Metro East Air & Health Forum:
Health and Climate Change

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BRACE-Illinois Project
October 17, 2014

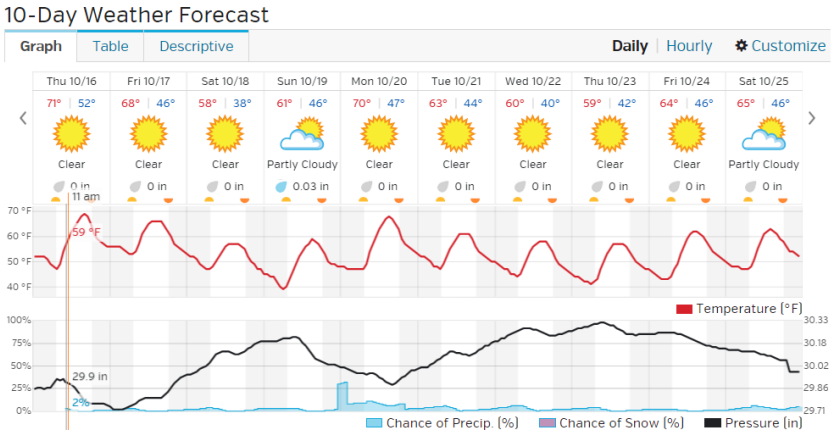
UIC UNIVERSITY OF ILLINOIS AT CHICAGO SCHOOL OF PUBLIC HEALTH
Environmental and Occupational Health Sciences Division

On the agenda

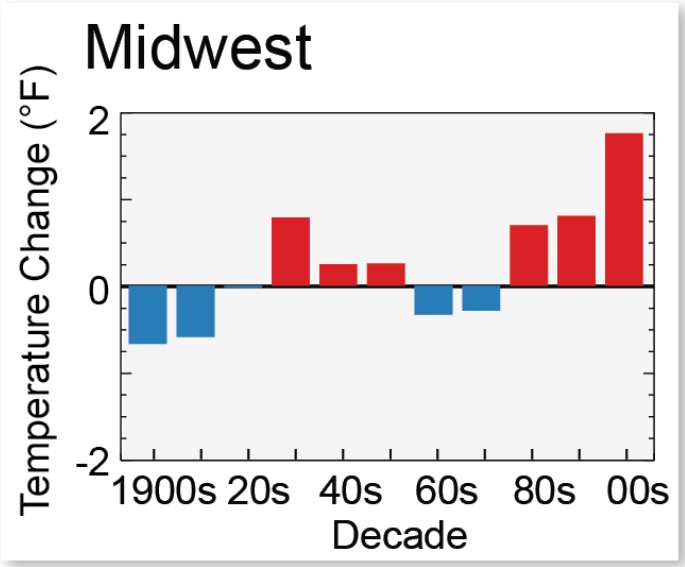
- Weather, climate, and climate change
- Climate change in the Midwest
- Climate change and health
- Asthma and climate change
- What to do?

Weather vs. Climate

10-Day Forecast for Caseyville



Average Temperatures across the Midwest from 1895-2010



National Climate Assessment: http://ncadac.globalchange.gov/

The long, cold winter of 2013-2014: How can climate be warming?

Warming is being observed consistently on a GLOBAL scale, but not always on the local level.

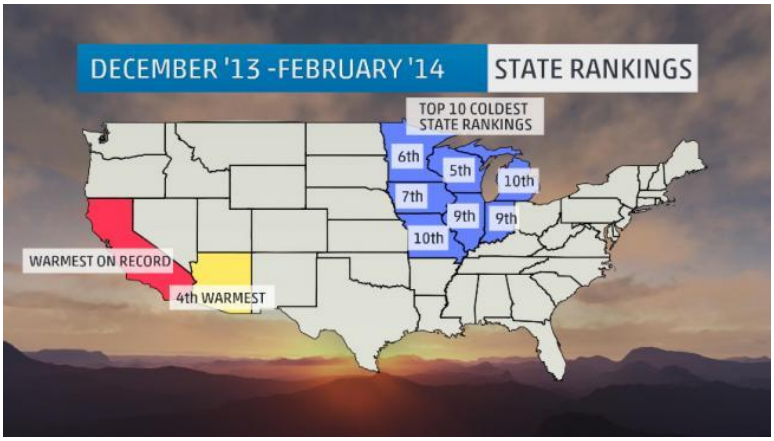
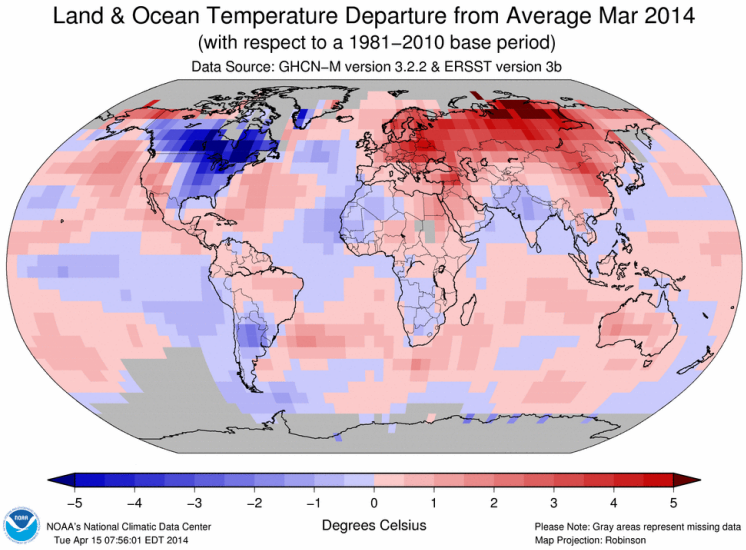


Image: NOAA/National Climatic Data Center



Michael Jordan and…Climate Change

Worst Game:
12/27/2001

Total points: 6
Field goal %: 20
Free throw %: 50
Turnovers: 4
Rebounds: 4
Assists: 4
Steals: 0

Career Statistics:
1984-98, 2001-03

Points/game: 30
Field goal %: 50
Free throw %: 84
Turnovers: 2
Rebounds: 6
Assists: 5
Steals: 2

The differences:

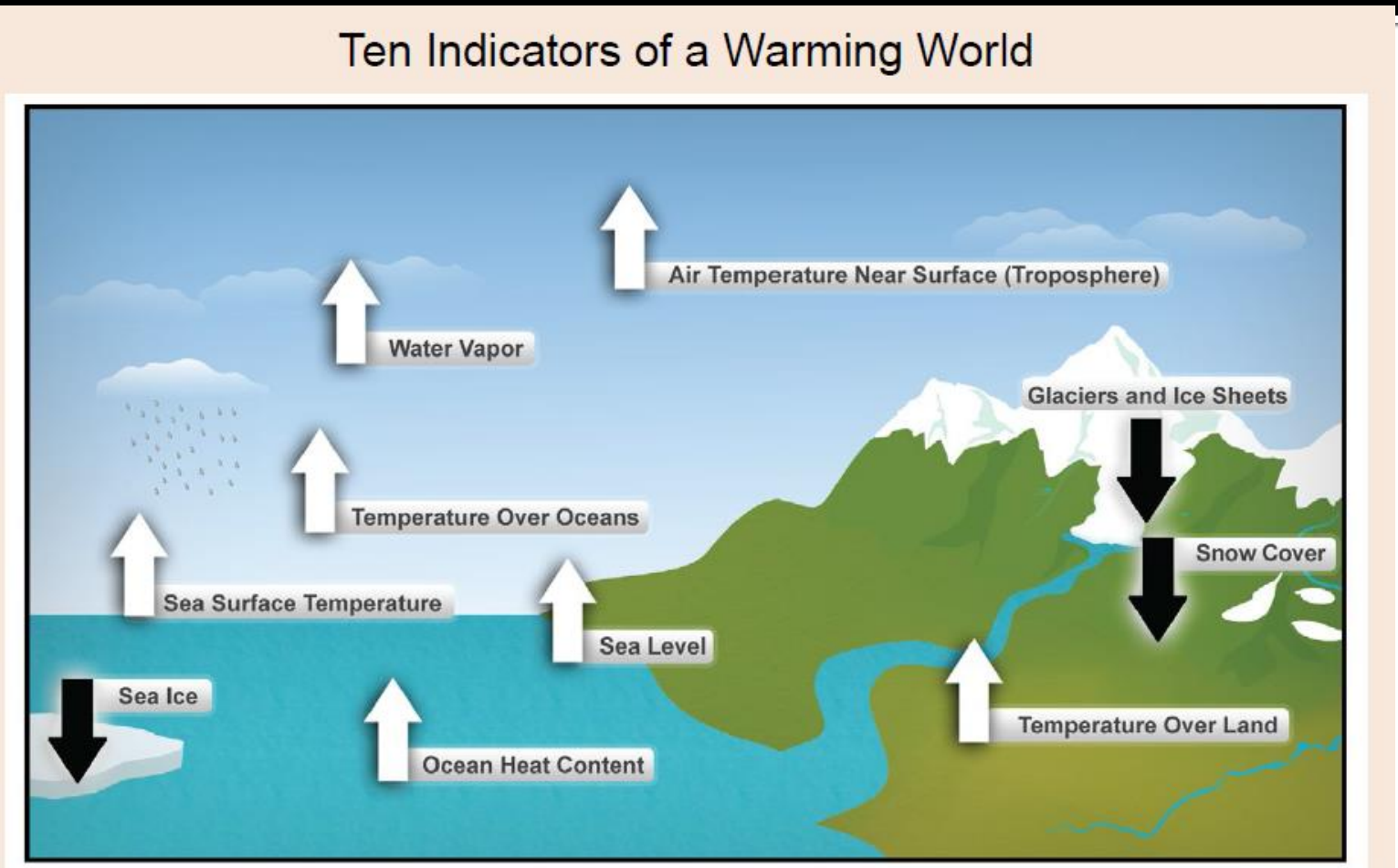
WEATHER IS

- What you see when you go outside
- Short-term
- Local

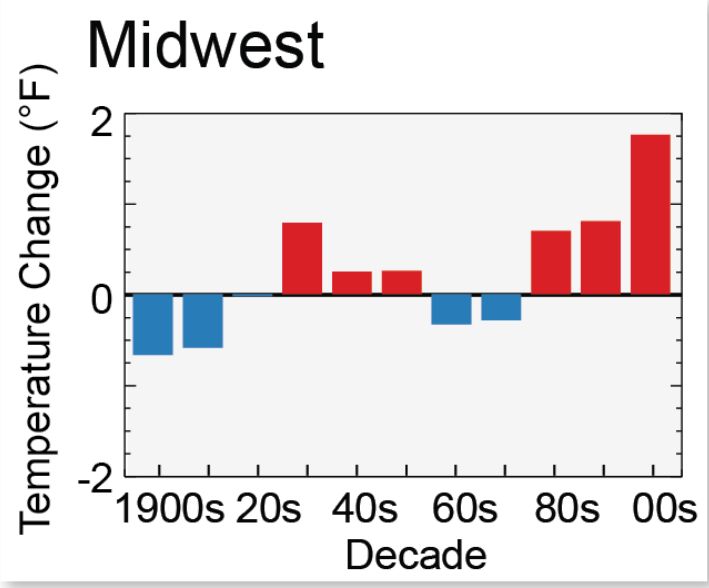
CLIMATE IS

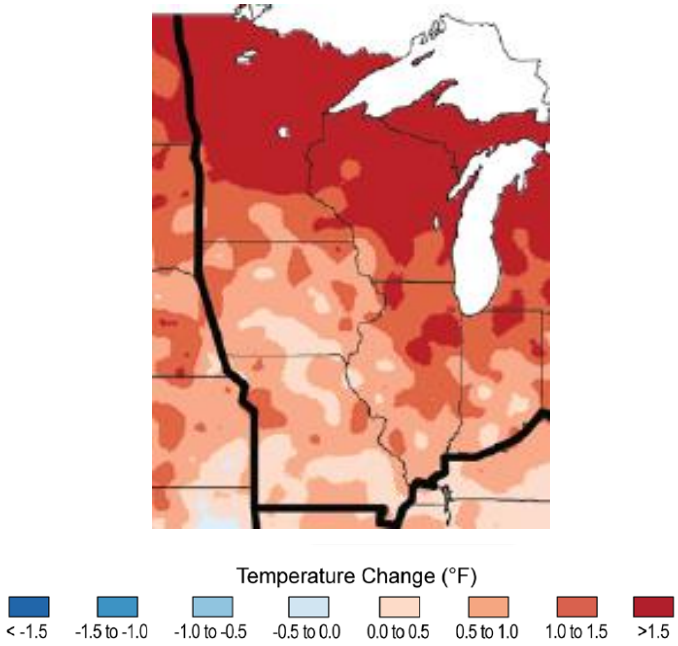
- Something you can't see…it is the average of weather in a place
- Long term
- Regional….but the average climate of world is what's changing, even if some places don't fit the pattern

