



# Implications of a Changing Climate on Public Health in New Jersey

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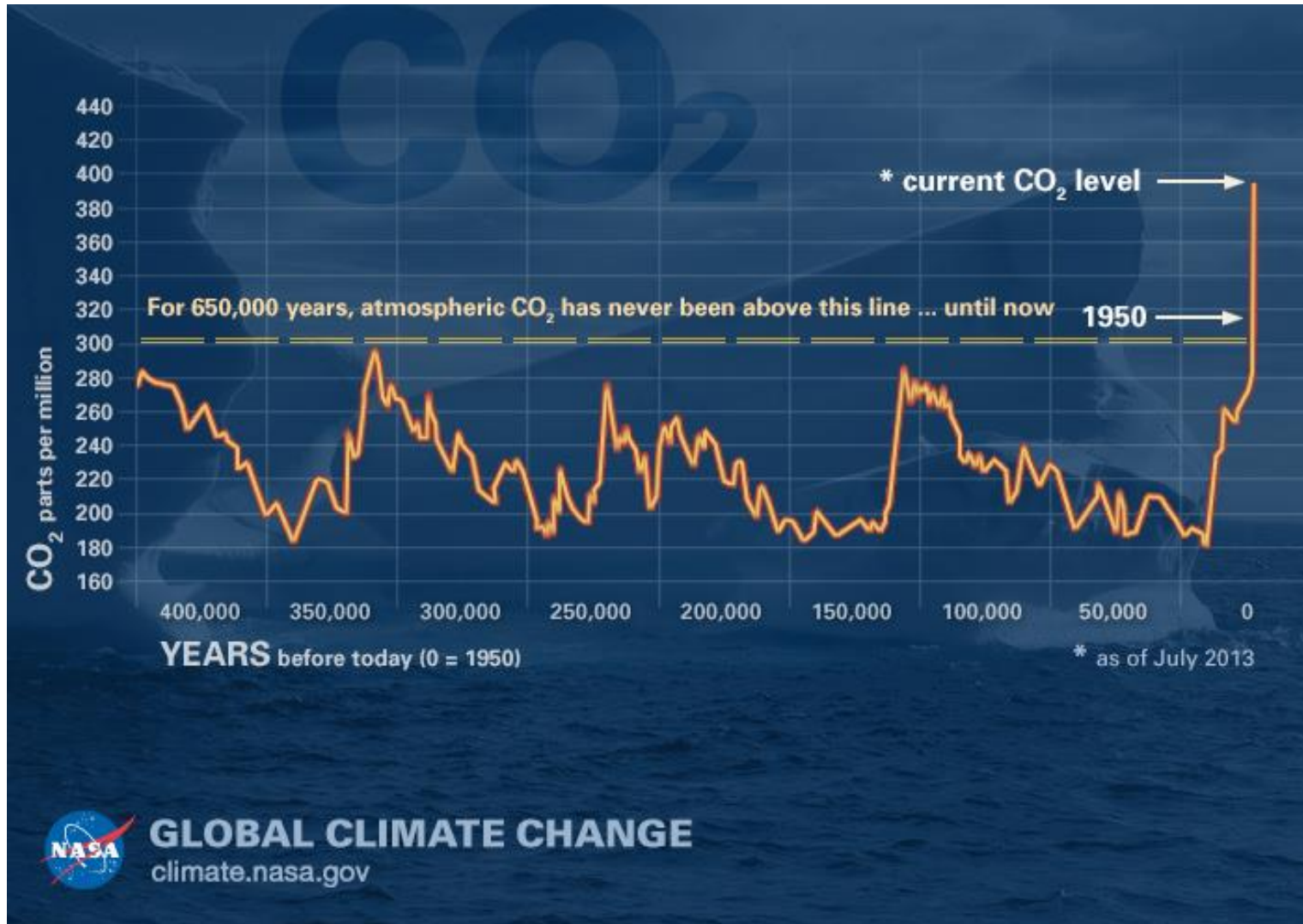
Associate Clinical Professor and Chair

