Building Resilience to Extreme Heat:
The National Integrated Heat Health Information System

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http://climate.gov/nihhis

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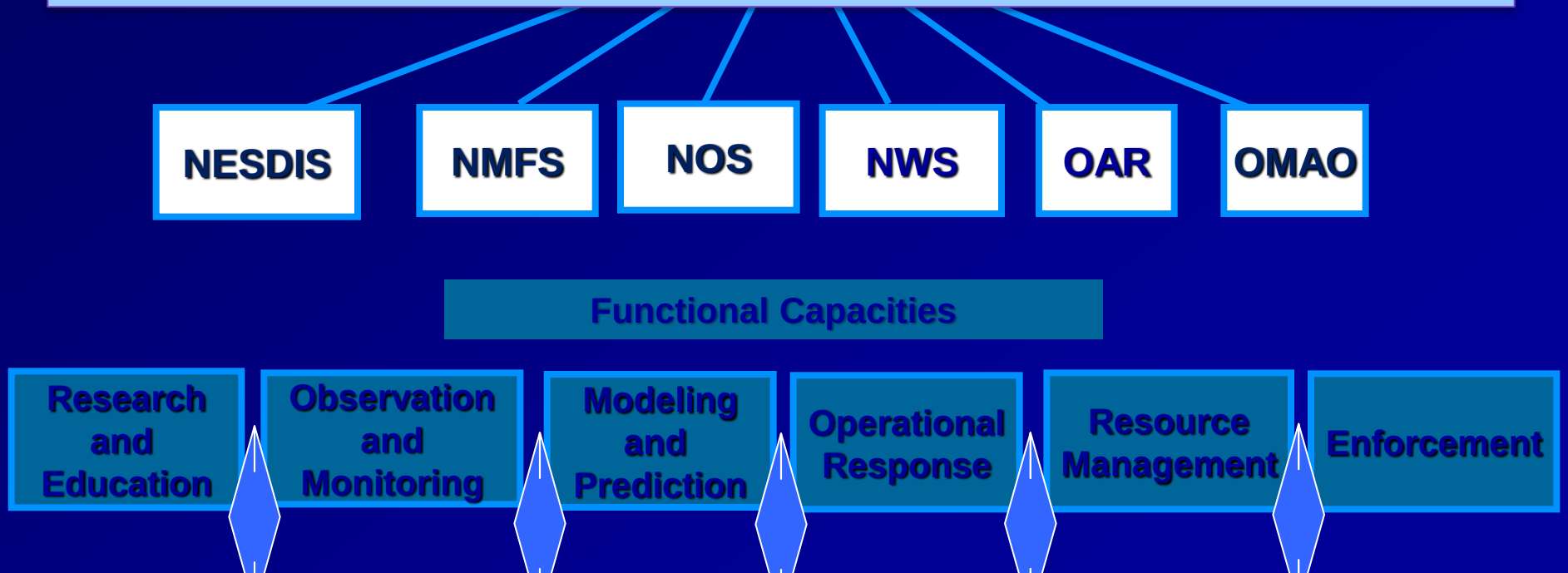
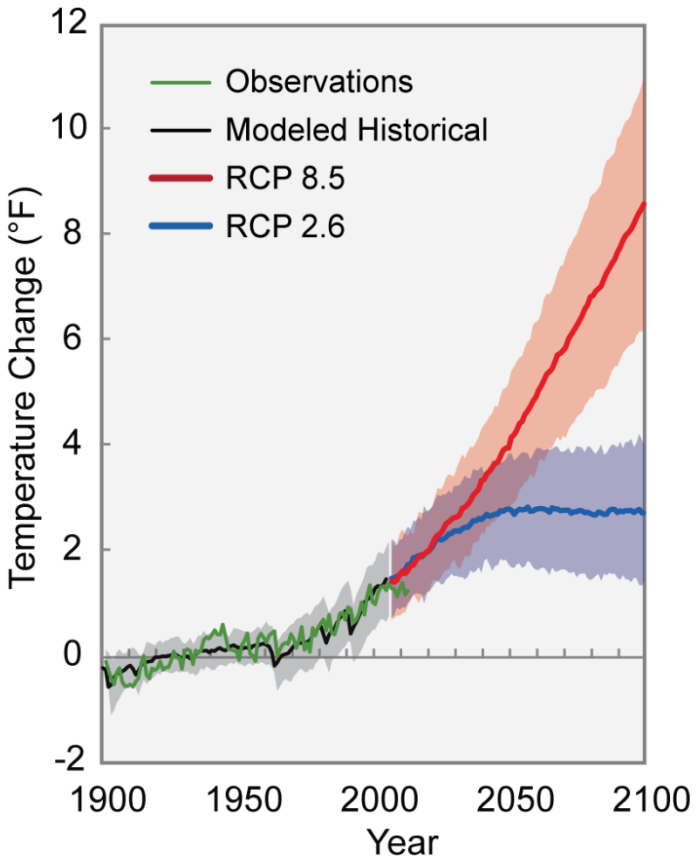
  - –Adding extreme heat as a focal area
  - –Adding climate & health as a focal area

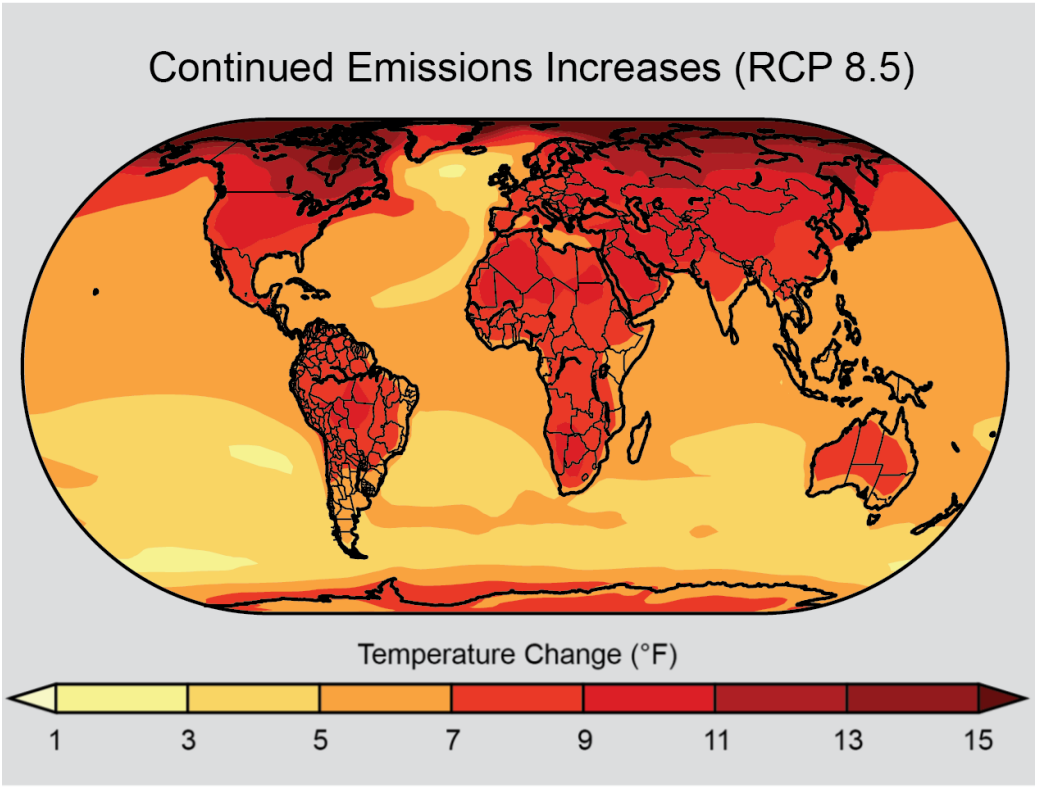
National Oceanic and Atmospheric Administration (NOAA)

- To understand and predict changes in climate, weather, oceans, and coasts,
- To share that knowledge and information with others, and
- To conserve and manage coastal and marine ecosystems and resources.



Global Average Temperature Changes





Global average temperature has increased and this is projected to continue.

Source: National Climate Assessment, 2014 - Recent US Temperature Trends

Heat Waves will Worsen in a Warming World

▲ Intensity

- The recent prolonged (multi-month) extreme heat has been **unprecedented** since the start of reliable instrumental records in 1895. (NCA 2014)
- The **intensity of extreme heat events will likely increase**. (NCA 2014)

▲ Duration

- Model results for areas of Europe and North America show that **future heat waves in these areas will be longer lasting** in the second half of the 21st century. (Meehl and Tebaldi, 2004)
- Over the period 1880 to 2005 the **length of summer heat waves** over W. Europe has **doubled** & the **frequency** of hot days has almost **tripled**. (Della-Marta, 2007)

▲ Frequency

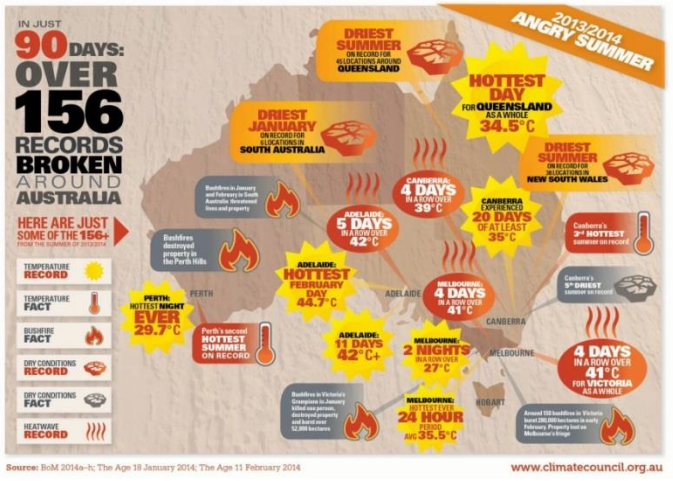
- Model results for areas of Europe and North America... show that **future heat waves will become more frequent**. (Meehl and Tebaldi, 2004)

▲ Character

- Most models project somewhat lower relative humidity on the hottest days, but the combined effect of temperature and humidity changes is **substantial increases in heat stress**. (Wuebbles et al., 2014)

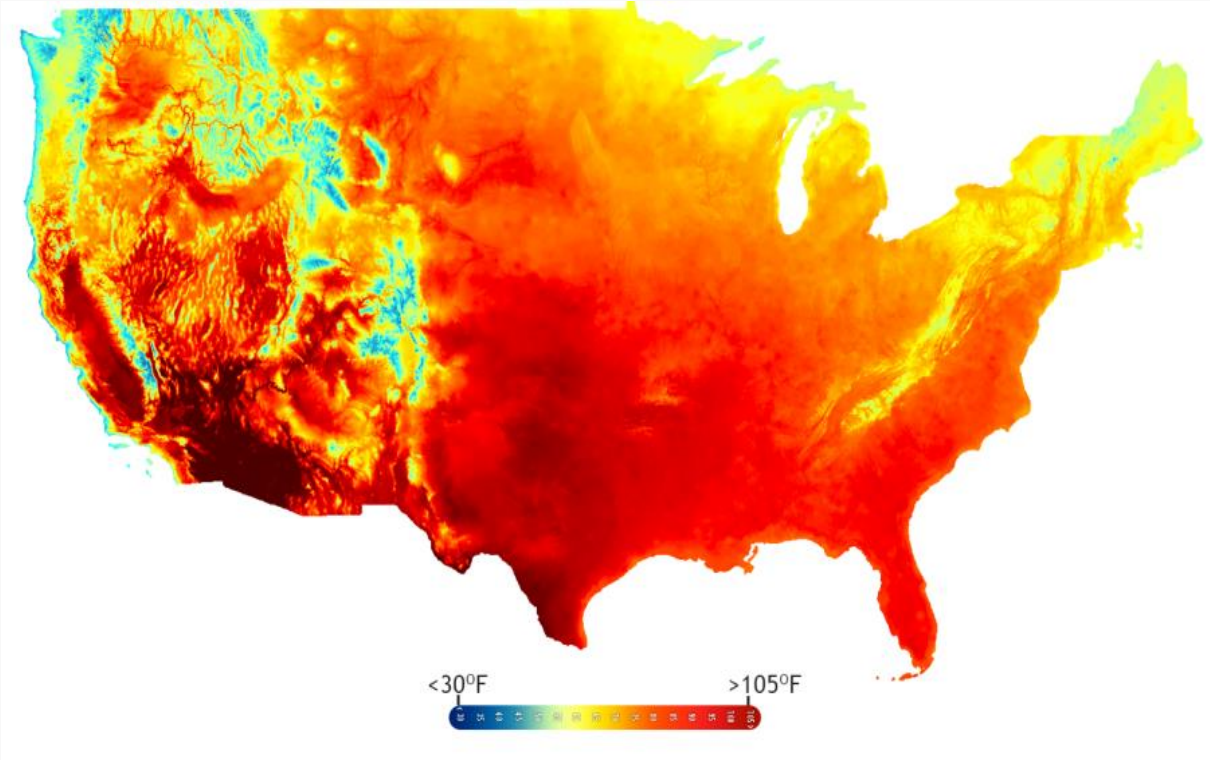
▲ Attribution

- "today about **75% of the moderate daily hot extremes over land are attributable to warming**. It is the most rare and extreme events for which the largest fraction is anthropogenic, and that contribution increases nonlinearly with future warming." (Fischer and Knutti, 2015)



Temperatures are on the Rise

Extreme heat events will be more frequent and more intense in the future….what now seems like an unusually hot day will become commonplace (NCA).



Impacts-Urban Environment

- Urban Heat Islands
- Vulnerable Populations
- Sporting Events
- Outdoor Workers
- Large Public Gatherings
- Infrastructure-Hospitals
- Electricity/Brown Outs

Image Source: Healthspablog.com

Impacts-Ecological

- **Agriculture**
  - Workers
  - Food supply
  - Pesticide
- **Water Quality**
  - Beaches
  - Runoff
- **Air Quality/Heat**
- **Wildfires**
- **Vector-Borne Disease**

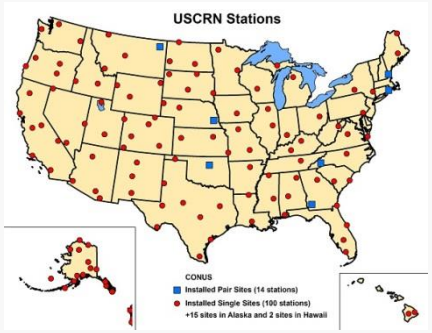
Multiple Heat Efforts in North America and Globally

NIHHIS Local Engagements

NWS Regional WFOs

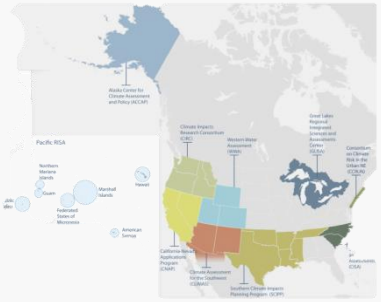
NOAA RCSDs

USCRN Stations

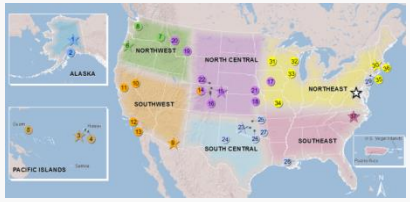


CDC BRACE Grantees

NOAA CPO RISAs



DOI Regional Climate Service Centers



USDA Regional Climate Hubs

Weather-Scale Heat Health Systems Around the World

United States[Ψ]

- Local action prompted by NWS WFO alerts
- NWS WFOs Issue watch/advisory/warning; local agencies respond; CDC has Natl Env. Public Health Tracking Network
- Alerts issued at forecaster discretion; NWS issues guidance
- 72-hour lead time for heat watch;6-10 excessive heat outlook
- Trigger is Heat Index, max/min temp., or synoptic system

Canada[¥]

- City/Province level HARS (Heat Alert & Response Systems)
- Environment Canada issues Humidex fcast., high-low temps; Provincial Med. Officer of Health (MOH) administers
- Alert ultimately determined by MOH (Toronto)
- MOH issues extreme alert if 3 day duration exceeds thresholds
- Trigger is flexible: air temp, Humidex, air pollution, mortality

Japan[Δ]

- City-level systems & national forecasts
- Local departments of Crisis Management, Health Promotion, or Sports Associations coordinate the systems
- Alert thresholds vary by city
- Advanced warning varies, one example is 21 hours
- WBGT is monitored at schools, as well as air temperature

Germany*

- National system with county-level warnings
- Developed and operated by federal environment agency and weather service in conjunction with public health office
- Warnings are produced at the county level
- 6 day forecast of heat pre-info from federal level
- Trigger is heat load based on perceived temperature

Australia[Ω]

- State-level systems (Natl. req. for Heatwave Sub Plans)
- Dept. of Health owns system in Victoria; Emergency Operations owns system in New South Wales
- Alert threshold varies by forecast district (Victoria)
- 3-4 day advanced warning; 7 day forecast
- Trigger is average temperature $^1/_2$(max + min)

India[¤]

- City-level system; Ahmedabad Heat Action Plan in 2013
- Ahmedabad Municipal Corporation (AMC) Nodal Officer issues alerts, Indian Met Centre declares heat wave
- 40C max daily temp threshold in plains, 30C in hilly regions
- 7 day forecast
- Hybrid dynamical-statistical probabilistic temperature forecast

United Kingdom*

- National system with regional thresholds
- Dept. of health owns and operates system while Met Office forecasts
- Alert threshold >30C day temp & 15C overnight
- 2-3 days lead time for lowest alert levels
- Trigger is min and max temperature

France*

- National system (SACS) with regional plans
- Health department issues plan and manages system while Meteo-France monitors and issues warnings
- Alert threshold regionally dependent
- 5 day forecast and 1 day alert lead time
- Trigger is min and max temperature; heat stress index

¥toronto.ca Ωhealth.vic.gov.au Δ*Martinez et al. 2011* Ψ*Hawkins & Brown 2015* ¤*Knowlton et al. 2014* **Lowe et al. 2011*

