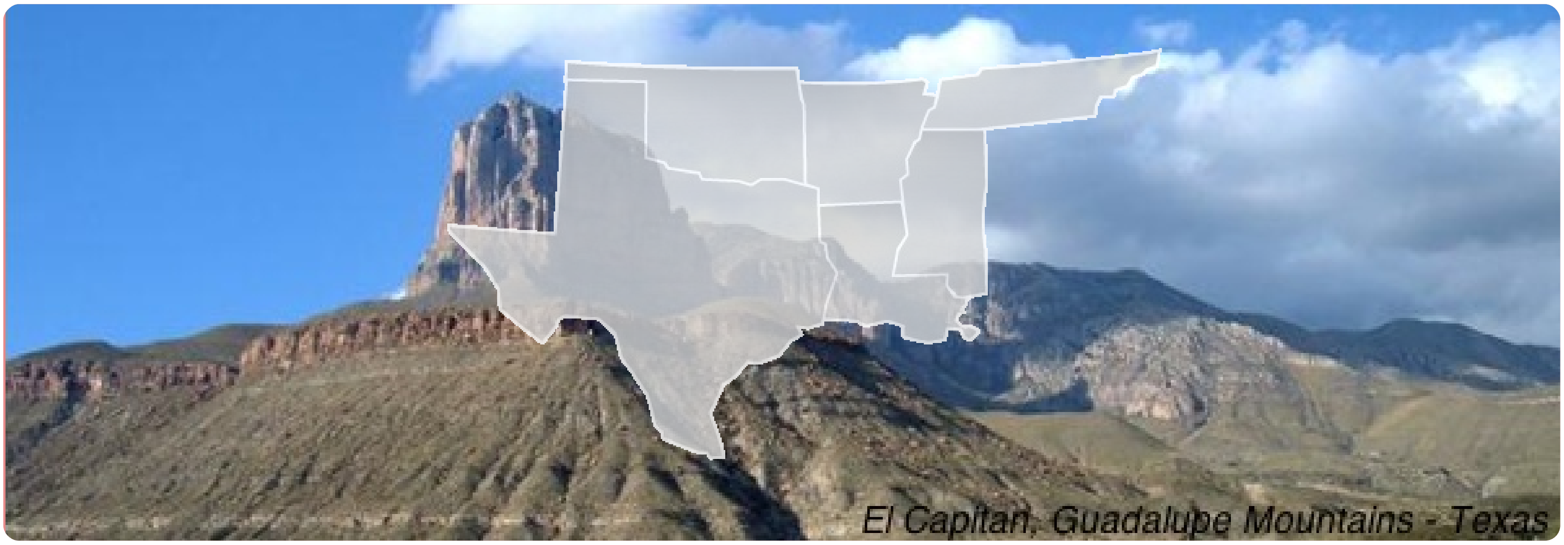


# SOUTHERN CLIMATE *MONITOR*

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The Southern Climate Monitor is available at **www.srcc.lsu.edu** & **www.southernclimate.org**

# ICE STORM FREQUENCY IN RESPONSE TO EL NIÑO, ARCTIC AND NORTH ATLANTIC OSCILLATION

*Carly Kovacik, University of Oklahoma*

The Sperry-Piltz Ice Accumulation Index, or "SPIA Index" – Copyright, February, 2009

