Les changements climatiques et l'avenir de la vie sur Terre: de la géophysique à la géopolitique

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Leçon inaugurale Chaire Francqui, ULB, Bruxelles, 6-3-2008

Plan

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  - **Mécanismes**
- **Futurs possibles du climat**
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  - **Scénarios**
- **Impacts**
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  - **Systèmes humains**
- **Conséquences géopolitiques**
- **Une nécessité: la restabilisation du climat, dans une économie plus « durable » et dans un monde plus juste**
  - **Objectifs globaux**
  - **Répartition des efforts**
- **Conclusions**

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Introduction

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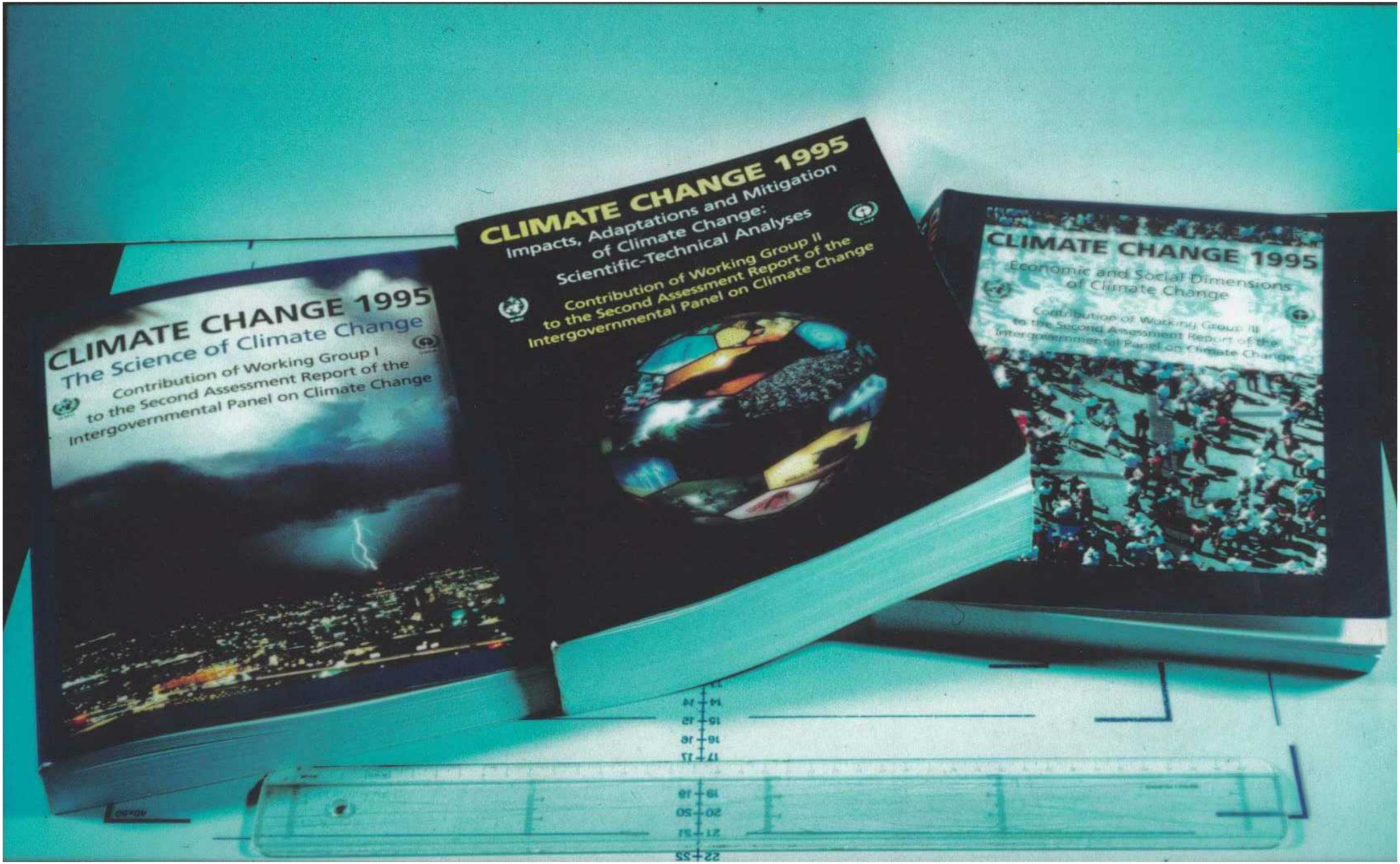

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GIEC : Groupe d'experts Intergouvernemental sur l'Evolution du Climat (=IPCC en anglais)

- **créé par l'OMM et le PNUE en 1988**
- **plus de 2500 chercheurs y participent (auteurs + relecteurs critiques)**
- **Mandat : évaluer les informations scientifiques, techniques et socio-économiques liées à la compréhension des risques associés aux changements climatiques (base scientifique, impacts potentiels, prévention et adaptation).**
- **publie des rapports (1990, 1996, 2001, 2007) (Cambridge University Press) qui font autorité.**
- **Prix Nobel de la Paix 2007.**
- **Web: www.ipcc.ch (résumés : www.climate.be)**

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Cycle d'écriture des rapports du GIEC (4 années, 2500 scientifiques)

- **Une réunion plénière décide de la table des matières des rapports**
- **Le Bureau choisit les auteurs parmi les meilleurs charcheurs mondiaux, sur la base de leur CV**
- **Les auteurs évaluent toute la littérature scientifique pertinente**
- ***Projet de texte n°1*** **– Revue par les experts –** ***Projet de texte n°2*** **et** ***Projet de Résumé pour les décideurs (SPM) n°1*****– Revue conjointe experts/gouvernements –** ***Version du texte n°3*** **et** ***Projet de Résumé pour les décideurs n°2*** **– Revue du Résumé par les gouvernements – Approbation ligne par ligne du résumé par une réunion plénière (interaction auteurs – gouvernements), acceptation du texte dans son ensemble**

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Contexte géophysique

- **Observations**
- **Mécanismes**

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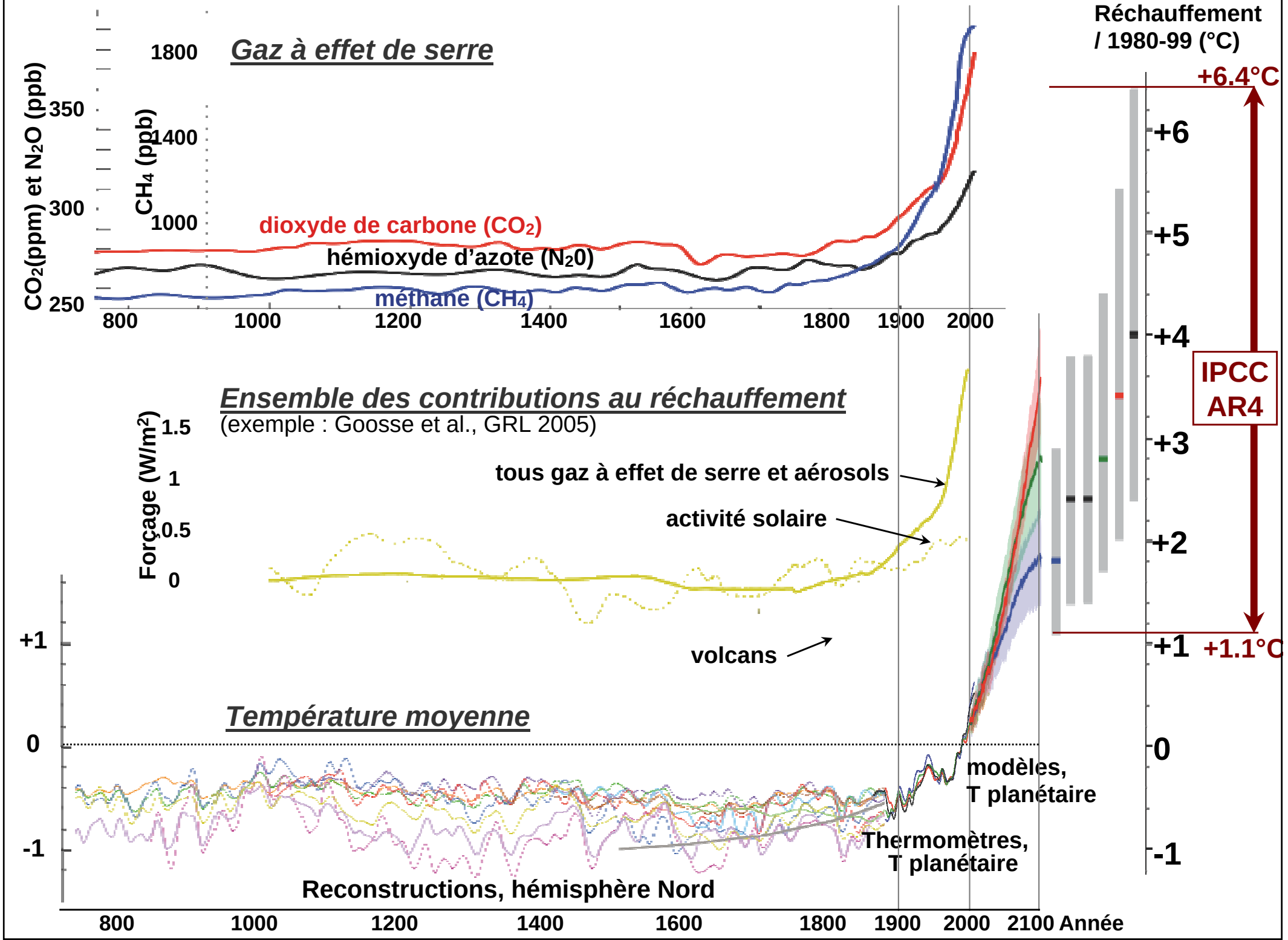
Gaz à effet de serre
CO2(ppm) et N2O (ppb)
CH4 (ppb)
dioxyde de carbone (CO2)
hémioxyde d'azote (N20)
méthane (CH4)
Réchauffement / 1980-99 (°C)
+6.4°C
+1.1°C
IPCC AR4
Ensemble des contributions au réchauffement
(exemple : Goosse et al., GRL 2005)
Forçage (W/m2)
tous gaz à effet de serre et aérosols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

Le système climatique terrestre

- **Machine thermique alimentée en énergie par le Soleil (1400 Wm-2 au sommet de l'atmosphère)**
- **« Sphère » en rotation→dynamique des fluides complexe**
- **Océan= 70% de la surface,**
- **Très fine atmosphère (N_2, O_2, H_2O, CO_2,…)**
- **Effet de serre**
- **Cycles bio-géo-chimiques**

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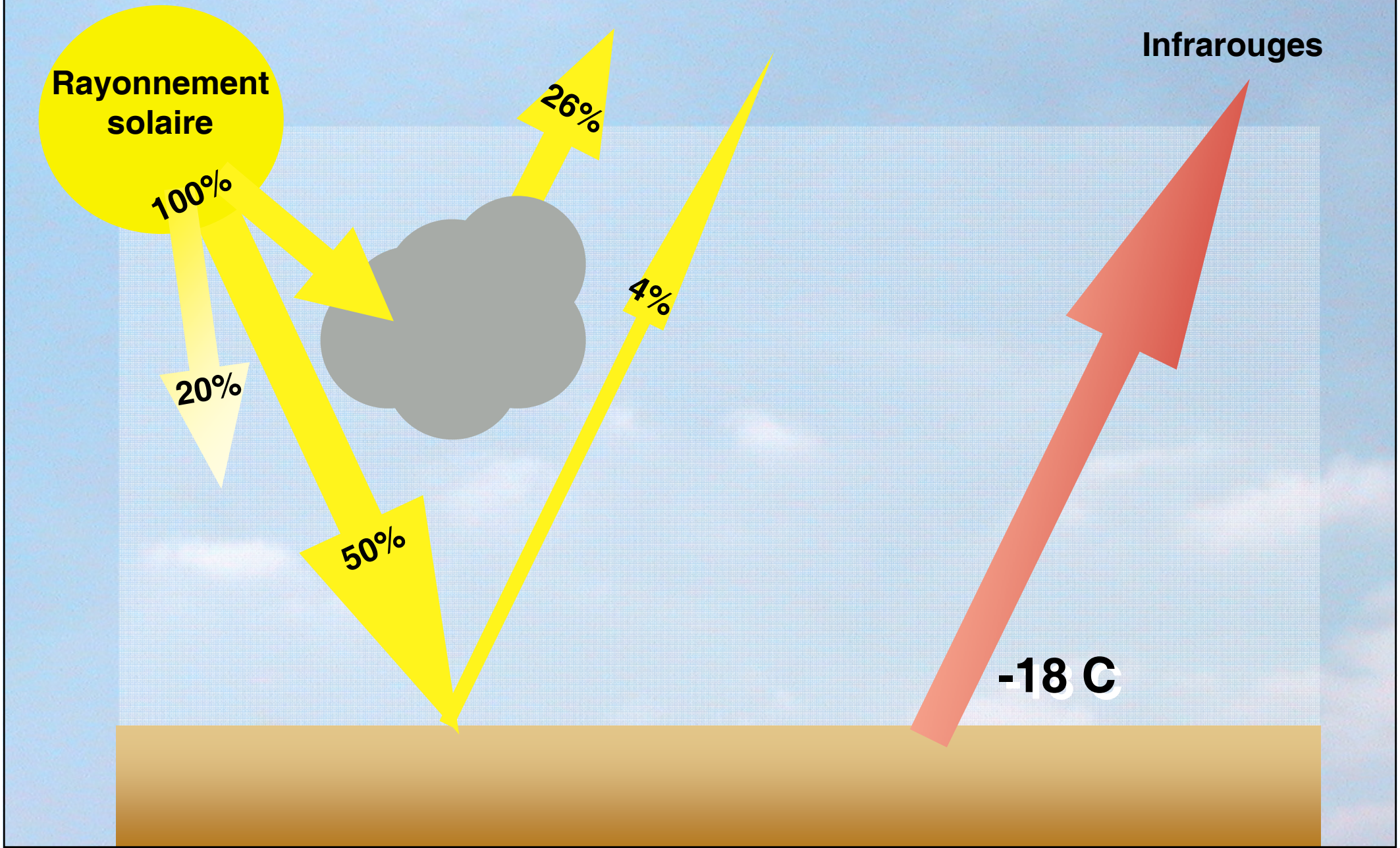
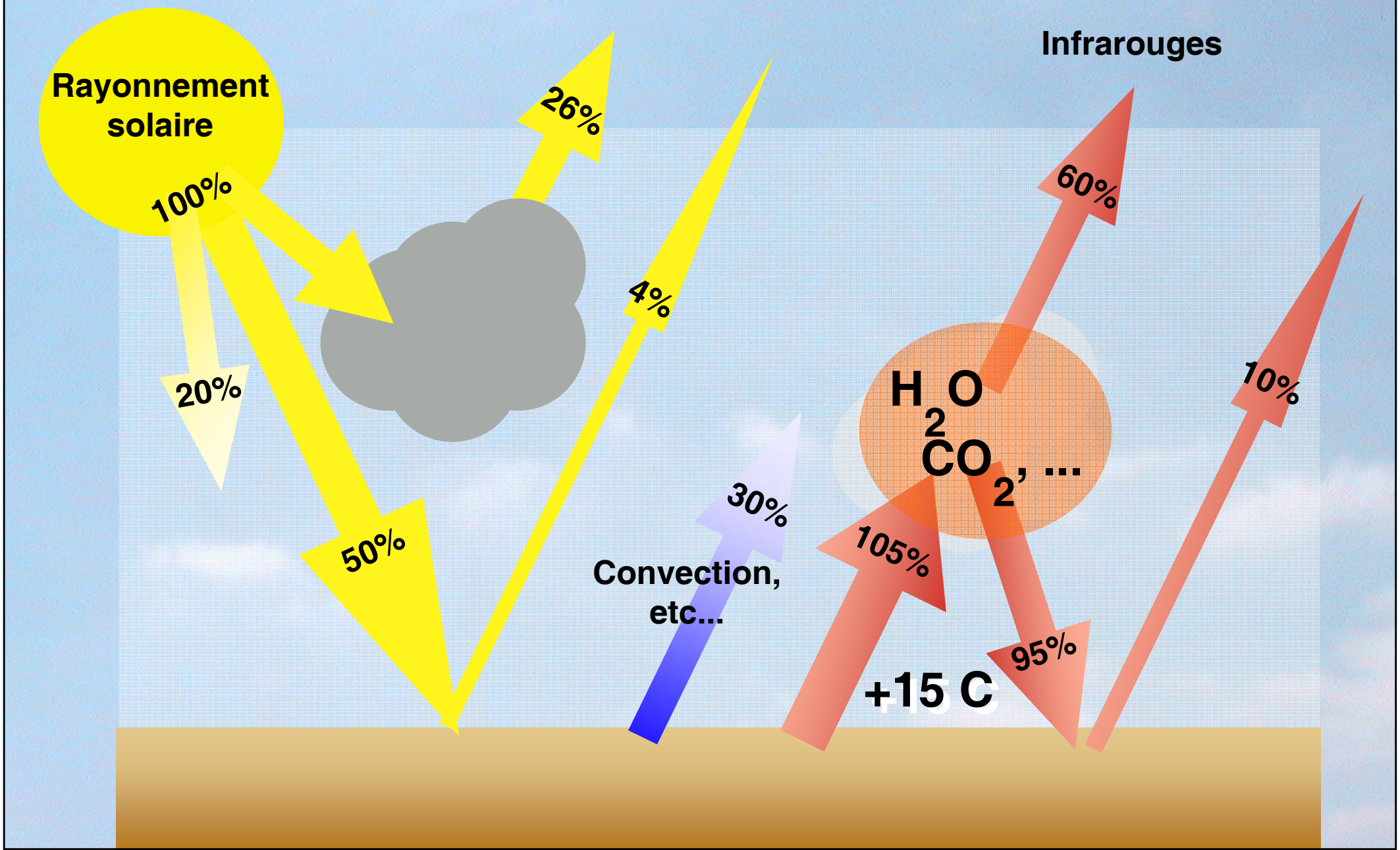
Cycle de l’énergie et effet de serre

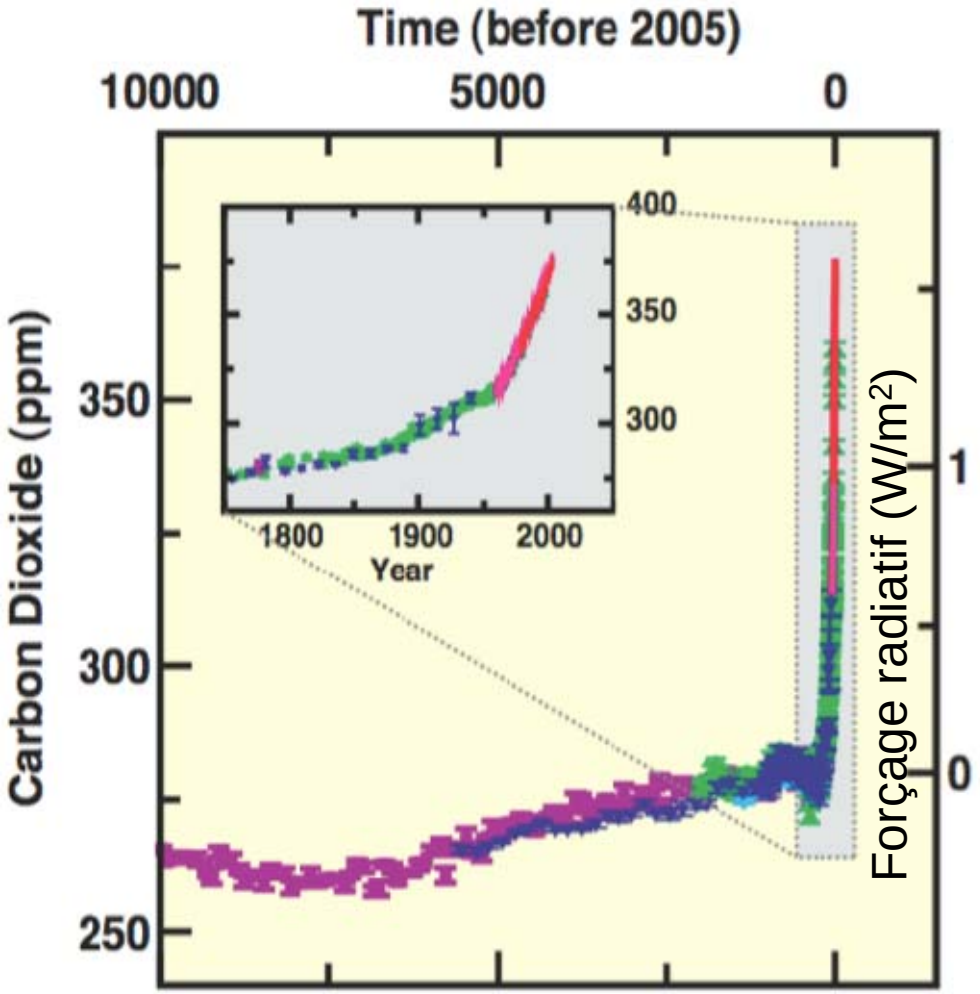


Cycle de l'énergie et effet de serre



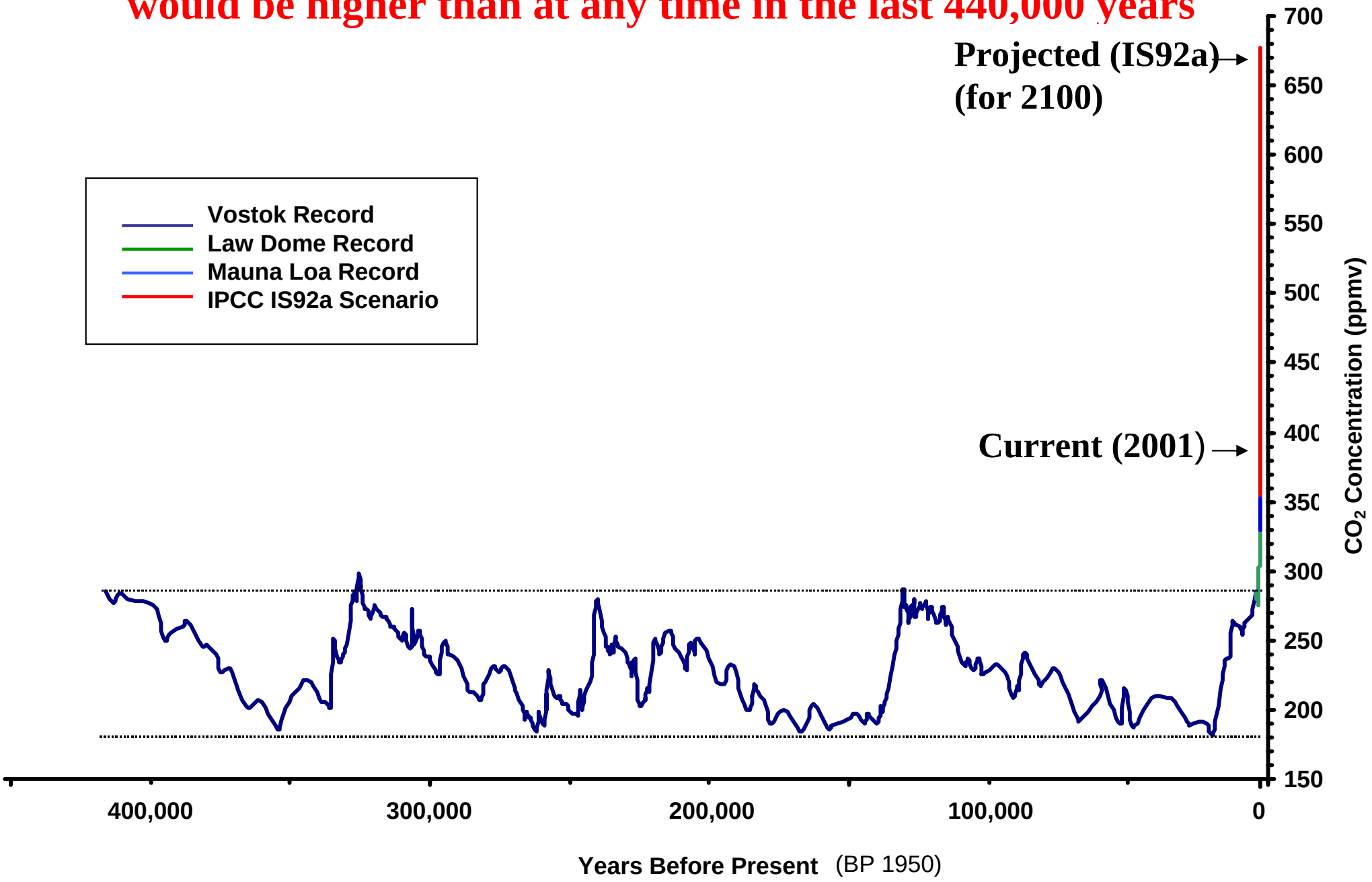
Causes humaines et naturelles des changements climatiques

