

<b>NWS FORM E-5</b> (11-88) (PRES. by NWS Instruction 10-924)	<b>U.S. DEPARTMENT OF COMMERCE</b> NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	HYDROLOGIC SERVICE AREA (HSA)	
		<b>Tulsa, Oklahoma (TSA)</b>	
<b>MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS</b>		REPORT FOR:	YEAR
		MONTH <b>July</b>	<b>2020</b>
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		SIGNATURE <b>Steven F. Piltz</b> (Meteorologist-in-Charge)	
		DATE <b>August 7, 2020</b>	

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.

Several mesoscale convective complexes affected eastern OK and northwest AR during July 2020. While there was localized heavy rain this month, no river flooding occurred, likely in part due to the dry June. Normal rainfall for the month of July ranges from 2.6 inches in McIntosh County to 3.4 inches in Ottawa County. The Ozark region of northwest Arkansas averages 3.1 inches for the month. This report, past E-5 reports, and monthly hydrology and climatology summaries can be found at <http://www.weather.gov/tsa/hydro-monthly-summary>.

### Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a), rainfall totals for July 2020 ranged from 1" to around 12" across eastern OK and northwest AR, with most of the area receiving 3"-7". These rainfall totals correspond to 50% to near 400% of the normal July rainfall for eastern OK and northwest Arkansas, with the greatest deficits across southeast OK and the greatest surplus in Okmulgee and surrounding counties (Fig. 1b).

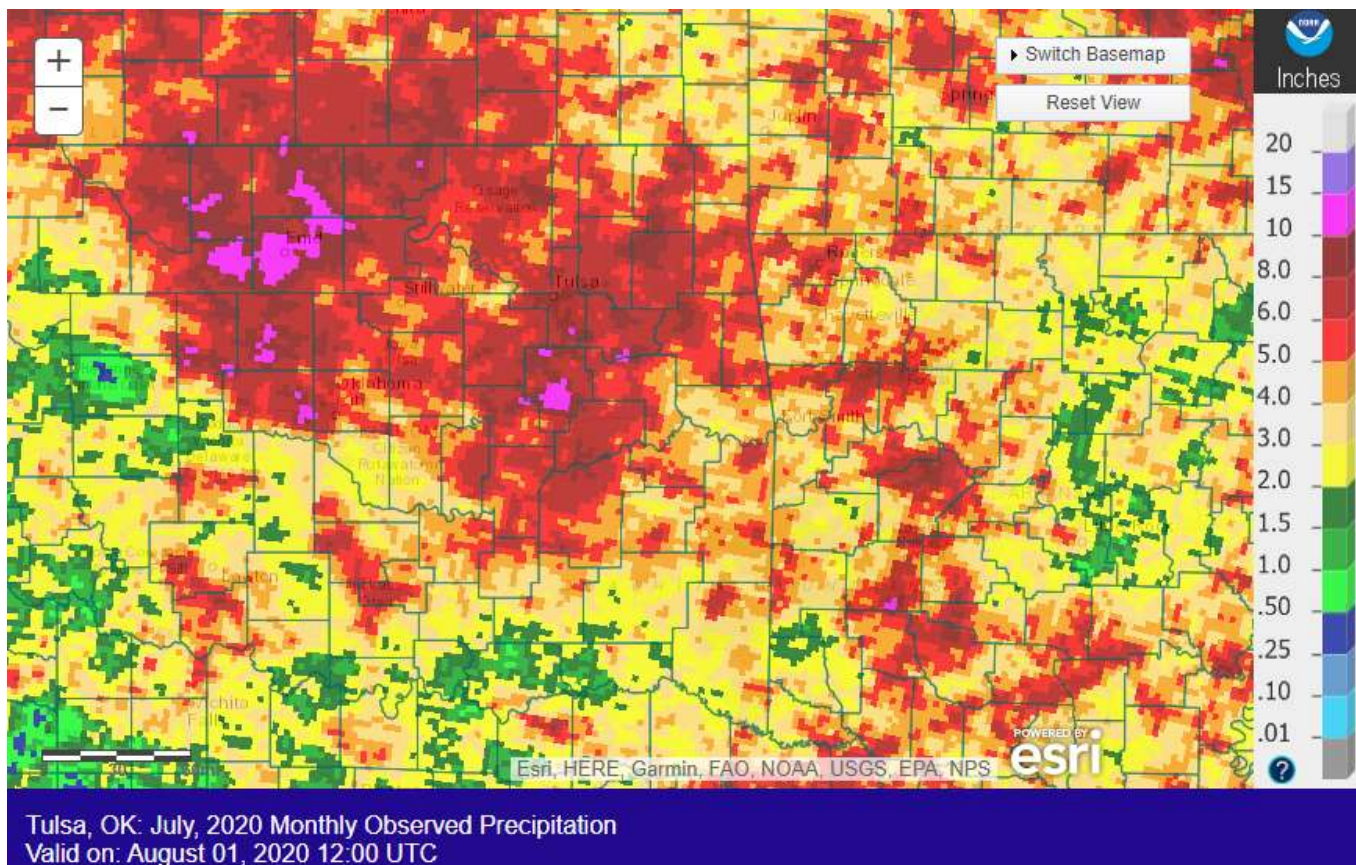


Fig. 1a. Estimated Observed Rainfall for July 2020

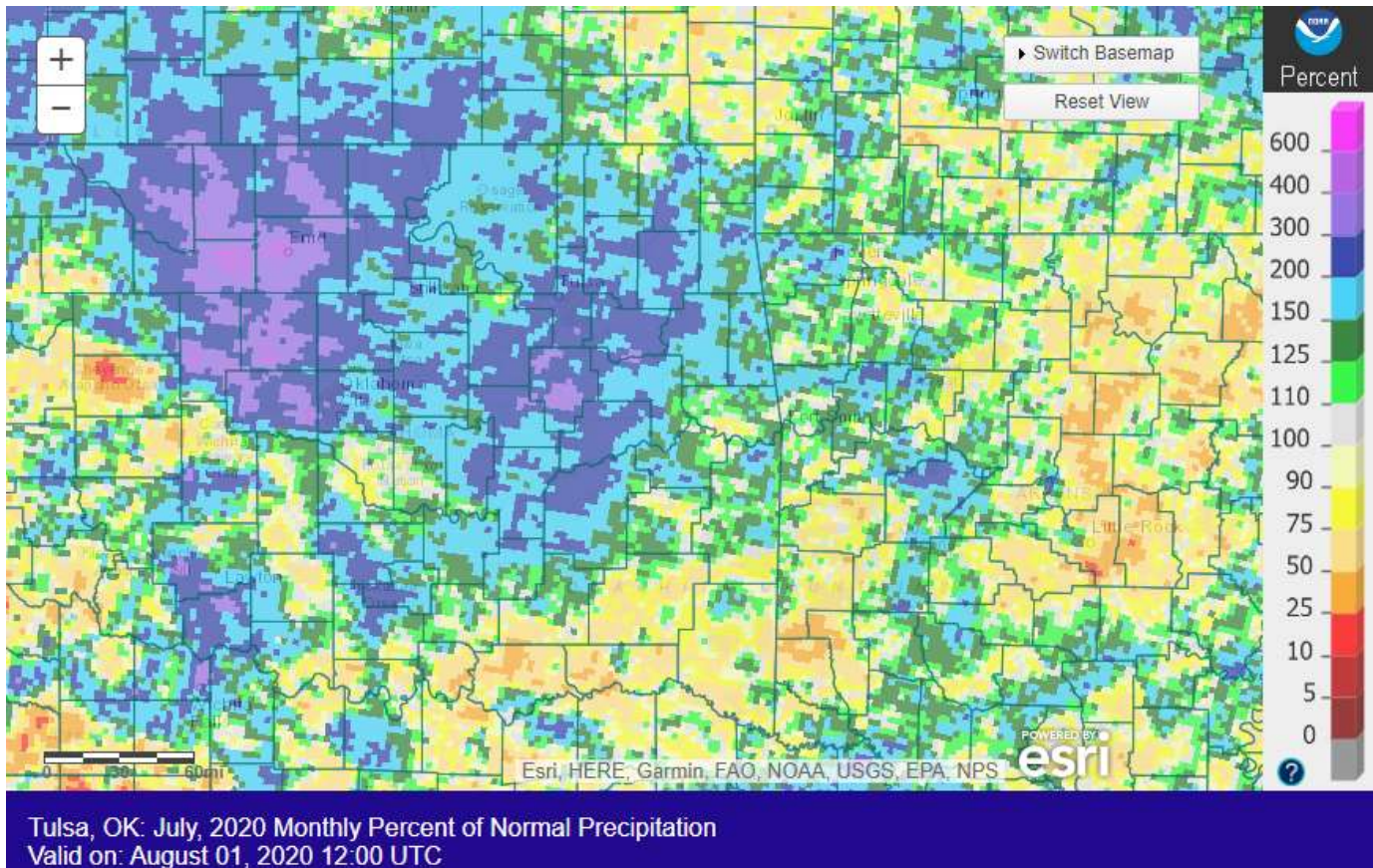


Fig. 1b. Estimated % of Normal Rainfall for July 2020

In Tulsa, OK, July 2020 ranked as the 50<sup>th</sup> warmest July (83.5°F; since records began in 1905) and the 14<sup>th</sup> wettest July (6.60"; since records began in 1888). Fort Smith, AR had the 32<sup>nd</sup> warmest July (83.9°F, tied 1912; since records began in 1882) and the 44<sup>th</sup> wettest July (3.55"; since records began in 1882). Fayetteville, AR had the 24<sup>th</sup> warmest (79.0°F, tied 1983) and the 21<sup>st</sup> wettest (4.24") July since records began in 1950.

Some of the larger precipitation reports (in inches) for July 2020 included:

Tulsa 6.3WSW, OK (coco)	11.05	Tulsa 5.4SSE, OK (coco)	10.52	Okmulgee, OK (meso)	10.19
Bixby, OK (meso)	9.53	Tulsa 6.3S, OK (coco)	9.34	Ochelata, OK (coco)	9.10
Jenks Riverside Arpt, OK (ASOS)	9.09	Pryor, OK (meso)	9.07	Morris 2.4SW, OK (coco)	8.98

Some of the lowest precipitation reports (in inches) for July 2020 included:

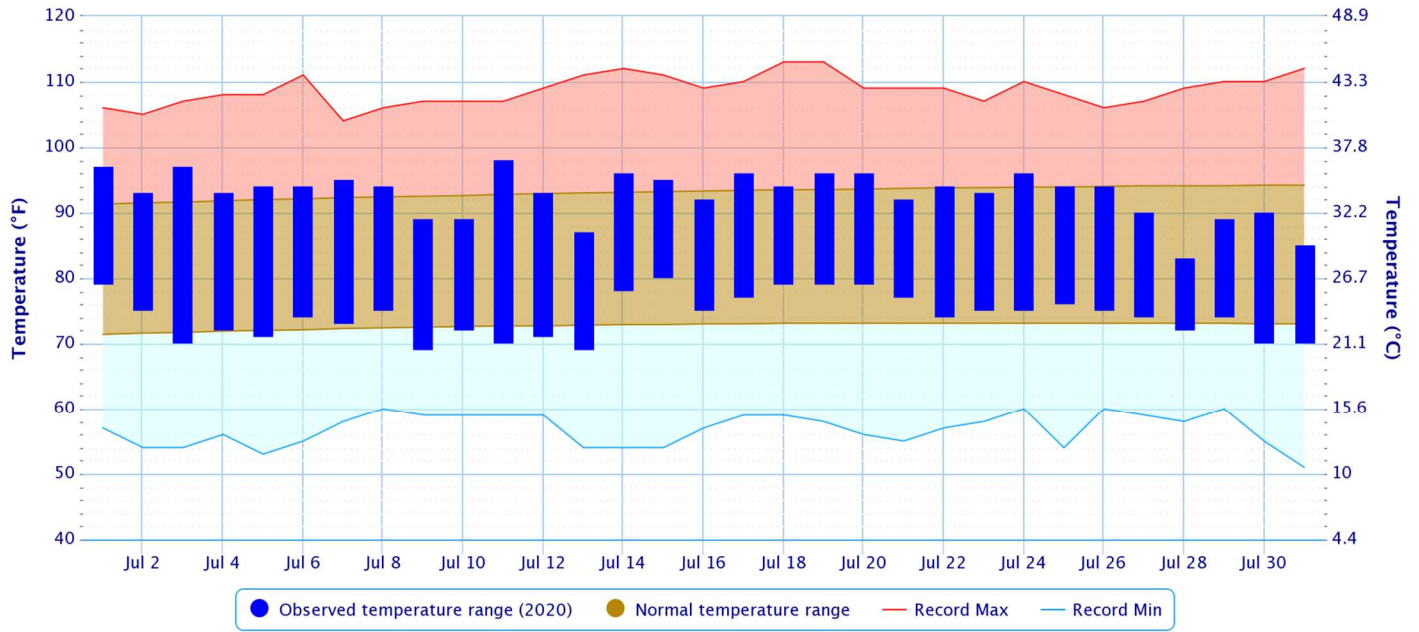
Antlers, OK (meso)	1.68	Viney Grove 2.4NW, AR (coco)	2.70	Hugo 1.9ENE, OK (coco)	3.03
Muskogee, OK (ASOS)	3.07	Wilburton, OK (meso)	3.14	Siloam Springs, AR (AWOS)	3.25
Sallisaw, OK (meso)	3.36	Fort Smith, AR (ASOS)	3.55	Cloudy, OK (meso)	3.56

