

A Framework to Understand the Health Impacts of Climate Change

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OUTLINE

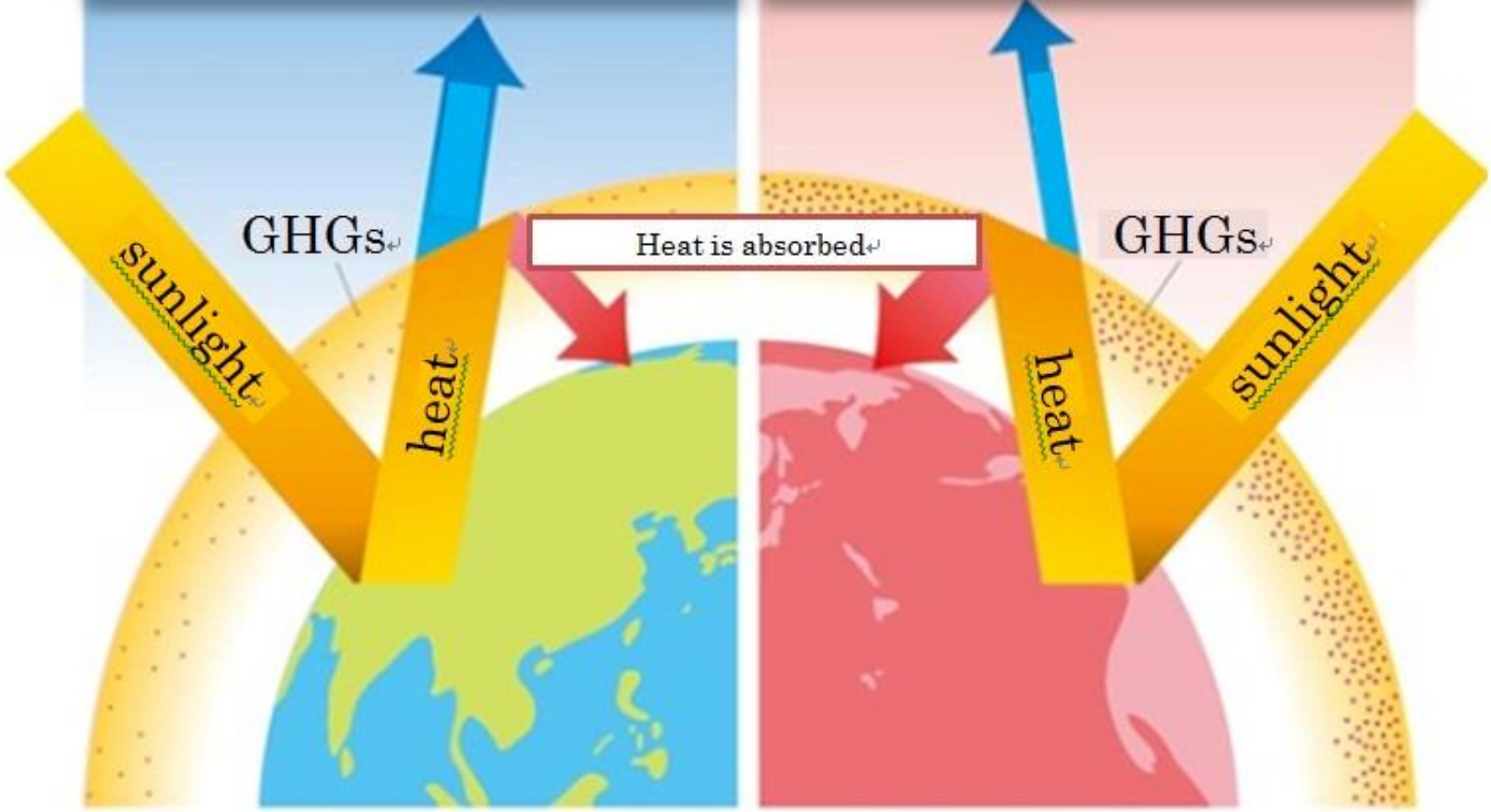
- **Mechanisms of climate change**
- Climate hazards and health impacts
- Phases of research
- Research examples and challenges
- Final thoughts

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)
- CO₂, other greenhouse gases absorb some of this infrared energy, limit radiation to space
- Increase in CO₂ by burning fossil fuels
- Increase earth surface temperature

