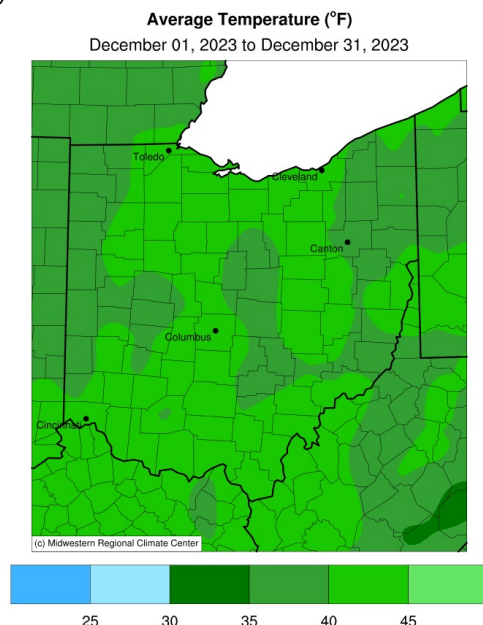


Review – December 2023

Temperature

December temperatures were above average across Ohio, resulting in significant departures from the record at the end of 2023. Although generally varied, average temperatures in the state ranged from 35-45°F, minimizing the occurrence and impact of frozen precipitation during December (Fig. 1a). Temperature departures followed a north-south gradient, with the southern half of Ohio seeing departures of around 4-7°F above normal and the northern half seeing departures of around 6-9°F above normal (Fig. 1b). At the county level, all of Ohio's 88 counties ranked within the warmest tenth of their 129-year records (Fig. 2). While Lucas County in the northeast recorded its warmest December on record, nearly every other county in northern Ohio saw their second warmest December. While rankings in the southern half of the state were less extreme, most counties still saw one of the top ten warmest Decembers in their records.

a)



b)

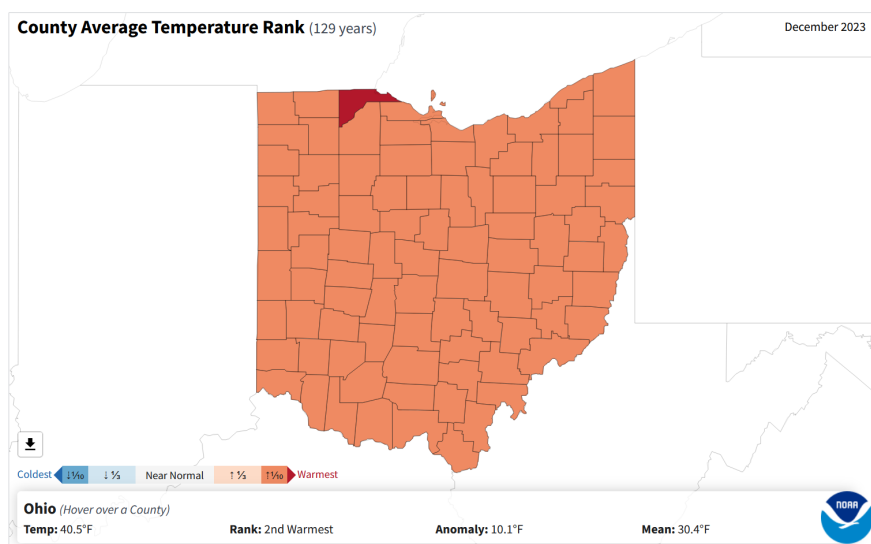
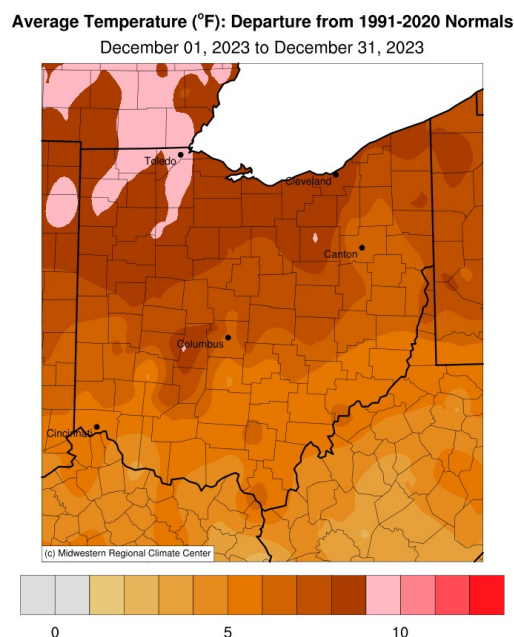


Figure 1a: Average temperature and 1b: Departure from Normal for the month of December 2023. Data courtesy of the Midwestern Regional Climate Center (<http://mrcc.purdue.edu>).

