

*Linkages in the hazards, and in information systems to manage risk*

# Heat and Drought

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**NATIONAL  
INTEGRATED  
DROUGHT  
INFORMATION  
SYSTEM**



**NATIONAL  
INTEGRATED  
HEAT HEALTH  
INFORMATION  
SYSTEM**

# Selected Significant Climate Anomalies and Events

## June 2018

### GLOBAL AVERAGE TEMPERATURE

June 2018 average global land and ocean temperature was the fifth highest for June since records began in 1880.

### ARCTIC SEA ICE EXTENT

June 2018 sea ice extent was 9.0 percent below the 1981–2010 average—the fourth smallest June sea ice extent since satellite records began in 1979.

### ASIA

Record warm temperatures were observed across much of central Russia. Overall, Asia had its seventh highest June temperature on record.

### NORTH AMERICA

June 2018 ranked as the sixth warmest June since continental records began in 1910. The contiguous U.S. had its third highest June temperature since national records began in 1895.

### HURRICANE BUD

(June 9–15, 2018)

Maximum winds - 215 km/h  
The second major hurricane in the Eastern North Pacific Hurricane basin in 2018. Bud brought heavy rain and floods to northern Mexico and parts of the southwestern contiguous U.S.

### EUROPE

Europe had its highest June temperature since 2003. Several European countries had a June temperature that ranked among the six warmest Junes on record.

### AFRICA

Africa had its fourth highest June temperature since 1910.

### OMAN

Oman recorded its highest minimum temperature on June 26 when temperatures only dropped to 42.6°C (108.7°F) in Quriyat.

### SOUTH AMERICA

Warmer-than-average temperatures were present in the northern half of South America, while southern South America had near- to cooler-than-average conditions during June 2018. Averaged as a whole, South America had its smallest June temperature departure from average since 2008.

### ANTARCTIC SEA ICE EXTENT

June 2018 sea ice extent was 3.8 percent below the 1981–2010 average—the eighth smallest June sea ice extent on record.

### AUSTRALIA

Drier-than-average conditions were present across much of Australia. Regionally, Northern Territory had the most notable precipitation deficit at 90% below average.

National Centers for Environmental Information

Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <http://www.ncdc.noaa.gov/sotc>



# Extreme Heat's Health Impacts



## Health Impacts

- Discomfort
- Workplace heat stress illness
- Long-term effects such as CKD
- Psychological distress
- Exacerbation of preexisting chronic conditions (asthma)
- Heat exhaustion
- Heat cramps
- Heat stroke
- Death