| ICE DAMAGE INDEX | * AVERAGE NWS ICE AMOUNT (in inches) *Revised-October, 2011 | WIND (mph) | DAMAGE AND IMPACT DESCRIPTIONS |
|---|---|---|---|
| 0 | < 0.25 | < 15 | Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages. |
| 1 | 0.10 – 0.25 | 15 - 25 | Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous. |
| | 0.25 – 0.50 | > 15 | |
| 2 | 0.10 – 0.25 | 25 - 35 | Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation. |
| | 0.25 – 0.50 | 15 - 25 | |
| | 0.50 – 0.75 | < 15 | |
| 3 | 0.10 – 0.25 | > = 35 | Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days. |
| | 0.25 – 0.50 | 25 - 35 | |
| | 0.50 – 0.75 | 15 - 25 | |
| | 0.75 – 1.00 | < 15 | |
| 4 | 0.25 – 0.50 | > = 35 | Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days. |
| | 0.50 – 0.75 | 25 - 35 | |
| | 0.75 – 1.00 | 15 - 25 | |
| | 1.00 – 1.50 | < 15 | |
| 5 | 0.50 – 0.75 | > = 35 | Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed. |
| | 0.75 – 1.00 | > = 25 | |
| | 1.00 – 1.50 | > = 15 | |
| | > 1.50 | Any | |

(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

**The SPIA damage index that was recently made available for public use. The index rates ice storms on a scale of 1-5, with 5 being the most catastrophic type of event. For more information, visit http://www.spia-index.com/.**

Over the past decade, many people in Oklahoma have suspected a potential increase in ice storm frequency. Ice storms have had a detrimental impact on both life and property across the entire United States, usually resulting in millions of dollars in damage, week-long power outages, and fatalities. Recently, electric companies over the country have been trying to improve their understanding of these storms in an effort to send crews out early to restore power as promptly as possible. In particular, the Oklahoma Association of Electric Cooperatives (OAEC) in Oklahoma City, Oklahoma has been interested in finding a potential association between ice storm frequency and phases in the El Niño/Southern Oscillation (ENSO), Arctic Oscillation (AO), and North Atlantic Oscillation (NAO) over the entire United States.

Sid Sperry, director of Public Relations, Communications, and Research for OAEC, and Steven Piltz, the Meteorologist in Charge at the National Weather Service in Tulsa, Oklahoma, have developed an ice damage prediction index (SPIA index) which uses an algorithm to predict a projected footprint of an ice storm, its total ice accumulation, and the potential damage associated with it. According to Sperry, this tool was designed to improve winter weather preparedness and risk management. With such a tool being recently introduced to the public, it is important to continue to study ice storm frequency and intensity to emphasize its importance and accuracy.

OAEC is particularly interested in the ENSO, AO, and NAO phases because each are associated with a specific pattern in temperature and precipitation across the United States. El Niño is characterized by warm ocean temperatures in the equatorial Pacific. This typically results in above-normal precipitation and cooler temperatures across the southern United States in the winter and milder temperatures in the Northern Plains, New England and the Midwest.

El Niño can generally be predicted several months in advance and typically persists over a period of several months or more. In contrast, the Arctic and North Atlantic Oscillation are difficult to predict more than several weeks in advance and can fluctuate periodically throughout the winter season, leading to varying weather patterns across the United States.

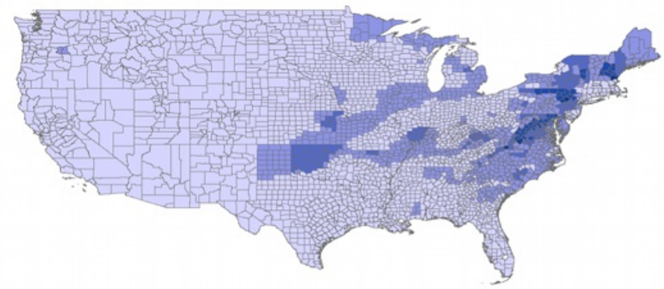
The Arctic Oscillation consists of circulations over the arctic region and is associated with a positive and negative phase. During a negative phase, low pressure over the arctic is weak, causing upper-level winds to weaken. This allows arctic air to travel into the United States, leading to cold temperatures and winter precipitation. During a positive phase, low pressure over the arctic is strong and arctic air is unable to migrate towards the United States, thus eliminating frigid temperatures and persistent winter weather.

