
# Southern Climate *Monitor*

July 2011 | Volume 1, Issue 7

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## TRENDS IN HEAVY PRECIPITATION OVER THE SOUTHERN REGION

*Esther White, Cooperative Institute for Mesoscale Meteorology*

### 1. Introduction

The recent Intergovernmental Panel on Climate Change (IPCC) report (2007) suggests that increasing global average temperatures will very likely lead to changes in the distribution and intensity of extreme events, including changes in precipitation (rain and snowfall). In a warmer climate, air is able to hold more water vapor, which creates a greater source of moisture for precipitation. As an example, studies have been able to use known relationships between temperature and water vapor to estimate that for every 1 degree C increase in temperature, the water holding capacity of the atmosphere increases by nearly 8% (the current global average temperature change since 1900 is about 0.7 degree C[1]). Note, however, that these changes are not uniform over the globe. Local scale precipitation is still highly dependant on the regional and local environmental conditions, which can change depending on pressure, wind direction, surface conditions, season, upper level winds, large scale teleconnections (such as El Nino), among others. Future changes are likely to manifest themselves as more variable precipitation events, which are generally more intense (i.e. when it rains, it rains harder, and when it is dry, this dryness may persist for longer). A number of studies have tried to look in more detail at the specific changes we might expect on a global and regional scale. Most of these studies support the aforementioned precipitation changes, based on consideration of the observational record, and information from climate models (Karl and Knight, 1998, Kunkel et al, 1999, Groisman et al, 2004). In this article, we present some recent early work in examining changes in 1-day heavy precipitation events over time in the Southern U.S.A. Our area is the region covered by the 'Southern Climate Impacts Planning Program' (or SCIPP), which includes Arkansas, Louisiana, Mississippi, Oklahoma, Tennessee and Texas[2].

### 2. Data and Methods

We use rain gauge data from the National Co-operative Network of rain gauges (COOP). This network is operated by the National Weather Service and the National Climatic Data Center (NCDC) and is a vital component of the climatological record of the United States. It uses observations from the general public in both official and unofficial capacities. The rain gauge network is made up of official stations, with once daily observations, typically at 12Z, but sometimes 18Z or 06Z. Since each station has a different record length and/or missing data, the following criteria must be satisfied in order to use the rain gauge in at least the first part of the analysis, that is: 1) The record must extend longer than 60 years and 2) Data at each location must be equal or greater than 95% complete.

A sequence of studies are performed. The first examines individual time series for 176 stations across the region. Heavy (very heavy) precipitation events are defined as those exceeding 1.5 (3) inches/day in west Texas, 2 (4) inches/day in Oklahoma and central Texas, 2.5 (5) inches/day in Arkansas, Mississippi and Louisiana, and 3 (5) inches/day in far eastern and southern Texas adjacent to the Gulf of Mexico. Three time periods are considered: 1) Total record length (variable), 2) 1920-2009, 3) 1948-2009. Although these definitions are somewhat subjective (albeit based on an annual precipitation climatology), they are comparable to those from other nationwide studies (e.g. Groisman et al, 2001). There are a number of methodologies available to examine trends, some of which are more rigorous and attempt to be more regionally specific with regard to the definition of 'heavy', 'very heavy' and 'extreme' precipitation and/or the problem being posed (e.g. hydrologic and damage causing flooding events versus simple diagnosis of precipitation trends). Our approach is simple

