# Climate changes health

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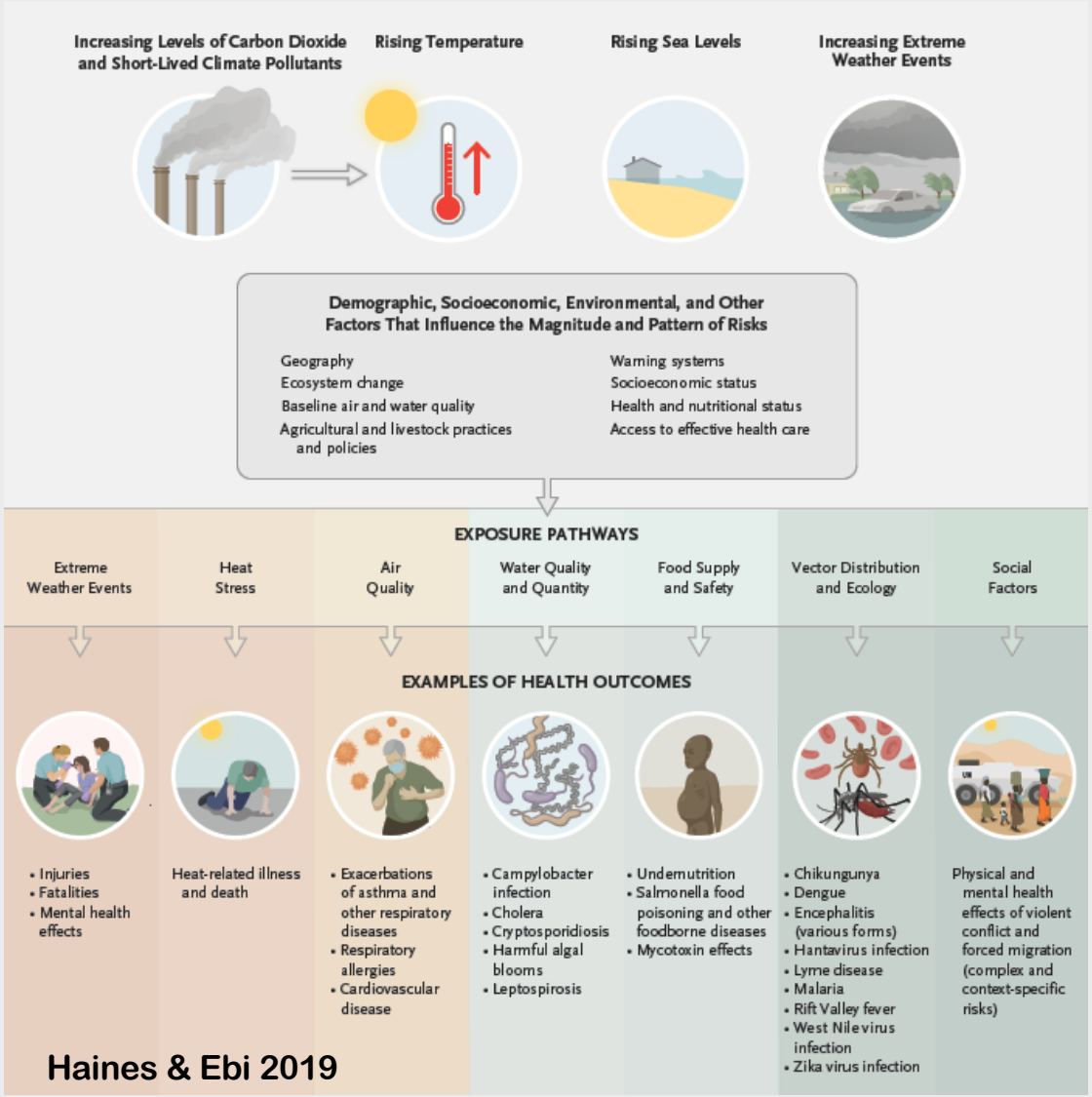
IPCC 2022




Haines & Ebi 2019

# Key conclusions of the IPCC 2022 chapter on human health

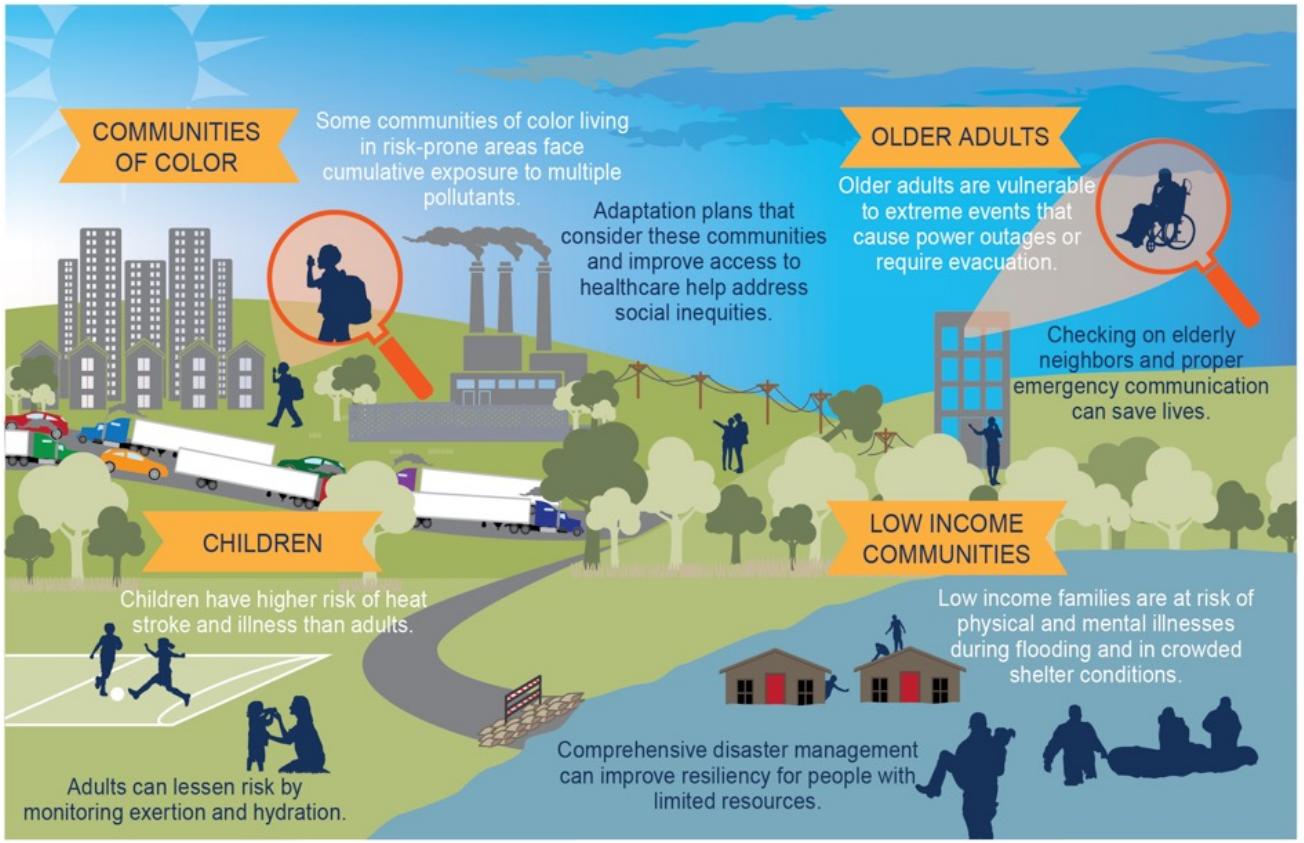
## Observed impacts: *climate change is adversely affecting the physical health of people globally and mental health of people in assessed regions*

- Extreme heat events
- Vector-borne and zoonotic diseases
- Water and food-borne diseases
- Some mental health challenges
- Health services disrupted by extreme events such as floods

## Projected risks

- Extreme events
  - Population exposure to heatwaves: increase with additional warming, strong geographical differences in heat-related mortality
- Food-borne, water-borne, and vector-borne diseases: increase under all levels of warming without additional adaptation
- Mental health (including anxiety and stress): increase in assessed regions

# Exposure and resilience vary across populations & communities



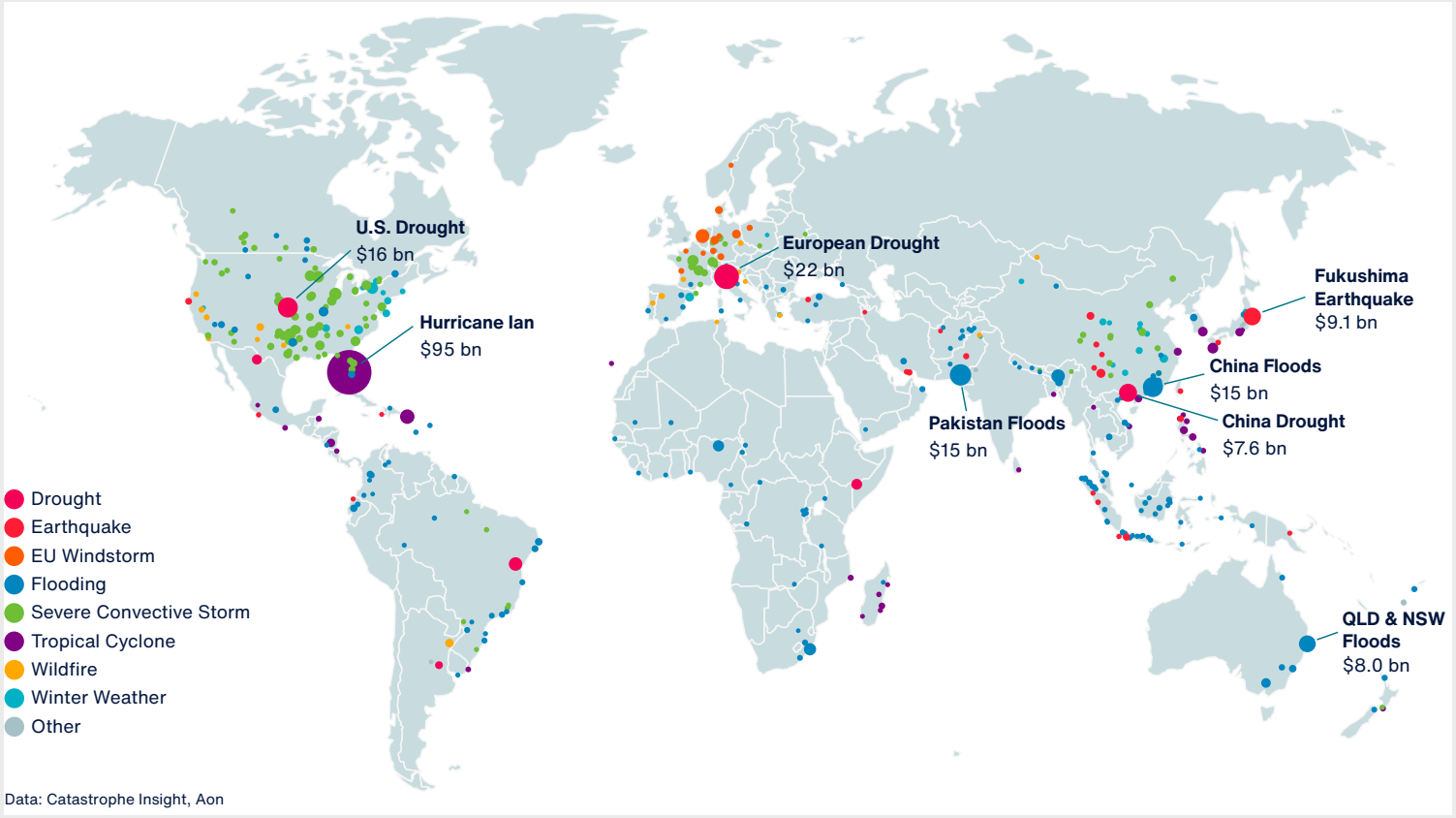
# USD 313 billion disaster losses in 2022

