THE GLOBAL BURDEN OF DISEASE DUE TO CLIMATE CHANGE:

QUANTIFYING THE BENEFITS OF STABILIZATION FOR HUMAN HEALTH

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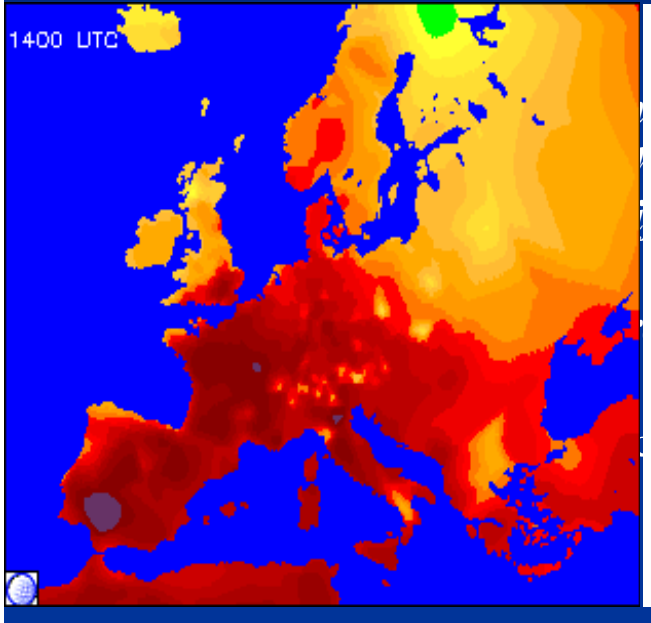
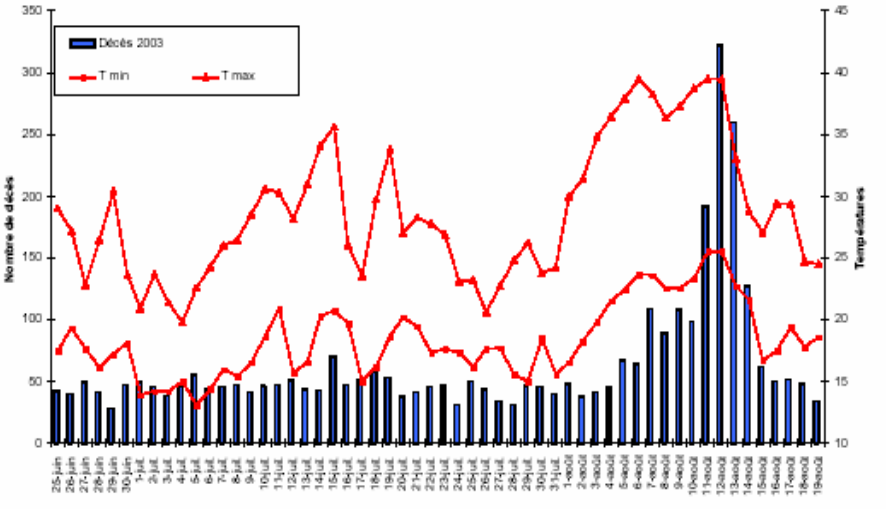
Climate, an ancient health determinant



Graphique n°1 : Nombre de décès journaliers à Paris et températures minimales et maximales entre le 25 juin et le 19 août 2003



Deaths During Summer Heatwave. Paris Funeral Services (2003)

