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In this Issue:

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SEVERE WINTER WEATHER EVENTS AND ASSOCIATED SOCIOECONOMIC IMPACTS FROM 2000 -2010

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High-impact winter storms appear to be increasing across the United States, especially across the southern plains. In terms of overall winter storms, Changnon (2007) found that although there was a statistically significant decrease in the number of catastrophic winter storms from 1949 – 2003 across the United States (i.e., storms with at least $1 million USD damage), there was a statistically significant upward trend in the intensity of the storms, as measured by monetary costs. Therefore, while the frequency of catastrophic winter storms decreased, these winter storm events incur a greater impact. This discussion examines high-impact winter storms that have occurred across Oklahoma over a ten-year period spanning 2000 – 2010. The goal is to determine the climatological relevance of the events and, based on federal aid expenditures, the economic impacts across the region.

When analyzed on a regional scale, Changnon (2007) found that high-impact winter storms were typically most frequent in the northeast U.S. and least frequent in the western United States. However, in comparison to the previous twenty-year period from 1964-1983 and despite a decreasing national trend, Oklahoma experienced a 105% increase in high-impact winter storm events during the twenty-year period between 1984-2003. Changnon (2007) also found that, over the same time periods, the average high-impact winter storm [economic] losses increased by 291% across the South category of the United States (including Oklahoma).

To better understand the consequences of the recent high-impact winter storm events in Oklahoma, this discussion compiled all United States National Weather Service (NWS) winter weather reports for the ten year period (2000 – 2010) with specific goals of determining the following: (1) the spatial distribution of winter storm event in Oklahoma during the discussion period, (2) whether the events occurred within climatological norms and, (3) the overall socioeconomic impacts of the severe, high-impact winter weather events.

Oklahoma led the nation with nine winter-related disaster declarations during the focus period of this discussion (1 November 1999 – 1 May 2010) which accounted for nearly $800 Million USD in total aid from the United States Federal Government. When compared with past climatological analyses, the number and intensity of the high-impact winter storm events was anomalously high across most of Oklahoma and particularly over southern and central portions of the state. For example, central Oklahoma experienced, on average, a two-year snow event (Changnon 2006) nearly every year while southwest and central Oklahoma experienced as

Table 1: Cost summary for major disaster declarations

				Public Assistance	Hazard Mitigation	
Disaster	Size (% of Counties)	Open Date	Close Date	2010 Amount	2010 Amount	Total Cost
1355	**84.42**	December 25, 2000	January 10, 2001	$195,273,585	$58,576,438	$253,850,023
1401	**58.44**	January 30, 2002	February 11, 2002	$131,435,131	$46,367,469	$177,802,600
1452	**18.18**	December 3, 2002	December 4, 2002	$5,142,582	$1,484,434	$6,627,016
1677	**3.90**	December 28, 2006	December 30, 2006	$7,131,386	$2,567,485	$9,698,871
1678	**62.34**	January 12, 2007	January 26, 2007	$82,643,557	$21,767,162	$104,410,720
1735	**32.47**	December 8, 2007	January 3, 2008	$103,873,997	$31,782,101	$135,656,098
1823	**12.99**	January 26, 2009	January 28, 2009	$9,479,711	$1,973,631	$11,453,341
1876	**70.13**	December 24, 2009	December 25, 2009	$18,063,800	$979,946	$19,043,746
1883	**64.94**	January 28, 2010	January 30, 2010	$75,457,829	$1,587,897	$77,045,726
			Totals	**$628,501,577**	**$167,086,563**	**$795,588,140**

many or more Blizzards during the study period than over the previous forty-year period from 1959 – 2000 (Schwartz and Schmidlin 2002). In addition, at least half of all Oklahoma counties reached or exceeded the ten-year, statewide, climatological average of catastrophic ice storms (Changnon 2003). Such ice storm events were particularly devastating across much of southern, central, and northeast Oklahoma and the results of this discussion demonstrate that statewide, approximately 50% of all Ice Storm reports occurred during disaster declaration periods. Because the number of Ice Storm events was anomalously large and the spatial area covered by each event was large, the impacts frequently occurred in regions less-prepared for these high-impact winter events.