- Les concentrations mondiales de dioxyde de carbone, de méthane et de protoxyde d'azote ont crû de façon notable par suite des activités humaines depuis 1750
  - *la concentration de dioxyde de carbone était de 280 ppm avant l'industrialisation et a atteint 379 ppm en 2005*
  - *Cette concentration dépasse de loin les variations naturelles durant les 650 000 dernières années (180 à 300 ppm)*

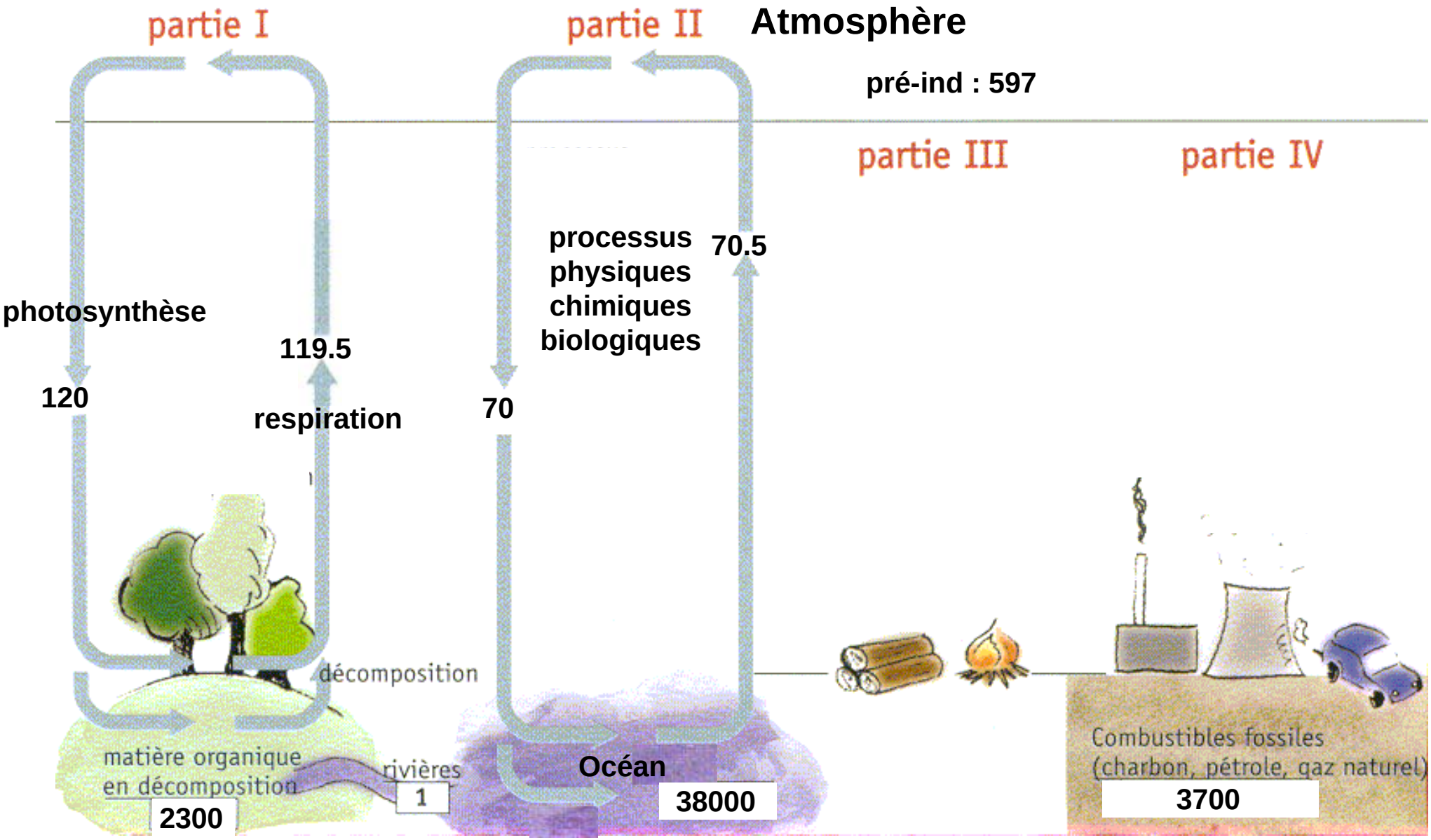


Source: GIEC AR4 (2007) www.ipcc.ch

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



Cycle du carbone



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

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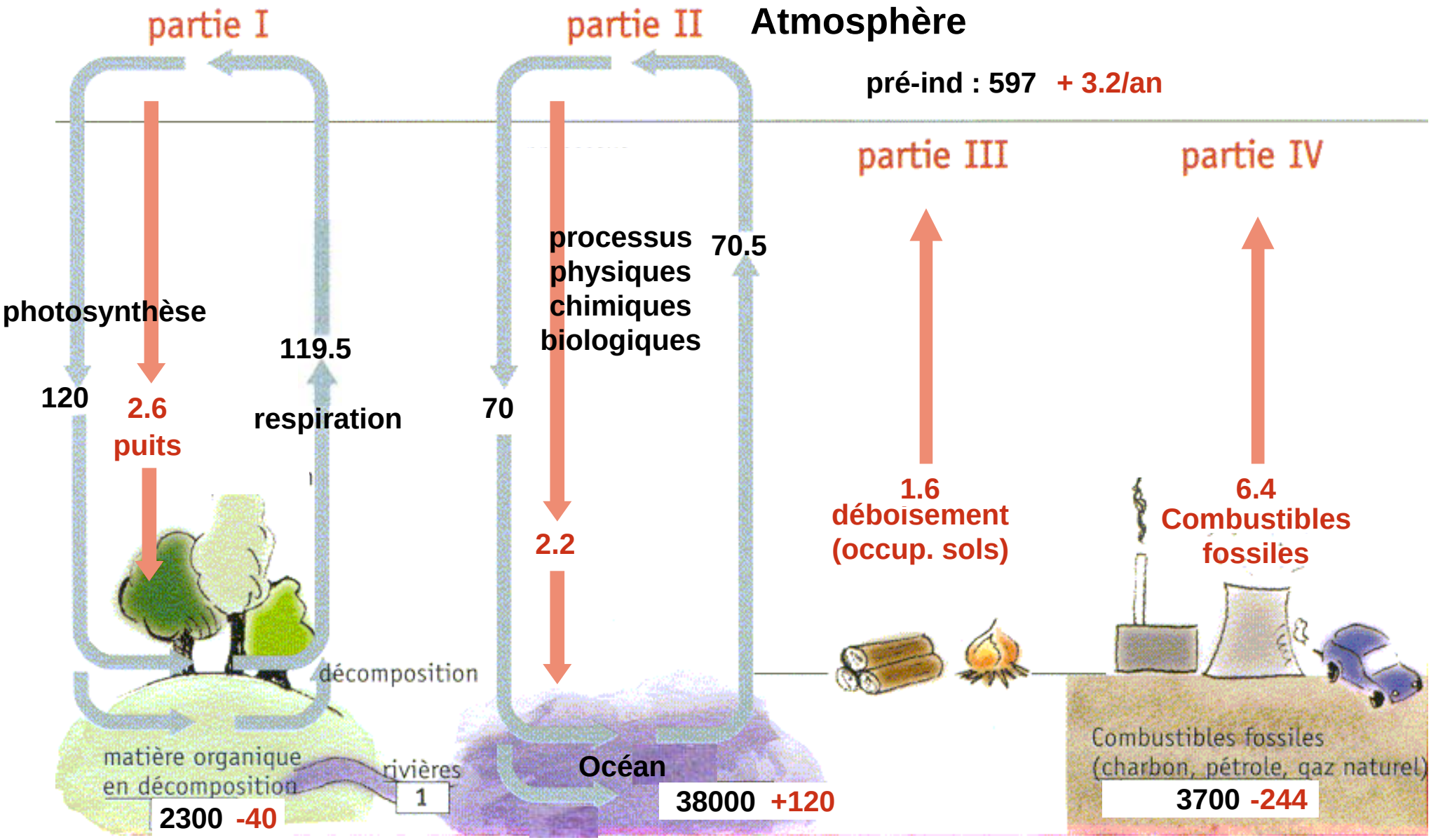
Cycle du carbone



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

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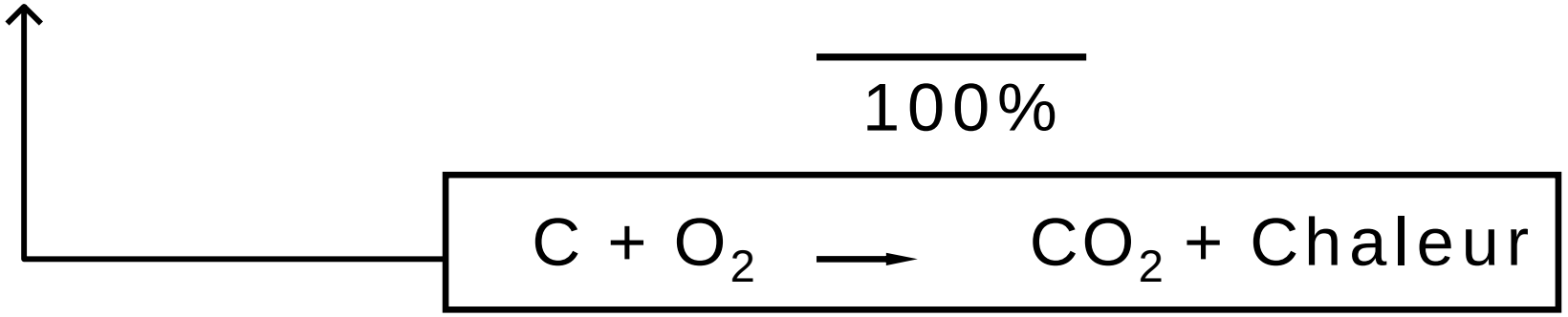
REPARTITION DES SOURCES D'ENERGIE (MONDE)

1990:

Biomasse : 14%
Hydroélec : 6%
Nucléaire : 5%

Combust. fossiles { Charbon : 24%, Pétrole : 33%, Gaz naturel : 18% } 75%

100%



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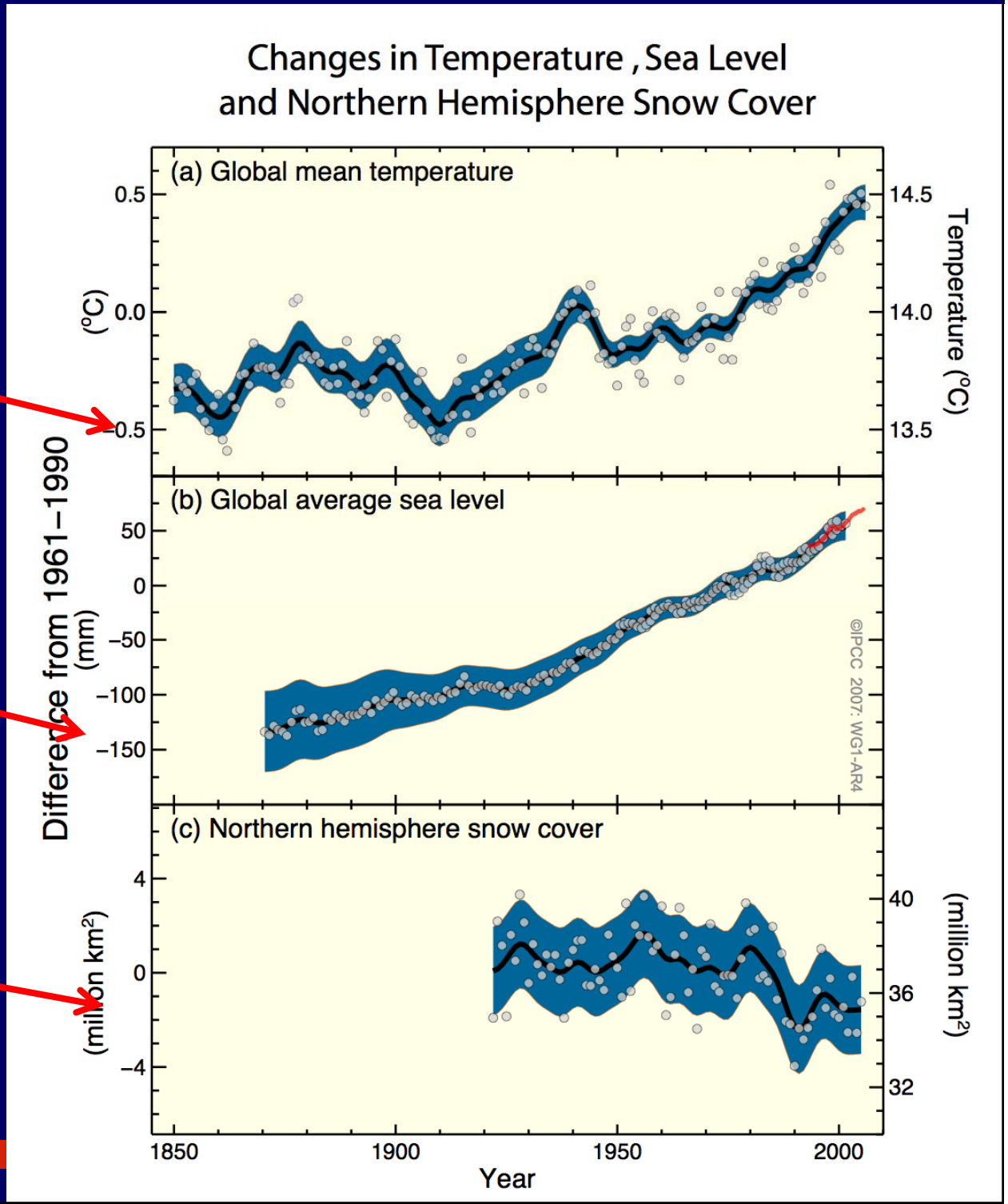
Source GIEC 1996

Le réchauffement est “sans équivoque”

Température atmosphérique

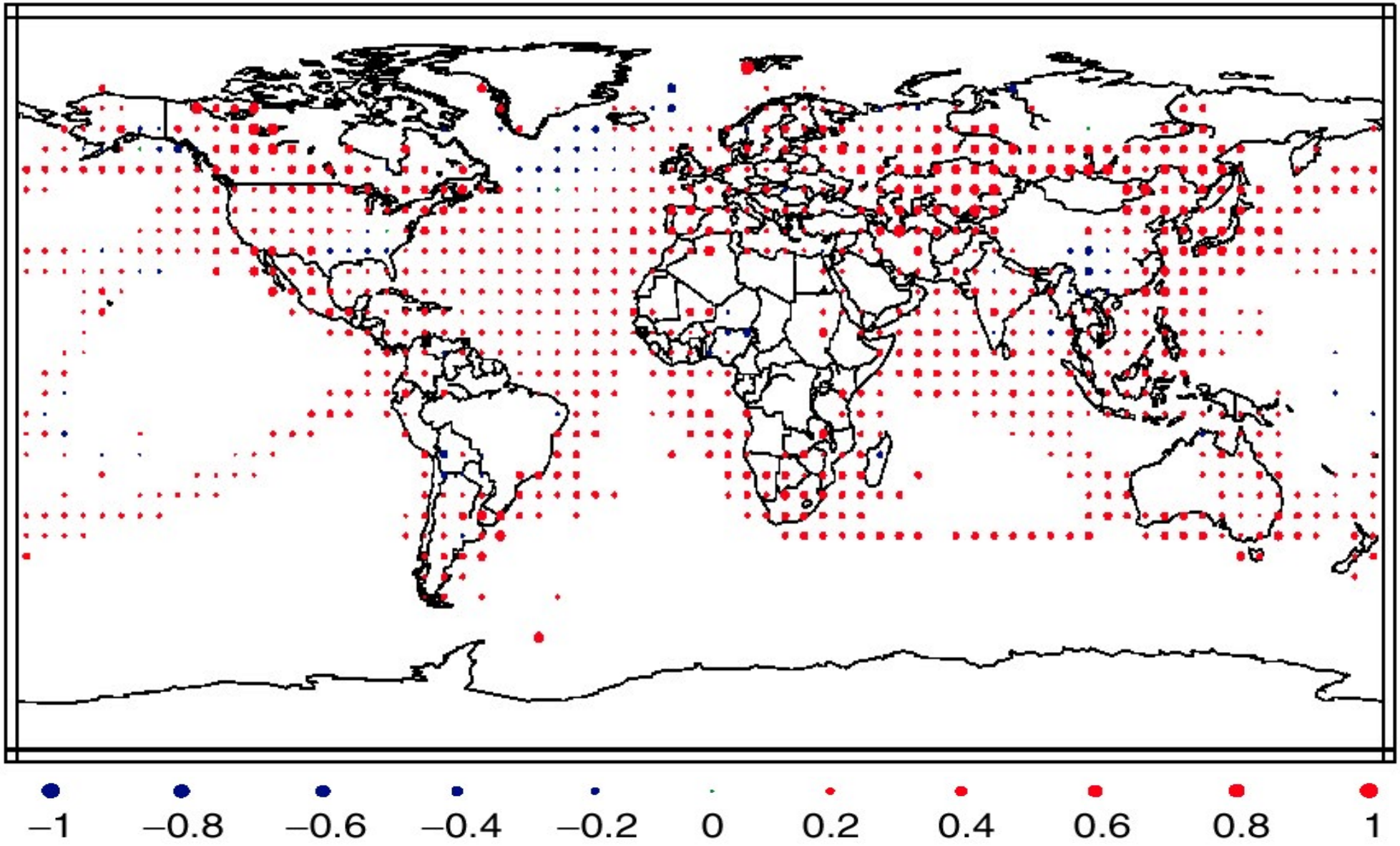
Niveau moyen des océans

Réduction de la couverture de neige (hémisphère nord)



Les terres et les océans se sont réchauffés

Tendance des températures annuelles de 1901 à 2000



Source: GIEC (2001)

Tendance (°C/décennie)

Futurs possibles du climat

- **Modélisation**
- **Scénarios**

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(Adapté d'après McGuffie & Henderson-Sellers, 1987)

