How to Conduct Research on the Health Impacts of Climate Change

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OUTLINE

- ***<u>Mechanisms of climate change</u>***
- Climate hazards and health impacts
- Phases of research
- Research examples and challenges
- Final thoughts

Mechanisms of climate change

- Sunlight comes in through atmosphere
- Solar energy absorbed by earth's surface
- Some energy radiated back towards space
- But at a longer wavelength (infrared) than incoming (visible light)
- CO_2, other greenhouse gases absorb some of this infrared energy, limit radiation to space
- Increase in CO_2 by burning fossil fuels
- Increase earth surface temperature

200 years ago (280ppm)

now
410 ppm
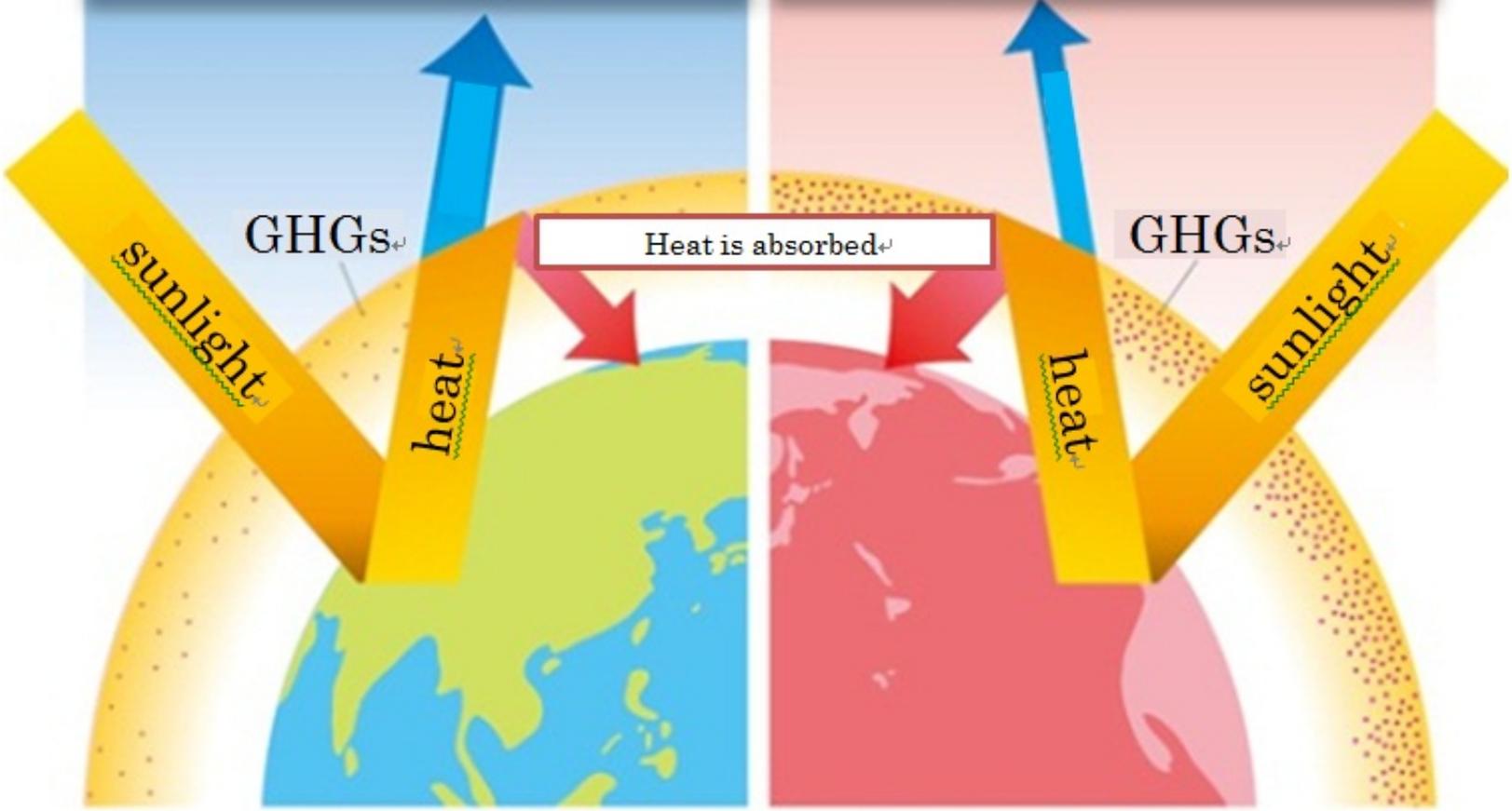
GHGs

Heat is absorbed

sunlight

heat

GHGs

heat

sunlight

Climate change urgency

- Already 1 degree C (2 degrees F)
- May not seem like much but
  - 130 degrees F California desert last summer
  - 5 times more large wildfires in US than 1970s
  - Houston five "500-year storms" in last 5 years
- Certain to increase to 1.5 degrees C (3 F)
- To prevent further increase, need to
