



THE AUSTRALIAN NATIONAL UNIVERSITY

# Environmental Change and Risks to Human Health

## Why “Sustainability” Matters

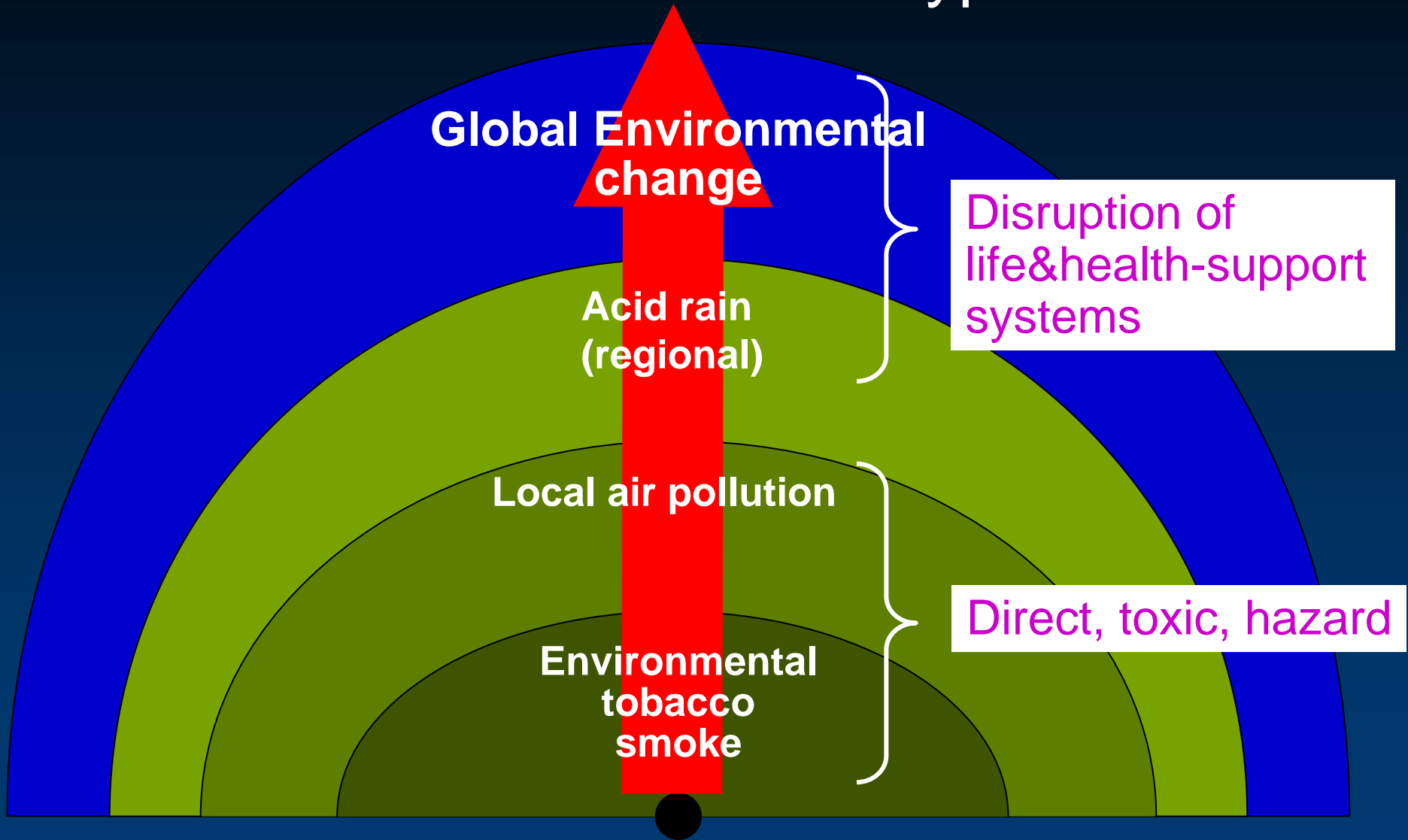
Tony McMichael

National Centre for Epidemiology and Population Health

The Australian National University

Canberra

# Environmental Health Risks: Scale and Type



Population health is:

- an **input** to sustainable development ; and
- a **criterion of success** in achieving sustainable development  
..... i.e., development, not growth

- “The Earth is one, but the world is not. We all depend on one biosphere for sustaining our lives. Yet each community, each country, strives for survival and prosperity with little regard for its impact on others.”\*
- “Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.”

\* “Some consume Earth’s resources faster than would leave little for future generations. Others, many more in number, consume far too little and live with the prospect of hunger, squalor, disease and early death.”

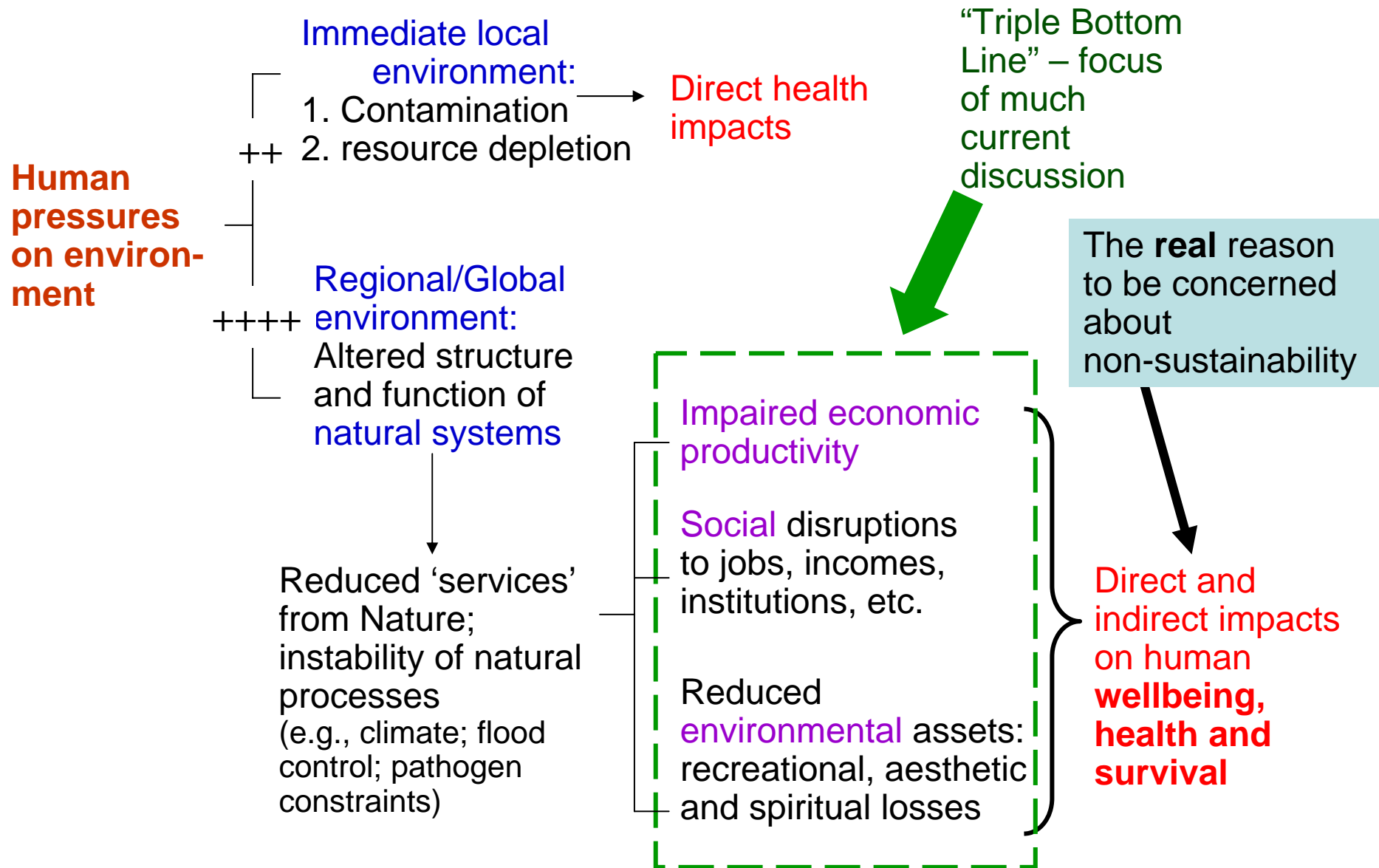
# Jim Lovelock's "Take"

"Until we stop acting as if human welfare was all that mattered, and was an excuse for our bad behaviour, all talk of further development of any kind is unacceptable."

