

NWS FORM E-5 (11-88) (PRES. by NWS Instruction 10-924)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	HYDROLOGIC SERVICE AREA (HSA)	
		Tulsa, Oklahoma (TSA)	
MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS		REPORT FOR:	YEAR
		MONTH May	2023
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		SIGNATURE Steven F. Piltz (Meteorologist-in-Charge)	DATE June 2, 2023

When no flooding occurs, include miscellaneous river conditions, such as significant rises, record low stages, ice conditions, snow cover, droughts, and hydrologic products issued (NWS Instruction 10-924)

An "X" in the box indicates no flood stages were reached in this Hydrologic Service Area (HSA) during the month above.

May 2023 was a dry month for nearly all of the NWS Tulsa HSA. There were no tornadoes in eastern OK and northwest AR in May 2023, which is the first time since 2009 and the fourteenth May since 1950 to have no tornadoes for the month. Normal precipitation values climatologically rank May as the wettest month of the year. These averages range from 5.0 - 5.5 inches across northeast Oklahoma to 5.5 - 6.0 inches across southeast Oklahoma. The Ozark region of northwest Arkansas averages 5.8 inches for the month. This report, past E-5 reports, and monthly hydrology and climatology summaries can be found at https://www.weather.gov/tsa/climo_summary_e5list.

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a), rainfall totals for May 2023 ranged from 2" to 10" across eastern OK and northwest AR, with much of the area receiving 2"-5". These rainfall totals correspond to 25% to 90% of the normal May rainfall for a large portion of the HSA, with isolated areas receiving 100% to around 150% of the normal May rainfall (Fig. 1b).

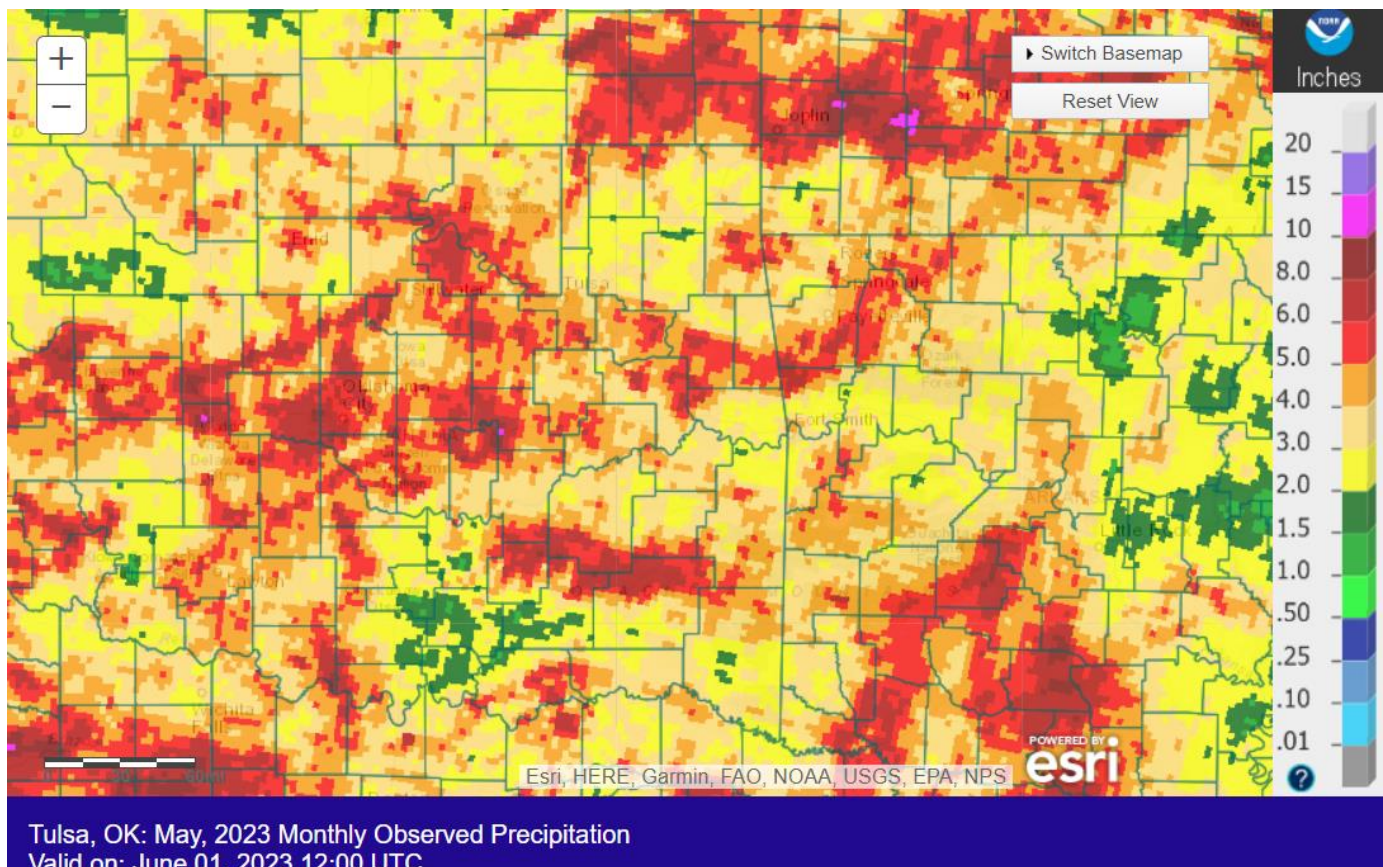
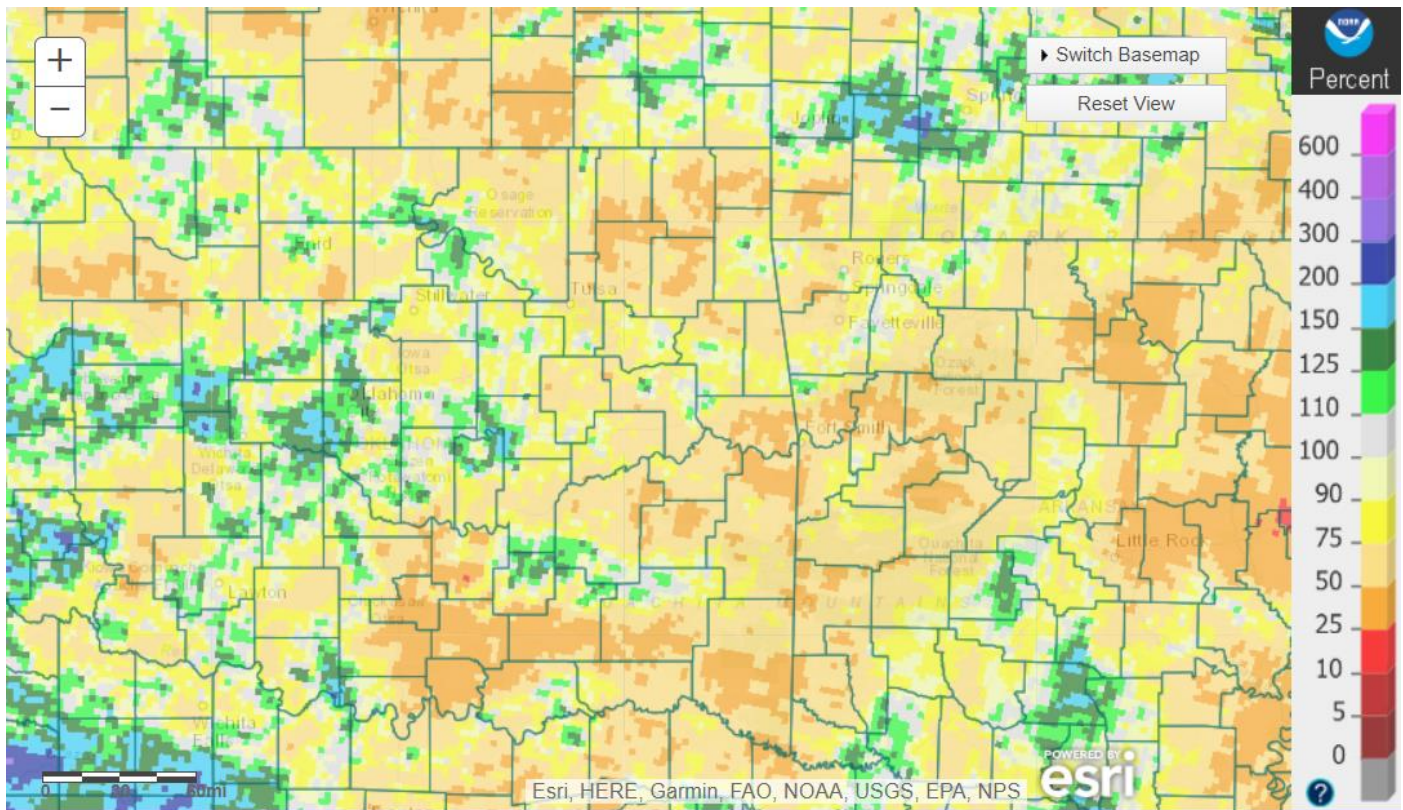


Fig. 1a. Estimated Observed Rainfall for May 2023



Tulsa, OK: May, 2023 Monthly Percent of Normal Precipitation
Valid on: June 01, 2023 12:00 UTC

Fig. 1b. Estimated % of Normal Rainfall for May 2023

In Tulsa, OK, May 2023 ranked as the 46th warmest May (69.9°F, tied 2003, 1969, 1939; since records began in 1905) and the 33rd driest May (3.09"; since records began in 1888). Fort Smith, AR had the 19th warmest May (72.4°F; since records began in 1883) and the 39th driest May (3.13"; since records began in 1883). Fayetteville, AR had the 15th warmest (67.9°F) and the 10th driest (3.21") May since records began in 1950.

Some of the larger precipitation reports (in inches) for May 2023 included:

Copan, OK (meso)	7.23	Pawnee, OK (meso)	7.11	Jay 3.3NNE, OK (coco)	7.06
Drumright 0.6SW, OK (coco)	6.84	Clayton, OK (meso)	6.48	Jay, OK (meso)	6.34
Ralston, OK (coop)	6.15	Webbers Falls, OK (meso)	6.14	Pawnee, OK (coop)	6.08

Some of the lowest precipitation reports (in inches) for May 2023 included:

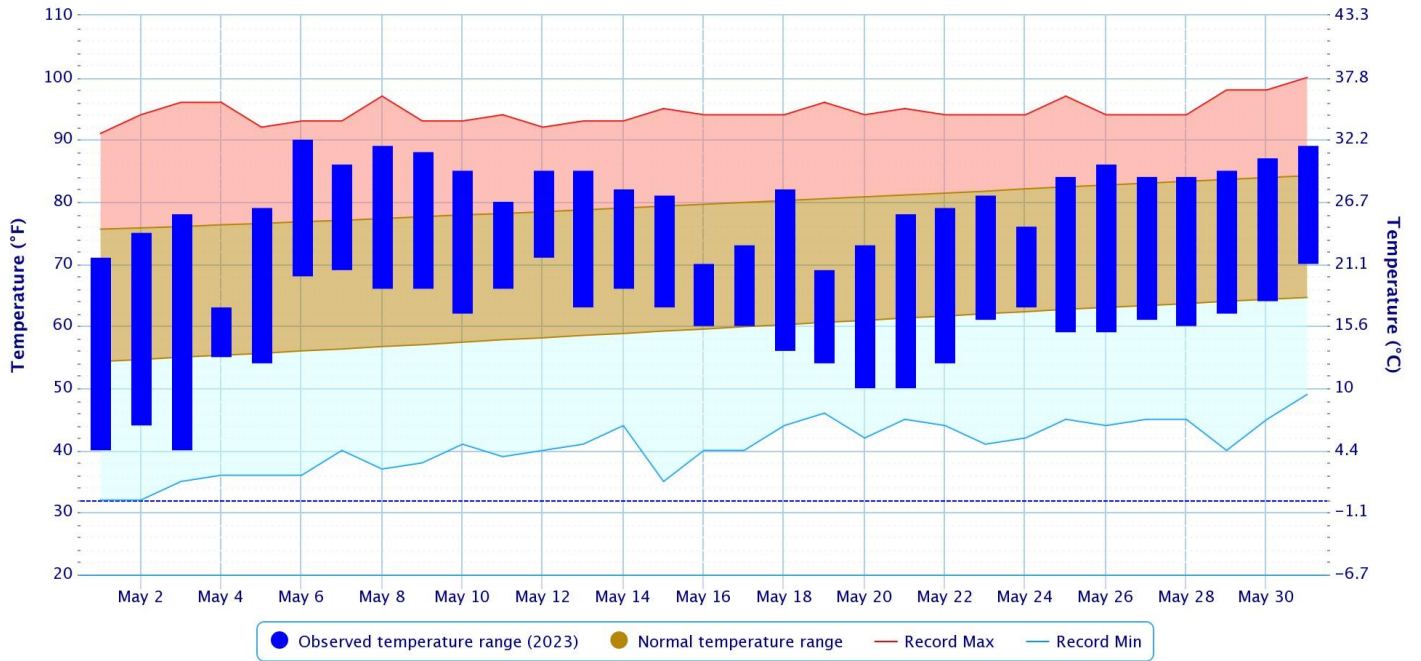
Talala, OK (meso)	2.36	Vinita, OK (meso)	2.38	Ozark, AR (coop)	2.52
Foraker, OK (meso)	2.59	Hugo, OK (meso)	2.66	Cloudy, OK (meso)	2.72
Skiatook, OK (meso)	2.83	Sallisaw, OK (meso)	2.83	Antlers, OK (meso)	2.84