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

Rank since 1921	Last 30 Days (Jul 4 – Aug 2)	Summer to Date (Jun 1 – Aug 2)	Warm Growing Season 2020 (Mar 1 – Aug 2)	Year-to-Date (Jan 1 – Aug 2)	Last 90 Days (May 5 – Aug 2)	Water Year-to-Date (Oct 1 – Aug 2)	Last 365 Days (Aug 4, 2019 – Aug 2, 2020)
Northeast OK	<b>8<sup>th</sup> wettest</b>	50 <sup>th</sup> driest	21 <sup>st</sup> wettest	16 <sup>th</sup> wettest	31 <sup>st</sup> wettest	11 <sup>th</sup> wettest	<b>7<sup>th</sup> wettest</b>
East Central OK	11 <sup>th</sup> wettest	44 <sup>th</sup> driest	18 <sup>th</sup> wettest	6 <sup>th</sup> wettest	30 <sup>th</sup> wettest	<b>4<sup>th</sup> wettest</b>	<b>2<sup>nd</sup> wettest</b>
Southeast OK	41 <sup>st</sup> wettest	29 <sup>th</sup> driest	14 <sup>th</sup> wettest	<b>10<sup>th</sup> wettest</b>	29 <sup>th</sup> wettest	<b>8<sup>th</sup> wettest</b>	<b>6<sup>th</sup> wettest</b>
Statewide	11 <sup>th</sup> wettest	46 <sup>th</sup> driest	37 <sup>th</sup> wettest	23 <sup>rd</sup> wettest	48 <sup>th</sup> wettest	21 <sup>st</sup> wettest	17 <sup>th</sup> wettest

### Daily Temperature Data – Tulsa Area, OK (ThreadEx)

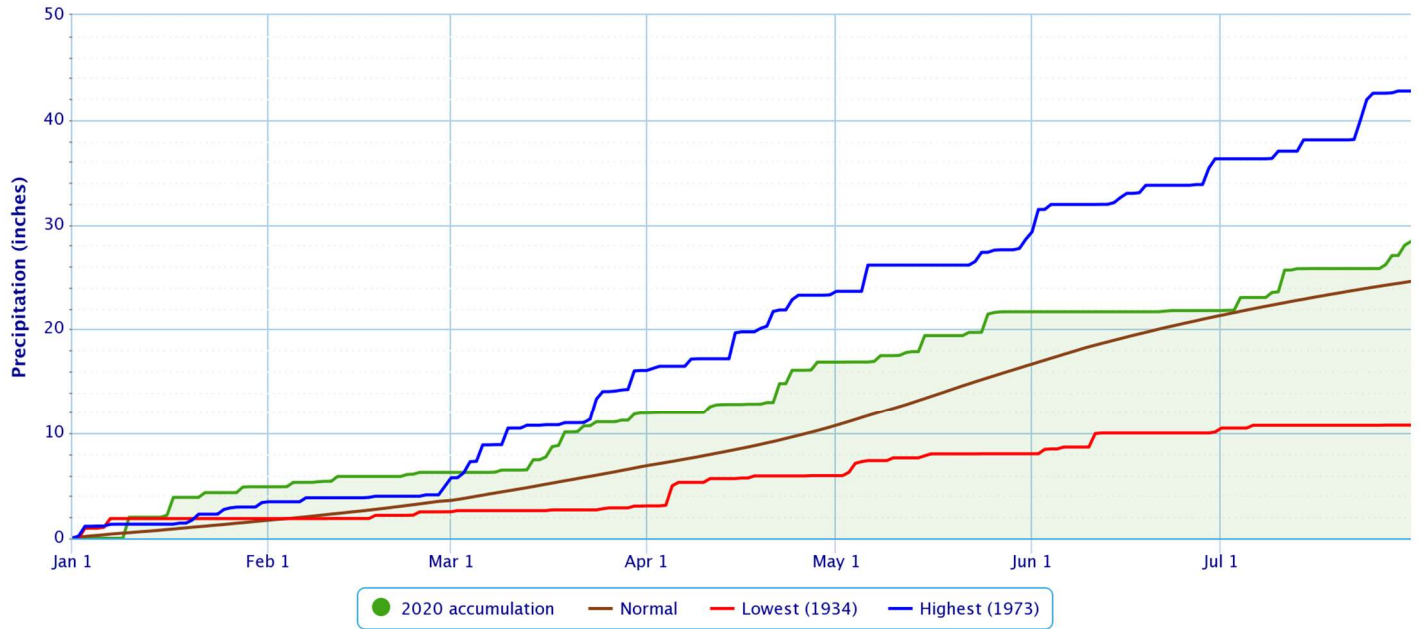
Period of Record – 1905-01-06 to 2020-08-02. Normals period: 1981-2010. Click and drag to zoom chart.



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### Accumulated Precipitation – Tulsa Area, OK (ThreadEx)

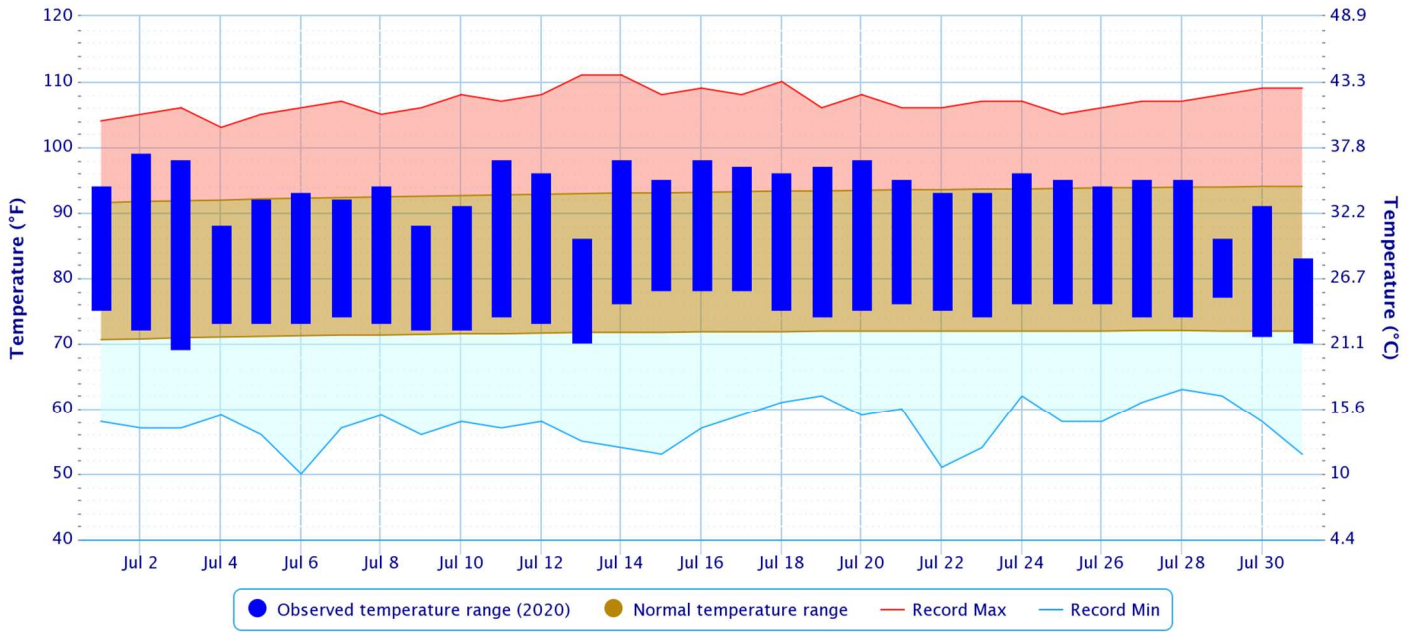
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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

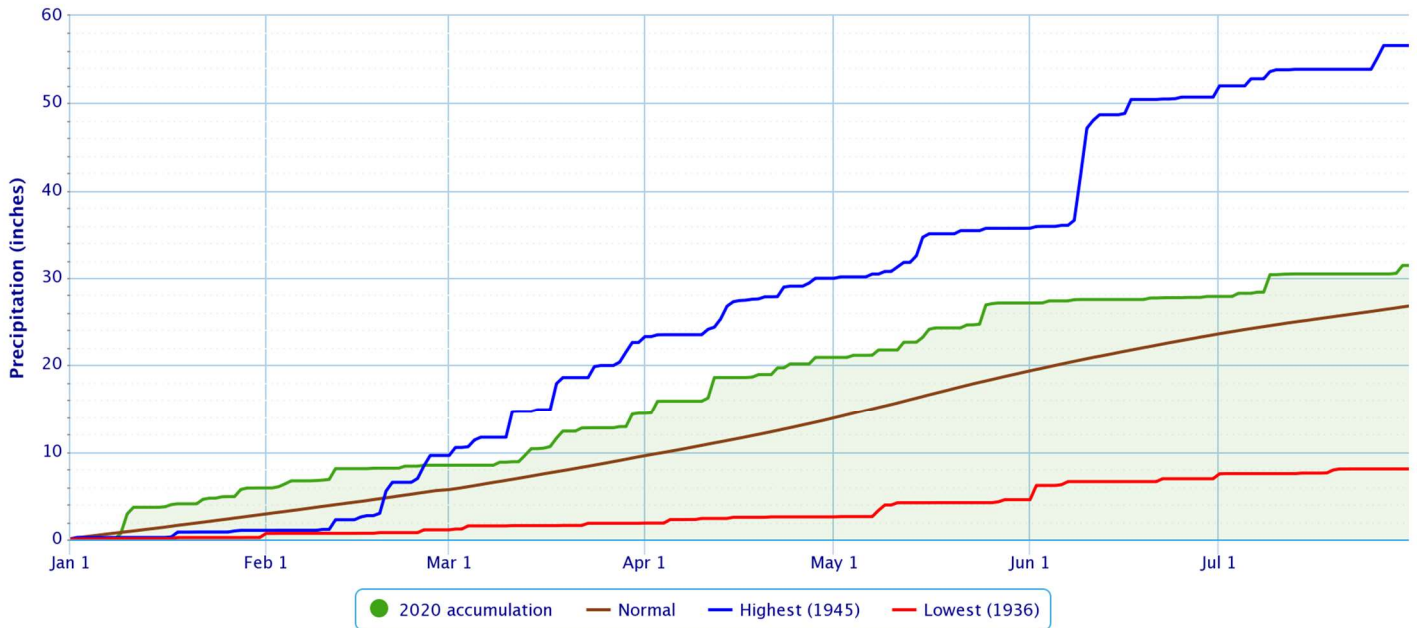
Period of Record – 1882-06-01 to 2020-08-02. Normals period: 1981-2010. Click and drag to zoom chart.



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### Accumulated Precipitation – Fort Smith Area, AR (ThreadEx)

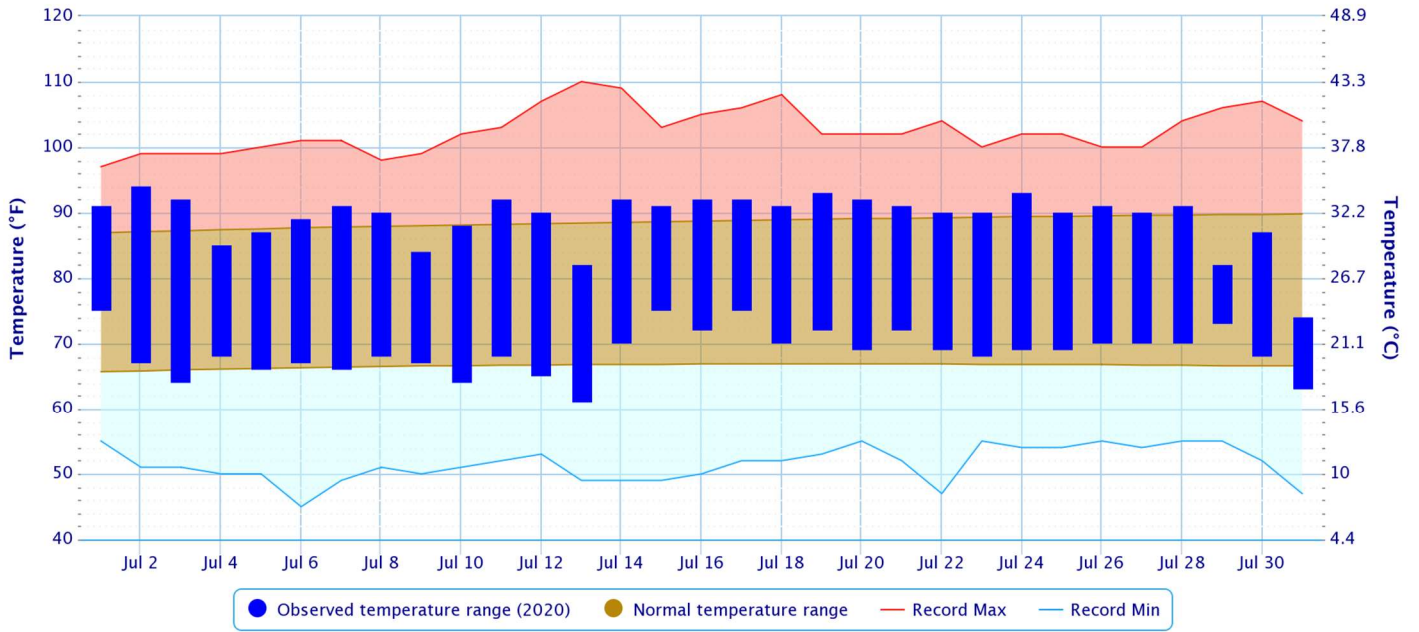
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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### Daily Temperature Data – FAYETTEVILLE DRAKE FIELD, AR

