



Clinicians' Update on Climate and Health:

Public health impacts,
emerging diseases, and
healthy solutions





Extreme Heat

1995

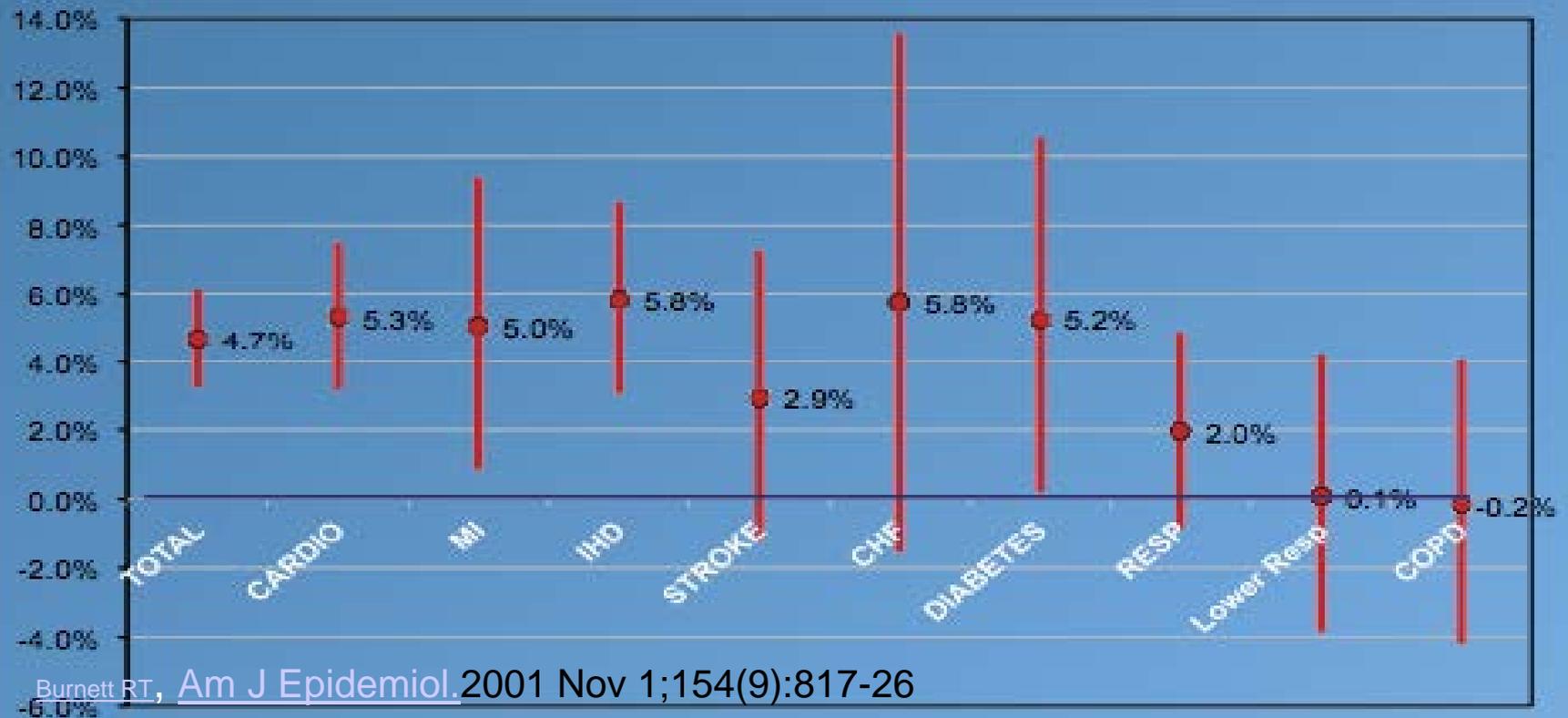
Chicago

2011



Extreme Heat Mortality

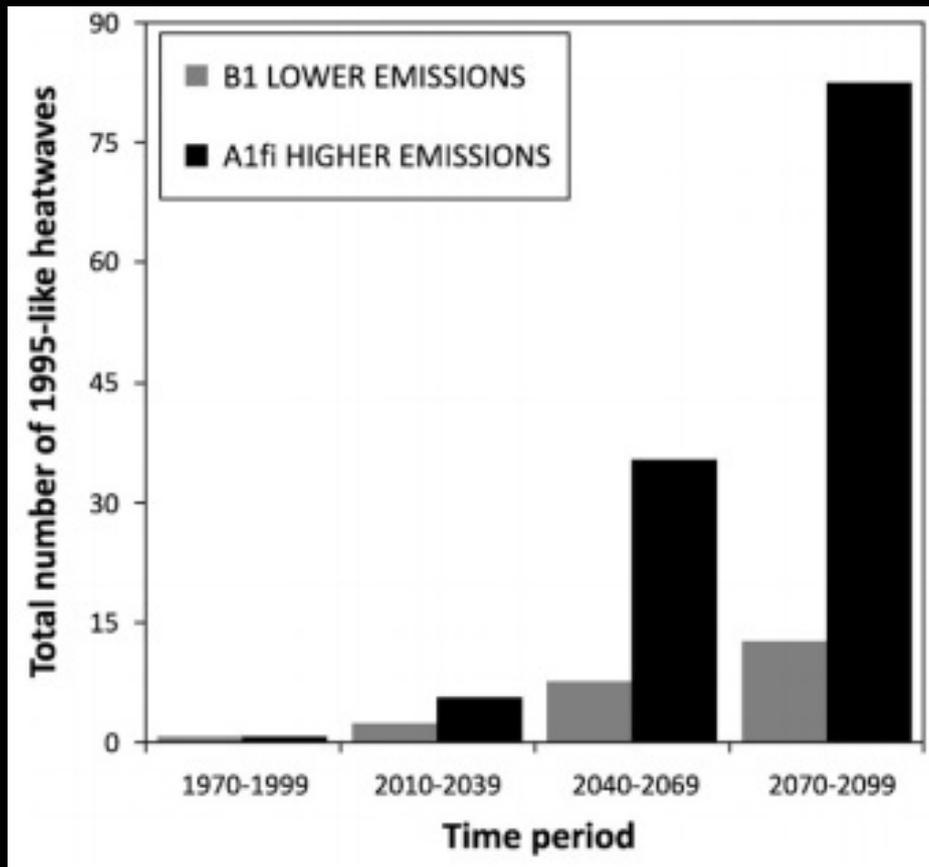
Disease-Specific Excess Risk of Mortality
(central estimate and 95% CI for a 10° F change in mean daily temperature)



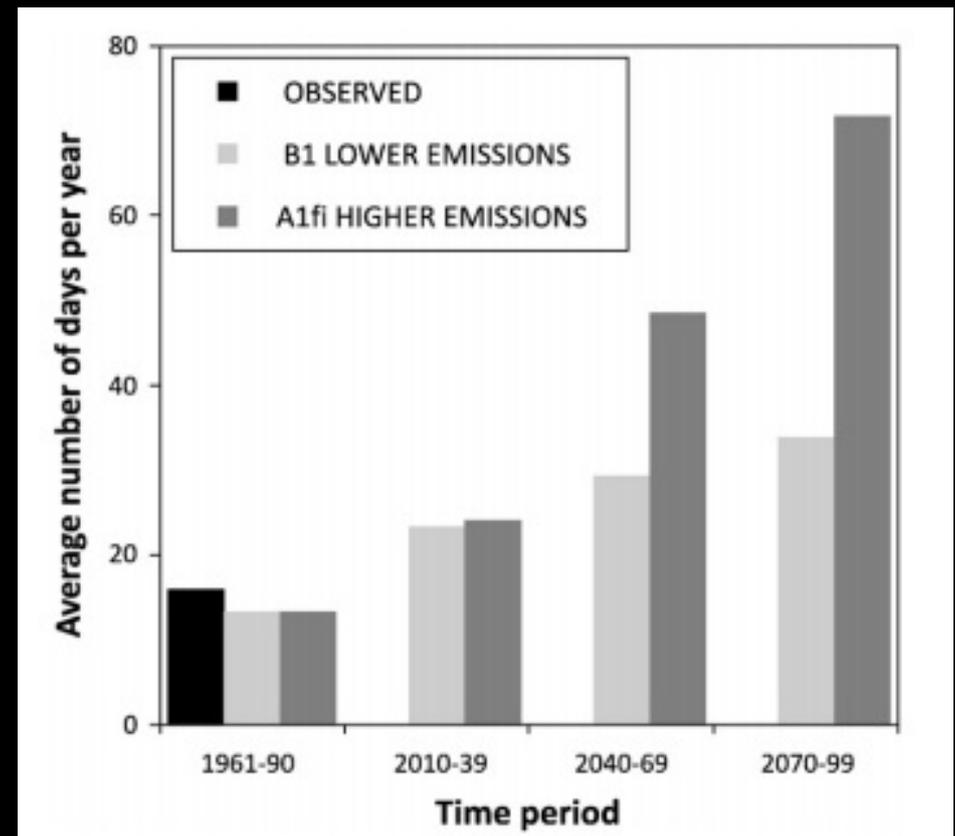
Burnett RT, *Am J Epidemiol.* 2001 Nov 1;154(9):817-26

CHICAGO Forecast

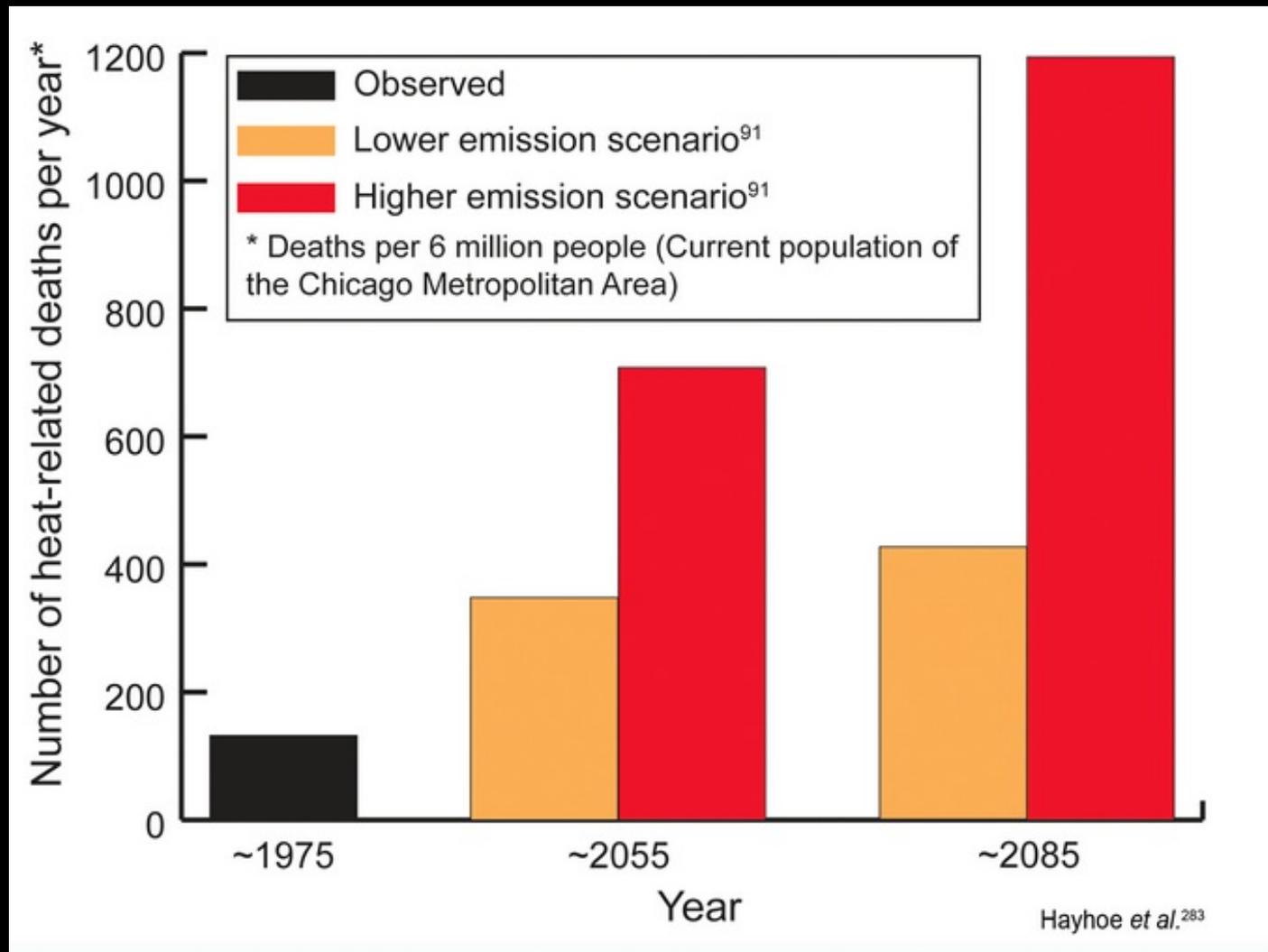
Heat Waves per 30 year period



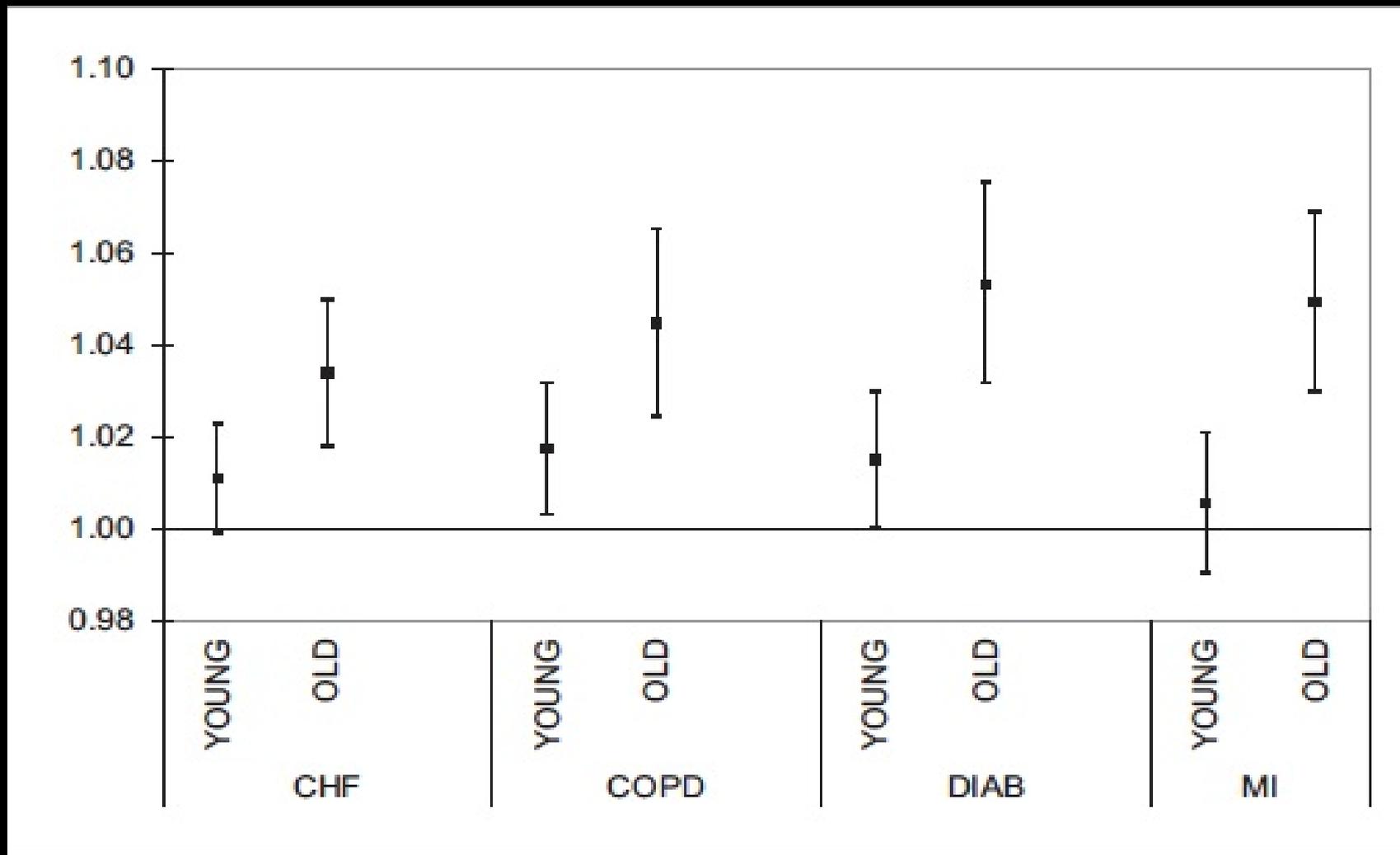
Extreme Heat Days



Chicago Future Heat Mortality



HR for Death per 1 degree C increase in Summer Temperature Variability



Mitigating effect of green space

Exacerbating effect of % nonwhite

Cohort	<i>P</i> value for modifier	HR at the 25th percentile			HR at the 75th percentile		
		25%	HR	95% CI	75%	HR	95% CI
Proportion green space modifier							
CHF	0.01	0.8	1.04	1.02–1.05	0.9	1.01	0.99–1.03
COPD	0.02		1.04	1.03–1.06		1.02	1.00–1.04
Diabetes	0.03		1.05	1.03–1.07		1.02	1.00–1.05
MI	0.03		1.05	1.03–1.06		1.02	1.00–1.04
Proportion nonwhite modifier							
CHF	0.00	0.16	1.01	0.99–1.03	0.33	1.04	1.03–1.06
COPD	0.00		1.02	0.99–1.04		1.05	1.03–1.07
Diabetes	0.00		1.02	1.00–1.04		1.06	1.04–1.08
MI	0.01		1.02	1.00–1.04		1.05	1.03–1.07

