doi:10.7289/V5930R6Q

Developing an Integrated Heat Health Information System for Long-Term Resilience to Climate and Weather Extremes in the El Paso-Juárez-Las Cruces Region

Report from the workshop held in El Paso, TX, July 13, 2016

Authors: Gregg Garfin (University of Arizona), Sarah LeRoy (University of Arizona), and Hunter Jones (NOAA)

doi:10.7289/V5930R6Q

Developing an Integrated Heat Health Information System for Long-Term Resilience to Climate and Weather Extremes in the El Paso-Juárez-Las Cruces Region

Authors:

Gregg Garfin (University of Arizona – gmgarfin@email.arizona.edu)

Sarah LeRoy (University of Arizona – sary21@email.arizona.edu)

Hunter Jones (NOAA – hunter.jones@noaa.gov)

Report from the workshop held in El Paso, TX, July 13, 2016

Published January, 2017

Suggested Citation:

Garfin, G., S. LeRoy, and H. Jones. 2017. Developing an Integrated Heat Health Information System for Long-Term Resilience to Climate and Weather Extremes in the El Paso-Juárez-Las Cruces Region. Tucson, AZ: Institute of the Environment, 63 p. doi:10.7289/V5930R6Q

Cover Photo: El Paso, Texas as seen from Scenic Drive on the Franklin Mountains. Credit: Bill Chizek.

Contents

Acknowledgements

This workshop was supported with funding from the National Oceanic and Atmospheric Administration (NOAA) and Texas Tech University (TTU) Climate Science Center, as well as in-kind support from the City of El Paso, University of Texas at El Paso, and the U.S. Environmental Protection Agency Region 6.

The authors are indebted to the members of the project steering committee, whose effort, insights, and input led to a successful workshop and continues to contribute to the ongoing work of the National Integrated Heat Health Information System (NIHHIS) Southwest Regional Pilot initiative. The committee consisted of the authors of this report, plus Lauren Baldwin (City of El Paso Office of Resilience & Sustainability), Michelle Del Rio (University of Texas at El Paso), Nicole Ferrini (City of El Paso Office of Resilience & Sustainability), William Hargrove (University of Texas at El Paso), Jenny Hernandez (City of El Paso Office of Resilience & Sustainability), Gregory Lundeen (National Weather Service), Graciela Ortiz (Texas Department of Family and Protective Services), Rebecca Palacios (New Mexico State University), Eugenia Posada (Texas Commission on Environmental Quality), Thomas Quinn (El Paso Office of Emergency Management), Carlos Rincon (Environmental Protection Agency), Juli Trtanj (NOAA), and Jennifer Vanos (Texas Tech University).

We thank Tahnee Robertson and Julia Sittig of Southwest Decision Resources, for their assistance in workshop planning, facilitation, and follow-up suggestions. We are indebted to our invited speakers, for providing superb insights into understanding heat-health issues in the El Paso-Juárez-Las Cruces region, and in other regional, national, and global contexts. A complete list of speakers is in Appendix B (Workshop Agenda), and a summary of their key points may be found in Table 1.

We thank the following individuals and their organizations for their support on workshop documentation and logistics: Stephanie Eggeling (Texas Tech University), Raquel Miranda (Texas Tech University), Tara Torres (University Center for Atmospheric Research), Celena Arreola (City of El Paso Office of Resilience & Sustainability), Candice Heins (City of El Paso Office of Resilience & Sustainability), David Hondula (Arizona State University), Susana Garcia (Environmental Protection Agency), Amit Raysoni (University of Texas at El Paso), Anthony Rodriguez (U.S.-Mexico Border Health Commission), Aman Wraich (City of El Paso Office of Resilience & Sustainability). Rosa Maria Boadella provided flawless simultaneous English-Spanish translation services. We thank the management and staff of the El Paso Water TecH2O Center for providing the workshop venue.

Finally, we owe a particular debt of gratitude to Albert Casella (formerly University of Arizona; currently Republic of Rwanda Ministry of Health), whose organizational skills and dedication to coordinating and planning the workshop set us on the right track.

Executive Summary

Background and Motivation. The workshop, *Developing an Integrated Heat Health Information System for Long-Term Resilience to Climate and Weather Extremes in the El Paso-Juárez-Las Cruces Region*, was held in El Paso, Texas, on July 13, 2016. Sponsored by a collaborative of universities and local and federal agencies, the workshop brought together individuals in government, practitioner, and academic communities from Mexico and the United States to discuss the intersection of the region's climate and weather with factors affecting public health risks related to extreme heat. The region is home to approximately 2.4 million people, most of whom are living in or near the urban centers of Ciudad Juárez (Chihuahua), El Paso, and Las Cruces (New Mexico). These cities share characteristics, such as a high proportion of residents of Hispanic origin, median income below the U.S. national average, and a range of climate-related environmental issues that include drought, flooding, air pollution, dust storms, and frequent occurrences of extremely high temperatures during the late spring and early summer. With hotter temperatures and more frequent and persistent heat waves projected for the El Paso-Juárez-Las Cruces region, it is critical to develop more robust systems of institutions, social learning, and partnerships to understand risks and strengthen public health resilience.

Workshop Goals

1. Gain a better understanding of historical climatology and vulnerabilities to heat in the region, including identification of particularly vulnerable populations and indicators that will be useful in improving preparedness for future heat episodes.
2. Identify and document science, communication, and public health needs and gaps with regard to the overall topic of extreme heat monitoring and public health preparedness in the region.
3. Establish specific information requirements and other needs for follow-on work to develop concrete information products, plans, requirements, and processes identified in this workshop.

This executive summary synthesizes the key points of the discussion from the meeting and serves as a starting point for evolving extreme heat resilience in the region.

***Key Challenges*.** Workshop participants identified five key challenges and research needs:

- Translation of climate and health research into evidence-driven interventions and actionable strategies;
- Co-production of discipline-specific environmental and health information to support decisions on all timescales;
- Evolving risk communication strategies to drive behavior changes and inform all populations (especially the most vulnerable) of the public health risks of extreme heat;
- Enhanced coordination and communication among emergency management entities; and
- Improved public health surveillance and monitoring coupled with improved climate prediction skill at timescales from weeks to inter-annual.

Recommendations. Participants broke into five groups (work streams) to focus on different aspects of heat health resilience. They provided a number of insights and recommendations:

1. *Historical Climatology and Vulnerability*. Participants identified vulnerability assessment and data synthesis and analysis as key priorities for further actions to improve understanding of extreme heat risks.
    a. Workshop participants pointed to the critical need to quantify regional vulnerabilities of diverse populations and develop indicators and metrics of heat-related illnesses. Participants recommended data synthesis and analyses, including historical information of heat-related deaths categorized by gender and vulnerable group (e.g., infants, elderly, mentally ill, and others).
    b. They also recommended laying the foundation for a mutually agreed upon, region-specific vulnerability assessment, which would require the identification of common data, assessment indicators, methods, and mapping.
    c. A first step would be to evaluate and validate existing assessments and methods and then test the most promising ones in the context of the region.
2. *Linkages Between Heat Parameters and Health Outcomes.* Participants in this group cited medical data as the most needed information and improved understanding of the relationship between heat parameters and interventions as the biggest hurdle for improving policy.
    a. Participants cited information on exposure in cases of heat-related death as a critical need. They also mentioned a lack of valid biomarkers for heat illness and limited availability of location- and time-specific health-outcome data.
    b. Other high-priority data needs included prevalence data, such as identification of heat-related deaths and illnesses and consequences to disease, and correlation data with co-morbidities, such as infection, dementia, and renal failure.
    c. Participants suggested strategies for improving heat-related health information and data, such as prioritizing data collection on power outages and usage during extreme heat events, and prevalence data on health visits related to outdoor temperatures, relative humidity, and heat index values.
    d. Improved understanding of heat parameters is needed to better prioritize implementation of health interventions.
3. *Prediction, Outlooks, Early Warning*. Workshop participants suggested forecast communication and research related to forecast lead time as key action priorities.
    a. Participants acknowledged that existing interagency coordination, including emergency warning and prevention teams, provide a strong foundation for risk communication. However, they expressed concern that forecast messages were not well understood by decision makers and the public. They recommended focused public communication around the theme of a *heat season awareness week*, with events at schools and shopping malls and communication through high visibility media—all of which could build upon Extreme Weather Task Force press releases and other campaigns.
    b. Participants noted that forecasts with longer lead times, which is a research and development priority for federal agencies, can be combined with communication strategies to provide benefits. These strategies include pre-positioning assets (mobile cooling units, for example), education and raising awareness at the start of the heat season, and implementing efforts to restore public trust in the event of an inaccurate severe weather forecast.

    c. They also recommended social science research to determine the optimal messaging approaches at various lead times to address uncertainty.
4. *Communication and Engagement.* Participants prioritized communicating to vulnerable populations and increasing trust in organizations that deliver heat health messages for further action.
    a. They advocated for increased effectiveness in reaching underserved communities, such as colonias, homeless populations, undocumented immigrants, and communities at the rural-urban interface. They urged removing barriers for aid to so-called "in-need" populations.
    b. They endorsed the development of an inventory of initiatives by community organizations and academic institutions, identification of and coordination with leaders and certified community workers from vulnerable communities, and coordinated collaborative delivery of educational materials and resources.
    c. They noted that community health workers and promotoras are particularly effective messengers to colonias, and that the use of multiple communication channels is an essential element to ensure effective communication to all populations.
    d. Participants also acknowledged the strength of community-academic partnerships for improving communication and engagement with the public.
5. *Capacity Building and Training*. Participants in this group identified collaboration and capacity-building planning and process as the highest priorities for enhancing capacity and developing and deploying training on heat health issues, preparedness, and response.
    a. They recommended that capacity building and training efforts (a) reflect the needs of the community, (b) be deployed proactively, (c) reach across multiple scales (i.e., individual, household, local government, and state and federal levels), and (d) be well coordinated across government and non-government entities and initiatives and the healthcare community.
    b. They identified the STEAR (State of Texas Emergency Assistance Registry) as an existing resource upon which to expand capacity; they noted that informing community members to register with STEAR would help raise awareness.
    c. Participants recommended working with local governments in El Paso and Juárez to foster a unified response to heat health risks.

Next Steps. Volunteers from the five work streams agreed to meet regularly following the workshop to carry out the recommendations. The original workshop organizing committee recommended a first step of inventorying and assessing existing data, initiatives, resources, and funding opportunities and developing a state-of-knowledge assessment for extreme heat and public health in the region. To contribute to this assessment, the El Paso Office of Resilience and Sustainability will be distributing a community survey to determine existing knowledge of extreme heat within the community and its capacity to cope with extreme heat events. The assessment will inform future actions and provide information useful to those pursuing funding to implement recommendations from the workshop. The workshop was conducted as part of the National Integrated Heat Health Information System (NIHHIS) initiative and served as the formal launch of the NIHHIS Southwest regional pilot. The NIHHIS pilot is designed to facilitate ongoing engagement with people in the region to understand climatic, institutional, social, and other aspects of extreme heat health risk and to create a long-term approach to improving resilience to extremes.

Resumen Ejecutivo

Información de contexto y motivación. El taller: *Desarrollo de un sistema de información integrada sobre calor y salud para resiliencia a largo plazo a eventos y climas extremos en la región de El Paso, Juárez y Las Cruces*, se llevó a cabo en El Paso, Texas, el 13 de julio de 2016. Patrocinado por una colaboración de universidades, agencias locales y federales, el taller reunió a representantes gubernamentales, profesionales y comunidades académicas de México y Estados Unidos para discutir factores e intersecciones del tiempo y el clima en regiones que afectan los riesgos de salud pública relacionados con el calor extremo. La región es hogar de aproximadamente 2.4 millones de personas, la mayoría de las cuales viven en o cerca de centros urbanos en Ciudad Juárez (Chihuahua, México), El Paso, y Las Cruces (Nuevo México). Estas ciudades comparten características tales como alta proporción de residentes de origen hispano, ingreso por debajo del promedio nacional de los Estados Unidos y una serie de asuntos ambientales relacionados con el clima, como sequías, inundaciones, contaminación del aire, tormentas de polvo y frecuentes episodios de temperaturas extremadamente altas a finales de primavera y principios de verano. Considerando que para esta región se proyectan temperaturas más altas y olas de calor más frecuentes y persistentes, es fundamental desarrollar sistemas institucionales más robustos, aprendizaje social y asociaciones para entender los riesgos y fortalecer la resiliencia de la salud pública.

Objetivos del taller

1. Lograr una mejor comprensión de la climatología histórica y vulnerabilidades al calor en la región, incluyendo la identificación de poblaciones particularmente vulnerables e indicadores que serán útiles para mejorar la preparación para futuros episodios de calor.
2. Identificar y documentar las necesidades y vacíos de ciencia, comunicación y salud pública respecto al monitoreo del calor extremo y la preparación en salud pública para la región.
3. Establecer requisitos específicos de información y otras necesidades para el seguimiento y elaboración de productos de información concretos, planes, requisitos, y procesos identificados en este taller.

Este resumen ejecutivo sintetiza los puntos clave de la discusión de la reunión y sirve como punto de partida para la evolución de la resiliencia al calor extremo en la región.

Desafíos clave. Los participantes del taller identificaron los siguientes desafíos clave y necesidades de investigación:

- Traducción de investigaciones sobre el clima y la salud e intervenciones y estrategias de acción impulsadas por medio de evidencia.
- Co-producción de información específica sobre materia ambiental y de salud para apoyar las decisiones respecto de todas las escalas temporales.
- Evolución de estrategias de comunicación de riesgo para impulsar acciones e informar a todas las poblaciones (especialmente a las más vulnerables) acerca de los riesgos para la salud pública que implica el calor extremo.

- Mayor coordinación y comunicación entre las entidades de gestión de emergencias.
- Mejora en el monitoreo de salud pública, junto con mejoras en la habilidad de predicción climática con escalas de tiempo desde semanales a interanuales.

Recomendaciones. Los participantes se dividieron en cinco grupos (flujos de trabajo) para concentrarse en diferentes aspectos de la resiliencia al calor. Los grupos proporcionaron varias ideas y recomendaciones:

1. *La climatología histórica y la vulnerabilidad.* Los participantes identificaron la evaluación de vulnerabilidad y la síntesis y análisis de datos como las prioridades clave para elaborar nuevas medidas que mejoren la comprensión de los riesgos del calor extremo.
    a. Los participantes del taller señalaron la necesidad crítica de desarrollar las vulnerabilidades regionales de poblaciones diversas, así como indicadores y métricas de enfermedades relacionadas con el calor. También se recomendó recomendaron realizar síntesis de datos y análisis, incluyendo información histórica de las muertes relacionadas al calor clasificadas por sexo y por grupos vulnerables (por ejemplo, los niños, ancianos, enfermos mentales y otros).
    b. También recomendaron establecer las bases para una evaluación de vulnerabilidad específica a la región y que sea de acuerdo mutuo. Esto requeriría identificar datos comunes, indicadores de evaluación, métodos y mapeo.
    c. Un primer paso sería examinar y validar las evaluaciones y métodos existentes para luego probar aquellas que sean más prometedoras en el contexto de la región.
2. *Vínculos entre parámetros de calor y resultados de salud.* Los participantes en este grupo apuntaron a datos médicos como la información más necesaria y hacia una mejor comprensión de la relación entre los parámetros de calor y las intervenciones como el mayor obstáculo para mejorar políticas.
    a. Los participantes apuntaros a hacia información sobre la exposición en los casos de muerte relacionados con el calor como una necesidad crítica. También se mencionó la falta de biomarcadores válidos para enfermedades por calor y la disponibilidad limitada de datos sobre resultados de salud en un lugar y tiempo específico.
    b. Otras necesidades de datos de alta prioridad incluyen datos de prevalencia, como la identificación de muertes relacionadas con el calor, y enfermedades y consecuencias para la salud, junto con datos de correlación con comorbilidades como la infección, la demencia y la insuficiencia renal.
    c. Los participantes sugirieron estrategias para mejorar la información y los datos de salud relacionados con el calor, tales como dar prioridad a la recopilación de datos sobre cortes y usos de energía durante eventos de calor extremo, y los datos de prevalencia en las consultas médicas relacionados con la temperatura exterior, humedad relativa y los valores del índice de calor.
    d. Es necesario entender mejor los parámetros de calor con el fin de dar prioridad a una mejor aplicación de intervenciones de salud.