All indicators: the world is warming

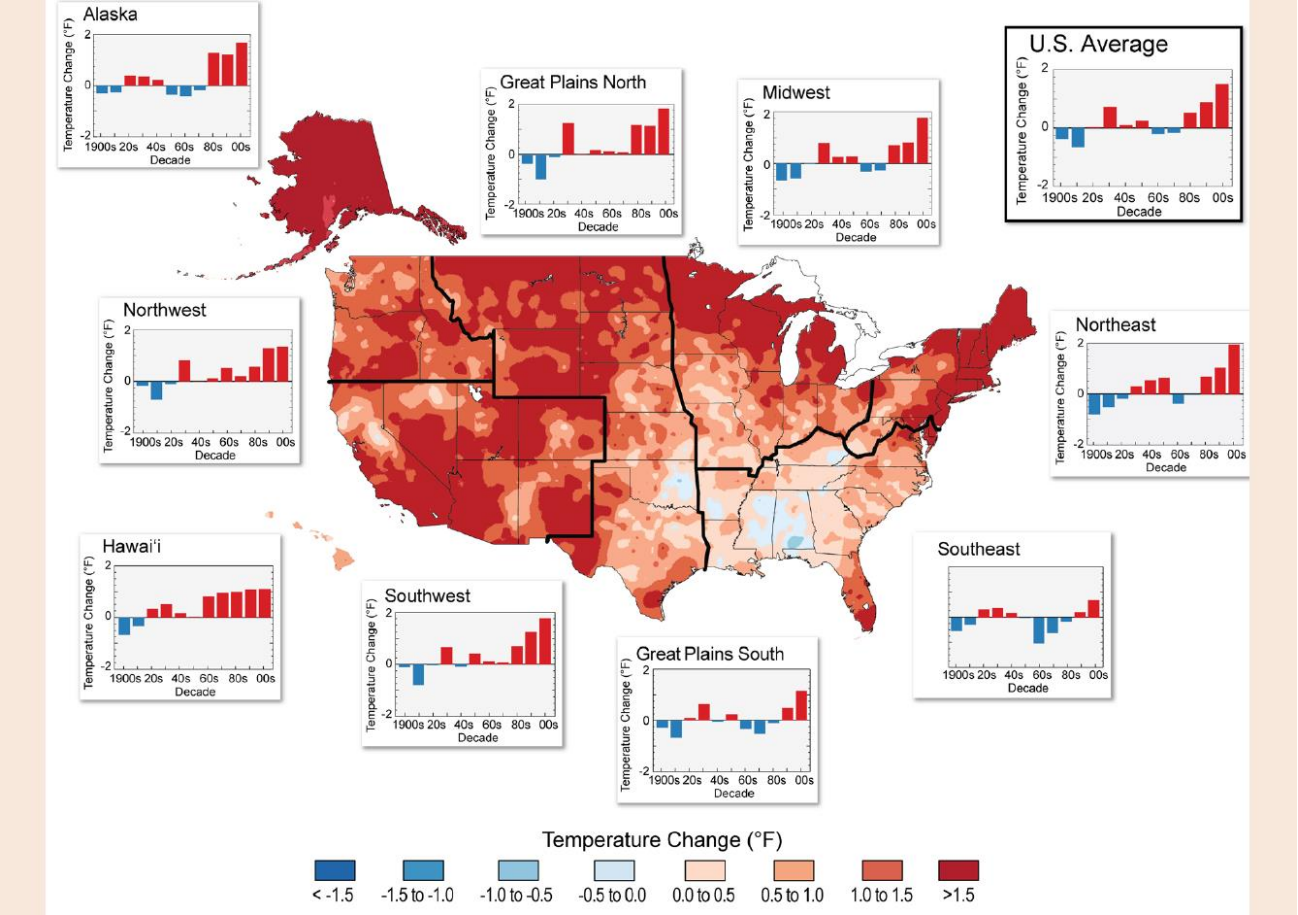


Our climate in the Midwest has been warming over the past 100 years

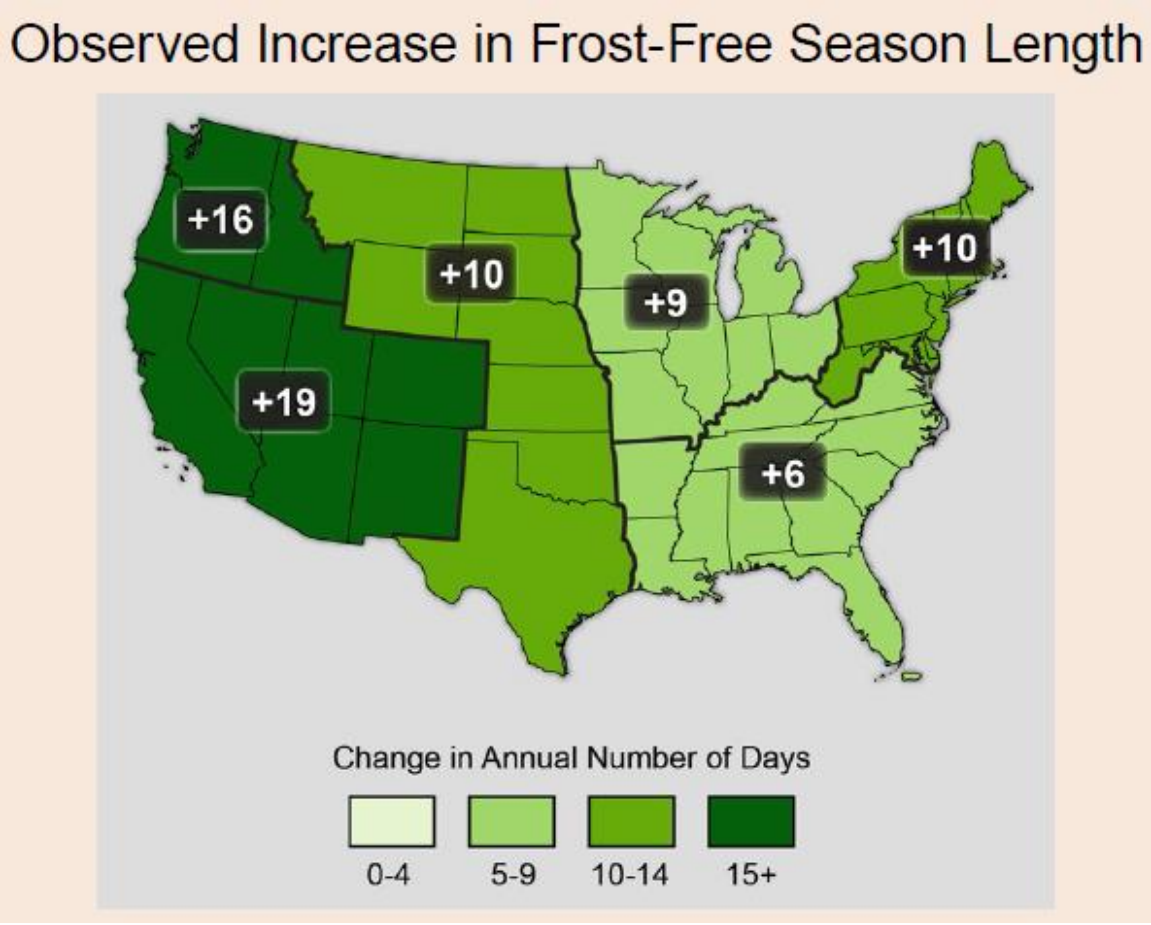




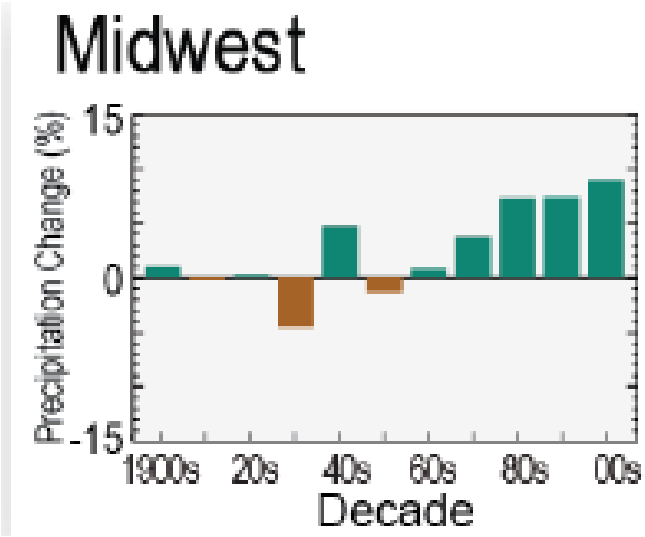
US Climate Warming is Taking Place NOW!

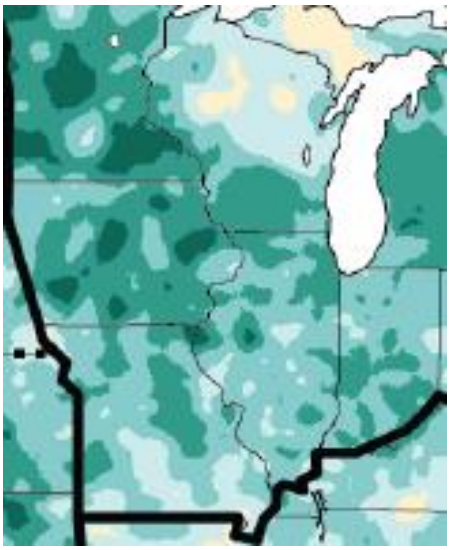


Frost season is getting shorter



The Midwest has gotten wetter…

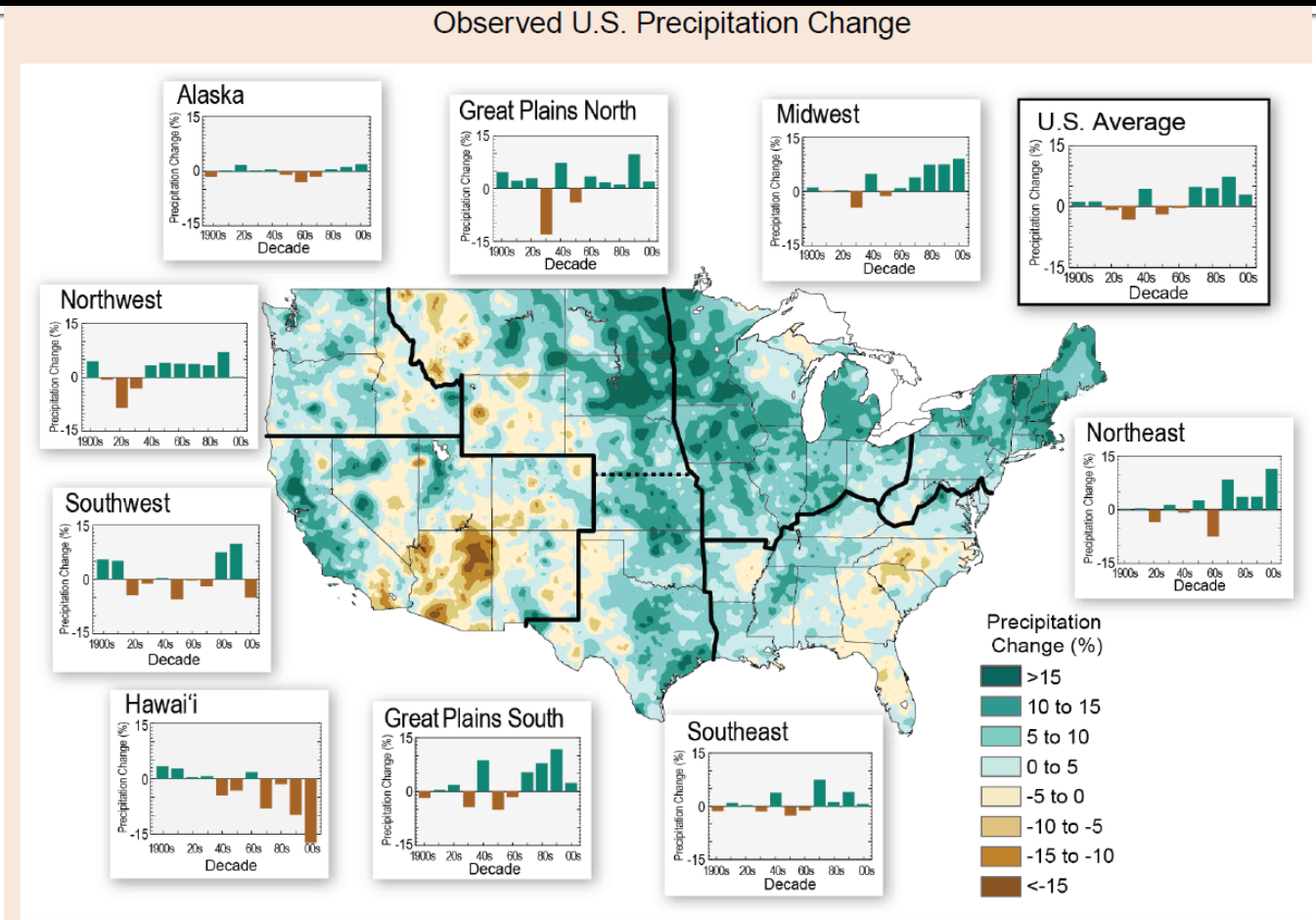




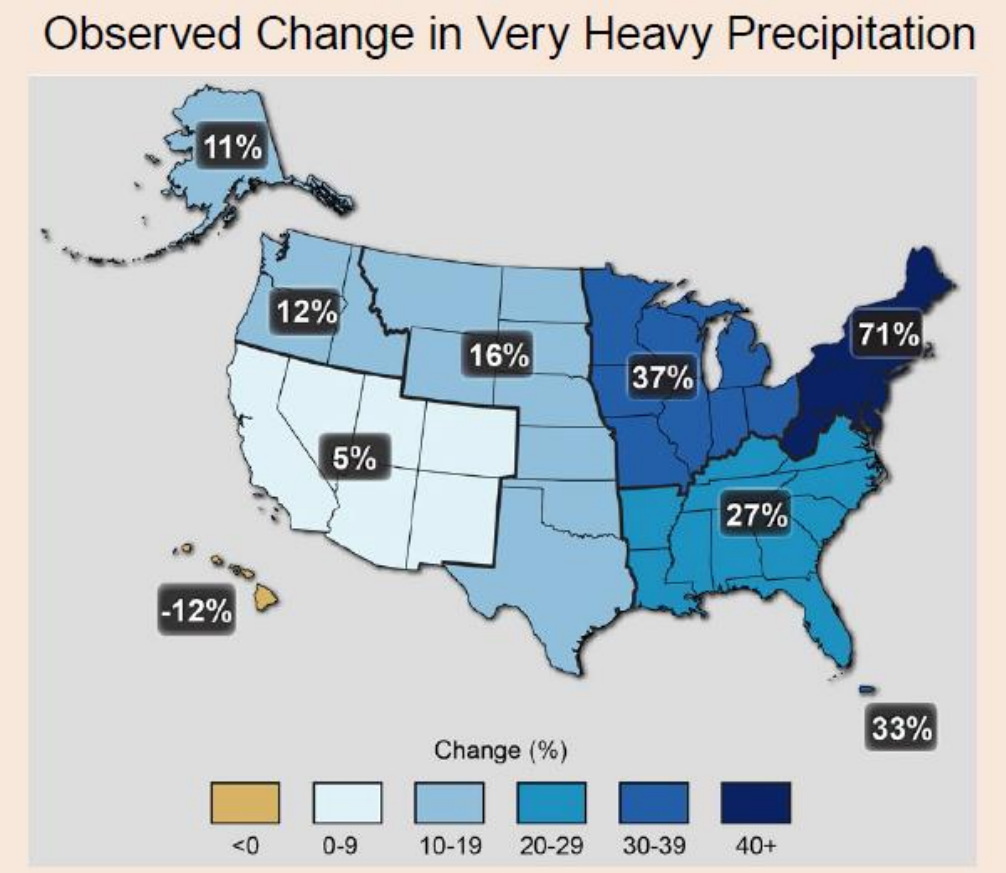
Precipitation Change (%)

- >15
- 10 to 15
- 5 to 10
- 0 to 5
- -5 to 0
- -10 to -5
- -15 to -10
- <-15

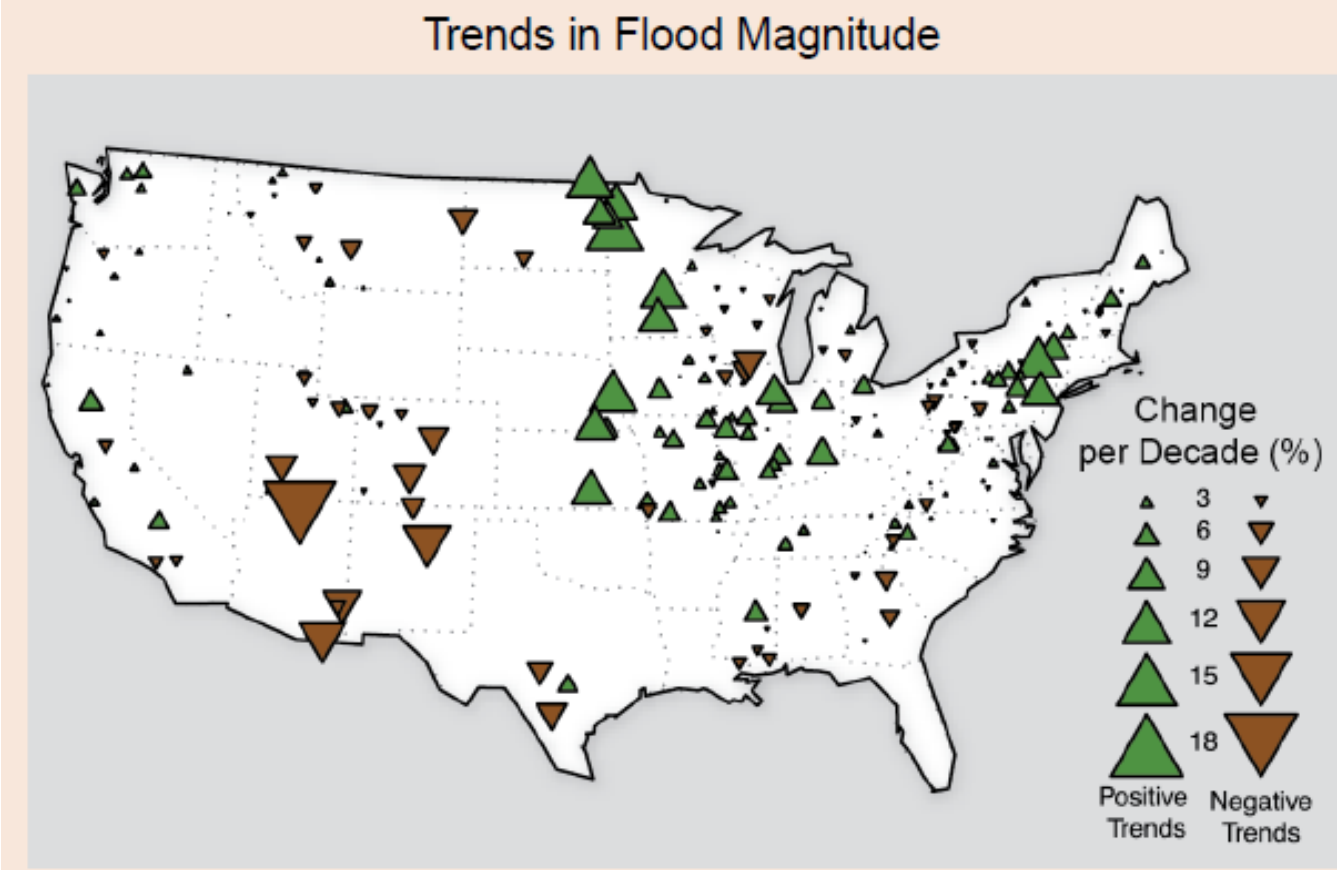
…while some parts of the US have gotten drier