OZONE

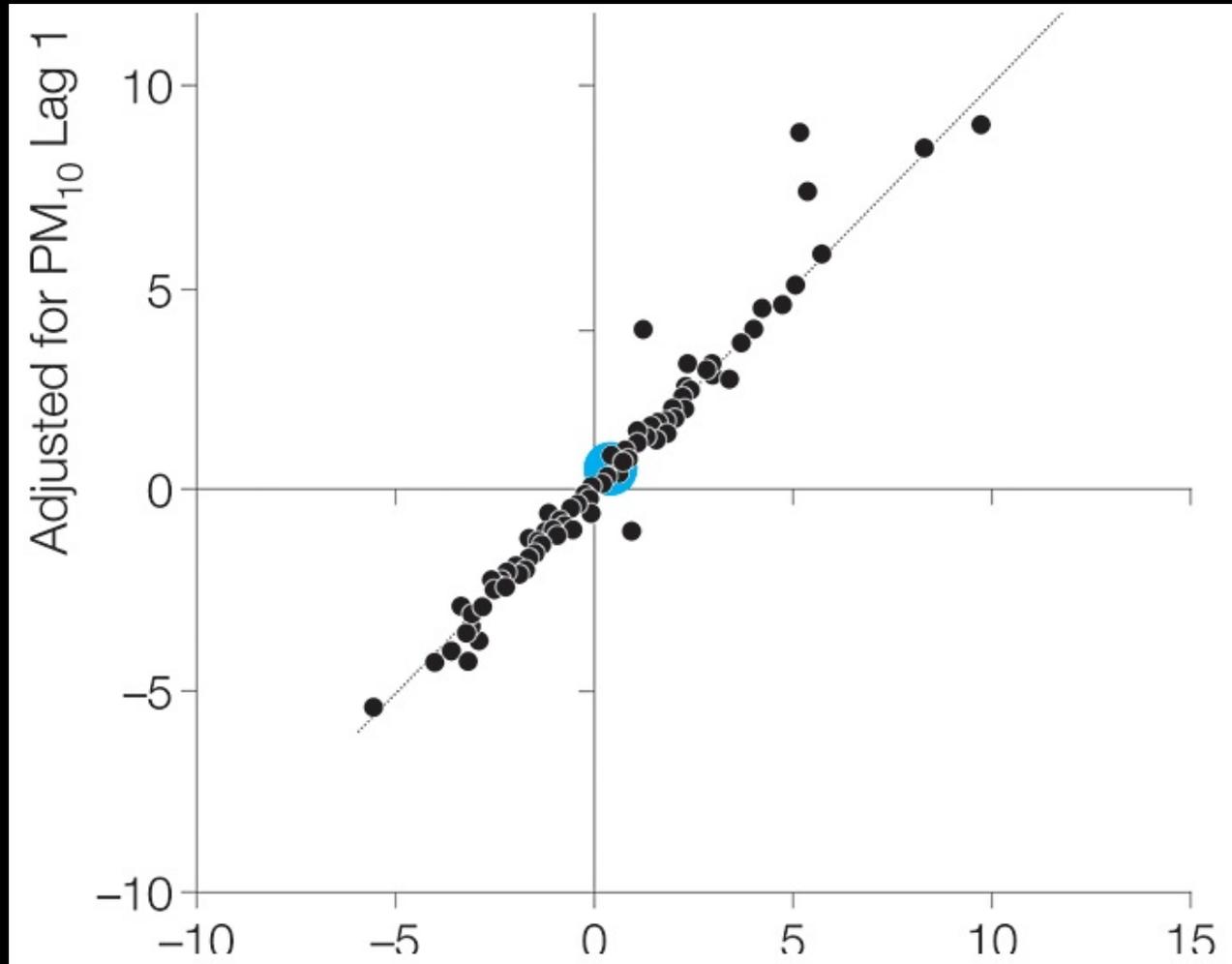
LA



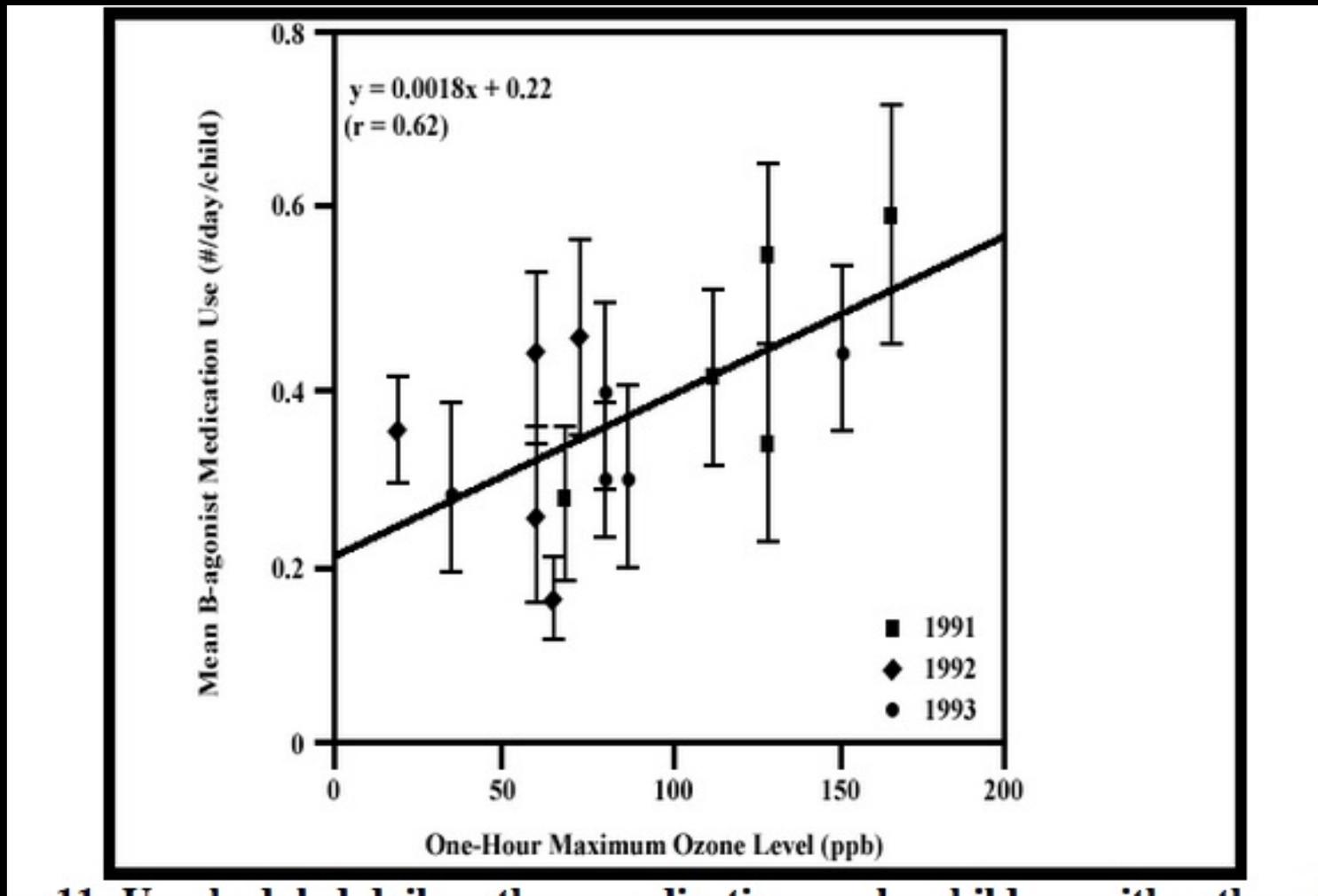
Columbus, OH



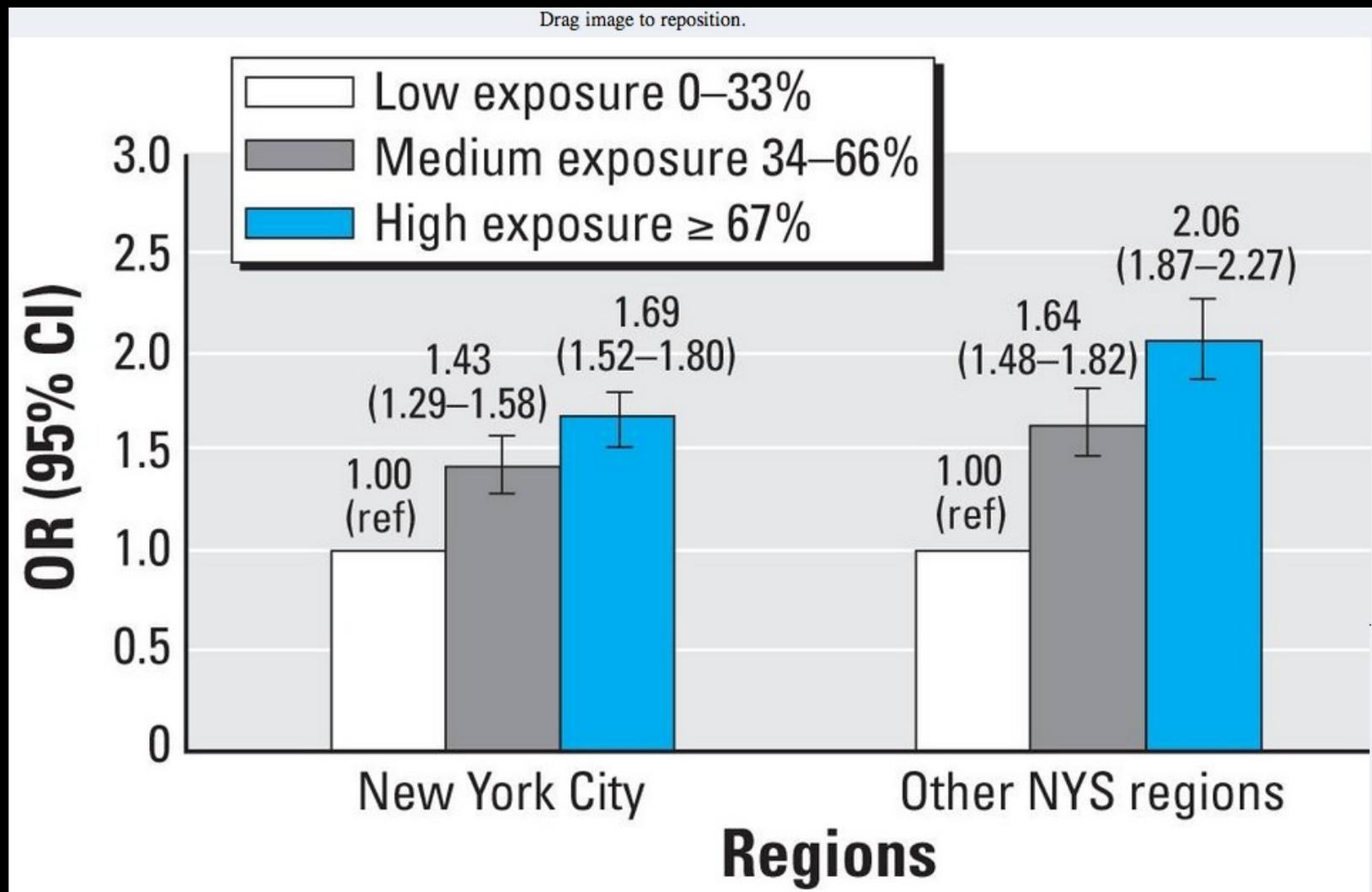
Mortality and Ground Level Ozone



Ozone level and beta agonist use



Chronic Ozone Exposure and Pediatric Asthma Admission

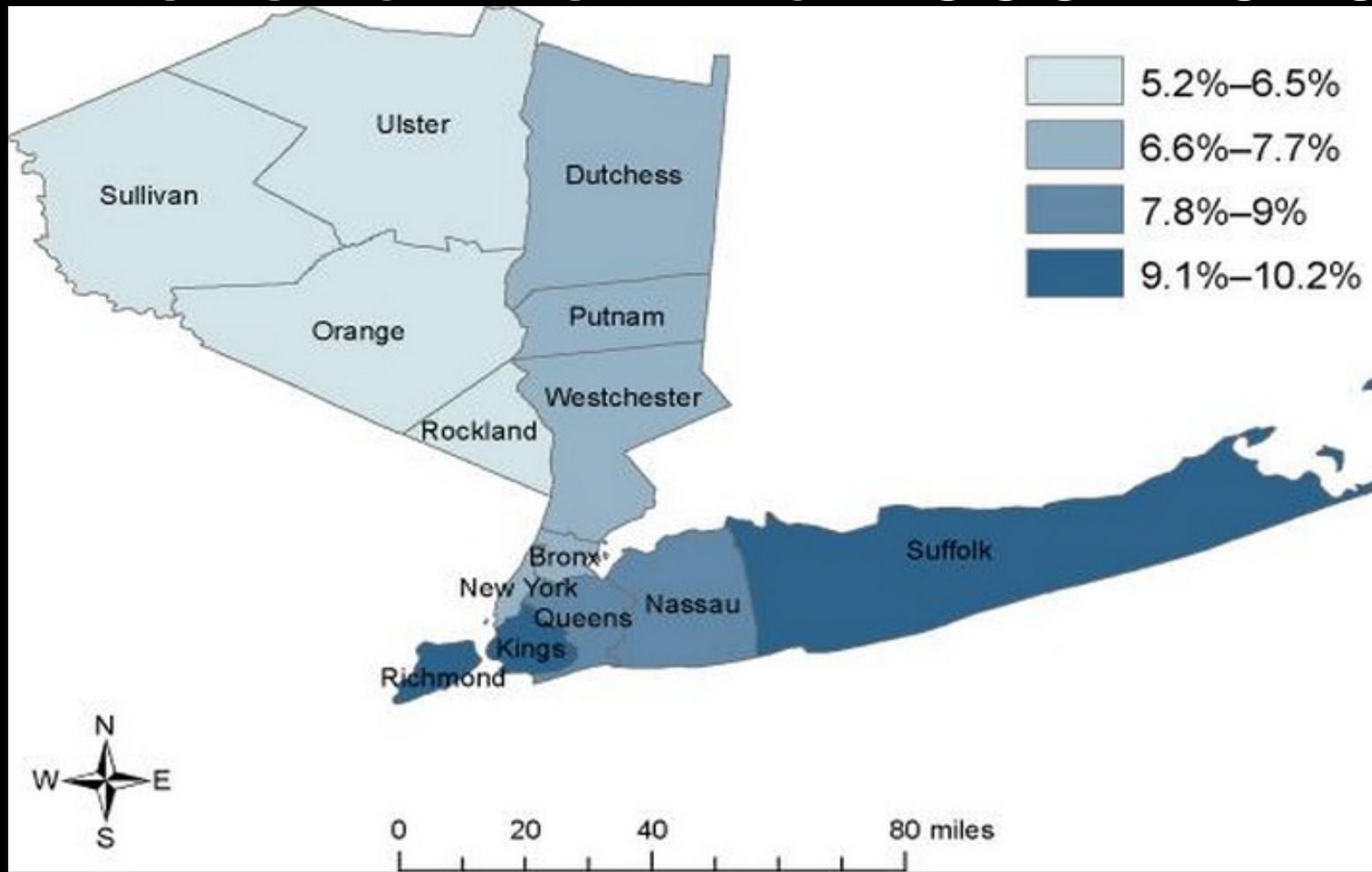


Ozone + Sports = Asthma



RMcConnell Lancet.304):386-91.

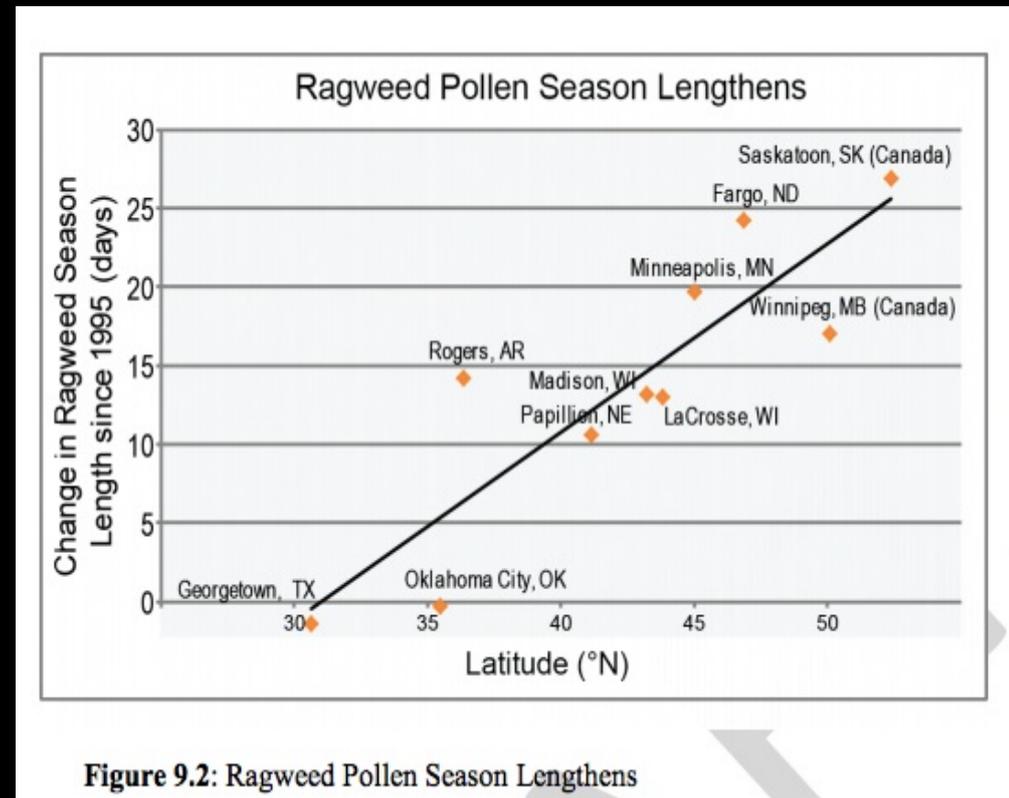
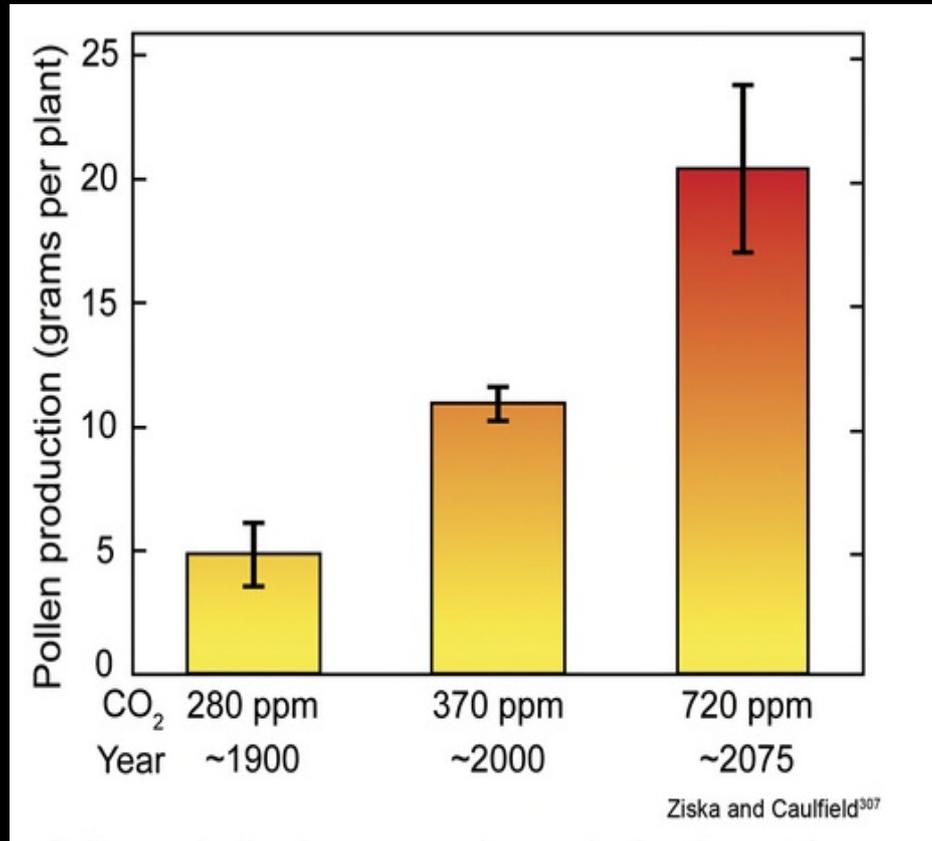
Ozone Effect on Pediatric ED Visits for Asthma 1990- 2020



Pollen

More

Longer

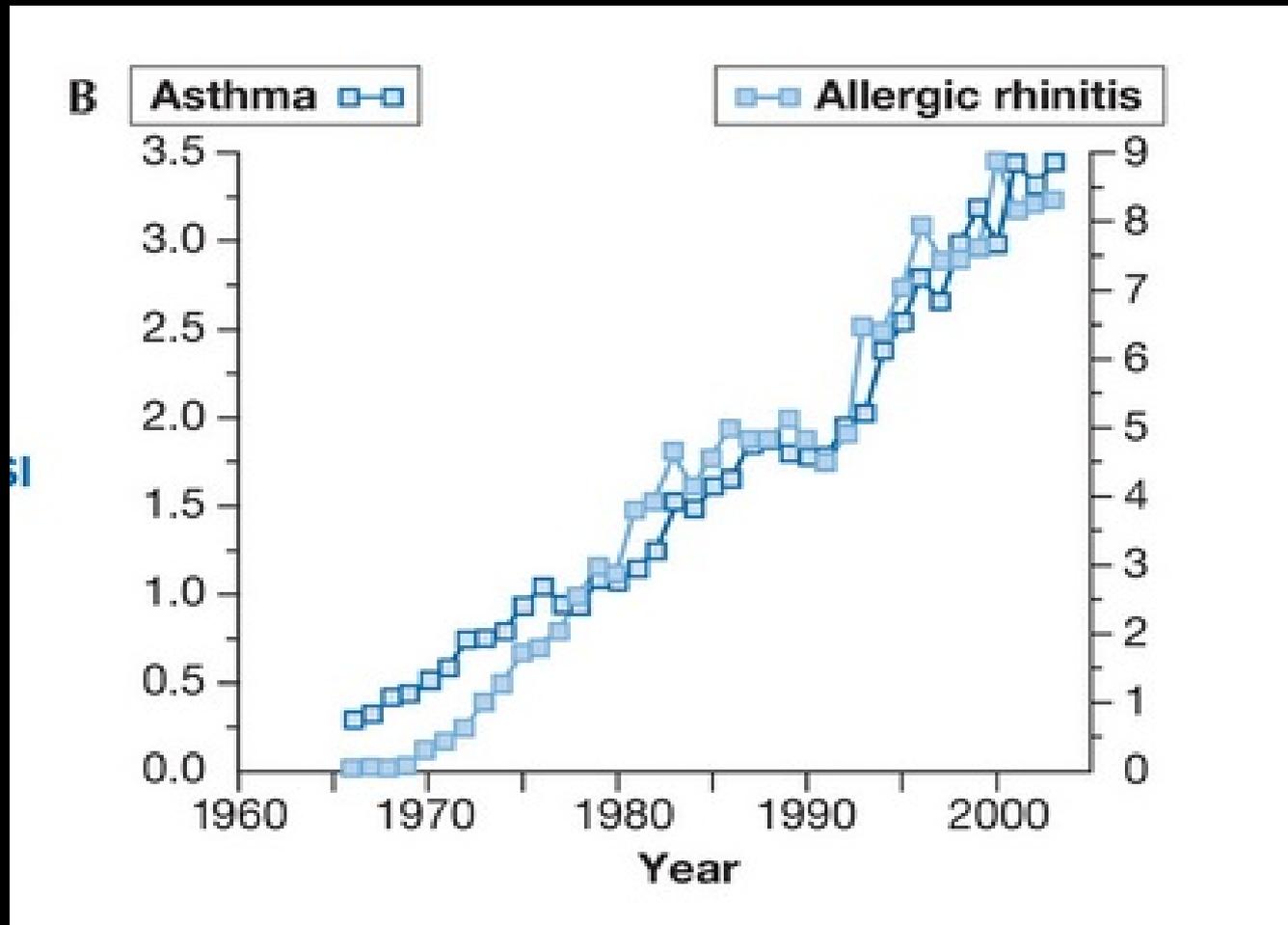


Mold and Asthma

Cedar Rapids, IA

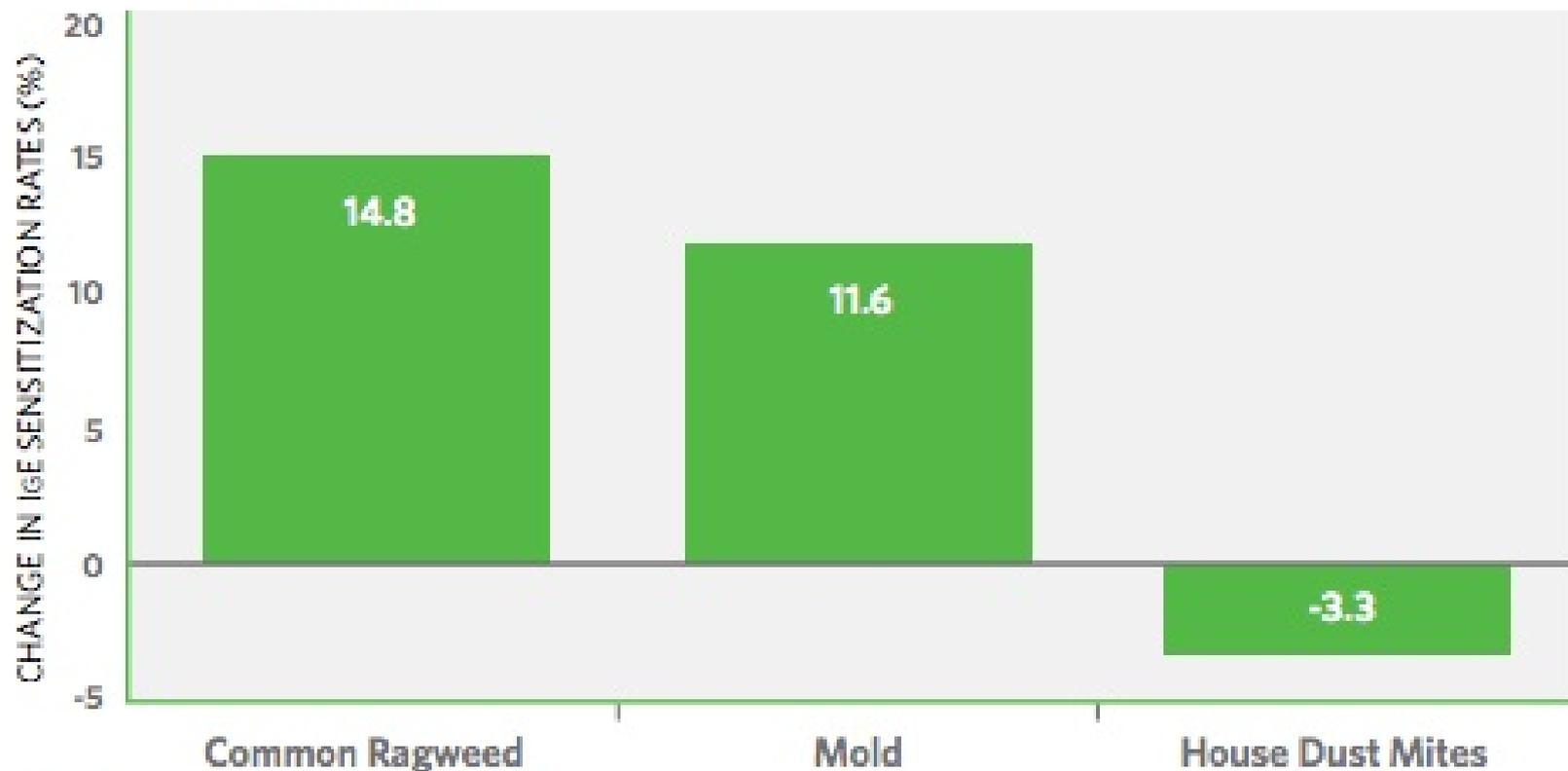


Rising Incidence Allergies and Asthma



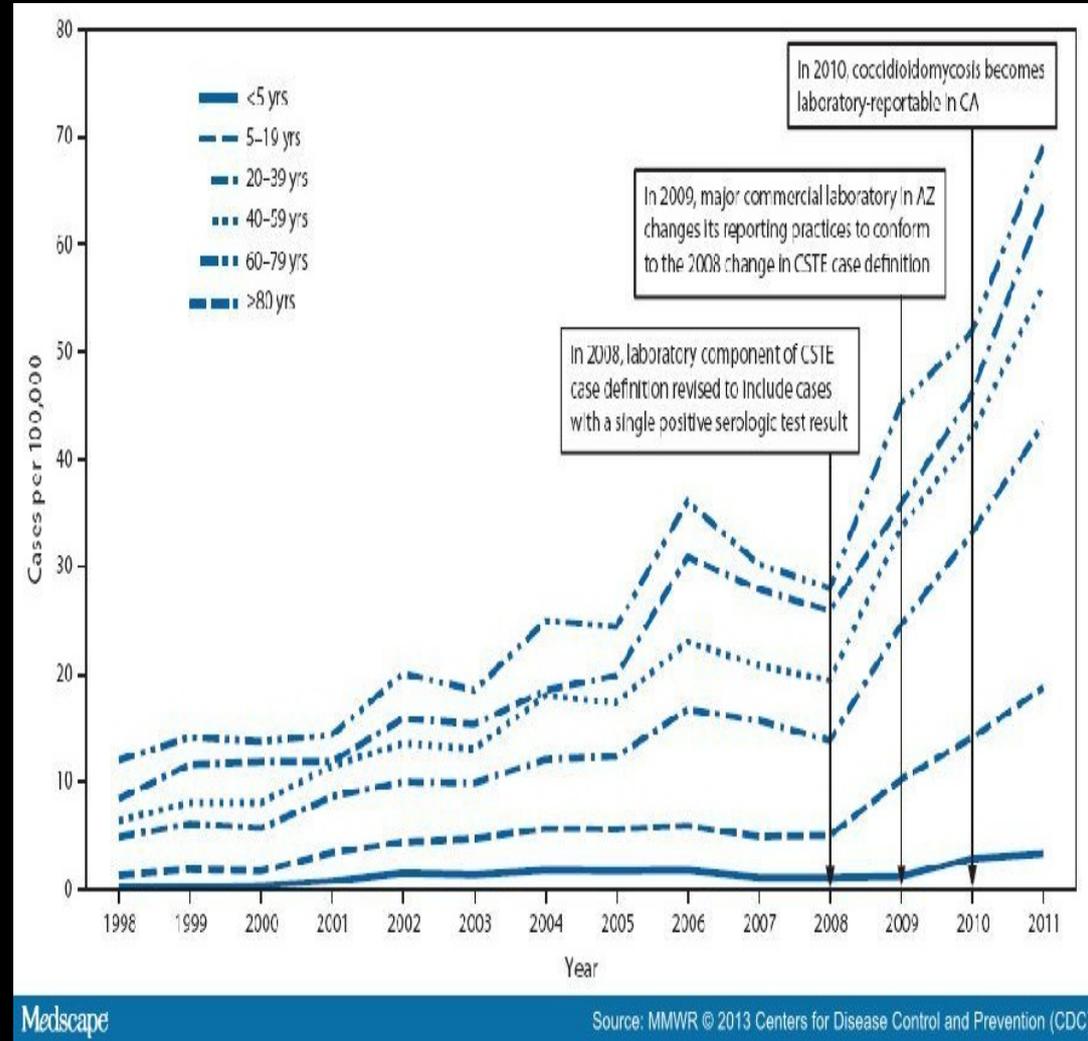
Quest 2011 14 million IgE tests

FIGURE 2. PERCENT CHANGE IN IgE SENSITIZATION RATES IN ENVIRONMENTAL ALLERGENS OVER 4 YEARS



Source: Quest Diagnostics Health Trends™

Valley Fever Coccidioidomycosis



Medscape

Source: MMWR © 2013 Centers for Disease Control and Prevention (CDC)

