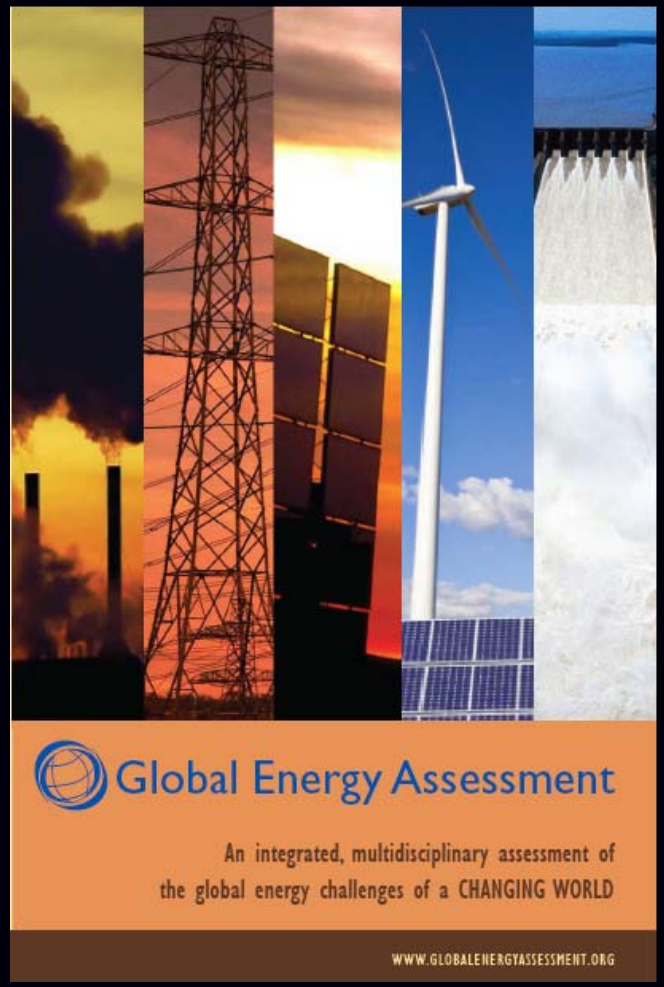
Climate Change, Energy, and Health: Findings from the 2011 Global Energy Assessment



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Climate Change, Environment and Population Symposium

UC Berkeley

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Overview

- WHAT: is the Global Energy Assessment?
- HOW: does cc* affect health?
- WHEN: and how much will cc impact health?
- WHY: do health co-benefits come from cc mitigation?
- KEY POINTS: if you remember nothing else…

Note: I use the abbreviation "**cc**" for **climate change** throughout.

GEA: Overview

- Secretariat:

  International Institute for Applied Systems Analysis (IIASA)
- Follow-up to *Energy in a Finite World* (1981), *Energy for Tomorrow's World* (1992), *World Energy Assessment* (2000)
- Includes: summary of knowledge and challenges; new scenarios; analysis of technology options and policy synergies.
- Focus on:
  - Providing "energy services," rather than energy carriers
  - How to end energy poverty
  - Energy for sustainable development
  - Innovation and strategic economic investment

See www.globalenergyassessment.org for more information.

GEA: 2011 “Energy and Health” Chapter Authors

- Kalpana Balakrishnan (Sri Ramachandra University, India)
- Colin Butler (Australian National University, Australia)
- Ian Fairlie (Int’l Consultant on Radiation in the Environment, UK)
- Patrick Kinney (Columbia University, USA)
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Funding: International Institute for Applied Systems Analysis (IIASA)

GEA: “Energy and Health”—What Else is Included?

- Household Energy Systems
- Occupational Effects of Energy Systems
- Community and Regional Effects
- Routine Health Impacts from Nuclear Fuel Chain
- Emerging Energy Systems
- Energy Efficiency
- Today: Global Climate Change; Co-Benefits

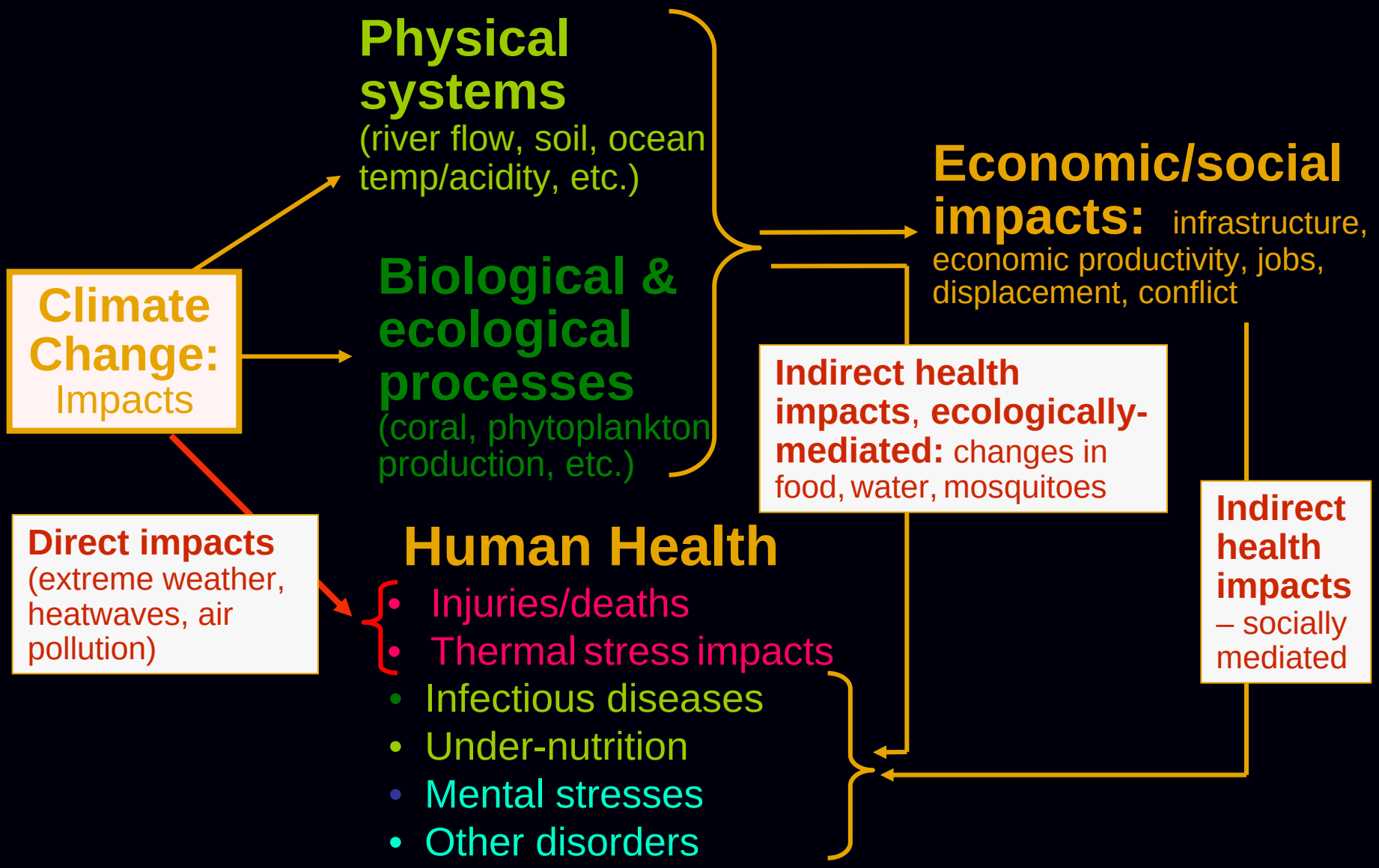
Why Study Climate and Health?

- Health impacts "reasonably attributable" to climate change have already occurred and continue to occur.
  - Rise in extreme weather events -> deaths and ill-health
  - Drying -> bad crop yields -> adverse mental health effects
- Recognizing risks to human health strengthens rationale for rapid abatement of climate-active pollutants (CAP).
- Human health can be a "canary" (ie early indicator of change)
- Given this, can build case for adaptation if we think more change is coming.
- Moral case: most deaths are/will occur among children in developing countries.