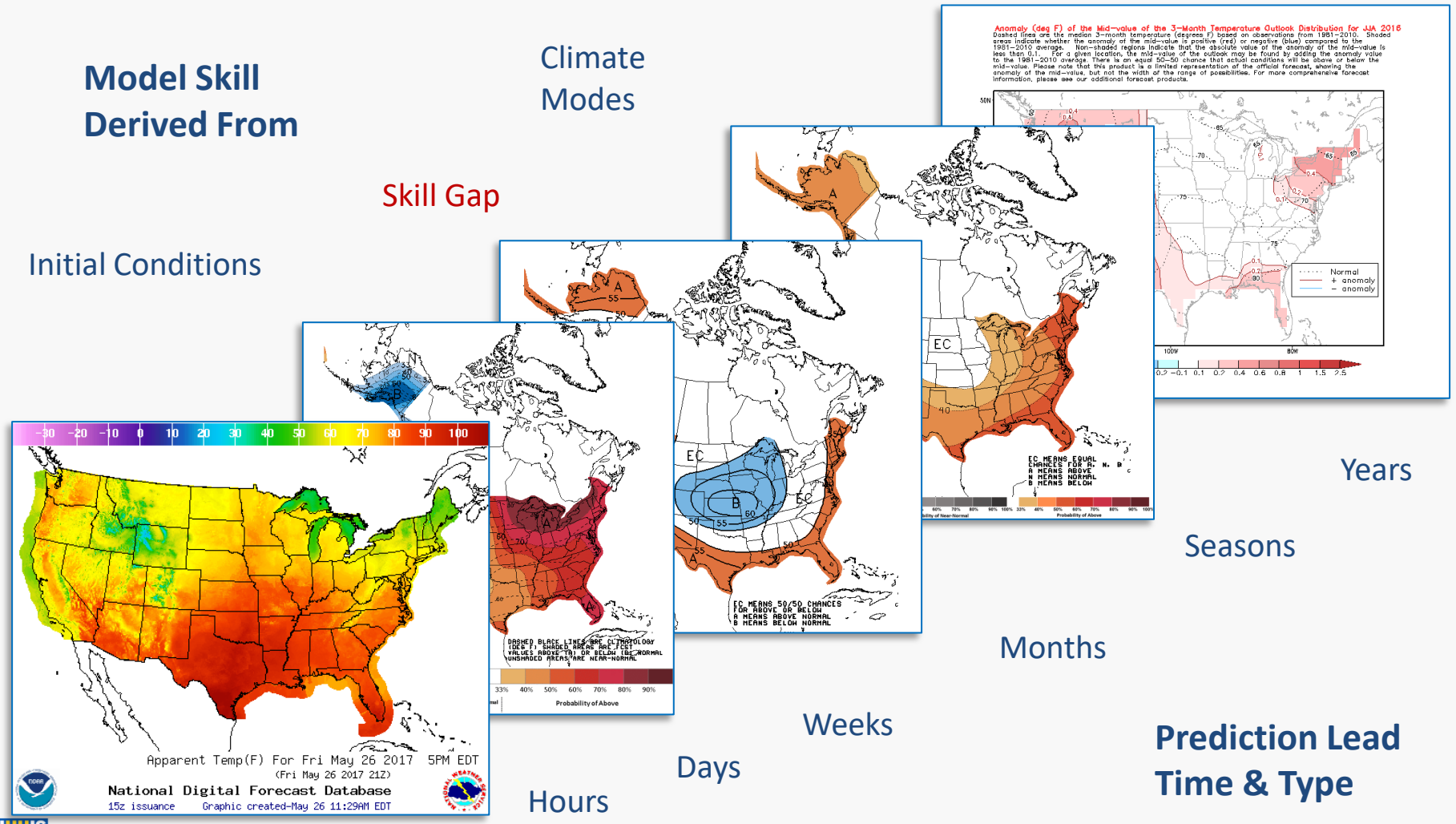
Current Prediction Products from NOAA

Model Skill Derived From

Climate Modes

Skill Gap

Initial Conditions



Years

Seasons

Months

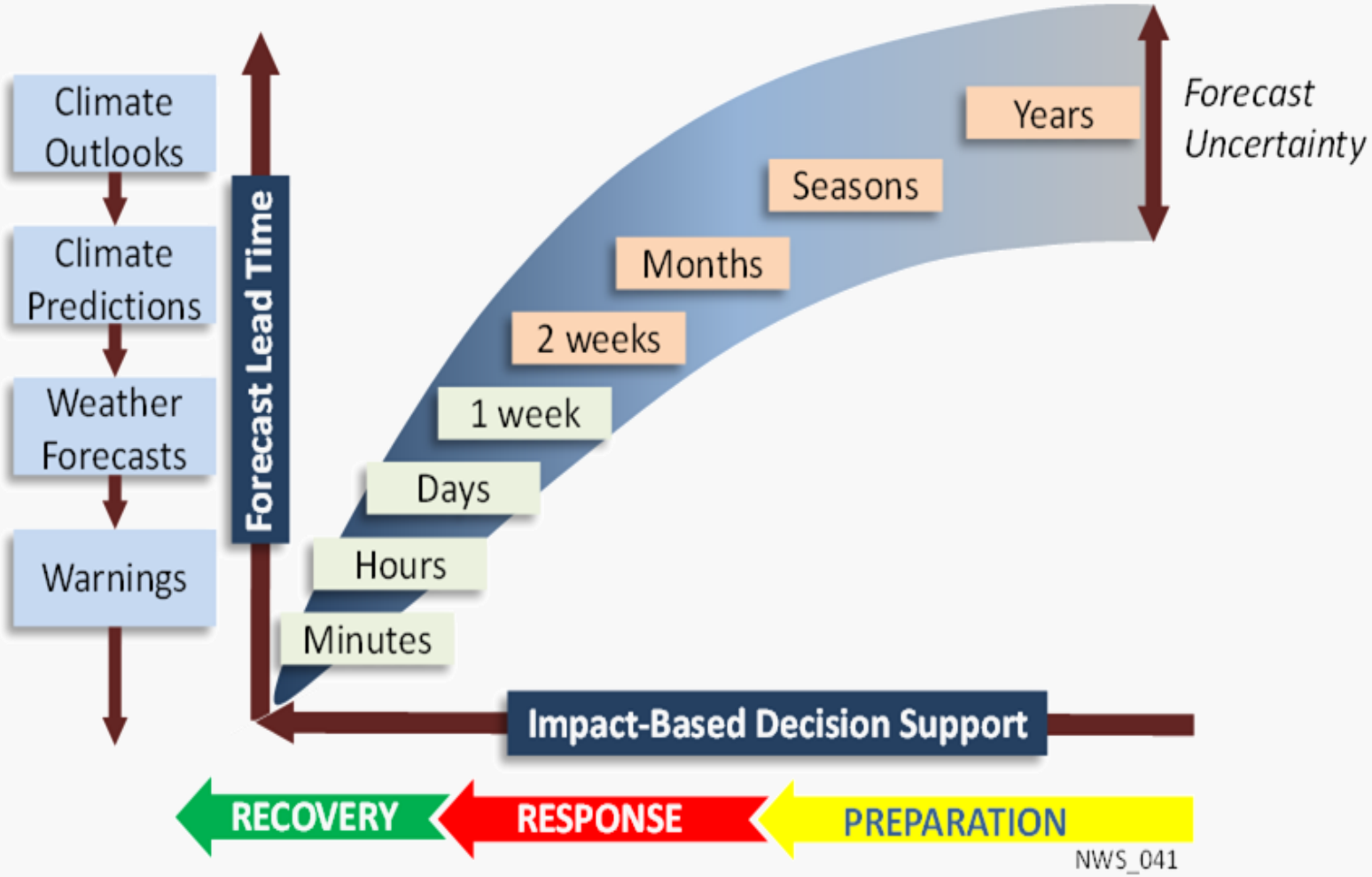
Weeks

Days

Hours

Prediction Lead Time & Type

Heat-Health Information along the Weather-Climate Continuum Service Delivery



So How Can We Prepare and Prevent?

- What public health decisions should we be making differently to be better prepared and reduce morbidity and mortality?
  - –How many cooling centers will we need next year?
  - –What are staffing and outreach needs if we have more heatwaves, or longer ones, or they start earlier or they happen later in the season?
- What are the budget and finance decisions and what time do those happen?
- How do we reach the most vulnerable populations in time?
- What are the other heat-related health impacts—air quality, vector-borne, water?
- What should we be predicting—Tmax, Tmin, Heat Index, WGBT? And at what time scale? And for which population?

What is an Integrated Information System?

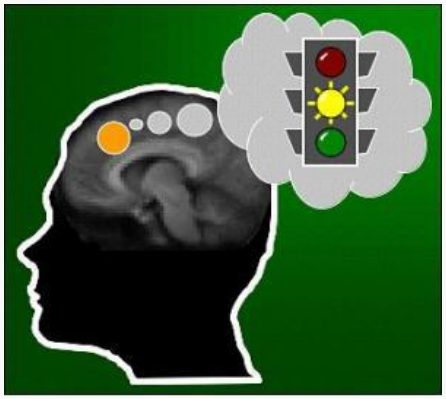
.....Informs early warning to early action across time

The systematic development, analysis, and communication of relevant information about and coming from areas of impending risk to:

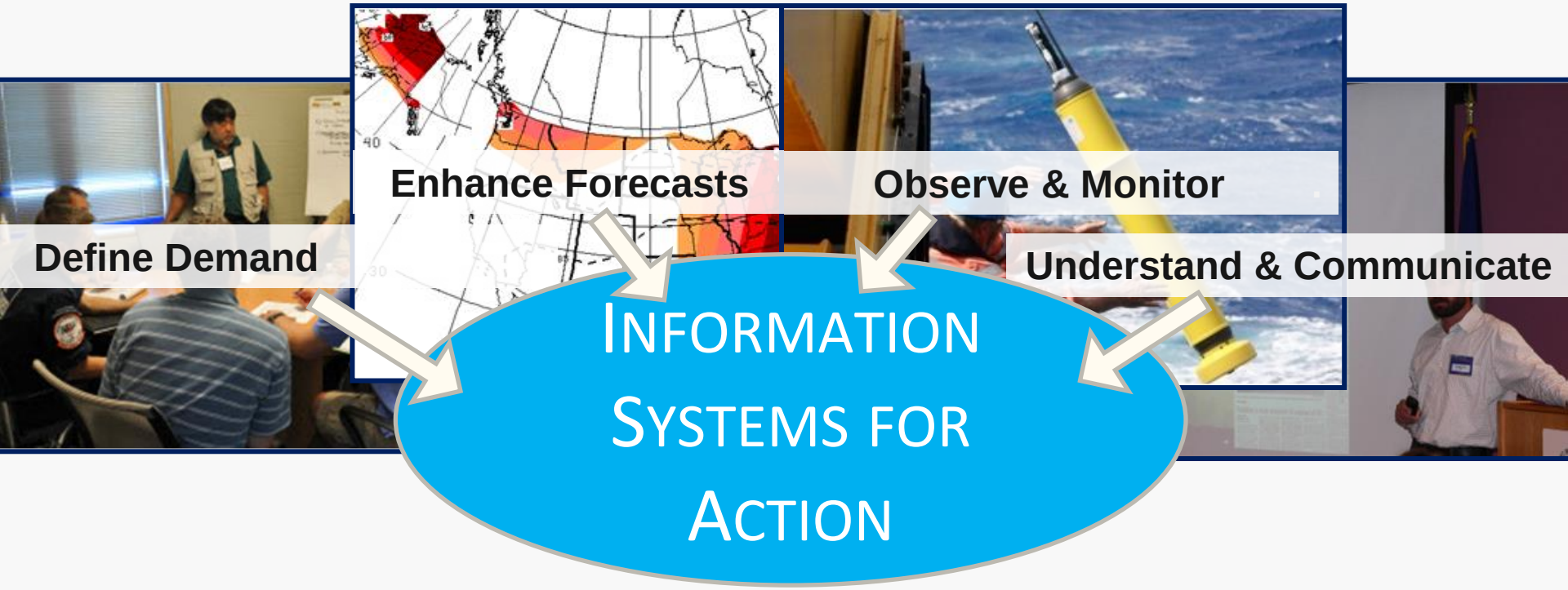
a) anticipate risk and opportunities and their evolution

b) inform development of strategic responses

c) communicate options to critical actors for the purposes of decision-making and response



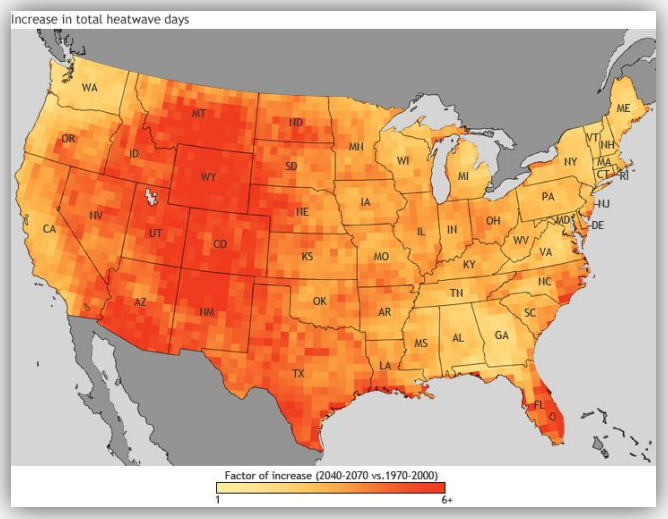
Information Systems Inform Climate **Preparedness** & **Resilience**



- **Customized climate information** is necessary to inform decisions.
- Cultivate partnerships—**map decision-making arrangements**
- Information systems **define the demand** for this information, support **knowledge sharing**, and enhance forecasting capabilities.
- They improve understanding & communication of **options for responding to future risk**.

National Integrated Heat Health Information System (NIHHIS): Improving Climate Services for Risk Reduction

- NOAA and CDC launched the National Integrated Heat Health Information System (NIHHIS) in June of 2015 to integrate efforts.
- In July of 2015, an international set of heat-health practitioners – from local emergency managers to national public health and international meteorology – convened to establish a plan to move forward together.
- NIHHIS is part of the international effort, and informs decision makers in many sectors while also focusing on heat-related impacts on many vulnerable groups including the elderly, children, athletes, pets, and outdoor workers.



The National Integrated Heat Health Information System weaves together existing pieces, identifies information needs and helps to develop needed climate services.

NIHHIS will facilitate an integrated approach to providing a suite of decision support services to reduce heat related risks to health people, communities and economies

NIHHIS as form and function

- The National Integrated Heat Health Information Systems (NIHHIS) is a structure for delivering the most useful information to decision makers seeking to reduce the heat-related health risks to people, communities and economies by enhanced planning from days to weeks to months and years

- NIHHIS consists of an Interagency Working Group, Pilots, and a Partner Group, International Partnerships (GHHIN), student rotations

- Common Web presence for citizens to access federal resources in one place: www.climate.gov/NIHHIS

NIHHIS Goals

- NIHHIS was created to provide a common system that sustains engagement across institutions, sectors and decision-makers in order to:
- Improve understanding the needs of decision makers managing heat-related health risks at multiple time scales
- Facilitate planning and preparing for extreme heat events and increases in extreme temperature using information at daily, weekly, seasonal, annual and longer time scales
- Provide a forum to discuss and test or pilot products, tools and communication strategies
- Learn from existing activities in order to improve planning, response, prediction, communication and outreach.
- Identify research, data, forecast products and communication needs

Define Demand

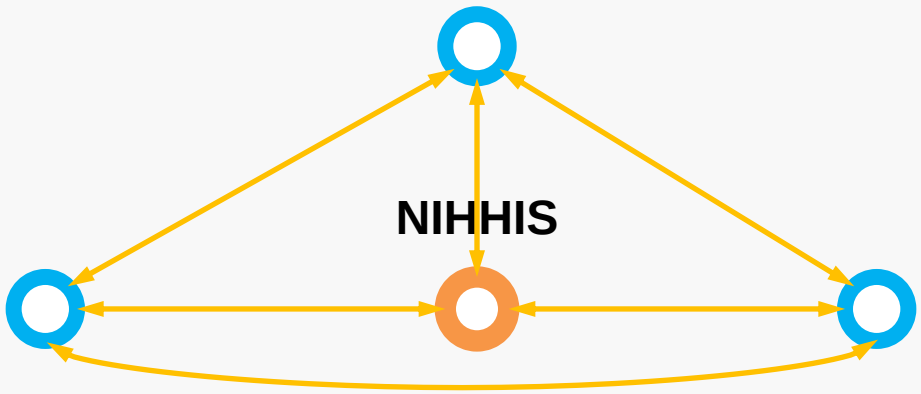
NIHHIS partners sustain continuous engagement between climate, health, and other communities to identify needs, evaluate solutions, and inform decisions.

Monsoon climate and a well established response mechanism for emergent heat, but vulnerable to heat-related water and energy shocks.

El Paso, USA

Monsoon climate with frequent extreme heat days and a relatively early heat season. At risk slum communities and in need of easy interventions to reduce heat exposure in home and healthcare settings.

Ahmedabad, India



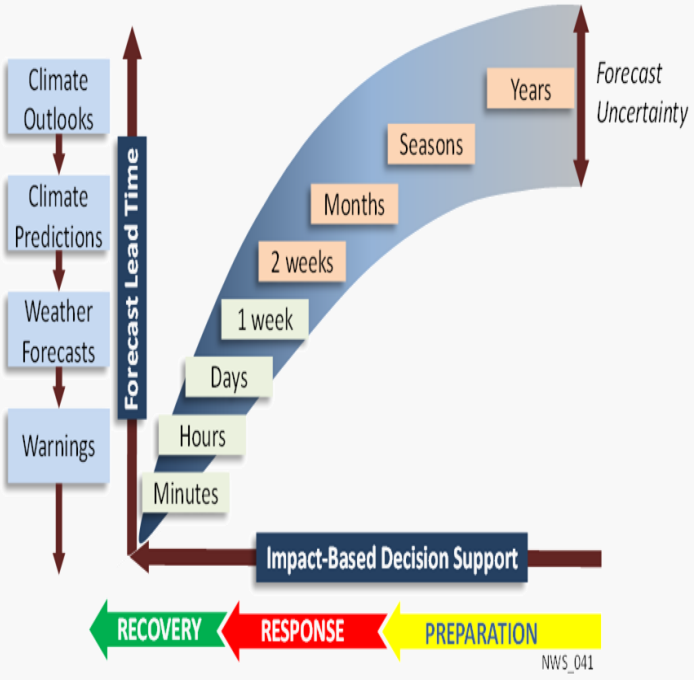
Highly humid tropical/ equatorial climate with low variability in temperature, but also affected by monsoons. Highly urbanized.

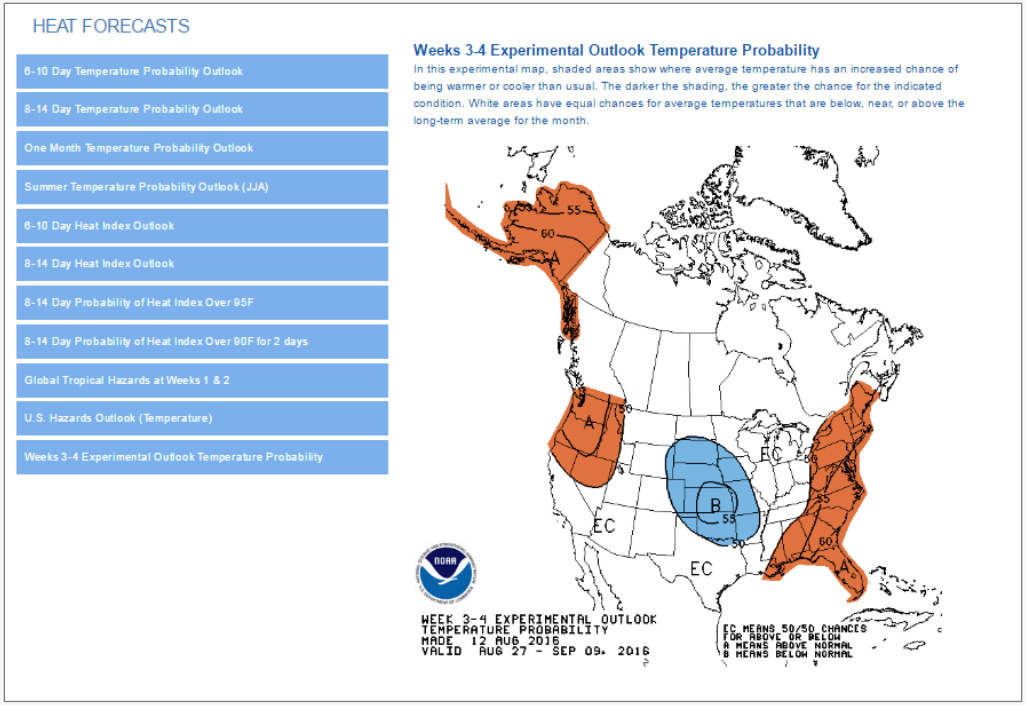
Singapore

Local engagements in the US and Globally are helping us understand needs – both unique and shared – and fostering shared solutions.

Enhance Forecasts

NIHHIS partners work to enhance current heat forecasts based on user needs and epidemiological requirements, extending projections from weeks to months and beyond.

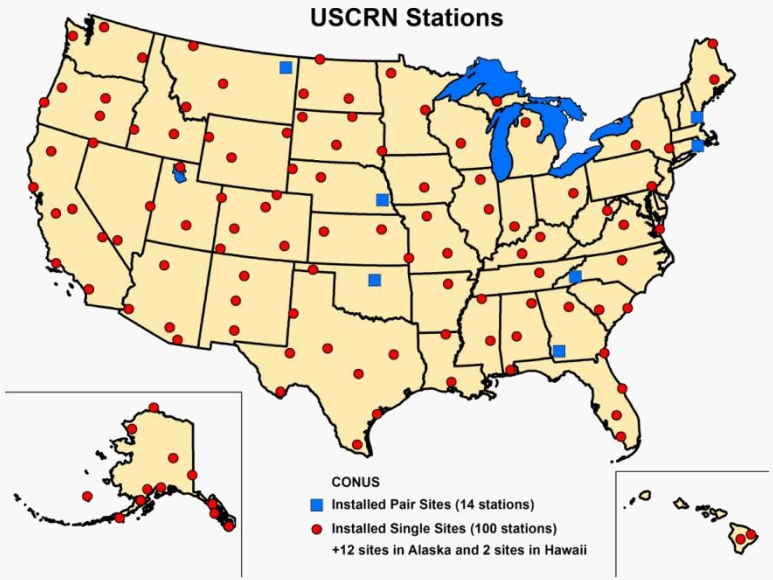


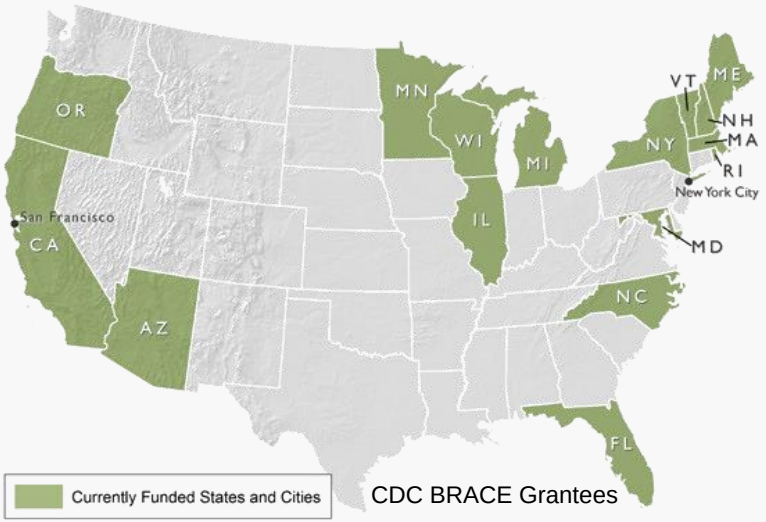


Investments in foundational science, observations, and applied science are targeted to improve heat-health information and predictions.

