Climate Change and Health:

Diverse Pathways of Impact

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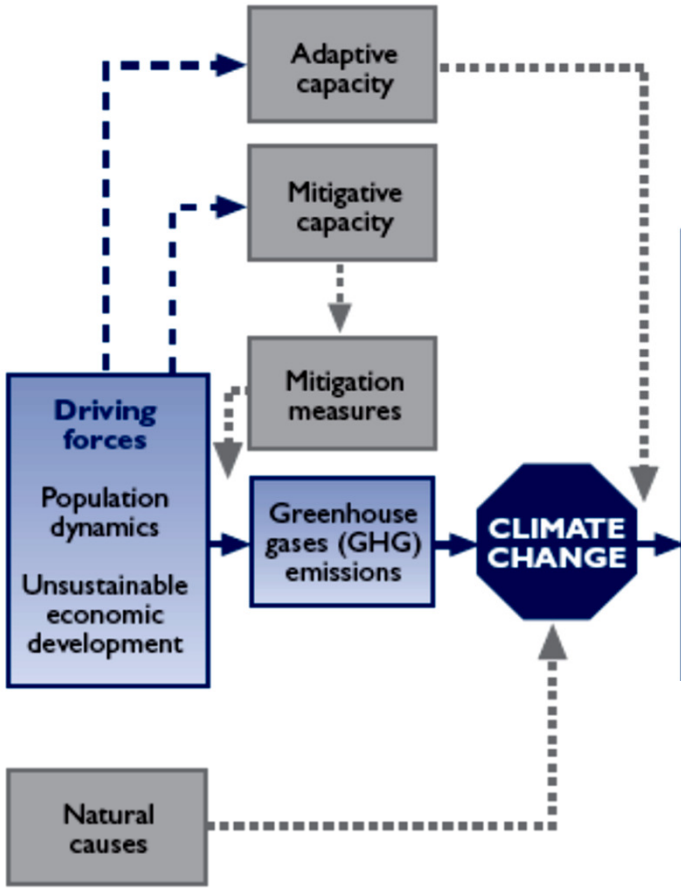
Training on Climate Change Related Health Impacts
Republic of Mauritius
14-18 May, 2012

Outline

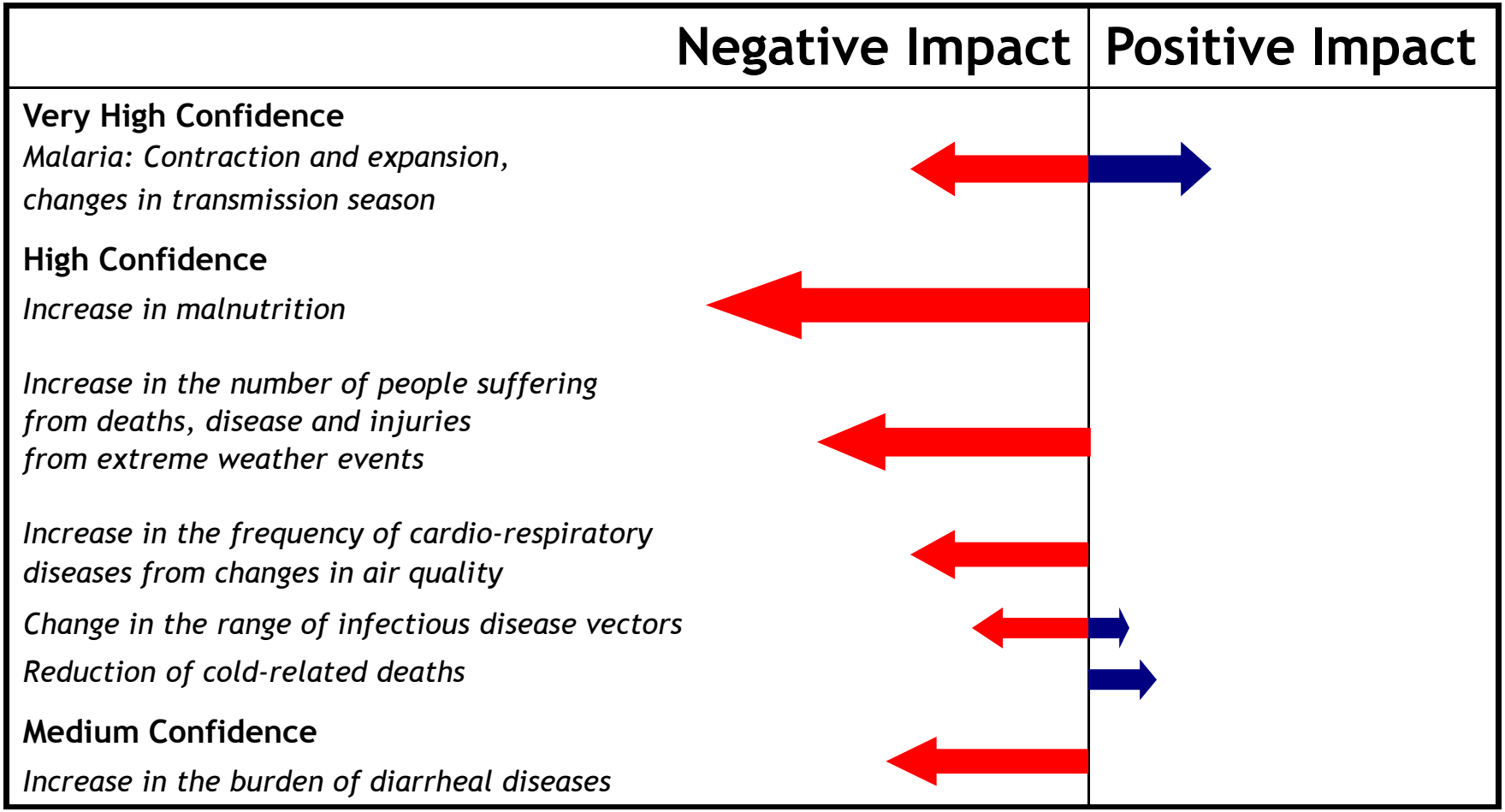
- Describe the major areas of environment and health impact
- Identify the most vulnerable populations
- Characterize climate-sensitive health outcomes
- Evaluate exacerbated burden of disease

Health Impacts of Climate Change



McMichael et al. 2003a

Direction and Magnitude of Change of Selected Health Impacts of Climate Change



(IPCC, 2007a)

WHO 2009

Pathways for Weather to Affect Health: Example of Diarrheal Disease

Distal Causes

Temperature
Humidity
Precipitation

Living conditions (water supply and sanitation)

Food sources and hygiene practices

WHO 2009

Multiple Factors Affect Climate-Sensitive Health Outcomes

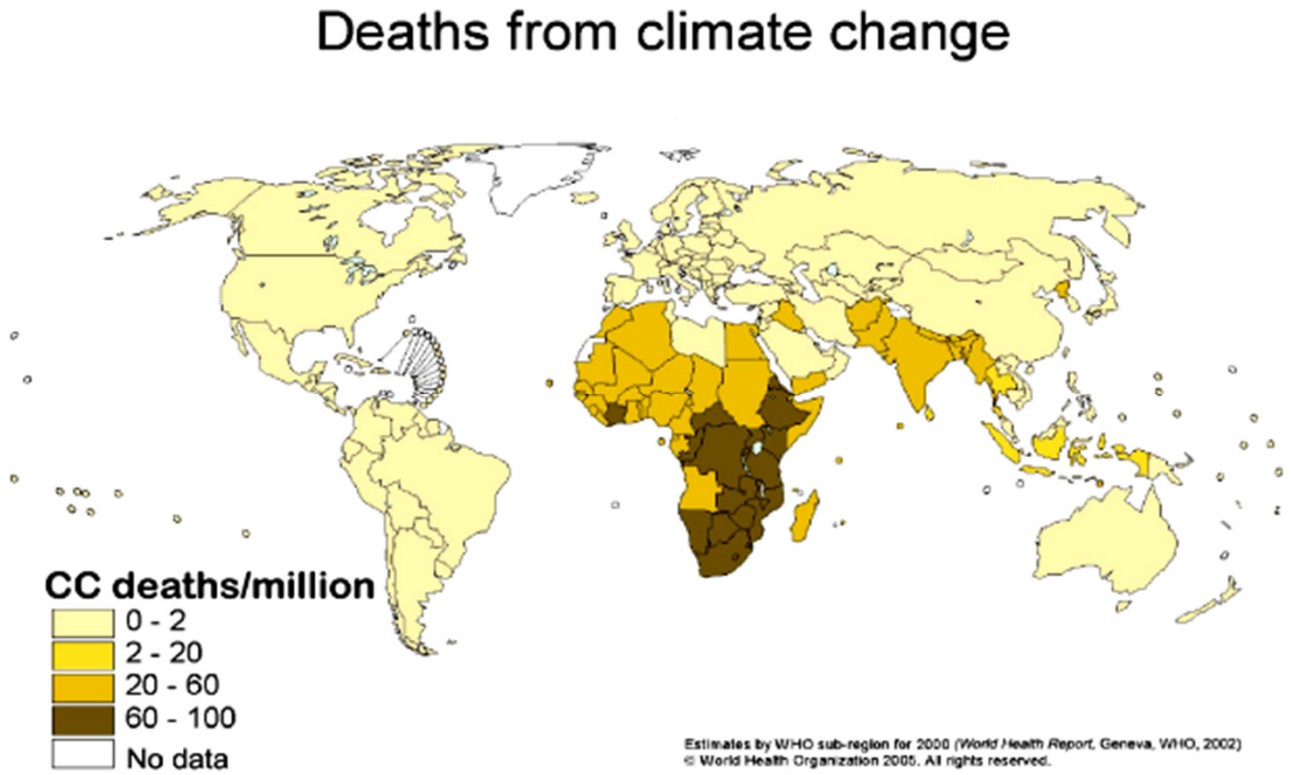
- Biophysical factors
  - Baseline climate
  - Elevation
  - Natural resources (e.g., water bodies, soil moisture)
- Biological sensitivity
  - Concomitant diseases
  - Acquired immunity
  - Genetic factors
- Socioeconomic status

Intergovernmental Panel on Climate Change 4th Assessment

- Health impacts due to climate change **are occurring**
  - Impacts **unevenly distributed**
- Impacts **will increase** with increasing climate change
  - **All regions** will be affected
- **Mitigation** and **adaptation** needed now
  - Inertia in the climate system means **change will continue for decades** after successful control of greenhouse emissions
  - Extent of health impacts over next few decades will depend on the **design and implementation of effective adaptation** measures

IPCC AR4 Health Impacts of Climate Change

- Emerging evidence of climate change impacts:
  - Altered **geographic distribution** of some vectors
  - Altered **seasonal distribution** of some pollen species
  - Increased risk of **heatwave deaths**