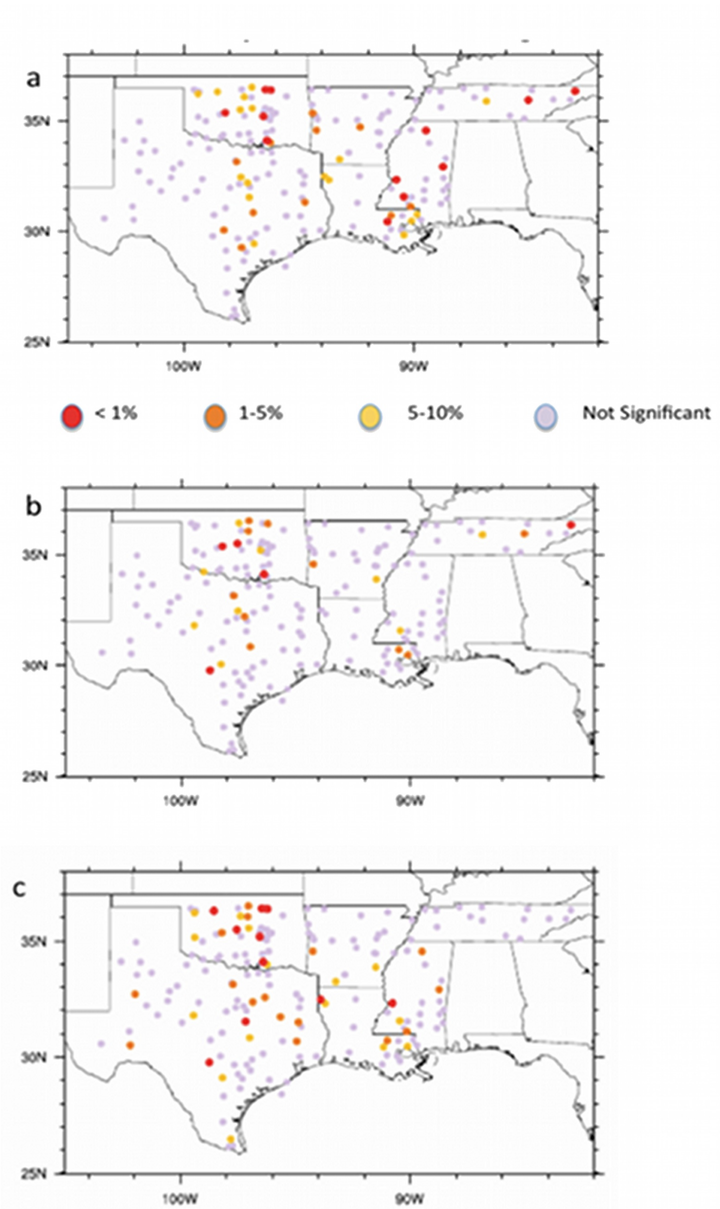


**Figure 1: Distribution of significant positive trends of heavy precipitation at <10% (a) all years in individual station record (varies), (b) 1920-2009 and (c) 1948-2009**

but our definitions are effective at identifying trends. The second analysis is for each climate division in each state (~9-10 divisions per state). In this case, all stations in each division are used, but the annual count of events exceeding a given threshold (0.01, 2, 3 and 5 inches/day) are normalized by the number of active stations in each division per year, so that we don't get biased results due to the changing number of active stations. This analysis was exclusively for 1948-2009, when digital data availability was greatest.

The final analysis constructs 'partial duration' time series by selecting the top 60 (0.2%) events by magnitude for each station (1948-2008) with a positive trend, and binning each event into one of the six decadal intervals. This results in a count of the number of top events per decade for a given station, which is then grouped into a total sum for each state. Linear trends are assessed using basic regression and analysis of variance, where a significant trend has a p-value $< 0.05$. This technique is sufficient for measuring changes in the low frequency component of heavy precipitation variability. To assess inter-decadal trends, a 10-year running mean is also applied to the time series.

## 3. Results and Discussion

### *3.1 Individual Stations*

Figure 1 shows the distribution of stations with positive trends across the SCIPP region. No individual stations were found to have statistically significant negative trends in heavy precipitation frequency, while about 23% of all stations had a significant positive trend (this reduces to ~15% for 1948-2009). There is some spatial consistency in the location of the trends, which lends support to the results. Most of the trends are clustered in areas including central Oklahoma through central and east central Texas, into parts of Mississippi, far south Louisiana and eastern and southern Arkansas. Tennessee and Arkansas have the lowest proportion of stations with significant trends. We see, therefore, that although there are clear signals for increasing heavy precipitation in certain sub-regions, local environmental conditions, high inter-annual variability, and the fact that we are observing point locations, which 'miss' many heavy events, tend to mask trends.

### *3.2 Climate Divisions*

Figure 2 shows the distribution of Climate Division trends in precipitation event frequencies between 0.01 and 5 inches/day. The frequency of days with precipitation > 0.01 inches/day (top left) may also

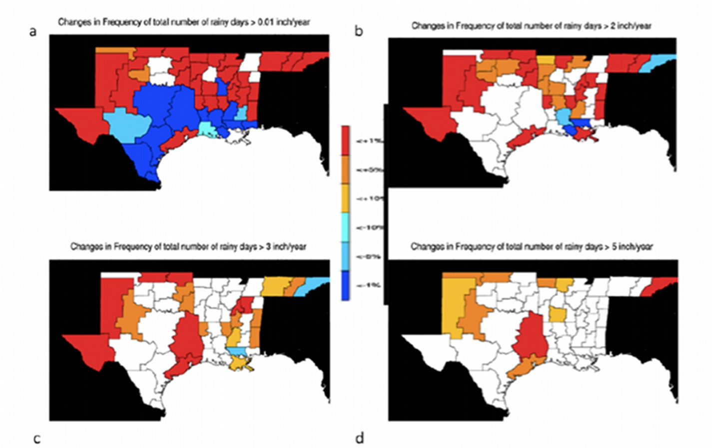


**Figure 2: Trends in the number of days of rain above thresholds from 0.01 to 5 inches/day for each climate division across the SCIPP region. Negative (positive) trends are shown in blue (red). Trends < 5% (p < 0.05) are statistically significant, but the figure also includes trends at p < 0.1 (10%). Areas without any notable trends are shaded in white.**

be termed the number of rainy days. As we can see, in the north and west, this has been increasing, while in the south, rainy days have been decreasing. For heavy and very heavy daily precipitation (> 2 inches/day), most significant trends are positive, especially in the northern and western region (including Texas, Oklahoma and Mississippi). A visual comparison between Figure 1(c) and Figure 2 for events between 2 and 3 inches/day shows some consistency between them in terms of location, which is expected, nonetheless, discrepancies arise from high variability and local climate influences that produce increased 'noise' in individual station records. Trends were also assessed seasonally for all thresholds. The seasons are defined as December-January-February (DJF), March-April-May (MAM), June-July-August (JJA), and September-October-November (SON). In order to establish a baseline with which to compare seasonal trends, climatological distributions of precipitation for each season were constructed for each state and each threshold. Due to the large land area and distinct change in climatological characteristics, Texas was split into two regions. Contributions by each climate division were weighted by area. Figure 3 shows these