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

Review – December 2023

Precipitation

Precipitation accumulation was highly varied in Ohio during December. While the northwestern part of the state recorded only 1-2 inches of accumulated precipitation in the month, most of Ohio recorded around 2-4 inches. As a result of lake-effect snow near the middle of December, northeast Ohio saw the most precipitation, recording up to 5 inches of liquid accumulation (Fig. 1a). Accumulated precipitation departures were most significant in western and southern Ohio, ranging from 0.5-2 fewer inches of precipitation than normal. In the east, most departures were within 0.5 inches of normal, save for a small area in the northeast that saw up to 2 more inches than normal over the month (Fig. 2b). At the county level, rankings were mild, with most of the state ranking near normal. Most of western Ohio ranked within the drier third of the record, while the two wettest counties in the state, Noble and Lorain Counties, ranked within the wetter third of the record (Fig. 3).

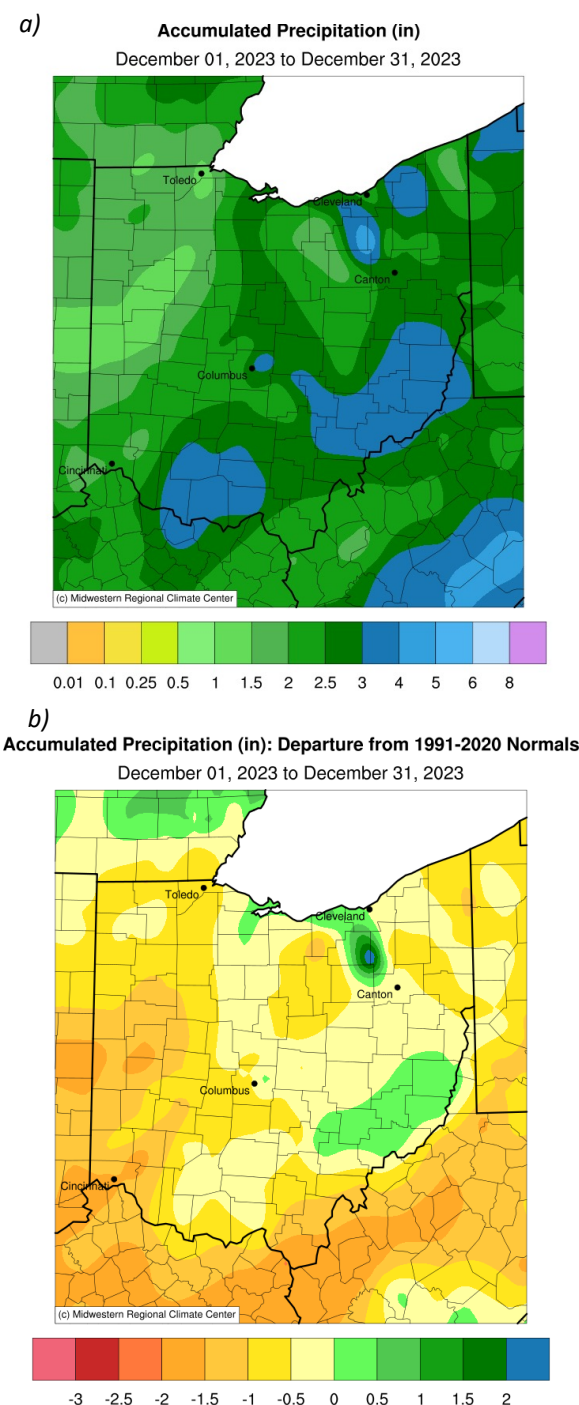


Figure 3a: Accumulated precipitation and 3b: Departures from Normal for the month of December 2023. Data courtesy of the Midwestern Regional Climate Center (<http://mrcc.purdue.edu>).

