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URBAN FLOODING AND THE CHANGING CLIMATE: COMMUNICATING FORECASTS TO CITY PLANNERS IN TEXAS AND OKLAHOMA

Mark Meo, Professor of Geography and Environmental Sustainability, University of Oklahoma

Urban flooding is one of several extreme events that confront city officials and planners on a routine basis. The toll that flooding takes in lives and property is high, and the damage that can occur to urban infrastructure systems such as electric power grids, transportation, and public health, can be devastating. In light of the likelihood that the changing climate may induce more hydrologic extremes, the challenge to anticipate and prepare for them is a public policy priority. The six state region encompassed by the Southern Climate Impacts Planning Program (SCIPP) includes a number of large cities that are vulnerable to extreme flood events such as the record-breaking one that occurred in Nashville in May of 2010. The figure below illustrates the vulnerability of the region to flooding in the period 2000-2009:

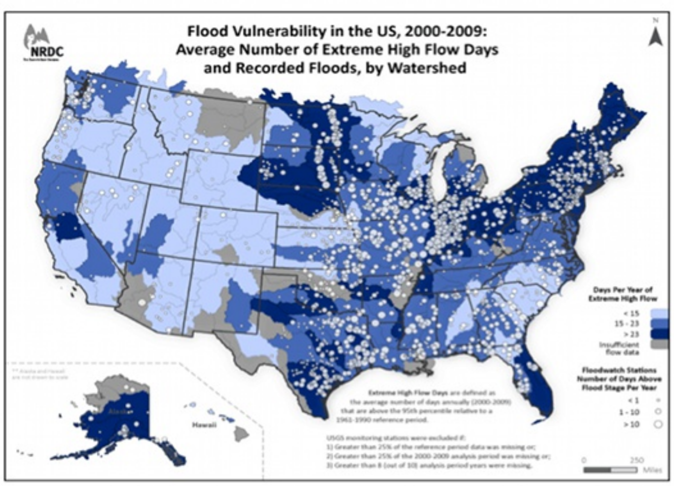


Figure 1: Flood vulnerabilities in the U.S. from 2000-2009

In the last year, a team of researchers at the University of Oklahoma has begun a research project that seeks to help urban planners get a better understanding of what kinds of flood events may await their cities in the future. Through the assistance of NOAA's SARP program, Prof. Mark Meo has assembled a group that includes Profs. Scott Greene, Yang Hong, and Baxter Vieux to develop a credible method that incorporates projected climate data into realistic models of flood events and communicate them to affected city officials in the SCIPP region. To this end the project has partnered with the cities of Oklahoma City and Tulsa in Oklahoma, and Austin, Dallas, and Houston in Texas to model specific watersheds of interest to each city and present the results to city managers. A key aspect of the research team is the variety of research expertise that has been assembled. Scott Greene is a climatologist; Yang Hong is a hydrological meteorologist who is extremely knowledgeable about Global Circulation Models and the techniques used to downscale them to a more useful regional scale; and Baxter Vieux is a hydrologist and civil engineer who has pioneered flood forecasting through the use of radar and GIS-based landscape flood models. Under Prof. Vieux's direction, Jonathan Looper, a graduate student, has been taken the lead role in modelling the urban watersheds.

The project has three clear objectives. First, it has sought to access the projected climate change data and downscale it to a scale that can be used at the local level. The team has used data from the World Climate Research Program's Coupled Model Intercomparison Project, which comprises 16 GCMs. As part of this objective, Regional Climate Models (RCMs) have been used to incorporate the data from GCM outputs. Secondly, the project has been working on deriving hydrological data for flood estimation from the North American Regional Climate Change Assessment Program (NARCCAP). This information is now being used to predict future climate from 2040 through to 2070. Finally, the team has been working on collecting geospatial data for the five urban watersheds they are studying. This information included soils, topography, land use and cover and imperviousness. Baxter Vieux and Jonathan Looper have used this to define model grids for each basin, variously from 10-100 m resolution. The first watershed which they have successfully characterised is Fred Creek in Tulsa, which the team will present a working draft to officials in Tulsa later this Fall.