  - Cut carbon emissions by 50% by 2030
  - Be carbon neutral by 2050

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Climate hazards & health impacts

- Categories of climate hazards
    - 1. Increased temperature
    - 2. Extreme weather
    - 3. Air pollution
    - 4. Vector-borne diseases
    - 5. Water and food supply
    - 6. Health care systems
   - 7. Society and economy

1. Increased temperature

- Dehydration, fatigue, heatstroke, kidney stones
- Outdoor laborers: kidney disease

2. Extreme weather

- Warming increases evaporation
- Storms, floods, droughts
- Injuries, deaths, mental health
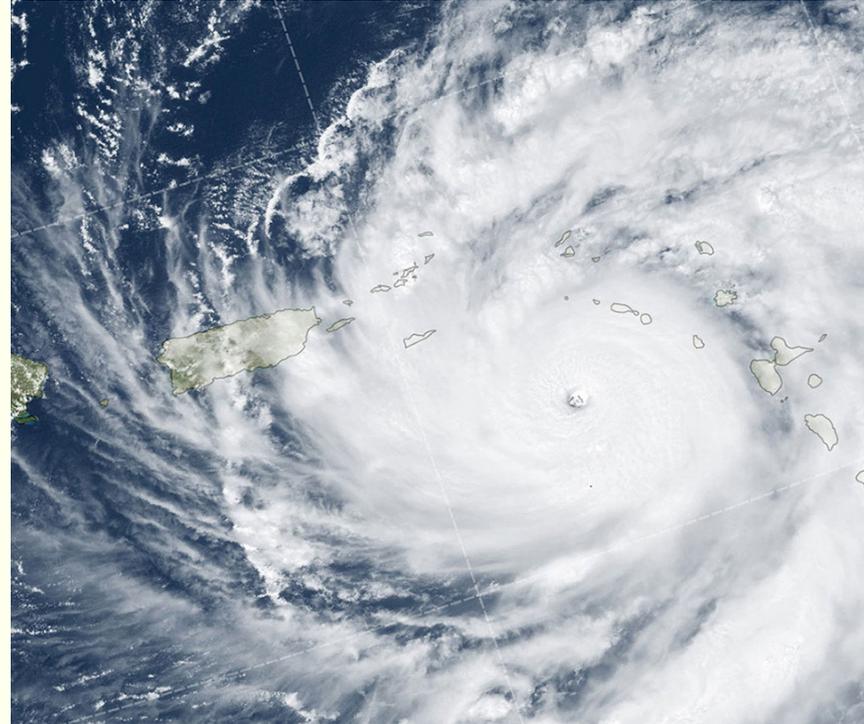
3. Air pollution

- Higher temperature increases wildfires, mold, pollen, other pollutants
- Asthma, allergies, cardiovascular disease, mortality

4. Vector-borne diseases

- Temperature, water: insect habitats, behavior
- Encephalitis, West Nile fever, Lyme disease

Reported Lyme Disease Cases in 1996 and 2014

1996

2014

Data source: CDC (Centers for Disease Control and Prevention). 2015. Lyme disease data and statistics. www.cdc.gov/lyme/stats/index.html. Accessed December 2015.

