

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)
		REPORT FOR: MONTH November YEAR 2022
MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS		SIGNATURE Steven F. Piltz (Meteorologist-in-Charge)
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		DATE December 12, 2022

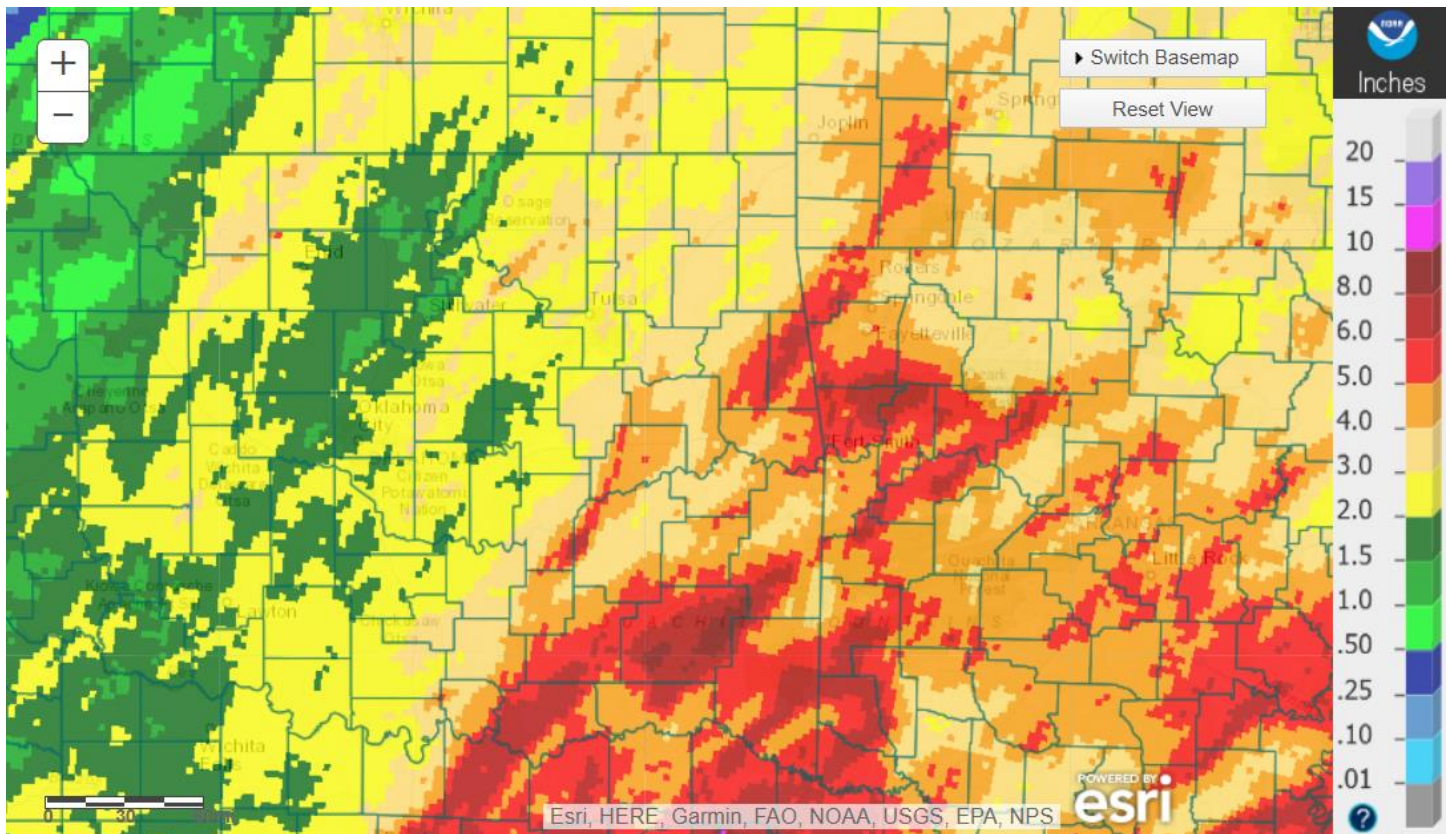
When no flooding occurs, include miscellaneous river conditions, such as significant rises, record low stages, ice conditions, snow cover, droughts, and hydrologic products issued (NWS Instruction 10-924)

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

There were a couple of snowfall events during November 2022, with temperatures generally near to below normal for the month. Most notable was the record number of tornadoes for November in the NWS Tulsa area. Normal precipitation for November ranges from 2.6" in Pawnee County to 4.4" in Haskell County. Normal precipitation for the Ozark region of northwest Arkansas averages 4.2". This report, past E-5 reports, and monthly hydrology and climatology summaries can be found at https://www.weather.gov/tsa/climo_summary_e5list.

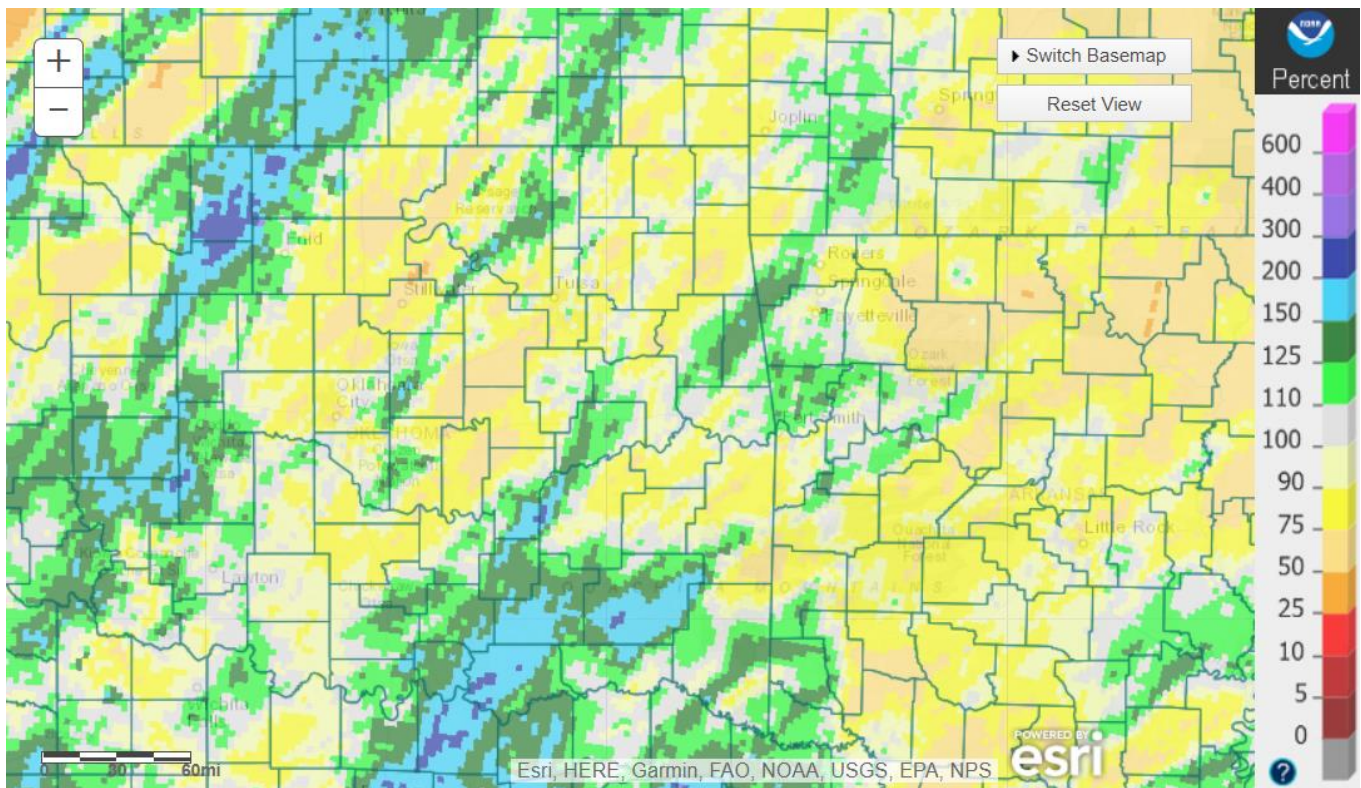
Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a), rainfall totals for November 2022 ranged from less than 1" to 10" across eastern OK and northwest AR, with much of the area receiving 2"-4". These rainfall totals correspond to around 50% to around 200% of the normal November rainfall (Fig. 1b).



Tulsa, OK: November, 2022 Monthly Observed Precipitation
 Valid on: December 01, 2022 12:00 UTC

Fig. 1a. Estimated Observed Rainfall for November 2022



Tulsa, OK: November, 2022 Monthly Percent of Normal Precipitation
Valid on: December 01, 2022 12:00 UTC

Fig. 1b. Estimated % of Normal Rainfall for November 2022

In Tulsa, OK, November 2022 ranked as the 41st coldest November (48.4°F; since records began in 1905), the 47th wettest November (2.80", tied 1984; since records began in 1888), and the 24th snowiest November (0.3", tied 1955; since records began in 1900). Fort Smith, AR had the 68th coldest November (50.9°F, tied 1941; since records began in 1882), the 35th wettest November (4.53", tied 1956; since records began in 1882), and the 18th snowiest November (Trace, tied with 18 other years; since records began in 1883). Fayetteville, AR had the 36th coldest (47.4°F), the 22nd wettest (4.71"), and the 6th snowiest (2.9") November since records began in 1949.

Some of the larger precipitation reports (in inches) for November 2022 included:

Cloudy, OK (meso)	7.49	Siloam Springs 1.8N, AR (coco)	6.76	Hugo, OK (meso)	6.52
Elkins 10.6SSE, AR (coco)	6.46	Kingston 2S, AR (coop)	6.44	Westville, OK (meso)	6.41
Mountainburg 2NE, AR (coop)	6.35	Winslow 7NE, AR (coop)	6.30	Hugo 1.9ENE, OK (coco)	6.17

Some of the lowest precipitation reports (in inches) for November 2022 included:

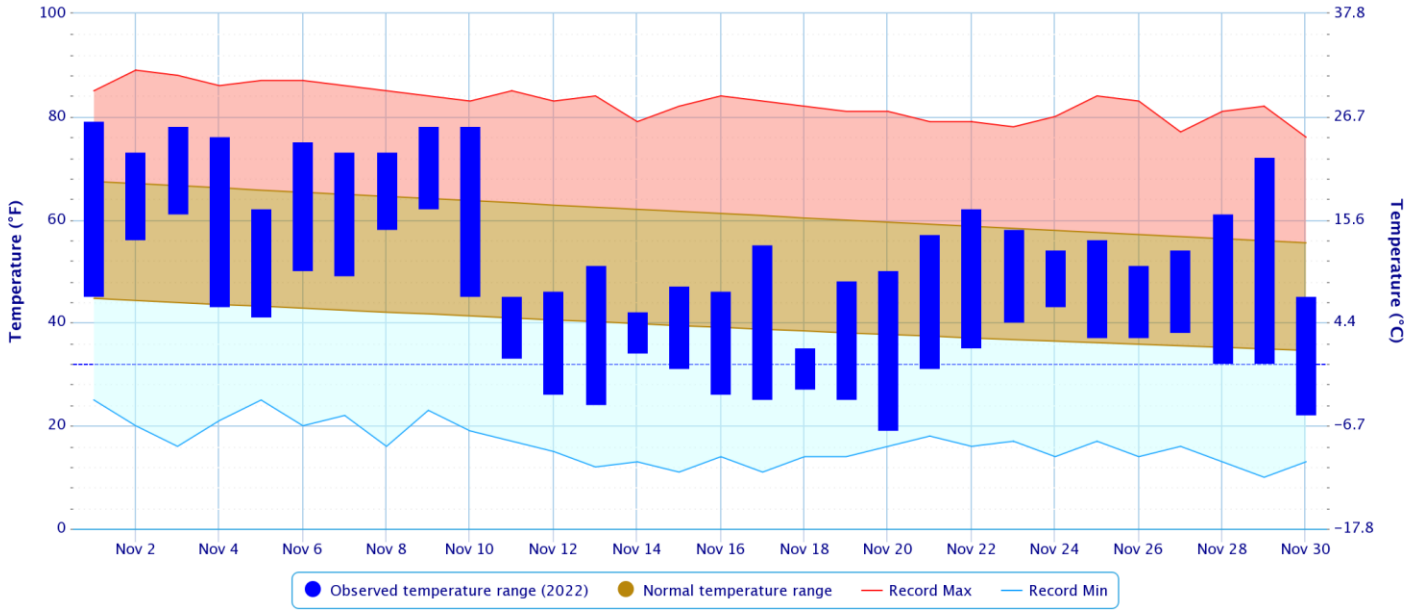
Burbank, OK (meso)	1.39	Kellyville 7.8S, OK (coco)	2.07	Bristow, OK (meso)	2.11
Spavinaw, OK (coop)	2.16	Pawnee, OK (meso)	2.20	Tulsa, OK (meso)	2.38
Oilton, OK (meso)	2.54	Jenks Riverside Arpt, OK (ASOS)	2.56	Tulsa 7.7SSE, OK (coco)	2.56