3. *Predicción, perspectivas, alerta temprana.* Los participantes en los talleres sugirieron como prioridades de acción clave las comunicaciones de pronóstico y las investigaciones relacionadas con el tiempo de pronóstico.
    a. Los participantes reconocieron que la coordinación interinstitucional existente, que incluye equipos de alerta y prevención de emergencias, provee una base sólida para la comunicación de riesgos. Sin embargo, los participantes expresaron preocupación porque los pronósticos no son bien comprendidos por los tomadores de decisiones y por el público. También se recomendó concentrar la comunicación pública del tema en una *semana de concientización de la temporada de calor,* con eventos en escuelas y centros comerciales, y a través de medios de alta visibilidad. Todo esto podría girar en torno a comunicados de prensa de los grupos de trabajo de clima extremo y otras campañas.
    b. Los participantes señalaron que los pronósticos con los plazos de entrega más largos, lo que es una prioridad de investigación y desarrollo para las agencias federales, se pueden combinar con las estrategias de comunicación sobre beneficios. Estas estrategias incluyen el pre-posicionamiento de la propiedad (unidades de refrigeración móvil, por ejemplo), educación y concientización al inicio de la temporada de calor, e implementación de esfuerzos para restaurar la confianza del público en caso de existir una proyección incorrecta del mal tiempo.
    c. También se recomendó realizar investigación en ciencias sociales para determinar procedimientos óptimos en mensajería acerca de distintos tiempos de espera para hacer frente a la incertidumbre.
4. *Comunicación y participación.* Los participantes priorizaron comunicarse con las poblaciones vulnerables, así como el aumento de confianza en las organizaciones que entregan mensajes de salud y calor para acciones futuras.
    a. Los participantes abogaron por una mayor eficacia para llegar a comunidades marginadas, como las colonias, poblaciones sin hogar, inmigrantes indocumentados y comunidades en el área urbano-rural. También instaron a eliminar las barreras para ayudar a las llamadas poblaciones "necesitadas".
    b. Se endorsó el desarrollo de un inventario de iniciativas de organizaciones comunitarias e instituciones académicas, así como la identificación y coordinación con líderes y trabajadores certificados en comunidades vulnerables y la colaboración para entregar materiales y recursos educativos.
    c. Señalaron que los trabajadores comunitarios de salud y sus promotores son mensajeros particularmente eficaces para las colonias y que el uso de múltiples canales de comunicación es un elemento esencial para asegurar una comunicación efectiva a todas las poblaciones.
    d. Los participantes también reconocieron la importancia de las asociaciones entre la comunidad y los académicos para mejorar la comunicación y el compromiso con el público.
5. *Capacitación y entrenamiento.* Los participantes en este grupo identificaron la colaboración, planificación y el proceso de creación de capacidad como prioridades clave

para mejorar la capacidad y desarrollar y desplegar capacitación sobre temas de calor-salud, preparación y respuesta.

a. Se recomienda que los esfuerzos de creación de capacidad y formación (a) reflejen las necesidades de la comunidad, (b) se desplieguen de forma proactiva, (c) lleguen a través de múltiples escalas (es decir, a niveles como personas y hogares, y gobiernos locales, estatales y federales) y (d) estén bien coordinadas en todas las entidades e iniciativas gubernamentales y no gubernamentales y en la comunidad de cuidado de la salud.
b. Identificaron al Registro de Asistencia de Emergencia del Estado de Texas (STEAR, por sus siglas en inglés) como un recurso existente cuya capacidad se puede ampliar. También señalaron que informar a los miembros de la comunidad para registrarse con STEAR podría ayudar a crear conciencia.
c. Los participantes recomendaron trabajar con los gobiernos locales en El Paso y Juárez para fomentar una respuesta unificada a los riesgos relacionados con el calor y la salud.

Los próximos pasos. Los voluntarios de los cinco grupos acordaron reunirse regularmente después del taller con el fin de llevar a cabo las recomendaciones. El comité organizador del taller original recomendó un primer paso para inventariar y evaluar los datos existentes, las iniciativas, los recursos, las oportunidades de financiación y desarrollar una evaluación del conocimiento sobre el calor extremo y la salud pública en la región. Para contribuir a esta evaluación, la Oficina de Resiliencia y Sostenibilidad de El Paso distribuirá una encuesta comunitaria para determinar el conocimiento existente sobre el calor extremo en la comunidad y su capacidad para enfrentar eventos de calor extremo. La evaluación informará sobre acciones futuras y proveerá información útil a quienes buscan financiamiento para aplicar las recomendaciones del taller. El taller se llevó a cabo como parte del Sistema Nacional de Información de Salud-Calor Integrado (NIHHIS por sus siglas en inglés) y sirvió como lanzamiento formal del piloto regional NIHHIS suroeste. El piloto de NIHHIS está diseñado para facilitar el compromiso continuo con la gente en la región para comprender los aspectos climáticos, institucionales, sociales y otros ámbitos de riesgo de calor extremo. También busca desarrollar un enfoque a largo plazo para mejorar la resiliencia a los eventos extremos.

Introduction

On July 13, 2016, the workshop, *Developing an Integrated Heat Health Information System for Long-Term Resilience to Climate and Weather Extremes in the El Paso-Juárez-Las Cruces Region*, brought together individuals in government, academia, and practitioner communities from Mexico and the United States, to discuss the region's experience with and vulnerability to extreme heat. Participants described and discussed the climatology of the region, studies to characterize vulnerability and responses to extreme heat, the institutions that support efforts to reduce heat-related health risks, and the regional networks of heat health practitioners, researchers, and other partners that can be sustained in order to strengthen public health resilience to extreme heat in the region. The workshop was conducted as part of the National Integrated Heat Health Information System (NIHHIS[1]) initiative, and served as the formal launch of the NIHHIS Southwest regional pilot. The NIHHIS pilot is designed to facilitate ongoing engagement with people in the region to understand climate, institutional, social, and other aspects of extreme heat health risk, and to evolve a long-term approach to improving resilience to extremes.

Workshop Goals

1. Gain a better understanding of historical climatology and vulnerabilities to heat in the region, including identification of particularly vulnerable populations and indicators that will be useful in improving preparedness for future heat episodes.
2. Identify and document science, communication, and public health needs and gaps with regard to the overall topic of extreme heat monitoring and public health preparedness in the region.
3. Establish specific information requirements and other needs for follow-on work to develop concrete information products, plans, requirements, and processes identified in this workshop.

[1] http://cpo.noaa.gov/AboutCPO/IntegratedInformationSystems/NIHHIS.aspx

Background

With hotter temperatures and more frequent and persistent heat waves projected for the Rio Grande-Rio Bravo region (Figure 1), it has become imperative to develop more robust systems for dealing with the public health risks associated with extreme heat. Addressing current and future extreme heat risks includes everything from improving the monitoring and prediction of heat waves to identifying vulnerable populations, communicating risk, and developing stronger connections between institutions, organizations, and disciplines that specialize in aspects of these challenges.

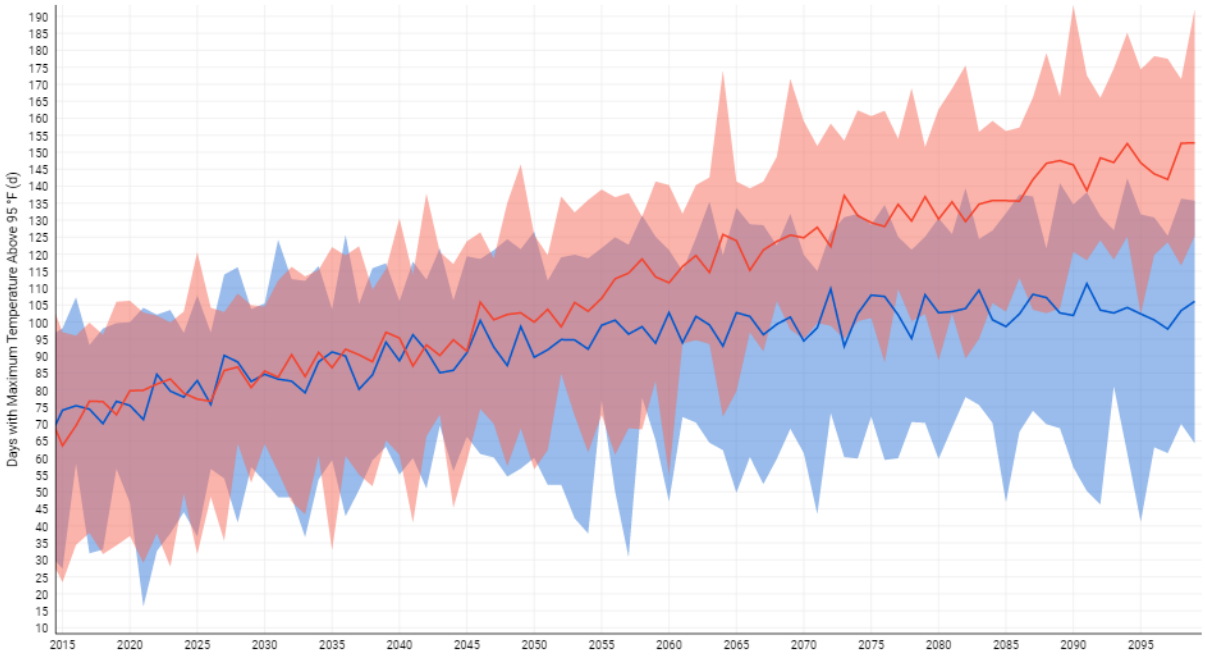

Figure 1. Projections for days with maximum temperatures over 95°F in El Paso County. Blue and red shaded regions are the range of climate model projections for low (RCP4.5) and high (RCP8.5) emissions scenarios, respectively. Red and blue lines are median projections for each scenario. Extremely hot days (maximum temperature over 95°F) in El Paso County are projected to increase from around 70 days in 2015 to between 105 and 150 days by the year 2100. Data from US Climate Resilience Toolkit – Climate Explorer 2.0.

Heat-Health Characteristics of the Region

For the purposes of the workshop, the region encompasses El Paso County (TX), Doña Ana County (NM), and Ciudad Juárez (Chihuahua) (Figure 2 inset). The region is home to an estimated 2.4 million people, most of whom are living in or near the urban centers of Ciudad Juárez, El Paso (TX), and Las Cruces (NM) (Borderplex Alliance[2]). Cities in the region share characteristics, such as a high proportion of residents of Hispanic origin, median income below the U.S. national average, and a range of climate-related environmental issues, including drought, flooding, air pollution and dust storms, and frequent occurrences of extremely high temperatures during the late spring and early summer seasons (Grineski et al. 2013).

[2] http://www.borderplexalliance.org/regional-data

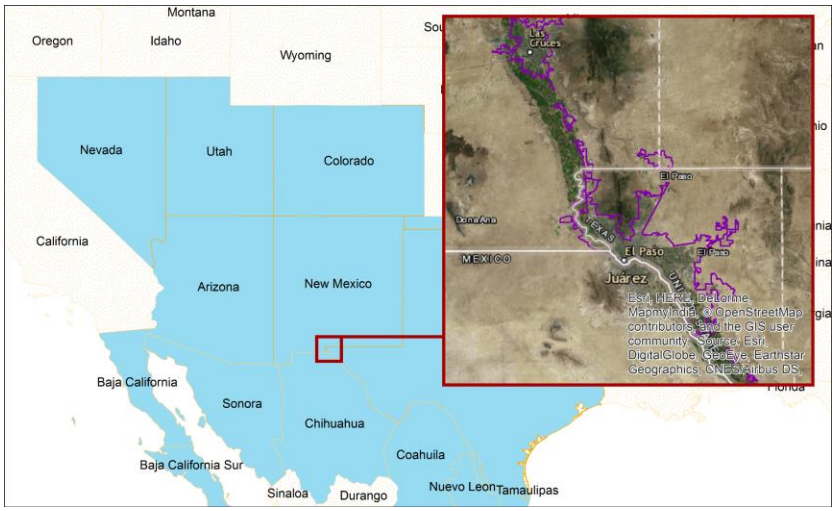

Figure 2. Map of the Southwest National Integrated Heat Health Information System (NIHHIS) region. Inset map shows the region of focus for the workshop, which includes the principal cities of Ciudad Juárez, El Paso, and Las Cruces. The purple outline shows the urban areas of El Paso and Las Cruces based on data by the U.S. Census Bureau.

Extreme Heat in the Region

The region's extreme heat season typically extends from the pre-summer monsoon dry season, in May and June, through the retreat of the summer monsoon, usually during the month of September; extreme high temperatures can occur as early as April and as late as October (Figure 3). During the drier months, maximum temperatures can exceed 110°F (43°C), in El Paso and Ciudad Juárez, with record temperatures approaching 110°F (43°C) in Las Cruces. Minimum temperatures can exceed 85°F (29°C) in El Paso and Ciudad Juárez. Minimum temperatures, usually measured just before sunrise, are important, because high minimum temperatures reduce the opportunities for people—especially those without air conditioning—to recover, overnight, from prolonged exposure to high temperatures. In addition, heat waves, with multiple weeks of consecutive days at or over 100°F, are not uncommon in the region; between 2010 and 2012 Ciudad Juárez consistently experienced more than 30 days over 100°F between June 1 and September 15 (Esquivel Ceballos and Peña López 2013).

