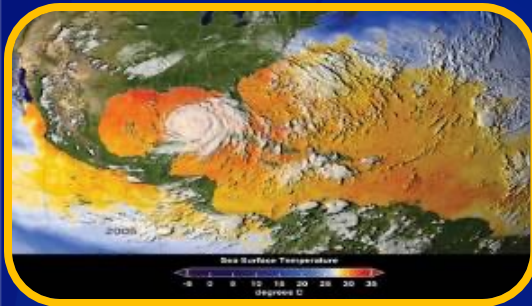


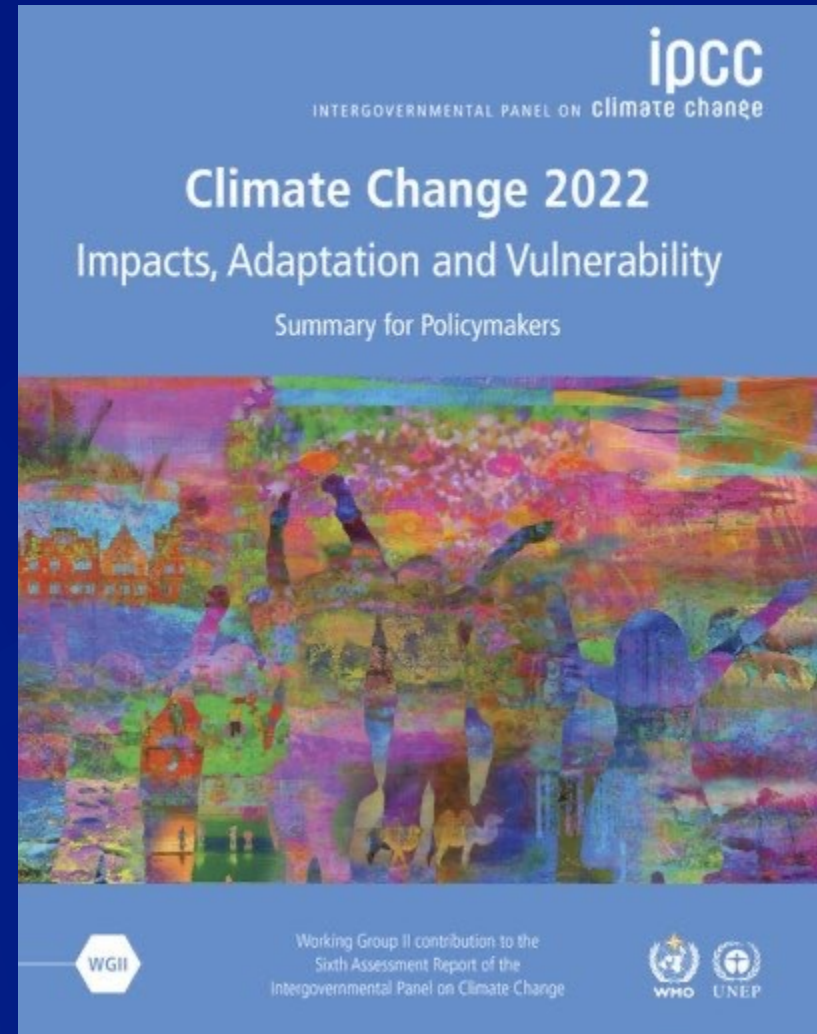
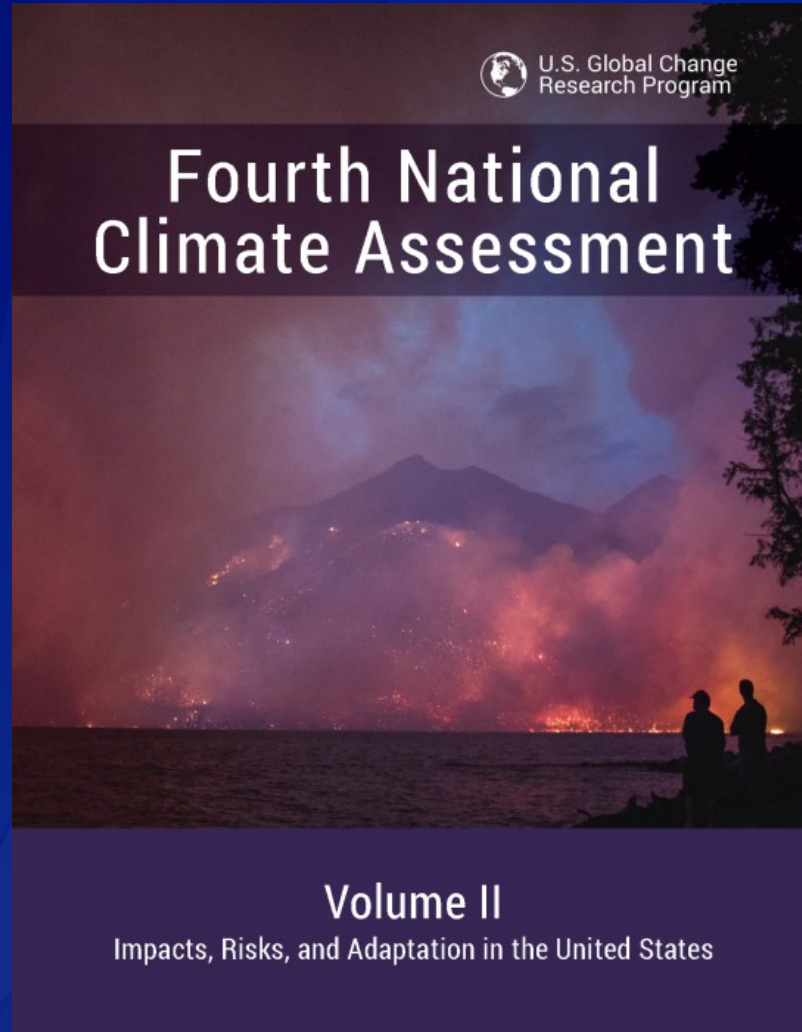
Under the Weather?

