

Climate Change and Fossil Fuel Depletion



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ASPO9, Brussels, 27-4-2011

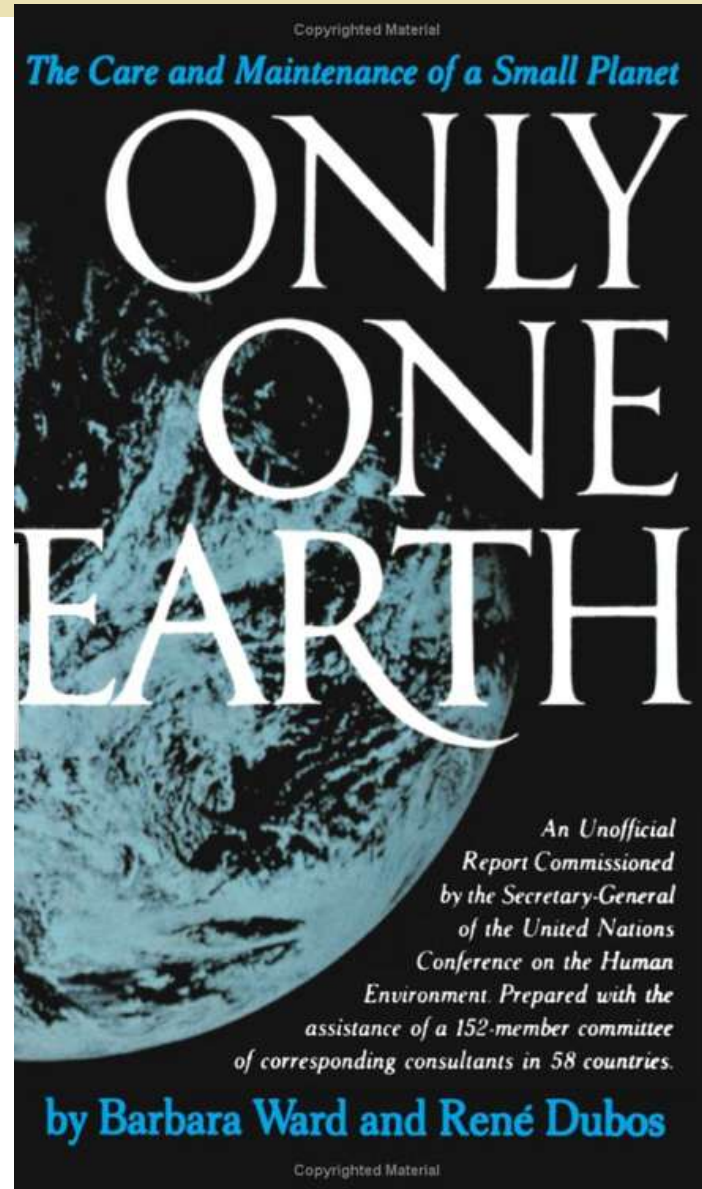
**NB: The support of the Belgian Science Policy
Office is gratefully acknowledged**

When was this written?

“... The sum of all likely fossil-fuel demands in the early decades of the [21st] century might ... greatly increase the emission of carbon dioxide into the atmosphere and by doing so bring up average surface temperature uncomfortably close to that rise of 2° C which might set in motion the long-term warming up of the planet.”



B. Ward & R. Dubos, 1972



B. Ward & R. Dubos,
*Only one Earth: the Care and
Maintenance of a Small Planet,*
New York, London:

W W Norton & Company, (1972) 1983

And this one, about fossil fuel?

“We cannot long maintain our present rate of increase of consumption . (...) The check to our progress must become perceptible within a century from the present time; that the cost of fuel must rise (...) and the conclusion is inevitable, that our present happy progressive condition is a thing of limited duration.” *William Stanley JEVONS (1866) « An inquiry concerning the progress of the nation and the probable exhaustion of our coal-mines » (see Google books).*

Outline



⌘ Climate Change

- ☑ Climate *is* changing

- ☑ IPCC

- ☑ WGI, II, and III AR4

⌘ (Fossil Fuel Depletion: not me!)

