



**VIRGINIA CLIMATE
AND HEALTH EDUCATION**
COLLABORATIVE

Climate Changes Health

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New York, NY

May 8, 2021



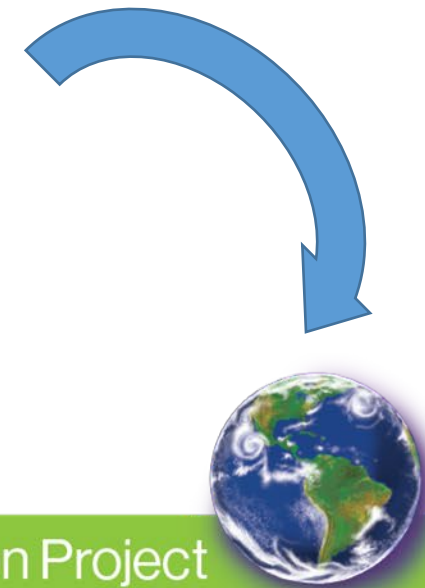
Introducing the Climate Change Curriculum Infusion Project

- Climate change...the greatest threat AND opportunity to health of the 21st century
- New disciplines like planetary health are emerging
- The CCCIP project addresses the gap in medical education linking the global environment to human health



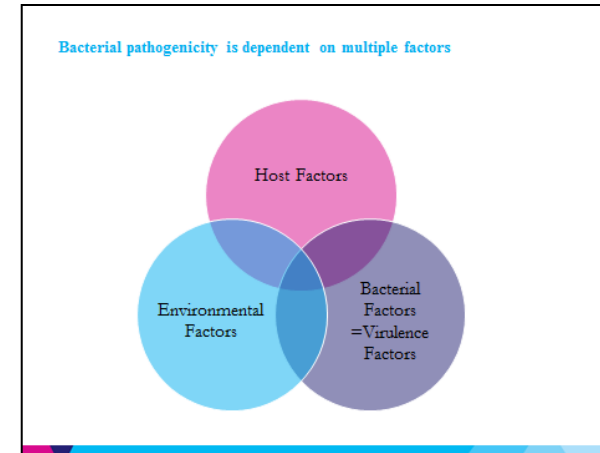
Climate Change Curriculum Infusion Project

- Climate change concepts and specific health examples will enhance existing didactic content
- Unique footer on slides designate content that is part of the CCCIP



How will this work?

Existing content →



Climate and health content added in between →

Climate change, food and farming: 2010s

According to the 2014 Assessment Report of the IPCC, climate change is affecting food and farming now.

It is affecting crop yields
Wheat and other grain crops have declined.

It is putting up prices
Rising crop prices have led to higher food prices.

Tropical regions are most vulnerable
Tropical regions are most vulnerable to climate change.

Four groups are worst affected
The most vulnerable groups are: the poor, women, children, and the elderly.

Adaptation is key to food security
Adaptation is key to food security.

Host Factors: Climate Change, Malnutrition, and Immunocompetence

- Extreme events, such as tropical storms, floods, heatwaves, and droughts can destabilize food supply.
- The Intergovernmental Panel on Climate Change (IPCC) estimates that 100-200 million people may be at risk of hunger as a result of climate change by 2050.
- Malnutrition is the primary cause of immunodeficiency worldwide.

Climate Change Curriculum Infusion Project

Existing content →

Environmental factors

- ▶ Overcrowding
 - e.g. outbreaks in college campuses, military
- ▶ Sanitation and access to clean water
 - cholera
- ▶ Climate
 - e.g. impetigo more common in humid climates

A close-up photograph of a child's face showing several red, crusted lesions characteristic of impetigo.

A small version of the Venn diagram from the first slide, showing the intersection of Host Factors, Environmental Factors, and Bacterial Factors = Virulence Factors.

It's Time for Medical Schools to Introduce Climate Change Into Their Curricula

Caroline Wellbery, MD, PhD, Perry Sheffield, MD, MPH, Kavya Timmireddy, Mona Sarfaty, MD, MPH, Arianne Teherani, PhD, and Robert Fallar, PhD

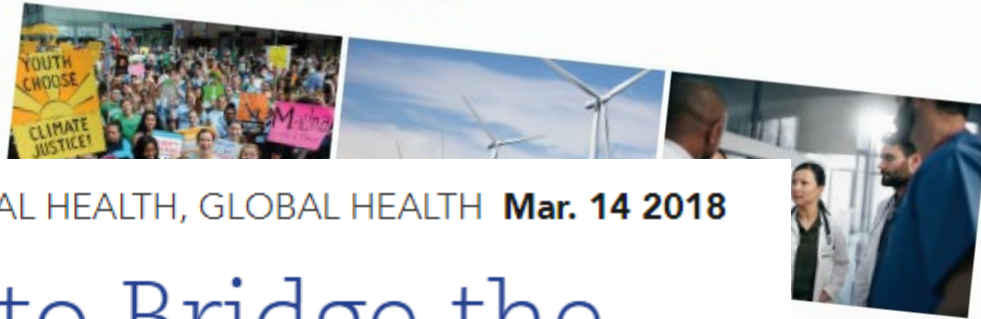
Association of American Medical Colleges (AAMC) supports a database in its Curriculum Inventory (CI) that aggregates institution reported curricular activity and allows queries through specific search terms...

...search indicated that schools do not report any explicit inclusion of climate change education in their curriculum.

Fortunately, many health topic areas already exist in medical school curricula where climate change education can be incorporated into the discussion simply by broadening the horizon within which these topics are taught. The querying of the AAMC's database described above did reveal educational activities that touched on topics of concern to climate change education, including basic disease entities such as asthma and Lyme disease.