Observe & Monitor

NIHHIS partners work to sustain Earth observations and biosurveillance in support of improved understanding of the role of climate on extreme heat and health, and to enhance operational efforts.





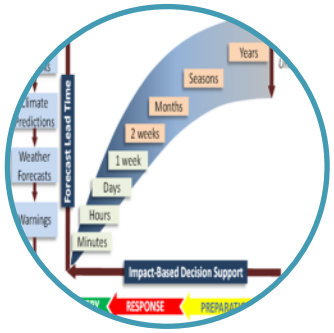
Physical climate observations, coupled with epidemiological surveillance, can improve understanding of connections between heat and health.

Communication and Action

NIHHIS partners enhance understanding of the impact of extreme heat events across time scales, build capacity across climate and public health communities, and develop timely and accessible communication tools to inform preparedness and adaptation.

The NIHHIS Web Portal consolidates heat-health resources, and the quick start guide helps decision makers get the right information quickly.

NIHHIS: an Integrated Information System



Seamless information at all timescales

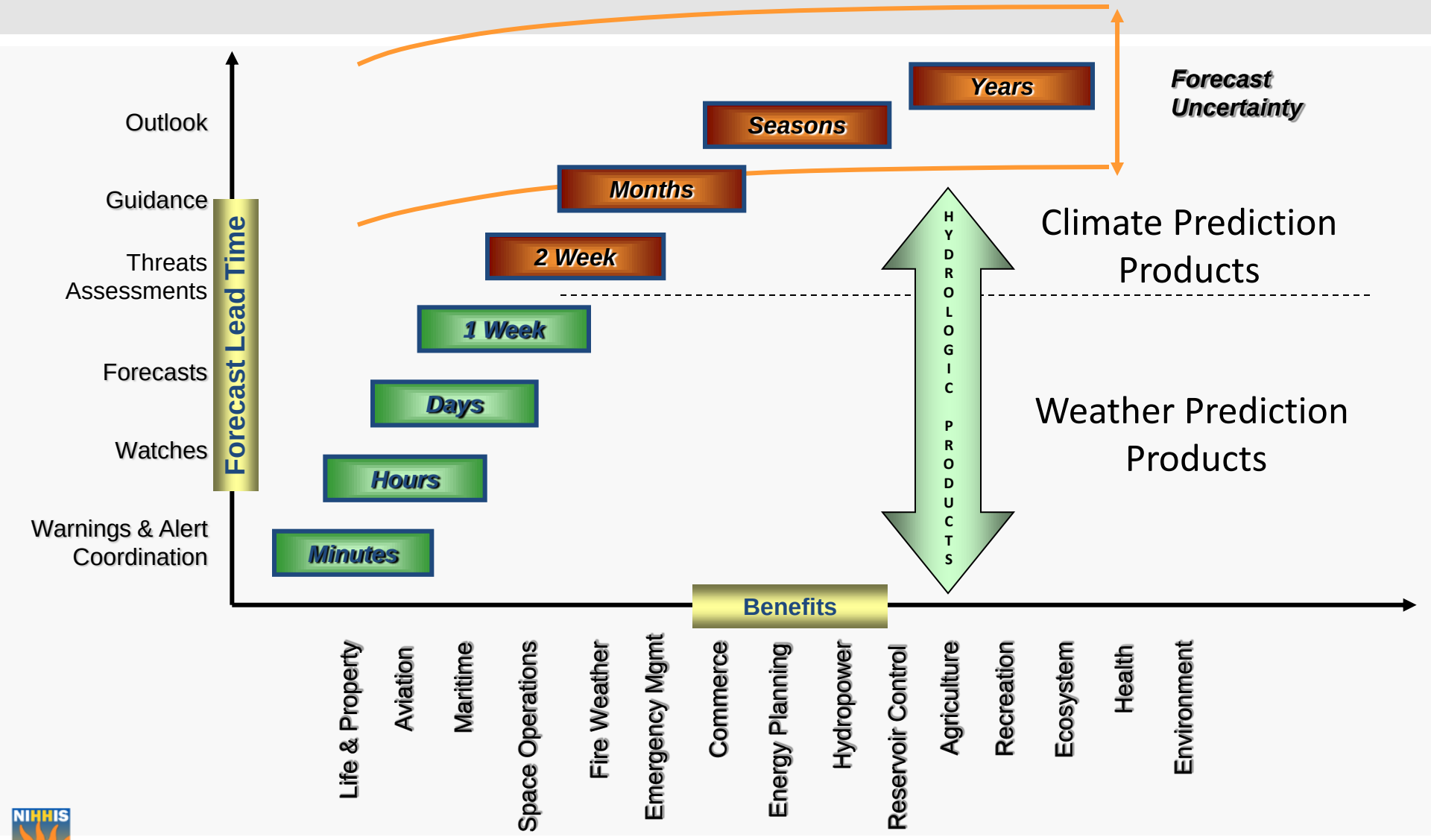
Regional-local pilots and international collaboration

Interagency w/ NGOs and private sector involvement

Translating science to evidence-based interventions to outcomes

Inter-disciplinary information for decision-makers

NIHHIS: A Seamless Suite of Information



The National Integrated Heat Health Information System

NIHHIS
NATIONAL INTEGRATED HEAT HEALTH INFORMATION SYSTEM

- Institutional Capacity and Partnerships
- Data and Forecast Products
- Heat Parameters and Health Outcomes
- Engagement & Communication Strategies

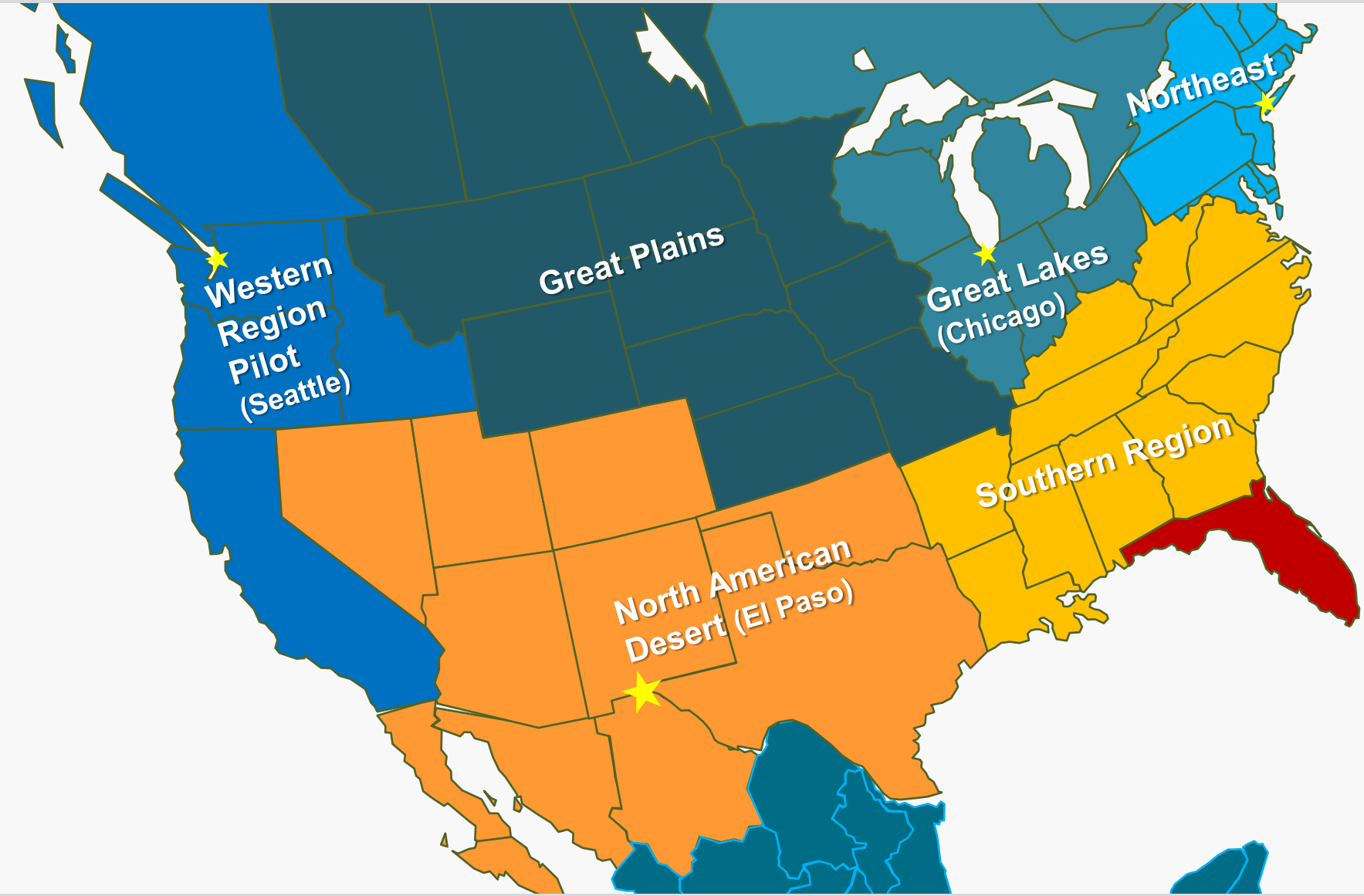
NIHHIS Framework:
core questions for all pilots

- NIHHIS White House Launch — June 2015
- Chicago Heat-Health Workshop — July 2015
- OSTP Sub-IPC Interagency Partnership Development — March 2015
- NYC-Northeast Pilot Development — February 2016
- Heat focused Health Forum for SASCOF8 — April 2016
- NIHHIS Web Launch — May 2016
- Inaugural NOAA Summer Heat Outlook — May 2016
- Launch of Global Heat Health Information Network (GHHIN) — June 2016
- First Pilot in RGB Region (El Paso) — July 2016
- CHI-Midwest Pilot Development — Fall 2016

NIHHIS Network: international partners and local-regional pilots

NIHHIS interagency web portal (climate.gov/nihhis)

National Integrated Heat Health Information Systems (NIHHIS) Pilots



NIHHIS North American Pilots consist of a region and a focal city, and are defined by a combination of climatological, political, social, and other boundaries.

NIHHIS RGB Pilot Engagement for Launch Workshop

RGB Pilot: Scope and Goals

- Improve understanding of regional public health risks to extreme heat.
- Identify and document capacities and gaps in science, preparedness, communication, and response.
- Establish information requirements to improve plans.
- Develop resources to inform research, outreach, and preparedness.
- Foster learning among research and practitioner communities.

RGB Pilot: Current Activities

- Working groups: historical connections, prediction, heat-health research, capacity and communication, built environment
- Document historical episodes of extreme heat, health outcomes, and responses
- Develop databases:
  - Research data
  - Information sources
  - Literature
  - Regional expertise directory

NIHHIS RGB Pilot Ongoing Activities

- Conducting a survey to understand vulnerability in the El Paso pilot area and to determine where vulnerable populations are in the region so they can be focused on.
- Building an inventory of heat-health practitioners in the region as well as data sources that can be used in heat-health research and early warning / emergency response.
- Building prototype products and documenting requirements for the use of extreme heat information in energy and home medical equipment contexts.
- Organizing pre-heat season 2017 public information sessions for the May timeframe to build awareness of the risks.

Rio Grande/Bravo NIHHIS Pilot Local Approaches

Promotoras: Incorporating Local Knowledge

- Members of the community who already have trust and are able to speak English and Spanish.
- They often receive some specialized training, but do not have advanced degrees in health.
- They not only educate, but also investigate, and can return with valuable information on vulnerability that is hard to capture in surveys.

Extreme Weather Task Force

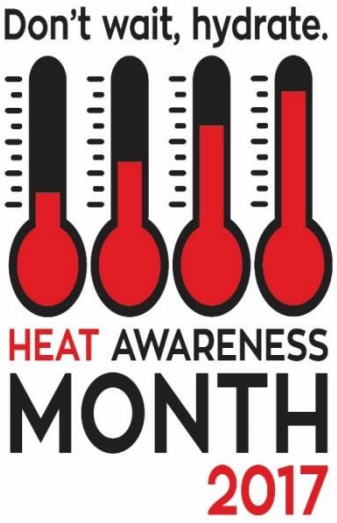
- Multi-organization and agency task force that provides assistance upon request to those most in need.

RGB Pilot: Upcoming Plans

- Regional assessment report (August 2017)
- Distribute databases (August 2017)
- Garner funding
  - Proposal writing in progress (May 2017)
  - Seek relevant RFPs
- 2017 heat season review (October 2017)

RGB Pilot: Current Activities

- Inform the public:
  - May 2017 – Extreme Heat Month proclamations (Ciudad Juárez, Las Cruces, El Paso)
  - Urban events
  - Bilingual brochures
  - Social media campaign
  - Shared website



Las temporadas de verano serán mas calientes que en el pasado

Para esta región, los datos científicos muestran la posibilidad de:

- Más días con altas temperaturas.
- Ondas de calor más frecuentes (3 o más días continuos con temperaturas más altas de lo normal).
- Temperatura más alta en algunas áreas de nuestra ciudad.

La demanda de electricidad y agua aumentan durante la temporada de calor, y puede resultar en...

- Baja presión de agua
- Apagones

Esto puede aumentar los riesgos para algunas personas y crear dificultades para mantener fresco el hogar.

¿SE SIENTE MAL?

¡No espere! Acuda al doctor si sufre de uno o varios de los siguiente:

SÍNTOMAS

Fatiga, cansancio

Mareos

Náusea o vómito

Dolor de cabeza

Latido rápido del corazón

Dificultades para respirar

Desmayo

Más información:

Clima: Servicio Nacional de Meteorología El Paso (www.weather.gov/epz/)

Emergencias: 911, Oficina de manejo de emergencias de Condado de Doña Ana

Local: Salud y servicios humanos, El Paso Electric, Oficina de sostenibilidad

Nacional: Centros de Control y Prevención de Enfermedades (www.cdc.gov/disasters/extremeheat/index.html)

Asociación de calor y salud de la frontera: www.borderheat-healthpartnership.org

10 PASOS PARA ESTAR A SALVO

1. **Entérese** del pronóstico del clima para planear sus actividades y tomar las precauciones necesarias.
2. **Mantenga fresco su cuerpo,** usando ropa ligera, de colores claros y tejidos naturales que cubran brazos y piernas.
3. **Beba** agua frecuentemente.
4. **Evite** actividades en el exterior durante las horas pico del día.
5. **Si camina,** use las rutas con sombra y áreas verdes.
6. **En la calle,** use sombrero o gorra de colores claros, o sombrilla de colores claros; tome descansos en la sombra.
7. **En el carro,** ventile antes de entrar. Nadie debe permanecer adentro del vehículo al estar estacionado.
8. **En transporte público,** abra las ventanas si no hay aire acondicionado; espere el camión o ruteraen la sombra.
9. **En el hogar,** mantenga encendido el aire acondicionado o abanicos; bloquee el sol con cortinas o pantallas reflejantes en las ventanas; instale aislanteen techo y paredes y un techo volado para dar sombra a las ventanas; plantearboles o arbustos alrededor de su casa y en banquetas para reducir la temperatura.
10. **Vaya a un lugar fresco por unas horas** si tiene dificultades para mantener fresca su casa.

2017 May and June Heat Actions

El Paso holds a press conference to announce the start of heat season and is planning several local events to build awareness. A new curriculum for training promotoras (community health workers) on heat-health is being developed for use along the border.

ANTE EL CALOR,
PROTÉGETE MEJOR
MES DE LA ADAPTACIÓN
Y PREVENCIÓN AL CALOR
2017

2017 May and June Heat Actions

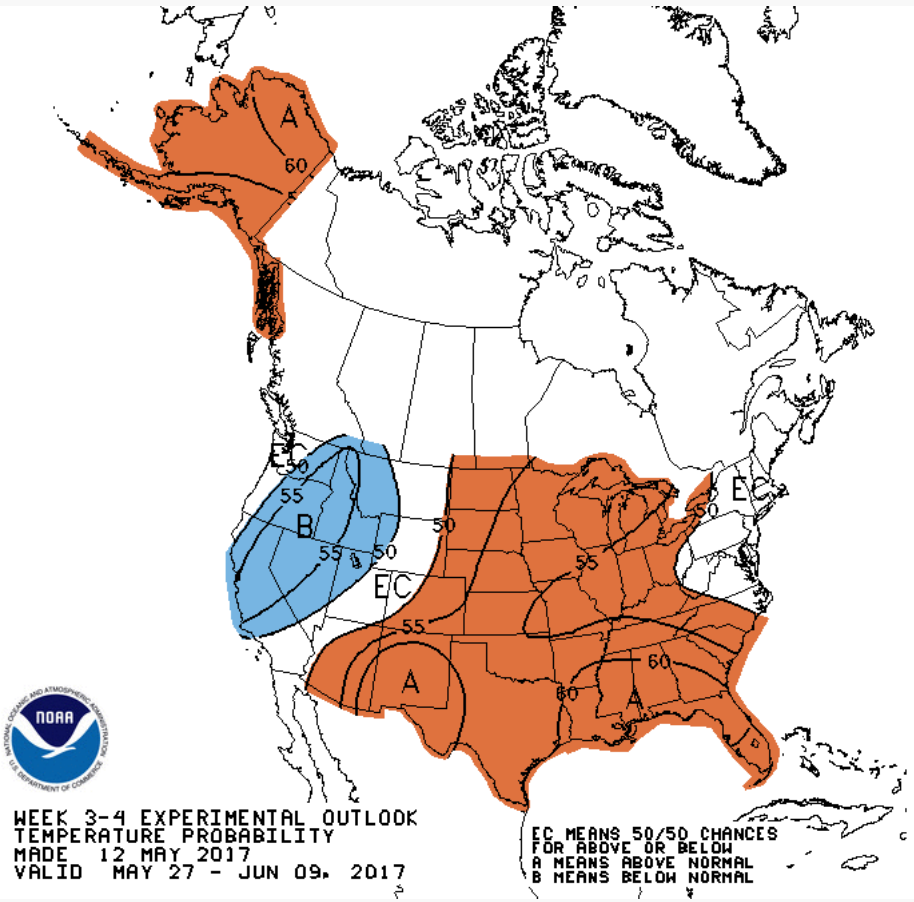
Juárez Resiliente was live — at Presidencia municipal de Juarez.
May 3 at 3:36pm · Ciudad Juárez, Mexico ·

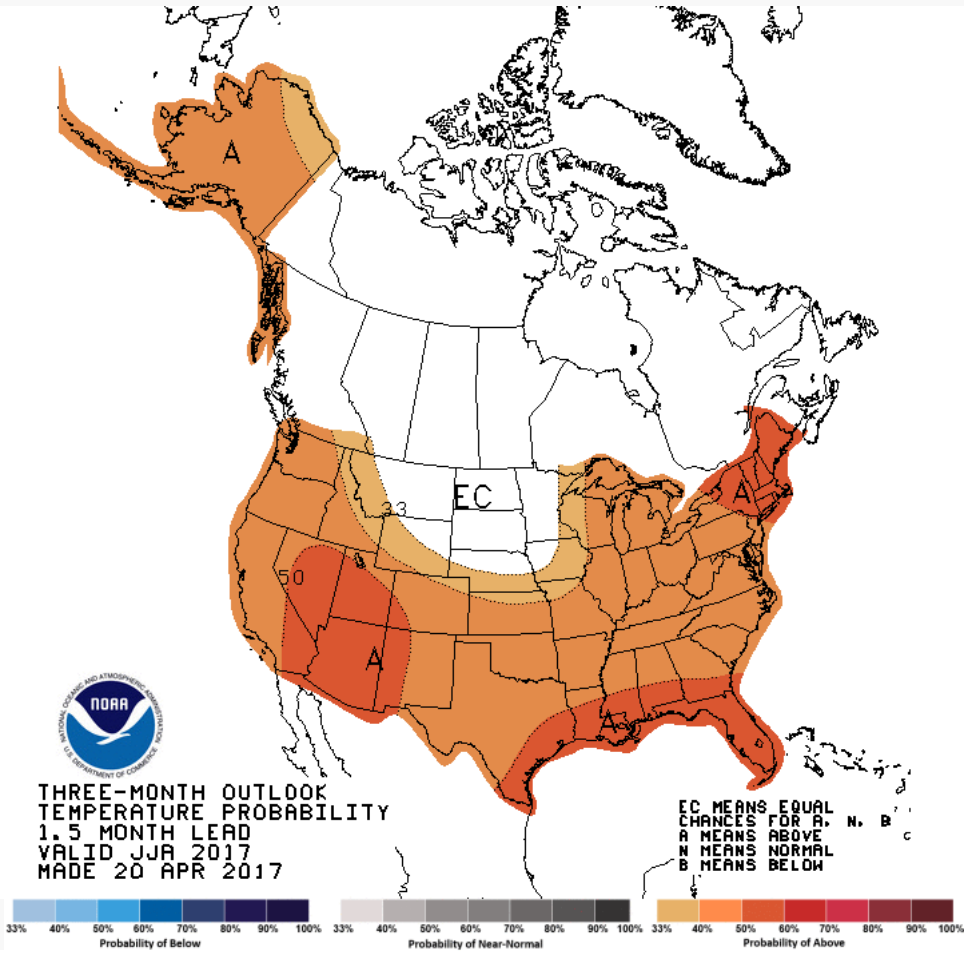
Proclamación del mes de mayo como el mes de la adaptación y prevención al calor

Ciudad Juárez issued a proclamation on extreme heat and organized several events to build awareness.

