

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	
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		REPORT FOR: MONTH March YEAR 2010
		SIGNATURE Steven F. Piltz (Meteorologist-in-Charge)
		DATE April 1, 2010

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 HSA during the month above.

After a quiet start to the month, a late winter storm brought heavy snowfall to eastern Oklahoma and northwest Arkansas on the first day of Spring. Overall, March 2010 received below average rainfall for the month, while many areas received above normal to record-breaking snowfall. Normal precipitation for the month of April ranges from 3.1 inches in Pawnee County to 4.7 inches in Latimer County. The Ozark region of northwest Arkansas averages 4.3 inches for the month.

Summary of Rain Events

March 1-14:

An upper-level system moving through central Texas brought light rain to locations south of I-40 on March 1. Rainfall totals were only a few hundredths to around one tenth of an inch. After several quiet weather days, light rain developed over southeast OK on the 7th as moisture increased ahead of an upper-level low. As the upper low deepened, widespread showers and isolated thunderstorms developed and swept rapidly to the northeast during the afternoon and evening hours on the 8th. This activity brought widespread rainfall totals from one quarter of an inch to around one inch.

A more potent upper-level system moved into the region on the 10th. Strong to isolated severe thunderstorms developed as a surface low, dryline, and cold front traversed the area during the afternoon and through the evening hours. Most of the HSA received around one tenth of an inch of rain from this activity, though locations across far northeast OK received one quarter to near one inch of rainfall. Golf ball sized (1.75") hail was also reported in Madison County, with a few reports of 0.75-1.0 inch hail reported in Wagoner, Ottawa, and Madison Counties. As the upper-level low meandered over the central plains, isolated to widely scattered light rain showers affected the region on the 11th and 12th but only brought a few hundredths of an inch of rainfall.

March 15-31:

Winter Storm March 20-21

A strong low pressure system brought a late winter storm to the region on the first day of Spring, March 20. A cold front initially moved through the HSA on the 19th, with a broken band of showers and thunderstorms occurring along and just behind the boundary. High temperatures on the 19th were in the upper 60s to low 70s followed by 3-hour temperature falls of over 25 degrees in the wake of the frontal passage. By early morning on the 20th, subfreezing temperatures had moved into northeast OK, which then progressed southeastward through the day. A mix of precipitation types occurred during the transition period, including sleet, freezing rain, and snow, before becoming all snow. As the strong low pressure system moved into central Arkansas on the 21st, bands of heavy snow brought rapid accumulations and over a foot of snow to portions of far east central OK and northwest AR. Widespread snowfall totals in excess of 6 inches were observed across a large portion of the HSA (see Fig. 1). The highest measured snowfall total was 15.0" at an approximate elevation of 2200 feet on Devils Den Rd 3NW of Wilson, AR and the highest estimated total was 15.5" in Hogeye, AR (both in Washington County). All of the snow and sleet lead to many car accidents and created power outages across

portions of east central OK and northwest/west central AR. As the low pressure system continued to push east on the 21st, surface and low-level temperatures began to rise above freezing.

The snow transitioned back to sleet and then rain, with a few locations receiving some minor freezing rain accumulation on elevated surfaces. Rapid melting then ensued, with a large portion of the snow disappearing on the 22nd as temperatures rebounded into the mid 50s to low 60s. Temperatures in the upper 60s to mid 70s melted most of the remaining snow on the 23rd. Liquid equivalent estimates from this event (March 19-21) ranged from half an inch across the northwest and southern portions of the HSA to over 2 inches across portions of east central OK and northwest AR (Fig. 2). This event created minor rises on area rivers and streams; however, no flooding occurred.

