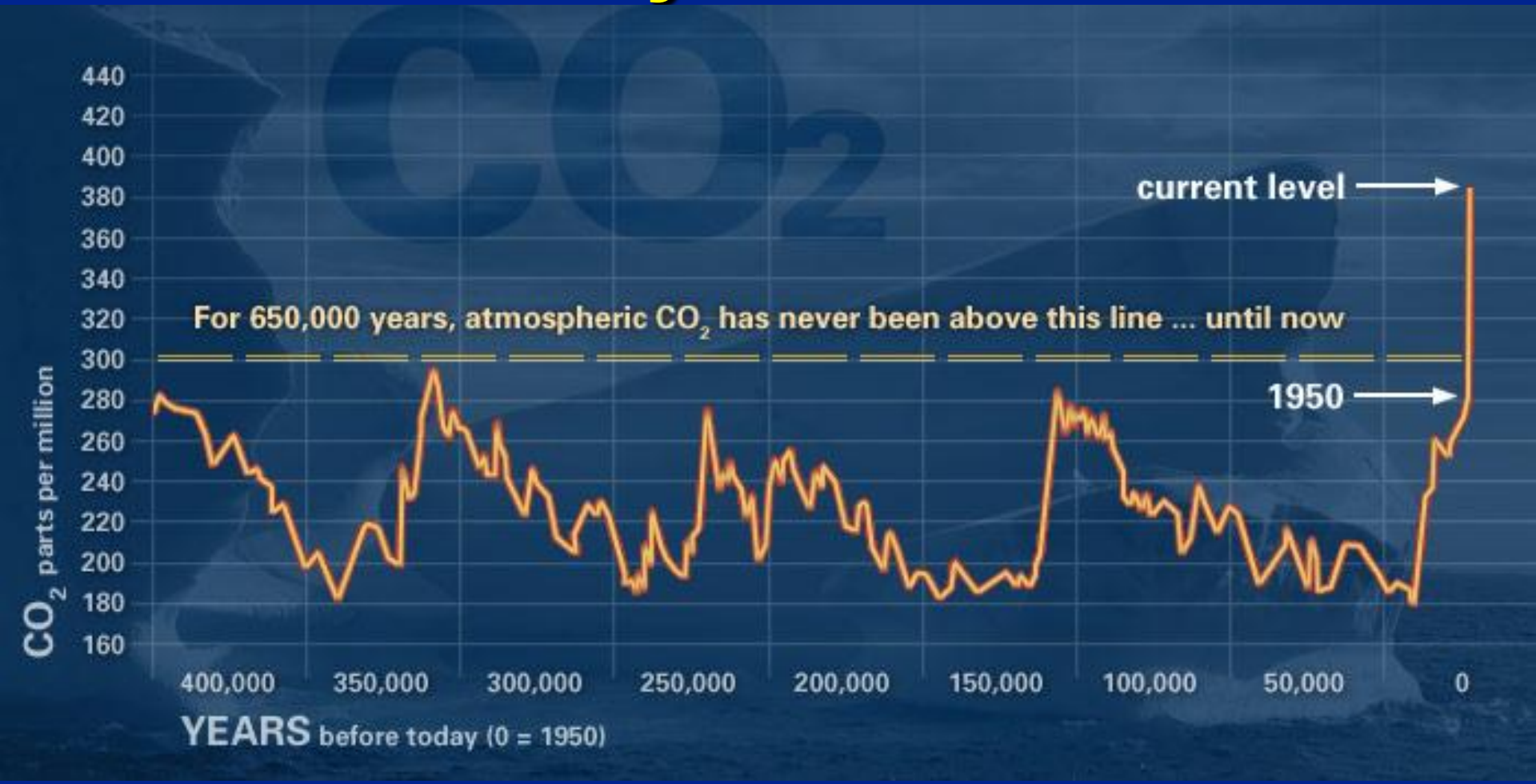
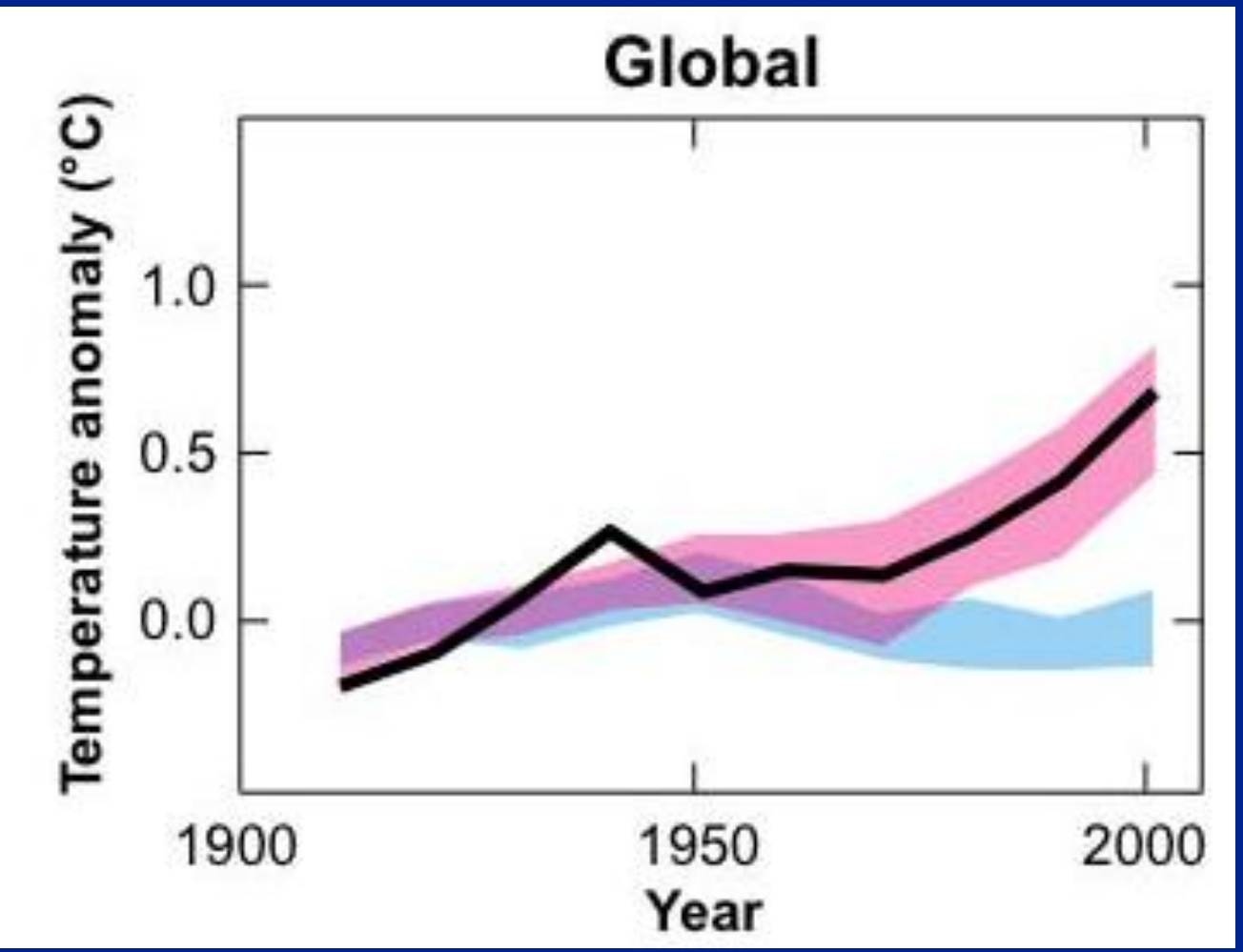
Climate Change and Health- Reducing Risks in an Uncertain Future

Professor Sir Andy Haines

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

CO 2 over the last 650,000 years





Human activities are *very likely* the cause of the warming of last 100 years.

Black line: temperature observation from thermometers.
Pink shade: Climate model simulations using all past radiative forcings.
Blue shade: Climate model simulation using only natural forcings (solar, volcanoes).

IPCC WGI SPM

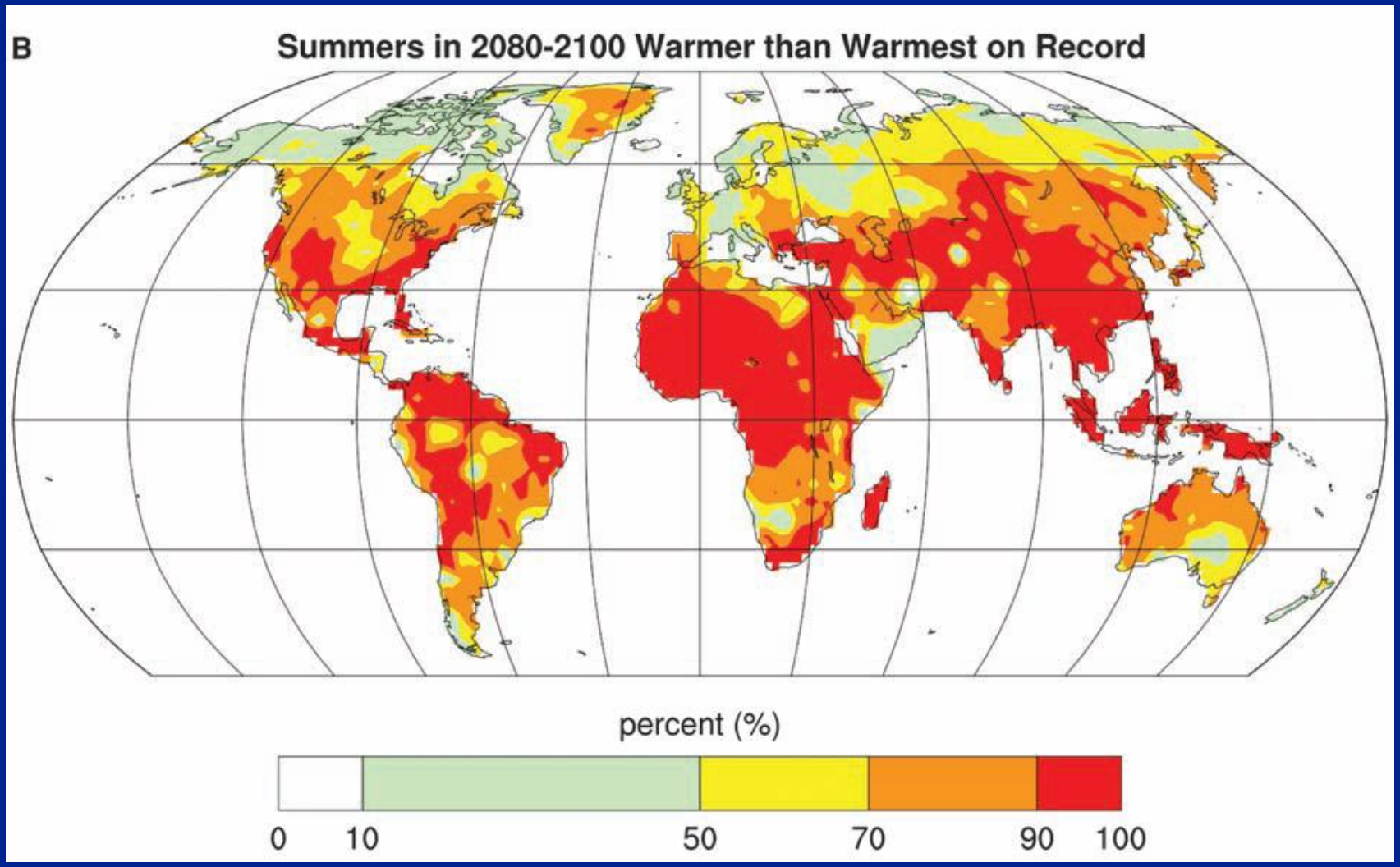
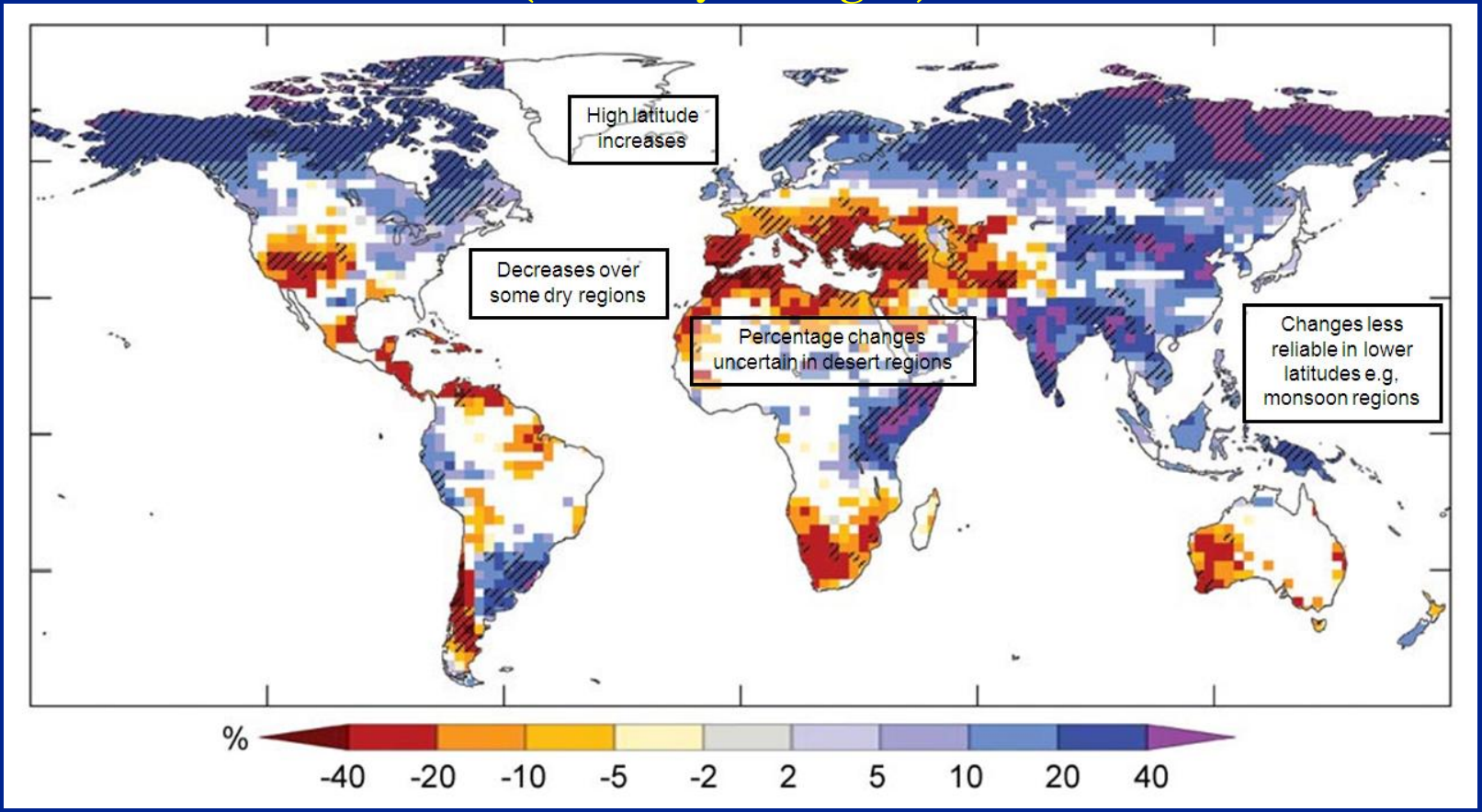


