Climate Change 2007:

IPCC Fourth Assessment Report

Tomorrow's climate - today's challenge for Sustainable Development

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Space Tools and Solutions for Monitoring the Atmosphere in Support of Sustainable Development
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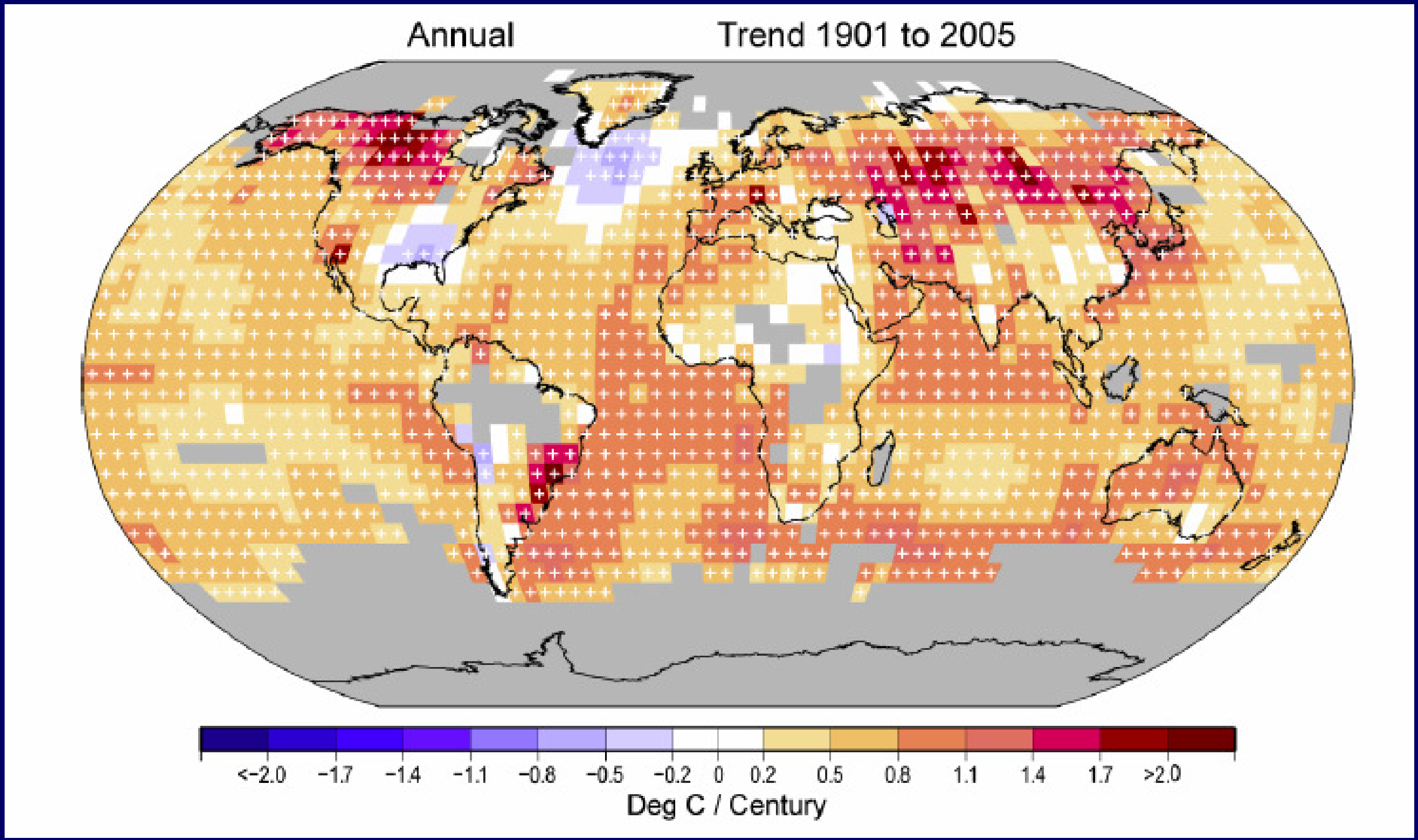
Outline

- WGI The Physical Science Basis
- WGII Impacts, Adaptation and Vulnerability
- WGIII Mitigation of Climate Change
- Consequences for SD

Climate Change 2007
IPCC Fourth Assessment Report
Some Key Messages

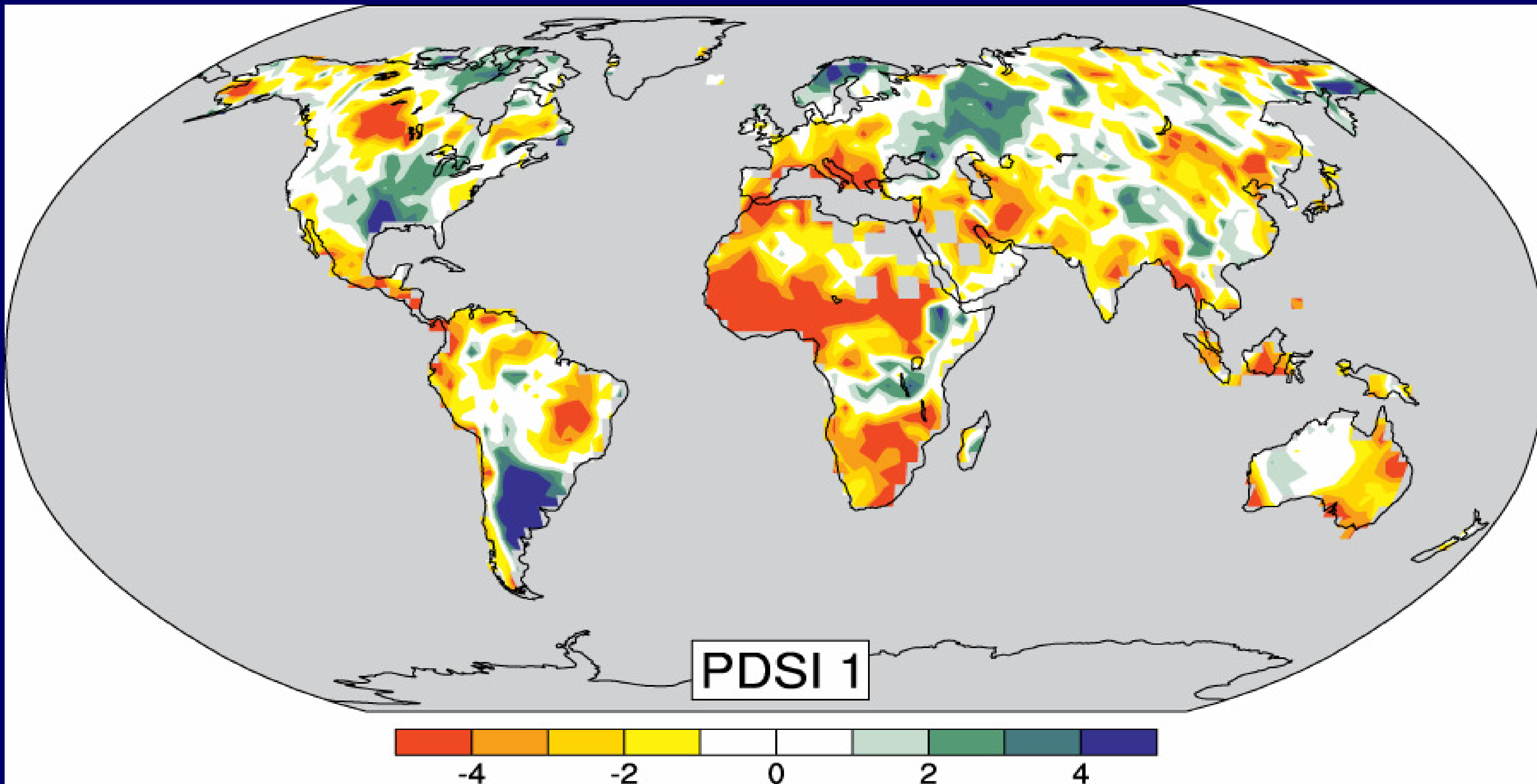
- CO_2 concentrations = unprecedented in the last 650,000 years
- Warming of the climate system = unequivocal
- Very likely (>90%) that most of the global warming of the past half-century is due to increases in greenhouse gases
- Already committed to more warming (next few decades), with choices affecting the longer term more and more.
- Expected future climate changes include: more extremes, wetter in high latitudes, drier in subtropics.