CONCERN: Erionite and Mesothelioma

Cappadocia, Turkey



PHOENIX, AZ 2012

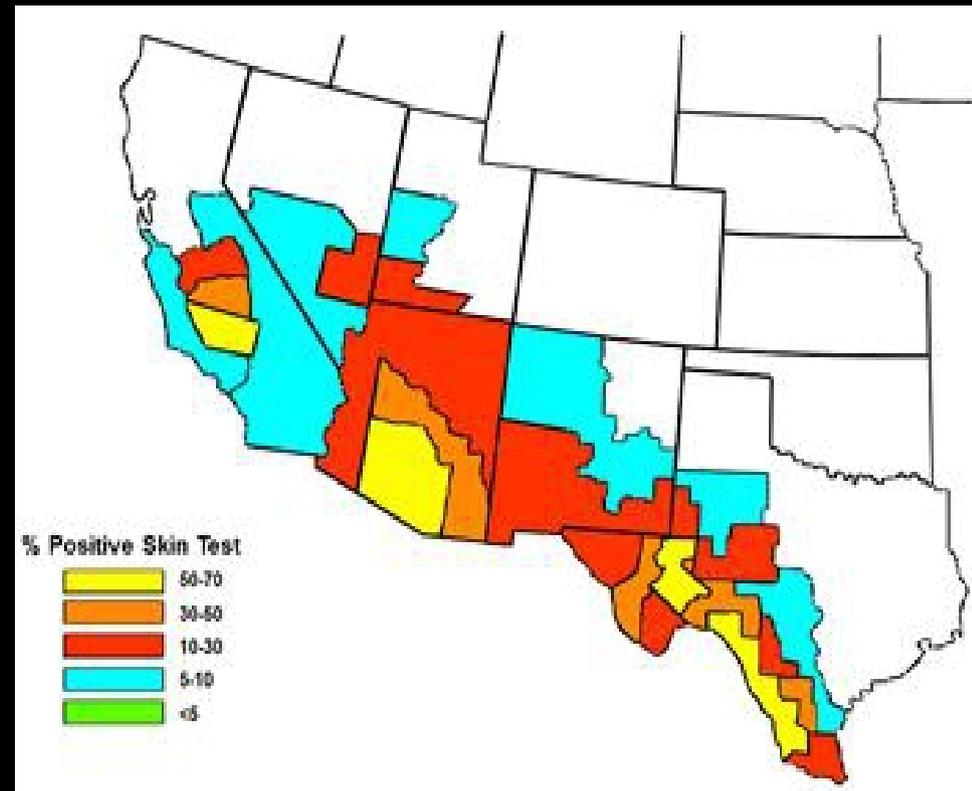


ERIONITE LOCATIONS

VALLEY FEVER ENDEMIC AREAS

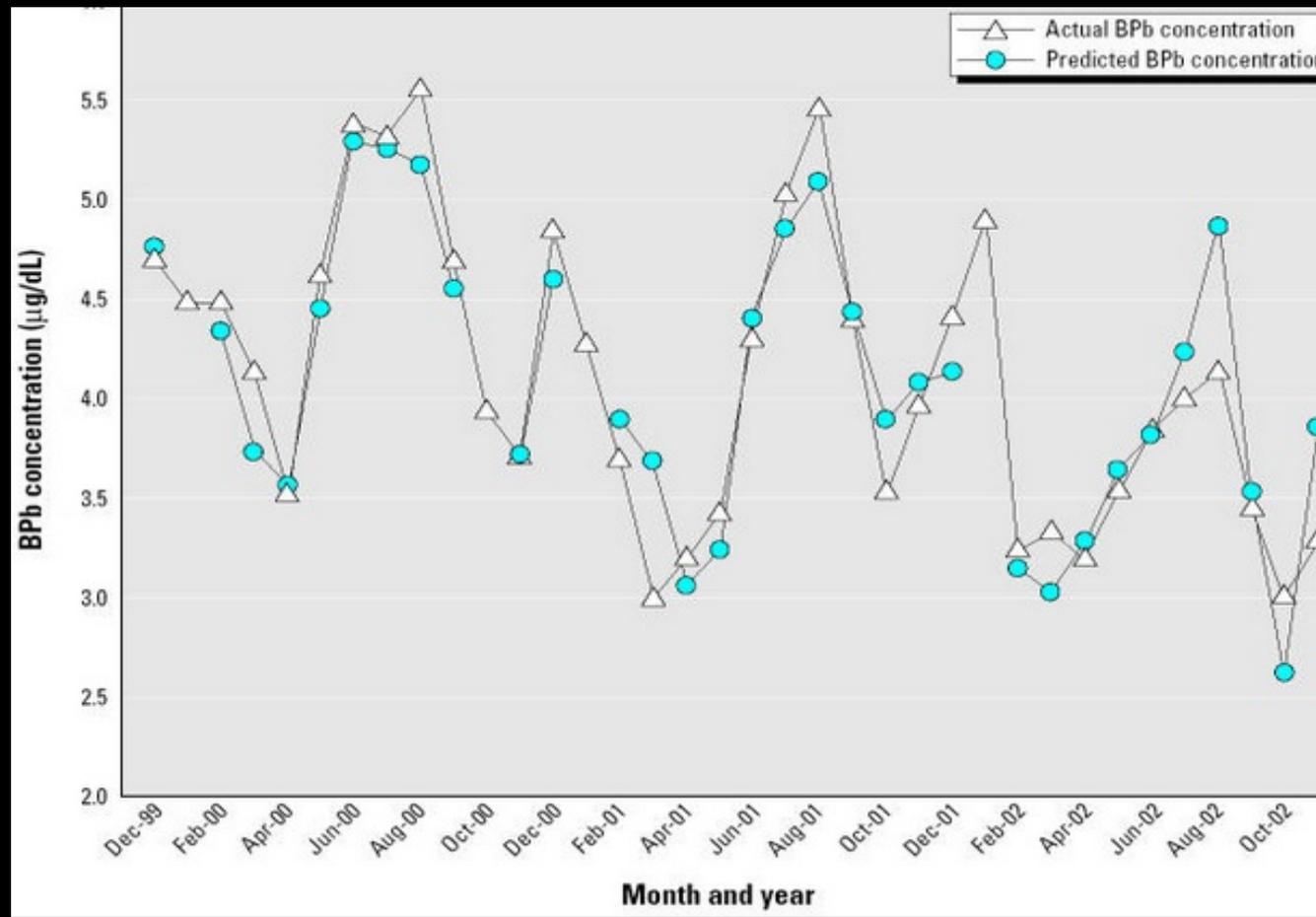
November 22nd, 2011 8:49 am ET - Administrator
From Sheppard R. [Occurrences of erionite in sedimentary rocks of the western United States](#). Denver, CO: US Department of the Interior, US Geological Survey; 1996. Open File Report 96-018.

[» Return to the blog entry](#)



BLOOD LEAD INCREASES IN WARM DRY WEATHER

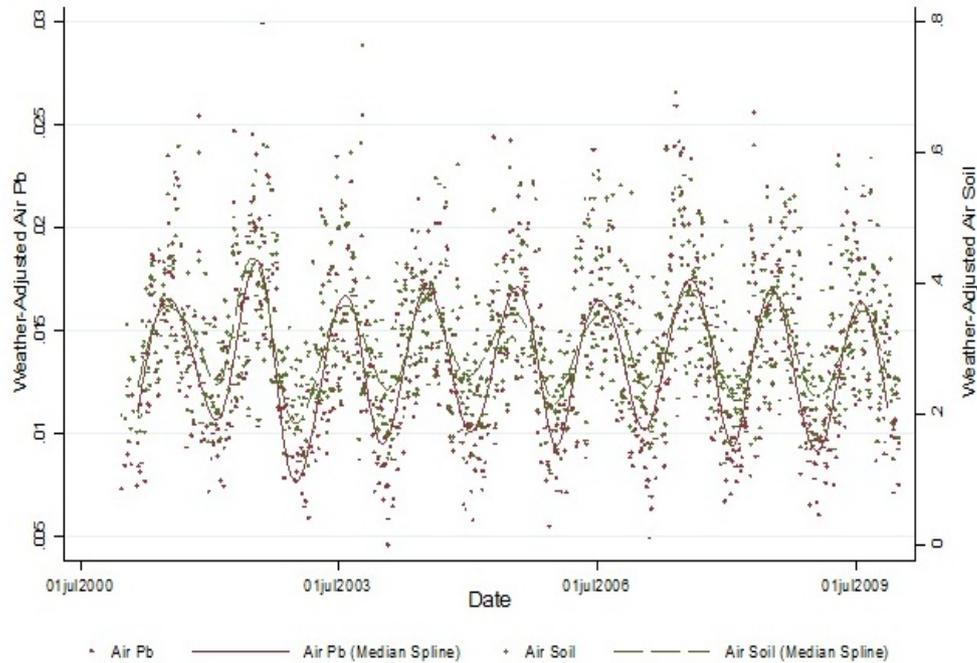
Indianapolis



Laidlaw. Environ Health Perspect. 2005 June; 113(6): 793–800.

Detroit, MI

Plot of Temporal Variation in Atmospheric Soil and Lead in Detroit - 2001-2009

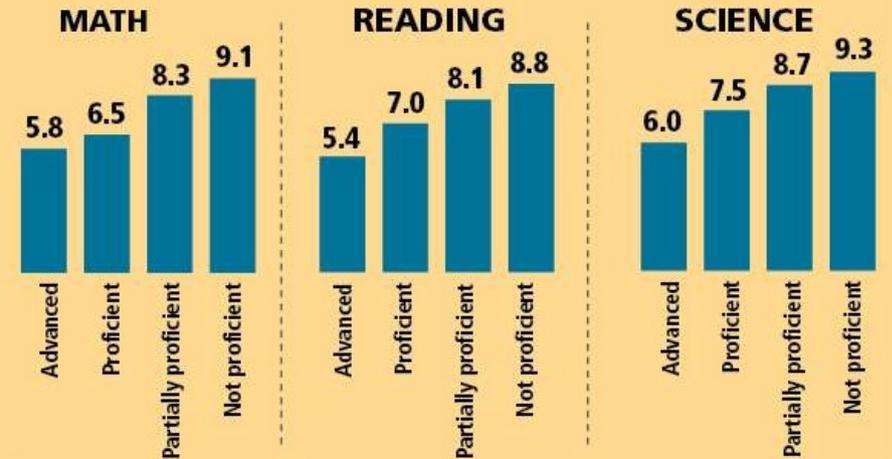


LEAD AND TEST SCORES

Students whose blood had a higher lead level scored lower on MEAP tests, based on a study of 21,281 Detroit Public Schools students.

AVERAGE LEAD LEVELS

(Lead levels are measured in micrograms of lead per deciliter of blood.)

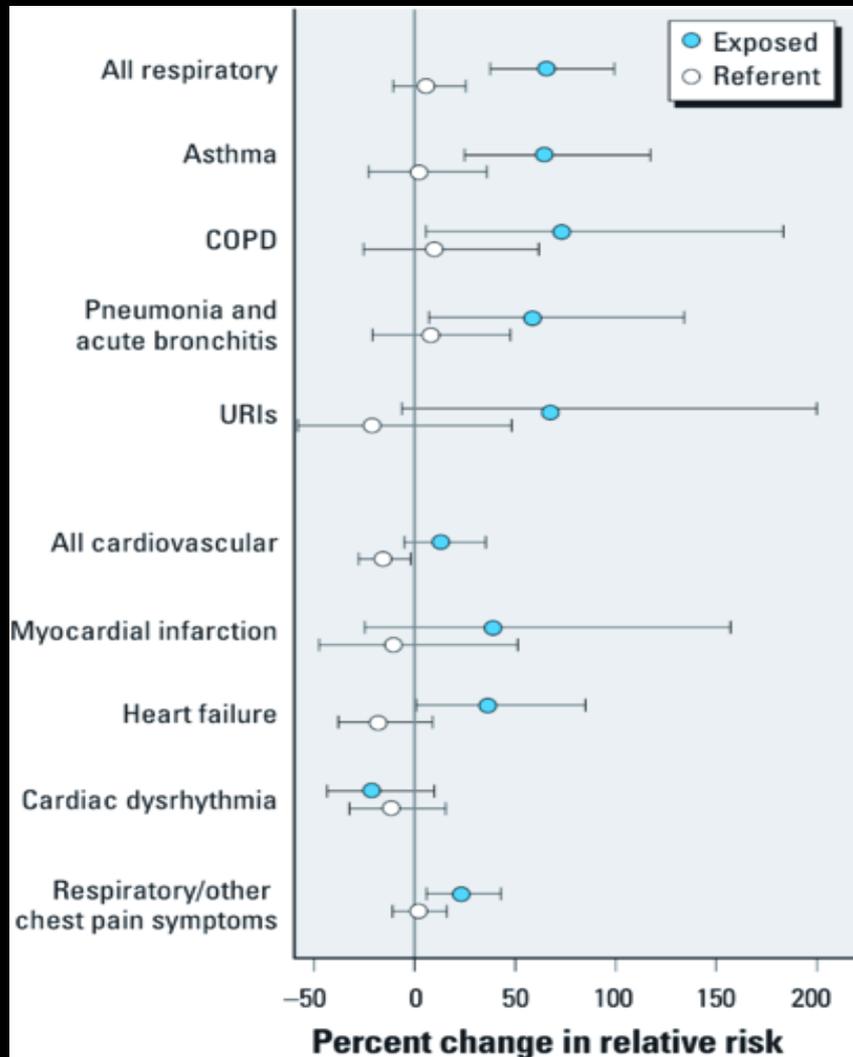


SOURCE: American Journal of Public Health

DETROIT FREE PRESS

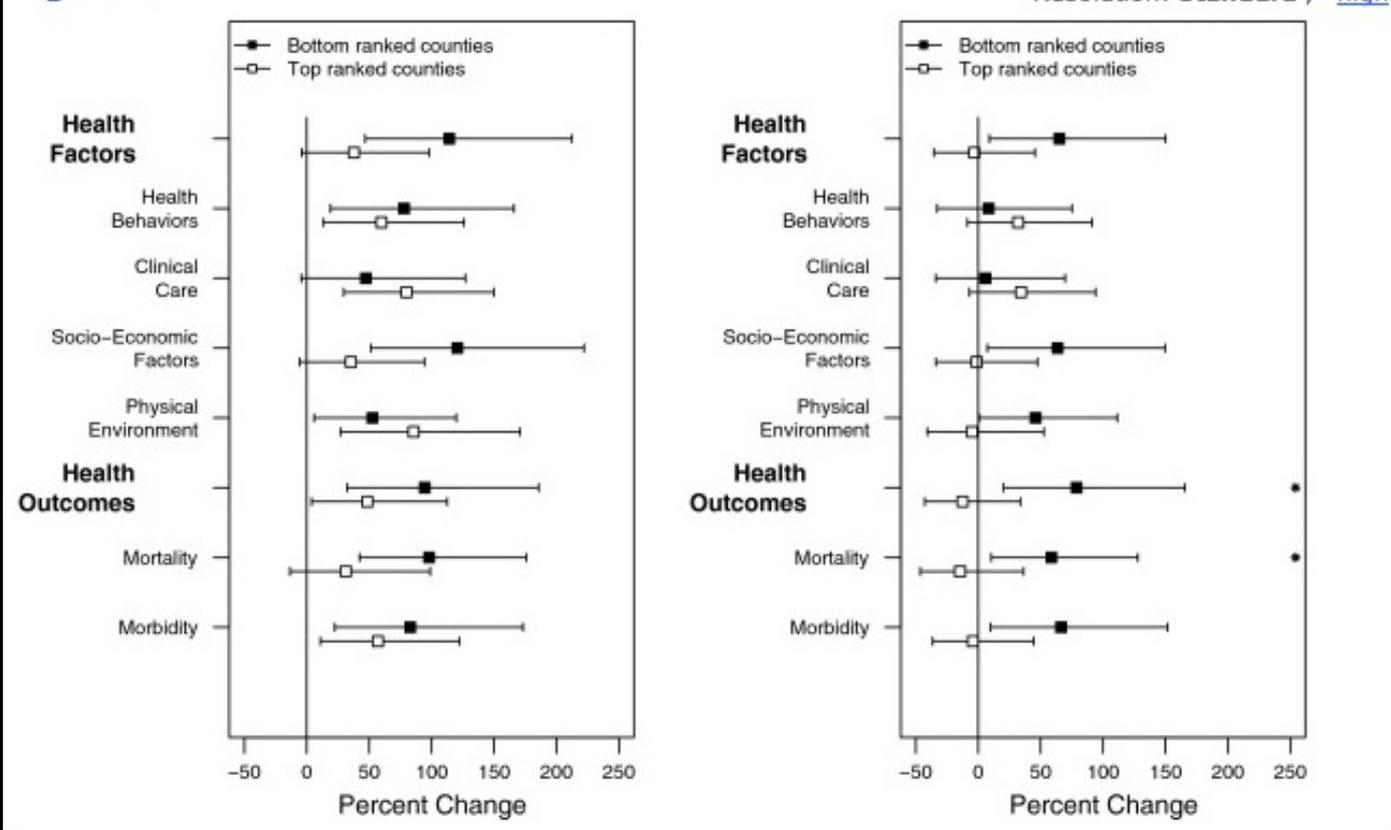
Cardiopulmonary ER Visits North Carolina 2008

Colorado Springs 2013



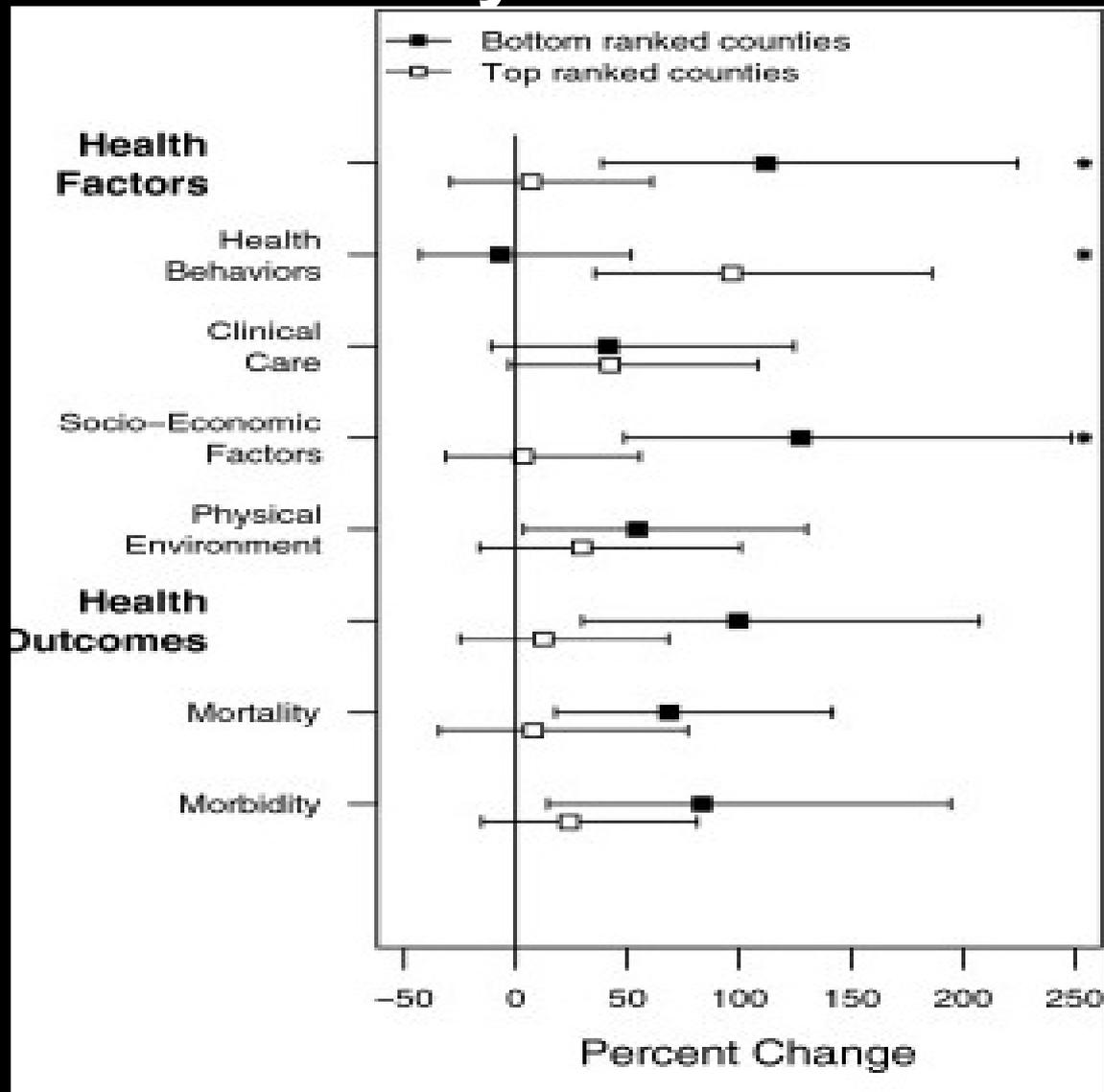
Wildfire Related Asthma ER Visits/Outcomes and County Characteristics

Figure 3.