Our road map...

Global Consortium on Climate and Health Education



PUBLIC HEALTH EDUCATION, ENVIRONMENTAL HEALTH, GLOBAL HEALTH **Mar. 14 2018**

Guidelines Aim to Bridge the Education Gap on Climate Change and Health

A GLOBAL CONSORTIUM OF HEALTH EDUCATORS AGREE ON A SET OF CORE COMPETENCIES TO EQUIP DOCTORS, NURSES, AND PUBLIC HEALTH PROFESSIONALS TO RESPOND TO CLIMATE CHANGE

The Global Consortium on Climate and Health Education (GCCHE), an international forum for developing curricula related to the health impacts of climate change, has announced a set of core competencies for students of public health, nursing, and medicine.

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educate their
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ther planetary
human health
o provide the
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CC cross walked with med school competencies...



Sampler of CCCIP slides from a selection of courses...

Art & Science of Medicine

Introduction

The Social Determinants of Health & Climate Change

What does **structural racism** have to do with **climate change** and **health equity**?



In 2014, researchers conducted a survey of Black physician members of the National Medication Association (NMA)¹, who care for a disproportionately high number of Black patients

- 86% said that climate change was relevant to direct patient care
- 61% said that their own patients were already being harmed by climate change

Most commonly occurring climate-related health issues:

- injuries due to severe weather (88%)
- air pollution-related increases in severity of chronic disease (88%)
- increased allergic symptoms (80%)
- heat-related effects (75%)

“I had a patient who had a severe respiratory infection. His family had the same infection. They were housebound due to Hurricane Sandy. This delayed their medical care.”

“Extreme weather (heat and dry climate) causing heat strokes and brush fires, with subsequent smog (and) worsening of asthma symptoms”

“In New Orleans there are a lot of patient’s who experience severe symptoms from asthma. This was a prevalent concern since we are surrounded by two large bodies of water. However following Katrina and it’s damage now mold has become an unwelcome presence in a lot of patient’s lives.”

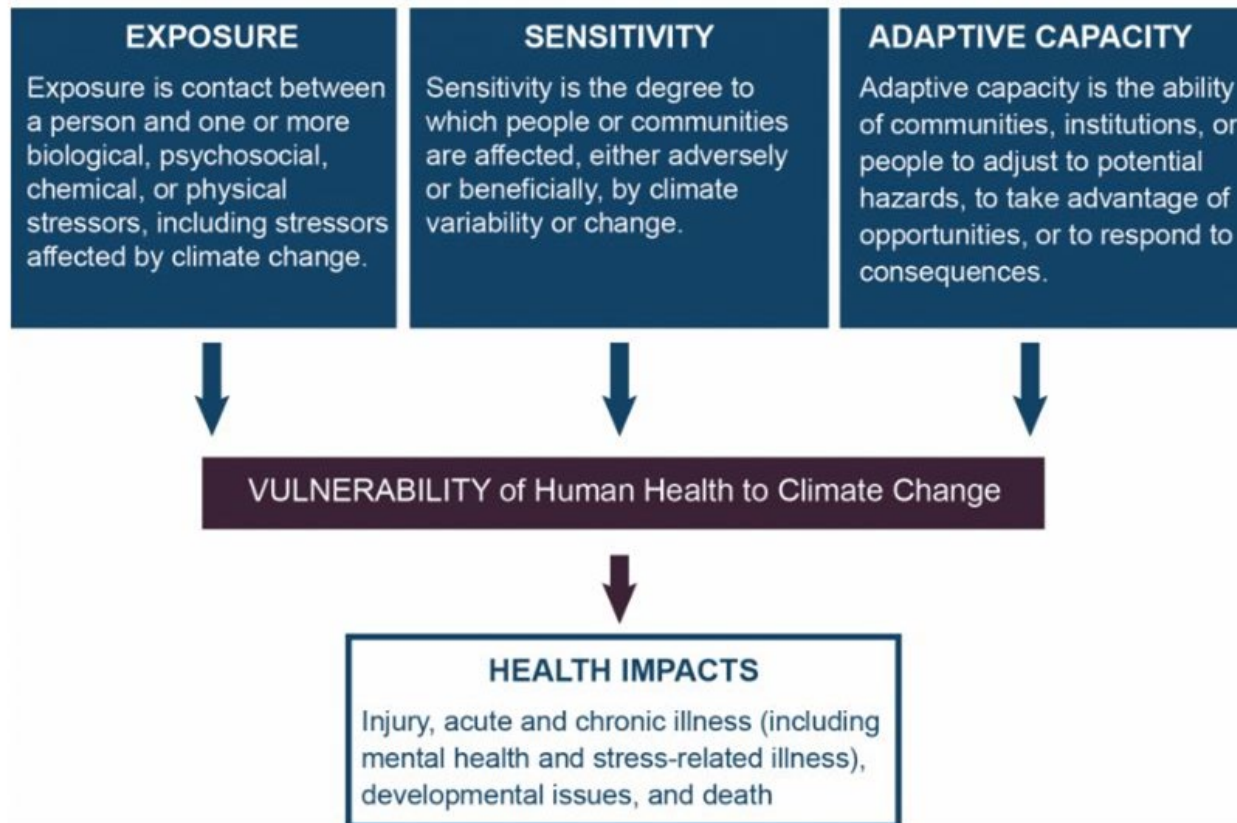
“Weather related increases in COPD exacerbation, cardiac failure exacerbations, Sickle crises, asthma...”

“My patient experienced atrocities during hurricane Katrina. As a result, she had PTSD and severe depression that prevented her from holding a stable job. I do believe that with climate change and global warming, we should expect more hurricanes of Katrina’s severity and such resultant mental health issues.”

