Photo: Gary Crow

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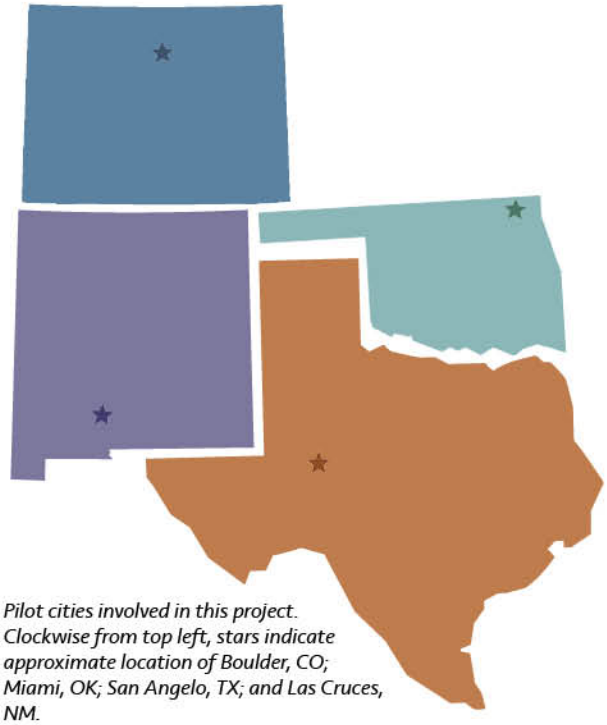
NOAA Critical Thresholds for Extreme Weather Events

PROJECT OVERVIEW

Critical Thresholds, Extreme Weather, and Building Resilience



Pilot cities involved in this project. Clockwise from top left, stars indicate approximate location of Boulder, CO; Miami, OK; San Angelo, TX; and Las Cruces, NM.

Communities already know that extreme weather events affect the people who live in their communities, challenge operations of City departments, and can negatively impact assets and resources. Many of these extreme weather vulnerabilities will increase as the climate changes.

This project developed and tested a community-specific participatory process to identify and develop climate projections around impact-relevant extreme events and guide climate change adaptation and resilience efforts.

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Over the course of 2015 and 2016, four small to medium-sized communities in the South Central United States (Boulder, CO; Las Cruces, NM; Miami, OK; and San Angelo, TX) joined a multi-disciplinary project team to:

1. Collaborate on identifying critical thresholds for extreme weather events in their communities;
2. Create downscaled climate projections specific to those thresholds;
3. Review the customized climate projections; and
4. Identify and implement a resilience action project.

A lot can be learned from the four pilot communities both about the potential value of using community-defined thresholds, and the nature of adaptation and building resilience in small and medium-sized communities across the United States.

STAKEHOLDER ENGAGEMENT

Both broad stakeholder engagement and expected attrition in participation can be used to strengthen efforts to build community climate resilience. Our experiences highlight that initial community engagement should draw from a large, highly varied pool, even if organizers doubt that all participants will remain engaged beyond an initial workshop. Community resilience to extreme weather ultimately requires awareness and engagement from the full range of community sectors. Focusing only on emergency management, water operations, etc. could leave out critical perspectives and issues. Indeed, Boulder, based in part on their experience with this project, determined that to effectively act on climate change they need a much broader base of understanding across all city government departments, including traditionally uninvolved departments such as information technology, finance, and human resources.

However, engagement that draws a highly diverse group will almost certainly include stakeholders who see little immediate connection between their daily roles and responsibilities and climate change. These stakeholders are unlikely to engage beyond an initial workshop. This self-selection and narrowing of the stakeholder base presents an opportunity to tailor later workshops to the expertise and needs of the participants that remain. This will allow the project team to provide more specific and concrete examples of adaptation strategies relevant to the roles and responsibilities of the attendees.

City of Boulder Municipal Climate Change Workshop.

CLIMATE SCIENCE THRESHOLDS

Communities are interested in threshold levels more extreme than those typically selected in scientific analyses, and in a wider range of extremes. The most important difference we saw between statistically-based and community-identified thresholds was the emphasis community stakeholders placed on impacts. Stakeholders selected many thresholds related to recent extreme weather and climate episodes, including heat waves, floods, cold snaps, and droughts. In many cases, the selected threshold values were significantly higher than those used by the World Meteorological Organization (WMO – Table 1). This qualitative difference is important. It highlights that, in general, what is challenging for communities is not the 90th percentile event, but, instead, less frequent and more extreme events or episodes, for which the community has not yet successfully prepared. This is a principal value of location-specific stakeholder engagement — impact based thresholds help stakeholders make the connection between their local experiences and potentially abstract climate projections, which, in turn, makes those projections more relevant to communities.