Fig. 3. Likelihood (in percent) that future summer average temperatures will exceed the highest summer temperature observed on record (A) for 2050 and (B) for 2090. For example, for places shown in red there is greater than a 90% chance that the summer-averaged temperature will exceed the highest temperature on record (1900–2006). Science 2009

21st Century Water Availability (Runoff) Changes

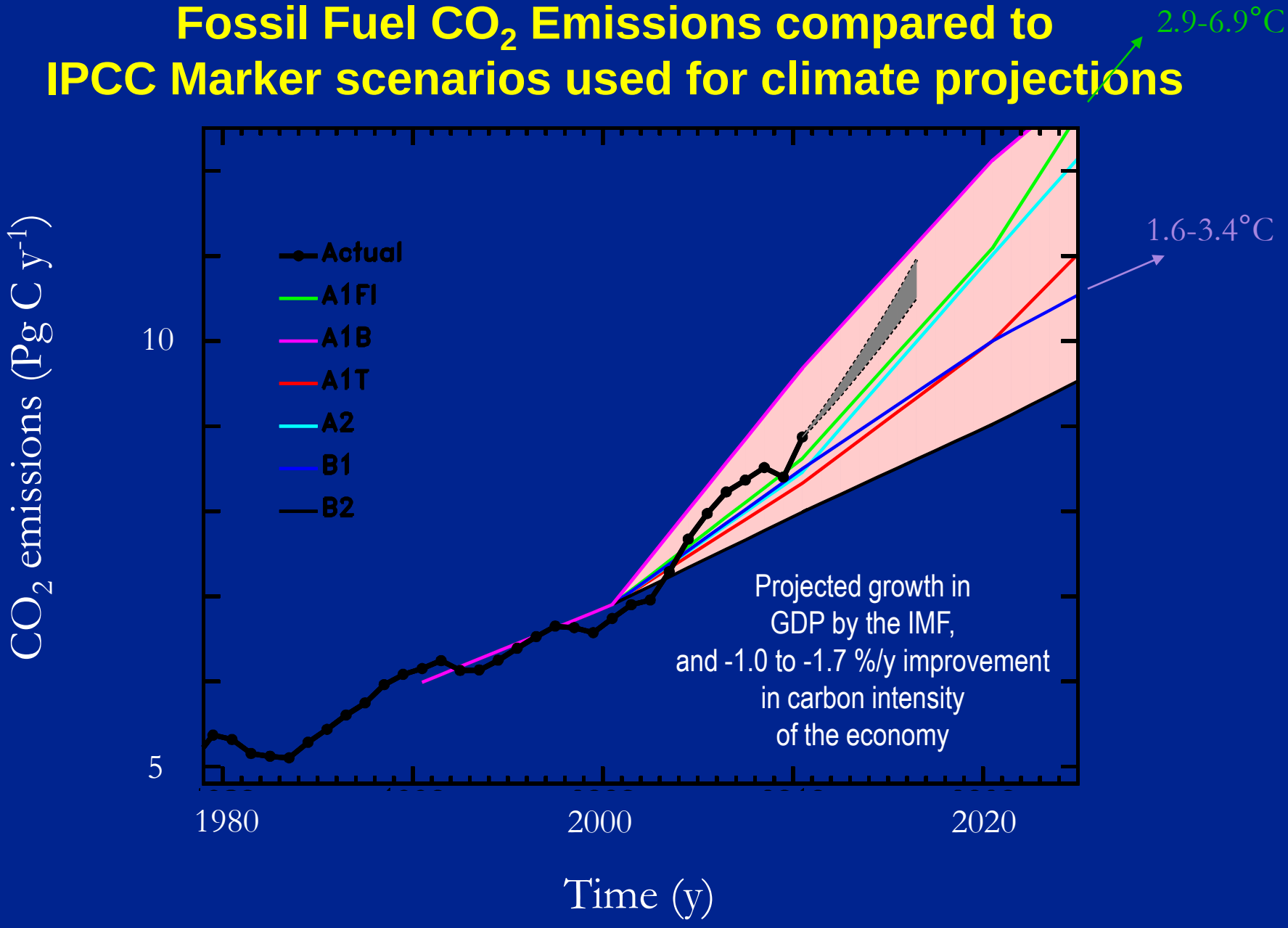
(Annually averaged)



- *Very likely* runoff will increase in high latitudes.
- *Likely* runoff will decrease over some subtropical and tropical regions.

IPCC AR4 Synthesis

Fossil Fuel CO_2 Emissions compared to IPCC Marker scenarios used for climate projections



Updated from Le Quéré et al (2009) Nature Geoscience, using Marker scenarios modified from Raupach et al. PNAS (2007)

Climate Change occurring faster than expected?

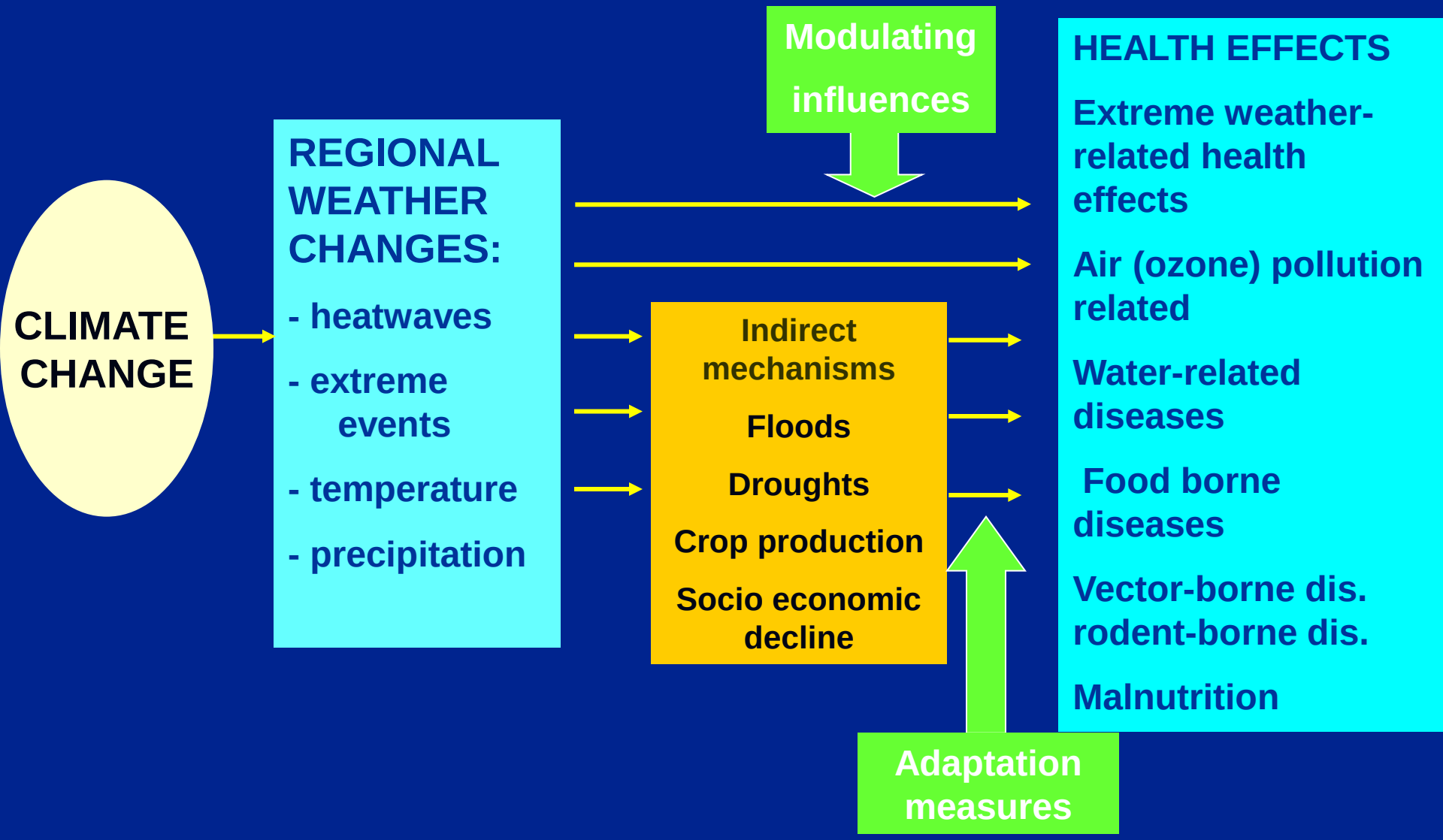
- IPCC's *4th Assessment Report* **now looks conservative**

