ENVIRONMENTAL LAW INSTITUTE

Title

Date, 2025

The webinar will begin shortly.

Today's Speakers

Name Name, Job Title, Organization

Moderator

Name Name, Job Title, Organization

Name Name, Job Title, Organization

Name Name, Job Title, Organization

IPCC 2022

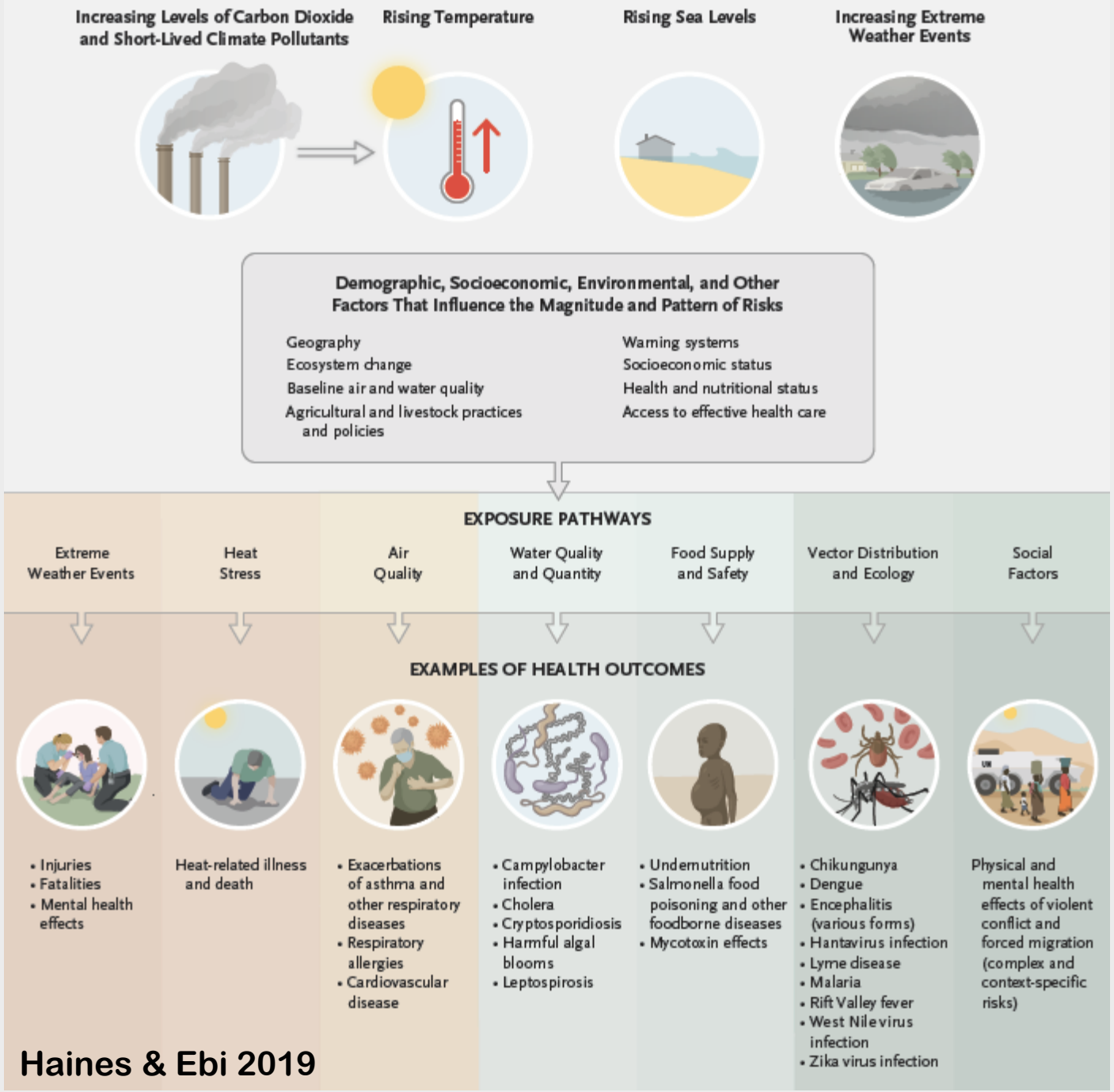
Climate change and health

Kristie L. Ebi, Ph.D., MPH

UW Medicine
SCHOOL OF MEDICINE

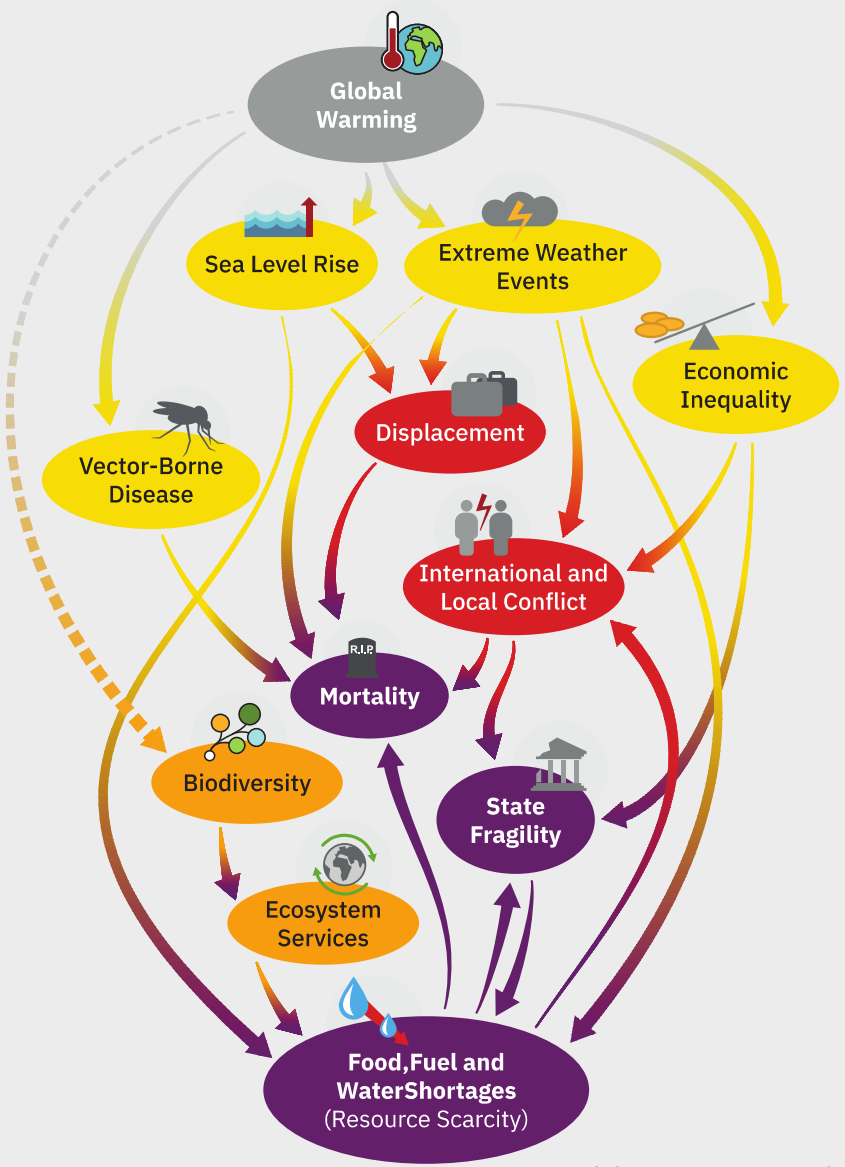
DEPARTMENT OF GLOBAL HEALTH
UNIVERSITY of WASHINGTON

SCHOOL OF PUBLIC HEALTH
UNIVERSITY of WASHINGTON



Haines & Ebi 2019

Cascading global climate risks



Kemp et al. 2022

Key conclusions of the IPCC 2022 chapter on human health

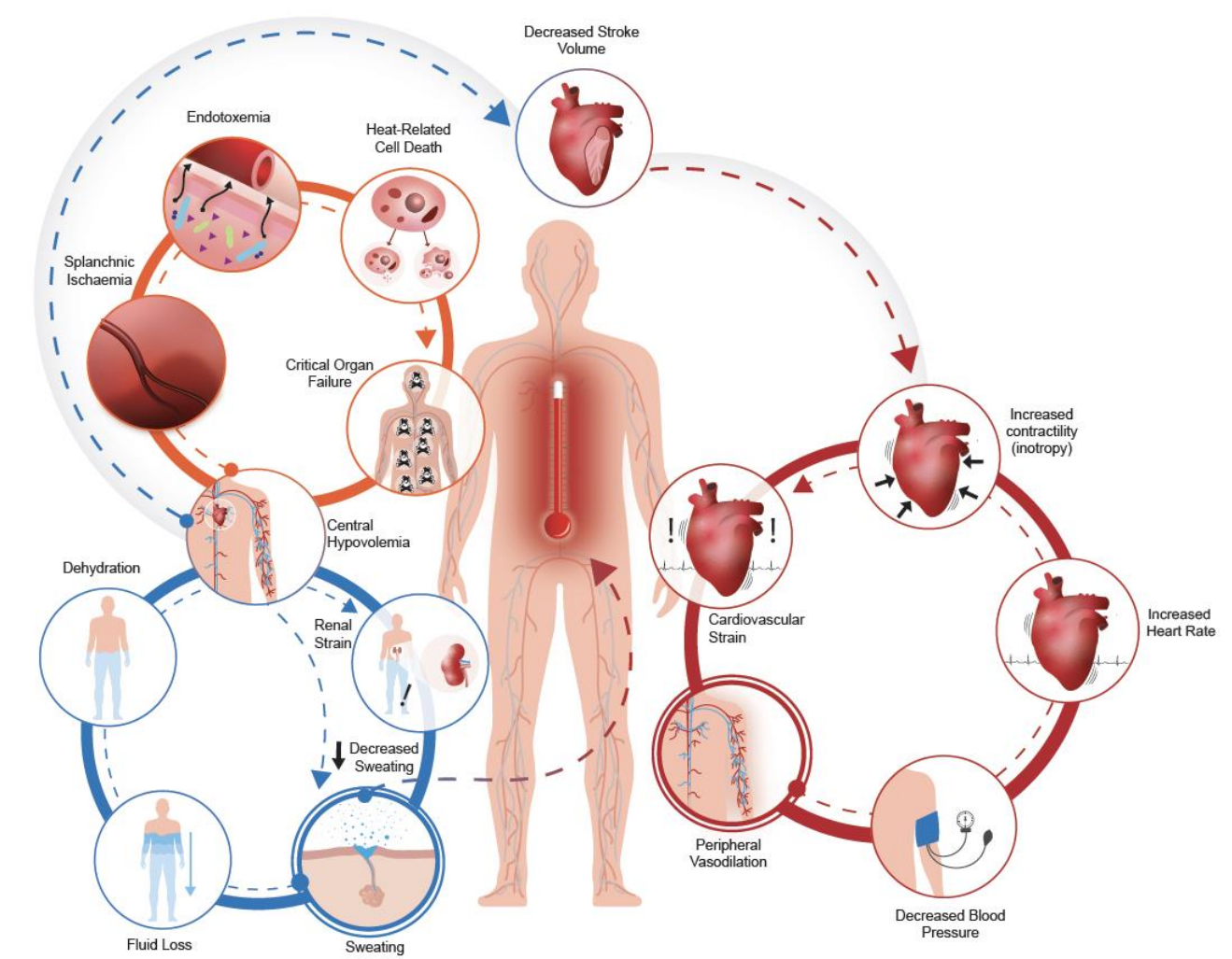
Observed impacts: *climate change is adversely affecting the physical health of people globally and mental health of people in assessed regions*

