Data and Surveillance:

How can we measure and monitor climate-related health effects?

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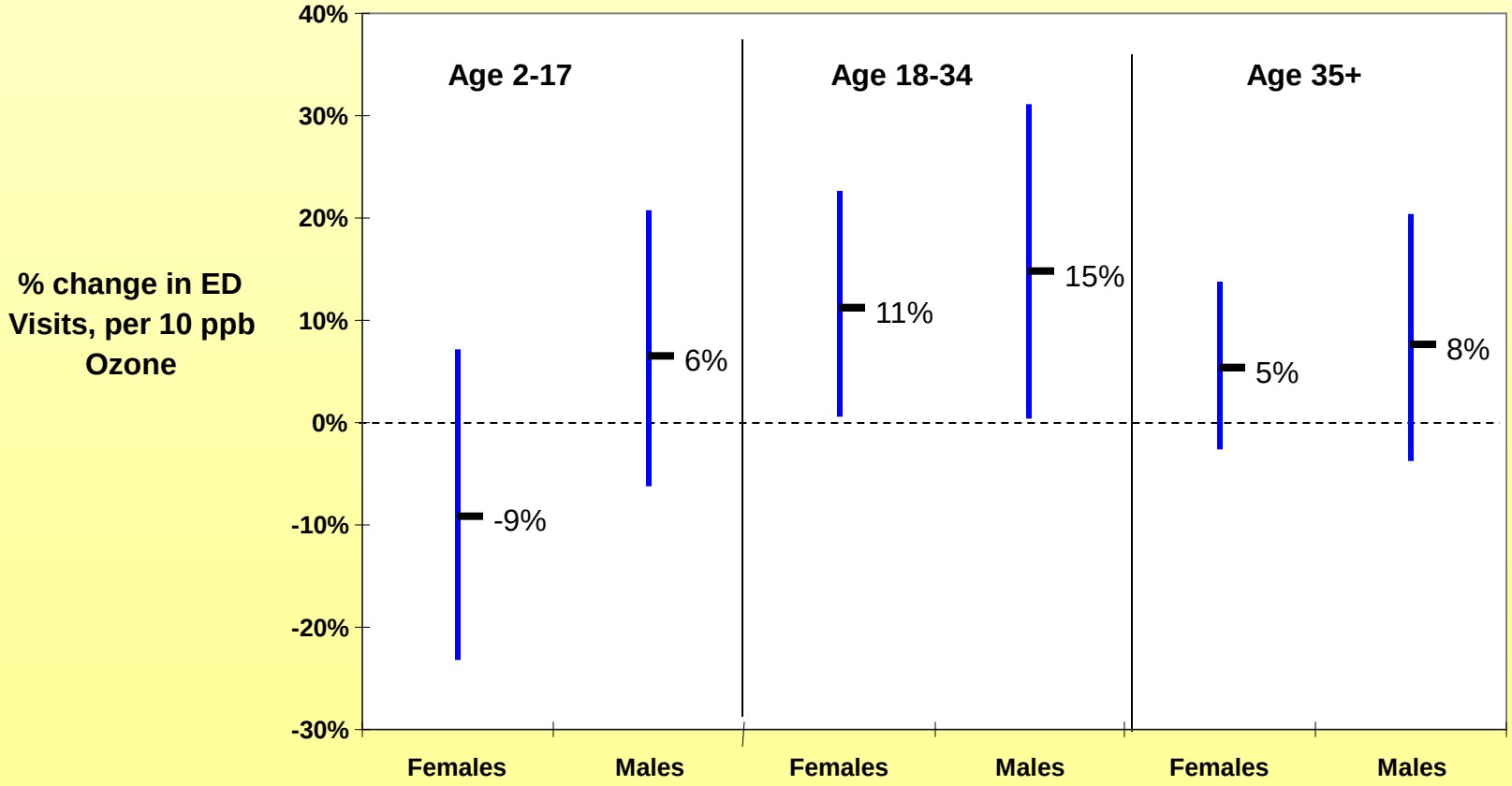
Why surveillance matters

Maine Asthma ED visits 2001: daily percent change associated with ozone by age and sex groups, adjusted model



Surveillance Needs Nationally Consistent Indicators

Review

Environmental Health Indicators of Climate Change for the United States: Findings from the State Environmental Health Indicator Collaborative

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Objective: To develop public health adaptation strategies and to project the impacts of climate change on human health, indicators of vulnerability and preparedness along with accurate surveillance data on climate-sensitive health outcomes are needed. We researched and developed environmental health indicators for inputs into human health vulnerability assessments for climate change and to propose public health preventative actions.

Data sources: We conducted a review of the scientific literature to identify outcomes and actions that were related to climate change. Data sources included governmental and nongovernmental agencies and the published literature.

Data extraction: Sources were identified and assessed for completeness, usability, and accuracy. Priority was then given to identifying longitudinal data sets that were applicable at the state and community level.

Data synthesis: We present a list of surveillance indicators for practitioners and policy makers that include climate-sensitive health outcomes and environmental and vulnerability indicators, as well as mitigation, adaptation, and policy indicators of climate change.

Conclusions: A review of environmental health indicators for climate change shows that data exist for many of these measures, but more evaluation of their sensitivity and usefulness is needed. Further attention is necessary to increase data quality and availability and to develop new surveillance databases, especially for climate-sensitive morbidity.

Key words: adaptation, air quality, climate change, environmental health, heat, indicators, vulnerability. *Environ Health Perspect* 117:1673–1681 (2009). doi:10.1289/ehp.0900708 available via *http://dx.doi.org/* [Online 18 May 2009]

established the State Environmental Health Indicators Collaborative (SEHIC) in 2004. SEHIC comprises a group of state-level environmental health practitioners interested in developing environmental public health indicators for use within environmental health surveillance and practice. The SEHIC first focused on developing indicators for air quality, asthma, and drinking water. Last year, it established a workgroup on climate change. This article presents the initial findings of that workgroup.

