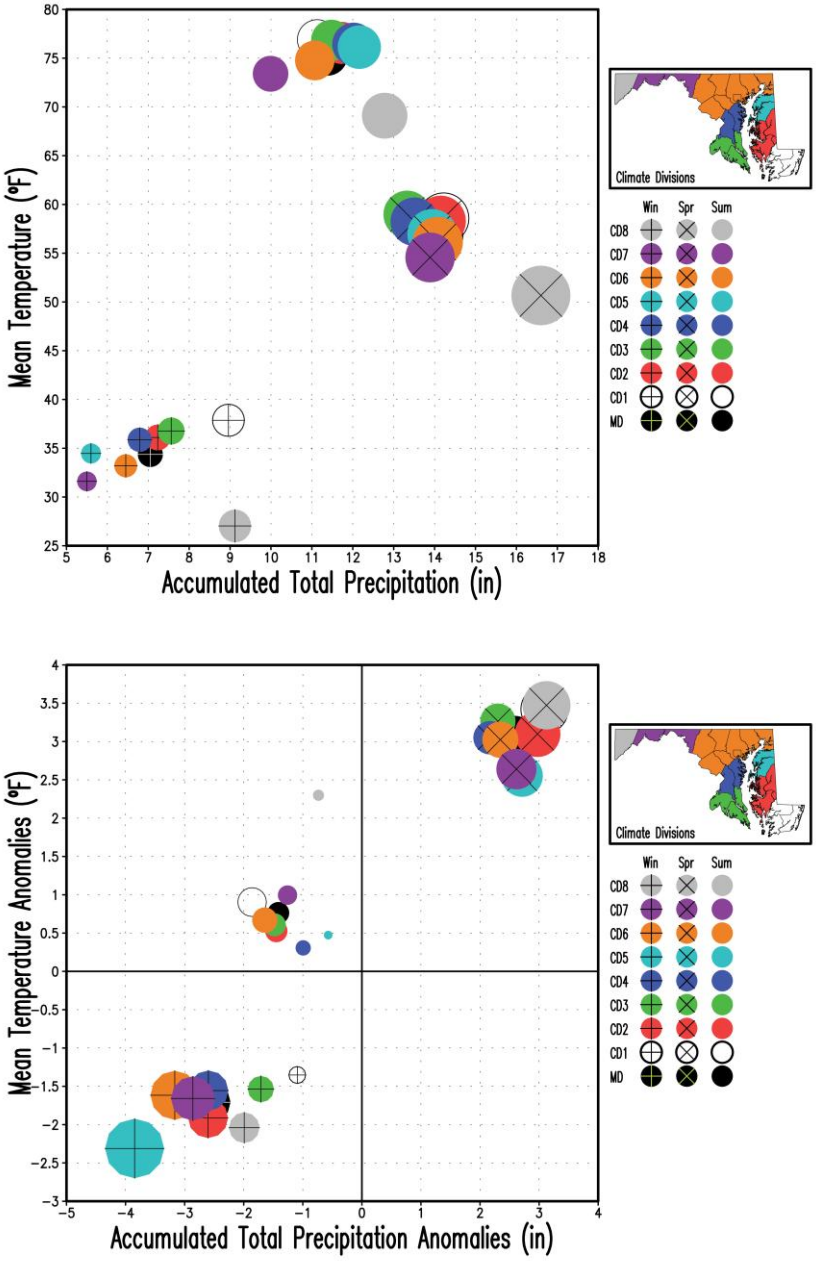

Figure 7. Scatter plots of Maryland (statewide) and Climate Divisions (CD#) seasonal mean surface air temperature vs. accumulated total precipitation for winter 2024-25, spring and summer 2025. The upper panel shows the mean temperature and total precipitation, and the bottom panel displays their anomalies 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 (16.60 inches in CD8 in spring, top panel) and by the maximum precipitation anomaly (|–3.85| inches in CD5 in winter 2024-25, bottom panel) among the nine regions and three months. Summer 2025 is displayed with filled circles only, while spring and winter 2024-25 are displayed with superposed multiplication and addition signs, respectively.

5. Summer 2025 Statewide Averages in the Historical Record

A. Box and Whisker Plots

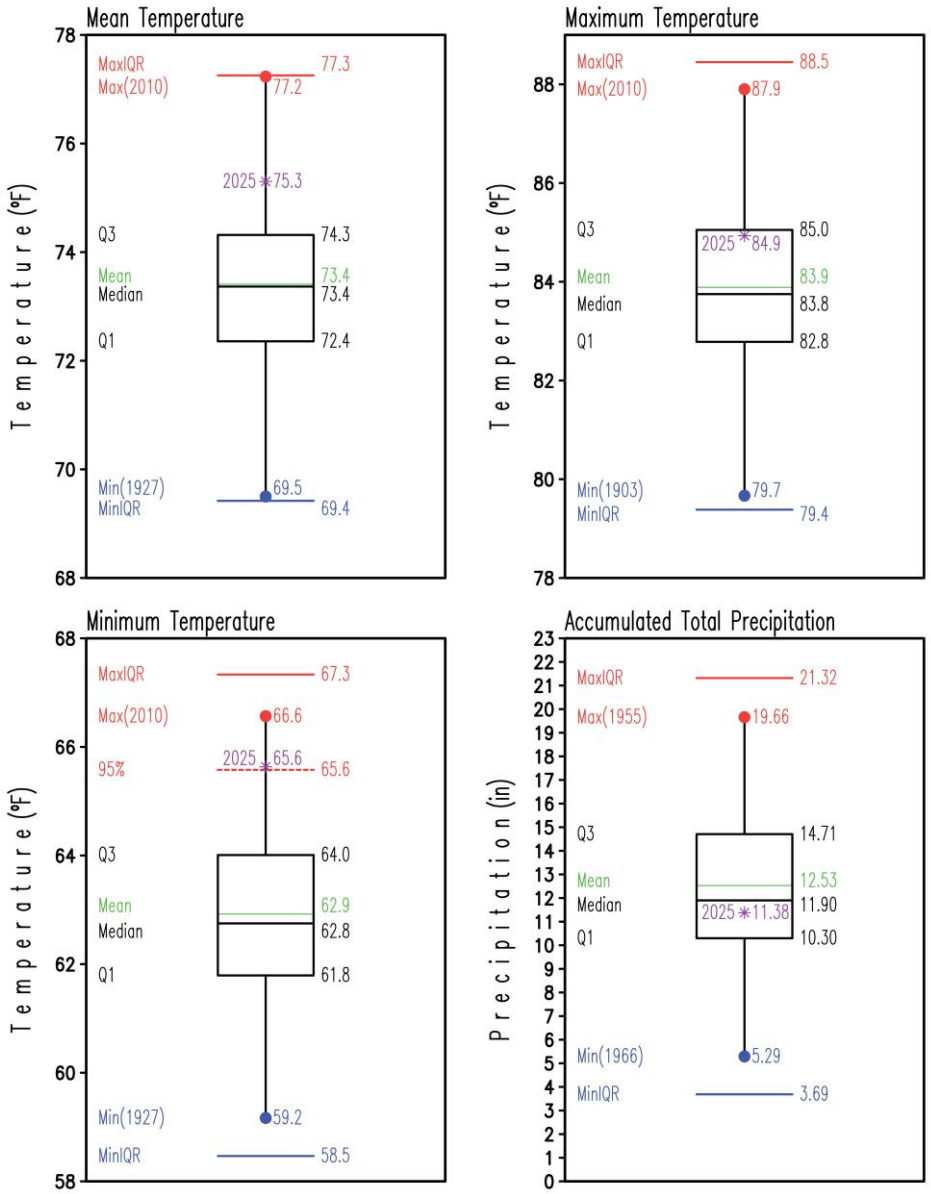

Figure 8. Box and Whisker plots of Maryland (statewide) seasonal mean (upper left), maximum (upper right), minimum (lower left) surface air temperatures, and accumulated total precipitation (lower right) for summer for the period 1895-2024. The label and asterisk in purple represent conditions for summer 2025. Statistics for the period 1895-2024 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. For reference, the 95th percentile in the minimum temperature is displayed with a red dashed line. 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.