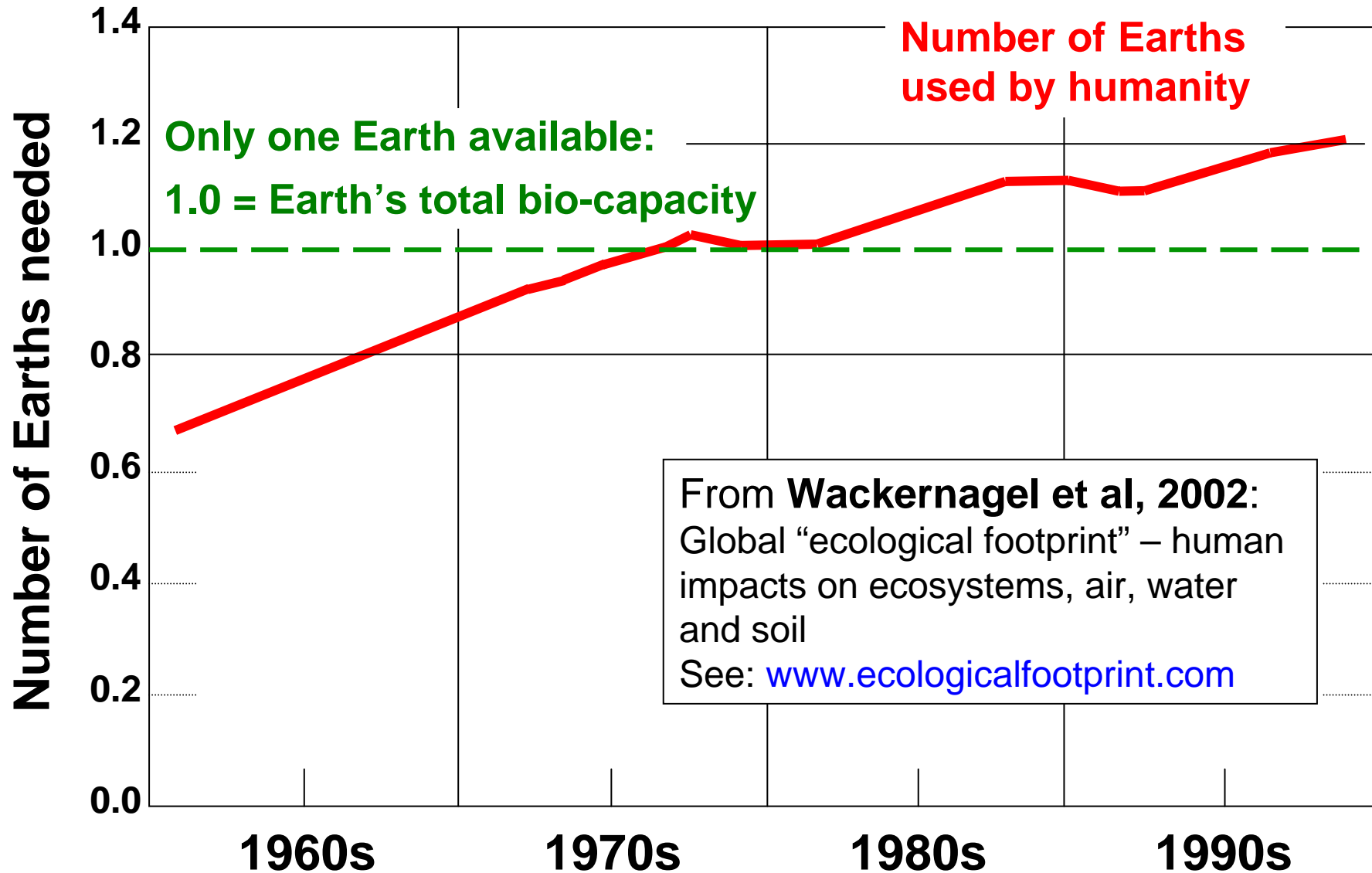
James Lovelock  
*The Revenge of Gaia*  
p. 148

# 'Sustainability': Definition in Wikipedia

A system of “parallel care and respect for the ecosystem and the people within”



# Overloading the Planet



# Main Types of Global/Worldwide Environmental Changes

1. Changes to atmosphere: climate system; stratosphere
2. Changes to food-producing ecosystems
  - Land cover, soil fertility
  - Coastal and marine ecosystems, fisheries
3. Biodiversity changes
  - Loss/extinction
  - Redistribution (invasion)
  - Rearrangements within ecosystems
4. Changes to global elemental cycles (N, P, S, etc.)
5. Changes to hydrosphere; depletion of freshwater
6. World-wide spread of persistent organic pollutants

# Millennium Ecosystem Assessment (2001-5): Main Conclusion

- Approx two-thirds of the world's ecosystems have been significantly damaged by humans in recent decades
- This seriously threatens the flow of Nature's 'goods and services' to human societies:
  - Providing, Regulating, Supporting, Cultural

Diverse implications for human health

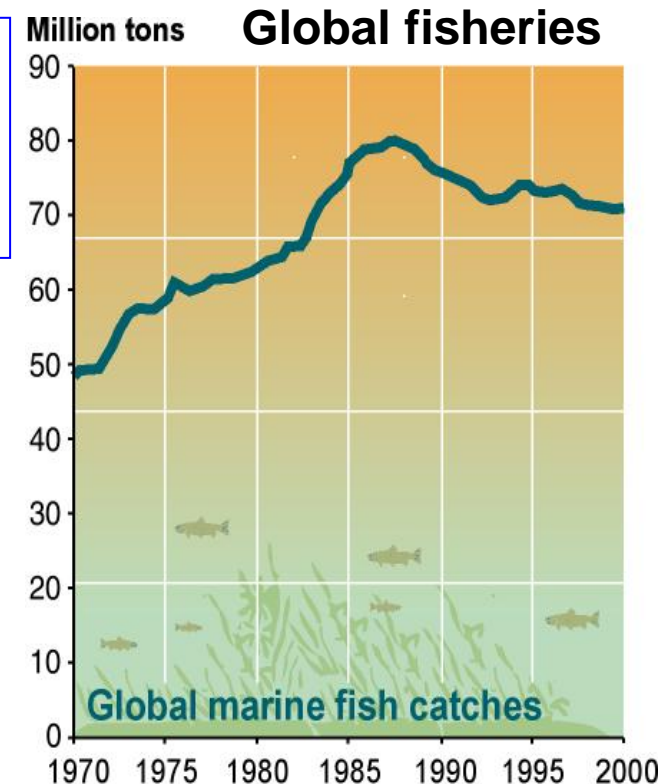
1950-2000: 25% of commercially exploited marine fish stocks are over-harvested  
*(Millennium Ecosystem Assessment conclusion, 2005)*

## Grand Banks cod fishery

Fish landings in tons

900 000  
800 000

Fish account for a high proportion of animal protein in the world's diet – especially in many developing-country coastal communities.