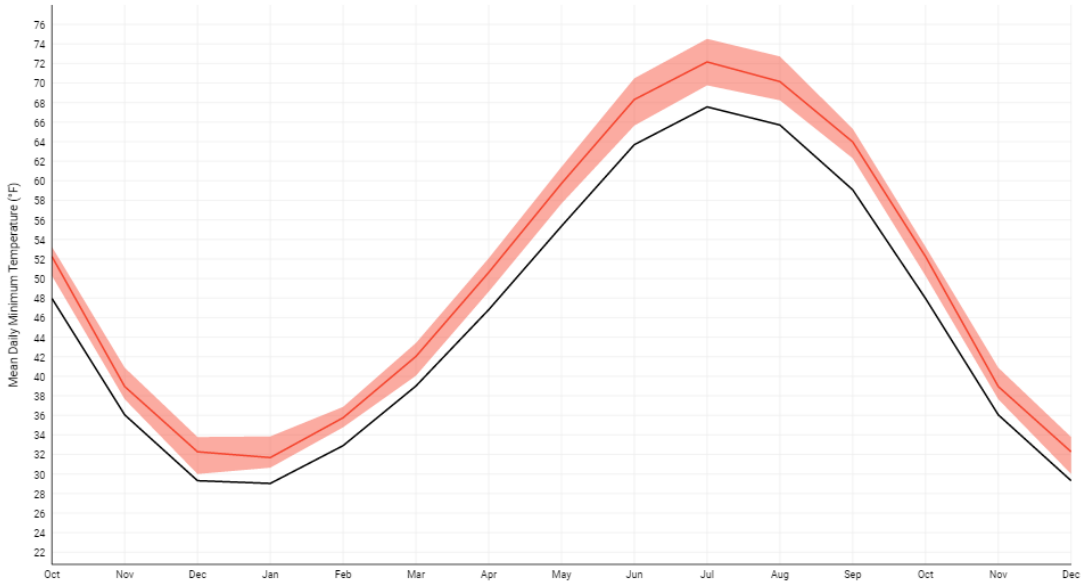

Figure 3. Daily minimum temperatures in degrees F, averaged for each month, for El Paso County. The black line shows averages based on historical observations, and the red shaded area shows the range of climate model projections using a high emissions scenario (RCP8.5). The red line is the median of the projections. Data from US Climate Resilience Toolkit – Climate Explorer 2.0.

One factor contributing to extreme heat is the well-known urban heat island effect (UHI), through which the heat capacity of building materials and roadways, and the density of built-environment infrastructure, amplifies extreme temperatures—particularly at night. El Paso's UHI has expanded substantially during the last three decades, as the city's population has grown, and as population density has increased (Amaya et al. 2016). Fortunately, mitigation of the UHI has been codified directly and indirectly in several of the goals of El Paso's award-winning Smart Growth Plan[3].

Stakeholders in the region have widely recognized extreme heat to be an important public health priority. Moreover, the third National Climate Assessment (Melillo et al. 2014) shows that temperatures in the region have been increasing during the last 50 years or more, and heat waves have become more frequent and intense in the western United States. The Assessment projects further increases in temperature across the United States, with more extreme heat days and warmer nights (Walsh et al. 2014). From 2013-2015, El Paso County set records for daily maximum temperatures; in 2015 alone, the county recorded 106 consecutive days above 90°F. The hot season in the county also seems to be lengthening; in the 2013-2015 timespan, El Paso has reached maximum temperatures above 90°F as early in the year as March 18 and as late as October 26. The 2013-2015 span of extreme heat in the region was preceded by a milder, but more deadly, period: from 2003 to 2008, there were 38 heat-related fatalities in El Paso County. In response, the City of El Paso made considerable efforts to improve extreme weather preparedness by initiating the Extreme Weather Task Force (EWTF).

About the Workshop

Who participated?

Given the geographic scope of the pilot project, the majority of the almost 70 participants in attendance at the workshop were from the core regional cities of El Paso, Ciudad Juárez, and Las Cruces. These participants were from city and county offices of emergency management, city offices of resilience and sustainability, city and state departments of health, local universities, the local National Weather Service forecast office, and other city departments such as public schools and planning and neighborhood services.

In addition to local participants, heat health experts from the U.S., Mexico, and Canada added regional, national, and international perspectives. These included guest speakers from Arizona State University, The University of Washington, Environment and Climate Change Canada, and Protección Civil de Ciudad Juárez, Mexico, and COFEPRIS (Federal Commission for the Protection against Sanitary Risk, Mexico). Other participants joined from University of Texas at El Paso, Louisiana State University, Texas Tech University, University of Oklahoma, and private sector organizations, such as Four Twenty Seven (a California climate risk consulting firm), and Paso del Norte Health Foundation. For a complete list of participants, see Appendix A. The diversity of participants contributed to rich discussions and multiple perspectives on heat health issues, and the large turnout for the event confirmed the salience of the issue within the region.

[3] http://www.planelpaso.org/

What was discussed?
The agenda was organized to elicit discussion and interaction by participants, through informational sessions interspersed with opportunities to interact and provide feedback. The morning began with introductions and presentations designed to set the stage and provide a climate, public health, and emergency management context on which the rest of the day would build upon. Afternoon sessions, divided into topical work groups, fostered discussion aimed to identify key climate/weather and public health research challenges. The full agenda can be found in Appendix B.

Presentations
Presentations at the workshop, given by both key stakeholders in the region and outside experts, were meant to set the stage and form a basis for informed discussion. Sessions 2A & B laid a foundation for the purpose of the workshop, with talks about the climatology of the region, heat-related deaths and morbidity in El Paso, a case study from the Phoenix area in Arizona, and an introduction to NIHHIS. Session 3 was composed of quick, 5-minute talks and a panel discussion by local experts about existing heat health capacity in the region, key aspects of heat health decision making, and extreme heat emergency management. Session 4 was designed to look ahead in early warning, with presentations focused on prospects for the latest science to inform heat health early warning, examples from other states and countries, and the latest capabilities for forecasting heat episodes multiple weeks in advance.

Table 1 (below) provides a listing of all speakers with key points from each presentation. A more detailed summary of each presentation can be found in Appendix C.

Table 1: Key points from each presentation.

Speaker	**Topic/Key Points**
Session 2A: Climate Context and Public Health & Emergency Management Decision-making in the Southwest Region	
Gregory Lundeen (National Weather Service, El Paso)	**History: Climatology of heat waves in the El Paso-Juárez-Las Cruces region, and discussion of seasonal outlooks** 1. The average number of 100-degree plus days in the El Paso area has been increasing over the past 130 years. This may be due to climate change and increased urbanization (heat island effects) of the El Paso metro area. 2. Based on climatology, the months of June and July are the most likely months for heat waves to occur in the El Paso area. 100-degree days can occur any time between the middle of May through the middle of September. 3. The Climate Prediction Center provides long-term outlooks for heat and temperature trends (seasonal, monthly, 2-week and 4-week windows). The National Weather Service and the local Weather Forecast Office provide detailed heat and temperature forecasts out to 7 to 10 days through multiple products and channels of communication.
Graciela Ortiz (Texas Department of Family and Protective Services)	**Public health decisions in extreme heat, deaths, morbidity** 1. The Extreme Weather Task Force in El Paso informs the public about preparing for extreme weather and provides help, such as fans and blankets, during extreme events.

Speaker	Topic/Key Points
	2. Individuals at high risk of heat-related illness include: infants and young children, people 65 years of age or older, people who are overweight, people who overexert during work or exercise, and people who are physically ill. 3. Tips for preventing heat-related illness include: using the "buddy system", drinking plenty of fluids, staying away from alcohol, taking a cool shower or bath, and going to designated cool zones. 4. Promotoras are an important resource in spreading awareness and building capacity in communities that are highly vulnerable due to language barriers, lower income, and even lacking official status in the U.S., preventing access to healthcare.
David Hondula (Arizona State University)	**Phoenix/Maricopa County case study: What has another southwest city done to prepare and respond to this challenge?** 1. Heat is a chronic stressor in Phoenix and other hot desert cities, requiring a different mindset for preparedness and response than that associated with short-term heat waves and heat emergencies. 2. Phoenix is not yet fully resilient to adverse public health effects of extreme heat, despite its many technological advances. In some years more than 100 people die from heat exposure in Maricopa County. 3. Air conditioning is widely used but not yet a universal or equitable solution to chronic extreme heat. In a 2015 survey, more than 25% of respondents indicated some type of constraints regarding air conditioning use, and a similar percentage reported that they are too hot inside their homes during the summer. 4. Sustaining investment in assessments is a perennial challenge, so they are often performed without a plan for updating them. An assessment performed in El Paso should include a regular period and process for revisiting the assessment.
Session 2B: NIHHIS, Heat-Health Early Warning, and NOAA's Climate Resilience Toolkit	
Juli Trtanj (NOAA Climate Program Office)	1. Temperatures are rising, and extreme heat is a serious and underappreciated problem that is only expected to get worse. 2. NIHHIS is an integrated information system, launched by NOAA and the Centers for Disease Control and Prevention (CDC) and including an international set of heat health practitioners that will facilitate an integrated approach to providing a suite of decision support services to reduce heat-related illness and death. 3. The Rio Grande-Bravo region is a unique place for a NIHHIS pilot project given: the North American monsoon creates a distinct climate, El Paso already has an existing network to address imminent heat waves and other issues (Extreme Weather Task Force), the region's hub cities are somewhat isolated, and the region can take advantage of a diverse set of ideas for addressing heat-related challenges, such as promotoras.
Session 3A: Lightning Talks and Discussion – Heat-Health Capacity in the Region	
Timothy Collins (University of Texas at El Paso – UTEP)	**Vulnerability overview** 1. Neighborhoods in the urban cores at the international border of El Paso and Ciudad Juárez are particularly vulnerable to extreme heat. 2. Urban greening can ameliorate extreme heat impacts in these neighborhoods.

Speaker	Topic/Key Points
	3. Some limitations of the study presented are lack of heat-health data and lack of information on stakeholder engagement and coordination needed to implement the urban greening projects.
David Daniels (New Mexico Department of Health)	**Epidemiology: Connecting heat and health** 1. Heat stress in New Mexico is highest in June and July and in the Southeast and Southwest portions of the state, and thus increased education and outreach efforts are needed in these regions, especially during these months. 2. Adaptation strategies and extreme heat warning systems need to be developed and implemented to prevent morbidity. 3. The New Mexico Department of Health should continue to explore other variables, such as wind and humidity, which are more predictive of heat events than temperature alone.
Efren Matamoros (Protección Civil de Ciudad Juárez, Mexico)	**Institutional capacity and arrangements** 1. Protección Civil has summer programs that take into consideration public health during extreme heat and during the wet season. 2. The agency meets with other city agencies regularly to review existing work and to identify gaps in services. 3. The agency coordinates with local media and meteorological offices prior to an extreme event to increase public awareness.
Thomas Quinn (El Paso City & County Office of Emergency Management)	**Emergency preparedness, coordination, and communication** 1. The El Paso Office of Emergency Management (OEM) mitigates extreme events by assessing risk and vulnerabilities and developing strategies to eliminate or reduce risk to life and property. 2. During an event OEM coordinates with several different local agencies, including the National Weather Service (NWS), to warn citizens through community outreach and emergency alerts. 3. After each event OEM performs damage assessments and writes reports to ensure lessons learned are recorded for other jurisdictions and for further improvement.
Carla Campbell (University of Texas at El Paso – UTEP)	**Capacity building and training** 1. There are many environmental impacts from climate change, including more extreme temperatures, increased flooding, increased droughts and water scarcity, and more frequent wildfires. 2. Climate change will also impact human health. The main adverse health effects include heat stress, food insecurity, population displacement, increase in diseases, and respiratory problems from air pollution. 3. Philadelphia has the longest-running heat-health intervention program in the country, which is considered the "gold standard" for heat management in the U.S. 4. The Philadelphia Health Department, CDC, NOAA and EPA all have good resources
Keith Glassbrook (Capital E)	**Solutions** 1. Albedo appears to be the best surface modification strategy for limiting urban heat islands in desert climates. 2. Though it is important not to discount the value of shade (e.g., from trees or solar canopies). 3. It is great to have the region come together because larger modification area means larger impact on temperature.

Session 4: Looking Ahead in Early Warning	
Jeremy Hess (University of Washington)	**Key early warning issues and examples from other contexts (states, countries)** 1. Broad collaboration among a wide range of service providers and stakeholders is key to success of heat early warning systems and action plans. 2. One agency should take the lead on coordinating early warning system and response activities. 3. Take time to identify the motivations of the stakeholders and participants, address the motivations in planning and administrative activities, and celebrate successes related to those particular motivations – it will build momentum and commitment to the project.
Melissa MacDonald (Environment and Climate Change Canada)	**Example of early warning system** 1. Weather service and public health both need to understand the requirements and challenges of both the other's work and extreme heat to work well together. 2. Creation of a system with multiple levels of government and partners always takes longer and with more bumps in the road than expected. 3. Evaluation has to be at the forefront of development, what is the point of a new or improved system if you cannot evaluate its effectiveness (or necessity).
Matiana Ramírez (COFEPRIS – Federal Commission for the Protection against Sanitary Risk, Mexico)	**Examples from Mexico** 1. The Ministry of Health in Mexico has implemented many medium- to long-term actions related to climate change, including research on managing the health risks of climate change. 2. The U.S., Canada, and Mexico are part of a pilot syndromic surveillance system for extreme heat as part of Mexico's Commission for Environmental Cooperation. 3. The "6 Steps to Health Prevention" program aims to minimize the impacts of climate change through basic sanitation, and targets vulnerable groups and regions.
Jon Gottschalck (NOAA Climate Prediction Center – CPC)	**Forecast capability for early warning** 1. CPC produces operational outlooks targeting excessive heat which includes information as part of the U.S. Hazards Outlook and Week-2 heat index products. 2. CPC is developing improved forecast tools targeting excessive heat events in Week-2 to support U.S. Hazards Outlook. 3. CPC has funding support for research to work towards the development of a prototype excessive heat event outlook for the Week 3-4 period if science supports. 4. Prediction of seasonal excessive heat information is an area of active research.

Participant Insights

Research, Information, and Outreach Needs and Opportunities

Research Challenges

During Session 2: Climate Context and Public Health & Emergency Management Decision-making in the Southwest Region, participants were tasked with identifying key research challenges related to: 1. Climate and weather, and 2. Public health. The goal of this exercise was to elicit thinking on the gaps in knowledge surrounding these two areas of research. Participants were asked to write their thoughts on index cards; transcriptions of the index card responses are in Appendix D.

The following research challenges and needs common to the topics *climate and weather* and *public health* research were identified by workshop participants:

- Translation of climate research into evidence-driven public health interventions and actionable strategies
- Discipline-specific environmental and health information, including surveillance and monitoring
- Knowledge dissemination—effective ways to communicate risk to the general public—and improved communication of information to the public and across groups (e.g., researchers and stakeholders)
- Emergency preparedness planning
- Observations and prediction skill improvement
- Funding, especially for academic research

Current and Future Actions

To create a baseline of information on current actions being implemented by organizations, and prospective future actions, participants were asked to answer the questions: "What is your organization/agency currently doing to address heat-health issues in the region?" and "What *could* your organization/agency do, and with whom, to bring about more effective preparedness?" Two major themes arose from the answers to the latter question, namely more collaboration and partnerships, and more effective community outreach.

Below is a synthesis of participants' answers to both questions. A full listing can be found in Appendix E.