200 years ago
(280ppm)

now
410 ppm



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

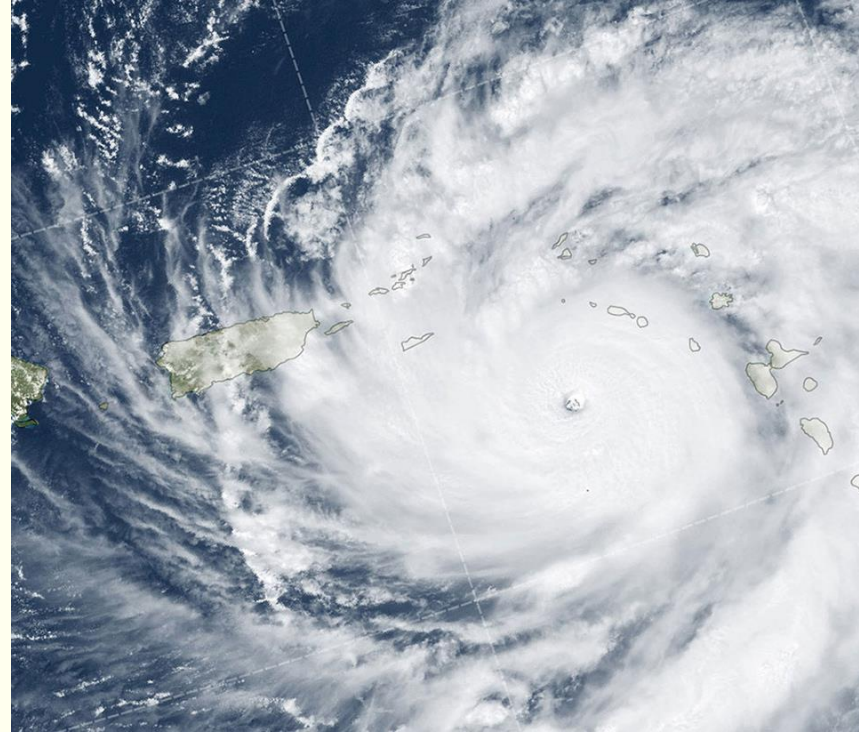
1. Increased temperature

- 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

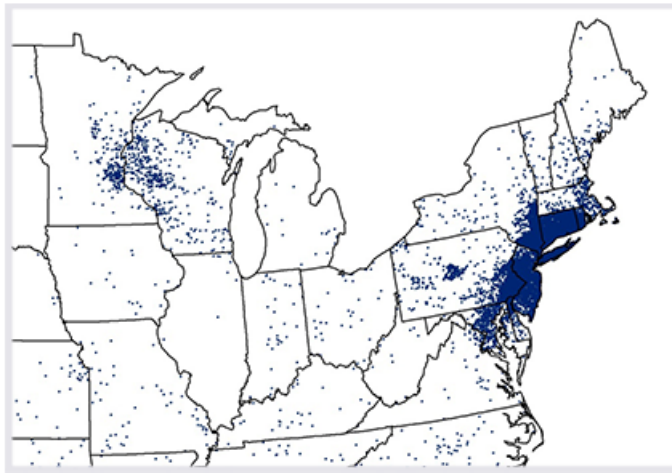
- Higher temperature increases wildfires, mold, pollen, other pollutants
- Asthma, allergies, cardiovascular disease, mortality



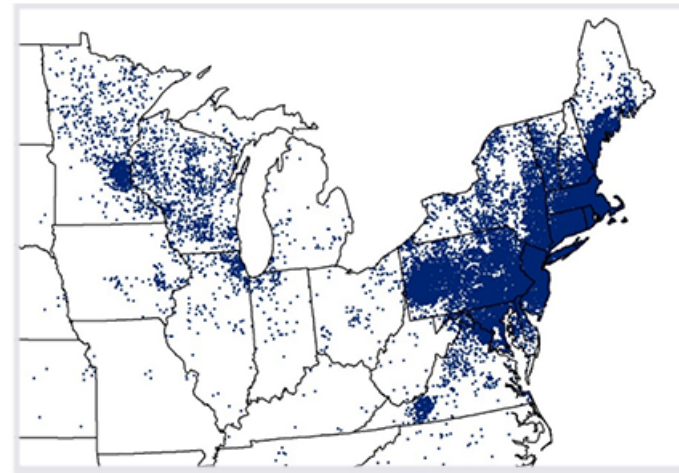
4. Vector-borne diseases

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

Reported Lyme Disease Cases in 1996 and 2014



1996



2014

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
-
- Applicable to other work (besides research)

