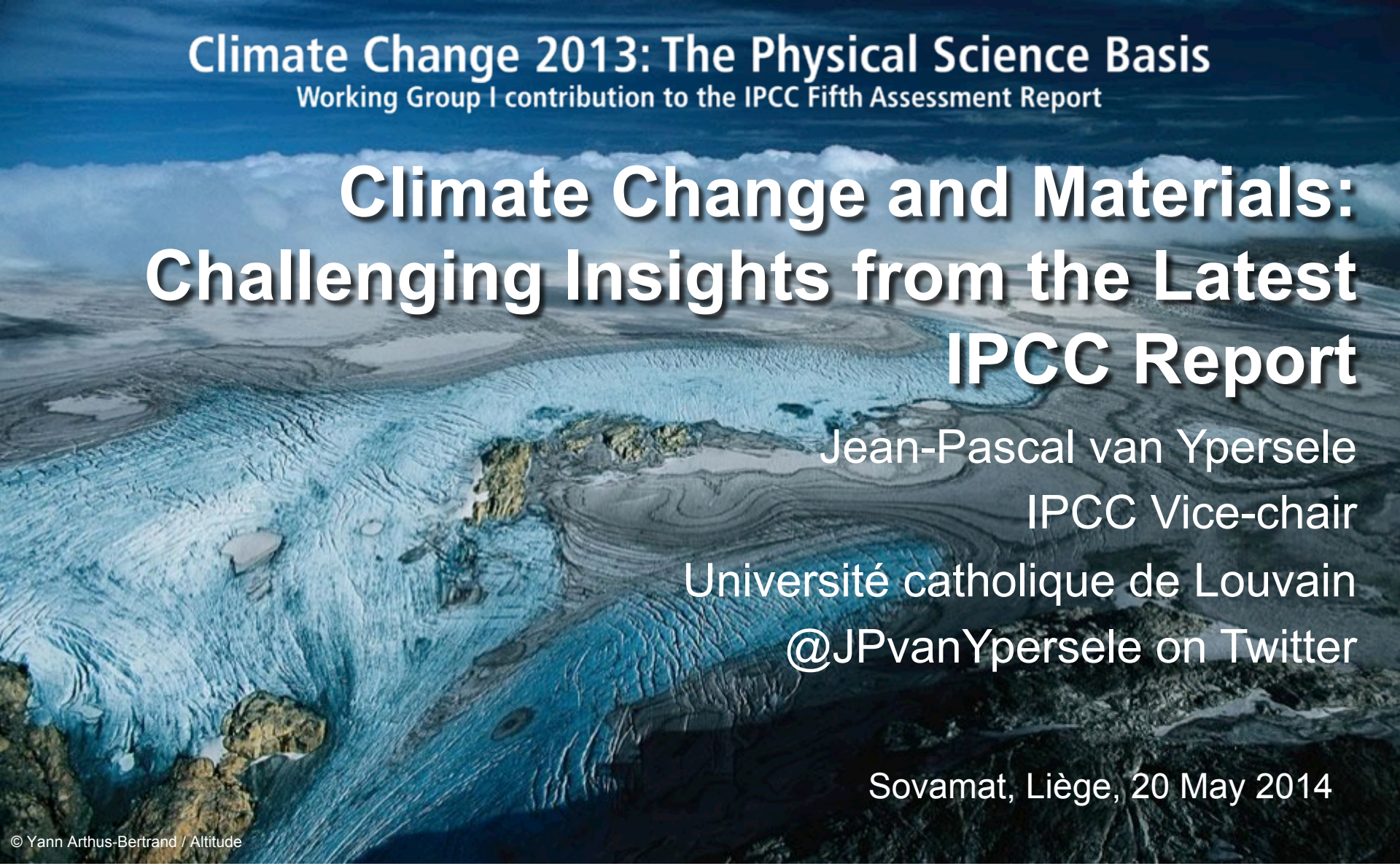
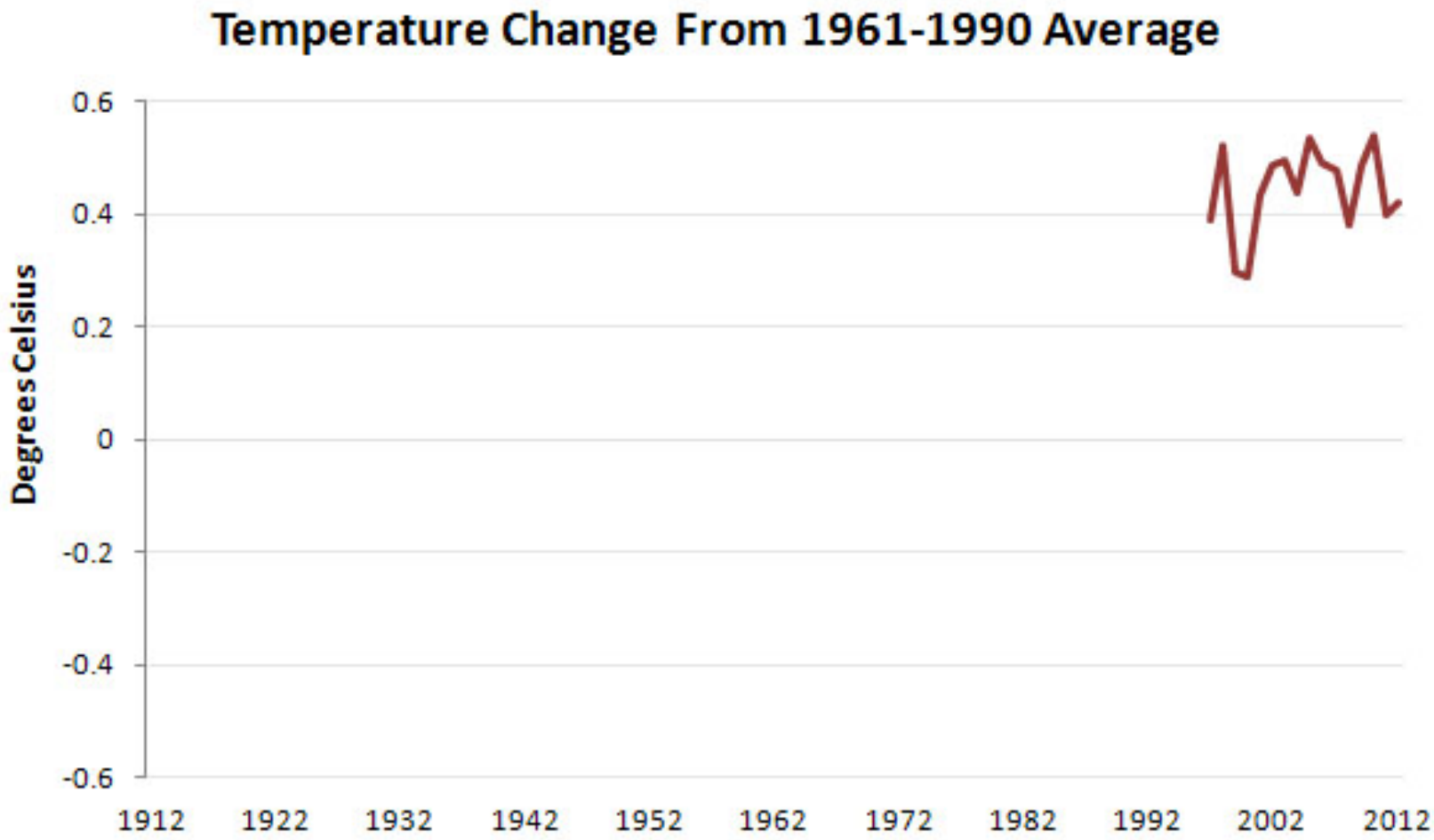


Climate Change and Materials: Challenging Insights from the Latest IPCC Report

Jean-Pascal van Ypersele
IPCC Vice-chair
Université catholique de Louvain
@JPvanYpersele on Twitter

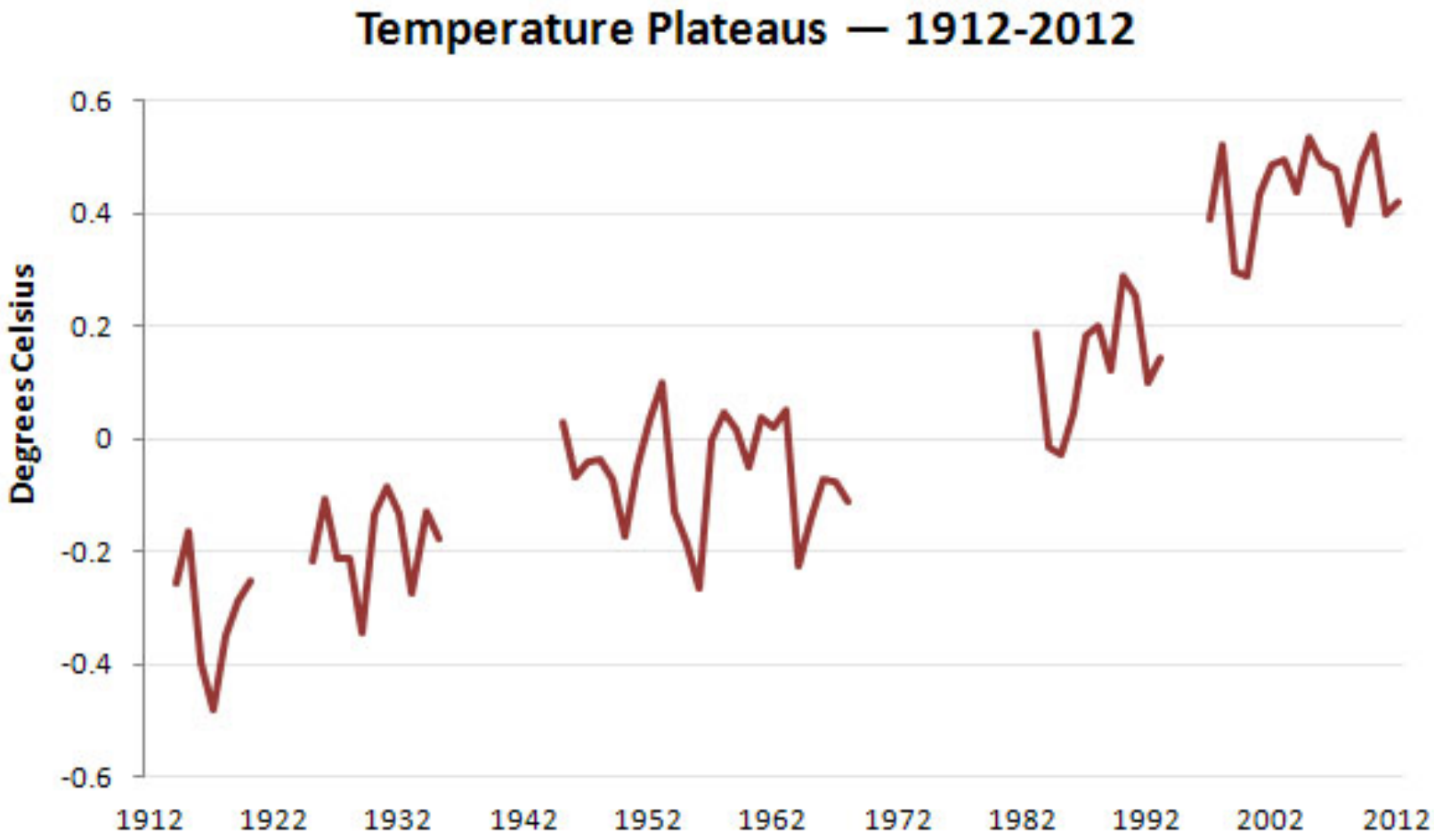
Sovamat, Liège, 20 May 2014

Thanks to the Belgian Federal Science Policy Office (BELSPO) for their support



http://www.motherjones.com/kevin-drum/2012/10/lying-statistics-global-warming-edition

Lying With Statistics, Global Warming Edition



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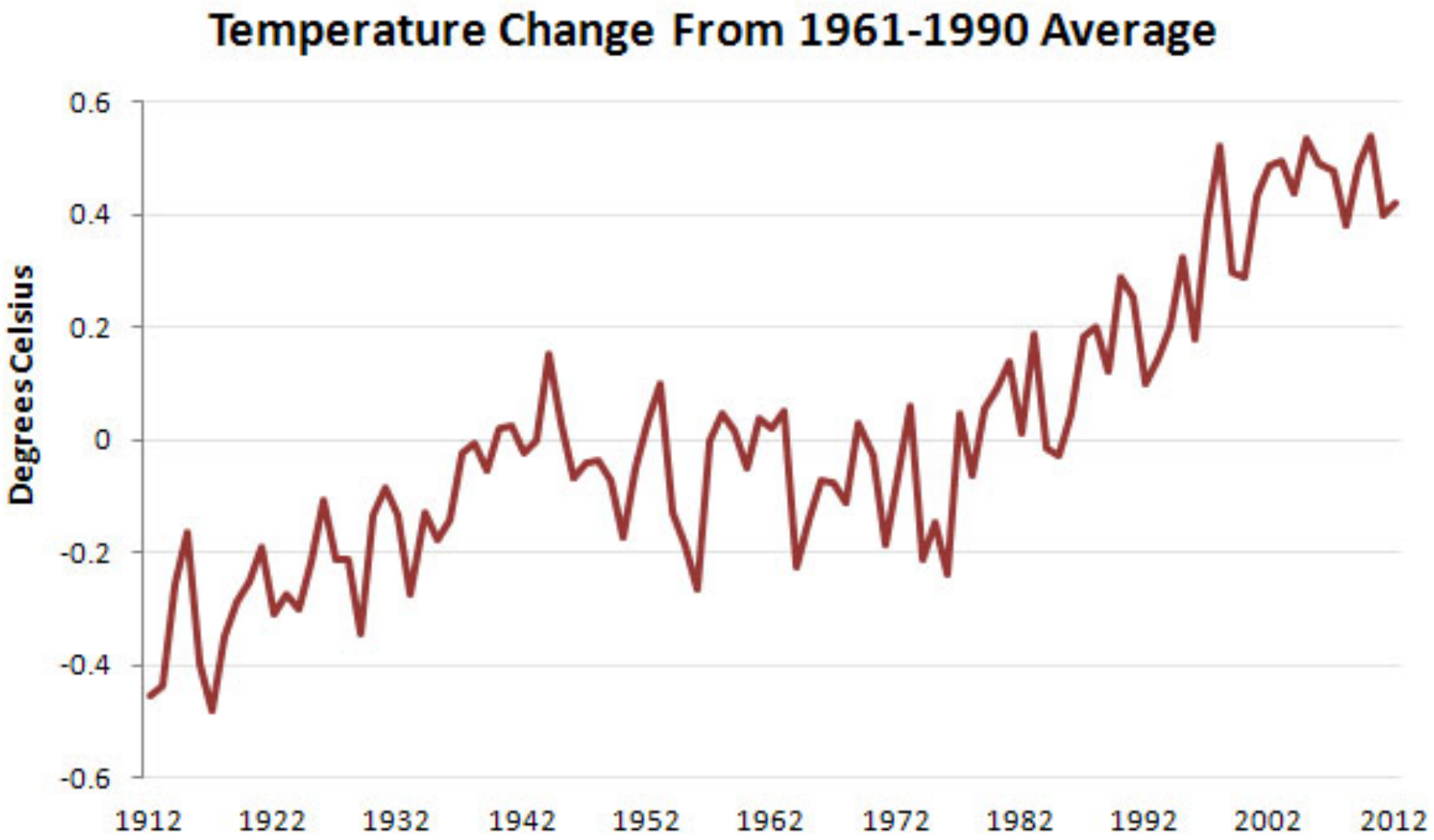
Lying With Statistics, Global Warming Edition



http://www.motherjones.com/kevin-drum/2012/10/lying-statistics-global-warming-edition

Why the IPCC ?