- Fort Smith, AR recorded an event total 7.5" inches of snow from this storm (2.0" 03/20 and 5.5" 03/21), breaking several records:
- * Record calendar day snowfall total in MARCH: 5.5" March 21, 2010 (previous record 5.0" March 12, 1890)
 - * Record 2-day snowfall total in MARCH: 7.5" March 20-21, 2010 (previous record 5.3" March 11-12, 1968)
 - * Latest 1" or greater snowfall: 5.5" March 21, 2010 and 7.5" March 20-21, 2010 (previous records 3.2" March 17-18, 1891 and 1.7" March 18, 1934)
 - * Highest monthly snowfall for MARCH: 7.5" March 2010 (previous record 5.3" March 1968)
 - * Record snowfall for March 20th: 2.0" March 20, 2010 (no previous record)
 - * Record snowfall for March 21st: 5.5" March 21, 2010 (no previous record)

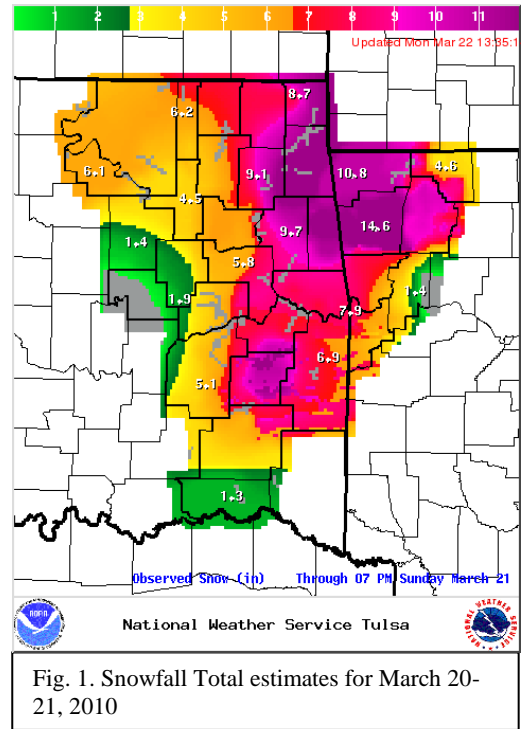


Fig. 1. Snowfall Total estimates for March 20-21, 2010

A slow moving cold front stalled across the area on the 24th, before shifting east overnight and into the early morning hours of the 25th. Precipitation increased during the afternoon and evening hours, with a line of thunderstorms developing along the cold front across far southeast OK and northeast TX. This activity brought from one half to around 2 inches of rain to far southeast OK and west central AR. Showers and thunderstorms continued through the first part of the 25th near the surface low as it moved out of northeast OK into northern AR. Additional rainfall wrapping around the lagging upper low continued into the early afternoon hours, before ending from west to east across the HSA. Rainfall totals were generally around one quarter to near one inch throughout the area, though portions of far northeast and east central OK received over one inch of rainfall (see Fig. 3). The highest totals of 2 to near 4 inches occurred across Ottawa and northern Delaware Counties. This persistent rainfall across northeast OK led to flash flooding, and road closures were reported in Mayes, Ottawa, and Delaware Counties. River rises occurred across northeast and east central OK as well. Minor flooding occurred along the Spring River near Quapaw and the Neosho River near Commerce (refer to E3 report for details). The Illinois River near Tahlequah reached action stage but remained below flood stage, while the Poteau River near Panama and the Arkansas River near Muskogee came to within one foot of flood stage.