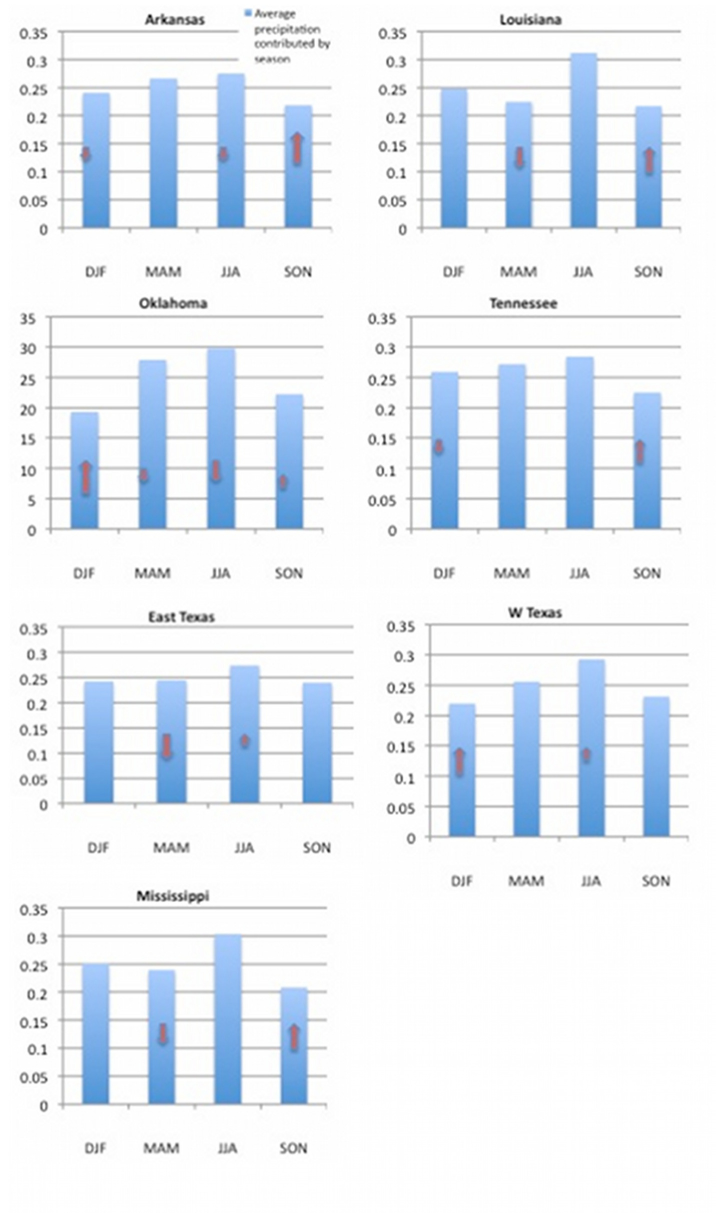


**Figure 3: Average fractional contributions to total annual precipitation by season (Oklahoma units in percent). Arrows are a schematic representation of the direction and magnitude of observed changes between 1948 and 2009. Upward (downward) arrows indicate an increase (decrease) in the seasonal contribution to the total number of heavy precipitation events (2-3 inches/day). Long arrows denote a significant change, medium arrows indicate at least half of the climate divisions within that state having strong or significant trends, and short arrows indicate about one quarter of climate divisions within that state having strong or significant trends.**