The Health Consequences of a Changing Climate



George Luber, PhD
Center for the Study of Human Health
Emory University

Two Major Reports



Climate Change Science: Key Findings

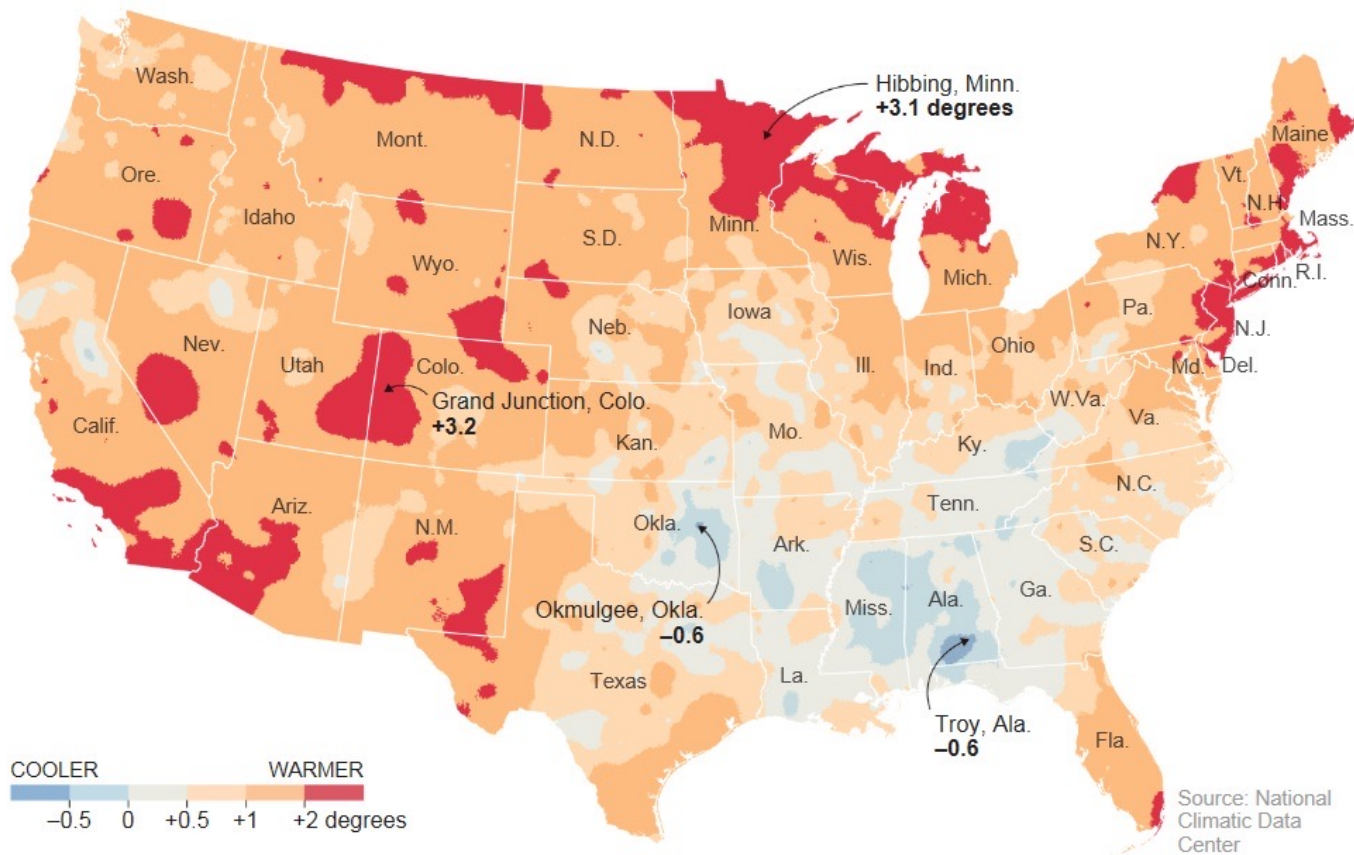
- ❑ Climate change is altering both the average (mean) global temperature *and* the global frequency of extremely hot temperatures (variance)
- ❑ The impacts of climate change will vary significantly by region; some places are warming faster than others.



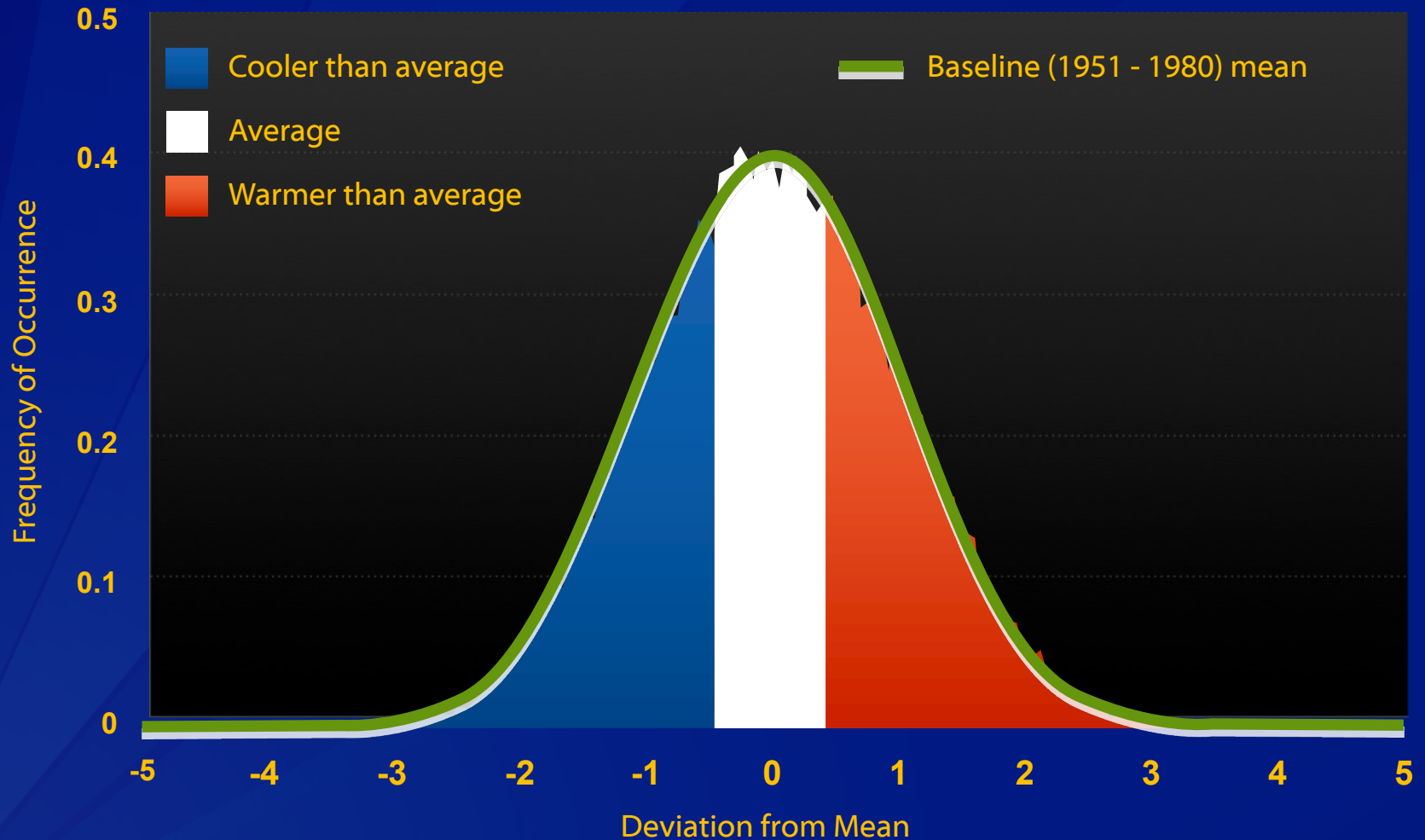
Warming has varied significantly by region (observed record)

Rising Temperatures

1991-2012 average temperature compared with 1901-1960 average MAY 6, 2014

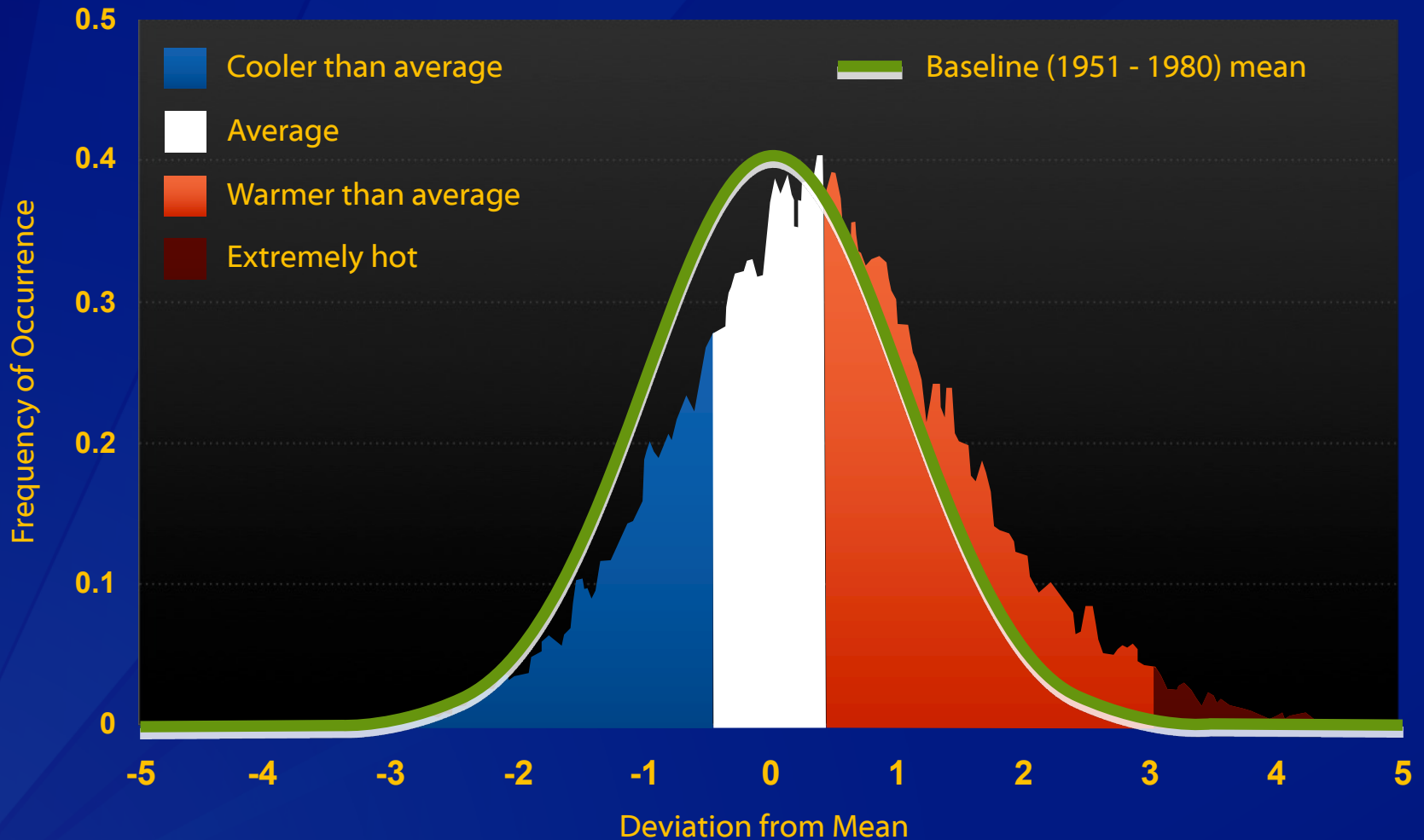


Summer Temperatures 1951-1980



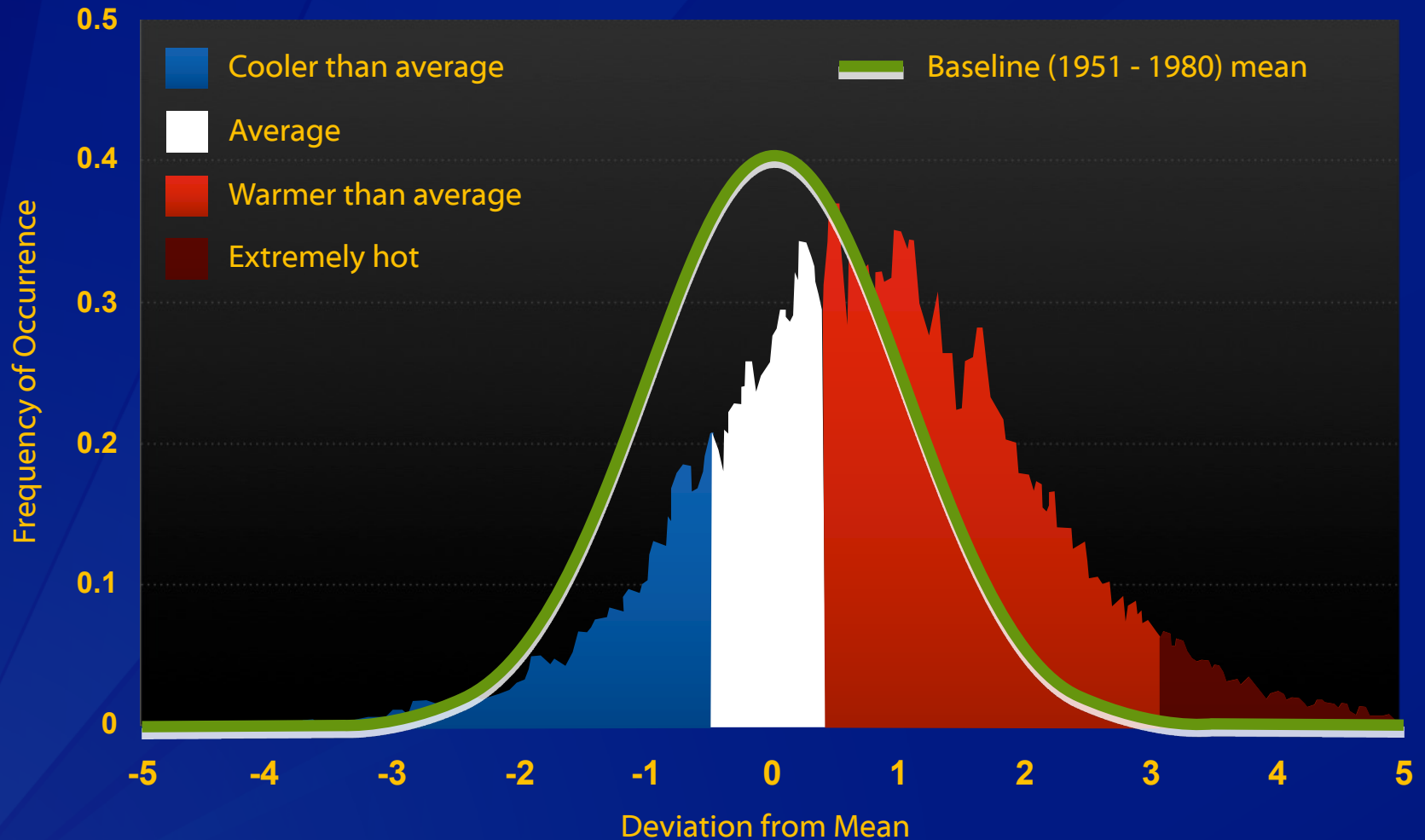
Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012

Summer Temperatures 1981-1991



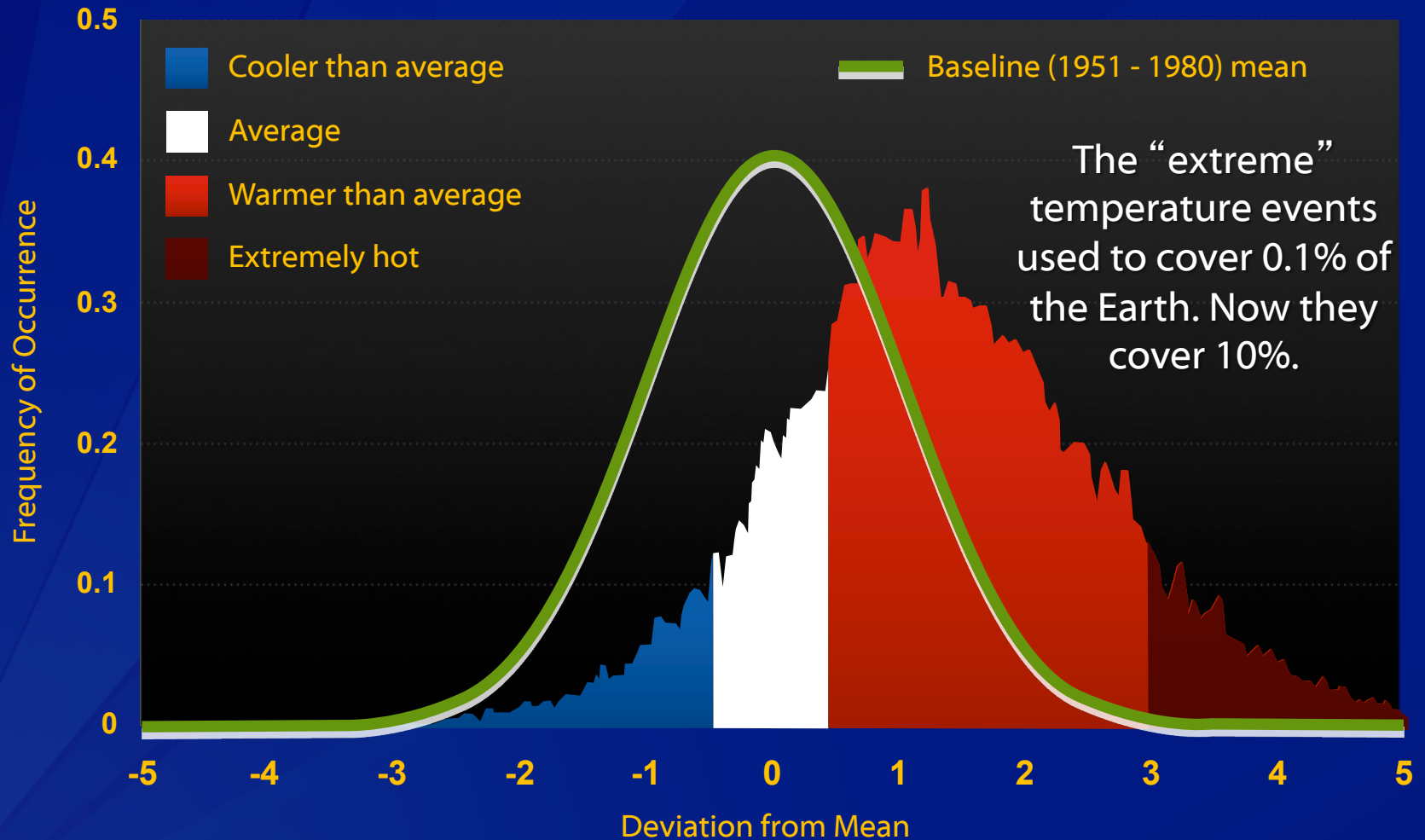
Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012

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

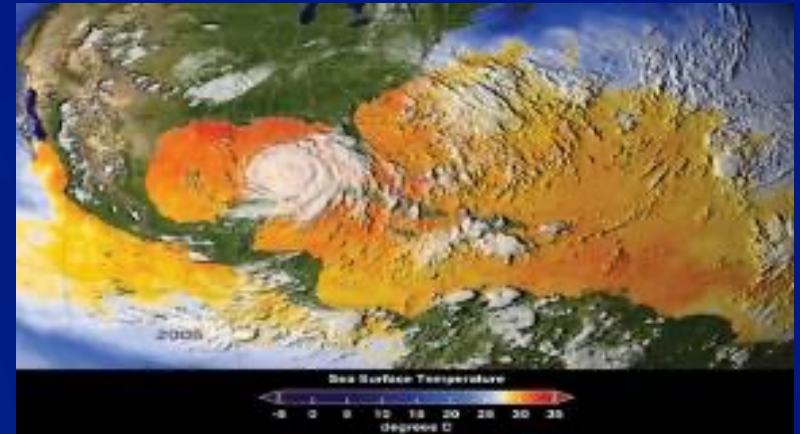


Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012

Key Health Threats from Climate Change

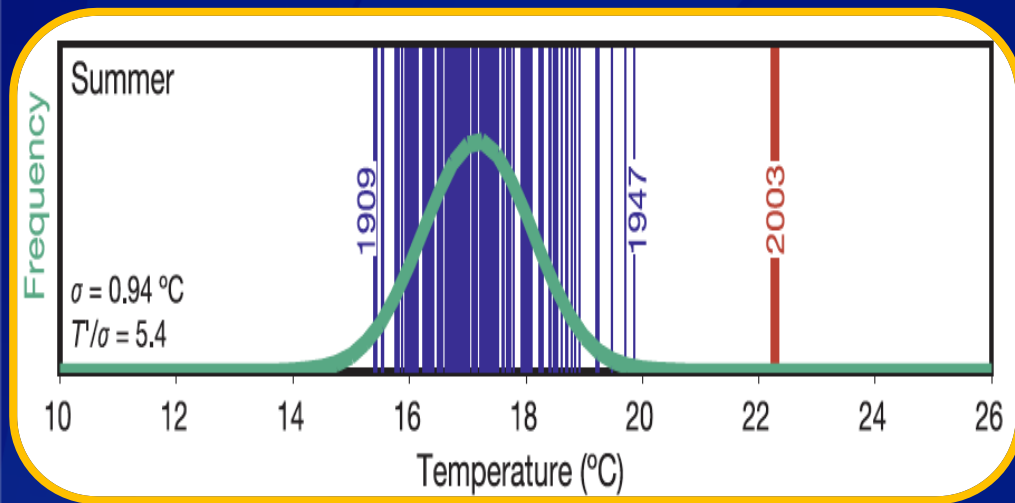
“Disaster within a disaster”

Extreme events increase the probability of “complex emergencies” where multiple system failures can occur which can exceed response capacity.



Heat Waves Impact Human Health

European Heat Wave of 2003



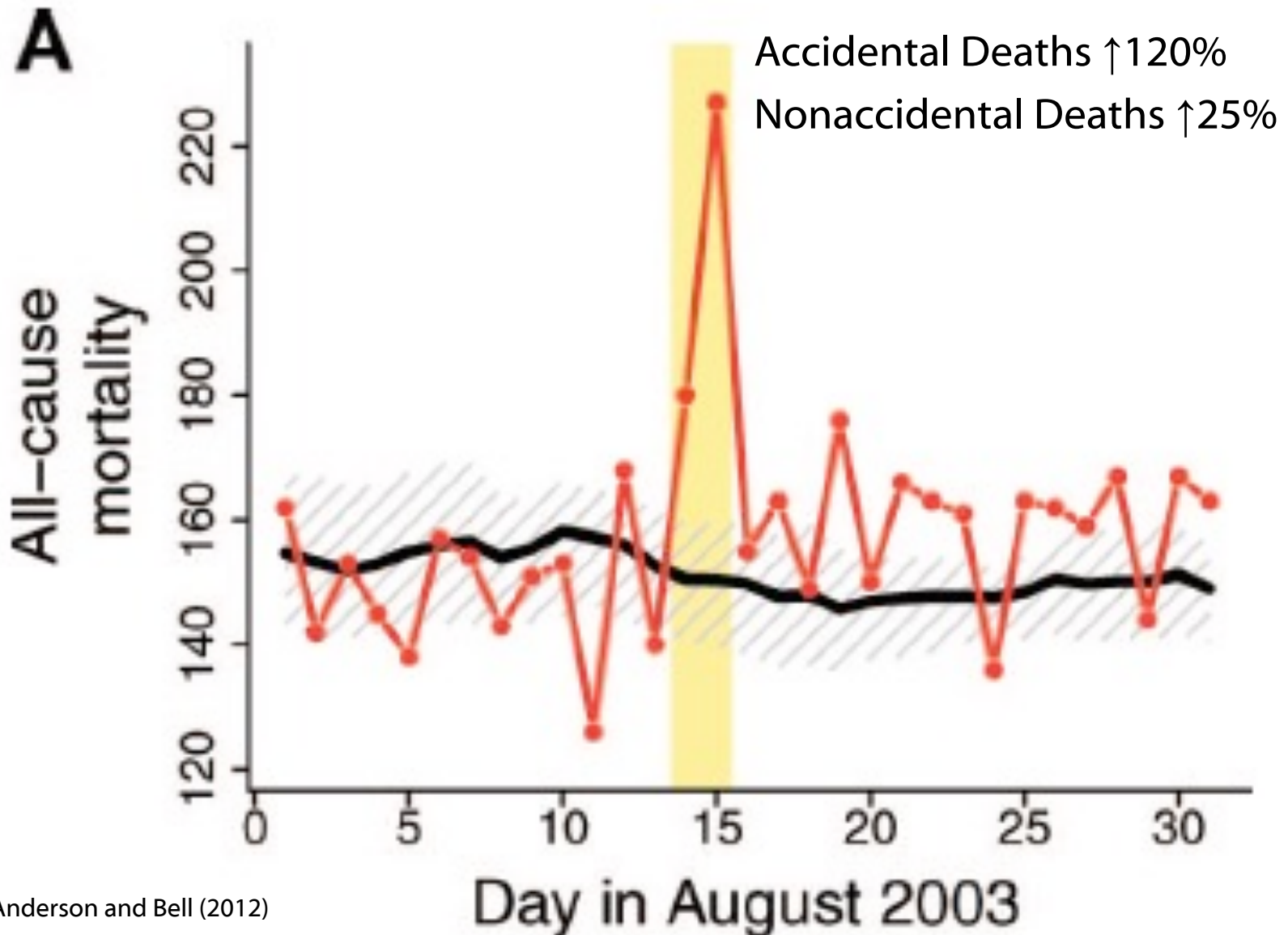
Confirmed Mortality

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

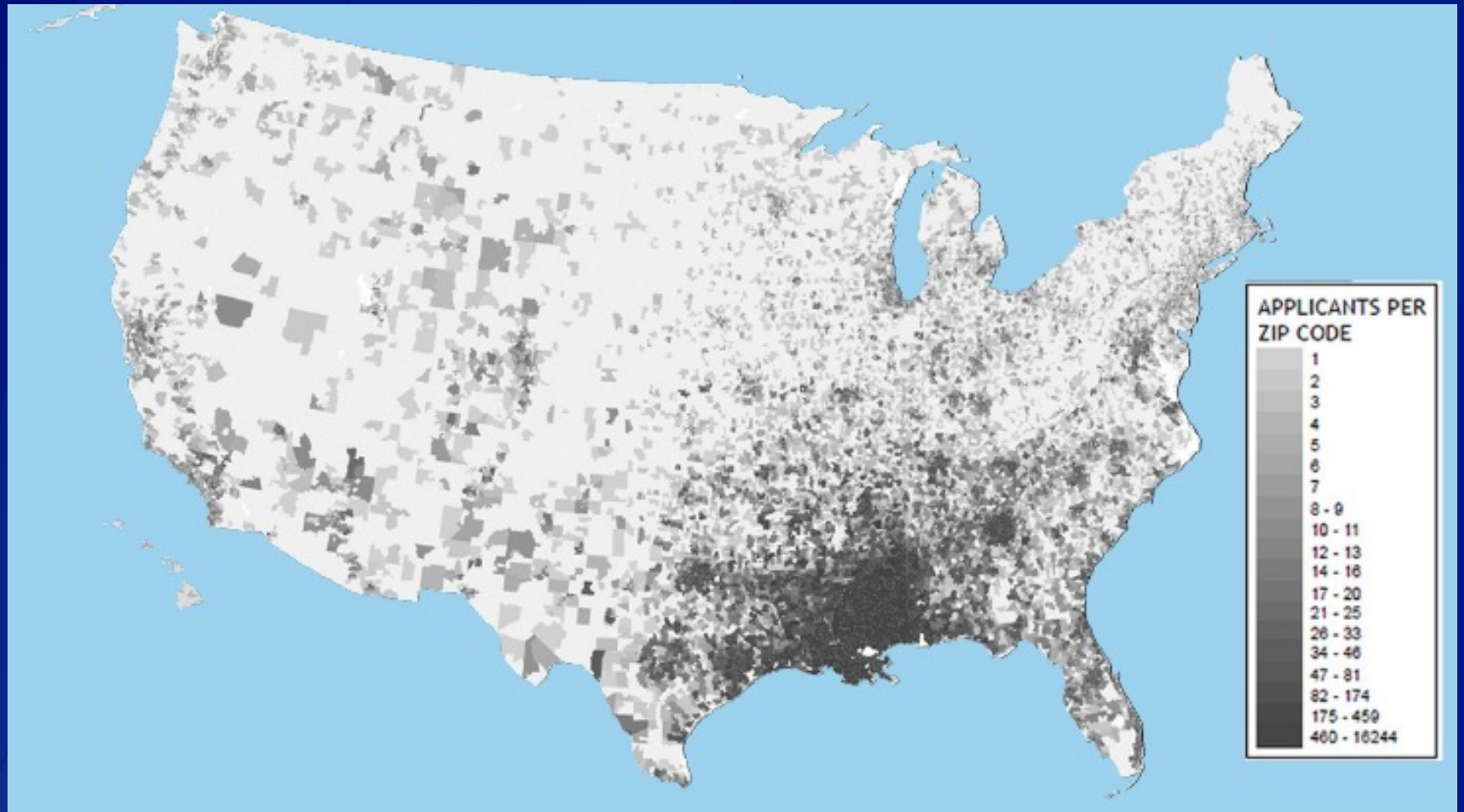
Vandentorren et al. *Am J Public Health* 2004; 94(9):1518-20.

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

NY Power Outage and All-Cause Mortality



Katrina Diaspora



Key Health Threats from Climate Change

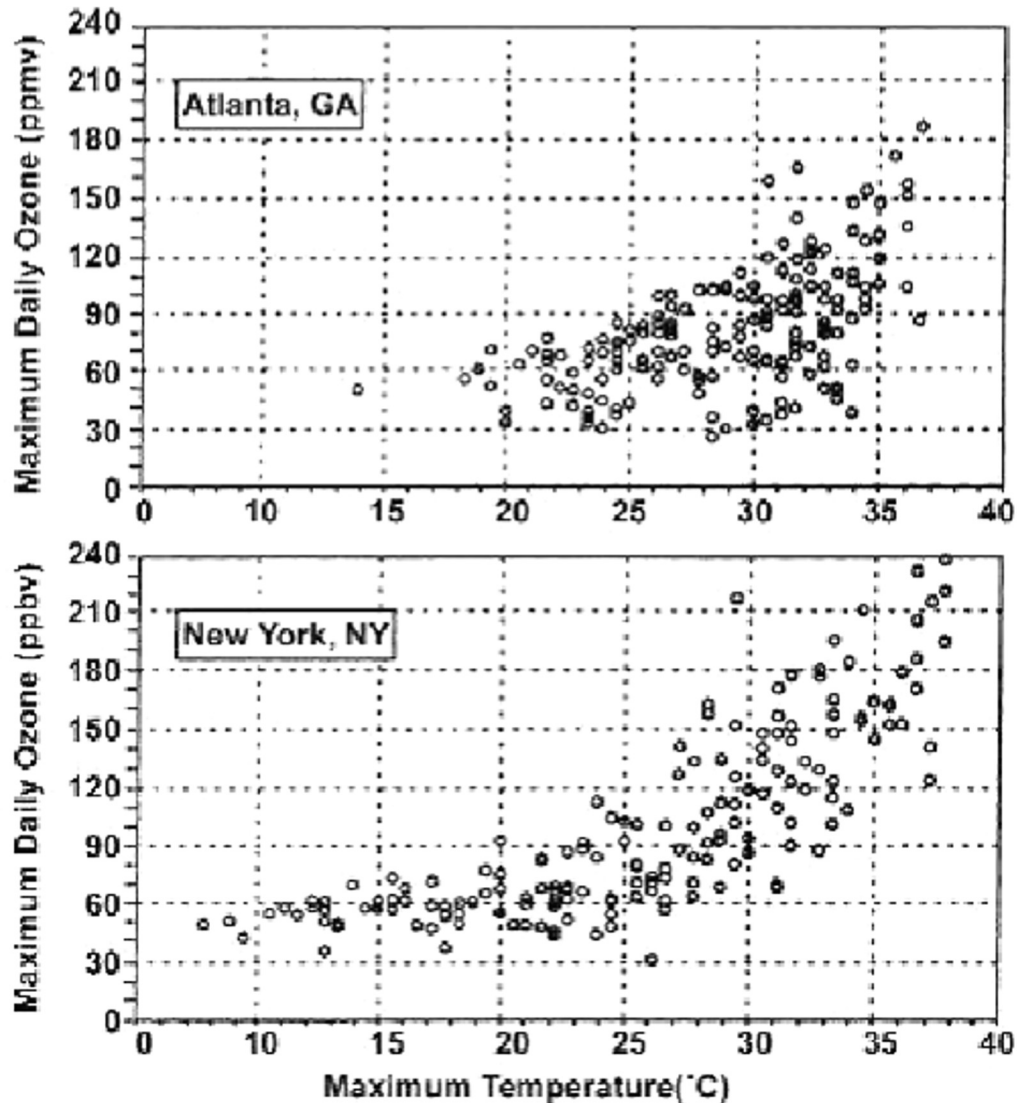
“Morbidity and Mortality by a thousand cuts”

Impacts add to the *cumulative* stresses currently faced by vulnerable populations and in locations most vulnerable to extreme events & ongoing, persistent climate-related threats



Heat Impacts on Air Pollution

Maximum Daily Ozone Concentrations vs. Maximum Daily Temperature

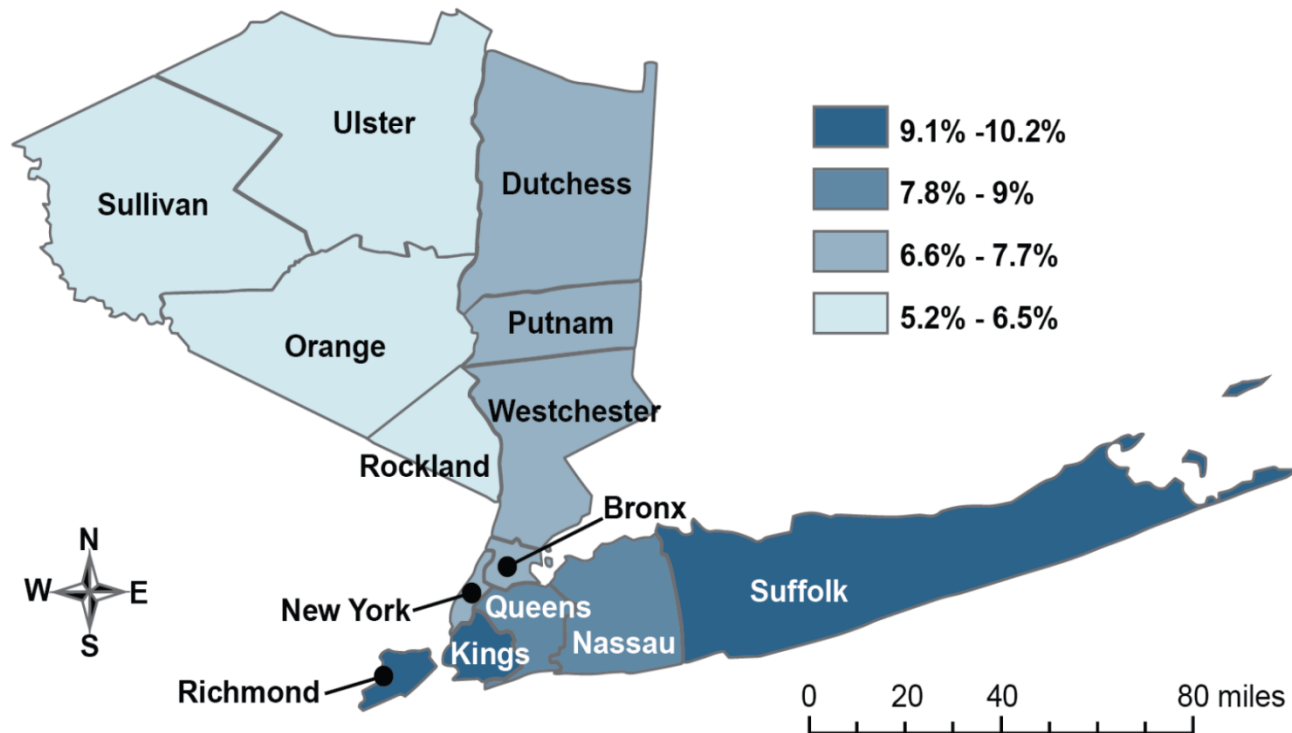


Atlanta

New York

Impact of Increased Ozone: Projected Increase in Pediatric ED Visits for Asthma in 2020

Projected Climate Change Worsens Asthma



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

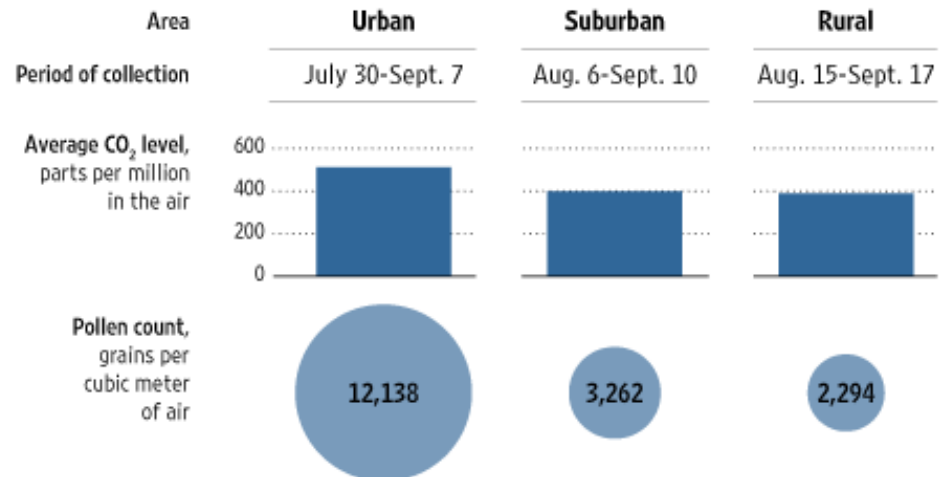


□ Ragweed

- ↑ CO₂ and temperature
- ↑ Pollen counts, longer growing season

Something in the Air

Researchers at the U.S. Dept. of Agriculture planted ragweed in and around Baltimore in 2001 to test how the plant responds to different concentrations of CO₂. The results:

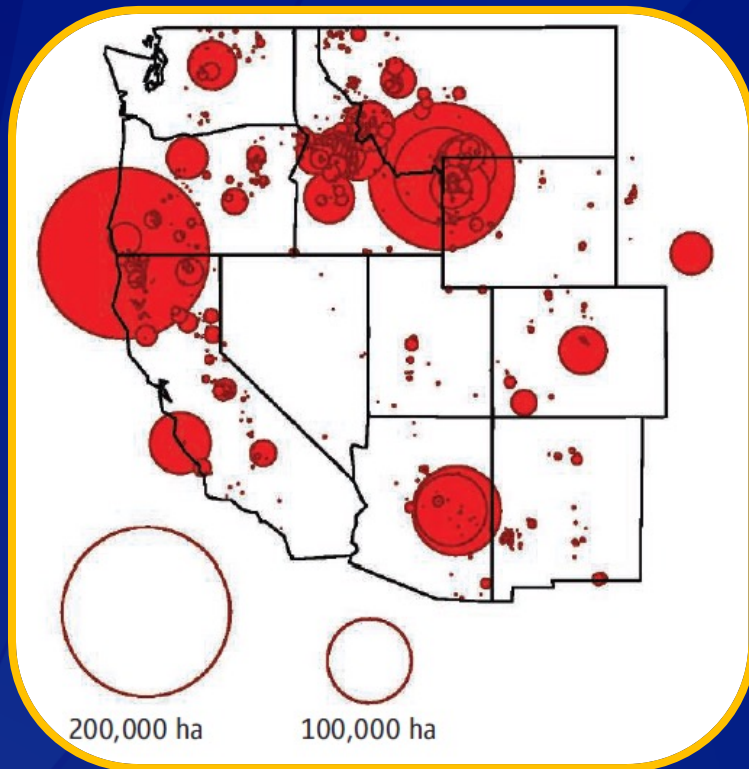


Source: Lewis Ziska, U.S. Dept. of Agriculture

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

Climate Change Impacts Air Quality: Wildfire Smoke

Wildfire Activity Since 1970

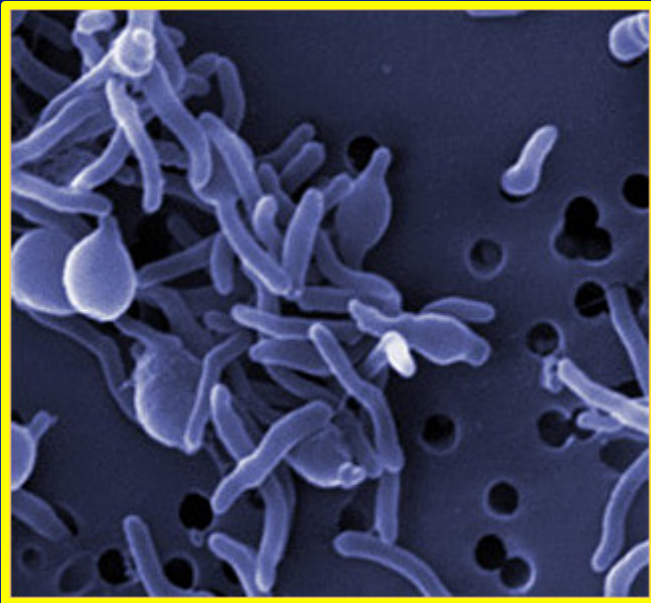


- **Since 1970**
 - Western US wildfire season increased by 78 days
 - Average duration of fires increased five fold

Key Health Threats from Climate Change

Novel threats emerge

Large scale ecological perturbations facilitate disease emergence and redistribution.



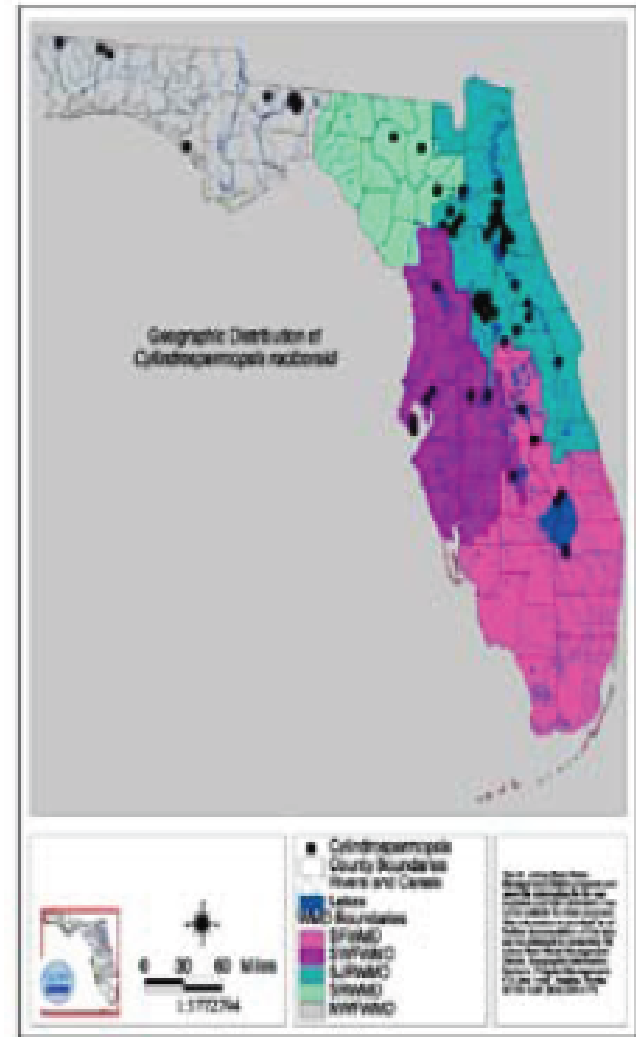
Harmful Algal Blooms (Red-tides)

Enhanced by:

- Increased water temps
- Nutrient runoff
- Upwelling events



Figure 2. Distribution of the CyanoHAB, *Cylindrospermopsis raciborskii*, in Florida (Williams 2001, Fristachi et al. 2007). *C. raciborskii*, which produces potent hepatotoxins (Table 2), was originally found only in tropical areas but has recently spread to cooler regions.

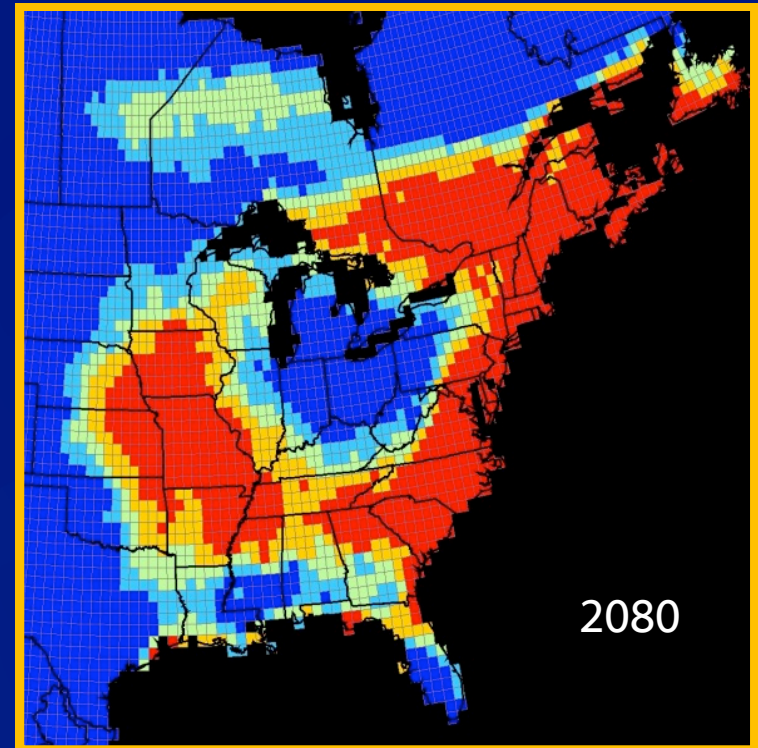


Precipitation, Humidity, and Temperature Changes Impact Human Health: Lyme Disease

□ Spread of Lyme disease factors

- Climate
- Ecological
- Social

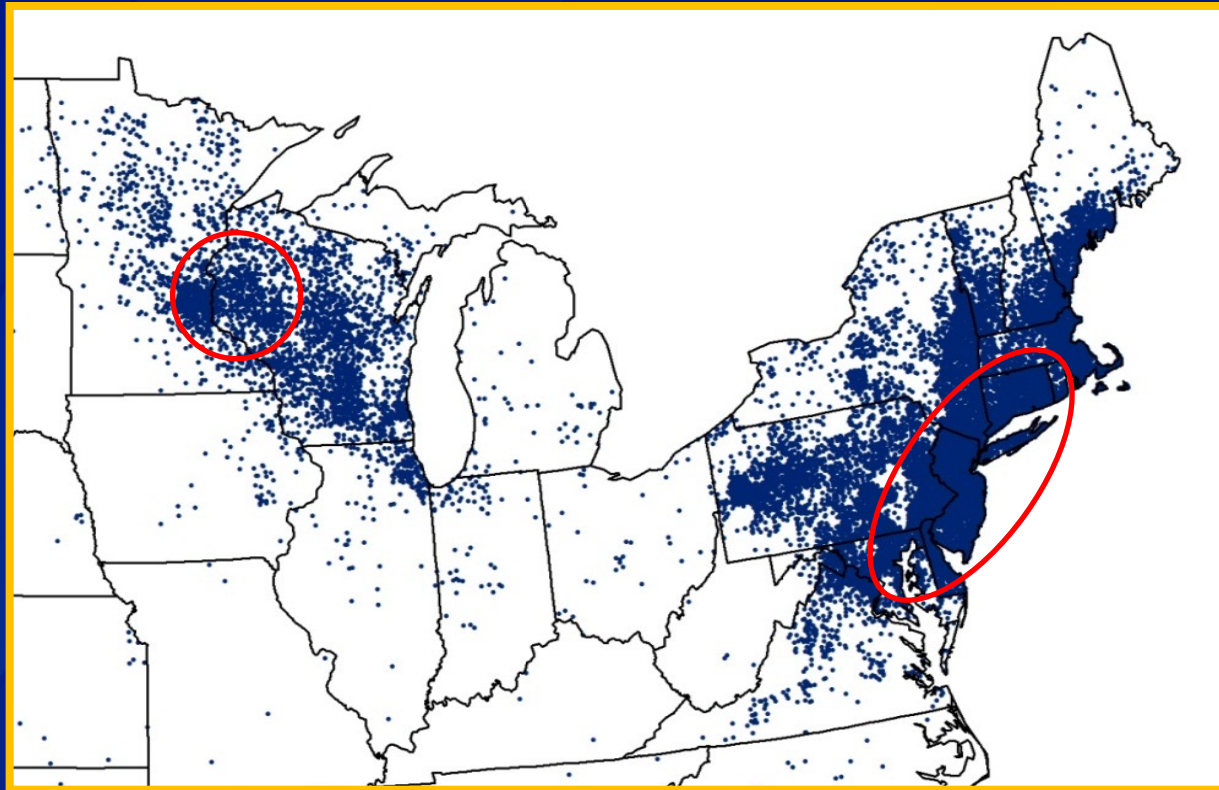
Range of suitable conditions
for *Ixodes scapularis*,
the Lyme disease tick



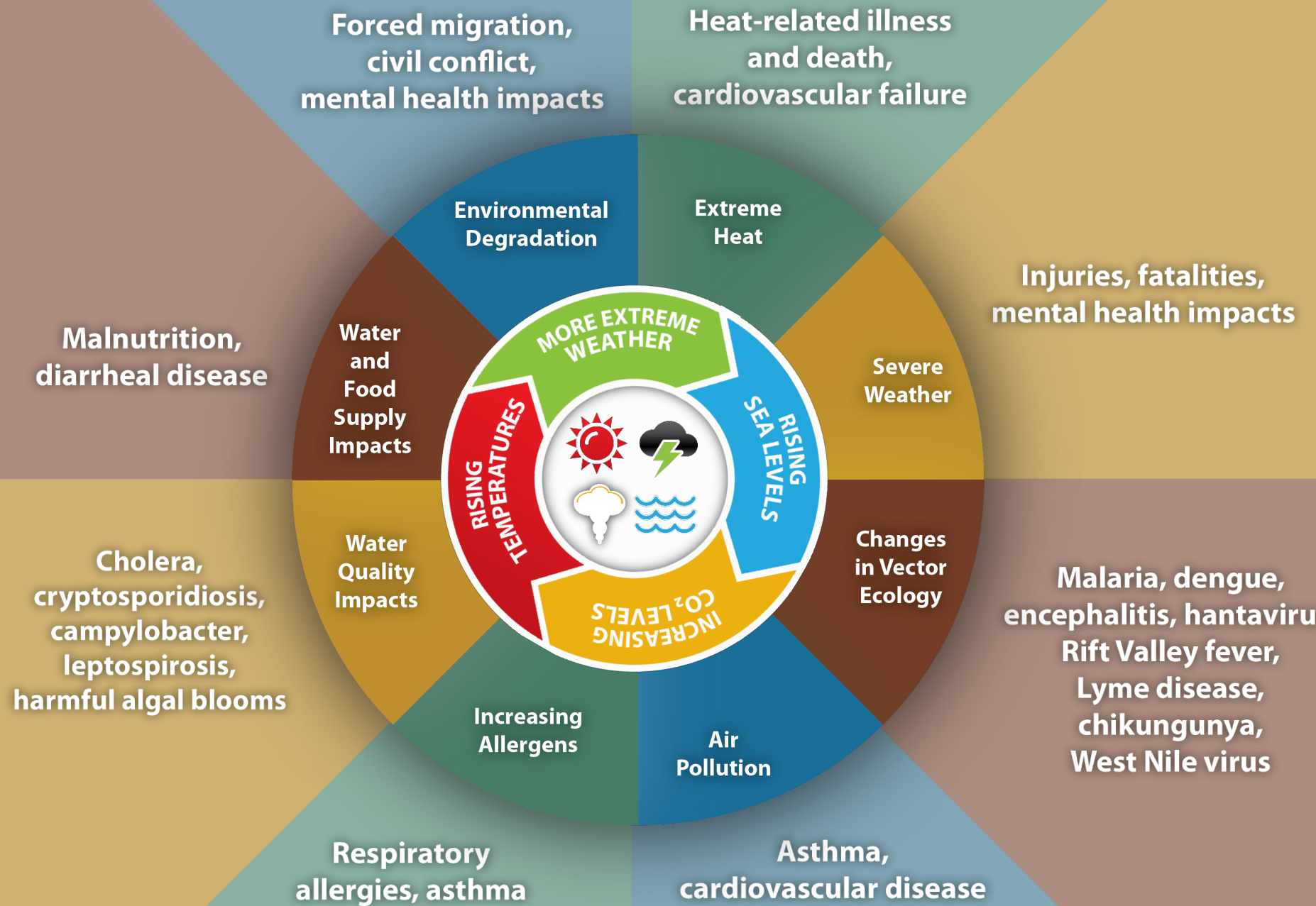
● Constant suitability ● Expanded suitability

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



Summary



- The effects of climate change are already evident in our communities
- Climate change must be framed as a human welfare and public health issue.
- Early action, through evidence-based approaches, can help to protect the public's health