

Public Health Vulnerabilities to Climate Change and Mapping of Risk

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Outline

- Definition of Vulnerability
- Extreme weather events and climate change
- Drought, Flooding, Sea-Level Rise Vulnerabilities
- Mapping for Heat Vulnerability
- Future Vulnerability Work

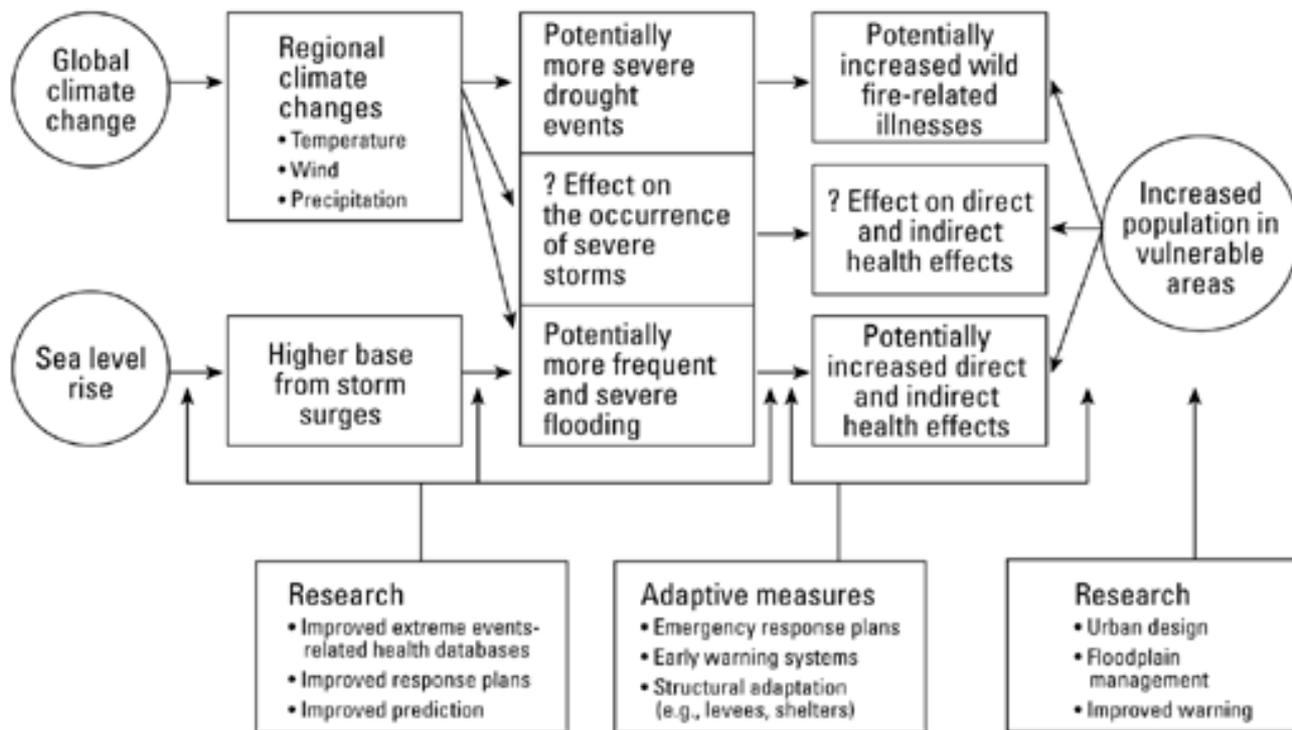


Figure 1. Extreme weather events-related health effects of global climate change. ?, uncertainty. Data from National Clinical Data Center (86).

From: Greenough, et al., 2001

Vulnerability

- Population sensitivity (e.g. popn characteristics)
- Exposure
- Adaptive capacity

- Vulnerability to extreme events
 - Effects of Urbanization/land use patterns
 - Living in flood plains
 - Coasts
 - Wildfire-prone areas

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

Drought

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

Populations vulnerable to drought

- dialysis patients,
- the elderly,
- pregnant and nursing women,
- infants,
- immunocompromised individuals (e.g., chemotherapy and AIDS patients),
- persons with preexisting health conditions, such as hypertension and diabetes.

