Climate change & Peace

Pr Jean-Pascal van Ypersele

IPCC Vice-chair
UCL-ASTR
(Université catholique de Louvain, Institut d'astronomie et de géophysique G. Lemaître)

Web: **www.climate.be**
E-mail: **vanyp@climate.be**

Foundation Culture of Peace, Barcelona, 3-11-2009

Introduction

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**

Jean-Pascal van Ypersele
(vanypersele@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)

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

Geophysical Context

- Observations
- Mechanisms

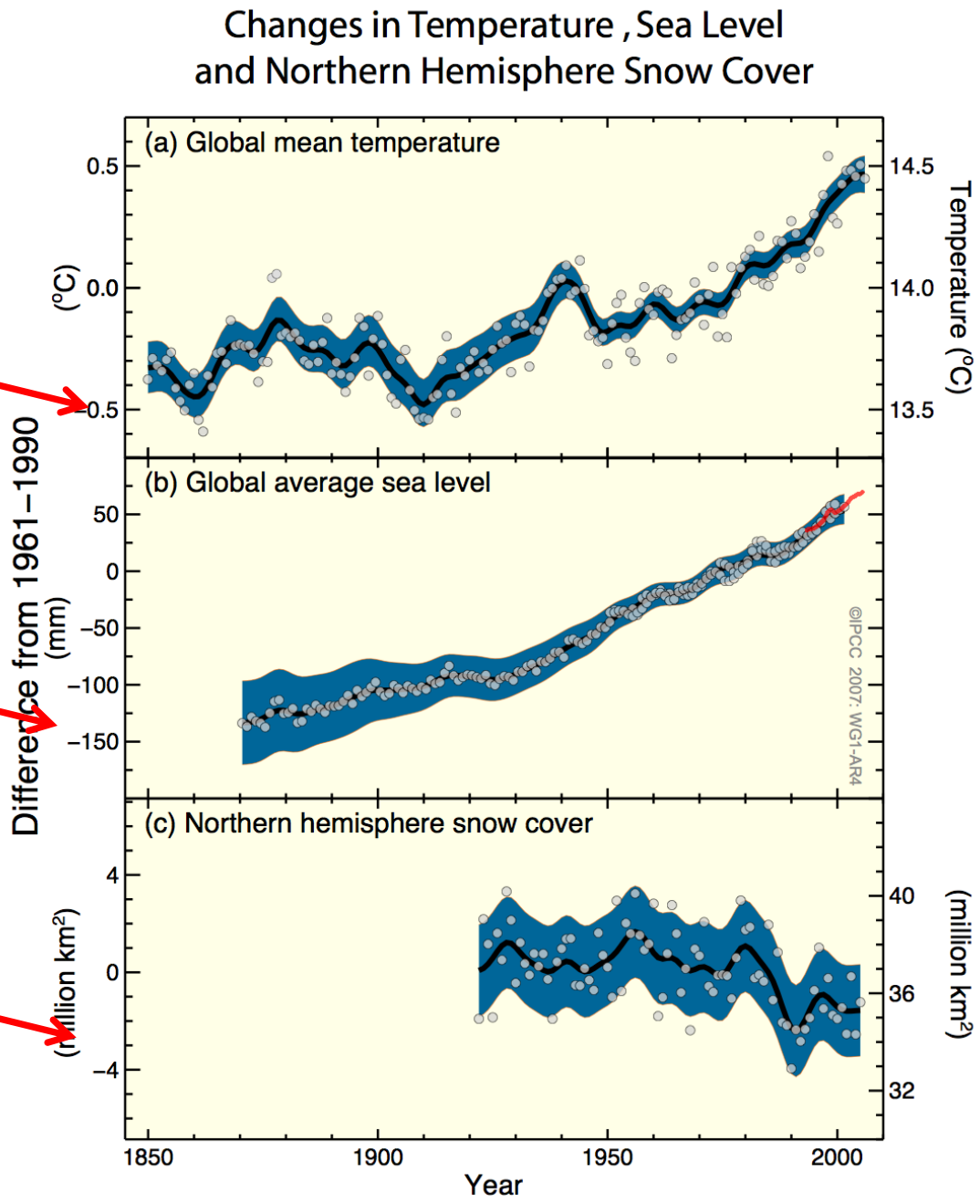
Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

Warming is Unequivocal

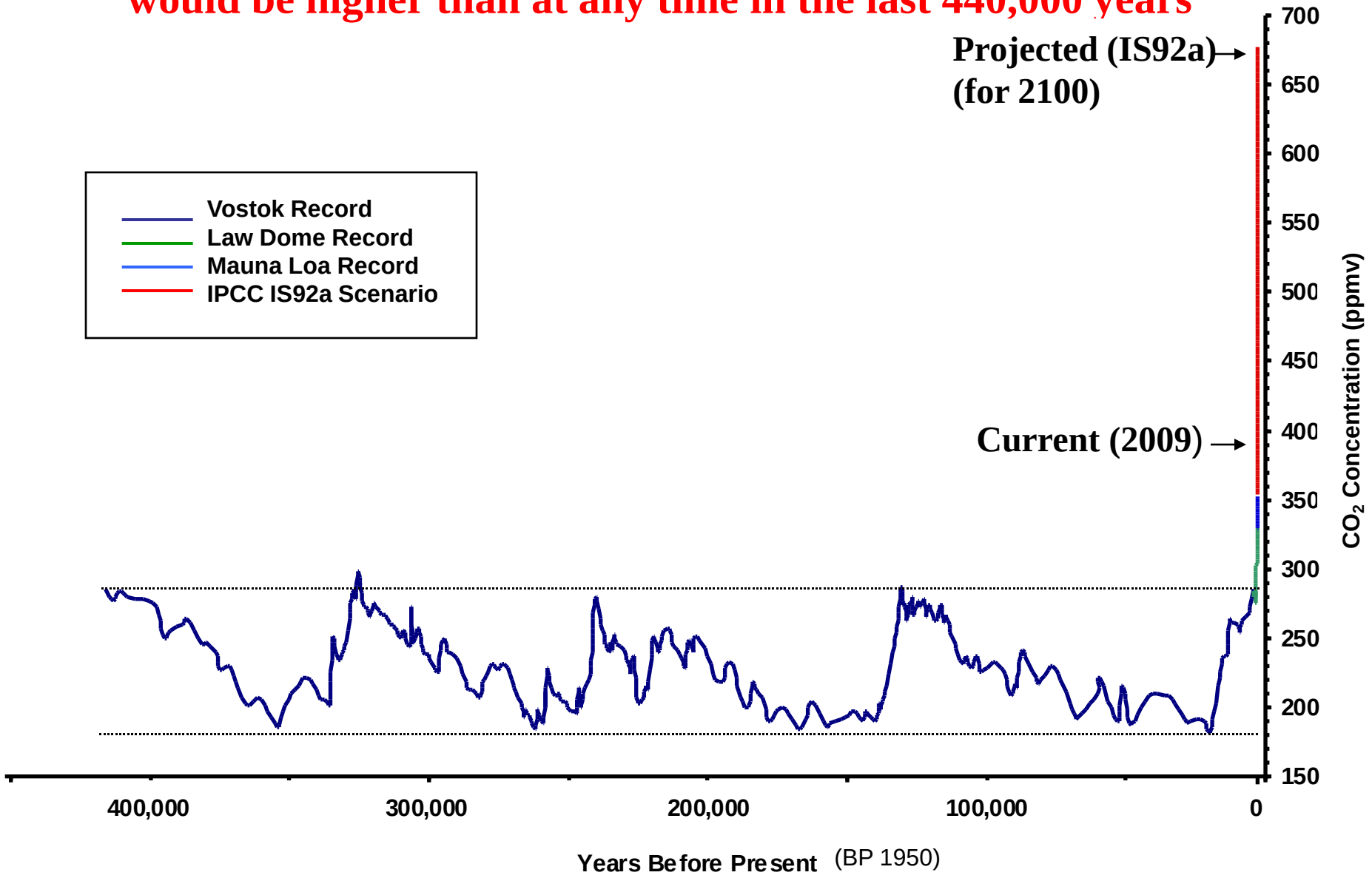
Rising atmospheric temperature

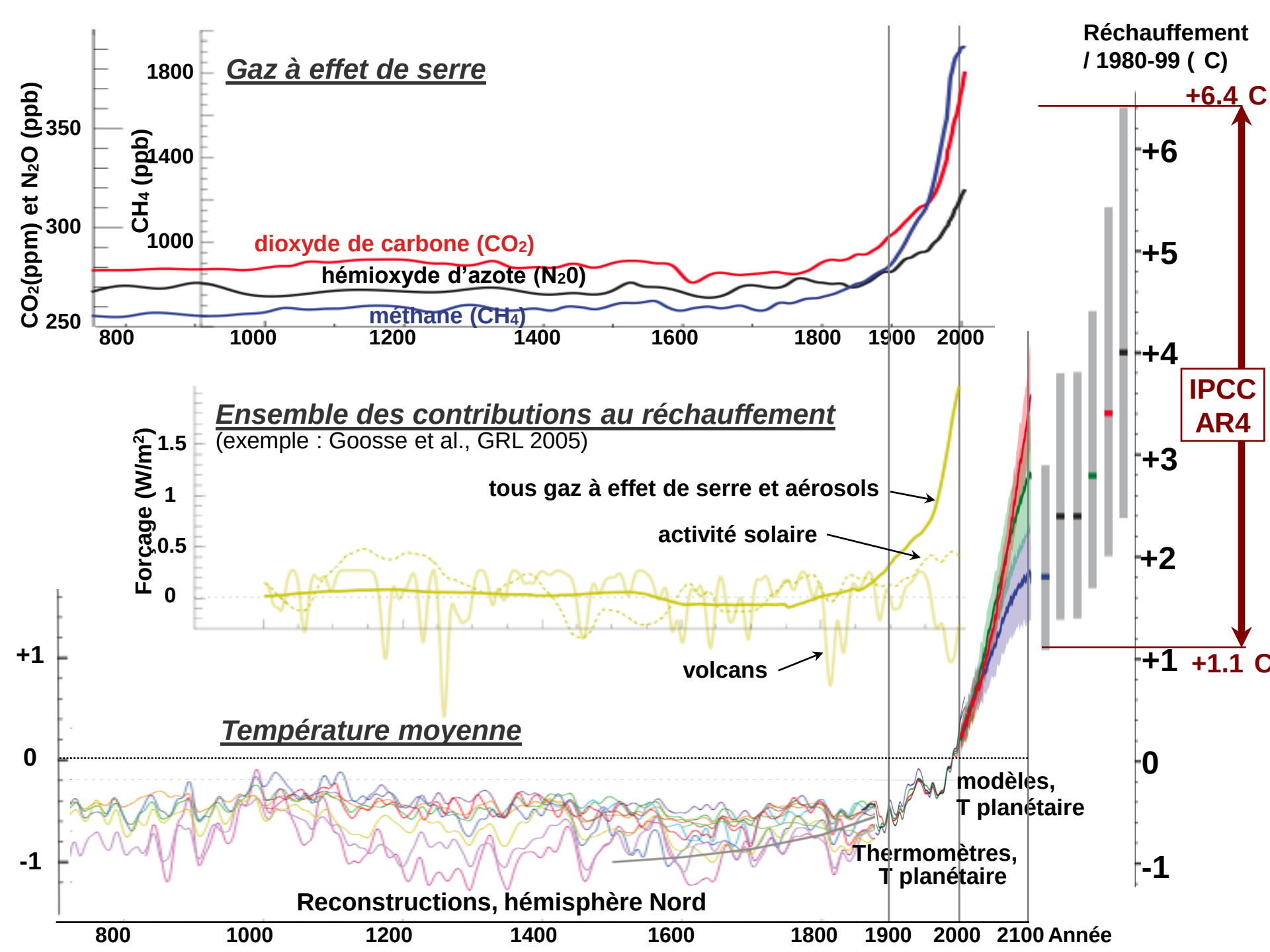
Rising sea level

Reductions in NH snow cover

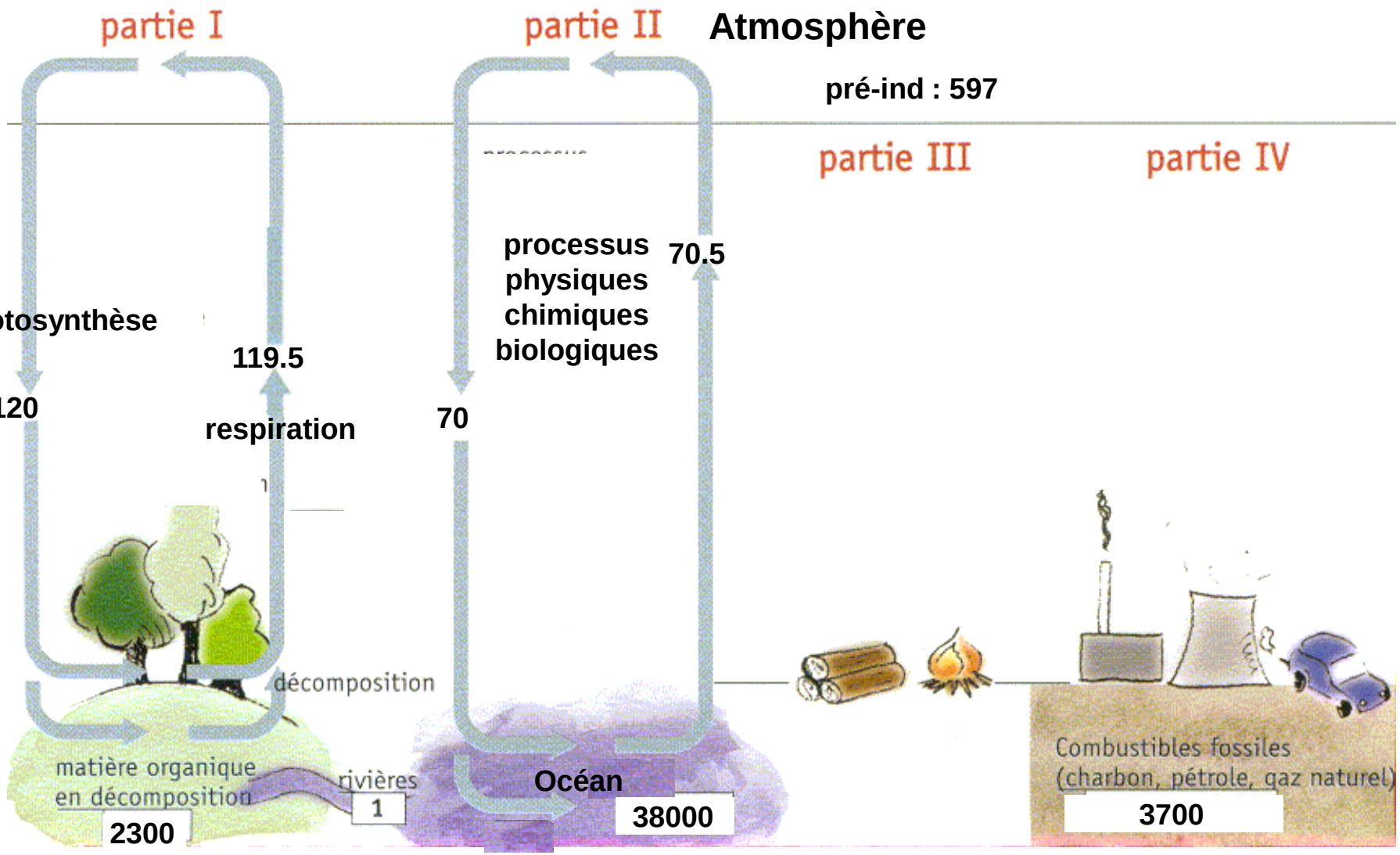


Projected levels of atmospheric CO_2 during the next 100 years would be higher than at any time in the last 440,000 years




Gaz à effet de serre
CO2(ppm) et N2O (ppb)
CH4 (ppb)
dioxyde de carbone (CO2)
hémioxyde d'azote (N20)
méthane (CH4)
Ensemble des contributions au réchauffement
(exemple : Goosse et al., GRL 2005)
Forçage (W/m2)
tous gaz à effet de serre et aérosols
activité solaire
volcans
Température moyenne
modèles, T planétaire
Thermomètres, T planétaire
Reconstructions, hémisphère Nord
Année
Réchauffement / 1980-99 (C)
+6.4 C
+1.1 C
IPCC AR4

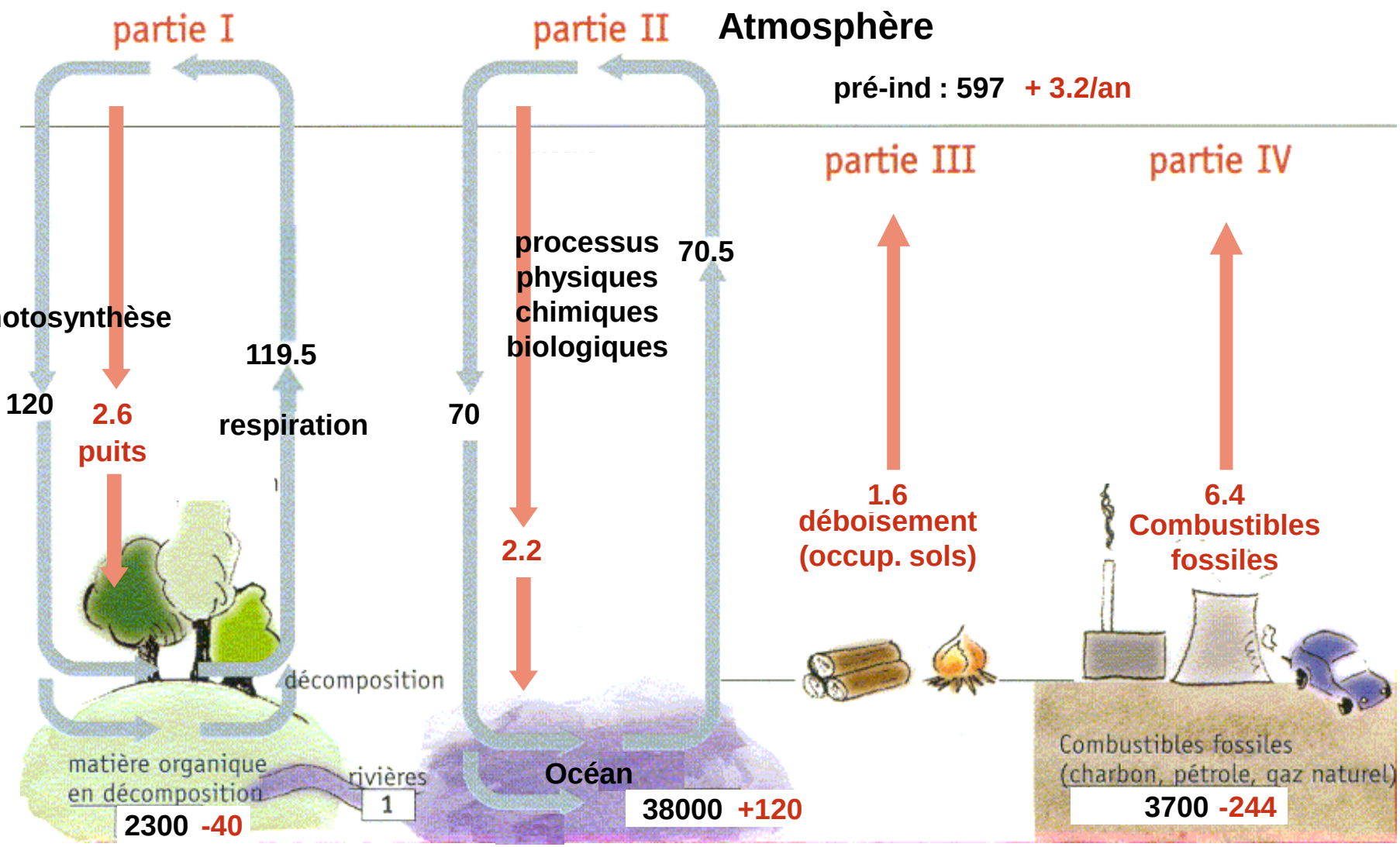
Cycle du carbone



Unités: GtC (milliards de tonnes de carbone) ou GtC/an

vanyp@climate.be

Cycle du carbone



Unités: GtC (milliards de tonnes de carbone) ou GtC/an

vanyp@climate.be

Possible Future climate

- Modelling
- Scenarios

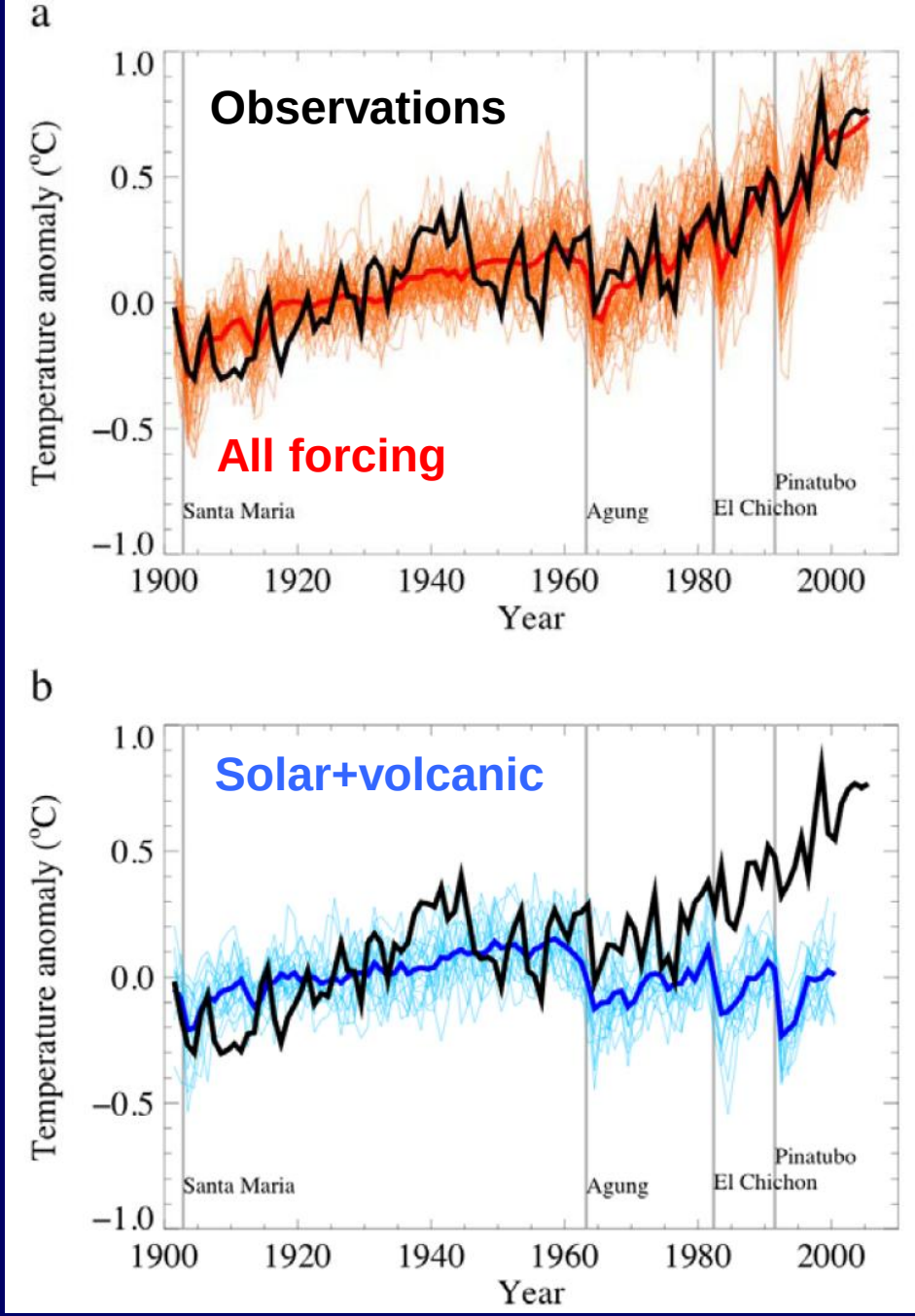
Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

Attribution

- are observed changes consistent with:

☑ expected responses to forcings?

☒ inconsistent with alternative explanations?

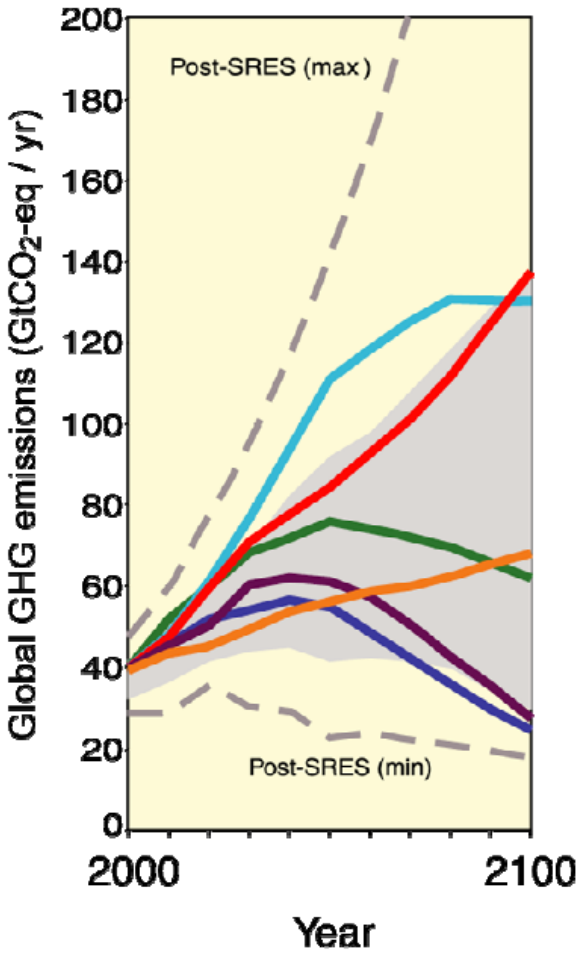


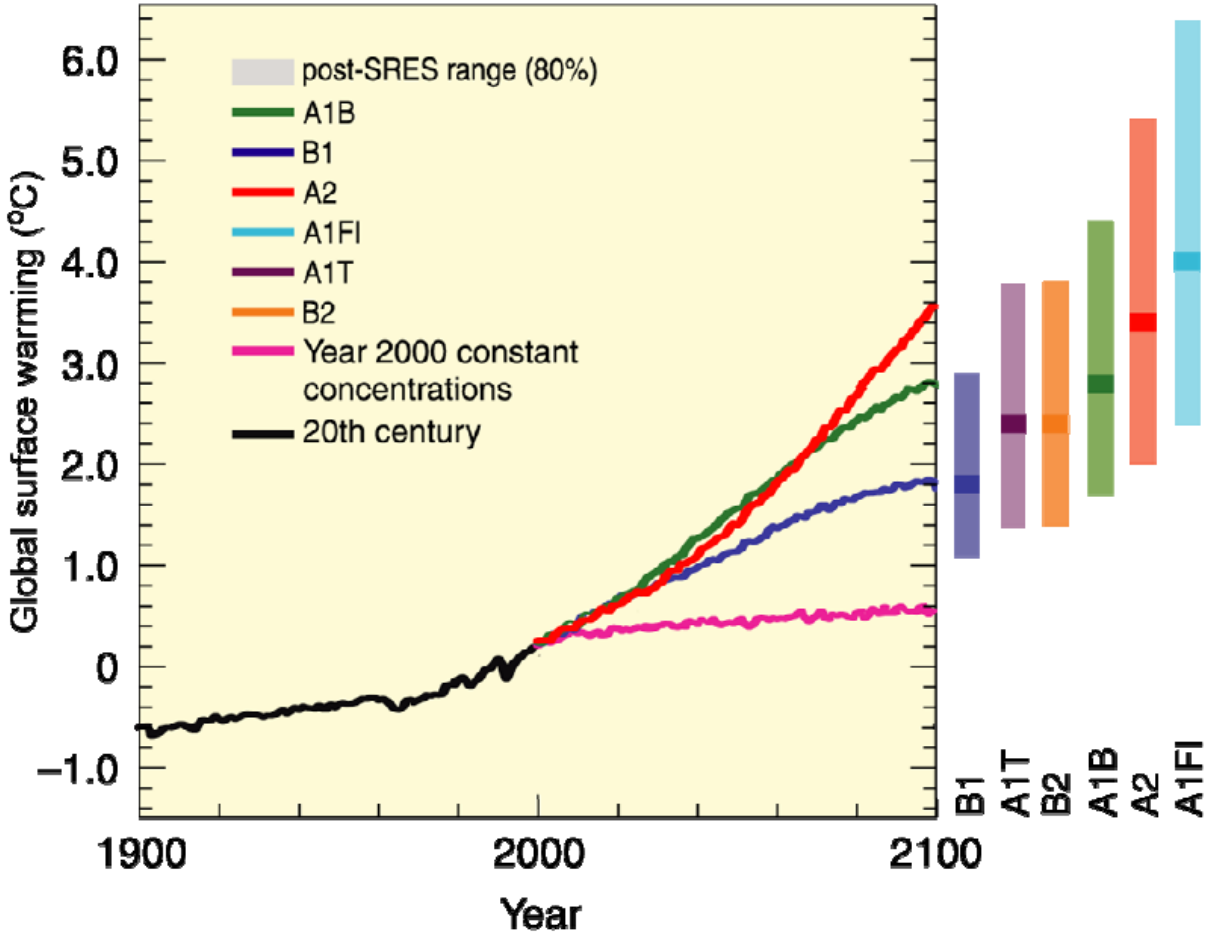
Key conclusion from the last IPCC report (2007):

- **Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations**
- **NB: « Very likely » means: probability > 90%**
- **NB: Same sentence as in previous IPCC report (TAR, 2001), but then with « likely », meaning probability > 66%**

Source: IPCC, AR4 (2007)

Projections du climat futur en l'absence de mesures





NB: écart par rapport à la moyenne 1980-1999

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

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	*Very likely* [c]	*Likely* [d]	*Virtually certain* [d]
Warmer and more frequent hot days and nights over most land areas	*Very likely* [e]	*Likely (nights)* [d]	*Virtually certain* [d]
Warm spells / heat waves. Frequency increases over most land areas	*Likely*	*More likely than not* [f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not* [f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not* [f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis) [g]	*Likely*	*More likely than not* [f, h]	*Likely* [i]

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

Impacts

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

Following addressed by WG II:

- Impacts observed so far

- Future scenarios
- Impacts on sectors:
  - Water
  - Ecosystems
  - Agriculture, forestry, fisheries
  - Coasts
  - Settlements and industry
  - Health

WMO

UNEP

Following addressed (cont.):

- Impacts on regions:
  - Africa, Asia, Australia and New Zealand, Latin America, North America, Polar regions, Small islands, and
  - Europe (including the Alps)

- Adaptation practices
- Adaptation vs. mitigation
- Key vulnerabilities
- Sustainability

WMO

UNEP

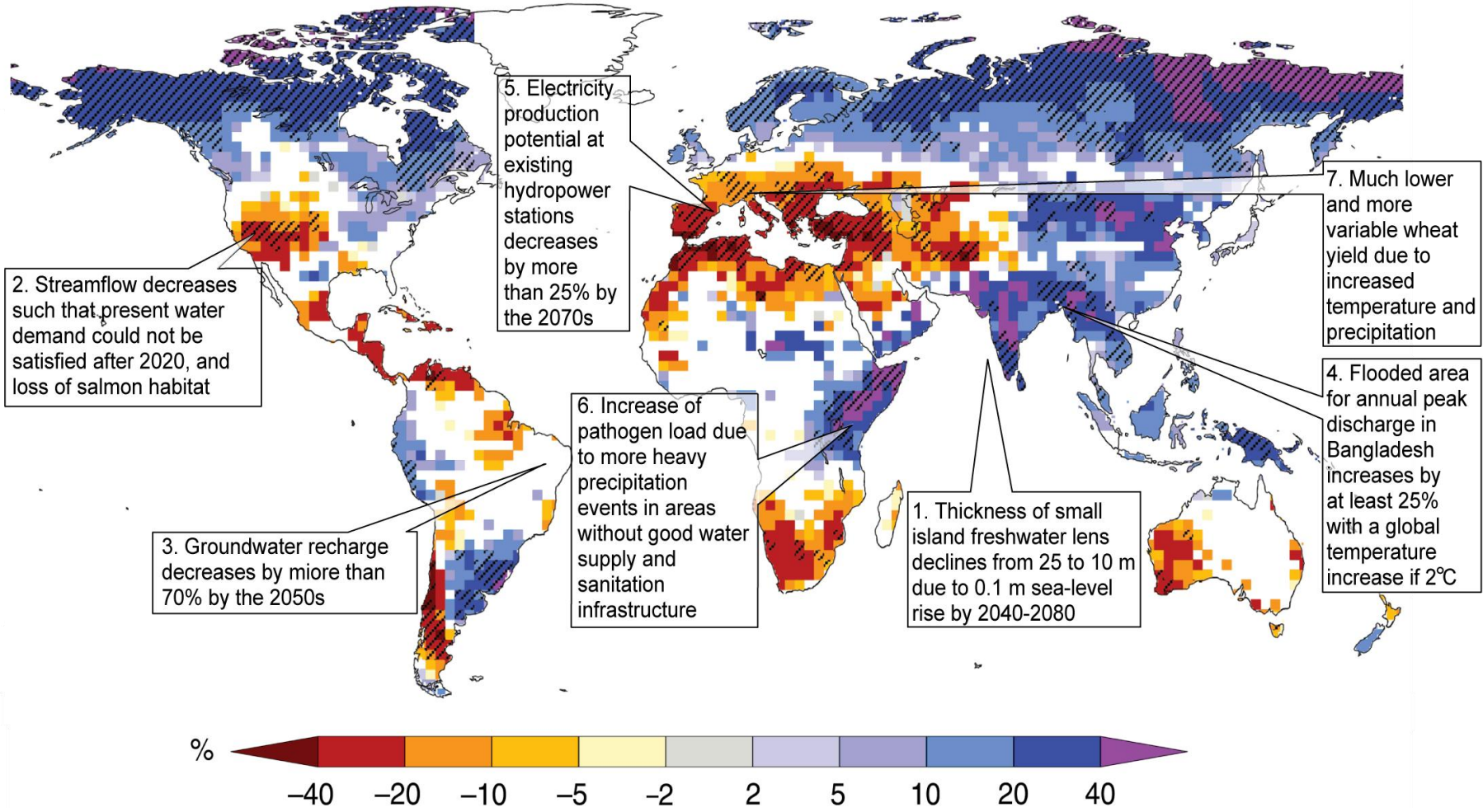
20% - 30% of plants and animals species likely at "increased risk of extinction"

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

WMO

UNEP

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).

WMO

UNEP

More heavy precipitation and more droughts….

Regions most affected

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

WMO

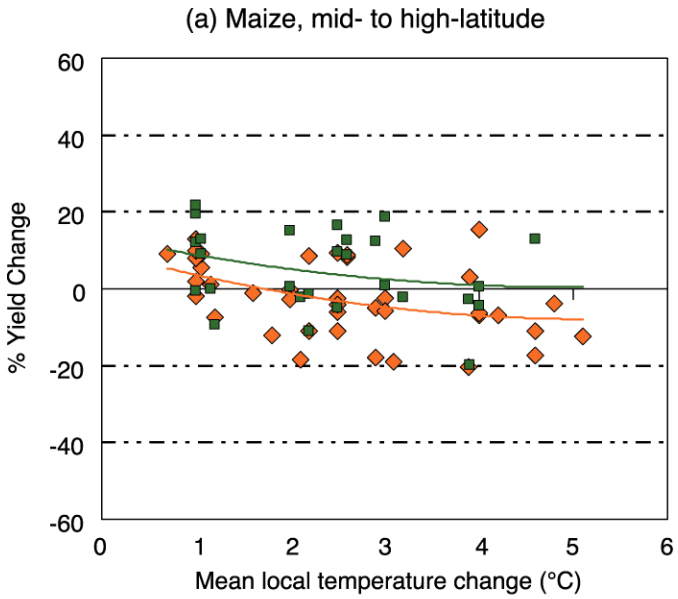
UNEP

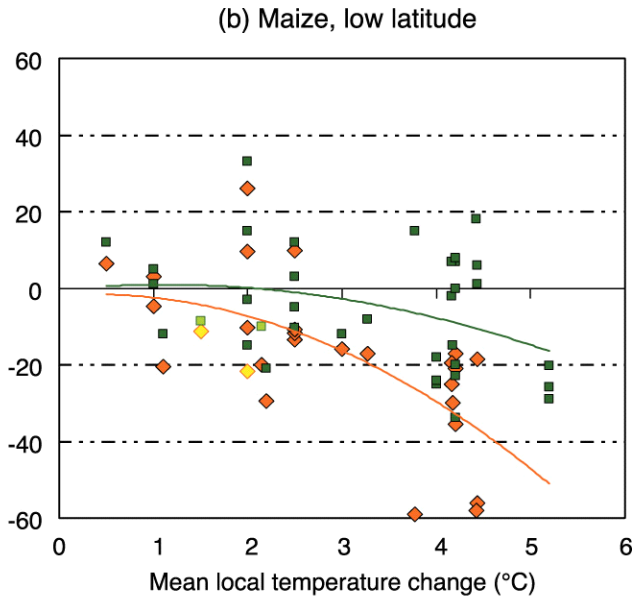
In all regions, there are some areas and communities which are particularly vulnerable

- The poor
- Young children
- The elderly

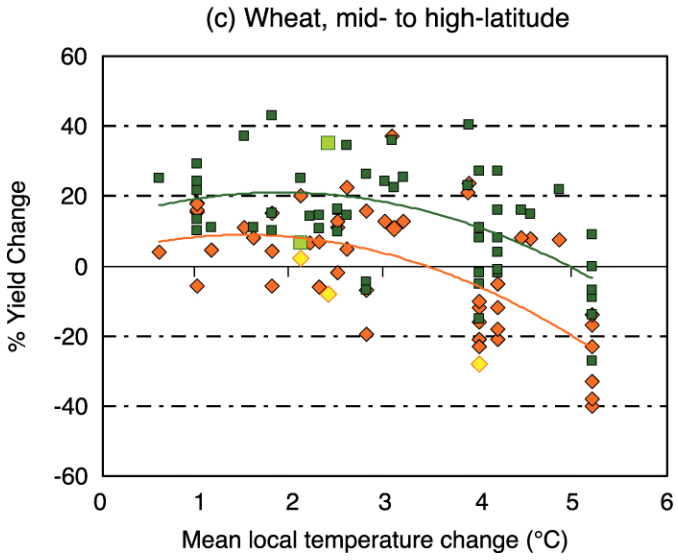
Figure TS.7. Sensitivity of cereal yield to climate change

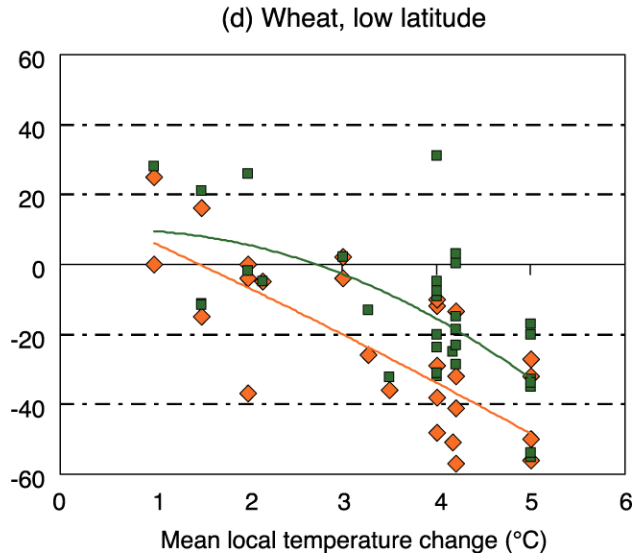
Maïs





Blé

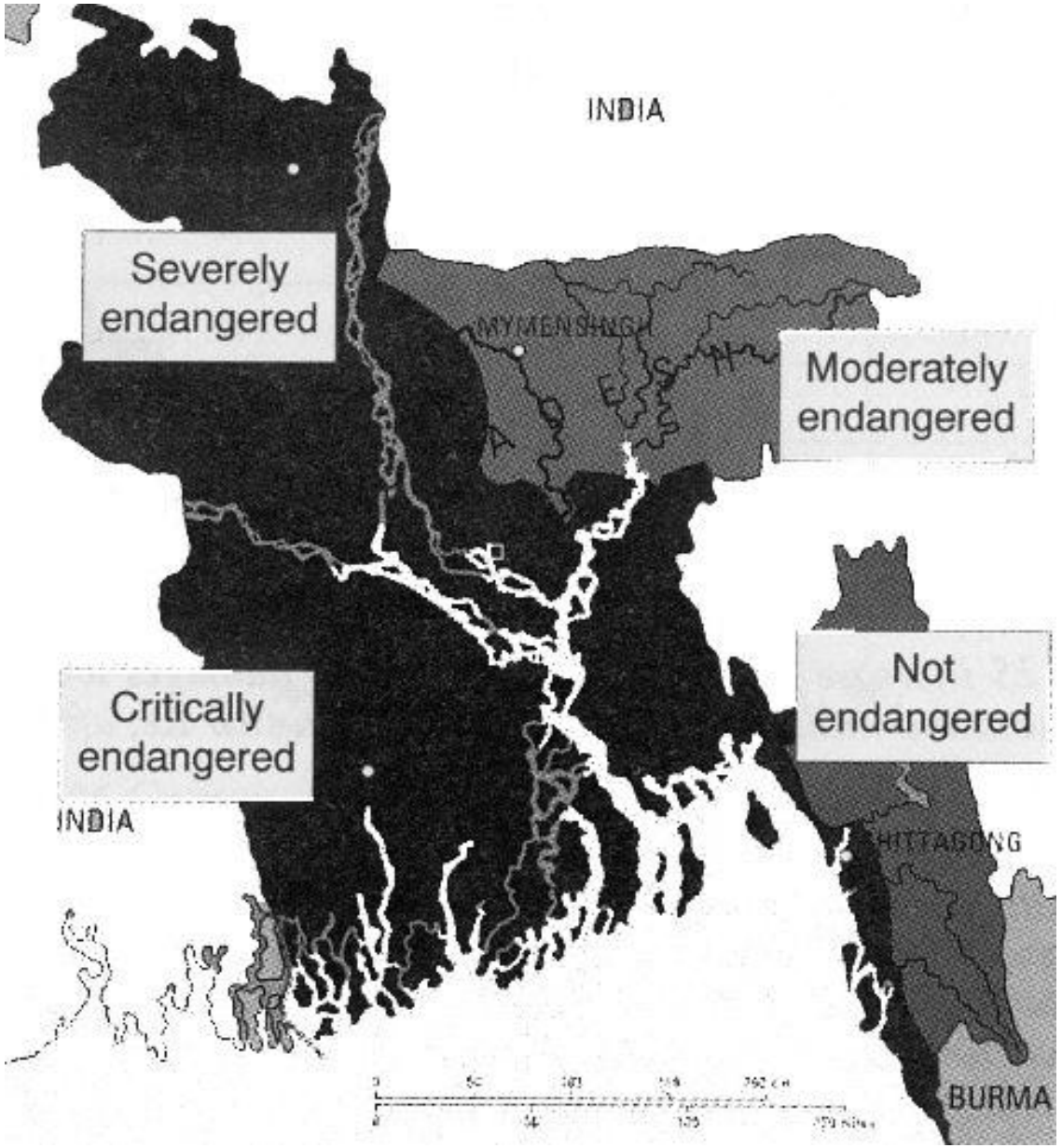




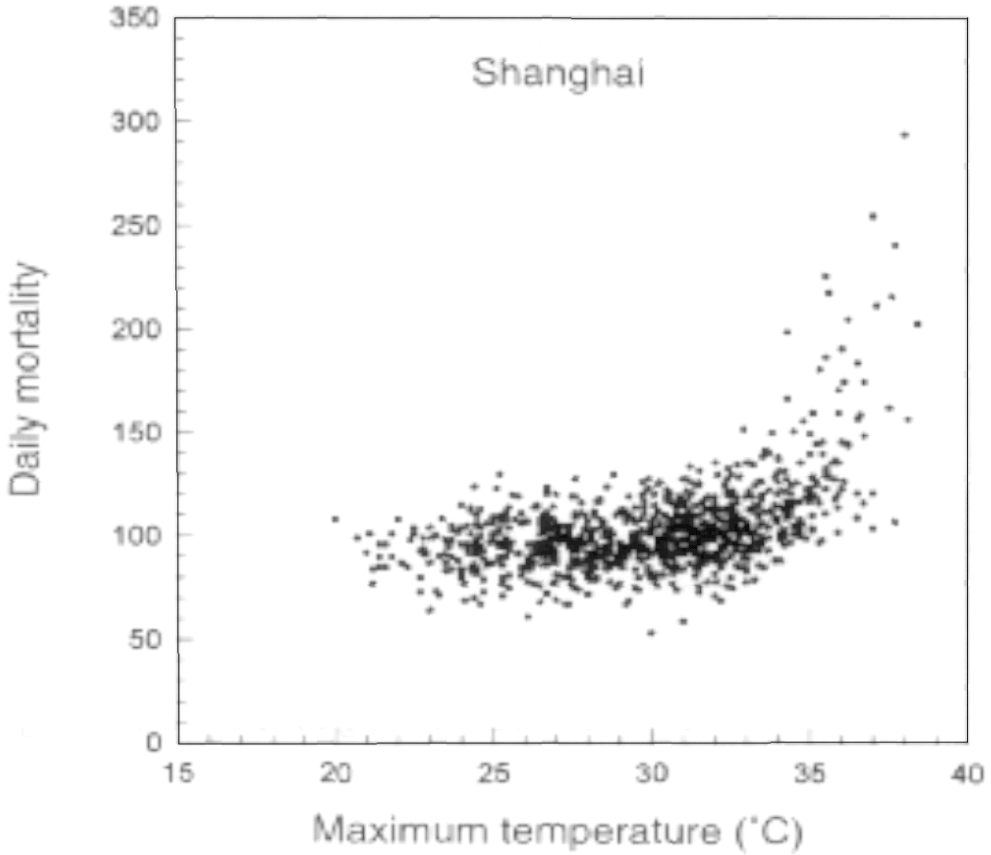
WMO

UNEP

Bangladesh and sea level rise

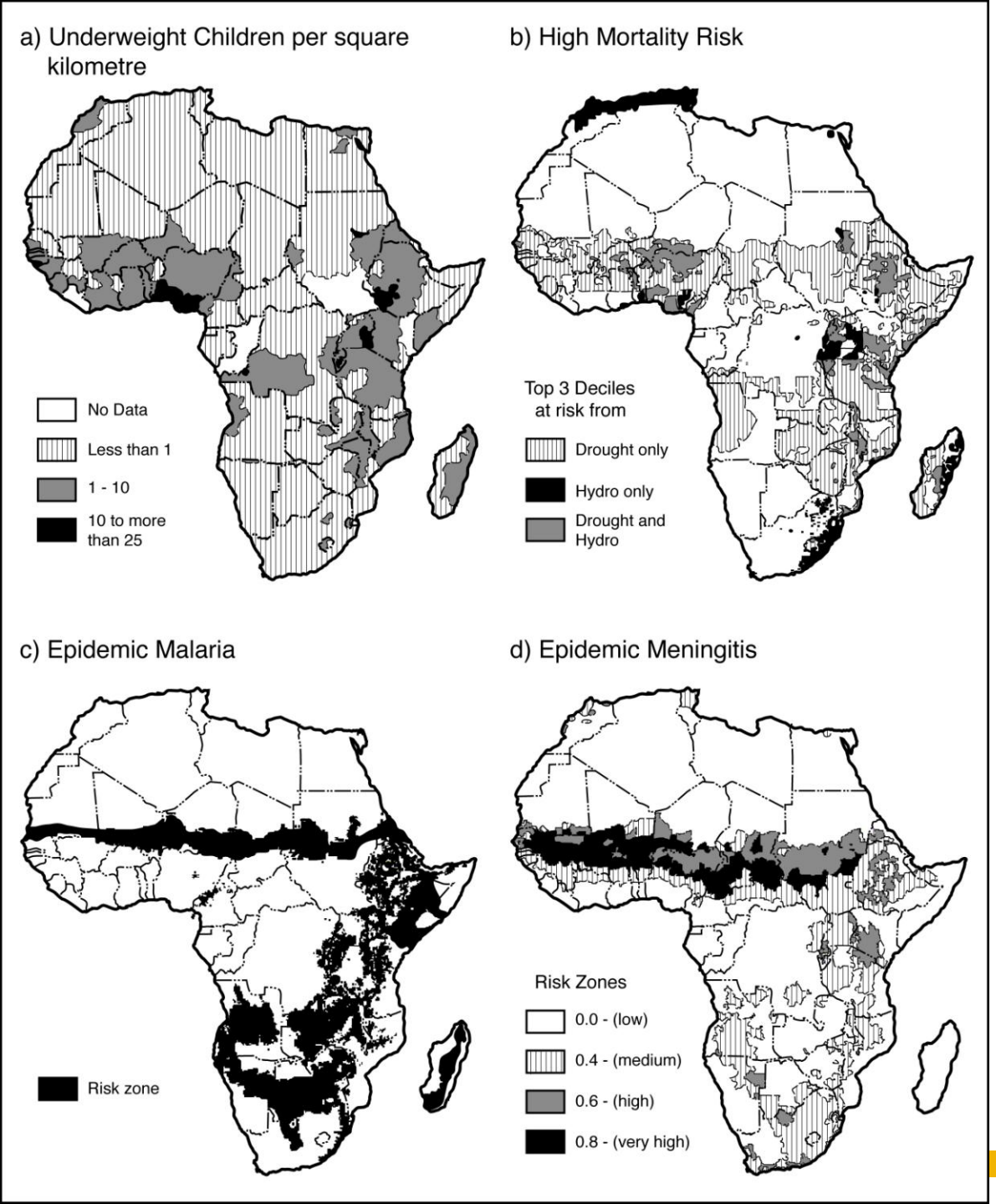


Relationship between maximum temperature and mortality in Shanghai, China, 1980-89



Référence : ClLIMATE CHANGE AND HUMAN HEALTH, 1996

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

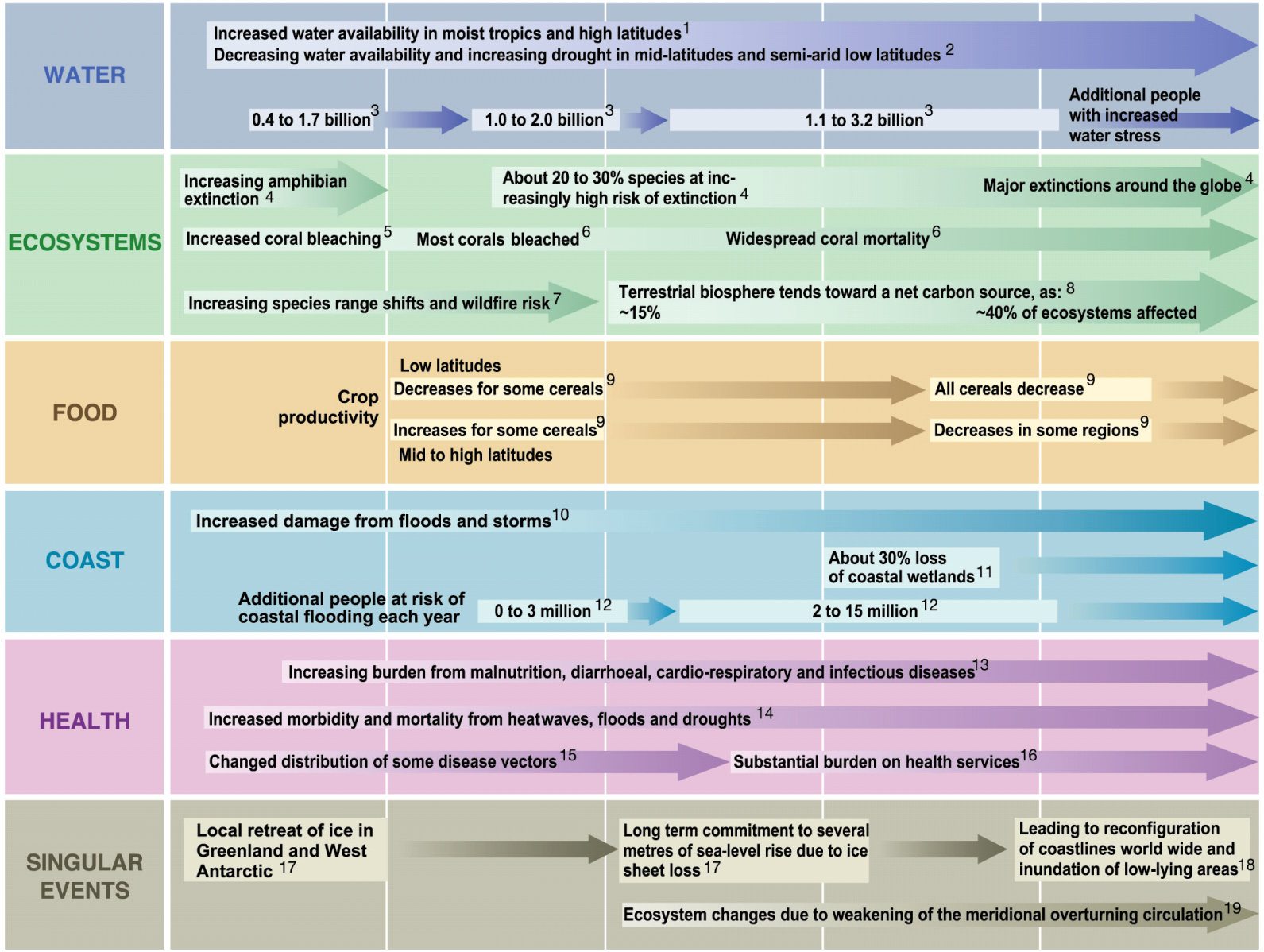


Vulnerability to climate change can be made worse by the presence of other stresses:

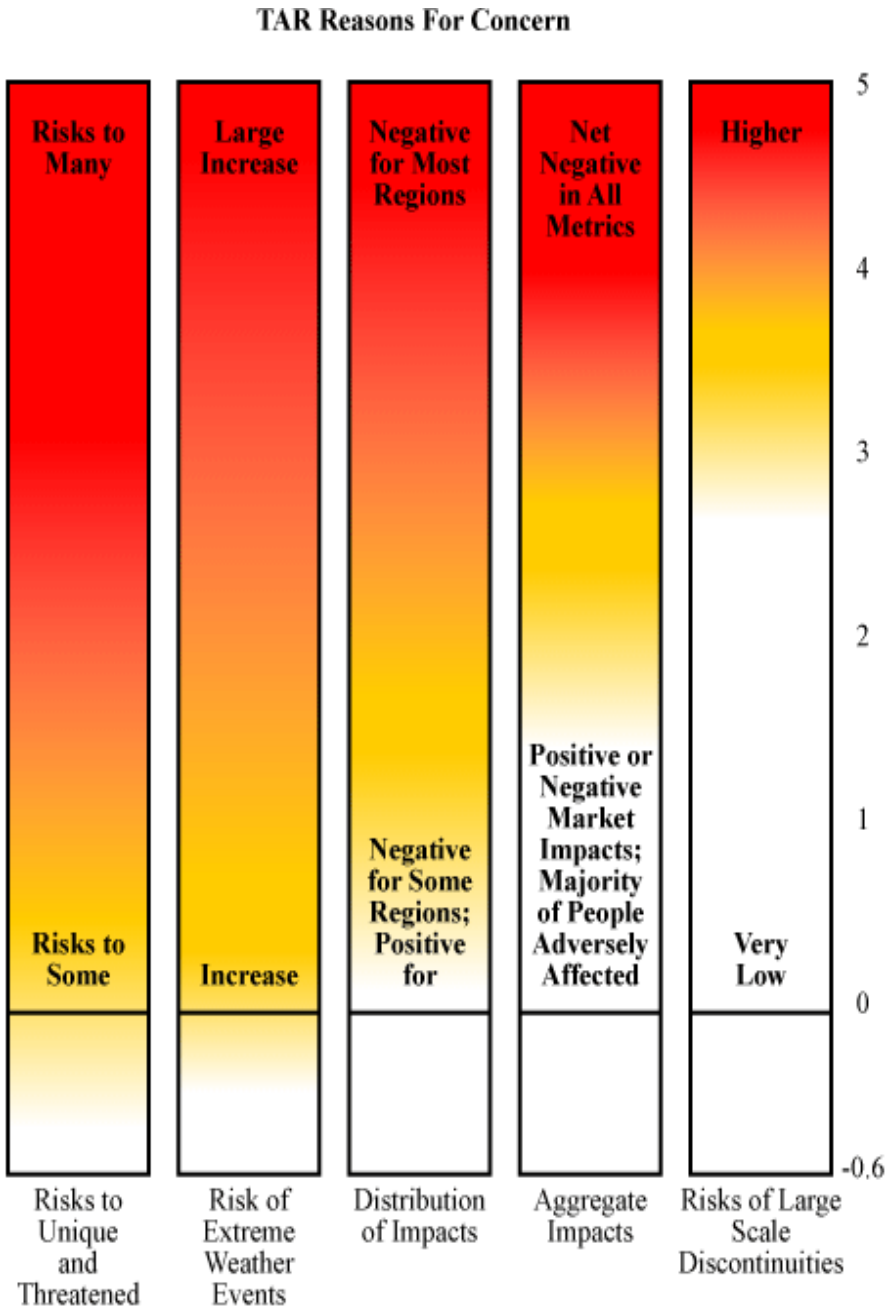
Multiple stresses in Africa (IPCC AR4 WG2 Ch 9)

UNEP

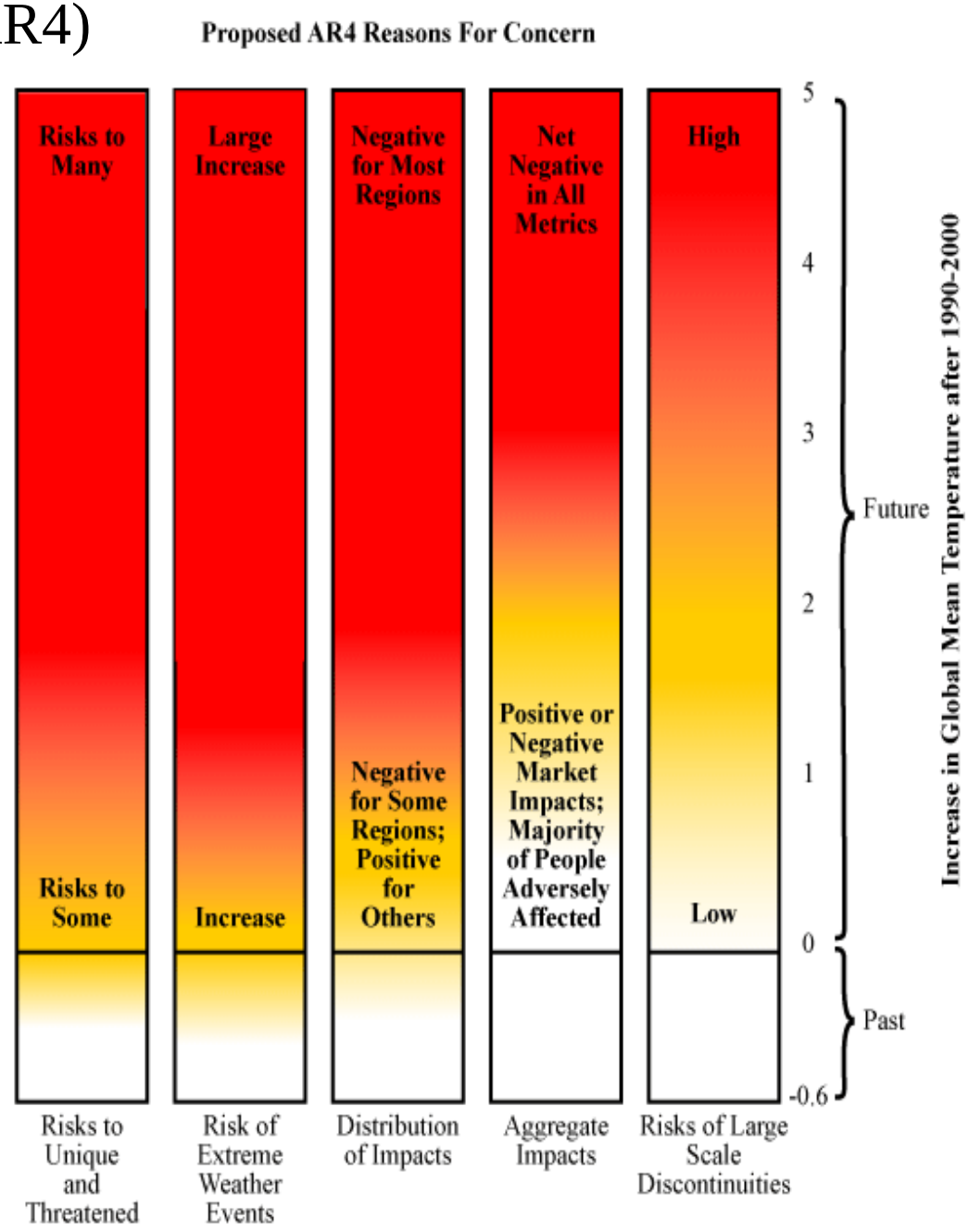
Table TS.3. (lower) Examples of global impacts projected for changes in climate (and sea level and atmospheric CO_2 where relevant)



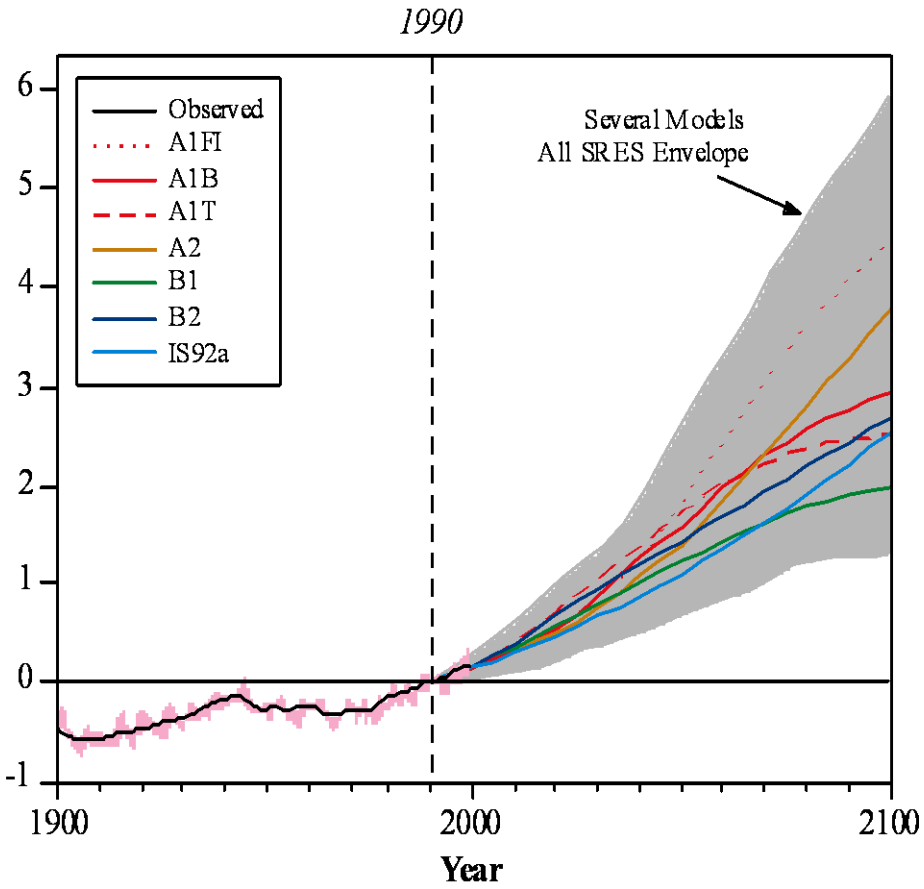
Source: IPCC WGII AR4

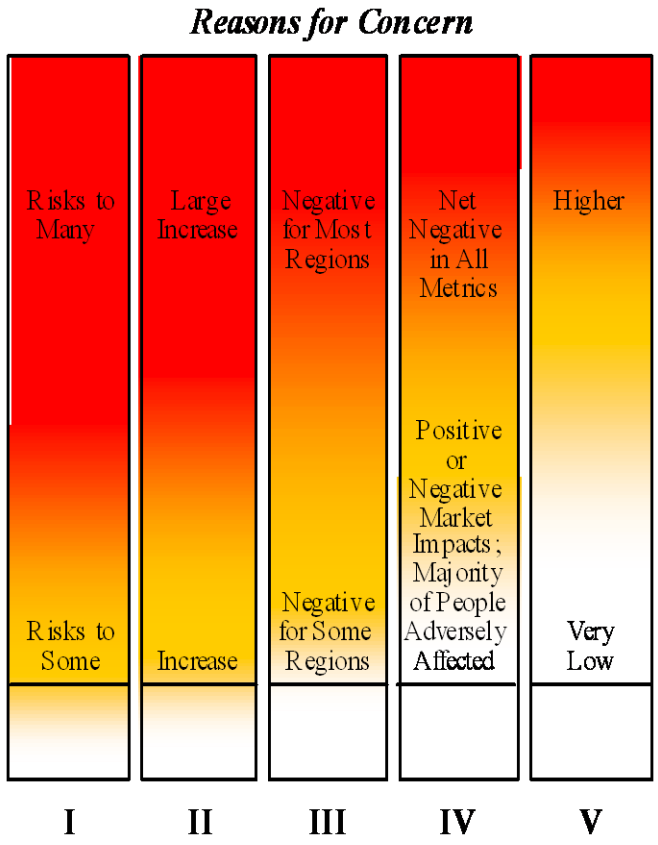

TAR Reasons For Concern
Risks to Many
Risks to Some
Large Increase
Increase
Negative for Most Regions
Negative for Some Regions; Positive for
Net Negative in All Metrics
Positive or Negative Market Impacts; Majority of People Adversely Affected
Higher
Very Low
5
4
3
2
1
0
-0.6
Risks to Unique and Threatened
Risk of Extreme Weather Events
Distribution of Impacts
Aggregate Impacts
Risks of Large Scale Discontinuities

(Based on IPCC AR4)



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 AR3 WG2 (2001)

Geopolitical Consequences

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

www.bgu.de (2007)

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

WBGU core message:

- **Without resolute counteraction, climate change will overstretch many societies' adaptive capacities within the coming decades.**
- **This could result in *destabilization and violence*, jeopardizing national and international security to a new degree.**
- **However, climate change could also unite the international community, provided that it recognizes climate change as a threat to humankind and soon sets the course for the avoidance of dangerous anthropogenic climate change by adopting a dynamic and globally coordinated climate policy.**

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

WBGU core message:

- **If it fails to do so, climate change will draw ever-deeper lines of division and conflict in international relations, triggering numerous conflicts between and within countries over the distribution of *resources*, especially *water and land*, over the management of *migration*, or over *compensation payments* between the countries mainly responsible for climate change and those countries most affected by its destructive effects.**

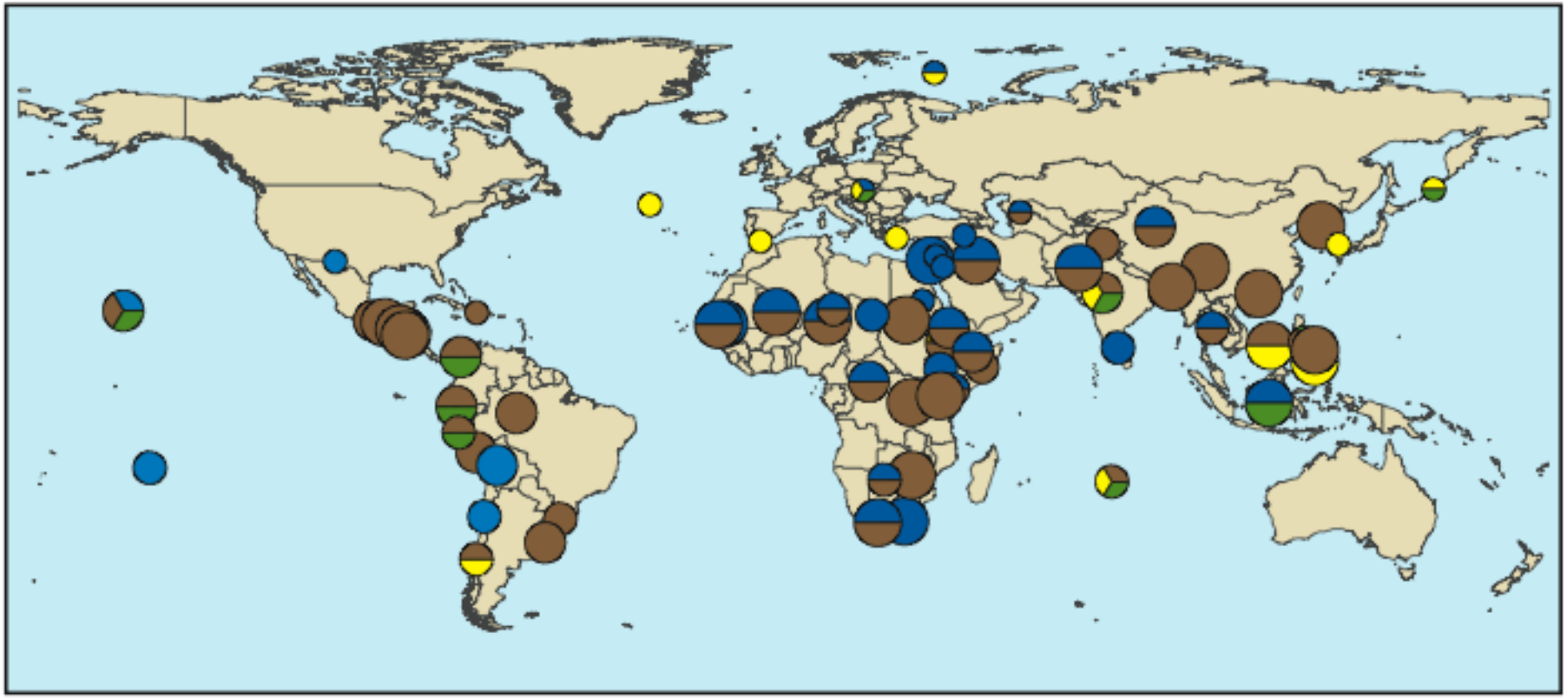
Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

WBGU:

- **In order to avoid these developments, an ambitious global climate policy must be put into operation over the next 10-15 years.**
- **An effective international climate protection regime must ensure that global greenhouse gas emissions are halved by the mid 21st century.**

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

World map of environmental conflicts (1980-2005)



Conflict intensity

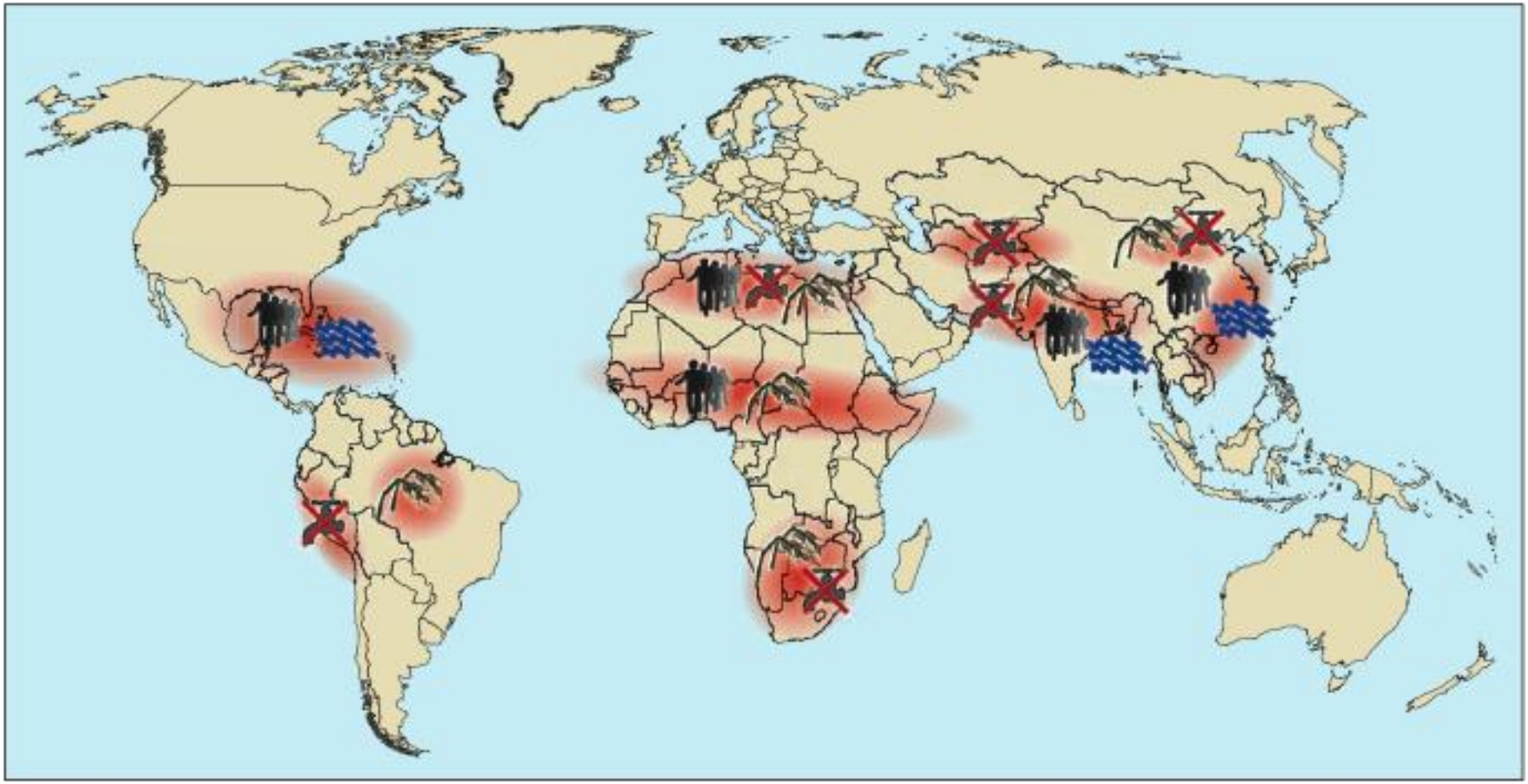
- Diplomatic crisis
- Protests (partly violent)
- Use of violence (national scope)
- Systematic/collective violence

Conflict cause

- Water
- Land/soil
- Fish
- Biodiversity

Source : WBGU (2007)

Climate Change as a security risk



Conflict constellations in selected hotspots

Climate-induced degradation of freshwater resources

Climate-induced decline in food production

Hotspot

Climate-induced increase in storm and flood disasters

Environmentally-induced migration

Source : WBGU 2007

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^{o}C over present-day temperatures would lead to partial melting over centuries to millennia

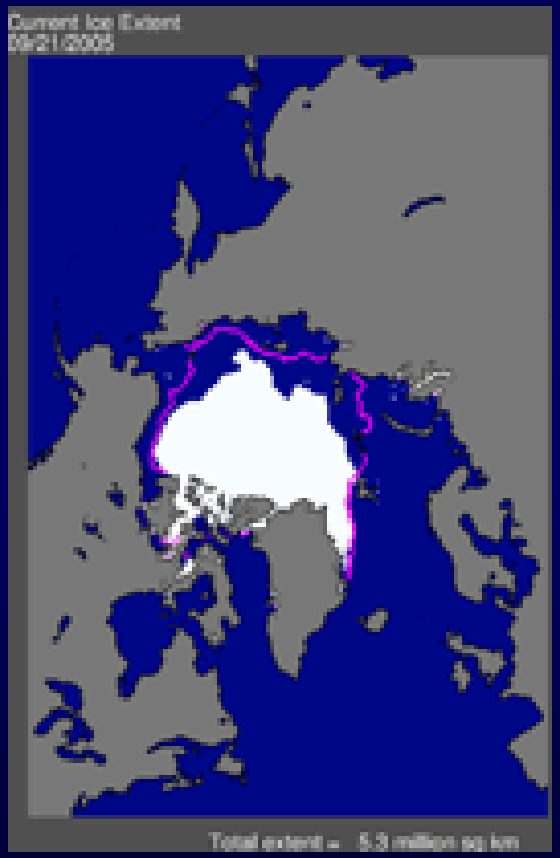
Effects on Nile delta: 10 M people above 1m

(Time 2001)

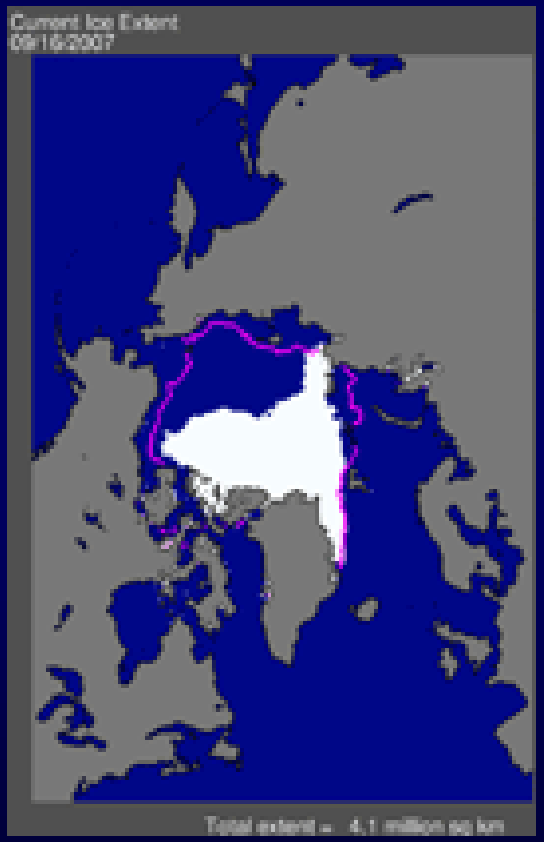
Extension of the Arctic ice cap

September 1979

September 2005



September 2007



The pink line indicates the average ice cap extension since 1979

Climate change a security risk, say Javier Solana and Commisioner Ferrero-Waldner (Financial Times, 3 march 2008)

- Climate change poses "serious security risks" and fighting it should be part of "preventive security policy", according to the European Union's top diplomats in a paper prepared for an EU summit this spring.

- It says « increased natural disasters and shortages of water, food and other resources in the developing world could affect European security. »

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

Climate change a security risk,say Javier Solana and Commisioner Ferrero-Waldner (Financial Times, 3 march 2008)

- **The threat of water wars is particularly grave in the Middle East.**
- **Two-thirds of the Arab world relies on external supplies.**
- **"Existing tensions over access to water are almost certain to intensify in the region, leading to further political instability with detrimental implications for Europe's energy security and other interests. Water supply in Israel might fall by 60 per cent over this century," the paper says.**

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

Climate change a security risk,say Javier Solana and Commisioner Ferrero-Waldner (Financial Times, 3 march 2008)

- It anticipates falling harvests in Turkey, Iraq, Syria and Saudi Arabia, creating instability there.
- "Climate change will fuel conflicts over depleting resources, especially where access to those resources is politicised," it says, citing the fighting in Darfur.
- It points to seven threats, including disappearing islands and coastlines, increased migration, a new scramble for resources in the Arctic and greater competition for access to energy.

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

CANADA
2.3%

FORMER SOVIET UNION
13.7%

UNITED STATES
30.3%

EUROPE
27.7%

MIDDLE EAST
2.6%

CHINA, INDIA, AND
DEVELOPING ASIA
12.2%

JAPAN
3.7%

AFRICA
2.5%

SOUTH AND
CENTRAL AMERICA
3.8%

AUSTRALIA
1.1%

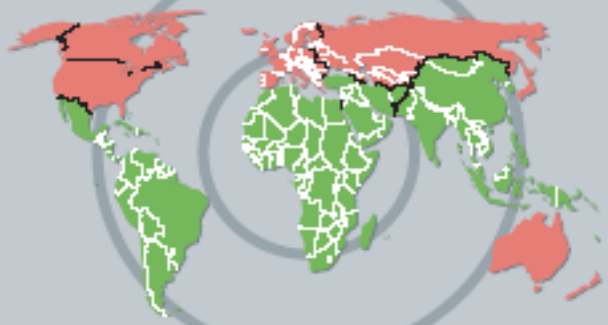
Contributions to Global Warming

Areas are proportional to historic carbon dioxide emissions from fossil fuel combustion, 1900–1999

INDUSTRIALIZED

DEVELOPING

EQUAL AREA WORLD: areas are proportional to actual physical size



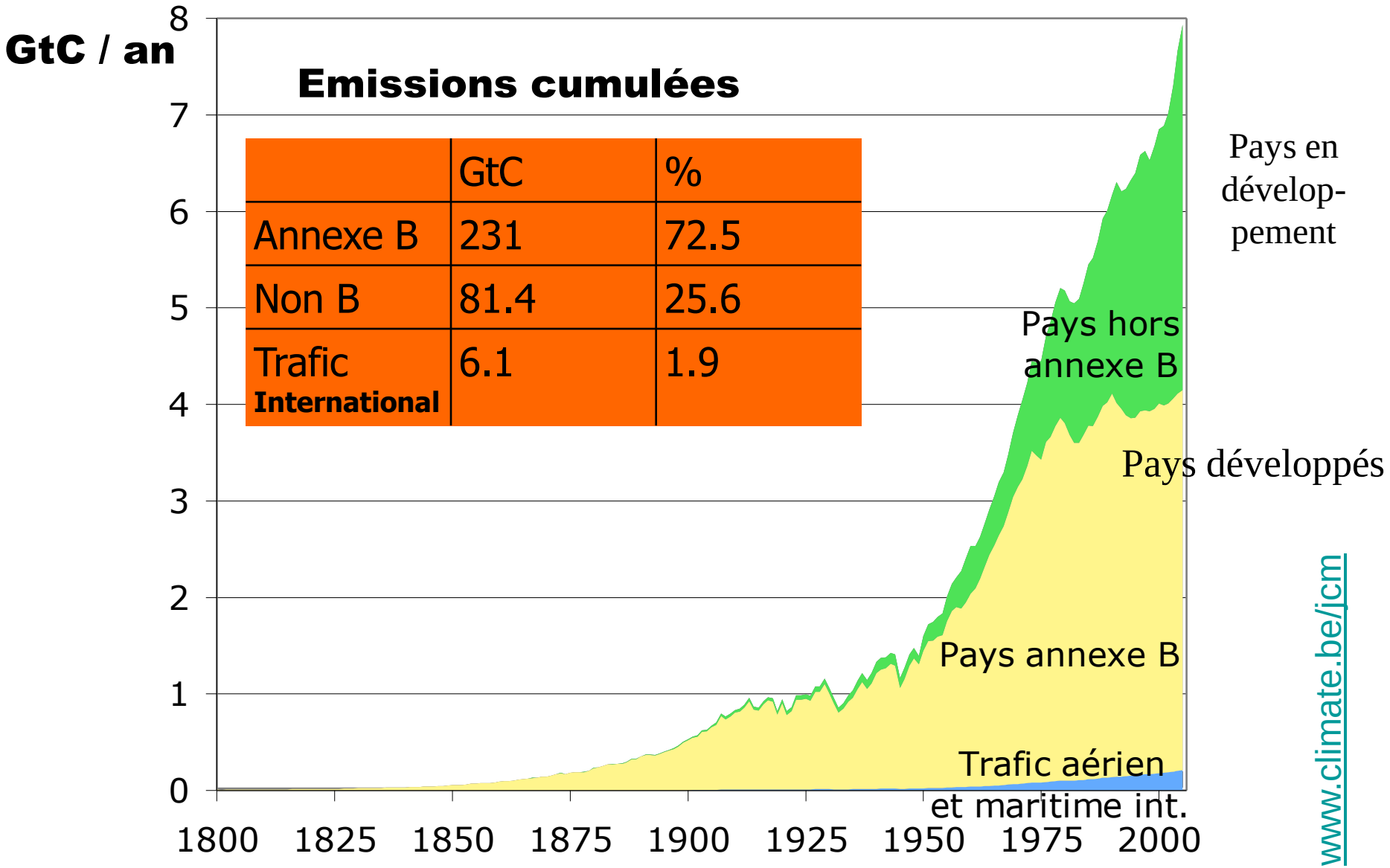
Underlying data sources:
United States Department of Energy, Energy Information Administration and the Carbon Dioxide Information Analysis Center

Map by Equator Graphics, Inc.

World Resources Institute
http://www.wri.org/
1-202-729-7600

WRI

Emissions historiques : CO_2



Mitigation: how to restabilize climate?

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

Stabilisation levels and equilibrium global mean temperatures

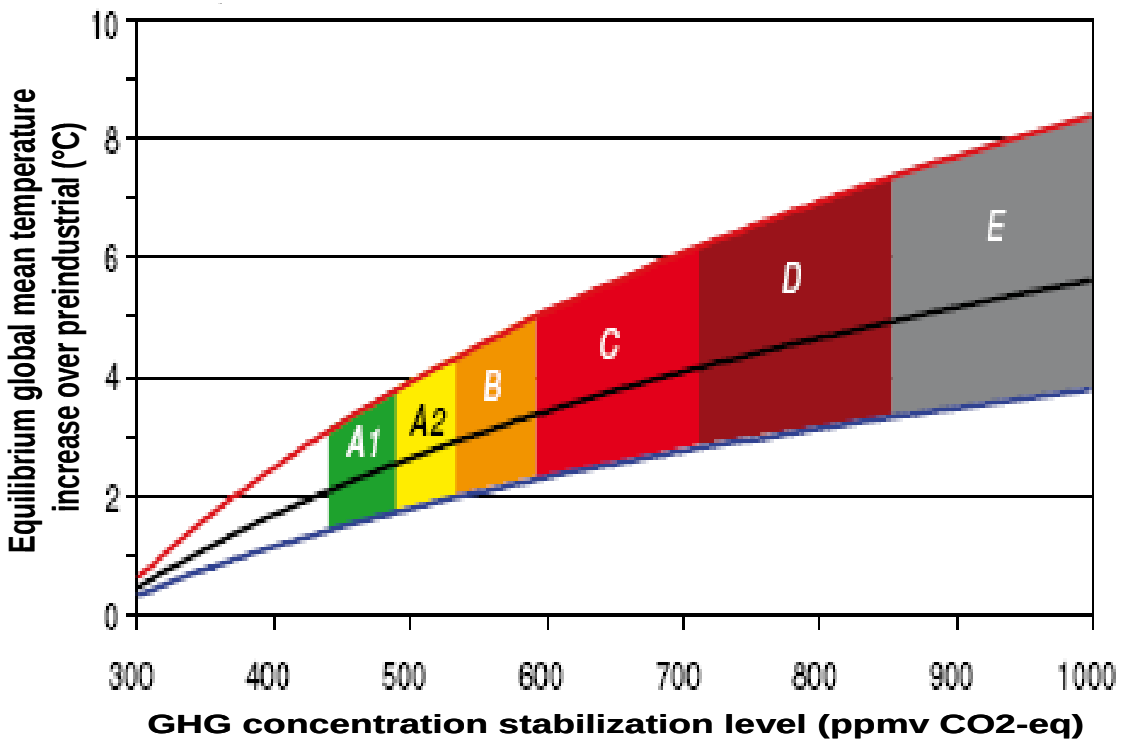
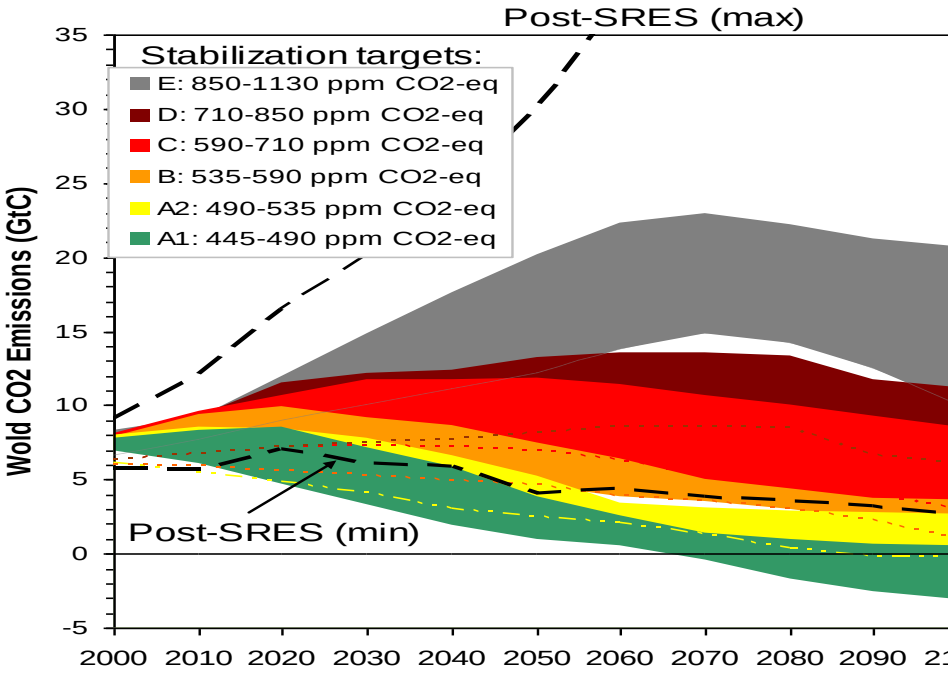
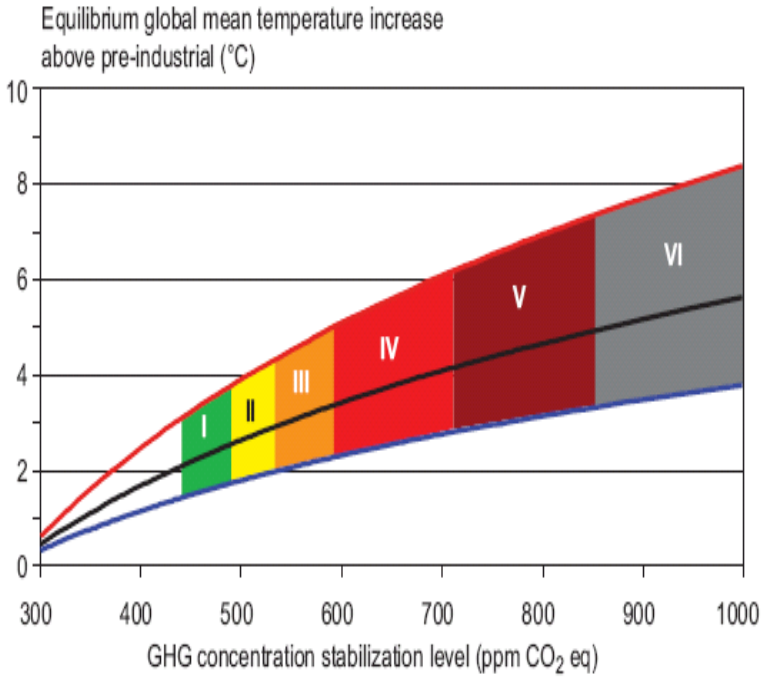


***Figure SPM 8**: Stabilization scenario categories as reported in Figure SPM.7 (coloured bands) and their relationship to equilibrium global mean temperature change above pre-industrial, using (i) "best estimate" climate sensitivity of 3 ℃ (black line in middle of shaded area), (ii) upper bound of likely range of climate sensitivity of 4.5 ℃ (red line at top of shaded area) (iii) lower bound of likely range of climate sensitivity of 2 ℃ (blue line at bottom of shaded area). Coloured shading shows the concentration bands for stabilization of greenhouse gases in the atmosphere corresponding to the stabilization scenario categories. The data are drawn from AR4 WGI, Chapter 10.8.*

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 CO2-eq)	Global Mean temp. increase at equilibrium (°C)	Year CO2 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

Contribution of Working Group III to the Fourth Assessment Report of the IPCC,

- **Chapter 13, page 776:**

Box 13.7 The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group[a]

Scenario category	Region	2020	2050
A-450 ppm CO_2-eq[b]	Annex I	–25% to –40%	–80% to –95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2-eq	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2-eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

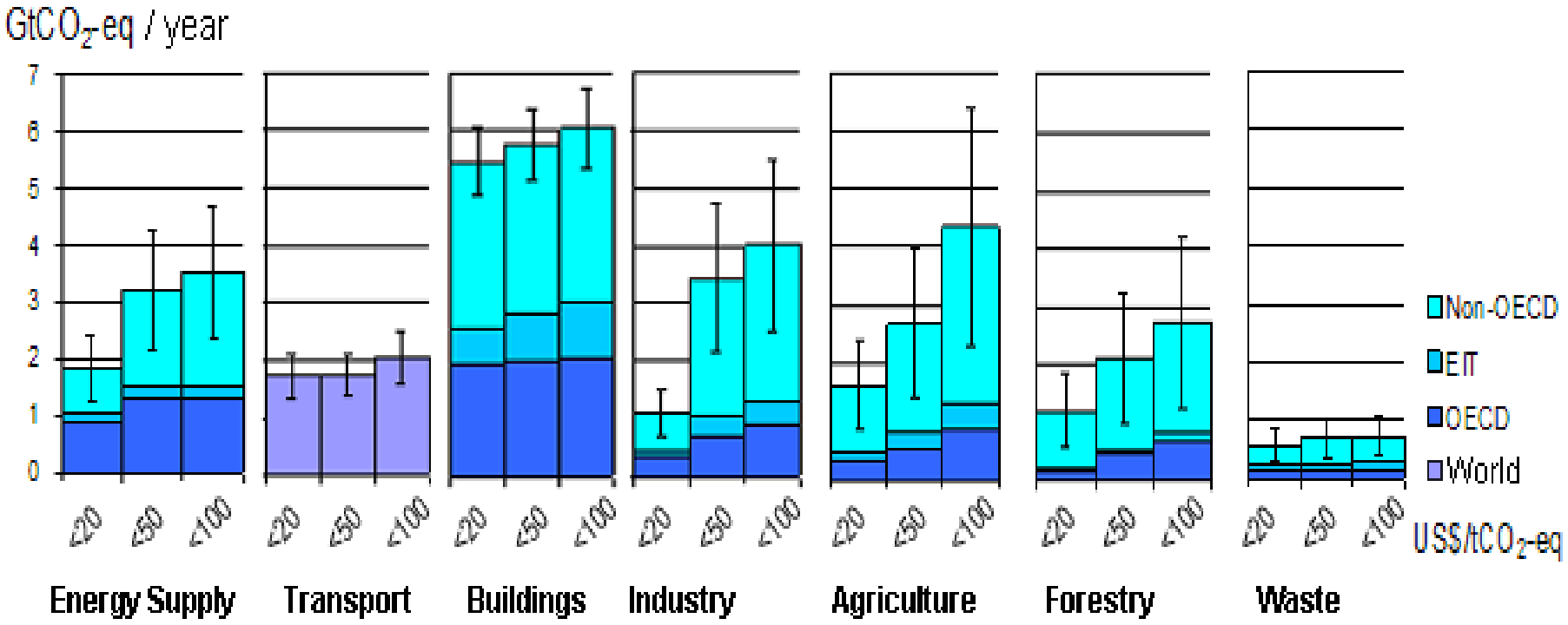
Notes:

[a] The aggregate range is based on multiple approaches to apportion emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.

[b] Only the studies aiming at stabilization at 450 ppm CO_2-eq assume a (temporary) overshoot of about 50 ppm (See Den Elzen and Meinshausen, 2006).

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

All sectors and regions have the potential to contribute by 2030:



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

What are the macro-economic costs in 2050?

Stabilization levels (ppm CO_2-eq)	Median GDP reduction[1] (%)	Range of GDP reduction [2] (%)	Reduction of average annual GDP growth rates [3] (percentage points)
590-710	0.5	-1 – 2	< 0.05
535-590	1.3	Slightly negative - 4	<0.1
445-535[4]	Not available	< 5.5	< 0.12

[1] This is global GDP based market exchange rates.
[2] The median and the 10th and 90th percentile range of the analyzed data are given.
[3] The calculation of the reduction of the annual growth rate is based on the average reduction during the period till 2050 that would result in the indicated GDP decrease in 2050.
[4] The number of studies that report GDP results is relatively small and they generally use low baselines.

John Holdren, President of the American Association for the Advancement of Science

- *'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.'*

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

Useful links:

- www.ipcc.ch : IPCC
- www.unfccc.int : Climate Convention
- www.climate.be/JCM: interactive climate model
- www.climate.be/vanyp : my slides and other documents

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