# Climate Change and Health:

# Determinants of Vulnerability

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# Overview

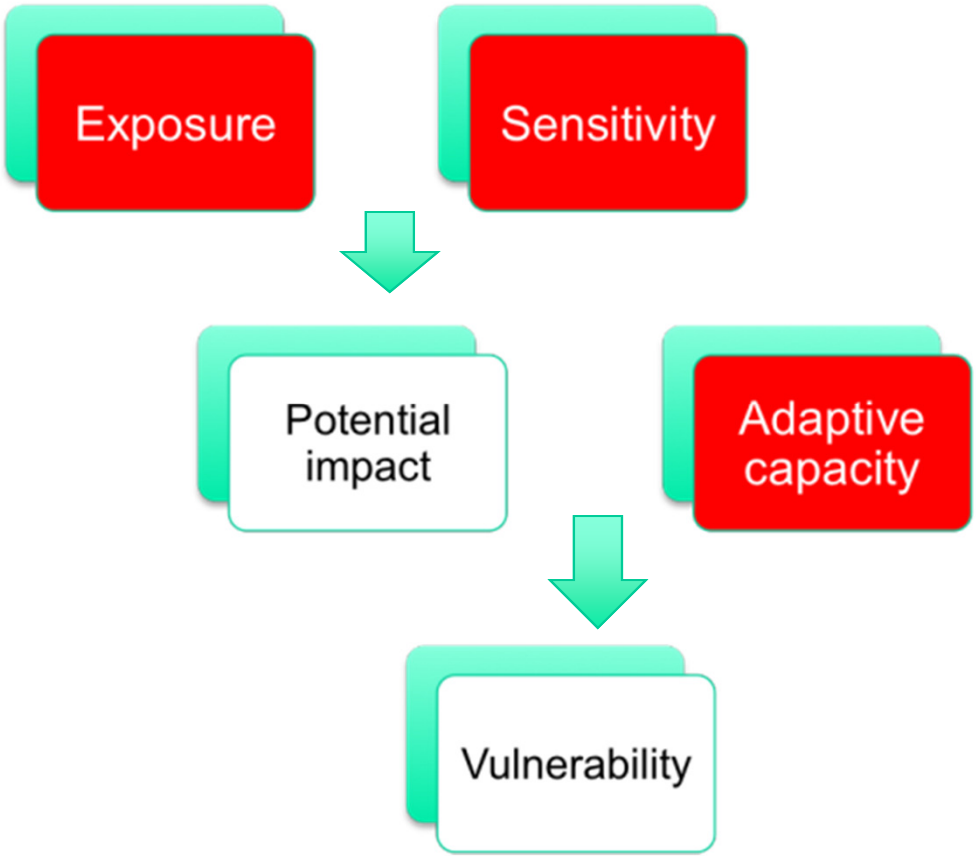
- Define terms
- Discuss causes of vulnerability to disease and injury resulting from climate change
- Describe examples of vulnerability to effects of heat, famine and storms
- Suggest opportunities to reduce vulnerability and improve population health