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

Rank since 1921	November 2022	Autumn (Sep 1 – Nov 30)	Water Year-to-Date (Oct 1 – Nov 30)	Last 120 Days (Aug 3 – Nov 30)	Last 180 Days (Jun 4 – Nov 30)	Year-to-Date (Jan 1 – Nov 30)	Last 365 Days (Dec 1, 2021 – Nov 30, 2022)
Northeast OK	34 th wettest	21 st driest	37 th driest	7th driest	7th driest	18 th driest	20 th driest
East Central OK	24 th wettest	41 st driest	32 nd wettest	36 th driest	34 th driest	49 th wettest	44 th wettest
Southeast OK	27 th wettest	49 th driest	22 nd wettest	50 th driest	29 th driest	33 rd driest	27 th driest
Statewide	35 th wettest	22 nd driest	40 th wettest	22 nd driest	10th driest	19 th driest	17 th driest

Daily Temperature Data – Tulsa Area, OK (ThreadEx)

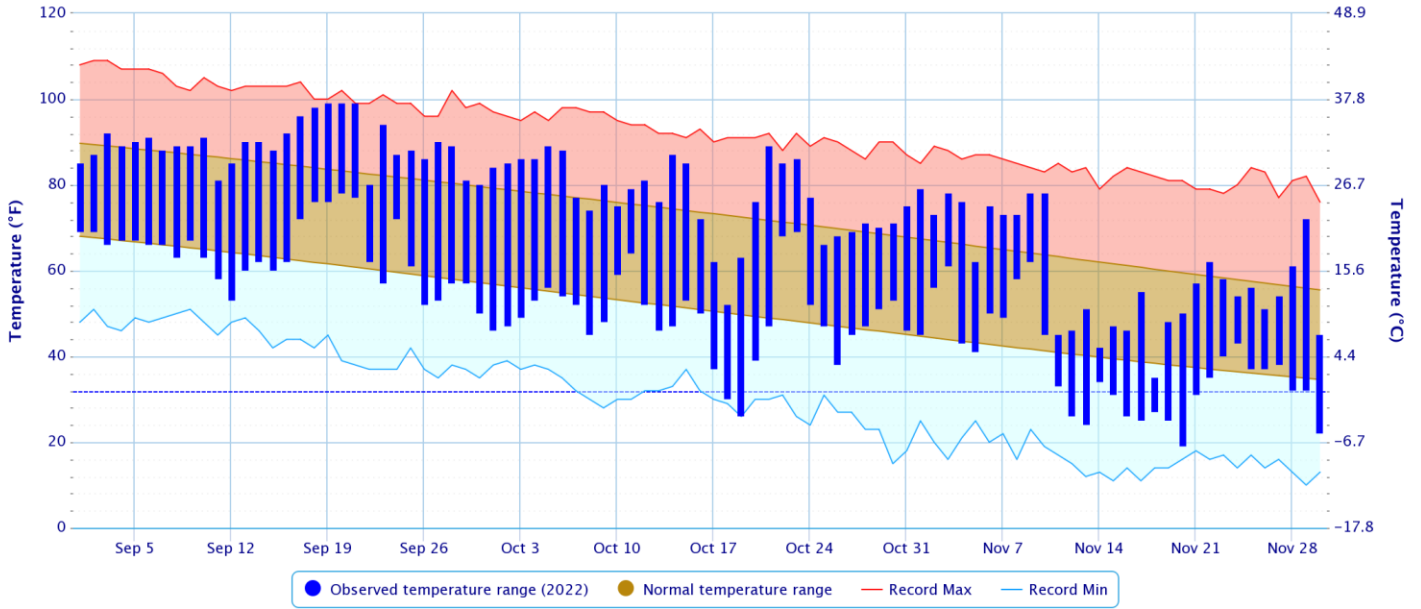
Period of Record – 1905-01-06 to 2022-12-07. Normals period: 1991-2020. Click and drag to zoom chart.



Powered by ACIS

Daily Temperature Data – Tulsa Area, OK (ThreadEx)

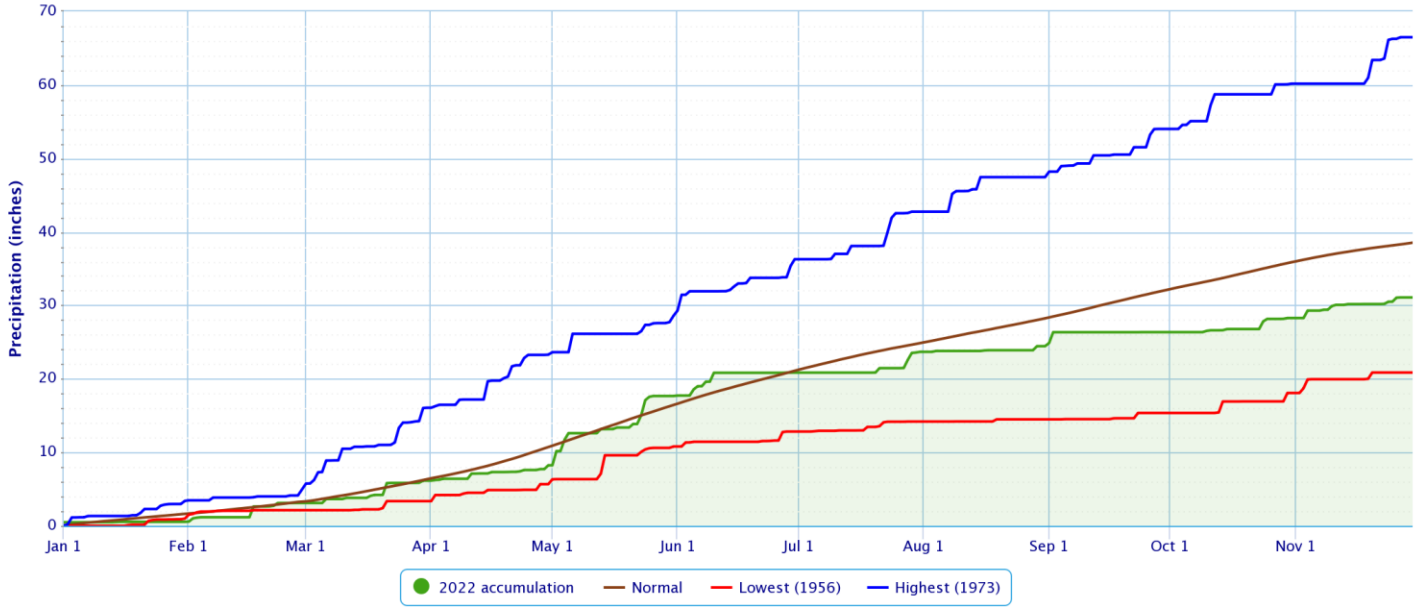
Period of Record – 1905-01-06 to 2022-12-07. Normals period: 1991-2020. Click and drag to zoom chart.



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Accumulated Precipitation – Tulsa Area, OK (ThreadEx)

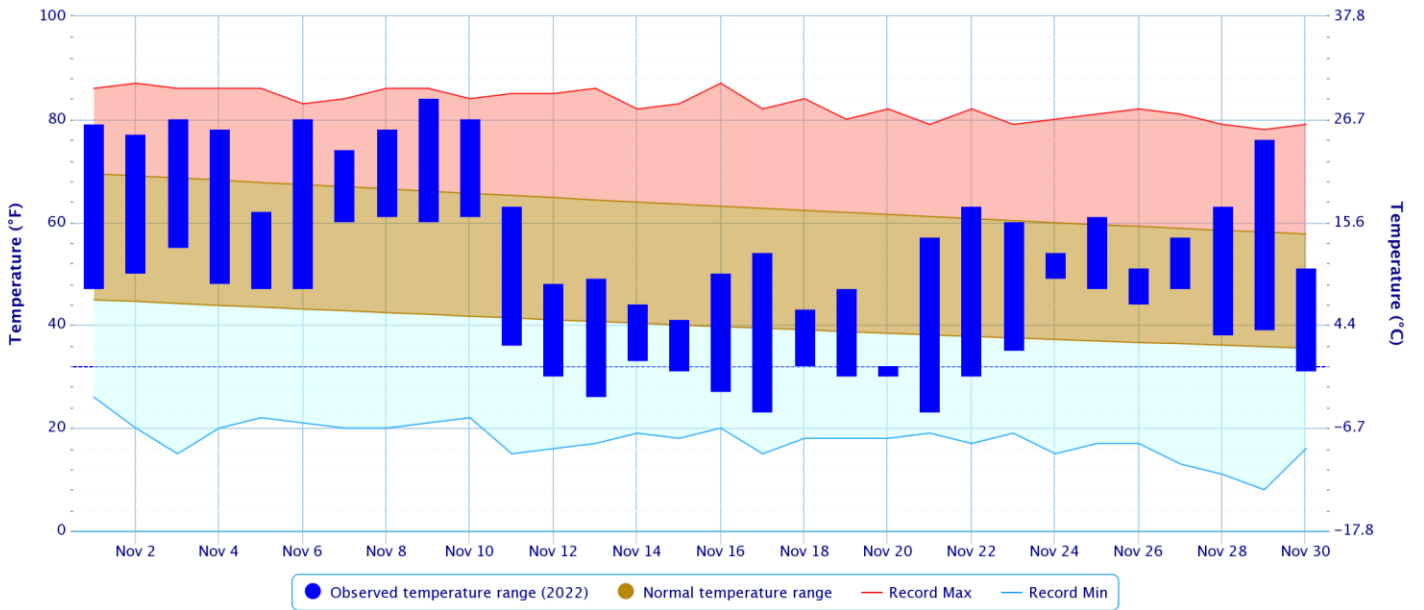
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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

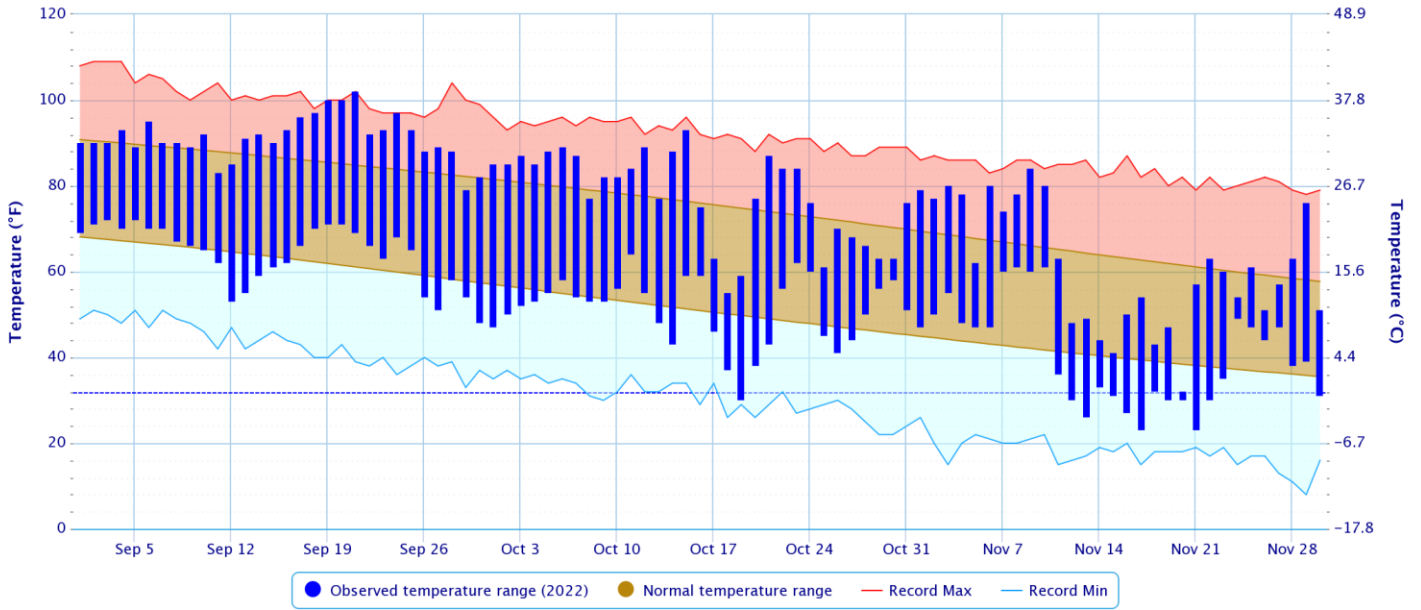
Period of Record – 1882-06-01 to 2022-12-07. Normals period: 1991-2020. Click and drag to zoom chart.