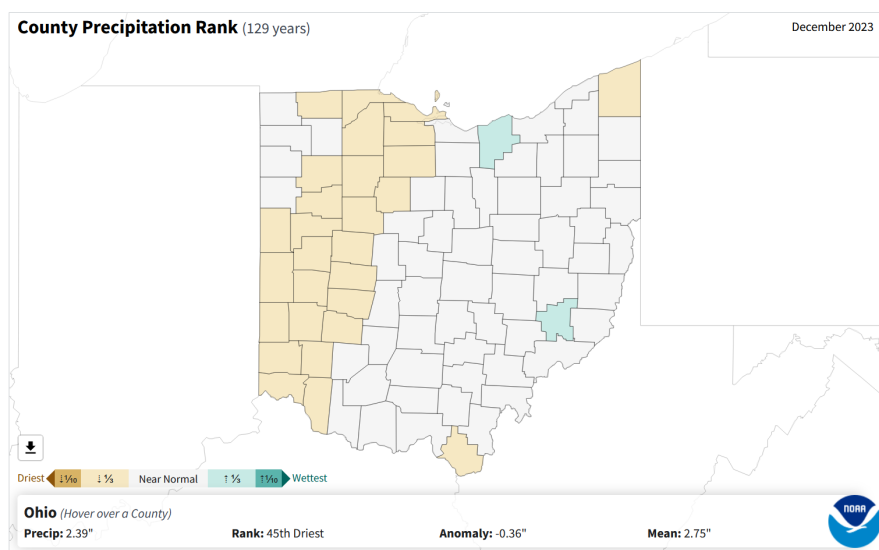
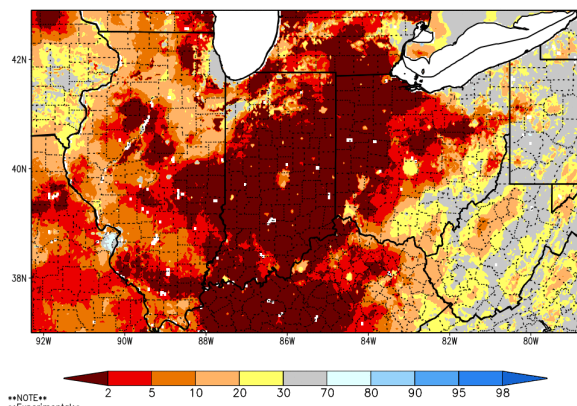


Figure 4: State of Ohio precipitation ranks by county for December 2023. Courtesy of the National Centers for Environmental Information (<https://www.ncdc.noaa.gov/sotc/>).

Review – December 2023

a) SPoRT-LIS 0–40 cm Soil Moisture percentile valid 31 Dec 2023



b) SPoRT-LIS 0–200 cm Soil Moisture percentile valid 31 Dec 2023

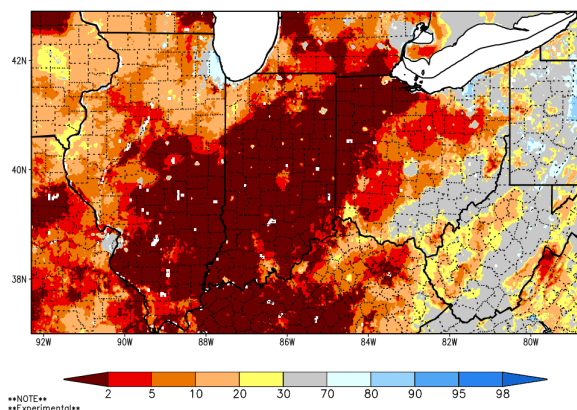


Figure 5a: 0–40 cm and 5b: 0–200 cm soil moisture percentile across the region at the end of December. Courtesy of NASA SPoRTLIS (https://weather.msfc.nasa.gov/sport/case_studies/lis_IN.html).

Climate Division	Heating Degree Days	Normal	Departure	Cooling Degree Days	Normal	Departure
1	783	1067	-283	0	0	0
2	762	1033	-270	0	0	0
3	797	1033	-236	0	0	0
4	784	1025	-241	0	0	0
5	773	990	-217	0	0	0
6	783	1024	-241	0	0	0
7	772	993	-221	0	0	0
8	778	963	-185	0	0	0
9	750	911	-161	0	0	0
10	569	957	-188	0	0	0
Statewide	775	998	-222	0	0	0



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

Soil and Energy

The continued lack of significant precipitation events around western Ohio has expanded the presence of exceedingly dry soil conditions across the region. Most of the state saw some level of moderately dry soil conditions at the end of December, with the most severe soil dryness found in western Ohio. Generally, the 0–40cm level exhibited more substantial dryness than the 0–200cm level, suggesting that the recent expansion of dryness can be largely attributed to the lack of precipitation over the region during December, as changes in weather patterns are seen more quickly in shallow soil than deep soil (Figs. 5a and 5b).