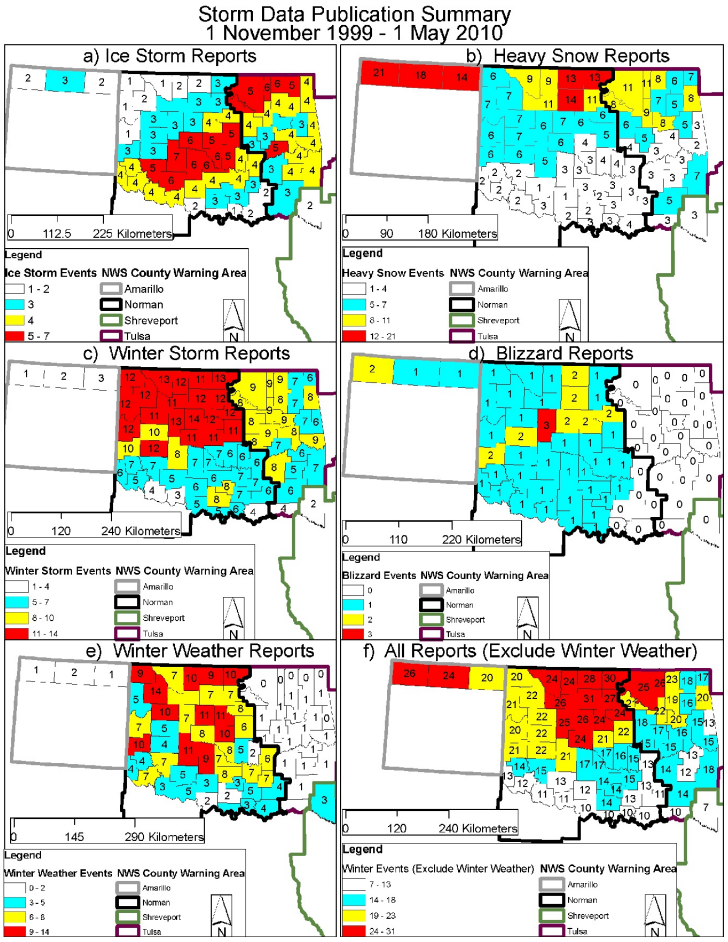

Figure 1: Spatial distribution of storm types from 1 November 1999 - 1 May 2010: Ice Storm (a), Heavy Snow (b), Winter Storm (c), Blizzard (d), Winter Weather (e), All reports except Winter Weather (f)

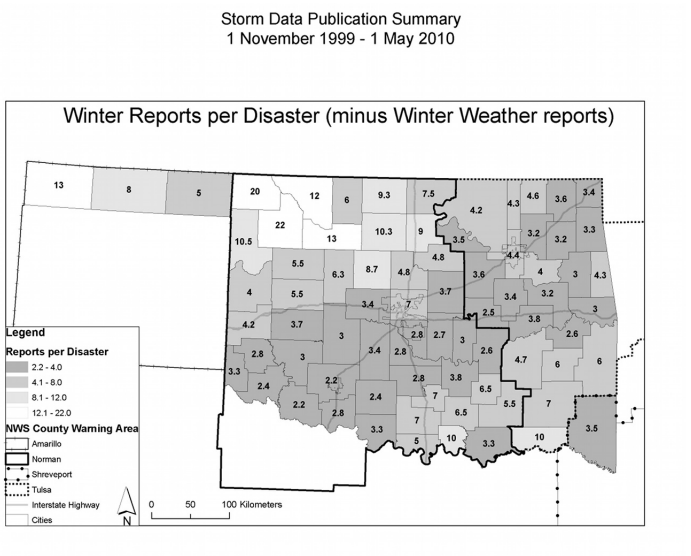

Figure 2: Ratio of total winter reports (minus Winter Weather) to major disaster declarations

The devastating socioeconomic impacts of these high-impact winter storm disasters was, in part, revealed by the federal aid distributed across the state. The spatial distribution of the aid revealed that, while the two most populous counties received the most monetary aid, the rural counties overall (1) received the majority of federal aid from the disaster events, and (2) yielded greater per capita cost than the more populated counties. Therefore, rural regions, with fewer resources at their disposal, were impacted more by the high impact winter weather events and required more assistance from outside resources.

In conclusion, despite national trends, high-impact winter storm events have greatly impacted Oklahoma. Not only has Oklahoma seen an increase in these high-impact events over the twenty-year period of 1984-2003, but socioeconomic impacts have also increased, as evidenced by the increase in Federal Disaster Declaration.

