# Gulf Coast Climate Information Needs Assessment

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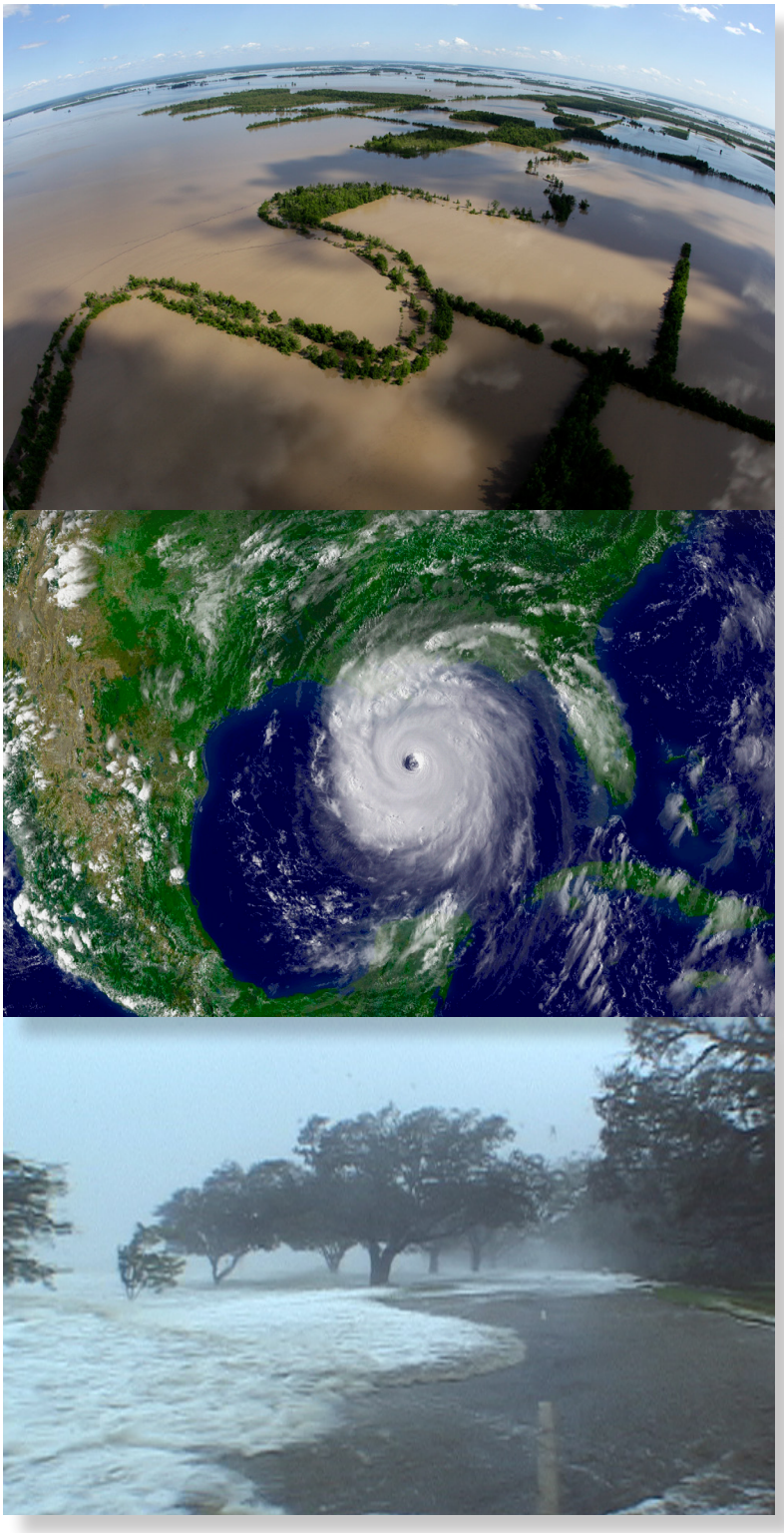
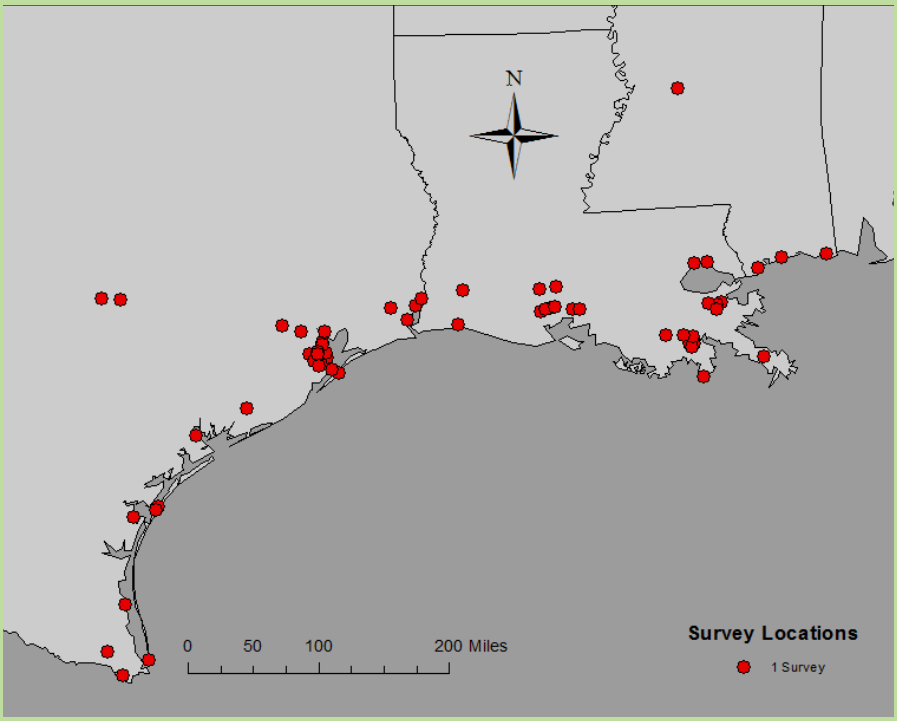


Southern Climate Impacts Planning Program

SCIPP (Southern Climate Impacts Planning Program) focuses on helping communities plan and prepare for extreme events, particularly in light of a changing climate. A National Oceanic and Atmospheric Administration (NOAA) Regional Integrated Science and Assessment program, SCIPP serves the six southern states of Texas, Oklahoma, Louisiana, Arkansas, Mississippi, and Tennessee. These are among the top states in billion-dollar climate and weather disasters as calculated by NOAA's National Climatic Data Center. SCIPP has offices at Louisiana State University and the University of Oklahoma, as well as multi-level partnerships with the state climate offices of Oklahoma and Louisiana, the Southern Regional Climate Center, and the National Weather Service.

## Figure 1




SCIPP conducted 62 climate-needs assessment surveys with coastal stakeholders in Texas, Louisiana, and Mississippi. Respondents in Texas completed 31 surveys, while 27 surveys were conducted in Louisiana and four in Mississippi. These surveys represented 25 counties and parishes, including 10 Texas counties, 11 Louisiana parishes and four Mississippi counties. Respondents also comprised a wide range of professional sectors, including emergency management and homeland security, planning and zoning, agriculture, health care, fishing and aquaculture, energy, water management, and marina and harbor managers. The combination of professional diversity and geographic expanse of this work enabled the survey to capture the viewpoints of coastal stakeholders from various perspectives and backgrounds.

## Informational Handouts

Three one-page handouts, available online at **www.southernclimate.org**, were developed to graphically convey information about observed and projected climate for the study region. Using colorful visuals and easy-to-understand language, each one-page handout contains information on one of the three principal climate drivers: temperature, precipitation, and sea level. The information on the handouts was generated from peer-reviewed, published sources, mostly from the 2009 USGCRP Global Climate Change Impacts in the United States.

# About the Gulf Coast needs assessment: Why and how did we do this?

The Gulf Coast Climate Needs Assessment surveys were undertaken to better understand the climate information needs of Gulf Coast region decision makers. SCIPP conducted 62 one-hour interviews with a wide range of decision makers located along the western Gulf Coast. The results identified specific needs that SCIPP will incorporate into the development of online visualization tools, education programs, and climate data to assist with local-level hazard mitigation planning.

