

Climate Change, IPCC, Policymakers, and Education



Prof. Jean-Pascal van Ypersele

**IPCC Vice-Chair,
(Université catholique de Louvain,
Louvain-la-Neuve, Belgium),**

**www.ipcc.ch & www.climate.be
vanyp@climate.be**

**The 2011 International Forum for a Low Carbon
Vision, Taipei (Taiwan), 23 March 2011**

**NB: The support of the Belgian Science Policy
Office is gratefully acknowledged**

Outline



⌘ Introduction:

- ☑ Climate Change

- ☑ What is the IPCC?

⌘ What does IPCC tell us about the challenge and opportunities of climate change?

- ☑ IPCC Group 1: climatology

- ☑ IPCC Group 2: impacts, vulnerability, & adaptation

- ☑ IPCC Group 3: mitigation

⌘ Role of policy makers and education

Introduction



Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

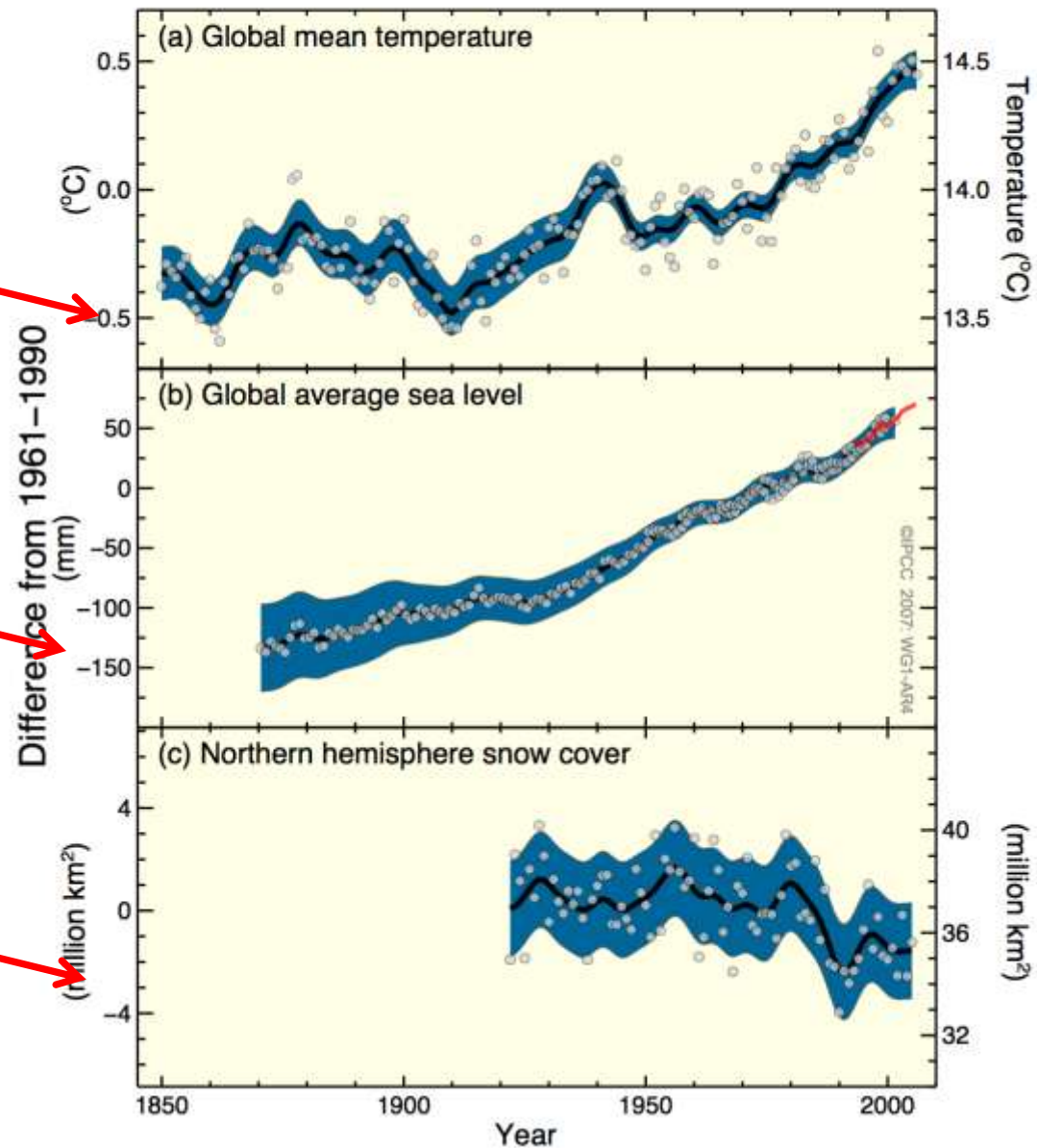
Warming is Unequivocal

Rising atmospheric temperature

Rising sea level

Reductions in NH snow cover

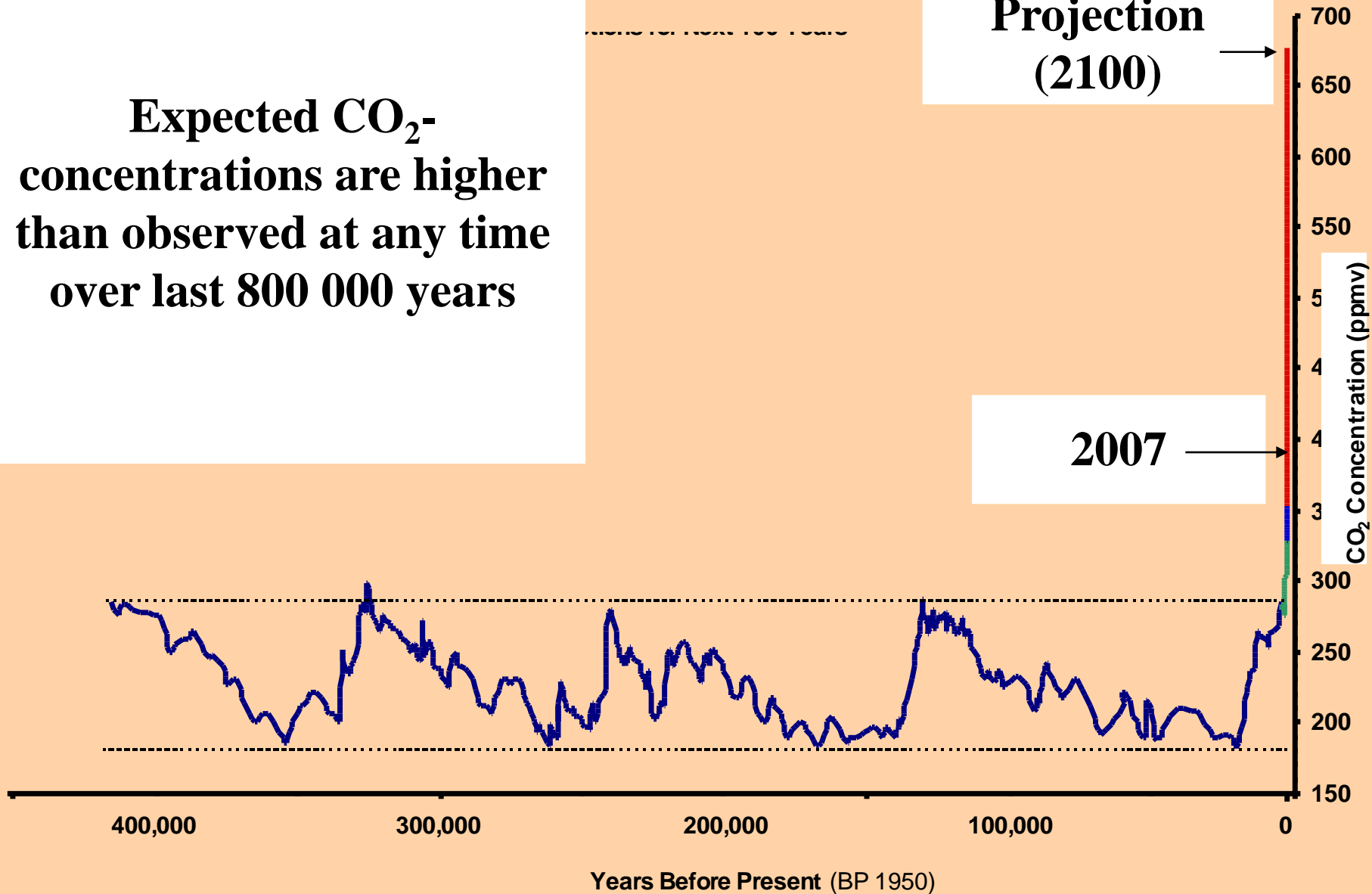
Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover



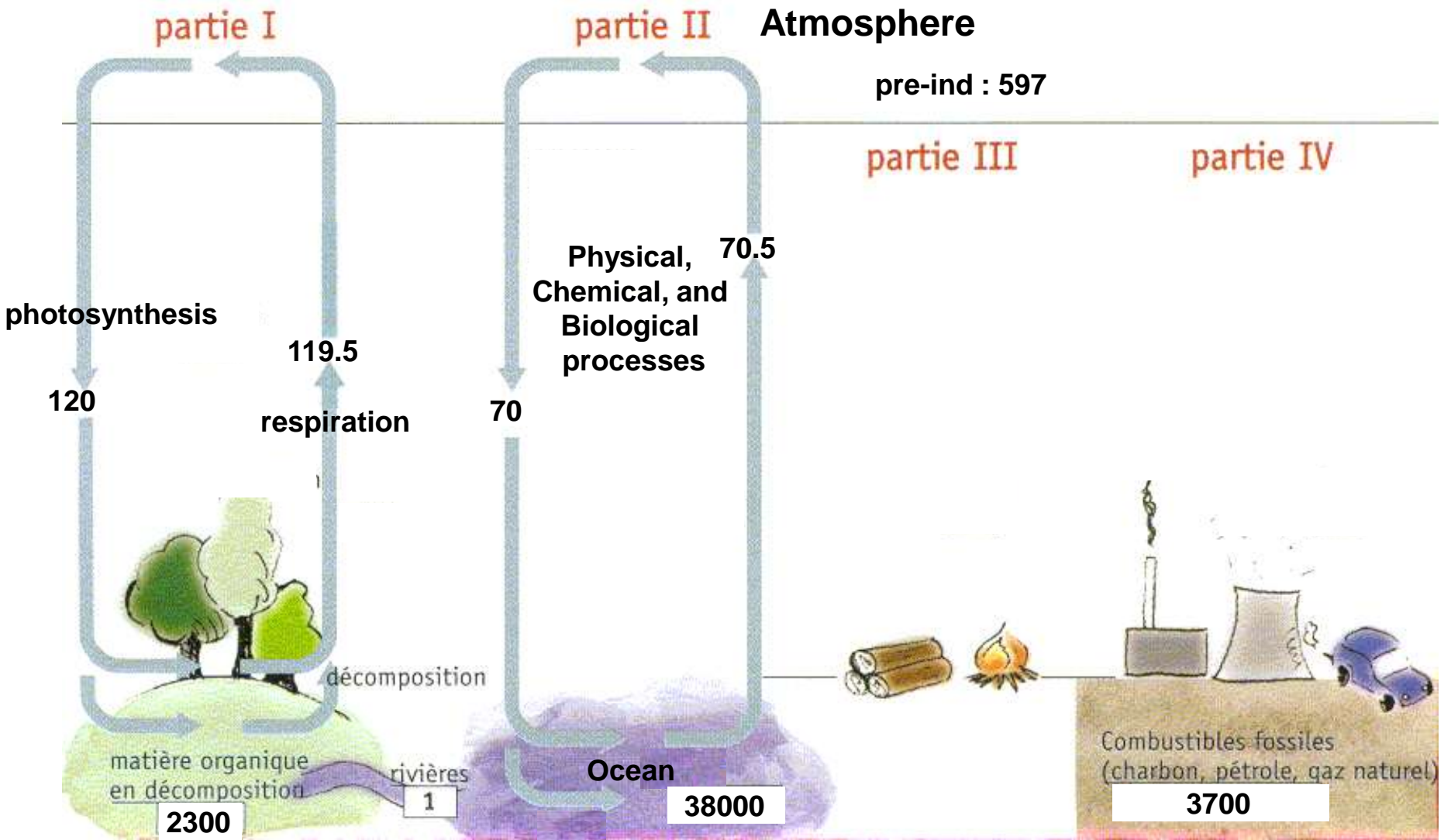
**Expected CO₂-
concentrations are higher
than observed at any time
over last 800 000 years**