NOAA Subseasonal and Seasonal Outlooks

These products show the probability of above/below/near average temperatures.





NIHHIS Interagency--Heat Month

- Starts tomorrow, May 18 with launch of Summer Heat Outlook!!
  - --Climate.gov Story
  - --Heat Health Story Map
  - --Multiple tweets
  - --One message for all agencies—focus on acclimatization

- June—focus on vulnerable populations per week:
  - --Outdoor Workers and athletes
  - --Children, pets
  - --Older Adults
  - --Socially isolated and other medically dependent

- #heathealth, driving to NIHHIS page, OSHA/NIOSH App highlighted

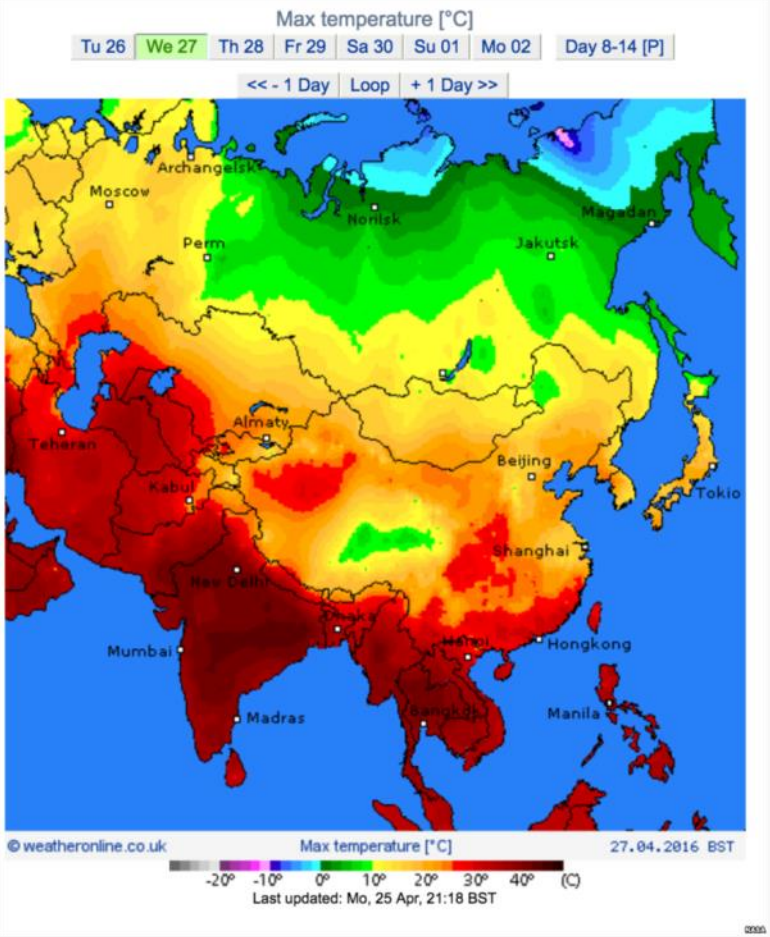
- Experimental Interpretation of heat forecast for health in June

NACSP and COF in Mexico City

- NOAA and other US and Canadian agencies were invited to the **North American Climate Services Partnership (NACSP)** meeting [29 Nov] and the **Mexico Outlook Forum (NCOF**) [30 Nov – 1 Dec].
- The NIHHIS RGB Pilot and Health were focal areas during the workshop.
- Gregg Garfin (University of Arizona), Hunter Jones (NOAA) attended to represent the NIHHIS RGB pilot.
- Mexico is developing information systems for extreme heat, arboviruses (Dengue), drought, respiratory infections. Required parameters and indicators have been documented.
- Representatives from the following agencies were present:

GHHIN: The Global Heat Health Information Network

- The Global Heat Health Information Network was launched on June 10th, 2016 at the International Research Institute for Climate and Society.
- The launch of GHHIN implements the international component of the Chicago 2015 Heat Health meeting Action Plan.
- GHHIN inherits the NIHHIS framework as a structured approach to heat resilience.



The first GHHIN Meeting will take place in 2017 in Bangkok.

GHHIN: a Common Framework Inherited from NIHHIS

designed to accelerate the implementation of heat health prevention

GHHIN Goals

Identify and communicate evidence, lessons learned, and propagate good practices across the network and with other scientists, policy-, and decision-makers.

Help members build capacity through the mobilization of and improved access to expert resources and opportunities for learning, exchange, and engagement.

Increase availability of actionable evidence and information vis-à-vis activities to develop, share, and promote standardized technical guidance, research, data, and decision-tools.

Help members use available evidence to advocate for action and cultivate sustained funding for the global network, its partners, and activities.

GHHIN CORE ACTIVITIES & SERVICES TO MEMBERS

COORDINATION & OUTREACH SERVICES

- Bi-Annual International Heat Health Forum
- GHHIN Annual Report
- Coordination
- Website and Online Platform
  - Member Profiles
  - Technical Resources
  - News, Science and Events
  - Information Kit

CORE TECHNICAL & CAPACITY BUILDING RESOURCES

- Technical Working Groups
  - Standards & Guidance
  - Vulnerability & Exposure Research
  - Data
  - Forecast Products & Alert Systems
  - Community Interventions
- National Heat Health Profiles
- Heat Alert & Virtual Technical Support Desk
- Heat/Health Learning Exchange Program

REGIONAL NODES

Europe

South Asia

North America

What's next for GHHIN?

TASK	DESCRIPTION	STATUS
1. **Establish and Staff GHHIN Coordination Unit**	The GHHIN Coordination Unit performs the day-to-day administration and operation of GHHIN.	Ad-hoc solution of 2 interns June-Aug in Geneva.
1. **Formalize the Ad-Hoc Advisory Committee**	The Committee provides guidance for GHHIN, representing many countries and disciplines.	In progress
1. **Establish Process to Produce Bi-annual Global Synthesis Report**	Report will be regularly updated to provide assessment of the state of the science on climate and health aspects of heat, key gaps, and country actions and progress.	Need resources
1. **Comparative Heat-Health System Stocktaking Report**	The report standardizes assessment of heat-health systems and feeds into the web portal where indicators are tracked.	Summer 2017 Interns assigned
1. **Develop and launch GHHIN Outreach Strategy**	The outreach strategy builds and sustains engagement amongst GHHIN members.	Summer 2017 Interns assigned
1. **Organize the 1st Global Forum**	The Forum follows the Chicago 2015 meeting, formalizes GHHIN, and launches SE Asia node.	Need to confirm location and funds

NIHHIS and GHHIN collaboration with CEC

A few ideas to get us started:

- Sharing knowledge, methods, networks, actions, successes
- Framing across multiple time scales-- Reaching decision makers beyond emergency management—planners, budget offices, energy, housing, hospitals and healthcare facilities, infrastructure, architect and design
- Decision-scenario table top exercise
- Research collaboration
- Working with our Weather, Climate and Health agencies together, regularly
- Creating useful products, tools, actions for use across border regions
- Expand to other heat impacts-ecosystem, agriculture, animals and livestock, energy, food production

- What else?

NIHHIS and RGB Pilot Contacts

For more information, visit: http://climate.gov/nihhis

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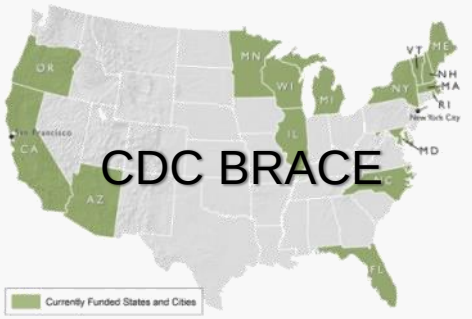
All heat deaths are preventable.

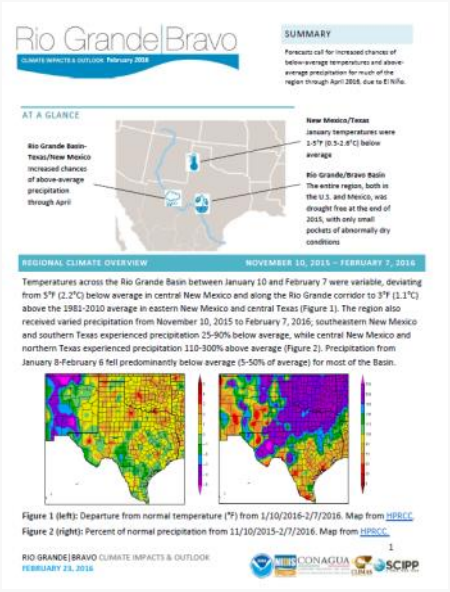

JUÁREZ INDEPENDIENTE
HEROICA CIUDAD JUÁREZ H. AYUNTAMIENTO 2016-2018

NIHHIS: built on new & existing partnerships & networks

- Launched via a White House announcement as a CDC & NOAA Initiative in June 2015.
- Kick-off workshop in Chicago in July 2015.
- Relationship building (New York, India, Africa, South Asia, Rio Grande/Bravo).
- First regional pilot in Rio Grande/Bravo region in 2016.
- Interagency coordination throughout 2016 including EPA, FEMA, OSHA…
- Global Heat Health Information Network (GHHIN) integrates international partners.



Interdisciplinary Information for Decision-makers



Regional Climate Outlooks

Interviews

Webinars

Climate Outlook Forums

Practitioner Workshops

Inter-agency Portal

http://climate.gov/nihhis


Juárez
RESILIENT

NIHHIS El Paso Workshop Goals

- Improve understanding of historical climatology and vulnerabilities to heat in the region.
- Identify vulnerable populations, and climate and health indicators, to improve preparedness for future heat episodes.
- Identify and document science, communication, and public health needs and gaps related to extreme heat monitoring and public health preparedness.
- Establish specific information requirements for ensuing work to develop concrete information products, plans and processes identified in this workshop.

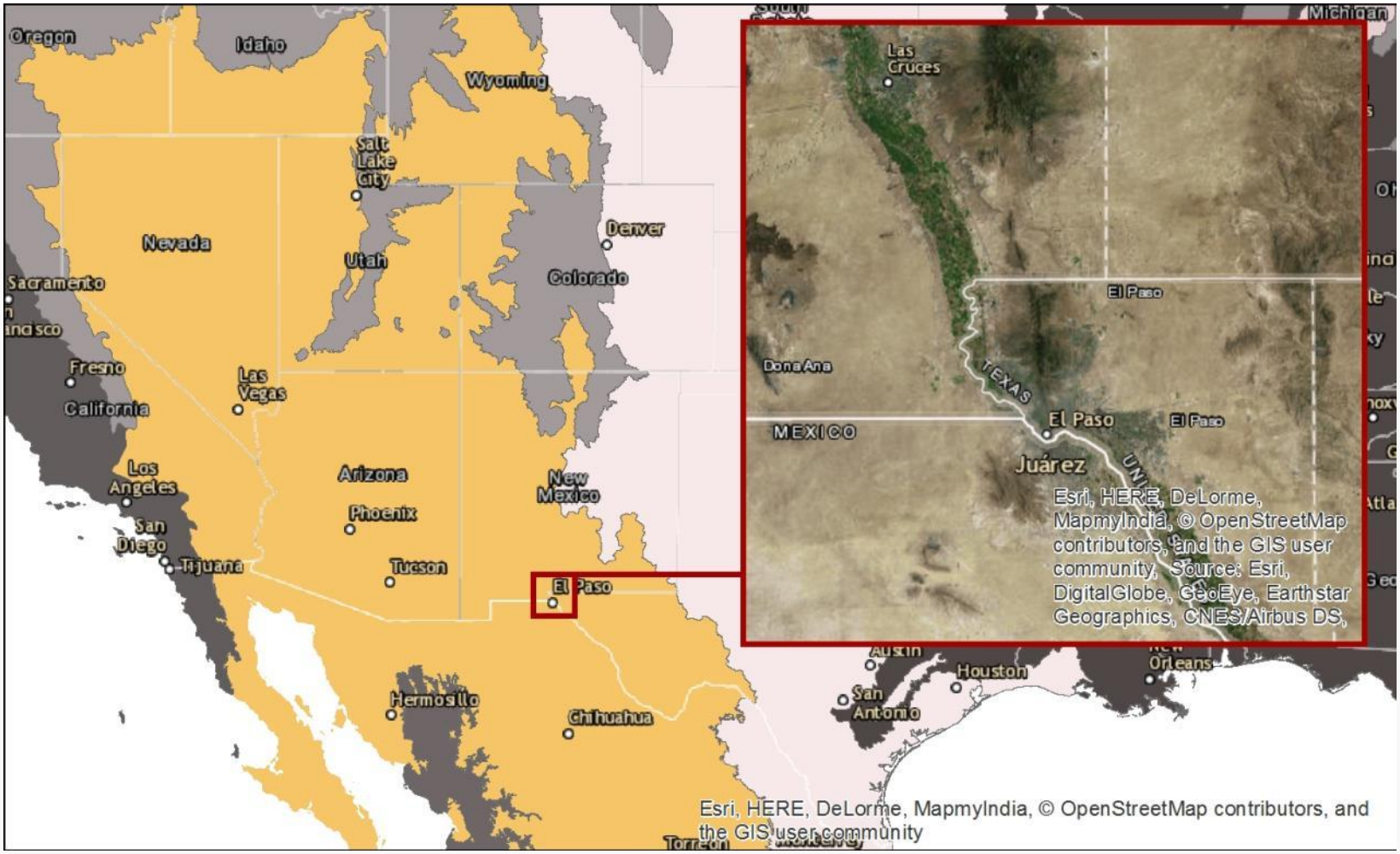
Key Gaps Emerging from NIHHIS Workshop

- Improved Public Health Data
  - –Morbidity and Mortality
  - –Access to Information
  - –Exposure and Outcomes
  - –Biomarkers for Heat Illness
  - –Prevalence Data
- Improved Understanding and Prediction of Health Outcomes
  - –identification of indicators and metrics of extreme heat-related illnesses
  - –validation of vulnerability assessments and assessment methods
  - –vulnerability mapping.
- Improved Communication of Heat and Health Information
  - –Improved product design and understandability
  - –Social science research on messaging to influence actions
  - –Outreach to most vulnerable populations
- Improved coordination among heat-health partners
  - –Leveraging the leadership of local governments
  - –leveraging existing regional strengths (emergency management coordination, neighborhood-level outreach organizations)

NIHHIS RGB Pilot Engagement for Launch Workshop

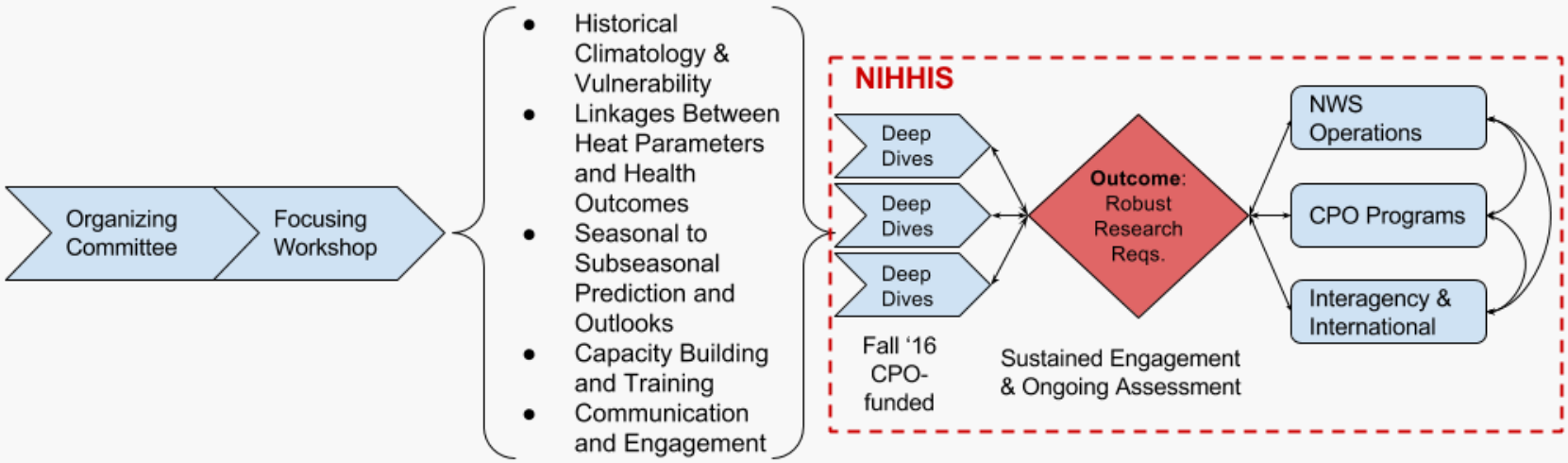
NACSP and COF in Mexico City

The North American Desert NIHHIS Pilot Region



NIHHIS and Pilots Timelines

Activity	2015	2016	2017	2018	2019	2020
Pilot Heat-Health Systems						
Establish Pilot Protocol - Eval methods tracking params & effectiveness						
Northeast (NYC) Pilot						
Rio Grande/Bravo Pilot (El Paso, Ciudad Juarez, Las Cruces)						
Midwest / Great Lakes Pilot (Chicago)						
Western Region (Reno)						
Other domestic and international city pairs						

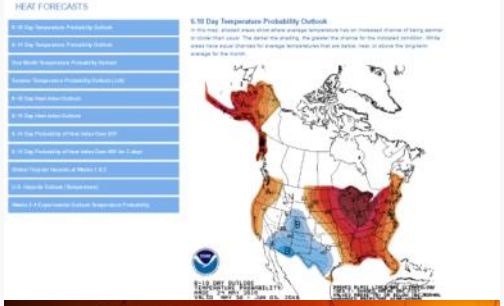


What is **unique** vs. **shared**: RGB's **Exposure and Risk**

- The North American **Monsoon** creates a distinct climate for the intermountain southwest.
- The RGB region faces some shared challenges – including the '**climate gap**' and concentrated vulnerability in **colonias**.
- But the region can also take advantage of a diverse set of ideas for addressing these challenges such as **promotoras**.
- And already has an existing network to address imminent heat waves and other issues in the **Extreme Weather Task Force**, and the **buddy** system.

NIHHIS is intended to understand and share these challenges, approaches, and successes, building local-regional and national-international resilience to extreme heat.