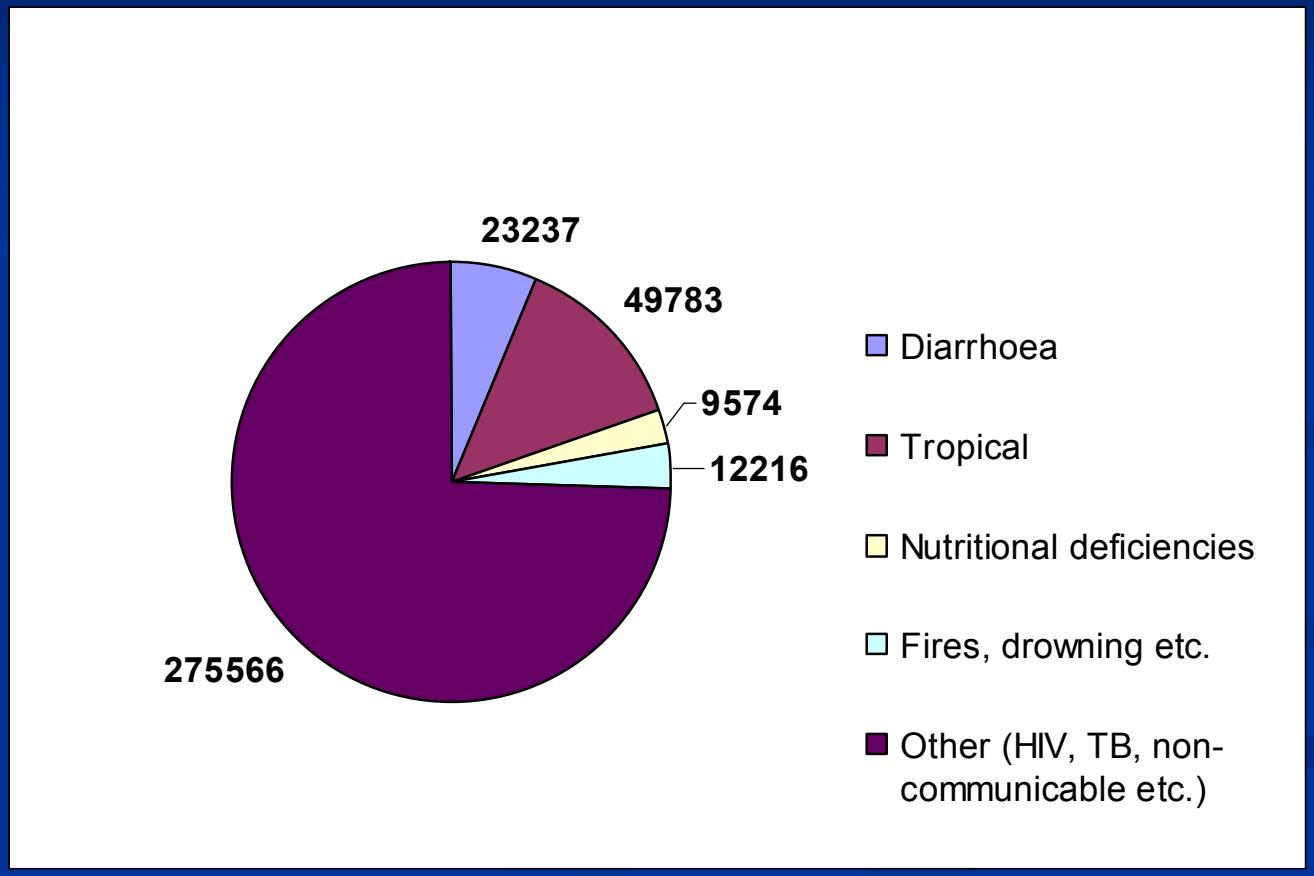
State of knowledge at IPCC TAR (2001)

Mainly qualitative assessment, with some health relevant quantification:

- Deaths in thermal extremes
- Area climatically suitable for malaria transmission
- Food deficit
- Exposure to coastal flooding

"Overall, climate change is projected to increase threats to human health, particularly in the lower income populations, predominantly within tropical/ subtropical countries". IPCC Third Assessment Report, 2001.

Global burden of disease in Sub-Saharan Africa (2002, Thousands of Disability-Adjusted Life Years)



Defining and Quantifying Exposure

Exposure 'Units':

Discrete climate scenarios derived from alternative future trajectories of GHG emissions.

