

Review – September 2023

Temperature

Temperatures were generally uniform across Ohio, staying close to historical normals for September. Average temperatures in the month ranged from 65-70°F in most of the state, with the northeast and a portion of northwestern Ohio dipping down into the 60-65°F range (Fig. 1a). Overall, the state did not stray far from historical temperature normals, with the majority seeing departures of less than 1°F in either direction. In addition, areas in the far north and south, as well as small patches of central Ohio saw slightly warmer average temperatures than normal, with departures of less than 2°F (Fig. 1b). At the county level, most counties ranked near normal, with much of western and northeastern Ohio ranking within the warmer third of the historical record. Overall, no county saw a significant departure from normal for the month (Fig. 2).

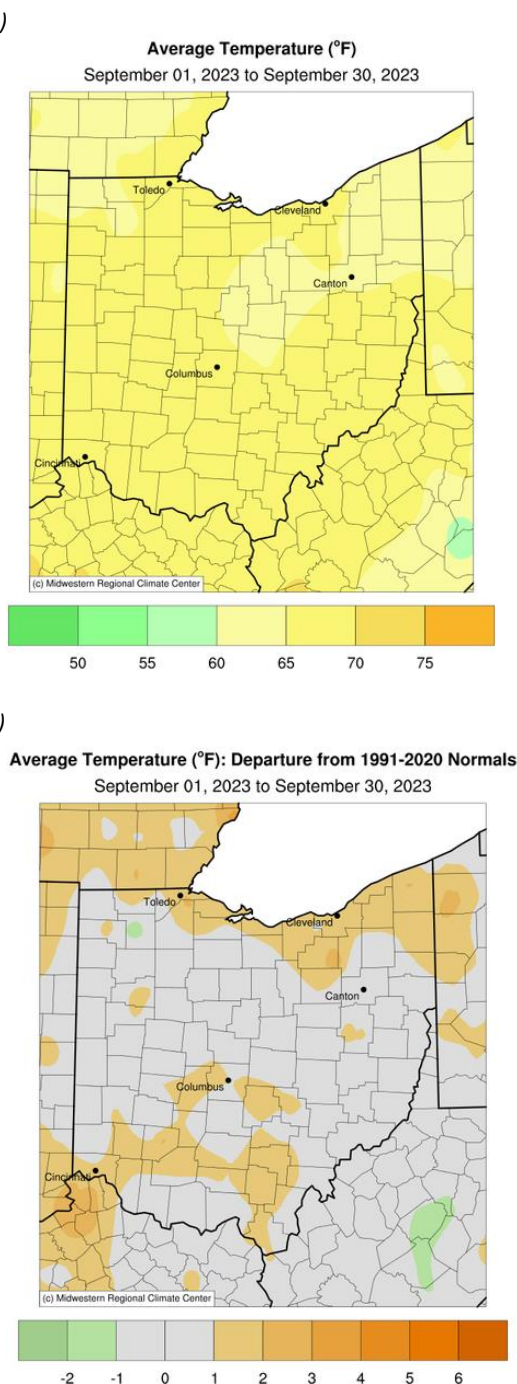


Figure 1a: Average temperature and 1b: Departure from Normal for the month of September 2023. Data courtesy of the Midwestern Regional Climate Center (<http://mrcc.purdue.edu>).