Table 1. *Comparison of single-day temperature and precipitation thresholds. WMO (World Meteorological Organization; Klein Tank et al. 2009). Temperatures expressed in degrees Fahrenheit where Tmax is the highest daily temperature and Tmin is the lowest daily temperature. Precipitation is expressed in inches per day.*

WMO	Boulder	Las Cruces	Miami	San Angelo
Tmax > 77°F	80°, 90°, 95°	90°, 100°, 105°	95°, 100°, 105°	90°, 100°, 105°
Tmax > 90th percentile	74th, 92nd, 98th	75th, 97th, 99.9th	93rd, 98th, 99.7th	72nd, 95th, 99.5th
Tmin > 68°F	75°	80°, 85°	80°	80°
Precip > 0.4", 0.8" per day	2", 4"	2.5"	2.7" in 2 days	2", 4"

RESILIENCE ACTIONS

Communities are opportunistic when acting to build community resilience. In most cases, the communities chose resilience projects that fit with on-going efforts. In San Angelo, for example, that choice was based on a combination of pragmatism and political feasibility. The city had a nascent residential rainwater harvesting program they were trying to grow that was already supported by the city council. They had also already investigated the potential installation of a larger rainwater harvesting system in a central city park and knew that it could be done within the budget and time constraints for the project. This does not mean that the selected projects did not address climate concerns or build climate resilience, rather, it highlights that there are many factors that influence action and whether those actions are initiated and successful. Further, initiating the rainwater harvesting project under this pilot program spurred action within the city to seek funding to expand their efforts. They successfully secured an additional $25,000 to develop new rainwater harvesting systems elsewhere in the city.

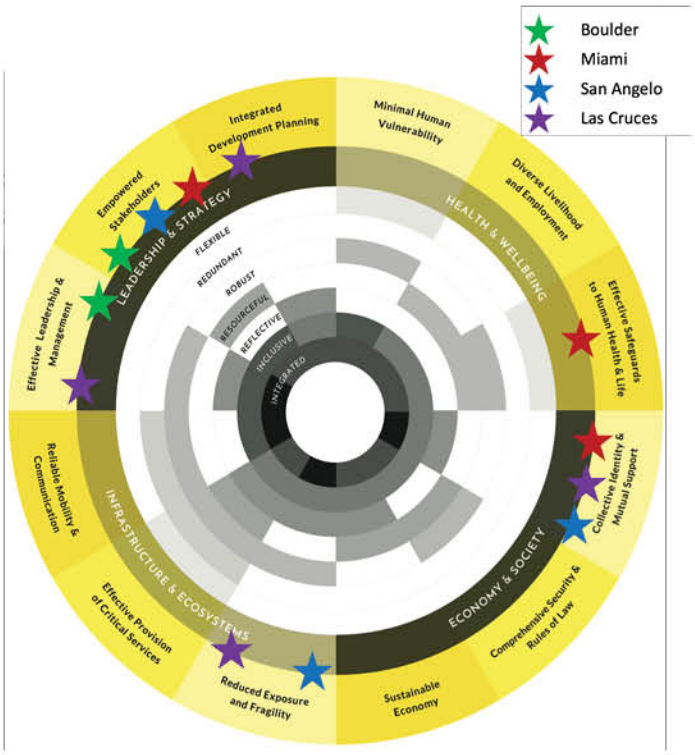
Installation of a rainwater harvesting system in a central park in San Angelo, TX.

Each community selected a project that has co-benefits and helps build more than one aspect of resilience. For example, in Las Cruces, the rainwater harvesting project and green infrastructure plan not only reduced physical drought vulnerability in the area near the project, but also helped the city develop a more integrated planning process for infrastructure that addresses an underserved portion of the community. This effort was the catalyst for a $400,000 future investment in green stormwater infrastructure in that same historically underserved community.

In Miami, the selected project was to design and teach a classroom lesson to all eighth graders in the community focusing on extreme weather thresholds and preparedness. This effort helped reach a broad set of families (through their children), built the awareness of appropriate extreme weather responses, and helped strengthen the City's connections with the school district and the community.

Photo: Danny Mattox

Eighth graders in Miami, OK experimenting with flooding thresholds during a lesson on extreme weather preparedness developed as part of this project.



Community Resilience Action Projects overlaid on factors contributing to community resilience as defined by the 100 Resilient Cities resilience framework. Aspects of resilience enhanced by each resilience action project are shown by the colored stars. City Resilience Framework used with permission from Arup and the Rockefeller Foundation.

INSIGHTS

The thresholds concept is useful as an entry point for discussions about climate change. It helped ground conversations in issues that matter to local stakeholders, helped put projected climate changes in the context of the past extreme events, and provided a foundation for presentations and discussions that demystified the black box of complex global climate models.

Nevertheless, ***most participants were either not prepared or not motivated to think beyond the daily to weekly time scales***. This is perhaps because most participants' job responsibilities are associated with these shorter time-frames or because professional standards of planning practice (e.g., civil engineering design standards) do not yet incorporate climate projections. Further research on these perceptions and constraints would be useful in informing future climate change adaptation planning.

Successful co-production of actionable science, based on the extreme weather events thresholds concept, shows potential to bridge the gap between climate science and on-the-ground action to build resilience.

Thank You! The project team would like to thank each of our community project leads: Brett KenCairn, Russ Sands, and Greg Guibert (Boulder); Glenda Longan (Miami); AJ Fawver and Sandra Villarreal (San Angelo); and Lisa LaRocque (Las Cruces) for all their insights, guidance, and support throughout this project. We would also like to thank Danny Mattox from the K20 Center, Monica Deming from the Oklahoma Climatological Survey, Laura James from Atmos Research, and Atalie Pestalozzi for her graphic design work. This project would not have been successful without all your contributions.

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