1) Unmitigated current GHG emissions trends
2) Stabilization at 750 ppm CO_2-equivalent
3) Stabilization at 550 ppm CO_2-equivalent
4) 1961-1990 levels of GHGs and associated climate

Data sources:

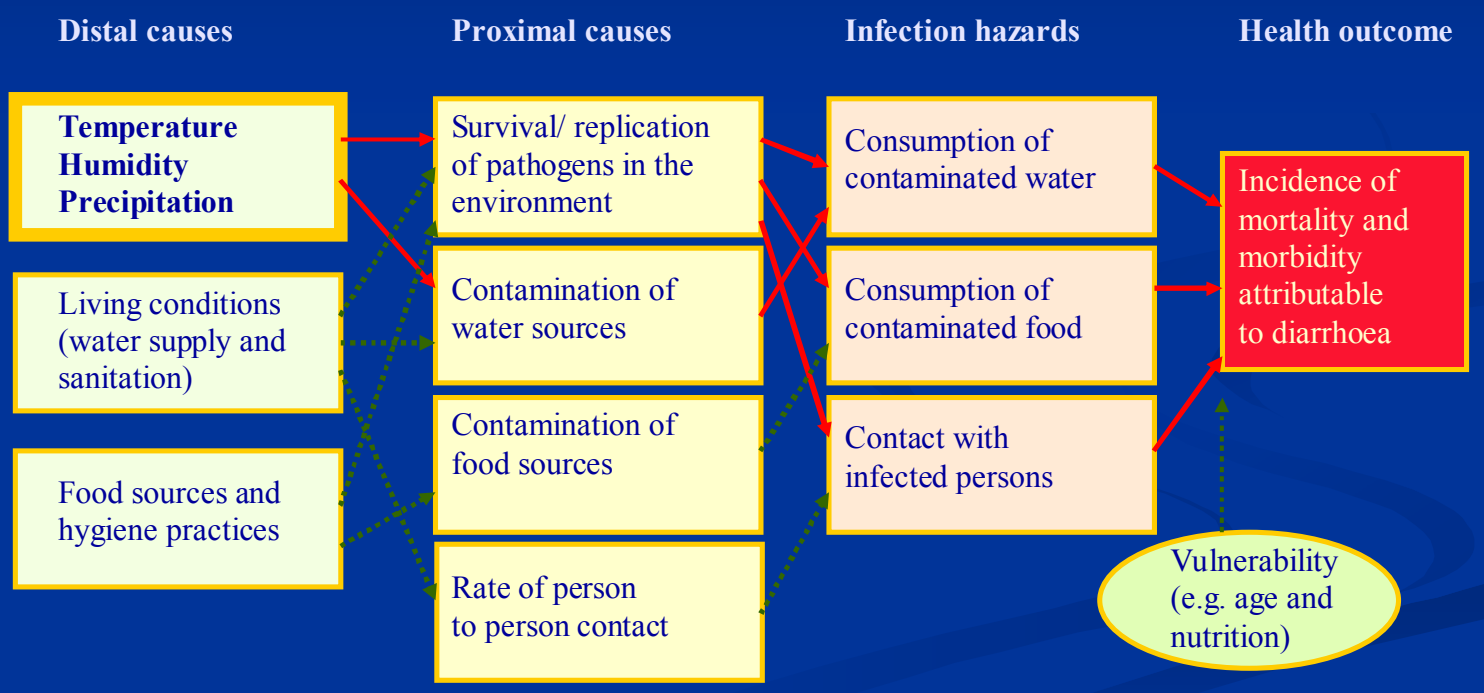
Climate projections from Hadley Centre (HADCM2) runs
Variation around projections from COSMIC model

