Material Prepared by
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Source: NASA

CLIMATE CHANGE AND HUMAN HEALTH

DR PAULSON HAS NO CONFLICTS OF INTEREST TO DISCLOSE.

OBJECTIVES

- Participants will be able to
  - describe some of the causes of climate change
  - explain some of the foreseeable impacts on human health and specific impacts on children
  - recommend lifestyle changes that individuals may make to address climate change
  - discuss the importance of policy change to deal with the problem of climate change

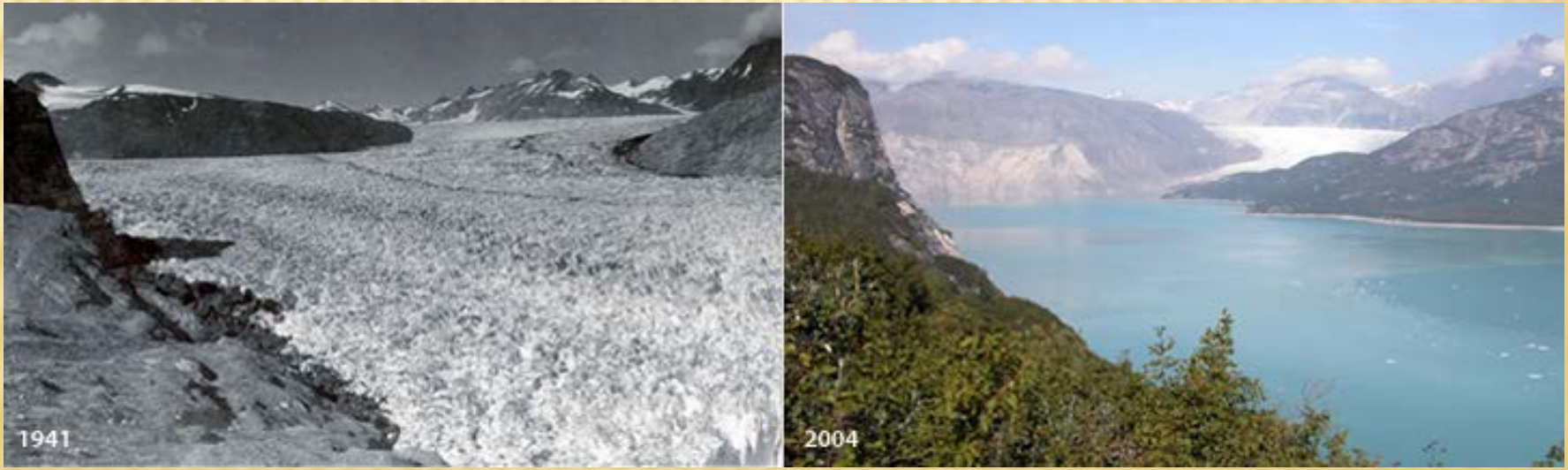
WHAT IS “CLIMATE CHANGE”?

- Climate = average weather over period of time, classically 30 years.
- Highly complex system of interacting components, including earth’s orbit, internal dynamics and external drivers.
- Weather – is it hot/cold, dry/wet, calm/stormy over short period of time

Photograph by Warren Faidley / Weatherstock

WHAT IS "CLIMATE CHANGE"?

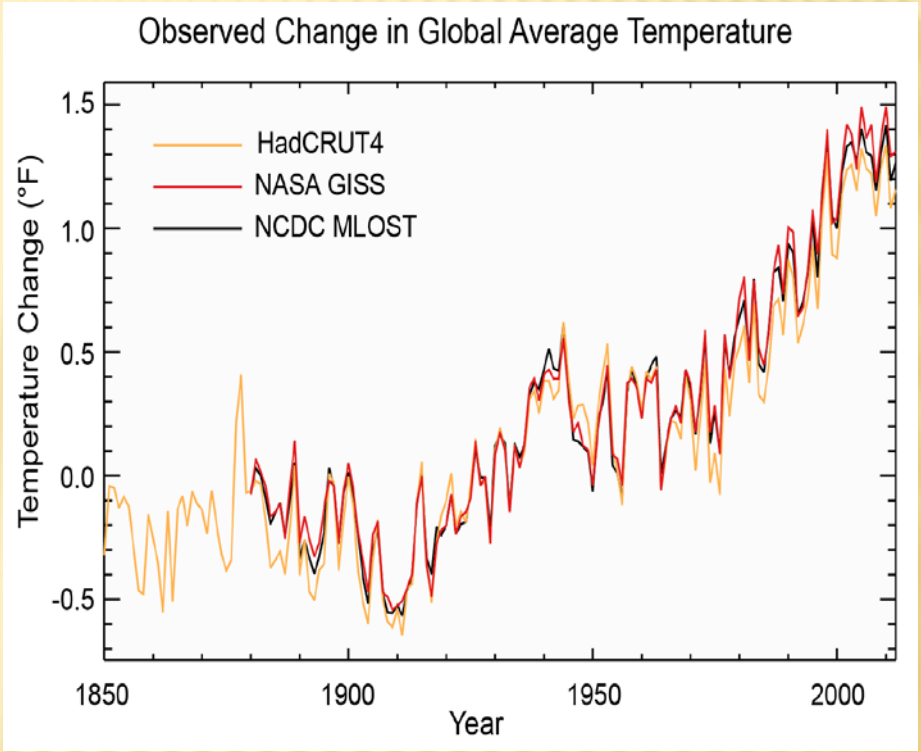
- Has changed throughout Earth's history.
- Last ice age about 14,000 years ago. Gradually warmed over 5,000 years, then stable until about 100 years ago.
- Over past 100 years, global temperature has changed much more rapidly than in the past.



Muir Glacier, Glacier Bay National Park, Alaska. 1941 – 2004. Source: NOAA

CLIMATE CHANGE IS REAL

- Warming of the planet is unequivocal.
- The global average temperature increased 0.85 (0.65-1.06)°C between 1850-2012.
- Much of this increased heat has been absorbed by the ocean.
- 10 warmest years in the instrumental record, with the exception of 1998, have occurred since 2000.
- 2014 hottest year recorded.
- Inertia in the climate system means change will continue for decades after successful control of greenhouse emissions
- Extent of health impacts will depend on our ability to design and