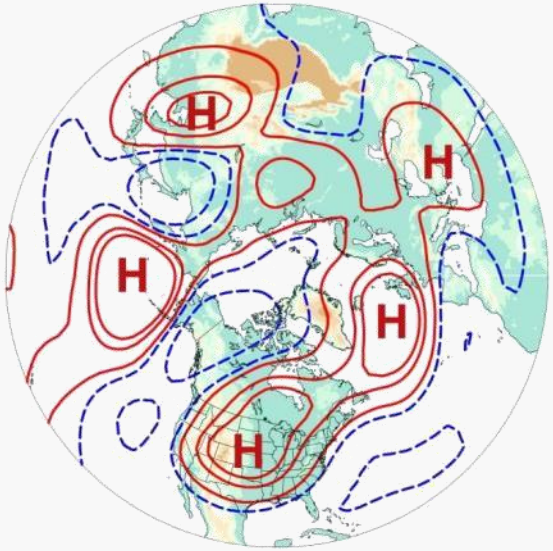
NIHHIS RGB Workshop: Desired Outcomes

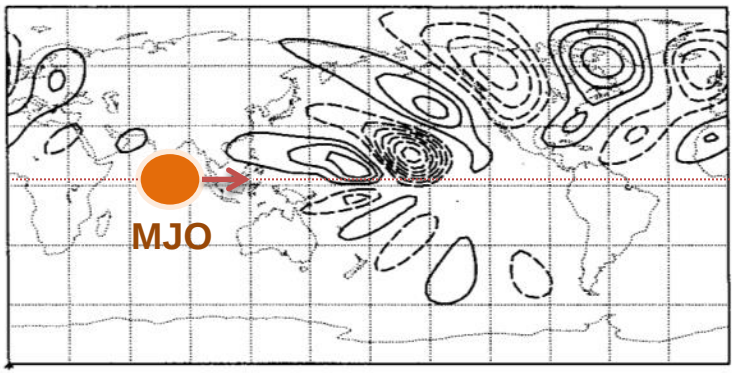


- Ongoing **work streams** focused on the **key questions** with the goal of developing an **outcome**:
  - Improved regional, seasonal heat outlook
  - Communication and information sharing plans
  - Local policy options for long-term resilience
  - Monitoring and indicators plans
- Enhanced **requirements** for health and climate information needs for NOAA, CDC, and other partners:
  - At all timescales
  - For many different disciplines
  - With consideration of thresholds
    - Skill, temperature, probability, etc…
- A Featured **Case Study** for NIHHIS

Planetary Wave Patterns and the Madden-Julian Oscillation

Wavenumber-5 anomalies precede some heat waves by two weeks, which affords predictability (15 days) in the sub-seasonal prediction gap between weather forecasts and climate predictions. (Teng et al., 2013)



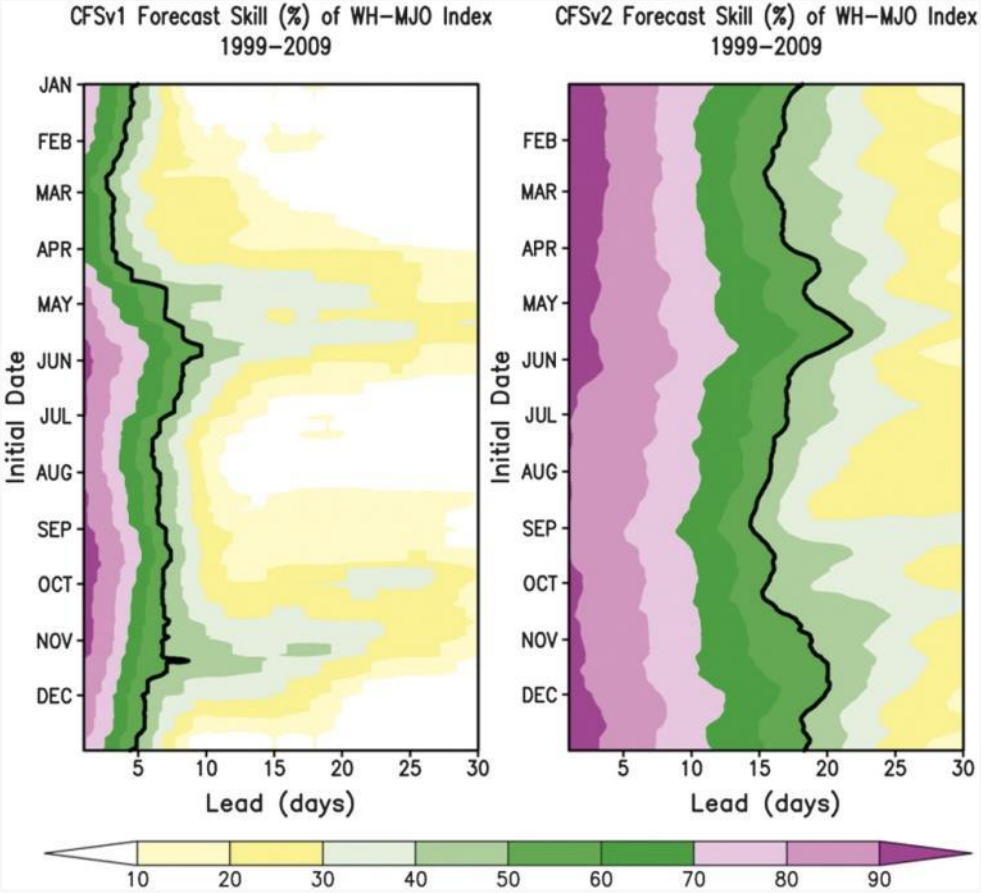


The Madden-Julian Oscillation (MJO), a sub-seasonal mode of atmospheric variability, can force Rossby wave trains - connecting the Tropical Pacific to the mid-latitudes . This could promote conditions that lead to a heat wave. (Vintzileos & Gottschalck)

ucar.edu/atmosnews/news/10508/long-term-forecasts-heat-waves doi:10.1038/ngeo1988

MJO improvements CFSv1 → CFSv2 → *CFSv3*

Over the 15 year gap between CFS versions 1 & 2, forecast skill for the MJO dramatically improved. This improvement is attributed to, among other things, improved representation of initial conditions for the tropical atmosphere and improved process-level understanding.



Saha et al., 2014 dx.doi.org/10.1175/JCLI-D-12-00823.1

Ensemble Forecasting: Using the NMME for Heat Outlooks

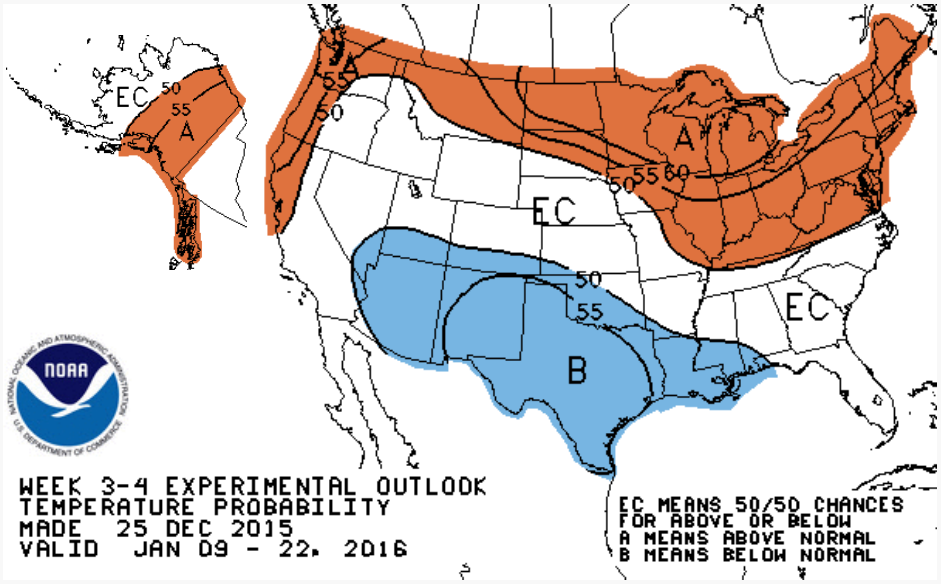
- The Subseasonal Excessive Heat Outlook System for Human Health (SEHOS-H) is a joint NOAA CPC and University of Maryland (ESSIC) project intended to improve early warning of extreme heat. Vintzileos & Gottschalck are currently evaluating whether the NMME can improve SEHOS-H predictions.

Heat Intensity

$$\int \text{NOAA Heat Index}$$

over days in exceedance of threshold
w/ seasonal weighting for acclimatization

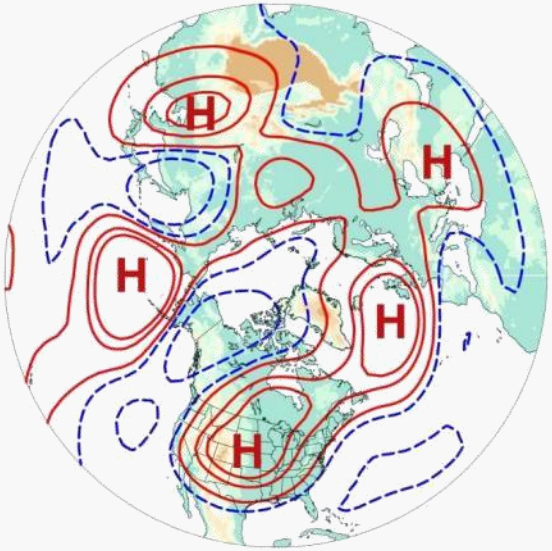
		Week 2	Weeks 3 & 4
Apparent Temp. & Dry Bulb Temp.	SEHOS-H	NCEP GEFS	NCEP CFS
		North American Multi-Model Ensemble (NMME)	

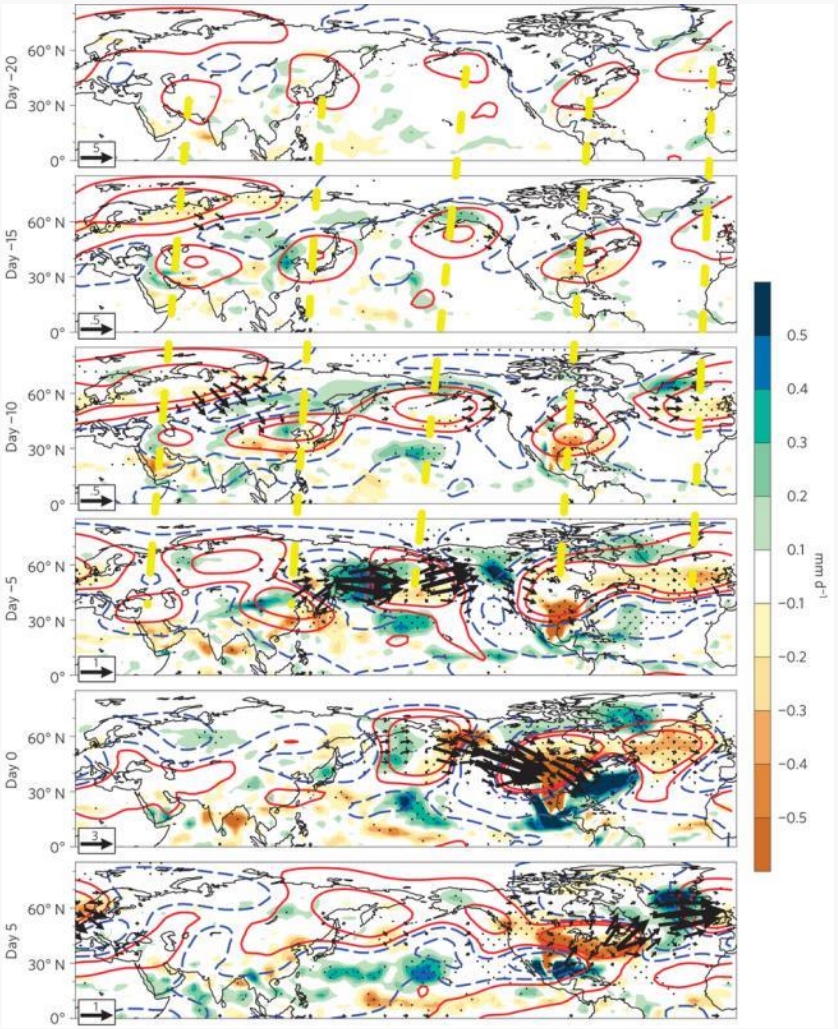


Current experimental weeks 3 & 4 product from NOAA NCEP CPC (currently T and P available).

Improving Sub-seasonal Prediction: Planetary Wave Patterns

Wavenumber-5 anomalies precede some heat waves by two weeks, which affords predictability (15 days) in the sub-seasonal prediction gap between weather forecasts and climate predictions. (Teng et al., 2013)

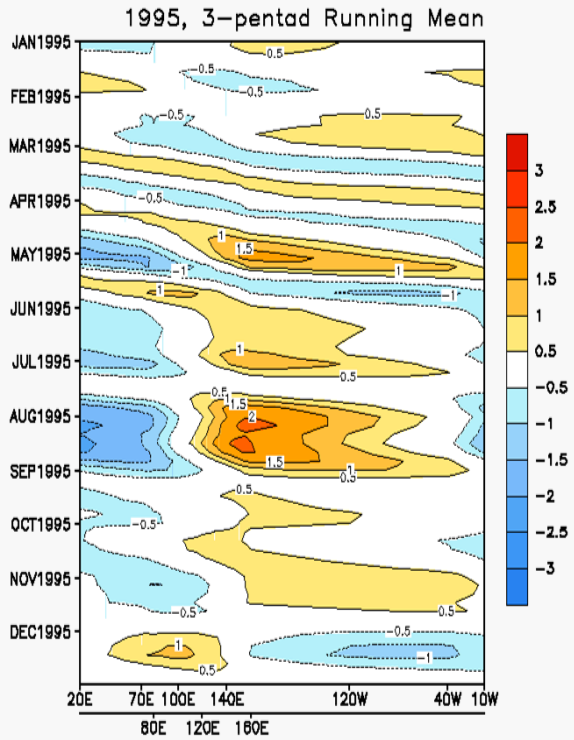




ucar.edu/atmosnews/news/10508/long-term-forecasts-heat-waves doi:10.1038/ngeo1988

Improving Seasonal to Sub-Seasonal Prediction: MJO

Corresponding MJO Activity

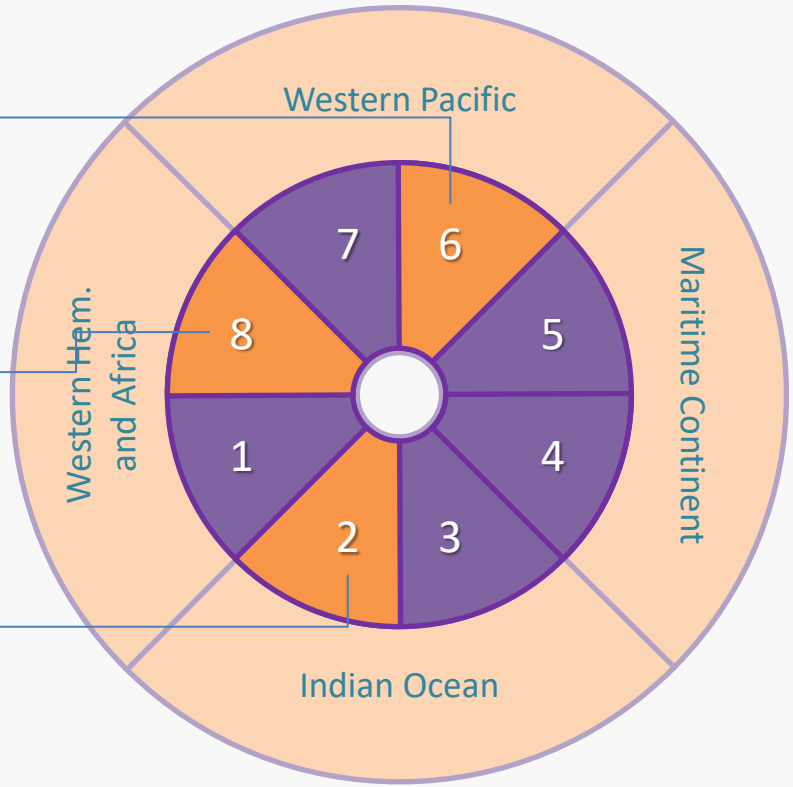


Abstract representation of Wheeler-Hendon Diagram

4-week lead time (70% confidence)

3-week lead time (88% confidence)

2-week lead time (90% confidence)



Phases 6, 8, and 2 of the MJO may be correlated with increased likelihood of heat wave mortality events at lead times of 4, 3, and 2 weeks respectively. (Vintzileos & Gottschalck)

Vintzileos & Gottschalck, AMS 2015 (http://tinyurl.com/hlw7pvx) *Jin & Hoskins, 1995*

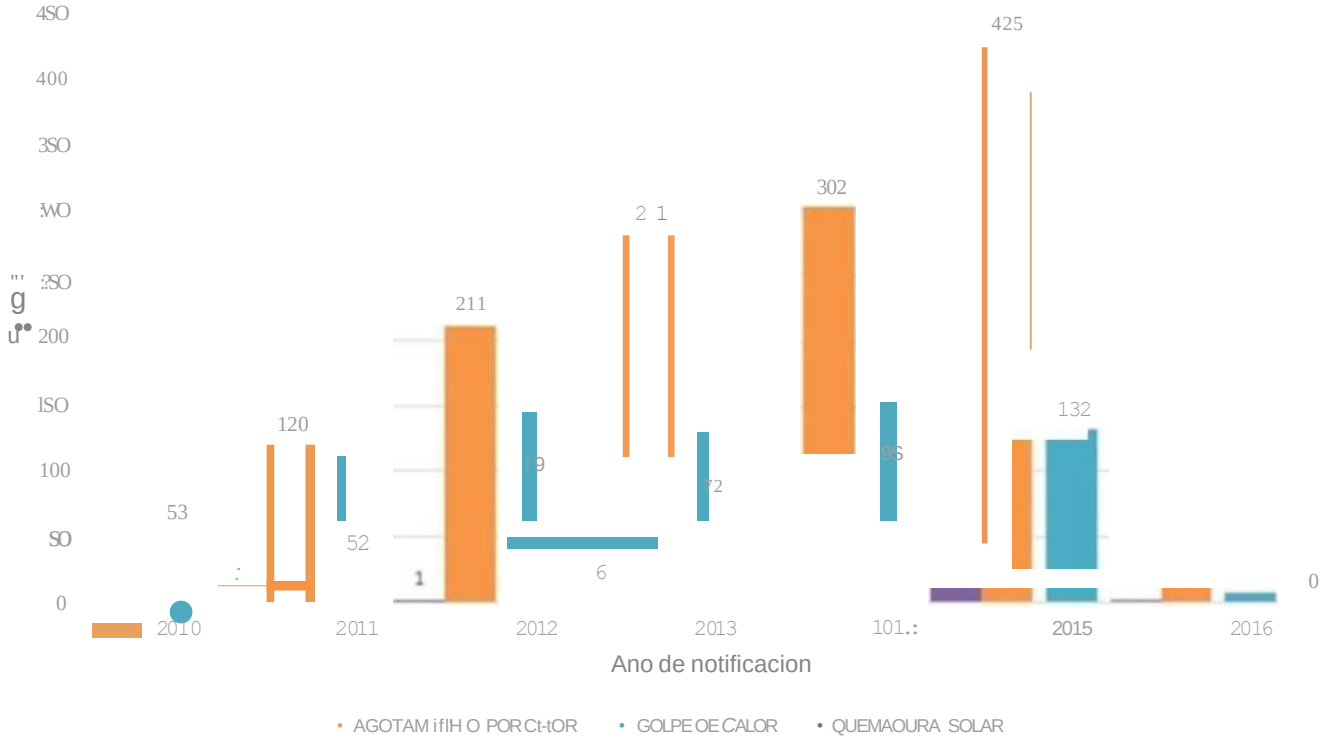
SALUD

SECRETARiA DE SALUD

Cofepris

Comislon Federal para la Proteccion contra Resgos Sanitarlos

Casas de lesiones por temperaturas naturales extremas en temporada de calor. Mexico 2010 - 2016.