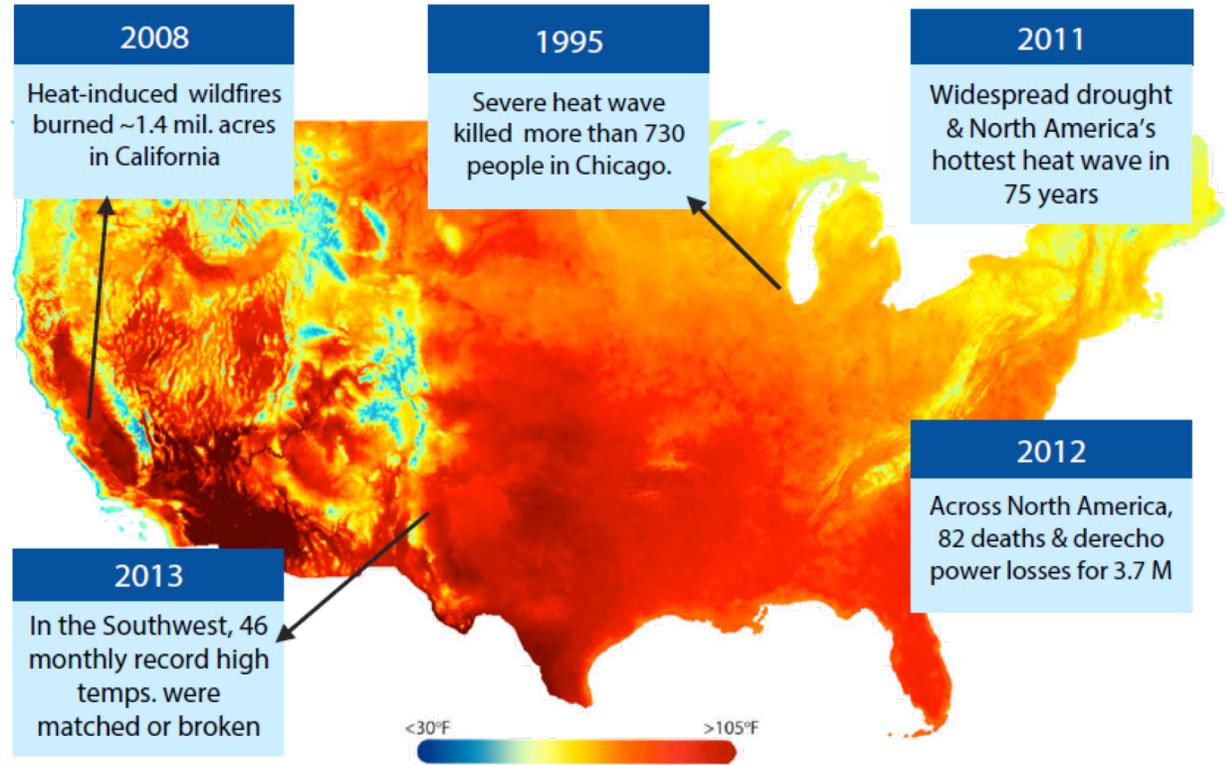


## Related Impacts

- Infrastructure: electricity, water, transportation
- Economy: labor productivity, agricultural output, tourism

Decision makers need information at different timescales, and have different risk tolerances and capacity to respond.

Decisions must be made in many disciplines to protect humans from extreme heat's health consequences

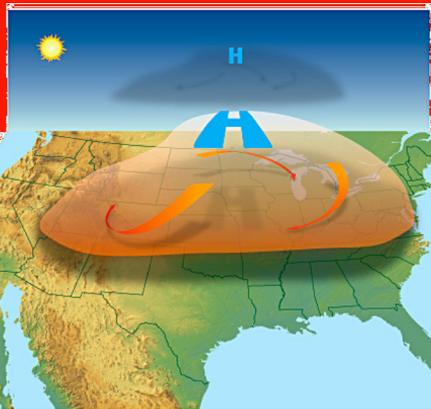


The base map shows projected average maximum temperatures for July 2030 in degrees Fahrenheit under a low emissions scenario (best case scenario). Call out boxes detail devastating effects of past heat waves across the country.

- Local health departments
- Utilities / Energy
- Emergency Management
- Resilience/Sustainability Offices
- Weather Forecast Offices
- Hospitals
- School districts

## Heat-Drought Dynamics

# Hazard Linkages



- “...**positive feedback** between atmospheric circulation, surface warming, and soil dryness” (Wang et al., 2019)
- “Anomalous persistent high with anti-cyclonic flow, supplemented with clear skies and depleted soil moisture are primarily responsible for the occurrence of heat waves over India.” (Rohini et al., 2016)
- “Regions where SM most impacts the atmosphere are **transitional zones** between dry and wet climates.”  
“...the impact of **soil moisture persistence** in the interactive simulations ... amounts to ca. 5–10% of the spell lengths of the 10% hottest days in the respective simulations” (Lorenz et al., 2010)
- “Simulations indicate that **without soil moisture anomalies** the summer **heat anomalies could have been reduced by around 40%** in some regions [of Europe].” (Fischer and Seneviratne, 2007)