⌘ A few Links between CC & FFD

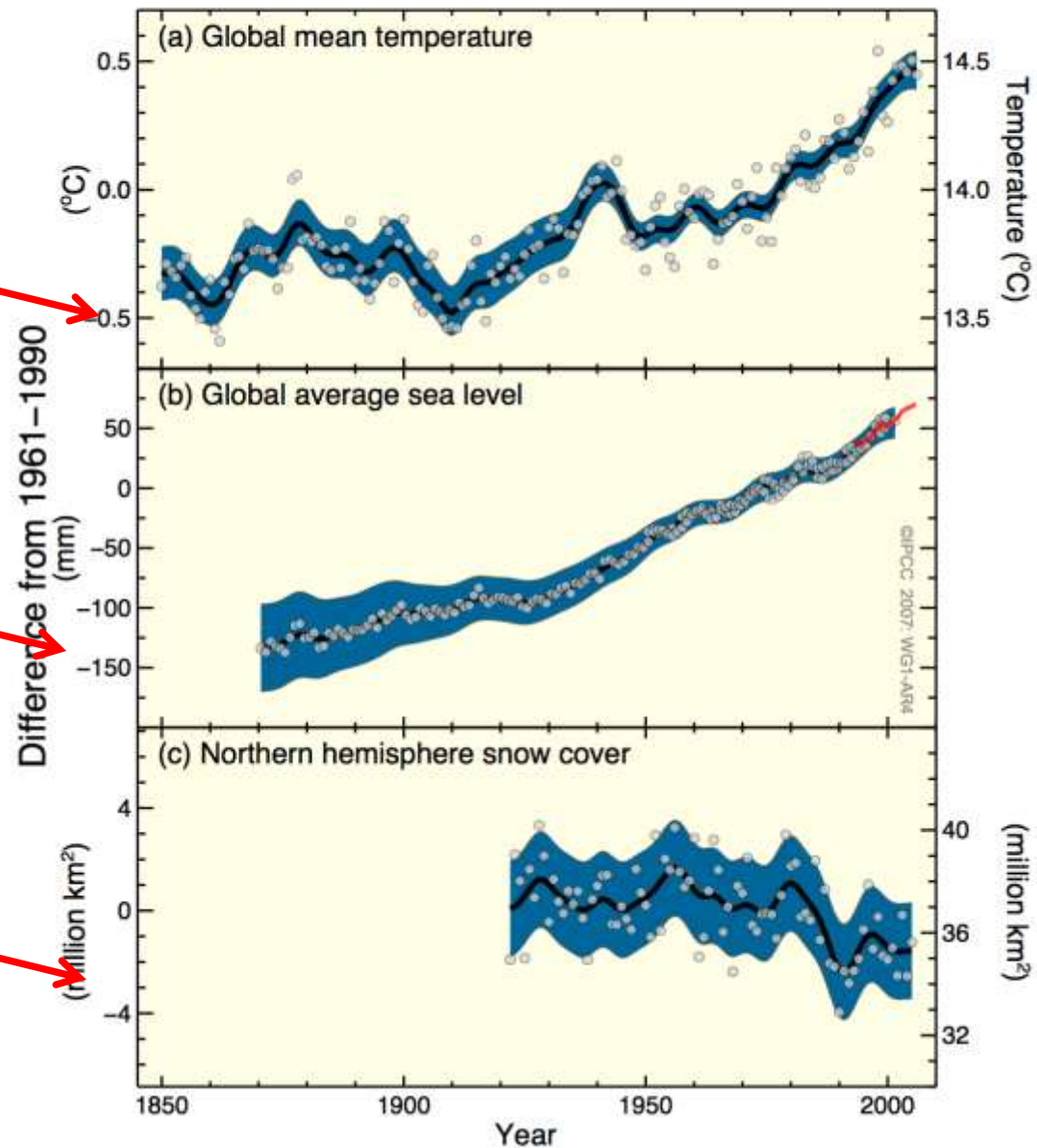
Warming is Unequivocal

Rising atmospheric temperature

Rising sea level

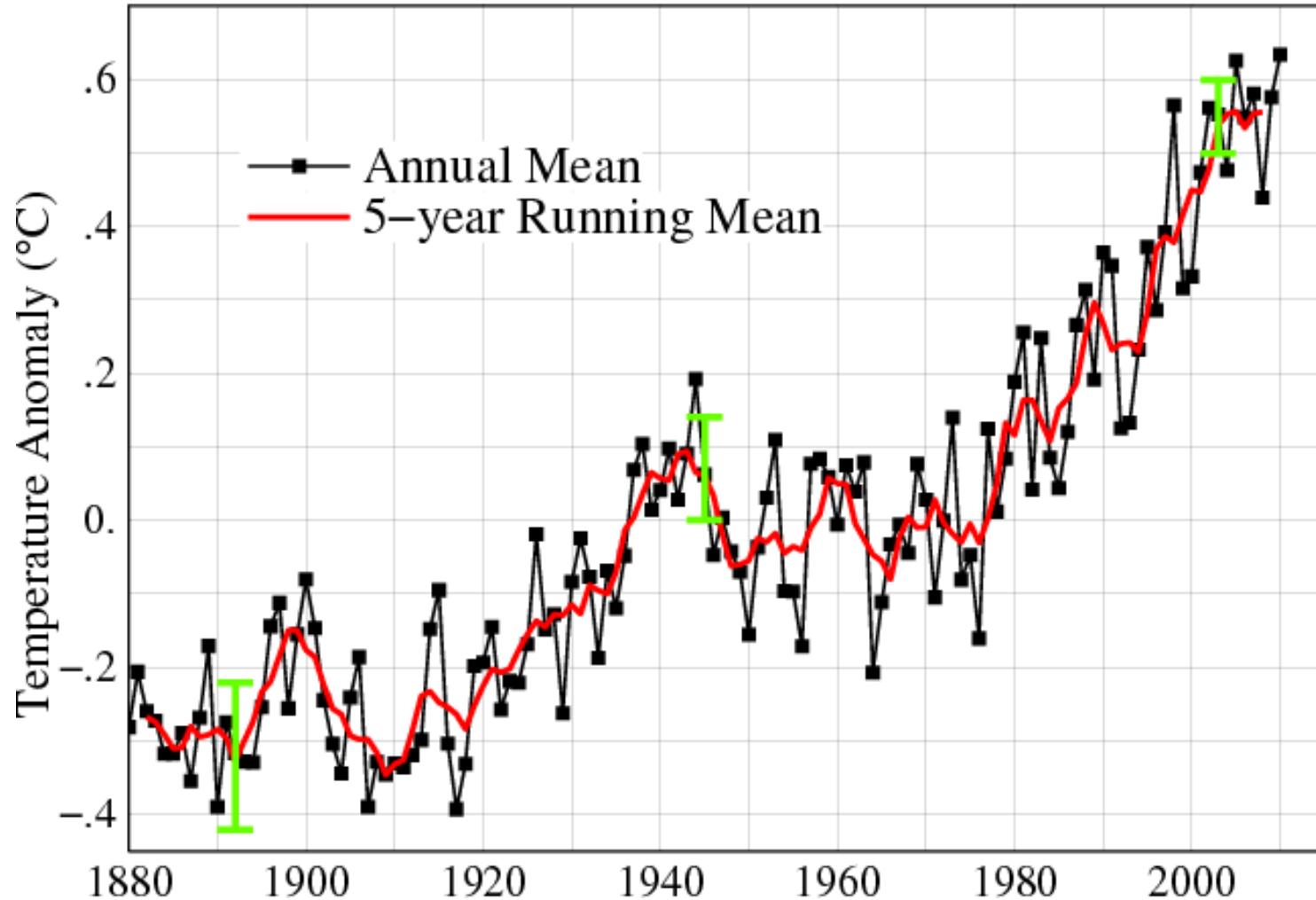
Reductions in NH snow cover

Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover



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

Global Land–Ocean Temperature Index



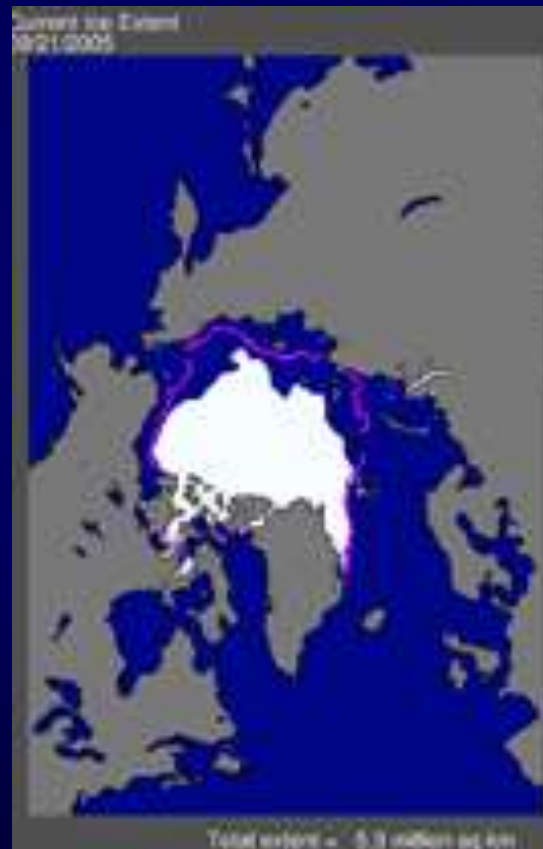
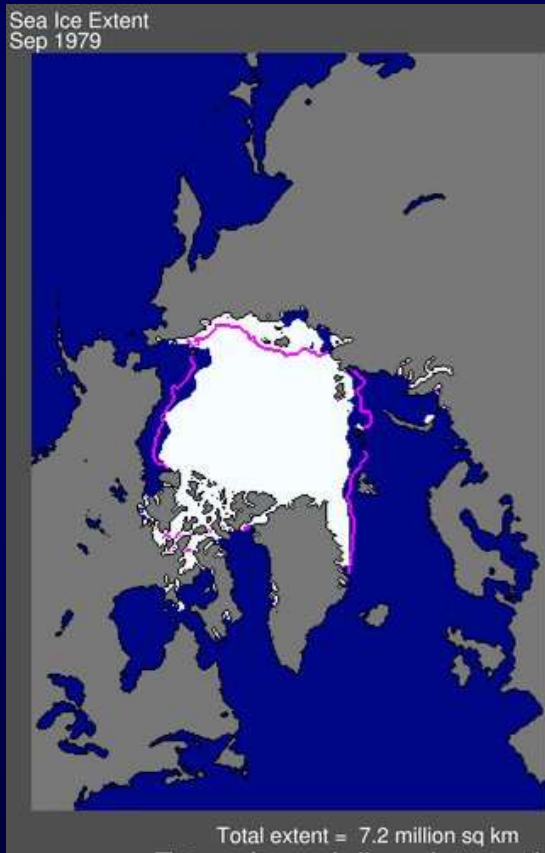
Source: NASA GISS