How Does CC Affect Health? Categories of Risks

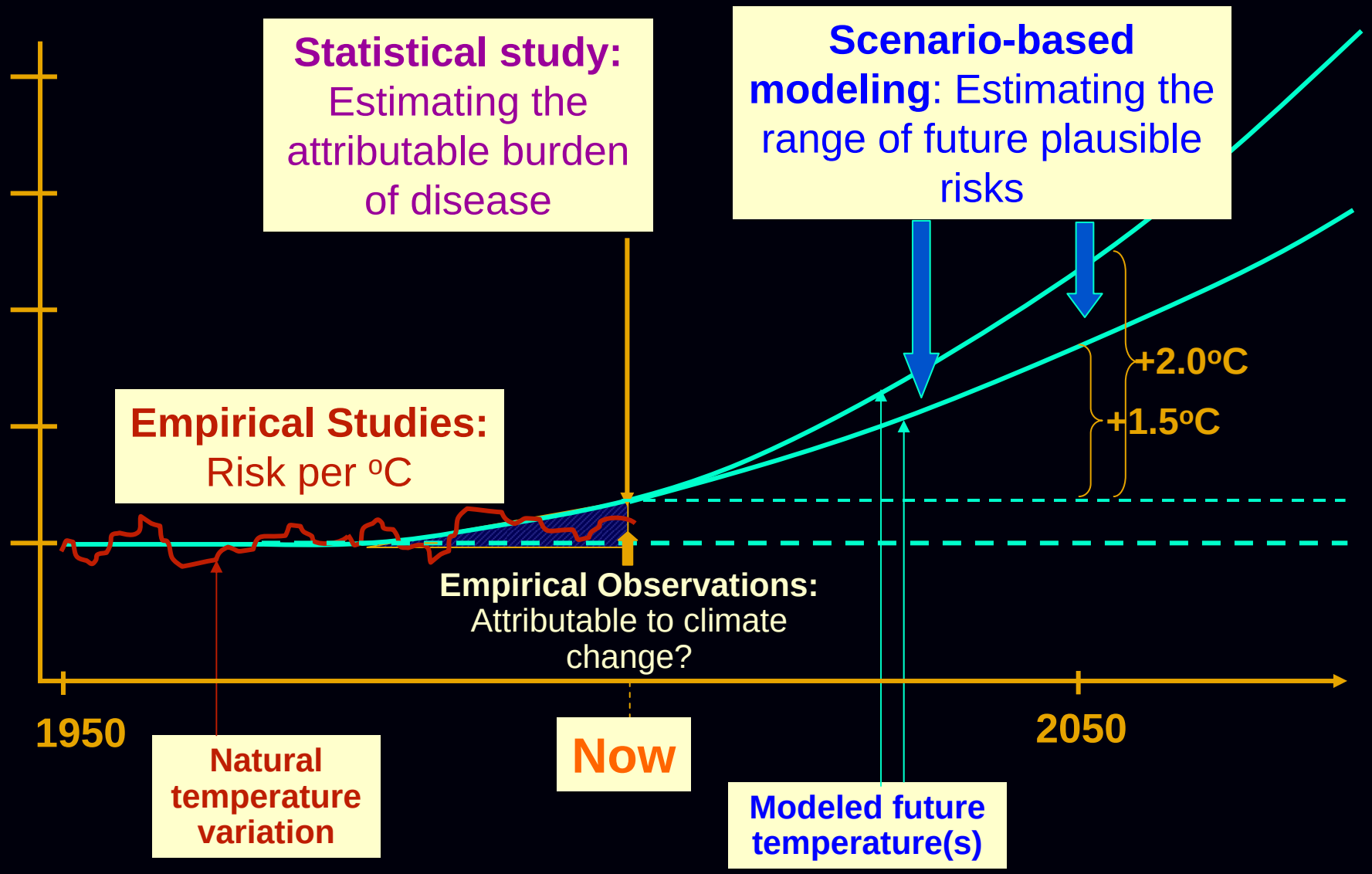
- Direct impacts: heatwaves, extreme events, urban air pollutants, etc.
- Ecologically-mediated: food yields, water flows, infectious-disease vectors and intermediate-host animal ecology
- More diffuse impacts: e.g. mental health problems in failing farm communities, displaced groups, disadvantaged indigenous and minority ethnic groups, etc.
- Consequences of tension and conflict, due to CC-related declines in basic resources (water, food, timber, living-space)

How Does CC Affect Health? Pathways



Source: Anthony McMichael, Australian National University

When and How Much: Health Risk Assessments (past, present, future)