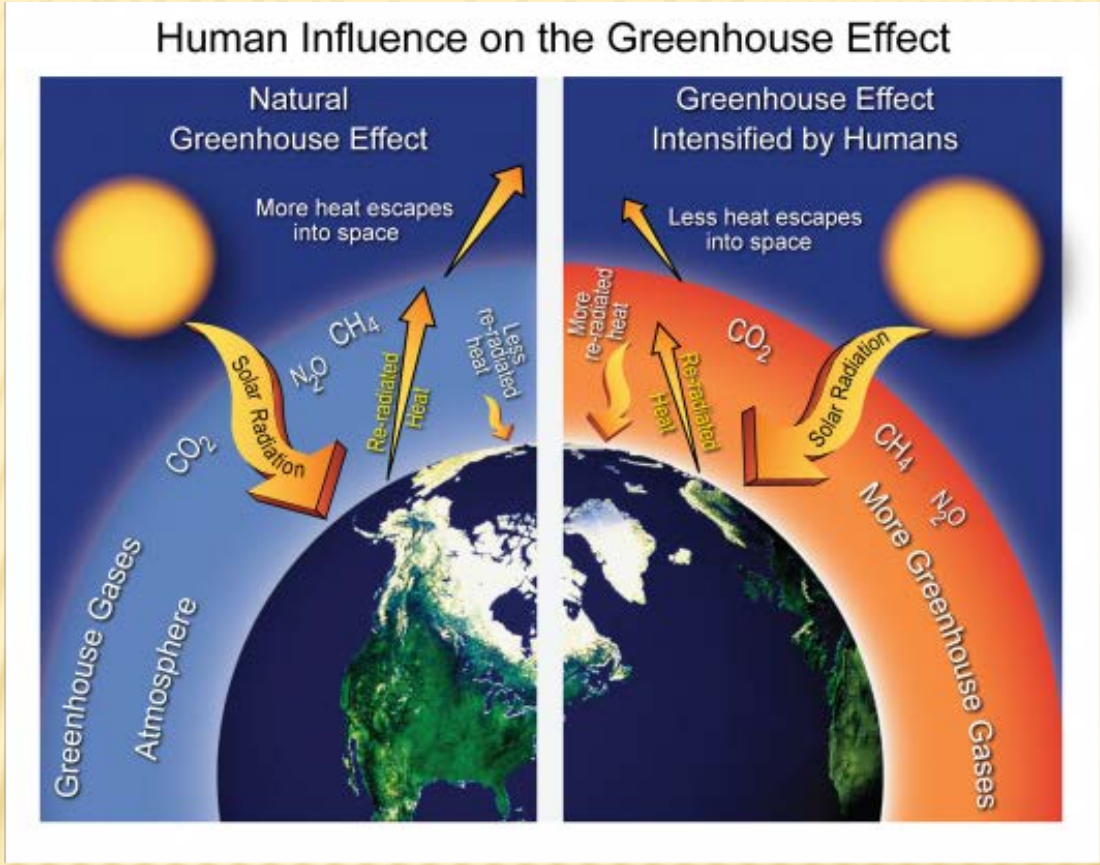
- Source: NCA (NASA/NOAA)

WHAT ARE THE IMPACTS OF CLIMATE CHANGE?

- Rising temperatures are causing broad range of climactic changes:
  - Worsening heat waves
  - Shrinking ice sheets
  - Rising Sea Levels
  - Worsening storms
  - More frequent/severe wildfires.
  - More extreme precipitation events/flood
  - Worsening drought

Image Source: NCA

THE GREENHOUSE EFFECT

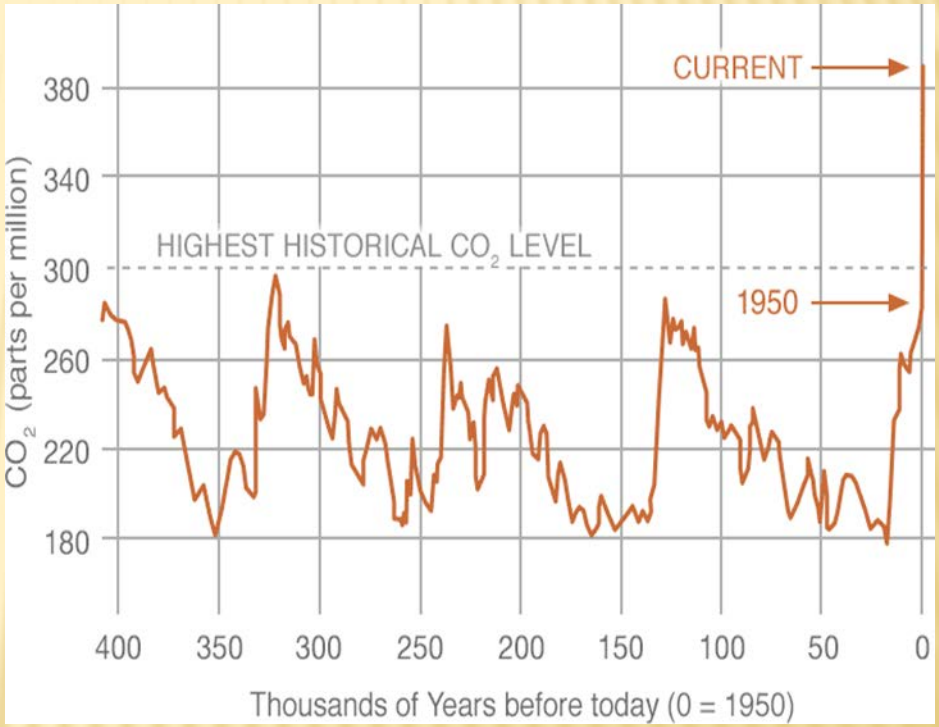


- Greenhouse gases trap heat in our atmosphere. Without them, planet would be ball of ice.
- Increasing concentrations trap more heat, and cause the Earth to warm.

Source: NCA

GREENHOUSE EFFECT & ATMOSPHERIC CO_2

- Burning of coal, oil and gas, and deforestation has led to rapid change in atmospheric CO_2.
- 1900: *about 280 ppm*
- 2013: *hit 400 ppm*



Data from reconstruction from ice cores.
Source: NOAA

CLIMATE CHANGE AND CHILD HEALTH

- Children are the most vulnerable group to climate associated health impacts.
  - Higher minute ventilation
  - Greater volume food & water per unit body wt
  - Physiologic/cognitive immaturity
  - Windows of vulnerability
  - Greater interaction with outdoor environment

- A woman and her baby sit atop a raft as they are rescued from rising floodwater by their neighbors in Pasig City, Manila.
-

CLIMATE CHANGE AND CHILD HEALTH

- Estimated 88% of the existing global burden of disease due to climate change occurs in children under the age of 5. (Zhang, J Environ Health 2007)