# Definition of Vulnerability

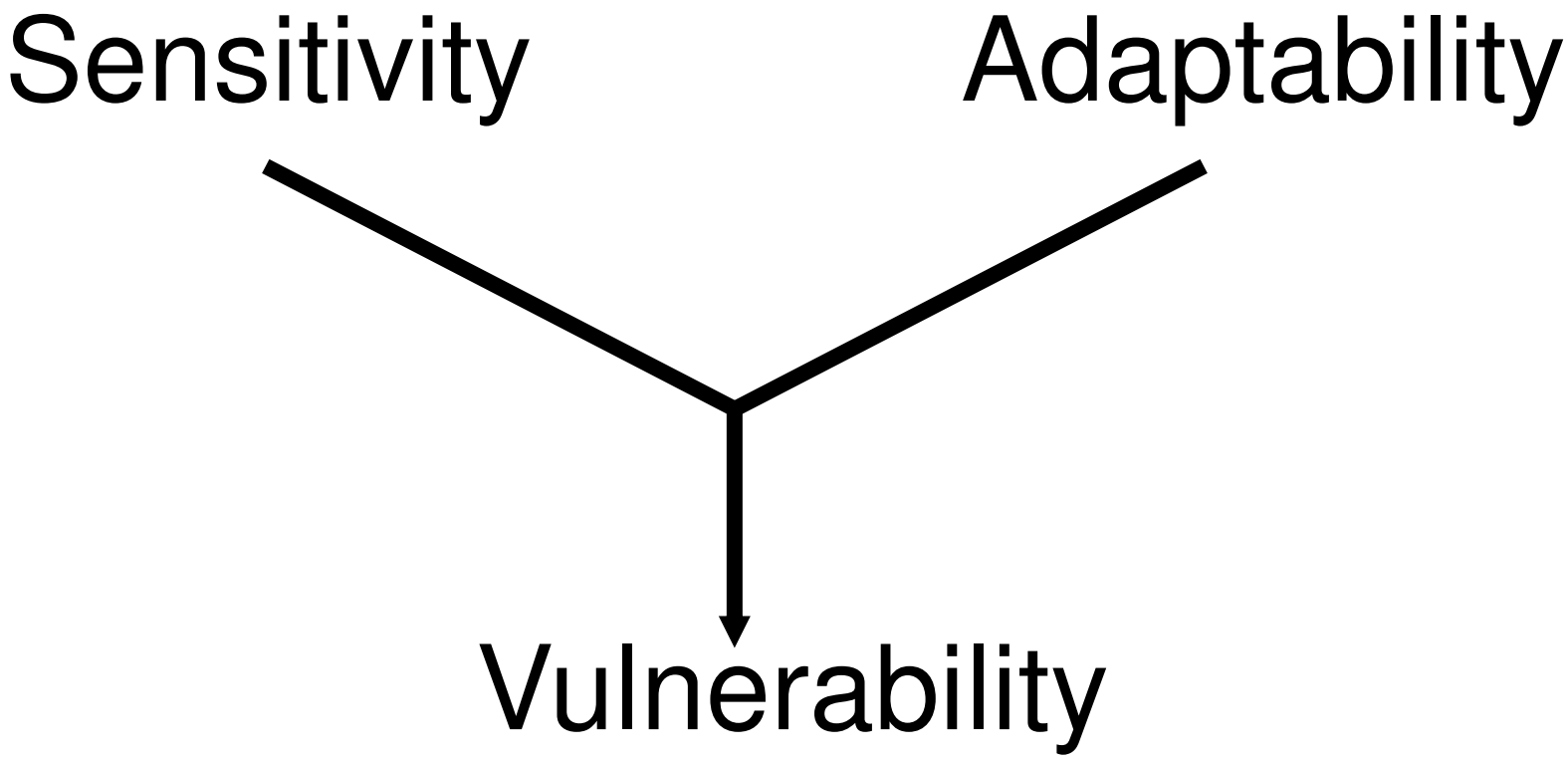
**“The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change”**

Intergovernmental Panel on Climate Change,
Fourth Assessment Report 2007
(IPCC AR4, 2007)

# Definition of Vulnerability




WHO 2009




Friberg 2006

# Sensitivity

- Biophysical effect of climate change
  - Change in crop yield, energy demand
- Considers socioeconomic context, e.g., agriculture system
- Grain crops typically are sensitive (esp. if rain-fed)
- Manufacturing much less sensitive to climate change

# Sensitivity to Damage

- 73% of disasters reported 1900-2004 climate-related
- GDP growth in Mozambique dropped from 8% (1999) to 2% (2000) post-cyclone.
- >1/4 of Africa's population lives within 100km of a coast. Pop. at risk from coastal flooding to rise from 1m in 1990 to 70m in 2080

Friberg 2006

# Adaptive Capacity

- Capability to adapt
- Function of:
  - Wealth
  - Technology
  - Education
  - Institutions
  - Information
  - Infrastructure
  - “Social capital”
- *Having* adaptive capacity does not mean it is *used* effectively

# Adaptation

- "…adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm of exploits beneficial opportunities"
  (IPCC Third Assessment Report, Working Group II)

  – Note: includes "actual" (realized) or "expected" (future) changes in climate

# Determinants of Vulnerability

- Character, magnitude, and rate of climate change
- Sensitivity to climate change
- Coping capacity (adaptation)

# Vulnerability

- Vulnerability to climate change is the risk that adverse things will be experienced
- Vulnerability is a function of three factors:
  - Exposure
  - Sensitivity
  - Adaptive capacity