## Case Study

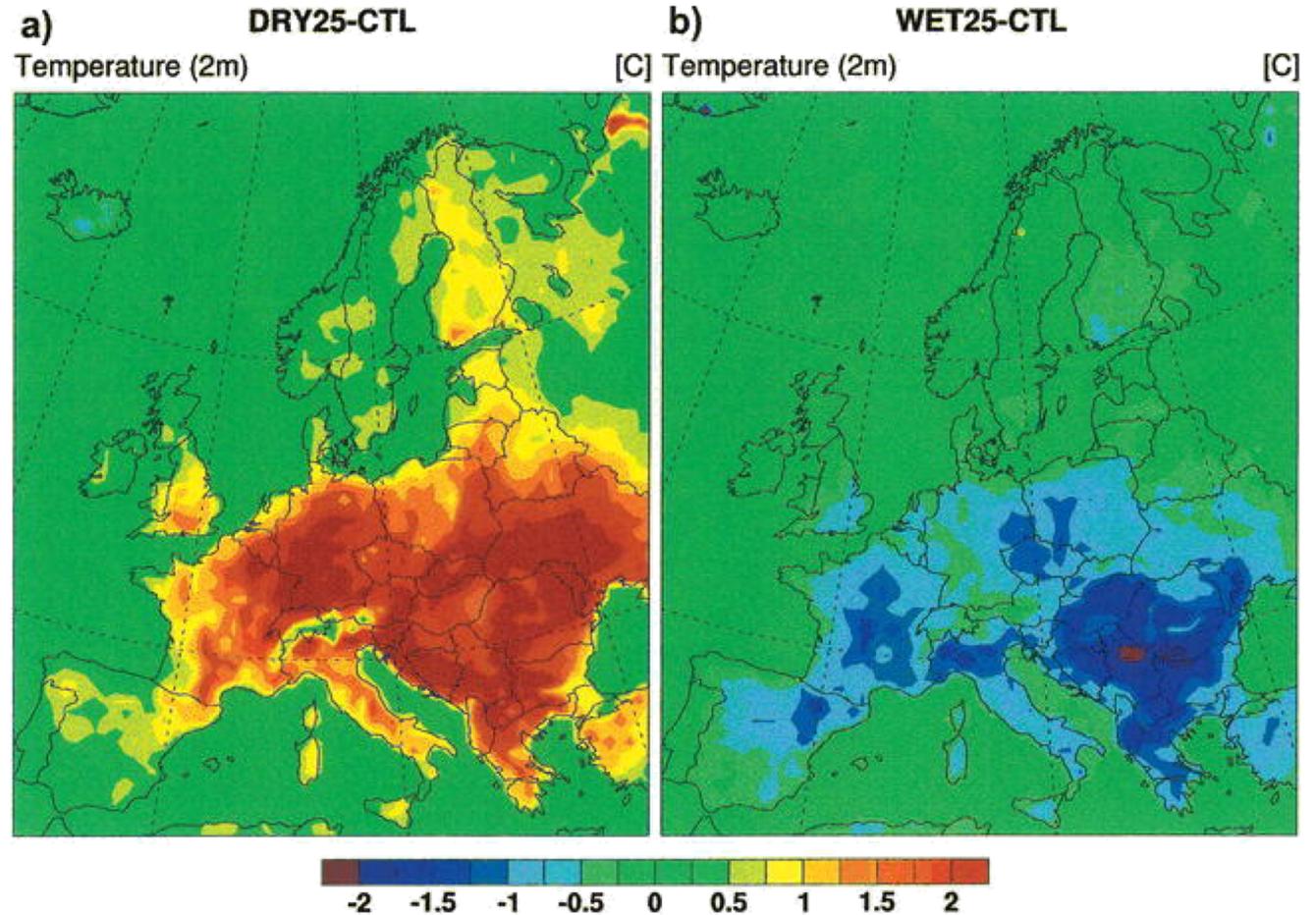
# The European Heat Wave of 2003



- Extreme heat persisted from ~June – August 2003 with temperatures reaching 114.8 °F in Italy, and eight consecutive days of temps exceeding 104 °F in parts of France.
- 35,000 to 70,000 + deaths were estimated from the event, though the exact count is unknown.
- The heat wave and high death toll was attributed to many factors including social isolation, lack of A/C, infrastructure failure, urban heat island, and **drought-enhanced temperatures**.
- Temperatures in Europe were exacerbated by a lack of soil moisture preceding the event, which not increased surface temperatures by **reducing latent cooling**, but