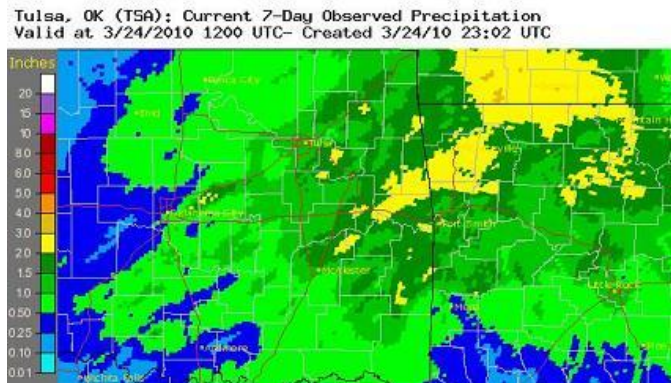


Fig. 2. March 19-21 storm total liquid precipitation estimates

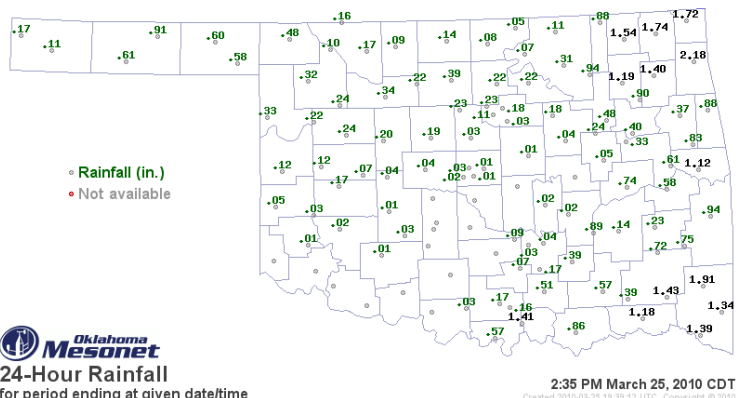


Fig. 3. 24-hour rainfall totals ending at 2:35 pm 03/25/10. Courtesy of OCS.

Another low pressure system moved across northern OK and into northern AR on the 27th. Showers and thunderstorms developed within an area of warm air advection and ahead of the surface low that tracked near the OK/KS state line. This activity primarily affected far eastern OK and northwest AR, where rainfall totals were generally one half inch or less. Hail ranging from pea to quarter size was reported in northwest AR.

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 4a.), rainfall totals for March 2010 showed a west to east gradient, with values ranging from 1.5-3.0” across the western HSA to 3.0-5.0” further east. However, much of Ottawa and northern Delaware Counties had March totals in excess of 5.0”. These totals correspond to below normal March precipitation (see Fig. 4b) for all but far northeast OK. A large portion of the HSA only received 50%-75% of the average rainfall for March.

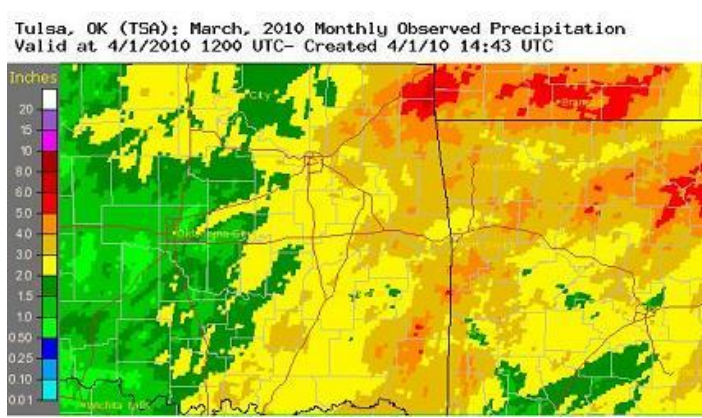
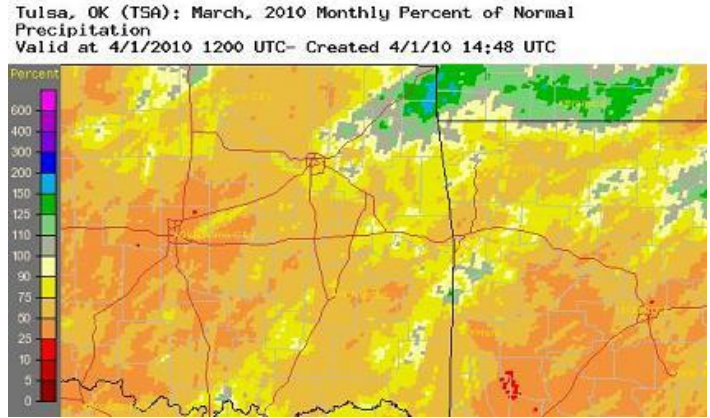


Fig. 4a. Estimated Observed Precip. for March 2010



4b. Estimated % of Normal Precip. for March 2010

After receiving 5.7” of total snow this month, the March winter storm brought the cold season 2009-2010 snowfall total for Tulsa, OK to 22.8”. This makes 2009-2010 the 2nd snowiest cold season since records began in 1900 (record is 25.6” in 1923-24). Interestingly, 2 of the top 3 snowiest cold seasons have occurred in the last 7 years: #2 2009-10 with 22.8” and #3 (tie) 2002-03 with 20.4”.