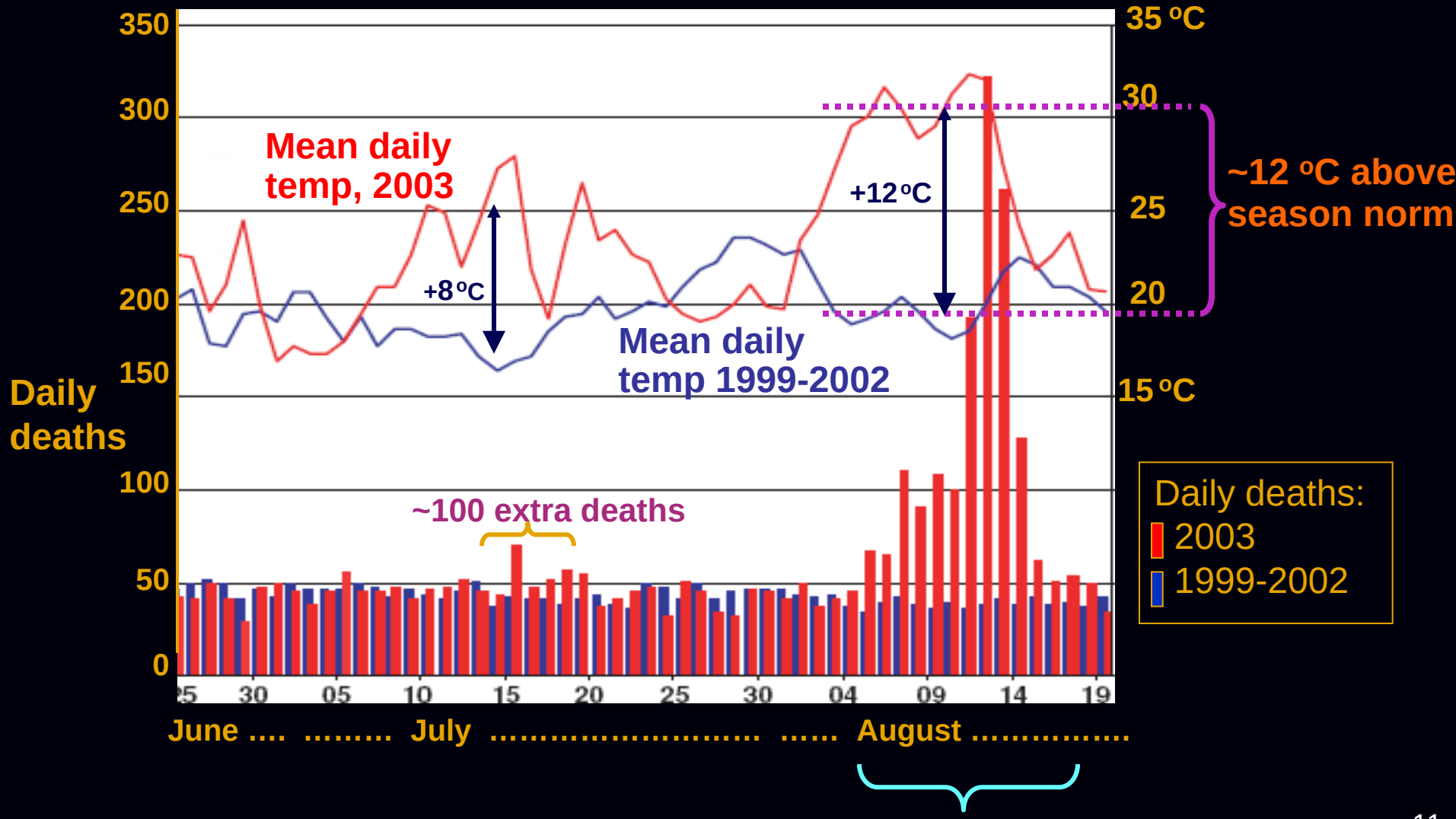


Source: Anthony McMichael, Australian National University

How Does CC Affect Health? Impacts Now

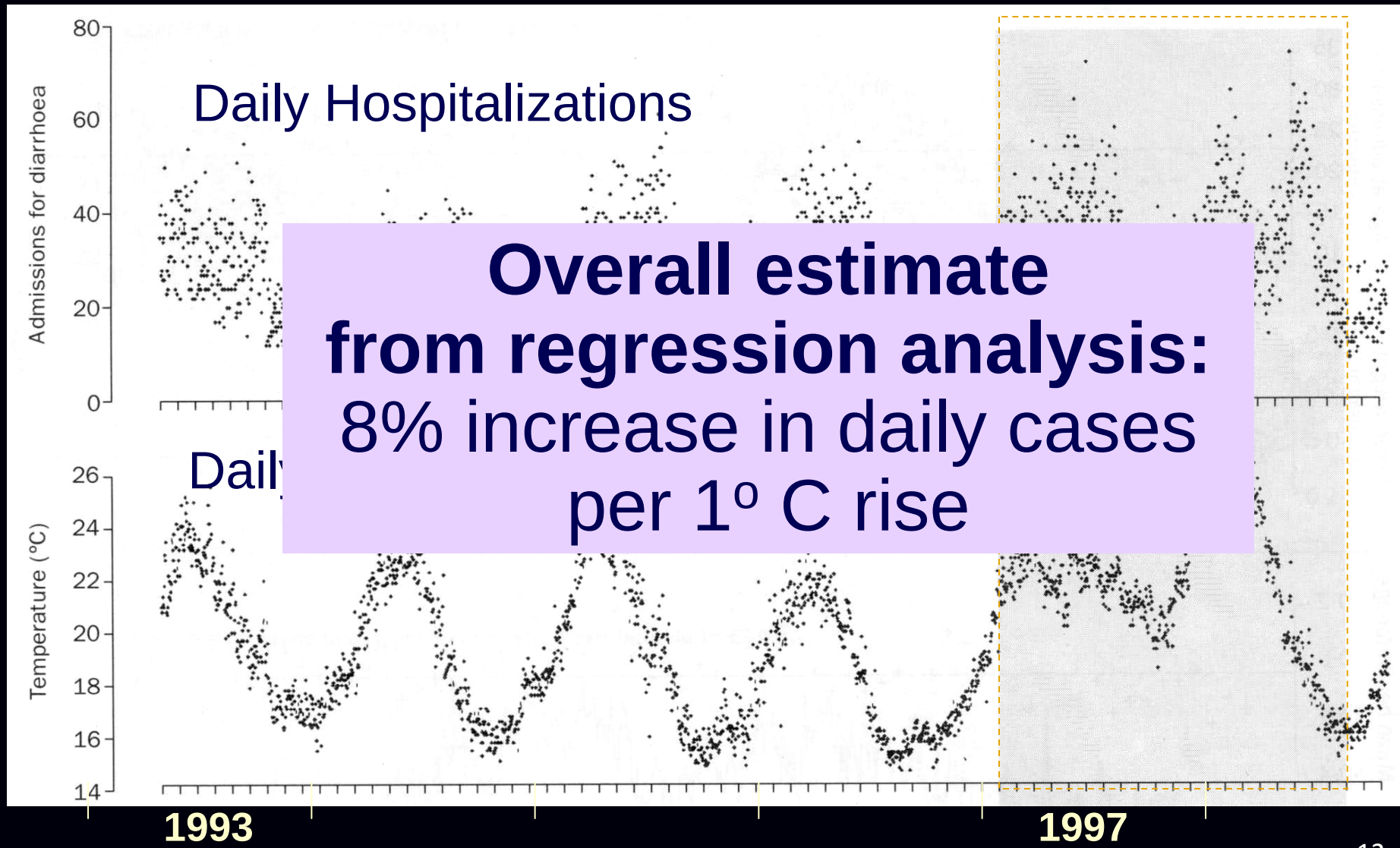
- Sea level rise: 3 mm/yr global average (50% greater than in 1980s)
  - Already endangering food yields, freshwater supplies, physical safety in small low-lying island states.
- Temperature extremes become more frequent
  - Leads to ground-level ozone formation; increased incidence of strokes/heart attacks in vulnerable; mood and behavior changes.
  - Example: Paris Heat Wave, 2003

Empirical: Paris Heatwave, Aug 2003, Daily Mean Temps and Deaths



Source: Vandentorren, AJPH, 2004

Empirical: Daily Hospitalizations for Diarrhea, by Daily Temp: Lima, Peru

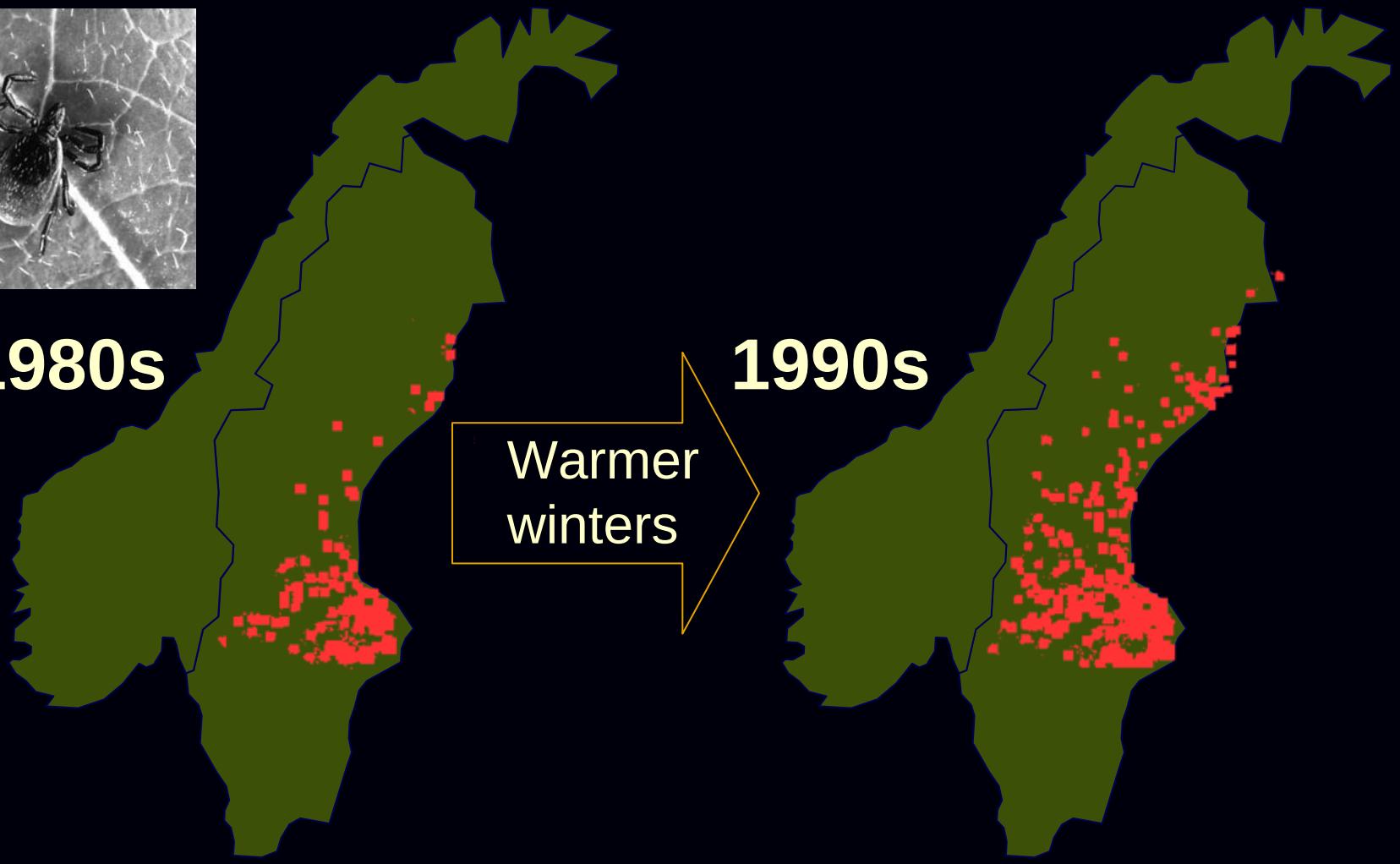


Overall estimate from regression analysis:
8% increase in daily cases per 1° C rise