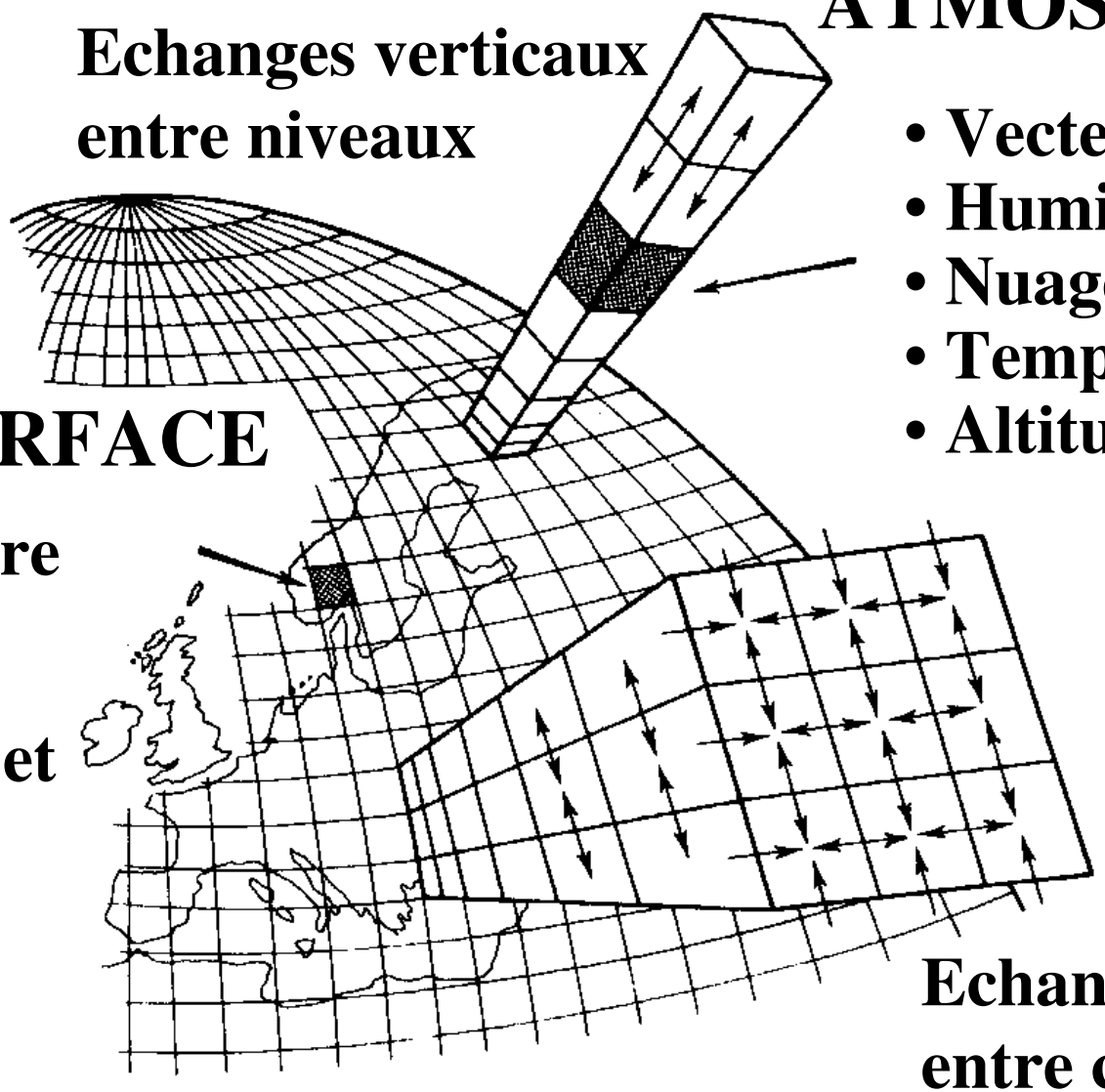
DANS LA COLONNE ATMOSPHERIQUE

Echanges verticaux entre niveaux

- **Vecteurs vent**
- **Humidité**
- **Nuages**
- **Température**
- **Altitude**

A LA SURFACE

- **Température au sol**
- **Flux d'eau et d'énergie**



Echanges horizontaux entre colonnes

Intervalle de temps ~ 30 minutes

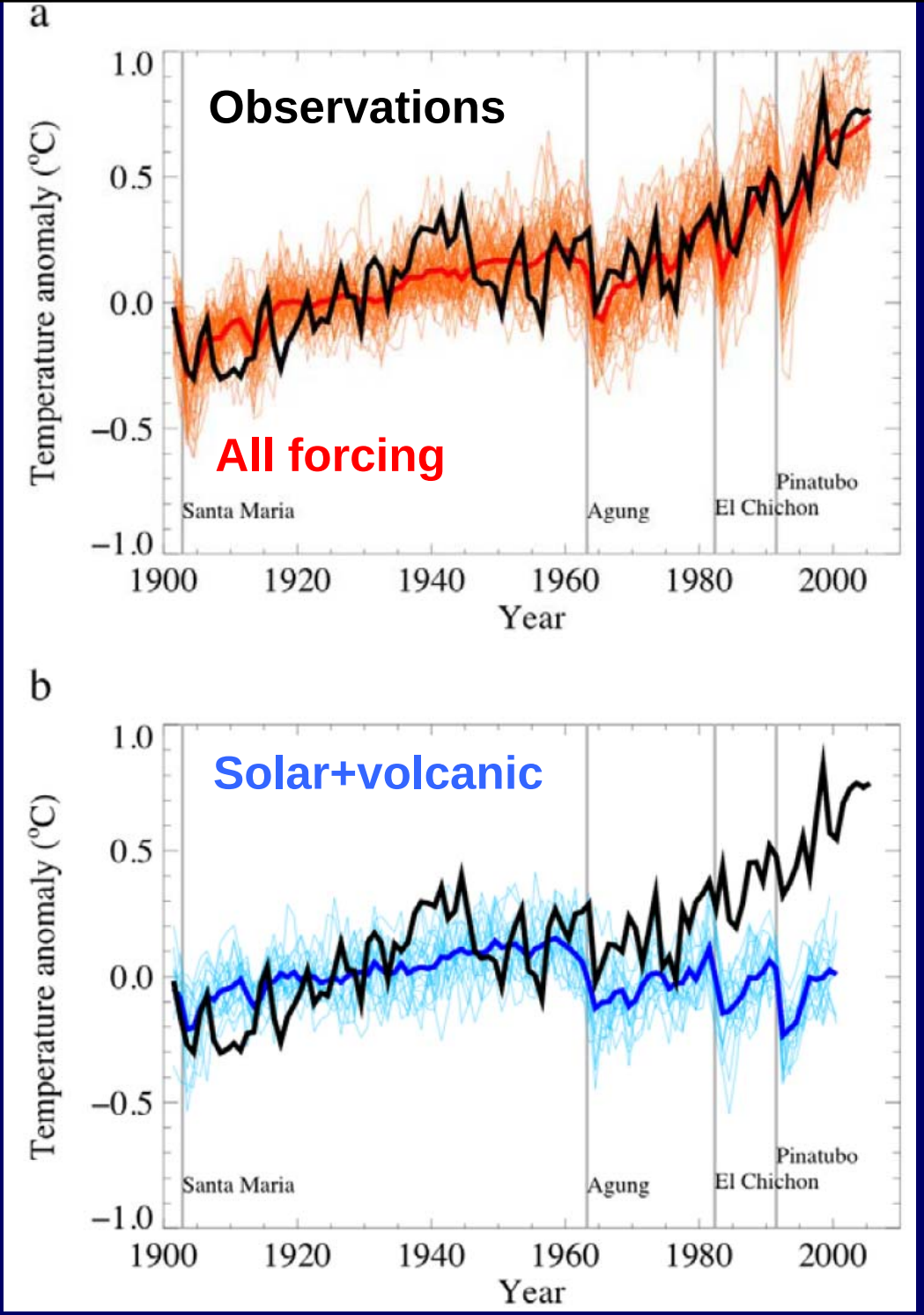
Résolution ~ 3°x 3°

Attribution

- are observed changes consistent with:

☑ expected responses to forcings?

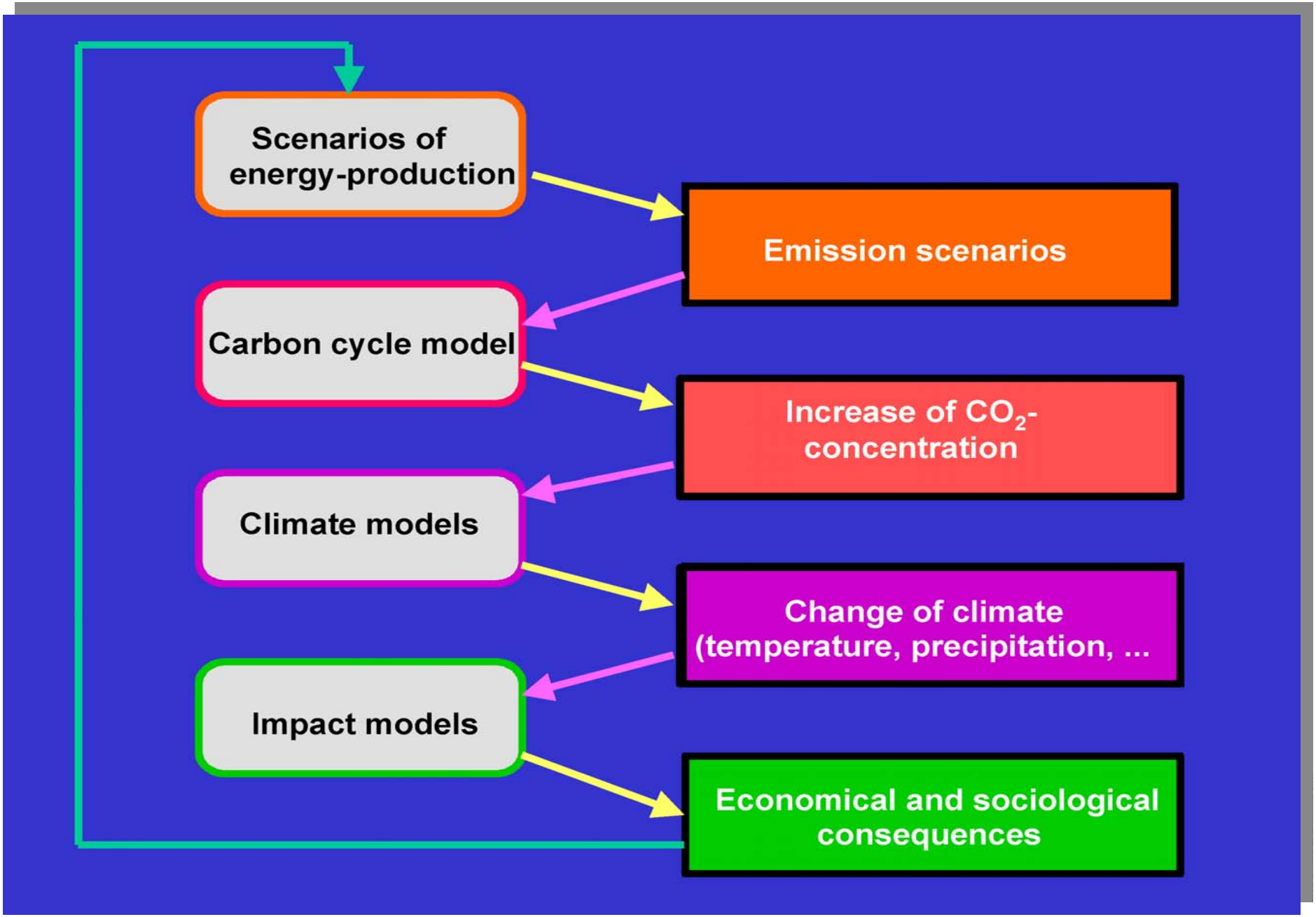
☒ inconsistent with alternative explanations?



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%**

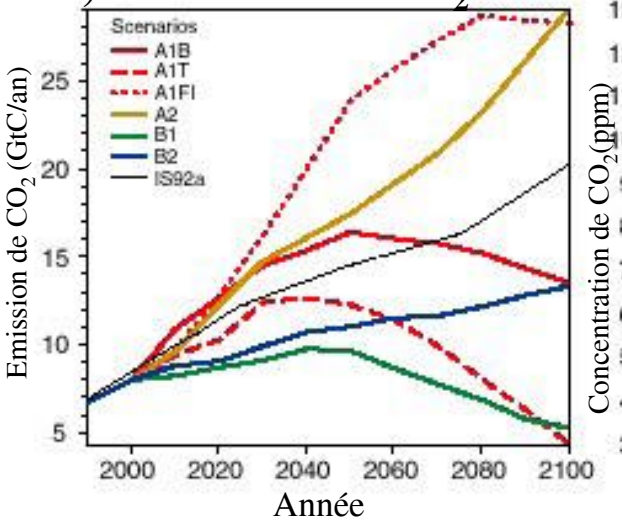
The information chain leading to a climate projection



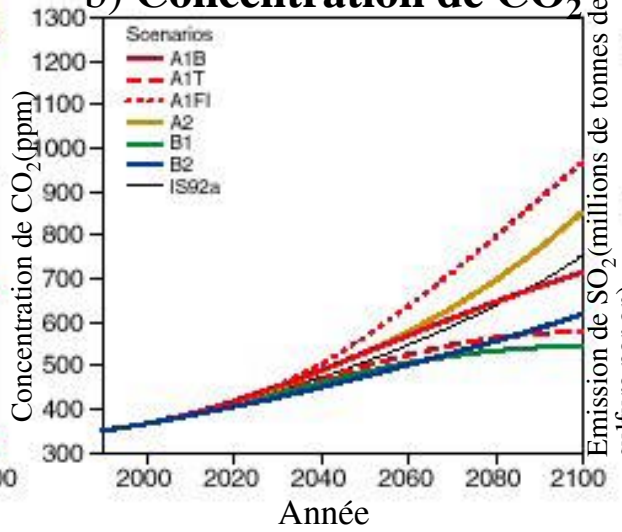
Source: Hadley Centre, UK

On projette un changement dans la composition de l'atmosphère, qui impliquera une augmentation de la température et du niveau des mers (schéma provenant du rapport du GIEC de 2001)

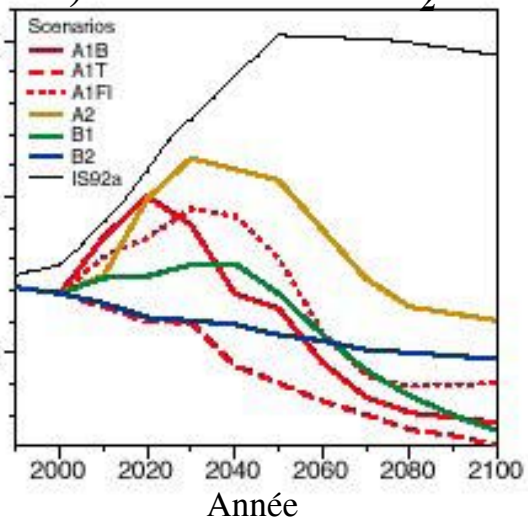
a) **Emissions de CO_2**



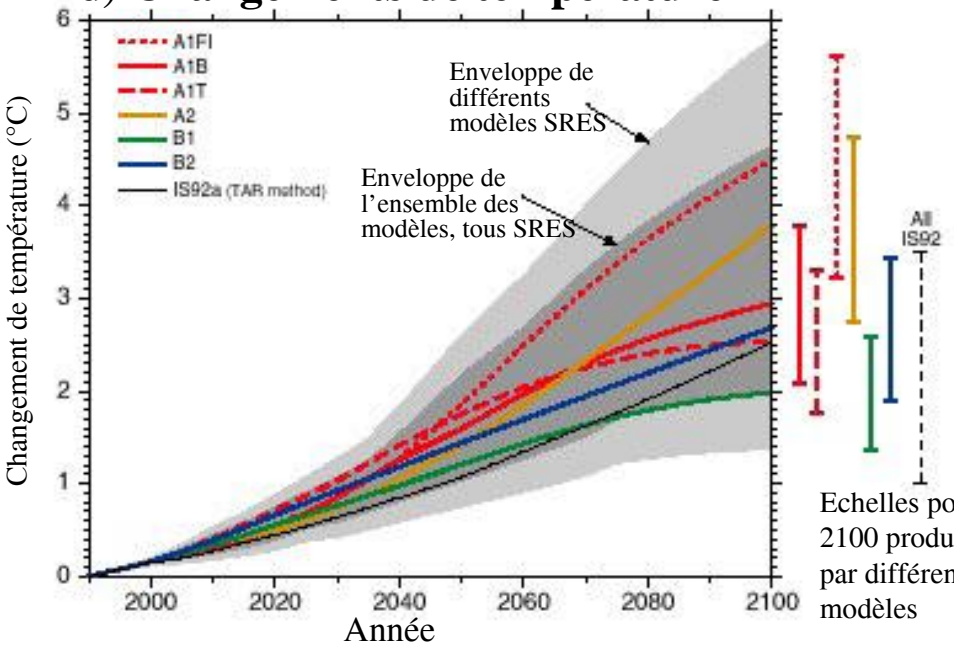
b) **Concentration de CO_2**



c) **Emissions de SO_2**

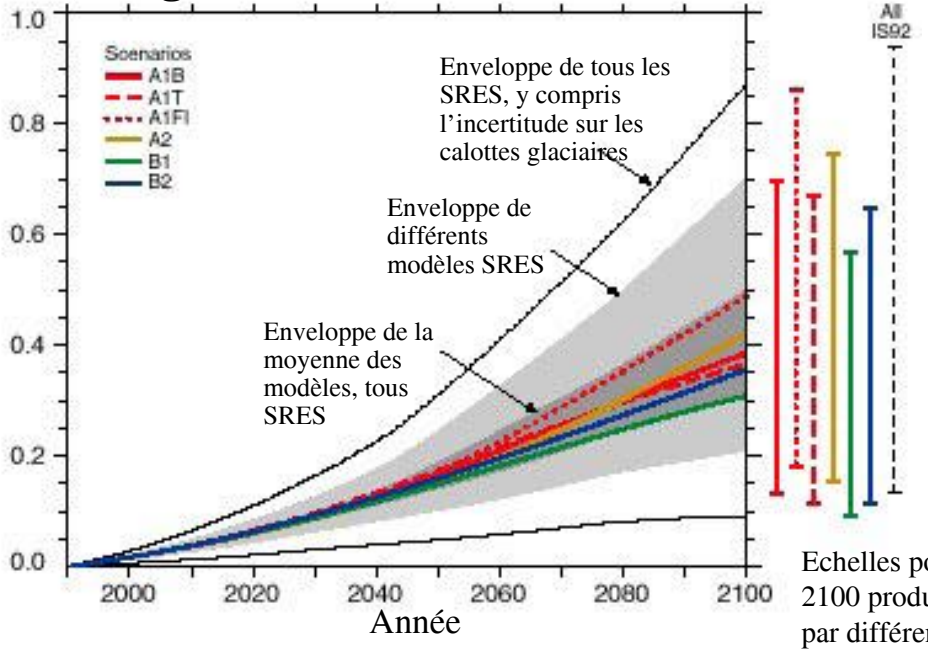


d) **Changements de température**



Echelles pour 2100 produites par différents modèles

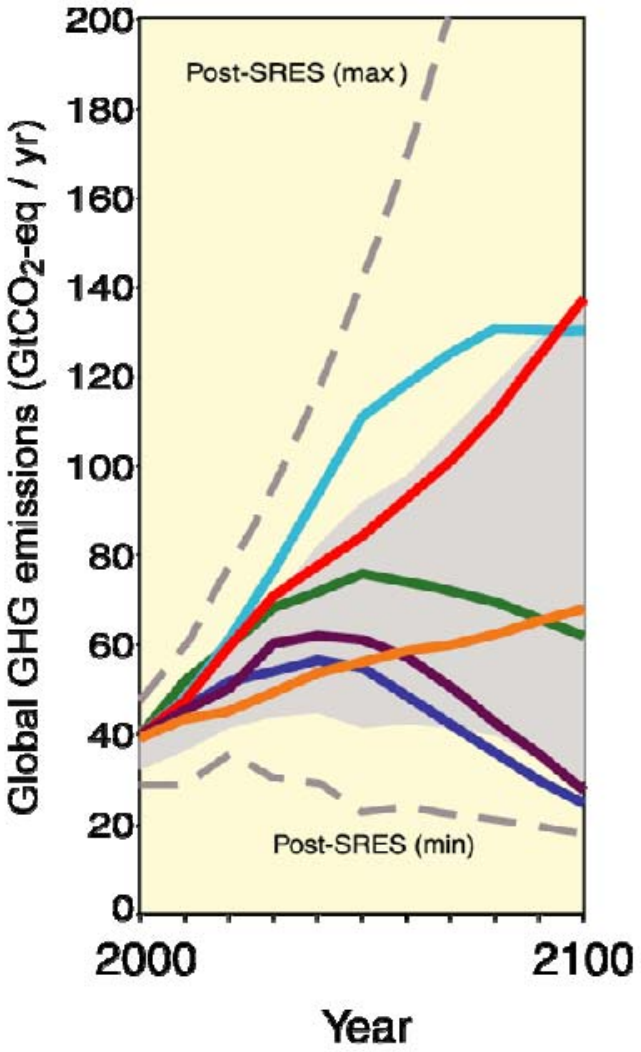
e) **Augmentation du niveau des mers**

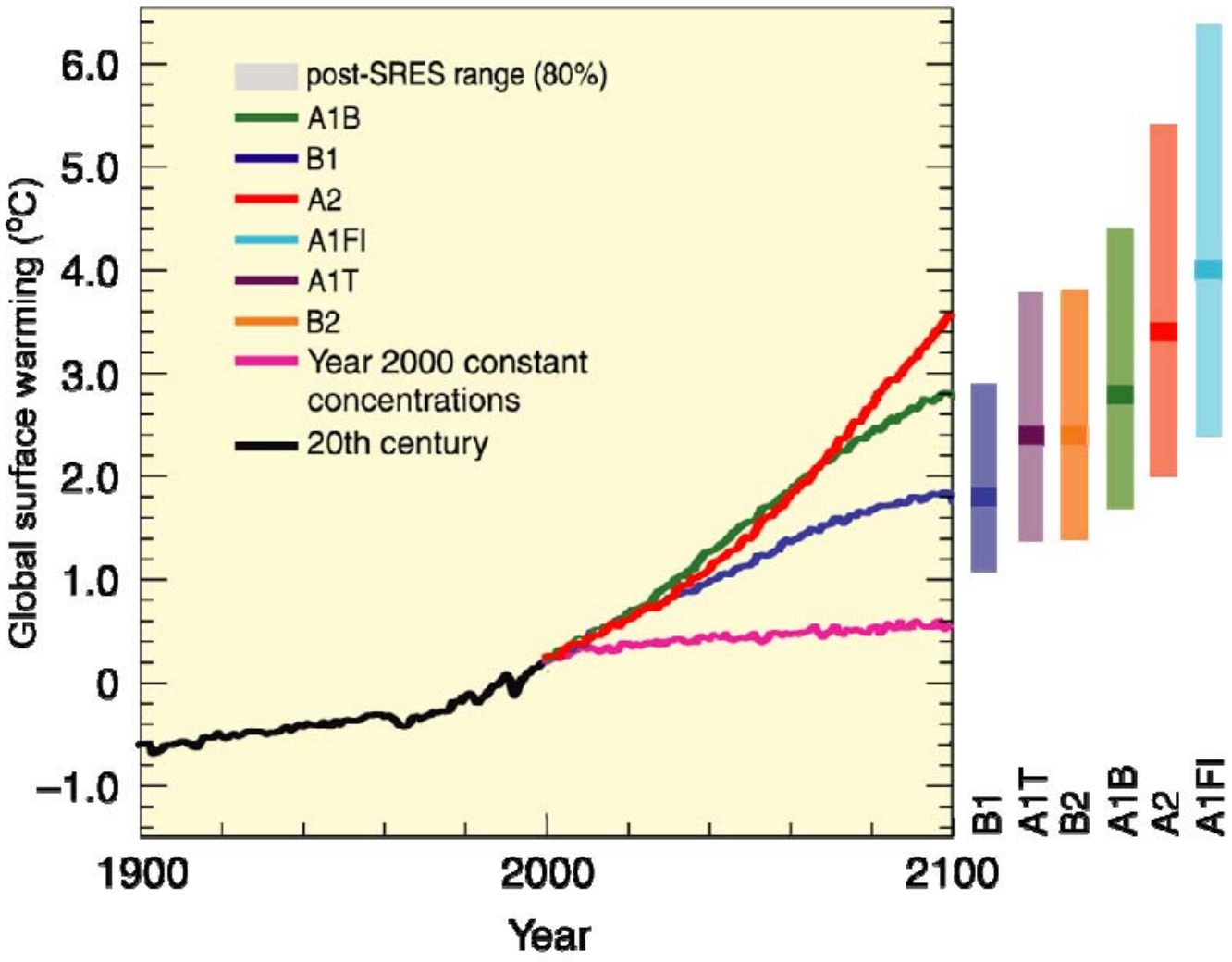


Echelles pour 2100 produites par différents modèles

Source: IPCC, AR4 (2007)