It is warmer on average across the globe than it was a century ago

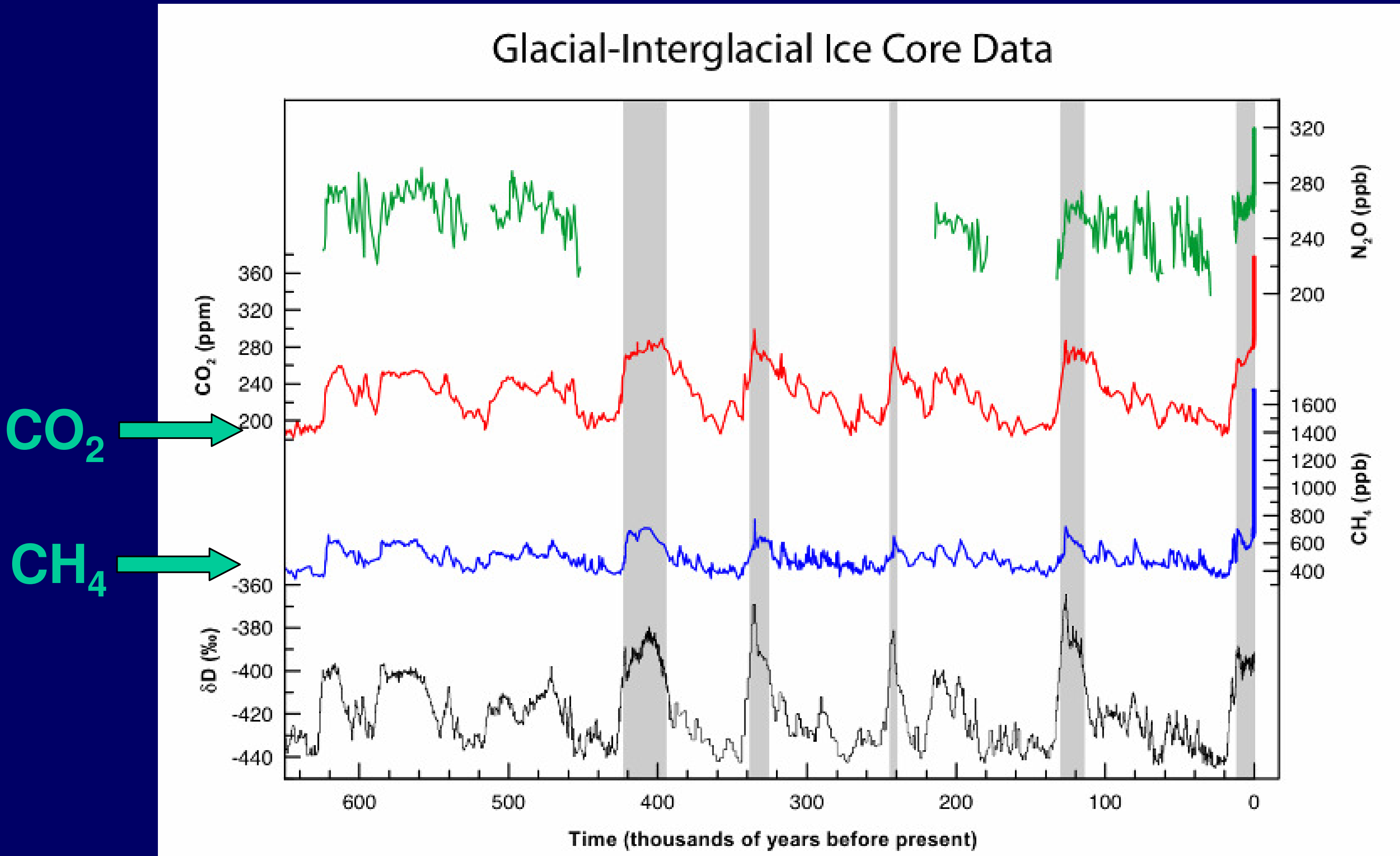


Globally averaged, the planet is ~0.75℃ warmer than it was in 1860

Drought is increasing most places

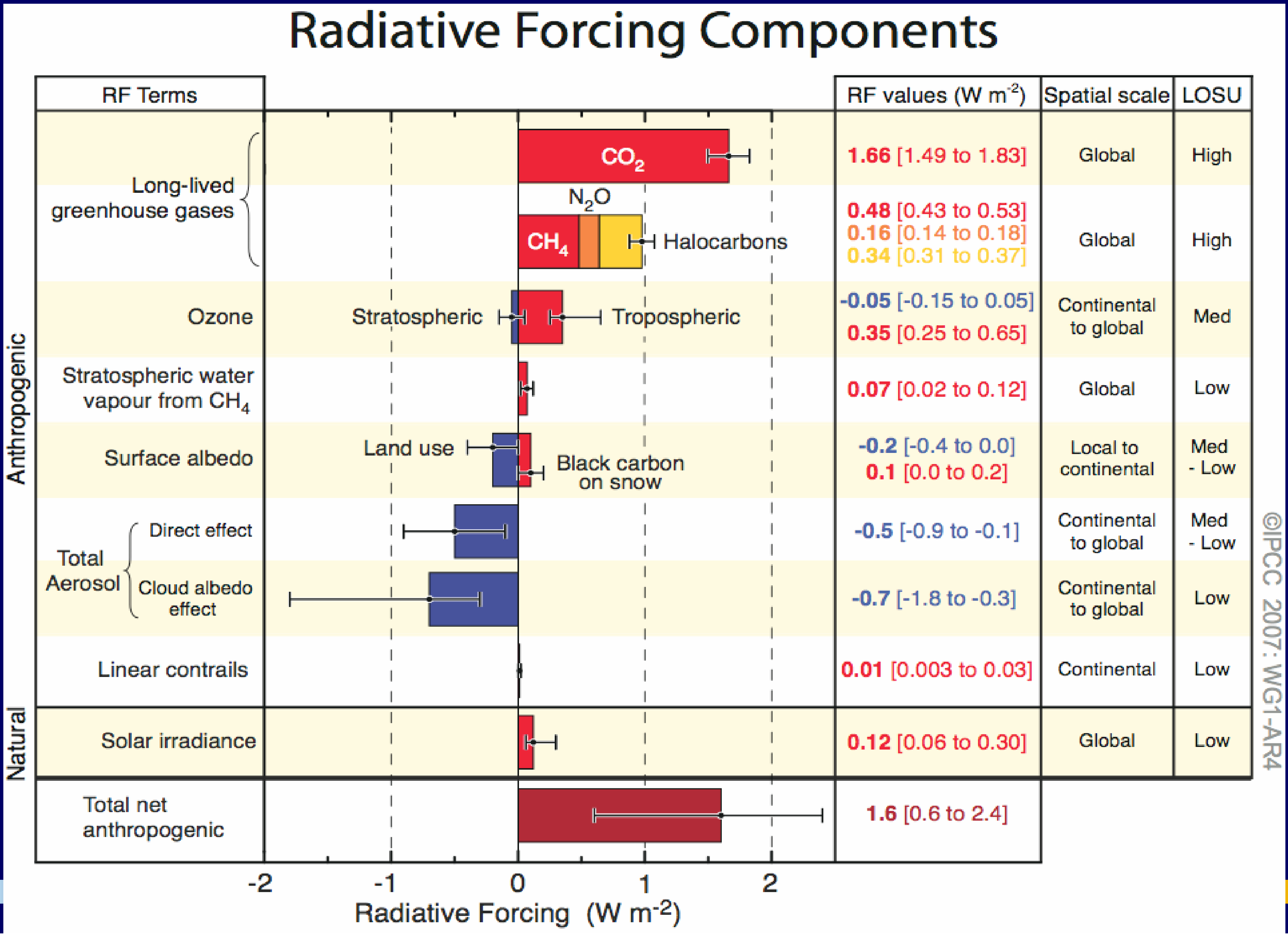


The most important spatial pattern of the monthly Palmer Drought Severity Index (PDSI) for 1900 to 2002.