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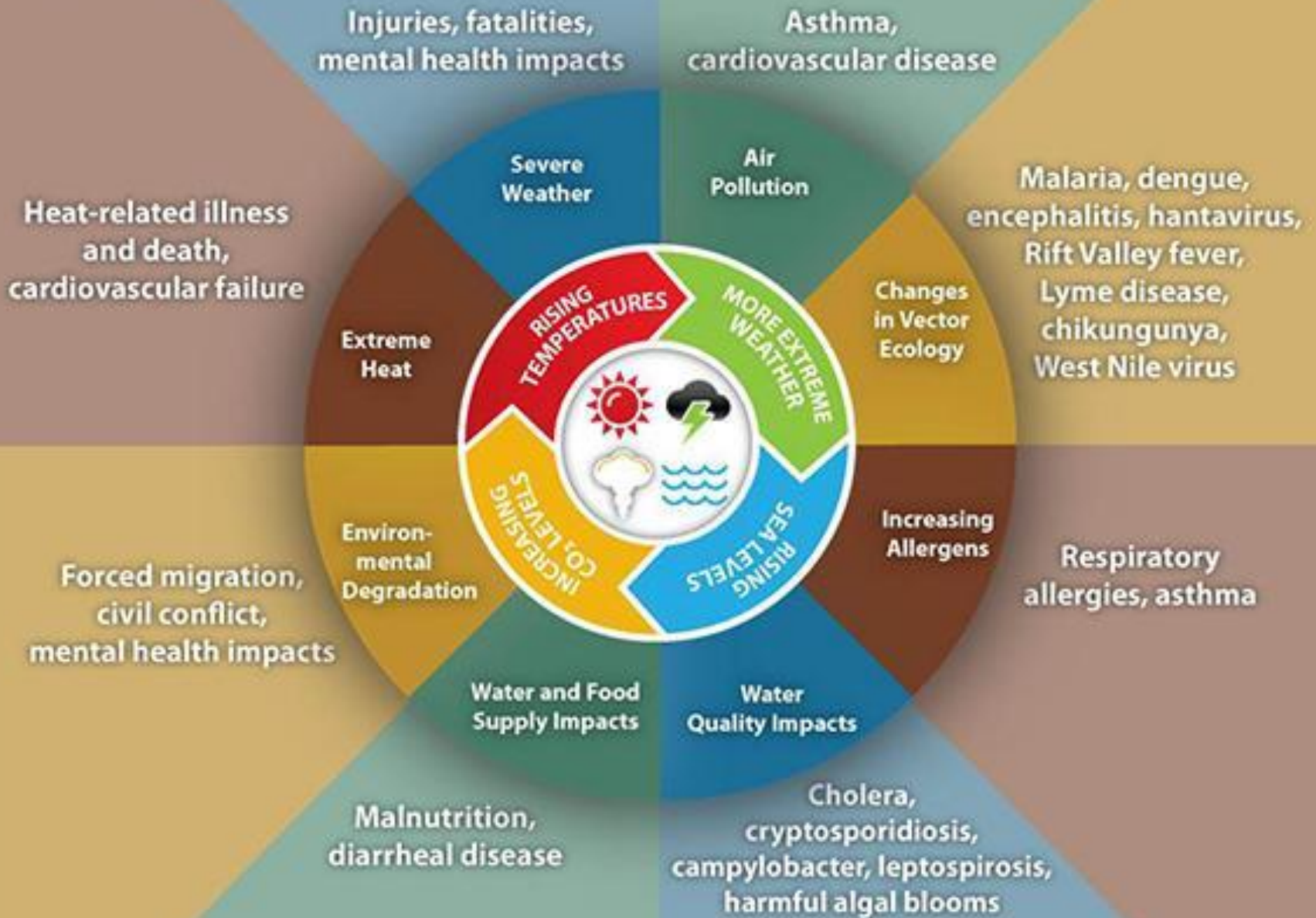
Dornsife School of Public Health, Drexel University

June 3, 2016

# Atmospheric CO<sub>2</sub> concentrations



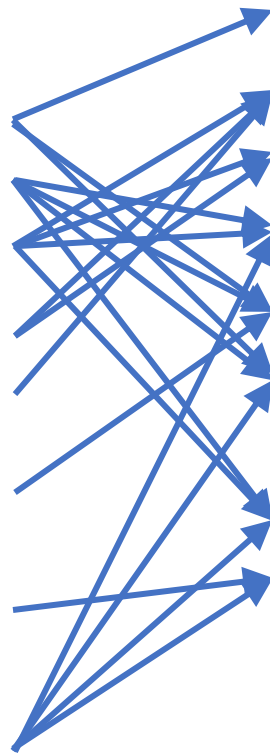
# Impact of Climate Change on Human Health



# Public health impacts of climate changes

## Factors

- More frequent, more intense, or longer lasting:
  - Temperature extremes
  - Precipitation extremes
- Wildfires
- Air pollutants
- Allergens
- Changing distribution of disease vectors
- Drought and other agricultural impacts
- Population displacement due to flooding and sea-level rise



## Health Outcomes

- Heat-related illness
- Respiratory effects
- Cardiovascular effects
- Injuries
- Vector-borne diseases
- Food- and water-borne diarrheal diseases
- Mental health impacts
- Poor nutrition

# Vulnerable populations

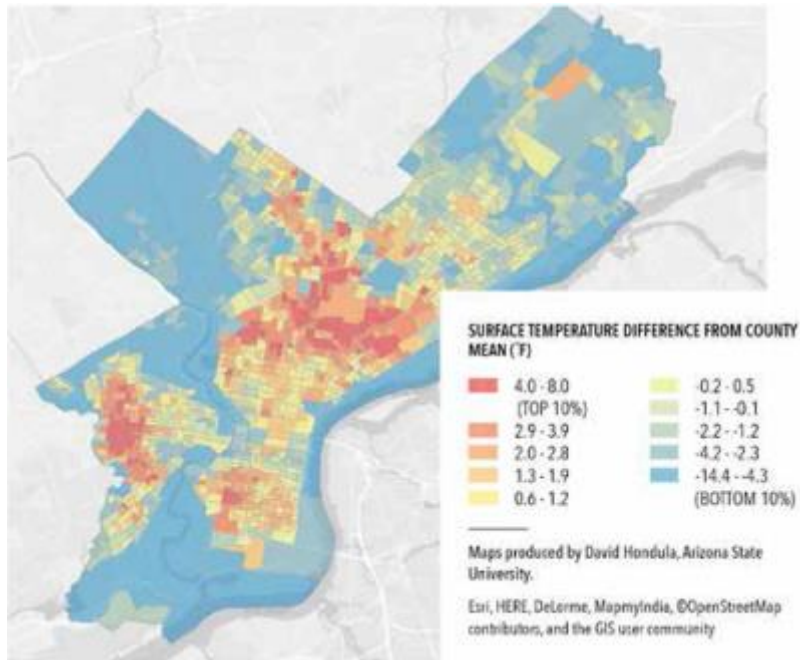
- Physiologic susceptibility *or* incapacity to act to protect self or family
  - Youngest and oldest
  - Pre-existing medical conditions
  - Living in poverty
  - Some working populations
  - Living at sea level or in areas prone to flooding, excess heat, drought, wildfires, conflict

# Extreme heat

## Heat waves increase mortality and morbidity

- **Heat wave mortality:**
  - 2010: 55,000 deaths in Russia
  - 2003: 65,000 heat-related deaths in Western Europe
- **Vulnerable populations:**
  - Elderly, infants, people with disabilities or co-morbidities
  - Outside workers
  - Those without access to cooled spaces
  - Urban populations

# Urban heat island effect



Average surface temperatures by census block, 2013-2015. Data are for the seven hottest days on which mostly cloud-free Landsat imagery was available. *Image courtesy of David Hondula, Arizona State University*

From: Growing Stronger: Toward a Climate-Ready Philadelphia. Mayor's Office of Sustainability and ICF International, November 2015.

