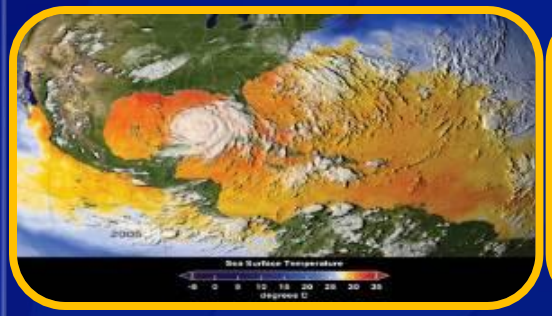
The Health Consequences of a Changing Climate

Findings from the 3rd US National Climate Assessment.

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Climate and Health Program
National Center for Environmental Health
Centers for Disease Control and Prevention

Objectives

- Summarize findings from 3rd US National Climate Assessment
- Review evidence for climate change and its impact on human health
- Describe CDC efforts to prepare for health effects of climate change

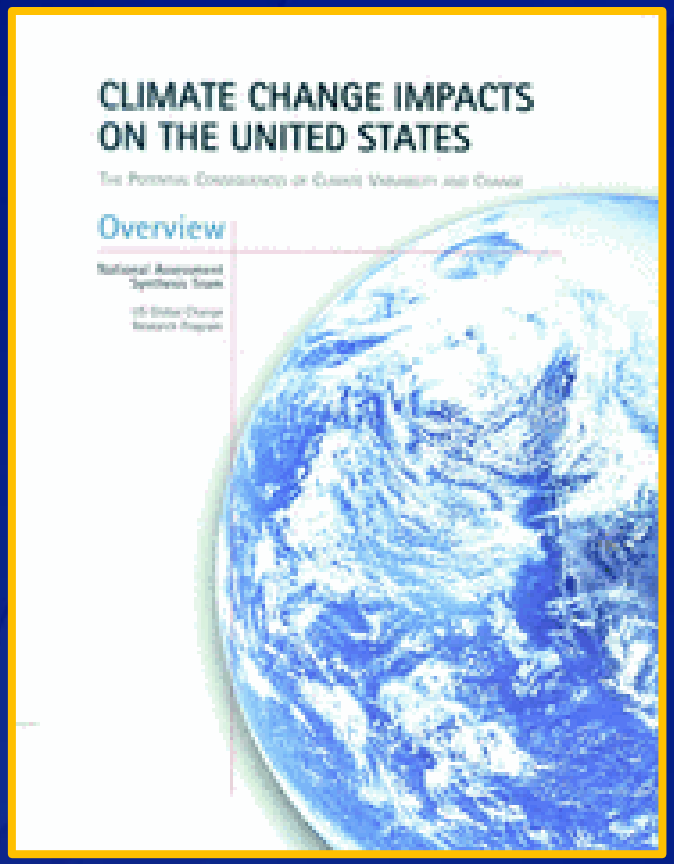
What is the National Climate Assessment?

- **Established through Global Research Act of 1990**
- **Led by White House Office of Science and Technology Policy**
  - Authors from academia; local, state, and federal government; private and nonprofit sectors
- **Analyzes impact of global climate change on various sectors of society, including public health**
- **Evaluates current trends in human-associated and natural global climate change**
- **Projects major climate trends in US for next 25-100 years**

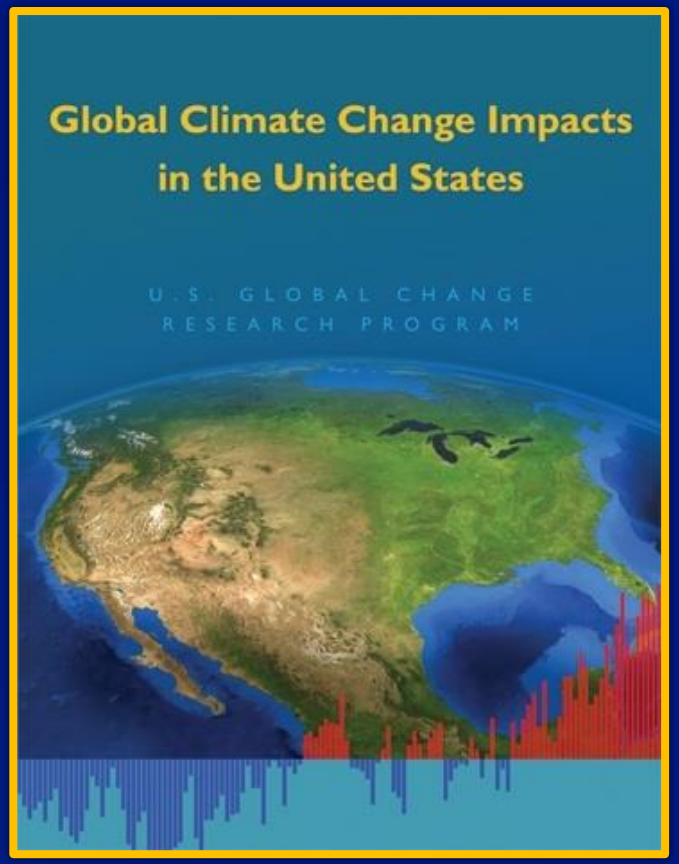
Source: National Climate Assessment Development Advisory Committee, *Draft Third National Climate Assessment Report*, http://ncadac.globalchange.gov

Previous National Climate Assessments

2000



2009



http://globalchange.gov/

3rd National Climate Assessment

- 3 year effort
- 240 authors
- 30 chapters

- Summarizes impacts for many sectors including public health, energy, water, transportation, and agriculture
- Will be published in spring 2014

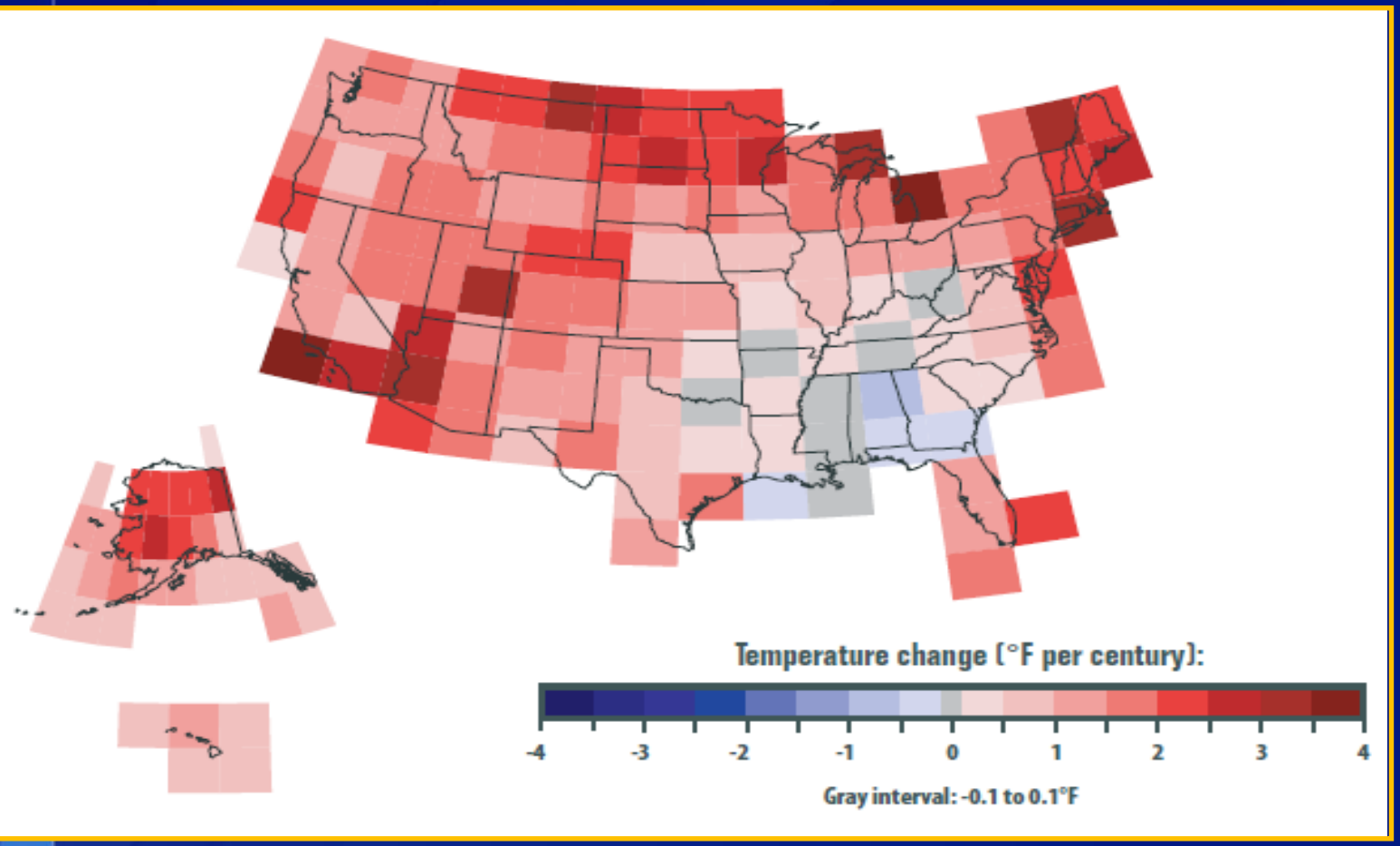
Source: National Climate Assessment Development Advisory Committee, *Draft Third National Climate Assessment Report*, http://ncadac.globalchange.gov

3rd National Climate Assessment
Key Findings
Increasing Strength of the Evidence

- Average US temperature has increased by about 1.5°F since 1895.
- Extreme weather events, including heat waves, floods, and droughts, have become more frequent and intense.
- Sea level has risen by about 8 inches since 1880, projected to rise another 1 to 4 feet by 2100.
- Frost-free season has been increasing since 1980s.
- Heavy downpours have increased in most US regions.
- Number of Category 4 and 5 hurricanes in North Atlantic has increased since early 1980s.