Extension of the Arctic ice cap

September 1979

September 2005

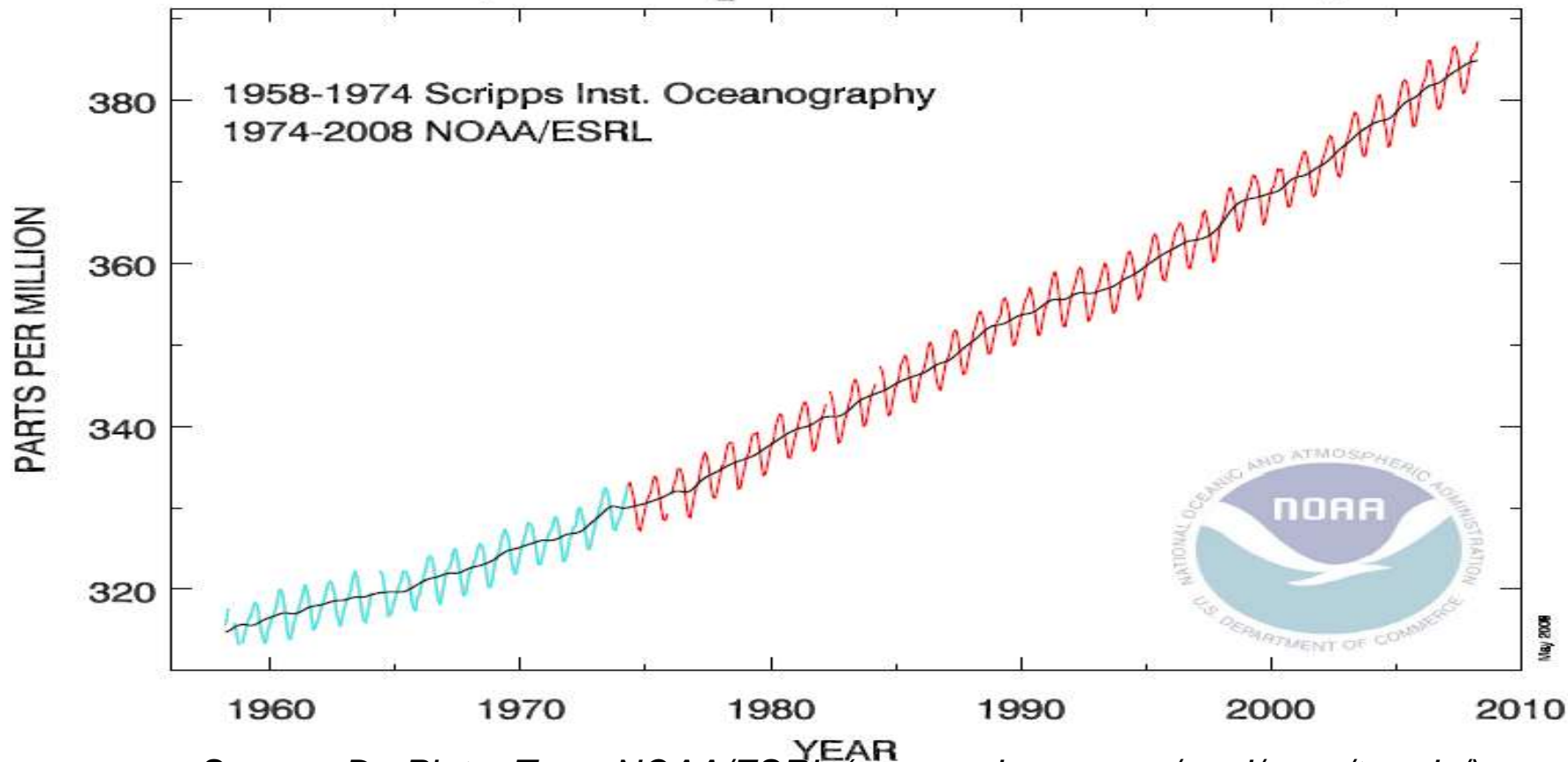
September 2007



The pink line indicates the average ice cap extension since 1979

CO₂ concentration measured at Mauna Loa (3400 m)

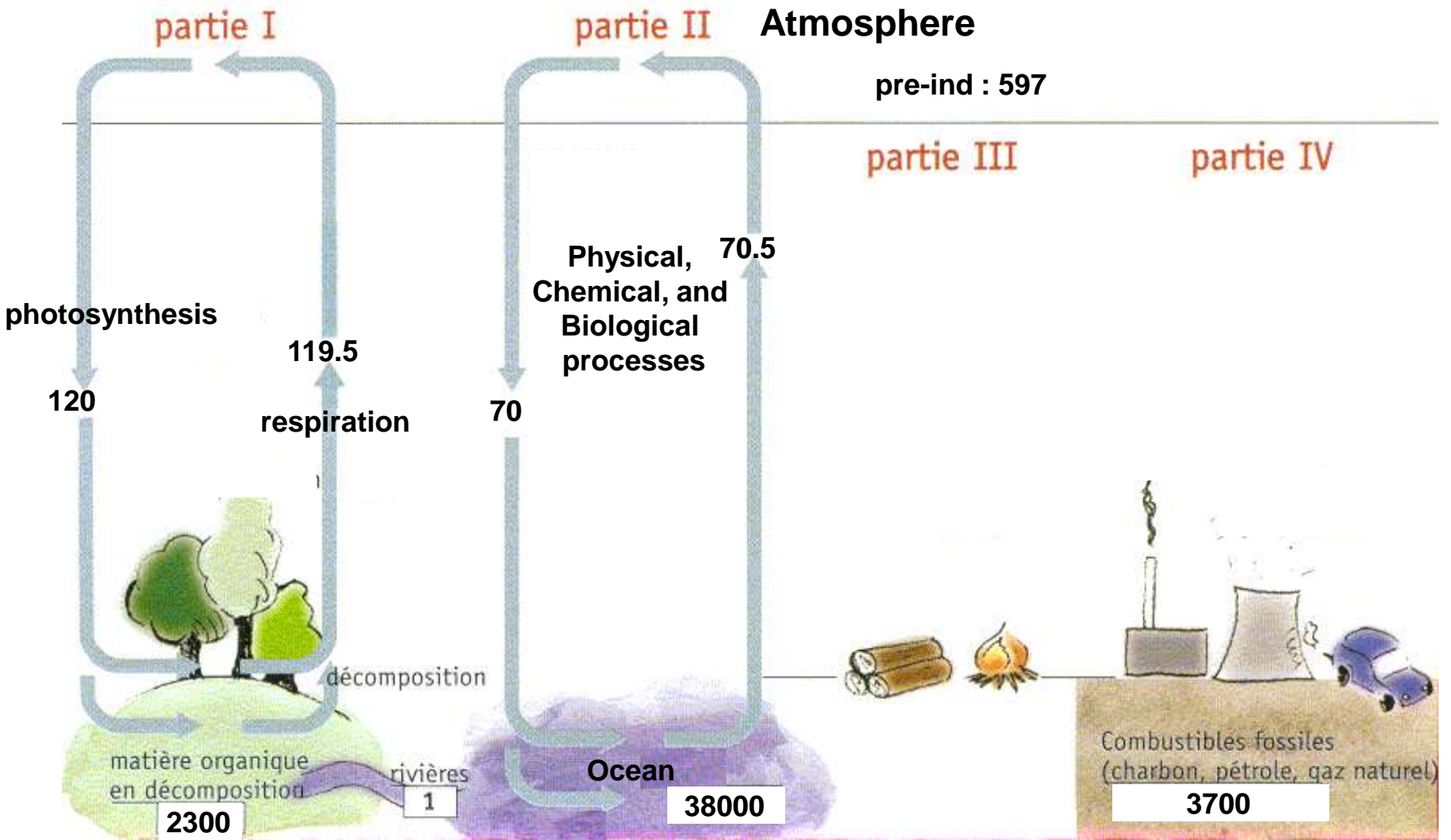
Atmospheric CO₂ at Mauna Loa Observatory