- Subsequent research shows increasing rates of:
  - Global Greenhouse Gas emissions
  - Ice melting (Arctic sea ice, Greenland/Antarctic ice-sheets, alpine glaciers)
  - Sea level rise
  - Increasing saturation of carbon 'sinks'
  - Carbon stored in permafrost = x2 atmospheric carbon

Anthropogenic warming could lead to some impacts that are abrupt or irreversible

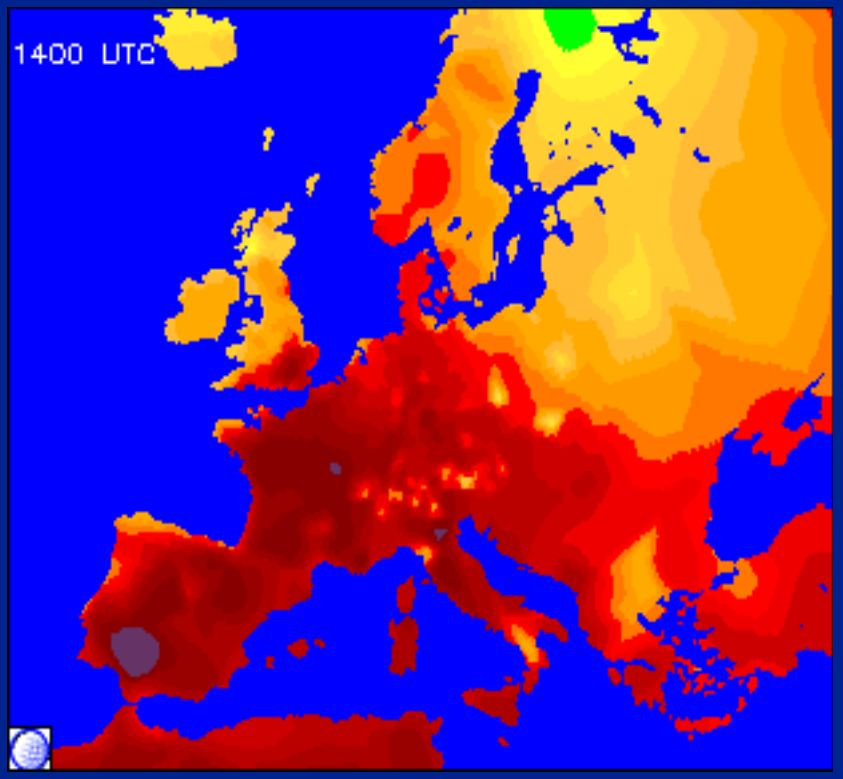
- There is *medium confidence* that approximately 20-30% of species assessed so far are *likely* to be at increased risk of extinction if increases in global average warming exceed 1.5-2.5^{o}C (relative to 1980-1999).
- As global average temperature increase exceeds about 3.5^{o}C, model projections suggest significant extinctions (40-70% of species assessed) around the globe.

Pathways by which climate change may affect health outcomes (Haines and Patz 2003)



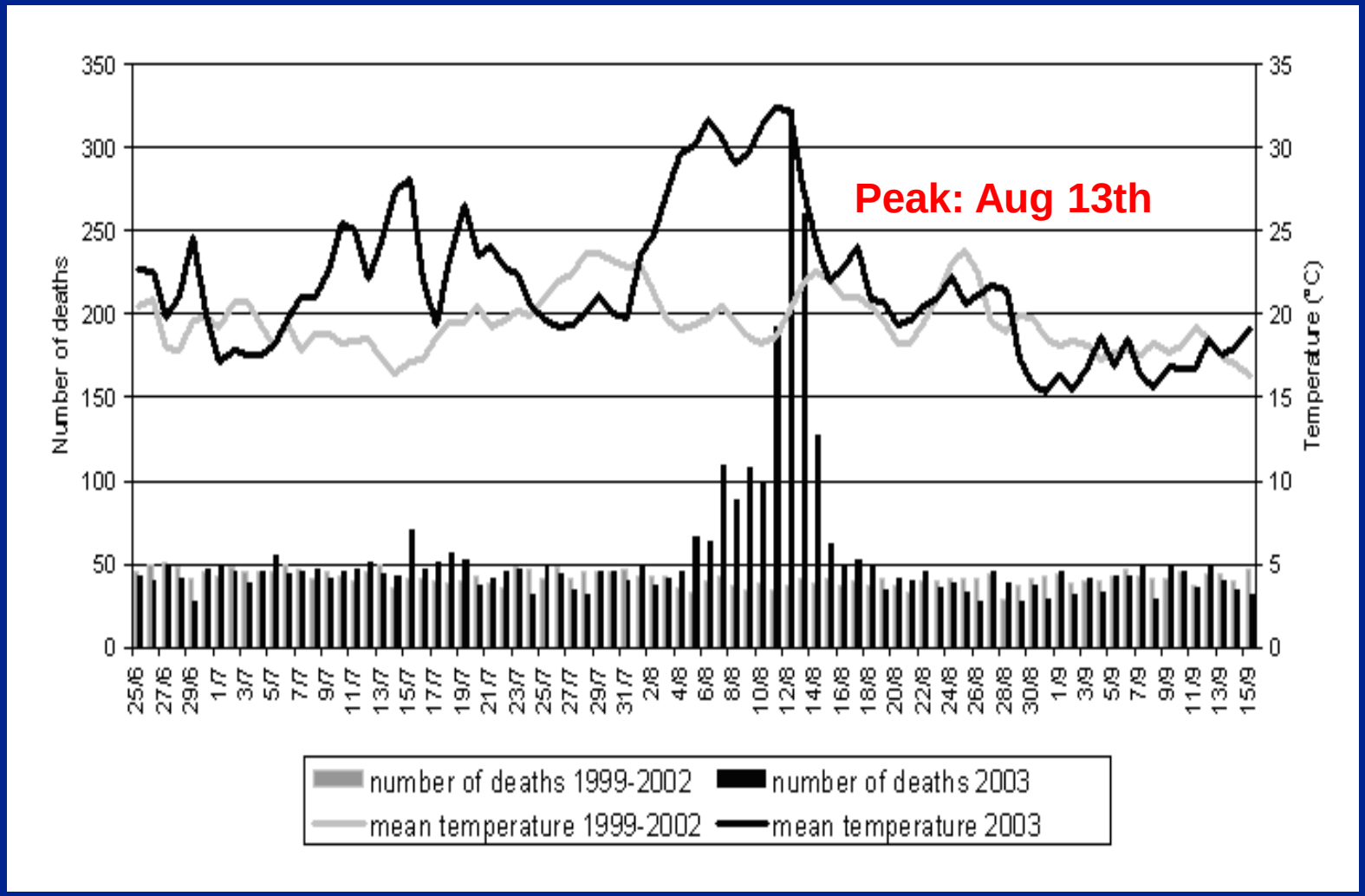
France, August 2003

~14800 deaths (30,000+ in Europe)



Temperature distribution across Europe on 10 August 2003 at 1500hrs

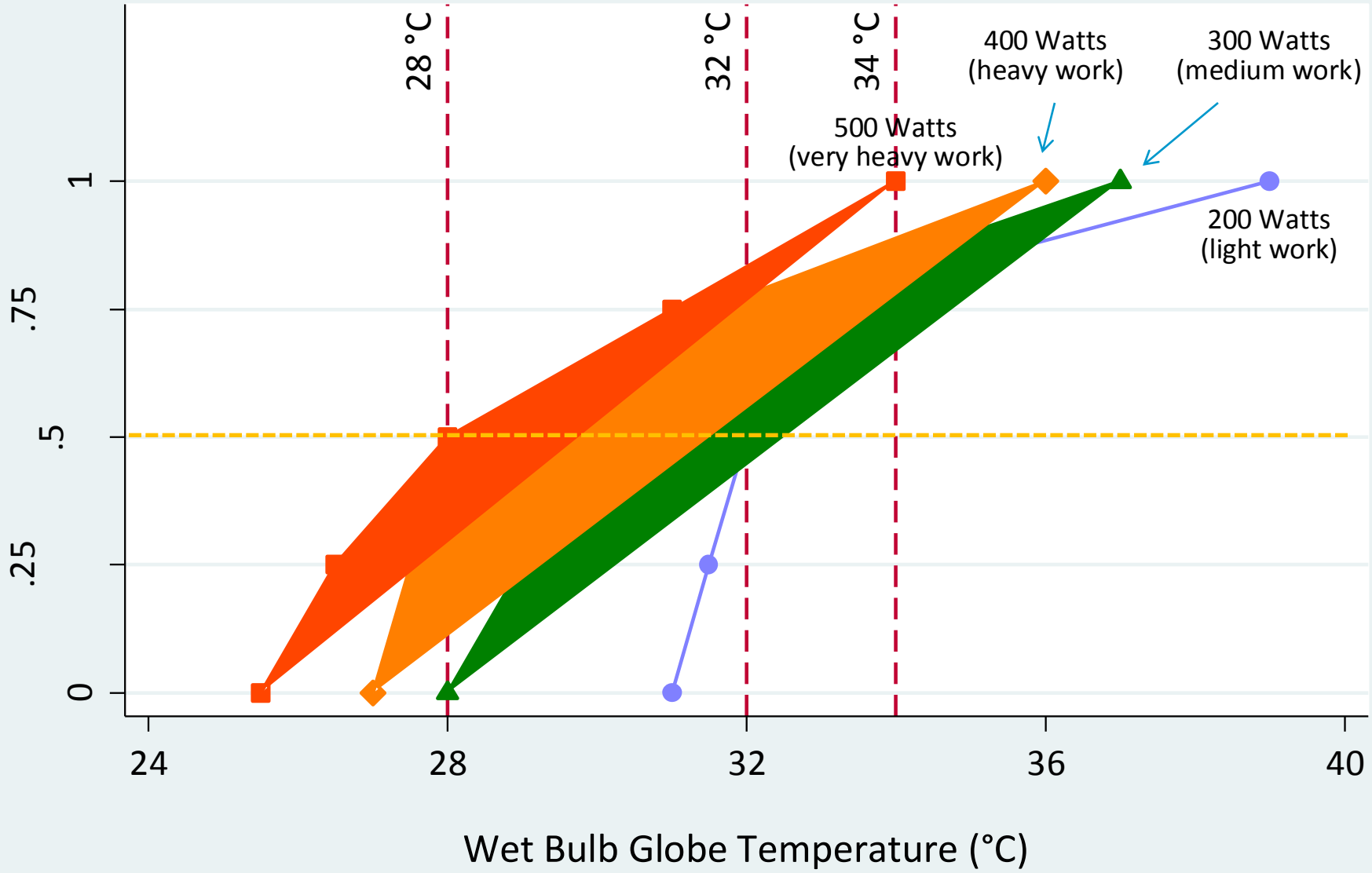
Mortality in Paris during heat wave 1999-2002 compared to deaths in 2003



Source: Institut de Veille Sanitaire , 2003

Possible work intensity as a function of temperature

Source: Kjellstrom T et al, Global Health Action 2009. DOI: 10.3402/gha.v2i0.2047



Diarrheal disease and rainfall

- Global overview of 36 published reports from LMICs from 1954-2000 (Lloyd, Kovats, Armstrong. Climate Res 2007)
- 4% (1-7%) increase in diarrhoea incidence in children aged <5 per 10 mm /month decrease in rainfall
- Reduced effect of hand washing where rainfall is low?