Established by WMO and UNEP in 1988

to provide **policy-makers** with an **objective source of information** about

- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options (adaptation & mitigation).

WMO=World Meteorological Organizatior

UNEP= United Nations Environment Programme

Completed IPCC Reports

5 Assessment Reports *(1990, 1995, 2001, 2007, 2013-14)*

1992 Supplementary Report and 1994 Special Report

8 Special Reports *(1997,1999, 2000, 2005, 2011)*

Guidelines for National GHG Inventories, Good Practice Guidanc

(1995-2006)

6 Technical Papers *(1996-2008)*

Recent/Coming IPCC Products

- ***2011: Special report on Renewable Energy Sources and Climate Change Mitigation***
- ***2011: Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation***
- ***2013: AR5 WGI report (physical science)***
- ***2014: AR5 WGII (Impacts & Adaptation); WGIII (Mitigation), Synthesis Report***
- ***All available on www.ipcc.ch***

What is happening in the climate system?

What are the risks?

What can be done?

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

WG I (Physical science basis): 209 lead authors, 2014 pages, 54.677 review comments

WG II (Impacts, Adaptation, and Vulnerability): 243 lead authors, 2500 pages, 50.492 review comments

WG III (Mitigation of Climate Change): 235 coordinating and lead authors, 2000 pages, 38.315 review comments

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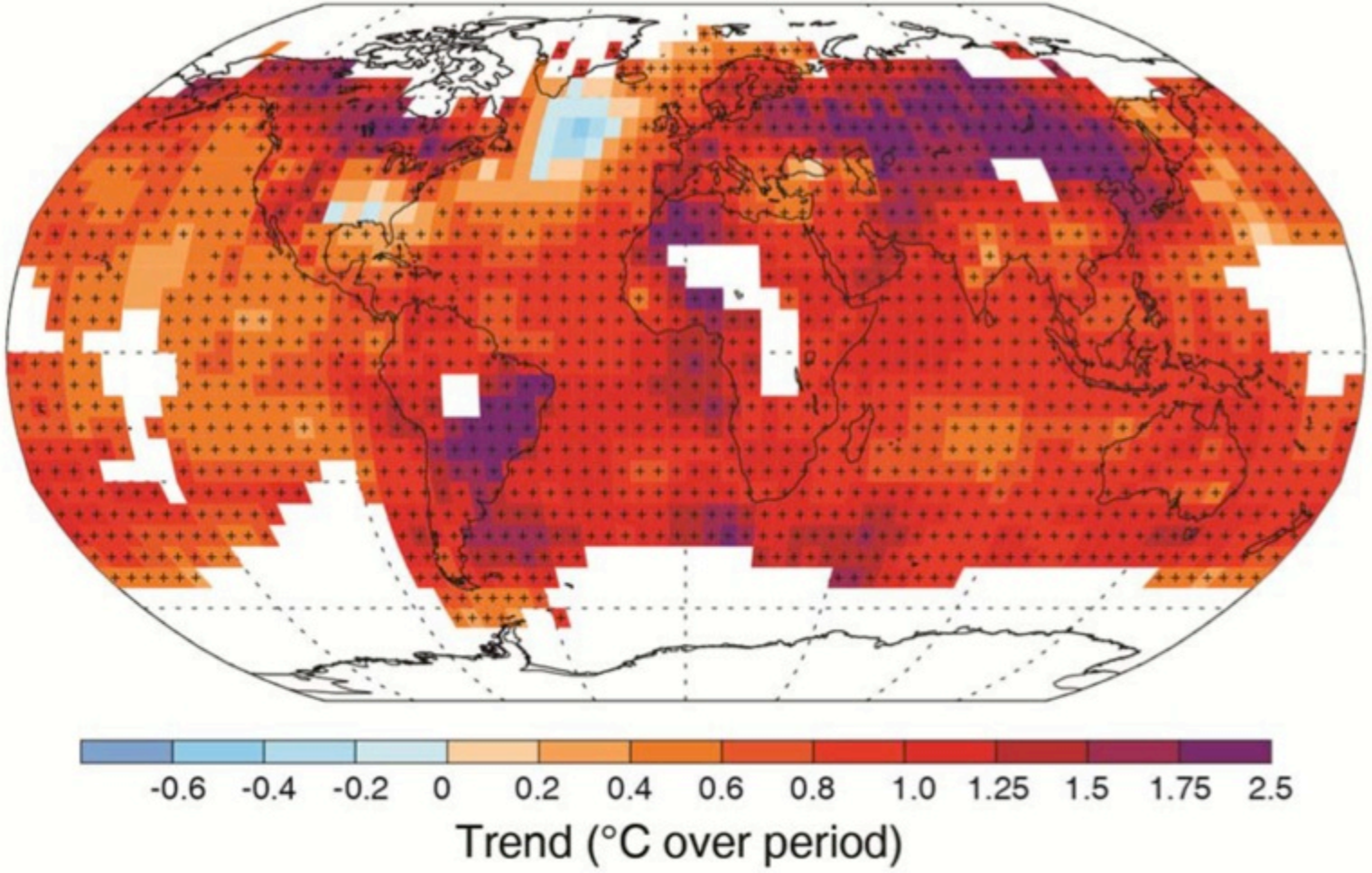
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

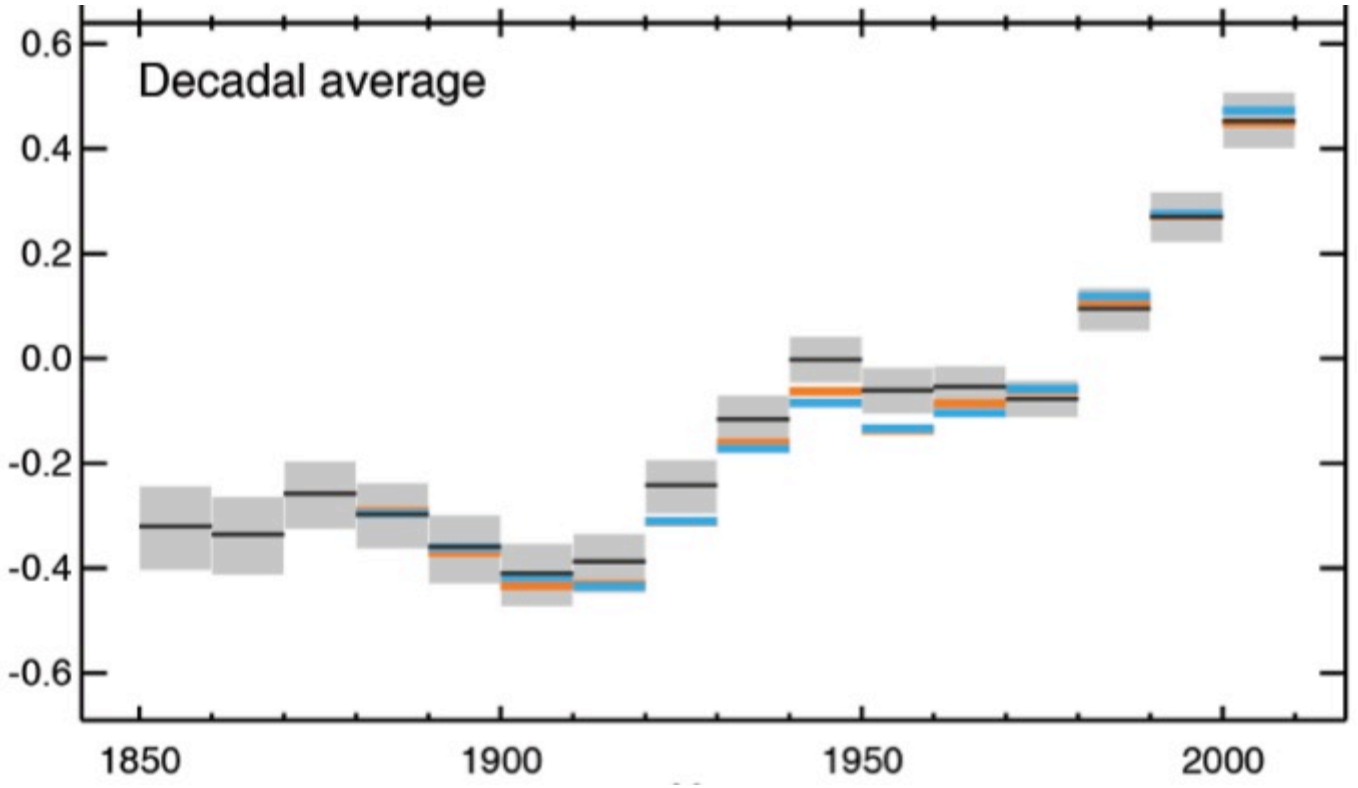
What is happening in the climate system?

Evolution de la température moyenne en surface 1901-2012: +0.89°C



(IPCC 2013, Fig. SPM.1b)

Le réchauffement du système climatique est sans équivoque



(IPCC 2013, Fig. SPM.1a)

Chacune des trois dernières décennies a été successivement plus chaude à la surface de la Terre que toutes les décennies précédentes depuis 1850

Dans l'hémisphère nord, la période 1983–2012 a probablement été la période de 30 ans la plus chaude des 1400 dernières années (degré de confiance moyen).

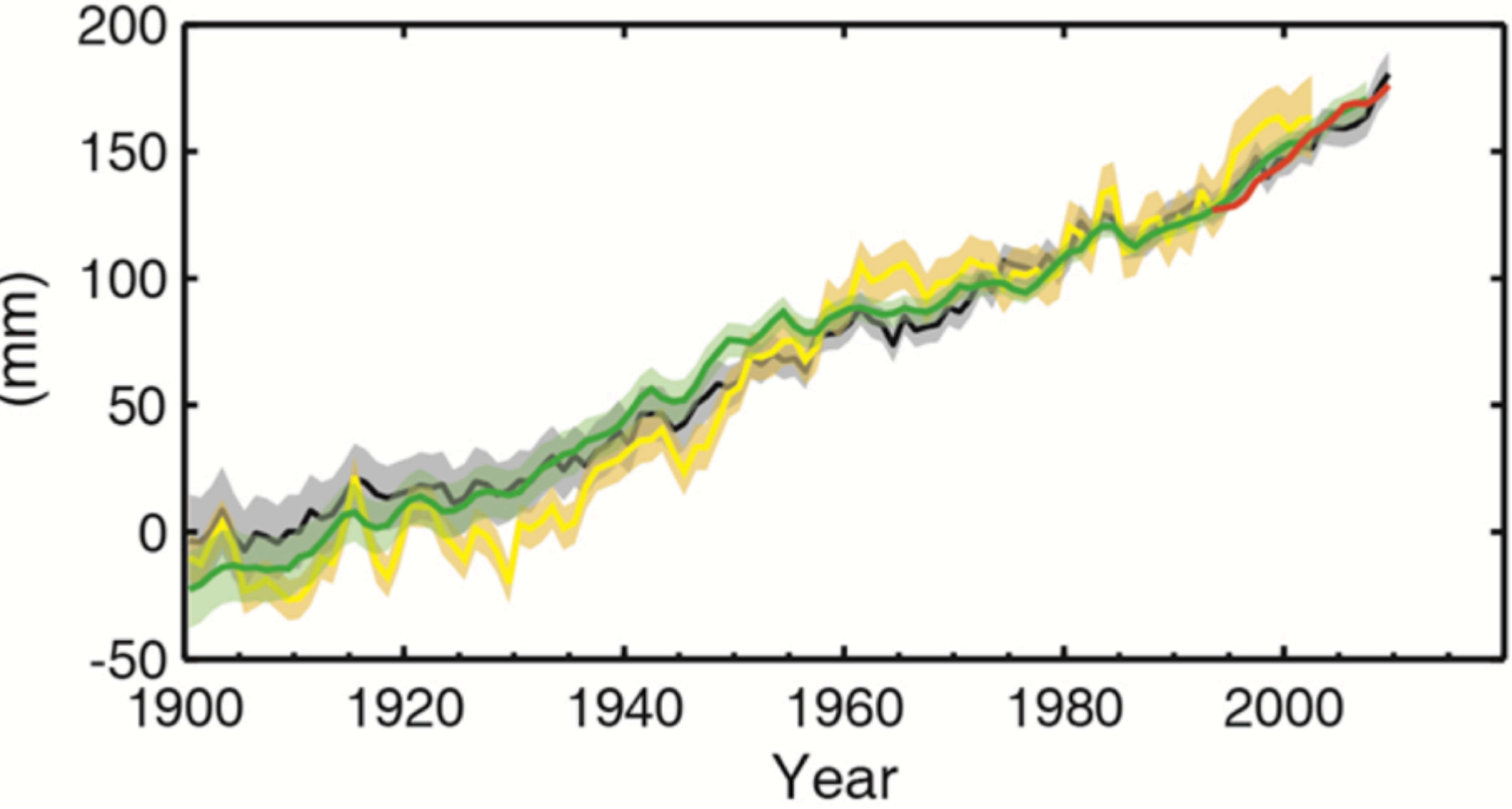
Plateau Glacier (1961)
(Alaska)

http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Plateau Glacier (2003) (Alaska)

http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Change in average sea-level change