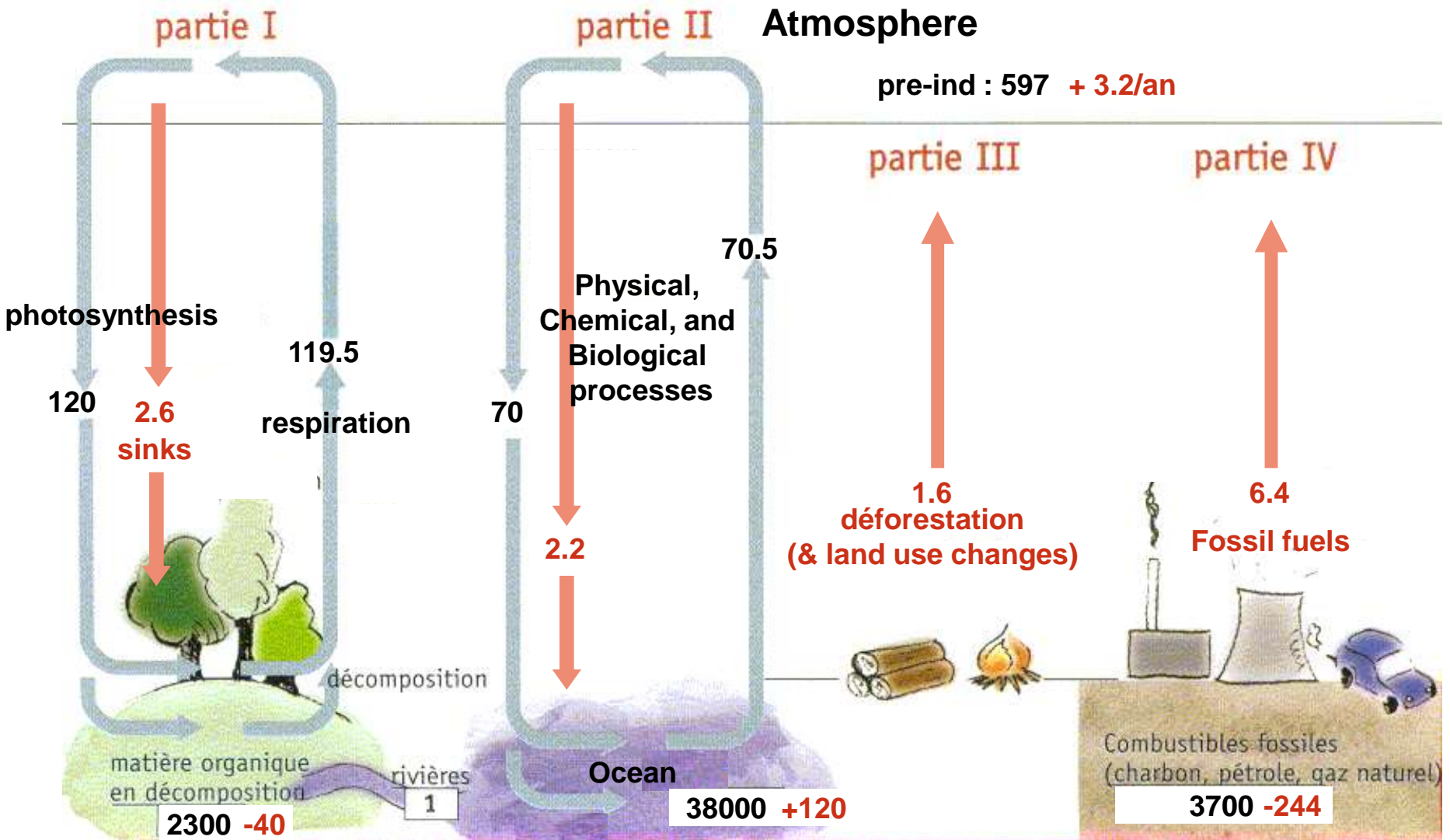
Source: Dr. Pieter Tans, NOAA/ESRL (www.esrl.noaa.gov/gmd/ccgg/trends/)

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Carbon cycle

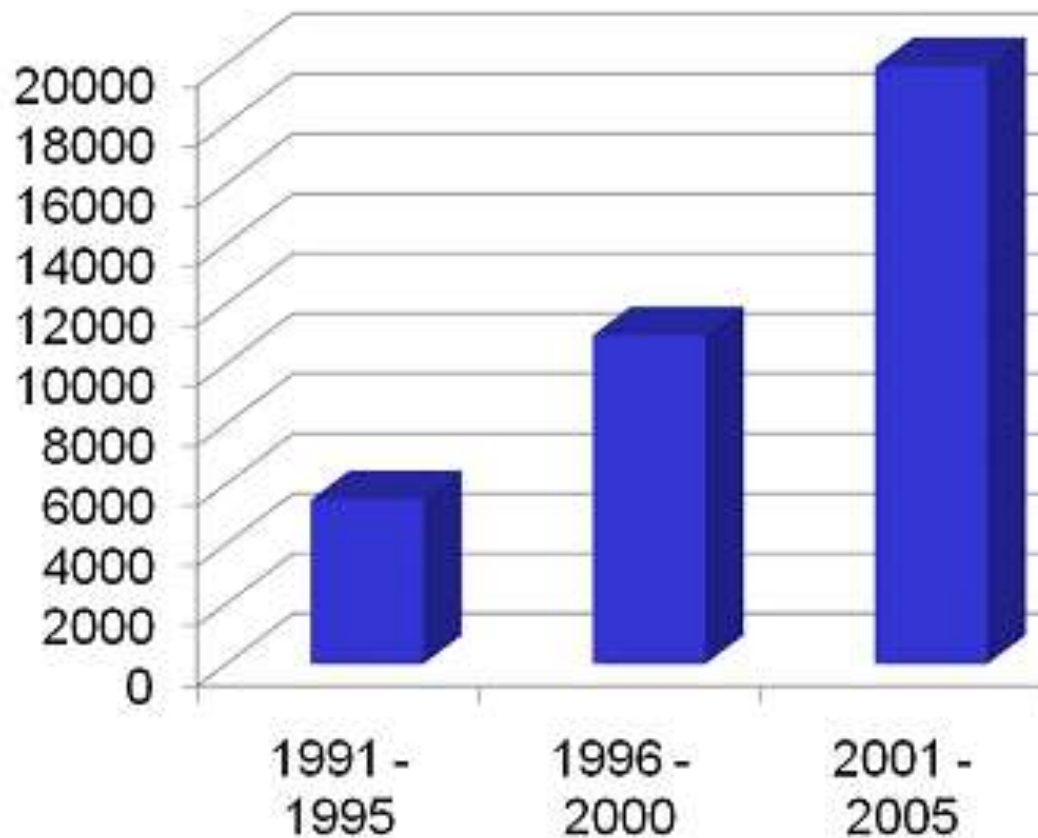


Carbon cycle



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

Number of papers published on climate change



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.