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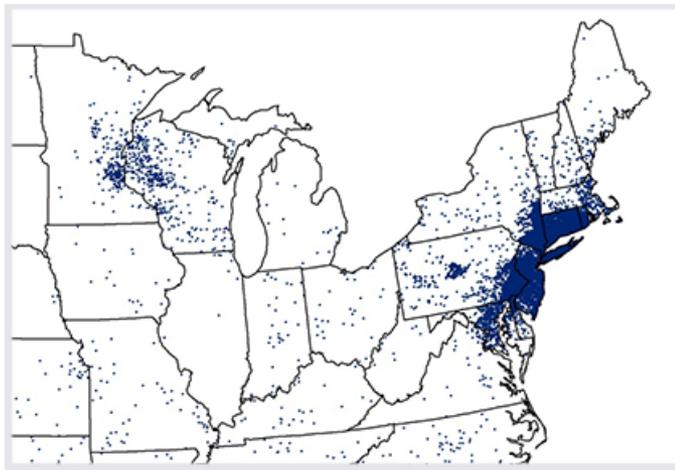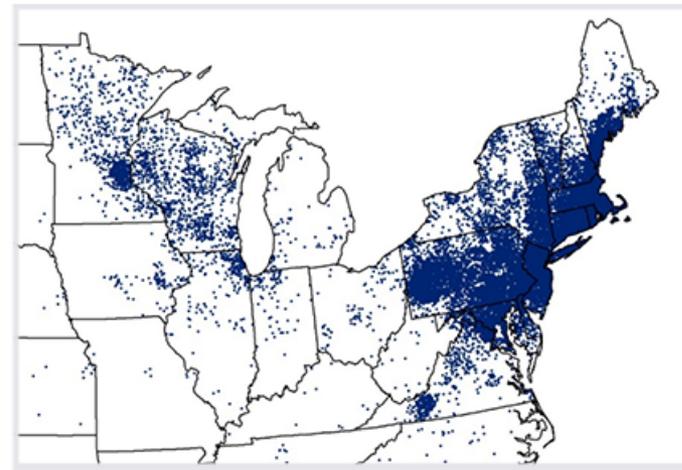
5. Water and food supply

- Floods, droughts reduce fresh water supplies and agricultural production
- Malnutrition, diarrheal diseases

6. Health care systems

- Changes in prevalence, geography of illnesses
- Extreme weather disrupt utilities, transportation, communication systems
- Sizeable carbon footprint (10% US)

7. Society and economy

- Deterioration of built infrastructure
- Conflicts, migration, and refugees
- Job losses in some regions, industries

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Phases of Climate Change and Health Research

- A. Description: describe health impact
- B. Mechanism: understand causes
- C. Prediction: model future events
- D. Intervention: reduce impact
- E. Dissemination: share widely

- (Phases applicable to other research also)

Phases of research on health impacts of climate change
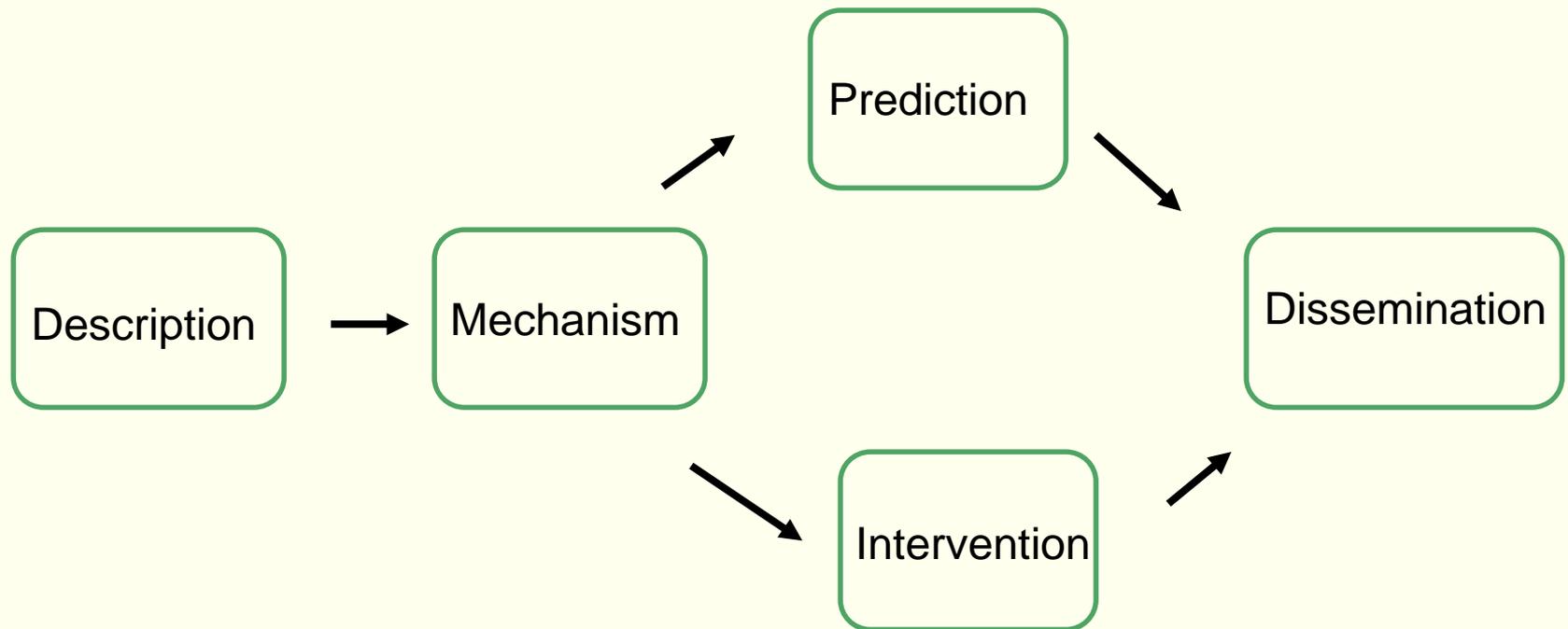
Description → Mechanism → Prediction → Dissemination

