# Climate and Heat Health Task Force

## Data and Research

January 11, 2022

Hosted by The Miami Foundation

# Agenda

1. Overview Presentation 10:30-10:50
   - Outline and Data Layers of ArcGIS StoryMap
   - Heat Vulnerability Assessment
   - Heat Wave Ranking & Warning Advisory Systems
   - Heat Exposure at home, workplace, urban heat islands

2. Breakout Sessions 10:50 - 11:50

3. Breakout group summaries 11:50 - 12:00

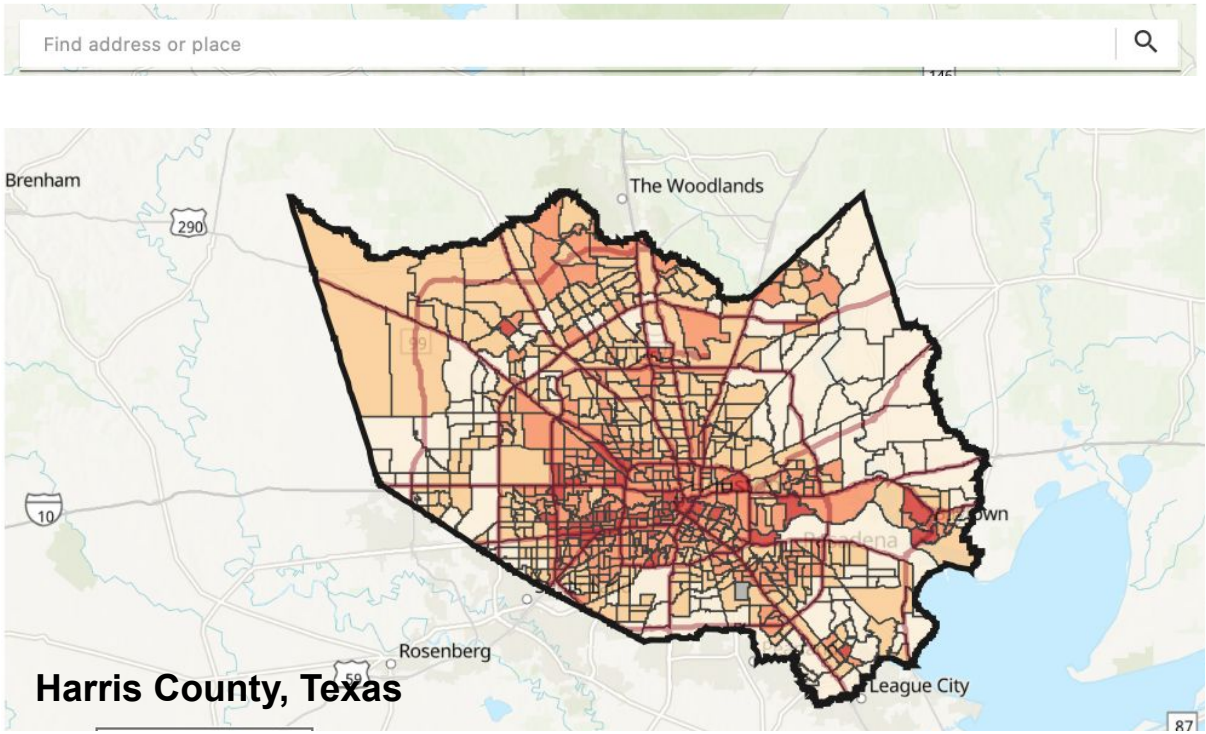
**EXTREME HEAT**

**accelerate & coordinate efforts**

# Heat Vulnerability Mapping Example

## Identifying Vulnerable Areas

The map below depicts the overall vulnerability for extreme heat and health throughout Harris County. Click on the map for an interactive look at all of the indicators. **Click here to open this map in a new tab.**