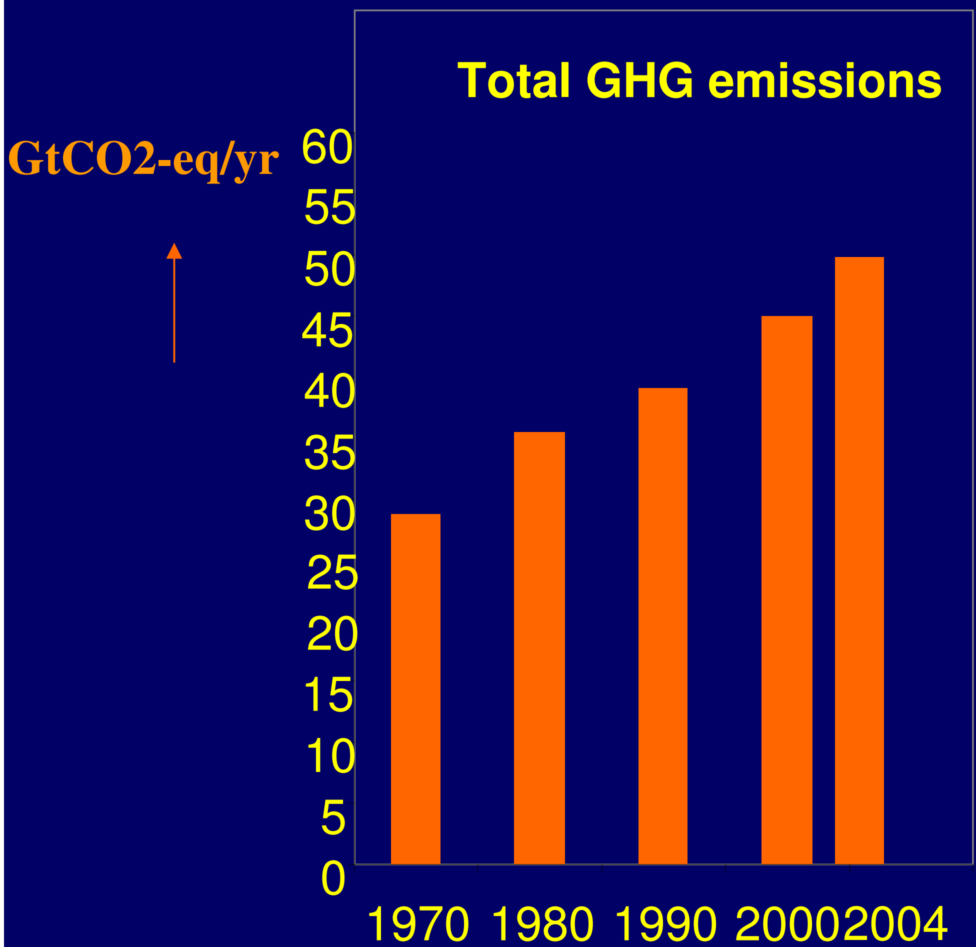


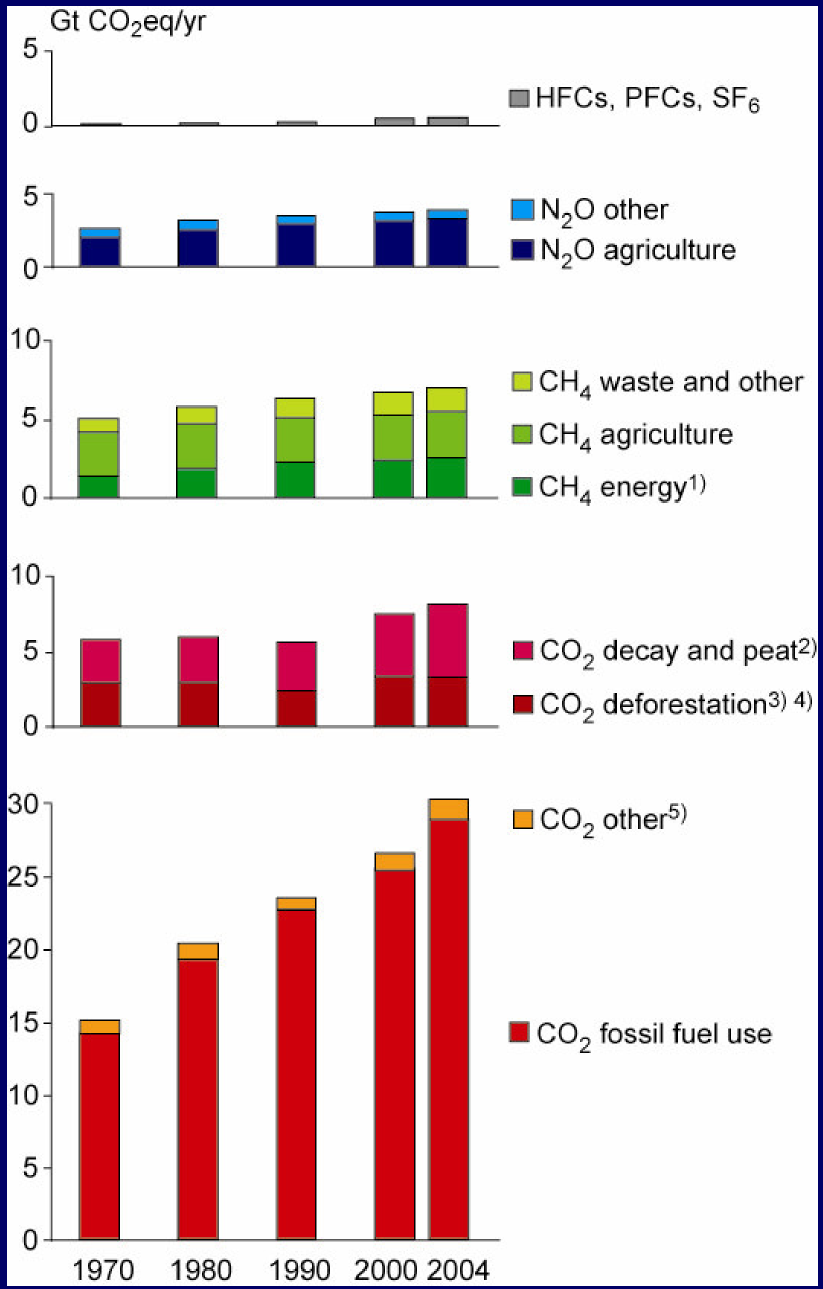
The atmospheric concentration of CO_2 and CH_4 in 2005 exceeds by far the natural range of the last 650,000 years