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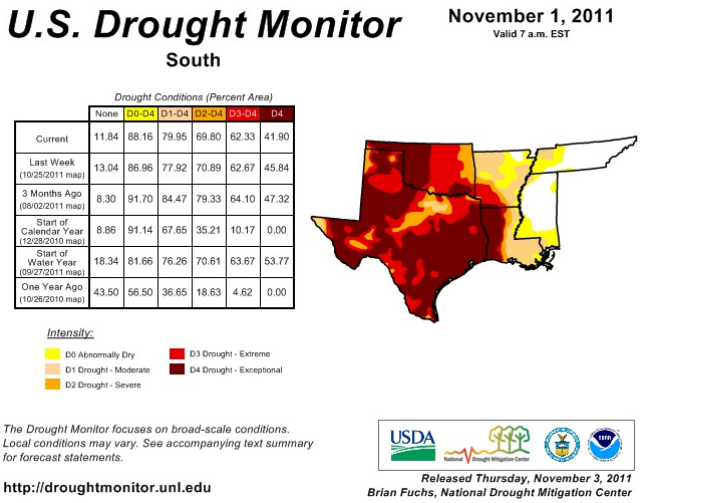
DROUGHT CONDITIONS

Luigi Romolo, Southern Regional Climate Center

Over the month of October, drought conditions did not change much from September in Mississippi, Tennessee and Arkansas. Conditions have changed, however; in Texas, Oklahoma and Louisiana. In Oklahoma, much of the central portion of the state did see a one category improvement from exceptional drought to extreme drought. This was also the case for central Texas, where rainfall for the month was abundant. In Louisiana, the south east parishes went from being drought free to moderate drought. In addition, much of the western part of the state is now experiencing exceptional drought. In total for the Southern Region, there was a decrease in exceptional drought from 53.77 percent areal coverage to 41.90 percent areal coverage.

The bulk of weather impacts for the Southern Region continue to pertain to the longstanding Texas drought. The effects of the drought and wildfires on Texas agriculture have been devastating. Cotton has been particularly hard hit with a loss of more than half of the 7.1 million acres planted this season. With prices being extremely high, cotton crop losses alone have translated into a $1.8 billion loss to the Texas cotton industry. Precipitation during the second half of October helped to replenish livestock tanks and ponds and helped with the plating of fall crops



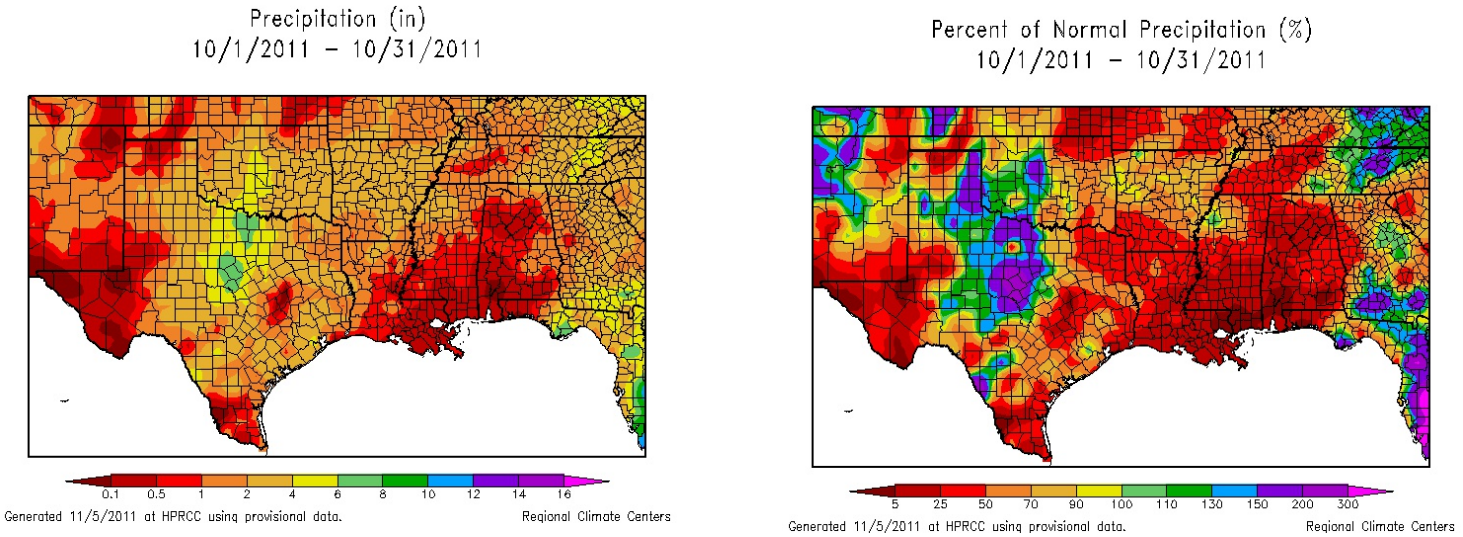
Above: Drought conditions in the Southern Region. Map is valid for October 2011. Image courtesy of the National Drought Mitigation Center.