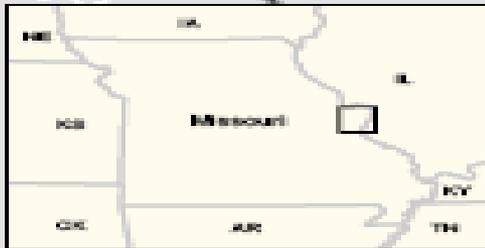
Wildfires

- 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

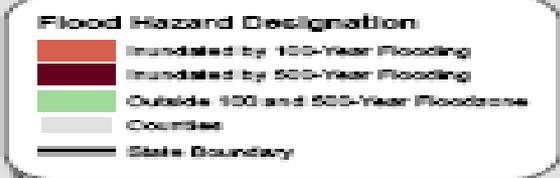
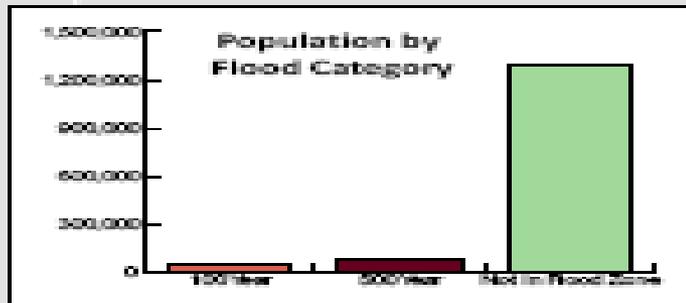
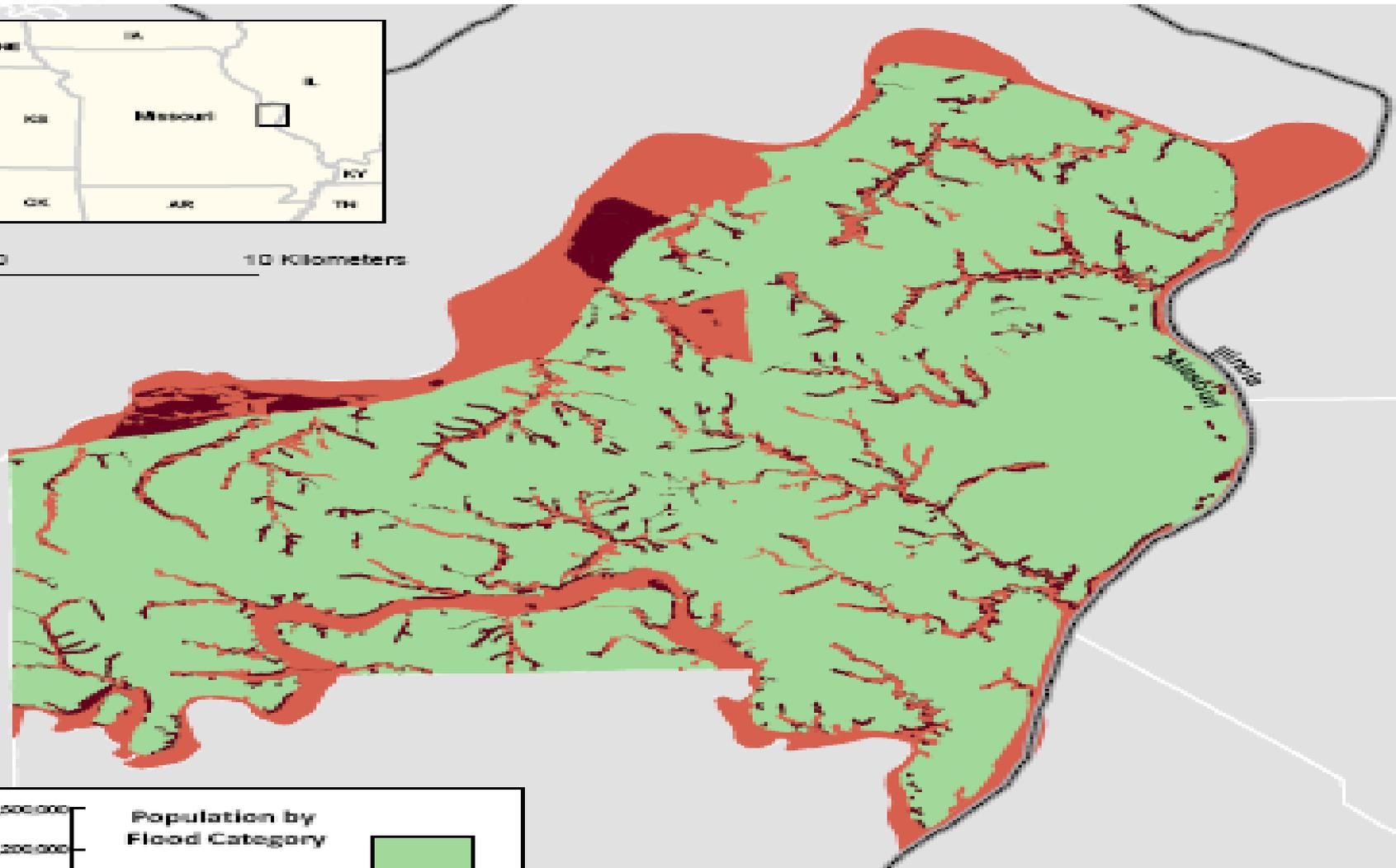
Populations vulnerable to flooding

- the elderly
 - the poor
- people who live in areas that have experienced little or no flooding in the past
 - infants,
 - immunocompromised persons,
- those with chronic diseases or receiving drug treatment
 - the obese
- immobility due to lack of transportation or disability
 - disabled living in 100- and 500-year flood zones