Health impacts assessed

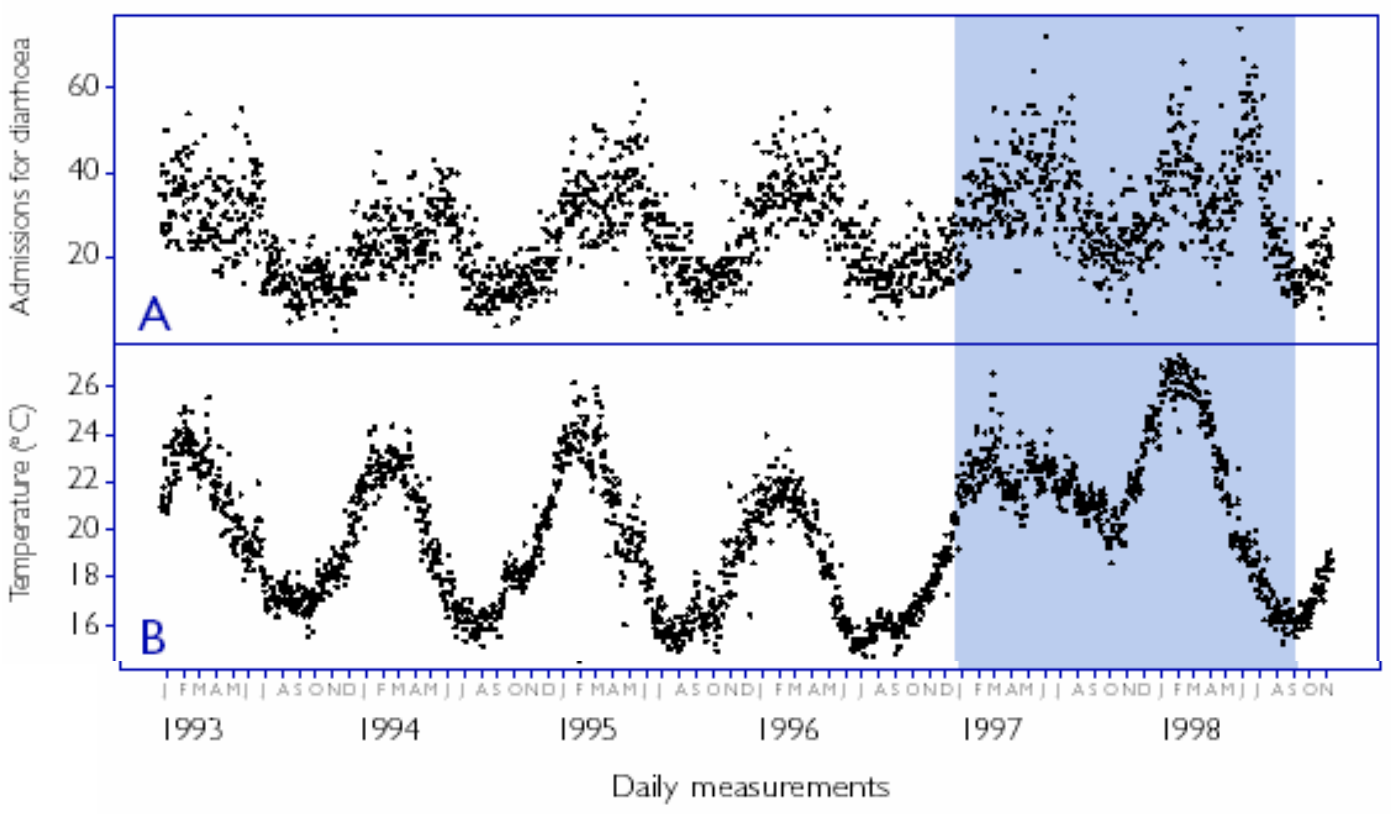
Health Impact	Underlying model
Direct physiological effects of heat and cold	New model based on time-series studies of temperature vs. CVD mortality in 4 climate zones
Diarrhoea	New model based on time-series of temperature vs. diarrhoea
Malnutrition	UEA Food availability model (e.g. *Parry et al, 1999*)
Malaria	Mapping Malaria Risk in Africa (MARA) Climate suitability model – (e.g. *Tanser et al, 2003*)
Disasters: Deaths in coastal floods	Middlesex Uni. coastal flood model, coupled with coastal flood deaths reported from EMDAT-CRED (e.g. *Nicholls et al, 1999*)
Disasters: inland floods and landslides	New model based on frequency of extreme precipitation, with inland flood deaths reported from EMDAT-CRED

How does climate impact on health?