Global-average radiative forcing estimates and ranges

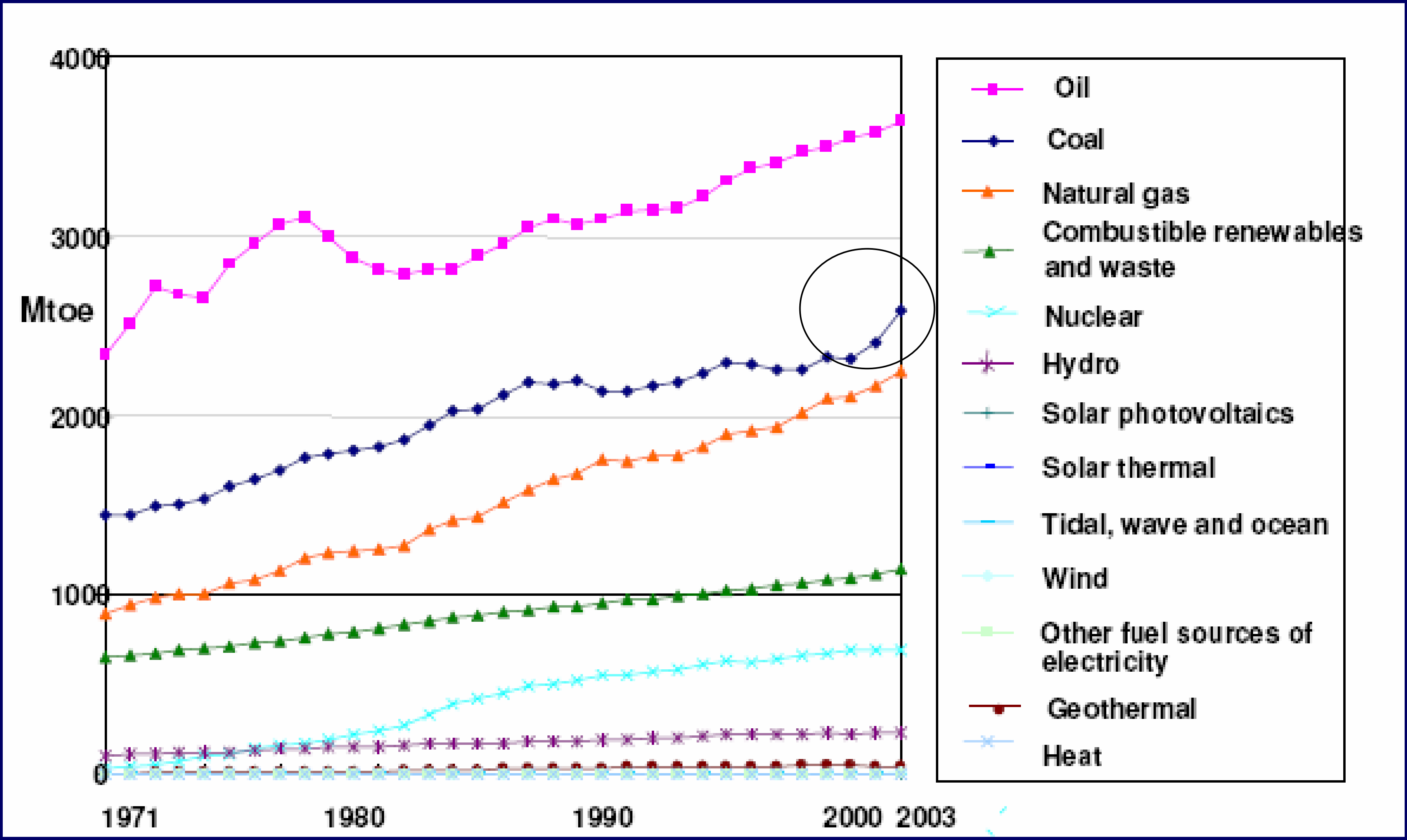


Between 1970 and 2004 global greenhouse gas emissions have increased by 70 %



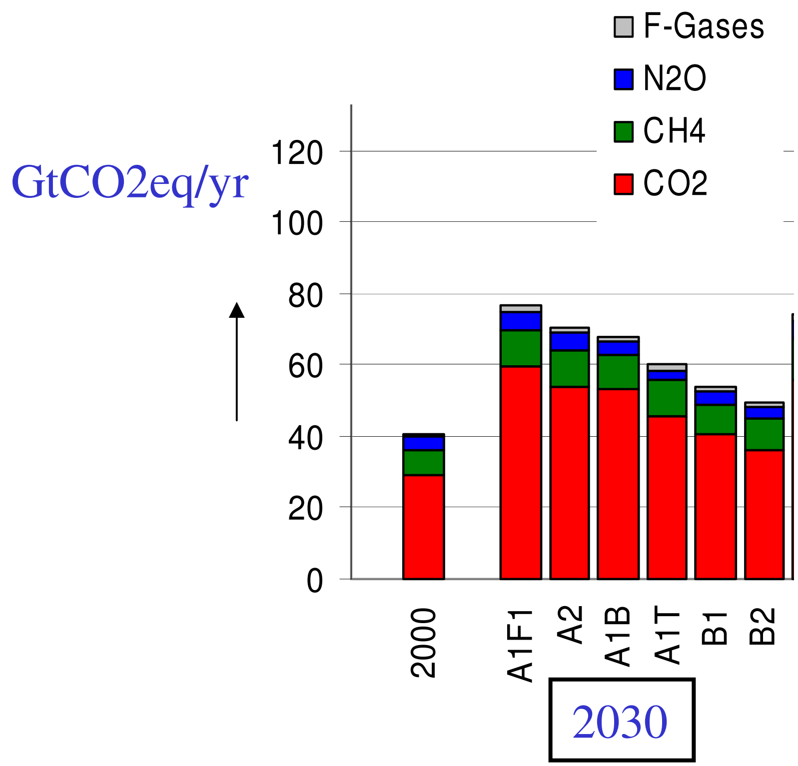


World primary energy consumption by fuel type



With current climate change mitigation policies global GHG emissions will continue to grow over the next few decades

- IPCC SRES scenarios:
  25-90 % increase of GHG emissions
  in 2030 relative to 2000

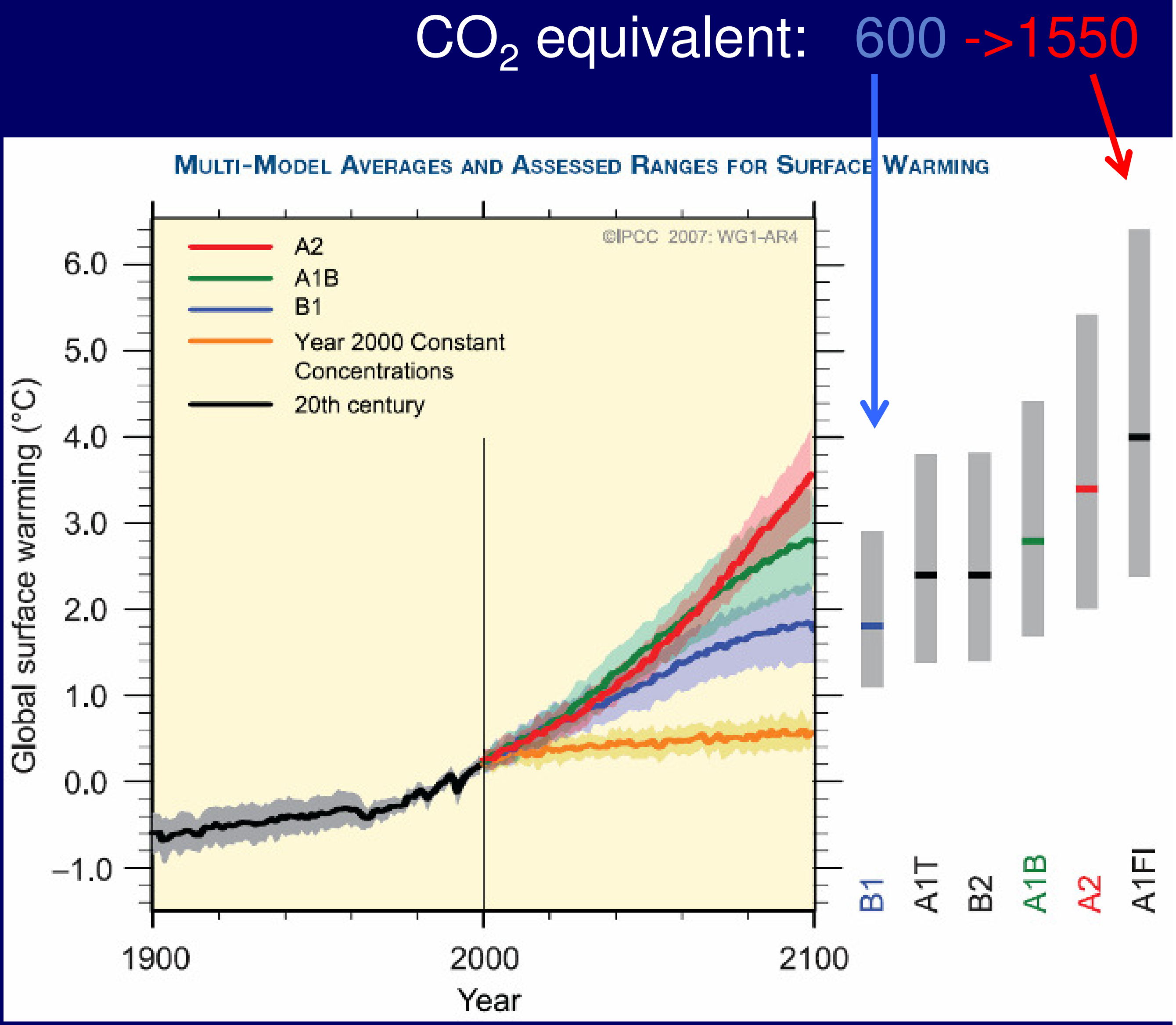


Projections of future climate changes

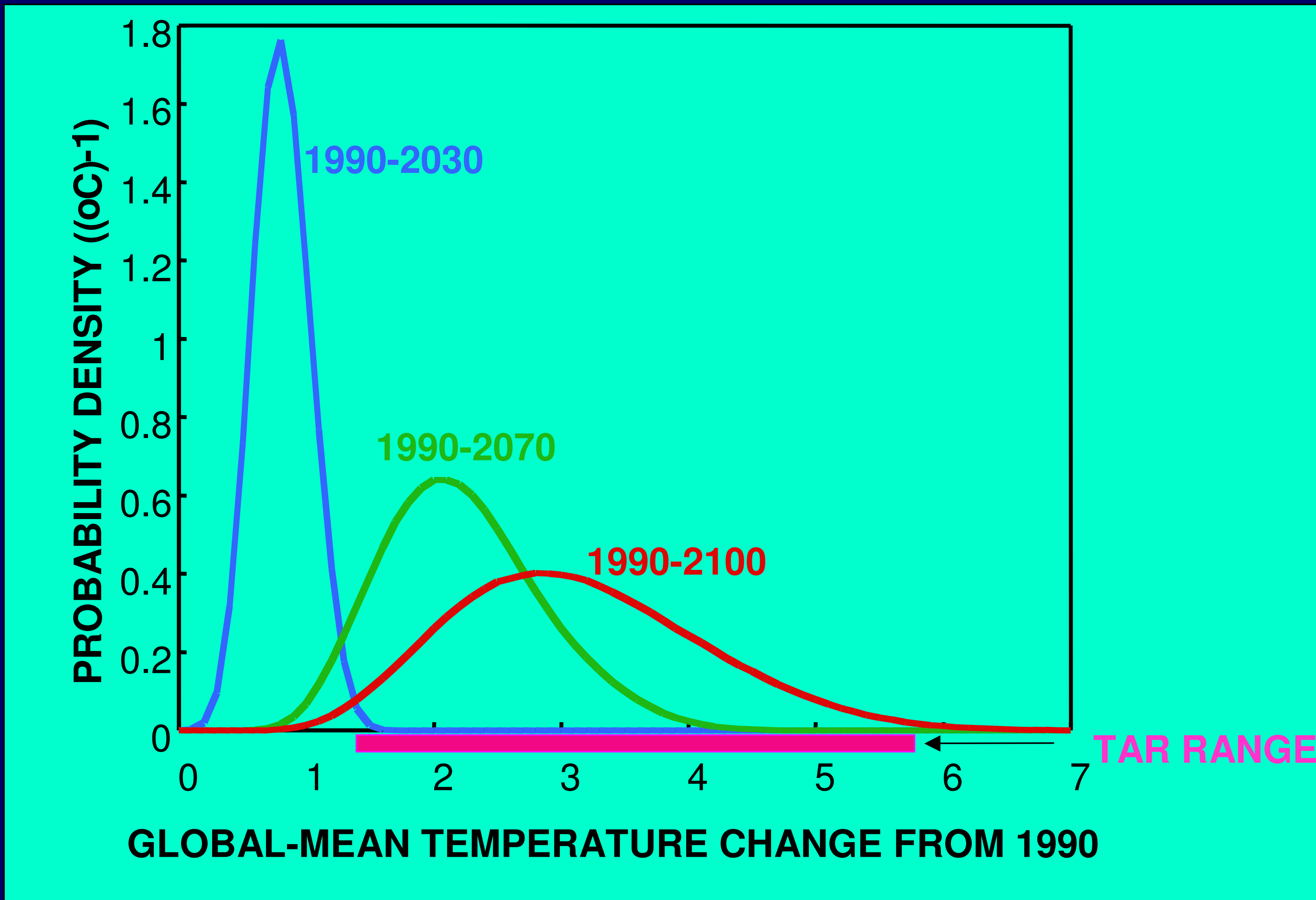
The future depends on human choices about emissions.