Source: Millennium Ecosystem Assessment

**Global marine fish harvest has declined since late '80s**

# That is, in combination:

- Over-fishing
- Ocean warming
- Ocean acidification

... are all impairing the food web and the future productivity of ocean fisheries

Illustrates well the emerging problem of global non-sustainability

An aerial photograph of a coastal landscape. The foreground is dominated by a large, dark blue body of water, possibly a bay or a large lake. The shoreline is rocky and covered with sparse, low-lying vegetation in shades of green and yellow. In the background, there are more landmasses or islands, some with visible structures or buildings. The overall scene is a mix of natural and possibly human-made elements.

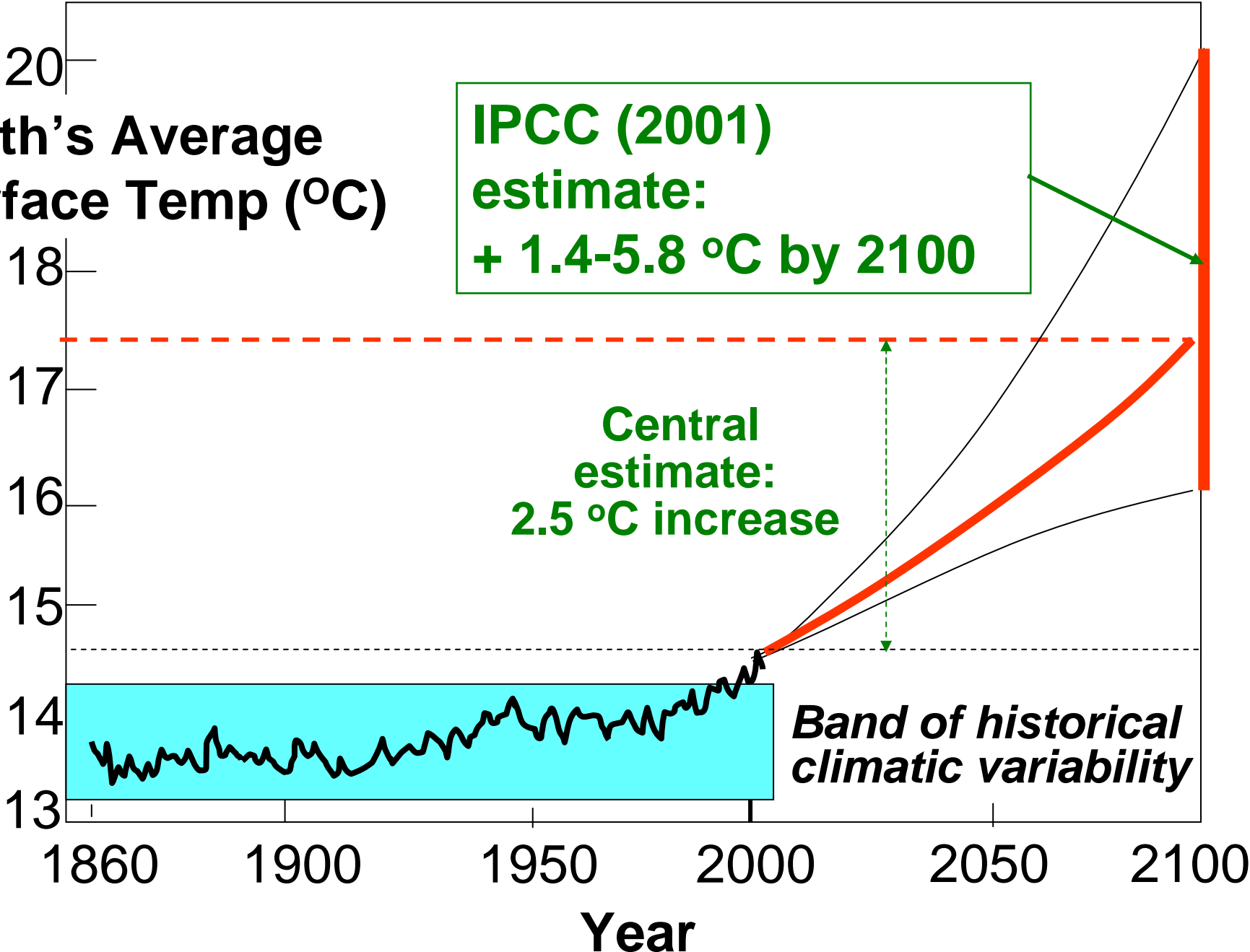
# Climate Change

# Earth's Average Surface Temp (°C)

**IPCC (2001)  
estimate:  
+ 1.4-5.8 °C by 2100**

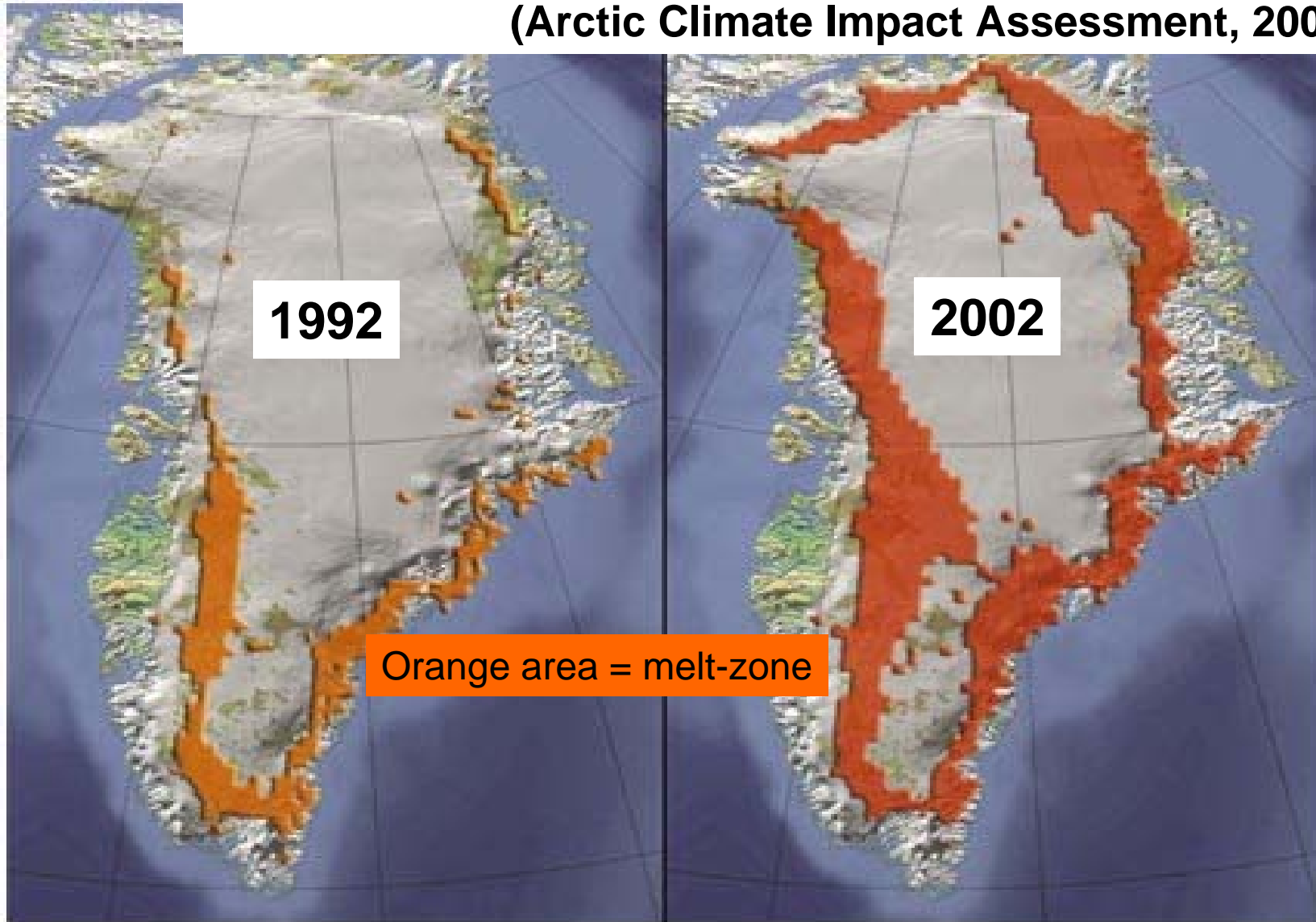
**Central  
estimate:  
2.5 °C increase**