According to statistics from the [Oklahoma Climatological Survey \(OCS\)](#) Mesonet:

Rank since 1921	Last 30 Days (May 2 – 31)	Spring 2023 (Mar 1 – May 31)	Last 60 Days (Apr 2 – May 31)	Year-to-Date (Jan 1 – May 31)	Last 180 Days (Dec 3 – May 31)	Water Year-to-Date (Oct 1 – May 31)	Last 365 Days (Jun 1, 2022 – May 31, 2023)
Northeast OK	42 nd driest	23 rd driest	16 th driest	41 st driest	46 th driest	37 th driest	10th driest
East Central OK	34 th driest	34 th driest	12 th driest	35 th wettest	37 th wettest	31 st wettest	45 th driest
Southeast OK	21 st driest	21 st driest	18 th driest	27 th wettest	33 rd wettest	25 th wettest	50 th driest
Statewide	44 th driest	30 th driest	28 th driest	47 th driest	46 th driest	49 th driest	18 th driest

Daily Temperature Data – Tulsa Area, OK (ThreadEx)

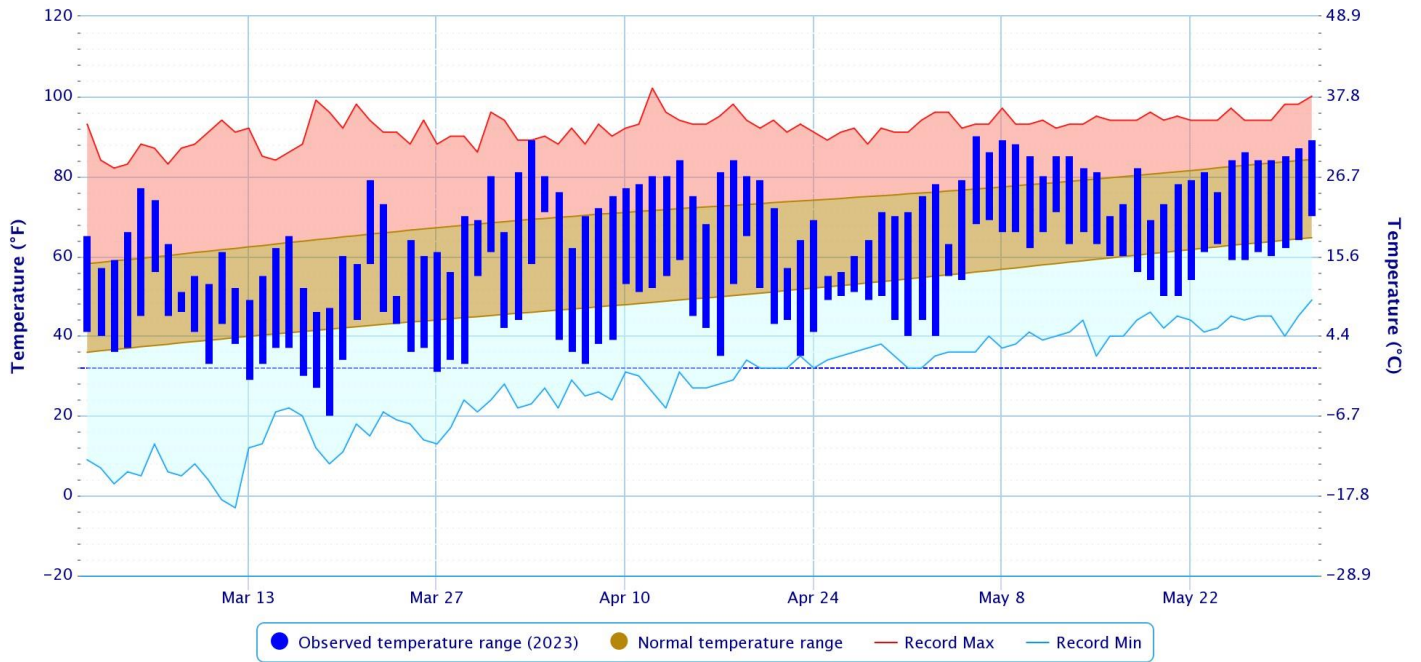
Period of Record – 1905-01-06 to 2023-06-01. Normals period: 1991-2020. Click and drag to zoom chart.



Powered by ACIS

Daily Temperature Data – Tulsa Area, OK (ThreadEx)

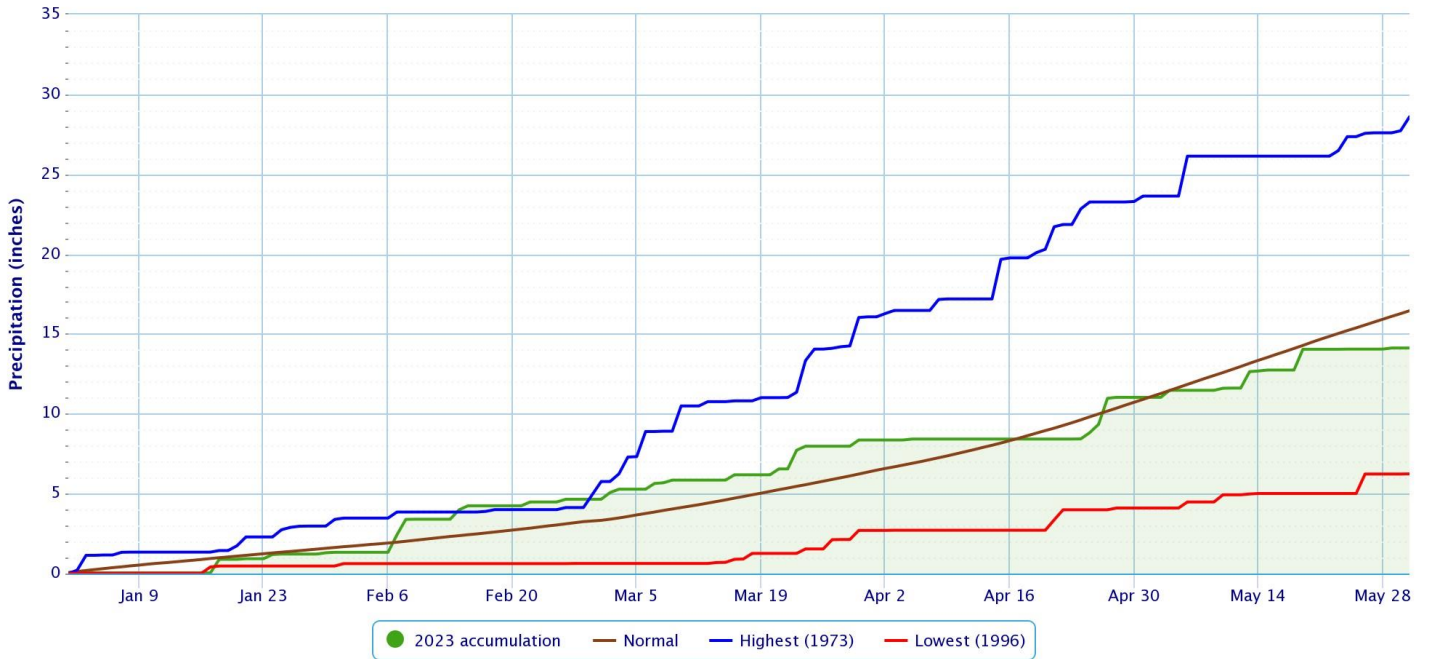
Period of Record – 1905-01-06 to 2023-06-01. Normals period: 1991-2020. Click and drag to zoom chart.



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Accumulated Precipitation – Tulsa Area, OK (ThreadEx)

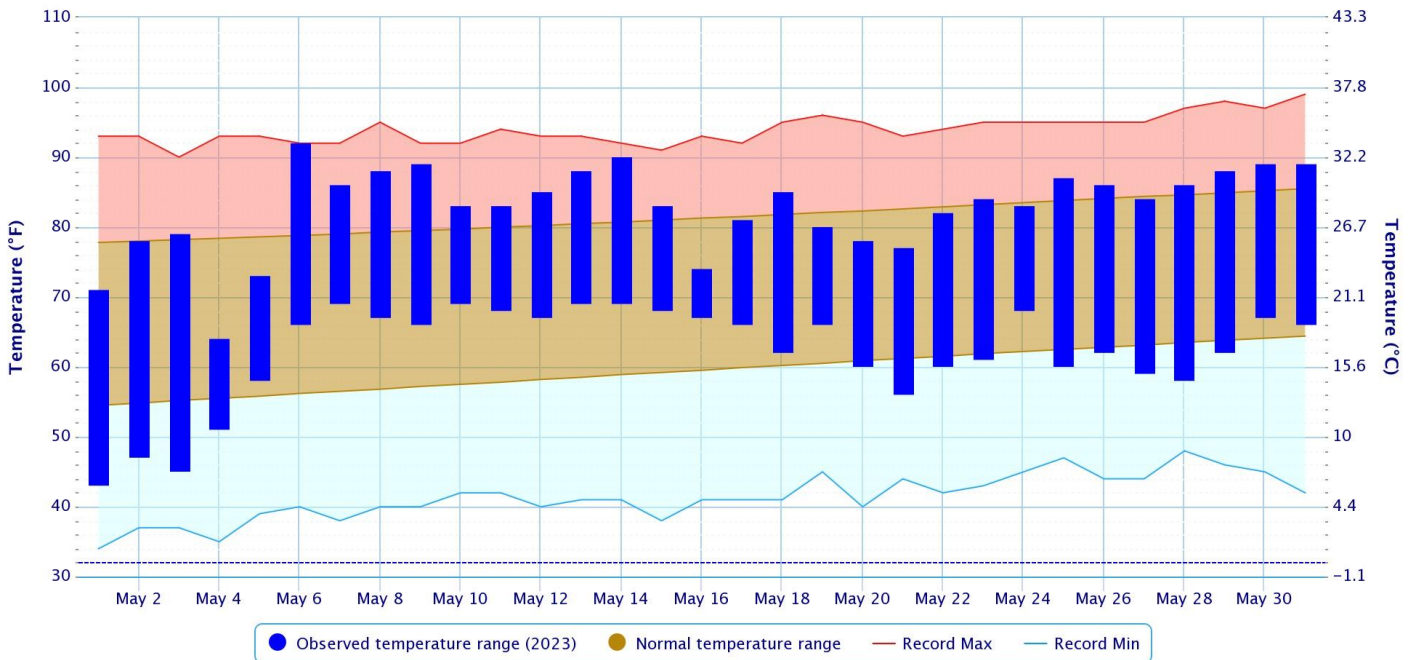
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Daily Temperature Data – Fort Smith Area, AR (ThreadEx)

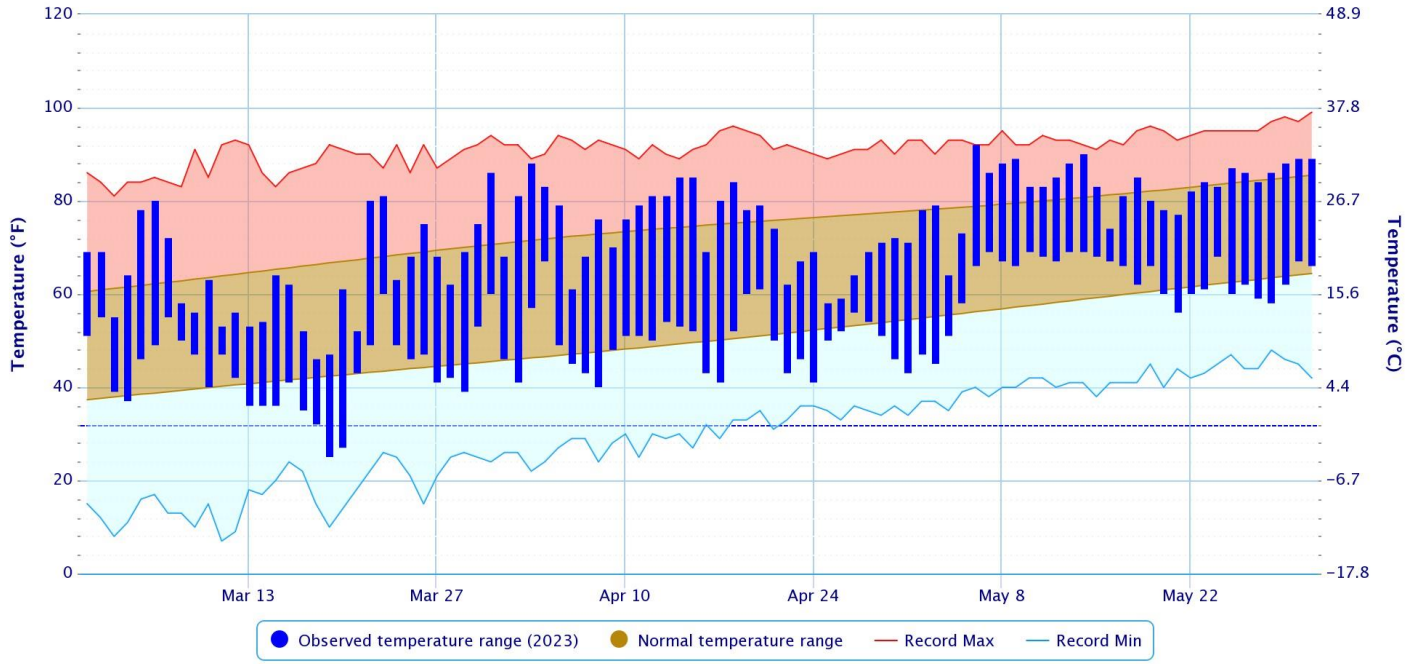
Period of Record – 1882-06-01 to 2023-06-01. Normals period: 1991-2020. Click and drag to zoom chart.