The interviews helped SCIPP assess different information needs between coastal and inland decision makers, as well as identify issues facing states and the region as a whole. The project included identifying the primary stakeholders in the region and assessing their perceptions of climate change and variability. SCIPP expected these interactions to also provide insight into products and information stakeholders are already using, as well as future needs.

This information will enable SCIPP to produce relevant, place-based, climate-related research, information, and tools. This is phase one of the analyses of the responses – identification of the climate information needs of this group as well as their perceptions and present information use.

The sampling technique included presentations and discussions on the survey effort with knowledgeable locals, including coastal zone management personnel, Sea Grant extension agents, and other regional contacts, and then asking for appropriate suggestions of individuals to interview.

The goal was to reach community and hazard management decision makers first, followed by several sector personal (e.g. fisheries and energy), for as many coastal counties and parishes as was possible. Since each interview lasted at least one hour, it was difficult to conduct more than three per day.

Interviews spanned the entire Mississippi and Louisiana Coasts, as well as the Texas Coast from the Louisiana border to Corpus Christi. Most of the interviews were conducted in person. However, in several cases respondents could not meet in person, so interviews were conducted via telephone. These interviews provided SCIPP with answers for people south of Corpus Christ, Texas.

Of the 62 interviews that make up the survey, 31 came from Texas, 27 in Louisiana and four in Mississippi. The spatial distribution of these surveys is depicted on Page 2, Figure 1. These surveys represent people from 10 Texas counties, 11 Louisiana parishes and four Mississippi counties.

## The Survey Components

The four basic research questions in this survey were:

- What are the most significant weather or climate-related issues facing stakeholders in the western Gulf Coastal area today?
- What are the spatial and temporal scales used by Gulf Coast stakeholders in making decisions?
- What are the most significant climate-related issues that stakeholders in the western Gulf Coastal area perceive they will face in the future?
- What do stakeholders perceive as their biggest climate-related research needs? What do they want to know? What are the research gaps?

Rachel Riley, associate program manager of SCIPP at the University of Oklahoma, developed the original survey for the Oklahoma assessment process. In an effort to remain as comparable as possible, that original survey instrument was modified and shortened for use along the western Gulf Coast.

## Survey Results/Responses

**The survey questions were developed to answer four main research questions. The responses are grouped by the research questions they address. In addition to the four research questions, there was a category of questions related to demographics which included position or occupation and education.**

# Demographic Data

The survey asked respondents to provide some basic demographic information, such as age, gender, education, race, professional title and location of employment.

Age was categorized into four 15-year groups: 20-34 years, 35-49 years, 50-64 years, and 65-80 years.

The 50-64 year group contained more than 50 percent of the respondents, followed by the 35-49 year group, which contained approximately 33 percent of the respondents. More than 85 percent of the respondents were male.

## Education Level

| | |
|---|---|
| Four-year college | 29.3 percent |
| High school | 27.6 percent |
| Master's degree | 22.4 percent |
| Two-year college | 13.8 percent |
| Doctorate degree | 6.9 percent |

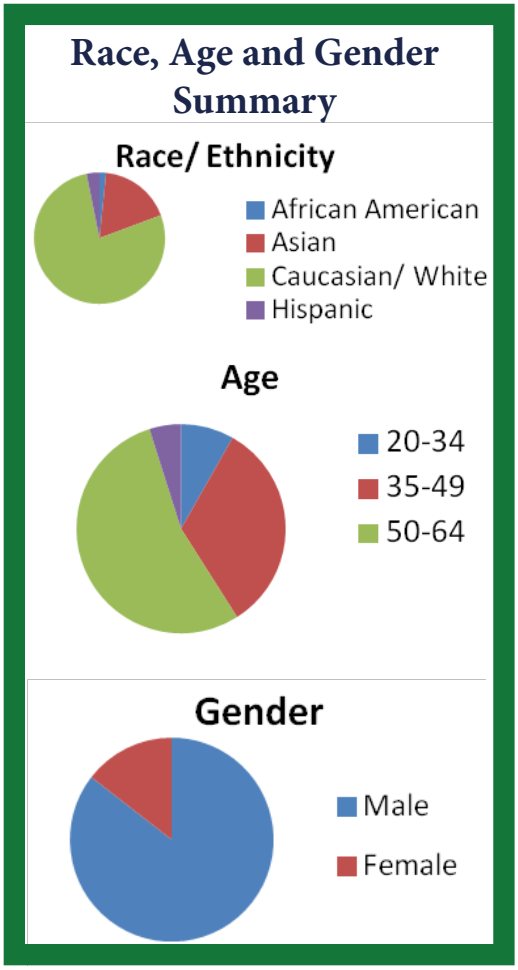
The highest level of education was distributed fairly equally between four-year college (29.3 percent), high school (27.6 percent) and master's degree (22.4 percent), followed by two-year college degree (13.8 percent) and doctorate (6.9 percent).

Respondents identified themselves within four ethnic groups: African American, Asian, Caucasian/ White, and Hispanic.

People identifying as Caucasian or White represented the largest group of respondents, approximately 77 percent, followed by Asian, who completed nearly 18 percent of the surveys. African American and Hispanic respondents combined made up less than five percent of the total number of respondents.

The survey also asked respondents several "yes" or "no" questions to better understand their background and willingness to help with future research. One such question asked, "Have you been formally involved with hazard planning for your community/ region?" Approximately two-thirds of respondents indicated that they have received formal training.

Another question asked, "Would you be willing to help with a similar survey related to where people get their climate information?" Approximately 94 percent of respondents indicated that they would be willing to help, while the other six percent indicated that they do not use climate information or already have an established data source, therefore eliminating the need for such a survey.




**Have you been formally involved with hazard planning for your community/region?**
Yes - 65 percent
No - 35 percent

**Would you be willing to help with a similar survey related to where people get their climate information?**
Yes - 94 percent
No - 1 percent
Do not use climate information/already have an established data source - 5 percent

**Research Question 1**: What are the most significant climate-related issues facing stakeholders in the Gulf Coast region today (Figure 2)? Identify present weather/climate issues impacting your community today AND if you have any interest in how other communities are dealing with similar issues.

## Present Weather Impacts

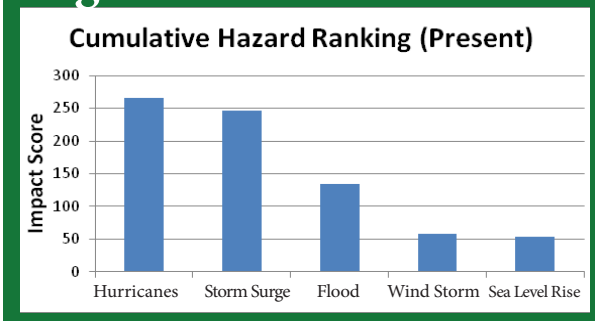
The survey asked respondents to indicate which weather or climate issues currently impact their community or region. They were provided with a list of 12 different hazards, each of which contained "yes" and "no" check boxes next to the hazard type. The 12 hazards were hurricanes, storm surge, sea level rise, rainfall flood, drought, windstorm, tornadoes, lightning, heat waves, extreme cold, severe winter storms, and air stagnation/pollution.

The survey also asked respondents to rank the hazards according to the severity of their effect. All 62 respondents completed this question. The cumulative total of these weather and climate impact points reveal that hurricanes are perceived to have the greatest regional impact, followed by storm surge, rainfall flood, wind storms and sea level rise (Figure 2).

Maps of these responses reveal spatial patterns related to the severity of each hazard in various regions. For example, a map of hurricane impacts along the Gulf Coast (Figure 3) reveals high or very high impacts in most locations. Respondents along the South Texas Coast rated hurricanes as a very high impact hazard; eight of the 11 respondents south of Galveston, Texas, rated hurricanes as the most severe hazard. However, most respondents north and east of Galveston chose storm surge as the most severe hazard (Figure 4).

It is possible that recent hurricane activity influenced these responses.

## Figure 2




Respondents from locations near or east of recent hurricane landfalls more often chose storm surge as the most severe hazard, while respondents from locations west of these storms more commonly chose hurricanes as the most severe hazard. This pattern makes sense when one considers that storm surges are most severe to the right of a hurricane track.

