

CLIMATE CHANGE, ENVIRONMENTAL CHALLENGES AND VULNERABLE COMMUNITIES:

Assessing Legacies of the Past, Building Opportunities for the Future

RESEARCH REPORT



FEBRUARY 2012

FOREWORD

The Joint Center for Political and Economic Studies is grateful to the Texas Health Institute (THI) for a partnership that enabled us to develop a framework for assessing national research and programs on climate change and environmental priorities for vulnerable populations, especially communities of color.

This report, Joint Center research project *Climate Change, Environmental Challenges and Vulnerable Communities: Assessing Legacies of the Past, Building Opportunities for the Future*, and its Executive Summary offer guidance to advocates, policymakers, researchers and others who must set priorities, so that they can avoid duplication, maximize the use of scarce resources and encourage the development of policies that engage diverse populations while bringing environmental justice to their communities.

The report was prepared for the Joint Center by THI with project support from the U.S. Forest Service, U.S. Department of Agriculture.

We offer special thanks to members of the THI Project Team who prepared this report: Dennis Andrulis, Ph.D., M.P.H., Nadia Siddiqui, M.P.H. and Maria Rascati Cooper, M.A. We also are grateful to Gina E. Wood, Kellee James and Clori Jones of the Joint Center for their guidance and support.

Finally, we want to offer our appreciation to members of the *Commission to Engage African Americans on Climate Change* who have provided content recommendations, direction and support throughout all phases of this project.

Ralph B. Everett
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The members of the Texas Health Institute Project Team are Dennis Andrulis, Ph.D., MPH, Nadia Siddiqui, MPH and Maria Rascati Cooper, M.A. The Project Team acknowledges and thanks the U.S. Forest Service and the Joint Center for Political and Economic Studies for supporting this project. We also are grateful to Gina Wood and Kellee James of the Joint Center for their guidance in preparation of this report. Finally we want to offer our appreciation to members of the C*ommission to Engage African Americans on Climate Change* who, with Center staff through their invaluable contributions, have provided content recommendations, direction and support throughout all phases of this project.

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EXECUTIVE SUMMARY

INTRODUCTION

Vulnerability to climate change differs substantially across regions, communities and even households, and the communities that are most vulnerable to climate change also face poverty, health disparities, and other social inequities. Recognizing that these socio-economic challenges impede the resilience, health, and prosperity of communities, the recent *Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy* sets forth as one of its guiding principles that policymakers should prioritize helping the people, places and infrastructure that are the most vulnerable to climate impacts, and meaningfully involve these same communities in designing and implementing adaptation plans.

As the *Progress Report* notes, helping vulnerable people and places reduce their exposure and sensitivity to climate change and improve their capacity to predict, prepare for, and avoid adverse impacts requires thoughtful planning. Such planning, in turn, requires a comprehensive understanding of the status and scope of research, programs and actions on climate change and environmental challenges for vulnerable communities, particularly as they relate to eliminating disparities and advancing health equities across the range of climate and environmental issues. Notwithstanding recent research and advocacy in the field, this kind of comprehensive assessment has not been undertaken, leaving policymakers with insufficient data with which to implement the *Progress Report's* recommendations and other policy priorities. As such, this research offers direction and guidance to advocates, policymakers, scholars and others on priorities and gaps that leverage limited resources, prevent unnecessary duplication, and encourage the development and consistent implementation of policies and programs that appropriately engage racially and ethnically diverse populations in climate change and bring environmental justice to communities.

A growing body of evidence suggests that certain populations are more vulnerable to the effects of a changing climate. Specifically, these individuals and their communities—due to socioeconomic status, geography, racial and ethnic health disparities and lack of access to care—are likely to face greater susceptibility to such events. Moreover, the resultant frequency and intensity of impact from storms, wildfires, pollution, drought and other events that have been related to a changing climate will differ across areas where they reside.

This report draws from social vulnerability models and other resources to examine the effects of extreme weather events and climate-related challenges among vulnerable populations and highlights opportunities for future focus. The intent of this research is to provide an inventory of available baseline data and prior research as well as a compendium of resources on policies and programs to inform public health practitioners, policymakers, advocates, and others. Drawing from these findings, this report also offers recommendations to develop future policies and priorities that incorporate vulnerable populations into both their scope and goals.

RESEARCH DESIGN

The geographic focus for this report was a six state region of the southern United States: Arizona, Arkansas, Louisiana, New Mexico, Oklahoma and Texas. In selecting this region, the project team developed an analytical framework drawing from peer-review research, seminal reports and publicly available data from national, state and local sources. It applied a vulnerability framework specific to climate change around four dimensions: hazard, temporal reference, system and attribute of concern. This vulnerability framework guided the analysis of 16 indictors selected and categorized according to: social and economic factors (e.g. poverty); climate and environmental concerns (e.g. air quality); health disparities in exposure to environmental hazards (e.g. difference in racial and ethnic populations share of health risk from exposure to air toxins versus their share of the population); and adaptation programs and policies (e.g. states with a climate change action plan). A weighted analysis of these indicators revealed a cluster of southern states as, collectively, among the most at-risk to climate change. With valuable input from the Joint Center for Political and Economic Studies as well as the members of the Commission to Engage African Americans on Climate Change, the project team decided to focus on the southern states within the EPA's Region 6 and to include Arizona due to its high level of diversity, especially in Native American/American Indian populations.

The project team undertook a review of literature for this region to identify prior resources describing climate change effects among diverse and low income communities. To complement this information, the project team identified current programs and policies within the six states using a systematic search strategy. Key informants were sought throughout the region to complement findings from data and existing research, providing perspective on program effectiveness, leading climate challenges in their state and region, as well as suggesting future climate change priorities. Publicly available data measures on demography, climate and extreme weather events, health and health access were overlayed using Geographic Information Systems (GIS) tools and presented in a series of regional maps. Climate events that were examined included: air pollution (ozone, particulate matter and industrial toxins) and extreme weather events (wildfires, water shortage, drought, extreme heat, hurricanes and flooding).

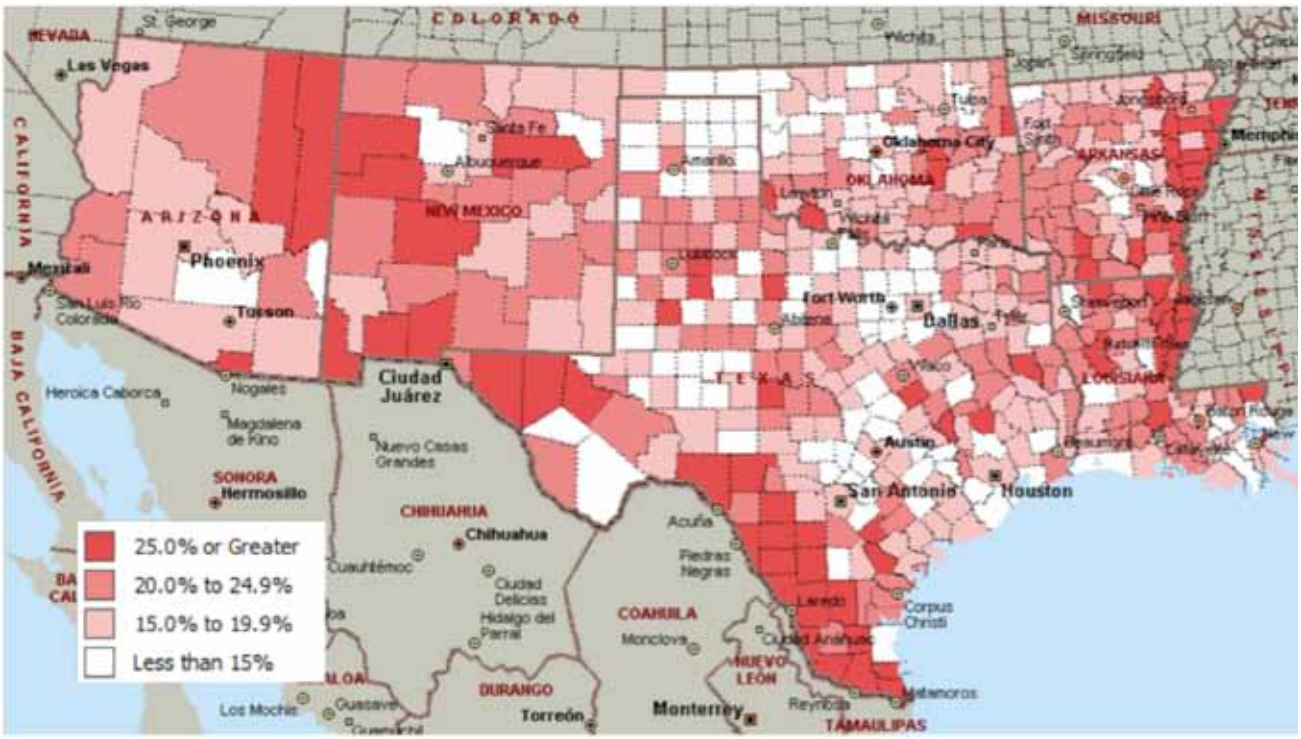
MAJOR FINDINGS

Common climate threats and population vulnerability. Our review provided a socio-demographic and health/health care portrait of the region and states within it, revealing both the nature and extent of vulnerable populations and their vulnerability to environmental challenges. The data-based findings revealed multiple commonalities across states. Poor air quality, drought and water shortages affect residents across the region. Other threats such as sea level rise, extreme heat and wildfires present major multi-state, cross-border consequences. We further identified emerging challenges around infectious diseases, which are increasingly manifest due to a warmer and wetter climate. As one-fourth of the region is considered rural, these events and threats have potentially significant consequences for urban areas, but also for the agricultural industry and those whose livelihood depends on it.

At risk populations in each state, by poverty or other socio-demographic vulnerabilities, face climate change vulnerabilities as well. For example, there are high levels of poverty virtually across all six states with pockets of poverty concentrated around urban cores and other non-urban areas such as the Texas-Mexico border and Eastern Arkansas (Map 13). Hispanic/Latino and other diverse populations—many of whom are also low income and reside in areas with significant climate change concerns— are significant and growing in all states across the region. Over one in 10 residents in these states is limited in English proficiency.

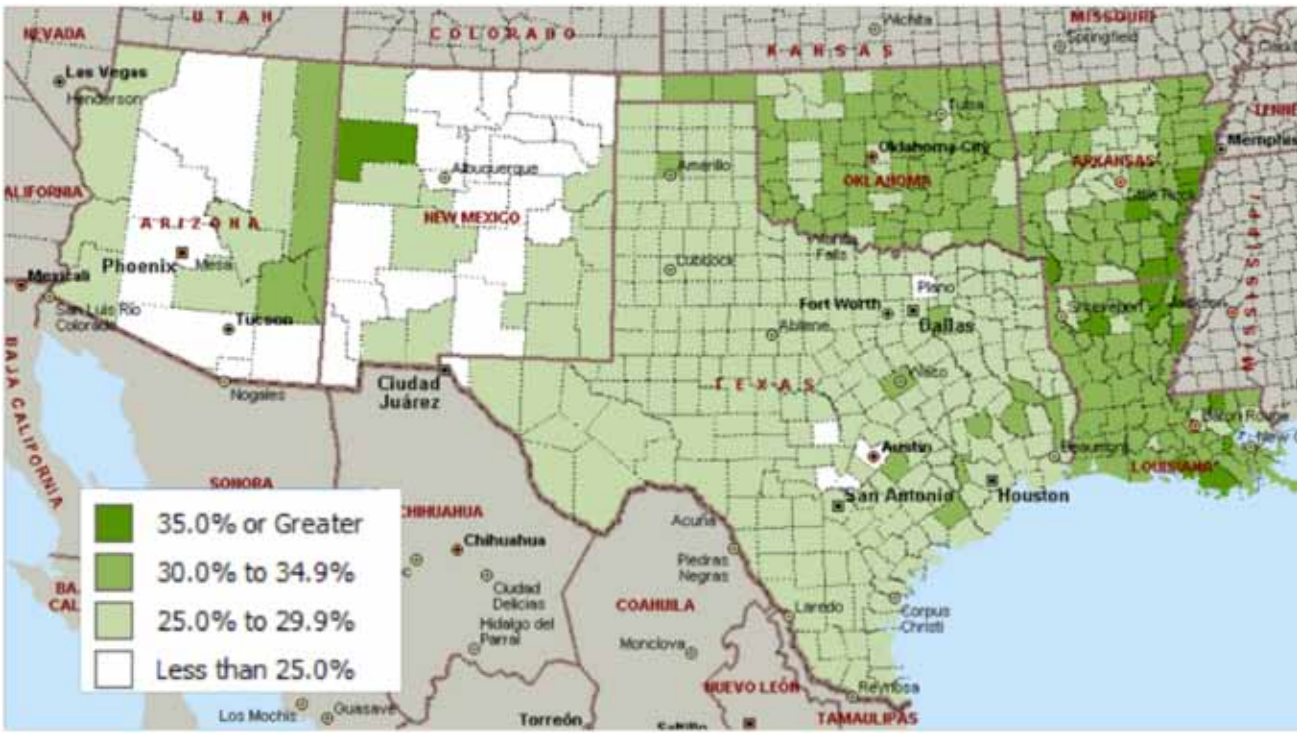
Compounding the effects of socio-demographic vulnerability are challenges to health and access to health care that can influence an individual's ability to cope, plan for and mitigate the adverse effects of climate change. Almost one in five adults across the region (18.2%) self-reports their health status as fair or poor. Poor health status, obesity, uninsurance, and a low rate of primary care providers may further disadvantage populations during or after extreme weather events or in the face of environmental challenges. Additionally, effects related to climate, such as extreme heat, may exacerbate pre-existing conditions already prevalent in a community. In this region, health and health care concerns intersect with the previously cited climate change concerns: rates of obesity and uninsurance are widespread and are higher than the national average across states in this region (Maps 20 and 22). With higher rates, these conditions and circumstances are significant barriers especially for low income and racially and ethnically diverse communities.

MAP 13. PERCENT POPULATION (ALL AGES) IN POVERTY BY COUNTY, 2010



Source: U.S. Census Bureau's Small Area Income and Poverty Estimates (SAIPE) with estimates derived from the 2010 Decennial Census

MAP 20. PERCENT OBESE BY COUNTY, 2007

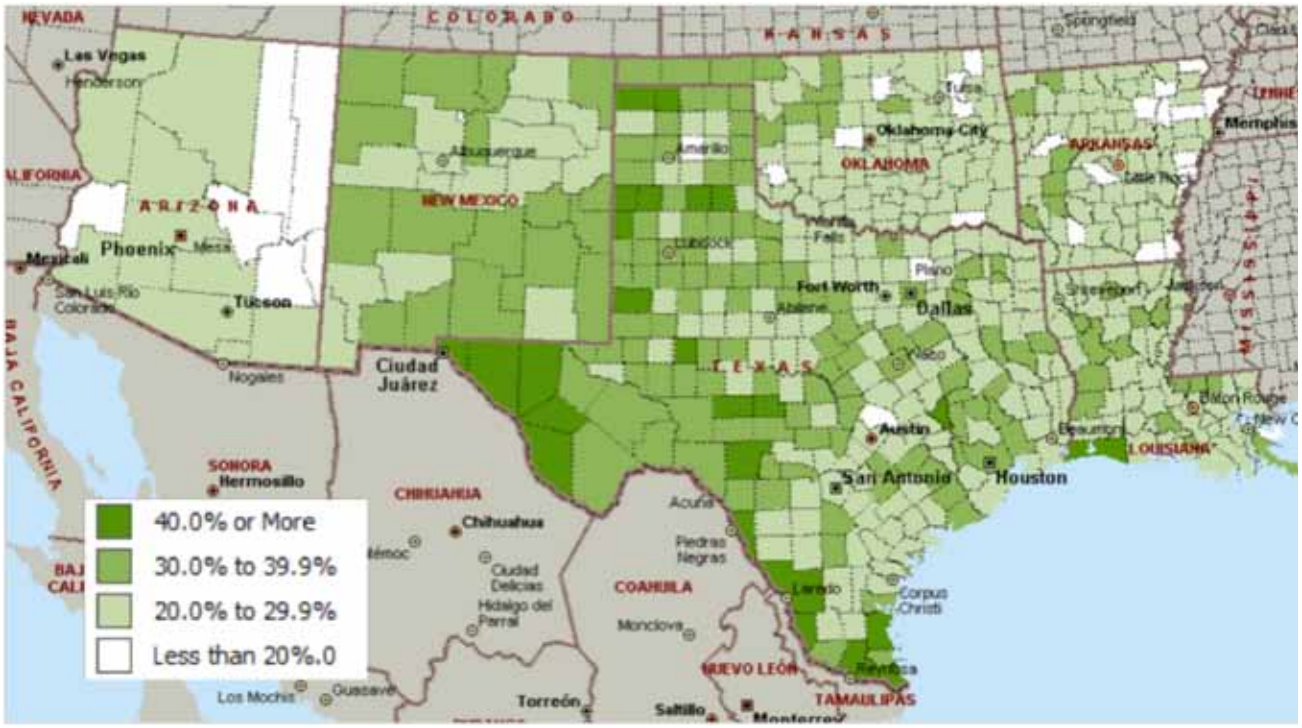


Source: National Center for Chronic Disease Prevention and Health Promotion, 2008

The climate change threat for most vulnerable communities. Our analysis generally revealed that populations in some areas within all states are especially susceptible to climate change threats. For example, as illustrated in Map 25, without exception, elevated unhealthy air quality days due to ozone overlap with many diverse areas in these states. And virtually all states in the region have among the greatest racial and ethnic disparities in health risks from industrial air toxins (Map 31).

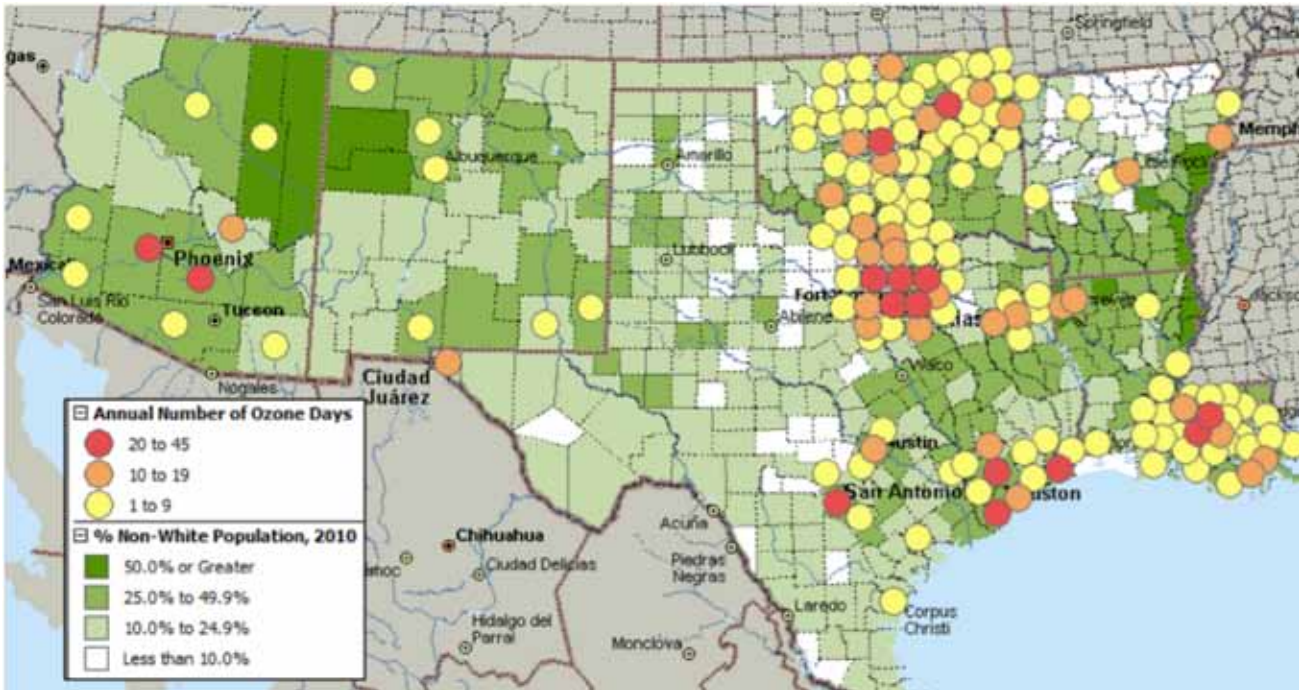
However, for certain communities and states the convergence of these challenges further elevates their risk to create the potential for a climate change-related "perfect storm." For example, Louisiana's strikingly high rate of obesity and poverty as well as challenges in access to health care, coupled with several climate-related events such as sea level rise, an increased frequency and intensity of storms and poor air quality could lead to possibly devastating effects for these vulnerable communities. But other areas are also alarmingly susceptible: extreme water shortages along the Texas-New Mexico border and eastern Arkansas could have profound effects on these communities who are both among the poorest, the most diverse and report the poorest health status.

MAP 22. PERCENT UNINSURED BY COUNTY, 2007



Source: U.S. Census Bureau, Small Area Health Insurance Estimates, 2007

MAP 25. ANNUAL NUMBER OF UNHEALTHY AIR QUALITY DAYS DUE TO OZONE, 2006 AND PERCENT NON-WHITE POPULATION, 2010, BY COUNTY



Source: Data on air quality were obtained from the 2011 County Health Rankings. Demographic data were obtained from the U.S. Census Bureau's 2010 Decennial Census.

MAP 31. DIFFERENCE BETWEEN MINORITY SHARE OF HEALTH RISK FROM INDUSTRIAL AIR TOXICS AND MINORITY SHARE OF POPULATION BY STATE

Source: Ash M, Boyce JK, Chang G, Pastor M, Scoggins J and Tran J. Justice in the Air: Tracking Toxic Pollution from America's Industries and Companies to our States, Cities and Neighborhoods. April 2009.

Questionable and varied progress in state and local mitigation and adaptation. This six state region faces significant challenges related to planning and mitigating the effects of climate change (Table 18). As a whole, the region is lacking in statewide policies. Only 3 states had written, established climate change action plans; and implementation of recommended actions from those plans in many cases has progressed slowly or not at all. Our review found that none of the states in the region have formal and comprehensive adaptation plans in place, nor do they include communities of color or economically disadvantaged populations.

There is some variation in state legislative progress to mitigate the effects of climate change in the region, however. For example, New Mexico and Arkansas have taken some actions to implement emission targets. But Texas, Louisiana and Oklahoma have not passed significant legislation to promote a statewide goal or plan to reduce greenhouse gas emissions. According to our review, virtually none of the state laws include vulnerable populations in climate change mitigation strategies.

TABLE 18. SUMMARY OF CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES

	Active Climate Legislative Commissions And Executive Advisory Groups	Climate Change Action Plan	States with Greenhouse Gas Emissions Targets	Range of Greenhouse Gas Emissions Targets	Regional Greenhouse Gas Initiatives	State Greenhouse Gas Reporting and Registries	Renewable Portfolio Standard	State Adaptation Plan
Arizona	Yes	Yes	Yes	2000 levels by 2020, 50% below 2000 by 2040	No	Climate Registry	Yes	Recommended in climate action plan but not adopted
Arkansas	Yes	Yes	No	Recommended in climate change action plan but not adopted	No	No	No	No
Louisiana	No	No	No	—	No	No	No	No
Oklahoma	No	No	No	—	No	Climate Registry	No	No
New Mexico	No	Yes	Yes	2000 levels by 2012, 10% below 2000 by 2020, 75% below 2000 by 2050	No	Climate Registry and Mandatory Reporting	Yes	No
Texas	No	No	No	—	No	Independent Voluntary Registry	Yes	No

Source: Center for Climate and Energy Solutions' U.S. Climate Policy Maps

This lack of attention to vulnerable communities among state legislative actions is also reflected in local and community level initiatives. A number of cities in all states have undertaken initiatives to address issues specific to climate change after recognizing the need to address local priorities and/or acknowledging the lack of state leadership; however, there is little focus on the circumstances and threat-related needs of vulnerable populations in these city or area plans, initiatives or task forces. There is also little attention devoted at the state or local level to profiling the challenges or issues specific to vulnerable populations in reports and other publications such as those involving limited English proficiency or immigrant workers. Key informants confirmed these findings as they had difficulty citing current efforts or progress. Finally, there is a general lack of awareness of information and resources to document degree and extent of vulnerability in the context of climate change. Informants also acknowledged that little documentation is available that links poverty and diversity in the context of climate change vulnerability.

Other potential barriers to progress. Our review and interviews revealed other barriers contributing to and compounding progress toward incorporating vulnerable populations into climate change initiatives, including political opposition, skepticism of climate change effects and influence from industry. Political realities have restricted both development and expansion of these programs and policies in virtually all states in the region. Key informants also cited skepticism about climate change and its causes as a major barrier. This perpetuation of the concept of global warming as a myth has created widespread doubt on the topic that reaches deeply into many communities, including low income and racially and ethnically diverse populations. Across states, there is a strong opposition to climate change policies by industry (including fossil fuel and electricity companies) and its lobbying efforts. This opposition extends to communities who may be concerned around threat of job losses and economic impact.

RECOMMENDATIONS

State level initiatives. Our review has documented and affirmed many of the significant challenges that lie ahead in mitigating the effects of climate change for vulnerable communities in this region. Nonetheless, efforts to date, data, and research offer guidance for integrating diverse, low income and other vulnerable population priorities into state climate change policies, programs and strategies. As such, recommendations build on existing state efforts and suggest new initiatives to document populations and their needs; and to take action to redress longstanding absence in state climate change goals.

- **Review and renew existing current state climate change efforts and work to include vulnerable populations within them.** Our review found that all states have passed climate change legislation but with little attention to vulnerable populations each state should identify and consider revising current laws and regulations to include these communities; Examples of information for potential inclusion into existing climate change policies and actions are: degree of vulnerability to climate change threat; plans for event response; and community engagement in the context of programs and policies. Such a review may serve an important secondary purpose. Reinvigorating previously fallow efforts through reassessing original intent in the context of vulnerable populations and seeking support may offer renewed opportunity within existing policy.

- **Coordinate and communicate promising climate change related priorities and actions across states and regionally, and integrate vulnerable priorities into these cross state initiatives.** When addressing cross-border priorities, states in the region can benefit from sharing data, coordinating and monitoring efforts, and developing mutually beneficial policies. Multistate partnerships could also be developed in planning for drought, preparing for wildfires and sea level rise, and creating sustainable strategies in agricultural farming.

- **Integrate vulnerable population concerns and representation into task forces and advisory groups.** Many states have created and convened commissions, expert panels and other advisory bodies. Current and future groups should include vulnerable population representation. They should also assure that addressing related circumstances and concerns such as assessing vulnerable populations' needs and priorities and developing recommendations to promote equity in action are among their core objectives.

- **Develop data that targets climate change priorities to inform programs and state actions.** States should consider developing data sets and measures not only addressing climate change concerns such as degree of temperature rise and number of poor air quality days but also extend and link such data to demographic and health care dimensions that may influence resiliency and vulnerability.

Community level initiatives. As communities have taken on responsibility for mitigating and adapting to climate change, they offer important opportunities to promote actions that can engage and positively affect their most vulnerable. Such efforts include sharing local resources across states, building messages that are acceptable and understandable to vulnerable populations, engaging communities in a meaningful way, and tapping into the strengths of both academic institutions and foundations.

- **Make available local climate change actions occurring across the region.** Counties and cities have undertaken local efforts to target climate change priorities. Their programs, reports and lessons learned could serve as a resource, providing opportunities to transfer knowledge and tap into expertise for other areas seeking to mitigate climate change effects. At the same time such resource development and discussion will need to assure representation of vulnerable populations.

- **Work to assure that vulnerable populations can accept and understand messages about climate change.** Effective outreach, education as well as information development and dissemination to racially, ethnically and linguistically diverse residents around climate change require tailoring health messages to build trust, facilitate understanding, participation and adherence to recommended actions. Involving known cultural "references", including knowledgeable representatives from these communities, is key to developing culturally competent health communication.

- **Community engagement is essential to advancing climate change strategies for vulnerable populations.** Communities bring assets, knowledge and experience that can be invaluable in providing important input to program planning and policy, by assuring that results will be of value to residents and building trust. Strategies to engage communities will need to recognize the circumstances and challenges that they face in their lives in the context of climate change actions.

- **Leverage academic institutions, to include Minority-Serving Institutions for advancing vulnerable population climate change research, outreach and education.** These entities can offer attention through academic grantmaking capacity, ability to offer expertise and, for faculty with community-based experience, through Community Based Participatory Research initiatives, for example. Their research can foster action, while for those who focus on the needs of vulnerable communities, faculty participation in climate change task forces and advisory groups can add substance to related deliberations. University expertise and experience may also serve as a resource for states in assessing threats and developing and evaluating policies to address them.

- **Elevate the presence of foundations and the private sector in developing and advancing vulnerable population climate change programs and policies.** Foundation leadership, their ability to adapt their objectives to meet area priorities and their capacity for grantmaking can offer valuable resources in: raising the importance of climate change as a state or local priority; supporting research that targets critical issues of concern; and advancing legislative agendas. Corporate commitments to related local priorities can provide additional resources for populations most likely to be adversely affected.

While environmental challenges such as wildfires, coastal change and floods may demonstrate the consequences of inattention to climate change, one of the major challenges is to expand awareness, engagement and action to address the underlying causes. Policymakers, agencies, researchers, advocates and community based organizations can take advantage of "windows of opportunity" emerging from tragic events to bring attention to both targeted need and broader climate change priorities—and to take actions before events occur. The energy behind these tragedies should not dissipate as they recede from today's headlines. Communities and their governments in this region, as well as the nation have a responsibility to foster broader awareness, understanding and involvement of how vulnerability and climate change are integrally linked. In so doing those committed to redressing legacies of the past can work to promote a healthier environment for the future.

INTRODUCTION

Vulnerability to climate change and adverse environmental events differs substantially across regions, communities and even households, and the communities that are most vulnerable also face poverty, health disparities, and other social inequities. Recognizing that these socio-economic challenges impede the resilience, health, and prosperity of communities, the recent *Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy* sets forth as one of its guiding principles that policymakers should prioritize helping the people, places and infrastructure that are the most vulnerable to climate impacts, and meaningfully involve these same communities in designing and implementing adaptation plans.
As the *Progress Report* notes, helping vulnerable people and places reduce their exposure and sensitivity to climate change and improve their capacity to predict, prepare for, and avoid adverse impacts requires thoughtful planning. Such planning, in turn, requires a comprehensive understanding of the status and scope of research, programs and actions on climate change and environmental challenges for vulnerable communities, particularly as they relate to eliminating disparities and advancing health equities across the range of climate and environmental issues. Notwithstanding recent research and advocacy in the field, this kind of comprehensive assessment has not been undertaken, leaving policymakers with insufficient data with which to implement policy and program priorities, such as recommendations embedded within the *Progress Report*.

To this end, with initial funding from the U.S. Forest Service of the U.S. Department of Agriculture, the Joint Center for Political and Economic Studies (Joint Center) partnered with the Texas Health Institute (THI) to develop a framework to assess and document the status and progress of data, research and programs across the nation in addressing climate change and environmental priorities for vulnerable populations, including in particular, communities of color. Utilizing Southern U.S. as a case study, this report highlights the impact of climate change and environmental challenges on vulnerable communities in Arizona, Arkansas, Louisiana, New Mexico, Oklahoma, and Texas, and discusses program and policy related progress and challenges. As such, it offers direction and guidance to advocates, policymakers, researchers and others on priorities and gaps to leverage limited resources, prevent unnecessary duplication, and encourage the development and consistent implementation of policies and programs that appropriately engage diverse populations in climate change and bring environmental justice to communities. We note that hereafter our use of the term climate change is also intended to encompass environmental issues as well; and that our reference to "states" includes tribal communities.

This effort represents a unique attempt to develop a status report and establish a baseline of current data, research, resources, programs and policies as they relate to vulnerable communities of color and climate change priorities.

THIS REPORT IS ORGANIZED INTO THE FOLLOWING PARTS:

I. BACKGROUND This section summarizes the current literature related to climate change, environmental hazards and extreme weather events as it applies to vulnerable populations.

II. METHODOLOGY This section describes the methodology used to select the six state region, literature searches and key informant interviews.

III. REGIONAL DATA FINDINGS This section provides a comprehensive look at demographic, health, and weather-related data mapped to the county level for the six state region.

IV. REGIONAL, STATE AND LOCAL PROGRAMS AND POLICIES An overview of current literature on climate change and environmental hazards as it applies to the six state region as well as a review of the current mitigation and adaptation policies and programs by state and region.

V. DISCUSSION This section provides an in-depth analysis of the regional data and policy findings.

VI. RECOMMENDATIONS This portion includes next steps and recommendations for future actions.

VII CONCLUSION

I. BACKGROUND

CLIMATE CHANGE AND VULNERABLE POPULATIONS

There is growing recognition that vulnerable populations, and especially racially/ethnically diverse communities (also referred to as "communities of color" in this report) will suffer disproportionately from the earth's changing climate. This impact is likely to be compounded by factors associated with low socioeconomic status, discrimination and disparities in access to health care and essential social services. While some recent literature has drawn attention to the potentially unequal burden and impact of climate change, research on this topic is still under-developed and piecemeal. For example, reports such as *The Climate Gap* and *Justice in the Air*, serve as seminal pieces of work that draw attention to this issue, however, are limited in focus and scope—i.e., the former focuses on California, while the latter on air pollution. In an exploratory report in 2004, the Congressional Black Caucus Foundation developed a report titled *Black Americans and Global Warming: An Unequal Burden* detailing the disproportionate health effects this community suffers from events such as air pollution, heat waves, drought, and flooding. Though this report was crucial to building a case for groups more vulnerable to climate change impacts, its focus did not include other racially and ethnically diverse populations.

Nonetheless, researchers focused on "social vulnerability" issues have played a somewhat leading role to begin to paint a fuller portrait of the vulnerability of communities of color to climate change (Lynn, MacKendrick, & and Donoghue, 2011). As defined by the Intergovernmental Panel on Climate Change (IPCC), an international scientific body of the World Meteorological Organization and the United Nations Environment Programme, vulnerability to climate change is "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change… vulnerability is a function of the character, magnitude and rate of climate change and variation to which the system is exposed, its sensitivity, and its adaptive capacity" (Lynn et al., 2011). Social vulnerability offers the ability to understand the types of populations that suffer increased impacts from extreme events related to climate change based on limited capacity (Lynn et al., 2011).

In their 2002 assessment of studies conducted under the United Nations Framework Convention on Climate Change, Burton et al. describe climate vulnerability as a function of impacts (or a system's sensitivity and exposure to climate-related events) and adaptation (referring to a system's capacity to plan, respond and adapt to reduce vulnerability). (Burton, Huq, Lim, Pilifosova, & Schipper, 2002). As research suggests, the impacts of climate change will differ across communities and regions, and some may be more at risk to its stresses and impacts, such as the poor, the elderly, people living alone, people with poor health status, indigenous populations and individuals with limited power and rights (Gamble, Ebi, Sussman, & Wilbanks, 2008; Karl, Melillo, & Peterson, 2009)

In addition, the impact of climate change should not be considered confined to any specific population or even jurisdiction, geographic area, political boundary, or time. Rather, with tourism, migration and immigration, the impacts and stresses of climate change often flow across communities. Hurricane Katrina in New Orleans illustrates this point as cited in Gamble et al.'s 2008 report:

> *As Hurricane Katrina made clear, impacts felt in one community ripple throughout the region and nation. Many of the persons made homeless in New Orleans resettled in Baton Rouge, Lafayette, and Houston, creating stresses on those communities. Vulnerable groups migrate from stricken areas to more hospitable ones, taking their health, economic, and educational needs and problems with them across both national and state lines* *[Gamble et al. 2008: 123].*

Following is a summary of what research and literature say about factors which contribute to vulnerability generally and especially for racially/ethnically diverse communities to climate change and their ability to adapt and respond to its effects.

Socioeconomic Status

The impacts from a changing climate will not affect all communities equally. Low socioeconomic status is considered a component of vulnerability as these individuals, due to low literacy, poverty or underinsurance, are more susceptible to both the damages and risks associated with extreme weather events (Shonkoff, Morello-Frosch, & Pastor, 2009). Furthermore, low income populations are overburdened by events such as drought due to the overall lack of resources, both financial and informational, as well as more likely to lack insurance coverage (Liverman & Merideth, 2002).The Oxfam Report also suggests that several different factors associated with poverty make these particular communities more vulnerable than wealthy communities to environmental hazards. Substandard housing as well as poor access to transportation and communication further compounds the ability of low income persons to survive disasters (Cutter, Emrich, Webb & Morath, 2009).

Race, Ethnicity and Immigrant Status

Peacock (2000) relates increased vulnerability of racially and ethnically diverse communities to hazards due to their greater likelihood to be in poverty. Furthermore, real estate discrimination may lead these populations to live in subpar or even hazard-prone housing (Peacock & Girard, 1997).

Hoerner and Robinson (2008) provide in-depth insight into the impacts that African Americans suffer as a consequence from climate change. Their contribution to greenhouse gases has been measured to be less than the white population. However, despite contributing less to these environmental changes, African Americans are more susceptible to its impact on housing, the economy, and health. Compounding these effects is the fact that African Americans are more likely to have higher energy bills and suffer directly from recessions and unemployment. Among the public health concerns, Africans Americans suffer disproportionately from heat-related deaths during heat waves. In addition, due to their likelihood to live within counties violating air pollution standards or in close proximity to industrial plants, African Americans are particularly susceptible to respiratory illness, such as asthma. As Hoerner and Robinson (2008) cite, the rate of asthma among African Americans is 36% higher than whites.

The high price of energy bills is a significant barrier for many African Americans, and energy rates are increasing with changes in climate patterns. African Americans spend a higher proportion of their income on energy costs than whites. Additionally, food supply will be impacted from climate change (resulting from damage to crops from extreme weather events) and food costs are expected to increase. African Americans are also expected to feel the burden of rising health problems associated with climate change as they lack health insurance at a significantly higher rate than whites (Hoerner & Robinson, 2008).

Hispanic/Latino populations are also expected to experience disproportionate effects from climate change. At increasing numbers, they are living in poverty, experience reduced access to services such as health care due to their high uninsurance rate and are more likely to live in substandard housing. Impacts are broad based on this community and include not only health, but economy and jobs. The agricultural industry, which employs a large number of Hispanics/ Latinos, suffers due to extreme weather events. Additionally, an overwhelming 72 percent of the Hispanic/ Latino population within the U.S. lives in an area that is not compliant with federal air pollution standards. This alarming number indicates that Hispanics/Latinos are at a higher risk for respiratory diseases associated with air pollutants (National Hispanic Environmental Council, 2010). Keating (2004) further corroborates the barriers that Latino populations face which heighten their sensitivity to the impacts of climate change. The most significant barriers are poverty and limited English proficiency which further add to this group's vulnerability to the impacts from toxic air (Keating, 2004).

American Indian populations are also vulnerable to the effects of climate change on the environment for several reasons. Their culture, which is deeply connected to the environment and its resources, is threatened in the face of the scarcity of water, especially in the Southwest. merican Indian nations rely on treaties with the federal government whereby the government is expected to protect these resources. These treaty rights, however, only apply to the tribe's reservations and lands, and in cases of diminishing resources, a tribe's right to these resources may be threatened (Lynn et al., 2011). In addition, American Indians are more likely to live in poverty than the general U.S. population (Ogunwole, 2006). They also live in poorer housing conditions, often times lacking amenities such as electricity (Houser, Teller, MacCracken, Gough, & Spears, 2000). Geographic location of many tribes places them at an increased risk for environmental-related changes. For example, several non-federally recognized tribes fled to the bayous of Louisiana to avoid persecution more than two hundred years ago. This land, however, is now one of the foremost concerns for sea level rise in the U.S., and relocation has become a reality for these tribes (Lydersen, 2009).

Geographic Disparities

Health impacts resulting from climate change are often associated with geographic conditions such as availability of resources, nearby water sources, elevation level as well as baseline climate. Communities that populate the Gulf Coast, especially those in low-lying regions, are more susceptible to health effects resulting from a changing climate (Gamble et al, 2008).

Especially vulnerable due to their geographic location are the "suburban poor" or populations who live in poverty among older suburbs, typically closer to the city's center. These areas have a high immigrant and elderly population and their homes may be outdated providing a poor barrier to the environment and comprising an increased risk factor for indoor toxins such as lead or mold (Gamble et al, 2008).

Rural populations, who already experience challenges such as limited access to health care and emergency services and high unemployment rates, face disproportionate effects of climate change due to the these factors. Especially in the Midwest, increasing temperatures adversely affect these communities as their economies are closely linked to the environment. Due to limited resources, rural communities spend a larger portion of their income on necessities such as food and travel, the cost of which is expected to increase both with a changing climate and its respective mitigation strategies (Keller Jensen, 2009). Adaptive measures undertaken in respect to this population have been limited in scope, and only sector-specific. For example, planting with drought resistant seeds may help reduce impacts from a changing climate, but a multi-pronged approach designed to address multiple underlying factors of vulnerability is preferred (Eriksen & Kelly, 2007).

Health Disparities

Air pollution, both in industrial zones as well as in urban areas, has health consequences that vary among different populations. Ozone exposure has been shown to poorly affect lung health as well as worsen respiratory illness. California, a state with a grave air pollution concern, will experience a worsening of effects due to changes in climate and temperature (Morello-Frosch, Pastor, Saad, & Shonkoff, 2009). These effects do not fall solely on one group of people, and are in fact distributed more amongst the poor and communities of color Michael Ash and colleagues (2009) mapped industrial air pollution throughout the U.S. and determined that low income populations and diverse populations including Hispanics/Latinos, American Indians, African Americans and Asian Americans were most exposed to this toxic air. This report concluded that essential factors to consider when assessing vulnerability to air pollution are race, ethnicity, and class.

Urban areas, where blacks are twice as likely to live as whites, are susceptible to "heat island effects," a phenomenon that occurs as a result of dark-colored structures absorbing more heat than vegetation such as trees, soil, and grass. (Oke, 1973). It is agreed by many that these heat islands, which are prominent in inner city neighborhoods, impact low income persons and communities of color more due to their inhabitance of these areas (Schulz, Israel, & Lempert, 2002; Williams & Collins, 2001; Levi, Vinter, Gratale, Juliano, & Segal, 2009). It has also been shown that low income populations and communities of color are less likely to have air conditioning, a finding that has been shown to worsen the morbidity and mortality of exposure to extreme heat (Morello-Frosch, et al., 2009). Extreme heat is also known to exacerbate the health risks of individuals with diabetes with events such as kidney stones or heat exhaustion. The increasing prevalence of diabetes in the U.S. is higher among communities of color than White populations (Karl et al., 2009).

Other Demographic Variables

Both race and age are important demographic factors to include when assessing the vulnerability of populations. For various reasons, women are at a higher risk to climate-related hazards. They are more likely to live in poverty (Bianchi & Spain, 1996), more likely to have a low-paying job such as the service industry which is particularly affected after a disaster (Morrow, 2008) and may be limited in their evacuation capacity due to caring for young children. Both the very young and the elderly are considered more at risk when extreme events and disasters occur. Children without strong familial ties will be more affected during extreme weather events (Phillips & Hewett, 2005). The elderly may experience health problems or have fewer economic resources required for disaster preparedness hindering their ability to respond to disasters (Ngo, 2001).

Models of Social Vulnerability in Climate Change Research

Social vulnerability has been explored extensively in the literature and its definitions vary among theories and frameworks. Cutter et al. (2009) use the following definition:

> *Vulnerability is the susceptibility of a given population, system or place to harm from exposure to hazard and directly affects the ability to prepare for, respond to, and recover from hazards and disasters.*

The variables included within the concept of social vulnerability are those that worsen or diminish the impacts of such hazards on the affected communities (Oxfam America, 2008). These have been compiled into a model for determining social vulnerability. In 2003, the Social Vulnerability Index (SoVI) was developed to explore the effects of climate change amongst different populations. The model uses a summation of 32 variables (wealth, age, race, gender, ethnicity, etc.) to determine an overall reference measure of vulnerability. In a study commissioned by Oxfam America, this model was applied to states in the southeastern United States. As such, the study has generated a series of maps overlaying demographic data from the 2000 U.S. Census with data on extreme weather events such as drought, floods, and sea level rise among others (Oxfam America, 2008).

The Hazards of Place (HOP) model differs from the SoVI in that rather than assuming social vulnerability as a predisposing condition for which to overlay environmental hazards, it incorporates the idea of place into the model. This framework is especially appropriate for assessing a population's vulnerability to climate-related hazards because it incorporates both demographic information and information related to physical and environmental hazards (Cutter et al, 2009).

This report's methodology for assessing vulnerability draws from these resources, among others, and is described in detail in the following section.

II. METHODOLOGY

This section describes the methodology for the selection of the study's region of focus and review of existing research, information and resources for this region. In so doing, it describes the design for performing literature reviews and key informant interviews, and procedures for mapping and compiling publicly available data.

REGION SELECTION

THI was commissioned by the Joint Center to develop an analytical framework to select a region to serve as a case study and prototype for assessing status and progress in addressing climate change for diverse communities across the U.S. To this end, an extensive review of national literature and data sets was conducted, including major national reports, peer review research and publicly available data sources on climate change, social vulnerability and racial/ethnic diversity.

Vulnerability is equated with concepts such as "resilience, marginality, susceptibility, adaptability, fragility and risk".[1] In context of climate change, more specifically, scholars have described vulnerability in terms of at least the following four dimensions.[2,3]

- **System:** a population group or geographical region that is potentially threatened by a hazard.
- **Attribute of Concern:** the attributes of the system, such as health, cultural identity, and income, that is/are threatened by exposure to a hazard.
- **Hazard:** a potentially damaging event that may cause loss of life, injury, property damage, social and economic disruption or environmental degradation.
- **Temporal Reference:** the point in time, period of reference or frequency.