600 ppmv CO_2 equiv (B1) Best estimate is +1.8° C [likely 1.1-2.9° C] by 2100;

1550 ppmv (A1FI) Best 4° C [likely 2.4-6.4° C]



PROBABILISTIC PROJECTIONS OF GLOBAL WARMING



Stabilization levels

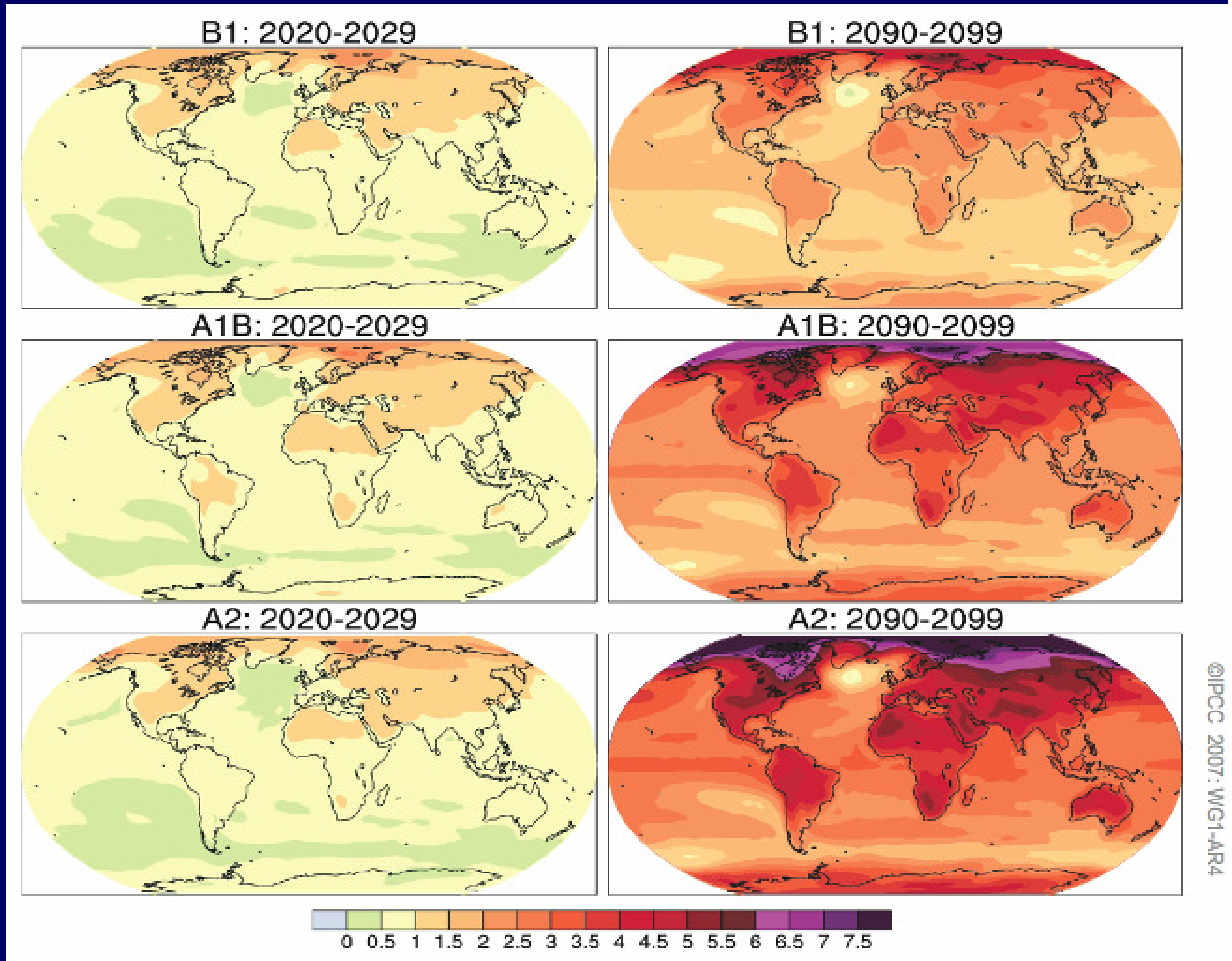
Concentration	Global mean Temperature increase	Peaking year	CO_2 emission change
ppm CO_2-eq	ºC	Year	Percent
445 – 490	2.0 – 2.4	2000 - 2015	-85 to -50
490 – 535	2.4 – 2.8	2000 - 2020	-60 to -30
535 – 590	2.8 – 3.2	2010 - 2030	-30 to +5
590 – 710	3.2 – 4.0	2020 - 2060	+10 to +60
710 – 855	4.0 – 4.9	2050 - 2080	+25 to +85
855 – 1130	4.9 – 6.1	2060 - 2090	+90 to +140

Projections of Future Changes in Climate

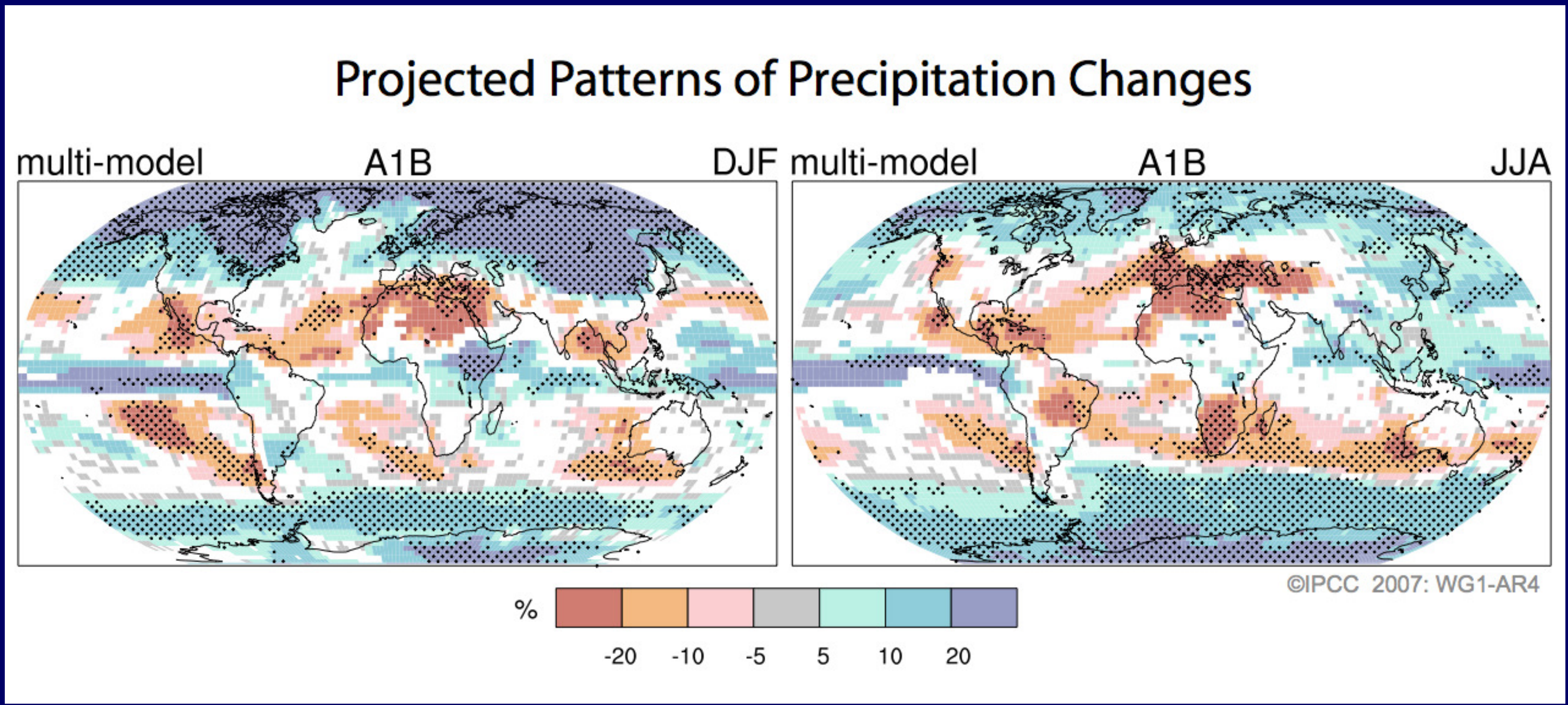
Projected warming in 21st century expected to be

greatest over land and at most high northern latitudes

and least over the Southern Ocean and parts of the North Atlantic Ocean



Projections of Future Changes in Climate



Precipitation increases *very likely* in high latitudes

Decreases *likely* in most subtropical land regions

Regions most affected

- The Arctic
- Sub-Saharan Africa
- Small islands
- Asian megadeltas

In EUROPE greatest impacts on

- Arctic regions
- Moisture-limited ecosystems
- Mediterranean

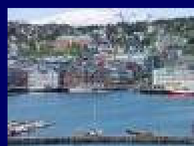
Vulnerable systems and sectors

- Some ecosystems:
  - **Coral reefs; sea-ice regions**
  - **Tundra, boreal forests, mountain and Mediterranean regions**
- Low-lying coasts, mangroves & salt marshes
- Water resources in mid-latitudes & dry Tropics
- Low-latitude agriculture
- Human health where adaptive capacity is low