The Global Water Crisis

- Water scarcity is growing - by 2025 more than half of the world's population is projected to live under conditions of severe water stress
- Water quality is declining in many parts of the world
- 70% of all freshwater is used for irrigation
- 50-60% of wetlands have been lost
- Water has the lowest rate of cost recovery among all infrastructure sectors (about 20%)

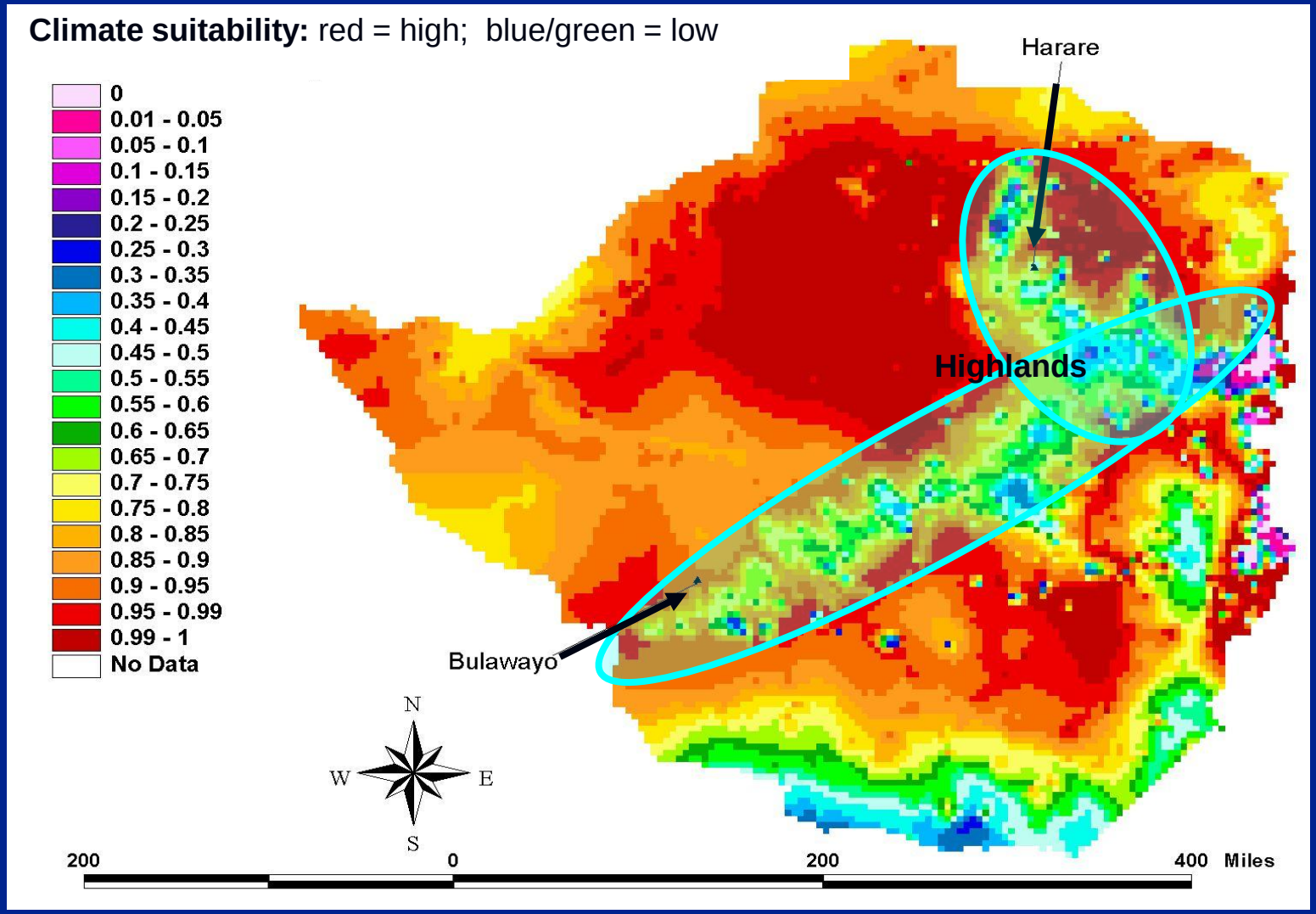
Modelled impact of climate change on global cereal grain production: % change, 1990-2080

(Tubiello and Fischer 2006)

	% Change (range)		
World	**-0.6**	**to**	**-0.9**
Developed countries	+2.7	to	+9.0
Developing countries	-3.3	to	-7.2
Southeast Asia	-2.5	to	-7.8
South Asia	-18.2	to	-22.1
Sub-Saharan Africa	-3.9	to	-7.5
Latin America	+5.2	to	+12.5

Climate Change and Malaria
Potential transmission in Zimbabwe

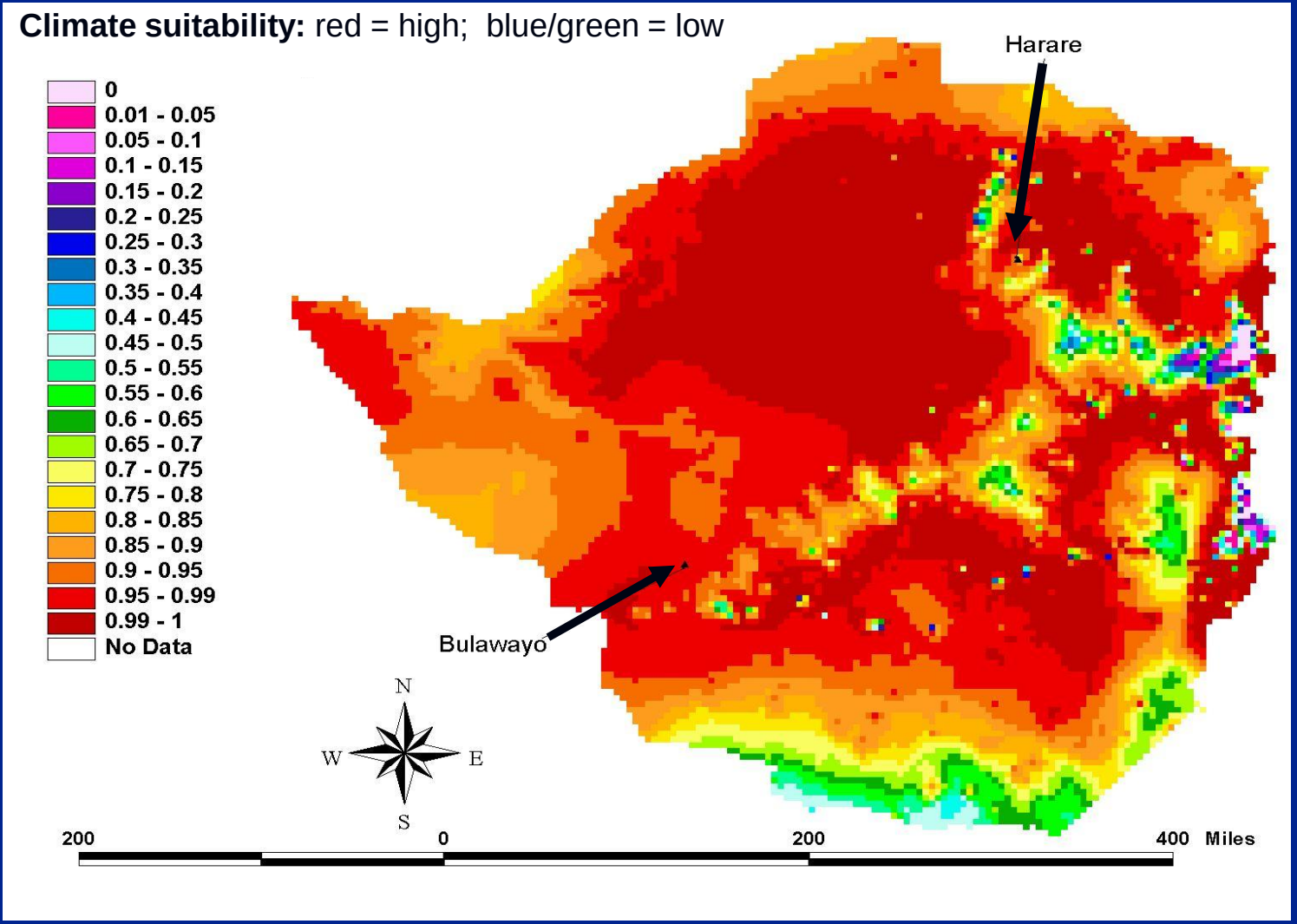
Baseline 2000



Source: Ebi et al., 2005

Climate Change and Malaria - Potential transmission in Zimbabwe

2025



Source: Ebi et al., 2005

Vector-borne issues in 21st century Europe

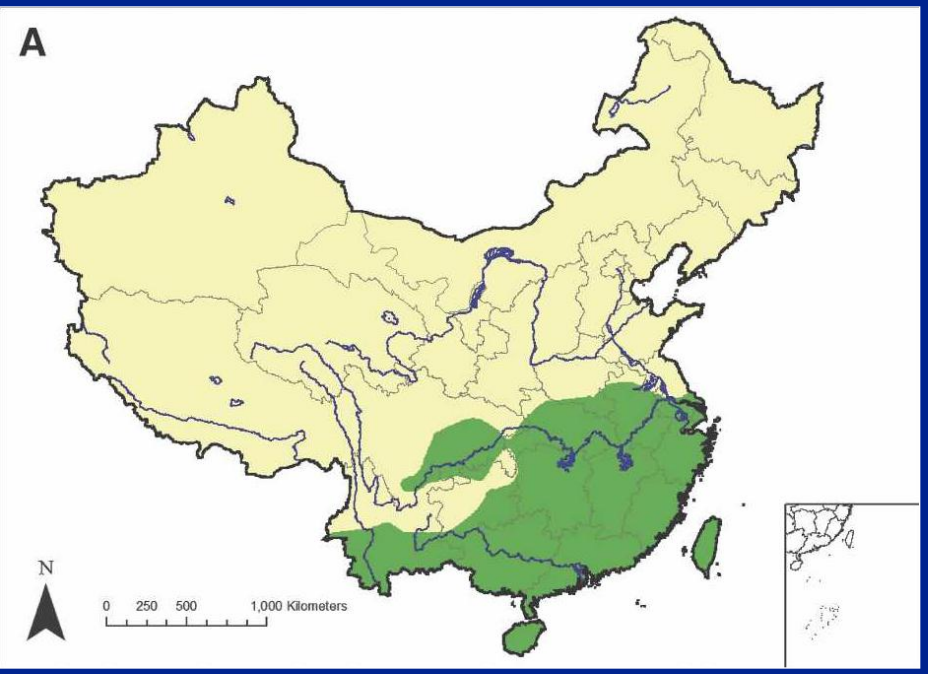
(from Medlock HPA)

First decade

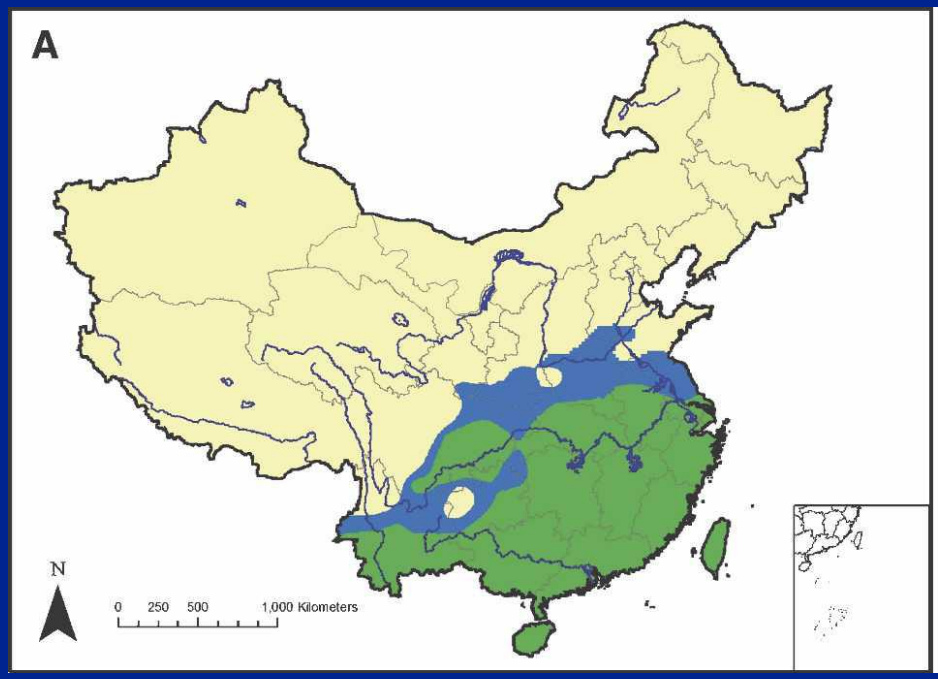
Second decade?