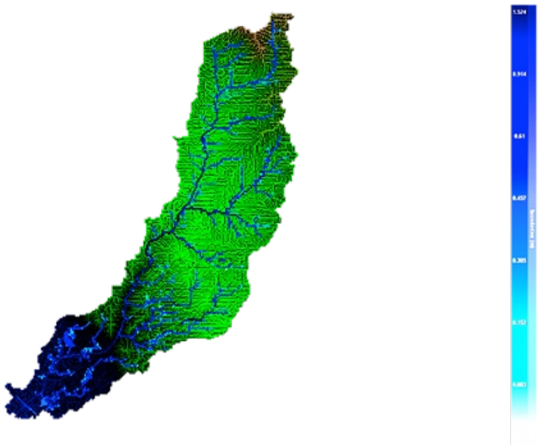


Figure 2: Innundation channels in lower watershed

An example of this approach is pictured in figures 2 and 3 that illustrate Joe's Creek, the case study watershed in Dallas. Figure 2 illustrates inundation in channels along the lower reaches of the watershed, and figure 3 shows the location of the watershed in the community.

Once the watersheds are modeled, they will be transformed through visualization techniques to present them to decision makers in a more easily

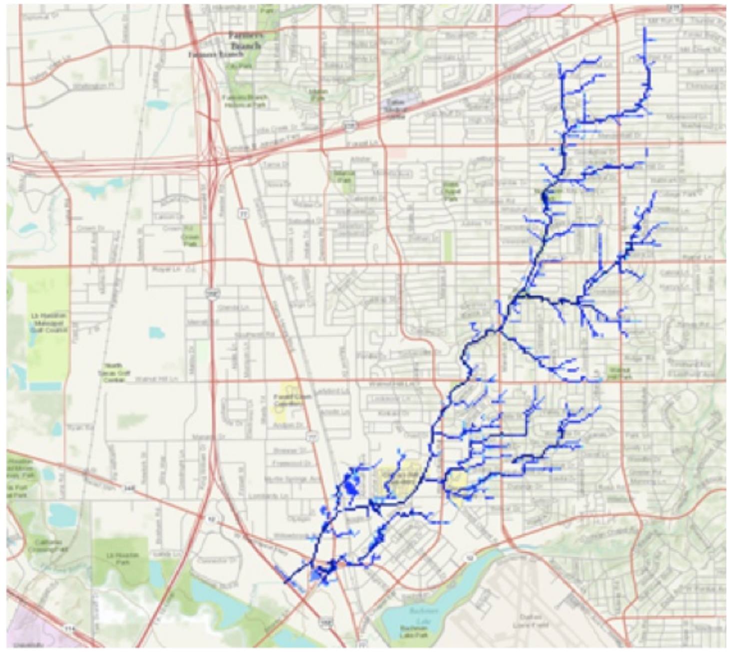


Figure 3: Surrounding geography of watershed

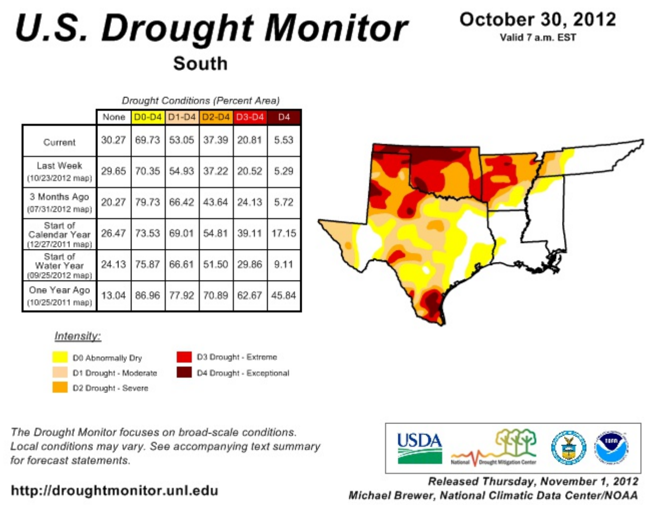
understood manner. With the emergence of computer visualization a communication tool, the team is planning to test what aspects of visualization techniques provide the most useful information to floodplain managers in each of the five cities. One of the issues that motivated this project is the need to develop a cost-effective technique to help planners and managers make better decisions about future events that link the best available climate information with the appropriate decision making techniques. While the team expects that continued progress in climate and hydrology research will render their findings dated, the procedure to build better lines of communication and exchange between the climate research community and urban decision makers is expected to become stronger.

DROUGHT CONDITIONS

Luigi Romolo, Southern Regional Climate Center

Despite widespread dryness in October over much of the Southern Region, drought conditions have not changed significantly over the past month. Slight improvements occurred in western Tennessee and in northern Mississippi. There was also a one category improvement in northern Arkansas, which improved from exceptional drought to severe and extreme drought. Elsewhere, conditions remained relatively unchanged.

To the Right: Drought conditions in the Southern Region. Map is valid for October 2012. Image courtesy of the National Drought Mitigation Center.