Fuente SSNOGE/OVEENT/S1stema de Vig1lanc1a Ep1dem1ol6g1ca de Danos a la Salud por Temperaturas Naturales Extremas Temporada de calor 2010-2016

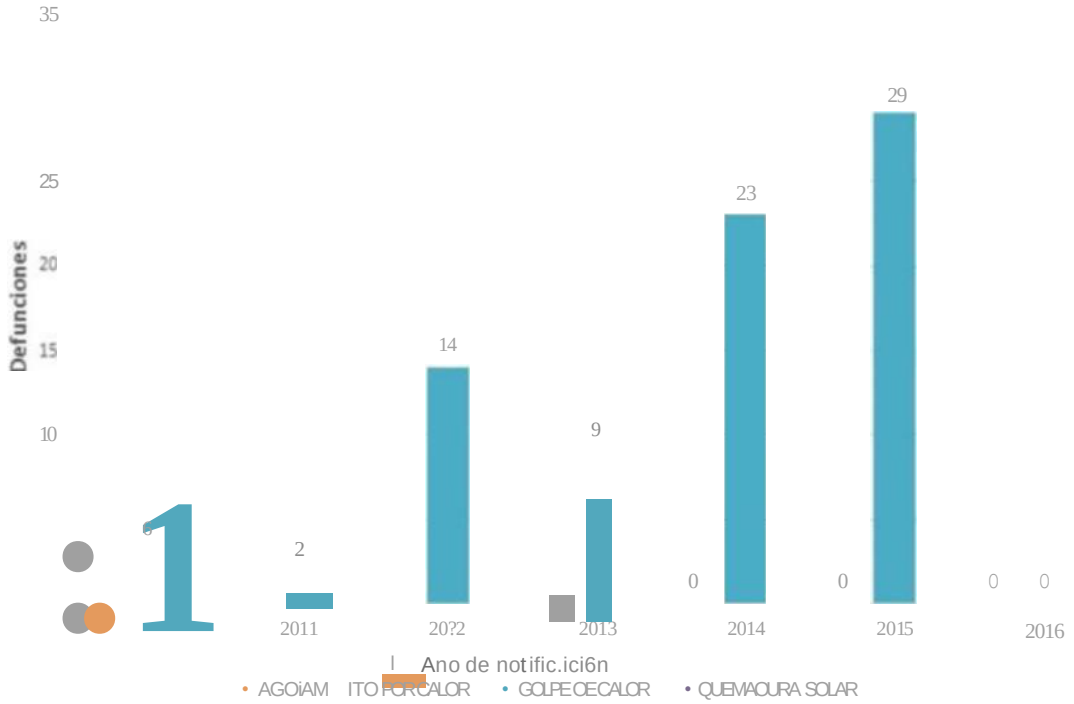
SALUD

SECRETARiA DE SALUD

Cofepris

Comislon Federal para la Proteccion contra Rlesgos Sanitarlos

Defunciones por temperaturas naturales extremas en temporada de calor. Mexico 2010 - 2016.



Fuente SSA/DGE/DVEENT/S1stema de V191lanc1a Epidelllol6g1ca de Danos a la Salud por Temperaturas Naturales Extremas Temporada de calor 2010-2016

Pulso EPIDEMIOLÓGICO

Respecto a la morbilidad, en México durante el año 2015, se tienen 559 casos de afectados por calor (0.47 casos/ 100,000 población) esto ocurre en 18 estados.

Los estados más afectados fueron: **Sonora**, Baja California, Veracruz, Chihuahua y Jalisco con 63.3%, 9.7%, 7.5%, 6.4% y 3.0% porcentaje de casos respectivamente.

Casos de lesiones por temperaturas naturales extremas en temporada de calor, por entidad federativa. México 2015.

Fuente: SSA/DGE/DVEENT/Sistema de Vi
Naturales Extremas. Temporada de calor 2015.

EPIDEMIOLÓGICO

SALUD
SECRETARÍA DE SALUD

Cofepris
Comisión Federal para la Protección contra Riesgos Sanitarios

Municipios con mayor temperatura reportada de 2011, 2013 y 2015

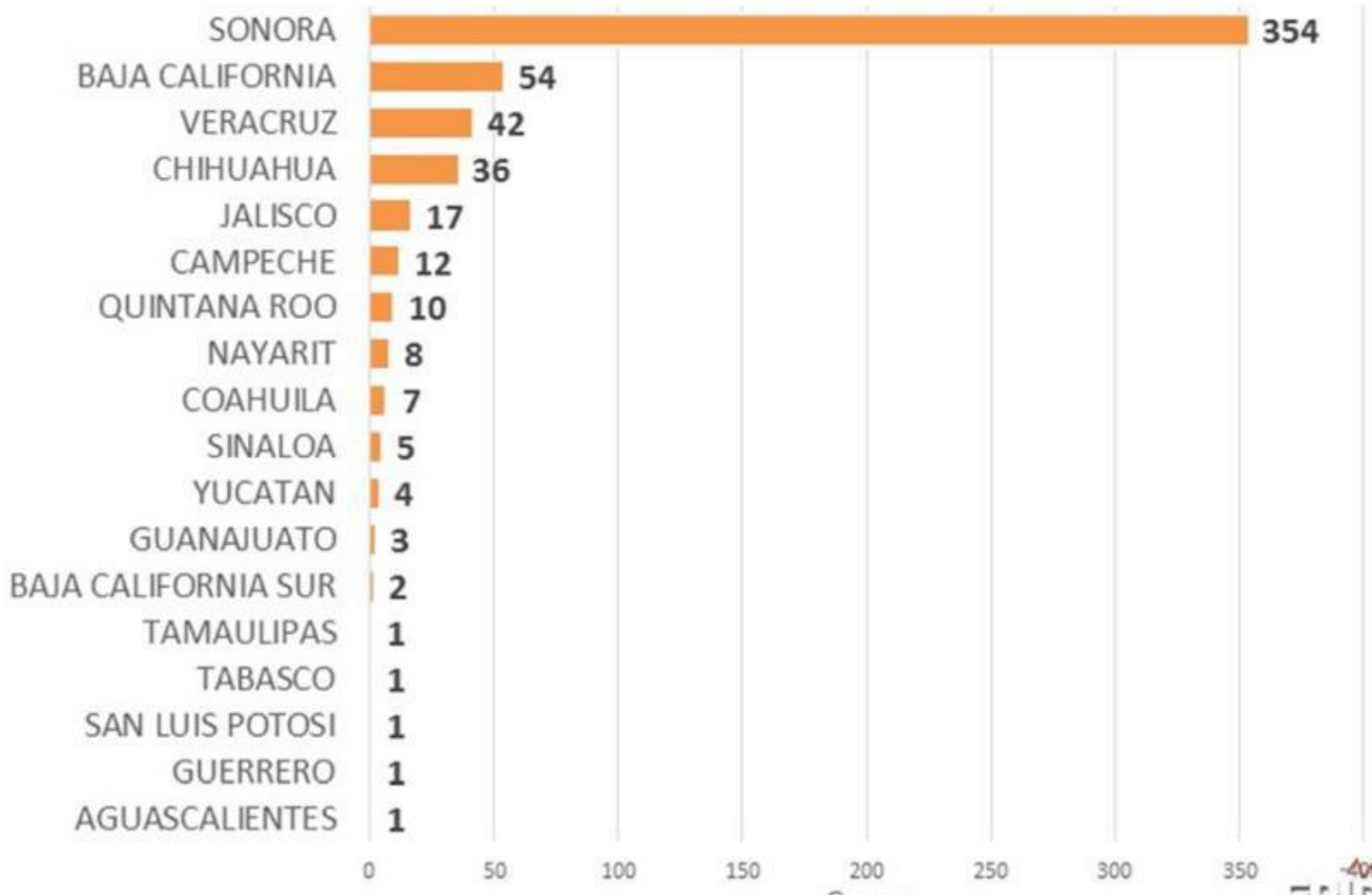
2011			2013			2015		
Estado	Municipio	Temp.° C	Estado	Municipio	Temp. °C	Estado	Municipio	Temp. °C
BC	Ejido Nuevo León	46.9	**BC**	Ejido Nuevo León	45.3	**BC**	Mexicali	45.0
BC	San Felipe	46.7	**Son.**	Hermosillo	44.5	**Son.**	Paso Nacori	44.6
Coah.	Piedras Negras	44.8	**Tamaul.**	Sabinas	44.0	**BC**	Ejido Nuevo León	44.2
BC	Ejido Nuevo León	44.8	**BC**	San Felipe	43.4	**BC**	Ejido Nuevo León	44.1
Son.	Altar	43.0	**Coah.**	Piedras		**Nay.**	Jesús	

En particular respecto a la vigilancia sindromática para los efectos del calor y luz, el sistema comenzó a operar en el año 2005.

En México existe un sistema epidemiológico para los daños a la salud por las temperaturas extremas (SVEDSTNE).

Sin embargo actualmente la información tiene un flujo similar al Sistema de Vigilancia Epidemiológica y un boletín de información semanal, que informa los profesionales de la salud y la población general sobre los eventos relacionados con olas de calor.

Casos de lesiones por temperaturas naturales extremas en temporada de calor, por entidad federativa. México 2015.

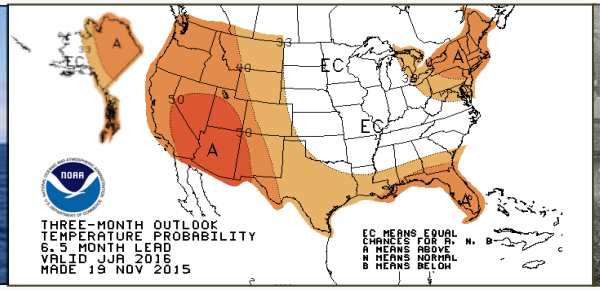


Fuente: SSA/DGE/DVEENT/Sistema de Vigilancia Epidemiológica de Daños a la Salud por Temperaturas

The National **Integrated** Heat Health Information System (NIHHIS)

Define Demand: sustained engagement with government, society, researchers

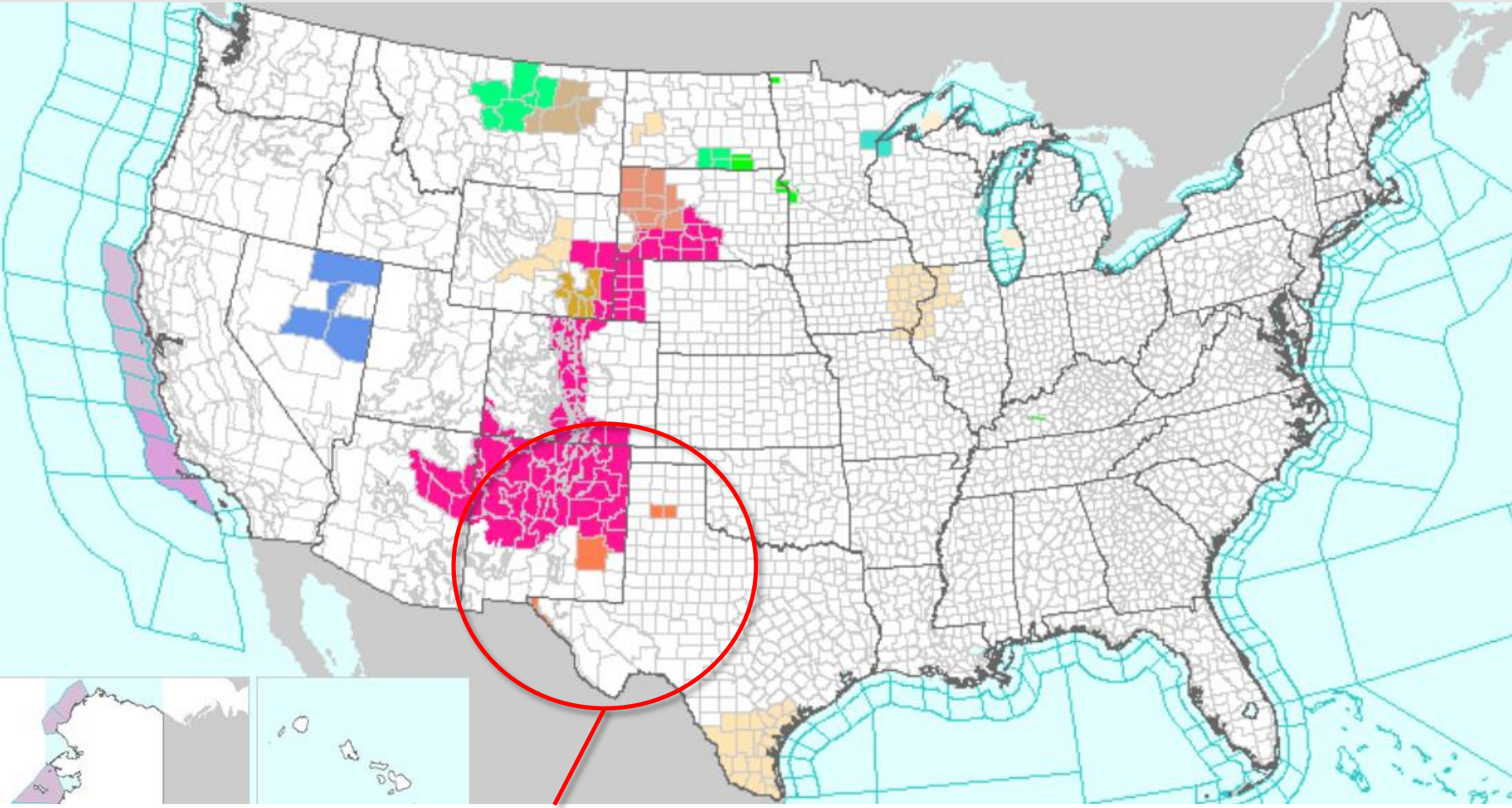
The *National Integrated Heat Health Information System* enhances societal resilience to extreme heat via several goals:

Improve **Prediction**	Improve **Communication**	Improve **Capacity**
		
Seamless prediction at every timescale, with increased spatial resolution, reduced uncertainty, and an enhanced set of indicators – based on defined demand.	Timely, reliable delivery of information, services, and products that are easily understood, with clear uncertainty characterization - and in flexible formats.	Improved user understanding, facilitation of knowledge sharing, adequate and sustained funding, ongoing assessments, and adaptation to varying needs.

Why focus specifically on Heat Waves?

- Extreme heat a **serious and underappreciated problem**.
  - –From 1979-2003, excessive heat exposure caused **8,015 deaths** in the U.S.
  - –During that period, **more people died from extreme heat** than from hurricanes, lightning, tornadoes, floods, and earthquakes **combined**.
- And it is only **expected to get worse**.
  - –The IPCC and National Climate Assessment state that episodes of extreme heat will likely increase in intensity, duration, and frequency.
  - –The National Academies released a report earlier this year finding that extreme heat is one of the easiest phenomena to link to a changing climate.
- But **all heat deaths are preventable**.
  - –Morbidity and mortality from extreme heat can be complex – it can exacerbate many existing conditions, and there are many factors that can increase vulnerability.
  - –But – with improved, customized information (at many **time scales**, for many different **types of decisions** in many **different disciplines**) as well as capacity building, planning, and long-term investments to improve resilience, nobody need suffer from extreme heat.

Seeking a **consistent approach** to extreme heat



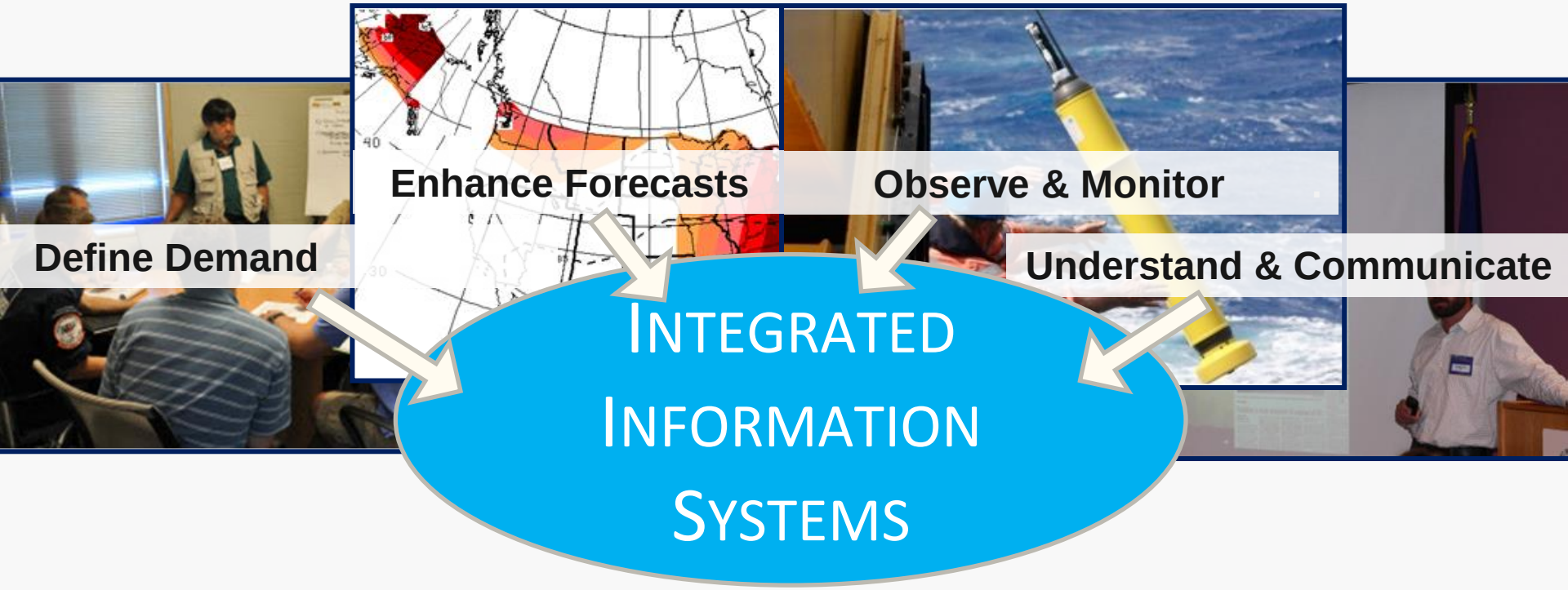
NIHHIS: Improving Climate Services for Risk Reduction

- NOAA and CDC launched the National Integrated Heat Health Information System (NIHHIS) in June of 2015 to integrate efforts.
- In July of 2015, an international set of heat-health practitioners – from local emergency managers to national public health and international meteorology – convened to establish a plan to move forward together.
- NIHHIS is part of the international effort, and informs decision makers in many sectors while also focusing on heat-related impacts on many vulnerable groups including the elderly, children, athletes, pets, and outdoor workers.

The National Integrated Heat Health Information System weaves together existing pieces, identifies information needs and helps to develop needed climate services.

NIHHIS will facilitate an integrated approach to providing a suite of decision support services to reduce heat related illness and death

Integrated Information Systems Inform Climate **Preparedness** & **Resilience**

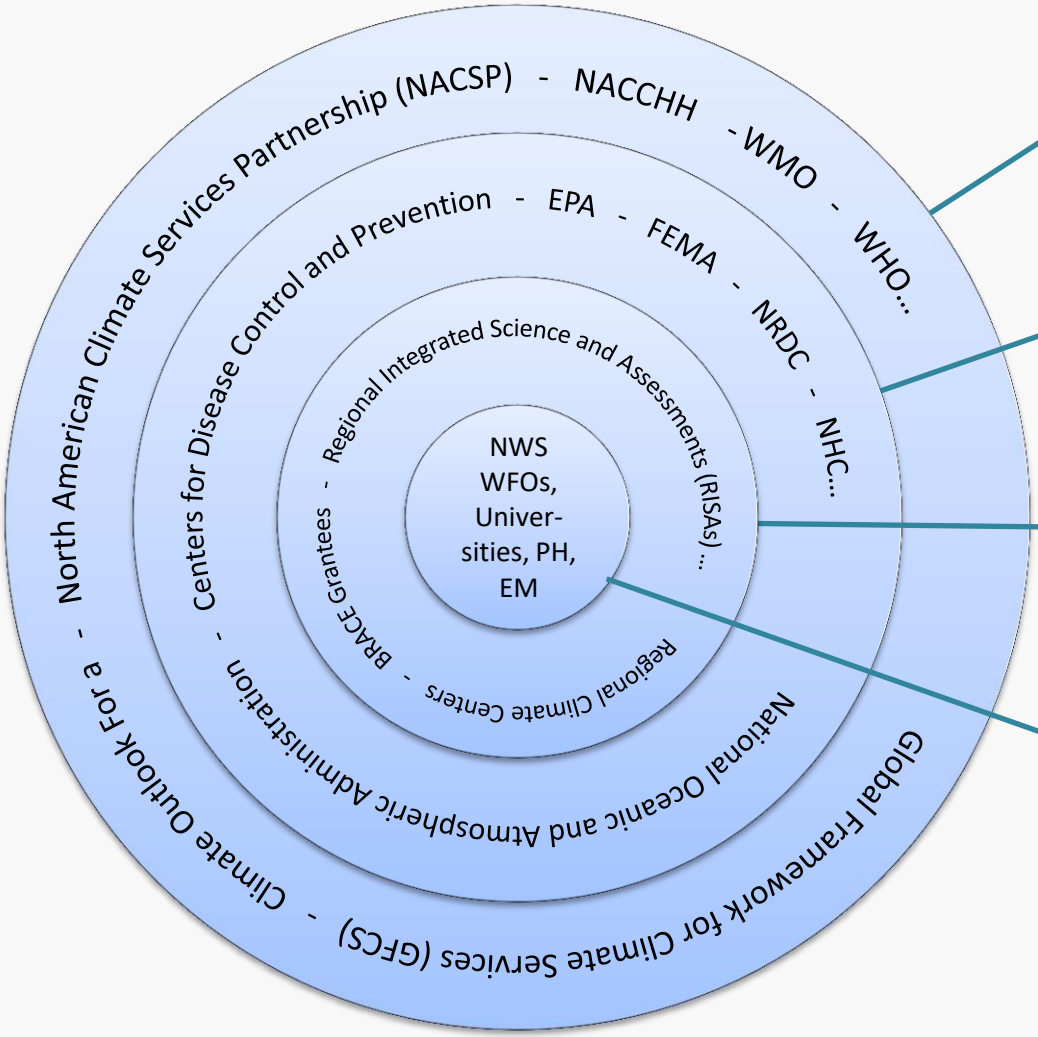


- **Customized climate information** is necessary to inform decisions.
- Information systems **define the demand** for this information, support **knowledge sharing**, and enhance forecasting capabilities.
- They improve understanding & communication of **options for responding to future risk**.