Aedes aegypti (DENV vector)

Schistosomiasis transmission, China



Risk map of schistosomiasis transmission in China in 2000 (green colour = potential risk areas for schistosomiasis transmission)



Predicted risk map of schistosomiasis transmission in China in 2030 (blue colour = predicted additional risk areas)

Xiao-Nong Zhou,Guo-Jing Yang, Kun Yang, Xian-Hong Wang, Qing-Biao Hong, Le-Ping Sun, John B. Malone, Thomas K. Kristensen, N. Robert Bergquist, and Jürg Utzinger. Am. J. Trop. Med. Hyg 2008; 78(2): 188–194.

Health impacts of floods

- Immediate deaths and injuries
- Infectious diseases - leptospirosis, cholera and diarrhoeal diseases, hepatitis, respiratory diseases, vector-borne diseases e.g. Rift Valley fever, malaria.
- (NB floods may also wash away vector breeding sites e.g. highland Tanzania 1997)
- Secondary to economic losses
- Long term mental health effects
  - depression, suicide

Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s

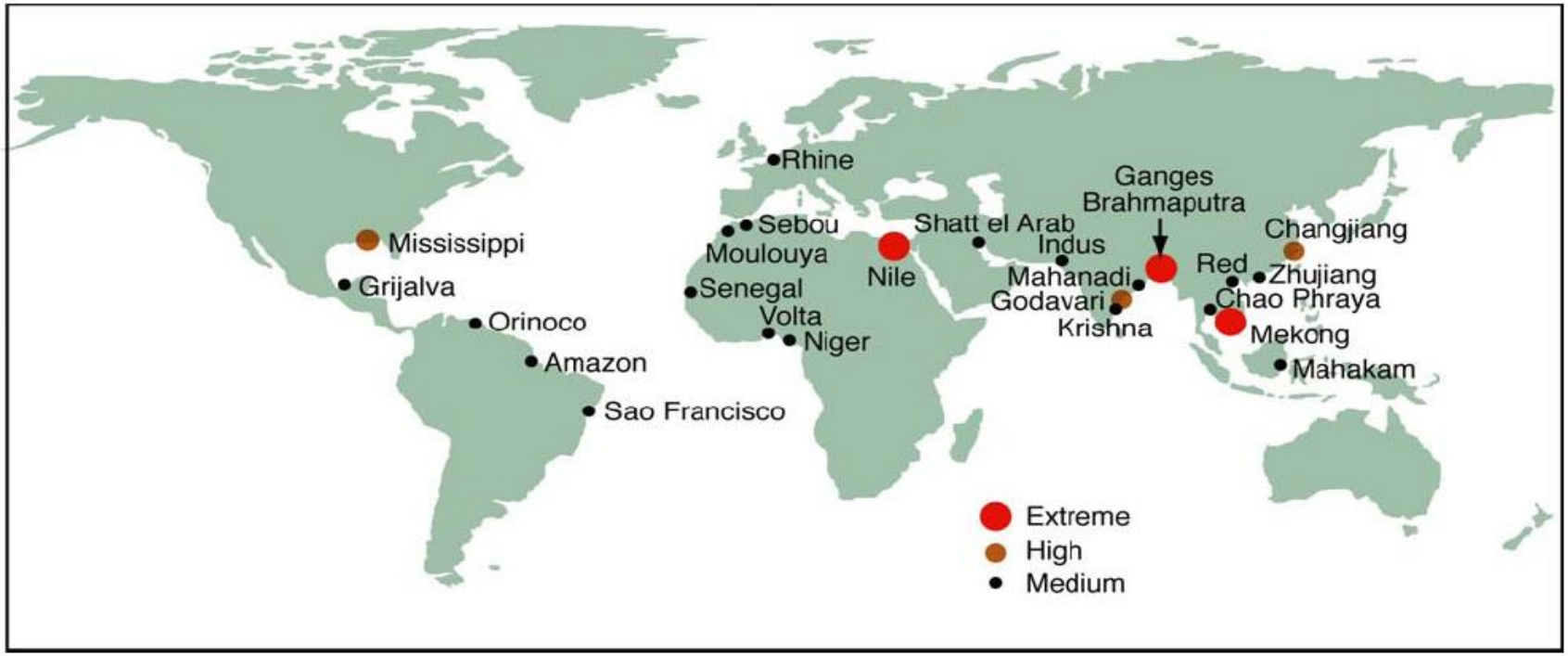


Figure TS-8: Relative vulnerability of coastal deltas as indicated by the indicative population potentially displaced by current sea level trends to 2050 (Extreme ≥ 1 million; high =1 million – 50,000; medium 50,000 – 5000 [B6.3]. Climate change would exacerbate these impacts.

Source: IPCC Wg II, TSI 2007.

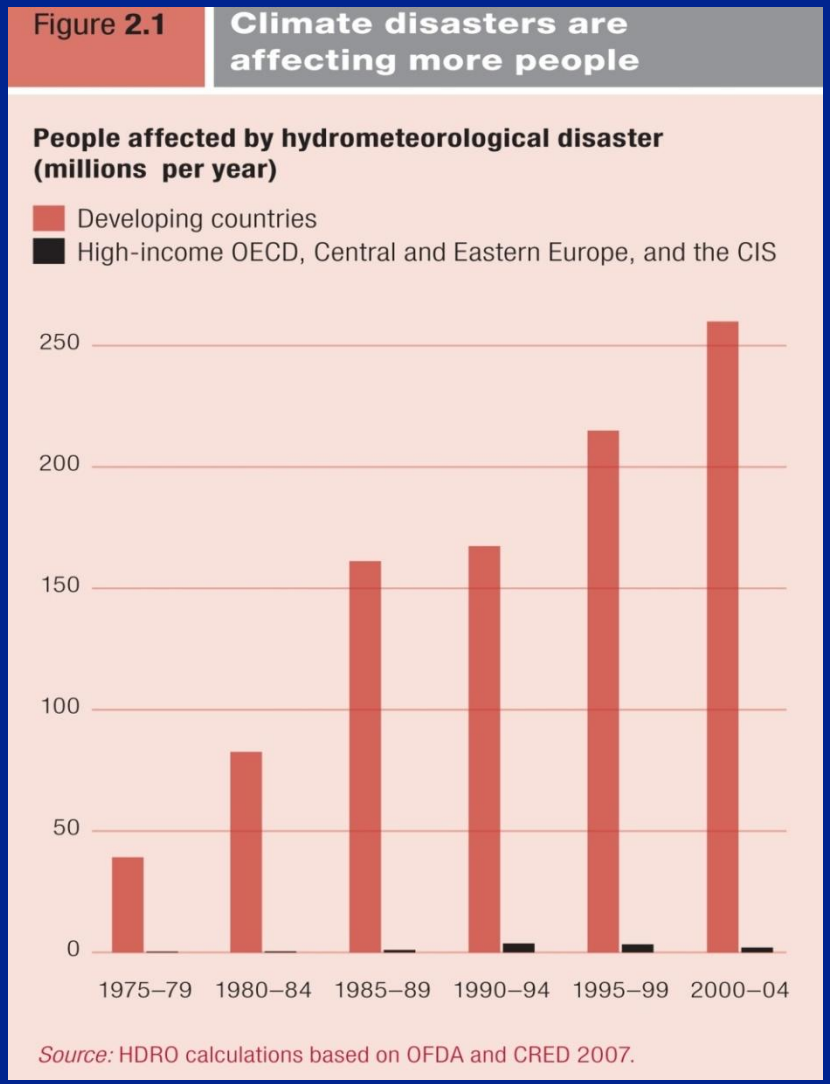
Health Impacts of Hurricane Mitch 1999

- 9550 deaths; 138,000 homes destroyed or damaged; and affected ~3.2 M people
- increased vector-borne diseases, especially malaria and dengue
- increases in gastrointestinal and respiratory diseases
- damage to infrastructure and services
- Honduras lost over 70% of banana, coffee and pineapple crops

Source: PAHO. *Disasters: preparedness and mitigation in the Americas* (Supplement 1): S1-S4 (1999).

Growing burden of climate disasters (UNDP 2007)

- Greatest impacts in developing countries
- Weather related insurance losses going up faster than population, inflation and coverage
- Climate change may be contributing
- Increases in floods, droughts, lightning strikes, intensity of tropical cyclones



2010 – a harbinger of things to come?