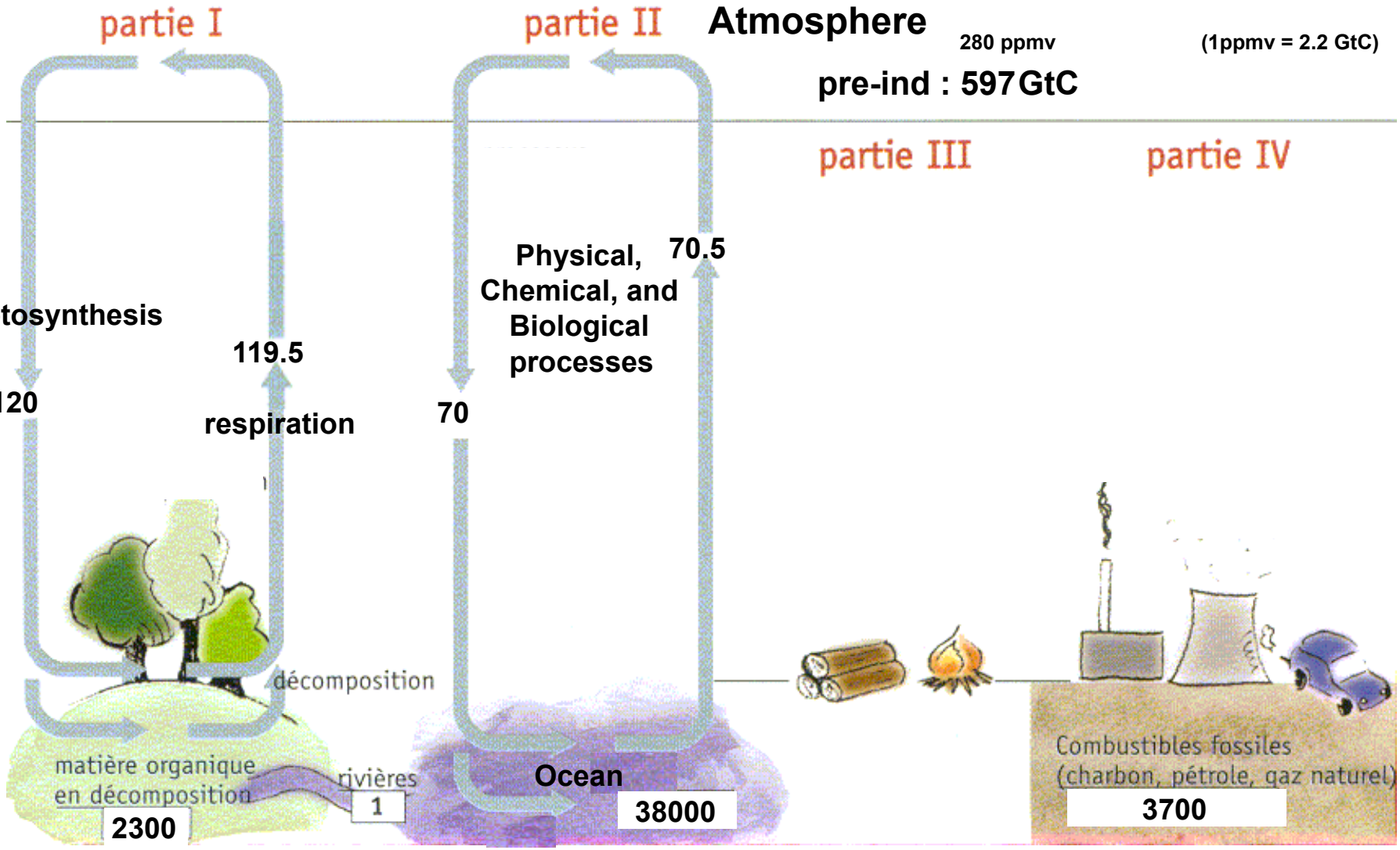


AR5 WGI SPM - Approved version / subject to final copyedit

(Lüthi et al.,2008, NOAA)

The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years.

Carbon cycle: unperturbed fluxes

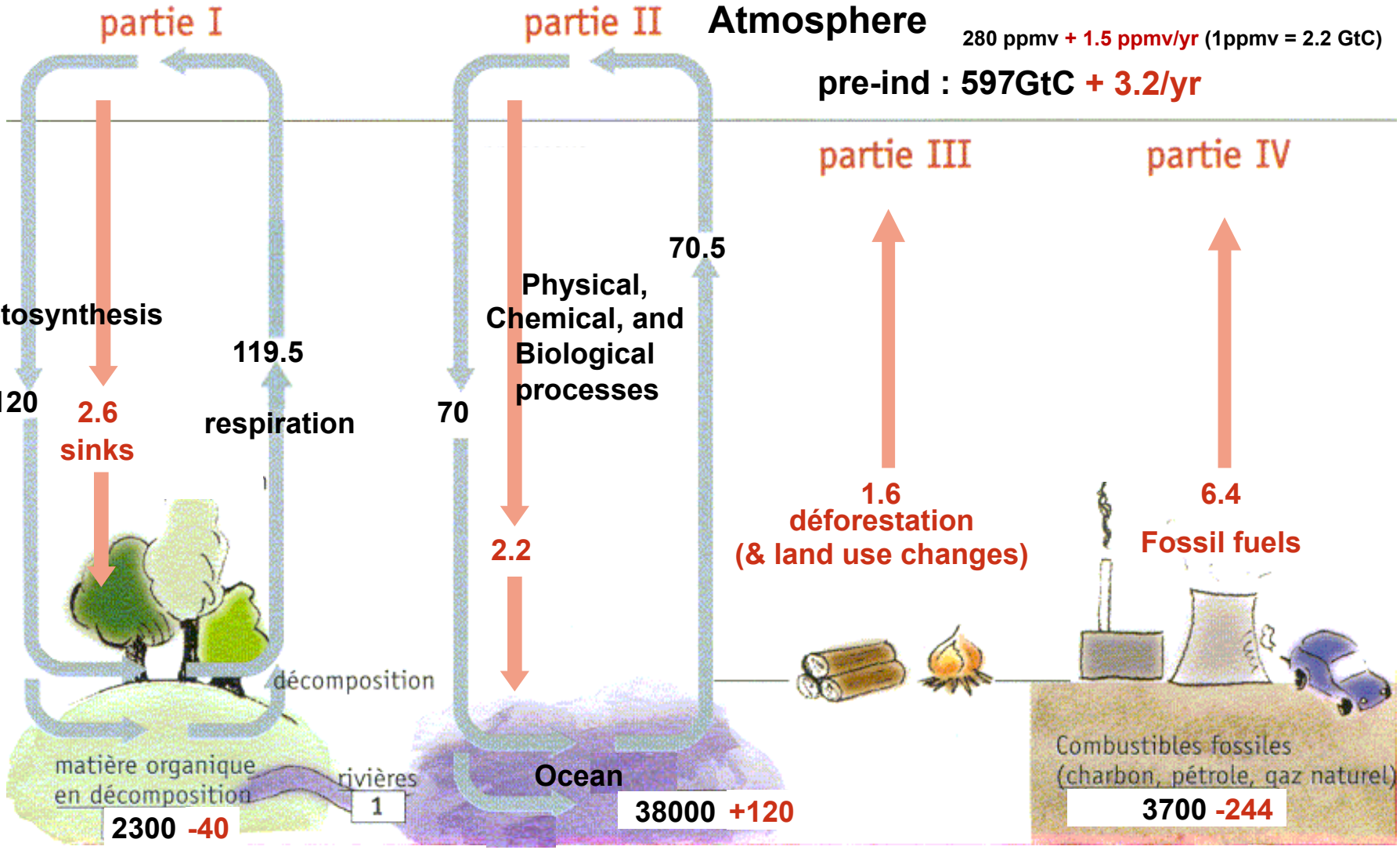


Units: GtC (billions tons of carbon) or GtC/year (multiply by 3.7 to get $GtCO_2$)

vanyp@climate.be

Carbon cycle: perturbed by human activities

(numbers for the decade 1990-1999s, based on IPCC AR4)



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

Stocks!

vanyp@climate.be

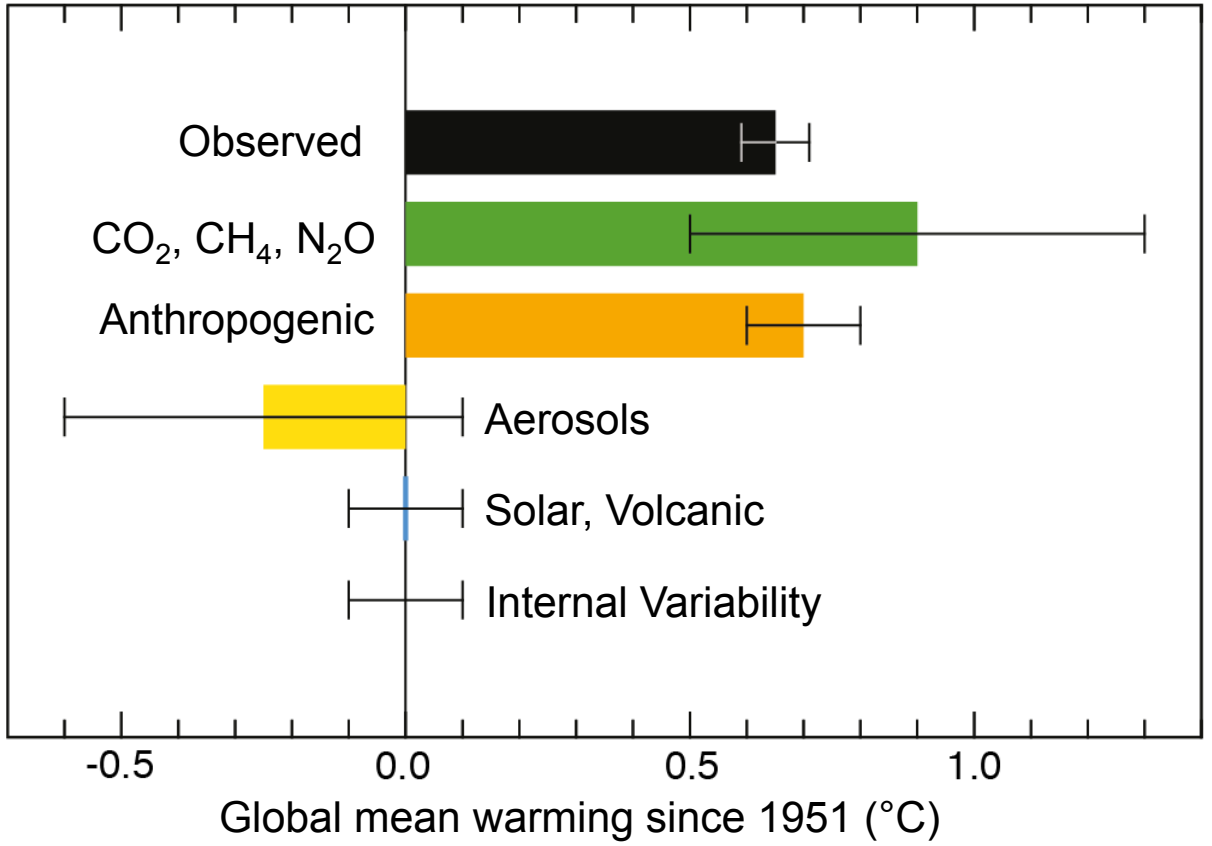
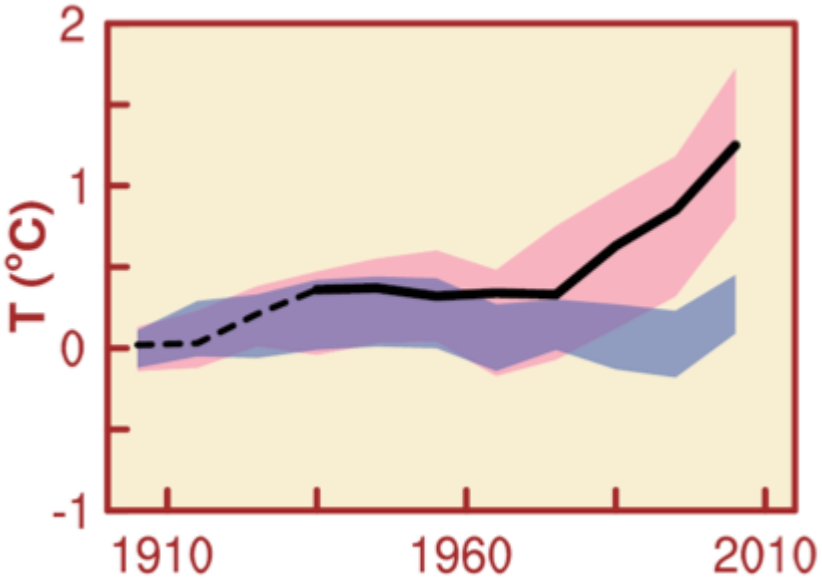
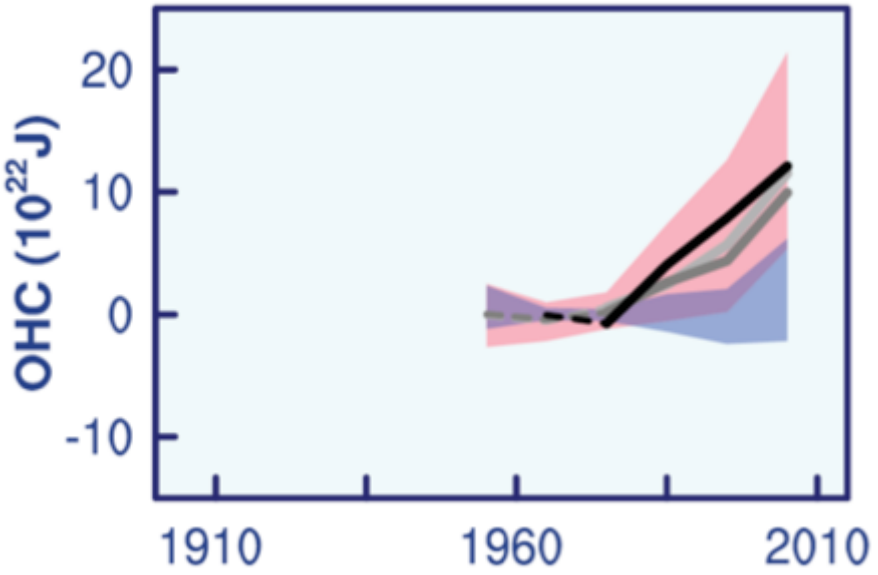


Fig. TS.10

Human influence on the climate system is clear.