- 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

Hot weather and heat extremes: health risks

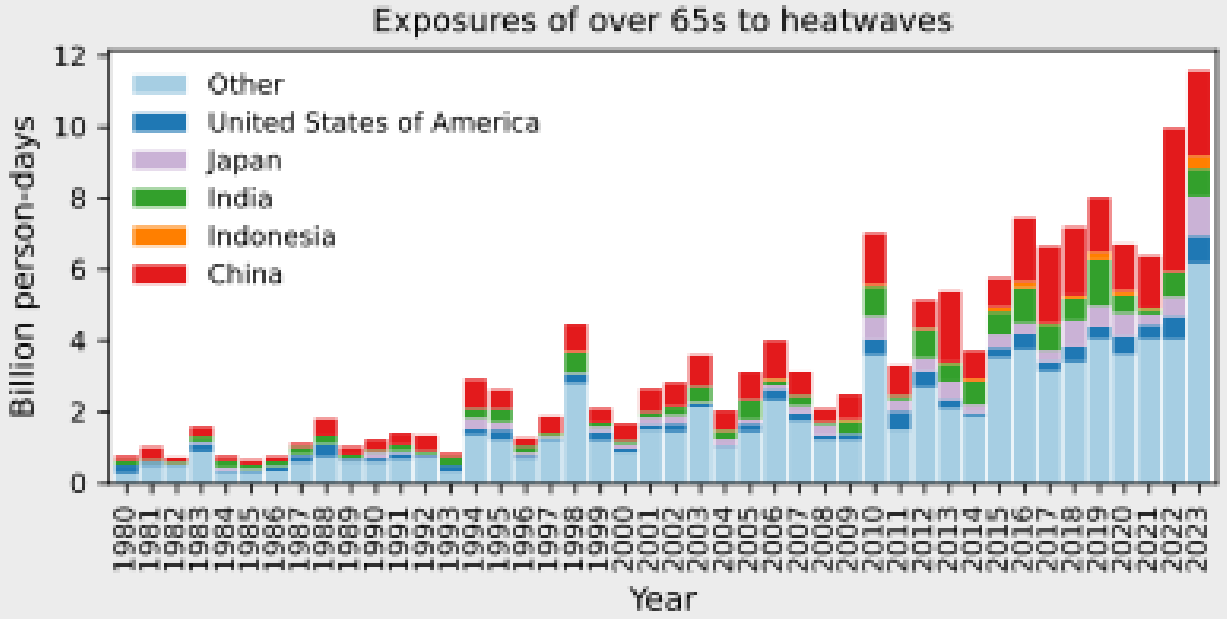


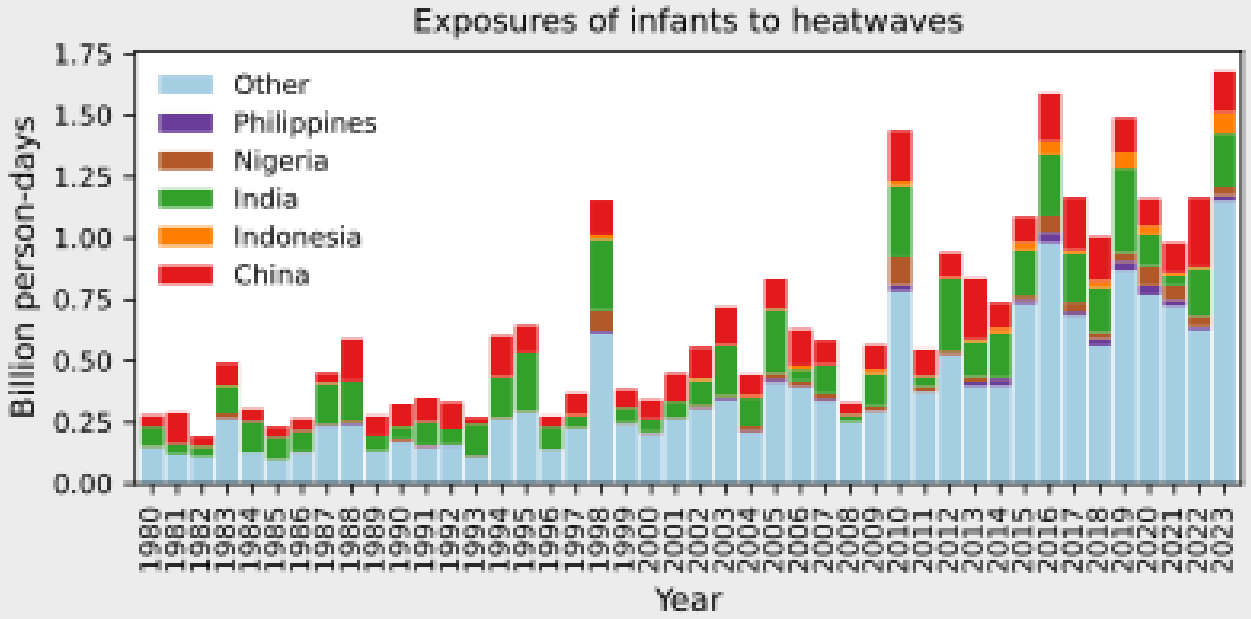
Ebi et al. Lancet 2021

- People are unnecessarily suffering & dying in the heat
- Other heat-related effects include occupational health & productivity; increased sports injuries & illnesses; adverse pregnancy outcomes
- Physiological limits of heat tolerance are finite
  - Other factors substantially reduce these limits
- Climate change will continue to increase heat-related morbidity and mortality without urgent investments in research & risk management

Exposure of vulnerable populations to heatwaves

In 2023, infants < 1 year and adults > 65 years experienced, on average, a record high of 13.8 heatwave days per person. There were 13.4 billion more person-days of heatwave exposure, compared with 1986-2005

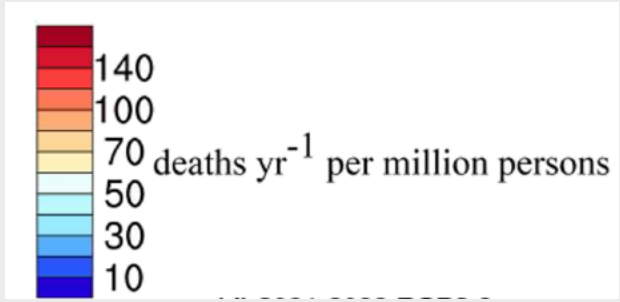




2024 Report of the Lancet Countdown

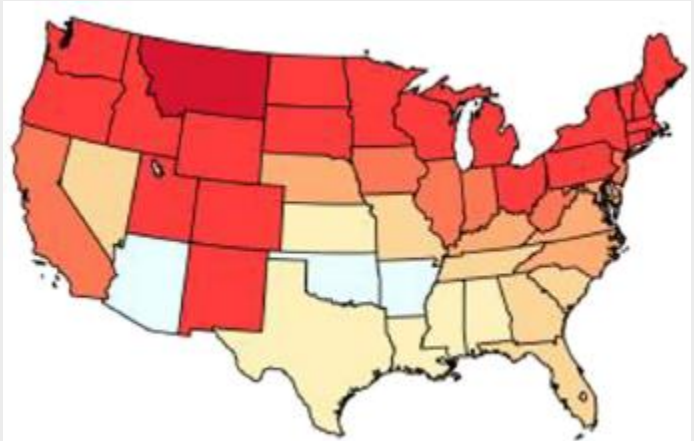
Projected annual heat-related deaths in 2091-2099