Projections du climat futur en l'absence de mesures





NB: écart par rapport à la moyenne 1980-1999

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Evénements extrêmes (Source: IPCC WG1 AR4)

Phénomène et tendance	Probabilité qu'il y ait eu une tendance à la fin du 20è S	Influence humaine sur ces tendances (probabilité)	Probabilité que la tendance se poursuive au 21è siècle pour les scénarios SRES
Journées et nuits froides plus chaudes et moins nombreuses sur la plupart des régions	très probable (> 90%)	probable (> 66%)	virtuellement certain (> 99%)
Journées chaudes plus chaudes et plus fréquentes sur la plupart des régions	très probable	probable (nuits)	virtuellement certain
Vagues de chaleur plus fréquentes sur la plupart des régions	probable (> 66%)	plus probable que non (> 50%)	très probable
Evénements de fortes précipitations sur la plupart des régions	probable	plus probable que non	très probable
Accroissement de l'étendue affectée par des sécheresses	probable dans beaucoup de régions depuis 1970	plus probable que non	probable
Accroissement de l'activité des cyclones tropicaux intenses	probable dans beaucoup de régions depuis 1970	plus probable que non	probable
Accroissement de la fréquence des niveaux de la mer extrêmes (hors tsunamis)	probable	plus probable que non	probable

Principales incertitudes

- **Microphysique des nuages**
- **Effets radiatifs des aérosols**
- **Interactions biosphère-atmosphère**
- **Stabilité de la circulation océanique**
- **Stabilité des calottes glaciaires**
- **Distribution des effets sur les pluies**
- **Fréquence & intensité des événements extrêmes**

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Impacts

- **Systèmes naturels**
- **Systèmes humains**

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GIEC GT-II (Impacts) (2) 2001 (426 auteurs, 440 relecteurs)

- Certains systèmes naturels pourraient subir des dommages importants et irréversibles:
  - glaciers
  - récifs coralliens et atolls
  - palétuviers
  - forêts boréales & tropicales
  - écosystèmes polaires & alpins
  - zones de prairies humides
  - pâturages naturels résiduels

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GIEC AR4 GT2 (2007): 20% - 30% des espèces végétales et animales connues sont soumises à risque accru d'extinction si $\Delta T_{globale}$ 1.5°C - 2.5°C (au – dessus de la température de 1990)

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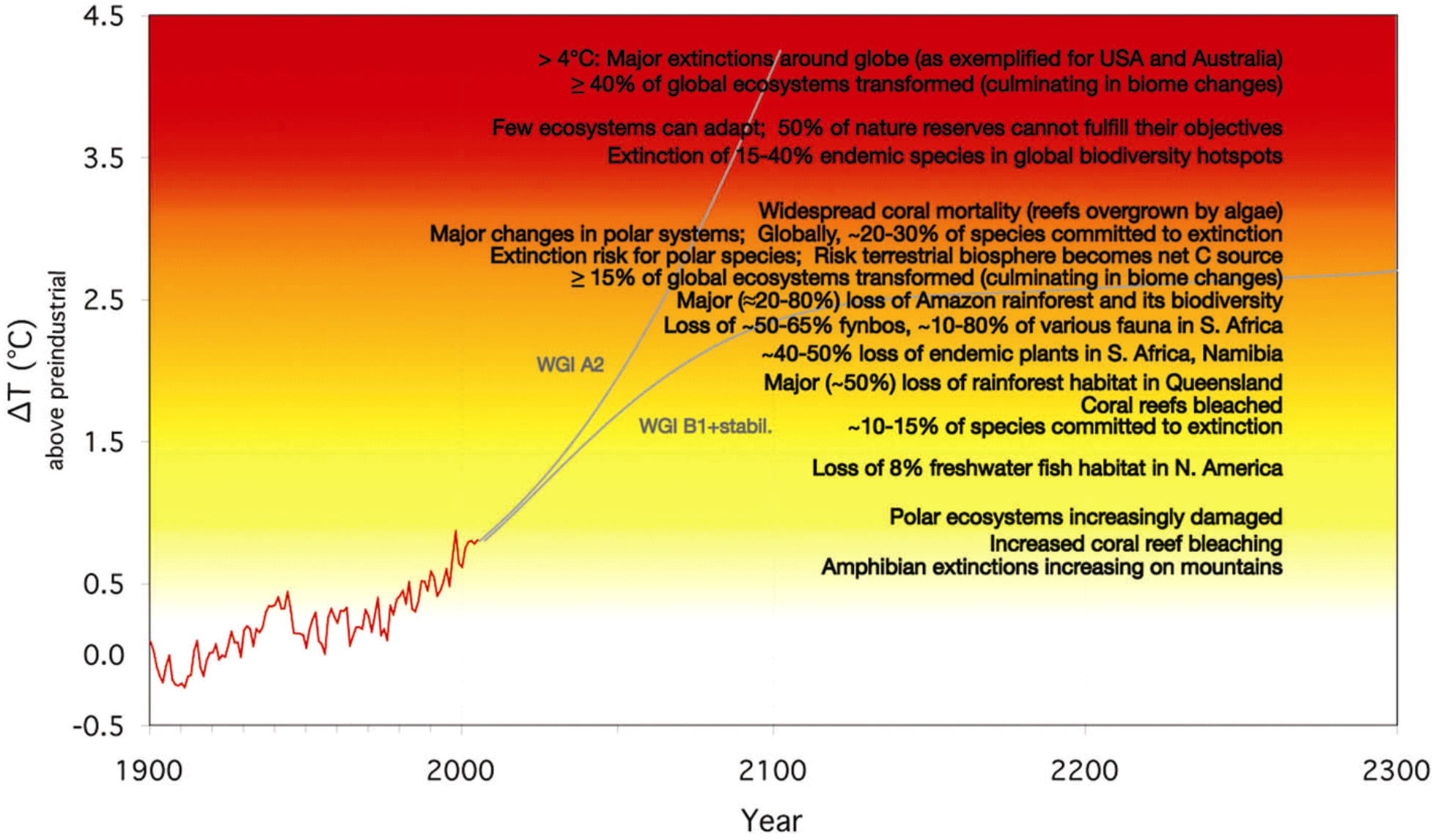
Figure TS.6. Projected risks due to critical climate change impacts on ecosystems



Source: IPCC AR4 WG2 (2007)

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GIEC GT-II (Impacts) (3) 2001 (426 auteurs, 440 relecteurs)

- Les systèmes humains qui sont sensibles aux changements climatiques incluent principalement:
  - ressources en eau
  - agriculture (spécialement sécurité alimentaire) et foresterie
  - zônes côtières et systèmes marins (pêcheries)
  - établissements humains
  - énergie et industrie
  - assurances, services financiers
  - santé humaine

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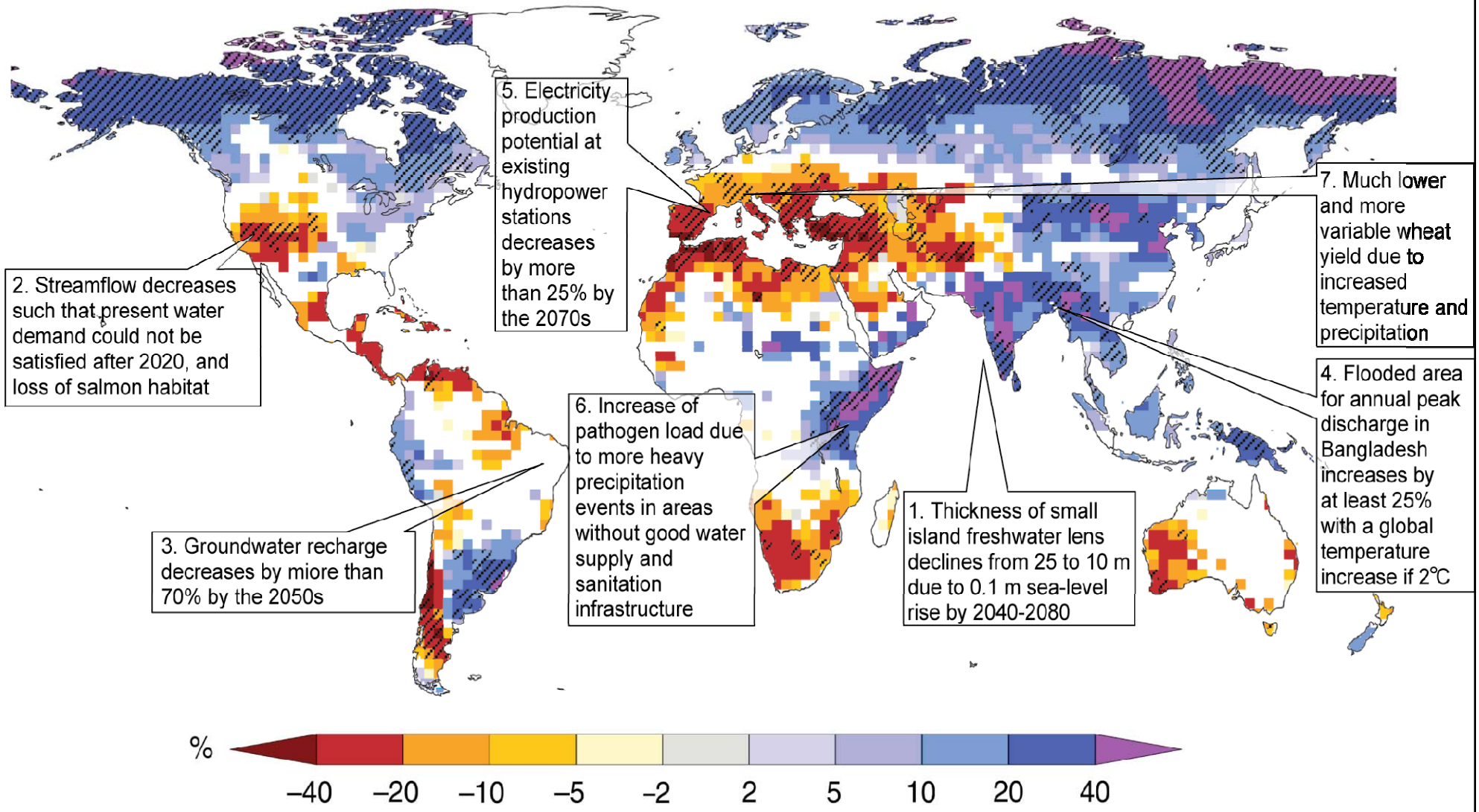
Water at the end of the 21st century for SRES A1B



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).

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More heavy precipitation and more droughts….

Régions les plus affectées par les effets des CC

- L'Arctique
- L'Afrique sub-saharienne
- Petites îles
- Grands deltas

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

- The poor
- Young children
- The elderly

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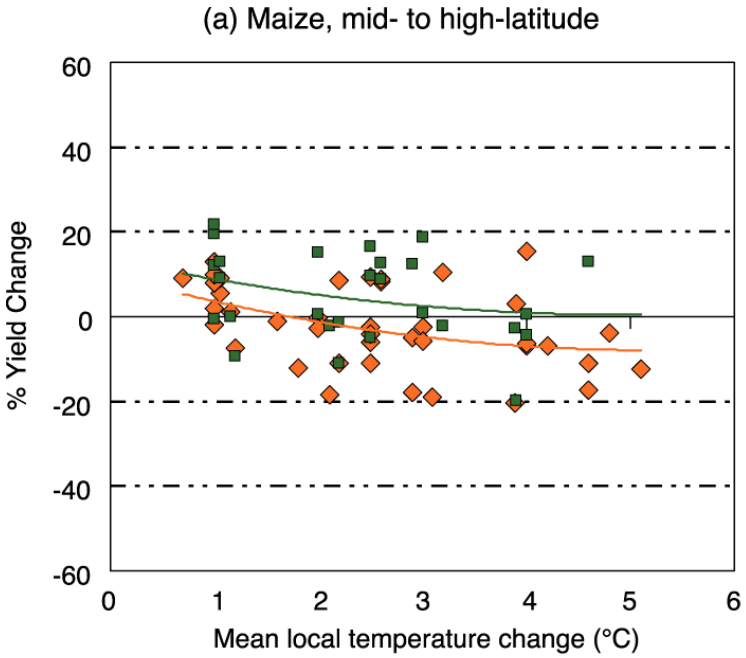
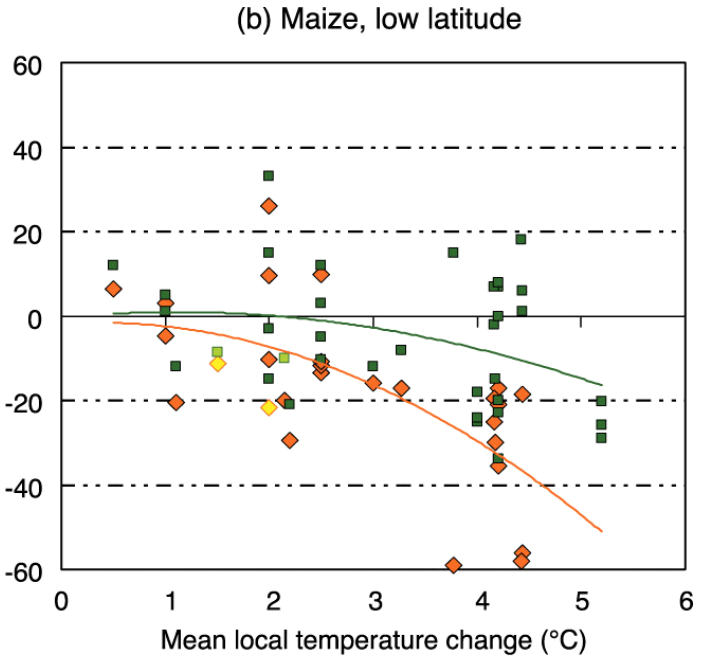
Figure TS.7. Sensitivity of cereal yield to climate change

Maïs





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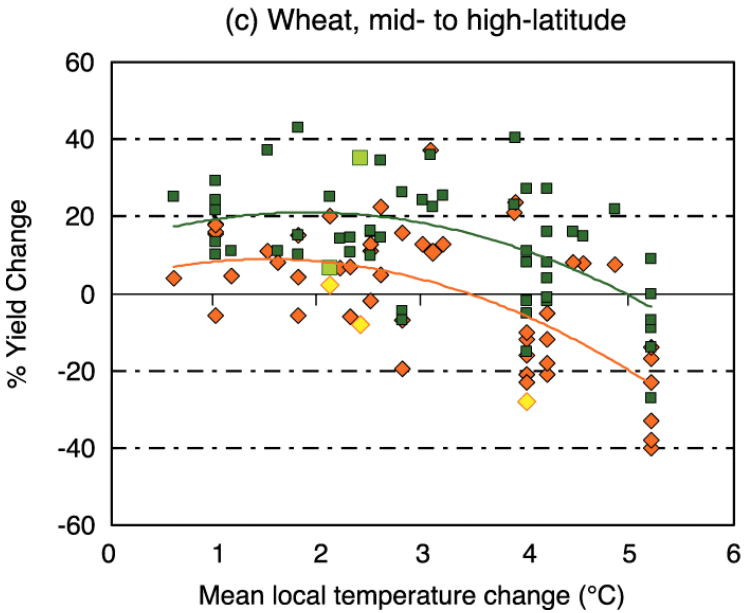

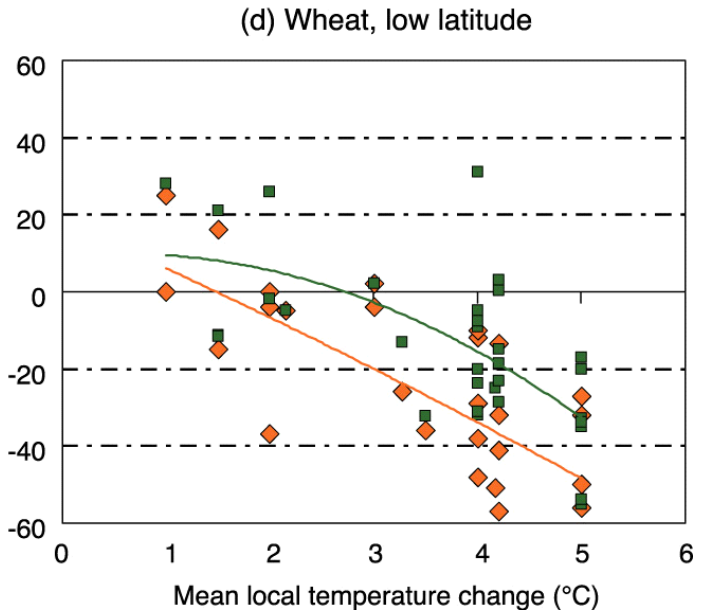

Source: IPCC AR4 WG2 (2007)

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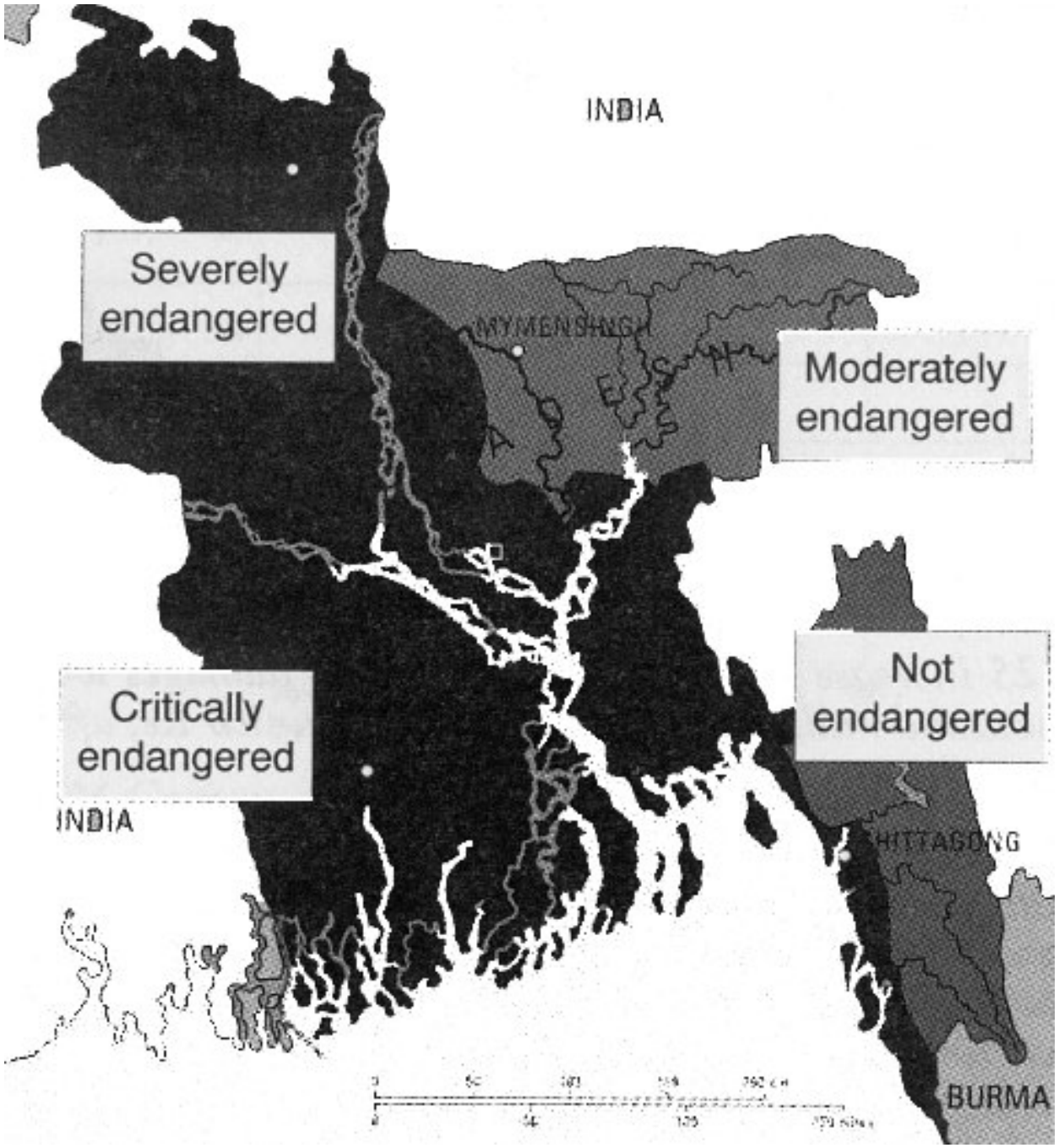
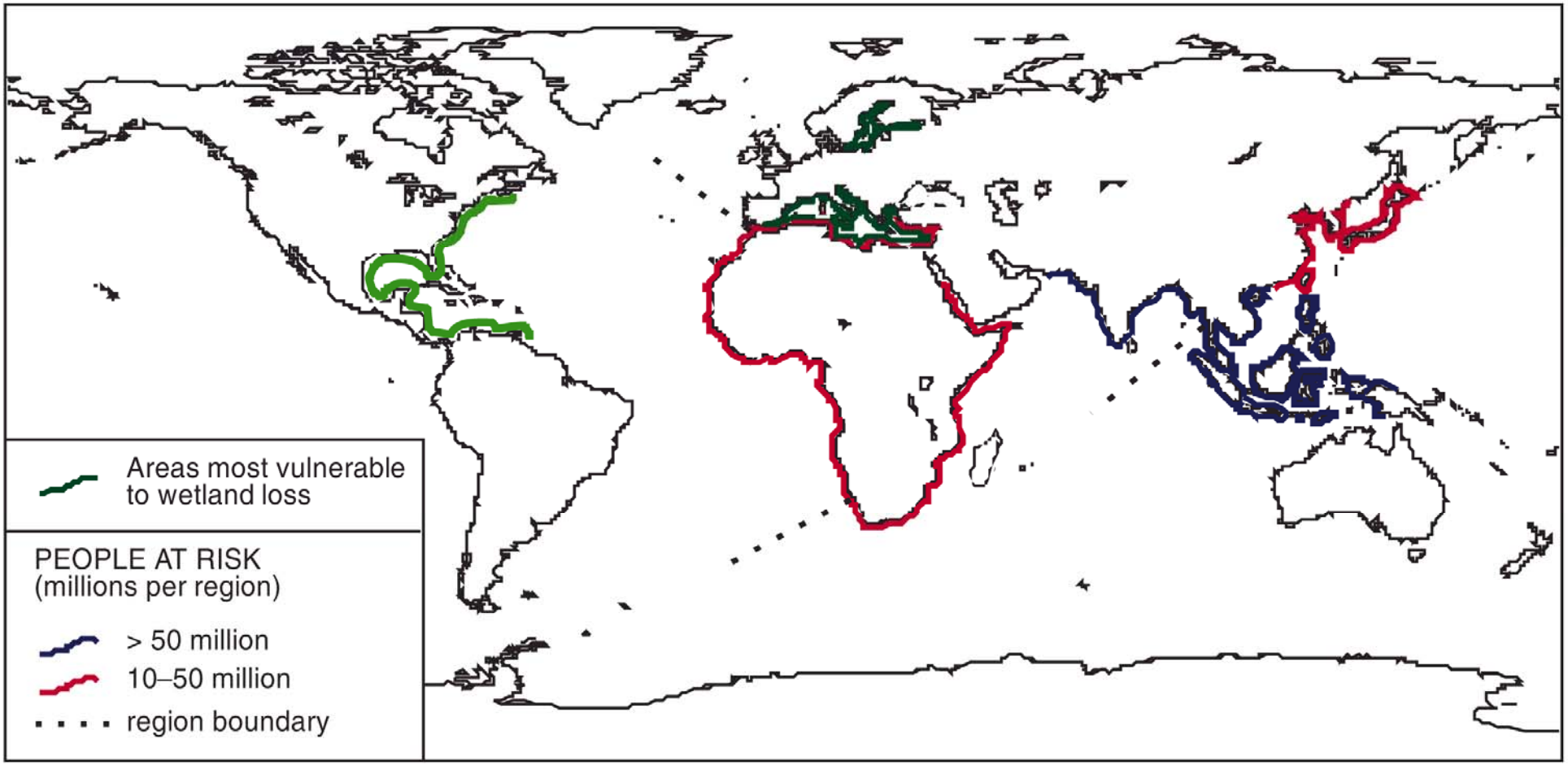
Bangladesh and sea level rise



