Managing the health risks of climate change

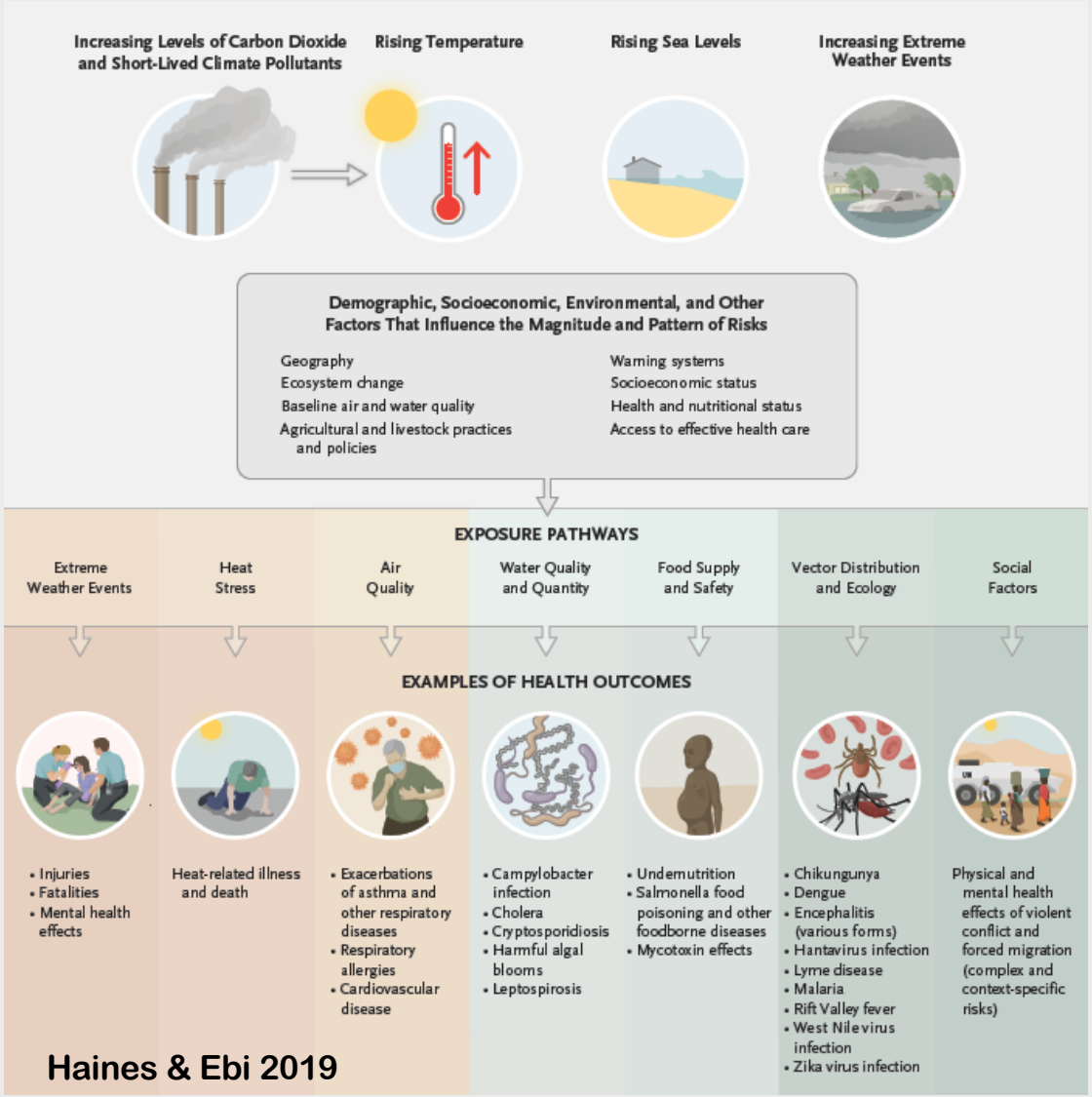
Kristie L. Ebi, Ph.D., MPH

UW Medicine
SCHOOL OF MEDICINE

DEPARTMENT OF GLOBAL HEALTH
UNIVERSITY of WASHINGTON

SCHOOL OF PUBLIC HEALTH
UNIVERSITY of WASHINGTON

IPCC 2022



Haines & Ebi 2019

Key conclusions of the IPCC 2022 chapter on human health

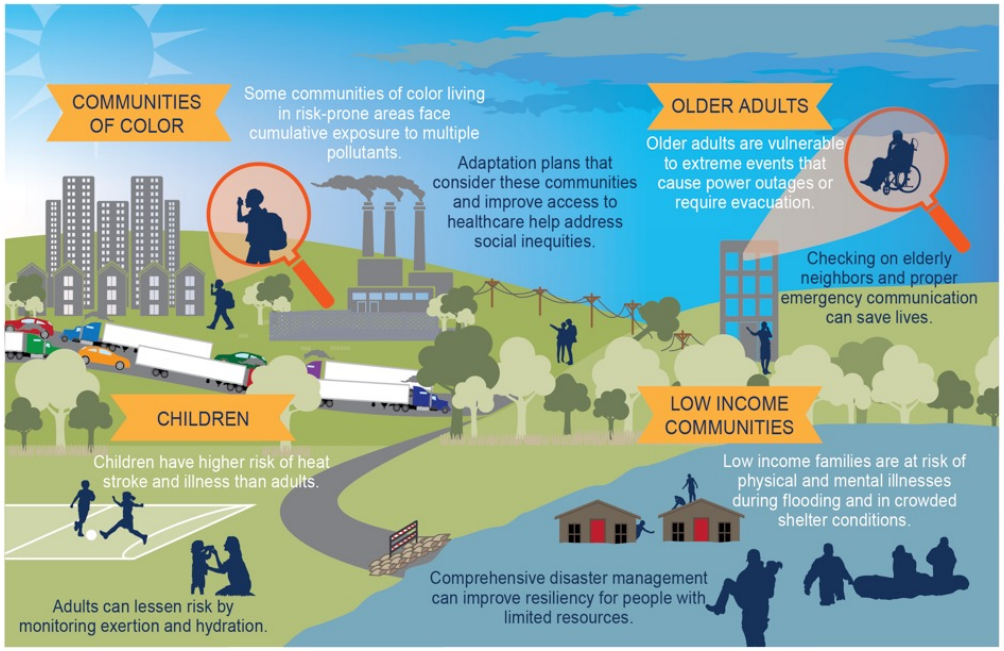
Observed impacts: *climate change is adversely affecting the physical health of people globally and mental health of people in assessed regions*

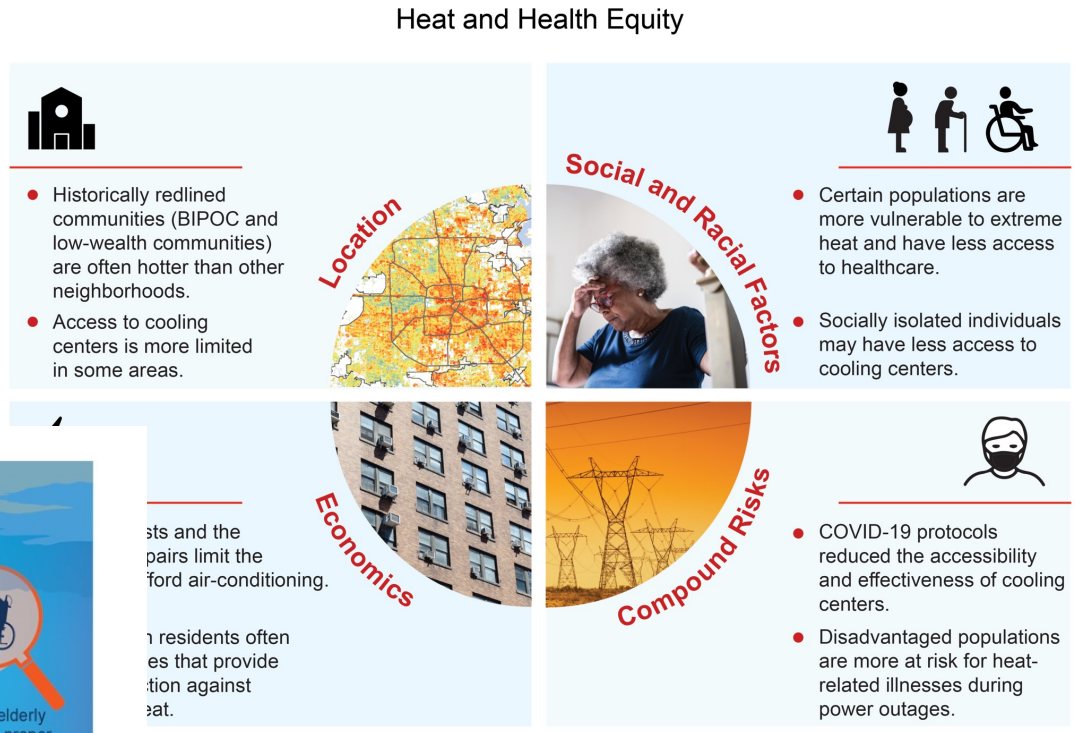
- Extreme heat events
- Vector-borne and zoonotic diseases
- Water and food-borne diseases
- Some mental health challenges
- Health services disrupted by extreme events such as floods

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 vulnerability vary across populations