NIHHIS Framework: Network and Domestic Pilots

NIHHIS is a global network that integrates partners' knowledge, experience, and activities to effect a coordinated response to heat-health at many levels.

NIHHIS: Involvement of Partners at Every Level



International Network

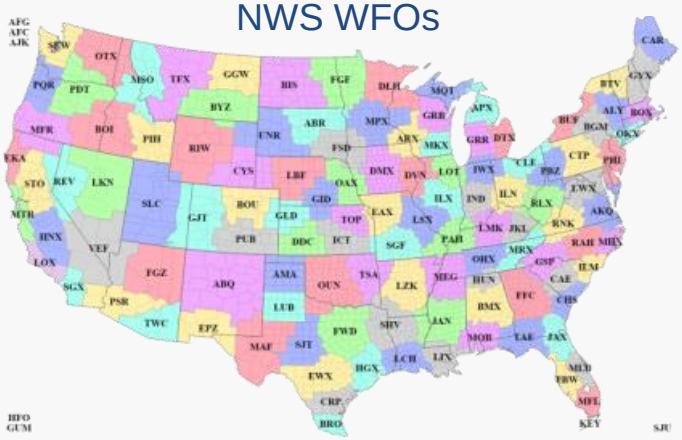
National

Regional Engagements

Local Pilots

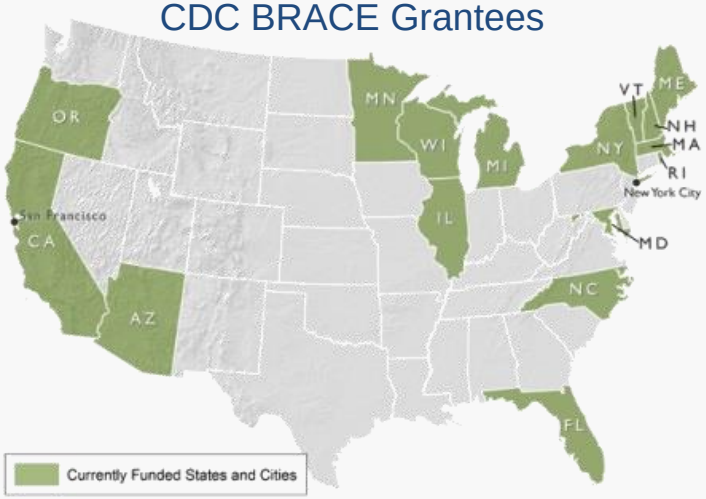
Regional NIHHIS Partners from US Agencies

NWS WFOs



NOAA RCSDs

CDC BRACE Grantees



Regional Integrated Science and Assessments Teams

NIHHIS: US Pilots and International Network

The NIHHIS Network is composed of international knowledge-sharing partnerships and U.S. local pilots, but all address shared questions.

NIHHIS Pilots Characteristics and Framework

Common Characteristics of NIHHIS Pilots

- Well defined heat-health problems or questions
- Institutional buy in and commitment.
- Capacity Building: climate and health data, human resources (time), funding, knowledge and training.
- A process for selecting and evaluating heat health parameters depending upon climate & vulnerability.

Framework

All domestic pilots address a shared set of questions in these categories:

Institutional Capacity and Partnerships	Data and Forecast Products
Heat Parameters and Health Outcomes	Engagement & Communication Strategies

NIHHIS Timeline

NIHHIS—Backbone for Executing the Heat Wave Implementation Plan of the Disaster Reduction Grand Challenge

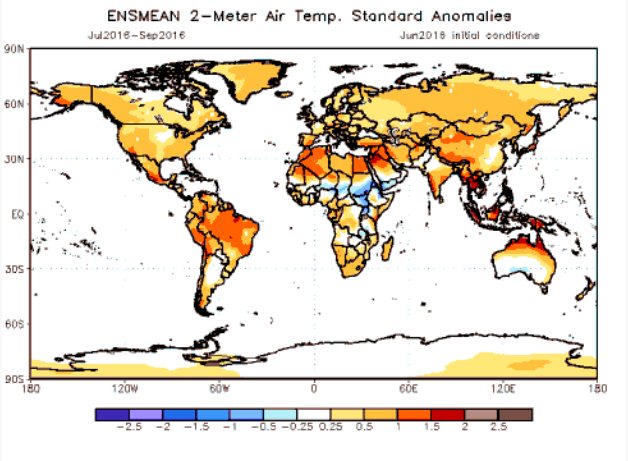
- White House NSTC Subcommittee on Disaster Reduction spun up a 2016 task force addressing the grand challenge.
- FEMA PrepareAthon's first Extreme Heat Week: 23-28 May 2016.
- Launch of NIHHIS web portal to share interagency resources and coordinate an integrated approach to resilience.
- Multi-agency webinar featuring OSTP Director Dr. John Holdren and several distinguished guests to discuss community resilience needs and approaches to protect the most vulnerable from extreme heat.
- At risk groups include: athletes, older adults, children, emergency responders, outdoor workers, and pets.

National Integrated Heat Health Information System (NIHHIS) Federal Partners

The Broader Perspective: From NIHHIS To GHHIN

NIHHIS and GHHIN weave together engagements to characterize demand, and existing capacities, to identify information needs and to develop useful weather and climate services.

- NIHHIS was launched by the White House in June of 2015, was designed to **inform decision makers in many sectors** including urban planning, design, construction, public health, emergency management, and energy.
- GHHIN was launched in June of 2016 to provide a **common framework**, similar to NIHHIS, to coordinate and facilitate **sustained partnership and knowledge sharing** on heat health globally. GHHIN is a global network that unites national investments in heat-health and **seeks synergies** across national systems.



- NIHHIS and GHHIN, support the Climate Services for Resilient Development (CSRD) partnership by developing an **international network of practitioners and information**.

NIHHIS and GHHIN will facilitate an integrated approach to providing a suite of decision support services to reduce heat related illness and death.

Weather-Scale Heat Health Systems Around the World

United States[Ψ]

- Local action prompted by NWS WFO alerts
- NWS WFOs Issue watch/advisory/warning; local agencies respond; CDC has Natl Env. Public Health Tracking Network
- Alerts issued at forecaster discretion; NWS issues guidance
- 72-hour lead time for heat watch;6-10 excessive heat outlook
- Trigger is Heat Index, max/min temp., or synoptic system

Canada[¥]

- City/Province level HARS (Heat Alert & Response Systems)
- Environment Canada issues Humidex fcast., high-low temps; Provincial Med. Officer of Health (MOH) administers
- Alert ultimately determined by MOH (Toronto)
- MOH issues extreme alert if 3 day duration exceeds thresholds
- Trigger is flexible: air temp, Humidex, air pollution, mortality

Japan[Δ]

- City-level systems & national forecasts
- Local departments of Crisis Management, Health Promotion, or Sports Associations coordinate the systems
- Alert thresholds vary by city
- Advanced warning varies, one example is 21 hours
- WBGT is monitored at schools, as well as air temperature

Germany*

- National system with county-level warnings
- Developed and operated by federal environment agency and weather service in conjunction with public health office
- Warnings are produced at the county level
- 6 day forecast of heat pre-info from federal level
- Trigger is heat load based on perceived temperature

Australia[Ω]

- State-level systems (Natl. req. for Heatwave Sub Plans)
- Dept. of Health owns system in Victoria; Emergency Operations owns system in New South Wales
- Alert threshold varies by forecast district (Victoria)
- 3-4 day advanced warning; 7 day forecast
- Trigger is average temperature $^{1}/_{2}$(max + min)

India[¤]

- City-level system; Ahmedabad Heat Action Plan in 2013
- Ahmedabad Municipal Corporation (AMC) Nodal Officer issues alerts, Indian Met Centre declares heat wave
- 40C max daily temp threshold in plains, 30C in hilly regions
- 7 day forecast
- Hybrid dynamical-statistical probabilistic temperature forecast

United Kingdom*

- National system with regional thresholds
- Dept. of health owns and operates system while Met Office forecasts
- Alert threshold >30C day temp & 15C overnight
- 2-3 days lead time for lowest alert levels
- Trigger is min and max temperature

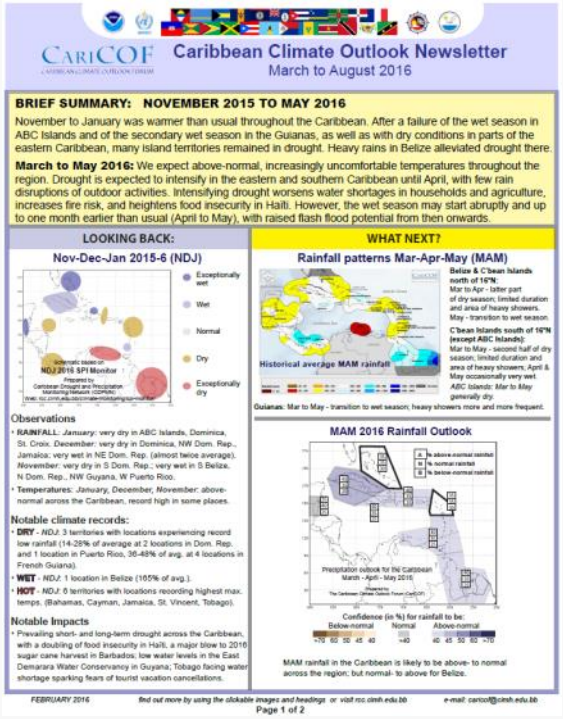
France*

- National system (SACS) with regional plans
- Health department issues plan and manages system while Meteo-France monitors and issues warnings
- Alert threshold regionally dependent
- 5 day forecast and 1 day alert lead time
- Trigger is min and max temperature; heat stress index

¥toronto.ca Ωhealth.vic.gov.au Δ*Martinez et al. 2011* Ψ*Hawkins & Brown 2015* ¤ *Knowlton et al. 2014* **Lowe et al. 2011*

Existing Regional Climate Outlooks: RGB

The CariCOF Climate Outlook is prepared by the Caribbean Institute for Meteorology and Hydrology with some regional Meteorological Services.



CariCOF
Caribbean Climate Outlook Newsletter
March to August 2016

BRIEF SUMMARY: NOVEMBER 2015 TO MAY 2016

November to January was warmer than usual throughout the Caribbean. After a failure of the wet season in ABC Islands and of the secondary wet season in the Guianas, as well as with dry conditions in parts of the eastern Caribbean, many island territories remained in drought. Heavy rains in Belize alleviated drought there.

March to May 2016: We expect above-normal, increasingly uncomfortable temperatures throughout the region. Drought is expected to intensify in the eastern and southern Caribbean until April, with few rain disruptions of outdoor activities. Intensifying drought worsens water shortages in households and agriculture, increases fire risk, and heightens food insecurity in Haiti. However, the wet season may start abruptly and up to one month earlier than usual (April to May), with raised flash flood potential from then onwards.

LOOKING BACK:

Nov-Dec-Jan 2015-6 (NDJ)

Observations

- **RAINFALL:** *January:* very dry in ABC Islands, Dominica, St. Croix. *December:* very dry in Dominica, NW Dom. Rep., Jamaica; very wet in NE Dom. Rep. (almost twice average). *November:* very dry in S Dom. Rep.; very wet in S Belize, N Dom. Rep., NW Guyana, W Puerto Rico.
- **Temperatures:** *January, December, November:* above-normal across the Caribbean, record high in some places.

Notable climate records:

- **DRY** - *NDJ:* 3 territories with locations experiencing record low rainfall (14-28% of average at 2 locations in Dom. Rep. and 1 location in Puerto Rico, 36-48% of avg. at 4 locations in French Guiana).
- **WET** - *NDJ:* 1 location in Belize (165% of avg.).
- **HOT** - *NDJ:* 6 territories with locations recording highest max. temps. (Bahamas, Cayman, Jamaica, St. Vincent, Tobago).

Notable Impacts

- Prevailing short- and long-term drought across the Caribbean, with a doubling of food insecurity in Haiti, a major blow to 2016 sugar cane harvest in Barbados; low water levels in the East Demarara Water Conservancy in Guyana; Tobago facing water shortage sparking fears of tourist vacation cancellations.

WHAT NEXT?

Rainfall patterns Mar-Apr-May (MAM)

Historical average MAM rainfall

Belize & C'bean Islands north of 16°N: Mar to Apr - latter part of dry season; limited duration and area of heavy showers. May - transition to wet season.

C'bean Islands south of 16°N (except ABC Islands): Mar to May - second half of dry season, limited duration and area of heavy showers; April & May occasionally very wet. *ABC Islands: Mar to May* generally dry.

Guianas: Mar to May - transition to wet season; heavy showers more and more frequent.

MAM 2016 Rainfall Outlook

Precipitation outlook for the Caribbean March - April - May 2016

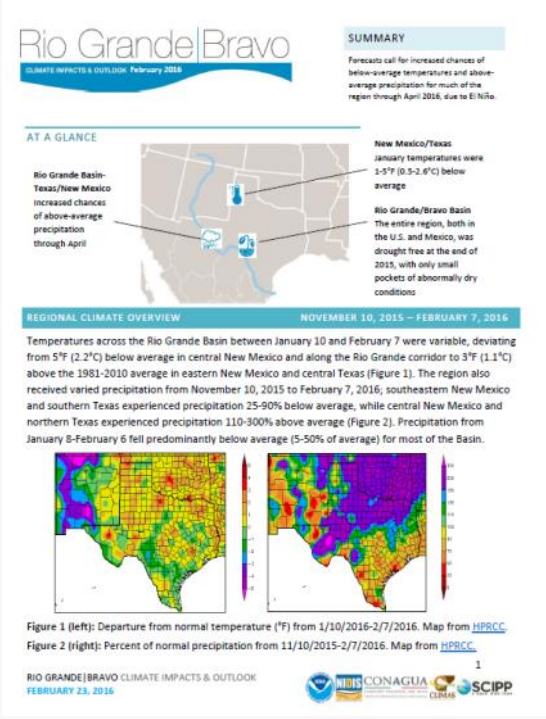
Confidence (in %) for rainfall to be: Below-normal | Normal | Above-normal

MAM rainfall in the Caribbean is likely to be above- to normal across the region; but normal- to above for Belize.

FEBRUARY 2016 find out more by using the clickable images and headings or visit rsc.cimh.edu.bb e-mail: caricof@cimh.edu.bb

Page 1 of 2

The RGB Climate Impacts & Outlook newsletter is produced monthly via CLIMAS and the NACSP.



Rio Grande|Bravo

CLIMATE IMPACTS & OUTLOOK February 2016

SUMMARY

Forecasts call for increased chances of below-average temperatures and above-average precipitation for much of the region through April 2016, due to El Niño.

AT A GLANCE

Rio Grande Basin-Texas/New Mexico increased chances of above-average precipitation through April

New Mexico/Texas January temperatures were 1-5°F (0.5-2.6°C) below average

Rio Grande/Bravo Basin The entire region, both in the U.S. and Mexico, was drought free at the end of 2015, with only small pockets of abnormally dry conditions

REGIONAL CLIMATE OVERVIEW NOVEMBER 10, 2015 – FEBRUARY 7, 2016

Temperatures across the Rio Grande Basin between January 10 and February 7 were variable, deviating from 5°F (2.2°C) below average in central New Mexico and along the Rio Grande corridor to 3°F (1.1°C) above the 1981-2010 average in eastern New Mexico and central Texas (Figure 1). The region also received varied precipitation from November 10, 2015 to February 7, 2016; southeastern New Mexico and southern Texas experienced precipitation 25-90% below average, while central New Mexico and northern Texas experienced precipitation 110-300% above average (Figure 2). Precipitation from January 8-February 6 fell predominantly below average (5-50% of average) for most of the Basin.

Figure 1 (left): Departure from normal temperature (°F) from 1/10/2016-2/7/2016. Map from HPRCC.

Figure 2 (right): Percent of normal precipitation from 11/10/2015-2/7/2016. Map from HPRCC.

RIO GRANDE|BRAVO CLIMATE IMPACTS & OUTLOOK
FEBRUARY 23, 2016

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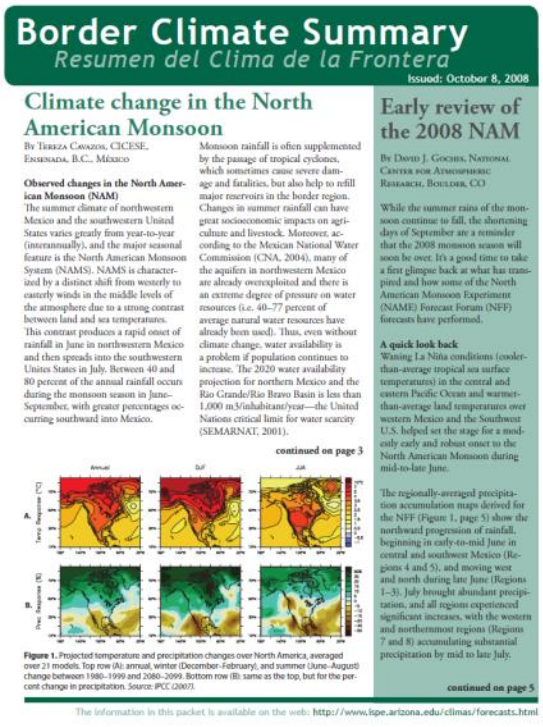
The Border Climate Summary was produced monthly in '08 and '09 by Gregg Garfin via CLIMAS with IAI and SARP funding.



Border Climate Summary
Resumen del Clima de la Frontera

Issued: October 8, 2008

Climate change in the North American Monsoon

By Teresa Cavazos, CICESE, Ensenada, B.C., México

Observed changes in the North American Monsoon (NAM)

The summer climate of northwestern Mexico and the southwestern United States varies greatly from year-to-year (interannually), and the major seasonal feature is the North American Monsoon System (NAMS). NAMS is characterized by a distinct shift from westerly to easterly winds in the middle levels of the atmosphere due to a strong contrast between land and sea temperatures. This contrast produces a rapid onset of rainfall in June in northwestern Mexico and then spreads into the southwestern Unites States in July. Between 40 and 80 percent of the annual rainfall occurs during the monsoon season in June–September, with greater percentages occurring southward into Mexico.

Monsoon rainfall is often supplemented by the passage of tropical cyclones, which sometimes cause severe damage and fatalities, but also help to refill major reservoirs in the border region. Changes in summer rainfall can have great socioeconomic impacts on agriculture and livestock. Moreover, according to the Mexican National Water Commission (CNA, 2004), many of the aquifers in northwestern Mexico are already overexploited and there is an extreme degree of pressure on water resources (i.e. 40–77 percent of average natural water resources have already been used). Thus, even without climate change, water availability is a problem if population continues to increase. The 2020 water availability projection for northern Mexico and the Rio Grande/Rio Bravo Basin is less than 1,000 m3/inhabitant/year—the United Nations critical limit for water scarcity (SEMARNAT, 2001).

continued on page 3

Figure 1. Projected temperature and precipitation changes over North America, averaged over 21 models. Top row (A): annual, winter (December–February), and summer (June–August) change between 1980–1999 and 2080–2099. Bottom row (B): same as the top, but for the percent change in precipitation. *Source: IPCC (2007).*

Early review of the 2008 NAM

By David J. Gochis, National Center for Atmospheric Research, Boulder, CO

While the summer rains of the monsoon continue to fall, the shortening days of September are a reminder that the 2008 monsoon season will soon be over. It's a good time to take a first glimpse back at what has transpired and how some of the North American Monsoon Experiment (NAME) Forecast Forum (NFF) forecasts have performed.

