

Public Health Impacts of Heat

Paul English, PhD MPH
Environmental Health Investigations Branch
California Department of Public Health

Difference between climate and weather

- January was seen as unusually cold in much of the United States. Globally, the combined global land and ocean average surface temperature was 0.60°C above the 20th century average of 12.0°C . This is the fourth warmest January on record.(NOAA)
- Last 10 years were [the hottest decade since modern records have been kept](#).

Outline

- Health effects from heat events due to climate change
- Vulnerability
- Adaptation
- Research Needs

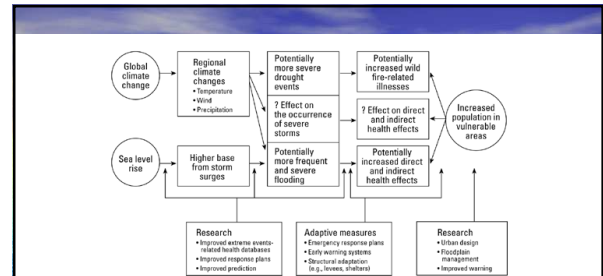


Figure 1. Extreme weather events-related health effects of global climate change. ?, uncertainty. Data from National Clinical Data Center (86).

From: Greenough, et al., 2001

Extreme Weather Events Associated with Climate Change

- Hurricanes/Tornadoes
 - U.S. most significant tornado disasters
- Severe Storms, Flooding; Extreme Precipitation; Floods: most common natural disaster in the U.S.
- Heat Waves (more deaths than all the other events combined)
- Related events:
 - Wildfires
 - Drought

Heat Waves

- Expected to increase in severity and frequency, last longer and occur earlier:
 - Significant increases in the risk of illness and death related to extreme heat and heat waves are very likely; deaths to double by 2050 in 21 U.S. cities (CCSP, 2009)
 - Number of heat wave days in L.A. expected to double by the end of the century
 - 2003 : Europe heat wave: at least 22,000 deaths (range 22-45 heat related deaths)

Heat Waves

- Average annual temps in the U.S. in six of the past 10 years have been among the hottest 10% on record
- Air pollution effects need to be taken into account because of correlation with temp.

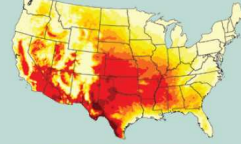
Global Climate Change Impacts in the United States

Projected Increase in Number of Days with Heat Index Over 100°F

Lower Emissions Scenario*



Higher Emissions Scenario*



Number of Days

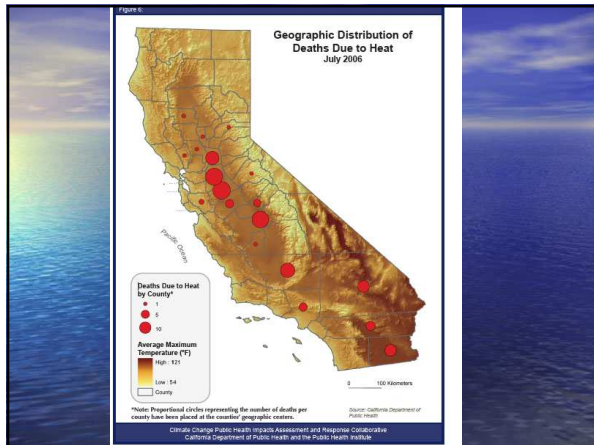
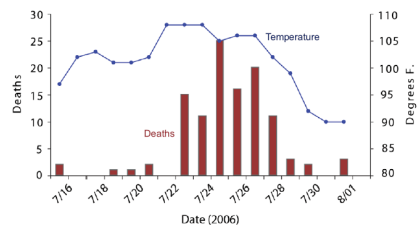


Figure 7: Deaths due to Extreme Heat in California and Typical Central Valley Temperature*, July 15-August 1, 2006



Severity of heat-related illness

- Heat cramps. Mild and easy to treat, this level involves fevers generally under 102 degrees Fahrenheit.
- Heat exhaustion: Involves fevers over 102 degrees Fahrenheit, often with vomiting, diarrhea, and fatigue.
- Heat stroke: A severe and life-threatening failure of body's ability to cool (e.g., sweating ceases), with fevers over 104 degrees Fahrenheit. Heat stroke can result in organ and neurologic damage and lead quickly to death.