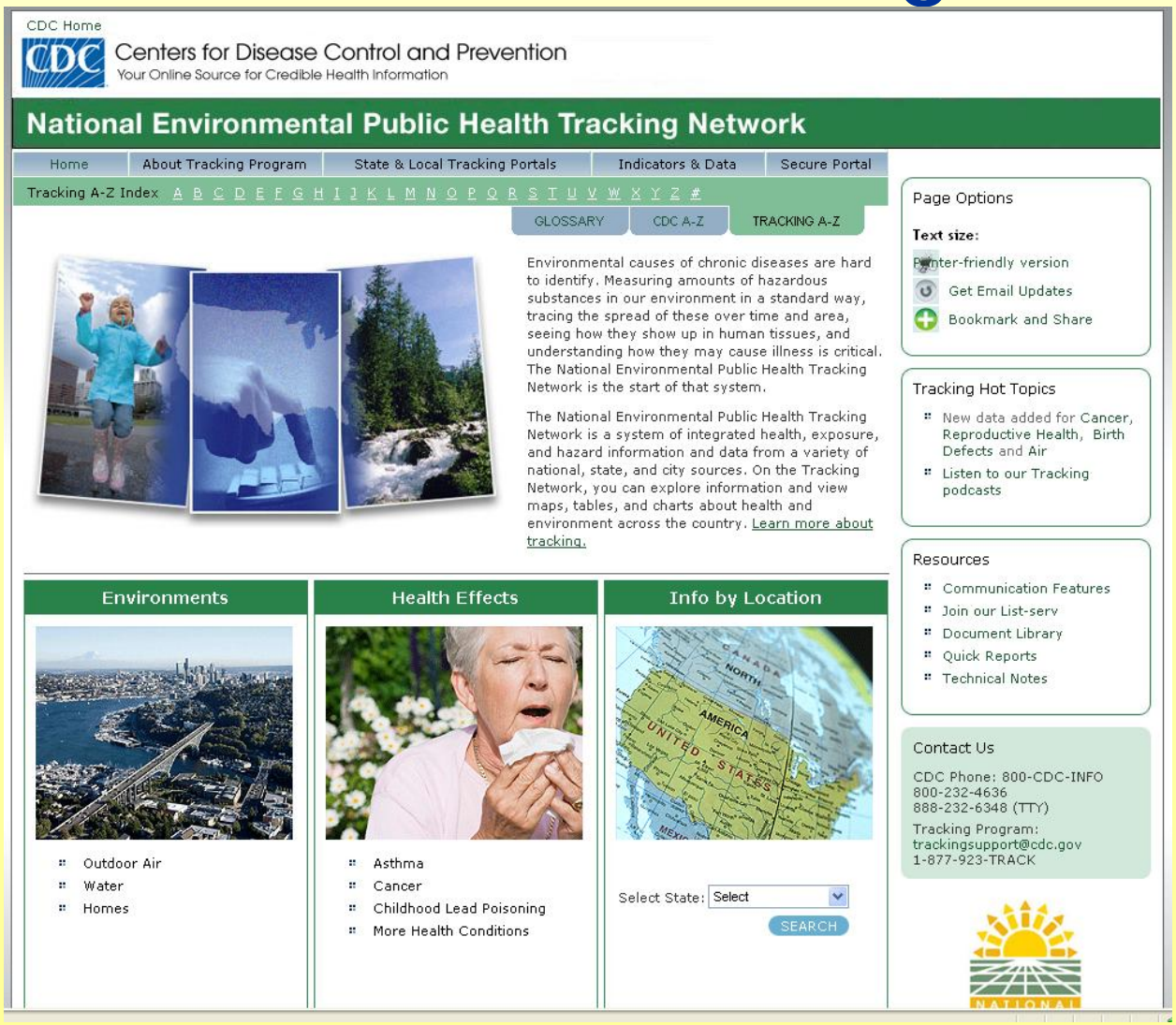
Materials and Methods

Indicators are quantitative summary measures that can be used to track changes in conditions by person, place, and time. The purpose of environmental health indicators as established by the SEHIC is to describe elements of environmental sources, hazards, exposures, health effects, and intervention and prevention activities. Indicators can be used to assess

CSTE SEHIC
Proposed indicators

- Environmental indicators
  - Greenhouse gases, temperature, etc.
- Morbidity/mortality indicators
  - Morbidity/mortality from heat, extreme weather, etc.
- Vulnerability indicators
  - Poverty, elderly living alone, vulnerability to sea level rise, etc.
- Mitigation indicators
  - Energy efficiencies, no. of vehicle miles traveled, etc.
- Adaptation indicators
  - Access to cooling centers, no. of heat wave warning systems, etc.
- Policy indicators
  - No. of states/cities participating in climate change initiatives, etc.