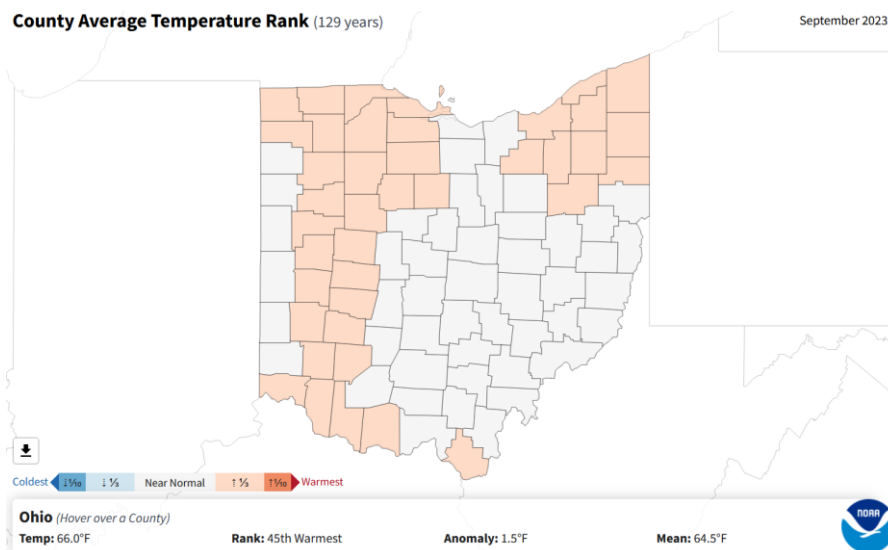
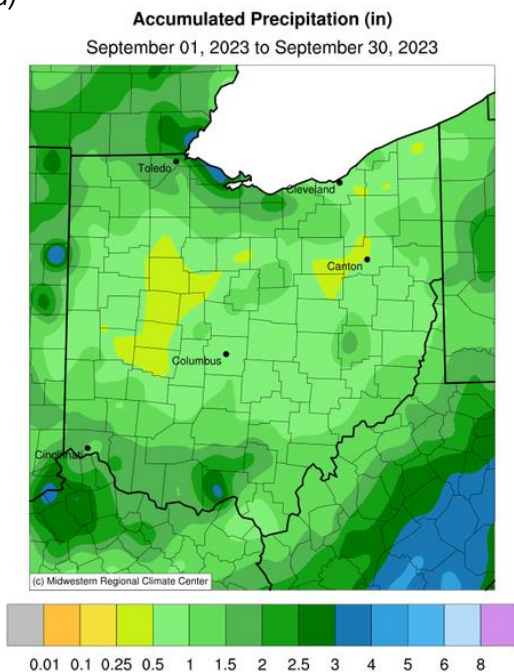


Figure 2: State of Ohio average temperature ranks by county for September 2023. Courtesy of the National Centers for Environmental Information (<https://www.ncdc.noaa.gov/sotc/>).

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a)



b)

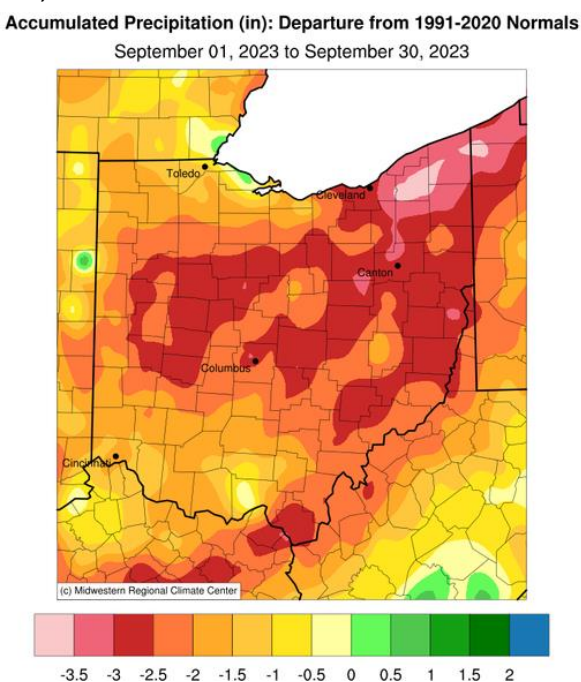


Figure 3a: Accumulated precipitation and 3b: Departures from Normal for the month of September 2023. Data courtesy of the Midwestern Regional Climate Center (<http://mrcc.purdue.edu>).

Precipitation

In stark contrast to the previous month, a significant lack of substantial precipitation events in Ohio resulted in reduced accumulation and sizeable negative departures from historical normals in September. Accumulated precipitation was varied throughout Ohio, mostly ranging from 0.5-2 inches, with some areas in the core of the state seeing only 0.25-0.5 inches (Fig. 3a). Conversely, parts of Ottawa and Scioto Counties recorded up to 4 inches of accumulated precipitation. Overall, the lack of rain resulted in 1-3 fewer inches of accumulated rain than average in many parts of the state, with the northeast seeing departures as great as 3-4 inches less than normal (Fig. 3b). At the county level, every county in the state except Pike County ranked at least in the drier third of their record. Most counties reached the driest tenth of their record, with six counties in central and northeast Ohio seeing their driest September ever recorded (Fig. 4).