# Determinants of Health Vulnerability to Climate Change

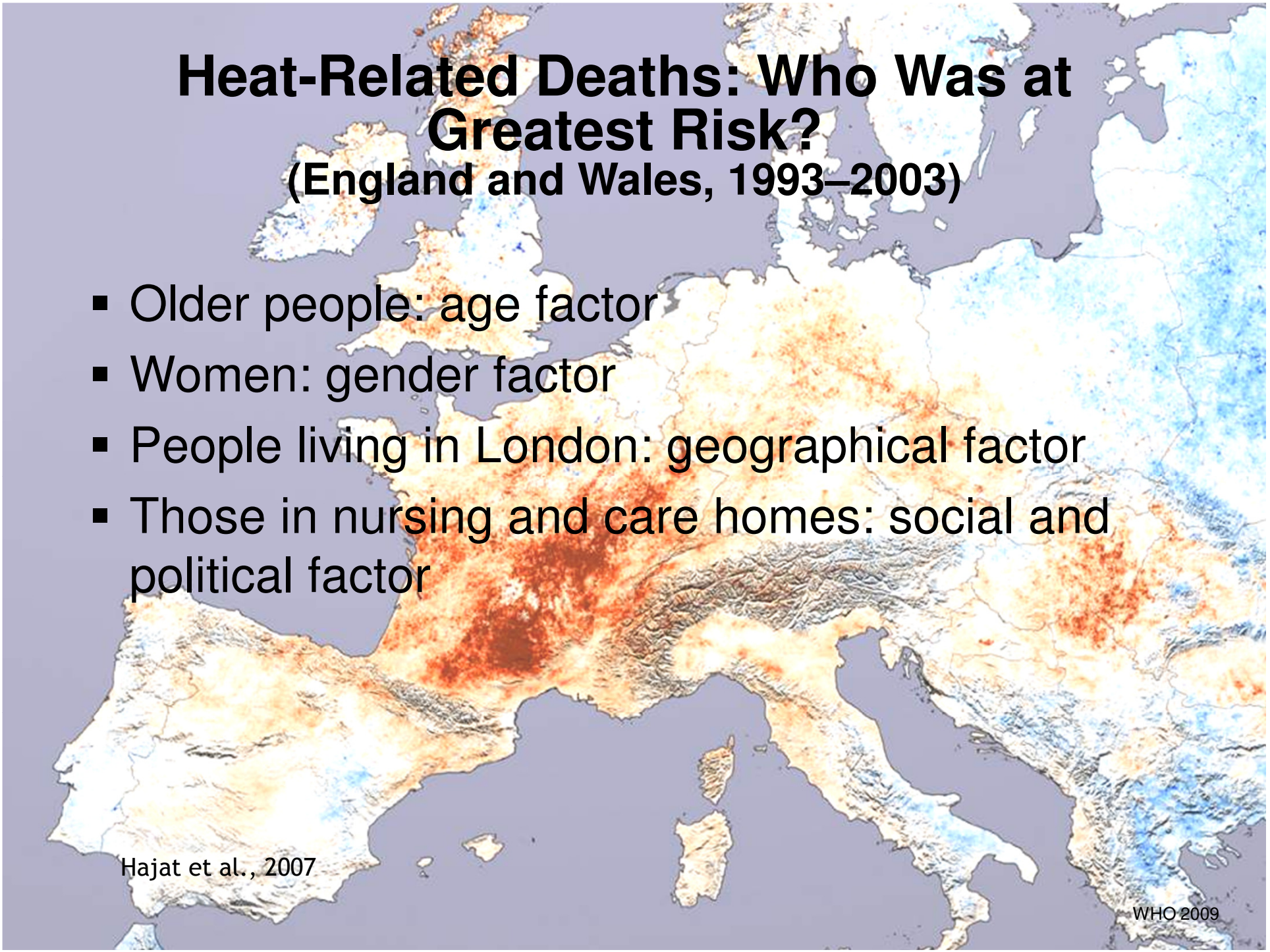
- Biological
- Physical
- Geographical
- Social
- Economical
- Political

# Example of Vulnerability to Climate Change — Coral Reefs

REASONS:

- Exposed to rapid ocean warming
- Sensitive to small increases in temperature
- Limited adaptive capacity

# Heat-Related Deaths: Who Was at Greatest Risk?
## (England and Wales, 1993–2003)



- Older people: age factor
- Women: gender factor
- People living in London: geographical factor
- Those in nursing and care homes: social and political factor