Current actions:

- Educating healthcare providers about emergent care and treatment of environmental illness
- Public awareness and outreach
- Home Rehabilitation program provides weatherization grants to increase efficiency and improve livability of residences
- Working to improve the predictability of abnormal heat periods as far out in time as the science will allow
- Research on new techniques to observe intra-urban heat variability and how best to apply mitigation techniques

- Distribution of fans and blankets to underserved populations

Future actions:

- Public health surveillance and data acquisition from local health departments
- Ensure that feedback on research products make it back to partners/communities
- Implement warning system on campus through different medias
- Creating more effective Public Service Announcements (PSAs)
- Collaboration with local university to conduct studies on vulnerable populations
- Collaborate and work more closely with local and state agencies (in both the U.S. and Mexico)
- Increase data sharing and improve access to data

Work Stream Reports

Workshop participants were preassigned to one of five groups corresponding to focal areas, or "work streams," identified by NIHHIS leaders. The work streams aimed to assess current understanding in the key areas mentioned below, and to develop the basis for post-workshop efforts to implement ideas and actions to reduce heat-related vulnerabilities and improve preparedness for episodes of extreme heat. The work streams topics are as follows:

- A: Historical Climatology and Vulnerability
- B: Linkages Between Heat Parameters and Health Outcomes
- C: Prediction, Outlooks, and Early Warning
- D: Communication and Engagement
- E: Capacity Building and Training

Each work stream group was charged with reviewing and refining a draft work stream goal, and identifying and prioritizing themes for research and actions. For as many themes as time would allow, the work stream participants (a) identified the strengths and opportunities, (b) identified knowledge gaps and needs, (c) proposed strategies and actions, (d) identified potential participants and partners, (e) suggested available and needed resources, and (f) identified potential first steps for future actions. Below, we have briefly documented the discussions from each work stream, and provided a description of outcomes from extended discussions of the two highest priority themes identified by each group. Information about other themes identified by work stream participants are presented in tables in Appendices F through J.

Work Stream A: Historical Climatology and Vulnerability

This work stream is focused on historic responses to extreme heat events and the vulnerabilities associated with those events. Participants identified the main goal as establishing a baseline of historical climate and vulnerability, and then using that baseline for prevention of future heat episodes.

Goal: Improve understanding of (a) the historical climatology of the region, with respect to extreme heat episodes, (b) the historic responses to previous occurrences of extreme heat and the

efficacy of those responses, (c) the regional vulnerabilities to episodes of extreme heat, and (d) indicators that will be useful in providing early warning of extreme heat episodes**.**

Participants identified the following research and action themes (in priority order):

1. Vulnerability Assessment
2. Data Synthesis and Analysis
3. Collaboration
4. Education and Outreach
5. Funding

Theme 1: Vulnerability Assessment

Work stream participants identified strengths and opportunities for assessing vulnerability in the region. Current vulnerable groups and regions have already been identified, and trusted methodologies for vulnerability assessments already exist, creating a strong baseline for additional assessment. However, there are still many needs that should be addressed prior to assessment. For example, developing indicators other than mortality, hospital admissions, and morbidity. What other metrics can be used when determining heat illness? It would also be useful to have historical information of heat-related deaths categorized by gender and vulnerable group (infants, elderly, mentally ill, etc.), and to quantify regional vulnerabilities of diverse populations—what method would be needed for this?

The participants discussed some strategies and actions to close these gaps in knowledge of vulnerability assessment. First, participants suggest defining vulnerability and common data and methods used for vulnerability assessment, and identifying common indicators across the region and the border. Additional strategies include mapping vulnerabilities, identifying known methods for vulnerability assessment and adapting them to address local issues, and evaluating and validating existing assessments.

There are many partners to collaborate with to implement strategies. In the U.S., participants thought of the Emergency Care Coordination Center (ECCC) and NIHHIS, the integrated system for which this workshop was convened. In Mexico, collaborators might include the National Institute of Ecology and Climate Change (INECC), and the Network of Climatic and Hydrometeorological Phenomena and Associated Disasters (REDESClim). Other resources that could prove useful, including potential funding sources, are Health Canada, the National Science Foundation (NSF), and the National Institute of Environmental Health Sciences (NIEHS).

Theme 2: Data Synthesis and Analysis

Synthesizing and analyzing data emerged as another theme participants deemed important for improving understanding of historical climate and vulnerability in the region. Participants noted that data is available back to 1882, and combined with statistical methods can provide a historical climate baseline. Participants also noted many opportunities for data synthesis and analysis, including advancing statistical approaches for extreme heat return level frequency (how severe and how often into the future will episodes occur?), using current literature to address gaps in methods and future climate outlooks, and monitoring changes in humidity when temperatures are above 100 degrees F to determine future usability of evaporative coolers.

In addition to strengths and opportunities, participants noted many gaps in current knowledge of heat- and health-related data. For example, there needs to be climatology information at fine scales, and data on historic responses to heat episodes. Additionally, the effects of microclimates are not well known, as well as the combined effects of air quality, extreme heat, and other health problems. Participants from Mexico expressed the need for institutional memory in regards to responses to extreme heat so that knowledge isn't lost when administrations change. Lastly, participants noted a need for a regional climatology that uses different temperature indices, and a comparison of historical climatology and vulnerabilities in the El Paso region to other similar regions.

The group brainstormed some ideas for initial strategies and actions that can address the needs outlined above. These include: collection of data on climate and health, statistical analyses and modeling of existing data, mapping, and linking all of these strategies to vulnerability in the region. Local universities, National Weather Service (NWS) forecast offices, hospitals, and Health Information Exchanges would be good organizations to partner with to move these strategies forward. Participants also identified useful resources, which could provide funding and other assistance. These include: NOAA, Environment and Climate Change Canada, NIHHIS, the U.S. Department of Energy and Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and, in Mexico, The Federal Commission for the Protection against Sanitary Risk (COFEPRIS) and the Ministry of Health.

Additional discussion by Work Stream A can be found in Appendix F.

Work Stream B: Linkages between Heat Parameters and Health Outcomes

This work stream bridges the gap between heat-related parameters and health consequences. Discussion at the workshop mostly focused on the state of health data and information—what is currently available and what is still needed. In particular participants stressed the importance of obtaining access to health data, which is notoriously challenging to obtain. Additionally, participants repeatedly noted the need for funding, if any actions identified during the workshop are to be implemented.

Goal: Improve understanding of the connections and correlations between heat-related parameters and health consequences, in order to determine the most effective parameters to monitor for reducing heat-related morbidity and mortality.

Participants identified the following research and action themes (in priority order):

1. Information/Data
2. Research and Policy
3. Collaboration and Communication
4. Communication to Public

Theme 1: Information/Data

There are several opportunities for health information in the El Paso region, including apps and biometric monitoring devices as warnings, temperature monitoring devices, and remote alarm buddy systems. In addition, participants identified many challenges associated with health

information and data. Access to medical data, especially information on exposure in cases of death, is probably the biggest hurdle for acquiring health data, and also the most needed information. There is also a lack of valid biomarkers for heat illness and limited availability of location- and time-specific health-outcome data. Participants noted the need for prevalence data, such as identification of heat-related deaths and illnesses and consequences to disease, and correlation data with co-morbidities, such as infection, dementia, and renal failure. In addition to health-related data, participants noted the need for research funding to evaluate various approaches to communicating climate and weather risk.

Some strategies that participants identified for improving heat-related health information and data include collecting data on power outages and usage during extreme heat events (starting with utility companies) and collecting prevalence data on health visits based on outdoor temperatures and other factors, such as relative humidity and heat index values. Other suggested strategies include making data available from the Agency for Healthcare Research and Quality (AHRQ) and engaging the El Paso County Public Health Department to gain access to data on heat-related deaths and illnesses. Learning how Maricopa County or other counties or states pool their heat-related health data from the Emergency Departments would also be beneficial information.

Theme 2: Research and Policy

Research needs and policy were deemed important themes by participants at the workshop. Most importantly, a basic understanding of heat parameters is needed in order to know at what level interventions should begin. Opportunities for policy changes do exist, such as the ability to create a statewide policy once a plan is in place and approved. However, several challenges need to be overcome first, such as the limited funding available for research into climate and health and for personnel to conduct surveillance and needs assessments, and making the topic of heat and health a priority for stakeholders and the public among competing issues.

Due to time constraints, Work Stream B was only able to identify potential strategies/actions for Theme 1: Information/Data. The group did, however, brainstorm ideas and suggestions for future work. For example, participants suggest creating a research funding announcement to test the efficacy of climate-health interventions. Another suggestion was using monitoring devices in homes for vulnerable groups (e.g. elderly, disabled, mentally ill), which has already been implemented in a small pilot group of the elderly population.

Additional discussion by Work Stream B can be found in Appendix G.

Work Stream C: Prediction, Outlooks, Early Warning

This work stream discussed issues related to official and experimental forecasts, products to inform decision makers and the public, and prospects for improving early warning for episodes of extreme heat. The participants focused on issues related to conveying existing forecast information, rather than the state of the art with respect to forecasting extreme heat.

Goal: Improve understanding of the heat-health forecast products and services that can be made available to predict episodes of extreme heat, on multiple timescales, in order to provide advance warning to reduce heat-related morbidity and mortality.

Participants identified the following research and action themes (in priority order):

1. Forecast communication
2. Forecast lead time
3. Heat parameter metrics and meanings
4. Education (intersects with communication and lead time)
5. Reaching all segments of the population
6. Expertise and coordination

Theme 1: Forecast Communication

There are multiple opportunities to improve the communication of extreme heat forecasts. A regional strength is existing interagency coordination, including emergency warning and prevention teams. Participants noted that there are abundant channels of information dissemination, including static or print media—such as bus stop posters, bulletins, billboards, brochures, and newspapers—and dynamic or electronic media, such as social media (e.g. YouTube, Facebook), mobile and phone technology applications, television, LED highway and road signs and others. While various organizations already disseminate information among these channels, the group emphasized the need to focus on threats that may not be well understood, and to make better use of graphics to make heat-related risks more understandable.

Participants expressed concern that forecast messages were not well understood by decision makers and the public, due to inconsistent language in messages, the multiple interpretations of language used in warning messages (e.g., *advisory* vs. *watch* vs. *warning* – what do these mean to individuals?), and varied perception of heat-related risk. They noted that it is difficult to relate the urgency of an extreme heat wave with adverse health effects and heat-related deaths, which are often not widespread, and are not well reported. Whereas there is a need to convey a sense of urgency, (a) there is a well-documented tendency for the public to think that messaging amounts to "crying wolf" if a warning is not accompanied by a notable impact, and (b) there is a tendency for large segments of the community to ignore repetitive warnings, which might occur during an extended extreme heat episode. To address these issues, participants recommended that effort and research be aimed at garnering further input for information, impact assessments, and to provide coordinated and consistent messaging among a variety of organizations and agencies. They recommended the use of warnings based on a probability of occurrence, and impact-based warnings that highlight the likelihood of the potential effects of extreme heat, rather than the level of the heat parameter.

Among the potential communication strategies and actions, work stream members recommended focused public communication around the theme of a *heat season awareness week*, with events at schools, shopping malls, and communication through high visibility media. They noted that heat season awareness week could build upon Extreme Weather Task Force press releases and other campaigns. Key participants would include the NWS and other federal agencies, news media (e.g., print, radio, television, online), city and county health departments, offices of emergency management and Protección Civil in Juárez, mayors and city councils, county judges,

universities, non-governmental organizations, schools, religious organizations, and organizations that have access to and are trusted by vulnerable and hard-to-reach populations.

Participants noted that the Extreme Weather Task Force provides a strong foundation for this effort, and that coordinated narratives would help with consistent messaging. Whereas financial resources are always needed, they noted the following potential sources of financial, in-kind, and human resources: non-governmental organizations, businesses (e.g., Wal-Mart), refinery and pipeline companies, El Paso electric and water utilities, and local governments.

Work Stream C participants suggested the following next steps:

- Contact agencies already doing this kind of work
- Learn from other cities
- Prepare public service announcements to meet the formats of multiple media outlets, including social media and online radio (i.e., Pandora)
- Coordinate with other work streams to reach vulnerable populations, especially those in hard to reach places outside of city limits and in adjacent rural areas

Theme 2: Lead Time

Adequate forecast lead time is needed to raise awareness and prepare decision makers and the public for extreme heat episodes. Participants identified a need to determine the optimal lead time for outlooks and messaging, and noted that issuing warnings too far in advance undermines their effectiveness; nonetheless, some participants saw opportunities to use 2-week in advance forecasts to prepare for large public events. They noted a number of existing strengths upon which to build, including existing NWS outlooks and products, prospects for detailed predictions out to 7 days, and early education to raise awareness and inform people on how to use advanced lead warnings. They noted that with sufficient lead time people can prepare themselves (stock up on water, stay cool, use kitchen ovens early in the day rather than during afternoon high temperature hours, plan to go to cooling stations, find transportation ahead of time). They also advocated reducing risk by enhancing building standards to encourage sustainable and resilient design for heat—which incorporates the concept of *lead time,* by preparing months or years in advance of the threat of increased extreme heat.

In addition to conducting social science research to determine the optimal lead time for forecast messaging, participants recommended the following lead-time uses and communication strategies:

- Identify opportunities to garner attention for heat
- Early education and warnings at start of heat season
- Research to determine specific agency needs
- Pre-positioning of assets, such as mobile cooling units
- Prioritizing messaging and efforts to restore public trust in the event of an inaccurate severe weather forecast
- Provide advanced lead messaging related to specific conditions and potential health impacts related to outdoor activities (work and leisure)

Participants recommended a variety of regional partners to implement activities related to improved forecast lead times, including prediction practitioners (i.e., meteorologists and

climatologists), interdisciplinary research teams from universities, GIS practitioners, city, county and state departments of health, and promotoras. Participants identified the following specialized disciplines as critical to improving understanding of how to make the best uses of improved lead times, and to improve communication of advanced lead forecasts: risk resource scientists, anthropologists, and other social scientists.

The group recommended the following initial sources of funding for this work: federal and state agencies, private entities, NGOs, foundations devoted to increasing societal resilience, the Council for Environmental Cooperation, and the Border Economic Cooperation Commission.

Next steps identified by Work Stream C participants include:

- Seek funding for and begin research
    - Length and amount of time above thresholds for crops, transformers, highways, outdoor activities, and other infrastructure or human activities affected by extreme heat
- Prediction product needs assessments
- Higher spatial resolution forecast and analyses
- More frequent forecast updates
- Develop a 2-week high temperature prediction and 24-hour mean temperature (along with humidity consideration)

Additional discussion by Work Stream C can be found in Appendix H.

Work Stream D: Communication and Engagement

This work stream discussed issues related to outreach to the public, with a special focus on vulnerable and underserved communities, effective communication and messaging, with a special focus on cultural sensitivity, and the collaboration, partnerships, and networks needed to improve preparedness and responses to episodes of extreme heat.

Goal: Ensure the improved understanding of heat waves and health impacts is broadly accessible and well understood so that it influences behavior and reduces morbidity and mortality. Accomplish this by incorporating cultural sensitivity and facilitating inter-organization dialogue and engagement.

Participants identified the following research and action themes (in priority order):

1. Communication to vulnerable populations
2. Developing trust in organizations delivering the message
3. Economic opportunity
4. Informal communication networks
5. Cultural sensitivity
6. Interdisciplinary approaches
7. Measuring effectiveness
8. Message overload

Theme 1: Communication to vulnerable populations
Participants noted a strong need to increase effectiveness in reaching underserved communities, such as colonias, homeless populations, the undocumented population and rural communities. In particular, they identified a need to remove barriers to aiding so-called "in-need" populations.