*>16,000 died in heatwaves in Europe*

*1,700 died in flooding in Pakistan*

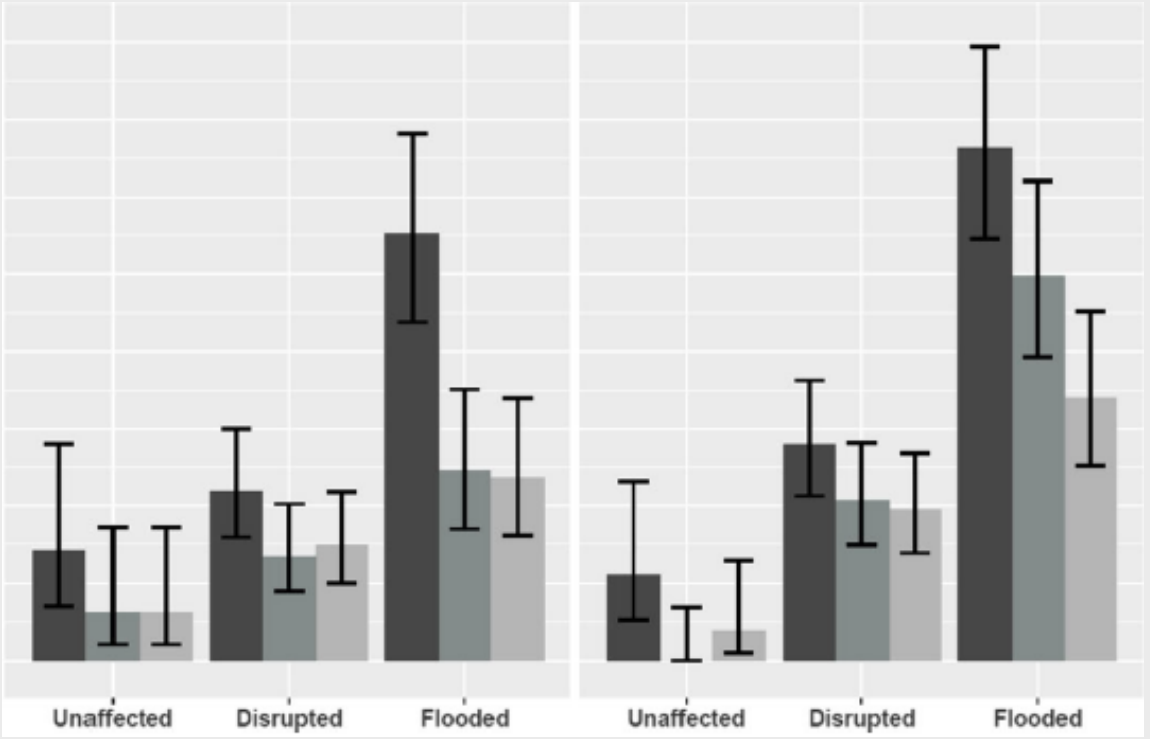
*Drought losses > USD 38 billion*

## 2022 significant economic loss events



# 2013-2014 UK winter floods

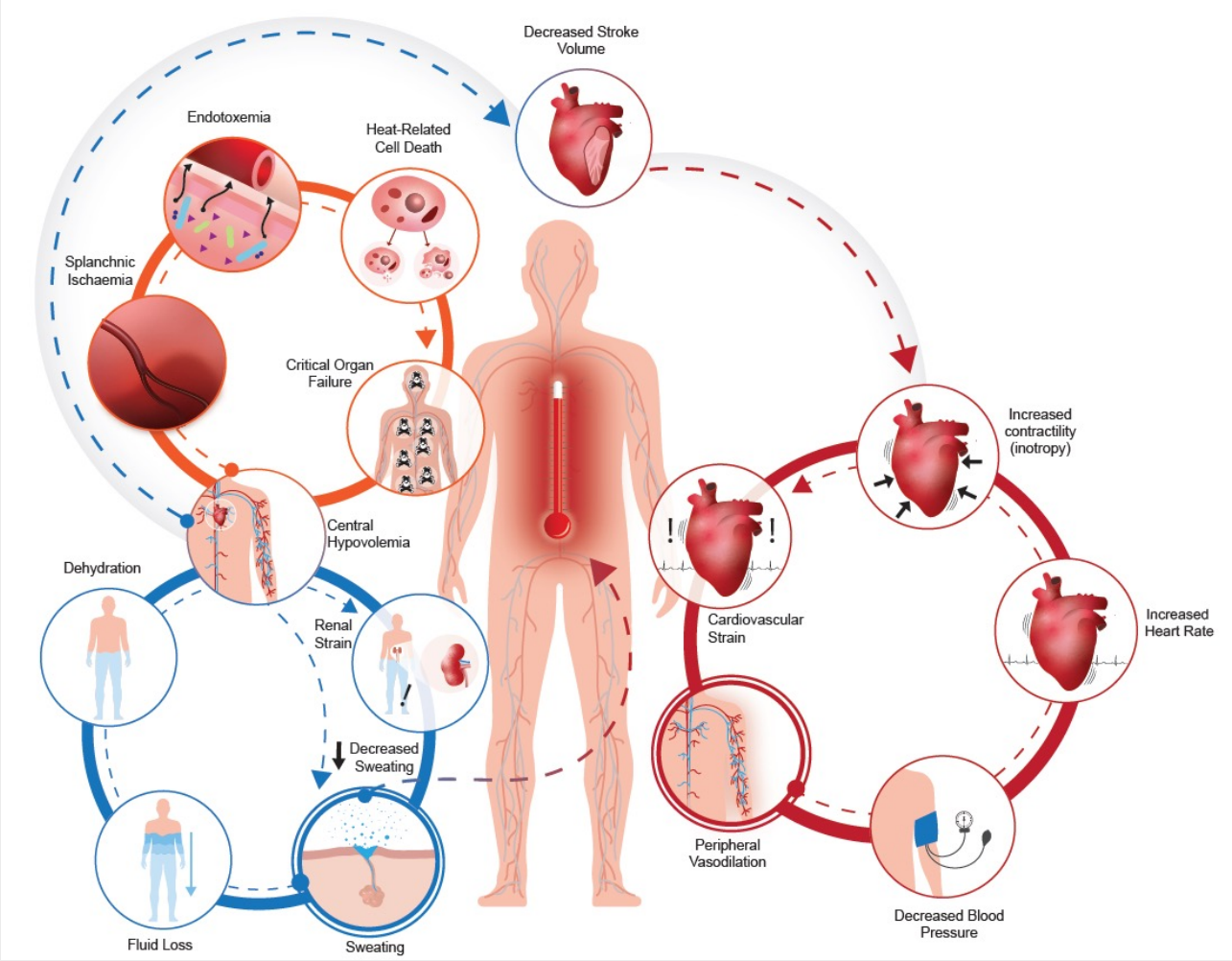
**In year 3, prevalence of probable PTSD in people who were flooded with persistent damage was 30%**




Anxiety PTSD

Mulchandani et al. 2020

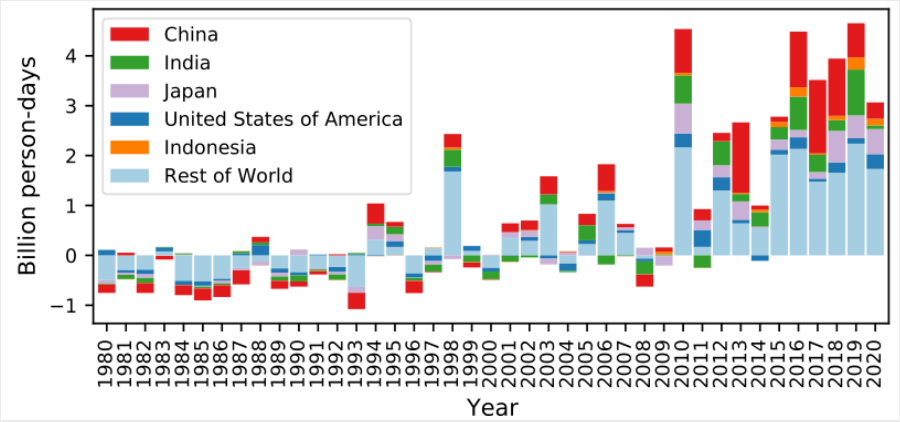
# Physiological pathways of human health strain



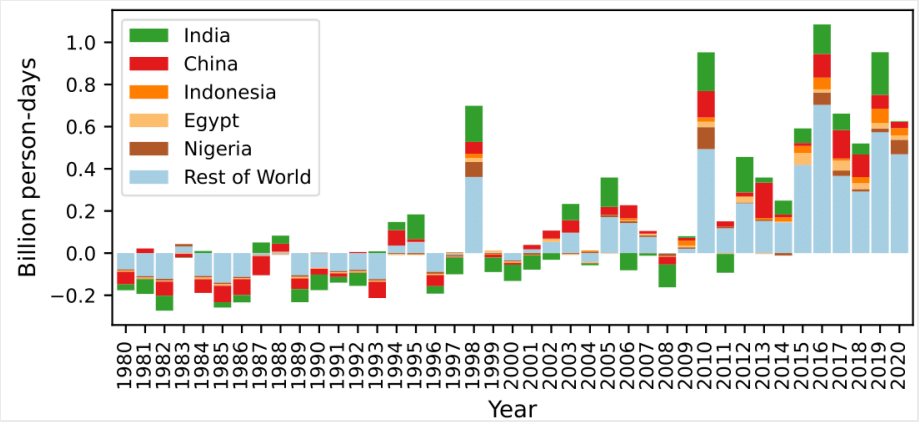

Ebi et al. 2021

# Exposure of vulnerable populations to heatwaves

**Children younger than 1 year were affected by 626 million more person-days of heatwave exposure and adults older than 65 years were affected by 3·1 billion more person-days of heatwave exposure in 2020 than in the 1986–2005 average**




>65 year old

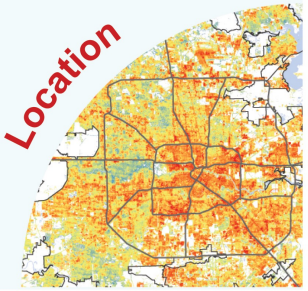



<1 year old

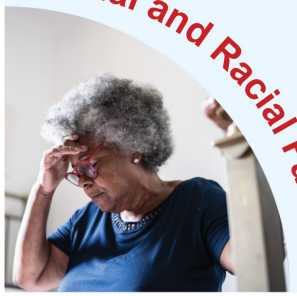
# Heat and Health Equity

## Location

- Historically redlined communities (BIPOC and low-wealth communities) are often hotter than other neighborhoods.
- Access to cooling centers is more limited in some areas.