also reinforced **anti-cyclonic ridging**, keeping the oppressive weather pattern in place. (Fisher et al., 2007)
- “The return time of a summer as hot as in 2003... has decreased from thousands of years to tens or hundreds of years (best estimate of 127 years).” (Christidis et al., 2015)

## Case Study

# The European Heat Wave of 2003



- **FIG. 7.** Summer 2003 temperature anomaly due to spring soil moisture perturbation in (a) DRY25 – CTL and (b) WET25 – CTL.

▪ Fischer and Seneviratne, 2007

## Case Study

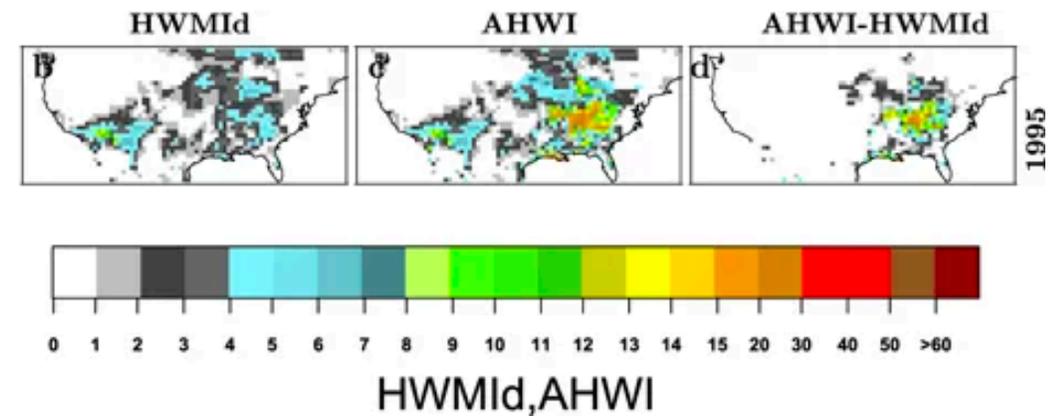
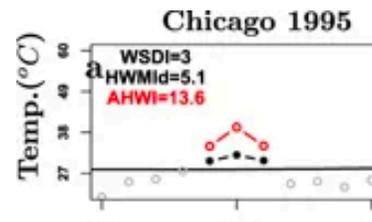
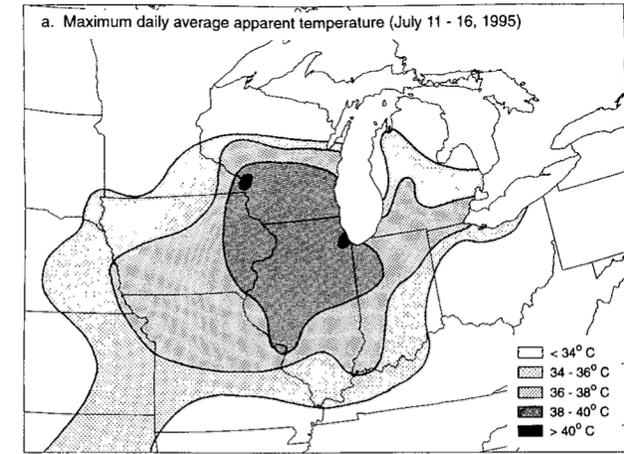
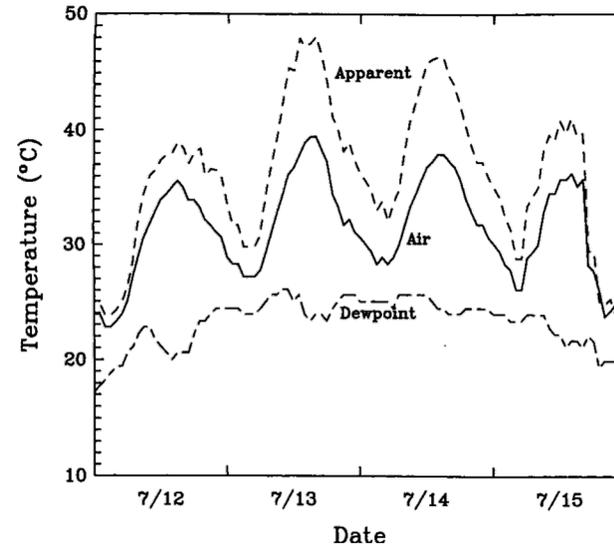
# The Chicago Heat Wave of 2005