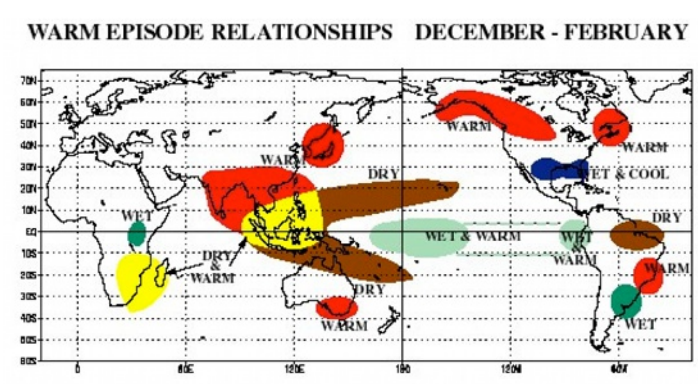


	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	30.27	69.73	53.05	37.39	20.81	5.53
Last Week (10/23/2012 map)	29.65	70.35	54.93	37.22	20.52	5.29
3 Months Ago (07/31/2012 map)	20.27	79.73	66.42	43.64	24.13	5.72
Start of Calendar Year (12/27/2011 map)	26.47	73.53	69.01	54.81	39.11	17.15
Start of Water Year (09/25/2012 map)	24.13	75.87	66.61	51.50	29.86	9.11
One Year Ago (10/25/2011 map)	13.04	86.96	77.92	70.89	62.67	45.84

EL NINO WATCH CALLED OFF

Barry D. Keim, Louisiana State Climatologist, Louisiana State University

Since last summer, the meteorological community has predicted that this upcoming winter would likely be an El Nino winter. What that means is that El Nino conditions would take place in the tropical Pacific Ocean, leading to a host of teleconnections – which are associated climate anomalies across the globe, as shown in Figure 1 below. For Louisiana, El Nino conditions in winter typically means that the region will be cooler and wetter throughout the season, with increased chances of having a snow event. This is because under that scenario, we tend to get more winter storms forming in the Gulf of Mexico, that track over the State, bringing us rain and overcast conditions. Having said all that, the Climate Predication Center is now forecasting this winter to be ENSO neutral. In other words, a big NEVERMIND on that El Nino. What that means is that we are not likely to experience the previously forecasted El Nino, nor is it likely that La Nina conditions will prevail. With neither an El Nino, nor a La Nina, we call this neutral conditions, which prevail most of the time. As a result, in Louisiana, we should expect normal wintertime conditions. Of course in Louisiana, we all know what “normal” means, which is to expect the unexpected. Ahhhh….the joys of climate forecasting! If you have any questions, feel free to contact me at keim@lsu.edu.