More recently, scholars also emphasize the need to identify internal and external scope of vulnerability. Internal factors are those that are endogenous to a system, such as population characteristics and topography, whereas external factors are beyond the scope of a system, such as national policies that may impact a local community or extreme weather patterns.

Our study builds on these concepts in an attempt to select a "system" or geographic region most vulnerable to climate change based on a set of attributes of concern and hazards, while also considering issues of time and scope. As such, we selected 16 indicators to assess the vulnerability of states and their racially/ethnically diverse communities to climate change-related events. These indicators were categorized into four groups:

- **Social and Economic Factors:** These include internal attributes or socioeconomic characteristics of states, such as population race, ethnicity, language and poverty.
- **Climate and Environmental Concerns:** These are hazards faced by states related to the environment, topography, and weather. Many of these measures are also intended to capture the "time" factor—e.g., frequency or intensity of event over short or long time periods.
- **Health Disparities in Exposure to Environmental Hazards:** These are the internal attributes of states related to environmental disparities measures.
- **Adaption Programs and Policies:** Internal (state/local) or external (national/global) policies and programs which promote adaptation to climate change.

Table 1 outlines each of the 16 indicators and their data source.

Appendix A provides state-based data across the 16 indicators. We established thresholds for each indicator based on national averages or rates and weighted data accordingly within each group so that the maximum score for each group was 1.0 (i.e., being most "vulnerable" or "at risk"). Group scores were aggregated to generate a composite score (maximum possible was 4.0) by which states were rank-ordered. States most "vulnerable" or "at risk" to climate change were those with a higher composite score and generally characterized as having:

[1] Fussel HM. Vulnerability: A Generally Applicable Conceptual Framework for Climate Change Research. Global Environmental Change, 2007: 17; pgs. 155-167.

[2] Metzger MJ, et al. A Multidisciplinary Multi-Scale Framework for Assessing Vulnerabilities to Global Change. International Journal of Applied Earth Observation and Geoinformation, 2005: 7; 253-267.

[3] Downing TE and Patwardhan A. Assessing Vulnerability for Climate Adaptation. In: Lim B and Spanger-Siegfried E (Eds.), Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures, 2004: Cambridge University Press (Cambridge), Chapter 3.

- A large percentage of poor and racially, ethnically, or linguistically diverse population;
- The greatest level of risk or impact from various environmental, extreme weather and climate change issues, taking into account event frequency and intensity;
- Large racial, ethnic and/or income disparities in health risk from environmental hazards (in this case toxic air exposures); and
- Little or no state or local planning, funding or programming related to climate change.

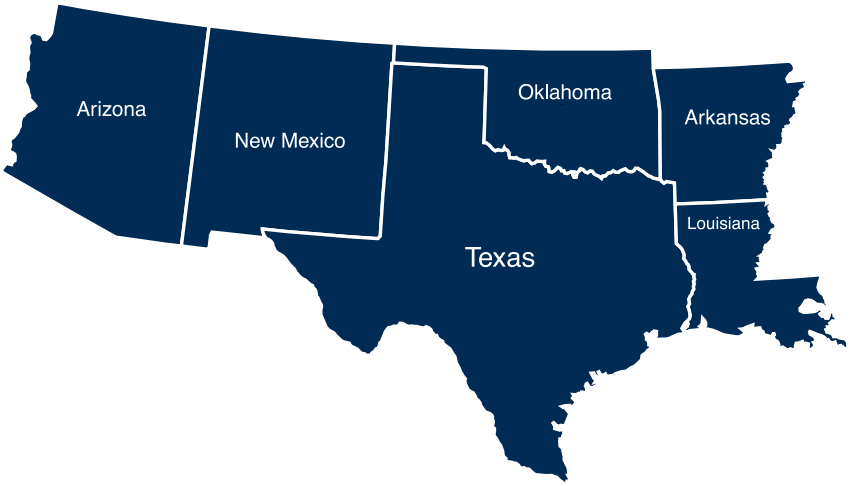
While this framework does not capture all the possible factors associated with vulnerability to climate change, it is intended to offer a useful tool for assessing racial, ethnic, and linguistic diversity of states in relation to their climate change challenges, progress and opportunities.

Based on findings from the application of this framework, a cluster of Southern states were identified as being most "at risk" or "vulnerable" to climate change: Texas, Arizona, Louisiana, and New Mexico (refer to Appendix A). The Project Team shared findings with the Joint Center's Commission to Engage African Americans in Climate Change (CAEC) for feedback on site selection. The Commission voiced almost unanimous agreement that the study focus on at least these four Southern states, while also considering the Environmental Protection Agency's (EPA) designation of regions. As EPA's Region 6 is comprised of Texas, Louisiana and New Mexico, along with Arkansas and Oklahoma (two additional states with high vulnerability based on our data), the region and states within were selected and included in this study. The Commission also agreed to add Arizona given the high level of vulnerability identified through our initial data analysis and also its large American Indian population.

TABLE 1. INDICATORS OF VULNERABILITY TO CLIMATE CHANGE

CATEGORY	INDICATORS	DATA SOURCES
Social and Economic Factors: *3 Indicators; 40% of Composite Score*	• Percent Non-White Population [1] • Percent Population with Limited English Proficiency (LEP) [2] • Percent Below Poverty Level [2]	[1] 2010 Decennial Census, U.S. Census Bureau [2] 2005-2009 5-Year American Community Survey Estimates, US Census Bureau
Climate & Environmental Concerns: *6 Indicators; 25% of Composite Score*	• Air Quality: Median Exposure to Industrial Air Toxins, 2006 [3] • Heat: Number of Deaths due to Exposure to Excessive Natural Heat, 2007 [4] • Hurricanes: Number of Major Direct Hurricane Strikes 1854-2009 (Major is defined as Category 3, 4, or 5). This measure intends to capture both intensity and frequency of hazard.[5] • Floods: Significant Floods of the 20th Century (Significant defined in terms of number of lives lost and/or property damage). This measure intends to capture both intensity and frequency of hazard.[6] • Wildfires: Number of Wildfires by State, 2010 [7] • Drought: Number of Reported Drought Impacts (on agriculture, water/energy, environment, fire or other), July 2011. [8]	[3] *Justice in the Air,* 2009 [4] CDC National Center for Health Statistics [5] NOAA Atlantic Oceanographic and Meteorological Laboratory [6] U.S. Geological Survey [7] National Interagency Fire Center [8] National Drought Mitigation Center, University of Nebraska-Lincoln
Health Disparities in Exposure to Environmental Hazards: *2 Indicators; 10% of Composite Score*	• Difference between the Racially/Ethnically Diverse Communities' Share of Health Risk from Industrial Air Toxics and the Racially/Ethnically Diverse Communities' Share of the Population [9] • Difference between the Low-Income Share of Health Risk from Industrial Air Toxics and the Low-Income Share of the Population [9]	[9] *Justice in the Air,* 2009
Adaption, Programs and Policies: *5 Indicators; 25% of Composite Score*	• States with Strategic Climate Change Plan [10] • States with Climate Commission or Advisory Panel [10] • States with NACCHO or ASTHO funding for pilot projects on climate change (FY 09) [10] • States with CDC Environmental Public Health Tracking Program Grant (FY 09) [10] • States demonstrating inter-agency collaboration with public health sector [10]	[10] *Health Problems Heat Up: Climate Change and the Public's Health,* Trust for America's Health, October 2009

FIGURE 1. SELECTED REGION FOR STUDY



REGIONAL STUDY DESIGN

The Project Team used complementary data sources and research methodologies. From this review and analysis we developed a portrait of research findings to date, baseline state of vulnerability, and programs and policies for addressing climate change in racially/ethnically diverse communities of the selected study region—i.e., Southern U.S., including the states of Arizona, Arkansas, Louisiana, New Mexico, Oklahoma and Texas.

We first conducted a comprehensive review of literature for the region to identify and understand the status of existing research and resources. Building on this work, and to paint a data-based portrait of the region's baseline vulnerability to climate change, we identified and analyzed publicly available data on demographic, health, climate and environmental measures. Where possible and appropriate, we utilized Geographic Information System (GIS) mapping to geographically overlay demographic measures (such as race and ethnicity) with climate-sensitive measures.

To understand where the region is in terms of programs and policies to address vulnerability and climate change, we conducted an extensive review of federal, state and local mitigation and adaption policies and actions, including identifying leading models and best practices. Finally, realizing the limitations of literature, data and other web-based sources, we incorporated key informant interviews into the study design to fill informational gaps and add depth and dimension to study findings. Interviews were conducted with leading professionals from state and local agencies, academicians, and community advocates on climate, public health and environmental justice.

The following narrative describes the design, methodology and sources of data for the major components of this study: (1) literature review; (2) public data, analysis and mapping; (3) program and policy review; and (4) key informant interviews.

Literature Review

Through a multi-step process, we identified and conducted a review of literature focusing on climate change, racially/ethnically diverse communities, and social vulnerability. We identified peer-reviewed literature through a search of the PubMed/MEDLINE database for English language articles for 1980-2010 using combinations of key terms such as: race, ethnicity, immigrant, language, culture, Hispanic, Latino, African American, Asian, American Indian, climate change, social vulnerability, extreme heat, air pollution, flood, hurricane, and wildfire.

We also searched major government, for-profit, not-for profit, community-based, academic, and foundation Web sites for relevant reports and publications. The bibliographies of resources identified as relevant to the theme and focus of our study were reviewed for additional references. Our literature review only included publications and peer-reviewed studies that explicitly addressed vulnerable communities within the context of climate change and related environmental concerns nationally, and in the selected study region.

Appendices C and D include a compendium of national literature and compendium of regional literature, respectively.

Public Data, Analysis and Mapping

We obtained data on measures of demographics, health, and climate change through various publicly available data sources. The following describes the data sources, measures and analyses we conducted.

Demographic Data. We extracted data on select population characteristics concerned with the project focus on climate change vulnerability and adaptive capacity. These measures were selected based on past research and studies that have suggested or shown that there is a relationship between certain demographic measures and vulnerability to climate change or ability to adapt to climate change. (See Background section of this report for further information on demographic factors which contribute to vulnerability to climate change).

We thus obtained data from the U.S. Census Bureau's 2000 and 2010 Decennial Census at the state and county levels for Arizona, Arkansas, Louisiana, New Mexico, Oklahoma and Texas for the following measures and years:

- Total population (2000, 2010)
- Population by race (2000, 2010), including the following categories:
  - White
  - Black or African American
  - American Indian
  - Asian-American
  - Native Hawaiian and Other Pacific Islander
  - Some Other Race
  - Two or More Races
- Population by Hispanic or Latino ethnicity (of any race) (2000, 2010)
- Total female population (2010)
- Total population under the age of 5 years (2010)
- Total population 65 years or older (2010)
- Total number of households with female head of household (2010)

In addition, we obtained estimates for the number and percent of poor by state and county from the U.S. Census Bureau's Small Area Income and Poverty Estimates (SAIPE). Estimates for 2010 were derived from the 2010 Decennial Census.

Data on total population 5 years and older, who speak English less than very well—or have Limited English Proficiency (LEP)—and total rural population were obtained from the 2011 County Health Rankings. Total population with LEP was based on 2009 data from U.S. Census Bureau's American Community Survey (ACS) 5-Year Estimates. Total rural population was based on data from ACS 2009 1-Year Estimates.

The Project Team analyzed all demographic data descriptively by state and county—e.g., we calculated percents to describe the proportion of the population that belonged to a certain demographic category. In addition, for measures of total population, race and ethnicity, we calculated percent change between 2000 and 2010. Finally, we used Microsoft Map Point 2011 software to geographically map select demographic measures by region, state and county (alone, as well as in combination with other measures on health and climate change).

Health and Health Care Access. The 2011 County Health Rankings were a main source of data on key health and health care access measures at the state and county levels. The following list identifies measures included in this study, along with their original sources of data as analyzed and provided through the 2011 County Health Rankings website.

Health Status

- Percent of adults self-reporting fair or poor health status (Original Data Source: Centers for Disease Control (CDC) and Prevention, Behavioral Risk Factor Surveillance System (BRFSS), 2003-2009)
- Percent of live births with low birth weight (National Center for Health Statistics, 2001-2007)
- Percent of adults who are obese (or report a BMI greater than or equal to 30) (Original Data Source: National Center for Chronic Disease Prevention and Health Promotion, 2008)

Health Care Access

- Primary Care Provider Rate (Original Data Source: Health Resources and Services Administration, Area Resource File, 2008)
- Percent of population under 65 years without health insurance (Original Data Source: U.S. Census Bureau, Small Area Health Insurance Estimates, 2007)

In addition, we obtained state and local-area data on the prevalence of asthma from CDC/BRFSS. The Selected Metropolitan/Micropolitan Area Risk Trends (SMART) database offered by BRFSS was utilized to obtain asthma data by the metropolitan areas in our study region for 2010. Prevalence of asthma was based on self-reports of adults who have "ever been told they have asthma".

Data on health status and health care access measures were analyzed descriptively at the state-level and where possible by county. As noted, data were mapped by county—both alone, and in combination with race and ethnicity.

Climate Change Impact Measures. The following section summarizes the data sources and measures used to develop a regional profile of potential climate change impacts. Measures of climate change and impact were descriptively analyzed and presented in tabular form in this report, as well as where possible, have been geographically mapped. We discuss findings at the county level, both broadly and in context of race and ethnicity.

Air Pollution

- **Greenhouse Gas Emissions.** We obtained data on total Greenhouse Gas Emissions by state and region for 2000 and 2007 from the Climate Analysis Indicators Tool of the World Resources Institute. Specifically included in this report are measures of total emissions—provided in metric tons for carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the F Gases, also known as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6)—and emissions per capita. In addition, a rank of states is provided along with the percentage of emissions the state contributes toward the U.S. total. Finally, we calculated change in total emissions and emissions per capita for each state and the region for the period 2000-2007.

- **Annual Number of Unhealthy Air Quality Days.** Data on annual number of unhealthy air quality days due to ozone and fine particulate matter were obtained from the 2011 County Health Rankings for each state and counties within for 2006. The original data sources for these measures is the Centers for Disease Control and Prevention (CDC) and Environmental Protection Agency (EPA) Collaboration, 2006. Data were analyzed descriptively and mapped, both alone and in combination with measures of race and ethnicity (i.e., Non-White race and Hispanic/Latino ethnicity).

- **Industrial Air Toxics.** Finally, we drew secondary data and maps on racial/ethnic disparities in exposure to industrial air toxics from the recent research report entitled, *Justice in the Air.* We specifically include in this report the following two maps with state-level data: (1) Median exposure to industrial air toxics; and (2) Difference between racially/ethnically diverse communities' share of health risk from industrial air toxics and racially/ethnically diverse communities' share of population.

Extreme Weather Events

- **Wildfires.** Data on wildfires were acquired from the National Interagency Fire Center. Specifically, we include two measures related to wildfires: (1) Number of fires burned by state for the period 2005-2011; and (2) Number of acres burned of wildland fires by state for 2005-2011. State-level data are provided in tabular form.

- **Water Shortage.** The National Resources Defense Council (NRDC) developed a new Water Sustainability Index (WSI) to capture projected impacts of climate change at the county-level across the country in 2050. Data and maps from NRDC on WSI and water shortage are included in the report. According to NRDC, level of risk to water sustainability is based on the following criteria: (1) Projected water demand as a share of available precipitation; (2) Groundwater use as a share of projected available precipitation; (3) Susceptibility to drought; (4) Projected increase in freshwater withdrawals; and (5) Projected increase in summer water deficit. Counties with "extreme" risk to water sustainability are those meeting four or more of the aforementioned criteria, while counties meeting two or three of the criteria are classified as having "moderate" or "high" risk, respectively. Counties meeting less than two criteria are at low risk.

- **Drought Impacts.** We obtained data and maps on number of drought impacts in 2010 from the National Drought Mitigation Center. Drought impact is defined as any "observable losses or changes that occurred at a specific place and time because of a drought." These impacts are identified and categorized as being related to agriculture, business or industry, energy, fires, plants or wildlife, response or restrictions, public health, tourism or recreation and water supply or quality.

- **Drought Vulnerability.** In addition, a geographic map and related data on drought vulnerability were acquired from NRDC. Drought vulnerability was measured as the average number of extreme low flow days as reported by watersheds in each state. Extreme Low Flow Days are defined as the average number of days annually (2000-2009) that are below the 5th percentile relative to a 1961-1990 reference period.

- **Extreme Heat.** A map of extreme heat vulnerability by county for the period 2000-2009 was obtained from NRDC. Extreme heat vulnerability was measured as days with daily maximum temperatures above the 90th percentile June-July-August temperature relative to a 1961-1990 reference period.

- **Flooding.** A map of flood vulnerability, measured as the average number of extreme high flow days and recorded floods, by watershed, was obtained from NRDC for the period 2000-2009. Extreme high flow days are defined as the average number of days annually (2000-2009) that are above the 95th percentile relative to 1961-1990 reference period.

Infectious Diseases

- **West Nile Virus (WNV).** We acquired data and maps on the total number of cases and incidence of WNV from the following sources:
  - **CDC, Division of Vector-Borne Diseases.** The total number of cases and deaths from WNV Human Infection were obtained from the CDC for each state in the region for 2005 and 2010.
  - **United States Geological Survey (USGS).** County-level data on WNV cases for each state within the selected region were obtained from USGS for 2005 and 2010. The 2000 Census was utilized to calculate incidence for 2005 and the 2010 Census was used to calculate incidence for 2010. Incidence was calculated per 1 million population and mapped alone as well as with Non-white race and Hispanic/Latino ethnicity.
  - **National Resources Defense Council (NRDC).** Additional state-level data on total cases of WNV for the period 1999-2010 were obtained from the National Resources Defense Council.
- **Dengue Fever.** We procured state-level data and a map of Dengue fever Vulnerability from NRDC. State-level data were provided for total cases of Dengue fever for the period1995-2005. A map of areas vulnerable to Dengue fever was also obtained from NRDC for 1995-2005.
- **Lyme Disease.** Total number of cases of Lyme disease by state were also acquired from NRDC for 1990-2008.

Program and Policy Review

We reviewed national and regional resources identifying and abstracting policies and programs related to the six state region. To identify additional resources, we conducted internet searches with a combination of the following search terms: weather, climate, mitigation, adaptation, policy, programs, state law, energy, water management, air quality, ecosystems, coastal, transportation, and public health.

Key Informant Interviews

We conducted 11 semi-structured telephone-based key informant interviews between November 2011 and January 2012 to elicit information on: (1) leading climate change or environmental-related challenges affecting the region/state; (2) climate change-related vulnerabilities associated with racially/ethnically diverse populations; (3) federal, state or local actions for adaptation and mitigation; (4) future priorities to effectively prepare, adapt and respond to vulnerable populations, including racially/ethnically diverse communities in climate change.

Key informants were identified through recommendations made by the Joint Center's Commission to Engage African Americans in Climate Change, as well as contacts we identified through our extensive review of the field and recommendations that our interviewees suggested for follow up. We used the following criteria for interview selection:

1. Knowledge or experience related to key climate change issues affecting the region/state and progress toward mitigation and adaptation, including funded initiatives (and where possible, their status or outcomes), policies, programs, challenges and successes; and/or
2. Knowledge and understanding of social vulnerability issues, particularly those affecting racially, ethnically diverse populations generally; and any actions, plans or progress toward addressing their needs in the region/state.

Eleven individuals completed the interview process. They represented one state climatology office, two academicians, two state environmental quality agencies, two community organizers, and two environmental non-profit leaders. The following table lists the number of respondents per state.

TABLE 2. NUMBER OF KEY INFORMANTS INTERVIEWED PER STATE

STATE	NO. KEY INFORMANTS
Arizona	2
Arkansas	2
Louisiana	2
New Mexico	2
Oklahoma	1
Texas	2
Total	**11**

A review of the literature guided the development of a semi-structured interview protocol (see attached Appendix B). Qualitative data from each interview were manually coded, sorted and analyzed in two stages. The first round involved the extraction of overarching and reoccurring themes expressed within the aforementioned four areas of inquiry. The second round of analysis identified sub-themes.

III. REGIONAL DATA FINDINGS

DEMOGRAPHIC FACTORS

This section describes the demographic composition of the region to set the context for understanding the social vulnerability of communities to climate change. Data for the region and states are provided in tabular form and where possible, mapped at the county level.

Total Population

As a growing body of evidence suggests, population and climate change are inextricably linked. As populations grow, they not only contribute to factors associated with the earth's changing climate (e.g., growing emissions), but also bear the brunt of its negative impacts (e.g., poor air quality, urban heat island effects and increased health threats). Thus, knowing population size and growth rates are important precursors for framing the discussion of vulnerability to climate change.

According to the 2010 Census, the southern region, including the states of Arizona, Arkansas, Louisiana, New Mexico, Oklahoma and Texas, is home to a population of nearly 44.8 million (see Table 3). Between 2000 and 2010, the region's population grew by 16.7% from 38.4 million. Texas, by far, has the largest population (25.1 million in 2010) in the region. Arizona has the next largest population (6.4 million in 2010) and has experienced the greatest percentage growth in the region between 2000 and 2010 (24.6%). New Mexico has the smallest population (nearly 2.1 million), but has also witnessed some growth since 2000 (13.2%). Louisiana, on the other hand, has had a fairly stable population between 2000 and 2010 (i.e., 4.5 million). Map 1 displays total population by county for the region based on the 2010 National Census. As expected, metropolitan areas within the states were home to the greatest concentrations of people. Harris County (Houston area) in Texas, Maricopa County (Phoenix area) in Arizona, and Dallas County in Texas had the largest populations (approximately 4.0 million, 3.8 million, and 2.4 million, respectively). In addition, Tarrant County (Fort Worth area), along with Bexar (San Antonio area) and Travis (Austin area) counties in Texas, each had between one to two million people according to the 2010 Census. Other counties with 500,000 to one million people in 2010 included: Pima in Arizona; El Paso, Collin, Hidalgo, Denton, and Fort Bend in Texas; Oklahoma and Tulsa in Oklahoma; and Bernalillo in New Mexico. Parishes with the largest population in Louisiana included East Baton Rouge and Jefferson (with approximately, 440,000 and 430,000 people, respectively). Pulaski County had the largest population in Arkansas, with just over 380,000 people.

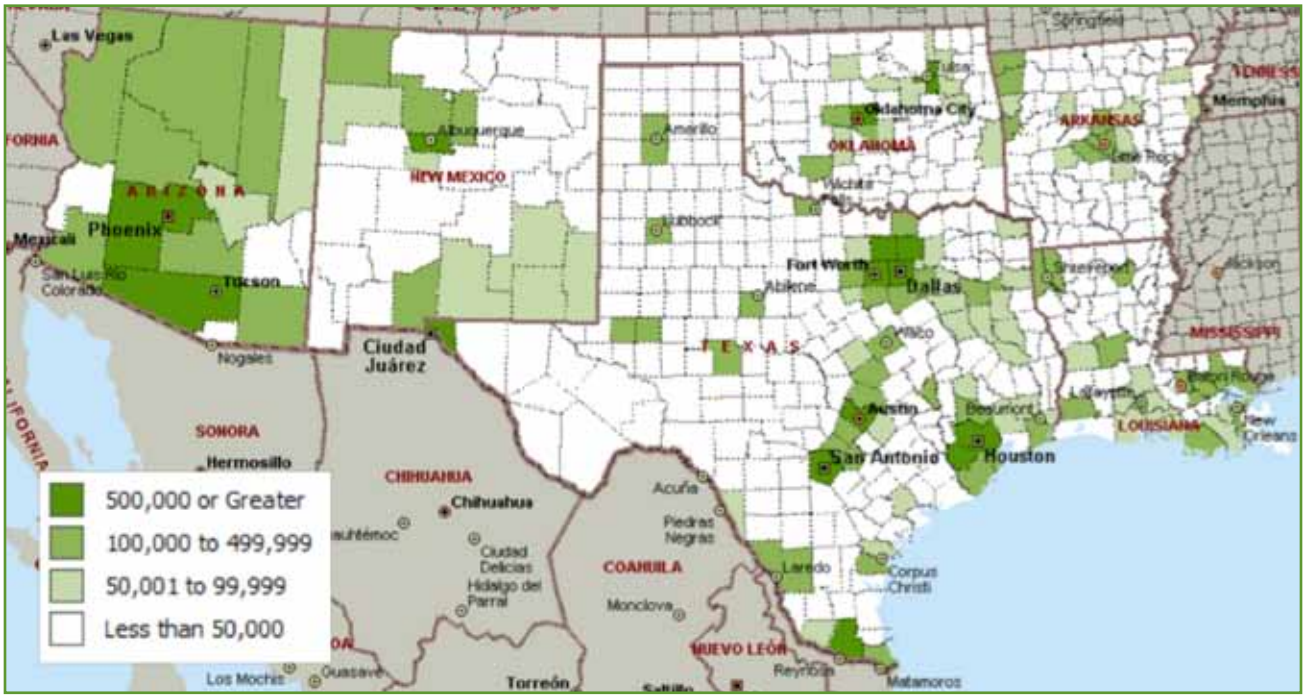
Change in Total Population

Map 2 shows the change in total population by county for the region between 2000 and 2010. Generally, the greatest growth in population was seen in counties surrounding the largest cities. Specifically, 341 of the 518 counties in the region (or two-thirds) witnessed an increase in population. Thirty-nine of these counties saw a 25% or greater increase in population, mainly in suburban counties. Pinal County, just south of Phoenix, Arizona experienced the greatest growth (109.1%). In addition, counties surrounding Dallas/Fort Worth (Rockwall, Collin, Denton and Kaufman), Houston (Fort Bend and Montgomery), and Austin (Williamson and Hays) in Texas also experienced some of the highest rates of population growth (i.e., between 44.9%

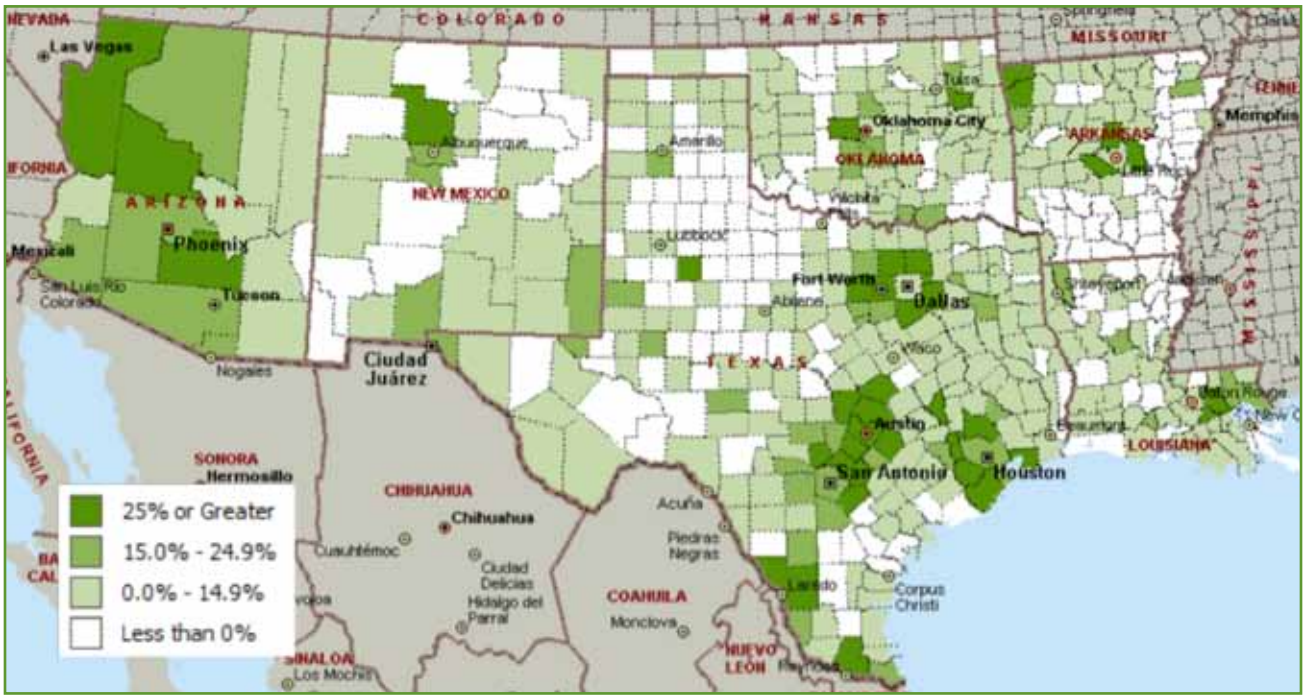
TABLE 3. TOTAL POPULATION AND CHANGE IN POPULATION BY STATE AND REGION, 2000 AND 2010

STATE	POPULATION 2000	POPULATION 2010	% CHANGE IN POPULATION
Arizona	5,130,632	6,392,017	24.6%
Arkansas	2,673,400	2,915,918	9.1%
Louisiana	4,468,976	4,533,372	1.4%
New Mexico	1,819,046	2,059,179	13.2%
Oklahoma	3,450,654	3,751,351	8.7%
Texas	20,851,820	25,145,561	20.6%
Region	**38,394,528**	**44,797,398**	**16.7%**

MAP 1. TOTAL POPULATION BY COUNTY, 2010



MAP 2. CHANGE IN TOTAL POPULATION BY COUNTY, 2000 - 2010



- 81.8%). In New Mexico, Sandoval County (just north of Albuquerque) witnessed a 46.4% growth. In Arkansas, Benton County experienced the greatest population increase (44.3%), followed by Faulkner, Lonoke and Saline counties (nearly 30%), all located around the city of Little Rock. In Louisiana, Ascension and Livingston Parishes, near Baton Rouge, saw a nearly 40% increase in population. Finally, in Oklahoma, Canadian County, just west of Oklahoma City, grew by 31.8% and Wagoner County, southeast of Tulsa grew by 27.1%.

Population by Race, Ethnicity and Language Proficiency

Racially and ethnically diverse communities are more vulnerable to environmental and weather-related hazards as compared to whites for a variety of reasons. In particular, diverse populations are more likely to live in poverty, encounter discrimination (such as in real estate where minorities are confined to certain hazard-prone areas), face health and social disparities as well as language and cultural barriers (Peacock W. G., 2000; Peacock & Girard, 1997; Peguero, 2006; Leong K. J., et al., 2007; Leong K. J., Airriess, Li, Chen, & Keith, 2007; Trujillo-Pagan, 2007). The following sections offer a portrait of the region's racial, ethnic and language diversity to set the context for understanding climate-related vulnerability of communities of color.

Blacks or African Americans.

A growing body of literature cites the disproportionate impact that climate change will have on predominantly Black or African American communities (Hoerner & Robinson, 2008). Thus, knowing where these populations are concentrated and growing, both generally and in context of climate change events, is critical to enabling these communities to effectively plan, adapt and respond.

The six-state southern region saw a 15.5% increase in African Americans, from approximately 4.7 to 5.5 million, between 2000 and 2010. Texas has the largest and steadily growing Black or African American population (nearly 3 million in 2010, up from 2.4 million in 2000). Louisiana, however, has the greatest proportion of African Americans (32%), and this community is fairly stable—i.e., there were approximately 1.4 million Blacks or African Americans in the state in both 2000 and 2010. Similarly, Arkansas and Oklahoma only saw marginal increases in this subgroup. Arizona, though inhabiting a relatively small African American population, experienced the greatest growth in this sub-group (63.0%), with 158,873 in 2000 to 259,008 in 2010.

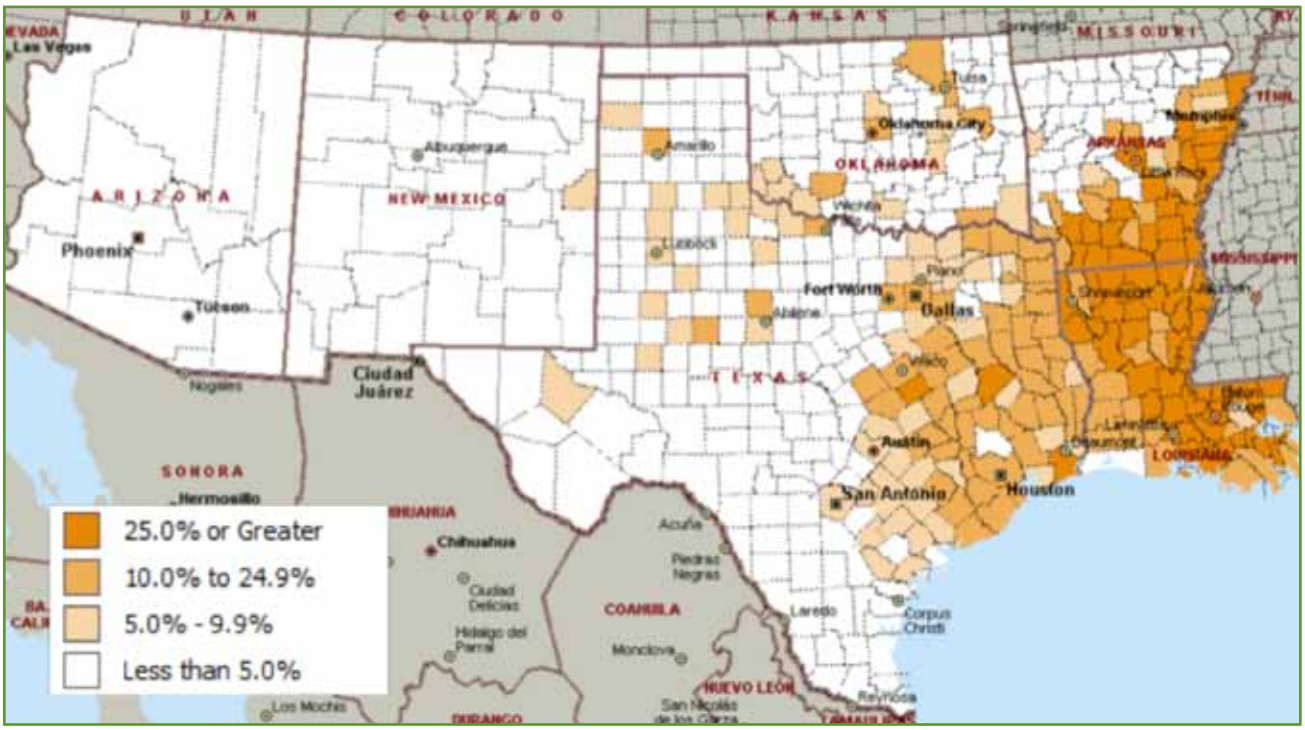
Map 3 displays the proportion of Blacks or African Americans in 2010 by county for the six states in the Southern Region. Counties in Louisiana and Arkansas have some of the greatest proportions of Blacks or African Americans (i.e., 50% or more). Specifically, eight parishes in Louisiana (East Carroll, Madison, Orleans, Tensas, St. John the Baptist, St. Helena, Claiborne and St. James) and six counties in Arkansas (Phillips, Lee, Jefferson, Chicot, St. Francis, and Crittenden) have a majority Black or African American population. Furthermore, 68 of the 518 counties in the region (or 13%) are comprised of at least one-fourth Black or African American residents. These include 43 parishes in Louisiana, 22 counties in Arkansas, and 3 counties in Texas. Though many states and counties in the region have a small number and proportion of Blacks or African Americans, as Map 4 shows, this sub-group has grown and dispersed into many of these regions. Between 2000 and 2010, African Americans grew by 50% or more in population in 103 of the 518 counties (nearly 20%) in the Southern Region. Of particular note are suburban counties in Texas which, while already home to a sizeable Black or African American population, have seen steep growth. These include, for example: Collin and Denton counties around Dallas/

TABLE 4. TOTAL, PERCENT AND PERCENT CHANGE IN BLACK OR AFRICAN AMERICAN POPULATION BY STATE, 2000- 2010

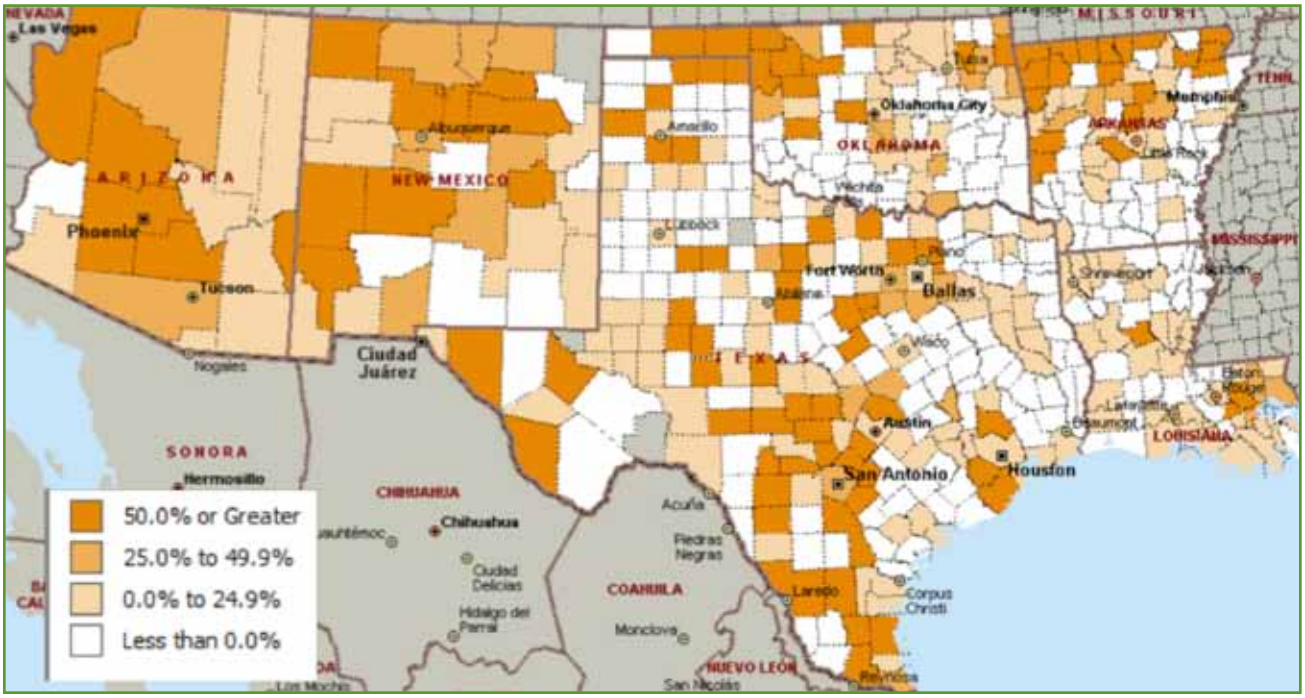
STATE	NUMBER 2010	PERCENT 2010	NUMBER 2000	PERCENT 2000	% CHANGE 2000-2010
Arizona	259,008	4.1%	158,873	3.1%	63.0%
Arkansas	449,895	15.4%	418,950	15.7%	7.4%
Louisiana	1,452,396	32.0%	1,451,944	32.5%	0.0%
New Mexico	42,550	2.1%	34,343	1.9%	23.9%
Oklahoma	277,644	7.4%	260,968	7.6%	6.4%
Texas	2,979,598	11.8%	2,404,566	11.5%	23.9%
Region	**5,461,091**	**12.2%**	**4,729,644**	**12.3%**	**15.5%**

Fort Worth which saw a 181.8% and 118.9% growth, respectively; Williamson County, north of Austin, which more than doubled; and Montgomery, Brazoria, and Fort Bend counties around Houston, which each grew by approximately 80%. Other notable communities with large and expanding African American populations include Maricopa County in Arizona, which grew by 66.3%, and Ascension Parish in Louisiana, which grew by 53.5%.

MAP 3. PERCENT BLACK OR AFRICAN AMERICAN BY COUNTY, 2010



MAP 4. PERCENT CHANGE IN BLACK OR AFRICAN AMERICAN POPULATION BY COUNTY, 2000-2010



American Indians.

American Indian populations are at-risk to the effects of a changing climate due to their higher likelihood to live in poverty and lack services such as electricity or running water. In addition, a restriction in the supply of water adversely affects their economic viability (Lynn et al., 2011). The six states in this study's Southern Region are home to over 1 million American Indians (AIs), and this population has grown 19.8% since 2000. Oklahoma (321,687) and Arizona (296,529) are home to the largest number of AI, followed by New Mexico (193,222) and Texas (170,972). Between 2000 and 2010, Texas witnessed the greatest percentage growth in this sub-group (44.4%).

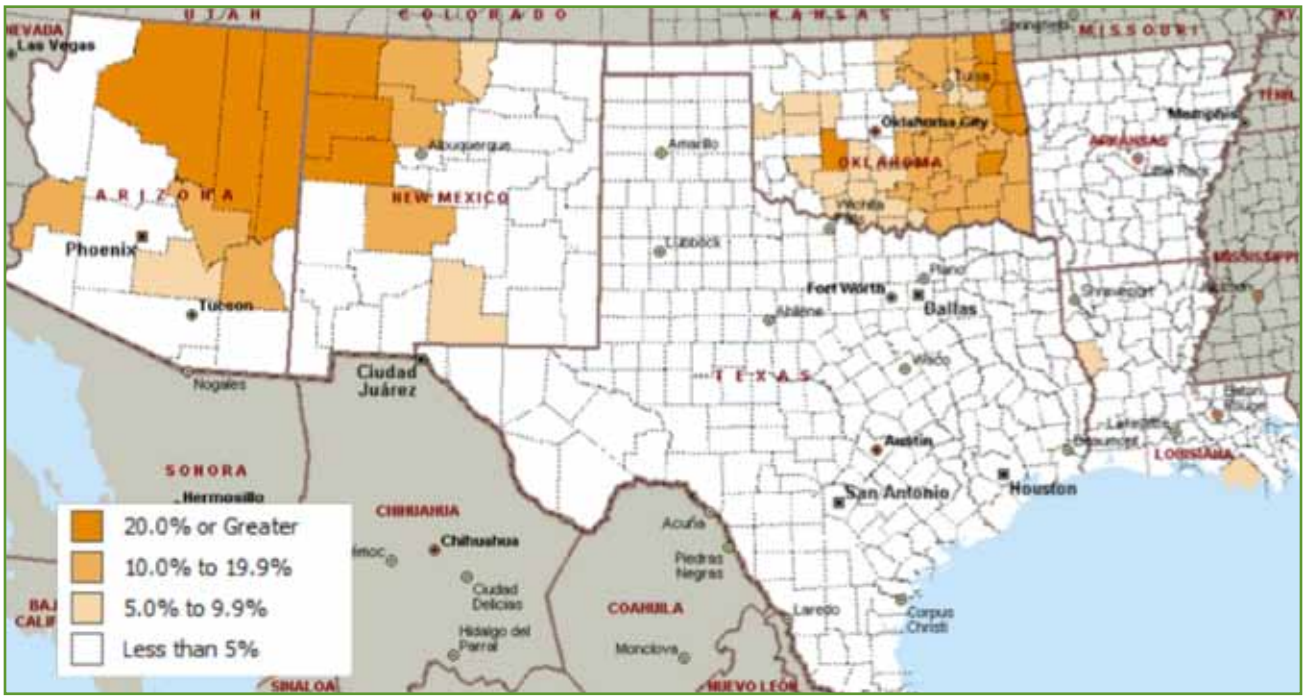
Map 5 displays the percent of AI population in the region by county. According to the 2010 Census, two counties in the region have a majority AI population. This includes McKinley County, New Mexico, where 75.5% of the population identify as AI, and Apache County, Arizona, where 72.9% of the population are AI. Another twelve counties in the region have between 20-50% AIs. These include: Navajo and Coconino counties in Arizona; Cibola and San Juan counties in New Mexico; and Adair, Cherokee, Caddo, Delaware, Mayes, Sequoyah, Latimer and Craig counties in Oklahoma. In addition, while only 2.1% of Maricopa County in Arizona is AI, the county is home to the largest number of AIs (78,329) in the region.

Between 2000 and 2010, the AI population grew in many counties across the Southern region, particularly in Texas, Louisiana and Arkansas (see Map 6). However, counties which saw a 100% or greater increase (i.e., doubled or more) in the number of AIs are generally those with a small AI population. Examples of counties with large AI population and considerable growth between 2000 and 2010 include: Harris County in Texas, which grew by 82.9% from 15,180 to 27,763; Pinal County in Arizona, which grew by 49.3% from 14,034 to 20,949; and Maricopa County, also in Arizona, which grew by 38.1% from 56,706 to 78,329.