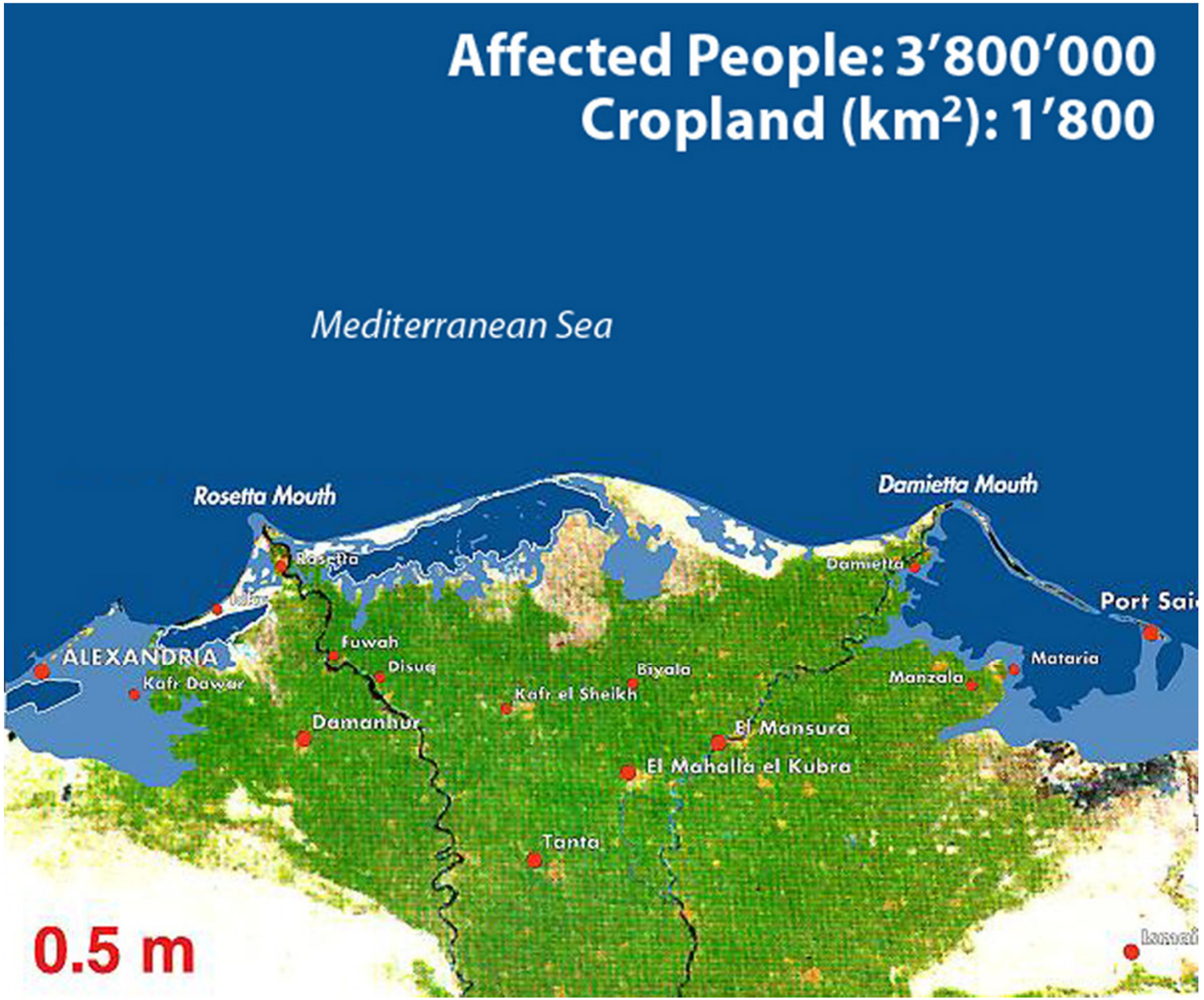
Hajat et al., 2007

WHO 2009

# Effects of 2006 Heat Wave in France

- **2,065** excess deaths (July 11–28)
- **Expected** number was **6,452** based on rates seen during the 2003 heat wave
- Possible explanations
  - Model imperfections (over-estimate of expected deaths)
  - Reduced vulnerability (e.g., heat warning system, better informed public, more responsive health services)

# Potential Impact of Sea Level Rise: Nile Delta




Friberg 2006

Sources: Otto Simonett, UNEP/GRID Geneva; Prof. G.Sestini, Florence; Remote Sensing Center, Cairo; DIERCKE Weltwirtschaftsatlas

# Vulnerability of Pacific Islands to Sea Level Rise

Table 3. Pacific island states ranked by susceptibility to sea level rise (ranking based on equal weighting to altitude, island numbers, total land area and island type; Pernetta 1990). References: Pernetta (1990), World Resources Institute (1996), Asia & Pacific Review (1997)