PHASE →	Description	Mechanism	Prediction	Intervention	Dissemination
HAZARD ↓ -impact					
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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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

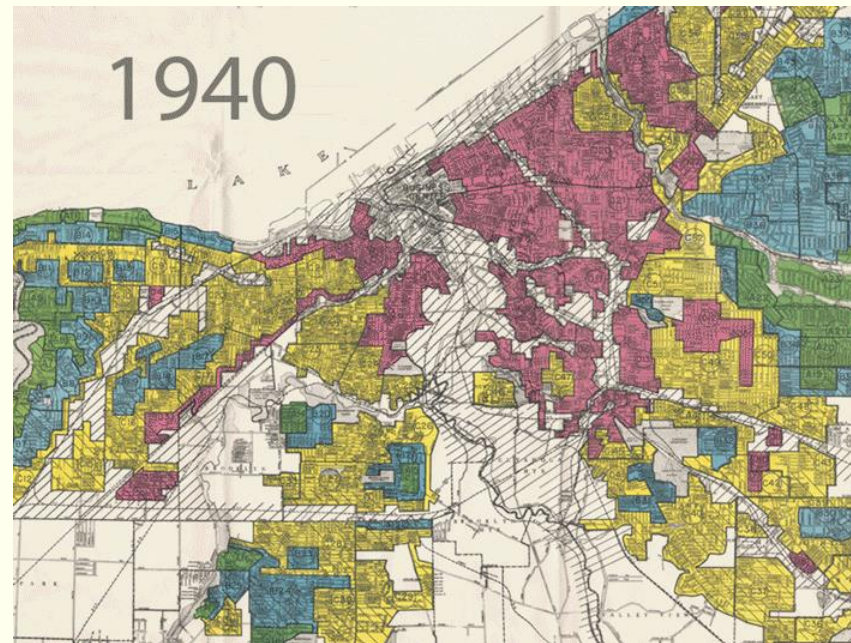
- Unable to interview cases: neighbor, relative
- Unable to obtain some data from surrogates: liquid intake, bath or shower frequency, open windows
- About 40% of controls declined to participate
- Controls who participated may have been more mobile, healthy than non-participants
- Difficult to determine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

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Mechanism: Urban heat islands

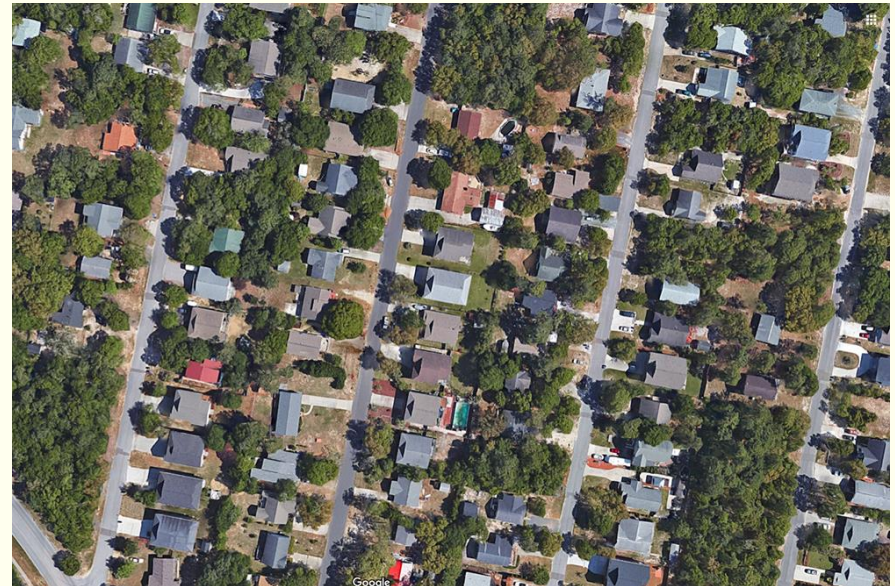
- What is association between historical housing policies and current heat patterns?
- Redlining: refuse home loans based on race