*Band of historical  
climatic variability*



# Greenland Ice Sheet: Increase in Area Melted in Summer, from 1992 to 2002

(Arctic Climate Impact Assessment, 2004)



ANU

# Snow-fall recently in Kalimantan!



# CC Impacts on Non-Human Species

- Recent study of 1700 species found, in second half of last century:<sup>1</sup>
  - poleward average migration rate of 6 km/decade
  - vertical alpine average migration of 6 m/decade
- Accelerated warming may cause migration rates of 50 km/decade latitude and 30 m/decade altitude (> paleo-climate rates of change)
  - This would disrupt (uncouple) ecosystems and threaten species survival<sup>2</sup>
- Warming of 3°C could eliminate ~60% of all species on Earth<sup>3</sup>
- In Earth's history, several mass extinctions of 50-90% of species have accompanied global temperature changes of ~5°C<sup>4</sup>

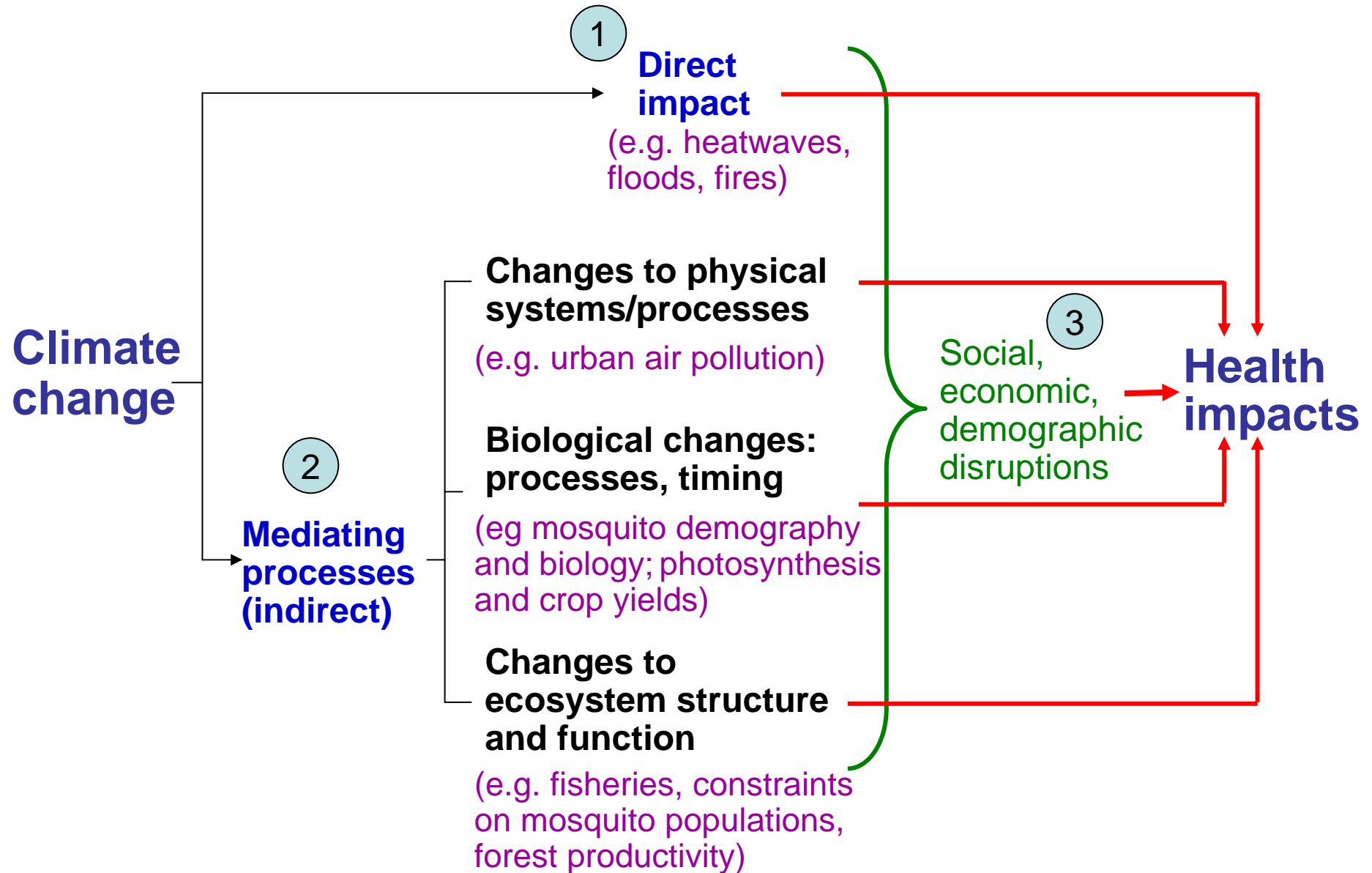
1. Parmesan, C. & Yohe, G. (2003) *Nature* 421, 37-42.