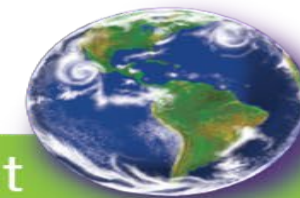


For reflection:

Consider these Determinants of Vulnerability to the health impacts of climate change.²



Why might the patients of the physicians in the NMA survey carry a high vulnerability burden?



Structural racism exposes Black patients to a high burden of climate and environmental risk factors which adversely affect maternal and fetal outcomes

Correlations disproportionately strong for Black patients:

- Heat exposure and risk of preterm birth
- Air pollution exposure and risk of low birth weight

Exposure is high in majority-Black zip codes

Heat exposure:

intra-urban heat islands and heat injuries during summer months track with historical redlining

Air pollution exposure:

air quality and respiratory illnesses track with deliberate placement of industrial plants and transportation depots

The New York Times

Climate Change Tied to Pregnancy Risks, Affecting Black Mothers Most

Original Investigation | Environmental Health

June 18, 2020

Association of Air Pollution and Heat Exposure With Preterm Birth, Low Birth Weight, and Stillbirth in the US

A Systematic Review

Bruce Bekkar, MD¹; Susan Pacheco, MD²; Rupa Basu, PhD^{3,4}; et al

“Climate change is not the Great Equalizer. It is the Great Multiplier.”

*-Mary Annaïse Heglar,
Climate Journalist*



What does **structural racism** have to do with **climate change** and **health equity**?

FLOODING

Exposures and Impacts

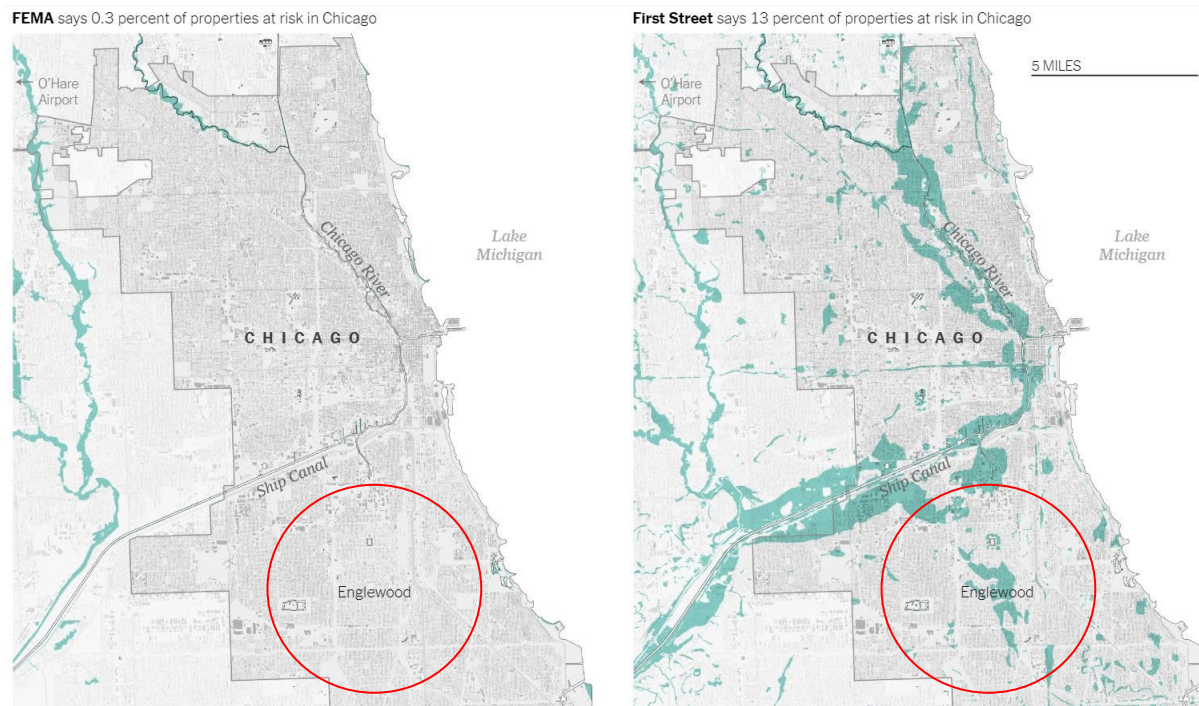


FEMA flood maps: systemic neglect and exposure to flood-related health risks

An independent 2020 study⁴ revealed hidden flood risk across the U.S. which FEMA had failed to identify.

In $\frac{2}{3}$ of states, the burden of hidden risk fell disproportionately on communities of color.

Example: Chicago neighborhood of Englewood



<https://drrobertbullard.com/>

*When you start peeling the onion and uncovering layers and layers of inequity that have been **subsidized by government**, it makes a lot of people uncomfortable.*

-Dr. Robert Bullard, "The Father of Environmental Justice"