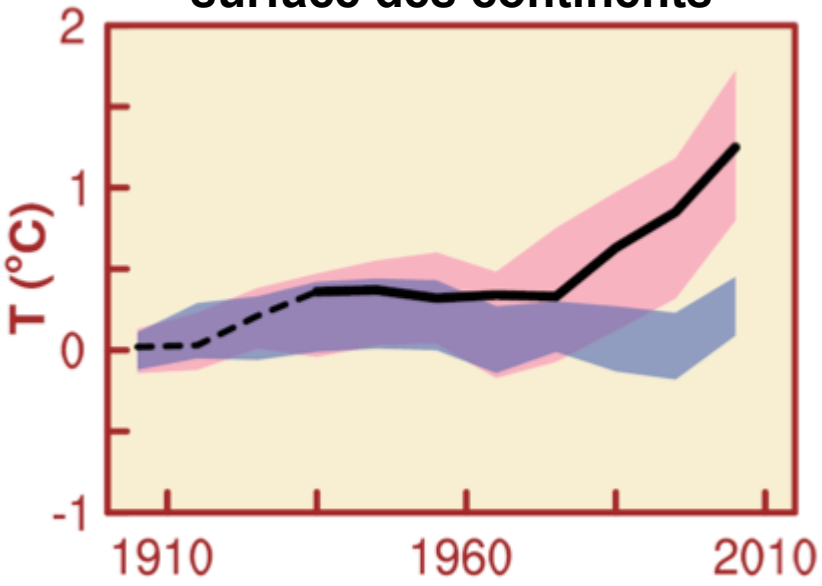




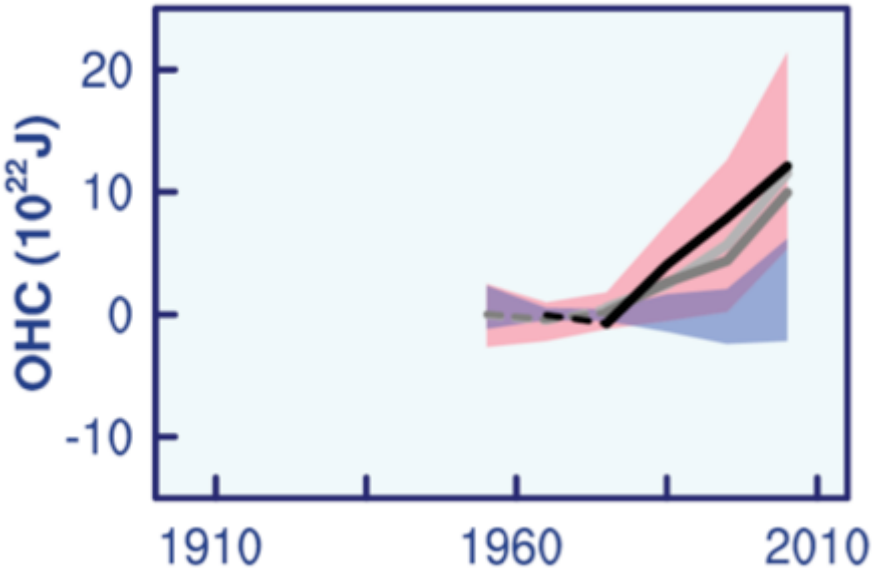
(IPCC 2013, Fig. SPM.6)

Human influence on the climate system is clear

Température moyenne surface des continents



Contenu thermique des océans



(IPCC 2013, Fig. SPM.6)

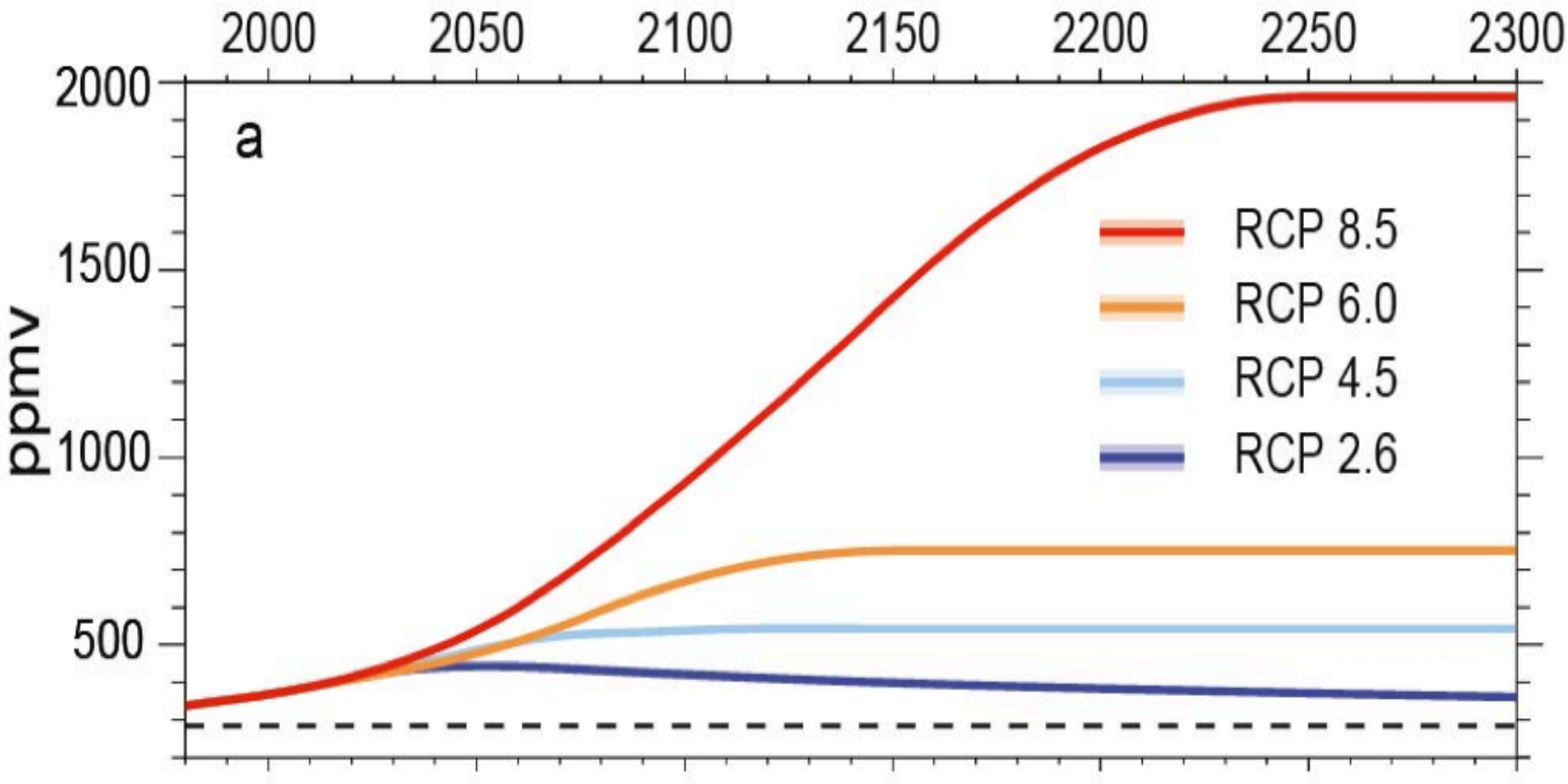
Noir: observations

Bleu: simulations avec seuls facteurs naturels

Rose: simulations avec facteurs naturels & humains

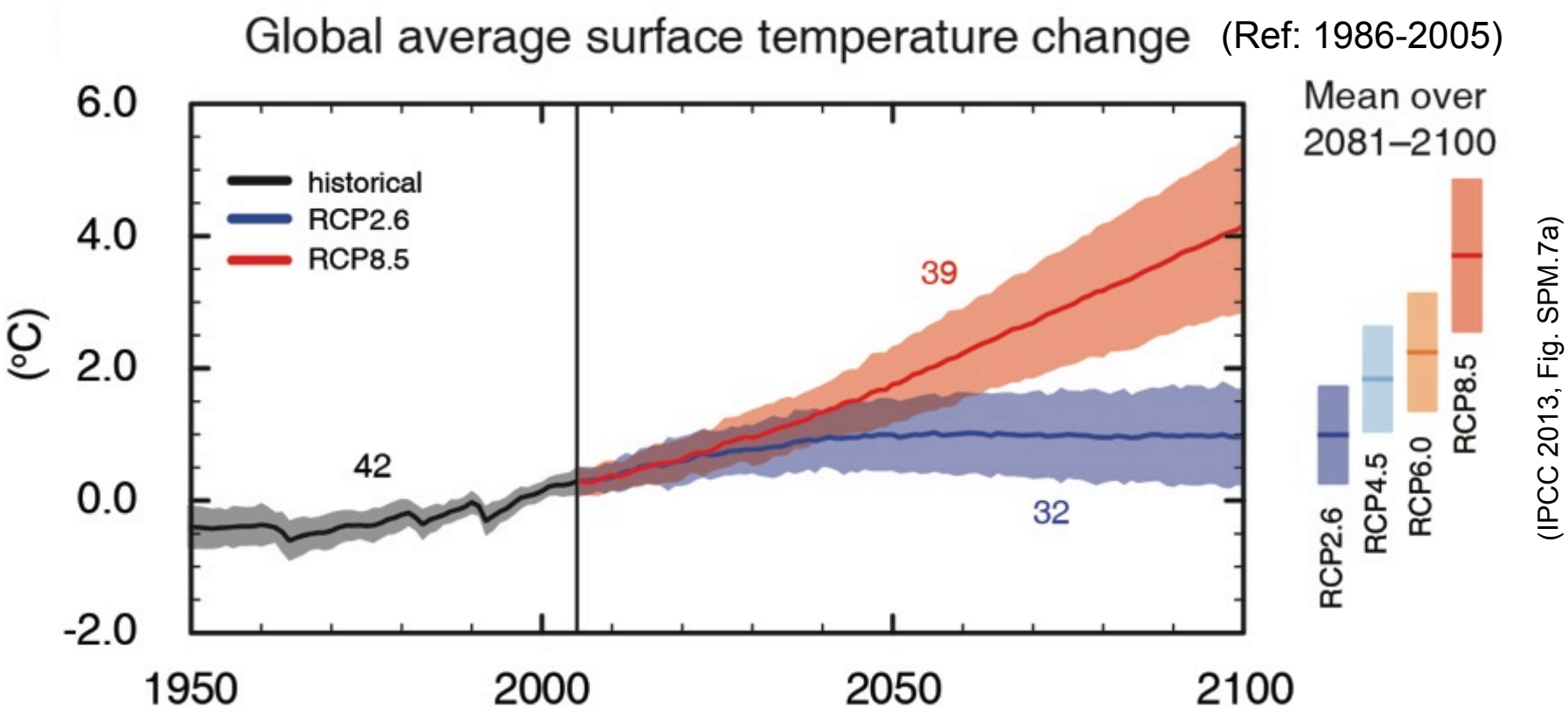
L'influence humaine sur le système climatique est sans équivoque; Il est *extrêmement probable* (95%) que l'influence humaine a été la cause principale du réchauffement depuis le milieu du 20ème siècle

RCP Scenarios: Atmospheric CO_2 concentration



Three stabilisation scenarios: RCP 2.6 to 6
One Business-as-usual scenario: RCP 8.5

AR5, chapter 12. WGI- Adopted version / subject to final copyedit



Le changement de la température moyenne du globe en surface pour la fin du XXI^e^ siècle dépassera *probablement* 1,5°C relativement à 1850-1900 pour tous les scénarios sauf pour le RCP2.6.
Dépassement *probable* de 2°C pour RCP6 et RCP8.5