No adaptation; high emissions



No adaptation; low emissions

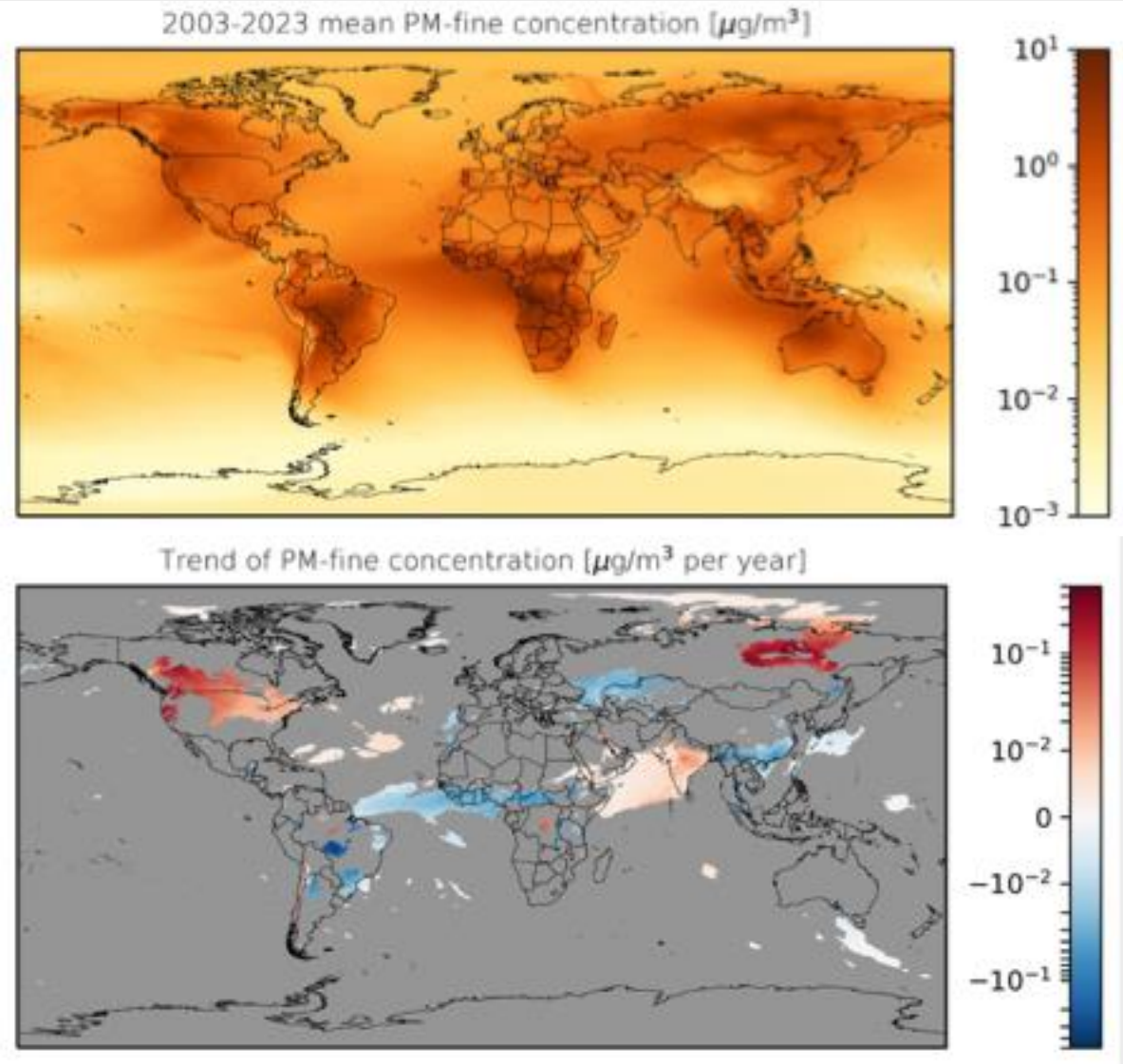
Adaptation; high emissions



Adaptation; low emissions

Shindell et al. 2020

Gridded mean personal exposure to fire-induced PM and 2003-2021 trend



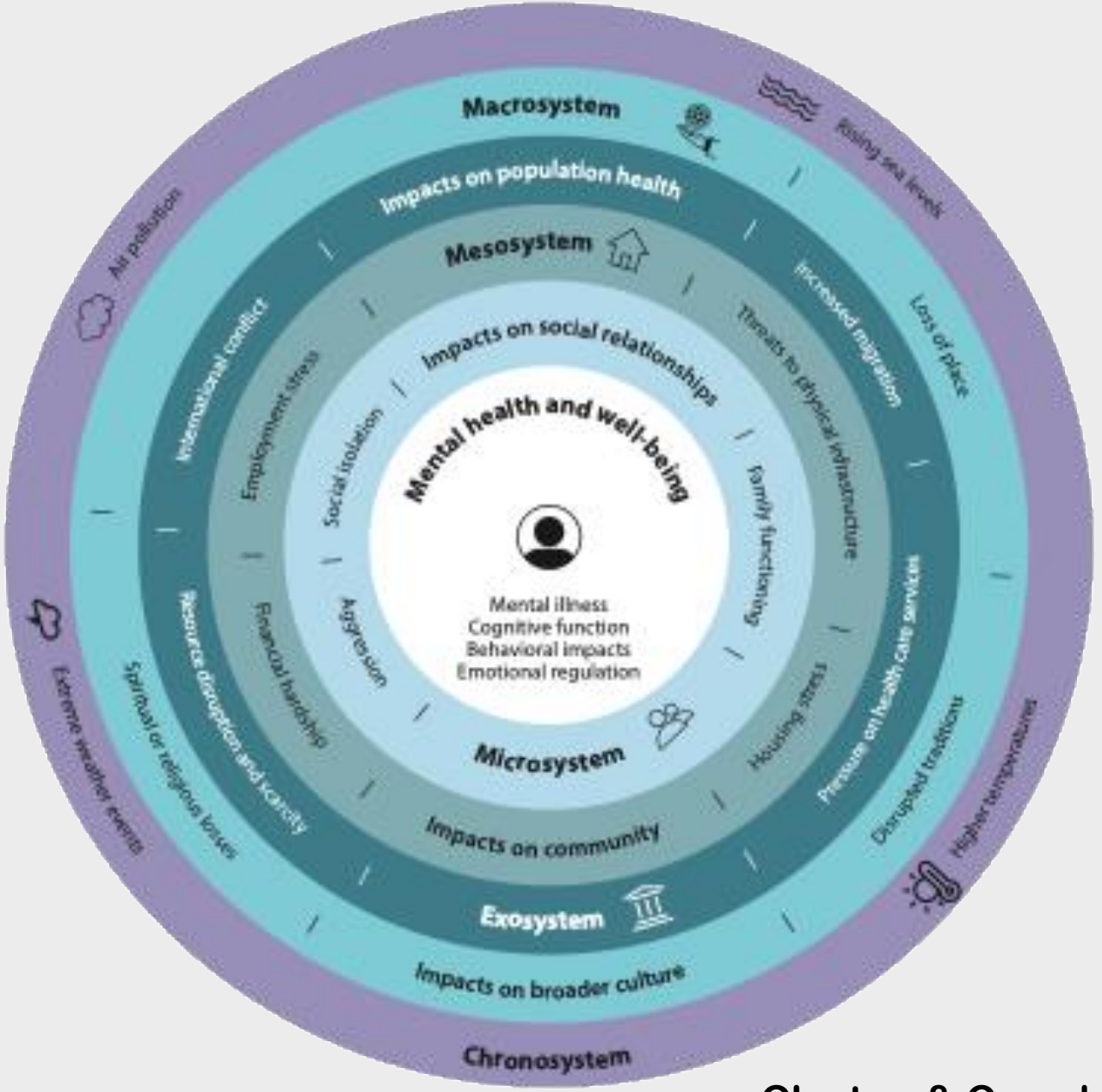
2024 Report of the Lancet Countdown

Short-term mortality impacts of wildfire smoke in Europe

- Cumulative RR for a 1 ug/m3 increase in fire-related PM2.5 was 1.009 for CVD mortality and 1.013 for respiratory mortality
- RRs higher for fire-related than non-fire-related PM2.5
- Using RR for total PM2.5 underestimated fire-related mortality by 93%

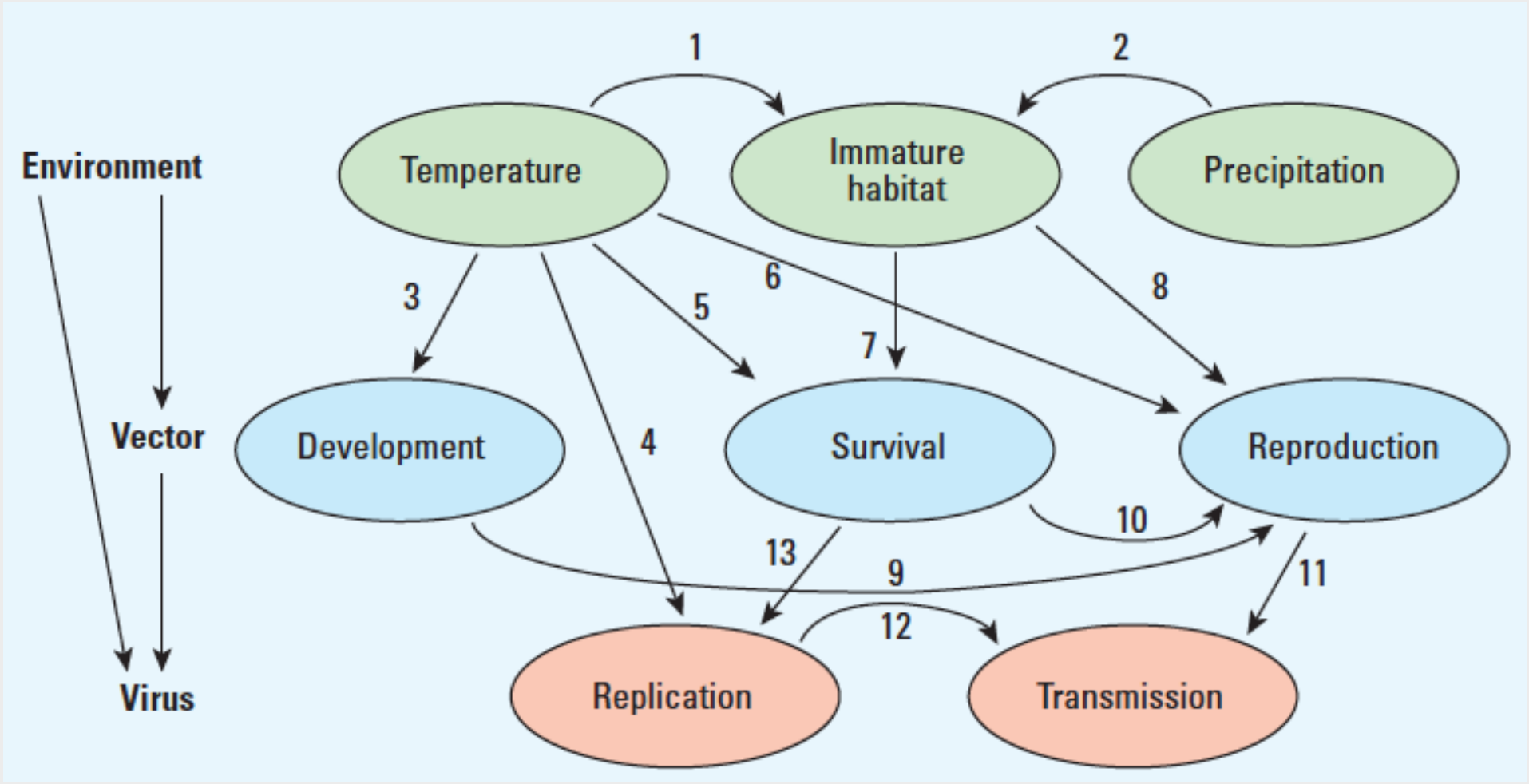
Alari et al. 2025

Impacts of climate change on mental health and well-being across multiple systems