Excess relative risk of emergency department visits for Asthma a) on the day of the exposure (at lag 0) and b) on the day following the exposure (lag 1). Stars denote statistically significant difference in risk between two groups of counties. Estimates are reported per 100 $\mu\text{g}/\text{m}^3$ of $\text{PM}_{2.5}$.

Wildfire Related CHF ER Visits/Outcomes and County Characteristics

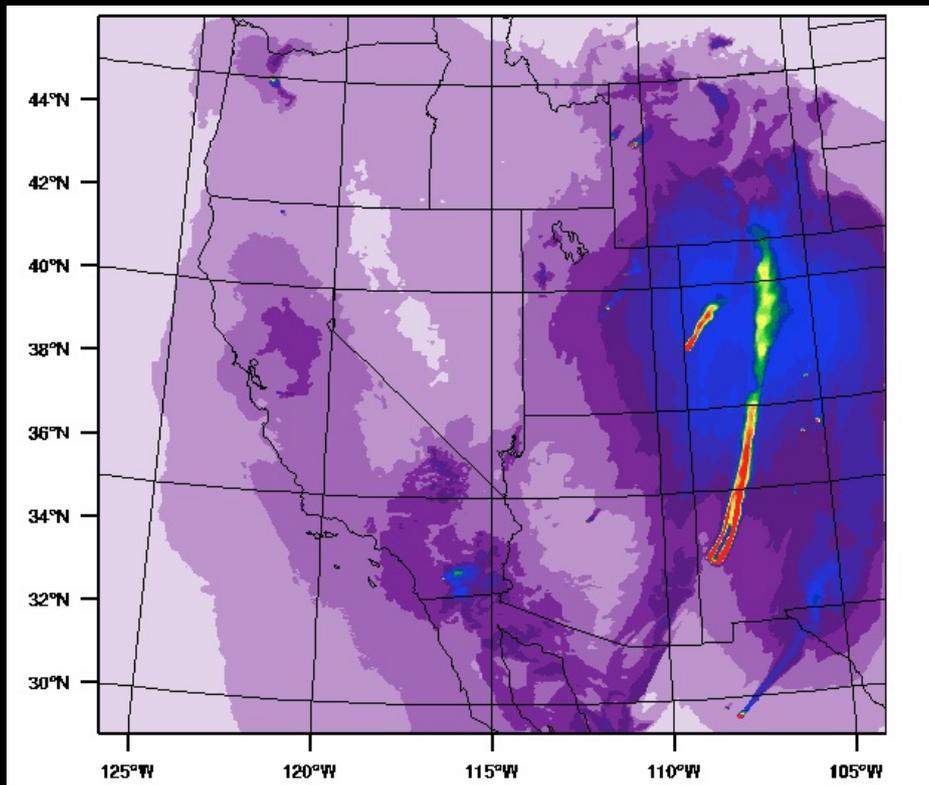


PM 2.5 Dissemination

Fire in NM

Smoke in Denver, CO

Memorial Day 2012



Fox Lake, IL 2013



JIM HOUNGHEUTER/ESPRESSO

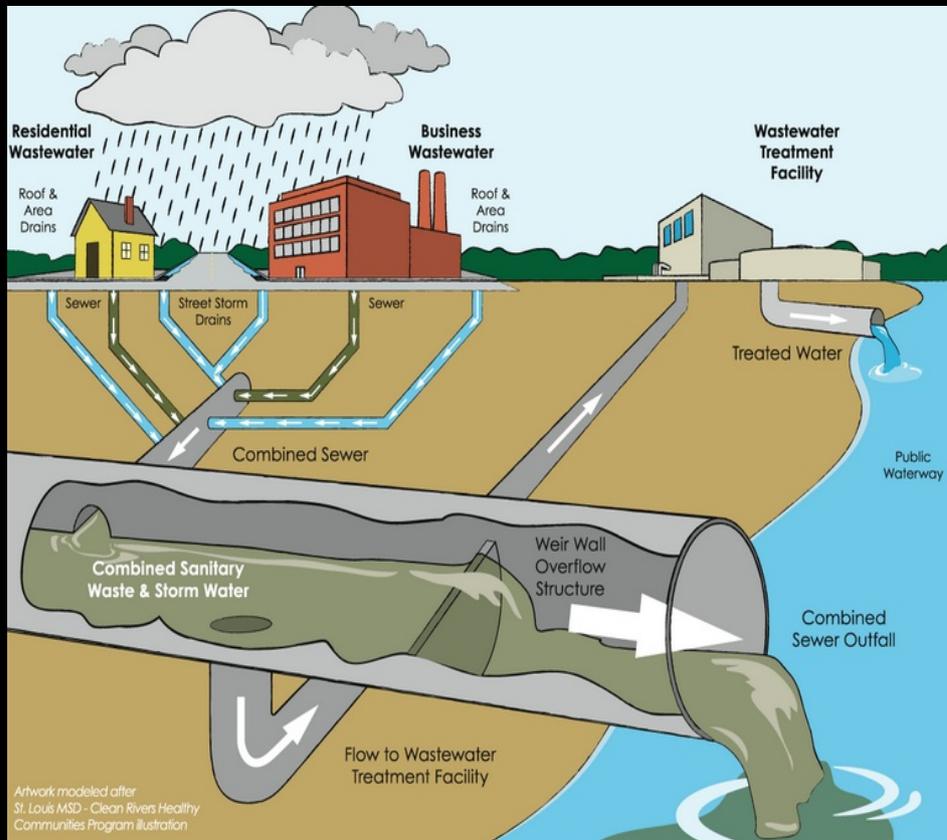
Pekin, IL

Morehouse, MO
April 2013



Combined Sewer Overflow

Pittsburgh, PA Allegheny River

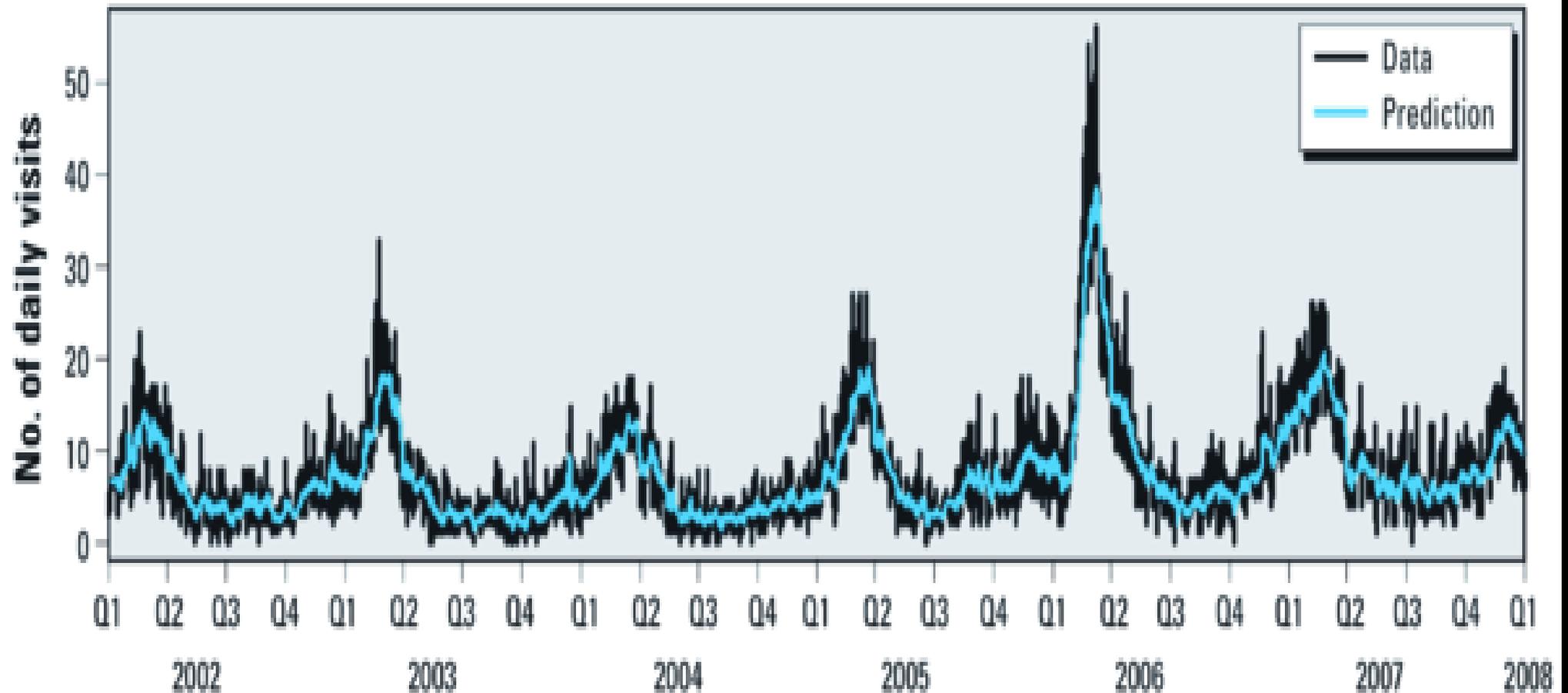


Sewage in the Streets

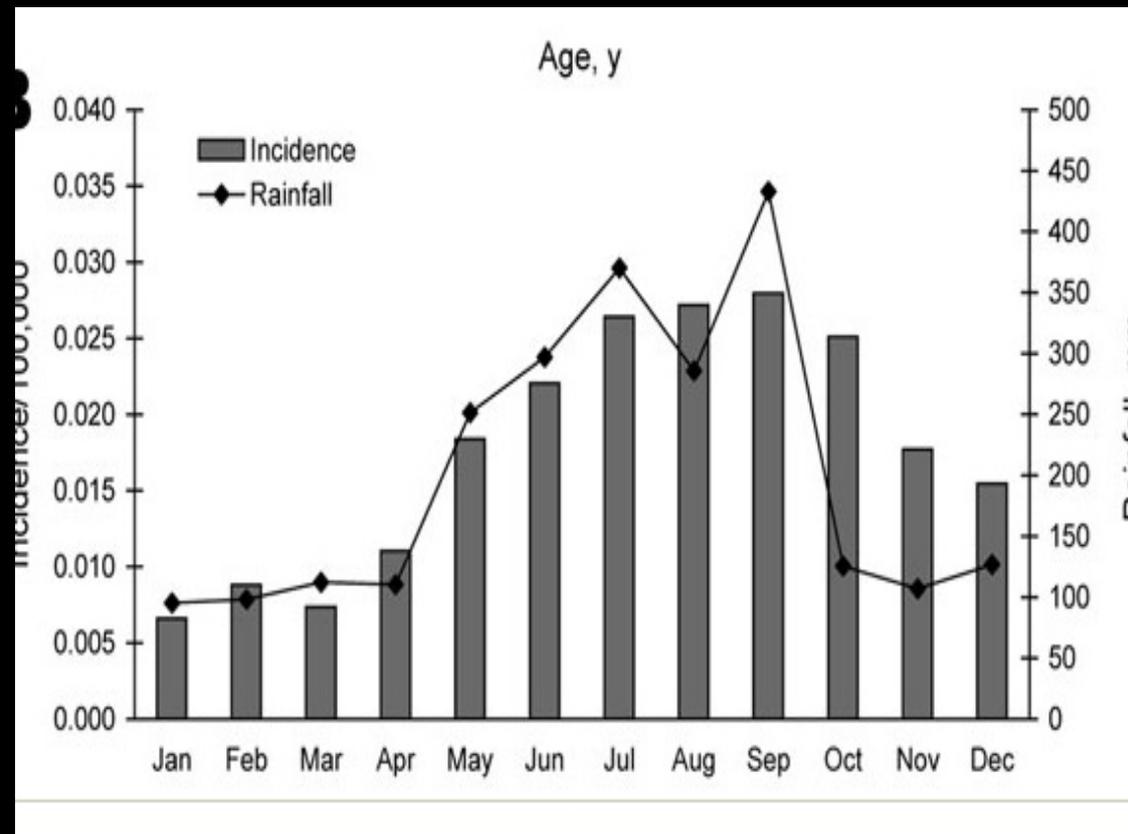
Duluth, MN 2012



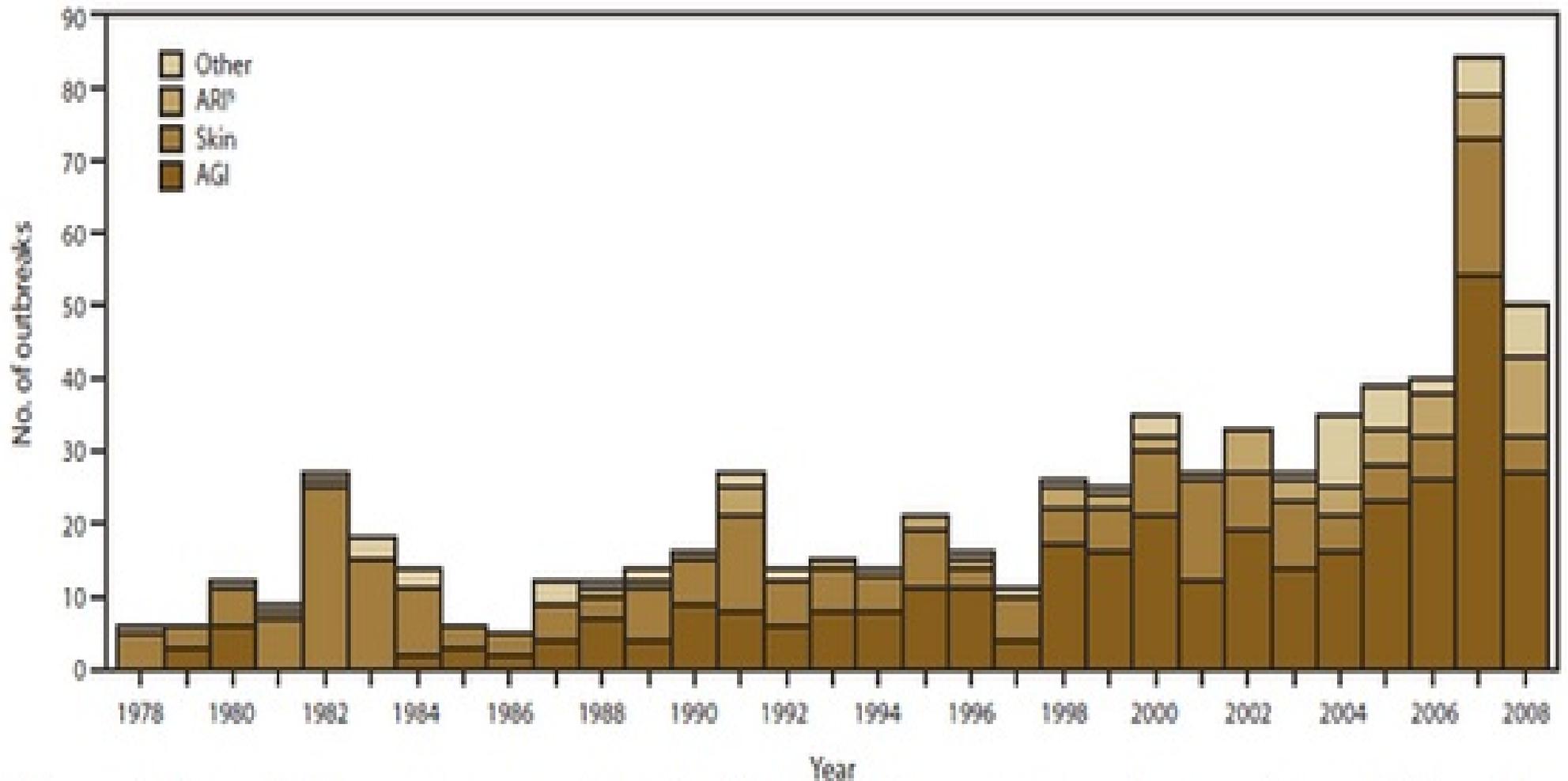
Gastroenteritis and Rainfall Pediatric ED Visits Wisconsin



EMERGING: Leptospirosis



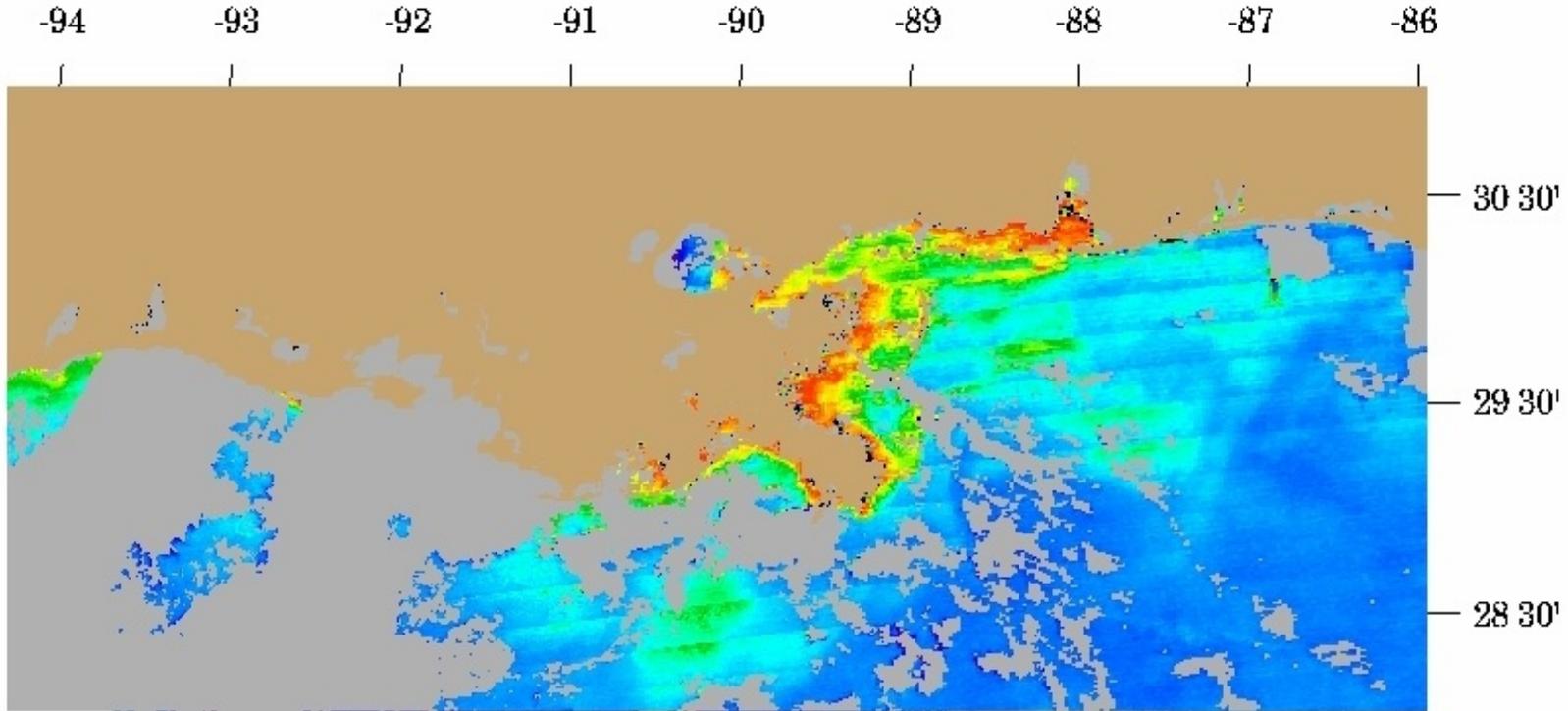
Recreational Water Borne Infectious Disease Outbreaks 1978-2008



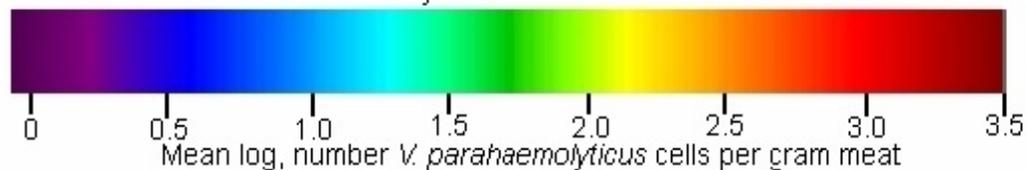
Chesapeake Bay Sea Surface Temperatures *V. parahemolyticus* cells/gm oyster meat