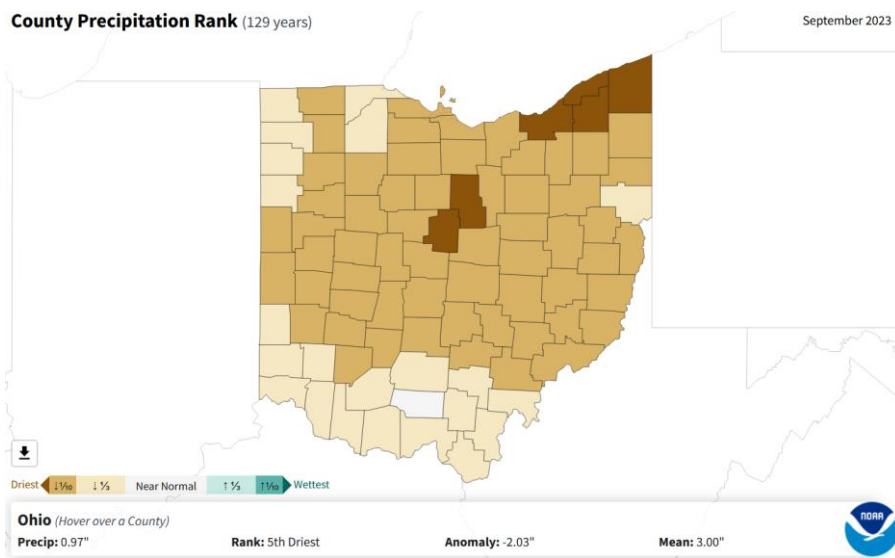
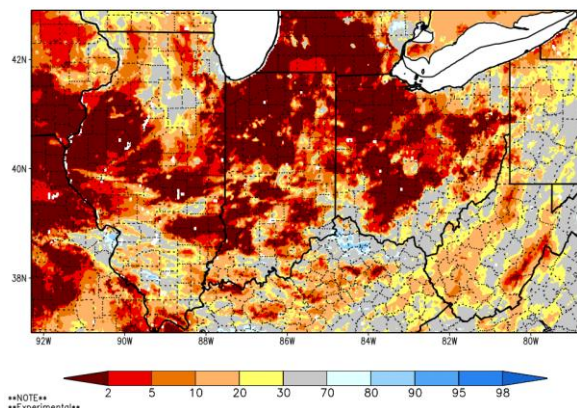


Figure 4: State of Ohio precipitation ranks by county for September 2023. Courtesy of the National Centers for Environmental Information (<https://www.ncdc.noaa.gov/sotc/>).

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a) SPoRT-LIS 0–40 cm Soil Moisture percentile valid 30 Sep 2023



b) SPoRT-LIS 0–200 cm Soil Moisture percentile valid 30 Sep 2023

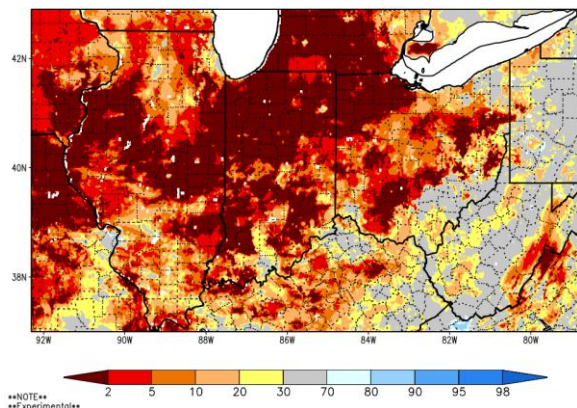


Figure 5a: 0–40 cm and 5b: 0–200 cm soil moisture percentile across the region at the end of September. Courtesy of NASA SPoRTLIS (https://weather.msfc.nasa.gov/sport/case_studies/lis_IN.html).

Soil and Energy

With reduced precipitation in September, Ohio saw a substantial expansion of dry soil conditions. At both 0–40cm and 0–200cm levels, much of the state experienced at least moderately dry soil conditions by the end of September, with small areas in southwest, south-central, and northeast Ohio being the only areas without significant soil dryness at the end of the month (Figs. 5a and 5b). The conditions seen in Ohio are part of a larger migration of dryness from the great plains towards the Midwest and South, indicating a shift in weather patterns as the transition into the cold seasons continues.