The North Atlantic Oscillation also has a positive and negative phase. During a positive phase, low pressure near Iceland and high pressure near the Azores strengthen, causing wet, yet mild weather over the eastern United States. Colder temperatures are typically seen in the Midwest, Northern, and Southern Plains. In contrast, during a negative phase, low pressure near Iceland and high pressure near the Azores weaken, leading to colder temperatures across much of the United States. For further information on ENSO, AO, and NAO, contact the State Climate Office of North Carolina.

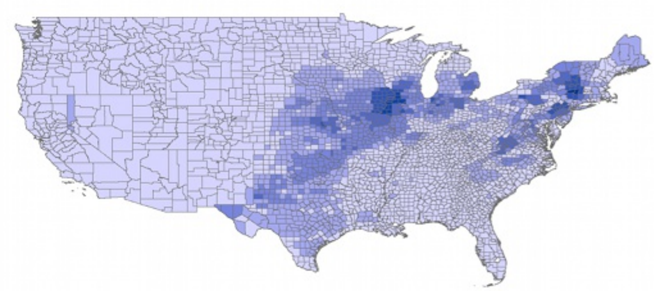
It is now obvious that these patterns have an important impact in terms of winter precipitation. The question then becomes: if ENSO, AO, and NAO are studied together over a long period of time, can we begin to predict when and where ice storms are likely to occur?

Unfortunately, the answer to this question is still in progress. However, all ice storms that have occurred throughout the United States from 2000-2011 have been documented. The term "ice storm" for this project refers to any freezing precipitation event that has led to hazardous travel conditions, power outages, and/or fatalities, regardless of the amount of ice accumulation or presence of other precipitation types. Shown below are two example images of all ice storms that occurred in January, February, and December of 2002 and 2007, respectively. Spatial differences are apparent between the two years and it is possible that particular phases in the ENSO, AO, and NAO are responsible for this.

Over the next several months, the aim of this project will be to group the ice storm reports into winter seasons (i.e., winter of '01-'02, etc.), as opposed to yearly, and then compare the results to the different phases of ENSO, AO, and NAO. The ultimate goal will be to provide preliminary conclusions regarding a potential association between ice storm frequency and particular phases in the ENSO, AO, and NAO. For further information or questions regarding this project, please contact Carly Kovacik at cekovaci@ou.edu.



**Total ice storm reports that occurred in January, February, and December of 2002. Legends have not yet been formatted. The darker the shade, the higher the number of reported ice storms.**



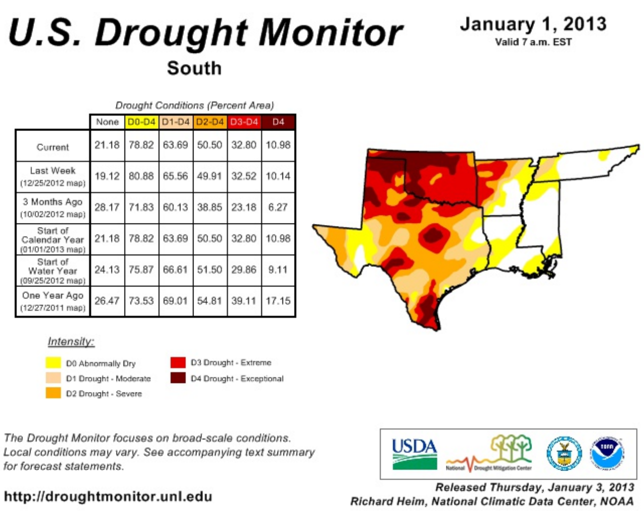
**Total ice storm reports that occurred in January, February, and December of 2007. Legends have not yet been formatted. The darker the shade, the higher the number of reported ice storms.**

Special thanks is given to Sid Sperry and Steven Piltz for allowing the use of the ice index image and to the State Climate Office of North Carolina for the supporting information regarding ENSO, AO, and NAO.