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>

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

Next IPCC Report
(published 9 May 2011)

**Special Report on Renewable
Energy Sources and Climate
Change Mitigation**



⌘ IPCC Working Group I: climatology

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Key points from the WG1 IPCC AR4 Report

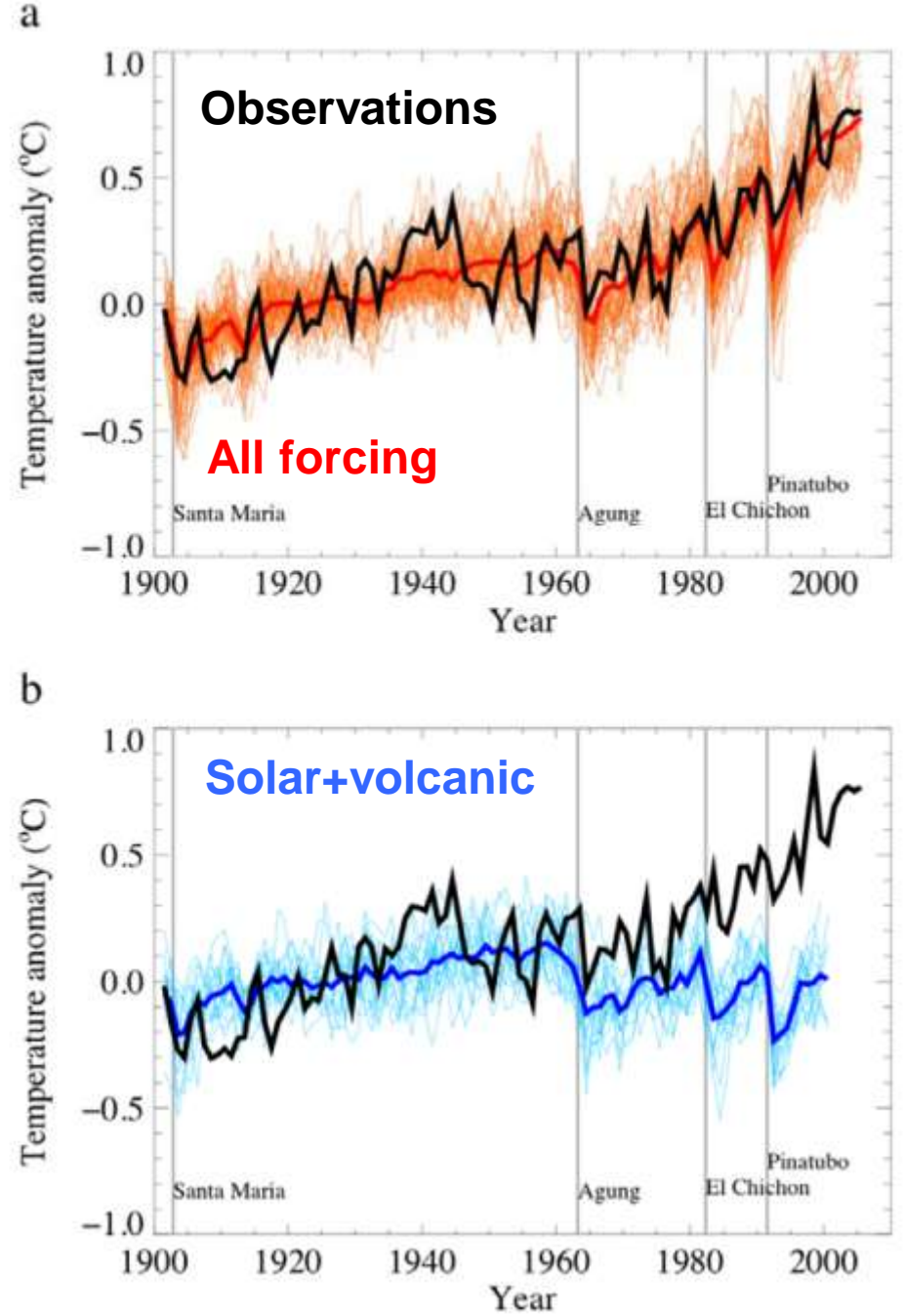


- ⌘ **Warming of the climate system is unequivocal**
- ⌘ **Very high confidence that net effect of human activities since 1750 = warming**
- ⌘ **Last 50 years likely to be highest temperature in at least last 1300 yrs**
- ⌘ **Most of this warming is very likely due to increase in human greenhouse gases**
- ⌘ **Without emission reduction policies, global temperature could increase by 1.1 to 6.4°C, or even higher in 2100 compared to 1990**
- ⌘ **Sea level could increase by 18 to 59 cm, or more**
- ⌘ **Frequency/intensity of several extreme phenomena due to increase (ex: heat waves, droughts, floods, ...)**