20% - 30% of plants and animals at high risk of extinction

if ΔT 1.5℃ - 2.5℃

Europe
North ↔ South differences



N Europe

S Europe

Increased forest growth

(only in the beginning*?)*

⟺

Increased fire risk

Increased water availability
(*2070 ca.*↑*1/5*)

⟺

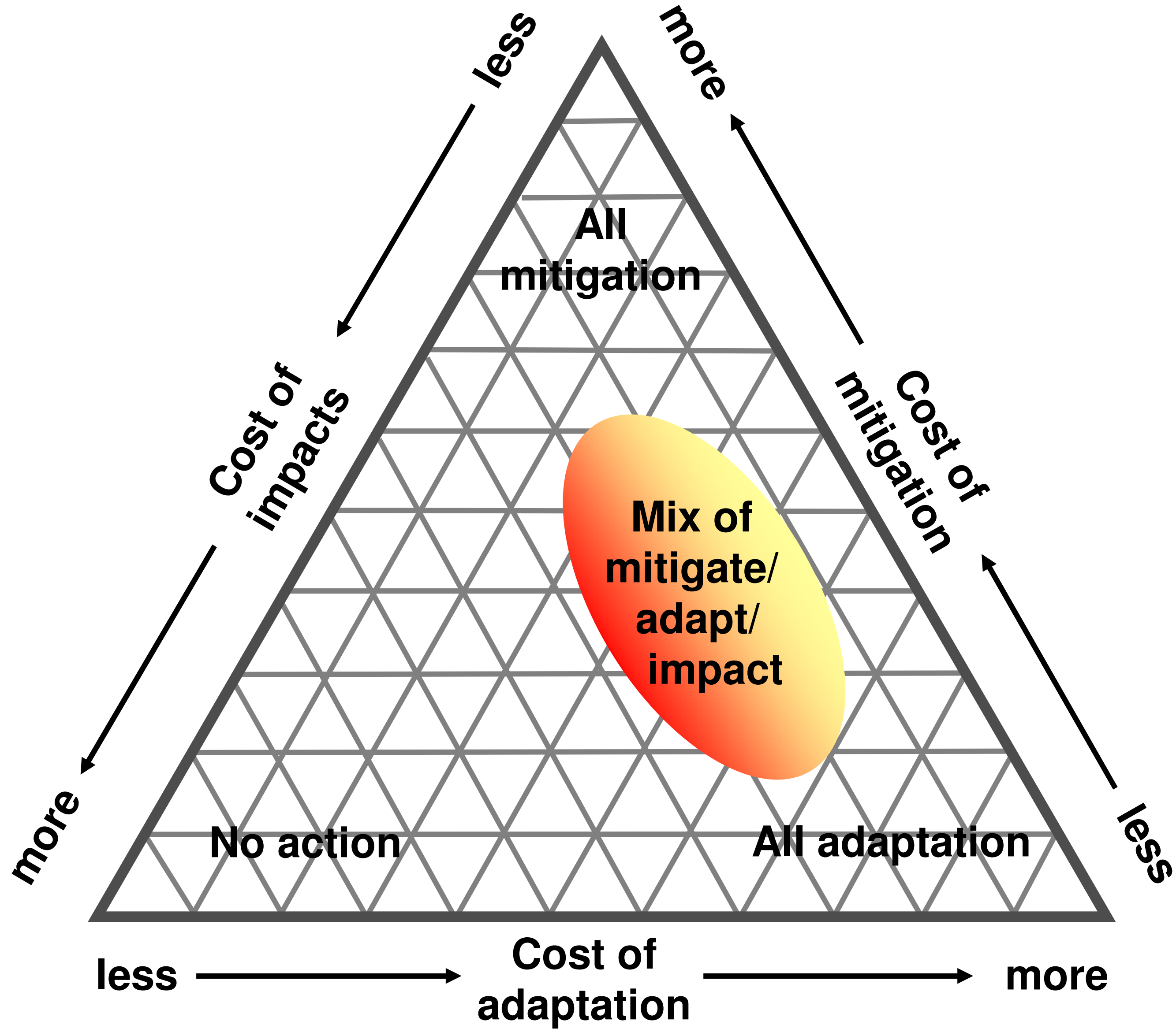
Decreased water availability
(*2070 ca.*↓*1/3*)

Increased yields
(only in the beginning*?*)

⟺

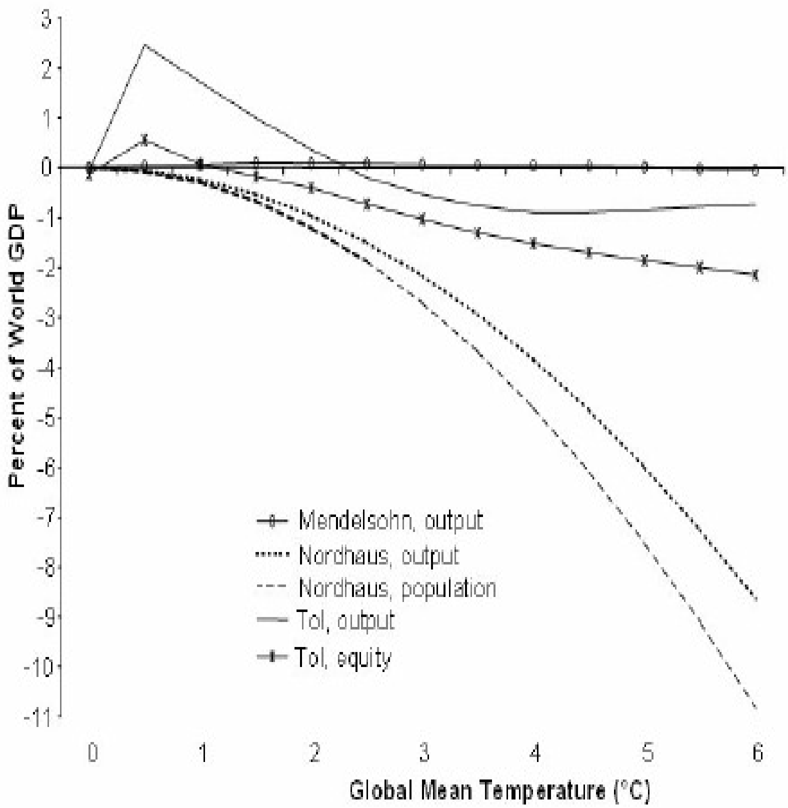
Decreased yields

Connections between mitigation, adaptation and impacts ?