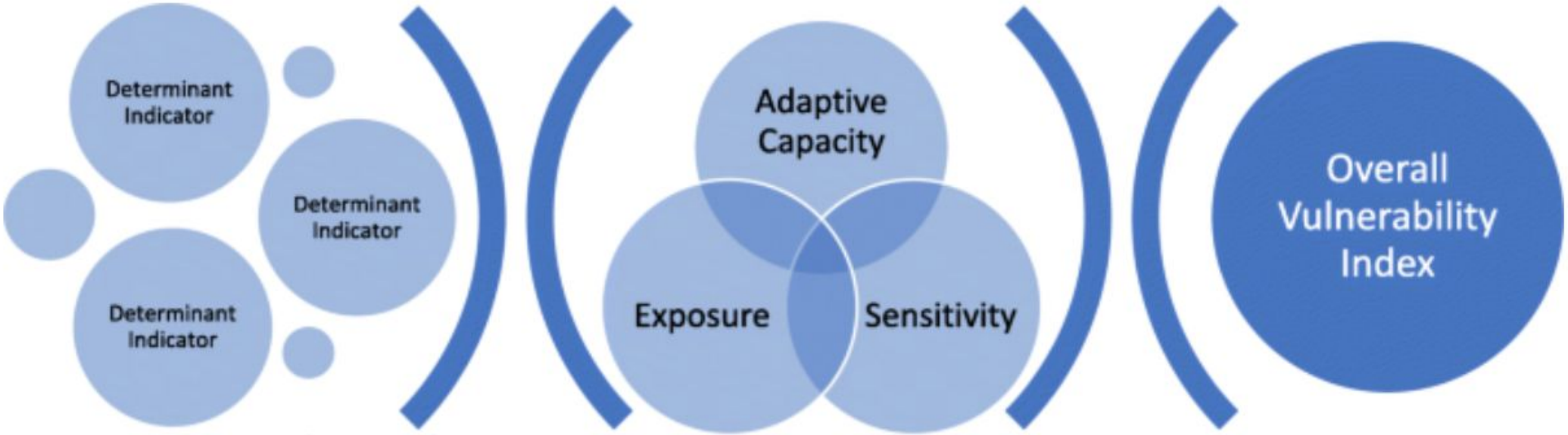



https://publichealth.harriscountytx.gov/Services-Programs/All-Programs/Built-Environment-BE-Program/Climate-Program/Climate-and-Health-Vulnerability-Assessments/Extreme-Heat-Vulnerability-Assessment

## Vulnerability Indicator Categories

| Exposure | Sensitivity | Adaptive Capacity |
|---|---|---|
| Heat Index* | Diabetes | Household air conditioning |
| Night-time cooling | Cardiovascular diseases | Distance to cooling center |
| | Respiratory conditions | Tree canopy coverage |
| | Households living below poverty line | |
| | 65+ years of age | |
| | Less than 5 years of age | |
| | Limited English proficiency | |
| | Outdoor workers | |
| | Population of Color | |
| | No health insurance | |
| | People with disabilities | |

# Heat Vulnerability Assessment




**Step 1:** Run PCA to choose and reduce determinants with multiple indicators within each of the three (Exposure, Adaptive Capacity, Sensitivity) indices.

**Step 2:** Run PCA to identify weights of different determinants within each category and sum the scores to create final score for each component (component-specific index).

**Step 3**: Sum scores of each component to create overall vulnerability index.

Yu, J., Castellani, K., Forysinski, K., Gustafson, P., Lu, J., Peterson, E., ... & Brauer, M. (2021). Geospatial indicators of exposure, sensitivity, and adaptive capacity to assess neighbourhood variation in vulnerability to climate change-related health hazards. *Environmental Health*, *20*(1), 1-20.

# Heat Vulnerability Mapping in Miami

- **<u>GOAL:</u> Determine the sociodemographic, urban heat island, and historical development characteristics of places with disproportionately classified heat related illness burdens**

  - Review and briefly summarize the evidence base surrounding at-risk (vulnerable) groups and heat-related illness
  - Obtain and synthesize datasets to conduct a heat related illness vulnerability assessment at the zip code level (5 digit)
  - Conduct statistical analysis to develop new evidence of the most important causes of local heat vulnerability risk