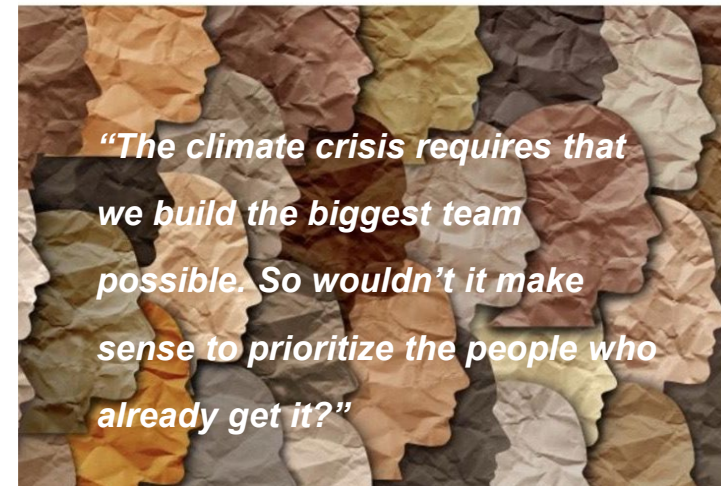
References

1. Sarfaty M, Mitchell M, Bloodhart B, Maibach E. A Survey of African American Physicians on the Health Effects of Climate Change. *Int J Environ Res Public Health*. 2014;11(12):12473-12485. doi:10.3390/ijerph111212473
2. Gamble J, Balbus J, Berger M et al. Ch. 9: Populations of Concern. Health2016.globalchange.gov. <https://health2016.globalchange.gov/populations-concern#figure-138>. Published 2016. Accessed August 10, 2020.
3. Hoffman J, Shandas V, Pendleton N. The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas. *Climate*. 2020;8(1):12. doi:10.3390/cli8010012
4. First Street Foundation. *The First National Flood Risk Assessment: Defining America's Growing Risk*. 1st Street Foundation, Inc.; 2020. https://assets.firststreet.org/uploads/2020/06/first_street_foundation__first_national_flood_risk_assessment.pdf. Accessed August 10, 2020.
5. 10128, New York | Flood Factor. Flood Factor. https://floodfactor.com/zip/10128/10128_fsid. Published 2020. Accessed August 10, 2020.

We Can't Solve the Climate Crisis Unless Black Lives Matter

BY **AYANA ELIZABETH JOHNSON**

JULY 9, 2020 6:28 AM EDT



<https://time.com/5864705/climate-change-black-lives-matter/>



Art & Science of Medicine

The Patient as a Person:
Obtaining an Effective Social
History

Social History: Vulnerable Patient Populations

Thinking about environmental factors:

○ Heat waves/Extreme cold

- Do you have enough air conditioning and heat?
- Do you work outdoors?
- Do you have trouble paying the fuel bill in winter or electric bills in summer?
- Do you have someone you could call if it feels too hot or too cold in your home?

○ Disasters

- Is your home vulnerable to flooding?
- If you have life support equipment, are you registered with the electric utility?