Powered by ACIS

Daily Temperature Data – Fort Smith Area, AR (ThreadEx)

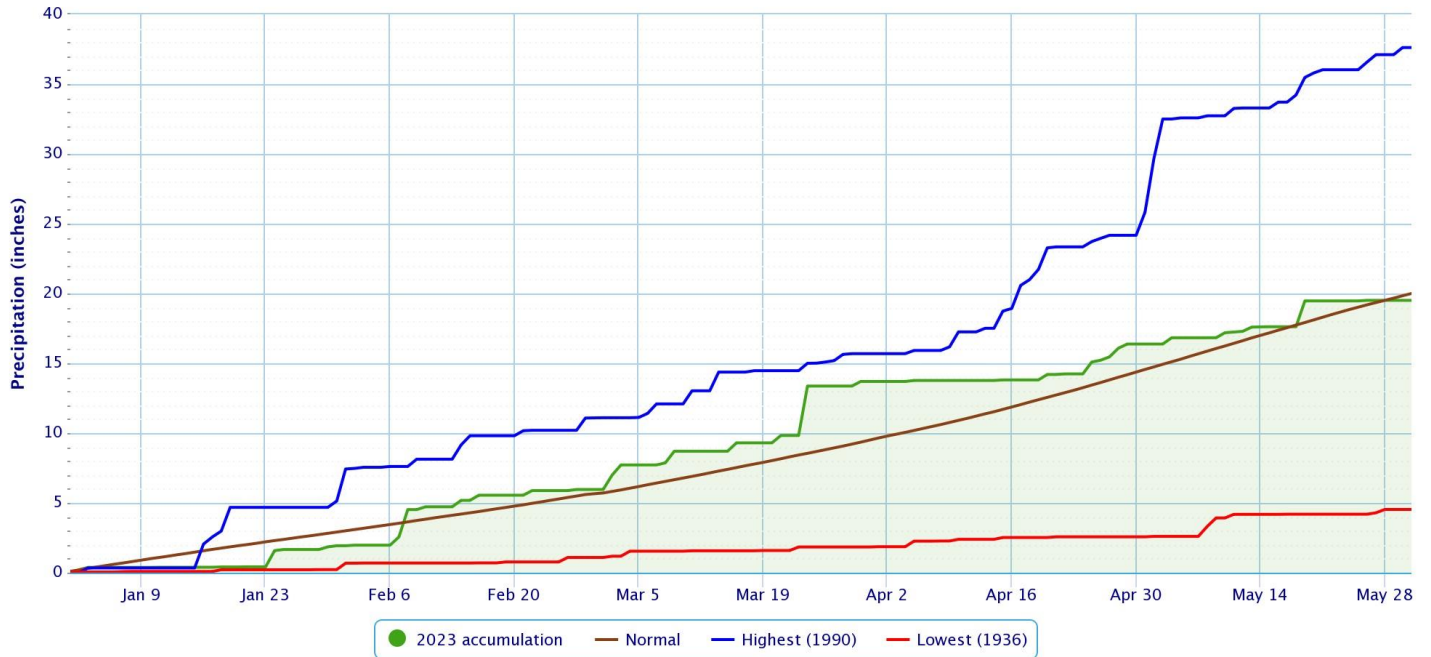
Period of Record – 1882-06-01 to 2023-06-01. Normals period: 1991-2020. Click and drag to zoom chart.



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Accumulated Precipitation – Fort Smith Area, AR (ThreadEx)

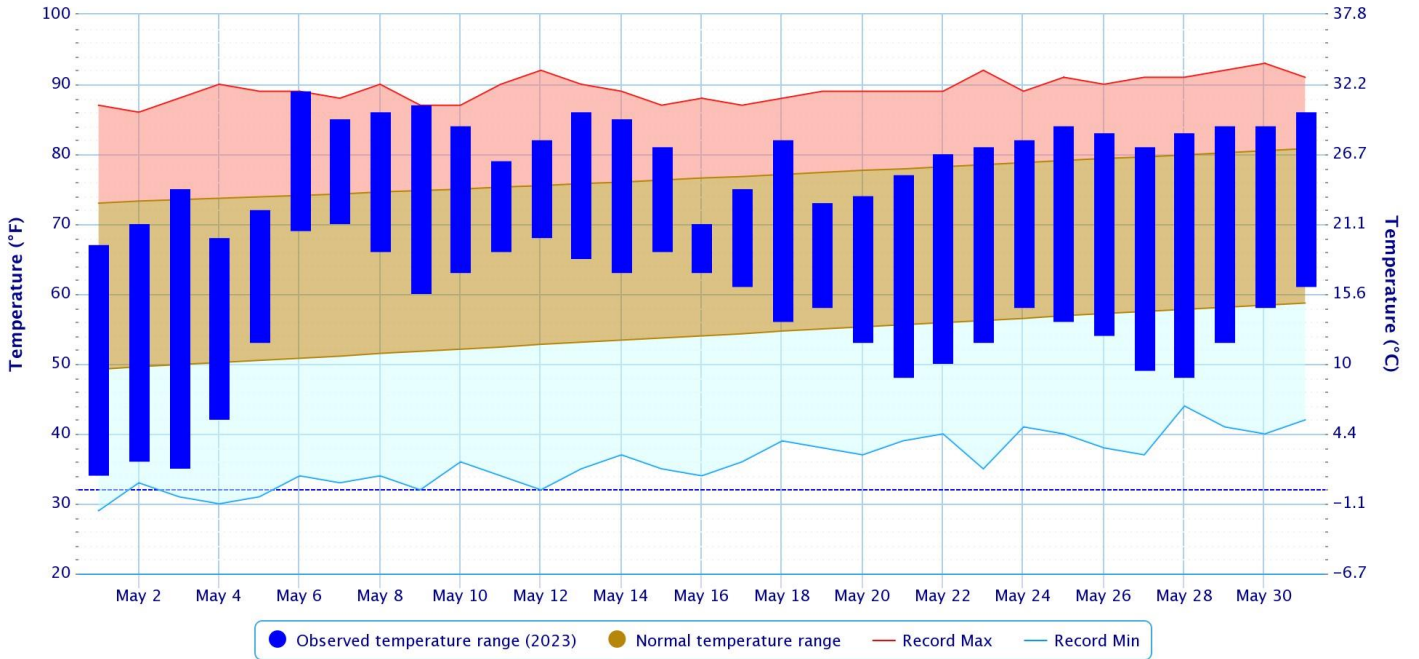
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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Daily Temperature Data – FAYETTEVILLE DRAKE FIELD, AR

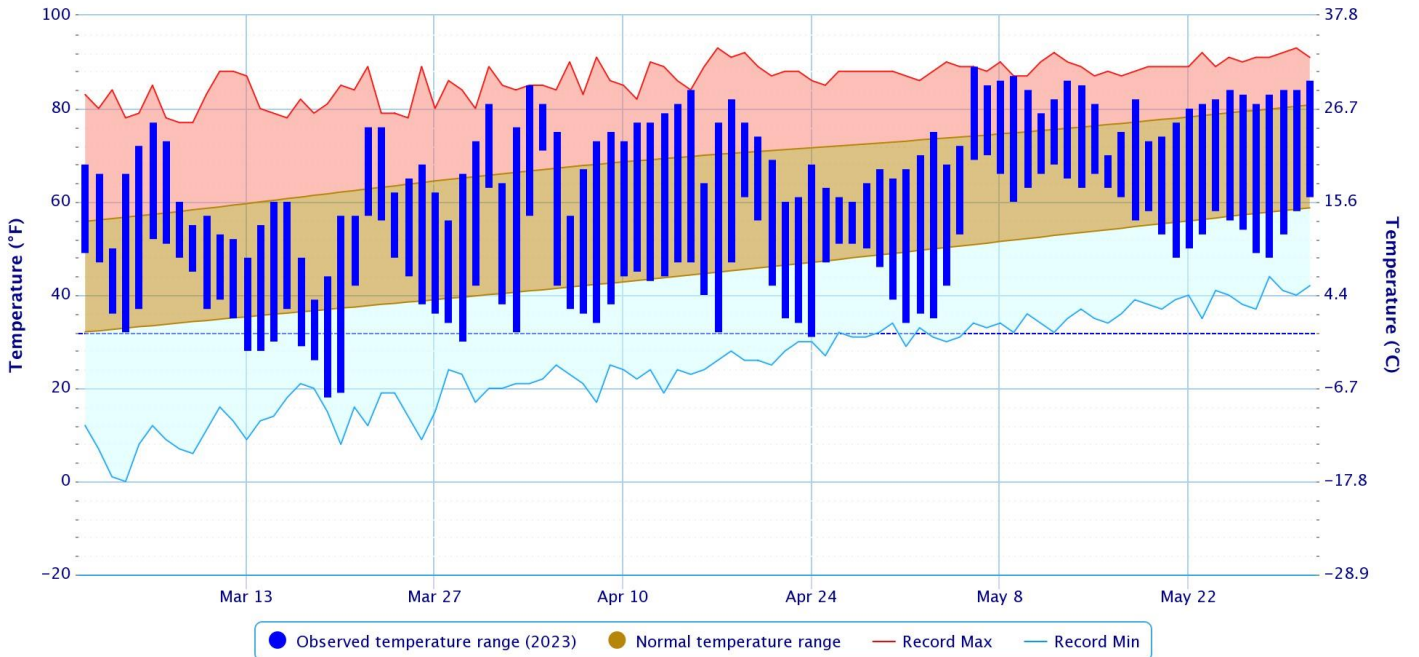
Period of Record – 1949-07-14 to 2023-06-01. Normals period: 1991-2020. Click and drag to zoom chart.



Powered by ACIS

Daily Temperature Data – FAYETTEVILLE DRAKE FIELD, AR

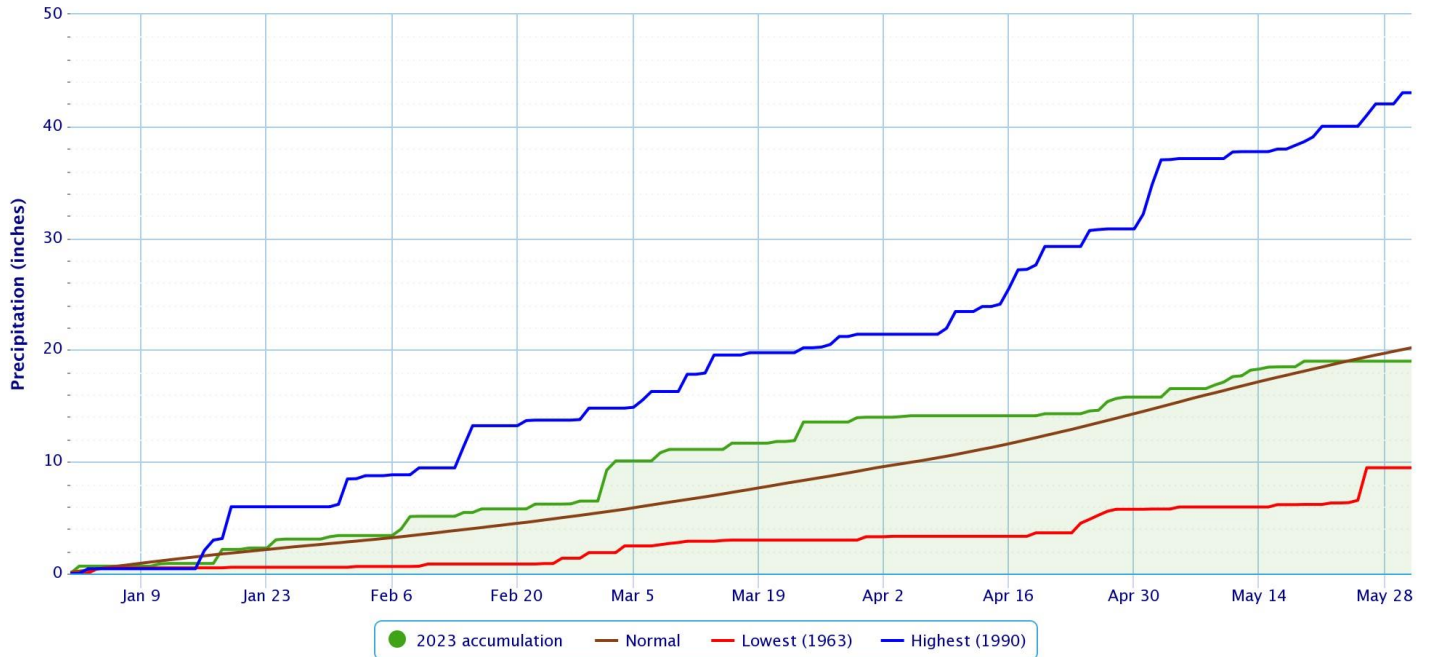
Period of Record – 1949-07-14 to 2023-06-01. Normals period: 1991-2020. Click and drag to zoom chart.