Dr. Christopher Uejio

# Heat Vulnerability Assessment

| | |
|---|---|
| **Context** | Historical Redlining |

| | |
|---|---|
| **Exposure** | Landsat Land Surface Temperature Dat |
| | Urban Tree Canopy |
| | Pervious/impervious surfaces |
| | vegetative cover |

| | |
|---|---|
| **Sensitivity** | Elderly |
| | Elderly, Living Alone |
| | Children 0-5 |
| | Health disparties |
| | LIHEAP Requests |
| | % living in poverty |
| | % at or below 80% AMI? |
| | % with english as a second language |
| | % African American |

| | |
|---|---|
| **Adaptability** | cooling centers |
| | evacuation shelters |
| | CERT Volunteers and teams |

| | |
|---|---|
| **Health Data** | # excess mortalities (county level) |
| | # ED Visits for HRIs, 2015-2019 Average Rate |
| | # Hospitalizations |
| | # mortalities |

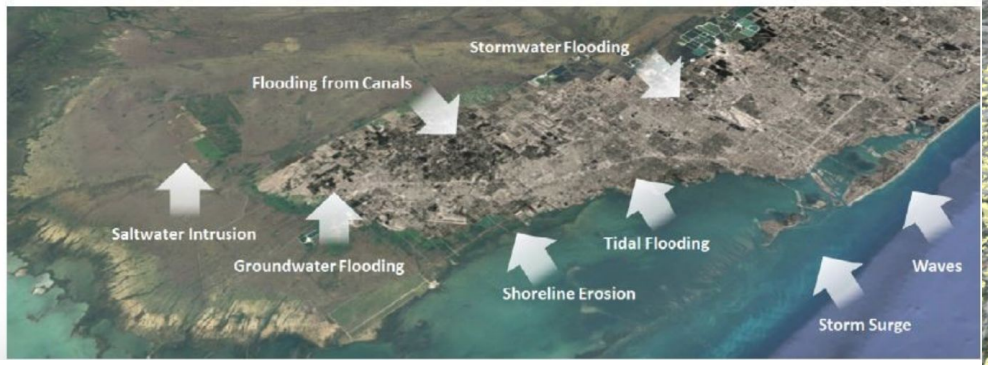
# ArcGIS StoryMap

Sea level is changing | Impacts | Benefits of adaptation | Community perspectives | Guiding principles

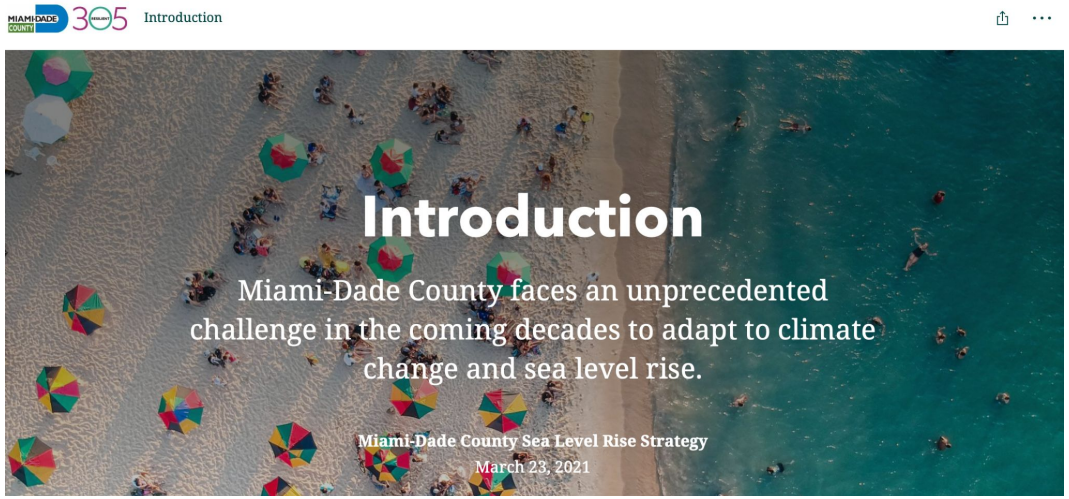
## Impacts of rising sea levels

Our water system is interconnected: higher sea level leads to higher groundwater along the coast and changes the way water moves through our canals. Because of these connections, even inland communities will be affected as it becomes more challenging to drain water off the terrain.

Because we live just a few feet above the ocean and a few feet above our groundwater, small changes in sea level ripple through our entire water system.