As autumn officially began in the tail end of September, Heating Degree Days (HDDs) became more commonplace throughout the state, though mild temperatures resulted in fewer HDDs than normal in every climate division. Similarly, such temperatures also reduced the number of Cooling Degree Days (CDDs) seen in Ohio compared to historical normals. Despite this, the CDDs in the eastern third of the state were generally close to expectations for the month (Fig. 6).

Climate Division	Heating Degree Days	Normal	Departure	Cooling Degree Days	Normal	Departure
1	44	92	-48	70	82	-12
2	42	87	-45	71	83	-13
3	72	110	-38	62	59	3
4	37	78	-42	80	96	-16
5	38	72	-34	77	96	-19
6	56	96	-40	63	72	-9
7	53	85	-32	75	76	-1
8	21	63	-42	94	112	-18
9	26	58	-31	105	113	-8
10	40	73	-33	87	91	-4
Statewide	42	80	-38	79	89	-10



Figure 6: (Left) September 2023 heating & cooling degree days. (Right) Corresponding Ohio Climate Divisions. Data courtesy of the Midwestern Regional Climate Center (<http://mrcc.purdue.edu>).

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Notable Events

With dry conditions seen throughout Ohio, September was notable for its lack of precipitation events over the state, especially in comparison to the active weather patterns seen in previous months. Ohio was part of a nationwide expansion of drought, with 96.71% of the state experiencing abnormally dry conditions. In addition, 45.58% of Ohio, mostly centered in the south and west, were classified as experiencing moderate drought by the start of October (Fig. 7). This coincides with recorded totals of accumulated precipitation across the state, which exhibited significant departures from historical precipitation records in Ohio's largest population centers, varying from 1 inch to more than 3 inches below normal for the month (Fig. 8). September's dryness is the result of three converging factors, those being the climatological dryness brought about during autumn, the persistence of El Niño in the Pacific Ocean, and the emergence of a generally dry weather pattern over the central United States. With all these factors in play, the U.S. Drought Monitor predicts that the current level of drought will persist in Ohio through at least the end of the year.

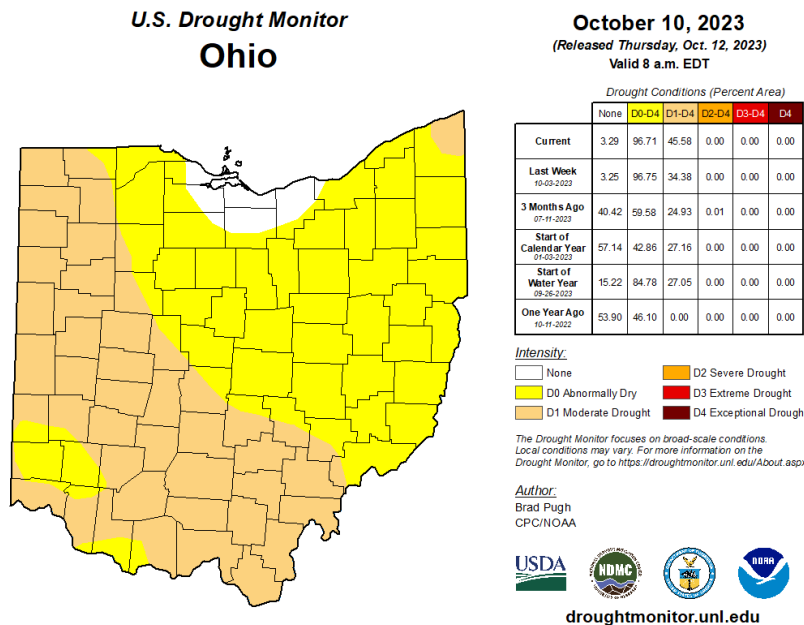


Figure 7: Drought monitor for the state of Ohio as of October 10, 2023, showing levels of drought by intensity. Courtesy of the U.S. Drought Monitor.
(<https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?OH>)

Site	Total Precipitation (in)	Departure from Normal (in)
Columbus (CMH)	0.77	-2.37
Cincinnati (CVG)	0.94	-2.16
Dayton (DAY)	0.54	-2.77
Toledo Express (TOL)	1.07	-1.86
Lima	0.29	-2.9
Cleveland (CLE)	0.77	-3.16
Youngstown	1.29	-2.43
Athens	0.68	-2.62
Portsmouth	1.82	-1.19
Washington C.H.	0.54	-2.19