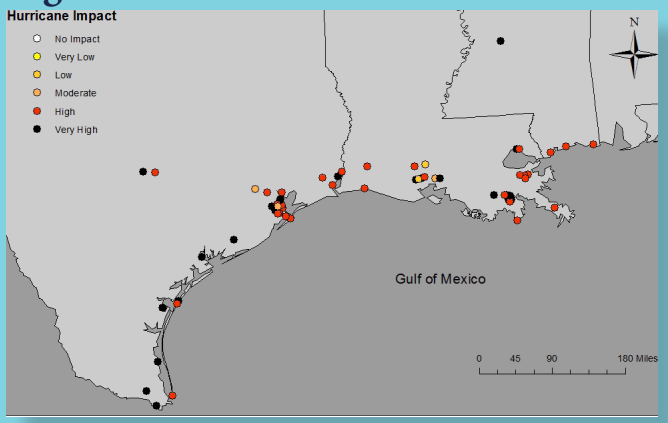
Although storms may produce damaging winds to the left of a hurricane track, winds generally blow offshore, minimizing the surge height. Several substantial hurricanes made landfall near or to the east of Galveston in the past decade, including Hurricanes Lili in 2002, Katrina and Rita in 2005, Gustav and Ike in 2008. Each of these storms produced destructive storm surges to the east of the hurricane track (Needham and Keim 2011). The map of heavy rainfall impacts (Figure 5) also reveals an interesting signature. Most respondents indicated that heavy rainfall had a low to moderate impact; however, numerous people in Southeast Texas indicated that heavy rainfall and flooding has

**Highest Summary Results for Research Question 1:**

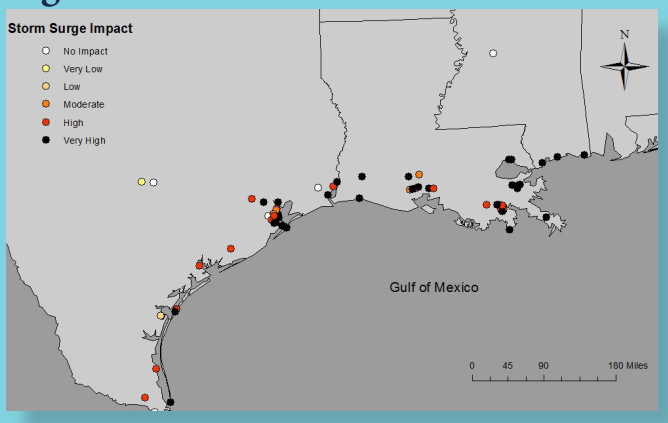
***Most significant climate-related issues in region today:***

1. Hurricanes
2. Storm Surge
3. Rainfall Flood
4. Wind Storm
5. Sea level rise

## Figure 3




## Figure 4




Respondents ranked hurricane (top) and storm-surge impact (bottom) as the first and second most severe weather-related issues, respectively.

a high or very high impact. In fact, three respondents in this region chose heavy rainfall flooding as the worst hazard, while several others chose it as the second worst hazard.

These results may reveal that heavy rainfall is a greater hazard in highly urbanized areas, as impervious surfaces increase runoff and exacerbate flooding. Many of the high impact responses from this region came from the Houston – Galveston urban corridor. It is also noteworthy that several extreme rainfall events impacted this area in the past decade. For example, Tropical Storm Allison dumped more than 30 inches of rain in portions of Houston, Texas in 2001, creating catastrophic flooding (Stewart 2002). FEMA reported nearly $5 billion in damage, including $4.8 billion in the Houston metropolitan area (Stewart 2002).

**Q: Would examples from other communities and how they addressed similar issues be helpful? Why or why not?**

Of the 51 responses to this question, 48 replied positively, expressing interest in examples from other communities facing similar circumstances. These respondents also provided 14 specific reasons why they thought such examples might be helpful, from lessons learned, more effective ways to communicate, best practices, coordination and cooperation. Examples include:

"Some communities face the same problems that we are currently facing or that we could potentially face in the future. For example, we could get hit by multiple hurricanes in one season: How would we deal with that? Some communities in Florida were hit by 4 hurricanes in 2004. We could learn from them about how to deal with multiple hazards in one season."

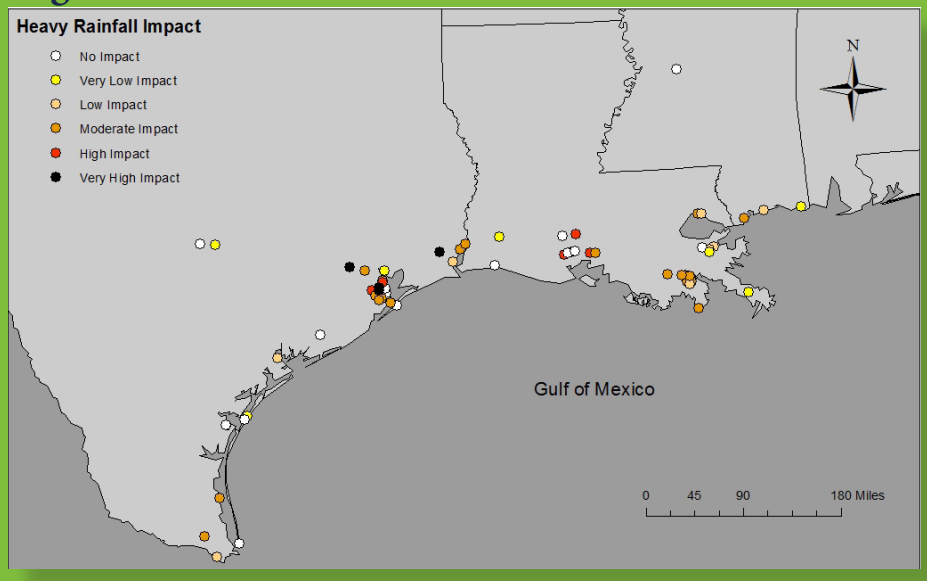
"We need to find better ways to raise storm surge awareness. I would like to see how other communities are doing things."

"Especially communities in other regions. For example, how do other locations deal with crises related to hurricanes and storm surge? How do they best take care of the elderly, children, and other special needs groups?"

"It's always good to work together. For example, we have a network among the Emergency Management community to help each other out. This has developed over a 4-5 year period. We don't let geographic boundaries hold us back... we will share resources, like generators. I was just on a conference call with St. Tammany talking about how the Bonnet Carre Spillway is now open. They were sharing about what they are seeing. We expect fresh water will come into MS Sound. We are planning for driftwood and the potential for debris in the ship channel. If we know what to prepare for, we are taking a proactive approach to the situation."

Interest in building a system for sharing information, examples, success stories and lessons learned is promising. Communities facing new challenges can be better equipped, more proactive in preparation, and ready to respond when disaster strikes if they have help from others who have already dealt with similar situations.

**Figure 5**




Respondents ranked heavy-rainfall impact (above) as the third most severe weather-related issue. This hazard was most pronounced in southeast Texas.

**Research Question 2:** What are the spatial and temporal scales in which Gulf Coastal region stakeholders make decisions? How does weather and/or climate information impact your decision making? How often? How far ahead do you plan? What spatial scales would be helpful for weather and climate information?

## Preparing for Weather and Climate Impacts

Weather and climate information often highlights the vulnerability of communities to natural hazards, such as the track of approaching hurricanes or the likelihood of ice storms. Stakeholders acquire this information in order to make decisions that reduce losses by saving lives and protecting property. Other times, weather and climate information provide insight into optimal conditions for certain types of activities, such as servicing energy infrastructure or planting crops. This information is utilized by stakeholders to optimize productivity. This section discusses how stakeholders utilize weather and climate information for both hazard response and optimizing productivity.