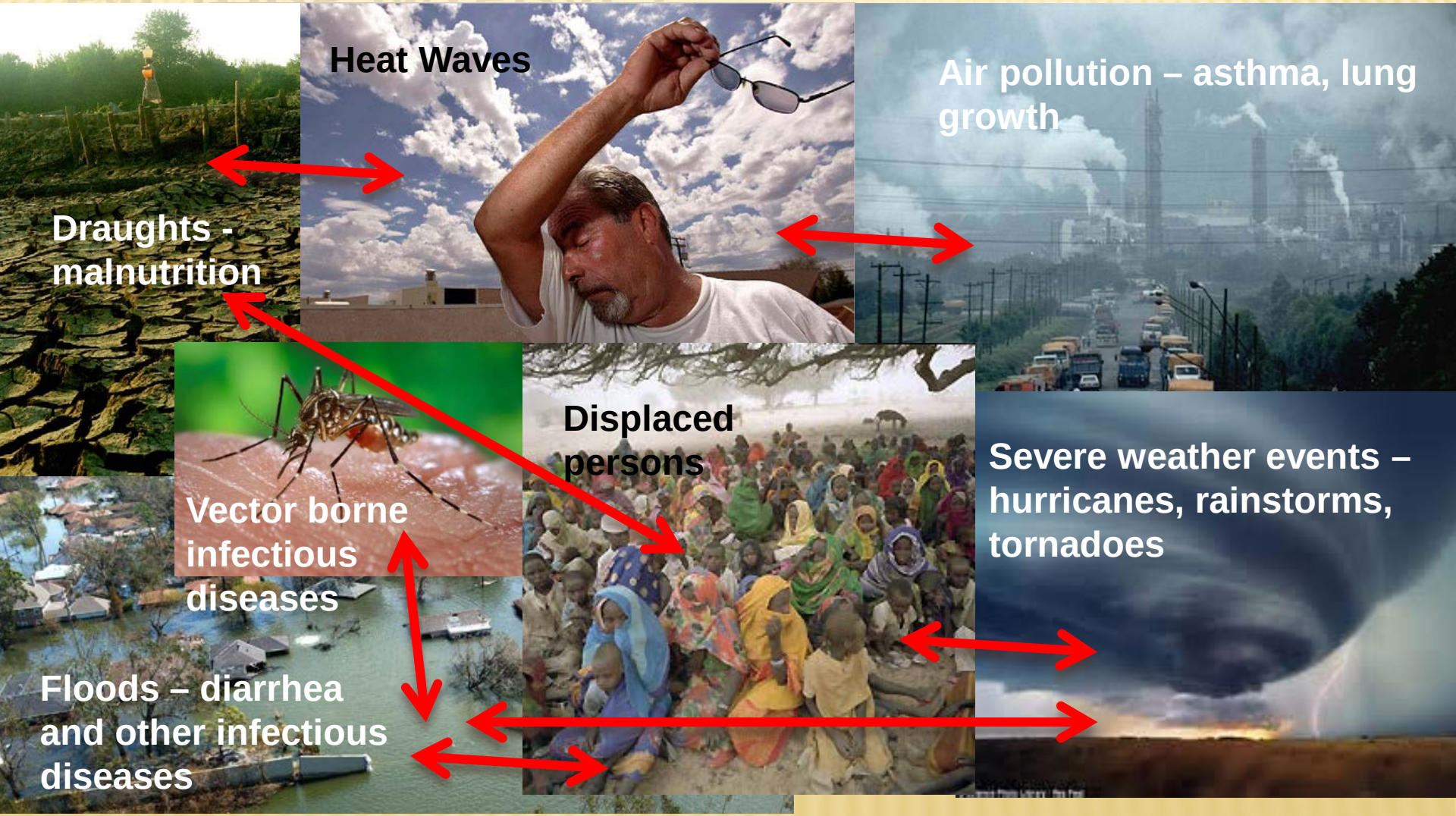
- Children in the world's poorest countries, where the disease burden is already disproportionally high, are most affected by these impacts. (Haines, Lancet 2006)

Save the Children

CLIMATE CHANGE AND HUMAN HEALTH

- Climate change affects human health through:
  1. Increased heat related illness
  2. Impacts on air quality
  3. Altered disease patterns of some climate sensitive infections
  4. Physical and mental health impacts of extreme weather events
  5. Food and water insecurity

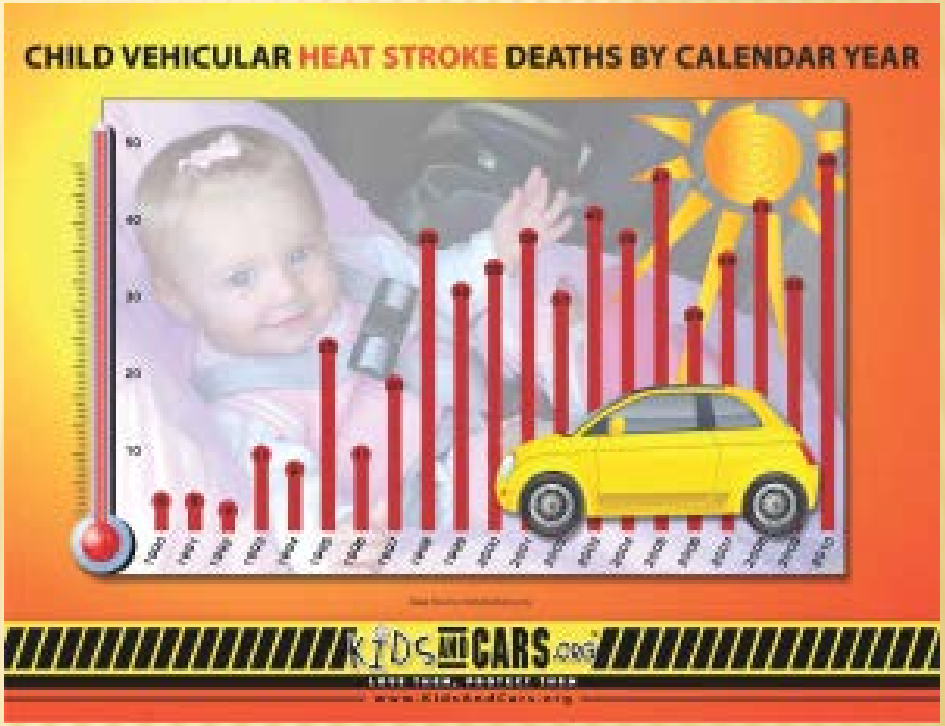
FACTORS INTERACT



http://graphics8.nytimes.com/images/2007/09/07/us/07heat.600.jpg; http://eofdreams.com/data_images/dreams/draught/draught-01.jpg
http://www.greenoptimistic.com/wp-content/uploads/2013/09/air-pollution.jpg; http://myweb.rollins.edu/jsiry/Internally_Displaced_Persons_in_Darfur.jpg
http://www.kmzu.com/wp-content/uploads/2014/03/Severe-Weather.jpg; http://www.ready.gov/sites/default/files/Floods%201.1.1.0%20Tab%202%20of%204_1.jpg; http://wwwnc.cdc.gov/travel/images/aedes-aegypti-mosquito.jpg