## Social and Racial Factors



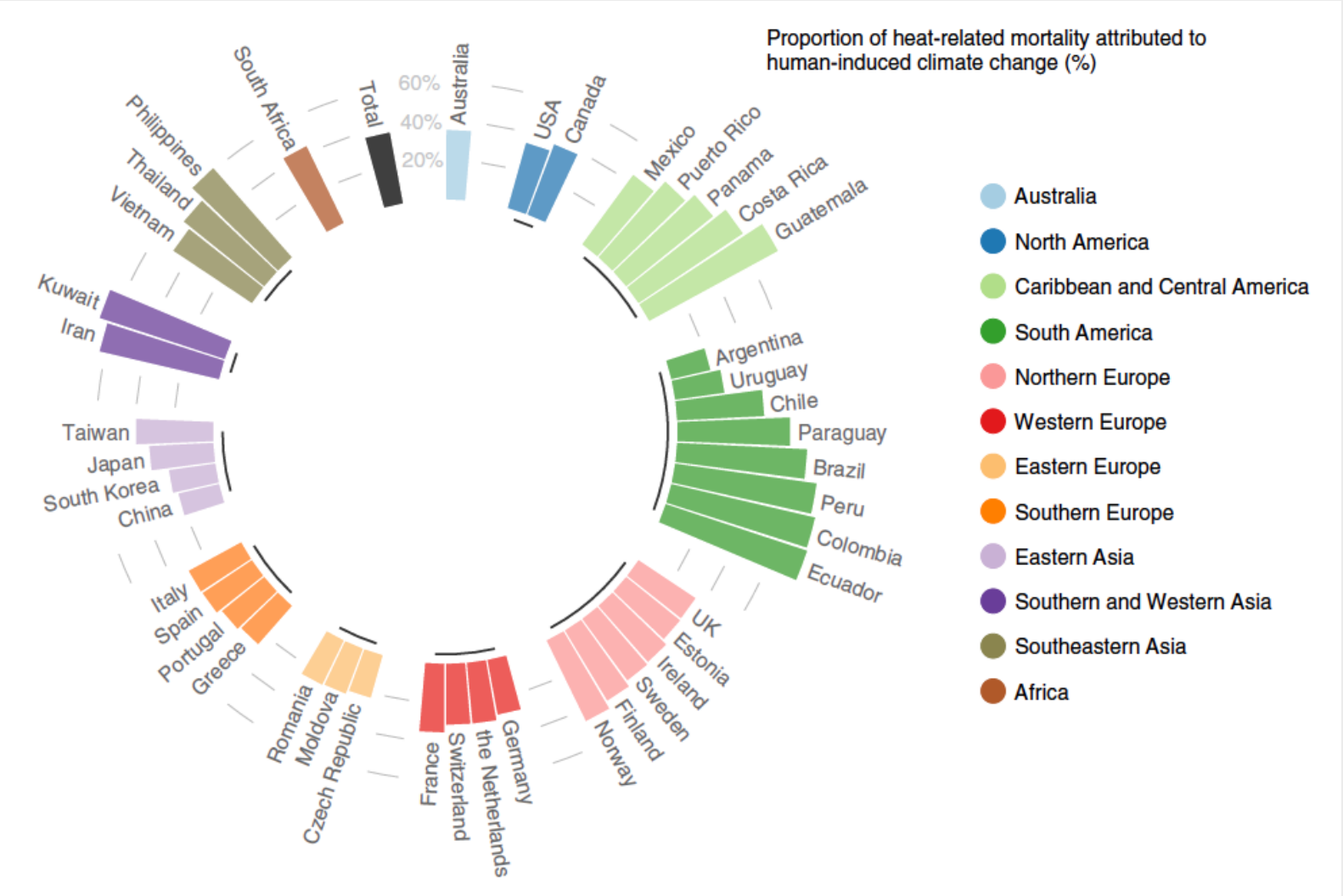
- Certain populations are more vulnerable to extreme heat and have less access to healthcare.
- Socially isolated individuals may have less access to cooling centers.

## Economics

- Energy costs and the costs of repairs limit the ability to afford air-conditioning.
- Low-wealth residents often live in homes that provide less protection against extreme heat.

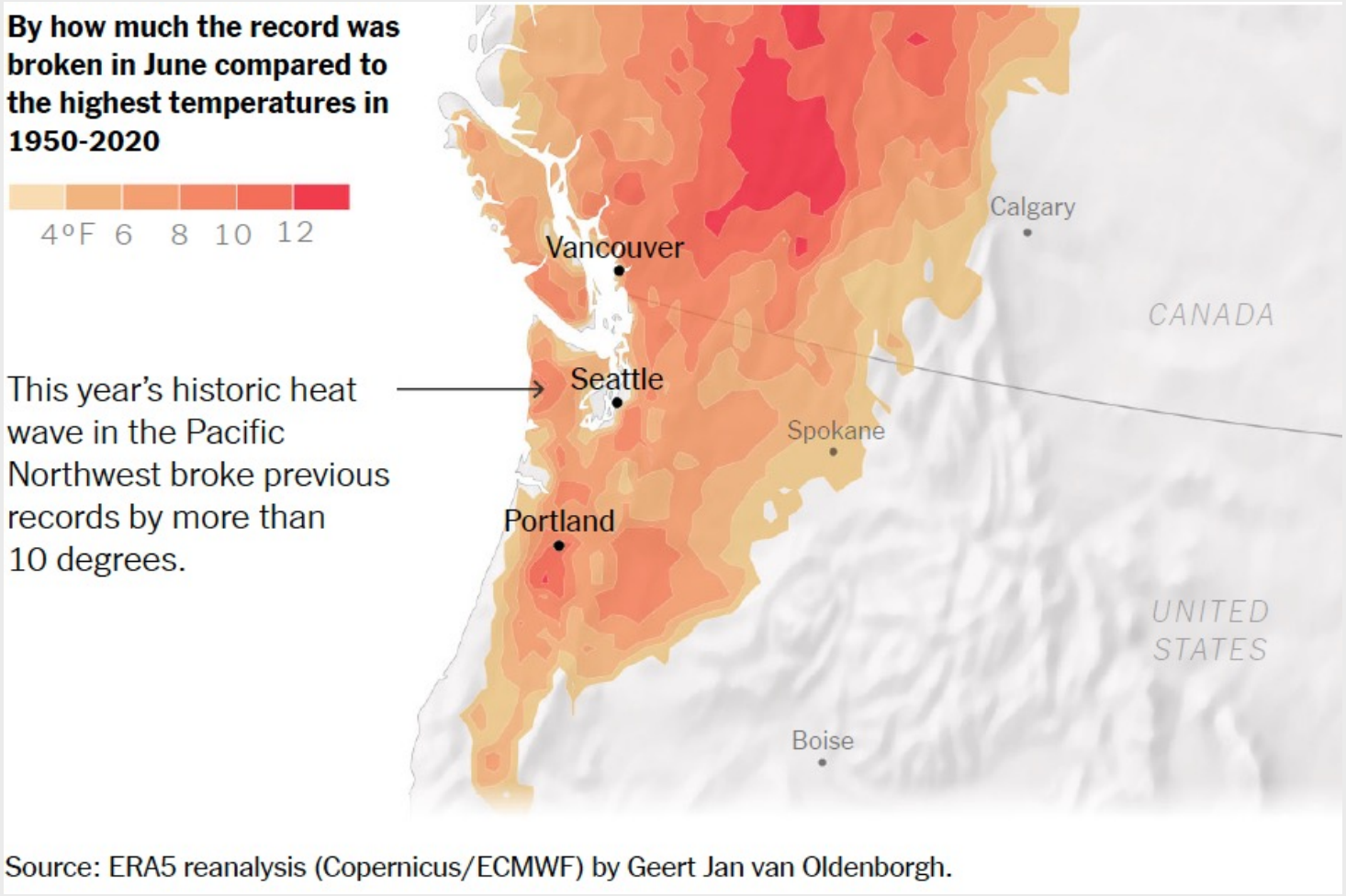
## Compound Risks

- COVID-19 protocols reduced the accessibility and effectiveness of cooling centers.
- Disadvantaged populations are more at risk for heat-related illnesses during power outages.




Vicedo et al. 2021

# https://www.worldweatherattribution.org



## Sustainable and accessible ways to keep cool

Mitigating climate change is vital, but inevitible rising temperatures means that identifying sustainable cooling strategies is also important. Strategies at the individual scale that focus on cooling the person instead of the surrounding air can be effectively adopted, even in low-resource settings.

### Electric fans

- ⊕ Can provide effective cooling for young healthy adults up to 42˚C in 50% humidity
- ⊖ Effectiveness is reduced with low humidity, and in older adults (>65 years), unless accompanied by self-dousing
- ⊖ Increases dehydration, but can be offset by drinking an extra glass of water per h

### Self-dousing

- ⊕ Can reduce heat strain and dehydration up to 47˚C if dousing is sufficient to keep the skin wet
- ⊕ Can be used during power outages
- ⊖ Low compatibility with high clothing coverage

### Foot immersion*

- ⊕ Can reduce dehydration and thermal discomfort in hot and humid conditions
- ⊕ Can be used during power outages
- ⊖ Risk of slips and falls

* Feet immersed above the ankles in 20˚C water

### Wet clothing

- ⊕ Provides high evaporative heat loss without needing to sweat
- ⊕ Can be used during power outages
- ⊖ Clothing must be re-soaked roughly every 60 min

***Electric fans can be used below these temperatures irrespective of humidity:***

| | |
|---|---|
| 39˚C | *Healthy young adults (aged 18 to 40 years)* |
| 38˚C | *Healthy adults (aged over 65)* |
| 37˚C | *Over 65s taking anti-cholinergic medication* |

### Evaporative coolers

- ⊕ Can cool air temperatures in dry conditions
- ⊖ Minimal effect in high humidity
- ⊖ Risks creating mosquito breeding sites without proper maintainence

### Misting fans

- ⊕ Lowers air temperatures in hot and dry conditions
- ⊖ Must be used in well ventilated or outdoor areas otherwise humidity increases offset any benefit
- ⊖ Risk of slips and falls

### Ice towels*

- ⊕ Can reduce core temperature and cardiovascular strain in conditions up to 45˚C
- ⊖ Requires access to ice
- ⊖ Labour-intensive to prepare

* Crushed ice wrapped in a damp towel applied to the neck and chest

### Cold water ingestion

- ⊕ Can provide internal cooling
- ⊕ Water should be ingested at a temperature that is most palatable (~10˚C) to ensure optimal hydration
- ⊖ If person has already started sweating, not effective at lowering core temperature

Read the full paper: Jay O, Capon A, Berry P, et al. Reducing the health effects of hot weather and heat extremes: from personal cooling strategies to green cities. *The Lancet* 2021. Published online August 19

## Sustainable cooling strategies to protect health in heat-vulnerable settings

Heat extremes and hot weather are harming health. While mitigating climate change is vital, the inevitble rise in global temperature is expected to exacerbate these harms in future, and identifying opportunities for applying sustainable cooling strategies in heat-vulnerable settings is also important

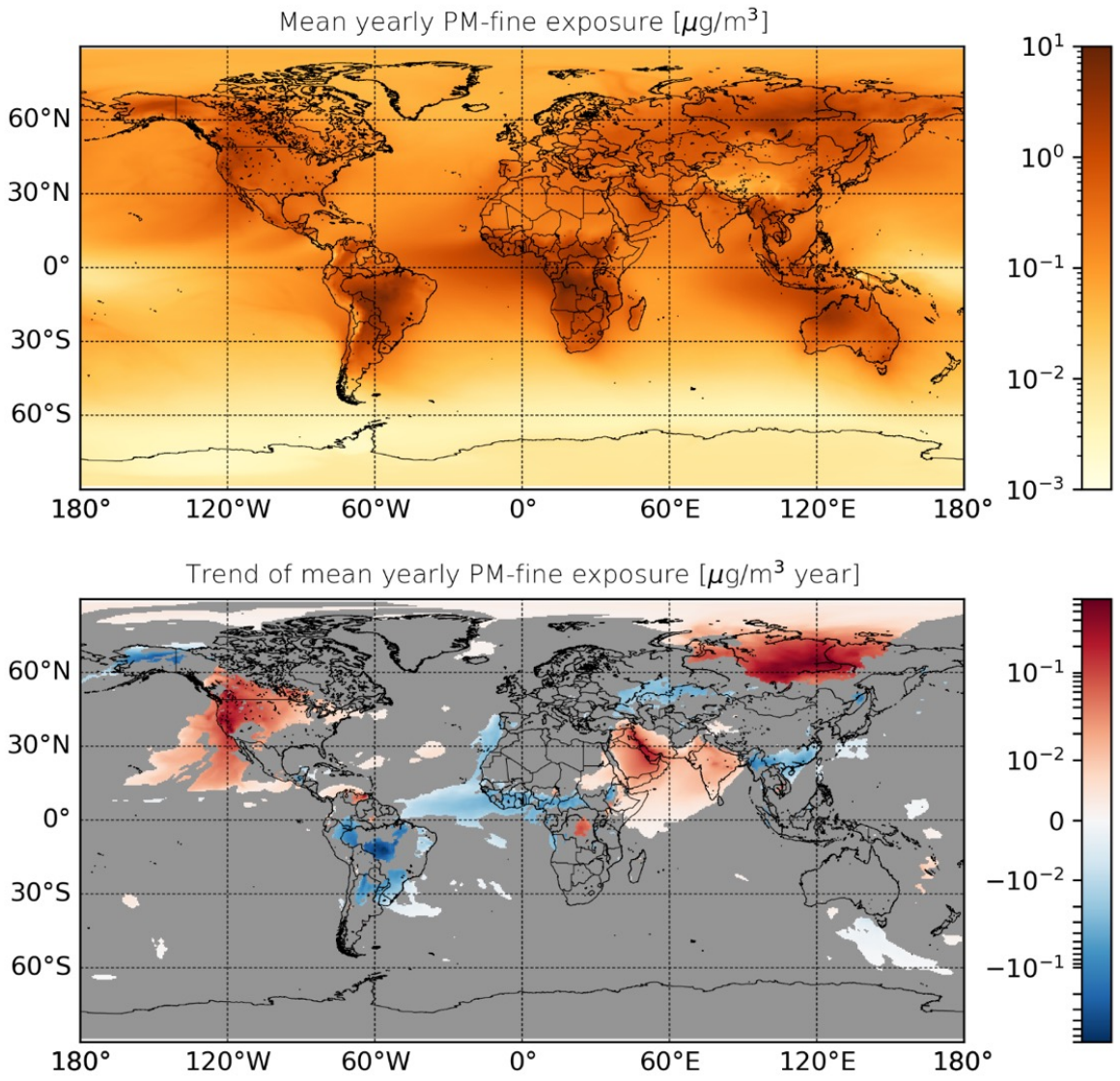

1=to be used up to 38˚C; 2=if water sanitation allows; 3=at a temperature that is most palatable (eg, ~10˚C); 4=without compromising any required protective equipment