## Preparing for Hurricanes

Hurricanes are the most devastating natural disasters along the Gulf Coast in terms of both loss of life and property. The 1900 Galveston Hurricane, for example, claimed more than 6,000 lives (Rappaport and Fernandez-Partagas 1995), while Hurricane Katrina (2005) caused more than $80 billion in damage (McTaggart-Cowan et al. 2008). Katrina also provides examples of the long-term personal impacts of hurricanes on the region; hundreds of thousands of survivors fled the Greater New Orleans Metropolitan Area, traveling to cities outside the zone of destruction. Houston, Texas, for example, housed more than 200,000 evacuees (Coker et al. 2006). As many of these people suffered physical and/or psychological trauma (Coker et al. 2006), they depended on the resources of their host city to help them recover. As such, this mass evacuation impacted many cities for hundreds of miles.

Gulf Coast communities prepare for hurricanes on both long-term and short-term scales. Long-term preparations involve physical preparations in the community, such as trimming trees, cleaning storm drains, and servicing equipment, such as chain saws and gas-powered generators. Community-wide outreach events are another important part of long-term planning. These events educate citizens about hurricane hazards, provide information about evacuation and emergency planning, and provide the public with opportunities to interact with local government officials. Local leaders often refer to seasonal hurricane forecasts throughout the long-term preparation period.

Short-term hurricane preparations involve rapid decision making once a tropical storm or hurricane has formed and is moving towards a community. Accurate forecasts are essential to stakeholders as they prepare to alert and evacuate the public. These decision makers need accurate information on the hurricane track, intensity, and size, as well as the height, extent, and timing of storm surge. Slight changes in the forecast track can greatly change the intensity of winds or storm surge height at a particular location.

## Highest summary results for Research Question 2

***How does weather and climate information impact decision-making?***

A variety of responses include:

- Highlighting the risk of local and regional natural hazards.
- Specific hazard preparation and response planning.
- Used to optimize productivity, cultivation, and harvest choices

***How far ahead do you plan?***

- Approximately a quarter of the respondents each replied less than five or less than one year
- Some longer term responses – up to 50 years related to infrastructure planning

***What spatial scales would be helpful for climate/weather data?***

- More than 60 percent of respondents indicated that data for their city or county/ parish would be useful.
- Approximately 42 percent of respondents indicated that state and multi-state data would be beneficial
- A surprise response: nearly 20 percent of respondents indicated that offshore or marine data would be beneficial

## Responding to Other Natural Hazards

Although hurricanes have historically produced the most devastating losses on the Gulf Coast, other natural hazards also inflict loss of life and property. Some of these hazards are long-term events, such as droughts, while other events, such as heavy

rainfall floods, may occur within a few hours. Respondents indicated that these shorter duration events may catch them completely off-guard because they have little time to prepare and the mainstream media may not give them as much attention as more catastrophic events, such as hurricanes.

A heavy rainfall event in April 2009, which dumped more than seven inches of rain in just a few hours along the Houston-Galveston corridor, provides an example of this type of event. The unexpected deluge flooded buildings and roads and stranded many motorists. Other events include strong onshore winds preceding frontal passages, which threaten to flood low-lying communities. Weather and climate play an important role in response to fires, chemical releases, and fallout from nuclear facilities. Although such hazards are often man-made, weather conditions, such as wind speed and direction, may impact disaster response and evacuation.

## Adapting to Salty Soil in South Louisiana

Farmers in South Louisiana may plant soybeans instead of rice if soil and water salinity are elevated, because soybeans generally adapt better to salt. Such practices are most common during drought or in the year after a storm surge inundation. These farmers rely on accurate soil and water salinity data, as well as local precipitation records to make such decisions.

## The Complexity of Storm Surge

### Spotlight on Hurricane Ike

Although Hurricane Ike was only a category 2 hurricane at landfall, it generated a massive 17-foot storm surge, placing this event in the top 10 Gulf Coast surges in the past 130 years (Needham and Keim 2011). The timing of Ike's surge also caught many people off guard. The surge arrived much earlier than anticipated, inundating coastal communities at least 12 hours before the arrival of tropical storm force winds and more than 24 hours before the hurricane made landfall. This early surge cut off evacuation routes, trapping at least 600 people along the Bolivar Peninsula. Finally, this event inundated some inland areas with surge for the first time in modern history. This photograph depicts Ike's surge in Orange, Texas, located more than 20 miles from the Gulf of Mexico.


*Photo Credit: Hal Needham*

## Weather and Climate Information for Optimizing Productivity

Some stakeholders indicated they use weather and climate information to optimize productivity. This perspective is quite different than hazard response, which generally focuses on minimizing death and destruction. Sectors such as agriculture, fishing, and energy must sometimes respond to hazards, but at other times utilize weather and climate data to maximize crop harvests or the sale of energy.

Agricultural professionals utilize weather, climate, and soil information to determine the types of crops to plant and the timing of the planting and harvesting cycle. In most parts of the country, temperature, precipitation, and soil moisture are the main drivers behind these choices. Farmers near the Gulf Coast must also consider salinity levels in the soil and water, which may increase dramatically after a storm surge inundates farmland or during a drought.

Fishermen rely on weather and climate information to optimize productivity. However, unlike agriculture, federal and state regulations often determine approved fishing locations and the limits of the season. Time-tested climate information, passed down from generation to generation, provides helpful insight for the current season. For example, brown shrimp respond very well to hot weather, sometimes growing one inch during a hot week, whereas white shrimp prefer cooler weather or a mid-

summer storm. Weather forecasts and marine conditions are crucial for decision making in this industry.

Energy professionals utilize weather forecasts and climate projections to accommodate energy demand. Along the Gulf Coast, electricity demand generally is greatest during the summer and lowest during the fall and spring. Energy demand is generally moderate during the winter, but may dramatically increase during cold snaps. Careful production and transmission management is required to prevent brownouts and maximize productivity.

## How Often Do Weather and Climate Impact Your Decision Making?

Nearly 60 percent of respondents indicated that weather and climate impact their decisions daily. Slightly more than 20 percent indicated that these factors impact decisions daily during hurricane season, while approximately 16 percent felt that these factors are only important during extreme weather events. Approximately 10 percent of respondents indicated that weather and climate impacts their decisions weekly or yearly. It should be noted that respondents were encouraged to select more than one of these choices if necessary.

Weather and climate impacts farmers and fishermen daily, as temperature, precipitation, wind direction and speed may influence daily operational decisions. Various local government personnel also consult weather and climate information every day. For example, emergency managers in communities near chemical facilities monitor wind information daily in case of a fire or chemical release, while permitting officers consult flood plain maps before issuing building permits every day.

Stakeholders involved in water management often consult weather and climate data weekly. For example, a coastal community in Texas consults the weekly weather forecast to optimize waste and storm water releases, which drain better when the level of Galveston Bay is lower.

Widespread power outages, usually caused by hurricanes or ice storms, generally impact the energy industry about once a year. Forecasts are critical in these events, as slight changes in the hurricane track or temperature during an ice storm may dramatically increase or decrease power losses. Some planners consult climate data approximately one time per year, especially to gather information at the onset of a project about flood risk or threat from hurricane winds.

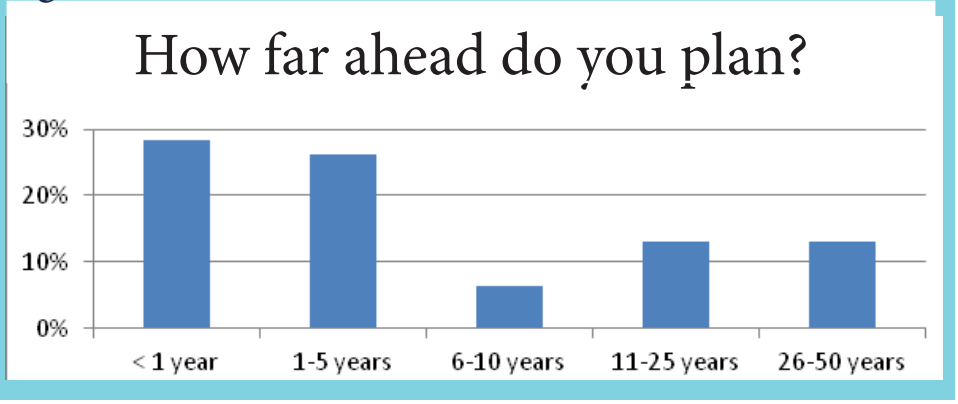
## How Far Ahead Do You Plan?