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

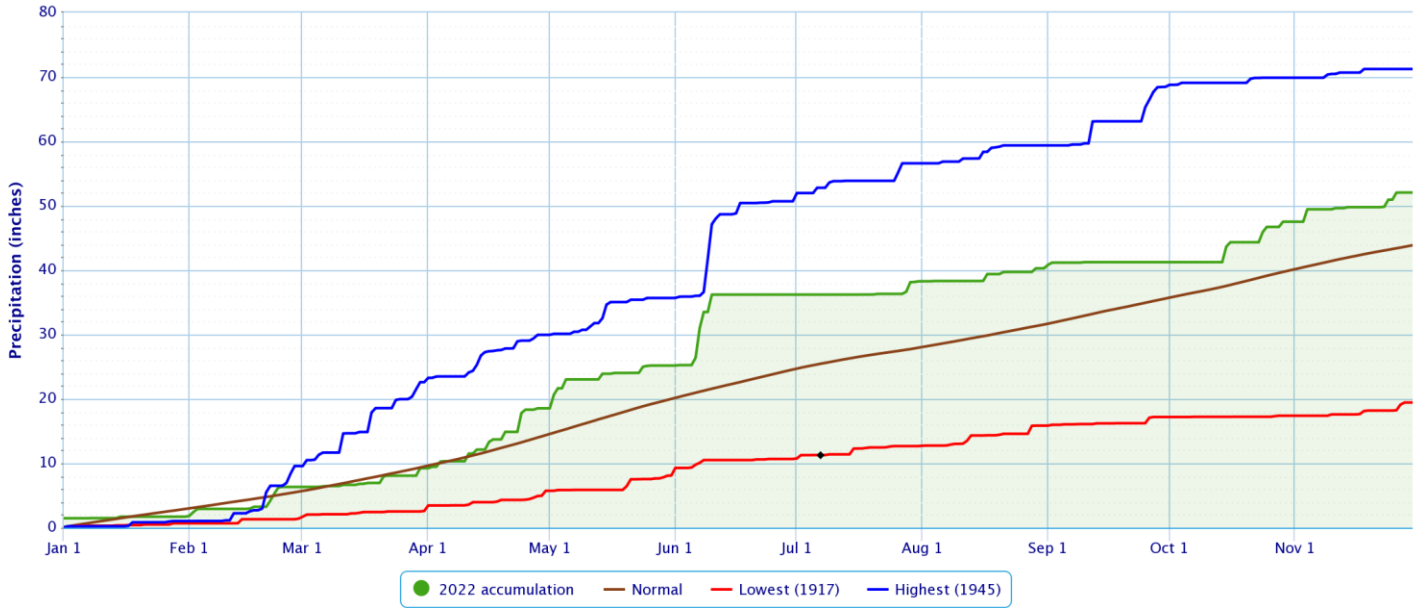
Period of Record – 1882-06-01 to 2022-12-07. Normals period: 1991-2020. Click and drag to zoom chart.



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Accumulated Precipitation – Fort Smith Area, AR (ThreadEx)

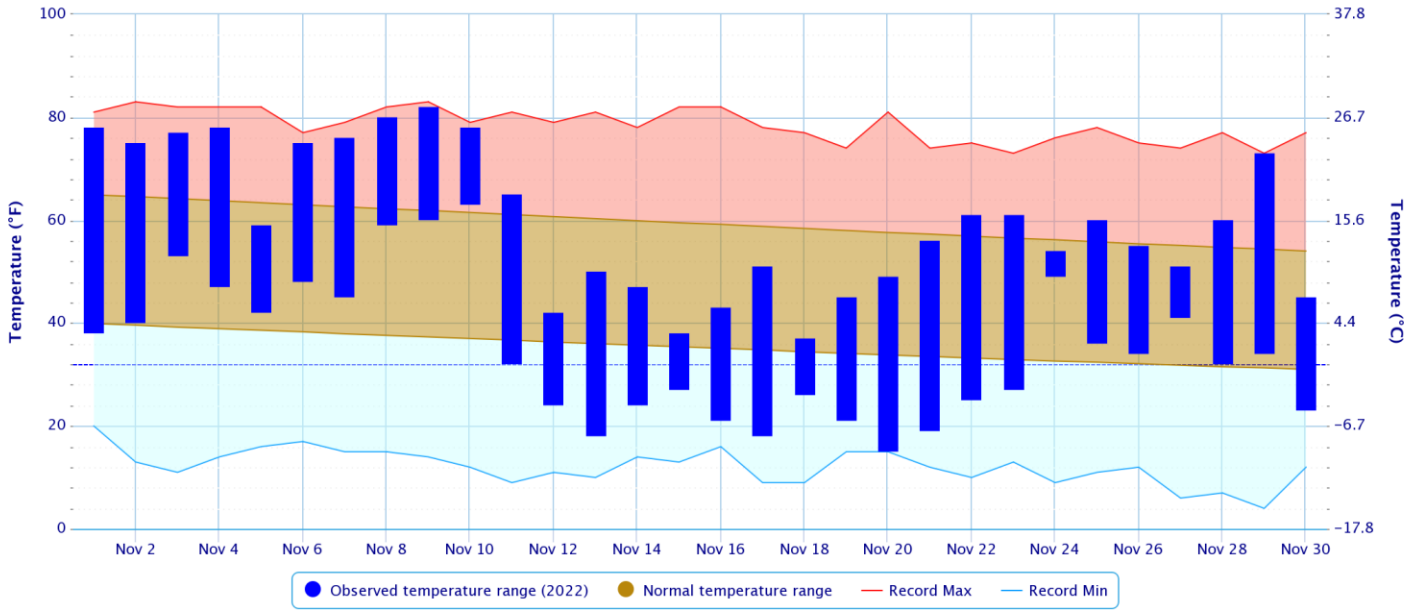
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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Daily Temperature Data – FAYETTEVILLE DRAKE FIELD, AR

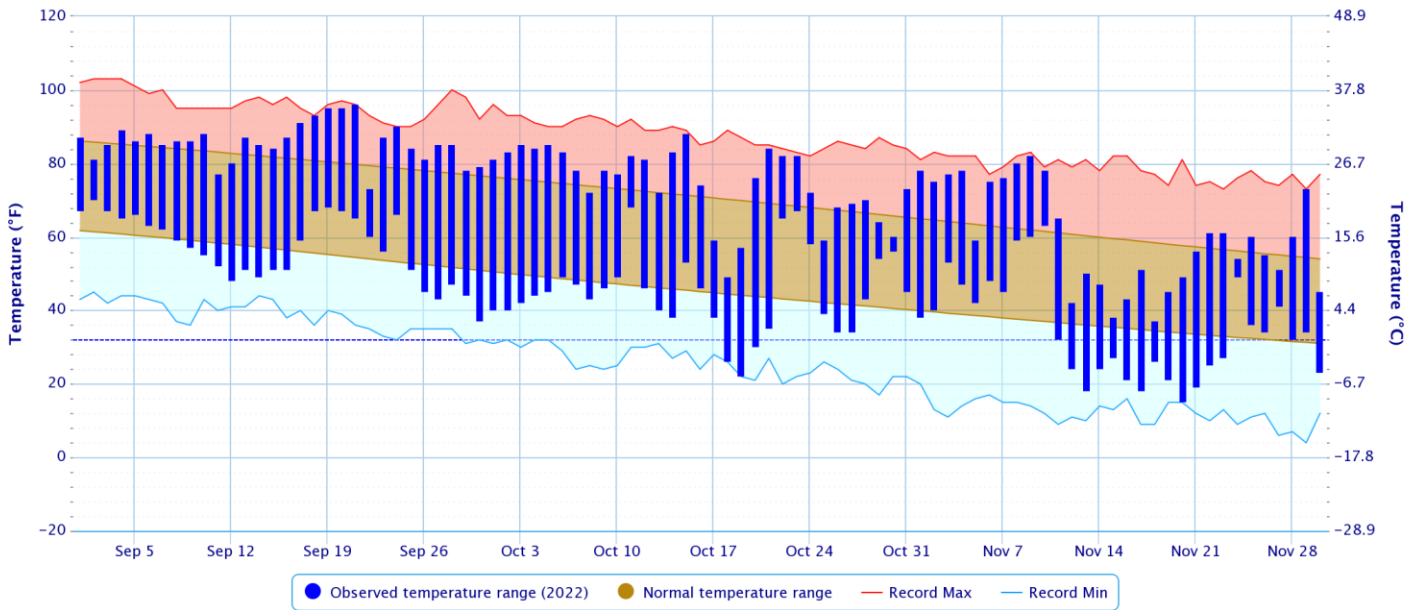
Period of Record – 1949-07-14 to 2022-12-07. Normals period: 1991-2020. Click and drag to zoom chart.



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Daily Temperature Data – FAYETTEVILLE DRAKE FIELD, AR

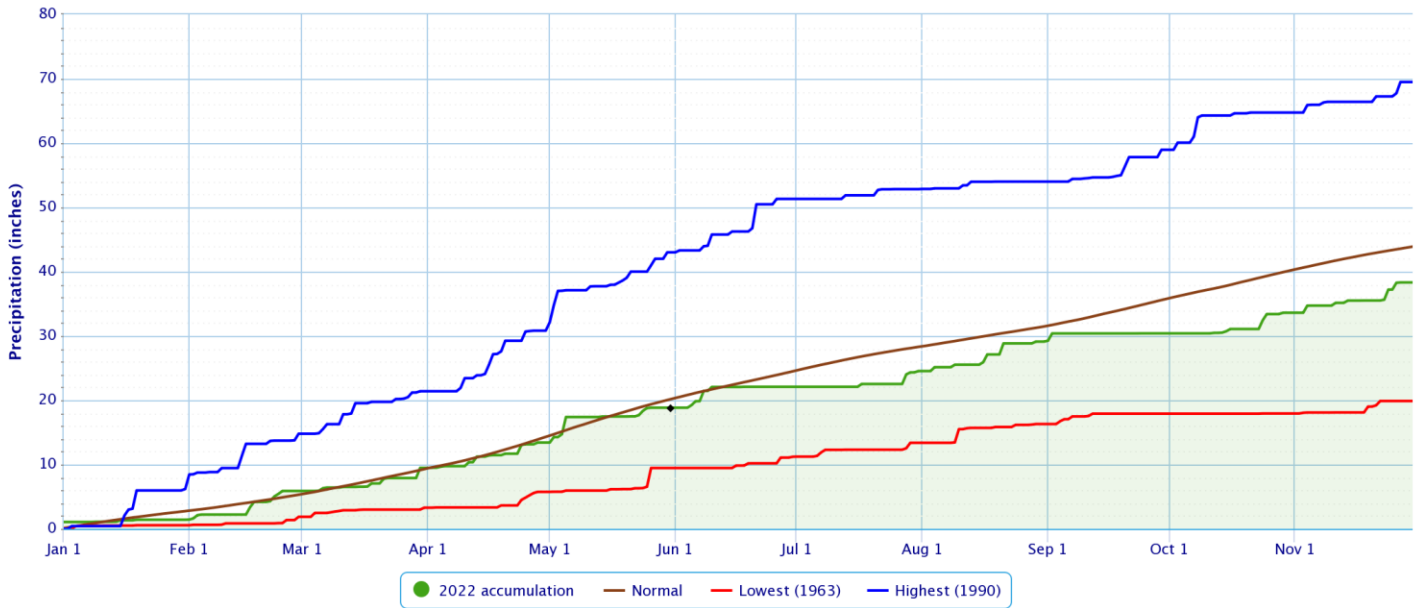
Period of Record – 1949-07-14 to 2022-12-07. Normals period: 1991-2020. Click and drag to zoom chart.