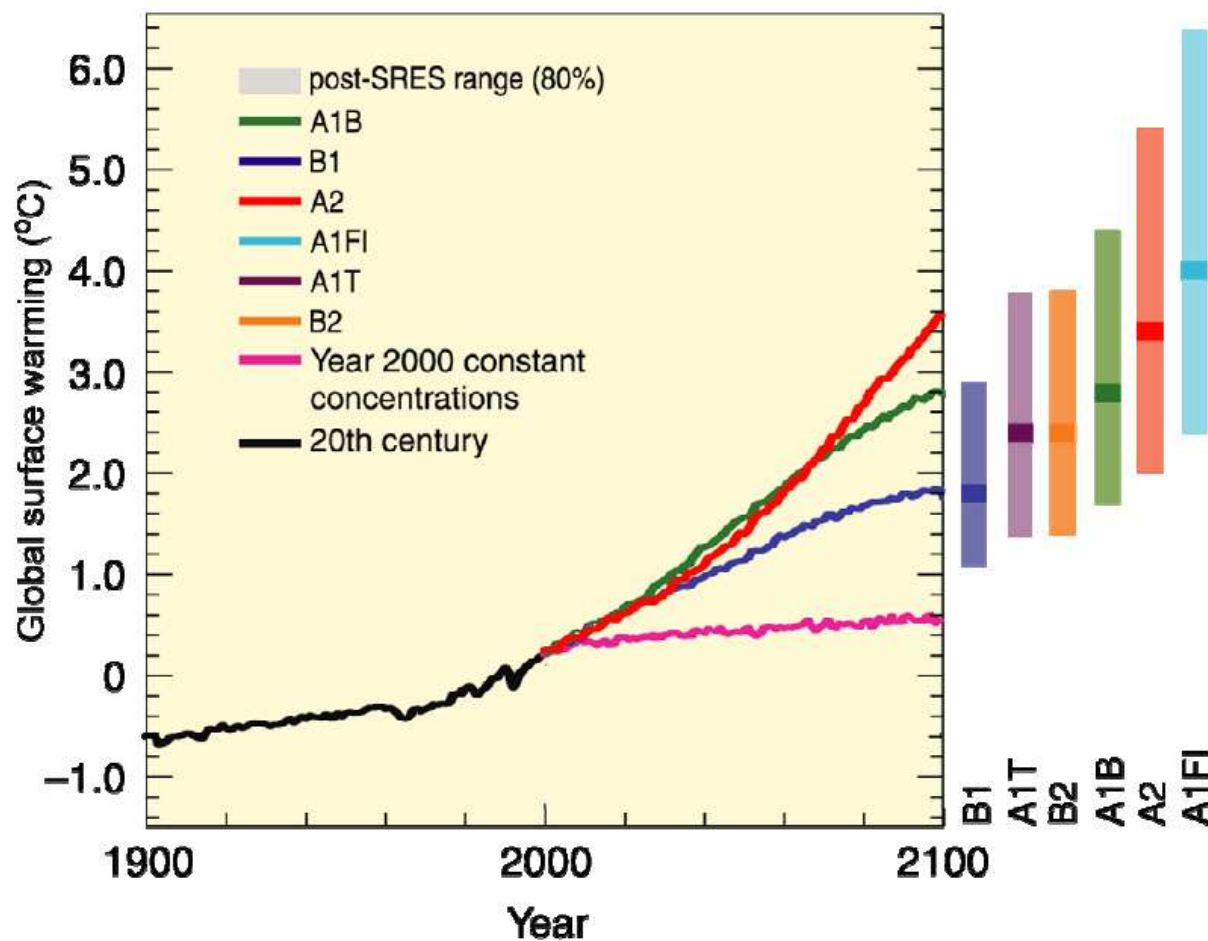
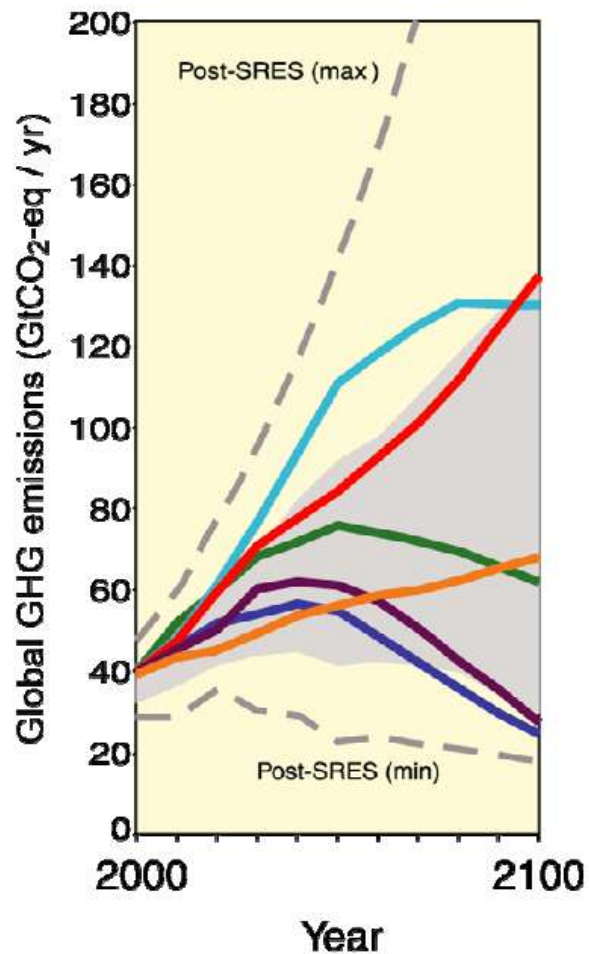
Attribution

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

More heavy precipitation and more droughts....



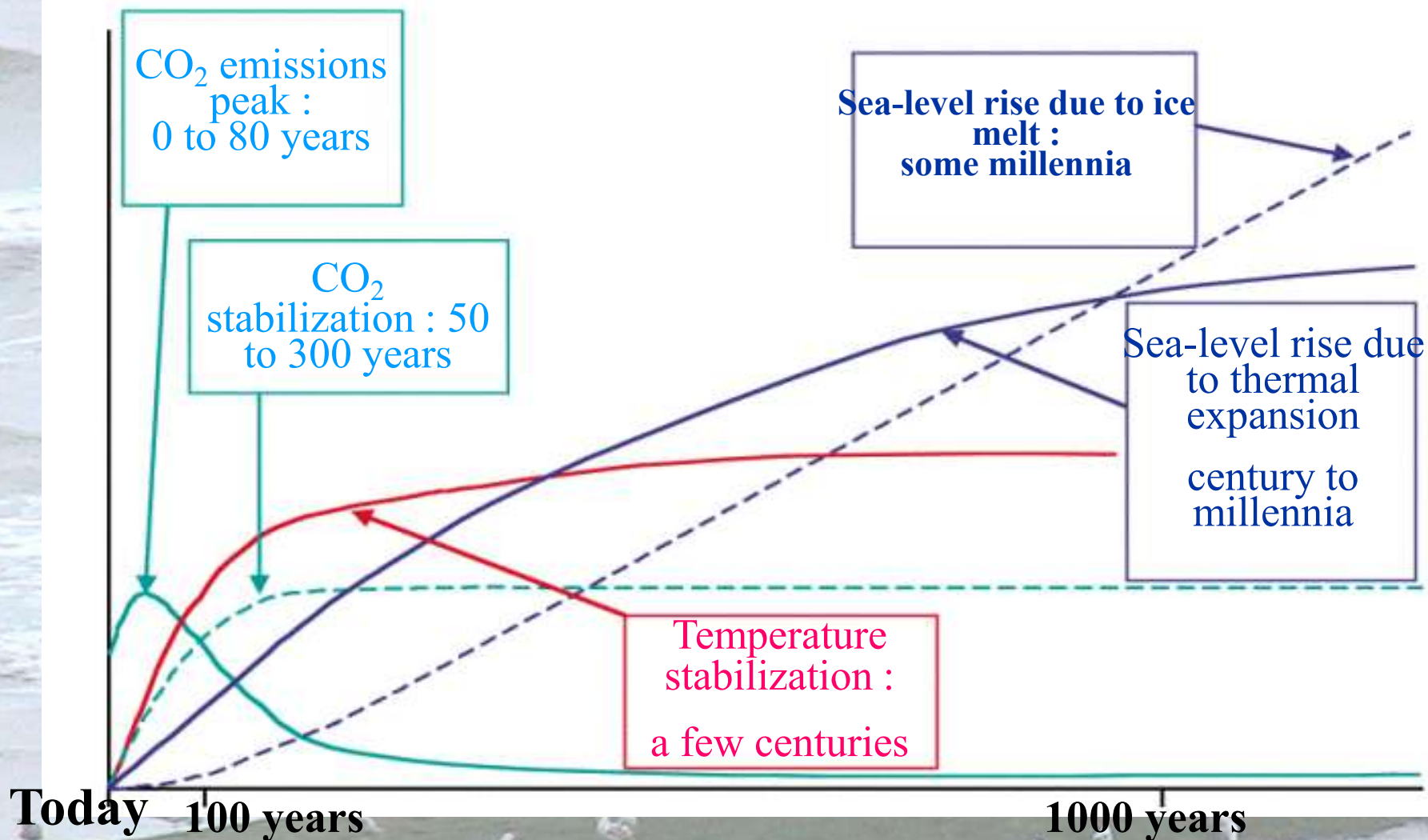
More heavy precipitation and more droughts....