Example: Diarrhoeal diseases



Does climate have a *measurable* impact on health?



Diarrhoea increases by 8% for each 1 degree centigrade increase in temperature.

(Reproduced with permission from Checkley et al., Lancet, 2000)

Does climate *change* have a *measurable* impact on health?

Climate sensitivity:
5% increase in diarrhoeal disease for each 1^{o} C temperature increase (developing countries only)

Change in relative risk:

Projected temperature changes relative to 1961-1990, overlaid on population distribution map to give *per capita* increase in diarrhoea risk.

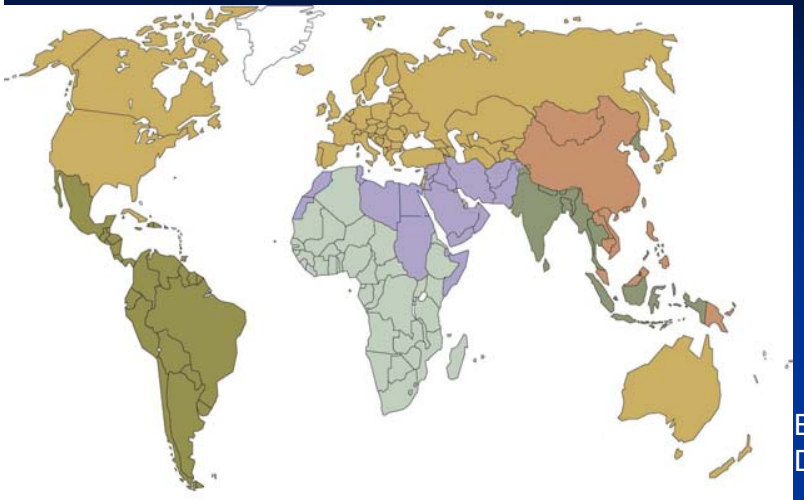
Disease burden attributable to climate change:
Relative risk under each scenario/time point multiplied by WHO estimates of current and future 'baseline' diarrhoea burden in each region.

Estimated 2.4% of diarrhoea (47,000 deaths) attributable to CC in 2000, and approximately 5% (60,000 deaths) in 2020. (World Health Report 2002)