2. Thomas et al, *Nature* (2004) .....

3. Flannery, T. (2005) *The Weather Makers*, Atlantic Monthly, New York, 357 pp.

4. Benton, M.J. (2003) *When Life Nearly Died*, Thames & Hudson, London, 336 pp.

# Climate Change and Health: Direct and Indirect Pathways



# 12-day Heatwave, 3-14 Aug, 2003

Maximum Temperature, Aug 10

## Excess Mortality:

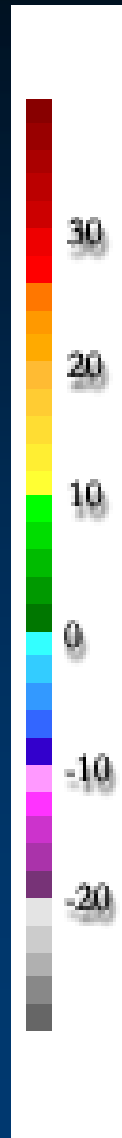
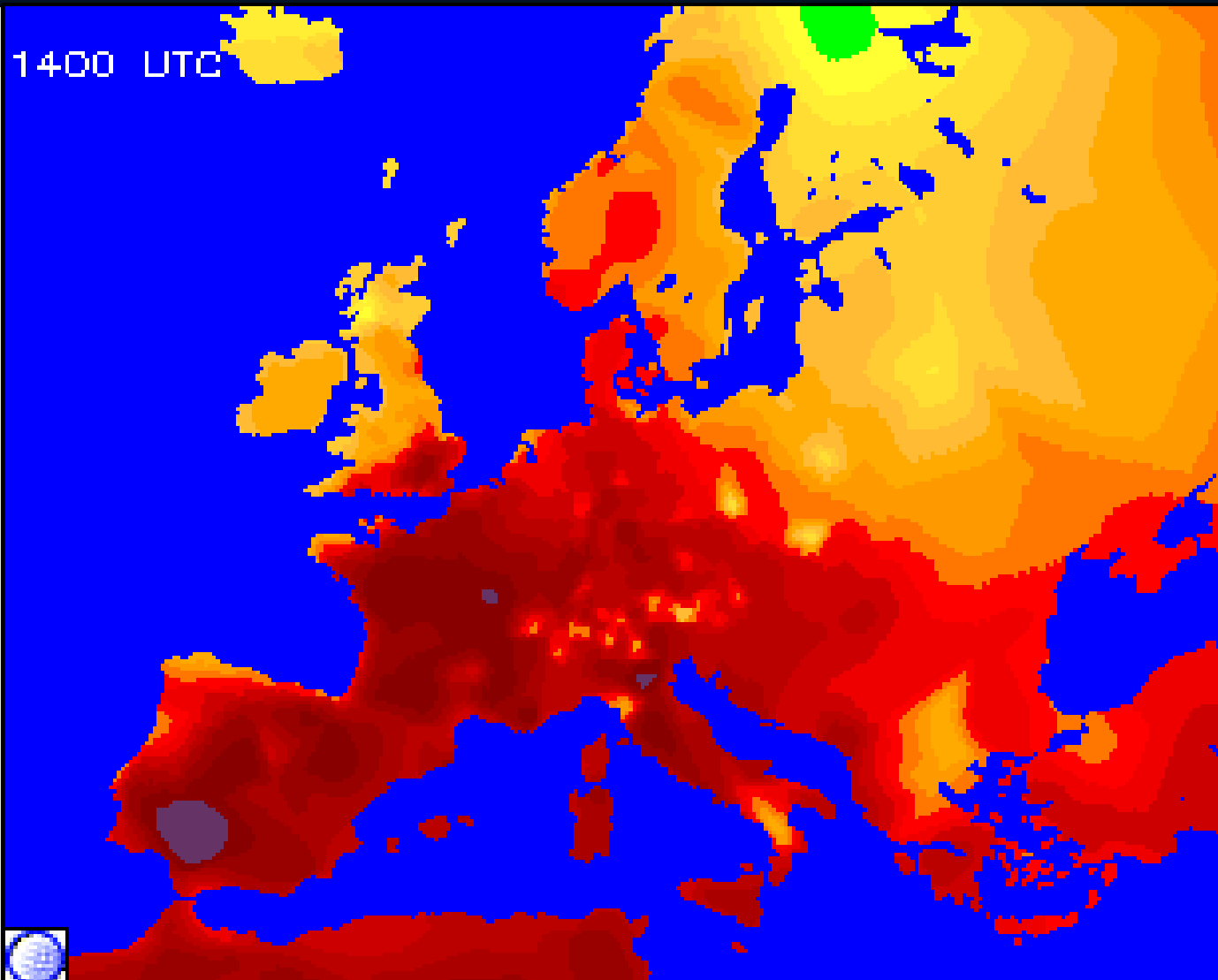
France:  
14,800

Italy:  
10,000

Spain &  
Portugal:  
5,000

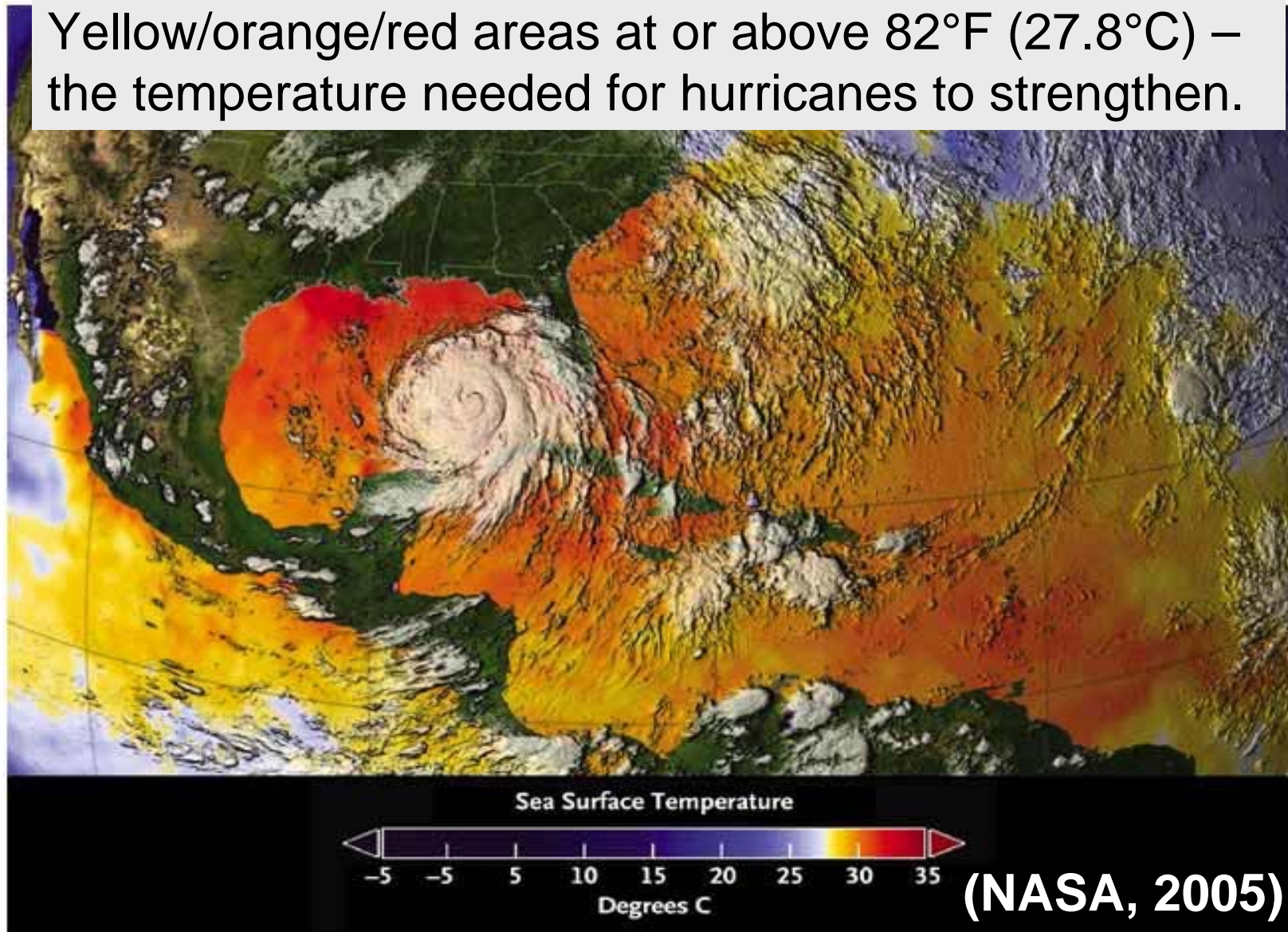
Etc.