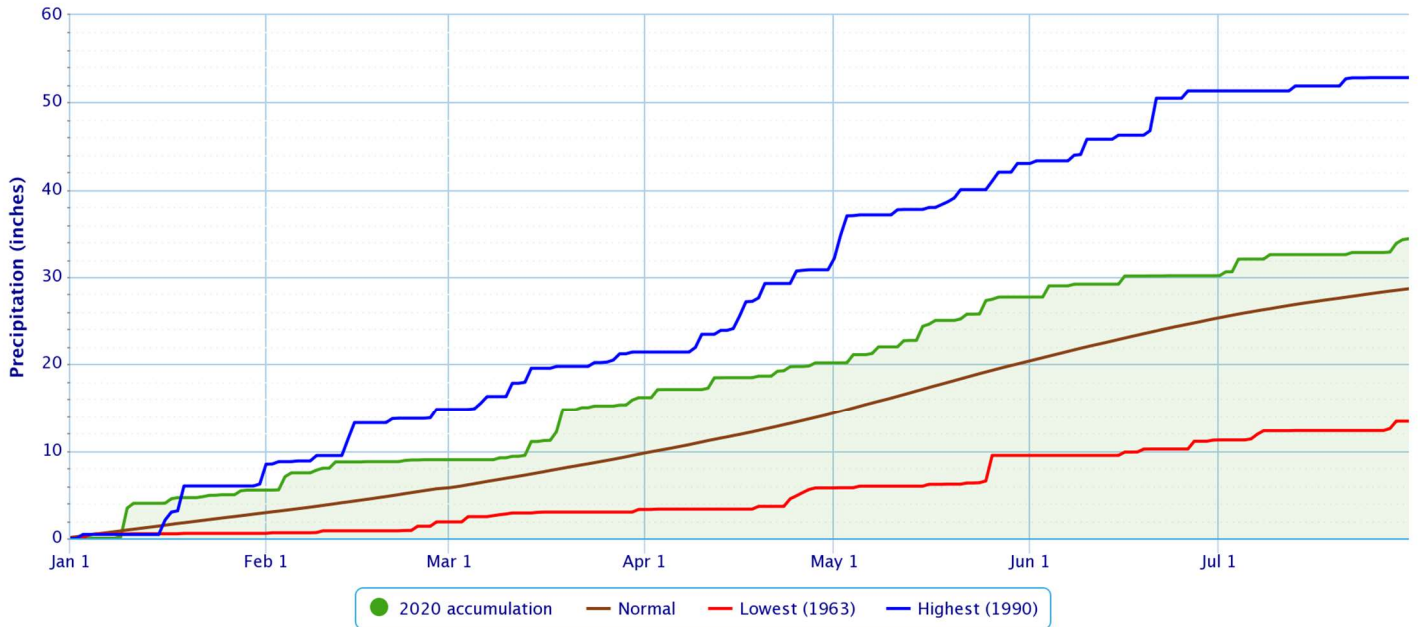
Period of Record – 1949-07-14 to 2020-08-02. Normals period: 1981-2010. Click and drag to zoom chart.



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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

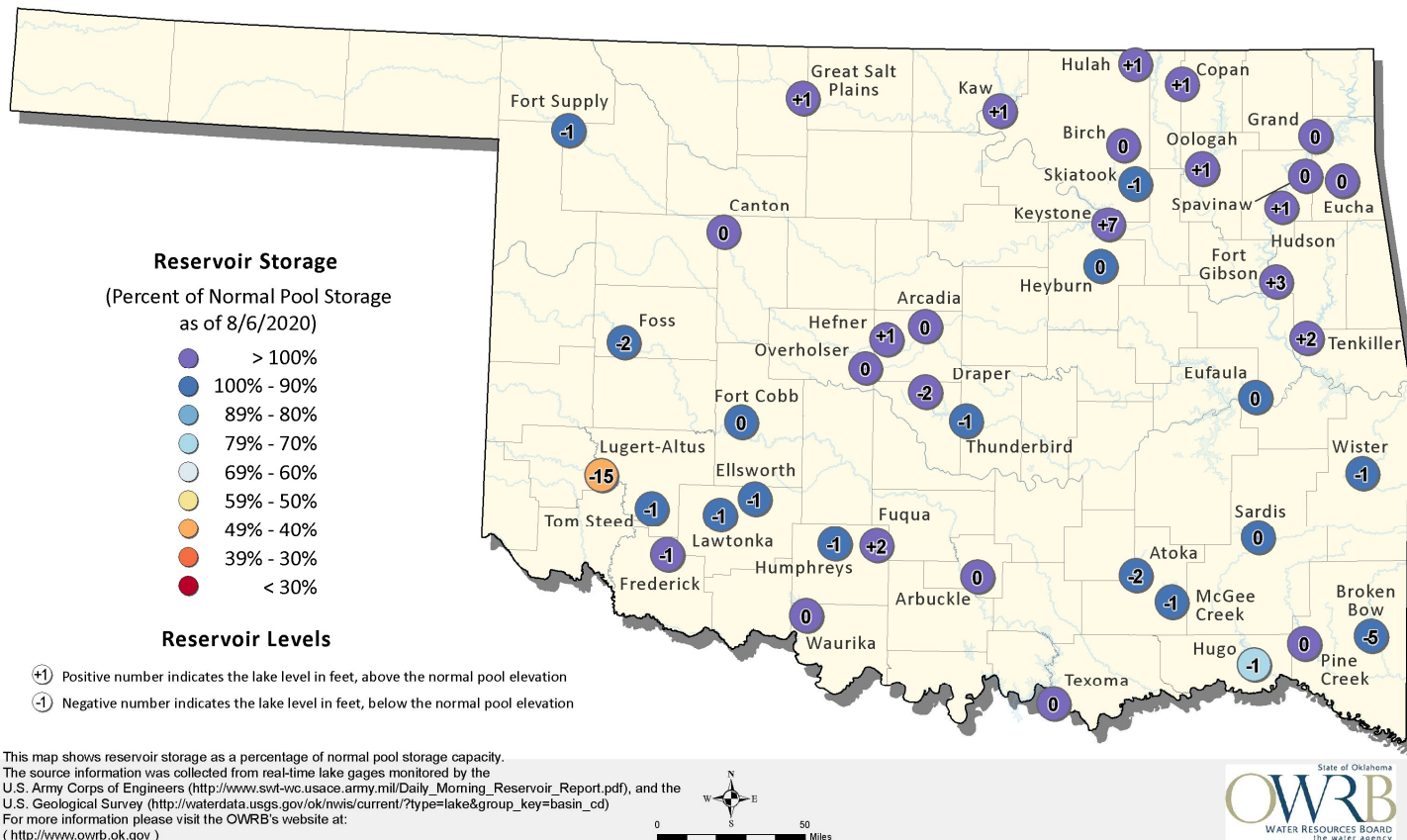


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## Reservoirs

# Oklahoma Surface Water Resources

## Reservoir Levels and Storage as of 8/6/2020



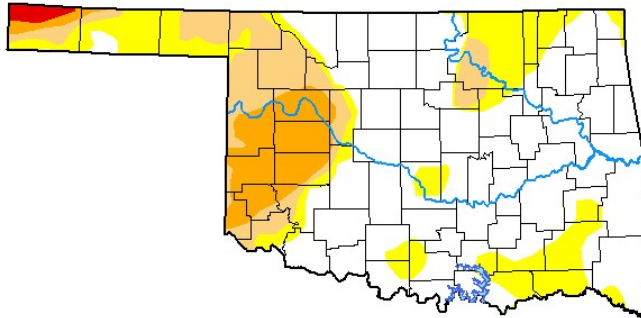
According to the USACE, most of the lakes in the HSA were within  $\pm 3\%$  of top of their conservation pools as of 7/31/2020. However, a few lakes were still using a higher percentage of their flood control pools: Beaver Lake 51%, Keystone Lake 8%, Hudson Lake 4%, and Tenkiller Lake 4%. Some lakes in southeast OK were operating below 3% of the top of their conservation pools: Hugo Lake 94% and Wister Lake 91%.

## Drought

According to the [U.S. Drought Monitor](#) (USDM) from August 4, 2020 (Figs. 2, 3), Moderate (D1) Drought conditions were present in portions of Osage, Pawnee, and Creek County in eastern OK. Abnormally Dry (D0), but not in drought, conditions were affecting portions of Osage, Pawnee, Creek, Washington, Tulsa, Rogers, Nowata, Craig, Ottawa, Haskell, Pushmataha, and Choctaw Counties in eastern OK. Northwest AR was drought free.

# U.S. Drought Monitor Oklahoma

**August 4, 2020**  
(Released Thursday, Aug. 6, 2020)  
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	60.23	39.77	21.12	9.56	0.73	0.00
<b>Last Week</b> 07-28-2020	39.83	60.17	25.96	10.26	2.79	0.00
<b>3 Months Ago</b> 05-05-2020	76.46	23.54	5.44	2.40	0.00	0.00
<b>Start of Calendar Year</b> 12-31-2019	76.45	23.55	10.47	3.64	0.00	0.00
<b>Start of Water Year</b> 10-01-2019	71.94	28.06	11.08	1.01	0.00	0.00
<b>One Year Ago</b> 08-06-2019	54.55	45.45	15.08	3.70	0.00	0.00

**Intensity:**  
 None (White)      D2 Severe Drought (Orange)  
 D0 Abnormally Dry (Yellow)      D3 Extreme Drought (Red)  
 D1 Moderate Drought (Light Orange)      D4 Exceptional Drought (Dark Red)

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:**  
Brian Fuchs  
National Drought Mitigation Center

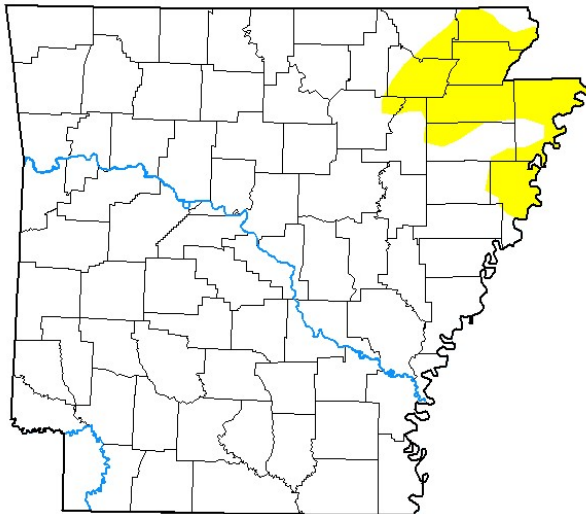


[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)

Fig. 2. Drought Monitor for Oklahoma

# U.S. Drought Monitor Arkansas

**August 4, 2020**  
(Released Thursday, Aug. 6, 2020)  
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	92.24	7.76	0.00	0.00	0.00	0.00
<b>Last Week</b> 07-28-2020	76.92	23.08	0.00	0.00	0.00	0.00
<b>3 Months Ago</b> 05-05-2020	100.00	0.00	0.00	0.00	0.00	0.00
<b>Start of Calendar Year</b> 12-31-2019	86.68	13.32	4.35	0.31	0.00	0.00
<b>Start of Water Year</b> 10-01-2019	54.35	45.65	11.77	5.79	0.00	0.00
<b>One Year Ago</b> 08-06-2019	100.00	0.00	0.00	0.00	0.00	0.00

**Intensity:**  
 None (White)      D2 Severe Drought (Orange)  
 D0 Abnormally Dry (Yellow)      D3 Extreme Drought (Red)  
 D1 Moderate Drought (Light Orange)      D4 Exceptional Drought (Dark Red)

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:**  
Brian Fuchs  
National Drought Mitigation Center



[droughtmonitor.unl.edu](https://droughtmonitor.unl.edu)

Fig. 3. Drought Monitor for Arkansas

## **Outlooks**

The [Climate Prediction Center](#) (CPC) outlook for August 2020 (issued July 31, 2020) indicates an enhanced chance for below normal temperatures and an equal chance for above, near, and below median precipitation across eastern OK and northwest AR. This outlook takes into account dynamical model guidance, the weeks 3-4 outlook, and current soil moisture. The increased odds for below normal temperatures are based primarily on the first half of the month, with moderating temperatures and possibly above normal favored for the second half of August.

For the 3-month period August-September-October 2020, CPC is forecasting an enhanced chance for above normal temperatures and an equal chance for above, near, and below median precipitation across eastern OK and northwest AR (outlook issued July 16, 2020). This outlook is based on both statistical and dynamical forecast tools, current soil moisture, and decadal timescale climate trends. According to CPC, the combined effect of the ocean-atmosphere system is consistent with ENSO neutral conditions. ENSO-neutral is favored to continue through the summer, with a 50-55% chance of La Niña development during Northern Hemisphere fall 2020 and continuing through winter 2020-21 (~50% chance). Therefore, CPC has issued a La Niña Watch.