| Nation | Major island type | GNP per capita 1994 (US $) | Population (1995) | Maximum altitude (m) | Susceptibility to sea level rise |
|---|---|---|---|---|---|
| Tokelau | Atoll | 4000 | 1500 | 4 | Extreme |
| Marshall Islands | Atoll | 2500 | 54700 | 4 | |
| Tuvalu | Atoll, raised coral | – | 9500 | 4 | |
| Line Islands | Raised coral | – | | 8 | |
| Kiribati | coral, atoll | 730 | 78400 | 81 | |
| Micronesia | Various | 1890 | 105700 | 791 | Severe |
| Palau | Coral | 3250 | 16500 | 207 | |
| Pitcairn | Coral, atoll | – | 50 | 304 | |
| Nauru | | 12000 | 10500 | 71 | |
| French Polynesia | Volcanic, atoll | 7000 | 218000 | 2237 | |
| Cook Islands | Volcanic, varied | 2750 | 19100 | 652 | |
| Niue | Coral | 2250 | 2500 | 67 | |
| Tonga | Various | 1640 | 98200 | 1125 | |
| American Samoa | Volcanic | 8000 | 54800 | 931 | Moderate |
| Fiji | Mixed | 2220 | 774800 | 1323 | |
| New Caledonia | Mixed | 11000 | 182200 | 1628 | |
| N Marianas | Volcanic | – | 56700 | 965 | |
| Solomon Islands | Mixed, volcanic | 1200 | 367800 | 2446 | |
| Vanuatu | Mixed | 1300 | 164100 | 1979 | Modest |
| Wallis and Fatuna | Volcanic | 3000 | 14400 | 769 | |
| Easter Island | Volcanic | – | 2811 | 600 | |
| Papua New Guinea | Mixed | 1120 | 4302000 | 4694 | |
| Guam | Mixed | 11800 | 149300 | 393 | |
| Western Samoa | Volcanic | 900 | 163400 | 1857 | |

**Woodward et al., 1998**

WHO 2009

# Paradise lost?

Existential threat for SIDS nations

# Developed Country Catastrophes

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# Typhoon Impacts by Classification: a Preparedness Evaluation