- Extreme heat persisted from ~12 – 16 July 2005 with the hottest temperature recorded 106 °F on July 13.
- > 700 deaths were estimated from the event, though the exact count is unknown.
- The heat wave and high death toll were attributed to many factors including social isolation, lack of A/C, infrastructure failure (hospitals, electricity, ambulances, morgues), urban heat island, and high humidity.
- The increased humidity (apparent temperature) has been attributed to increased soil moisture due to the abundance of corn and soybean farming in the Midwest. (Kunkel et al., 1996; Changnon et al., 2003)
- The number of days in Chicago exceeding 100 °F is predicted to increase to  $33 \pm 30$  according to the NCA4 analysis by CICS. (<https://ncics.org/report-landing-page/nca4-data/>)

## Case Study

# The Chicago Heat Wave of 2005



- **ABOVE:** MAX DAILY AVG APPARENT TEMP 11-16 JULY 1995 (Kunkel et al., 1996)
- **BELOW:** Historical heat waves and humid heat waves across world regions with different climates and their HWMId (Heat Wave Magnitude Index daily) and AHWI (Apparent Heat Wave Index) spatial distribution. (Russo et al., 2017)

# Research Needs

- **Research Needs**
  - Investigating the connection between soil moisture memory and heat wave persistence and predictability. (Lorenz et al., 2010)
  - Improved observing and monitoring systems for soil moisture to improve estimation of soil moisture memory. Quantification of soil moisture memory requires long-term records, which are not globally available. (Koster and Suarez 2002)
  - More research is needed into summer droughts to understand the role of interactive vegetation and land use. (Zampiere et al., 2009)

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



## Background

- NOAA and CDC launched the National Integrated Heat Health Information System (NIHHIS) in June of 2015 to address heat across timescales
- NIHHIS quickly grew to include representation from several agencies (right) in an interagency working group. The group launched the [NIHHIS portal](#) and began harmonizing information and guidance.
- NIHHIS has also launched regional, trans-boundary pilots to understand local decision-making contexts and needs, and to improve the information.

## Ongoing activities:

- Expanding border health network in the south,
- ‘[Decision calendar](#)’ exercises to understand multi-disciplinary needs in the Northeast,
- National projects to improve the utility of information such as [Urban Heat Island campaigns](#).

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

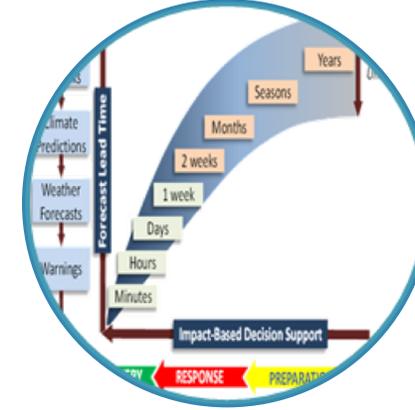




**Define demand by building relationships to understand local context**



**Co-develop inter-disciplinary decision calendars, prototypes, requirements**



**Integrate information across timescales and disciplines**



**Foster inter-agency, NGO, and private sector involvement**



**Co-learning, sharing best practices, and sharing information**

**Build Capacity, Inform Decisions, Encourage Risk-Reducing Actions**

# NIHHIS Core Questions

## Institutional Capacity & Partnerships

- What institutional partners have you engaged to help define the needs (esp. bridging disciplines: health, env. science, emergency management); is that sustainable and if so, how and why?