Work stream D participants suggested a variety of actions to improve interactions and engagement with vulnerable communities, including: a) identification of existing networks that interface with vulnerable populations (e.g., the promotora network), b) an inventory of the initiatives by community organizations and academic institutions and the degree of overlap associated with these initiatives, c) identification of and coordination with leaders and certified community workers from vulnerable communities—especially promotoras and liaisons living within vulnerable communities, and d) collaborative delivery of educational materials, including communication of available resources.

Participants noted that the promotora network, along with community centers that provide services to vulnerable communities form a foundation upon which to build enhanced communication and outreach. They mentioned water and transportation resources and noted a need for funding for outreach materials. Key participants to implement actions include community members, homeless shelters, governments, and academia. Coordination with municipal governments and organizations is needed to initiate bylaw changes (e.g., for amending work laws). Coordination with state and federal governments is needed to identify and solve problems. Academic and other research projects that are engaged with communities are important for outreach and knowledge generation.

Work Stream D participants suggested the following next steps:

- Identify agencies that already have useful resources, and garner funds from these agencies by aligning requests with agency mission and vision statements
- Identify agency mandates pertaining to extreme heat and communication around this issue
- Conduct further roundtables and workshops, and broaden participation to be more inclusive

Theme 2: Developing trust in organizations delivering the message
Discussions related to trust-building focused on tuning the message to the intended audiences, and putting greater attention to fostering collaboration with trusted messengers. Participants noted that climate change is a poor point of entry for discussions of extreme heat, and recommended using people's experience and memories as a point of departure. They noted that community health workers and promotoras are particularly effective messengers to colonias. Community-academic partnerships were seen as strengths, and the use of multiple communication channels was noted as an essential element to ensure effective communication to all populations.

Participants mentioned the following pitfalls in developing trust in heat risk messaging: use of technical jargon, lackluster messaging that doesn't catch people's interest, and, importantly, an over-reliance on online or technically sophisticated means of conveying messages to the public; the latter is a critical consideration, if heat-related messages are to penetrate to the most

vulnerable populations. In addition, participants noted a lack of access to reliable data, information, and research on community beliefs, skills, and knowledge. Related to these concerns were concerns about providing culturally sensitive and culturally relevant messages to binational border community residents, many of whom may not speak English as their primarily language and who also possess strong local knowledge. The group also noted a problem with "alert fatigue," which can desensitize people to important messaging.

The group identified several local and regional resources, including the El Paso Department of Health (which has a wide platform for media distribution), COEP Office of Public Affairs, local Chambers of Commerce, and local foundations, e.g., PDNHF, which may be able to provide funding. Key participants and partners in developing trusted messaging include religious organizations, occupational organizations, radio and television stations, and academic-community research partnerships.

Next steps for developing trust include convening monthly meetings that coordinate among partners, agencies, and interest groups, and developing so-called engaged research projects, with co-equal academic and community participants, to co-produce information and knowledge. Some additional key ideas raised by participants included: exchange of information through binational health councils and informal cross-border communication networks, connections with economic opportunity initiatives (including industry innovations), and a need for research on the effectiveness of outreach efforts.

Additional discussion by Work Stream D can be found in Appendix I.

Work Stream E: Capacity Building and Training

This work stream discussed issues related to planning processes, coordination, collaboration, communication and training needed to improve regional capacities to prepare for and respond to extreme heat episodes. The group focused, in particular on leveraging and enhancing existing leadership, fostering collaboration to build resilience, and developing capacity across multiple scales of governance and expertise. They noted a close alignment with other work streams, especially communication and outreach.

Goal: Assess and improve the financial, institutional, and community capacity and training needed to effectively use early warning information and implement or enhance early warning capabilities, in order to reduce heat-related morbidity and mortality, and enhance resilience to extreme heat episodes.

Participants identified the following research and action themes (in priority order):

1. Planning and process
2. Collaboration
3. Public health communication and information
4. Linkages to public health networks and expertise

Work Stream E participants identified several over-arching topics, heuristics, and characteristics related to capacity building. First, they noted that capacity building and training efforts must

reflect the needs of the community, and must be proactive in order to be effective. They noted that efforts must reach across multiple scales and needs to reach individual, then household, then local government, then state and federal levels. In order to facilitate cross-scale cohesion, government and non-government entities and initiatives, including the healthcare community, need to collaborate and be unified in their efforts. They noted that stakeholders must have the proper capacity and training to be able to move forward and engage the community. Developing sufficient capacity and training in facilities, communities and businesses within the region will improve the prospects for proper outreach to other organizations and the community. The group also suggested that good capacity means being able to communicate and engage, by training everyone to communicate—fire department, police officers, emergency managers and others.

Theme 1: Planning and process

Participants in Work Stream E identified the STEAR (State of Texas Emergency Assistance Registry) as an existing resource upon which to expand capacity; they noted that informing community members to register would help raise awareness. They saw opportunities to develop unified training, appropriate for each group, and to coordinate and align existing resources for maximum impact. Another opportunity identified by the group is to take leadership with other regions nationwide and share best practices.

In order to follow through on potential opportunities, the group identified several needs, including identification of existing community resources, assessment and comparison of information and harmonization through coordinated messaging. The group suggested the development of a well-coordinated regional strategy for increasing capacity, including further training for all stakeholders and partners on heat-related morbidity and mortality and plans to address heat episodes.

Strategies to address needs and challenges centered on coordination and development of analytical tools for rigorous assessment of needs and gaps. Key analytical strategies include:

- Development of a website, with tools to interact with one another and to facilitate documentation and sharing of ideas; the tool would be interactive and used in between face-to-face meetings.
- Creation of a concept map, to explore and connect into other initiatives, in order to identify needs and gaps.
- Development of a list of vulnerable populations that need to be reached.
- Compiling data, including development of metrics to show (a) the extent to which extreme heat causes serious health problems, (b) insurance companies' codes that indicate hospitalizations related to heat, and (c) measures of successful capacity building and training effectiveness.

Coordination strategies include:

- Identification of a leader to guide online collaboration.
- Involvement of entities that deliver health services.
- Communication across different groups, in order to coordinate messaging and to distinguish unique messaging for particular communities or sectors.

Work Stream E participants identified these partners and participants, to implement capacity and training planning: Public health leaders and providers in Juárez, Mexico, southern New Mexico, and West Texas; OEM; EMS; Public Schools (K-12); Red Cross; local utilities; Public Information Officers (from schools as well); Border Health Commission; promatoras; NGOs that serve communities; and the Paso del Norte Foundation.

The group noted the need to identify resources in order to garner data on populations affected by extreme heat, and data that supports the idea of using cool roofs. They also cited a need to coordinate with entities familiar with the indicators for the consequences of extreme heat, and initiatives on how to correctly mitigate the factors associated with these dangerous indicators.

Theme 2: Collaboration
Collaboration, in any capacity, opens doors to a myriad of opportunities, and Work Stream E participants noted that uniting many groups will help build preparedness capacity. They suggested working with environmental health groups or organizations to do more preventative work on heat-health issues, and engaging private businesses to determine their interest in the NIHHIS project. Participants noted that the local government is the key for collaboration and a unified response, and collaborations in general should work together in a unified manner. Institutional collaborations and collaboration between El Paso and Juárez were also identified as important collaborations.

To best utilize the collaborations outlined above, participants identified several needs and challenges that would need to be overcome. First and foremost, there are always competing government priorities at all levels of government, and how to bring extreme heat to the forefront will be an important challenge to overcome. Also, leadership, again at all levels of government, will need to work together in a unified manner. Participants noted that the heat-health conversation needs to be a regional one, including El Paso, New Mexico, and Mexico, and also including rural areas such as Hudspeth County.

Work Stream E participants identified some overall next steps for the group to take. These include engaging the Extreme Weather Task Force and communicating with neighboring areas, such as San Elizario and Sunland Park, who might be doing different things that are working well and that El Paso can learn from. Additional discussion by Work Stream E can be found in Appendix J.

Summary and Next Steps

Through presentations, discussion, and focused working groups, workshop participants identified and prioritized key needs and strategies for further enhancing knowledge about public health preparedness for and response to episodes of extreme heat in the El Paso-Juárez-Las Cruces region. Participants seeded the development of an initial assessment of regional heat health knowledge, organizations, institutions and initiatives. Work stream discussions and recommendations provided a starting place for more in-depth investigations on regional capacities, data and knowledge bases, and feasible actions to increase preparedness and reduce vulnerabilities to episodes of extreme heat.

To improve understanding of regional heat waves, forecasting, connections between heat extremes and health outcomes, and communication of critical information, workshop participants placed the strongest emphasis on:

1. Data and information needs, especially improved access to public health data on exposure in cases of heat-related death, biomarkers for heat illness, and prevalence data.
2. Research and methods for monitoring and predicting heat health outcomes, including identification of indicators and metrics of extreme heat-related illnesses, validation of vulnerability assessments and assessment methods, and vulnerability mapping.
3. Research on and implementation of best practices for conveying information and forecasts for extreme heat-related risks, including social science research on forecast messaging, and improved efforts to remove barriers to reaching the most in-need populations.
4. Improved coordination among heat health partners, with foci on leveraging the leadership of local governments, and leveraging existing regional strengths in cross-border and regional emergency management coordination, and neighborhood-level outreach organizations.

Several key recommendations for moving forward include:

1. Development of an inventory of heat health initiatives by community organizations and academic institutions, identification of and coordination with leaders and certified community workers from vulnerable communities.
2. Focused public communication around the theme of a *heat season awareness week,* with events at schools, shopping malls, and communication through high visibility media—leveraging the excellent work of the Extreme Weather Task Force.
3. Building upon the efforts of state and regional organizations to expand public capacity to respond to extreme heat episodes, and to enhance the capacity of organizations to coordinate across scales of governance in order to develop improved training and outreach.

The aforementioned recommendations, and the efforts of work stream groups will inform future actions, and provide information useful to those pursuing funding to implement recommendations from the workshop. The workshop was conducted as part of the National Integrated Heat Health Information System (NIHHIS) initiative, which will help this Southwest regional pilot project to contribute to national and international efforts to evolve a long-term approach to improving resilience to climate and weather extremes.

Action Plan

Following the workshop, the Steering Committee for the initiative met, at the University of Texas at El Paso. The committee recommended that work stream groups first inventory and assess existing data, initiatives, resources, funding opportunities, and develop a state of knowledge regarding extreme heat and public health in the region. An assessment will form the

basis for informing future action, and will provide information useful to those pursuing funding to implement recommendations from the work and work streams.

Having initiated work stream meetings at the workshop, and given a near-term deadline of the heat season beginning in May 2017, participants agreed to carry out planning and implementation activities via the existing Southwest NIHHIS pilot steering committee and the work streams. An initial organizational document (Appendix K – Work Stream Priming and Priorities) was drafted to impart momentum from the workshop to the work streams, and to encourage each work stream to focus on both an initial project to engage participants in the near term, and to consider longer-term projects that would require collaboration with other work streams, longer term research requirements, and investments over time (such as mitigating urban heat through city planning).

References

Amaya, M. A., M. Mohammed, N. E. Pingitore, R. Aldouri and B. Benedict (2016). Community Exposure to Nighttime Heat in a Desert Urban Setting, El Paso, Texas. *International Journal of Advanced Remote Sensing and GIS*: pp. 1507-1513.

Esquivel Ceballos, V.H., and A.V. Peña López (2013). Base de datos de temperature máxima diaria para la estación meteorológica IIT-UACJ (2002-2012). Laboratorio de Climatología y Calidad del Aire del Departamento de Ingeniería Civil y Ambiental, Instituto de Ingeniería y Tecnología, Universidad Autónoma de Ciudad Juárez. Ciudad Juárez, Chihuahua, México.

Grineski, S., T. Collins, Y. McDonald, R. Aldouri, F. Aboargob, A. Eldeb, L. R. Aguilar and G. Velázquez-Angulo (2013). Double exposure and the climate gap: changing demographics and exposure to extreme heat in Ciudad Juárez, Mexico. *Local Environment* 20: 180-201.

Melillo, J. M., T. C. Richmond, and G. W. Yohe, Eds. (2014). Climate change impacts in the United States. Third National Climate Assessment. Washington, DC, U.S. Global Change Research Program.

Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville (2014). Ch. 2: Our Changing Climate. In J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe (eds.), *Climate Change Impacts in the United States: The Third National Climate Assessment*. Washington, DC: U.S. Global Change Research Program, 19-67. doi:10.7930/J0KW5CXT.

Appendices

Appendix A: List of workshop participants. Participants highlighted in blue are members of the steering committee.

Last Name	First Name	Organization
Adams	Freida	New Mexico Department of Health
Arreola	Celena	City of El Paso Office of Resilience & Sustainability
Barnes	John	University of Texas at El Paso Environment Health & Safety Office
Beltran Garcia	Nancy	Protección Civil
Camiro	Rogelio Tobón	Federal Commission for the Protection against Sanitary Risk (COFEPRIS)
Campbell	Carla	University of Texas at El Paso College of Health Sciences
Carmona	Carlos	Texas Department of Emergency Management
Castro	Ralph	City of El Paso Water Utility
Collins	Timothy	University of Texas at El Paso Department of Sociology and Anthropology
Crawford	Scott	Texas Tech University Health Sciences Center
Daniels	David	New Mexico Department of Health
Delgado Rios	Marcos	Universidad Autonoma de Ciudad Juárez
Del Rio	Michelle	University of Texas at El Paso Center for Environmental Resource Management
Dominguez	Marisol	U.S. Environmental Protection Agency (EPA) Region 6
Dubois	David	New Mexico State University/New Mexico Climate Center
Fausett	John	National Weather Service – El Paso Office
Ferrini	Nicole	City of El Paso Office of Resilience & Sustainability
Furtado	Jason	University of Oklahoma School of Meteorology
Garcia Acosta	Jorge Alfredo	Protección Civil
Garcia	Susana	U.S. Environmental Protection Agency (EPA) Region 6
Garfin	Gregg	University of Arizona Institute of the Environment
Glassbrook	Keith	Capital E
Gottschalck	Jon	National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center (CPC)
Gutierre	Bernadette	New Mexico Department of Health – Epidemiology and Response
Hargrove	William	University of Texas at El Paso Center for Environmental Resource Management
Heins	Candice	City of El Paso Office of Resilience & Sustainability
Hernandez	Erika	New Mexico Department of Health
Hernandez	Jenny	City of El Paso Office of Resilience & Sustainability
Hess	Jeremy	University of Washington Division of Emergency Management
Hondula	David	Arizona State University School of Geographical Sciences & Urban Planning
Huerta	Diane	Texas Tech University Health Sciences Center
Jimenez	Christian	City of Las Cruces Office of Sustainability
Jones	Hunter	National Oceanic and Atmospheric Administration (NOAA) Climate Program Office (CPO)
LaRocque	Lisa	City of Las Cruces Office of Sustainability

LeRoy	Sarah	University of Arizona Institute of the Environment
Lundeen	Greg	National Weather Service – El Paso Office
MacDonald	Melissa	Environment and Climate Change Canada
Martinez	Bea	Texas Department of State Health Services
Mata	Enrique	Paso del Norte Health Foundation
Matamoros-Barraza	Efren	Protección Civil
Monks	Stormy	Texas Tech University Health Sciences Center
Mubako	Stanley	UTEP Center for Environmental Resource Management and Department of Geology
Munoz Slack	Grace	UTEP Environment Health & Safety Office
Murphy	Ric	Community Health Centers/North American Management
Navarrete	Lorraine	U.S.-Mexico Border Health Commission
Ortiz	Graciela	Texas Department of Family and Protective Services
Palacios	Rebecca	New Mexico State University Department of Public Health Sciences
Perales	Carlos	City of El Paso Water Utilities
Posada	Eugenia	Texas Commission on Environmental Quality – Border Affairs
Quinn	Thomas	City of El Paso Office of Emergency Management
Ramírez	Matiana	Federal Commission for the Protection against Sanitary Risk (COFEPRIS)
Raysoni	Amit	University of Texas at El Paso Department of Public Health Sciences
Renner	Jana	Paso del Norte Health Foundation
Rincon	Carlos	U.S. Environmental Protection Agency (EPA) Region 6
Robertson	Tahnee	Southwest Decision Resources (Workshop Facilitator)
Rodriguez	Anthony	U.S.-Mexico Border Health Commission
Romo Aguilar	Lourdes	El Colegio de la Frontera Norte
Sanchez	Dawn	New Mexico Department of Health
Sandoval Granados	Jose Luis	Universidad Autonoma de Ciudad Juarez (UACJ)
Saucedo	Sara	City of El Paso Department of Health – Emergency Management Division
Sittig	Julia	Southwest Decision Resources (Workshop Facilitator)
Stafford	Patrick	New Mexico Department of Health
Steinberg	Nik	Four Twenty Seven
Trepanier	Jill	Louisiana State University Department of Geography & Anthropology
Trtanj	Juli	National Oceanic and Atmospheric Administration (NOAA) Climate Program Office (CPO)
Vanos	Jennifer	Texas Tech University Department of Atmospheric Sciences
Velazquez	Gilberto	Universidad Autonoma de Ciudad Juarez (UACJ)
Vicente Duran	Juan	City of El Paso Water Utilities
Wraich	Aman	City of El Paso Office of Resilience & Sustainability
Wilson	Kevin	City of Las Cruces Planning & Neighborhood Services

Appendix B: Workshop agenda.