Source: Checkley et al, Lancet 2000

Empirical: Sweden—Tick-borne Encephalitis

Spread of Ixodes ricinus tick to higher latitudes (and altitudes)



Source: Lindgren, et. al., Environmental Health Perspectives, 2000

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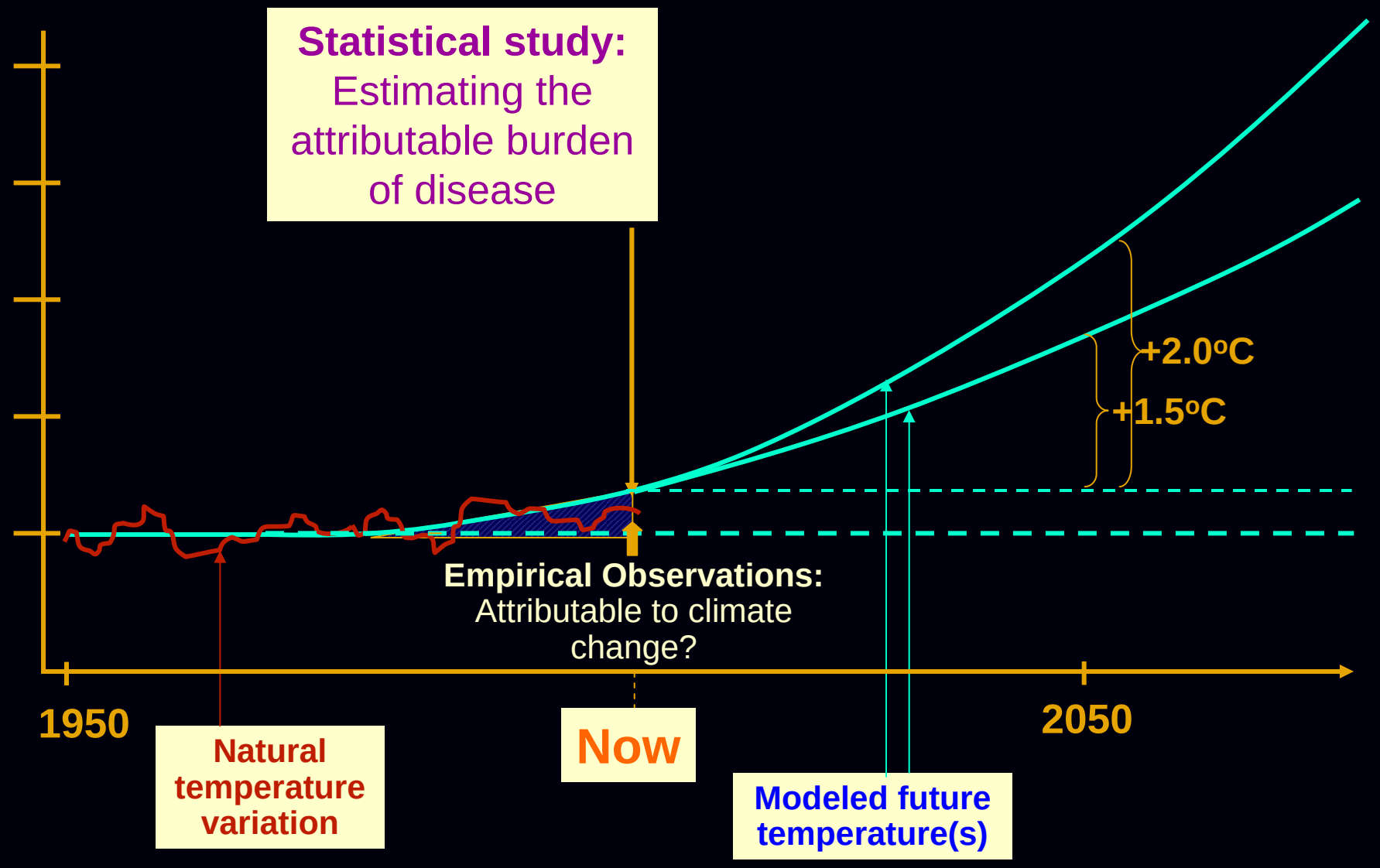


Source: Anthony McMichael, Australian National University

Statistical: Comparative Risk Assessment

- Part of the Global Burden of Disease project organized by the World Health Organization; published 2004
- Begins with known exposure-response relationships for climate, with evidence from various regions:
  - Diarrheal disease, malaria, malnutrition, deaths due to flooding, and cardiovascular events/deaths due to heat.
  - Not included: asthma, infectious disease during extreme events, pollen levels, population movement etc.
- Use climate models to estimate "climate change exposure" in future years.
- Results expressed in 1) premature deaths, 2) DALYs*

