

# CLIMATE CHANGE – THE MOST VULNERABLE PLACES AND PEOPLE

**Martin Parry**

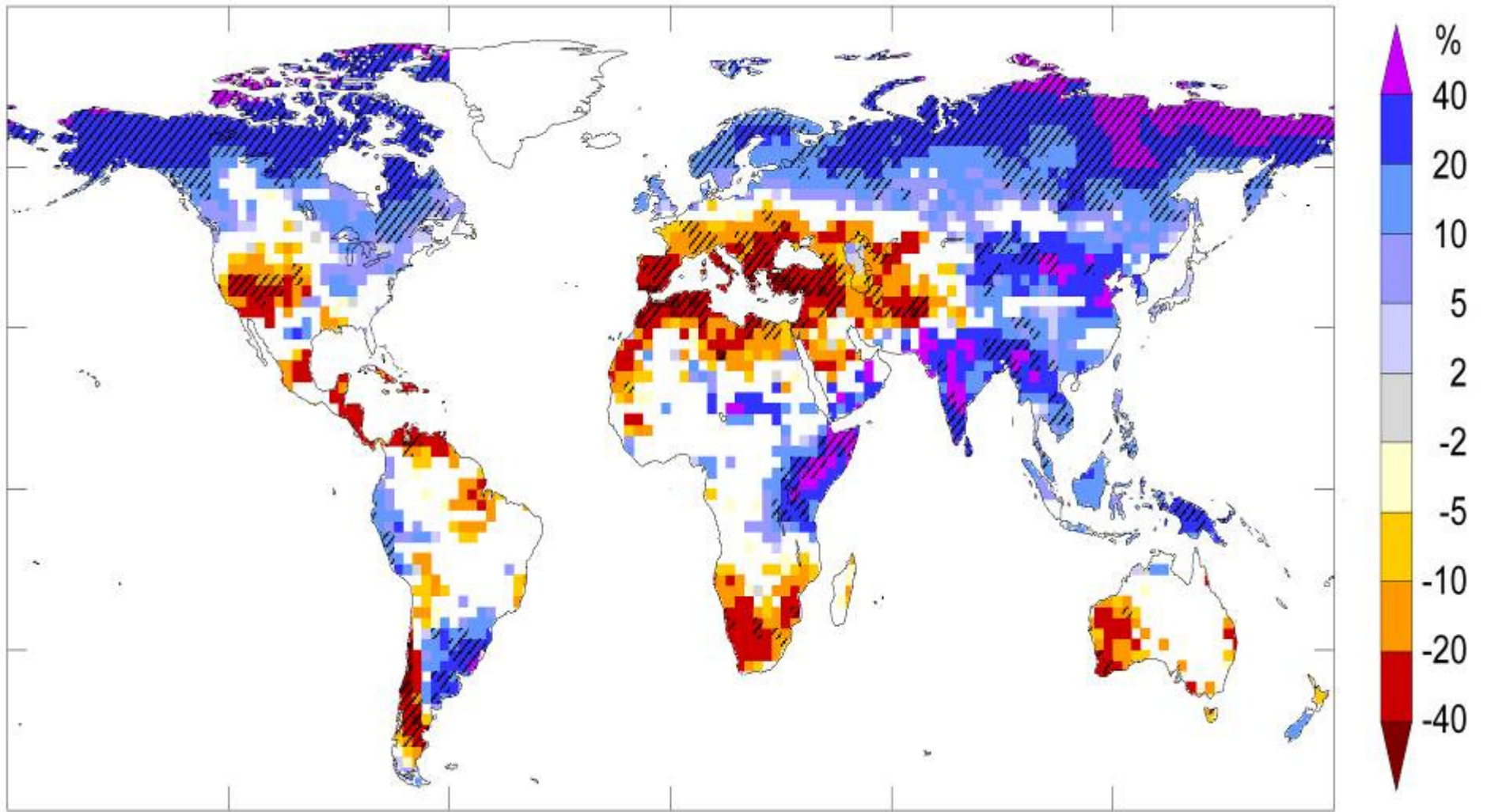
Grantham Institute /Centre for Environmental Policy, Imperial College London  
and UK DfID

[martin@mlparry.com](mailto:martin@mlparry.com)

[Co-Chair Working Group (Impacts, Adaptation and Vulnerability)  
2007 Intergovernmental Panel on Climate Change Assessment]

# 1. Most key impacts stem from reduced water availability.

Hundreds of millions of people will be additionally exposed to increased water stress. Changes in run-off, 21st century. White areas are where less than two-thirds of models agree, hatched are where 90% of models agree (IPCC SYR)



Global mean annual temperature change relative to 1980-1999 (°C)

0 1 2 3 4 5°C

CO<sub>2</sub> stabilisation: TAR

- 450 ppm (560 ppm CO<sub>2</sub> eq.)
- 550 ppm (680 ppm)
- 650 ppm (810 ppm)
- 750 ppm (945 ppm)

Legend for CO<sub>2</sub> stabilisation:

- 2020s (brown dashed line)
- 2050s (blue dashed line)
- 2080s (orange dashed line)

Increased water availability in moist tropics and high latitudes<sup>1</sup>  
 Decreasing water availability and increasing drought in mid-latitudes and semi-arid low latitudes<sup>2</sup>

WATER

Population projections and water stress:

- 0.4 to 1.7 billion<sup>3</sup> → 1.0 to 2.0 billion<sup>3</sup> → 1.1 to 3.2 billion<sup>3</sup>
- Additional people with increased water stress