TIME	Wednesday, July 13, 2016
8:00-8:30	**Registration**
8:30-9:05	**SESSION 1: Welcome, Overview, Introductions** **Introduce the opening remarks**: *Gregg Garfin (Climatologist, University of Arizona)* **Welcome and remarks**: *Nicole Ferrini (Chief Resilience Officer, City of El Paso)* **Welcome and remarks**: *Thomas Quinn (Assistant Emergency Management Coordinator, El Paso City & County Office of Emergency Management)* **Workshop Heat and Health**: *Jennifer Vanos (Bioclimatologist, Texas Tech University, South Central Climate Science Center)* **NIHHIS Overview**: *Hunter Jones (Special Projects Manager, NOAA Climate Program Office)* **Workshop Overview, Logistics, Packets**: *Gregg Garfin* **Participant Introductions**
9:05-10:30	**Stage-setting Talks and Discussion (Disciplines)**
9:05-9:45	**SESSION 2A: Climate Context and Public Health & Emergency Management Decision-making in the Southwest Region** ● **History: Climatology of heat waves in the El Paso-Juárez-Las Cruces region, and discussion of seasonal outlooks** – *Greg Lundeen (Science Operations Officer, National Weather Service, El Paso)* ● **Public health decisions in extreme heat** – *Grace Ortiz (Community Engagement Specialist for Adult Protective Services, Texas Department of Family and Protective Services)* ● **Phoenix/Maricopa case study: What has another southwest city done to prepare and respond to this challenge?** – *David Hondula (Assistant Professor, School of Geographical Sciences and Urban Planning, Arizona State University)*
9:45-10:15	**Q&A/DISCUSSION – Physical and Health Sciences Research Challenges Panel** ● What are key climate and weather research challenges? ● What are key public health research challenges?
10:15-10:35	**SESSION 2B: NIHHIS, Heat-Health Early Warning, and NOAA's Climate Resilience Toolkit** *Juli Trtanj (One Health and Integrated Climate and Weather Extremes Research Lead, NOAA Climate Program Office)* *Hunter Jones (Special Projects Manager, NOAA Climate Program Office)*
10:35-10:50	**Break**
10:50-11:40	**SESSION 3A: Lightning Talks and Discussion - Heat-Health Capacity in the Region** ● **Introduce Session** – Gregg Garfin ● **Vulnerability Overview** – *Timothy Collins (Professor of Geography, UTEP)* ● **Epidemiology: Connecting heat and health** – *David Daniels (SW Region Emergency Preparedness Specialist, New Mexico Department of Health)* ● **Institutional Capacity and Arrangements** – *Efren Matamoros (Director, Protección Civil, Ciudad Juárez)* ● **Emergency Preparedness, Coordination, and Communication** – *Thomas Quinn (Assistant Emergency Management Coordinator, El Paso City & County Office of Emergency Management)* ● **Capacity Building and Training** – *Carla Campbell (Associate Professor of Public Health, UTEP)* ● **Solutions** – *Keith Glassbrook (Senior Analyst, Capital E)* ● **PANEL Q&A**

11:40-11:55	**SESSION 3B: Dialogue: Social and Institutional Dimensions for El Paso-Juárez-Las Cruces** ● **Exercise: Think – pair – share.** a. Current: What is your agency currently doing to address heat-health issues in the region? b. Future needs/opportunities: What could your organization do, and with whom, to bring about more effective preparedness? ● **Report back to plenary – popcorn style**
11:55-12:45	**Lunch**
12:45-1:45P	**SESSION 4: Looking Ahead in Early Warning** ● **Key early warning issues and examples from other contexts (states, countries)** – *Jeremy Hess (Associate Professor, Division of Emergency Medicine, University of Washington)* ● **Example of Early Warning System** – *Melissa MacDonald (Health and Air Quality Program Meteorologist, Environment and Climate Change Canada)* ● **Examples from Mexico** – *Matiana Ramírez (Federal Commission for the Protection against Sanitary Risk (COFEPRIS))* ● **Forecast capability for early warning** – *Jon Gottschalck* (*Deputy Business Activities Director, NOAA Climate Prediction Center)* ● **Panel Q&A**
1:45-4:40	**Moving Ahead on Development of a Heat-Health Information System for El Paso-Juárez-Las Cruces**
1:45-3:15	**SESSION 5: Work Stream Breakout Discussions** ● Five **facilitated** work stream breakouts **A. Historical climatology and vulnerability** ▪ Goal: Improve understanding of (a) the historical climatology of the region, with respect to extreme heat episodes, (b) the historic responses to previous occurrences of extreme heat and the efficacy of those responses, (c) the regional vulnerabilities to episodes of extreme heat, and (d) indicators that will be useful in providing early warning of extreme heat episodes. **B. Linkages between heat parameters and health outcomes** ▪ Goal: Improve understanding of the connections and correlations between heat-related parameters and health consequences, in order to determine the most effective parameters to monitor for reducing heat-related morbidity and mortality. **C. Prediction, outlooks, early warning** ▪ Goal: Improve understanding of the heat-health forecast products and services that can be made available to predict episodes of extreme heat, on multiple timescales, in order to provide advance warning to reduce heat-related morbidity and mortality. **D. Communication and engagement** ▪ Goal: Ensure the improved understanding, of heat waves and health impacts, is broadly accessible and well understood, so that it influences behavior and reduces morbidity and mortality. **E. Capacity building and training** ▪ Goal: Assess and improve the financial, institutional, and community capacity and training needed to effectively use early warning information and implement or enhance early warning capabilities, in order to reduce heat-related morbidity, and enhance resilience to extreme heat episodes.
3:15-3:30	**Break**
3:30-4:40	**SESSION 6: Marketplace of Ideas** Report-back and cross-disciplinary discussion ● Group volunteers give brief highlight presentations o Gaps/needs + challenges

	○ Strengths + opportunities ○ Strategies/actions ○ Leadership + coordination ○ Resources ○ Next steps ● Priorities - in original work stream: review feedback from other groups, prioritize actions/next steps, identify work stream leaders and participants
4:40-5:00P	**SESSION 7: Next Steps** ● **Next steps** - *Gregg Garfin* ● **Closing comments** - *Gregg Garfin, Juli Trtanj/Hunter Jones, Nicole Ferrini* ● **Workshop evaluation**

Appendix C: Presentation summaries.

Sessions 2A & B: Climate Context and Public Health & Emergency Management Decision-making in the Southwest Region

Presentations in this session laid the foundation for the purpose of the workshop.

Gregory Lundeen (National Weather Service, El Paso Weather Forecast Office) began the session by describing the climatology of heat in the region and forecast products that are commonly used to forecast heat events. Lundeen elaborated on his Weather Forecast Office's definition of a heat wave—a period of 48 hours during which neither the overnight low nor the daytime temperature falls below the NWS heat stress thresholds of 80 degrees F to 105 degrees F—and outlined the necessary atmospheric conditions (e.g., subtropical high pressure aloft) for this to occur in the El Paso area. These heat waves typically occur in June and July. Lundeen also described various forecast products that can be used to predict extreme heat, such as long-range (two weeks to seasonal) forecasts from the NOAA Climate Prediction Center (CPC) and short-term (out to 10 days) forecasts from the NWS and the NOAA Weather Prediction Center (WPC). One important issue to consider regarding making heat information more useful for local decision-makers is the spatial scale of the information. Heat predictions could be refined if mesonets (dense networks of automated weather stations) were deployed to get local-scale information on meteorological parameters in a city, combined with coarser-scale forecast model output.

Graciela (Grace) Ortiz (Texas Department of Family and Protective Services) presented information about the Extreme Weather Task Force (EWTF), a partnership of local, state, and federal government agencies and community partners that informs the public about preparing for severe weather. The EWTF holds press conferences at the beginning of the winter and summer seasons to initiate health advisories and provide tips on preventing illness, such as using the "buddy system" and drinking plenty of fluids in the summer. These measures are especially important for high-risk individuals, such as young children, the elderly, and outdoor workers. Interventions include a phone number that can be called to request that a fan be delivered to a home in need of cooling. She identified a lack of funding to support "cooling zones"—where overheated people can go to cool off—as a constraint to reducing extreme heat risk. At the moment these zones are supported by donations. Much of the data available is from the medical examiner's office, rather than from hospitals, due to privacy concerns. A majority of the deaths tracked in El Paso are in the elderly population, with children being the next most vulnerable group. Another concern is alcohol use combined with dehydration, both of which increase vulnerability in the remaining adult population. Additional vulnerable populations include field workers and temporary or seasonal workers near the border, mostly those working construction.

David Hondula (Arizona State University) described an extreme heat case study from Maricopa County, Arizona. He described ten strategies that the Phoenix area uses to cope with heat. These include: air conditioning, cooling centers, reporting and surveillance of heat associated illness and death, education and messaging, heat alerts, regulations, canvassing and outreach, cooling infrastructure, emergency response plans, and knowledge exchange. These interventions come with caveats. For example: 96% of households have air conditioning, but 1/3 of these households feel financially constrained in their air conditioner use; and 39% of heat-related deaths still occur

indoors. Hondula identified the need for a transboundary framework for disease surveillance. Though there are National Climate Services Partnership and North American Working Group on Climate Change and Human Health memoranda of understanding, they are not sufficient to provide a robust framework. Maricopa County and Arizona State health departments have demonstrated a model of open heat-health information and data exchange, which may be useful for the El Paso region.

Juli Trtanj (NOAA Climate Program Office) introduced the National Integrated Heat Health Information System (NIHHIS) initiative, and the role of the Southwest pilot project within NIHHIS. She began by explaining that global temperatures have been rising and are expected to continue to rise, increasing the risk of excessive heat exposure, which caused 8,015 deaths in the U.S. from 1979-2003. Trtanj then described ways to prepare for extreme heat and prevent heat-related morbidity (illnesses) and mortality (deaths). In particular, she elaborated on NIHHIS, which helps decision-makers in many disciplines understand heat-related vulnerabilities, risks, and interventions, and how NIHHIS aims to provide early warning on the seasonal-to-annual timescales related to climate resilience. NIHHIS—launched by NOAA and CDC—is an integrated information system, which facilitates an integrated approach to providing a suite of decision-support services to reduce heat-related illness and death. Trtanj outlined the NIHHIS framework (e.g., data and forecast products, communication strategies, and institutional partnerships) and described the common characteristics of related international pilot projects. Finally, she outlined the desired outcomes of the workshop, including the development of ongoing work streams, and identification of health and climate information requirements that can be used by NOAA, CDC, and other partners, to meet the needs of the public.

Session 3: Heat-Health Capacity in the Region

This session was designed for the participants to learn from regional experts about existing heat-health capacity in the region, and key aspects of heat-health decision making and extreme heat emergency management.

Timothy Collins (University of Texas at El Paso – UTEP) described a study, conducted at UTEP, to characterizing the geography of population risks to extreme heat, and neighborhood-level urban greening adaptation options for El Paso and Ciudad Juárez. The study showed that neighborhoods in the urban cores along the international border have high surface temperatures, coupled with low amounts of vegetation. This makes them highly vulnerable to extreme heat. The study identified particularly vulnerable neighborhoods that would benefit from cooling provided by urban green infrastructure.

David Daniels (New Mexico Department of Health) discussed heat-stress data collected by the New Mexico Department of Health. The results of surveillance from 2008-2010 showed that (a) June and July were the months with the highest burden of heat stress visits to the hospital emergency departments, and (b) the southeast and southwest regions of New Mexico had the highest rate of visits. The study recommended increased education and outreach efforts for residents in the higher risk communities, and adaptation strategies (such as cooling centers), the implementation of which would prevent heat-related morbidity.

Efren Matamoros (Protección Civil de Ciudad Juárez, Mexico) described the preparedness and response measures his agency implements prior to and after a severe situation. In general, prior to an extreme event, Protección Civil coordinates with the local media and weather forecasting agencies (e.g., the U.S. NWS, Santa Teresa Weather Forecast Office and radar station, Servicio Meteorológico Nacional, and the Universidad Autónoma de Ciudad Juárez Meteorological Center) to improve awareness. Response measures include sending information to the Department of Public Safety, to notify them to survey canals, rivers, and public swimming pools, where people may seek refuge from extreme heat. On a regular basis, the agency has weekly meetings with other city agencies, to review current work being done and to identify gaps in services. Protección Civil has heat-health programs in the summer that focus on public health during extreme heat episodes, and during the summer wet season. After the presentation, John Fausett (NWS) indicated that the Santa Teresa Weather Forecast Office, charged with covering El Paso, cannot issue heat alerts for Cuidad Juárez, but would like help working more closely with Mexican partners to harmonize efforts – using NIHHIS as a guiding framework.

Thomas (Tom) Quinn (El Paso Office of Emergency Management) outlined what his department does before, during, and after extreme heat events. Prior to events, they mitigate by assessing risk and vulnerabilities and developing strategies to eliminate or reduce risk to life and property. During an extreme heat event they activate the Emergency Operation Center, coordinate with the NWS and local responding agencies, set up cooling shelters, and perform community outreach, including emergency alerts in both English and Spanish. After an event the department performs damage assessments, creates After Action Reports that outline lessons learned, and depending on the severity of the event, they receive federal reimbursement and mitigation grants. Discussion between Ms. Ortiz (Texas Department of Family and Protective Services) and Mr. Quinn shed light on the need for their departments to better coordinate, in order to improve access to heat-related morbidity and mortality information.