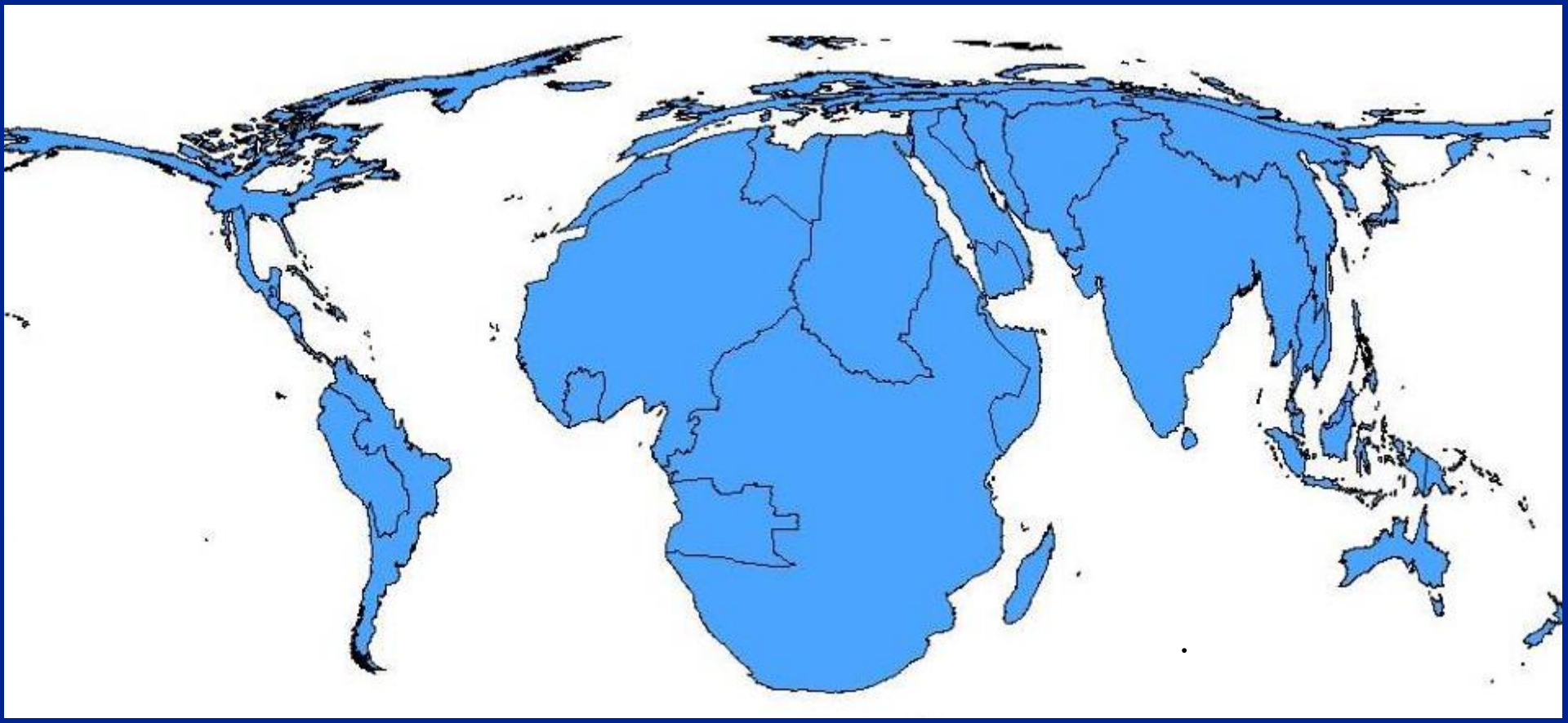
Pakistan floods ~ 20 m affected

Chinese floods ~ 12m displaced

Russian drought and fires –wheat harvest down ~ 30%

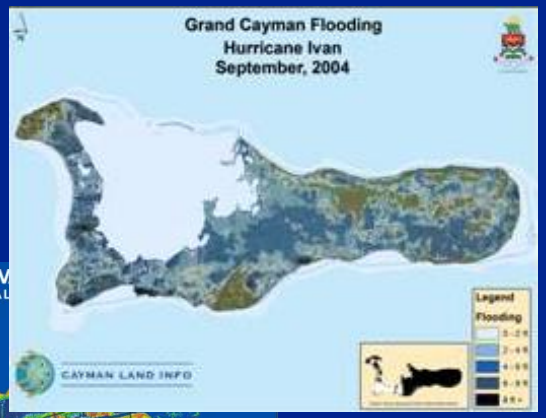
Record temperatures in 17 countries.

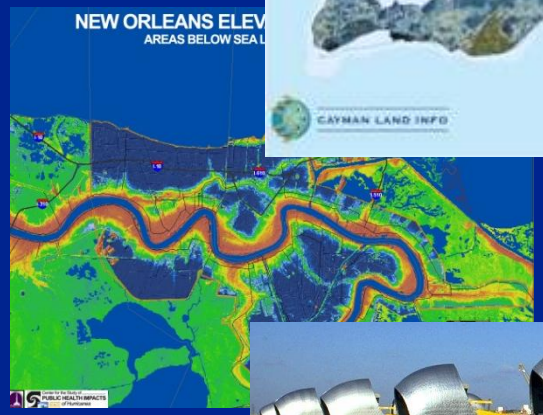
Cartogram of Climate-related Mortality (per million pop) yr. 2000

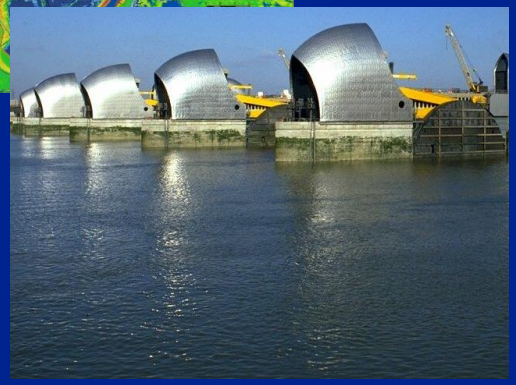


Source: from the WHO Comparative Risk Assessment, 2004

Are there limits to how much we can adapt?…physical, behavioural and technological limits





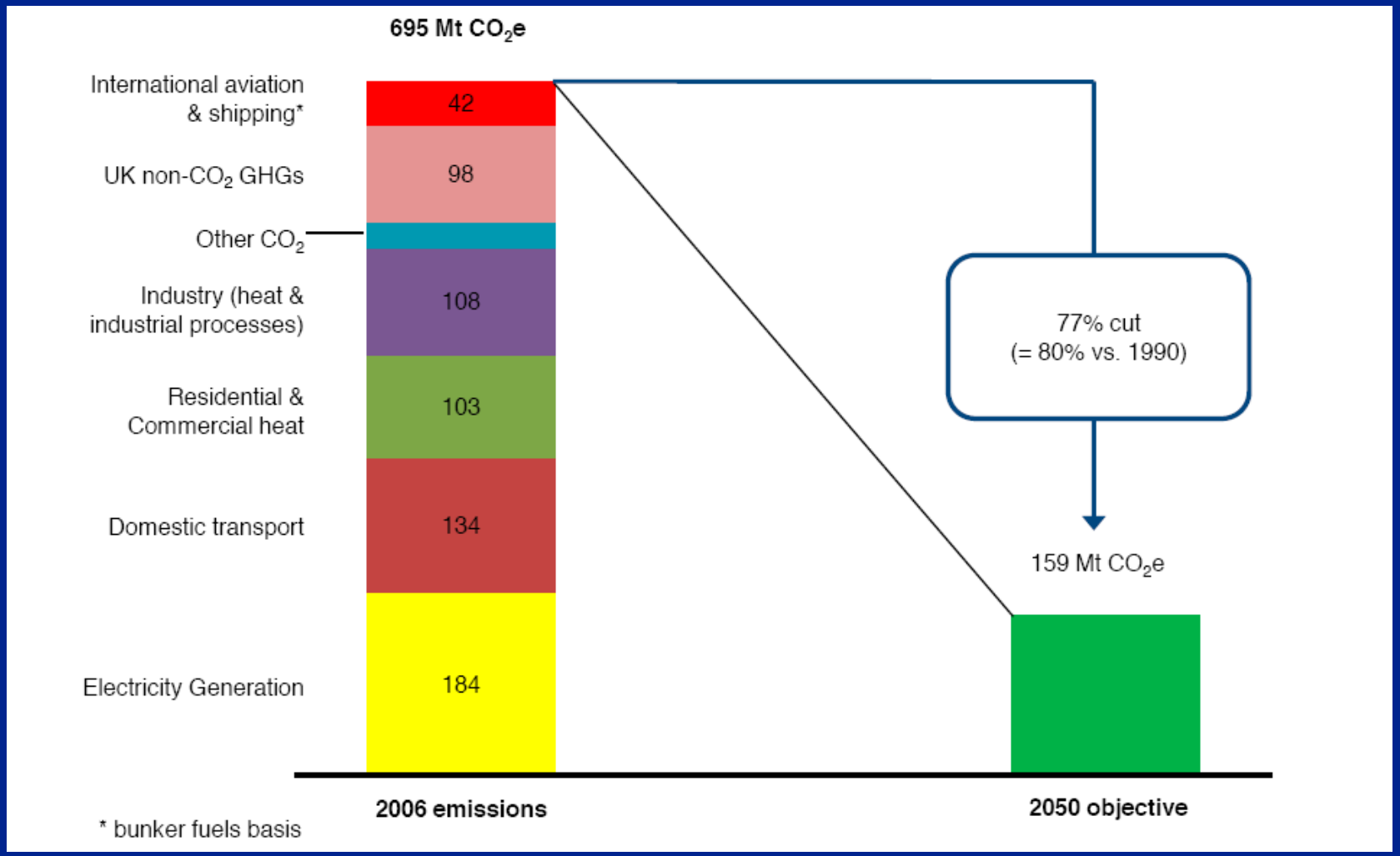


- Physical limits: small low lying islands e.g. Cayman Islands
- Behavioural limits: influence where we live and why, e.g. New Orleans
- Technological limits: e.g. to the flood defences such as Thames Barrier, London

Stabilisation scenarios

Global mean temp. increase (°C)	Stabilization level (ppm CO_2-eq)	Year CO_2 needs to peak
2.0 – 2.4	445 – 490	2000 – 2015
2.4 – 2.8	490 – 535	2000 – 2020
2.8 – 3.2	535 – 590	2010 – 2030
3.2 – 4.0	590 – 710	2020 – 2060

The scale of the emissions challenge for a high income country (UK)



Source: UK National Atmospheric Emissions Inventory (2008).

Key mitigation instruments, policies & practices

Research, development and demonstration

Appropriate energy infrastructure investments

Regulations and standards

Taxes and charges

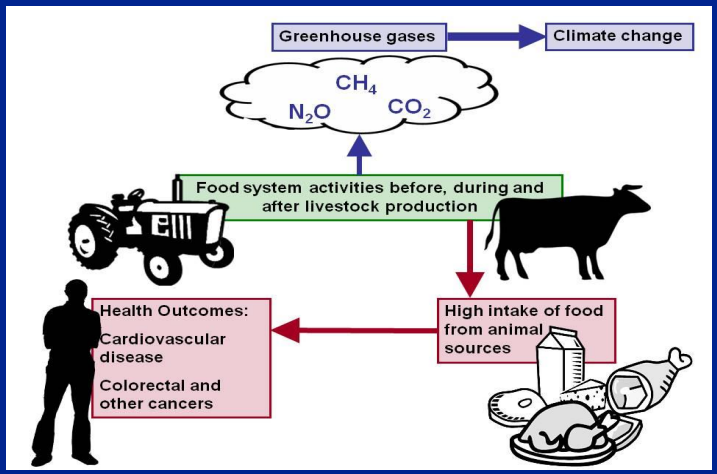
Change in lifestyles & consumption patterns

Effective carbon-price signal

Many low carbon policies good for health

(Series of papers in Lancet 2009)

Case studies in four sectors responsible for large emissions of greenhouse gases (GHGs) showed major health benefits



Indian Stoves – Traditional and Modern

Traditional Biomass Stove

Per meal

~15x less black carbon and other particles

~10x less ozone precursors

~5x less carbon monoxide

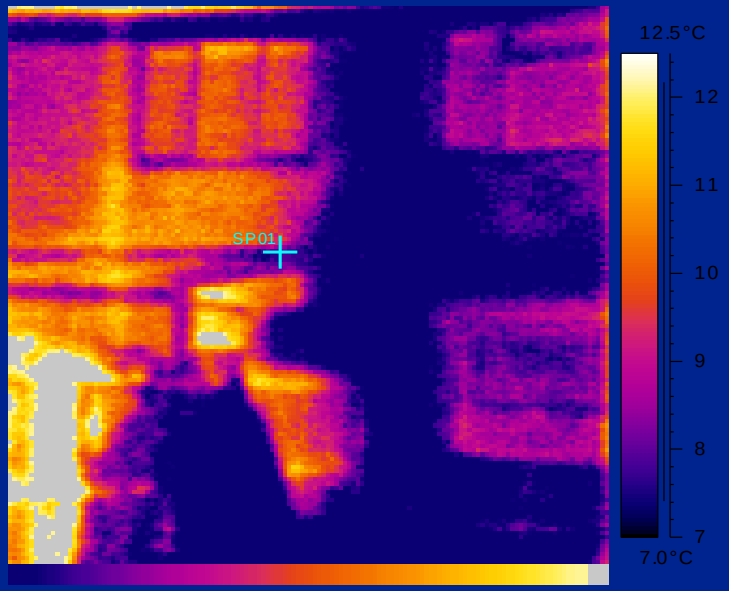
Gasifier Stove with Electric Blower (battery recharged with cell phone charger)

Health benefits of an Indian stove programme- 150 m improved stoves over 10 years

	Deaths from ALRI	Deaths from COPD	Deaths from IHD
Avoided in 2020 (%)	30.2%	28.2%	5.8%
Total avoided 2010-20	240,000	1.27 million	560,000

ALRI=acute lower respiratory infections. COPD=chronic obstructive pulmonary disease. IHD=ischaemic heart disease.