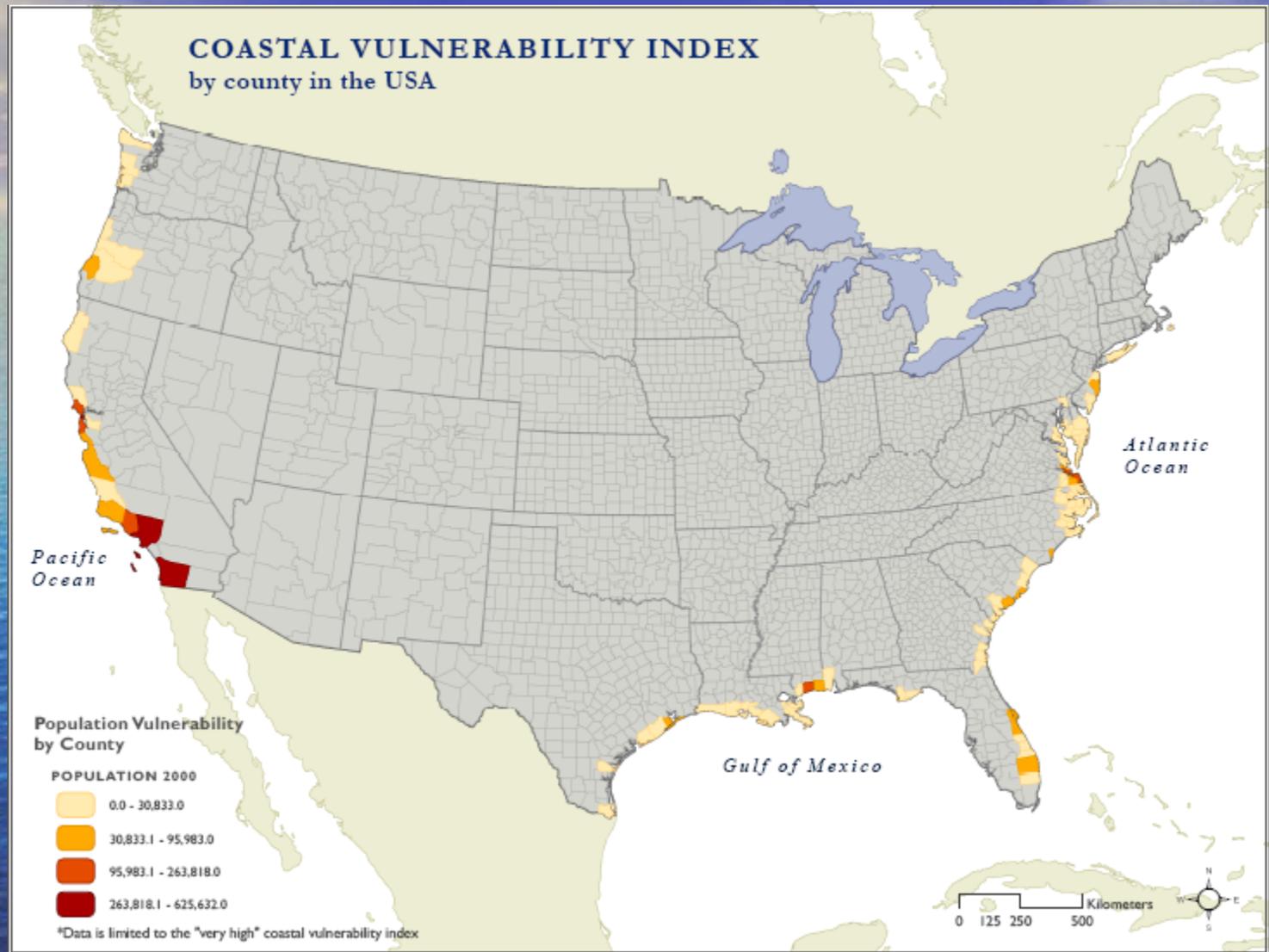
Digital Q3 Flood Data Example St Louis (City and County)



0 10 Kilometers



Population by County within 5 km of coast with “very high” vulnerability to sea level rise



Source: USGS and U.S.
Census 2000

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.

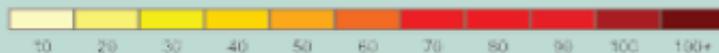
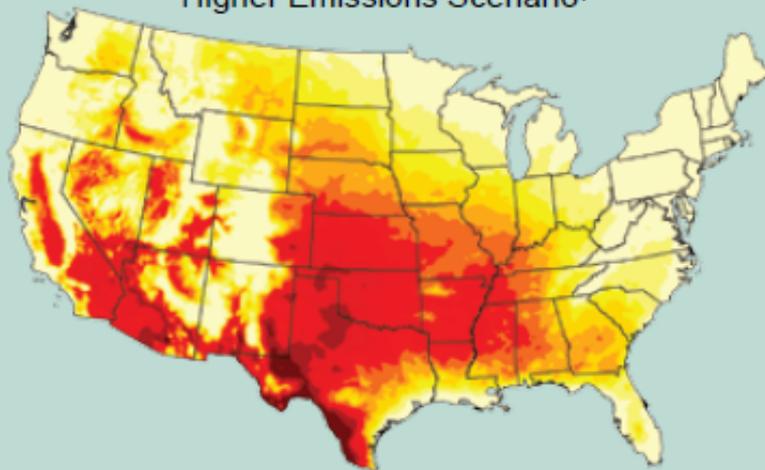
Global Climate Change Impacts in the United States

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

Lower Emissions Scenario†



Higher Emissions Scenario†



Number of Days

Vulnerabilities to Heat

- California counties have varying and unique indicators of risk, including:
 - high proportions of elderly,
 - socially isolated populations,
 - children,
 - outdoor workers,
 - the poor,
 - the chronically ill,
 - medically under served.



Public Health Impacts of Climate Change in California: Community Vulnerability Assessments and Adaptation Strategies

Report No. 1:

Heat-Related Illness and Mortality *Information for the Public Health Network in California*