OCEANS & HUMAN
HEALTH INITIATIVE

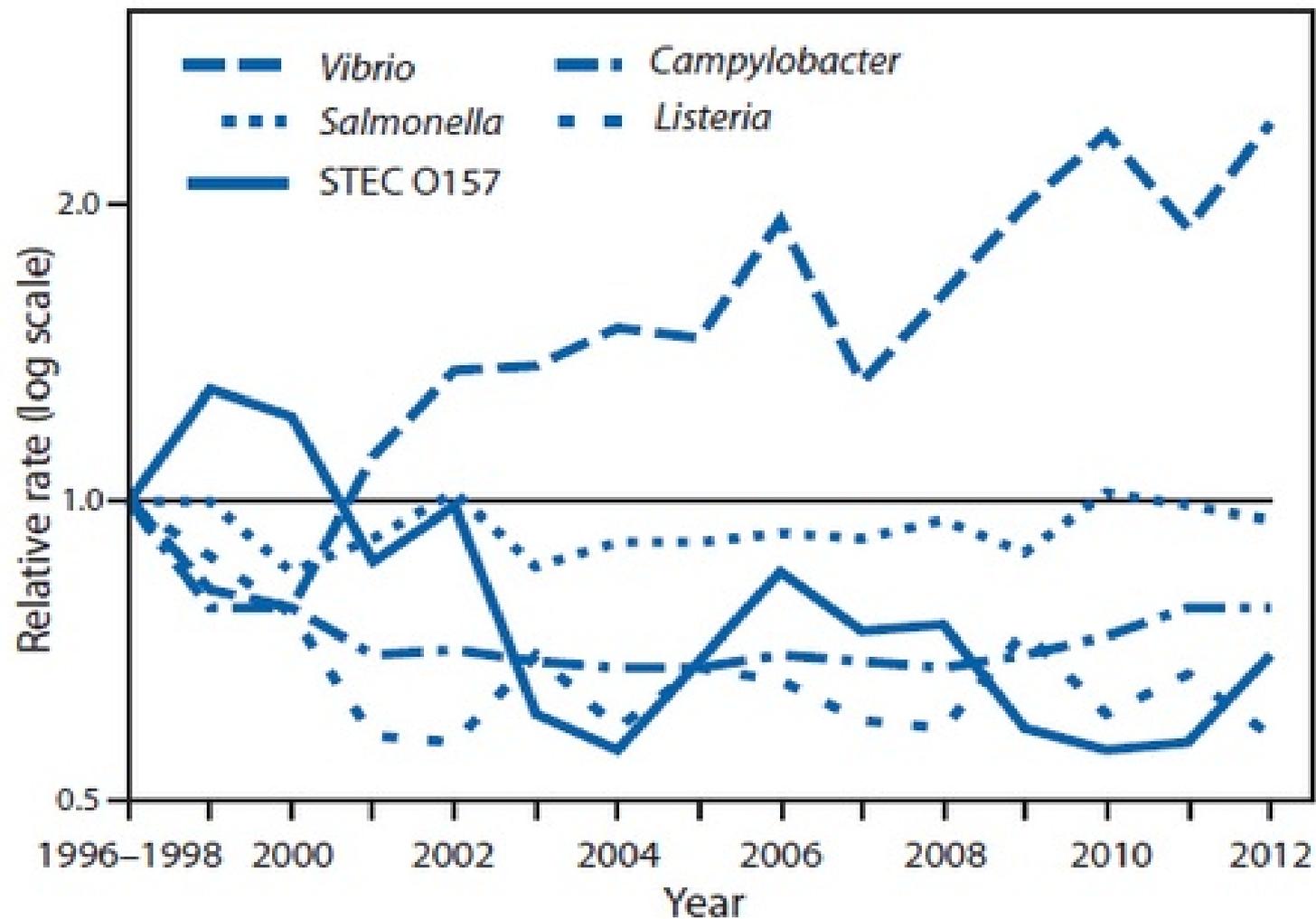


Scenario 1: Oysters at time of harvest



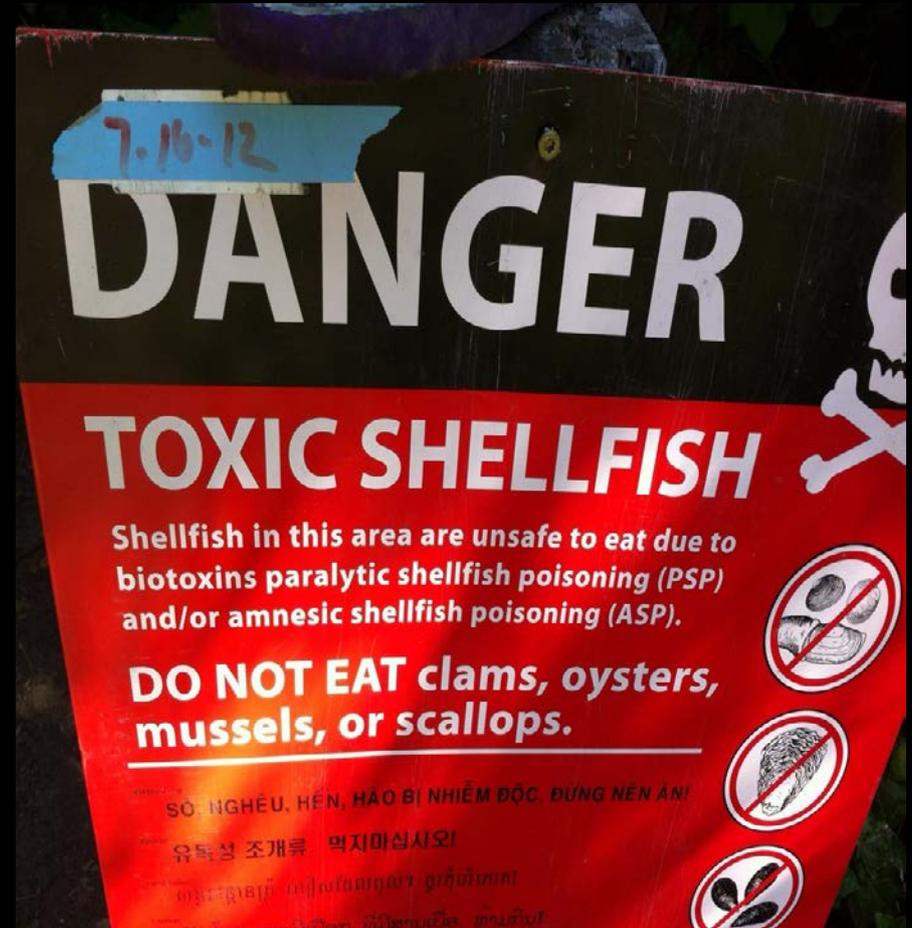
VIBRIO INCIDENCE

MMWR 2012



SHELLFISH POISONING

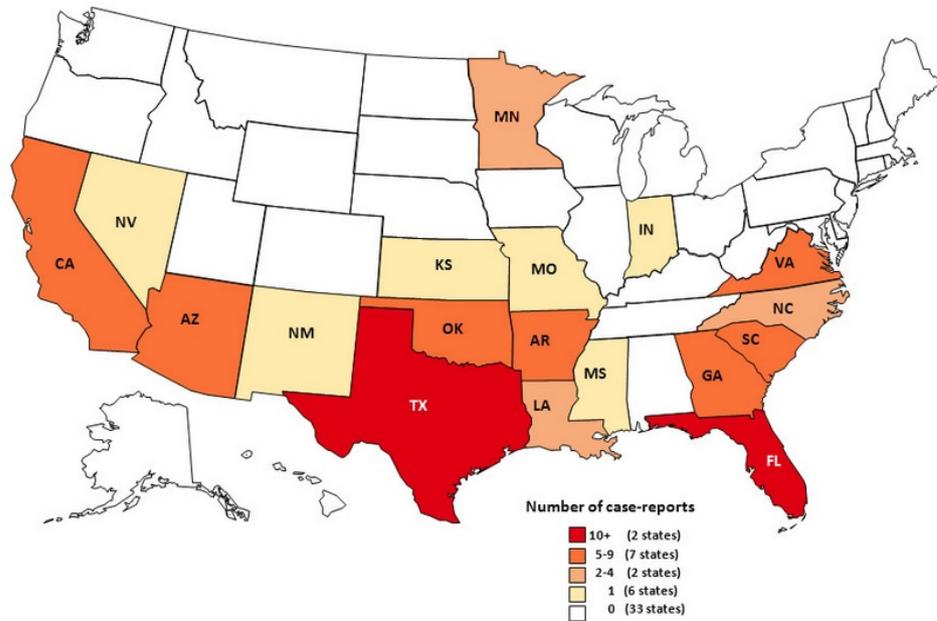
San Mateo, CA



AMOEBIC MENINGOENCEPHALITIS

CASES as of 2012

Lilly Lake, MN 2012



BLUE GREEN ALGAE TOXINS

Lake Erie



Table 1. Cyanotoxins on the Contaminant Candidate List (CCL)

Cyanotoxin	Number of known variants or analogues	Primary organ affected	Health Effects ¹	Most common Cyanobacteria producing toxin ²
Microcystin-LR	80~90	Liver	Abdominal pain Vomiting and diarrhea Liver inflammation and hemorrhage	<i>Microcystis</i> <i>Anabaena</i> <i>Planktothrix</i> <i>Anabaenopsis</i> <i>Aphanizomenon</i>
Cylindrospermopsin	3	Liver	Acute pneumonia Acute dermatitis Kidney damage Potential tumor growth promotion	<i>Cylindrospermopsis</i> <i>Aphanizomenon</i> <i>Anabaena</i> <i>Lyngbya</i> <i>Raphidiopsis</i> <i>Umezakia</i>
Anatoxin-a group ³	2-6	Nervous System	Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death	<i>Anabaena</i> <i>Planktothrix</i> <i>Aphanizomenon</i> <i>Cylindrospermopsis</i> <i>Oscillatoria</i>

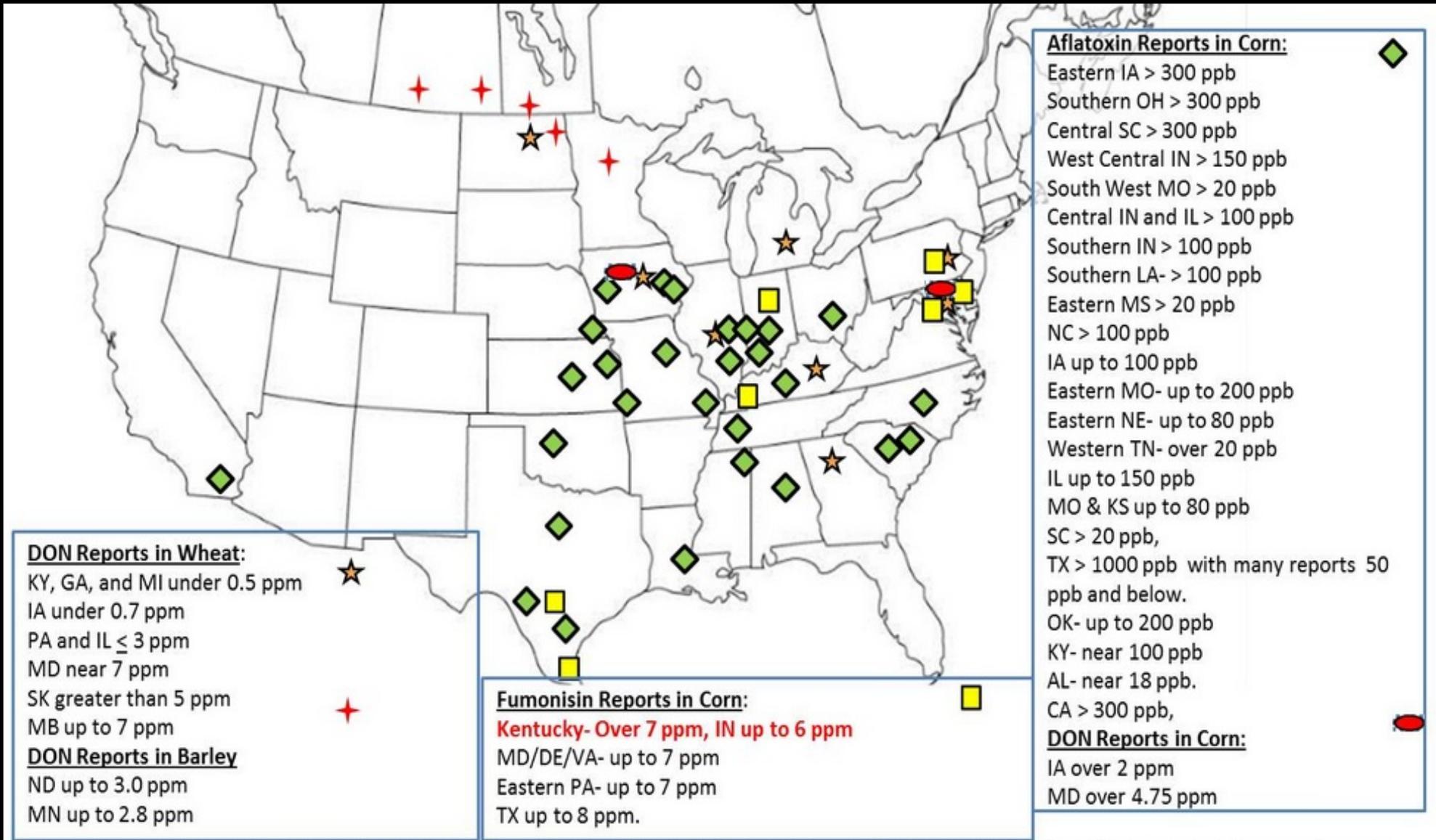
¹Source: *Harmful Algal Research and Response National Environmental Science Strategy (HARRNESS)*

CONCERN: AFLATOXIN and HCC

Missouri 2012



Crop mycotoxin map 10/12



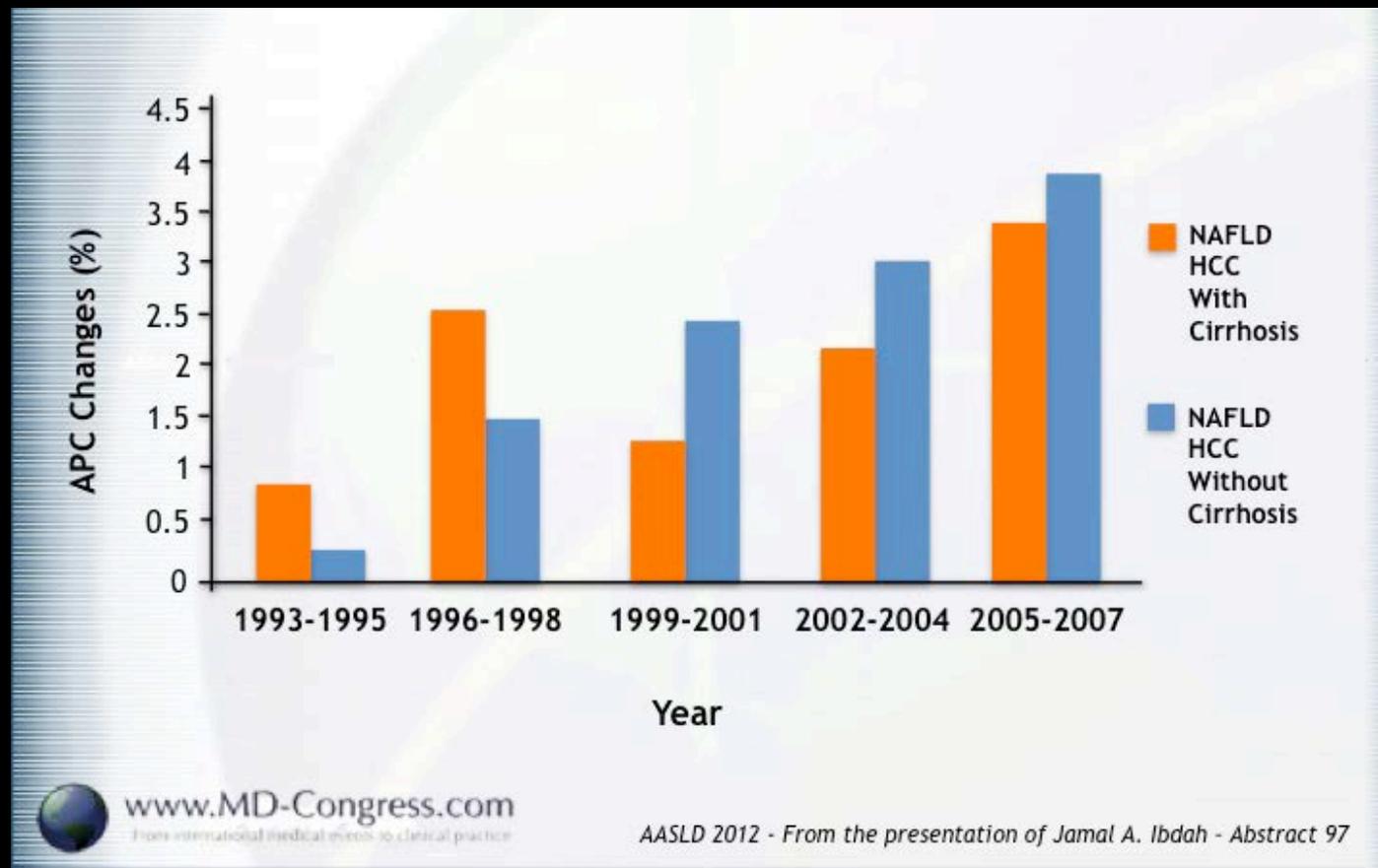
Aflatoxin and Hepatitis

Aflatoxin and HBV Infection in Liver Cancer

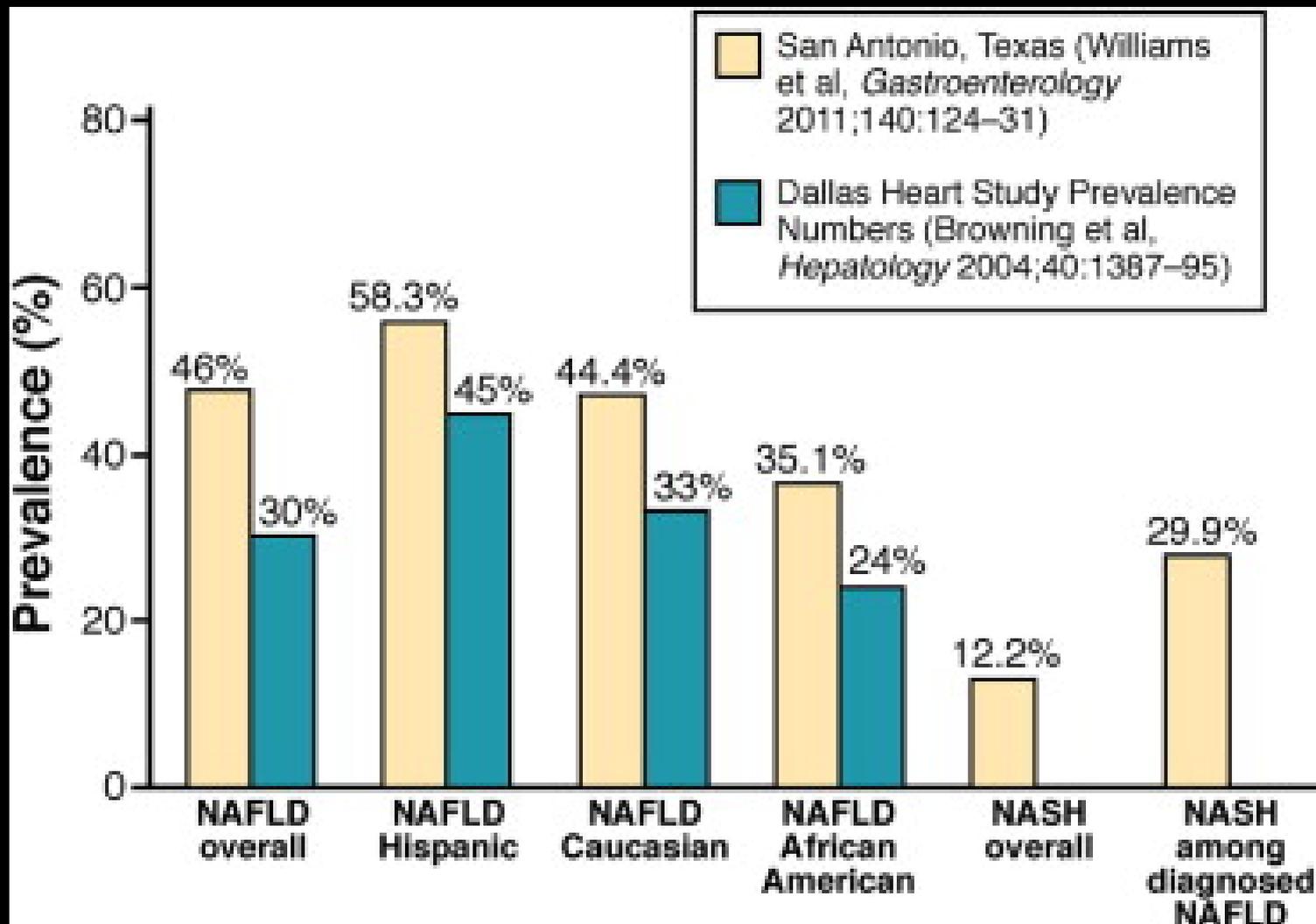
Aflatoxin	HBsAg	Odds ratio	95% CI
<i>Shanghai</i>			
Negative	Negative	1.0	
Positive	Negative	3.4	1.1-10.0
Negative	Positive	7.3	2.2-24.4
Positive	Positive	59.4	16.6-212.0
<i>Taiwan</i>			
Low	Negative	1.0	
High	Negative	1.7	0.3-10.8
Low	Positive	22.8	3.6-143.4
High	Positive	111.9	13.8-905.0

(*Lancet* 339: 943-946, 1992; *C.E.B.P.* 3: 3-11, 1994; *Int. J. Cancer* 67: 620-625, 1996)

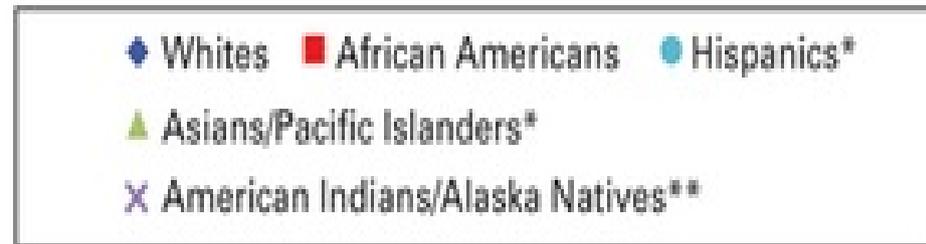
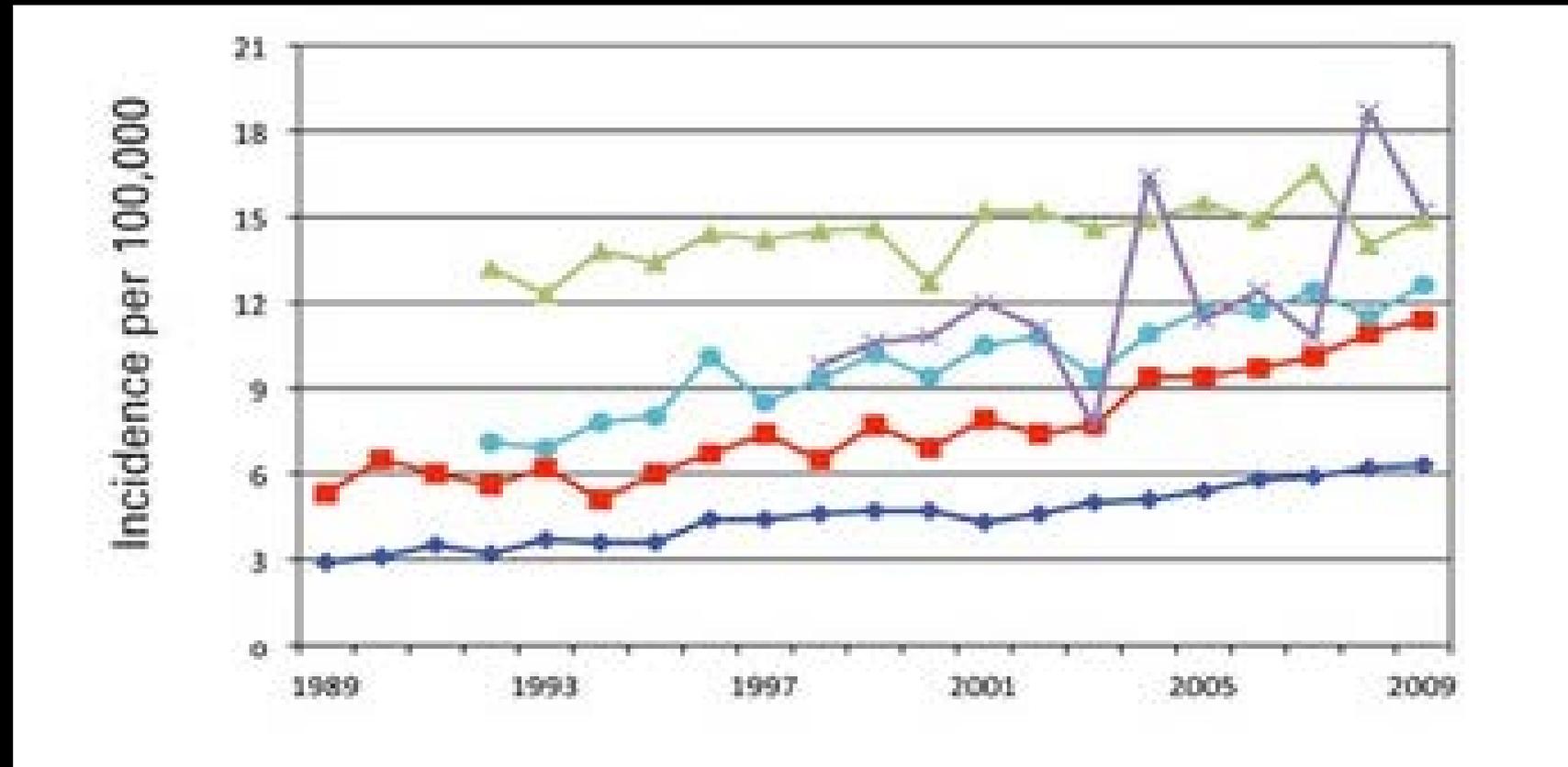
Rising Incidence of HCC in NAFLD with and without cirrhosis