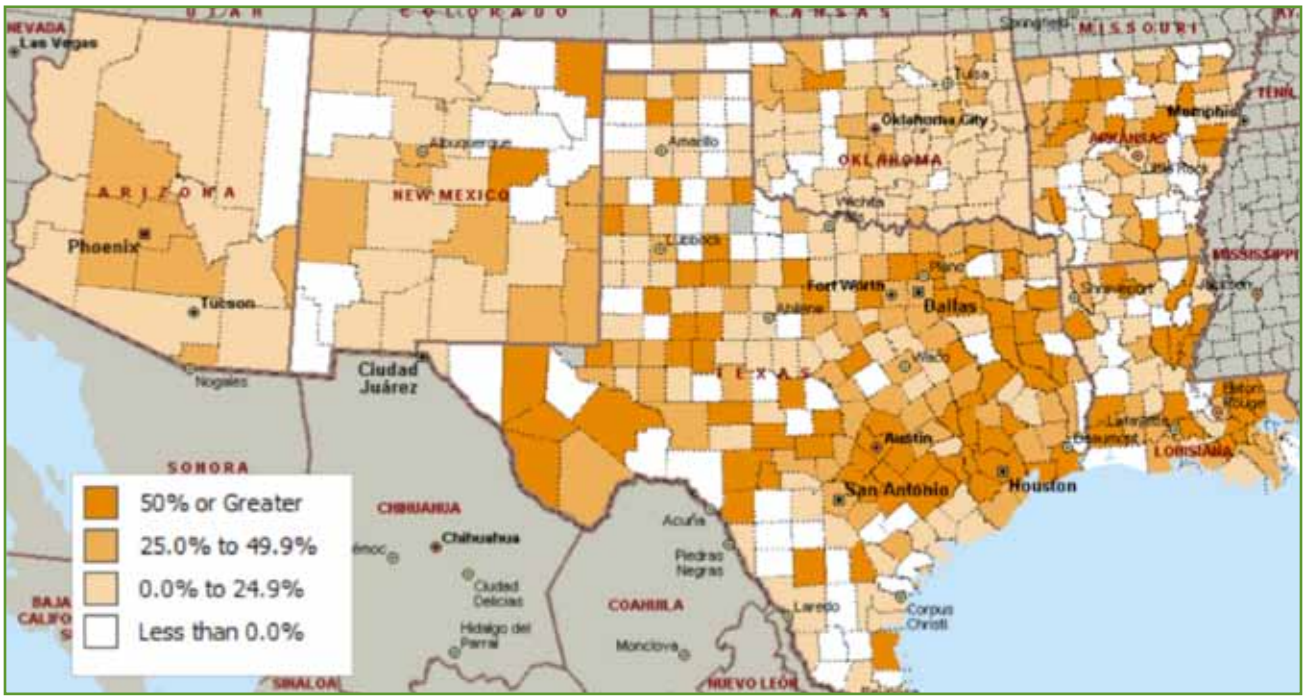
TABLE 5. TOTAL NUMBER, PERCENT AND PERCENT CHANGE IN AMERICAN INDIAN (AI) POPULATION BY COUNTY, 2000-2010

STATE	NUMBER 2010	PERCENT 2010	NUMBER 2000	PERCENT 2000	PERCENT CHANGE 2000-2010
Arizona	296,529	4.6%	255,879	5.0%	15.9%
Arkansas	22,248	0.8%	17,808	0.7%	24.9%
Louisiana	30,579	0.7%	25,477	0.6%	20.0%
New Mexico	193,222	9.4%	173,483	9.5%	11.4%
Oklahoma	321,687	8.6%	273,230	7.9%	17.7%
Texas	170,972	0.7%	118,362	0.6%	44.4%
Region	**1,035,237**	**2.3%**	**864,239**	**2.3%**	**19.8%**

MAP 5. PERCENT AMERICAN INDIAN POPULATION BY COUNTY, 2010



MAP 6. PERCENT CHANGE IN AMERICAN INDIAN POPULATION BY COUNTY, 2000-2010



Asian-American Population.

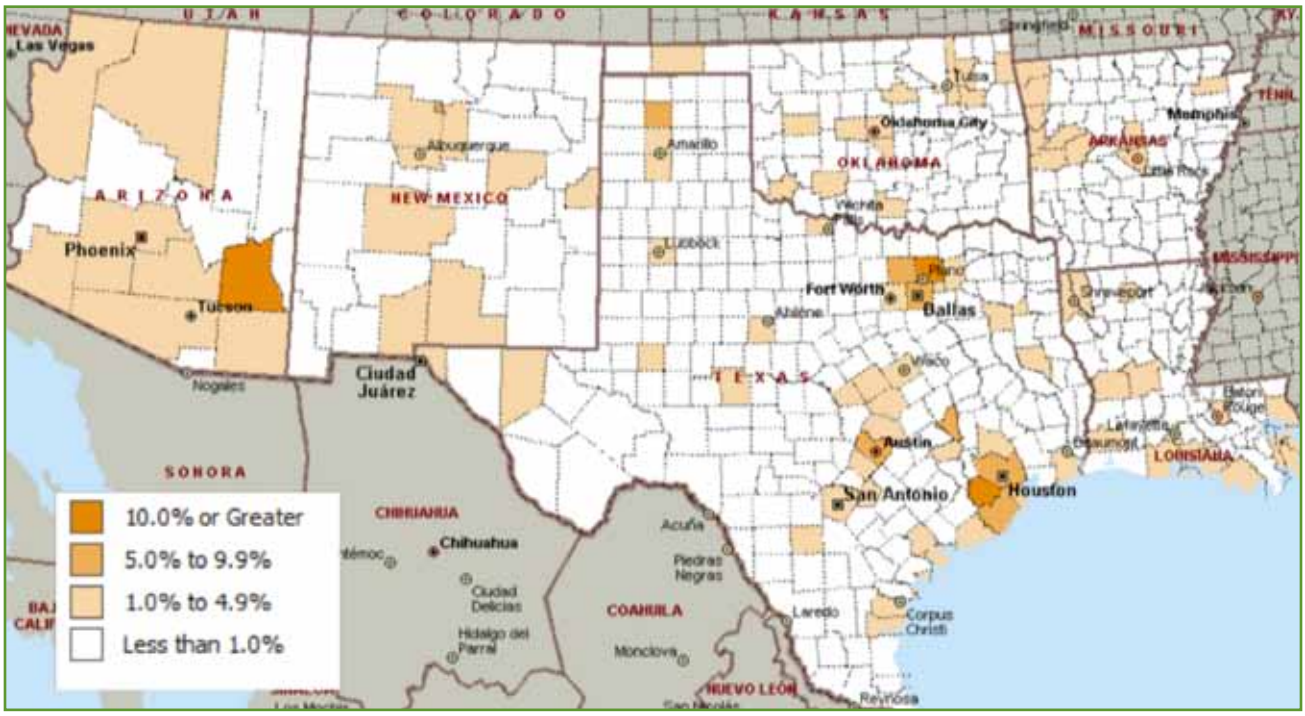
Foreign born Asian-Americans may having difficulty securing health insurance due to limited English proficiency (Perkins, 2003) making them more susceptible to the adverse health effects of environmental causes. The Asian-American population in the six southern states is the fastest growing racial sub-group. Between 2000 and 2010, number of Asian-Americans grew by 68.5% from 795,555 to 1,340,809. States with the greatest growth rate include Arizona (91.6%), Arkansas (78.5%) and Texas (71.5%). Texas, however, has by far the largest Asian-American population, reaching almost 1 million in 2010. As depicted in Map 7, there are only three counties in the region where more than one-tenth of the population is Asian-American. These include: Fort Bend County in Texas, where 17.0% of the population is Asian-American; Graham County in Arizona, where 14.4% are Asian-American; and Collin County in Texas where 11.2% belong to this sub-group. In terms of number of people, according to the 2010 Census, Harris County in Texas has the most Asian-Americans (253,032), followed by Maricopa County in Arizona (132,225), and Dallas, Fort Bend, Collin, Tarrant and Travis counties in Texas, where each is home to at least 50,000 Asian-Americans.

Furthermore, between 2000 and 2010, 146 of the 518 counties (28.2%) in the region doubled or more in its Asian-American population (see Map 8). Of these counties, 80 were in Texas, 26 in Arkansas, 22 in Oklahoma, 7 in Louisiana, 6 in Arizona and 5 in New Mexico. Several metropolitan and suburban counties in Texas had both the largest Asian-American population and also experienced a sharp growth in this sub-group. These include: Brazoria County, which grew from 4,842 to 17,227; Williamson County, which grew from 6,595 to 20,433; Collin County, which grew from 34,047 to 87,752; Fort Bend County, which grew from 39,706 to 99,370; and Denton County, which grew from 17,444 to 43,478.

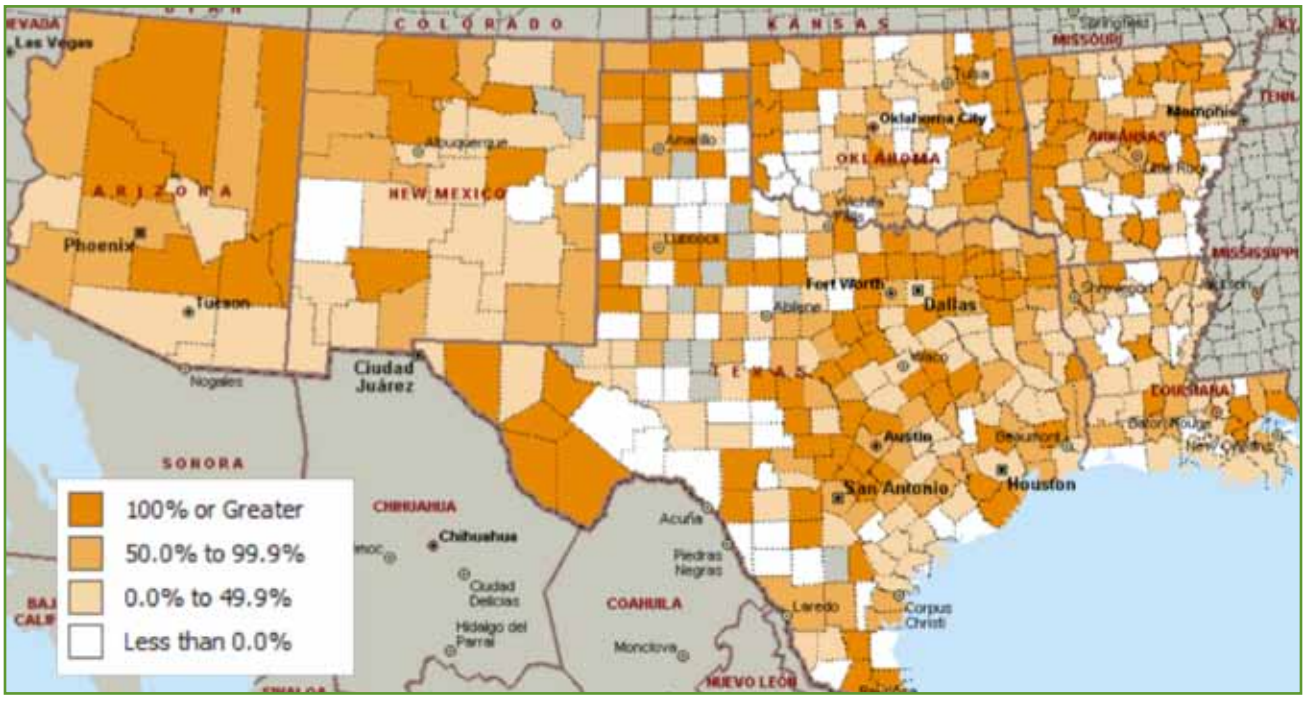
TABLE 6. NUMBER, PERCENT AND PERCENT CHANGE IN ASIAN-AMERICAN POPULATION BY COUNTY, 2000-2010

STATE	NUMBER 2010	PERCENT 2010	NUMBER 2000	PERCENT 2000	% CHANGE 2000-2010
Arizona	176,695	2.8%	92,236	1.8%	91.6%
Arkansas	36,102	1.2%	20,220	0.8%	78.5%
Louisiana	70,132	1.5%	54,758	1.2%	28.1%
New Mexico	28,208	1.4%	19,255	1.1%	46.5%
Oklahoma	65,076	1.7%	46767	1.4%	39.1%
Texas	964,596	3.8%	562,319	2.7%	71.5%
Region	**1,340,809**	**3.0%**	**795,555**	**2.1%**	**68.5%**

MAP 7. ASIAN-AMERICAN POPULATION BY COUNTY, 2010



MAP 8. PERCENT CHANGE IN ASIAN-AMERICAN POPULATION BY COUNTY, 2010



Hispanics or Latinos.

As with other communities of color, climate change is likely to have a disproportionate impact on Hispanics/Latinos. Factors such as poverty, lack of English proficiency, poorer health status and access to health care resources, and others, increase the vulnerability of Hispanics/Latinos to climate change events and impacts (National Hispanic Environmental Council, 2010). Following, we highlight population dynamics and trends related to Hispanics/Latinos.

The Hispanic/Latino population (of any race) has been steadily growing in the region. Between 2000 and 2010, Hispanics/Latinos grew by 43.0% from approximately 9.1 to 13.0 million. In terms of number of Hispanics/Latinos, Texas has the largest population reaching nearly 9.5 million (37.6%) in 2010, and up from 6.7 million (32.0%) in 2000. New Mexico, however, has the largest and a growing proportion of Hispanics/Latinos. In 2010, 46.3% of the state was Hispanic/Latino, up from 42.1% a decade earlier. While home to the smallest number of Hispanics/Latinos in the region, Arkansas has more than doubled in this population over the past decade.

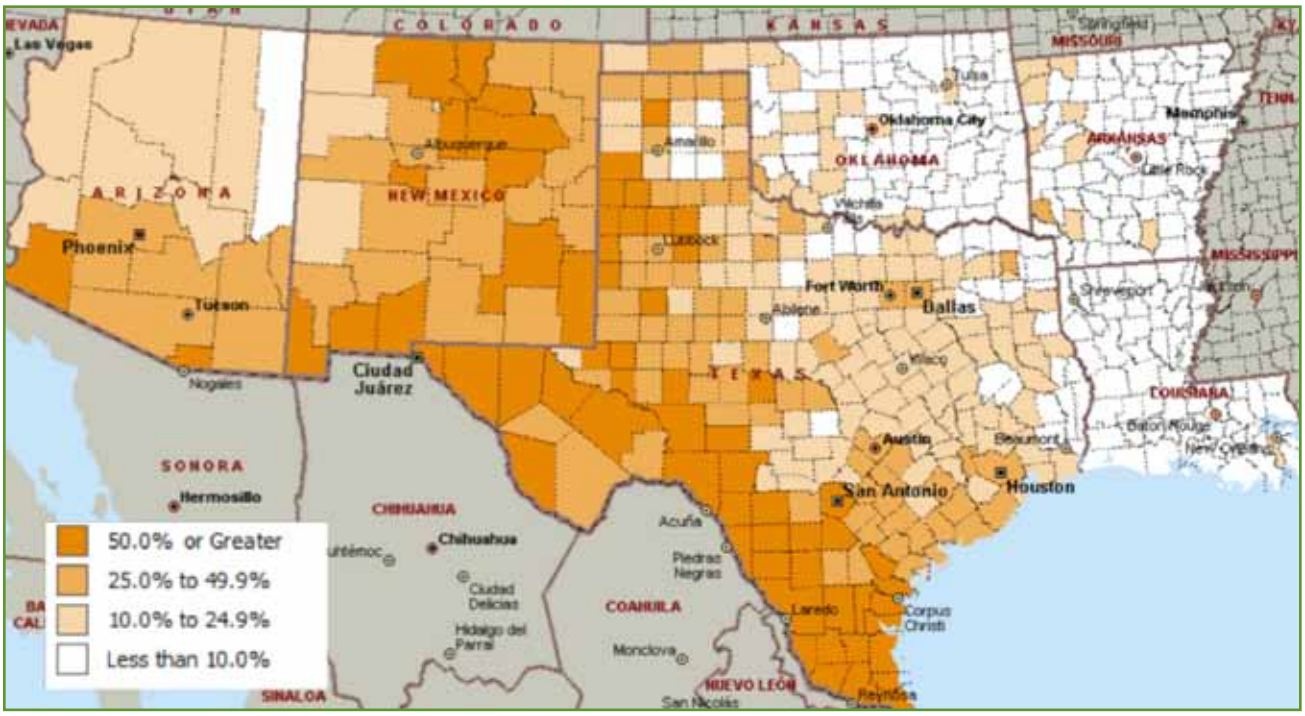
As Map 9 shows, the proportion of Hispanics/Latinos (of any race) is highest in the Southwest region in Texas, New Mexico and Arizona. Of the 518 counties in the region, 65 have a majority Hispanic/Latino population (i.e., 50% or more). Many of these counties are generally located near the Mexico border. In terms of absolute numbers, three counties in the region have at least 1 million Hispanics/Latinos—i.e., Harris County (Houston area) and Bexar County (San Antonio area) in Texas and Maricopa County (Phoenix area) in Arizona.

As shown in Map 10, 243 of 518 (46.9%) counties in the region experienced at least a 50% increase in Hispanics/Latinos, and 80 (15.4%) counties more than doubled in this sub-population. Greatest percentage growth was generally seen in counties in Louisiana, Arkansas and Oklahoma where the Hispanic/Latino population was fairly small. However, in Texas, suburban counties with already large Hispanic/Latino populations have seen substantial growth as well. These include, for example: Montgomery County (Houston area) which grew by 154.9% from 37,150 to 94,698; Denton County (Dallas area) which grew by 129.6% from 52,619 to 120,836; Collin County (Dallas area) which grew by 128.4% from 50,510 to 115,354; and Williamson County (Austin area) which grew by 128.0% from 42,990 to 98,034.

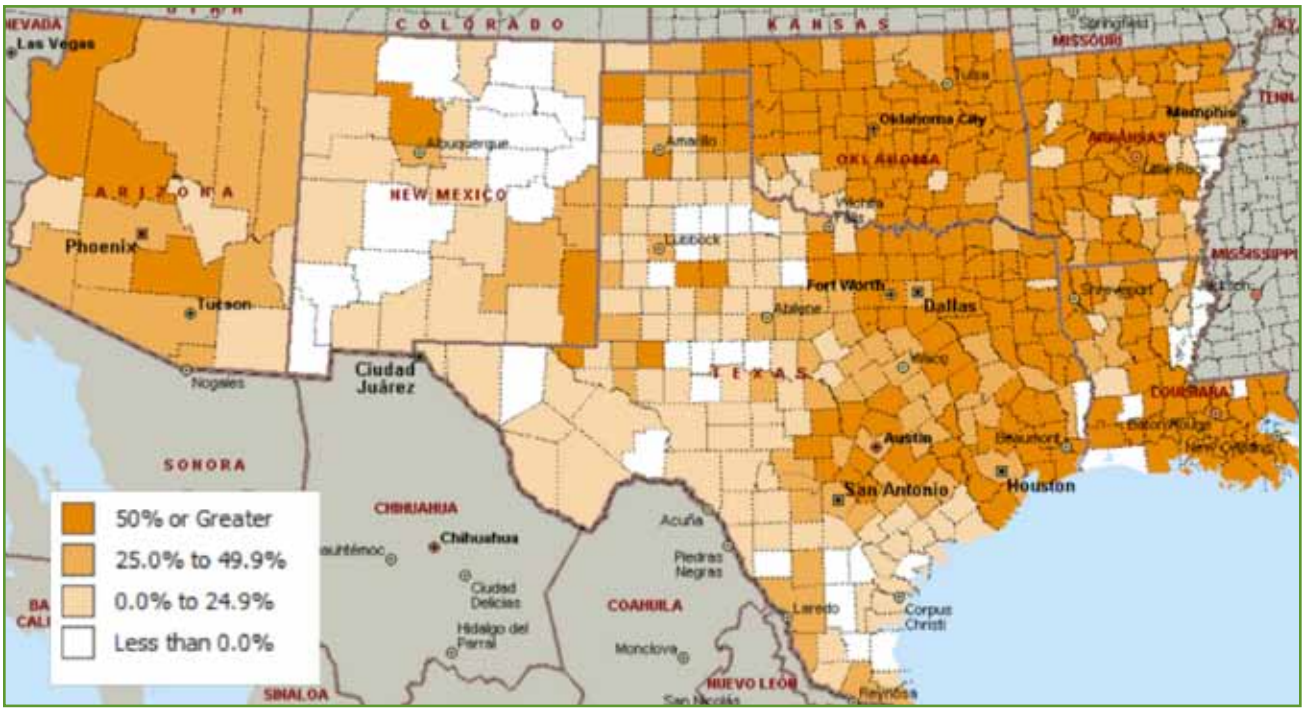
TABLE 7. NUMBER, PERCENT AND PERCENT CHANGE IN HISPANIC/LATINO POPULATION (OF ANY RACE) BY COUNTY, 2000-2010

STATE	NUMBER 2010	PERCENT 2010	NUMBER 2000	PERCENT 2000	% CHANGE 2000-2010
Arizona	1,895,149	29.6%	1,295,617	25.3%	46.3%
Arkansas	186,050	6.4%	86,866	3.2%	114.2%
Louisiana	192,560	4.2%	107,738	2.4%	78.7%
New Mexico	953,403	46.3%	765,386	42.1%	24.6%
Oklahoma	332,007	8.9%	179,304	5.2%	85.2%
Texas	9,460,921	37.6%	6,669,666	32.0%	41.8%
Region	**13,020,090**	**29.1%**	**9,104,577**	**23.7%**	**43.0%**

MAP 9. PERCENT HISPANIC OR LATINO POPULATION (OF ANY RACE) BY COUNTY, 2010



MAP 10. PERCENT CHANGE IN HISPANIC OR LATINO POPULATION (OF ANY RACE) BY COUNTY, 2000-2010



Limited English Proficiency.

People with Limited English Proficiency (LEP) include persons five years or older who speak English less than very well. Nearly 4.9 million (7.9%) people in the Southern Region are LEP and Texas has by far the largest LEP population (nearly 3.2 million or 14.5% of the population).

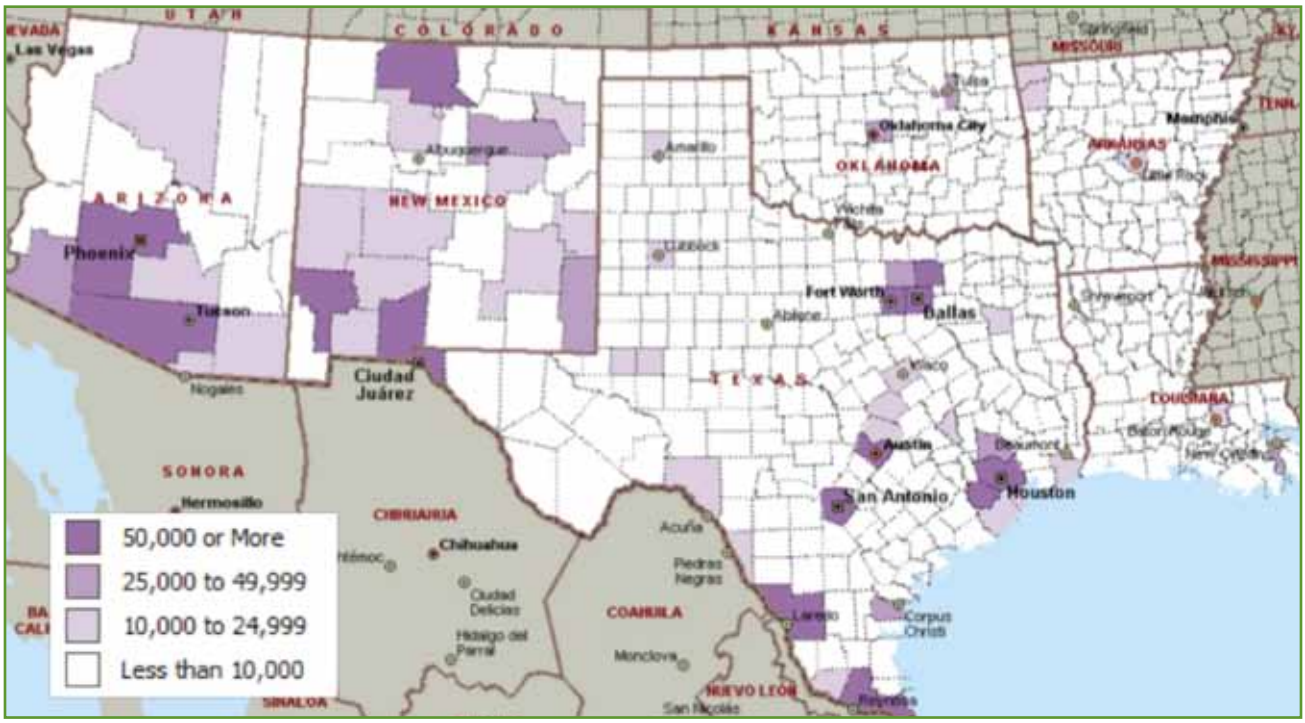
In 2009, there were 16 counties in the region where more than 50,000 of the residents were LEP (see Map 11). Of these counties, Harris County (Houston area) in Texas had the largest LEP population (742,272), followed by Maricopa County (Phoenix area) in Arizona (463,747) and Dallas County (Dallas area) in Texas (443,819).

Of the 518 counties in the region, more than one-fifth of the population in 35 of these counties were LEP. These counties were generally located along the border of Mexico in Texas, Arizona and New Mexico.

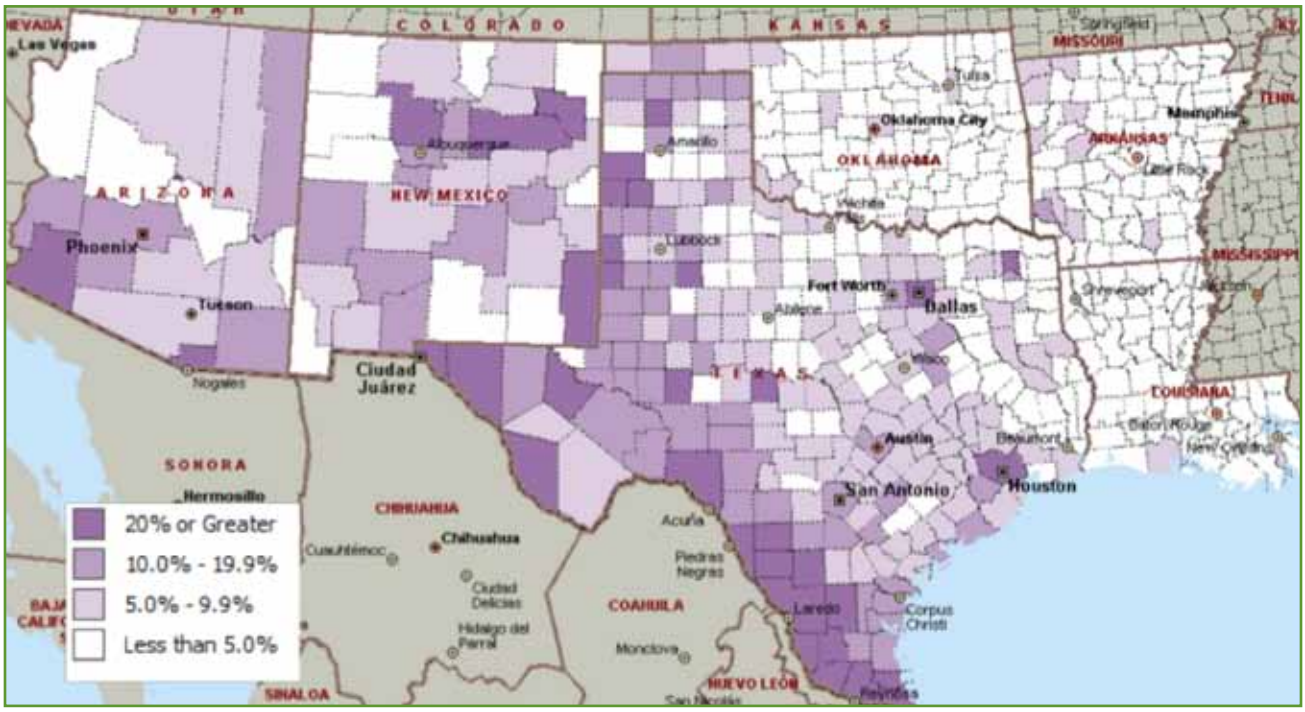
TABLE 8. NUMBER AND PERCENT OF POPULATION WITH LIMITED ENGLISH PROFICIENCY, BY COUNTY, 2009

STATE	NUMBER	PERCENT
Arizona	690,719	11.9%
Arkansas	80,750	3.1%
Louisiana	106,911	2.6%
New Mexico	184,528	10.1%
Oklahoma	121,687	3.6%
Texas	3,166,913	14.5%
Region	**4,351,508,699**	**11.0%**

MAP 11. TOTAL POPULATION WITH LIMITED ENGLISH PROFICIENCY BY COUNTY, 2009



MAP 12. PERCENT OF POPULATION WITH LIMITED ENGLISH PROFICIENCY BY COUNTY, 2009



Population by Poverty

A large body of evidence suggests that in general, people living in poverty are more vulnerable to losses and impacts from climate, weather and disaster events (Fothergill & Peek, 2004). Poor and low-income people have fewer monetary resources to spend on prevention, emergency supplies, and recovery. They are also more likely to live in substandard housing conditions and are less likely to have access to critical resources, such as air-conditioners, transportation and communication, often essential to adapting and responding to climate-related events (Cutter et al., 2009). Across states, the key informants interviewed continuously cited poverty as an important component of vulnerability to climate change. Thus an understanding of where poor populations are located, concentrated and growing is important to understanding which areas within the region are more vulnerable to climate change.

Based on the U.S. Census Bureau's 2010 Small Area Income and Poverty Estimates (SAIPE), there are nearly 7.9 million (18.3%) people in poverty in the six southern states of Arizona, Arkansas, Louisiana, New Mexico, Oklahoma and Texas. Texas has the largest poor population (over 4.4 million), followed by Arizona (over 1.1 million). New Mexico, however, has the greatest proportion of poor—i.e., nearly 20% of the entire population is in poverty.

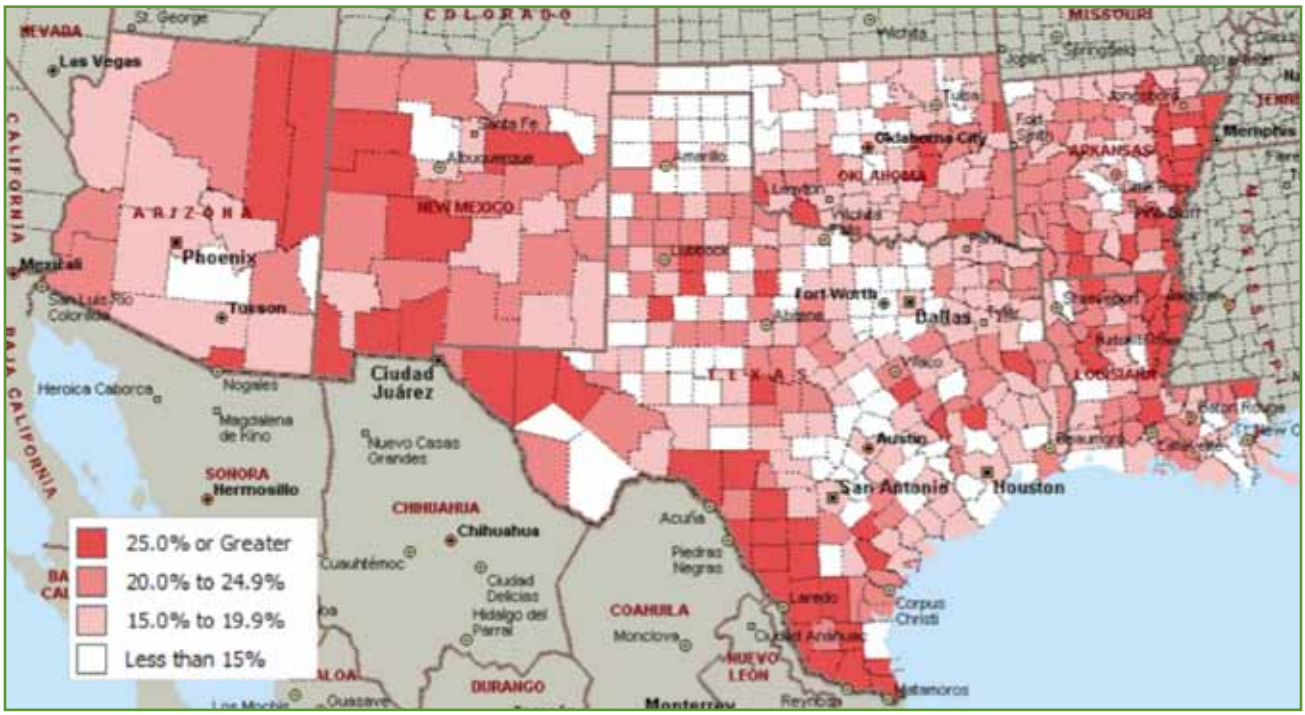
Map 13 geographically displays the percent of population in poverty by county for 2010 for the six states. At least one-fourth of the population in approximately 75 of the 518 counties (14.5%) is poor. Counties with some of the highest percentage of poor in the region are located in the border region of Texas (e.g., Maverick, Starr, Zavala, Cameron and Hidalgo) as well as East Louisiana (e.g., East Carroll and Madison), East Arizona (e.g., Apache) and East Arkansas (e.g., Lee and Phillips). As expected, poverty is generally concentrated in urban cores (see Map 14).

TABLE 9. ESTIMATED NUMBER OF PEOPLE AND PERCENT OF PEOPLE (ALL AGES) IN POVERTY BY COUNTY, 2010

STATE	NUMBER IN POVERTY	PERCENT IN POVERTY
Arizona	1,105,075	17.6
Arkansas	529,710	18.7
Louisiana	831,512	18.8
New Mexico	400,779	19.8
Oklahoma	613,067	16.8
Texas	4,411,273	17.9
Region	**7,891,416**	**18.3**

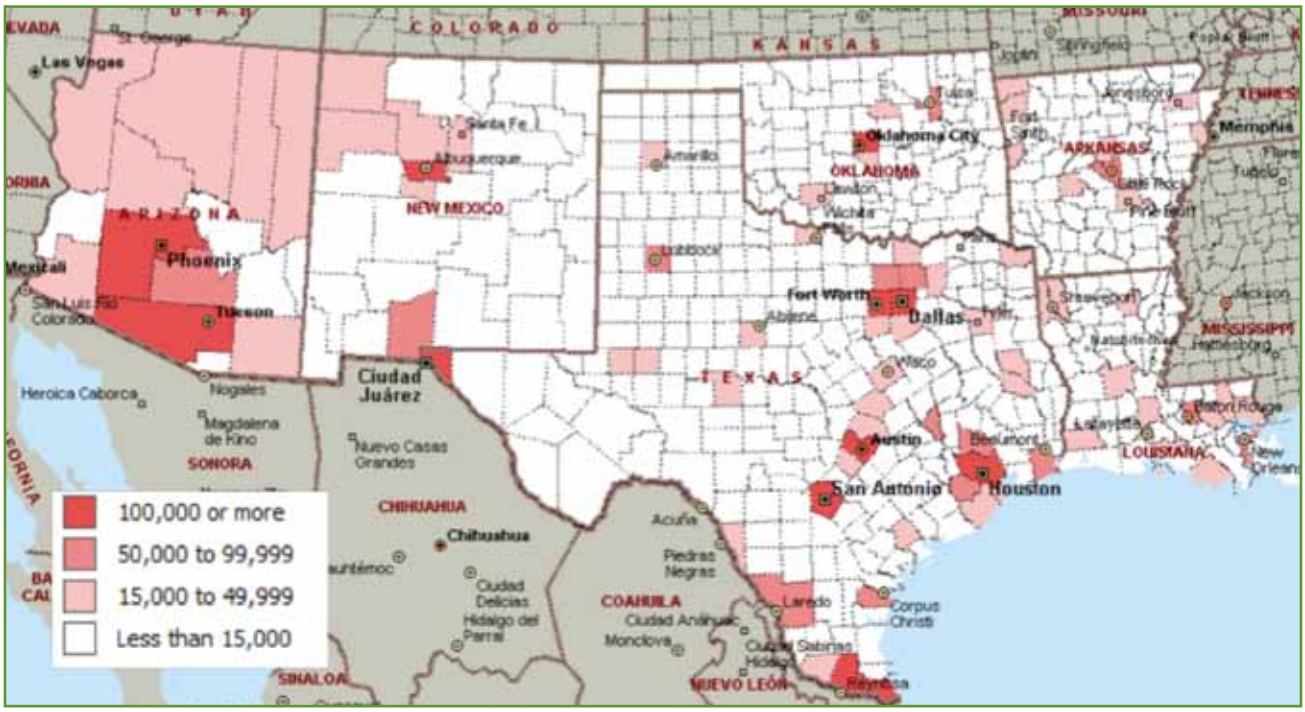
Source: U.S. Census Bureau, Small Area Income and Poverty Estimates (SAIPE), 2010

MAP 13. PERCENT POPULATION (ALL AGES) IN POVERTY BY COUNTY, 2010



Source: U.S. Census Bureau, Small Area Income and Poverty Estimates (SAIPE), 2010

MAP 14. NUMBER OF PEOPLE (ALL AGES) IN POVERTY BY COUNTY, 2010



Source: U.S. Census Bureau, Small Area Income and Poverty Estimates (SAIPE), 2010

Population by Age

Given older adults and children are more susceptible to changes in weather and climate, the following section summarizes data for these two demographic groups.

Children: Under 5 Years

According to the 2010 Census, approximately 3.1 million or 6.9% of the population in the Southern Region are under 5 years of age. This percentage, on average, is reflective of all six states in the region, however given its larger population, Texas has the greatest number of children—i.e., over 1.9 million. Based on county level data (see Map 15), two counties in Texas (Zapata and Gaines) have at least 10% children under 5 years. Furthermore, 202 of the 518 counties had a greater percentage of children under 5 years as compared to the regional average (6.9%). Many of these counties are located in the Mexico border region of Texas and Arizona, as well as in metropolitan areas.

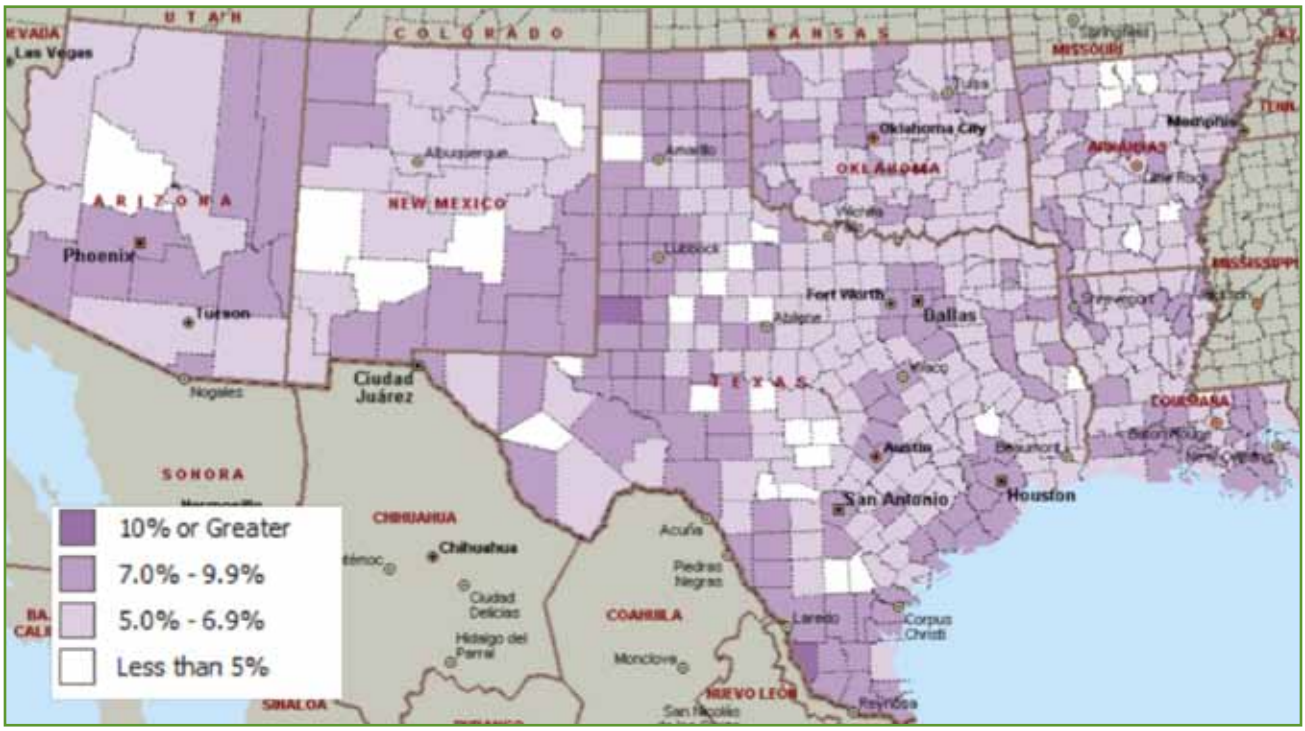
Seniors: 65 Years or Over

In 2010, 9.4% of the population or nearly 4.2 million people in the region were 65 years or older. Arkansas had the largest proportion of seniors (14.4%), followed by Oklahoma (13.5%), Louisiana (12.3%) and Texas (10.3%). New Mexico and Arizona had the lowest percentage of people 65 years and older (approximately 6 percent). As displayed in Map 16, 77 of the 518 counties in the region have one-fifth or more people 65 years or older. Counties with the greatest percentage of seniors include: La Paz in Arizona (32.6%); Llano in Texas (31.1%); Sierra and Harding in New Mexico (30.6% and 29.2%, respectively); and Baxter in Arkansas (28.1%). In terms of numbers of seniors, Maricopa County (Phoenix area) has the largest population in the region (462,631), followed by four Texas counties—Harris County (Houston area) with 333,487 seniors, Dallas County (Dallas area) with 207,972, Bexar County (San Antonio area) with 175,883, and Tarrant County (Fort Worth area) with 161,385—as well as Pima County in Arizona with 151,293 seniors.

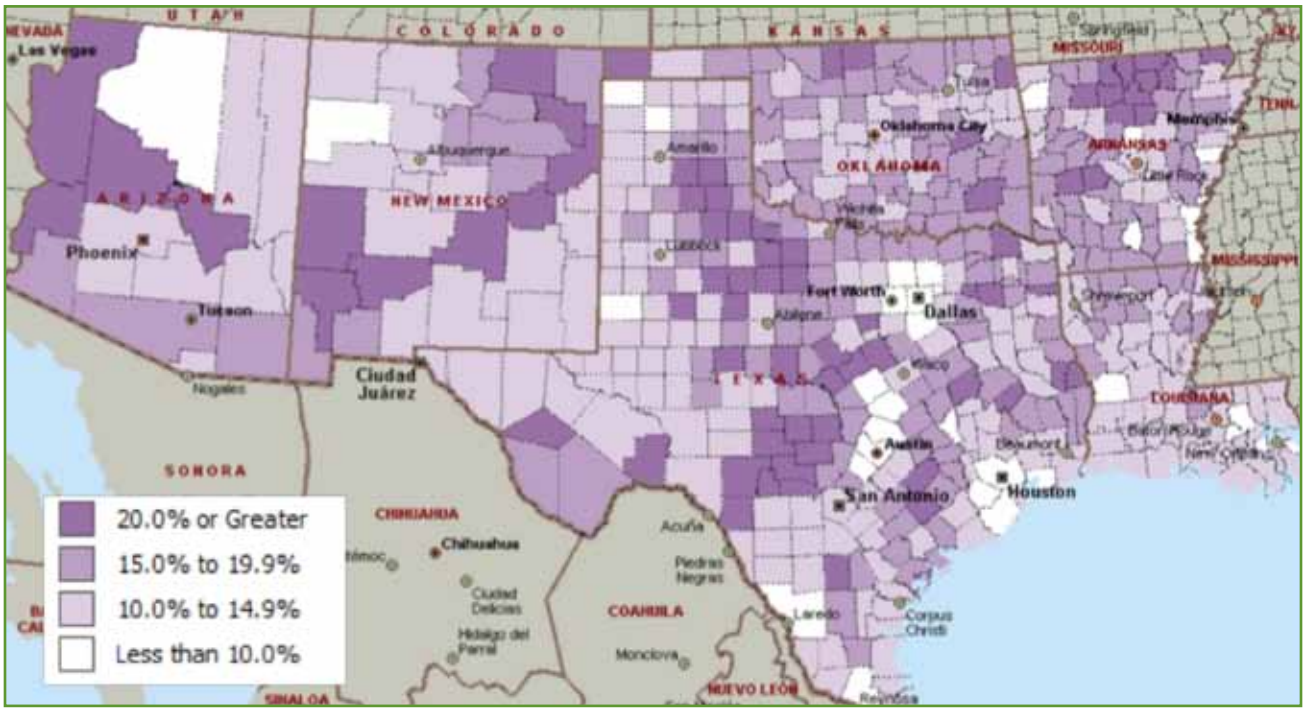
TABLE 10. TOTAL AND PERCENT OF POPULATION UNDER 5 YEARS AND 65 YEARS AND OLDER BY STATE AND REGION, 2010

STATE	TOTAL < 5 YEARS	PERCENT < 5 YEARS	TOTAL 65+ YEARS	PERCENT 65+ YEARS
Arizona	455,715	7.1%	401,695	6.3%
Arkansas	197,689	6.8%	419,981	14.4%
Louisiana	314,260	6.9%	557,857	12.3%
New Mexico	144,981	7.0%	122604	6.0%
Oklahoma	264,126	7.0%	506,714	13.5%
Texas	1,928,473	7.7%	2,601,886	10.3%
Region	**3,107,555**	**6.9%**	**4,190,756**	**9.4%**

MAP 15. PERCENT OF POPULATION UNDER 5 YEARS IN AGE BY COUNTY, 2010



MAP 16. PERCENT OF POPULATION 65 YEARS OR OVER IN AGE BY COUNTY, 2010



Rural Population

Vulnerable populations in rural settings, particularly young children, elderly, poor and communities of color, are at increased risk from climate change given they often already face limited access to health and social services, emergency services and employment opportunities (Keller Jensen, 2009). In addition, mitigation and adaptation policies which address climate change issues and impacts in urban settings have the potential to adversely impact rural populations. Thus, having a knowledge of the size and location of rural populations is important to effective planning and response to climate change.