Percent of annual rainfall that comes down in top 1% of rain events

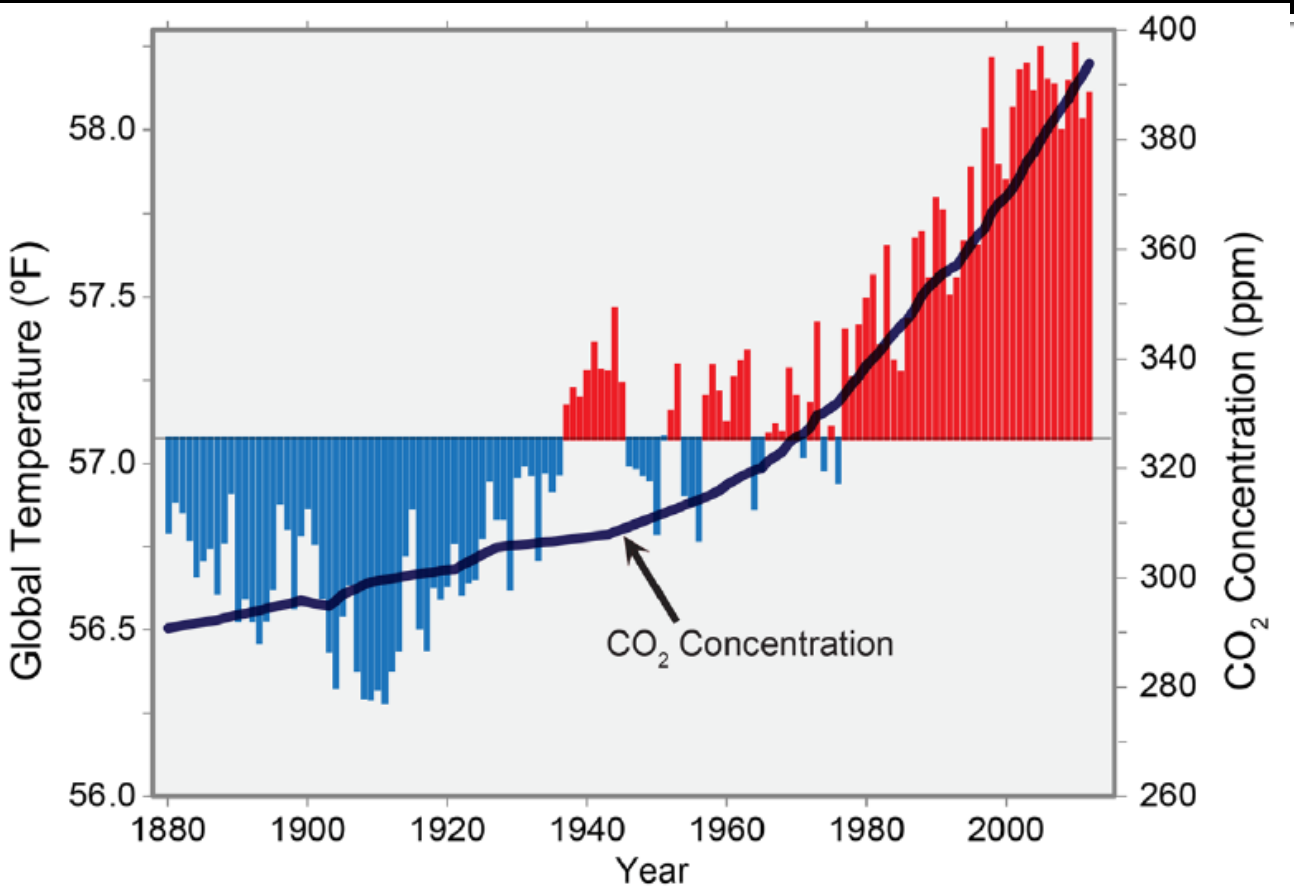


Observed changes in flood magnitude of the 20th century

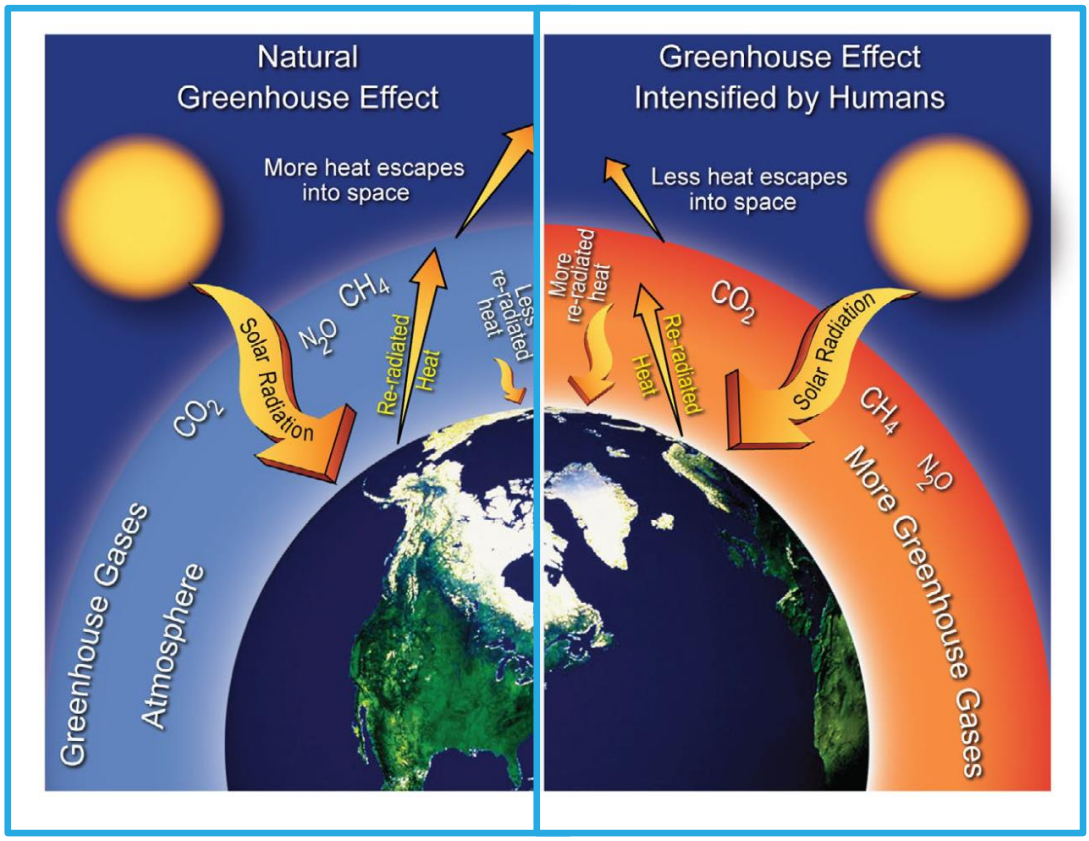


The road ahead

Need to understand: What is causing climate change?



Greenhouse Effect



NCA 2014

Regular carbon dioxide vs. Rampant carbon dioxide

5 cups
270 calories

vs.

11 cups
630 calories

11 cups
630 calories

11 cups
630 calories

Controversial?

- Climate change has become a *political* controversy in the US

- **It is NOT a scientific controversy**
  - **That the world is warming**
  - **That human factors, carbon dioxide emissions, are causing the warming**

Not controversial to many corporations

Not controversial in the re-insurance industry

Munich RE

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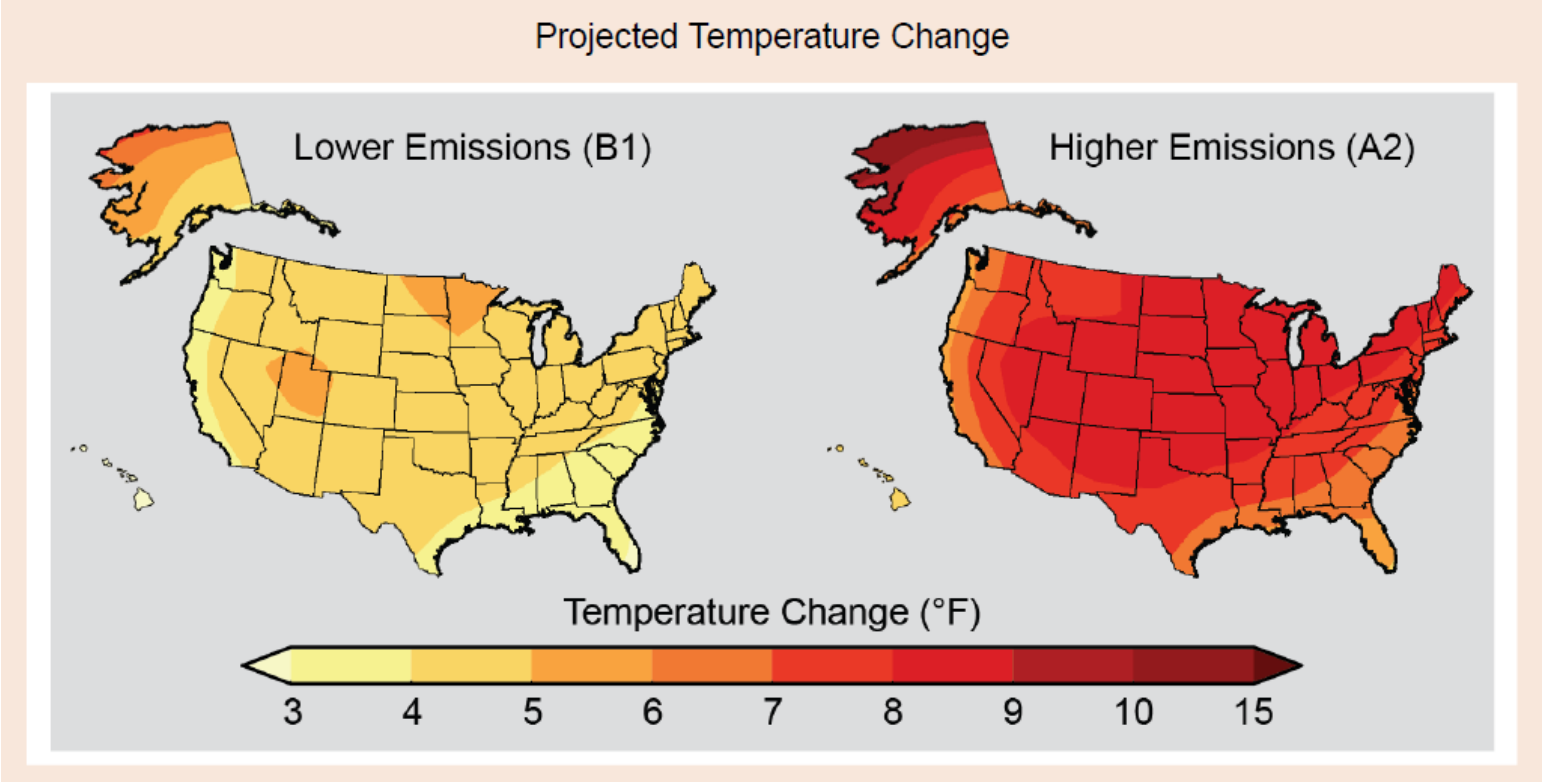
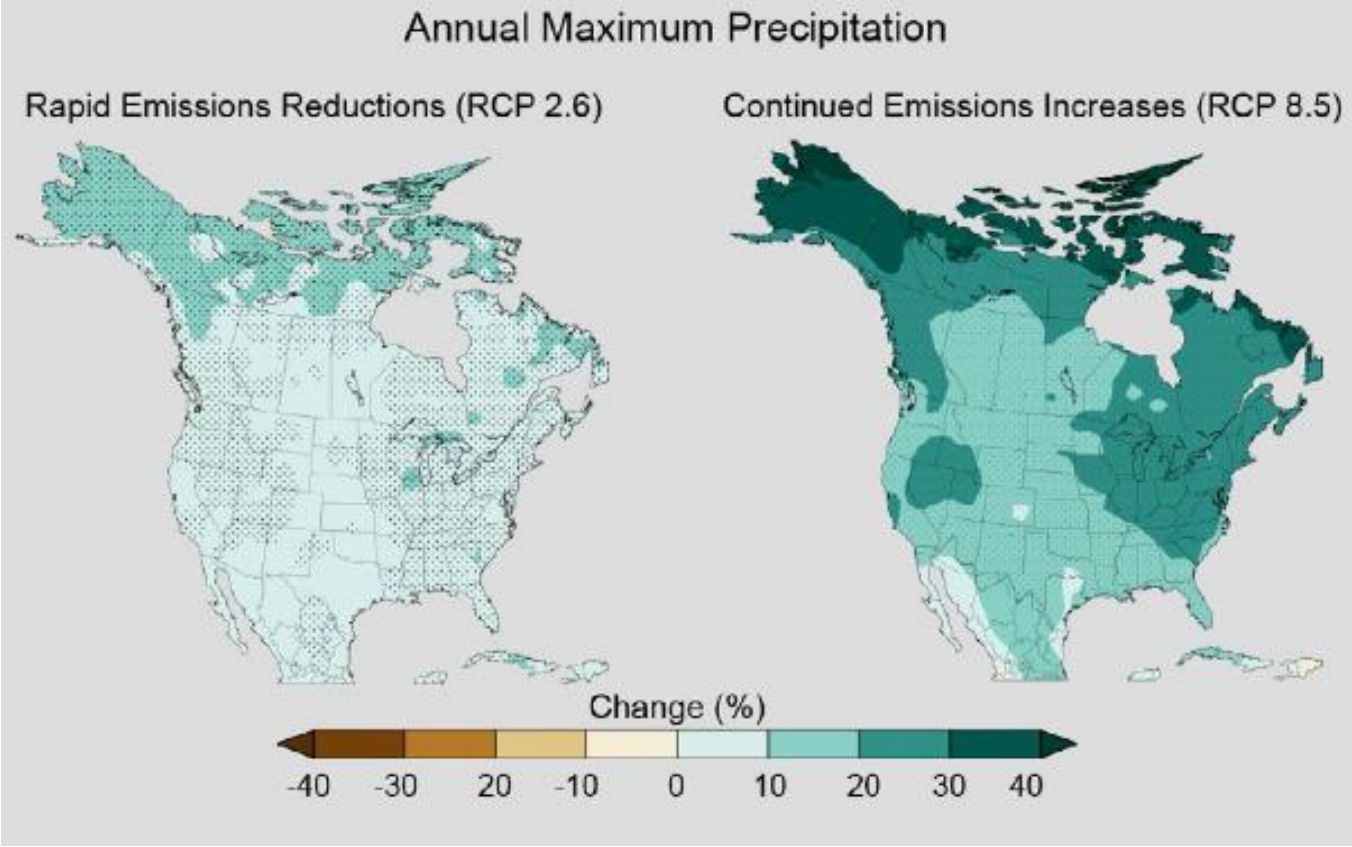
CLIMATE CHANGE

How much hotter will it get here? It depends.
Changes in temp 2070-2099, relative to 1970-1999