Meanwhile, warmer-than-average temperatures were beneficial to Ohio's energy consumption during December, as the occurrence of Heating Degree Days (HDDs) was significantly lower than normal in every climate division in the state. Conversely, as expected for this time of year, Cooling Degree Days (CDDs) were entirely absent in Ohio during December (Fig. 6).

Review – December 2023

Notable Events

While December extended the continued lack of singular impactful weather events in Ohio, the temperature and precipitation anomalies seen during the month are indicative of the impacts that natural influences can have on Ohio's climate. Specifically, they're characteristic of the El Niño-Southern Oscillation (ENSO), a recurring climate pattern that results from changes in water temperature in the tropical Pacific Ocean. While Ohio's climate is determined by a wide variety of factors, ENSO is an important influence that is commonly overlooked. During an El Niño, warm Central Pacific waters strengthen and stabilize the subtropical jet stream, allowing it to keep a similar shape and location for long periods of time, usually over the southern United States. Because storm systems usually occur along jet streams, this region receives most of the precipitation, leaving the Ohio Valley with drier-than-average conditions, along with warmer temperatures (Fig. 7).

An example of eye-catching warmth fueled in part by El Niño during this period occurred during Christmas Day, December 25th. Southern Ohio as well as many urban centers observed high temperatures at or above 60°F, with remaining areas averaging highs between 55-60°F (Fig. 8). This continues a rollercoaster of warm and cold Christmas Day highs over the last 4 years and contrasts significantly with Christmas 2022, where high temperatures in the low to mid 10°Fs dominated.

WINTER EL NIÑO PATTERN

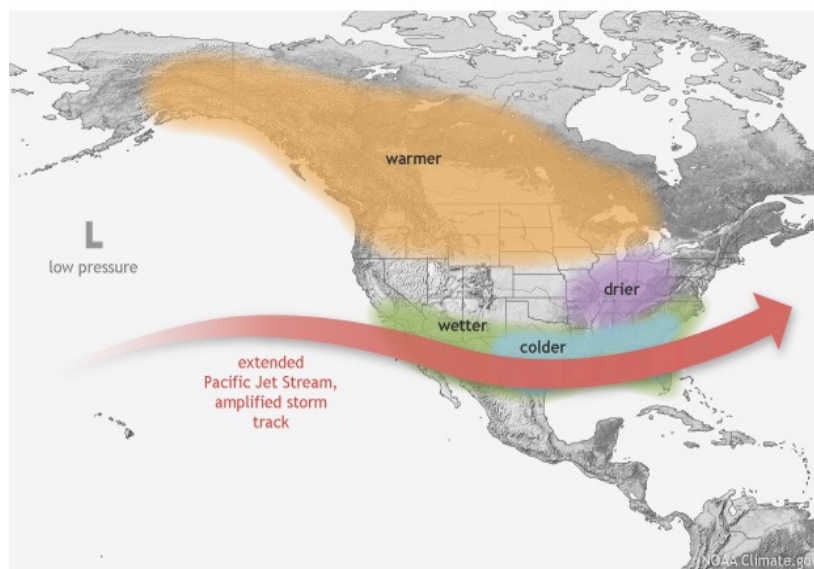


Figure 7: Map of the winter El Niño pattern, showing drier and warmer conditions over the Ohio Valley, as well as wetter and colder conditions over the southern United States. Data Courtesy of NOAA (<https://www.climate.gov/enso>).

Average Maximum Temperature (°F)
December 25, 2023 to December 25, 2023

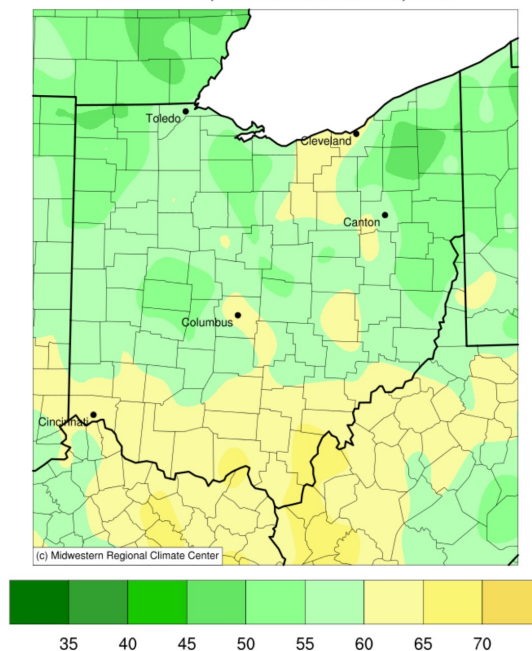


Figure 8: Average maximum temperature for the month of December 25th, 2023. Data courtesy of the Midwestern Regional Climate Center (<http://mrcc.purdue.edu>)