DALYs = Disability-Adjusted Life Years, a measure of morbidity and mortality

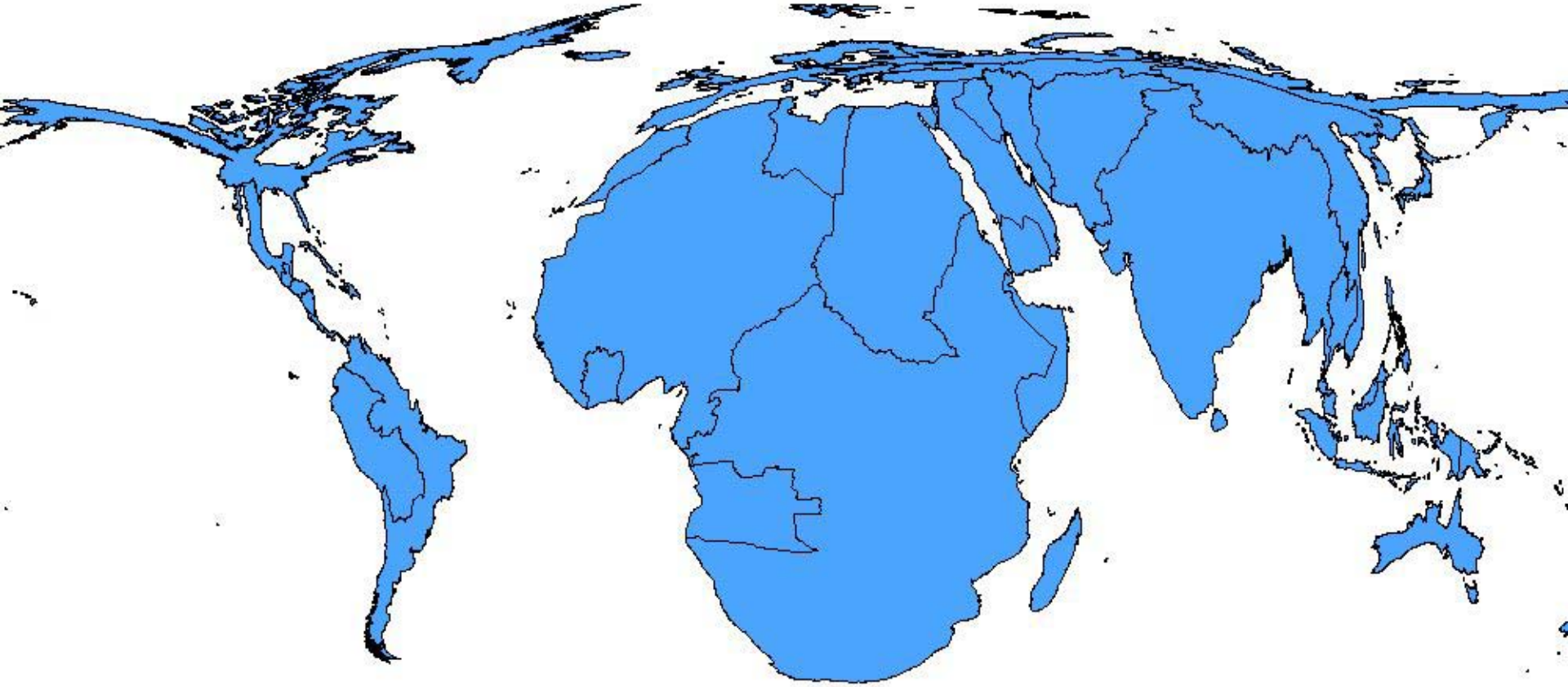
Statistical: CRA Results

- In 2000: 0.4% of global DALYs and 0.3% of premature deaths
  - About 150,000 deaths, with 99% in developing countries
- 88% of loss of DALYs (to climate change) occur in children under 5 in developing countries.
- Estimated that climate change burden will double in 2020; while population grows 25% over same time period.
  - Malnutrition will play strongest role in increase

Source: McMichael et al., "Global Climate Change," in Ezzati et al. (2004, WHO)

Deaths Attributable to Climate Change: Year 2000

Estimated annual deaths due to climate change from: malnutrition (~80K), diarrhoea (~50K), malaria (~20K), flooding (~3K)



14 WHO statistical regions scaled by estimated annual mortality (in 2000) due to change in climate since ~1970. Selected major causes of death.

Source: Patz, Gibbs et al, 2007: based on McMichael, Campbell-Lendrum, et al, 2004

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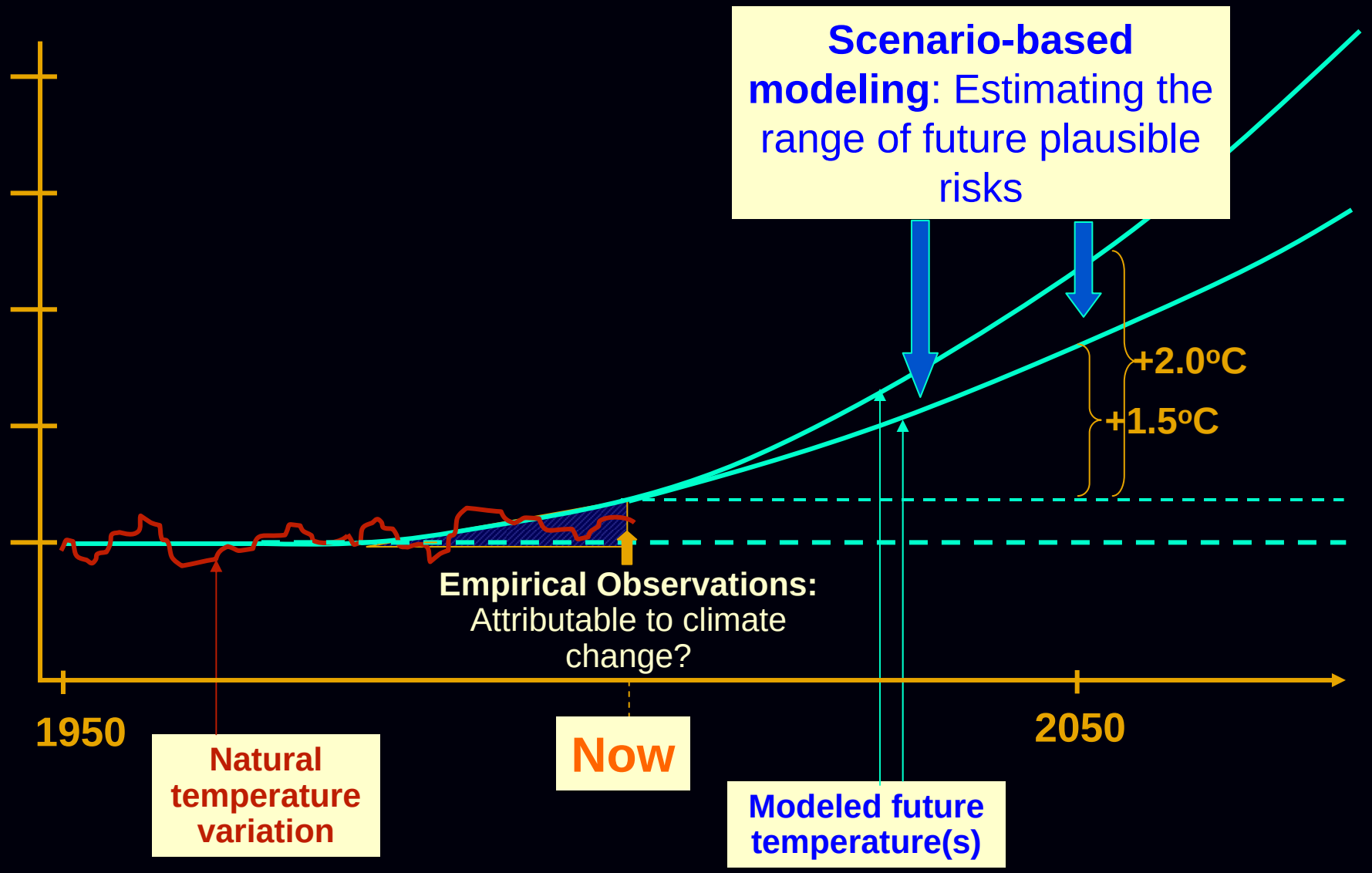
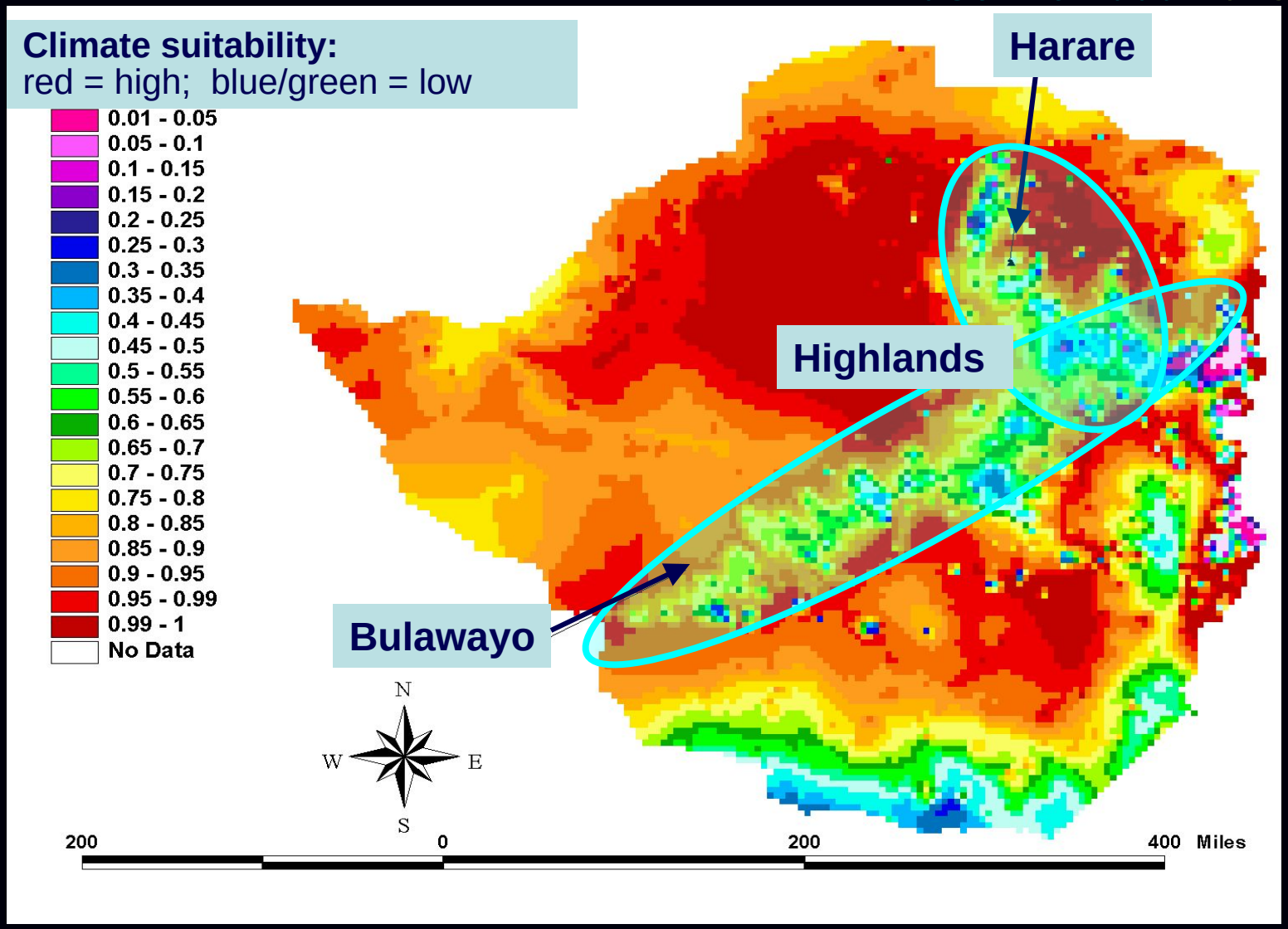