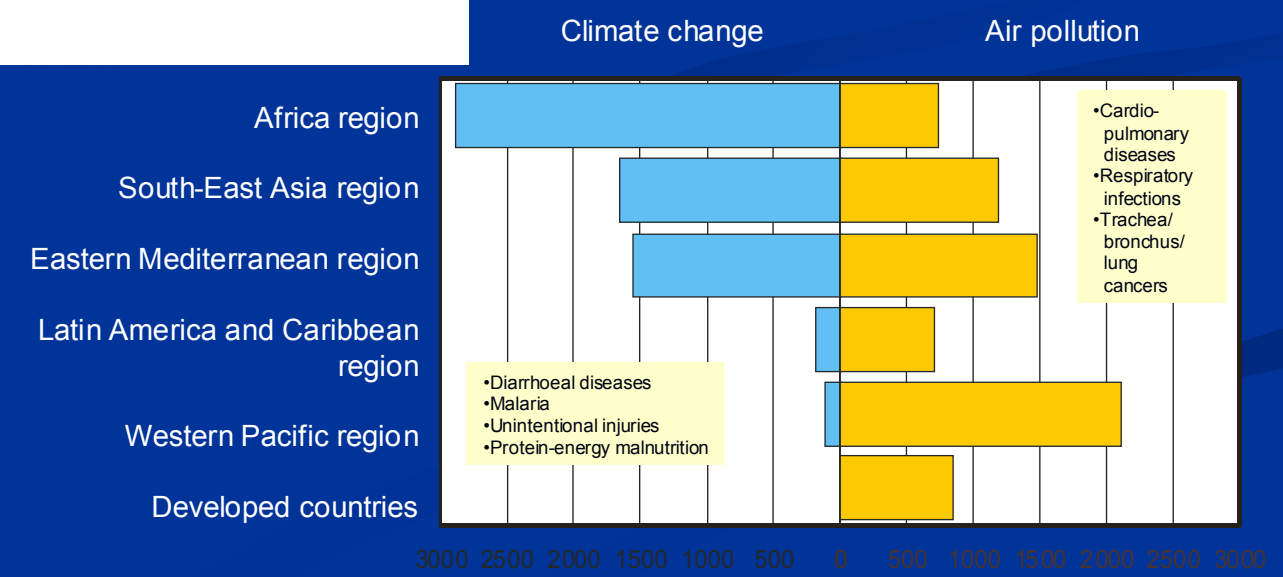
Assumptions on adaptation

Health Impact	Changes to Climate Sensitivity
Direct physiological effects of heat and cold	Temperature associated with lowest mortality changes with temperature increases
Diarrhoea	RR = 1 if GDP per capita rises above US$ 6000/year
Malnutrition	Future increases in crop yields from technological advances, trade liberalization, increased GDP
Malaria	None (for RR)
Disasters: Deaths in coastal floods	RR of deaths in floods decreases with GDP, following Yohe and Tol (2002)
Disasters: inland floods and landslides	RR of deaths in floods decreases with GDP, following Yohe and Tol (2002)

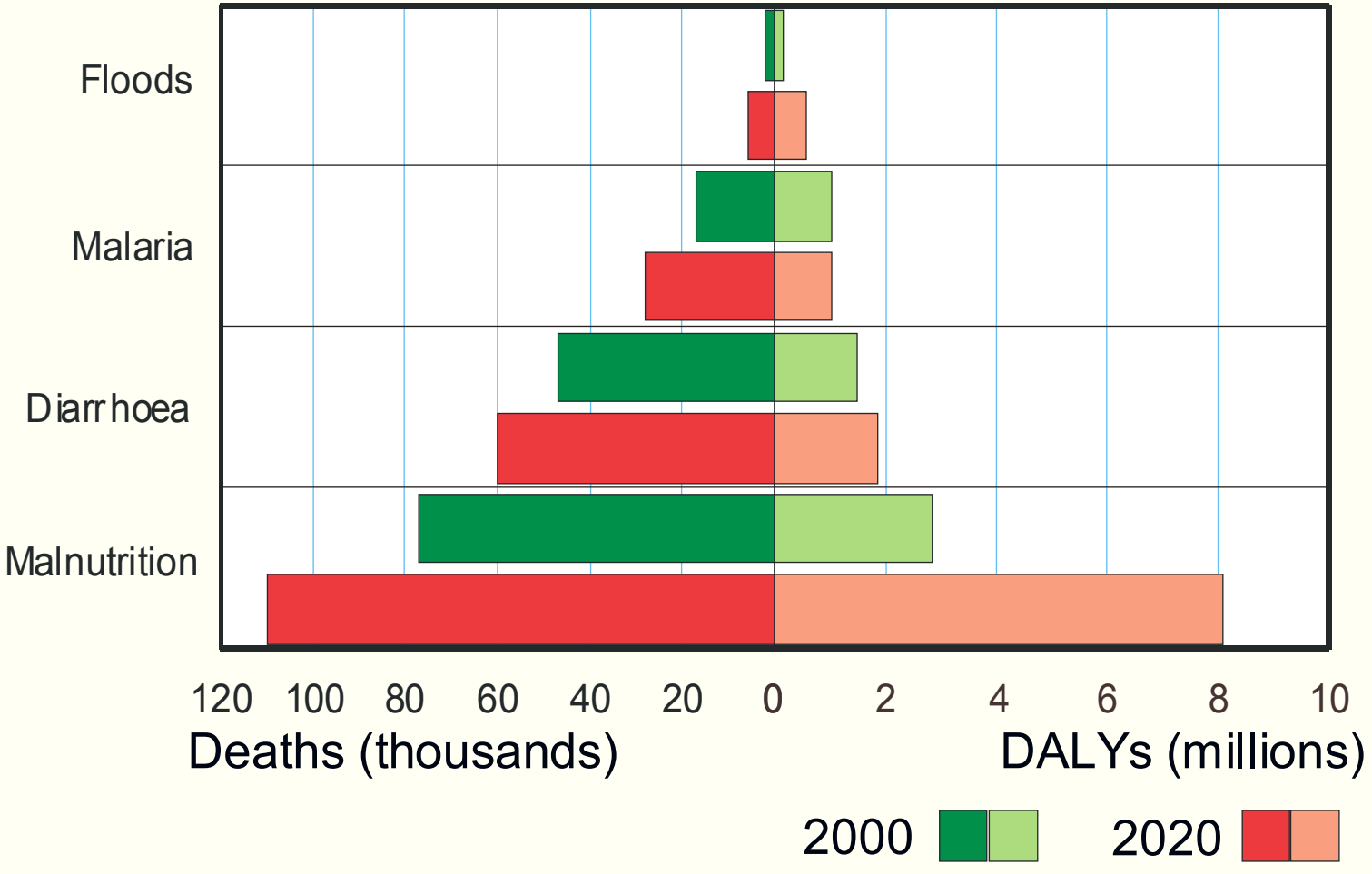
Quantifying health impacts of climate change