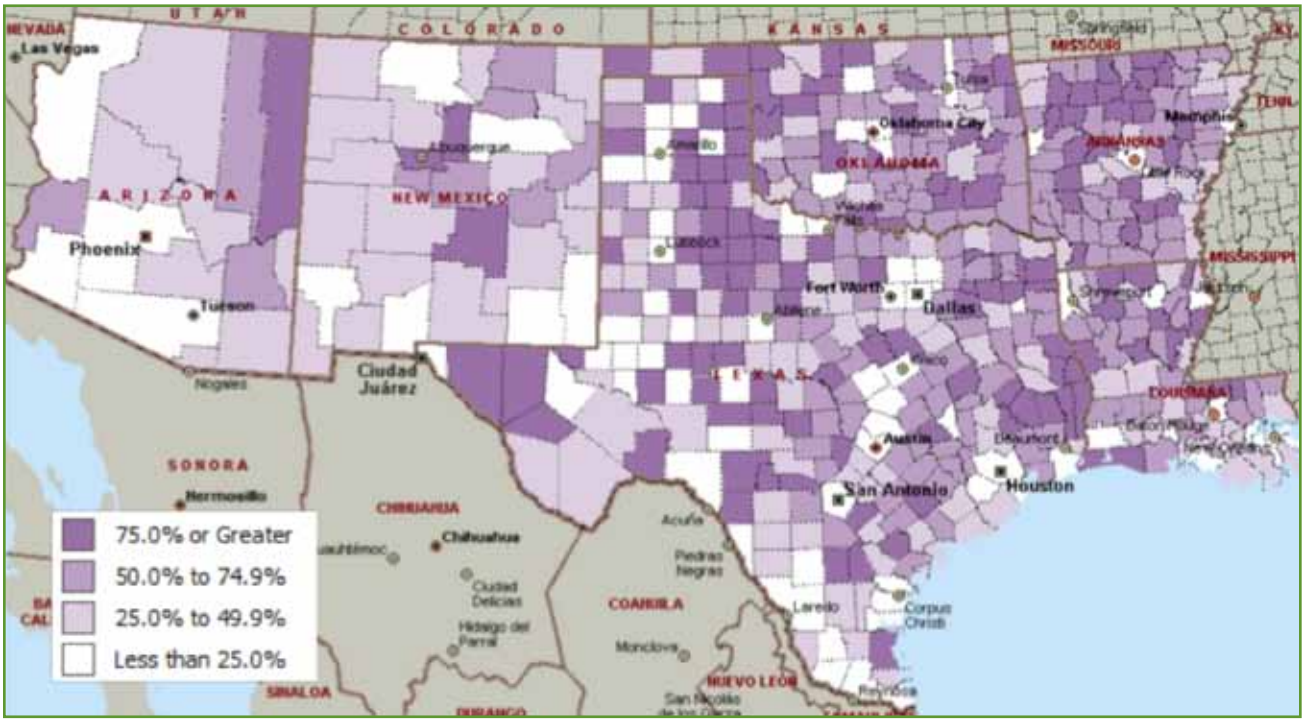
According to the 2009 American Community Survey, approximately one-fourth of the six-state southern region is rural. Arkansas (47.5%), followed by Oklahoma (34.7%) and Louisiana (27.4%) are home to the largest proportion of people living in rural settings.

Over half the counties (i.e., 274 of the 518 counties in the region) have a majority (greater than 50%) rural population (see Map 17). These include 136 counties in Texas, 58 in Arkansas, 56 in Oklahoma, 32 in Louisiana, 9 in New Mexico and 4 in Arizona.

TABLE 11. PERCENT RURAL POPULATION BY STATE AND REGION, 2009

STATE	PERCENT
Arizona	11.8%
Arkansas	47.5%
Louisiana	27.4%
New Mexico	11.8%
Oklahoma	34.7%
Texas	17.5%
Region	**25.1%**

MAP 17. PERCENT RURAL POPULATION BY COUNTY, 2009



Households with Female Head

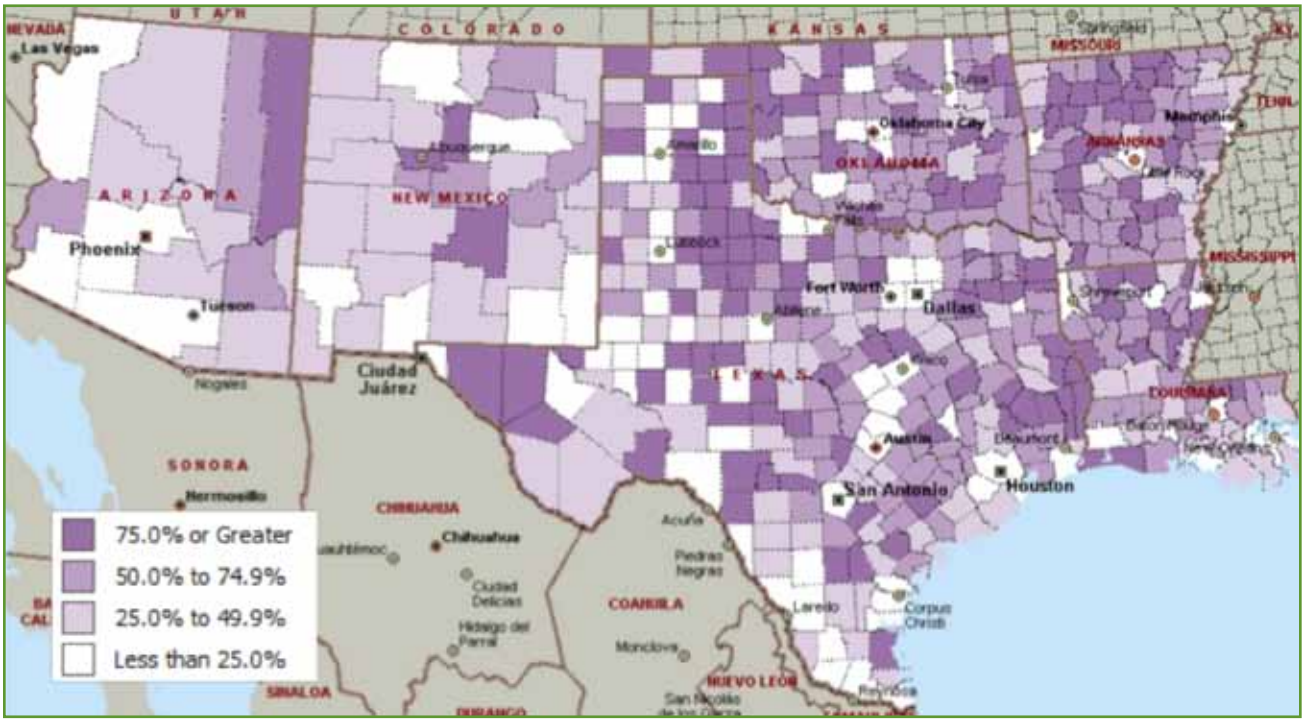
Women, particularly single mothers or female heads of households, are disproportionately more likely to suffer from adverse affects of extreme weather and climate events. This is due, in large part, to the fact that women are more likely to live in poverty: "Women are also more vulnerable to disasters because of their roles as mothers and caregivers: when disaster is about to strike, their ability to seek safety becomes restricted by their responsibilities to the very young and the very old, both of whom require help and supervision" (Morrow, 2008).

Nearly 2.3 million households (13.9%) in the region are female-headed. While Texas has the largest number of such households (1.2 million), Louisiana has the greatest proportion (17.2%), a rate higher than the region as a whole. Over one-fifth of households in 26 counties in the region have households with female heads (see Map 18). Among these are eleven counties in Louisiana (East Carroll, Madison, Tensas, Morehouse, Concordia, Orleans, St. John the Baptist, Caddo, Iberville, St. James and Ouachita), seven counties in Arkansas (Phillips, Crittenden, St. Francis, Lee, Desha, Jefferson, and Chicot), five counties in Texas (Zavala, Webb, Brooks, El Paso and Cameron), two counties in New Mexico (McKinley and Cibola), and one county in Arizona (Apache).

TABLE 12. NUMBER AND PERCENT OF HOUSEHOLDS WITH FEMALE HEADS, BY STATE AND REGION, 2010

STATE	NUMBER OF HOUSEHOLDS	PERCENT OF HOUSEHOLDS
Arizona	296,313	12.4%
Arkansas	153,323	13.4%
Louisiana	296,504	17.2%
New Mexico	110,936	14.0%
Oklahoma	179,308	12.3%
Texas	1,254,704	14.1%
Region	**2,291,088**	**13.9%**

MAP 18. PERCENT OF HOUSEHOLDS WITH FEMALE HEADS BY COUNTY, 2010



HEALTH AND HEALTH CARE MEASURES

This section focuses on the health and health care access measures which are likely to place racially/ethnically diverse, low income and other vulnerable communities in the region at a greater risk to climate change impacts. While this section does not include health impacts directly related to climate change, such as deaths due to excessive heat, unhealthy air quality days, and incidence of vector-borne diseases, these are discussed in the next section in context of "Climate Change Concerns and Impacts".

Health Status

Individuals with pre-existing conditions or diseases such as respiratory illness or diabetes are more vulnerable to climate-related health effects. Weather-related events such as rising heat and poor air quality are likely to worsen the health status of these populations with potentially fatal consequences (The Potential Effects of Climate Change in New Mexico, 2005). In addition, individuals who are in poor health will be more susceptible during emergencies due to a reduced capacity to prepare for and respond to these events.

Fair or Poor Health

Approximately 18.2% of adults in the region self-reported their health as fair or poor. The prevalence of fair/poor health status was highest in Texas (19.3%) and Arkansas (19.2%), and lowest in Arizona (15.6%). Map 19 displays the prevalence of fair/poor health status by county in the region. At least one-fourth of the population in 36 counties self-reported their health as fair/poor. These include: 12 counties in Arkansas; 11 in Texas; 7 in Oklahoma; 5 in Louisiana; and 1 in New Mexico. Nearly 1 in 3 persons in three counties in Texas (Starr, Val Verde and Maverick), two counties in Oklahoma (Latimer and Pushmataha), and one county in Arkansas (Sharp) self-reported their health as fair/poor. The three Texas counties have a predominantly Hispanic/Latino population (i.e., greater than 80%), and the two counties in Oklahoma have a sizeable proportion of AIs (i.e., nearly 20%).

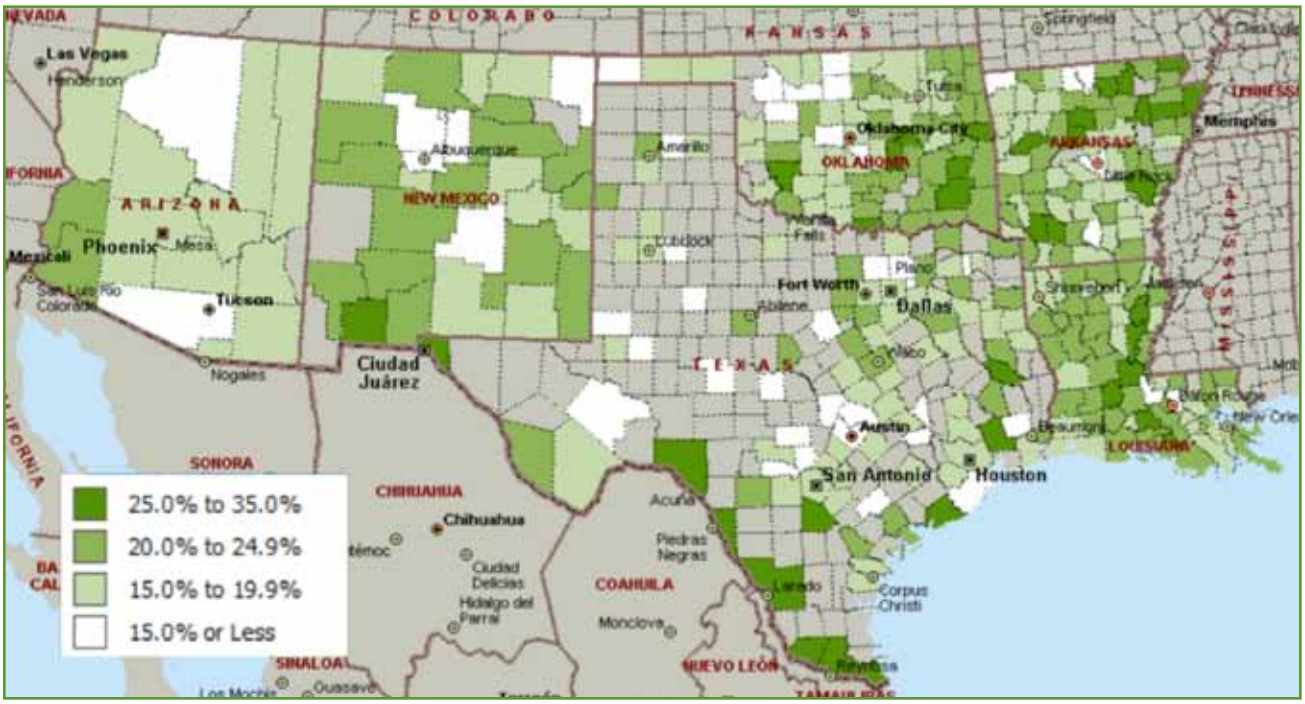
Obesity

The prevalence of obesity in the region is 27.6%. Louisiana has the largest percentage of obese adults (31.5%), followed by Arkansas and Oklahoma which each have approximately 30% obese adults. As depicted in Map 20, approximately 31 counties in the region have 35% or more people who are obese, including 18 in Louisiana, 11 in Arkansas, 1 in Oklahoma and 1 in New Mexico. Counties in Louisiana and Arkansas with the highest prevalence of obesity have disproportionately high percentages of African Americans. For example, St. John the Baptist, Bienville and East Carroll Parishes in Louisiana have between 42-69% African Americans and a 36-39% prevalence of obesity. In Arkansas, counties such as Phillips, Jefferson and Crittenden all have a majority African American population (between 51-63%) and 36-38% prevalence in obesity.

TABLE 13. HEALTH STATUS MEASURES BY STATE AND REGION

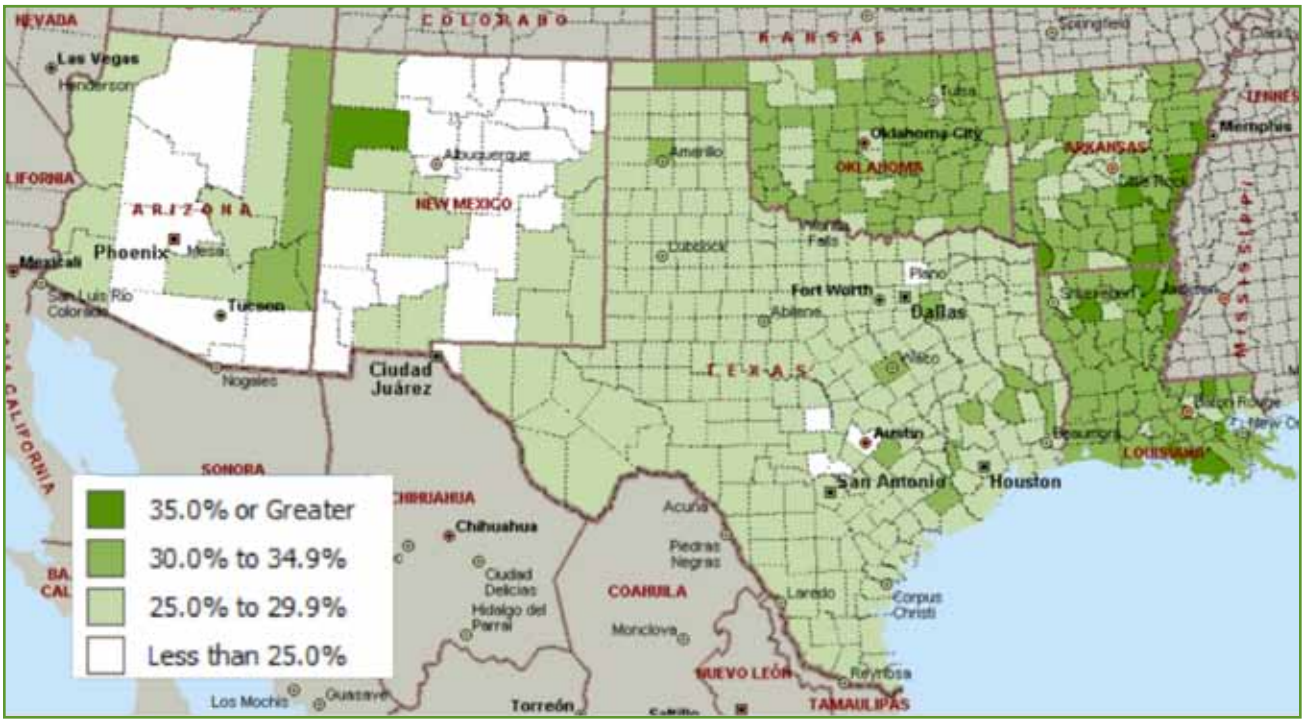
GEOGRAPHY	% FAIR OR POOR HEALTH	% OBESE	% LOW BIRTH WEIGHT	% ASTHMA
Arizona	15.6	23.8	7.0	14.8
Arkansas	19.2	30.3	9.0	14.4
Louisiana	18.9	31.5	10.9	11.6
New Mexico	17.4	22.9	8.4	14.6
Oklahoma	18.5	30.2	8.0	14.2
Texas	19.3	27.0	8.1	12.8
Region	**18.2**	**27.6**	**8.6**	**13.7**

MAP 19. PERCENT SELF-REPORTING FAIR OR POOR HEALTH STATUS, BY COUNTY, 2007



Note: Gray areas denote missing data or counties with small sample sizes with unreliable estimates.

MAP 20. PERCENT OBESE BY COUNTY, 2007



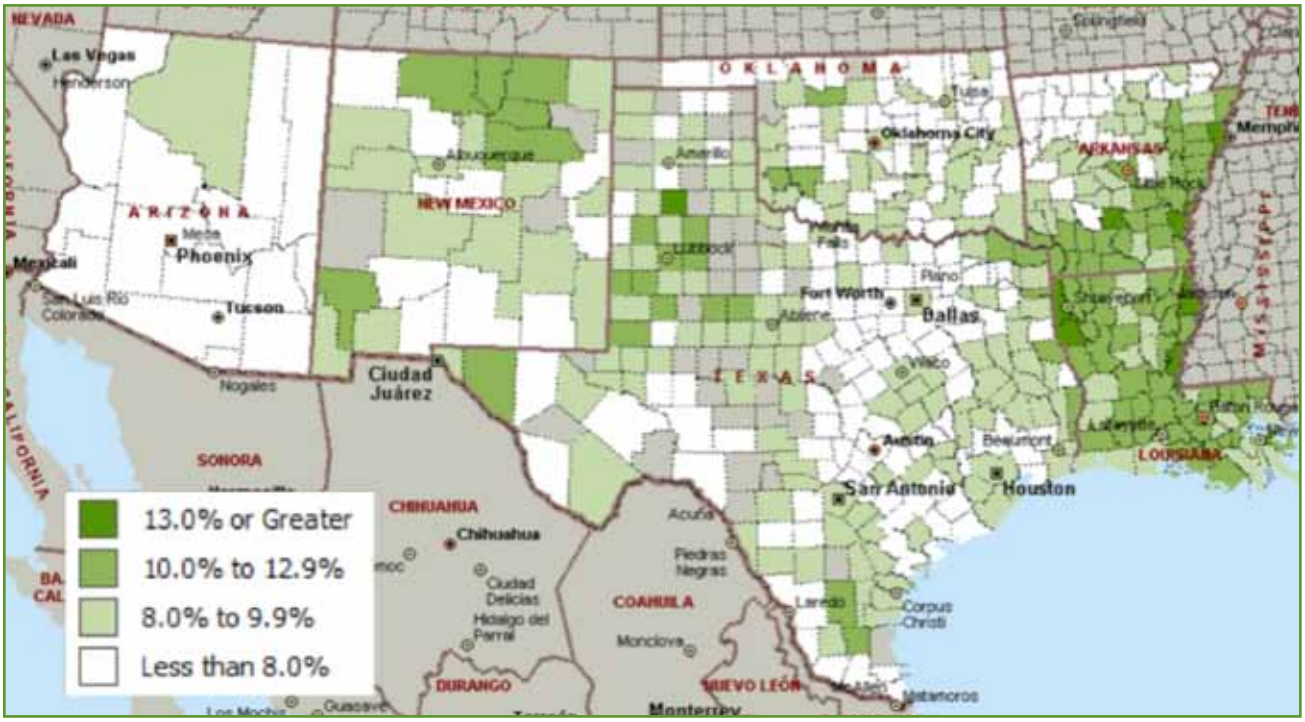
Low Birth Weight

Approximately 8.6% of births in the region were low birth weight. Louisiana had the highest percentage of births with low weight (10.9%), followed by Arkansas (9.0%). Twelve counties in the region had 13% or more low birth weight infants, including 7 in Louisiana, 4 in Arkansas and 1 in Texas. Counties with the highest prevalence of low birth weight infants were generally those with large racially/ethnically diverse populations. For example, in Louisiana, Concordia, Madison, East Carroll, Orleans and Caddo Parishes had between 40-69% African Americans and a prevalence of low birth weight infants between 13-14%. Similarly, in Arkansas, Desha and Dallas counties had among the highest prevalence of low birth weight infants and between 42-48% African Americans.

Asthma

The prevalence of asthma in the region is 13.7%. Arizona, New Mexico, Oklahoma and Arkansas all have a prevalence rate between 14-15%. Approximately 12.8% of Texas adults and 11.6% of Louisiana adults report ever having asthma.

MAP 21. PERCENT LIVE BIRTHS WITH LOW BIRTH WEIGHT (<2500 GRAMS), 2001-2007



Health Care Access

Those with limited monetary resources are frequently unable to purchase medical insurance and access health care resources (Physicians for Social Responsibility, 2000). As a consequence, limited access to health care increases a group's vulnerability to climate challenges such as extreme heat. In the U.S., the working poor may suffer most as they are neither wealthy enough to purchase insurance nor do their employers offer adequate coverage. In addition, they may not earn little enough to qualify for government subsidized health insurance.

Uninsured

Approximately 26.2% of the region is uninsured, a rate significantly higher than the U.S. average of 16.7% (U.S. Census Bureau, 2010). Texas and New Mexico have the highest uninsured rates (30.4%), followed by Louisiana where 26.4% of the population is uninsured. As depicted in Map 22, there are 25 counties in Texas where between 40-54% of the population is uninsured. These are located in West Texas, near the border of Mexico and also in the northwest region, where Hispanics/Latinos represent the dominant ethnicity.

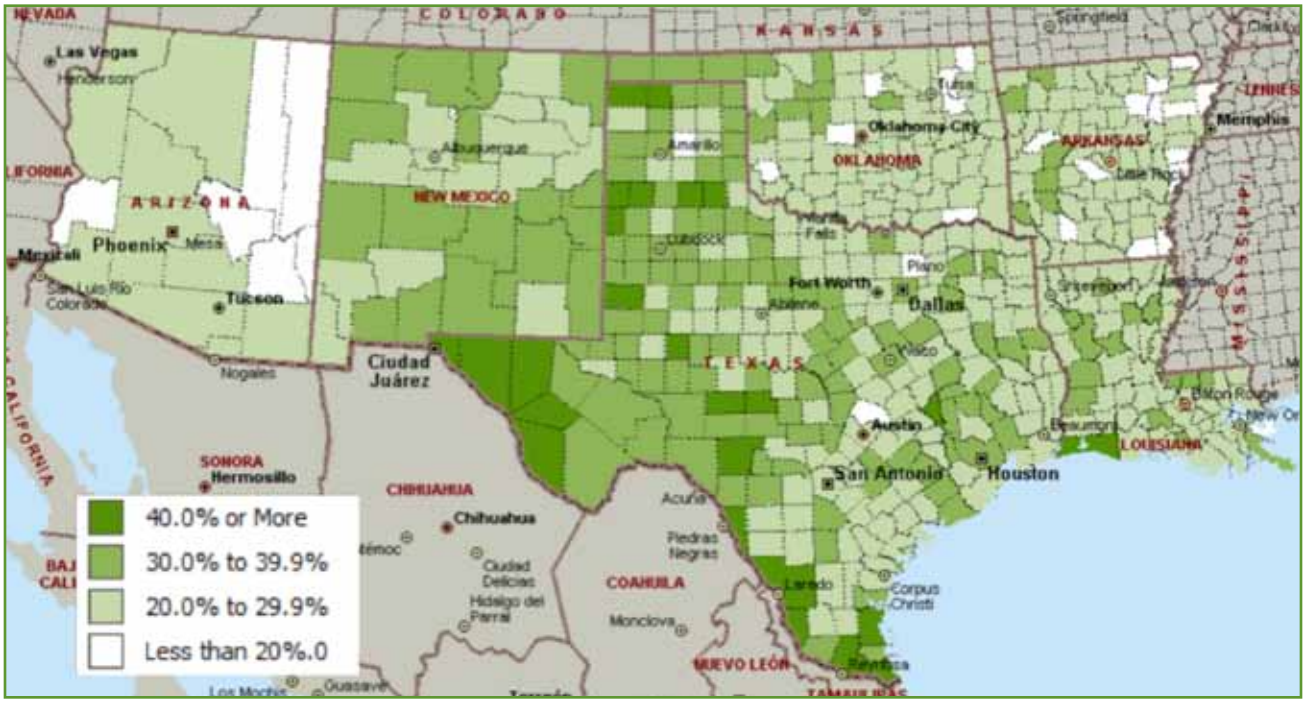
TABLE 14. HEALTH CARE ACCESS MEASURES BY STATE

GEOGRAPHY	% UNINSURED	PCP RATE PER 100,000 POPULATION
Arizona	23.9	89
Arkansas	23.4	115
Louisiana	26.4	116
New Mexico	30.4	120
Oklahoma	22.6	87
Texas	30.4	95
Region	**26.2**	**104**

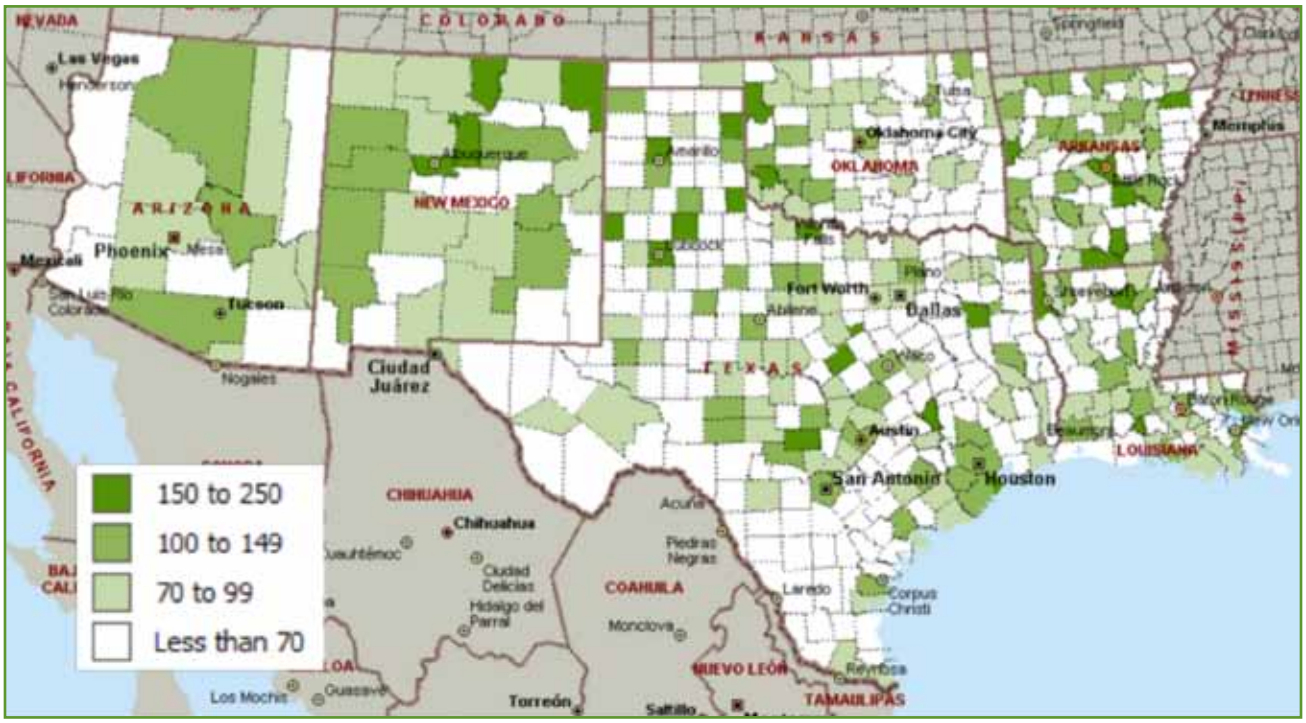
Primary Care Providers

The region has approximately 104 primary care providers per 100,000 population as compared to the U.S. which has 72 per 100,000 (Goodman, Brownlee, Chang, & Fisher, 2010). New Mexico has the highest primary care provider rate (120), whereas Oklahoma (87), Arizona (89) and Texas (95) have lower rates or supply of providers per 100,000 population. As shown in Map 23, 286 of the 518 counties (or 55.2%) in the region have fewer than 70 providers per 100,000 population. While generally dispersed across the region, more than half of these counties with a potential shortage of primary care providers are located in Texas.

MAP 22. PERCENT UNINSURED BY COUNTY, 2007



MAP 23. NUMBER OF PRIMARY CARE PROVIDERS PER 100,000 POPULATION, BY COUNTY, 2008



CLIMATE CHANGE CONCERNS AND IMPACTS

This section includes data from measures that have been linked to consequences of a changing climate. Air pollution from a variety of sources is displayed visually by county. The occurrence of extreme weather events is presented for the region and includes extreme heat, wildfires, flooding, hurricanes, drought and water shortages. Infectious diseases including West Nile Virus, Lyme disease and Dengue fever have been shown to increase in hotter and more humid climates, and data on this measure is also shown.

Air Pollution

Rising temperatures tend to be associated with increases in air pollutants, such as ozone, carbon monoxide, sulfur-dioxide, lead, nitrogen dioxide, and fine particulates (smaller than 10 microns), resulting in lowering air quality, particularly in urban areas (Longstreth, 1999). According to the Environmental Protection Agency's 2010 report, *Our Nation's Air: Status and Trends through 2008*, approximately 127 million people lived in counties across the U.S. that exceeded national air quality standards and racial/ethnic minorities were disproportionately more likely to inhabit such areas. For example, according to the National Hispanic Environmental Council, 72% of the Hispanic/Latino population in the U.S. resides in areas that do not meet federal air pollution standards and 70% live in areas that fail to meet federal standards for ozone (National Hispanic Environmental Council, 2010). Similarly, a recent research study appearing in the 2011 *American Journal of Public Health* found that census tract concentrations of particulate matter were associated with the racial composition of census tracts, with concentrations higher in census tracts with higher percentages of racially/ethnically diverse populations (Brochu, et al., 2011).

The following sections summarize data on air quality—specifically, greenhouse gas emissions, unhealthy air quality due to ozone, unhealthy air quality due to fine particulate matter, and air pollution from industrial toxics—for the six states in our study region. Where specific data are available, counties and areas most susceptible to changing climate and rising temperatures are highlighted, particularly for vulnerable populations, including racially/ethnically diverse and low income communities.

TABLE 15. TOTAL GREENHOUSE GAS EMISSIONS (CO2, CH4, N20, F-GASES), 2000 AND 2007

	2007					2000						
GEOGRAPHY	MTCO2e	RANK	% OF US TOTAL	METRIC TONS CO2E PER PERSON	RANK	MTCO2e	RANK	% OF US TOTAL	METRIC TONS CO2E PER PERSON	RANK	% CHANGE IN EMISSIONS	% CHANGE IN PER CAPITA EMISSIONS
United States	**7088.1**	**-**	**100.00%**	**23.5**	**-**	**6920.2**	**-**	**100.00%**	**24.5**	**-**	**2.43%**	**-4.08%**
Region	**1417.0**	**-**	**19.99%**	**33.0**	**-**	**1410.3**	**-**	**20.38%**	**36.6**	**-**	**0.48%**	**-9.84%**
Arizona	112.0	26	1.58%	17.6	37	94.9	27	1.37%	18.4	37	18.02%	-4.35%
Arkansas	84.2	32	1.19%	29.6	18	83.6	31	1.21%	31.2	18	0.72%	-5.13%
Louisiana	216.3	9	3.05%	49.4	6	236.2	9	3.41%	52.9	5	-8.43%	-6.62%
New Mexico	78.8	35	1.11%	40.0	12	75.3	33	1.09%	41.3	9	4.65%	-3.15%
Oklahoma	140.9	19	1.99%	39.0	14	127.3	21	1.84%	36.8	16	10.68%	5.98%
Texas	784.7	1	11.07%	32.9	16	793.1	1	11.46%	37.9	15	-1.06%	-13.19%

Source: Climate Analysis Indicators Tool (CAIT US) Version 4.0. (Washington, DC: World Resources Institute, 2011). See: http://cait.wri.org/cait-us.php?page=yearly&mode=view.

Greenhouse Gas Emissions

In April 2009, EPA issued *Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Clean Air Act,* which found that current and projected concentrations of six primary greenhouse gases in the atmosphere—carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the 3-F Gases, also known as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6)—are a threat to the public's health. In its findings, EPA stated that motor vehicles are a key source of these greenhouse gas emissions and thus are contributing to the threat of climate change. Table 15 presents data on total greenhouse gas emissions by state, region and for the nation for 2000 and 2007, highlighting total emissions, per capita emissions, percent emissions of U.S. total and state ranks.

The six southern states in our study accounted for approximately 20% of all greenhouse gas emissions in the U.S. Between 2000 and 2007, the region experienced a slower growth in emissions as compared to the nation (0.48% vs. 2.43%) and a greater decline in per capita emissions than the U.S. (9.84% vs. 4.08%).

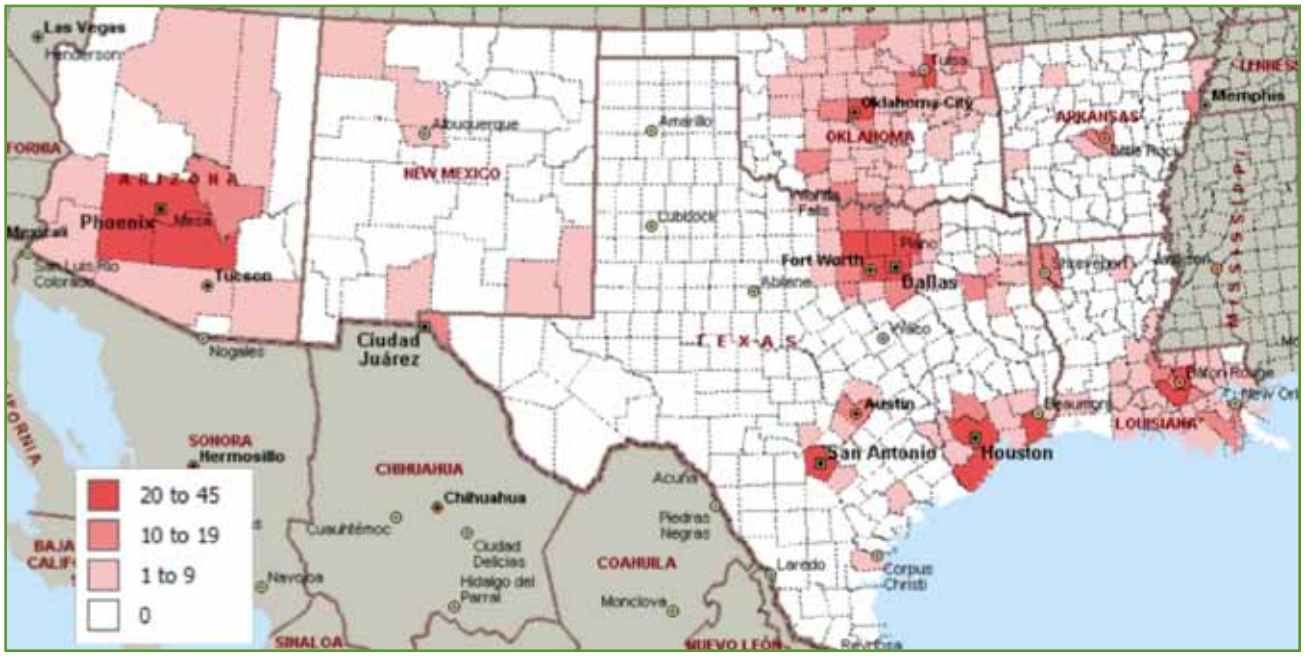
Texas was ranked on top among all states in the U.S. in both 2000 and 2007 as contributing the greatest amount of greenhouse gases in the atmosphere. Over this time period, nonetheless, the state had seen a slight decline in total emissions. In terms of per capita emissions, Louisiana was ranked among the top six states in the U.S. in 2007 (and on top in the Southern Region).

Unhealthy Air due to Ozone.

The influence of changing temperatures on ground-level ozone concentrations is well established (Longstreth, 1999). In addition, increases in ozone levels are associated with increases in incidence of common chronic conditions, including asthma, allergic disorders, and cardio-respiratory diseases and deaths. Some studies suggest that low-income populations of color have a disproportionate risk of being affected by increased ozone levels as they are more likely to reside in urban areas that frequently experience such increases (Longstreth, 1999).

Map 24 shows the annual number of unhealthy air quality days due to ozone by county for the Southern Region. There were fifteen counties (depicted in the darkest shades) with 20 or more unhealthy days due to ozone. These counties generally coincided with major metropolitan areas in Texas, Arizona, Oklahoma and Louisiana. Arizona's Maricopa County (Phoenix area) had the greatest number of unhealthy days due to ozone (i.e., 43 days), followed by Harris County (Houston area) and Tarrant and Denton Counties (Dallas/Fort Worth area). Furthermore, 9 out of 15 counties with 20 or more unhealthy ozone days were located in Texas, mainly around the Dallas/Fort Worth, Houston and San Antonio metropolitan areas.

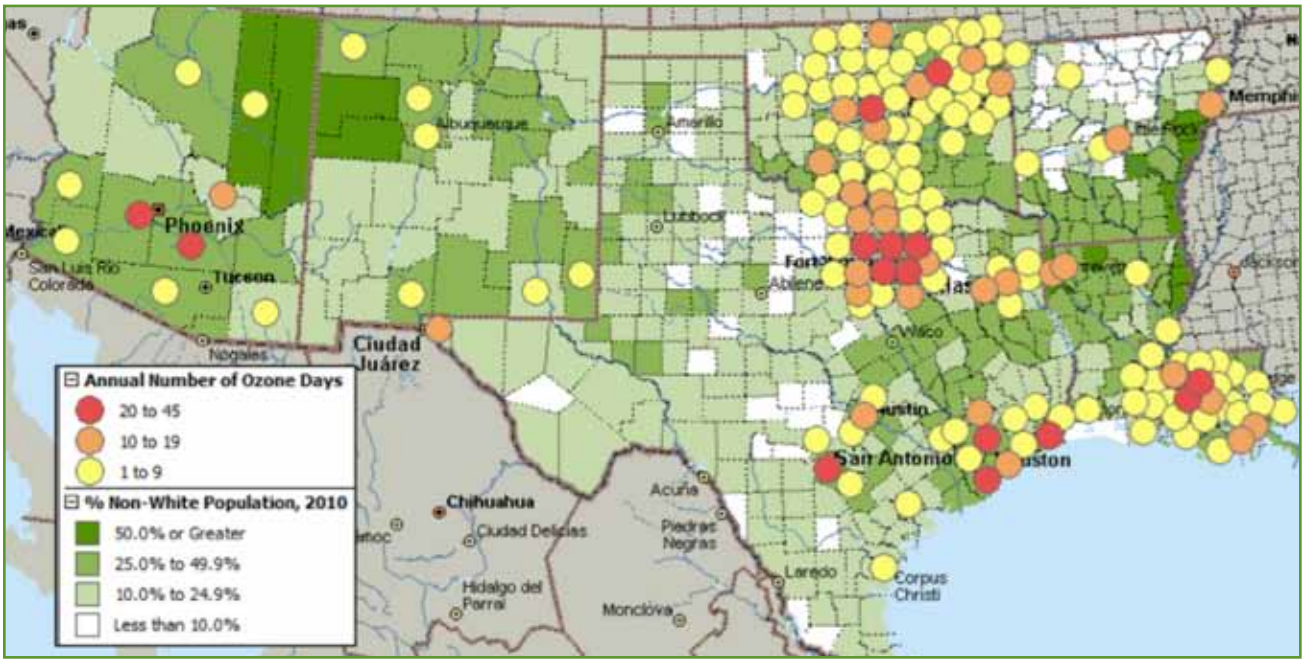
MAP 24. ANNUAL NUMBER OF UNHEALTHY AIR QUALITY DAYS DUE TO OZONE BY COUNTY, 2006



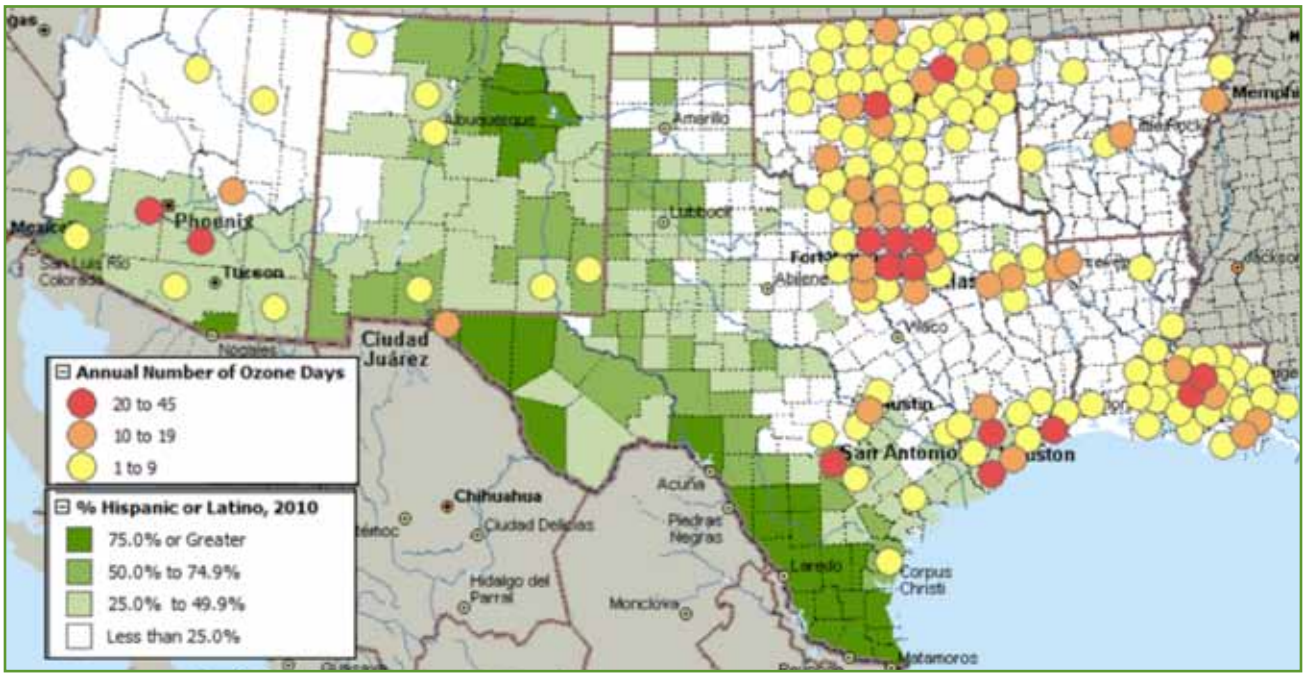
Source: CDC Environmental Protection Agency (EPA) Collaboration, 2006. Data for each state were obtained from the 2011 County Health Rankings website (http://www.countyhealthrankings.org/).

Maps 25 and 26 overlay the annual number of unhealthy air quality days due to ozone with percent non-white and percent Hispanic/Latino population, respectively. Generally, unhealthy air quality is higher in regions inhabited by a large percentage of non-white and Hispanic/Latino sub-populations. This is mainly due to the fact that racially/ethnically diverse residents are generally concentrated in metropolitan and surrounding suburban regions, more susceptible to rises in ground-level ozone. In contrast, highly diverse, outlying and rural counties (such as those in Northeast Arizona with large American Indian populations or those along the border of Texas with large Hispanic/Latino populations) are less exposed to unhealthy air due to ozone.

MAP 25. ANNUAL NUMBER OF UNHEALTHY AIR QUALITY DAYS DUE TO OZONE, 2006 AND PERCENT NON-WHITE POPULATION, 2010, BY COUNTY



MAP 26. ANNUAL NUMBER OF UNHEALTHY AIR QUALITY DAYS DUE TO OZONE, 2006 AND PERCENT HISPANIC OR LATINO POPULATION, 2010, BY COUNTY

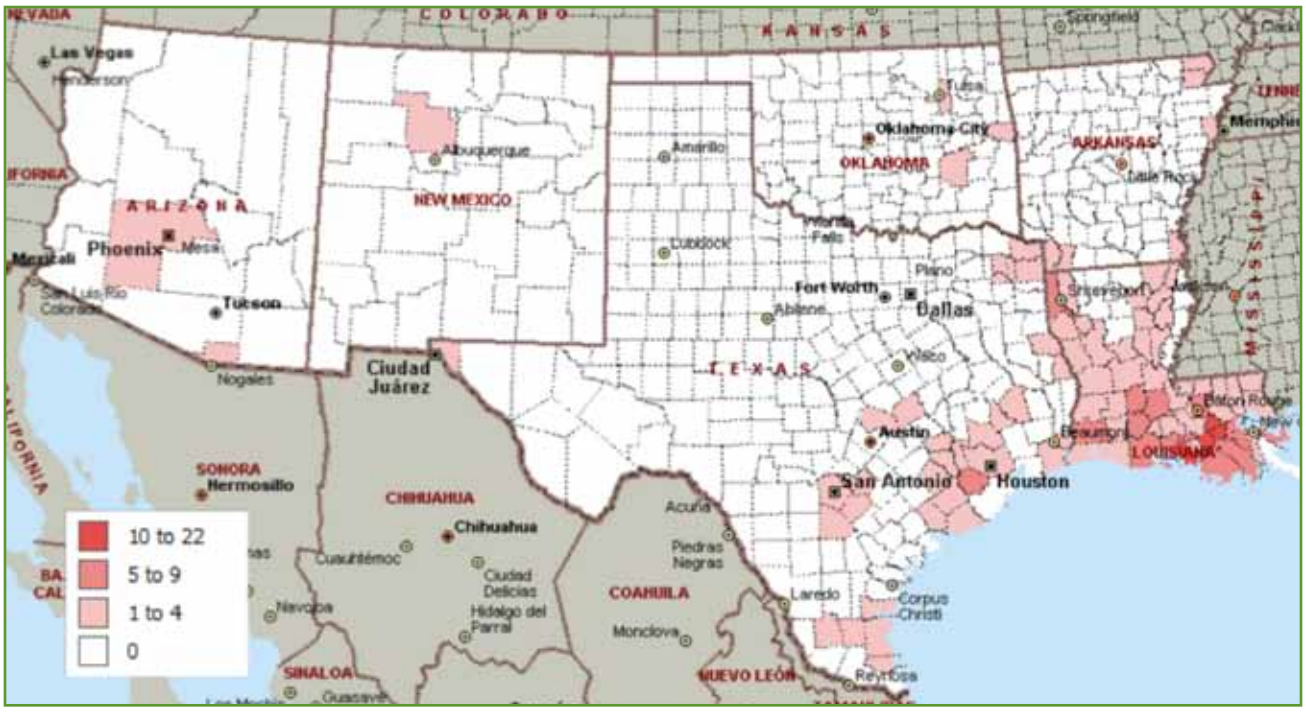


Unhealthy Air due to Fine Particulate Matter.