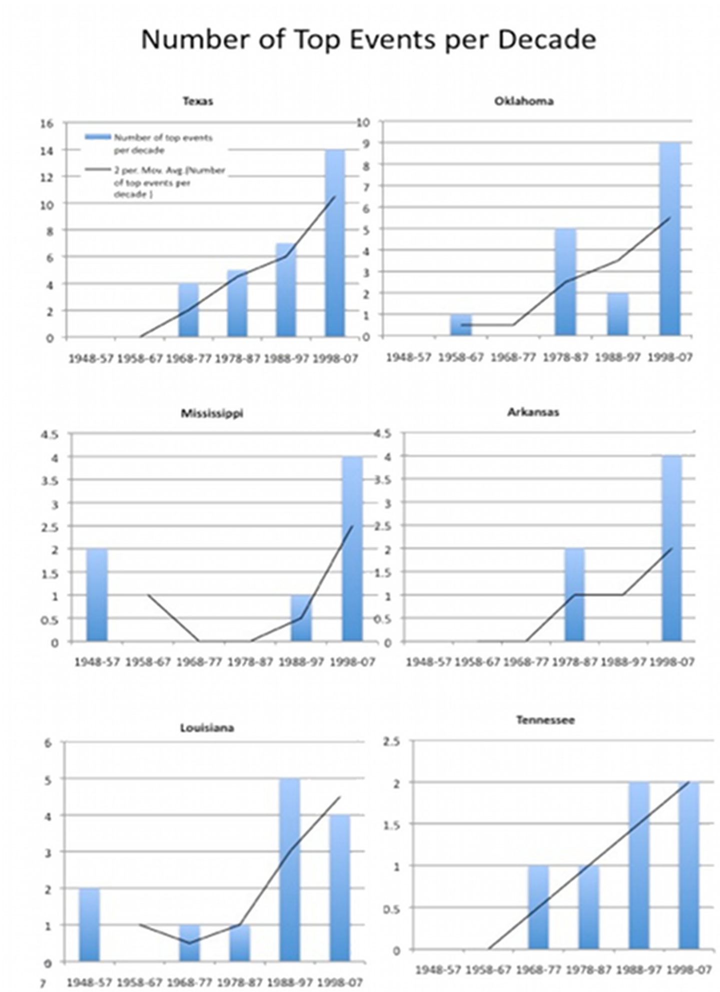


**Figure 4: Top 0.3% of events broken down by decade for all stations with strong or significant positive trends in heavy precipitation. Note that the y-axis is a count of the number of stations with the most number of events in a given decade (e.g. four stations in Arkansas had the largest number of high magnitude precipitation events during 1998-07, and the other 2 stations had their most events during 1978-87).**

distributions, along with observed changes in seasonal precipitation (at 2 inches/day). Broadly speaking, results included:

1) Trends in 0.01-inch/day precipitation are largest over northern and western sections, with a general decrease in rainy days in summer and an increase in fall.

2) At 2 inches/day, relative fractions of precipitation events have increased in winter for Oklahoma (balanced slightly by a decreasing trend during summer in eastern Oklahoma) and in fall for parts of the northeast sections of the region (see Fig. 3)

3) At 3 inches/day, results are suggestive of a shift in events characterized by more heavy precipitation events in Oklahoma and northern Texas during the winter (DJF), as well as portions of the eastern states during the fall (SON). Meanwhile, there is a reduction in spring (MAM) heavy rainfall in parts of northeastern and central Texas.

4) At 5 inches/day significant trends are more sporadic, given the limitations of establishing linear trends with sparser data. Once more, the largest and most consistent signal across divisions is in the fall, where trends are positive and clustered in eastern sections.

### *3.3 Temporal Distribution of High Magnitude Events*

Figure 4 shows the distribution of top magnitude events for each State. It is immediately apparent that the majority of high magnitude precipitation events occurred during the latter part of the period, especially 1988-07. These results are suggestive of an increase in high magnitude events since 1948, the precise value of which varies from station to station. Ideally, a longer time series should be considered, which would allow us a clearer understanding of the role of Anthropogenic Climate Change. Nonetheless, this, and the aforementioned results produce a signal for a sustained period of higher heavy precipitation event frequencies, especially since the 1980s, over much of the SCIPP region.

### *3.4 Role of Climate Variability*

Since our precipitation record extends predominantly between 1920/1948-2009, long-term climate variability from natural sources (such as El Nino and other Planetary Scale tele-connections, or changes in land surface conditions) versus climate change signal is not clear. Increasing trends since mid-century may, in fact, be simply the result of a drier mid-century versus latter century resulting from these natural processes. If we changed the starting point of our time series, we might discover that our significant trend changes. Studies have shown that the 1930s and 1950s were particularly dry over the U.S, whereas the 1980s and 90s were particularly wet (e.g. Kunkel et al, 1999). This inter-decadal variability is seen in this regional analysis. We also note that for most stations, heavy precipitation frequencies decline on average during 2000-2009. This is not unexpected given the unprecedented wetness of the 1990s, however, it does indicate the large role of natural variability in moderating regional trends. It remains a topic of future research to begin to detail the influence of these climate variability signals versus climate change.

### 4. Results in Context

This study is one of the first to examine trends in precipitation exclusively across the SCIPP domain. Karl and Knight (1998) did examine the southern region, analogous to SCIPP minus Tennessee. This study showed a statistically significant increase in 2-inch/day precipitation during 1910-1995 that exceeded the national average trend. Furthermore, about 53% of the total precipitation amounts that had been observed nationally were contributed by the upper 10% of heavy precipitation events (although there were regional differences across the U.S). Studies that consider seasonal changes in precipitation (including the above) find that, as a nationwide average, the number of days with precipitation (i.e. > 0.01 inch/day) tends to increase most in the spring and fall. For heavy precipitation events (> 2 inches/day), the fall increasing trend was noted. This supports the findings shown in out analysis, where fall event frequencies at nearly all thresholds increase fairly consistently across a broad area of our domain.

In terms of climate model projections, there is some uncertainty over future precipitation patterns for the Southern U.S. Most climate models are able to simulate more variable precipitation with increasing carbon dioxide concentrations but often struggle to accurately simulate current precipitation behavior (e.g. distribution and magnitude) on the regional scale. However, a recent climate model inter-comparison, which collectively evaluated the forecasts of a number of climate models (Mearns et al, 2005), was found by IPCC (2007) to be quite good in terms of correctly simulating present conditions. Results of a 2041-2070 minus 1971-2000 changes in both average and heavy precipitation for the Canadian coupled global climate model with a nested regional model show some similarities with the patterns observed with our results. In conclusion therefore, we may cautiously state (especially for precipitation thresholds below 3 inches/day) that our results are consistent with at least some future climate change predictions for parts of this region, lending support to the possibility that some of the recent increases in precipitation frequency/intensity of daily events may be driven by global climate change.