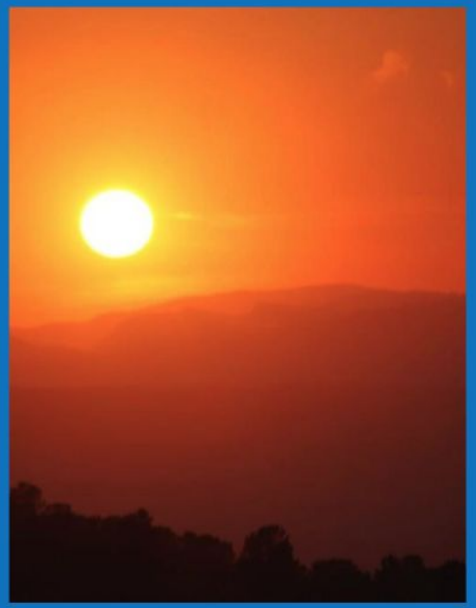



https://miami-dade-county-sea-level-rise-strategy-draft-mdc.hub.arcgis.com




# Heat Warning Advisory Systems

## Legacy Heat Products



### Heat Index

- Issued daily May - September
- Deterministic forecast and probability of exceedance of max/mean/min Heat Index

### Kalkstein Heat/Health Warning System

- Developed in the 1990s to help public health officials, meteorologists, and others predict, respond, and mitigate the impacts of heat waves
- Combines climatological information with health statistics (ie, CDC mortality data)
- Some NWS WFOs utilize this method; 10-15 WFOs have system at their disposal



https://www.weather.gov/media/safety/heat/Heat%20Workshop%20Day%202%20PDF.pdf

# Heat Warning Advisory Systems

## NWS Heat Watch, Warning, Advisory (WWA) for South Florida

| | |
|---|---|
| Excessive Heat **Watch** | issued at least 12 hours, but no more than 48 hours, from when the conditions meeting Excessive Heat Warning criteria are forecast with a 50% chance or greater of occurence |
| Heat **Advisory** | issued within 12 hours of Heat Index values of 108 degrees Fahrenheit or higher lasting at least two hours with an 80% change or greater of occurrence |
| Excessive Heat **Warning** | issued within 12 hours of Heat Index values of 113 degrees Fahrenheit or higher, lasting at least two (2) hours with an 80% chance or greater of occurrence. The Excessive Heat Warning should normally be in effect for no more than a 24-hour period but may be reissued every 24 hours until the excessive heat event ends |



https://www.weather.gov/media/safety/heat/Heat%20Workshop%20Day%202%20PDF.pdf

## Heat Index Above 90°F

Outdoor workers become more susceptible to heat-related illness.

## Heat Index Above 100°F

Children, elderly adults, pregnant women, and people with underlying conditions are at heightened risk of heat-related illness.

## Heat Index Above 105°F

Anyone could be at risk of heat-related illness or even death as a result of prolonged exposure.

## Heat Index Off the Charts

Undetermined: any level of exposure is presumed extremely dangerous for all people and likely to result in heat-related illness or even death.

# Heat Warning Advisory Systems

## Future Heat Tools

### Wet Bulb Globe Temperature (WBGT)

**What is it?**

- Estimates the effect of temperature, humidity, wind, and solar radiation on the human body
- Effective indicator of heat stress for active populations

**What are the benefits?**

- Particularly useful for outdoor workers, athletes, people exercising or active outdoors, etc.
- Can help establish guidelines for activity modifications during exercise or outdoor work

Experimental in NDFD: https://digital.mdl.nws.noaa.gov/
WBGT Handout

| | WBGT | HEAT INDEX |
|---|---|---|
| Measured in the sun | ● | ○ |
| Measured in the shade | ○ | ● |
| Uses temperature | ● | ● |
| Uses relative humidity | ● | ● |
| Uses wind | ● | ○ |
| Uses cloud cover | ● | ○ |
| Uses sun angle | ● | ○ |