Powered by ACIS

Accumulated Precipitation – FAYETTEVILLE DRAKE FIELD, AR

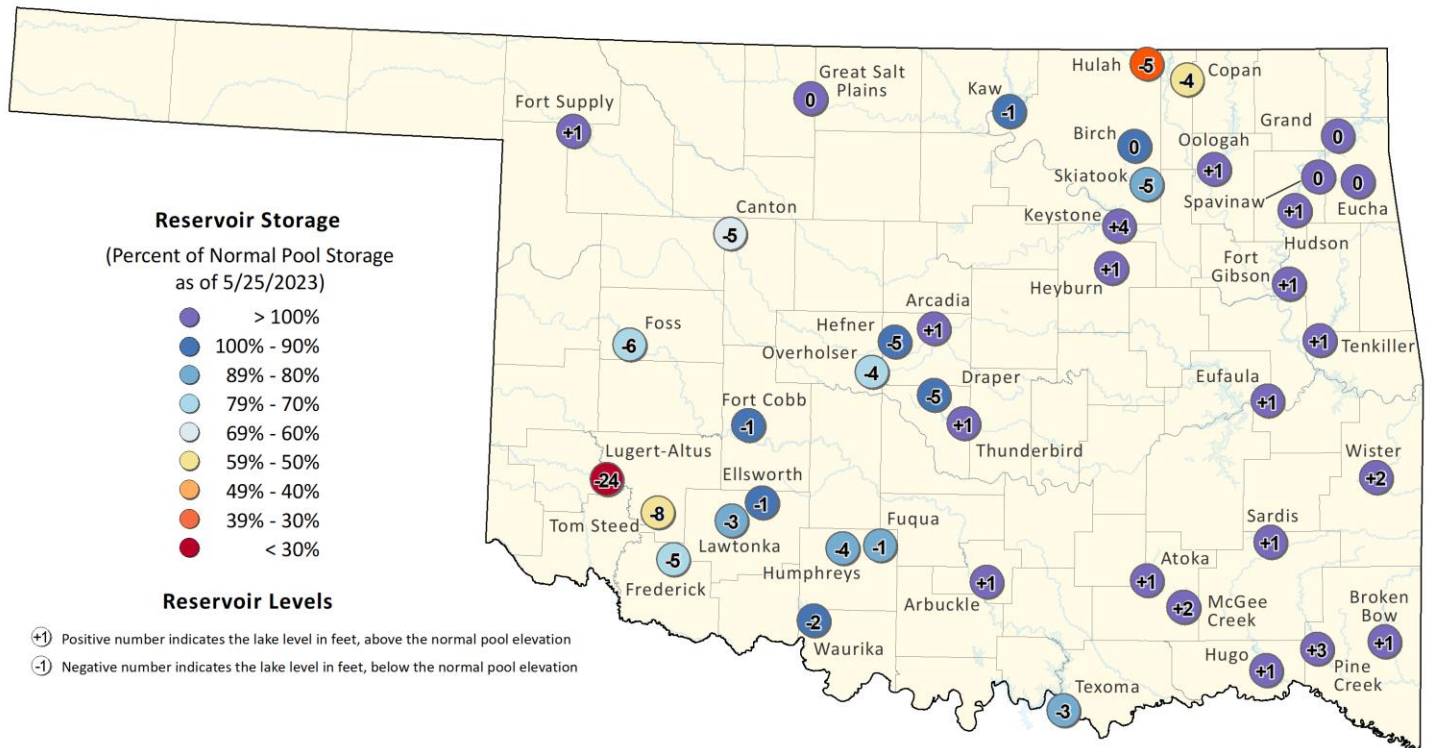
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

Reservoirs

Oklahoma Reservoir Levels and Storage as of 5/25/2023



This map shows reservoir storage as a percentage of normal pool storage capacity. The source information was collected from real-time lake gages monitored by the U.S. Army Corps of Engineers (https://www.swt-wc.usace.army.mil/Daily_Morning_Reservoir_Report.pdf), and the U.S. Geological Survey (https://waterdata.usgs.gov/ok/nwis/current/?type=lake&group_key=basin_cd). For more information please visit the OWRB's website: (<https://www.owrb.ok.gov>).



According to the USACE, several of the lakes in the HSA were below 3% of top of their conservation pools as of 05/31/2023: Hulah Lake 42%, Copan Lake 55%, Skiatook Lake 84%, Birch Lake 95%, and Kaw Lake 96%. Some lakes were above 3% of the top of their conservation pools: Beaver Lake 38%, Keystone Lake 4%, Tenkiller Lake 4%, and Hudson Lake 4%.

Drought

According to the [U.S. Drought Monitor](#) (USDM) from May 30, 2023 (Figs. 2, 3), Exceptional (D4) Drought conditions persisted across portions of eastern Kay and Osage Counties in eastern OK. Extreme (D3) Drought conditions were occurring in portions of eastern Kay, Osage, Pawnee, and Washington Counties in eastern Oklahoma. Severe (D2) Drought conditions exist in portions of Craig, Nowata, Washington, Osage, and Pawnee Counties in eastern Oklahoma. Moderate (D1) Drought conditions were present in portions of Ottawa, Craig, Nowata, Washington, Osage, and Pawnee Counties in eastern OK. Abnormally Dry (D0) but not in drought conditions were occurring in Ottawa, Delaware, Craig, Nowata, Washington, Rogers, Mayes, Tulsa, Osage, Pawnee, Creek, Adair, Sequoyah, Le Flore, Pushmataha, and Choctaw Counties in eastern OK, and Benton, Carroll, Washington, Madison, Crawford, Sebastian, and Franklin Counties in northwest AR.

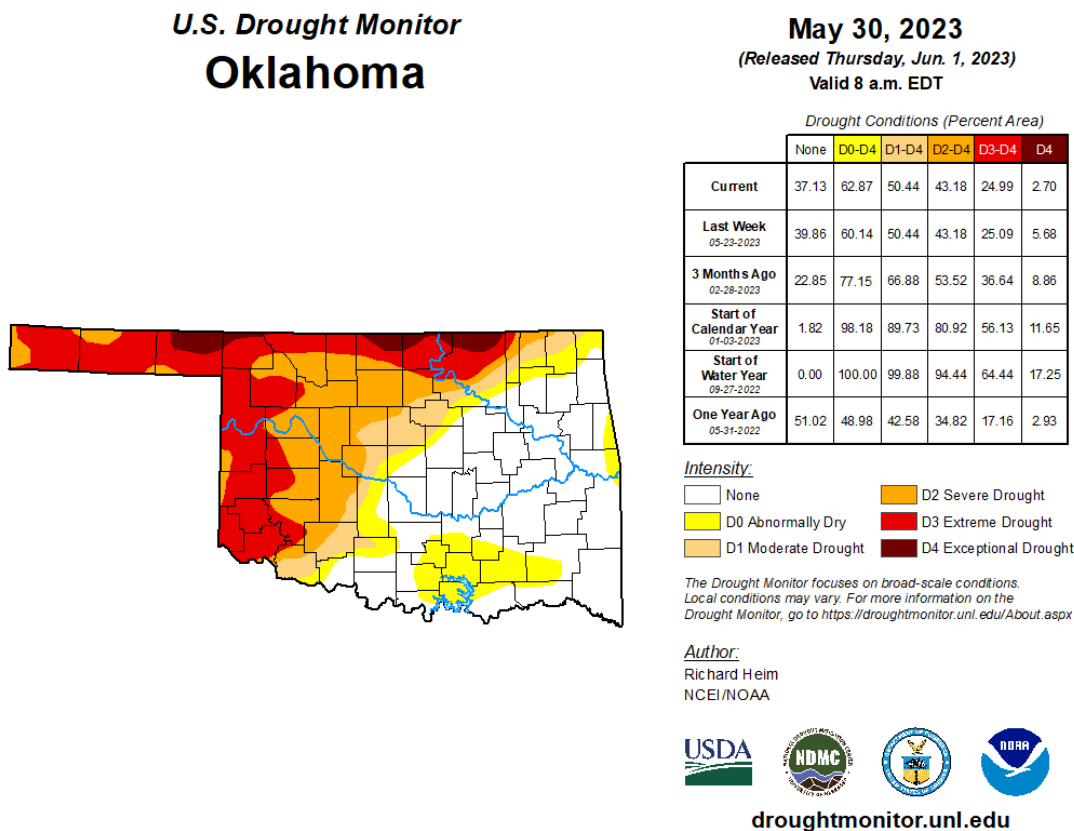
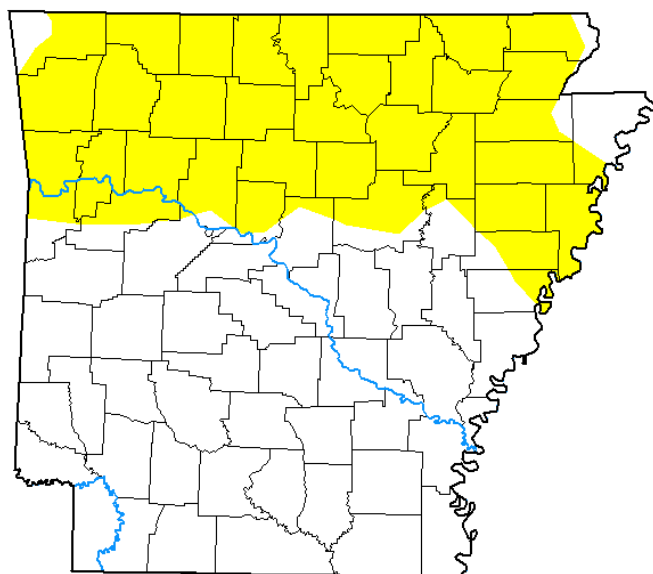


Fig. 2. Drought Monitor for Oklahoma

U.S. Drought Monitor Arkansas

May 30, 2023
(Released Thursday, Jun. 1, 2023)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	58.48	41.52	0.00	0.00	0.00	0.00
Last Week <i>05-23-2023</i>	100.00	0.00	0.00	0.00	0.00	0.00
3 Months Ago <i>02-28-2023</i>	100.00	0.00	0.00	0.00	0.00	0.00
Start of Calendar Year <i>01-03-2023</i>	53.09	46.91	2.26	0.00	0.00	0.00
Start of Water Year <i>09-27-2022</i>	4.99	95.01	69.68	39.30	2.96	0.00
One Year Ago <i>05-31-2022</i>	96.22	3.78	0.00	0.00	0.00	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme 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>

Author:

Richard Heim
NCEI/NOAA



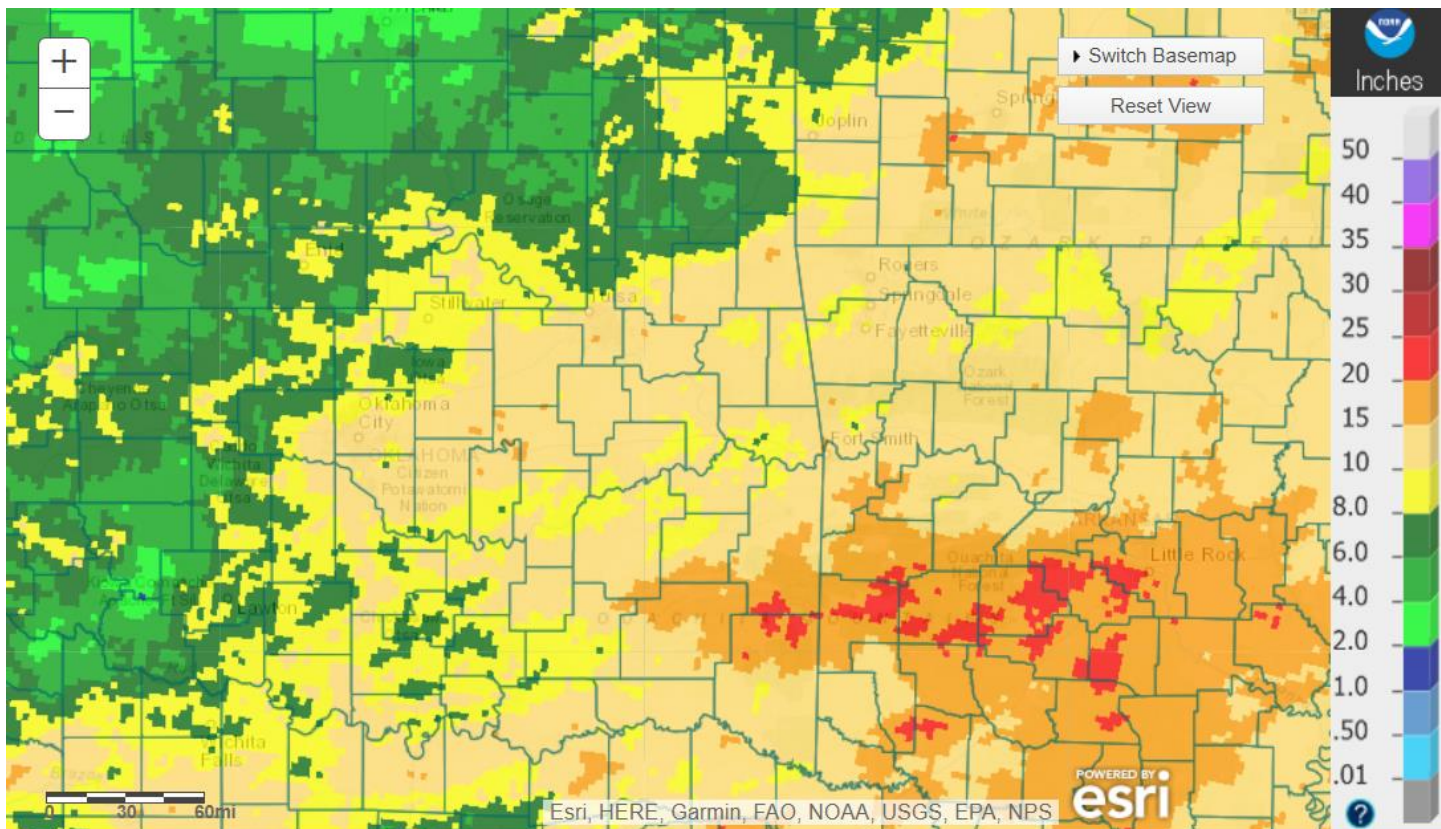
droughtmonitor.unl.edu

Fig. 3. Drought Monitor for Arkansas

Spring (March-April-May) 2023 Summary

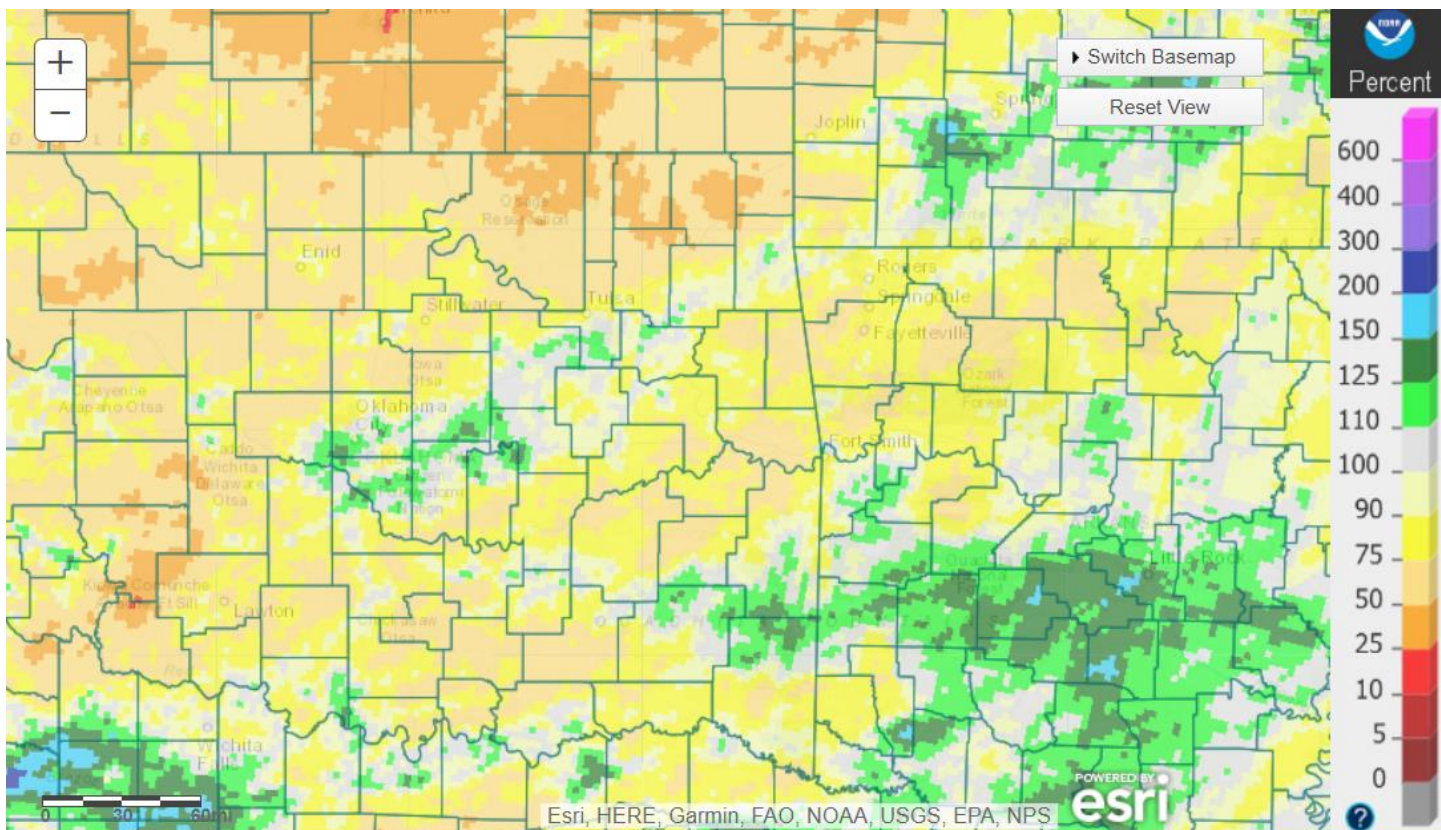
Using the radar-derived estimated observed precipitation from the RFCs (Fig. 4a), rainfall totals for Spring 2023 ranged from 4" to around 22" from northwest to southeast across eastern OK and northwest AR. These rainfall totals correspond to 25% to 90% of the normal Spring rainfall for most of eastern OK and northwest AR. However, locations near the I-44 corridor and parts of Pushmataha, Latimer, Le Flore, and Sebastian Counties received 90% to near 150% of the normal Spring rainfall (Fig. 4b). There were two tornadoes during spring 2023 (see <https://arcg.is/8jKij> for details). So far, this ties with 1977, 1963, 1958, and 1951 as the 4th severe weather season (March-June) with the fewest number of tornadoes since 1950.

In Tulsa, OK, Spring 2023 ranked as the 56th coldest Spring (60.0°F, tied 1980, 1973; since records began in 1905) and the 38th driest Spring (9.47"; since records began in 1888). Fort Smith, AR had the 30th warmest Spring (62.7°F, tied 2010, 1910; since records began in 1883) and the 54th wettest Spring (13.55", tied 1903; since records began in 1883). Fayetteville, AR had the 16th warmest (58.6°F) and the 28th driest (12.51") Spring since records began in 1950.



Tulsa, OK: Last 90-Day Observed Precipitation
Valid on: June 01, 2023 12:00 UTC

Fig. 4a. Estimated Observed Rainfall for Spring 2023



Tulsa, OK: Last 90-Day Percent of Normal Precipitation
Valid on: June 01, 2023 12:00 UTC

Fig. 4b. Estimated % of Normal Rainfall for Spring 2023

Outlooks

The [Climate Prediction Center](#) (CPC) outlook for June 2023 (issued May 31, 2023) indicates an equal chance for above, near, and below normal temperatures and a slightly enhanced chance for above median precipitation across all of eastern OK and northwest AR. This outlook was largely based on dynamical model output, soil moisture, and Madden-Julian Oscillation (MJO) influence. Shortwaves are expected to undercut the high-latitude ridging, leading to a signal for above median precipitation across the southern plains through at least the first half of June.

For the 3-month period June-July-August 2023, CPC is forecasting an enhanced chance for above normal temperatures across eastern OK and northwest AR. This outlook also calls for an enhanced chance of above median precipitation across northeast and east central OK and northwest AR, and an equal chance for above, near, and below median precipitation across southeast OK (outlook issued May 18, 2023). This outlook is based on long-term trends, ENSO state, soil moisture, and incorporates both statistical and dynamical forecast tools. According to CPC, ENSO-neutral is present in the equatorial Pacific Ocean, and a transition to El Niño is expected in the next couple of months. There is a greater than 90% chance of El Niño continuing into the winter.

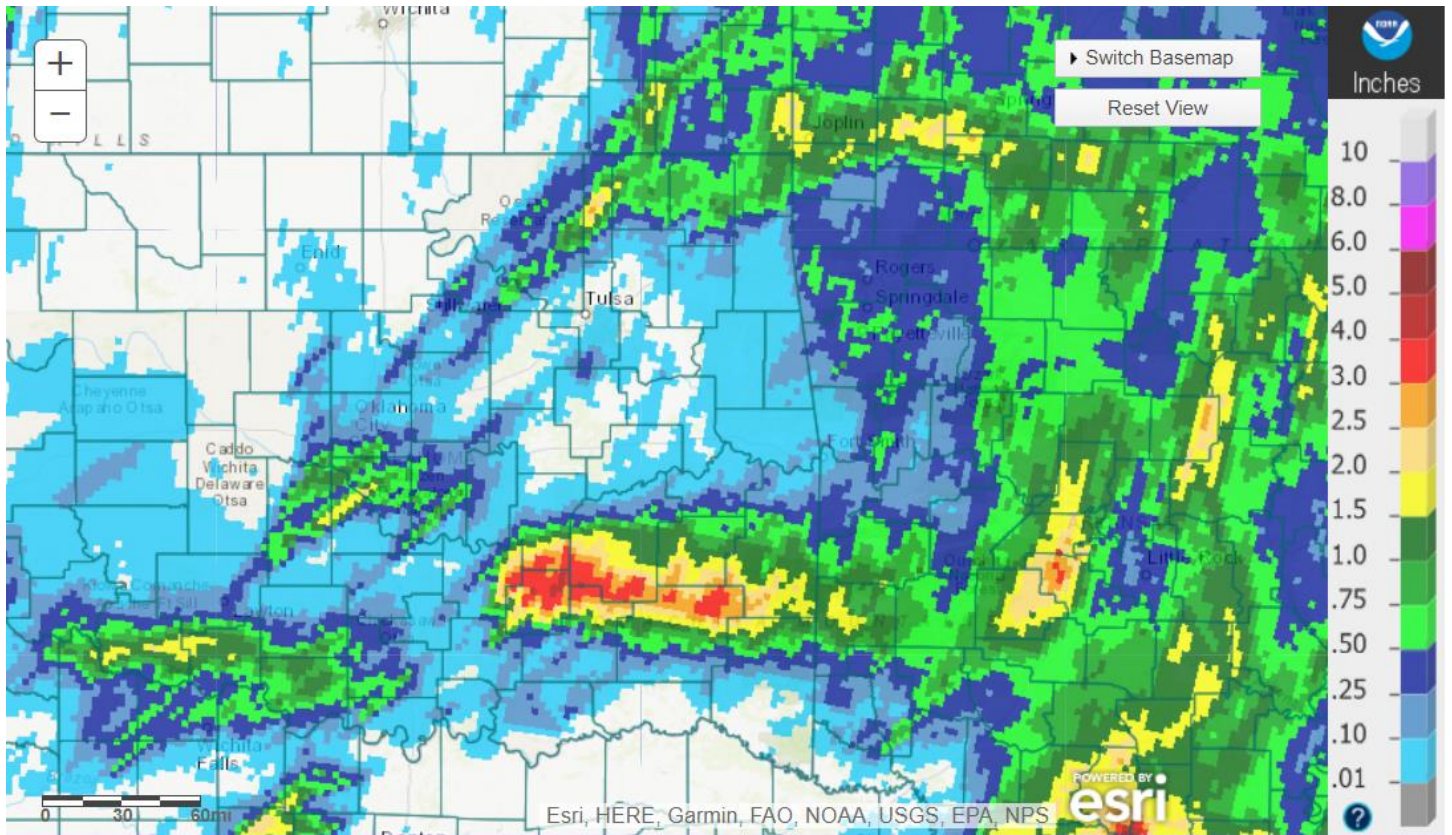
Summary of Heavy Precipitation Events Daily quality-controlled rainfall maps can be found at: http://water.weather.gov/precip/index.php?location_type=wfo&location_name=tsa

Thunderstorms developed along a dry line in central OK on the 11th, and two clusters of storms continued into eastern OK during the late evening hours. One cluster moved into northeast OK and the second cluster progressed across southeast OK and west central AR. These two storm clusters moved east through the overnight hours, exiting the forecast area around sunrise of the 12th. Rainfall totals for the northern cluster ranged from around 0.25" to isolated 2.5", while the rainfall with the southern cluster was around 0.5" to 4" (Figs. 5, 6).

During the evening of the 12th, thunderstorms developed along a front that stretched from southeast KS to southwest OK. By late evening, a line of thunderstorms had formed across northeast OK and then moved southeast across eastern OK and northwest AR through the overnight and early morning hours. By 7 am on the 13th, the leading edge of the storms was located from northwest AR into southeast OK, with trailing showers and thunderstorms continuing across northeast and east central OK. This activity rapidly diminished after sunset, coming to an end by mid-morning. Rainfall totals through 7 am ranged from around 0.25" to around 3" (Fig. 7), with an additional 0.10" to 1.5" across southeast OK into northwest AR after 7 am (Fig. 8).

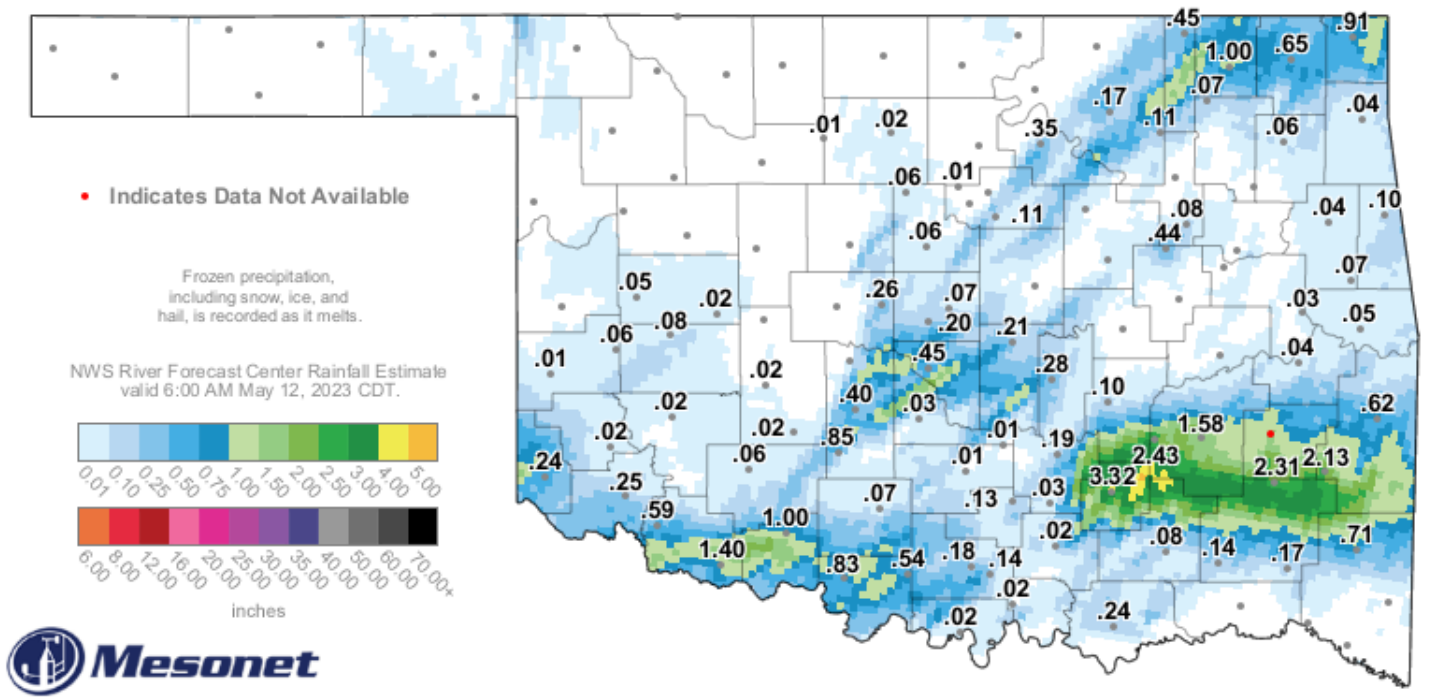
Deep layer southerly flow continued to increase over the region on the 13th as an upper-level low lifted north over west TX and a mid-level ridge set up over MS. This resulted in isolated to scattered showers and thunderstorms from the afternoon through overnight hours across the area. Rainfall from this activity ranged from a few hundredths of an inch to around 2" (Fig. 8).

The area remained in the moist, deep layer southerly flow on the 14th, with widely scattered showers and thunderstorms during the peak heating hours of the afternoon and evening. During the early morning hours of the 15th, an upper low that originated from convection near the Gulf Coast moved from near the Red River northward across the area. Additional scattered showers and thunderstorms developed in response to this low pressure, affecting the region through the morning and afternoon hours. A broader upper-level trough was also moving east, keeping isolated convection going through the evening. The scattered storms brought 0.10" to around 3" of rain each of the two days (Figs. 9, 10). This active mid-month weather pattern brought a 7-day total rainfall of around 0.5" to around 5" to eastern OK and northwest AR (Fig. 11).



Tulsa, OK: May 12, 2023 1-Day Observed Precipitation
 Valid on: May 12, 2023 12:00 UTC

Fig. 5. 24-hour Estimated Observed Rainfall ending at 7am CDT 5/12/2023.

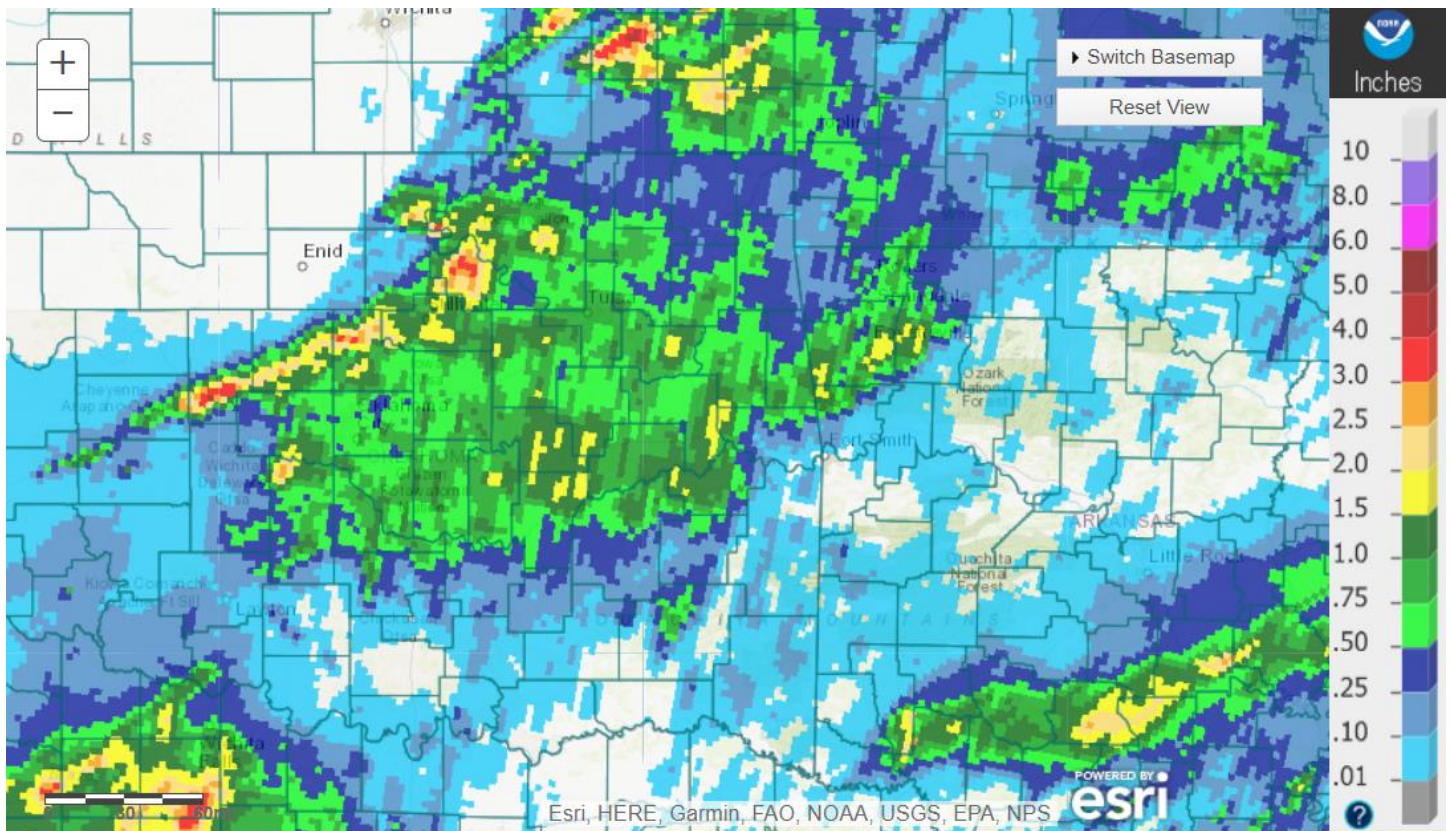


Mesonet
 24-Hour Rainfall Accumulation (inches)

7:15 AM May 12, 2023 CDT

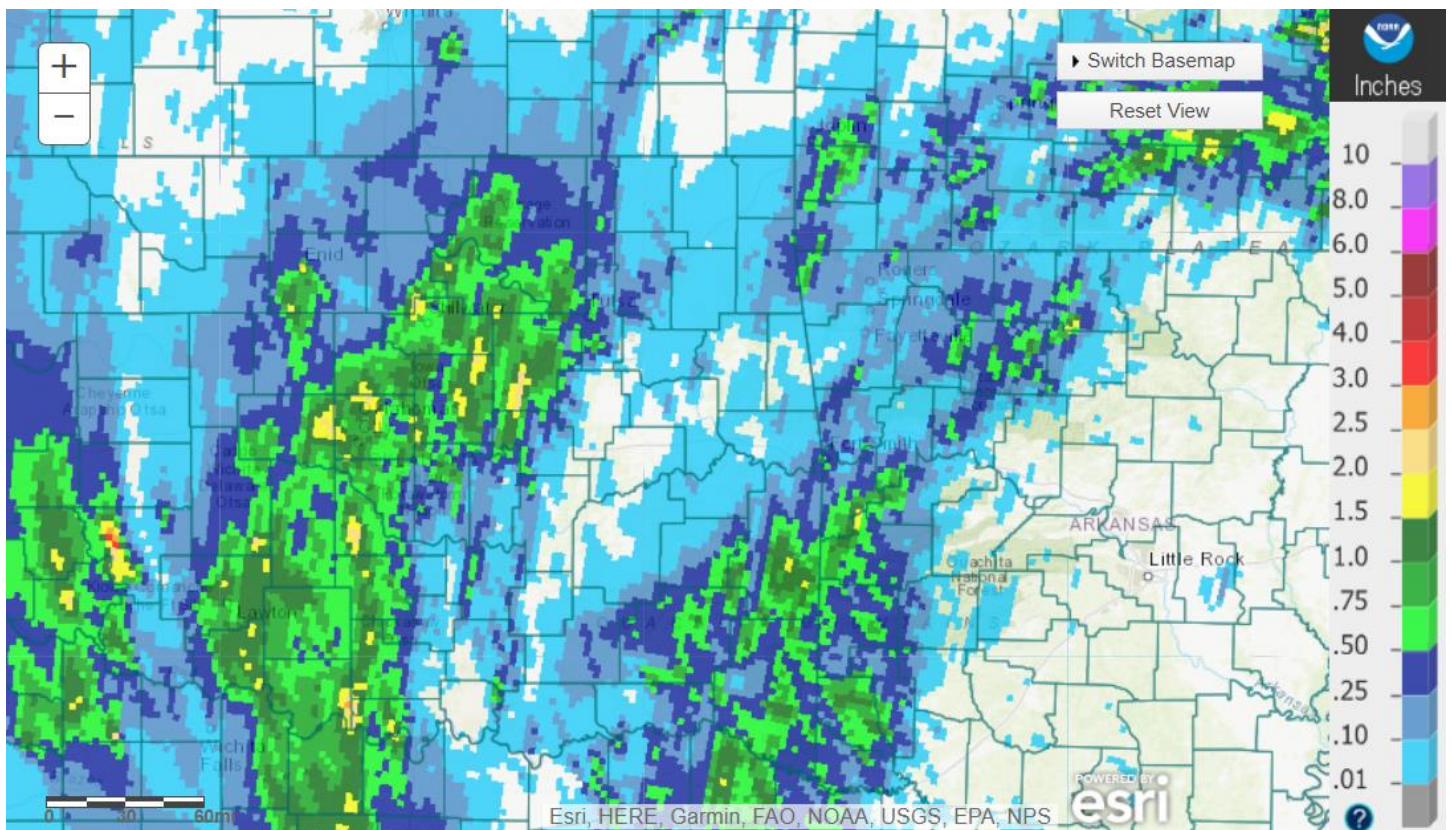
Created 7:20:59 AM May 12, 2023 CDT. © Copyright 2023

Fig. 6. OK Mesonet (values) and NWS RFC rainfall estimate (image) 24-hour rainfall ending at 7:15 am CDT 05/12/2023.



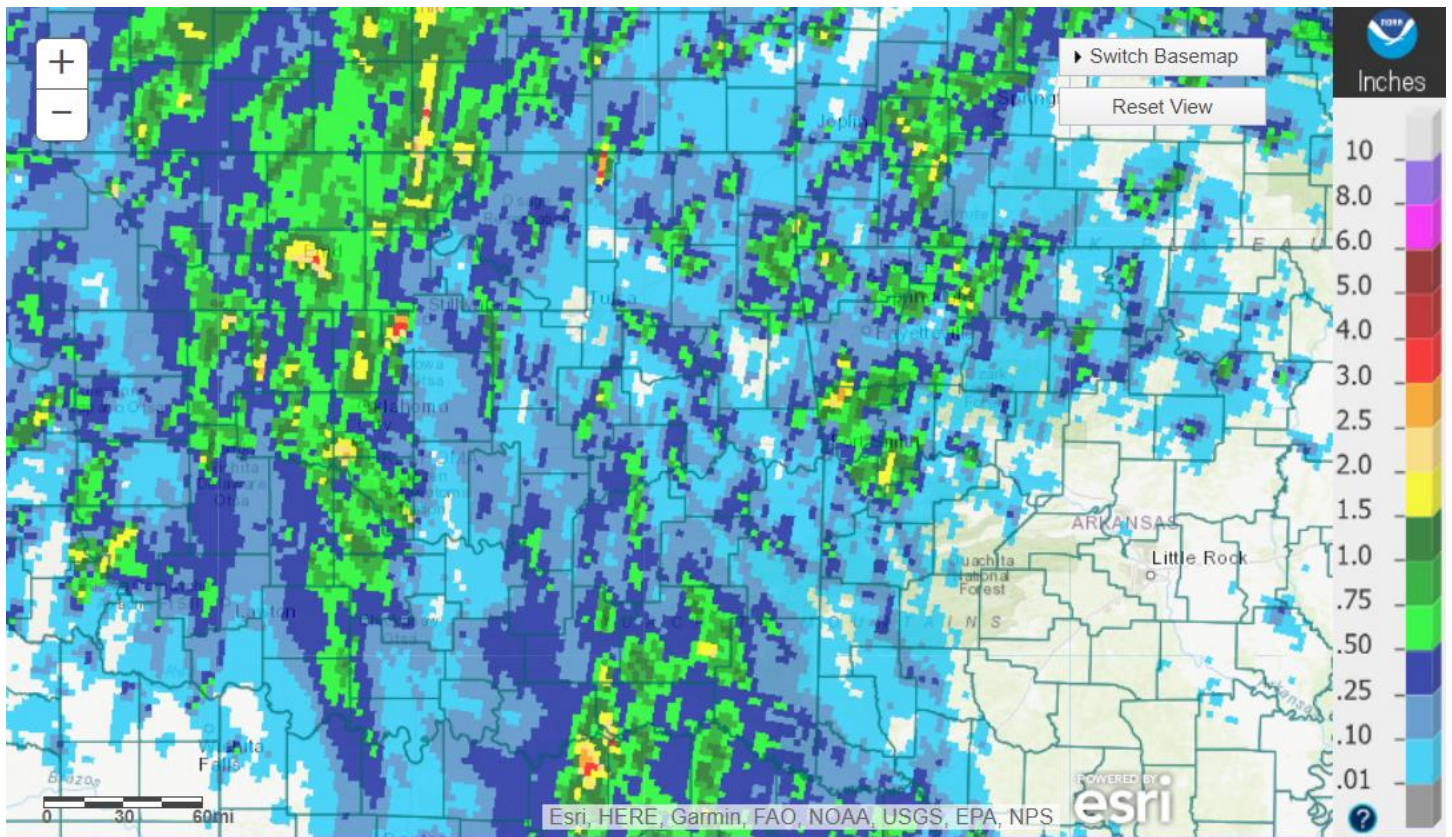
Tulsa, OK: May 13, 2023 1-Day Observed Precipitation
 Valid on: May 13, 2023 12:00 UTC

Fig. 7. 24-hour Estimated Observed Rainfall ending at 7am CDT 5/13/2023.