US NCA4 2018

US NCA5 2023

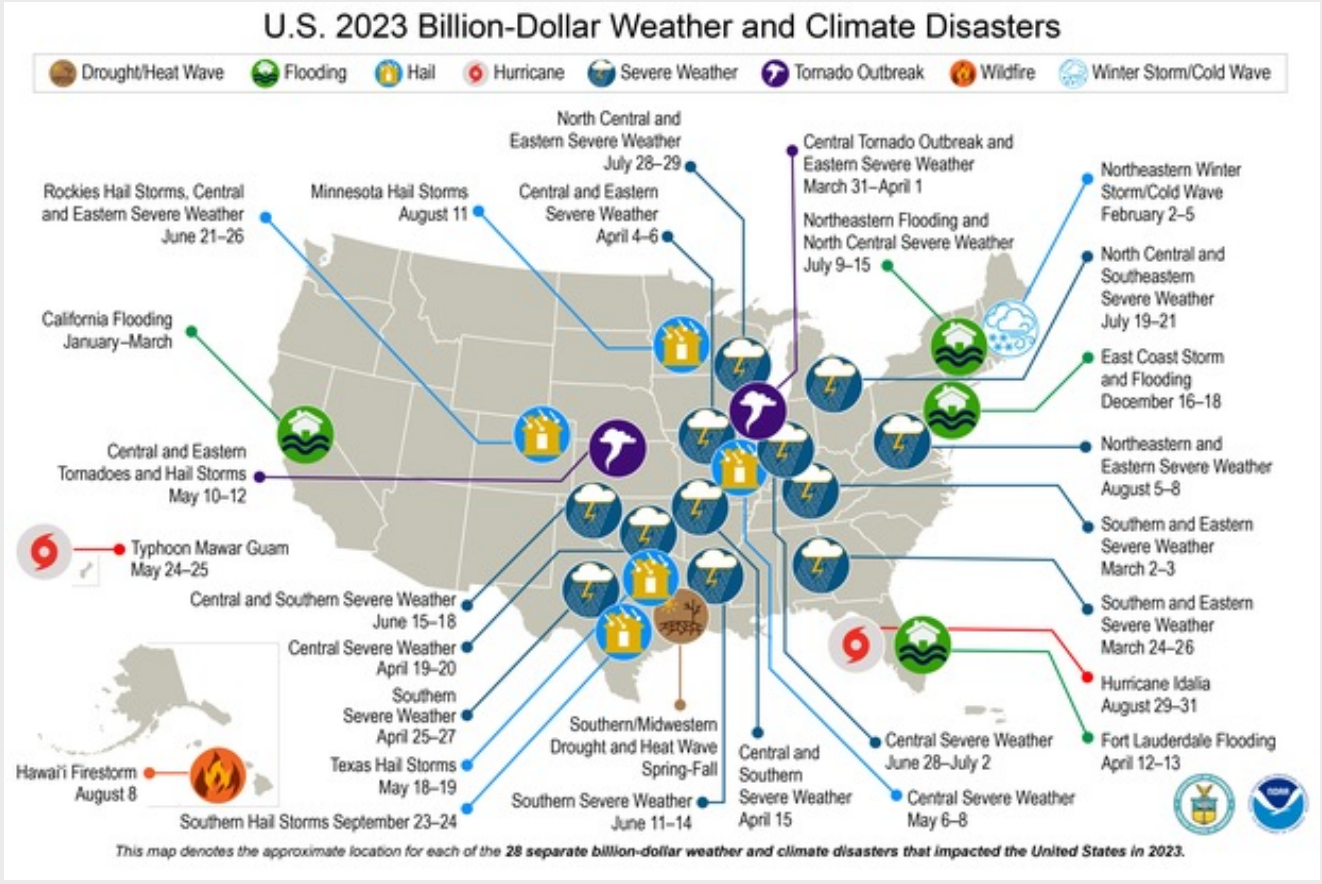
2023 significant economic loss events

USD 93 billion disaster losses in 2023

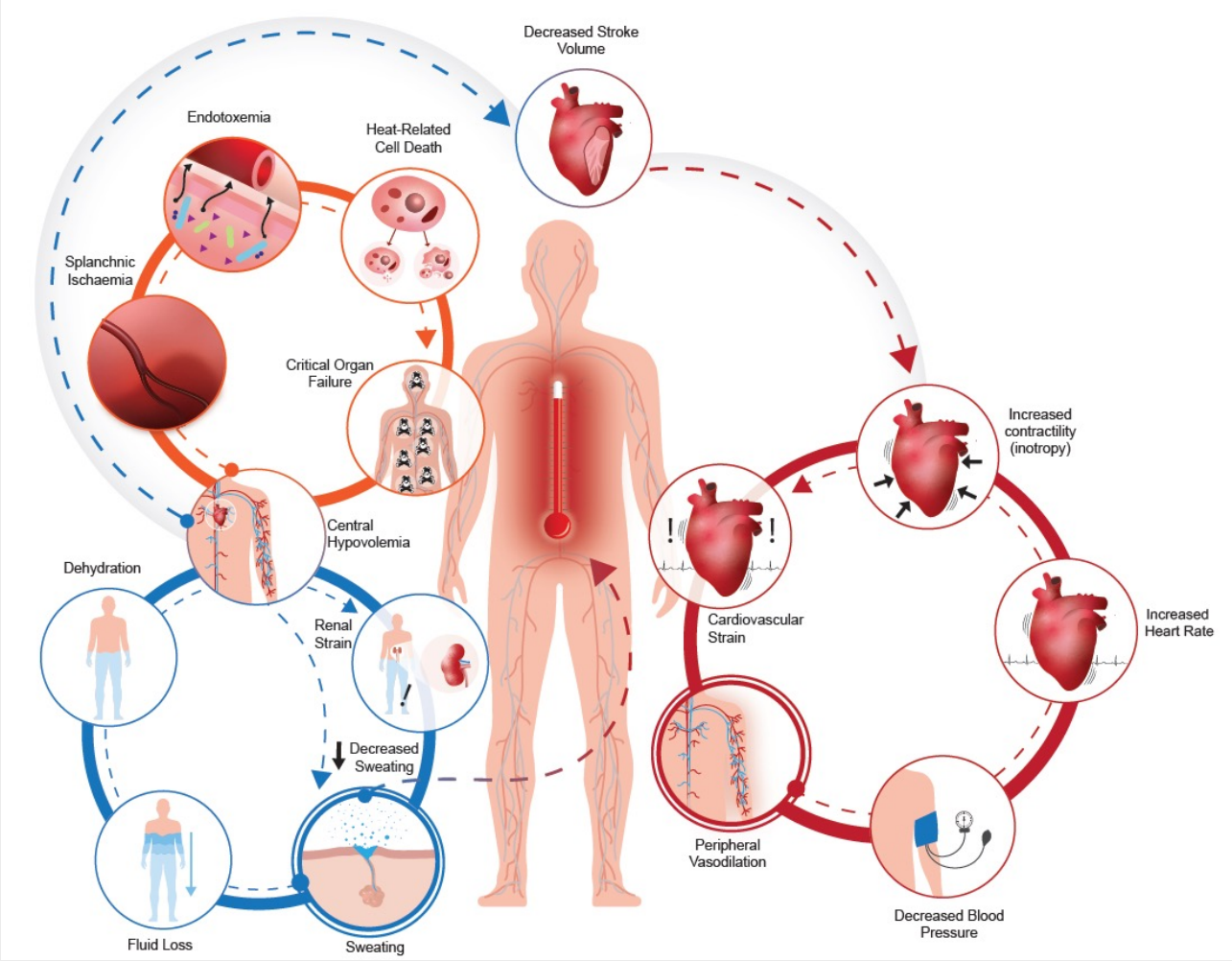
28 separate events

492 direct or indirect fatalities

>47,000 died in heatwaves in Europe



Physiological pathways of human health strain



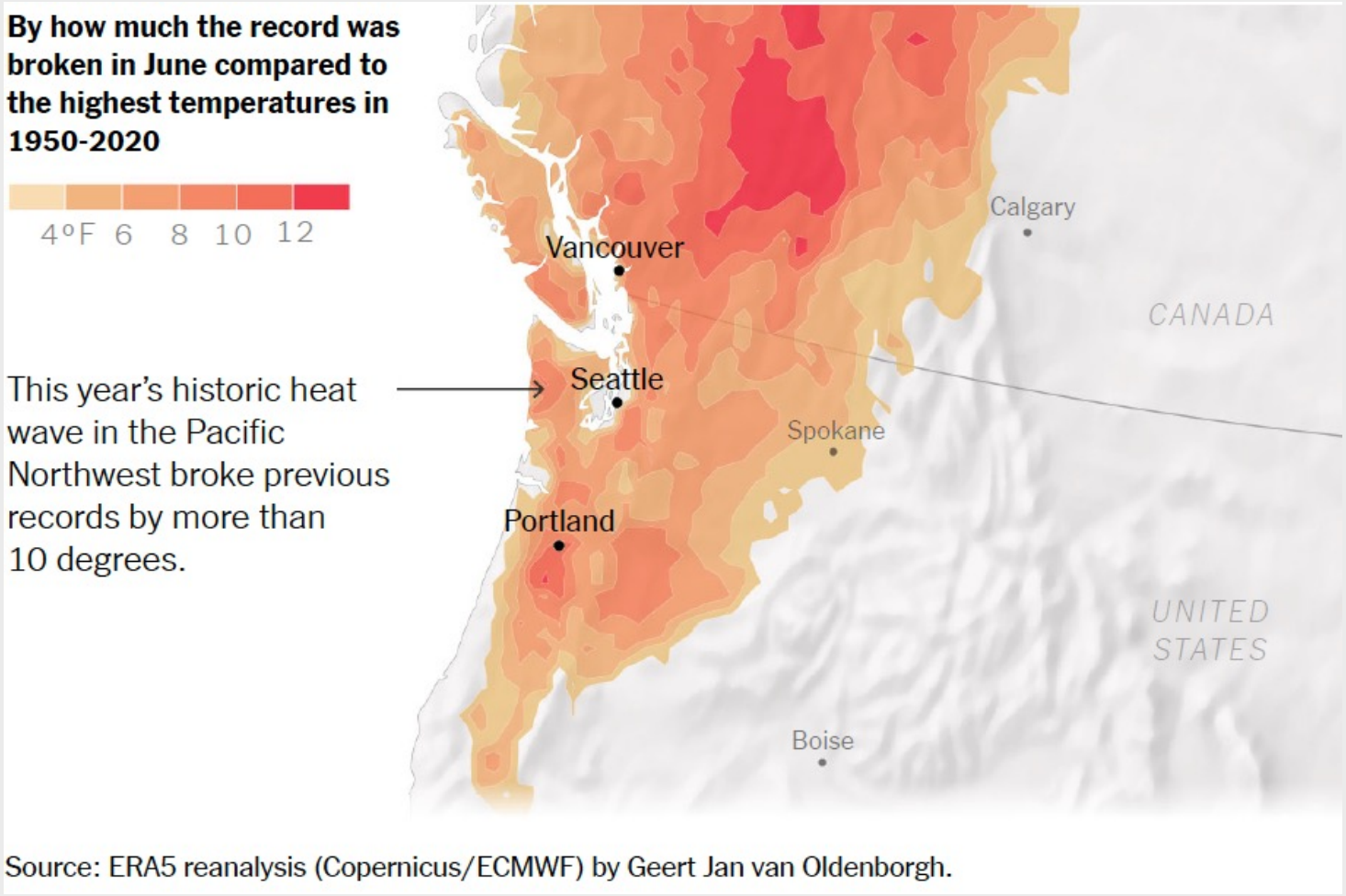
Ebi et al. 2021

Exposure of vulnerable populations to heatwaves

- In 2013-2022, infants (children younger than 1) and people older than 65 years experienced, on average 108% more heatwave days than compared with 1986-2005
- Compared with 1986-2005, the number of heatwave days increased 94% globally
  - For infants, an increase of 4.4 days per year on average
  - For adults over 65 years, an increase of 4.8 days per year on average
- Combined with demographic changes, total person-days of exposure increased 134% for infants and 228% for older adults