## Heat Parameters & Health Outcomes

- What heat parameters (tmax, tmin, heat index, etc) are most important for which specific population and in what geographic conditions?

## Data and Forecast Products

- What data and forecast products, indicators, surveillance, and monitoring is needed (at what spatial and temporal resolution & lead time) and what is currently being used by practitioners to make decisions?

## Engagement and Communication Strategies

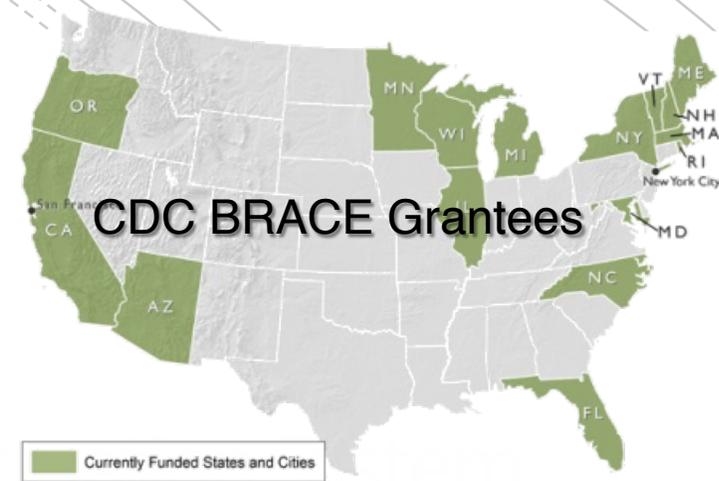
- What communication strategies are most effective both during an event and for long lead time planning (seasonal outlooks)?

## Interventions and Effectiveness

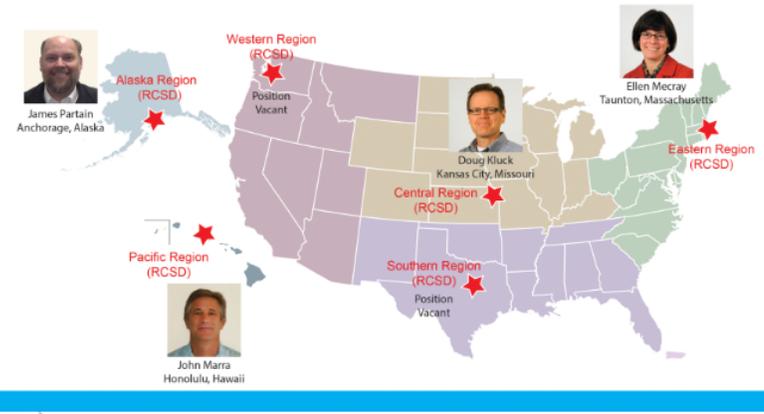
- What health interventions are currently being employed in managing heat risk and at what timescales?
- Are these interventions successful, and to what extent to they depend on local context & capacity?

All NIHHIS engagements are used to understand the answers to these core questions – as well as how and why those answers change given local context.

# Building user engagement via other networks

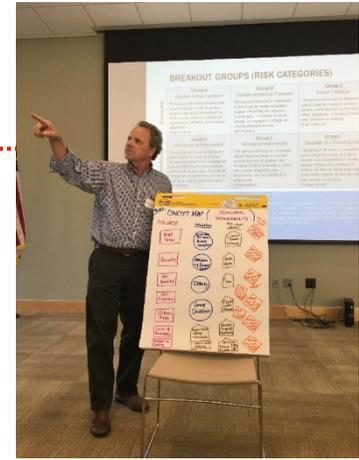


## NOAA's Regional Climate Services Directors



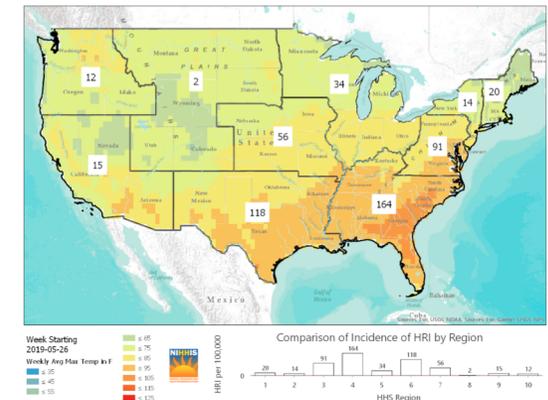
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# Defining Local Context and Understanding Sector-based Decisions