New Jersey, Avg. Temperature, Jun.-Aug.

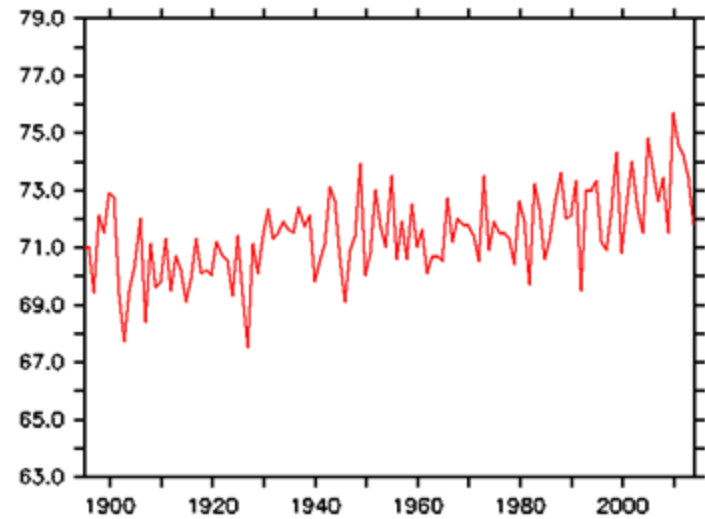
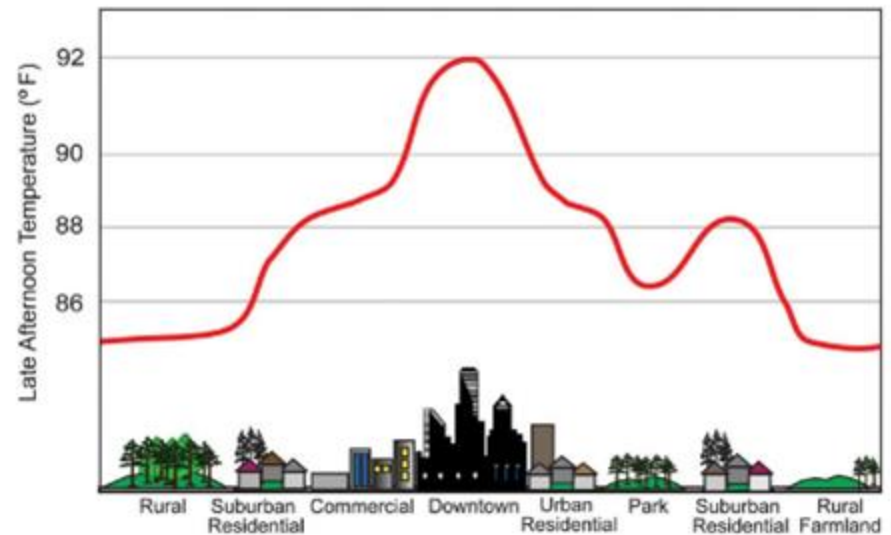


Figure courtesy of Marjorie Kaplan, Rutgers University.  
Data source: National Climatic Data Center



Source, U.S. EPA, <http://www3.epa.gov/climatechange/images/impacts-adaptation/UrbanHeatIsland-large.jpg>

# Health effects of extreme heat

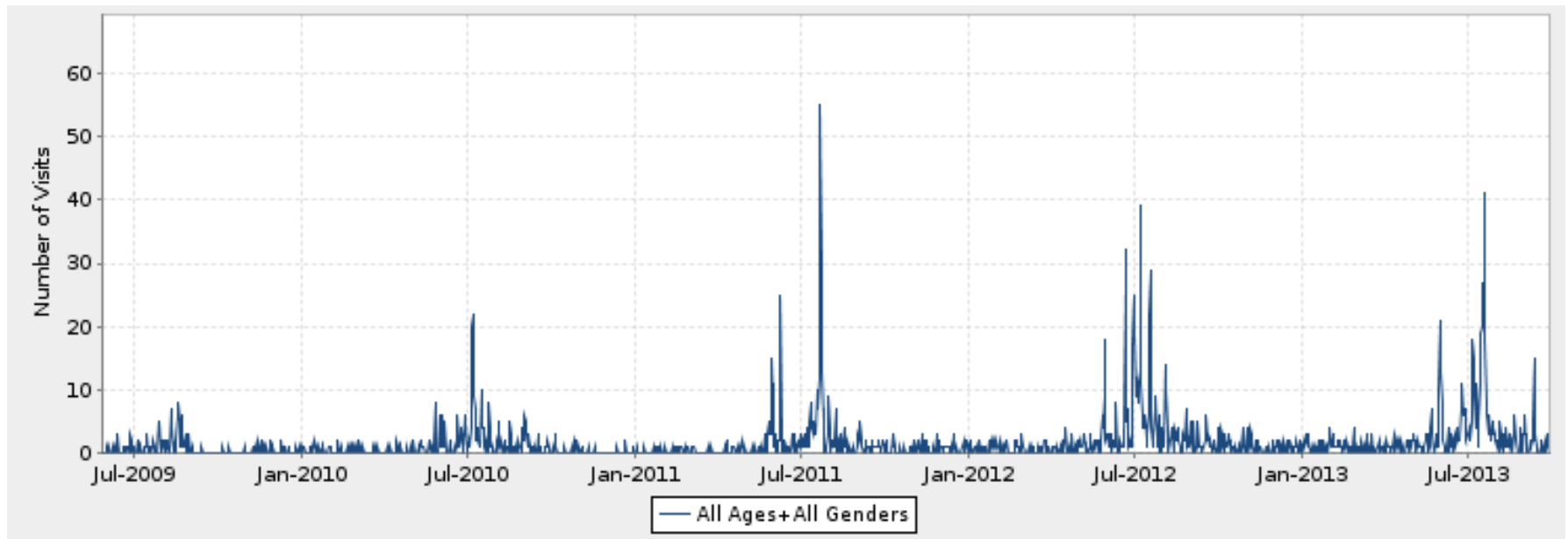
- Heat stress, heat exhaustion
  - Increased body temperature and dehydration from ambient conditions and exertion
    - Organ damage, loss of consciousness, death
    - Increased accident risk