SRES: AR4 WG I simple climate model

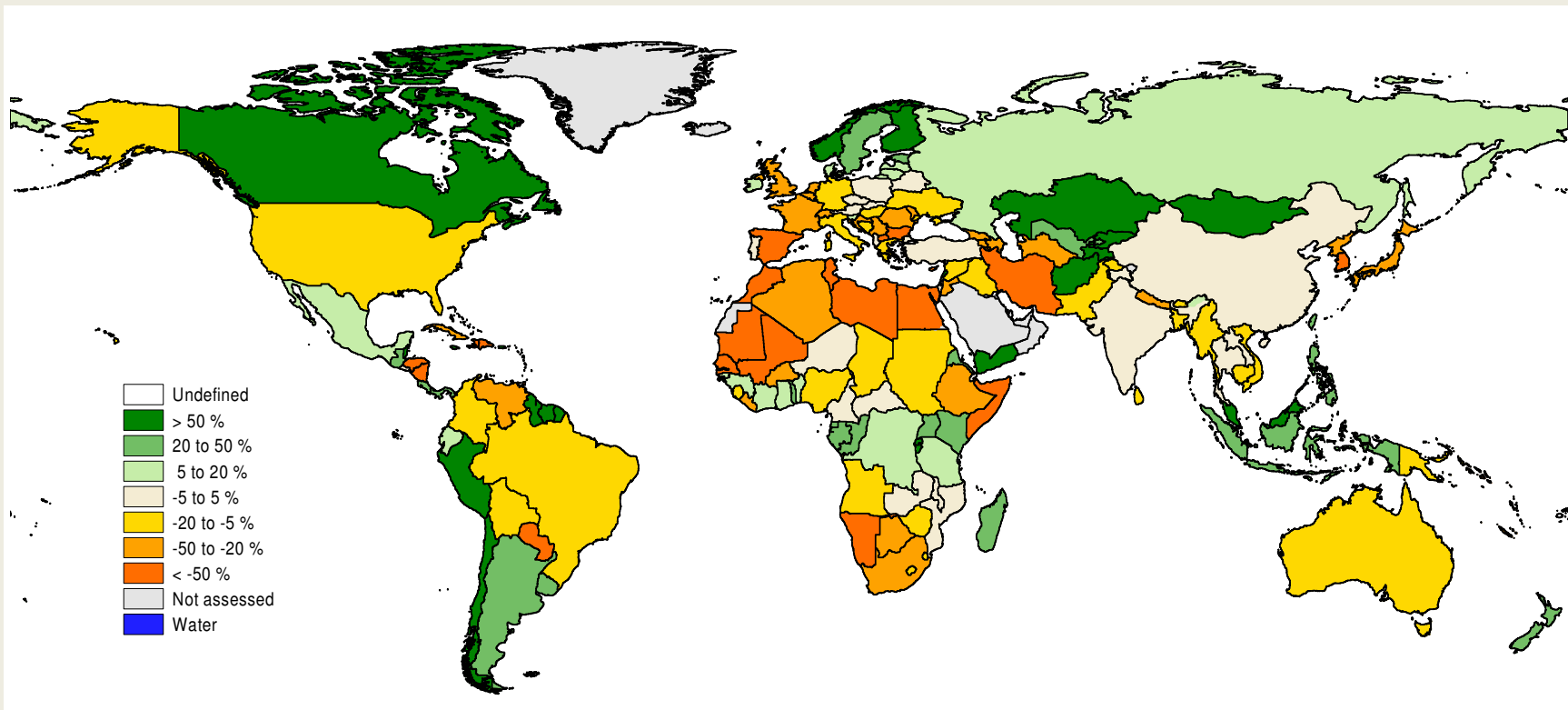
- B1
- B2
- A1T
- A1B
- A2
- A1FI

Legend for SRES scenarios:

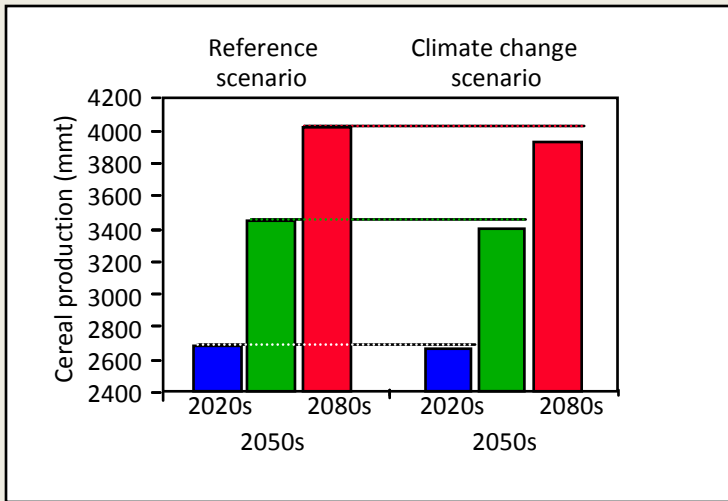
- 2020s (brown line)
- 2050s (blue line)
- 2080s (orange line)
- 2090s (red line)

5.2  
5.8

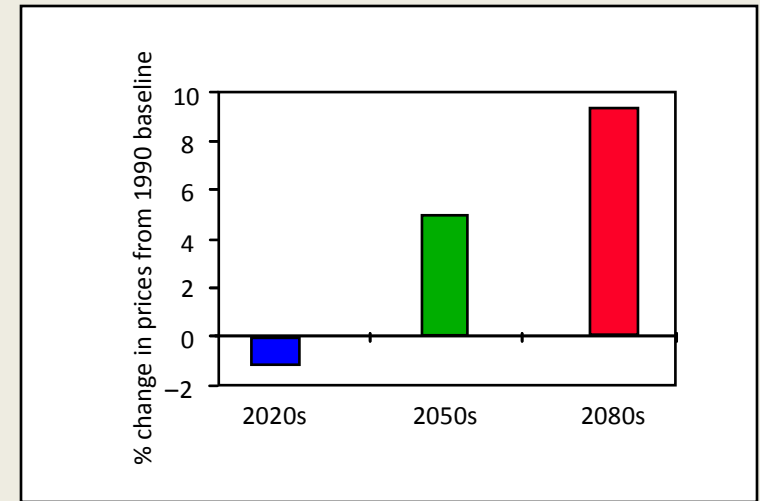
**2. Crop yields are projected to decrease , especially at lower latitudes  
Tens of millions estimated to be additionally at risk from hunger.**



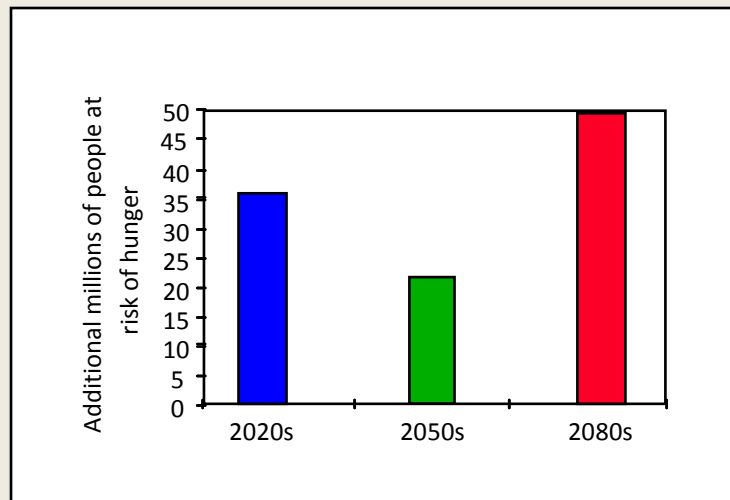
**Country-level impacts on rain-fed cereals, % yield change , 2080s(HadCM3-A1FI)**



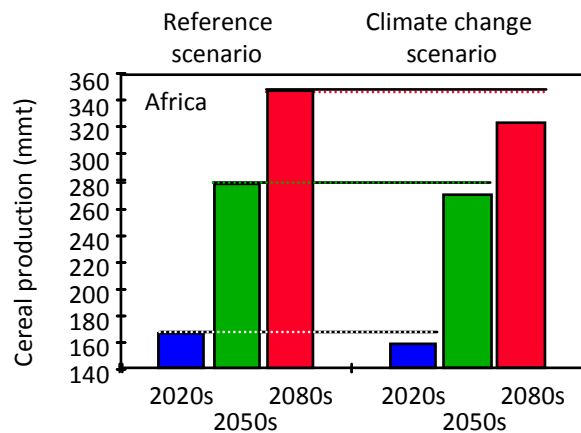
Projected global cereal production for reference case and the climate change scenario.