**Projection
(2100)** →

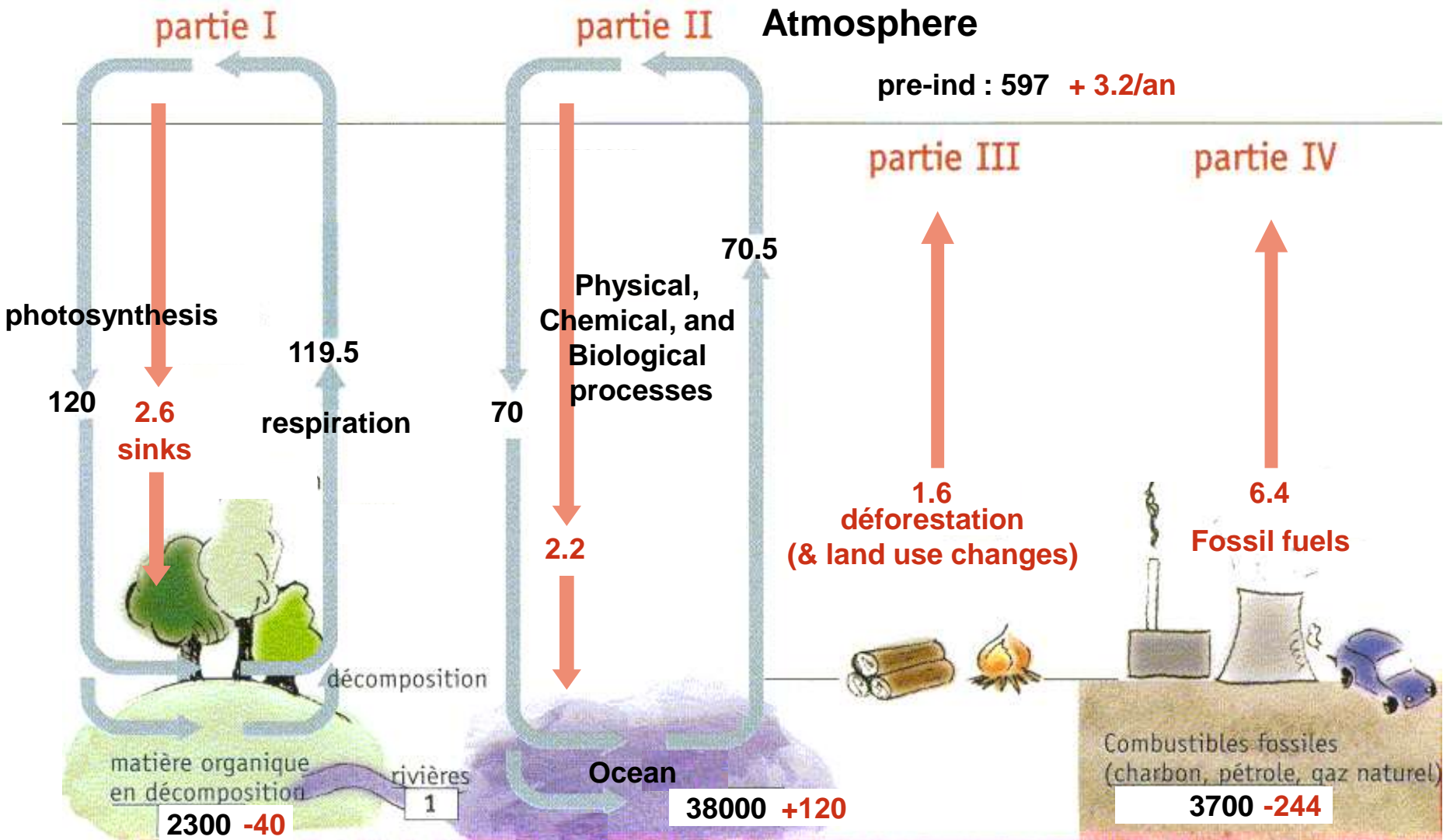
2007 →



Carbon cycle



Carbon cycle



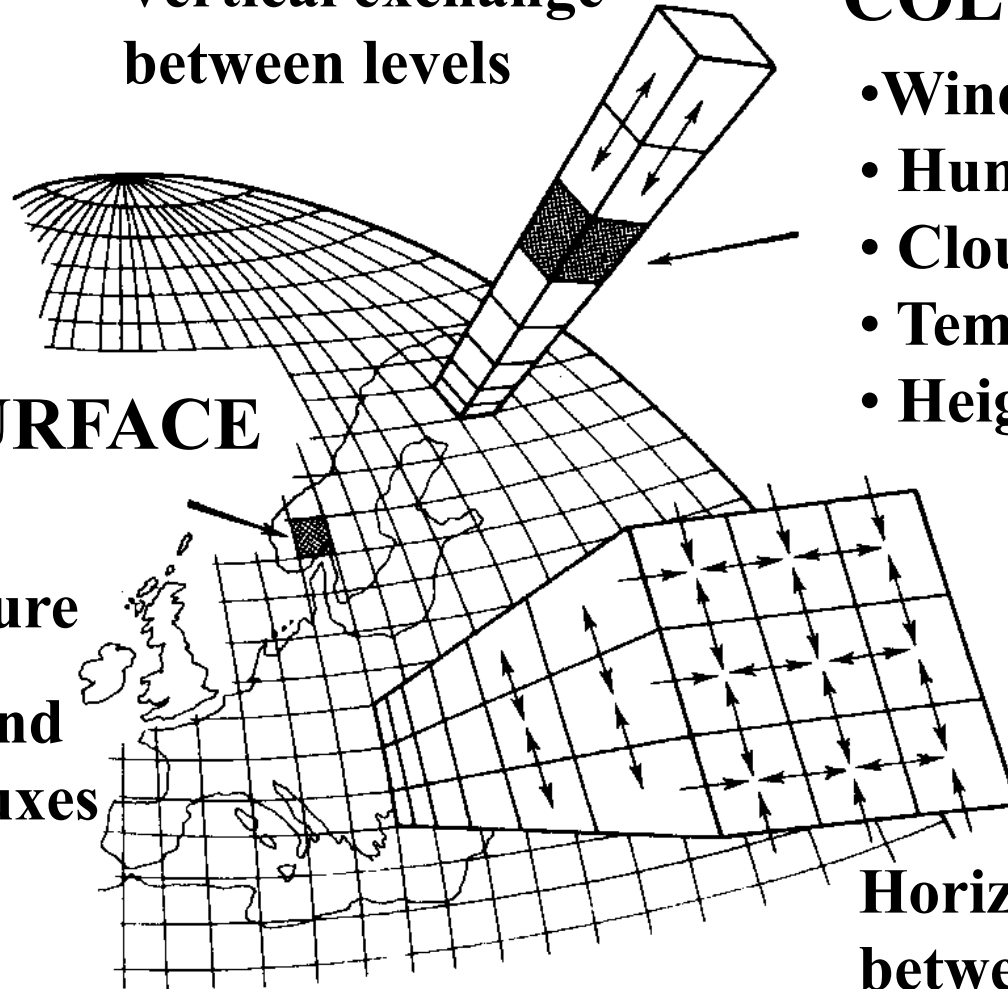
Units: GtC (billions tons of carbon) or GtC/year

A climate model:

IN THE ATMOSPHERIC COLUMN

Vertical exchange
between levels

- Wind vectors
- Humidity
- Clouds
- Temperature
- Height



AT THE SURFACE

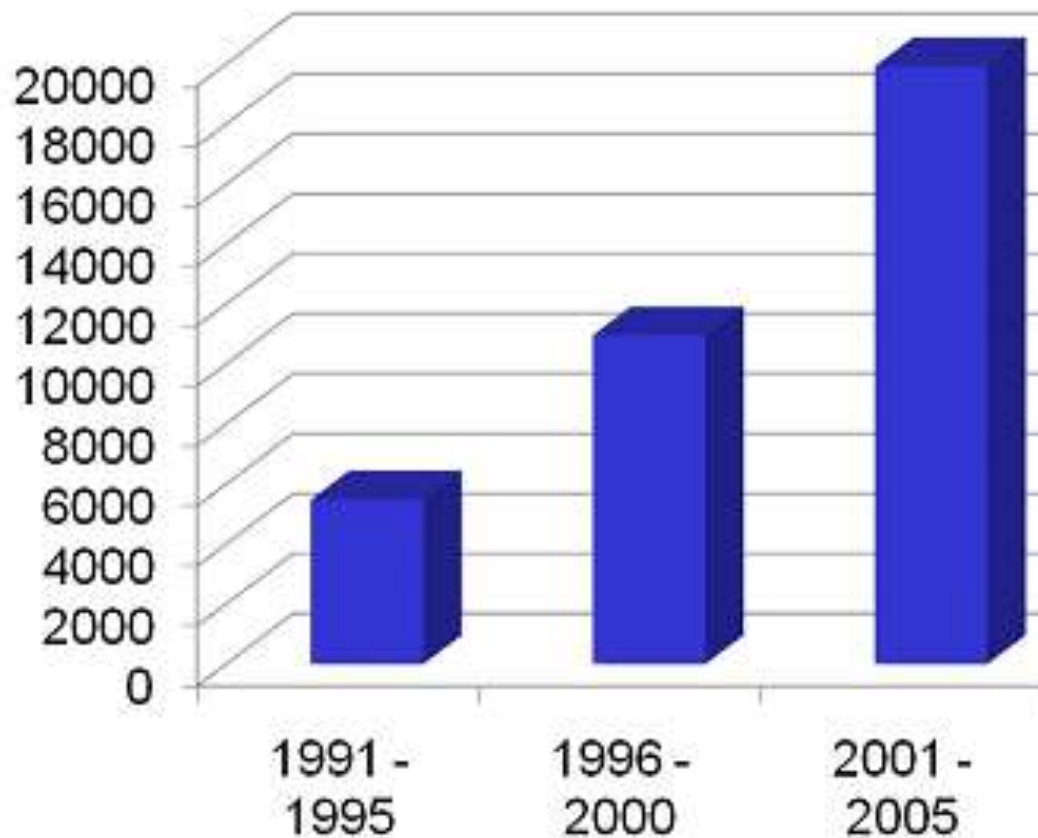
- Ground temperature
- Water and energy fluxes

Horizontal exchange
between columns

Time step ~ 30 minutes

Grid spacing ~ 3°x 3°

Number of papers published on climate change




The IPCC



Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

What is the IPCC (GIEC in French) ?

- ⌘ IPCC : Intergovernmental Panel on Climate Change
- ⌘ Created by World Meteorological Organisation (WMO) & United Nations Environment Programme (UNEP) in 1988
- ⌘ Mandate : assess the science of climate change, impacts and adaptation, mitigation options
- ⌘ Publishes consensus reports (1990, 1996, 2001, 2007) (Cambridge University Press)
Advises Climate Change Convention
- ⌘ Nobel Peace prize (2007)
- ⌘ Web : <http://www.ipcc.ch>



IPCC Reports are
policy-relevant,
NOT
policy-prescriptive

Jean-Pascal van Ypersele
(vanypers@astr.ucl.ac.be)

IPCC Structure



⌘ 3 Working Groups, 1 Task Force

⌘ WG1: Physical basis for climate change

⌘ WG2: Impacts, adaptation & vulnerability

⌘ WG3: Mitigation (emission reductions)

⌘ TF: Emission inventories (methodologies)

The IPCC Fourth Assessment Report (2007)

+130 countries

around 450 lead authors

around 800 contributing authors

+2500 scientific expert reviewers

+18000 peer-reviewed publications cited

+90000 comments from experts and Governments

Completed IPCC Reports

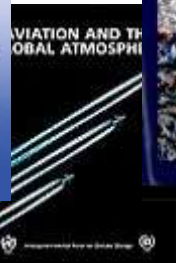
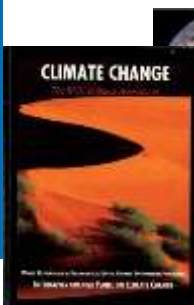
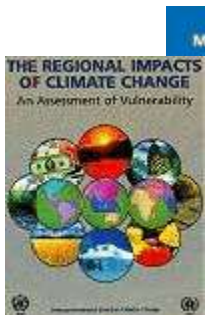
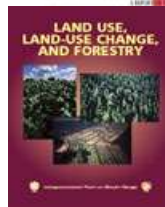
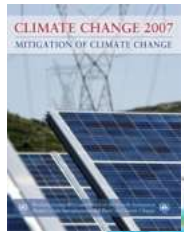
4 Assessment Reports (1990, 1995, 2001, 2007)

1992 Supplementary Report and 1994 Special Report

7 Special Reports (1997, 1999, 2000, 2005)

Guidelines for National GHG Inventories, Good Practice Guidance (1995-2006)

6 Technical Papers (1996-2008)





⌘ IPCC Working Group I: climatology

Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

The IPCC WG1 Sequence (1).....

IPCC (1990) “The size of this warming is broadly consistent with predictions of climate models, but it is also of the same magnitude as natural climate variability (...) The unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more”

IPCC (1995) “The balance of evidence suggests a discernible human influence on global climate”

The IPCC WG1 Sequence (2).....

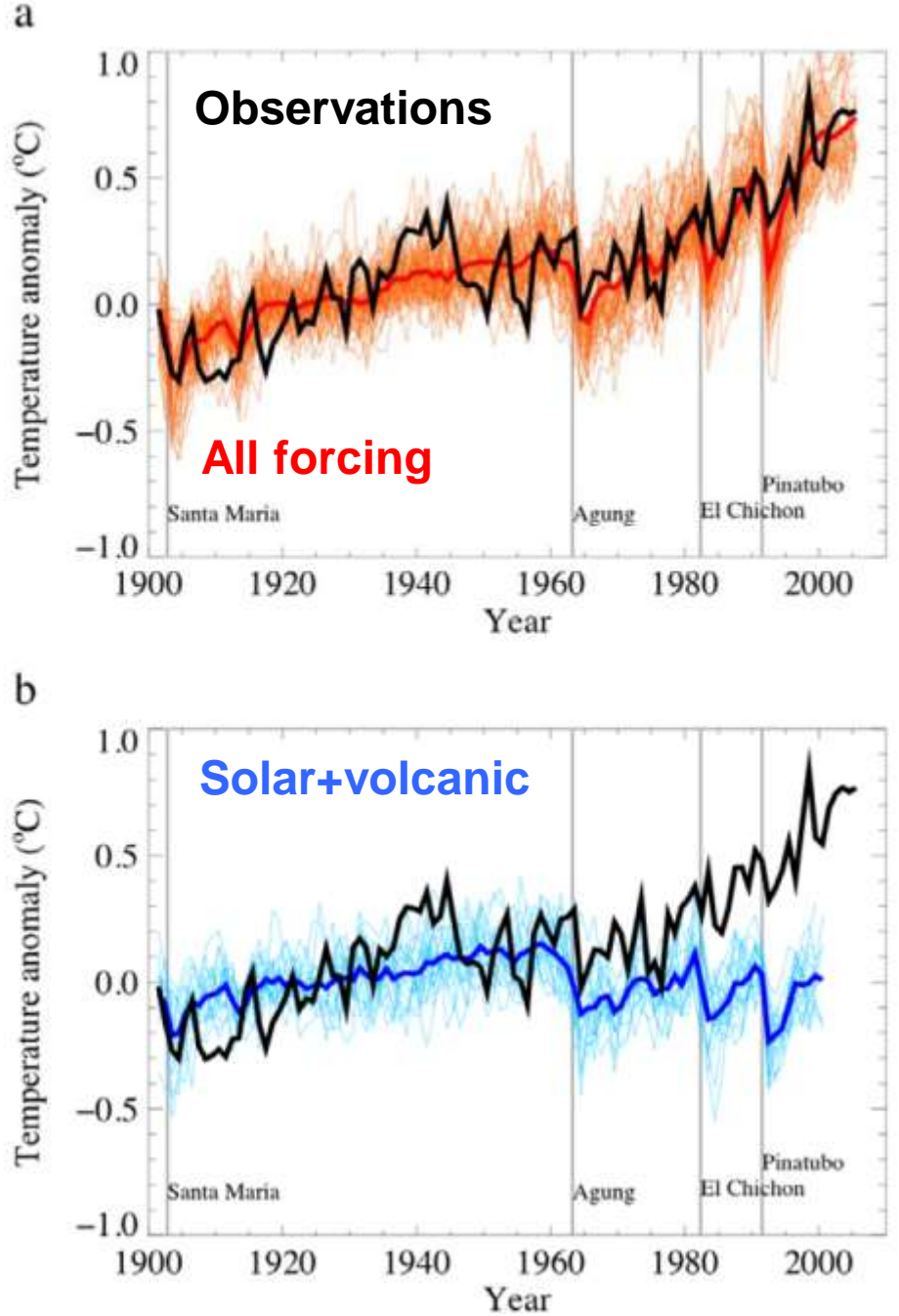
IPCC (2001) “Most of the observed warming over the last 50 years is likely ($P > 66\%$) to have been due to the increase in greenhouse gas concentrations.”