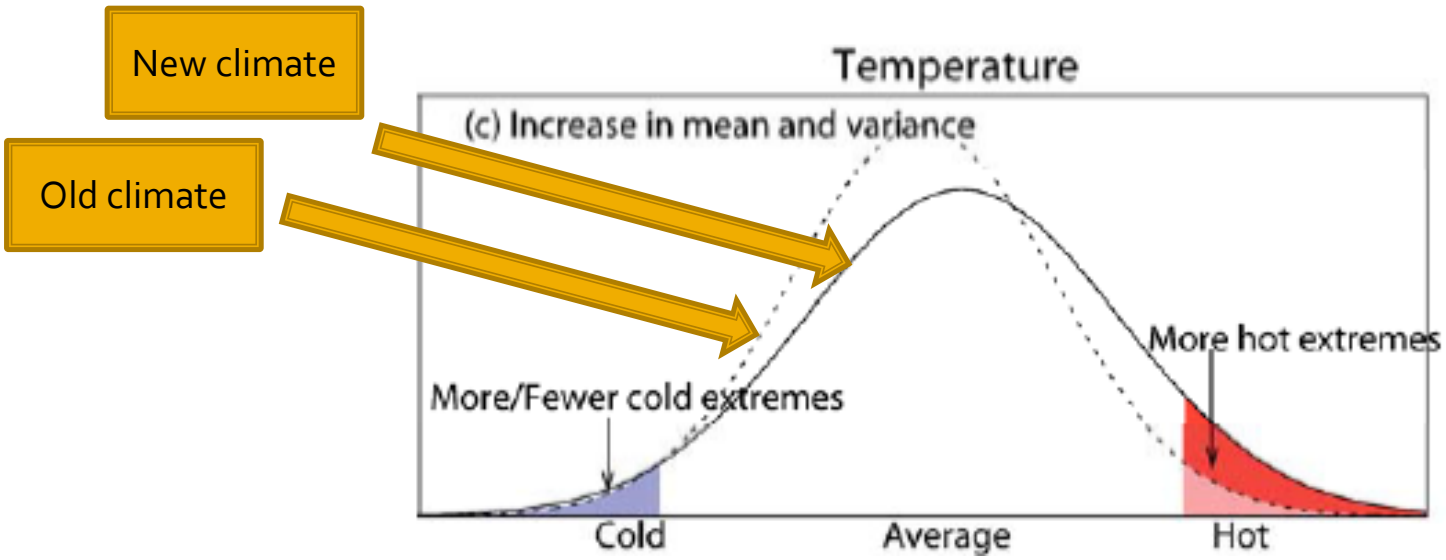


How much wetter will the Midwest become? It depends….



What's the big deal about a slightly warmer or wetter climate?

More <u>frequent</u> and more <u>severe</u> <u>extreme weather events</u>



Chicago heat wave, 1995

Homewood Memorial Cemetery, Homewood IL
A.P. file photo in the Chicago Tribune Aug. 25, 1995

Heatwaves

- Europe, 2003: ~50,000 excess deaths
- Russia, 2010: ~15,000 excess deaths

- Not random who dies in heat waves
  - Elderly
  - Live alone, don't get out much
  - Chronic medical or psychiatric conditions
  - No access to air conditioning

Spring and Fall floods

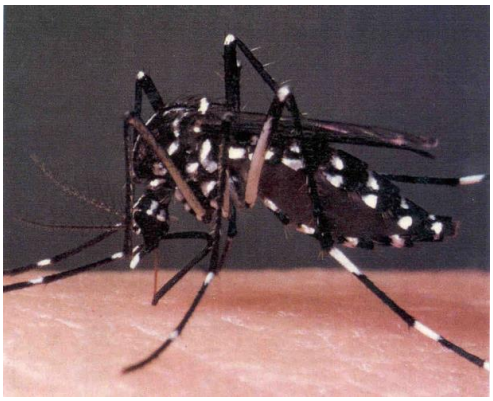
Photo : National Weather Service

- Health risks:
  - Waterborne gastrointestinal illness
  - Carbon monoxide poisoning
  - Injuries
  - Mold-damaged buildings
  - Displacement & emotional distress

Summer drought

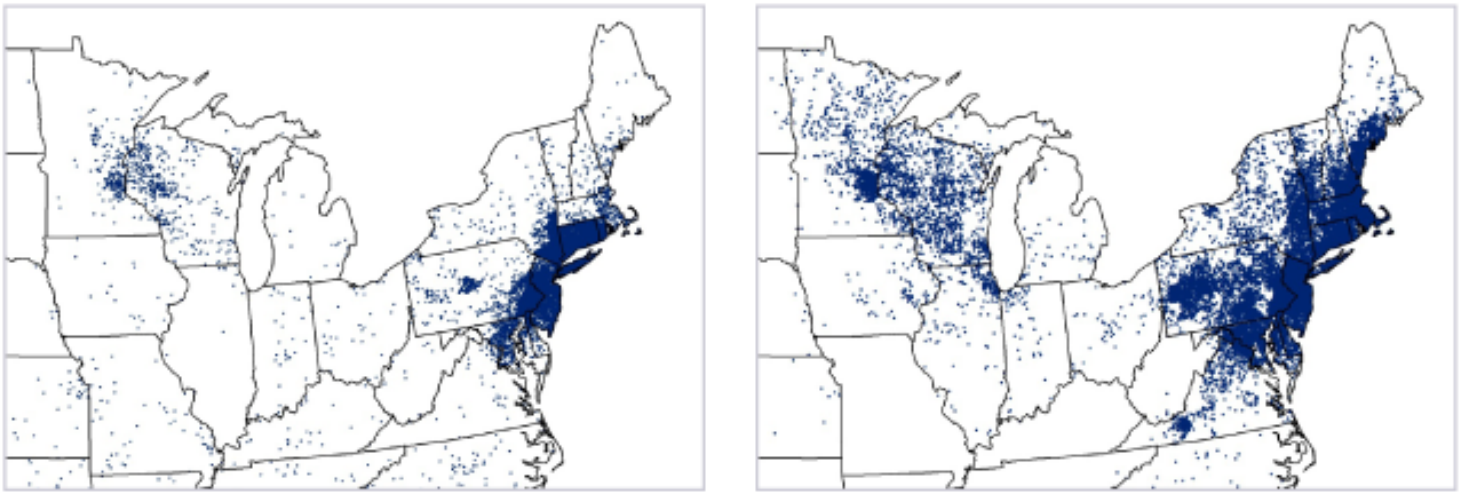
Vectorborne Diseases:

- In the Midwest and moving north now:
  - Lyme disease
  - West Nile Virus
  - Lone Star Tick/Ehrlichiosis
- Marching north:
  - Dengue fever, Chikungunya virus



Vectorborne Diseases
Changing geographic ranges

Example: Reported Lyme Disease Cases in 1996 and 2012



1996 2012

Data source: CDC (Centers for Disease Control and Prevention). 2014. Lyme disease data and statistics. www.cdc.gov/lyme/stats/index.html. Accessed January 2014.

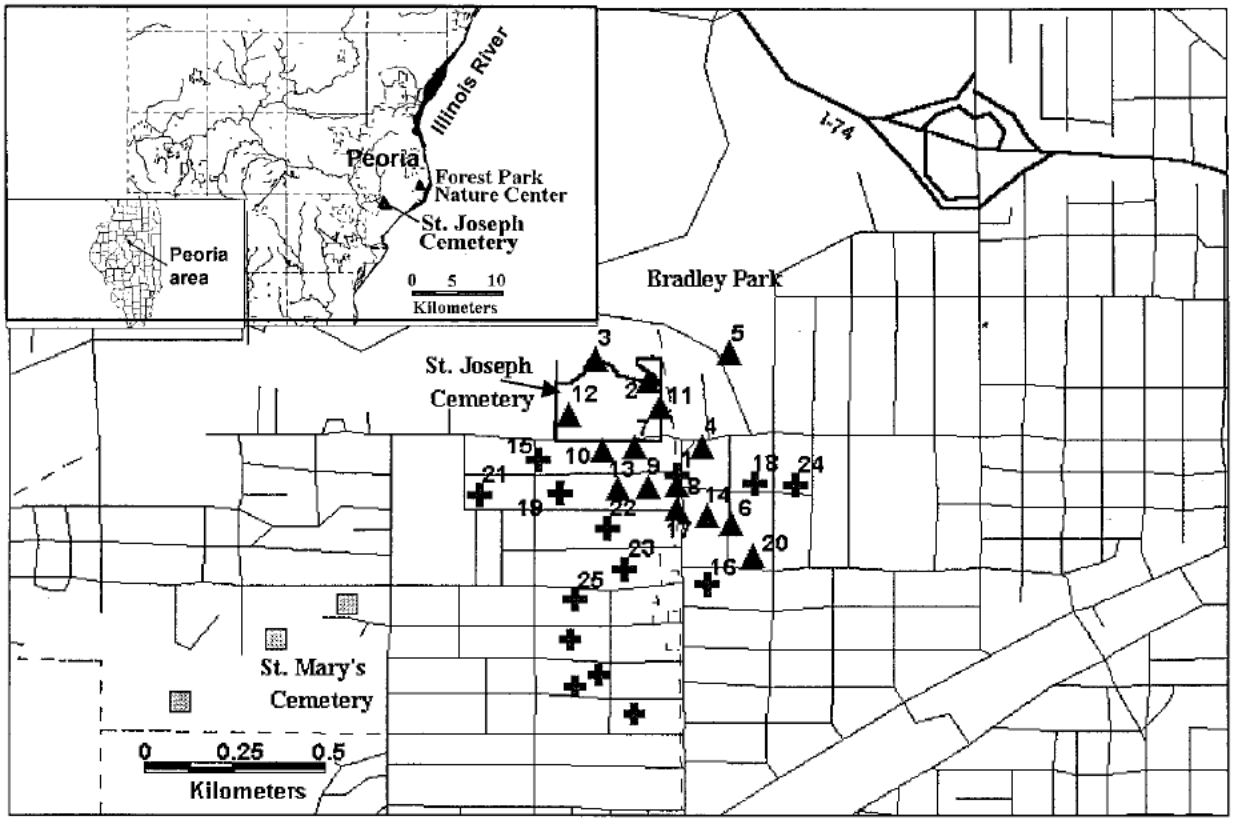
http://www.epa.gov/climatechange/science/indicators/health-society/lyme.html

United Kingdom
Belarus
Poland
Germany
Ukraine
Austria
Kazakhstan
France
Romania
Italy
Uzbekistan
Kyrgyzstan
Greece
Turkey
Turkmenistan
Mediterranean Sea
Syria
Tunisia
Iraq
Iran
Afghanistan
Pakistan
Algeria
Libya
Egypt
Saudi Arabia
India
Oman
Mali
Niger
Sudan
Yemen
Chad
Gulf of Aden
Arabian Sea
Burkina Faso
Nigeria
South
Ethiopia

Epidemic clusters

Last update Nov 11, 2007

Ae. albopictus: enjoying IL



Mental Health: A concern after extreme weather events

- A study of 815 people impacted by Katrina

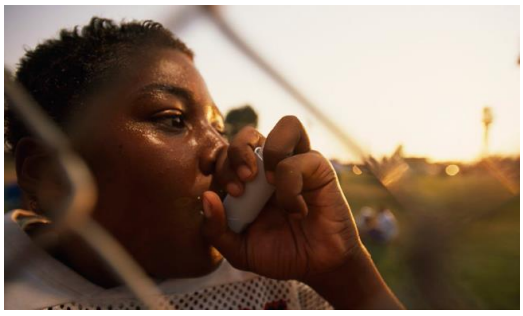
Condition	5-8 months after Katrina	1 year after Katrina
Post Disaster Mental Disorder	14.9%	20.9%
Serious mental illness	10.9%	14%
Suicidal Ideation	2.8%	6.4%
Suicidal Plans	1%	5%

- Common symptoms include the inability to stop thinking about the hurricane, nightmares and emotional numbness.

Kessler et al, 2008

Asthma, COPD & Climate Change

- Chronic conditions
- Episodes of cough, wheeze, shortness of breath
- Management plans
- Avoid triggers



Triggers that are related to climate

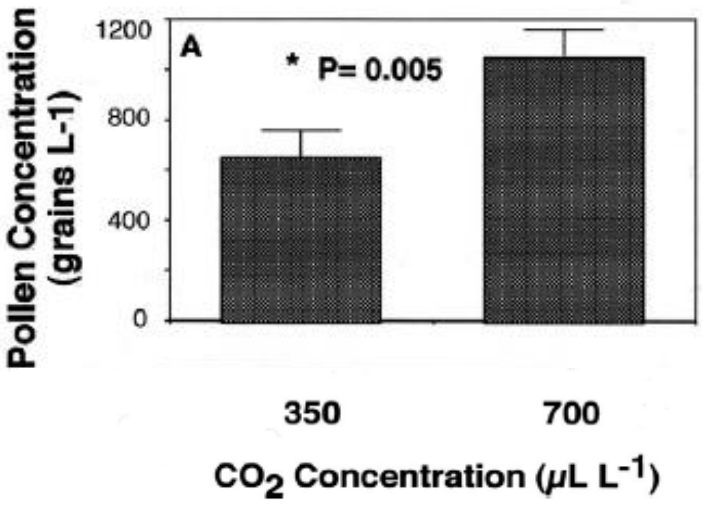
- Ozone
- Particulate matter air pollution
- Allergens

Pollen, allergies, and asthma

- Pollen seasons:
  - Spring – tree pollen
  - Summer – grass pollen
  - Fall – ragweed pollen ("hay fever")
- Pollen season
  - Start, duration
  - Amount of pollen produced
  - Distribution of plants in a given area (climate region)

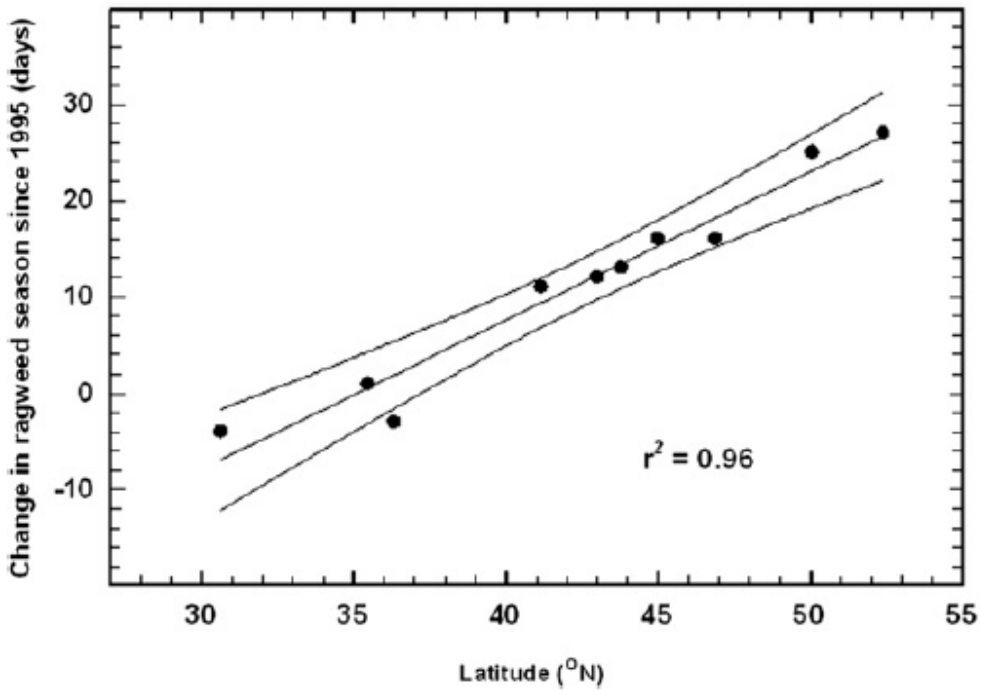
Experiment Ragweed pollen production and CO_2 (Wayne 2002)

- Grow ragweed in greenhouse
- 350 vs. 700 ppm CO_2
- 61% increase in pollen produced