### 5. Conclusions and Implications

This study has examined trends in observed frequencies of precipitation at various thresholds, with an emphasis on heavy 1-day events for individual rain-gauge stations and Climate Divisions over 6 States. The broad trends are that of an increase in the frequency of heavy precipitation, as we have defined them. For individual stations, there were no statistically significant decreases in heavy precipitation, which is also the case for climate division trends above 2 inches/day. The frequency of rainy days was found to be generally increasing in northern and eastern sections of the domain, and decreasing in much of the south. Seasonal trends for each climate division in a broad sense show a decrease in summer precipitation (especially in Texas/west) and an increase in fall precipitation, especially in the east. Oklahoma and west Texas also show a significant increase in heavy winter precipitation. In addition, the partial duration analysis shows a clear bias for heavier events in the last 20 years.

Clearly a sustained change in precipitation intensity and/or frequency will alter some aspects of the local environment that will require forms of adaptation and mitigation. A projected increase in the overall amount of precipitation could have some beneficial results, for example recharge of groundwater and increased water availability for human use. On the other hand, increasing intensity of precipitation events has the potential to produce an increased risk of flooding, depending on its intensity, duration and timing (e.g. Trenberth 1999). The relationship between heavy precipitation and flooding is rather complicated. Nonetheless, it is fair to suggest that increases in precipitation intensity are likely to increase flooding probabilities, particularly in existing high-risk locations (Pielke, 1999). Policymakers should be aware of potential changes to flooding resulting from changes in precipitation, and make judgments about how to incorporate this information in urban planning, transportation and other infrastructure. In addition, there are opportunities to educate the public on flood risks in their region so they are able to make informed choices.

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**Footnotes**

[1]See http://www2.ucar.edu/climate/faq
[2]See http://www.southernclimate.org/

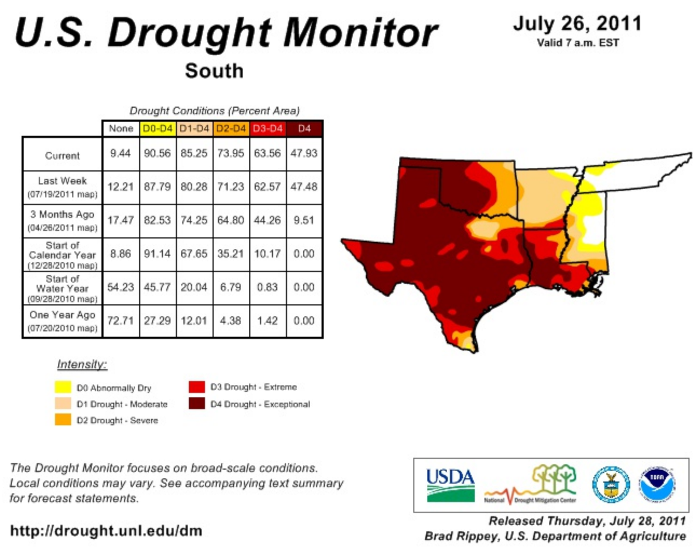
## DROUGHT CONDITIONS

*Luigi Romolo, Southern Regional Climate Center*

Another month of anomalously high temperatures and anomalously low precipitation totals has led to expansion and worsening of drought conditions in Arkansas, Texas and Oklahoma. In Arkansas, the western half of the state is now experiencing severe drought, which last month was mostly drought-free. Central Oklahoma has been downgraded to exceptional drought, while eastern portions of the state are now seeing the introduction of extreme drought. There has also been some expansion of exceptional drought in central Texas. Some improvements in drought conditions have occurred in southern Louisiana, where precipitation has been plentiful. The southwest saw a one category improvement to extreme drought, while the southeast saw a two category improvement to severe drought. This is also the case for southern Mississippi, most of which is now upgraded to moderate and severe drought conditions. As was the case in the previous month, Tennessee remains drought free. In total, 47.32 percent of the Southern Region is in exceptional drought or worse, with 79.33 percent experiencing severe drought conditions or worse.

In Texas, numerous cities were privy to triple digit high temperatures for more than half of the month, and some places already have broken their record of 100+ degrees F (37.78+ degrees C) days for a year. (Information provided by the Texas Office of State Climatology)

Since the beginning of wildfire season in November, Texas has seen 16,368 fires and close to 3.5 million acres (14,163.99 square km) have burned. Among the properties destroyed, 2,300 structures and 601 were lost in the fires this season. By the end of July, 248 out of 254 counties had issued a burn ban. The remaining six counties were located in far South Texas and along the coast near Louisiana in areas that are least affected by the drought. For many, Independence Day fireworks were out of the question because of the burn bans. (Information provided by the Texas Office of State Climatology). Ranchers' herds had been reduced to minimal populations and some had been depleted completely. A few individuals had continued to enforce supplemental feeding, but water was scarce to be found. The drought hit Texas with such ferocity that the entire state was declared a natural disaster zone. Over $1.5 billion in agriculture losses were estimated, and the economic impacts were expected to increase across the state. Texas closed in on the $4.1 billion record set in 2006, and was predicted to surpass it. Tropical Storm Don ignited the hopes of many for potential relief, but it only left traces of precipitation behind in South Texas and it fizzled out after making landfall. (Information provided by the Texas Office of State Climatology).