Source: Anthony McMichael, Australian National University

Scenario-Based: Potential Malaria Transmission in Zimbabwe

Baseline *2000* 2025 2050



Source: Ebi et al., Climatic Change, 2005

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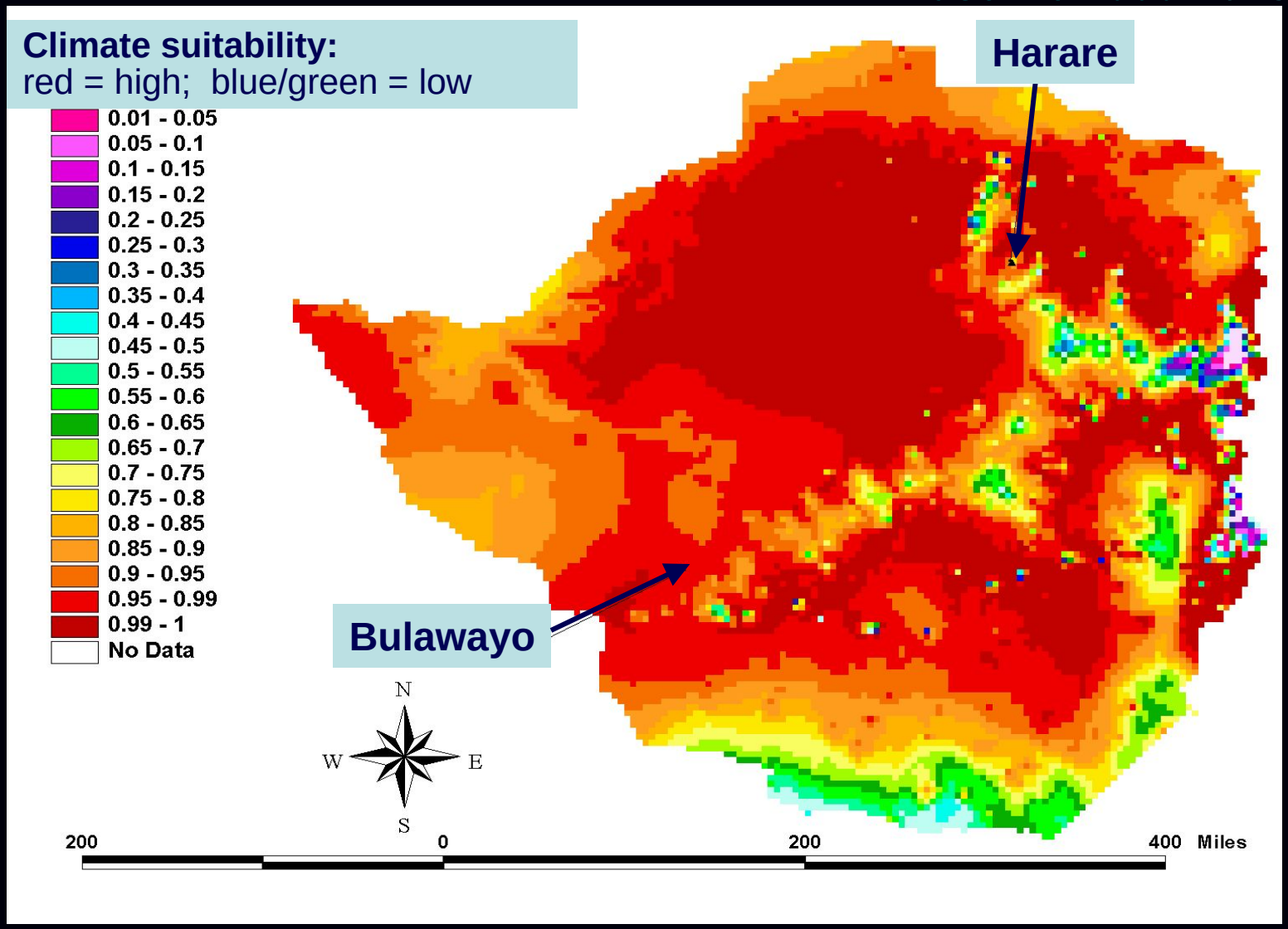