**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](http://water.weather.gov/precip/index.php?location_type=wfo&location_name=tsa)

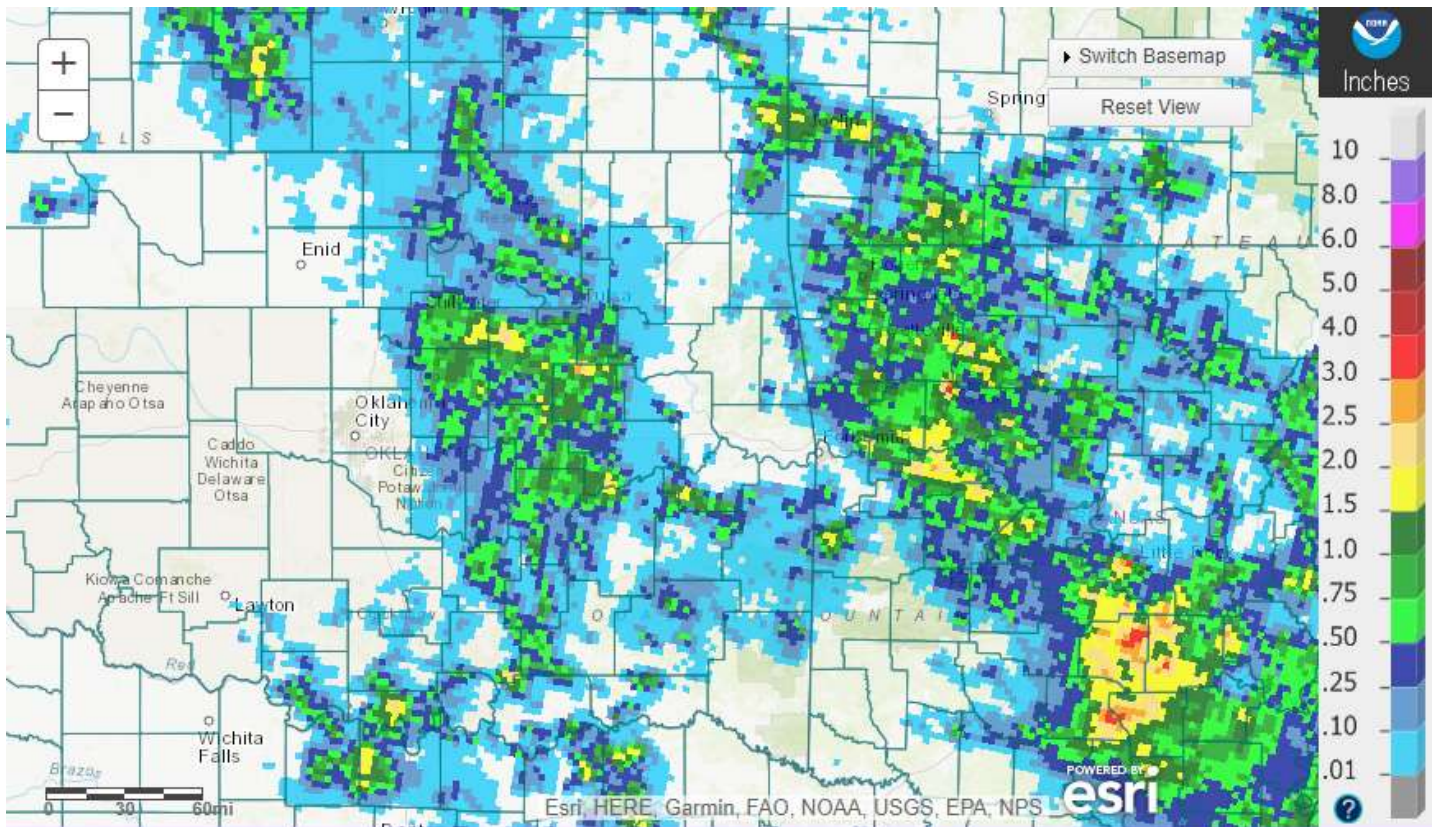
A few thunderstorms along a weak boundary moved out of KS into Osage County during the late morning of the 2<sup>nd</sup>. As these storms continued southward, they increased in coverage and developed into a small thunderstorm complex. The complex continued to move south, generally affecting locations along and west of Hwy 75/Indian Nation Turnpike before shifting to the southeast across far southeast OK. This activity moved out of the area by early evening. Meanwhile, afternoon thunderstorms developed over northwest AR and far eastern OK during the afternoon. These storms became more widespread over northwest AR during the evening, before dissipating with the loss of daytime heating. Most places that received rain had around 0.50" to around 1", though some locations received 1" to around 2" of rain (Fig. 4).

Isolated showers and thunderstorms occurred over eastern OK and northwest AR during the afternoon and evening hours of the 3<sup>rd</sup>, as an outflow boundary moved southeast across the region. This activity dissipated with the loss of daytime heating. However, by late evening, a prominent mesoscale convective vortex (MCV) over eastern KS moved south into the area, igniting additional shower and thunderstorm development over northeast OK and northwest AR through the overnight hours. This activity continued to push southeast into southeast OK and west central AR through the morning of the 4<sup>th</sup> before exiting the region shortly after noon. Typical summer afternoon showers and thunderstorms then developed across the area during the afternoon and evening hours. Rainfall totals ranged from around 0.25" to around 3" (Figs. 5, 6).

A mesoscale convective system (MCS) moved into northeast OK during the morning of the 9<sup>th</sup> and continued to move southeast across far eastern OK and western AR through the afternoon hours. Rainfall was heavy at times, with the OK Mesonet measuring 1" to 1.65" in one hour across northeast OK. A second wave of showers and thunderstorms moved south out of KS into northeast OK during the afternoon and also continued southeast into western AR through early evening. Scattered showers and thunderstorms continued north of these storms across northeast OK as well during this time. All of the activity dissipated by mid-evening. Rainfall totals were 0.25" to around 2.5" (Fig. 7).

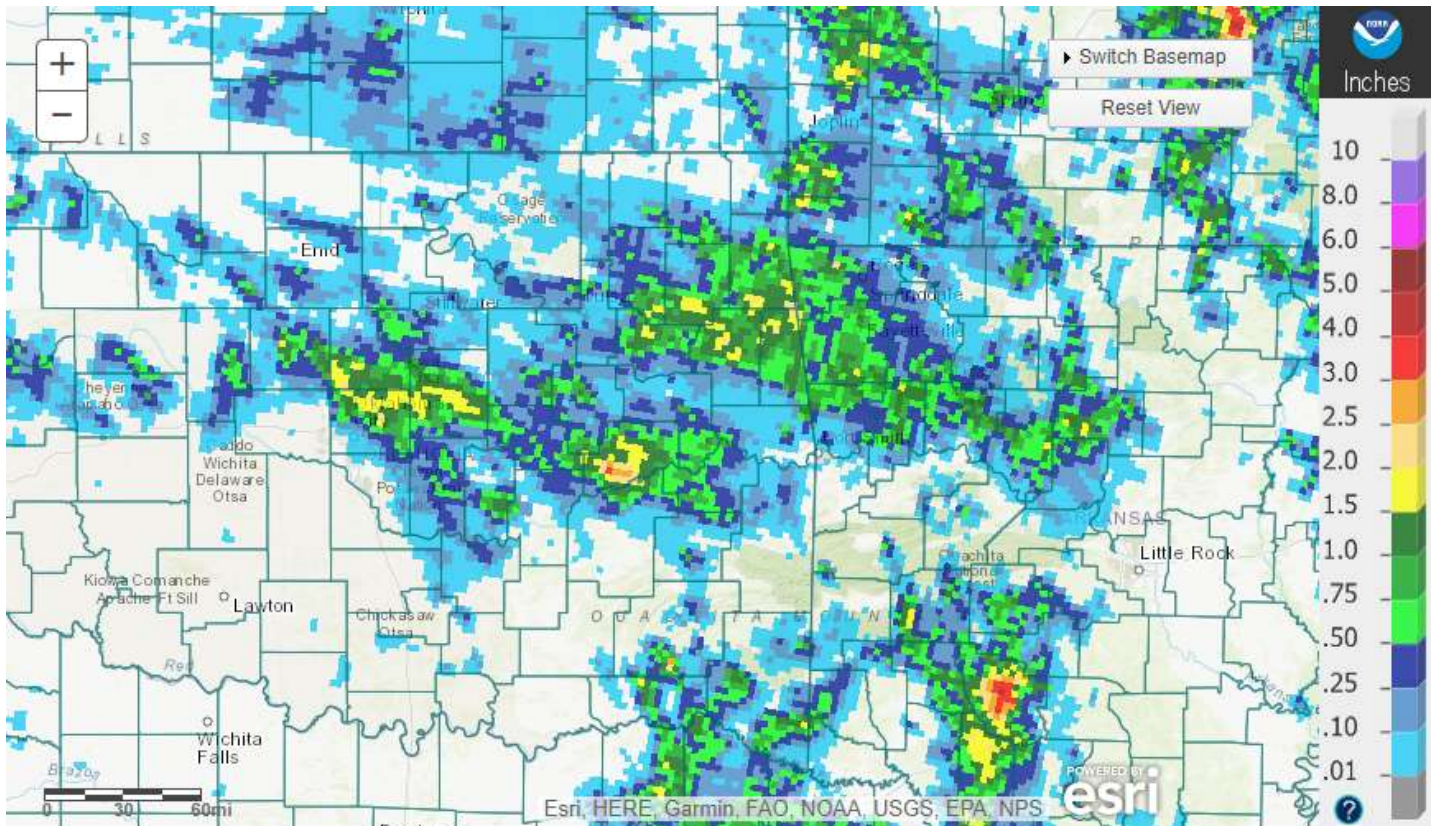
Once again, an MCS dropped south out of KS into north central and northeast OK during the mid-morning hours of the 10<sup>th</sup>. With precipitable water values around 2", some of the stronger thunderstorms within the MCS produced very heavy rainfall. The ASOS site at Jenks/R.L. Jones Riverside Airport measured 1" of rain in just 15 minutes and 2.6" of rain in 45 minutes. The MCS weakened and eventually dissipated through the afternoon as it moved into southeast OK. Rainfall totals for most of the affected locations were around 0.25" to around 1", with isolated totals of 1" to 2.5" (Fig. 8).





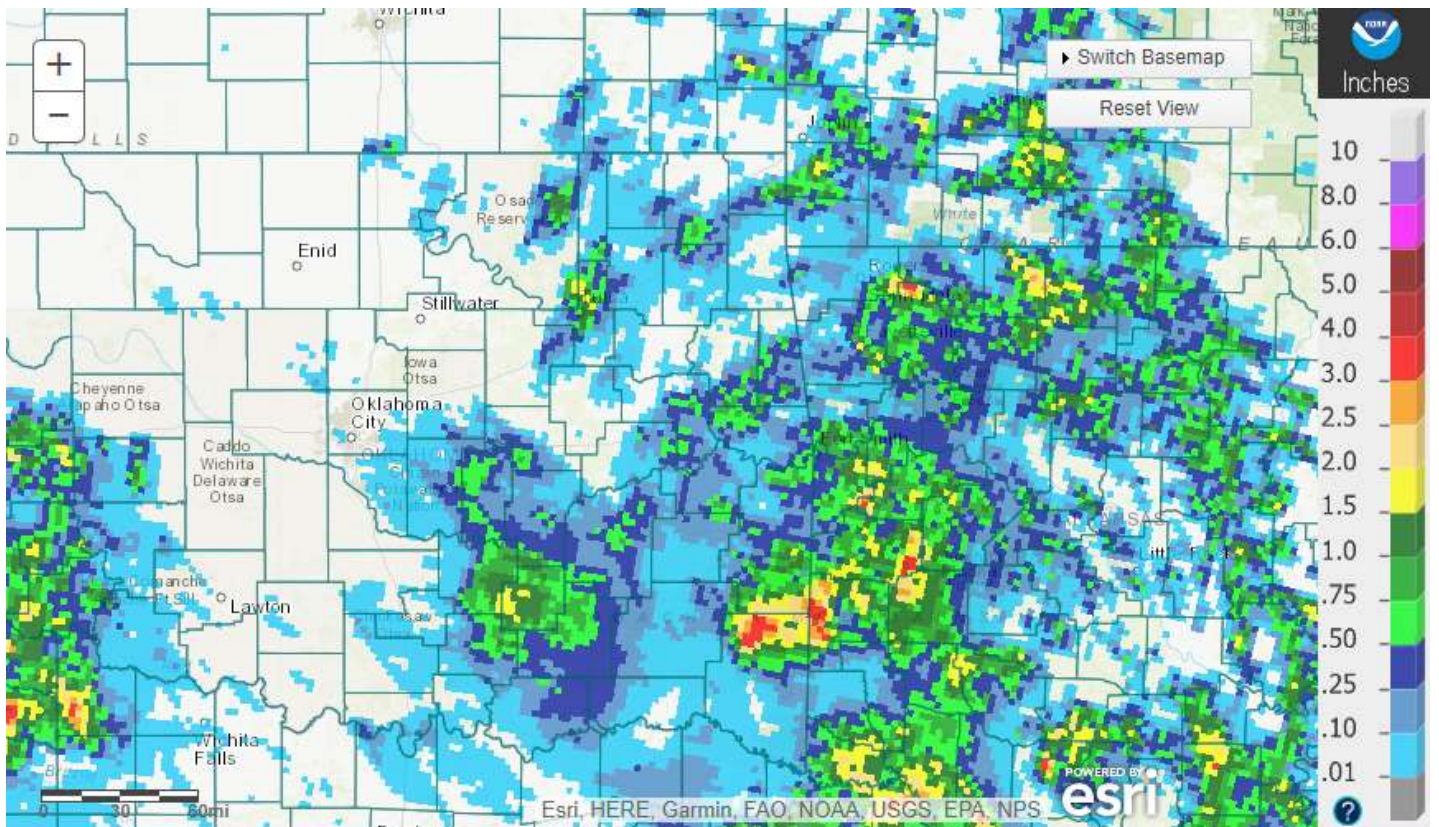
Tulsa, OK: July 03, 2020 1-Day Observed Precipitation  
Valid on: July 03, 2020 12:00 UTC

Fig. 4. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/03/2020.