■ Hoffman JS. Climate. 2020;volume 8;issue 12



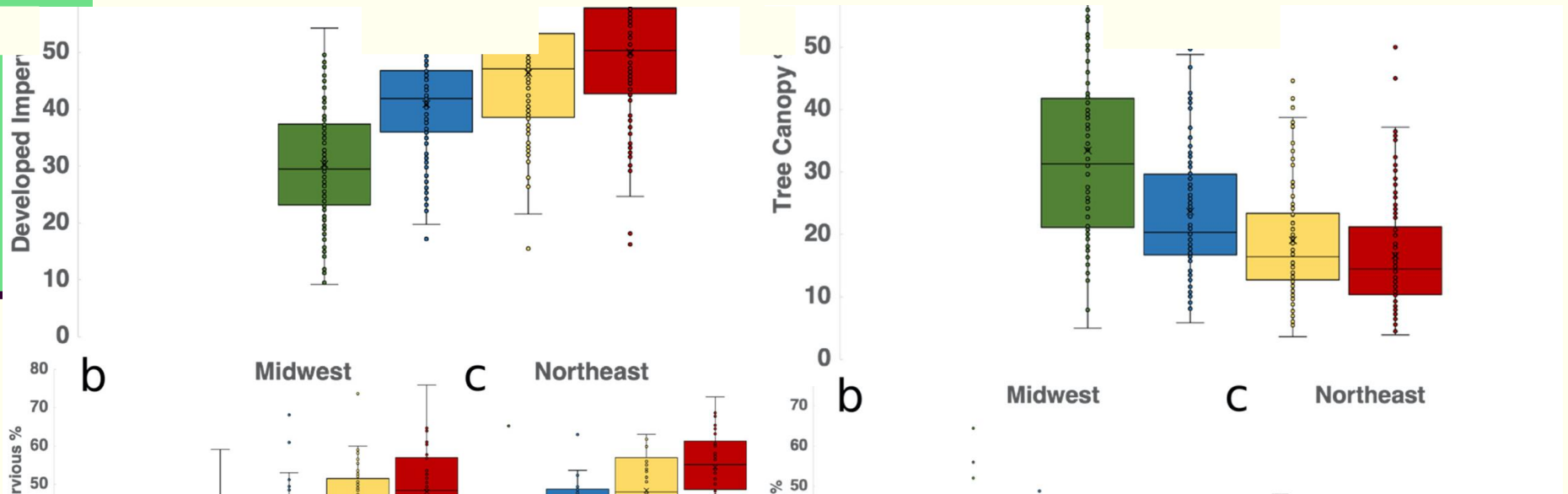
Heat islands: methods

- 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)



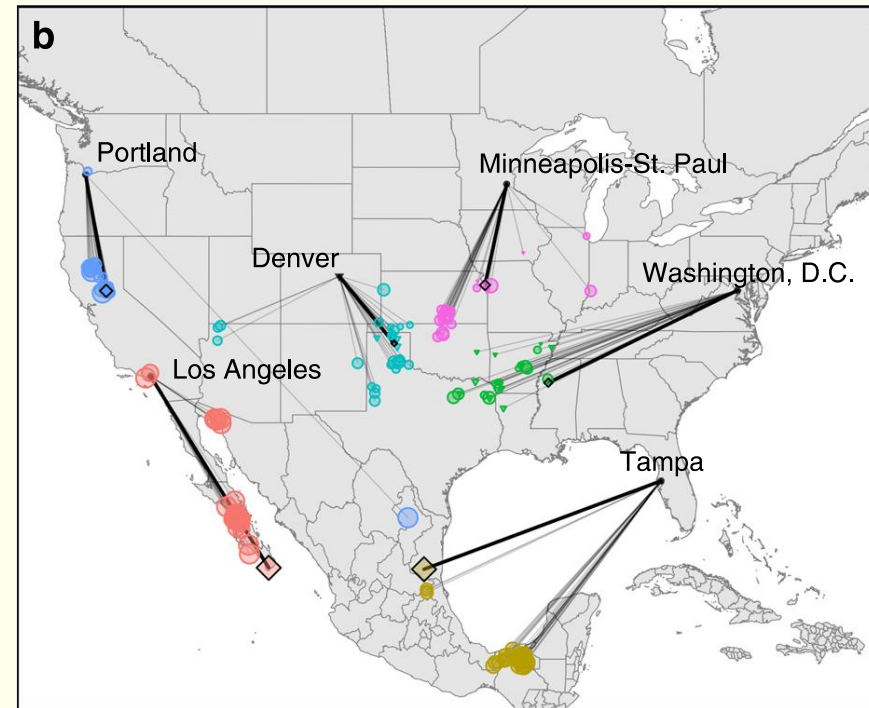
Heat islands: limitations

- 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

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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