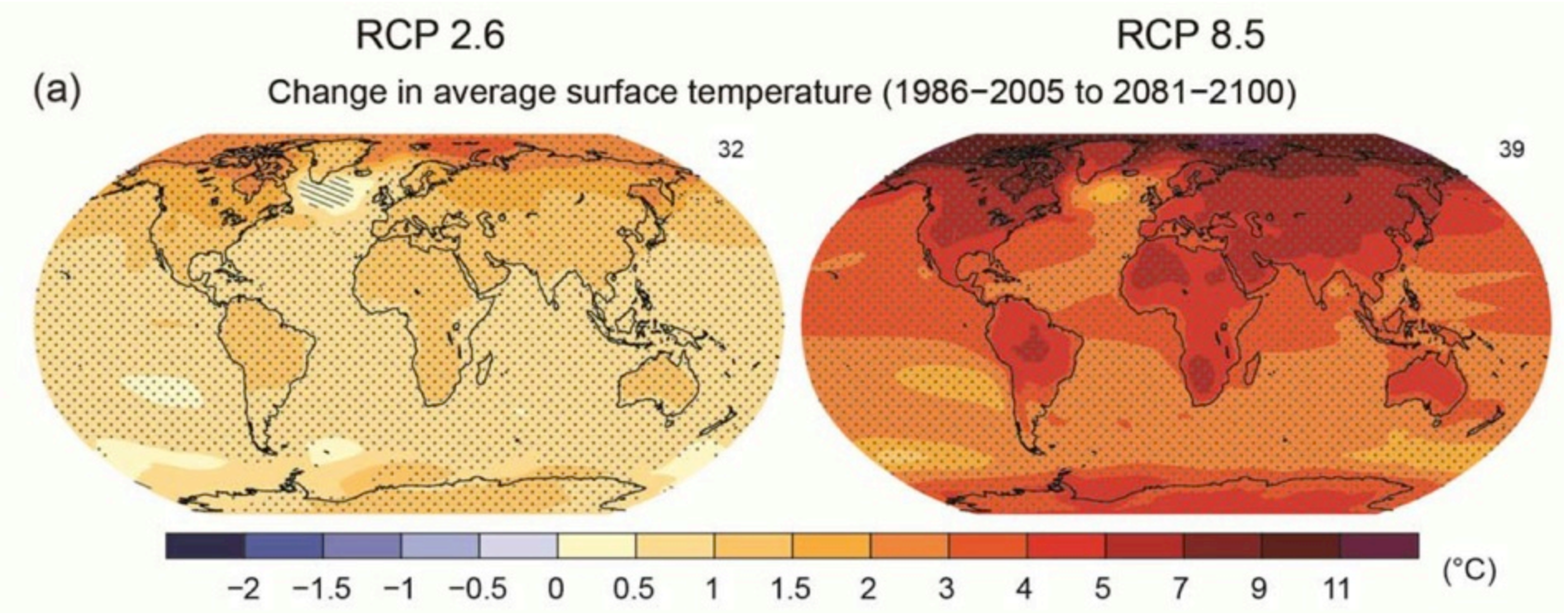
Global mean surface temperature change projections

Increase from end of 20th century to end of 21st century

	mean	likely range
RCP2.6	1.0	0.3 to 1.7
RCP4.5	1.8	1.1 to 2.6
RCP6	2.2	1.4 to 3.1
RCP8.5	3.7	2.6 to 4.8

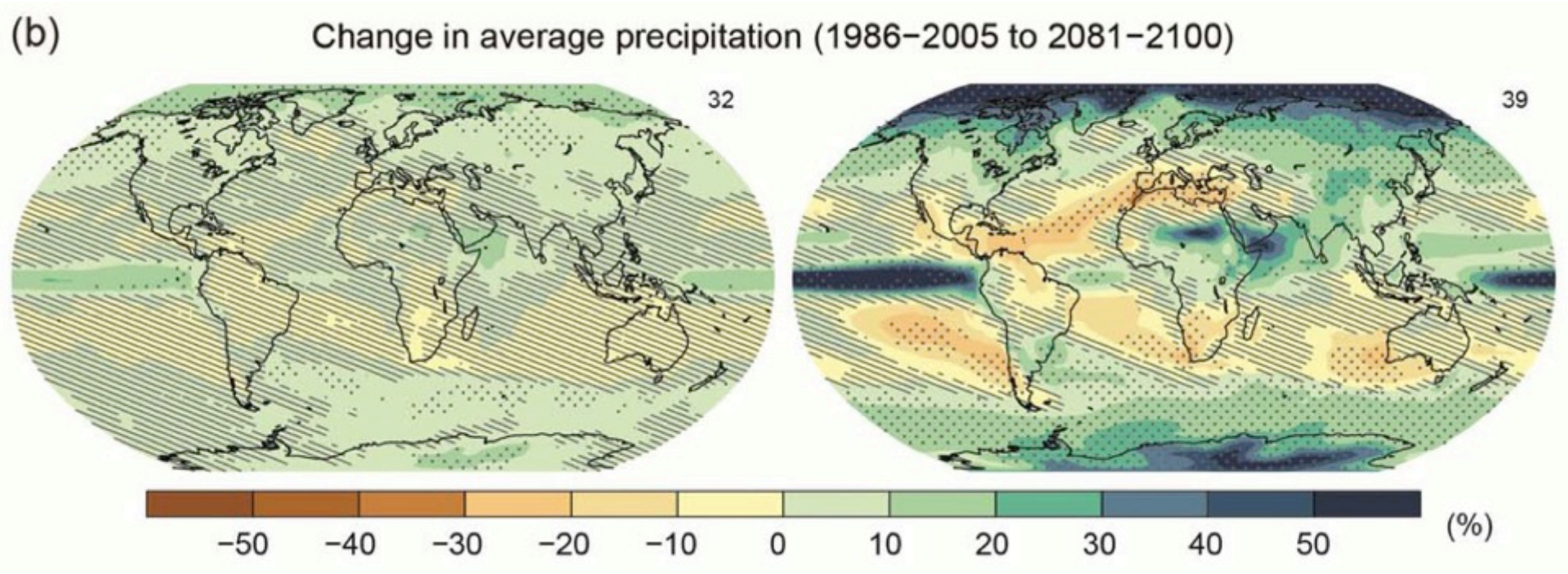
(°C)

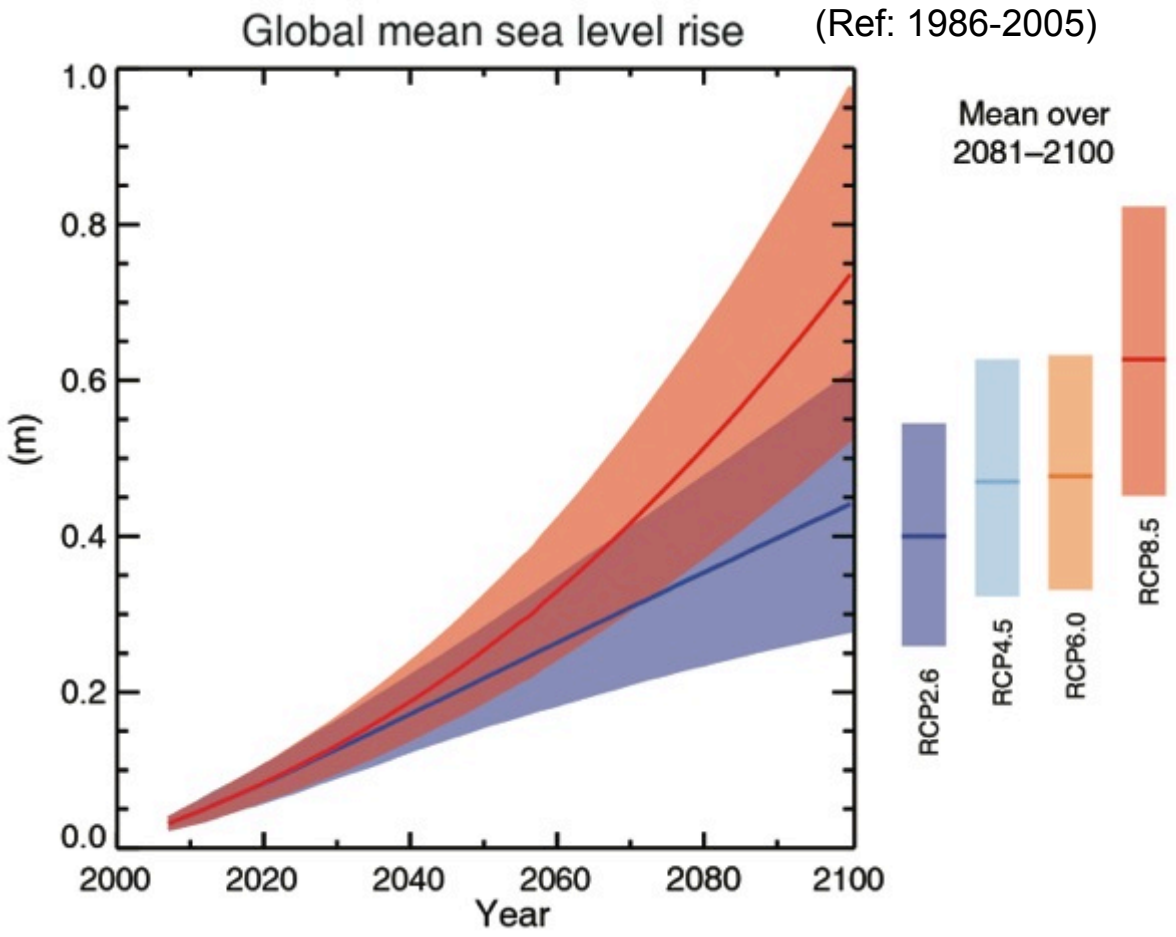
Surface temperature projections



AR5 WGI SPM - Approved version / subject to final copyedit

Precipitation projections



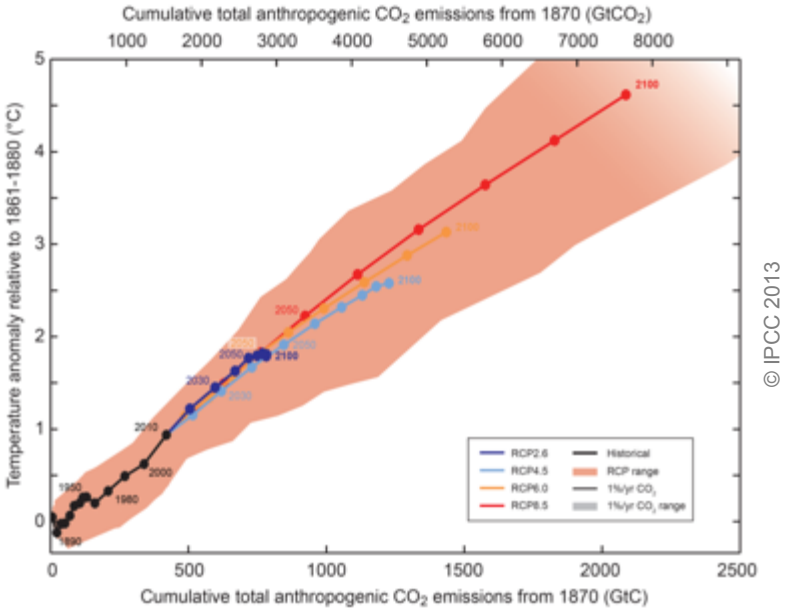


(IPCC 2013, Fig. SPM.9)

Le niveau moyen des mers continuera à s'élever au cours du XXIe siècle

Since 1950, extreme hot days and heavy precipitation have become more common

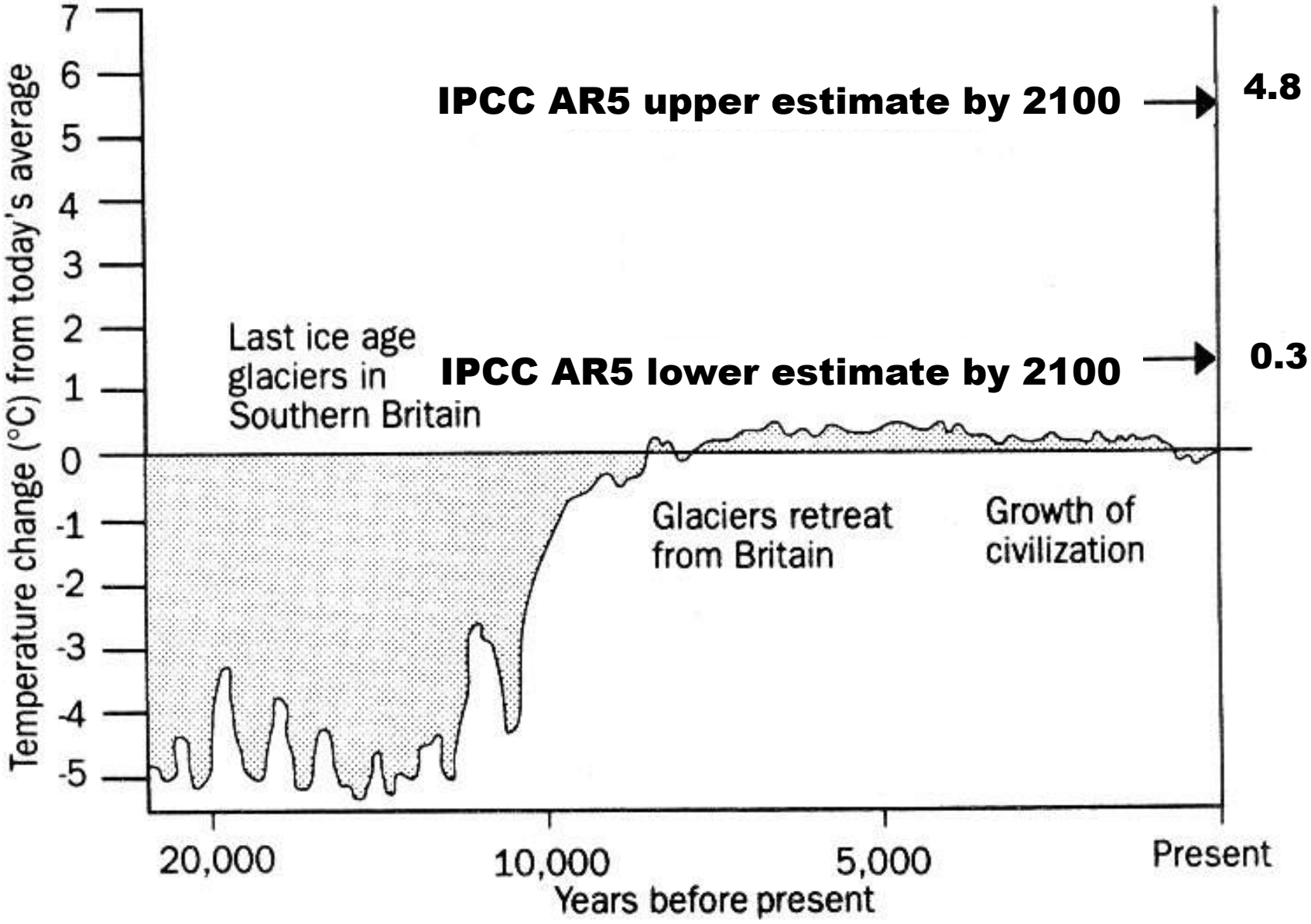
There is evidence that anthropogenic influences, including increasing atmospheric greenhouse gas concentrations, have changed these extremes



Limiting warming to *likely* less than 2°C since 1861-1880 requires cumulative CO_2 emissions to stay below 1000 GtC. Until 2011, over 50% of this amount has been emitted.