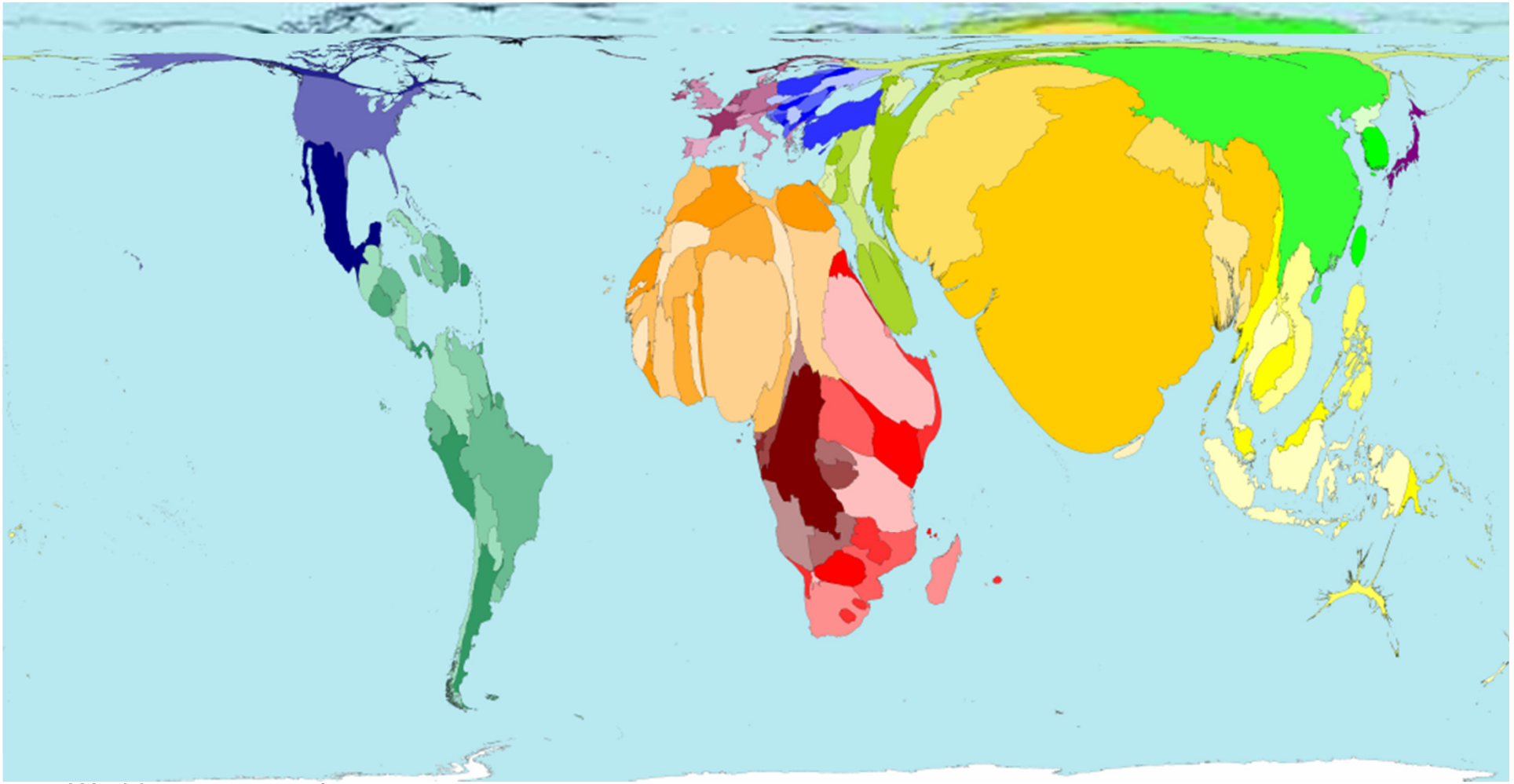


WHO 2009

Consequences of Diarrheal Diseases, Malaria, and Malnutrition in Children in Developing Countries

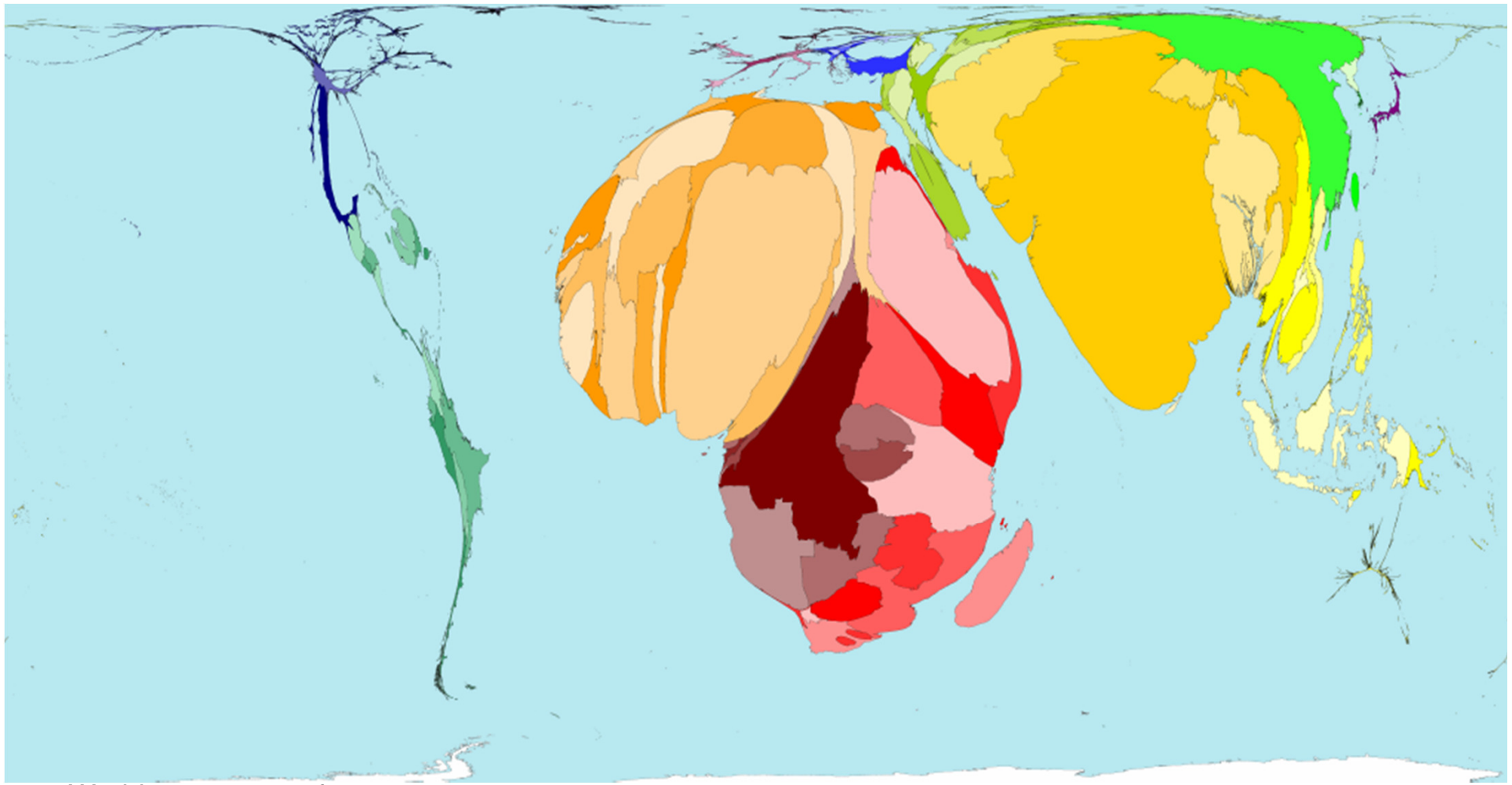
- Diarrheal diseases cause ~2 million deaths annually, most attributable to contaminated water and inadequate sanitation and hygiene
- Malaria causes 300–500 million infections every year, leading to approximately 1–3 million deaths
- Malnutrition is an underlying cause of approximately half of the 10.5 million deaths every year in children under five years old

Childhood Diarrhea (0–4 Years)



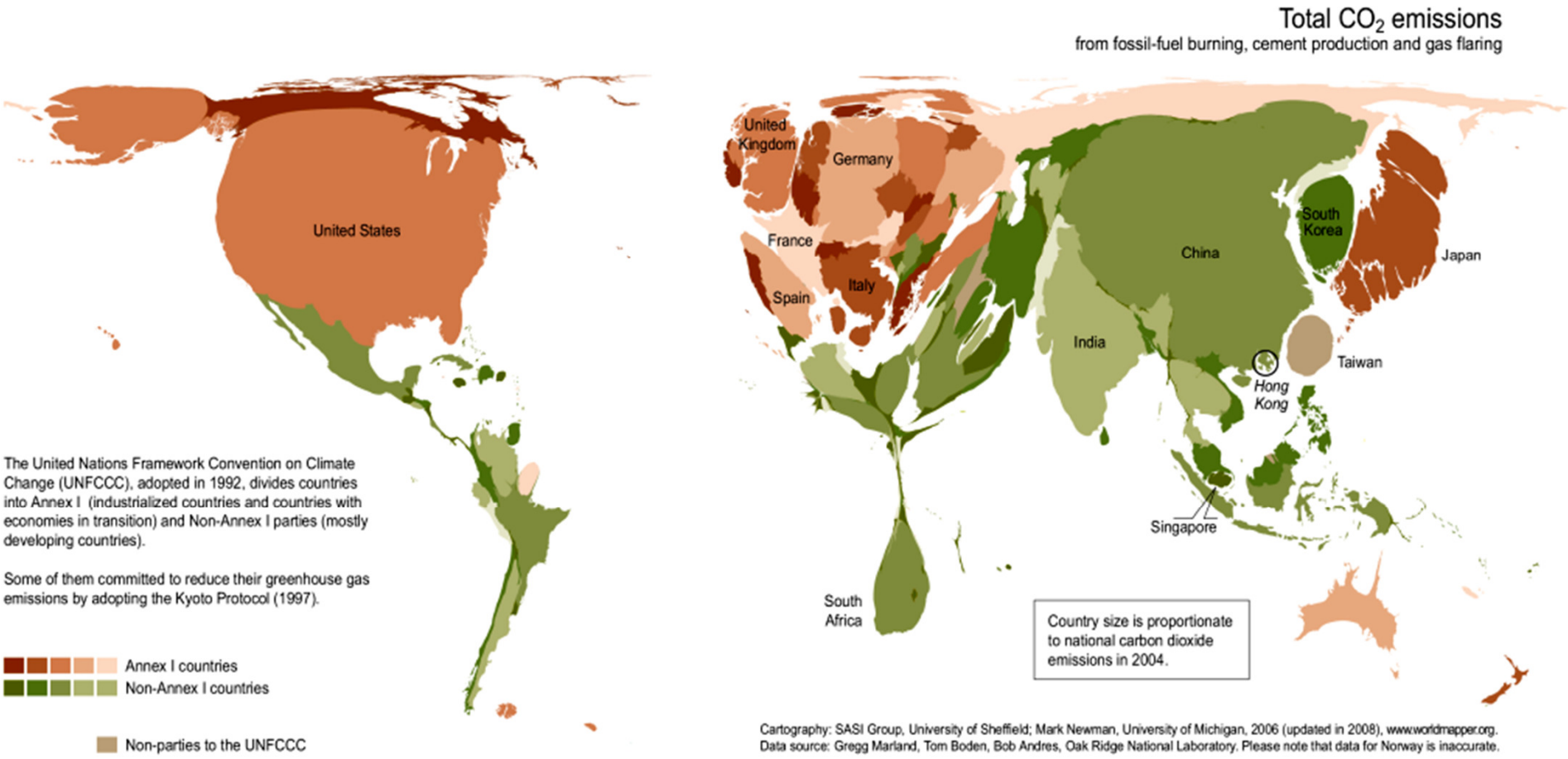
Worldmapper 2008f

Childhood Mortality (0–4 Years)



Worldmapper 2008f

Total CO_2 Emissions



UNEP 2009

WHO 2009

Health Burden of Climate Change Impacts

Deaths from malaria and dengue fever, diarrhoea, malnutrition, flooding, and (in OECD countries) heatwaves

This map shows estimated mortality (per million people) attributable to climate change by the year 2000. Map is a density-equalizing cartogram in which the sizes of the 14 WHO regions are proportional to the increased mortaility.