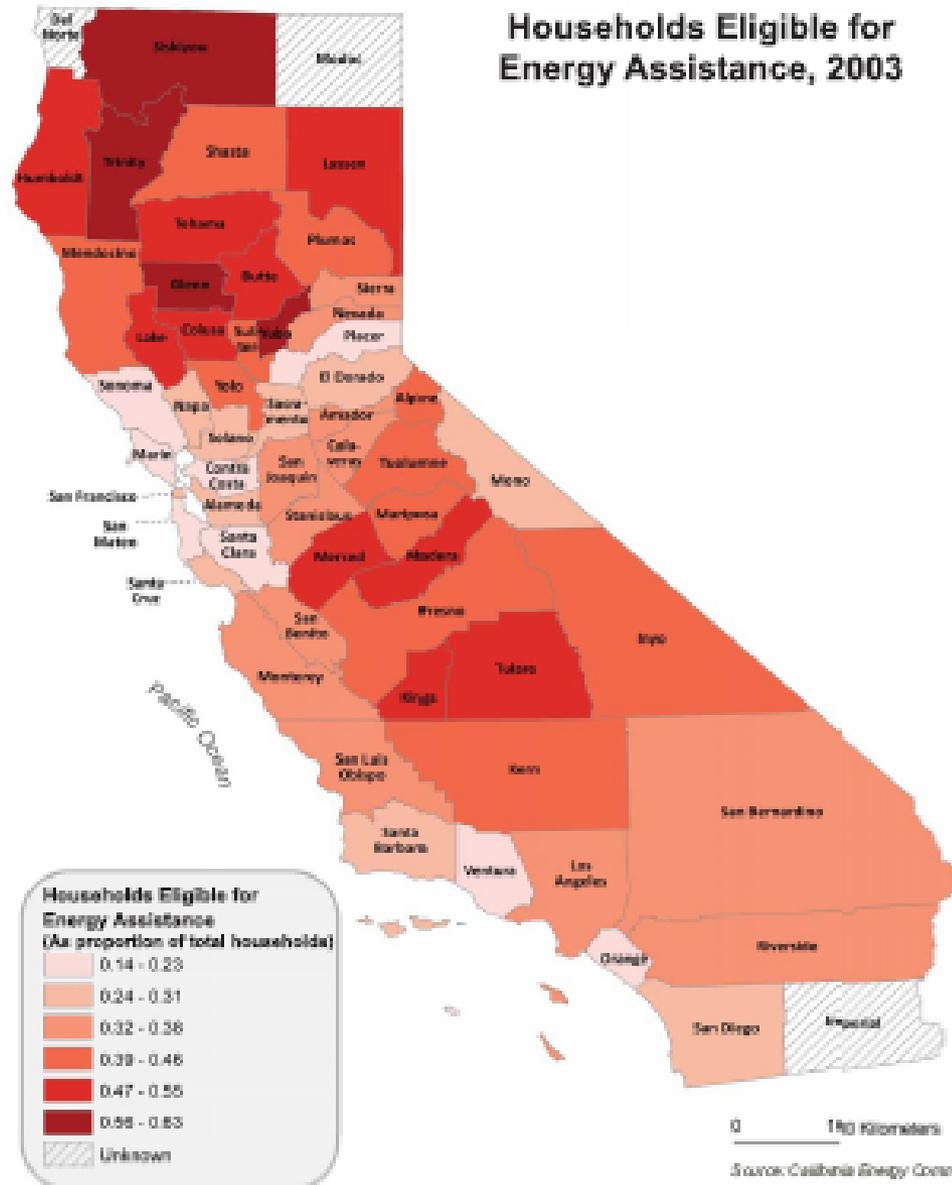


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Figure 5:



Figure 14



Notes on 140 coroner cases California 2006

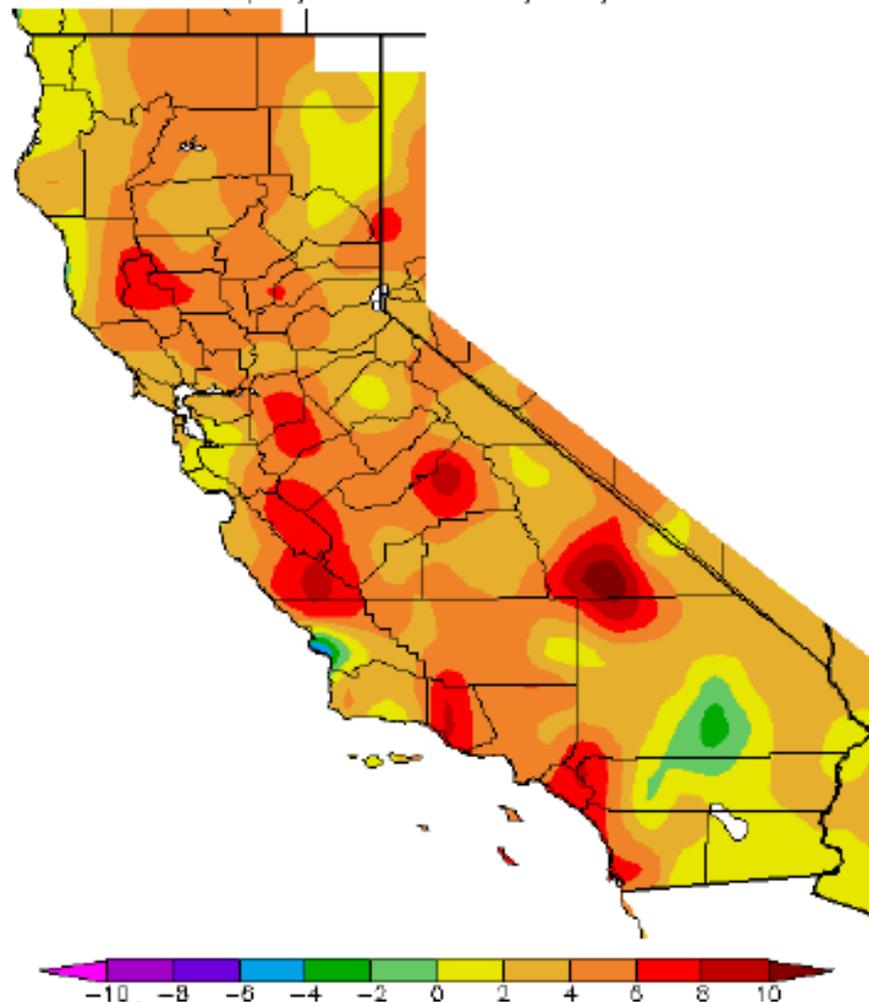
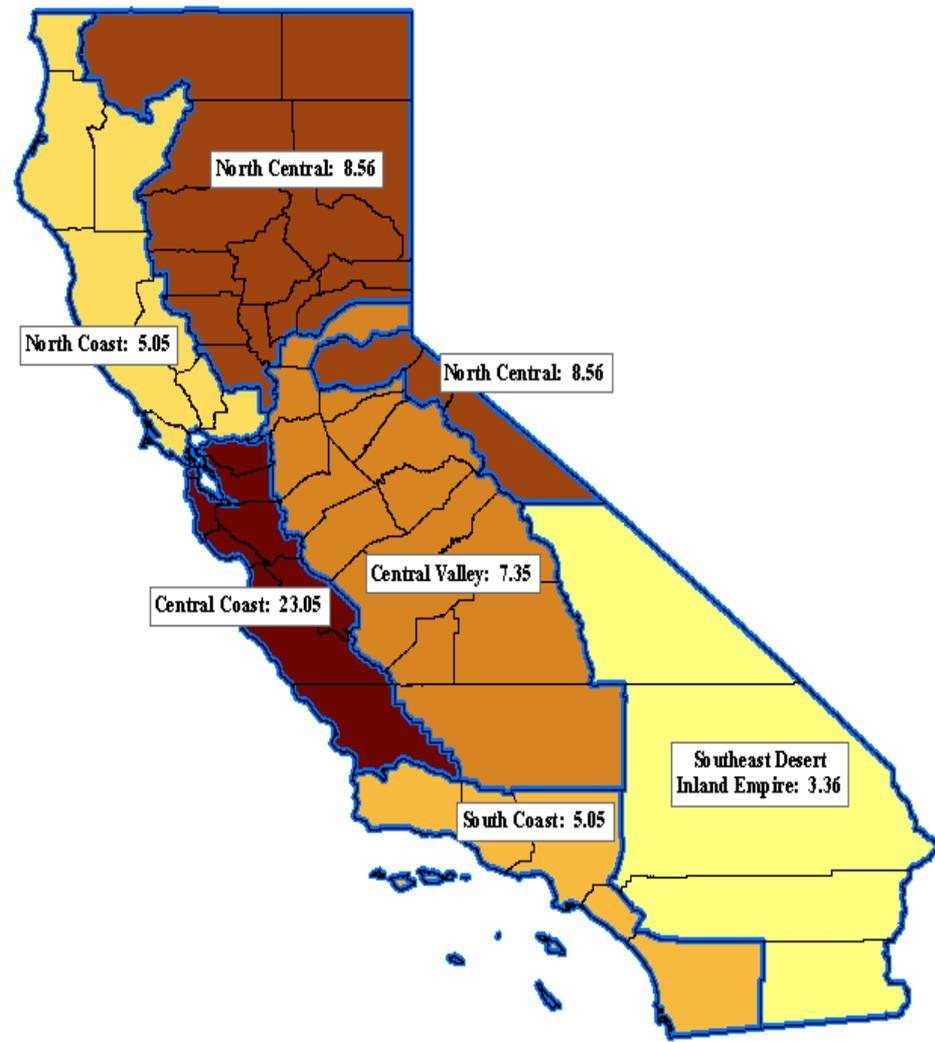
- Inside temperatures (noted in 36 of 140 cases) averaged 103.5 degrees Fahrenheit with a range of 85 to 140 degrees Fahrenheit
- 46% of decedents lived alone, 55% of these had a social contact who routinely checked on them, and 19% seen by social contacts within 24 hours prior to death.
- Isolation, 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.