Clayton & Crandon 2025

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

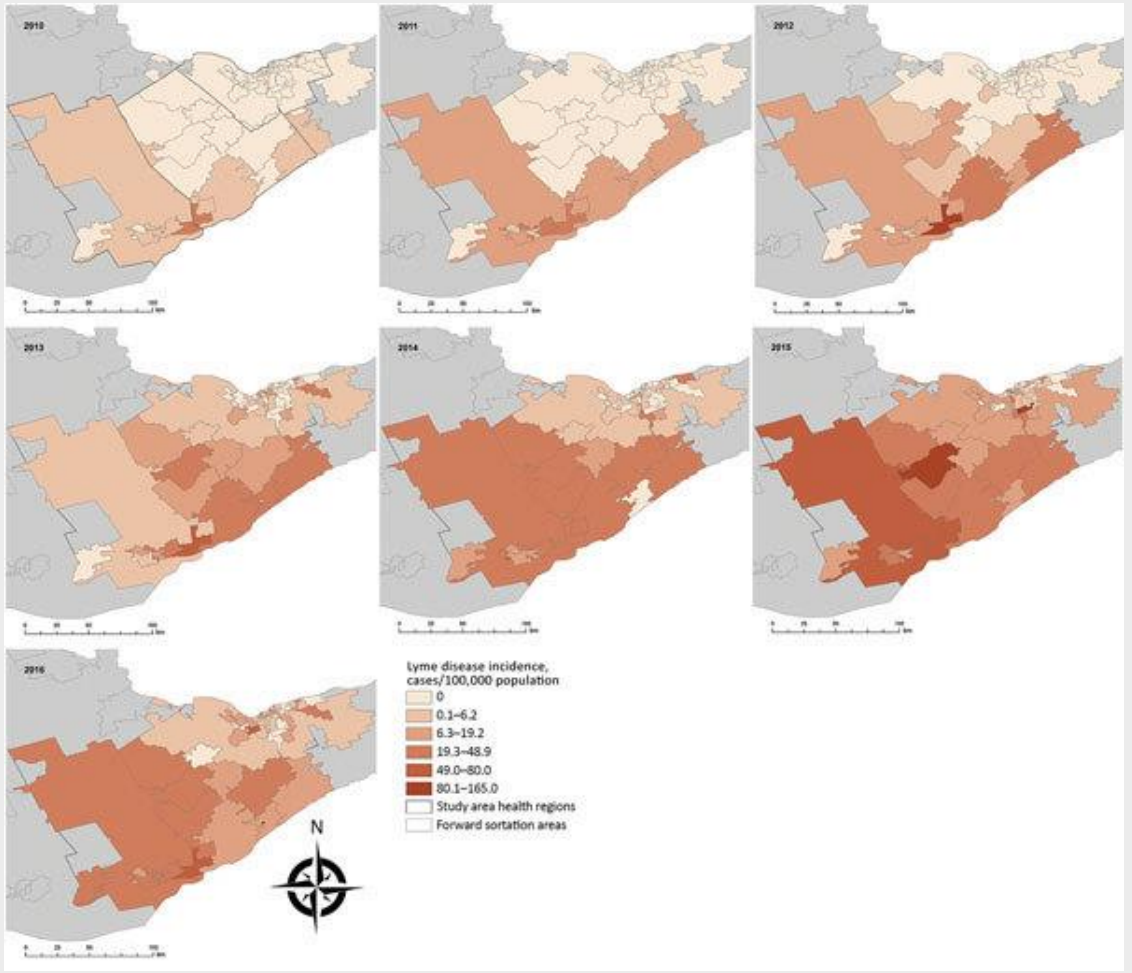


Morin et al. 2013

Lyme disease emergence in Canada

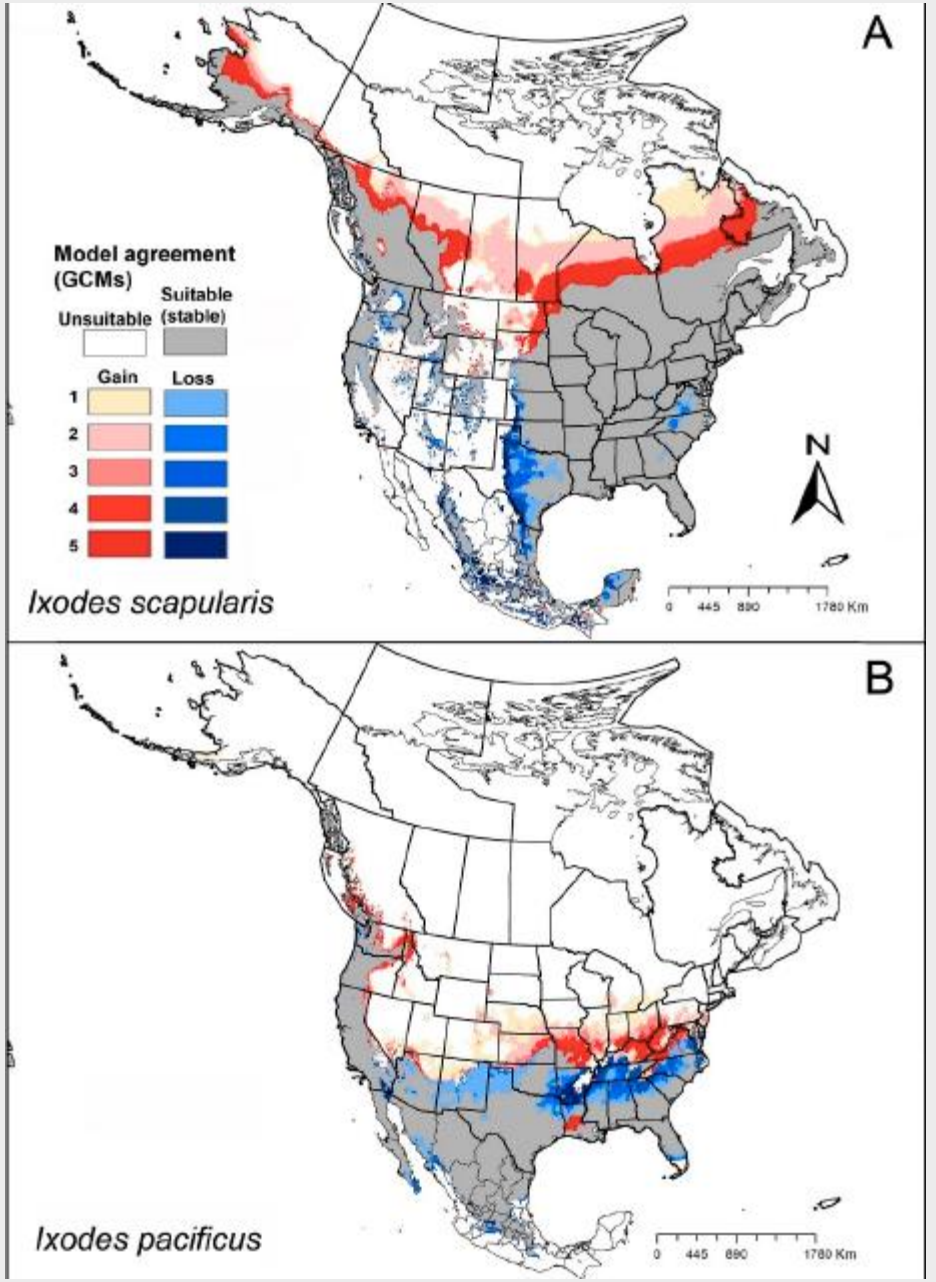
- **Climate impacts Lyme disease risk:**
  - **Tick vector distributions & abundance**
  - **B. burgdorferi transmission cycle occurrence & efficiency**
  - **The likelihood of transmission to humans**
- **Surveillance demonstrated geographic pattern changed (latitude and altitude)**
  - **Geographic range associated with temperature trends**
  - **Changing temperatures attributed to climate change**

Lyme disease incidence 2010-2016; Eastern Ontario



Kulkarni et al. 2019

Potential geographic distribution of two species of Ixodes, present and 2050 under RCP4.5



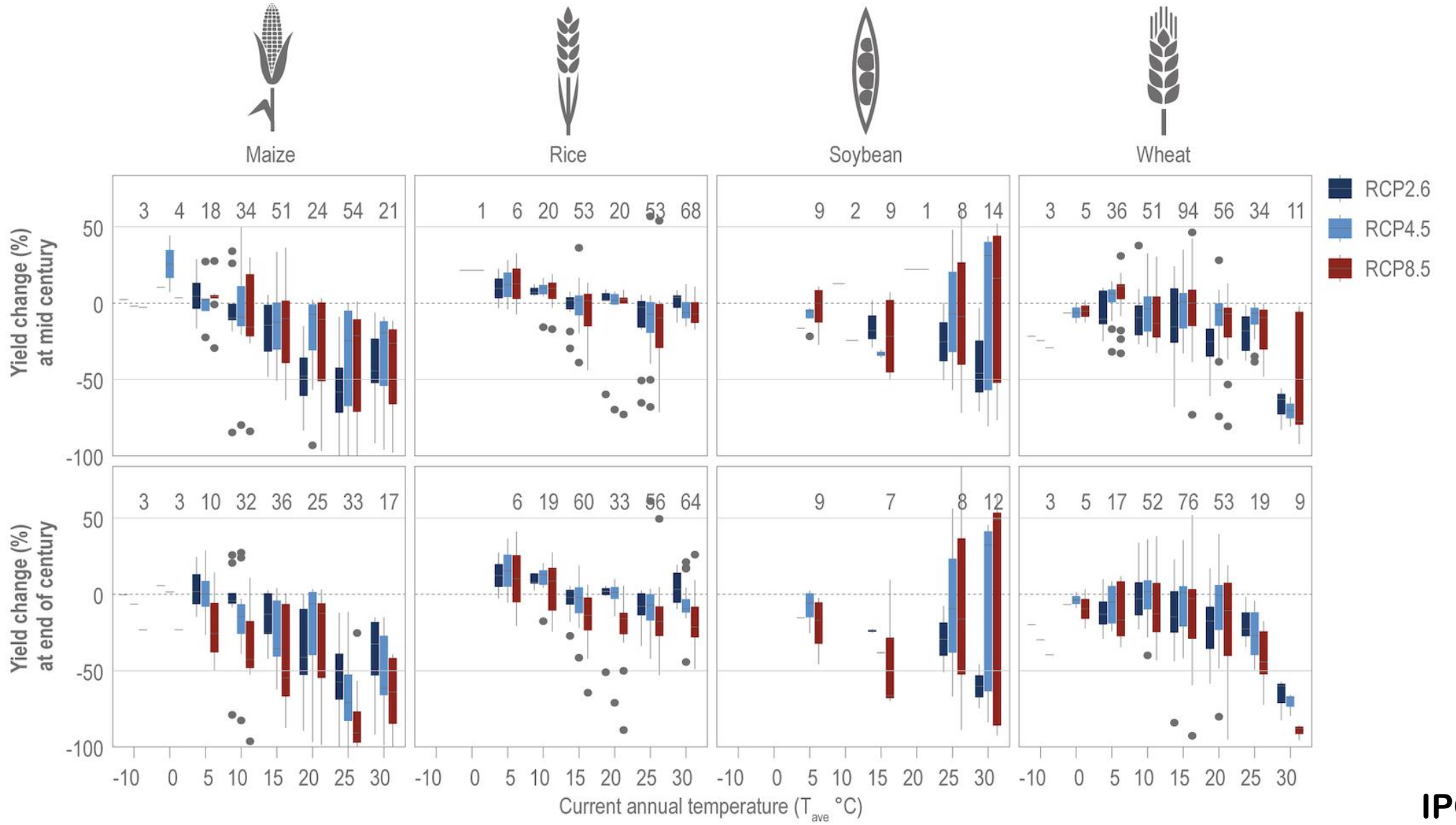
- Red indicates expansion of suitable areas under future conditions (dark red = high model agreement
- Blue indicates suitable in current time but not in the future (dark blue = high model agreement