Health and GHG Benefits in UK households



Setting	Intervention	Time course	Principal exposures	Main outcomes
UK	Changes to: insulation, ventilation control, fuel source, temperature setting	2010, with and without intervention	Particles Radon Tobacco smoke Mould Temperature (cold)	Cardio-respiratory disease Lung cancer Cold-related death

UK household energy efficiency (combined insulation and ventilation control improvements)

Impact in UK 2010 population	
Premature deaths averted	~ 5400/ year
Mt-CO_2 saved (vs 1990)	55

Urban Transport

70% of London car trips are <8 km.
Only 2% trips by bicycle

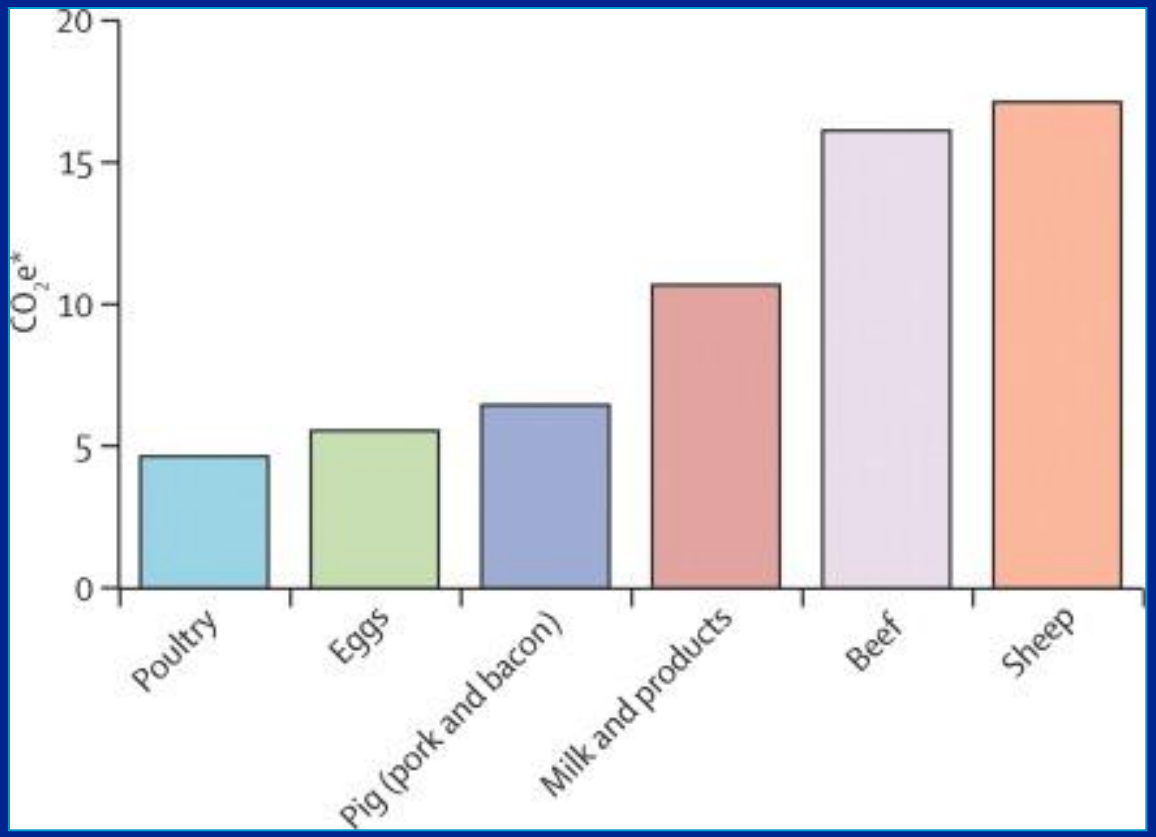
Estimated Health Effects of increased active transport in London

	Change in disease burden	Change in premature deaths
Ischaemic heart disease	10-19%	1950-4240
Cerebrovascular disease	10-18%	1190-2580
Dementia	7-8%	200-240
Breast cancer	12-13%	200-210
Road traffic crashes	19-39%	50-80

Estimates of total greenhouse-gas emissions for livestock products in the UK†

CO_2e=carbon dioxide equivalents

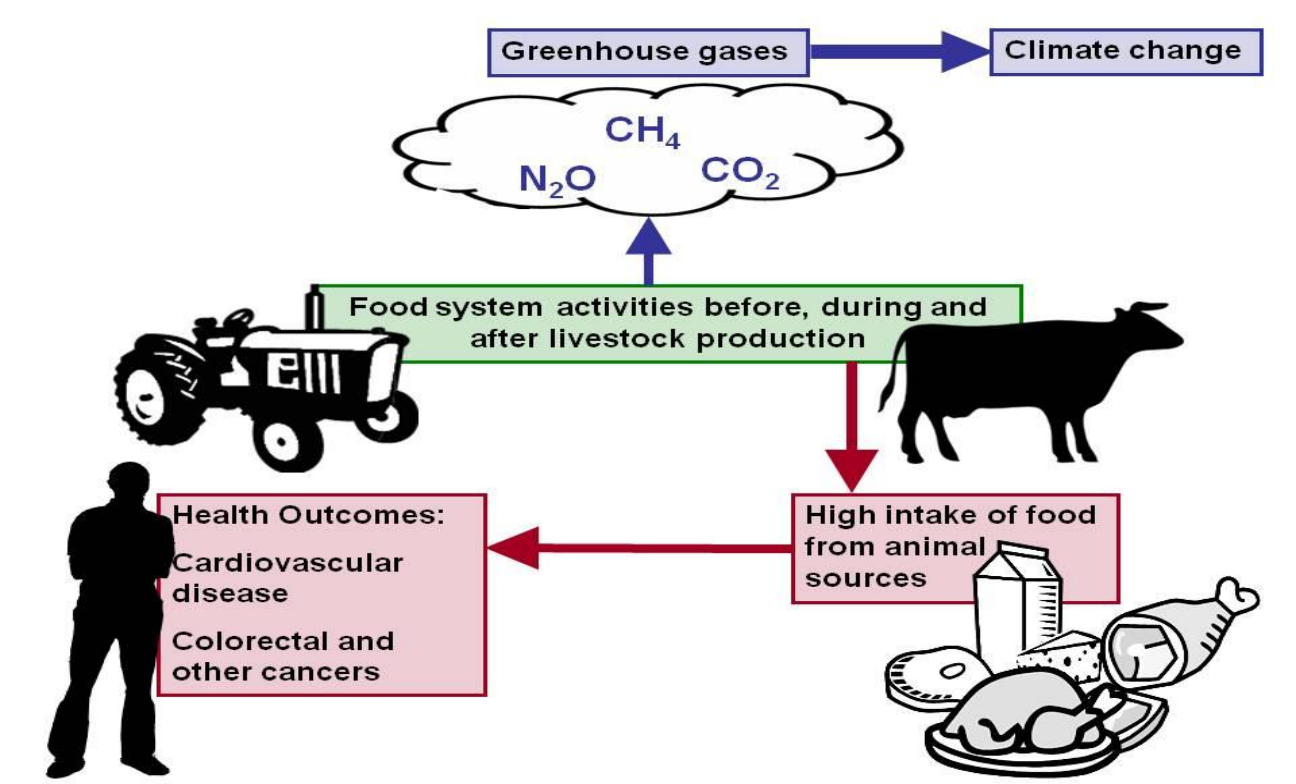
*Tonnes of CO_2e per tonne of carcass weight, 20 000 eggs (about 1 tonne), or 10 m^3 milk (about 1 tonne dry matter equivalent).



†These estimates do not include additional emissions resulting from global change in land use that is associated with livestock production in the UK.

Source: Friel S, Dangour AD, Garnett T, Lock K, Chalabi Z, Roberts I, Butler A, Butler CD, Waage J, McMichael AJ, Haines A. Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture. Lancet 2009; 374: 2016-25.

Food and Agriculture Sector



- 80% of total emissions in sector from livestock production
- Reducing animal source saturated fat by 30 % in the UK could reduce heart disease deaths by ~ 15% (~ 18,000 premature deaths)