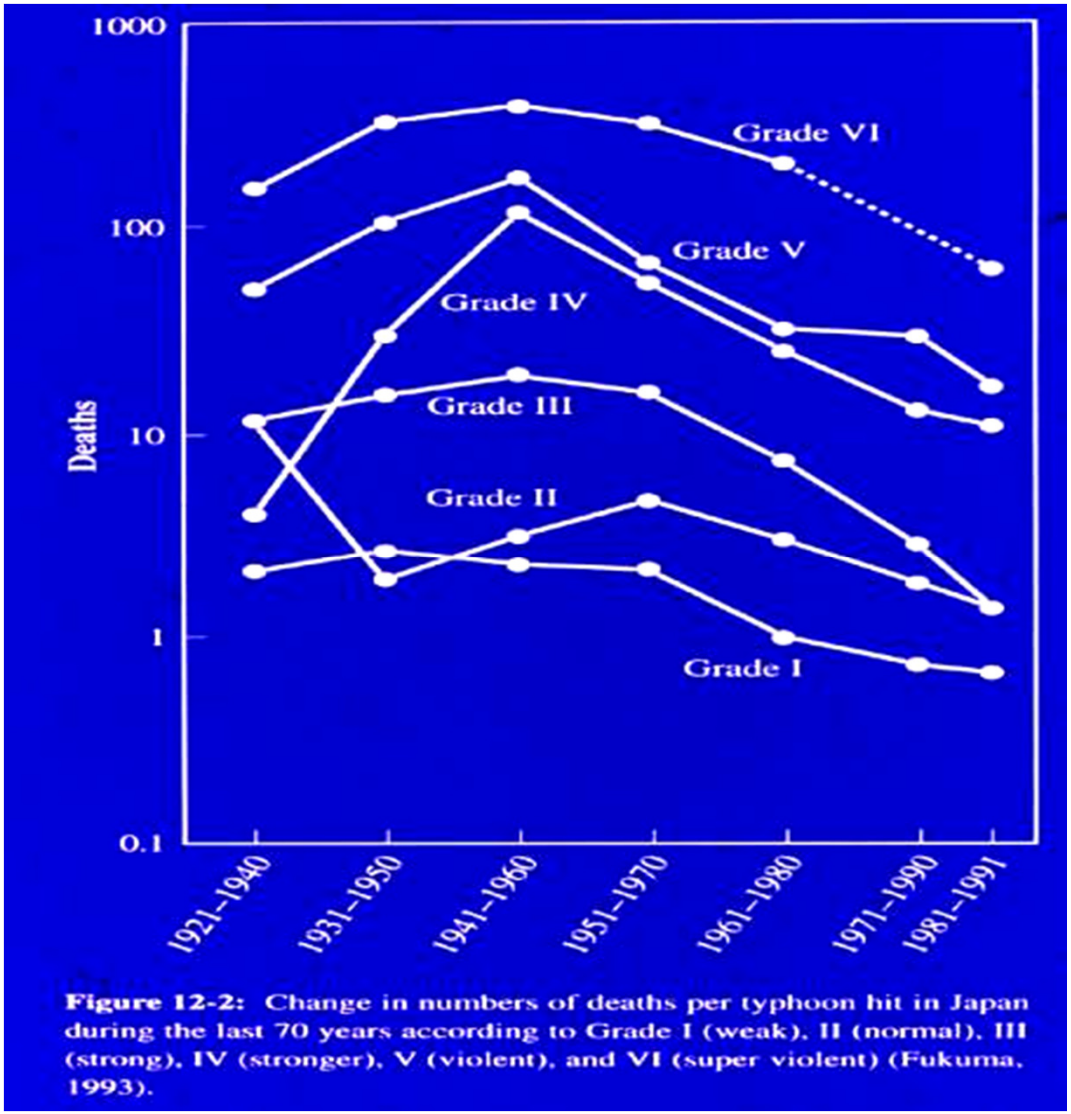



**Figure 12-2:** Change in numbers of deaths per typhoon hit in Japan during the last 70 years according to Grade I (weak), II (normal), III (strong), IV (stronger), V (violent), and VI (super violent) (Fukuma, 1993).

- Loss of life due to typhoons is decreasing owing to better preparedness (Fukuma,1993)

# Vulnerability to the Future Effects of Climate Change

"The rich will find their world to be more expensive, inconvenient, uncomfortable, disrupted and colorless — in general, more unpleasant and unpredictable, perhaps greatly so. The poor will die."

Kirk R. Smith, 2008

Professor: Environmental Health Sciences

University of California, Berkeley

# Diminishing Number of Deaths Due to Hurricanes Striking Cuba, 1998–2002

| Hurricane | Category | People evacuated | Homes damaged | Deaths |
|---|---|---|---|---|
| George 1998 | 3–4 | 818,000 | 40,000 | 6 |
| Irene 1999 | 1 | 162,000 | 3,000 | 4 |
| Michelle 2001 | 4 | 712,000 | 90,000 | 5 |
| Isidore 2002 | 2 | 280,000 | 51,000 | 0 |
| Lili 2002 | 2 | 165,000 | 51,000 | 1 |

**Oxfam America, 2004**

# Foundation of Low Storm Mortality in Cuba

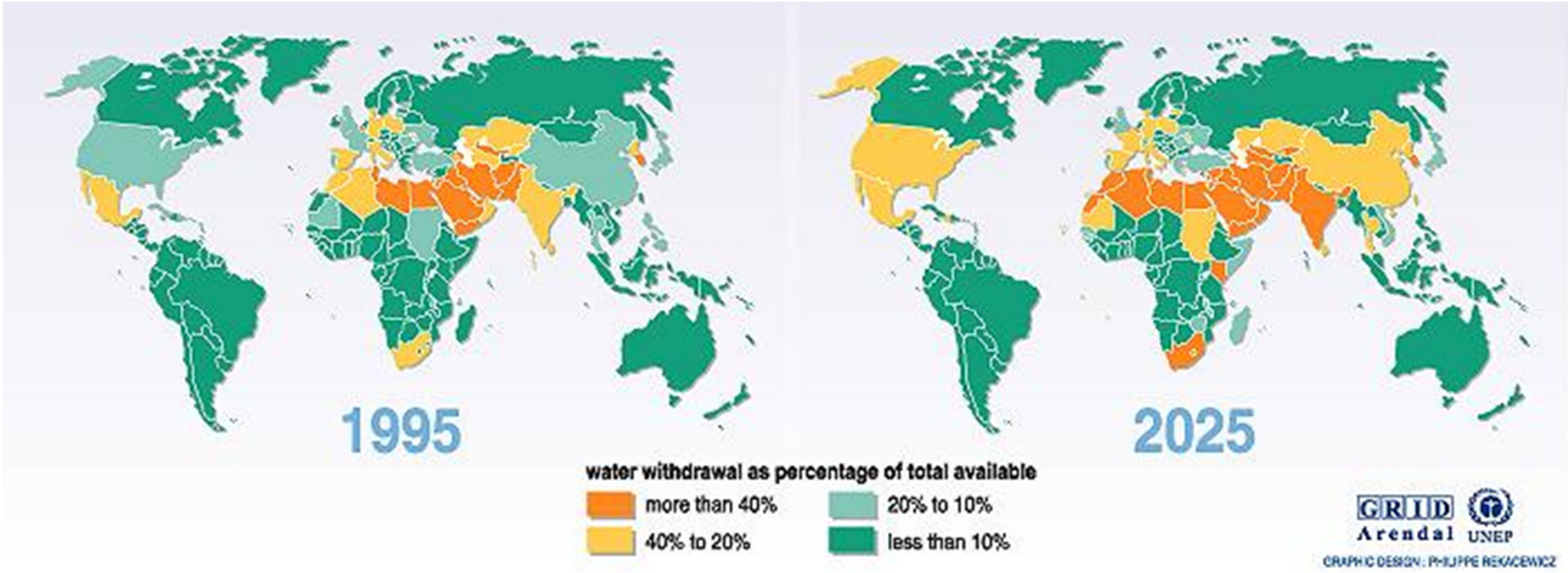
- Tangible preparedness assets — stockpiles, plans, equipment, early warning systems
- Infrastructure — high levels of literacy, rural development, access to reliable health care
- Social capital — engagement of local communities, high levels of participation, commitment to reconstruction and recovery