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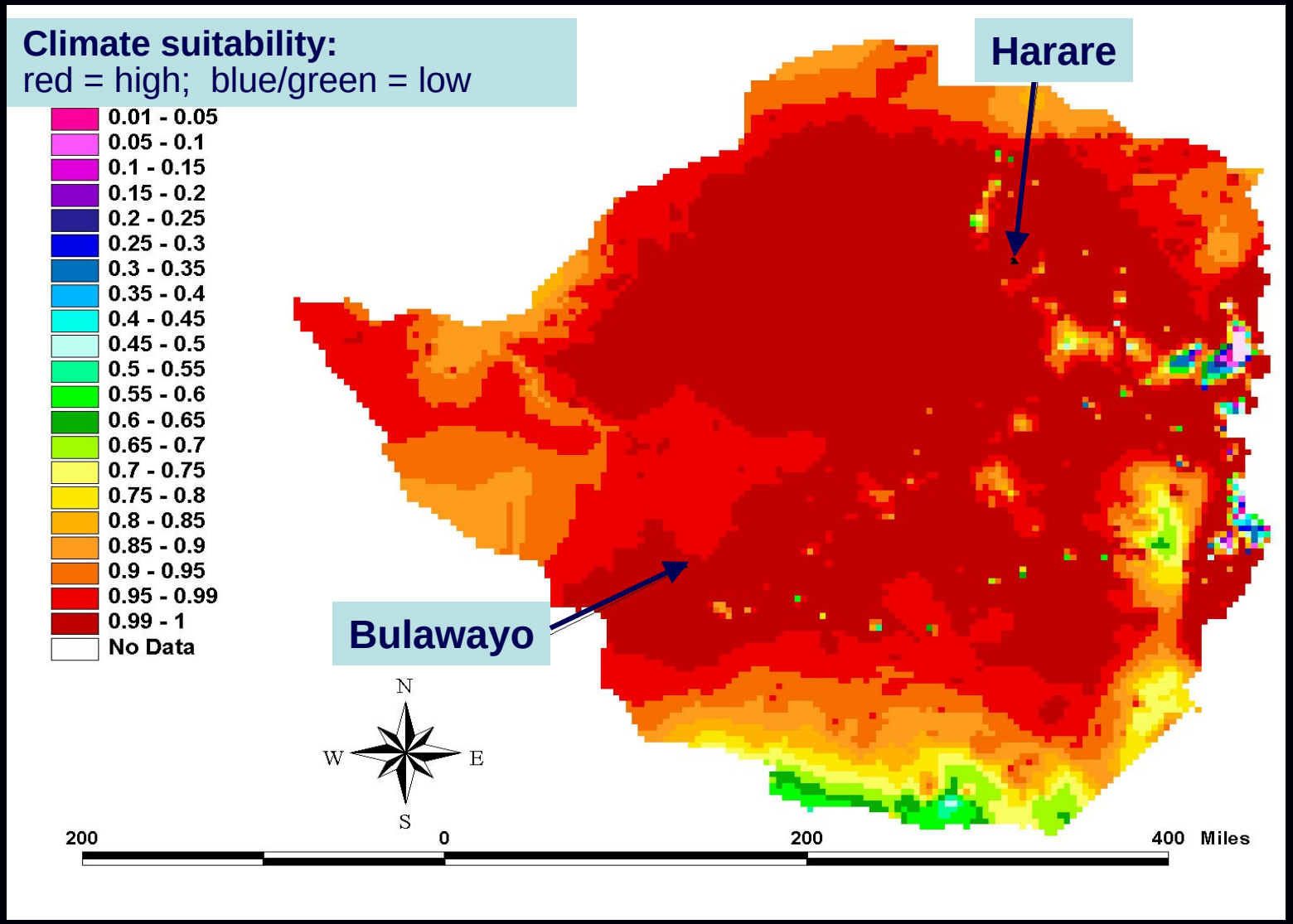
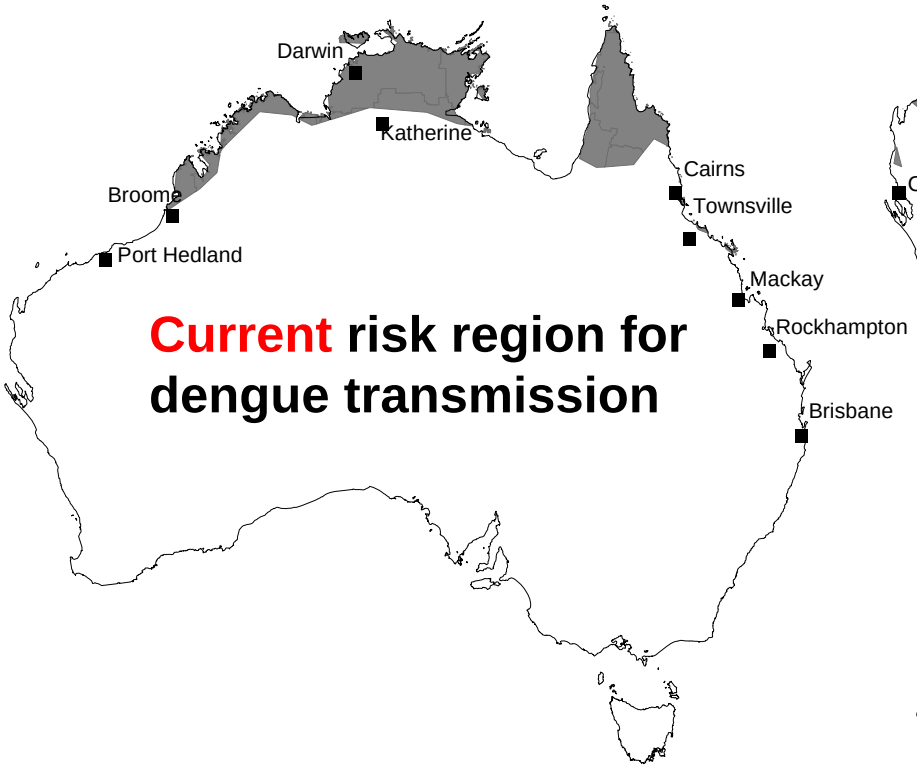
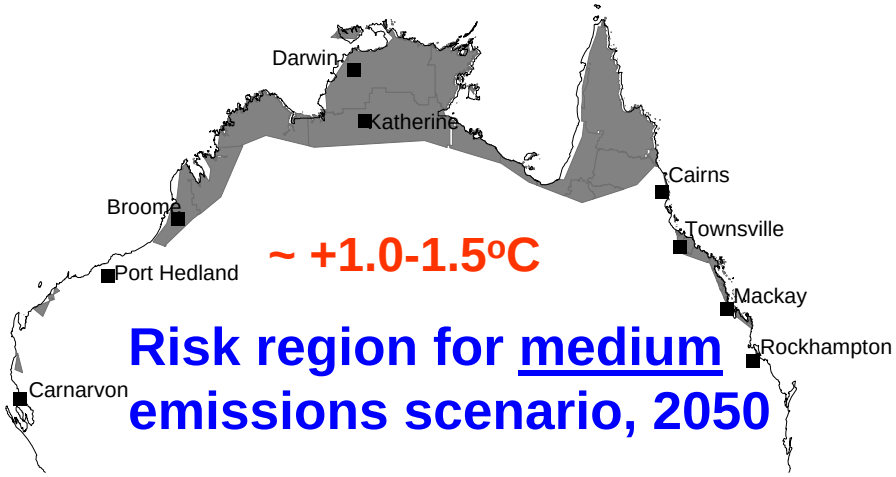


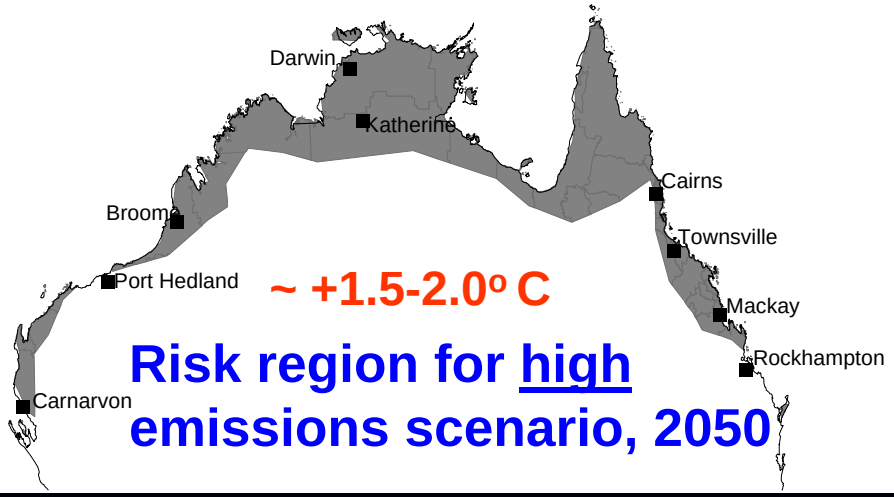
Source: Ebi et al., Climatic Change, 2005

Scenario-Based: Dengue in Australia

Estimated 'receptive' region for Ae. aegypti mosquito vector (2050)