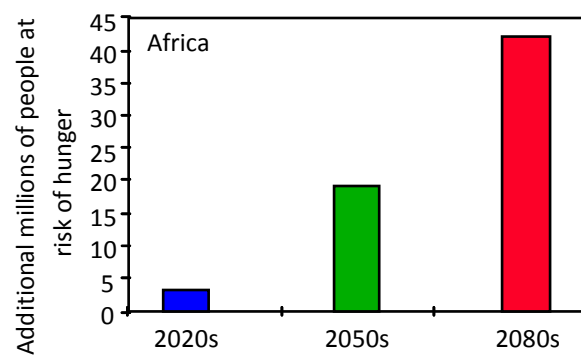
Percentage change in global cereal prices under the climate change scenario (0 = reference case).



Additional people at risk of hunger (0 = reference case, i.e. about 300 million in 2000, FAO ).

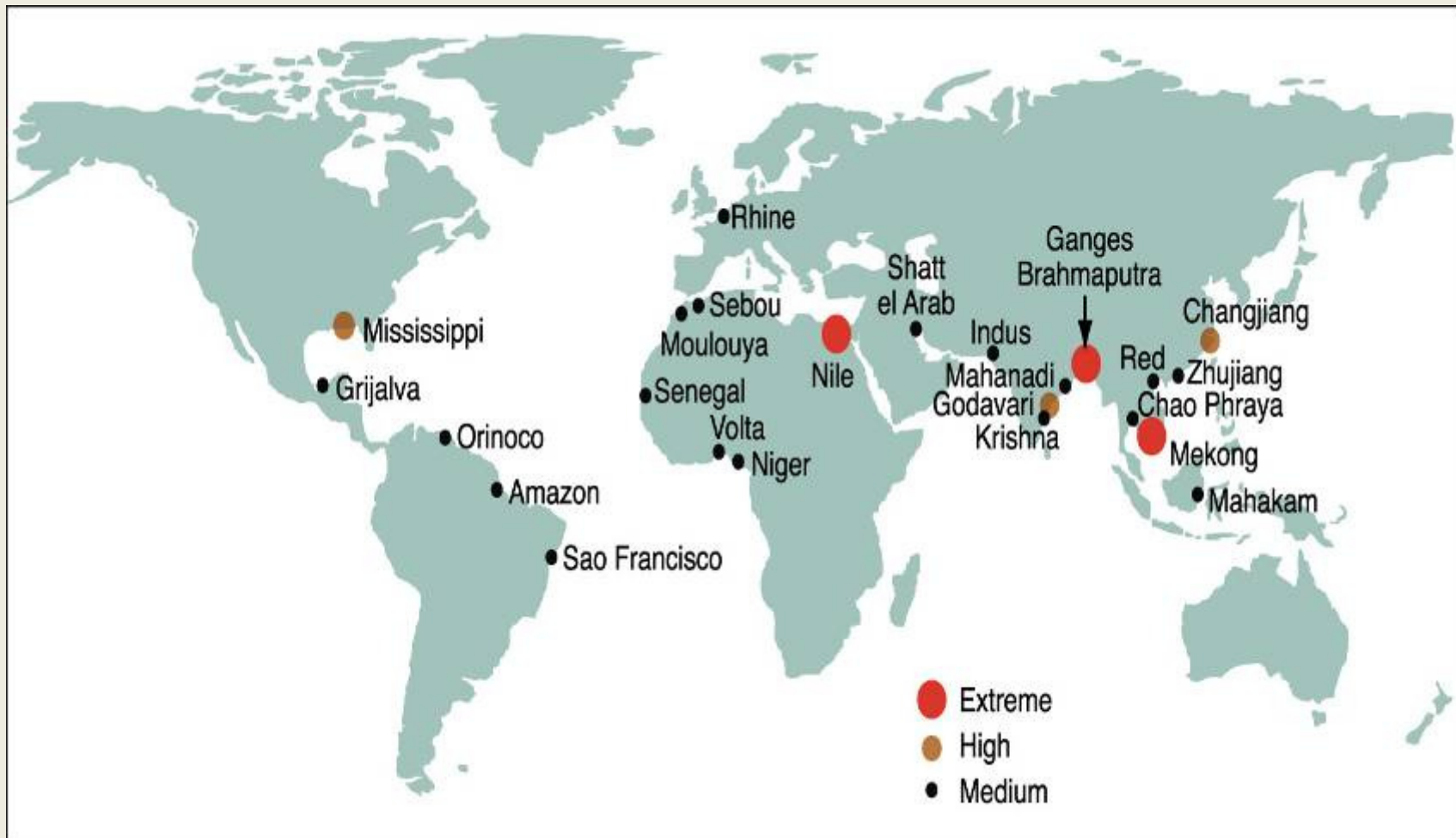


Projections for cereal production in Africa under the reference case and the climate change scenario



Additional number of people at risk of hunger in Africa under the climate change scenario (0 = Projected reference case).

**3. Densely populated “megadeltas” especially in Asia and Africa, are most at risk. Tens of millions will be additionally at risk**



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0 1 2 3 4 5°C

CO<sub>2</sub> stabilisation: TAR

450 ppm  
(560 ppm CO<sub>2</sub> eq.)

550 ppm  
(680 ppm)

650 ppm  
(810 ppm)

750 ppm  
(945 ppm)