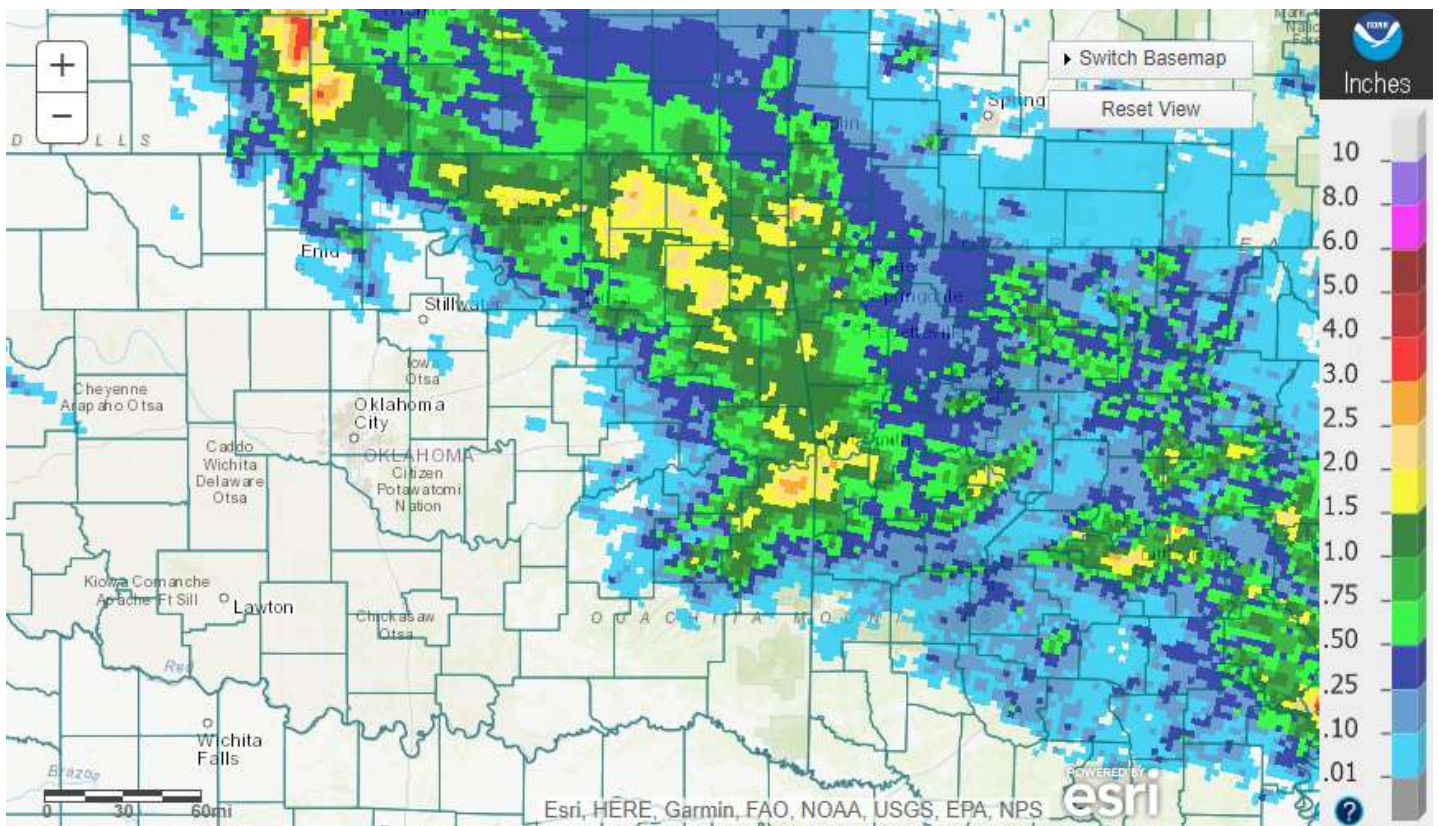
Tulsa, OK: July 04, 2020 1-Day Observed Precipitation  
Valid on: July 04, 2020 12:00 UTC

Fig. 5. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/04/2020.



Tulsa, OK: July 05, 2020 1-Day Observed Precipitation  
Valid on: July 05, 2020 12:00 UTC

Fig. 6. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/05/2020.



Tulsa, OK: July 10, 2020 1-Day Observed Precipitation  
Valid on: July 10, 2020 12:00 UTC

Fig. 7. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/10/2020.

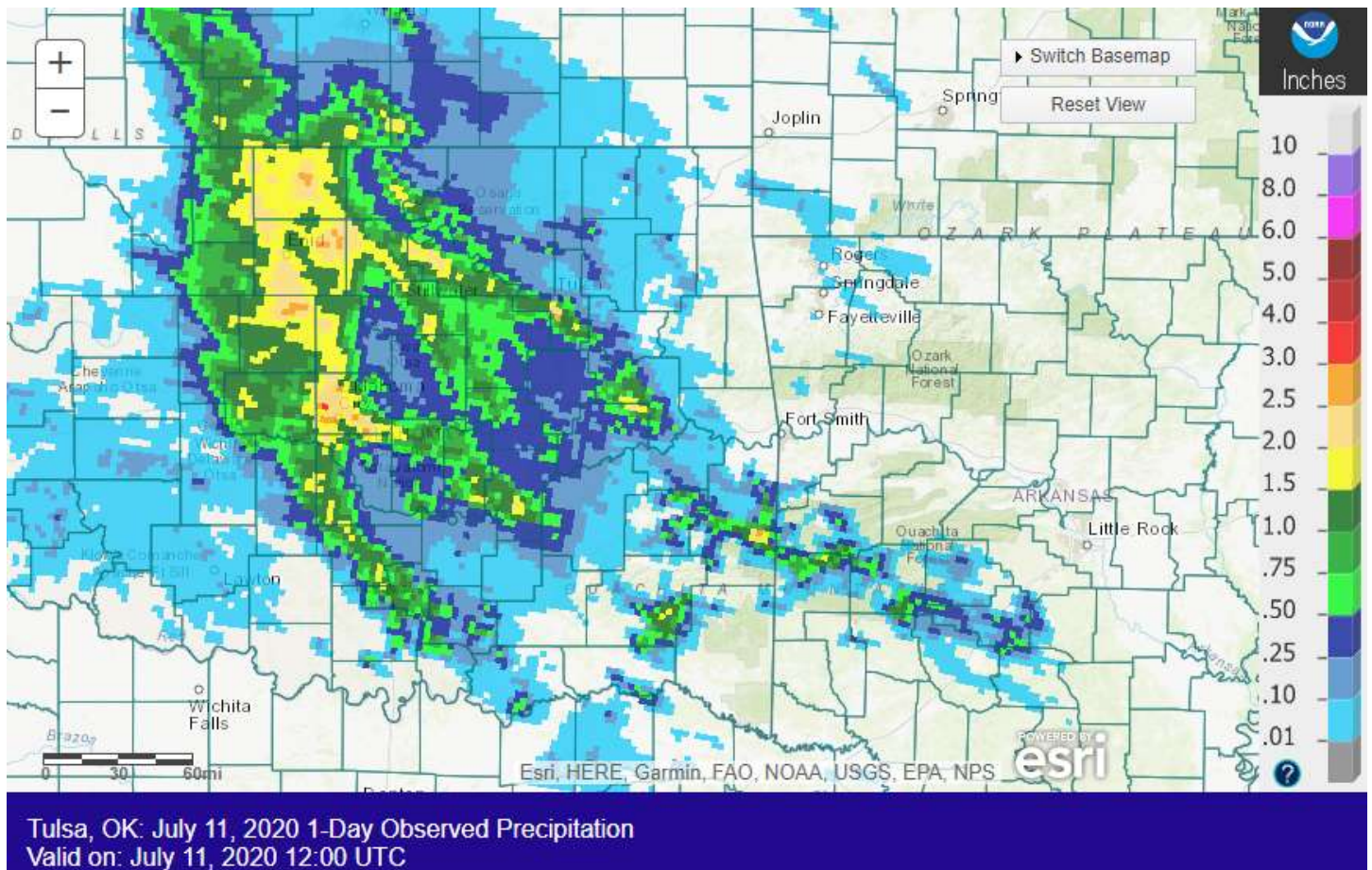


Fig. 8. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/11/2020.

Thunderstorms developed on the 11<sup>th</sup> in northeast KS along a southward moving cold front, and these storms entered northeast OK during the mid-evening hours. Additional thunderstorms developed over north central OK during this time. Both areas of thunderstorms expanded in coverage and became severe thunderstorms as they impacted northeast OK and locations along the OK/AR border through the evening. By midnight, the leading edge of the MCS had pushed south into southeast OK, with convection continuing over a large portion of northeast OK. This activity ended from north to south during the overnight hours and was south of the Red River by sunrise on the 12<sup>th</sup>. Rainfall totals were 0.50" to 2" for a large portion of eastern OK, with locations in northeast OK receiving 2"-3" of rain (Fig. 9).

Showers and thunderstorms moved east southeast from central OK across a large portion of northeast/east central OK and into west central AR from sunrise through the early afternoon on the 13<sup>th</sup>. While most of the area received around 0.25" or less of rain, much of Pittsburg County and portions of Latimer, Okfuskee, McIntosh, Le Flore, and Pushmataha Counties received 0.50"-2" of rain (Fig. 10).

A line of showers and thunderstorms moved to the northeast out of central OK during the morning of the 16<sup>th</sup>, remaining north of I-44. This activity brought around 0.10" to around 1" of rain to a large portion of this area, though higher totals of 1"-2" occurred over a small portion of Ottawa and Craig Counties (Fig. 11).

Around midnight on the 22<sup>nd</sup>, widely scattered thunderstorms developed along a weak frontal boundary draped over far northwest AR and far northeast OK. Thunderstorms persisted over Benton County for several hours, resulting in rainfall totals around 5" southwest of Rogers, AR and 4.5" in Cave Springs, AR (Fig. 12). Other areas that saw thunderstorms received around 0.25" to around 1.5" of rain.



Fig. 9. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/12/2020.