Source: National Climate Assessment Development Advisory Committee, *Draft Third National Climate Assessment Report*, http://ncadac.globalchange.gov

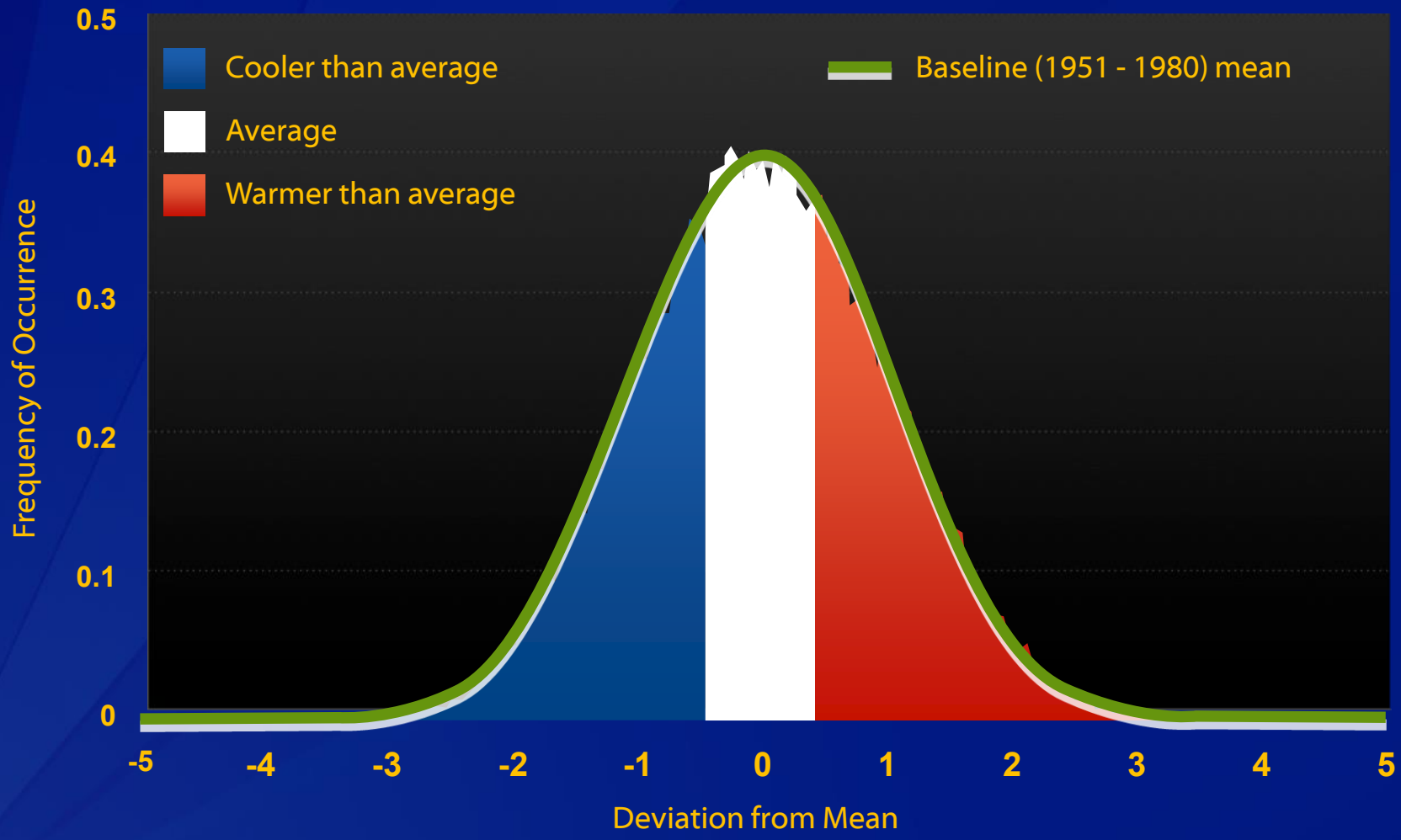
Warming has varied significantly by region (observed record)