Accounting for other forcings, the upper amount of cumulative CO_2 emissions is 800 GtC; over 60% have been emitted by 2011.

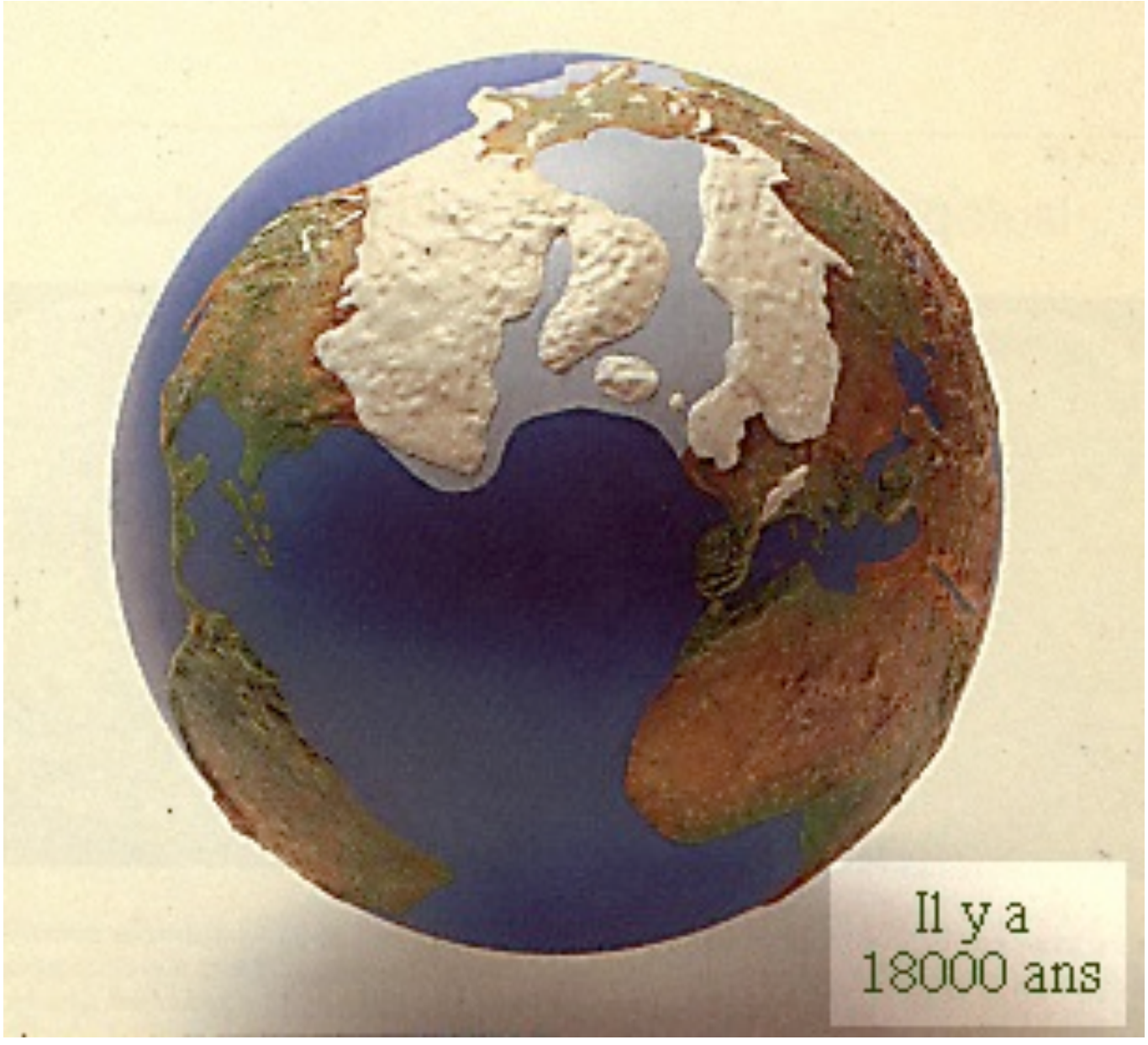
What are the risks?



Adapted from: International Geosphere Biosphere Programme Report no.6, Global Changes of the Past, July1988

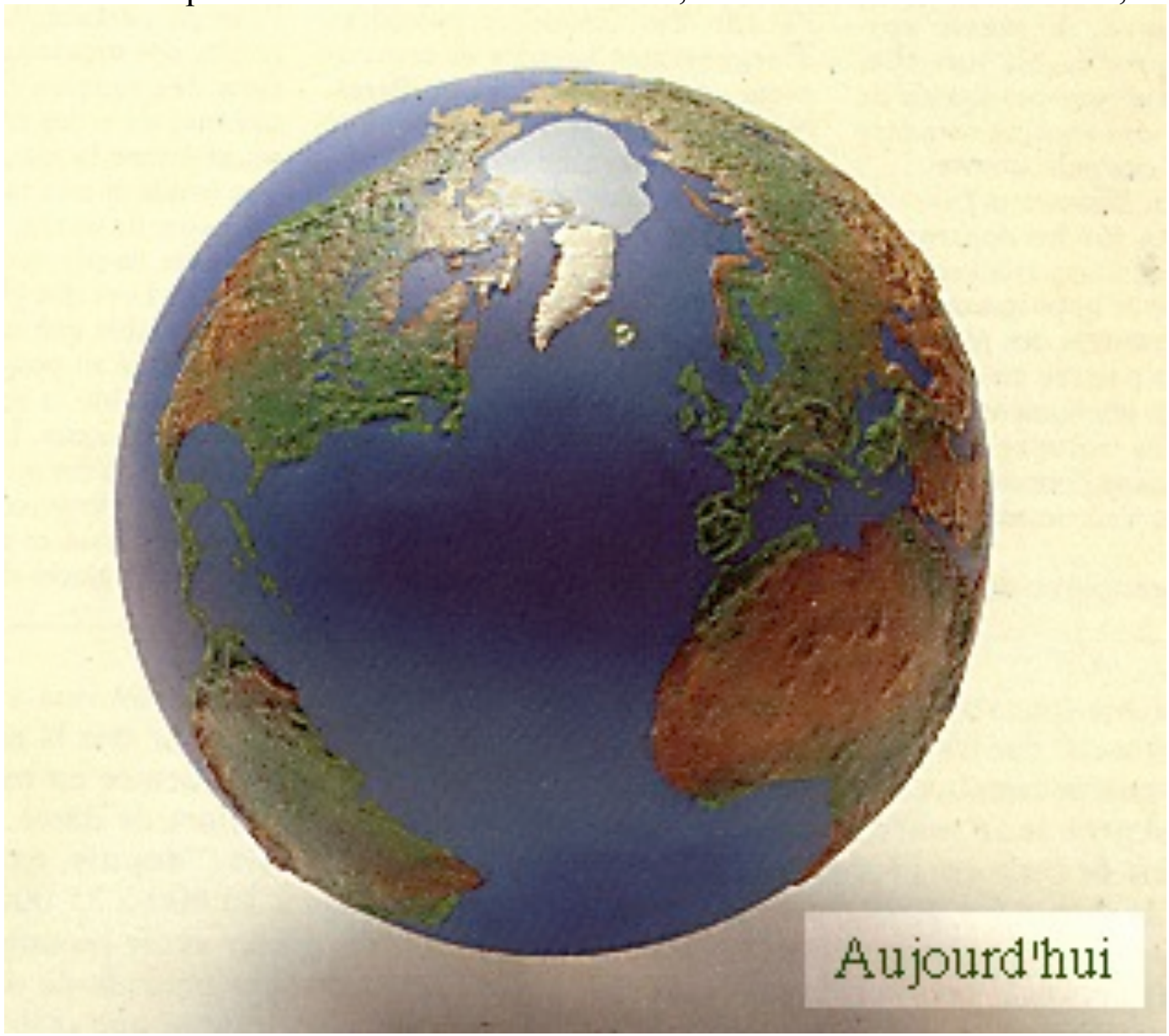
18-20000 years ago (Last Glacial Maximum)

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.



Today, with +4-5°C globally

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.




VULNERABILITY
AND EXPOSURE
AROUND THE WORLD
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WIDESPREAD
OBSERVED IMPACTS
A CHANGING WORLD
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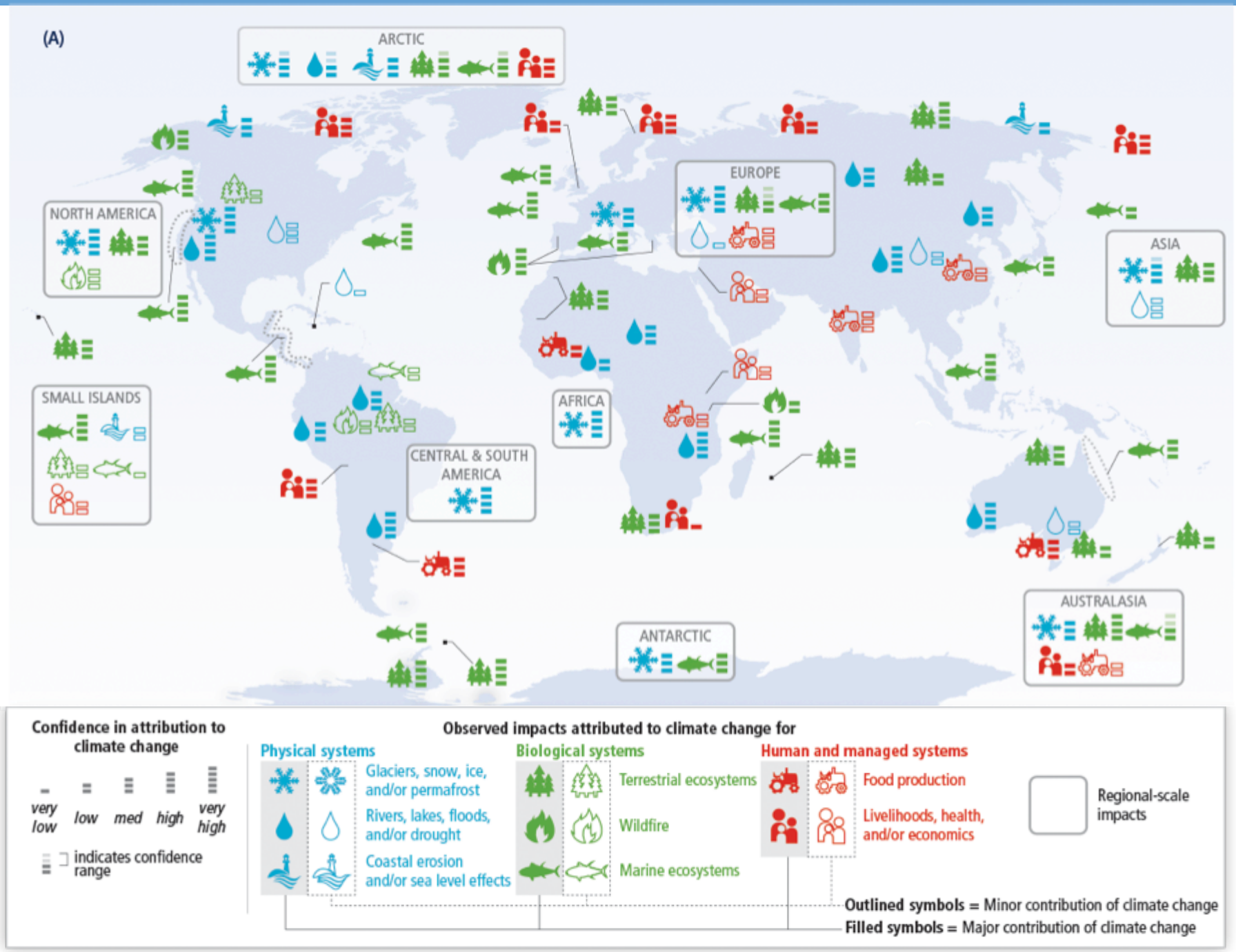
(A)
ARCTIC
NORTH AMERICA
EUROPE
ASIA
SMALL ISLANDS
AFRICA
CENTRAL & SOUTH AMERICA
AUSTRALASIA
ANTARCTIC
Confidence in attribution to climate change
very low
low
med
high
very high
indicates confidence range
Observed impacts attributed to climate change for
Physical systems
Glaciers, snow, ice, and/or permafrost
Rivers, lakes, floods, and/or drought
Coastal erosion and/or sea level effects
Biological systems
Terrestrial ecosystems
Wildfire
Marine ecosystems
Human and managed systems
Food production
Livelihoods, health, and/or economics
Regional-scale impacts
Outlined symbols = Minor contribution of climate change
Filled symbols = Major contribution of climate change


RB Chemnitz Hbf


ADAPTATION IS
ALREADY OCCURRING
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INCREASING MAGNITUDES
OF WARMING INCREASE
THE LIKELIHOOD OF
SEVERE AND
PERVASIVE IMPACTS
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RISKS OF
CLIMATE CHANGE
INCREASE
WITH CONTINUED
HIGH EMISSIONS
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What can be done?