5=heat-reflective window glass; 6=playing surfaces that minimise heat retention and emitted radiation; 7=breathable tents; 8=insulating roofs and walls

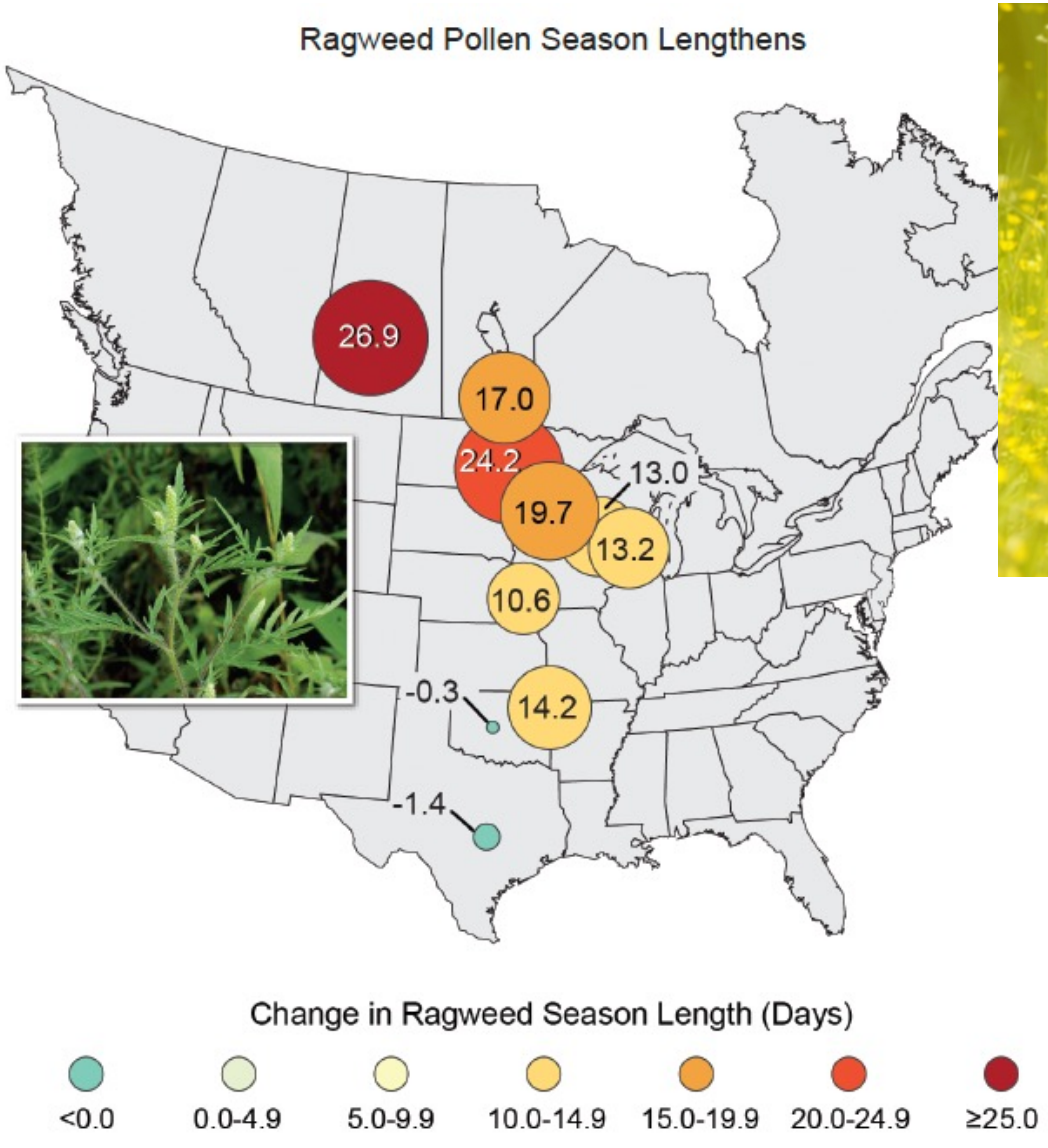
Read the full paper: Jay O, Capon A, Berry P, et al. Reducing the health effects of hot weather and heat extremes: from personal cooling strategies to green cities. *The Lancet* 2021. Published online August 19

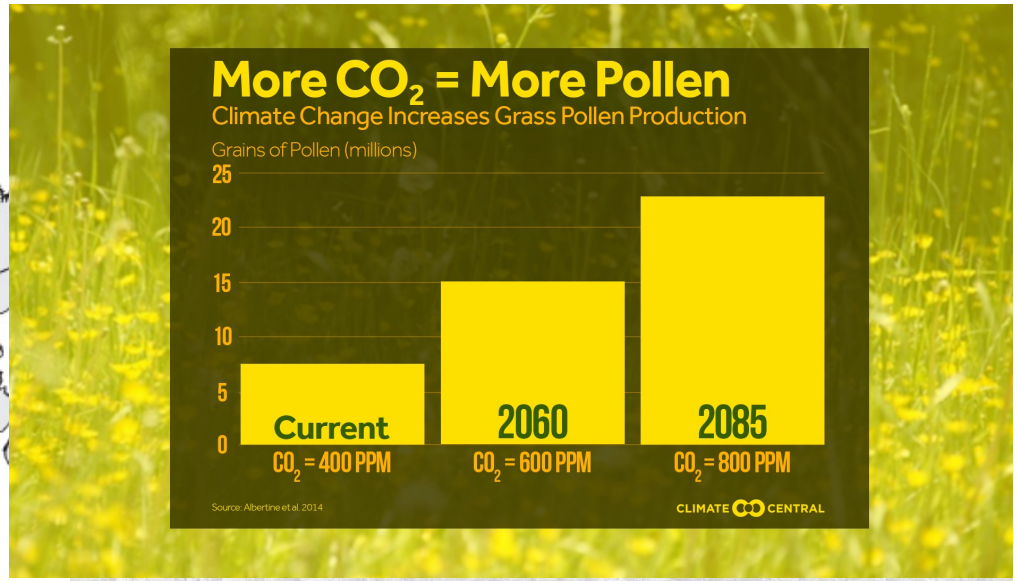
**Jay et al. 2021**

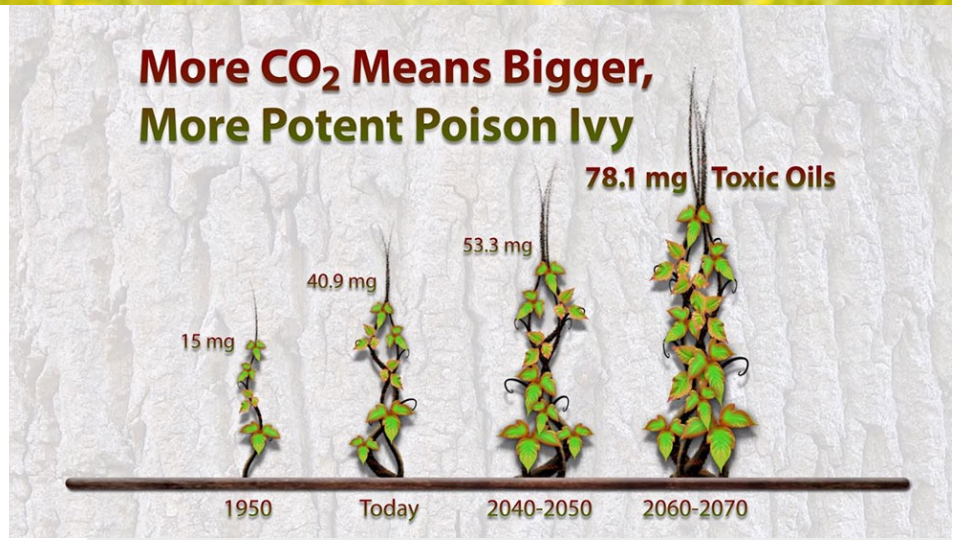
# Gridded mean personal exposure to fire-induced PM and its 2003-2021 trend; only significant trends shown



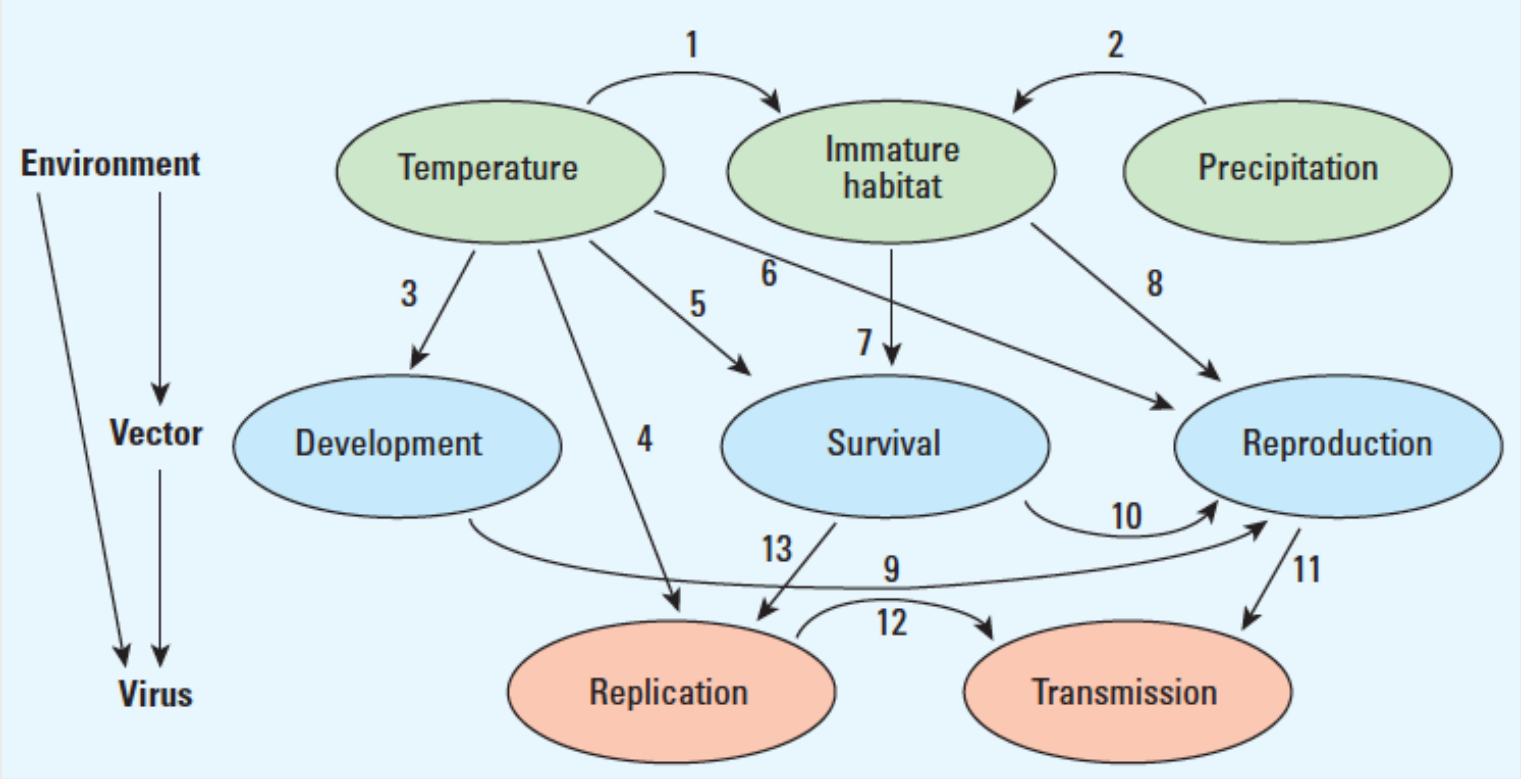

2022 Report of the Lancet Countdown


Ragweed Pollen Season Lengthens
26.9
17.0
24.2
19.7
13.0
13.2
10.6
-0.3
14.2
-1.4
Change in Ragweed Season Length (Days)
<0.0
0.0-4.9
5.0-9.9
10.0-14.9
15.0-19.9
20.0-24.9
≥25.0