Carla Campbell (UTEP) provided background on the environmental and health impacts of climate change, and highlighted concerns about projections for more extreme temperatures and heat stress. She presented examples of past heat waves, with death tolls ranging from a few hundred in California in 2006 to over 45,000 in Europe in 2003. Several U.S. cities are already planning for extreme heat, such as Detroit, New York City, Phoenix, and Philadelphia; Campbell suggested that Philadelphia's heat-health intervention program is the "gold standard" for heat management in the U.S. Campbell recommended that the El Paso/Juárez border region develop a program that incorporates (a) elements from other cities' heat-health plans, (b) best practices recommended by CDC, NOAA, and EPA, and (c) that also takes into account the city's infrastructure and all parties actively engaged in emergency response.

Keith Glassbrook (Capital E Consulting) offered various solutions for mitigating extreme heat, from his experiences working at Capital E—a firm that works with companies, cities, and government agencies to reduce their impacts to climate change. Glassbrook compared two solutions for reducing UHI—increasing albedo[4] via green/cool roofs and increasing vegetation—and explained that albedo modification is much more effective than vegetation at cooling

[4] Albedo is the reflectivity of a surface. For example white surfaces are highly reflective, compared with darker-colored surfaces.

surroundings. Based on this assessment, Los Angeles, CA has developed an aggressive plan to install 10,000 cool roofs by 2017, which will reduce its UHI by 3°F.

Session 4: Looking Ahead in Early Warning

After a morning of setting the stage and describing the current state of heat-health capacity in the region, the afternoon of the workshop was set in the future tense. Presentations in Session 4 focused on prospects for the latest science to inform heat-health early warning, examples from other states and countries, and the latest capabilities for forecasting heat episodes multiple weeks in advance.

Jeremy Hess (University of Washington) presented insights on the keys to developing an effective heat action plan, based on his experience creating a plan for Ahmedabad, India. According to Hess, the keys to success include: (a) partnership and coordination, with a single lead agency responsible for leadership; (b) public engagement and building awareness; (c) local emphasis; and (d) high quality data. Another important factor to keep in mind is that stakeholders have different motivations and interests; thus, it is important to incorporate knowledge of the variety of motivations and interests in order to develop a strong plan for working together.

Melissa MacDonald discussed how her organization (Environment and Climate Change Canada) provides public health warnings, triggered by maximum temperature exceedance criteria. MacDonald focused on Ontario—Canada's largest province—which experiences the highest annual temperatures annually in the country. Ontario has a heat alert collaborative made up of agencies at multiple levels of government; the collaborative meets regularly and works well, because the respective strengths of the membership are well-articulated and respected. They developed a 3-level harmonized heat-health warning system, allowing for public health stakeholders and individuals to know how to mobilize prior to an extreme heat event to reduce risk. MacDonald strongly advocated for program evaluation—a key requirement of any warning system—in order to identify challenges and lessons learned. Ontario's key lessons included the need for agreement on the definitions and use of heat alert terminology (e.g., heat alert vs. heat warning) to ensure clear understanding by the public, and she noted that working across multiple levels of government can make for difficulties in messaging for media releases, which are another key avenue for increasing public preparedness.

Matiana Ramírez (COFEPRIS) outlined Mexico's national strategy and policy on climate change, and structure of the country's Commission on Climate Change, including its work groups and secretariats. COFEPRIS (Federal Commission for the Protection against Sanitary Risk) is a component of SALUD (the Ministry of Health). SALUD has implemented many medium- and long-term actions, such as research in managing the health risks of climate change, and fostering strong public communication of the public health risks related to climate change. The Commission for Environmental Cooperation[5] (CEC) piloted a surveillance system for extreme heat, with participants in the U.S., Canada, and Mexico. Another program being implemented by CEC is the "6 Steps to Health Prevention" program, which has targeted vulnerable regions and vulnerable populations.

[5] The Commission for Environmental Cooperation is a tri-national organization through which the governments of Canada, Mexico and the United States collaborate, with input from civil society, on the protection, conservation, and enhancement of North America's environment.

Jon Gottschalck (NOAA Climate Prediction Center - CPC) ended the session by discussing existing forecast capabilities for extreme heat early warning, which is an area of active research. Current official heat-related products and services from CPC include heat predictions (14 days in advance), and an experimental extreme heat forecast product that covers conditions 3-4 weeks in advance. Gottschalck also introduced new tools—the Week-2 Excessive Heat Event Tools—which are in the process of being evaluated by forecasters. These tools aim to better inform the NOAA Week-2 Hazards Outlook, and to give the probability of an excessive heat event exceeding the top 5% of historic events, at a lead time of 2 weeks in advance. NOAA CPC is also working on an experimental excessive heat outlook for 3-4 weeks in advance, based on extension of ongoing week-2 methods, informed by statistical and hybrid forecast methods. Lastly, Gottschalk mentioned that NOAA seasonal temperature outlooks give probabilities of whether seasonal temperatures will be below, near, or above average, at lead times of one to several months in advance.

Appendix D: Key research challenges identified by participants during Session 2A.

Category	Climate and Weather
Translation - Evidence Driven Interventions	Translation of research into public health interventions Translation of climate and weather information into actionable beneficial strategies Determining the metric of heat events that is most informative/useful for public health officials Impacts on infrastructure (what redundancies of electric and water infrastructure when there is not sufficient power or water)
Discipline-specific custom environmental and health information	Ability to predict weather changes for use in developing cooling or heating centers Developing mid- and short-term forecasts that include probability of exceedance over specific thresholds Accessing future and past climate data (scale, location, quality, accuracy) Changes in the duration and magnitude of extreme heat events under global climate change The format of information needed to assess climate data in conjunction with public health impacts
Communication and dissemination of information and warnings	Public response to different "warning" systems (i.e., advisory, watch, warning) Knowledge dissemination (effective ways to communicate risks to general public) Improved public awareness and notification to at risk populations How best to report forecasts: probabilistic or deterministic? Climate products for the general public Dissemination tools (e.g., smart phones) Relationships and information sharing with community partners Effective systems to broadcast alerts, especially in Mexico (they currently lack development towards early warning)
Emergency Preparedness Planning	Research on identifying the most effective aspects of heat early warning and response plans Data on emergency preparedness plans and heat-related procedures for New Mexico
Observations and Prediction Skill Improvement	Relate city maps and urban heat island maps Observation stations locations (more thorough coverage) and data availability Understanding historical (pre-1882) climate patterns Increasing lead-time predictions of extreme heat events Variability in heat in different microclimates in the region Researching what large-scale climate drivers are responsible for generating heat waves across different U.S. regions Accuracy of forecasts needed to be useful for the public and public officials
Funding	Funding, especially for academic research

Category	Public Health
Translation - Evidence Driven Interventions	Best avenues to increase awareness Studies to show what type of public health education and interventions work best Heat stress (especially regarding high night-time temperatures) Addressing complacency, especially in vulnerable populations Determining limits to adaptation to heat Research into A/C use—does it hurt resiliency if overused? Balancing the fact that A/C is very protective against heat but maladaptive from a climate change standpoint Long-term health effects of heat exposure, and the health implications of extended time periods of extreme heat Discerning how much heat contributes to heat-related fatalities
Health Surveillance	Use of population health indications and communication technology (i.e., take aggregate health information exchange data and cross reference against climate data to develop timely preventative interventions) Working with Mexico on prevention education and surveillance/monitoring How to create just-in-time interventions and detect those in danger Greater precision in the early identification of symptoms related to changing weather and climate conditions
Communication and dissemination of information and warnings	Reaching vulnerable populations (e.g., isolated, mentally ill, low-income), including colonias and rural communities Evacuation routes Communication, coordination, and exchange of information across groups (e.g., researchers, stakeholders) How does the public react to heat waves—is the message getting out to the public?
Emergency preparedness planning	Capturing and collecting data on heat-related illness deaths at the local level, especially in vulnerable populations. There is a lack of data from hospitals and other medical care facilities. Spread of infectious diseases (e.g., malaria, zika) resulting from higher temperatures Maps and better identification of the location of outdoor laborers Working with large datasets that are collected and recorded differently over time
Funding	Funding

Appendix E: Participants' responses during Session 3B regarding current and potential actions their organizations are, or could be, taking to address heat-health issues in the region.

Organization	Current: What is your organization/agency currently doing to address heat-health issues in the region?	Future: What could your organization/agency do, and with whom, to bring about more effective preparedness?
University of Texas at El Paso Office of Emergency Management	Educational and advisory information related to high heat periods is periodically provided with UTEP community as well as other weather systems.	Collectively, there are many agencies and departments with expertise that should meet on a regular basis to share data and information to form the basis for specific planning otherwise it will remain compartmentalized.
NOAA Climate Program Office	Leading NIHHIS to identify research and science needs and operational requirements to support public health and community resilience to extreme heat.	Potential to support sustained engagement across the agencies and disciplines involved in planning, managing and preventing heat mortality - morbidity on weather and climate time scales.
Department of Family Protective Services - Adult Protective Services	Works closely with the EWTF. If an elderly person is neglected due to extreme heat DPS will get involved in order to expedite concern and prevent a death.	Work with Border RAC and collaboration is key to being more successful in our community.
New Mexico State University Department of Public Health Sciences	Serve on national advisory board - Good Neighbor Environmental Board to identify border impact and needs related to climate change. Research on vulnerability and adaptation to climate change. Water quality assessments and development of water filtration.	
Texas Tech University Health Sciences Center	Educating healthcare providers about emergent care and treatment of environmental illness.	EMS training. Public health surveillance and data acquisition from local health departments. Pediatric Environmental Health Specialty Unit (PEHSU) community training through promotoras and engaged students.

Arizona State University, School of Geographical Sciences & Urban Planning	Conduction research (at University) to support local/regional/national partners, especially: • Monitoring indoor and experienced temperatures • Heat epidemiology • Urban climate modeling • Decision-maker needs • Cooling infrastructure	• Complete more rigorous assessments/evaluations of public health interventions • Ensure that research products make it back to partners/communities • Set an example for preparedness and sustainable "cool design" at our campus
UTEP Center for Environmental Resource Management	Do not know, maybe research • Identifying vulnerable populations - Tim Collins • Heat-health outcomes?	• Research, maybe, create strategic plans? • Become a partnership to disseminate warning in campus and ensure students' health, protecting them from extreme heat. • Implement warning system in campus through different medias
UTEP Department of Public Health Sciences	Some researchers are developing research projects/proposals for submission to federal agencies for studying heat-related issues in the region	Coordinate with the local and state agencies to develop effective strategies for effective preparedness
U.S. - Mexico Border Health Commission	Collaborates with other organizations at various levels to raise awareness about issues and identify potential solutions to challenges. This workshop is an example.	Continue supporting local and regional entities to educate and raise awareness of heat-health issues.

U.S. - Mexico Border Health Commission	Public awareness and outreach	Create more PSAs, awareness is key, more networking. Examples: • Making PSA "personal". General public tends to follow "one ear-out the other" • Commercials on YouTube (can target specific areas and demographics • Media players such as Pandora/Spotify • News outlets (TV, papers, etc.) • Facebook, etc... • Billboards, brochures, signs at public parks and trails
City of Las Cruces Office of Sustainability	We have a few heating and cooling centers; emergency response plan	• Minimize heat island effect • Increase shade • Increase energy efficiency in low/mod houses
City of Las Cruces Office of Sustainability	I have only been a part of the City of Las Cruces for about half a year, but as far as I know only advisories are issued here when we have a heat wave. Heat is such a norm that I feel like awareness isn't really there.	Change the codes or ordinances. Policy and design standard changes. Collaboration with NMSU to conduct studies on vulnerable populations. Contemporary technological advances such as photovoltaic and sustainable resilient standards. Make sure the city is better prepared and knowledgeable about natural disaster or blackouts. Mitigating the UHI.
City of Las Cruces Planning & Neighborhood Services	The City of Las Cruces has adopted a sustainability plan that includes health issues. Home Rehabilitation program provides weatherization grants to increase efficiency and improve livability of residences.	• Possible redirection of funding for programs to directly benefit most adversely affected population. • Re-dedication of open spaces for green scape to cool inner city • Promoting a change in expectations for work hours • Promoting reflectivity in as many areas as possible
UTEP College of Health Sciences	No response	Partner with the EP Health Department and City of El Paso to provide consultation and guidance for extreme heat adaptation and preparedness.

UTEP Center for Environmental Resource Management	No response	• Help distribute/share info/forecasts • Training/education: • At the university, we need to meet the challenge of connecting environment, public health, socio-economic status. • How to train students in interdisciplinary approaches
El Colegio de la Frontera Norte	Researching	Collaborate with other agencies/organizations (government, private and social) through knowledge exchange
Federal Commission for the Protection against Sanitary Risk (COFEPRIS)	Mexico has a program coordinated by COFEPRIS and several specific activities are in the areas of climate change adaptation and particularly for heat-health work, it has a diagnostic and are now participating in a pilot project with him Commission for Environmental Cooperation North America	To work closer with local and state governments on protection for sanitary risks, and in the areas of health and epidemiological and preventive programs
University of Oklahoma School of Meteorology	Not specific with heat right now. From the university perspective, our work focuses on traditional research avenues in weather and climate. But, through our partnership with the SC CSC, we can take our research and make them relevant for stakeholders and decision makers. Thus, this partnership facilitates communication for relevant research and produce actionable information.	I would anticipate specific projects for heat waves/heat events to follow current protocols -> working together between OU School of Meteorology and the SC CSC to develop effective communication of results to the appropriate emergency managers and public health officials.
National Weather Service - El Paso Office	NWS is working to improve the predictability of abnormal heat periods as far out in time as the science will allow. The NWS is also working to improve capabilities to get the information out to the public and core partners.	Work with partners to better define the information they need to take effective action. Provide better data sets and models to aid in prediction.

National Weather Service - El Paso Office	The NWS issues heat advisories and excessive heat warnings. We also provide heat safety through internet and social media, and give presentations at conferences on the subject. Finally, we partner with the emergency management and health communities to educate the public about heat safety and the dangers of heat.	The NWS could tailor its products to more closely mirror the actual impacts of heat. We could also use the findings of social scientists to find more effective ways to reach the public.
New Mexico State University/New Mexico Climate Center	At NMSU added water filling stations across campus. At NM Climate Center we provided information and climate literacy resources that include heat and health.	Communicate impacts of heat and health a lot more. Right now there is no information. Work on more extreme heat summaries with various communities; share info.
Louisiana State University Department of Geography & Anthropology	Nothing. Our climate science is typically focused on Louisiana and areas within the humid southeast. However, we did recently publish a paper about dry spells that extended westward to El Paso (which had the longest dry spell on record)	• Work with local weather offices and agencies to share historical climatology of heat and precipitation amounts. • Hold meetings with local offices and the public to explain the concerns and risks of heat waves paired with dry spells.
Environment and Climate Change Canada	Nothing within the El Paso-Juarez-Las Cruces region, however I am here to share work that has developed within Canada on early-warning systems for helping public health be prepared prior to heat events.	We can continue to share our work, lessons learned, and outcomes from Canadian work and be engaged in the process. Evaluation is key.
Texas Tech University Department of Atmospheric Sciences	Mostly research, developing new techniques to observe intra-urban heat variability and how best to apply mitigation techniques.	• Communicate better • Data collection on heat health • Find out what the research needs are
Community Health Centers/North American Management	Limited-currently provide national conferences, workshops and white papers on emergency preparedness. Local participants attend our conferences but to date we have not focused enough on issues related to heat and climate. But, this will change going forward	Work with regional community and public health professional in developing best practices and protocols. Develop strategies to address and mitigate unmet needs for regional special and vulnerable populations.

