9-1-2019

2019 September - Tennessee Monthly Climate Report

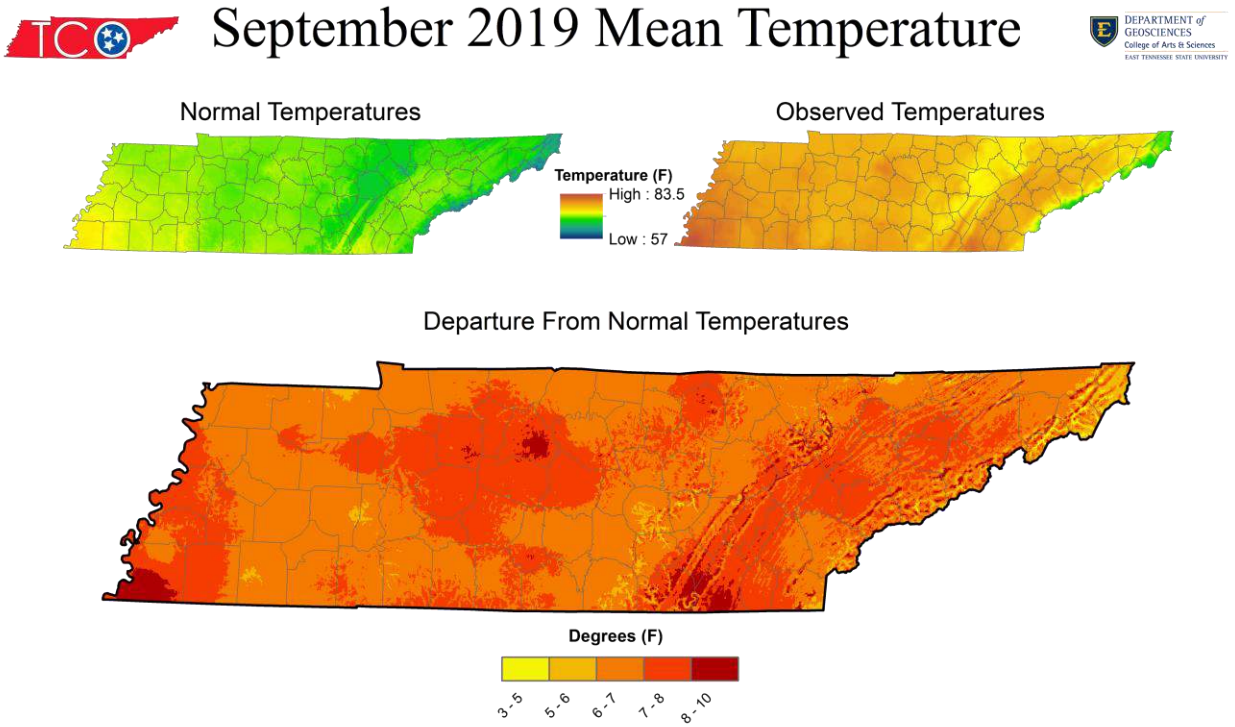
Tennessee Climate Office, East Tennessee State University

September 2019 Tennessee State Climate Summary

*Tennessee Climate Office * East Tennessee State University*
Prepared by William Tollefson and Dr. Andrew Joyner
With contributions by Climate Data Representatives at University of Tennessee-Martin, Vanderbilt University, and University of Tennessee-Institute of Agriculture

Monthly Temperature Summary:

September is the time when temperatures usually start to drop as fall begins, but this year summer temperatures remained for the entire month. In fact, 120 of the 149 weather stations that reported temperatures this month observed their warmest day of 2019 in September, with at least one station recording the warmest day of the year each day from September 10th to the 19th. September brought record setting heat across the state of Tennessee, with all locations averaging more than 3˚F above normal. Memphis, Nashville, and Chattanooga each recorded mean temperatures for the month over 8˚F above normal. Many cities across the state, including Memphis, Jackson, Clarksville, Nashville, Crossville, Oak Ridge, Knoxville, Chattanooga, and the Tri-Cities, recorded multiple days with record high temperatures in September, you can read more about the heat in the story of the month section of this report on pages 13-17.



Stations with the highest mean temperature

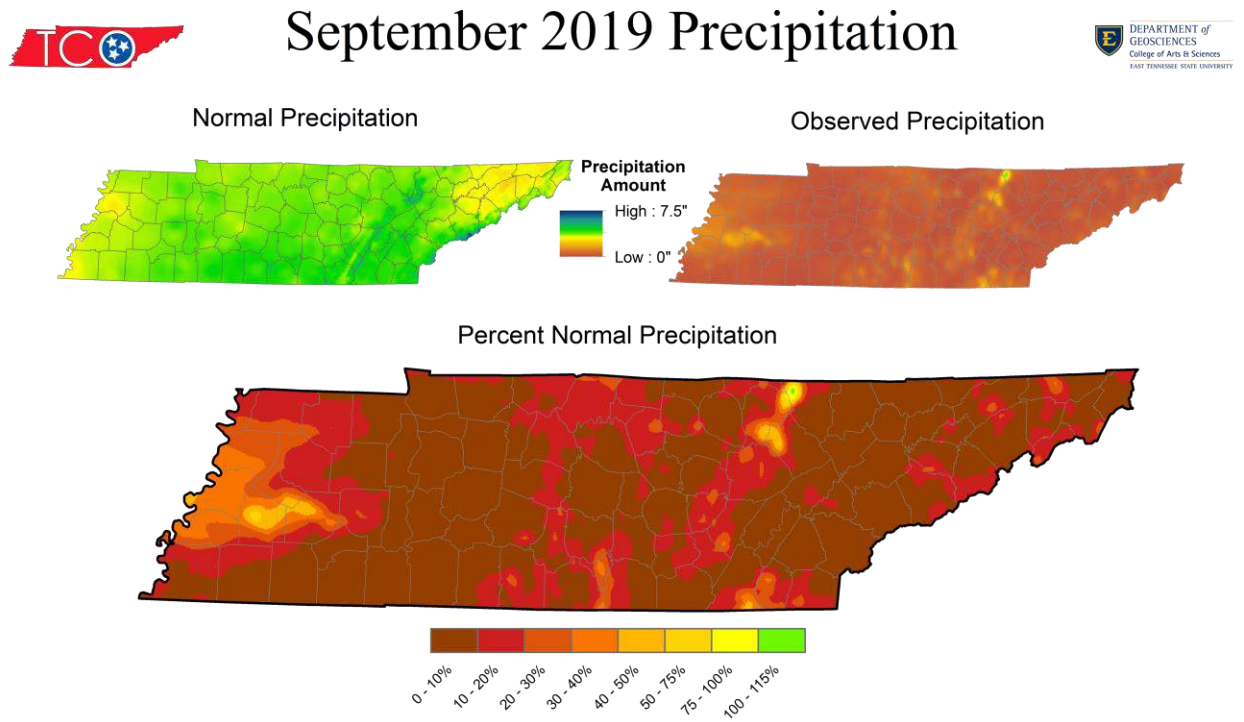
Station Name	Station Type	Mean Temperature (F)
MEMPHIS INTERNATIONAL AP	WBAN	83.5
GERMANTOWN 4SE	COOP	82.3
MEMPHIS WFO	WBAN	81.4
CHATTANOOGA AP	WBAN	81.1
NASHVILLE INTL AP	WBAN	80.4

Map Data From: PRISM Climate Group, Oregon State University.
1981-2010 Normals Used
Station Data retrieved from SC ACIS2

Stations with the lowest mean temperature

Station Name	Station Type	Mean Temperature (F)
MT LECONTE	COOP	58.4
NEWFOUND GAP	COOP	66.2
ROAN MOUNTAIN 3SW	COOP	67.5
CHEROKEE TENNESSEE	RAWS	69.9
CROSSVILLE EXP STN	COOP	70.4

Monthly Precipitation Summary:



Stations with the most precipitation

Station Name	Station Type	Total Precipitation (in)
CLEVELAND 4.1 NNE	CoCoRaHS	3.26
LYNCHBURG	COOP	2.98
TULLAHOMA 4NE	COOP	2.36
ALTAMONT 3.9 NW	CoCoRaHS	2.18
MT LECONTE	COOP	2.09

Map Data From: PRISM Climate Group, Oregon State University.
1981-2010 Normals Used
Station Data retrieved from SC ACIS2

Stations with the least precipitation

Station Name	Station Type	Total Precipitation (in)
HOHENWALD	COOP	0
KINGSPORT	COOP	0
SODDY DAISY-MOWBRAY MTN	COOP	0
CHEATHAM LOCK & DAM	COOP	0
LEWISBURG 6.2 SSE	CoCoRaHS	0

Along with the heat, dry conditions continued from August into September, with over half of the state recording less than 10% normal rainfall for the month. Five rain gauges in the state recorded zero inches of rain for the month, an additional six gauges reported only a trace (less than 0.01”) of rain during the month, and only one station reported a monthly rainfall total of more than 3”. Only 12% of rain gauges across the state reported a monthly rainfall total of 1” or more. This dryness only compounded the heat across the state, allowing daytime high temperatures to soar 8-10 degrees above normal for the month. Both the high heat and extremely dry patterns were caused by a strong high pressure system that dominated weather for the month. This strong high pressure kept cold fronts and precipitation well to the west and north of the state.

Three long-term climate stations in the state recorded their driest September on record: the Nashville area station with only 0.02” of rain, the Knoxville area station with only 0.03” of rain, and the Oak Ridge area station with only 0.13” of rain.

Putting our current dryness in perspective, even with the extremely dry pattern this month, most areas of the state are still above normal rainfall totals for the year to-date, due to the record wet February, and the generally wetter than average spring and summer seasons. However, the quick shift from above normal rainfall to virtually no rainfall coupled with the much warmer than normal temperatures produced rapid drying of surface soil moisture, and noticeable drought impacts across the state.