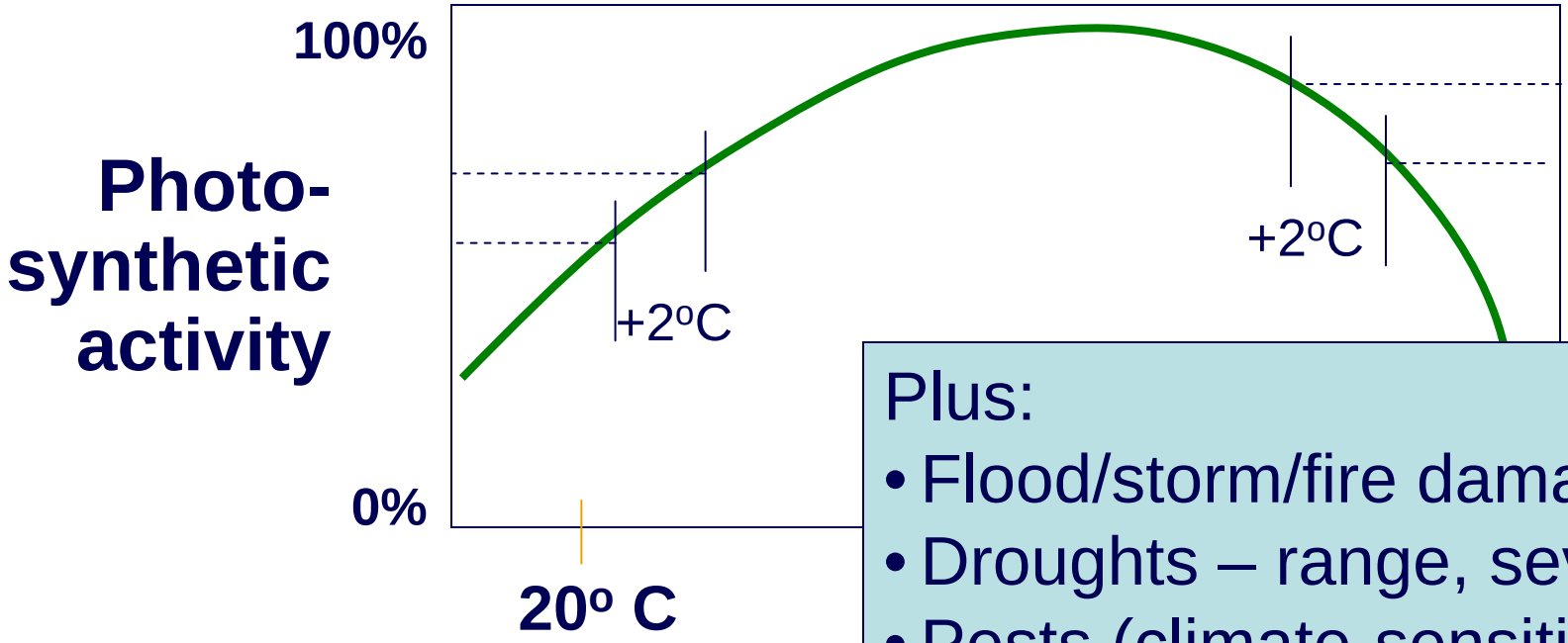






Source: ANU NCEPH/CSIRO/BoM/UnivOtago, 2003

Food Yields: General Relationship of Temperature and Photosynthesis

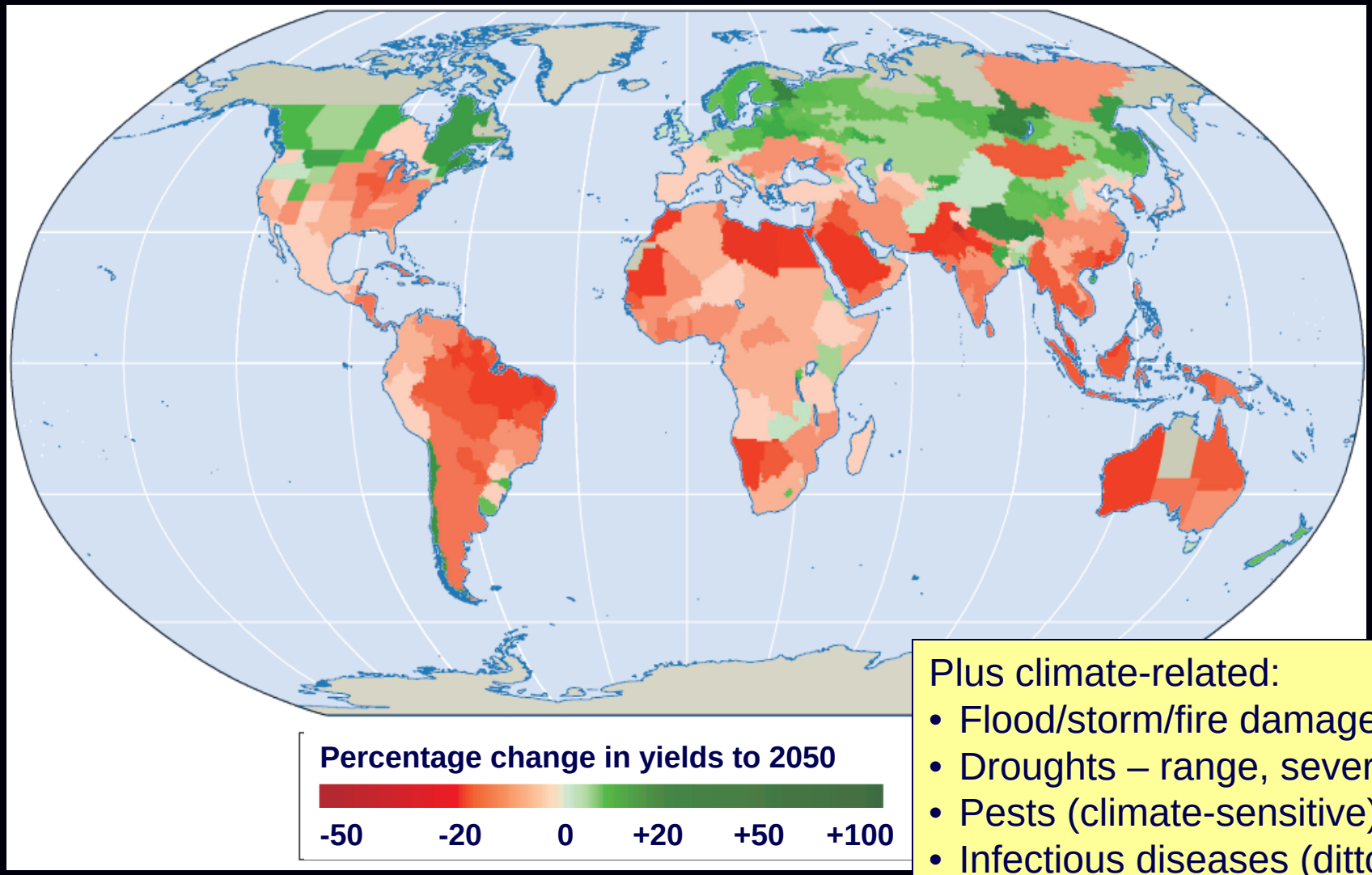


Plus:
- Flood/storm/fire damage
- Droughts – range, severity
- Pests (climate-sensitive)
- Diseases (ditto)

Globally averaged estimate: +0.5°C reduces crop yields by 3-5%.

Source: Lobell and Field, Environ Research Letters, 2007

Modeled Changes in Cereal Grain Yields, to 2050



Plus climate-related:

- Flood/storm/fire damage
- Droughts – range, severity
- Pests (climate-sensitive)
- Infectious diseases (ditto)

Source: UN Development Program, 2009

On the bright side: health "co-benefits"

- Reducing fossil fuel use for power production:
  - Improves air quality; reduces respiratory and cardio disease.
- Increasing use of mass transit, cycling and walking:
  - Increases physical activity, reduces obesity, stimulates social contact.
- Promoting women's control over their fertility worldwide:
  - Reduces maternal and child mortality, assists in meeting Millennium Development Goals
- NOTE: not all climate mitigation strategies align well with health goals.
  - Eliminating "cooling" particulate mixes will help meet health goals, but will not help mitigate climate change.

Key points

- Most impacts of CC on health will be adverse. CC will exacerbate existing health problems.
- CC will make it more difficult to 1) improve health in low-income countries and 2) reduce persistent health inequities.
- WHO estimates that malnutrition—among children in developing countries—was the largest cause of ill-health and premature death in 2000.
- "Broad agreement": as CC progresses, the largest burdens will come from indirect effects (malnutrition, infectious disease, conflict and displacement).
- Mitigation policies will, in general, create local health benefits ("health co-benefits")—a further incentive to take action on CC.
- Health sector must be a part, but not the whole, response to health and climate concerns, especially vis a vis adaptation.

Acknowledgements

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Avoiding the Unmanageable

Mitigation **and** Adaptation

Managing the Unavoidable