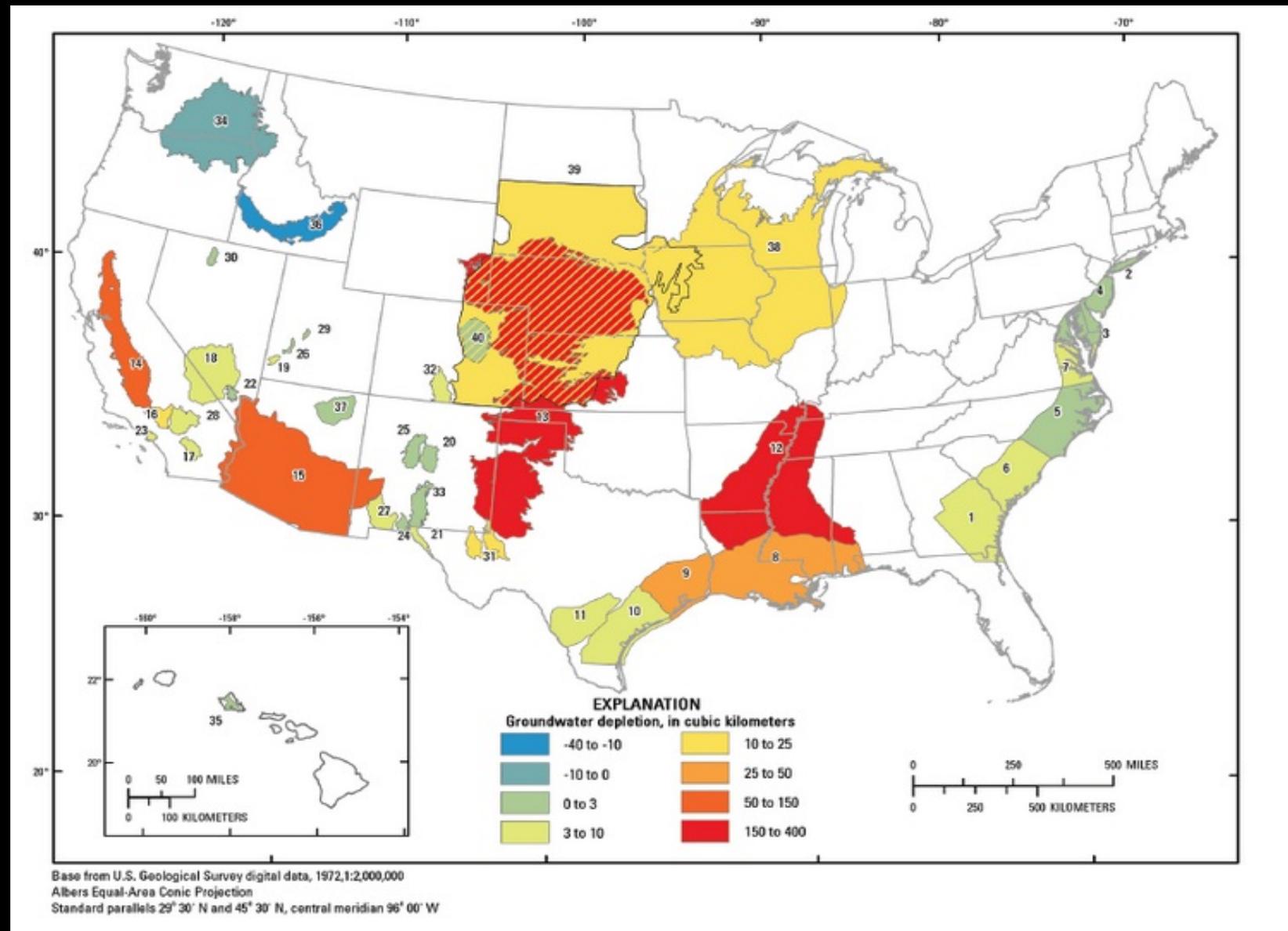
45-58% of Hispanics have NAFLD



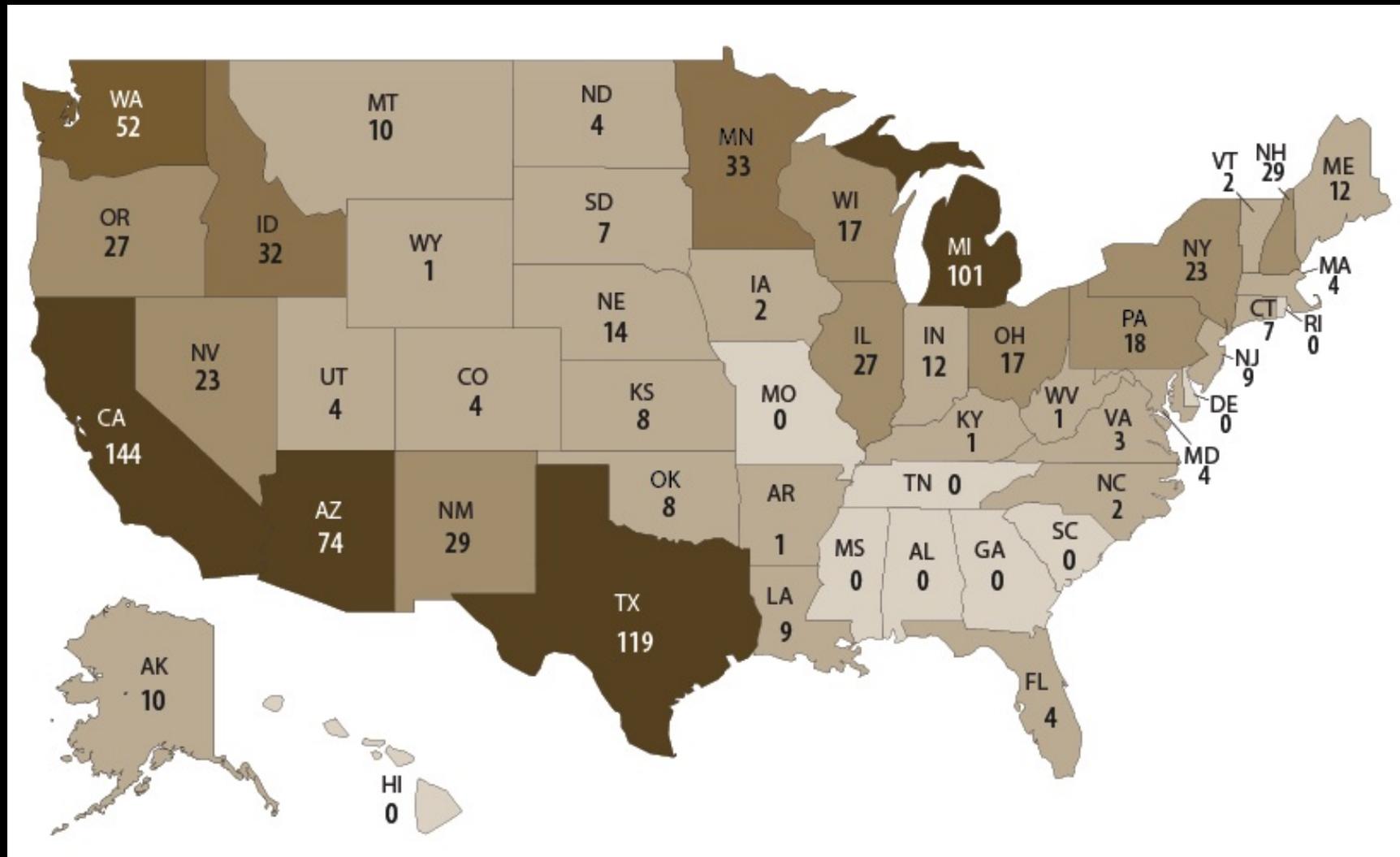
Incidence Liver and Bile Duct Cancer



DROUGHT, GROUNDWATER DEPLETION, AND WATER QUALITY



PUBLIC WATER SYSTEMS WITH ARSENIC > 10 ppb



Arsenic in Drinking Water and Cancer Risk

Arsenic Level in Tap Water (in parts per billion, or ppb)	Approximate Total Cancer Risk (assuming 2 liters consumed/day)
0.5 ppb	1 in 10,000
1 ppb	1 in 5,000
3 ppb	1 in 1,667
4 ppb	1 in 1,250
5 ppb	1 in 1,000
10 ppb	1 in 500
20 ppb	1 in 250
25 ppb	1 in 200
50 ppb	1 in 100

Effects of Common Groundwater Contaminants

Arsenic

Skin Cancer
Bladder Cancer
**Decreased Immune
response**

Atrazine + nitrate

Non Hodgkins Lymphoma

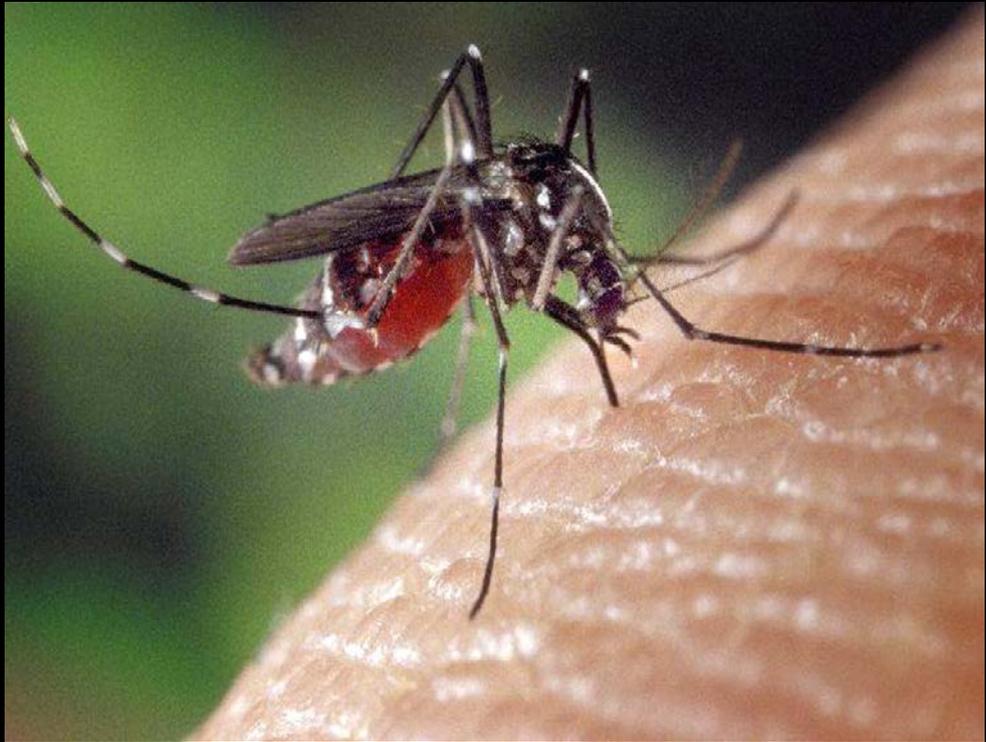
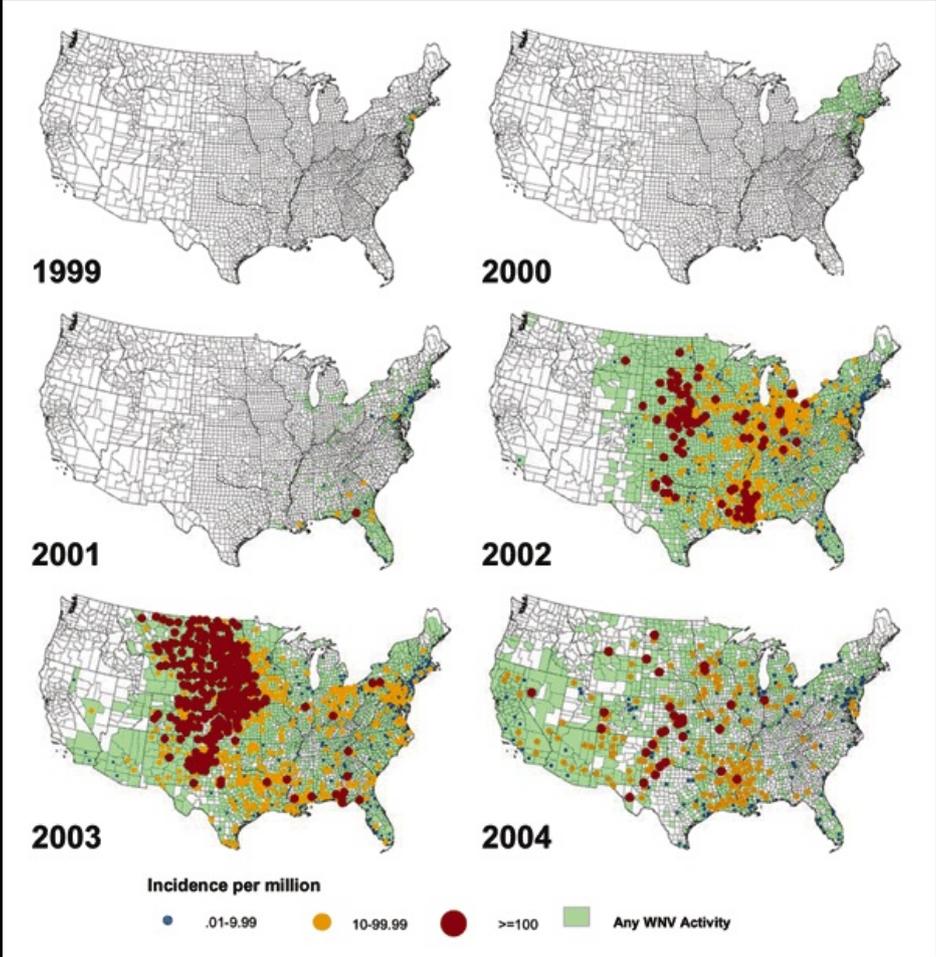
Nitrate

Thyroid Cancer
Hypothyroidism

Methemoglobinemia

Neural Tube Defects
Spontaneous Abortion

West Nile Virus



EMERGING: DENGUE FEVER

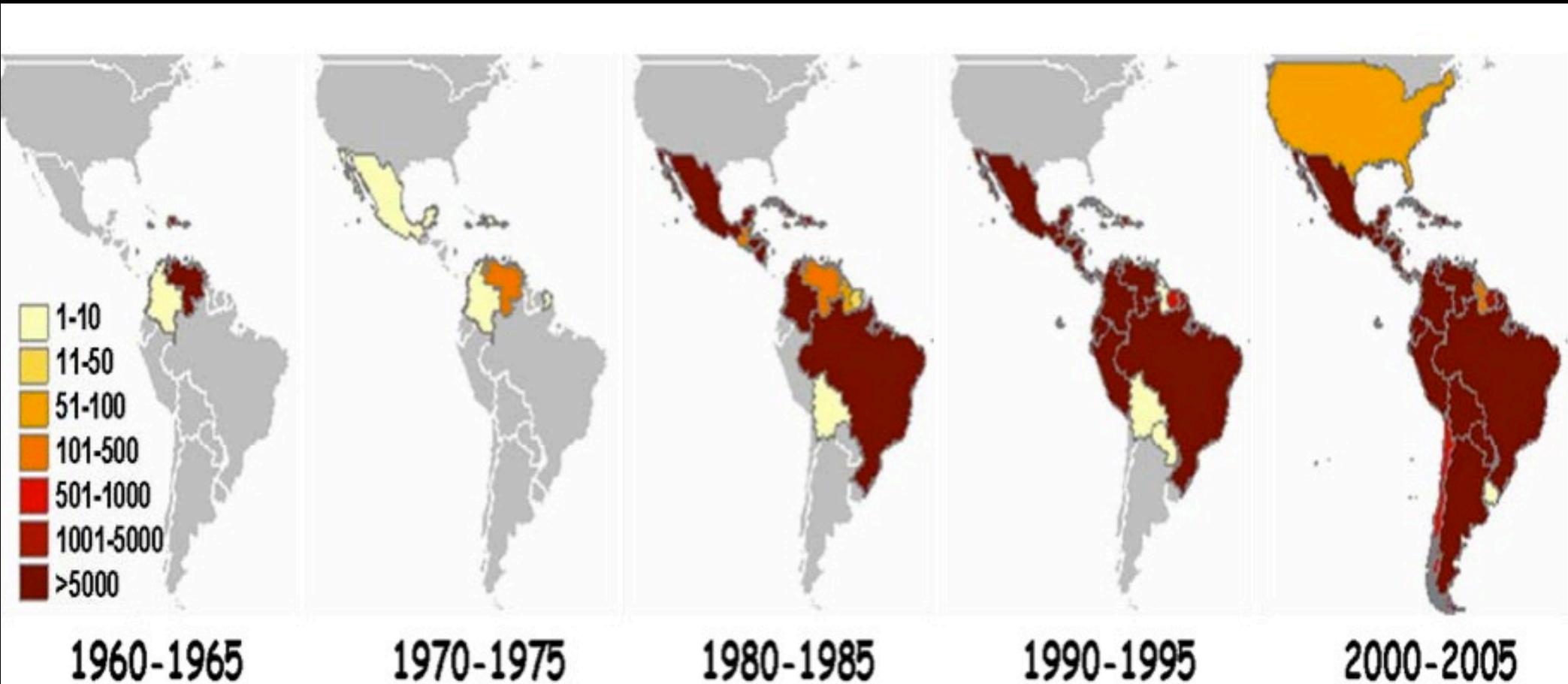
Florida 2012



Dengue

1960

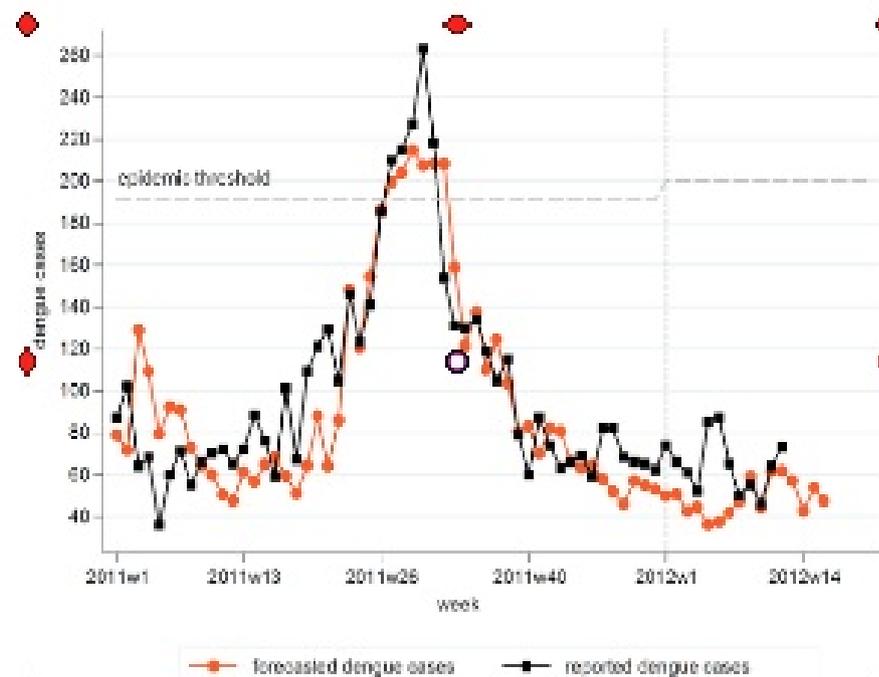
2005



Source: WHO DengueNet

Dengue Weather Model

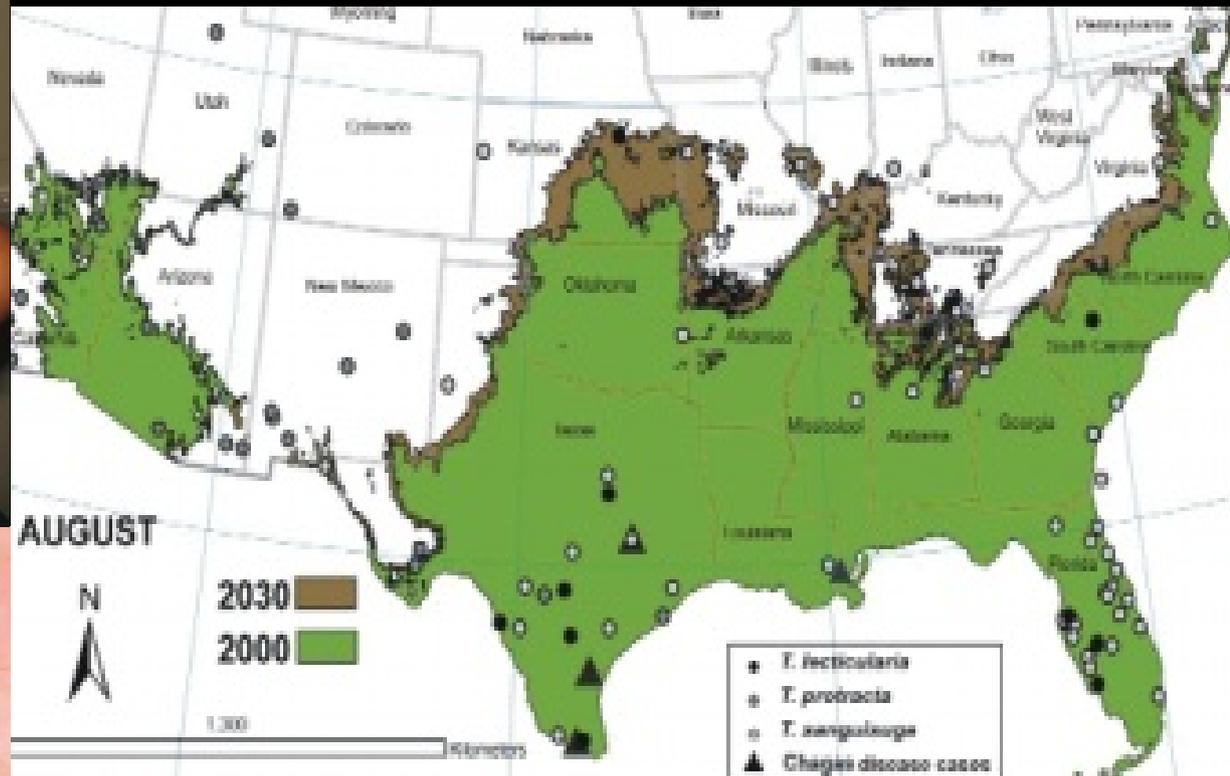
Figure 3. Forecasted dengue cases versus reported dengue cases in 2011–2012.