WHO 2009

Economic Co-Benefits of GHG Mitigation on Health

Findings of IPCC AR4

- **Health benefits** make up between 50% and 400% of carbon mitigation costs
- Benefits range from $7/ton C (USA) to several $100/ton C (China)

WHO 2009

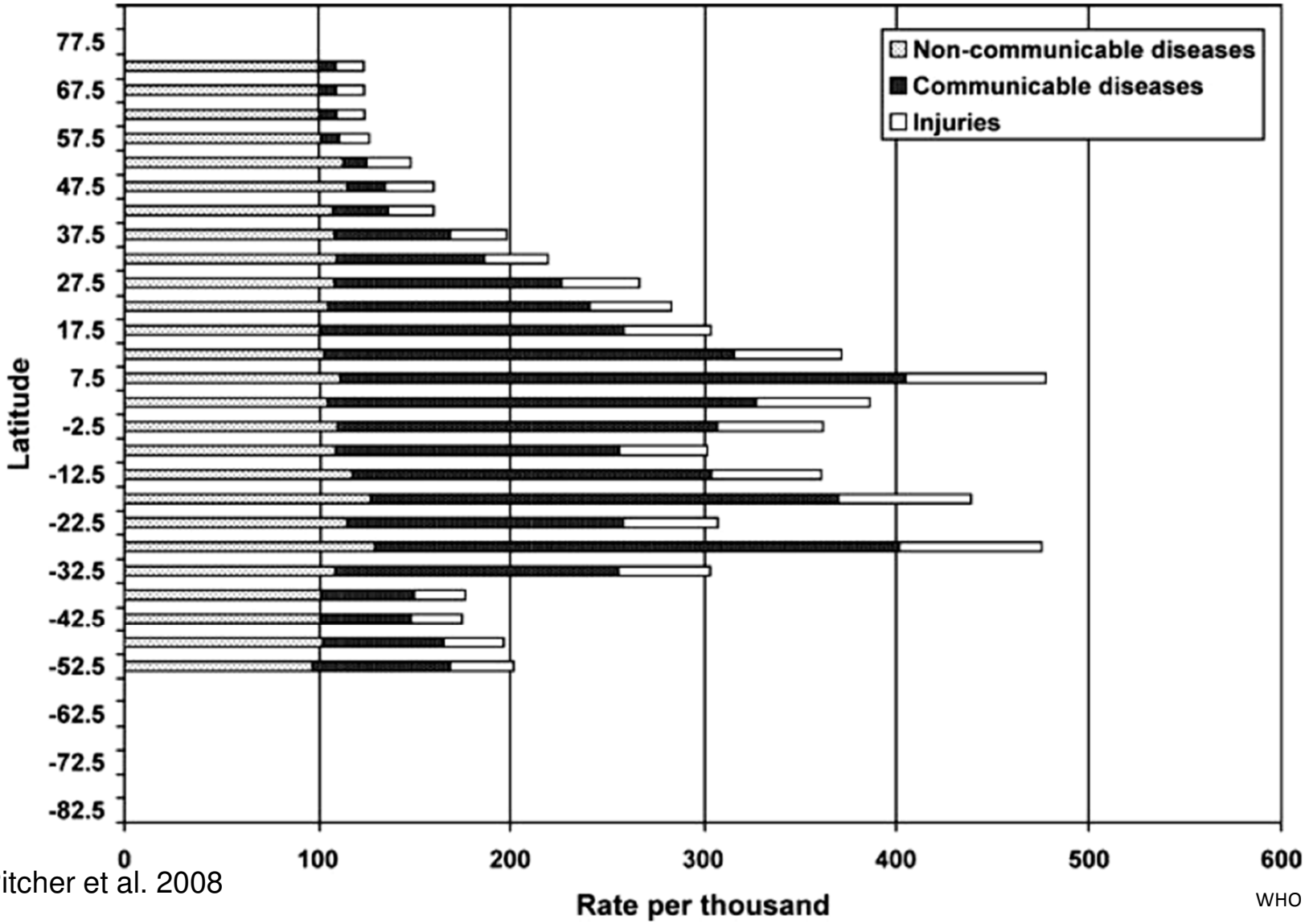
Climate Change is about Children

WHO 2009

And Other Vulnerable Groups

WHO 2009

Sum of Years of Life Lost and Years of Life Lived with Disability by Cause and Latitude



Pitcher et al. 2008

WHO 2009

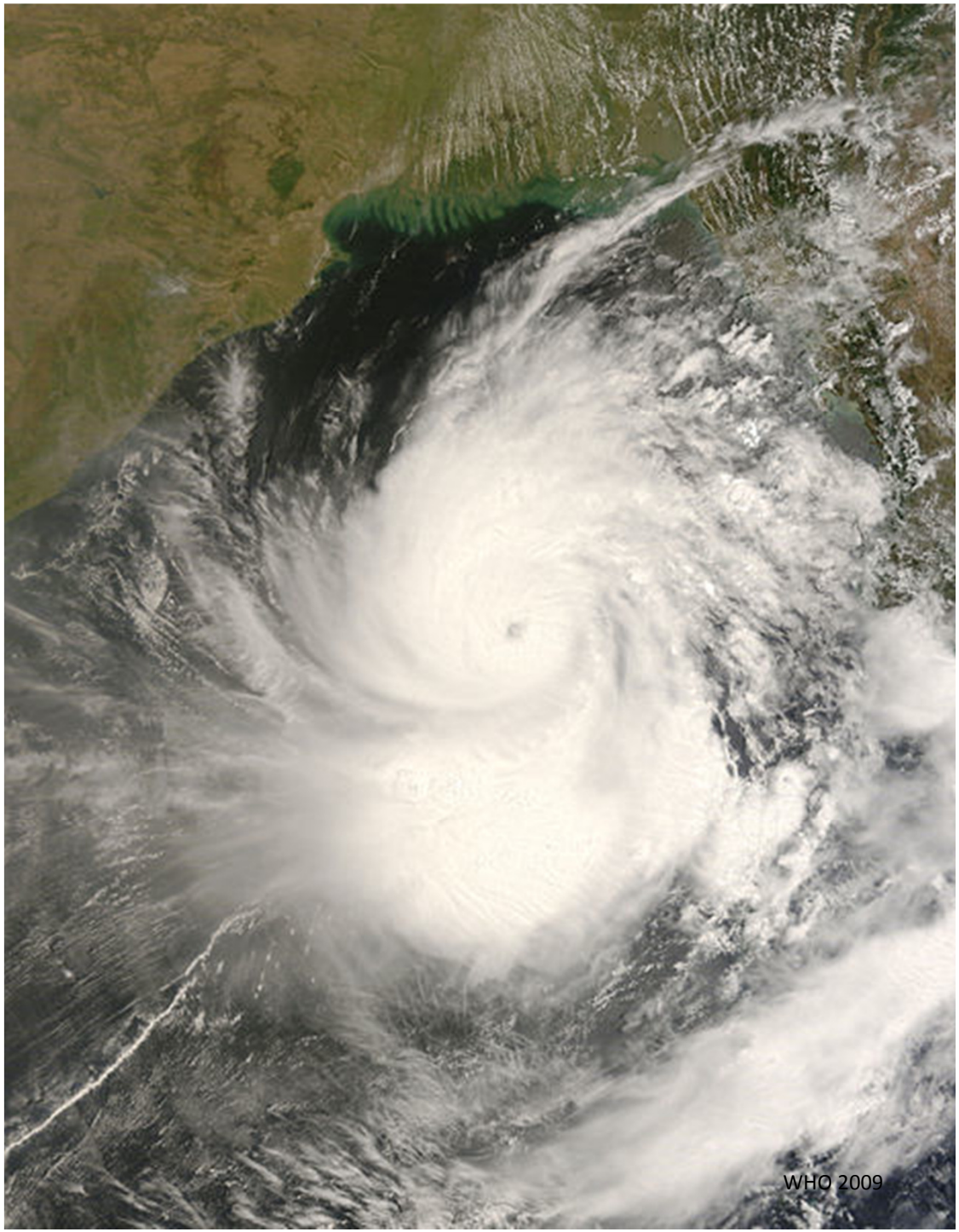
Impacts Depend on Local Context

Philip Wijmans, LWF/ACT Mozambique, March 2000

Possible Impact Scenarios

- Single large-scale disasters
- Repeated smaller disasters
- Continuous temperature increase producing gradual, linear increase in climate-sensitive health outcomes
- Any combination of the above
- Adverse health impacts of mitigation and adaptation measures