Forecast: January - March

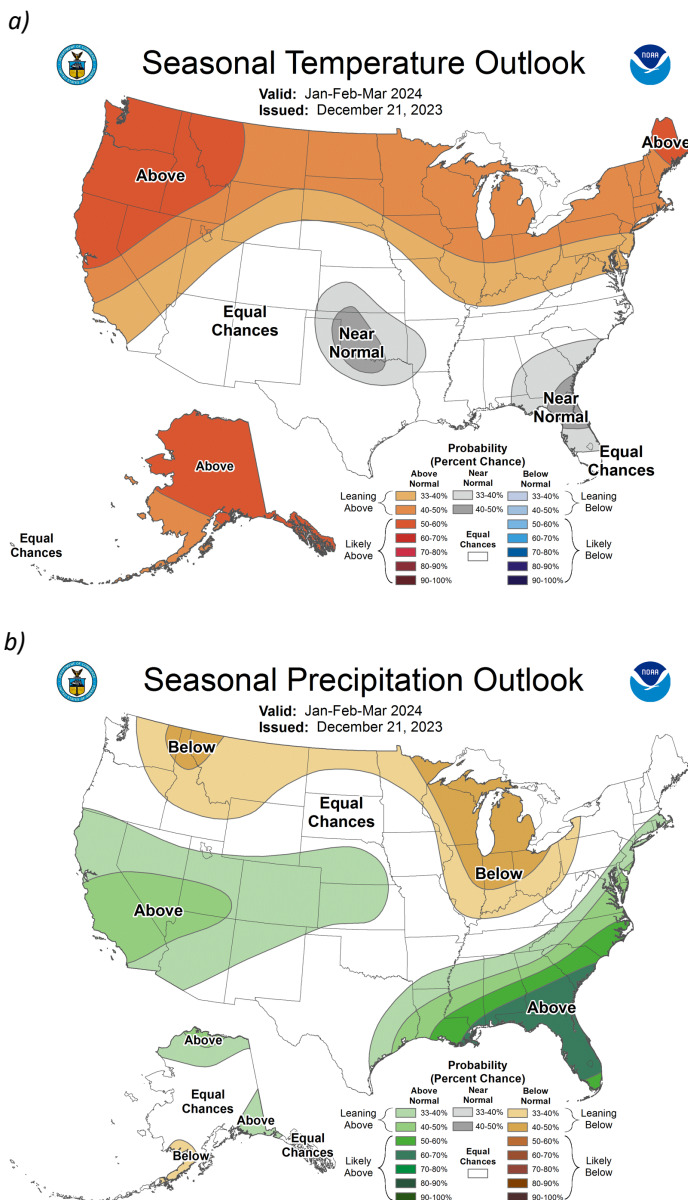


Figure 9a: Nationwide Seasonal Temperature and 9b: Precipitation Outlook for January-March. Courtesy of the Climate Prediction Center (<https://www.cpc.ncep.noaa.gov/>).

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Looking Ahead

The CPC's 3-month outlooks continue predictions of warm and dry conditions in Ohio during the first quarter of 2024. Temperatures are likely to be above-normal in the coming months, with the northern half of the state having the highest likelihood of seeing such a departure (Fig. 9a). That said, a well-advertised cold snap through the middle of January may counter the early portion of this outlook initially. Meanwhile, Ohio is forecast to see below-normal precipitation for the remainder of the winter season, with the highest confidence focused on the northwestern half of the state (Fig. 9b). Overall, these outlooks are consistent with those of previous months, as well as the actual weather patterns seen in December. Combined with the reintroduction of moderate drought conditions to the state, soil moisture may also continue to see negative impacts with potential impacts on the state's early growing season beginning in late March. The CPC is now predicting a 60% chance of a transition away from El Niño conditions during April-June 2024, but until then, the current El Niño's warm and dry impact on the Ohio Valley will remain.

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