More CO2 = More Pollen
Climate Change Increases Grass Pollen Production
Grains of Pollen (millions)
25
20
15
10
5
0
Current
CO2 = 400 PPM
2060
CO2 = 600 PPM
2085
CO2 = 800 PPM
Source: Albertine et al. 2014
CLIMATE CENTRAL


More CO2 Means Bigger,
More Potent Poison Ivy
78.1 mg Toxic Oils
53.3 mg
40.9 mg
15 mg
1950
Today
2040-2050
2060-2070

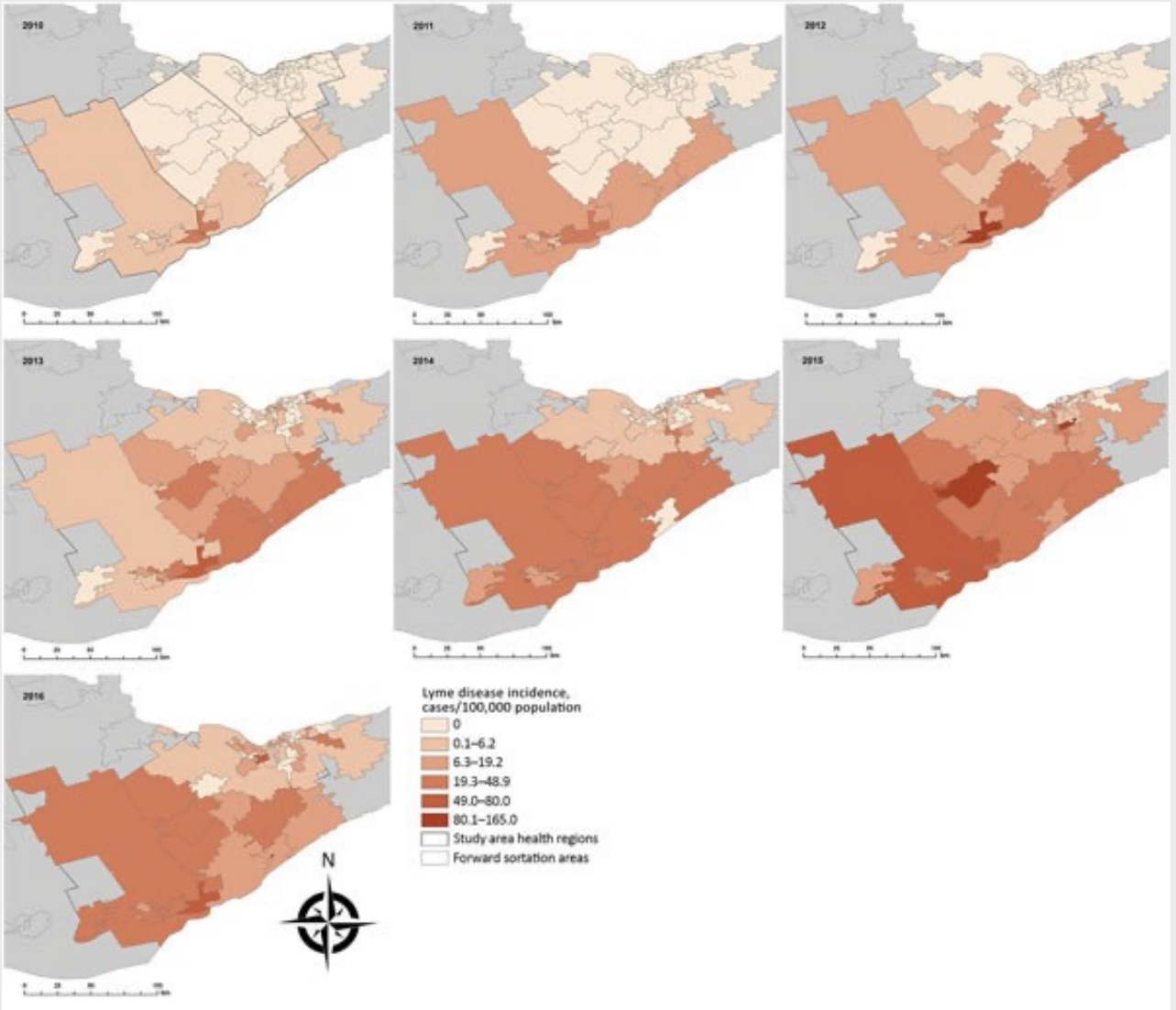
# Biophysical influences on dengue ecology showing the interactions between climate variables, vectors, and the virus



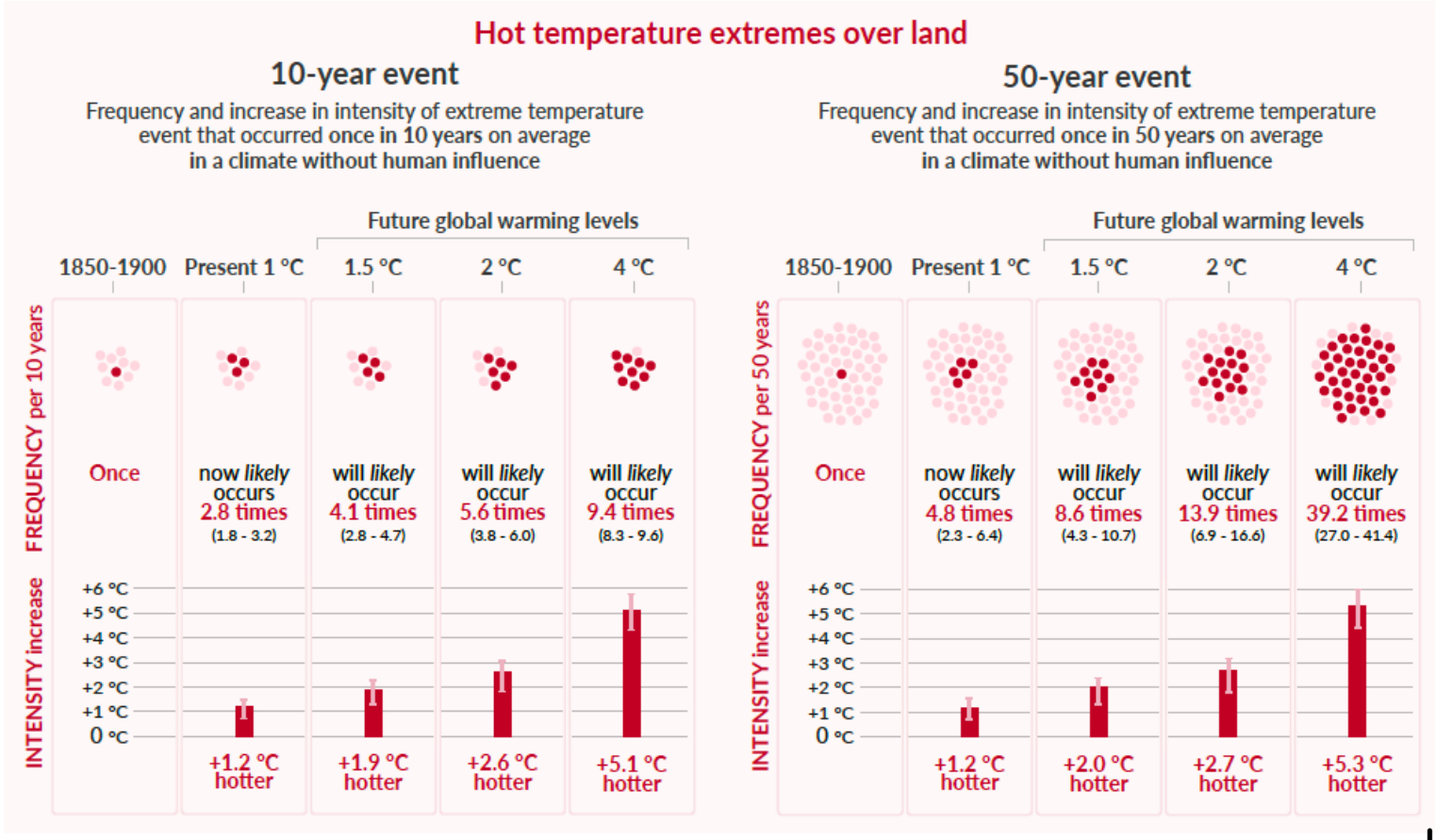

Morin et al. 2013

# Spatiotemporal spread of human Lyme disease incidence, 2010-2016, three public health units in Eastern Ontario

Kulkarni et al. 2019



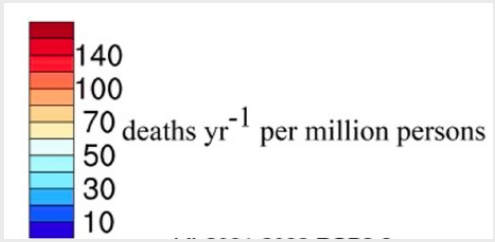
# Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming




IPCC WGI 2021

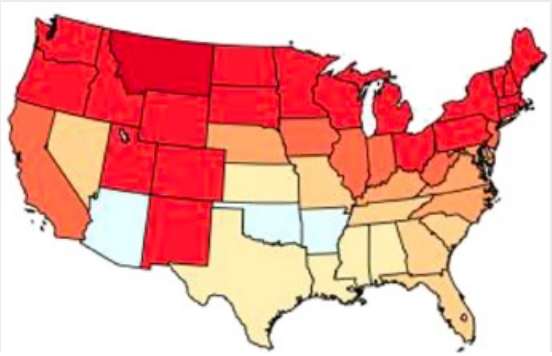
# Projected annual heat-related deaths in 2091-2099