A quick look back

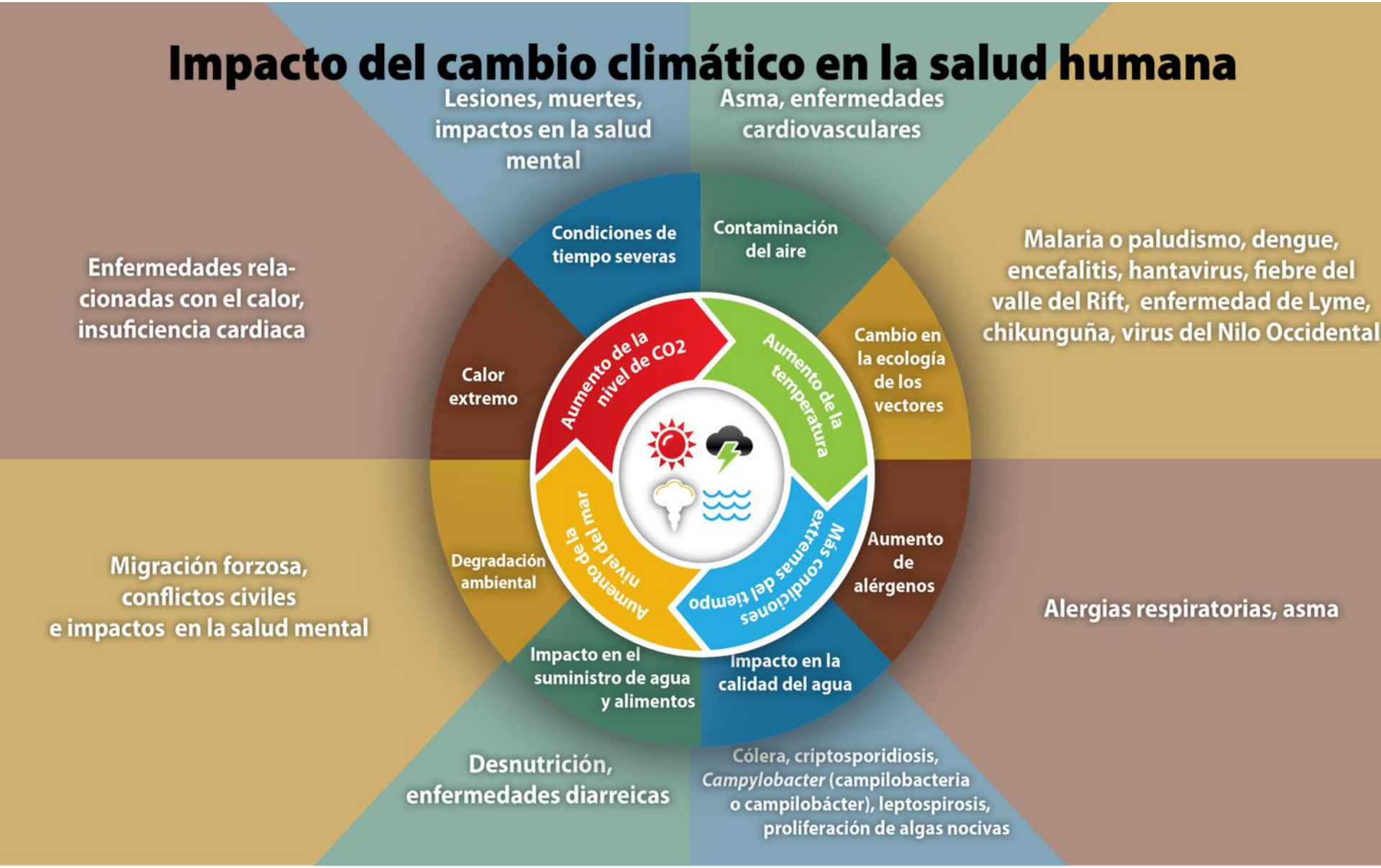
Waning La Niña conditions (cooler-than-average tropical sea surface temperatures) in the central and eastern Pacific Ocean and warmer-than-average land temperatures over western Mexico and the Southwest U.S. helped set the stage for a modestly early and robust onset to the North American Monsoon during mid-to-late June.

The regionally-averaged precipitation accumulation maps derived for the NFF (Figure 1, page 5) show the northward progression of rainfall, beginning in early-to-mid June in central and southwest Mexico (Regions 4 and 5), and moving west and north during late June (Regions 1–3). July brought abundant precipitation, and all regions experienced significant increases, with the western and northernmost regions (Regions 7 and 8) accumulating substantial precipitation by mid to late July.

continued on page 5

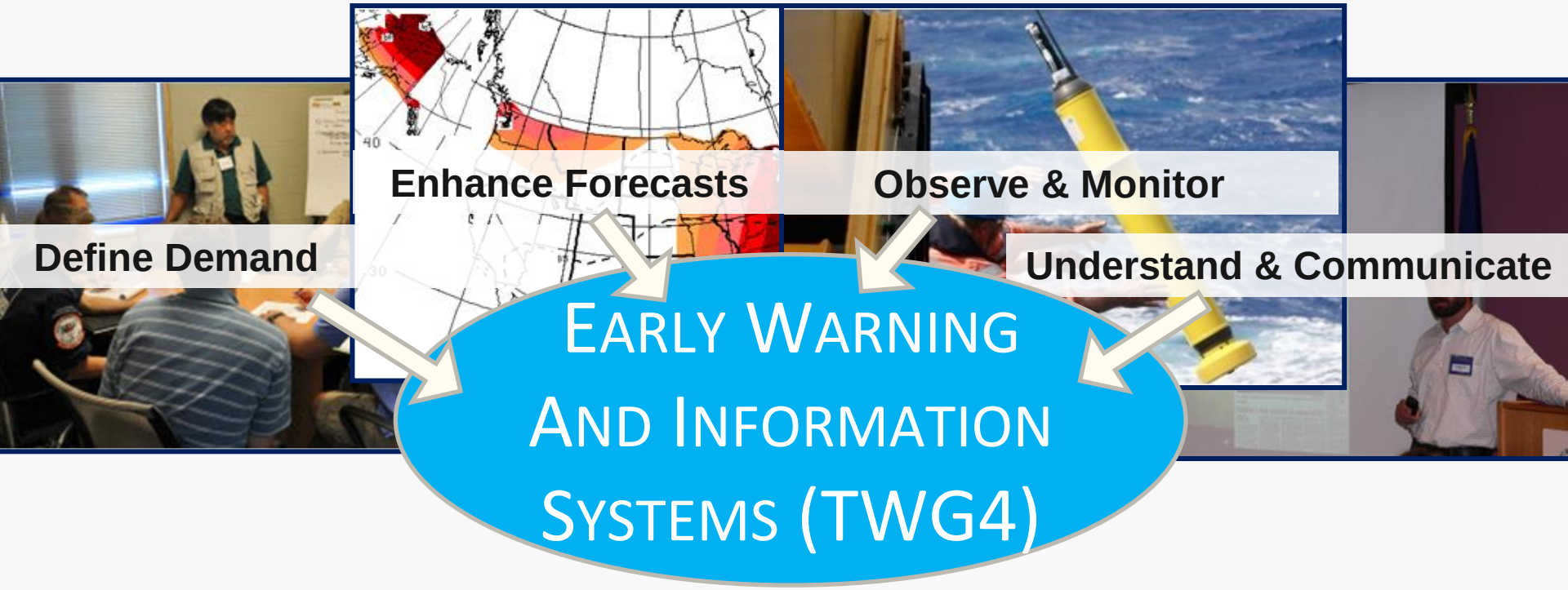
The information in this packet is available on the web: http://www.ispe.arizona.edu/climas/forecasts.html

Impacto del cambio climático en la salud humana



The NACSP

Information Systems Inform Climate **Preparedness** & **Resilience**



- **Customized climate information** is necessary to inform decisions.
- Information systems **define the demand** for this information, support **knowledge sharing**, and enhance forecasting capabilities.
- They improve understanding & communication of **options for responding to future risk**.

Define Demand

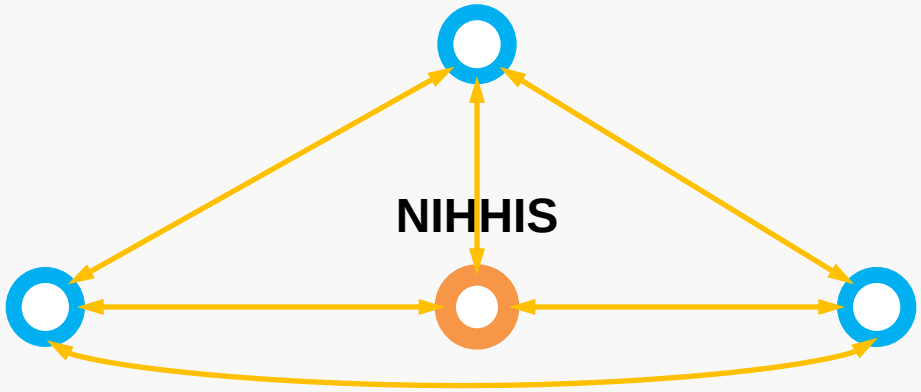
NIHHIS partners sustain continuous engagement between climate, health, and other communities to identify needs, evaluate solutions, and inform decisions.

Monsoon climate and a well established response mechanism for emergent heat, but vulnerable to heat-related water and energy shocks.

El Paso, USA

Monsoon climate with frequent extreme heat days and a relatively early heat season. At risk slum communities and in need of easy interventions to reduce heat exposure in home and healthcare settings.

Ahmedabad, India



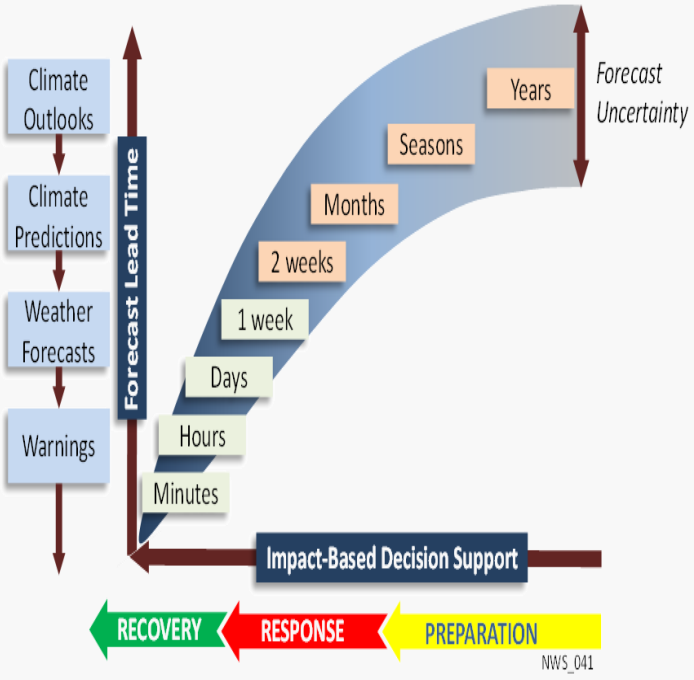
Highly humid tropical/ equatorial climate with low variability in temperature, but also affected by monsoons. Highly urbanized.

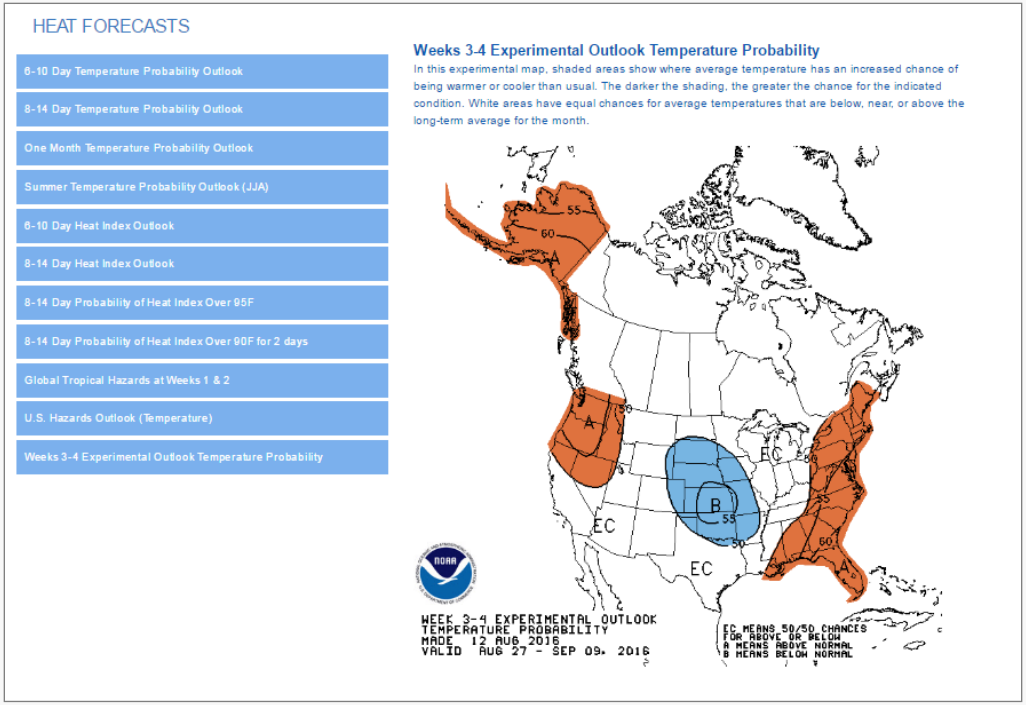
Singapore

Local engagements in the US and Globally are helping us understand needs – both unique and shared – and fostering shared solutions.

Enhance Forecasts

NIHHIS partners work to enhance current heat forecasts based on user needs and epidemiological requirements, extending projections from weeks to months and beyond.

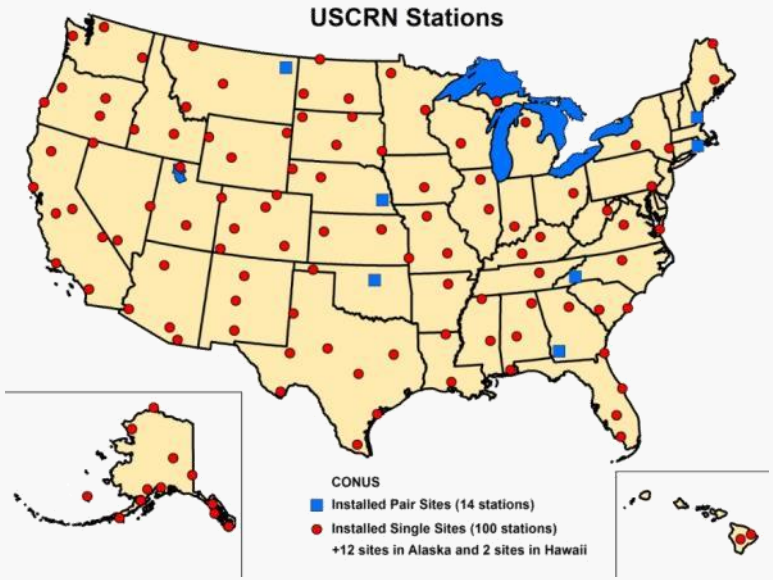


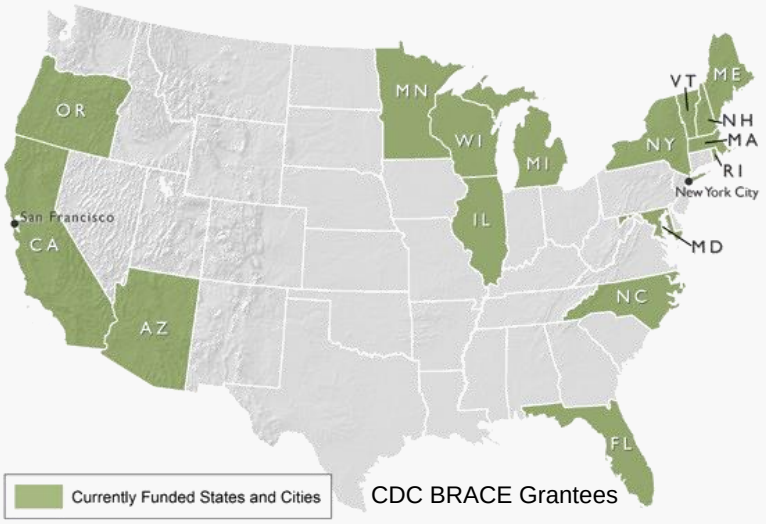


Investments in foundational science, observations, and applied science are targeted to improve heat-health information and predictions.

Observe & Monitor

NIHHIS partners work to sustain Earth observations and biosurveillance in support of improved understanding of the role of climate on extreme heat and health, and to enhance operational efforts.

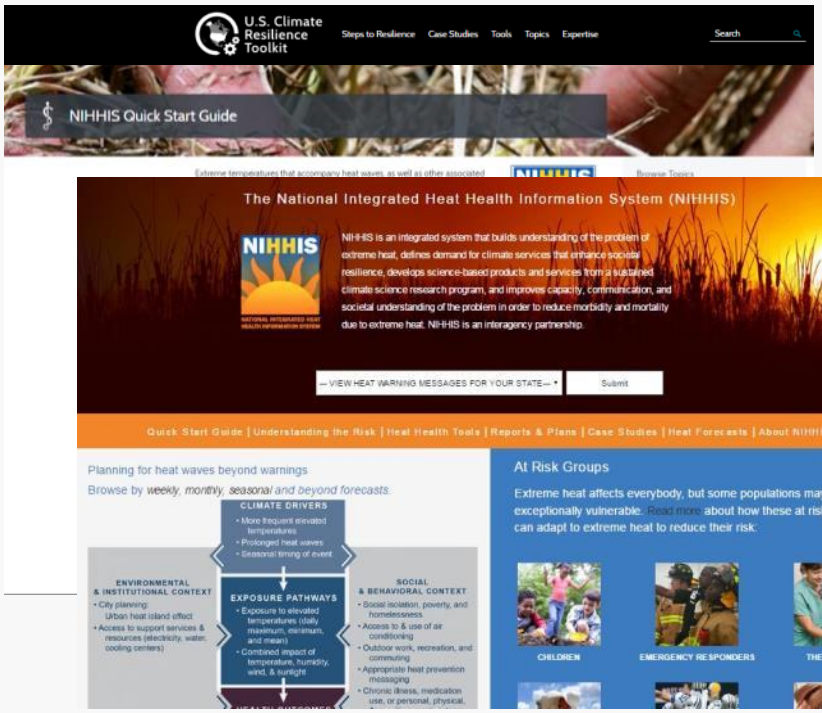




Physical climate observations, coupled with epidemiological surveillance, can improve understanding of connections between heat and health.

Understand and Communicate

NIHHIS partners enhance understanding of the impact of extreme heat events across time scales, build capacity across climate and public health communities, and develop timely and accessible communication tools to inform preparedness and adaptation.

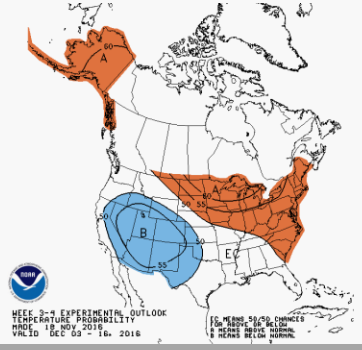


The NIHHIS Web Portal consolidates heat-health resources, and the quick start guide helps decision makers get the right information quickly.

The National Integrated Heat Health Information System (NIHHIS)

Informing Resilience Decision-making by Understanding Needs

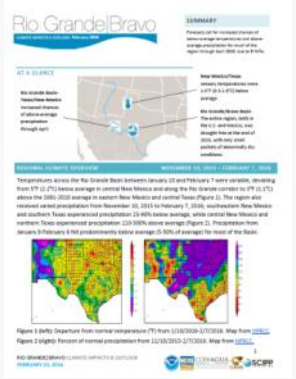
Regional Pilots cultivate an understanding of decision-making contexts



Targeted Research Improves Observations, Monitoring, Forecasting

Integrated Information Systems build relationships between those who need to make climate-informed decisions, and those who can provide climate knowledge.

Informing Planning and Policy



North American Extreme Heat Outlooks

South Asia Climate Outlook Forum