Climate Change Is Adding More Energy to the Atmosphere

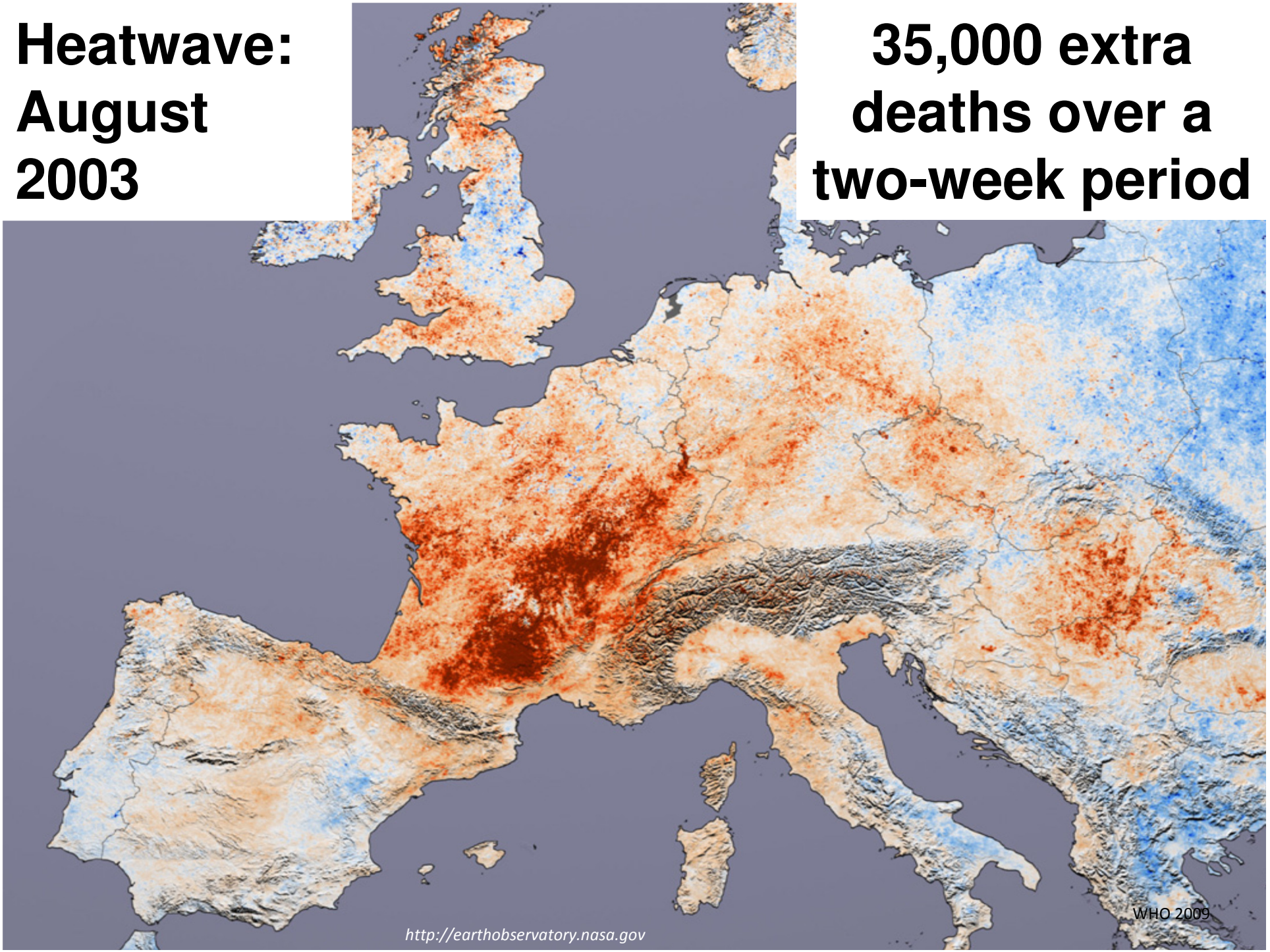


http://earthobservatory.nasa.gov

WHO 2009

Heatwave: August 2003

35,000 extra deaths over a two-week period



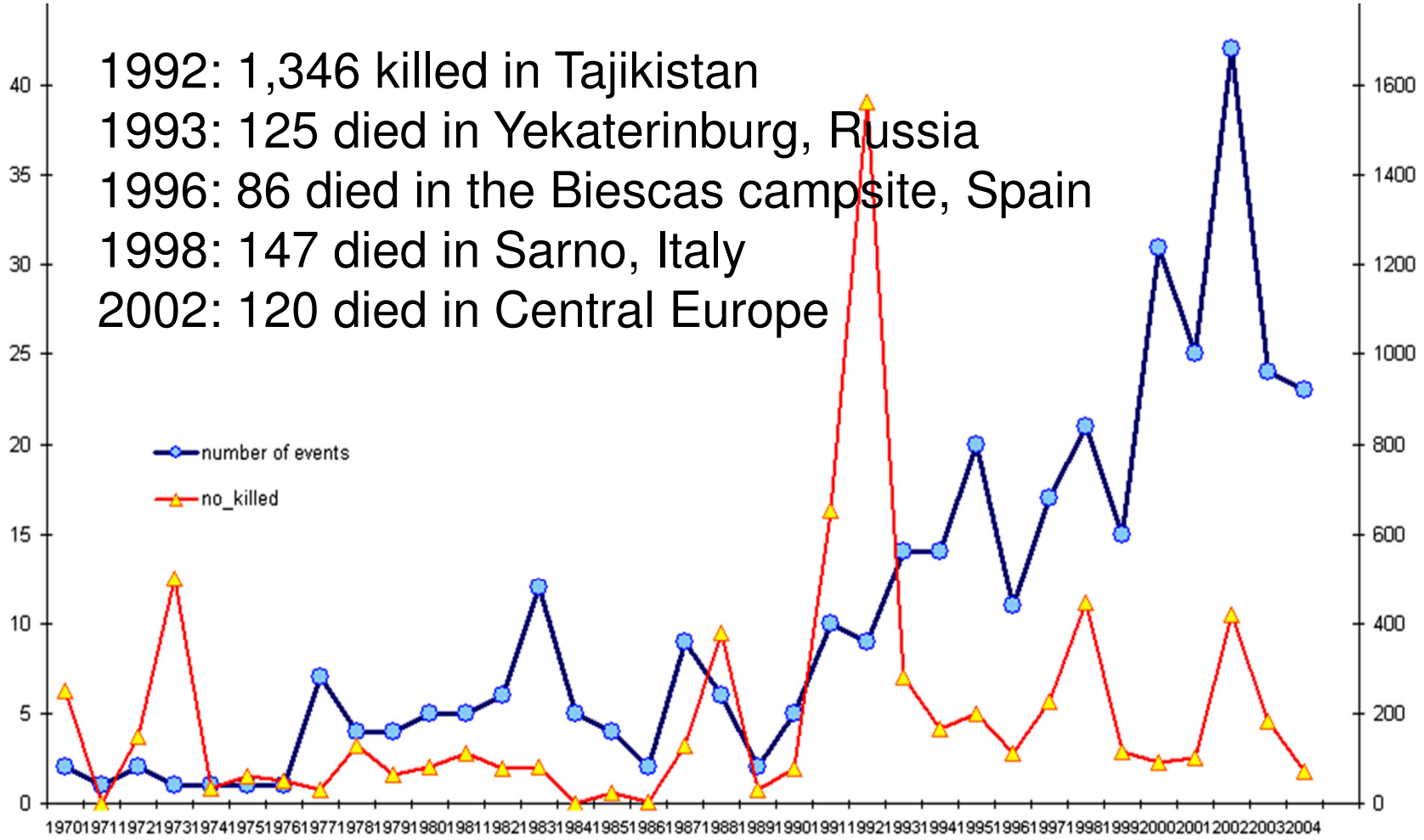
WHO 2009

Climate Change and Heatwave Impacts in California

Scenario	B1	A1fi
Heatwave days (Los Angeles)	↑ 4X	↑ 6–8X
Length of heatwave season	↑ 5–7 weeks	↑ 9–13 weeks
Heat-related mortality (Los Angeles)	↑ 2–3X	↑ 5–7X

Hayhoe et al. 2004

Floods in Europe

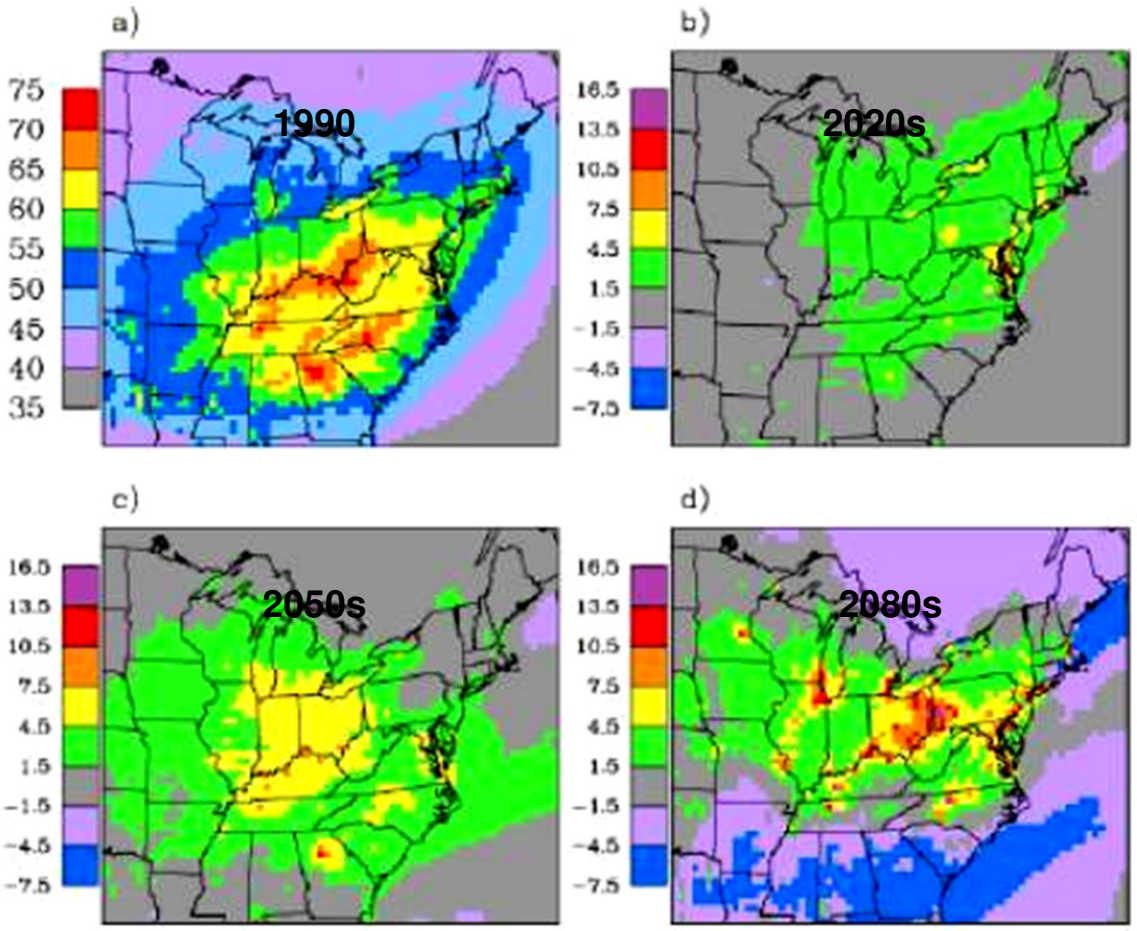


"EM-DAT: The OFDA/CRED International Disaster Database, www.em-dat.net – Université Catholique de Louvain – Brussels – Belgium." Created on: May-23-2005. Data version: v05.05

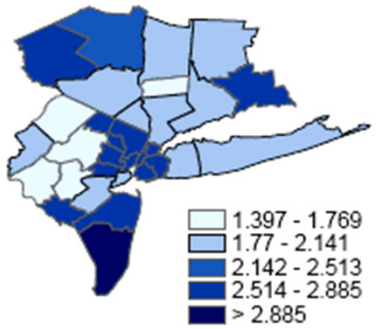
Trends in Disasters over Time

WHO 2009

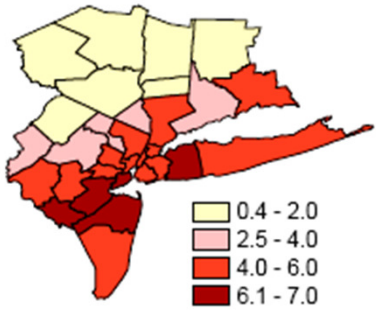
Projected Changes in Ozone and Related Deaths, New York Metro Area