The Role of Environmental Public Health Tracking



The Role of Environmental Public Health Tracking

https://tracking.publichealth.maine.gov

The Role of Environmental Public Health Tracking

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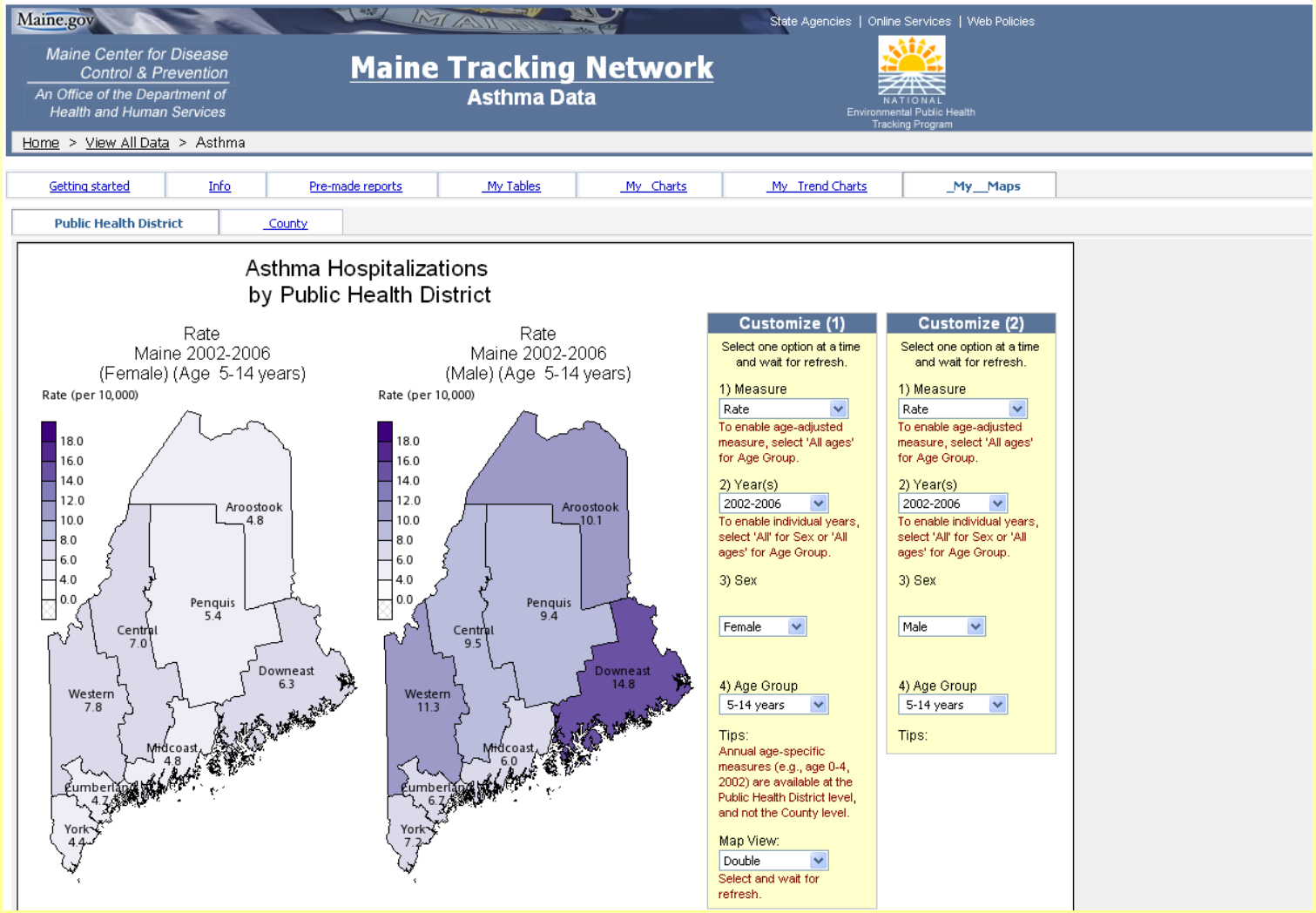
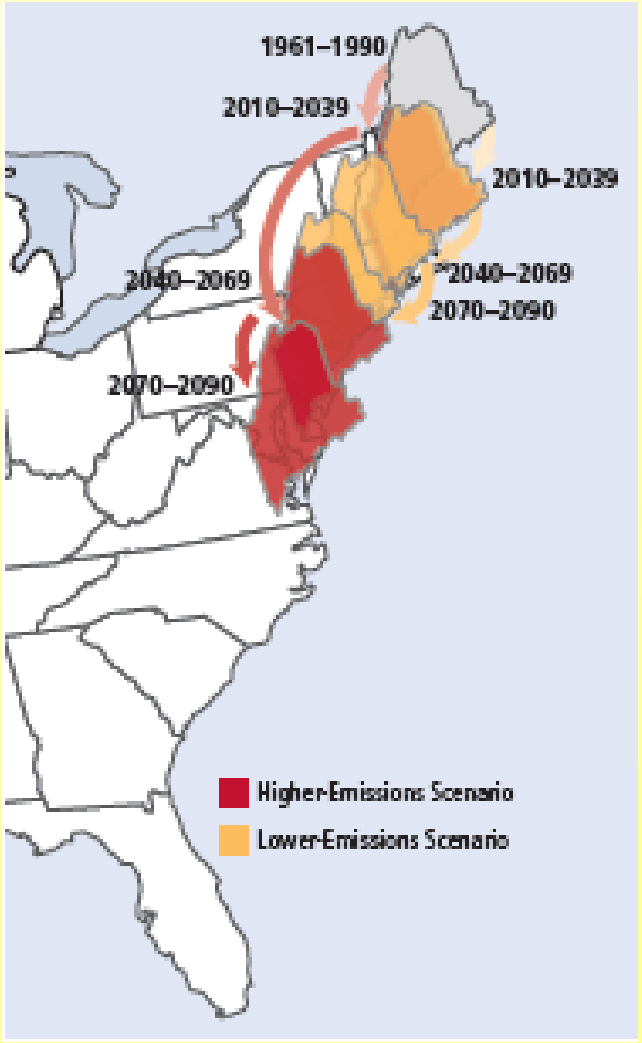


Surveillance of Heat Related Mortality

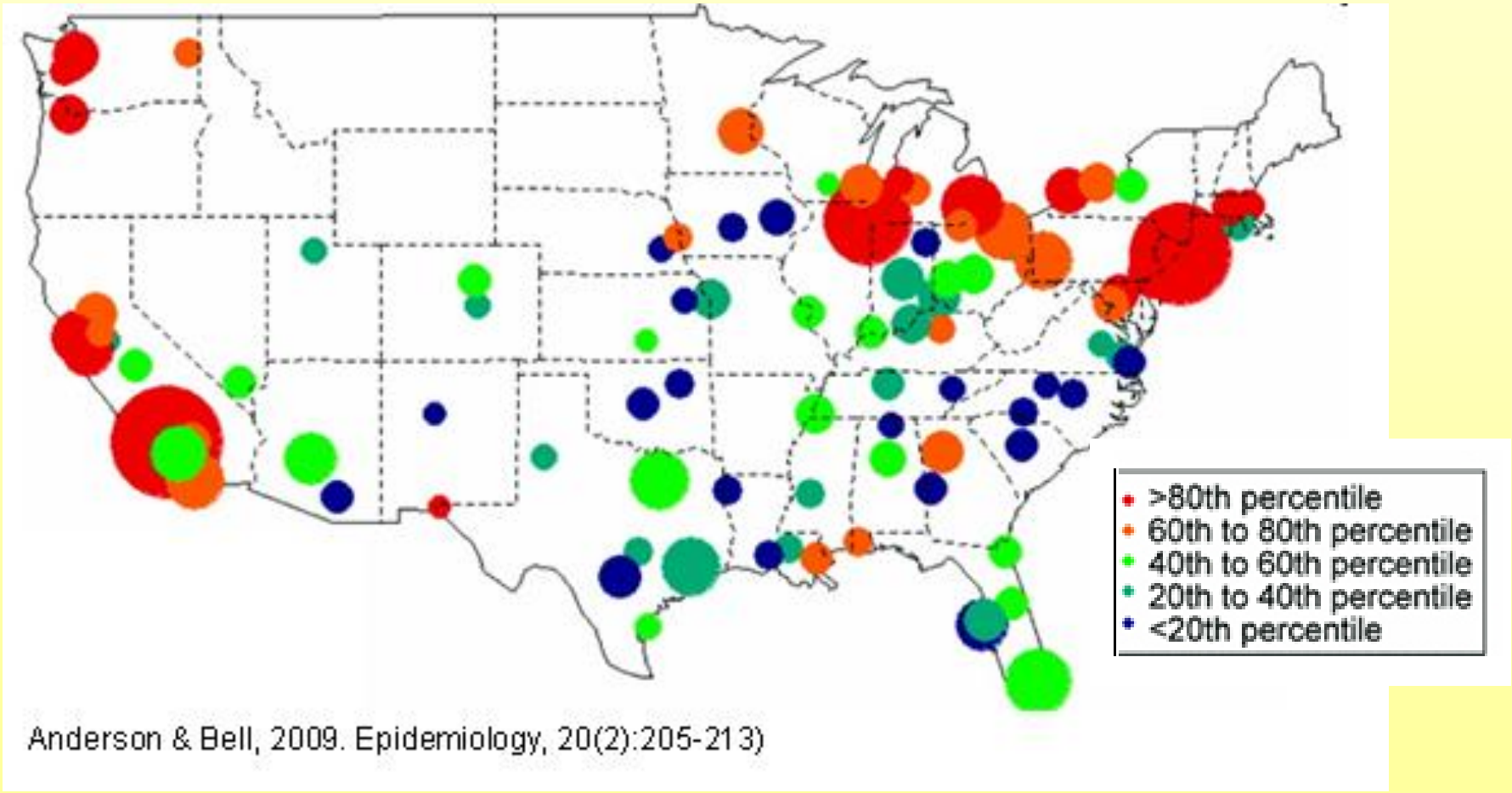
Why start with heat waves?