https://www.weather.gov/media/safety/heat/Heat%20Workshop%20Day%202%20PDF.pdf

# Heat Warning Advisory Systems

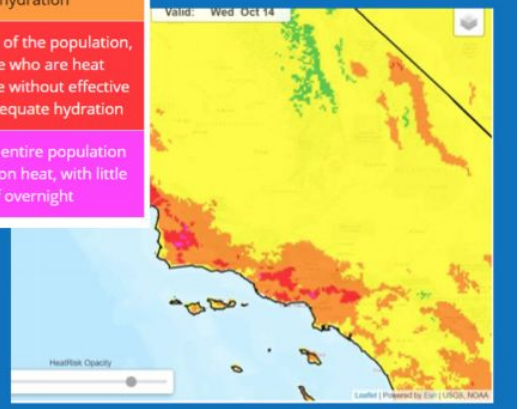
## Future Heat Tools

### HeatRisk

**What does it take into account?**

- How above normal temps are for a location
- Time of the year
- Duration of unusual heat
- Overnight temps
- Difference between lows and highs

| Category | Level | Meaning |
|---|---|---|
| Green | 0 | No Elevated Risk |
| Yellow | 1 | Low Risk for those extremely sensitive to heat, especially those without effective cooling and/or adequate hydration |
| Orange | 2 | Moderate Risk for those who are sensitive to heat, especially those without effective cooling and/or adequate hydration |
| Red | 3 | High Risk for much of the population, especially those who are heat sensitive and those without effective cooling and/or adequate hydration |
| Magenta | 4 | Very High Risk for entire population due to long duration heat, with little to no relief overnight |



**What are the benefits?**

- Helps people understand what forecasted heat means to them
- Provides heat risk guidance for decision makers and heat sensitive populations who may need to take action below NWS heat product levels

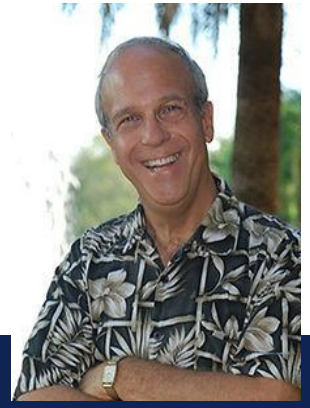
Prototype in NWS Western Region



https://www.weather.gov/media/safety/heat/Heat%20Workshop%20Day%202%20PDF.pdf

# Heat Wave Ranking

- **<u>Heat Wave:</u>** a period of abnormally hot weather lasting more than two days with or without high humidity (National Weather Service)
- Ranking & Naming Heat Waves
  - a new approach to **reduce** the number of heat related fatalities
  - based on projected health outcomes rather than meteorology
  - Categories 1-3 will be tied to specific actions deployed by local government to reduce adverse health impacts



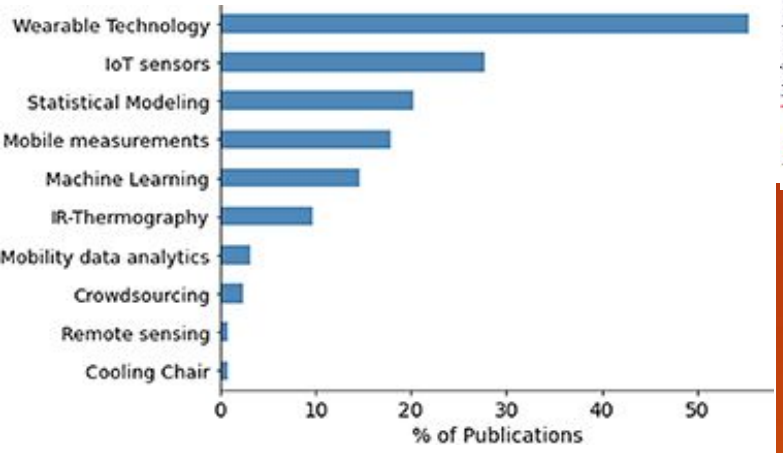
Dr. Larry Kalkstein

Capital Weather Gang https://www.washingtonpost.com/weather/2021/12/01/heat-wave-ranking-los-angeles-california

## California moves toward launching nation's first heat wave ranking system

Categorizing heat waves could help communities better prepare and reduce deaths.