## No adaptation; high emissions




## No adaptation; low emissions

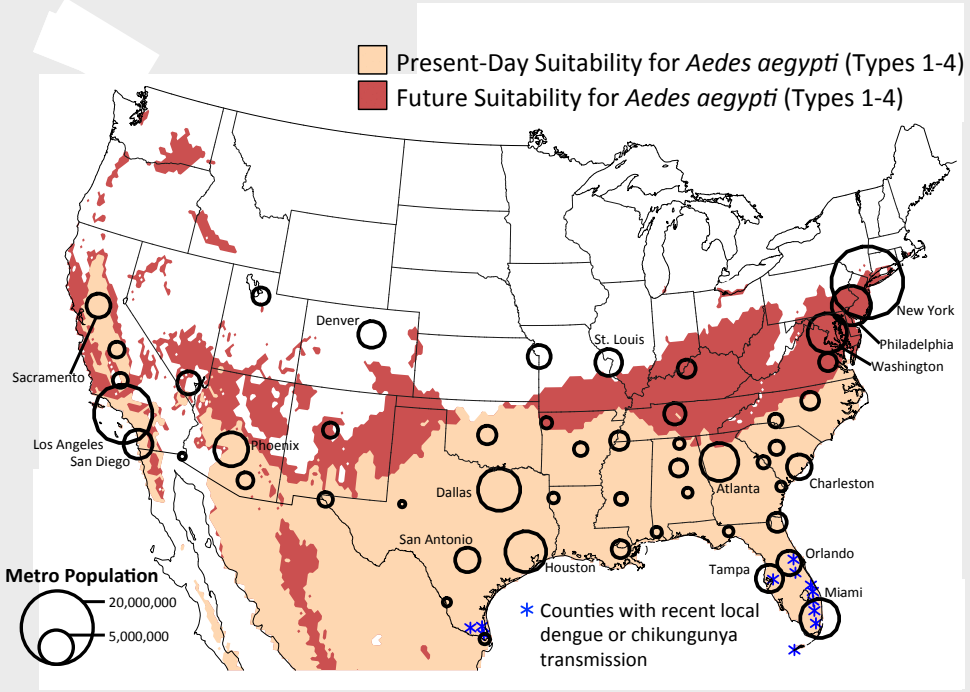
## Adaptation; high emissions



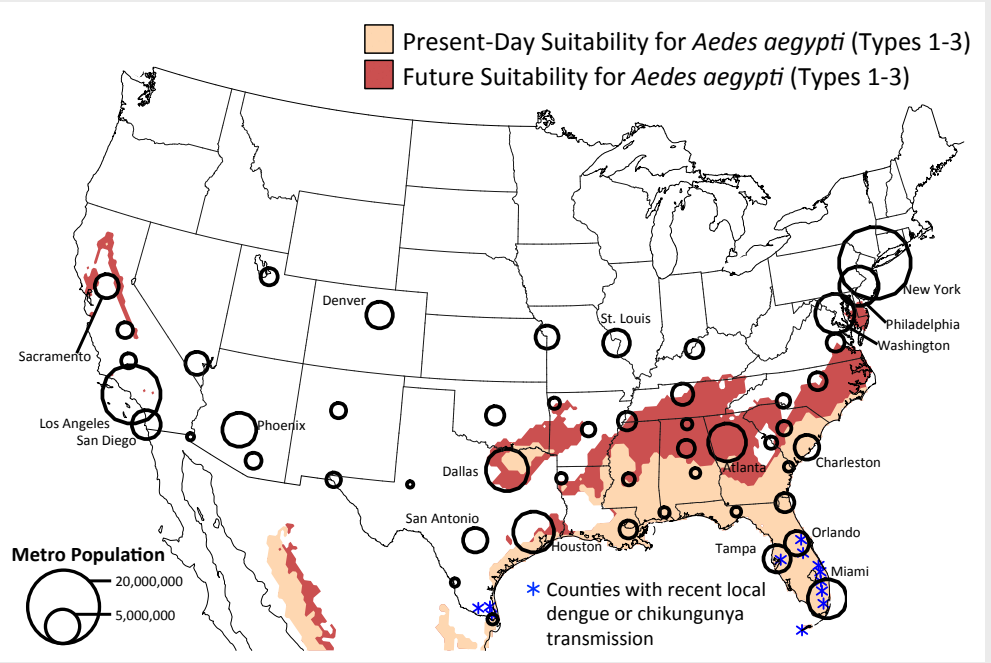
## Adaptation; low emissions

Shindell et al. 2020

# *Ae. aegypti* suitability



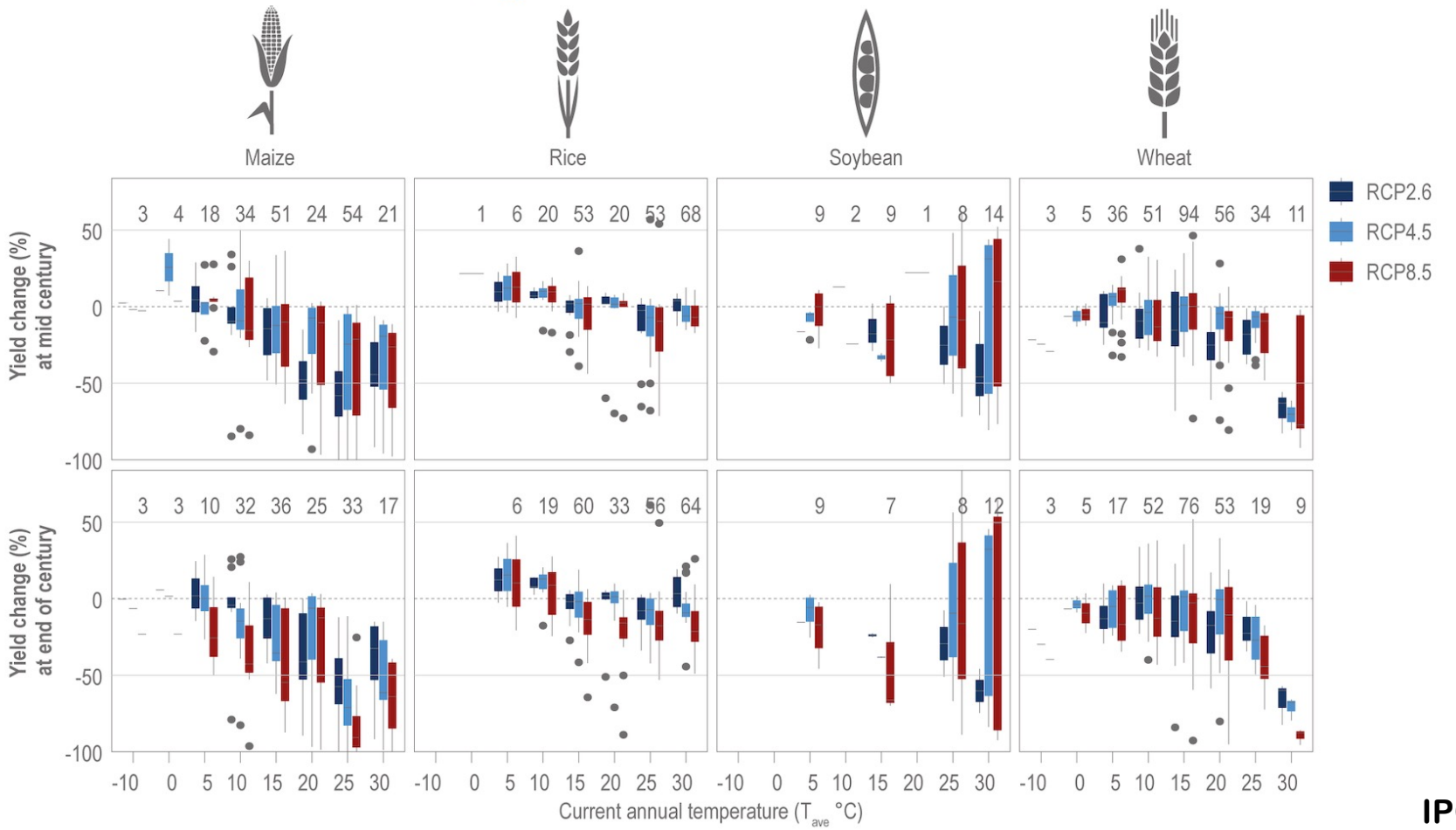

# *Ae. aegypti* transmission suitability




**Map shows the range of the *Aedes aegypti* mosquito for present-day (1950-2000) and future (2061-2080; RCP8.5) conditions. Larger cities have higher potential for travel-related virus introduction and local virus transmission. Adapted from: Monaghan et al. (2016)**

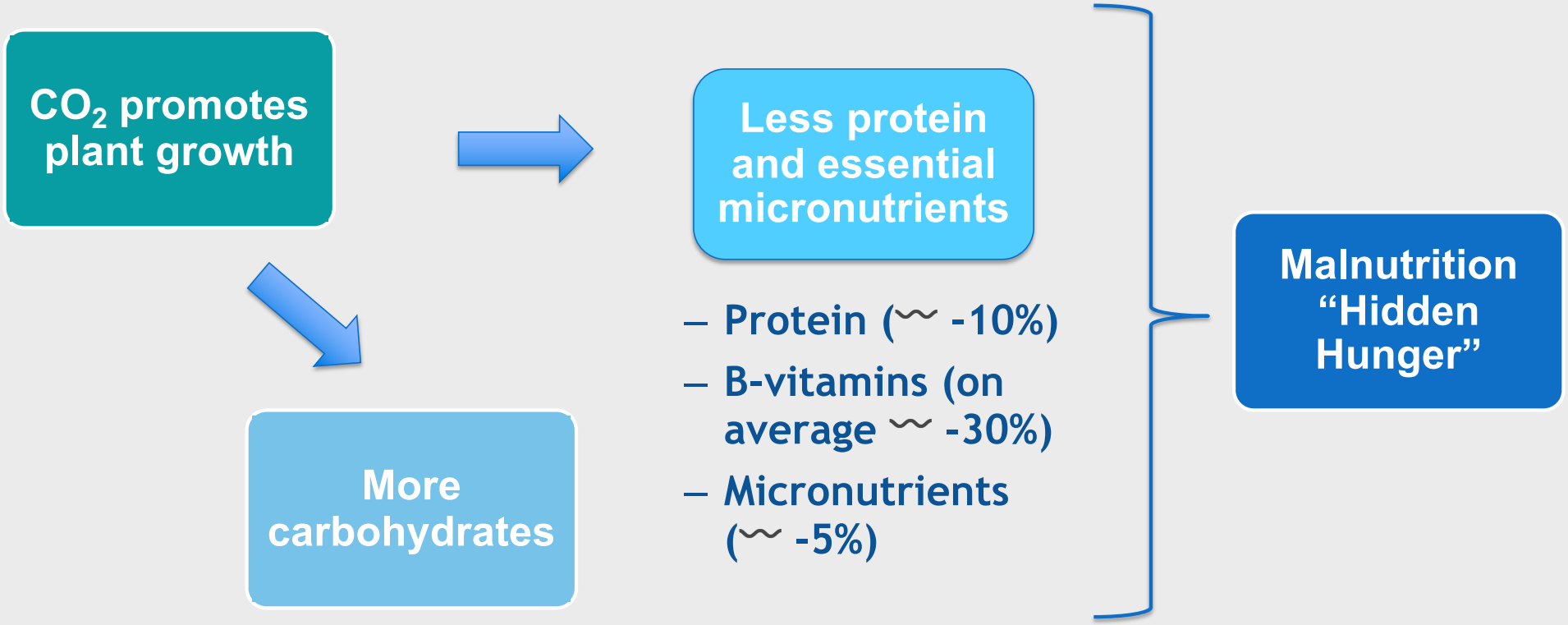
## Projected yield changes relative to the baseline period (2001–2010) without adaptation and with $CO_2$ fertilization effects

(a) As a function of current annual temperature ($T_{ave}$)

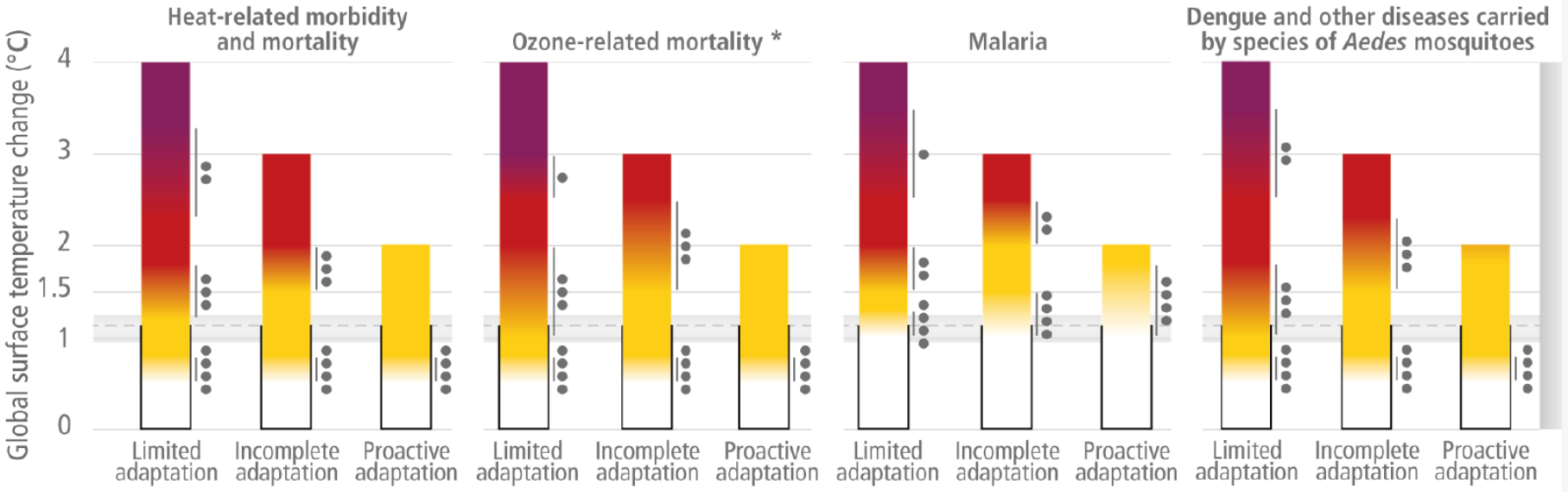



IPCC 2022

# Higher CO2 concentrations alter the nutritional quality of C3 plants



## (e) Climate sensitive health outcomes under three adaptation scenarios




* Mortality projections include demographic trends but do not include future efforts to improve air quality that reduce ozone concentrations.