2020s  
2050s  
2080s

Increased damage from floods and storms<sup>10</sup>

COAST

About 30% loss of coastal wetlands<sup>11</sup>

Additional people at risk of coastal flooding each year

0 to 3 million<sup>12</sup>

2 to 15 million<sup>12</sup>

SRES: AR4 WGI simple climate model

B1

B2

A1T

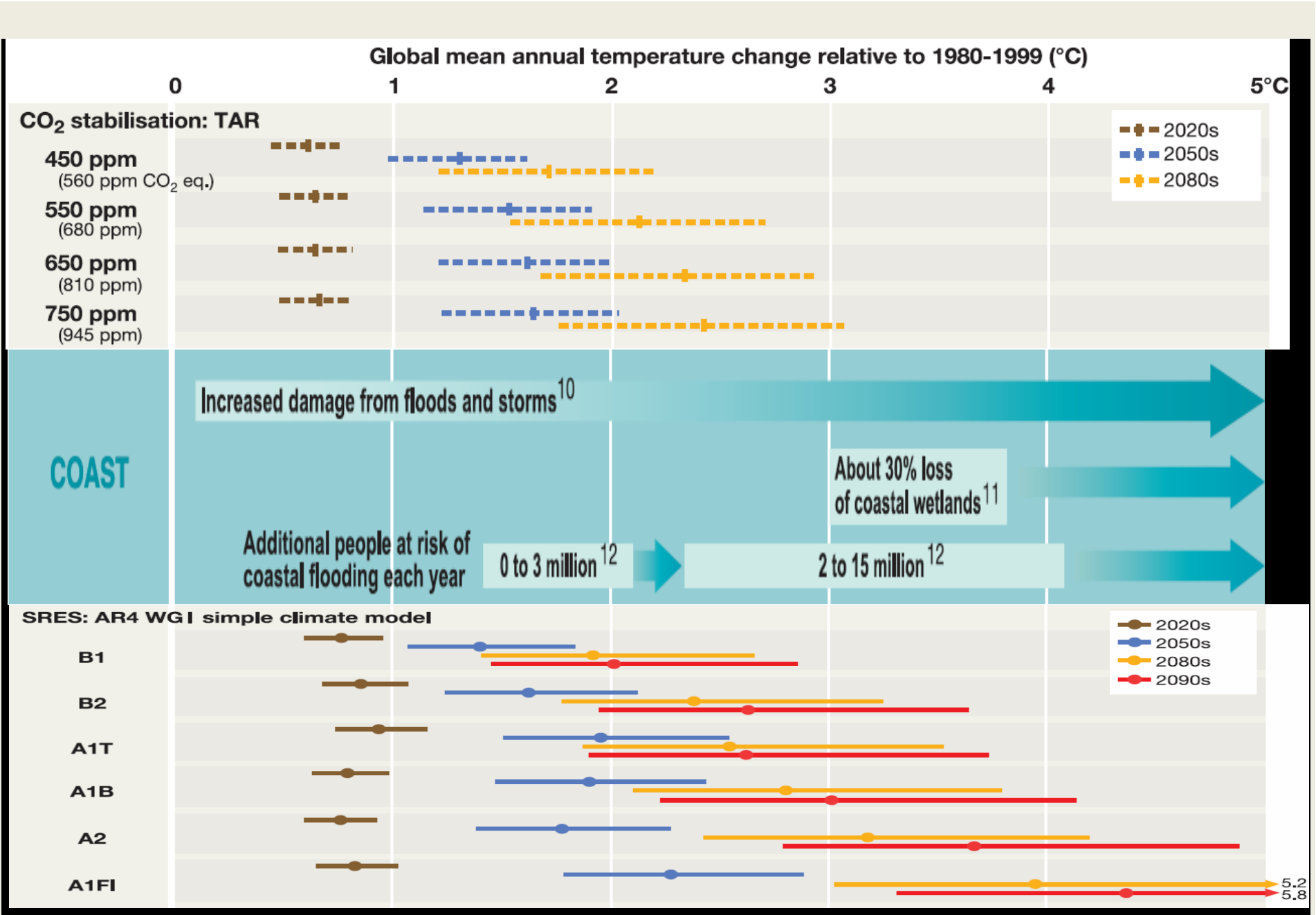
A1B

A2

A1FI

2020s  
2050s  
2080s  
2090s

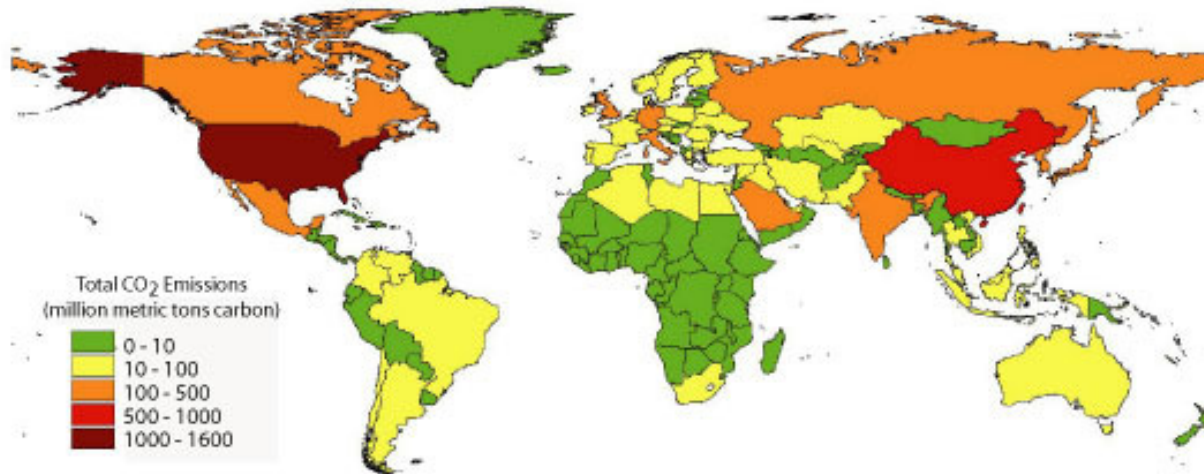
5.2  
5.8



4. Health effects will be generally negative, especially on the poor, elderly, young and the marginalised

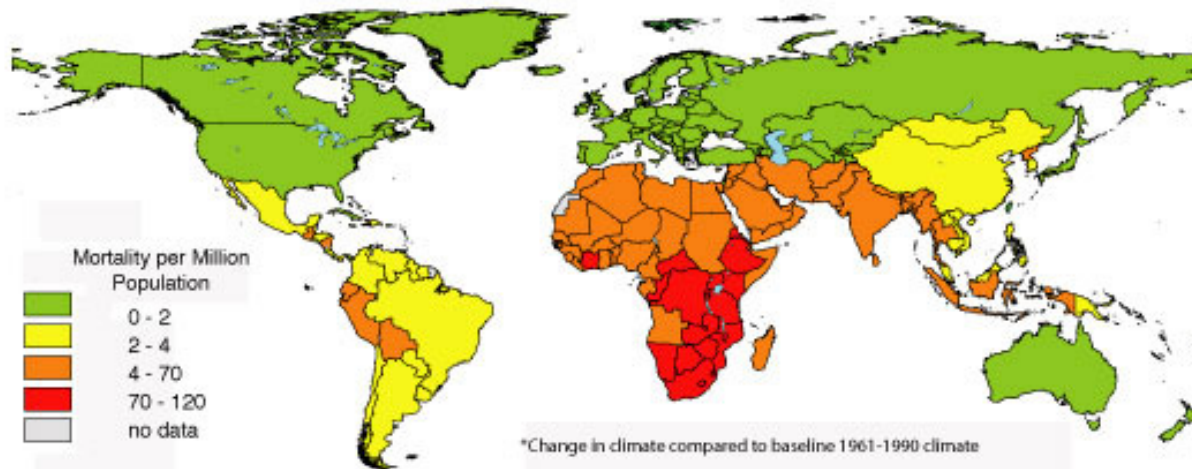
	Negative impact	Positive impact
<b>Very high confidence</b>		
Malaria: contraction and expansion, changes in transmission season	←	→
<b>High confidence</b>		
Increase in malnutrition	←	
Increase in the number of people suffering from deaths, disease and injuries from extreme weather events	←	
Increase in the frequency of cardio-respiratory diseases from changes in air quality	←	
Change in the range of infectious disease vectors	←	→
Reduction of cold-related deaths		→
<b>Medium confidence</b>		
Increase in the burden of diarrhoeal diseases	←	

### Total CO<sub>2</sub> Emissions from Fossil-Fuel Burning, Cement Production, and Gas Flaring for the World's Countries in the Year 2000



Data Source:  
 Marland, G., T.A. Boden, and R.J. Andres. 2003. Global, Regional, and National Fossil Fuel CO<sub>2</sub> Emissions. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.