- More deaths from heat wave than all other weather events combined (CDC)
- Predicted to increase
- Currently ~700 U.S. heat-related deaths per year…
- If greenhouse gas emissions remain steady, estimated heat-related deaths in 2050 between 3,000 and 5,000 (CDC)

Heat waves in Maine??



Cooler climates are more vulnerable

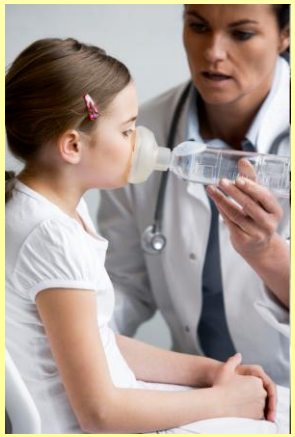


Anderson & Bell, 2009. Epidemiology, 20(2):205-213)

Vulnerable Populations

Vulnerable to heat waves:

- Elderly living alone
- Those with chronic diseases
- Rural?



Maine is:

- 3rd nationwide for % of elderly residents living alone
- 5th nationwide for % of adults with asthma
- 2nd nationwide for % of population living outside urban areas

Example: Chicago heat wave of 1995

July 12-16, 1995

- Daily Max T: 93-106 F
- Record humidity
- Nightly Min T: high 70s/low 80s
- ~**700** excess deaths
  - 85% increase over the same time period in 1994

Characteristics of Heat-Related Mortality

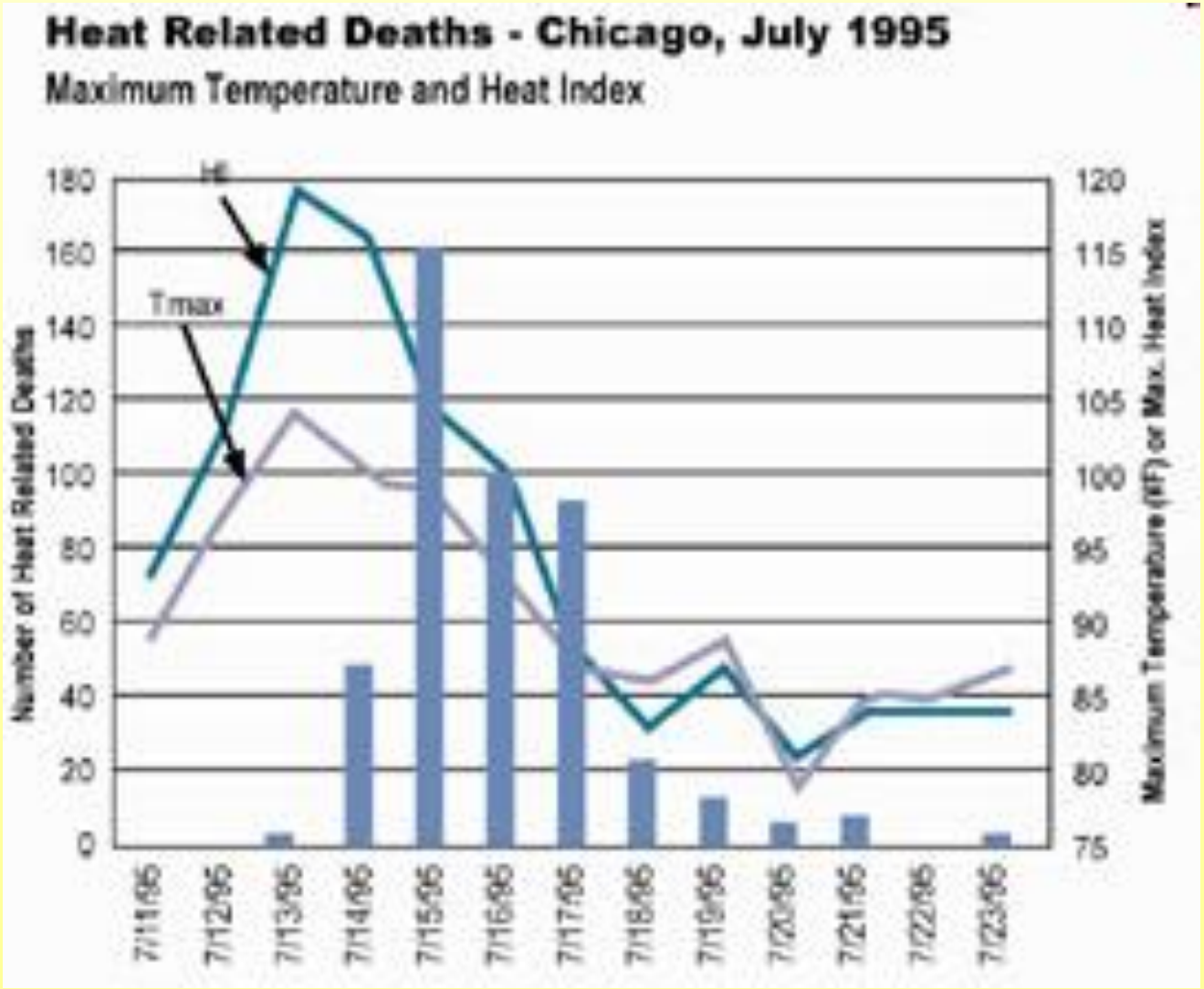


Figure: US Global Change Research Program

How to measure mortality?

CAUSE OF DEATH (See instructions and examples)

32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.

Approximate interval: Onset to death

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. Congestive heart failure — 7 years
Due to (or as a consequence of):

Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST
b. Coronary heart disease — 25 years
Due to (or as a consequence of):
c.
Due to (or as a consequence of):
d.

PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I.