Station Data and Top Tenn. (warmest/wettest, coldest/driest stations of the month):

Station data for airports across the state using WBAN weather stations:

Station Name	Temperatures (˚F)								Precipitation (inches)		
	Averages				Extremes				Totals		
	High	Low	Mean	Departure	High	Date	Low	Date	Obs	Departure	%Norm
Memphis	93.7	73.3	83.5	+8.3	100	09/16	68	09/24	0.12	-2.97	4%
Jackson	92.2	64.1	78.1	+6.7	99	09/17	54	09/24	1.07	-2.31	32%
Clarksville	90.8	63.2	77	+6.9	96	09/16	54	09/25	0.31	-3.22	9%
Nashville	93.2	67.6	80.4	+8.9	99	09/16	57	09/25	0.02	-3.39	1%
Chattanooga	94.4	67.8	81.1	+8.6	103	09/13	58	98/25	0.56	-3.48	14%
Crossville	85.8	60.9	73.3	+6.1	91	09/13	49	09/25	0.53	-3.35	14%
Knoxville	90.8	66	78.4	+7.3	97	09/13	55	09/25	0.03	-3.21	1%
Bristol	88.3	60.6	74.4	+7.3	96	09/13	52	09/25	0.68	-2.31	23%

Departures and %Norm Key: **Warmer than Normal**, **Cooler than Normal**; **Wetter than Normal**, **Drier than Normal**

Hottest Stations (highest maximum temperature)

Station Name	Station Type	Highest Temperature (F)
CHATTANOOGA AP	WBAN	103
WOODBURY 1 WNW	COOP	103
MEMPHIS INTERNATIONAL AP	WBAN	100
MEMPHIS WFO	WBAN	100
SHILOH NMP TENNESSEE	RAWS	100
JACKSON MCKELLAR- SIPES AP	WBAN	99
NASHVILLE INTL AP	WBAN	99
MERIWETHER LEWIS TENNESSEE	RAWS	99
SEWANEE	COOP	99
ATHENS	COOP	99
LEWISBURG EXP STA	COOP	99
OLD HICKORY DAM	COOP	99
LEBANON 7 N	COOP	99
CAMDEN	COOP	99
NASHVILLE BERRY FIELD	COOP	99
GERMANTOWN 4SE	COOP	99

Coldest Stations (lowest minimum temperature)

Station Name	Station Type	Lowest Temperature (F)
MT LECONTE	COOP	37
PORTLAND SEWAGE PLANT	COOP	43
PICKETT STATE PARK	COOP	46
TAZEWELL	COOP	47
ROAN MOUNTAIN 3SW	COOP	47
CROSSVILLE 7 NW	WBAN	48
BLEDSOE SF TENNESSEE	RAWS	48
SMITHVILLE 2 SE	COOP	48
CROSSVILLE EXP STN	COOP	48
ONEIDA	COOP	48

Warmest Stations (highest mean temperatures)

Station Name	Station Type	Mean Temperature (F)
MEMPHIS INTERNATIONAL AP	WBAN	83.5
GERMANTOWN 4SE	COOP	82.3
MEMPHIS WFO	WBAN	81.4
CHATTANOOGA AP	WBAN	81.1
NASHVILLE INTL AP	WBAN	80.4
SHILOH NMP TENNESSEE	RAWS	80.2
LEWISBURG TOWER TENNESSEE	RAWS	80.1
NASHVILLE BERRY FIELD	COOP	79.8
CAMDEN TOWER TENNESSEE	RAWS	79.5
SAVANNAH 6 SW	COOP	79.5

Coolest Stations (lowest mean temperatures)

Station Name	Station Type	Mean Temperature (F)
MT LECONTE	COOP	58.4
NEWFOUND GAP	COOP	66.2
ROAN MOUNTAIN 3SW	COOP	67.5
CHEROKEE TENNESSEE	RAWS	69.9
CROSSVILLE EXP STN	COOP	70.4
GATLINBURG 2 SW	COOP	71.2
TAZEWELL	COOP	71.4
TOWNSEND 5S	COOP	71.4
CROSSVILLE 7 NW	WBAN	71.5
COALMONT	COOP	71.5

Wettest Stations (highest precipitation totals):

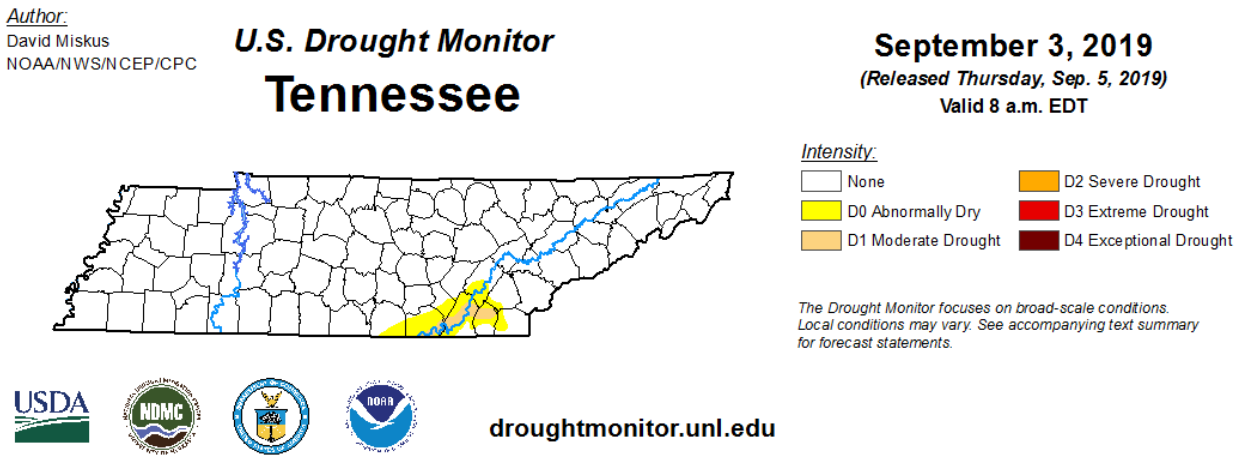
Station Name	Station Type	Total Precipitation (in)
CLEVELAND 4.1 NNE	CoCoRaHS	3.26
LYNCHBURG	COOP	2.98
TULLAHOMA 4NE	COOP	2.36
ALTAMONT 3.9 NW	CoCoRaHS	2.18
MT LECONTE	COOP	2.09
JACKSON 5.9 NW	CoCoRaHS	2.07
JACKSON 4.7 NW	CoCoRaHS	2
OOLTEWAH 2.0 S	CoCoRaHS	1.96
WOODBURY 4.0 SE	CoCoRaHS	1.76
CLEVELAND FILTER PLANT	COOP	1.75
SAVANNAH 6 SW	COOP	1.75

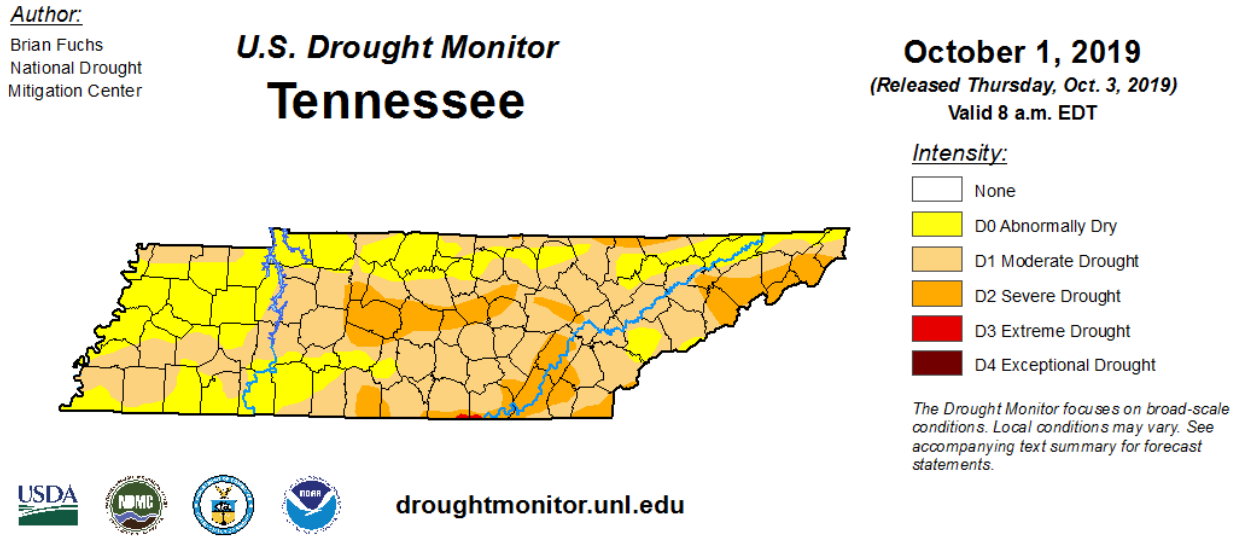
Driest Stations (lowest precipitation totals):

Station Name	Station Type	Total Precipitation (in)
HOHENWALD	COOP	0
KINGSPORT	COOP	0
SODDY DAISY-MOWBRAY MTN	COOP	0
CHEATHAM LOCK & DAM	COOP	0
LEWISBURG 6.2 SSE	CoCoRaHS	0
BOLIVAR WATER WORKS	COOP	T
COOKEVILLE	COOP	T
COLUMBIA 1.2 SSW	CoCoRaHS	T
JASPER 1.7 N	CoCoRaHS	T
PETROS 0.2E	CoCoRaHS	T
ROCKWOOD 11.3 S	CoCoRaHS	T