INCREASED HEAT ILLNESS

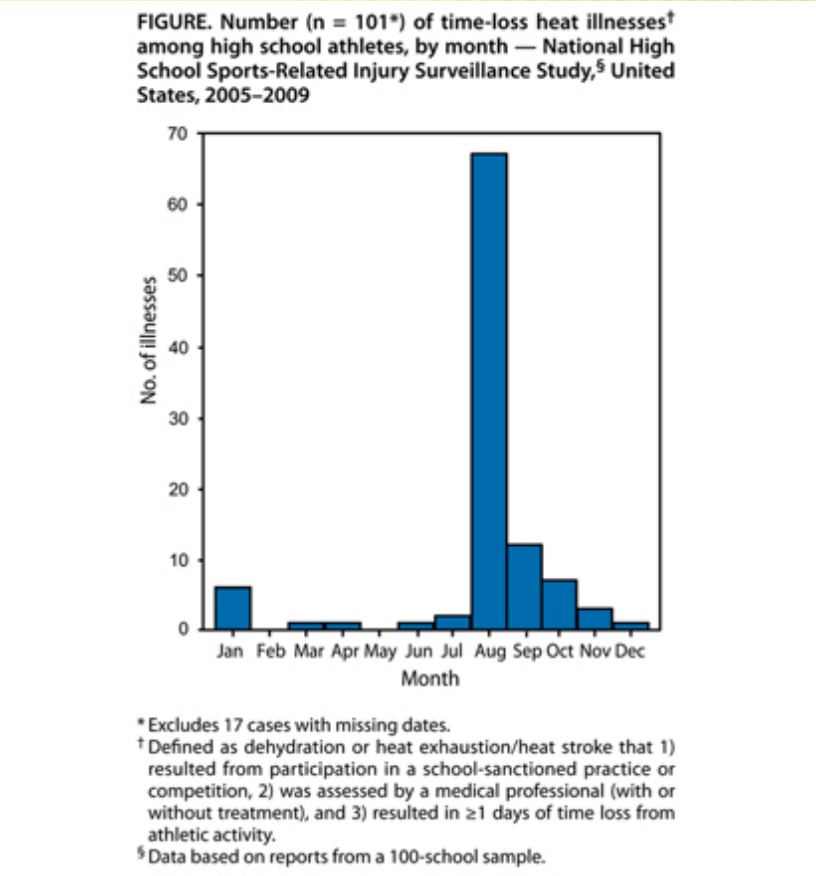
- Extreme heat - leading cause of environmental deaths in the U.S.,
  - Kills more people than hurricanes, lightning, tornadoes or floods combined. (Voorhees, Environ Sci Technol 2011)
- Is “virtually certain” that will be warmer/more frequent hot days/nights this century. (IPCC, WGI 2013)
- Elderly at greatest risk.
- Children at risk
  - Infants < 1 year
  - high school athletes, particularly football players.



http://www.kidsandcars.org/userfiles/dangers/heat-stroke/heat-stroke-fatals-by-year-chart.pdf

HEAT ILLNESS IN U.S STUDENT ATHLETES

- > 1/3 U.S. ED visits for exertional heat injury are in teenage male athletes. (MMWR 2011)
- Heat illness is a leading cause death/disability in high school athletes. >9,000 illnesses/year. (MMWR 2010)



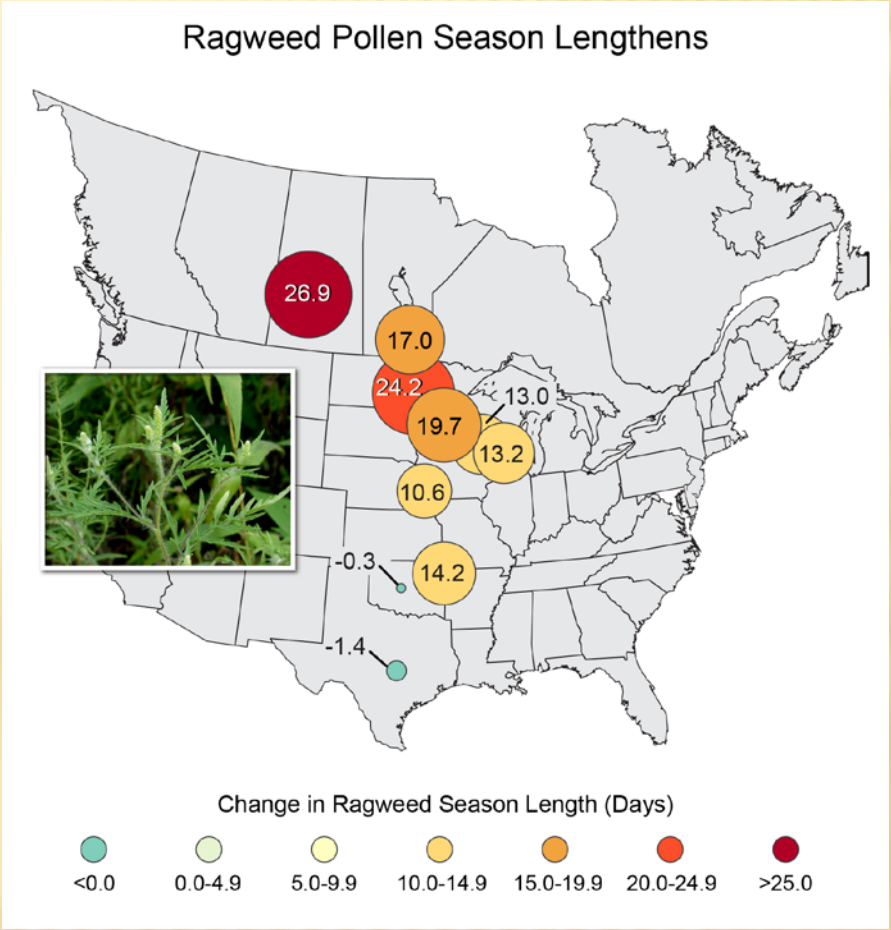
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5932a1.htm

ALLERGIC RHINITIS

- Affected 9% of American children in 2012.
- Climate change impacts allergies through:
  - Delayed First Frost
  - Earlier Spring Thaw
  - Higher atmospheric CO_2 alters plant pollen production.