Map 27 displays the annual number of unhealthy air quality days due to fine particulate matter by county. Louisiana leads the region in the number of unhealthy air quality days from fine matter. In 2006, 52 of its 64 parishes (over 80% of counties) had at least one day in the year where residents faced unhealthy air quality related to fine particles. As Map 27 shows, four parishes in Southern Louisiana (Ascension, St. James, Assumption and St. Mary) faced between 10 to 21 unhealthy days from fine particles and thirteen parishes experienced between five to nine days of unhealthy air (Iberia, St. Charles, Terrebonne, Acadia, Caddo, Calcasieu, East Baton Rouge, Evangeline, Lafourche, St. Bernard, St. John the Baptist, St. Landry, and Vermilion). In addition, Fort Bend County in Texas (southwest of Houston) was among counties with high exposures to unhealthy air from fine particulate matter—i.e., in 2006, the county faced six such days.

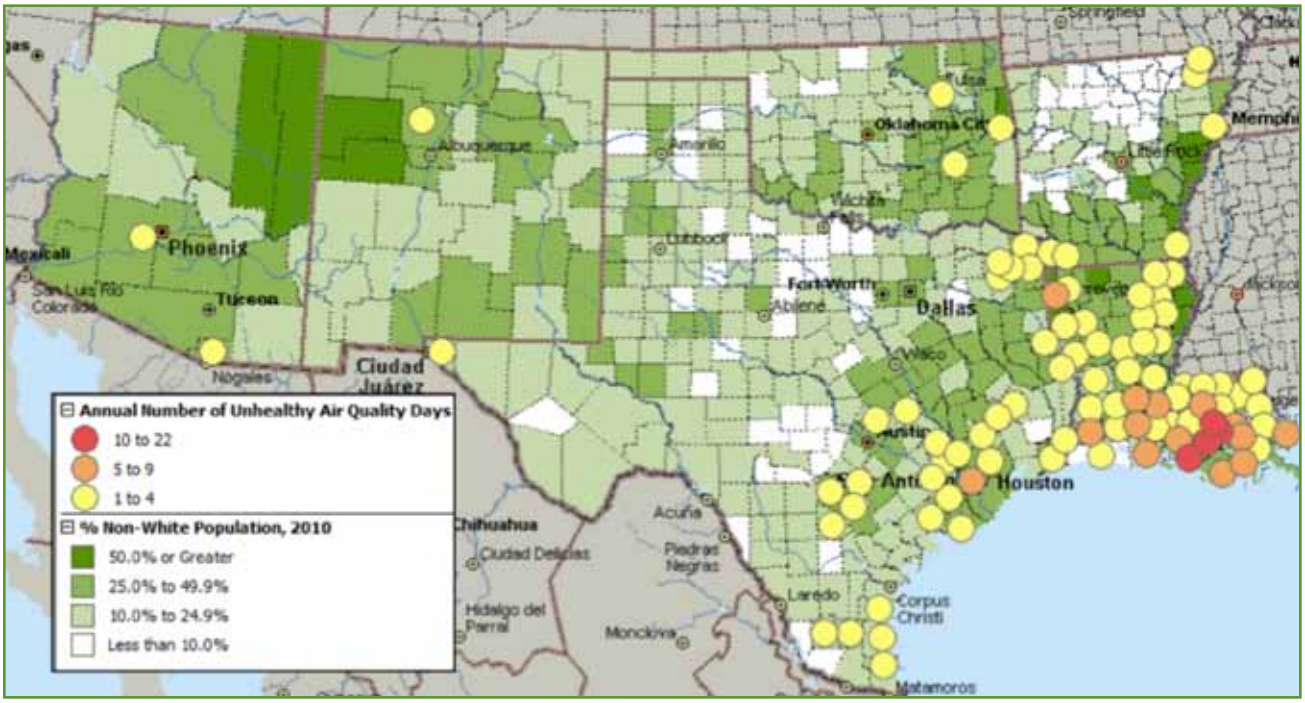
As Map 28 displays, non-white populations in Louisiana (particularly African Americans) are at a greater risk for exposure to unhealthy air quality days from fine particulate matter. For example, parishes such as St. John the Baptist, St. James, Caddo, East Baton Rouge, and St. Landry are home to a large number and proportion of African Americans (i.e., at least 40%). While the Hispanic/Latino population in Louisiana is relatively small as compared to other states in the region, parishes with the highest unhealthy air quality days due to particulate matter (see Map 29) also had some of the highest proportion of Hispanics/Latinos—e.g., St. Bernard Parish, where nearly one out of ten residents (or 56,723) were Hispanic/Latino. Furthermore, Fort Bend County in Texas—which had six unhealthy air quality days in 2006—is home to a large percentage of non-whites (43.4%) as well as Hispanics/Latinos (40.8%).

MAP 27. ANNUAL NUMBER OF UNHEALTHY AIR QUALITY DAYS DUE TO FINE PARTICULATE MATTER BY COUNTY, 2006

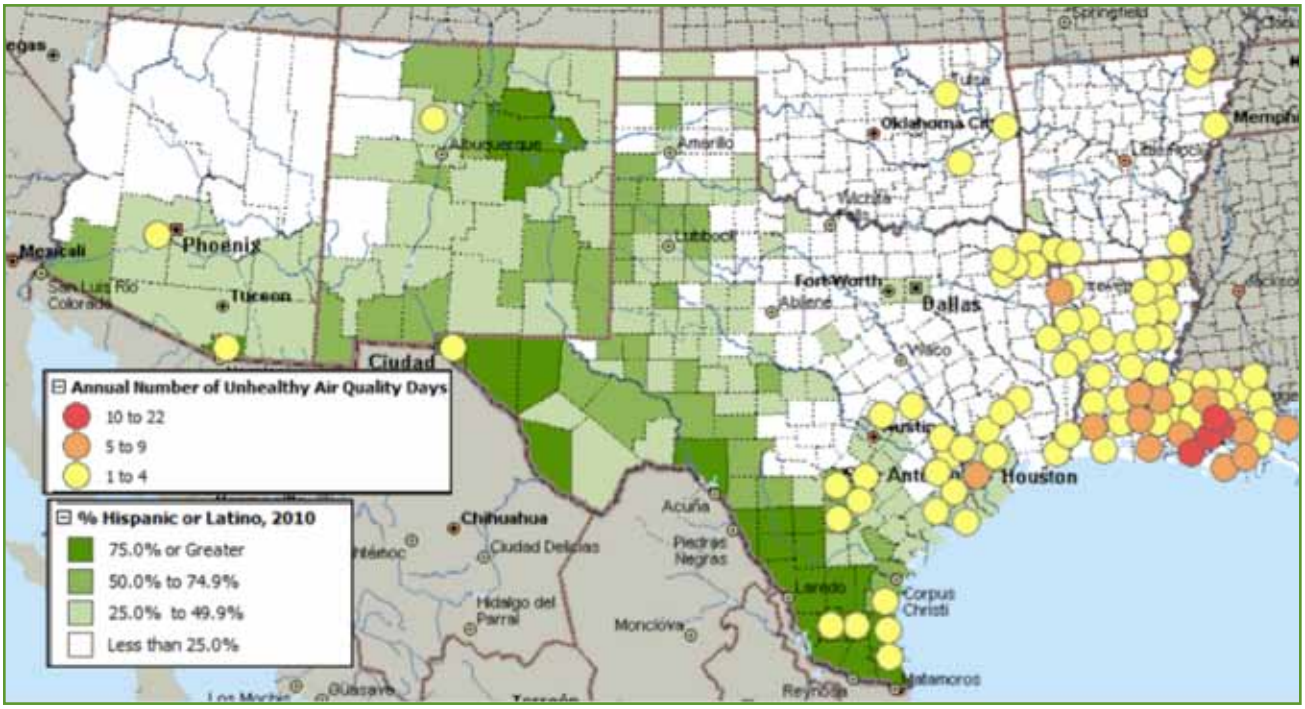


Source: CDC Environmental Protection Agency (EPA) Collaboration, 2006. Data for each state were obtained from the 2011 County Health Rankings website (http://www.countyhealthrankings.org/).

MAP 28. ANNUAL NUMBER OF UNHEALTHY AIR QUALITY DAYS DUE TO FINE PARTICULATE MATTER, 2006 AND PERCENT NON-WHITE POPULATION, 2010, BY COUNTY



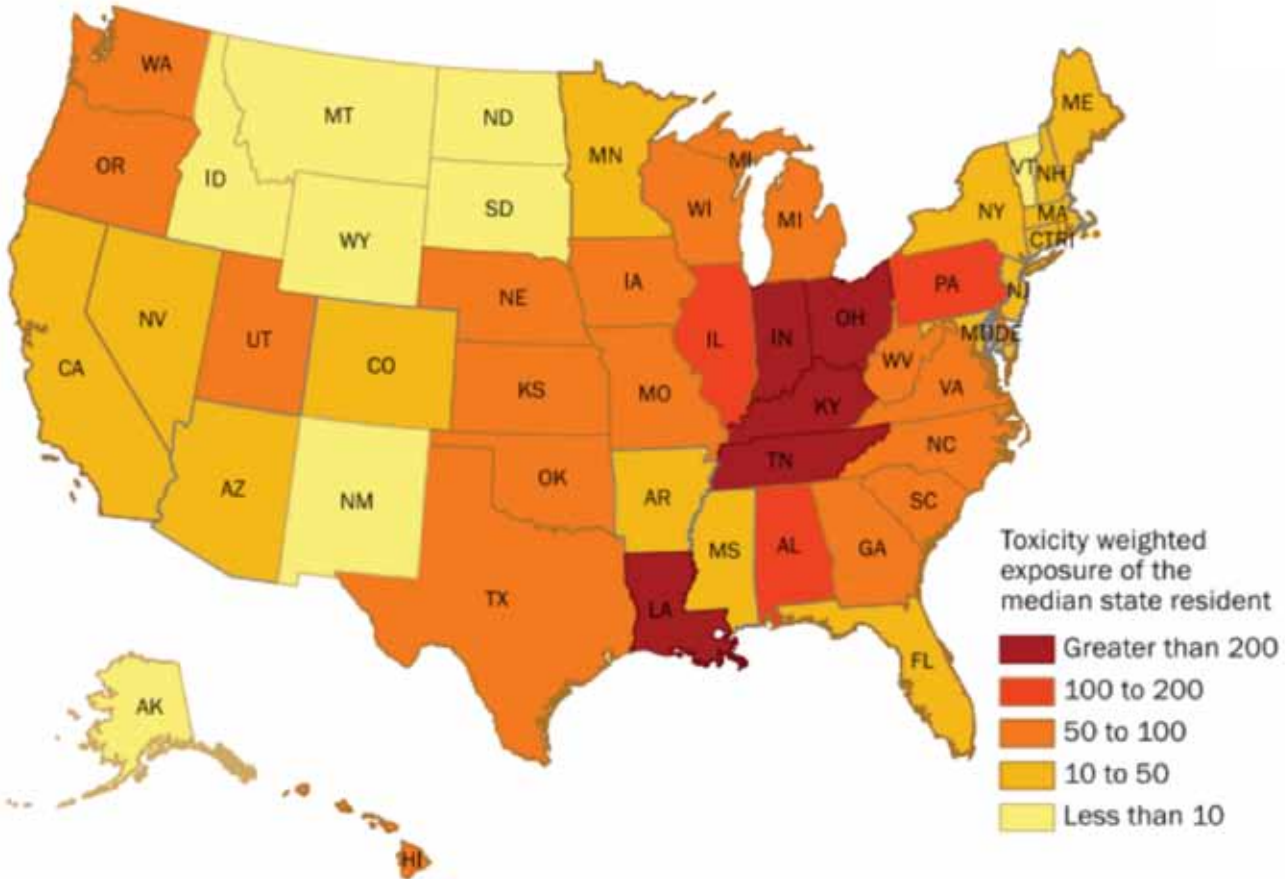
MAP 29. ANNUAL NUMBER OF UNHEALTHY AIR QUALITY DAYS DUE TO FINE PARTICULATE MATTER, 2006 AND PERCENT HISPANIC OR LATINO POPULATION, 2010, BY COUNTY



Industrial Air Toxics.

The following map (Map 30), obtained from the April 2009 report, *Justice in the Air: Tracking Toxic Pollution from America's Industries and Companies to our States, Cities and Neighborhoods*, depicts the level of exposure to toxic air pollution by state. States with the darkest shade have the highest levels of exposure. Louisiana, in our study region, is among five states across the nation with the highest level of exposure to toxic air pollution, followed by Texas and Oklahoma. New Mexico is among states with the lowest level of toxicity weighted exposure. Variations in median exposure to industrial air toxics, as the report suggests, is likely the result of industrial facilities, but can also be linked to air toxics from automobiles—which accounts for much of the nation's air pollution. This map generally identifies regions that may be more susceptible to worsening air quality conditions due to the changing climate—i.e., rising temperatures.

MAP 30. MEDIAN EXPOSURE TO INDUSTRIAL AIR TOXICS



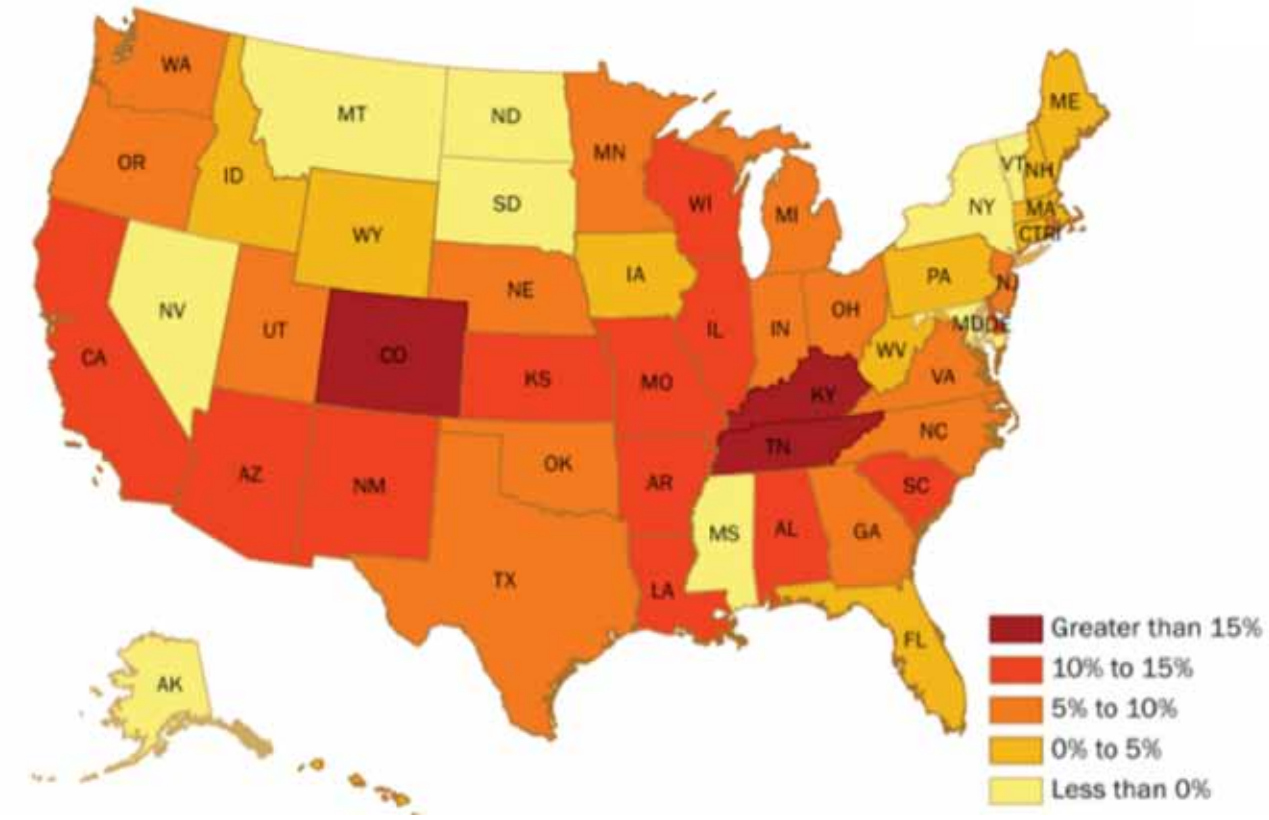
Source: Ash M, Boyce JK, Chang G, Pastor M, Scoggins J and Tran J. Justice in the Air: Tracking Toxic Pollution from America's Industries and Companies to our States, Cities and Neighborhoods. April 2009.

Racial/Ethnic Disparities in Exposure to Industrial Air Toxics.

Map 31, also obtained from *Justice in the Air,* shows the "difference between the share of people of color in the total human health risk of industrial air toxics and their share in the state's population" (Ash et al., 2009). Arizona, Arkansas, Louisiana and New Mexico, in our study region, are among 14 states with the greatest racial/ethnic disparities in health risk from industrial air toxins—i.e., the difference between racially/ethnically diverse communities' share of health risk from industrial air toxins and racially/ethnically diverse communities' share of population is 10% or greater. This concept is reaffirmed by key informants within the region. According to an air quality organizer in New Mexico, the Pueblo and Navajo communities are placed at risk due to their proximity to coal plants as well as the gaps in amenities available to them like plumbing and electricity. In addition, Hispanic/Latino groups in the south of Albuquerque are vulnerable to the effects of the nearby super sites and incinerators.

Air quality issues also plague southeastern New Mexico, an area that is predominantly low-income and Hispanic/Latino. One key informant in Arkansas cites an area of concern as the southwestern part of the state where emissions are high due to air pollutants from nearby oil refineries. The surrounding neighborhoods are comprised largely of African American populations. In Texas and Oklahoma, this difference between racially/ethnically diverse communities' share of health risk from industrial air toxins and racially/ethnically diverse communities' share of population is lower and ranges between 5 to 10%.

MAP 31. DIFFERENCE BETWEEN RACIALLY/ETHNICALLY DIVERSE COMMUNITIES' SHARE OF HEALTH RISK FROM INDUSTRIAL AIR TOXICS AND RACIALLY/ETHNICALLY DIVERSE COMMUNITIES' SHARE OF POPULATION BY STATE



Source: Ash M, Boyce JK, Chang G, Pastor M, Scoggins J and Tran J. Justice in the Air: Tracking Toxic Pollution from America's Industries and Companies to our States, Cities and Neighborhoods. April 2009.

Extreme Weather Events

As the earth's climate evolves, extreme weather events—such as hurricanes, tropical storms, flooding, drought and wildfires—are likely to be more severe. Heavy rainfall associated with hurricanes and tropical storms are likely to increase the risk of flooding, lead to greater runoff and erosion, and could ultimately have an adverse effect on water quality, rise in vector-borne illnesses and increase disaster-related morbidity and mortality. Regions that experience dryer weather (i.e., decline in precipitation) are at greater risk of suffering from disease and injury related to droughts and wildfires, as well as poorer quality of water. The following sections present regional data for various extreme weather events, highlighting areas with large communities of color that may be disproportionately more susceptible.

Wildfires

A warmer and dryer climate is projected to contribute to an increase in wildfires, especially in our study region which already experiences a large number and proportion of fires in the country. Approximately 23% of all wildfires that burned in the nation between 2005 and 2010 occurred in our study region. Texas accounted for the greatest number (49,512) and proportion (40%) of wildfires regionally in this time period, followed by Oklahoma which experienced 20,564 wildfires (17%) and Arizona which had 17,195 fires (14%).

Between 2005 and 2010, wildfires affected nearly 14.5 million acres of land. Approximately half of this burn area was located in Texas which saw over 7 million acres of its land burn during this time period. One academician cites the displacement resulting from events such as wildfires as a top climate change concern facing the state of Texas. While New Mexico had fewer fires than many other states in the region, the impact it faced in terms of acres of land burned was much larger as compared to Oklahoma, Louisiana and Arkansas, all of which faced a greater number of fires, but fewer acres burned.

Data suggest that in states such as Texas, Arizona and New Mexico, dryer conditions could fuel a 54% increase in out-of-control wildfires by 2050 (Natural Resources Defense Council, 2010).

Water Shortage

Warmer and dryer climate conditions are projected to lower water levels and in-turn could lead to serious water shortages or a decline in quality of water for vulnerable communities. The National Resources Defense Council has developed a new Water Sustainability Index (WSI) to capture projected impacts of climate change at the county-level across the country in 2050. Level of risk to water sustainability is based on the following criteria:

1. Projected water demand as a share of available precipitation;
2. Groundwater use as a share of projected available precipitation;
3. Susceptibility to drought;
4. Projected increase in freshwater withdrawals; and
5. Projected increase in summer water deficit.

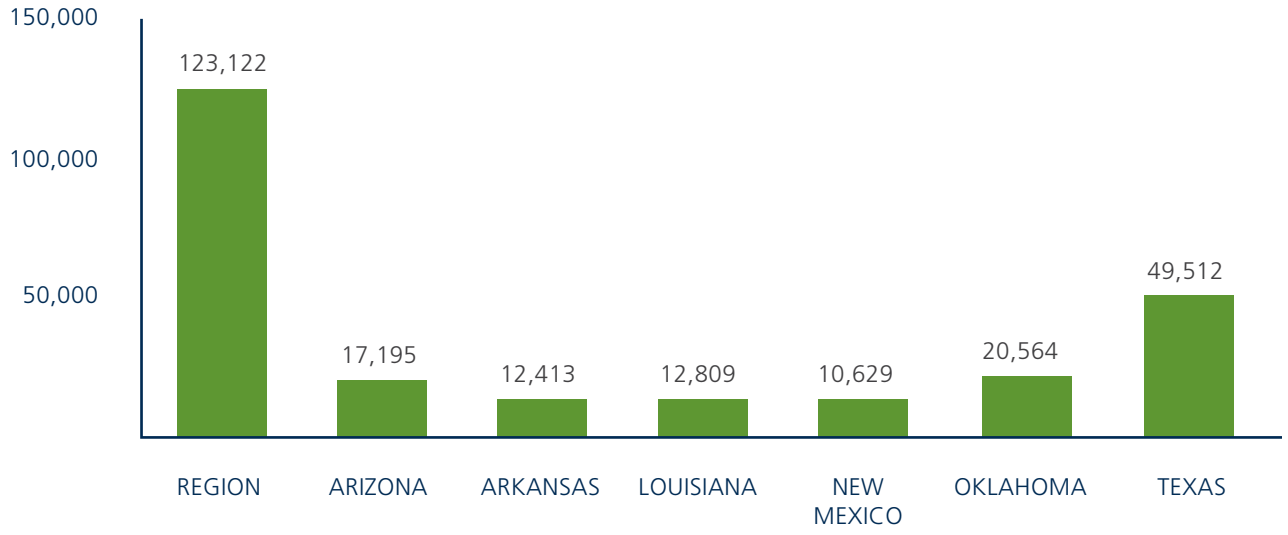
Table 16 displays state-level data and Map 32 shows county-level data on risk to water sustainability in the study region. Counties with "extreme" risk to water sustainability are those meeting four or more of the above criteria, while counties meeting two or three of the criteria are classified as having "moderate" or "high" risk, respectively. Counties meeting less than two criteria are at low risk.

TABLE 16. WATER SHORTAGE RISK VALUE IN AT-RISK COUNTIES, BY STATE

GEOGRAPHY	PERCENT OF COUNTIES AT-RISK	TOTAL AT-RISK	EXTREME RISK	HIGH RISK	MODERATE RISK
Arizona	93%	14	8	5	1
Arkansas	85%	64	24	13	27
Louisiana	81%	52	1	19	32
New Mexico	82%	27	10	9	8
Oklahoma	91%	70	25	27	18
Texas	98%	249	162	73	14
Region	**88%**	**476**	**230**	**146**	**100**

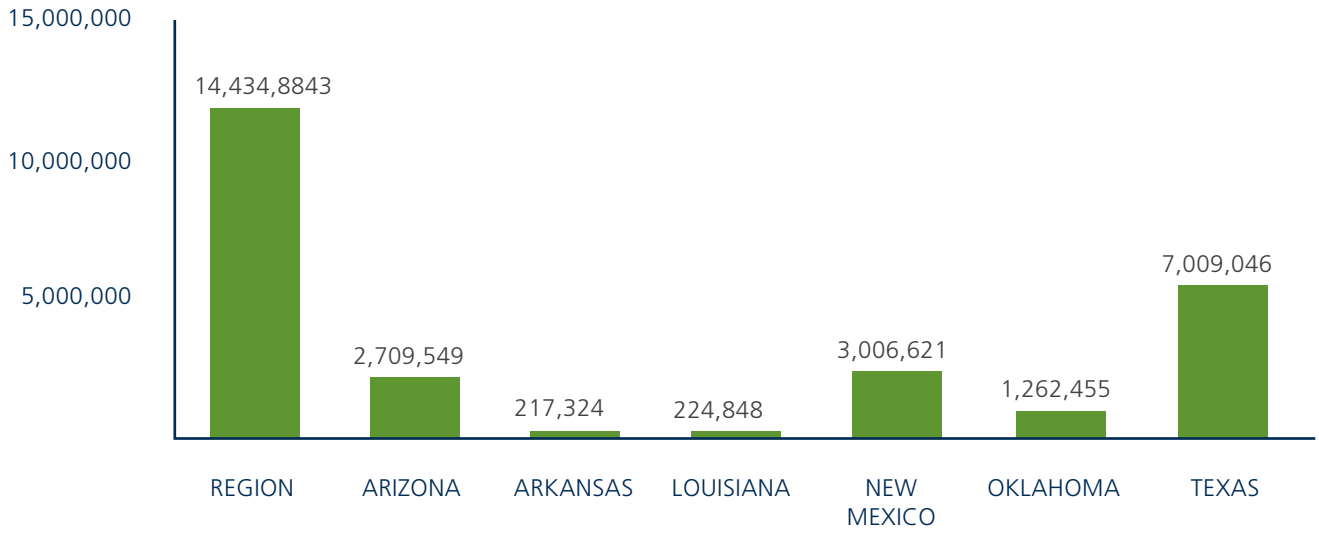
Source: National Resources Defense Council. Note: County Risk Level from "Evaluating Sustainability of Project Water Demands Under future Climate Change Scenarios," Tetra Tech, Inc., 2010.

FIGURE 2. NUMBER OF WILDFIRES BY STATE AND REGION, 2005-2010



Source: National Year-to-Date Report on Fires and Acres Burned by State, 2005-2011, National Interagency Fire Center, http://www.nifc.gov/fireInfo/fireInfo_statistics.html.

FIGURE 3. NUMBER OF ACRES BURNED DUE TO WILDFIRES BY STATE AND REGION, 2005 - 2010



Source: National Year-to-Date Report on Fires and Acres Burned by State, 2005-2011, National Interagency Fire Center, http://www.nifc.gov/fireInfo/fireInfo_statistics.html.

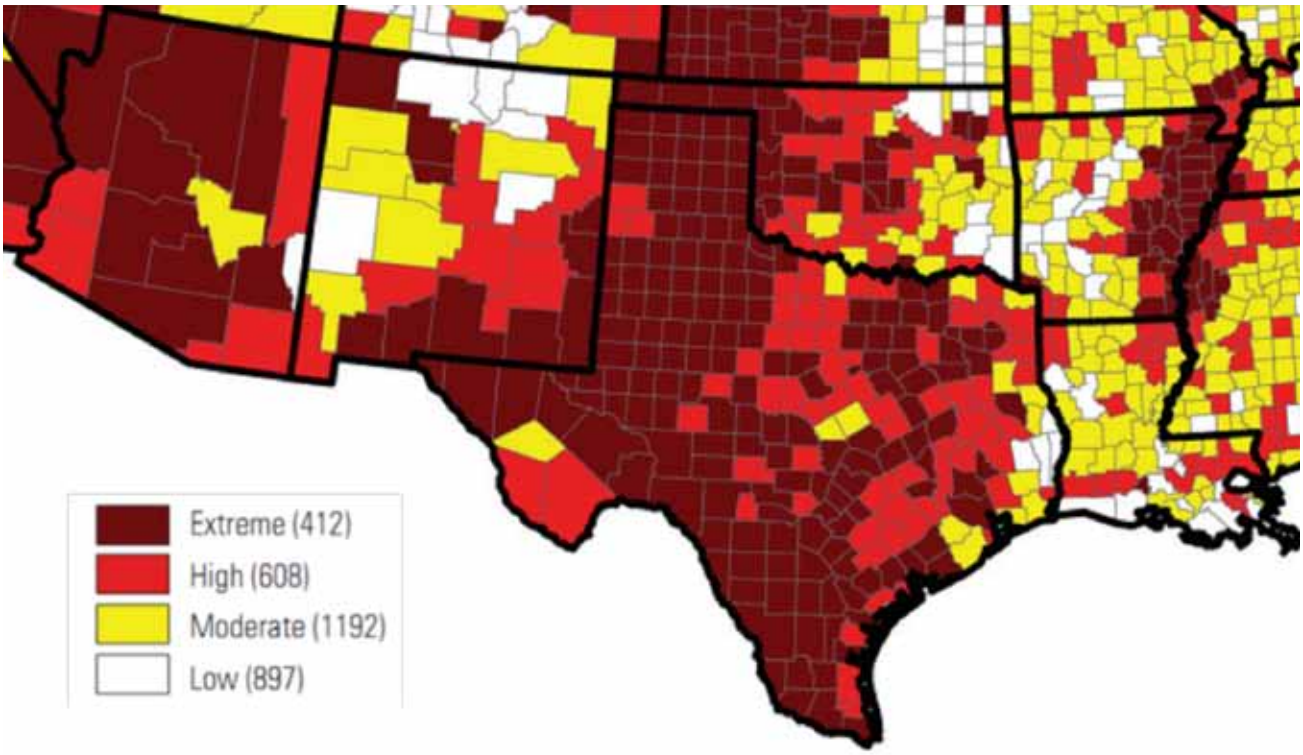
Most of Texas (98%) is seriously at-risk for water shortages. Specifically, 249 of its 251 counties are at risk, with 162 counties in west Texas, along the border region, and parts of Central and Coastal regions at extreme risk for a shortage in water. Many of these counties, particularly in the west and along the border, have a majority of Hispanic/Latino population (i.e., 50% or greater) and a large proportion of people with LEP. One key informant, an expert in climatology, cites Texas' foremost climate challenge as rising temperature's affect on water supplies and also refers to the poor's ability to obtain water during water shortages as a prominent problem.

Over 90 percent of Arizona and Oklahoma are also at risk. Specifically, eight counties in Arizona are at extreme risk of water shortage, including Mohave, Coconino, Navajo, Yavapai, Maricopa, Pinal, Graham, and Pima. Many of these counties are home to a sizeable number and proportion of AI population. For example, 47.7% of Navajo County (46,532) and 28.5% of Coconino County (33,161) are AIs. In addition, Arizona counties with extreme risk are home to large Hispanic/Latino populations. Pima County, for example, has over one-third (or 338,802) Hispanics/Latinos. Maricopa County is home to over 1.1 million Hispanics/Latinos as well as 56,706 AI and 463,747 people with LEP. Furthermore, Graham County, which is also at extreme risk for water shortages, is home to a large percentage of Asian-Americans (14.4%).

Ten counties in New Mexico are at extreme risk, including San Juan, Sandoval and Bernalillo Counties in northeast of the state, and remaining in South and Southeast, such as Luna, Dona Ana, Otero, Eddy, Lea, Roosevelt and Curry. Many of these counties are also racially/ethnically diverse. San Juan and Sandoval counties, for example, are home to some of the largest proportions of AI in the state (i.e., 36.6% or 47,640 in San Juan and 12.9% or 16,945 in Sandoval). In addition, nearly 40 percent of Sandoval County's population has LEP. Other counties, such as Dona Ana, Luna and Lea, inhabit a majority of Hispanics/Latinos (i.e., greater than 50%), and some also have a large proportion of LEP populations (e.g., nearly one-fourth of Lea County is LEP).

Arkansas has 24 counties, mainly located in the east, which are at extreme risk for water shortages. Many of these counties are home to a large number and percentage of African Americans. Another key informant, an environmental non-profit professional in Arkansas, affirms this idea and adds that compounding this effect is the agricultural state's status as a top consumer of water due to the water-intensive nature of rice farming. Oklahoma has 25 counties located in western and central parts of the state with extreme water shortage threats. Finally, Louisiana has one parish which is at extreme risk for water shortage.

MAP 32. WATER SUPPLY SUSTAINABILITY INDEX, 2050



Source: National Resources Defense Council. (2010 July). Climate Change, Water, and Risk: Current Water Demands are Not Sustainable. See: http://www.nrdc.org/globalwarming/watersustainability/files/WaterRisk.pdf.

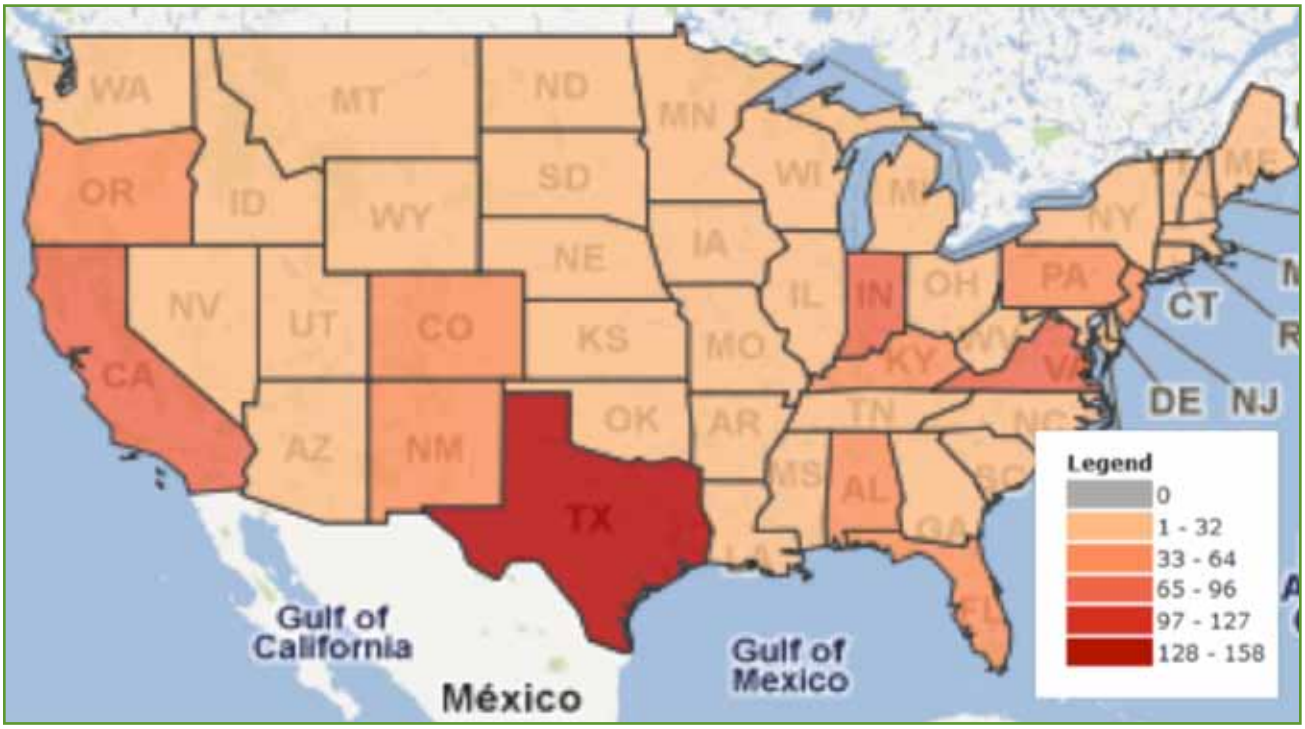
Drought

Rising air temperatures tend to increase evaporation, which in turn contributes to dry and arid conditions. When coupled with decreasing or less frequent precipitation, these conditions can lead to serious droughts. Drought can be measured in a variety of ways, one commonly used measure being "drought impact".

The National Drought Mitigation Center defines drought impact as any "observable loss or change that occurred at a specific place and time because of a drought." These impacts are identified and categorized as being related to agriculture, business or industry, energy, fires, plants or wildlife, response or restrictions, public health, tourism or recreation and water supply or quality. In 2010, Texas faced the greatest number of drought impacts in the Southern Region, followed by New Mexico. Key informants in both states felt that drought was the leading climate change concern and a top priority. In New Mexico, northern tribal communities are disproportionately affected as lack of rainfall affects their crops and thereby their economy.

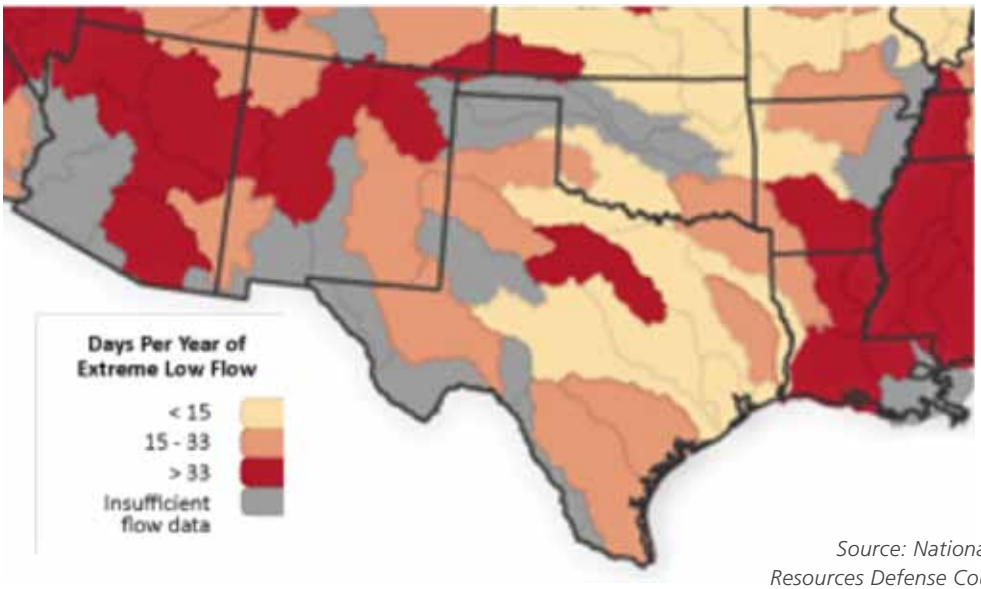
Drought vulnerability can also be measured in terms of the average number of extreme low flow days as reported by watersheds. Map 34 displays drought vulnerability data as provided by the National Resources Defense Council. Areas most susceptible to drought in our study region (i.e., have 33 or more days of extreme low flow) include east, northeast and southeast parts of Arizona, west and north central parts of New Mexico, central Texas, southern Arkansas and a large portion of Louisiana, particularly its northeast and south central regions. Generally, areas susceptible to drought in Arkansas and Louisiana are also home to a large proportion of African Americans. In Arizona and New Mexico, regions with extreme low flow days are also those inhabiting large AI populations.

MAP 33. TOTAL NUMBER OF DROUGHT IMPACTS BY STATE, 2010



Source: Drought Impact Reporter, National Drought Mitigation Center.

MAP 34. DROUGHT VULNERABILITY, 2000-2009 AVERAGE NUMBER OF EXTREME LOW FLOW DAYS, BY WATERSHED



Source: National Map: Drought Vulnerability, National Resources Defense Council, see: http://www.nrdc.org/health/climate/drought.asp

Note: Extreme Low Flow Days are defined as the average number of days annually (2000-2009) that are below the 5th percentile relative to a 1961-1990 reference period.

Extreme Heat

Heat waves and exposure to extreme heat are associated with increased mortality, particularly related to cardiovascular, cerebrovascular and respiratory causes among elderly and chronically ill people (Haines, Campbell-Lendrum, & Corvalan, 2006). A growing body of research documents that socially and economically disadvantaged communities are more likely to face adverse health impacts from extreme heat for a range of reasons such as limited preventive resources (e.g., air conditioning), higher prevalence of pre-existing chronic medical conditions (e.g., obesity, diabetes and respiratory illnesses), and geographic location (e.g., living in city centers which absorb more heat during the day and retain more heat at night, also known as the "urban heat island effect").

Based on data from the National Resources Defense Council, the following section highlights areas within the study region which are most vulnerable to extreme heat. Vulnerability to extreme heat is defined in terms of the average number of days where daily maximum temperatures were above the 90th percentile of June-July-August temperature relative to a 1961-1990 reference period.

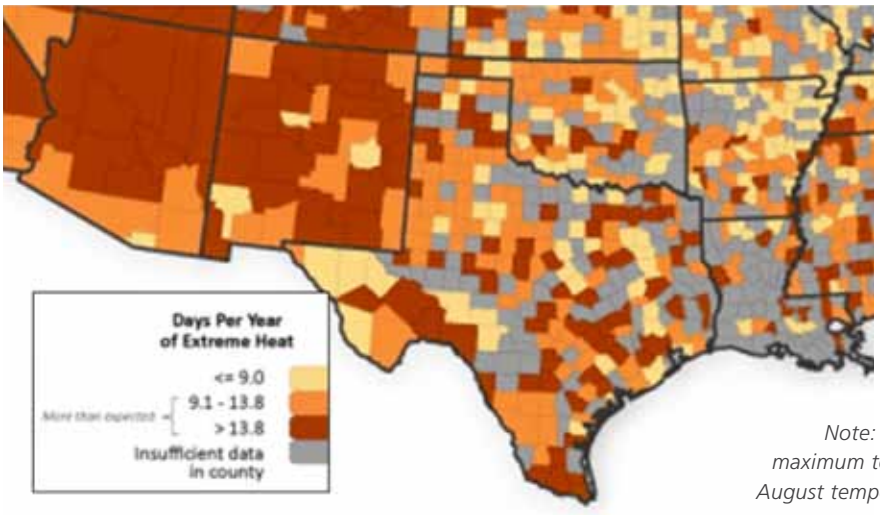
In the south central region of Arizona, some of the hottest temperatures ever recorded in that region occurred in the summer of 2010. In the last 50 years, in the city of Phoenix, the number of hours during each summer day with a temperature of 100 degrees Fahrenheit has doubled. In addition, heat-related mortality is between 3 -7 times the national average, making it the greatest in the U.S. (Natural Resources Defense Council).

In Arkansas, there is a risk that heat-related deaths could rise by 2050, and by some accounts could double. By the end of the century, the state may experience almost 150 days of over 90 degrees Fahrenheit in a year. Louisiana also feels the impacts of extreme heat, and in the summer of 2010 suffered from all time high nighttime temperatures in 16 parishes and summer temperatures are expected to continue to rise 3-7 degrees Fahrenheit.

In New Mexico, 2010 was also a record-setting year in five counties experiencing high nighttime temperatures. Also in 2010, three counties, made up of almost 45,000 people, experienced all time high average summer temperatures. In the summer of 2010 in Oklahoma, six counties set records for high nighttime temperatures. The frequency and severity of summer temperatures is also expected to rise. Multiple regions in Texas are more highly susceptible to heat waves and temperatures during the summer may increase by 3-7 degrees Fahrenheit. By the late century, some parts may see a fivefold increase in number of days over 100 degrees Fahrenheit. Heat-related morality may more than double in the city of Dallas (Natural Resources Defense Council). Other research within Texas identified a disparity in heat-related deaths that occurred during a 1980 heat wave. The authors found that mortality rates were highest among several groups including the elderly, African Americans, and those involved in strenuous labor with the suggestion that socioeconomic status was the underlying factor (Greenberg, Bromberg, Reed, Gustafson, & Beauchamp, 1983).

MAP 35. EXTREME HEAT VULNERABILITY, 2000-2009

Average Number of Extreme Heat Days



Note: Extreme Heat Days are defined as days with daily maximum temperatures above the 90th percentile June-July-August temperature relative to a 1961-1990 reference period.

Source: National Map: Extreme Heat Vulnerability from the Natural Resources Defense Council. See: http://www.nrdc.org/health/climate/heat.asp.

Hurricanes

Of the states in the Southern Region, Texas and Louisiana are most susceptible to major hurricane activity—i.e., Category 3, 4 or 5. Between 1851 and 2009, Texas witnessed 19 major hurricanes and Louisiana had 29 major hurricanes. Key informants from both states cite the increased severity and frequency from such storms as a leading threat to their communities. Those among low income populations cannot afford to make the adaptations necessary, such as home elevation, to prevent against these adverse effects. Area residents are faced with the high cost of evacuation and in many cases choose not to evacuate due to these costs. Evacuations also require people to be in good health which presents a challenge for elderly community members.