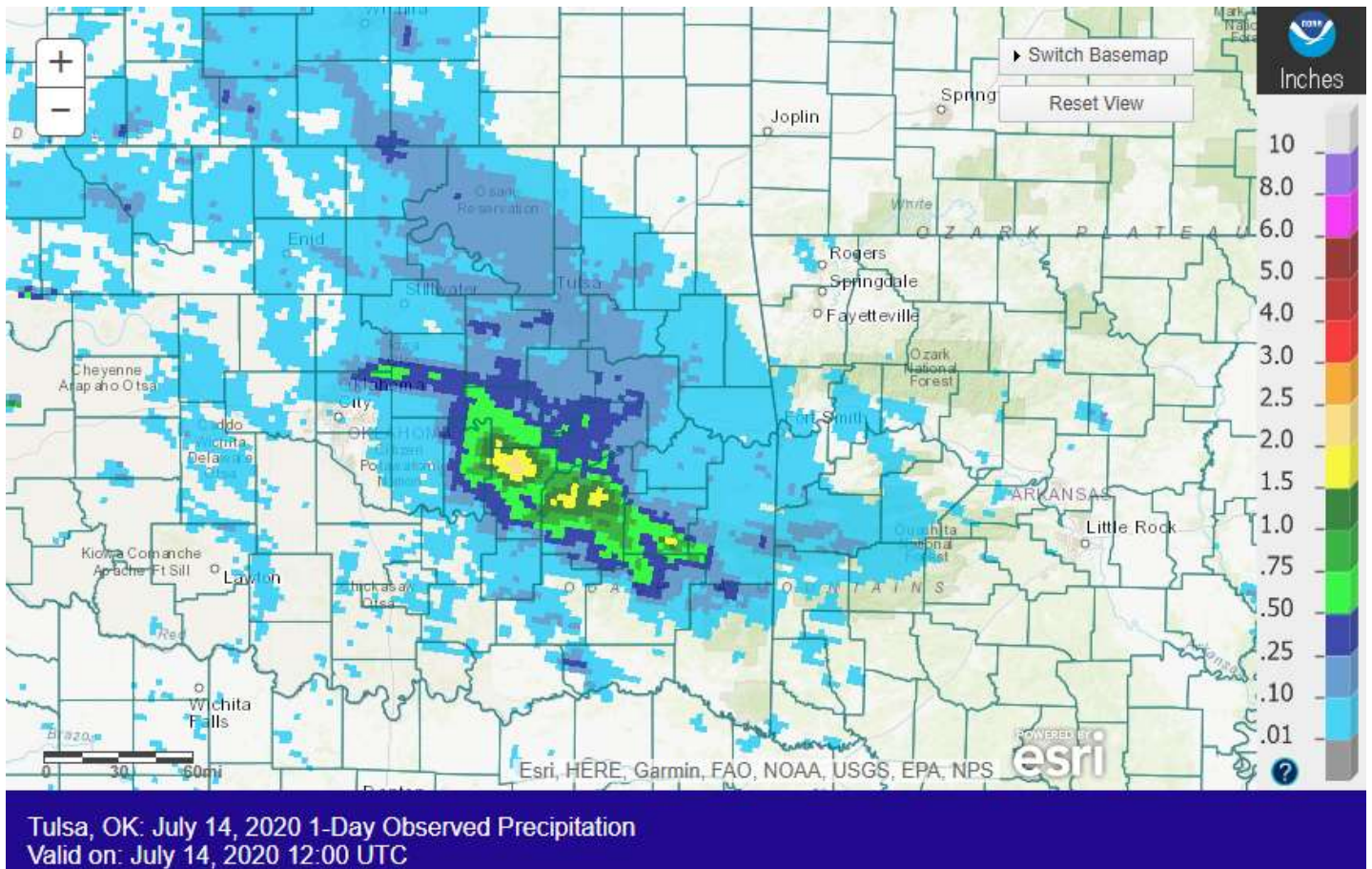
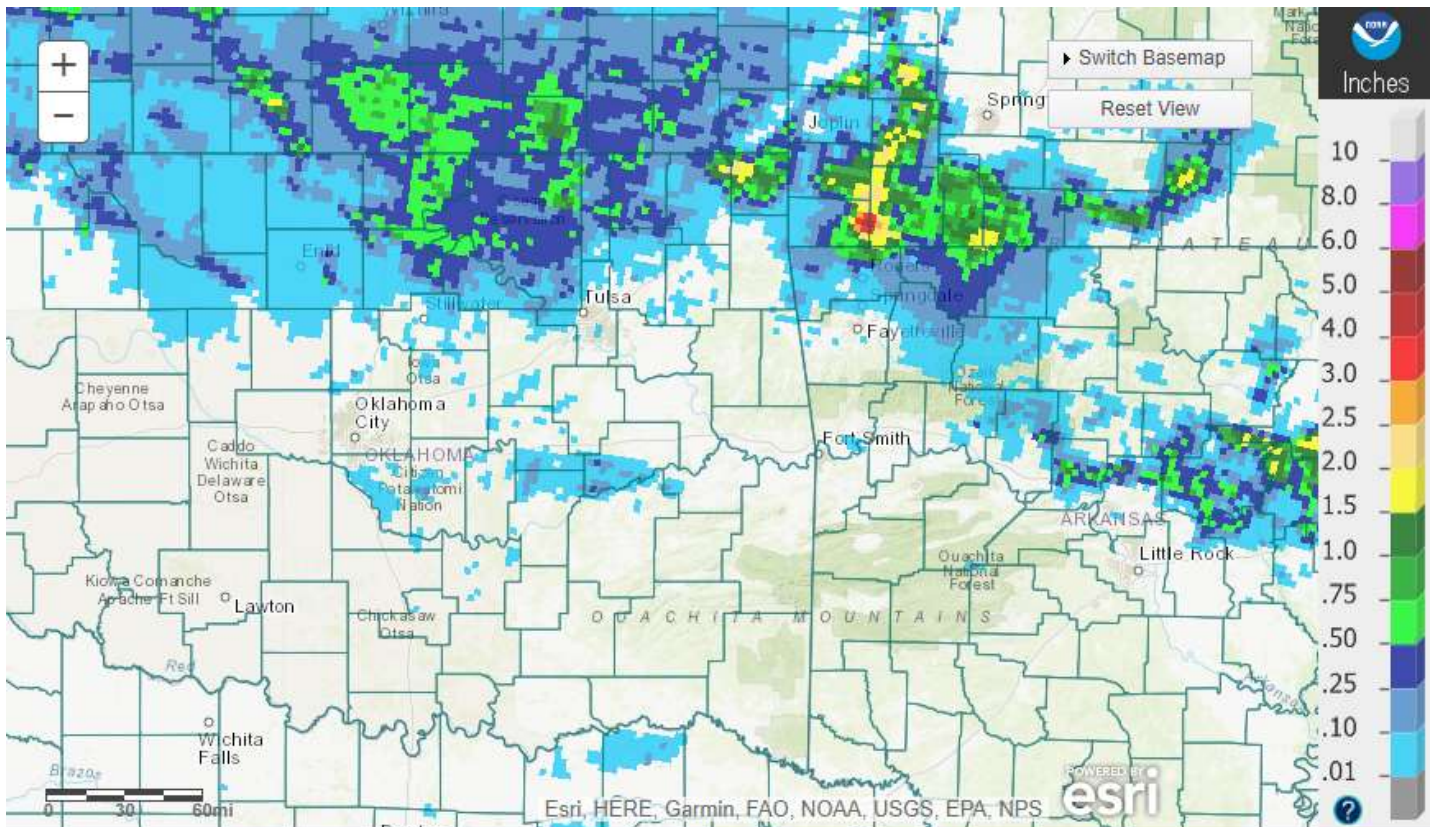
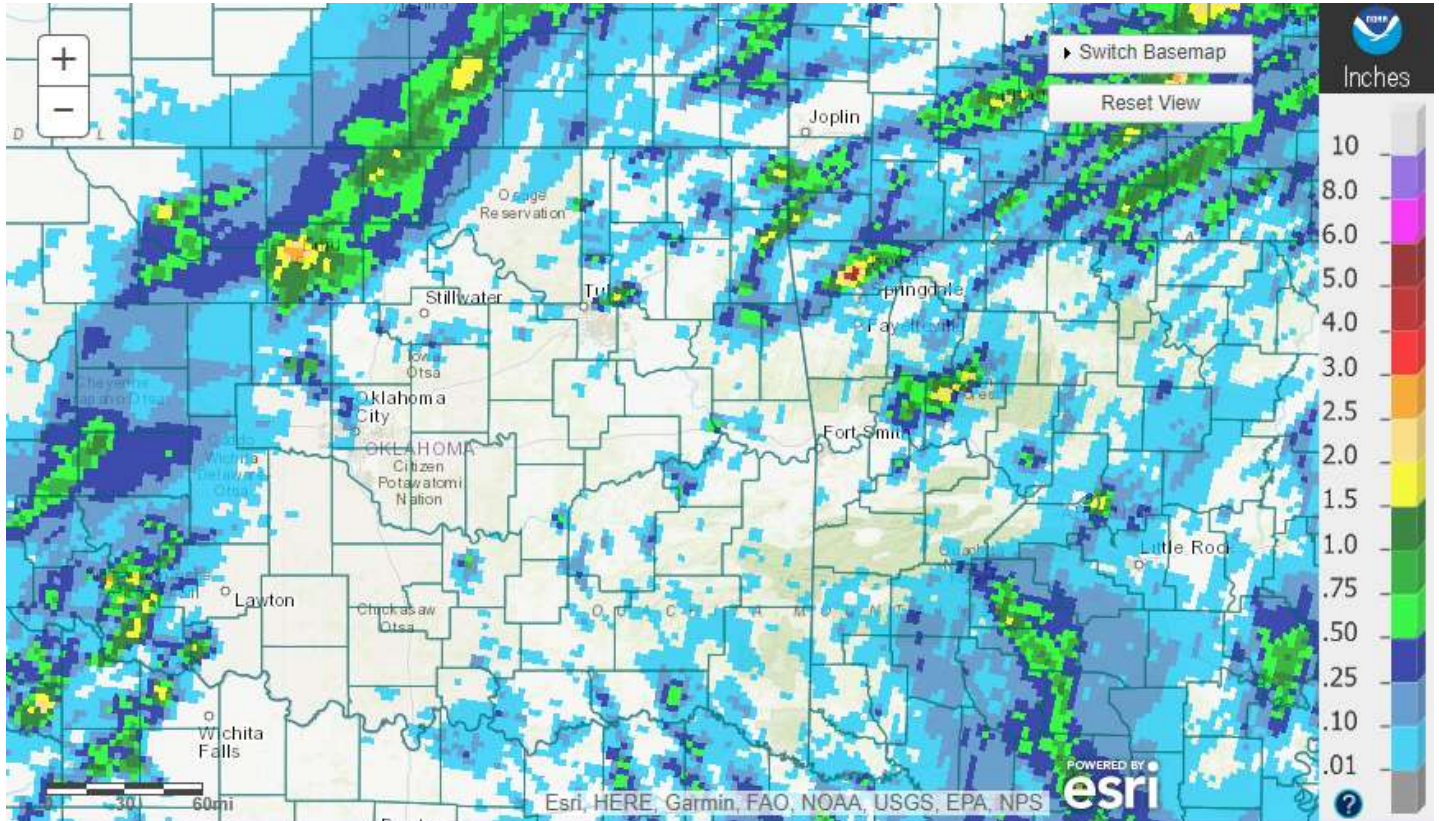


Fig. 10. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/14/2020.



Tulsa, OK: July 17, 2020 1-Day Observed Precipitation  
Valid on: July 17, 2020 12:00 UTC

Fig. 11. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/17/2020.



Tulsa, OK: July 22, 2020 1-Day Observed Precipitation  
Valid on: July 22, 2020 12:00 UTC

Fig. 12. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/22/2020.

Showers and thunderstorms developed near the OK/KS state line along a cold front during the late morning hours of the 27<sup>th</sup>. This activity slowly shifted south through the afternoon, dissipating by early evening. The showers and thunderstorms were widespread across northeast OK and a portion of east central OK, with isolated convection over northwest AR. Just before midnight, convection renewed as a mesoscale convective vortex (MCV) moved into eastern OK. This activity brought additional rainfall to locations primarily between I-44 and I-40 in eastern OK and northwest AR through sunrise on the 28<sup>th</sup>. Rainfall totals by 7 am CDT on the 28<sup>th</sup> ranged from around 0.25" to 4" (Fig. 13). An upper ridge continued to retrograde over the next few days, with an upper trough taking its place over the plains, resulting in numerous rounds of showers and thunderstorms through the end of the month.

An area of showers and thunderstorms developed over Creek, Pawnee, Okfuskee, and Okmulgee Counties during the morning of the 28<sup>th</sup> within a convergent zone of the low-level jet axis. This activity moved northeast into Tulsa, Wagoner, Rogers, and Osage Counties through the late morning and early afternoon before dissipating. Additional isolated convection then developed throughout eastern OK and northwest AR during the afternoon and evening hours. Most of this activity waned by midnight, though an area showers and isolated thunderstorms persisted through the overnight hours across northeast OK. Precipitable water (PWAT) values were around 2.2", which is three standard deviations above normal for this time of year, resulting in very efficient rain production. By 7am CDT on the 29<sup>th</sup>, rainfall totals ranged from around 0.25" to 1.5", with higher totals of 1.5" to around 3" over portions of Creek, Tulsa, and Okmulgee Counties (Fig. 14).