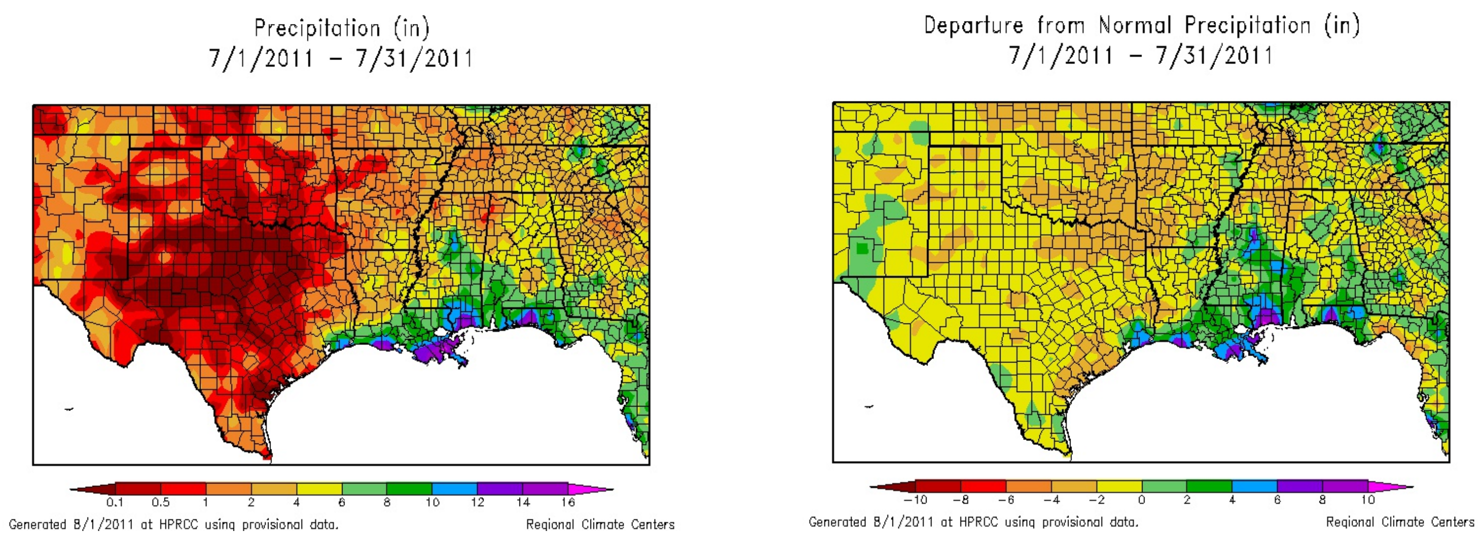

| | None | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4 |
|---|---|---|---|---|---|---|
| Current | 9.44 | 90.56 | 85.25 | 73.95 | 63.56 | 47.93 |
| Last Week (07/19/2011 map) | 12.21 | 87.79 | 80.28 | 71.23 | 62.57 | 47.48 |
| 3 Months Ago (04/26/2011 map) | 17.47 | 82.53 | 74.25 | 64.80 | 44.26 | 9.51 |
| Start of Calendar Year (12/28/2010 map) | 8.86 | 91.14 | 67.65 | 35.21 | 10.17 | 0.00 |
| Start of Water Year (09/28/2010 map) | 54.23 | 45.77 | 20.04 | 6.79 | 0.83 | 0.00 |
| One Year Ago (07/20/2010 map) | 72.71 | 27.29 | 12.01 | 4.38 | 1.42 | 0.00 |

**To the right: Drought conditions in the Southern Region. Map is valid for July 2011. Image courtesy of the National Drought Mitigation Center.**

## PRECIPITATION SUMMARY

*Luigi Romolo, Southern Regional Climate Center*

With the exception of southern Louisiana, southern and central Mississippi, the month of July was very dry across the Southern Region. In Texas, most stations received less than 25 percent of normal precipitation, while stations in the central portion of the state received less than five percent of expected values. Some stations did not see a drop of rain in the entire month. With a state average precipitation total of just 0.72 inches (18.28 mm), it was the driest July on record (1895-2011) for the state. Similar conditions occurred throughout most of Oklahoma and western Arkansas, where the majority of stations received less than one quarter of normal precipitation. Oklahoma averaged only 0.9 inches (22.86 mm)of precipitation for the month, which was the ninth driest July on record (1895-2011). Arkansas averaged 2.20 inches (55.88 mm), or its eighteenth driest July on record (1895-2011). In Tennessee, precipitation totals ranged from twenty-five to ninety percent of normal. The state averaged 3.67 inches (93.22 mm) of precipitation and it was the twenty-seventh driest July on record (1895-2011) there. Southern Louisiana and much of Mississippi did experience normal to above normal precipitation. Precipitation totals in those areas ranged from one hundred to two hundred percent of normal. Louisiana averaged 6.28 inches (159.51 mm) of precipitation for the month, while Mississippi averaged 6.69 inches (169.93 mm). For Mississippi it was the twentieth wettest July on record (1895-2011), while for Louisiana it was the thirty-seventh wettest on record (1895-2011).