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.

Rate Ratios for ER visits for heat related illness; California July 15-August 1, 2006 (Knowlton, et al EHP, 2008)

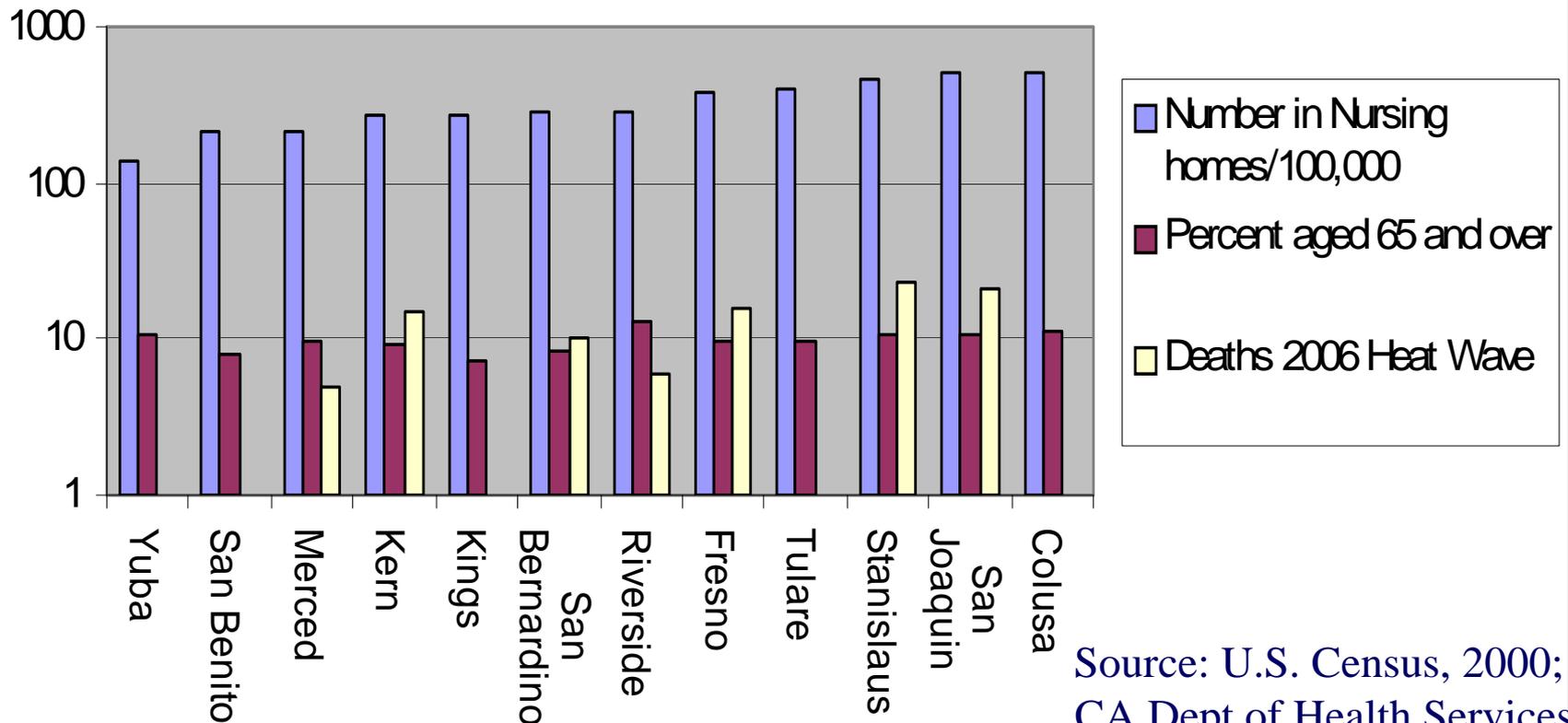
Av. Max. Temperature dep from Ave (deg F)
7/1/2006 - 7/31/2006