Oxfam America, 2004

# Water shortage e.g. North Africa

For a global mean warming of 1.8-2.6°C all climate change projections forecast precipitation decrease up to 40% by 2050 compared to 1961-1990 levels. This in an already extremely dry area with high population growth.

# Freshwater Stress – Billions at risk




Source: Global environment outlook 2000 (GEO), UNEP, Earthscan, London, 1999.

# Socioeconomic impacts

- Even small increases of temperature will prompt food prices to increase due to a slowing in the expansion of global food supply relative to growth in global food demand
- Climate change will lower incomes of the vulnerable populations and increase the absolute number of people at risk of hunger
- What would the impacts be in a already fragile society of mass starvation? Climate refugees?
- How would the rich world react? Especially if it was also struggling with the negative effects of climate change?

# Climate Change & Poverty

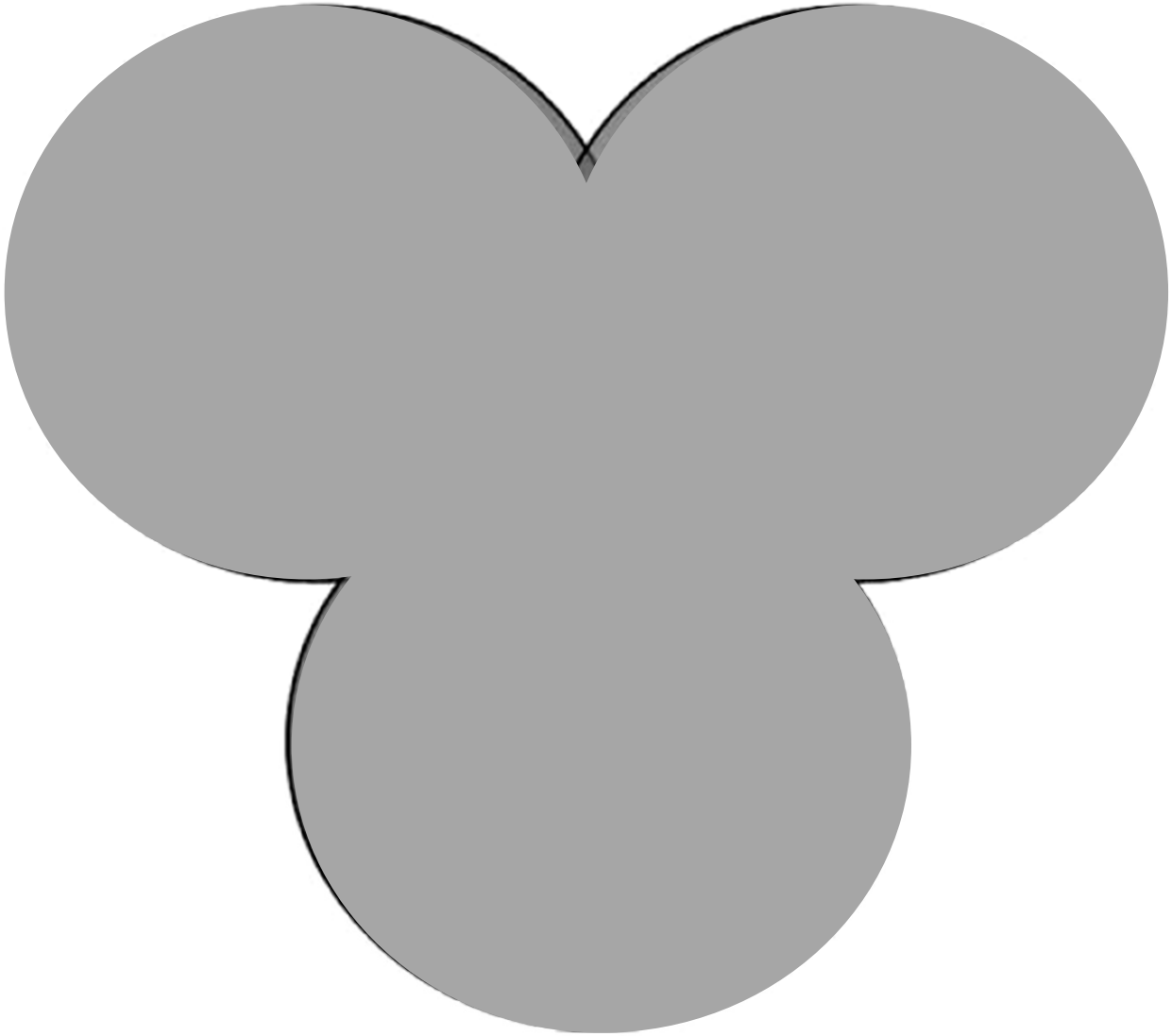
- Disproportionate negative impact on poor
  - 94% of disasters and 97% of natural disaster related deaths occur in developing countries
- Annual costs of "natural" disasters estimated at $55 B (2004). Economic damages greatest in developed countries
  - e.g. total economic impact of Hurricane Katrina in Louisiana and Mississippi >$150 Billion
- Climate Change impact is a structural factor that exacerbates inequality and thwarts pro-poor growth
- Impacts dependent on climate sensitive sectors
- 22-53% of total ODA in Bangladesh (~$1B) at risk from climatic changes