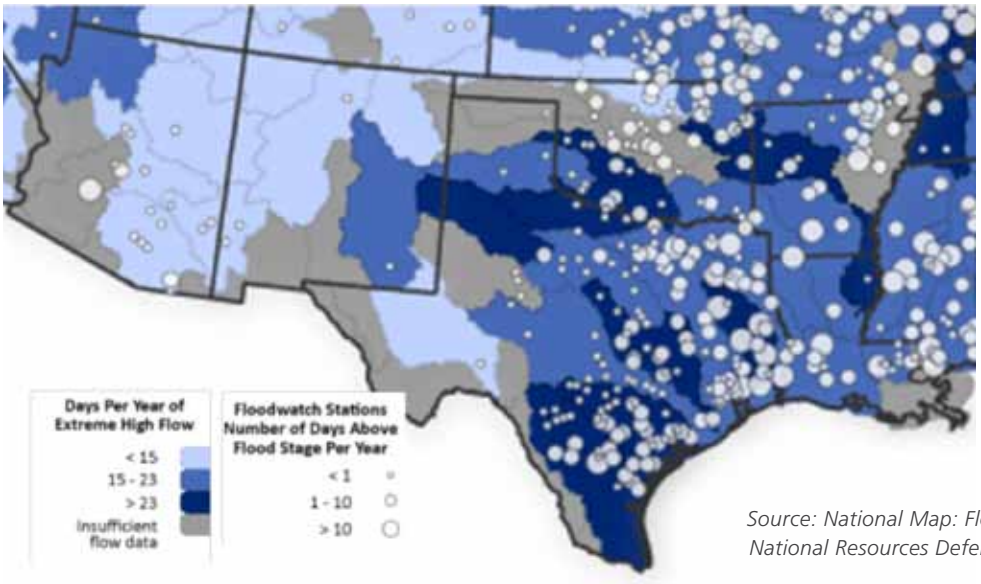
Flooding

As the earth continues to warm, heavy downpours, tropical storms and hurricanes are projected to increase further. Total precipitation in the U.S. has increased by 7 percent, with "the amount of precipitation falling in the heaviest 1 percent of rain events increase[ing] by 20 percent in the past century" (Karl et al., 2009). Our study region has notably seen an increase in heavy downpours, particularly in the warm season over the past few decades which has contributed to flooding. Flooding is associated with a number of serious health impacts, such as direct injuries as well as increased incidence of waterborne diseases. Flooding can also result in sewage overflows, potentially contaminating drinking water. This particular challenge was cited by a tribal leader in Louisiana to be harmful to her community; damaged septic systems caused water pollutants during a recent flood. In addition, Hughes, Arkansas experienced sewage leaks after flooding. In Arkansas, low income and racially/ethnically diverse populations are more likely to live in highly susceptible areas such as flood plains.

Map 36 geographically displays flood vulnerability, measured as extreme high flow days reported by watersheds in the study region. Extreme high flow days are defined as the average number of days annually (2000-2009) that are above the 95th percentile relative to 1961-1990 reference period. Texas has the most watersheds with high flows days (more than 23 days per year) and areas of south Texas, central Texas and areas of the panhandle are more prone to these high flow days. Louisiana and New Mexico each have one watershed with over 23 days of high water flow per year, while both Arkansas and Oklahoma have portions of two different watersheds with this high rate of water flow.

MAP 36. FLOOD VULNERABILITY IN THE U.S., 2000-2009

Average Number of Extreme High Flow Days and Recorded Floods, by Watershed



Source: National Map: Flooding Vulnerability, Reproduced from National Resources Defense Council, see: http://www.nrdc.org/health/climate/floods.asp

Note: Extreme high flow days are defined as the average number of days annually (2000-2009) that are above the 95th percentile relative to 1961-1990 reference period.

The National Resources Defense Council provides a state-by-state summary of severe storm and flooding activity. Texas and Louisiana are among states in the region which have experienced the greatest damage from storms, hurricanes and flooding (i.e., over billions of dollars). Since 2000, Texas has been declared a disaster area 14 times and recent estimates show that sea levels could rise 17 inches by 2050. In Louisiana, there have been 13 major declared disasters related to flooding, storms and hurricanes since 2000. Sea level rise and coastal flooding pose serious threats to the infrastructure, health and social well-being of Louisiana's major coastal cities, such as New Orleans. Arkansas has also had 15 major disasters declared since 2000, however, its damages have generally been less costly than Texas and Louisiana.

Since 2000, Oklahoma has faced the greatest frequency of disasters related to storms and flooding (i.e., 18 times). In addition, Arizona and New Mexico have each had seven major declared disasters since 2000 related to storms and flooding. In New Mexico, it is projected that "warmer temperatures in the winters could cause precipitation to fall as rain instead of snow in mountain regions—raising stream flows and potential for floods" (Natural Resources Defense Council, 2008). One key informant specifies that the colonias located on the Mexico-New Mexico border, which are populated heavily by migrants, are disproportionately affected by flooding events as these individuals are more likely to live in substandard housing.

Infectious Diseases

Global warming has been shown to increase conditions such as rising temperatures and more humid conditions. Due to these changes, a rise in infectious diseases has been predicted which are more favorable among these conditions. In addition, diseases endemic to the U.S., such as arbovirus encephalitis, may expand and diseases not endemic to the region, such as Dengue fever, may become so due to these climate changes (Longstreth, 1999).

The following sections present data on the vulnerability of communities within the study region to West Nile Virus (WNV), Dengue fever and Lyme disease—vector-borne diseases likely to increase in incidence with a warming climate.

TABLE 17. TOTAL CASES OF DENGUE FEVER, WEST NILE VIRUS AND LYME DISEASE

GEOGRAPHY	DENGUE FEVER 1995-2005	WEST NILE VIRUS 1999-2010	LYME DISEASE 1990-2008
Arizona	19	1,061	66
Arkansas	3	195	191
Louisiana	5	1,044	117
New Mexico	12	437	43
Oklahoma	3	327	365
Texas	6,186	2,175	1,468
Region	**6,228**	**5,239**	**2,250**

Source: National Resources Defense Council

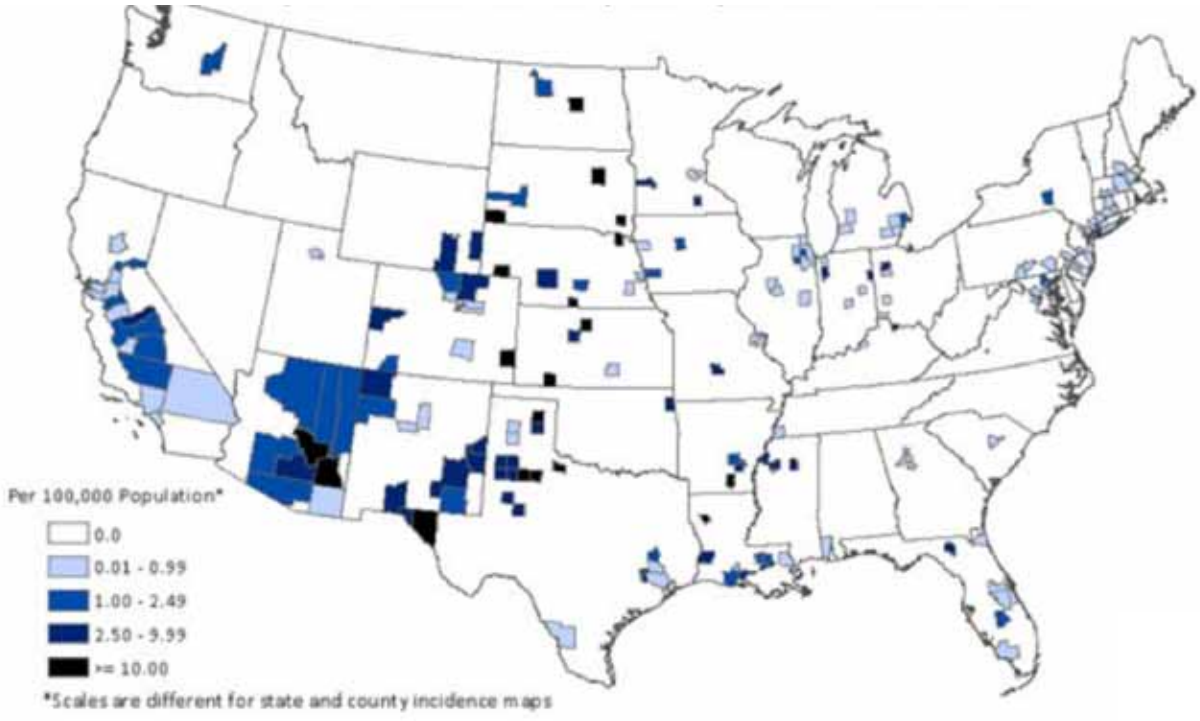
West Nile Virus

Between 1995 and 2005, there were 5,239 cases of West Nile Virus (WNV) in the region. The largest number of cases (2,175 or approximately 42 percent) were in Texas, followed by 1,061 cases in Arizona and 1,044 cases in Louisiana.

Map 37, from the Centers for Disease Control and Prevention, depicts the reported incidence rate of WNV neuroinvasive disease per 100,000 population, by county, for the entire nation for 2010. Twelve counties in the region were among those with the highest incidence of WNV in the country in 2010—i.e., greater than or equal to 10 cases per 100,000 population. These included eight counties in Texas (Roberts, Crosby, Foard, Dickens, Hudspeth, Fisher, Dawson and Swisher), two in Arizona (Graham and Gila), one in Arkansas (Bradley) and one in Louisiana (Red River). Maricopa County in Arizona had by far the highest number of West Nile Virus cases (116) in 2010, followed by El Paso and Harris counties in Texas (26 and 23 cases, respectively).

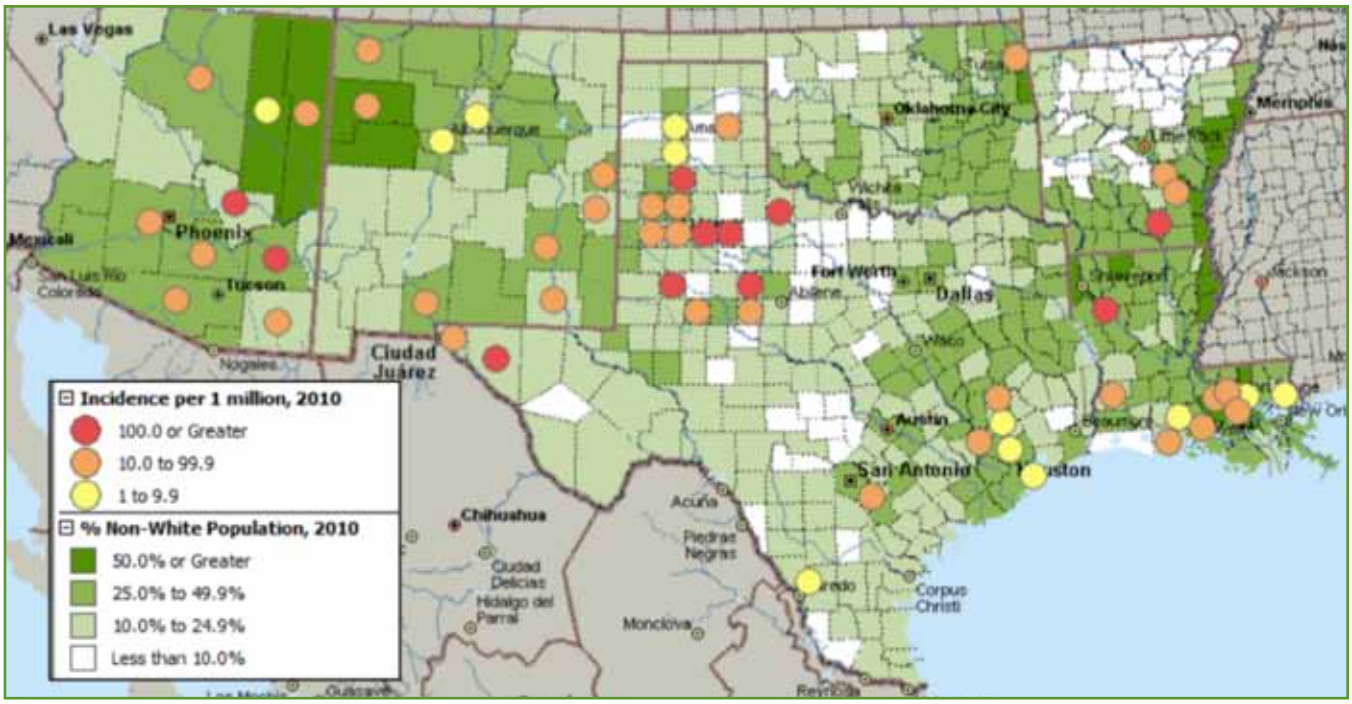
Maps 38 and 39 display the incidence rate of WNV in relation to where non-white and Hispanic/Latino populations are located. In Texas, six of the eight counties with the highest incidence of WNV are also those with at least a one-third Hispanic/Latino population. Counties such as Hudspeth, Dawson and Crosby have a majority of Hispanics/Latinos (52.3%-79.6%). Counties in Arkansas and Louisiana with the highest incidence of WNV are also those with a large percentage of African Americans (i.e., 40%). Graham County in Arizona had a high incidence of WNV in 2010, along with 30.4% Hispanic/Latino population and 41.8% non-white population.

MAP 37. WEST NILE VIRUS (WNV), BY COUNTY, UNITED STATES, 2010



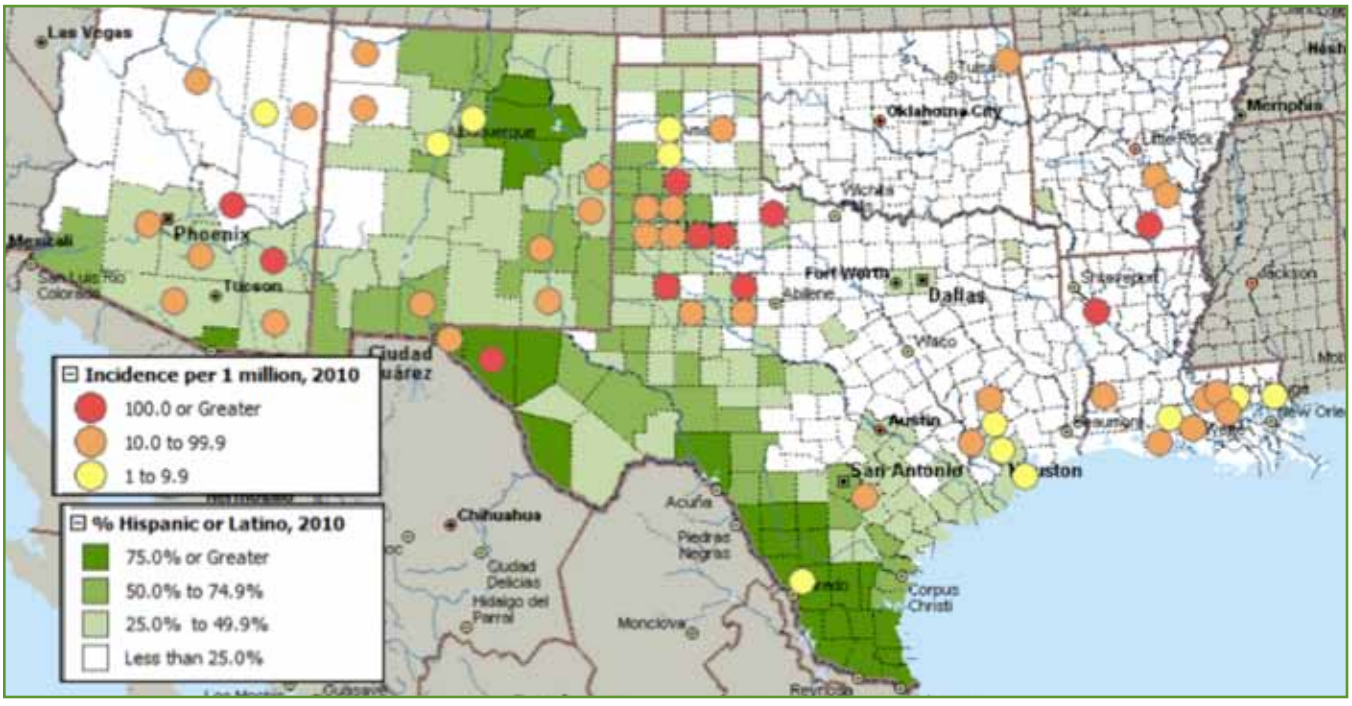
Source: Centers for Disease Control and Prevention, 2010

MAP 38. WEST NILE VIRUS HUMAN INFECTION INCIDENCE AND PERCENT NON-WHITE RACE BY COUNTY, 2010



Source: Statistics, Surveillance and Control. Division of Vector-Borne Diseases, Centers for Disease Control and Prevention, 2005-2010. See: http://www.cdc.gov/ncidod/dvbid/westnile/surv&control_archive.htm.

MAP 39. WEST NILE VIRUS HUMAN INFECTION INCIDENCE AND PERCENT HISPANIC OR LATINO BY COUNTY, 201



Source: Statistics, Surveillance and Control. Division of Vector-Borne Diseases, Centers for Disease Control and Prevention, 2005-2010. See: http://www.cdc.gov/ncidod/dvbid/westnile/surv&control_archive.htm

Dengue Fever

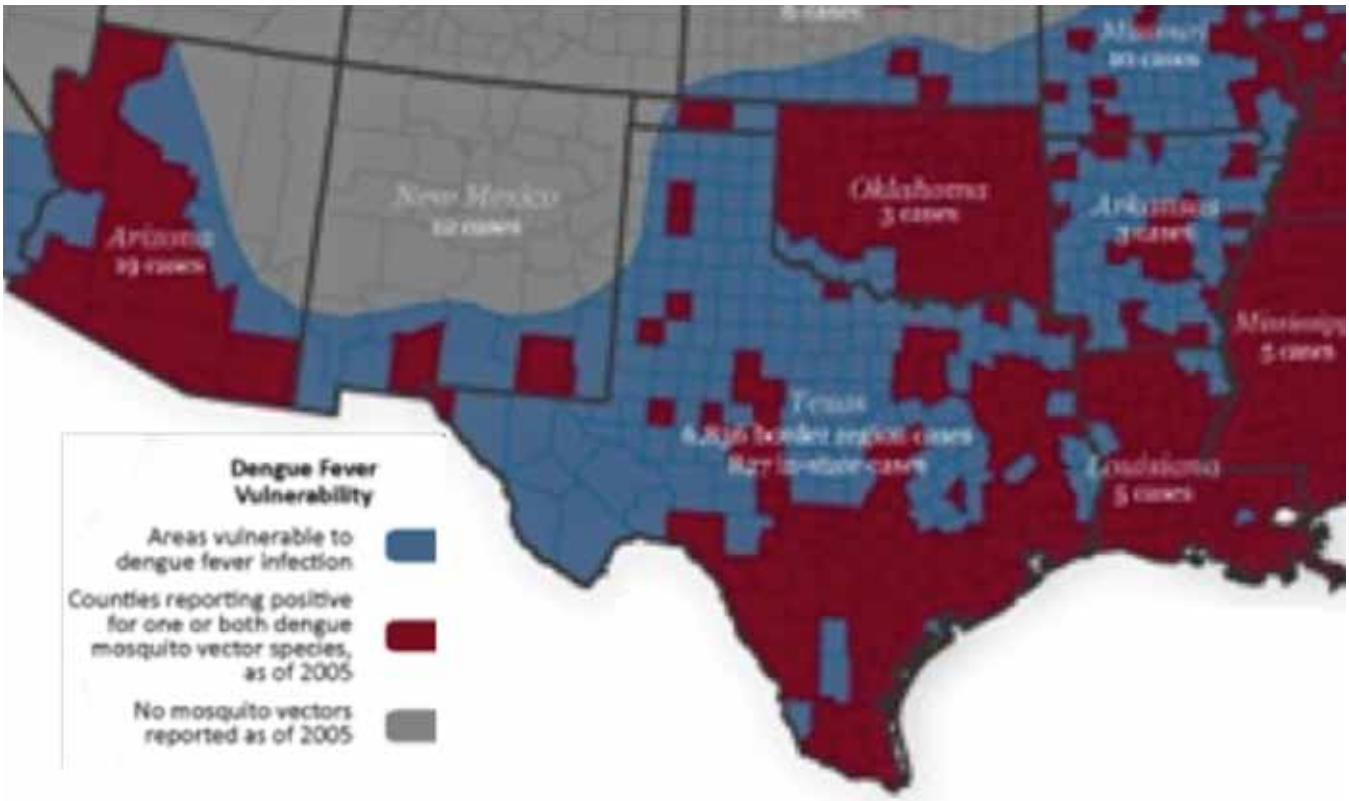
Between 1995 and 2005, there were 6,228 cases of Dengue fever in the region. Texas had, by far, the most cases (6,186 or approximately 99%). Arizona had 19 cases, New Mexico had 12, followed by Louisiana with 5 cases, and Arkansas and Oklahoma, with 3 cases each.

Lyme Disease

Between 1990 and 2008, there were 2,250 reported cases of Lyme disease in the region, with Texas accounting for the most cases (i.e., 1,468 or approximately 65.2%). Oklahoma had 365 cases, followed by Arkansas with 191, Louisiana with 117, Arizona with 66 and New Mexico with 43.

Key informants within the state of Texas, cited the rising incidence of infectious diseases due to a warmer and more humid climate as a climate change priority. In Arkansas, the literature further confirms that an increased number of mosquito and water-borne diseases is expected (Center for Health and Global Environment, 2009).

MAP 40. AREAS VULNERABLE TO DENGUE FEVER, 1995-2005



Source: National Resources Defense Council. See: http://www.nrdc.org/health/climate/disease.asp

IV. STATE, LOCAL, AND REGIONAL PROGRAMS & POLICIES

This section reviews climate change priorities and planning efforts for each state in the region. First, we present an overview of literature relevant to climate change and vulnerable populations. Next we describe mitigation and adaptation efforts undertaken for each state. Finally, we outline state policies and community and local programs to counteract, prepare for, or minimize climate change impacts, especially as they may relate to vulnerable populations, including economically disadvantaged groups and communities of color.

TABLE 18. SUMMARY OF CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES

	Active Climate Legislative Commissions And Executive Advisory Groups	Climate Change Action Plan	States with Greenhouse Gas Emissions Targets	Range of Greenhouse Gas Emissions Targets	Regional Greenhouse Gas Initiatives	State Greenhouse Gas Reporting and Registries	Renewable Portfolio Standard	State Adaptation Plan
Arizona	Yes	Yes	Yes	2000 levels by 2020, 50% below 2000 by 2040	No	Climate Registry	Yes	Recommended in climate action plan but not adopted
Arkansas	Yes	Yes	No	Recommended in climate change action plan but not adopted	No	No	No	No
Louisiana	No	No	No	—	No	No	No	No
Oklahoma	No	No	No	—	No	Climate Registry	No	No
New Mexico	No	Yes	Yes	2000 levels by 2012, 10% below 2000 by 2020, 75% below 2000 by 2050	No	Climate Registry and Mandatory Reporting	Yes	No
Texas	No	No	No	—	No	Independent Voluntary Registry	Yes	No

Source: Center for Climate and Energy Solutions' U.S. Climate Policy Maps

ARIZONA

Arizona is one of the more advanced states across the region in development of formal policies for adapting and mitigating climate change effects. It has developed a statewide mitigation strategy and has undertaken a number of programs at the local level targeting climate challenges. Although similar to other states in the region in its lack of focus on vulnerable populations in policies and programs, we do identify a number of more promising examples of vulnerable population inclusion in research.

Climate Change Priorities and Vulnerable Populations

Arizona reports have focused primarily on heat-related illness or health effects from poor air quality with a number highlighting vulnerable populations, which were most likely to be identified by age-related concerns as well as availability of air conditioning, or overall health status. A CDC report on heat-related mortality in Arizona specifies multiple groups that are more at-risk: children, the elderly, those without air conditioning, and those with pre-existing health conditions. Among the policy recommendations is identifying high risk populations and avenues to communicate important public health messages to them (CDC, 2005). Harlan, Brazel, Prashad, Stefanov and Larsen (2006) used a simulation model to examine eight neighborhoods in Phoenix during the summer and found that the poor as well as communities of color were more likely to live in warmer neighborhoods. Higher temperatures were thought to be caused by less vegetation and open space as well as more highly populated areas. Fewer resources were available to those in warmer neighborhoods thus affecting ability to manage the adverse effects from these heat islands. Recommendations encouraged more equitable strategies for adaptation to climate change threats (Harlan, Brazel, Prashad, Stefanov, & Larsen, 2006).

Of special concern is the city of Phoenix. The city has a large African American community and Hispanic/Latino residents comprise 30 percent of its population. Type of employment and lack of health insurance place these residents at greater risk in one of the most highly polluted areas in the region which results from unsafe levels of particulate pollution and ozone (Madrid & Vasquez, 2011).

Climate Change Planning: Adaptation and Mitigation Strategies

In 2006, the Climate Change Advisory Group issued the state's mitigation plan pursuant to an executive order issued by the governor. The overarching goal established within that report was to set goals for greenhouse gas emissions

ARIZONA CLIMATE CHANGE PLANNING AT A GLANCE

Climate change action plan developed
No statewide adaptation plan
Some academic research include vulnerable populations

Air Quality and Energy

State policy
E.O. 2006-13, E.O. 2010-06, H.B. 2766, H.B. 2390, H.B. 2324, E.O. 2005-05, E.O. 2006-13

Local programs
The Arizona Renewable Energy Tax Incentive Program, Tuscon's Sustainable Action Plan, Phoenix Environmental Justice Project, Green Phoenix

Extreme heat

Local programs
Phoenix' Tree and Master Shade Plan, "heat relief stations" in place by local department of public health

Water Management

State policy
S.B. 1624, ARS 45, Winters v. United States

Local programs
Phoenix' Water Resources Plan, Rural Community Assistance Corporation

Emerging Infectious Disease

State and local programs
Surveillance by state and local health departments

Wildfires

State program
Arizona State Forestry Division works to prevent fires throughout the state

which includes the target of 2000 levels by the year 2020 and to 50 percent below 2000 levels by the year 2040. These recommendations are outlined by sector and include: the residential, industrial and waste management sector, the energy supply sector, the transportation and land use sector, and the agriculture and forestry sectors. These reductions are achieved through energy efficiency as well as renewable energy policy among the residential, commercial and industrial sectors. Other mitigation efforts include the state's greenhouse gas registry for reporting these emissions. These actions are intended to track and manage emissions and are seen as prerequisites for participation in greenhouse gas reduction programs.

Adaptation planning is currently ongoing in the state but remains in the preliminary phases. Recommendations from the climate change action plan specified that the adaptation plan describe the effects of climate change on human, economic and natural sectors resulting from Arizona's top climate concerns such as drought, forest fires, and increasing temperatures. The recommendations, however, do not include special provisions for vulnerable populations, including racially/ethnically diverse communities. The Arizona State Health Department recieved a CDC grant award to advance adaptation efforts as part of its "Climate-Ready States & Cities Initiative". Currently in the assessment phase, the state is evaluating its ability to respond to consequences such as the adverse health effects of climate change through gap analyses and needs assessments.

Current Policies and Programs

Primary climate-related issues affecting Arizona, as identified by the literature, data findings, and interviews, drought, extreme heat, air quality and wildfires. The following is a review of the state legislative policies and community programs targeting these concerns.

Air Quality and Energy. Several state laws are in place aimed at directly reducing greenhouse gas emissions. Executive Order 2006-13 was signed by former Governor Napolitano and formalized the goal of reducing greenhouse gas emissions to 2000 levels by 2020. Included in the order was the state's adoption of the Clean Cars Law, a vehicle standards program similar to California's. The Arizona Department of Environmental Quality, in 2007, began to outline rules and implement this law which was formally approved in 2008 by the Governor's Regulatory Council. The 2012 model year will begin compliance scheduling. In 2010, Executive Order 2010-06, signed by Governor Brewer, pulled the state out of the Western Climate Initiative (WCI)'s (see Regional Programs) cap and trade program due to increasing costs on the state's economy. In 2011, the state formally left the collaborative.

Executive Order 2010-06 further aims to strengthen the state's economy through promoting energy efficiency standards. Arizona's energy efficiency policies include requiring the state government to comply with certain building standards or requiring state agencies to purchase certain energy efficient vehicles or products. For example, 2003's H.B. 2324 specified that all state agencies purchase energy-efficient products unless these products were not proven to be cost-effective. Executive Order 2005-05 specified that state buildings meet certain LEED (Leadership in Energy and Environmental Design) standards and H.B. 2324 required state agencies and universities to realize a 15 percent energy use reduction by 2011. 2006's Executive Order 2006-13 requires state agencies to purchase only certain vehicles that were either hybrid, met low emissions standards or use more fuel-efficient fuels; it further established that all state-owned vehicles meet these requirements by 2010. Other policies targeting energy efficiency include applications for those outside of state government. H.B. 2766, the Omnibus Energy Act of 2008, put into place energy standards for equipment and appliances and 2005's H.B. 2390 created energy efficient minimums for 12 specific appliances. Laws 2000, Chapter 214 outlined the provision of an individual income tax subtraction to taxpayers who sell one or more energy efficient single family residence, condominium or town home that met certain energy efficiency requirements.

Executive Order 2010-06 also has the goal of leveraging the state's potential in renewable energy to improve its economy. For example, Arizona, as of January 1, 2010, established a new resource to advance its solar platform and broaden the scope into the domain of renewable energy by creating The Arizona Renewable Energy Tax Incentive Program. This program is designed to stimulate renewable energy companies such as solar, wind, geothermal among others. In addition, it will promote new investments in manufacturing and headquarter operations of these energies.

In addition to these state laws, several air quality and energy programs and policies have been developed and implemented locally. In 2009, the mayor of Phoenix announced an ambitious plan termed "Green Phoenix" to transform the city into the most sustainable city in the U.S. The plan addresses six areas including creating more energy-efficient homes, using solar energy for public, residential and commercial buildings, replacing public traffic lights with energy-efficient lights among other initiatives. The City of Tucson and the City of Phoenix have adopted the 2006 International Energy Conservation Code which set minimum requirements for energy efficient design for both new and renovated buildings. In 2008, Tucson's Pima County adopted "Sustainable Action Plan for

"Vulnerable populations have drier landscapes showing that they have less water for irrigation and fewer plants to moderate extreme temperatures. Overall, they have fewer resources to moderate these types of hazards."

– Key Informant, Arizona.

County Operations" which specifies ways to incorporate sustainability goals into government operations. The plan requires that city facilities use cool roofing materials for both new construction and replacements. Adopting this policy at the local level has encouraged the use of the products among private projects as well.

Academic institutions in Arizona also provide input regarding climate change priorities. The Phoenix Area Environmental Justice Project, led by Arizona State University researchers, examines the impact of manufacturing plants in the area on their nearby neighborhoods. Toxic emissions from the plants are also examined including the reduction of these emissions, and results have suggested that while the volume has decreased the toxicity has increased. Transferring these toxic materials is hazardous, both en route and for the locations receiving them. Researchers found that despite intentions to reduce greenhouse gas emissions, African American and Hispanic/Latino communities are still considered most-affected by these plants.

Extreme Heat. Our review did not find any state laws related to extreme heat. However, several local and community programs have been developed to assist in both mitigating and adapting to this concern. The City of Phoenix' Tree and Shade Master plan promotes the value of trees within the city. According to the plan, an investment in trees by the city can achieve several important goals: to reduce its overall carbon footprint, to address the urban heat island effect, to create cleaner air, to decrease costs of energy, to reduce storm water runoff, and to increase biodiversity as well as property values. This plan describes the outline of an urban forest with the goal of 25 percent tree canopy coverage by the year 2030. Also in an effort to combat extreme heat, the public health department in Phoenix' Maricopa County has developed a comprehensive effort to keep the public informed and safe. Heat advisory warnings coupled with "heat relief" stations are in place to keep citizens both cool and hydrated. Maricopa County's public health department has also undertaken further analysis of death certificates for a more complete heat surveillance program, which has been an asset for prevention efforts. These extreme heat policies, however, have not included vulnerable communities in planning or implementation.

Water Management and Water Rights for American Indians. Several state laws and statutes are in place to regulate water supply in Arizona. The Environmental Budget Reconciliation Bill (S.B. 1624) passed in 2011 includes in Section 2 amendments to the Arizona Revised Statutes allowing the Department of Water Resources to collect fees from state municipalities based on the population in each municipality. The statute establishes a water resources fund which is funded with fees paid to the department. The funds are used to carry out several water management tasks such as establishing and regulating ground and surface water rights. For example, the statute and its congruent rules put in place requirements for new subdivision development, requiring a water supply sufficient for 100 years be proven and approved by the Arizona Department of Water Resources.

For American Indians, access to water supply is a major concern that is exacerbated by climate change. According to one source, 40 percent of the population on the Navajo Reservation in Arizona lacks a potable water supply (Colby, 2007). The Arizona legislature has attempted to pass solutions to American Indians' water rights issues, but to date, most efforts have been insufficient. Policies describing water rights for American Indians exist, but they are described in treaties with the federal government rather than at the state level. The Supreme Court ruling *Winters v. United States* guaranteed American Indian tribes' rights to water near where they had settled. However, problems surfaced during implementation of this ruling: tribes failed to obtain access to water due to a lack of funding to develop their adjudicated water rights. An additional challenge has been the competing interests for water in the state. As American Indians have petitioned the government for their promised water, other stakeholders continue to bring forth challenges and appeals claiming they own the resource.

"It's my understanding that if we're going to be prepared [for climate change] there has to be a serious discussion around the legal rights we have to water. And this is an issue for indigenous groups around the world. At the community level, we haven't had that discussion yet."

– Navajo Key Informant, Arizona

Some communities and cities have engaged in water planning efforts in the face of looming water shortages. For example, Phoenix's Water Resources Plan provides guidance plans for water acquisition, management, and infrastructure. Its recommendations include necessary tasks to guarantee sufficient supply of water for a growing population. Different development scenarios are considered under the plan including water shortage conditions as well as the effects of climate change. At the community level, non-profit organizations support groups with water shortage concerns. For example, the Rural Community Assistance Corporation is a non-profit organization that assists western states including New Mexico and Arizona and their low income and rural populations. This organization provides both education and assistance to American Indian tribes in a variety of domains, including safe drinking water.

Other Climate Change Concerns. In Arizona, other climate change concerns have surfaced as public health priorities. These include emerging infectious diseases and the occurrence of wildfires. Arizona Department of State Health Services performs surveillance for West Nile Virus, which was first detected in the state in 2003, as well as Dengue fever and Lyme disease. Maricopa County Public Health Department also does surveillance for West Nile Virus and responds to complaints related to mosquitoes to perform appropriate testing of the insects. The Arizona State Forestry Division works to prevent and suppress wildfires throughout the state. However, our review does not reveal that these efforts have included any strategies to incorporate vulnerable populations into either surveillance or planning.

Evaluation of Programs and Policies. During our review, we sought the input from key informants about the perceived effectiveness of climate change policies as a whole and as they relate to vulnerable populations. One key informant noted that although the state's 2009 climate action plan has resulted in cities implementing measures to reduce greenhouse gas emissions, the efforts have not been especially visible. Key informants agreed that actions taken by county health departments were both effective and important for assisting residents adapt to climate-related challenges. These actions include Maricopa County's heat surveillance effort and its initiative to provide relief from extreme heat.

Key informants identified the following assets in Arizona: the state's environmental and climate research, grassroots movements and non-profit organizations. Research in climate change has been incorporated into the secondary education curriculum in the state. Workshops for middle school teachers have used the example of urban heat islands and their implications for equity for educational purposes. While this academic research has both included vulnerable populations and been incorporated into a local initiative, the scope or reach of other efforts remains limited as the majority of the state's climate change policies do not address the needs of the low income, racially/ethnically diverse and other vulnerable communities.

ARKANSAS

Climate change adaptation and mitigation efforts are, to some extent, underway in Arkansas. The state has initiated some policy efforts to curb the negative effects of climate change, but only a few programs at the community level have resulted from them. Non-profit groups throughout the state have taken the lead in developing programs to mitigate climate change effects.

Climate Change Priorities and Vulnerable Populations

Our selected review of Arkansas-based research studies described health effects on the state's population due to climate change, but did not focus specifically on vulnerable populations. Priority issues included projected incidence of respiratory and cardiovascular disease due to heat stress and asthma; and the anticipation of increased numbers of mosquito and water-borne diseases due to warmer and wetter climate patterns (Center for Health and Global Environment, 2009).

Climate Change Planning: Adaptation and Mitigation Strategies

In Arkansas, a statewide climate mitigation action plan was developed by the Governor's Commission on Global Warming in 2008. The plan's primary goals were to examine the current impacts of global warming on the state as well as to develop a comprehensive plan to mitigate those effects on the environment, the economy and the state's residents. The plan outlines 54 recommendations to reduce the state's greenhouse gas emissions to below 2000 levels in the following increments: 20 percent by 2020, 35 percent by 2025, and 50 percent by 2045. In addition, five technical working groups are in place to support the Governor's Commission on Global Warming, which is charged with conducting analyses and policy development. The working groups are made up of Commission members and supplemented by other climate change experts as needed. The technical working groups are supported by an Advisory Body, composed of state agency representatives from the following departments: Agriculture, Environmental Quality, Forestry, Highway and Transportation, Natural Resources Commission, Economic Development, Parks and Tourism, Public Service Commission, State Game and Fish Commission and the Oil and Gas Commission to offer added expertise. The plan is laid out by sector and includes recommendations for land use, transportation, and other priority sectors.

ARKANSAS CLIMATE CHANGE PLANNING AT A GLANCE

Climate change action plan developed
No statewide adaptation plan

Air Quality and Energy

State policy
H.B. 2445, S.B. 237, E.O. 09-07, H.B. 1050, Arkansas Water and Air Pollution Control Act

Local programs
Little Rock's Home Energy Affordability Loan Program, energy audits and education programs led by natural gas companies, government-sponsored home weatherization programs

Water Management

State policy
Act 472, The Safe Drinking Water Fund Program (Act 772), The Arkansas State Water Plan (Act 217, Act 1051), partnership with the EPA's WaterSense Program

Local programs
Audubon Arkansas, the Nature Conservancy, Heifer International

Emerging Infectious Disease

State and local programs
Surveillance by The Arkansas Department of Health

Emergency Preparedness

State program
The Arkansas Department of Emergency Management

"In Arkansas we are tackling climate change through different avenues: through the state water planning process or through the state energy planning process. But the processes don't address the impact [of climate change] on vulnerable or diverse populations."

- Key informant, Arkansas

Among the climate change action plan's recommendations are the development of adaptation strategies. Related work includes further investigating the impact of climate change on individuals, water resources, temperature-sensitive populations, and ecosystems. The action plan also implies the need for a vulnerability assessment; however a particular model for vulnerability assessment is not suggested.

Current Policies and Programs

Our review found little background literature describing the effects of climate change on Arkansas. However, our data findings as well as reports from the key informants indicated that significant climate issues in the state revolved around poor air quality and drought.

Air Quality and Energy. The state has enacted policies to promote energy efficiency. The Arkansas Public Service Commission (APSC) is authorized to address high energy costs by creating energy efficiency and conservation programs. In 2007, APSC issued an order approving programs with energy efficient goals that applies to investor-owned utility companies. In addition, in order to address the declining usage in gas utilities, APSC approved mechanisms to prevent the loss of revenue for certain utility companies. These mechanisms allow gas utilities to develop conservation programs while preserving revenues, and as a result utility companies have initiated energy efficient programs and policies. In December of 2010, the APSC issued ten orders as part of the Sustainable Energy Resource Action Plan for Arkansas that were intended to expand the state's energy efficient efforts. This was the first set of comprehensive policies developed to encourage utility energy efficiency programs. However, while these actions indicate some progress, other work has been thwarted. For example, 2005's H.B. 2445, which was introduced to promote better building standards in state facilities, was classified as no action because no goals specific to energy savings were included (EPA: State and Local Climate Energy Program).

The state has several policies in place encouraging fuel efficiency. The Arkansas Alternative Fuels Development Act (S.B. 237, Act 699) was signed in 2007 and specified that state agency-owned diesel-powered vehicles and equipment be converted to diesel fuel containing at least 2 percent biofuels by volume by 2009. In 2009, Executive Order 09-07 required that strategic energy plans be developed by individual state agencies including using more fuel-efficient vehicles to reduce energy consumption. In 2011, House Bill 1050 initiated the Arkansas Alternative Fuels Development Program which distributes grants for alternative fuels. Alternative fuel producers, feedstock processors, and alternative fuel distributors are eligible for this funding. Also under this program are rebates for making school buses more energy efficient.

Arkansas' "Air Code" was developed under the Water and Air Pollution Control Act and includes the rules and regulations for controlling air pollution. This program is administered by the Arkansas Pollution Control and Ecology Commission and the Arkansas Department of Environmental Quality.

In addition to state-level laws and regulations related to energy and air quality, several local programs are in existence. For example, currently underway are municipal actions such as Fayettesville's plan for sustainability and North Little Rock's "Think Global, Act Local" initiative to reduce greenhouse gases for the city. The City of Little Rock has also reduced greenhouse gas emissions through a Home Energy Affordability Loan Program in partnership with the William J. Clinton Foundation's Climate Change Initiative. The plan will provide 30 home energy retrofits and plans to quantify the results and share lessons learned with other stakeholders (Combating Climate Change: Clinton Climate Initiative).

Several local initiatives stem from APSC's previously mentioned order encouraging energy savings programs by utility companies. For example, Entergy Arkansas, Inc. Home Energy Solutions Program provides coupons for

the purchase of energy-efficient appliances and windows to residential customers. The Natural Gas Commercial and Industrial Energy Audits implement energy audits for natural gas customers to identify potential energy savings. Reports and recommendations are provided to customers and may suggest weatherization improvements or installing energy-efficient equipment. Also in place are Natural Gas Customer Education Programs in which several energy companies will promote messages to support a statewide campaign directing consumers to programs at each company with opportunities for energy efficiency.

Arkansas also has a weatherization program currently in place designed after a similar program developed by the U.S. Department of Energy. Targeting 2,500 of the most energy insufficient homes in the state, the goal of the program is to provide weatherization assistance in form of attic, floor, wall and duct insulation among other upgrades and replacements, paying up to 50 percent of the costs. In addition, compact fluorescent light bulb replacement programs are offered by several electric companies, who provide coupons toward the purchase of these energy-efficient bulbs.

Outreach and education programs are available through the Arkansas Department of Environmental Quality, the Arkansas Energy Office and the Arkansas Game and Fish Commission. Also involved in education and outreach is the Arkansas Agriculture Department and Forestry Commission which administers Arkansas' Alternative Fuels Development Program.

Water management. Water quality standards are set by the state to regulate the use of streams for public water supplies, agricultural uses, aesthetics, recreational uses, and other purposes. 1997's Arkansas Act 772 initiated the Safe Drinking Water Fund Program to distribute funds and resources to cities, counties, community water systems among others. These entities are eligible to receive funding for water-related programs including: compliance, water supply, public health, plan and design. The Arkansas State Water Plan, in accordance with Act 217 (1969) and Act 1051 (1983) consists of numerous reports that identify potential problems for both surface and groundwater and provide recommended solutions.

The Arkansas Natural Resource Commission is the agency charged with protecting the state's water and land resource programs in the state. Non-profit organizations, including Audubon Arkansas and the Nature Conservancy, provide both planning and management support to the Arkansas Natural Resource Commission's programs, and include assistance in developing irrigation systems for croplands. The Arkansas Farm Bureau has also been involved in the Commission's planning efforts. Another non-profit organization active in the climate change arena is Heifer International whose goals are to teach sustainable farming techniques. In addition, large companies such as Wal-Mart are beginning to participate in the dialogue of climate change. Central Arkansas partners with The EPA's WaterSense Program whose resources encourage conservation of outdoor, indoor, and irrigation water systems.

Other Climate Change Concerns. A number of state policies target emerging infectious diseases and emergency preparedness in Arkansas. The Arkansas Department of Health conducts surveillance for West Nile Virus, Dengue fever and Lyme disease. The Arkansas Department of Emergency Management helps residents prepare, respond, recover and mitigate damages during extreme weather events and other emergencies. Our review suggests that neither program uses strategies to target vulnerable communities of color.

Evaluation of Programs and Policies. We asked key informants in Arkansas to identify and describe state policies and programs that were most effective in addressing and meeting climate change goals. According to one informant, progress from the 2008 climate change action plan has been minimal. To date, only one of the plan's recommendations has been implemented (the aforementioned Sustainable Energy Resource Action Plan) and it resulted from two years of APSC inquiries involving public comments and hearings, sworn testimony, legal briefs, and technical conferences. The state does have the capacity to lay the foundation for climate change mitigation and adaptation work, both at the state and the local level. But as a key informant stated, there is no doubt that "much needs to be done to see these recommended policies become a reality." Effective actions to alleviate the stress of climate change effects include the weatherization programs provided with government support as well as the energy audits performed by utility companies. Though the state has made significant progress in energy efficiency policy, one informant stated that the policies are over-protective of the state's energy industry.

Key informants agree that assets in Arkansas have been government and non-profit support to help farmers install irrigation systems. They noted that non-profit groups such as Heifer International and the William J. Clinton Foundation who have special provisions within their programs for climate-related impacts, have helped the state in its pursuit of climate change goals. Wal-mart's commitment to sustainability in these small, rural communities is considered a positive feature for the state.

LOUISIANA

At the state level, with some focused exceptions, Louisiana has undertaken only limited planning for climate change adaptation and mitigation. Some communities have developed efforts on more pressing climate change concerns especially around receding coastline and preparing for emergencies resulting from an increased number and severity of storms.