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Accumulated Precipitation – FAYETTEVILLE DRAKE FIELD, AR

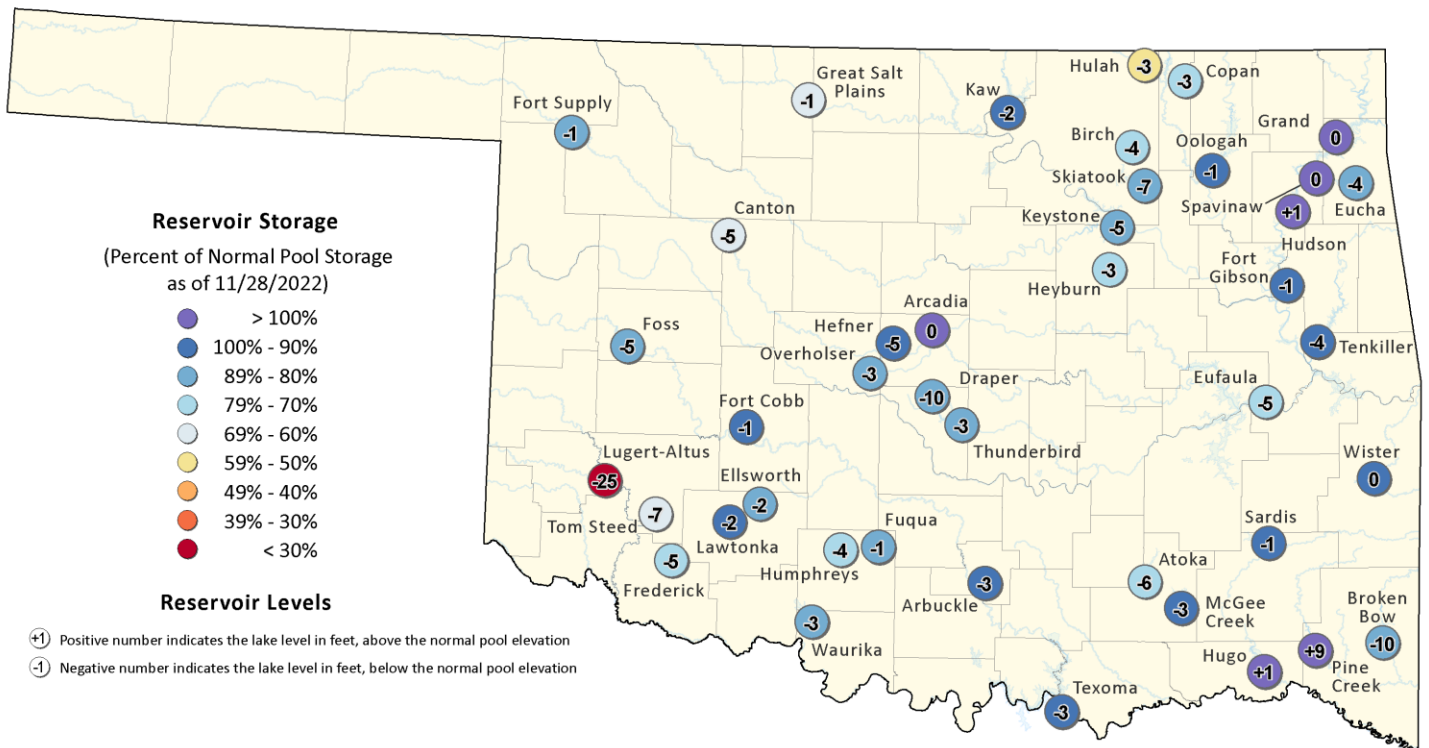
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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Reservoirs

Oklahoma Reservoir Levels and Storage as of 11/28/2022



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, most of the lakes in the HSA were below 3% of top of their conservation pools as of 12/01/2022: Heyburn Lake 49%, Hulah Lake 54%, Eufaula Lake 66%, Keystone Lake 67%, Copan Lake 69%, Birch Lake 74%, Skiatook Lake 80%, Beaver Lake 86%, Kaw Lake 91%, Tenkiller 92%, Oologah Lake 92%, Ft. Gibson Lake 93%, and Sardis Lake 94%. One lake was above 3% of the top of its conservation pool: Hudson Lake 4%.

Drought

According to the [U.S. Drought Monitor](#) (USDM) from November 29, 2022 (Figs. 2, 3), Exceptional (D4) Drought conditions were impacting portions of eastern Kay, Osage, Pawnee, Nowata, Craig, Ottawa, Rogers, Mayes, Tulsa, Wagoner, Cherokee, Okfuskee, Creek, Okmulgee, McIntosh, and Pittsburg Counties in eastern Oklahoma. Extreme (D3) Drought conditions were occurring in portions of Osage, Pawnee, Washington, Nowata, Craig, Ottawa, Delaware, Mayes, Rogers, Tulsa, Wagoner, Creek, Okfuskee, Okmulgee, McIntosh, Muskogee, Cherokee, Pittsburg, Haskell, and Latimer Counties in eastern Oklahoma. Severe (D2) Drought conditions exist in portions of Ottawa, Delaware, Cherokee, Muskogee, Haskell, Latimer, Pittsburg, Pushmataha, and Le Flore Counties in eastern Oklahoma. Moderate (D1) Drought conditions were present in portions of Cherokee, Delaware, Adair, Sequoyah, Haskell, Latimer, Pushmataha, and Le Flore Counties in eastern Oklahoma, and Carroll, Madison, and Sebastian Counties in northwest Arkansas. Abnormally Dry (D0) conditions were occurring in portions of Delaware, Cherokee, Adair, Sequoyah, Le Flore, Pushmataha, and Choctaw Counties in eastern Oklahoma, and Benton, Washington, Crawford, Sebastian, Franklin, Carroll, and Madison Counties in northwest Arkansas.

U.S. Drought Monitor Oklahoma

November 29, 2022
(Released Thursday, Dec. 1, 2022)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.03	99.97	91.21	85.98	64.01	19.77
Last Week 11-22-2022	0.00	100.00	97.68	87.88	64.46	19.77
3 Months Ago 08-30-2022	0.02	99.98	98.98	88.22	47.13	2.19
Start of Calendar Year 01-04-2022	5.02	94.98	88.14	72.26	40.44	0.00
Start of Water Year 09-27-2022	0.00	100.00	99.88	94.44	64.44	17.25
One Year Ago 11-30-2021	13.32	86.68	60.71	15.92	2.23	0.00

Intensity

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate 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:

David Simeral
Western Regional Climate Center



droughtmonitor.unl.edu

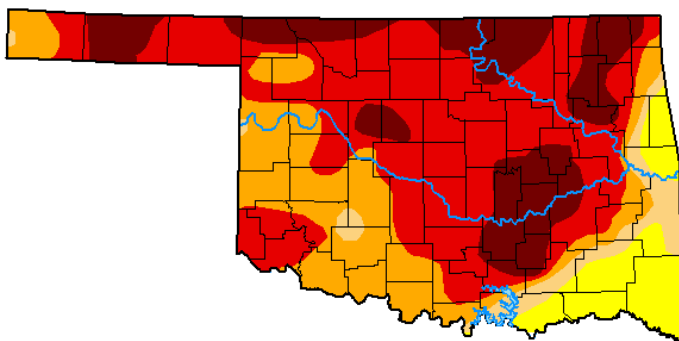
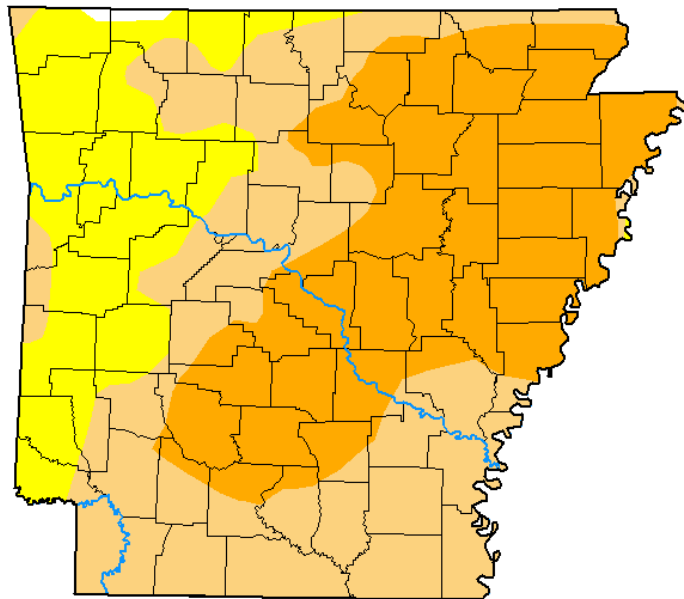


Fig. 2. Drought Monitor for Oklahoma

U.S. Drought Monitor Arkansas

November 29, 2022
(Released Thursday, Dec. 1, 2022)
Valid 7 a.m. EST



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.29	99.71	78.64	40.32	0.00	0.00
Last Week 11-22-2022	0.00	100.00	88.07	40.36	0.00	0.00
3 Months Ago 08-30-2022	24.29	75.71	58.13	28.33	0.01	0.00
Start of Calendar Year 01-04-2022	39.91	60.09	28.99	14.24	0.41	0.00
Start of Water Year 09-27-2022	4.99	95.01	69.68	39.30	2.96	0.00
One Year Ago 11-30-2021	9.62	90.38	41.41	7.18	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>

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David Simeral
Western Regional Climate Center