### Estimated Mortality per Million Population Attributable to Climate Change in the Year 2000\* by Subregion



Data Source:  
 McMichael, J., Campbell-Lendrum D, Kovats RS, et al. Global Climate Change. In Comparative Quantification of Health Risks: Global and Regional Burden of Disease due to Selected Major Risk Factors. M. Ezzati, Lopez, AD, Rodgers A., Murray C.J.L. Geneva, World Health Organization, 2004



Maps produced by the Center for Sustainability and the Global Environment (SAGE)

## 5. Summary: People will be most at risk in:

- **Most vulnerable regions**:

- Africa, Asian mega-deltas, small islands, the Arctic

- **Most vulnerable sectors**:

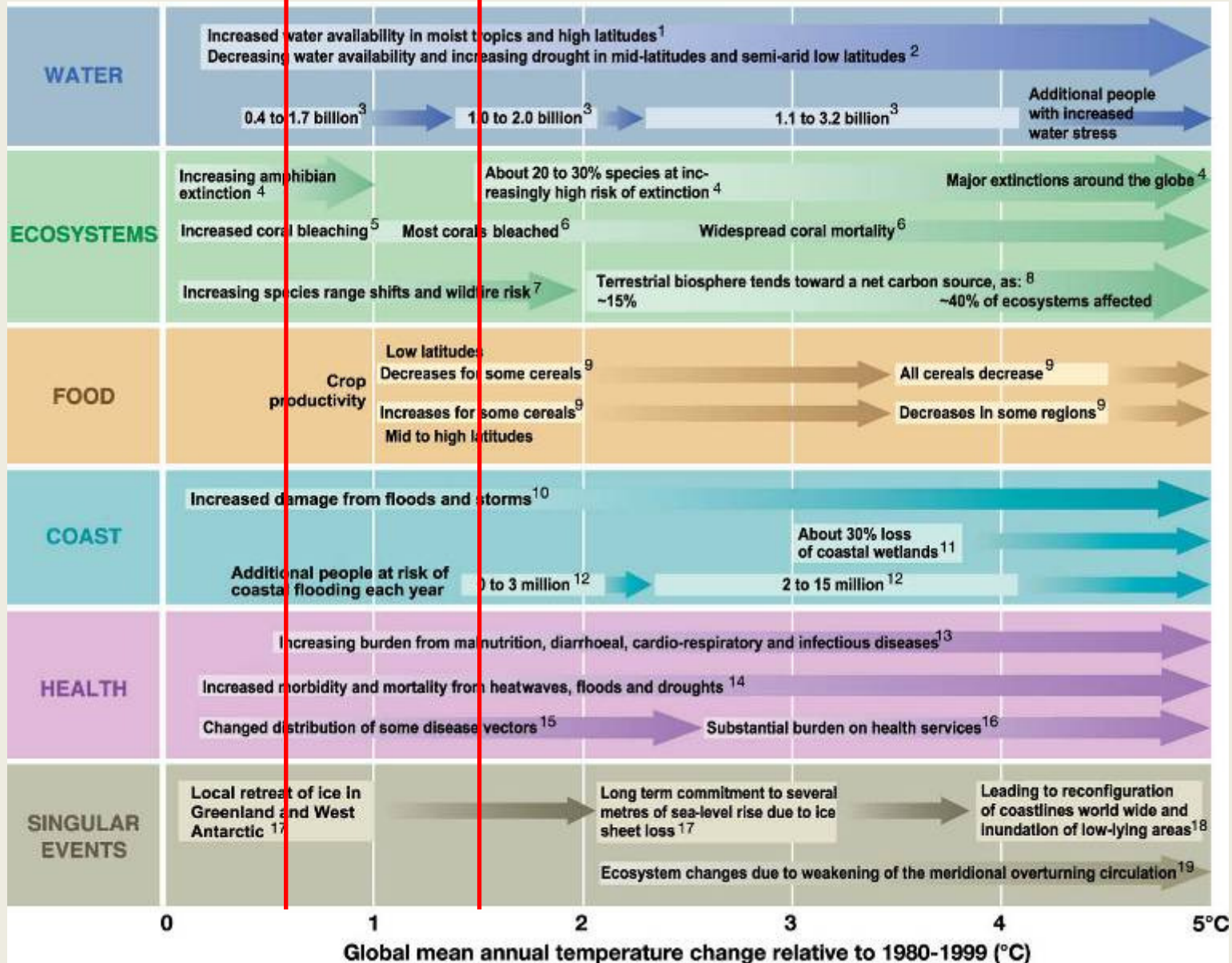
- water in the dry tropics
- agriculture in low latitudes
- human health in poor countries
- where activities depend on sensitive ecosystems, especially: tundra, boreal, mountains; or ecosystems already stressed: e.g. mangroves, coral reefs.

**In all countries**, even those with high incomes, some are especially at risk: the poor, young children, the elderly, the marginalised.

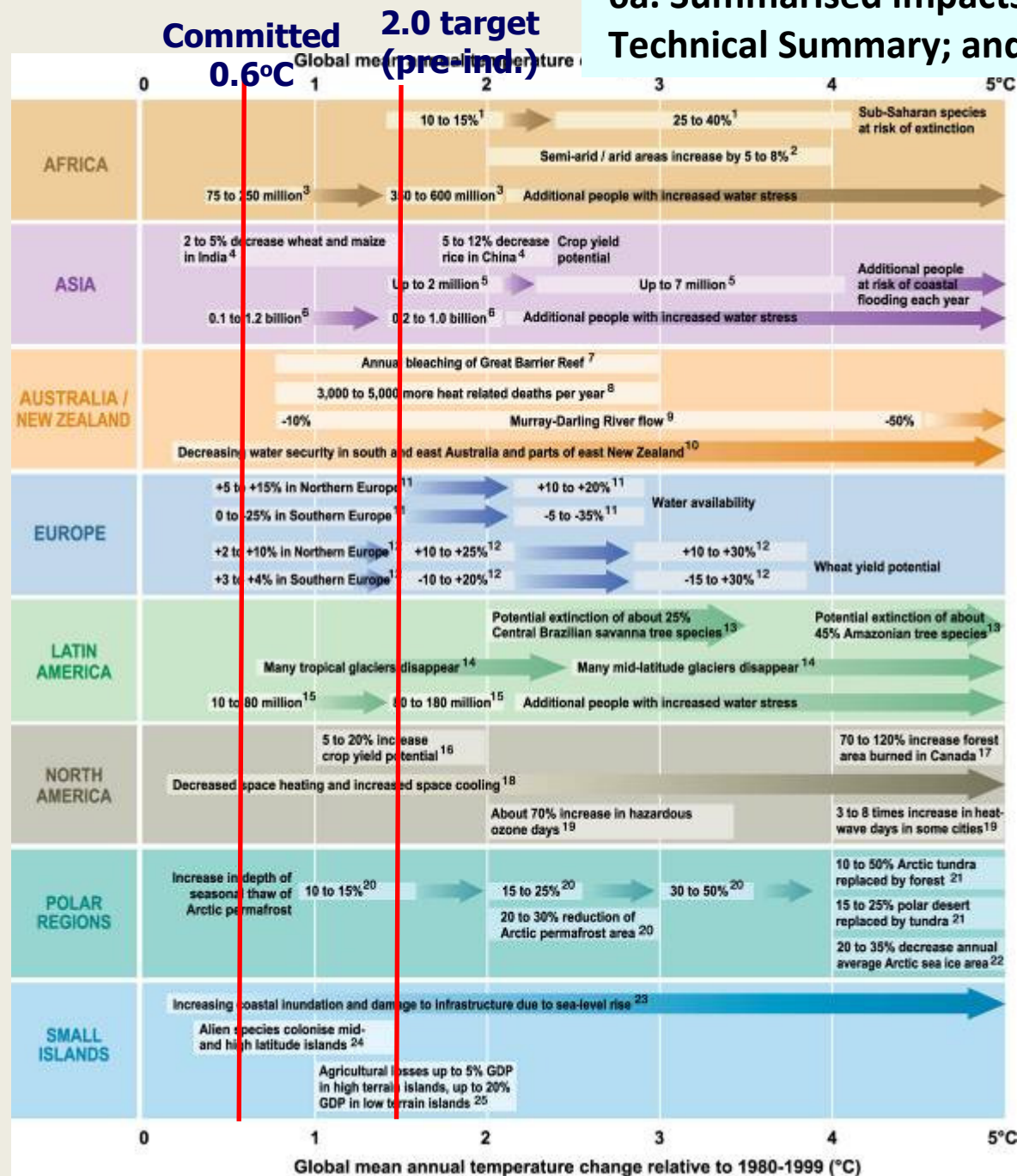
## 6. How can we best respond?