Mechanism → Intervention → Dissemination

PHASE → HAZARD ↓ -impact	Description	Mechanism	Prediction	Intervention	Dissemination
Temperature -heatstroke					
Weather -injuries					
Air pollution -asthma					
Vector-borne -West Nile					
Water, food -malnutrition					
Health care -carbon footprint					
Society and economy -refugees					

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PHASE → HAZARD ↓ -impact	Description	Mechanism	Prediction	Intervention	Dissemination
Temperature -heatstroke	France heat wave				
Weather -injuries					
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Vector-borne -West Nile					
Water, food -malnutrition					
Health care -carbon footprint					
Society and economy -refugees					

Description: French heat wave

- 2003 summer hottest since record keeping began
- 15,000 heat-related deaths, mostly elderly
- Characteristics of elderly who died?

- Vandentorren S. Eur J Publ Hlth. 2006;16:583

Heat wave: methods

- Case-control study
- 315 randomly selected deaths
- Survivors matched for age, sex, region
- Examined variety of health, behavior, social, housing, environment factors

Heat wave: results

- Health: cardiovascular disease, mental disorder, confined to bed
- Behavior: dressed as usual (vs. lightly)
- Social: manual work
- Housing: bedroom under the roof
- Environment: heat island
  - 1.2 higher odds of a heat-related death per 2 degrees F

Heat wave: limitations

- Unable to interview cases: neighbor, relative
- Unable to obtain some data from surrogates: liquid intake, bath or shower frequency, open windows
- About 40% of controls declined to participate
- Controls who participated may have been more mobile, healthy than non-participants
- Difficult to determine if death was heat-related

PHASE → HAZARD ↓ -impact	Description	Mechanism	Prediction	Intervention	Dissemination
Temperature -heatstroke	France heat wave	Heat islands Redlining			
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Mechanism: Urban heat islands

- What is association between historical housing policies and current heat patterns?

- Redlining: refuse home loans based on race

- Hoffman JS. Climate. 2020;volume 8;issue 12
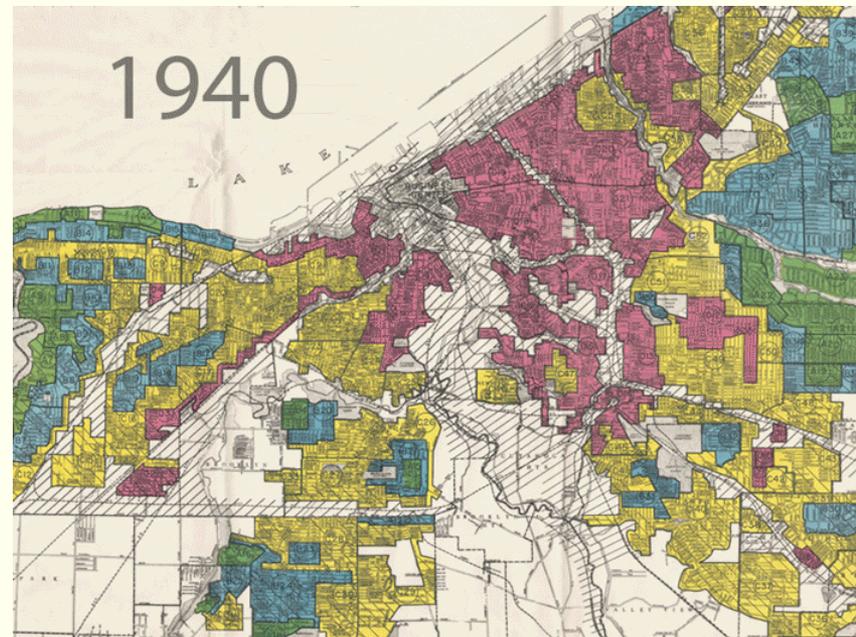
Heat islands: methods