Kinney et al. 2006



Baseline Daily Mortality Rate per 100,000



Percent Increase in O_3-related Deaths

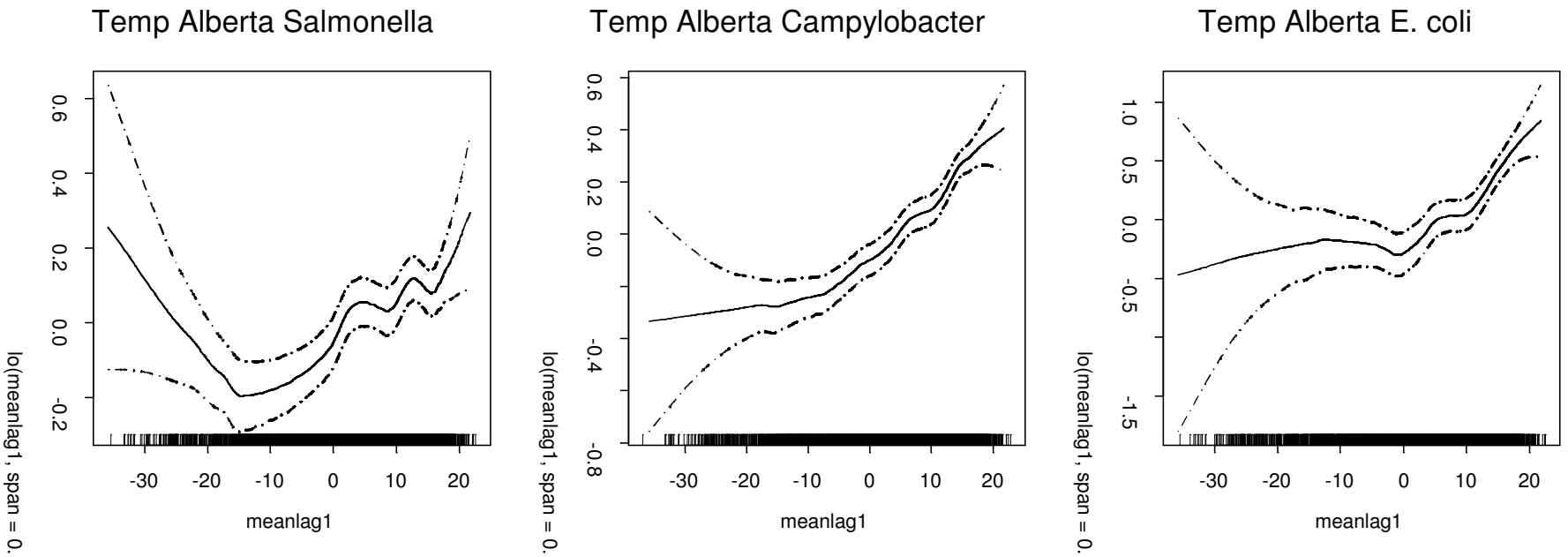
2050s

WHO 2009

Climate Change Will Affect Flora &Fauna

WHO 2009

Temperature and Enteric Disease



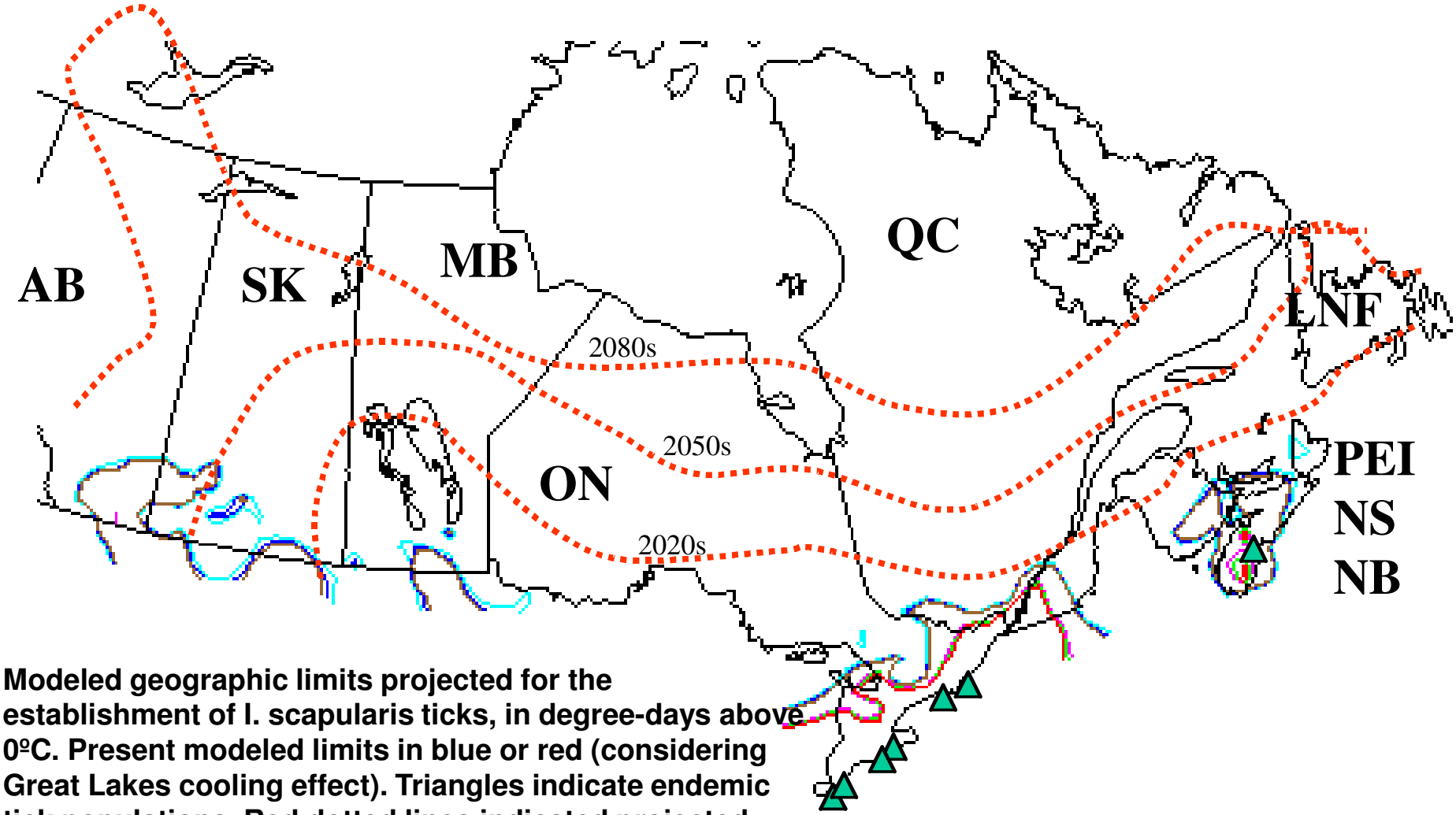
***RR* of *Salmonella* increased by 1.2% per degree above - 10˚C**

***RR of Campylobacter* increased by 2.2% (4.5% in Newfoundland) per degree above - 10˚C**

***RR of E. coli* increased by 6.0% per degree above - 10˚C**

Fleury et al. 2006

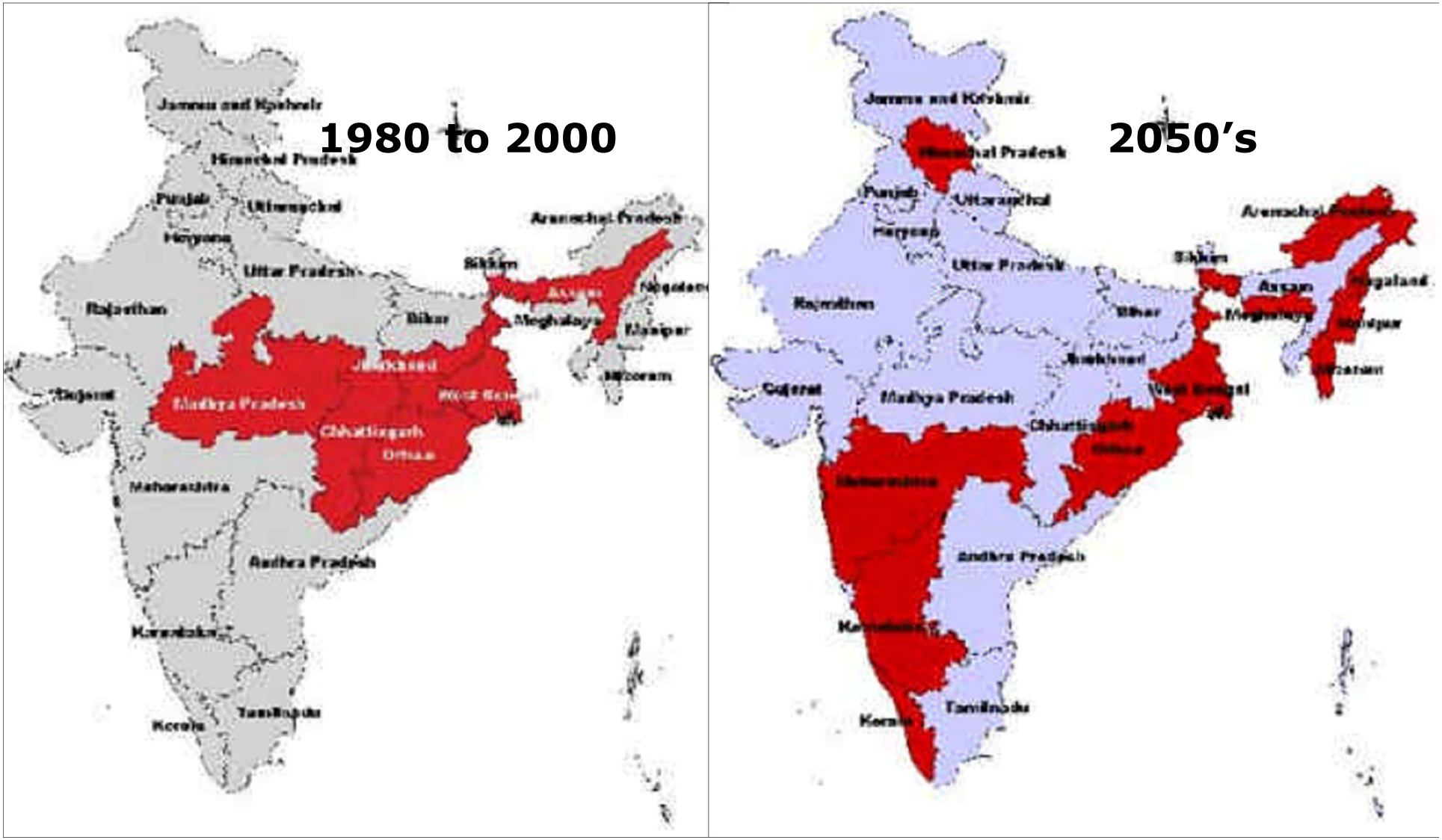
Spread of Lyme Disease with Climate Change



Modeled geographic limits projected for the establishment of I. scapularis ticks, in degree-days above 0ºC. Present modeled limits in blue or red (considering Great Lakes cooling effect). Triangles indicate endemic tick populations. Red dotted lines indicated projected change in the modeled geographic limits in three future time periods according to climate change scenarios (Ogden et al., 2005).