CLIMATE CHANGE AND ALLERGIC RHINITIS

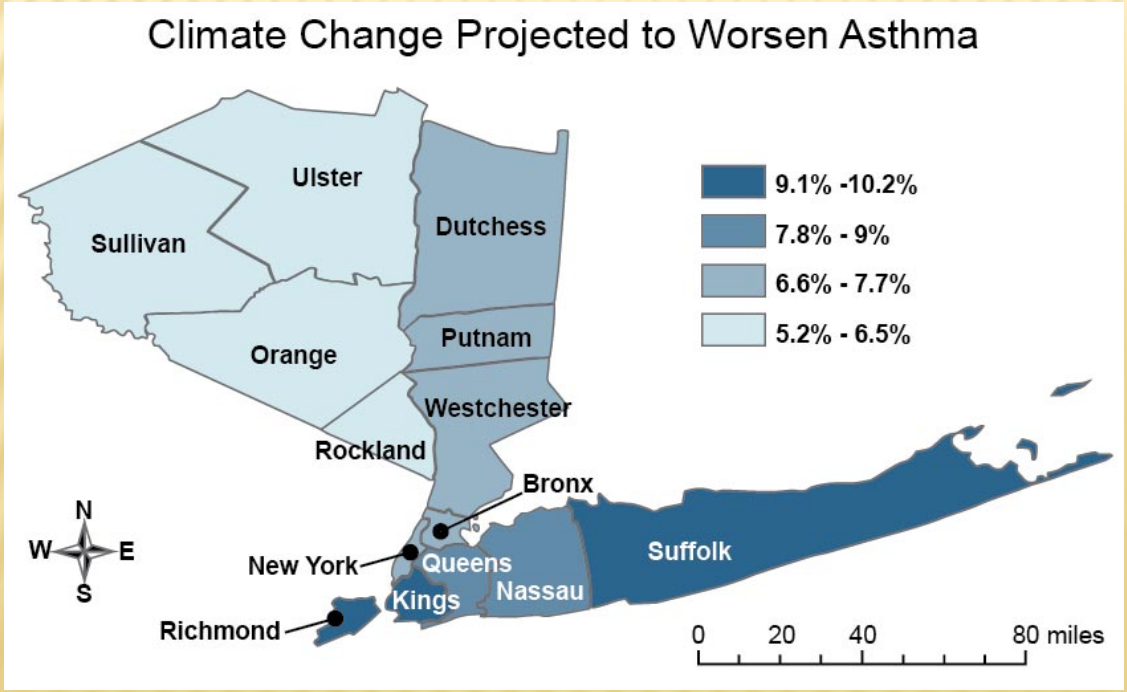
- Ragweed plants produce higher pollen counts when grown in conditions of increased temperature and CO_2. (Singer, *Funct Plant Biol* 2005)
- Plants grown in today's CO_2 concentrations produce about twice as much pollen as in CO_2 of last century. (Ziska , *World Resource Rev* 2000)



http://nca2014.globalchange.gov/report/sectors/human-health#intro-section-2

CLIMATE CHANGE AND ASTHMA

- Climate Change impacts child asthma:
  - Worsening of seasonal allergies.
  - Increased concentrations of ground level ozone.

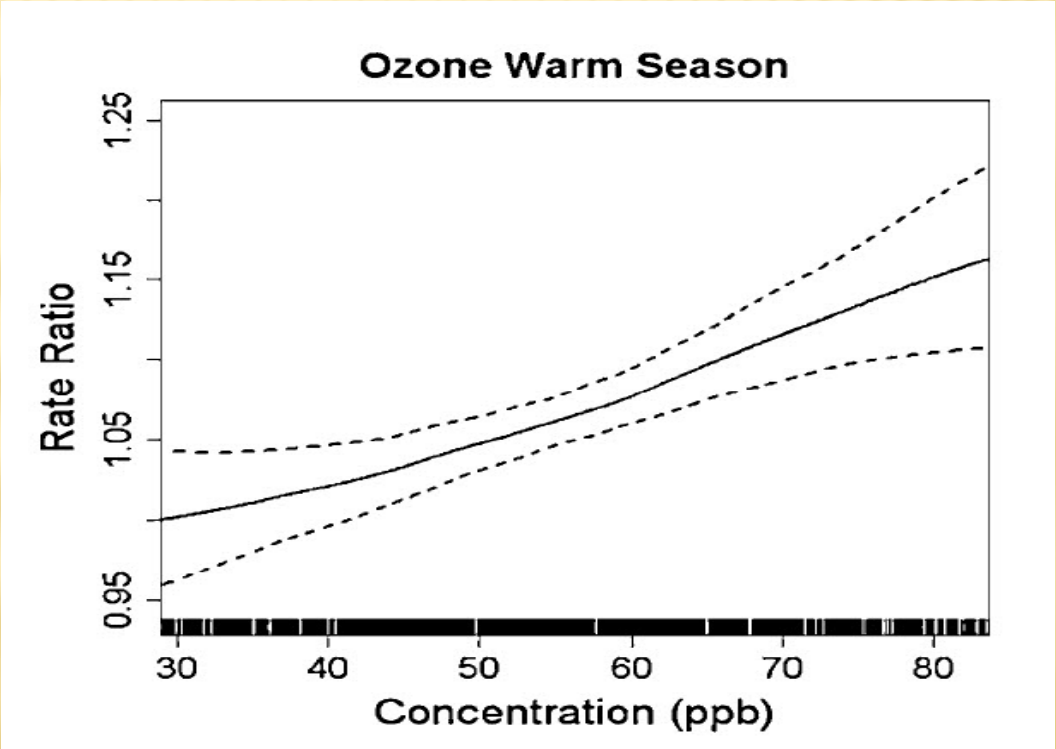


Projected changes in ozone-related emergency room visits for children in New York in the 2020s (compared to the mid-1990s) resulting from climate change related increases in ozone concentrations.

http://nca2014.globalchange.gov/report/sectors/human-health

OZONE AND PEDIATRIC ASTHMA

Dose-response estimate (solid line) and twice-standard error estimates (dashed lines) for association between 3-day moving average of ozone concentration and emergency department visits for pediatric asthma.
*(*Strickland*, Am J Respir Crit Care Med* 2010) (Data from Atlanta Georgia, 1993-2004)



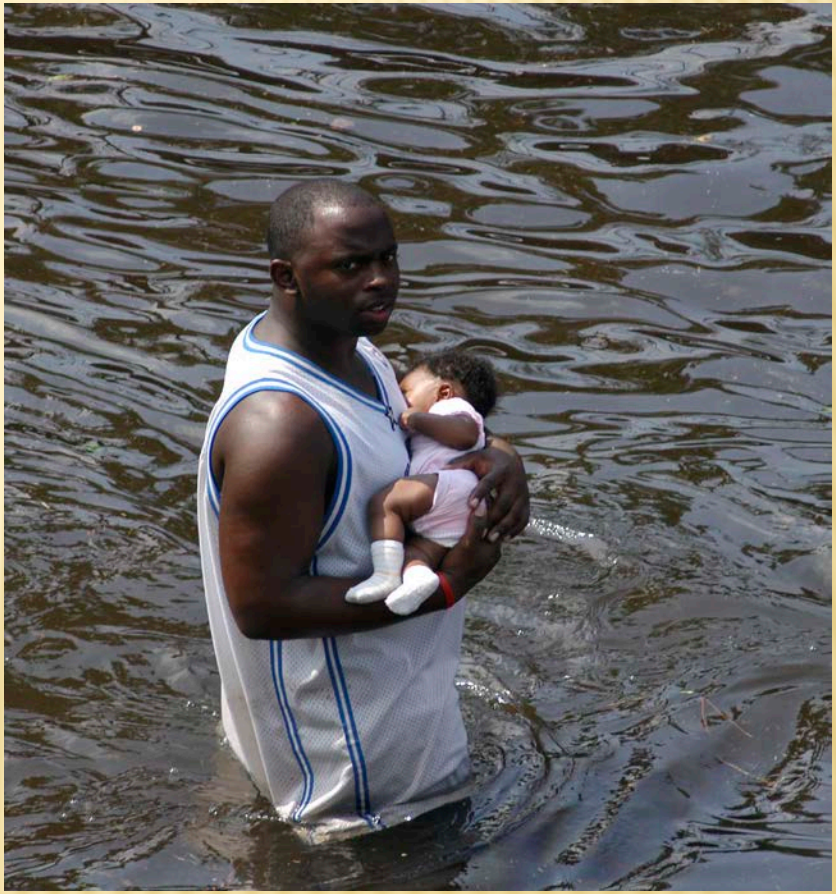
CLIMATE CHANGE AND NATURAL DISASTERS

- Three times as many events occurring between 2000 and 2009 as did between 1980 and 1989.
- The scale has increased, due to deforestation, environmental degradation, urbanization and intensified climate variables. (Leaning, *NEJM* 2013)