Generated 8/1/2006 at WRCC using provisional data.
NOAA Regional Climate Centers

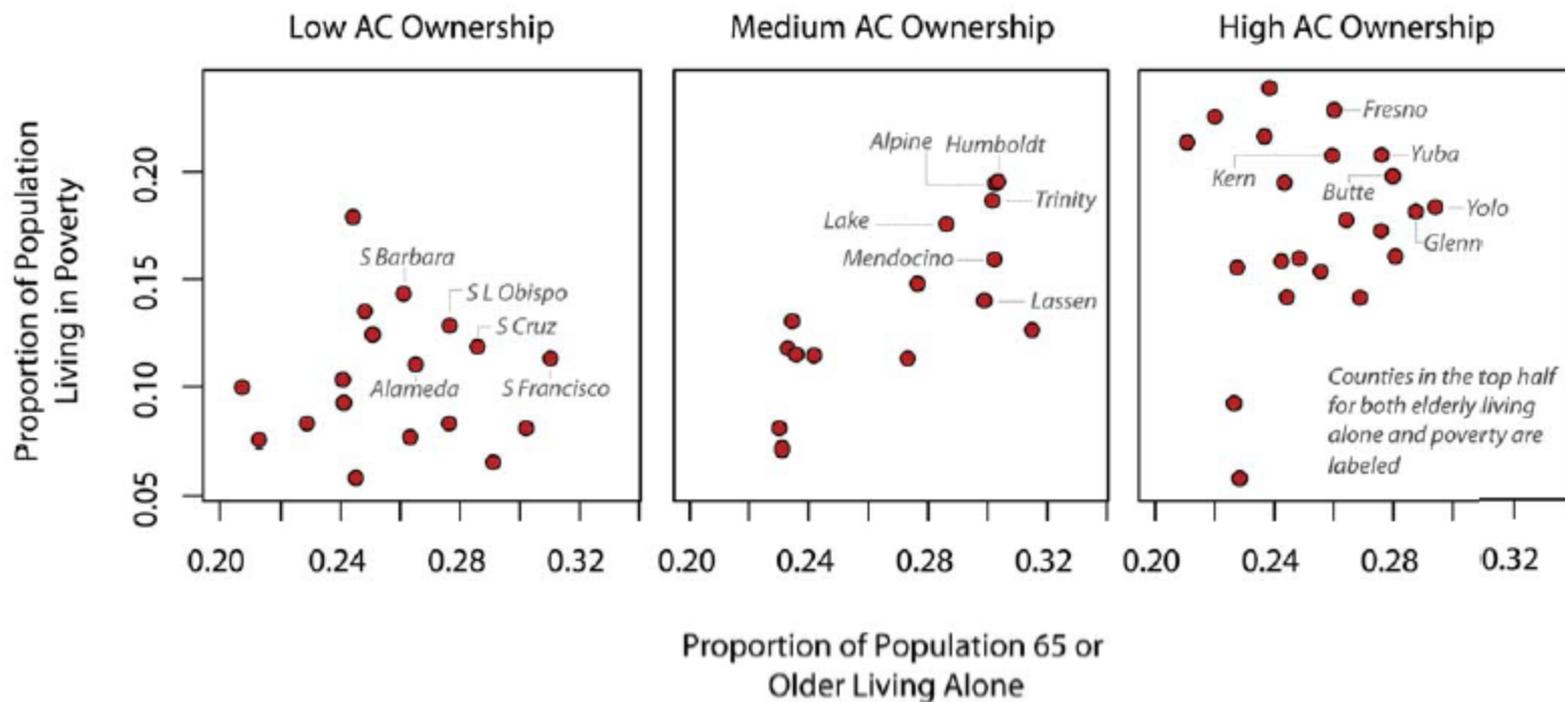
Indicators of population vulnerabilities to climate change

Population Vulnerabilities - Selected CA Counties



Source: U.S. Census, 2000;
CA Dept of Health Services

Figure 13: Poverty and Social Isolation in California Counties Categorized by Air Conditioner Ownership