WHO 2009

Malaria in India



Bhattacharya et al. 2006

WHO 2009

IPCC AR4 Health Impacts of Climate Change

- Health **co-benefits** from reduced air pollution as a result of actions to reduce greenhouse gas emissions can be substantial and may offset a substantial fraction of mitigation costs
- Actions to reduce methane will decrease global concentrations of surface ozone

IPCC AR4 Health Impacts of Climate Change (cont.)

- **Adaptive capacity** needs to be improved everywhere
  - Even high-income countries not prepared for extreme weather events
- Adverse impacts will be **greatest in low-income countries**
  - Those at greatest risk include the urban poor, the elderly and children, traditional societies, subsistence farmers, and coastal populations
- Economic development is important, but is **insufficient** to protect the world's population against the health impacts of climate change
  - Critical factors include the **manner in which growth occurs**, the **distribution** of benefits, **public health infrastructure**, and other factors that determine population health

WHO 2009

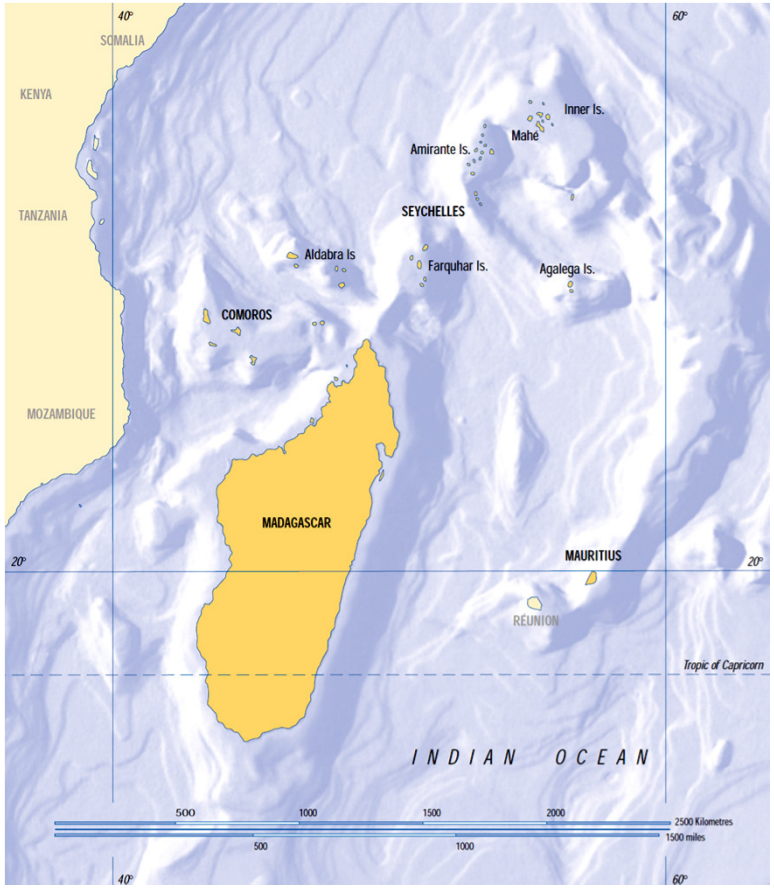
Need for New Knowledge

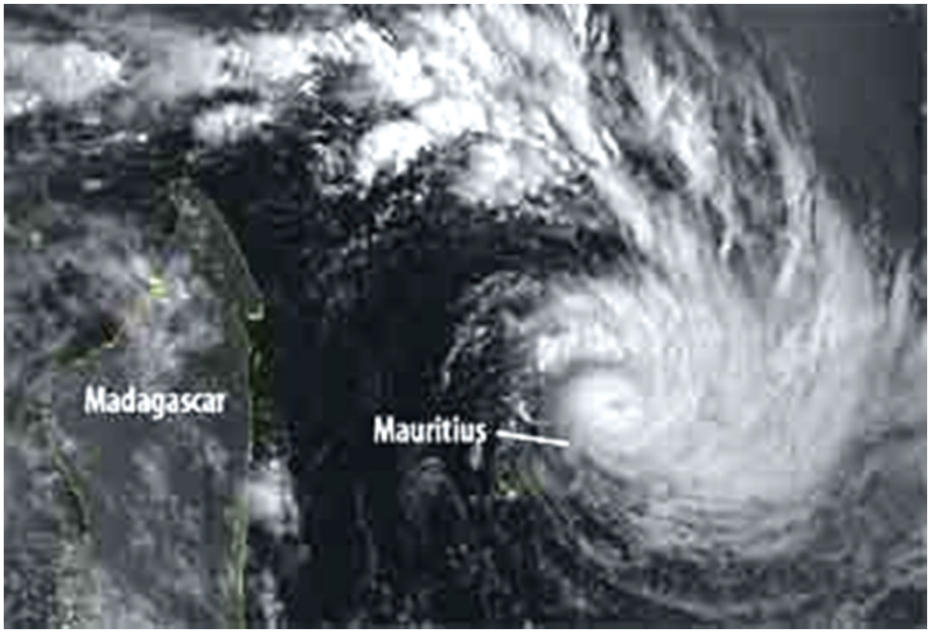
- Understand **exposure-response relationships** between background climate variation and health outcomes
- Estimate current **health burden** (e.g., annual deaths) attributable to climate change
- Develop **scenario-based modeling** to project health risks
- Assess health harms and benefits of proposed **mitigation and adaptation policy** options

Mauritius and Region

- **Small Island Developing States (SIDS)** are disaster prone
- The most vulnerable people and places live in poverty and inadequate shelter
- Climate-sensitive health outcomes vary in type and degree among different SIDS
- Extreme events and climate variability are exacerbating current burden of disease

Mauritius and Region





http://www.grida.no/publications/other/aeo/?src=/aeo/047.htm

South East Asia Region (SEAR) Shares Similar Vulnerabilities

- 44% of all disasters, globally
- 1996-2005: 57% of people killed globally in natural disasters were from SEAR countries
- Indonesia, 2007: 3 flood events; 4 landslides; 2 tornadoes
- Maldives, May 2007: high tide floods
- Bangladesh November 2007: Super cyclone SIDR: 4,000 dead, millions affected
- Myanmar, May 2008: Cyclone Nargis, 135,000 perish

Photo: http://cache.daylife.com/imageserve/02fAd1d1tWeAW/340x.jpg

“Adverse health impacts will be greatest in low-income countries. Those at greater risk include, in all countries, the urban poor, the elderly and children, traditional societies, subsistence farmers, and coastal populations (high confidence).” (IPCC AR4, 2007)

WHO 2009

Global Warming Impacts on Climate and Risk Factors

- More extreme weather events: storms, cyclones
- Heat waves: more frequent, more intense, and longer
- Air pollution: increase in levels of ground ozone, more allergens
- Disturbed rainfall patterns: more droughts, more extreme precipitation events, floods, and disrupted water supply
- Warmer temperatures: warmer minima
- Sea-level rise: inundation, saltwater intrusion, loss of land

WHO 2009

Climate Change Impacts on Health: Increase in Climate-Sensitive Outcomes

- Injuries, disability, drowning
- Heat stress
- Water- and food-borne diseases
- Malnutrition
- Vector-borne diseases
- Psychological stress

Photo: http://southasia.oneworld.net/ImageCatalog/climate-picture.jpg

WHO 2009

More Injuries, Disabilities, and Drowning from Extreme Weather Events

Photo: ©Abir Abdullah/Still Pictures

Photo: ©Abir Abdullah/Still Pictures

Adding to the Existing Burden

India: “Super-cyclone” 1999 shattered lives and livelihoods of 12 million people in Orissa

Bangladesh: Cyclone SIDR, 2007

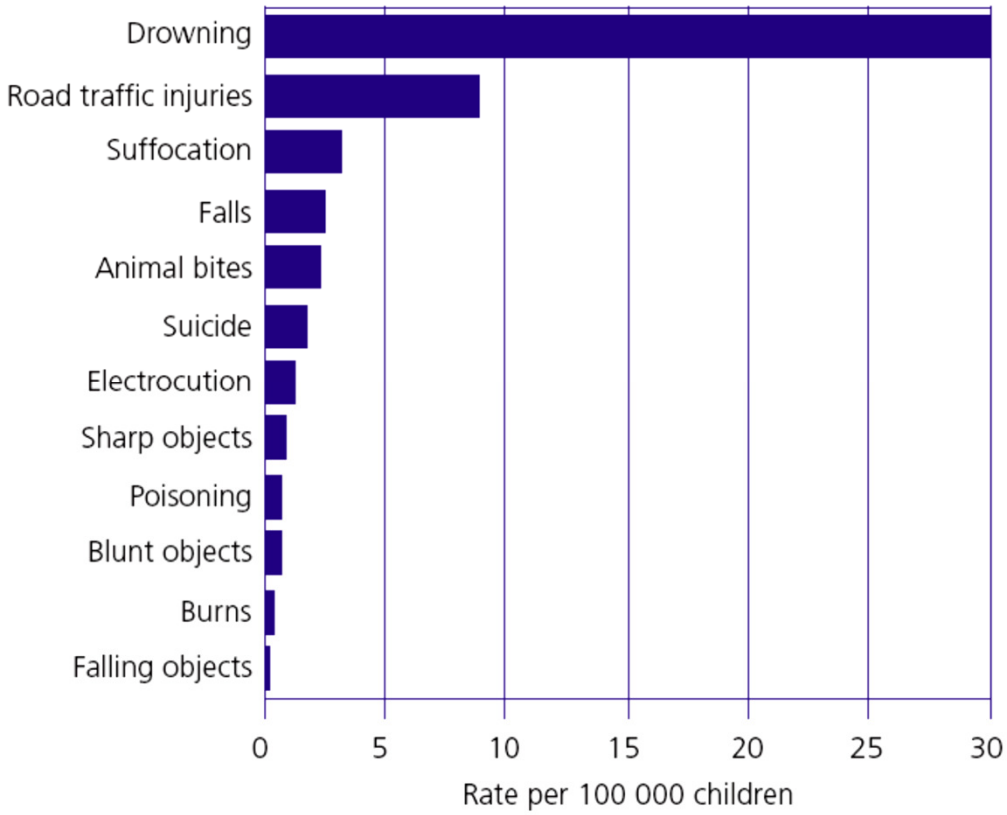
Photo: xanthis.wordpress.com

Myanmar: Nargis 2008

http://media.economist.com/images/20080906/3608AS2.jpg

Drowning: A Leading Cause of Child Death in Many Asian Countries

Fatal injury rates per 100 000 children aged 0–17 years in five[a] Asian countries



[a] Bangladesh, China (Beijing, Jiangxi), Philippines, Thailand, Viet Nam

- More than 175,000 children and teenagers die from drowning each year
- Children under the age of 5 years are most at risk
- Most child drowning events happen in and around the home

World Health Organization, 2008c

More Heat Waves and Heat Strokes

Refugee Study Centre (RSC), http://www.rsc.ox.ac.uk

- 2003 Andhra Pradesh, India heat wave, with temperatures of up to 54^{o}C, took a toll of at least 3,000 lives
- The number of heat strokes was not recorded

More Respiratory Diseases

Air pollution: Meeting increasing energy demands by greater use of fossil fuels will increase in ground ozone levels and allergens