Notes on 140 coroner cases California 2006

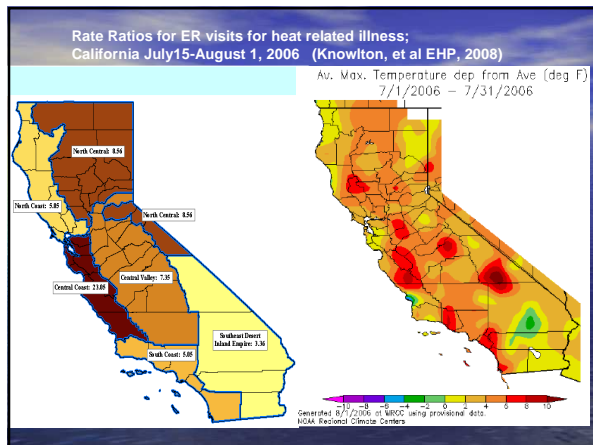
- Inside temperatures (noted in 36 of 140 cases) averaged 103.5 degrees Fahrenheit with a range of 85 to 140 degrees Fahrenheit
- 46% of decedents lived alone, 55% of these had a social contact who routinely checked on them, and 19% seen by social contacts within 24 hours prior to death.
- Isolation, residence in a poor area, age, and chronic disease are common risk factors. Risk rises rapidly with age, after about age 50 years old. Only one child death.
- Only one decedent had AC on.
- Some classic heat stroke victims were reported to have had a fan trained on them.

Measuring heat deaths

- Coroners' reports
- Excess mortality
 - Estimated 655 excess deaths, 6% increase
- Case definition:
 - Primary and underlying cause of death

Morbidity from CA heat wave

- 16,166 excess ED visits and 1,182 excess hospitalizations
- Children and the elderly were at greatest risk.
- ED visits showed significant increases for HRI, acute renal failure, cardiovascular diseases, diabetes, electrolyte imbalance and nephritis.
- Significantly elevated RRs for hospitalizations for HRI (RR 10.15; 95% CL 7.79, 13.43), acute renal failure, electrolyte imbalance and nephritis.

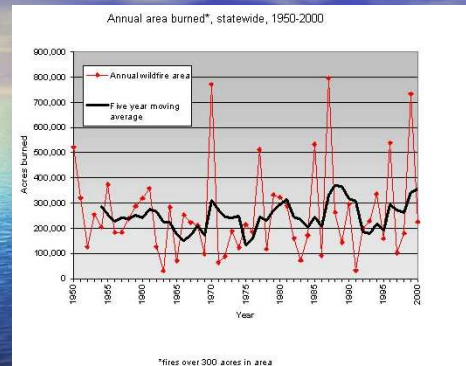


Drought

- Higher sea surface temps causes changes in air circulation that reduces rainfall.
- Impact on wildfires
- Increase potential for infectious disease
- Desertification

Wildfires

- Vary regionally with projected increases in the frequency, severity, distribution, and duration in the Southeast and West
- Wildfire activity in the Western U.S. became more prevalent in the mid-1980's with greater frequency and duration, and longer wildfire seasons
- More PM, more CO₂