Temp. Change 1901-2008

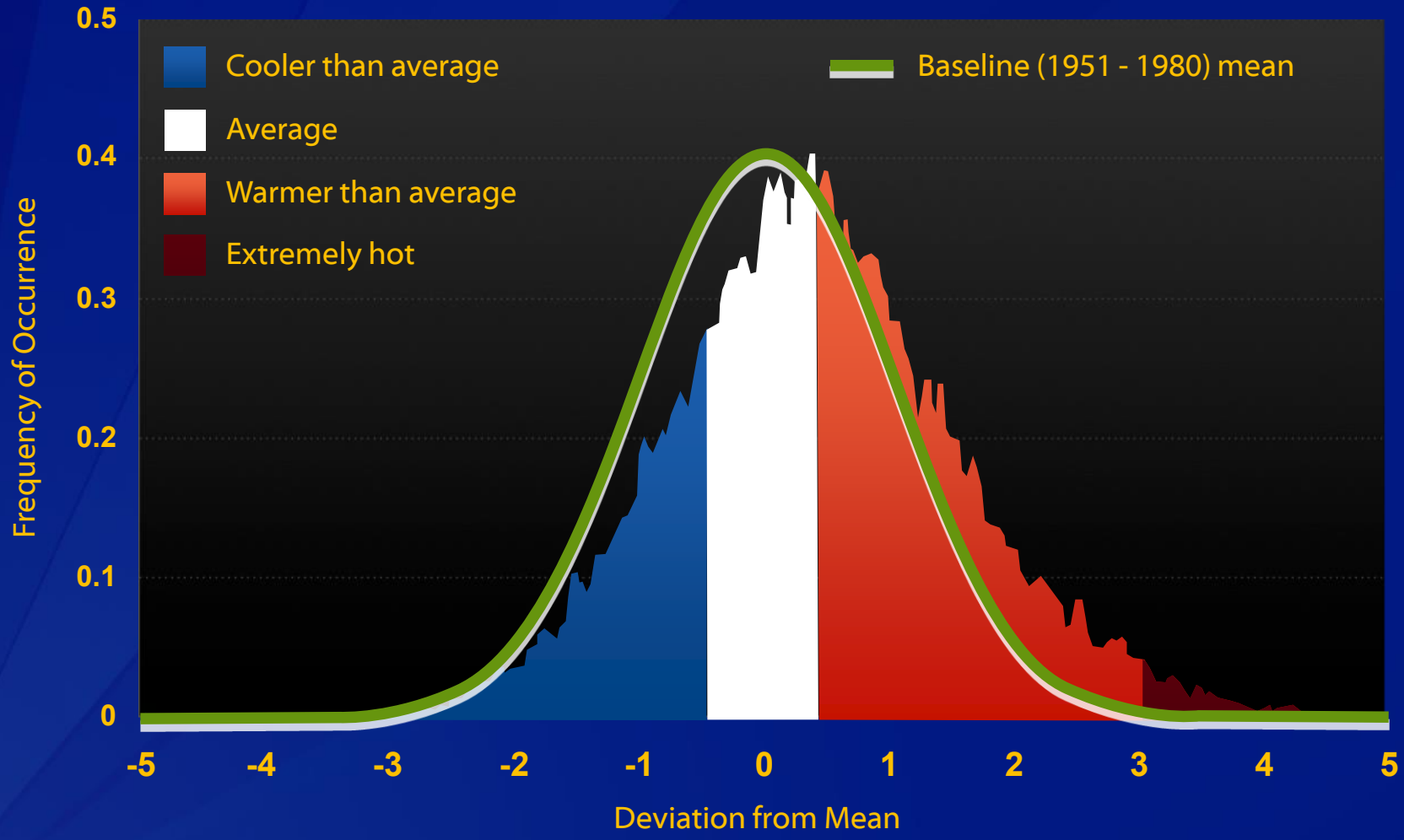
IPCC 4AR 2007

Summer Temperatures 1951–1980



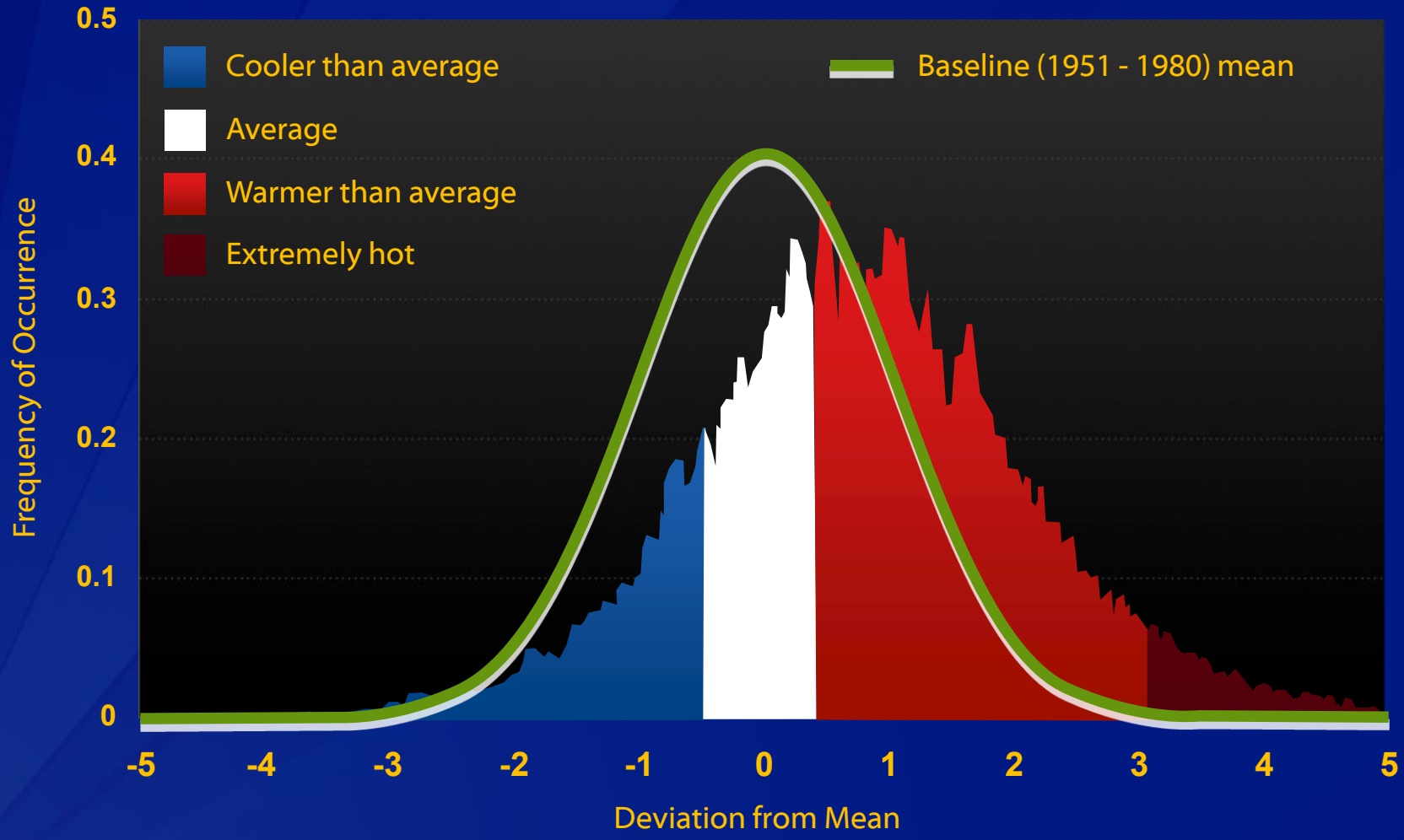
Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012

Summer Temperatures 1981–1991



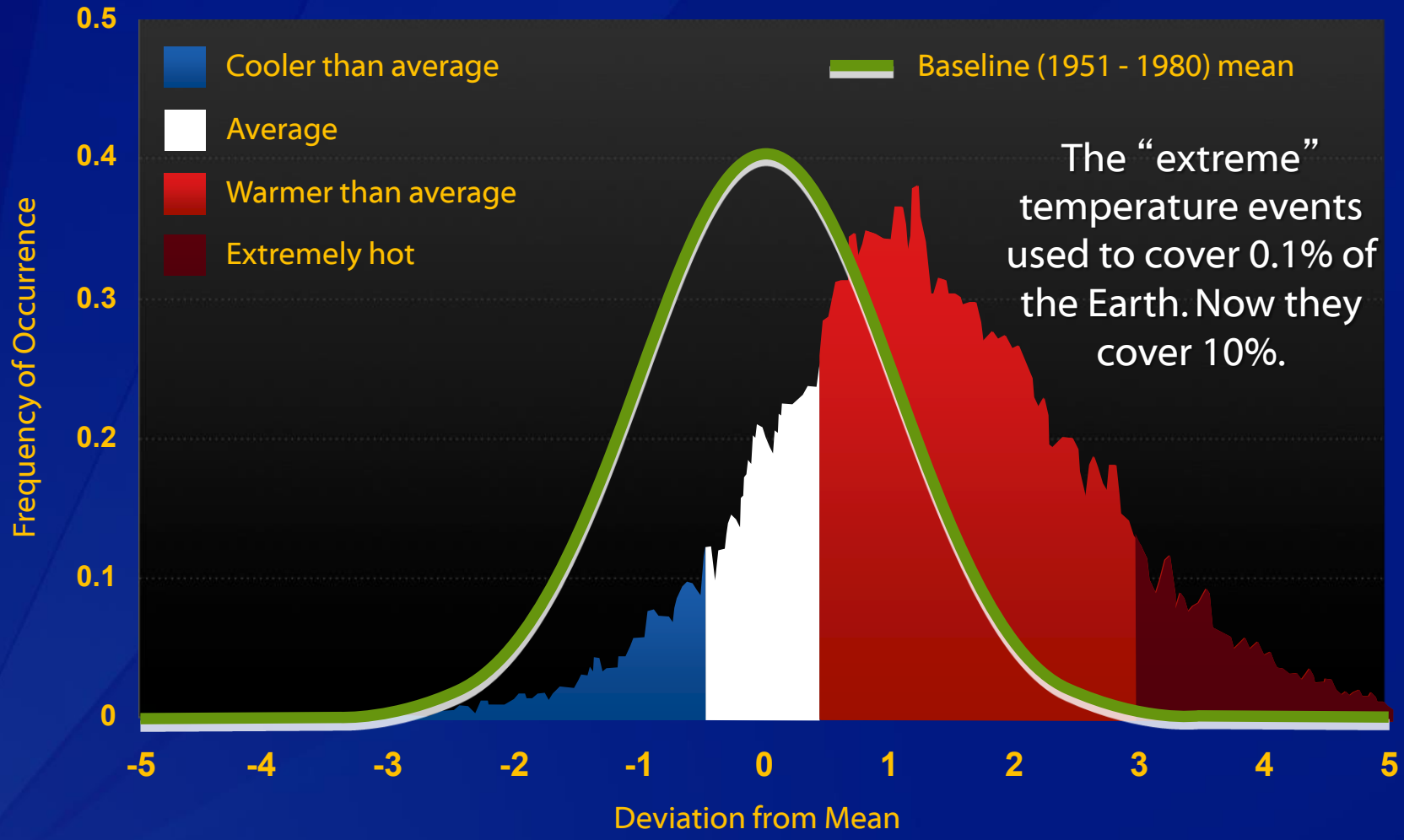
Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012