and winter forages, but much more additional precipitation will be needed to maintain growth. Additionally, Texas corn farmers were expected to only harvest about half of the normal 200 million bushels the state normally produces each year. The devastating wildfire season has been estimated to have caused $200 million in damage to Texas agriculture alone. Overall, the $5.2 billion in estimated 2011 losses to Texas agriculture set in August have only increased since this estimate was put forth (Information provided by the Texas Office of State Climatology).

PRECIPITATION SUMMARY

Luigi Romolo, Southern Regional Climate Center

With the exception of central Texas and eastern Tennessee, the bulk of the Southern Region experienced a very dry October. In central Texas, stations averaged between 100 and 250 percent of normal precipitation for the month. It is worth noting that these stations received between 4 to 8 inches (101.60 to 203.20 mm) of precipitation for the month. In eastern Tennessee, stations averaged between 100 to 200 percent of normal precipitation, or approximately 3 to 6 inches (76.20 to 152.4 mm) for the month. By contrast, conditions were extremely dry in Louisiana, Mississippi, eastern Texas, and southern Arkansas. Stations in southern Louisiana and southern Mississippi averaged only between 0 to 25 percent of normal, or approximately 3 to 5 inches (76.20 to 127.00 mm) less than they normally receive for the month. Louisiana averaged only 0.82 inches (20.83 mm) for the month, making it their ninth driest October on record (1895-2011). For Mississippi, it was the seventeenth driest October on record with an average precipitation total of 1.10 inches (27.94 mm). Other state average precipitation totals for the month include: Arkansas with 2.48 inches (62.99 mm) of precipitation, Oklahoma with 2.67 inches (67.82 mm) of precipitation, Tennessee with 2.39 inches (60.71 mm) of precipitation, and Texas with 2.18 inches (55.37 mm) of precipitation.

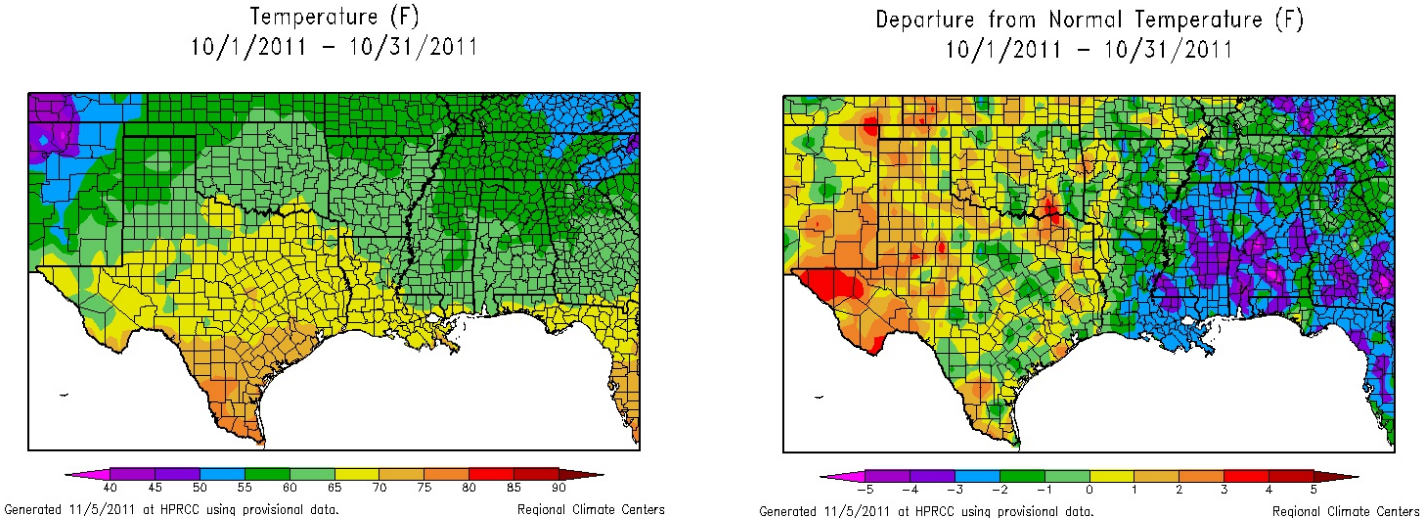


Total precipitation values (left) and the percent of 1971-2000 normal precipitation totals (right) for October 2011.