Alkishe et al. 2021

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

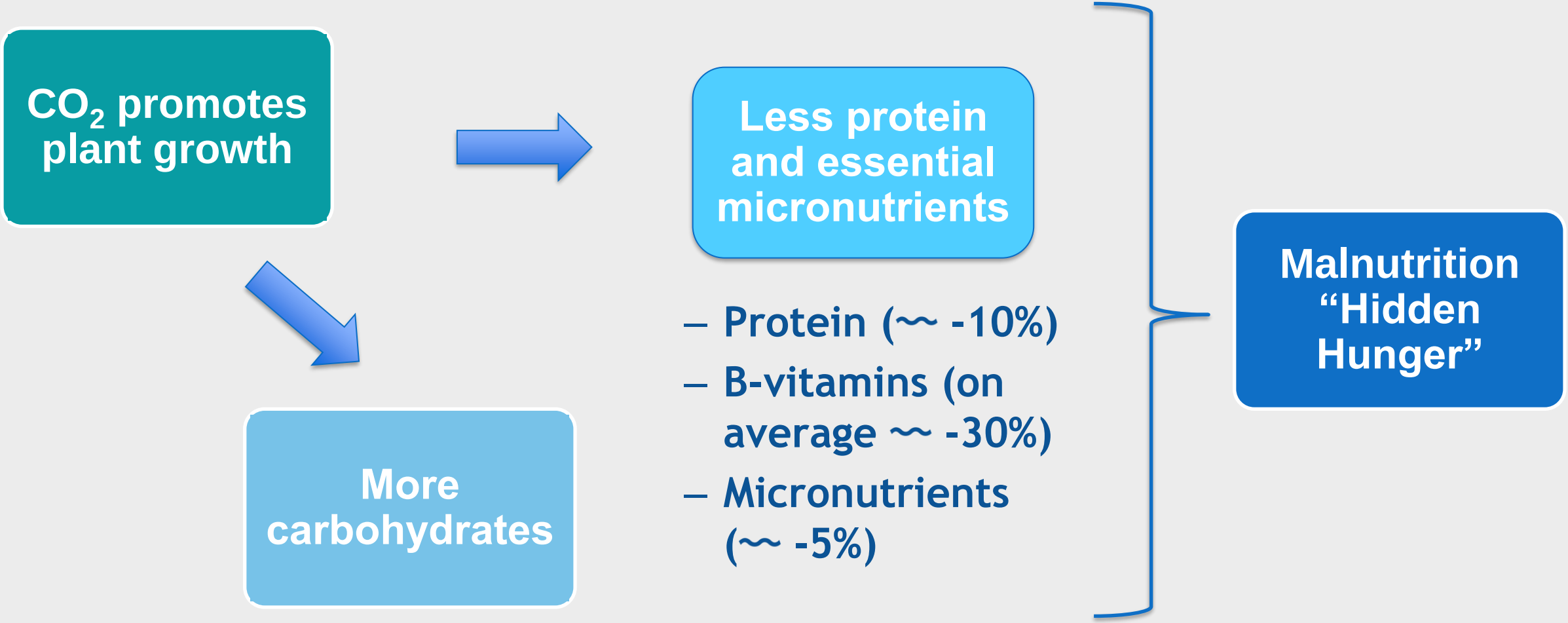
Numbers are the number of simulations

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



IPCC 2022

Higher CO_2 concentrations alter the nutritional density of C3 plants



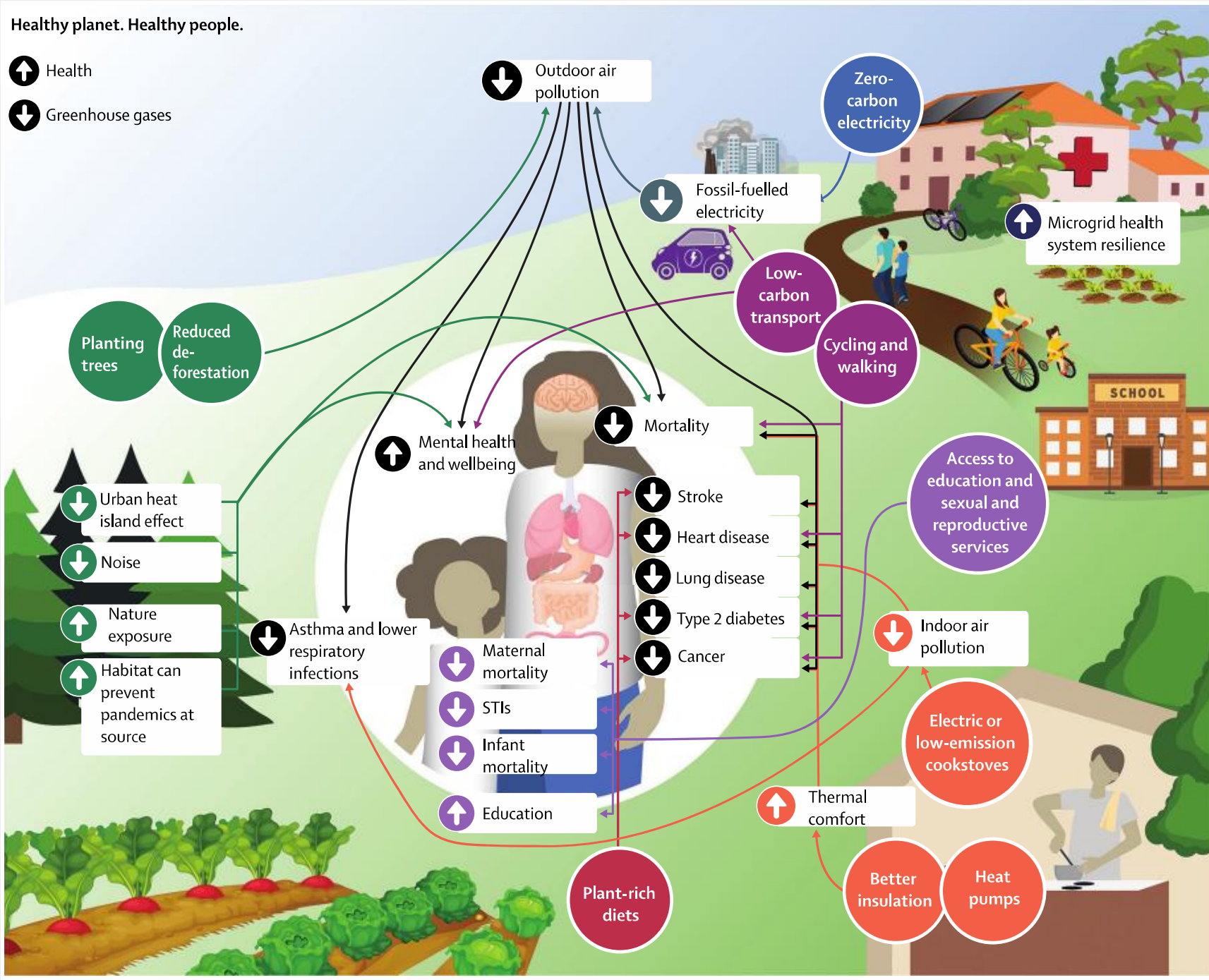
Effective adaptation options include

- 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

Health benefits of reducing greenhouse gas emissions

Howard et al. 2024



Climate science: strong in 2009, stronger in 2025

Kristina Dahl
September 15, 2024

CLIMATE CENTRAL

The central focus of attribution science is understanding and quantifying the role human-caused climate change is playing in changing environmental hazards and their consequences.

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Letter | Published: 02 December 2004

Human contribution to the European heatwave of 2003

Peter A. Stott, D. A. Stone & M. R. Allen

Nature **432**, 610–614 (2004) | Cite this article

world weather attribution

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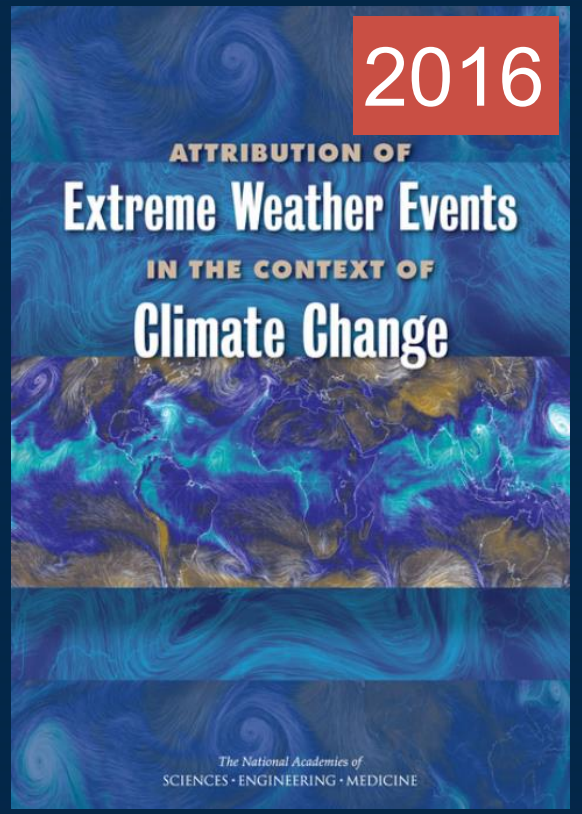
Latest analyses

Climate change likely increased extreme monsoon rainfall, flooding highly vulnerable communities in Pakistan

Without human-caused climate change temperatures of 40°C in the UK would have been extremely unlikely

Climate change increased heavy rainfall, hitting vulnerable communities in Eastern Northeast Brazil



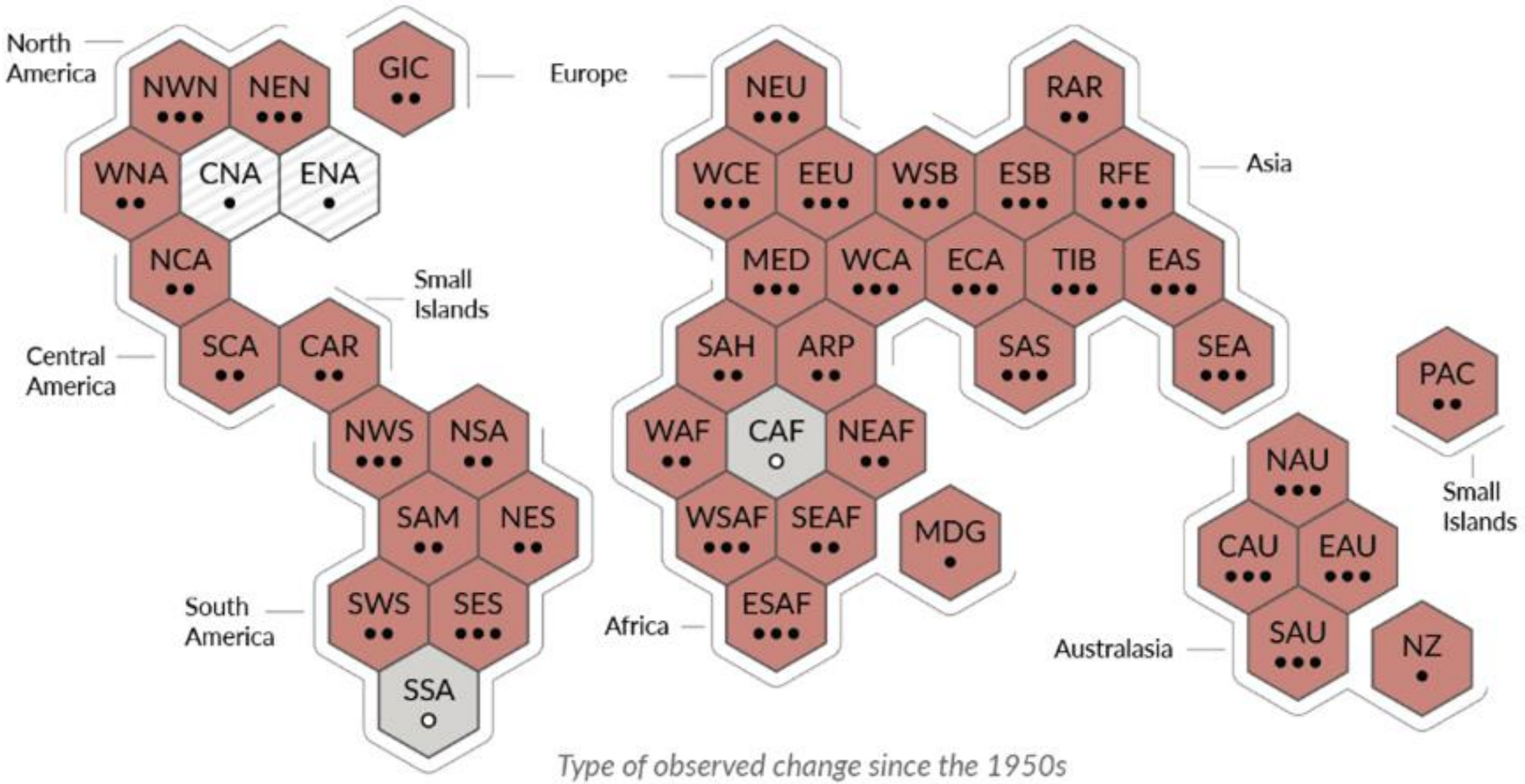
Extremes are increasing. We know it's climate change.