Burden of disease by region: Climate change and air pollution
Disability Adjusted Life Year / million. World Health Report 2002.



Estimated death and DALYs attributable to climate change. Selected conditions in developing countries



Limitations of these analyses

- Non-climatic determinants are crudely represented
- Unavoidable uncertainty in complex relationships
- Models cover changes in mean, not extremes
- Many important climate-health relationships are not represented at all

Missing links

- Climate effects on other infectious diseases – dengue, sleeping sickness, filariasis, cholera…….
- Effects of changing water availability
- Long-term effects of sea-level rise and population displacement
- Species extinction and ecosystem disruption

Summary

- Much of the global burden of disease is closely linked to climate variability, especially in the poorest countries

- Failure to stabilize climate may already be causing the loss of 5.5 million years of healthy life (or 150,000 lives) per year, with an expected doubling by 2020

- Current quantitative models fail to capture the full extent of the health threats from climate change

- Climate change makes it even more important to tackle basic health problems in developing countries

- Global, long-term nature of climate change, and diversity of health links, argue for a precautionary approach to stabilization

Applying the precautionary principle

"All scientific work is incomplete - whether it be observational or experimental. All scientific work is liable to be upset or modified by advancing knowledge. This does not confer upon us a freedom to ignore the knowledge that we already have, or to postpone the action that appears to demand at a given time"

Hill, A.B. The environment and disease: association or causation?

Proceedings of the Royal Society of Medicine 58: 295-300 (1965).

"Decisions taken today will affect the climate for many decades, and many of the consequences will be permanent. While many uncertainties remain, we know enough to have serious concerns over the threats posed by a rapidly changing climate. In these circumstances, it is important to prevent as well as to cure. We should aim to minimize our impact on the global climate, and avoid imposing health risks on future generations".

J.W. Lee, Director General, World Health Organization, December 2004.