6. 1895-2025 Trends

A. Statewide Mean Temperature, Cooling Degree-Days, Accumulated Total Precipitation, and Partial Water Year (October 2024-August 2025)

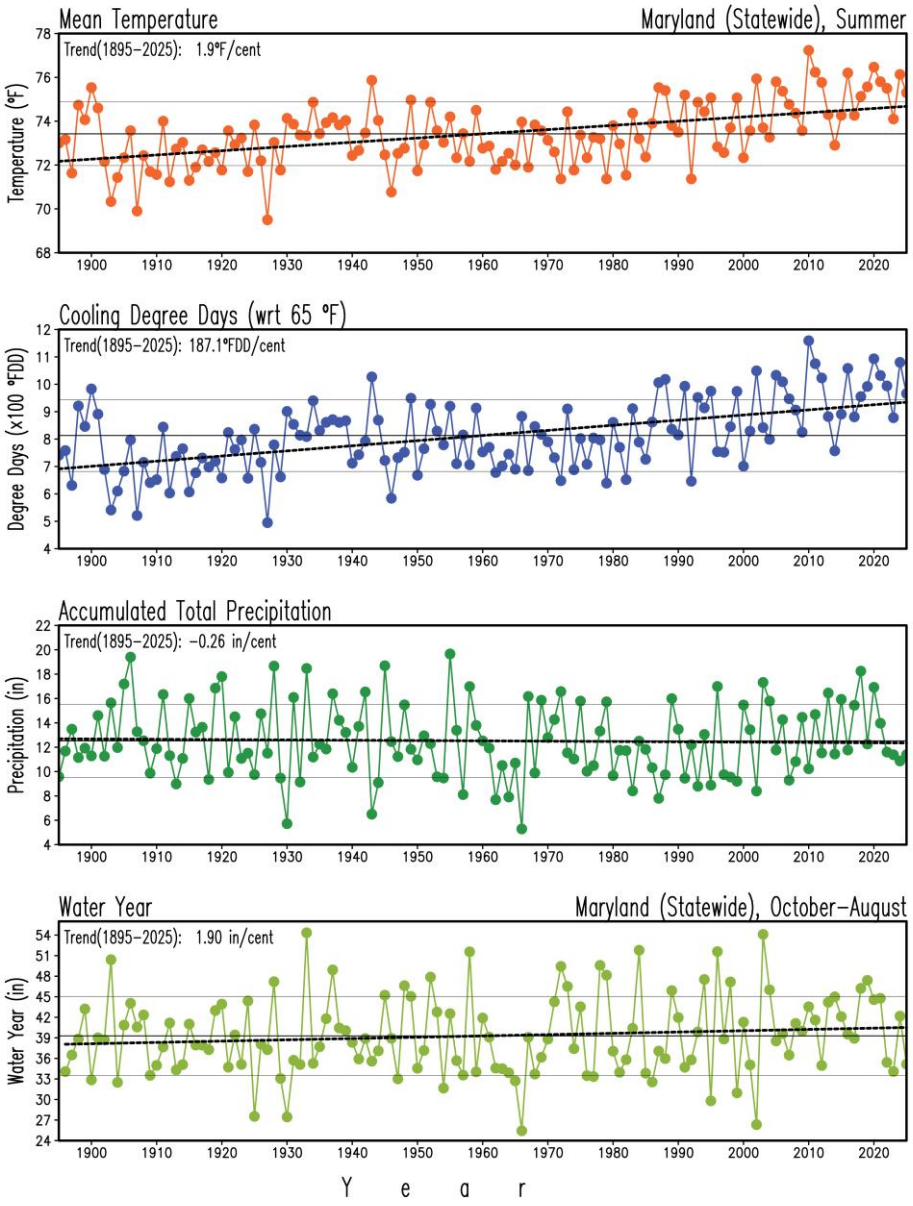

Figure 9. Maryland (statewide) mean surface air temperature, cooling degree-days, accumulated total precipitation in summer, and partial water year (October 2024 – August 2025) for the period 1895-2025. Temperature is in °F, cooling degree-days is in °F degree-days (°FDD), and precipitation and water year are in inches. The thin, continuous black lines in each panel display the long-term means (73.4°F, 813.0°FDD, 12.52 in, and 39.29 in, 1895-2025), and the double thin, continuous gray lines indicate the standard deviation (1.4°F, 131.1°FDD, 3.00 in, and 5.76 in) above/below the long-term mean. The thick dashed black lines show the long-term linear trends. The warming temperature trend (1.9°F/century) and the increasing cooling degree-days trend (187.1°FDD/century) are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000), but not the drying precipitation trend (−0.26 in/century) or the increasing water year trend (1.90 in/century).