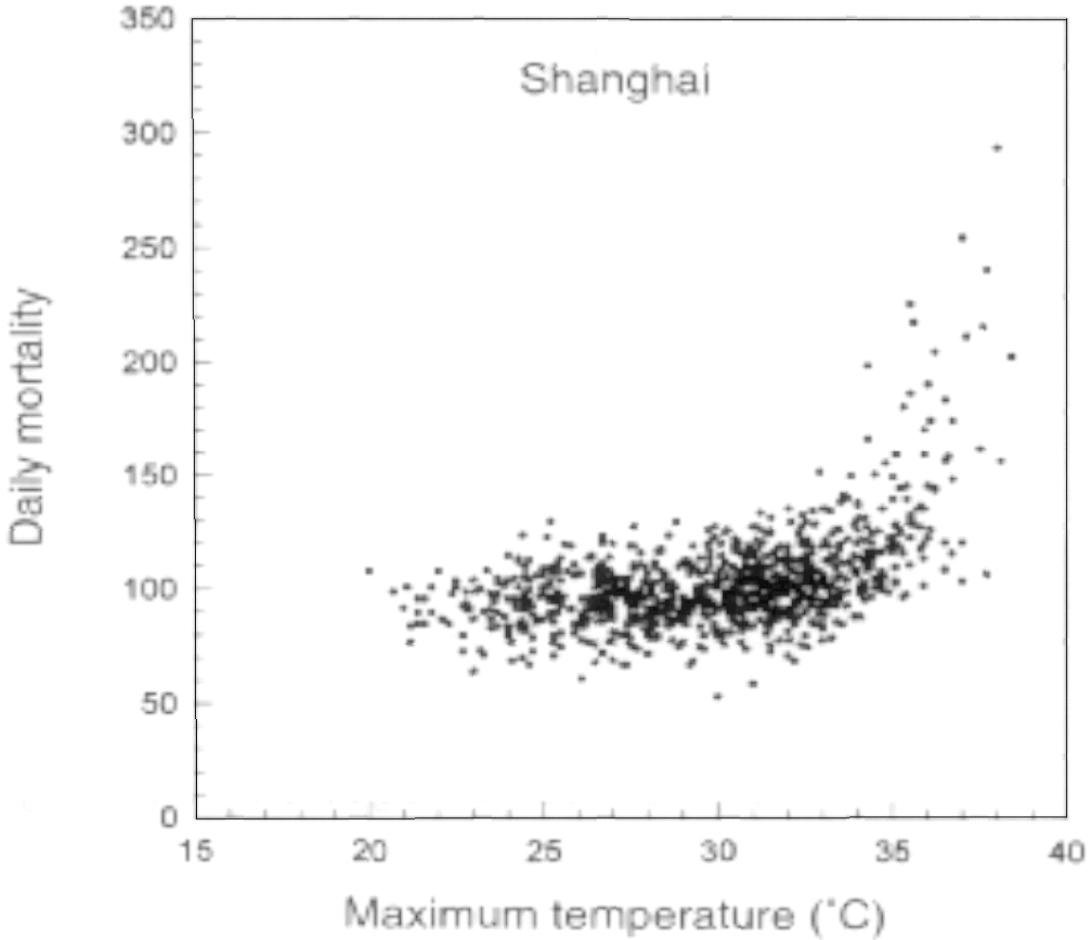
Tens of millions of people are projected to be at risk of being displaced by sea level rise

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.*

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



Référence : ClLIMATE CHANGE AND HUMAN HEALTH, 1996

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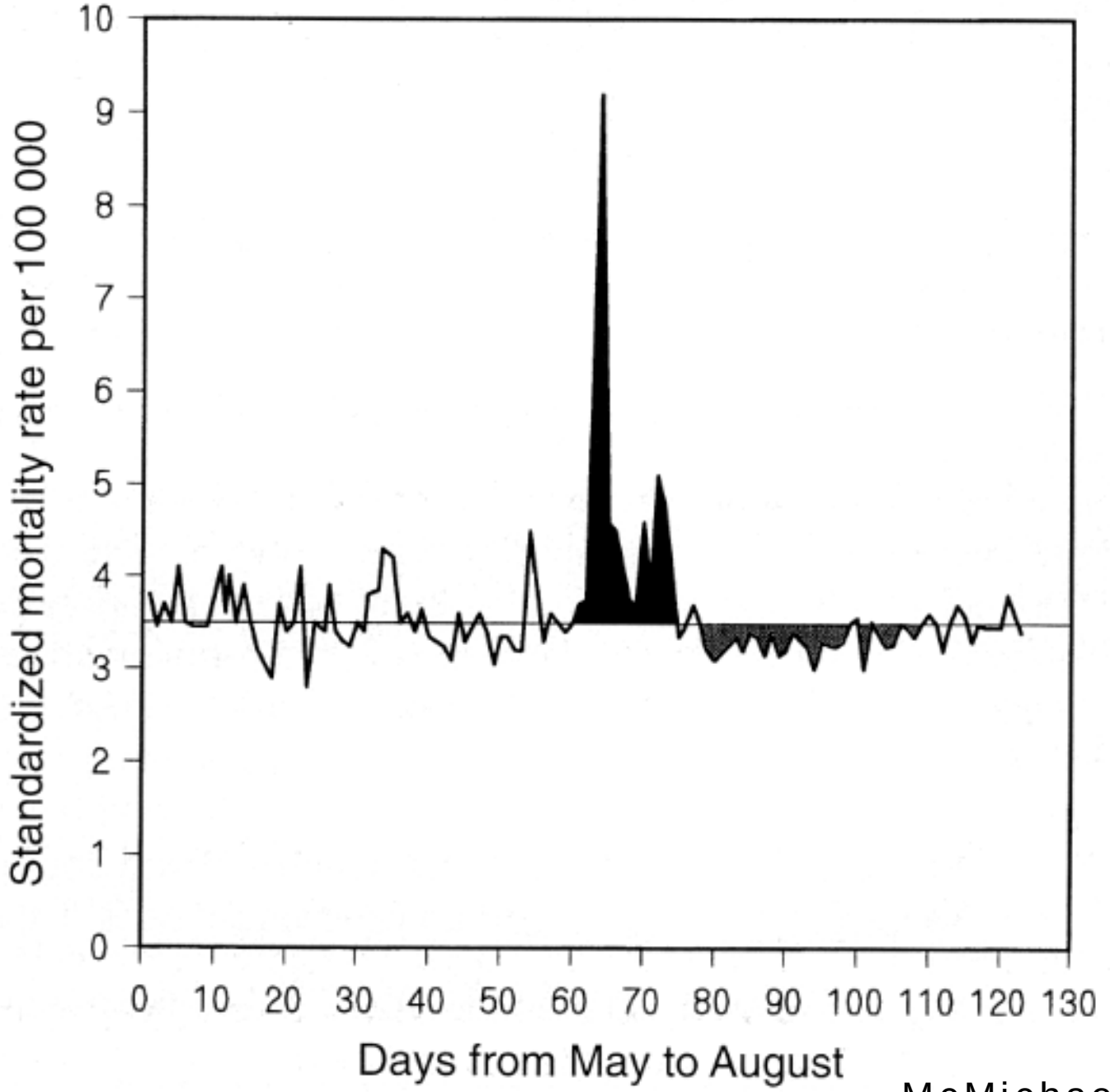
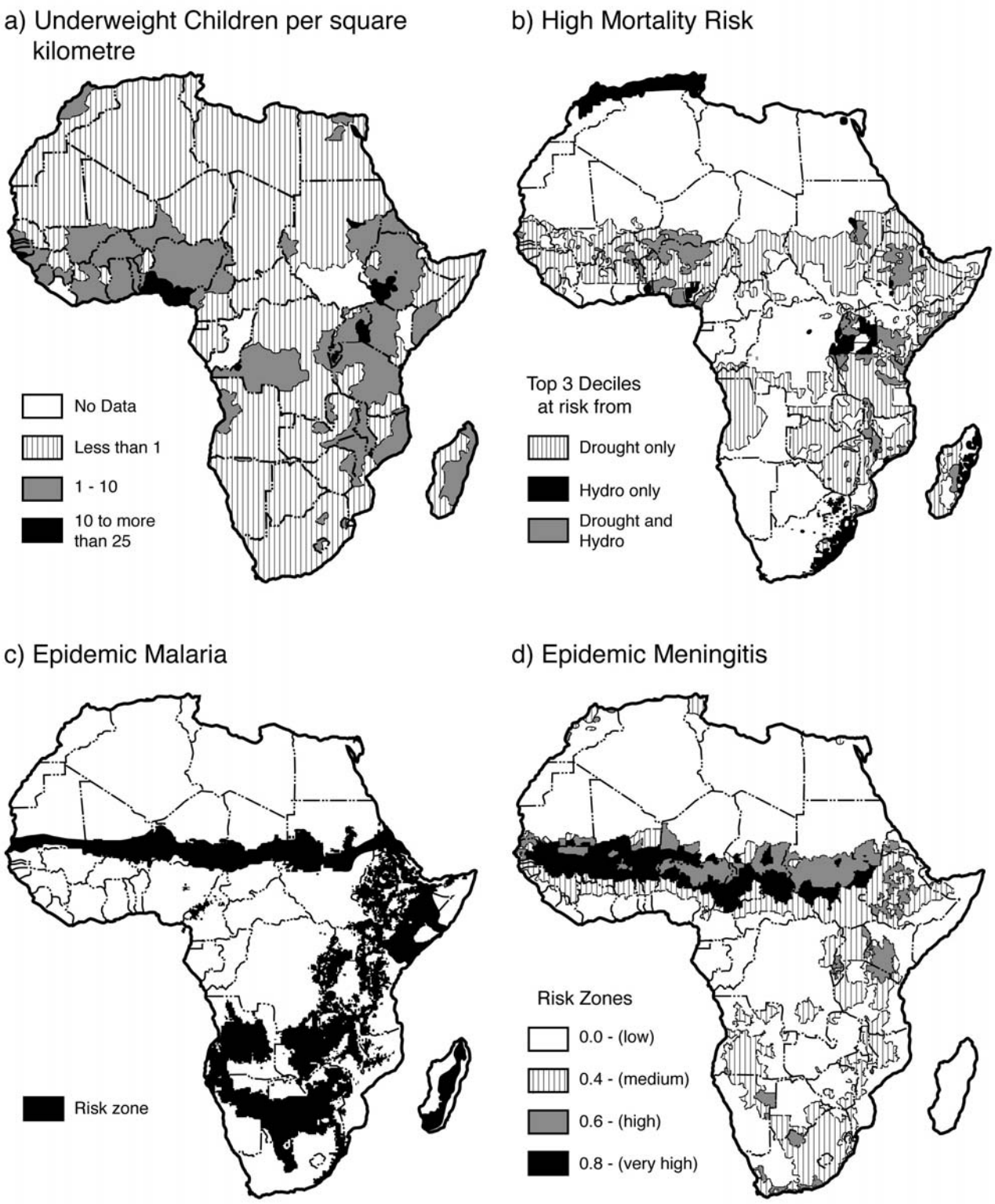
Daily summer mortality during a New York heat wave in 1996



McMichael & al., 1996



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

Multiple stresses in Africa (IPCC AR4 WG2 Ch 9)

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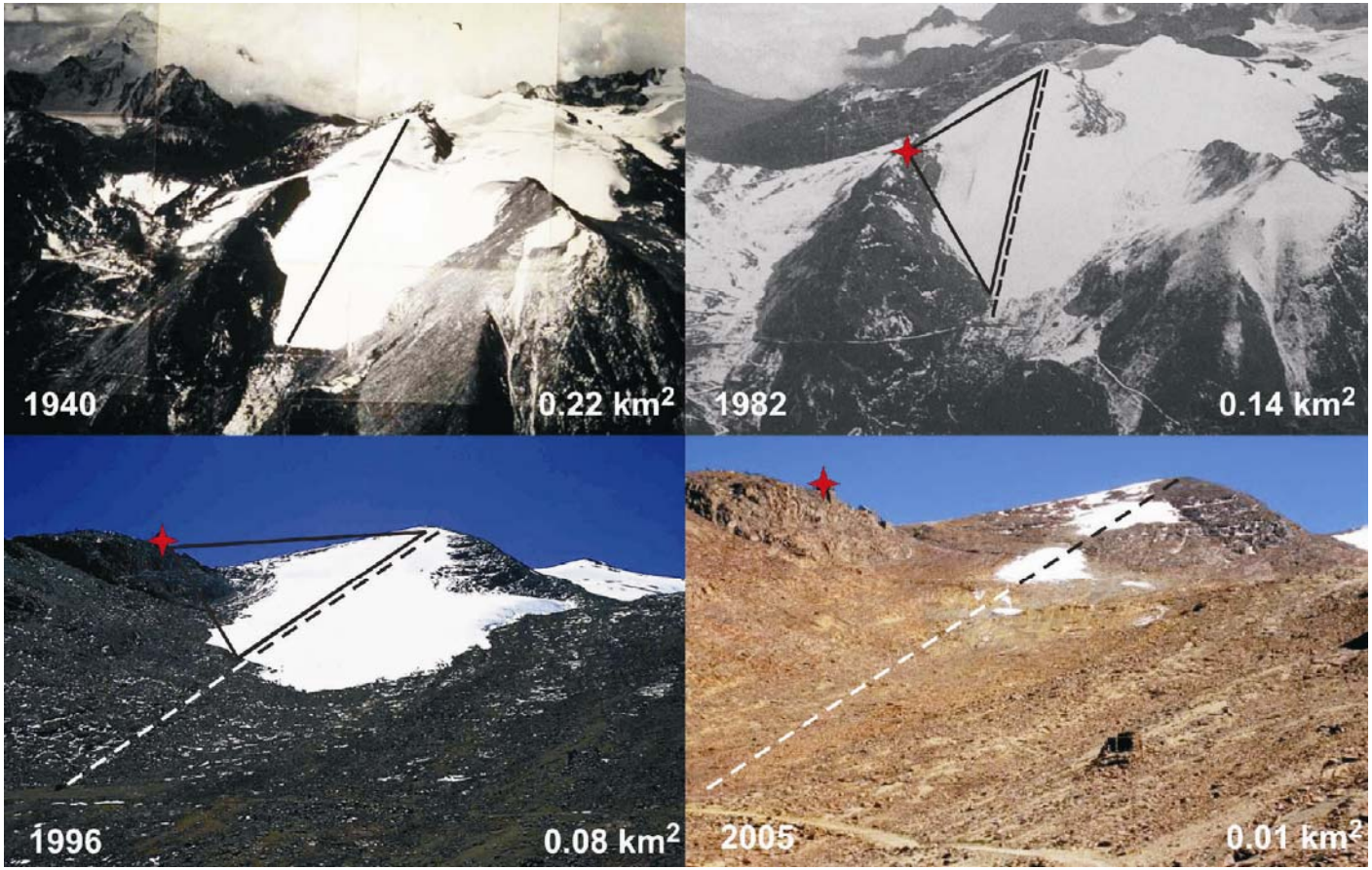
The Chacaltaya glacier and ski-lift, Bolivia

Skiing was no longer possible after 2004



Source: IPCC AR4 WG2 (2007)

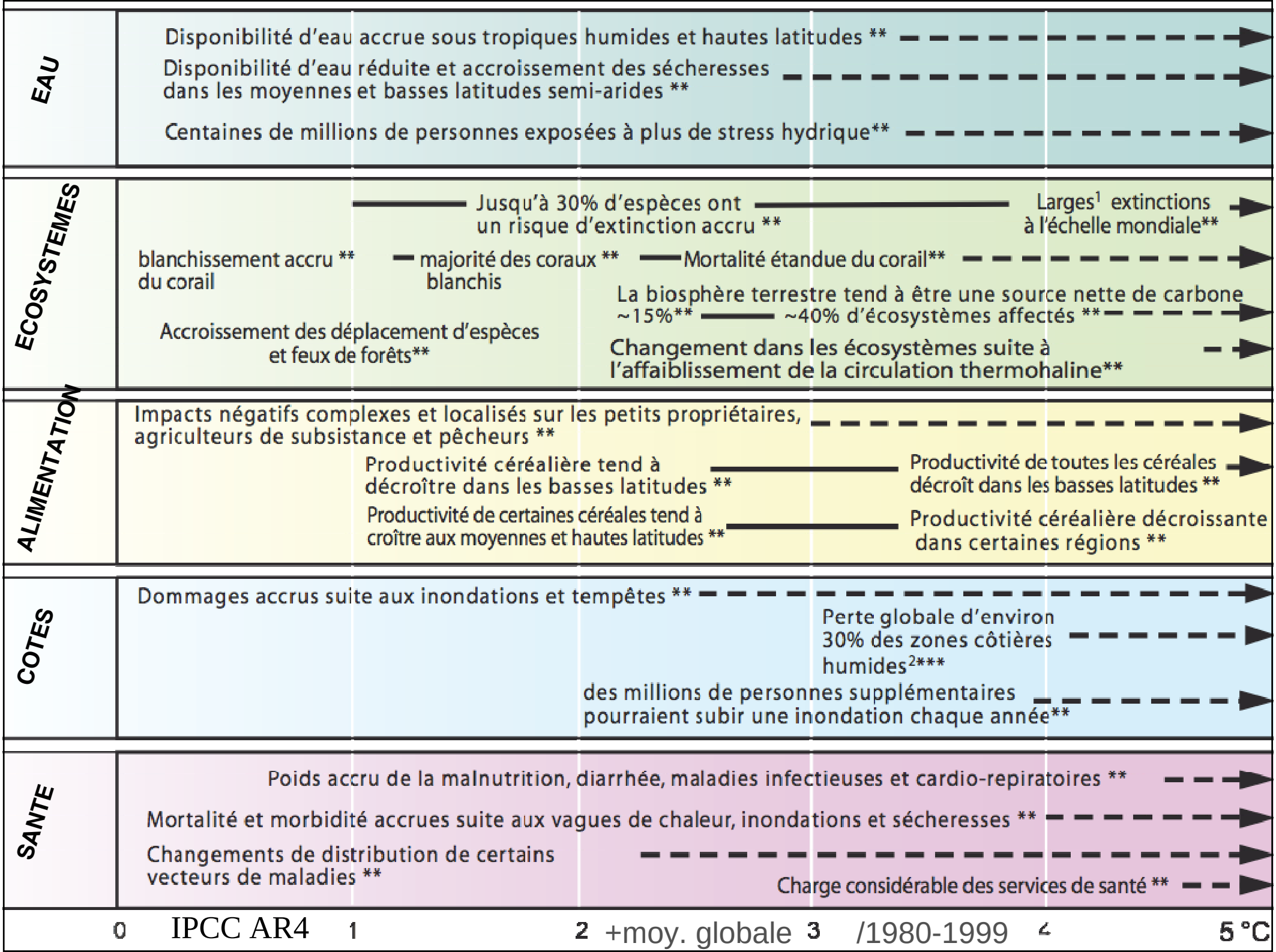
WMO

UNEP

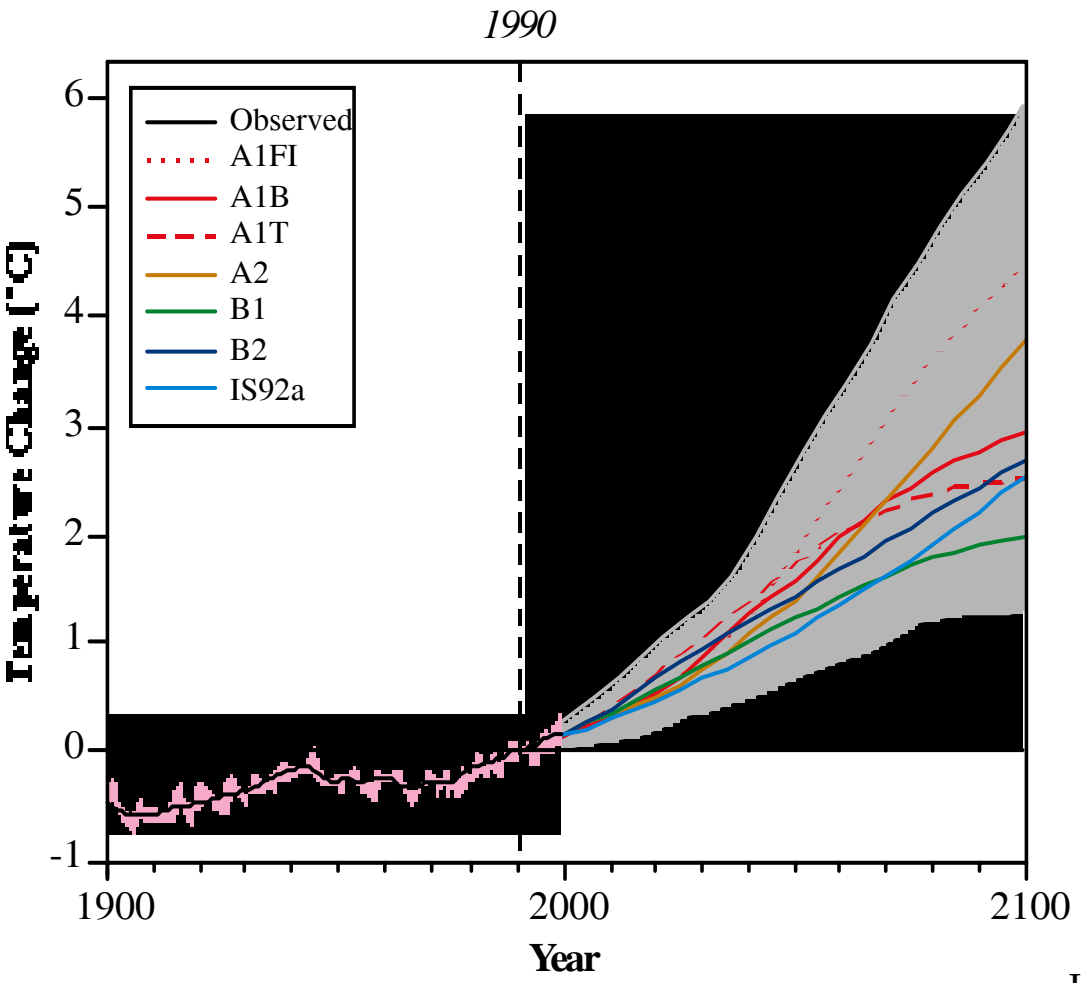
Developing countries are the most vulnerable to climate change