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

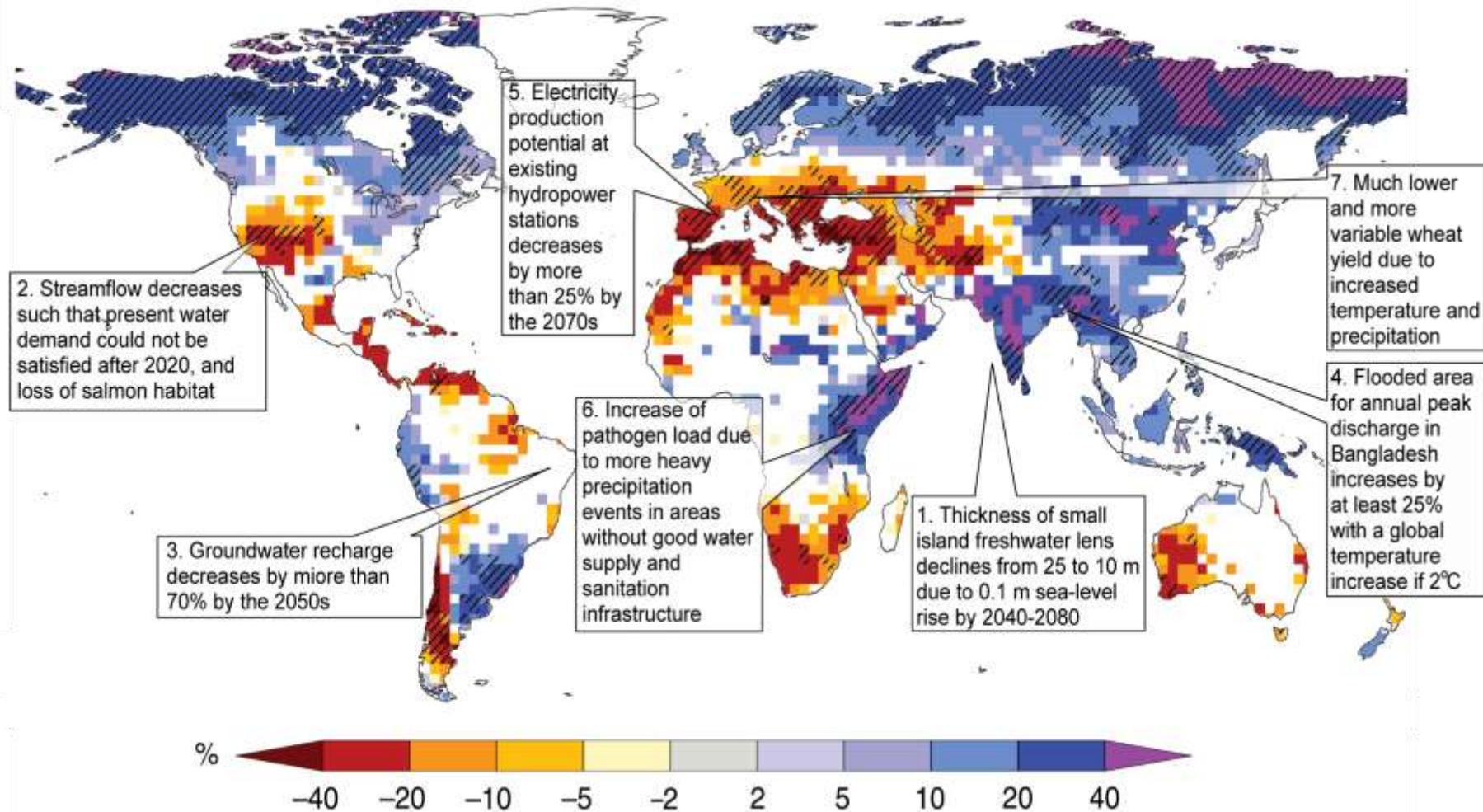




⌘ IPCC Working Group II: Impacts, Vulnerability, and Adaptation

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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).