IPCC (2007) “Warming is unequivocal, and most of the mid-20th century is very likely ($P > 90\%$) due to the observed increase in anthropogenic greenhouse gas concentrations”

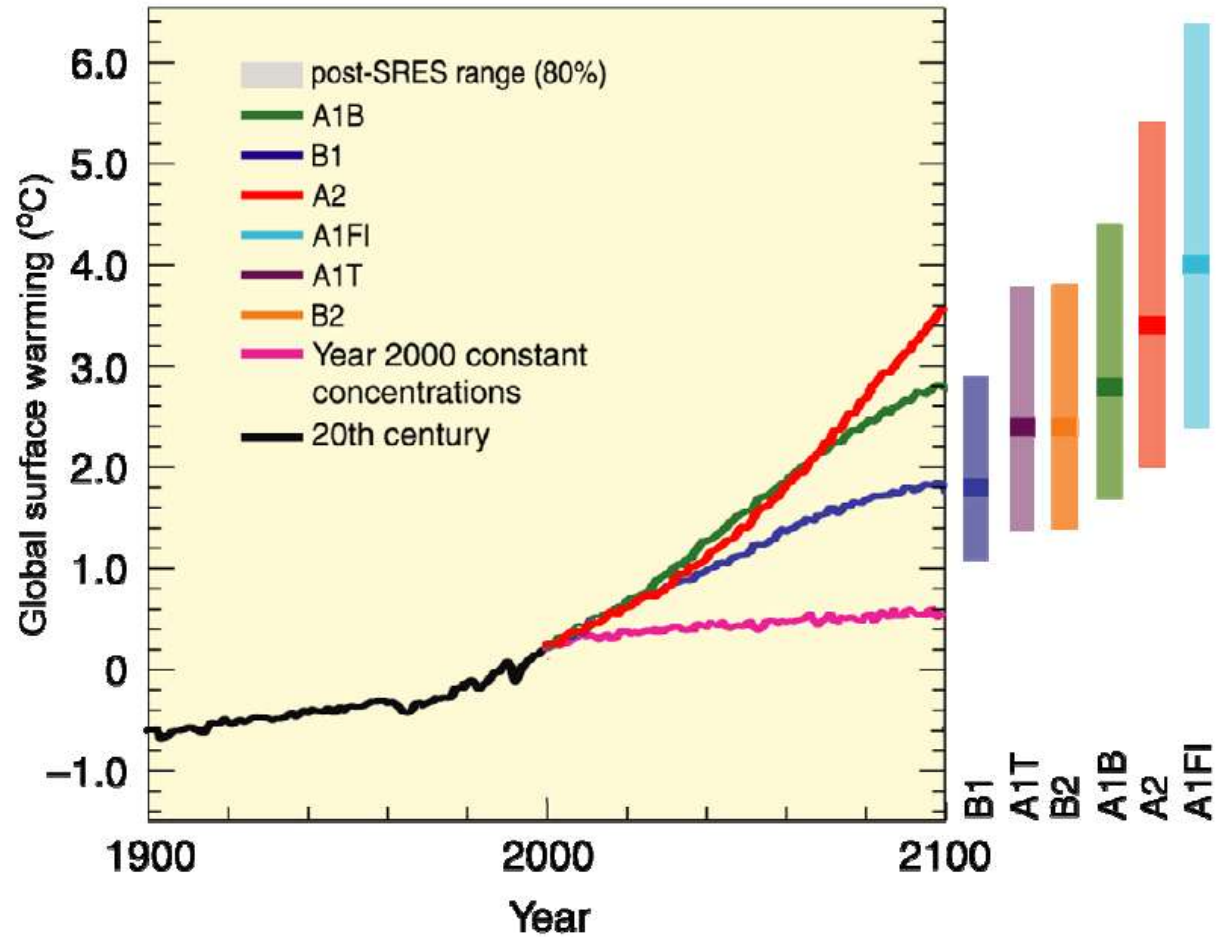
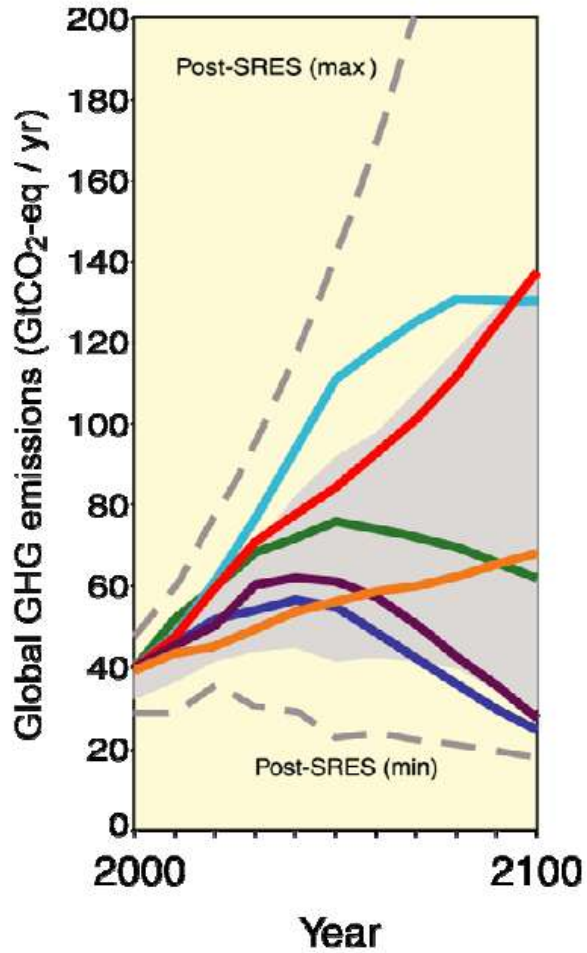
Attribution

Are observed changes consistent with expected responses to natural forcings?

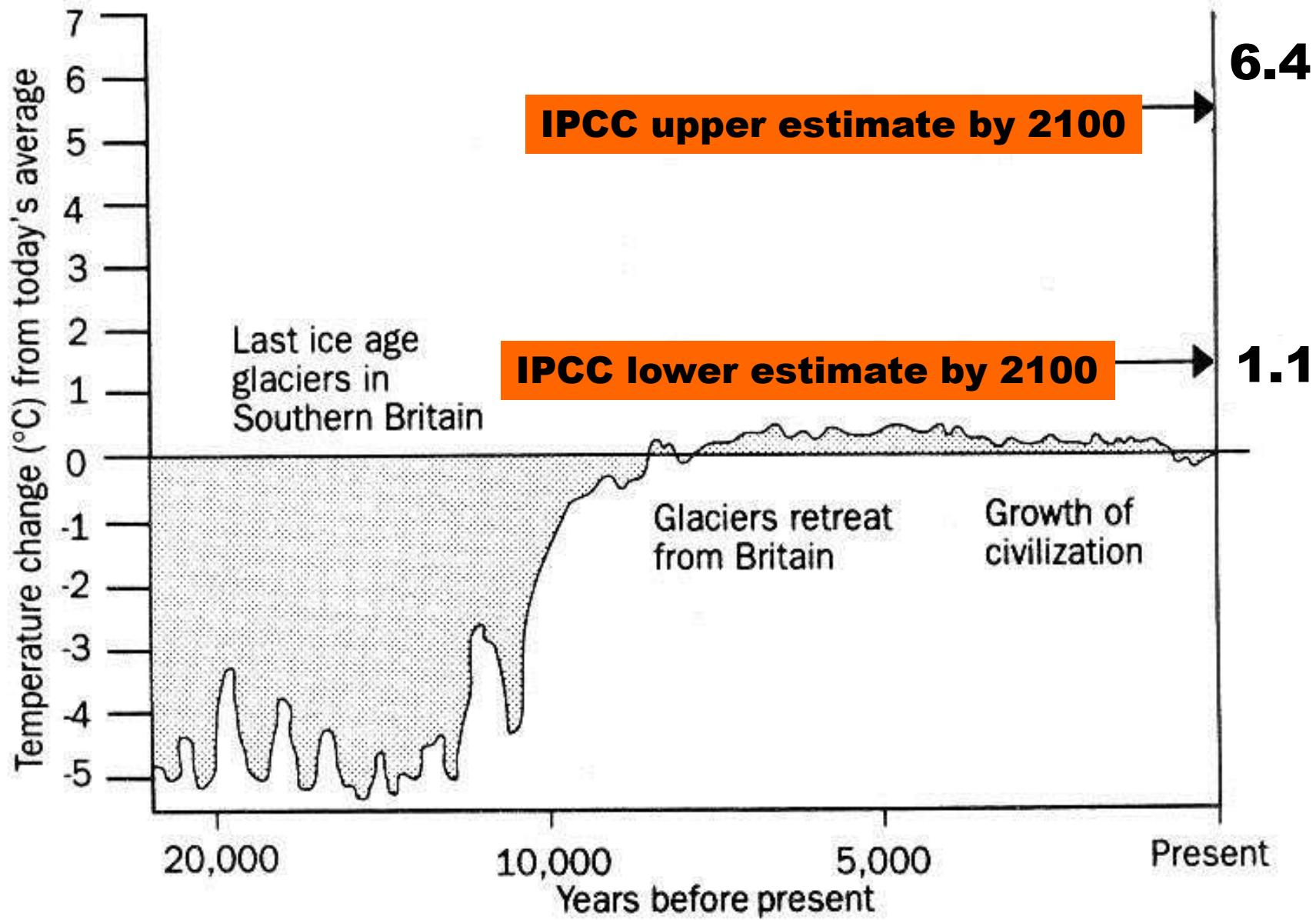
IPCC (2007):
“Warming is unequivocal, and most of the warming of the past 50 years is very likely (90%) due to increases in greenhouse gases.”



Climate projections without mitigation

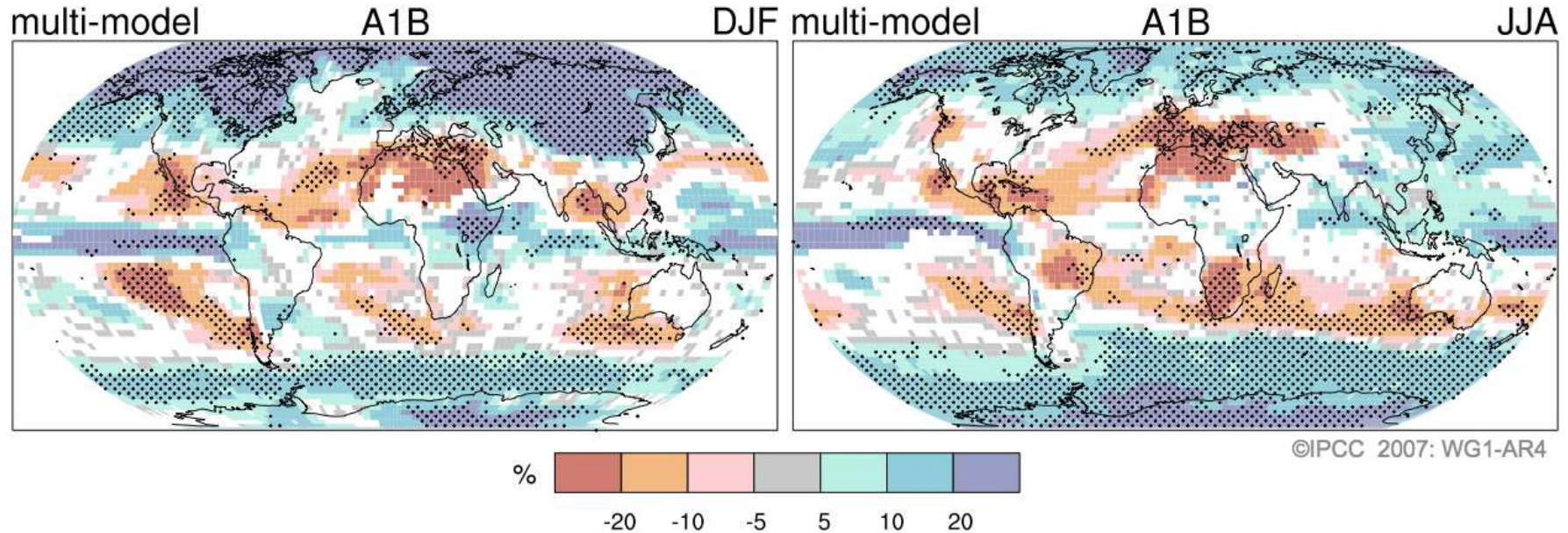


NB: écart par rapport à la moyenne 1980-1999



Projections of Future Changes in Climate (A1B in 2100)

Projected Patterns of Precipitation Changes



Brand new in AR4: Drying in much of the subtropics, more rain in higher latitudes, continuing the broad pattern of rainfall changes already observed.

Assessment of projected climate change for Asia

All of Asia is very likely to warm during this century; the warming is likely to be well above the global mean in central Asia, the Tibetan Plateau and northern Asia, above the global mean in **East and South Asia**, and similar to the global mean in Southeast Asia.

It is very likely that summer heat waves/hot spells in **East Asia** will be of longer duration, more intense, and more frequent.

It is very likely that there will be fewer very cold days in **East Asia** and South Asia

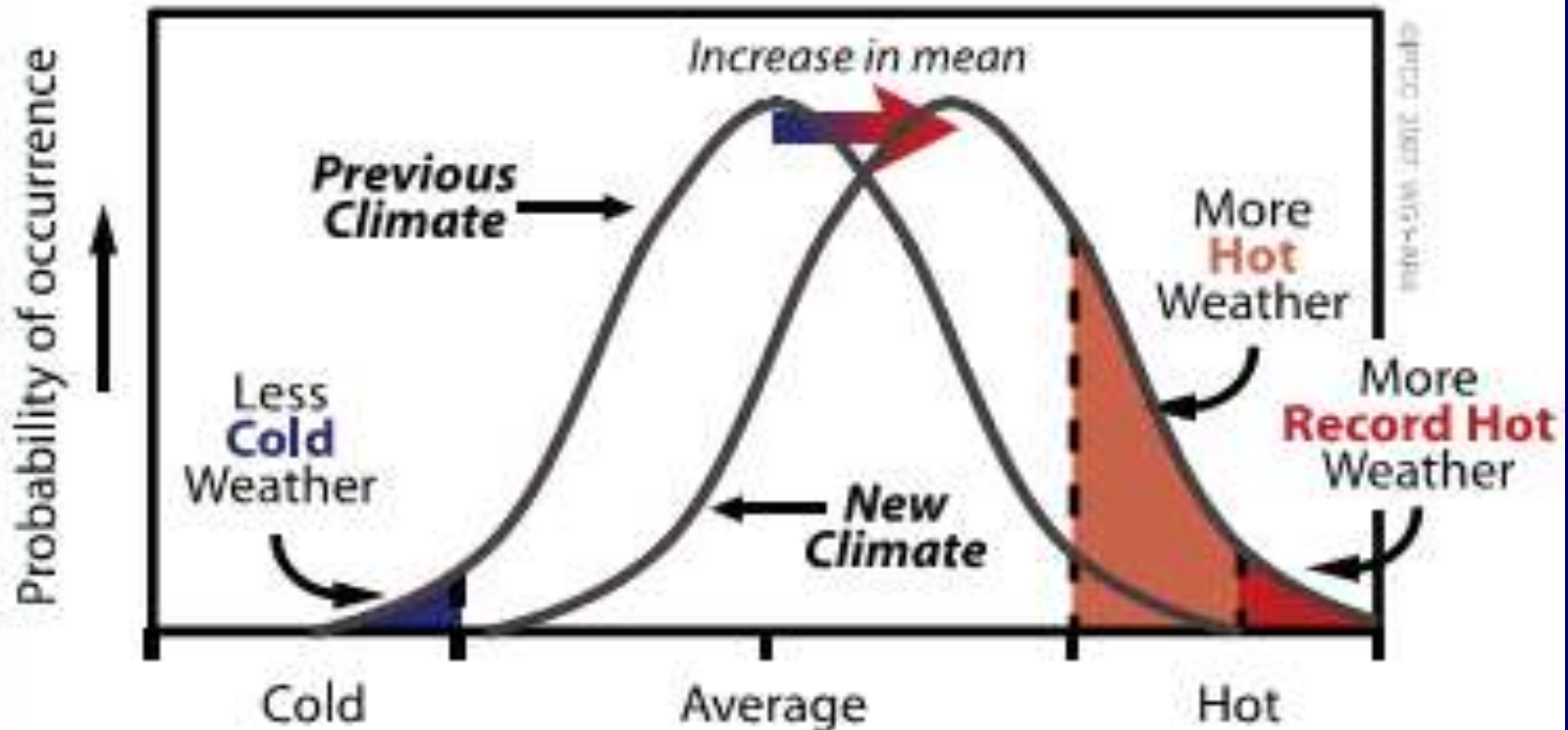
Assessment of projected climate change for Asia

Summer precipitation is likely to increase in northern Asia, **East** and South **Asia** and most of Southeast Asia (...).