2023 Report of the Lancet Countdown

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

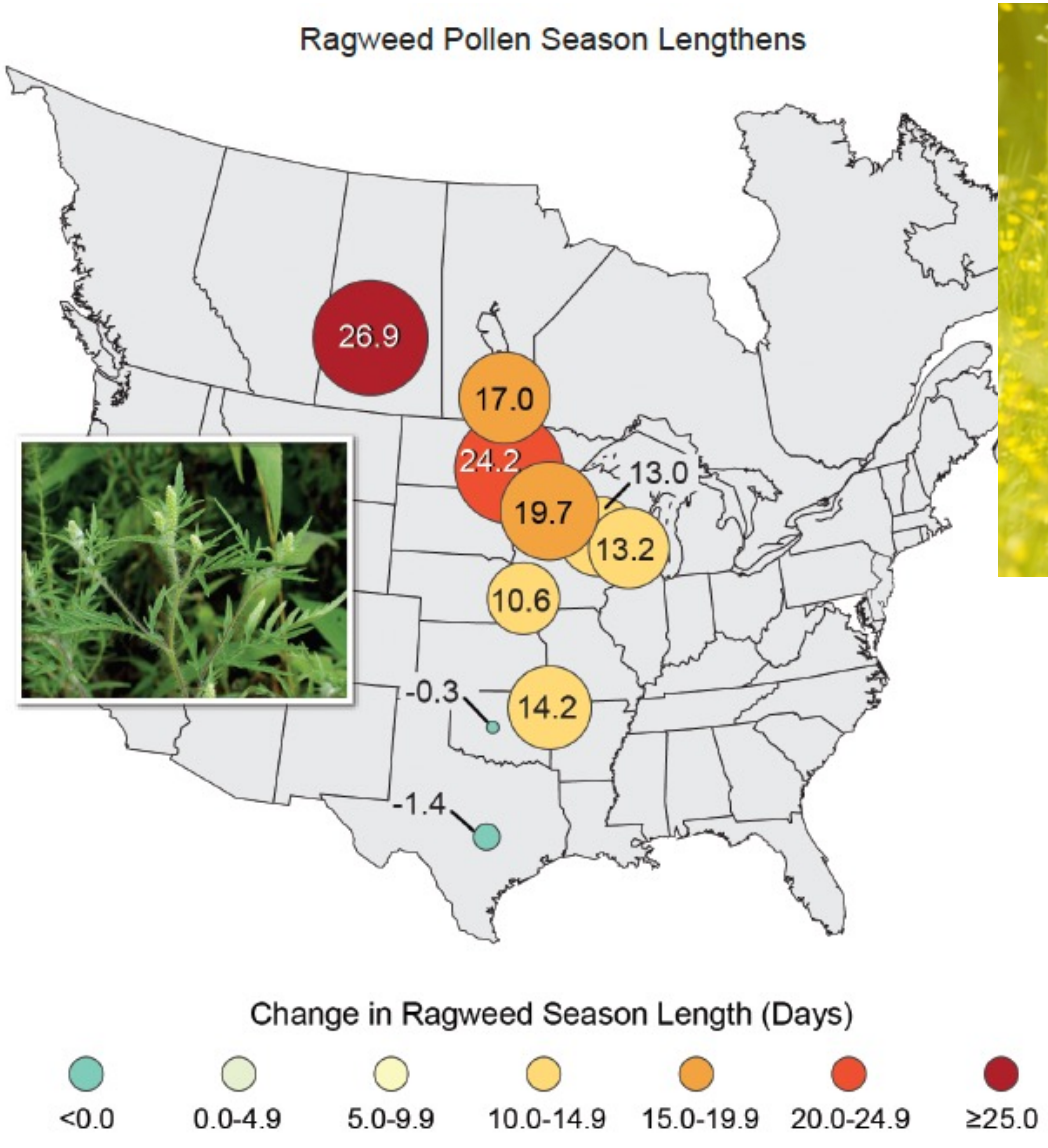
Heat extremes and hot weather are harming health. While mitigating climate change is vital, the inevitble rise in global temperature is expected to exacerbate these harms in future, and identifying opportunities for applying sustainable cooling strategies in heat-vulnerable settings is also important

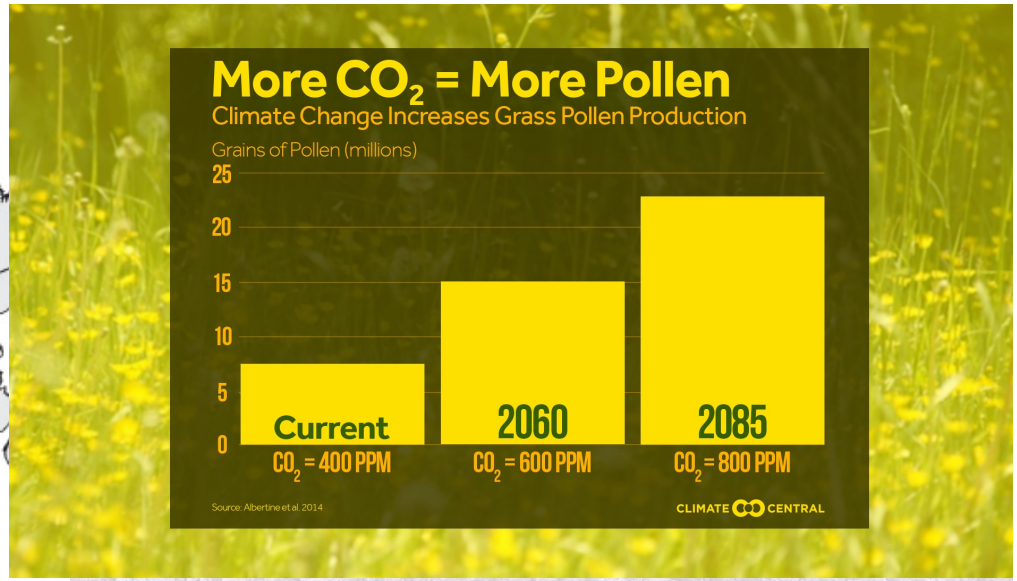
1=to be used up to 38˚C; 2=if water sanitation allows; 3=at a temperature that is most palatable (eg, ~10˚C); 4=without compromising any required protective equipment

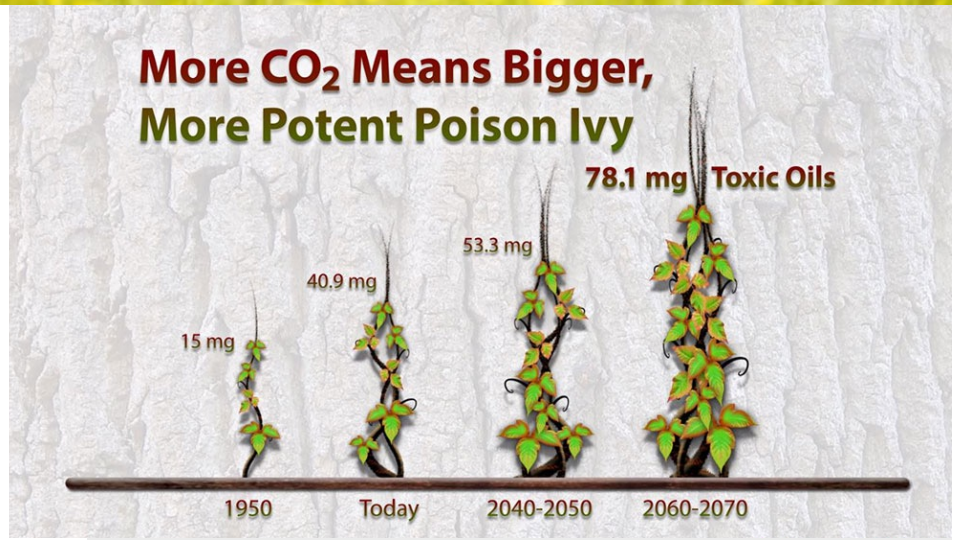
5=heat-reflective window glass; 6=playing surfaces that minimise heat retention and emitted radiation; 7=breathable tents; 8=insulating roofs and walls