Hypertension, atrial fibrillation

33. WAS AN AUTOPSY PERFORMED? ☐ Yes ■ No

34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? ☐ Yes ■ No

35. DID TOBACCO USE CONTRIBUTE TO DEATH? ☐ Yes ☐ Probably ■ No ☐ Unknown

36. IF FEMALE: ■ Not pregnant within past year ☐ Pregnant at time of death ☐ Not pregnant, but pregnant within 42 days of death ☐ Not pregnant, but pregnant 43 days to 1 year before death ☐ Unknown if pregnant within the past year

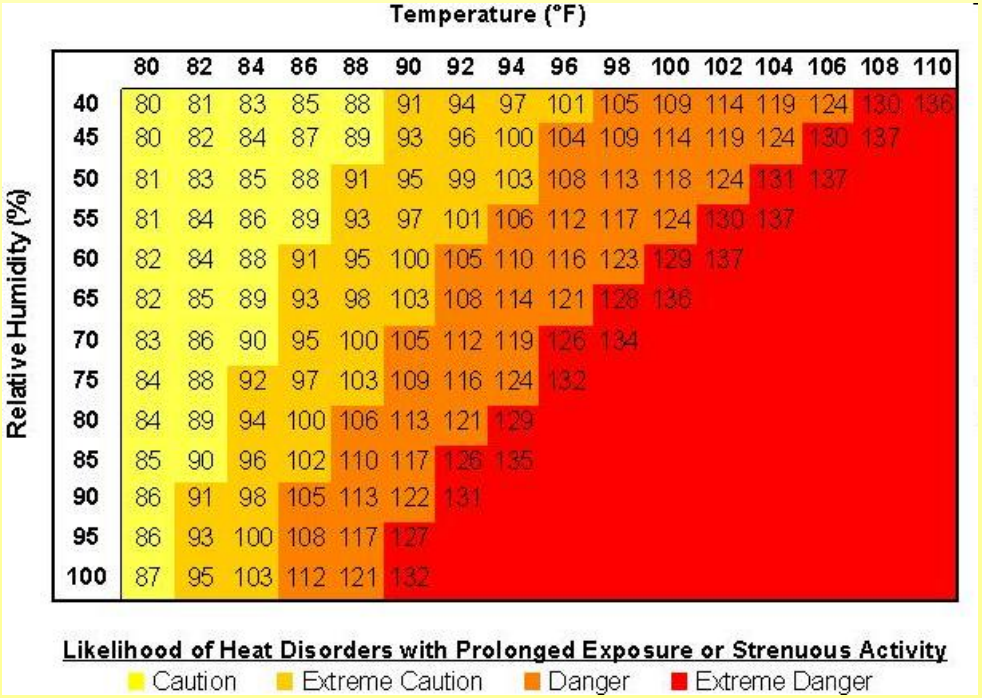
37. MANNER OF DEATH ■ Natural ☐ Homicide ☐ Accident ☐ Pending investigation ☐ Suicide ☐ Could not be determined

Problem: How to determine whether a death is heat-related?

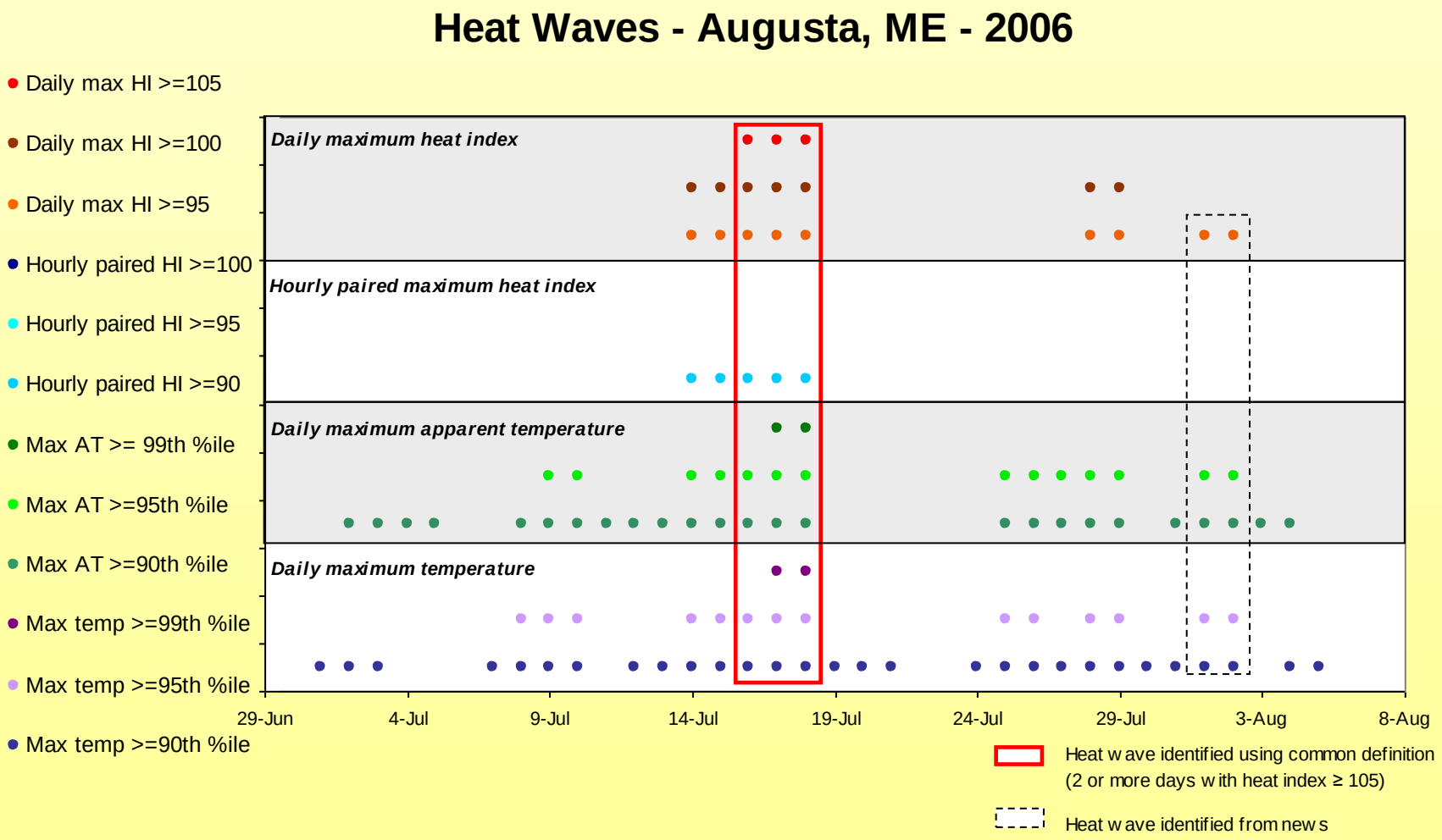
→ One solution: Count all-cause mortality during heat wave and compare to non-heat wave periods

How to measure heat waves?