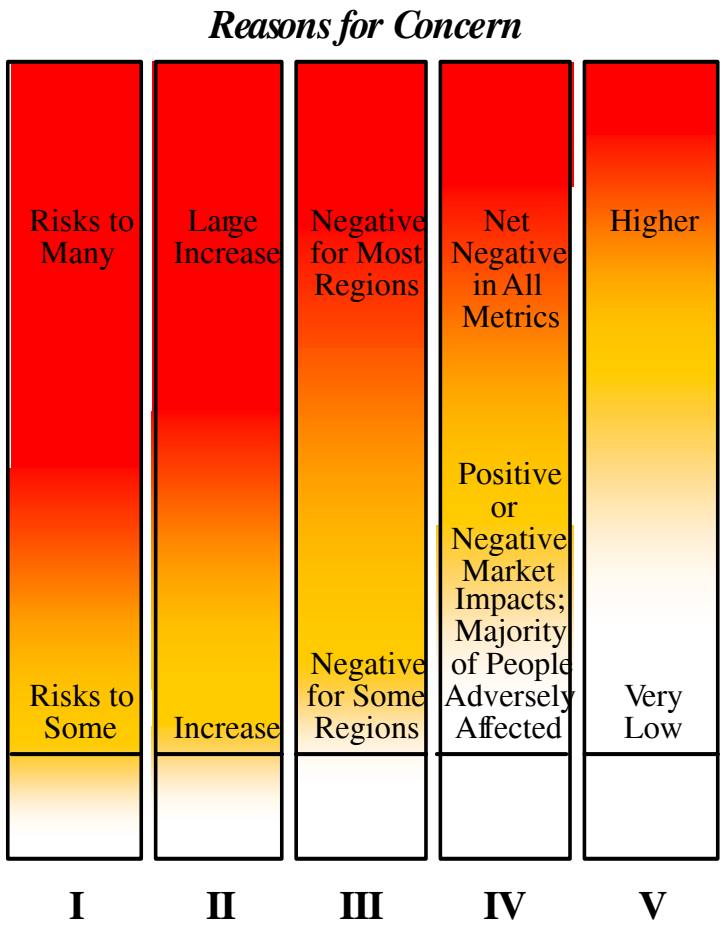
- **Impacts are worse** - already more flood and drought prone and a large share of the economy is in climate sensitive sectors
- **Lower capacity to adapt** because of a lack of financial, institutional and technological capacity and access to knowledge
- **Climate change is likely to impact disproportionately upon the poorest countries and the poorest persons within countries**, exacerbating inequities in health status and access to adequate food, clean water and other resources.
- **Net market sector effects are expected to be negative in most developing countries**

(Based on IPCC AR3 (2001))


EAU
Disponibilité d'eau accrue sous tropiques humides et hautes latitudes **
Disponibilité d'eau réduite et accroissement des sécheresses dans les moyennes et basses latitudes semi-arides **
Centaines de millions de personnes exposées à plus de stress hydrique**
ECOSYSTEMES
Jusqu'à 30% d'espèces ont un risque d'extinction accru **
Larges[1] extinctions à l'échelle mondiale**
blanchissement accru ** du corail
majorité des coraux ** blanchis
Mortalité étandue du corail**
La biosphère terrestre tend à être une source nette de carbone
~15%**
~40% d'écosystèmes affectés **
Accroissement des déplacement d'espèces et feux de forêts**
Changement dans les écosystèmes suite à l'affaiblissement de la circulation thermohaline**
ALIMENTATION
Impacts négatifs complexes et localisés sur les petits propriétaires, agriculteurs de subsistance et pêcheurs **
Productivité céréalière tend à décroître dans les basses latitudes **
Productivité de toutes les céréales décroît dans les basses latitudes **
Productivité de certaines céréales tend à croître aux moyennes et hautes latitudes **
Productivité céréalière décroissante dans certaines régions **
COTES
Dommages accrus suite aux inondations et tempêtes **
Perte globale d'environ 30% des zones côtières humides[2]***
des millions de personnes supplémentaires pourraient subir une inondation chaque année**
SANTE
Poids accru de la malnutrition, diarrhée, maladies infectieuses et cardio-repiratoires **
Mortalité et morbidité accrues suite aux vagues de chaleur, inondations et sécheresses **
Changements de distribution de certains vecteurs de maladies **
Charge considérable des services de santé **
0
IPCC AR4
1
2
+moy. globale
3
/1980-1999
4
5 °C

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)

Beyond adaptation

- **Adaptation to climate change is necessary** to address impacts resulting from the warming which is already unavoidable due to past emissions
- However:
  - Adaptation alone cannot cope with all the projected impacts of climate change
  - The costs of adaptation and impacts will increase as global temperatures increase

Making development more sustainable can enhance both mitigative and adaptive capacity, and reduce emissions and vulnerability to climate change

Based on IPCC AR4 (2007)

Conséquences géopolitiques

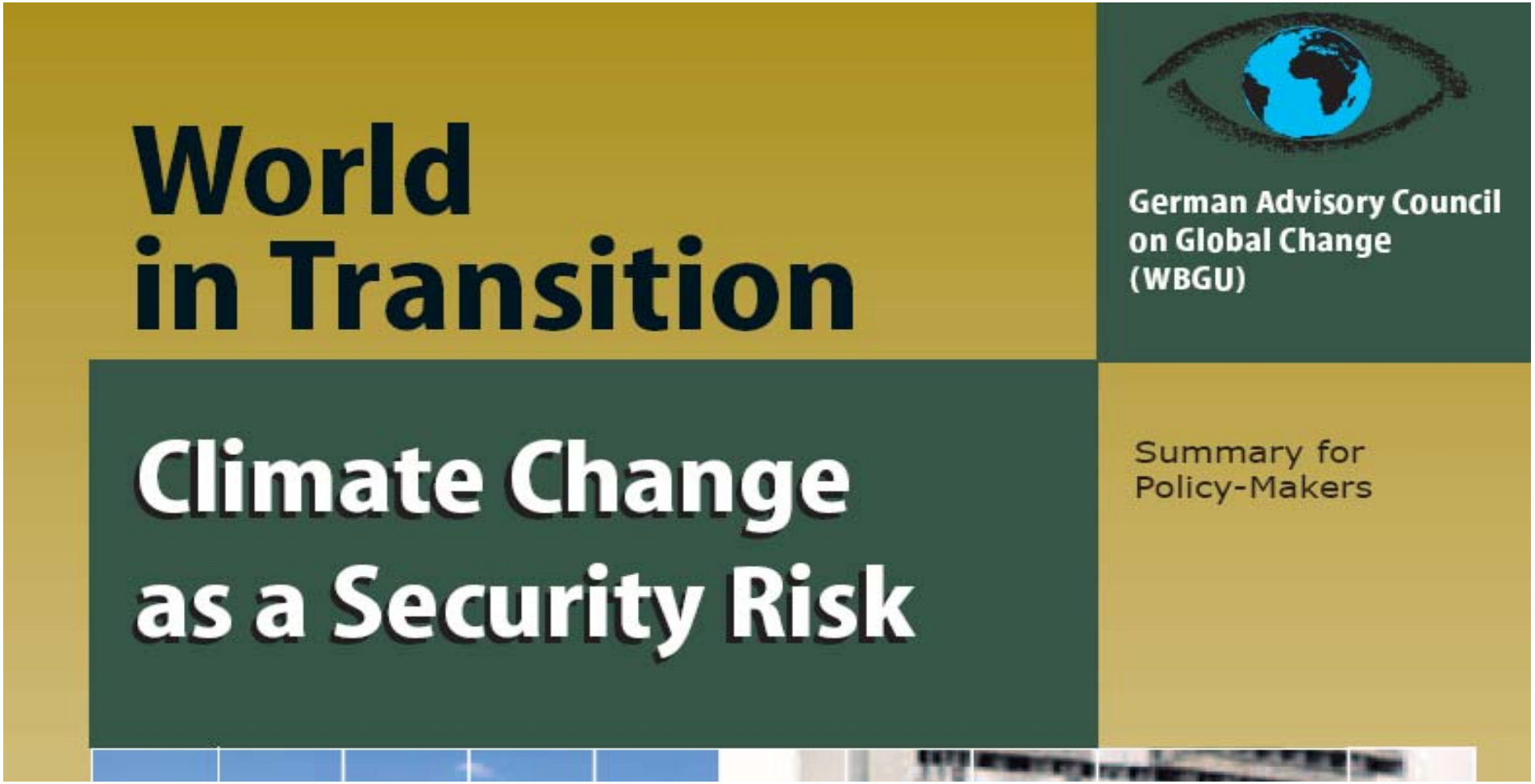
Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

Géopolitique

… désigne tout ce qui concerne les rivalités de pouvoir ou d'influence sur des territoires et les populations qui y vivent (Y. Lacoste, « Géopolitique », Larousse 2006)

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

www.wbgu.de (2007)



Jean-Pascal van Ypersele
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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.

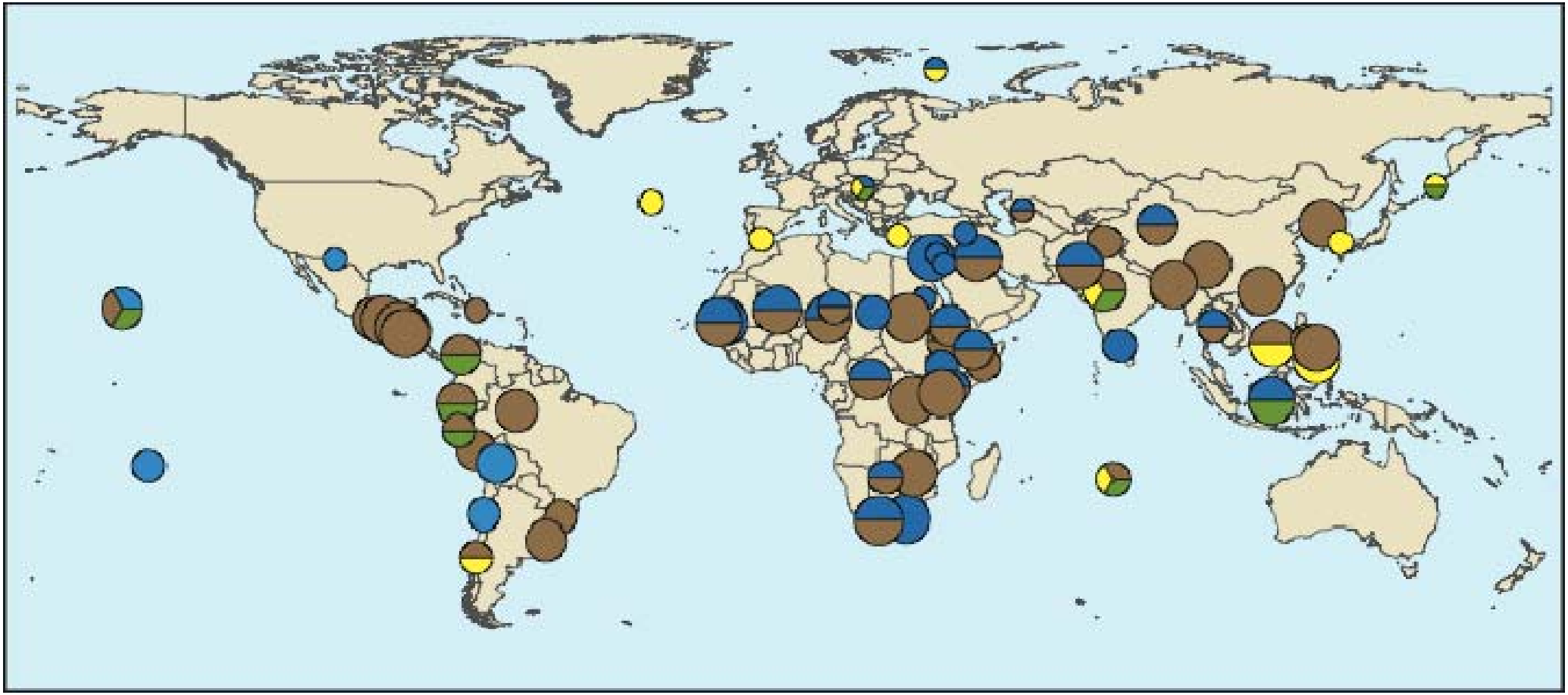
Jean-Pascal van Ypersele
(vanypersele@astr.ucl.ac.be)

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

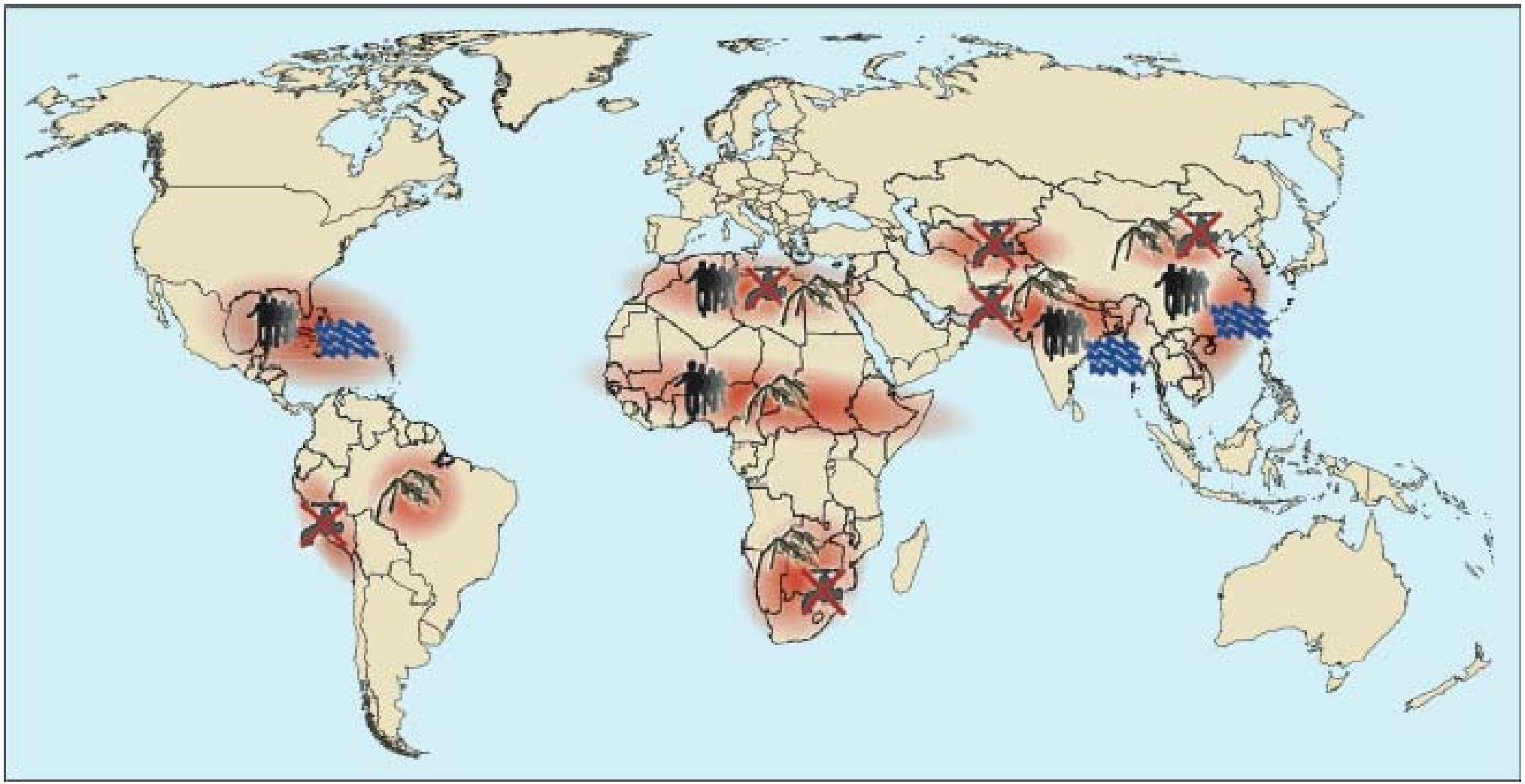
- Diplomatic crisis
- Protests (partly violent)
- Use of violence (national scope)
- Systematic/collective violence

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

Hausse du niveau des mers à long terme: fonte des calottes glaciaires

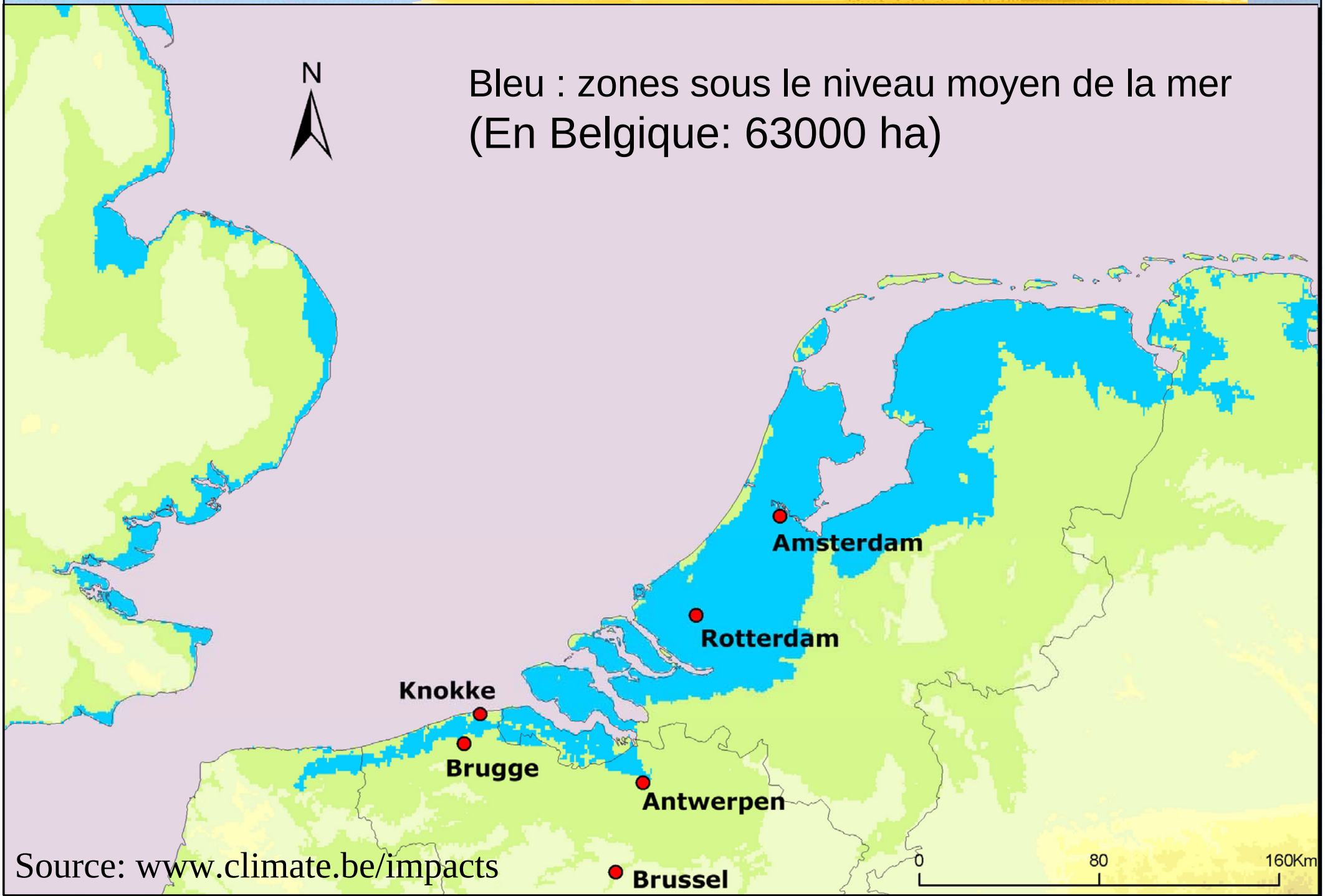
- Groenland:
  - Sa fonte totale représenterait une contribution de 7 m au niveau moyen des océans
- Calotte glaciaire de l'Antarctique occidental
  - Sa fonte totale représenterait une contribution de 5 m au niveau moyen des océans
- Un réchauffement de 1 – 4°C au dessus de la température actuelle conduirait à une fonte partielle au cours des prochains siècles et millénaires

Basé sur IPCC AR4 (2007)

WMO

UNEP

+1m (max /21è S)



Source: www.climate.be/impacts

+8m (possible vers l'an 3000 dans un scénario moyen):

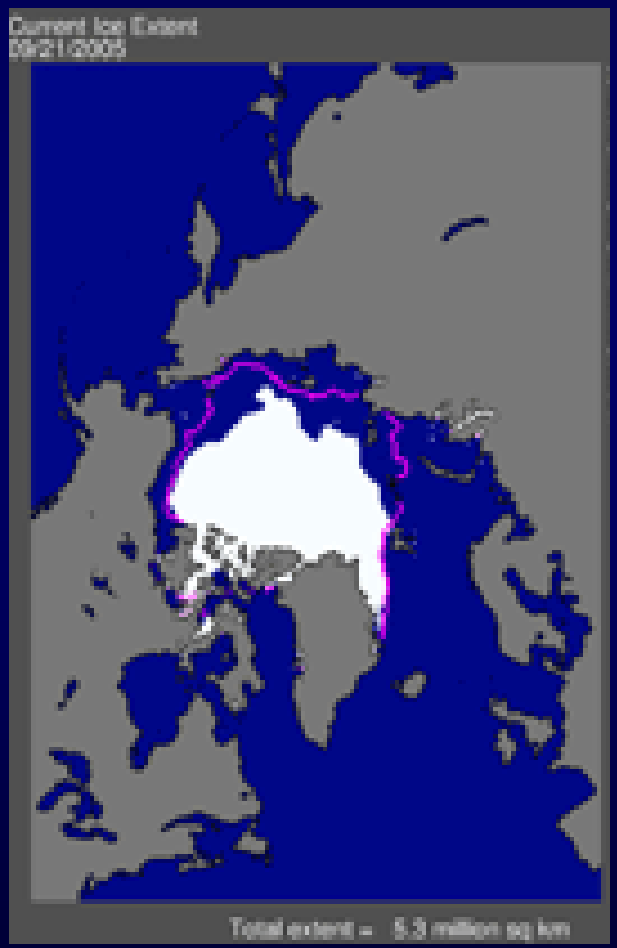
10 millions d’habitants = autant de réfugiés?