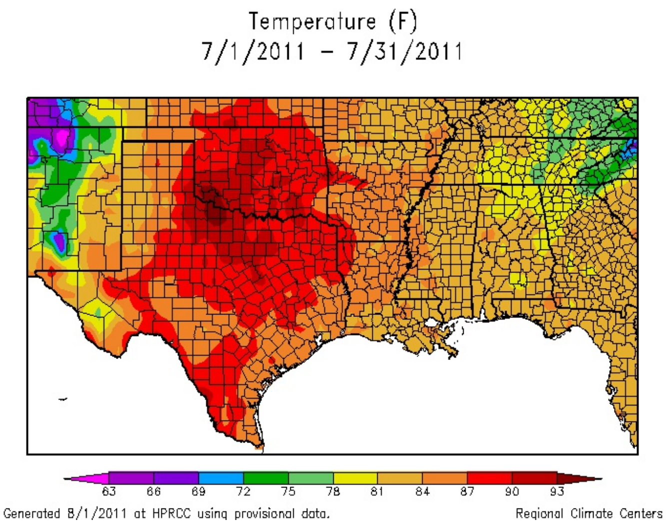


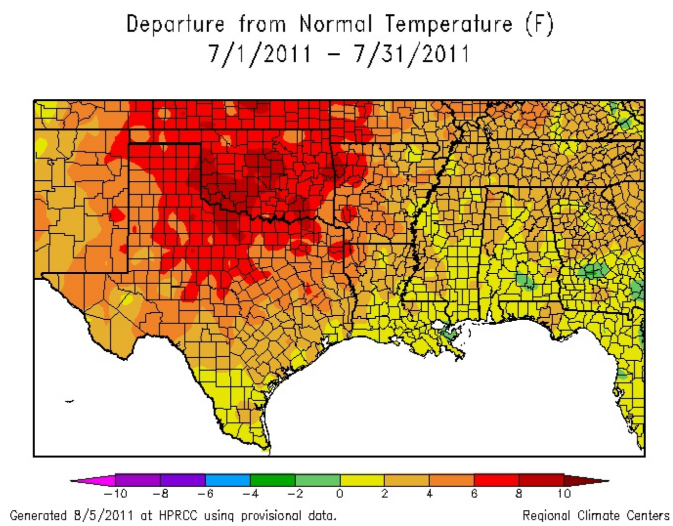

**Total precipitation values (left) and the percent of 1971-2000 normal precipitation totals (right) for July 2011.**

## TEMPERATURE SUMMARY

*Luigi Romolo, Southern Regional Climate Center*

As was the case in the previous month, July was again a very warm month for the Southern Region. The region as a whole averaged a temperature of 85.80 degrees F (29.89 degrees C). This is the warmest July on record (1895-2011) for the Southern Region. This is not surprising given that the majority of stations in the region averaged between 2 to 6 degrees F (1.11 to 3.33 degrees C) above monthly normals. The highest anomalies were observed in Oklahoma and northern Texas, where average temperatures ranged between 6 to 10 degrees F (3.33 to 5.56 degrees C) above expected values. Both Oklahoma and Texas experienced their warmest July on record (1895-2011), with state average temperatures of 88.90 and 87.10 degrees F (31.61 and 30.61 degrees C), respectively. Arkansas had a state average temperature of 84.50 degrees F (29.17 degrees C), which was the fourth warmest July on record (1895-2011). With a state average temperature of 83.80 degrees F (28.78 degrees C), Louisiana experienced its fifth warmest July on record (1895-2011). In Mississippi, it was the twelfth warmest July on record (1895-2011). The state average temperature there was 82.60 degrees F (28.11 degrees C). Tennessee averaged 80.00 degrees F (26.67 degrees C) and it was the tenth warmest July on record (1895-2011).




**Average temperatures (left) and departures from 1971-2000 normal average temperatures (above) for July 2011, across the South.**

## CLIMATE PERSPECTIVE

| State | Temperature | Rank | Precipitation | Rank |
|---|---|---|---|---|
| Arkansas | 84.5 | 4th Warmest | 2.2 | 18th Driest |
| Louisiana | 83.8 | 5th Warmest | 6.28 | 37th Wettest |
| Mississippi | 82.6 | 12th Warmest | 6.69 | 20th Wettest |
| Oklahoma | 88.9 | Warmest Ever | 0.9 | 9th Driest |
| Tennessee | 80 | 10th Warmest | 3.67 | 27th Driest |
| Texas | 87.1 | Warmest Ever | 0.72 | 2nd Driest |

**State temperature and precipitation values and rankings for July 2011. Ranks are based on the National Climatic Data Center's Statewide, Regional and National Dataset over the period 1895-2011.**