TEMPERATURE SUMMARY

Luigi Romolo, Southern Regional Climate Center

Average temperatures varied spatially in the Southern Region. In Mississippi, southern Tennessee, and south eastern Louisiana, temperatures were generally 2 to 4 degrees F (1.11 to 2.22 degrees C) below normal. Much of Arkansas and the remainder of Louisiana experienced a slightly cooler than normal October, while in Oklahoma and Texas, temperatures averaged between 2 to 4 degrees F (1.11 to 2.22 degrees C) above normal. The state average temperatures were as follows: 60.50 degrees F (15.83 degrees C) in Arkansas, 65.30 degrees F (18.50 degrees C) in Louisiana, 60.90 degrees F (16.06 degrees C) in Mississippi, 61.50 degrees F (16.39 degrees C) in Oklahoma, 56.40 degrees F (13.56 degrees C) in Tennessee, and 66.80 degrees F (19.33 degrees C) in Texas. For Mississippi, it was the twelfth coldest October on record (1895-2011), while Louisiana recorded its twentieth coldest October on record (1895-2011). In Tennessee it was the eighteenth coldest October on record (1895-2011).



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

CLIMATE PERSPECTIVE

State	Temperature	Rank	Precipitation	Rank
Arkansas	60.5	34th Coldest	2.48	43rd Driest
Louisiana	65.3	20th Coldest	0.82	9th Driest
Mississippi	60.9	12th Coldest	1.10	17th Driest
Oklahoma	61.5	55th Coldest	2.67	57th Driest
Tennessee	56.4	18th Coldest	2.39	46th Driest
Texas	66.8	48th Warmest	2.18	54th Driest

State temperature and precipitation values and rankings for October 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	78.4	45.1	61.8	-2.6	91.0	10/16	27.0	10/20	1.49	-2.84	34
Little Rock, AR	77.1	48.9	63.0	-0.3	88.0	10/17+	36.0	10/30+	2.27	-1.98	53
Baton Rouge, LA	80.0	51.3	65.6	-2.5	89.0	10/16	36.0	10/20	0.49	-3.32	13
New Orleans, LA	79.9	58.9	69.4	-0.6	87.0	10/16	44.0	10/20	0.22	-2.83	7
Shreveport, LA	82.2	52.6	67.4	0.7	92.0	10/16+	35.0	10/20	1.56	-2.89	35
Greenwood, MS	76.0	45.6	60.8	-4.1	87.0	10/16	27.0	10/21	1.11	-2.45	31
Jackson, MS	76.7	47.8	62.3	-2.1	87.0	10/16	32.0	10/30	0.94	-2.48	27
Tupelo, MS	73.5	46.2	59.8	-2.1	88.0	10/16	30.0	10/30	0.94	-2.44	28
Oklahoma City, OK	75.8	50.4	63.1	1.1	88.0	10/4+	34.0	10/20	5.95	2.31	163
Ponca City, OK	75.0	46.8	60.9	-0.4	87.0	10/4	26.0	10/20	1.32	-1.91	41
Tulsa, OK	76.8	50.0	63.4	0.8	91.0	10/16	30.0	10/20	1.87	-2.18	46
Knoxville, TN	68.9	47.0	58.0	-0.9	83.0	10/6	33.0	10/30	4.76	2.11	180
Memphis, TN	74.6	50.8	62.7	-1.1	86.0	10/17+	36.0	10/29	1.28	-2.03	39
Nashville, TN	71.3	46.0	58.6	-1.3	84.0	10/16	30.0	10/29	0.93	-1.94	32
Amarillo, TX	74.1	44.7	59.4	1.2	90.0	10/2	28.0	10/28	1.23	-0.27	82
El Paso, TX	82.2	53.3	67.7	2.8	90.0	10/17+	38.0	10/28	0.01	-0.80	1
Dallas, TX	79.8	56.5	68.1	1.0	90.0	10/7	39.0	10/29	3.12	-0.99	76
Houston, TX	83.2	58.4	70.8	0.4	91.0	10/8+	44.0	10/30+	3.36	-1.14	75
San Antonio, TX	83	59.0	71.0	0.3	93.0	10/7	40.0	10/29	3.28	-0.58	85

Summary of temperature and precipitation information from around the region for October 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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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.