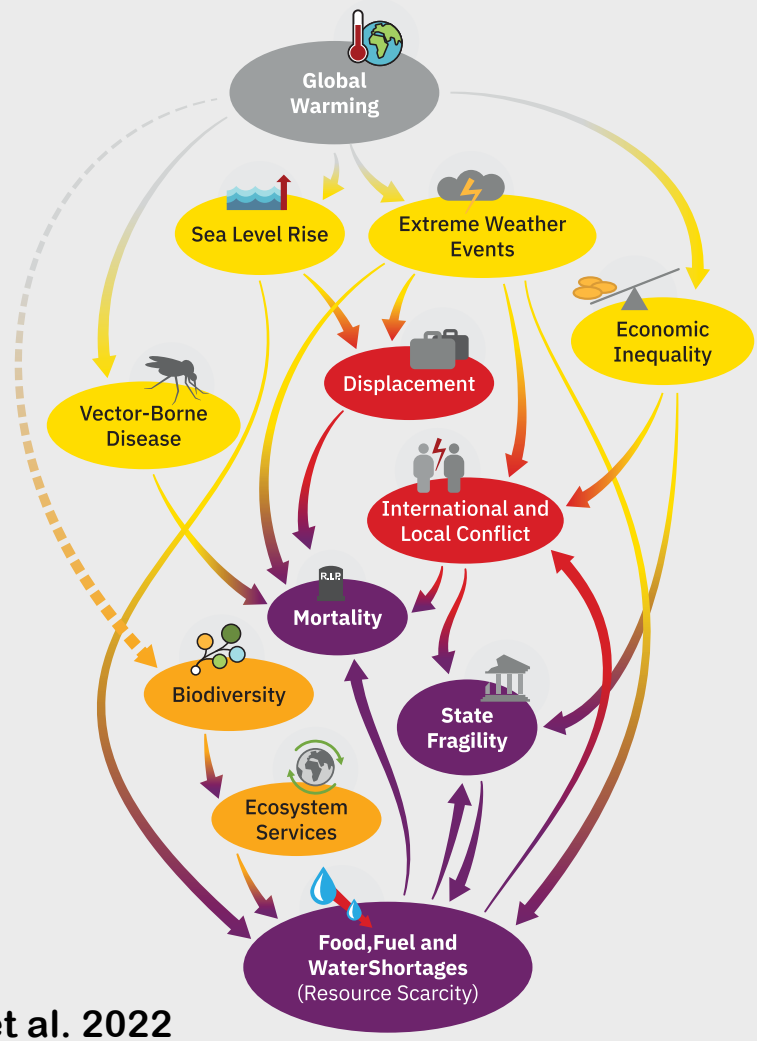
**Scenario narratives**

**Limited adaptation**: Failure to proactively adapt; low investment in health systems

**Incomplete adaptation**: Incomplete adaptation planning; moderate investment in health systems

**Proactive adaptation**: Proactive adaptive management; higher investment in health systems

# Cascading global climate failures




- **Extreme temperatures, droughts leading to crop failures and undernutrition increasing vulnerability to infectious diseases**
- **Floods, storms, and droughts leading to displacement increasing infectious disease outbreaks, including dengue and leishmaniasis**

Kemp et al. 2022

Semenza et al. 2022

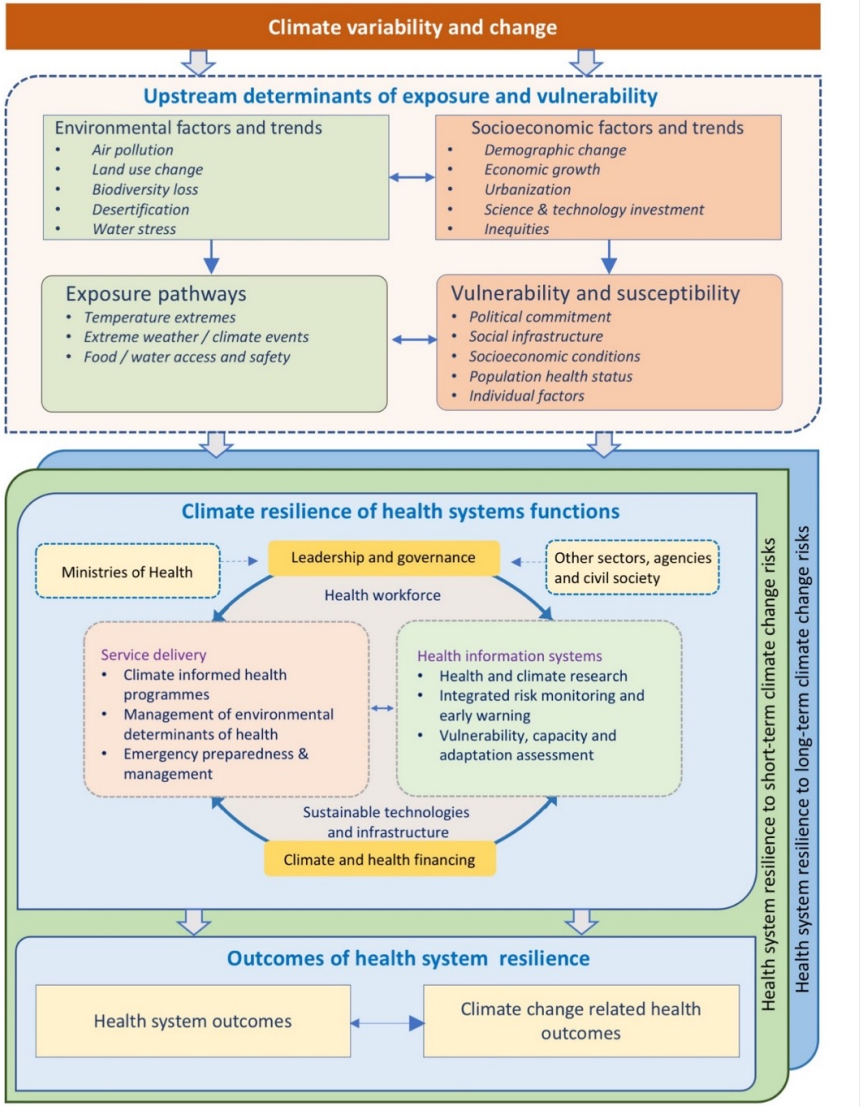
## Effective adaptation options include

- Strengthening the resiliency of health systems
- Protect against exposure to climate hazards, particularly for those at highest risk
  - Heat Action Plans that include early warning and response systems
- Improve access to potable water, reducing exposure of water and sanitation systems to flooding and extreme weather and climate events, and improving early warning systems
- For mental health, improve surveillance, access to mental health care, and monitoring of psychosocial impacts from extreme weather and climate events
- Integrated adaptation approaches that mainstream health into food, livelihoods, social protection, infrastructure, water and sanitation policies

** Major constraint is limited investment

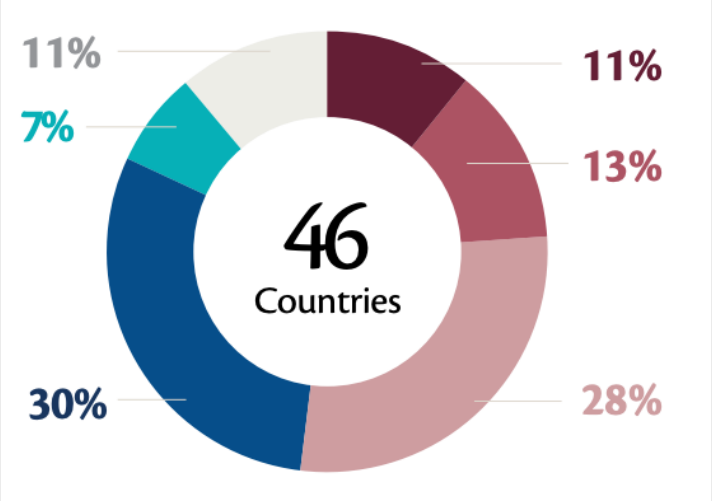
# WHO framework for promoting climate-resilient health systems

- Recognize upstream determinants
- Systems-based approach to promoting climate-resilient health systems
- Health system and climate change health outcomes

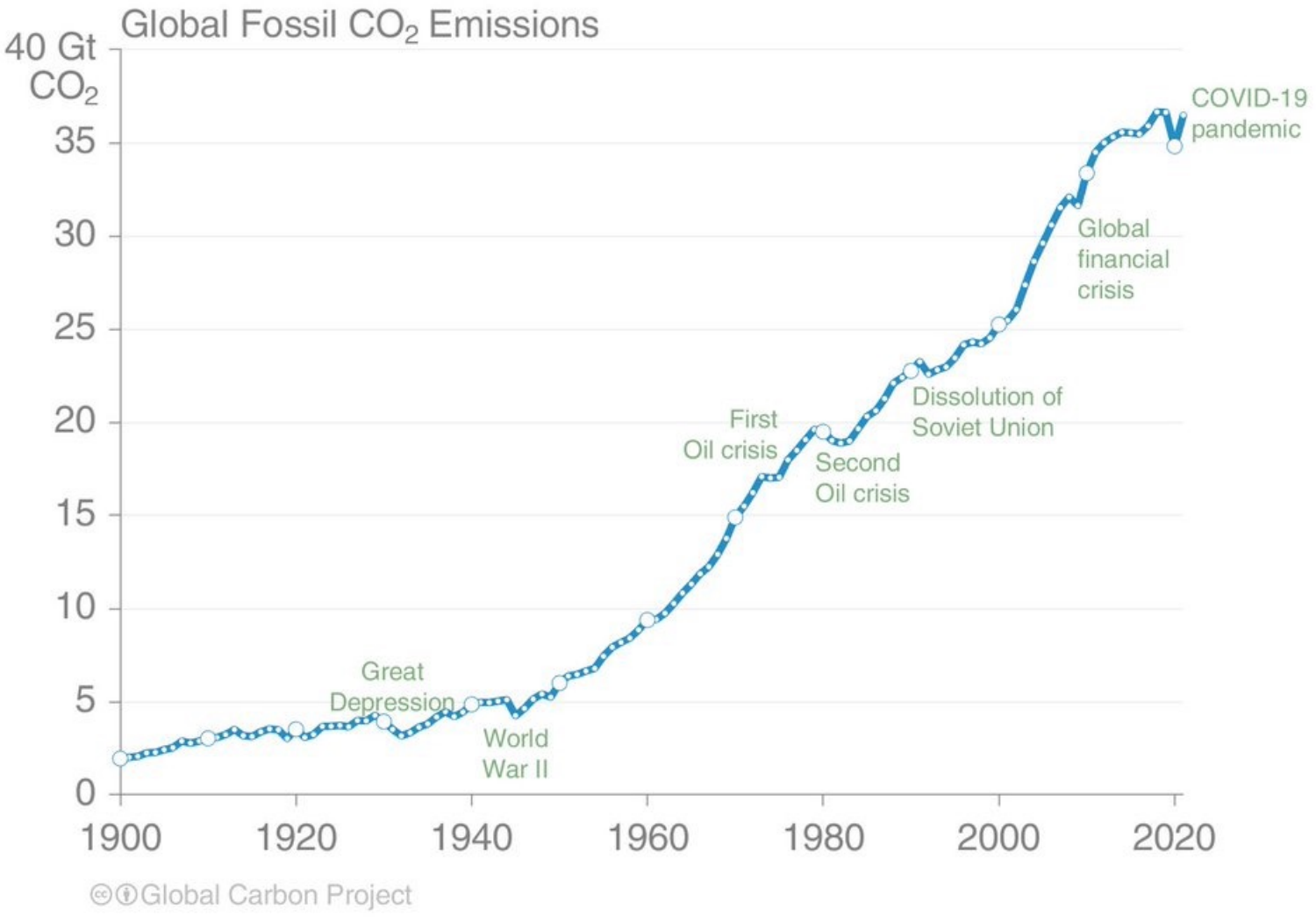


# National health and climate change strategies

- **In 2021, 49 of 95 countries reported having a national health and climate change strategies or plans in place**
  - **48 had completed a V&A**
  - **Of which, 18 reported that the findings strongly influenced health policy**
  - **Only 9 reported that the findings strongly influenced resource allocation**
  - **Implementation remains a challenge, as well as equity issues – e.g., inclusion of gender considerations is limited**