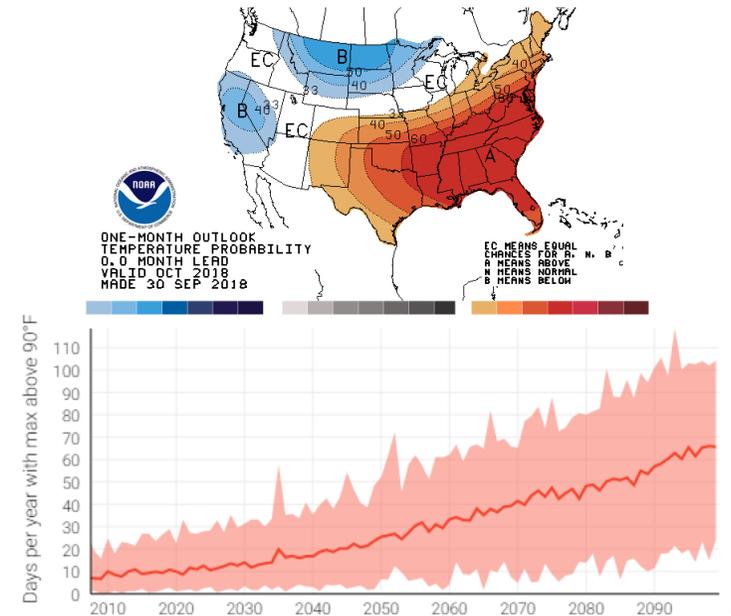
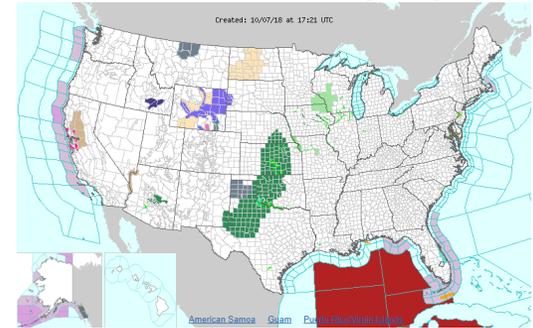
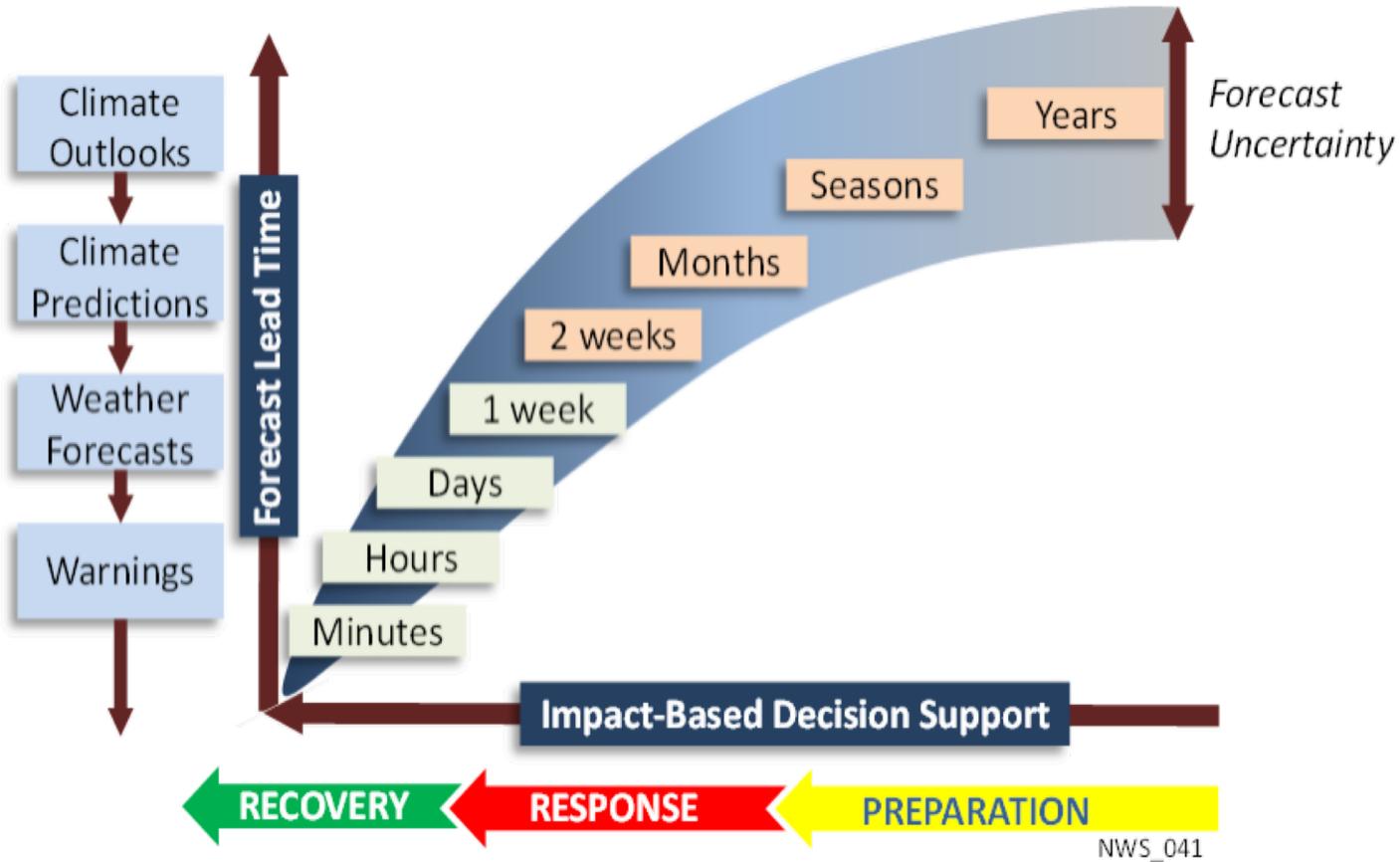