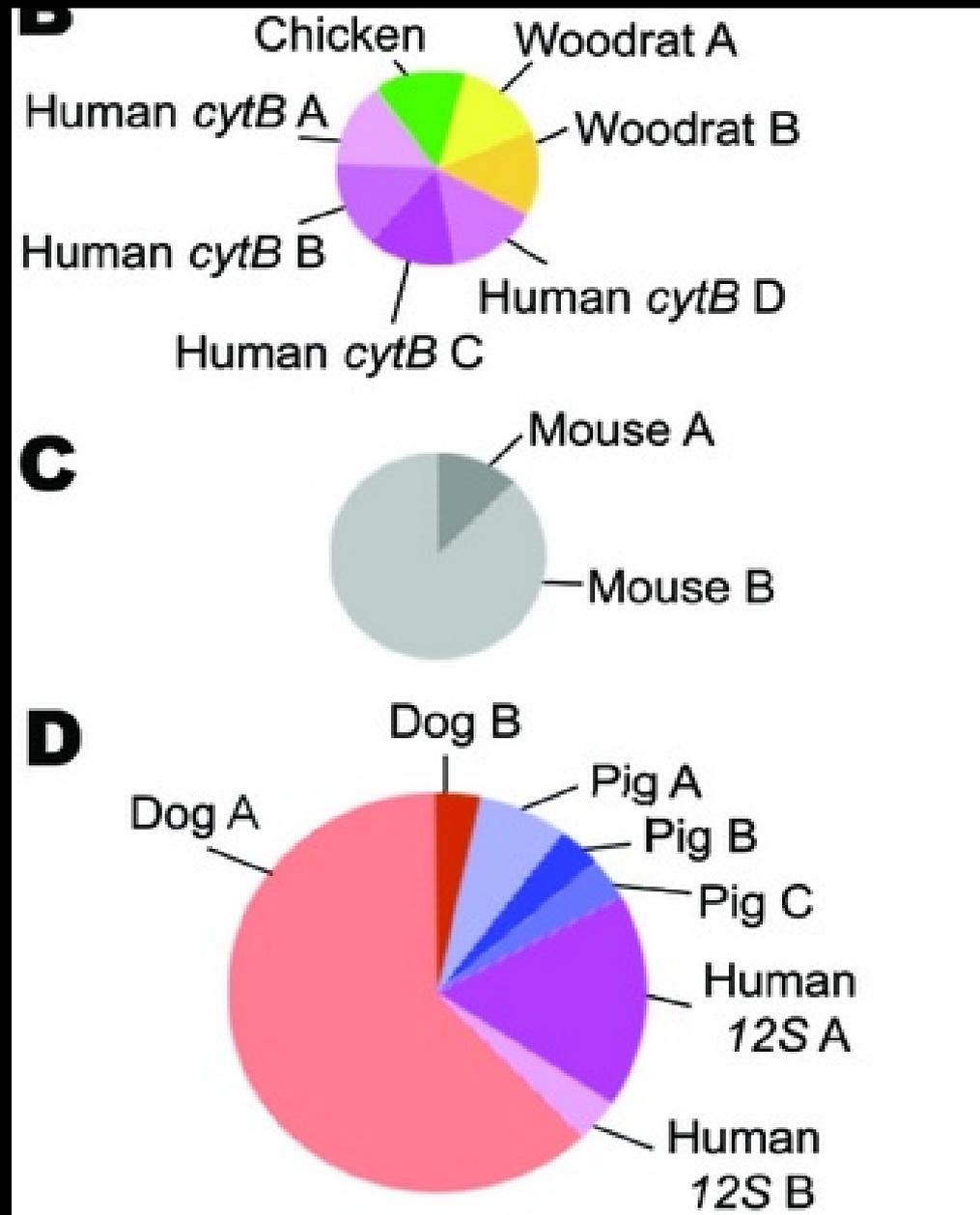
Hu, YL, Zhu, H, Hu, H, Hu, LC, et al. (2012) Forecast of Dengue Incidence using Temperature and Rainfall. *PLoS Negl Trop Dis* 6(10): e1908. doi:10.1371/journal.pntd.0001908

<http://www.plosone.org/article/info:doi/10.1371/journal.pntd.0001908>

EMERGING: CHAGAS DISEASE



Triatomine Blood Meals AZ & CA



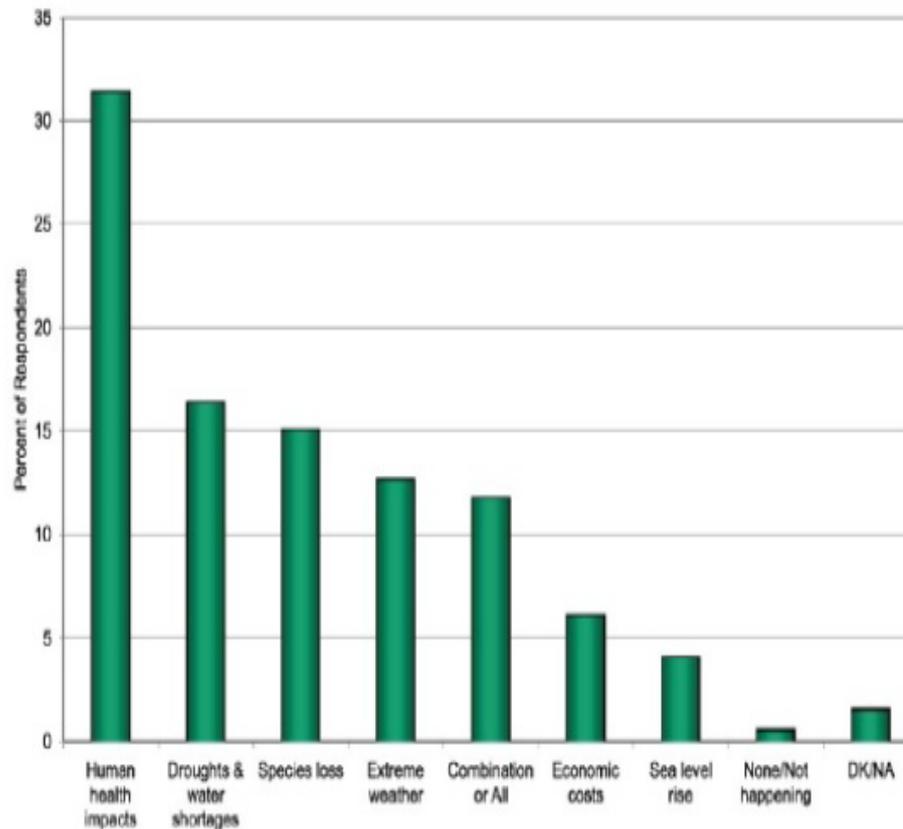


A photograph of a white rectangular sign with the word "EMERGENCY" in red capital letters and a red arrow pointing to the right. The sign is illuminated and set against a dark background with some blurred lights in the distance.

EMERGENCY

7-12
DEGREES F
BY 2100

HEALTH IS WHAT MAKES PEOPLE CARE ABOUT CLIMATE CHANGE

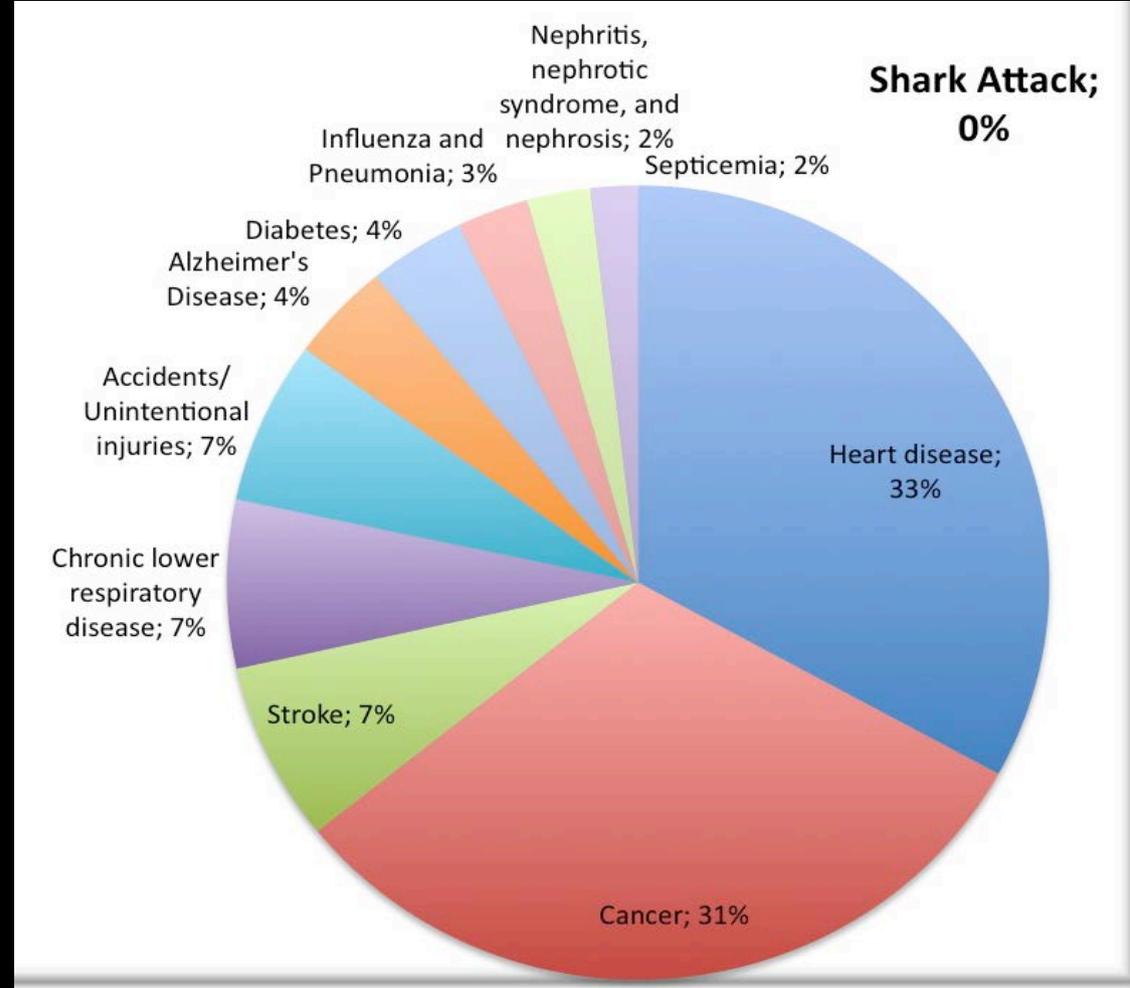
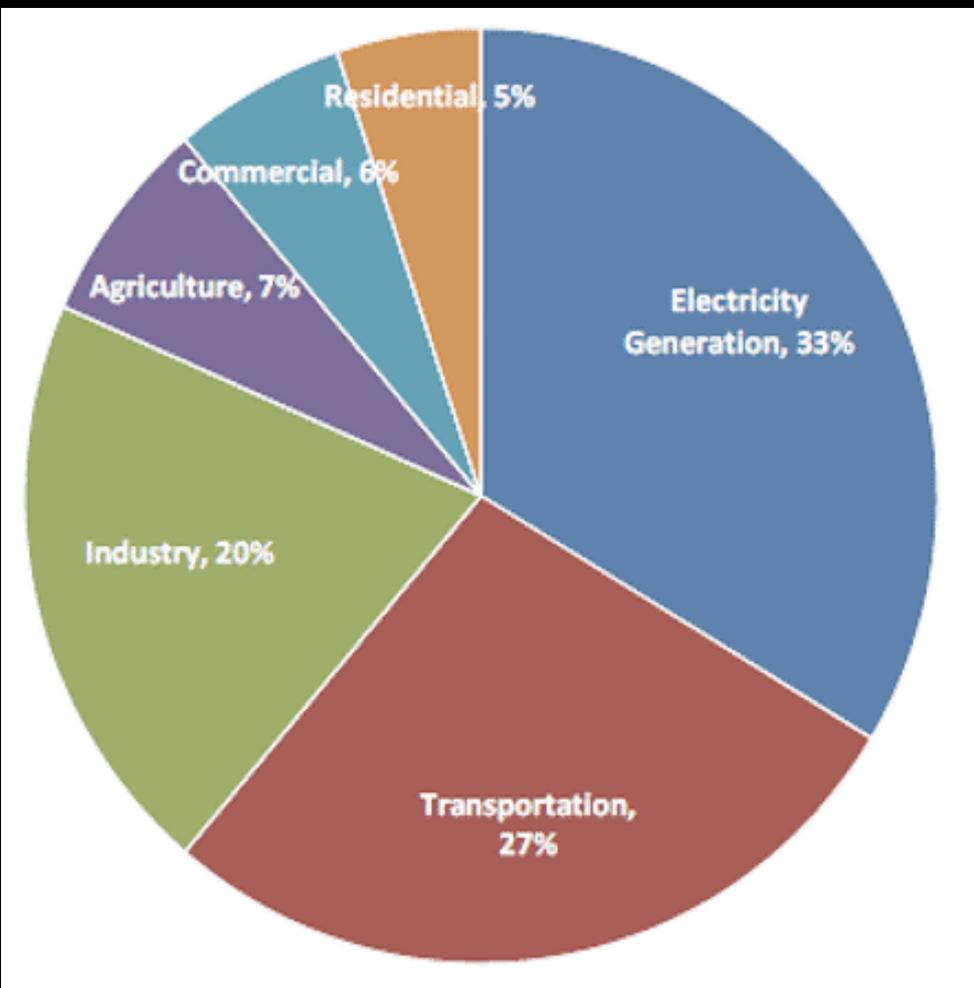


Globescan poll in 30 countries (UNDP 2007):

“Now I would like to ask you some questions about climate change, which is sometimes referred to as global warming or the greenhouse effect. Which ONE of the following possible impacts most concerns you personally, if any?”

Sources of GHG

Top 10 causes of death

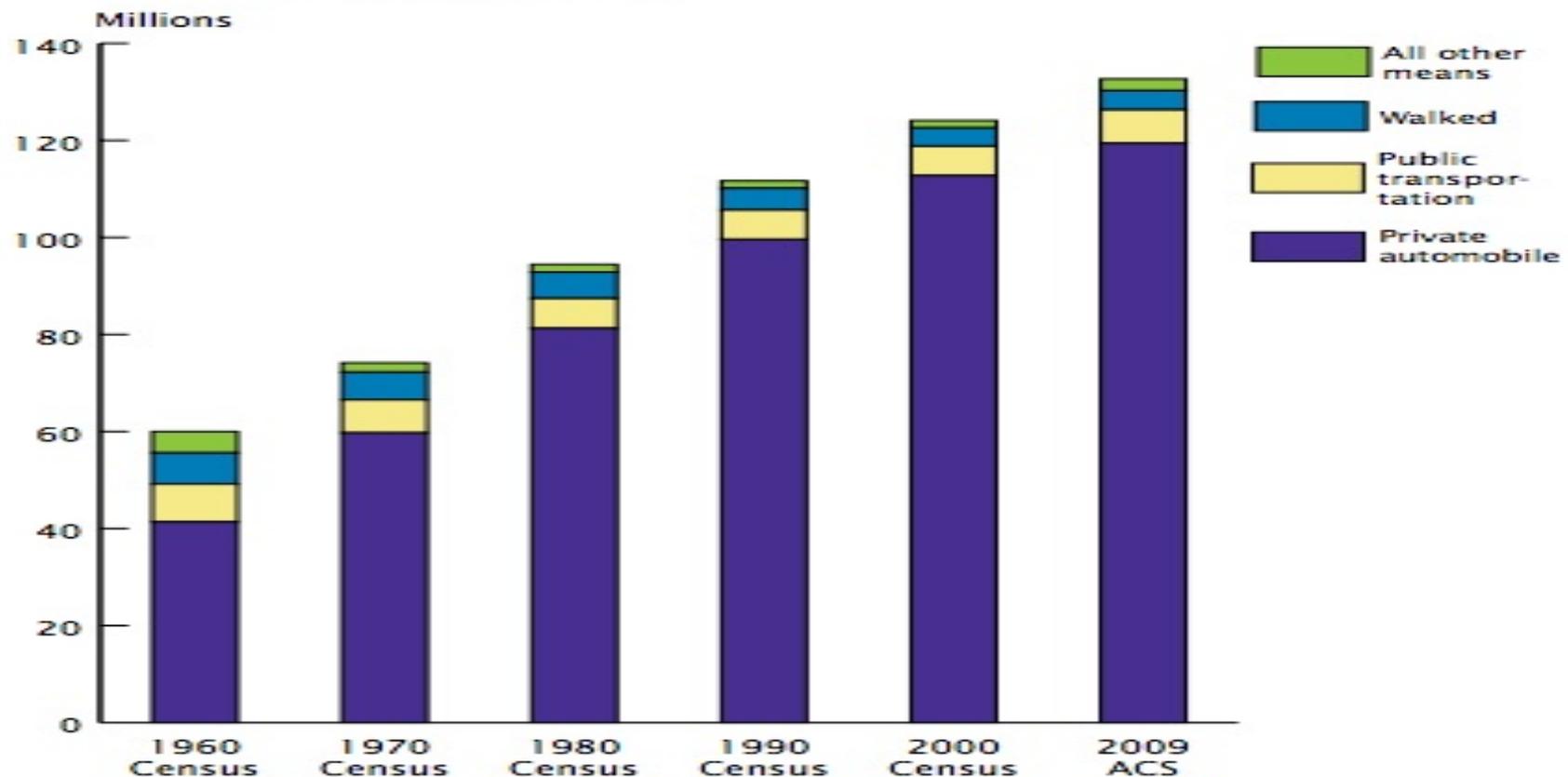


Trends in US Transportation

Figure 2.

Means of Transportation: 1960 to 2009

(Workers 16 years and over. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see www.census.gov/acs/www/)



Sources: U.S. Census Bureau, Decennial Census, 1960, 1970, 1980, 1990, 2000; U.S. Census Bureau, American Community Survey, 2009.

INTERNATIONAL COMPARISON ACTIVE SHARE OF DAILY TRIPS

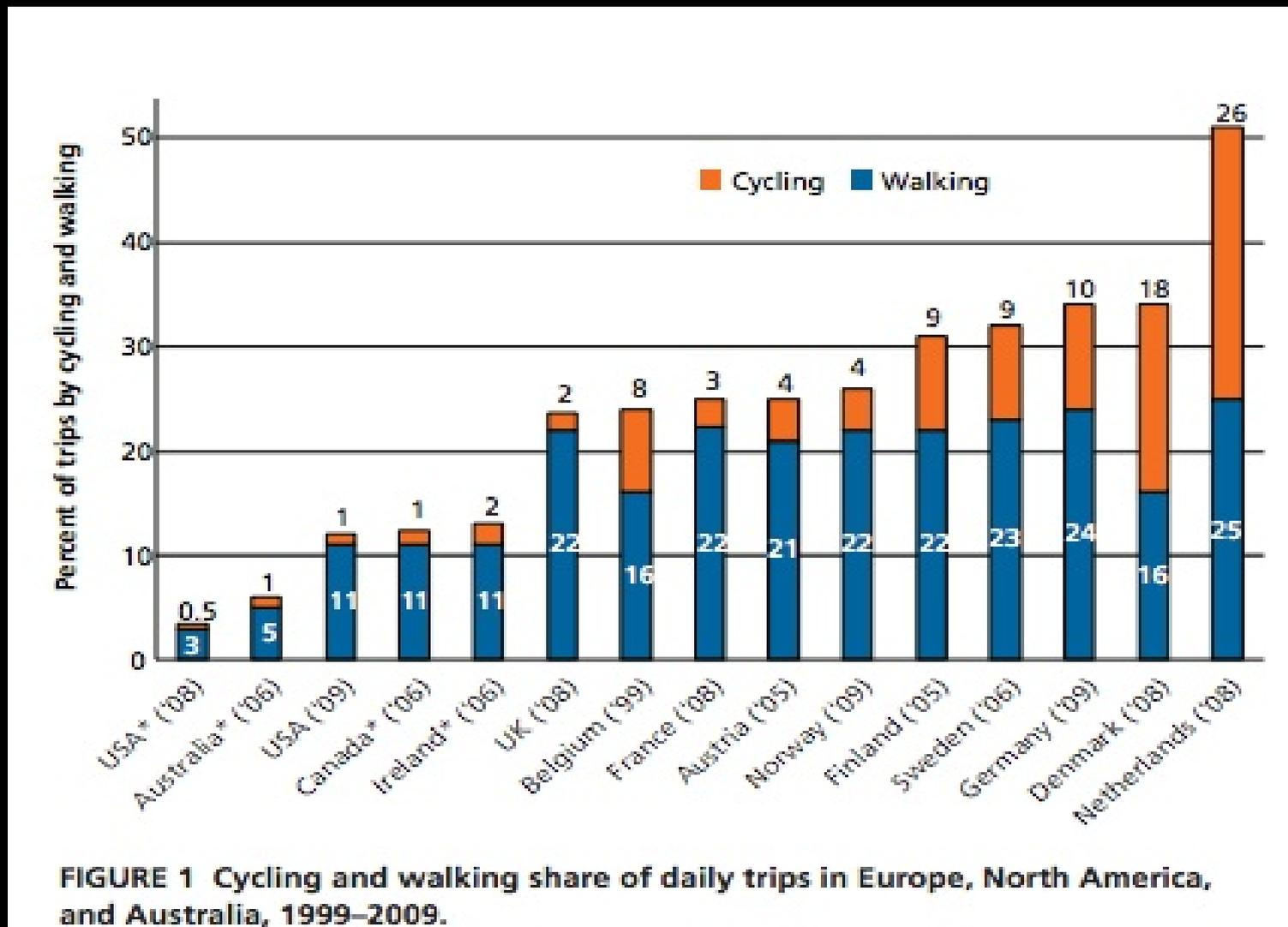


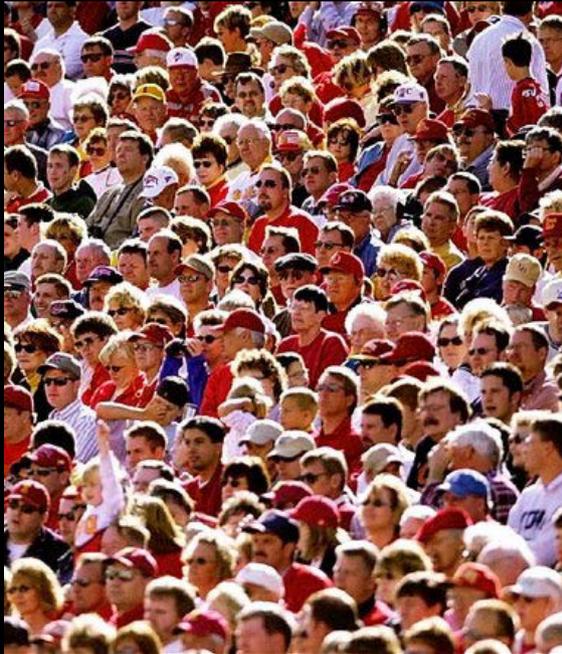
FIGURE 1 Cycling and walking share of daily trips in Europe, North America, and Australia, 1999–2009.