(Time 2001)

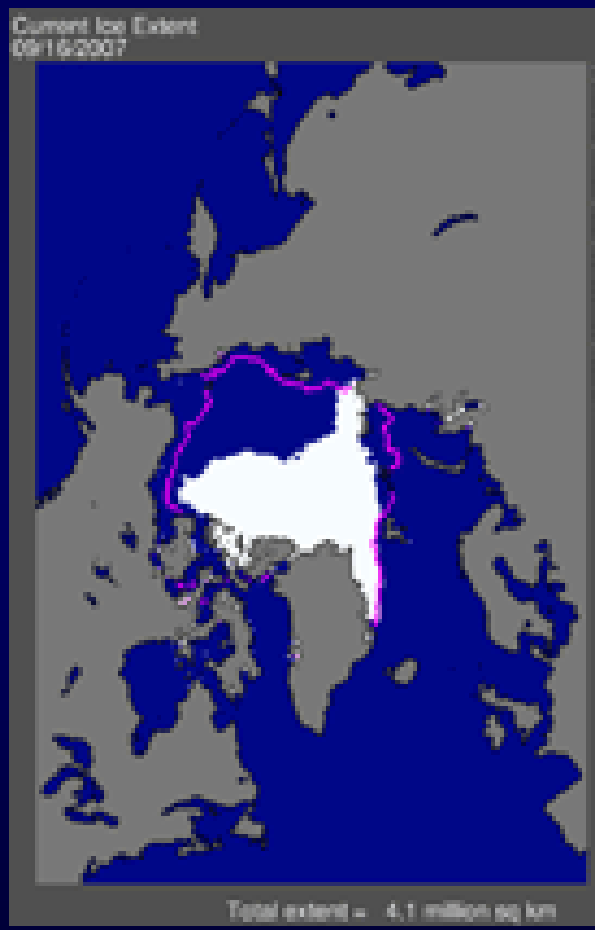
Extension of the Arctic ice cap

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. »

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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.

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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.

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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%

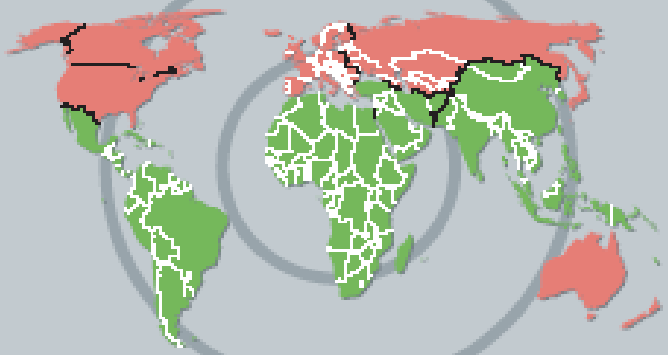
Contributions to Global Warming

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



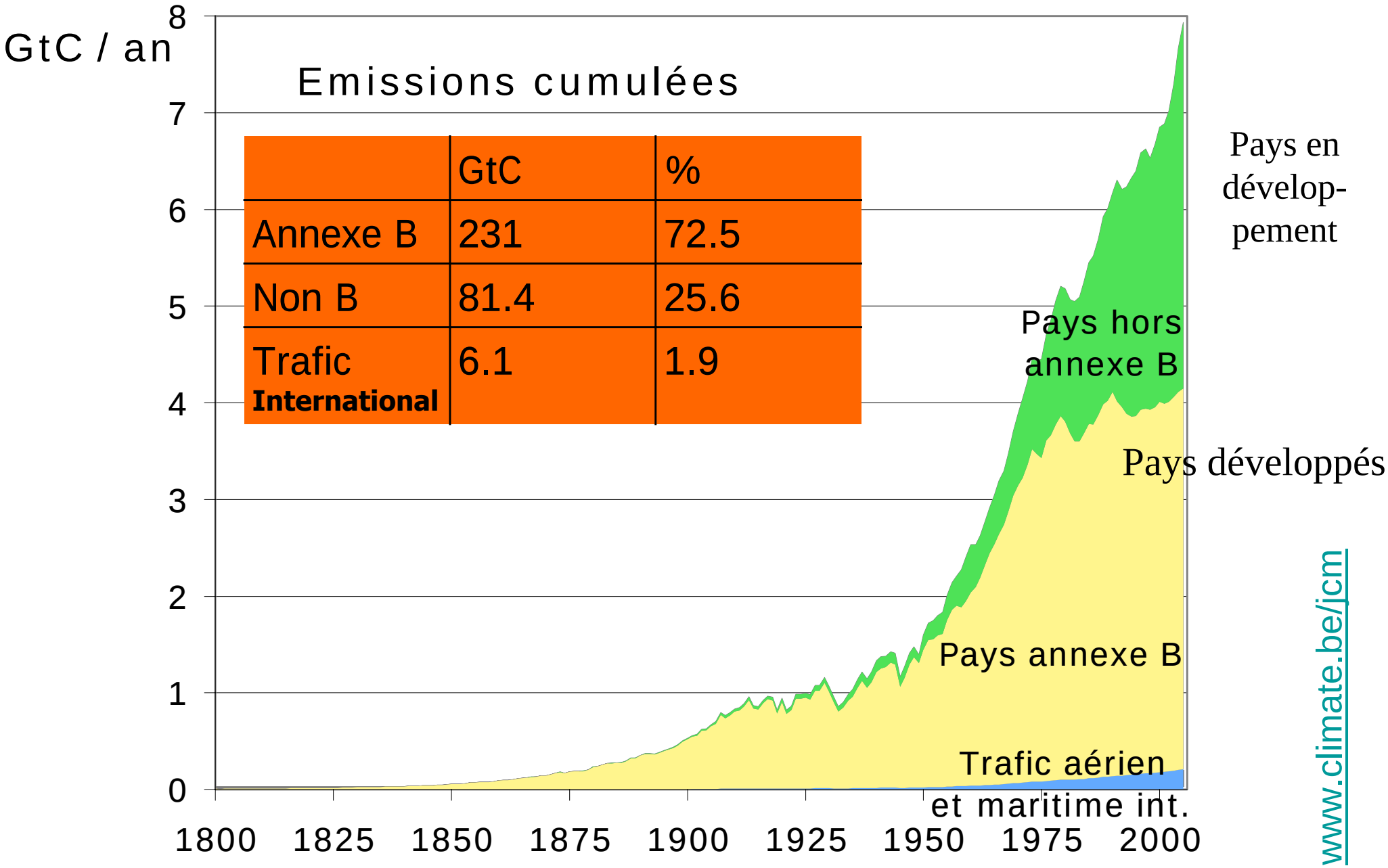
Underlying data sources:
United States Department of Energy, Energy Information Administration and the Carbon Dioxide Information Analysis Center

Map by Equator Graphics, Inc.

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

WRI

Emissions historiques : CO_2



Conférence de Toronto, 1988

- **" L'humanité se livre sans frein à une expérience qui touche l'ensemble du Globe et dont les conséquences définitives ne seraient dépassées que par celles d'une *guerre nucléaire mondiale* "**

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

Une nécessité: la restabilisation du climat

- **dans une économie vraiment « durable »**
- **dans un monde plus juste**
  - **Objectifs globaux**
  - **Répartition des efforts**

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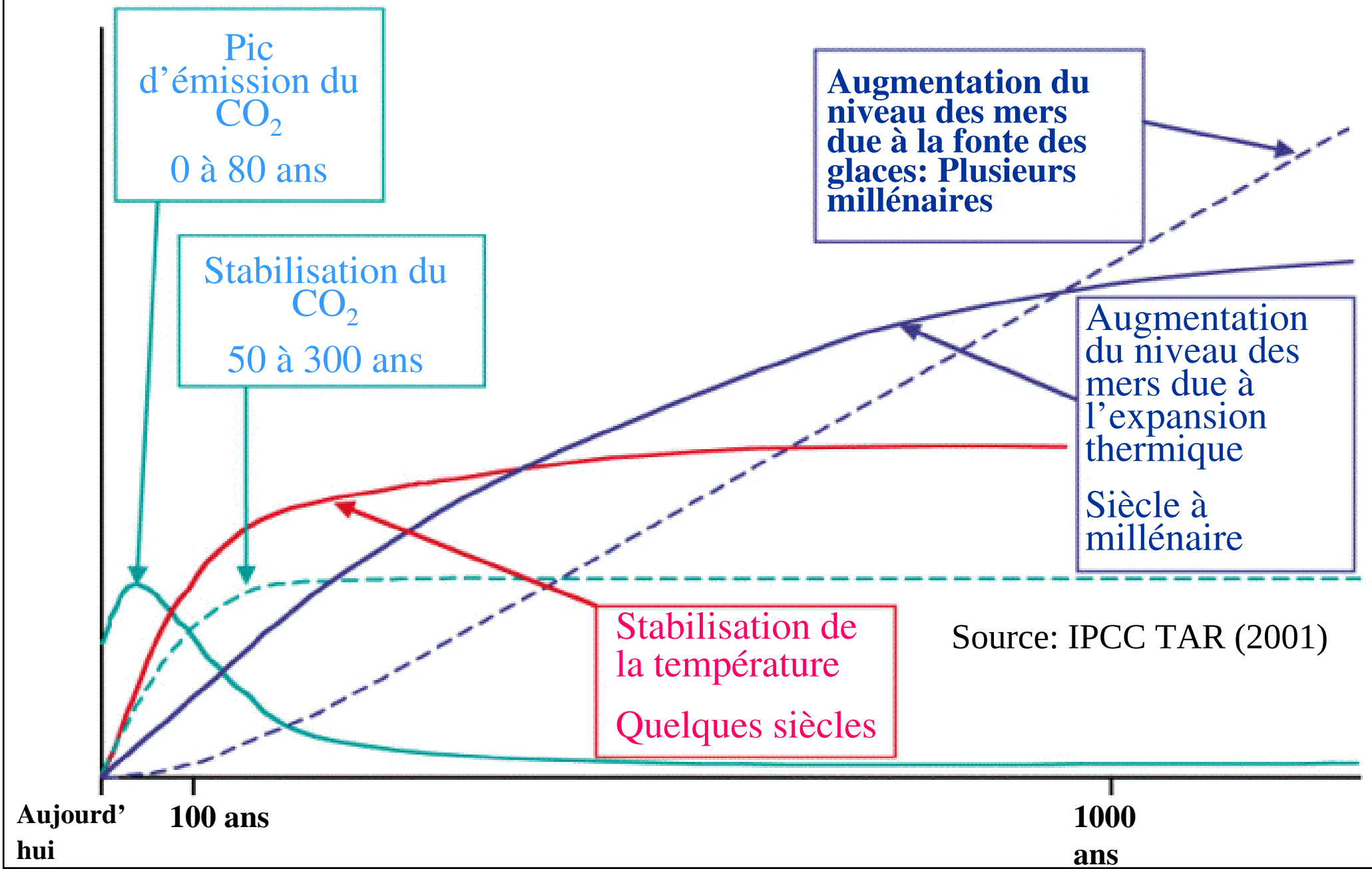
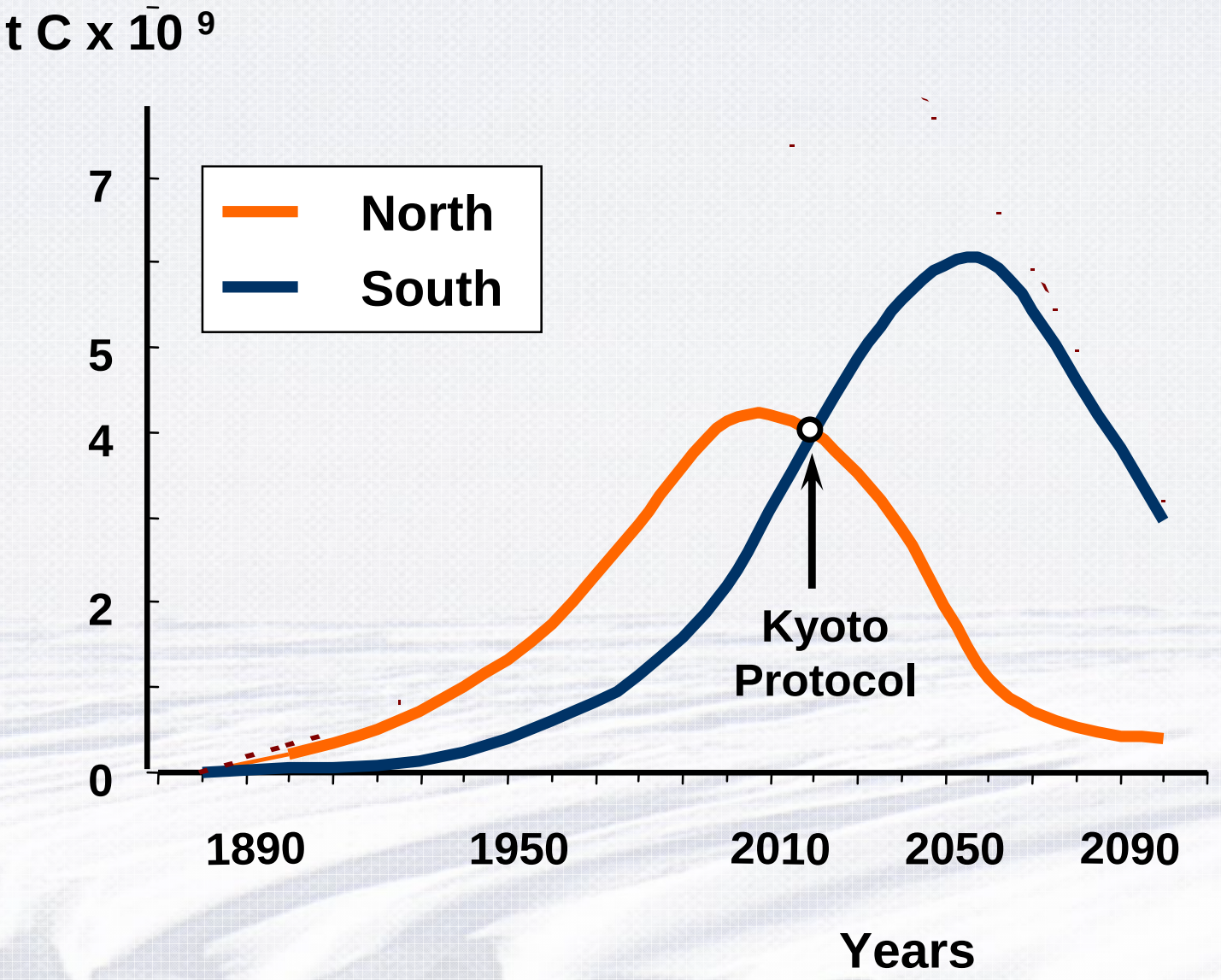
Difficulté:
l'inertie significative du système climatique