Photo: © Deb Kushal -UNEP / Still Pictures

More Water-Borne Diseases

Photo credit: © Shehzad Noorani/Still Pictures

- In 2005, diarrhoeal diseases accounted for 20.1% of deaths in children less than five years

Changes in Agriculture = Malnutrition

Photo credit: © Shehzad Noorani / Still Pictures

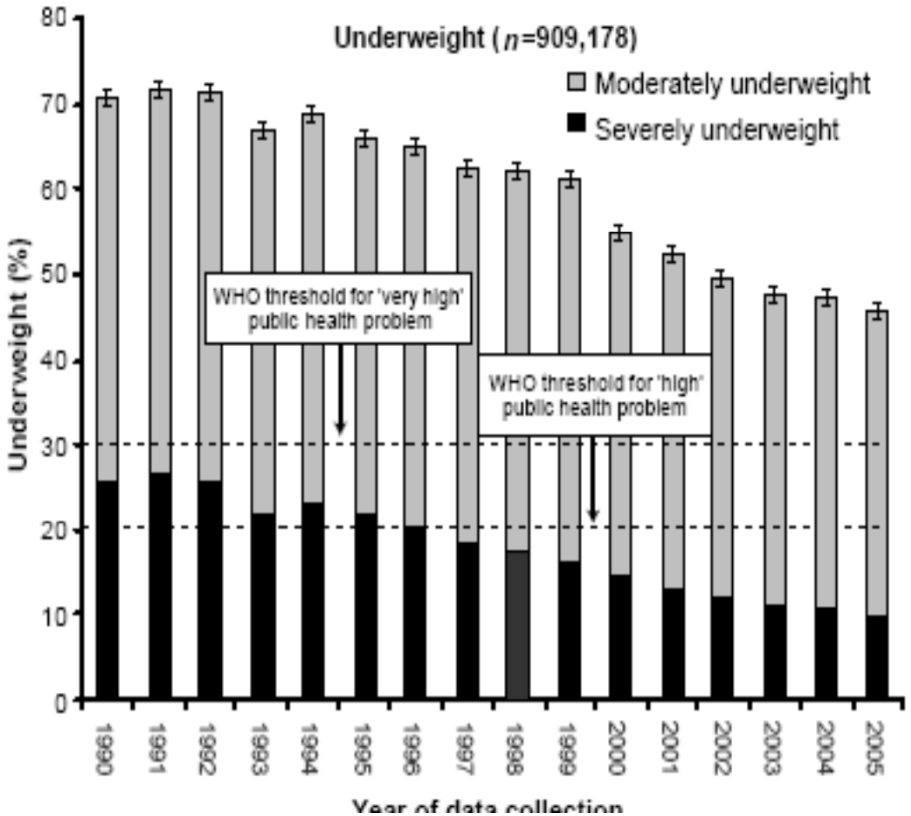
WHO 2009

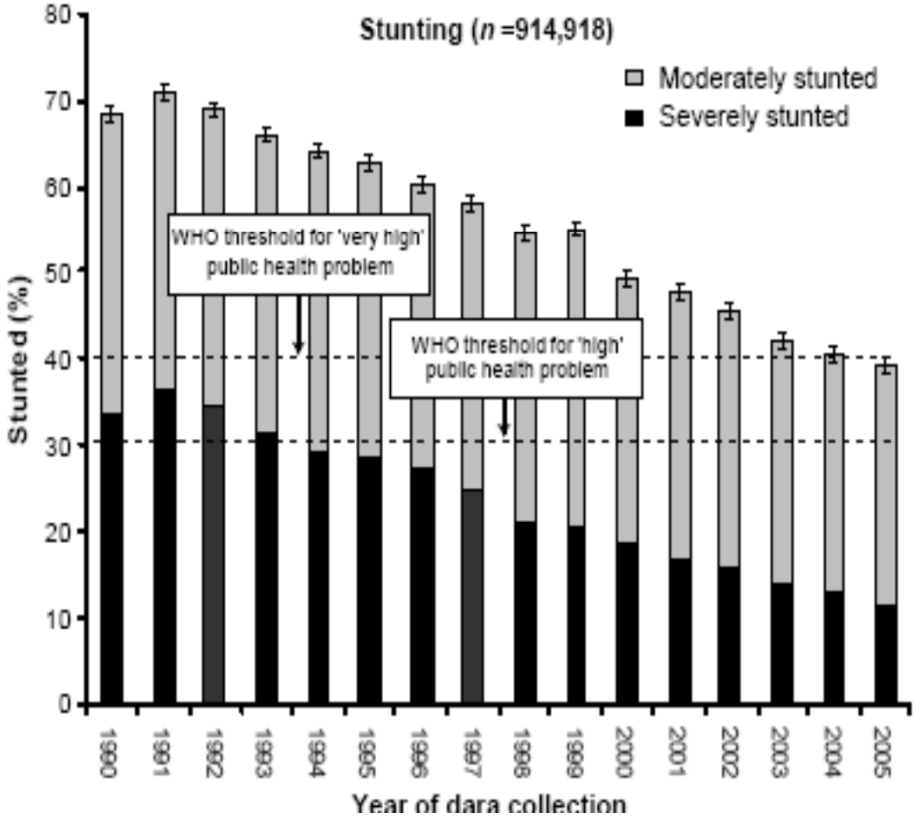
Malnutrition: First Cause of Childhood Mortality

Proportional mortality among children under five years of age – World 2002

WHO 2009

Underweight and Stunting among Children in Bangladesh, 1990 to 2005





Prevalence of underweight and stunting (height-for-age <-2 Z-scores) among children under five years of age in rural Bangladesh, 1990 to 2005

WHO 2009

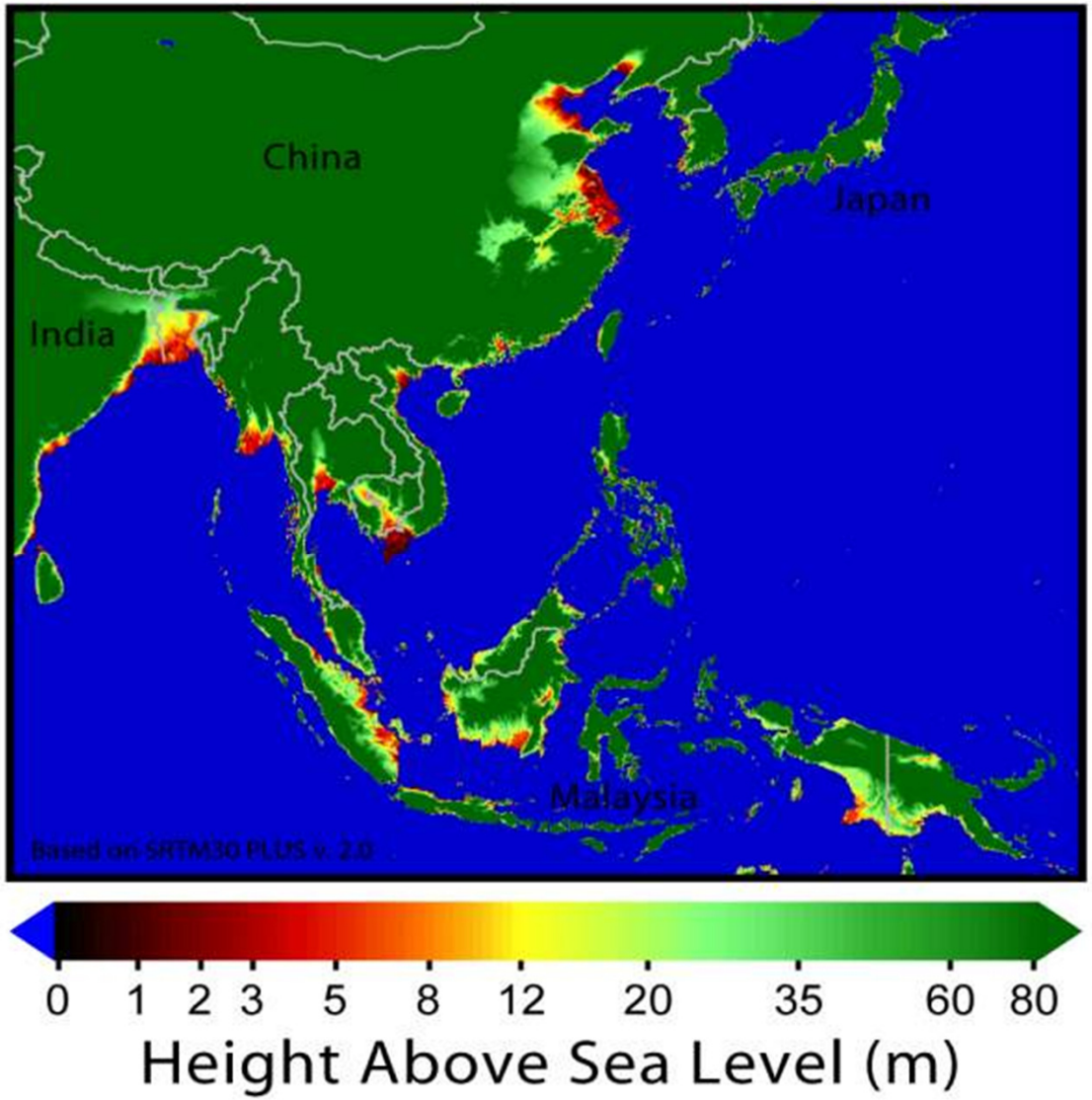
More and Widespread Vector-Borne Diseases

Aedes aegypti

- Warmer temperatures and disturbed rain patterns could alter the distribution of important disease vectors
- Combined with altered rainfall patterns, hotter conditions may increase the spread of disease, such as malaria, dengue, and chikungunya, to new areas