- Wildfires
  - Burns
  - Respiratory effects from smoke inhalation



# Tracking “heat-related illness” with syndromic surveillance

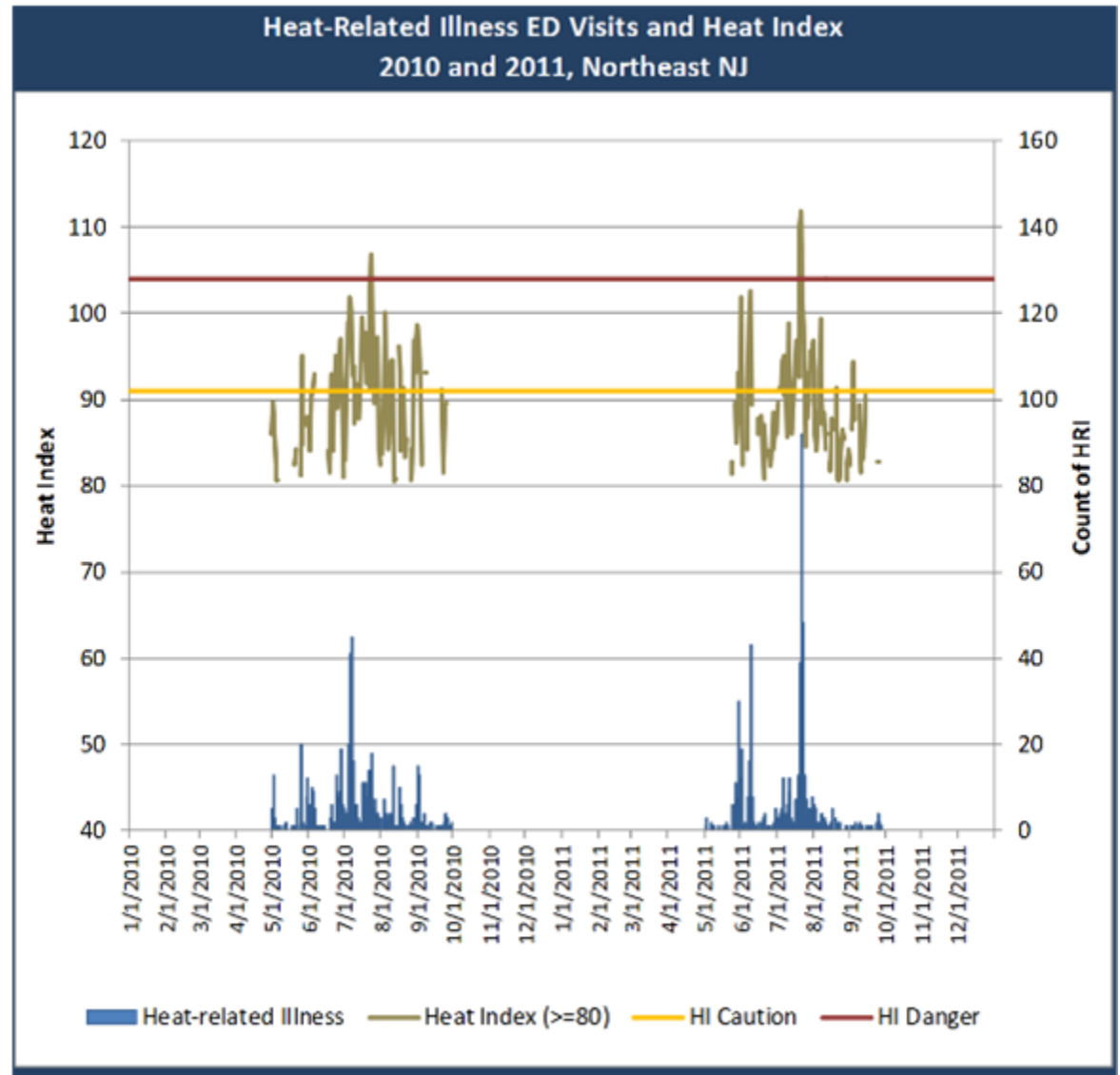


Data from EpiCenter Syndromic Surveillance System, May 2009 through September 2013