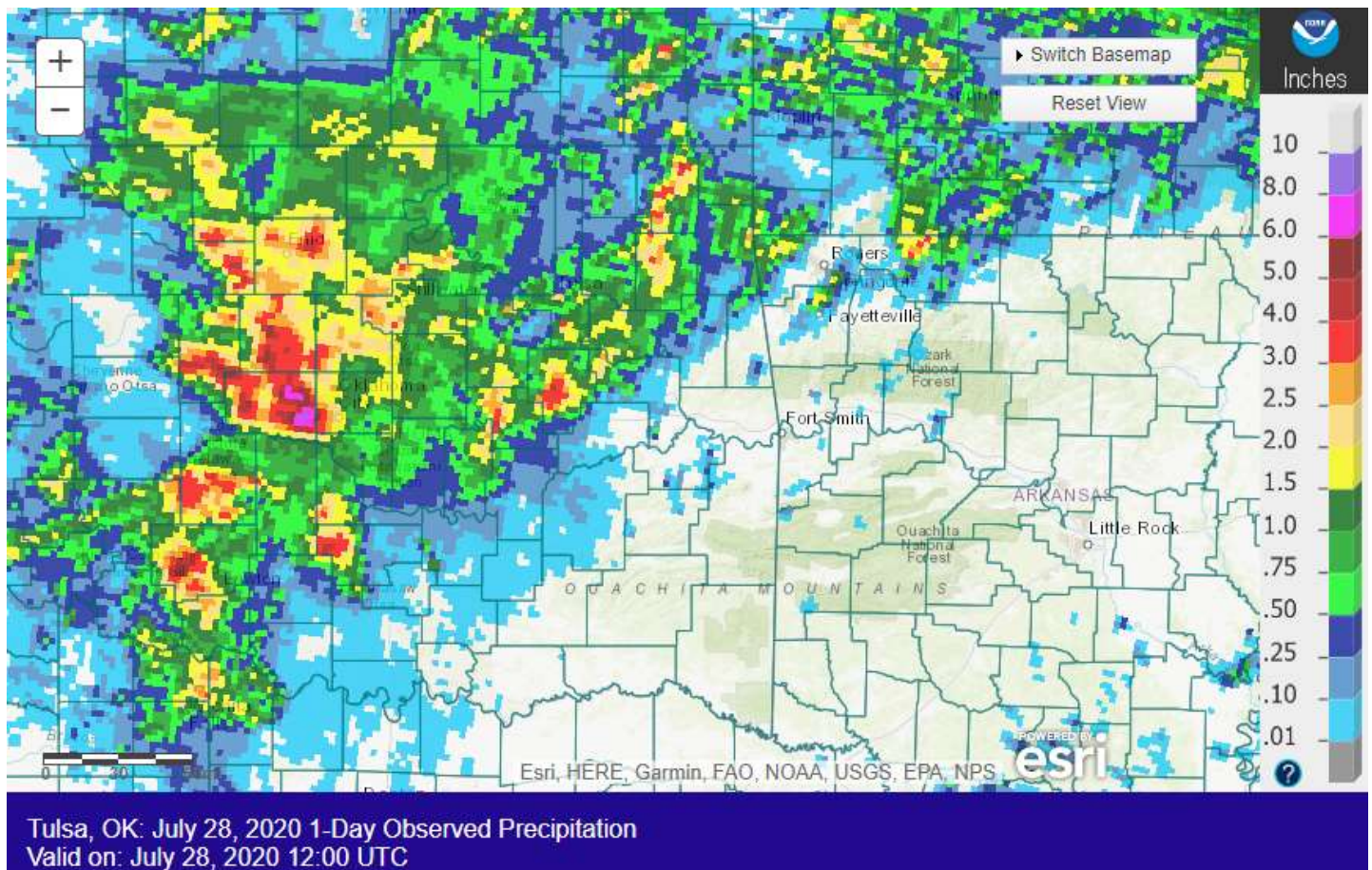
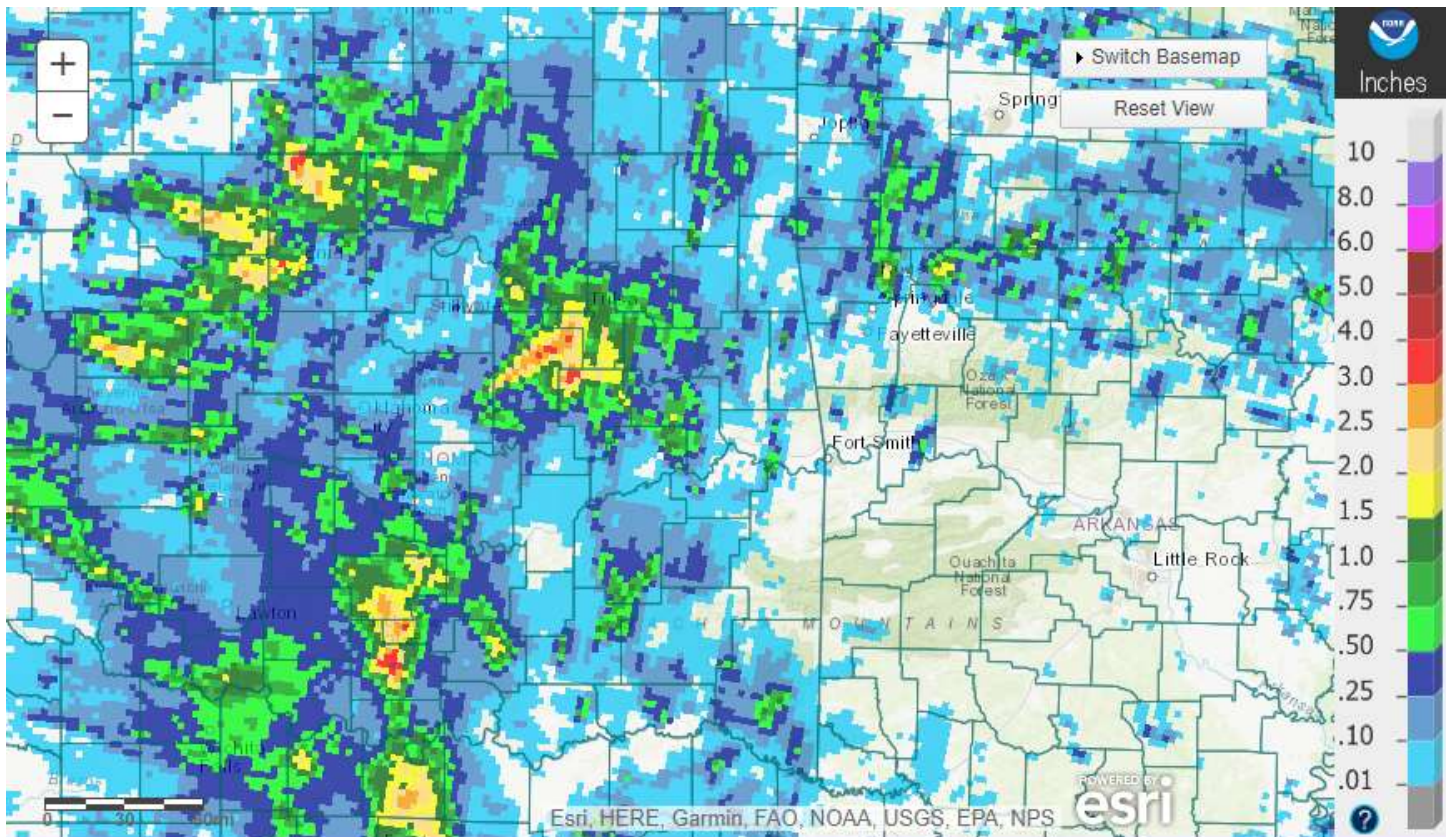
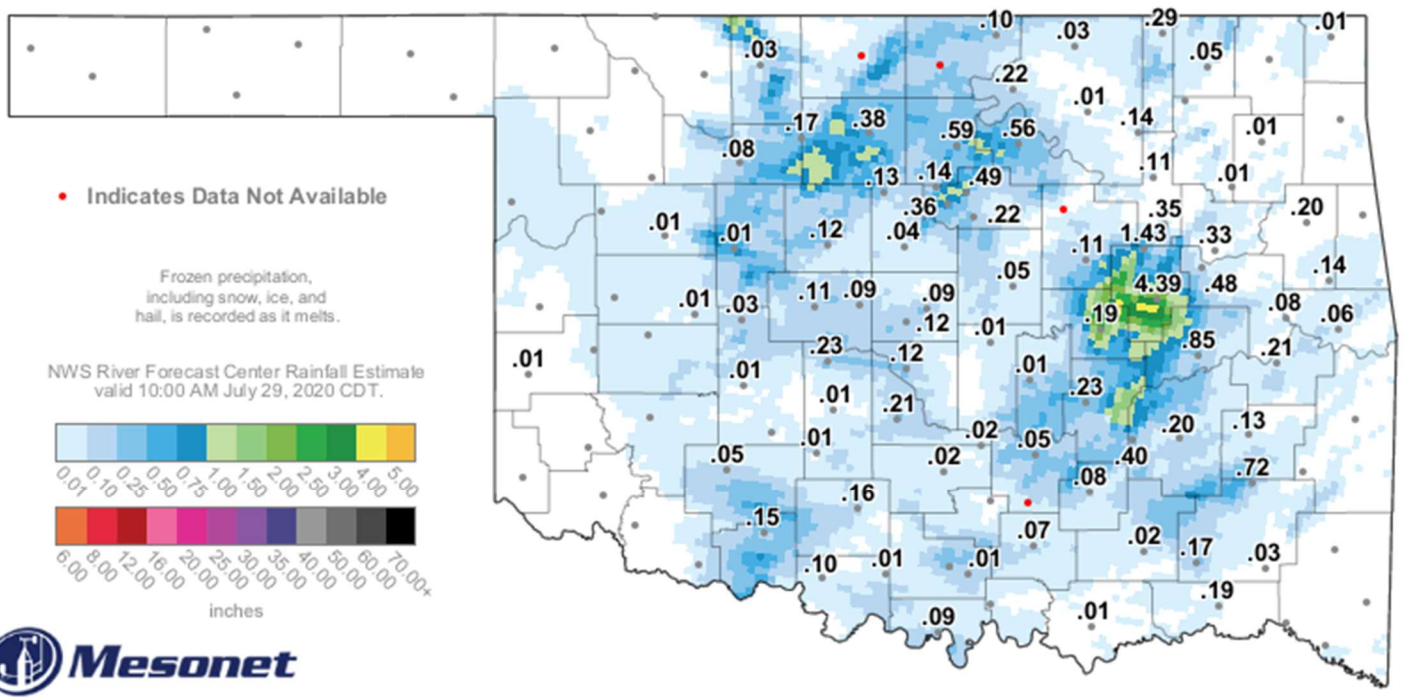


Fig. 13. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/28/2020.



Tulsa, OK: July 29, 2020 1-Day Observed Precipitation  
Valid on: July 29, 2020 12:00 UTC

Fig. 14. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/29/2020.

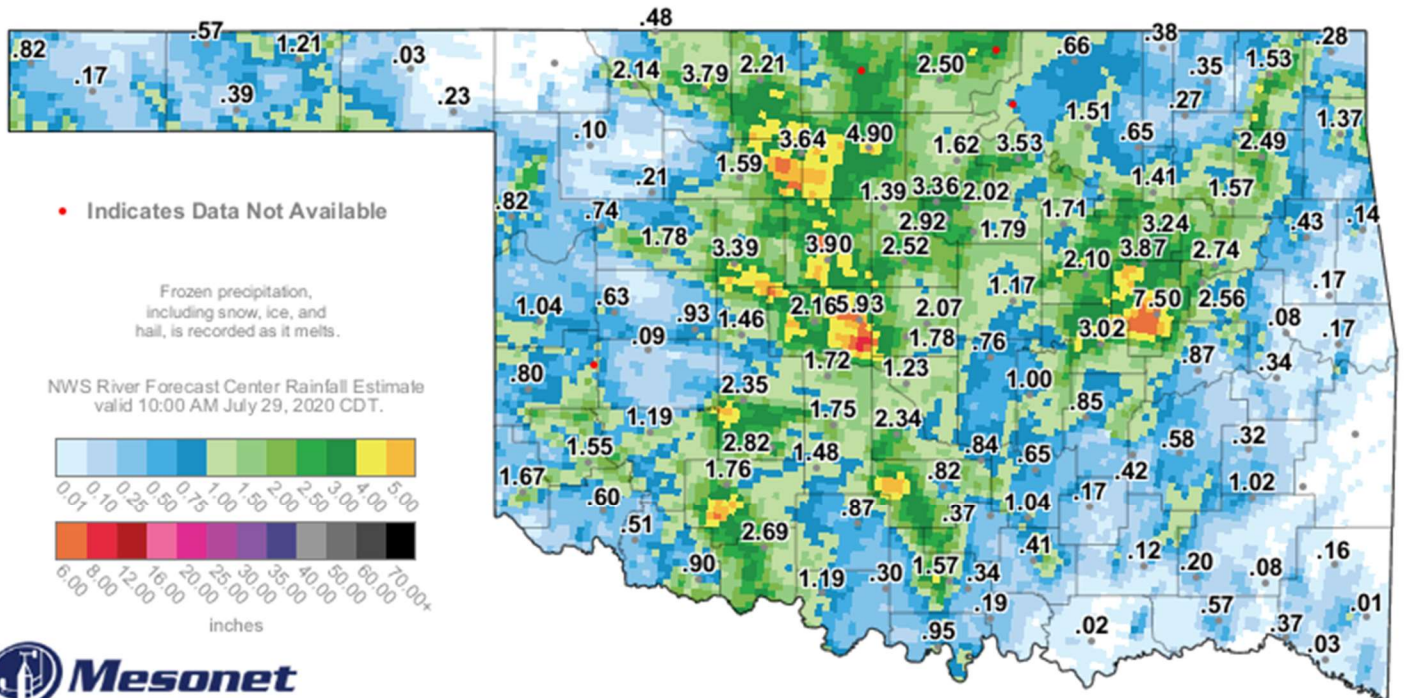


**3-Hour Rainfall Accumulation (inches)**

11:20 AM July 29, 2020 CDT

Created 11:25:49 AM July 29, 2020 CDT. © Copyright 2020

Fig. 15. OK Mesonet (values) and NWS RFC rainfall estimate (image) 3-hour rainfall ending at 11:20 am CDT 7/29/2020.



## 2-Day Rainfall Accumulation (inches)

11:25 AM July 29, 2020 CDT

Fig. 16. OK Mesonet (values) and NWS RFC rainfall estimate (image) 2-Day rainfall ending at 11:25 am CDT 7/29/2020.