Fort Smith, AR ranked as the 6th snowiest cold season with a total of 18.5”. Fort Smith also set an all-time record snowfall for the month of March with 7.5” from the March 20-21, 2010 storm. The previous March record was 5.3” in March 1968. (Refer to the winter storm summary above for additional snowfall records broken in Fort Smith this month.)

In Tulsa, OK March 2010 ranked as the 51st coldest March (50.4°F, since records began in 1905), was the 47th wettest March (3.25”, since records began in 1888), and the 15th snowiest March (5.7”, since records began in 1900). Fort Smith, AR was the 57th coldest March (51.4°F), the 55th driest March (2.62”), and 1st snowiest March (7.5”) since records began in 1883.

Some of the larger precipitation reports (in inches) for March 2010 included:

Jay, OK (meso)	5.18	Berryville 5NW, AR (coop)	4.78	Ozark, AR (coop)	4.61
Eureka Springs 3WNW, AR (coop)	4.44	Cookson, OK (meso)	4.30	Claremore, OK (meso)	4.21
Miami, OK (meso)	4.15	Pryor, OK (meso)	3.90	Odell 2N, AR (coop)	3.79

According to the [U.S. Drought Monitor](#) (USDM) from March 30, 2010, drought conditions did not exist across northeast OK and northwest AR.

The major reservoirs in the Tulsa HSA reported full conservation pools and flood control pool levels within 6% as of April 1, 2010. However, the following reservoirs were reporting a higher percentage of storage within the flood pool: Eufaula Lake 10%, Oologah Lake 13%, Tenkiller Lake 15%, and Pensacola Lake 22%

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

Rank since 1921 ("Last XX days" ending March 31, 2010)	March 2010	Year-to- Date 2010	Last 60 days (Jan. 31 – Mar. 31)	Water Year (Oct. 1 – Feb. 28)	Last 120 days (Dec. 2 – Mar. 31)	Last 365 days (Apr. 1, 2009 – Mar. 31, 2010)
Northeast OK	44 th wettest	37 th wettest	37 th wettest	26 th wettest	42 nd wettest	19 th wettest
East Central OK	39 th driest	42 nd driest	44 th wettest	24 th wettest	42 nd driest	16 th wettest
Southeast OK	36 th driest	30 th wettest	40 th wettest	11 th wettest	31 st wettest	1 st wettest

The [Climate Prediction Center](#) (CPC) outlook for April 2010 (issued March 31, 2010) indicates an enhanced chance for above median precipitation and an equal chance for above, near, and below average temperatures. Despite an expectation for El Niño to continue through April, shorter term model forecasts indicate a pattern contrary to the typical atmospheric pattern during El Niño for the first part of April. This model output was combined with typical El Niño responses as well as the effects on temperature from soil moisture and 'greening-up' vegetation, to influence this low confidence outlook. For the 3-month period Apr-May-Jun 2010, CPC is forecasting a slightly enhanced chance for below average temperatures and equal chances for above, near, and below median precipitation (outlook issued March 18, 2010). Sea-surface temperatures in the equatorial Pacific indicate that moderate El Niño conditions currently exist. According to CPC, El Niño is expected to continue, though gradually weaken, through the spring. The three-month outlook for the Southern Plains is consistent with the general impacts expected during El Niño events and global climate model output. An El Niño Advisory remains in effect.

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Products issued:

- 2 River Flood Warnings (FLW)
- 10 River Flood Statements (FLS)
- 1 River Flood Advisories (FLS) (3 Advisory FLS CON/EXT/CAN)
- 0 River Flood Watches (FFA) (0 Watch FFA CON/EXT/CAN)
- 0 River Statements (RVS)
- 1 Hydrologic Outlooks (ESF)
- 0 Drought Information Statements (DGT)