## Engagement through Pilots, Decision Calendars, and Prototyping

- Hold multi-disciplinary decision calendar development workshops in communities.
- Compare and refine discipline or decision domain specific decision calendars with other communities and using prototypes.
- Iterate to understand information needs and elucidate requirements for research & ops.

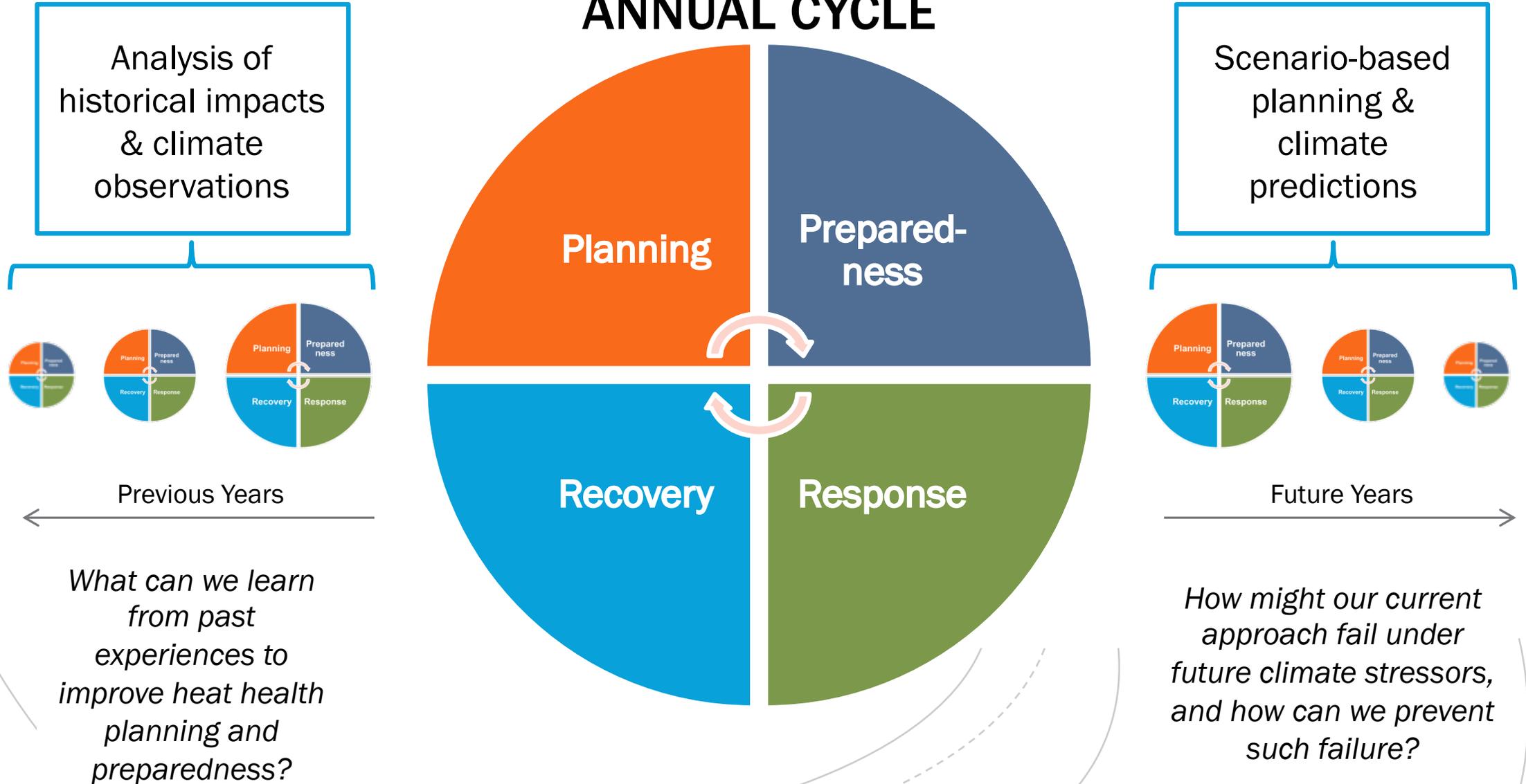


# Environmental Information at All Timescales

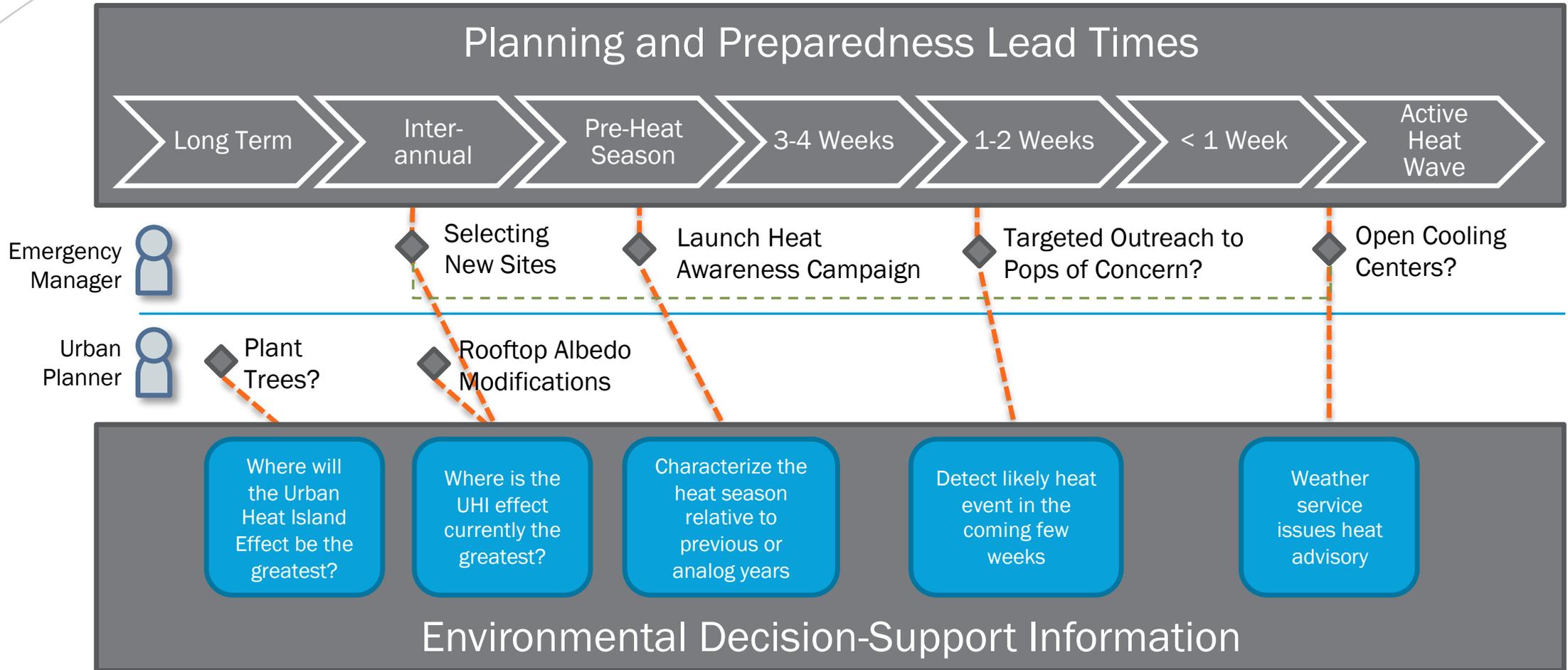


Decision calendars document information needs at all timescales. While NOAA offers environmental information at all timescales, it may not be prepared in the form necessary for certain discipline & decisions.

# HEAT HEALTH RISK MANAGEMENT ANNUAL CYCLE



# Decision Calendars



Decision calendars are a framework to organize information about user context in decision-making. They document what needs to be known when, by whom, and with what certainty in order to take actions to reduce heat health risk.

Thank you  
for listening



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## BAMS MEETING SUMMARY

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BAMS-D-19-0042.1](https://dx.doi.org/10.1175/BAMS-D-19-0042.1)

## LEARN MORE

### NIHHIS

- [cpo.noaa.gov/nihhis](https://cpo.noaa.gov/nihhis)
- [climate.gov/nihhis](https://climate.gov/nihhis)

### NIHHIS NE Materials

- [https://github.com/  
hunterjonesm/NIHHIS-  
Northeast](https://github.com/hunterjonesm/NIHHIS-Northeast)

### GHHIN

- <https://ghhin.org>

# UNDERSTANDING DECISION CONTEXT TO IMPROVE HEAT HEALTH INFORMATION

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