A large, intense Hurricane Katrina heading for a Gulf Coast landfall. Katrina was the costliest hurricane to ever hit the US.
Source: NASA

CHILDREN AND NATURAL DISASTERS

- Extreme weather events place children at risk of:
  - Injury and death
  - Loss of /separation from caregivers
  - Exposure to infectious diseases post disaster
  - Uniquely high risk of mental health consequences.



New Orleans, La. (Aug 31, 2005) A man carries a baby through the flooded streets of New Orleans.
U.S. Navy photo (RELEASED)

HURRICANE KATRINA

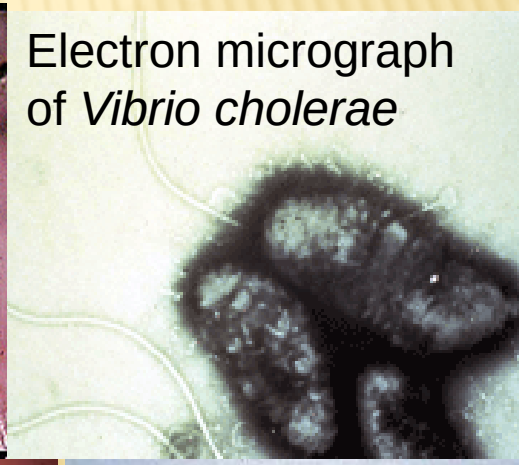
- >5,000 children separated from their families.
- Last child reunited 6 months after the event.
- >34,000 calls made to missing and exploited children hotline.
- 400 children rescued from flooded homes.
- 11,000 children placed in Convention Center/Superdome.
- 200,000-300,000 children evacuated and relocated

Source: The National Center for Missing & Exploited Children/AP

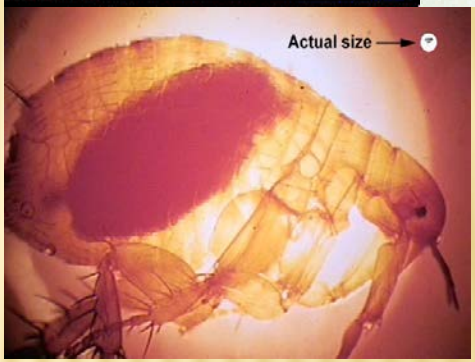
Source: National Commission on Children and Disasters. *2010 Report to the President and Congress*

CLIMATE CHANGE AND INFECTIOUS DISEASES

- Climate sensitive infections include:
  - Diarrheal illness
    - Food and Water-borne
  - Vector borne illness
    - Lyme Disease
    - Dengue Fever, West Nile
  - Emerging Infections
    - Coccioiodomycosis ("Valley Fever")
    - Amebic Meningoencephalitis



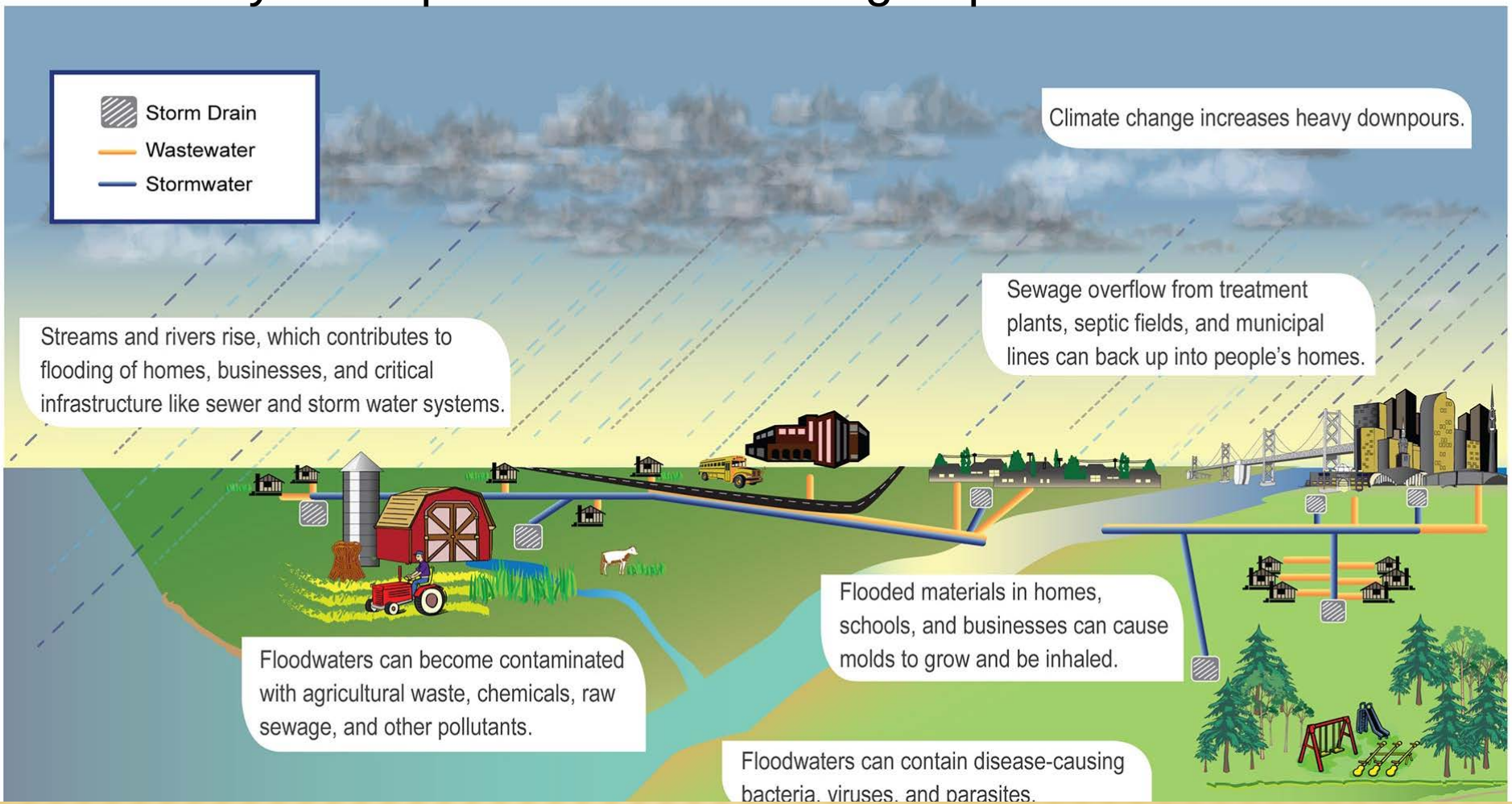
Electron micrograph of *Vibrio cholerae*