**Total =  
35,000**



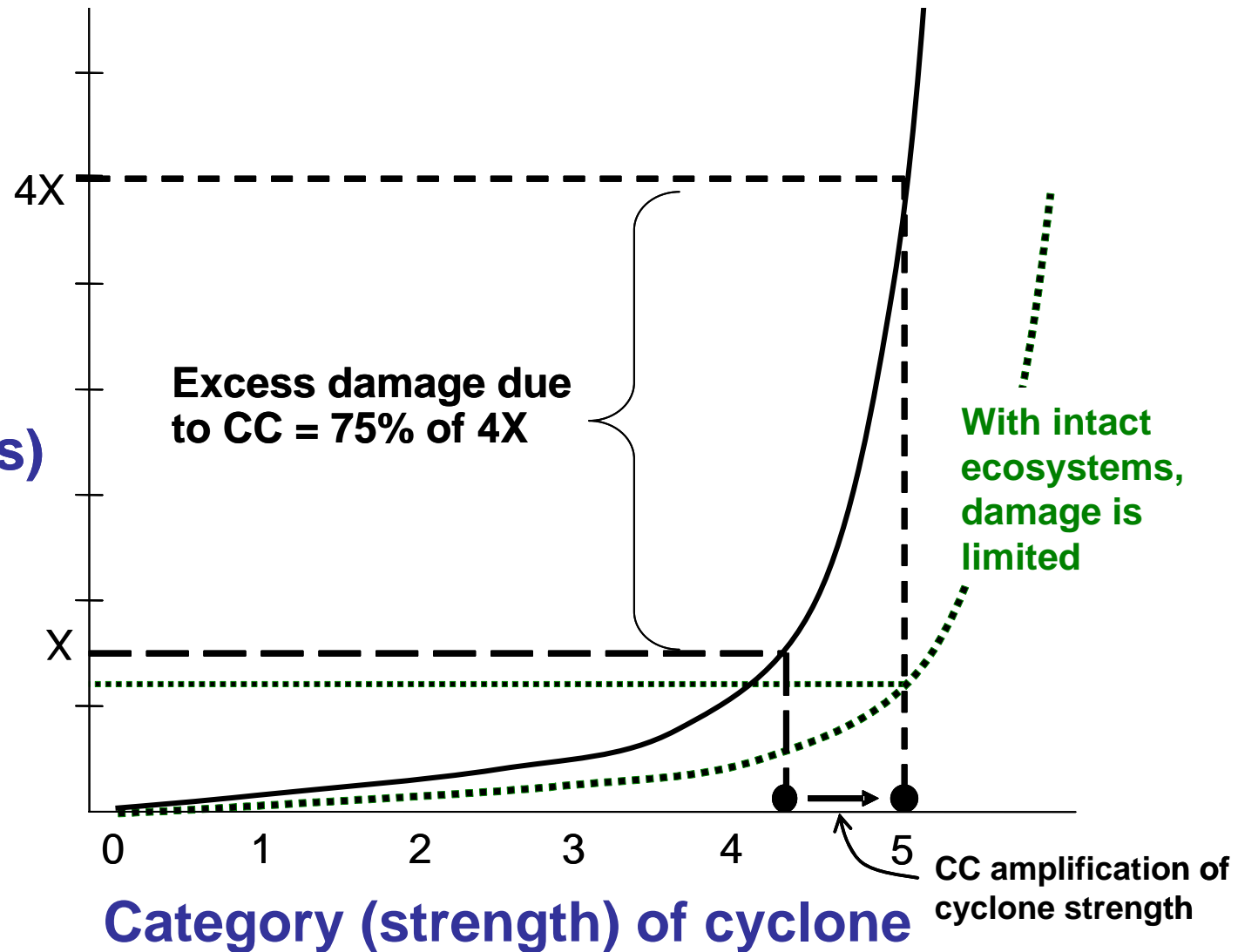
# Hurricane Katrina crossing Gulf of Mexico

Yellow/orange/red areas at or above 82°F (27.8°C) – the temperature needed for hurricanes to strengthen.



# Apportioning Impact between 'Natural' and 'CC-induced' Components

Damage  
(e.g. no.  
of deaths)