Respondents indicated that they most commonly plan less than five years ahead. When provided with choices about planning schedules, 28 percent indicated they plan ahead less than one year, while 26 percent selected one to five years. While some respondents indicated that lack of funding hinders them from planning further into the future, others indicated that the nature of their work requires them to make short-term decisions.

Farmers and fishermen consistently plan less than one year ahead because they must react to the weather. Farmers often plan on a weekly or even daily basis as they plant and harvest during optimal conditions. During daily operations farmers are increasingly looking at radar loops on smart phones to avoid working outdoors during afternoon thunderstorms.

Energy companies often use climate teleconnection data to plan ahead six months. Teleconnections, such

**Figure 6**



as the El Nino Southern Oscillation (ENSO) may help them prepare for widespread power outages. In general, when El Nino conditions prevail, hurricane activity decreases but the likelihood of ice storms increases. The opposite is true during La Nina conditions. Such long-term forecasts can help companies manage inventories.

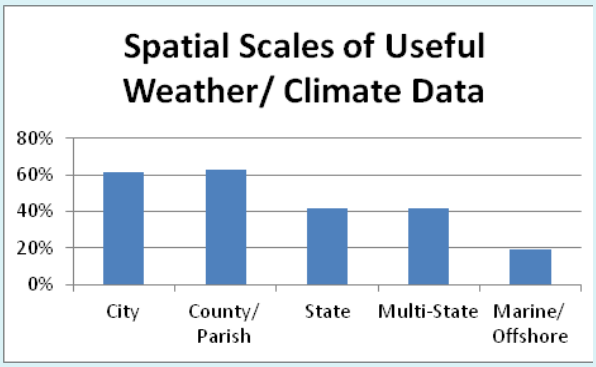
In other circumstances, energy companies plan ahead one to five years, particularly for load managing and expansion of the energy network. Agricultural and fishing professionals sometimes plan within this time frame as well. For example, citrus orchards may require multiple seasons to fully recover from a hurricane or severe freeze, and oysters take three years to mature from a spat, or oyster seed, into a full-grown oyster.

Planning for more than 10 years was more common for infrastructure, facility designs, and drainage projects. Such projects include road development and resurfacing, building wastewater treatment plants, and developing marinas, harbors and yacht clubs. A community in coastal Texas elevated two wastewater lift stations, a water plant and a police station 14 feet above ground level, even though the community is in a 12-foot storm surge zone. This community added two feet to the elevation of these facilities to account for the possibility of larger storm surges and sea level rise, planning that these facilities will operate for at least 40 years.

## Spatial Scales of Weather and Climate Data

Respondents indicated that localized weather and climate data are most beneficial. More than 60 percent of respondents indicated that data for their city or county/parish would be useful.

**Figure 7**




Every professional sector that participated in this survey confirmed the importance of these data. For example, a planner in the Houston/ Galveston metro area indicated that rainfall on the east side of Houston tends to be greater than on the west side. He emphasized the importance of localized rainfall data, as rainfall climatology can vary greatly from one side of the city to the other. An emergency manager in the same metro area indicated the need for city and county-level data that could help emergency services prepare for, and respond to, heavy localized rainfall.

Approximately 42 percent of respondents indicated that state and multi-state data would be beneficial. These respondents included emergency management personnel, water management personnel, farmers and fishermen. The 2011 spring floods along the Mississippi River impacted professionals in these fields, even though the rain and melting snow that caused the flood occurred hundreds of miles to the north of the Gulf Coast. Energy professionals also described the importance of larger-scale weather and climate data, as energy is often bought and sold on a regional or national scale.

Surprisingly, nearly 20 percent of respondents indicated that offshore or marine data would be beneficial, even though this category was not listed as a choice. These respondents wrote this under the "other" category. These data include information on wave heights and water currents, as well as offshore meteorological conditions, such as wind direction, wind speed, and fog.

Most respondents, 62 percent, indicated that they prefer weather and climate data on different spatial scales, depending on the application. Hurricane forecasts and Teleconnections data, such as the ENSO phase, were examples of data that was most helpful on a larger scale. Other types of data, such as temperature information or radar animations, were most useful at the local level.

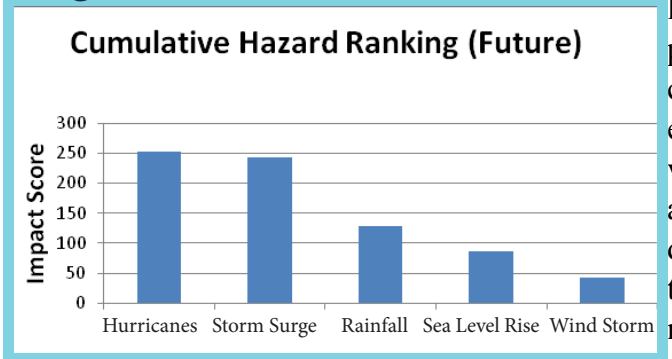
Research Question 3: What do you think will be the most significant climate-related issues that stakeholders in the Gulf coastal region will face in the future? There has been a lot of talk about a changing climate. Have you noticed any changes yourself (Figure 8)? Rank likely future issues of concern under a changing climate?

## Future Weather Impacts

The survey asked respondents to indicate which weather and climate hazards they anticipate will impact their community and region in the future, and to rank these hazards in the same manner which they ranked the present-day hazards. These hazards were awarded the same point system as present hazards.

The ranking reveal that stakeholders anticipate hurricanes, storm surge, and rainfall floods to have the most severe future impacts on the region, just as they perceive these phenomena to have the most severe present impacts. However, respondents ranked sea level rise as a more severe future impact than wind storms, a result that is opposite the findings from the present hazard rankings. This change likely reveals that stakeholders believe sea level rise is a hazard that will become more severe in the future.

## Figure 8




## Observed Changes

Of the 59 responses that were analyzed, eight were considered Not Appropriate in that they said something only about this year or this month but were not clearly comparing the present to the past in a long-term outlook. Some may have meant their comments in a comparative way but since it was unclear they were not counted as YES or NO responses.

The responses were almost evenly split between those who responded yes they had seen changes and those who said they had not. It was notable, however, that of the 26 "NO" responses, 16 specifically mentioned that they had indeed seen changes but related them to climate cycles such as drought-wet-drought or cold-hot-cold, not to a changing climate.

There were 25 positive responses to the question about noticing changes over time in relation to a changing climate. Many of these respondents identified specific examples, which included changes in sea levels, erosion, and land loss; changes in plants, animals or the landscape found in their locations; agricultural productivity; seasonal changes; changes in extremes or more variable "weather;" and rainfall and drought. Sometimes their examples also mentioned other confounding issues such as subsidence and man-made canals in addition to sea level rise.

## Some examples related to sea level rise:

"I have noticed when I was younger water would push 200-300 yards offshore after a strong front. I used to ride my motorcycle along the extended beach during these times. Now, that doesn't happen anymore. I do not know why this is happening, if it's subsidence or sea level rise, or a combination of both."

"Yes - migration of barrier islands - six to 20 feet per year. This is not anecdotal, but actually mapped."

"I've seen changes in our shoreline. We're protected by a levee at Port Arthur. But Pleasure Island, just southeast of here (in Sabine Lake, just offshore from Port Arthur) was formed by dredging spoils. Residential properties at the south end of the island have experienced sea level rise."

## Highest Summary Results for Research Question 3:

***Most significant climate-related issues for the region in the future?***

1. Hurricanes
2. Storm surge
3. Rainfall Flood
4. Sea level rise
5. Windstorm

*Have you noticed any changes related to a changing climate*?

- Nearly even split between 'yes' and 'no' responses.
- Many 'yes' respondents provided specific examples.
- Of the 26 'no' responses, 16 further noted that they had seen changes but they were due to natural cycles .

"We are seeing big differences in the landscape. I grew up near marsh on the east side of Leeville/ Golden Meadow. If you cross the new Leeville Bridge and head south to Port Fourchon, you see big open water now. 25-30 years ago this was all marsh (near Bayou Lafourche)."