2022 Report of the Lancet Countdown; 2021 WHO Health and Climate Change Global Survey


Global Fossil $CO_2$ Emissions
40 Gt $CO_2$
35
30
25
20
15
10
5
0
1900
1920
1940
1960
1980
2000
2020
COVID-19 pandemic
Global financial crisis
Dissolution of Soviet Union
First Oil crisis
Second Oil crisis
Great Depression
World War II
Global Carbon Project

## ENERGY

*(emissions primarily from electricity production for homes, workplaces, schools, and hospitals)*

***Health benefits that arise from reduced air pollution***

**Mitigation measures that:**

- Develop clean energy technologies
- Improve energy efficiency
- Change the energy system structure
- Expand renewable energy use
- Reduce fossil fuel use

Introduction of global carbon price >

▼ 1M

prevented deaths by 2050

▲ 27%

US solar energy increase >

US$298B

in public-health benefits

## AGRICULTURE

*(emissions from animal and plant food production, and soil)*

***Health benefits that arise from eating a low-emissions diet***

**Mitigation measures that:**

- Increase livestock farming efficiency
- Increase sustainable land management and use, eg regenerative agriculture practices
- Reduce fossil fuel use
- Reduce animal-based food production
- Reduce food transportation
- Improve agricultural technology

Transition to plant-based diet >

▼ 70%

reduction in GHG emissions

▼ 10%

prevented deaths by 2050

Replace 50% meat and dairy in UK >

▼ 37,000

prevented deaths from heart disease and cancer per year

## BUILDINGS AND CITIES

*(emissions associated with building materials, heating and cooking, and urban planning)*

***Health benefits that arise from clean and efficient buildings, compact cities, active living and reduced air pollution***

**Mitigation measures that:**

- Reduce fossil fuel-powered energy use and incentivise renewable energy sources
- Increase energy efficiency
- Provide equitable, accessible, and affordable public transport
- Increase safe walking and cycling infrastructure
- Increase use of low-carbon building materials

Energy-efficient measures > reduce $CO_2$ emissions

▼ 55 Mt

2000–2016 green building standards >

▲ US$5.8B

in climate and health benefits

## INDUSTRIAL

*(emissions from processes used to produce goods and materials)*

***Health benefits that arise from reduced toxins and air pollution***

**Mitigation measures that:**

- Reduce emissions intensity
- Improve energy efficiency
- Expand renewable energy use
- Reduce fossil fuel use
- Increase the use of low-emission materials

65%

renewable energy in China by 2050 >

US$222B

worth of health benefits

Electrifying industrial sectors >

▼37M

prevented premature deaths by 2060

## TRANSPORT

*(emissions from cars, buses, trucks, ships, trains, and planes)*

***Health benefits that arise from reduced air and noise pollution and increased physical activity***

**Mitigation measures that:**

- Decrease the use of motor vehicles
- Where motor vehicles are used, prioritise public over private transport and increase use of low- or zero-emission (eg, electric) models
- Increase active transport (eg, walking, cycling) and public transport

▲ 18 mins

increase in walking & cycling per day >

▼ 14%

reduction in GHG emissions

Replace 10% car trips with cycling in NZ >

USD$308M

saving in health costs

## NATURE-BASED SOLUTIONS

*(sustainable solutions that are supported by nature and address emissions associated with deforestation and ecosystem degradation)*

***Health benefits that arise from increased green space and its use***

**Mitigation measures that:**

- Restore and Increase land and soil health
- Improve freshwater and marine ecosystems
- Increase forestation, conservation, protected areas and urban greening

30 mins

green space use per week > reduce depression and high blood pressure

▲ 10%

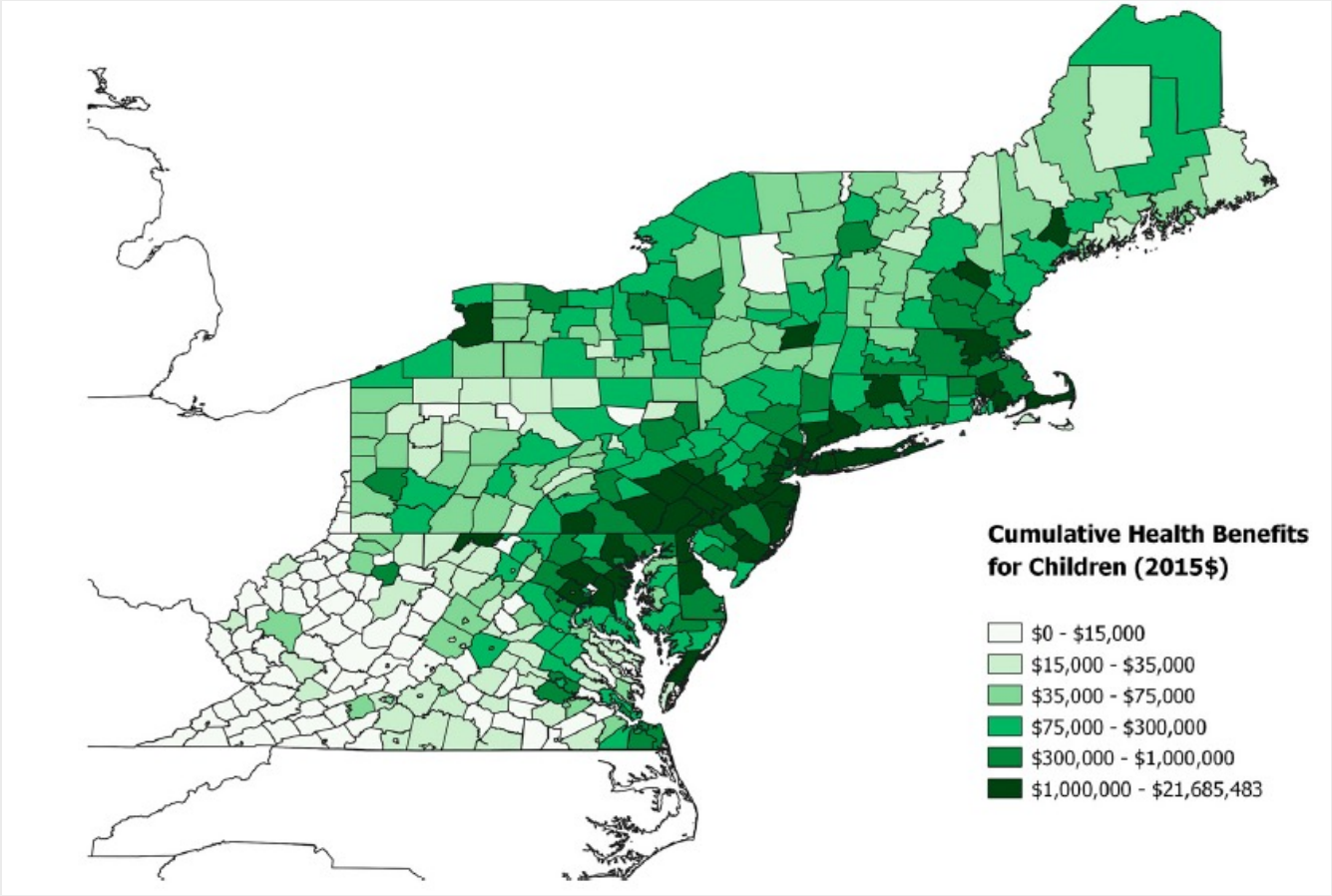
increased neighbourhood tree canopy >

▼ 400

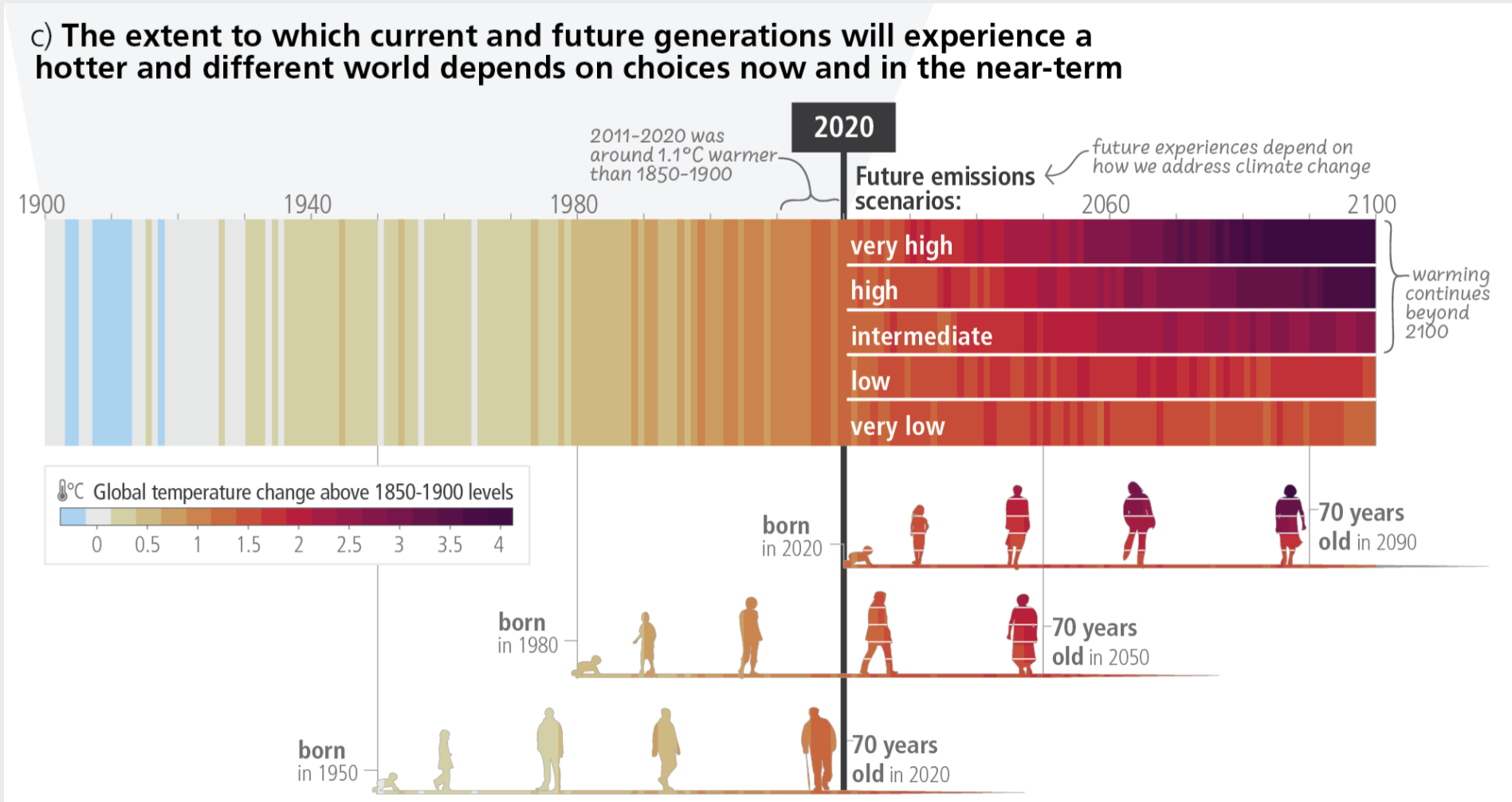
prevented premature deaths per year

Bowen & Workman 2022

# Economic benefits of avoided cases of child health outcomes attributed to the U.S. Regional Greenhouse Gas Initiative by county, 2009 to 2014




Perera et al. 2020


c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term
2020
2011-2020 was around 1.1°C warmer than 1850-1900
future experiences depend on how we address climate change
Future emissions scenarios:
1900
1940
1980
2060
2100
very high
high
intermediate
low
very low
warming continues beyond 2100
°C Global temperature change above 1850-1900 levels
0
0.5
1
1.5
2
2.5
3
3.5
4
born in 2020
70 years old in 2090
born in 1980
70 years old in 2050
born in 1950
70 years old in 2020

IPCC 2023