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

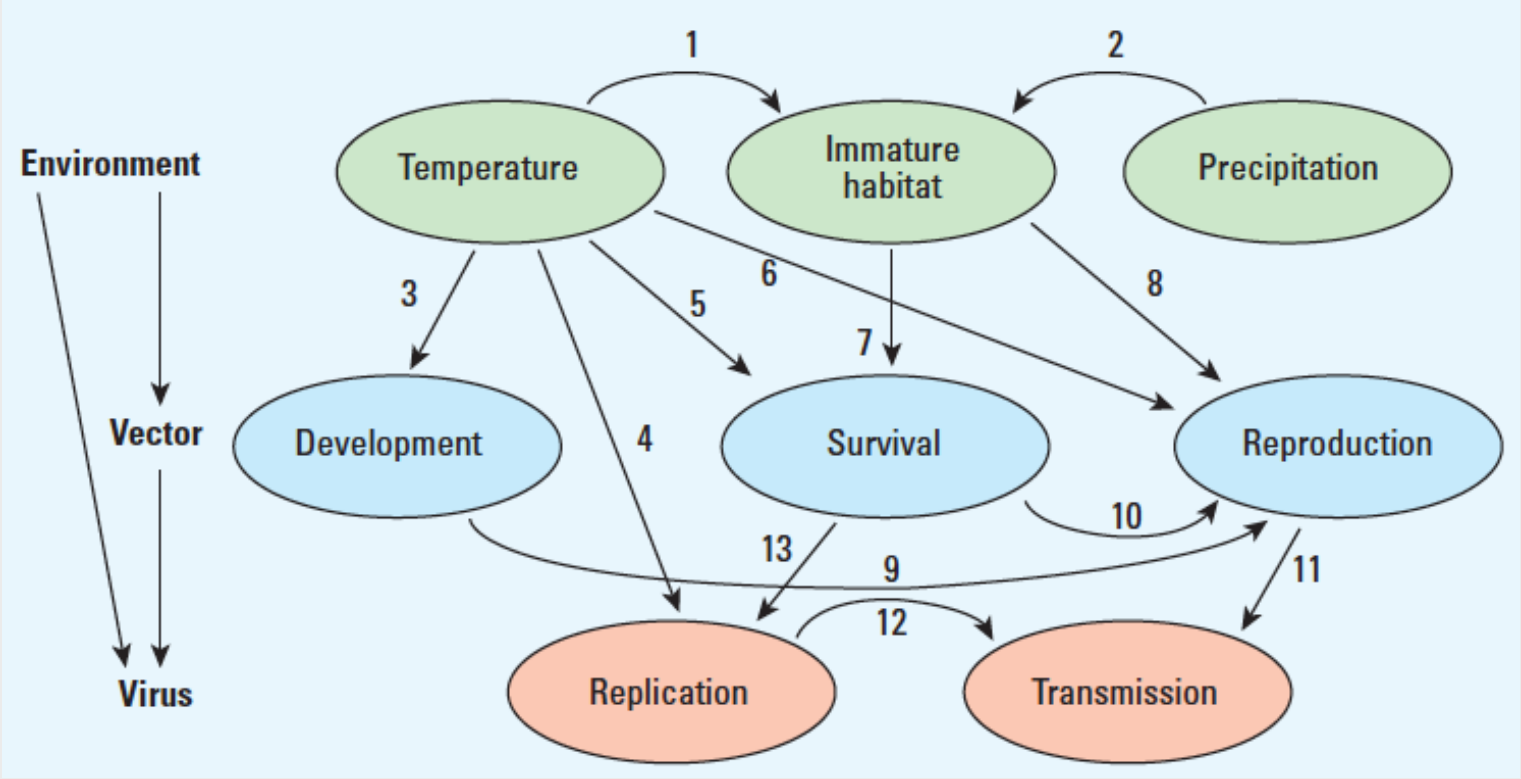
Jay et al. 2021


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

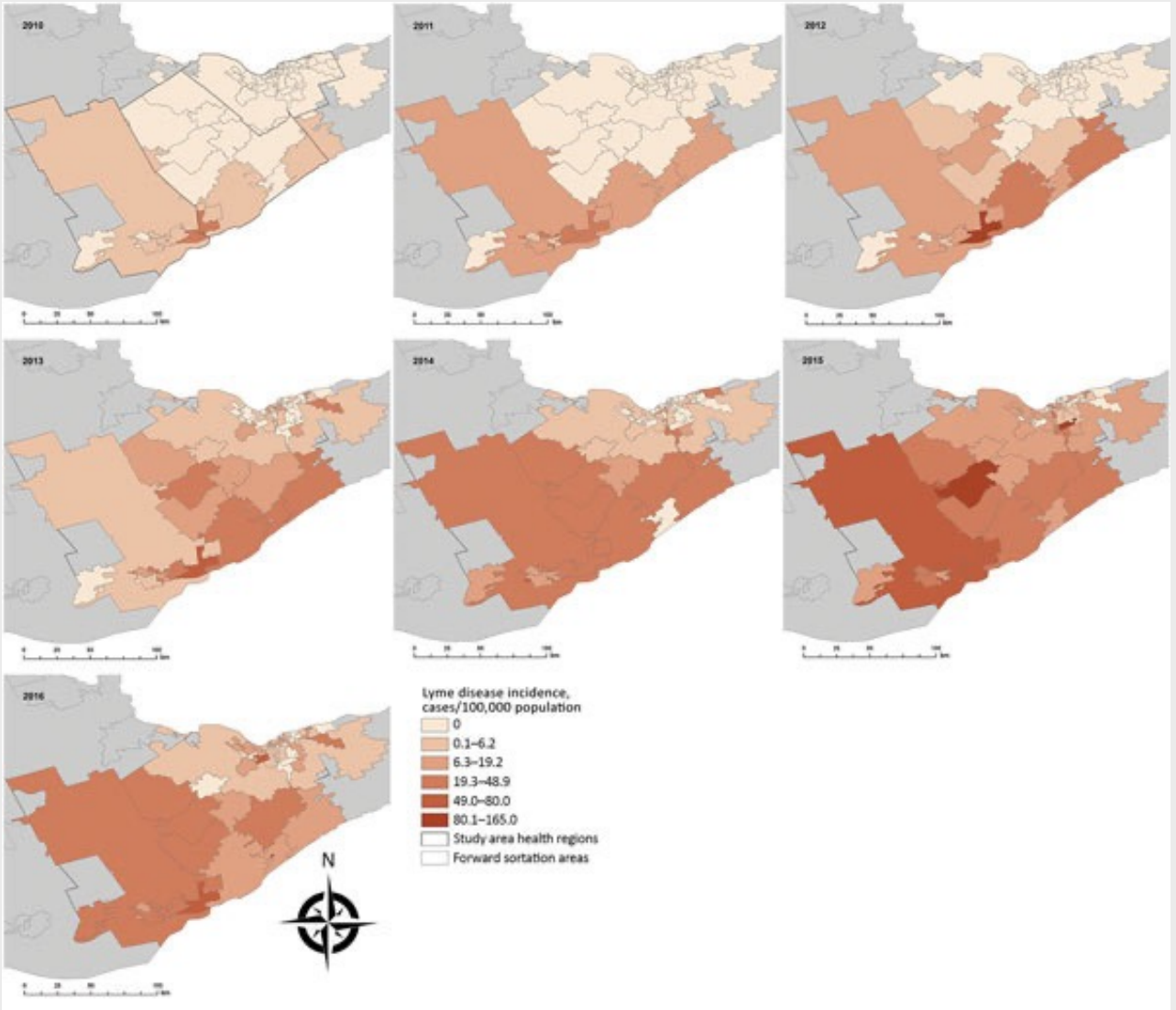
Biophysical influences on dengue ecology showing the interactions between climate variables, vectors, and the virus



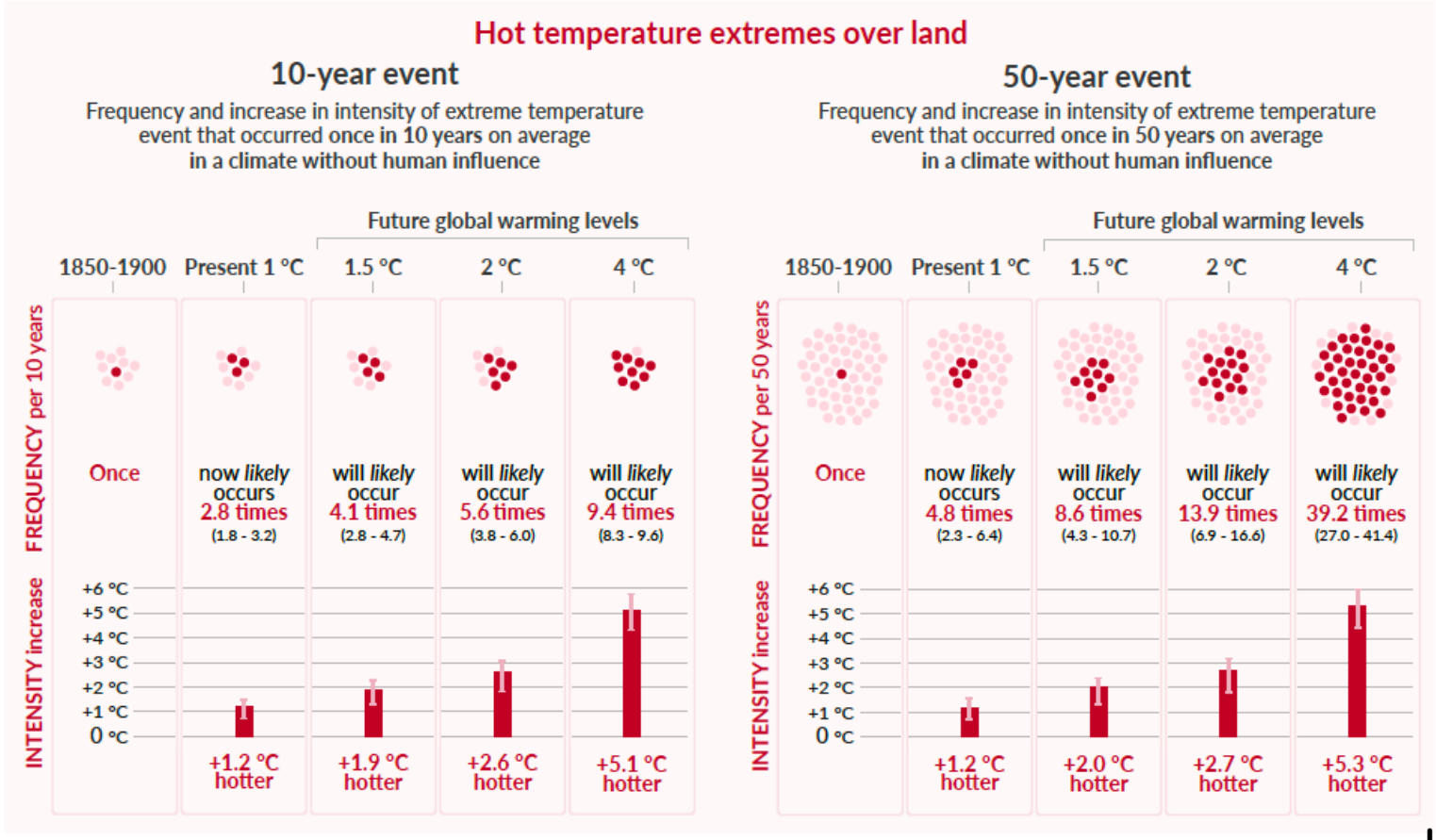
Morin et al. 2013

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

Kulkarni et al. 2019



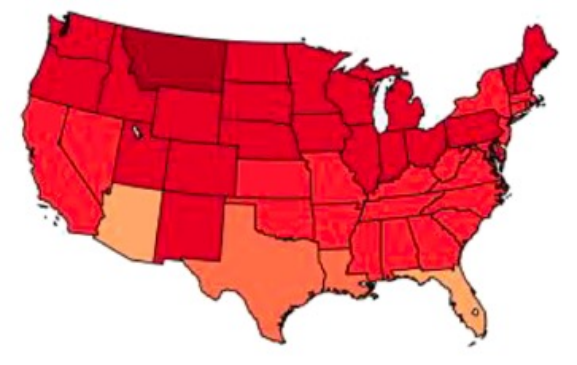
Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming

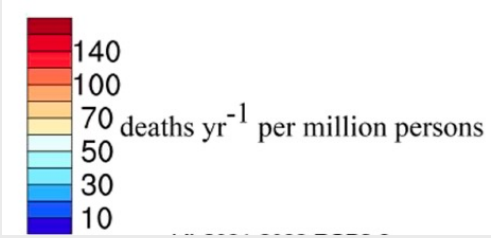


IPCC WGI 2021

Projected annual heat-related deaths in 2091-2099

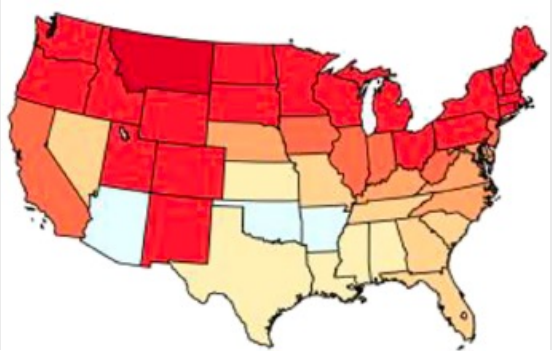
No adaptation; high emissions





No adaptation; low emissions

Adaptation; high emissions

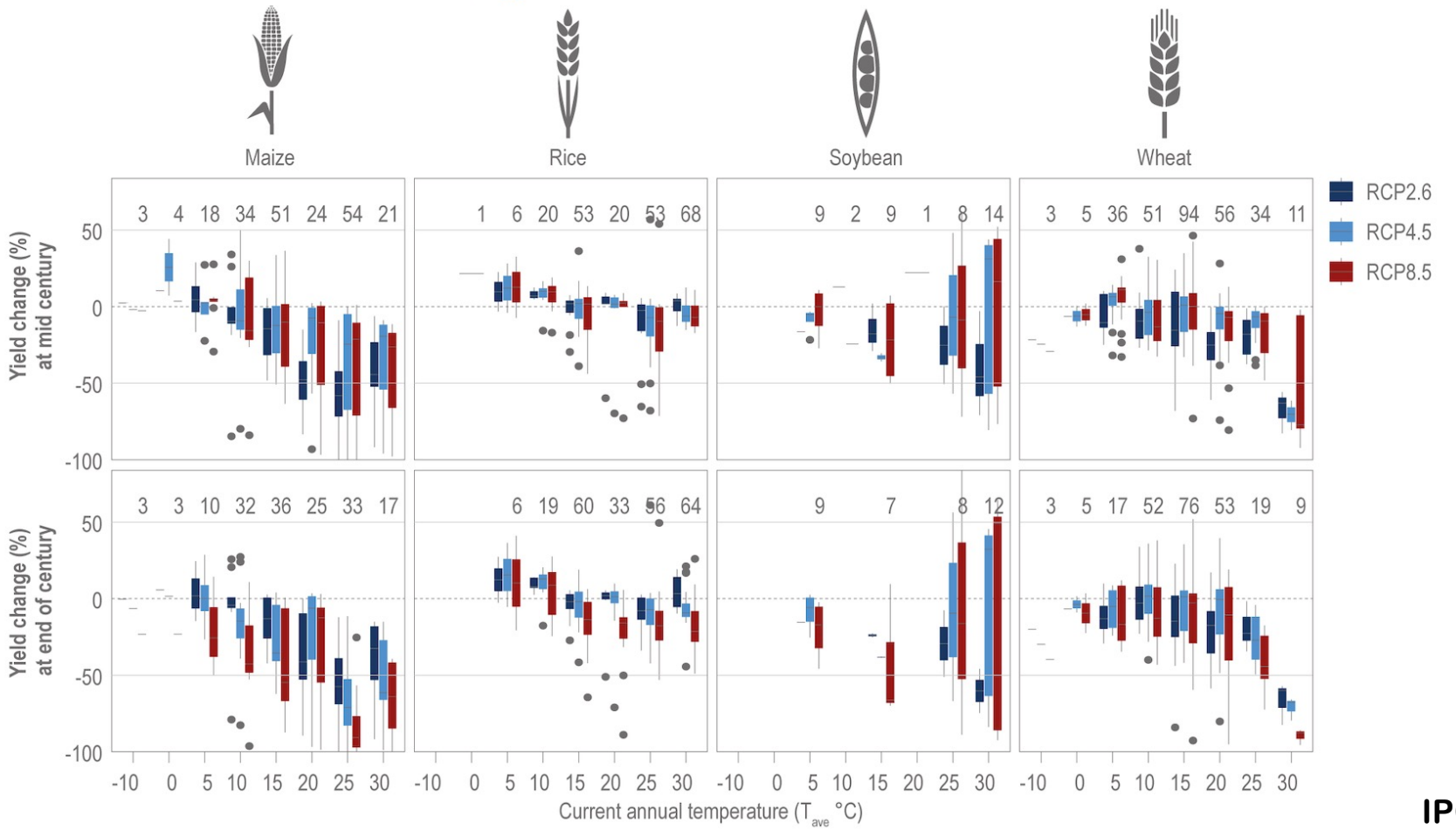


Adaptation; low emissions

Shindell et al. 2020

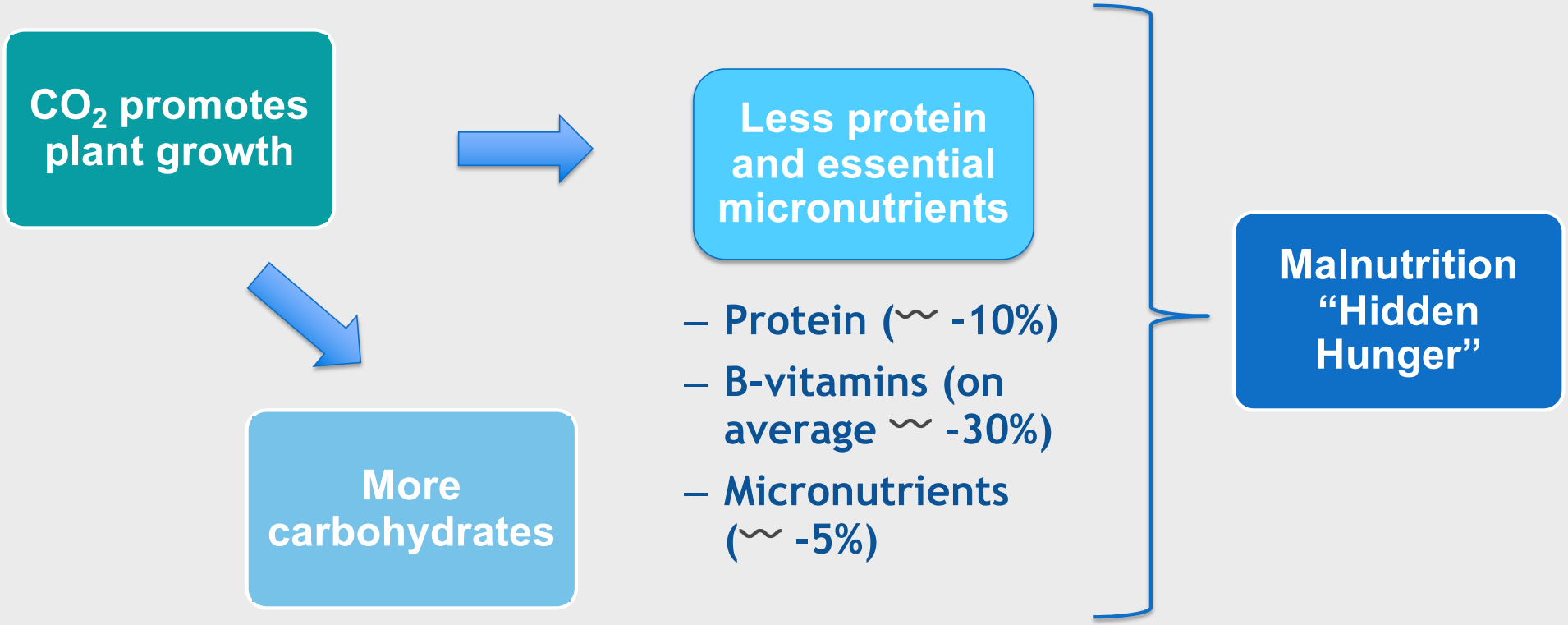
Projected yield changes relative to the baseline period (2001–2010) without adaptation and with CO_2 fertilization effects

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

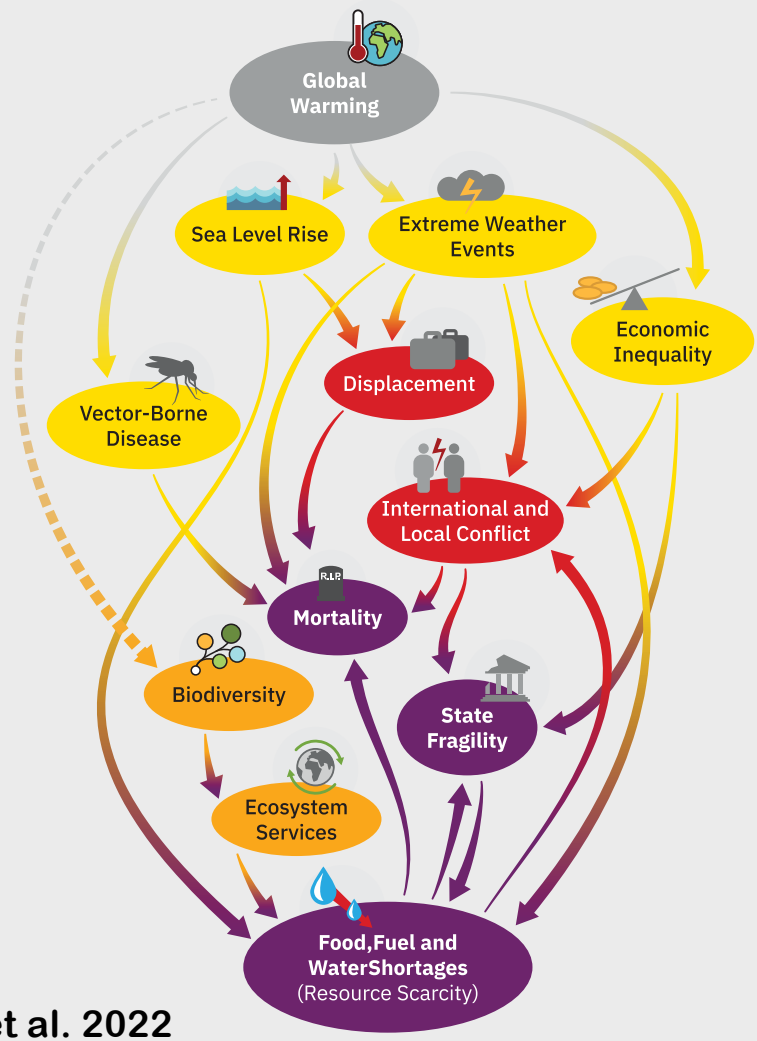


IPCC 2022

Higher CO2 concentrations alter the nutritional quality of C3 plants



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

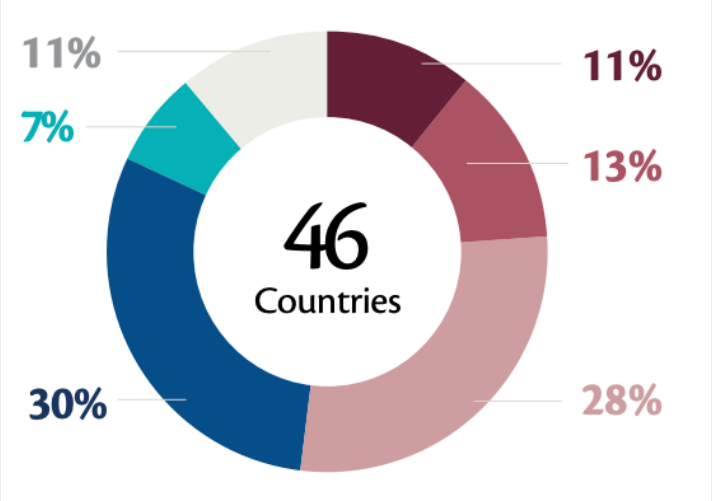
Effective adaptation options include

- 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

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

Co-benefits – early health gains from wise climate moves

Shifting 5% of short urban car trips to bicycles in New Zealand would save annually