Summer Temperatures 1991–2001



Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012

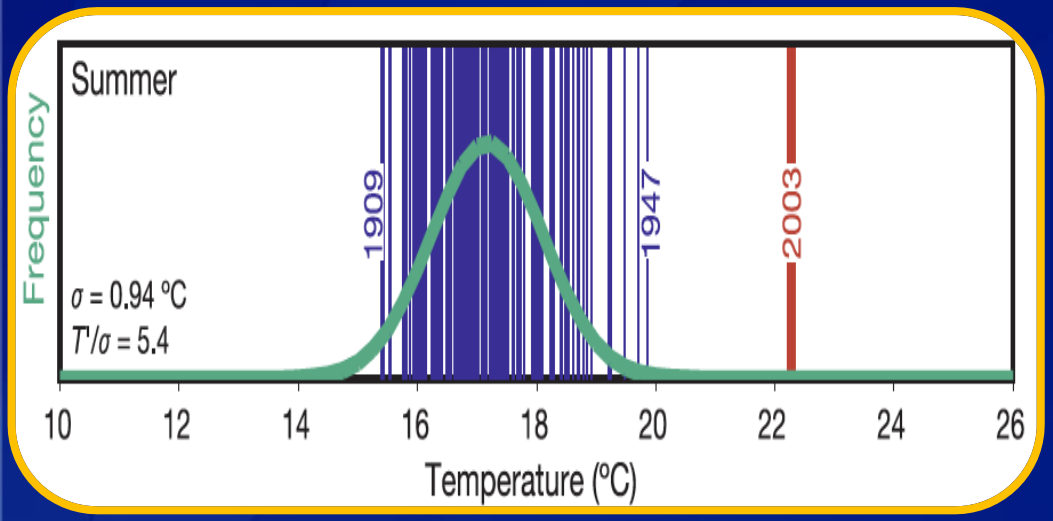
Summer Temperatures 2001–2011



Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012

Some Extreme Events will be well beyond historical experience

European Heat Wave of 2003

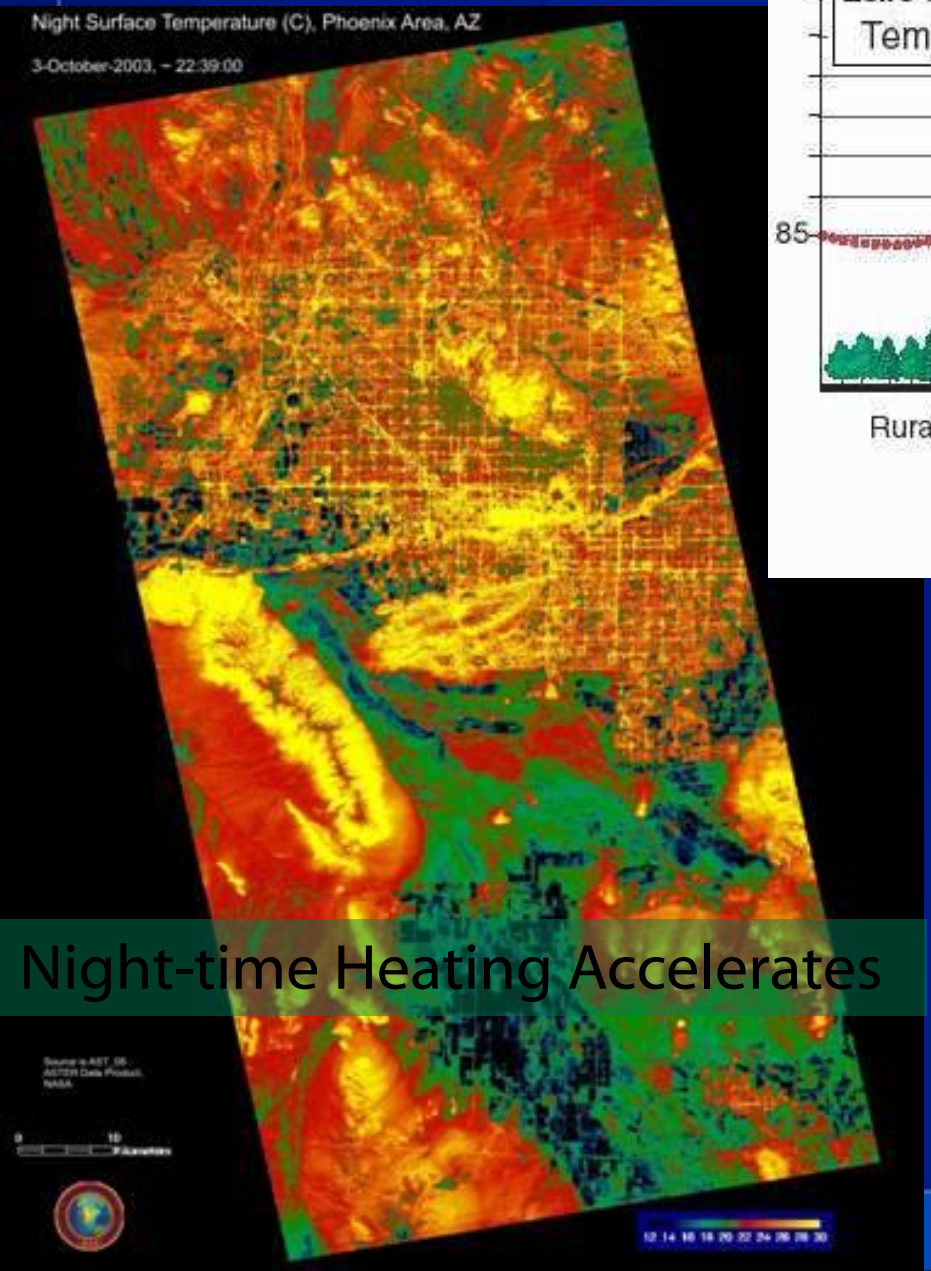


Confirmed Mortality

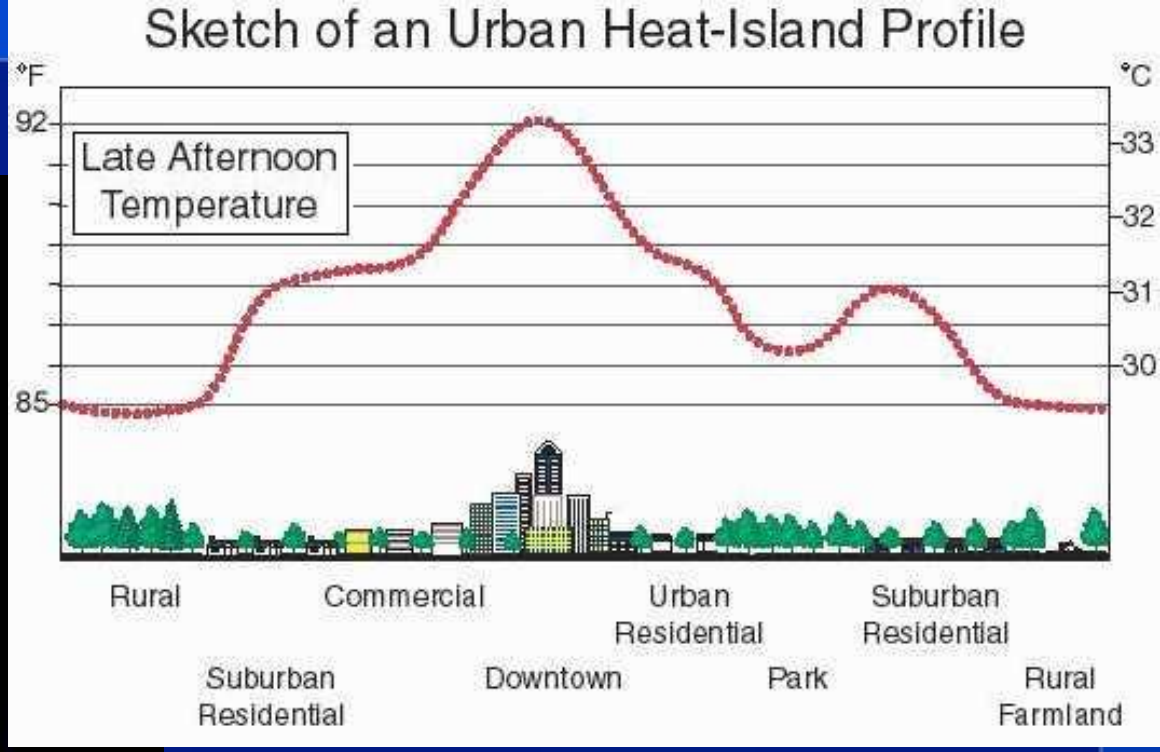
UK	2,091
Italy	3,134
France	14,802
Portugal	1,854
Spain	4,151
Switzerland	975
Netherlands	1,400-2,200
Germany	1,410
TOTAL	29,817-30,617

Haines et al. *Public Health* 2006;120:585-96.

Vandentorren et al. *Am J Public Health 2004; 94(9):1518-20.*



Night-time Heating Accelerates



Urban Heat Island can add 7° – 12° F

Thermal Satellite Image of Phoenix, AZ Night Surface Temperature

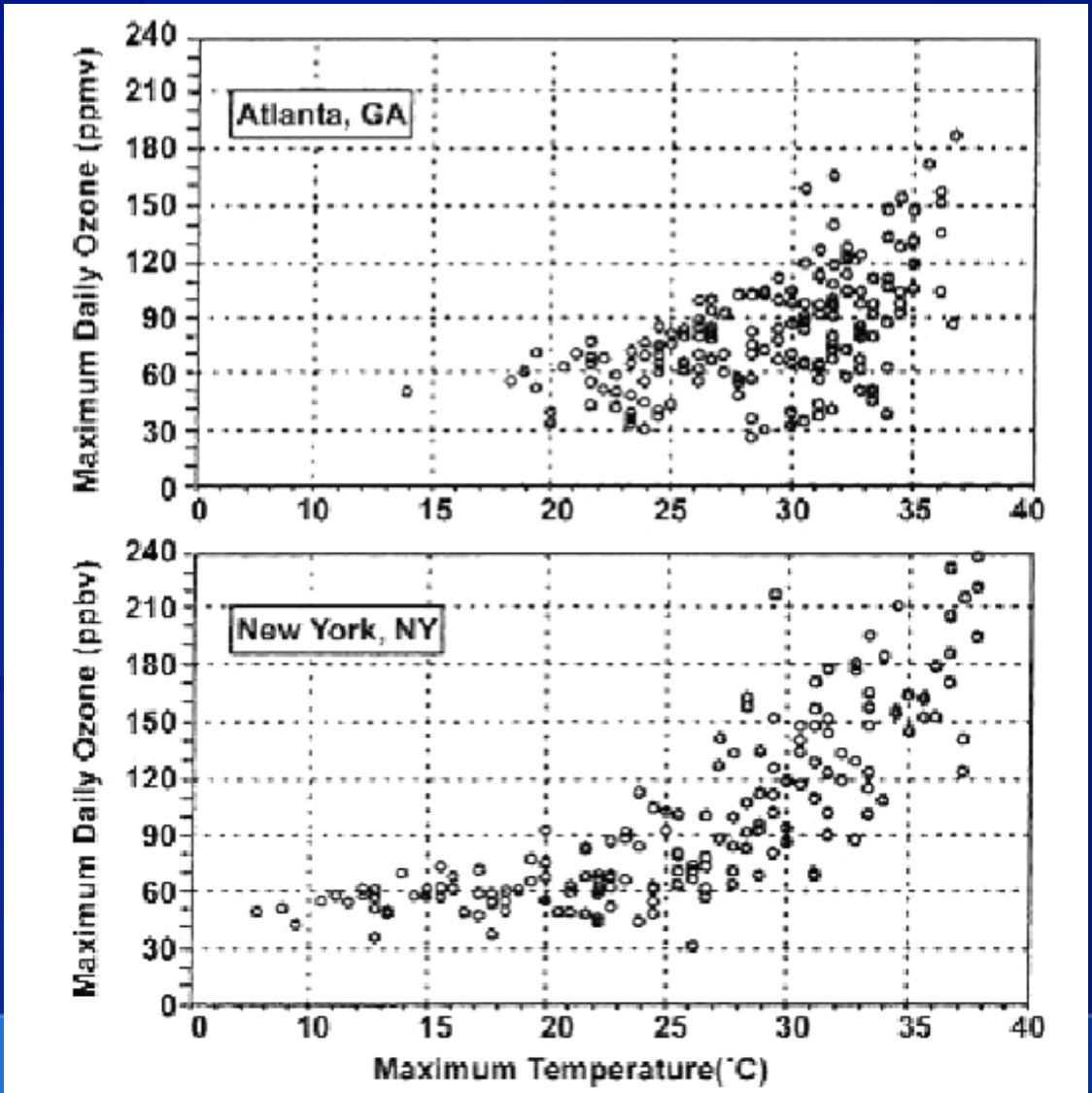
CDC
Environmental Health

Heat Island Impacts on Air Pollution

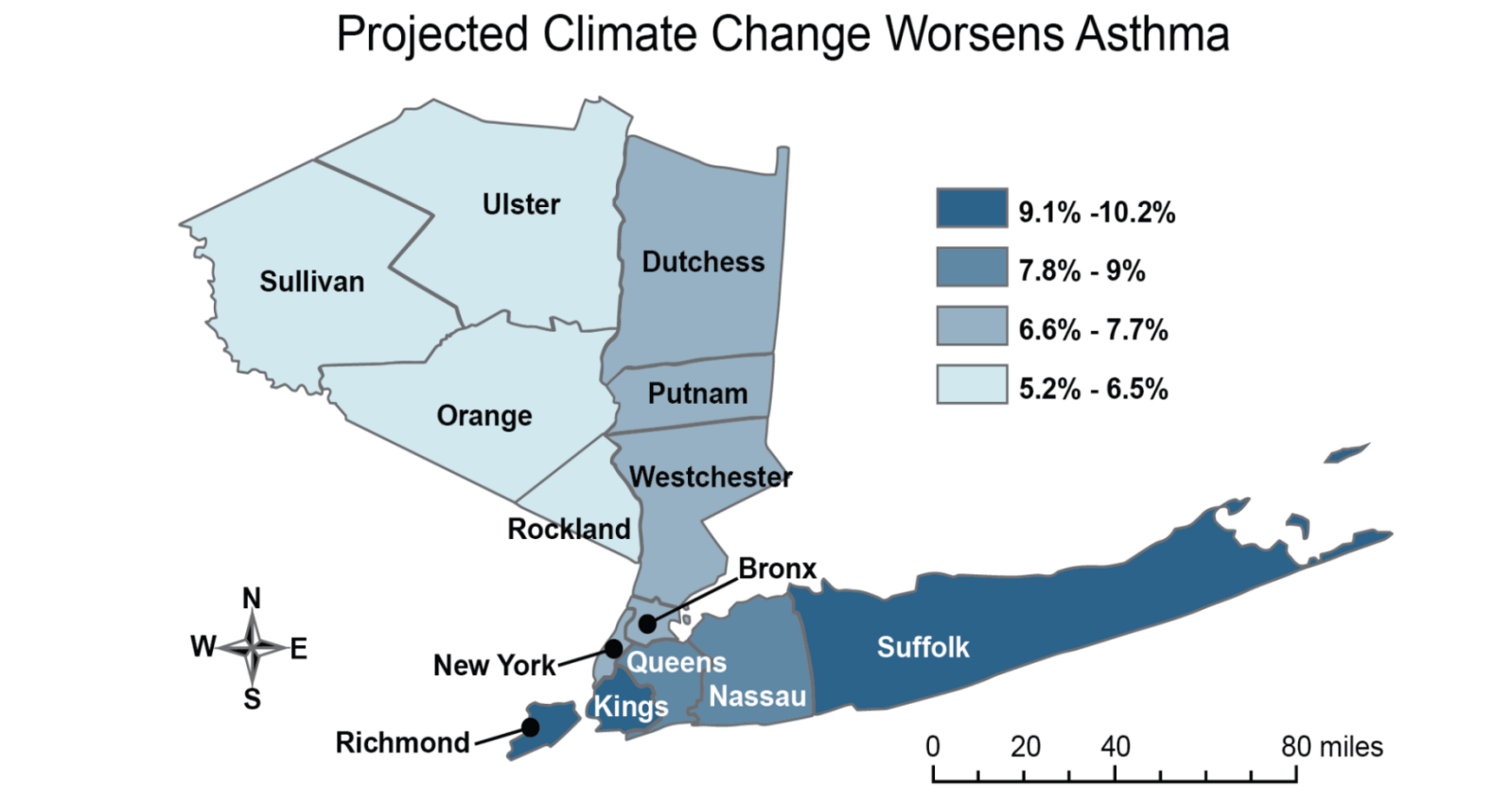
Maximum Daily Ozone Concentrations vs. Maximum Daily Temperature

Atlanta

New York



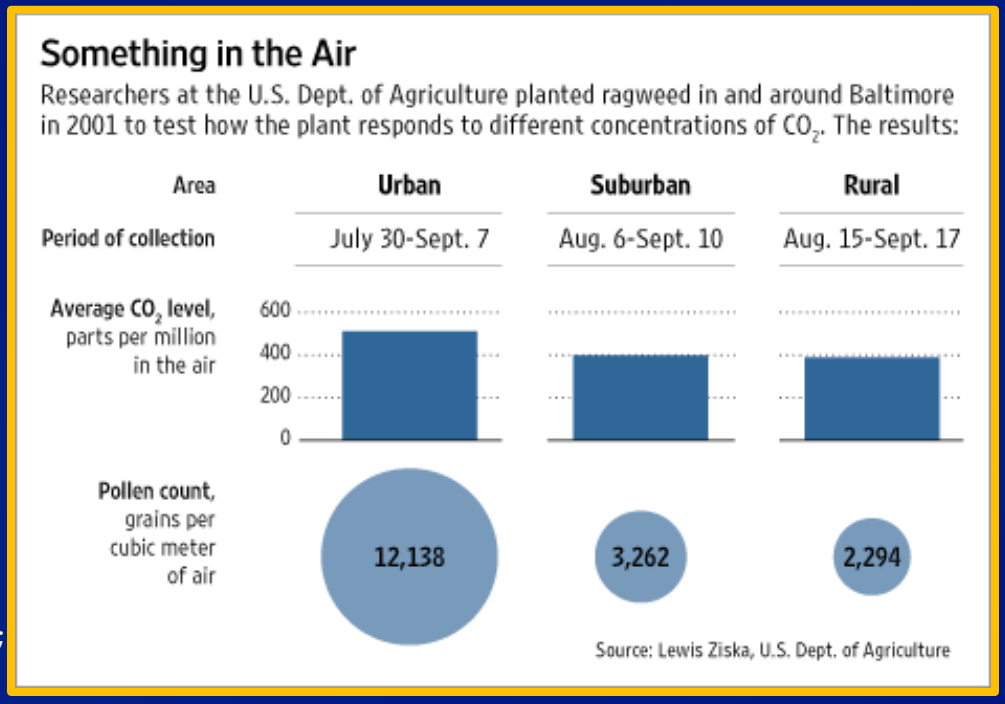
Increased Pediatric Emergency Department Visits for Asthma, 2020s



Source: Sheffield PE, Knowlton K, Carr JL, Kinney PL. 2011. Modeling of Regional Climate Change Effects on Ground-Level Ozone and Childhood Asthma. American Journal of Preventive Medicine 41(3):251-257

Climate Change Impacts Air Quality: Pollen

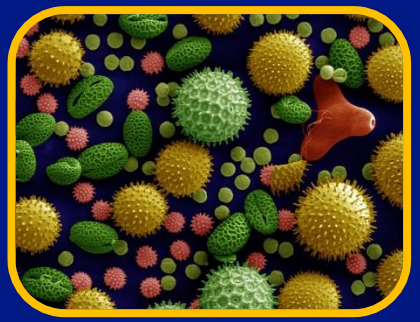
- **Ragweed**
  - ↑ CO_2 and temperature
  - ↑ Pollen counts, longer growing season



Source: Ziska et al., *J Allerg Clin Immunol* 2003;111:290-95;
Graphic: *Wall Street Journal*, 3 May 2007.