(Holdridge diagram)

The economic damage will be large



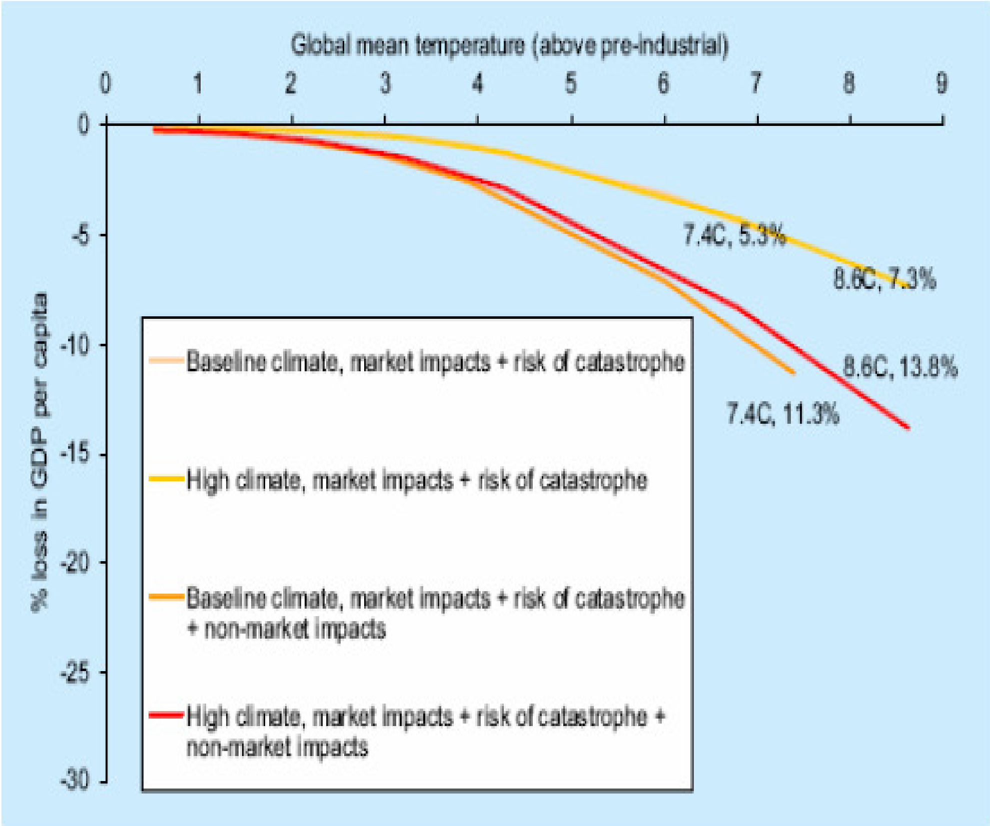


Figure 20.3a: *(left): Damage estimates, as a percent of global GDP, as correlated with increases in glob mean temperature. Source: IPCC, 2001b.* ***Figure 20.3b:*** *(right): Damage estimates, as a percent of globa GDP, as correlated with increases in global mean temperature. Source, Stern et al. (2006).*

The costs of stabilising the climate are manageable – delay would be dangerous and much more costly

1% GDP

Costs of mitigation to stabilise emissions at 550ppm by 2050

vs

5% GDP

Income losses if we do nothing: market impacts only

20% GDP

Income loss including non-market impacts, risk and equity

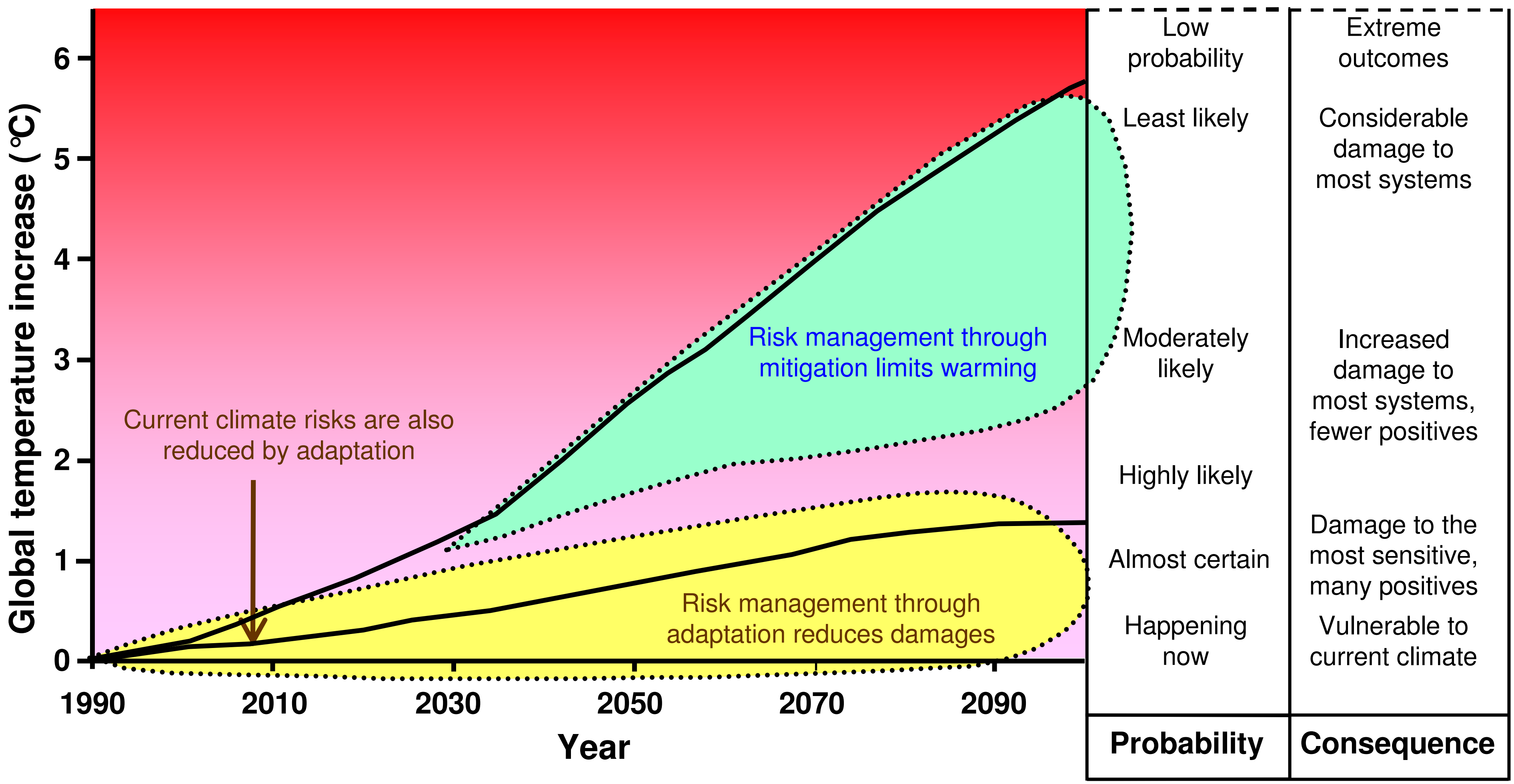
Damages from climate change rise disproportionately with temperature !!!

(A 25% increase in storm wind speeds is associated with an almost 7-fold increase in damages to buildings).

- Climate change could lead to floods, massive population shifts, and wars over natural resources.
- Ecosystems are unlikely to be able to adapt at the rapid rates of change expected.

Stern Review (2006)

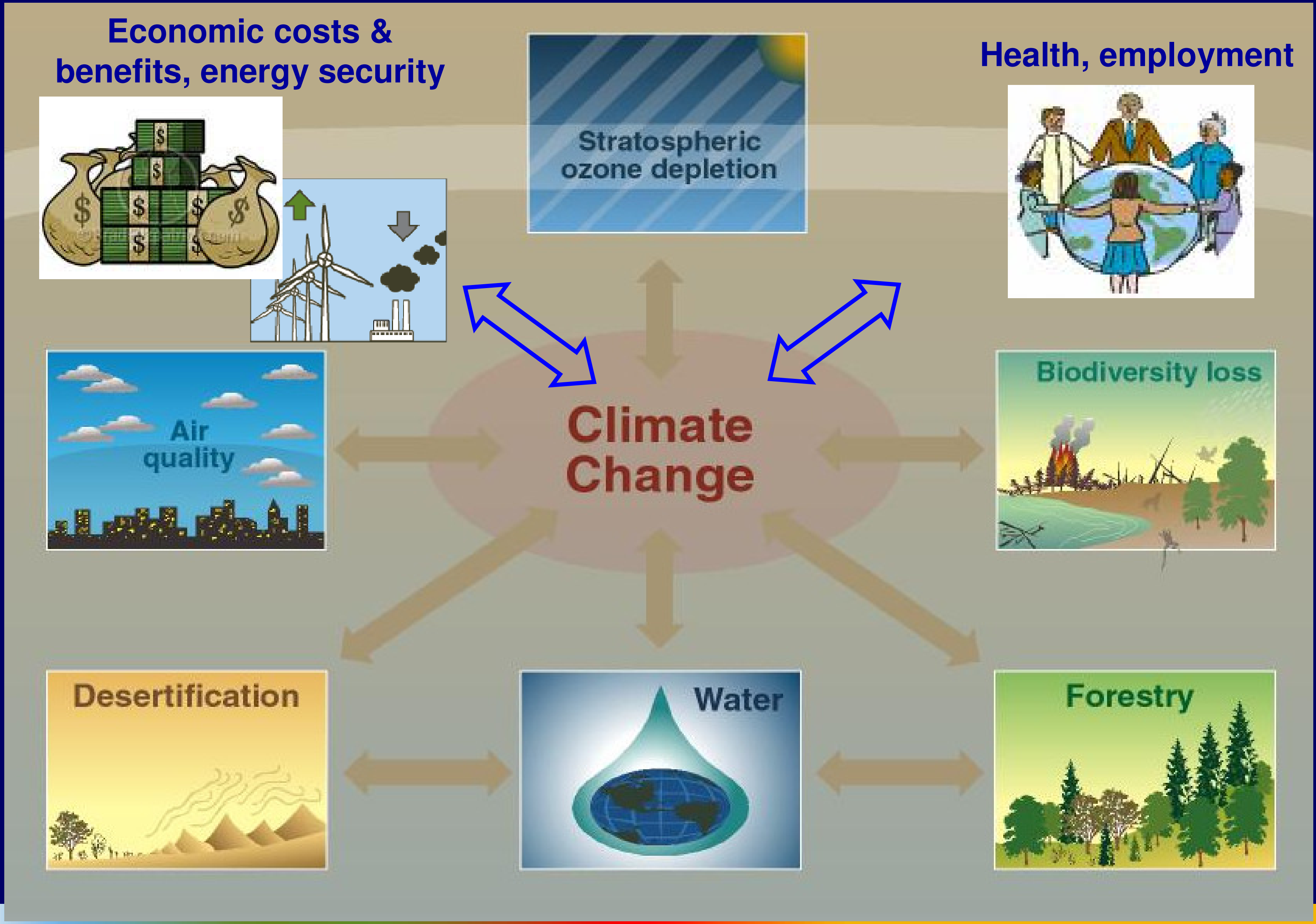
Synthesis of risk assessment approach to global warming