Low Carbon Electricity Generation

2030 business as usual

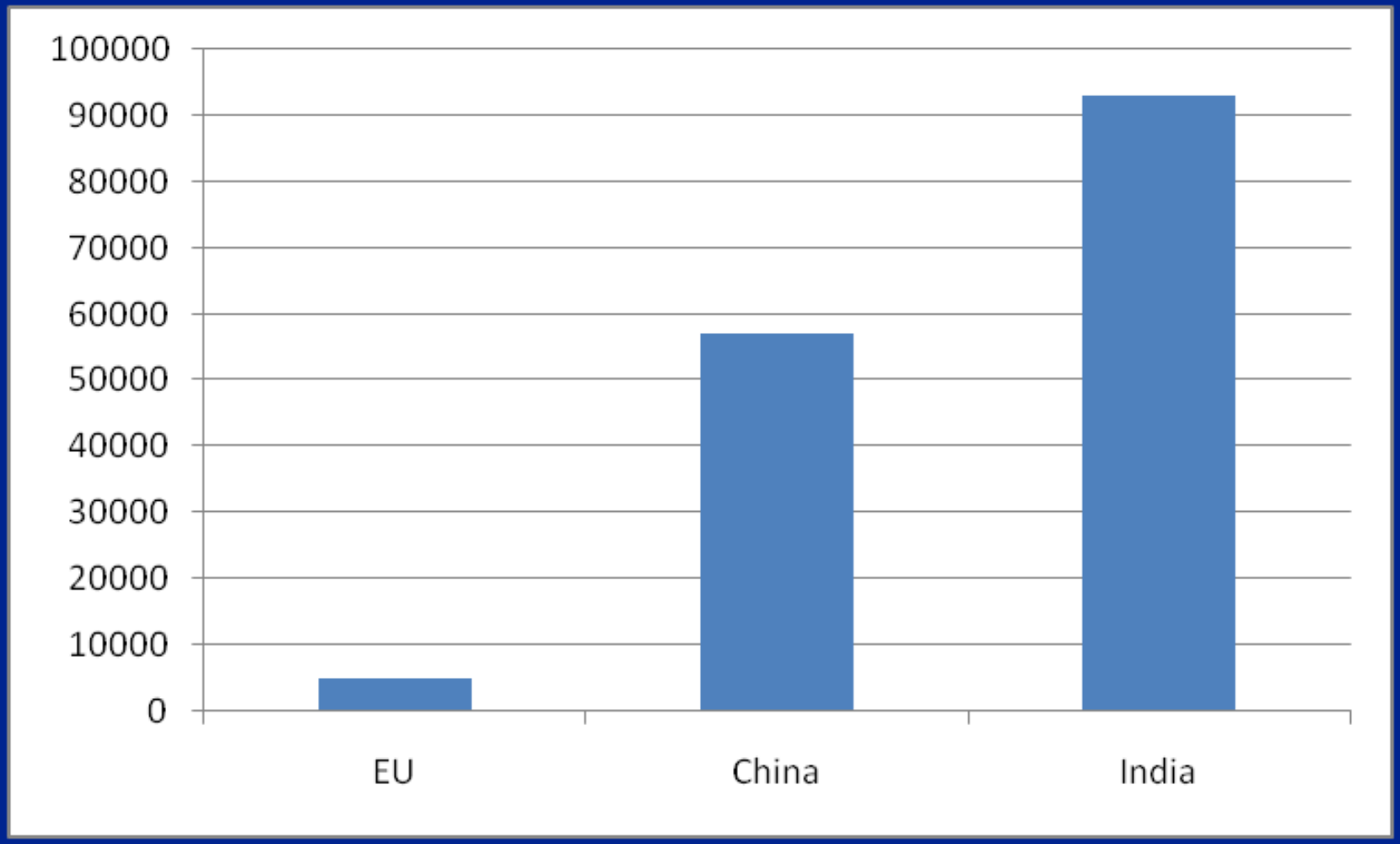
Vs

2030 ~50 % reduction from 2000

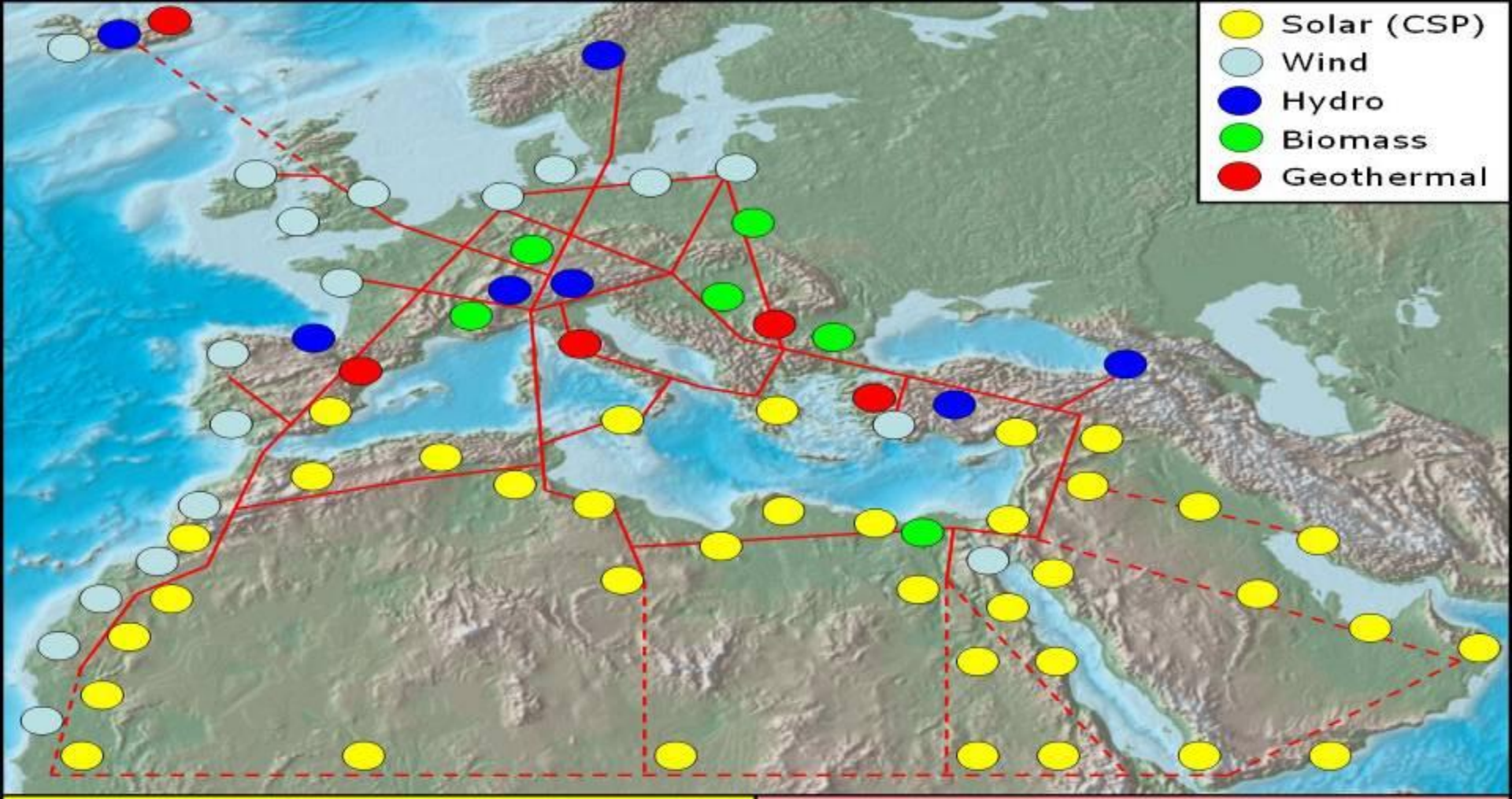
Less coal and more low carbon sources

Estimated reduced deaths from cardiopulmonary disease from reduced particulate air pollution.

Premature Deaths Avoided in 2030



New technologies for clean energy



Concentrated **S**olar Thermal **P**ower (**CSP**):
- Solar heat storage for day/night operation
- Hybrid operation for secured power
- Power & desalination in cogeneration

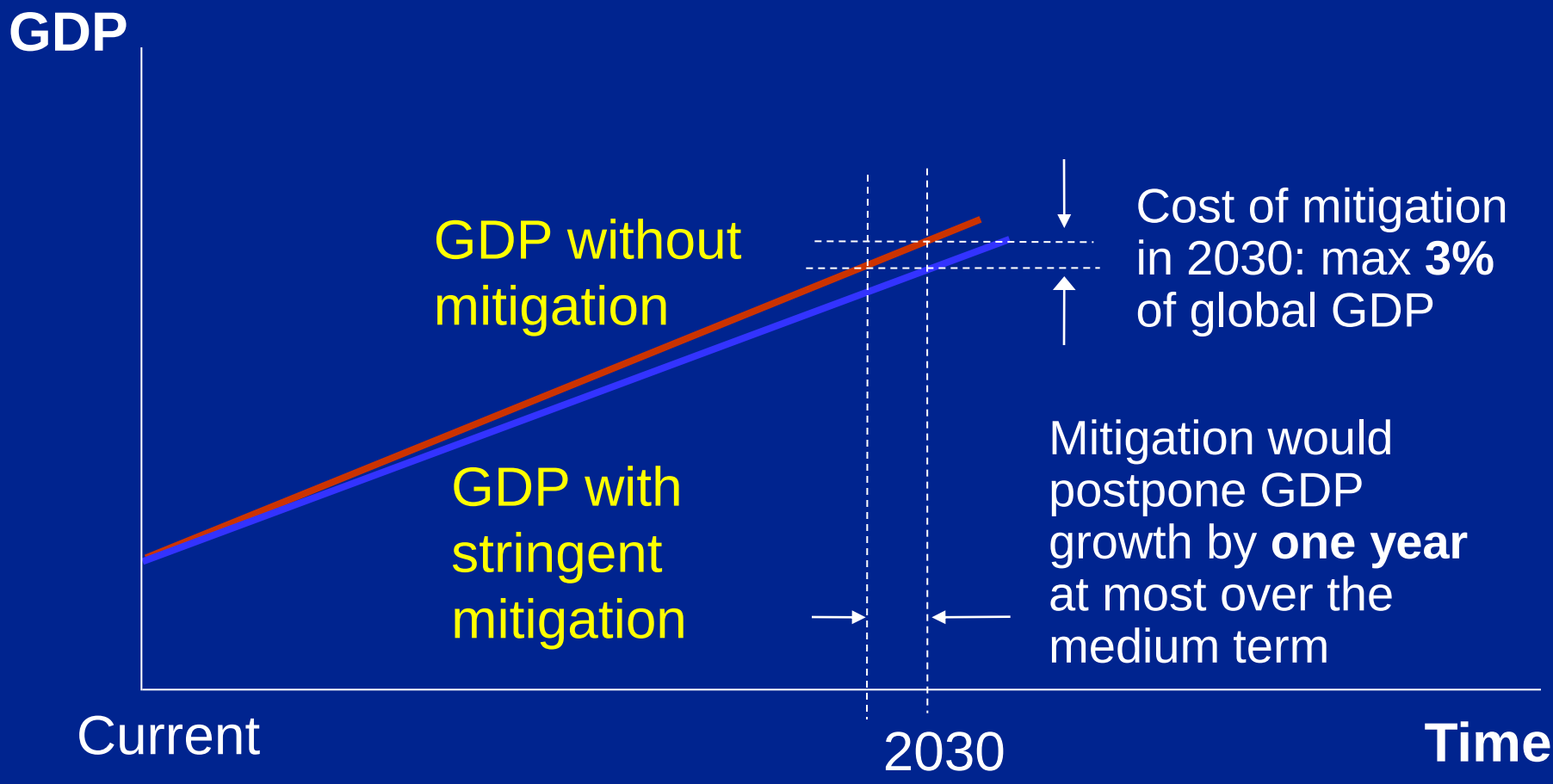
Sketch of **H**igh-**V**oltage **D**irect **C**urrent (**HVDC**) grid: Power transmission losses from the **M**iddle **E**ast and **N**orth **A**frica (**MENA**) to Europe less than 15%.

Power generation with CSP and transmission via future **EU-MENA** grid: 5 - 7 EuroCent/kWh
Various studies and further information at **www.TRECers.net**

Within 6 hours, deserts receive more energy than the world uses in a year.

Impacts of mitigation on GDP growth

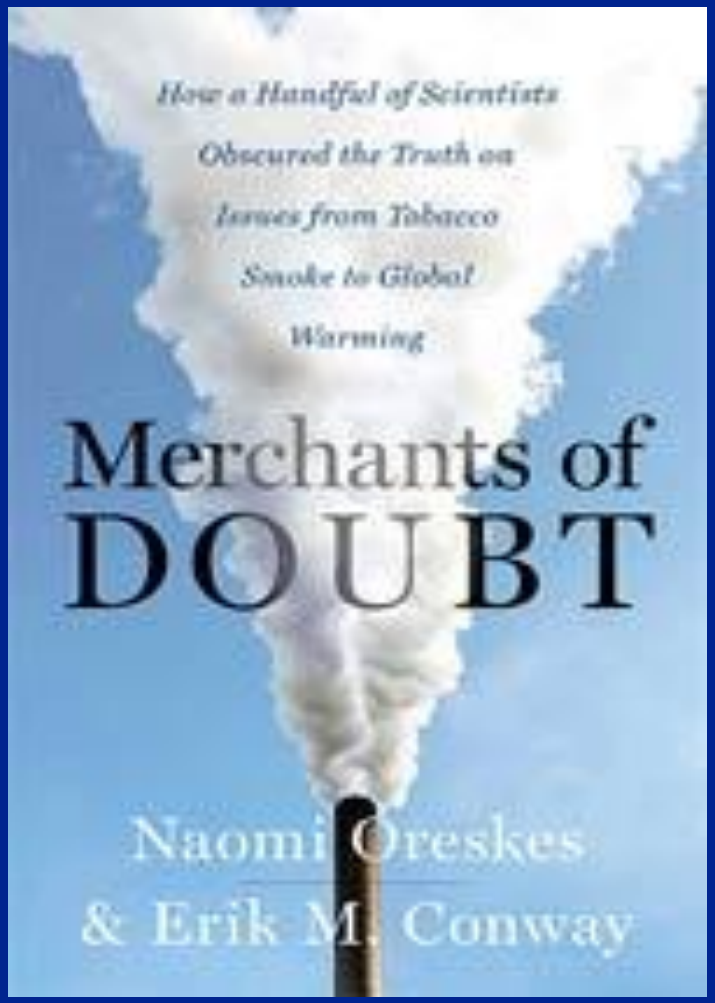
(for stabilisation scenario of 445-535 ppm CO_2-eq)



Schematic graph

Barriers to policy change

- Vested interests
- Organised denialism
- Political short-termism
- Divided public opinion
- Perception that change is expensive and difficult



The roles of health care professionals

Assessing vulnerability

Supporting adaptation

Promoting mitigation by focusing on health co-benefits

Educating decision makers

Reducing emissions from the health system

Acknowledgements

The work of the Task Force on Climate Change Mitigation and Public Health was supported by a consortium of funding bodies led by the Wellcome Trust

Involving 55 researchers from UK, USA, India, Canada, Australia, Spain, France, New Zealand, WHO Geneva