- 22 million liters of fuel
- 116 deaths due to increased physical activity (vs. 5 extra road crash deaths)
- $200 million in health costs

ANZJPH 2011

Mental Health Impacts of Climate Change: An Overview

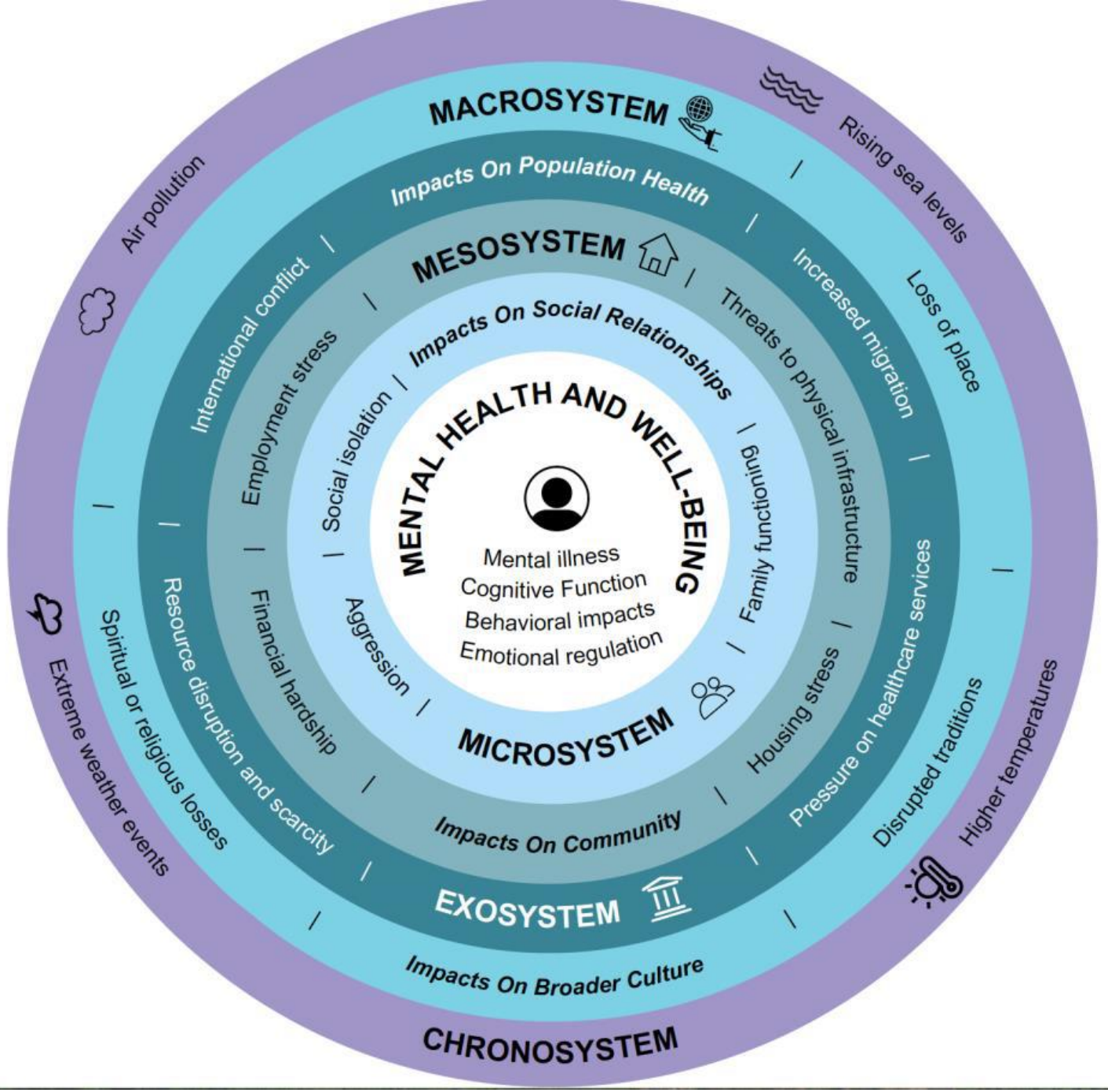
Susan Clayton

Presentation for the Northwest Mental Health Technology Transfer Center

29 August 2024

THE COLLEGE OF WOOSTER

How does climate change affect mental health?



Thinking broadly about climate change

- Acute events
  - Storms, wildfires, floods
- Chronic changes
  - Increased heat, rising sea levels, changing patterns of precipitation, loss of biodiversity, impaired air quality
- Indirect impacts
  - Displacement, threats to physical health, threats to economic wellbeing
- Impacts of perceptions
  - Existential anxiety about an uncertain future

Acute impacts: extreme weather events

- PTSD, depression, general anxiety
- Suicide
- Misuse of drugs and alcohol
- Sleep disorders
- Domestic and interpersonal violence

E.g., 2017's Hurricane Maria in Puerto Rico

More than 1/5th needed mental health services

13% increased use of medication for emotional problems

Suicide increased by 18%

The rate of PTSD doubled

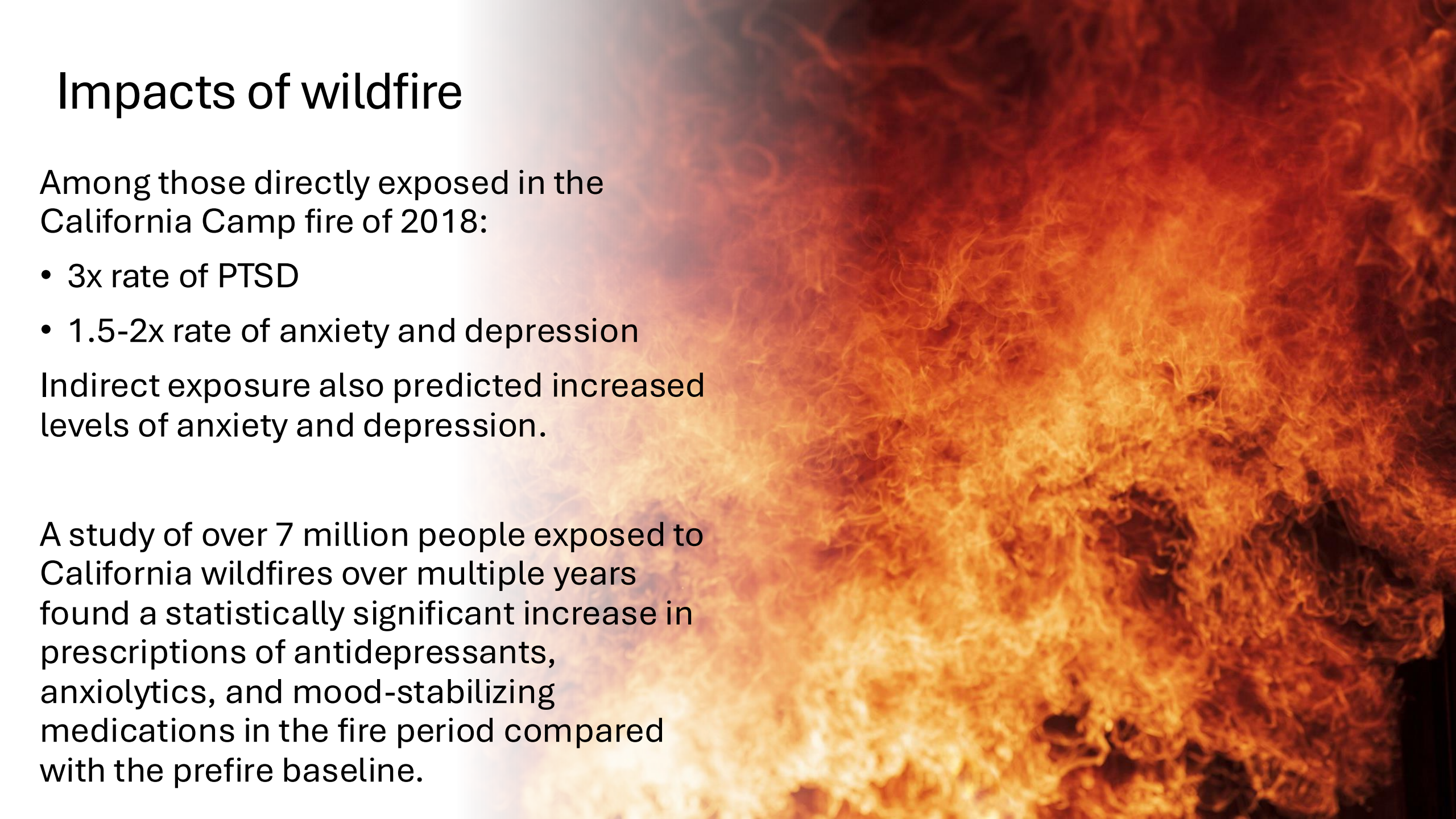
Impacts of wildfire

Among those directly exposed in the California Camp fire of 2018:

- 3x rate of PTSD
- 1.5-2x rate of anxiety and depression

Indirect exposure also predicted increased levels of anxiety and depression.

A study of over 7 million people exposed to California wildfires over multiple years found a statistically significant increase in prescriptions of antidepressants, anxiolytics, and mood-stabilizing medications in the fire period compared with the prefire baseline.



Impacts can last.

One year after the 2016 Alberta wildfire:

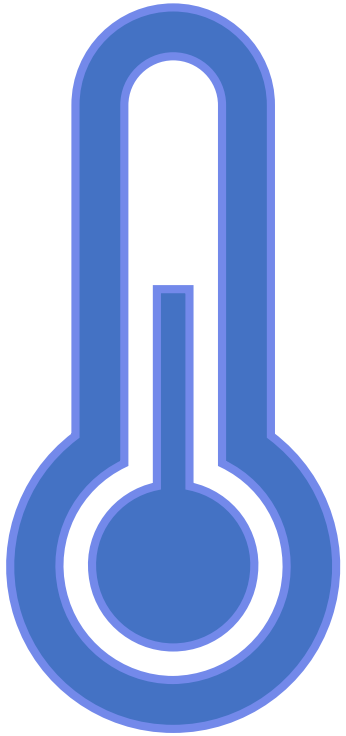
- 15% probable PTSD
- 15% depression
- 15% anxiety
- 8% substance misuse
- 38% mental health problems overall

- Significantly elevated over baseline

Chronic changes and mental health

Higher temperatures associated with

- Increases in suicide
- Increases in psychiatric hospitalization
- Increases in aggression
- Decreases in happiness and positive mood
- Impact on physical and mental functioning



Air pollution: fine ambient particles (PM2.5) linked to

- Cognitive decline
- Neurodegenerative diseases such as Alzheimer’s and Parkinson’s

Indirect impacts of climate change

- Involuntary displacement
- Threats to economic status
- Food insecurity

Impacts of migration

- Refugees experience stressors over the pre-flight, flight, and exile periods.
- Immigrants are at increased risk of psychosis
- This is true even among second-generation immigrants.