## DROUGHT CONDITIONS

*Luigi Romolo, Southern Regional Climate Center*

Because much of the drought in the Southern Region is confined to Texas, Arkansas and Oklahoma, where precipitation was below average for the month, drought conditions remained relatively unchanged. There is a slightly larger area of extreme and severe drought in central Texas. In addition, the heavy rains in Louisiana helped remove drought conditions in the west central parishes. Some improvement also occurred in western Tennessee.




**Above: Drought conditions in the Southern Region. Map is valid for December 2012. Image courtesy of the National Drought Mitigation Center.**

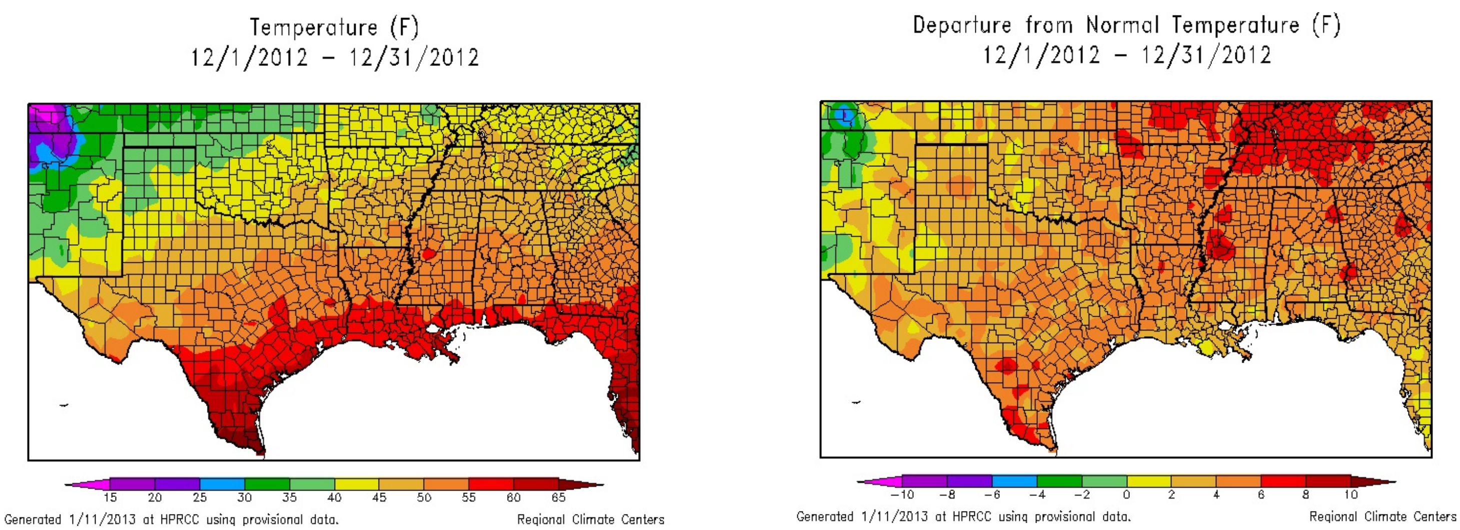
With state-wide reservoir storage in a declining trend, new water usage restrictions are in place in Austin, Corpus Christi, and several places in north central Texas. Other places are developing new plans for water conservation and storage. The North Texas and Upper Trinity water districts have seen significant declines in reservoir storage in recent months, with the latter planning on adding new lakes to its draw pool to increase total supply storage. Older plans are being further developed, such as the San Angelo plan to develop piping to the Hickory Aquifer, which is expected to see completion by September, 2014. Above average temperatures and low short-term rainfall are also driving concerns over potential wildfires, as evidenced by Bastrop's requesting an additional $7 million for fire response and grassland fires causing strain on some fire response teams (Information provided by the Texas Office of State Climatology).