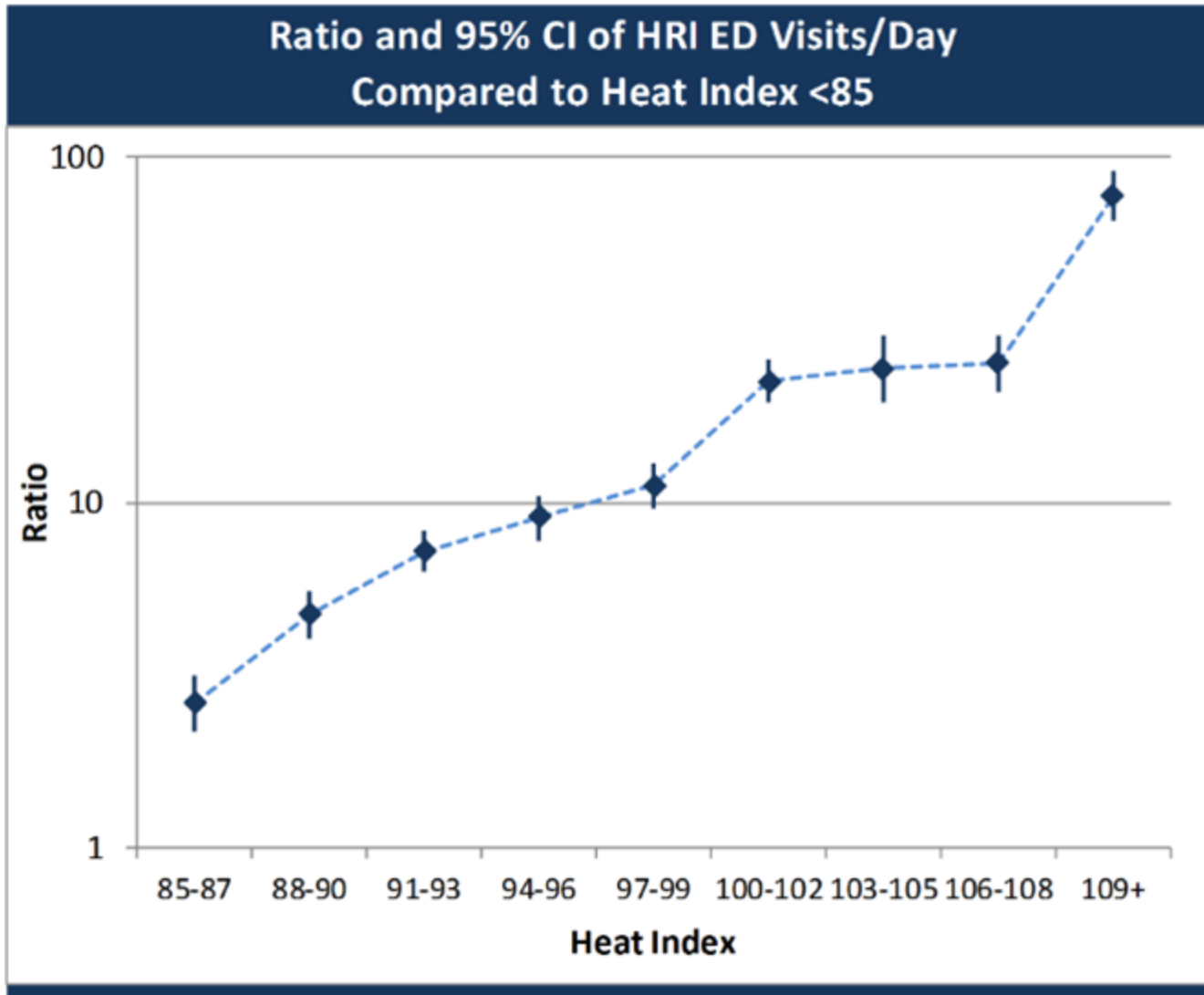
# Linking heat-related emergency department and meteorology data

Heat index and counts of heat-related illness at hospital emergency departments in NJ during summers of 2010 and 2011

Uniform Billing data source: New Jersey Department of Health; Heat index data source: Office of New Jersey State Climatologist.



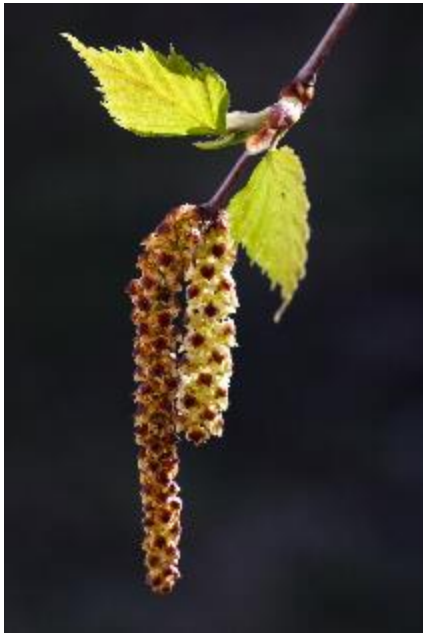
# Relative risk of heat-related illness with rising heat index



Ratios of average daily heat-related illness counts at heat index range, compared to heat index < 85