- a) Reduce emissions (mitigation)
- b) Adaptation (reduce vulnerability)
  
- c) Follow pathways of development and governance which effectively combine mitigation AND adaptation

**Committed 2.0°C target  
0.6°C (pre-ind.)**



# 6a. Summarised impacts from IPCC WG2 Technical Summary; and mitigation targets



## 6b. Adaptation options are extensive and well tested. But what are their limits and costs?

	Food, fibre and forestry	Water resources	Human health	Industry, settlement and society
<b>Drying/ Drought</b>	<i>Crops:</i> development of new drought-resistant varieties; intercropping; crop residue retention; weed management; irrigation and hydroponic farming; water harvesting	Water demand management Soil moisture conservation Conservation of groundwater	Grain storage and provision of emergency feeding stations Provision of safe drinking water and sanitation	Improved water supply systems and co-ordination between jurisdictions
<b>Increased rainfall/ Flooding</b>	<i>Crops:</i> Polders and improved drainage; development and promotion of alternative crops	Enhanced implementation of protection measures including flood forecasting and warning	Early-warning systems; disaster preparedness planning; effective post-event emergency relief	Improved flood protection infrastructure Flood hazard mapping; flood warnings
<b>Warming/ Heatwaves</b>	<i>Crops:</i> Development of new heat-resistant varieties; altered timing of cropping activities; pest control and surveillance of crops	Water demand management through metering and pricing Education for sustainable water use	International surveillance systems for disease emergence Strengthening of public institutions and health systems	Assistance programmes for especially vulnerable groups Improve adaptive capacities Technological change
<b>Wind speed/ Storminess</b>	<i>Crops:</i> Development of wind-resistant crops (e.g., vanilla)	Coastal defence design and implementation to protect water supply against contamination	Early-warning systems; disaster preparedness planning; effective post-event emergency relief	Emergency preparedness, including early-warning systems More resilient infrastructure Financial risk management options for both developed and developing regions

Peak c. 2065  
with start 2015

Peak c. 2080  
with start 2025

Peak c. 3000  
with start 2035

Recovery by  
2200 with start  
2015

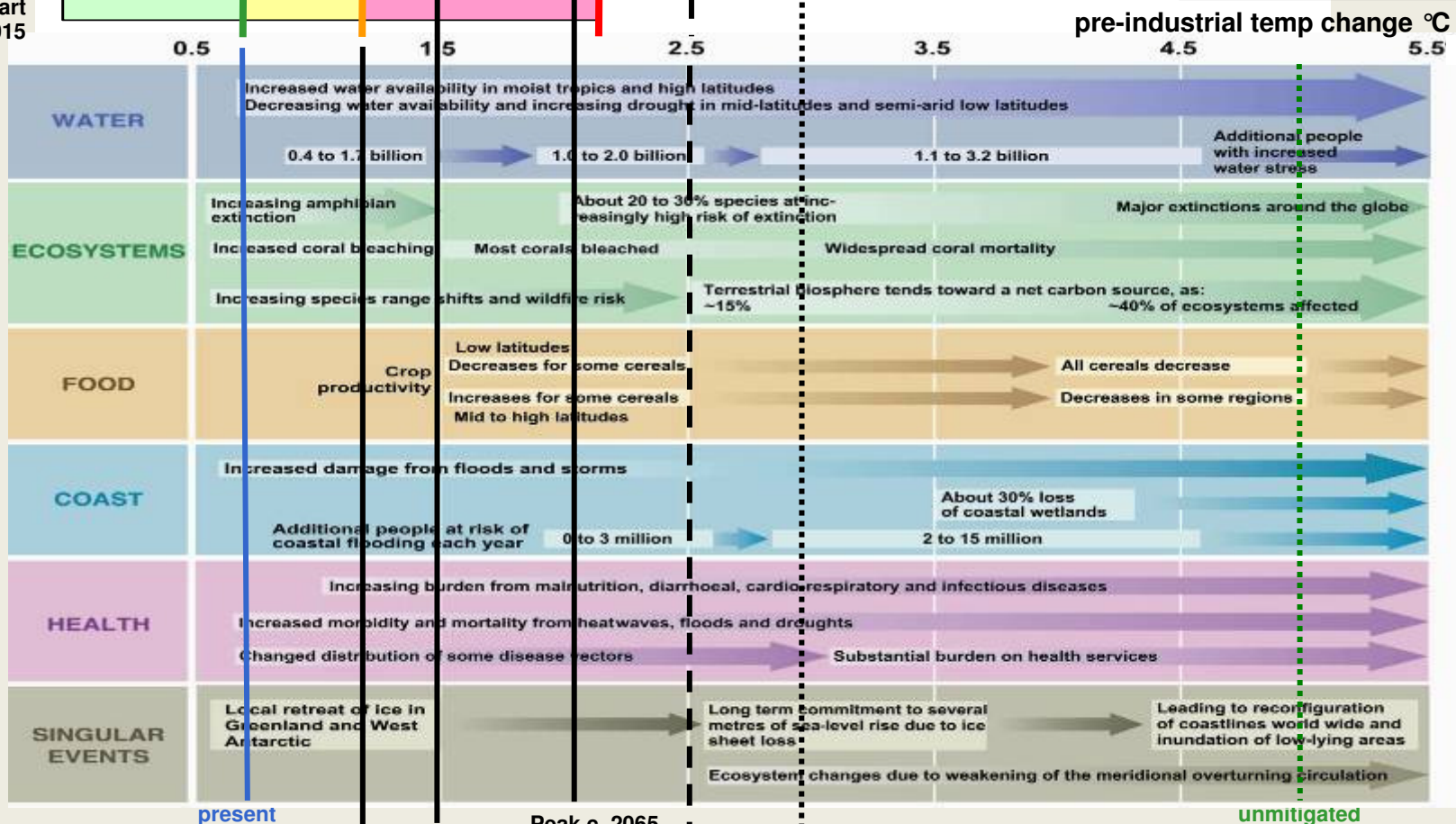
Recovery by  
2300 with start  
2015

**T uncertainty range:**

- 90<sup>th</sup> percentile temp.
- 50<sup>th</sup> percentile temp.
- 10<sup>th</sup> percentile temp.