# Heat Exposure




## Data Collection Methods

Nazarian, N., & Lee, J. K. (2021). Personal assessment of urban heat exposure: a systematic review. *Environmental Research Letters*, *16*(3), 033005.

## Urban Heat Island



## Workplace

## Home

# Heat Exposure: Urban Heat Island

- Need for better understanding of how interventions (e.g., proposed large developments, cool pavements, tree planting) positively or negatively impact urban heat exposure and specifically impacts to human health, walkability and thermal comfort.

**Urban Heat Island**


Nazarian, N., & Lee, J. K. (2021). Personal assessment of urban heat exposure: a systematic review. *Environmental Research Letters*, *16*(3), 033005.

# Heat Exposure: Urban Heat Island

- Shift from highly accurate, but sparse weather stations to low-cost, citizen-science, or crowd-sourced sensors and devices that are deployed more extensively

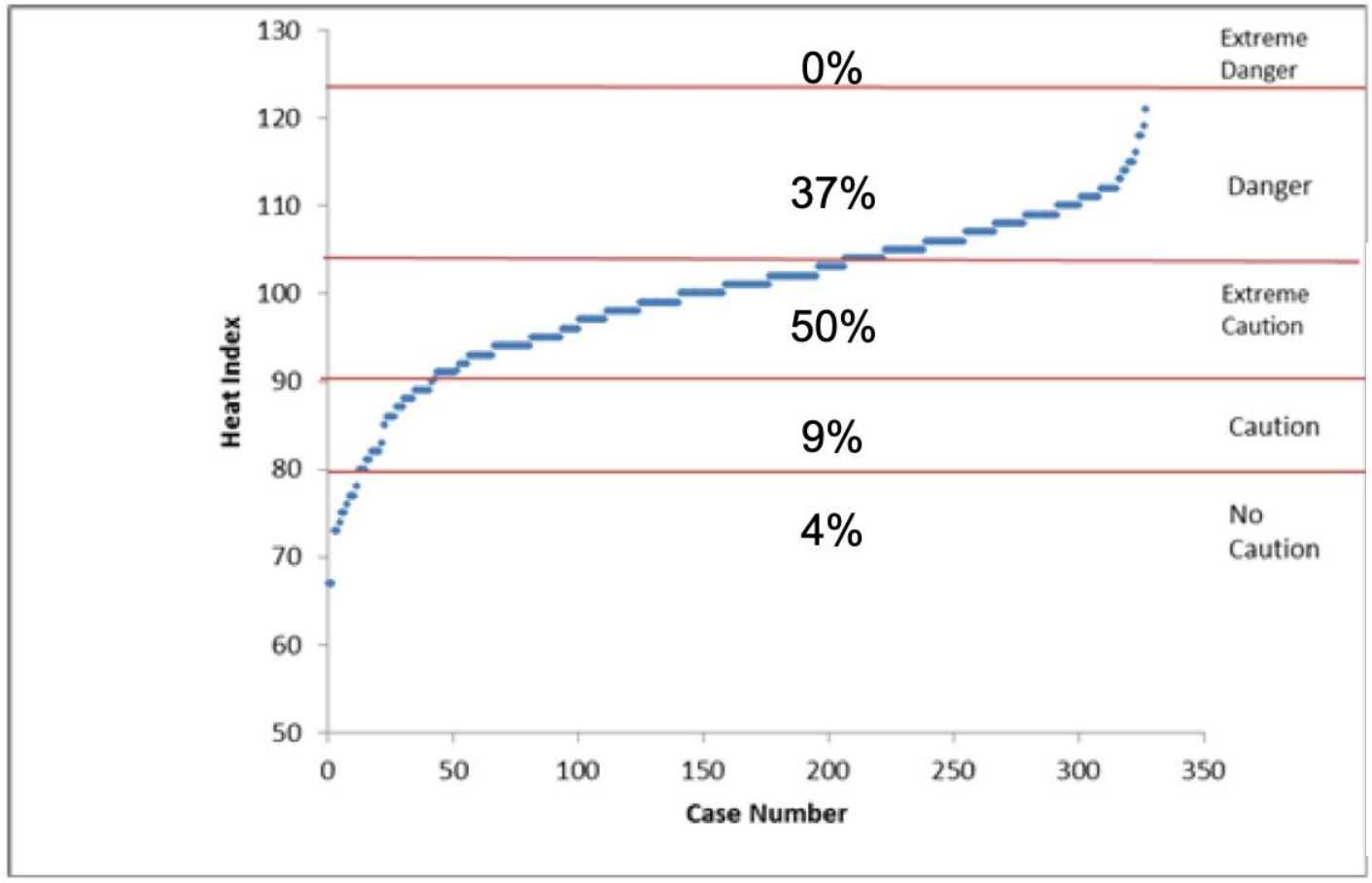
- Modeling thermal environment of cities (very complex)