Figure 8: September 2023 Total Precipitation and Departures from Normal at sites in and around the drought area. Data courtesy of NOAA's Applied Climate Information System. (<https://scacis.rcc-acis.org/>)

Forecast: October - December 2023

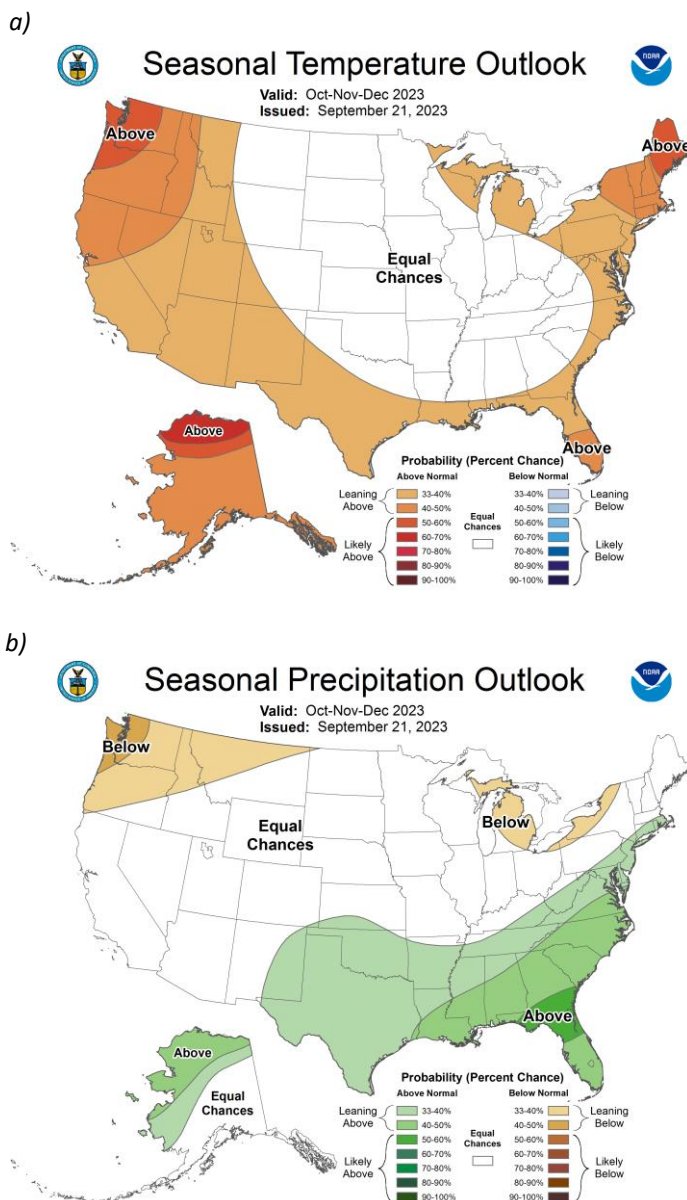


Figure 9a: Nationwide Seasonal Temperature and 9b: Precipitation Outlook for October-December. Courtesy of the Climate Prediction Center (<https://www.cpc.ncep.noaa.gov/>).

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Looking Ahead

The CPC's 3-month outlooks show a general lack of confidence for Ohio as the state moves through autumn. Temperatures are predicted to lean above normal in the northeastern portion of the state, though this forecast comes with low confidence. At the same time, the rest of Ohio has equal chances of above- or below-normal temperatures in the coming months (Fig. 4a). Similarly, the state has equal chances of above- or below-normal precipitation, with only the northeastern tip of Ohio falling within the area of below-normal precipitation, though this too comes with low confidence (Fig. 4b). Overall, these predictions are held back by the variable weather patterns the state has seen in past months. While autumn brings a seasonal cooling and drying to Ohio's climate, the past few months have seen the frequent passage of widespread weather systems over the Midwest that not only increase the amount of precipitation, but moderate temperature as well. While September saw a break in this trend, weather conditions in the coming months will be defined by how the pattern develops.

Note: these outlooks do not provide the quantity of above or below normal conditions, just the likelihood of occurrence (i.e., the probability).