PHASE →	Description	Mechanism	Prediction	Intervention	Dissemination
HAZARD ↓ -impact					
Temperature -heatstroke	France heat wave	Heat islands Redlining	City predictions	Green roofs	
Weather -injuries					
Air pollution -asthma					
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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 →	Description	Mechanism	Prediction	Intervention	Dissemination
HAZARD ↓ -impact					
Temperature -heatstroke	France heat wave	Heat islands Redlining	City predictions	Green roofs	Heat preparedness
Weather -injuries					
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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



BEAT THE HEAT: Extreme Heat

Heat-related deaths are preventable

WHAT:

Extreme heat or heat waves occur when the temperature reaches extremely high levels or when the combination of heat and humidity causes the air to become oppressive.



Children

WHO:

More males than females are affected



Older adults



Outside workers



People with disabilities

WHERE:



Houses with little to no AC



Construction work sites



Cars

HOW to AVOID:



Stay hydrated with water, avoid sugary beverages



Stay cool in an air conditioned area



Wear lightweight, light-colored, loose-fitting clothes



During extreme heat the temperature in your car could be deadly!

Outside Temperature 80°



Time Elapsed: 20 minutes



Time Elapsed: 40 minutes



Time Elapsed: 60 minutes

HEAT ALERTS: Know the difference.