Impacts of economic insecurity

- Those with the lowest incomes are 1.5 to 3 times more likely than the rich to experience depression and anxiety
- Causality can be inferred from the impacts of a loss of income (from, e.g., bad harvest or job loss) and of antipoverty programs that provide financial support.
- Poverty experienced in childhood or in utero increases risk to cognitive development and adult mental illness

Impacts of food insecurity

- Food insecurity is associated with worse mental health worldwide, independent of SES.
- Food insecurity among children is associated with higher lifetime rates of depressive symptoms.
- Food insecurity is related to lower positive wellbeing and lower life satisfaction even after controlling for household income and country differences.

Vicarious awareness

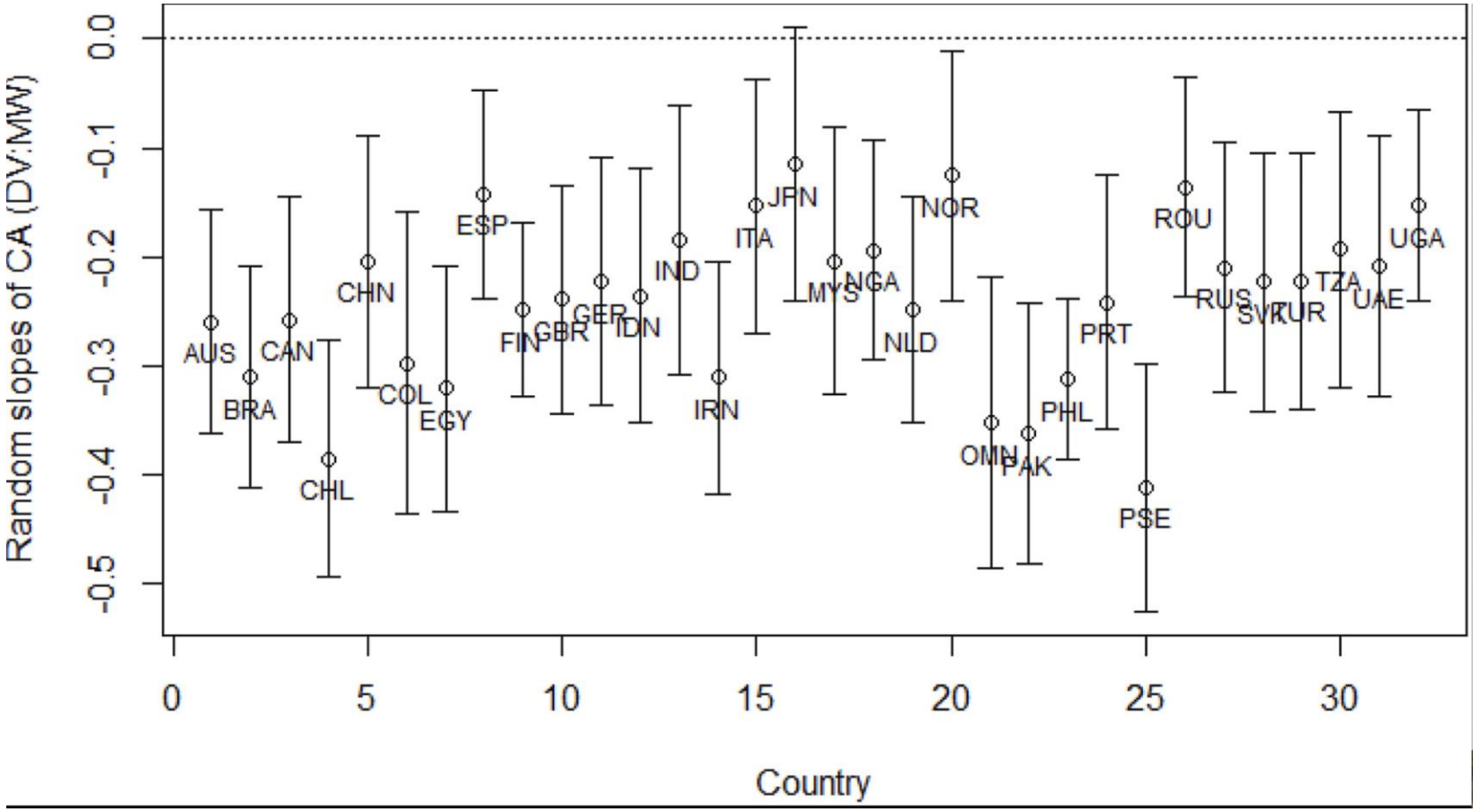
“my feelings had almost a physical manifestation – I felt stress, panic”

“I was depressed and disempowered… I stopped eating properly”

“I would get to the stage where I would freeze"

Climate anxiety and mental health

- About 20% of people reported functional impairment due to climate anxiety in US studies
- Climate anxiety is associated with standard clinical measures of anxiety and depression
- There is a negative relationship with WHO-5 wellbeing index



Ogunbode, C. A., Doran, R., Hanss, D., Ojala, M., Salmela-Aro, K., van den Broek, K. L., ... & Karasu, M. (2022). Climate anxiety, wellbeing and pro-environmental action: correlates of negative emotional responses to climate change in 32 countries. *Journal of Environmental Psychology*, *84*, 101887.

Thinking broadly about mental health

Climate change also impacts cognitive functioning

- Heat interferes with learning and cognitive performance.
- Prenatal stress from heat or extreme weather increases preterm birth, which is associated with cognitive deficits.

Social relationships are also part of health and wellbeing

Individual behaviors and decision-making can be impaired by stressors and anxiety

Perceptions of climate change may affect behavior

Planning for the future in a sample of 15,000 U.S. youth:

- 69% said “climate change will influence where I choose to live”
- 64% said “climate change will influence my plans for the future”
- 60% said “I question whether the work I put into my education will matter”
- 58% said “I question whether the work I put into my career, job, or vocation will matter”
- 52% said “I’m hesitant to have children”

Negative effects are not inevitable.

- Mitigation: behavior, technology, and policy changes that reduce the emissions of CO_2 and/or increase uptake of emissions
  - Communicate risks to public health
  - Develop evidence-based interventions for behavior change

- Adaptation: Strategies to reduce mental health risks
  - universal access to mental health care
  - mental health training and responses integrated into pre- and post-extreme event responses
  - culturally-appropriate, climate-specific and place-specific mental health resources, including nature-based therapy
  - attention to impacts on diverse communities

Promoting resilience

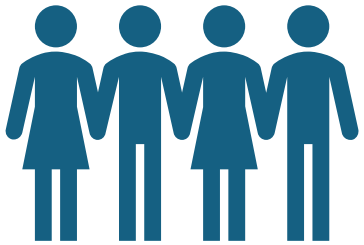
Individual mental health:

Emotion-focused coping

Problem-focused coping

Meaning-focused coping

Promoting resilience



Collective well-being:

Social support

Education

Policies that fund mental health care

The mental health field can prepare

1. Provide professional training on the impacts of climate change
2. Educate the public
3. Advocate for better mental health funding
4. Advocate for mitigation
5. Research and implement evidence-based interventions
6. Examine and acknowledge their own experiences and emotions
7. Adopt sustainable clinical practices

Climate Change & MENTAL HEALTH

Sherilee HARPER
University of Alberta

August	2024

@sherilee_h
www.sherileeharper.com


ipcc
INTERGOVERNMENTAL PANEL ON
climate change
WMO
UNEP


ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP
"The scientific evidence is unequivocal: climate change is a threat to human well-being and the health of the planet. Any further delay in concerted global action will miss the brief, rapidly closing window to secure a liveable future."

Global warming has caused *dangerous and widespread* disruption in nature...

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP


ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP
... and climate change is affecting the lives of billions of people, despite efforts to adapt.


Climate change has already impacted the health of
millions of people
ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP

3.3 – 3.6 billion people live in hotspots of *high vulnerability* to climate change.