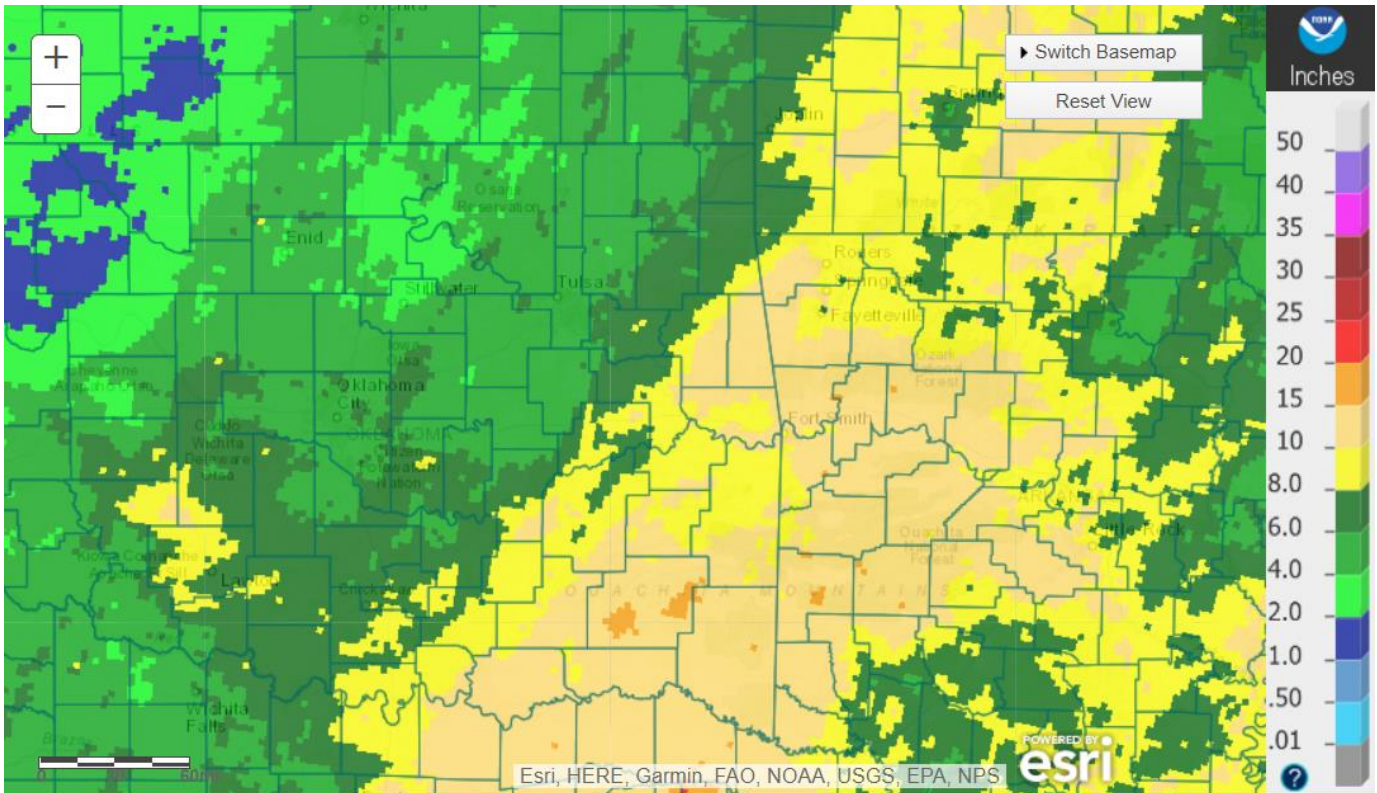
droughtmonitor.unl.edu

Fig. 3. Drought Monitor for Arkansas

Autumn (September – October – November) Summary

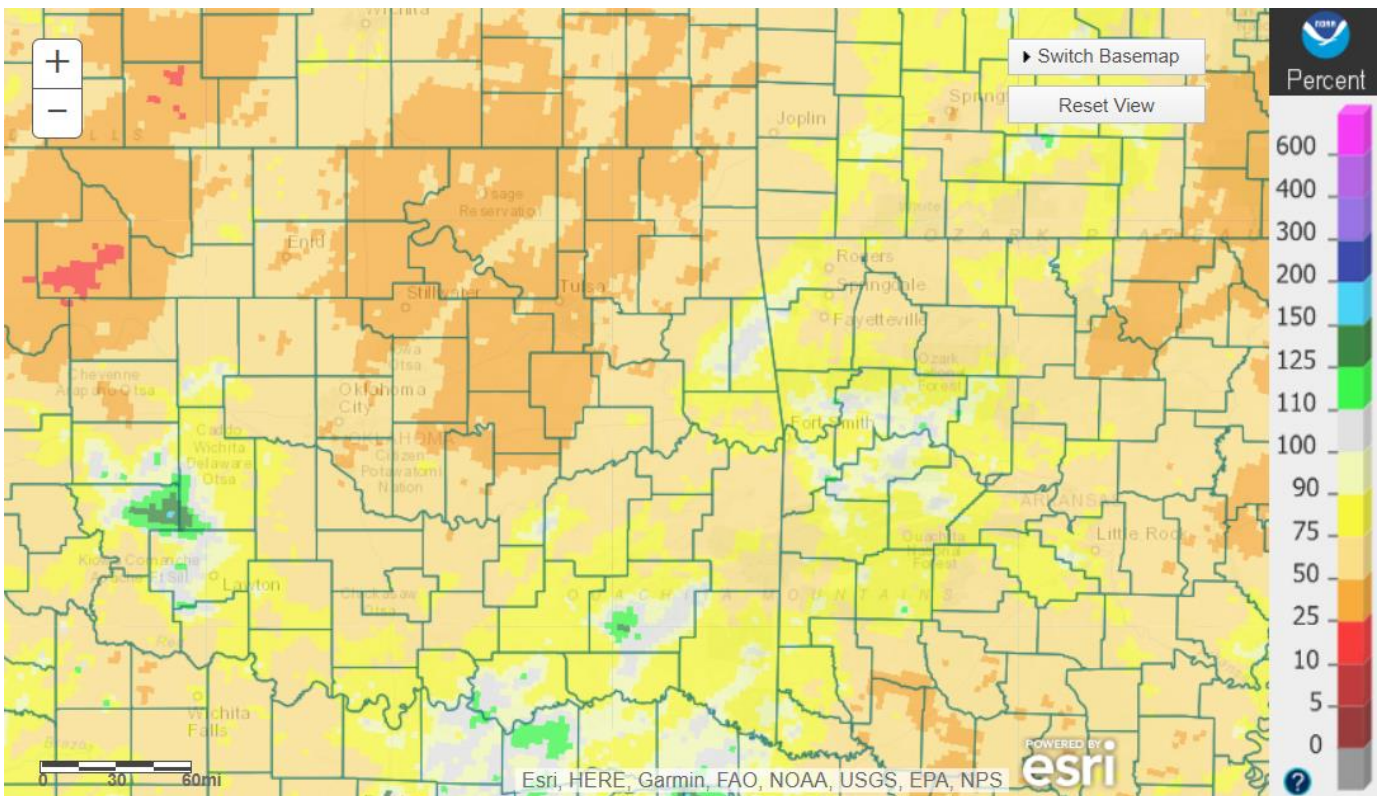
Using the radar-derived estimated observed precipitation from the RFCs (Fig. 4a), rainfall totals for Autumn 2022 ranged from 2” to around 15” from northwest to southeast across eastern OK and northwest AR, with much of the area receiving 4”-10”. These rainfall totals correspond to 25% to 90% for nearly all of eastern OK and northwest AR (Fig. 4b).

In Tulsa, OK, Autumn 2022 ranked as the 46th warmest Autumn (62.7°F, tied 1971, 1944, 1941; since records began in 1905) and the 38th driest Autumn (6.63”; since records began in 1888). Fort Smith, AR had the 37th warmest Autumn (64.2°F; since records began in 1882) and the 49th wettest Autumn (11.77”; since records began in 1882). Fayetteville, AR had the 22nd warmest (59.4°F, tied 1956) and the 24th driest (9.20”) Autumn since records began in 1949.



Tulsa, OK: Last 90-Day Observed Precipitation
Valid on: December 01, 2022 12:00 UTC

Fig. 4a. Estimated Observed Rainfall for Autumn 2022



Tulsa, OK: Last 90-Day Percent of Normal Precipitation
Valid on: December 01, 2022 12:00 UTC

Fig. 4b. Estimated % of Normal Rainfall for Autumn 2022

Outlooks

The [Climate Prediction Center](#) (CPC) outlook for December 2022 (issued November 30, 2022) indicates an equal chance for above, near, and below normal temperatures and precipitation for all of eastern OK and northwest AR. This outlook was largely based on dynamical model output and La Niña, Arctic Oscillation (AO), North Atlantic Oscillation (NAO), and Madden-Julian Oscillation (MJO) influences. A negative AO is expected to bring below normal temperatures to the northern U.S., and there is uncertainty in how far south this cold air will go. If a strongly negative AO occurs, it would overwhelm the typical warmer than normal pattern from La Niña in the southern plains for the second half of the month.

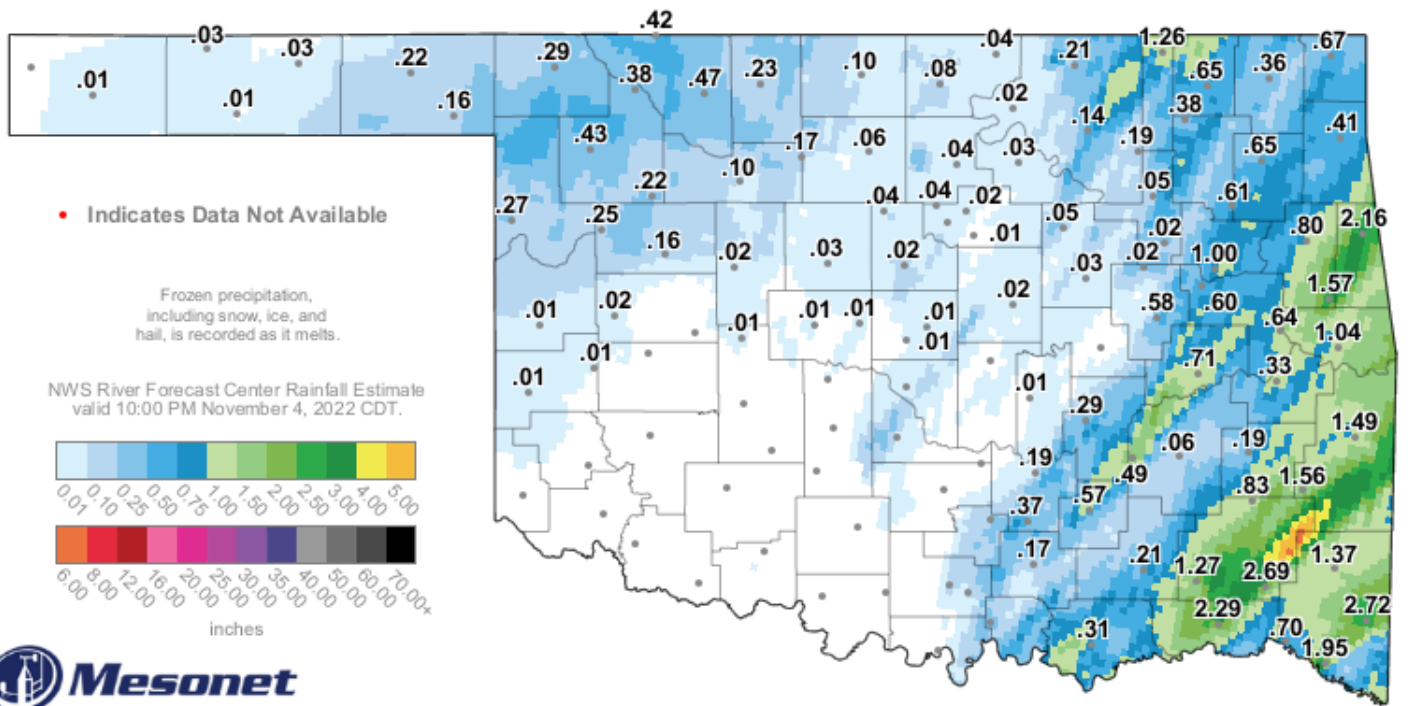
For the 3-month period December-January-February 2022-23, CPC is forecasting an equal chance for above, near, and below normal temperatures across all of eastern OK and northwest AR. This outlook also indicates an enhanced chance for below median precipitation from north central to southeast OK, with equal chances for above, near, and below median precipitation elsewhere across northeast OK and northwest AR (outlook issued November 17, 2022). This outlook is based on long-term trends, La Niña impacts, and incorporates both statistical and dynamical forecast tools. According to CPC, the combined effect of the ocean-atmosphere system remains consistent with La Niña conditions. La Niña conditions are expected to continue through winter 2022-23 (76% chance), decreasing to a 57% chance of ENSO-neutral by early spring. CPC continues the La Niña Advisory.

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

Severe thunderstorms moved through eastern OK and northwest AR on the afternoon and evening of the 4th. The atmosphere became moderately unstable ahead of a cold front approaching from the north and dry line approaching from the west. Deep-layer and low-level wind shear increased during the afternoon and evening across the area and became very strong by early evening. The combination of moderately strong instability and strong to very strong wind shear resulted in some supercell thunderstorm structures, as well as eventually a severe squall line that moved through the region. Eleven tornadoes associated with these storms occurred within the NWS Tulsa area (see <https://arcg.is/1eT4580> for details). This set a new record number of tornadoes for November (previous record was 7 tornadoes in Nov. 1983). Most of eastern OK and northwest AR received rain from these storms before they shifted east of the area by late evening. Rainfall totals ranged from around 0.10" to around 5", with several corridors of 1.5"-4" (Figs. 5-7). Sadly, a 43-year old man and his 6-year old passenger drowned when he attempted to drive his SUV across a low-water crossing with water flowing over it near Stilwell, OK. His 14-year old male passenger and 9-year old female passenger survived. While localized flash flooding occurred, ongoing drought precluded any mainstem river flooding.

Showers and thunderstorms developed along a cold front from north central into northeast OK during the late afternoon hours of the 10th, affecting much of northeast OK along and north of I-44 through the evening hours. By late evening, more convection developed further south along the front in eastern OK. This activity shifted east, entering northwest AR soon after midnight. Post-frontal scattered showers and isolated thunderstorms continued through the overnight hours across eastern OK and northwest AR, before ending from west to east by mid-morning on the 11th. Rainfall totals were around 0.25" to around 2.5", with the highest totals occurring in a portion of Pawnee and Osage Counties (Fig. 8). Additional scattered showers redeveloped across southeast OK and west central AR during the afternoon in response to the approach of a secondary upper-level wave. This activity shifted east through the evening hours, coming to an end around midnight. The rainfall totals from 6am through midnight ranged from a few hundredths of an inch to near 1" (Fig. 9).

Around noon on the 14th, rain began to spread into southeast OK as a compact upper-level low ejected into OK. Strong forcing aloft coupled with wet-bulb affects supported a switchover to a rain/snow mix or all snow as the heavier precipitation spread into southeast OK during mid-afternoon and into northwest AR by late afternoon. The dry low-levels and lighter precipitation limited the amounts further north across OK. The precipitation quickly moved off to the northeast, coming to an end by late evening. Snowfall totals ranged from flurries to around 4" in the higher terrain areas (Fig. 11), while rainfall/liquid equivalent totals were around 0.10" to 0.75" (Fig. 10).

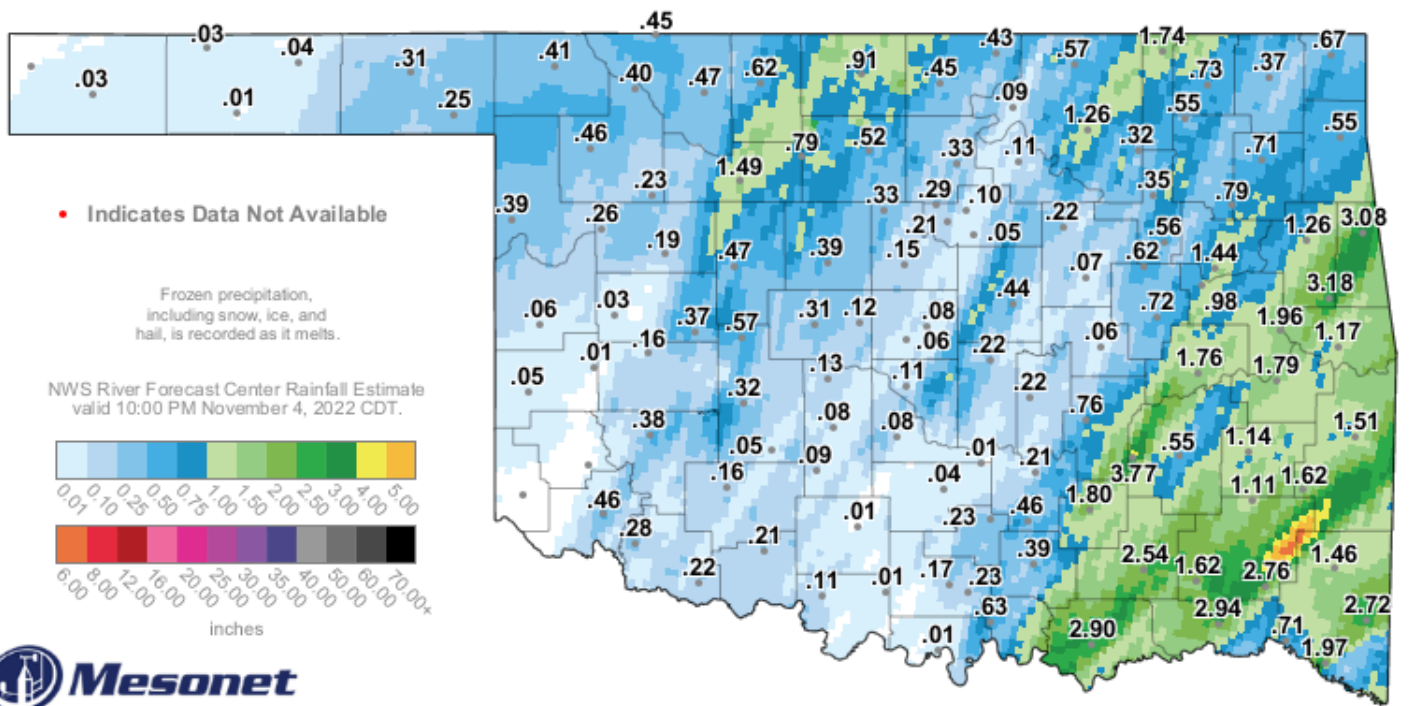


6-Hour Rainfall Accumulation (inches)

10:45 PM November 4, 2022 CDT

Created 10:49:51 PM November 4, 2022 CDT. © Copyright 2022

Fig. 5. OK Mesonet (values) and NWS RFC rainfall estimate (image) 6-hour rainfall ending at 10:45 pm CDT 11/04/2022.