DAILY NEWS

19 dead in New York City during scorching summer heat wave

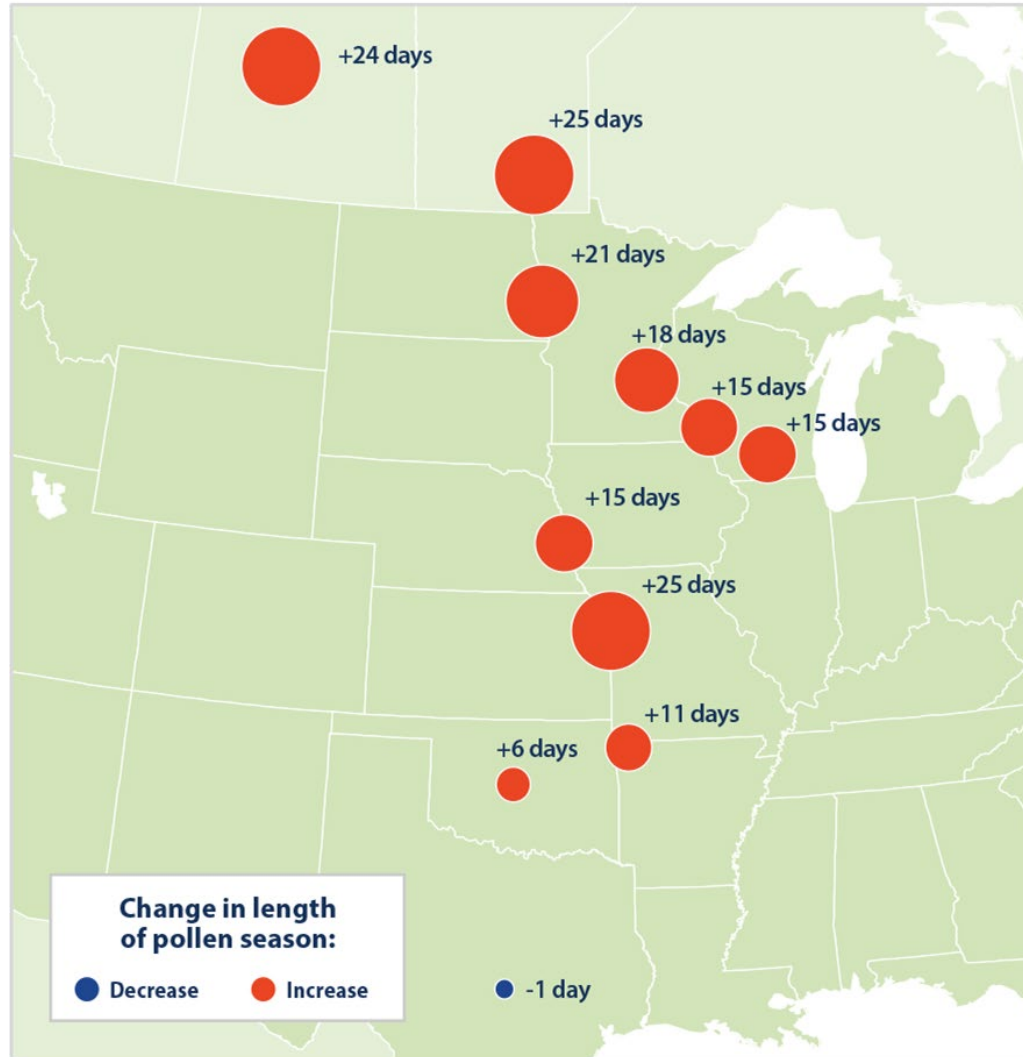
SEP 01, 2011



Immunology

Lecture: Immunology of Allergic
Responses

Change in Ragweed Pollen Season, 1995–2015



Data source: Ziska, L., K. Knowlton, C. Rogers, National Allergy Bureau, Aerobiology Research Laboratories, Canada. 2016 update to data originally published in: Ziska, L., K. Knowlton, C. Rogers, D. Dalan, N. Tierney, M. Elder, W. Filley, J. Shropshire, L.B. Ford, C. Hedberg, P. Fleetwood, K.T. Hovanky, T. Kavanaugh, G. Fulford, R.F. Vrtis, J.A. Patz, J. Portnoy, F. Coates, L. Bielory, and D. Frenz. 2011. Recent warming by latitude associated with increased length of ragweed pollen season in central North America. *P Natl. Acad. Sci. USA* 108:4248–4251.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Allergies and Climate Change

- Ragweed is the primary allergen trigger of fall hay fever.
- Ragweed grows faster, produces more pollen per plant, and has higher allergenic content under increased carbon dioxide levels. (Ziska and Caulfield, 2000)
- More airborne allergens could mean more asthma attacks.



Medical Microbiology

Lecture: Bacterial biology,
mechanisms

Host Factors: Climate Change, Malnutrition, and Immunocompetence

- Extreme weather can destabilize food supply and high CO2 can decrease nutritional content
- 200 million may be at risk of hunger and zinc deficiency by 2050 (IPCC 2013 and Myers et al Lancet GH 2015)...
- Both are major contributors to immunodeficiency and diarrhea and pneumonia morbidity.

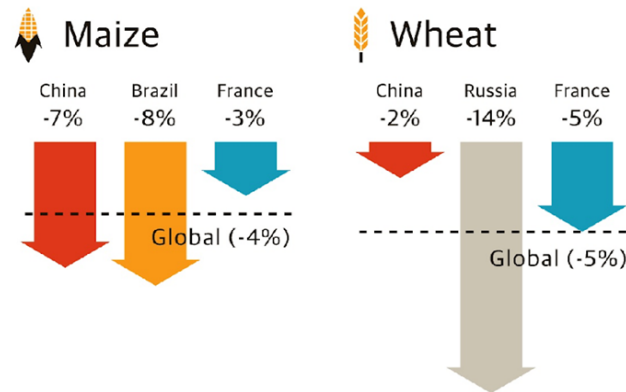
Climate change, food and farming: 2010s

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It is affecting crop yields

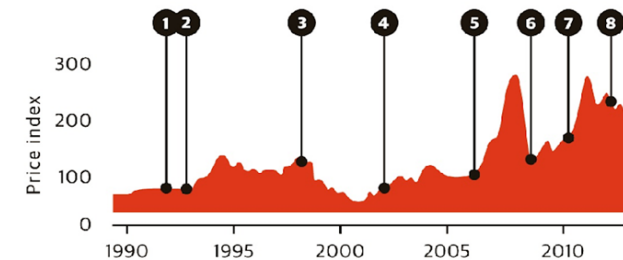
Maize and wheat yields show climate impacts