# Air pollution and aeroallergens

Climate change is expected to increase levels of certain air pollutants

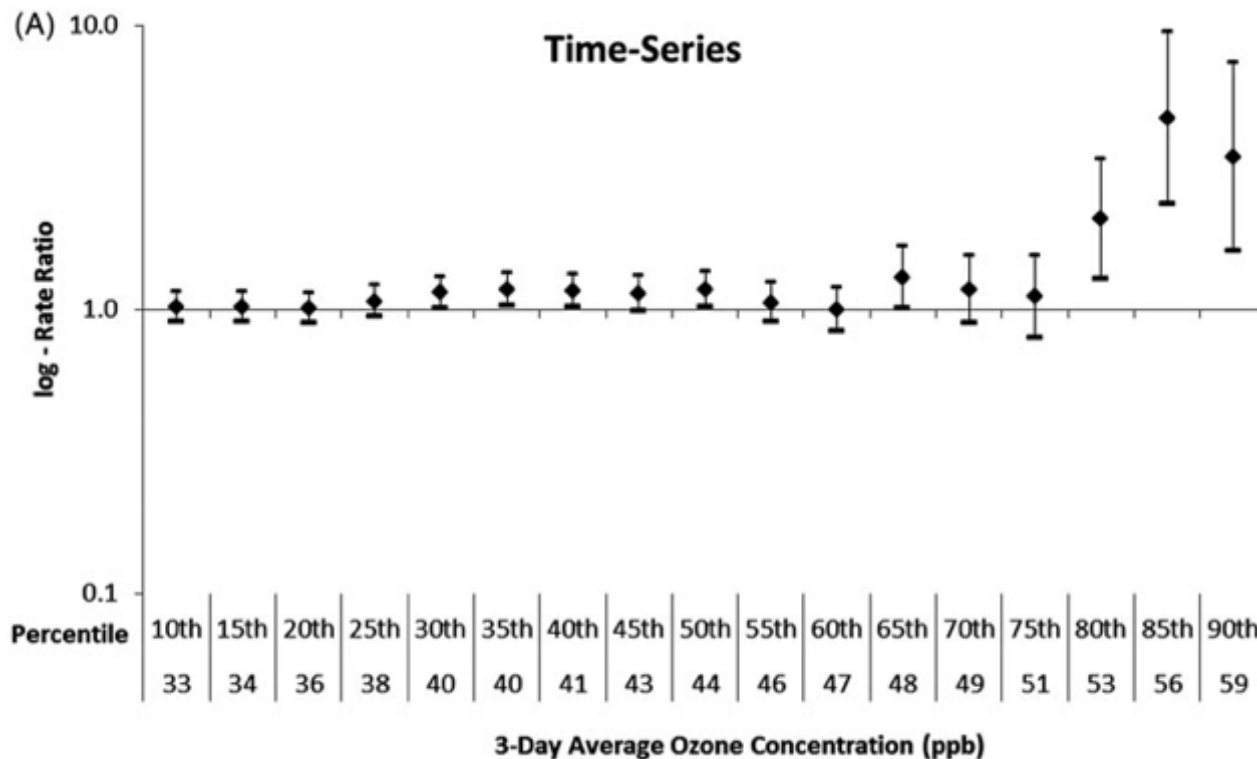


- Higher temperatures increase reaction rates leading to formation of ozone and fine particulate matter
- Pollen and other allergens likely to increase due to higher CO<sub>2</sub> levels and temperatures promoting plant growth

# Ozone and Children's Emergency Department Visits for Asthma

Newark, New Jersey, 2004-2007, months of May through September

- Time series study of 3,657 pediatric asthma cases
- Single-pollutant models, adjusted for temperature, pollen levels, day of week, year



# Extreme precipitation

Hurricanes/cyclones and floods from other storms cause deaths and displacement of populations

- Storm and flood mortality:
  - 2013: Philippines (Typhoon Haiyan): 7,354 deaths
  - 2013: North India flood, 6,054 deaths
  - 2008: Myanmar (Cyclone Nargis): 138,000 deaths
  - 2007: Bangladesh (Cyclone Sidr), 4,234 deaths
  - 2005: U.S. gulf coast (Hurricane Katrina), 1,833 deaths
- Displaced populations suffer mental illness, poor nutrition, compromised hygiene, and infectious diseases

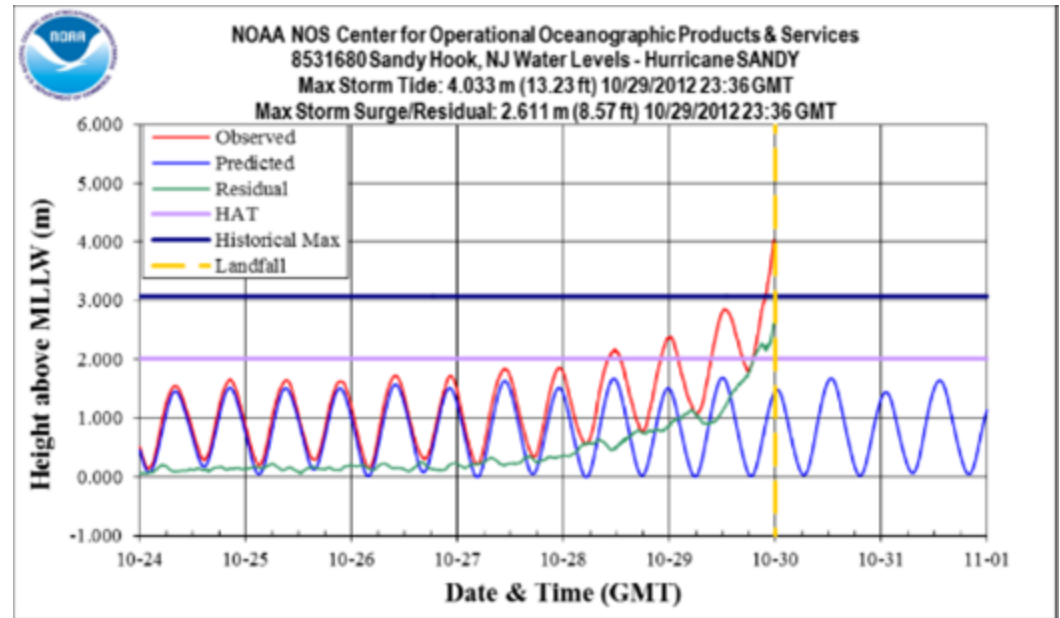
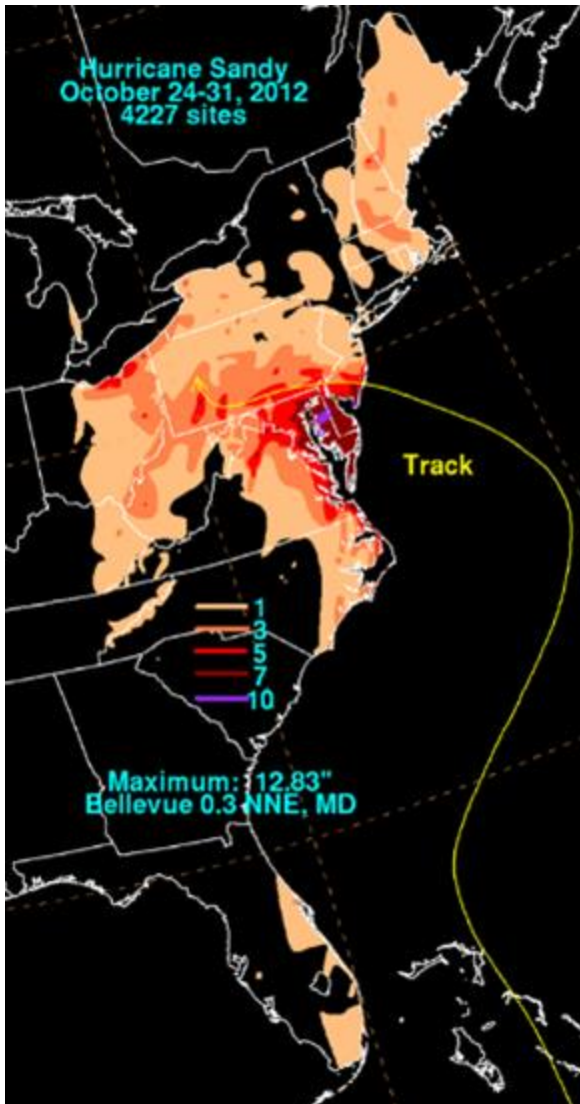
# Superstorm Sandy