- 108 urban areas: Redlining maps 1930s
- Satellite data on current land surface temperatures, impervious land, tree canopy
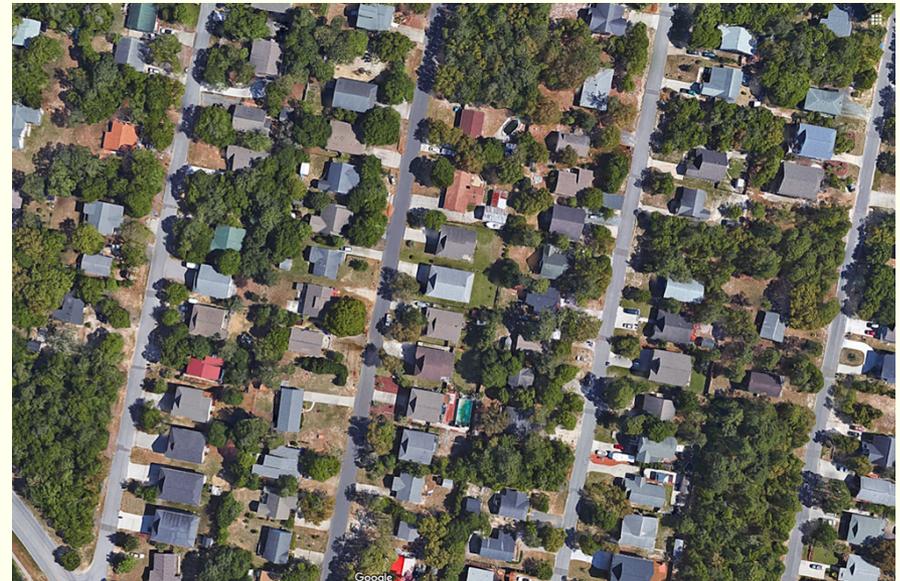
Heat islands: results

- Redlined neighborhoods 5 degrees F warmer (up to 13)
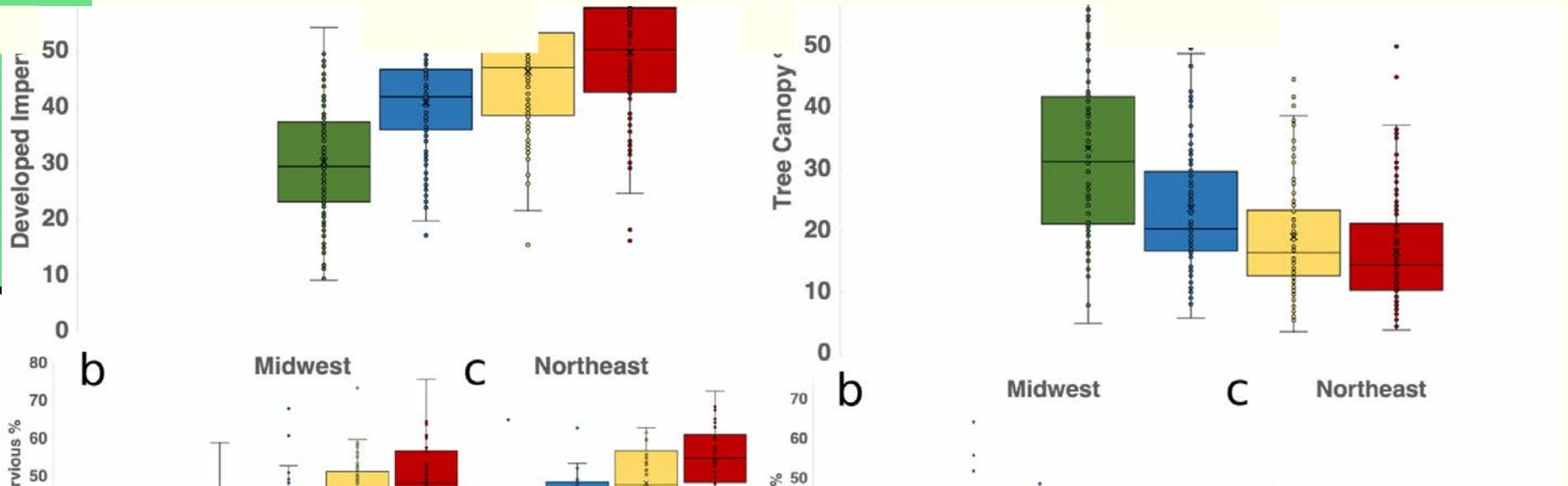
Heat islands: limitations