Change (days) in ragweed season, 1995-2009, by latitude (Ziska 2011, 2012)

Location	Latitude
Georgetown, TX	30.63°N
Oklahoma City, OK	35.47°N
Rogers, AR	36.33°N
Papillion, NE	41.15°N
Madison, WI	43.00°N
LaCrosse, WI	43.80°N
Minneapolis, MN	45.00°N
Fargo, ND	46.88°N
Winnipeg, MB, Canada	50.07°N
Saskatoon, SK, Canada	52.07°N



Ziska 2004, continued

- More ragweed growth in urban (warmer, higher CO_2) than rural areas

Productivity and height (±SE) by site

Site	Biomass	Height
Rural	1,819±107 c	241±19.4 c
Suburban	2,932+193 b	286±15.4 b
Urban	3,896±52.5 a	338+25.4 a

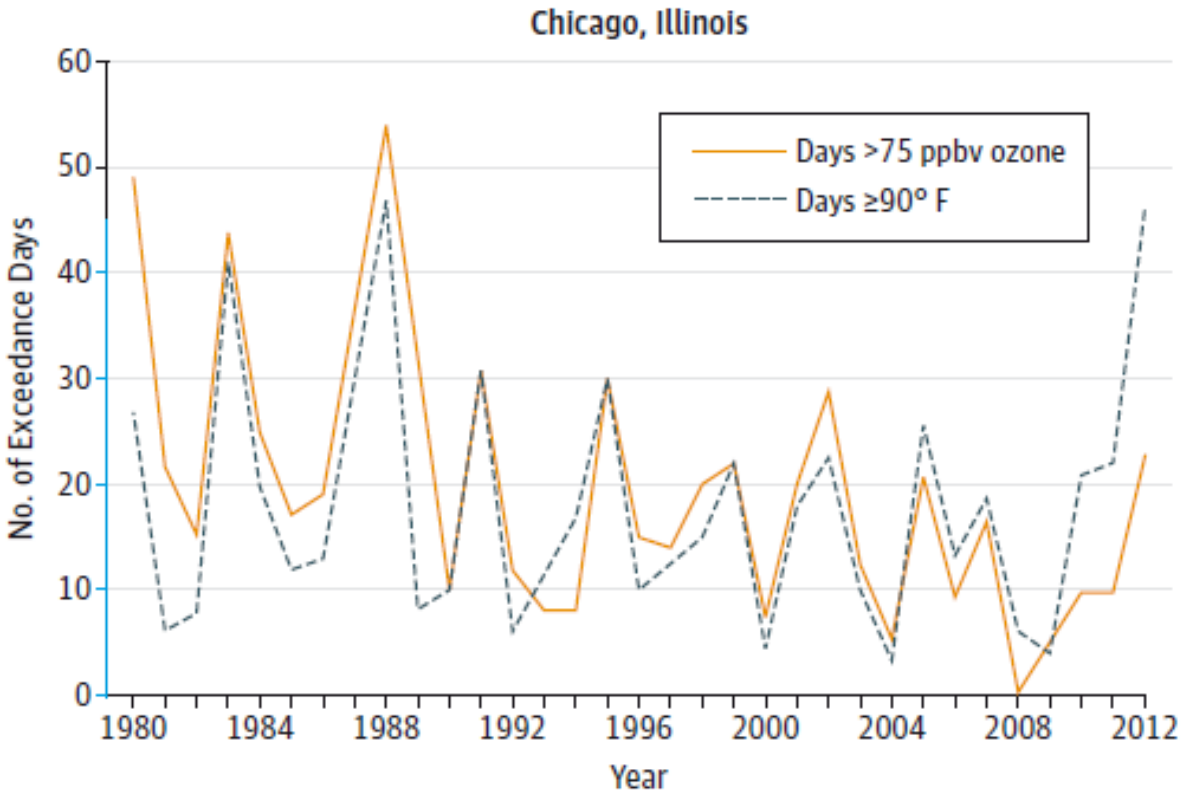
CO_2 and fungal spore production (Wolf 2010 EHP)

- Alternaria, a common mold that triggers allergies
- Grow grass at different concentration of CO_2 (300, 400, 500, 600 ppm)
- Grow mold on the grass
- Higher CO_2, different composition of grass (higher C:N ratio)
- More mold allergen produced per plant with higher CO_2 concentrations during grass growth

A bit deeper

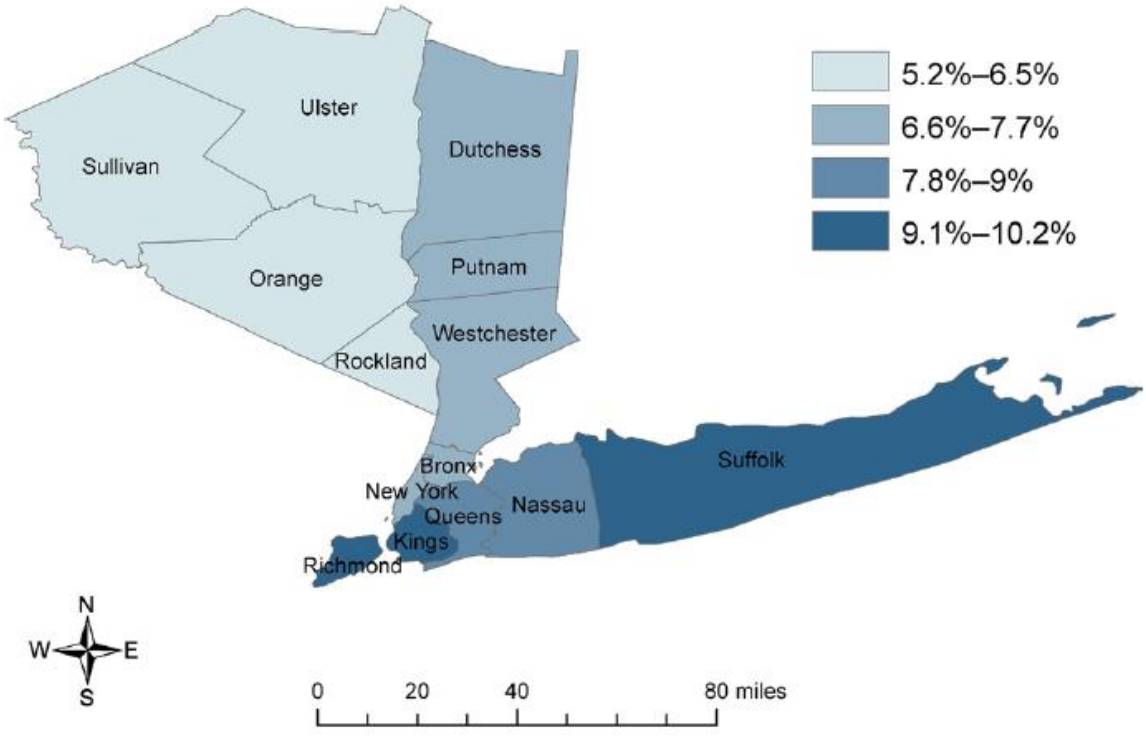
- A "secondary air pollutant": generated when NOx, volatile organic compounds mix in the presence of sunlight
- Higher temperatures: more ozone production
- Transported from areas of NO2, VOCs release

JAMA, Oct 15, 2014

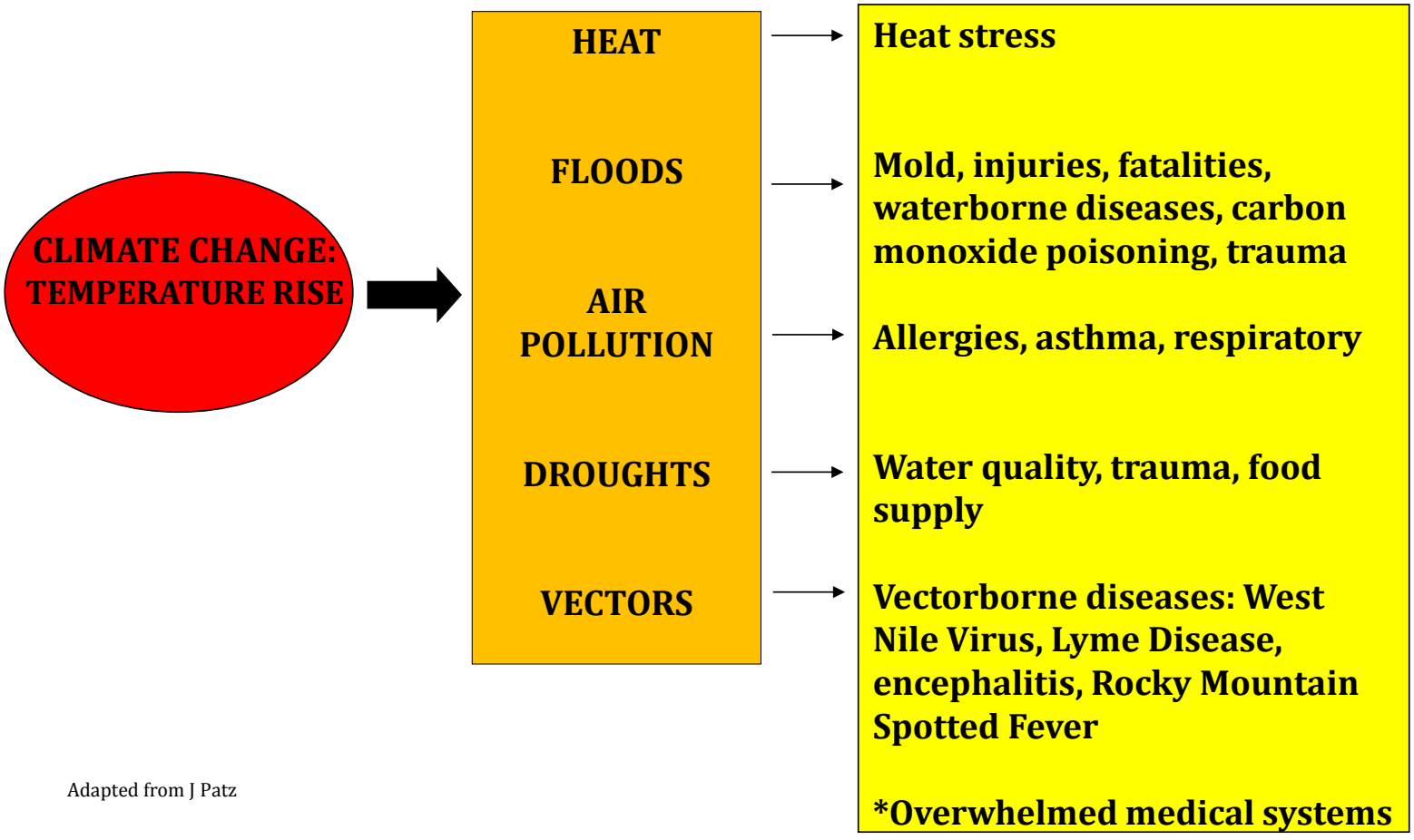


Expected changes in pediatric asthma ED visits due to ozone, 2020 vs. 1990

Sheffield et al, 2011

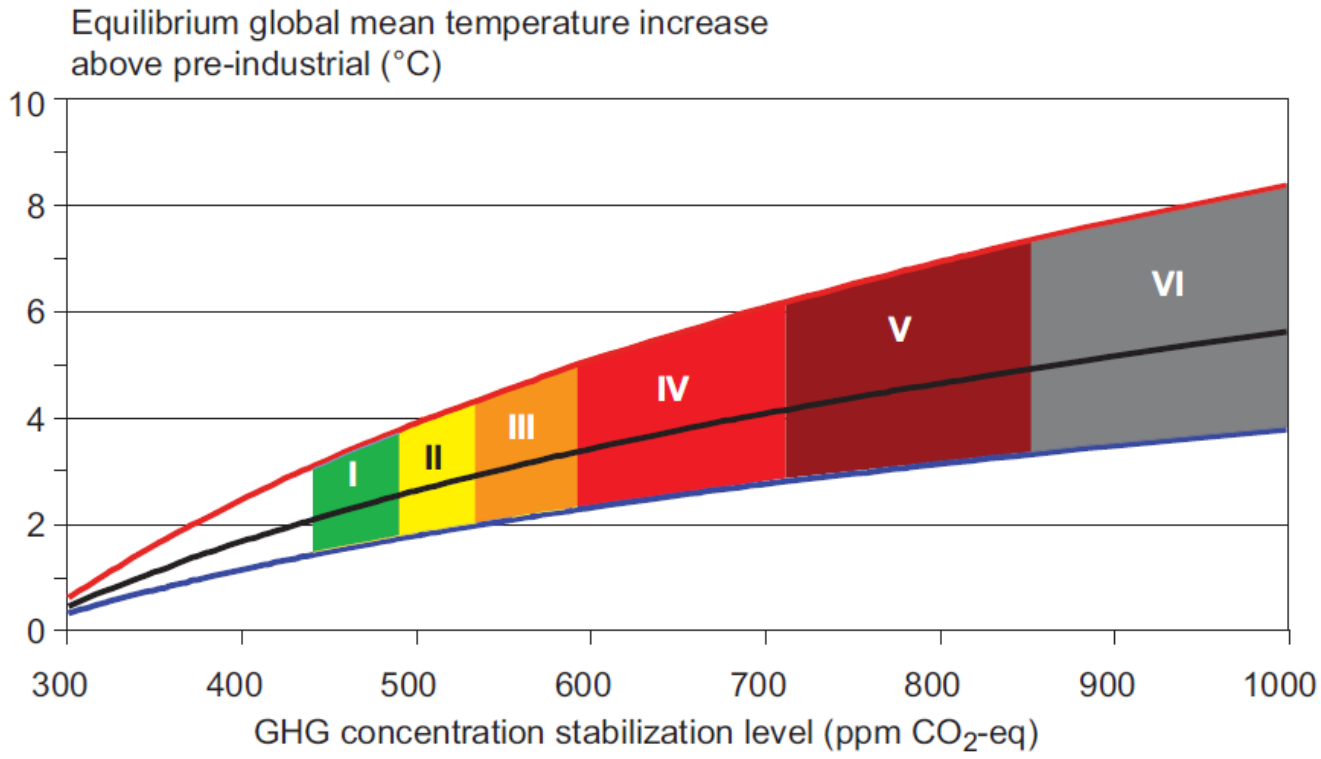


Climate change Health Effects in Illinois

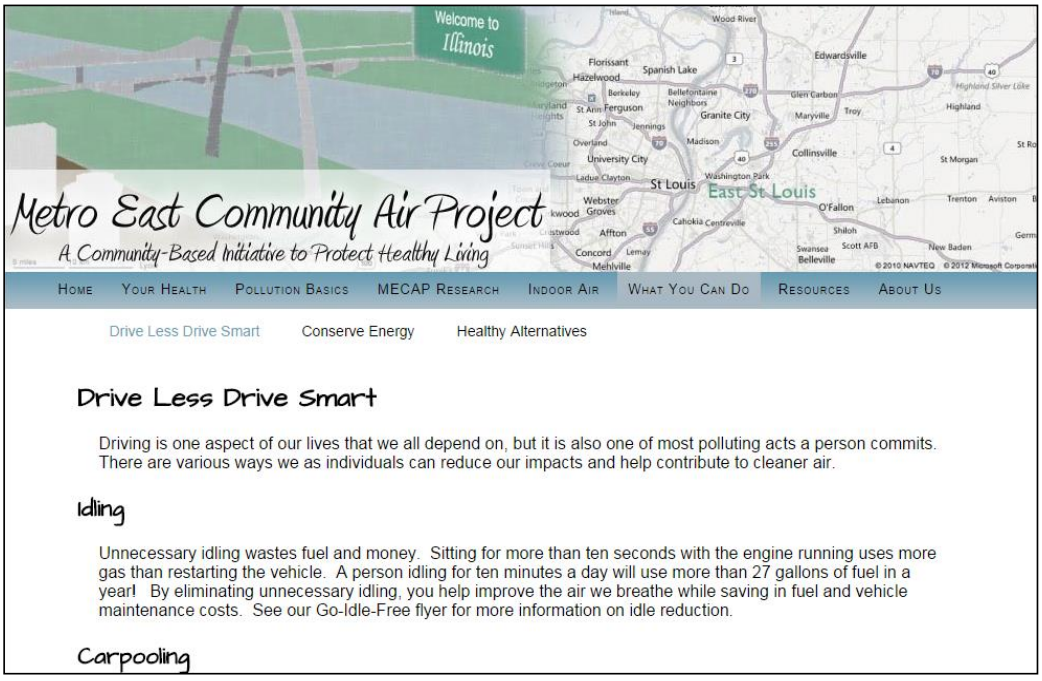


Adapted from J Patz

What can we do to protect our children and grandchildren from the effects of climate change? Answer 1: "Mitigation"