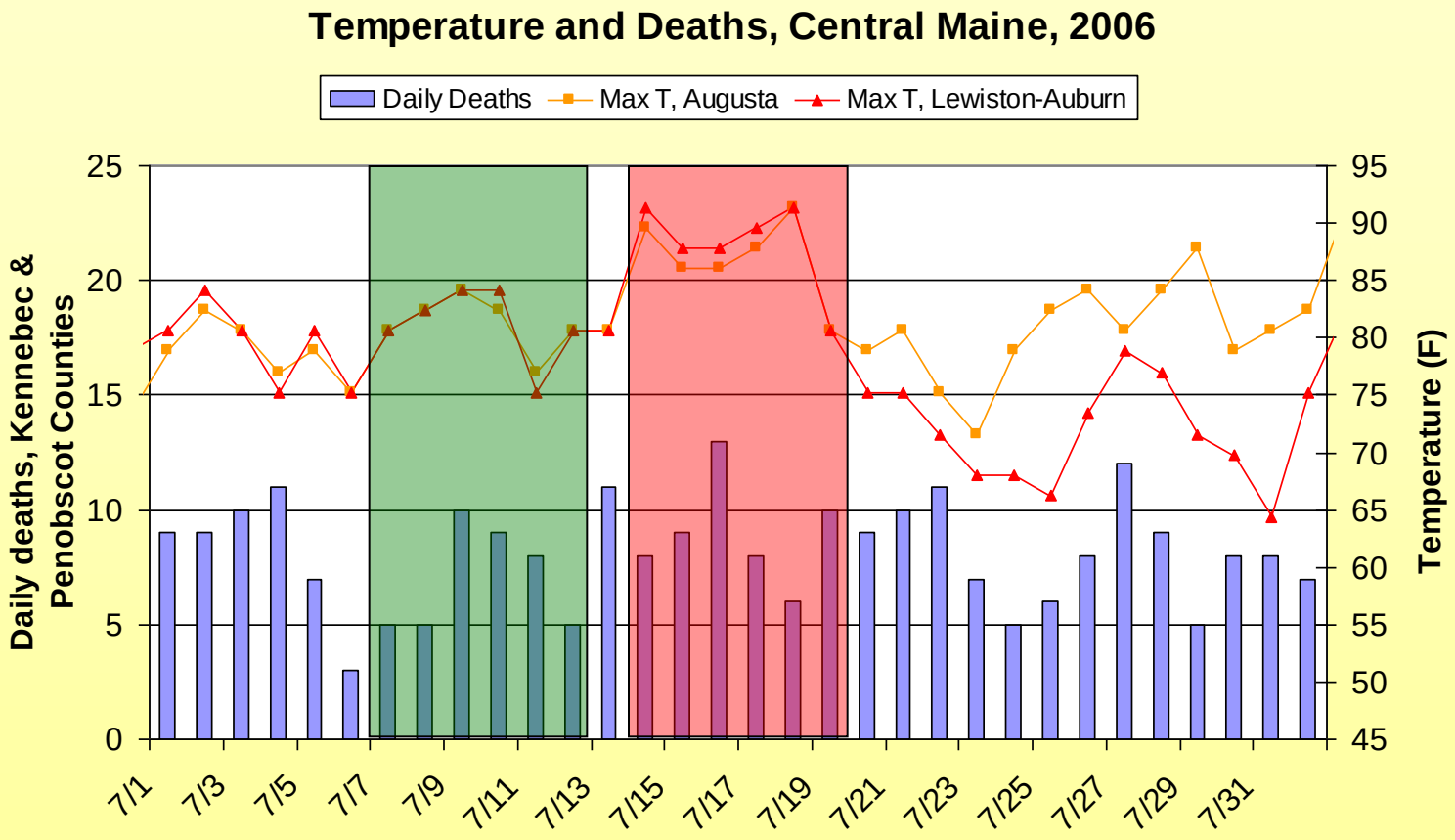
- Problem: There is <u>no consistent, universal definition</u>
  - Best working definition is a ‘prolonged period of excessively hot weather’ – but workgroup is still determining what this means
- Problem: Many different ways to measure *heat*



Heat Wave in Maine?

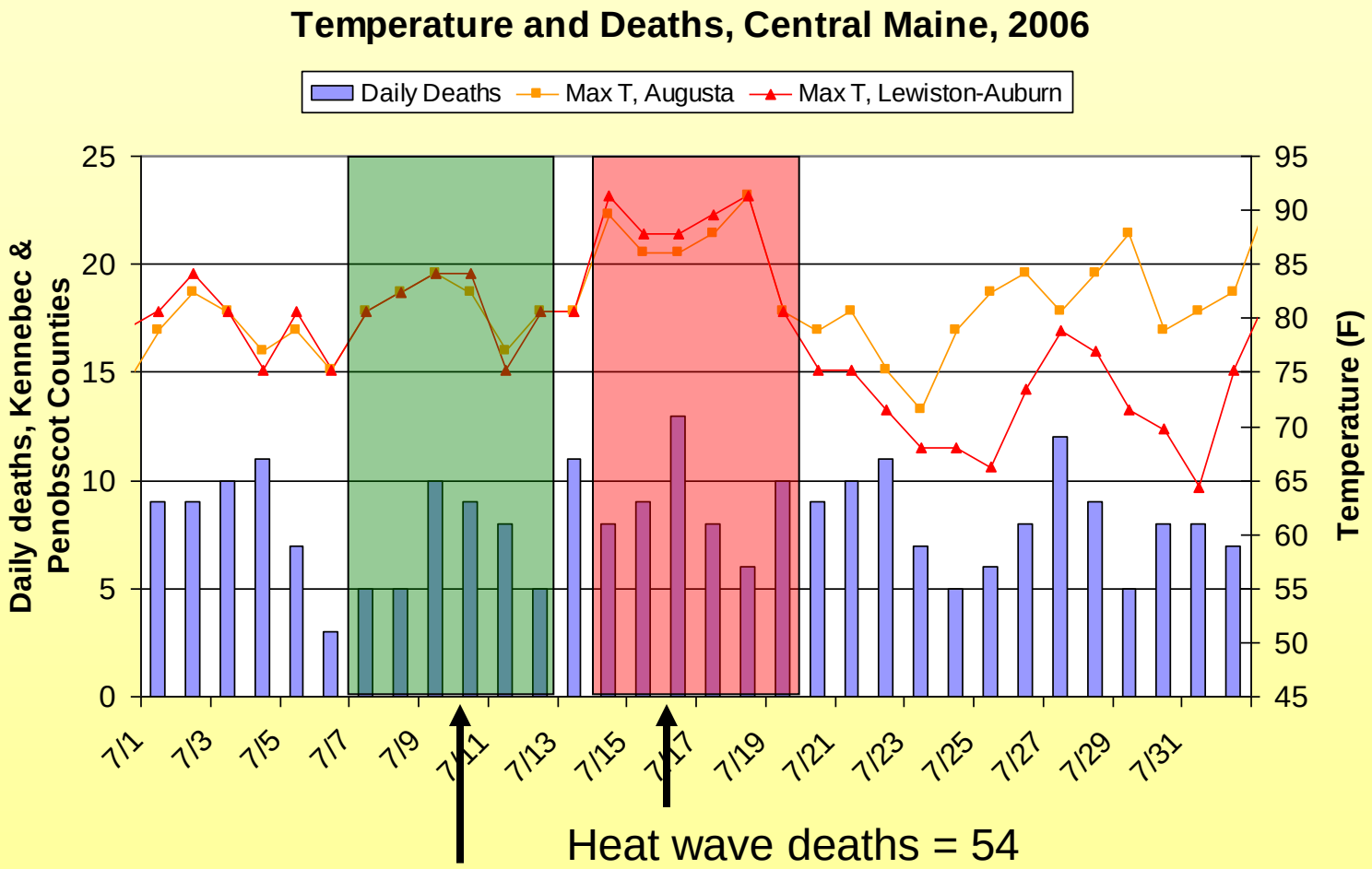


Mortality rate ratio example



1. Define a ‘heat wave’ period
2. Define a ‘reference’ period
3. Calculate the ratio of deaths in the heat wave period to deaths in the reference period