Texas Division of Emergency Management	As district coordinator, I serve El Paso, Hudspeth, Calborson, Brewster, Presidio and Jeff Dares Counties. I work closely with county judges and emergency management coordinators and other partners to ensure we are communicating and sharing information with all partners in community preparedness. Example of other partners are VOADS, first responders, military national guard, NGOs, TXDOT, DSHS, public health, etc. • STEAR database is an excellent tool for emergency planners (state of Texas Emergency Assistance Registry)	Continue to work closely with El Paso County agencies and in particularly El Paso CO office of emergency management. Share all pertinent information learned with all counties outside El Paso under my purview.
UTEP Environment Health & Safety Office	UTEP has CERM involved in climatology. Additionally, the COHS at UTEP has various public health programs involved in awareness.	• Collaborate with the OEM to think about real world/real life situations that have the potential of being research projects/thesis/etc. • Data sharing/information sharing with public officials to ensure accurate data of the population is available for accurate emergency planning.
Universidad Autonoma de Ciudad Juarez (UACJ)	La Universidad Autonoma de Ciudad Juarez (UACJ) is developing research topics of heat islands, heating at the surface, urban growth influence on regional temperature changes, among others	Working with the community in adapting housing, using a bioclimatic approach to reducing energy consumption and vulnerability, not only for extreme heat but also for extreme cold
Extreme Weather Task Force	Distribution of fans and blankets to underserved populations.	Continue with the collaboration with the EWTF to assure more funding/donations from community/business/stakeholder to assure we are reaching all clients in need especially in the colonia residents.
	Research, on community health and public policy	Increased data sharing and heightened access to data

	No response	Look at ways to expand scope of current priority areas (healthy eating/active living, alcohol prevention, and mental and emotional health).
	I am not aware of work being done at UACJ combining heat and health issues. There is a meteorological network at UAXJ that can provide data and forecast for the population.	We could partner with health departments and Proteccion Civil in Ciudad Juarez to prepare better for heat waves. We could also partner as an educational institution with U.S. organizations to have better forecasts for extreme heat and share that information with local authorities to better prepare for heat wave events.
	• Research on heat-health issues • Community outreach activities	Collaborative research with emergency management agencies and community organizations who are in touch with the people.
	Report temperature and climate outlooks	We are in the process to build a dissemination platform
	Risk prevention; adult education	Collaboration with other agencies and institutions, including federal and state governments

Appendix F: Discussion of additional themes by Work Stream A (in priority order).

Theme	Strengths/Opportunities	Needs/Challenges	Strategies/Actions	Who?	Resources
Collaboration	Development of collaborations		Identify agencies and engage them	Everyone	Government (federal, state, local)
	To take advantage of informal collaboration between local and binational organizations/agencies		Identify and categorize sectors		State and local NGOs
			Leadership structure (Memorandum of Understanding)		Private groups
			Communications: sharing, data/results, mapping networks		Educational institutions
Education and Outreach	Historical baseline can be used to determine if over-warning is occurring	Educate community on effects of health to vulnerable populations	Translate science to non-technical language/actions	NGOs	Same as "who?" to the left
	Educate one another in order to educate the community	Assistance in rural communities in order to prevent deaths and illnesses	Start outreach at a young age	Schools	
	Involve the media more in work to promote warnings	Translate scientific language and climatological information so the public understands	Identify existing programs/"conduits"	Media	
	Work with schools and bring in STEM learning about extreme heat and health effects		Utilize range of groups and media	Public Health	
	Need to do more outreach to rural communities			State agencies	
	Urgently noting the importance of mitigation by the action of people			National Weather Service	

				Interdisciplinary education/training at universities	
Funding		Where do we get funding for further research?			

Appendix G: Discussion of additional themes by Work Stream B (in priority order).

Theme	Strengths/Opportunities	Needs/Challenges
Collaboration and Communication	Urban planning and knowledge of climate and weather effects	New Mexico has a centralized state government
	Inter-sectoral transversal work at different levels	Lack of collaboration
	Cross sector collaborations; engaging more people from public health	
	Ability to work on a public health issue with non-traditional partners	
	Existing partnerships	
	Collaborations with the public health substance abuse/mental health community	
	Public health focus among medical doctors	
	There is now better understanding between sectors	
Communication to Public	Existing community education and training programs	Social media will fall short
	Ability to reach rural areas with consistent message	Translation research—ensuring the community understands what everything means
	Raise awareness about global issues by focusing on individual impacts	Framing the issue for those not currently engaged
	Buddy system	Urgency of issue and ability to mobilize effectively and efficiently
	Leverage National Emergency Department Sample (NEDS) and other AHRQ data for climate and health research	Message fatigue
	Communication to at risk populations	

Appendix H: Discussion of additional themes by Work Stream C (in priority order).

Theme	Strengths/Opportunities	Needs/Challenges	Strategies/Actions	Who?	Resources	Next Steps
Heat Parameter Metrics and Meanings	Focus on impacts which can vary with time of year or location	What is the "right" metric for conveying heat-health risk?	Research on existing criteria in use (lit review on studies already published)	Federal agencies	Local and federal agencies	Assessment needs
		Determine the range of relevant temperature based on actual effect on health	Local study on thresholds and indicators more in line with the region (such as Maricopa)	Local universities (e.g., UTEP, UACJ, NMSU, TTU, community colleges)	Universities through research	Research the right metric or standard for heat-warning system
		Do thresholds have meaning (actionable understanding)?	Matching impacts with thresholds	NWS Weather Forecast Office	Private entities and stakeholders	
		Verifying the impacts	Color coded system or warning	SMN		
			Meteorological education to include heat/health	Health Department		
Education (intersects with communication and lead time themes)	Providing education and prevention seminars in the local community	Public perception of heat	See Communication and Lead Time themes in report text	See Communication and Lead Time themes in report text	See Communication and Lead Time themes in report text	See Communication and Lead Time themes in report text
	Prevention is key: it can save lives and reduce heat-related injuries/illness	Public awareness and education				
	Early education					
Reaching all Segments of the Population	Products oriented to social mobilization	Reaching those with limited or no access to radios, TV, social media, etc.	Donations (radios, fans, etc.)	Walmart and other stores		

	Voluntaries (businesses/citizens; "buddy-system")	Reaching the entire population, especially those in rural communities	Door-to-door (volunteers or neighbors; buddy system)	Promatoras		
	Segmented/different communication approaches and thresholds by vulnerable population		Community cooling centers	Charity and outreach organizations		
			Advertisement in grocery stores and gas stations	Community donations and volunteers		
			Warnings at airports and trailheads			
			Highway signs			
Expertise and Coordination	Large pool of experts					
	Diversity of expertise					
	Interpreters of predictions for vulnerable populations (impact based)					
	Inter-agency/inter-city coordination					

Appendix I: Discussion of additional themes by Work Stream D (in priority order).

Theme	Strengths/Opportunities	Needs/Challenges
Economic Opportunity	Fundraising opportunities	Funding shortages
	Economic opportunities	Financial constraints
	Present new industry innovations	
Informal Communication Networks	Binational health councils exchange information	
	Communication with border friends	
Cultural Sensitivity	Border population are here for generations	Appropriate messages for different audiences
	Certified community workers	Cultural relevance
	Many bilingual health service providers	Ensure that in a binational region language and cultural sensitivity are taken into consideration
	Use of local knowledge	
Interdisciplinary Approaches	Collaboration (diversity of stakeholders)	
Measuring Effectiveness		How (which metric) to measure effectiveness of outreach
Message Overload	Long-term historical reference (memory)	Alert fatigue
	Opportunity to harmonize data in the region	Use of music/TV streaming (don't get alerts)
		Responsible messages to the public
		Time frame of needed information
		Knowing the impacts of heat and communicating
		Overcoming weather apathy

Appendix J: Discussion of additional themes by Work Stream E (in priority order).

Theme	Strengths/Opportunities	Needs/Challenges
Public Health Communication and Information		Identify metrics that are relevant to funders and lenders
		Access to data about vulnerable populations
		Moving discourse to health impact
		Involve school systems and administrators
		Lacks uniqueness as a problem because it is always hot
		Clear information from the U.S.-Mexico border with unified and common terminology in English and Spanish related to heat-health issues
		Put climate change on the radar of local authorities so that they include heat-health issues in their political agendas
		Fix reverse 911 early warning systems to be operable
		Making health a priority—there are other priorities that seem more urgent
Linkages to Public Health Networks and Expertise	Consistent message: public health issues	Involve the many levels of healthcare (i.e., community health centers, medical centers, doctor's offices, etc.)
		Get EMTs involved
		Identify relationship between extreme heat and other health vulnerabilities so that early warning systems alert critical populations

Appendix K: Work stream priming and priorities document, drafted by the steering committee to transfer momentum from the workshop to the work streams.

Heat-Health Work Streams: Suggested Guidance

This document will assist with getting the work streams off the ground by setting some *common* tasks for every work stream, and by suggesting jumping off points for the groups to begin work.

Overarching Goals:

- **Develop a formal plan, to share with other work streams**
- **Initiate activities by late October**
- **Develop assessments and other deliverables by the start of the 2017 heat season.**

Timeline

Each work stream should aim to meet virtually 3 times prior to late October, when the steering committee will convene an in-person or virtual (yet to be determined) meeting with each work stream. Following the late October meeting, virtual meetings continue (ideally 2x per month) until a potential spring (pre-heat season) in-person meeting to solidify outcomes and implement for the 2017 heat season. Work streams should also provide feedback to the workshop report in September.

Suggested Agenda for First Virtual Meeting

- Introductions
- Discuss who else to invite to participate in the group.
- Brainstorm actionable, realistic projects to implement prior to the 2017 heat season. Use suggested list of launching points at the end of this document as a starting place.
- Identify potential funding opportunities and resources that can be used to implement projects.
- Discuss upcoming, related extra-regional activities.
- Discuss whether a virtual or in-person meeting (or both) in late October/early November would be useful.

Assign Roles

1. Lead/Co-Leads (calls meetings, sets agenda, provides direction, accountable for deliverables and pre-meeting materials, lead communicator)
2. Information Lead (establishes information sharing mechanism(s) such as wikis and is responsible to lead writing of the deliverable under leader guidance).
3. Active Participants (attend meetings having pre-read materials, provides subject matter expertise, takes ownership of some deliverables or research activities).

Review Meeting Notes from July 13, 2016 NIHHIS Workshop

Review the synthesized meeting notes, to refresh work stream participants on discussions held at the workshop, to re-evaluate the workshop outcomes, and to fill in gaps and elaborate on key points. The notes serve as point of reference for drawing up projects for the group.

Brainstorm, Prioritize, and Select Projects

Determine which projects fall within the work stream domain - effectively where gaps exist in heat-health resilience in this region that the work stream group can address - if not completely then at least those that fall within the group's scope.

Identify and Report Gaps

Identify and report on gaps, essential to the success of your work stream, that cannot be addressed by your work stream's proposed activities. These gaps may be able to be addressed by another workstream, or may need the attention of a broader collection of participants in the NIHHIS (http://toolkit.climate.gov/nihhis/) network. Share your ideas about these gaps in advance of the October meeting, and discuss them at that meeting.

Solicit Additional Participants

Your work stream may benefit from additional participants, regardless of their attendance at the July 13, 2015 NIHHIS workshop. Poll existing members for potential new invitees and task one participant with reaching out to invite new members. Consider the disciplinary makeup of your current membership and address any gaps, particularly after identifying some initial activities and determining who will be needed to accomplish them. Also consider the regional balance of your team - do you have people from outside El Paso, including Juarez?

Conferences and Intra/Extra-Regional Activities

Identify conferences, other working groups or organizations, and activities working on your work stream topic, both in-region and nationally of internationally. Consider opportunities to connect with others concerned with your workstream topic at conferences, and other groups that may be important to engage in the region and elsewhere.

Funding/Resources

The availability of funding to carry out proposed or needed activities is clearly a constraint for all work streams. Please identify 2-3 potential funding sources, including a link for web-based information, and/or point of contact, that are directly relevant to your work stream. Document their requirements and timeline, sharing them with the Steering Committee by September 28, 2016. In addition, resources were identified by each work stream at the July 13, 2016 NIHHIS workshop. They are listed under the "Who?" and "Resources" sections of the notes. Starting with this list, please provide a link and/or point of contact for resources that will be useful for moving your work stream forward. The funding and resource opportunities will be compiled and added to opportunities identified by the steering committee; we aim to discuss these at meetings in late October.

Inventory of Initiatives/Current Actions

Inventory existing initiatives and current actions related to your work stream topic. Inventories from each work stream will create a baseline for moving forward. Please identify as many initiatives as possible and document their status, with the estimated completion date of these initiatives, if applicable and possible. These will be compiled and discussed in October.

Work Stream Launching Points

The following are ideas for initial 'quick win' projects to get the work streams started.

Work Stream A: Historical Climatology and Variability

- Catalog existing meteorological and vulnerability data and information
- Establish an information protocol for collecting information during and after heat waves - what data/metadata do you wish you had to work with?
- Identify gaps/needs

Work Stream B: Linkages between heat parameters and health outcomes

- Inventory of existing public health data
- Conduct a survey, similar to the one used by Maricopa County (AZ--mentioned at the July 13, 2016 workshop), to gather regional information

Work Stream C: Prediction, Outlooks, and Early Warning

- Develop 2-3 new forecast product ideas that can draw on existing model variables and capabilities, prototype these products, and if necessary, draw up CARD requests to be submitted to the National Weather Service.
    - Impact-based warnings
    - Heat load predictions for energy and transportation
- (later) Develop research paper ideas for new ways of thinking about the threat of extreme heat, that could ultimately lead to new predictions or outlooks.
- Establish broad guidelines/needs for a transboundary heat product that could be used in the upcoming Mexican COF this spring.

Work Stream D: Communication and Engagement

- Inventory existing networks, initiatives, and leaders
- Strategize and develop ideas for how to best deliver messages related to heat-health risks, preparedness, and responses
- Conduct decision-maker interviews to create scenarios for each actor or organization, that indicates what decisions they make at various lead times, what information they currently use and how they get it, what gaps there are in information and information utility, and who they partner with. What are they truly responsible and accountable for? How have they fared in previous heat waves? Consider how we can use these to develop case studies.
    - This action will be useful for all groups

Work Stream E: Capacity Building and Training

- Strategize about what training is needed
- How can heat waves become learning events? What is the process for documenting actions taken and results while a heat wave is active, and for analyzing outcomes and making changes to a heat action plan? What is needed for a Heat Wave Hotwash? HW^2
- Gap analysis
    - Create concept map