Dryland crops in central Texas continue to struggle with concerns that winter wheat will not have significant yields. Farmers in the Panhandle are feeling the same concerns, though slightly higher precipitation accumulations are buoying their crops for the time being. Farmers all over the state are concerned about their fiscal future, as the 2008 farm bill allocating $300 billion in farm subsidies expired this year and progress on a new bill has been slow; suggested cuts to the bill between 20 to 30 billion dollars over 10 years is another cause for concern (Information provided by the Texas Office of State Climatology).

# TEMPERATURE SUMMARY

*Luigi Romolo, Southern Regional Climate Center*

December was a much warmer month than normal over the entire Southern Region. Most stations averaged approximately 4 to 8 degrees F (2.22 to 4.44 degrees C) above normal. Temperatures in northern Texas, western Oklahoma and southern Louisiana typically averaged between 2 to 4 degrees F (1.11 to 2.22 degrees C) above normal. The highest anomalies were observed in northern Tennessee, where stations averaged between 6 to 8 degrees F (3.33 to 4.44 degrees C) above normal. All six states reported warmer than normal temperatures for the month. The statewide average temperatures for December are as follows: Arkansas reported 46.00 degrees F (7.78 degrees C), Louisiana reported 55.00 degrees F (12.78 degrees C), Mississippi reported 51.40 degrees F (10.78 degrees C), Oklahoma reported 41.80 degrees F (5.44 degrees C), Tennessee reported 45.30 degrees F (7.39 degrees C), and Texas reported 51.00 degrees F (10.56 degrees C). For Tennessee, it was the ninth warmest December on record (1895-2012), while Texas experienced its eleventh warmest on record (1895-2012). The remaining state rankings are as follows: Arkansas with its thirteenth warmest on record (1895-2012), Mississippi with its fourteenth warmest on record (1895-2012), Louisiana with its eighteenth warmest on record (1895-2012), and Oklahoma with its twenty-seventh warmest on record (1895-2012). Two states in the Southern Region also reported 2012 as its warmest year on record (1895-2012). These states are Oklahoma and Texas. Oklahoma's annual temperature average was 62.99 degrees F (17.22 degrees C), while in Texas, the state annual average temperature was 67.48 degrees F (19.71 degrees C). Arkansas reported its second warmest year on record (1895-2012) with an annual temperature average of 63.39 degrees F (17.44 degrees C).