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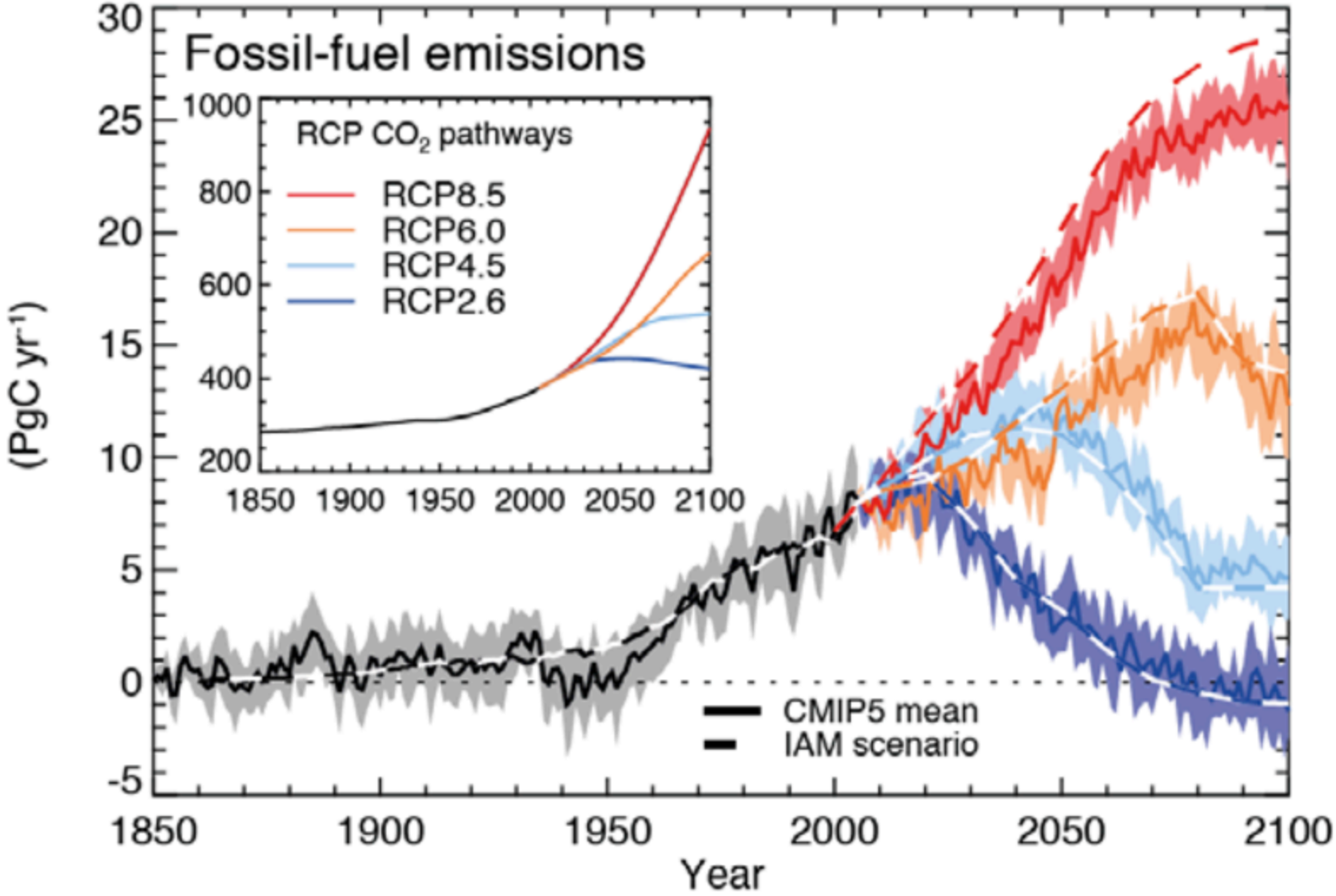
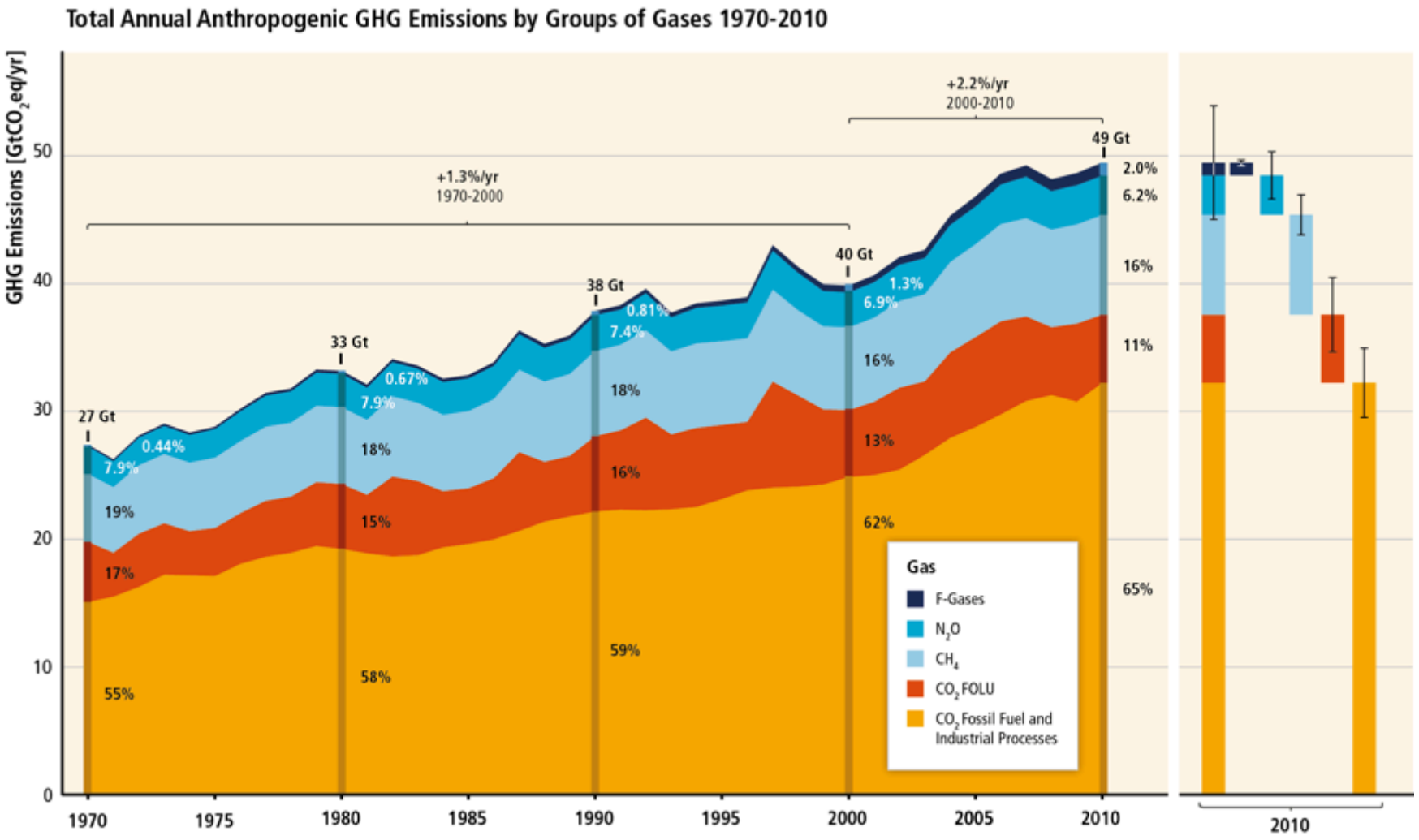
WMO UNEP

Compatible fossil fuel emissions simulated by the CMIP5 models for the four RCP scenarios



AR5 WGI TS – Fig TS 19

GHG emissions accelerate despite reduction efforts. Most emission growth is CO_2 from fossil fuel combustion and industrial processes.



Working Group III contribution to the
IPCC Fifth Assessment Report

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

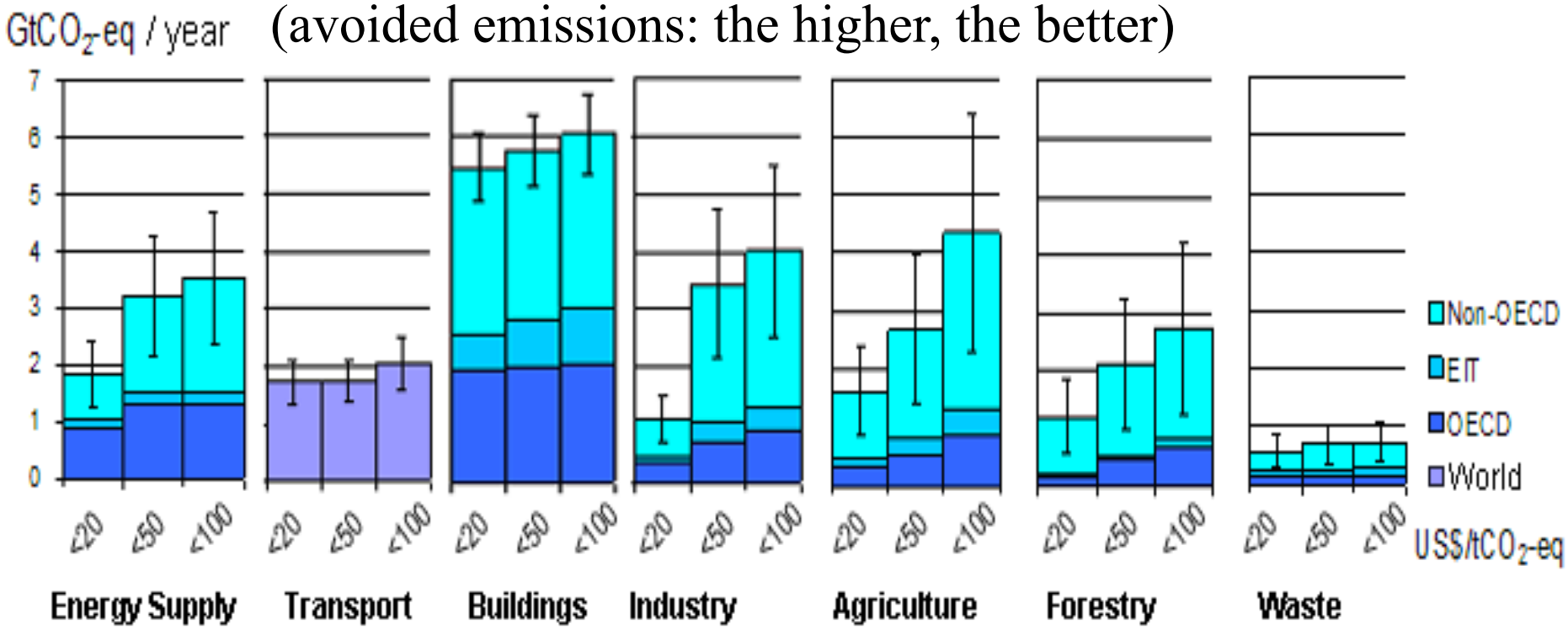
Can temperature rise still be kept below 1.5 or 2°C (over the 21st century) compared to pre-industrial ?

- **Many scenario studies confirm that it is technically and economically feasible to keep the warming below 2°C, with more than 66% probability ("likely chance").** This would imply limiting atmospheric concentrations to 450 ppm CO_2-eq by 2100.
- **Such scenarios** for an above 66% chance of staying below 2°C **imply reducing by 40 to 70% global GHG emissions compared to 2010 by mid-century, and reach zero or negative emissions by 2100.**

Can temperature rise still be kept below 1.5 or 2°C (over the 21st century) compared to pre-industrial ?

- **These scenarios are characterized by rapid improvements of energy efficiency and a near quadrupling of the share of low-carbon energy supply (renewables, nuclear, fossil and bioenergy with CCS), so that it reaches 60% by 2050.**
- **Keeping global temperature increase below 1.5°C would require even lower atmospheric concentrations (<430 ppm CO_2eq) to have a little more than 50% chance.** There are not many scenario studies available that can deliver such results, **requiring even faster reductions** in the medium term, indicating how difficult this is.