Climate Change Priorities and Vulnerable Populations

Review of state-based investigations focused on the increased frequency of storms, including hurricanes, and the continued sea level rise. Of particular concern resulting from these changes in weather is the rise of indoor air toxins as many homes experienced high levels of these pollutants after flooding occurs (Committee on the Effect of Climate Change on Indoor Air Quality and Public Health, 2011). For example, reports such as "Adapt or Die" paint a picture of how the poorest suffer the effects of global warming more severely than compared with wealthier populations. Due to the city's geography below sea level, this report raises concerns of New Orleans' continued viability (Hertsgaard, 2007). Both of these resources cite poverty as the leading factor determining vulnerability.

Climate Change Planning: Mitigation and Adaptation Strategies

Louisiana has neither a formal statewide climate change mitigation plan nor a strategy for adapting to the effects of climate change. However, efforts have been undertaken at the city or parish level to plan for changes related to weather and climate concerns. For example, as an effort to mitigate adverse effects related to climate, the City of New Orleans developed a plan in 2009 titled "The City of New Orleans Carbon Footprint Report" which describes the city's participation in the Cities for Climate Protection (CCP) Campaign and summarizes the results of this campaign. The plan also outlines a greenhouse gas inventory as well as describes current programs for their reduction, and makes recommendations for the future.

Despite the lack of a statewide adaptation strategy, efforts at the community level have been taken to proactively plan and prepare for the effects of extreme weather events. For example, the local community of Mandeville has an adaptation plan to incorporate sea level rise into planning and decision making for land use. The plan aims to allow Mandeville to continue to grow in a sustainable way as well as ensure the community's resiliency. In addition, the Coastal Protection and Restoration Authority has drawn

ARKANSAS CLIMATE CHANGE PLANNING AT A GLANCE

Climate change action plan developed
No statewide adaptation plan
New Mexico's Drought Planning Team established
New Mexico Wildlife Strategy is sector-specific adaptation plan in the state.

Air Quality and Energy

State policy
E.O. 2005-033, Efficient Use of Energy Act, S.B. 994, H.B. 305, H.B. 205, S.B. 418, the Renewable Energy Act, S.B. 237, S.B. 257, H.B. 375, H.B. 572, S.B. 647, the "Pit Rule."

Local programs
Sustainable Santa Fe Plan, Border 2012, Southwest Organizing Project

Water Management

State policy
Interstate Stream Commission investigates, protects and conserves water resources, State Water Plan Act requires that the state water plan be updated every five years

Local programs
WaterSense and WaterWise education programs

Emergency Preparedness

State program
Health Emergency Management Programs

Emerging Infectious Diseases

State and local program
Surveillance by New Mexico Department of Health

"In Louisiana, we have a large population of people of color; these groups were given the land that is less valuable which are the wetlands or swamp."

- Key informant, Louisiana

up coastal restoration and hurricane protection actions (including new alternatives to standard levees). The plan documents that Louisiana will be one of the first regions within North America to suffer the effects of sea level rise. These local mitigation and adaptation plans indicate geographic location as the contributing factor for increased vulnerability to Louisiana's continued weather-related challenges but do not include sociodemographic variables.

Current Policies and Programs

According to the literature review and to key informants, the most pressing climate change challenges facing Louisiana are increased frequency and intensity of storms, including hurricanes, as well as the impending rise of the sea level. Our data findings also suggest that the state's poor air quality is a high priority. Some efforts have been undertaken at the state and community levels to combat the impacts of these climate and environmental-related changes.

Coastal Conservation. The magnitude of the sea level problem was identified in the 1970s. Chapters within the Louisiana Administrative Code enacted coastal management legislation in 1979; and permits for coastal use were specified under coastal management legislation with the intention of minimizing human impacts to the region. Since then, several planning initiatives have been undertaken proposing solutions to save the dramatic loss of land caused by warming temperatures.

Act 6, a statute passed in 1989, initiated the state's work in coastal restoration. The statute had many purposes including charges to conserve, restore, create and enhance the wetlands as well as to establish the Governor's Office of Coastal Activities and the Wetland Conservation and Restoration Authority. Both of these entities are required to direct and coordinate the efforts for the coast. The statute further develops a funding source for these activities by creating the Coastal Wetlands Conservation and Restoration Fund, which also receives matching federal funds. In 1998, the Wetland Conservation and Restoration Authority, in collaboration with other entities began creating blueprints for a coastal restoration plan. The collaborating entities included the Louisiana Department of Natural Resources, parish governments and the Coastal Wetlands Planning, Protection and Restoration Act Task Force. The initiative's purpose was to create a plan for coastal sustenance as well as design an ecosystem management technique in conjunction with the communities within the state. The resulting document entitled "Coast 2050: Toward a Sustainable Coastal Louisiana" was released in 1998. This document enumerates the local, state, and federal approaches addressing the significant concern of a diminishing coastline.

Recommendations from the Coast 2050 report were developed into a report by the Louisiana Coastal Area and served as the foundation for their Ecosystem Restoration Plan. In 2004 the plan was submitted to Congress for approval, though funding was later reduced to $2 billion from $14 billion. Before Congress approved the plan's recommendations, however, Hurricane Katrina hit Louisiana. Eventually, the report resulting from this effort advanced to the "Near-Term Priority LCA" plan which was granted under the Water Resources Development Act of 2007.

In the aftermath of Hurricanes Katrina and Rita, in 2005, Louisiana passed Act 8 which restricted the Wetland Conservation and Restoration Authority. The new body, The Coastal Protection and Restoration Authority (CPRA), became the designated authority and coordinator of all efforts to promote coastal protection and restoration over the long-term. Included in this coordinated effort, are both flood control and wetland restoration which were previously separate areas. The act mandates that CPRA set clear priorities to meet coastal protection needs in the state. In 2007, CPRA released "Louisiana's Comprehensive Master Plan for a Sustainable Coast" and has updated the plan in early 2012 with more specific provisions for rebuilding the coast with input from state, national and coastal scientists. The plan, assuming a budget of $50 billion, details specific projects necessary to restore the wetlands. Before any of the projects can be undertaken, however, the plan must be approved by the legislature.

Several local entities incorporate planning tools to evaluate the effects of sea level rise on their communities. One example, "REACT" or Real-time Emergency Action Coordination Tool, uses weather data from St. Tammany Parish and other sources. Data are combined with other information and transferred to

an emergency management system which, in turn, creates a visualization of the information. Statistics are captured in real-time as water rises.

Also involved in wetlands restoration efforts are the Army Corps of Engineers who have started closing the Mississippi Gulf River Outlet as part of the "Sewerage and Water Board Assimilations Project." This body of water has been implicated as a cause in the destruction of wetlands.

Air Quality & Energy. The legislature in Louisiana has enacted few laws to regulate energy and improve air quality. No greenhouse gas performance standards or reporting are required in the state. Louisiana also lacks a renewable portfolio standard. However, energy efficient policy has been incorporated into building efforts after Hurricane Katrina, and the 2006 International Residential Code is mandatory statewide. In 2007, S.B. 240 was passed, specifying that state building or renovation efforts must exceed state energy efficiency targets by 30 percent. Policies targeting net metering, or the billing arrangement that allows customers to receive savings as a result of their clean energy systems, have become more effective with the enactment of recent legislation. Act No. 543 was signed into law by the governor in 2008 and amends the state's net metering standards and expands the limit of kilowatts to meter for non-residential systems. S.B. 359 was passed in 2008 to increase the eligible size of commercial and agricultural power generators.

Also in 2008, the governor signed Executive Order BJ 2008-8, termed "Green Government," with several objectives: to establish energy efficiency goals for state-owned buildings; to undergo energy analysis of all state facilities and take action to reduce energy consumption; to develop fuel economy goals for the state fleet of vehicles and to develop a plan to meet those goals; and to review purchasing practices to conserve energy by procuring energy efficient appliances. At the local level, energy efficient programs for utility customers are available in New Orleans, but are not present outside of the city. For example, Energy Smart is a citywide program allowing all New Orleans residents to receive weatherization retrofits to their homes without out-of-pocket costs.

Louisiana has enacted few laws targeting air quality. One investigative exception is H.B. 661, passed in 2009, which establishes funding for research and development for geologic sequestration of carbon dioxide emissions, a process that curbs their release into the atmosphere.

Other Climate Change Concerns. Policies related to emerging infectious diseases, emergency preparedness and water management also have implications for the manner and degree in which individuals are affected by Louisiana's changing climate. The Louisiana Department of Health & Hospitals began West Nile Virus surveillance in 2000. Surveillance is also ongoing for Dengue fever and Lyme disease. Louisiana's Department of Health & Hospital's Center for Community Preparedness maintains disaster preparedness efforts for the state; and programs such as the previously mentioned "Project Reconnect" draw on universities for expertise and support.

In 2000, the governor signed an Executive Order to create the Water Policy Advisory Task Force. This task force was charged with creating a comprehensive water management plan for the state; its recommendations included enacting a short-term plan to protect aquifers and surface waters. In 2001, S.B. 965 was enacted to create the Water Management Advisory Task Force to begin the process of creating a statewide comprehensive plan. To date, however, the state still lacks a legislatively mandated water policy.

Evaluation of Programs and Policies. Louisiana has made some effort to plan for and adapt to its climate challenges. According to key informants, however, these efforts so far have not focused on protecting vulnerable populations including low income individuals and communities of color residing in the zones most susceptible to these effects. Noticeably absent are robust state and local policies aimed at improving air quality, a climate-related concern across the state.

According to a leader from a tribe located on Louisiana's coast, coastal preservation efforts for lower Bayou communities have been minimal to date, as these communities have essentially been termed "unrescuable." In many ways, the American Indians who inhabit these lands are facing a loss of culture as they may eventually be forced to move. The conversation has focused on actions to preserve the city of Houma while lower Bayou communities are ignored and presented with few options as their land disappears.

Though our review indicates programs such as "Project Reconnect" include vulnerable communities into disaster planning, key informants noted this to be the exception. For example, in general, evacuation information rarely takes into account cultural-specific customs or circumstances. American Indian groups may not trust city or other officials when given information regarding evacuation. However, they do look to tribal leaders for advice on planning.According to key informants, plans for Louisiana's coast, such as Coast 2050, have not been exceptionally visible or effective. Coastal communities in Louisiana anticipate the release of Louisiana's Comprehensive Master Plan for a Sustainable Coast, which is slated for early 2012 though they realize that during the legislative approval process competing priorities may influence which recommendations are carried out. Key informants reinforced the value of maximizing transparency during this process.

NEW MEXICO

New Mexico has taken several important steps to planning for climate change though many have been slowed or halted in their initial stages of implementation after changes in administration. Not unlike other surrounding states, New Mexico's foremost climate-related concerns are drought as well as poor air quality. And to some extent, both the state and communities developed policies and programs to combat these challenges.

Climate Change Priorities and Vulnerable Populations

New Mexico-based literature cited concerns around lack of air conditioning, health insurance and general access to health care for populations more vulnerable to the social and health consequences of extreme weather events. Individuals with pre-existing illnesses such as respiratory or cardiovascular disease or outdoor workers were identified as more susceptible to the effects of poor air quality and toxins (The Potential Effects of Climate Change in New Mexico, 2005). A report entitled "Death by Degrees: The Health Threats of Climate Change in New Mexico" identified adverse health effects related to extreme heat, flooding, hailstorms and landslides. Populations determined more at-risk to these effects were the poor and those who were uninsured (Physicians for Social Responsibility, 2000). Though the literature identified in New Mexico describes specific populations and their vulnerability, little specific attention is given to race, ethnicity and language. A more comprehensive model for determining vulnerability is also lacking in the state.

Climate Change Planning: Adaptation and Mitigation Strategies

New Mexico has an official climate change action plan. The plan describes 69 recommendations for meeting the greenhouse gas emissions target outlined within former Governor Richardson's Executive Order. The report also details the projected growth of the state's greenhouse gas emissions, the targets specified by the Executive Order and a projection of emission reductions expected if the recommendations are implemented in full. New Mexico also has mandatory reporting of greenhouse gas emissions by industries such as petroleum refineries and cement manufacturing plants, among others. A phase-in reporting system is outlined to include data for carbon dioxide and methane emissions as well as nitrous oxide and other emissions.

New Mexico's Drought Planning Team, created by former Governor Richardson, has the mission of creating a plan for several key areas: 1) assessing vulnerabilities to drought throughout the state; 2) identifying strategies to reduce the effects of drought before they occur; and 3) planning appropriate responses to drought effects. Drought action plans have been developed yearly with the most

NEW MEXICO CLIMATE CHANGE PLANNING AT A GLANCE

Climate change action plan developed
No statewide adaptation plan
New Mexico's Drought Planning Team established
New Mexico Wildlife Strategy is sector-specific adaptation plan in the state.

Air Quality and Energy

State policy
E.O. 2005-033, Efficient Use of Energy Act, S.B. 994, H.B. 305, H.B. 205, S.B. 418, the Renewable Energy Act, S.B. 237, S.B. 257, H.B. 375, H.B. 572, S.B. 647, the "Pit Rule."

Local programs
Sustainable Santa Fe Plan, Border 2012, Southwest Organizing Project

Water Management

State policy
Interstate Stream Commission investigates, protects and conserves water resources, State Water Plan Act requires that the state water plan be updated every five years

Local programs
WaterSense and WaterWise education programs

Emergency Preparedness

State program
Health Emergency Management Programs

Emerging Infectious Diseases

State and local program
Surveillance by New Mexico Department of Health

recent recommendation report to former Governor Richardson in 2008. More recent recommendations or progress are not available.

A statewide plan for adaptation to climate change has not been developed nor does it appear to be in the development process. There is a sector-specific ecosystems adaptation plan in place titled "New Mexico Wildlife Strategy" which outlines specific conservation recommendations for particular species and habitats. Time- and cost-effective approaches are identified to achieving these recommendations.

Current Policies and Programs

Our review of the literature and data as well as input from key informants in the state suggests that the key climate change priorities for the state include poor air quality, drought, extreme heat as well as emerging infectious diseases. The following is a review of the current state and local policies that address these foremost climate concerns.

Air Quality, Energy, and Pollution. Former Governor Richardson issued Executive Order 2005-033 which put in place greenhouse gas emission reduction targets statewide. Specifically, the order has the goal of 2000 emission levels by 2012, 10 percent below 2000 levels by 2020 and 75 percent below 2000 levels by 2050.

The legislature has passed significant policies targeting energy efficiency. 2005's Efficient Use of Energy Act permits public utilities (both gas and electric) to roll out cost-effective programs for energy reduction. In 2007, S.B. 994 establishes the provision of tax credits for electric power plants that meet carbon dioxide emission requirements. This energy tax credit equals six percent of the eligible generation plant costs of the qualified generating facility up to a maximum amount of $60,000,000. H.B. 305 was passed in 2008 and its purpose was to add to the 2005 Efficient Use of Energy Act amendments by negotiating a more aggressive timeline for the reduction of energy use by investor-owned utilities. Included in the amendments were targets to reduce energy use by 10 percent by 2012 and 20 percent by 2020. Submission of an annual report to the Commission is required detailing compliance standards. In 2008, H.B. 205 was passed, which developed targets for energy efficiency for the state. An achievement of a 5 percent reduction from 2005 sales by 2014 as well as a 10 percent reduction by 2020 is required by each utility.

Also among the legislature's priorities are policies for renewable energy. In 2007, the former governor signed S.B. 418 which created a renewable energy plan for the state including mandating that 20 percent of an electric utility's power be generated from renewable sources (solar, wind, hydropower, geothermal, etc.) by 2020. The Renewable Energy Act, requires that investor-owned utilities offer a renewable energy tariff to their customers, which is voluntary. Customers of rural electric distribution co-ops are given the choice of buying green power to the degree that they are made available by the suppliers. All utilities are mandated to provide educational resources conveying the options of using green power. This rule also provides a "Renewable Portfolio Standard" requiring utilities to produce at minimum 5 percent of energy sales from renewable sources by 2006 and at minimum 10 percent by 2011. Expanding the Advanced Energy Tax Credit of 2007 is S.B. 237 (The Renewable Energy Tax Credit) which involves other types of renewable energy while S.B. 257, Solar Market Tax Development Credit, piggybacks on credits from the federal level. Other tax-based assistance from H.B. 375 provided credit for heat pumps, both purchase and installation. H.B. 572, Solar Energy Improvement Special Assessments, gives counties the authority to assess solar energy improvements if properties owners request it, and will make access to financing easier. S.B. 647, the Renewable Energy Financing District Act, permits counties to develop financing districts for renewable energy. The purpose is to assist in funding renewable energy improvements (solar, geothermal, and wind).

In addition to legislation targeting the reduction of greenhouse gases, improved energy efficiency and renewable energy goals, the state has policies protecting its resources from other types of environmental contamination. The Oil Conservation Division of the New Mexico Energy, Mineral and Natural Resources Department is the authority for underground injection in the state and its administrative code includes Rule 19.15.17, also termed the "Pit Rule" which regulates oil field waste pits to prevent contamination of the surrounding environment including water supplies. This rule was amended in 2008 to include higher standards for waste disposal after increased incidence of groundwater contamination was reported in the state.

The Sustainable Santa Fe Commission was re-commissioned in 2006 to draft the Sustainable Santa Fe Plan. The plan, adopted in 2008, includes plans for greenhouse gas emission reduction in the community. A 2009 progress report detailed barriers and next steps to each item in the plan. Common barriers included limited staff time and funding. More recent progress reports are not available, however.

Another important resource for New Mexico's communities is a federal grant titled "Border 2012." This Environmental Protection Agency plan gives support to local entities and funds projects to improve both public health and the environment on the U.S.-Mexico border. Its six goals include reducing water, air, and land contamination, improving environmental health and environmental stewardship as well as improving emergency preparedness in the region.

"The majority of people impacted [by climate change] are low income communities of color. The focus now is on how to group them together when our governor is against us. We need a statewide strategy to push back. We can't work in silos."

- Key informant, New Mexico

In addition, the state's universities have been focusing on climate-related research; for instance, several researchers at The University of New Mexico focus on the science of environmental health and conservation. New Mexico State University, jointly with HelioDynamics, Inc. and the City of Albuquerque have developed Solar Combined Heat and Power. This system's installation at the Albuquerque Sunport develops space cooling and heating as well as electricity with renewable sources rather than fossil fuel sources. Research at both of these institutions, however, does not explicitly include the effects on vulnerable communities.

Community level environmental justice initiatives have made some effort to include racial and ethnic minorities. New Mexico has grassroots organizations in existence, such as the Southwest Organizing Project, who make a concerted effort to advocate for disenfranchised groups in the face of increased change and variation in climate.

Water Management. The Interstate Stream Commission has the authority to investigate, protect and conserve the state's water resources. The commission is made up of eight members who are appointed by the governor while the ninth member is the State Engineer. This commission is also required to review the state water plan every five years while the State Water Plan Act mandates that the plan be updated with changing conditions. The state's Water Use Program, part of New Mexico Office of the State Engineer, coordinates and maintains inventories of surface and groundwater use. The Water Conservation Program, under the same department, has the following goals: to increase awareness regarding the value of water; to assist entities providing water conservation programs; and to assist policymakers in efforts to conserve water.

WaterWise is an educational program, supported by the Water Use and Conservation Department of the Office of the State Engineer. Its goals are to increase awareness of this resource and to promote water efficient practices. Other educational programs in the state include its partnership with the EPA's WaterSense program, which encourages checking irrigation systems for leaks.

Other Climate Change Concerns. New Mexico's challenges related to weather and climate are not limited to drought and poor air quality. Our review found that emerging infectious diseases, extreme heat and challenges around disaster preparedness are likely to affect certain groups to a greater degree. At the state level the New Mexico Department of Health provides programs to monitor and plan for two of these issues: it performs surveillance and issues weekly reports on the incidences of West Nile Virus, Dengue fever, and Lyme disease; and oversees the Health Emergency Management Programs which includes special planning tools for individuals with disabilities, who reside on the border and for Spanish-speaking populations, the elderly and American Indians. We did not identify state or local policies focused on mitigating the effects from extreme heat.

Evaluation of Programs and Policies. Key informants in New Mexico provided a qualitative review of the state's current progress toward its climate change targets. They noted that actions already implemented to combat effects of climate change, while previously established, have now been disbanded. The climate change panel responsible for the climate change action plan is no longer in place, and no new, significant actions have been taken to advance these goals; furthermore, the plan is not referenced among state government officials. The change in administration to more conservative leadership has prevented these policies from being implemented, and political opposition has surfaced as the most significant barrier in this state.

One key informant emphasized that low income communities feel the majority of these effects; though it is notable to mention that not all of these policies aimed at ameliorating effects from climate change were popular among environmental justice groups, especially those involving cap and trade plans. According to one key informant, the Border 2012 initiative is a promising resource to assist communities in sustainability efforts on the border, a community with greater poverty and concentrations of residents with limited English proficiency. In sum, New Mexico is an example of progress toward climate change planning being deterred by political opposition. Climate challenges have been addressed partially by current programs, with some modest focus on vulnerable populations. Some environmental organizers advocate for these groups; however official policies and programs at both the local and state level do not substantially include vulnerable populations.

OKLAHOMA

Oklahoma has employed few statewide strategies for climate change mitigation or adaptation. However, a number of statewide efforts have focused on planning, data collection and documentation of priorities. In addition, some communities have undertaken efforts to both prepare for and lessen the adverse effects of climate change.

Climate Change Priorities and Vulnerable Populations

In one of the leading state-based reports, "Statement of Impact of Climate Change and Its Implication for Oklahoma," the Oklahoma Climatologic Survey, established by the state legislature to provide residents with climatological services, recommends three activities to mitigate climate change in the state: 1) a comprehensive assessment of the state's social and economic vulnerability; 2) programs designed to promote energy efficiency; and 3) investment in renewable energy, especially since it has shown promise in the wind energy sector. A recent presentation, also by the Oklahoma Climatologic Survey, recommends that adaptation efforts be undertaken in Oklahoma. Among these recommendations was the assessment of hazards and their physical, economic, and cultural impacts as well as assessing which sectors were deemed more vulnerable to effects from changing weather patterns. Recommendations included more targeted assessments of impact on vulnerable communities (Shafer, n.d.). This information indicates that researchers and policy makers in Oklahoma are in the preliminary stages of climate change adaptation and mitigation efforts, and much evaluation still needs to be done to adopt policies to prepare their citizens, especially vulnerable populations, for future weather-related events and environmental hazards.

Climate Change Planning: Adaptation and Mitigation Strategies

The Oklahoma Conservation Commission's Carbon Sequestration Certification program is currently bringing together information on climate change. The purpose of the program is to verify and certify carbon sequestration from the agriculture, forestry, and geologic sectors. In the future, the plan may include wetlands restoration in the verification of carbon offsets. The National Wetlands Inventory is already in place with the purpose of promoting wetlands restoration as well as soil carbon research and mitigation of carbon sequestration. Oklahoma's climate registry is in place to monitor and report greenhouse gases.

Oklahoma's Comprehensive Wetlands Conservation Plan outlines an approach for successful management of the

OKLAHOMA CLIMATE CHANGE PLANNING AT A GLANCE

No climate change action plan developed
No statewide adaptation plan

Air Quality & Energy

State policy
H.B. 3028, The Conserving Oklahoma Act (H.B. 394), H.B. 1815

Local programs
Tulsa's Partners for a Clean Environment, and a long-term sustainability plan; Choctaw Healthy Energy Living Project, Oklahoma State University Medical Center Retrofit project, Get Around OK

Wetlands Conservation

State policy
Oklahoma Scenic Rivers Act, H.B. 1235, Oklahoma Environmental Quality Act

Local programs
Education programs such as Project WET and Wonders of the Wetlands, the Conservation Cost-Share program

Emerging Infectious Disease

State and local program
Surveillance by The Oklahoma State Department of Health

Disaster Preparedness

State program
Oklahoma Department of Health houses the Emergency Preparedness and Response Division

Water Management

State policy
S.B. 288, S.B. 510

Local program
Oklahomans for Responsible Water Policy

state's natural wetlands. The strategy also includes future needs and highlights unresolved issues. The plan also reviews and discusses limitation of available Wetland data and science. Additionally, the Office of the Secretary of the Environment established the Oklahoma Wetlands Technical Working Group, which collects technical data used to report on the status of the wetlands.

Adaptation efforts for the state of Oklahoma were discussed over a half-day seminar hosted by the Oklahoma Climatological Survey and the Southern Climate Impacts Planning Program in 2009. The workshop had several goals including initiating a conversation on how to ensure community members' resiliency during extreme weather events, as well as to determine any feasible and cost-effective projects that may not require new resources, and to identify future research needs.

Current Policies and Programs

Leading climate challenges identified within the state have impacts on air quality and energy as well as the state's wetlands. The programs and policies in place that have been developed to address these are few but are outlined below.

Air Quality and Energy. In 2010, the governor signed into law H.B. 3028, which created renewable energy goals for the state. Identified targets include 15 percent of the electricity generated in the state be generated from renewable sources (wind, solar, biomass, hydro, etc) by 2015. The Conserving Oklahoma Act, H.B. 394, enacted in 2008, specifies that all new or renovated state buildings use energy efficient standards.

2011's H.B. 1815 requires that owners pay an annual flat fee on vehicles using propane, compressed natural gas, and other heavily-polluting fuels. This law was passed instead of a motor fuel excise tax. The Oklahoma Department of Environmental Quality's Air Quality Division is charged with implementing the federal Clean Air Act to reduce emissions and improve air quality in the state.

Most of the local programs associated with energy we identified have been implemented in the city of Tulsa. For example, the city's Public Works Department coordinates Partners for a Clean Environment. This initiative extends free training on pollution prevention, public outreach and technical assistance to individuals committing to help the environment. The aim is to lessen the amount of hazardous materials and the amount of waste across commercial, governmental and residential entities. It is administered by the Quality Assurance section of the Environmental Operations Division.

The Oklahoma State University Medical Center Retrofit project calls for the upgrade of certain equipment to use more energy-efficient models as well as to maximize cost-effectiveness. A total of $1.4 million dollars is available to fund this program while its results will generate an estimated $210,000 in energy savings annually.

The City of Tulsa, with funding from Energy Efficiency and Conservation Block Grant (EECBG), conducts energy audits among the city's top energy-consuming buildings. The program also funds the implementation of the audit's recommendations. The goal is to reduce 25 percent of the energy consumption in these city-owned buildings. Also with EECBG funds, the city plans to perform feasibility assessments among selected city facilities for renewable energy, especially solar energy.

The city has replaced highway lighting with more energy efficient models such as LED lighting. Also created with the EECBG funds, was a 3-5 year plan targeting broad goals in sustainability. Included are plans to monitor greenhouse gas emissions as well as to create, implement and measure success of an education program focused on sustainability. The city's long term sustainability plan will also report the cost savings and energy savings over time of the city's goals.

City of Tulsa employees can carpool through a match program titled Green Traveler which aims to reduce traffic, emissions, as well as the costs and stresses associated with commuting. Get Around OK is a rideshare program developed by the Association of Central Oklahoma Governments and is sponsored by the Oklahoma Department of Environmental Quality's Air Quality Division. This same division also provided educational opportunities related to alternative energy during the 9th Annual ScienceFest.

Communities indigenous to the state of Oklahoma are also engaged in climate-related actions. The Choctaw Healthy Energy Living Project will support both educational efforts as well as programs to improve energy efficiency within the Choctaw Nation Indian Hospital System. The hospital system is integral to the community as it is the only provider of inpatient care within a 25-mile radius. Five facilities will benefit from an upgrade to energy-efficient lighting as well as receive education and training for employees and patients with the goals of reducing energy use overall. This project is essentially a pilot program in the area, and marketing materials will be distributed to other hospitals, such as small, tribal hospitals, to encourage similar actions.

"In Oklahoma, our strength is our tight-knit communities and strong social structure which can be tapped into when spreading messages."

- Key informant, Oklahoma

Wetlands Conservation. Oklahoma Scenic Rivers Act mandates preservation efforts for the state's free flowing rivers and streams. It also allows for the creation of a Scenic Rivers Commission for the purpose of supervising studies as well as to distribute financial support to qualifying entities. H.B. 1235, passed in 1993, targets federal wetlands regulation and their restricted uses. This law requires the state legislature to approve the acquisition of wetlands over the objection of the landowner.

The Oklahoma Environmental Quality Act of 1992 designated the Conservation Commission, with the role of coordinating environmental education across the state. The commission's program, Oklahoma Comprehensive Wetlands Conservation Plan, emphasizes a public and private partnership effort to manage the wetlands through education, technical assistance, and incentives.

As part of the Oklahoma Environmental Quality Act, the Conservation Commission assists in providing education programs including Project WET, which provides education regarding water conservation to children, adults and other educators and WOW The Wonder of Wetlands, which is part of the Wetlands Conservation program and serves as a resource guide for those teaching grades kindergarten through 12th.Other initiatives include Conservation Cost-Share, which assists landowners financially in implementing soil and water conservation best practices with the goals of improving the quality of water and soil throughout Oklahoma.

Other Climate Change Concerns. Other climate-related priorities in Oklahoma's include preventing emerging infectious diseases, promoting efficient water management and preparing communities for storms, tornadoes, and flooding. The Oklahoma State Department of Health performs surveillance for Lyme disease and Dengue fever. In 2003, S.B. 288 was passed, regulating groundwater permitting throughout the state. Developed after the passage of S.B. 510, the state also has in place the Oklahoma Comprehensive Water Plan (updated for 2012). It was primarily created to address future water demands of the state. Oklahomans for Responsible Water Policy is a citizens group with the mission of protecting the use and value of the state's precious resource.

Developed in 2002, the Oklahoma Department of Health houses the Emergency Preparedness and Response Division to assist citizens during disasters. These efforts include measures for vulnerable populations, including children, pregnant women, the elderly, those with existing health conditions and those with limited English proficiency.

Evaluation of Programs and Policies. One key informant working within the state's Department of Environmental Quality singled out small rural communities who tend to rely on farming and agricultural production—particularly those without irrigation systems as especially vulnerable to drought and other climate change effects in Oklahoma. Storms, such as a 2008 ice storm which left several counties in the southeastern Oklahoma without electricity for weeks were also cited as disproportionately affecting low income communities due to lack of resources to purchase needed generators when public utilities are unavailable.

In conclusion, Oklahoma has undertaken more assessments and research but is generally lacking efforts to plan and act on mitigating climate change effects. However, some promising actions have occurred at the community level, where the city of Tulsa has taken the lead in promoting sustainability and energy efficiency at the local level while some American Indian tribal organizations have incorporated climate change education in health care facilities.

TEXAS

Texas, though not considered a leader in climate change efforts, does have a number of community level policies and programs that aim to mitigate the effects of a changing climate. In general, however, statewide, goals for climate change adaptation and mitigation have not been developed.

Climate Change Priorities and Vulnerable Populations

Texas research and investigations we identified address the effects of sea level rise and increasing heat on the area. According to one key informant, the consequences for increasing temperatures in Texas are far-reaching. Increasing heat affects the state's water supplies due to increased evaporation and reduced stream flow and places an increased demand on water by humans, plants and animals. Also related to heat and drought are an increasing number of wildfires and floods. Rising heat stress also has a negative impact on ecosystems, affecting species' adaptation and migration behaviors.

Another prominent climate challenge in the state is rising sea levels and the impending impact on development and sustainability within the coastal zone. Modeling of sea level rise on the three county Galveston Bay area indicates that over the next 100 years, assuming a 1.5 meter level rise, approximately 99,000 households will be displaced and over 75,000 structures will be affected. Also included in the model are the consequences for public facilities, with projections estimating that sea level rise would adversely affect 16 wastewater treatment plants including 9 solid waste sites. Significant governmental resources will be required to protect communities from the potential health effects of such damage (Yoskowitz, Gibeaut, & McKenzi, 2009). This report provides valuable insight into the socioeconomic impact of climate change on this three county region, though lacking from its findings are implications for specific mitigation and adaptation strategies.

Though the research conducted for the region of Texas does imply certain populations are more vulnerable to the consequences of climate change, these efforts do not offer a comprehensive model or framework for identifying or addressing the needs of vulnerable populations.

Climate Change Planning: Adaptation and Mitigation Strategies

Texas lacks formal, statewide adaptation and mitigation plans. Perhaps in response to this inattention as well as the need to address more community based priorities, areas within the state have undertaken initiatives in planning

TEXAS CLIMATE CHANGE PLANNING AT A GLANCE

No statewide climate change action plan
No statewide adaptation plan

Air quality and Energy

State policy
H.B. 2201, H.B. 469, Texas Clean Air Act, S.B. 20, H.B. 3693, S.B. 7

Local programs
Austin Climate Protection Plan, Houston's Flex in the City, Power to the People, Clean Vehicle Technology Initiative, the Mayor's Hybrid Initiative, Vertical Gardens Matching Grant Initiative, rebates for cool roofing installations and weatherization of homes.

Water management

State policy
H.B. 803, H.B. 2660, H.B. 2663, S.B. 1094, H.B. 3338

Local programs
City of Dallas Water Utilities conservation efforts, The Edwards Aquifer Protection Plan

Coastal Conservation

State policy
The Coastal Public Lands Management Act, the Texas Coastal Wetland Acquisition Act, Coastal Erosion Planning and Response Act (S.B. 1690)

Local programs
Texas Sea Grant, the Texas Coastal Watershed Program

Disaster Preparedness

State program
Texas Division of Emergency Management, part of the Texas Department of Public Safety manages these program

Local programs
Project Reconnect

Wildfires

State and local programs
Texas Forest Service and the Texas Wildfire Relief Fund provide local resources for fire prevention

Emerging Infectious Disease

State and local programs
Surveillance by state and local health departments

Extreme Heat

Local program
Vertical Gardens Matching Grant Initiative, cool roof installation in Austin and Frisco

for climate change. For example, the Houston-Galveston Area Council formed a panel to investigate the impact of climate change in the Houston-Galveston area. This panel developed the "Foresight Panel on Environmental Effects Report" in 2008 with a twofold mission: to describe the consequences of climate change on the region and to make adaptation recommendations. This report hypothesized the potential effects of climate change on the area using the Intergovernmental Panel on Climate Change's change scenario and projected the following will occur by 2100: an average annual temperature rise of two to seven degrees Fahrenheit; a sea level rise of two feet; greater frequency of intense weather events; and equivalent precipitation levels but with increased dry spells and more intense storms. The Panel's work also included projected effects on health and safety, public infrastructure, and natural systems. Twenty-five regional adaptation recommendations were developed to address these potential consequences and include objectives such as improving coordination in evacuation plans, creating an implementation plan for heat-wave management, improving coastal erosion management, implementing green building standards, among others. Also included in this report is a model for vulnerability assessment in which the authors identify vulnerable populations including those in poverty, the elderly, the infirm, the very young, and those with mobility issues. The panel's model does not explicitly include racially and ethnically diverse populations (Houston-Galveston Area Council, 2008).

Texas does have a greenhouse gas registry after a long history of neither mandatory nor voluntary greenhouse gas reporting. The current registry is independent and voluntary (Center for Climate and Energy Solutions, 2012). Without a statewide mandatory plan, efforts for climate change mitigation, including greenhouse gas reduction, are often executed at the city or county level. For example, the City of Houston developed the "Emissions Reduction Plan" in 2008, outlining baseline emissions inventory, as well as measures and 2010 emissions goals for the following areas: building and structures, mobile sources, and waste (Green Houston, 2008). This plan has facilitated the development of more than 20 projects in the city and estimates that they have curbed more than 1.5 million tons of greenhouse gas emissions.

In November 2009, a roundtable discussion was held at the University of Texas at Arlington's School of Urban and Public Affairs. The subsequent report "Planning for Climate Change Mitigation and Adaptation in North Texas" included guidance from city planning directors, public citizens, representatives from the Environmental Defense Fund, among others. Its findings highlighted the economic situation as dominating progress in climate change policy, especially in light of carbon-intensive development in the North Texas area. By the panel's assessment, North Texas businesses have made little headway in climate change mitigation processes, with the exclusion of the city of Denton which has increased purchases of wind power. Another major finding included the political sensitivity of climate change, and contributors agreed that terms such as "sustainability" or "urban heat islands" were more socially acceptable than "climate change" in their conservative communities. Municipalities in the North Texas area have had very little in the way of adaptation policies or efforts implemented (Howard & Hurst, 2009).

Current Policies and Programs

A number of legislative policies have emerged at the state level to address these challenges, and some communities have enacted climate change.

Air Quality and Energy. Legislative policies addressing air quality have been diffuse. H.B. 2201, enacted in 2005, designates the appropriation of $22 million in grants and incentives for low-emission projects. This law included expedited permitting for projects such as Future Gen, which is a public-private partnership to build low-emission, coal-fueled power plants. In 2009, H.B. 469 established a sales tax exemption, as well as a franchise tax credit, and reduction of oil tax rate incentivizing lowering emissions. The Texas Clean Air Act establishes the Texas Commission of Environmental Quality (TCEQ) as the regulator, and for oversight of the state's air quality. Texas Emissions Reduction Plan (TERP) appropriated $150 million to fund local and private programs with the aim of lowering nitrogen dioxide emissions and bettering air quality in ozone non-attainment

regions. This program provides funding to eligible individuals, businesses or local governors to reduce emissions, and new grant opportunities are ongoing.

S.B. 7, passed in 1999, developed the first Renewable Portfolio Standard in the state. Governor Perry, in 2005, signed S.B. 20, which increased the amount of renewable generation required in Texas to 5,880 megawatts by 2015. This equates to 5 percent of the state's electric demand. Also included is a 2025 target of installing 10,000 megawatts capacity of renewable energy generation. By 2025, the law also specifies that Texas meet 500 megawatts of that target with non-wind energy in an attempt to diversify the energy portfolio. In just six years, Texas achieved its ten year goal associated with the Renewable Portfolio Standard, making this program successful. Along with renewable energy law, Texas has also passed legislation directing energy efficiency standards. The Energy Efficiency Resource Standard (EERS), established in 1999, requires utilities to employ end-use efficiency to decrease their load growth by 10 percent. In 2007, Governor Rick Perry signed H.B. 3693 which increased this load growth progressively. The law also commissioned a study to investigate increasing the saving targets to 50 percent by 2015. The study found that these targets were feasible. The law further specifies that utilities that outperform the minimum saving goals are eligible for incentives which utilities have generally done.

Local policies and community programs have also been implemented to achieve energy and air quality goals. In 2008, the Austin Climate Protection Plan and Action Items was developed by Austin Energy and presented to the Austin City Council as an outline of environmental goals at the municipal and county levels. Goals include making Austin facilities carbon neutral by 2020, to make Austin Energy the leading utility in the nation for greenhouse gas reduction, to implement energy efficient building codes, as well as to establish an interdepartmental City Climate Action Team who reports to the City Council. A 2009 progress report on the Austin Climate Protection Plan found Austin Energy programs implemented through the plan have avoided 188,452 tonnes of greenhouse gas emissions, though some have described its overall impact and outreach as "feeble" (Gregor, 2009).

The city of Houston has a number of initiatives in place to improve air quality and reduce emissions. Flex in the City, a program implemented by the city of Houston with the goal of reducing rush hour traffic, encourages employers to implement compressed work weeks, alternative start and end times, and telecommuting. Power to People is an education campaign sponsored by Wal-mart, Sam's Club, and CenterPoint energy with the goal of education on ways to reduce energy consumption. The Clean Vehicle Technology Initiative, which is implemented by the Houston Airport System, is designed to improve air quality by directing its tenants to state and federal grants to reduce air emissions. The Houston Airport System has also implemented a formal Environmental Management System which is charged with acting as an oversight for assessing the organization's environmental goals. In 2006, Houston's General Services Department began a project to implement citywide lighting retrofit and replacement; in 2005, the city initiated the Mayor's Hybrid Initiative which specified the replacement of 50 percent of the city's vehicles with gasoline/hybrid vehicles by 2010. The city of Houston also attempts to decrease its energy use by employing use of light emitting diode (LED) bulbs in traffic lights in favor of traditional incandescent bulbs.

The Dallas City Council authorized a measure that would make Dallas the lead municipal purchaser of renewable energy in the nation. The city of Dallas also offers a weatherization assistance program to help homeowners increase the energy efficiency of their homes. Houston weatherized 641 homes in collaboration with CenterPoint Energy to lower the emissions related to power generation.

Water Management. The principal water quality law in the state is the Texas Water Code, which implements portions of the federal Clean Water Act. However, unlike the federal act, the Texas Water Code applies to groundwater, surface water, and to nonpoint and point source pollution. H.B. 803 imposes new conservation prerequisites on groundwater resources. Before the condemnation of land to obtain groundwater, the city, county or subdivision must develop a plan for drought contingency, prepare a water conservation plan, show that it has tried and failed to obtain other water sources elsewhere and prove that it will require the water within ten years.

In 1999, the Texas Legislature passed House Bill 2660 which created the Texas Drought Preparedness Council. The bill designates the coordinator of the Division of Emergency Management of the Governor's Office as the State drought manager. Other entities appointed to the Council include representatives of the Texas Water Development Board (TWDB), the TNRCC, the Texas Parks and Wildlife Department, the Texas Department of Agriculture, the State Soil and Water Conservation Board, the Texas Department of Housing and Community Affairs, the Texas Forest Service, the Texas Department of Transportation, the Texas Department of Economic Development. The Council's main charge is to assess drought and water supply conditions and report its findings to the public. It also advises the

Governor about significant drought conditions. Other responsibilities of the Council include recommending specific provisions for a State response to drought-related disasters as well as advising regional water planning groups about related issues. It also assists in promoting effective coordination of drought planning activities among federal, state, and local agencies. The Council is required to report to the Legislature in January of each odd-numbered year about drought conditions in Texas.

The Council has the authority to determine if drought conditions exist within individual counties. When a countywide drought condition is declared, the Council is required to give notice to the chairman of the appropriate regional water planning group as well as each entity or individual required to develop a water conservation plan. The Council is required to develop, implement, and update a comprehensive statewide preparedness plan which can help mitigate the effects of droughts. The statewide plan is to provide for timely and systematic data collection, analyses, and dissemination of drought information and to define the duties and responsibilities of state agencies.

S.B. 1094 creates the Water Conservation Implementation Task Force to be overseen by the Texas Water Development Board with tasks such as evaluating and implementing water conservation strategies. Public utilities, in the past, have lost 30 percent or more of pumped water. H.B. 3338 requires these utilities to perform water audits periodically to calculate annual water loss. This information is used by regional water planning groups when deciding appropriate strategies for water management in developing regional water plans.

The City of Dallas Water Utilities is partnering in water conservation efforts with local hotels and restaurants. This program is, however, voluntary. Dallas Water Utilities also conducts free systems "check ups" for irrigation systems as well as to ensure that the watering schedule is appropriate for yard needs. The city also has a minor plumbing and repair program that assists water users in saving costs in electric bills and preventing waste by fixing minor plumbing problems. It also offers cost-saving pre-rinse spray nozzles to local area restaurants and provides a voucher for upgrading to energy-efficient, low-flow toilets.

Coastal Conservation. Several state policies are in place to regulate and promote conservation of Texas' coast. The Coastal Public Lands Management Act was updated in 1995 and requires the development of a comprehensive coastal management plan by the Land Office Commissioner. Required components include ongoing description of potential land and water uses within the coastal zone; a list of state and federal actions/laws that may have a direct impact on the area; guidelines on priority of uses; and an inventory of coastal natural resource areas. The Texas Coastal Wetland Acquisition Act attempts to acquire

"The year 2011 continues the recent trend of being warmer than the historical precipitation-temperature relationship would indicate, although with no previous points so dry it's hard to say exactly what history would say about a summer such as this one. Except that this summer is way beyond the previous envelope of summer temperatures and precipitation."

- Key informant, Texas

wetlands in a responsible way. Under the Act, the Parks and Wildlife Department is given the authority to acquire as well as manage coastal wetlands. This department, in conjunction with the Land Office Commissioner, can certify essential wetlands and make decisions on prioritizing acquisitions. Within the Parks and Wildlife Department, the Resources and Protection Division began efforts in 2005 to create a conservation plan with the focus on incentivizing private landowners in conservation efforts.

The Coastal Erosion Planning and Response Act (CEPRA) was enacted in 1999 after the passage of S.B. 1690. The coastal erosion response program is funded from state, federal, and local sources. The program invests in projects that evaluate the erosion response methods and engineer designs of preferred methods as well as funds beach, dune and habitat restoration. In addition, the Act funds research and data collection in support of these programs and assistance in the removal of debris in order to conserve prior investments.

In addition to state policy targeting the preservation of coastal lands, several other resources are available for community members to assist in planning for changes in the coastal environment. The Texas Sea Grant program awards researchers at universities to explore coastal and community sustainability and health. Researchers from Texas A&M University have used this granting venue to develop technology to help coastal residents plan for change. Their research produced the Texas Coastal Community Planning Atlas which employs Geographic Information Systems (GIS) data to create visual maps and aid decision-makers in future planning for coastal sustainability. The Texas Coastal Watershed Program then used this developed data set to create a new software model allowing coastal residents the ability to view the effects of climate change on their community. These climate change scenarios include water consumption, pollution runoff, and storm surge damage, with the software allowing participants to compare the consequences and test multiple situations.

Disaster Preparedness. In the face of increasing hurricanes, wildfires, and flooding, disaster preparedness has become an important issue as Texas attempts to prepare for climate changes. State level programs to prepare communities for disasters are administered through Texas Department of Public Safety's Texas Division of Emergency Management.

In an effort to include diverse communities into emergency preparedness, Baylor College of Medicine's Chronic Disease Prevention and Control has undertaken several projects. "Project Reconnect" will provide disaster preparedness to five communities. Ongoing technical assistance and site visits will be provided after the training. One goal of the project is to develop a Global Emergency Preparedness Risk Protocol. Other programs aim to build resiliency and increase communication among communities within areas with significant concentrations of low income and racially and ethnically diverse populations.