Mortality rate ratio example



Heat wave deaths = 54

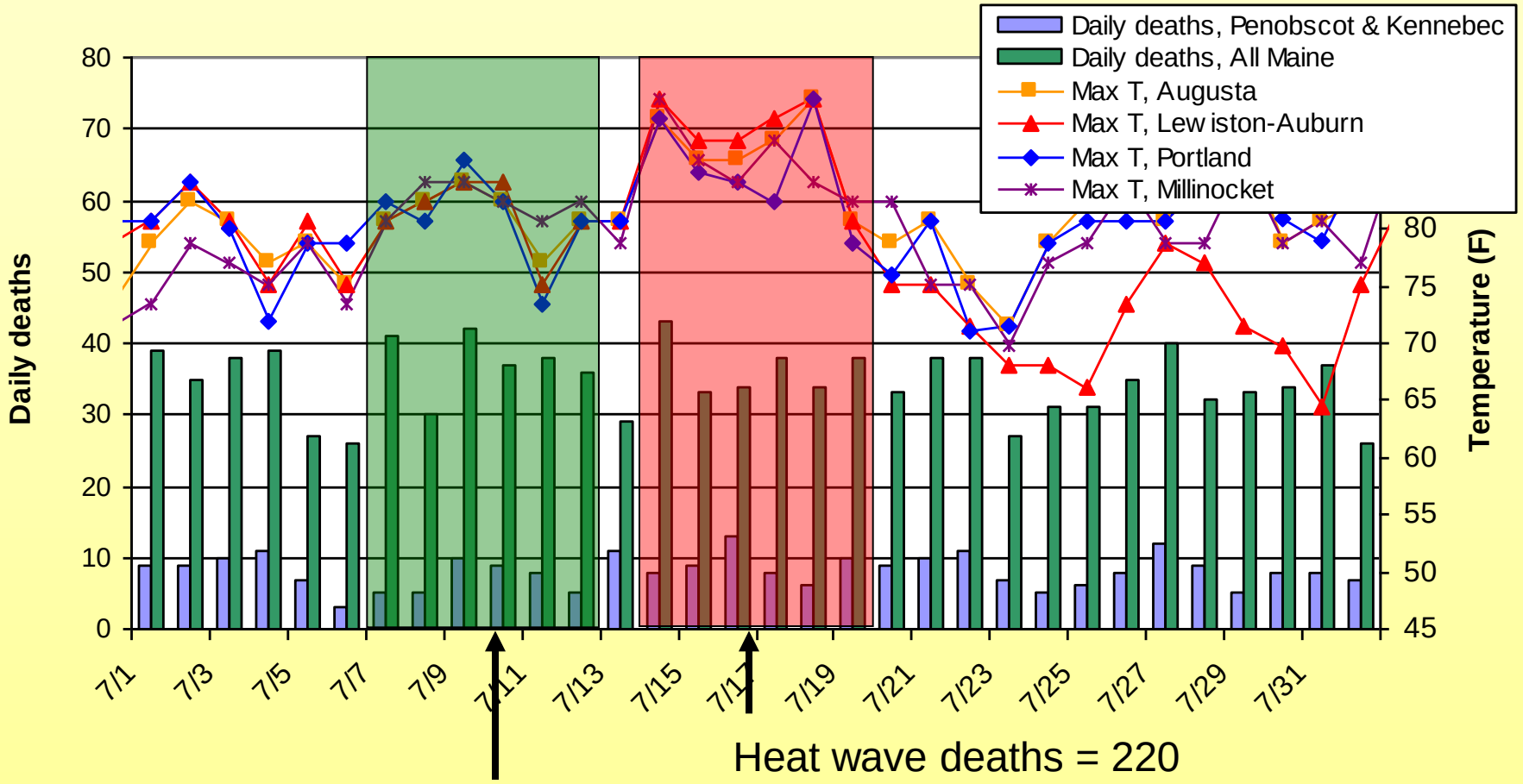
Reference period deaths = 42

Rate ratio = 54/42 = **1.29** → 29% more deaths than expected

95% Confidence Interval = 0.86-1.93

What comes next

Mortality rate ratio example: All ME



Heat wave deaths = 220

Reference period deaths = 224

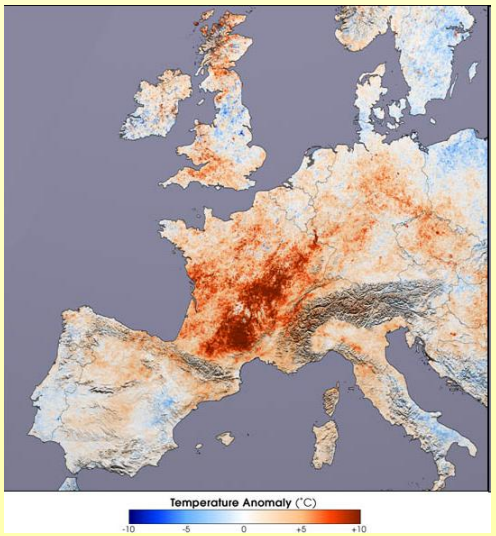
Rate ratio = 220/224 = **0.98** → 2% fewer deaths than expected

95% Confidence Interval = 0.82-1.18

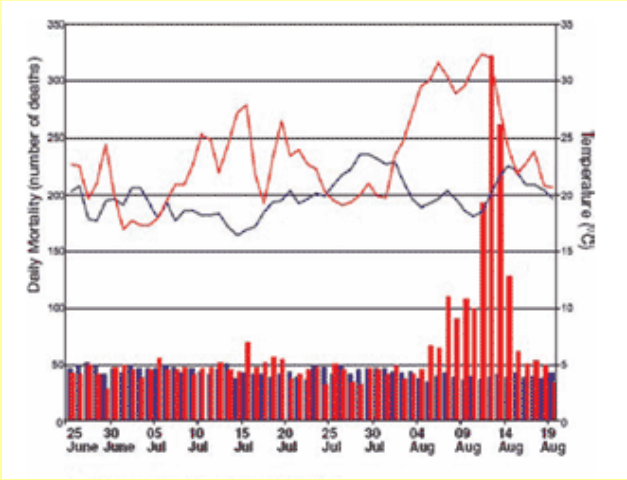
European heat wave of 2003

Late July-August, 2003

- Daily maximum temperatures 10 C (18 F) higher than average
- Nightly minimum temperatures also elevated
- Between **35,000 and 55,000** excess deaths (~**15,000** in France alone).