Improve air quality and promote energy efficiency: Less CO_2



Mitigation and "health co-benefits"

Decreased CO_2 pollution

Decreased asthma triggers (PM, ozone)

Increased physical activity

Mitigation and "health co-benefits"

- ↓ need for A/C
- ↓ urban heat island effect
- ↓ Storm water runoff
- ↑ greenspace, physical activity

Image: http://grist.org/climate-change/2011-08-25-neoliberalism-and-climate-change-adaptation/

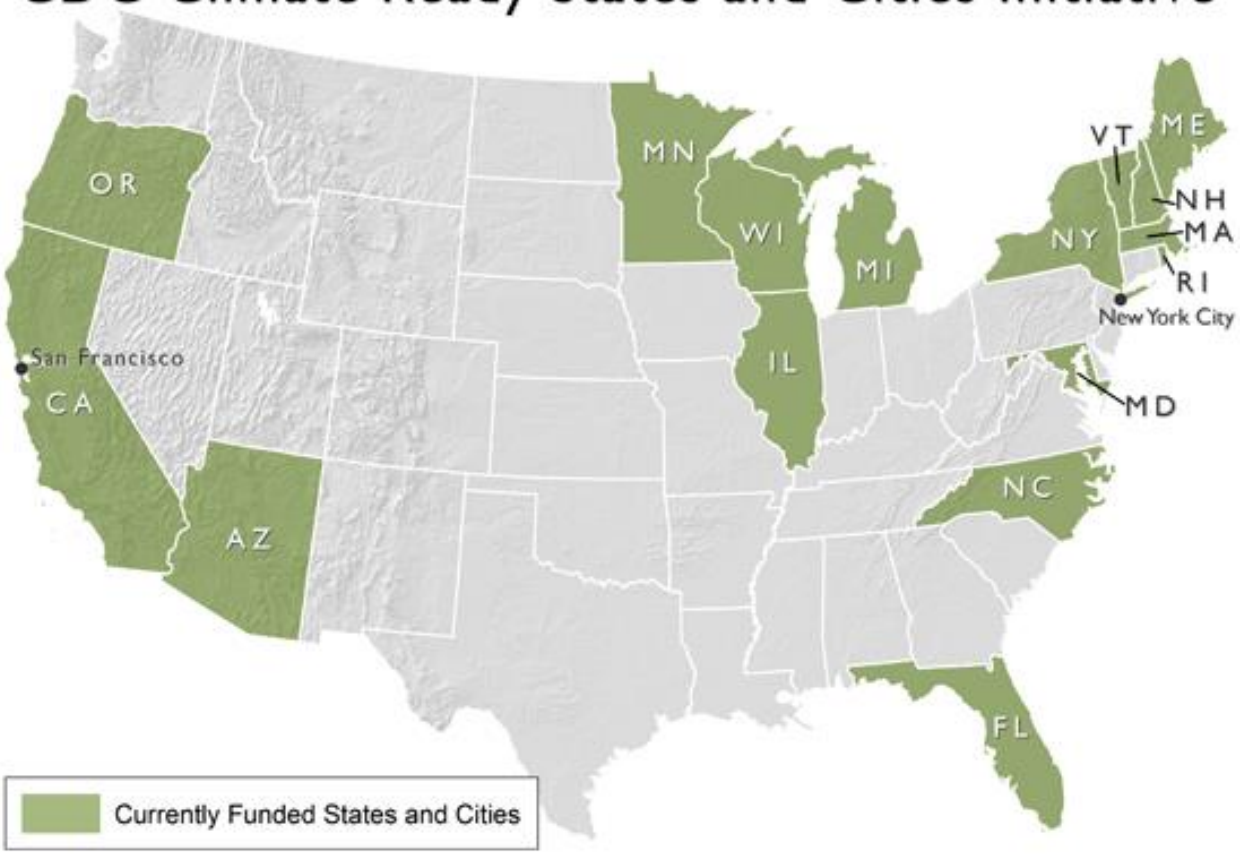
January 21, 2013: President Obama's Second Inaugural Address

"We will respond to the threat of climate change, knowing that the failure to do so would betray our children and future generations. Some may still deny the overwhelming judgment of science, but none can avoid the devastating impact of raging fires and crippling drought and more powerful storms."

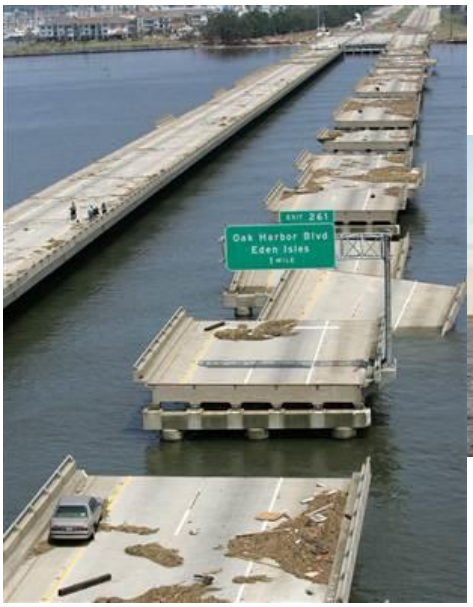
June 2013: The President's Climate Action Plan

- "And, building on lessons from pilot projects underway in 16 states, [the DHHS] will help train public-health professionals and community leaders to prepare their communities for the health consequences of climate change, including through effective communication of health risks and resilience measures."

CDC Climate Ready States and Cities Initiative

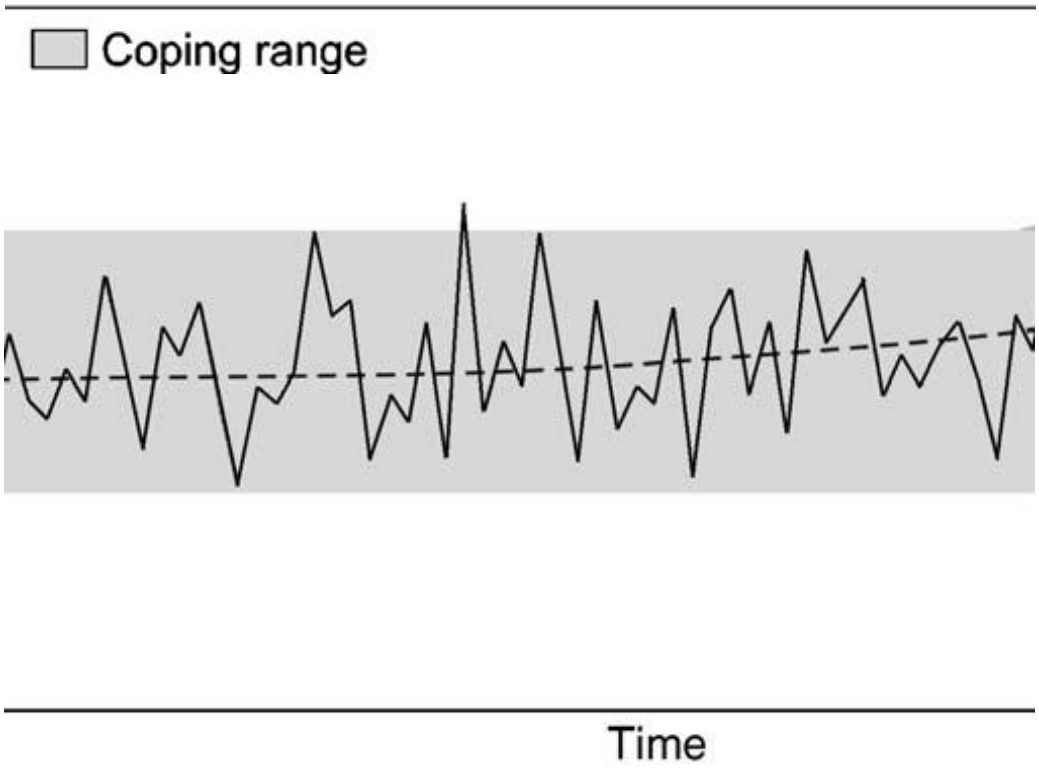


Adjustments in a system's behavior and characteristics that enhance its ability to cope with external stress" (Smit 2006)

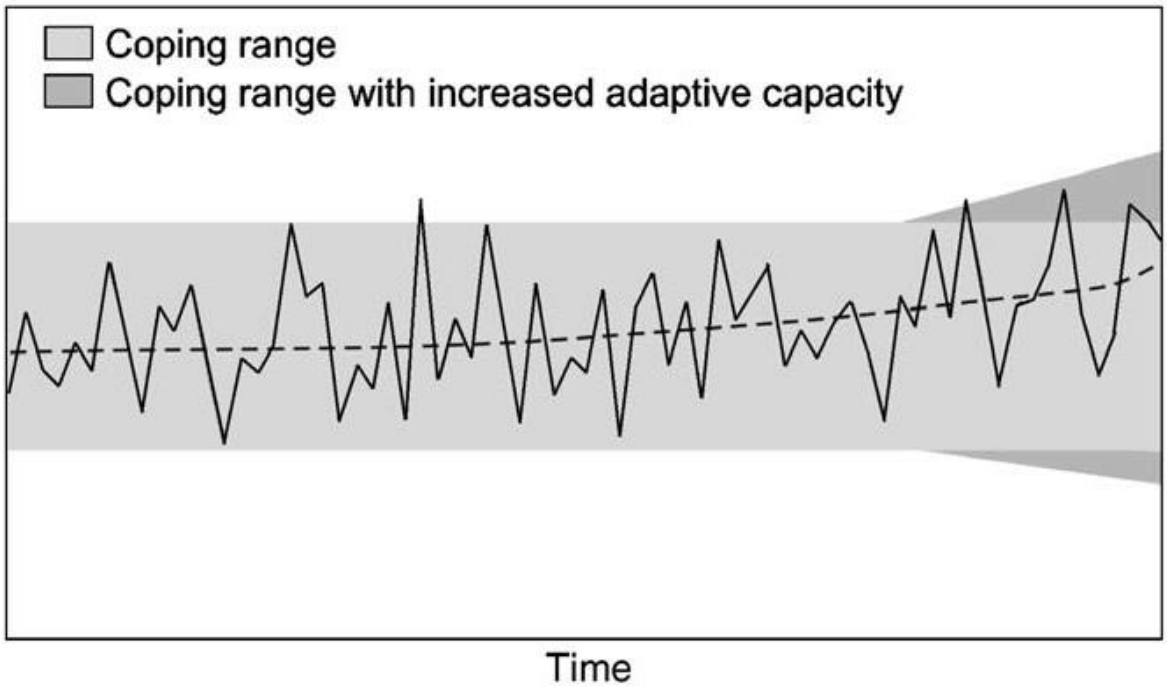


I-10, August 30, 2005
Associated Press

http://www.twinspanbridge.com



Smit and Wandel, 2006



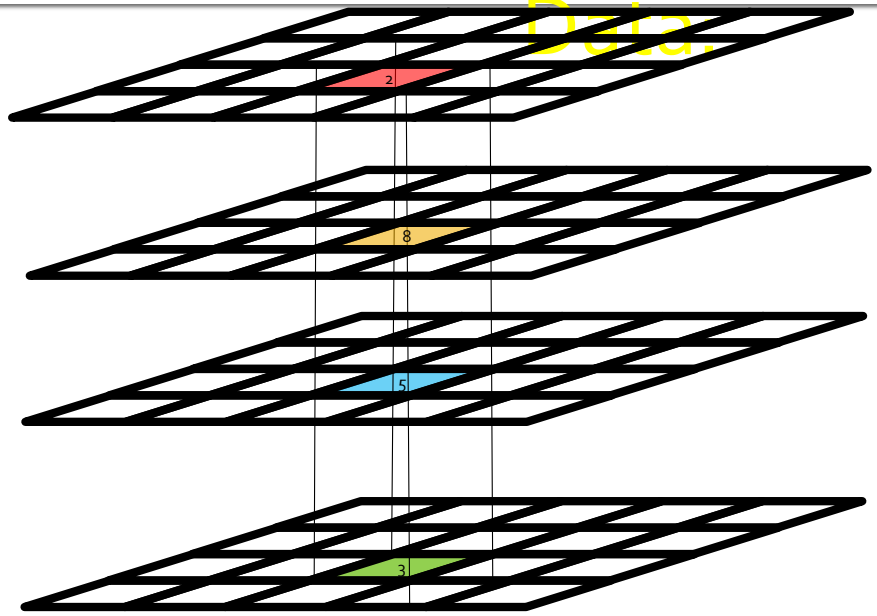
Smit and Wandel, 2006

The BRACE Framework

Building **R**esilience **A**gainst **C**limate **E**ffects

1. Forecast climate impacts, assess vulnerabilities
2. Project disease burden
3. Assess public health interventions
4. Develop and implement a climate and health adaptation plan
5. Assess impacts, improve quality of that plan