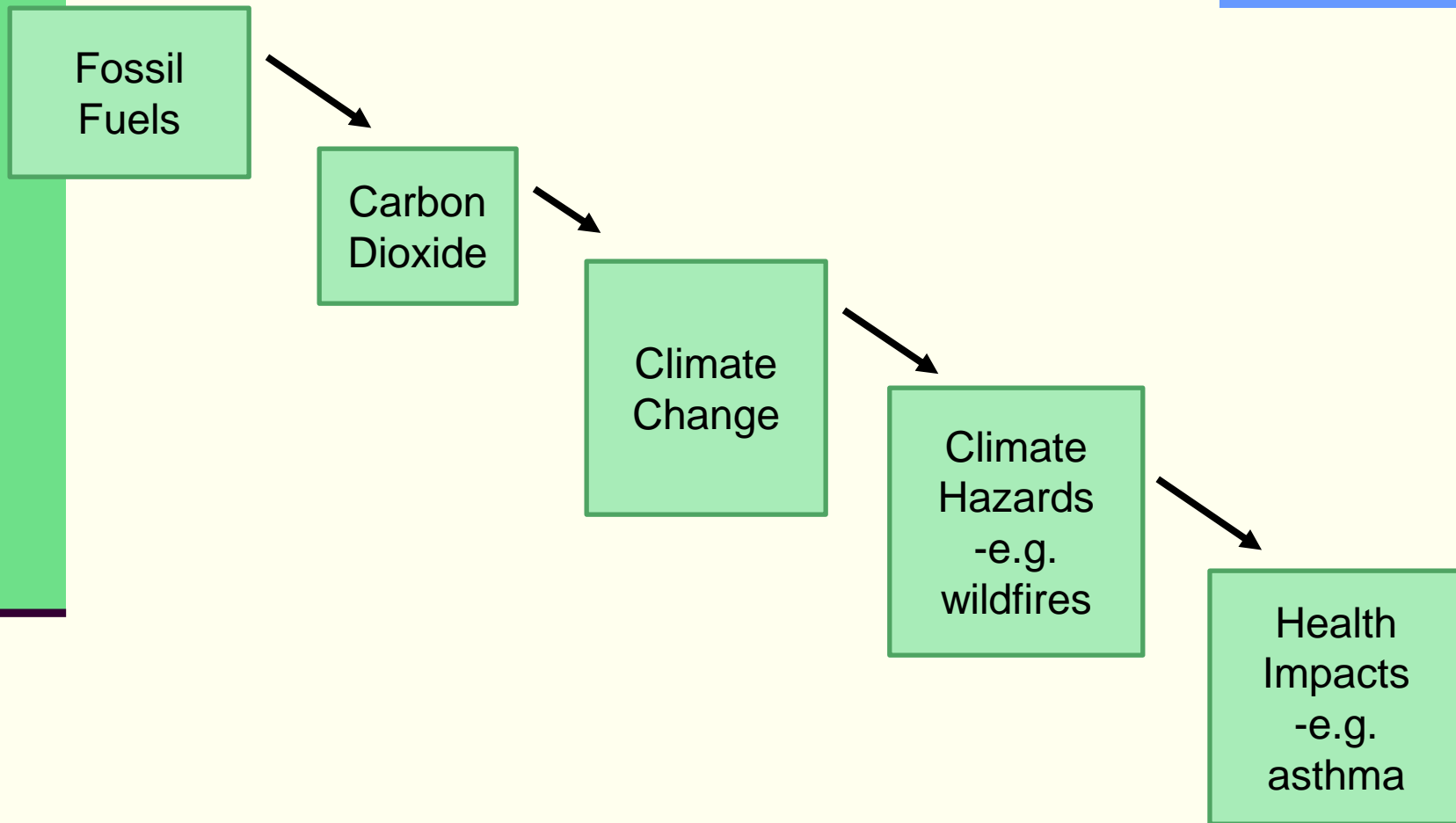
Challenges

- 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

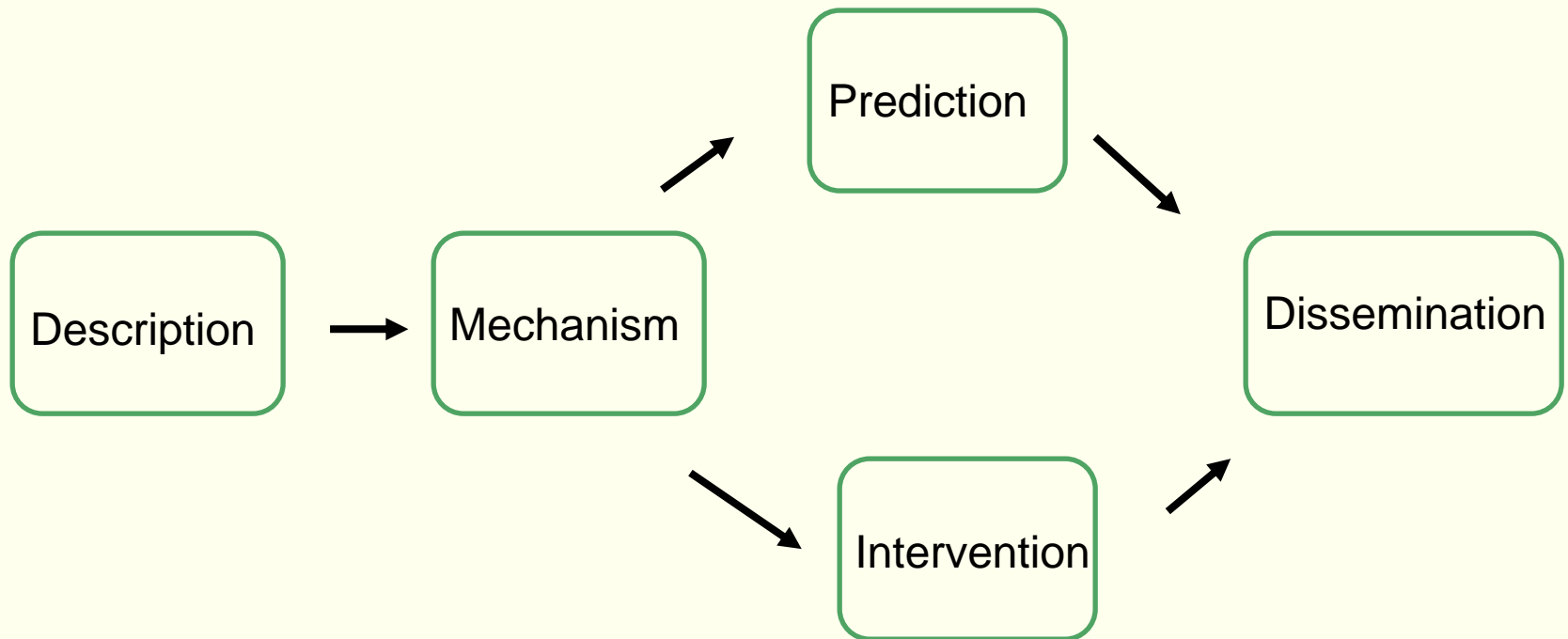
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Climate change cascade



Phases of research on health impacts of climate change



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**