It is putting up prices

Recent price spikes for food have been linked to extreme weather events

SEASONAL CLIMATE EXTREMES AND THE FOOD PRICE INDEX

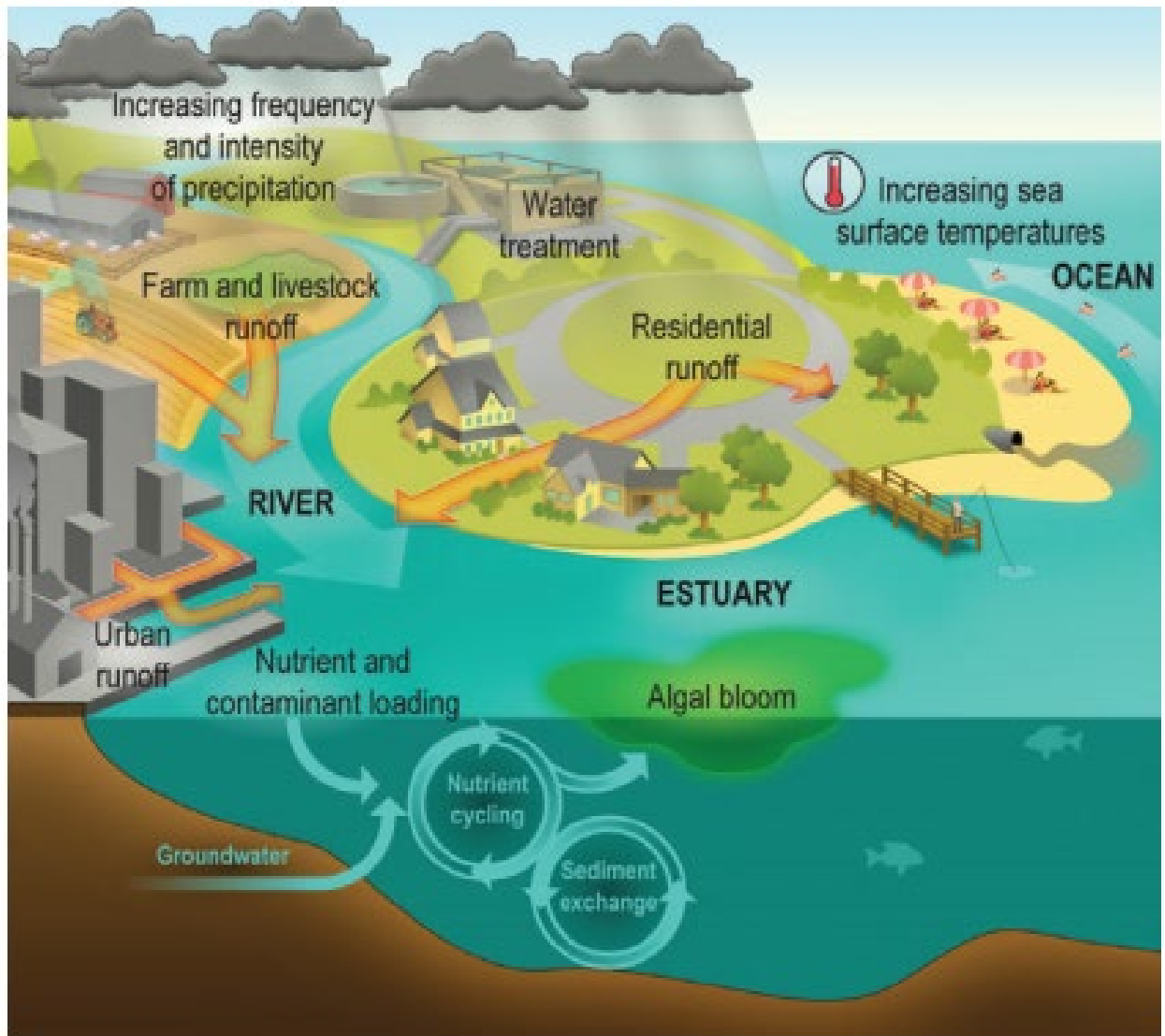


1. Australia wheat. 2. US maize. 3. Russia wheat. 4. US wheat, India soy, Australia wheat. 5. Australia wheat. 6. Argentina maize, soy. 7. Russia wheat. 8. US maize.



Medical Microbiology

Lecture: Other bacterial GI
pathogens



Urban, rural, and agricultural runoff contaminate drinking water, recreational water, and fish/shellfish, especially after more intense precipitation.

As climate changes, the risk of human exposure to water-related pathogens will increase.

For example, the **cholera vibrio** harbors in algae and copepods (a group of small crustaceans), whose proliferation is affected by sea-surface temperature and other environmental factors.

From *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment 2016*



Medical Microbiology

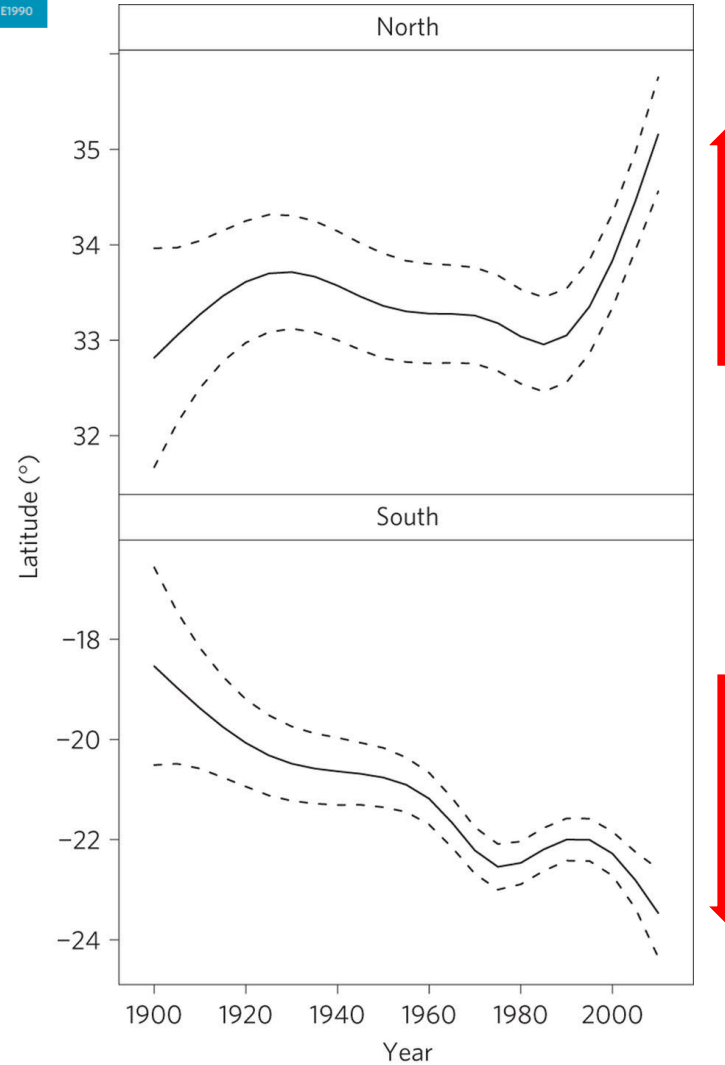
Lecture: Global perspective

Crop pests and pathogens move polewards in a warming world

Daniel P. Bebber¹, Mark A. T. Ramotowski² and Sarah J. Gurr^{1*}

Published observations of 612 crop pests and pathogens:

Fitted values (solid line) and standard errors (dashed lines) derived from generalized additive mixed models of latitude against year of observation.



The observed latitudinal trends in many taxa support the hypothesis of global warming-driven pest movement.