Photos from CDC

CLIMATE CHANGE AND DIARRHEA

Heavy Downpours Are Increasing Exposure to Disease



http://nca2014.globalchange.gov/report/sectors/human-health

CLIMATE CHANGE AND DIARRHEA

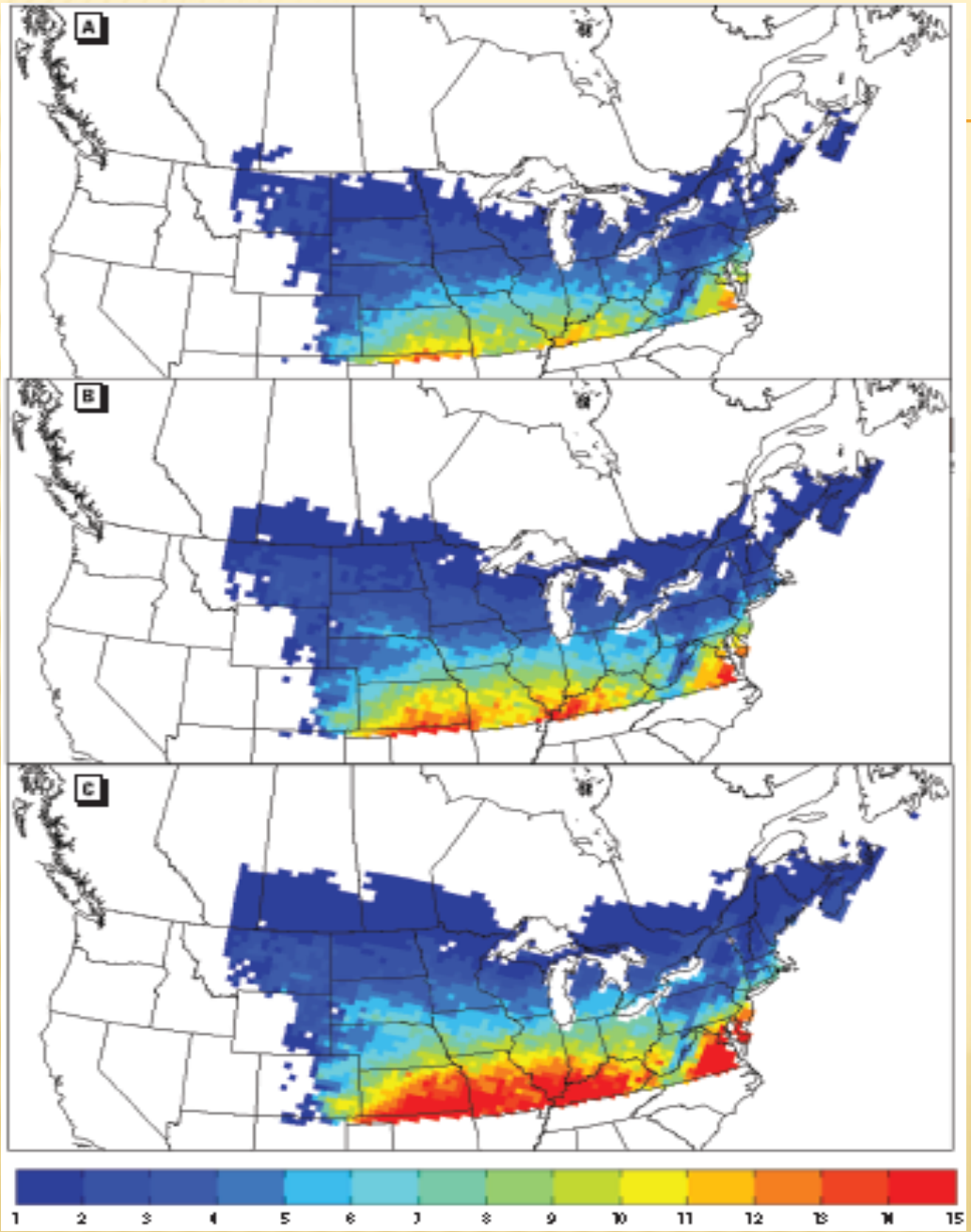
- Leading cause of child mortality across the world, approximately 1.6 million annual deaths in children < 5 years.
- Climate change projected to cause additional 48,000 deaths in children under 15 years due to diarrheal disease in 2030, primarily in Asia and sub-Saharan Africa.

(WHO 2014)

CLIMATE CHANGE AND VECTOR BORNE ILLNESS

phil.cdc.gov

- Multiple confounding variables.
- Impacts of human activities such as land development, time outdoors, air conditioning, self protection.
- Changes in climate influence include habitat suitability and reproductive rate for host, vector, and infectious organism.
- Clearest current conclusion:
  - Plants and animals are moving poleward.
  - They may be bringing diseases with them.



NORTHWARD MOVEMENT OF TICS

Values of basic reproductive number of Ixodes Scapularis in Canada:

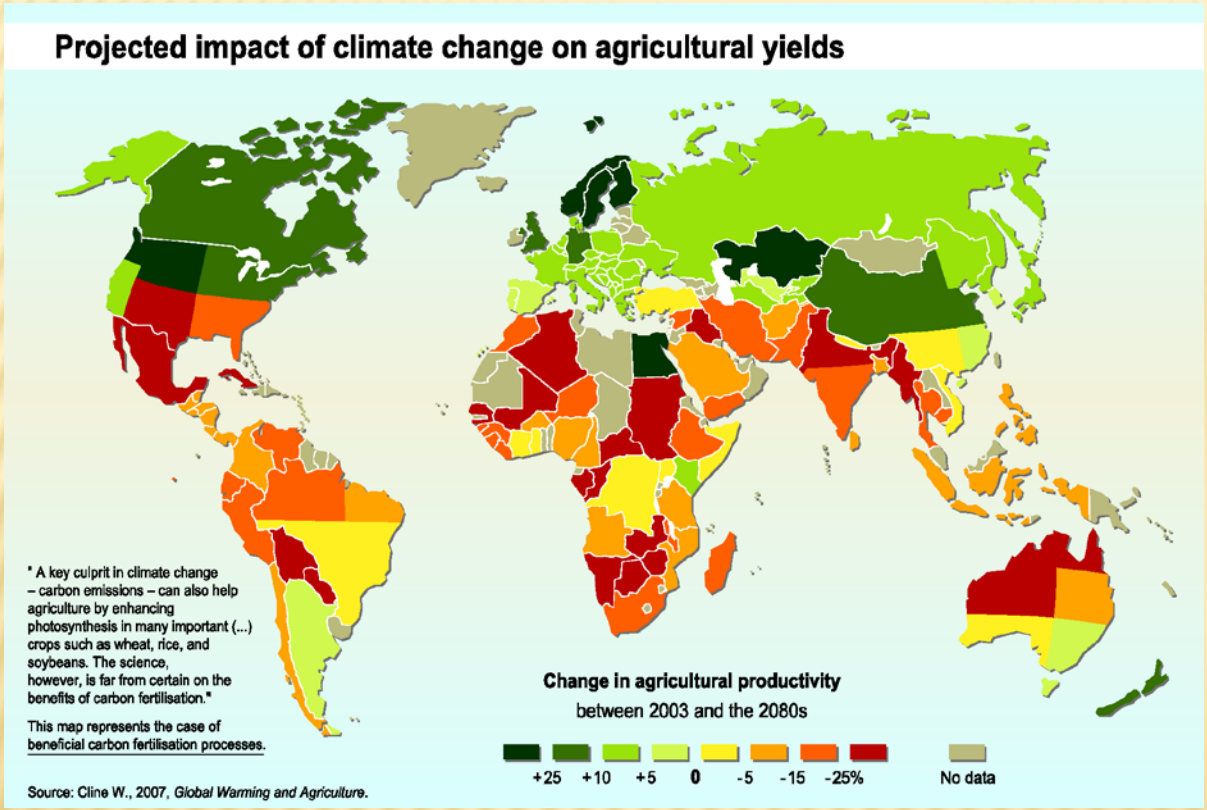
- A) Estimated from observations 1971-2000
- B) Projected for 2011-2040
- C) Projected for 2041-2070

Color scale indicates basic reproductive number (R0).

At threshold temperature, mortality outstrips reproduction and the tick populations die out (or fails to become established).

Source: Ogden, Envir Health Perspect, 2014

CLIMATE CHANGE AND FOOD SECURITY



- Threatens the sufficiency and nutrient quality of the food supply in developing and developed countries.
- Increases risk of food insecurity and child malnutrition.

https://commons.wikimedia.org/wiki/File:Projected_impact_of_climate_change_on_agricultural_yields_by_the_2080s,_compared_to_2003_levels_(Cline,_2007).png

AGRICULTURAL IMPACTS OF CLIMATE CHANGE

1. CO_2 fertilization of crops
2. Water availability, quality
3. Increasing temperature
4. Air pollutants, weeds, pathogens and disease
5. Climate extremes
6. Implementation of adaptation strategies

MALNUTRITION IMPACTS IN DEVELOPING WORLD

- In children < 5 years worldwide, undernutrition annually underlies nearly:
  - 3.1 million deaths
  - 1/3 of global burden disease

Black, Lancet 2008

- Compared to world with no climate change WHO (2014) projects for 2030:
  - Additional 95,000 child deaths due to malnutrition
  - Additional 7.5 million moderate or severely stunted children
  - Mostly in Africa and Asia

NUTRIENT IMPACTS

- Elevated atmospheric CO_2 changes nutrient content of C_3 food crops (wheat, rice and soybeans). Less effect on C_4 crops (maize, sorghum).
- Decreases crop concentration of protein, iron and zinc.
- Exact mechanism is unknown.
- May already be occurring in current crops.

CLIMATE CHANGE WILL WORSEN HEALTH DISPARITIES BETWEEN RICH AND POOR

- Poor housing to begin with, more difficulty replacing housing after severe weather events
- Lack of AC → ↑risk of heat-related death
- Low income – decreased use of AC because of fear of cost
- Increase food insecurity by decreasing crop yield

SUMMARY & CONCLUSIONS

- Climate change is real
- Climate Change is effecting & will effect the life of EVERY human on earth
- Impact will increase over time
- Impact will vary by geography
- Impact will vary by financial status of the region – richer regions have more ability to implement technological adaptations
- Some of the potential impacts of global warming are preventable through changes in policy and in civil society

CLIMATE CHANGE AND HUMAN HEALTH

What is a health care provider to do????

CLIMATE CHANGE AND HUMAN HEALTH

- Public health initiatives have played a tremendous role in child health in the past.
  - *Vaccination Programs*
  - *Water Sanitation Systems*
  - *Tobacco Legislation*
  - *Removal of lead from paint and gasoline*
- **Providers can play unique role in climate change adaptation and mitigation strategies.**

PROVIDERS AND CLIMATE CHANGE

- Promote education about health impacts of climate change in professional schools.
- Reduce the carbon footprint of health facilities, including hospitals, medical offices and transport. Increase efficiency, incorporate renewables, reduce waste, and brag about it.
- Encourage active (walking/biking) /shared and public transportation for office employees, provide incentives.

PROVIDERS AND CLIMATE CHANGE

- Use existing anticipatory guidance framework to discuss climate change with families.
  - Encourage walking/biking as way to promote fitness and reduce emissions.
  - Promote consumption of plant-based proteins to improve cardiovascular health and reduce agricultural pollutants.
  - Discuss with families financial and ecologic benefits of fuel-efficient vehicles and public transportation use.

http://www.nhlbi.nih.gov/health/educational/wecan/images/matte3.jpg

PROVIDERS AND CLIMATE CHANGE

Samantha Ahdoot, MD

http://timesdispatch.mycapture.com/mycapture/folder.asp?event=1543920&CategoryID=20834&view=1

- Become a voice in the climate change debate
  - Advocate for policies that reduce greenhouse gas emissions
  - Educate elected officials on the risks climate change poses to human health.
  - Provide expert testimony. You now know more than they do!
  - Write letters to the editor, Op-Eds, or share related articles on your office Facebook/website

PROVIDERS AND CLIMATE CHANGE

- Help build a broader coalition that will address climate change at local and national level.

  - Advocate for sustainable electricity generating systems.
  - Promote accessible public/active transportation and green spaces in your community.
  - Collaborate with health departments and research facilities to enhance surveillance and reporting of climate sensitive health impacts, and to strengthen disaster preparedness.

CLIMATE CHANGE AND HEALTH RESOURCES

- American Public Health Associationhttps://www.apha.org/topics-and-issues/climate-change
- US Global Change Research Program
  http://www.globalchange.gov
- American Association for the Advancement of Science
  http://whatweknow.aaas.org
- UNICEF- Climate Change and Children
  http://www.unicef-irc.org/publications/pdf/ccc_final_2014.pdf
- WHO Climate Change and Human Health
  http://www.who.int/globalchange/en/
- Lancet Commission on Climate Change and Health
  http://www.thelancet.com/commissions/climate-change
- NASA
  http://climate.nasa.gov
- NOAA
  http://noaa.gov/climate.html


QUESTIONS?
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