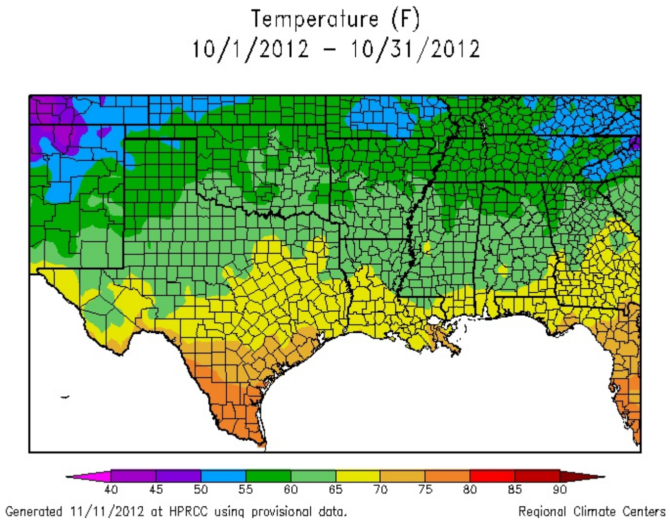


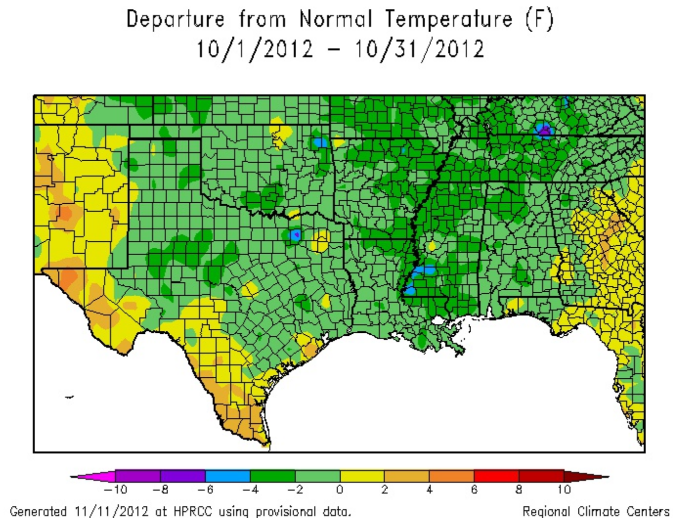
To the Left: Winter teleconnections during winter El Ninos. Note that the northern Gulf Coast, including Louisiana is typically wet and cool. Graphic from the International Research Institute for Climate and Society found at <http://iri.columbia.edu/climate/ENSO/globalimpact/temp_precip/region_elnino.html>.

TEMPERATURE SUMMARY

Luigi Romolo, Southern Regional Climate Center

October was a slightly cooler than normal month for much of the Southern Region. Slightly warmer than normal temperatures were observed in southern and western Texas. Elsewhere, temperatures averaged between 0 to 4 degrees F (0 to 2.22 degrees C) below expected values. The lowest temperature averages occurred in the central parts of the region where temperatures ranged between 2 to 4 degrees F (1.11 to 2.22 degrees C) below normal. The state average temperature values are as follows: Arkansas reported 58.90 degrees F(14.94 degrees C), Louisiana reported 65.50 degrees F (18.61 degrees C), Mississippi reported 61.50 degrees F (16.39 degrees C), Oklahoma reported 59.50 degrees F (15.28 degrees C), Tennessee reported 56.50 degrees F (13.61 degrees C) and Texas reported 65.70 degrees F(18.72 degrees C). For Mississippi, it was the fifteenth coldest October on record (1895-2012), while for Arkansas, it was their sixteenth coldest October on record (1895-2012). In Tennessee it was their twentieth coldest October on record (1895-2012), and it was the twenty-third and twenty-fourth coldest October on record (1895-2012) for Louisiana and Oklahoma, respectively. Lastly, the state of Texas recorded its forty-third coldest October on record (1895-2012).



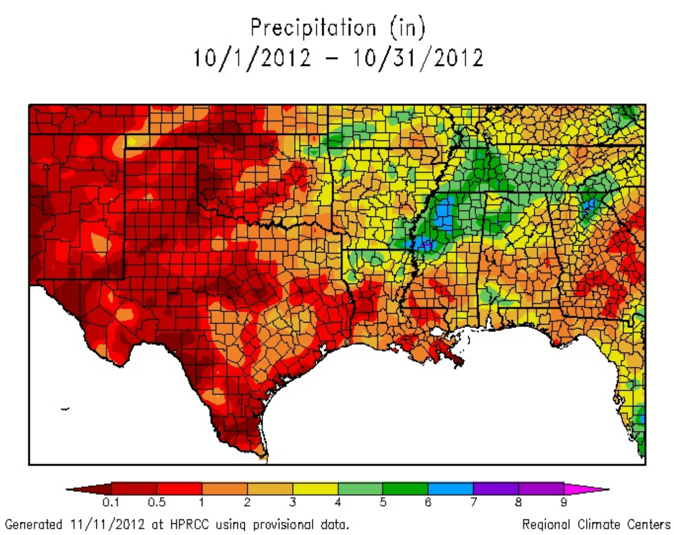


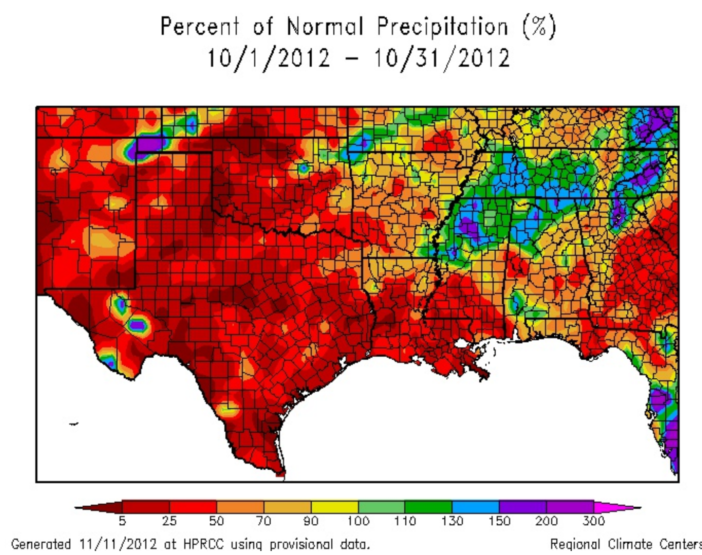
Average temperatures (left) and departures from 1971-2000 normal average temperatures (right) for October 2012, across the South.