People and places at risk: Vulnerability maps



Flood plain

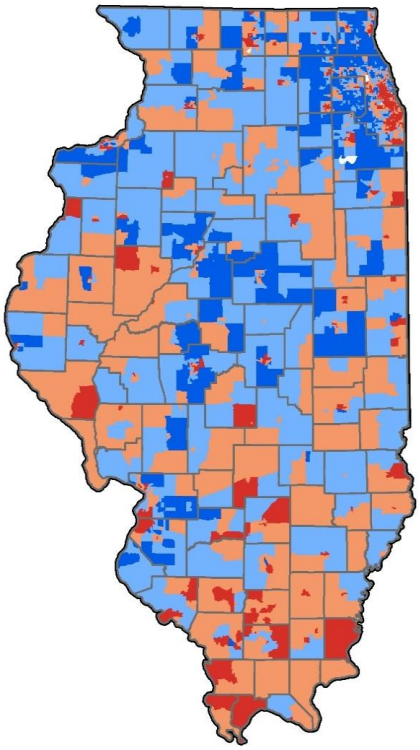
Poverty, unemployment

Non-English speaking

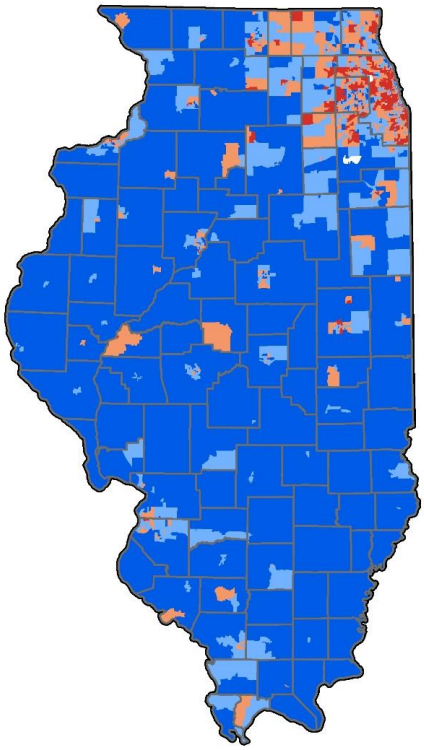
Extremes of age

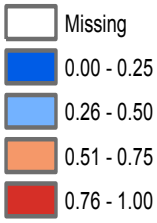
CDC Social Vulnerability Index

Socioeconomics



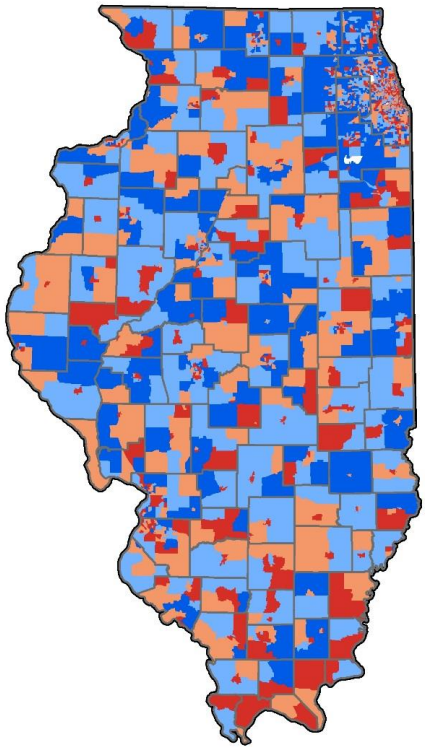
Minority / language



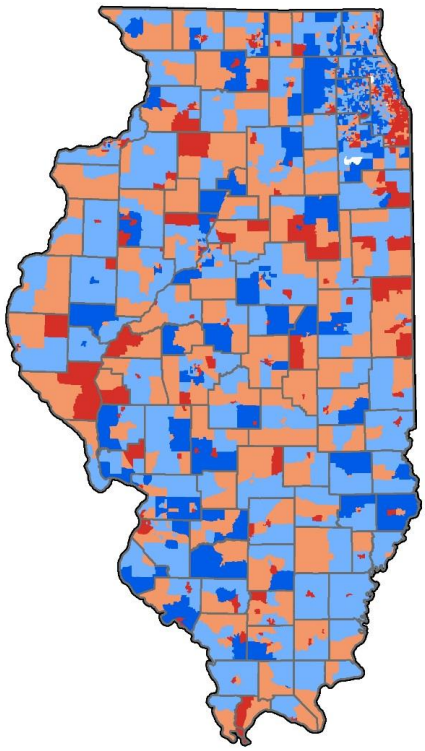


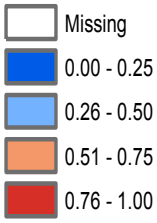
CDC Social Vulnerability Index

Housing/Transportation

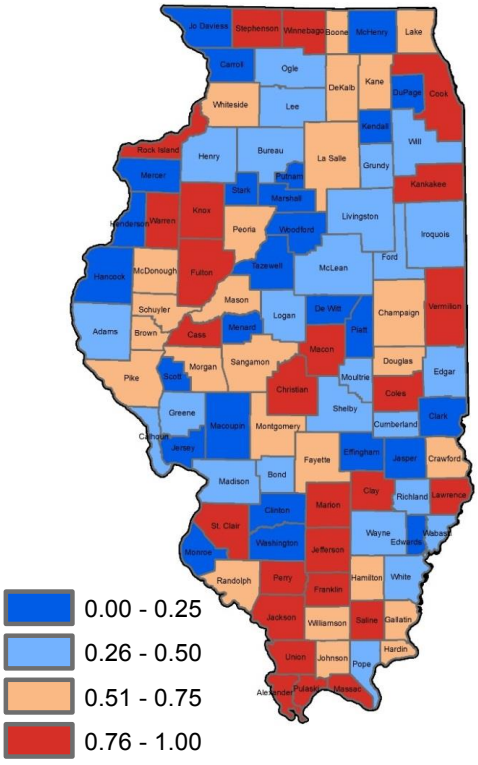


Household composition





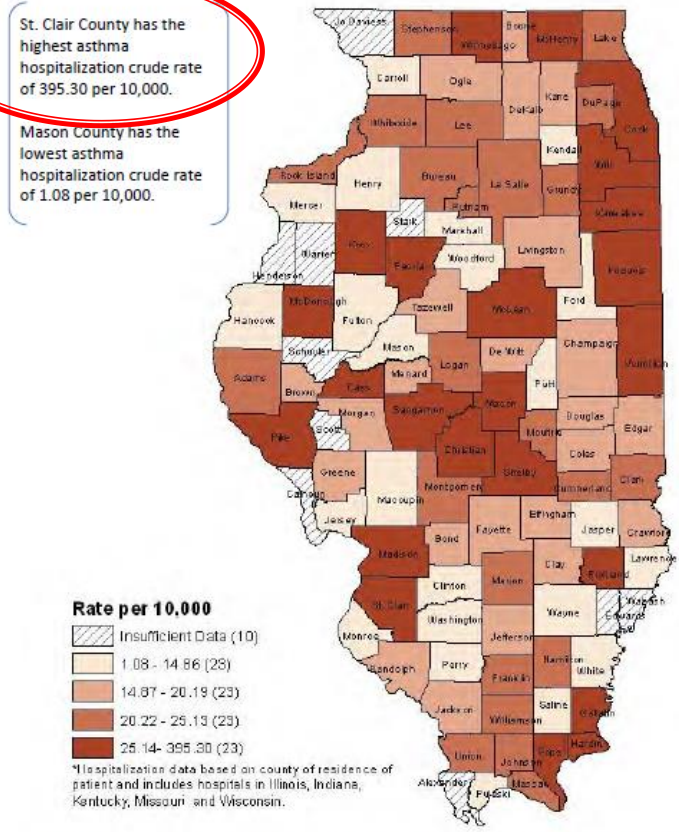
Overall SVI, county level



Asthma hospitalizations by county, 2009-2010 (The Burden of Asthma in Illinois, 2000-2011, IDPH)

St. Clair County has the highest asthma hospitalization crude rate of 395.30 per 10,000.

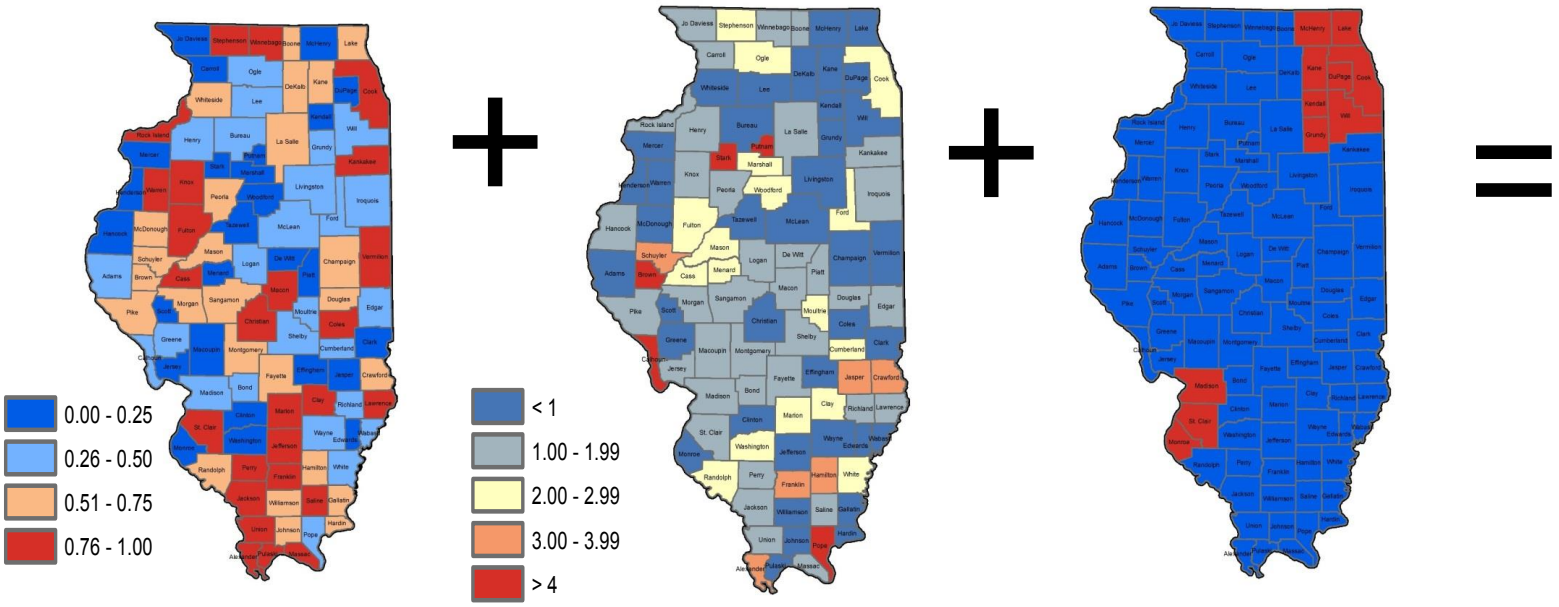
Mason County has the lowest asthma hospitalization crude rate of 1.08 per 10,000.



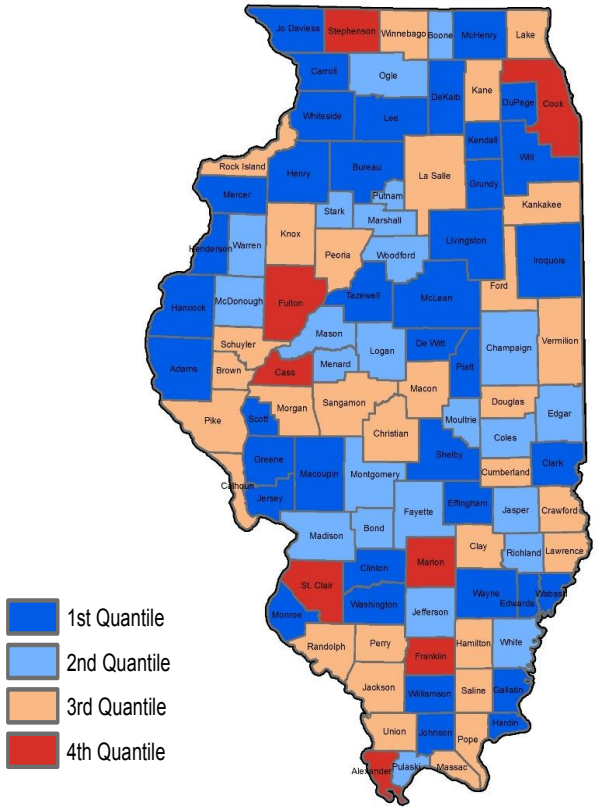
Source: Illinois Department of Public Health, Hospital Discharge Data; Indiana State Department of Health; Kentucky Cabinet for Health and Family Services; Missouri Department of Health; Wisconsin Department of Health Services

Vulnerability assessment

Overall SVI **Asthma deaths per 10,000** **Ozone**

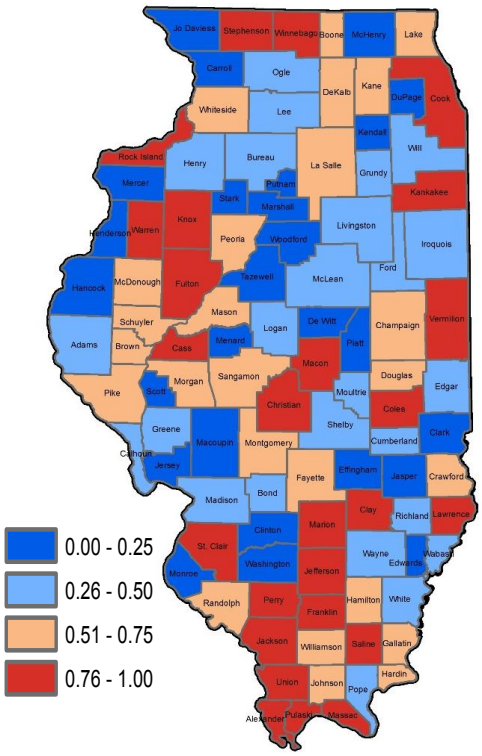


Vulnerability to climate change and respiratory illness in Illinois



Vulnerability to flooding

Overall SVI



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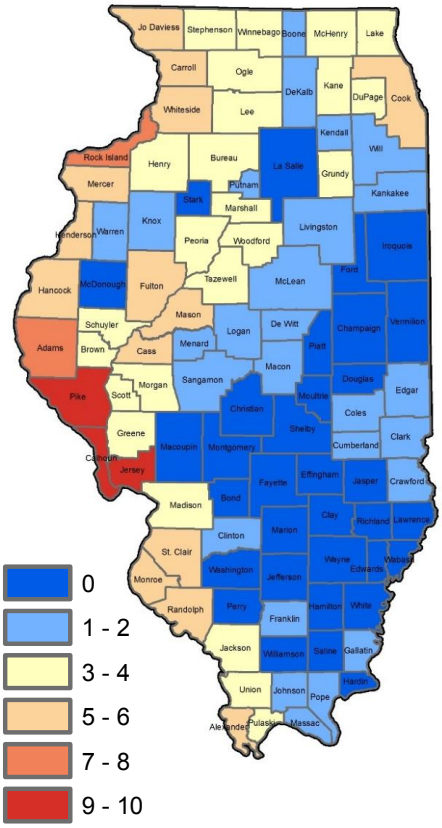
Flood disasters



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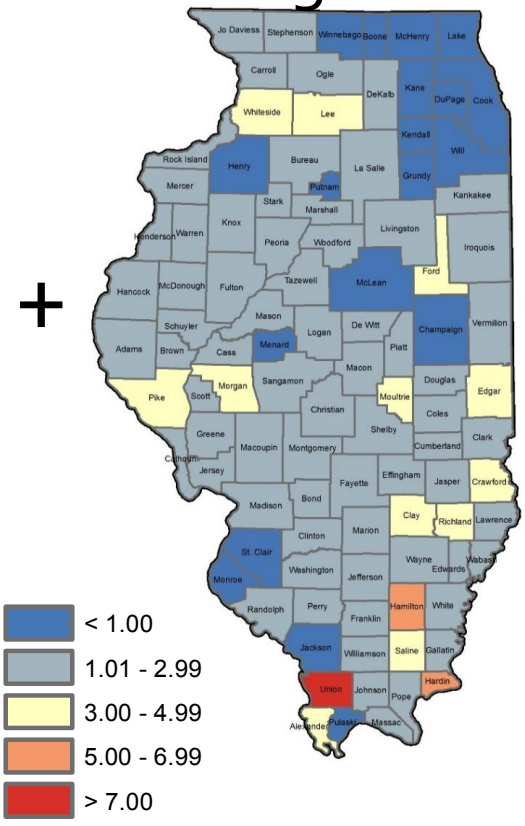
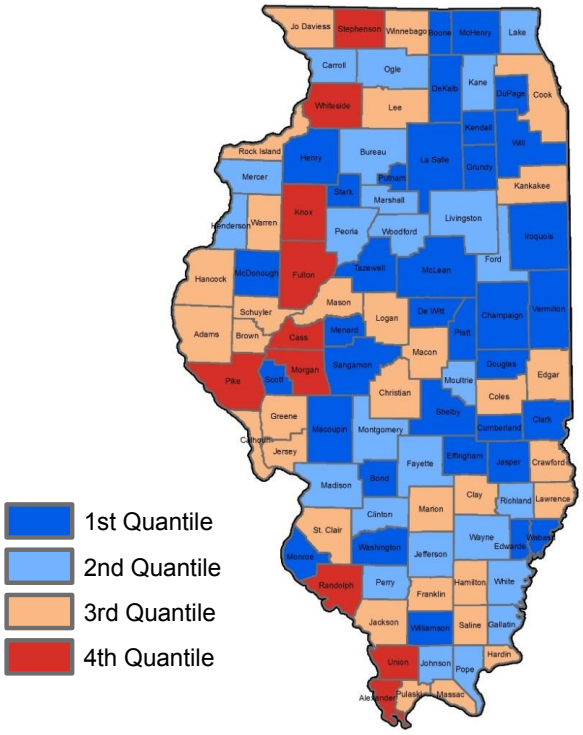
Nursing homes