Friberg 2006

# Impact on Human Development and Millennium Development Goals

- Biophysical effects associated with climate change will in turn impact on human development and the achievement and sustainability of MDGs
  - **MDGs 4,5,6 (health):** Incidence of Cholera increased 6-fold in Nicaragua following flooding as a result of Hurricane Mitch
  - **MDG2 (education):** In Bihar India, annual flooding shuts schools across the state for 3 months.
  - **MDG3 (gender):** 90% of victims in 1991 Bangladesh cyclone were women and children.
  - **MDG7 (environment):** 1997 El Niño-related drought killed ~80% of livestock in Somalia and Kenya.

# Population Vulnerability Interaction



Xun et al. 2010

# Conclusions

- **Vulnerability** = susceptibility to adverse effects + inability to adapt
- **Causes** of vulnerability include **biological** characteristics, the **physical** environment, **social** circumstances, and national and international **politics**
- Opportunities to reduce vulnerability cover a correspondingly wide range
- Reducing vulnerability to damage resulting from climate change will bring other substantial benefits, earlier.

# Mauritius Vulnerability and Adaptation Plan For Human Health

"Analysis shows that **higher temperature, precipitation and humidity** facilitate the spread of diseases such as **chikungunya** and **dengue**. These are vector-borne viral infectious agents transmitted by mosquitoes which are known to increase their activities in warmer temperatures. Furthermore, although **respiratory complications, cardiovascular diseases, food poisoning, diarrheal and skin diseases** cannot be avoided, their occurrences can increase and be aggravated during **hot spells.**"

Second National Communication of the Republic of Mauritius under UNFCCC 2010

# Mauritius Vulnerability and Adaptation Plan For Human Health

**Vulnerability.** Mauritius likely to become more vulnerable to health impacts of climate change through the following:

- Propagation of **vector-borne and infectious diseases** as a result of higher temperature and recurrent floods
- Lengthening of the **transmission period** of important vector-borne diseases due to rise in temperature
- Increase in the frequency of **gastroenteritis and respiratory** problems.

Second National Communication of the Republic of Mauritius under UNFCCC 2010

# Mauritius Vulnerability and Adaptation Plan For Human Health

**Adaptation.** To reduce the vulnerability of the population from health hazards, adaptation measures are proposed:

- Adopt preventive measures to further reduce the load of **air-pollutant**
- Strengthen the existing **disease surveillance system**
- Reduce **exposure to extreme heat** of those afflicted by cardiovascular problems
- Organize regular **training programmes** for health personnel to deal with emerging diseases and natural disasters.
- **Simulation exercises** to be carried for the evaluation of interventions in emergencies.

Second National Communication of the Republic of Mauritius under UNFCCC 2010

# Discussion

**Questions?**

**Thoughts?**

**Concerns?**

**Suggestions?**

# Acknowledgements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