Type of observed change
in hot extremes

- Increase (41)
- Decrease (0)
- Low agreement in the type of change (2)
- Limited data and/or literature (2)

Confidence in human contribution
to the observed change

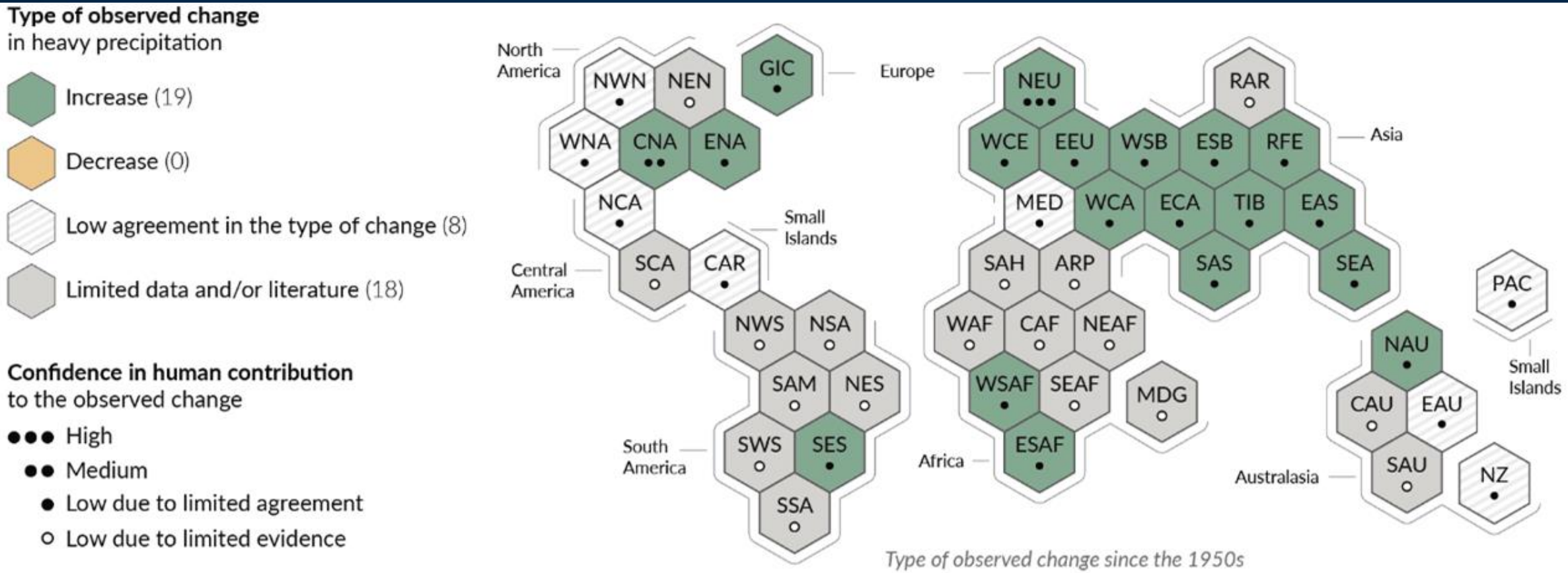
- ●●● High
- ●● Medium
- ● Low due to limited agreement
- ○ Low due to limited evidence



Type of observed change since the 1950s

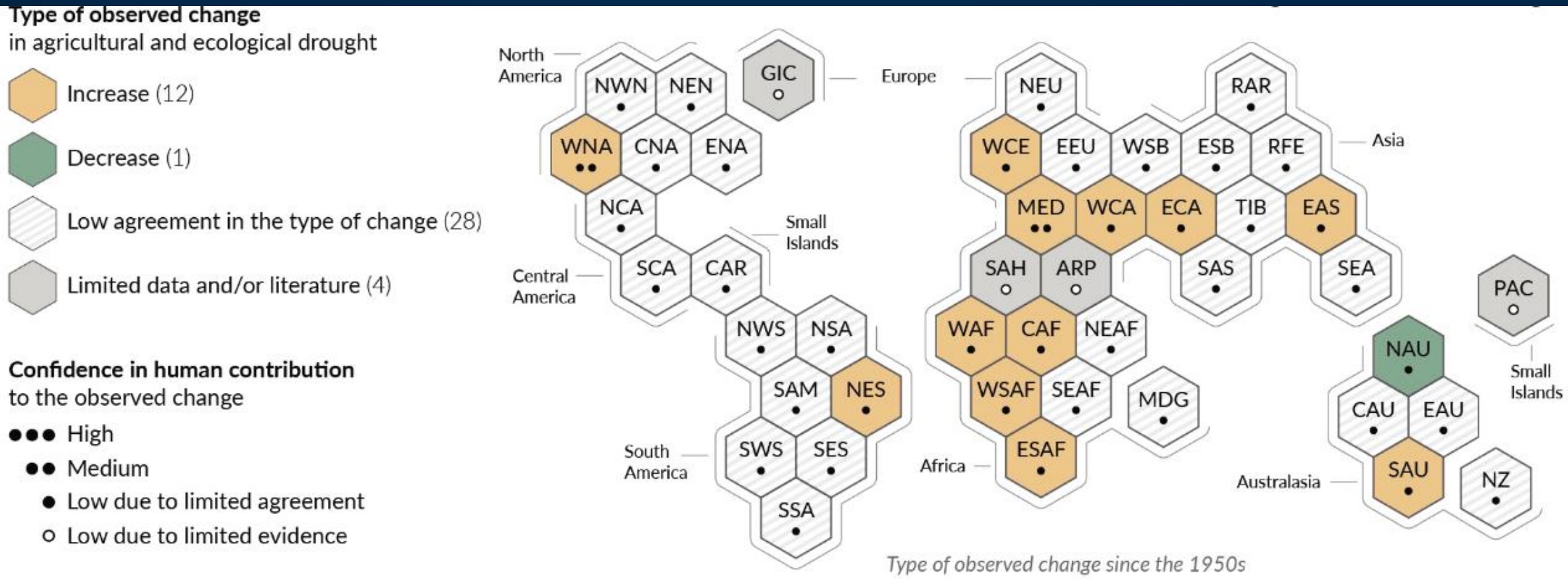
IPCC AR6 WGI SPM, 2021

Some extremes are more attributable than others…

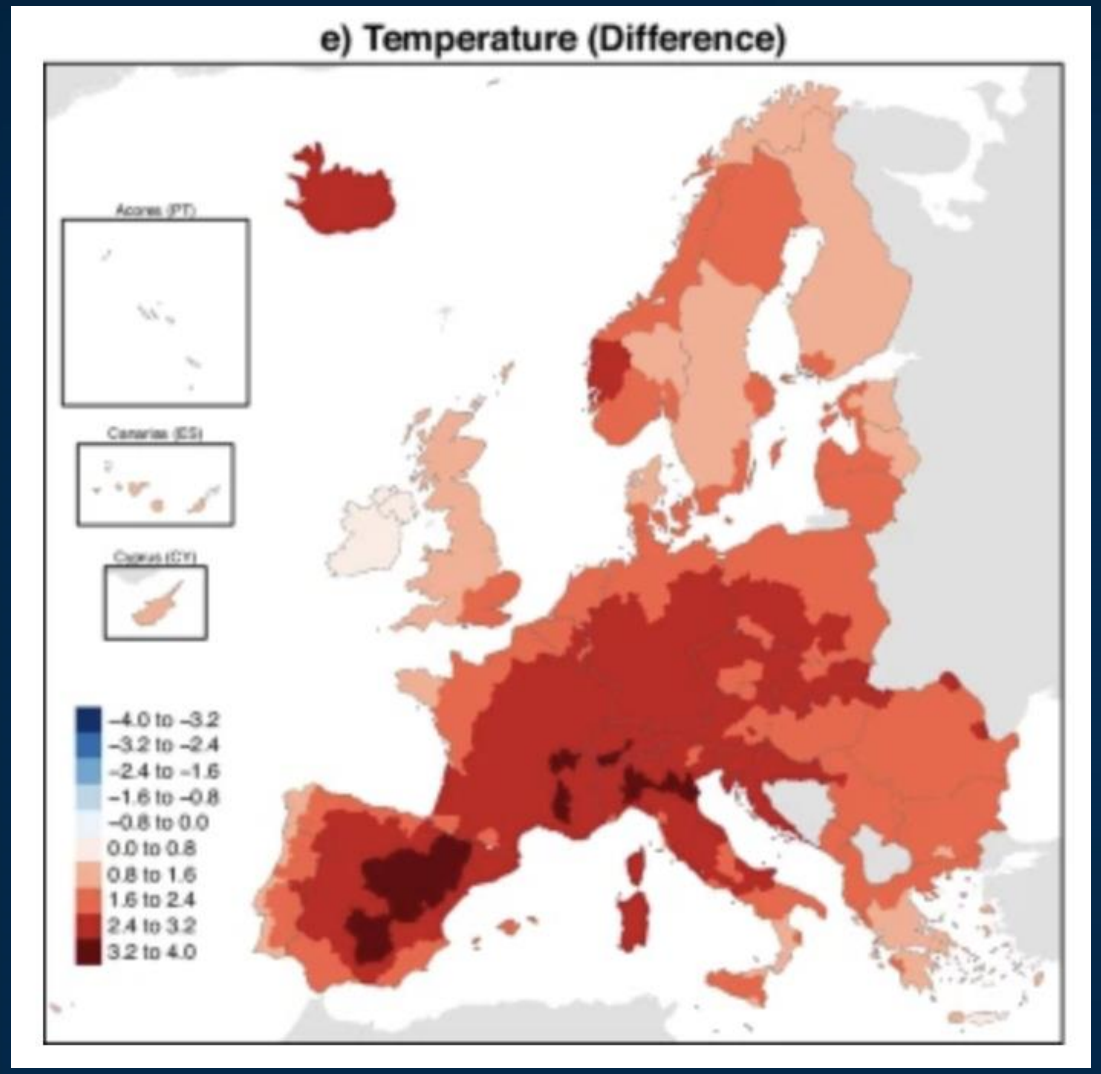


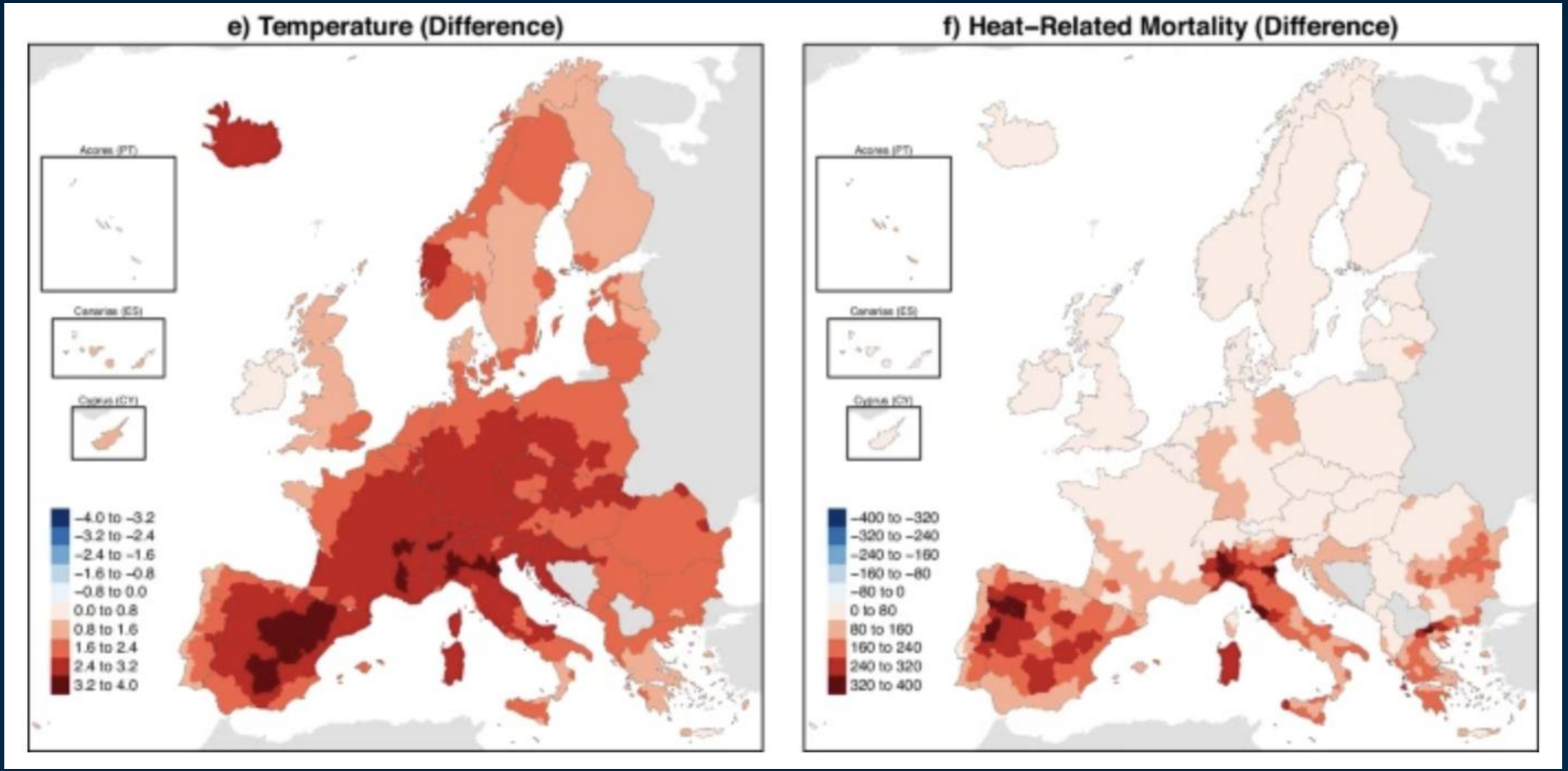
[IPCC AR6 WGI SPM, 2021]

Some extremes are more attributable than others…



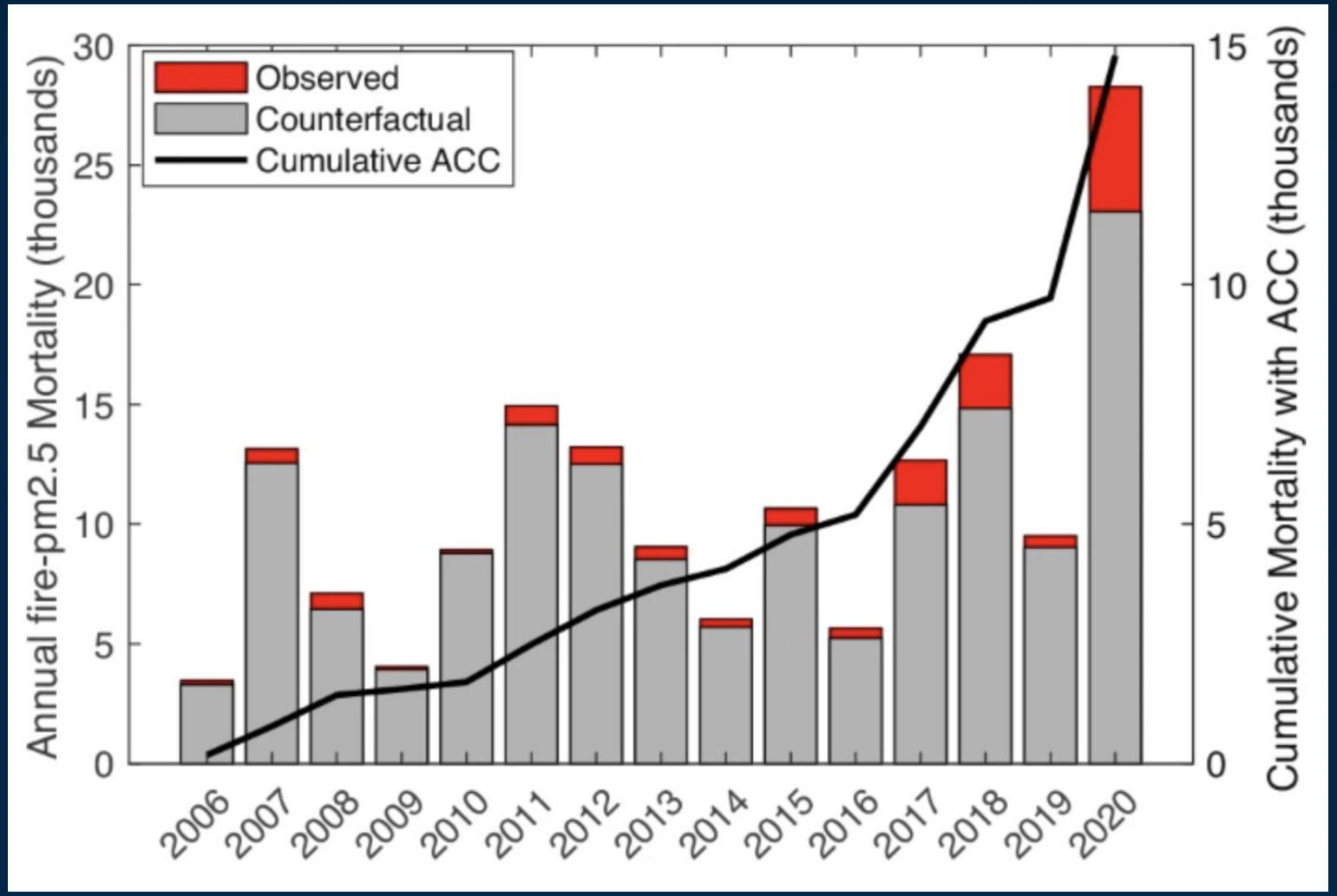
IPCC AR6 WGI SPM, 2021


e) Temperature (Difference)
Acores (PT)
Canarias (ES)
Cyprus (CY)
−4.0 to −3.2
−3.2 to −2.4
−2.4 to −1.6
−1.6 to −0.8
−0.8 to 0.0
0.0 to 0.8
0.8 to 1.6
1.6 to 2.4
2.4 to 3.2
3.2 to 4.0



"The record-breaking temperatures in Europe during the 2022 summer were associated with over 60,000 heat-related deaths…We attribute **half of this mortality burden** to anthropogenic warming."

Beck et al., 2024



"Climate change contributed to approximately 15,000 wildfire particulate matter deaths over 15 years…and a cumulative economic burden of $160 billion."

Law et al., 2025

Agriculture in the Endangerment Finding

David Lobell

dlobell@Stanford.edu

Stanford University

Some text from 2009 endangerment finding:

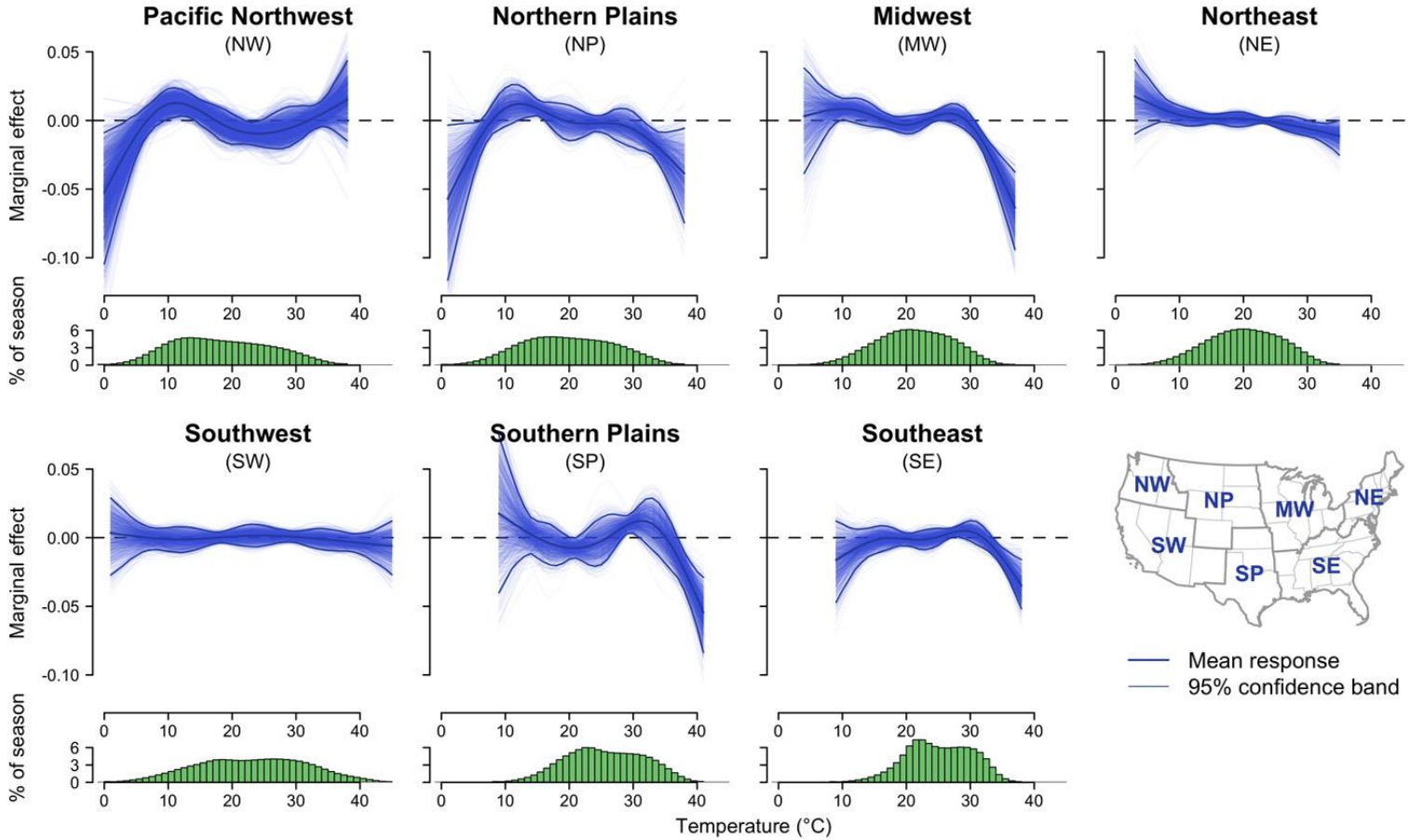
- “Overall, the benefits of CO2 rise over the next 30 years are projected to mostly offset the negative effects of temperature for most C3 crops except rice and bean, while the C4 crop yields are reduced by rising temperature because they have little response to the CO2 rise.”
- “Weeds generally respond more positively to increasing CO2 than most cash crops, particularly C3 invasive weeds”
- “Disease pressure on crops and domestic animals will likely increase with earlier springs and warmer winters, which will allow proliferation and higher survival rates of pathogens and parasites.”