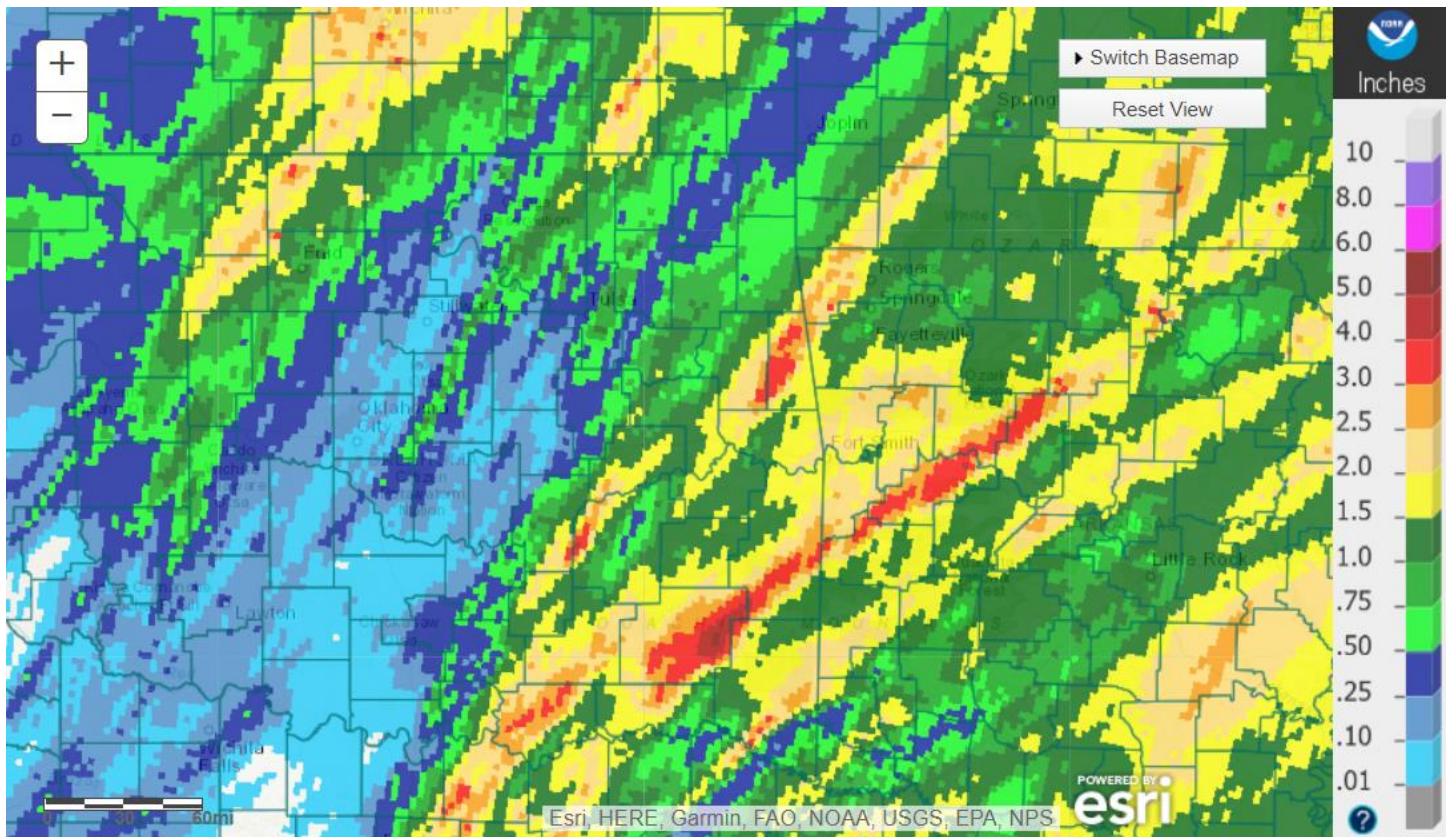


12-Hour Rainfall Accumulation (inches)

10:45 PM November 4, 2022 CDT

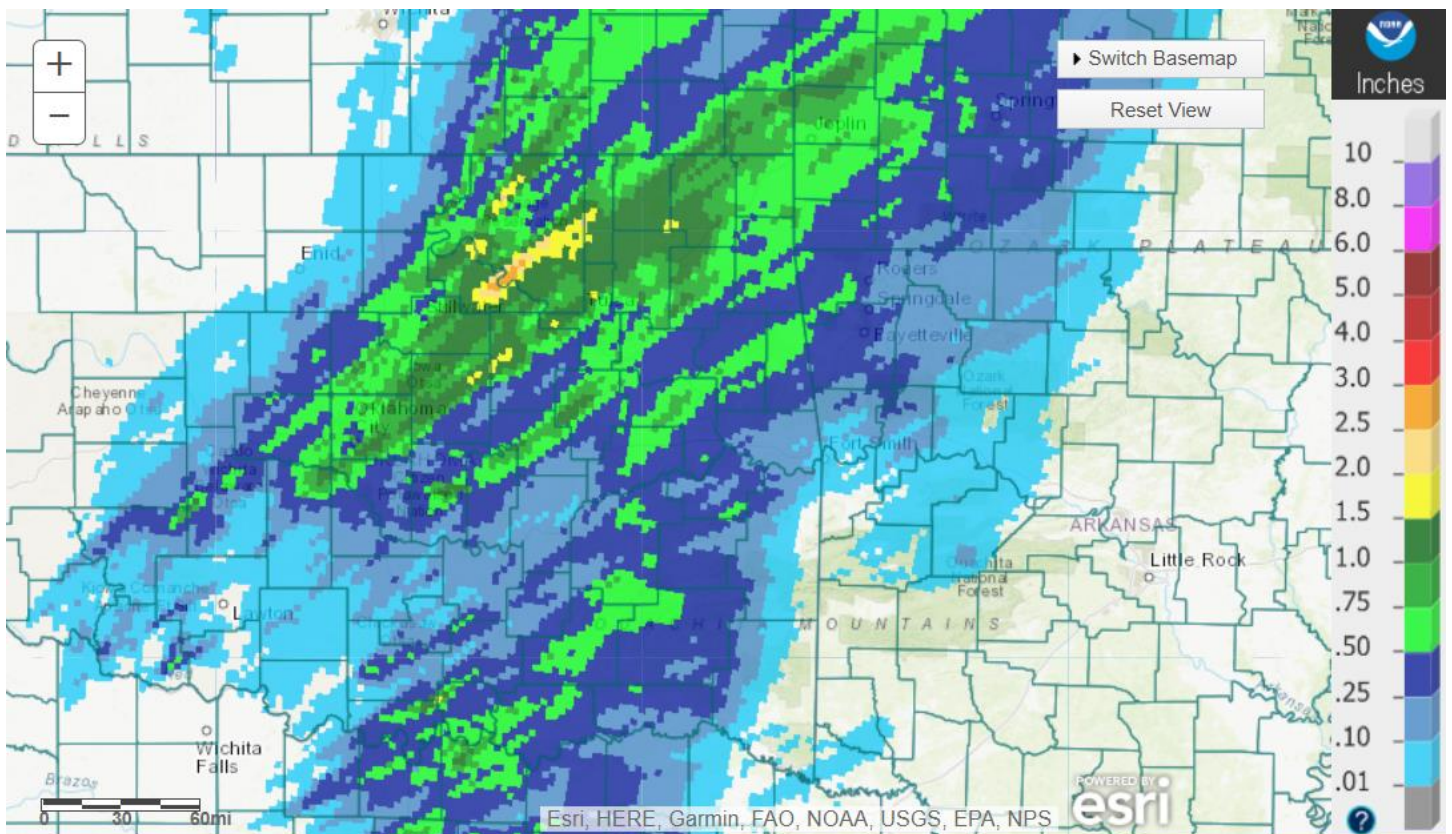
Created 10:49:51 PM November 4, 2022 CDT. © Copyright 2022

Fig. 6. OK Mesonet (values) and NWS RFC rainfall estimate (image) 12-hour rainfall ending at 10:45 pm CDT 11/04/2022.



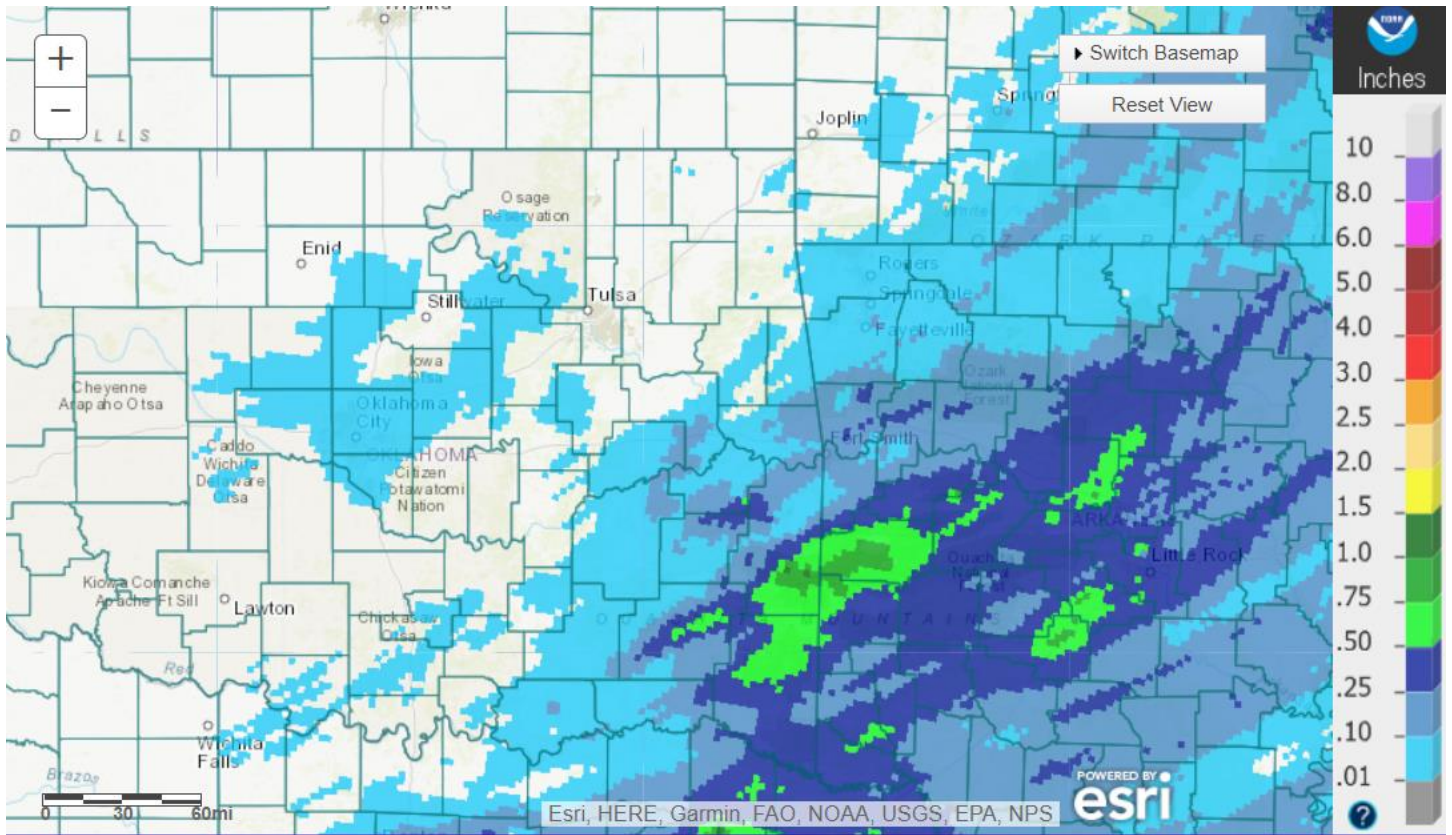
Tulsa, OK: November 05, 2022 1-Day Observed Precipitation
 Valid on: November 05, 2022 12:00 UTC

Fig. 7. 24-hour Estimated Observed Rainfall ending at 7am CDT 11/05/2022.



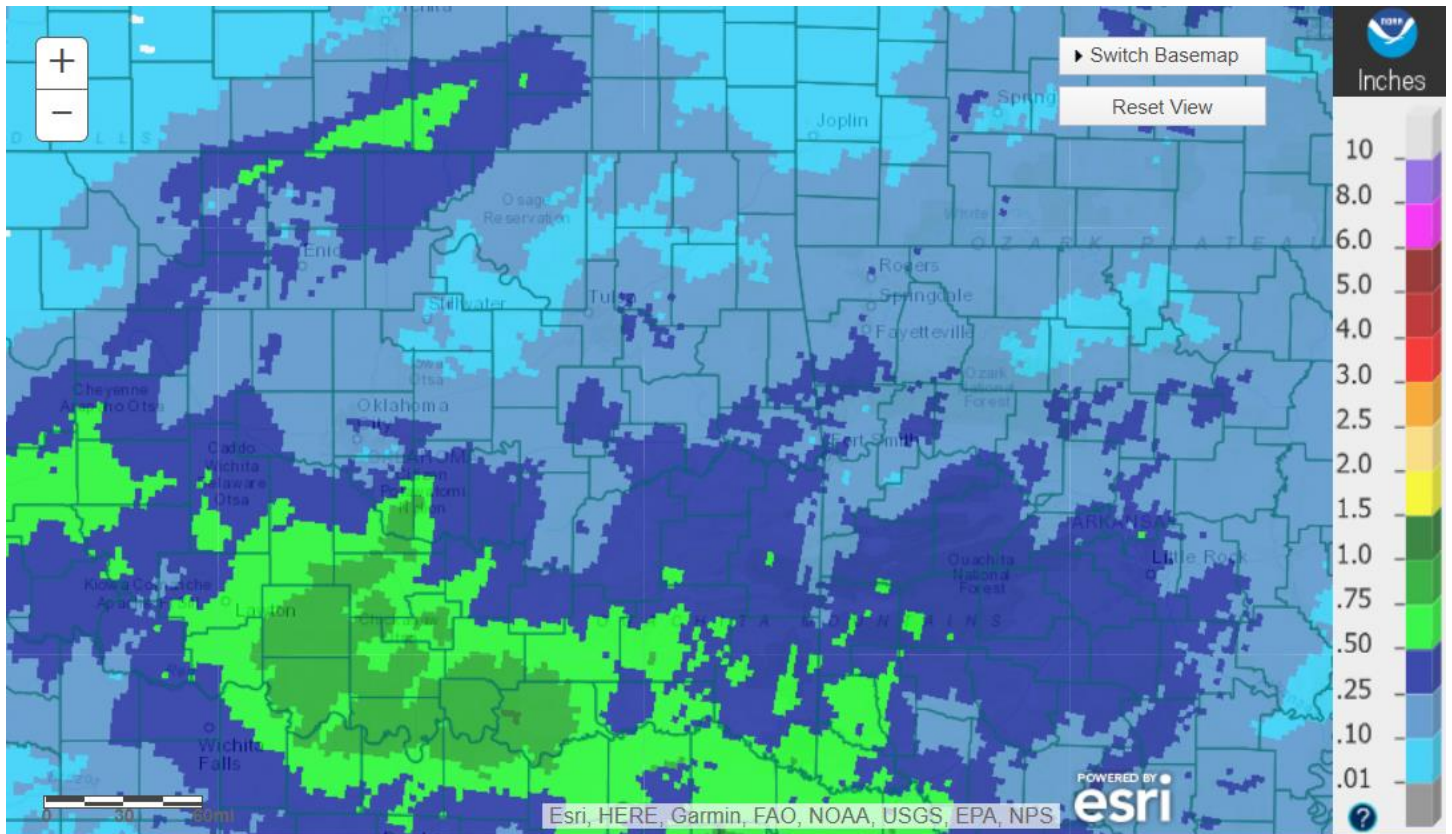
Tulsa, OK: November 11, 2022 1-Day Observed Precipitation
 Valid on: November 11, 2022 12:00 UTC

Fig. 8. 24-hour Estimated Observed Rainfall ending at 6am CST 11/11/2022.



Tulsa, OK: November 12, 2022 1-Day Observed Precipitation
Valid on: November 12, 2022 12:00 UTC

Fig. 9. 24-hour Estimated Observed Rainfall ending at 6am CST 11/12/2022.



Tulsa, OK: November 15, 2022 1-Day Observed Precipitation
Valid on: November 15, 2022 12:00 UTC

Fig. 10. 24-hour Estimated Observed Rainfall ending at 6am CST 11/15/2022.

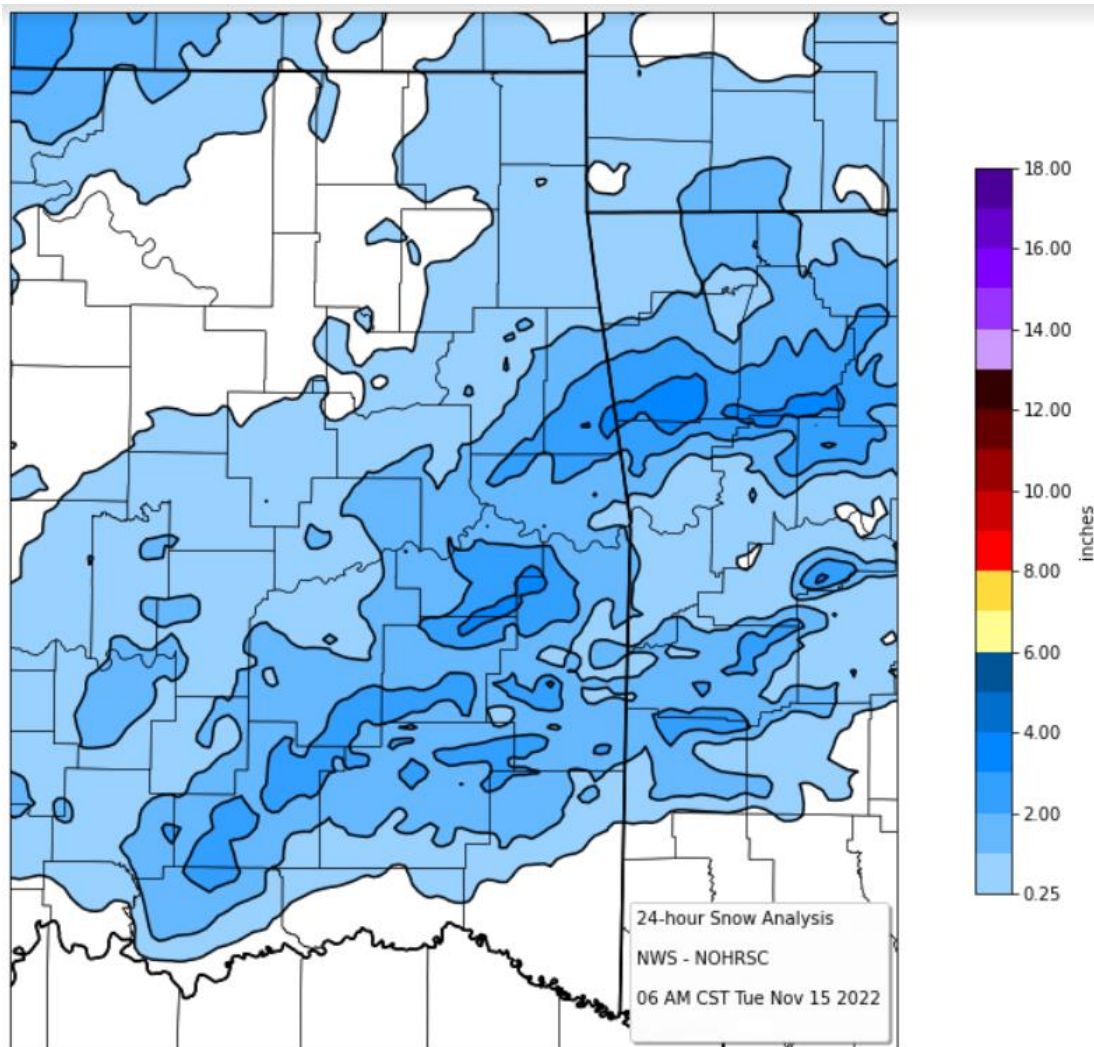


Fig. 11. 24-hour Estimated Snowfall Analysis at 6 am CST 11/15/2022.

A cold front dropped south across the region during the evening of the 17th and moved south of the Red River by sunrise of the 18th. There was enough moisture return, combined with low-level frontogenetic forcing and cold temperatures behind the front, to produce some light snow across northeast OK and northwest AR. While the liquid equivalent totals were less than a tenth of an inch, snowfall totals ranged from a dusting to around 1" (Fig. 12).

Ahead of a storm system to the west, upper-level divergence increased over the region. Along with the low-level jet, this allowed showers and isolated thunderstorms to develop across eastern OK and northwest AR south of I-44 during the late evening hours of the 23rd, getting the Thanksgiving holiday off to a soggy start. Widespread rain continued along and south of I-44 through the overnight hours and into Thanksgiving morning (24th). The rain then tapered off from west to east, ending at mid-morning. Rainfall totals were around 0.50" to 2" along and southeast of I-44 (Fig. 13).

The aforementioned storm system was centered over far southwest TX early on the 26th, with an expansive precipitation shield expanding north and west from it across TX. This widespread rainfall began to move into eastern OK around sunrise on the 26th and continued to spread to the northeast through the day as the upper-level low also moved northeast into the ArkLaTex area. The activity exited the area from southwest to northeast by mid-evening. A few additional wrap-around light showers affected locations near the KS and MO borders overnight. All of eastern OK and northwest AR received rainfall from this system, with totals around 0.50" to 2.5" (Fig. 14). For the entire holiday weekend storm system, rainfall totals ranged from 0.50" to 1" north of I-44, and 1" to 4" south of I-44 (Fig. 15).

Estimated Snow Accumulation

Friday Morning

Weather Forecast Office
Tulsa, OK
Issued Nov 18, 2022 2:37 PM CST

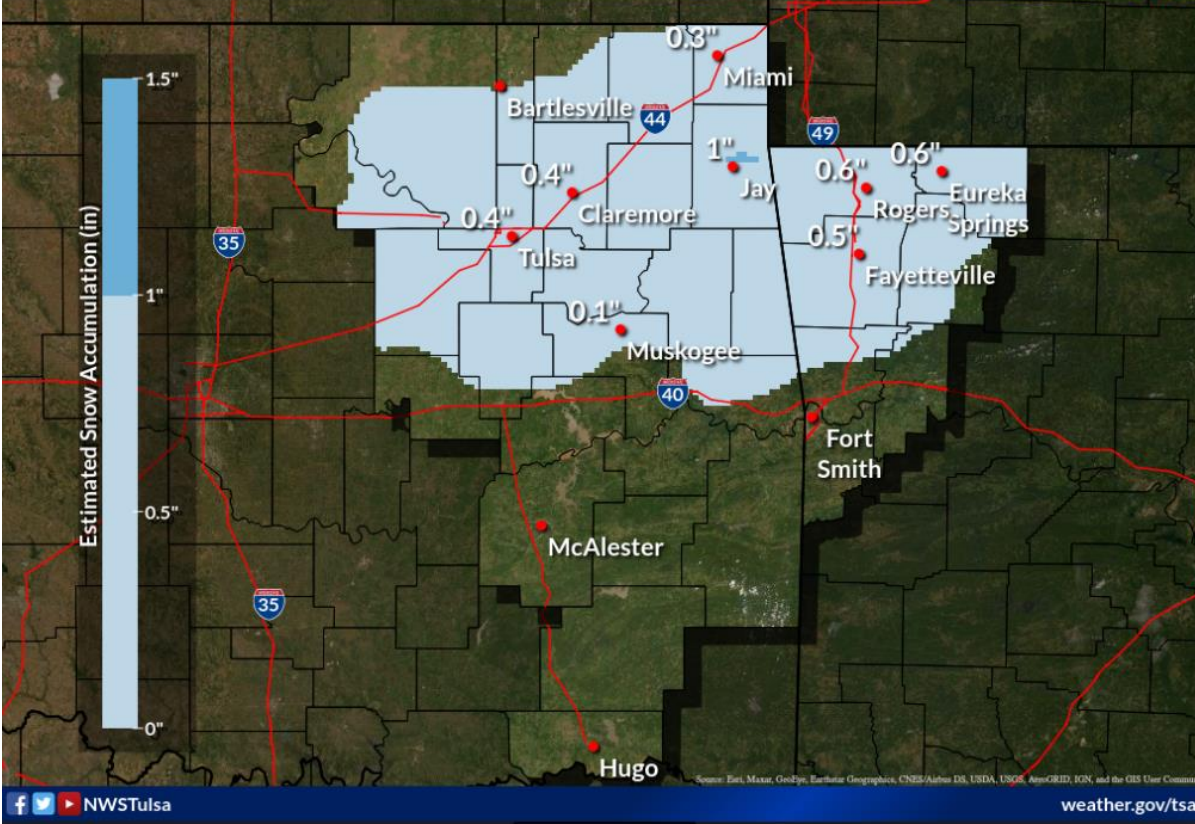


Fig. 12. Estimated Snowfall Analysis for 11/17-18/2022.