- Other factors besides redlining:
  - Placement of public housing complexes, industries, university campuses
  - Zoning regulations that allow multi-family homes to cover 100% of lot area
  - Difficulty of sustaining tree canopy in different areas
  - General pattern of urban disinvestment and suburban investment

PHASE → HAZARD ↓ -impact	Description	Mechanism	Prediction	Intervention	Dissemination
Temperature -heatstroke	France heat wave	Heat islands Redlining	City predictions		
Weather -injuries					
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Prediction: City climates

- Match future climate with current climate of another location
- Cleveland: Memphis
- 9 degrees F warmer
- Many cities closer to equator will be uninhabitable

- Fitzpatrick MC. Nature Communications. 2019;10:614

PHASE → HAZARD ↓ -impact	Description	Mechanism	Prediction	Intervention	Dissemination
Temperature -heatstroke	France heat wave	Heat islands Redlining	City predictions	Green roofs	
Weather -injuries					
Air pollution -asthma					
Vector-borne -West Nile					
Water, food -malnutrition					
Health care -carbon footprint					
Society and economy -refugees					

Intervention: Green roofs

- Reduce temp 2-10 deg F
- Albedo
  - Reflection incident radiation
  - Concrete, asphalt 10-25%
  - Trees, plants 75%
- Evaporation
- Insulation

PHASE → / HAZARD ↓ -impact	Description	Mechanism	Prediction	Intervention	Dissemination
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Society and economy -refugees					

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Dissemination: Heat preparedness

- Some tax incentives for green roofs
- Health departments
  - 586 counties
  - 73% communicated about heat risks
  - 40% cooling centers

- White-Newsome JL. Environ Health Perspectives 2014;122:573

PHASE → HAZARD ↓ -impact	Description	Mechanism	Prediction	Intervention	Dissemination
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Water, food -malnutrition					
Health care -carbon footprint	Hospitals	→			
Society and economy -refugees					

Cleveland Health Systems Collaborative

- Better Health Partnership
- 4 health systems
- Understand, reduce carbon footprint
- Identify, address climate-sensitive health conditions

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Water, food -malnutrition					
Health care -carbon footprint	Hospitals Dialysis	→ →			
Society and economy -refugees					

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Hemodialysis carbon footprint

- High environmental impact
    - Home electricity 7.7 mos
    - Car 9,400 miles
    - Charge 485,000 phones
- Estimate at treatment, patient, facility levels
- Determine sources of variation

Healthcare emissions

- Energy, water use
- Patient, employee, visitor transportation
- Supplies, equipment
- Laundry, waste

Challenges

- Large spatial and temporal scale over which climate change operates
- Difficult to distinguish among effects of climate change, weather fluctuations, other disease risk factors
- Lack of a control Earth that is not experiencing climate change
- Limited research funding

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How to get started

- Pick a climate hazard or health impact
- Review what has already been done in each phase of research
- Decide where you can contribute
  - Educate public, policy makers, providers
  - Implement programs in your health system
  - Conduct research to address gaps
  - **Most important: push government, corporations on carbon footprint**

Course, Faculty Recruit, Journal

- New graduate course
  - MPHP 441: Climate Change and Health
  - Spring semester: Wed 6-830pm via Zoom
- New MD/PhD climate change & health faculty
  - Research, education, community collaboration
  - Up to 25% time patient care
- Journal of Climate Change and Health
  - Open access
- sehgal@case.edu