Those reliant on the environment for subsistence and livelihoods

Underlying physical or mental health challenges

Those facing socioeconomic inequities and marginalisation

Vary by gender, age, occupation, and other characteristics

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Two *examples* from Canada

Wildfires in Alberta

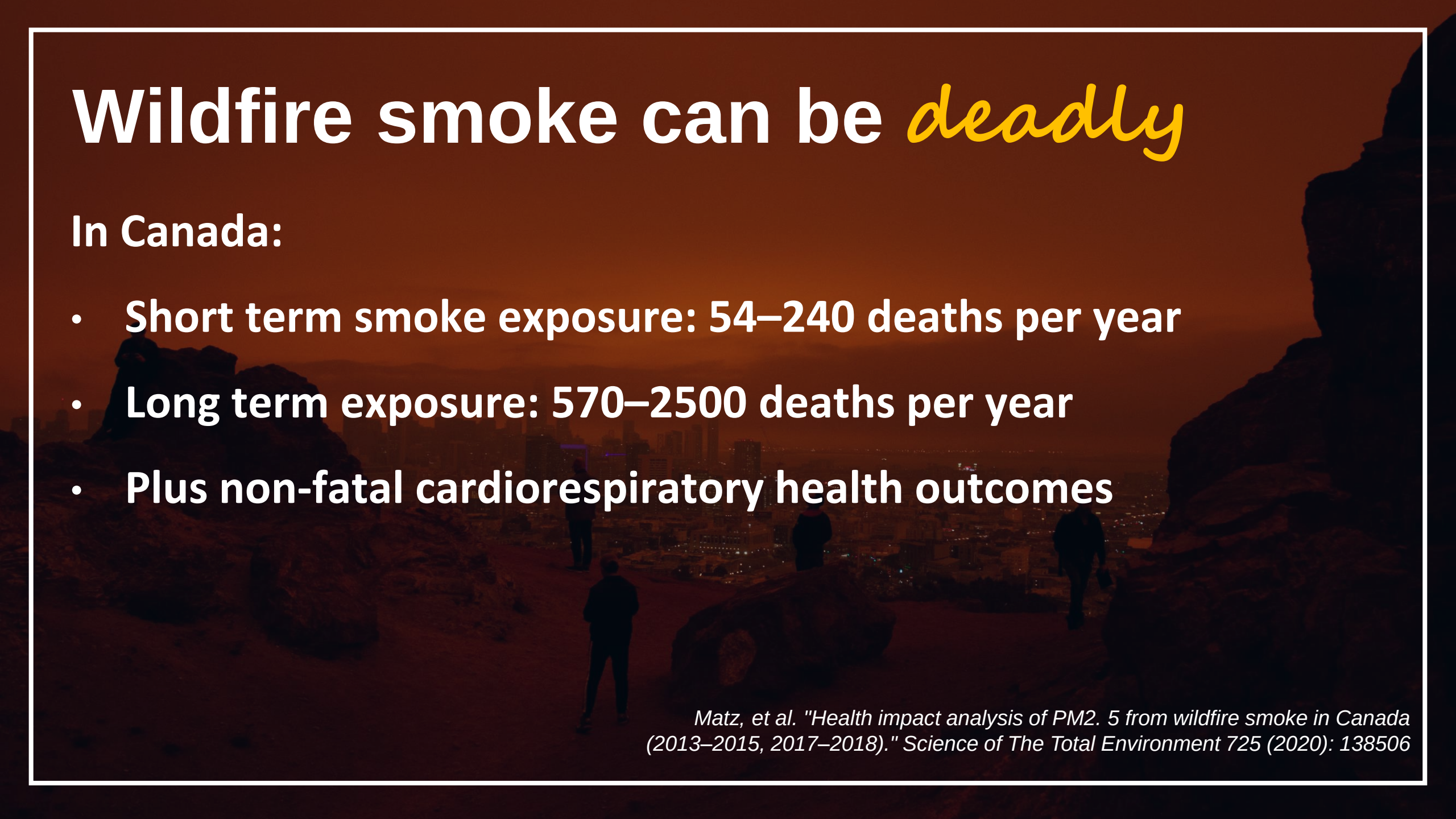
Ecoanxiety in the Arctic


Wildfires impact
our Health
ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP

Wildfire smoke can be *deadly*

In Canada:

- **Short term smoke exposure: 54–240 deaths per year**
- **Long term exposure: 570–2500 deaths per year**
- **Plus non-fatal cardiorespiratory health outcomes**



Matz, et al. "Health impact analysis of PM2. 5 from wildfire smoke in Canada (2013–2015, 2017–2018)." Science of The Total Environment 725 (2020): 138506

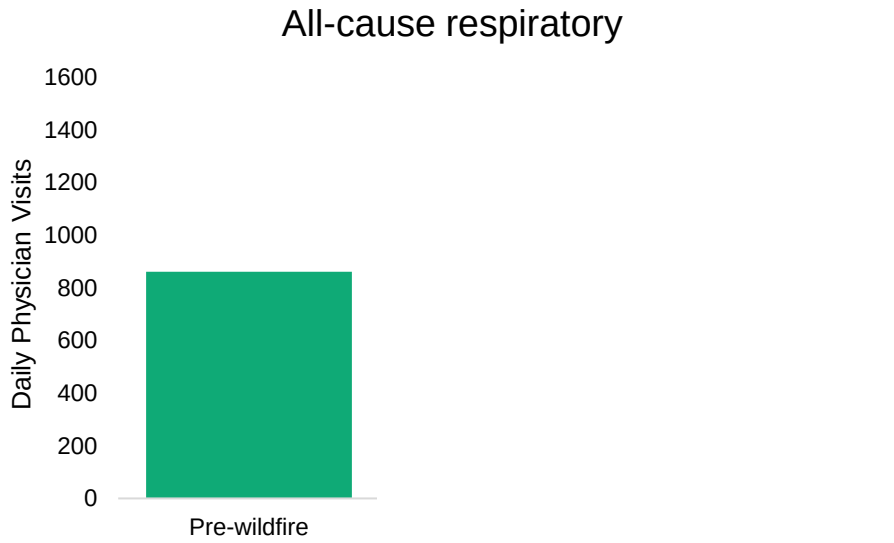
How much does this *Cost?*

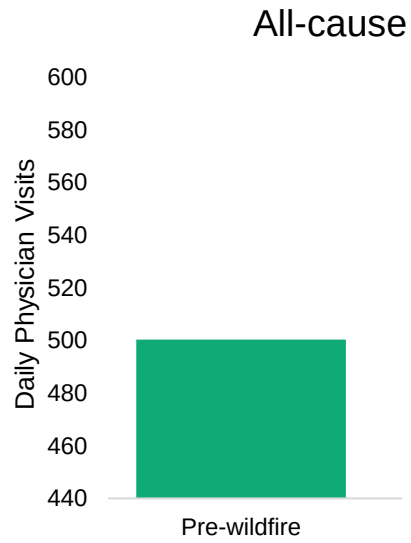
In Canada:

- **Acute health impacts: $410M–$1.8B per year**
- **Chronic health impacts: $4.3B–$19B per year**
- **Largest economic impacts in BC and Alberta**
- **Most expensive Canadian disasters?**

Matz, et al. "Health impact analysis of PM2. 5 from wildfire smoke in Canada (2013–2015, 2017–2018)." Science of The Total Environment 725 (2020): 138506

What does this look like in Alberta?





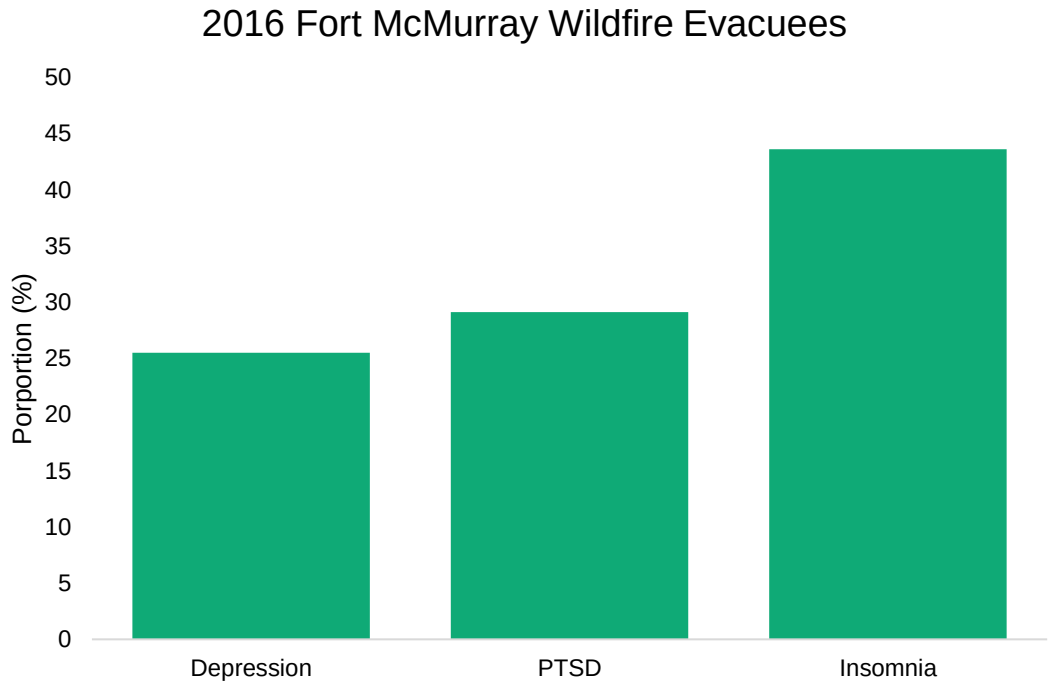
Mahsin et al, (2022). Respiratory and cardiovascular condition-related physician visits associated with wildfire smoke exposure in Calgary, Canada, in 2015, International Journal of Epidemiology, 51(1): 166–178

Diverse and serious *mental health* impacts

2016 Fort McMurray wildfire

88,000 people abruptly evacuated

Attributed to climate change



Belleville et al. (2019). Post-Traumatic Stress among Evacuees from the 2016 Fort McMurray Wildfires: Exploration of Psychological and Sleep Symptoms Three Months after the Evacuation. *International Journal of Environmental Research and Public Health*. 16(9):1604.

Mental health impacts for our kids

Increased tobacco use (10% → 13%)

Increased suicidal thinking (4% →16%)

Increased moderately severe depression (9% →17%)

27% probable anxiety

probable alcohol or substance use disorder (15%)

37% probable PTSD

31% probable depression

Lower self-esteem and quality of life scores

46% of students met criteria for one or more probable diagnosis of PTSD, depression, anxiety, or alcohol/substance abuse, whether or not they were present at the fire

Brown et al. (2019). Significant PTSD and other mental health effects present 18 months after the Fort McMurray wildfire. Frontiers in Psychiatry.10.
Brown et al. (2019). After the Fort McMurray wildfire there are significant increases in mental health symptoms in grade 7-12 students compared to controls. BMC Psychiatry. 2019;19(1).

Mental health impacts for our kids

Greater impact from fires

= greater adverse mental health impacts

1.5, 2.5, and 3.5 years after the wildfire

= mental health worsened

Brown et al. (2019). Significant PTSD and other mental health effects present 18 months after the Fort McMurray wildfire. Frontiers in Psychiatry.10.

Brown et al. (2019). After the Fort McMurray wildfire there are significant increases in mental health symptoms in grade 7-12 students compared to controls. BMC Psychiatry. 2019;19(1).

Brown et al. (2021). Mental health symptoms unexpectedly increased in students aged 11–19 years during the 3.5 years after the 2016 Fort McMurray wildfire. Frontiers in Psychiatry, 12.

Two *examples* from Canada

Wildfires in Alberta

Ecoanxiety in the Arctic

ARCTIC CONTEXT

"The ice is no longer predictable, it is not stable, ***people don't trust it****"*

*"…****accidental death*** *through changes in ice conditions and weather conditions"*

*"****people are jeopardizing their lives*** *going out on unstable elements"*

Harper et al., 2015, BMC Public Health
Driscoll et al., 2013, International Journal of Circumpolar Health

Complex *mental health* responses

Loss of cultural continuity, disruptions to intergenerational knowledge transfer

Loss of place-based identities and connections (i.e., solastalgia)

Emotional reactions
(e.g., sadness, fear, anger, distress and anxiety)

Mental health outcomes
(e.g., depression, post-traumatic stress disorder and generalised anxiety)

Experiences with grief and loss
(i.e., ecological grief)

Drug/alcohol use, family stress, domestic violence, suicide ideation

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Two *examples* from Canada

Wildfires in Alberta

Ecoanxiety in the Arctic

Adaptation *Examples*

Within the health sector:

- Heat plans
- Early warning systems
- Mental health services in emergency response

Outside of the health sector:

- Improved food security
- Green spaces
- Climate cafes

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Effectiveness of many mental health treatments are understood; but, there is limited evidence evaluating these interventions within the context of climate change


Mental health risks are becoming more complex and, therefore, more challenging to manage.
ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP

thanks!

ANY QUESTIONS?

You can find me at:

sherilee@ualberta.ca

@Sherilee_H

www.sherileeharper.com

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP