IPCC 2022

Climate change and health

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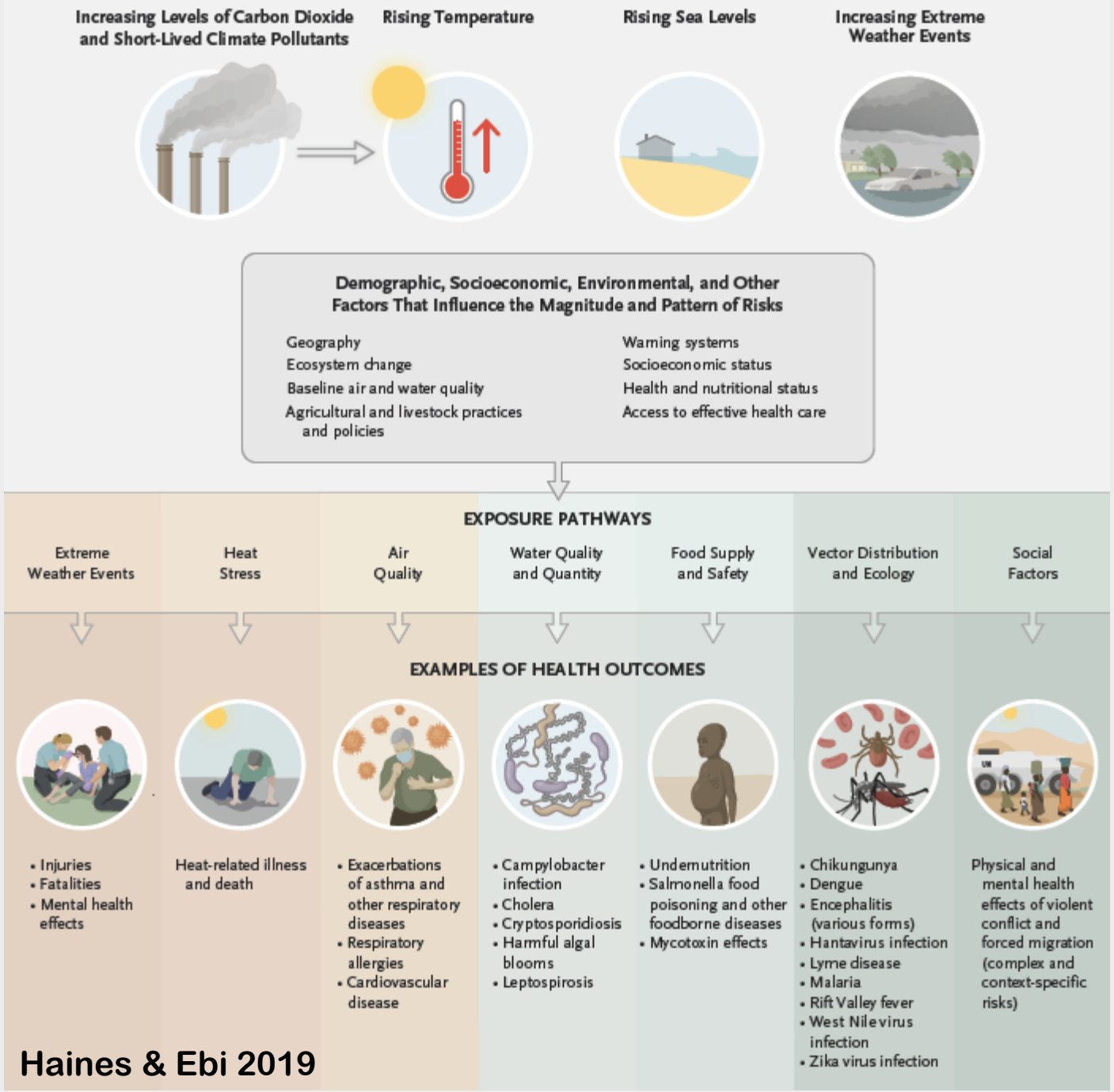
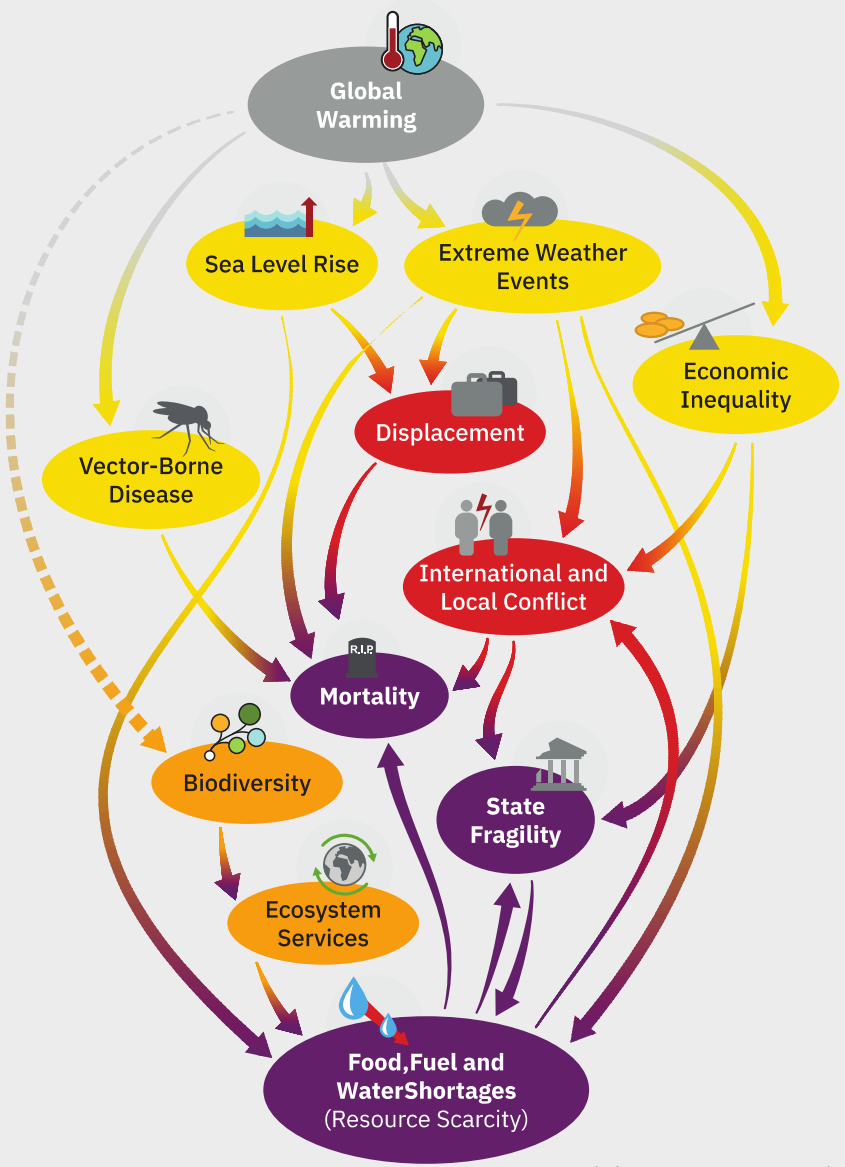


Haines & Ebi 2019

Cascading global climate risks



Kemp et al. 2022

Key conclusions of the IPCC 2022 chapter on human health

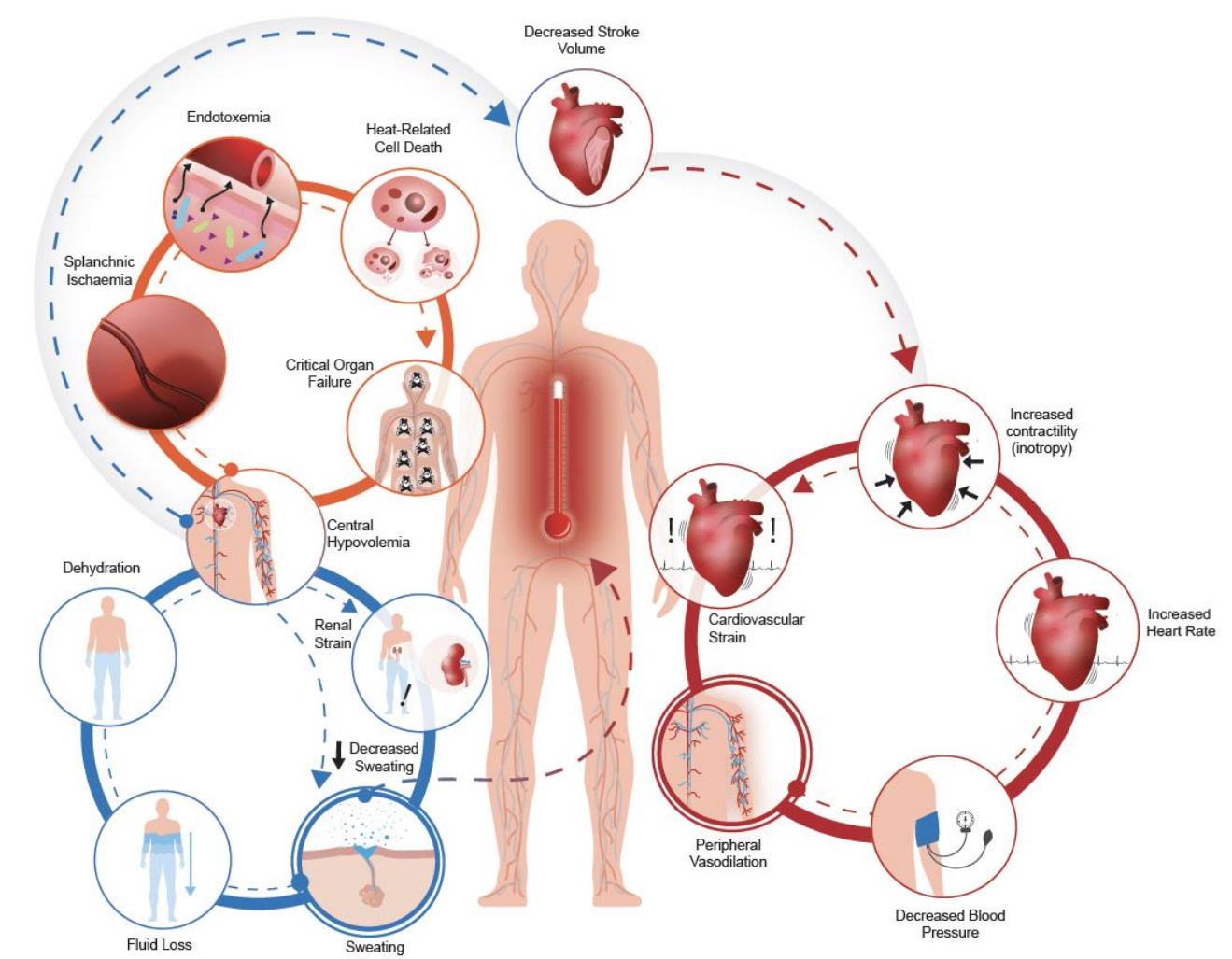
Observed impacts: *climate change is adversely affecting the physical health of people globally and mental health of people in assessed regions*

- 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

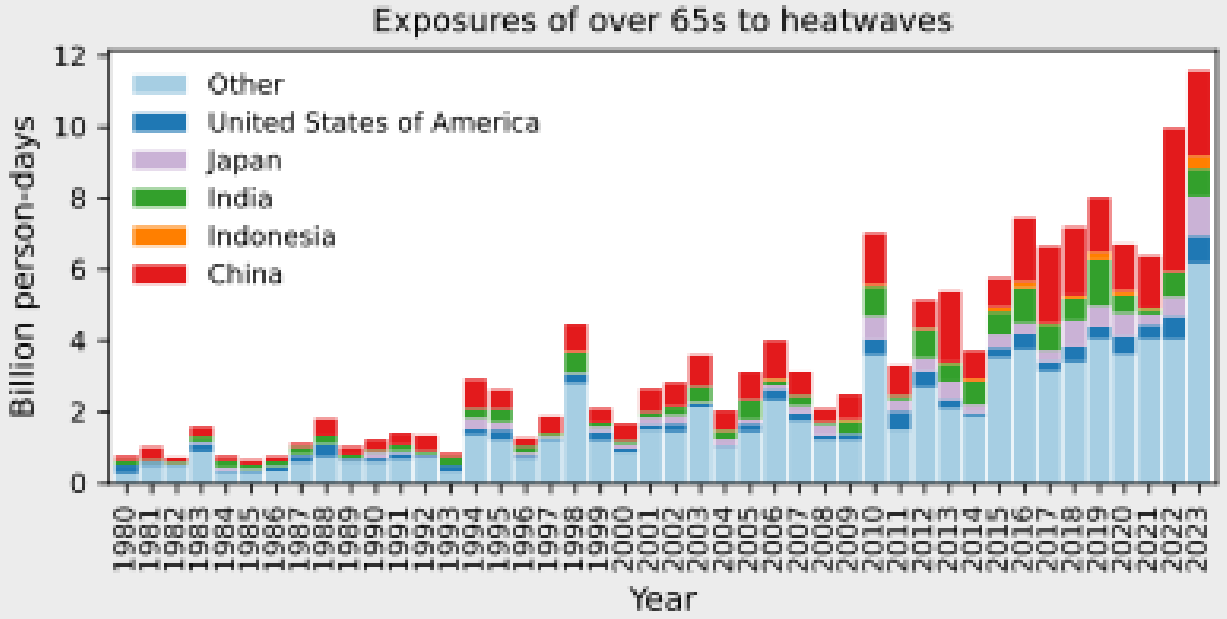


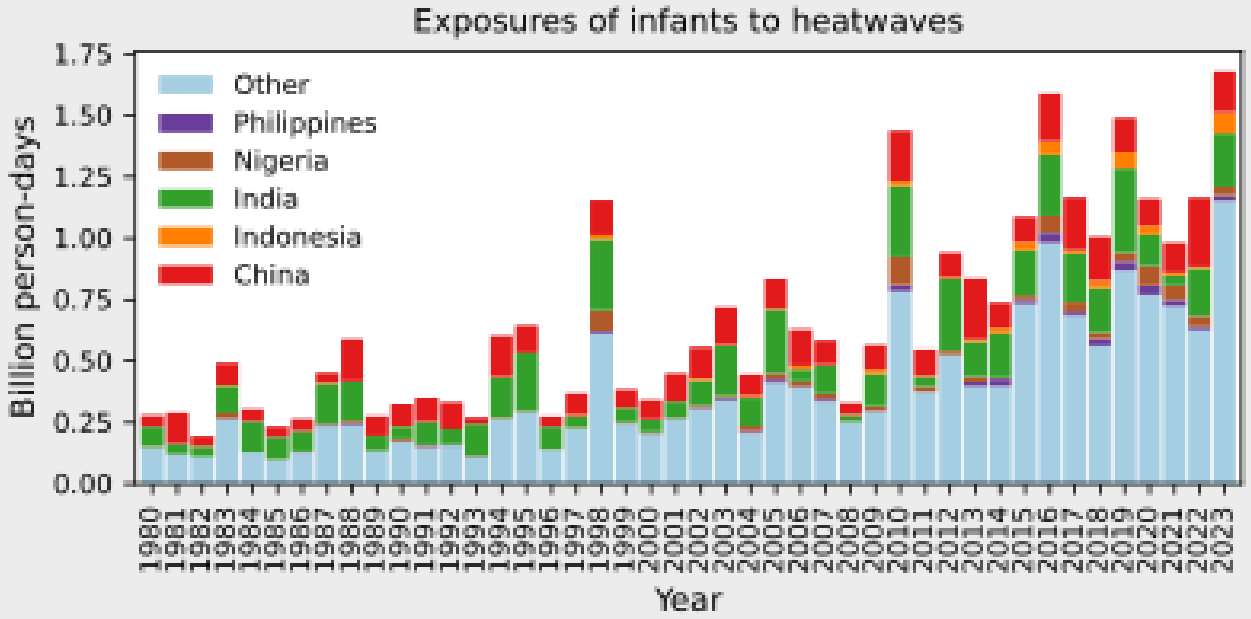
Ebi et al. Lancet 2021

- 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

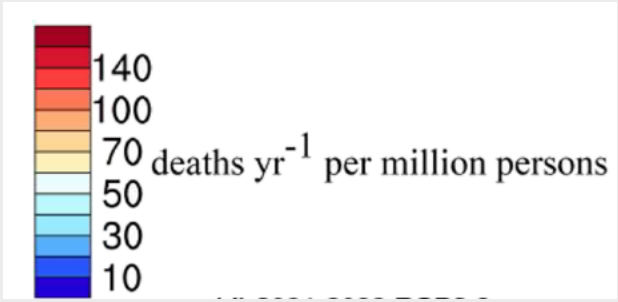




2024 Report of the Lancet Countdown

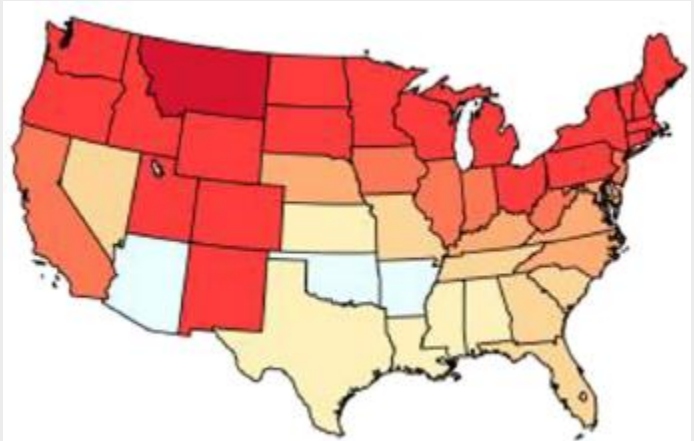
Projected annual heat-related deaths in 2091-2099

No adaptation; high emissions



No adaptation; low emissions

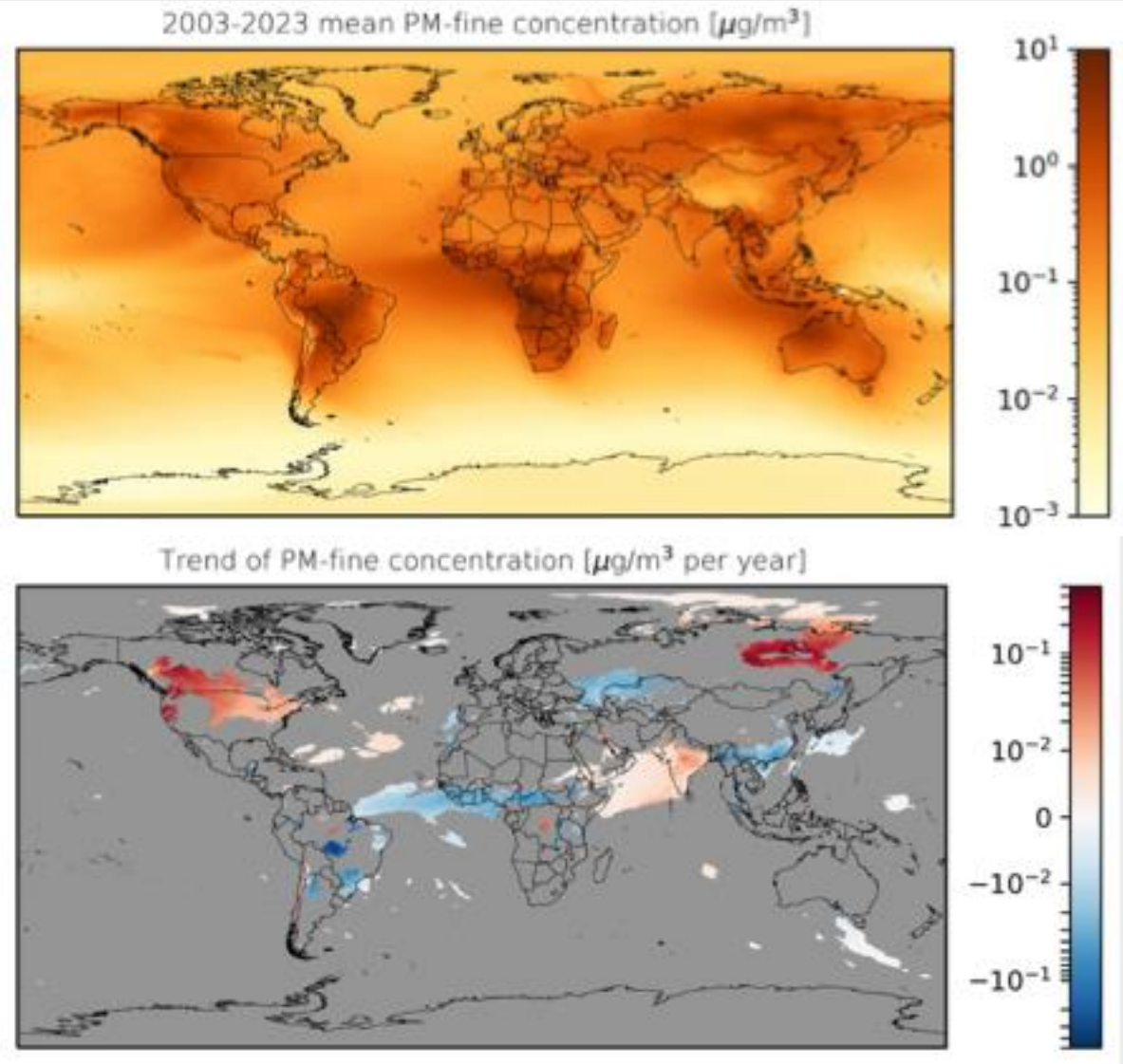
Adaptation; high emissions



Adaptation; low emissions

Shindell et al. 2020

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



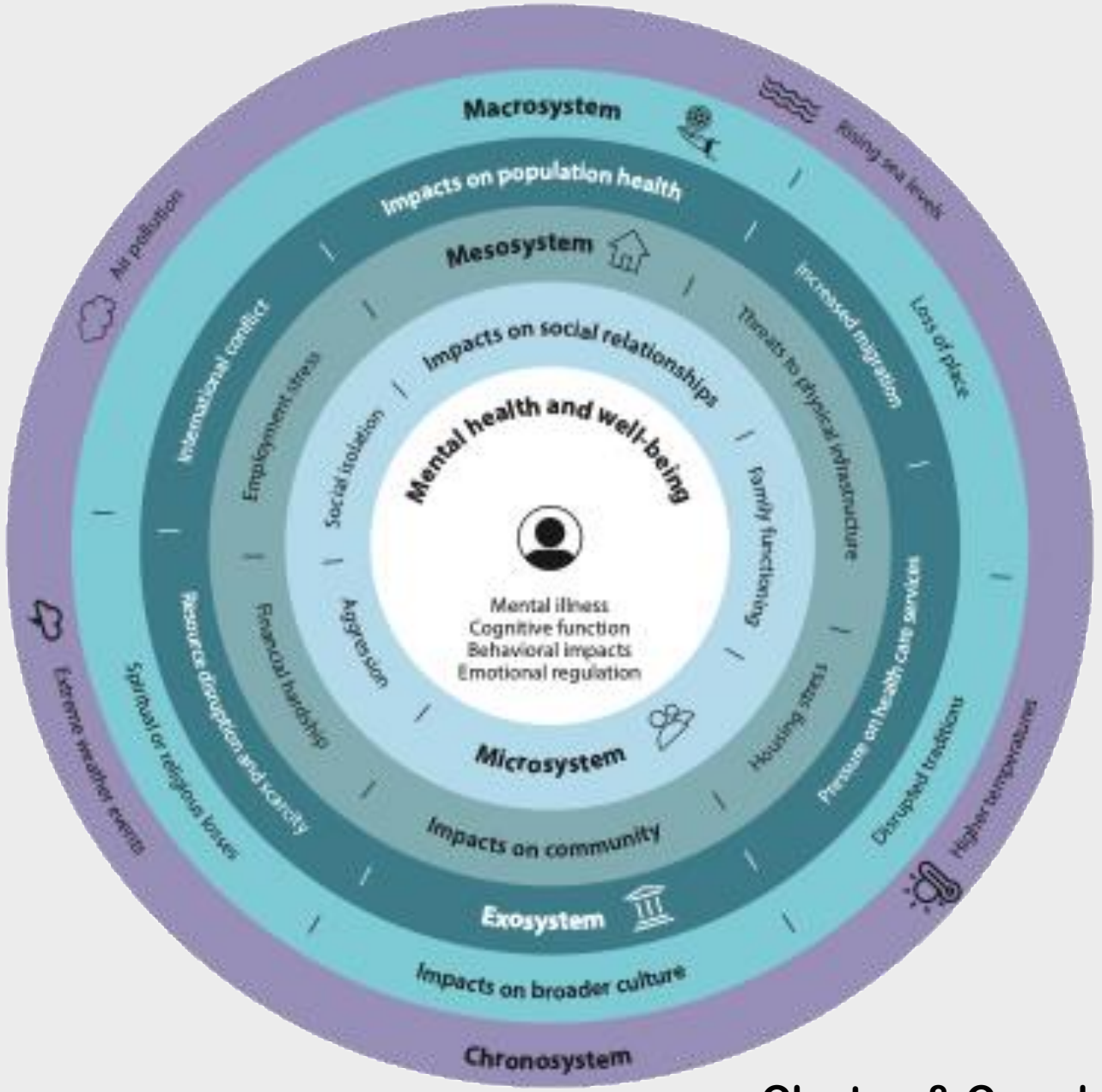
2024 Report of the Lancet Countdown

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%

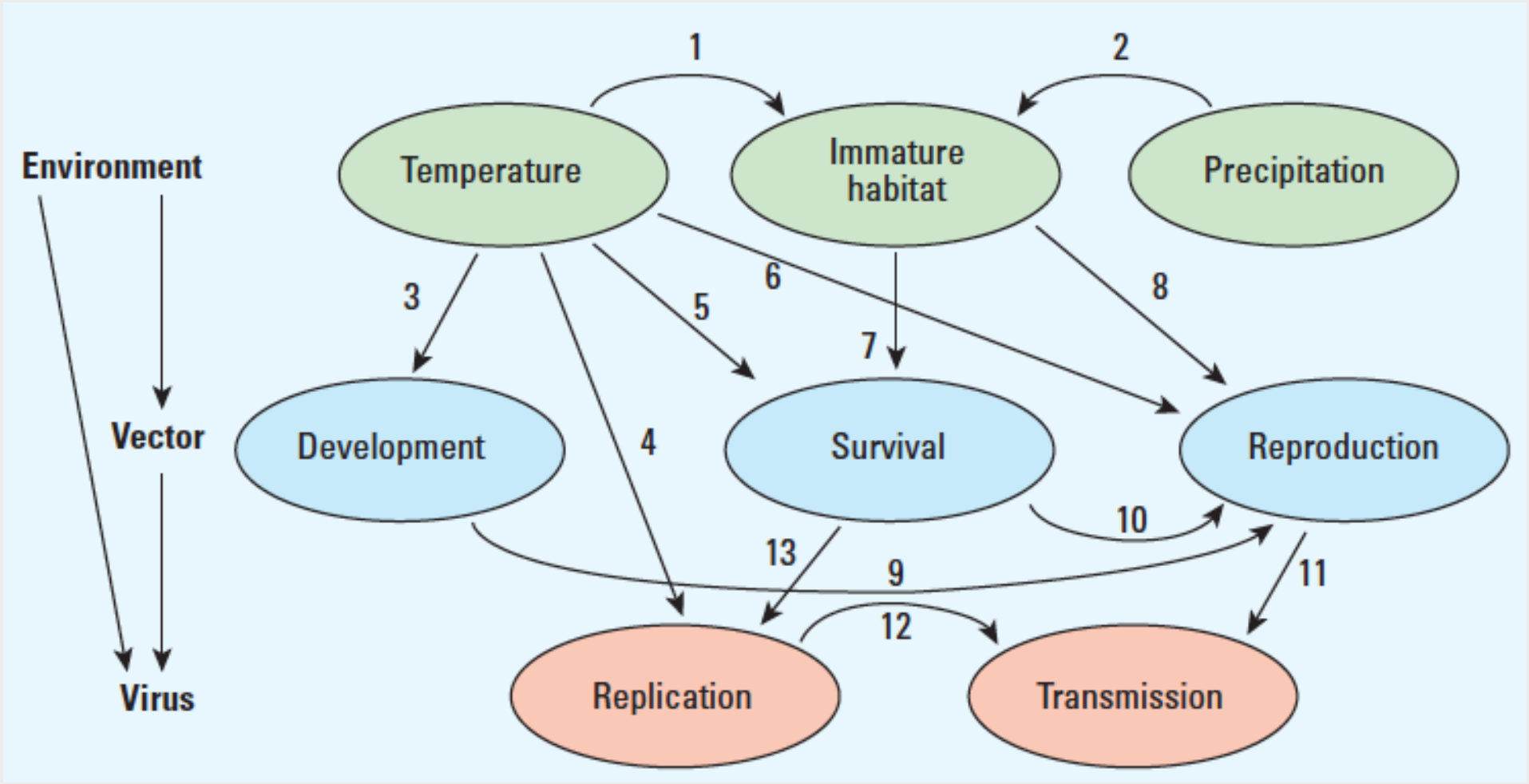
Alari et al. 2025

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

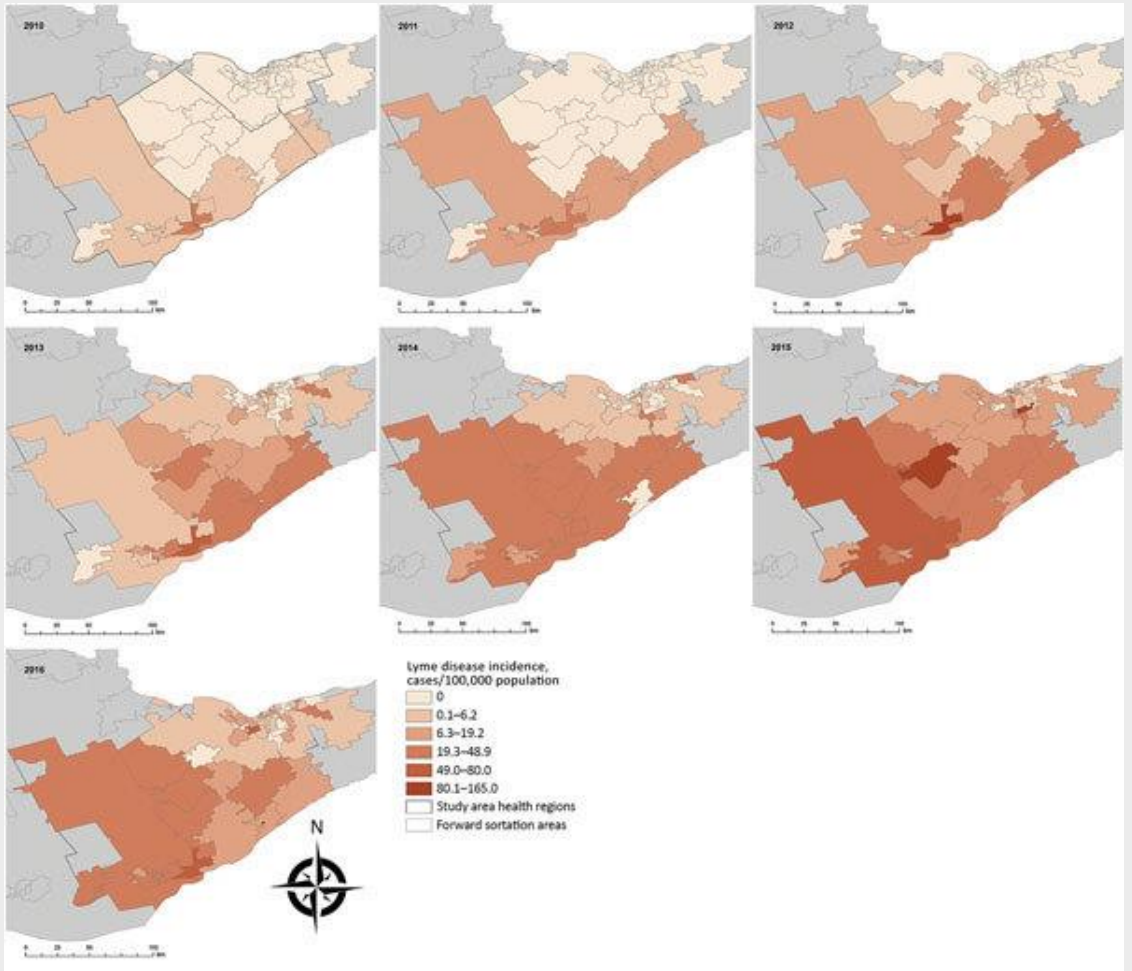


Morin et al. 2013

Lyme disease emergence in Canada

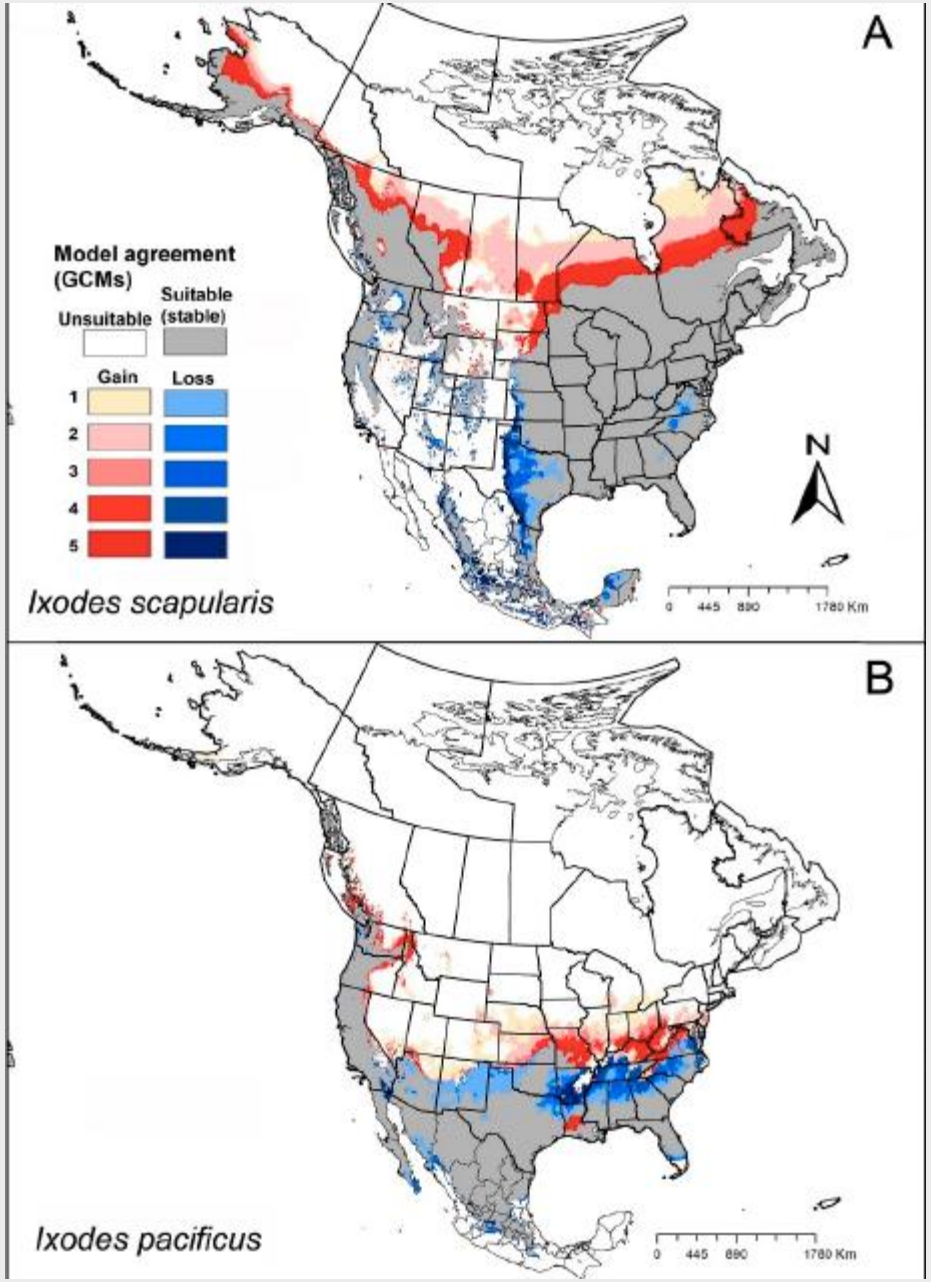
- **Climate impacts Lyme disease risk:**
  - **Tick vector distributions & abundance**
  - **B. burgdorferi transmission cycle occurrence & efficiency**
  - **The likelihood of transmission to humans**
- **Surveillance demonstrated geographic pattern changed (latitude and altitude)**
  - **Geographic 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



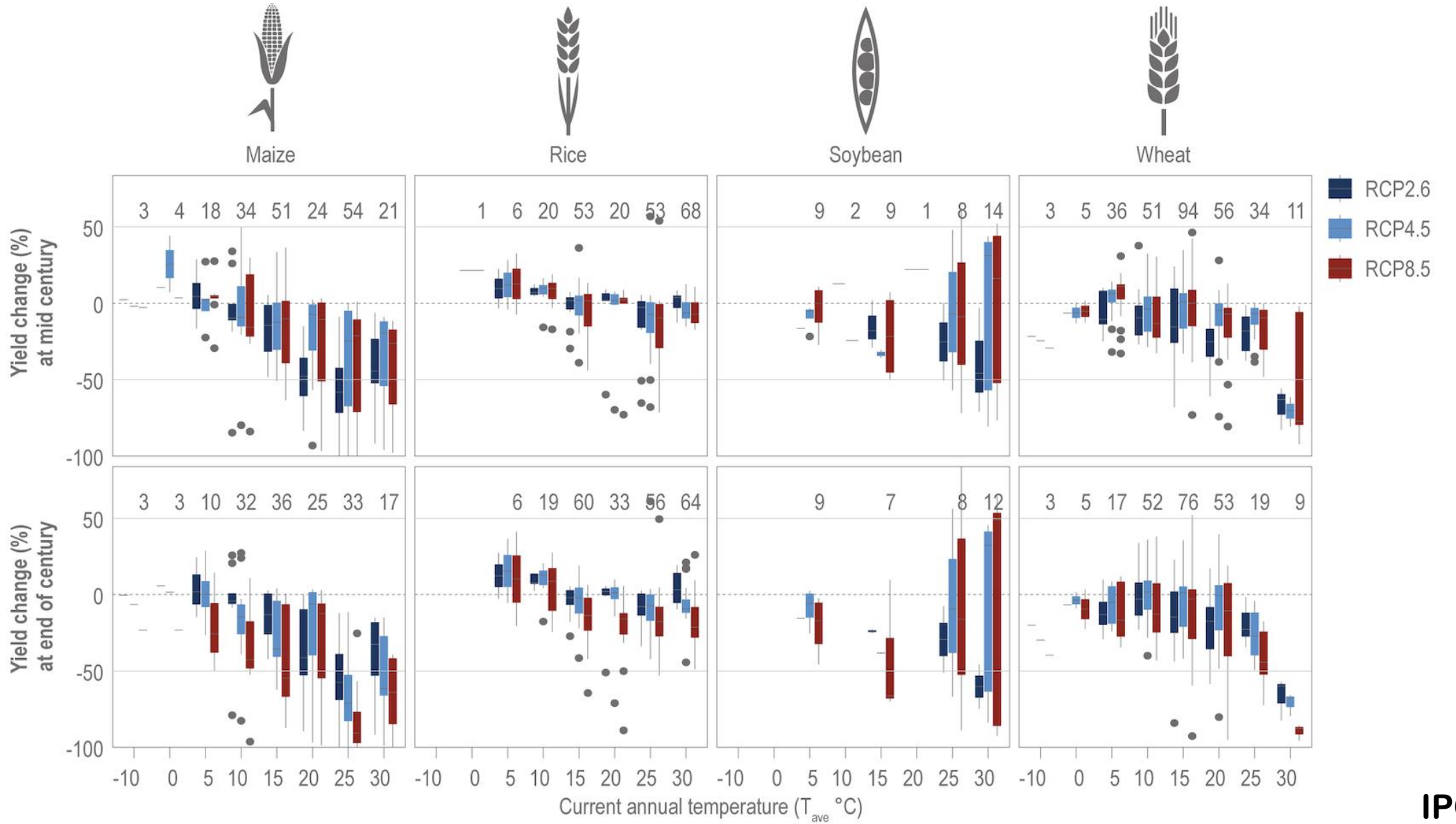
- **Red indicates expansion of suitable areas under future conditions (dark red = high model agreement**
- **Blue indicates suitable in current time but not in the future (dark blue = high model agreement**

Alkishe et al. 2021

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

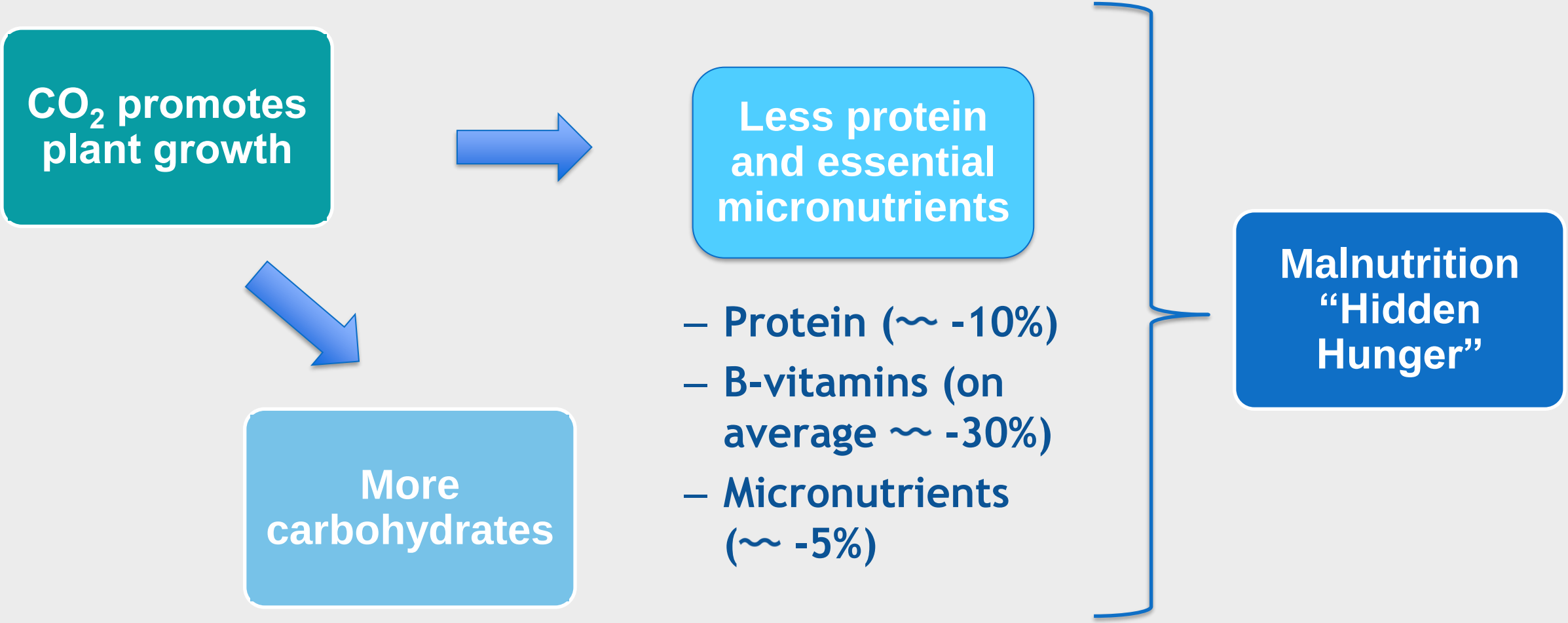
Numbers are the number of simulations

(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