B. Temperature and Precipitation Maps

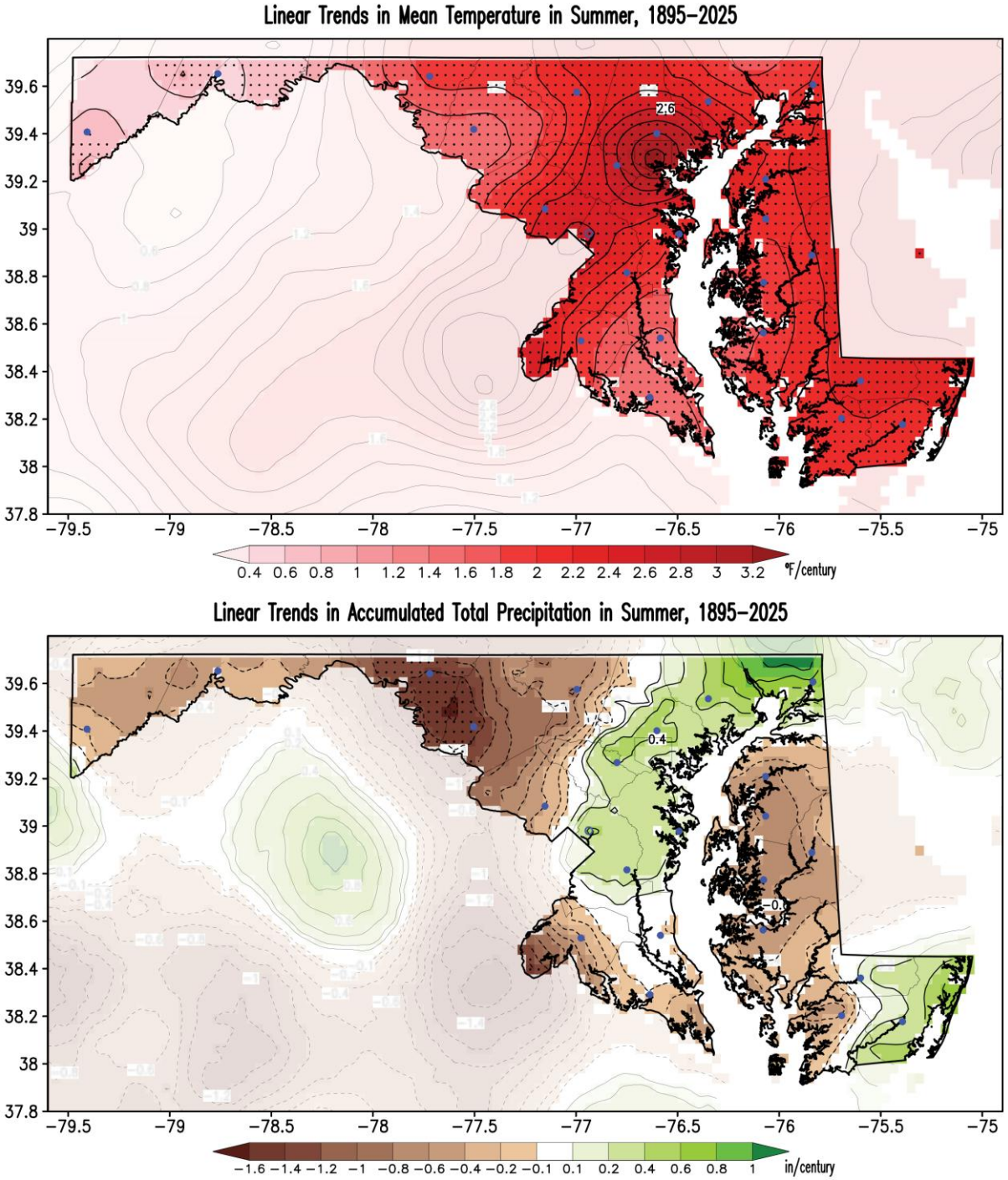

Figure 10. Linear trends in summer surface air mean temperature and accumulated total precipitation for the period 1895-2025. Temperatures are in °F/century, and precipitation is in inches/century following the color bars. Red shading in the temperature map marks warming trends. Brown/green shading in the precipitation map shows drying/wetting trends. Stippling in the maps shows regions where trends are statistically significant at the 95% level (*Student's t-test* −Santer et al. 2000). Note that shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

7. Chesapeake Bay's Satellite Sea Surface Temperatures

A. Maps

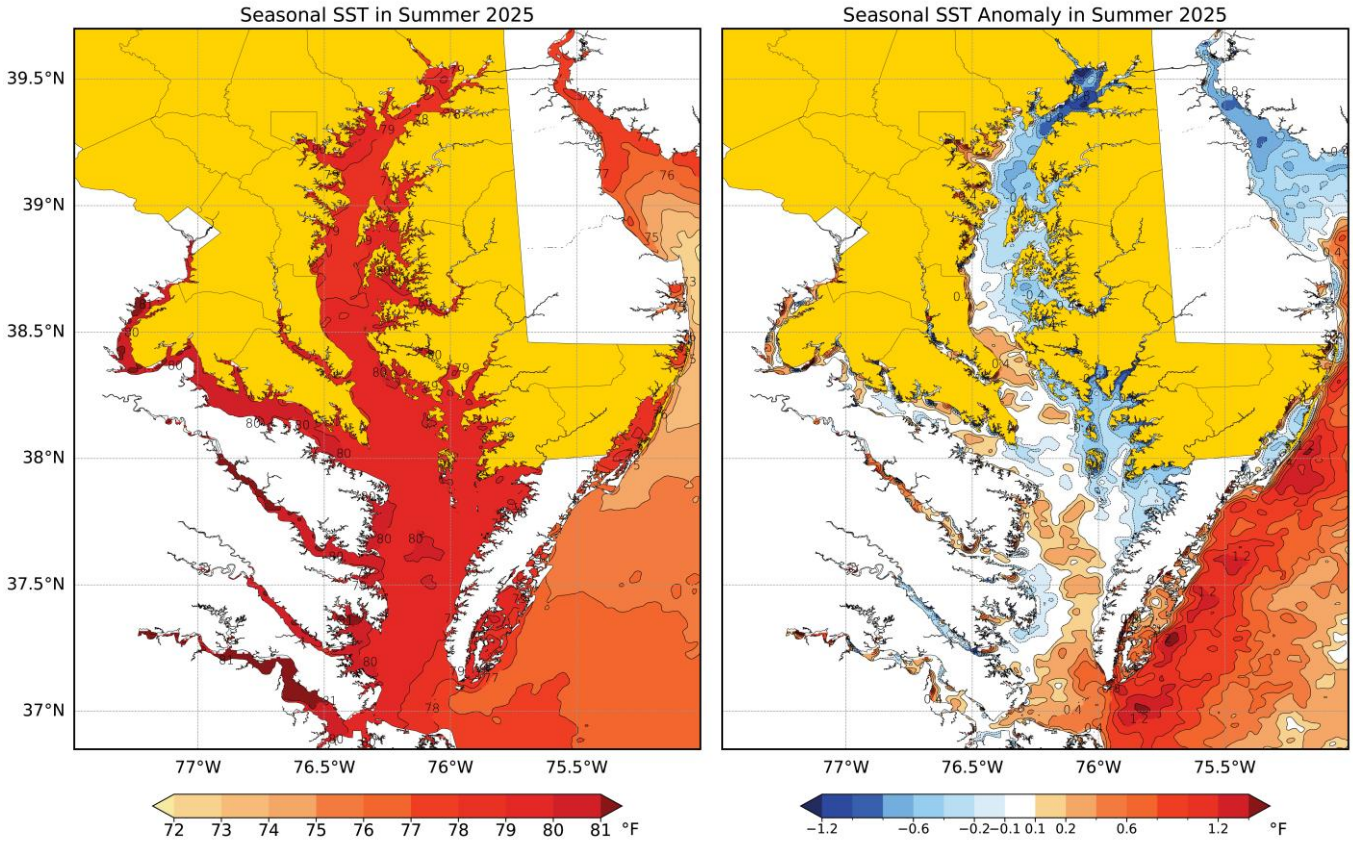

Figure 11. Seasonal sea surface temperature (left panel) and its anomaly (right panel) in the Chesapeake Bay and surrounding coastal areas in summer 2025. Temperatures are in °F following the color bar. Blue/orange shading in the anomaly map marks colder/warmer temperatures than the 2007-2020 mean. For clarity, the temperatures and their anomalies have been smoothed using a 9-point spatial smoother applied four times. Note that Maryland has been shaded yellow to facilitate focusing on the state waters. Be aware that the NOAA Chesapeake Bay Office (NCBO) develops seasonal summaries of water quality parameters in the Chesapeake Bay, and that a map of seasonal sea surface temperature anomalies using the same multi-sensor satellite set is also included. Differences with the NCBO's map arise due to differences in the units (°F here vs. °C there), in the mean to be subtracted from the temperatures of the season (2007-2020 here vs. 2007-2024 there), the spatial smoothing here (and none there), and the way the seasonal temperatures are obtained (from monthly temperature here vs. daily temperatures there).

B. Upper, Middle, Lower, and Entire Basins

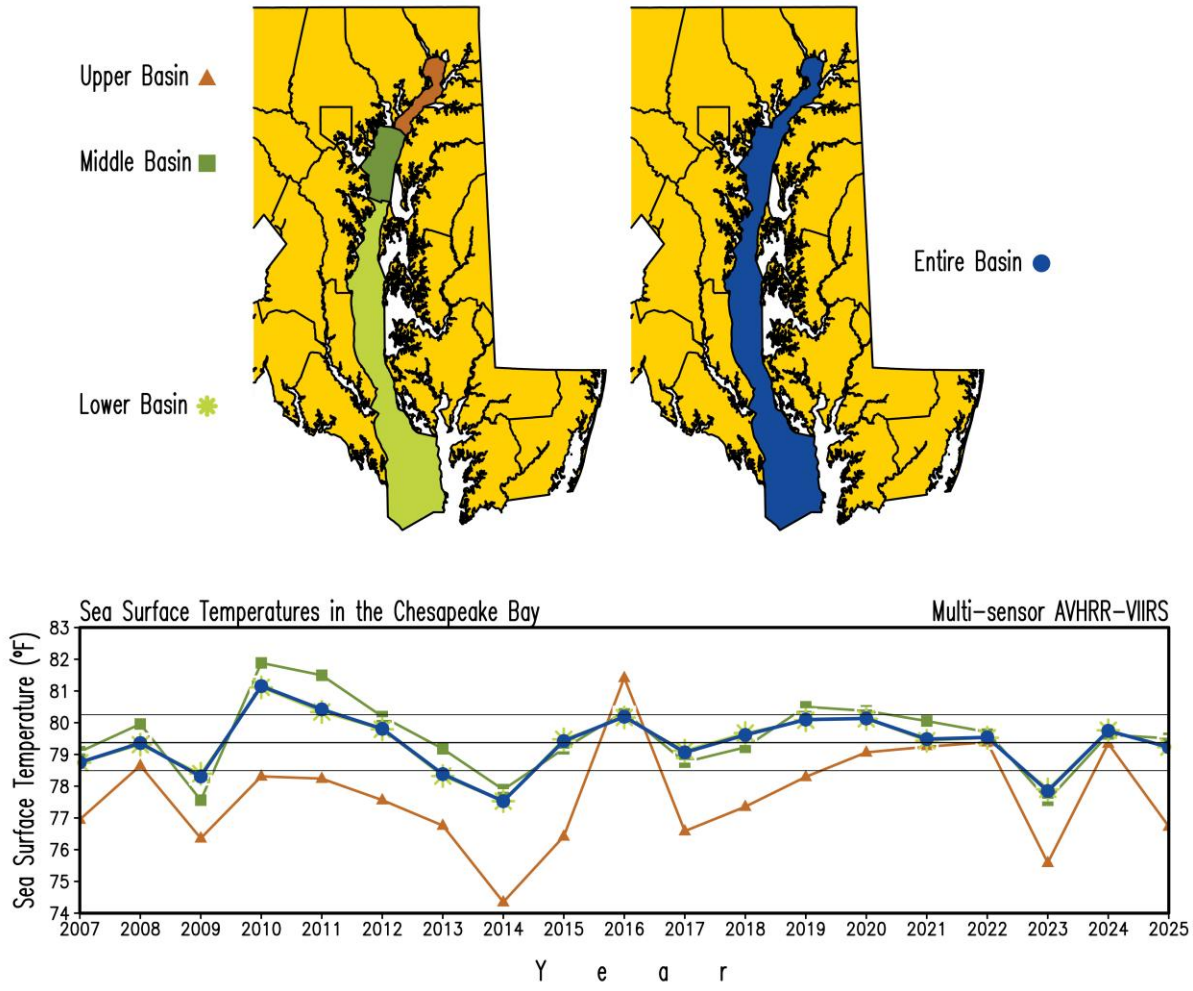

Figure 12. Watersheds in the Chesapeake Bay (top panel) and their area-averaged sea surface temperatures in summer for the period 2007-2025 (bottom panel). Temperatures are in °F. The color of the lines corresponds to the color of the watersheds in the Bay, as indicated on the maps: Brown for the Upper Bay, dark green for the Middle Bay, light green for the Lower Bay, and Navy Blue for the Entire Bay. The mean temperature for the Entire basin in summer 2025 was 79.2°F, while for the Upper, Middle, and Lower basins was 76.7, 79.5, and 79.2°F, respectively. The thin, continuous black line in the lower panel displays the 2007-2025 mean for the Entire Basin (79.4°F), and the double thin, continuous gray lines indicate the standard deviation (0.9°F) above/below the long-term mean. The 2007-2025 mean temperatures for the Upper, Middle, and Lower basins in summer were 77.7, 79.6, and 79.4°F, respectively, while their standard deviations were 1.6, 1.1, and 0.9°F, respectively. For consistency with the analysis of the atmospheric variables, the seasonal time series are obtained from the monthly time series.

Appendix A. Summer 2025 Tables: Statewide, Climate Divisions, and Counties

A. Mean Temperature and Precipitation

Region	Mean Air Temperature (°F)	Rank (#)
Statewide	75.3	115
Climate Division 1	76.9	120
Climate Division 2	76.6	114
Climate Division 3	76.8	115
Climate Division 4	76.4	109
Climate Division 5	76.1	112
Climate Division 6	74.8	114
Climate Division 7	73.4	115
Climate Division 8	69.1	130
Allegany	72.5	109
Anne Arundel	76.8	112
Baltimore	75.1	115
Baltimore City	77.1	115
Calvert	76.6	113
Caroline	75.9	110
Carroll	73.7	117
Cecil	75.0	109
Charles	76.8	112
Dorchester	76.9	115
Fredrick	74.4	116
Garrett	69.1	129
Harford	75.2	112
Howard	74.6	114
Kent	76.3	113
Montgomery	74.9	111
Prince George's	76.1	108
Queen Anne's	76.2	113
Saint Mary's	77.0	115
Somerset	77.5	120
Talbot	76.6	109
Washington	74.3	118
Wicomico	76.6	117
Worcester	76.7	121

Region	Acc. Total Precipitation (in)	Rank (#)
Statewide	11.38	50
Climate Division 1	11.13	50
Climate Division 2	11.73	56
Climate Division 3	11.48	52
Climate Division 4	12.02	68
Climate Division 5	12.16	69
Climate Division 6	11.07	50
Climate Division 7	9.99	39
Climate Division 8	12.78	58
Allegany	10.38	50
Anne Arundel	12.50	69
Baltimore	12.58	70
Baltimore City	11.71	57
Calvert	11.29	53
Caroline	12.28	63
Carroll	11.08	56
Cecil	11.60	54
Charles	11.51	54
Dorchester	11.22	46
Fredrick	8.98	28
Garrett	12.77	58
Harford	12.24	62
Howard	11.03	50
Kent	11.91	66
Montgomery	10.54	44
Prince George's	11.68	60
Queen Anne's	12.39	74
Saint Mary's	11.50	60
Somerset	10.73	41
Talbot	12.07	59
Washington	9.61	37
Wicomico	11.02	45
Worcester	11.53	62

Table A1. Seasonal mean surface air temperature (left) and accumulated total precipitation (right) in Maryland (statewide), climate division, and county levels for summer 2025. Temperatures are in °F, and precipitation is in inches. The rank is the order that the variable for summer 2025 occupies among the 131 summers since 1895 after the 131 values have been arranged from the lowest to the highest in the *standard competition ranking method*. The closer to 131 the rank is, the larger (i.e., warmer/wetter) the value of the surface variable is in the record; similarly, the closer to 1 the rank is, the smaller (i.e., the colder/drier) the value of the surface variable is in the record.

B. Maximum and Minimum Temperatures

Region	Maximum Air Temperature (°F)	Rank (#)
Statewide	84.9	94
Climate Division 1	85.4	101
Climate Division 2	85.9	95
Climate Division 3	85.9	89
Climate Division 4	85.9	90
Climate Division 5	85.4	82
Climate Division 6	84.8	93
Climate Division 7	84.8	95
Climate Division 8	79.0	103
Allegany	84.2	89
Anne Arundel	86.0	93
Baltimore	85.2	94
Baltimore City	86.5	103
Calvert	85.4	87
Caroline	85.9	88
Carroll	84.3	94
Cecil	84.2	82
Charles	86.1	82
Dorchester	86.1	97
Fredrick	84.8	100
Garrett	79.1	103
Harford	84.8	84
Howard	84.9	100
Kent	85.3	86
Montgomery	84.8	100
Prince George's	85.8	90
Queen Anne's	85.4	81
Saint Mary's	85.8	93
Somerset	85.8	106
Talbot	85.5	83
Washington	85.4	100
Wicomico	85.8	95
Worcester	84.8	102

Region	Minimum Air Temperature (°F)	Rank (#)
Statewide	65.6	125
Climate Division 1	68.4	126
Climate Division 2	67.2	122
Climate Division 3	67.7	122
Climate Division 4	67.0	118
Climate Division 5	66.9	121
Climate Division 6	64.7	123
Climate Division 7	62.0	127
Climate Division 8	59.2	131
Allegany	60.9	126
Anne Arundel	67.7	118
Baltimore	65.0	123
Baltimore City	67.6	122
Calvert	67.7	120
Caroline	65.9	122
Carroll	63.1	122
Cecil	65.8	119
Charles	67.5	122
Dorchester	67.7	123
Fredrick	64.0	123
Garrett	59.2	131
Harford	65.6	123
Howard	64.3	122
Kent	67.3	121
Montgomery	65.0	122
Prince George's	66.4	117
Queen Anne's	66.9	122
Saint Mary's	68.1	121
Somerset	69.2	128
Talbot	67.8	123
Washington	63.1	126
Wicomico	67.4	125
Worcester	68.6	127

Table A2. Seasonal maximum (left) and minimum (right) surface air temperatures in Maryland (statewide), climate division, and county levels for summer 2025. Temperatures are in °F. The rank is the order that the variable for summer 2025 occupies among the 131 summers since 1895 after the 131 values have been arranged from the lowest to the highest using the *standard competition ranking method*. The closer to 131 the rank is, the larger (i.e., the warmer) the value of the surface variable is in the record; similarly, the closer to 1 the rank is, the smaller (i.e., the colder) the value of the surface variable is in the record.

Appendix B. Summer 2025 Bar Graphs: Statewide, Climate Divisions, and Counties

A. Temperatures and Precipitation

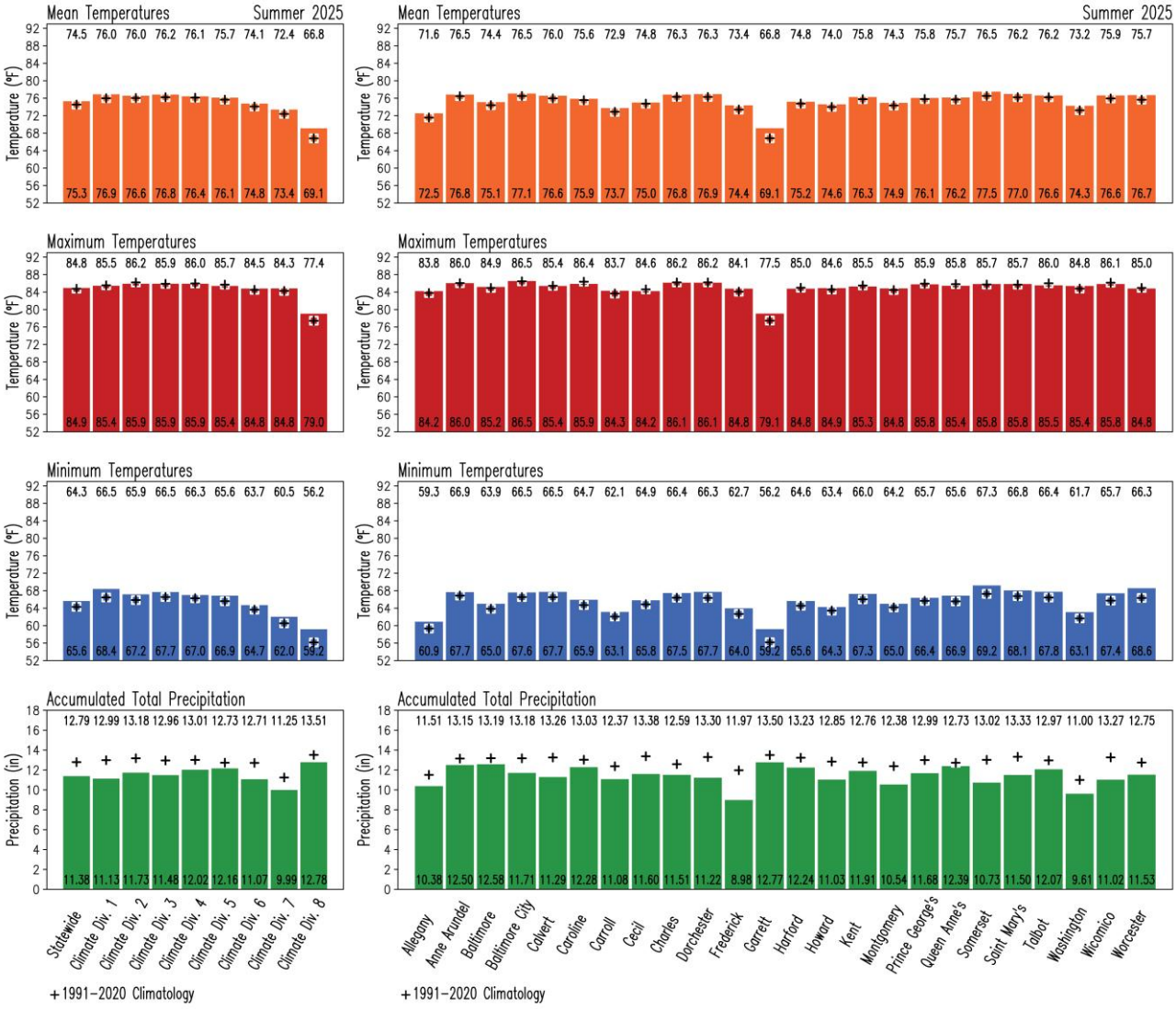

Figure B1. Seasonal surface variables in Maryland for summer 2025. Color bars represent the variables as follows: mean surface air temperature (orange), maximum surface air temperature (red), minimum surface air temperature (blue), and accumulated total precipitation (green) at statewide and climate division (left column), and at county (right column) levels. Temperatures are in °F, and precipitation is in inches. The numbers at the base of the bars indicate the magnitude of the variable for summer 2025. For comparison, the corresponding 1991-2020 climatological values for summer are displayed as black addition signs, and their magnitudes are shown at the top of the panels.

B. Temperature and Precipitation Anomalies

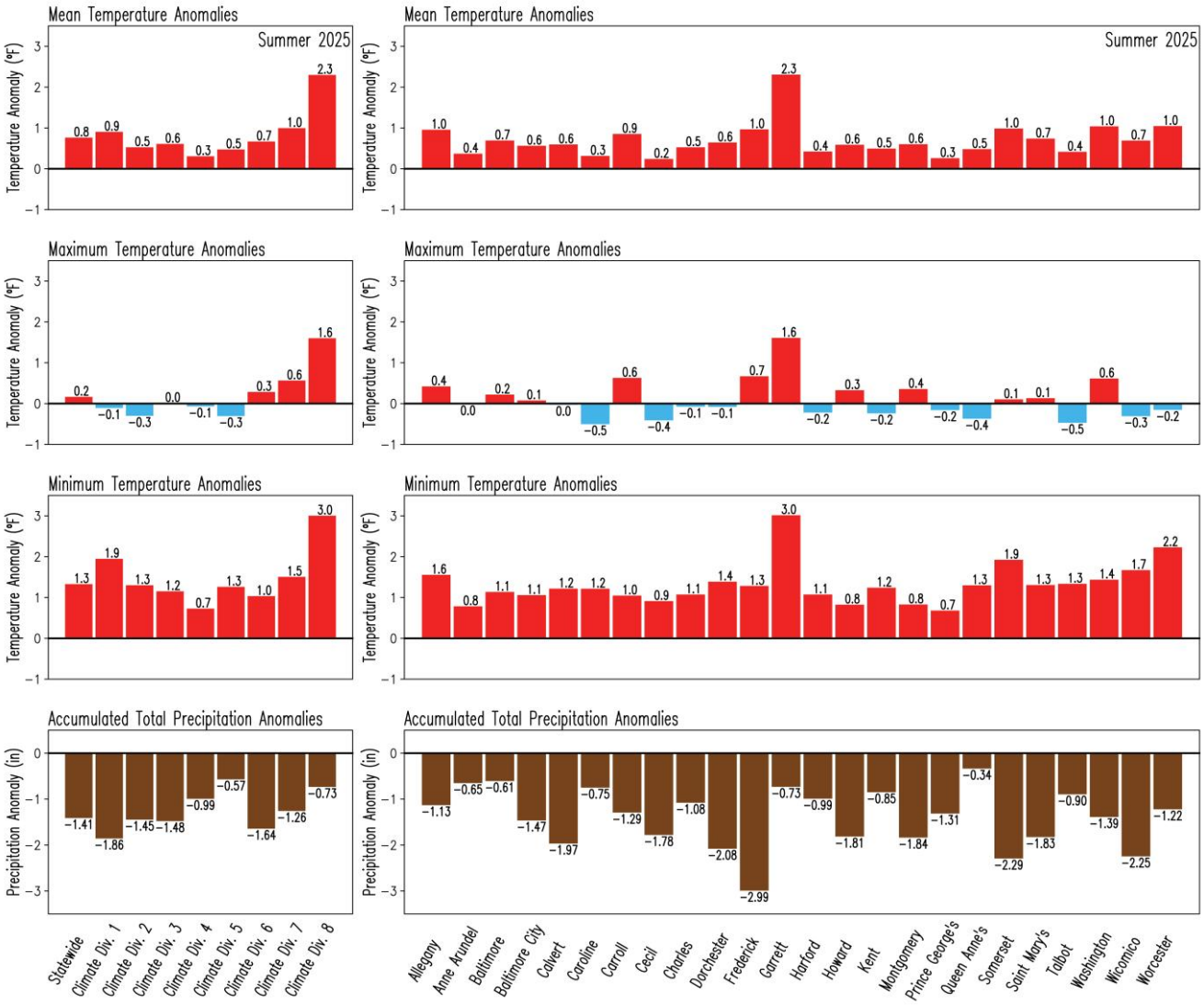

Figure B2. Anomalies of the seasonal surface variables in Maryland for summer 2025. Anomalies are with respect to the 1991-2020 climatology. The red/blue color represents warmer/colder than normal anomalies for mean surface air temperature (upper row), maximum surface air temperature (second row from top), and minimum surface air temperature (third row from top), while the brown color indicates drier than normal anomalies in accumulated total precipitation (bottom row) at statewide and climate division (left column), and at county (right column) levels. Temperatures are in °F, and precipitation is in inches. The numbers outside the bars indicate the magnitude of the anomaly for summer 2025.

Appendix C. Summer 1991-2020 Climatology Maps and Summer 2025 Precipitation as Percentage of Climatology

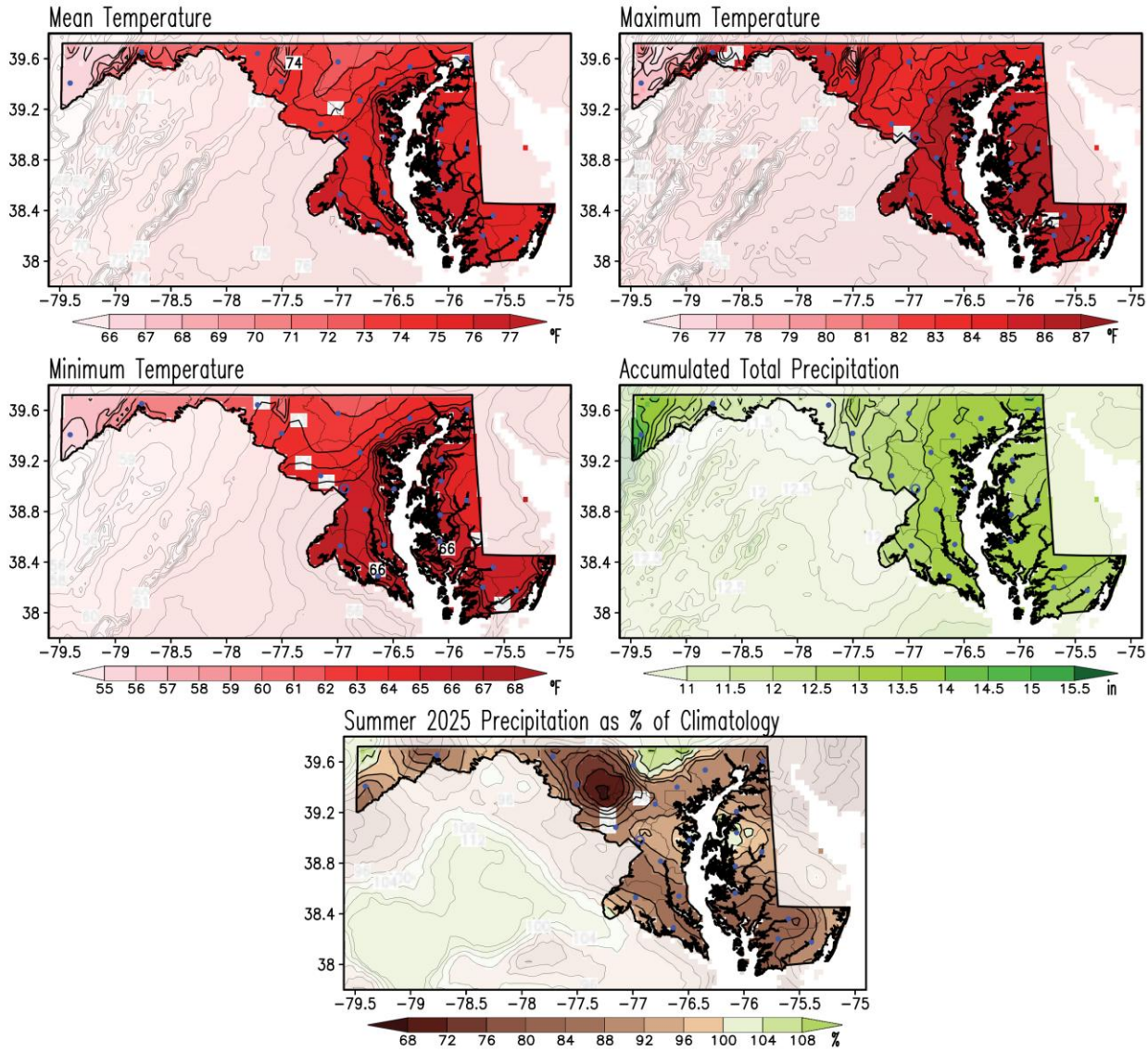

Figure C1. Summer climatology of the seasonal mean, maximum and minimum surface air temperatures, and accumulated total precipitation for the period 1991-2020 (upper and middle rows), and precipitation in summer 2025 as a percentage of climatology (bottom row). Temperatures are in °F, and precipitation is in inches according to the color bars. This is the current climate normal against which the summer 2025 conditions are compared to obtain the summer anomalies (from Figure 1 to 4). The precipitation as a percentage is obtained by dividing the total precipitation (from Figure 4) by the climatology (from the middle right panel) and multiplying that ratio by 100 so units are in percent of climatology (%); brown/green shading in this map shows drier/wetter 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.

Appendix D: The Water Year 1991-2020 Climatology, and October 2024 – August 2025 as Percentage of Climatology

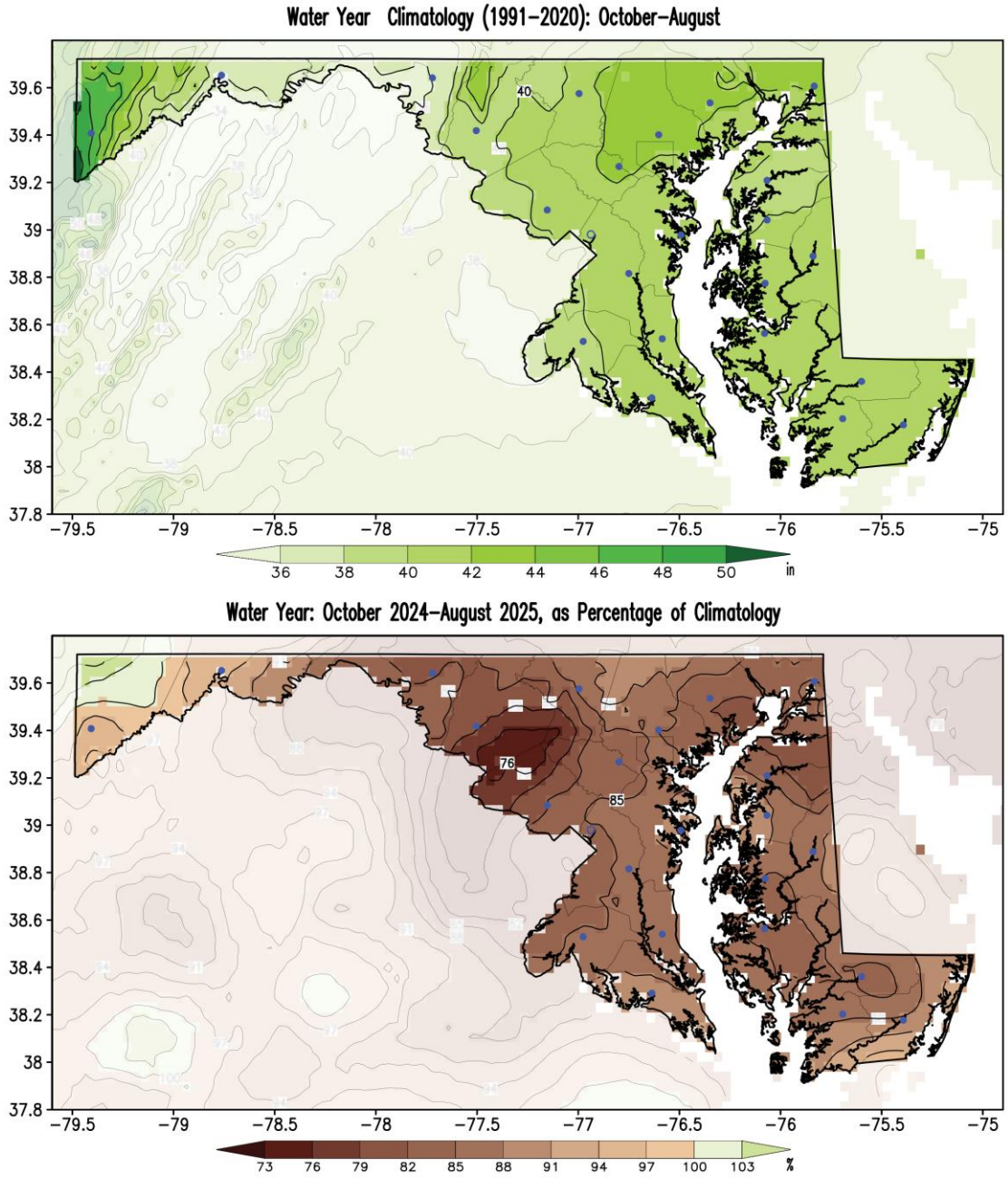

Figure D1. Climatology of the partial water year (October – August, top panel), and current partial water year (October 2024 – August 2025) as a percentage of the climatology (bottom panel). Climatology is for the period 1991-2020. The water year climatology is in inches, following the color bar. The current water year as a percentage of climatology is obtained by dividing the current water year (Figure 5 upper panel) by the climatology (upper panel) and multiplying the ratio by 100; hence, units are in percent (%). Brown/green shading in the percentage map highlights regions where the current water year is drier/wetter than normal. Note that shading outside the state has been washed out to facilitate focusing on Maryland. Filled blue circles mark the county seats.

Appendix E. Summer Standard Deviation and Summer 2025 Standardized Anomalies Maps

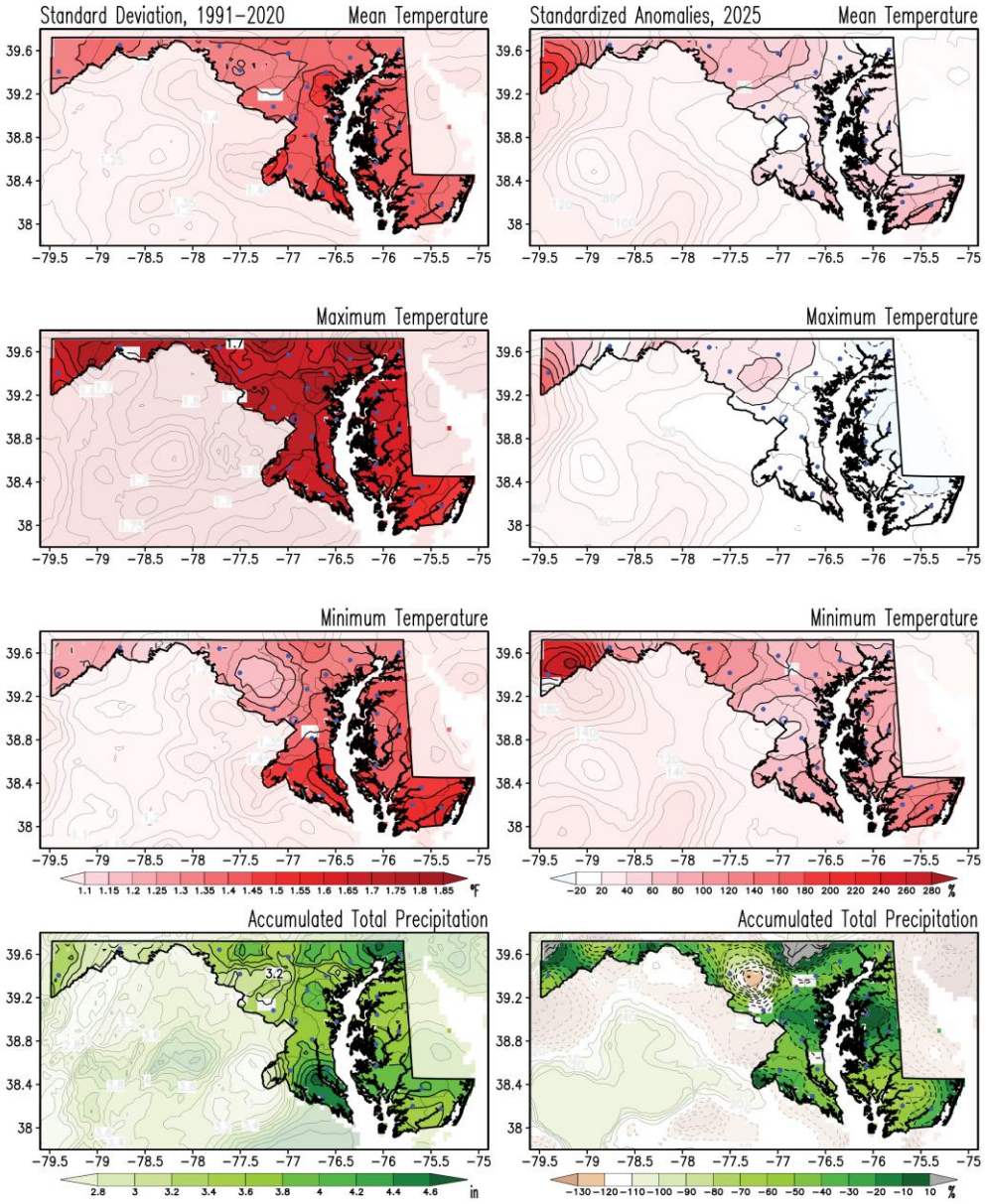

Figure E1. Standard deviation for summer and standardized anomalies of temperatures and precipitation for summer 2025. Standard deviations for seasonal mean, maximum, and minimum surface air temperatures and accumulated total precipitation were obtained for the 1991-2020 period (left column). Anomalies for summer 2025 (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. Blue/red shading in the anomaly temperature maps marks colder/warmer than normal conditions; brown/green shading in the anomaly precipitation map marks drier/wetter than normal conditions. 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.

Appendix F. 2007-2020 Mean and Standard Deviation of Sea Surface Temperatures in Summer

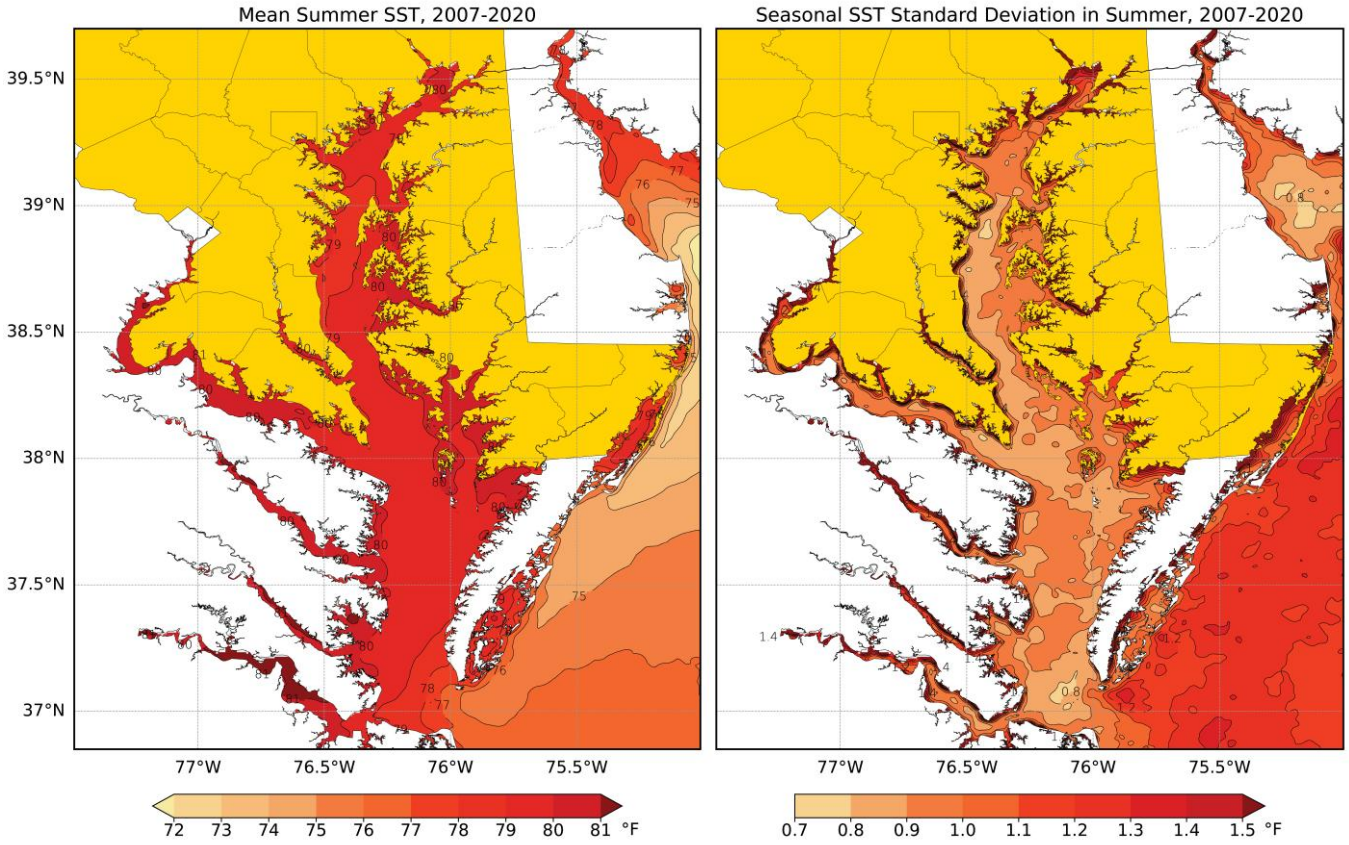

Figure F1. Mean (left panel) and standard deviation (right panel) of seasonal sea surface temperatures in the Chesapeake Bay and surrounding coastal areas in summer for the period 2007-2020. The mean and standard deviation of the temperatures are in °F according to the color bars. The mean temperature map is the current mean against which the summer 2025 conditions are compared to obtain the summer 2025 anomalies (from Figure 11). For clarity, the temperature mean and standard deviation have been smoothed using a 9-point spatial smoother applied four times. Note that Maryland has been shaded yellow to facilitate focusing on the state waters.

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.

CPC, 2023. Degree Days Explanation. https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/degree_days/ddayexp.shtml

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

Santer, B. D., and co-authors, 2000: Statistical significance of trends and trend differences in layer-averaged atmospheric temperature time series. *J. Geophys. Res.*, 105, 7337–7356, doi:10.1029/1999JD901105.

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 .

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.