**Adaptation levels:**

- low (10% cover)
- moderate (50% cover)
- large (90% cover)

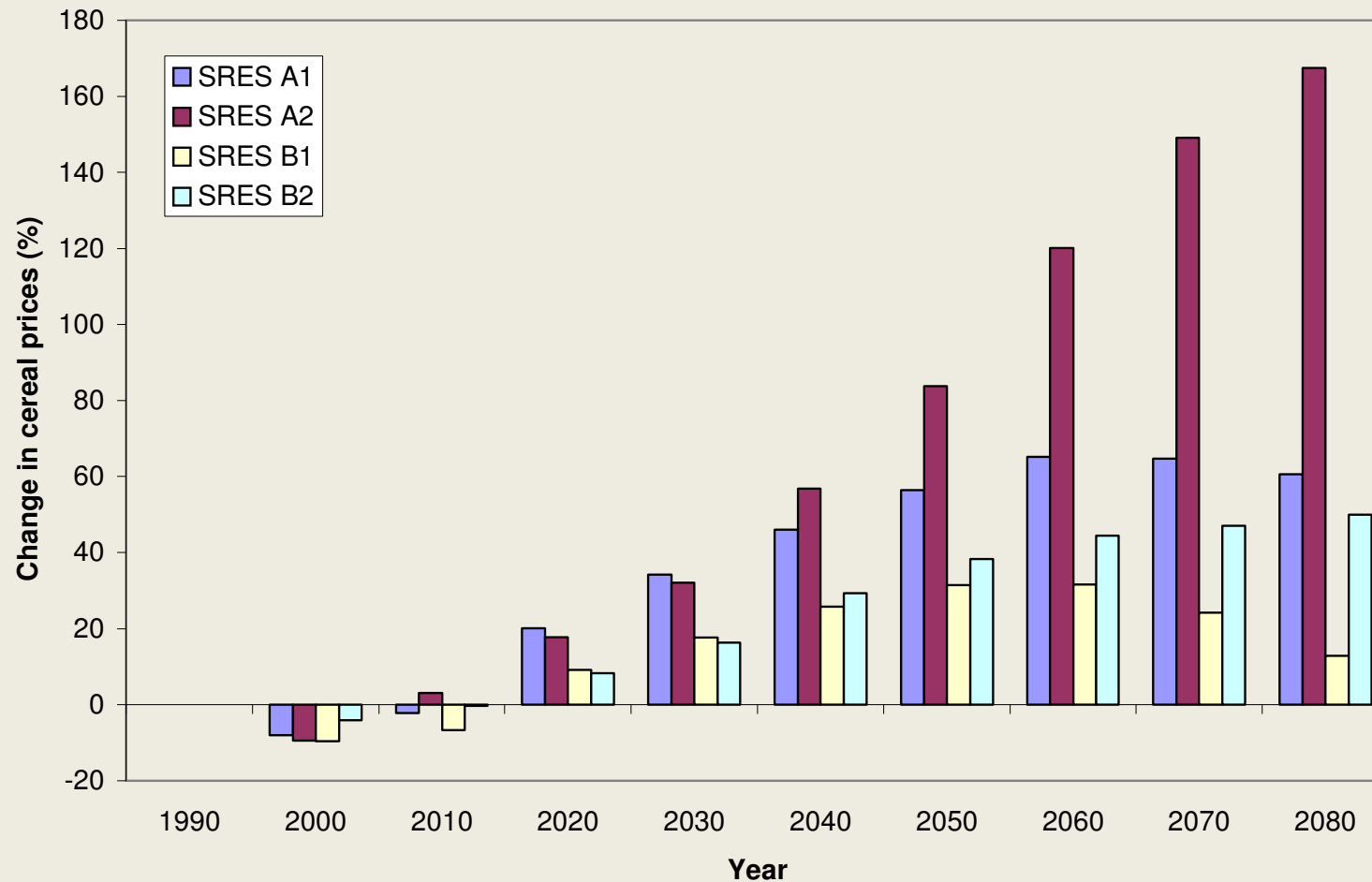


## 6c. Development Pathways (implicitly combining adaptation and mitigation). IPCC's SRES scenarios

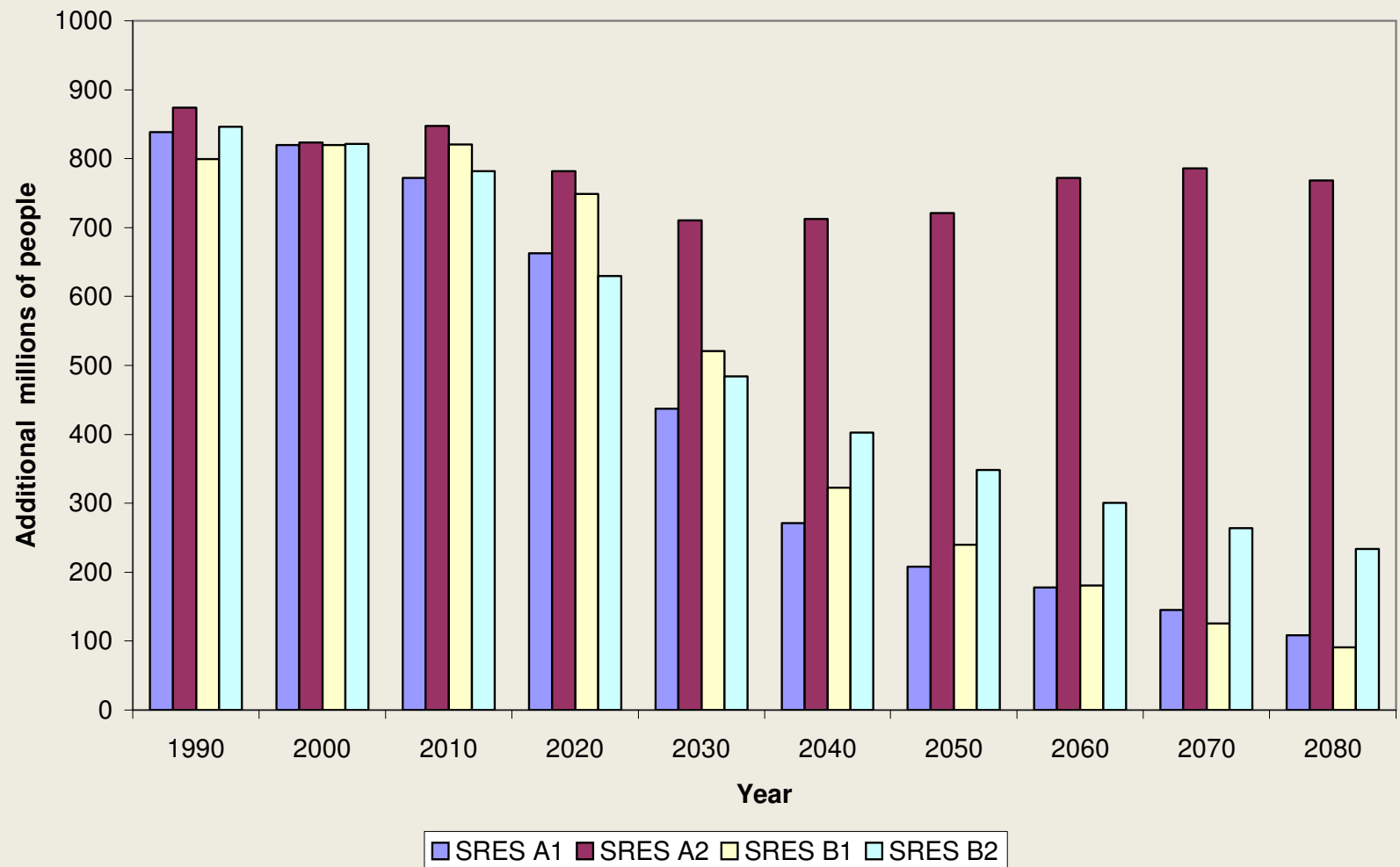
- **A1 = World of Global Markets: high growth, high tech, low pop,**
- **A2 = World of Regional Enterprise: high pop (11bn in 2050), high growth (but inequitable) [current pathway]**
- **B1 = World of Global Sustainability: low pop, moderate growth, global environmental agreements**
- **B2 = World of Local Stewardship: low pop (9 bn in 2050), moderate growth, local envt management**