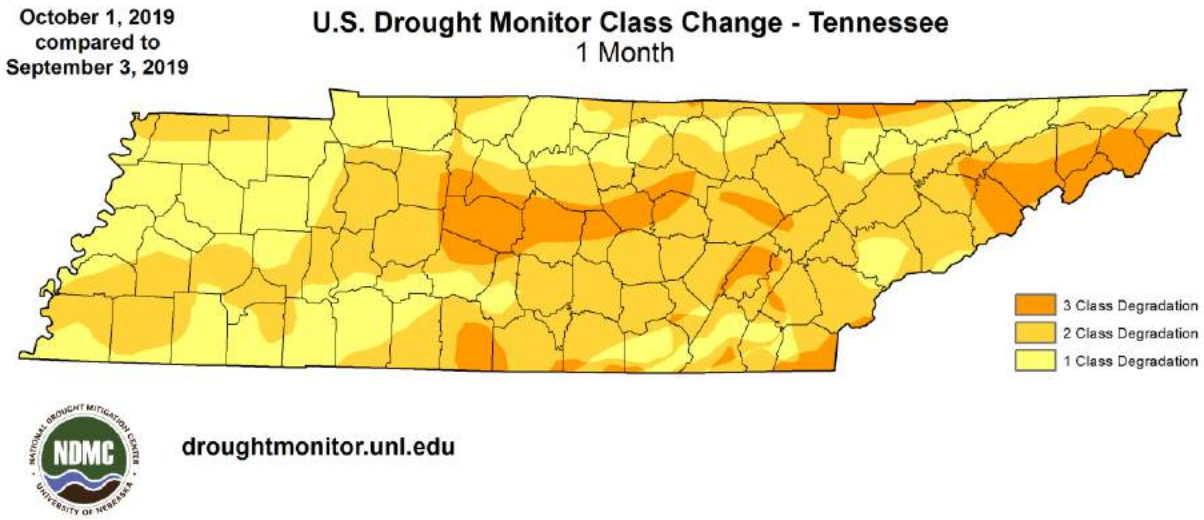
Drought Monitor:

The lack of rainfall and well above normal temperatures drove major expansion in drought conditions across the state during September. Tennessee started the month with only 4.24% of the state reporting drought conditions, but by October 1st 100% of the state was in some level of drought. The strongest drought (D3-Extreme Drought) was found in 0.10% of the state, in parts of Franklin and Marion counties at the border with Alabama, while D2 (Severe Drought) covered 15.8% of the state, mainly in East and Middle Tennessee.



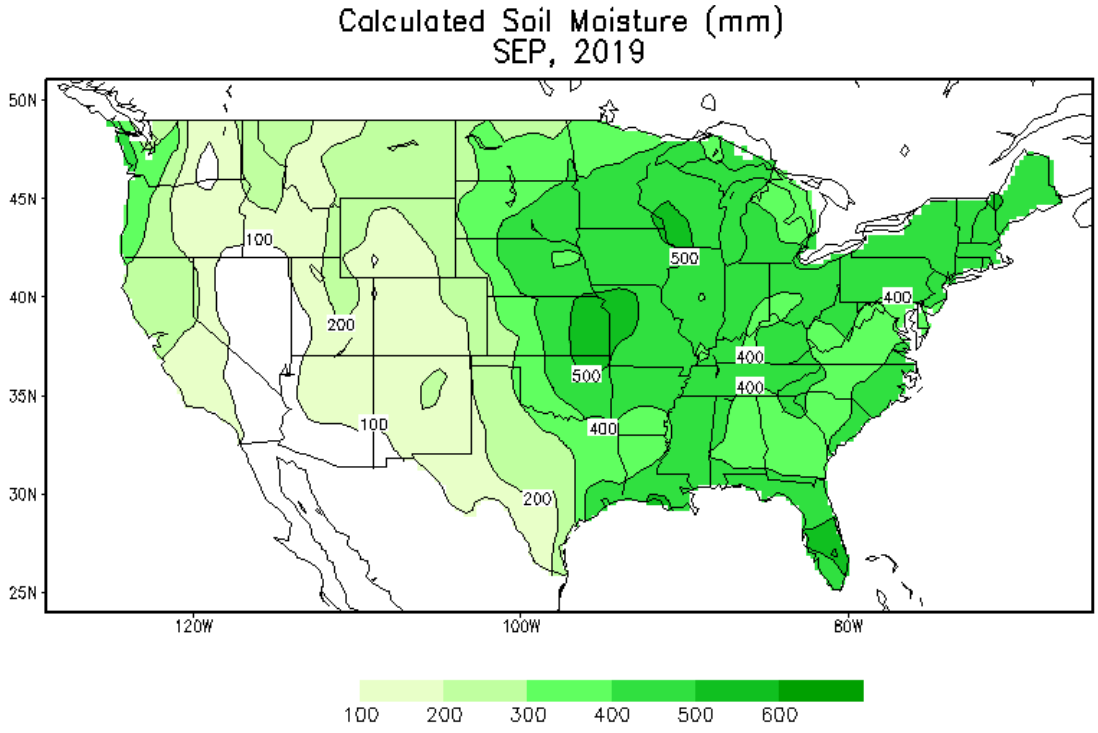


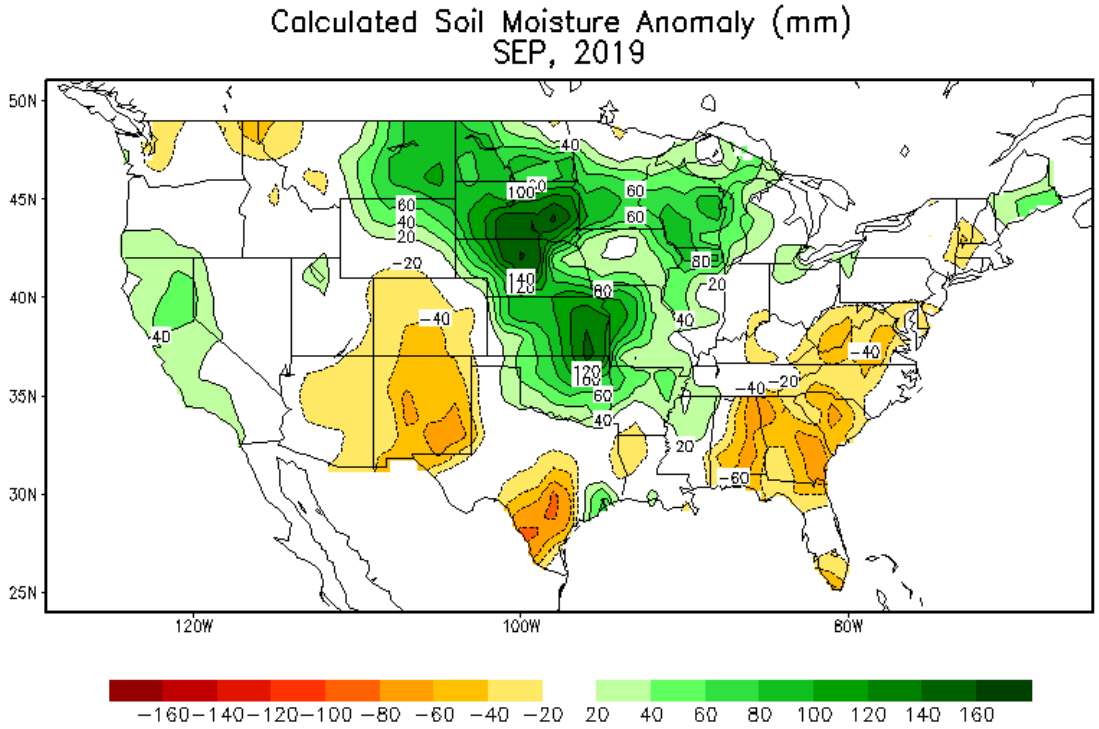
This can also be seen by looking at the 1-month change map from the Drought Monitor, where all areas of the state experienced at least a one class degradation in conditions, but some areas saw drought conditions degrade by three classes.



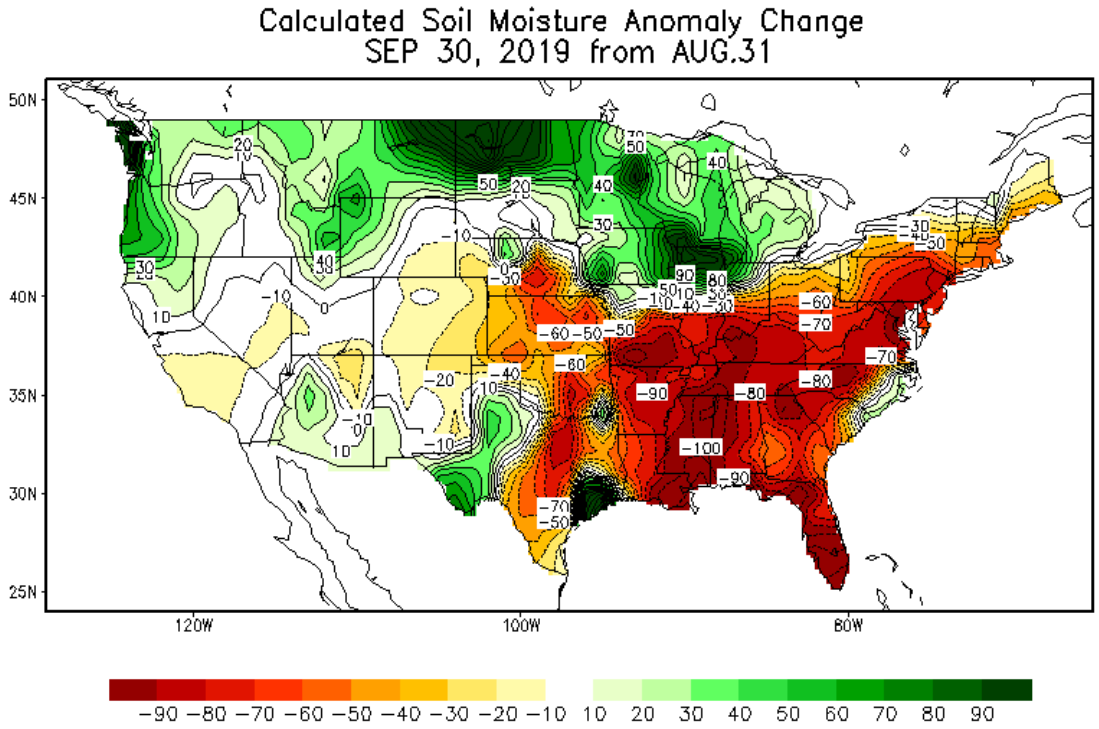
Soil Moisture:

Soil moisture across the state was close to 400mm when averaged for the month, which was within 20mm of normal for September. Some areas in southwest Tennessee, had slightly higher than normal soil moisture for the month, while the eastern end of the state recorded soil moisture averaging 20-40mm below normal for the month.