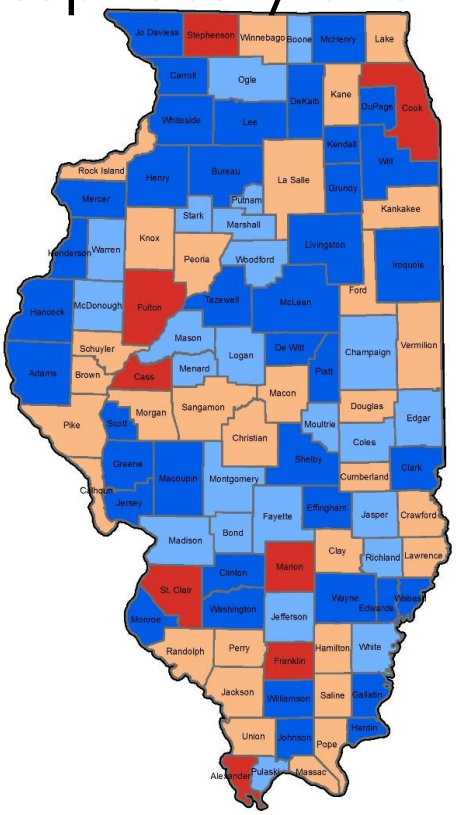


SVI + Flood + Nursing Home Overlay

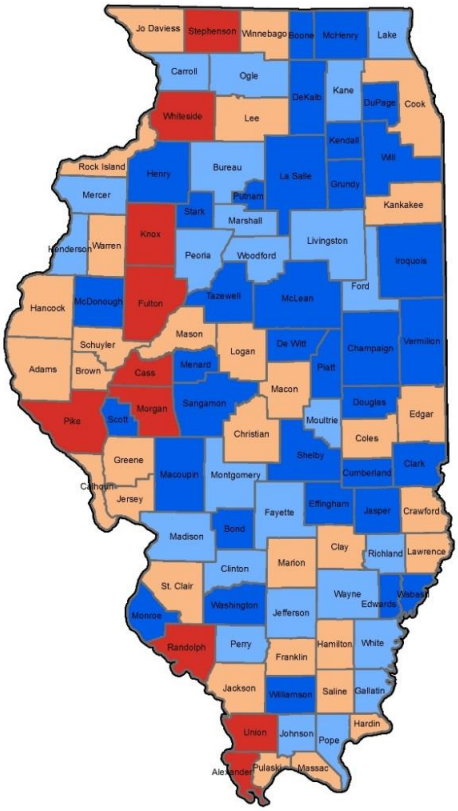


Prioritize, target counties/regions for specific adaptation efforts

Respiratory overlay



Flooding overlay



Summer Heat Tool Kit

Illinois Department of PUBLIC HEALTH

Pat Quinn, Governor
LaMar Hasbrouck, MD, MPH, Director

422 South Fifth Street, Fourth Floor • Springfield, Illinois 62701-1824 • www.idph.state.il.us

Summer Heat Toolkit

Summer weather means barbeques, baseball and parades. It also can mean heat and heat-related illness. Extreme heat can lead to heat rash, heat cramps, heat exhaustion and heat stroke, a condition that can result in death. Extreme heat has caused deaths throughout Illinois, in rural and in urban counties. Projected changes in climate indicate extreme heat events are likely to become more frequent and longer lasting. Local agencies are critical in protecting their communities from environmental hazards like heat. To strengthen existing heat illness prevention efforts, included are some strategies and tools that local health departments (LHDs) and/or local emergency management agencies (EMAs) can use during the summer to protect the communities they serve. These include: 1) monitoring information about excessive heat messages from the National Weather Service, 2) actions based on the National Weather Service messages, 3) sample communication messages and 4) sources for additional information.

Summer Heat Tool Kit

- Sample Press Release
- Sample Media Messages

Heat-related illness is preventable. Stay cool, stay hydrated, and stay informed!

Stay hydrated! Don't wait until you're thirsty to drink.

Stay cool! Reschedule or plan outdoor activities during cooler parts of the day.

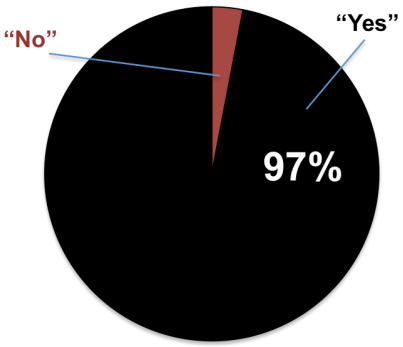
Other adaptations

- Cooling centers for heat
- Outreach to the most vulnerable (for heat, flooding)
- Education about ozone
- Education about vectorborne disease
- Education, training about mental health before/during/after disasters
- Improving preparedness planning for disasters

Before policies can be implemented: US public opinion

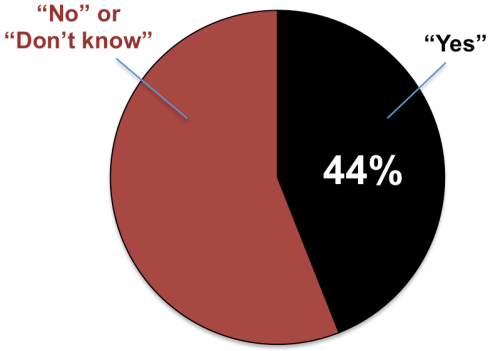
Is Global Warming Happening and Mostly Human Caused?

Climate Scientists[1] say…



[1]Proportion of peer-reviewed papers that stated a position on the reality of human-caused global warming and said it is happening and human caused (Cook et. al, 2013).

The American Public[2] says…



[2]Question asked of Americans (18+): Assuming global warming is happening, do you think it is caused mostly by human activities; caused mostly by natural changes in the environment; other; none of the above because global warming isn't happening."

Base: Americans 18+ (n=1,013). April, 2014.

YALE PROJECT ON CLIMATE CHANGE COMMUNICATION

4C

George Mason University
Center for Climate Change Communication

People's Climate March, NYC September 2014

Not making the connection between climate change and health

	Due to Global Warming…			
	Currently…		**50 Years From Now…**	
	Die each year	Become injured or ill	Die each year	Become injured or ill
	%	%	%	%
Number of people…				
No one	28	27	21	20
Hundreds	11	12	9	7
Thousands	16	16	18	16
Millions	2	4	13	16
Don't Know	42	40	38	39
No answer	1	2	1	2

Worldwide, how many people do you think …

Base: Americans 18+ (n=1,013). April, 2014.

YALE PROJECT ON CLIMATE CHANGE COMMUNICATION
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George Mason University
Center for Climate Change Communication

Conclusions

- The Midwest is getting warmer and wetter
- Changes in climate impact health
- Two policy responses: Mitigation and Adaptation
- Protecting the health of the public requires adapting to climate change, especially for vulnerable places and people
- A 'climate literate' public is essential

Questions?

CO_2, ragweed growth: observations in different microclimates

Ziska 2004

- Baltimore university science center
- Suburban park
- Organic farm 50km from Baltimore

Micro-climate characterized along the transect				
Site	CO_2 (µmol mol^{-1})	D Temp (°C)	N Temp (°C)	S Temp (°C)
Rural	385 b	24.6 b	12.9 b	4.3 c
Suburban	401 b	25.9 a	13.1 b	5.1 b
Urban	466 a	26.2 a	16.3 b	6.3 a

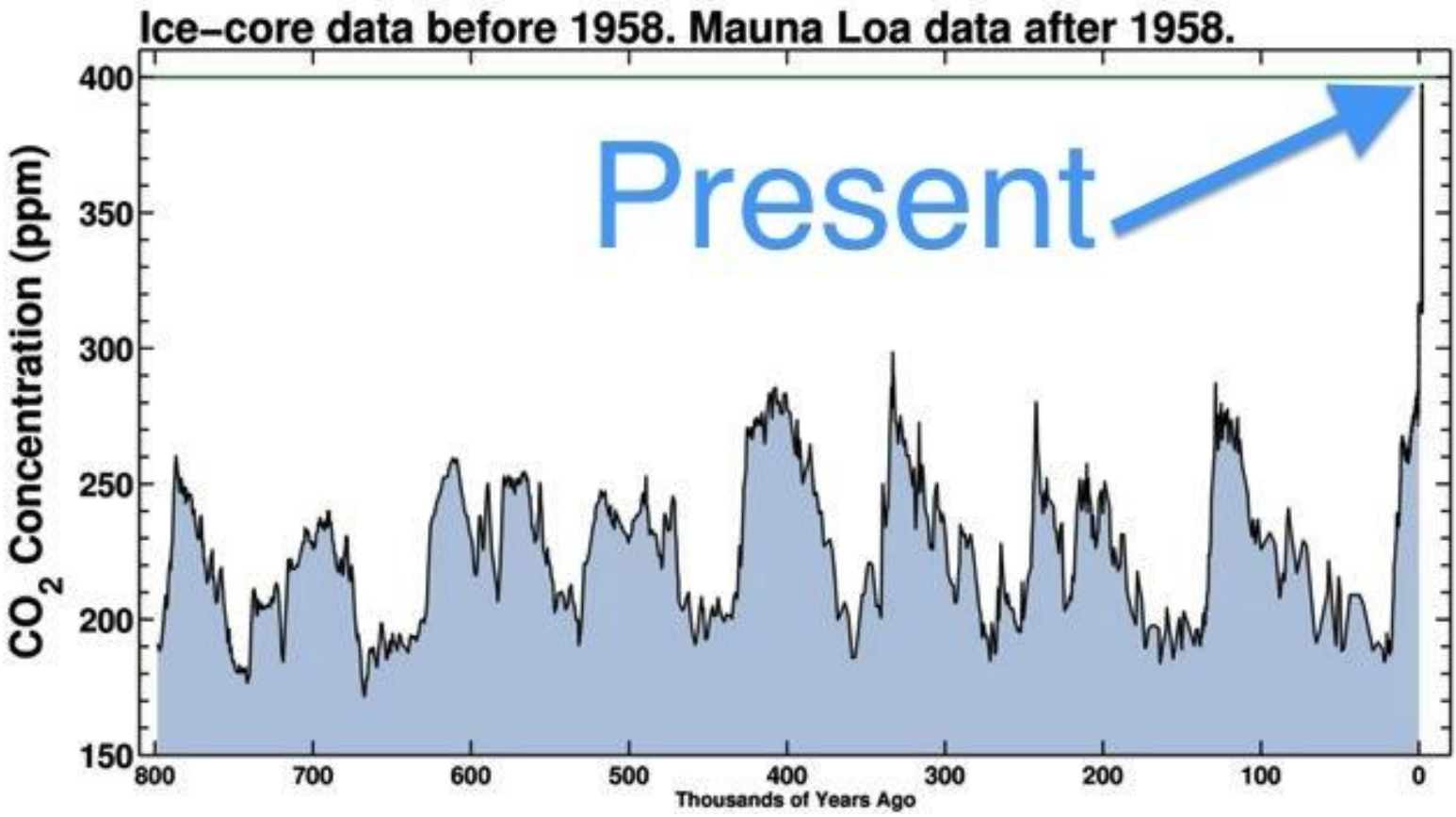
Mental Health: What LHDs can do about

- Train LHD staff and MRC volunteers on psychological first aid
- Triage cases
- Ensure those exposed to a traumatic event are able to receive the help they desire
- Inform people about the likelihood that more people will be exposed to traumatic events from the extreme weather
- Convene different partners to craft and implement solutions to care for those exposed to traumatic events

Vectorborne Diseases:

- Utilize MRC volunteers to provide education on prevention of vector-borne diseases and vector control
- Track diseases and trends
- Classify confirmed and probable cases in an event
- Provide annual community education on prevention of vector-borne diseases
- Test mosquitoes
- Identify ticks
- Vector control
- Identify cases
- Inform people about the likelihood of more vector-borne diseases and seeing ones we haven't seen before
- Educate people how to prevent the spread of some vectors (i.e.,: mosquitoes)
- Educate people how to prevent getting bitten
- Work on promoting ecosystems that reduce vector density

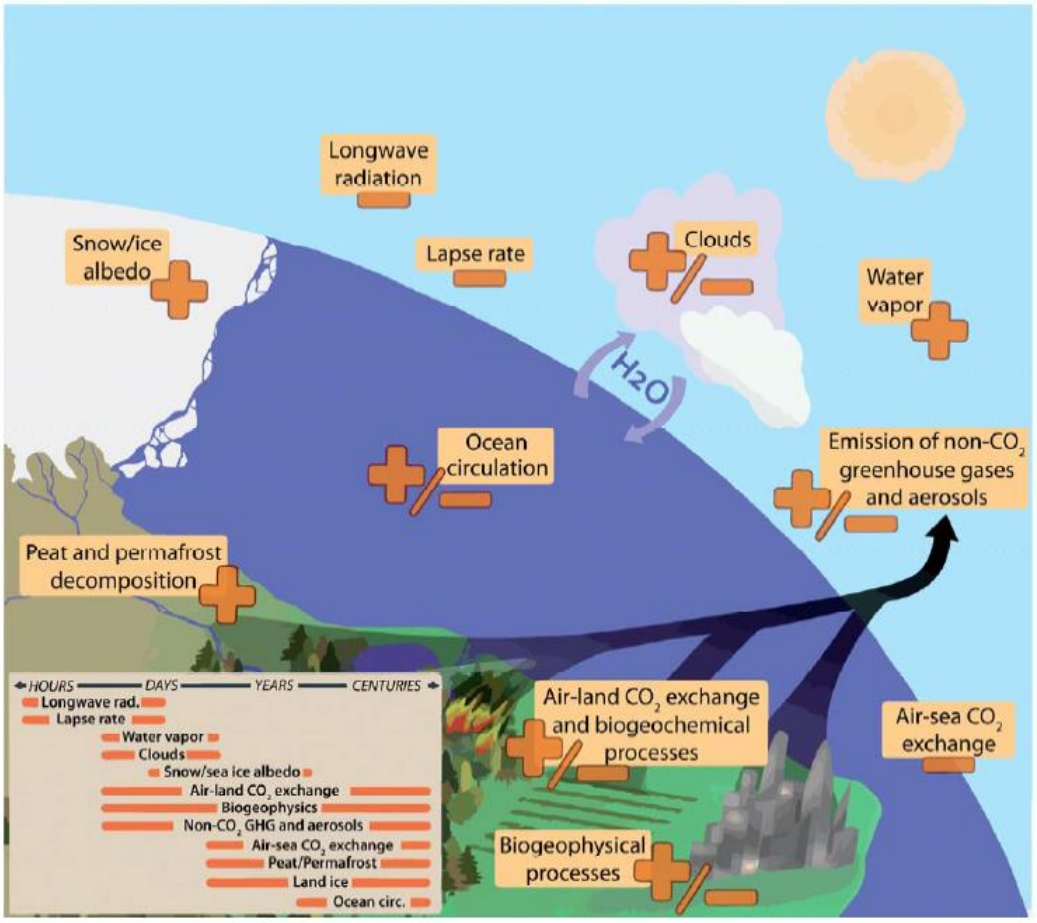
The problem in context



More heat-trapping gases in the atmosphere means more heat, reflected from earth, stays in the atmosphere

Gas	Chemical formula	Lifetime (years)	Global warming potential (GWP) for given time horizon		
			20-yr	100-yr	500-yr
Carbon dioxide	CO_2		1	1	1
Methane	CH_4	12	72	25	7.6
Nitrous Oxide	N_2O	114	289	298	153
CFC-12	CCl_2F_2	100	11,000	10,900	5,200

Climate Feedbacks (from IPCC AR5 WGI)



		Mitigation	
		Favorable	Unfavorable
Adaptation	Favorable		
	Unfavorable		

Two policy responses

MITIGATION

- Reduce carbon dioxide emissions
  - Energy efficient buildings
  - Mass transit
  - Renewable energy sources
- Increase methane capture in 'fracking' operations
- Reduce HFC releases
- Increase forest cover
- Decrease de-forestation
- Actions are local, benefits are not

ADAPTATION

- Sea walls and levees
- Resilient energy grids
- Design capacity of drinking water, wastewater, storm water systems
- Anticipating and preparing for increased demands on public health and health care delivery systems
- Actions are local, benefits are local