Acknowledgements:

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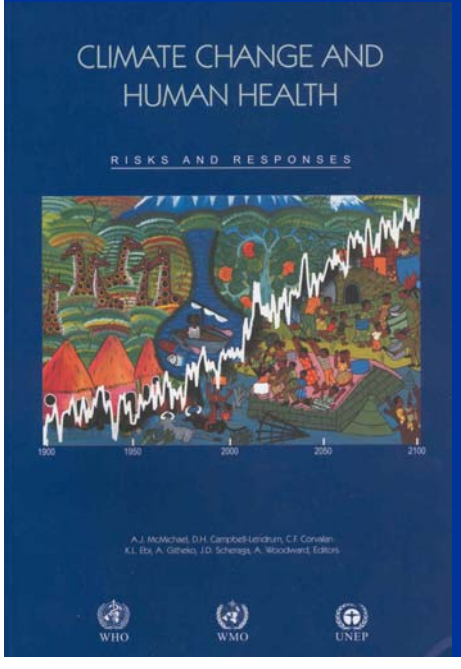
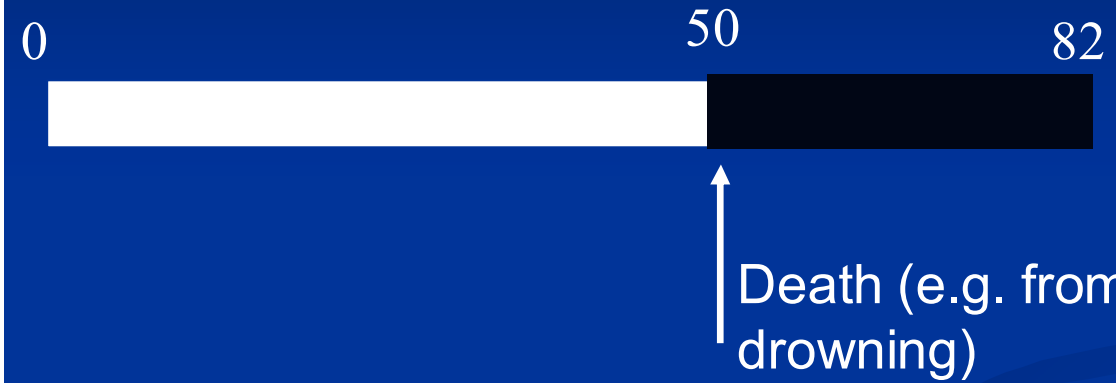


More Details:

Climate change and human health: Risks and Responses. Summary at http://www.who.int/globalchange/publications/cchhsummary/en/

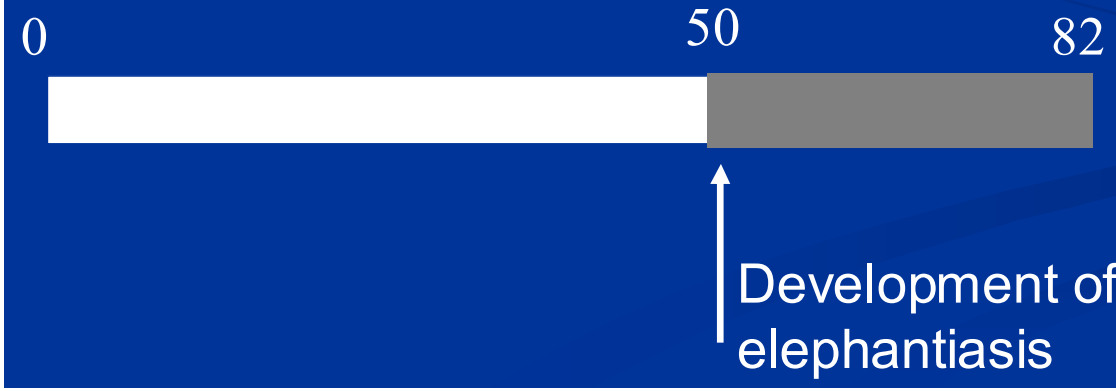
Climate Change: McMichael et al, in *Comparative Quantification of Health Risks*, Ed. M. Ezzati et al., WHO, Geneva, 2004

Adding Different Health Impacts Using 'Disability Adjusted Life Years (DALYS)'



Impact

= 32 DALYs lost



Impact = 32 x 0.2

= 6.4 DALYs lost