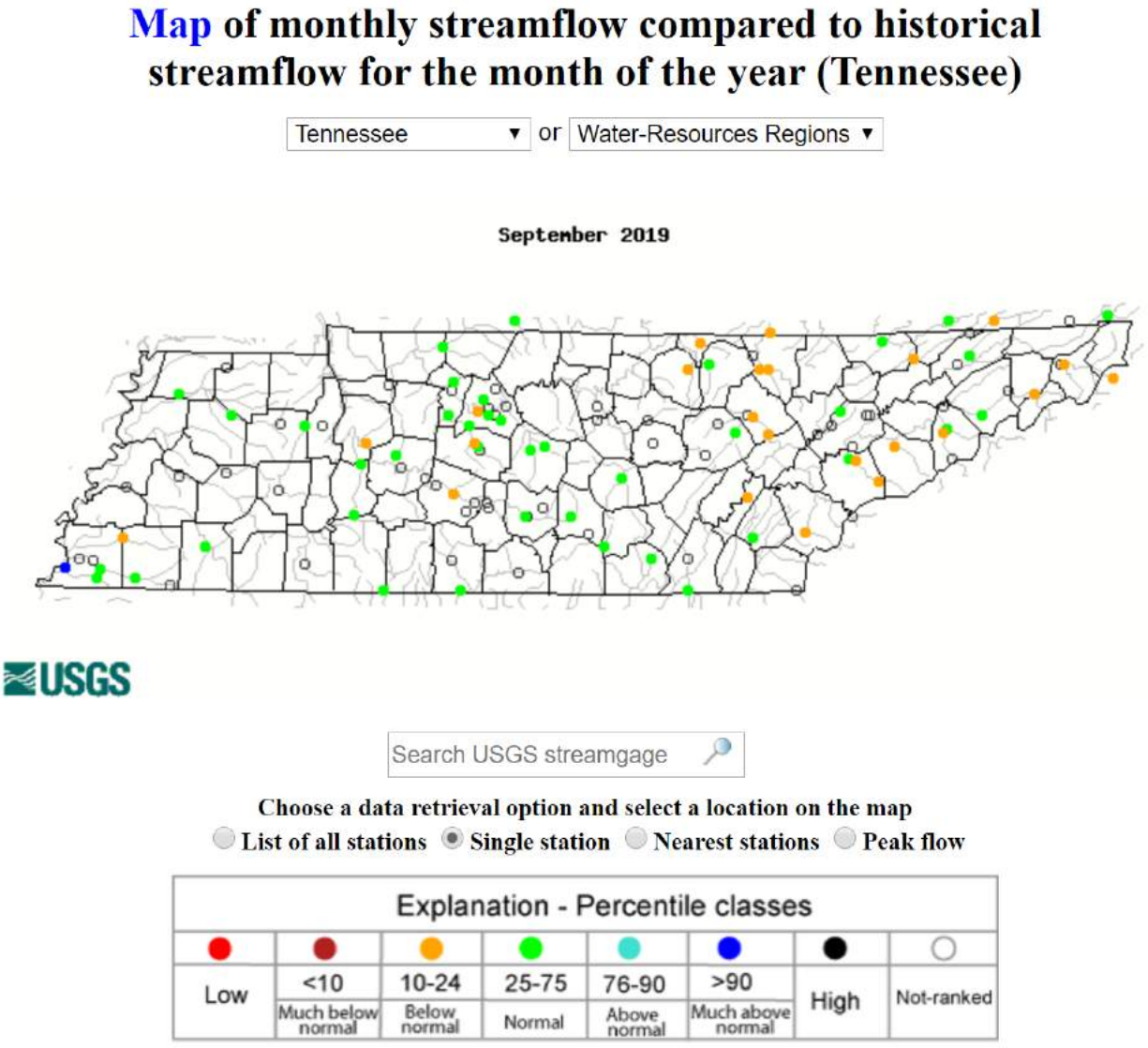


Even though large areas of the state did not record below normal soil moisture readings, the high temperatures and lack of rainfall led to a strong drying trend. Soil moisture readings dropped by 70-90mm over the month, with the largest drops in Middle and West Tennessee.



Streamflow:

Average Streamflow during the month, also showed the drying conditions. Most streams in the state reported normal to below normal streamflow for the month. The eastern half of the state, which saw drought conditions sooner in the month had mostly below normal streamflow.

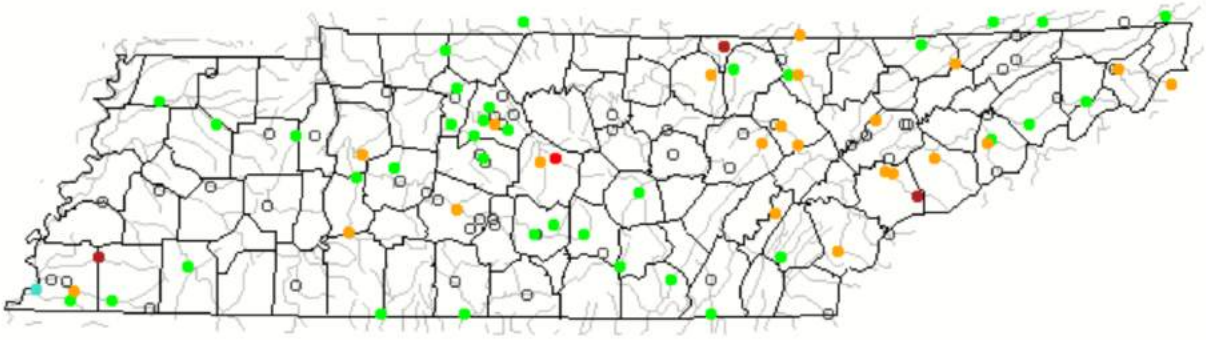


By October 1st, the number of streams reporting below normal streamflow increased, and some streams were reporting much below normal flow rates.

Map of daily streamflow compared to historical streamflow for the day of the year (Tennessee)

Tennessee ▾ or Water-Resources Regions ▾ All Days

Tuesday, October 01, 2019



USGS

Search USGS streamgage

Choose a data retrieval option and select a location on the map

List of all stations **Single station** **Nearest stations** **Peak flow**

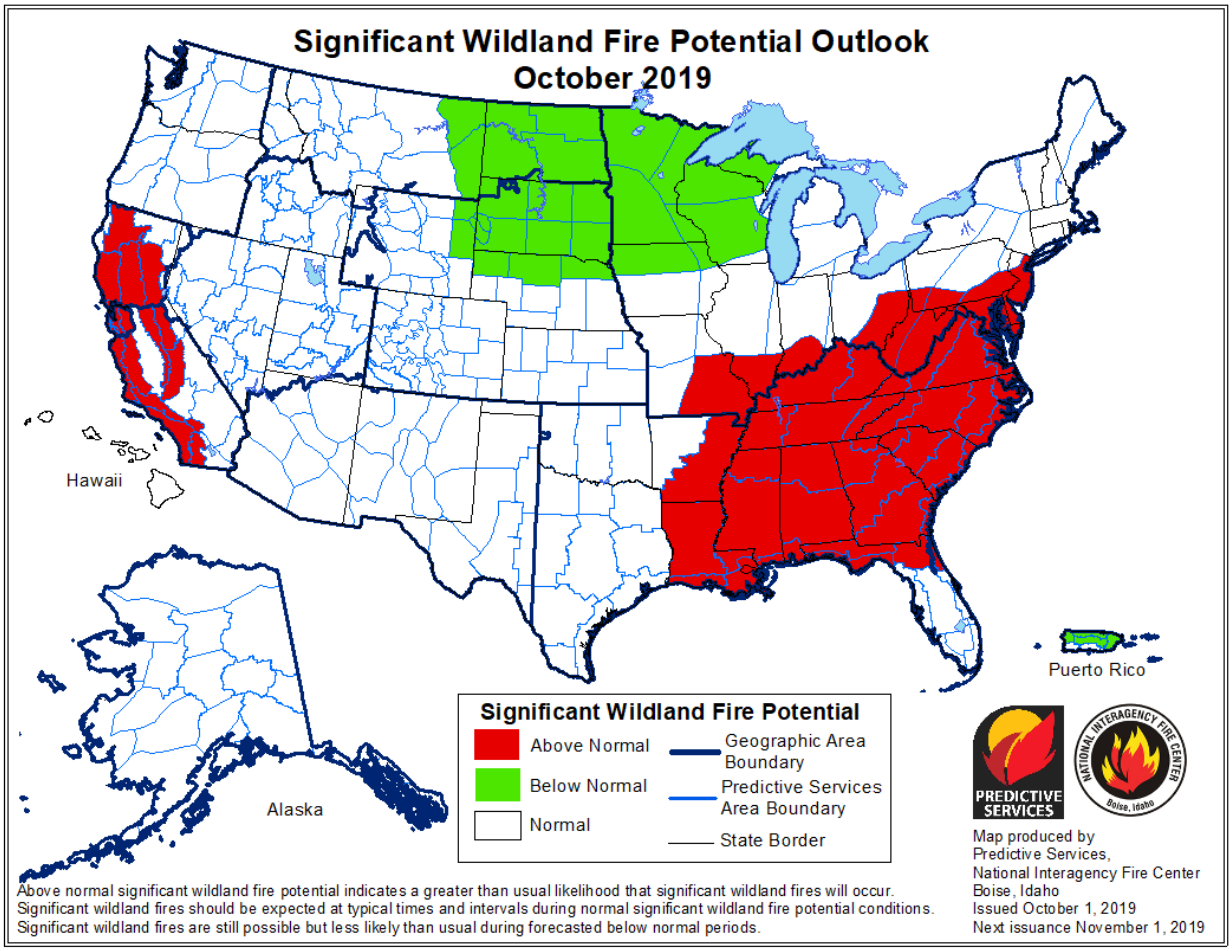
Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