"There is a longer-term trend related to coastal erosion. For example, Marsh Island is slowly decaying. Also, canals that the oil industry dug are widening, allowing more water to enter the coastal zone during a hurricane. This issue is made worse by erosion and the fact that the rivers have levees, which prevent them from depositing silt. I really believe a whole host of problems have caused coastal erosion, and this is definitely getting worse over time."

". . . Sea level rise - communities outside the levee protections used to have high tides three times per year in their yard now they have it like 20 times per year. Subsidence is an additional problem."

Other positive comments and examples related to plant species and the ability or lack of ability now to grow specific plants where they used to be common. Other related comments describe the changes in the seasons or conditions, sometimes related to agriculture and plants/ animals.

"In my lifetime, I noticed there are no new hackberry trees coming up. I noticed as a teenager there were many and now when they die there are no new ones. "Maypops" are taking over - they are susceptible to wind. We have lost many things in my lifetime - can't grow pomegranate trees here anymore."

"Some flowers blooming at different times than in the past … I used to do annual renewal of the Tree City."

"Because winters are generally warmer and drier you can get out in fields and plant, etc. in late winter (Jan/Feb) even if you had heavy rain in November. It used to be that if it rained hard in November, it was too wet to do anything until after February. This could be bad or good- it does allow us to get out in fields in late winter (February) and plant early crop."

There were numerous comments identifying changes in extremes or variability in both heat and cold as well as in rainfall and drought.

"We do not have balanced weather like we used to. We used to get showers/ thunderstorms a few times per week in summer. Now we see long dry/ wet periods."

"We have experienced different weather patterns recently. We've had more hurricanes in recent years, and during the past few years we've had hotter summers and colder winters."

## Hurricane Proofing a Yacht Club

Marinas, harbor facilities and yacht clubs in the region have incorporated creative designs that will likely reduce hurricane damage for several decades. Floating docks, which rise and break away during coastal flooding events, prevent docks from pulling out pilings and boats. Tide risers, buoyant devices attached to dock pilings, enable moorings to rise with the boat as storm surge levels rise. This prevents boats from pulling out docks or pilings as they rise with the surge. A yacht club in coastal Texas installed floating docks and tide risers after Hurricane Ike. Damage from Ike totaled $5 million, however, these improvements will likely decrease losses in a similar storm to around $1 million.

Tide risers enable moorings to rise when sea levels are elevated.

Floating docks break away from the pier during storm surge events, preventing the docks from pulling boats away.

*Photos by Hal Needham*

# Staying Ahead of the Sea


Stakeholders have provided many examples of sea level rise observations, including changes in the location of the shoreline, higher frequency of coastal flooding, and increased coastal erosion. This sign in Vermillion Parish, Louisiana addresses the need for many coastal residents to elevate their homes.

*Photo: Hal Needham*

"It's hotter now and it stays hotter longer- usually into November. This is true for both water and air temperature. Hot weather and fresh water are a bad combination for oysters."

"Yes, I have noticed changes, mostly related to more intense heat and drought. I can remember that it used to rain every week. Now we can go two months without rain. The Lafayette region is now restricting water use. This never happened several decades ago."

"Observed: drier summers – from '92-'96 you could set your watch by the fact that it will rain at 3:00 p.m. on a summer afternoon. Now we can go weeks without summer rain. Winters seem colder now and the snow is staying longer. Having more extremes may be a way to describe these sorts of changes."

"The climate is drier and summers are hotter now. Also, the summer heat persists much longer than before. For example, as of late September, 2011, Austin has had 85 or 86 days above 100 degrees F. This is the most number of days since record keeping began in 1895. I believe the previous record was 69 days in 1924. August 2011 was the hottest month in the history of Texas."

A few respondents included the impacts of their observations, which might be why they noticed the change. Impacts included water restrictions – something a community was not accustomed to; changes in plant flowering dates – noticed because they were participating in an annual Tree City festival; or being able to plant earlier in the season to get an additional crop yield.

Just more than half of the respondents did not notice changes associated with a changing climate. In fact, 16 of the 26 "NO" respondents noticed changes, but attributed them to weather or seasonal cycles that have happened before and will happen again. Many of those implied that trends exist within climatic variability, but these trends are not associated with a larger level of change.

## Some of the 'no' responses:

"No - We've seen different kinds of weather, but I feel this is cyclical. We see times of high hurricane activity, followed by times of low hurricane activity. The pattern seems to cycle back around."

"I haven't noticed any dramatic changes in long-term climate."

"No, I have not noticed any long-term changes, just cycles that repeat themselves. And I have lived here for 55 years."

"Carbon dioxide is probably having an effect on climate. But it's not like the world is coming to an end. Last year was hotter than normal, but things seem to cycle back around. For example, we had a bad drought in 1999-2000, and now we're having another drought. So I do not feel this is a long-term precipitation trend."

"I've lived here since 1972 and I have not noticed long-term changes. We're having a hot, dry summer now, but that's happened before. Sometimes it will be dry for 2-3 months, maybe as long as five months, but then it will rain."

It is difficult to physically recognize slow, small trends in climate, but people seem ready to understand, expect, and embrace changes in weather they can actually experience. Long-term changes in climate must be revealed through impacts that people recognize, such as changes in plant and animal location or frequency, changes in bloom dates or planting schedules, and changes in frequency of regular flooding events. The impacts of these changes seem to help people understand that something larger than the normal variability or cycles is at play.

Research Question 4: What do stakeholders perceive as their biggest climate-related research needs? What are the research gaps? Do they have enough information? What do people want to know? Considered incorporating climate projections into your planning efforts? What information have you used? Assessment information useful? Barriers? Suggested tools? Climate model outputs wanted. How could SCIPP help?

Highest summary results for Research Question 4:

***Perceived research needs/gaps. Do you have enough information?***

- Just more than one-half felt they had all the information they needed.
- Just less than one-half identified specific information that would be helpful.

Most of the requested information was quite location specific.

***Have you already or have you considered including climate information into planning efforts?***

- Eight respondents said 'yes' but many of those were seasonal or one year projection – not climate projections
- Two respondents actually utilized long-range projections for sea level rise

Unexpected responses:

- Many folks found the Assessment information in the handouts really informative and useful so were more interested in the assessment effort.
- While not yet utilizing long-term projections, many suggested ways that they might use such information if it would address their concerns and be delivered in a useful, understandable, and easy-to-access and apply way.

***Barriers:***

- Some identified specific barriers that would need to be overcome to utilize climate projections in planning efforts

***Suggested tools and visualizations:***

- 85 percent of respondents identified some tool or visualization that would be helpful

***Using Climate Model Data:***

- About one-half said they might be interested in using climate outputs but their time frames were much shorter than the 25 and 100 year outputs
- They were specific about format of use to them and that included: graphical/visual, paper, internet
- Many of the examples were for extremely specific and local information in the output

***How could SCIPP help?***

No. 1 answer: by providing climate information that is applicable to their areas

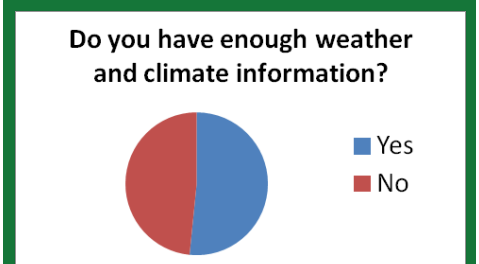
No. 2 answer: instruction on where to find trustworthy climate information

No. 3 answer: Training on how to interpret various climate information products

## Sufficient Weather and Climate Information? If not, what would be helpful?

All 62 respondents answered a question that asked them if they felt they had enough weather and climate information to make informed decisions in daily operations and hazard planning activities (Figure 9). Slightly more than half of the respondents, 51.6 percent, felt they had sufficient information, whereas 48.4 percent felt they did not have adequate information.

**Figure 9**




## Utilizing Projections Now? What information?

Of the 50 responses to this question, only eight responded that they utilize what they considered climate projections in various aspects of their work. However, many respondents noted that the projections they used were, in fact, seasonal and/or short/medium-term and were provided by NOAA or the National Weather Service. Some noted the usefulness of ENSO forecasts, as ENSO phases generally correlate with localized climate patterns, such as drought and fewer hurricanes in Texas. This information enables respondents to better prepare for extreme climate conditions, such as reducing water use in anticipation of drought.