## STATION SUMMARIES ACROSS THE SOUTH

| Station Name | Temperatures (degrees F) | | | | | | | | Precipitation (inches) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Averages | | | | Extremes | | | | Totals | | |
| | Max | Min | Mean | Depart | High | Date | Low | Date | Obs | Depart | %Norm |
| El Dorado, AR | 97.6 | 73.4 | 85.5 | 3.5 | 105.0 | 7/13 | 67.0 | 7/6+ | 2.02 | -2.11 | 49 |
| Little Rock, AR | 97.7 | 76.1 | 86.9 | 4.5 | 105.0 | 7/12 | 69.0 | 7/5 | 0.24 | -3.07 | 7 |
| Baton Rouge, LA | 92.4 | 75.1 | 83.7 | 2.0 | 98.0 | 7/11+ | 71.0 | 7/7+ | 6.22 | 0.26 | 104 |
| New Orleans, LA | 91.7 | 76.6 | 84.2 | 1.5 | 100.0 | 7/2 | 74.0 | 7/26+ | 13.00 | 6.80 | 210 |
| Shreveport, LA | 99.6 | 76.5 | 88.1 | 4.7 | 104.0 | 7/31+ | 71.0 | 7/1 | 1.85 | -2.14 | 46 |
| Greenwood, MS | 93.4 | 72.7 | 83.0 | 0.7 | 99.0 | 7/13+ | 64.0 | 7/1 | 4.44 | 0.25 | 106 |
| Jackson, MS | 95.0 | 73.8 | 84.4 | 3.0 | 102.0 | 7/10 | 69.0 | 7/6+ | 3.31 | -1.38 | 71 |
| Tupelo, MS | 94.0 | 73.6 | 83.8 | 3.2 | 100.0 | 7/12+ | 66.0 | 7/1 | 1.02 | -2.63 | 28 |
| Oklahoma City, OK | 102.5 | 75.9 | 89.2 | 7.2 | 110.0 | 7/9 | 71.0 | 7/5 | 3.04 | 0.10 | 103 |
| Ponca City, OK | 103.6 | 78.2 | 90.9 | 8.0 | 110.0 | 7/24+ | 68.0 | 7/8+ | 0.71 | -2.72 | 21 |
| Tulsa, OK | 103.0 | 78.7 | 90.9 | 7.4 | 107.0 | 7/31+ | 72.0 | 7/5 | 0.36 | -2.60 | 12 |
| Knoxville, TN | 91.9 | 71.6 | 81.8 | 4.0 | 97.0 | 7/28+ | 63.0 | 7/1 | 2.49 | -2.22 | 53 |
| Memphis, TN | 94.9 | 77.2 | 86.0 | 3.5 | 99.0 | 7/31+ | 72.0 | 7/1 | 2.95 | -1.27 | 70 |
| Nashville, TN | 93.1 | 72.8 | 83.0 | 3.9 | 100.0 | 7/11 | 63.0 | 7/1 | 3.46 | -0.31 | 92 |
| Amarillo, TX | 99.6 | 70.8 | 85.2 | 7.0 | 105.0 | 7/9 | 63.0 | 7/4 | 1.00 | -1.68 | 37 |
| El Paso, TX | 98.1 | 74.4 | 86.2 | 3.0 | 103.0 | 7/20 | 68.0 | 7/26+ | 2.59 | 1.10 | 174 |
| Dallas, TX | 101.7 | 81.0 | 91.4 | 6.4 | 106.0 | 7/25 | 75.0 | 7/1 | 0.09 | -2.03 | 4 |
| Houston, TX | 95.5 | 77.5 | 86.5 | 2.0 | 99.0 | 7/26+ | 76.0 | 7/31+ | 3.27 | -1.09 | 75 |
| San Antonio, TX | 98.7 | 77.0 | 87.9 | 3.5 | 101.0 | 7/27+ | 75.0 | 7/19+ | 0.96 | -1.07 | 47 |

**Summary of temperature and precipitation information from around the region for July 2011. Data provided by the Applied Climate Information System. On this chart, "depart" is the average's departure from the normal average, and "% norm" is the percentage of rainfall received compared with normal amounts of rainfall. Plus signs in the dates column denote that the extremes were reached on multiple days. Blue-shaded boxes represent cooler than normal temperatures; red-shaded boxes denote warmer than normal temperatures; tan shades represent drier than normal conditions; and green shades denote wetter than normal conditions.**

## SOUTHERN CLIMATE 101

*Have a question about Southern U.S. climate? Let us know and we may feature the answer in a future issue of the Monitor!*

In future issues of the Monitor, we will select a user submitted climate question and provide a reply, to appear in this spot on the back page of the Monitor. Though any aspect of climate is fair game, we will give greatest consideration to questions pertaining to extreme weather & climate events, recent conditions, and climate-related issues relevant to the South Central U.S. - specifically the states of Oklahoma, Texas, Arkansas, Louisiana, Tennessee, and Mississippi. For instance, perhaps you recently experienced a significant winter storm and you were curious how rare it was from a historical perspective. Contact us at **monitor@southernclimate.org** and we will consider your question among all the others we receive. In the subject line of your message, please use "Southern Climate 101." We look forward to your submissions!

Have a climate question, but do not want it to be answered in a public forum? No problem! Feel free to contact us at one of the options listed below, and we will do our best to address your question.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## CONTACT US

The *Monitor* is an experimental climate outreach and engagement product of the Southern Regional Climate Center and Southern Climate Impacts Planning Program. To provide feedback or suggestions to improve the content provided in the *Monitor*, please contact us at **monitor@southernclimate.org**. We look forward to hearing from you and tailoring the *Monitor* to better serve you. You can also find us online at **www.srcc.lsu.edu** and **www.southernclimate.org**.

For any questions pertaining to historical climate data across the states of Oklahoma, Texas, Arkansas, Louisiana, Mississippi, or Tennessee, please contact the Southern Regional Climate Center at 225-578-502. For questions or inquiries regarding research, experimental tool development, and engagement activities at the Southern Climate Impacts Planning Program, please contact us at 405-325-7809 or 225-578-8374.

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