PRECIPITATION SUMMARY

Luigi Romolo, Southern Regional Climate Center

With the exception of Tennessee and northern Mississippi, October was much drier than normal month in the Southern Region. A large portion of the region, including Oklahoma, Texas, Louisiana and southern Mississippi, received approximately half the normal amount of precipitation or less. Conditions were extremely dry throughout much of northwestern Texas and central Oklahoma, with many stations receiving only 5 to 25 percent of normal precipitation. Texas averaged only 0.83 inches (21.08 mm) of precipitation, making it their ninth driest October on record (1895-2012). The state of Oklahoma averaged 1.28 inches (32.51 mm), which is their twentieth driest October on record (1895-2012). Louisiana experienced its thirty-sixth driest October on record (1895-2012) with a state average precipitation of 1. 83 inches (46.48 mm). Conversely, conditions were wetter than normal in Tennessee. The state averaged 4.03 inches (102.40 mm), making it their twenty-fourth wettest October (1895-2012). Other state average precipitation values include Mississippi, which averaged 3.56 inches (90.42 mm) and Arkansas, which averaged 3.33 inches (84.58 mm).





Total precipitation values (left) and The percent of 1971-2000 normal precipitation totals (right) for October 2012.

CLIMATE PERSPECTIVE

State	Temperature	Rank	Precipitation	Rank
Arkansas	58.9	16th Coldest	3.33	56th Wettest
Louisiana	65.5	23rd Coldest	1.83	36th Driest
Mississippi	61.5	15th Coldest	3.56	40th Wettest
Oklahoma	59.5	24th Coldest	1.28	20th Driest
Tennessee	56.5	20th Coldest	4.03	24th Wettest
Texas	65.7	43rd Coldest	0.83	9th Driest

State temperature and precipitation values and rankings for October 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	73.3	49.7	61.5	-2.9	84.0	10/21	33.0	10/30+	2.57	-1.76	59
Little Rock, AR	72.4	50.6	61.5	-1.8	85.0	10/5	36.0	10/30	2.59	-1.66	61
Baton Rouge, LA	79.3	54.7	67.0	-1.1	87.0	10/5	36.0	10/30	0.40	-3.41	10
New Orleans, LA	79.8	60.6	70.2	0.2	87.0	10/14	47.0	10/30	0.40	-2.65	13
Shreveport, LA	77.1	53.7	65.4	-1.3	86.0	10/22+	37.0	10/29	4.12	-0.33	93
Greenwood, MS	73.5	49.5	61.5	-3.4	85.0	10/13	30.0	10/29	1.15	-2.41	32
Jackson, MS	75.9	51.4	63.6	-0.8	85.0	10/12+	34.0	10/30	1.05	-2.37	31
Tupelo, MS	72.2	49.6	60.9	-1.0	84.0	10/12+	37.0	10/30+	3.06	-0.32	91
Oklahoma City, OK	72.0	49.3	60.6	-1.4	88.0	10/21	30.0	10/28	2.67	-0.97	73
Ponca City, OK	73.8	46.3	60.0	-1.3	91.0	10/21	21.0	10/27	0.05	-3.18	2
Tulsa, OK	72.2	49.2	60.7	-1.9	86.0	10/21+	28.0	10/28+	2.75	-1.30	68
Knoxville, TN	67.7	48.5	58.1	-0.1	80.0	10/26	40.0	10/11	2.78	0.13	105
Memphis, TN	71.4	51.4	61.4	-2.5	83.0	10/13+	37.0	10/30+	3.66	0.35	111
Nashville, TN	69.5	47.3	58.4	-1.5	82.0	10/22+	35.0	10/31	3.83	0.96	133
Amarillo, TX	72.6	43.1	57.9	-0.3	90.0	10/23	27.0	10/27	0.01	-1.49	1
El Paso, TX	82.4	54.8	68.6	3.7	93.0	10/3	41.0	10/29	0.10	-0.71	12
Dallas, TX	77.8	56.1	67.0	-0.2	89.0	10/21	38.0	10/28+	1.02	-3.09	25
Houston, TX	82.3	59.5	70.9	0.5	90.0	10/10	42.0	10/30+	1.00	-3.50	22
San Antonio, TX	80.5	61.0	70.7	0.0	90.0	10/17+	41.0	10/29	2.40	-1.46	62

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

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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.