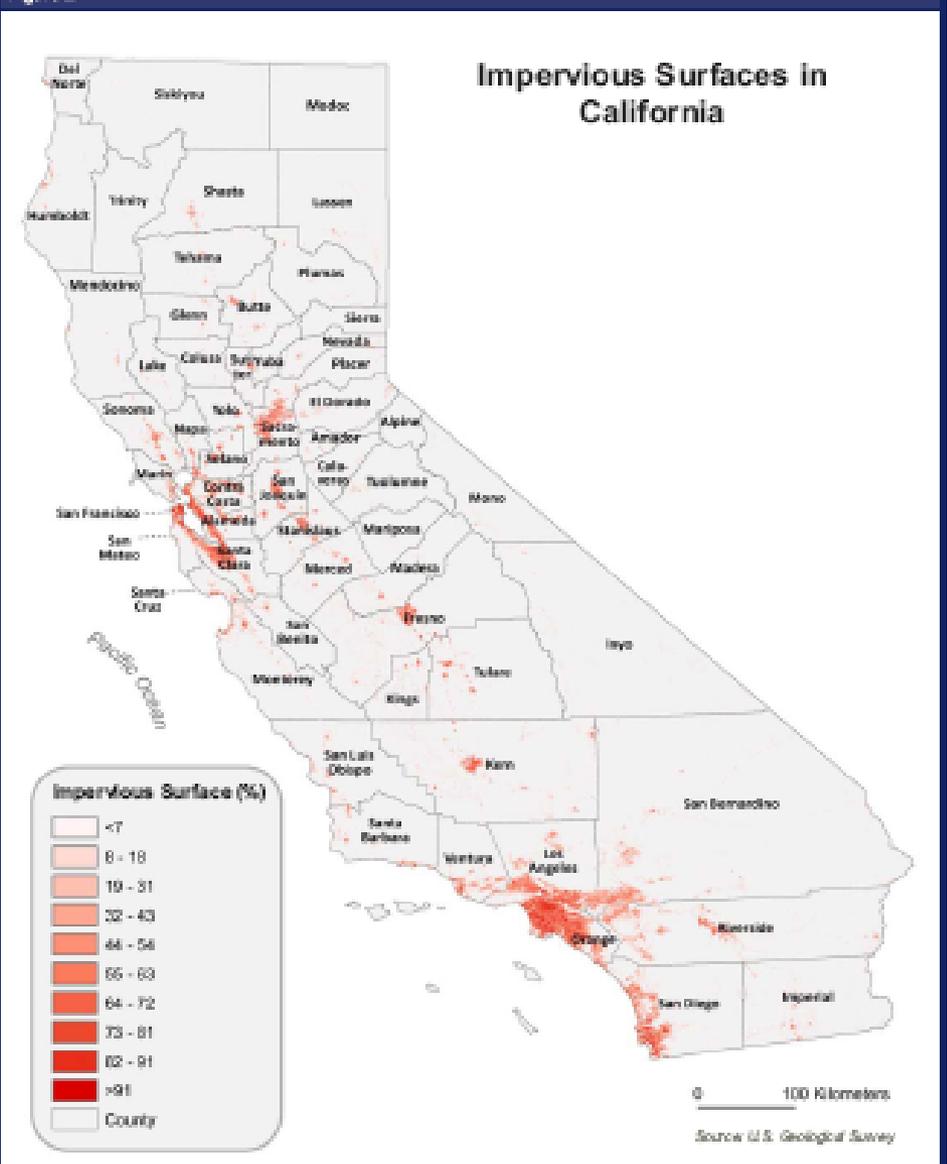
Source: California Energy Commission, U.S. Census 2000

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

Heat Islands

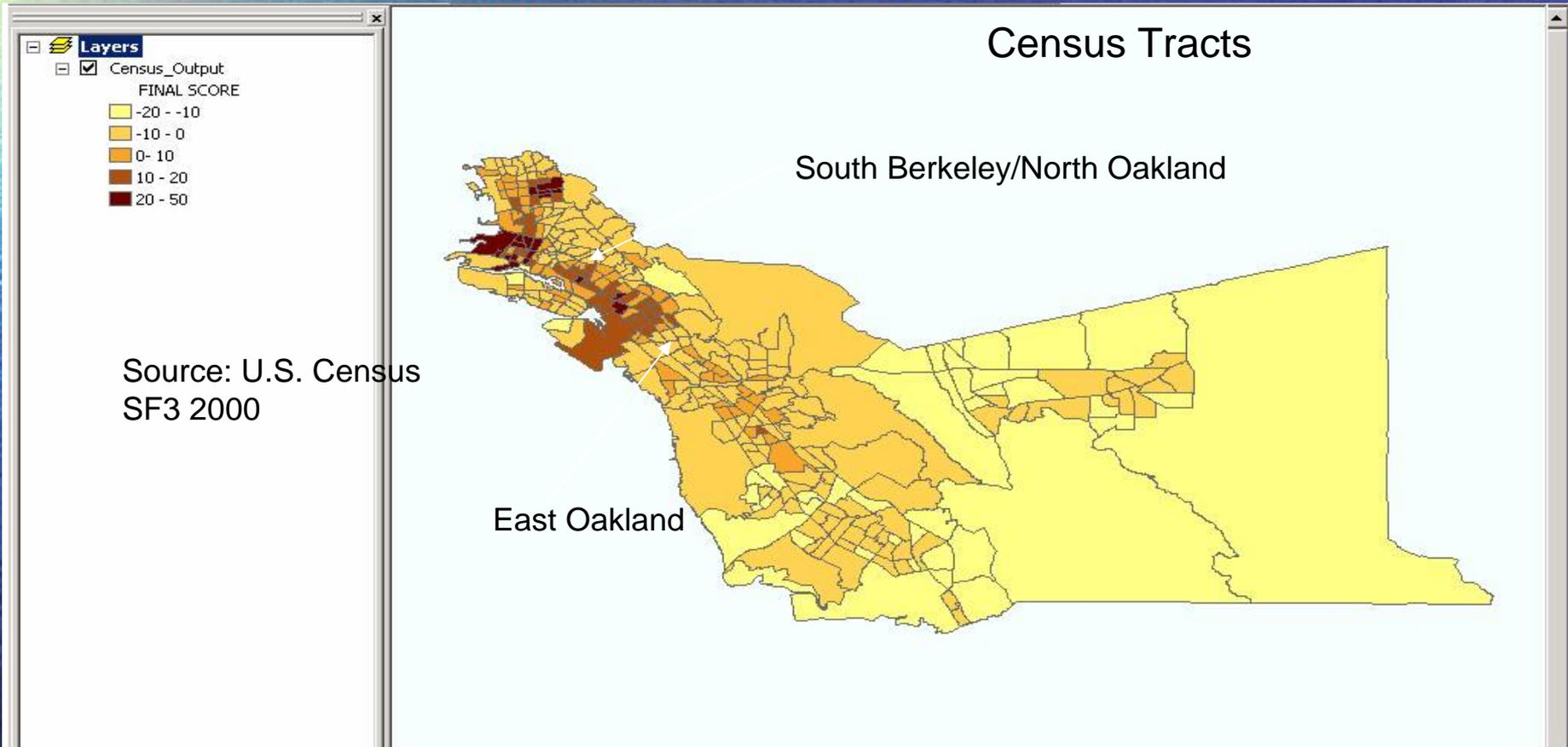
Figure 2:



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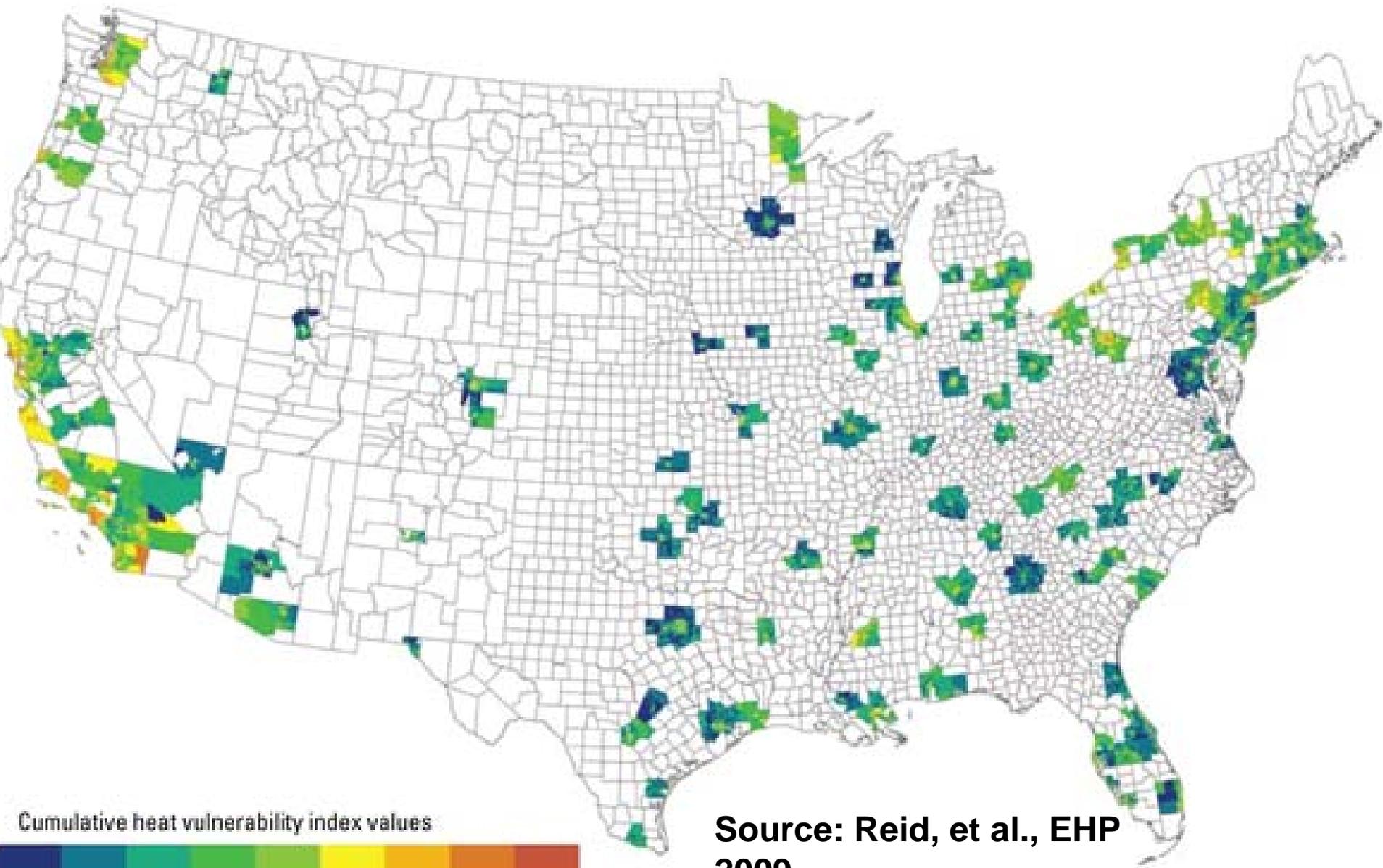
Alameda County, CA, Heat Vulnerability Index

- 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



Approach of Reid, et al, 2009

- Demographic characteristics:
 - age, poverty, education, living alone, and race/ethnicity
- Land cover: area not covered by vegetation
- Households without AC or without central AC (American Housing Survey)
- Diabetes prevalence from BRFSS.



**Source: Reid, et al., EHP
2009**

Cumulative heat vulnerability index values

7-10	11	12	13	14	15	16	17	18-22
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Approach of Reid, et al, 2009

- Examining hospitalizations and ER visits for heat during heat wave and non-heat wave periods, we are examining the sensitivity of the heat vulnerability scores with hosp and ER visits via the National Env. Health Tracking Network.

Future Vulnerability Work

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

Future Vulnerability Work

- Evaluation of education materials
- Standardized indicators to measure (mortality/morbidity, environmental, vulnerability)