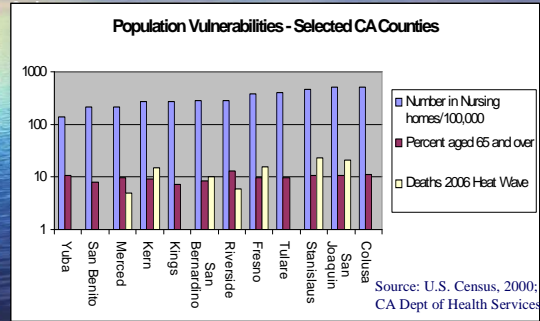


Source: CA Fire and Resource Assessment Program

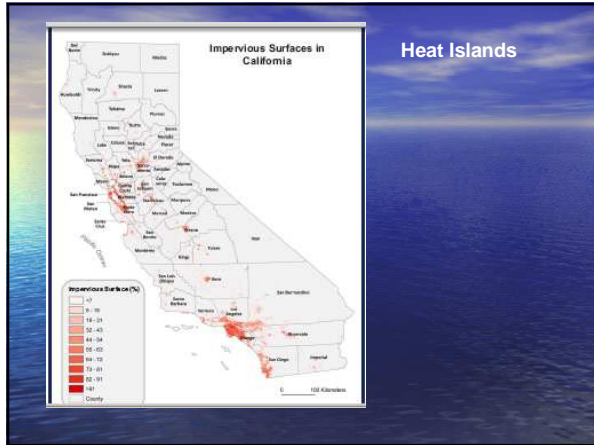
Vulnerability

- Population sensitivity (e.g. popn characteristics)
- Exposure
- Adaptive capacity
- Vulnerability to extreme events
 - Urbanization
 - Living in flood plains
 - Coasts
 - More risk from wildfires

Indicators of population vulnerabilities to climate change



Heat Islands

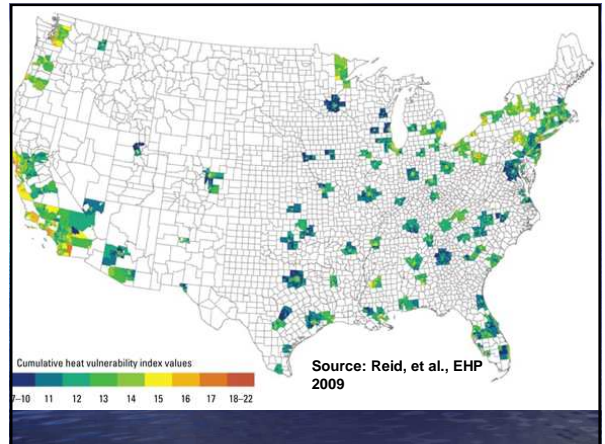
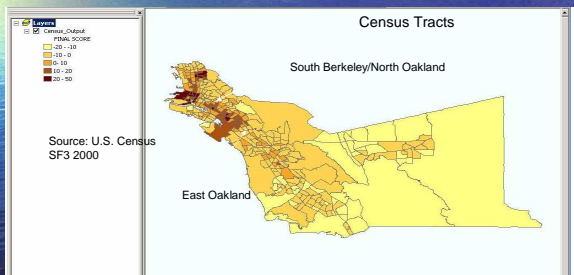


Heat Islands

- Urban/suburban areas 1 to 6 degrees hotter than nearby rural areas
 - Increases vulnerability to heat waves
 - Loss of natural cooling
 - Trapping of air and reduction of air flow
 - Nighttime cooling

Alameda County, CA, Heat Vulnerability Index

- Percent population below poverty level + percent households with elderly (65+) living alone (centered and summed)
- -20 (min; least vulnerability; +50 (max; most vulnerability); median=-3.2



Vulnerability Analyses

- Are there differential population vulnerabilities for heat mortality and morbidity? (e.g. by geography, race, age)
- Risk factors for vulnerability to drought, air pollution effects
- Identification of populations with co-morbidities

Adaptation Issues

- Preparedness
 - Emergency Preparedness Plans
 - Progress in Heat Warning Systems
- Public Health Education
 - e.g. education of social contacts of elderly for heat waves

Research needs

- Improvement, implementation of heat warning systems
- Evaluation of education materials
- Epi studies of long term effects from wildfires
- Standardized indicators to measure (mortality/morbidity, environmental, vulnerability)

Research needs

- Characteristics of air masses (humidity, stagnation, when they occur, length, etc.) in relation to heat morbidity and mortality.
- What is the best measure of heat warning (e.g., heat index) that can be used that is most predictive of morbidity and mortality.
- The effect of harvesting—the phenomena that some deaths would have occurred regardless of temperature exposure—has not been fully explained.