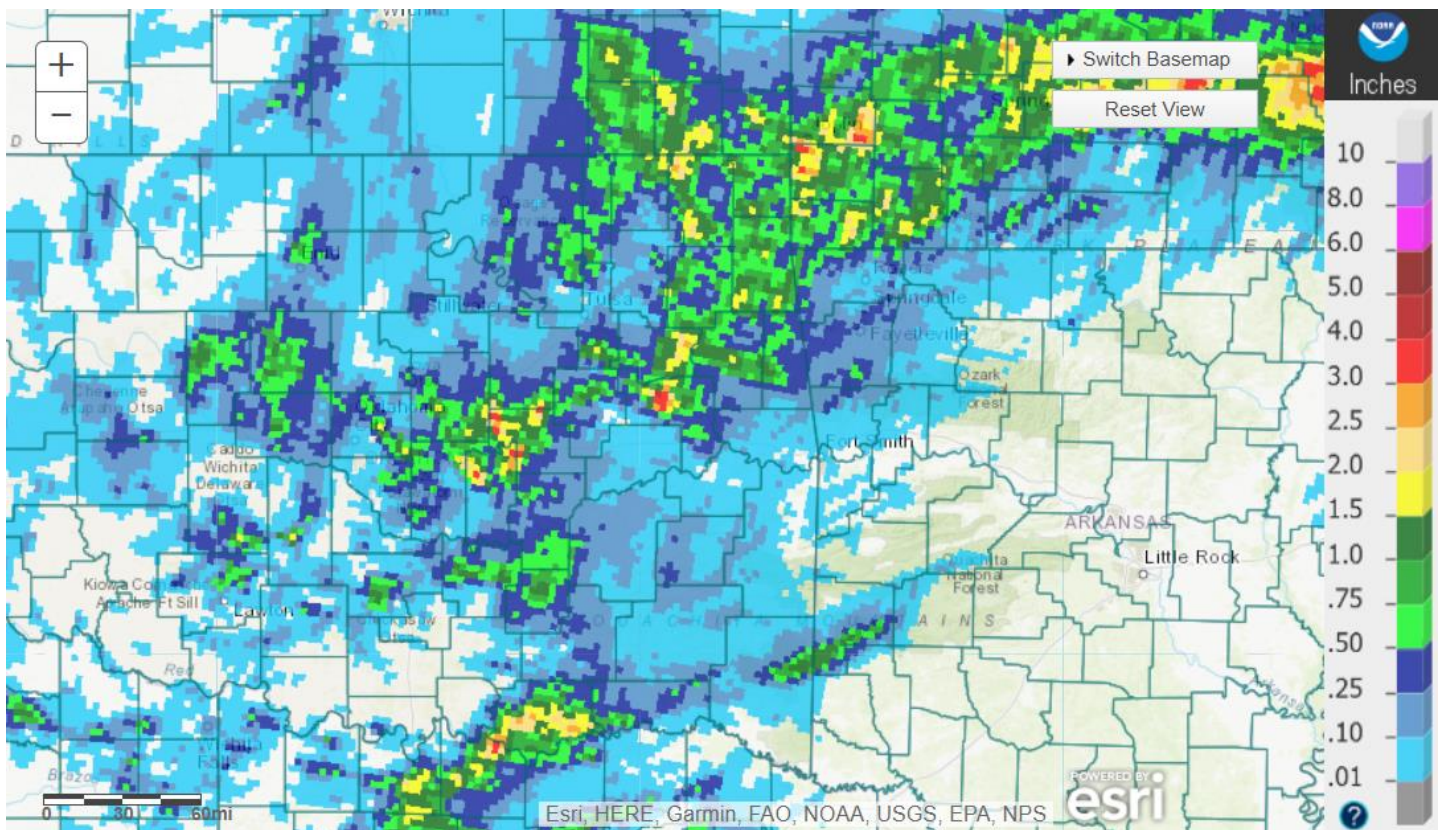
Tulsa, OK: May 14, 2023 1-Day Observed Precipitation
 Valid on: May 14, 2023 12:00 UTC

Fig. 8. 24-hour Estimated Observed Rainfall ending at 7am CDT 5/14/2023.



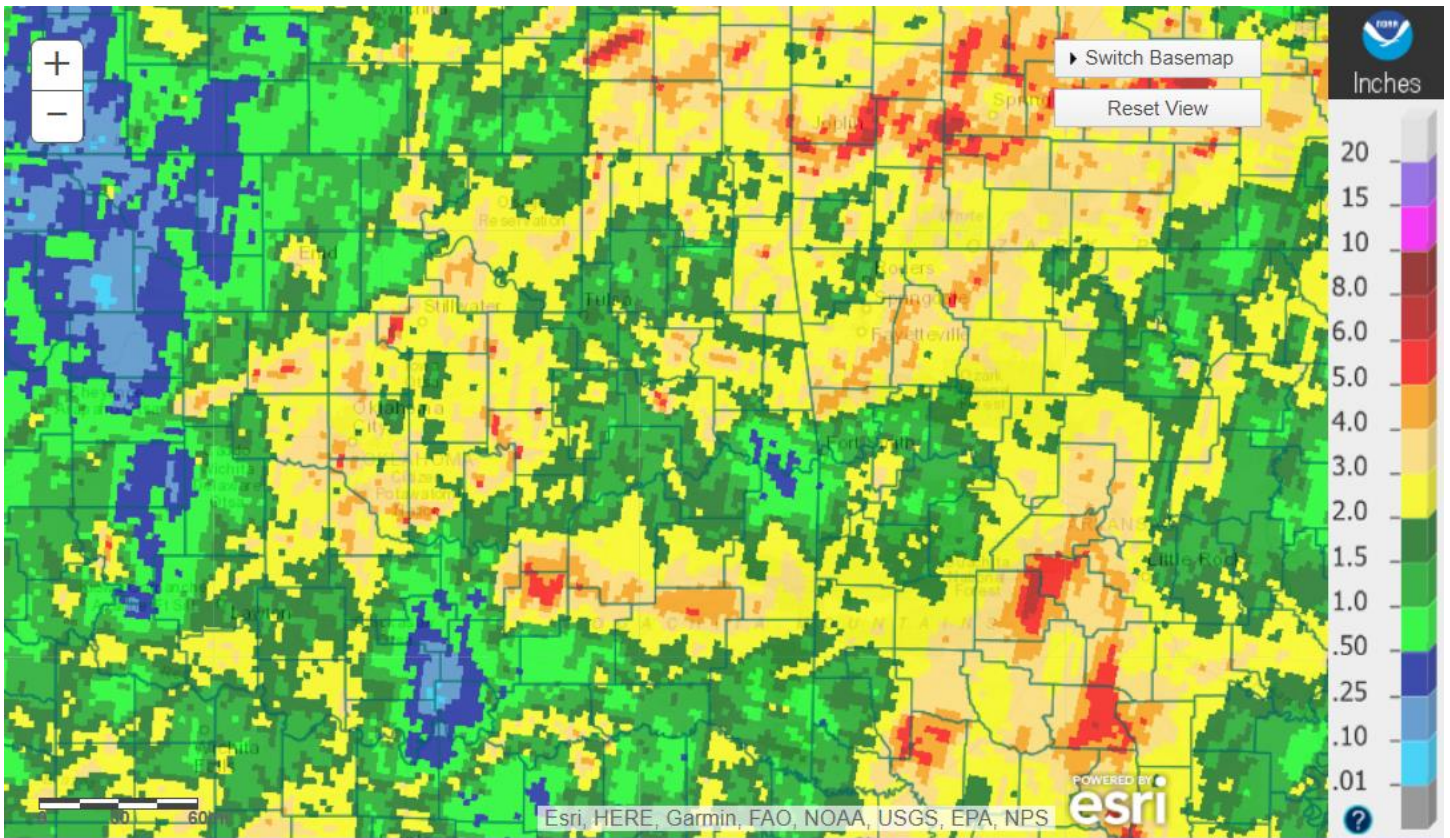
Tulsa, OK: May 15, 2023 1-Day Observed Precipitation
Valid on: May 15, 2023 12:00 UTC

Fig. 9. 24-hour Estimated Observed Rainfall ending at 7am CDT 5/15/2023.



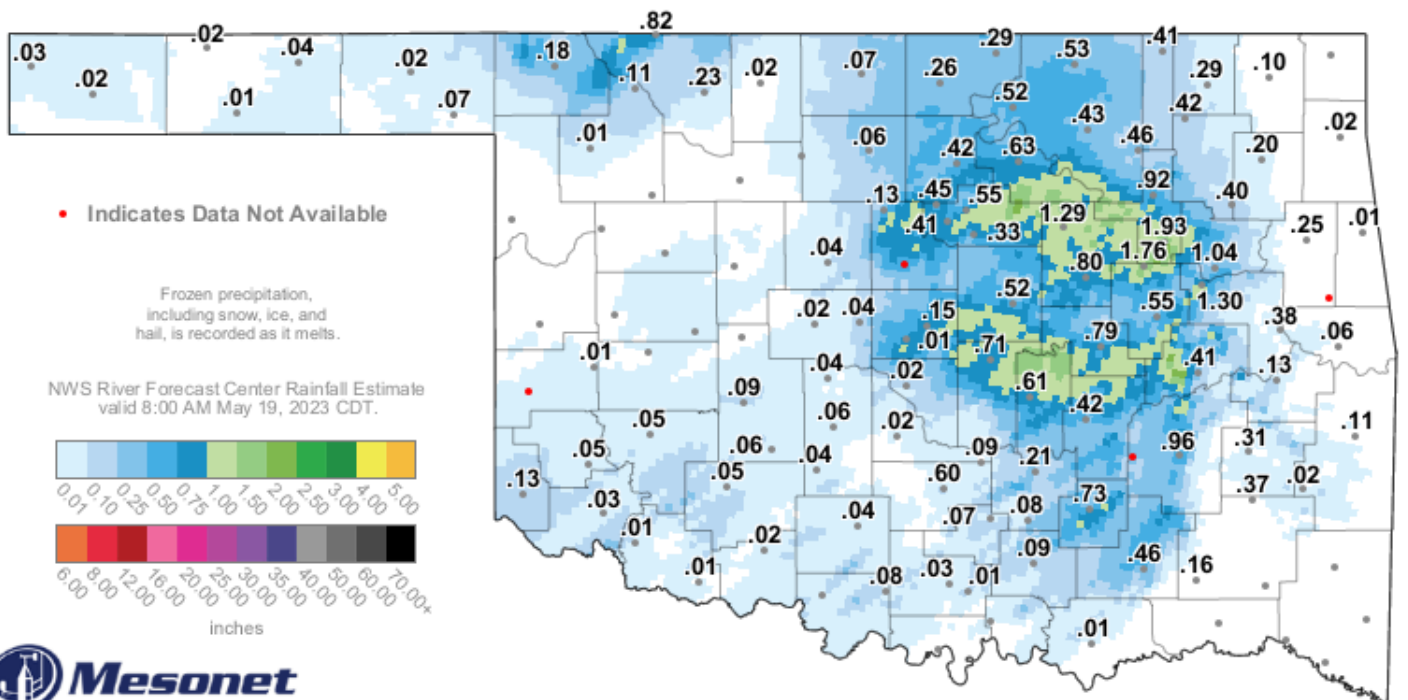
Tulsa, OK: May 16, 2023 1-Day Observed Precipitation
Valid on: May 16, 2023 12:00 UTC

Fig. 10. 24-hour Estimated Observed Rainfall ending at 7am CDT 5/16/2023.



Tulsa, OK: Last 7-Day Observed Precipitation
Valid on: May 16, 2023 12:00 UTC

Fig. 11. 7-Day Estimated Observed Rainfall ending at 7am CDT 5/16/2023.