An increase in the frequency of intense precipitation events in parts of South Asia, and in **East Asia**, is very likely.

Extreme rainfall and winds associated with tropical cyclones are likely to increase in **East**, Southeast and South **Asia**. Monsoonal flows and the tropical large-scale circulation are likely to be weakened.

Changes in average produce changes in probability of extremes



Box TS.5, Figure 1. Schematic showing the effect on extreme temperatures when the mean temperature increases, for a normal temperature distribution.

Climate change and extremes

(IPCC AR4 WG1)

Post 1960

21th century

Phenomenon ^a and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend ^b	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	<i>Very likely^c</i>	<i>Likely^d</i>	<i>Virtually certain^d</i>
Warmer and more frequent hot days and nights over most land areas	<i>Very likely^e</i>	<i>Likely (nights)^d</i>	<i>Virtually certain^d</i>
Warm spells / heat waves. Frequency increases over most land areas	<i>Likely</i>	<i>More likely than not^f</i>	<i>Very likely</i>
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	<i>Likely</i>	<i>More likely than not^f</i>	<i>Very likely</i>
Area affected by droughts increases	<i>Likely in many regions since 1970s</i>	<i>More likely than not</i>	<i>Likely</i>
Intense tropical cyclone activity increases	<i>Likely in some regions since 1970</i>	<i>More likely than not^f</i>	<i>Likely</i>
Increased incidence of extreme high sea level (excludes tsunamis) ^g	<i>Likely</i>	<i>More likely than not^{f, h}</i>	<i>Likelyⁱ</i>

Virtually certain > 99%, very likely > 90%, likely > 66%, more likely than not > 50%

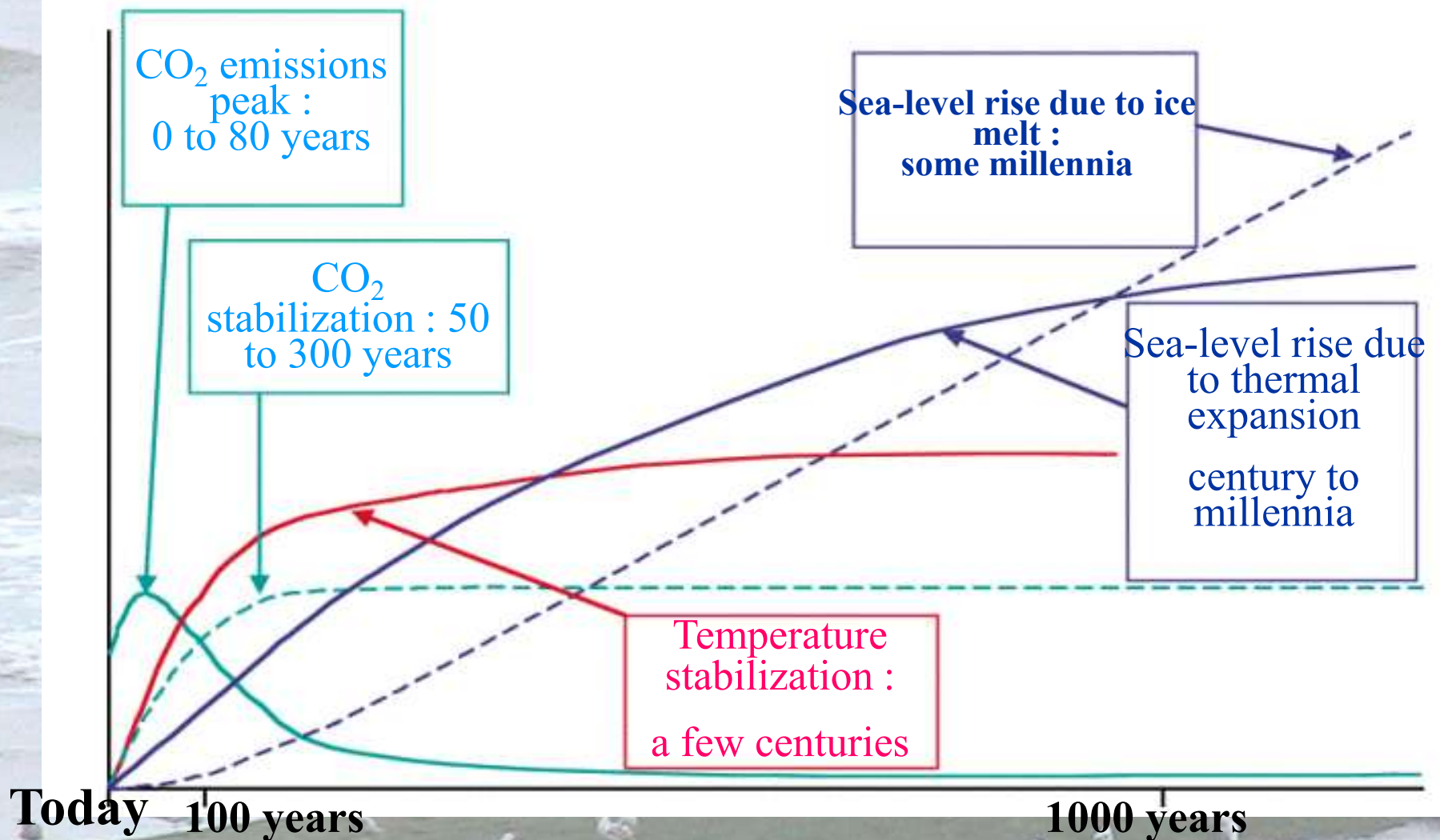
Typhoon Morakot (August 2009)



Ice sheet melting

- Melting of the Greenland ice sheet
 - Total melting would cause 7 m SLR contribution
- Melting of the West Antarctic Ice Sheet
 - Total melting would cause 5 m SLR contribution
- Warming of 1 – 4°C over present-day temperatures would lead to partial melting over centuries to millennia

Significant inertia exists in the climate system

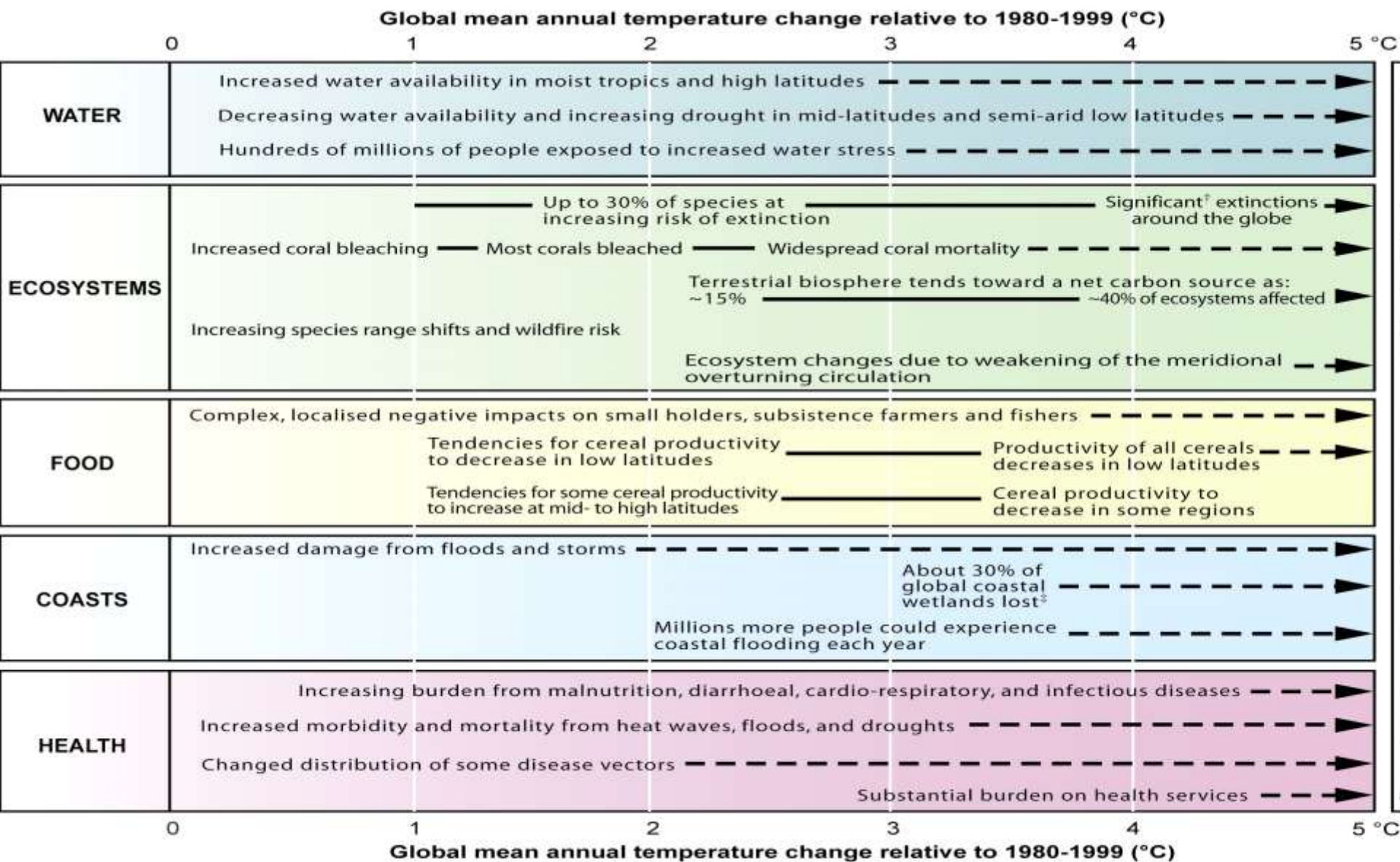




⌘ IPCC Working Group II: Impacts, Vulnerability, and adaptation

Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

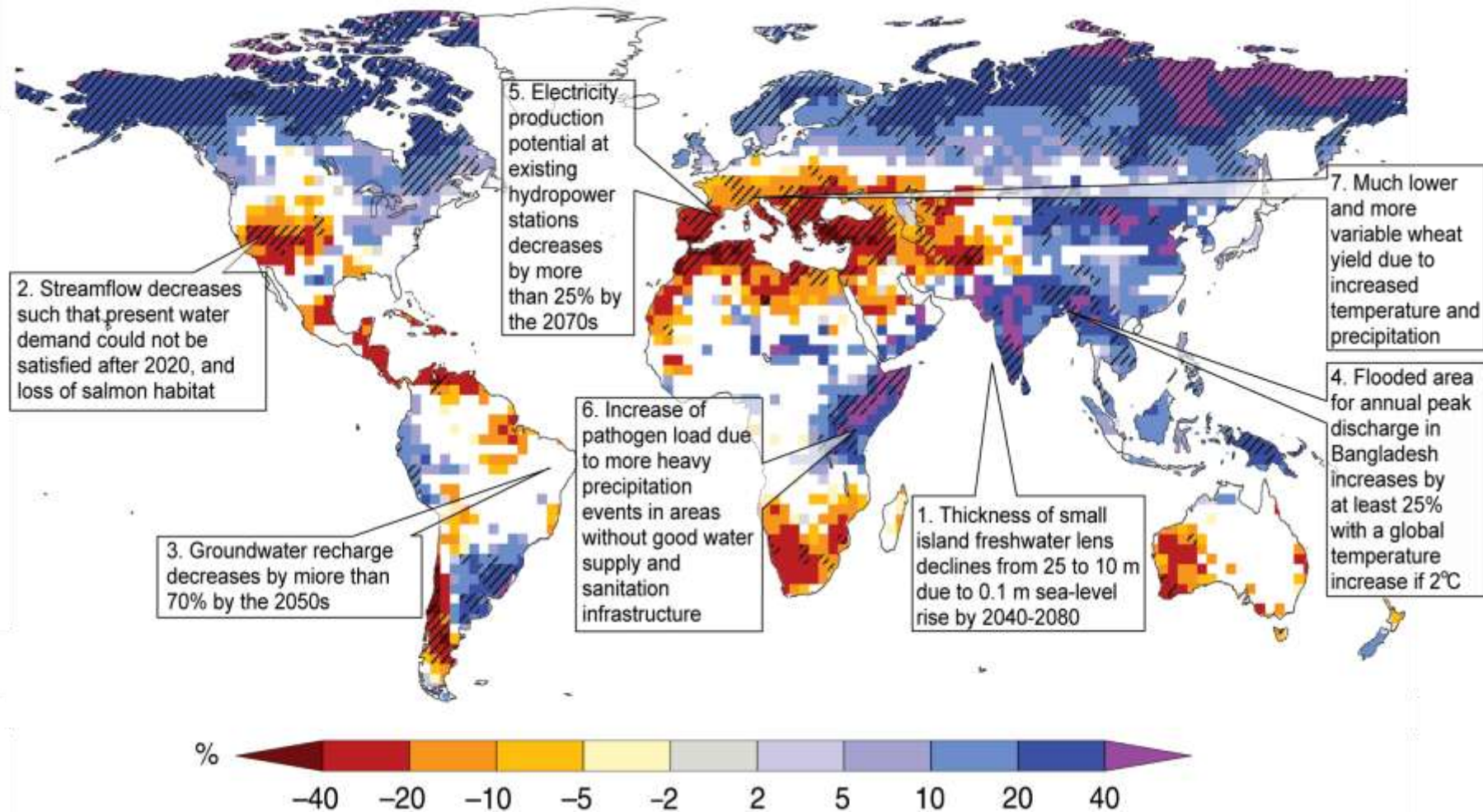
Figure SPM.2. Key impacts as a function of increasing global average temperature change
 (Impacts will vary by extent of adaptation, rate of temperature change, and socio-economic pathway)



[†] Significant is defined here as more than 40%.

[‡] Based on average rate of sea level rise of 4.2 mm/year from

Water at the end of the 21st century for SRES A1B



TP Figure 3.4: Ensemble mean change of annual runoff, in percent, between present (1980-1999) and 2090-2099 for the SRES A1B emissions scenario (based on Milly et al., 2005).

**20% - 30% of plants
and animals species
likely at “increased
risk of extinction”**

**if ΔT 1.5°C - 2.5°C
(above 1990 temperature)**

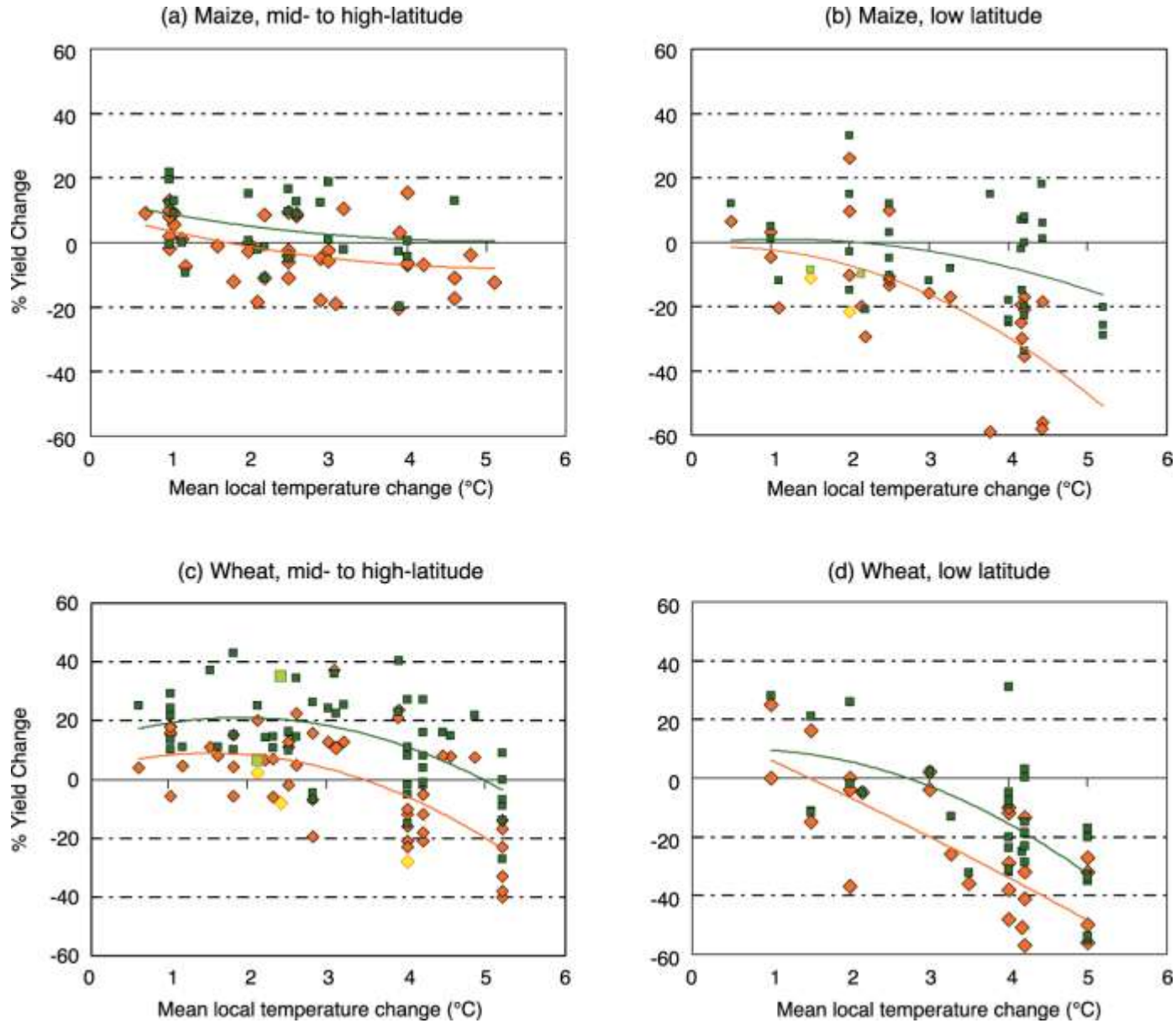


WMO



UNEP

Figure TS.7. Sensitivity of cereal yield to climate change



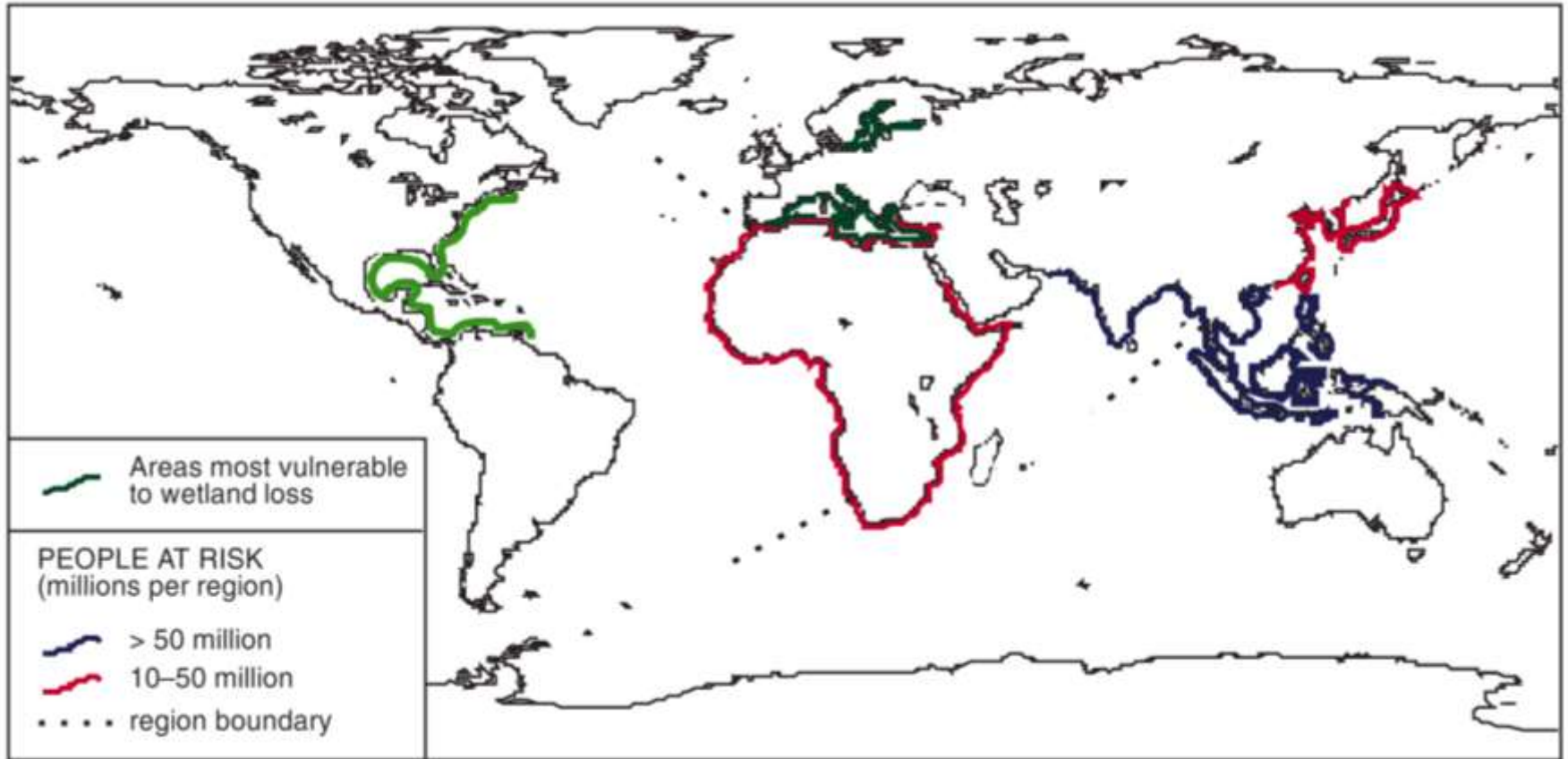
Effects on Nile delta: 10 M people above 1m



(Time 2001)

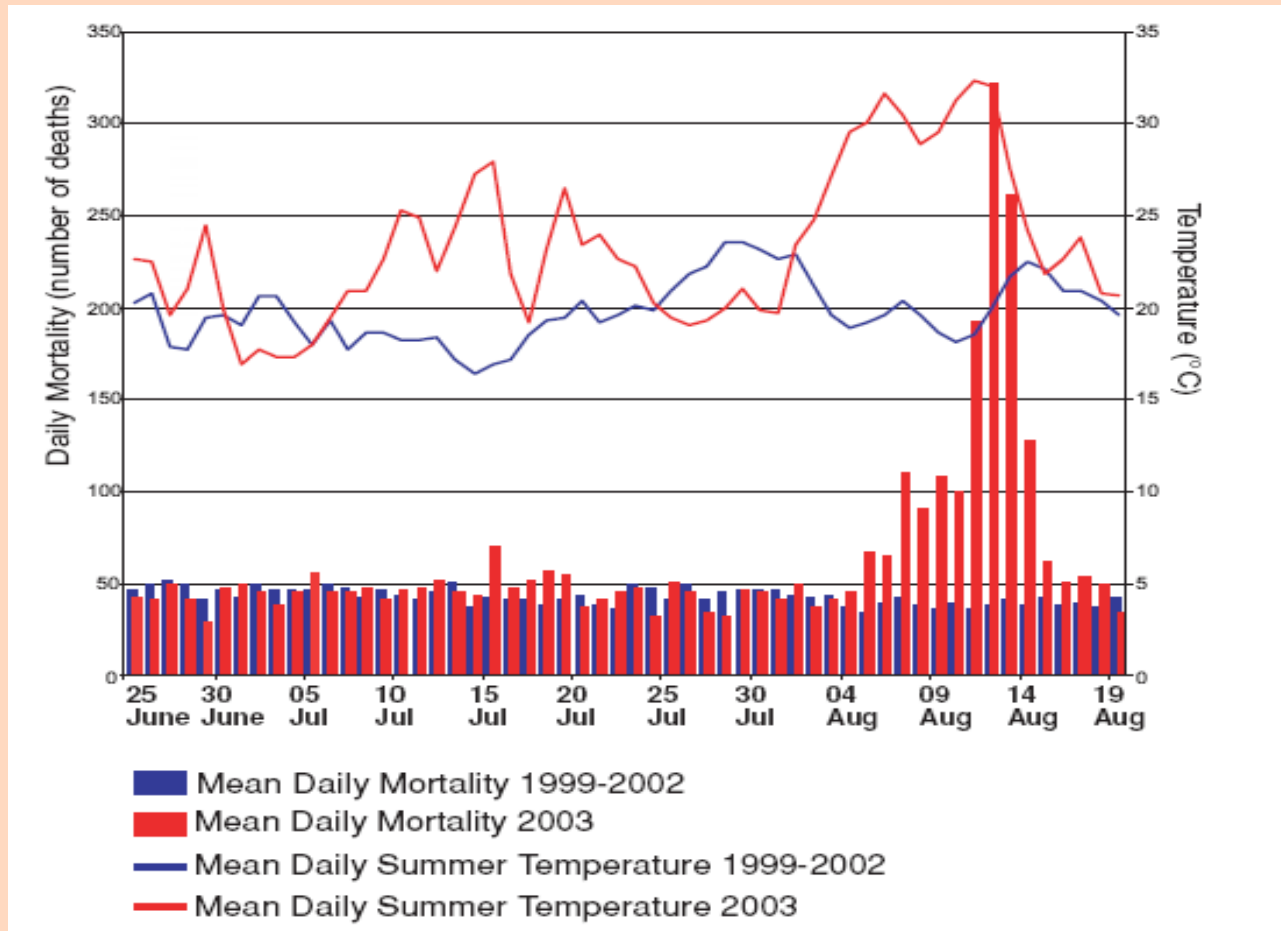
Figure 18: Tens of millions of people are projected to be at risk of being displaced by sea level rise

Assuming 1990s Level of Flood Protection



Source: R. Nicholls, Middlesex University in the U.K. Meteorological Office. 1997. *Climate Change and Its Impacts: A Global Perspective*.

Daily mortality in Paris (summer 2003) (IPCC AR4 Ch 8)



Regions most affected

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

In all regions, there are some areas and communities which are particularly vulnerable

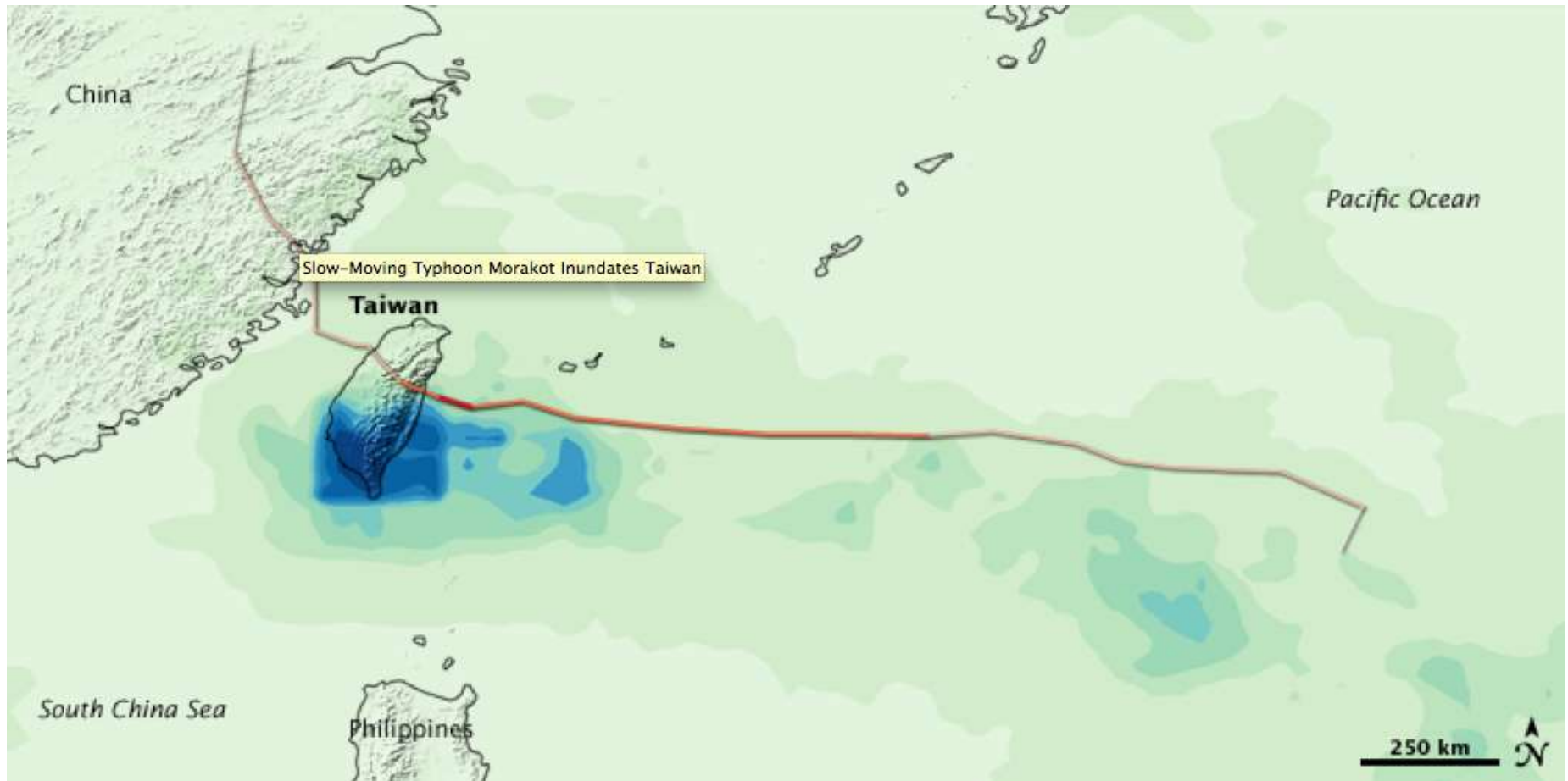
- The poor
- Young children
- The elderly

Excerpts from IPCC AR4 WG2 (Chapter Asia)

New evidences show that climate change has affected many sectors in Asia (medium confidence).

- The crop yield in many countries of Asia has declined, partly due to rising temperatures and extreme weather events. The retreat of glaciers and permafrost in Asia in recent years is unprecedented as a consequence of warming. The frequency of occurrence of climate-induced diseases and heat stress in Central, East, South and South-East Asia has increased with rising temperatures and rainfall variability. Observed changes in terrestrial and marine ecosystems have become more pronounced

Slow-Moving Typhoon Morakot Inundates Taiwan (Aug. 2009)



Typhoon Morakot: Taiwan mounts rescue operation to save 700 villagers



The Telegraph (BST 12 Aug 2009)

Excerpts from IPCC AR4 WG2 (Chapter Asia)

Future climate change is likely to affect agriculture, risk of hunger and water resource scarcity with enhanced climate variability and more rapid melting of glaciers (medium confidence).

- **About 2.5 to 10% decrease in crop yield is projected for parts of Asia in 2020s and 5 to 30% decrease in 2050s compared with 1990 levels without CO2 effects (medium confidence).**
- **Freshwater availability in Central, South, East and South-East Asia, particularly in large river basins such as Changjiang, is likely to decrease due to climate change, along with population growth and rising standard of living that could adversely affect more than a billion people in Asia by the 2050s (high confidence)**



WMO



UNEP

Excerpts from IPCC AR4 WG2 (Chapter Asia)

Marine and coastal ecosystems in Asia are likely to be affected by sea-level rise and temperature increases (high confidence).

- **Projected sea-level rise is very likely to result in significant losses of coastal ecosystems and a million or so people along the coasts of South and South-East Asia will likely be at risk from flooding (high confidence).**
- **(...) Coastal inundation is likely to seriously affect the aquaculture industry and infrastructure (...) (high confidence).**
- **Stability of wetlands, mangroves and coral reefs around Asia is likely to be increasingly threatened (high confidence).**
- **(...) Between 24% and 30% of the coral reefs in Asia are likely to be lost during the next 10 years and 30 years, respectively (medium confidence).**



WMO



UNEP

Excerpts from IPCC AR4 WG2 (Chapter Asia)

Climate change is likely to affect forest expansion and migration, and exacerbate threats to biodiversity resulting from land use/cover change and population pressure in most of Asia (medium confidence).

- Increased risk of extinction for many flora and fauna species in Asia is likely as a result of the synergistic effects of climate change and habitat fragmentation
- In North Asia, forest growth and northward shift in the extent of boreal forest is likely
- The frequency and extent of forest fires in North Asia is likely to increase in the future (...)



Excerpts from IPCC AR4 WG2 (Chapter Asia)

Future climate change is likely to continue to adversely affect human health in Asia (high confidence).

- **Increases in endemic morbidity and mortality due to diarrhoeal disease primarily associated with climate change are expected in South and South-East Asia** (high confidence).
- **Increases in coastal water temperature would exacerbate the abundance and/or toxicity of cholera in south Asia** (high confidence).
- **Natural habitats of vector-borne and water-borne diseases in north Asia are likely to expand in the future** (medium confidence).



WMO



UNEP

Excerpts from IPCC AR4 WG2 (Chapter Asia)

Multiple stresses in Asia will be compounded further due to climate change (high confidence).

- **It is likely that climate change will impinge on sustainable development of most developing countries of Asia as it compounds the pressures on natural resources and the environment associated with rapid urbanisation, industrialisation and economic development.**
- **Mainstreaming sustainable development policies and the inclusion of climate-proofing concepts in national development initiatives are likely to reduce pressure on natural resources and improve management of environmental risks**

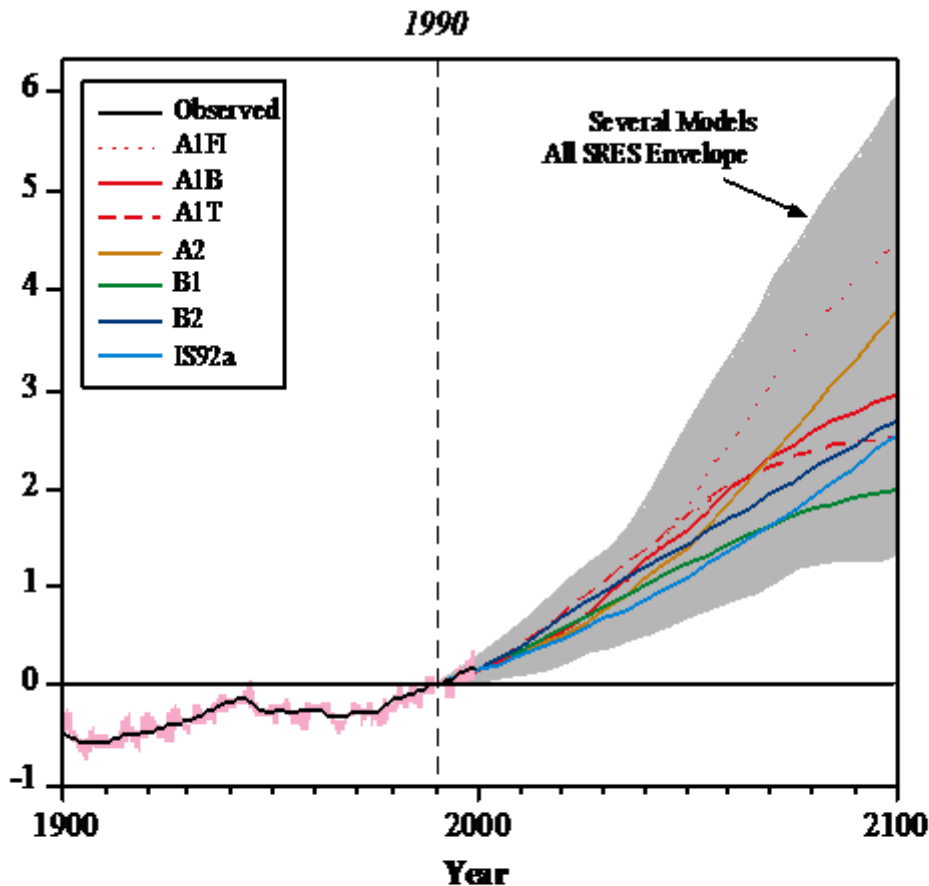


WMO

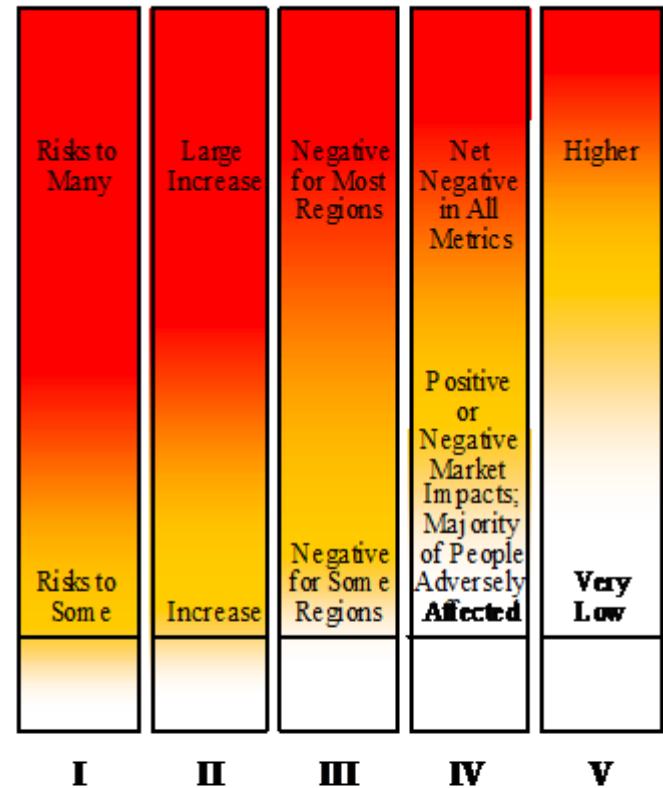


UNEP

Reasons for Concern



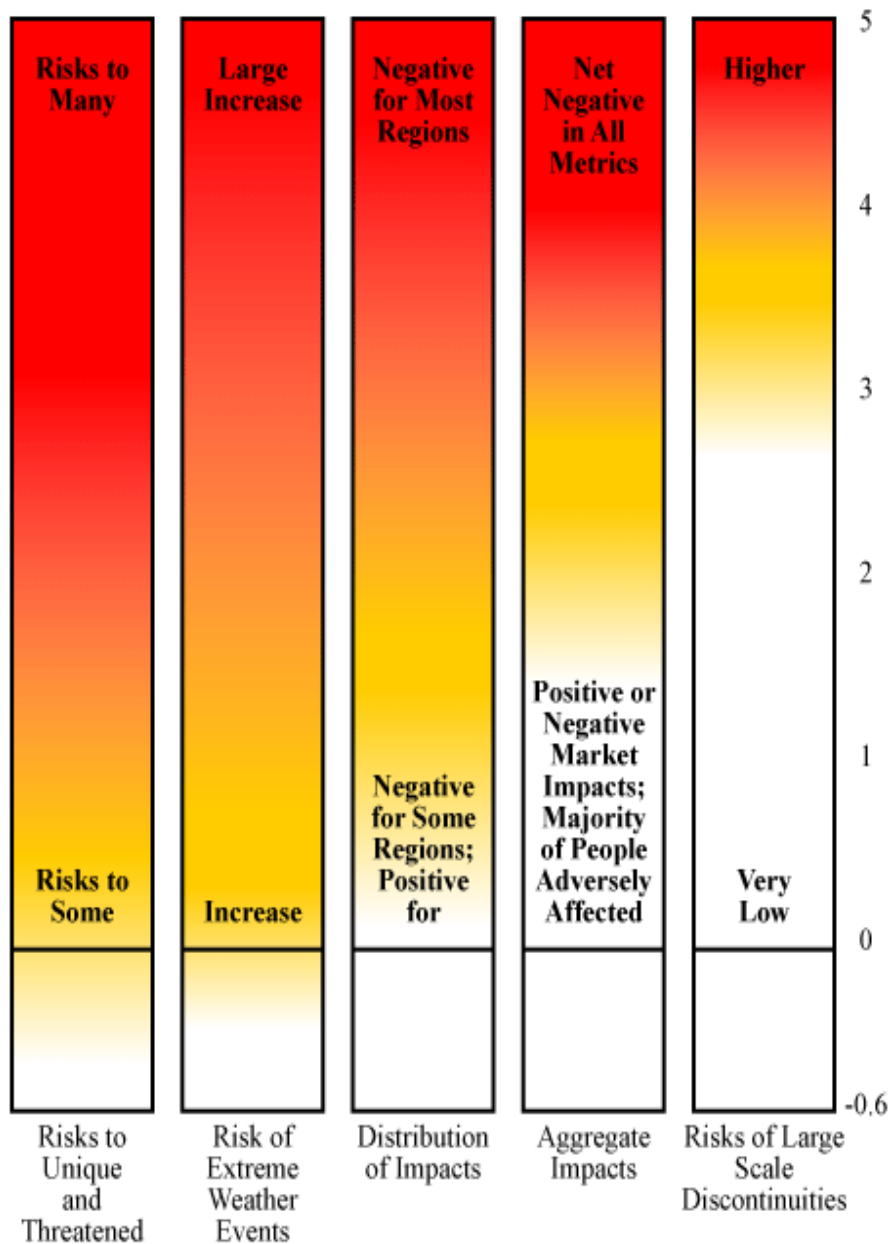
Reasons for Concern



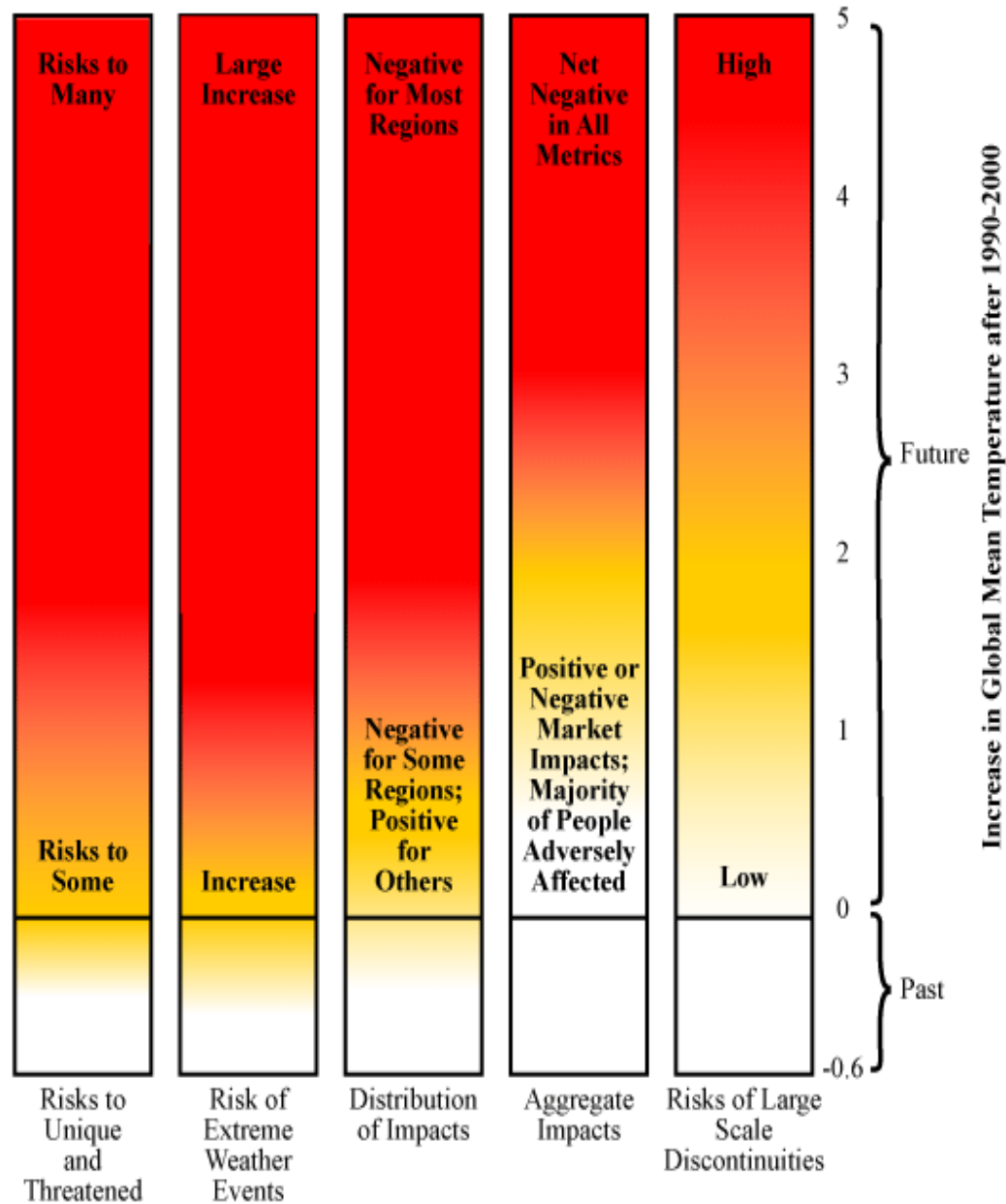
- I Risks to unique and threatened systems
- II Risks from extreme climate events
- III Distribution of Impacts
- IV Aggregate Impacts
- V Risks from large-scale discontinuities

Source: IPCC TAR WG2 (2001)

TAR Reasons For Concern



Proposed AR4 Reasons For Concern



**Adaptation will be
necessary to address
unavoidable impacts**



WMO



UNEP

Adaptation / Mitigation

(not verbatim)

- Some adaptation is occurring now, faces limitations and barriers
- Other stresses can exacerbate vulnerability
- Vulnerability depends also on development paths
- Sustainable development can reduce vulnerability
- Mitigation can reduce, delay or avoid impacts



WMO

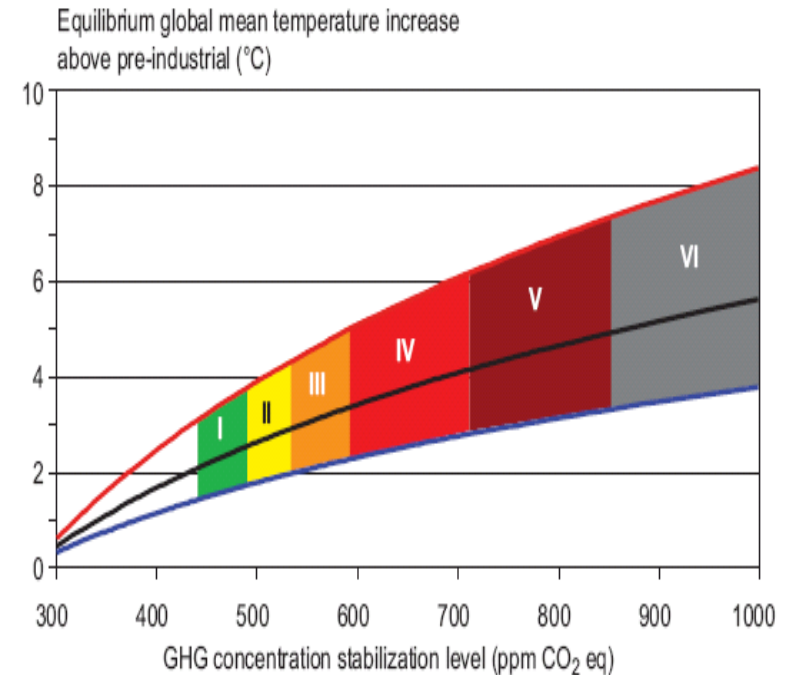
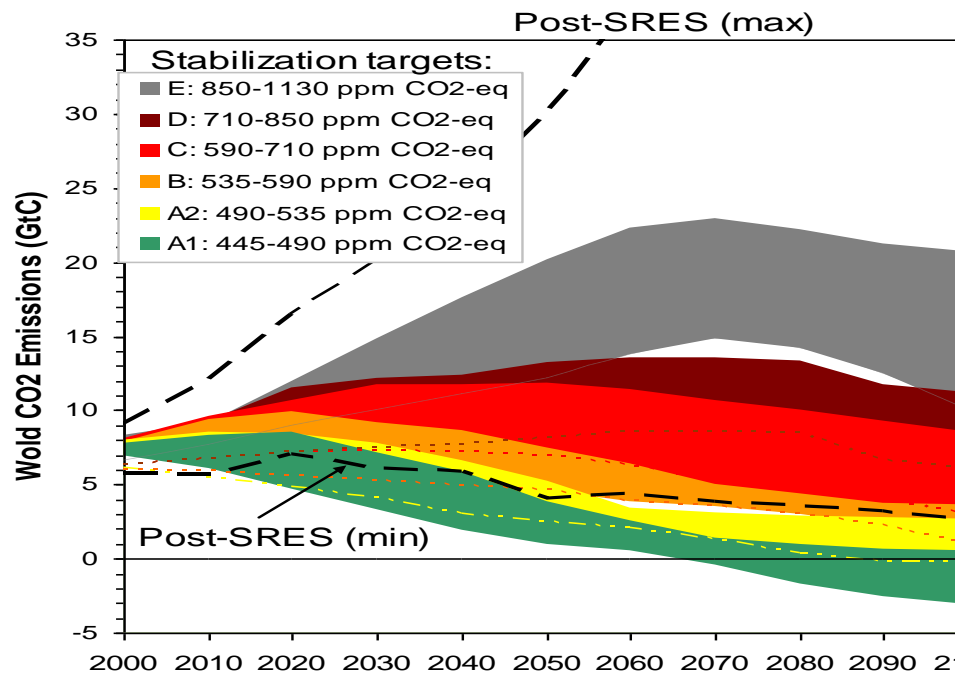


UNEP

What does IPCC tell us on mitigation?

⌘ WG3: Mitigation

The lower the stabilisation level the earlier global emissions have to go down



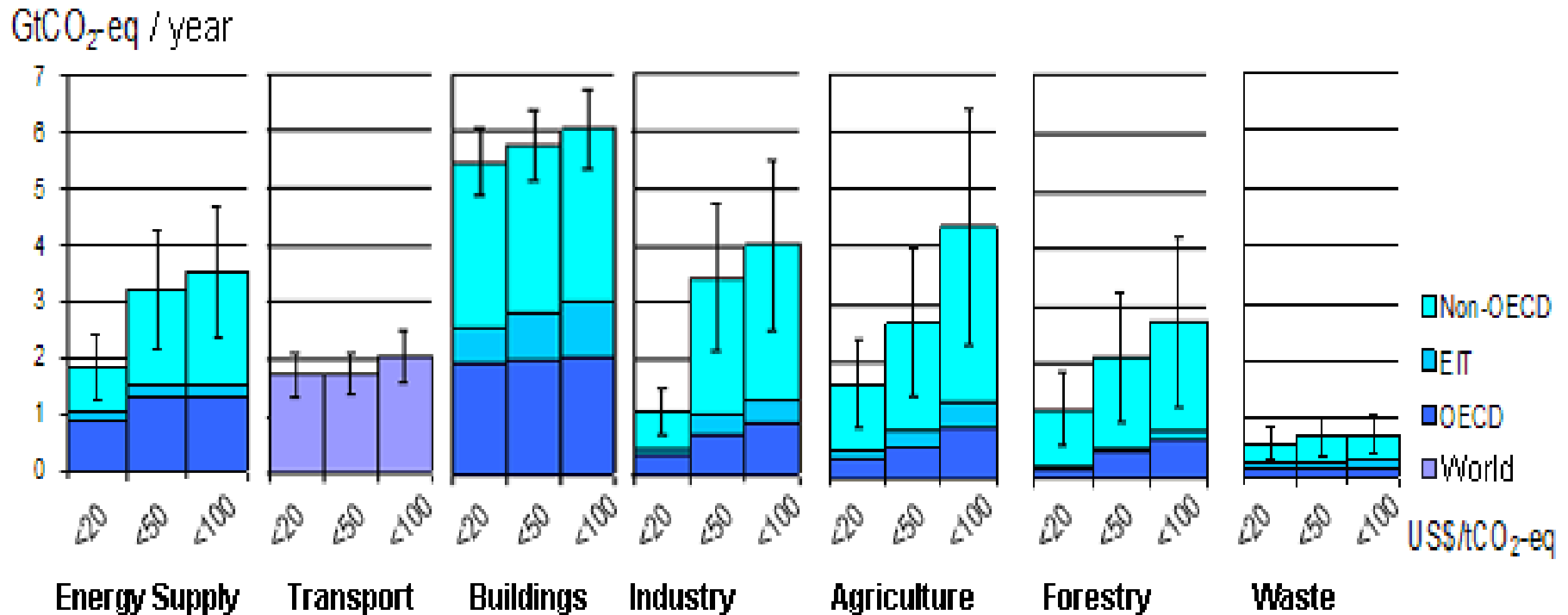
Multigas and CO₂ only studies combined

Long term mitigation (after 2030)

- The lower the stabilization level, the more quickly emissions would need to peak and to decline thereafter
- Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels

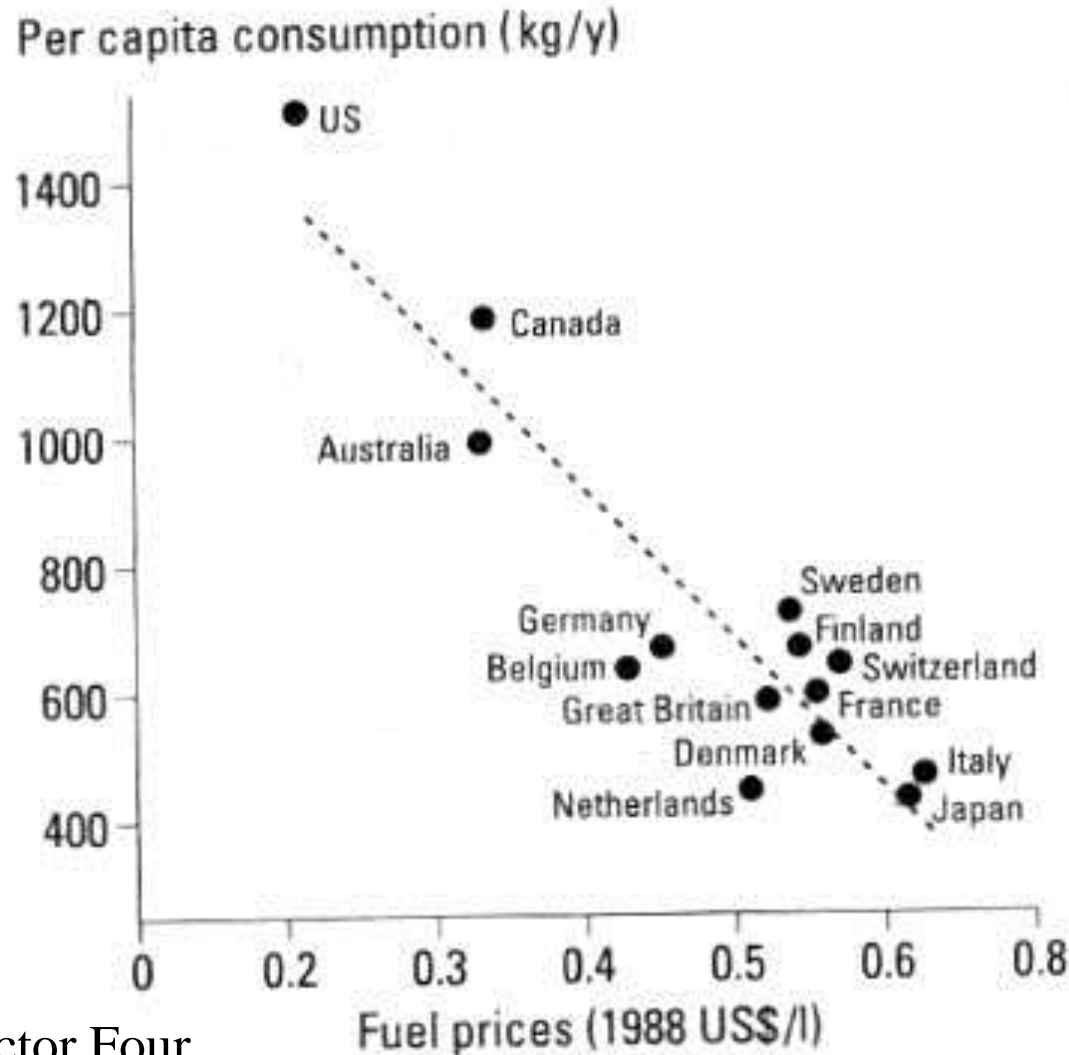
Stab level (ppm CO ₂ -eq)	Global Mean temp. increase at equilibrium (°C)	Year CO ₂ needs to peak	Reduction in 2050 compared to 2000
445 – 490	2.0 – 2.4	2000 - 2015	-85 to -50
490 – 535	2.4 – 2.8	2000 - 2020	-60 to -30
535 – 590	2.8 – 3.2	2010 - 2030	-30 to +5
590 – 710	3.2 – 4.0	2020 - 2060	+10 to +60
710 – 855	4.0 – 4.9	2050 - 2080	+25 to +85
855 – 1130	4.9 – 6.1	2060 - 2090	+90 to +140

All sectors and regions have the potential to contribute by 2030



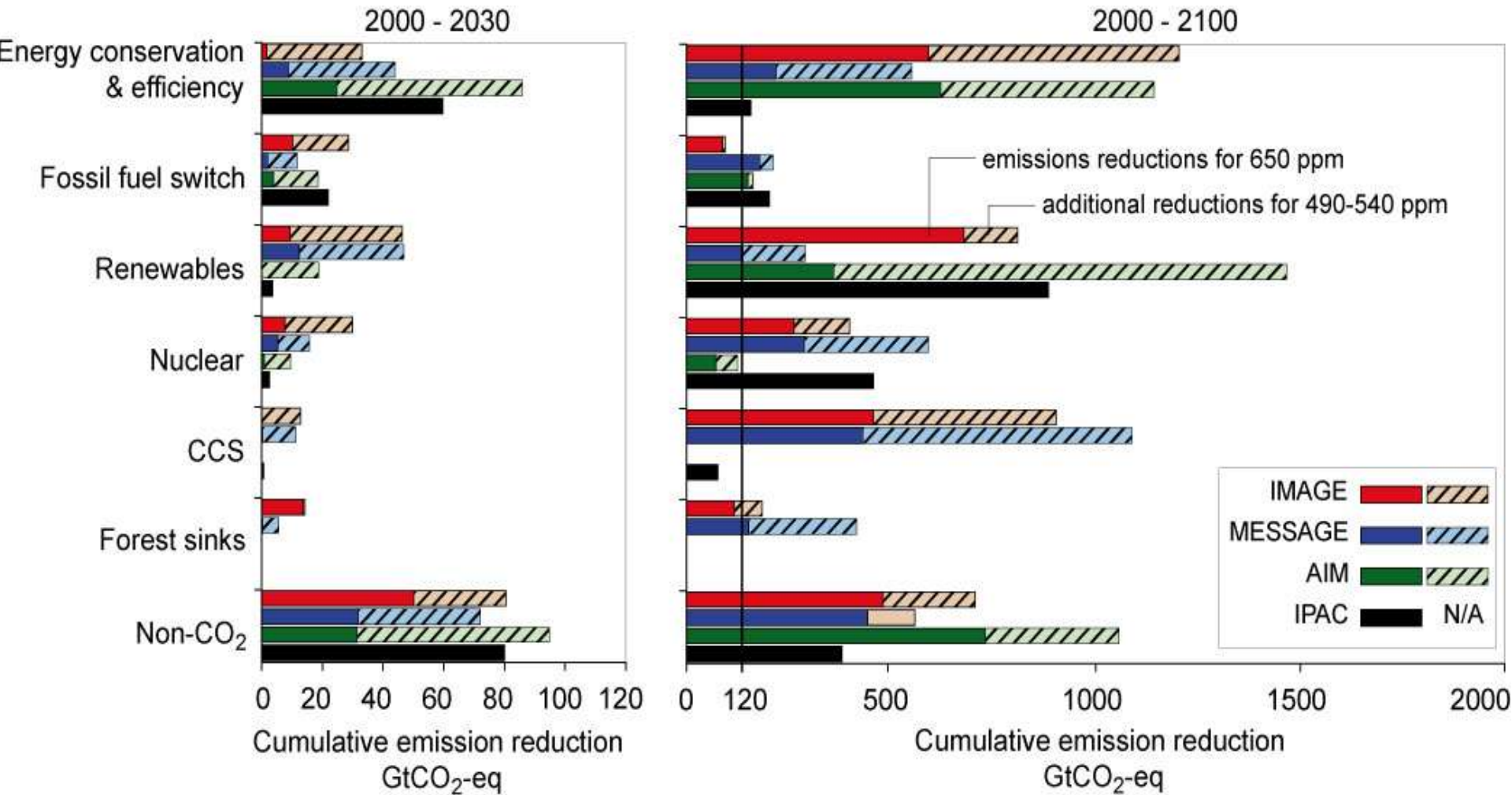
Note: estimates do not include non-technical options, such as lifestyle changes.

The pricing of carbon is effective: Negative correlation between fuel price and consumption



Source: Factor Four

Role of Technology, following IPCC AR4



What did « The Economist » say in 1990 already?



- **“Being dirty has lots of costs: being greener than the competition may have many advantages”**
- **“For far-sighted companies, the environment may turn out to be the biggest opportunity for enterprise and invention the industrial world has seen.”**

(Frances Cairncross, The Economist, 8 September 1990)

Role of policy makers & education



Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

« Is it enough for a scientist simply to publish a paper? Isn't it a responsibility of scientists, if you believe that you have found something that can affect the environment, isn't it your responsibility to actually do something about it, enough so that action actually takes place? »

John Holdren, Past-President of the American Association for the Advancement of Science, now President Obama's science adviser

- ⌘ ***'We basically have three choices – mitigation, adaptation, and suffering.'***
- ⌘ ***We're going to do some of each. The question is what the mix is going to be.***
- ⌘ ***The more mitigation we do, the less adaptation will be required, and the less suffering there will be.'***

Importance of climate education

- ⌘ Policymakers are now increasingly aware of both the causes and the consequences of climatic change.
- ⌘ Many are still underestimating the size of the challenge, and do not fully understand the opportunities that the appropriate combination of mitigation and adaptation policies could deliver.
- ⌘ Broad scale change will likely take place when informed citizens put pressure on policymakers to act more resolutely to implement climate policies.
- ⌘ Climate change education is therefore essential to create the right cultural context, and the informed citizens who will show the lead.

Jean-Pascal van Ypersele
(vanypers@astr.ucl.ac.be)

An ongoing dialogue on climate change

- Climate change communication will stimulate a **dialogue on hopeful visions of future** everyday life through democratic means
- Climate change communication will create a future vision that addresses **immediate** societal issues and needs while **linking them to larger**, systemic climate change issues
- Climate change communication will acknowledge and incorporate the **diversity of local and practices** that contribute to a sense of place

Defining and teaching environmental literacy

« ... A concerned citizen need not (and indeed cannot) understand all the technical details of an environmental policy debate. The citizen most needs competence in rating the **credibility of the assessment process itself** – the environmental literacy skill I believe is most lacking in our citizenry or its leadership.

The short-cut to building such skill is to learn to ask repeatedly the **three questions** →

Defining and teaching environmental literacy (Schneider)

The three questions lay persons need to ask experts to be more literate in environmental policy debates are:

- What can happen?
- What are the odds of it happening?
- How do you know (how are such estimates made)?

Defining and teaching environmental literacy (Schneider)

‘ ... Environmental literacy is not simply being well versed in the knowledge and methods of related environmental disciplines, but includes having familiarity with:

- interdisciplinary integration process,
- the policy-making process,
- knowledge/advocacy based assessments,
- the various gradations of uncertainty that necessarily accompany most environmental policy debates.’

A climate negotiation role-play at UCL (Belgium)



- ⌘ **Framework:** Course on « Society, populations, environment, development – problématique and interdisciplinary approaches » at the Université catholique de Louvain-la-Neuve, Belgium
- ⌘ **Audience:** post-graduate students from 3 programmes (environment, development studies, and demography)
- ⌘ **Four professors:** engineer, anthropologist, demographer-economist, climatologist

Distribution :CO2 Emissions

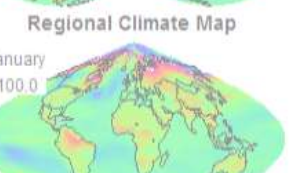
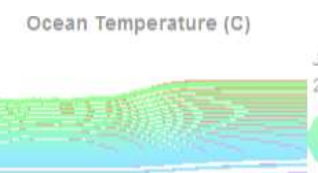
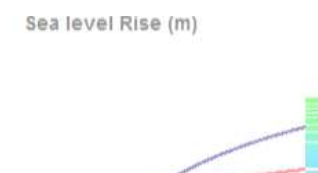
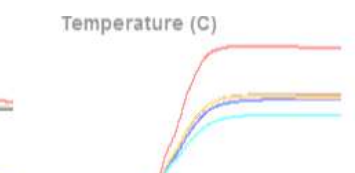
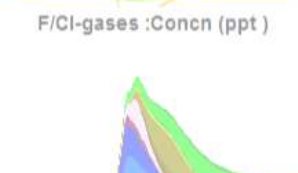
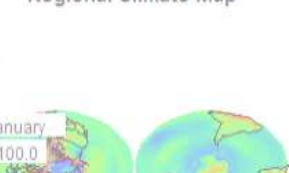
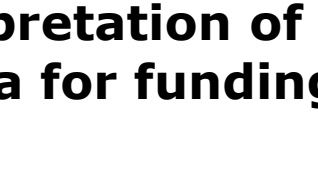
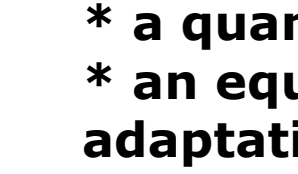
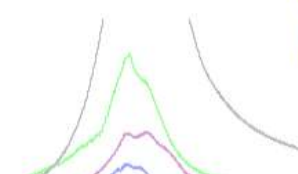
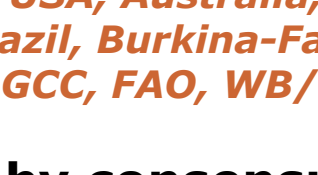
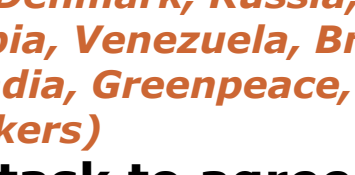
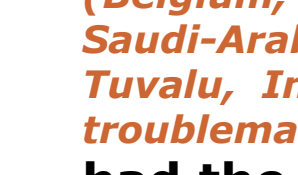
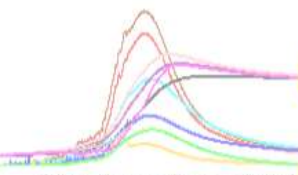
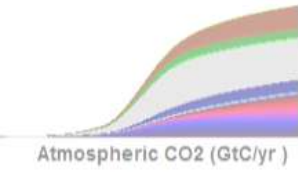
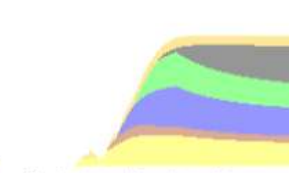
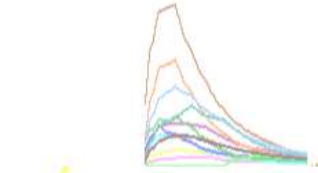
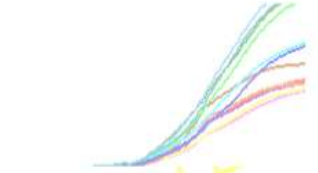
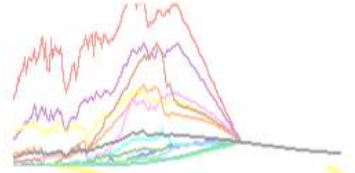
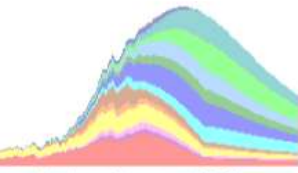
Emissions Regions Map

Distribution :CO2 Emissions /

Costs (Experimental) :Total-C

Distribution :Abatement /GDP

Attribution :Temperature (C



60 university students grouped in 17 delegations

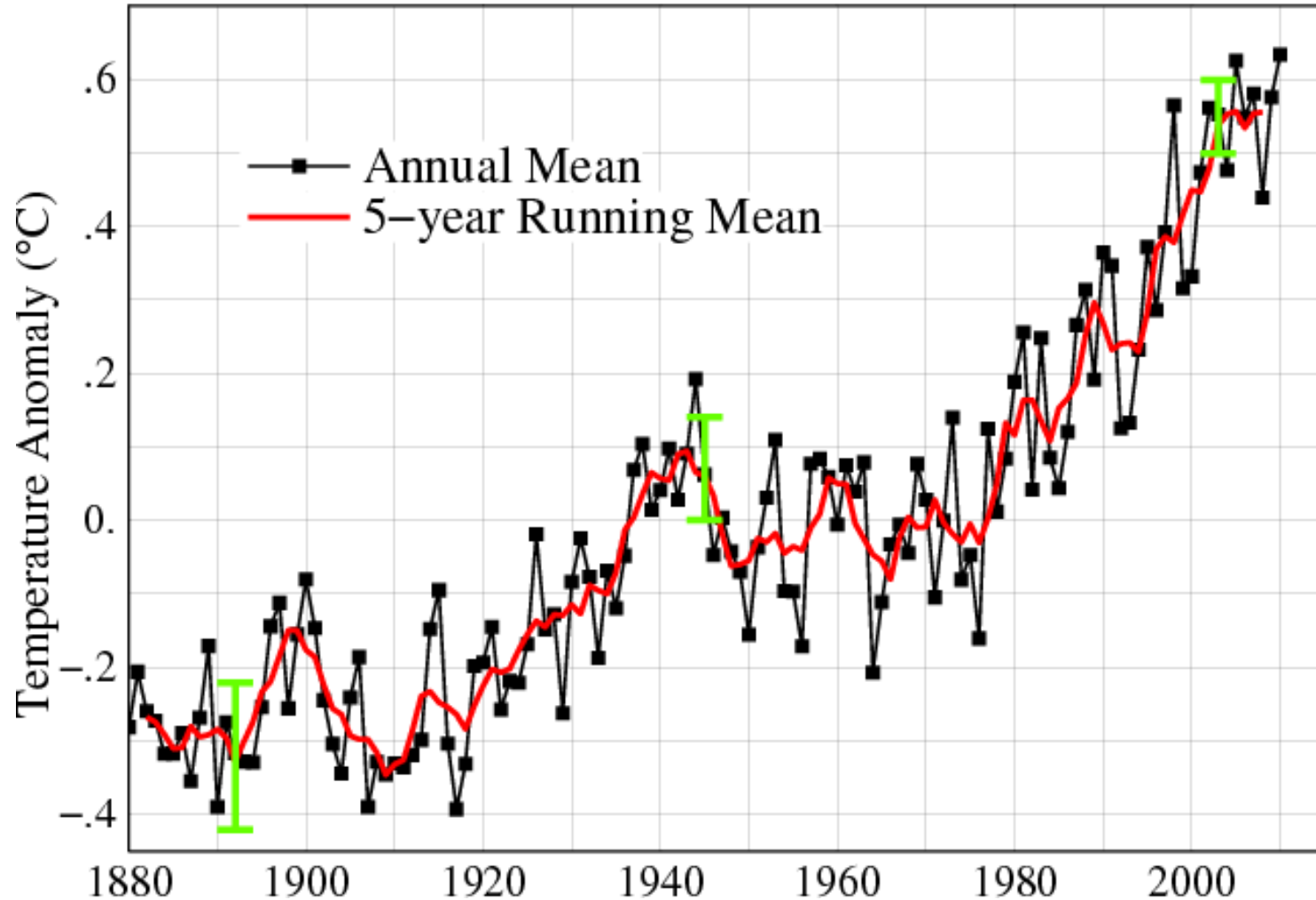
(Belgium, Denmark, Russia, USA, Australia, Saudi-Arabia, Venezuela, Brazil, Burkina-Faso, Marroco, Tuvalu, India, Greenpeace, GCC, FAO, WB/IMF, troublemakers)

had the task to agree by consensus:

- * a quantitative interpretation of Article 2,
- * an equitable formula for funding adaptation.

Warming has not « stopped »: Global (land & ocean) mean surface temperature change from NASA GISS until 2010

Global Land–Ocean Temperature Index



Source: NASA GISS

A poem to end:



« In the end, we conserve only what we love.
We will love only what we understand.
We will understand only what we are taught.»
(*Baba Dioum*, Senegalese poet)

**Thank you Steve Schneider, for teaching
us so much! (see www.climatechange.net)**

Useful links:



⌘ www.ipcc.ch : IPCC

⌘ www.unfccc.int : Climate Convention

⌘ www.climate.be/JCM: interactive climate model

⌘ www.climatechange.net: Stephen Schneider

⌘ www.climate.be/vanyp : my slides and other documents