North + South carbon emissions

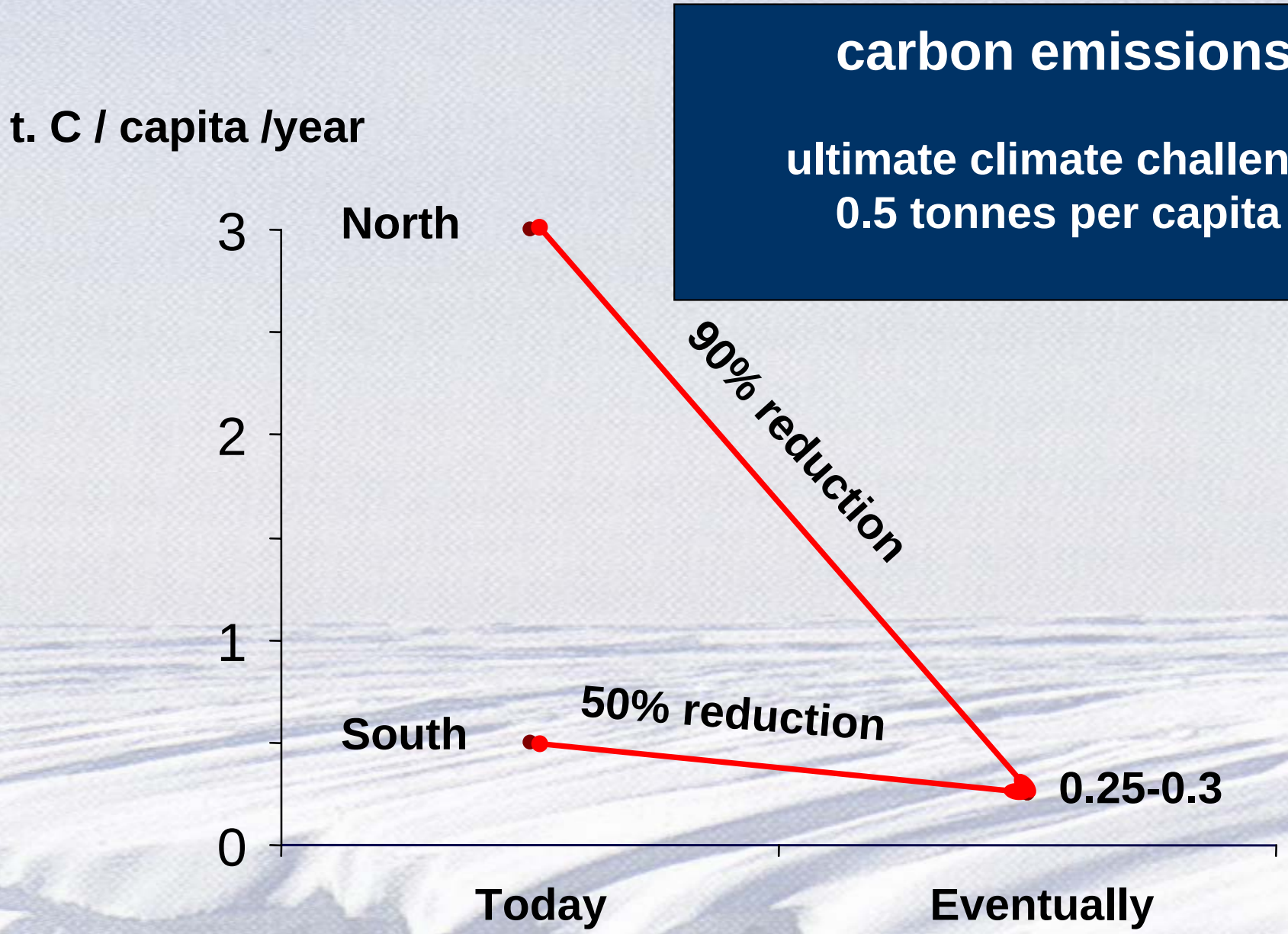
450 ppmv stabilization scenario



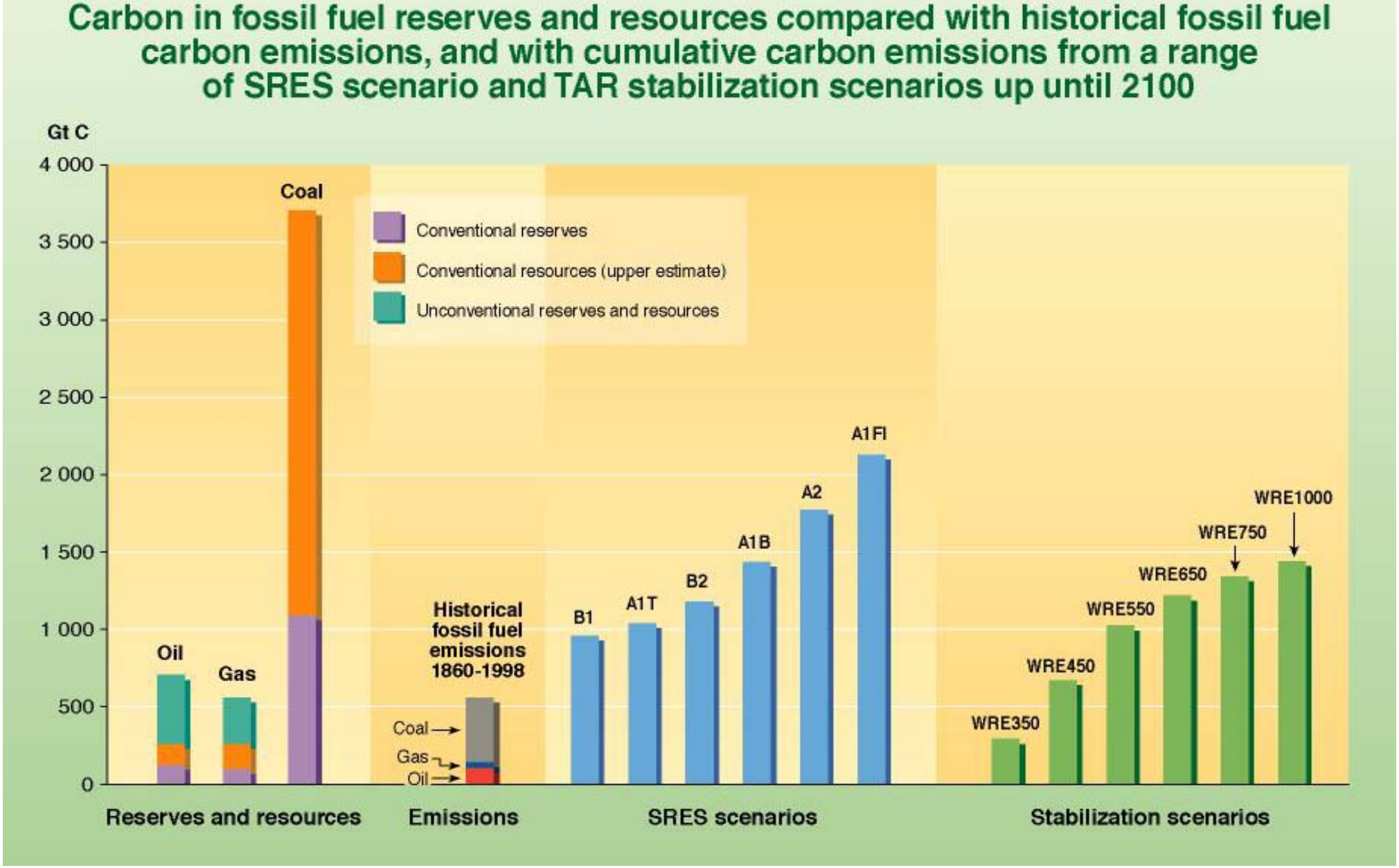
Source : *Sivan Kartha et al,* 1998

carbon emissions

ultimate climate challenge
0.5 tonnes per capita



Source : *Sivan Kartha et al,* 1998



Source: IPCC (2001)

Framework Convention on Climate Change

- **Signed at the Earth Summit in Rio, June 1992**
- **Ratified by almost every country**
- **Ultimate objective**
- **Commitment by all : inventorize emissions, design plans to limit or reduce, cooperate**
- **Commitment by developed countries : stabilize emissions by 2000 at 1990 level**
- **Web : http://www.unfccc.int (Convention Secretariat)**
- **No sanctions**

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Climate Change
Ultimate objective (Article 2):

'...stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Such a level should be achieved within a time frame sufficient
- to allow ecosystems to adapt naturally to climate change,
- to ensure that food production is not threatened and
- to enable economic development to proceed in a sustainable manner.'

inverse calculation

(technologies, lifestyles, policy instruments)

Emissions pathways

(biogeochemical cycles)

Critical Levels

(global temperature / radiative forcing)

Critical Limits

(regional climate changes)

Key Vulnerabilities

(socioeconomic factors)

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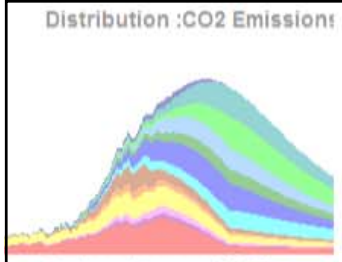
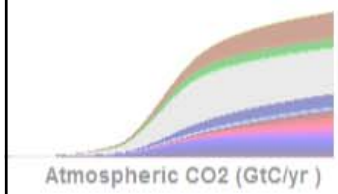
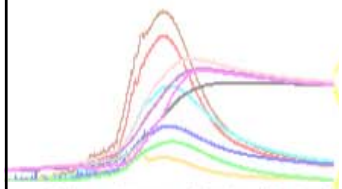
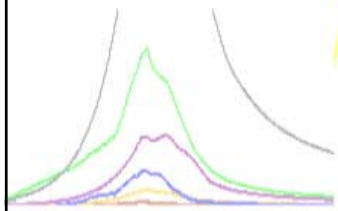
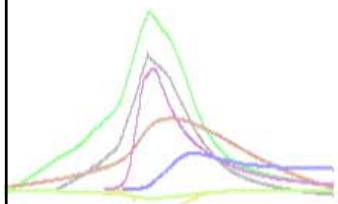
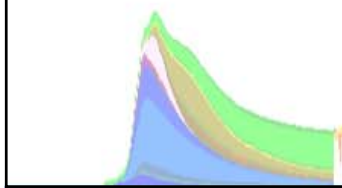


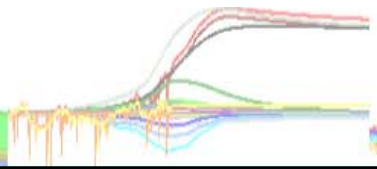


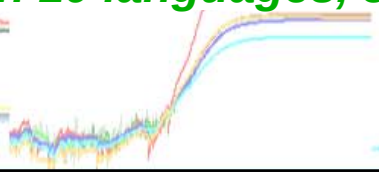


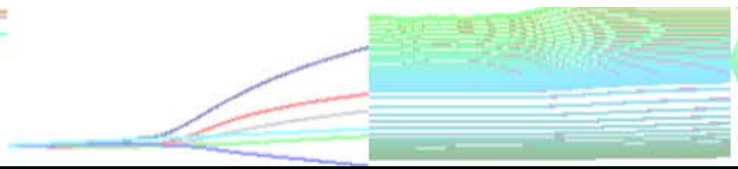












Java Climate Model

www.climate.be/jcm

In preparing positions for the role-play, the students used the Java Climate Model to explore options and uncertainties.

By selecting parameters / indicators, same model can "justify" diverse positions

Works in web browser, Instantly responding graphics,

Cause-effect from emissions to impacts,

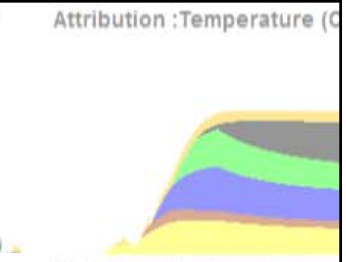
Based on IPCC-TAR methods / data,

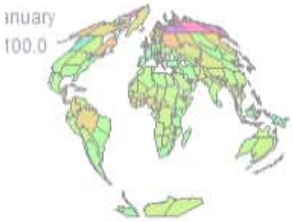
Flexible stabilisation scenarios

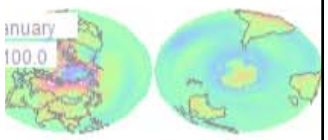
Regional distributions of responsibility and climate.

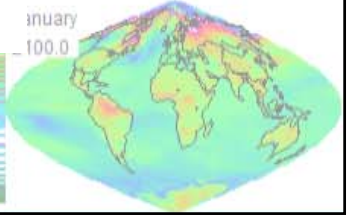
Transparent, open-source code,

Interface in 10 languages, 50000 words documentation









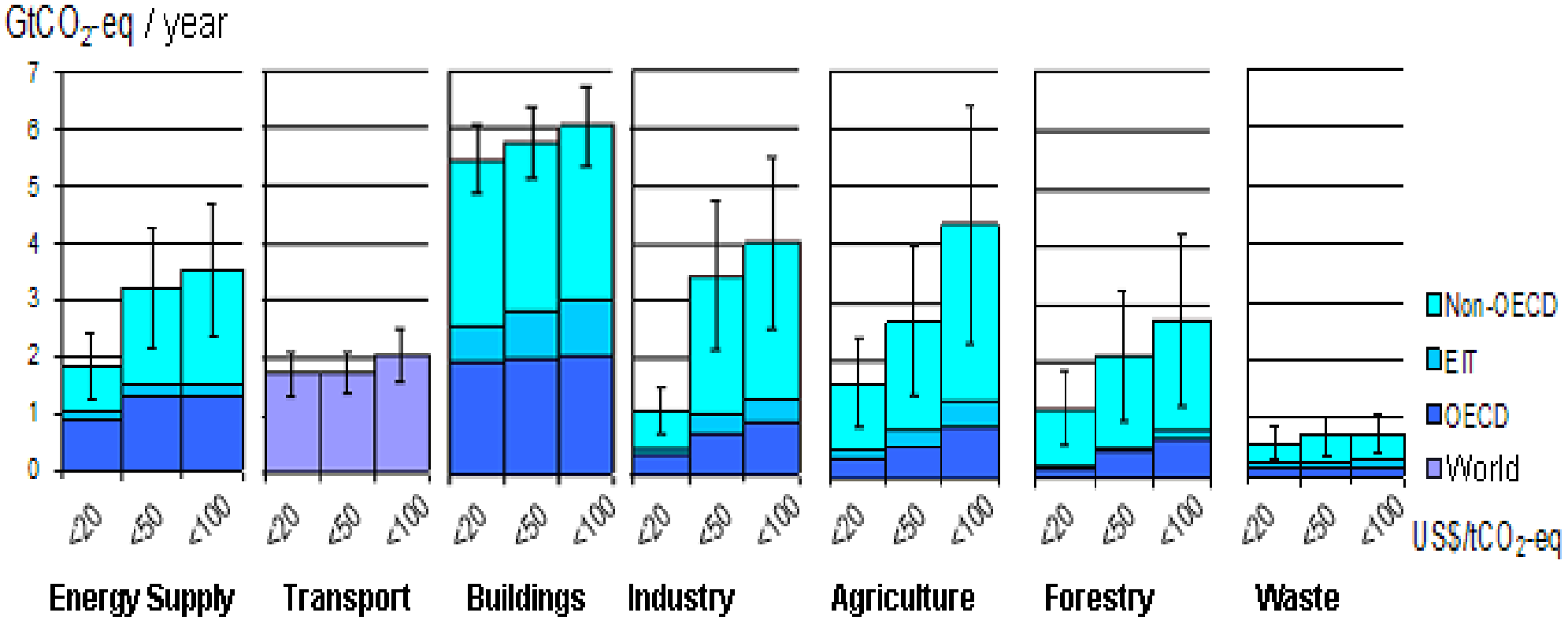
Vous pouvez essayer:

- jcm.chooseclimate.org :

(modèle interactif du Dr Ben Matthews (UCL, réseau Climneg)

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.

Stabilisation levels and equilibrium global mean temperatures

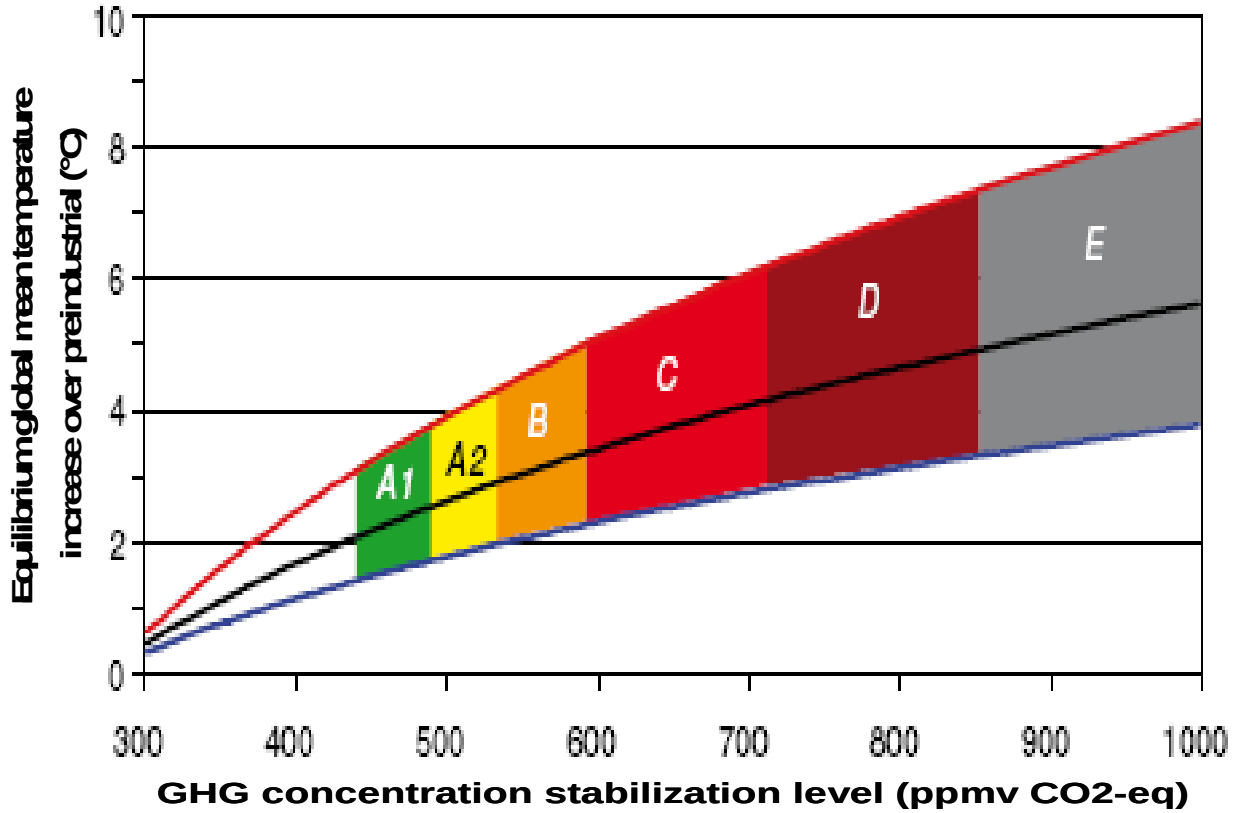


***Figure SPM 8**: Stabilization scenario categories as reported in Figure SPM.7 (coloured bands) and their relationship to equilibrium global mean temperature change above pre-industrial, using (i) "best estimate" climate sensitivity of 3 ℃ (black line in middle of shaded area), (ii) upper bound of 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.*

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

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.

Policies are available to to governments to realise mitigation of climate change

- Effectiveness of policies depends on national circumstances, their design, interaction, stringency and implementation
  - Integrating climate policies in broader development policies
  - Regulations and standards
  - Taxes and charges
  - Tradable permits
  - Financial incentives
  - Voluntary agreements
  - Information instruments
  - Research and development

The importance of a “price of carbon”

- Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes.
- Such policies could include economic instruments, government funding and regulation
- For stabilisation at around 550 ppm CO2eq carbon prices should reach 20-80 US$/tCO2eq by 2030 (5-65 if “induced technological change” happens)
- At these carbon prices large shifts of investments into low carbon technologies can be expected

État de la planète au début du XXIe siècle

- Les 20 % les plus riches de la population mondiale représentent 86 % des dépenses totales de consommation privée, consomment 58 % de l'énergie mondiale (à raison d'environ 5 tonnes d'équivalent-pétrole par personne), 45 % de la consommation de viande et de poisson, 84 % de celle de papier, et possèdent 87 % des voitures et 74 % des téléphones.
- Les 20 % les plus pauvres de la population mondiale consomment moins de 5 % de chacun de ces biens et services. **Environ 2 milliards de personnes n'ont pas accès à l'électricité, principalement en zone rurale.**

Sources principales: GEO-3 et WEHAB

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1. Implications of Climate Change Mitigation for Sustainable Development

- Climate change mitigation is likely to have significant impacts on the prospects for SD in various regions and sectors
  - Mitigation will reduce climate change and other impacts on human and natural systems ("ancillary benefits")
  - Effects of mitigation policies and regimes

Mitigation Policies and Sustainable Development

- Rate of mitigation affects employment, welfare and intergenerational impacts
  - Slower mitigation can reduce shock effects and lower costs if stabilization targets are higher
  - Faster mitigation can reduce negative longer-term impacts, induce technological change, and lower long-term costs if stabilization targets are lower

2. Implications of Sustainable Development for Climate Change Mitigation

- Achieving SD goals will reduce emissions and contribute to mitigative capacity
  - This can be seen by taking a look at the SRES and post-SRES analyses

3. Integrating Climate Change Mitigation and Sustainable Development Policies

- Climate change policies may be more effective if integrated into sustainable development goals and policies

Dernières remarques

- **Il est temps de définir des politiques sérieuses d'adaptation et de prévention**
- **Il faut voir à long terme, avec des objectifs de réduction d'émissions bien + ambitieux que Kyoto**
- **L'énergie la moins chère et la moins polluante est celle dont nous n'avons pas besoin**
- **Le Soleil nous fournit 8000 X plus d'énergie que la consommation mondiale de 1990: ne peut-on imaginer de focaliser des recherches pour arriver à en capter un millième ?**

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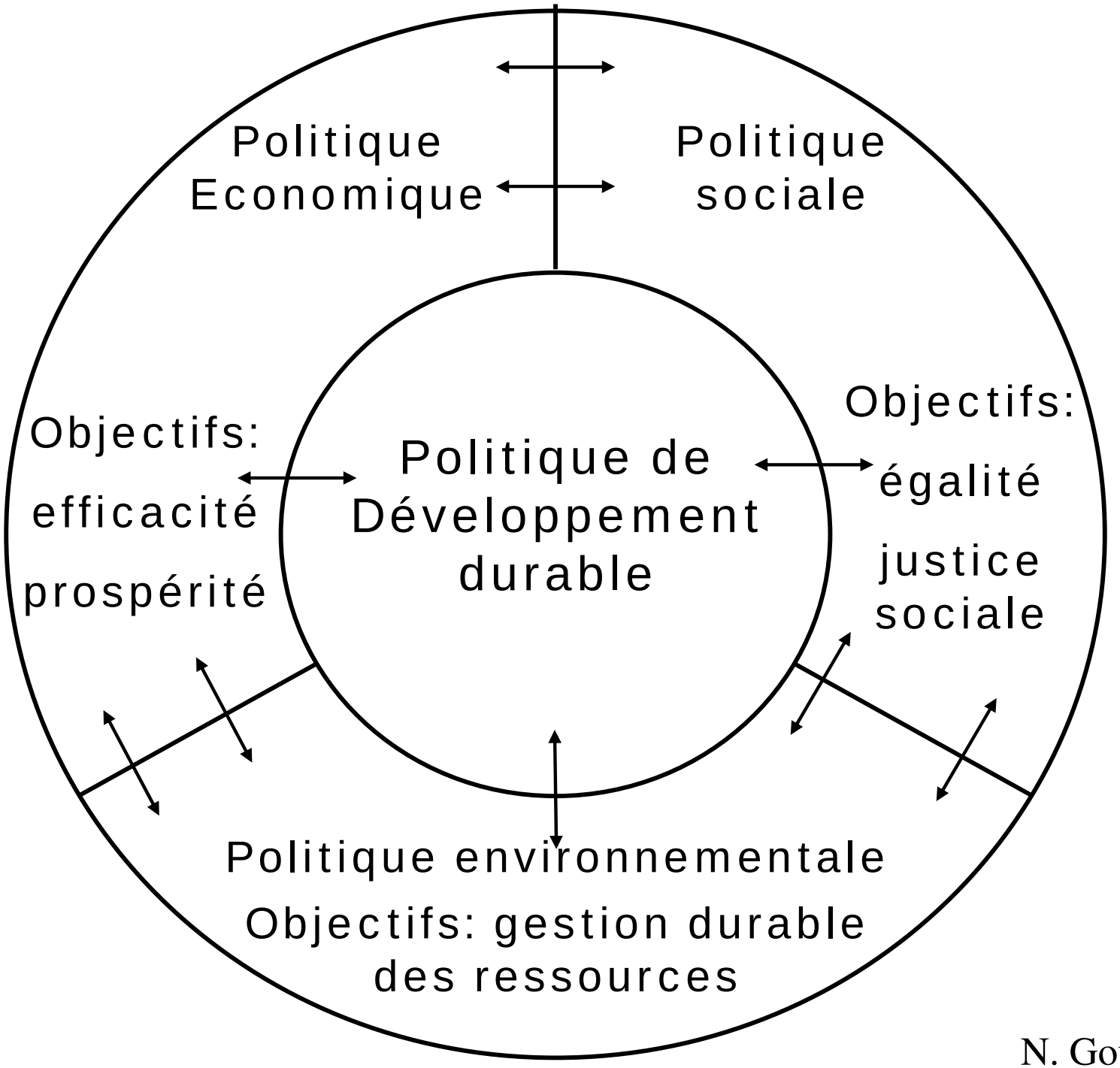

N. Gouzée
(Bureau Fed. Du Plan)

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.'***

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zNous n’avons pas de planète de rechange, et nous sommes tous dessus, ensemble.

Unicef

Pour en savoir plus...

- www.climate.be : ASTR-UCL
- www.ipcc.ch : IPCC ou GIEC
- www.unfccc.int : Convention & Protocole
- www.cfdd.be : Conseil fédéral développement durable
- www.climat.be : campagne climat du Gvt
- jcm.chooseclimate.org : modèle interactif du Dr B. Matthews, UCL-ASTR
- www.realclimate.org: réponse aux sceptiques

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Pour en savoir plus...

- JM Valantin: www.lignes-de-reperes.com
- Changements climatiques, impasses et perspectives (Points de vue du Sud), Editions Syllepse (voir www.cetri.be)

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