Wildfires. In Texas, the effects of rising temperatures and drought have culminated in disastrous wildfires. 2011 was the hottest summer on record for Texas. According to Lt. Governor Dewhurst, after 2011 brought the state's most severe wildfires and drought, the 2013 legislature will be charged with studying the impacts of drought on different sectors. The Natural Resources Conservation plans to study water conservation in the state, and the Agriculture and Rural Affairs committee will assess and make recommendations for drought impacts on the agricultural industry. The Subcommittees on Flooding and Evacuations, Transportation and Homeland Security will review policies in disaster preparation, evacuations and response. The Economic Development Committee will compile evaluations of the impact of

drought and wildfires, while the Intergovernmental Relations Committee will study housing issues and recommend ways to reduce fire risks for landowners. Reliability of power plants has become another priority concern as they require significant amounts of water to cool the plants. Reflecting this concern, the Business & Commerce Committee will evaluate drought's impact on nuclear, coal and gas plants (Galbraith, 2011). Though the legislature's future efforts appear promising, it is unclear that it will consider these issues within the broader context of a changing climate and even more unclear is if the needs of vulnerable populations, including racially/ethnically diverse and economically disadvantaged communities will be incorporated into these policies.

The Texas Forest Service implements wildfire prevention programs and ensures involvement at the local level to educate and create awareness among the public. The majority of the state, 250 out of 254 counties, are currently under a burn ban. According to The State's Firemen's and Fire Marshals' Association of Texas resources are insufficient at the local level for important first responders such as firefighters, especially evidenced by the strain placed on them during the recent events. Finally, the Texas Forest Service has experienced budget cuts that affect its grant support that underwrites equipment and fuel. In an attempt to help fill this gap, the Texas Wildfire Relief Fund, a local non-profit, has attempted to supplement local departments. However, to date, the funds raised by this group have fallen short relative to need.

Other Climate Change Concerns. Our review of the literature and data has also found both emerging infectious diseases and extreme heat to represent emerging or intensifying threats especially for vulnerable populations. The Texas Department of State Health Services provides surveillance mechanisms for West Nile Virus, Lyme disease, and Dengue fever. In addition this state agency developed the Dengue Fever Public Health Response guide in 2004 and updated it in 2008. The guide describes the threat of the disease as well as prevention and control recommendations. While our review did not uncover a state policy addressing extreme heat, several local programs are in place to combat heat island effects, including the Vertical Gardens Matching Grant Initiative that was implemented by the Houston Downtown Management District and encouraged wall-covering plantings. Other urban centers such as Frisco has required that cool roofs be part of their commercial green building plan. Finally, Austin Energy also gives rebates for cool roof installations since 2002. In May 2001, the Austin City Council adopted a heat island resolution to diminish effects from these phenomena and was awarded $1 million to implement the plan.

Evaluation of Programs and Policies. Key informants in Texas offered their perspective on the effectiveness of state's climate change policies. Informants recognized that state-led policies in climate change were for the most part not well developed. They agree that in the absence of a statewide plan to mitigate climate change and with a less than supportive legislature, the majority of the programs have been implemented primarily at the municipal level. Similar to other states in the region, informants cite the states' universities, non-profit foundations and local health departments as key to securing support and leading efforts in climate change mitigation and adaptation. Key informants cite the city of Austin as being the most progressive city in undertaking efforts to plan for and mitigate climate change.

Effective programs include emergency preparedness efforts, which became more fine-tuned and visible after Hurricane Katrina. One informant suggests that the most recent disasters have reinforced the importance of having preparedness systems in place and tested. Some of these preparedness programs include vulnerable populations. However, as one key informant points out, the progress in terms of outreach to vulnerable communities and climate change ends here. She emphasizes that these communities face week-to-week disasters as the more subtle effects of a changing climate, such as higher food costs and energy bills, set in.

REGIONAL PROGRAMS AND POLICIES

Within the region, several states have engaged in a few multi-state initiatives to address sea level rise within the Gulf region and to improve climate change literacy and education in the Southeast. Other states in the southern region, however, recently left a collaboration of states whose common goal was to reduce greenhouse gas emissions. These efforts are briefly described in the following section.

Climate Change Priorities and Vulnerable Populations

As discussed states in the southern region share a number of climate change priorities, especially along the Gulf coast: sea level rise, flooding, storms, salt water intrusion, among others (Wyman, Carter, & Weber, 2010). Wyman et al. (2010) cite Galveston as an example of an area that can expect an increased intensity and frequency of storms and notes that the city is already experiencing a sea level rise of over 2 feet per century. In addition, precipitation is expected to rise 10 percent among all Gulf Coast states with the exception of Florida. This region's forests will also see the effects of climate change: the health and distribution of mangrove communities is expected to be affected, increased wildfires will occur, and sea level rise will affect coastal vegetation habitat (Ning, Turner, Doyle, & Abdollahi, 2003). Climate change and its interaction with other variables like population growth, timber markets and invasive species is expected to adversely affect, both economically and ecologically, forests in the South. Southern forests will be further impacted by urbanization which is predicted to burden forest resources, increase carbon emissions and prompt forest losses (Wear & Greis, 2011).

Southwestern states are expected to experience added effects of heat waves from which both urban and low income populations will suffer more intensely (Ebi & Meehl, 2007). Others contend that the South and Southwestern regions are experiencing an increase in infectious diseases with the elderly, the young, those with pre-existing medical conditions and the uninsured being most at risk (Longstreth, 1999).

Climate Change Planning: Adaptation and Mitigation Strategies

Two states in the region had previously participated in a regional mitigation program but no longer do so. In 2007, the governors of Arizona, California, New Mexico, Oregon and Washington developed the Western Climate Initiative (WCI). This initiative's purpose is to address the reduction of greenhouse gases and thereby reduce the impacts of

REGIONAL CLIMATE CHANGE PLANNING AT A GLANCE

States in the region have recently left a multi-state collaborative on greenhouse gases

For the collaboratives identified there is virtually no participation by states in the southern study region.NOAA has released the Gulf Coast Adaptation Guide

Coastal Restoration

Gulf of Mexico Regional Collaboration Team

Emergency Preparedness

Project SECURE Gulf Coast

Climate Literacy

Climate Literacy Partnership in the Southeast

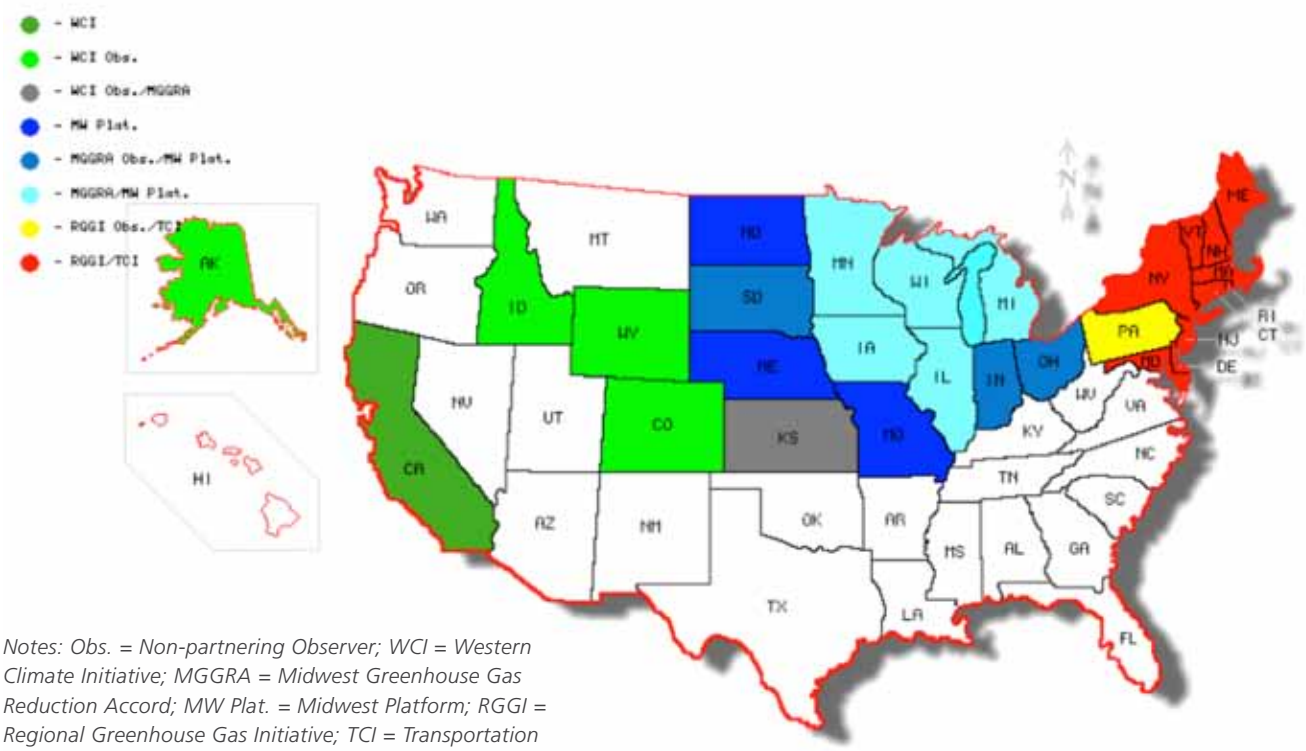
climate change. Later in 2007, the states of Utah and Montana and the Canadian provinces of British Columbia and Manitoba joined the founding members in the WCI. In 2008, Quebec also agreed to be a part of the joint effort. This group's memorandum of understanding specifies that they jointly develop a greenhouse gas emissions target as well as pursue cap and trade policies to meet targets. This regional goal was developed in concert with specific statewide goals. The WCI set their regional greenhouse gas emission goal to achieve 15 percent below 2005 levels by 2020. In 2008, the group outlined its cap and trade program (Center for Climate and Energy Solutions, 2012) but this recommendation caused considerable controversy: as of November 2011, six U.S. states had left the WCI due primarily to reluctance to implement the cap and trade program. This leaves only California and the Canadian provinces as the remaining members of this regional initiative (Vitelli & Marois, 2011). In fact, with their exit from the WCI, as Map 41 indicates, the southern states in our region, in general, are conspicuous by their absence from any of the cited collaboratives.

Several entities have recommended adaptation strategies in the context of coastal conservation and sea level rise among Gulf states. Under the Texas Sea Grant and the National Sea Grant Law Center, researchers have developed a resource describing policy frameworks for adapting the built environment to climate change. Recommendations include reforming flood insurance programs, putting in place mandates for community plans that incorporate hazard mitigation planning, as well as performing comprehensive vulnerability assessments to include economic and social components (Jacob & Showlater, 2007). The National Oceanic and Atmospheric Administration (NOAA) also released a planning guide for Gulf state coastal managers in 2010 that identified environmental threats in the region and outlined strategies for adaptation. This report dedicates a chapter to vulnerability assessment and includes a number of social vulnerability-related components: health, age, race, ethnicity, personal weather, occupation, and infrastructure dependence (National Oceanic and Atmospheric Administration, 2010).

Current Programs and Policies

The regional programs currently in place primarily address the climate issues of coastal restoration and sea level rise. The Gulf of Mexico Regional Collaboration Team was established by NOAA with the goal of building support from various stakeholders in the region for important climate-related priorities that affect both the Gulf of Mexico's built and natural environment. The Climate and Resiliency

MAP 41. REGIONAL GREENHOUSE GAS INITIATIVES



Notes: Obs. = Non-partnering Observer; WCI = Western Climate Initiative; MGGRA = Midwest Greenhouse Gas Reduction Accord; MW Plat. = Midwest Platform; RGGI = Regional Greenhouse Gas Initiative; TCI = Transportation and Climate Initiative

Source: Center for Climate and Energy Solutions.

Engagement Panel (C-REP), made up of 30 members from the private sector, state agencies, academic institutions, federal agencies and non-profit organizations, is charged with providing the team with direction on this topic.

An number of other programs target Gulf coast priorities as well. "Project Reconnect" is part of a larger initiative that incorporates Gulf coast states into disaster planning and preparedness efforts. Project SECURE Gulf Coast aligns several medical, research institutions and city governments in a combined effort to prepare communities for hurricanes and other disasters. It seeks to bridge efforts across states recognizing that recommendations and actions to date thus far have been generally "silo-driven" and narrow. This initiative is made up of six projects that are implemented throughout the Gulf Coast region and that seek to use a community-based participatory framework for program implementation. Several of these programs include in their scope an integration of diverse populations.

Another multi-state initiative currently underway is the Climate Literacy Partnership in the Southeast, which is a planning program funded for two years by the National Science Foundation's Climate Change Education Program. This partnership, which includes the states of Texas, Arkansas, and Louisiana, has the goal of improving climate literacy in the region. It aims to equip future professionals, such as engineers and climate scientists, with the skills to combat climate change and develop novel approaches to mitigation efforts as well as to ensure that individuals in the southeast understand climate change and its effects in ways that promote informed decisions and responses. Formal and informal learning environments are used to reach both children and adult audiences. The Climate Literacy Partnership in the Southeast includes in their goals an effort to integrate diverse communities into their education programs.

Evaluation of Programs and Policies

Our review of current climate change programs revealed that the regional programs enacted to address coastal concerns such as sea level rise and hurricane preparedness have not only been the most inclusive of vulnerable populations but include planning and adaptation strategies that address the complexity of vulnerability more effectively than other efforts.

The National Science Foundation's Climate Literacy Partnership represents one of the more innovative initiatives around regional coordination that we identified. With its focus on educating key audiences it serves as a potentially groundbreaking program to address climate change challenges before they occur, and engages and informs researchers, decision-makers and others around population vulnerability as well. Continuing to expand this program—to additional audiences, communities and venues, and linking to policymakers—could elevate the visibility of and need to address vulnerability in the context of climate change.

Furthermore, Project SECURE Gulf Coast, for example, has a comprehensive model for community engagement and includes diverse populations within its scope. However, as we discussed, states in the region have abandoned a potentially important regional effort to reduce greenhouse gas emissions. Our review did not reveal any multi-state efforts to combat the region's other growing threats, such as infectious disease and increasing heat and drought.

V. DISCUSSION

Our regional and state review found that vulnerable populations are generally absent from climate change actions. That is, these individuals and their communities are not part of policies and programs currently underway, revealing a significant gap in planning and mitigation priorities. This section presents a population portrait, bringing together sociodemographic and other data. It also discusses current policies and programs, identifying areas of considerable risk and need within the region.

Part I integrates data on demographic variables, health and health access in the context of climate change threats highlighting potential associations with climate change vulnerability on state and sub-state level. Part II documents the general lack of attention to vulnerable populations in the context of climate change programs and policies. Part III, identifies additional barriers to advancing a climate change agenda generally and specifically for vulnerable populations.

PART I: VULNERABLE POPULATIONS IN THE CONTEXT OF CLIMATE CHANGE

Our review provides a socio-demographic and health/health care portrait of the region and states within it, citing both the nature and extent of vulnerable populations and their vulnerability to climate change impacts. For each of the states in the region, certain population characteristics, in conjunction with the data on climate and weather-related events, reveal populations that are more at-risk to environmental hazards. As such, the following narrative offers a data-based portrait highlighting risks and reinforcing the need to address climate change threats from the perspective of populations' vulnerability in the region.

Common Climate Change Threats Across Regions

We found that states in the region share many common climate change threats. Drought, water quality and water supply are clearly growing concerns in the region. Wildfires remain a particular threat for most of the region, as 23 percent of all wildfires that burned in the U.S. between 2005 and 2010 occurred within this region; and where Texas, Arizona, and New Mexico bear the greatest consequences. This region also contributed to 20 percent of greenhouse gas emissions in the U.S. between 2000 and 2007, with Texas ranking first among states across the U.S. Exposure to poor air quality from industrial toxins and ozone also affects all states in the region: all states have 5 or more counties with more than 10 days per year of unhealthy air quality due to ozone, and Louisiana, Texas, and Oklahoma lead the region in median exposure to industrial air toxins.

These common threats have a wide ranging impact on the region's industries and populations. One-fourth of the region is rural, and many of these states are dependent on the agricultural industry. Climate challenges threaten farmers and their livelihood across all states. For example, according to one key informant in Texas, black farmers in the city of Hempstead have had difficulty recovering from the persistent drought. These climate-related events affect not only farming but farmworkers, especially those who are low income, have limited English proficiency and no health insurance.

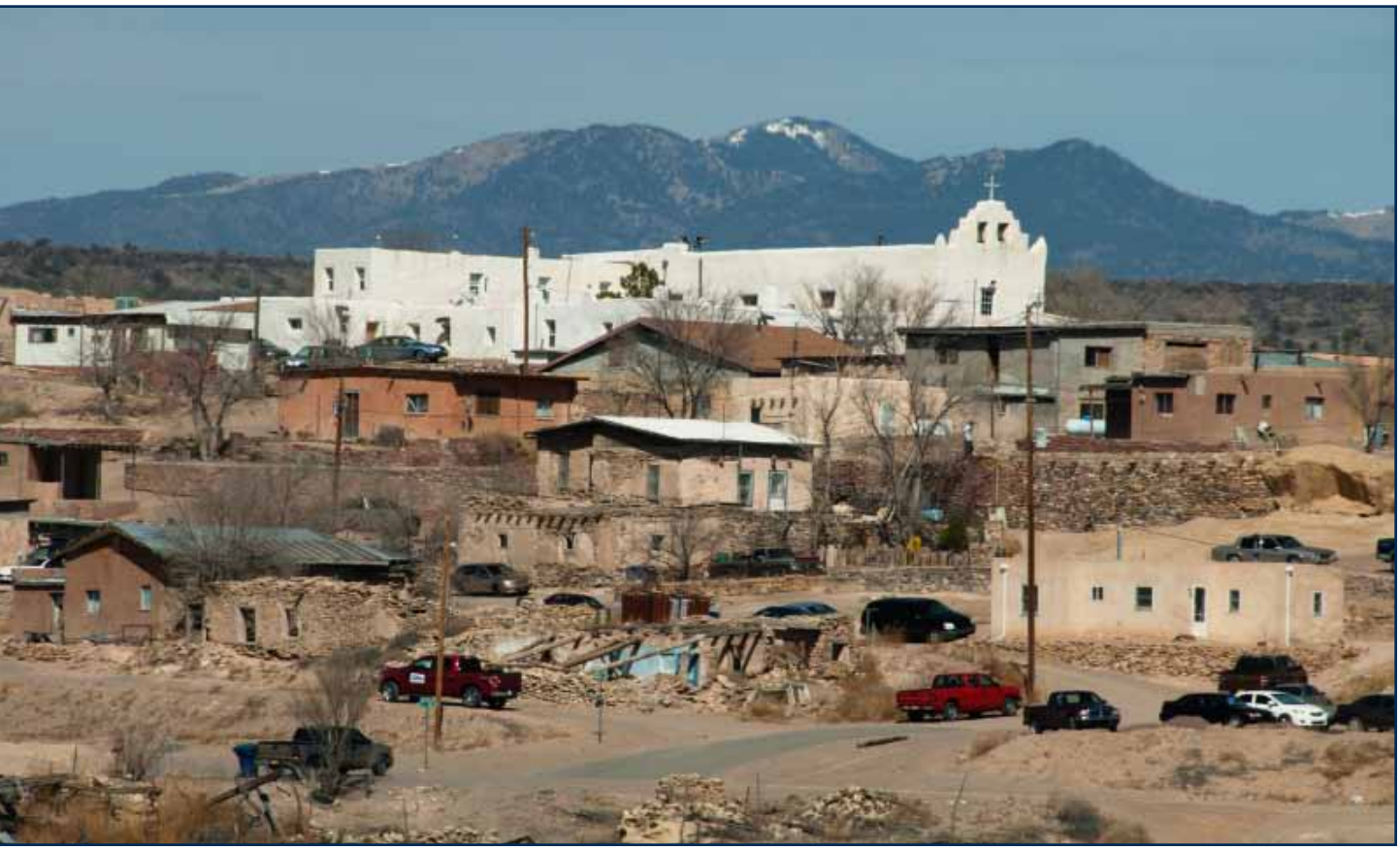
Many of the urban cores also face similar conditions. Extreme heat is a prevalent phenomenon. Current research suggests that the adverse affects from urban heat islands are more common among low income and racially/ethnically diverse communities who, due to limited resources, may experience difficulty mitigating these challenges (Harlan, Brazel, Prashad, Stefanov, & Larsen, 2006).

Potentially emerging threats have surfaced as well. Rates of infectious diseases have increased and have been associated with warming climate; and all states in the region have seen cases of West Nile Virus, Dengue fever, and Lyme disease with Texas reporting the highest number. These diseases represent a potential new hazard for which increased resources will be required for prevention and control.

Sociodemographic Vulnerability and Climate Change

Without exception, at risk vulnerable populations by state or sub-state face major climate challenges. That is, populations in each state, by poverty or other socio-demographic vulnerabilities, face climate change vulnerabilities as well. While certain climate change threats such as drought, water shortages and poor air quality pose significant challenges across all states in the region, others, such as seal level rise and wildfires present major multi-state, cross-border consequences.

Across these states certain demographic vulnerabilities are common. Rates of uninsured and those in poverty are significantly higher than the national average. At least one-fourth of the population in approximately 75 of the 518



counties (14.5%) is poor, with each state having major areas of urban and rural poverty. Poverty tends to be concentrated in the urban cores and along the Texas-Mexico border as well as in certain rural areas with greater concentrations of Hispanic/Latino residents, American Indians and African Americans. For example, rural/nonmetropolitan areas such as Eastern Louisiana, Eastern Arkansas, Eastern Arizona and Northwestern New Mexico represent some of the poorest communities in the region.

Racial/ethnic diversity is significant and increasing across the region. Oklahoma, Arizona and New Mexico, have high proportions of American Indians with several counties having 20 percent or greater proportions. In addition, the region demonstrates growth in the Hispanic/Latino population reporting several counties with a 50 percent or greater increase. The African American population is highest in Louisiana and in a number of urban areas such as Houston, Dallas, Forth Worth, Oklahoma City and Little Rock.

Each state faces major climate concerns likely to affect vulnerable communities. Arizona's climate change data reveal that rising temperatures and drought are taking a significant human toll; heat-related mortality in the city of Phoenix is 3-7 times the national average, making it not only the highest in this region, but in the U.S. Arizona is among the top three states in the region in number and size of wildfires; and 93 percent of its counties are at risk for water shortage. Maricopa County, home to one of the fastest growing American Indian population as well as a large Hispanic/Latino population, has the most number of unhealthy days due to poor ozone quality in the region. In East Arizona, Apache County is among the areas with the largest percentage of poor and has the greatest percentage of American Indians (75%). In the face of wildfires and drought, these communities may suffer disproportionately. The state is also leading the region in the incidence of West Nile Virus.

Many of Arkansas' climate-related challenges are expected to affect economically disadvantaged individuals, communities of color and other vulnerable populations. The state has large disparities in exposure to air toxins among racially/ethnically diverse populations, which may have especially adverse effects on those with asthma and other chronic health conditions (Ash et al, 2009). Many counties in east Arkansas (e.g., Lee and Phillips), which has a high proportion of African-Americans and poor, are at risk for water shortages. According to NRDC, heat-related deaths could double by 2050. West Nile Virus is also a threat especially for Arkansas and vulnerable populations who may lack access to care.

Of particular concern in Louisiana are the effects of rising sea levels and increased intensity and frequency of storms. The state is second only to Texas in damage caused by hurricanes, flooding and storms. Demographically, the state has the highest proportion of people of color in the region, with African-Americans representing 1 in 3 residents. Coastal communities, where many diverse individuals reside and work, experience greater susceptibility to the consequences of rise in sea levels. Poor air quality, especially related to fine particulate matter, is virtually a statewide phenomenon covering 80 percent of Louisiana, with the southern part of the state most affected. Per capita greenhouse gas emissions are the worst among the states in the region. Louisiana's exposure to industrial air toxins ranks not only the worst in the region, but also among the worst for all states. In addition, counties in Louisiana with the highest incidence of West Nile Virus also have the highest proportion of African-American residents.

In New Mexico, wildfires, drought and extreme heat are pervasive: the state has the second highest rate of drought; and the extensive burn area due to wildfires presents special challenges for diverse and vulnerable populations as New Mexico has the highest rate of poverty and uninsured in the region. While overall the state has low median exposure to industrial pollutants, racially/ethnically diverse communities and the poor may be most at risk as there is a clear disparity in their share of health risks from industrial air toxins (Ash et al., 2009). And the greater concentration of Hispanic/Latino and limited English speaking residents along the Mexico-New Mexico border may also face increased vulnerability during flooding events according to key informant interviews in the state.

Oklahoma has the highest percentage of exposure to industrial air toxins in the region; 91 percent of the counties are at-risk for water shortages. The state also ranks very high in the number of disasters related to storms and flooding. These broad scale challenges are likely to affect diverse communities and other vulnerable populations. Oklahoma is home to high proportions of American Indians and has the second highest percent increase in Hispanis/Latinos between 2000 – 2010. One in six people in the state live in poverty. Of special concern are eight counties in the east with higher concentrations of American Indians and higher rates of poverty.

Texas leads the region in population diversity and those with limited English proficiency as well as numbers of poor and uninsured. The state ranks first in its contribution to greenhouse gas emissions and counties surrounding metropolitan areas of Dallas/Fort Worth, San Antonio, El Paso and Houston have a high exposure of unhealthy air due to ozone. Of special concern are wildfires in Texas; the state has experienced the greatest number of wildfires as well as greatest number of acres burned across the region. Ninety eight percent of the counties are at risk of drought. Severely at risk counties, making up 65 percent of the state, are generally located in diverse communities including West Texas and along the border. Texas leads the region in damage from storms, hurricanes and floods. The state also has the largest number of cases of West Nile Virus, Dengue fever and Lyme disease.

Measures of Overall Health and Health Care Access in Context of Climate Change Vulnerability

Compounding the effects of socio-demographic vulnerability are challenges to health and access to health care that can influence an individual's ability to cope, plan for and mitigate the adverse effects of climate change. Poor health status, obesity, uninsurance, and a low rate of primary care providers may further disadvantage populations during or after extreme weather events or in the face of environmental hazards. Additionally, effects related to climate may exacerbate pre-existing conditions already prevalent in a community. For example, exposure to extreme heat has been shown to place individuals with cardiovascular disease at an increased risk for developing heart attack or stroke (The Potential Effects of Climate Change in New Mexico, 2005).

As a whole, the region has a higher rate of uninsured than the national rate. Many regions within all states face health care access and health care conditions that climate change events may exacerbate. Those who are uninsured face immediate concern for accessing care when it is needed, and the rate of primary care physicians in each region presents health care access challenges even for those who may be insured. This represents a significant obstacle for low income and racially/ethnically diverse communities who are most likely to have limited or no health insurance (Congressional Black Caucus Foundation, 2004).

In this context, health and health care concerns are likely to intersect with climate change concerns. For example, obesity is widespread across the region. Especially in children, obesity may also increase vulnerability to ill effects of poorer air quality and may foster greater susceptibility to infectious diseases (Sheffield & Galvez, 2009). And in a state where one-fifth of the population rates their health status as fair or poor--Louisiana is among states with poorest health. Both rates of obesity and low birth weight infants are second highest in the region. Louisiana has the highest percentage of female-headed households, and some of the poorest and more diverse areas in eastern Louisiana have some of the highest rates. Oklahoma, with one of the lowest rates of

primary care providers in the region, has an obesity rate of 30 percent. Measures of health and health care access are also grim for Texas, where obesity rates are also high, 20 percent of the population has a self-reported heath rating of poor to fair and 30 percent are uninsured.

In sum, the convergence of health-related challenges and poverty with the nature and intensity of climate change events for some areas of the region is portending a "perfect storm." Louisiana is in some ways the most prominent example with the intersection of several threats. The state's alarmingly high proportion of obesity and poverty overlay with high rates of poor air quality and flood susceptibility. But other areas are also alarmingly susceptible: extreme water shortages along the Texas-Mexico border and eastern Arkansas could have profound effects on these communities who are both among the poorest, the most diverse and report the poorest health status.

PART II: STATE OF CLIMATE CHANGE PROGRAMS AND POLICIES ACROSS THE REGION

Reviews of programs and policies across the region generally reveal a consistent pattern of inattention to population vulnerabilities. This lack of attention extends from state legislative actions to initiatives intended to provide direction and recommendations.

State Legislative Actions Targeting Mitigation of Climate Change Are Lacking Across the Region

This six state region faces considerable challenges related to planning and mitigating the effects of climate change. As a whole, the region is lacking in statewide policies. Only three have established climate change action plans, and implementation of recommended actions from those plans in many cases has progressed slowly or not at all. Our review found that none of the states in the region have formal and comprehensive adaptation plans in place, nor do they include communities of color, economically disadvantaged individuals or other vulnerable populations. Across states, some regional collaboratives have attempted to consolidate efforts for a common goal. The majority of these confront the sea level rise threat on the southern border region, some of which have led the way in including priorities of vulnerable populations.

There is some variation in state legislative actions to mitigate the effects of climate change in the region. For example, New Mexico and Arkansas have taken some steps to implement emission targets. But Texas, Louisiana and Oklahoma have not passed significant legislation to promote a statewide goal or plan to reduce greenhouse gas emissions. That is not to say, however, that these states have not succeeded in passing any legislation promoting climate change mitigation strategies. For example in Texas, although there is no statewide plan, a number of state laws promote policies to increase energy efficiency standards, improve air quality and reduce greenhouse gases.

According to our review, virtually none of the state laws include vulnerable populations in climate change mitigation strategies. Moreover, while other states such as California address the needs of low income and racially/ethnically diverse communities in its 2006 climate change action plan, our review of the plans in this six state region reveals that these priority populations are notably absent.

Inattention to Vulnerable Populations in Local Climate-related Reports, Program and Policies

In recognizing the need to address local priorities and/or acknowledging the lack of state leadership, a number of cities or municipalities in all states have undertaken initiatives to address issues specific to climate change priorities. Examples include Santa Fe, Houston and Phoenix, which have put in place organized strategies for a "greener" city by promoting energy efficiency standards, green building codes and electric vehicles. Notwithstanding these efforts, there is little attention to the needs of vulnerable populations in these city or area plans or task forces. There is also little attention devoted at the state or local level to profiling the challenges or issues specific to vulnerable populations in reports and other publications. In fact, with few exceptions (e.g., the Choctaw Community in Oklahoma, who developed information on energy efficient initiatives for their tribal hospitals and Arizona State University researchers who have helped to develop curricula for primary and secondary education that includes innovative ways to address issues related to populations who experience the effects of adverse climate events more severely), our review found little documentation or analysis of vulnerable communities related to climate change.

These findings were confirmed by our key informants, who had difficulty citing current efforts or progress. Many also seemed to be unaware of policies with the potential to inform and advance actions affecting vulnerable populations. This lack of awareness was common across interviewees representing or knowledgeable of community-based organizations (CBOs), programs and policies and other constituencies. In essence those at the local level had little knowledge of existing efforts on climate change.
Finally, there is a general lack of awareness of information and resources to document degree and extent of vulnerability in the context of climate change. Informants also acknowledged

that little documentation of poverty and diversity exists in the context of climate change vulnerability. Among constituent groups data availability that could inform policies within state or region appeared to be quite limited. One exception cited by one community organizer was Oxfam America's vulnerability index, which was seen as useful in their advocacy efforts to draw attention to groups most affected by environmental hazards.

PART III: ADDITIONAL BARRIERS TO CLIMATE CHANGE PROGRESS

The lack of awareness and inattention previously described is the prominent concern for vulnerable populations. However, our review and interviews uncovered other barriers contributing to and compounding this gap including: political resistance, skeptical views of climate change effects and industry influence.

Political Opposition Remains a Significant Barrier to Advancing Progressive Climate Change Policies

Political realities have restricted both development and expansion of these programs and policies. For example, one key informant requested confidentiality due to the political unpopularity of climate change as a policy priority. Political dynamics among these six states lead to changes that restrict funding and lack of follow through. New Mexico presents a prime example. According to a key informant in New Mexico, once in office, Governor Martinez attempted to dismantle several climate change initiatives including the carbon tax, the "pit rules," as well as dairy groundwater contamination rules. However, the Supreme Court of New Mexico upheld these previously implemented policies (as cited in the *New York Times*), whereby the administration redirected its efforts toward members of the Environmental Improvement Board, which plays a role in policy development. Other departments involved in environmental issues have also experienced re-structuring in an effort to weaken progress in climate change plans.

In Texas, prominent barriers cited among key informants included the lack of state-level leadership, and the failure to view climate change as a priority in the legislature. In Louisiana conservative leadership has thwarted efforts to address climate change and its causes. In Arkansas, a key informant representing an environmental non-profit organization commented that although the Governor for the most part is realistic in his view of the way changes in climate will affect the state's industry, the legislature has resisted actively pursuing policy development.

Promoting Climate Change and its Effects as "Myth"

Key informants cited skepticism about climate change and its causes as a major barrier. For example, Oklahoma Senator James Inhofe, in a 2003 Senate speech proffered: "With all of the hysteria, all of the fear, all of the phony science, could it be that man-made global warming is the greatest hoax ever perpetrated on the American people?" (Inhofe, 2003). In 2007, a Minority Report of the United States Senate Committee on Environment and Public Works challenged global warming theory and cited 400 "dissenting scientists." This perpetuation of the concept of global warming as a myth has created widespread doubt on the topic that reaches deeply into many communities, including low income and racially and ethnically diverse populations. As stated by one informant, "A big dilemma is the extremely conservative community in which we live. Their message is that climate change is a falsehood. And many people believe that and think it doesn't impact them, even though they can see [sea level rise] in their backyard."

Influence from Industry Affects the Climate Change Strategy in a Variety of Ways

Across states, there is a strong opposition to climate change policies by industry (including fossil fuel and electricity companies) and its lobbying efforts. For example, Texas has 425 lobbyists representing energy companies at the Capitol and in other venues, more than any other state.

An air quality community representative in New Mexico stressed that industries can use the threat of job loss or adverse economic impact to mute climate change action. During a recession, in particular, job creation rises to the top of the public's concern. Industry's tactic is to turn the discussion to job creation at the cost of reducing greenhouse gas emissions. In small communities in northeastern New Mexico, industry is the primary employer, so speaking out against them may create political or community backlash. Finally, in many areas the energy industry has supported community initiatives in education or other areas, thereby muting criticism at the local level. In New Mexico—which faces concerns similar to other states in the region- the overall presence and economic power of industry, coupled with lack of legislative or gubernatorial incentive or support, contribute to a landscape in which initiatives to plan and adapt for climate-related events may very well be stalled or suppressed.

VI. RECOMMENDATIONS

Our data, policy and key informant interviews have revealed daunting challenges to creating and advancing a responsive climate change agenda broadly, but especially for vulnerable communities. Nonetheless, our review also offers guidance that builds on current efforts and community assets. In the narrative that follows we identify areas where states in the region and their communities can work to make individual and community vulnerability part of a positive, progressive climate change agenda.

RECOMMENDATIONS FOR STATE LEVEL ACTIONS

The following recommendations identify strategies for integrating vulnerable population priorities into state climate change policies, programs and strategies. In all they build on existing state efforts and offer new initiatives to document populations and their needs; and to take action to redress longstanding absence in state climate change goals.

Review and renew existing current state climate change efforts and work to include vulnerable populations within them. Our review found that all states without exception have passed climate change related legislation but that vulnerable populations were conspicuous by their absence from many of these laws and other measures. And yet these state actions may offer opportunities for constituents to work with legislators within current policies to assure representation of vulnerable populations in priorities. For example, as low income and racially/ethnically diverse populations may spend a higher percentage of their earnings on utility bills, offering rebates and other incentives available under energy efficient programs can ease the financial costs they incur. There is also a strong need to work with constituents and legislators to review, assess and assure representation of these and other priority issues for these populations. Examples of information for potential inclusion are degree of vulnerability to climate change threat, plans for event response, and community engagement in the context of programs and policies.

Such a review may serve an important secondary purpose. States have allowed many legislative actions to fall fallow due to political decisions, failure to fully develop the original intent and/or insufficient funding. Reinvigorating these existing efforts through reassessing original intent in the context of vulnerable populations and seeking support may offer renewed opportunity within existing policy. For example, Arkansas' climate change plan is the result of legislative action and cross sector and multi-departmental collaboration aimed at developing strategic recommendations to mitigate greenhouse gases. However, as one key informant described, it remains "gathering dust on a shelf" with little resulting from this resource-intensive project. Reinvigorating such efforts, including explicitly integrating vulnerable populations concerns, should be part of progressive climate change initiatives.

Coordinate and communicate promising climate change related priorities and actions across states and regionally, and integrate vulnerable population priorities into these cross state initiatives. For example, preventing sea level rise and implementing other coastal priorities will work best if states in the region share data, coordinate monitoring, and develop mutually beneficial policies. A prime example of this type of intrastate coordination is Project SECURE Gulf Coast whose efforts include gulf coastal states and their respective academic and public health institutions in a Consortium to build effective disaster preparedness programs in the region. These coastal programs may serve as a model for cross-border interstate coordination. For example, multistate partnerships could also be developed in planning for drought, preparing for wildfires, and creating sustainable strategies in agricultural farming.

Integrate vulnerable population concerns and representation into task forces and advisory groups. Many states in the region have convened commissions, task forces or expert groups to consider climate change priorities. For example Phoenix created a task force on use of trees and shade to mitigate the effects of urban heat islands. New Mexico has a task force addressing drought, an issue with severe implications for low income and racially/ethnically diverse populations. Arkansas' Climate Change Advisory Group includes the directors of 10 state agencies, but does not include representation from diverse or other vulnerable populations. These bodies should include assessment of vulnerable populations' needs and priorities and include recommendations to promote equity in action. Assuring the availability and use of data (including existing measures, data assessments and future data needs) will be invaluable in quantifying the intensity of threats for susceptible communities. For example, current research undertaken at Arizona State University's School of Evolution and Social Change that addresses inequities

of racially/ethnically diverse groups in their exposure to extreme heat may benefit state and local level task forces on heat island mitigation. In turn, task forces could also provide direction and recommendations for future research. Furthermore, state legislatures should include representation from racially/ethnically diverse, low income or otherwise vulnerable communities in discussions and in developing recommendations for future actions. Other important examples of practical and "real time" opportunity include the Texas Senate subcommittee's recent charge to study drought and its impact across the state. Constituent organizations and communities should communicate to and work with legislative staff to assure that vulnerable populations are a central part of any review, assessments and recommendations related to this new work.

Develop data that targets climate change priorities to inform programs and state actions. Currently, states lack any comprehensive set of data on climate change, its impact on residents and the effectiveness of mitigation programs. One key informant in New Mexico, in commenting on the current lack of data, cited potential value in addressing health care concerns among Navajo: while their individual stories of Navajo nurses who see an increased incidence of asthma in their communities may be compelling, more robust data would substantiate their claims and work to justify action in mitigation and adaption plans.

Moving forward, states should consider developing data sets and measures not only addressing climate change concerns such as degrees of temperature rise and number of poor air quality days but also extend and link such data to demographic and health care dimensions that may influence resiliency and vulnerability. Quantitative information can play a central role in informing state and local actions and could provide evidence that supports and guides climate change research, advocacy and policy. Important health and health care access data, especially when linked to the effects of environmental hazards such as poor quality, can also inform future planning efforts. Data strategies should also take into consideration measurement of effect and outcomes.

RECOMMENDATIONS FOR COMMUNITY AND LOCAL PROGRAMS

The following recommendations offer guidance in promoting climate change actions at the local level. These include sharing local resources across states, building messages that are acceptable and understandable to vulnerable populations, engaging communities in a meaningful way, and tapping into the strengths of both academic institutions and foundations.

Make available local climate change actions occurring across the region. Many counties and cities across the region have undertaken initiatives targeting local climate change priorities—often in the absence of state action. These efforts represent a wealth of experience in their progress, success and challenges—lessons learned that could serve as resources for other areas seeking to mitigate climate change effects. As such, they could provide opportunities to transfer knowledge and tap into expertise. At the same time such resource development and discussion will need to assure representation of vulnerable populations.

Santa Fe offers an example of a promising program. Santa Fe's Sustainability Plan is a multi-pronged approach to both reducing greenhouse gases and improving the community's resiliency. The plan includes not only goals for greenhouse gas reduction, green building codes, and renewable energy, but also has an education and outreach component to integrate sustainability concepts into local schools' curriculum. It also proposed adaptation strategies related to food policy by encouraging sustainability through farmers' markets and community gardens. These local efforts could serve as important references for areas facing similar challenges in the region

Work to assure that vulnerable populations can accept and understand messages about climate change. Racially and ethnically diverse communities, for example may have norms and customs that involve family in decisions, while low income individuals may be concerned about job disruption around climate change-related circumstances. Immigrants may be worried about encounters with customs officials while individuals with limited English proficiency may not comprehend written messages. These and other circumstances require tailoring messages to build trust, facilitate understanding, participation and adherence to recommended actions. As succinctly stated by one key informant, using known cultural "references" is key to developing culturally competent health messages.

Message preparation and dissemination for these populations will also benefit from direct community involvement. Trusted and knowledgeable representatives from American Indian and Hispanic/Latino communities, for example, can assist in assuring cultural acceptability and accuracy of climate change messages. Faith leaders, tribal elders and representatives from ethnic media or other trusted venues can help disseminate messages intended to inform and educate around climate change priorities and engagement.

Community engagement is essential to advancing climate change strategies for vulnerable populations. Engaging communities generally, but especially vulnerable populations should be a priority among policymakers, task forces and university researchers involved with climate change. Communities bring assets, knowledge and experience that can be invaluable in providing important input to program planning and policy, in assuring that results will be of value to residents and building trust. Community members can speak to consequences and concerns affecting their world; provide guidance on development of practical strategies; and, both figuratively and literally, act to interpret the importance of climate change in the context of where they live. As one key informant commented, community leaders have an important role in the climate change dialogue: by participating in the web of agencies including groups such as non-profit organizations and with academic institutions, they can help to create equitable solutions for their respective communities.

Strategies to engage communities will need to recognize the circumstances and challenges that they face in their lives in the context of climate change actions. As one informant stressed, low income and racially/ethnically diverse communities and other vulnerable populations may feel more pressing problems than the need to adapt and plan for climate-related changes, however the issues are not totally separate. An overall improvement in financial well-being and quality of life will help in strengthening these communities for other challenges and may very well be a necessary precursor to engaging them around and protecting them from the effects of climate change.

Leverage academic institutions for advancing vulnerable population climate change research, outreach and education. As states, for political, economic or other reasons, have fallen short in pursuing a comprehensive climate change agenda, academic institutions have the potential to play a key role in initiating and advancing programs and policies. To the extent that vulnerable populations are seen as important to their work, academic grantmaking capacity, ability to offer expertise and, for faculty with community-based experience through Community Based Participatory Research initiatives, for example, can focus attention on neglected or little-studied priorities. Their research can galvanize action, while faculty participation in climate change task forces and advisory group can add substance to related deliberations. University expertise and experience may also serve as a resource for states in assessing threats and developing and evaluating policies to address them.

Examples of this important role include Arizona State University's Phoenix Environmental Justice Project, which has developed research on social inequities and environmental hazards, including drought and exposure to poor air quality and the Baylor College of Medicine, which has received support to train communities, including diverse populations, in emergency preparedness strategies that frequently overlap with climate change events.

Elevate the presence of foundations and the private sector in developing and advancing vulnerable population climate change programs and policies. Foundations have a unique opportunity to advance climate change programs in states and communities. Their leadership, their ability to adapt their objectives to meet area priorities, and capacity for grantmaking that can yield results in the short term can offer valuable resources in raising the importance of climate change as a state and/or local priority; supporting research that targets critical issues of concern; and advancing legislative agendas. For example, Heifer International a non-profit foundation based in Arkansas has made climate change a priority for rural farmers that, according to key informants has become an important resource in their state. The foundation has committed to teaching farmers sustainable farming techniques to reduce greenhouse gas emissions deemed harmful to the environment. Additionally, their support for improving local ecosystems, including improved soil water retention, may assist in reducing poverty. Encouraging similar investment by foundations can significantly broaden the reach and scope of climate change initiatives.

Finally, overcoming resistance and nurturing support from industry, corporations and others in the private sector must ultimately be part of any long term strategy. Building on current efforts and engaging supportive companies in bridging to others—including other private sector organizations and policymakers—will go a long way in this process. And continuing to assist communities will be critical especially in times of limited state support. Companies such as Wal-mart, which has already made a commitment to sustainability in some communities and is a presence across states in the region and beyond, and others could serve as key players in program, service and policy development.

VII. CONCLUSION

To date, tragic events and troubling trends such as hurricanes, floods and drought appear to be primary inducements that galvanize and concentrate efforts at the local and state level. And yet, there are events destined to happen or threats currently building that are not seen as concerns in daily lives of vulnerable communities, and more generally, but whose impact may prove even more insidious, with far-reaching implications both near and long term. Thus, while wildfires, coastal change and floods may demonstrate the consequences of inattention to climate change, one of the major challenges is to expand awareness, engagement and action to address the underlying causes.

Policymakers, agencies, researchers, advocates and community based organizations can take advantage of "windows of opportunity" emerging from tragic events to bring attention to both targeted need and broader climate change priorities—and to take actions before events occur. As cited by our key informants, lessons learned following the disastrous Hurricane Katrina, for example, led to actions with greater dimension. After the hurricane, evacuation programs became more visible, facilities were better equipped and workers were better trained. In addition, service programs and agencies are also working to improve system design whereby medical records are stored off-site, which may help low income and others with chronic conditions whose medical histories would otherwise be lost. Arizona's 2005 heat wave opened many community members' and health professional eyes' to the gravity of health effects resulting from extreme heat. A task force was developed to provide recommendations on preventing heat-related illness, while a newspaper featured reports on increased mortality of outdoor workers, prompting employers to take preventive actions. These responses illustrate how positive change is growing out of increasing awareness of population vulnerability.

The energy behind these tragedies should not dissipate as they recede from today's headlines. Communities and their governments in this region, as well as the nation have a responsibility to foster broader awareness, understanding and involvement of how vulnerability and climate change are integrally linked. In so doing those committed to redressing legacies of the past can promote a healthier environment for the future.

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