**Projected cereal production under the four SRES scenarios (no climate change). BLS run with FAO assumptions**

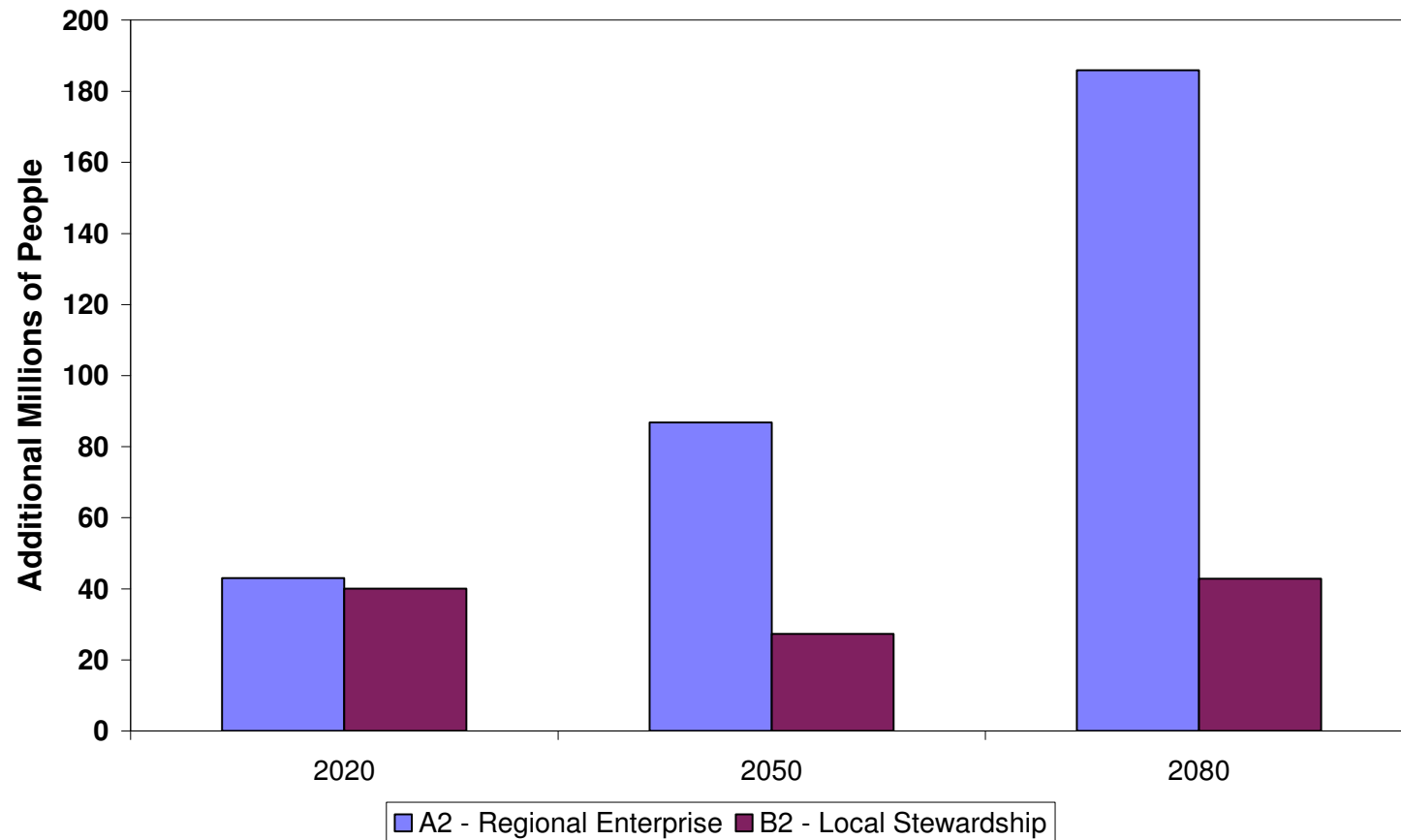


**Projected global cereal prices, relative to 1990 , for the four SRES marker scenarios (no climate change). BLS with FAO assumptions**



**Projected numbers of people at risk of hunger, for the four SRES scenarios (no climate change). BLS with FAO assumptions**

# Projected climate change- induced additional people at risk of hunger



# **CONCLUSIONS: HUMANITARIAN IMPLICATIONS OF CLIMATE CHANGE**

## **MOST AT RISK ARE:**

- People in most vulnerable places:  
Africa, small islands, Asian mega-deltas
- Main effects felt through:  
increased water shortage, increased risk of hunger, risks to human health
- People in most vulnerable livelihoods:  
un-irrigated farming in dry tropics, poor people in tropical megacities
- Poor, elderly, young and marginalised people, including those in developed countries

## **HOW CAN WE BEST RESPOND:**

- Even the most stringent mitigation may not avoid a further 2.5 deg C warming (i.e. 3 deg C above pre-industrial); and the implied impacts are very large.
- Adaptation is urgent, and we should plan to adapt for at least 3.5 deg C.
- Emissions reductions are needed now, or capacity to adapt may be exceeded.

**Equitable and sustainable development**, combining both adaptation and mitigation is probably the most effective response