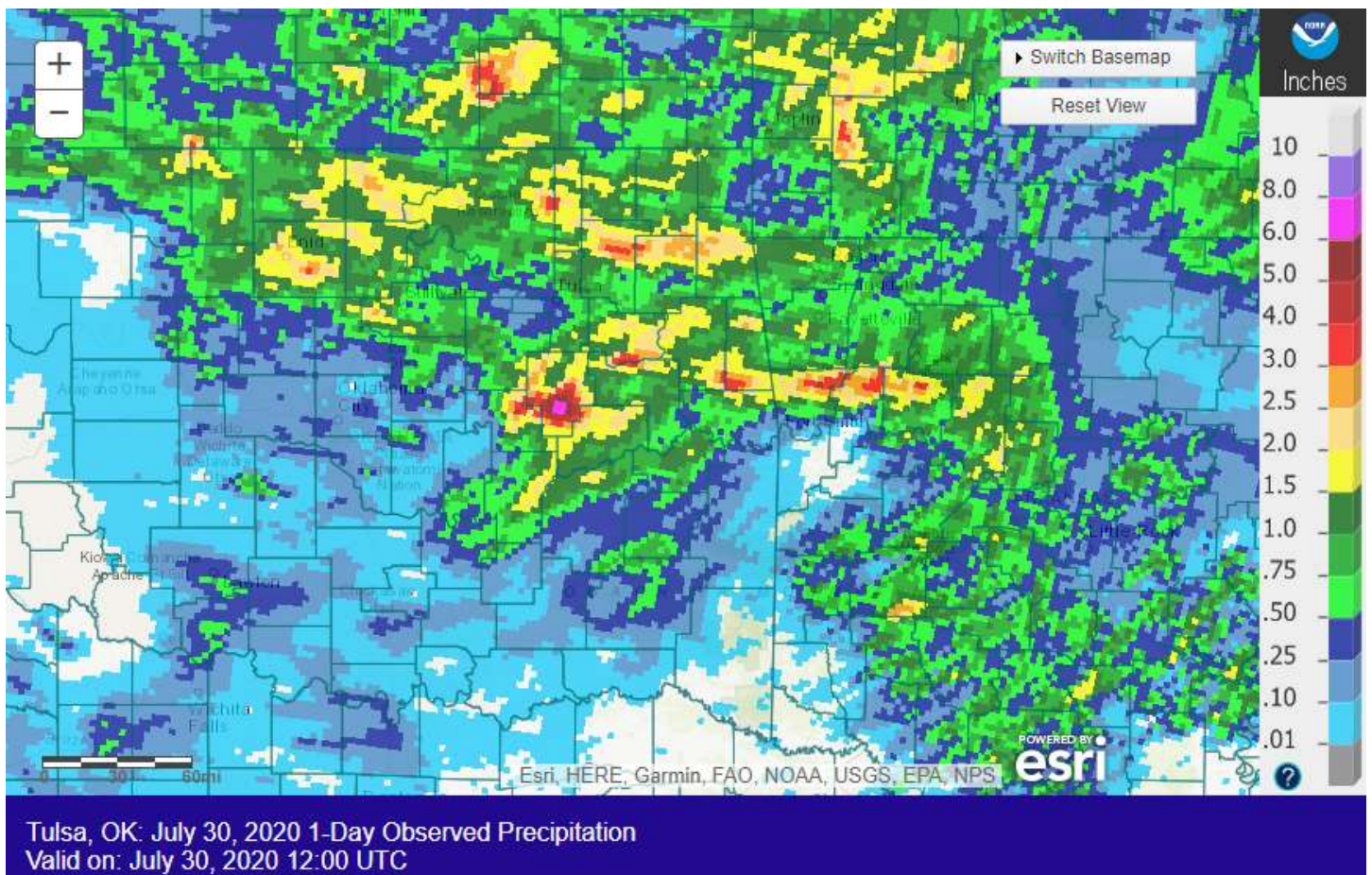
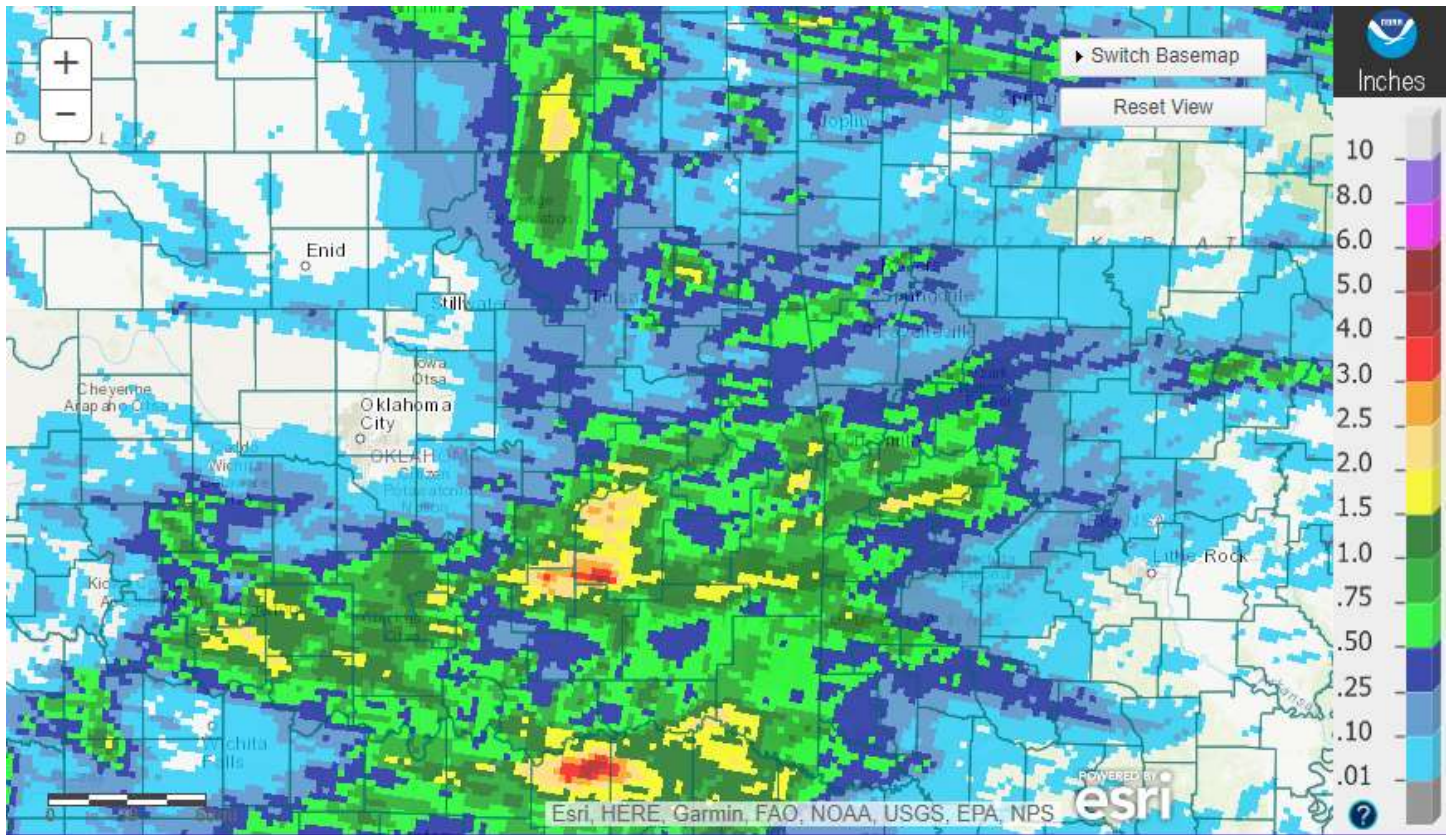


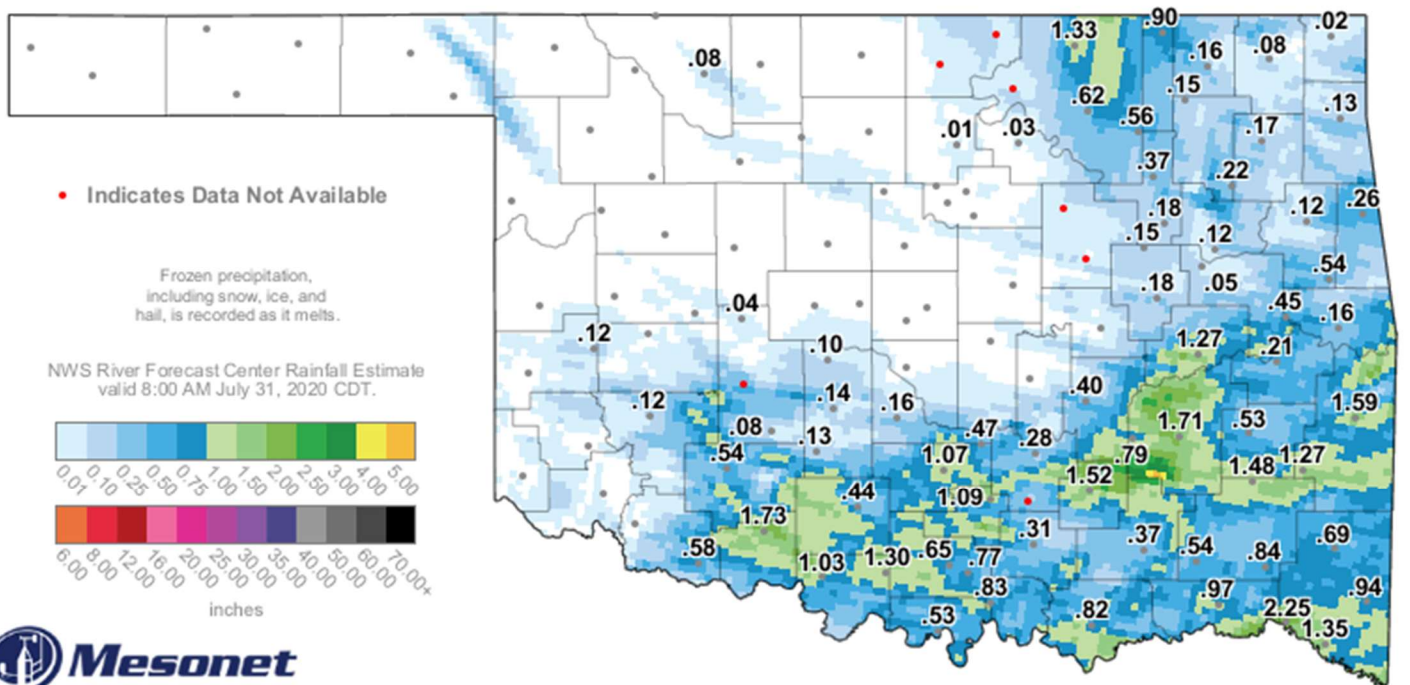
Fig. 17. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/30/2020.





Tulsa, OK: July 31, 2020 1-Day Observed Precipitation  
Valid on: July 31, 2020 12:00 UTC

Fig. 18. 24-hour Estimated Observed Rainfall ending at 7am CDT 7/31/2020.



**24-Hour Rainfall Accumulation (inches)**

9:35 AM July 31, 2020 CDT

Created 9:41:29 AM July 31, 2020 CDT. © Copyright 2020

Fig. 19. OK Mesonet (values) and NWS RFC rainfall estimate (image) 24-Hour rainfall ending at 9:35 am CDT 7/31/2020.

Showers and thunderstorms once again increased across eastern OK and northwest AR during the morning of the 29<sup>th</sup> in association with a subtle MCV-type feature. This activity shifted east of the area by mid-afternoon. A break in the rain was short-lived as isolated storms redeveloped north of I-40 by mid-evening. Additional convection moved south out of KS into northeast OK shortly before midnight. This activity moved southeast across northeast OK and northwest AR through the overnight and early morning hours. PWAT values remained highly anomalous for late July, with values around 2.5". Periods of heavy rain occurred with each round of storms. 3"-5" of rain fell over Okmulgee County in less than 3 hours during the morning of the 29<sup>th</sup> (Fig. 15), and street flooding was reported in Okmulgee, OK. Combined with rainfall from the previous day, a 2-day total of 4"-9" was observed in Okmulgee County (Fig. 16). By 7 am on the 29<sup>th</sup>, 24-hour rainfall totals throughout much of eastern OK and northwest AR ranged from around 0.50" to 4", with totals of 4"-7" in Okmulgee County (Fig. 17).

Another complex of storms moved into northeast OK from the west around sunrise on the 30<sup>th</sup> and quickly moved east across the region through the morning hours. By noon, scattered showers and thunderstorms remained along and south of I-40 along the outflow boundary from the morning's convection. These storms shifted to the southeast through the afternoon. By early evening, a cold front moved into southern OK, and new thunderstorms developed along it. These storms quickly developed into a thunderstorm complex that impacted southeast OK and west central AR along and south of I-40 through the remainder of the evening. A shortwave trough entered the region during the overnight hours, initiating additional scattered showers and thunderstorms across eastern OK and northeast AR. This activity finally dissipated by mid-morning of the 31<sup>st</sup>. Rainfall totals ranged from around 0.10" to 4", with the higher rainfall most widespread across southeast OK (Figs. 18, 19).

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### **Products issued in July 2020:**

\*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

- 7 Flash Flood Warnings (FFW)
- 7 Flash Flood Statements (FFS)
- 2 Flash/Areal Flood Watches (FFA) (6 Watch FFA CON/EXT/EXA/EXB/CAN)
- 19 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