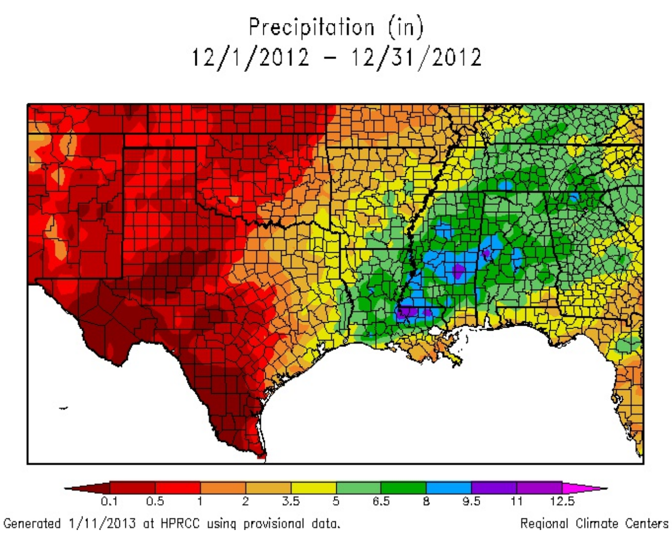


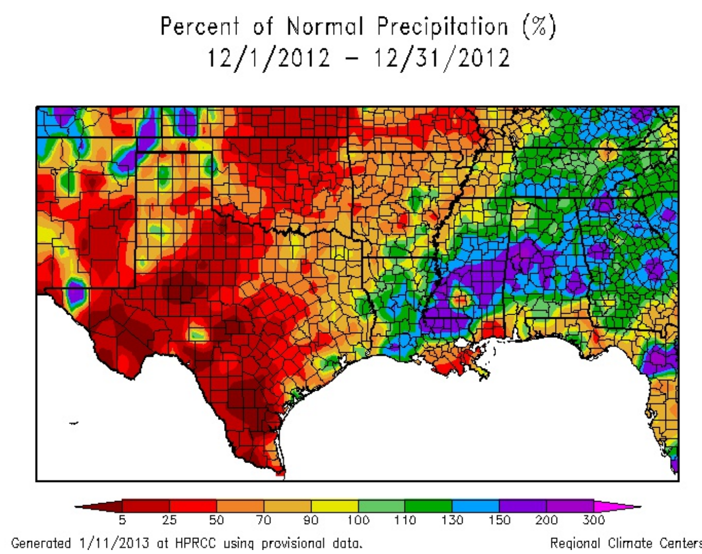

**Average temperatures (left) and departures from 1971-2000 normal average temperatures (right) for November 2012, across the South.**

## PRECIPITATION SUMMARY

*Luigi Romolo, Southern Regional Climate Center*

December was a drier than normal month for the western half of the Southern Region, while the eastern half experienced a wetter than normal month. The wettest portions of the region were observed in southern Mississippi, where precipitation totals averaged between 150-200 percent of normal. Conversely, much of southern and eastern Texas reported less than half the expected precipitation for the month. This was also the case for much of central Oklahoma. For Oklahoma, it was the thirty-second driest December on record (1895-2012), with a state monthly precipitation total of only 0.93 inches (23.62 mm). Texas experienced its twenty-fourth driest December on record (1895-2012) with a state precipitation total of 1.00 inches (25.40 mm). In contrast, Mississippi averaged 7.05 inches (179.10 mm), which was their twenty-seventh wettest December on record (1895-2012). Conditions were also wet across much of Louisiana. The state averaged 6.32 inches (160.50 mm), and it was their twenty-fifth wettest December (1895-2012). Other state average precipitation totals were as follows: Arkansas with 3.79 inches (96.27 mm), and Tennessee with 5.71 inches (145.00 mm). Ranks for both states fell in the middle two quartiles.




**Total precipitation values (left) and Th  percent of 1971-2000 normal precipitation totals (right) for December 2012.**

## CLIMATE PERSPECTIVE

| State | Temperature | Rank | Precipitation | Rank |
|---|---|---|---|---|
| Arkansas | 46.0 | 13th Warmest | 3.79 | 50th Driest |
| Louisiana | 55.0 | 18th Warmest | 6.32 | 25th Wettest |
| Mississippi | 51.4 | 14th Warmest | 7.05 | 27th Wettest |
| Oklahoma | 41.8 | 27th Warmest | 0.93 | 32nd Driest |
| Tennessee | 45.3 | 9th Warmest | 5.71 | 41st Wettest |
| Texas | 51.0 | 11th Warmest | 1.00 | 24th Driest |