Only two respondents used long-range projections, such as those

coming from climate models, in planning for the development of infrastructure. In both cases they were related to sea level rise and coastal impacts. One was to site a specific building along the Texas coast that could have a 100-year lifetime. The other involved long-term coastal planning for infrastructure development in China, which incorporated sea levels into the planning effort. They both considered those long-term projections important to planning and development, but neither identified the source.

Nearly all of the other respondents reiterated their need for short- and medium-term weather and climate information rather than the need for any long-term climate information. Some of these responses may have been due to the types of interviewees. For example, many of the respondents had some responsibility for hazard or emergency services, planning, and preparation, so their information needs are generally short-term. Some responded that they needed additional short-term information, such as wind speed and direction, which could be useful for responding to chemical spills or fires.

## Interest/Willingness

While few respondents are using long-term climate projections in their decision making, many provided examples of how they might use such information in the future. Respondents seem most open to using such information if it is delivered in a useful, understandable and accessible way that is easy to apply. Some examples include:

"For example, we get our water from subsurface wells. If long-range climate change will affect hydrology, this may be an issue for us. In the future, sea level rise and precipitation projections may be helpful."

"We're really focused on permitting here. So we just consult flood/ wind zone information to make decisions. However, if models/ projections helped people who designate the flood/ wind zones, this would mean our requirements are more effective, because we base our information off maps like FEMA flood zones."

"We could probably use climate projections to help us predict growing conditions. Farmers are very interested in detailed weather and climate information. For example, we aren't just interested in warmer or colder temperatures, but breaking those down into max and min temperatures. Warmer night temps = lower rice yields. Minimum temps above 70 degrees Fahrenheit hurts rice. Every five degree increase in temperature will affect rice yield. In warmer weather the plant is trying to grow 24 hours a day. But plants do best when they can rest at night in cooler weather. Anyway, projections about minimum overnight temperatures could be helpful."

Ten respondents indicated more openness to using projected data now that they better understand its importance. Some of these comments:

### Summary of data needs from various stakeholders:

- Planners: Long-term threat of storm surge and hurricanes
- Emergency Management: Improved hurricane tracking and elevation mapping to prepare for storm surge
- Fishermen, harbor masters: Need marine and offshore data
- Fishermen, city managers: Tide prediction should be adjusted for wind direction
- Agriculture: Improved surface water/ salinity data
- Planners, Emergency Management: Short- and long-term rainfall data
- Energy Sector: Information on ice storms and hurricanes to prepare for power outages.

### Future information needs:

Ice Storms: Localized temperature data

Storm surge return periods: What is the 100-year storm surge level?

Hurricanes: Size of hurricanes, rate of inland wind decay

"We did not use any assessment information either. We need to do this in the future and are very open to it. We need to learn more about how to find and incorporate reliable climate information."

"We do not look at long-term climate projections right now. We should consider this for planning. For example, if we wanted to build a satellite hospital, is it wise to build this closer to the coast? We are

## Barriers

A number of respondents identified specific barriers in using climate information for planning. They generally fell into at least one of the following three categories: cost or budget constraints; lack of knowledge of where to find trustworthy information and how to apply it; and the difficulty of a public that does not understand or "believe" the data about a changing climate. A large percentage of the barriers expressed by this group could be reduced by developing useful products that are easy to access. Providing insight on how to apply these data, potentially through small-group training or seminars, would likely help respondents use these data as well.

about 15 miles inland so we are not affected too much by storm surge and sea level rise. But what would projections say for storm surge and sea level rise only a few miles from the coast? Would this be a wise place to build a hospital, or might it be under water? Also, what happens if we get a 20-year drought? How would that affect the local economy and how could that, in turn, affect our patient census?"

## Assessment Information

Some participants specifically addressed the usefulness of Assessment information. The National Assessment information could not have influenced decision making of the respondents, as none of them specifically indicated they used information from the report. The implication was that they were not familiar with these reports, what was contained in them, how to access them, or how they could be useful to them. However, prior to beginning the interviews for this needs assessment, SCIPP at LSU had developed a series of three handouts containing graphics and information around climate issues- temperature, precipitation, and sea level rise- for the coastal areas of the SCIPP region - Texas, Louisiana, and Mississippi. The documents included the present state of these three climate drivers, changes during the past 50 years, and projections for the 25-100 year future time frames.

Most of the information contained in these documents was derived from the most recent (2009) US National Assessment product. Other information, such as present sea level rise rates in various locations, was taken from the NOAA Tides and Currents website. Those who commented noted that after reviewing the handouts they felt more informed about what changes have occurred here in the SE as well as the possible futures for the region. They thought the graphics were informative and easy to understand. Some who did not specifically comment wanted to keep those documents for their reference and for sharing with others.

Many respondents had not ever heard of the national assessment efforts but were informed and educated through these handouts. A wider outreach of information from many credible sources could be a valuable outreach and education effort to increase understanding of climate issues in this region.

## Climate Model Outputs

Of the total of 48 responses to this question, 21 stated clearly they were not interested in using long-term climate model projections. Many were more interested in local outputs or shorter time-frame projections. Ten of these respondents did not specify either a spatial or temporal scale for these projections.

There were 25 respondents – more than half of the total – who discussed some specific output that they would like from any models. They fell into categories that included:

**Time frames**: mostly shorter than the 25-100 years for most climate models, rather more like two-weeks to one year.

**Output format:** graphical/visual, paper, internet.

## Specific climate data or information needs:

**Sea level:** now, future, projected (relative and actual) rise, subsidence rates, rate of change and change in rate – this was the most requested information with 11 requests.

**Precipitation:** volume, frequency, intensity, extremes, trends, time lines – alone this topic was the second most requested information with eight requests.

**Hurricanes:** tracks, strength/ intensity, size, frequency, certainty of tracks – five requests.

**Storm surge**: two requests (but difficult to separate from information

around hurricanes and if added – would make that seven requests).

**Flooding and flood potentials:** local maps and projections – there were two specific requests for this information but this topic could be added to either or both: precipitation or hurricanes as an impact more so than a climatic feature.

**Temperature**: average, extremes (high and low), trends, time lines – there were six requests for specific temperature information.

**ENSO projections**: two respondents requested ENSO information including better accuracy out to 90 days.

**Winds:** on- and off-shore were requested by three respondents.

**Drought:** forecasts and in combination with other issues (e.g. heat) – two requests.

**Summer humidity levels:** one request.

Complex and often local outputs, such as: if temperature is high then drought is likely then if high intensity or high rain volume occurs likely results in flooding – what is the likelihood or percent chance of such a happening in a specific locale. Complex issues and impacts/output were mentioned by a number of respondents – just a few specifically but others in implication by including a list of requests – trends, time lines, probabilities, effects of impervious surfaces – listed under precipitation, etc.

# Suggested Tools and Visualizations

The majority of respondents provided ideas regarding tools or visualization products that could help them. In fact, more than 85 percent of respondents indicated that they could think of such tools.

Several respondents showed interest in handouts and brochures that summarize long-term climate information. Such information should be written in lay language, contain quality graphics, and should be something people can take with them, such as a handout.

Respondents also showed interest in tools that utilized graphics and visualizations to convey weather and climate information. Such tools were preferred more than information sources that contained mostly text. Sea level rise and storm surge were specific examples given multiple times; stakeholders felt this type of information is best conveyed through maps, graphics, visualizations, or animations.

Stakeholders also indicated the need for real-time data products. A tool that provided river water levels or storm surge levels along the coast was shared as an example of a potential useful tool. An emergency manager in coastal Texas indicated that the biggest problem she faces relates to delays of information coming from the National Weather Service, as it then takes her up to two hours to take action steps on the ground after a forecast changes.

Respondents also expressed interest in tools that would help them better understand sea level rise projections. Several stakeholders shared that such information is important in their current planning efforts. Similar to the suggested storm surge tool, some respondents expressed interest in a tool that would help them visualize the impacts of sea level rise in their communities.

Stakeholders indicated the need for mapping and visualizing flood potential from heavy rainfall events. One respondent suggested a mapping tool that ties in addresses from Google Maps to flood risk at that specific location. Such tools could map out the predicted extent of a 100-year or 50-year flood, and potentially even show visualizations of expected flood levels at specific addresses.