**Urban Heat Island**


Nazarian, N., & Lee, J. K. (2021). Personal assessment of urban heat exposure: a systematic review. *Environmental Research Letters*, *16*(3), 033005.

# Heat Exposure: Workplace

Figure 4-2. Heat Index of N=327 U.S. Occupational Heat-Related Deaths, 2000-2010 with NOAA Heat Index Categories





| Outdoors | Indoors |
|---|---|
| Agriculture | Bakeries, kitchens, and laundries (sources with indoor heat-generating appliances) |
| Construction – especially, road, roofing, and other outdoor work | Electrical utilities (particularly boiler rooms) |
| Construction – roofing work | Fire Service |
| Landscaping | Iron and steel mills and foundries |
| Mail and package delivery | Manufacturing with hot local heat sources, like furnaces (e.g., paper products or concrete) |
| Oil and gas well operations | Warehousing |

Source: Gubernot. 2015. Occupational Heat-related Mortality in the United States, 2000-2010: Epidemiology and Policy Recommendations. (DrPH dissertation)

OSHA Occupational Safety and Health Administration

# Heat Exposure: Workplace

**72% of deaths** occurred in workers with **less than seven days** on the job.

| Days on job | Deaths, % | Non-fatal heat illnesses, % |
|---|---|---|
| First day | 45% | 3% |
| 2 – 7 days | 27% | 16% |
| 8 – 14 days | 5% | 3% |
| More than 14 days | 23% | 77% |

- 80°F – threshold for requirement to provide shade
- 95°F – threshold for "High-heat procedures" to protect workers


OSHA Occupational Safety and Health Administration

Clinical Features of Heat Stroke Cases

| Characteristic | Value |
|---|---|
| Fatal, % | 85% |
| Kidney failure, % | 83% |
| Liver failure, % | 60% |
| Elevated CK, % | 50% |
| Highest recorded CK, median (range) | 25,530 (234 – 55,940) |
| DIC, % | 39% |
| Seizure, % | 19% |

NWS Heat Workshop 2020, https://www.weather.gov/media/safety/heat/Heat%20Workshop%20Day%202%20PDF.pdf

# Heat Exposure: Workplace

- **Wet Bulb Globe Temperature** is the recommended workplace environmental metric (Tustin et. al, 2018)
  - ➢ includes air temperature, relative humidity, wind speed, and radiation
  - ➢ if WBGT is unavailable, the next best metric is Heat Index


- Few data have documented the effectiveness of the exposure limits in real-life situations (National Institute for Occupational Safety and Health, 2016)

# Heat Exposure: Home

- People, on average, spend over 90% of their time indoors
- Indoor environment is greatly different than outdoor environment
- Largest protective factor to heat morbidity and mortality is **air conditioning** (Basu & Samet, 2002)
- In personal heat exposure research majority of studies focused on office spaces (more likely to have AC), not residential areas (Nazarian & Lee, 2021)
  - IoT and low cost sensors offer real-time and spatial monitoring

# Breakout Room Questions

- How do we begin to improve reporting on heat related ER visits, hospitalizations and mortalities?
- What should be priorities for current research or data needs to better understand and address heat exposure in Miami Dade's:
  - Urban Heat Island
  - Workplace
  - Home
- What are recommended next steps to improve on Heat Advisory Systems? What data/research do we need to do that?

- What partnerships are necessary to attain these goals? How can we fund it?

# Thank YOU!!!!

Register for more workshops at https://miamifoundation.org/extremeheat/

Provide more suggestions to: resilience@miamifoundation.org