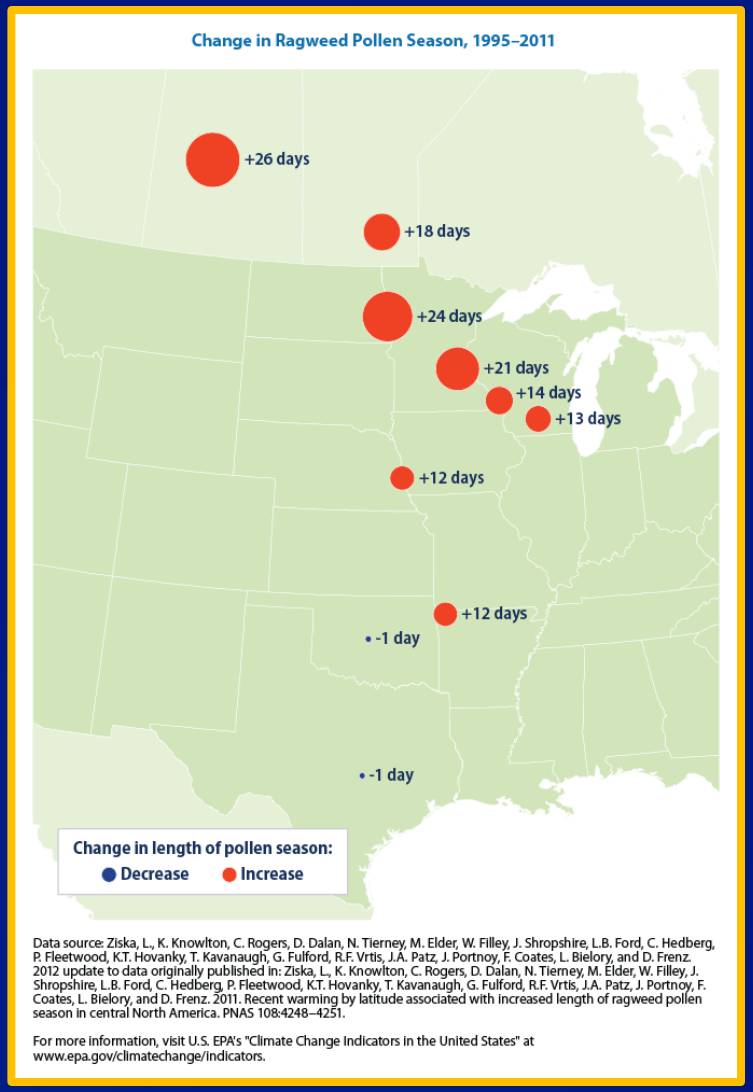
Pollen and Health

- Outdoor allergenic pollen and mold are the primary cause for allergic rhinitis or hay fever (Grammer, Greenberger, 2009).
- Annual treatment costs for allergic rhinitis are $11.2B (Blaiss, 2010) ; annual economic costs $5.4B (Kessler et al., 2001).
- As pollen count increases, allergy-related illnesses also increase (Heguy et al. 2008, Darrow et al., 2011).



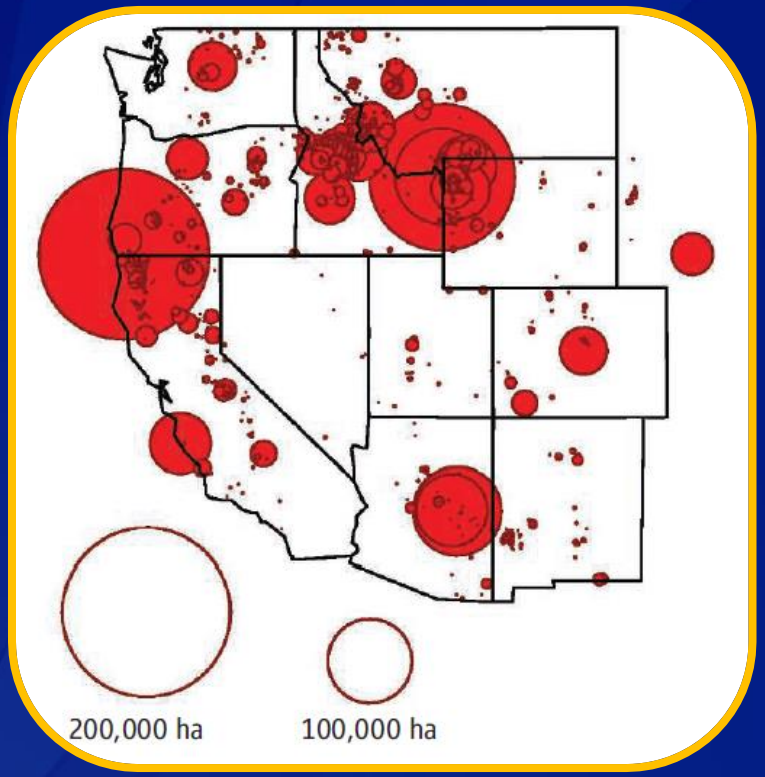
Pollen and Health

- **Seasonal Allergic Rhinitis affects 15%-20% of adults** (Grammer, Greenberger, 2009)
- **Ragweed pollen seasons are lengthening in the northern latitudes** (Ziska et al., 2012)
- **Increased CO2 concentrations and warmer temperature were associated with increased ragweed pollen production and an earlier pollen season.** (Ziska et al., 2003)



Climate Change Impacts Air Quality: Wildfire Smoke

Wildfire Activity Since 1970



- **Since 1970**
  - Western US wildfire season increased by 78 days
  - Average duration of fires increased five fold

Westerling et al. Warming and earlier spring increase western U.S. forest wildfire activity *Science*. 2006 Aug 18;313(5789):940-3

Climate Change Impacts Air Quality: Wildfire Smoke (cont.)

- **Increase of 10µg/m^3 in PM_{10} from wildfires results in about 1% increase in non-accidental mortality[1,2,3]**
- **During Australian bushfires**
  - Overall mortality rose 5%
  - Hospital admissions for respiratory illnesses increased 3-5%[4]

[1]Morgan G et al. Effects of bushfire smoke on daily mortality and hospital admissions in Sydney, Australia. *Epidemiology*. 2010 Jan;21(1):47-55.

[2]Sastry N. Forest fires, air pollution, and mortality in southeast Asia. *Demography*. 2002 Feb;39(1):1-23.

[3]Hanninen OO. Population exposure to fine particles and estimated excess mortality in Finland from an East European wildfire episode. *J Expo Sci Environ Epidemiol*. 2009 May;19(4):414-22

[4]Johnston F et al. Extreme air pollution events from bushfires and dust storms and their association with mortality in Sydney, Australia 1994-2007. *Environ Res*. 2011 Aug;111(6):811-6.

Dust Storms and Health

- Greater likelihood of injuries from motor vehicle accidents.
- Increased risk of asthma related hospitalizations.
- Increased Indoor and Outdoor Air Pollution ($PM_{2.5}$ and PM_{10})

Kanatani, et al., 2010. Desert dust exposure is associated with increased risk of asthma hospitalization in children. Am J Respir Crit Care Med.
Kuo, H. , 2009. Indoor and outdoor PM2.5 and PM10 concentrations in the air during a dust storm. Building and Environment.
Chen, et al., 2010. Ambient Influenza and Avian Influenza Virus during Dust Storm Days and Background Days. Environ Health Perspect.

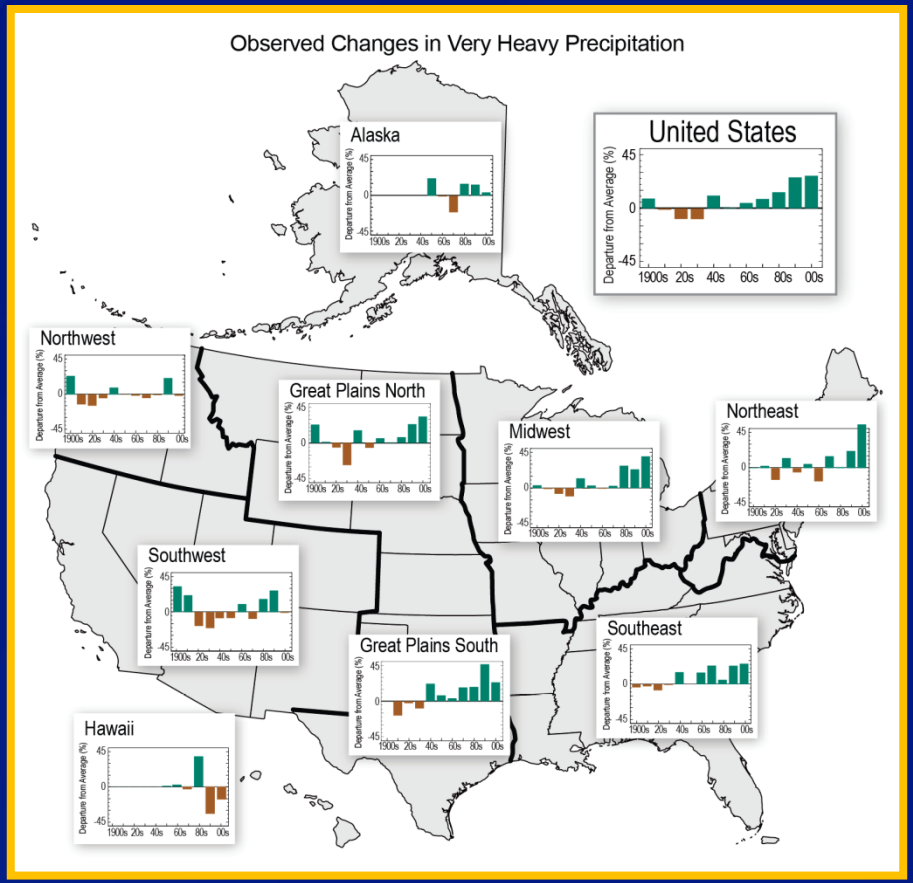
Dust Storms and Health - Coccidioidomycosis (Valley Fever)

- *Coccidioides immitis* **primarily dispersed by wind and dust storms.**
- *C. immitis* **thrives during wet periods following droughts**
- **Infections occur during dry season**

Source:
Pappagianis and Einstein, 1978. Epidemiology of coccidioidomycosis. Current Topics in Mycology.
Zender and Talamantes, 2006. Climate controls on valley fever incidence in Kern County, California. Int J Biometeorol.

Extreme Precipitation Events Impact Human Health: Waterborne Disease

- 67% of waterborne disease outbreaks preceded by precipitation above 80th percentile (across 50 year climate record)
- Heavy precipitation events projected to occur more frequently



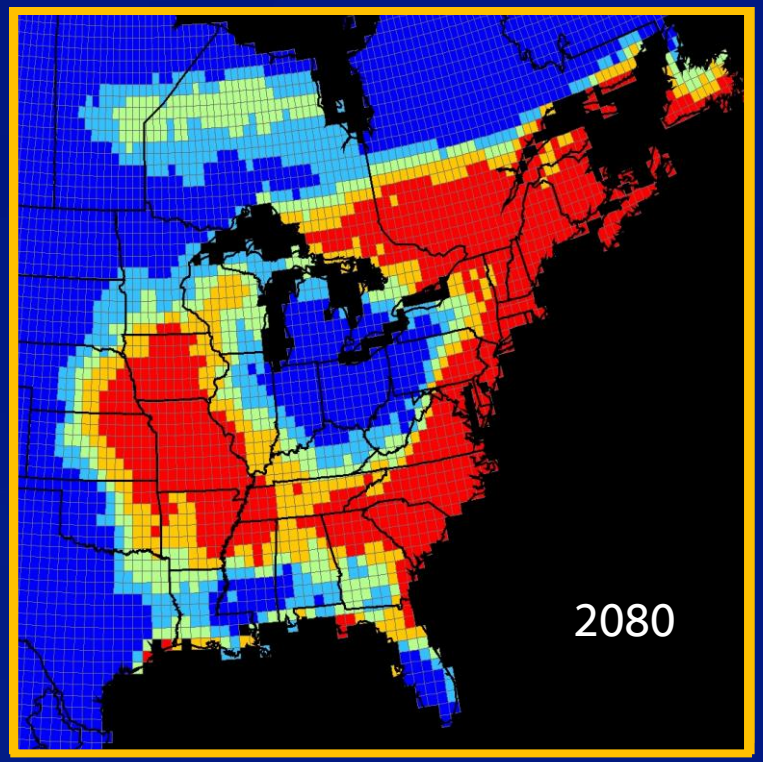
Observed Increases in Very Heavy Precipitation (heaviest 1% of all events) 1901 to 2011

Curriero, Patz, et al, 2001.

Source: Walsh et al. 2013: *Draft NCA Report*, Chapter 2

Precipitation, Humidity, and Temperature Changes Impact Human Health: Lyme Disease

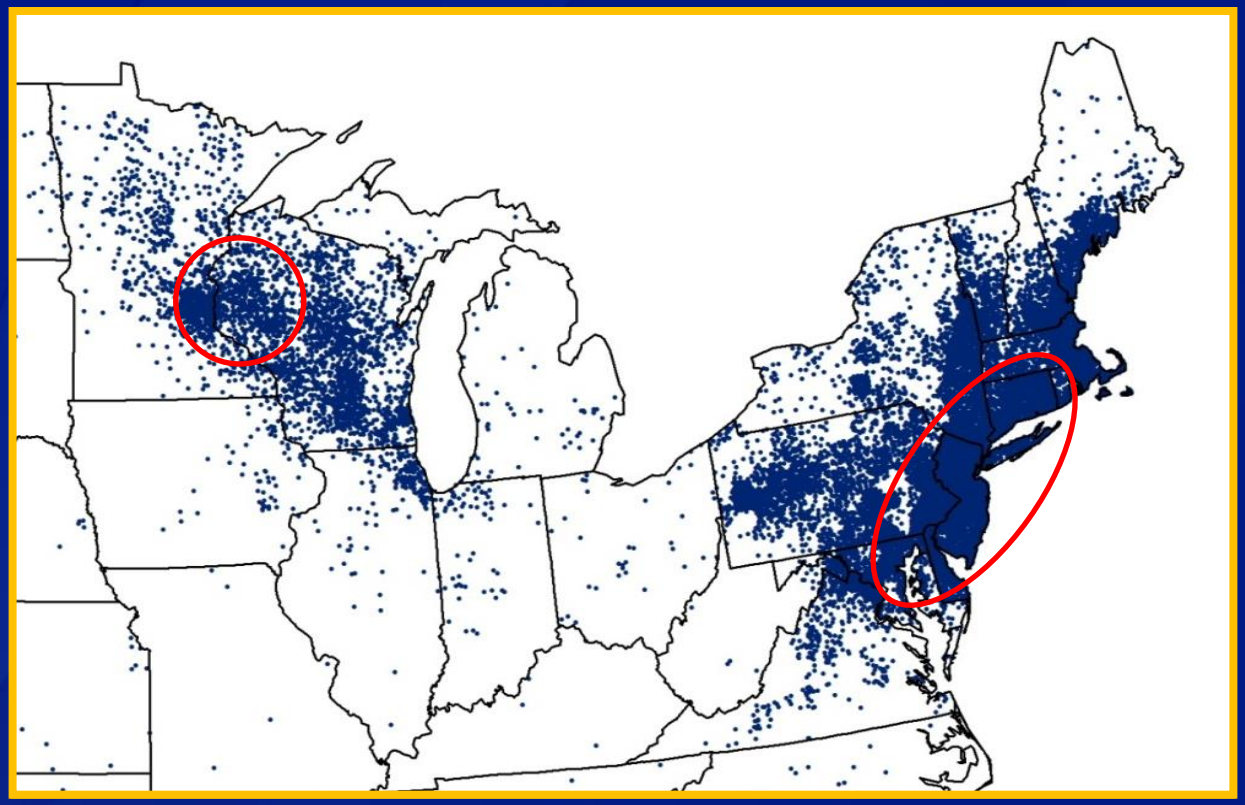
- **Spread of Lyme disease factors**
  - Climate
  - Ecological
  - Social



Range of suitable conditions for *Ixodes scapularis*, the Lyme disease tick

Source: Brownstein JS, Holford TR, Fish D. A climate-based model predicts the spatial distribution of the Lyme Disease vector *Ixodes scapularis* in the United States. *Environ Health Persp* 2003;111(9):1152-57.

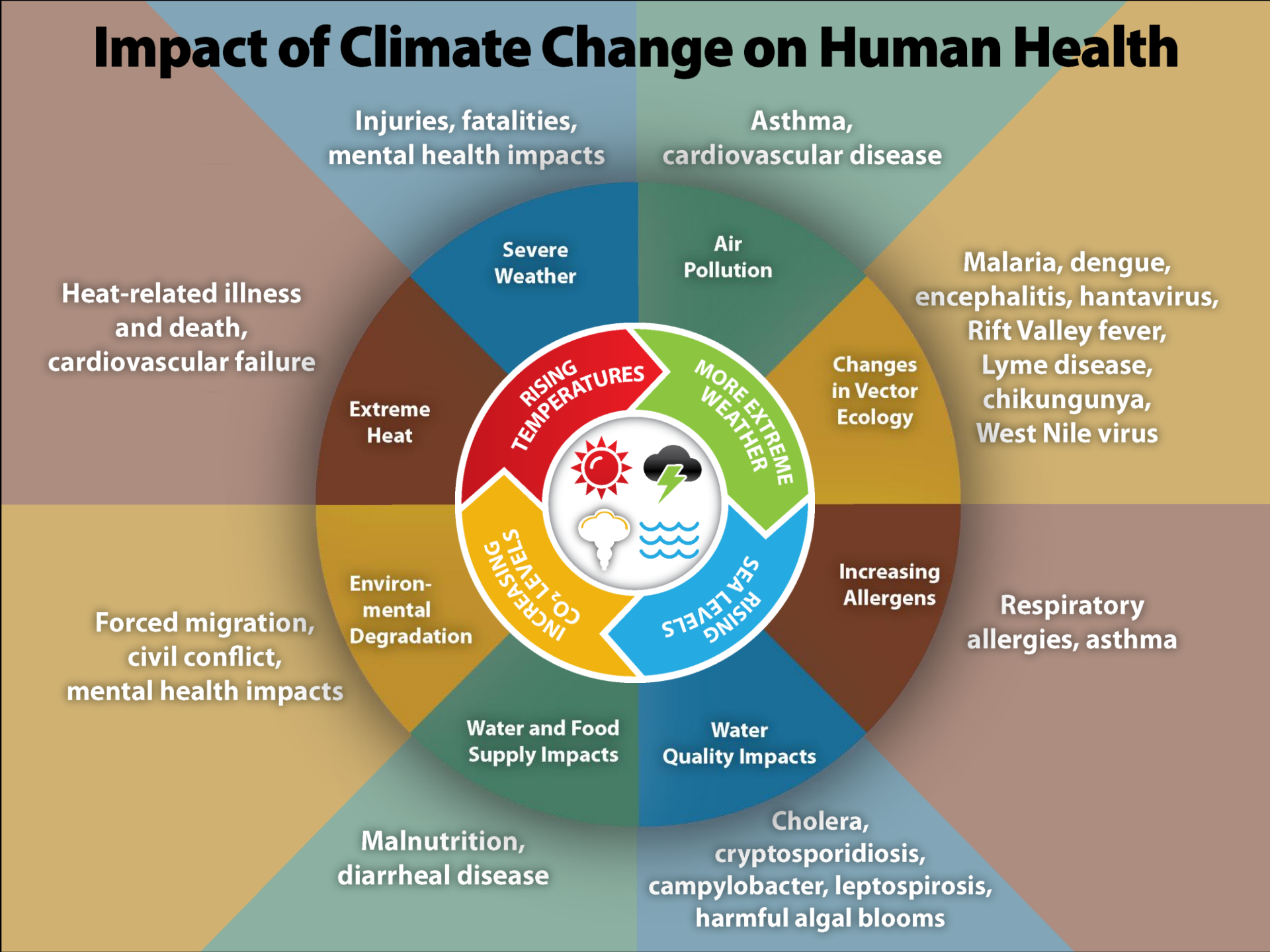
Lyme Disease Case Distribution Change in the United States



1996

http://www.cdc.gov/lyme/stats/maps/interactiveMaps.html

Impact of Climate Change on Human Health



Objectives

- Summarize findings from 3rd US National Climate Assessment
- Review evidence for climate change and its impact on human health
- Describe CDC efforts to prepare for health effects of climate change

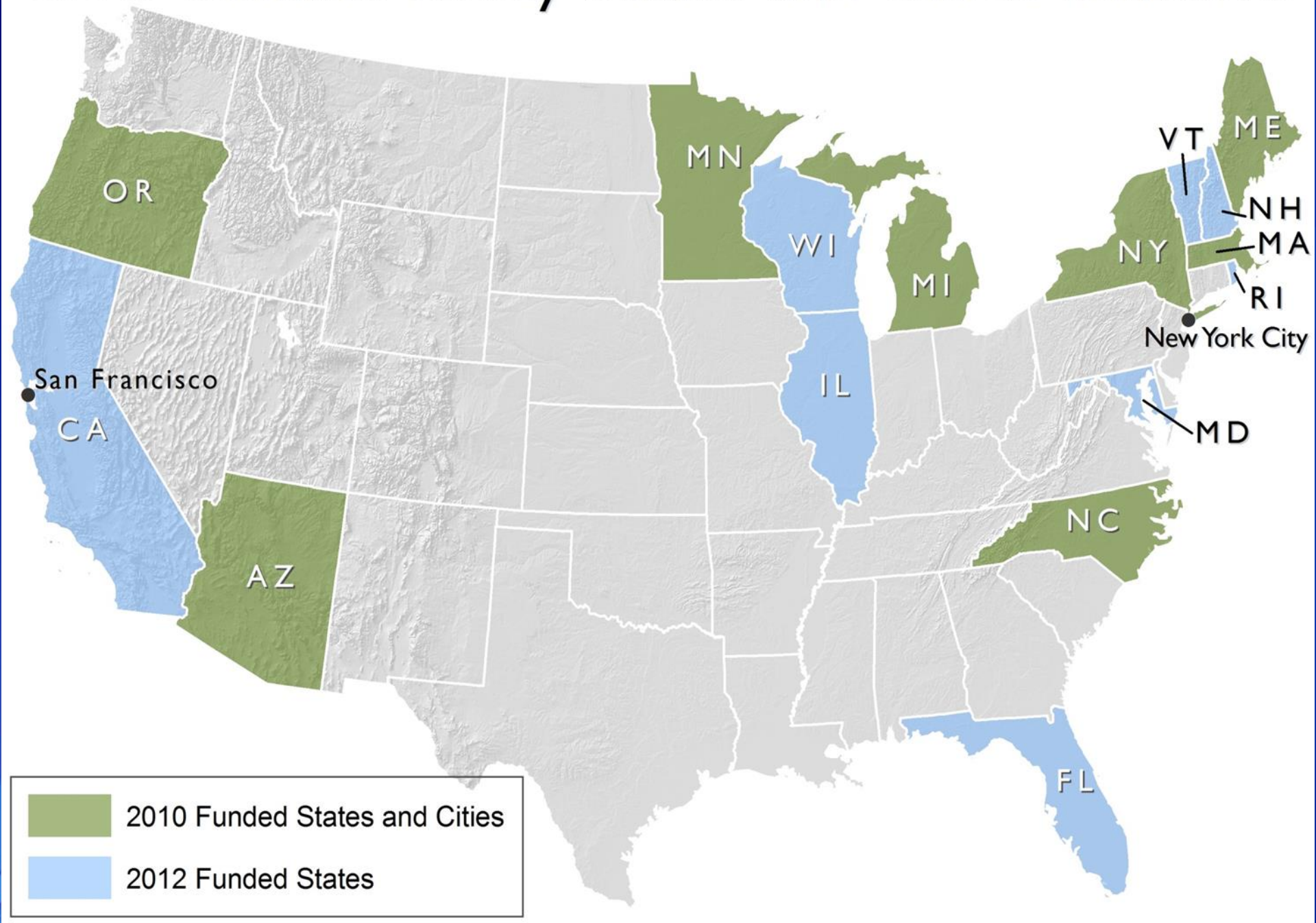
What is CDC doing to prepare for health effects of climate change?

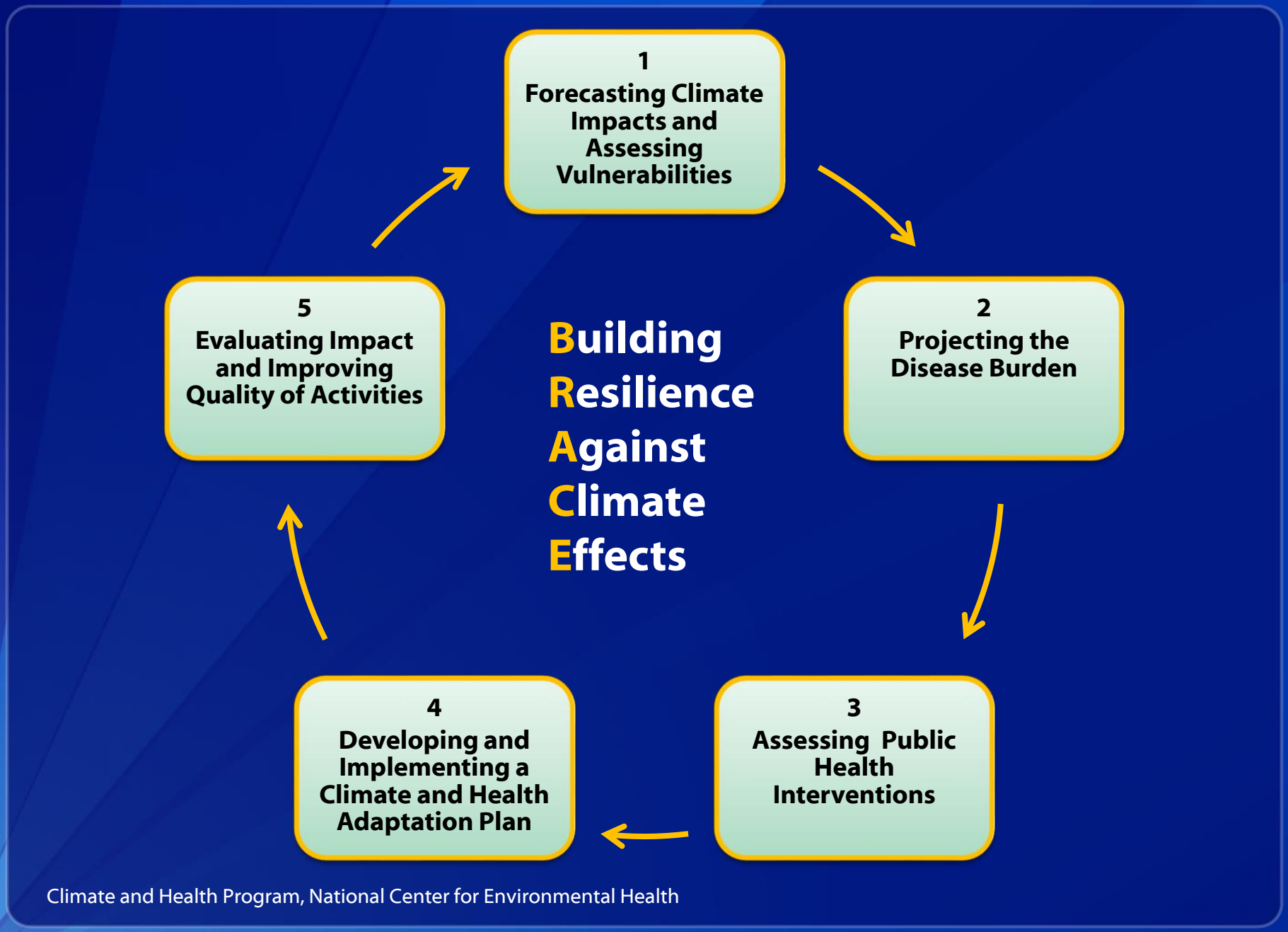
- **CDC helps states and cities prepare for health challenges of climate change by**
  - Providing scientific guidance
  - Developing decision support tools
  - Ensuring public health concerns are considered in climate change adaptation and mitigation strategies
  - Creating partnerships between public health and other sectors
- **CDC's Climate and Health Program – nation's only investment in climate change preparedness for public health sector**

Climate-Ready States and Cities Initiative

- **CDC effort to enhance capacity of state and local health agencies to deal with health challenges associated with climate change**
- **CDC accomplishes this by**
  - Funding 18 state and local health departments
  - Providing framework and tools for planning, implementing, and evaluating climate adaptation strategies
    - Tools to identify populations and places vulnerable to climate impacts
    - Materials to help communicate climate and health issues to public health partners (e.g., extreme heat toolkit)

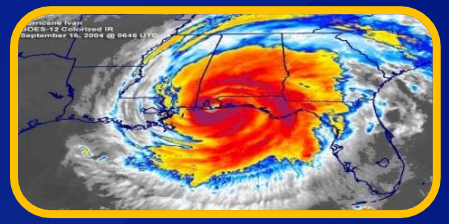
CDC Climate Ready States and Cities Initiative




1
Forecasting Climate Impacts and Assessing Vulnerabilities
2
Projecting the Disease Burden
3
Assessing Public Health Interventions
4
Developing and Implementing a Climate and Health Adaptation Plan
5
Evaluating Impact and Improving Quality of Activities
Building Resilience Against Climate Effects
Climate and Health Program, National Center for Environmental Health







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National Center for Environmental Health

Division of Environmental Hazards and Health Effects