Impacts: the impacts of a change in any of the above climate characteristics as well as in a change in management of those issues or implementation of adaptation actions. Again, a few folks asked for these specifically and others implied the need – similar to above.

Some of these requests are rather straightforward and fairly easy to include in model outputs. For example, the highest minimum temperatures can be highlighted in outputs and will then assist farmers in the region. This has already been

requested of the US National Climate Assessment projections. The format of outputs can be readily adjusted as well- some need paper versions, some want web access, all want clear graphics that make it easier to understand the issue and impacts.

Some of the information or data requested are available already in a variety of locations and formats. In those cases, SCIPP will provide stakeholders with access to those data. Other information/data may require some intermediary steps that SCIPP or some other source could provide with the result of those data being more useful.

Finally, some of the requests are for localized information that are not directly related to modeling and could be more difficult to support. An example would be the specific local impacts around runoff from climate changes to precipitation because such a calculation would need to include the local topography and the amount of impervious surface.

However, by providing down-scaled temperature and precipitation information in the smallest scales possible and providing methods on how to calculate estimates of various types of impacts, communities could generate local impact information that is critical for them. This would also increase the assessment capacity in this region. So while it is unlikely that impacts information could be included as straightforward model outputs, SCIPP could develop educational programs/trainings to enhance the ability of local planners and decision-makers to generate locally appropriate assessments of impacts from climate models.

## How Could We Help You in The Future?

The most chosen (first) response to the question of how SCIPP could assist the respondents in the future was #1 – ***by providing climate information that is applicable to their areas.*** Some of this response probably has to do with the fact that climate model outputs cover large areas and in many cases the data are averaged and there is only one value for a very large area.

But for the information to be most useful, it needs to be delivered in a scale that matches local decision making, rather than the coarse scale of global climate model grids. For example, the average annual increase in rainfall for the entire US is about five percent during the past 50 years (USGCRP, 2009), but regional values may be higher or lower than the national average. – For example, the northeast U.S. has generally experienced more than a five percent precipitation increase, while large portions of the southeast have experienced much less than the average rainfall.

It is important that local decision makers involved in water management decisions have access to local/ regional data, instead of using national averages that may not relate well to their location. Until recently, regional and local climate information have been difficult to find. This has discouraged decision makers from using climate data, as climate data were often seen as too "big" and not applicable for their location.

The second most numerous response was for ***instruction on where to find trustworthy climate information.*** Unfortunately, at this time, any discussion that includes climate runs the risk of degenerating into competing ideologies and polarized positions that may have no real scientific basis. Knowing where to find information that is credible, balanced, trustworthy, and usable can be important to a reasonable discussion that results in appropriate decisions and actions.

***Training on how to interpret various climate information products*** was the third most common request for assistance. It is difficult to understand man y of the available tools and products, as they are developed at such a fast pace. Learning about climate products in short training programs saves time for the individual and helps to assure that they are choosing the correct tool for the task.

***Information pertaining to future anticipated climate hazards*** ranked #4 in the options listing. This follows directly from the climate information needs – ranked #1 – but requires a localized view of what impacts are likely to result from the projected climate changes.

For example, if the projections show an increase in rainfall, localized issues determine whether that will be a benefit, a detriment, or neither. So an analysis of the projected climate changes along with the local/regional conditions will need to be considered to assess whether a climate change is likely to become a hazard or not. Responding to this request

8 ***The category of "other" was included to allow the respondents to let us know if they had ideas of other programs that would be helpful to them. The responses in this category included:***

1. Most of these choices involve long-term climate information, which we are not so concerned about. We need more help determining elevations in our town, so we can put up surge markers and help educate people about storm surge potential and vulnerability.
2. Tool on the Web. We could use information about rainfall amounts, soil saturation, and tide levels. Anything from real-time to projections.
3. It might be helpful if people from academia sat in our monthly planning meeting. We do address weather and climate issues, particularly when it comes to hurricane season.
4. Development of hurricane/ storm surge tools.
5. We're not really interested in climate presentations or longer-term climate data. We more need quick, reliable weather data. We'd be interested in any additional weather information we can get.
6. I don't think I'd really check off any of these boxes. What we need here is more information to help us do our job in a timely manner. We need quick information to respond to a crisis. We are not as interested in long-term climate trends.
7. K-12 education in these areas. Teaching elementary schools. Kids often pick this stuff up quickly and educate their parents. "Turn around, don't drown" was taught in school and caught on.
8. Also, for the "other" box, I'd like to include web-based tools.
9. Public education on the hurricane/ storm surge threat. A guy from LSU came here once to share about storm surge vulnerability. It was sort of a "traveling road show" and it was great. [Note: I asked if this was Maurice Wolcott, and he said, "Yes."] It is most helpful if someone can give a storm surge/ hurricane presentation with easy-to-understand slides and graphics.
10. Presentation on historical flood events and potential localized events. For example, if 100 percent of the Morganza Spillway was opened, what would the flooding have looked like in South Louisiana?
11. I really don't think any of these would be that helpful to me at this time. However, if more online data was available for offshore weather conditions, that would be the most helpful.
12. Climate model outputs.

will likely require identification of a methodology to allow local assessment of likely impacts. There are many existing approaches that are useful in many circumstances.

The fifth identified need was: ***increased engagement between decision-makers and climate scientists.*** Helping to build confidence in making climate-based decisions sometimes depends on how comfortable a decision-maker feels with the climate information. After interactions between community decision-makers and scientists through a series of community meetings, the decision-makers have expressed that they feel more comfortable with the available science and feel more prepared to look at new and emerging data.

Having this type of interaction builds decision makers' confidence, as these interactions are like taking a customized course. These interactions often result in more confidence for dealing with nay-sayers and making difficult decisions, as stakeholders are equipped with knowledge from credible and reputable sources.

***Education on the basics of climate and climate science*** was ranked #6 in the possible options. Just more than one-third of the respondents are looking for this type of information. It seems as though more respondents are seeking to understand the impacts to their communities rather than to understand the basics of the science around climate change.

The 7th choice was i***ncreased collaboration between different hazard planning groups.*** Sometimes working with hazard planners from adjacent communities from communities with similar issues can prompt more creative and successful response strategies.

There were two responses to option #9 – no help is needed in these areas. One of the respondents said that the National Weather Service was right next door to their office and they offer many trainings and information sources – implying they do not need another information source.

SCIPP is exploring a number of options to respond to the requests for assistance noted in the final question: How could we help you in the future? The options could include: education/ training programming, webinars, tool development, and making climate information more readily available and at smaller than national scales. All of these programs and tools will be announced on the SCIPP website (www.southernclimate.org).

The Southern Climate Impacts Planning Program (SCIPP) is a south central United States focused climate hazards and research program whose mission is to increase the region's resiliency and level of preparedness for weather extremes now and in the future. The area we serve includes the 6-state region of Oklahoma, Texas, Arkansas, Louisiana, Tennessee, and Mississippi.

From severe storms, flooding, drought, hurricanes and storm surge, heat waves, wildfires, to severe winter storms, the South experiences among the nation's most extensive collection of climate-related hazards with many southern states ranking at or near the top of the lists in disaster declarations and billion dollar disasters.

The SCIPP team emphasis is on supporting the multi-hazard mitigation planning process through interactions with planners, emergency managers, city government, and other stakeholders. We also focus on the development of new information tools, education and outreach on weather and climate, and new research to better understand social vulnerabilities, hazard perceptions, extreme events, climate variability, and information needs.

While multi-hazard planning represents the primary focus of SCIPP, additional related areas of work include coastal planning, water resources, and climate adaptation.

As a member of the National Oceanic and Atmospheric Administration (NOAA) Regional Integrated Sciences and Assessments (RISA) program, SCIPP strives to continue the success of the RISA program in working with stakeholders and conducting critical, interdisciplinary research. SCIPP is a collaborative research program of the University of Oklahoma and Louisiana State University with combined expertise provided through the state climate offices of Oklahoma and Louisiana, the Southern Regional Climate Center, and a variety of partners throughout the region and beyond.


**The SCIPP Oklahoma Needs Assessment is now available online at southernclimate.org**

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