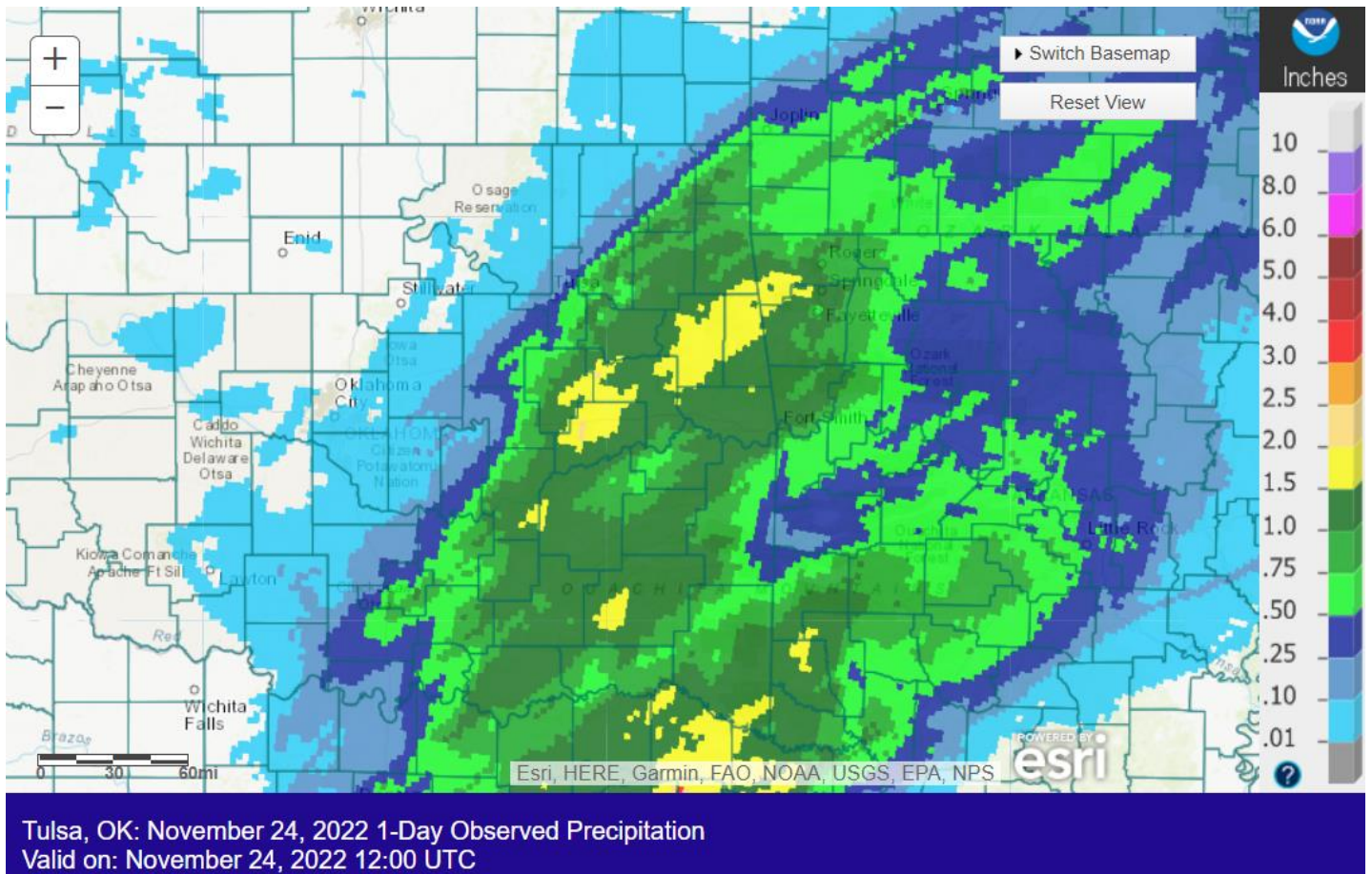
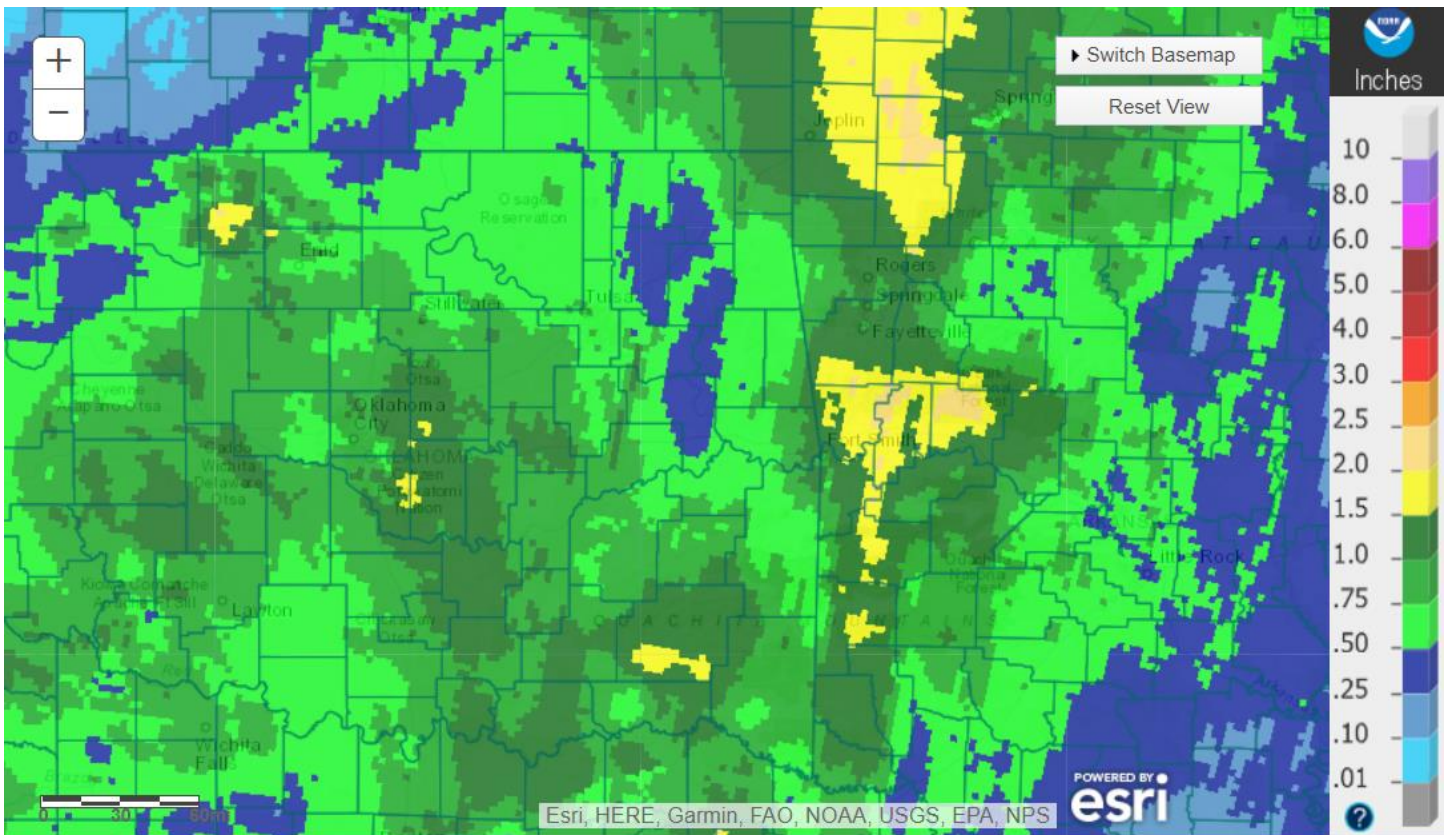
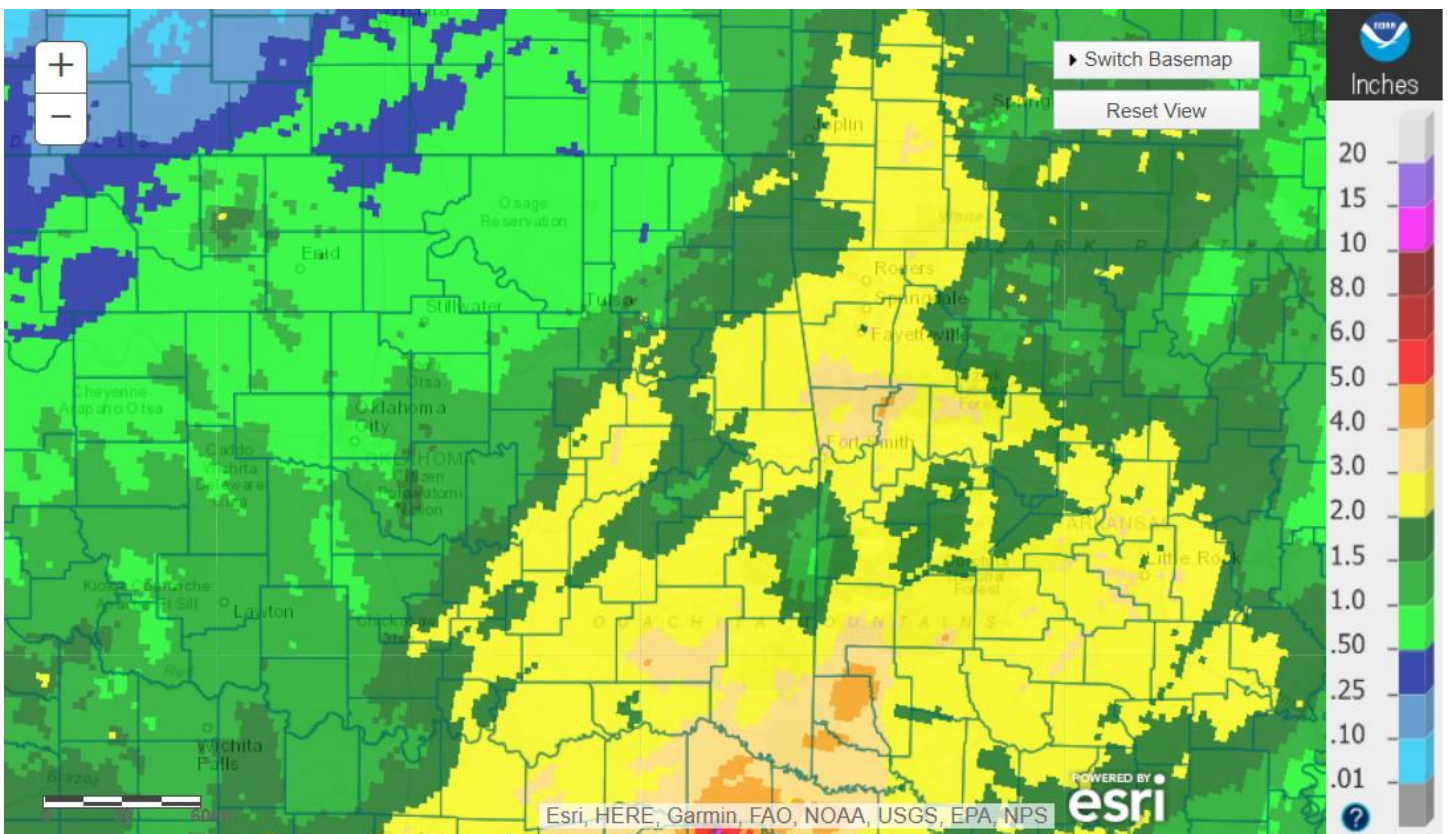


Fig. 13. 24-hour Estimated Observed Rainfall ending at 6am CST 11/24/2022.



Tulsa, OK: November 27, 2022 1-Day Observed Precipitation
Valid on: November 27, 2022 12:00 UTC

Fig. 14. 24-hour Estimated Observed Rainfall ending at 6am CST 11/27/2022.



Tulsa, OK: Last 7-Day Observed Precipitation
Valid on: November 28, 2022 12:00 UTC

Fig. 15. 7-Day Estimated Observed Rainfall ending at 6am CST 11/28/2022.

Written by:

Nicole McGavock
Service Hydrologist
WFO Tulsa

Products issued in November 2022:

*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

- 5 Flash Flood Warnings (FFW)
- 6 Flash Flood Statements (FFS)
- 0 Flash/Areal Flood Watches (FFA) (0 Watch FFA CON/EXT/EXA/EXB/CAN)
- 7 Urban and Small Stream Advisories (FLS)
- 0 Areal Flood Warnings (FLW)
- 0 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