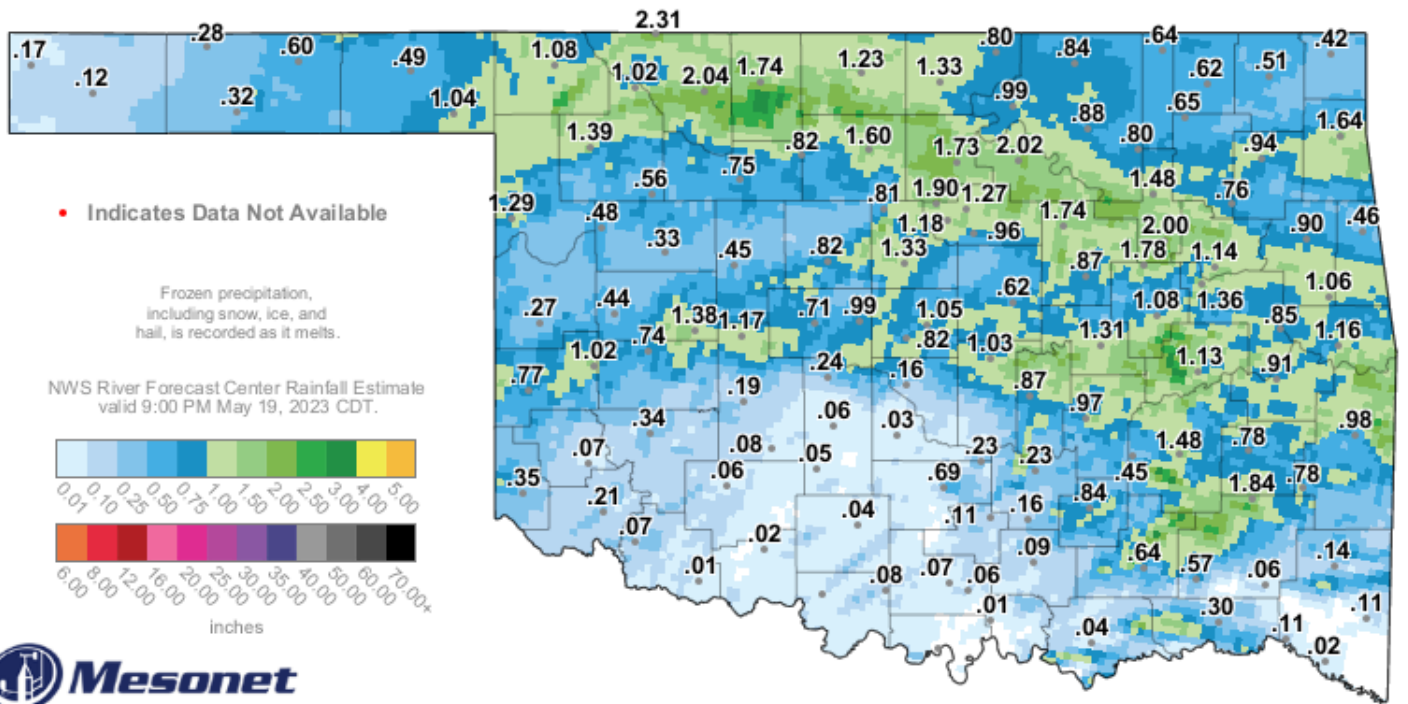


Mesonet 3-Hour Rainfall Accumulation (inches)

8:55 AM May 19, 2023 CDT

Created 9:00:55 AM May 19, 2023 CDT. © Copyright 2023

Fig. 12. OK Mesonet (values) and NWS RFC rainfall estimate (image) 3-hour rainfall ending at 8:55 am CDT 05/19/2023.

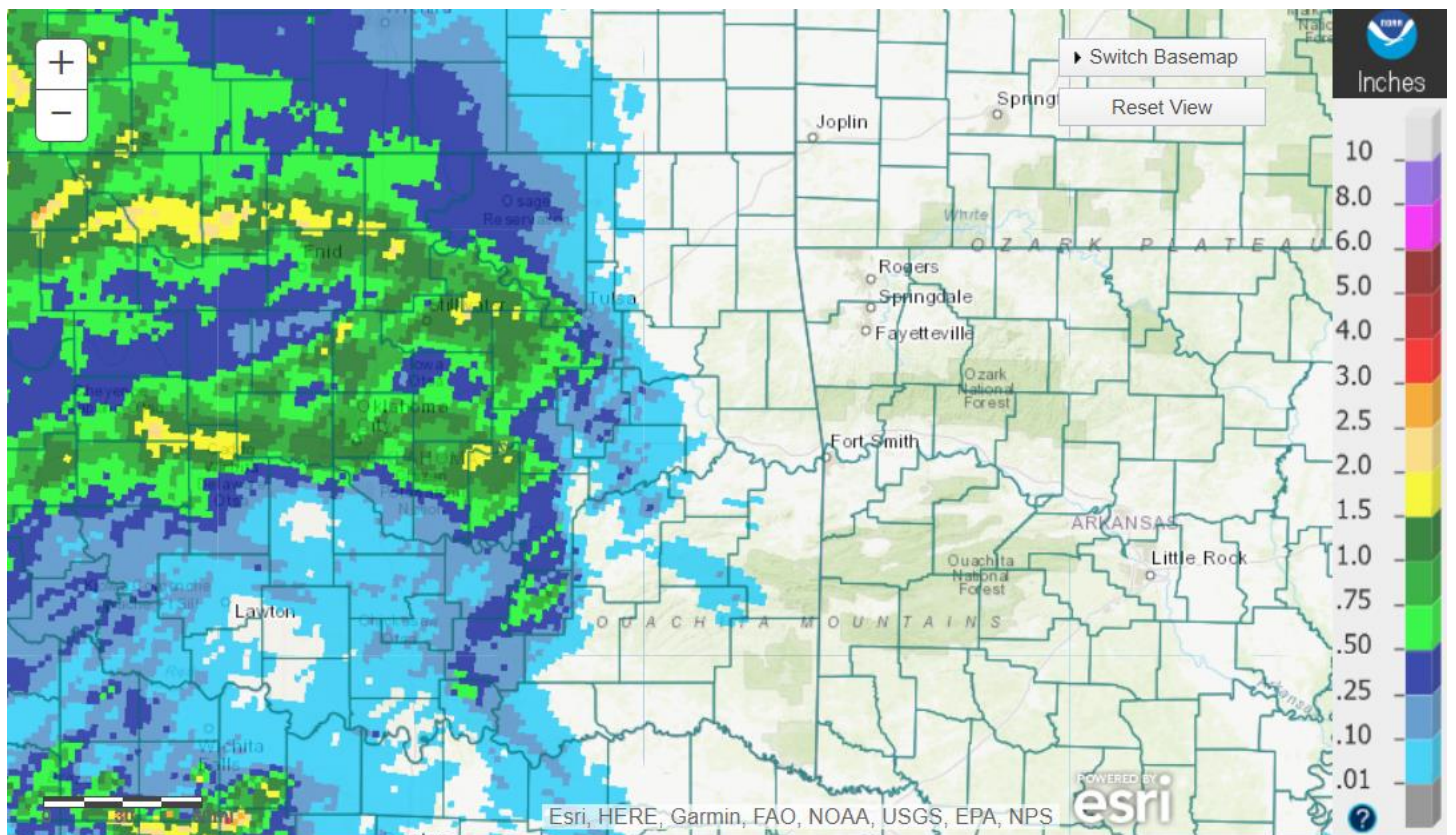


24-Hour Rainfall Accumulation (inches)

10:20 PM May 19, 2023 CDT

Created 10:24:16 PM May 19, 2023 CDT. © Copyright 2023

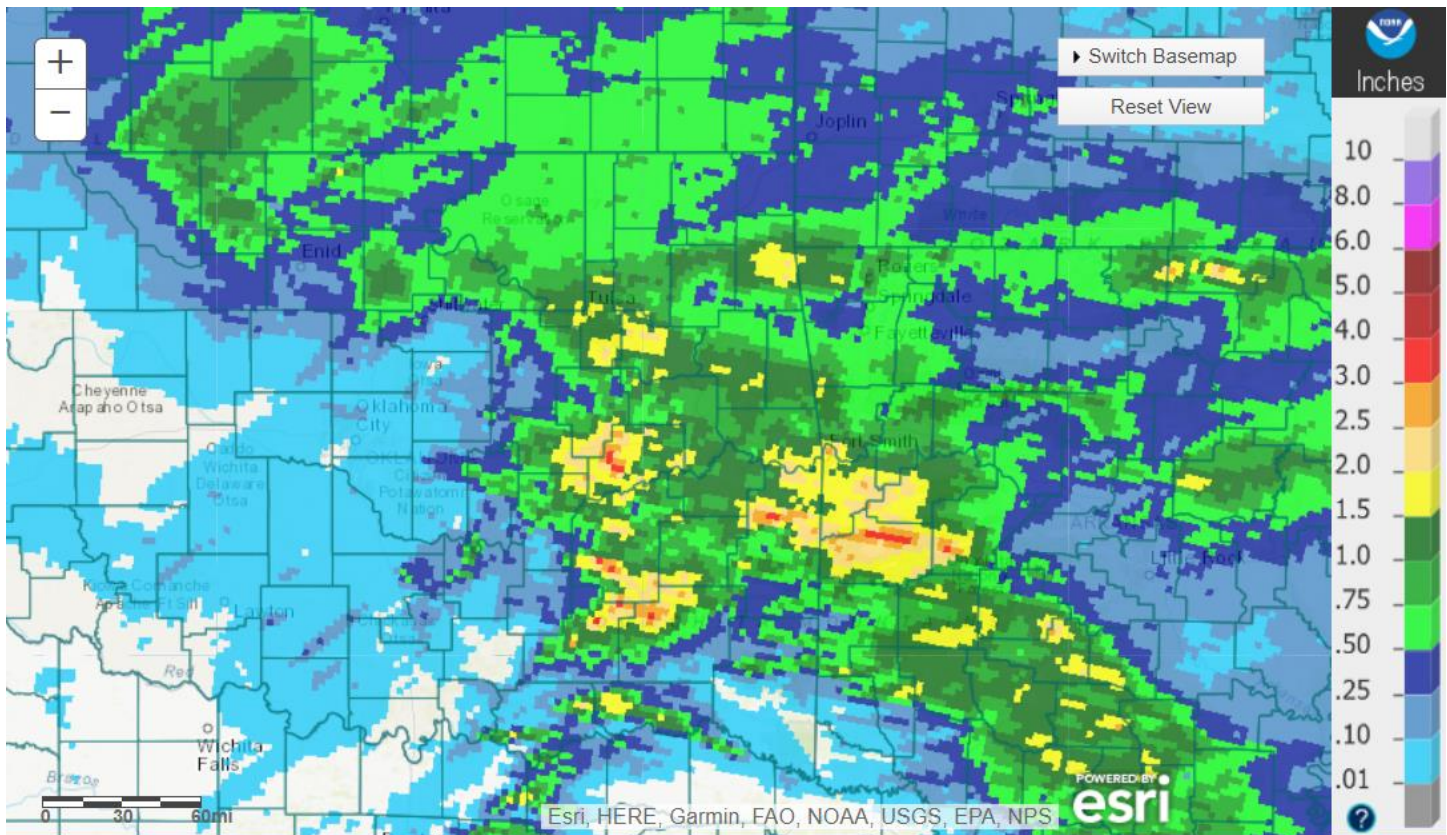
Fig. 13. OK Mesonet (values) and NWS RFC rainfall estimate (image) 24-hour rainfall ending at 10:20 pm CDT 05/18/2023.



Tulsa, OK: May 19, 2023 1-Day Observed Precipitation

Valid on: May 19, 2023 12:00 UTC

Fig. 14. 24-hour Estimated Observed Rainfall ending at 7am CDT 5/19/2023.



Tulsa, OK: May 20, 2023 1-Day Observed Precipitation
Valid on: May 20, 2023 12:00 UTC

Fig. 15. 24-hour Estimated Observed Rainfall ending at 7am CDT 5/20/2023.

During the early morning hours of the 19th, a cluster of storms moved into northeast OK from the west. By sunrise, these storms had developed into a line that stretched north to south from southeast KS to the Red River. This line of storms reached western AR at mid-morning and continued to move eastward through early afternoon. Heavy rain fell in a short period of time (Fig. 12). These storms left an outflow boundary across far southeast OK. With high CAPE and sufficient deep layer shear south of the outflow boundary, thunderstorms developed along this boundary in the afternoon. Additional scattered showers and thunderstorms reignited further north across eastern OK and northwest AR as a strong cold front moved south across the area during the afternoon and evening hours. Most of eastern OK and northwest AR received 0.50" to around 3" of rain (Figs. 13-15).

Written by:

Nicole McGavock
Service Hydrologist
WFO Tulsa

Products issued in May 2023:

- *CWYO2 became a daily river forecast point September 7, 2016
- *MLBA4 and OZGA4 transferred to NWS Tulsa HSA February 5, 2014
- *Mixed case River Flood products began July 31, 2013

- 1 Flash Flood Warnings (FFW)
- 2 Flash Flood Statements (FFS)
- 0 Flash/Areal Flood Watches (FFA) (13 Watch FFA CON/EXT/EXA/EXB/CAN)
- 10 Urban and Small Stream Advisories (FLS)
- 1 Areal Flood Warnings (FLW)

- 1 Areal Flood Statements (FLS)
- 0 River Flood Warnings (FLW) (includes category increases)
- 0 River Flood Statements (FLS)
- 0 River Flood Advisories (FLS) (0 Advisory FLS CON/EXT/CAN)
- 0 River Flood Watches (FFA) (0 Watch FFA CON/EXT/CAN)
- 0 River Statements (RVS)
- 0 Hydrologic Outlooks (ESF)
- 0 Drought Information Statements (DGT)

Preliminary Hydrographs:

None