Climate change 'will create world's biggest refugee crisis'

Experts warn refugees could number tens of millions in the next decade, and call for a new legal framework to protect the most vulnerable

Matthew Taylor

Thu 2 Nov 2017
02.01 EDT



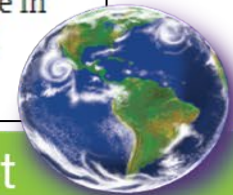
🕒 This article is over 6 months old

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▲ Successive droughts, like those seen in sub-Saharan Africa, could cause millions to migrate to Europe. Photograph: Peter Caton/Tearfund

Tens of millions of people will be forced from their homes by climate change in the next decade, creating the biggest refugee crisis the world has ever seen, according to a new report.



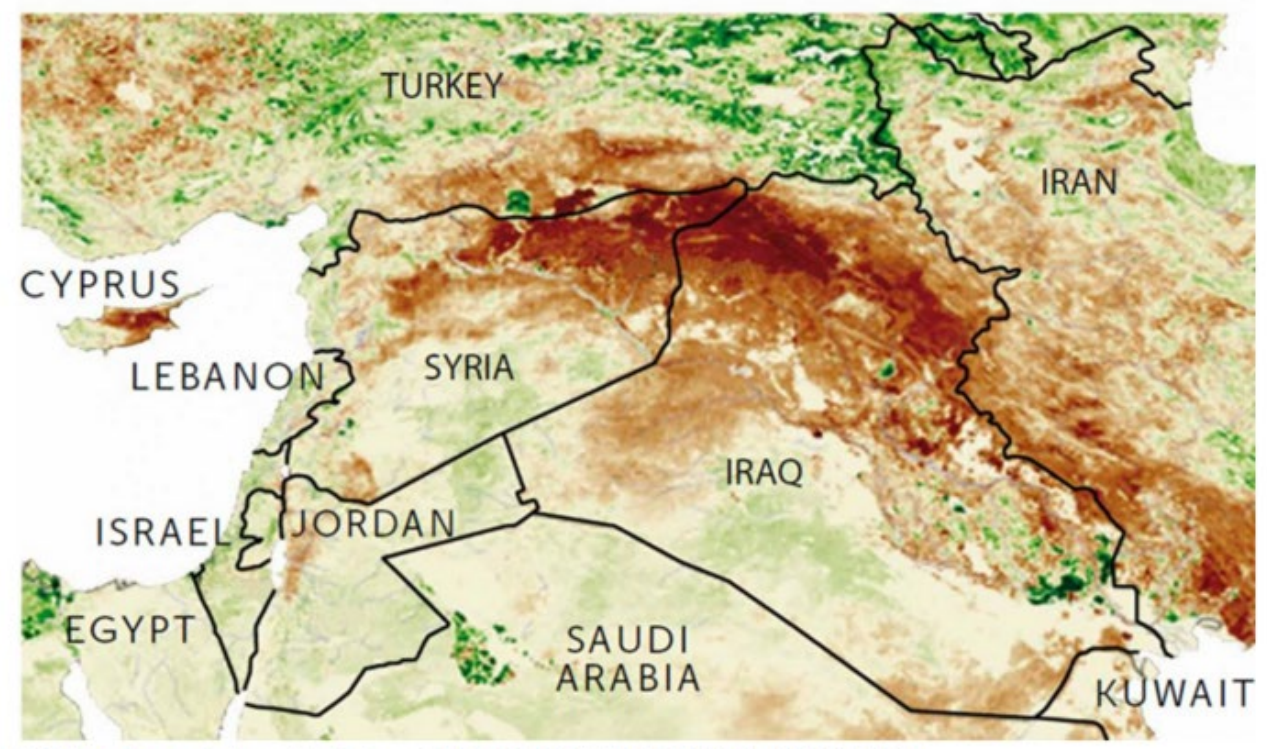
Refugee crisis: Is climate change affecting mass migration?

Beyond the fighting and fanaticism, another long-term threat menaces the world's troubled regions.

Tom Bawden | @BawdenTom | Monday 7 September 2015 | [5 comments](#)

 Brown areas indicate areas where few plants grow and vegetation is scarce

 Green areas indicate areas where vegetation is healthy, foliage is dense and plants are growing quickly



Did [climate change](#) help spark the Syrian war? THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY, NASA



Brain and Behavior

Lectures:

Child Development

ADHD and Autism

Nutritional and Metabolic
Disorders of the CNS

Climate Change and Malnutrition

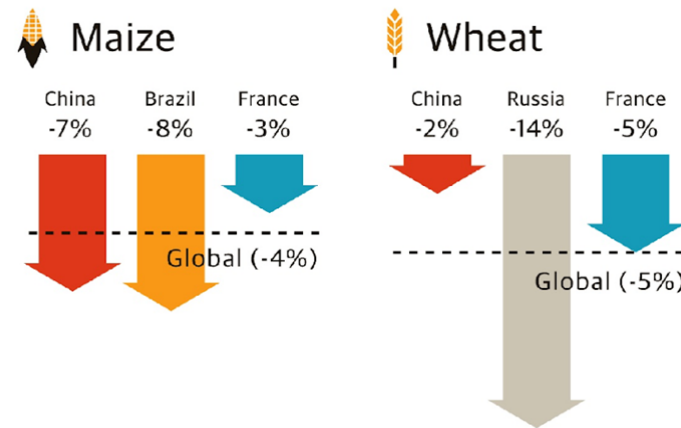
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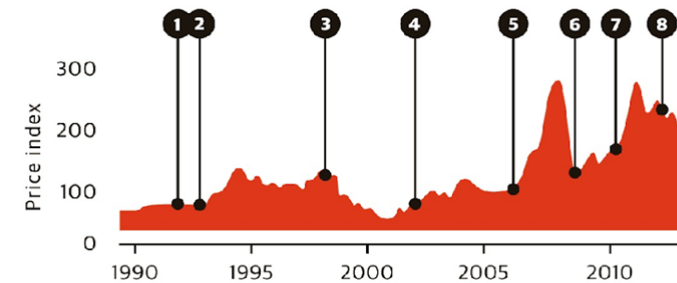
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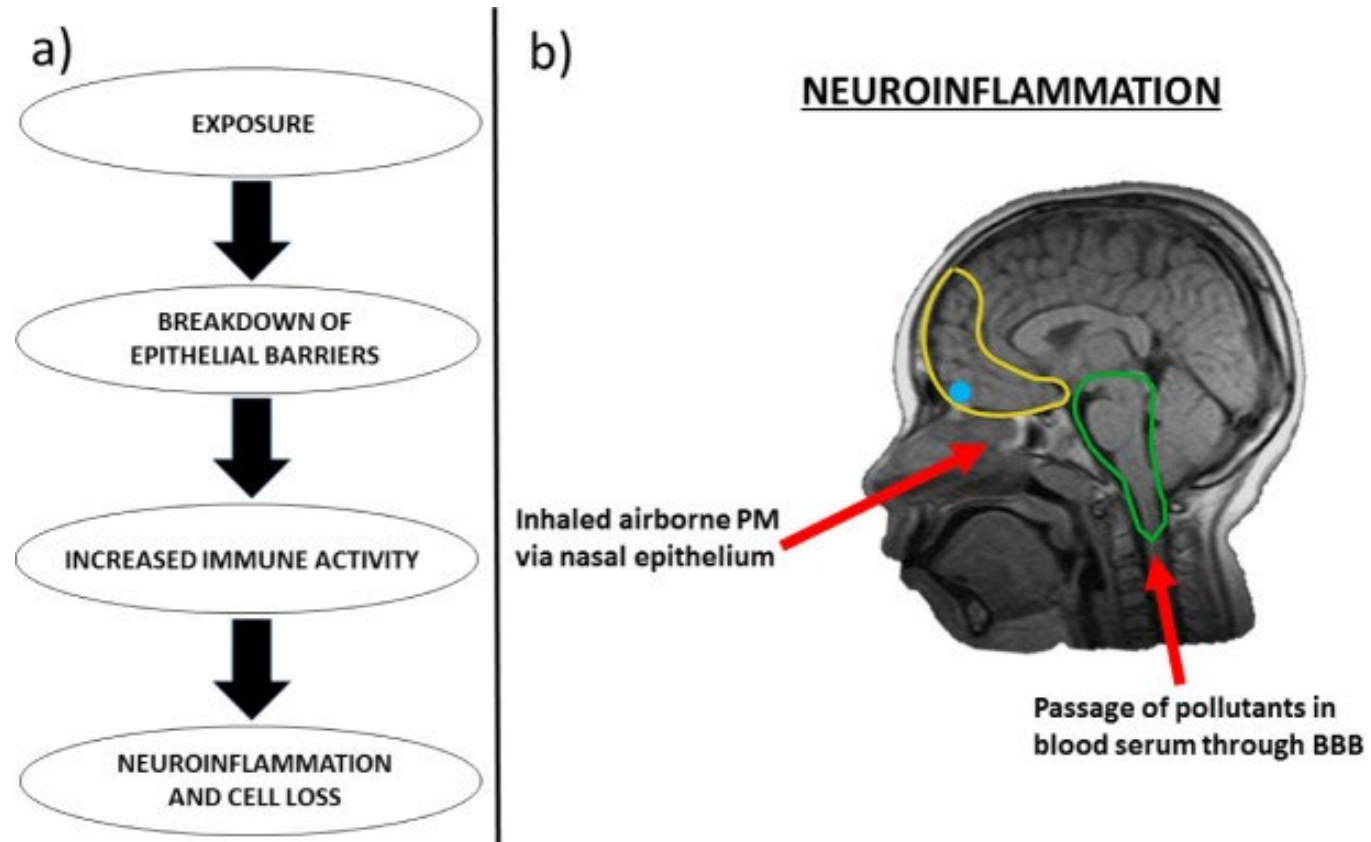


- 1. Australia wheat. 2. US maize. 3. Russia wheat. 4. US wheat, India soy, Australia wheat. 5. Australia wheat. 6. Argentina maize, soy. 7. Russia wheat. 8. US maize.

Extreme weather can destabilize food supply and high CO2 can decrease nutritional content. Changes in rainfall could affect both crop quality and quantity.



Increasing evidence linking air pollution to altered brain development





Brockmeyer S, D'Angiulli A. How air pollution alters brain development: the role of neuroinflammation. *Translational Neuroscience*. 2016;7(1):24-30. doi:10.1515/tnsci-2016-0005.



Original Article | OPEN | Published: 31 January 2017

Particulate air pollutants, APOE alleles and their contributions to cognitive impairment in older women and to amyloidogenesis in experimental models

M Cacciottolo, X Wang, I Driscoll, N Woodward, A Saffari, J Reyes, M L Serre, W Vizuete, C Sioutas, T E Morgan, M Gatz, H C Chui, S A Shumaker, S M Resnick, M A Espeland, C E Finch  & J C Chen 

US wide **cohort study** with 3647 older women with APOE alleles

Women who had the APOE-e4 variant were nearly three times more likely to develop dementia if they were exposed to high levels of air pollution than APOE-e4 carriers who were not.

Animal models

Transgenic mice with APOE exposed to urban nanosized particulate matter (nPM) over 15 weeks showed increased cerebral β -Amyloid deposits and selective atrophy of hippocampal neurites.

In vitro studies

In vitro nPM exposure of neuroblastoma cells increased the pro-amyloidogenic processing of the amyloid precursor protein.



Progress to date...

First Year



Second Year