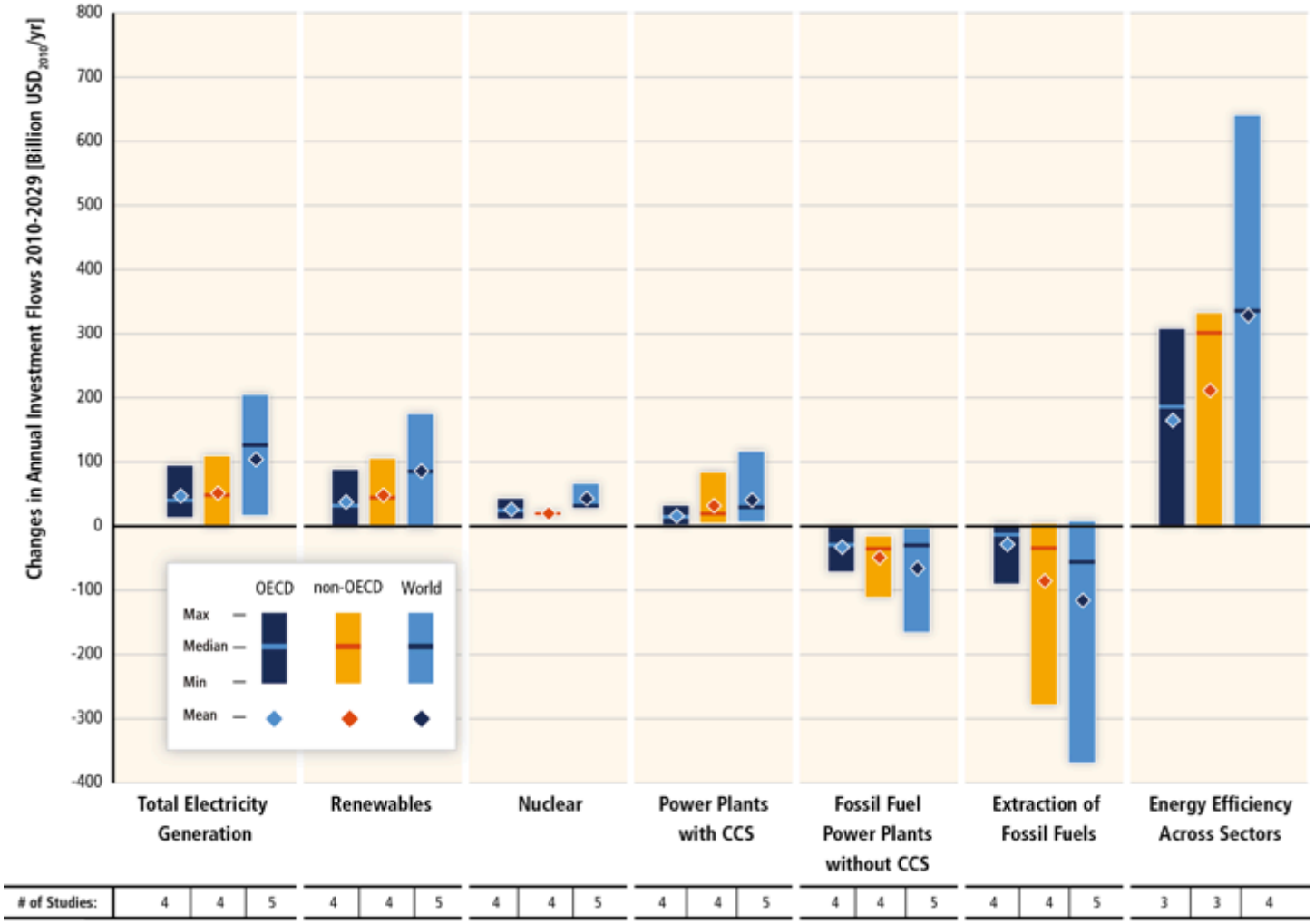
All sectors and regions have the potential to contribute by 2030



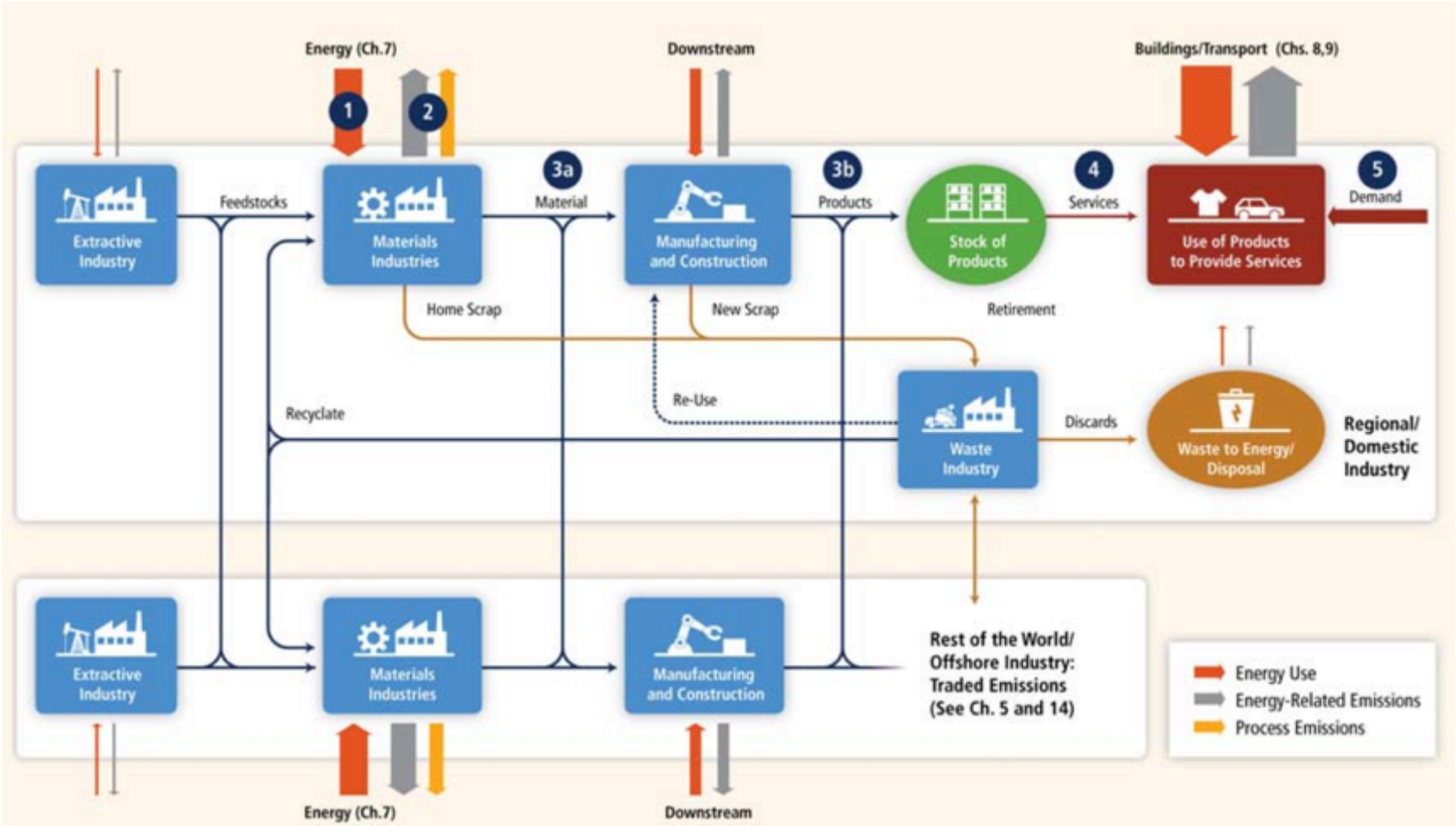
IPCC AR4 (2007)

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

Substantial reductions in emissions would require large changes in investment patterns.



A schematic illustration of industrial activity over the supply chain



AR5 (2014), WGIII, TS.25

Overview of potential co-benefits (green arrows) and adverse side-effects (orange arrows) of the main mitigation measures in the industry sector

Industry	Effect on additional objectives/concerns			
	Economic	Social	Environmental	Other
	For possible upstream effects of low-carbon energy supply (incl CCS), see Table TS.3. *For possible upstream effects of biomass supply, see Table TS.7.*			
CO_2/non-CO_2 emission intensity reduction	↑ Competitiveness and productivity (**m/h**)	↓ Health impact via reduced local air pollution and better work conditions (PFC from aluminium) (**m/m**)	↓ Ecosystem impact via reduced local air pollution and reduced water pollution (**m/m**) ↑ Water conservation (**l/m**)	
Energy efficiency improvements via new processes/technologies	↑ Energy security (lower energy intensity)(**m/m**) ↑ Employment impact (**l/l**) ↑ Competitiveness and productivity (**m/h**) ↑ Technological spillovers in DCs (due to supply chain linkages) (**l/l**)	↓ Health impact via reduced local pollution (**l/m**) ↑ New business opportunities (**m/m**) ↑ Water availability and quality (**l/l**) ↑ Safety, working conditions and job satisfaction (**m/m**)	Ecosystem impact via: ↓ Fossil fuel extraction (**l/l**) ↓ Local pollution and waste (**m/m**)	
Material efficiency of goods, recycling	↓ National sales tax revenue (medium term) (**l/l**) ↑ Employment impact (waste recycling) (**l/l**) ↑ Competitiveness in manufacturing (**l/l**) ↑ New infrastructure for industrial clusters (**l/l**)	↓ Health impacts and safety concerns (**l/m**) ↑ New business opportunities (**m/m**) ↓ Local conflicts (reduced resource extraction) (**l/m**)	↓ Ecosystem impact via reduced local air and water pollution and waste material disposal (**m/m**) ↓ Use of raw/virgin materials and natural resources implying reduced unsustainable resource mining (**l/l**)	
Product demand reductions	↓ National sales tax revenue (medium term) (**l/l**)	↓ Local conflicts (reduced inequity in consumption)(**l/l**) ↑ New diverse lifestyle concept (**l/l**)	↓ Post-consumption waste (**l/l**)	

ipcc INTERGOVERNMENTAL PANEL ON climate change

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AR5 (2014), WGIII, Table TS.6

Overview of potential co-benefits (green arrows) and adverse side-effects (orange arrows) of the main mitigation measures in the industry sector

Material efficiency of goods, recycling	↓ National sales tax revenue (medium term) (**l/l**) ↑ Employment impact (waste recycling) (**l/l**) ↑ Competitiveness in manufacturing (**l/l**) ↑ New infrastructure for industrial clusters (**l/l**)	↓ Health impacts and safety concerns (**l/m**) ↑ New business opportunities (**m/m**) ↓ Local conflicts (reduced resource extraction) (**l/m**)	↓ Ecosystem impact via reduced local air and water pollution and waste material disposal (**m/m**) ↓ Use of raw/virgin materials and natural resources implying reduced unsustainable resource mining (**l/l**)

AR5 (2014), WGIII, Table TS.6

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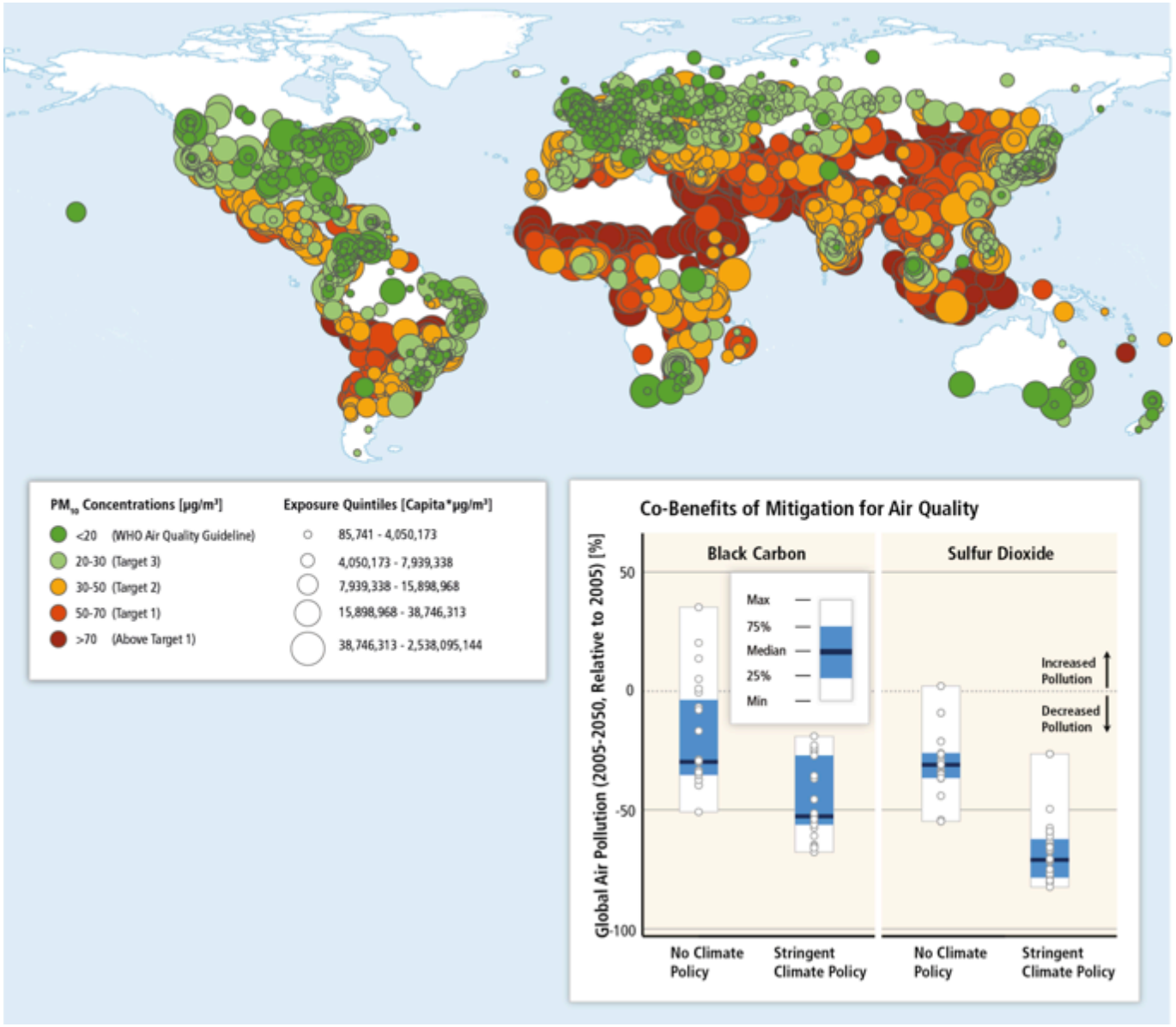
Material efficiency of goods, recycling	↓ National sales tax revenue (medium term) (**l/l**) ↑ Employment impact (waste recycling) (**l/l**) ↑ Competitiveness in manufacturing (**l/l**) ↑ New infrastructure for industrial clusters (**l/l**)	↓ Health impacts and safety concerns (**l/m**) ↑ New business opportunities (**m/m**) ↓ Local conflicts (reduced resource extraction) (**l/m**)	↓ Ecosystem impact via reduced local air and water pollution and waste material disposal (**m/m**) ↓ Use of raw/virgin materials and natural resources implying reduced unsustainable resource mining (**l/l**)

AR5 (2014), WGIII, Table TS.6



Mitigation can result in large co-benefits for human health and other societal goals.

Useful links:

- www.ipcc.ch : IPCC
- www.climate.be/vanyp : my slides and other documents
- www.skepticalscience.com: excellent responses to contrarians arguments
- **On Twitter: @JPvanYpersele**