October 29-30, 2012



# Superstorm Sandy

## October 29-30, 2012



Source: NOAA NOS Hurricane Sandy Water Level & Meteorological Data Report, January 24, 2013

- Impacts in New Jersey alone:
  - Two hospitals and 11 long-term care facilities evacuated
  - 39 acute care hospitals and 74 assisted living facilities lost power
  - Over 7,000 people in 127 shelters established at height of storm

Source: David Roth, National Weather Service, Weather Prediction Center, Camp Springs, MD



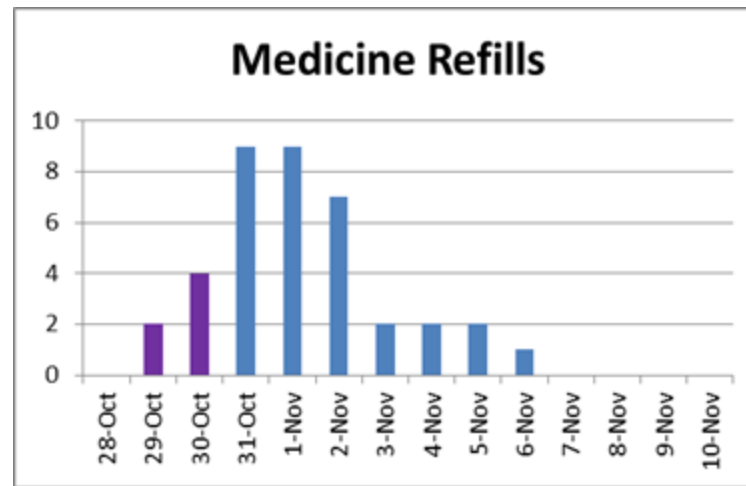
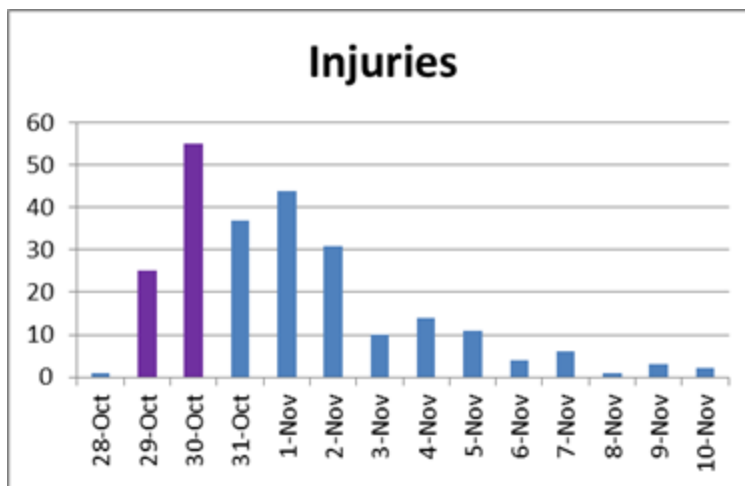
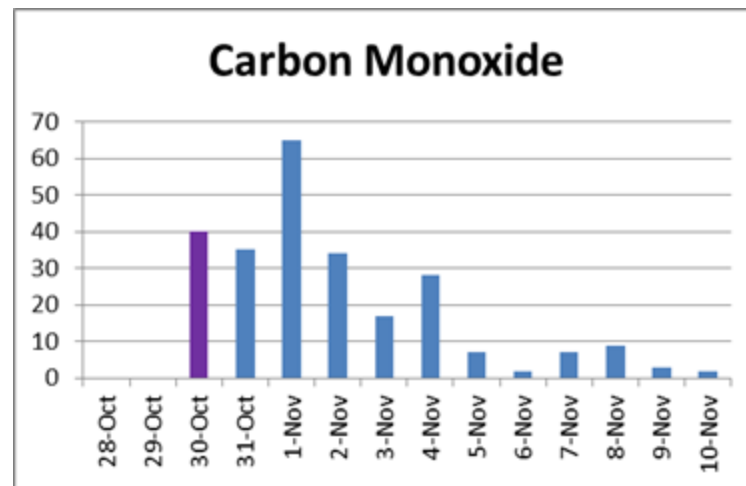
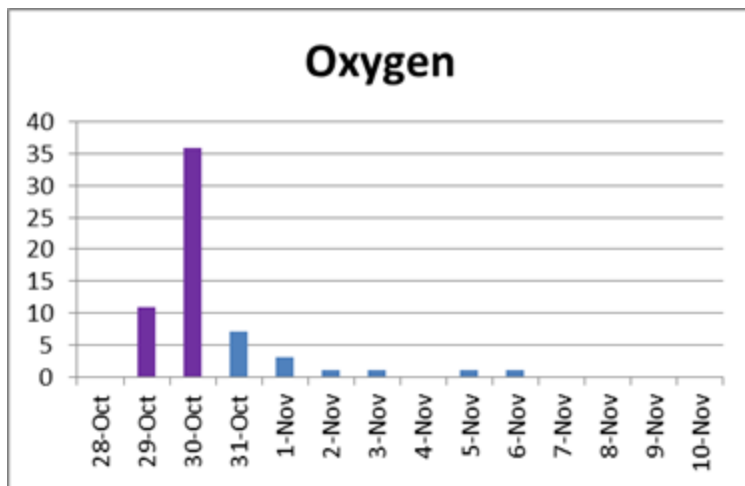