Risk = Probability x Consequence

Climate change and sustainable development

3 dimensions of sustainable development: economic/social/environmental



Two-way Relationship Between Climate Change and Sustainable Development

Examples of side-effects of climate mitigation

OPTIONS	SYNERGIES	TRADEOFFS
Energy: efficiency, renewables, fuel-switching 	• air quality • supply security • employment • costs (efficiency)	• particulate emissions (diesel) • biodiversity (biofuels) • costs (renewables)
Forestry: reduce deforestation, plant trees 	• soil protection • water management • employment • biodiversity (deforest.)	• biodiversity (plantations) • competition food production
waste: landfill gas capture, incineration 	• health & safety • employment • energy advantages	• ground water pollution • costs

Climate policy alone will not solve the climate change problem

- *Macro-economic policy*: taxes, subsidies, other fiscal policies, structural adjustment
- *Trade policy:* "embodied carbon", removing barriers for low-carbon products, domestic energy sources
- *Energy security policy :* efficient energy use, domestic energy sources (low-high carbon)
- *Access to modern energy:* bioenergy, poverty tariffs
- *Air quality policy:* clean fuel
- *Bank lending policies*: lending for efficiency/ renewables, avoid lock-in into old technologies in developing countries
- *Insurance policy:* Differentiated premiums, liability insurance exclusion, improved conditions for green products

How can emissions be reduced?
Example: transport

(Selected) Key mitigation technologies and practices currently commercially available	Key mitigation technologies and practices projected to be commercialized before 2030 (Selected)
More fuel efficient vehicles; hybrid vehicles; biofuels; modal shifts from road transport to rail and public transport systems; cycling, walking; land-use planning	Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries

Biofuel potential 2030:

- Depends on production pathway, vehicle efficiency, oil and carbon prices
- 3% of global transport energy in 2030
- 5-10% , if cellulose biomass is commercialised
- Watch out for: land and water availability, competition with food !!!

Selected environmentally effective sectoral policies, measures and instruments

Example: transport

Policies, measures and instruments shown to be environmentally effective	Key constraints or opportunities
Mandatory fuel economy, biofuel blending and CO_2 standards for road transport	Partial coverage of vehicle fleet may limit effectiveness
Taxes on vehicle purchase, registration, use and motor fuels, road and parking pricing	Effectiveness may drop with higher incomes
Influence mobility needs through land use regulations, and infrastructure planning	Particularly appropriate for countries that are building up their transportation systems
Investment in attractive public transport facilities and non-motorised forms of transport	

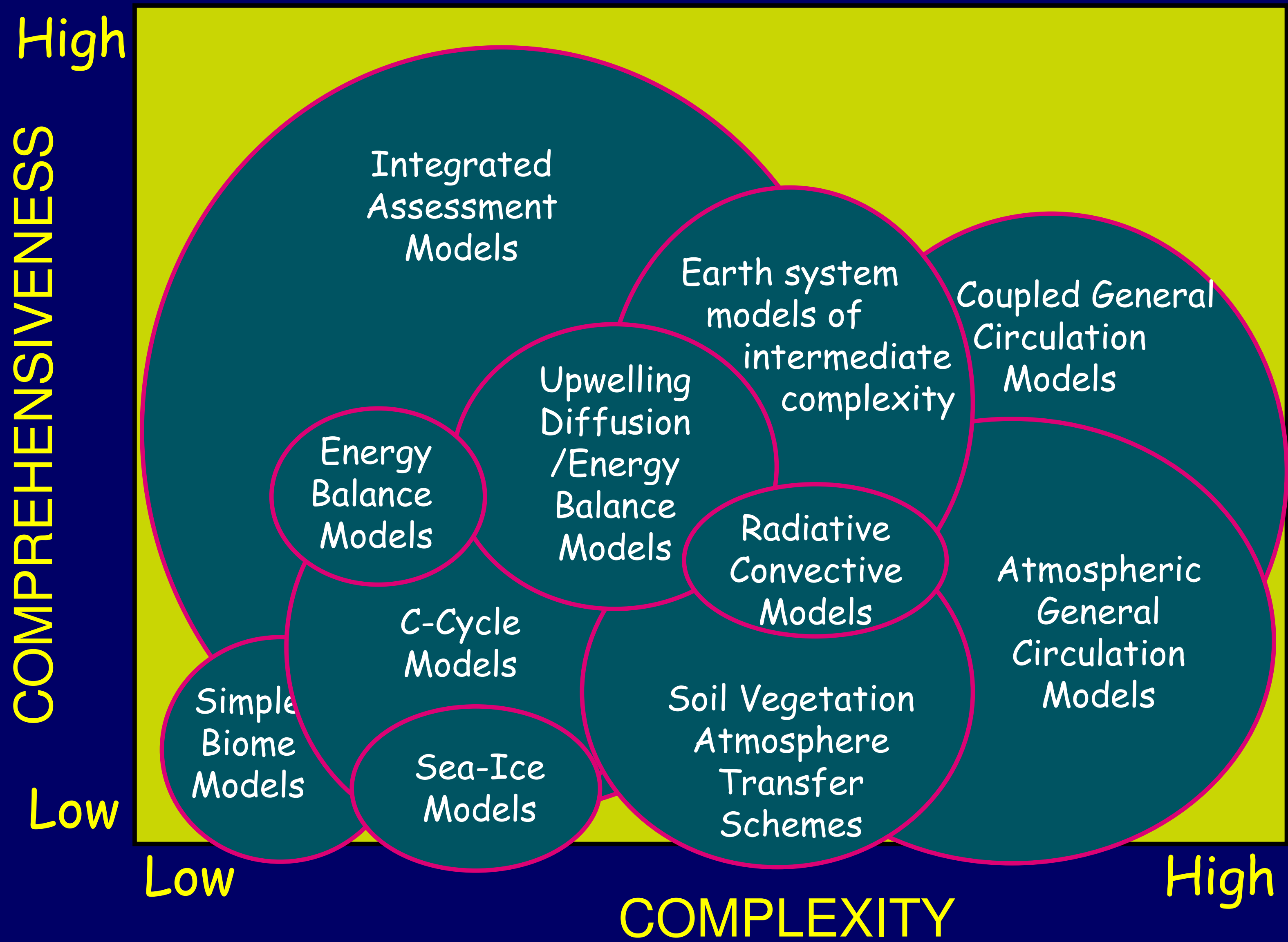
3 Ways to Broaden Climate Policies (Mitigation and Adaptation)

"Climate first" — from climate to development policy — "Development first"

International negotiations — from global agreement to local action — Local and sector actions

State — from government to governance — All actors (state, market, civil society)

Comparison of different models used for IPCC



IPCC priorities for climate observations

regarding Space Tools and Solutions for Monitoring the Atmosphere

- Maintain current satellite radiance and earth radiation budget climate data records which includes surface sensing channels.
- Ensure a year’s overlap between successive satellite systems for sounding atmospheric temperature and water vapour
- Reprocess of satellite records of climate variables: Hurricanes (intensity, size, duration, track); clouds, Top of Atmosphere radiation, Sea Surface Temperature, sea ice, precipitation, snow cover extent and thickness, ocean winds and surface fluxes

Conclusions

- **Global warming is real**: temperature has increased over the last 100 years, a rate and scale likely to have been greater than at any time in at least the past 1000 years.
- **Global warming is man-made**: most of the warming over the last 50 years is attributable to greenhouse gases from human activities.
- There is a rapidly emerging urgency for both adaptive and mitigative action
- **The challenge is to stabilise global GHG concentrations** at a level that will avoid the worst of climate change risks

Conclusions (cont.)

- The costs of stabilising the climate are manageable – delay would be dangerous and much more costly
- Mainstreaming climate mitigation in development decisions with climate consequences is essential
- Sustainable development can reduce vulnerability
- Challenges exist in how we manage the sheer complexity of climate change and the response options