Miscellaneous:

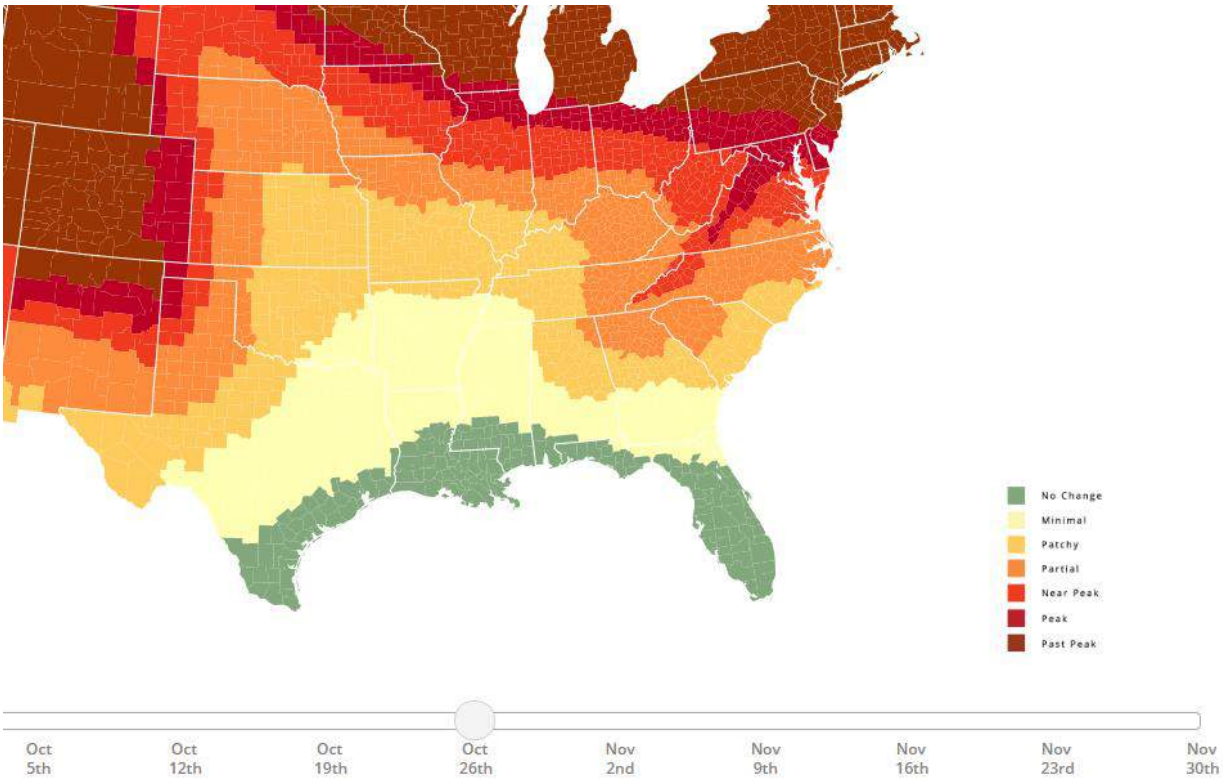
Crop Conditions from USDA: High heat and dryness were the dominant conditions for agricultural concerns this month. The dry conditions allowed harvests and hay bailing to progress ideally, but pasture conditions deteriorated rapidly through the month. Corn and soybean harvests continued with producers continuing to report favorable yields for both corn and early crop beans, but late crops were suffering from the hot-dry conditions. In some areas, deteriorating pasture conditions forced livestock producers to start feeding hay, leading to concerns that they may run short of hay during the winter months. Availability of water for livestock was also a concern, with some farmers having to haul in water for their herds. At the end of the month, topsoil moisture was rated 35% very short, 43% short, and 22% adequate. Subsoil moisture was rated 28% very short, 53% short, and 19% adequate. Hay & Roughage Supplies rated 1% very short, 13% short, 72% adequate, and 14% surplus. However, corn, cotton, soybeans, and tobacco harvests were ahead of 5-year averages.

CROP PROGRESS					CONDITION					
Crop	This Week	Last Week	2018	5 Year Avg.	Item	Very Poor	Poor	Fair	Good	Excellent
	Percent					Percent				
Corn – Dented	100	98	100	100	Corn	1	2	13	56	28
Corn – Mature	98	95	96	96	Cotton	4	7	29	46	14
Corn – Harvested	74	58	63	69	Soybeans	2	8	31	49	10
Cotton – Bolls Opening	82	69	95	80	Tobacco	7	17	31	34	11
Cotton – Harvested	12	6	13	7	Pasture	11	34	40	13	2
Soybeans – Dropping Leaves	71	57	66	67	Cattle	1	4	23	62	10
Soybeans – Harvested	27	18	18	16	Hay	1	9	33	51	6
Tobacco – Cut	94	90	89	81						
Winter Wheat – Planted	10	4	11	6						
Winter Wheat – Emerged	2	0	5	1						

Fire Danger: Due to the drought and persistent drying conditions heading into fall, the National Interagency Fire Center outlook for significant fire potential in October is above normal for Tennessee and almost the entire Southeast US.



Fall Foliage Forecast: As we head into October, fall foliage season should begin across the state, in the higher elevations of East Tennessee first, and then spreading across the state by the end of October. The 2019 Fall Foliage Prediction Map from Smokymountains.com shows near peak conditions by the end of October in the high elevations of Northeast Tennessee by October 26th, with partial to patchy color across most other areas of the state. Some tree varieties may be impacted by recent hot-dry conditions.



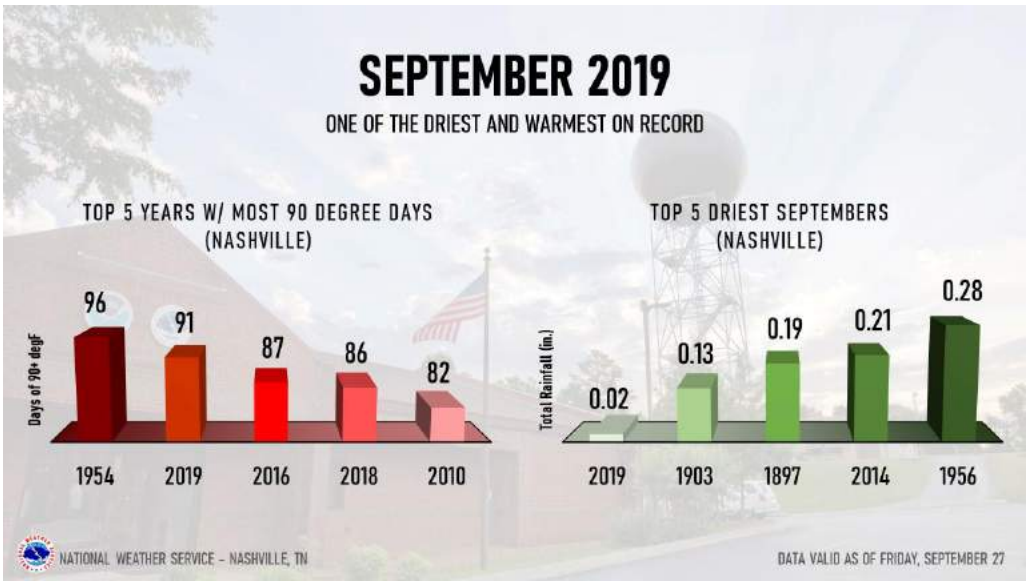
Story of the Month:

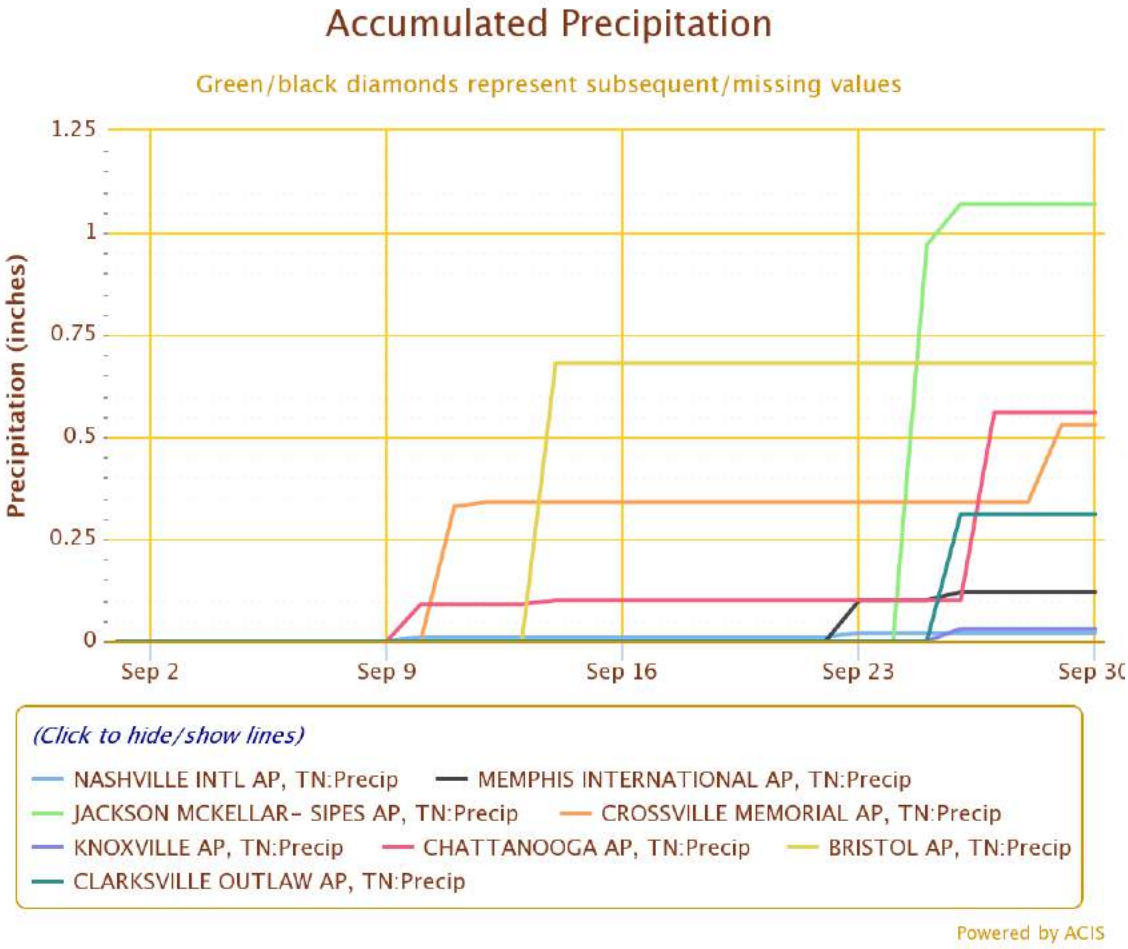
The story of the month for September was the record-setting heat and lack of rain across the state! This dry and hot pattern was caused by a strong high pressure system that dominated the weather across the state for most of the month. The dryness also enhanced the warmth and vice versa. With topsoil moisture dropping, solar energy went into warming the ground leading to increased daytime temperatures and stressed vegetation. The higher than normal temperatures also enhanced drought conditions. Daytime temperatures across the state averaged 8˚F to 12˚F warmer than normal, while nighttime temperatures were only 4˚F to 8˚F above normal. The only mitigating factor to this heatwave, was that for the majority of the month humidity was also relatively low; so heat index values did not get as high as they did in August. All climate reporting weather stations across the state reported at least 2 days with record high temperatures, but as many as 13 days of record-setting highs!

Weather/Climate Station Location	Number of Record Highs Set During September 2019	Station Period of Record
Oak Ridge	**13**	**1998-2019**
Clarksville	**12**	**2000-2019**
Chattanooga	**11**	**1938-2019**
Nashville	**9**	**1940-2019**
Crossville	**9**	**1954-2019**
Tri-Cities	**8**	**1937-2019**
Knoxville	**7**	**1910-2019**
Memphis	**3**	**1940-2019**
Jackson	**2**	**1948-2019**

The heat was also consistent through the month, with high temperatures reaching 90˚F or higher each day of the month for all but two days at Memphis, five days at Chattanooga, seven days at Nashville, and eight days at Oak Ridge. Memphis and Oak Ridge set records for warmest mean temperature for the month of September, with most other cities being in the top 5 warmest Septembers on record (1925 held onto the record in Nashville, Chattanooga and Knoxville, while 2018 held onto the record for the Tri-Cities).

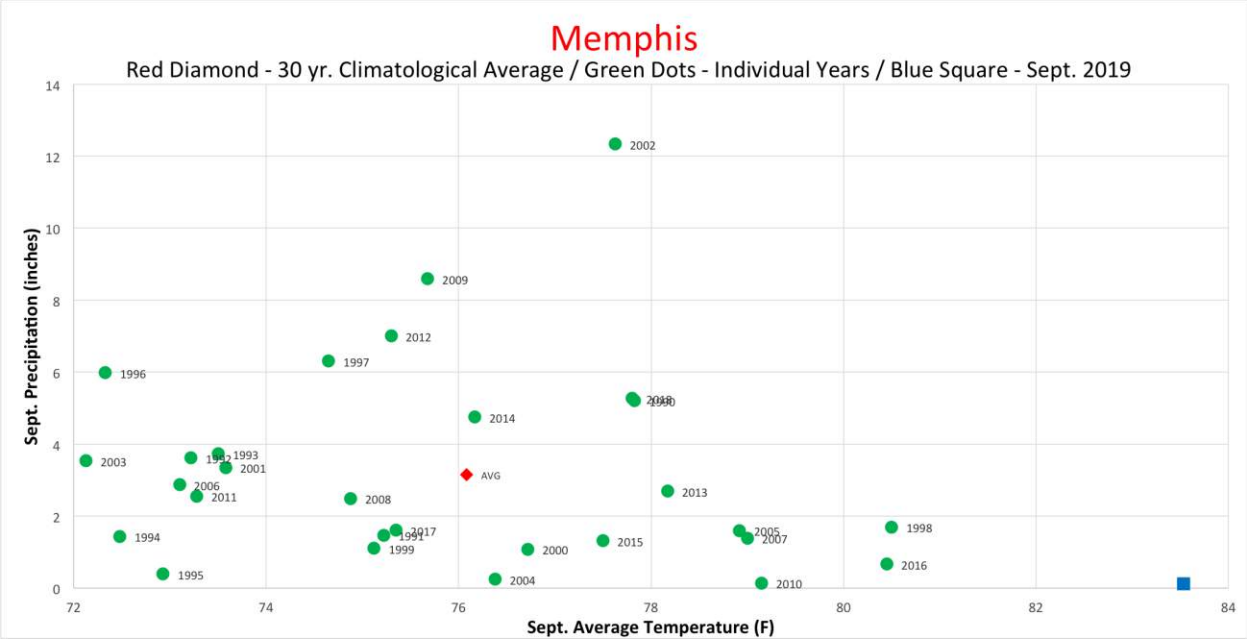
There was also a lack of rainfall across the state, with Nashville (0.02”), Knoxville (0.03”), and Oak Ridge (0.13”) recording their driest September on record. Across the state, most locations recorded less than 10% of the normal September rainfall totals, with five rain gauges reporting zero rainfall, and six more reporting only a trace of rainfall for the entire month!

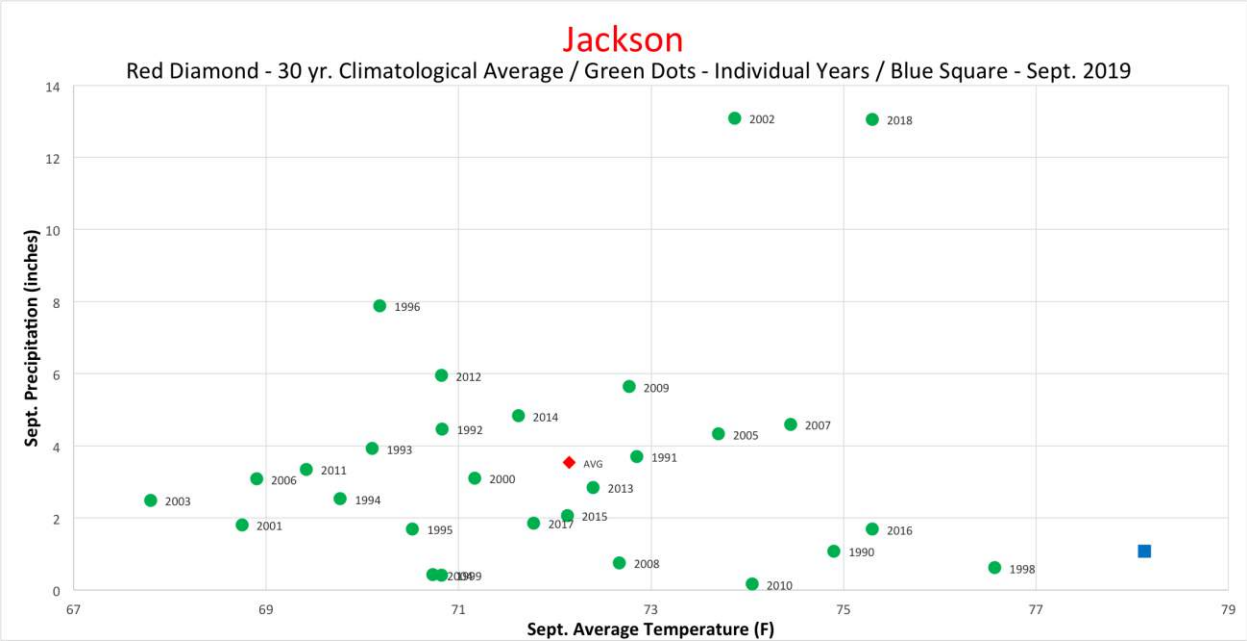


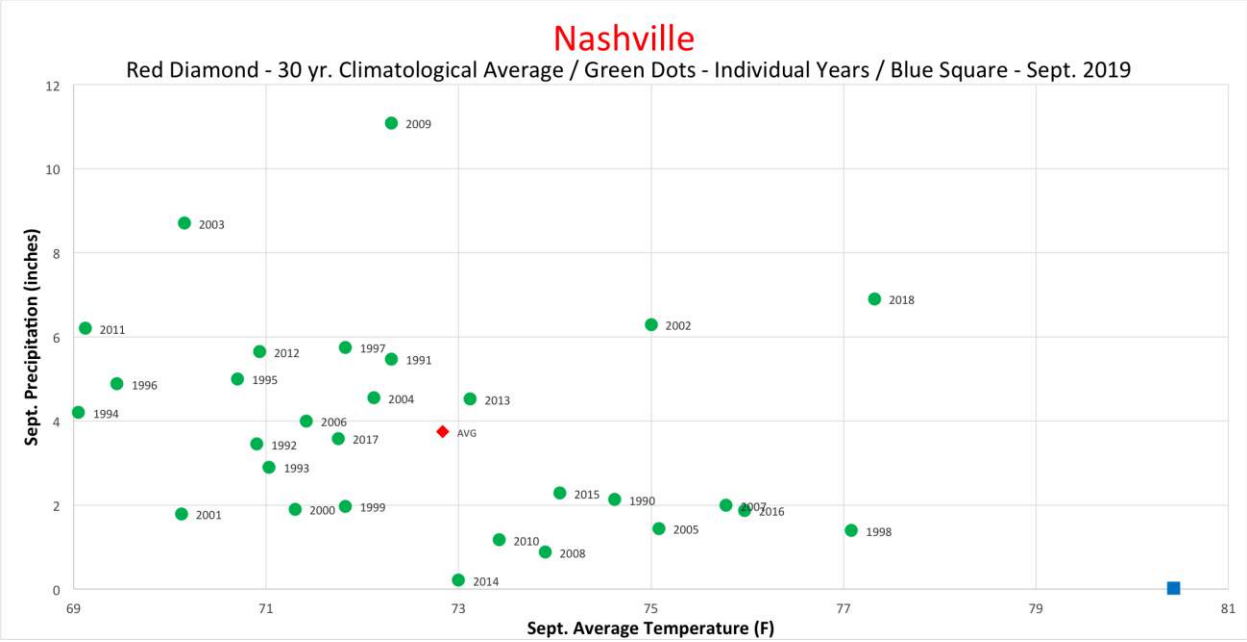


Another way to look at how exceptional this month was, is to compare the average temperatures and precipitation totals to Septembers for the last 30 years. On the following pages are scatter plots for six weather stations across the state, from west to east, showing the observations for this year compared