Some new developments since 2009:

- Much better quantification of yield impacts, generally in line with original finding
- Much better evidence on harms of heat to non-grain crops, animals, and human workers
- Much better evidence on adaptation, showing limited effectiveness
- A more complete understanding of the overall impact on net productivity (outputs:inputs)

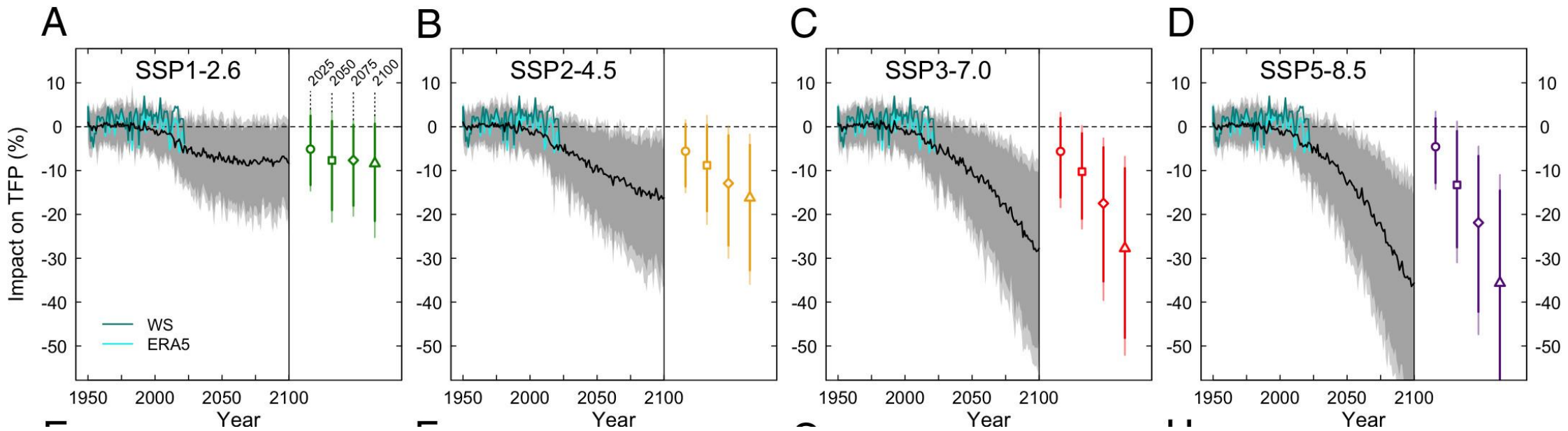
Large sensitivity of overall ag productivity

Response of regional total factor productivity to summer temperature



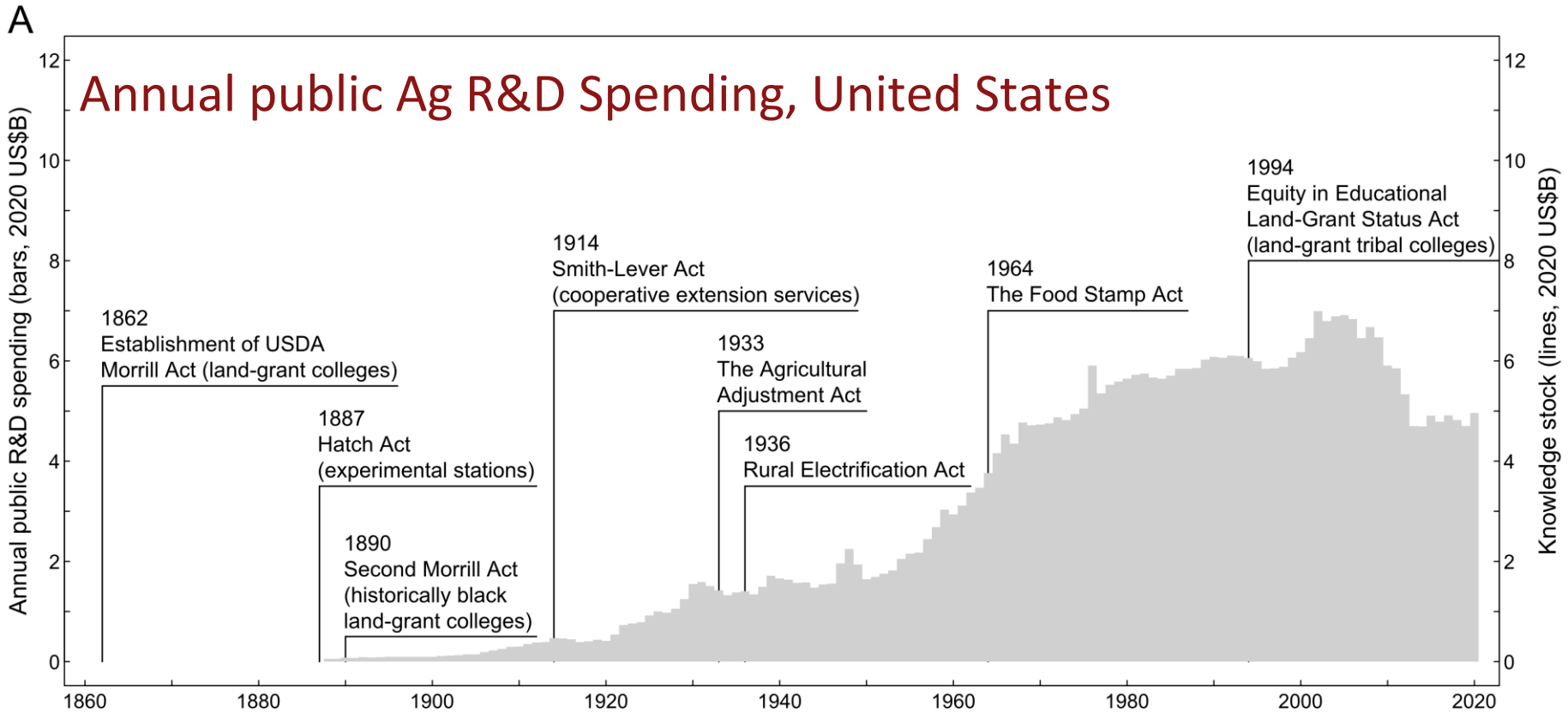
Ortiz-Bobea et al. 2018 https://doi.org/10.1126/sciadv.aat4343

Projected impact on US national ag productivity



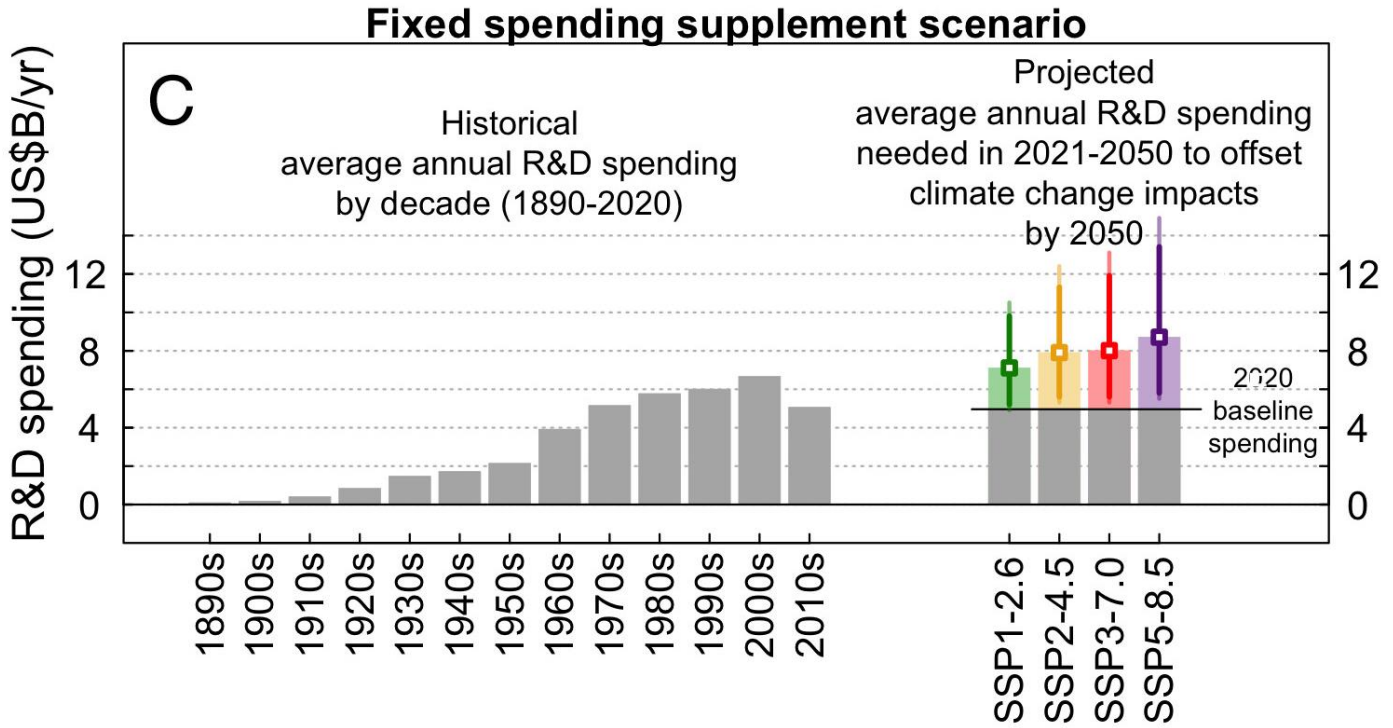
Ortiz-Bobea et al. 2025 https://doi.org/10.1073/pnas.2411010122

This is occurring in midst of slowing R&D



Ortiz-Bobea et al. 2025 https://doi.org/10.1073/pnas.2411010122

Projected impact on US ag productivity



Ortiz-Bobea et al. 2025 https://doi.org/10.1073/pnas.2411010122