- Public health impacts:
  - Injuries
  - Carbon monoxide poisoning
  - Anxiety/mental health
  - Hypothermia/cold
  - Disrupted medical services and access to medicines

- 35 fatalities from storm-related injuries in NJ
  - 7 work-related fatal injuries
    - including 4 deaths among landscape/tree care/cleanup workers



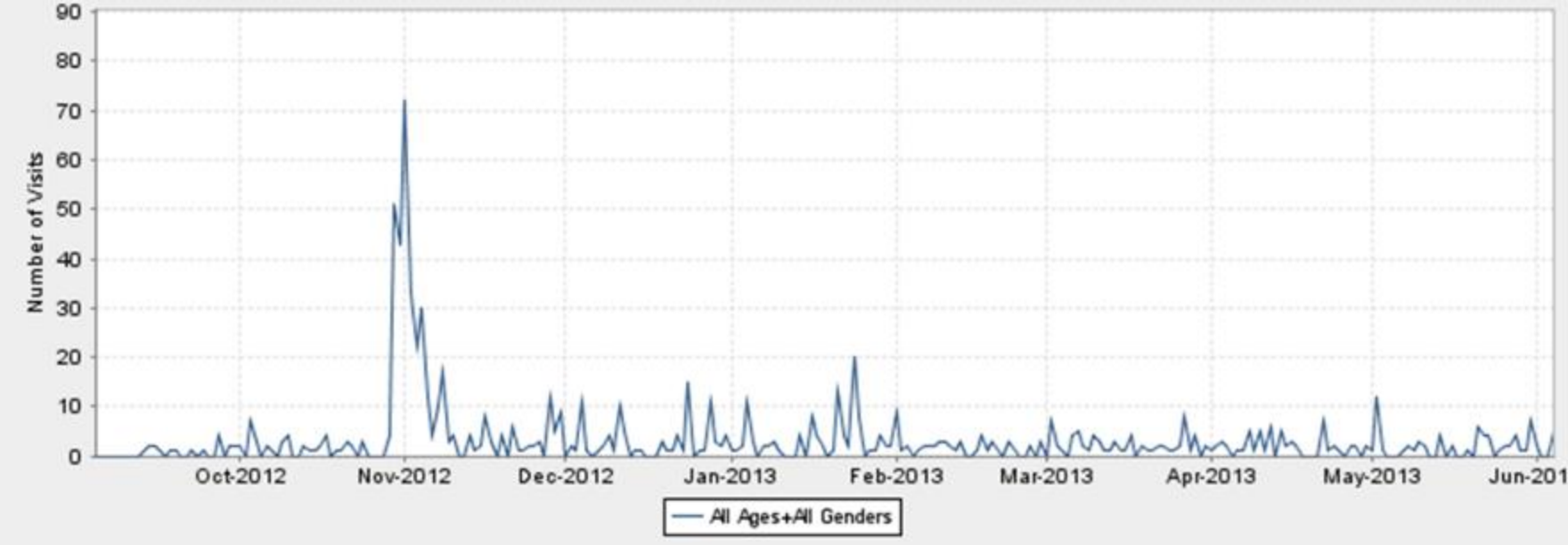
# Daily Counts of Sandy-Related ED Visits by Category



# Power outages and carbon monoxide poisoning



Carbon Monoxide Poisoning Emergency Department Visits, New Jersey Hospitals



Data from New Jersey Department of Health EpiCenter Syndromic Surveillance System

# Syndromic surveillance: Emergency department visits related to extreme weather

- NJDOH developed suite of 19 syndromic surveillance classifications for extreme weather-related conditions, including:
  - CO poisonings
  - Injuries
  - Disrupted medical care
- Allows assessment in real-time of:
  - severity of conditions
  - efficacy of response



Teresa J. Hamby and Stella Tsai  
New Jersey Department of Health

- *June 2015: Thunderstorms (“bow echo”) caused downed wires and power outages*
  - *Spike in visits for disrupted medical care, in particular for oxygen needs*
- *January 2016: Winter Storm Jonas (> 1 foot of snow)*
  - *CO poisoning visits spiked, as did visits for medication refills*

# Complex ecosystem-mediated impacts, I

- Changes in ranges and abundance of disease vectors sensitive to temperature, precipitation, humidity
- *Aedes albopictus* and *A. aegypti* mosquitoes
  - Dengue, Chikungunya, Zika



Source: [https://en.wikipedia.org/wiki/Ixodes\\_scapularis](https://en.wikipedia.org/wiki/Ixodes_scapularis)



Source: Centers for Disease Control and Prevention's Public Health Image Library, #4487

- *Ixodes scapularis* tick
  - Lyme disease and others

# Complex ecosystem-mediated impacts, II

- Algal/plankton blooms
  - Cyanobacteria: toxins affecting nervous system, kidney, liver
  - Dinoflagellates: neurotoxic shellfish poisoning
- Storm event -> contaminated runoff -> ineffective drinking water treatment -> waterborne diseases
  - *Vibrio*, *Cryptosporidium*, *Giardia*, enteric viruses

# Conclusions

- New Jersey faces public health impacts due to changing climate factors
  - Extreme heat
  - Extreme precipitation
  - Potential for more severe air pollution
  - Aeroallergens
  - Complex ecosystem-mediated effects
- Preparedness of public health system is essential
  - Track risk factors and effects
  - Develop adaptation responses to reduce harm
  - Protect most vulnerable populations