to the past 30 years, and the average for September in that City. Note that for all cities 2019 was the warmest or second warmest September in this period, and the driest or among the driest as well.






Nashville
Red Diamond - 30 yr. Climatological Average / Green Dots - Individual Years / Blue Square - Sept. 2019
Sept. Precipitation (inches)
Sept. Average Temperature (F)
AVG
2009
2003
2018
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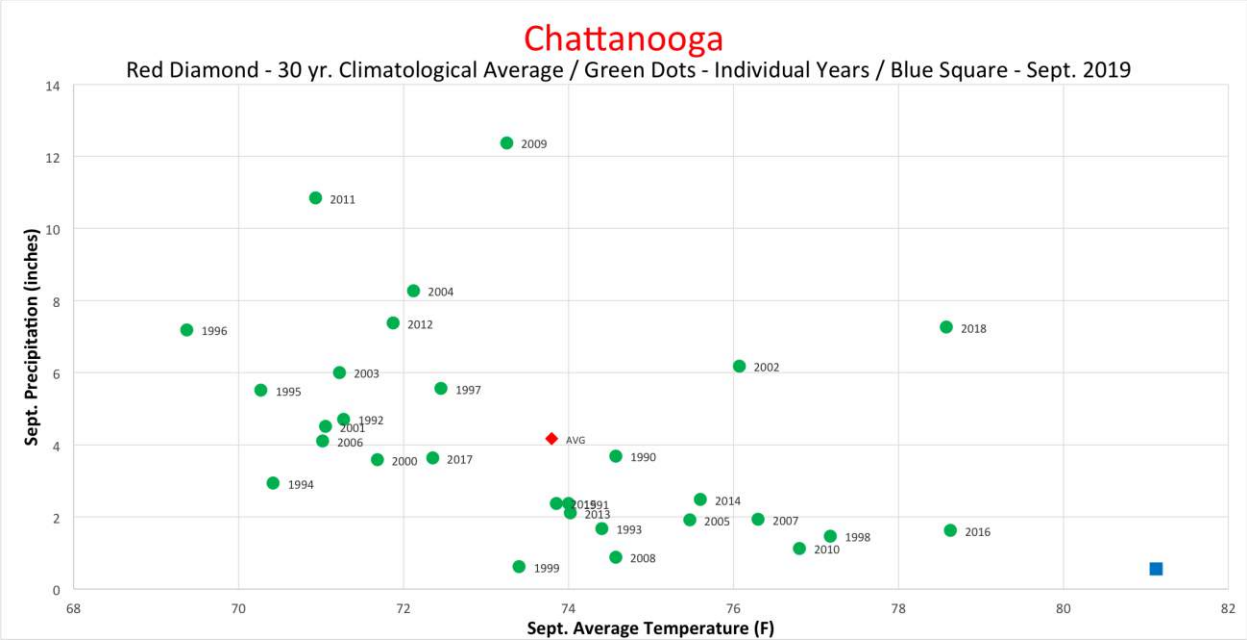
Chattanooga
Red Diamond - 30 yr. Climatological Average / Green Dots - Individual Years / Blue Square - Sept. 2019
Sept. Precipitation (inches)
Sept. Average Temperature (F)
AVG
2009
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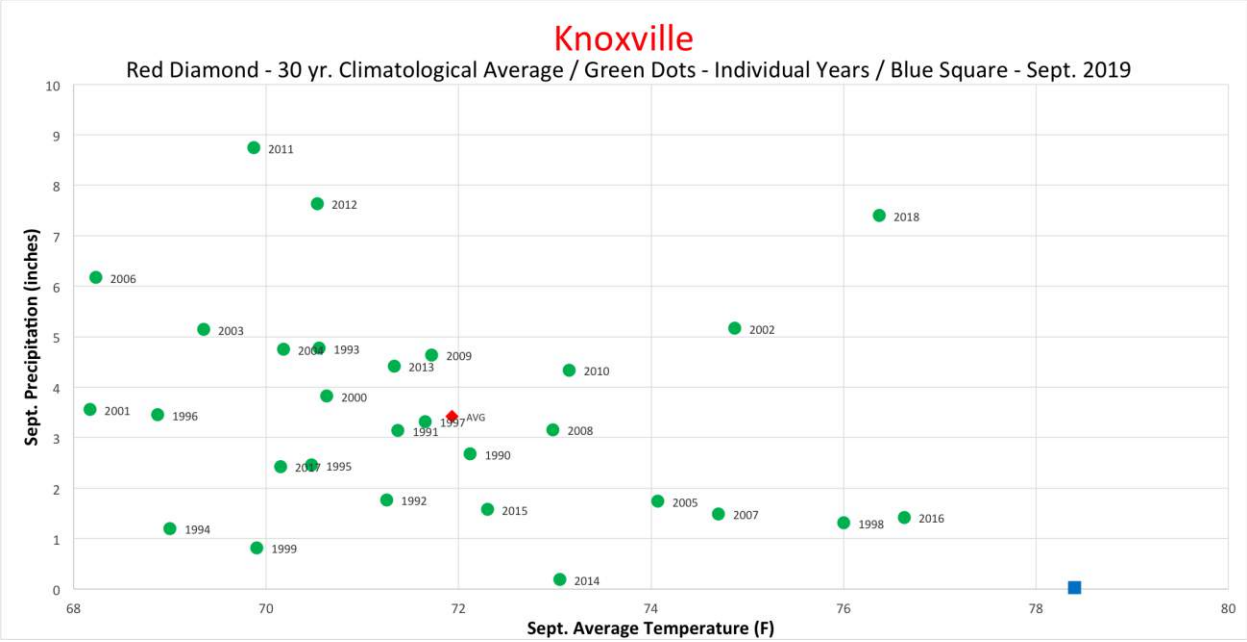
Knoxville
Red Diamond - 30 yr. Climatological Average / Green Dots - Individual Years / Blue Square - Sept. 2019
Sept. Precipitation (inches)
Sept. Average Temperature (F)
AVG
2011
2012
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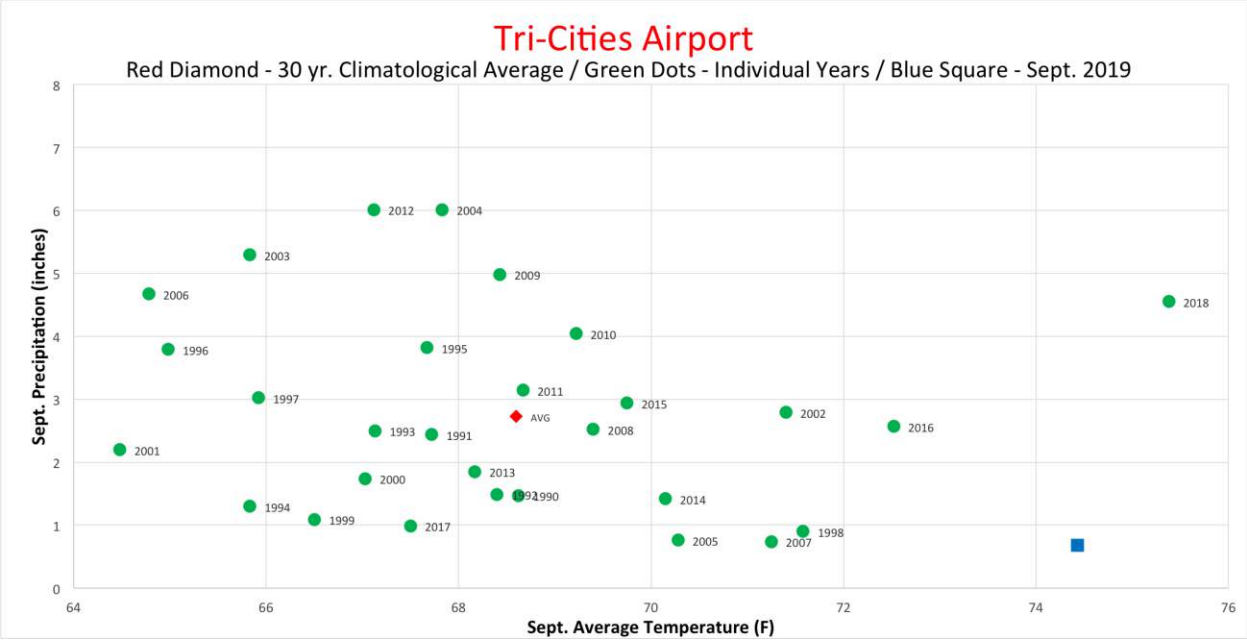
Tri-Cities Airport
Red Diamond - 30 yr. Climatological Average / Green Dots - Individual Years / Blue Square - Sept. 2019
Sept. Precipitation (inches)
Sept. Average Temperature (F)
AVG
2012
2004
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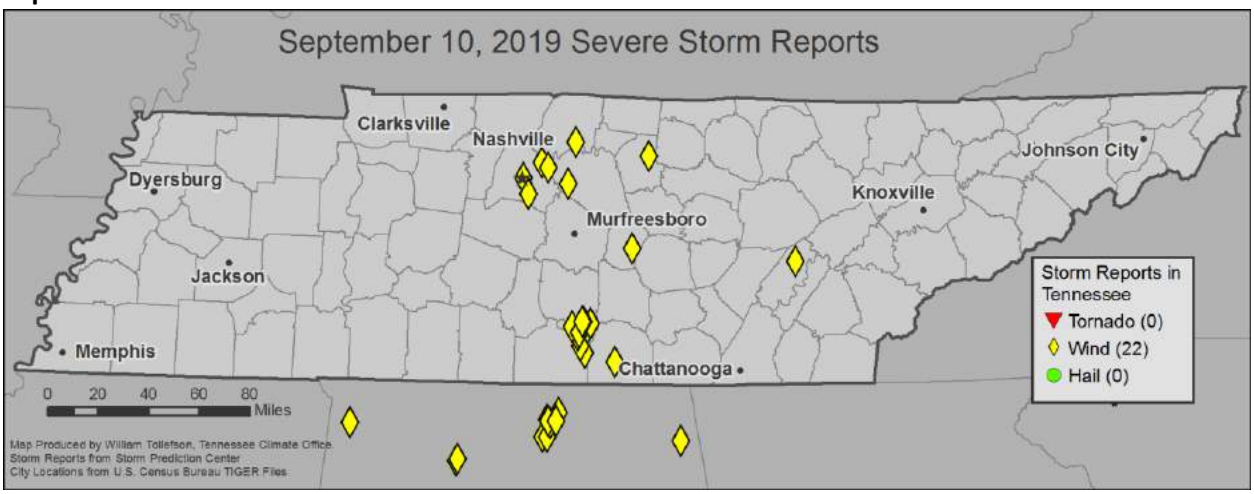
Storm Reports:

There were two days with severe weather reports, resulting in a total of 23 severe wind reports, 0 reports of severe hail, and 0 tornadoes.

September 10

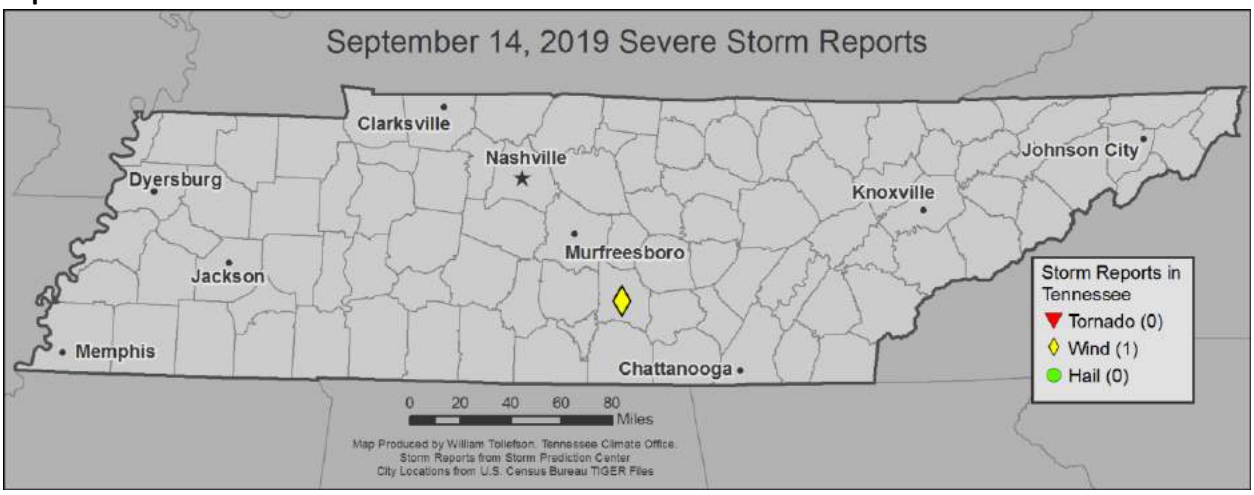


Severe Wind Reports:

Time (UTC)	Speed (mph)	Location	County	Lat	Lon	Comments
21:10	--	4 NE CARTHAGE	SMITH	36.3	-85.89	NUMEROUS TREES BLOWN DOWN AND ONE CAMPER WAS OVERTURNED FROM DEFEATED CREEK CAMPGROUND TO WAYSIDE DRIVE. (OHX)
21:25	--	5 SSW WINCHESTER	FRANKLIN	35.12	-86.13	A HAY BARN WAS DEMOLISHED AND TREES WERE KNOCKED DOWN. THIS OCCURRED ALONG FARRIS ROAD JUST WEST OF ROWE GAP ROAD/HWY 16. TIME ESTIMATED BY RADAR. (HUN)
21:42	--	NASHVILLE	DAVIDSON	36.17	-86.78	TREES AND POWER LINES DOWN NEAR I-65 AND FRANKLIN RD. (OHX)
21:56	--	OLD HICKORY	DAVIDSON	36.26	-86.65	TREE DOWN NEAR HADLEY AND 16TH (OHX)
22:15	--	11 ENE NASHVILLE	DAVIDSON	36.23	-86.6	AT LEAST 5 TREES SNAPPED AT OR ADJACENT TO OLD HICKORY COUNTRY CLUB. (OHX)
22:17	--	8 S LYNCHBURG	MOORE	35.17	-86.34	TREES WERE DOWN ON SULLENGER BEND ROAD. A POWER POLE WAS BROKEN ON EDDE BEND ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:20	--	1 ENE LYNCHBURG	MOORE	35.29	-86.34	TREES WERE KNOCKED DOWN ON HARRY HILL ROAD... PLEASANT HILL ROAD... AND GRIFFIN ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:24	--	7 SSE NASHVILLE	DAVIDSON	36.08	-86.74	TREE DOWNED DOWN THE STREET FROM CRIEVE HALL ELEMENTARY SCHOOL. (OHX)
22:25	--	5 S LYNCHBURG	MOORE	35.21	-86.37	TREES WERE KNOCKED DOWN ON PRESTON RIDGE ROAD AND WET PRONG ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:30	--	2 SSE BELINDA CITY	WILSON	36.14	-86.46	TREE TWISTED DOWN... BARN ROOF & HOUSE ROOF DAMAGED... TRAMPOLINE BLOWN

						SOME DISTANCE... EXTREMELY HEAVY RAINFALL... DAMAGE OCCURED AT 2929 HARKREADER RD. (OHX)
22:33	--	2 WSW LYNCHBURG	MOORE	35.27	-86.39	SEVERAL REPORTS OF TREES BEING KNOCKED DOWN THROUGHOUT MOORE COUNTY WERE RECEIVED. SOME OF THESE WERE BLOCKING ROADS. TIME ESTIMATED BY RADAR... BUT MAY NEED ADJUSTMENT (HUN)
22:36	--	1 W LYNCHBURG	MOORE	35.29	-86.38	A TREE WAS KNOCKED DOWN ON WIGGINS ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:38	--	5 WNW LYNCHBURG	MOORE	35.32	-86.43	TREES WERE KNOCKED DOWN ON SPANKHEM ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:41	--	3 N LYNCHBURG	MOORE	35.32	-86.36	TREES WERE KNOCKED DOWN ON FINNEY AND COUNTY LINE ROADS. TIME ESTIMATED BY RADAR. (HUN)
22:42	--	7 SSE NASHVILLE	DAVIDSON	36.08	-86.74	TREE DOWNED DOWN THE STREET FROM CRIEVE HALL ELEMENTARY SCHOOL. (OHX)
22:43	--	1 W LYNCHBURG	MOORE	35.29	-86.38	A TREE WAS DOWN ON WIGGINS AVENUE. (HUN)
22:43	--	5 NE LYNCHBURG	MOORE	35.34	-86.3	TREES WERE KNOCKED DOWN ON CUMBERLAND SPRINGS ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:43	--	5 N LYNCHBURG	MOORE	35.35	-86.35	A POWER POLE WAS BROKEN ON BLACKBURN HOLLOW ROAD. TREES WERE KNOCKED DOWN ON RUTLEDGE ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:44	--	4 N LYNCHBURG	MOORE	35.35	-86.36	TREES WERE KNOCKED DOWN ON RIDDLE ROAD. TIME ESTIMATED BY RADAR. (HUN)
22:45	--	5 SE WOODBURY	CANNON	35.77	-86.01	A POLE BARN WAS BLOWN DOWN AND A TREE WAS UPROOTED ALONG HIGHWAY 146. (OHX)
22:55	59	2 E GALLATIN	SUMNER	36.38	-86.41	AWOS AT SUMNER COUNTY REGIONAL AIRPORT MEASURED A WIND GUST OF 51 KTS. (OHX)
23:10	--	SPRING CITY	RHEA	35.69	-84.86	SEVERAL TREES WERE DOWNED. (MRX)

September 14



Severe Wind Reports:

Time (UTC)	Speed (mph)	Location	County	Lat	Lon	Comments
23:10	--	MANCHESTER	COFFEE	35.47	-86.08	SEVERAL TREES UPROOTED OR TWISTED OFF (OHX)

CPC Outlooks for the Next Month:

Climate Prediction Center outlooks for October show a high likelihood that the month will continue the above normal temperature trend that we observed in September, with all but the northwest potion of the state in the less than 60% likely above normal forecast area. The precipitation outlook also indicates that the drier than normal pattern will continue into October.