WHO 2009

Sea Level Rise Risks in South East Asia Region

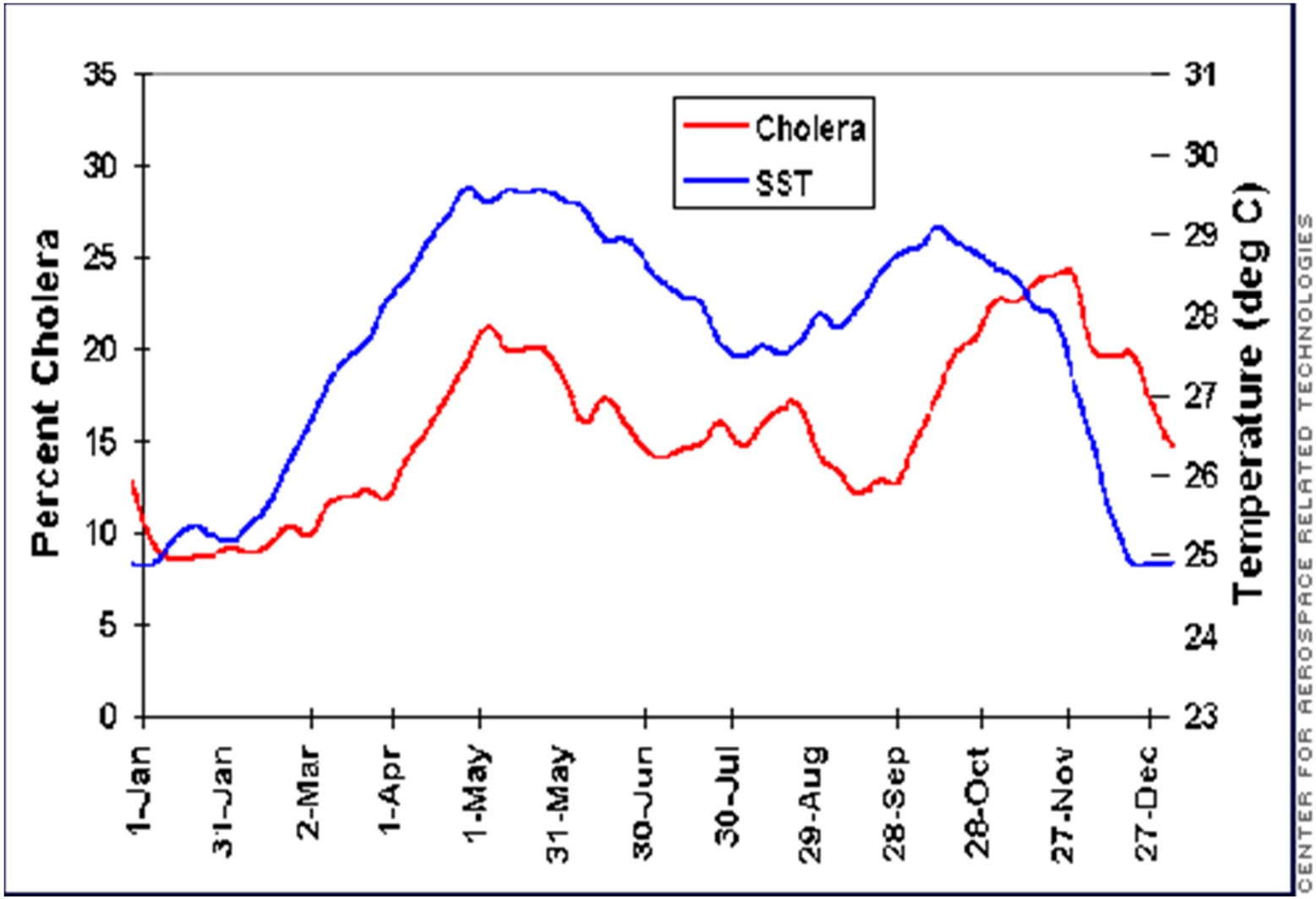


Robert A. Rohde / Global Warming Art

- IPCC, 2007: "Coastal areas, especially the heavily-populated mega deltas regions in South, East and South East Asia, will be at greatest risk due to increased flooding from the sea and, in some mega deltas, flooding from the rivers"

WHO 2009

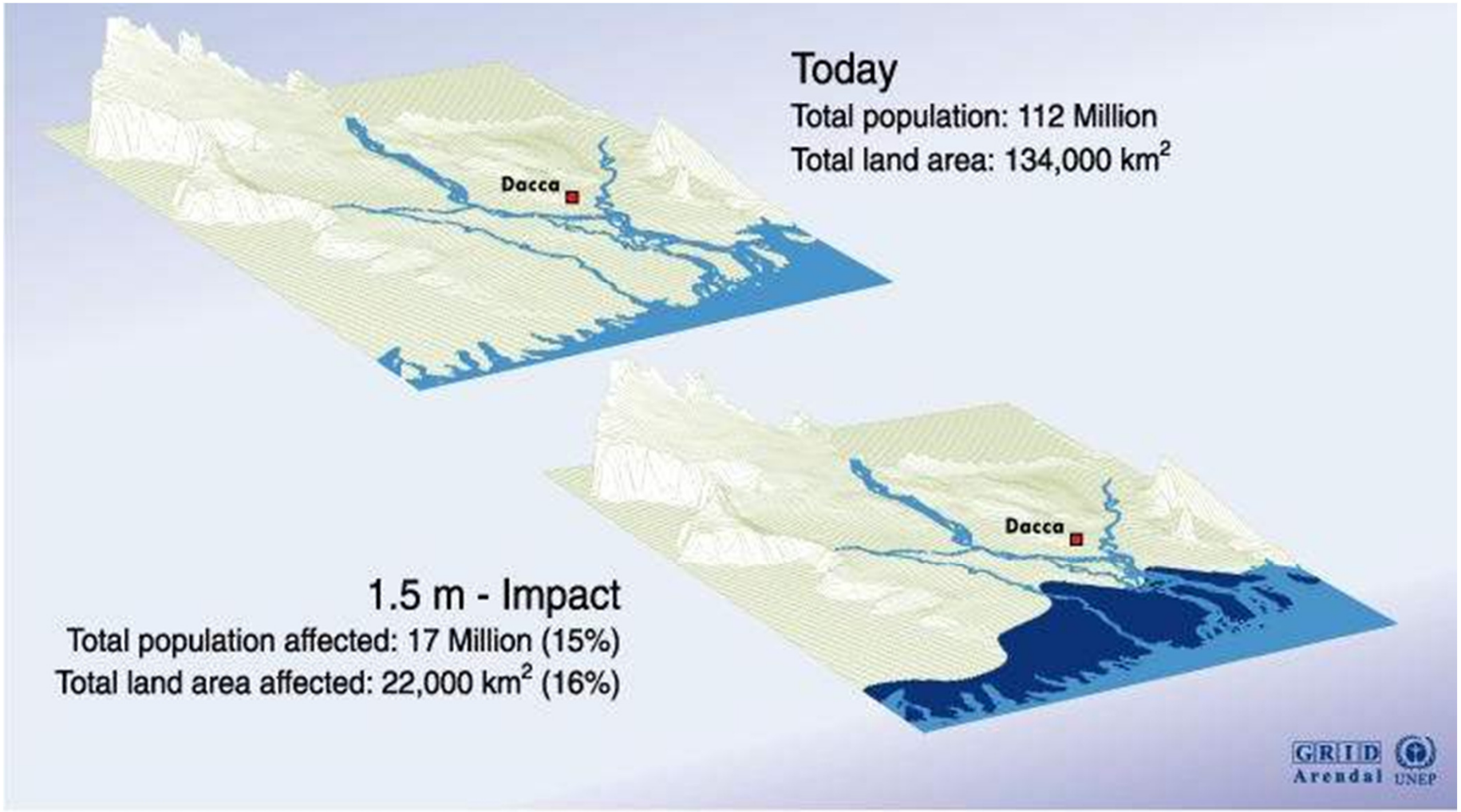
Sea Level Rise Enhances Cholera Outbreaks



Space.com, 2000

WHO 2009

Sea Level Rise: Bangladesh



Source : UNEP/GRID Geneva; University of Dacca; JRO Munich; The World Bank; World Resources Institute, Washington D.C.

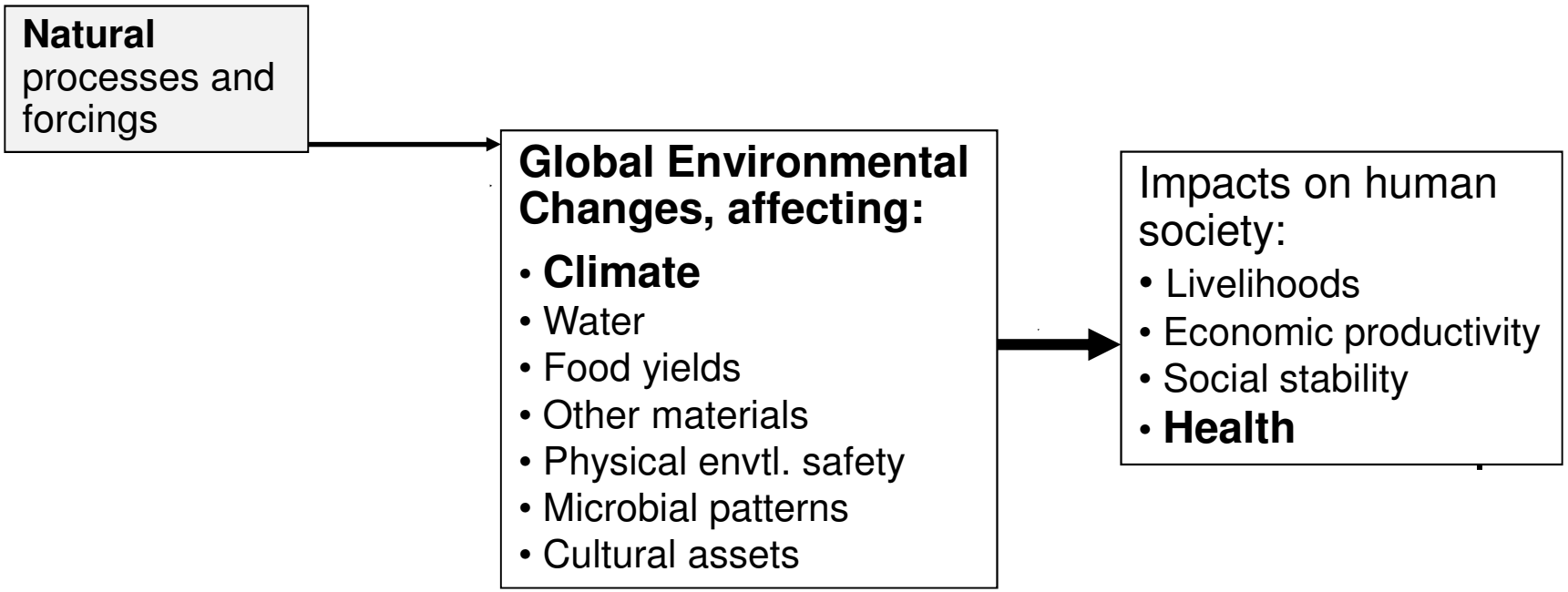
WHO 2009

Psychosocial Stress Will Affect the Health of Communities and Individuals

Photo credit: © Gil Moti / Still Pictures

Urgent Action is Needed

Adaptation for health sector: strengthen prevention, surveillance and early warning systems pertaining to climate sensitive diseases



Mitigation for health sector: to promote and support initiatives that protect health by reducing greenhouse gas emissions

WHO 2009

World Health Assembly adopts Global Action Plan, May 2009

- Aim: to scale up WHO's technical assistance to countries to assess and address the implications of climate change for health and health systems. It has four objectives:
  - Encourage advocacy and awareness raising
  - Engage in partnerships with other UN organizations and sectors other than the health sector at national, regional and international levels
  - Promote and support the generation of scientific evidence
  - Strengthen health systems to cope with the health threat posed by climate change, including emergencies related to extreme weather events and sea-level rise.

Conclusions

- The region has a population that is currently vulnerable to a number of climate sensitive health stressors
- These stressors are already having a significant adverse health impacts
- Climate change is likely to increase the risks linked to these stressors, and introduce new sources of risk going forward
- Without adaptation and mitigation climate change could result in a dramatically increased health burden in the region

Discussion

Questions?

Thoughts?

Concerns?

Suggestions?

Acknowledgements

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- Some material was taken or modified from the WHO “Training course for public health professionals on protecting our health from climate change (2009).”

- Supported by the Mauritius Ministry of Environment & Sustainable Development (No: MoESD/AAP/02/11)