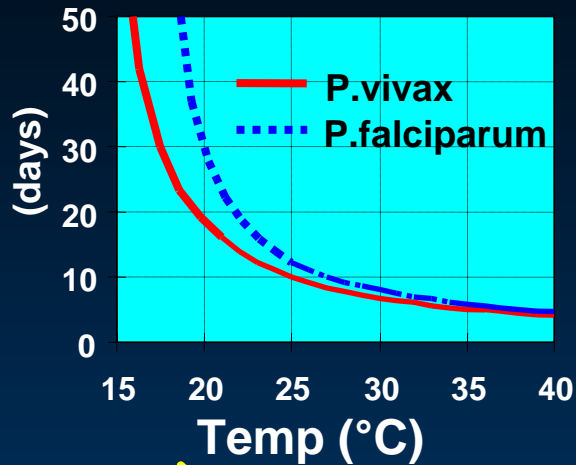


# Estimating Future Health Impacts of Climate Change

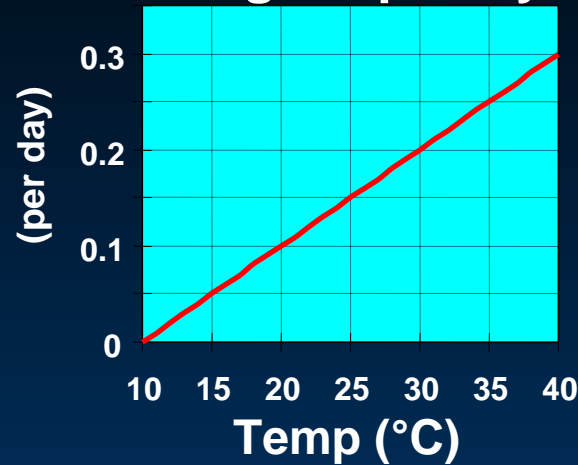
e.g. malaria, dengue fever

# Malaria Transmissibility: Temperature and Biology

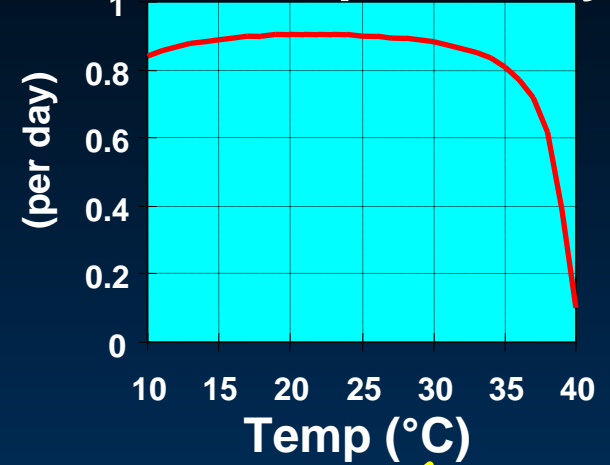
Plasmodium Incubation period



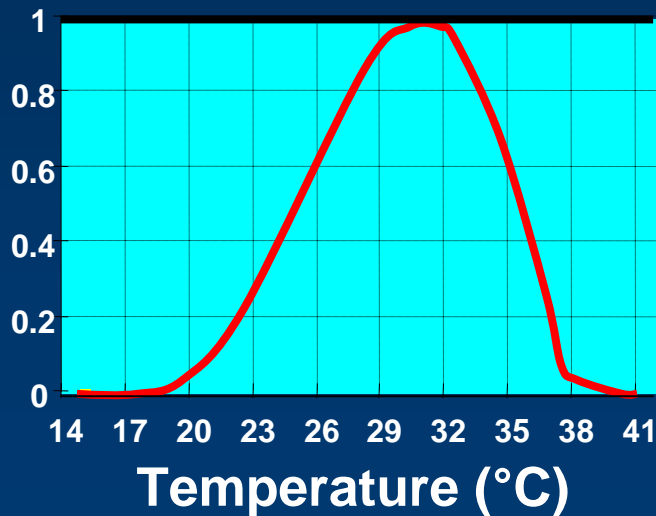
Biting frequency



Survival probability

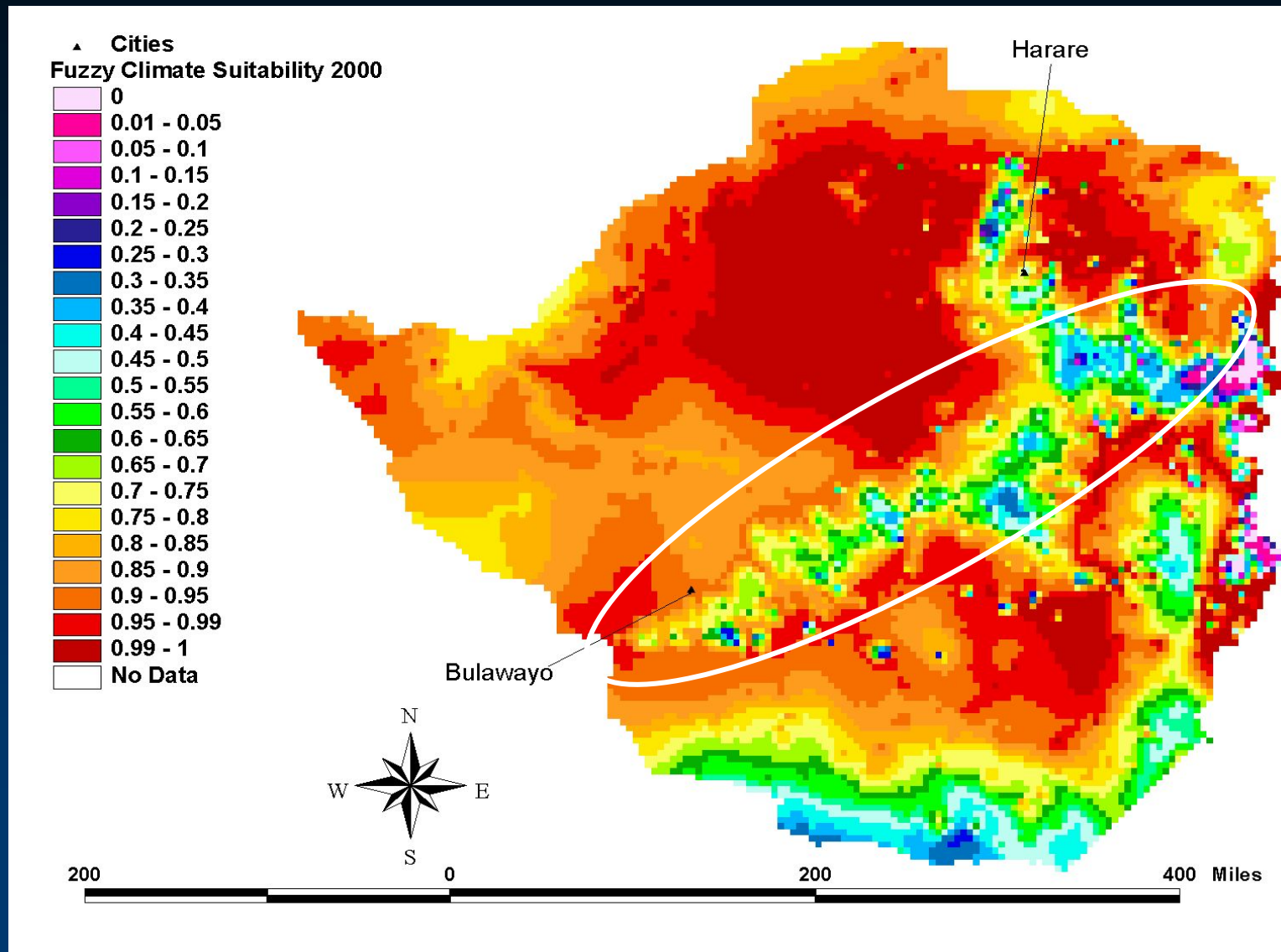


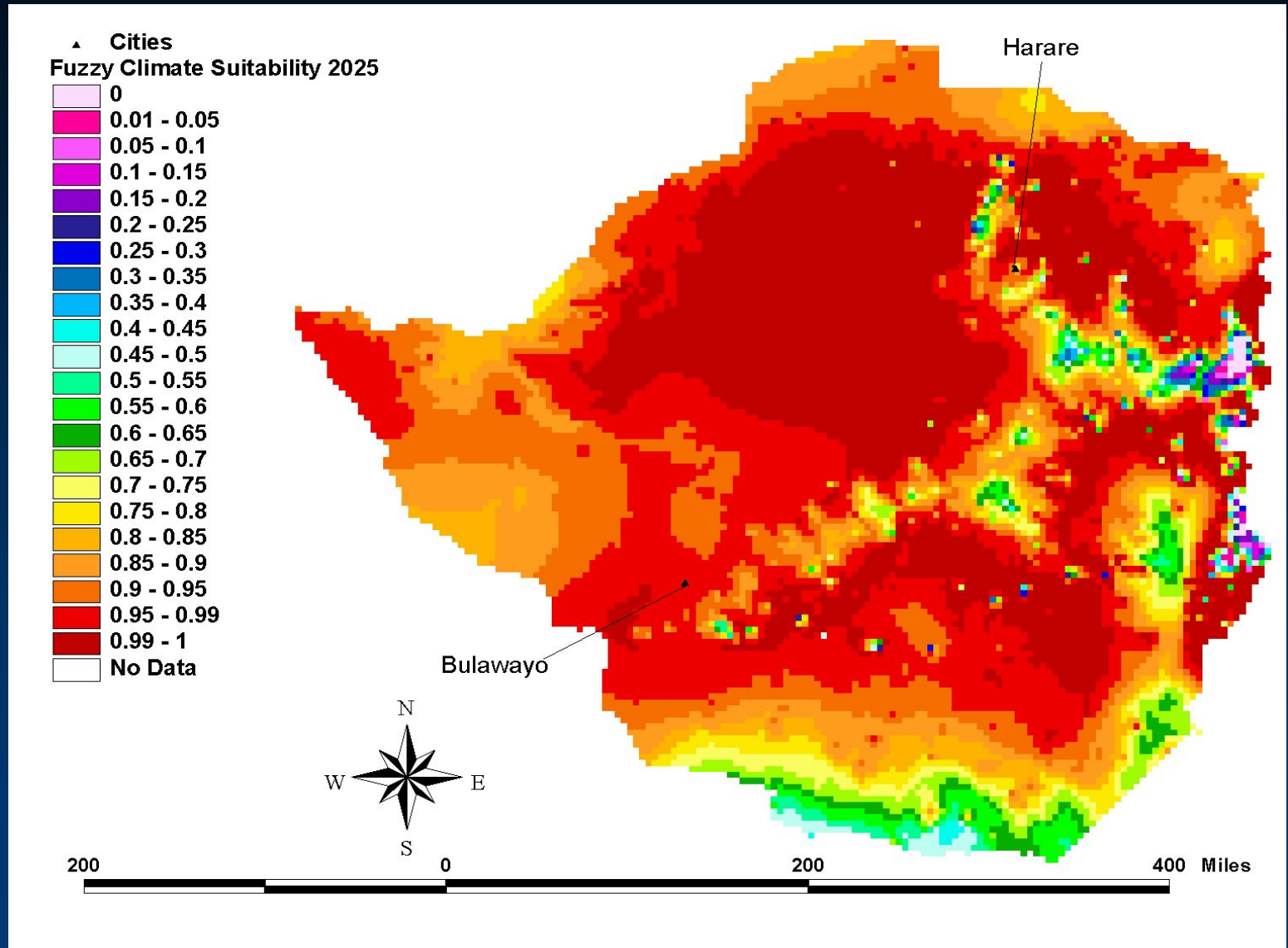
## TRANSMISSION POTENTIAL

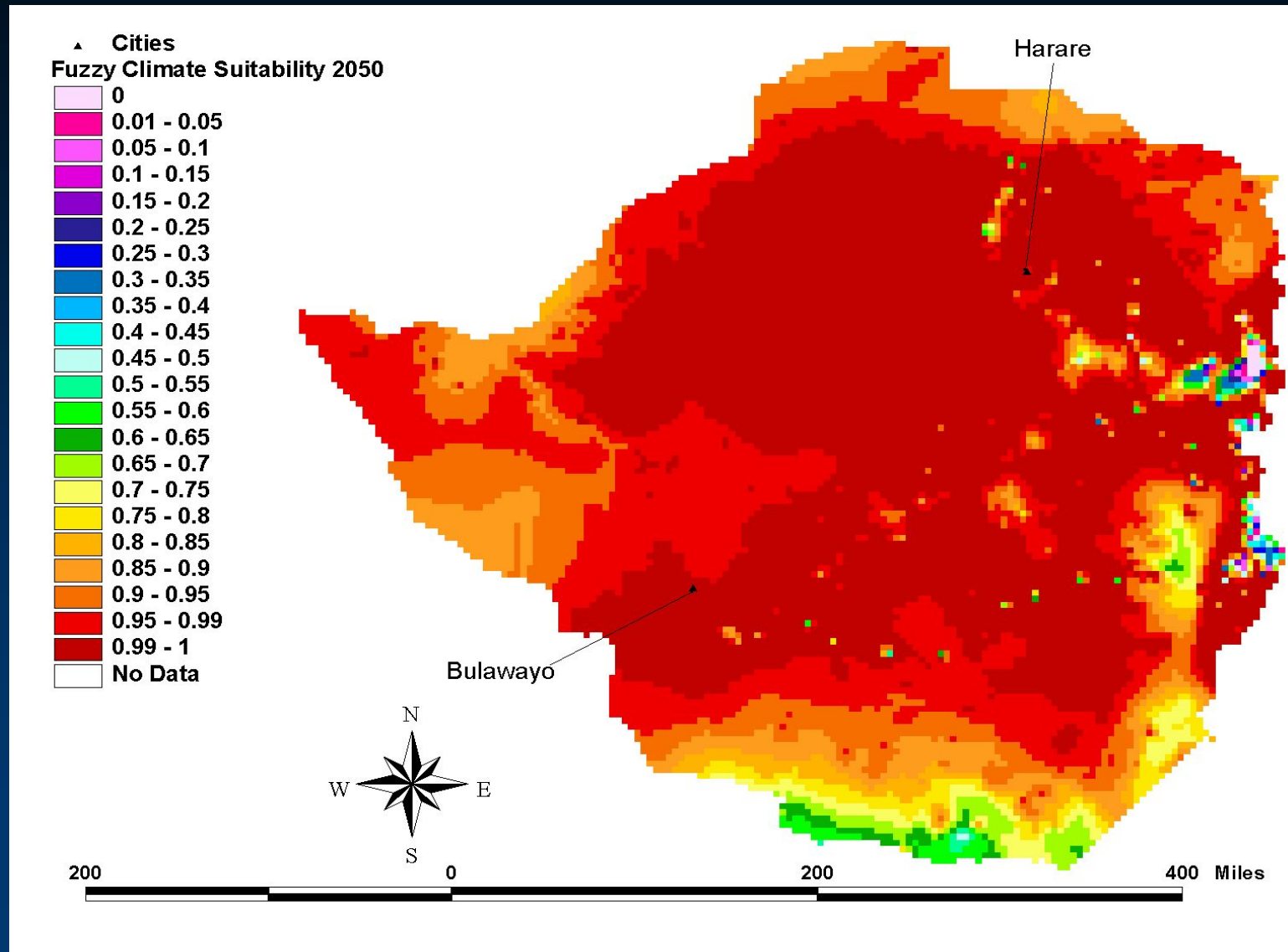


# Climate Change & Malaria (potential transmission) in Zimbabwe

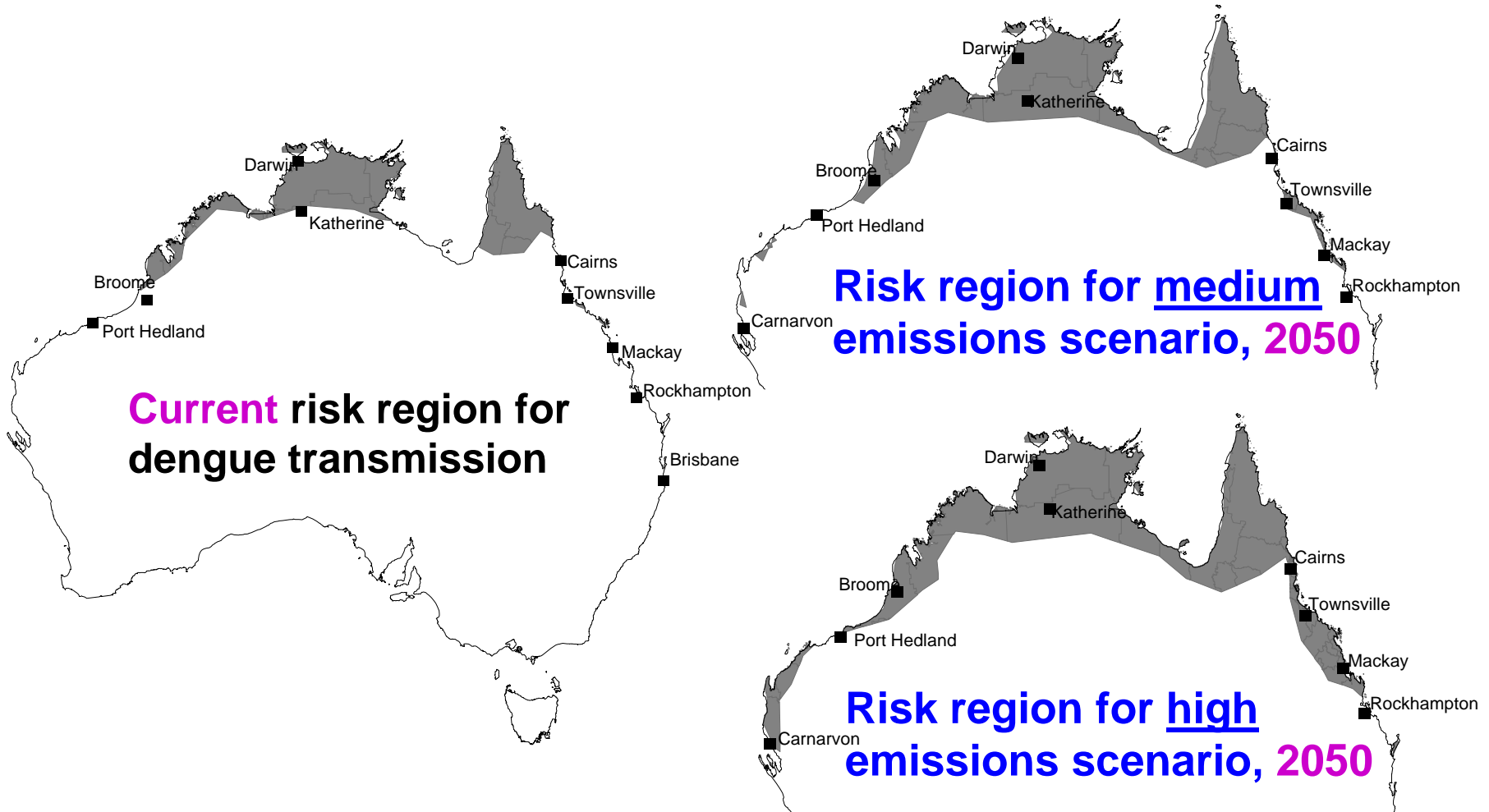
Baseline **2000** 2025 2050







# Dengue Fever: Statistical modelling of receptive geographic region for *Ae. Aegyptii* mosquito, under alternative climate-change scenarios for 2050



## UN projection (2006):

- By 2010 the world will be burdened with up to 50 million people escaping the effects of environmental deterioration. [ !!! ]
- Order of magnitude increase relative to 2005.

Population health is:

- an **input** to sustainable development ; and
- a **criterion of success** in achieving sustainable development

i.e. Population health is the the real  
“bottom line” of sustainability

**That's all,  
folks**



Norman Lindsay's "Albert, the Magic Pudding":  
never depleted; endless slices available – i.e., how  
some economists and others view the world.