ONE THIRD

OF

**ATTRIBUTABLE TO
PHYSICAL INACTIVITY**

**HEART DISEASE, OBESITY,
DIABETES; COLON CANCER,
PROSTATE CANCER, AND
RECURRENT BREAST CANCER**



ACTIVE TRANSPORTATION

SMART DEVELOPMENT

SAFE BIKING AND WALKING

RAPID EFFICIENT PUBLIC TRANSIT



10,000 colon cancers
215,000 heart attacks
570,000 new diabetes cases

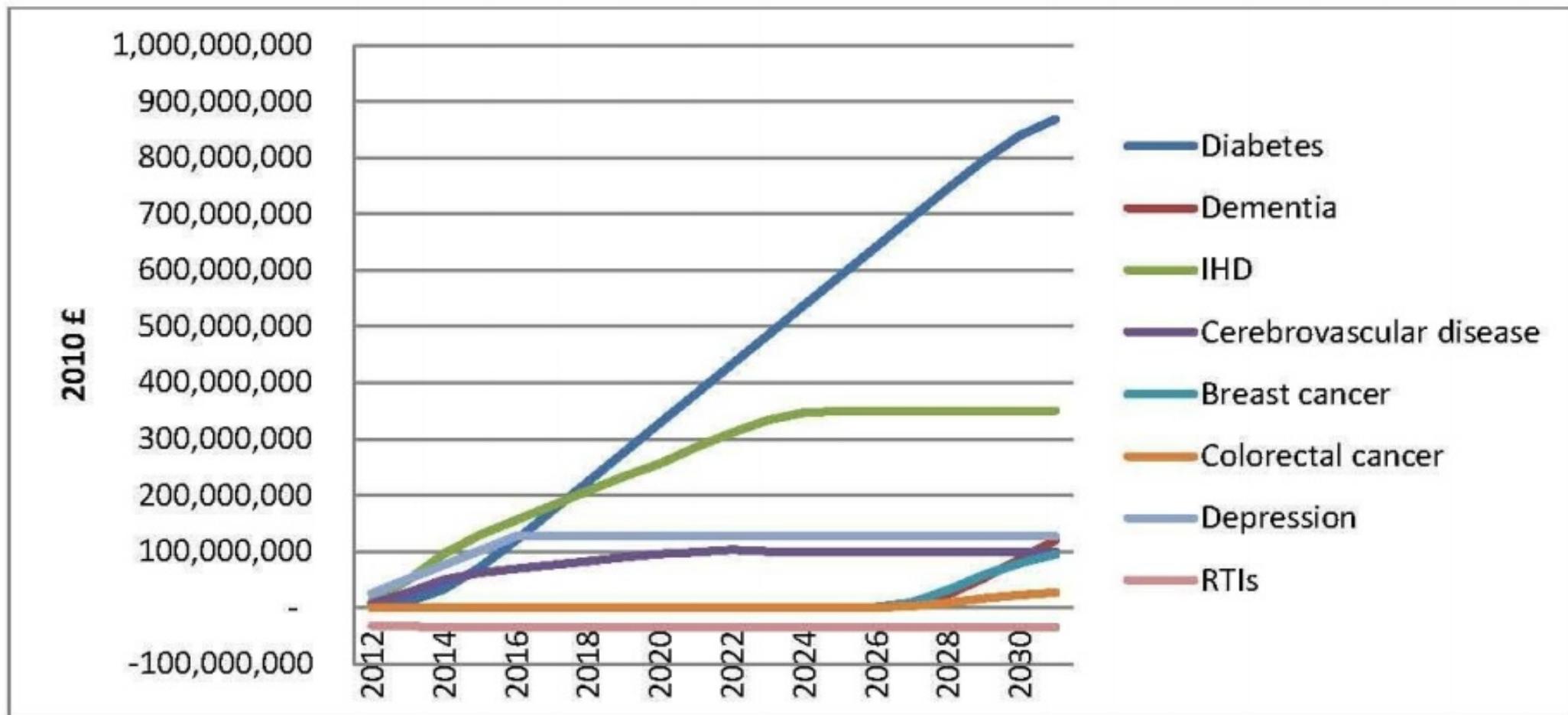
PREVENTED
each year



ANNUAL SAVINGS SF BAY AREA Maizlish, N. Am J Public Health.
1.4-22 BILLION DOLLARS PER YEAR 2013 Apr;103(4):703-9.

NHS Annual Savings London Active Travel

Figure 1: Potential annual NHS expenditure averted by year and health outcome from Increased Active Travel scenario



ENERGY EFFICIENT CARS AND HOMES

HOME RETROFITS, COMPETITIVE FUEL ECONOMY
ZERO EMISSIONS VEHICLES



118 mpg equivalent



Zero Energy Home

INVEST AND INCENTIVIZE CLEAN ENERGY

NO COAL EXPORTS

NO NEW COAL PLANTS

COST OF DIRTY ENERGY UP FRONT



20,000 Heart Attacks
23,000 Deaths

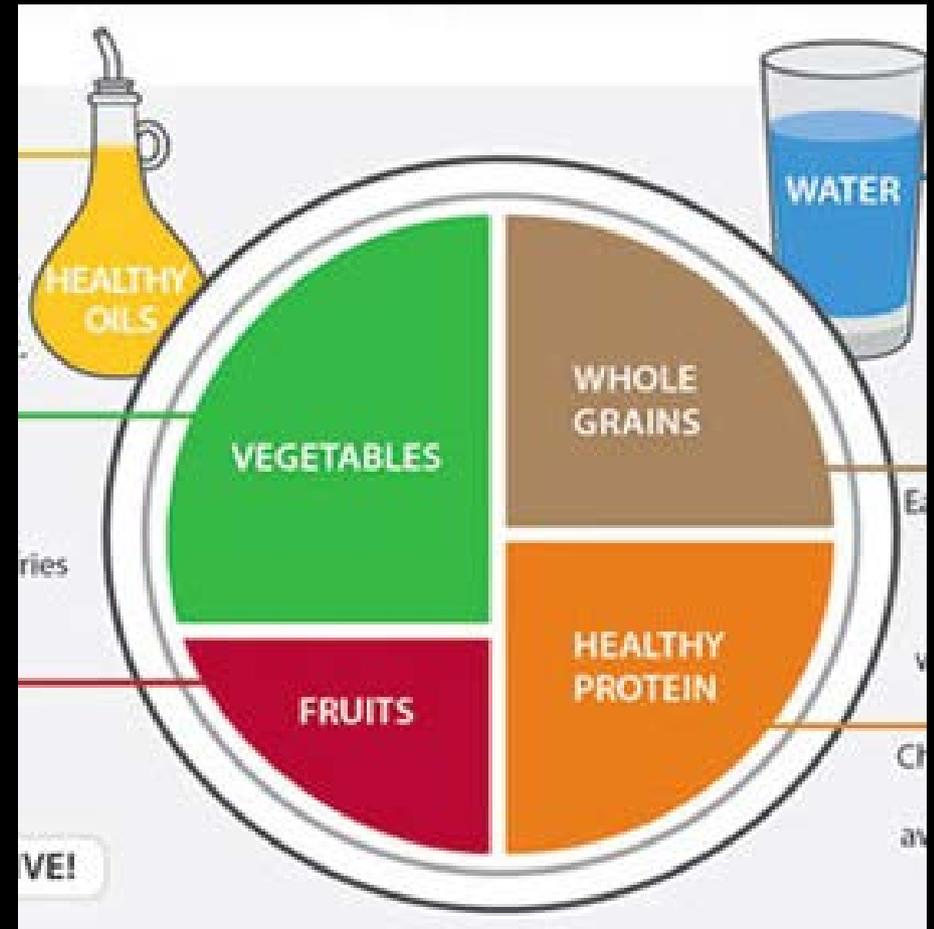
PREVENTED
each year



SAVED: OVER 100 BILLION DOLLARS PER YEAR

EPA 2013

SUBSIDIZE FARMERS WHO GROW WHAT WE SHOULD EAT



300,000 Heart Attacks/-strokes
260,000 New Diabetes Cases
144,000 Cancer Deaths

PREVENTED
each year



Benefits of Mediterranean-Type Diet on Chronic Disease Risk

Clinical intervention studies

- 70% ↓ MI, cardiac death, total mortality (DeLogeril 94)
- 60% ↓ cardiac events in CVD patients* (Ornish 98)
- ~50% ↓ metabolic syndrome (Esposito 04)
- ↓ insulin resistance (Esposito 04)
- ↓ weight (Esposito 04)



Prospective observation studies

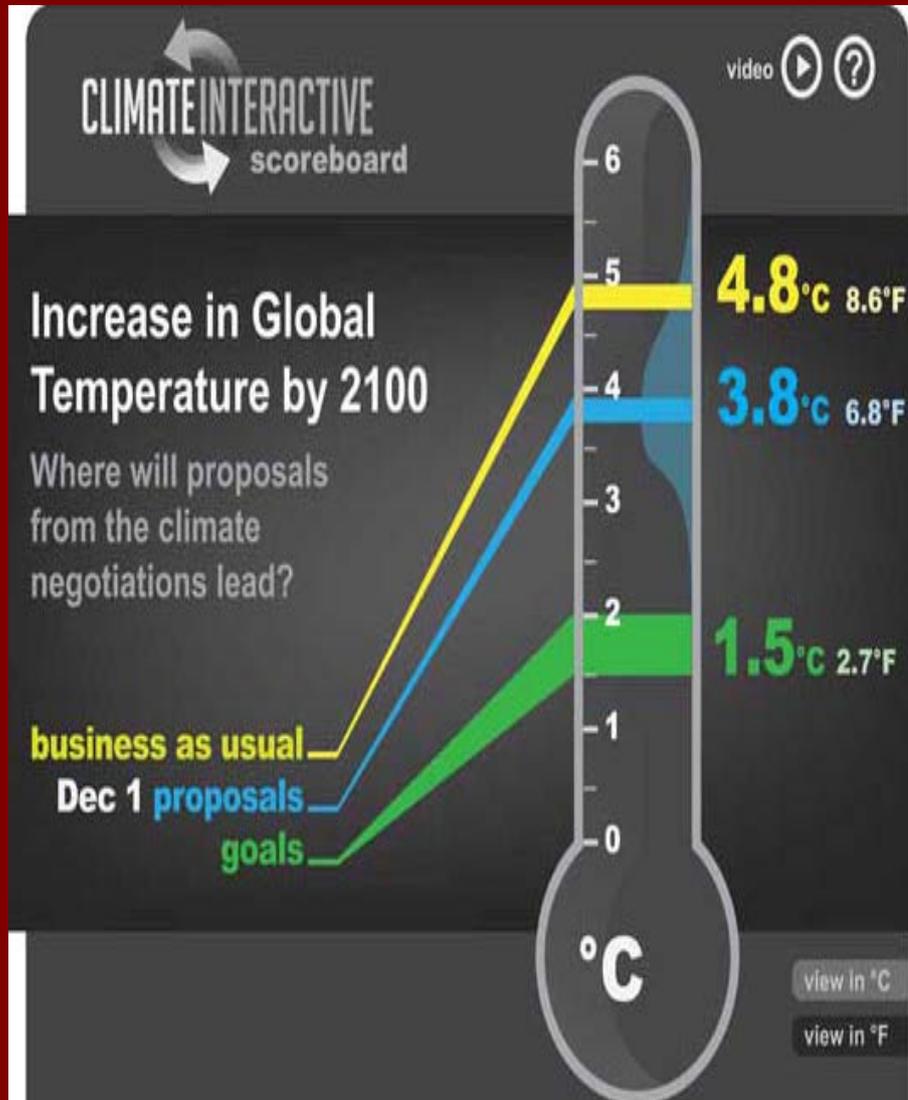
- 80% ↓ diabetes (Martinez-Gonzalez 08)
- ~31% ↓ all-cause & cardiovascular mortality, 22% ↓ cancer mortality* (Sofi 08*) 73% ↓ Alzheimer's mortality; 40% ↓ incident AD (5.4 yr F/U) (Scarmeas, 2007, 2009)
- 25-30% ↓ Parkinson's disease (Gao 07)



<http://climateinteractive.org/scoreboard>

June 2010

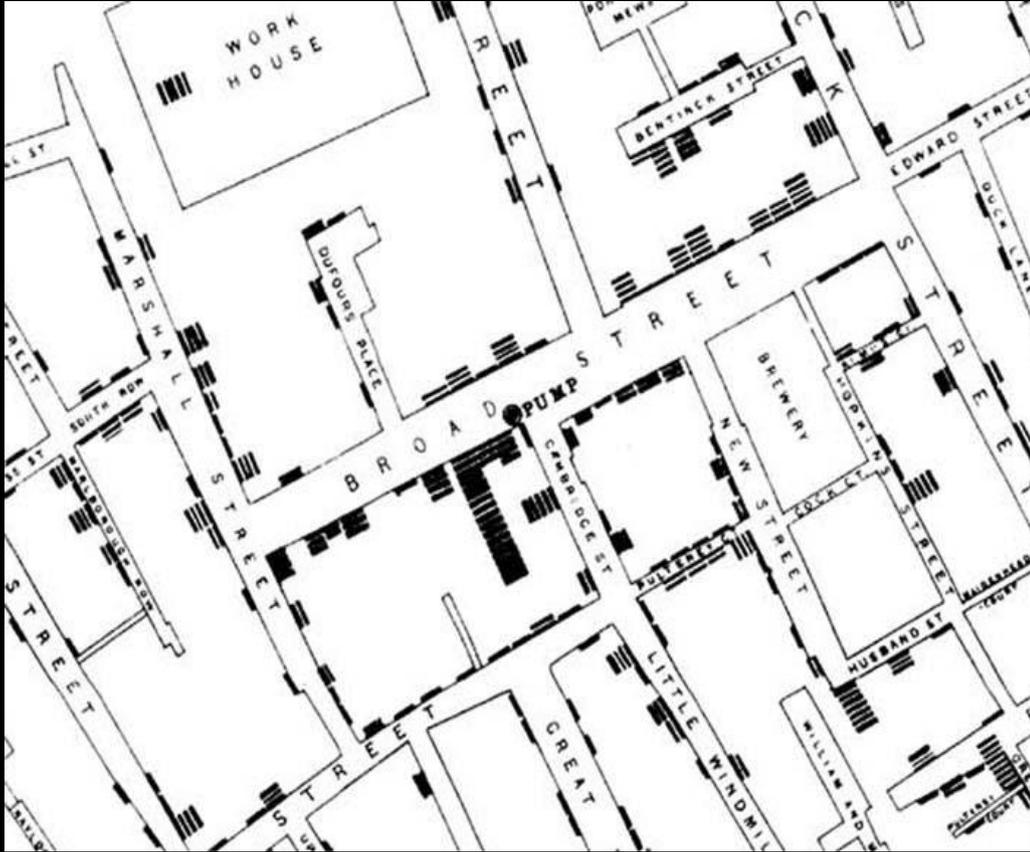
June 2013











Rx for Climate Action

Active Transportation

Efficient Cars and Homes

Clean energy

More vegetables





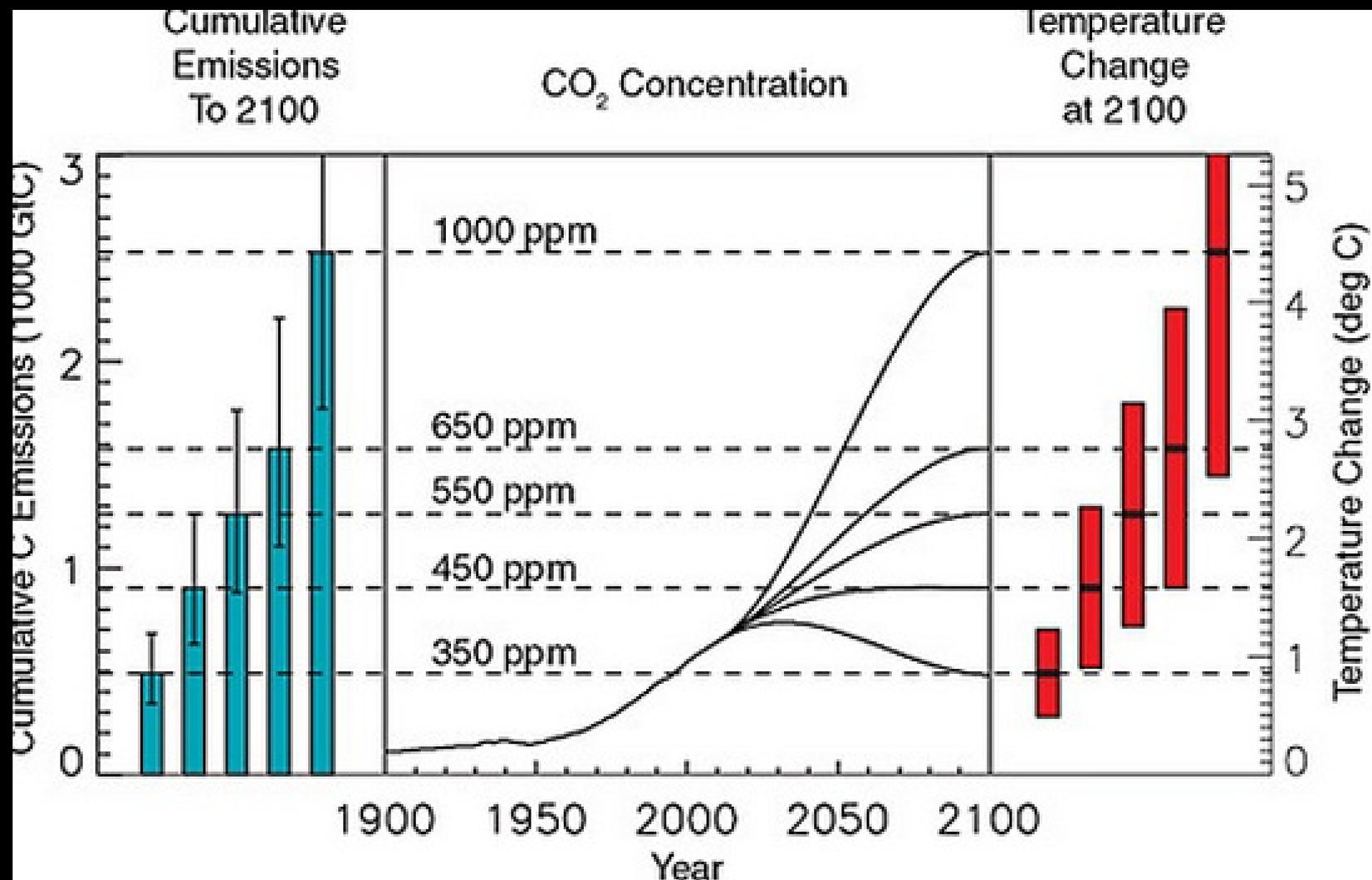
I'M TOO BUSY NOW. CAN'T I DO IT LATER?

World Carbon Budget (for a 2 degree F warmer world)

% Locked In By Existing Investment

- 2013
- 2015
- 2017
- 80%
- 90%
- 100%

Atmospheric CO₂ and Resulting TEMPERATURES



Committee on Stabilization Targets for Atmospheric Greenhouse Gas Concentrations;
National Research Council, National Academy of Sciences 2011



Shouldn't we be turning?

LAST TURN!
for a 5° C warmer world

SLOW DOWN!
4° C warmer world
Next hard right!

TURN NOW!
for a mere 3° C
of warming

LAST CHANCE!
for a 2° C warmer world

Not yet. We have enough fossil fuel to get all the way to 6...

... and then some.



HEALTHY PEOPLE = HEALTHY PLANET

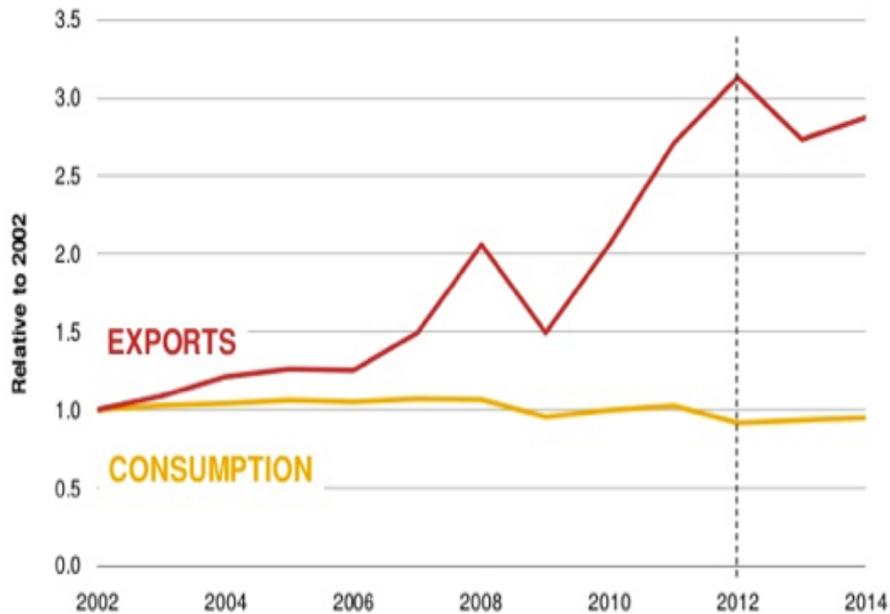


www.climate911.org

What About China?

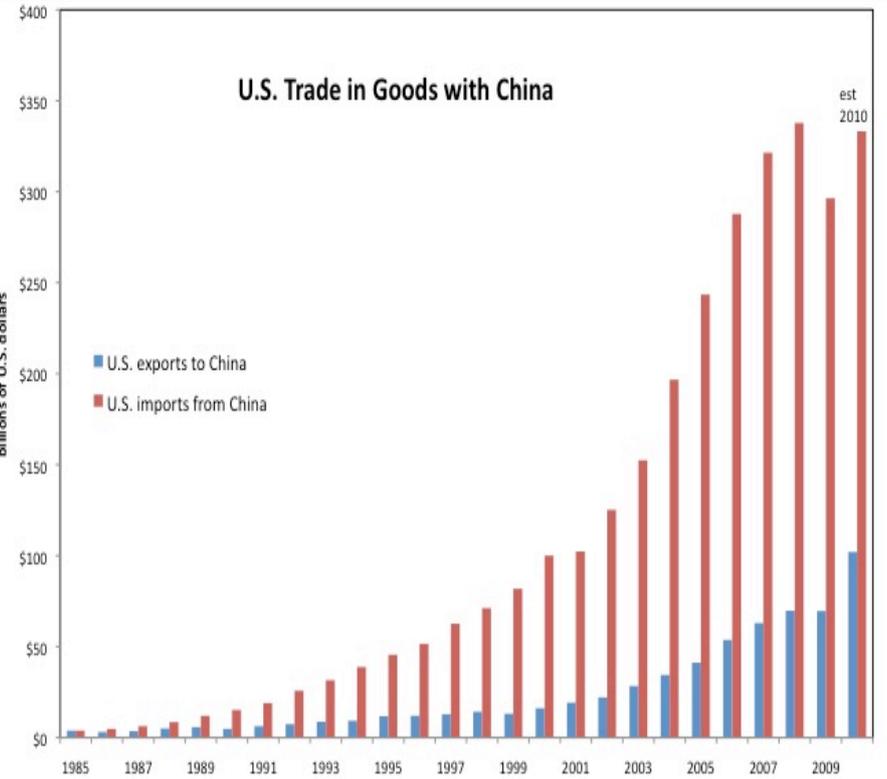
Outsourcing US Emissions

COAL | U.S. COAL EXPORTS ARE RISING (2002 = 1.0)



(EIA, 2012)

 WORLD RESOURCES INSTITUTE



Source: U.S. Census Bureau and Economic Policy Institute