**State temperature and precipitation values and rankings for November 2012. 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 | 61.4 | 40.2 | 50.8 | 4.7 | 77.0 | 12/1 | 22.0 | 12/30 | 6.06 | 1.26 | 126 |
| Little Rock, AR | 58.0 | 38.5 | 48.2 | 5.0 | 77.0 | 12/3 | 19.0 | 12/27 | 5.60 | 0.89 | 119 |
| Baton Rouge, LA | 67.4 | 45.1 | 56.3 | 3.9 | 80.0 | 12/3+ | 28.0 | 12/30 | 8.10 | 2.84 | 154 |
| New Orleans, LA | 68.3 | 49.5 | 58.9 | 3.8 | 80.0 | 12/9 | 35.0 | 12/30 | 5.13 | 0.06 | 101 |
| Shreveport, LA | 63.1 | 42.3 | 52.7 | 4.3 | 80.0 | 12/2 | 23.0 | 12/30 | 5.66 | 1.11 | 124 |
| Greenwood, MS | 62.1 | 40.0 | 51.1 | 4.3 | 78.0 | 12/4 | 19.0 | 12/30 | 7.07 | 1.66 | 131 |
| Jackson, MS | 63.7 | 41.5 | 52.6 | 5.0 | 77.0 | 12/2 | 22.0 | 12/30 | 8.71 | 3.37 | 163 |
| Tupelo, MS | 59.4 | 40.1 | 49.7 | 6.3 | 74.0 | 12/3 | 21.0 | 12/30 | 7.09 | 0.97 | 116 |
| Oklahoma City, OK | 53.5 | 31.6 | 42.6 | 3.1 | 79.0 | 12/3 | 13.0 | 12/26 | 0.67 | -1.22 | 35 |
| Ponca City, OK | 53.0 | 29.4 | 41.2 | 4.1 | 77.0 | 12/3 | 10.0 | 12/29+ | 0.25 | -1.42 | 15 |
| Tulsa, OK | 54.4 | 32.8 | 43.6 | 3.9 | 77.0 | 12/1 | 14.0 | 12/26 | 0.85 | -1.58 | 35 |
| Knoxville, TN | 54.9 | 35.6 | 45.3 | 5.7 | 72.0 | 12/4 | 21.0 | 12/23 | 6.36 | 1.27 | 125 |
| Memphis, TN | 58.0 | 41.5 | 49.8 | 6.5 | 75.0 | 12/3 | 21.0 | 12/30 | 3.73 | -1.95 | 66 |
| Nashville, TN | 56.0 | 38.5 | 47.2 | 6.7 | 75.0 | 12/3 | 22.0 | 12/30+ | 4.71 | 0.17 | 104 |
| Amarillo, TX | 56.1 | 26.9 | 41.5 | 4.5 | 78.0 | 12/2 | 8.0 | 12/26 | 0.54 | -0.07 | 89 |
| El Paso, TX | 59.9 | 34.8 | 47.4 | 2.0 | 75.0 | 12/1 | 20.0 | 12/12+ | 0.10 | -0.67 | 13 |
| Dallas, TX | 62.1 | 40.2 | 51.1 | 4.4 | 83.0 | 12/2+ | 22.0 | 12/26 | 1.95 | -0.62 | 76 |
| Houston, TX | 69.9 | 47.5 | 58.7 | 5.0 | 84.0 | 12/2 | 30.0 | 12/30 | 2.85 | -0.84 | 77 |
| San Antonio, TX | 68.8 | 45.4 | 57.1 | 4.7 | 82.0 | 12/19 | 27.0 | 12/21 | 0.37 | -1.59 | 19 |

**Summary of temperature and precipitation information from around the region for November 2012. 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.**

**Disclaimer:** This is an experimental climate outreach and engagement product. While we make every attempt to verify this information, we do not warrant the accuracy of any of these materials. The user assumes the entire risk related to the use of these data. This publication was prepared by SRCC/SCIPP with support in part from the U.S. Department of Commerce/NOAA. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA

## SOUTHERN CLIMATE MONITOR TEAM:

Luigi Romolo, Regional Climatologist
Southern Regional Climate Center (LSU)

Charlotte Lunday, Student Assistant
Southern Climate Impacts Planning Program (OU)

Lynne Carter, Program Manager
Southern Climate Impacts Planning Program (LSU)

Margret Boone, Program Manager
Southern Climate Impacts Planning Program (OU)

Rachel Riley, Associate Program Manager
Southern Climate Impacts Planning Program (OU)

Hal Needham, Research Associate
Southern Climate Impacts Planning Program (LSU)

Barry Keim, State Climatologist for Louisiana
Co-PI, Southern Climate Impacts Planning Program (LSU)

Mark Shafer, Principal Investigator
Southern Climate Impacts Planning Program (OU)

Gary McManus, Associate State Climatologist for Oklahoma
Southern Climate Impacts Planning Program (OU)

Kevin Robbins, Director
Southern Regional Climate Center (LSU)

## 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.