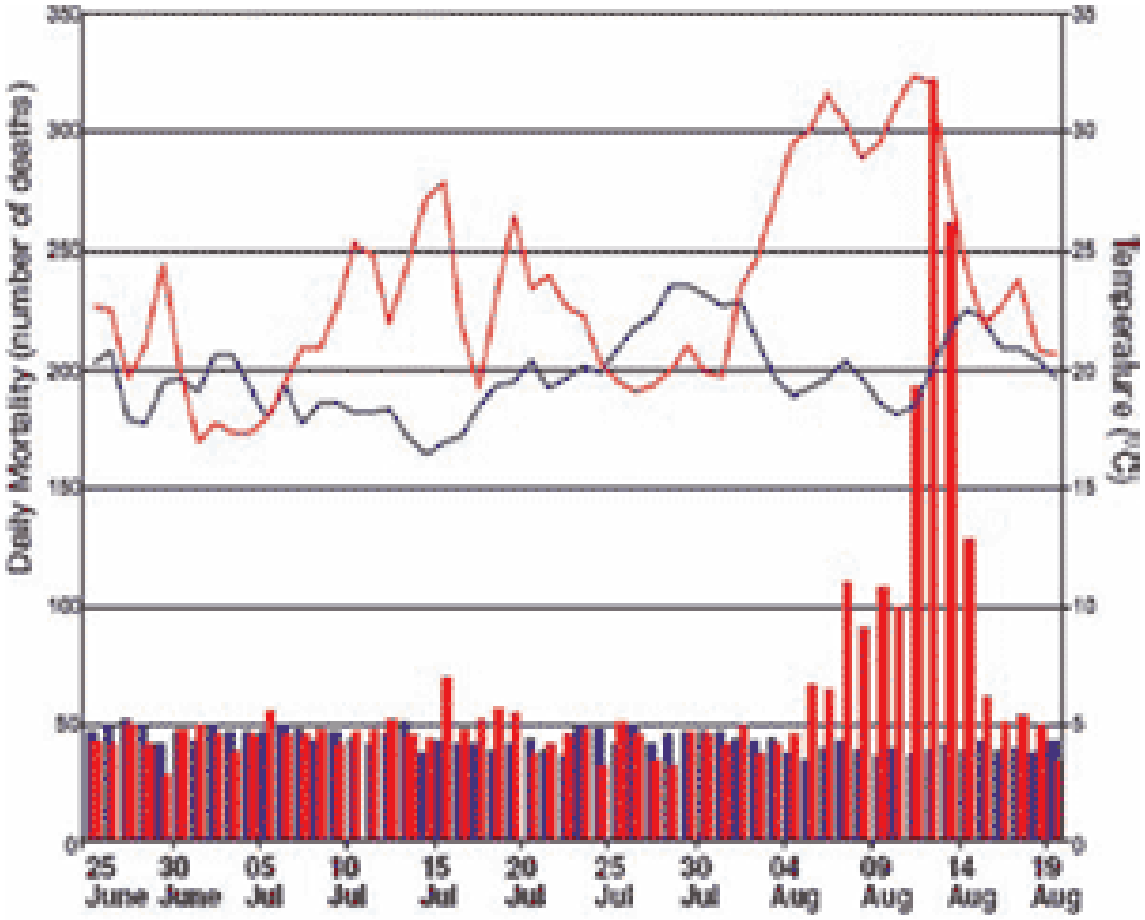


Temperature anomalies in southern Europe, 2003. Image: NASA



Daily temperature and deaths, France, 2003. Figure: Kalkstein et al., 2008. B Am Meteorol Soc, 89(1):75-85

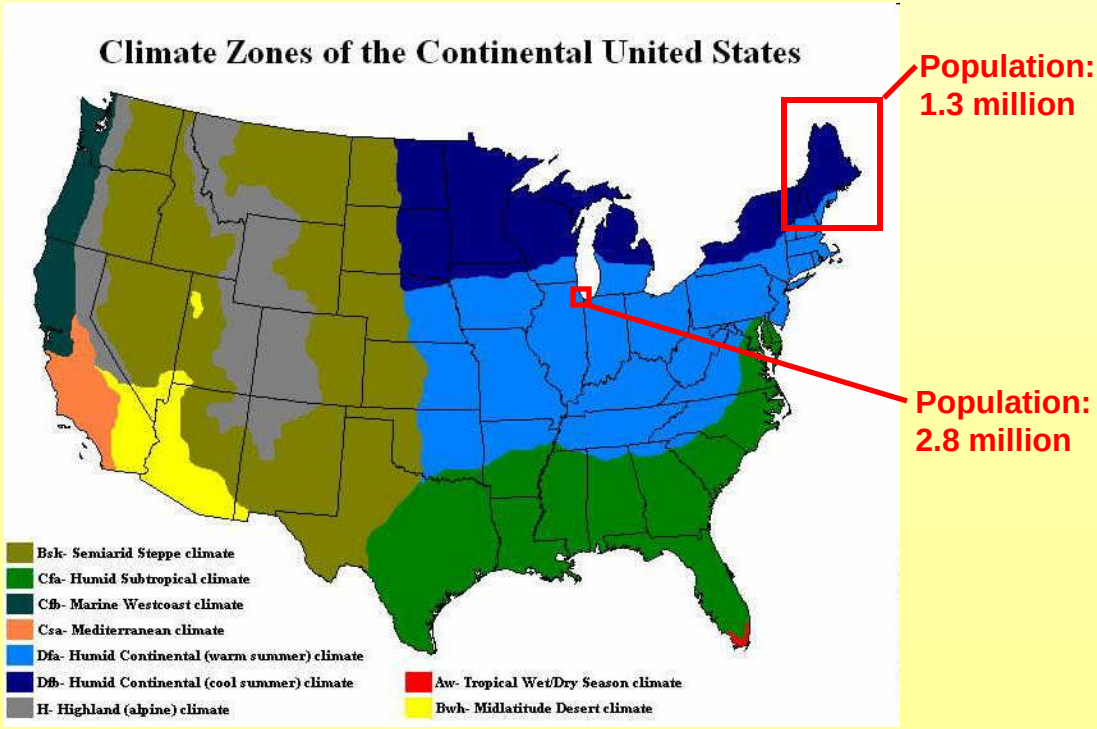
European heat wave of 2003



Daily temperature and deaths, France, 2003. Figure: Kalkstein et al., 2008. B Am Meteorol Soc, 89(1):75-85

Heat Waves in Maine?

- Cooler temperatures
- Smaller, more dispersed population



BUT…