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

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

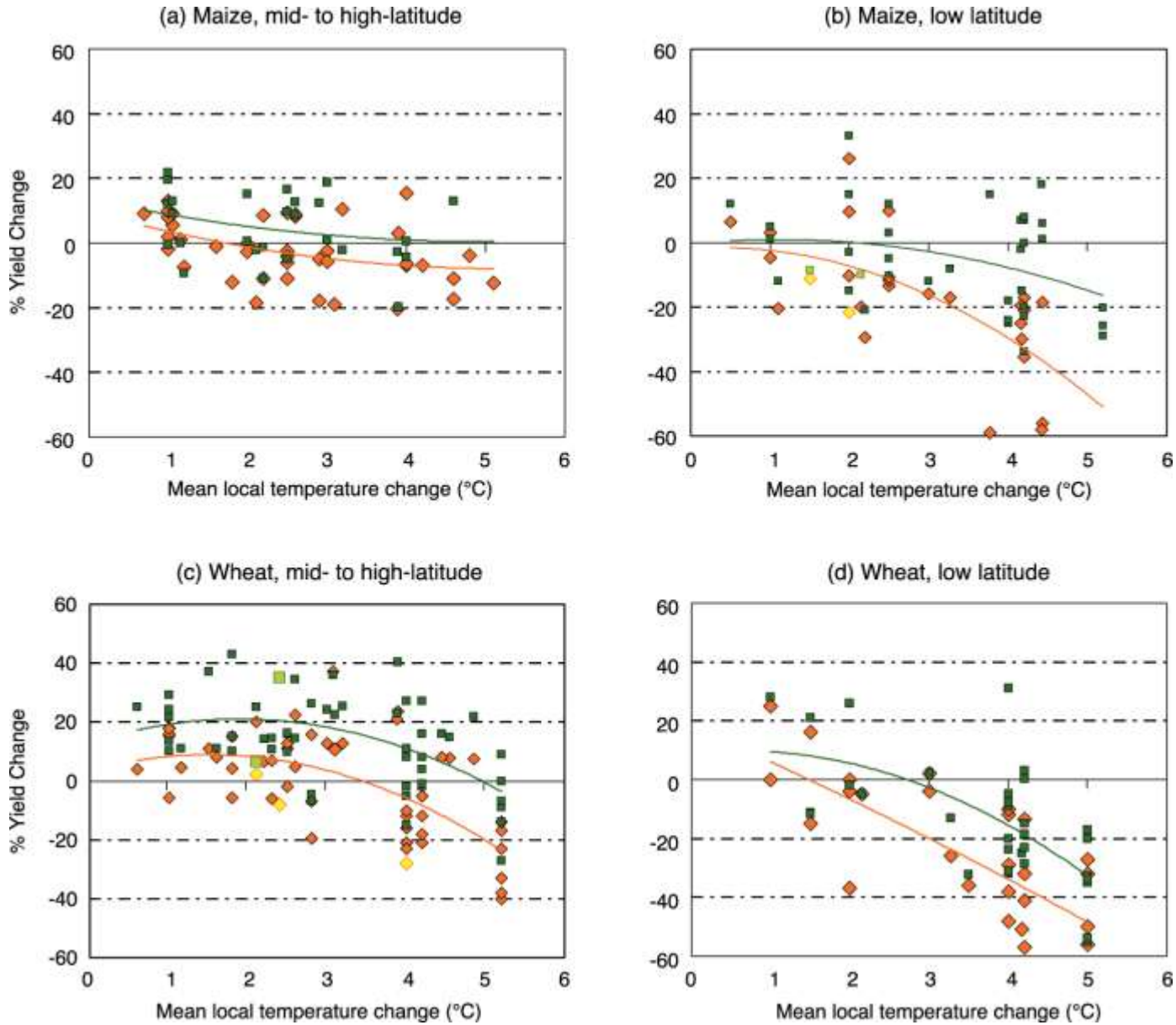


WMO



UNEP

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



Effects on Nile delta: 10 M people above 1m



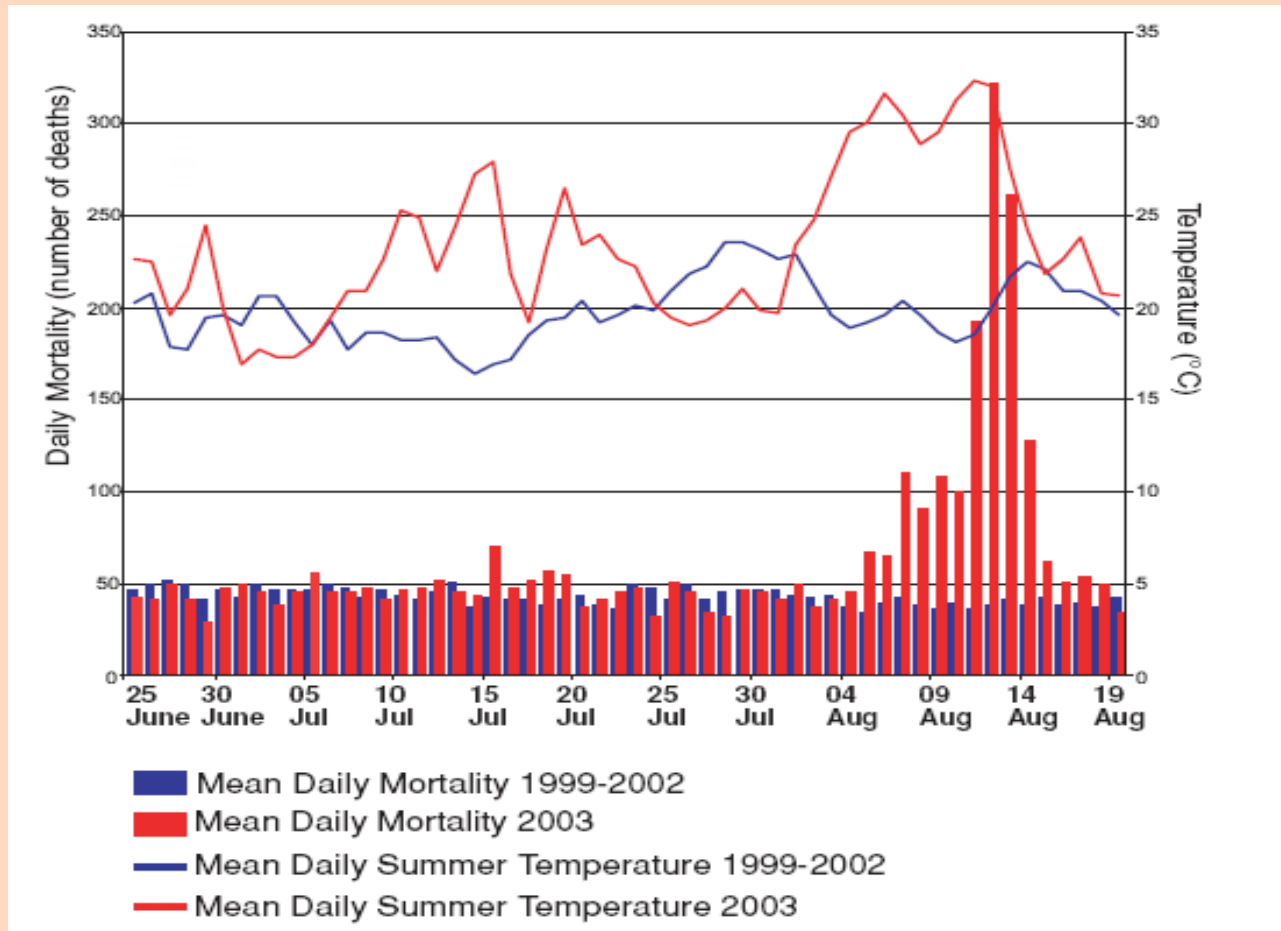
(Time 2001)

With 8 metre sea-level rise: 3700 km² below sea-level in Belgium
(very possible in year 3000)
(NB: flooded area depends on protection)

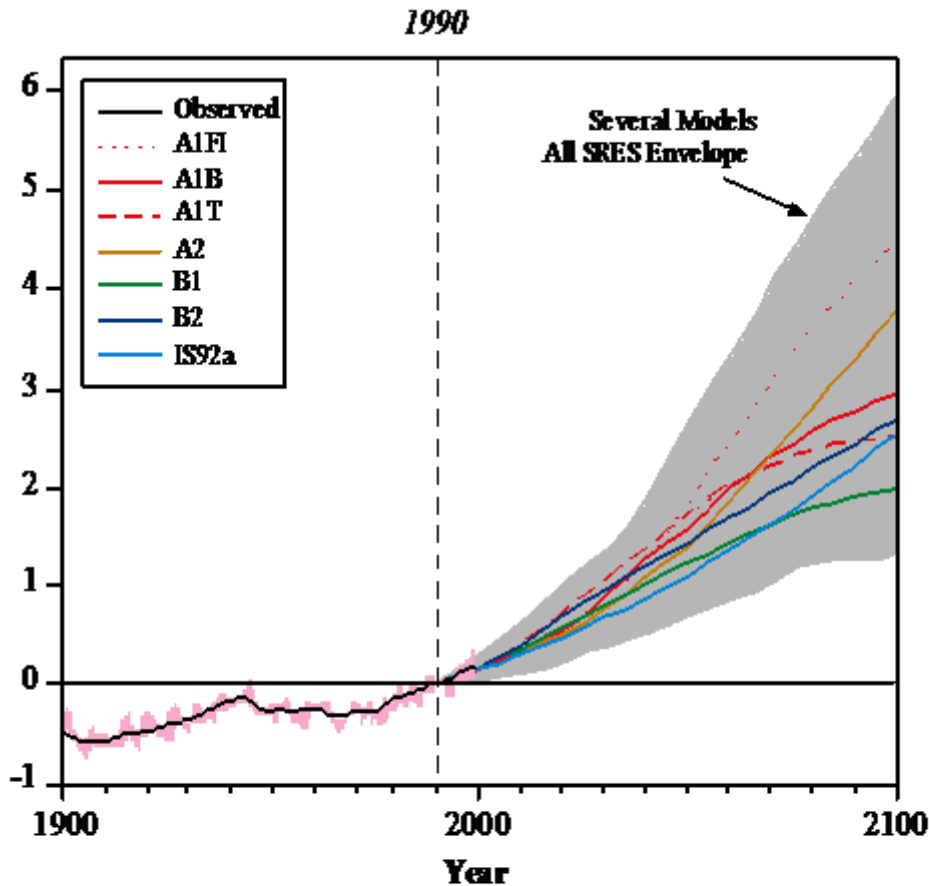


Source: N. Dendoncker (Dépt de Géographie, UCL), J.P. van Ypersele et P. Marbaix (Dépt de Physique, UCL) (www.climate.be/impact)

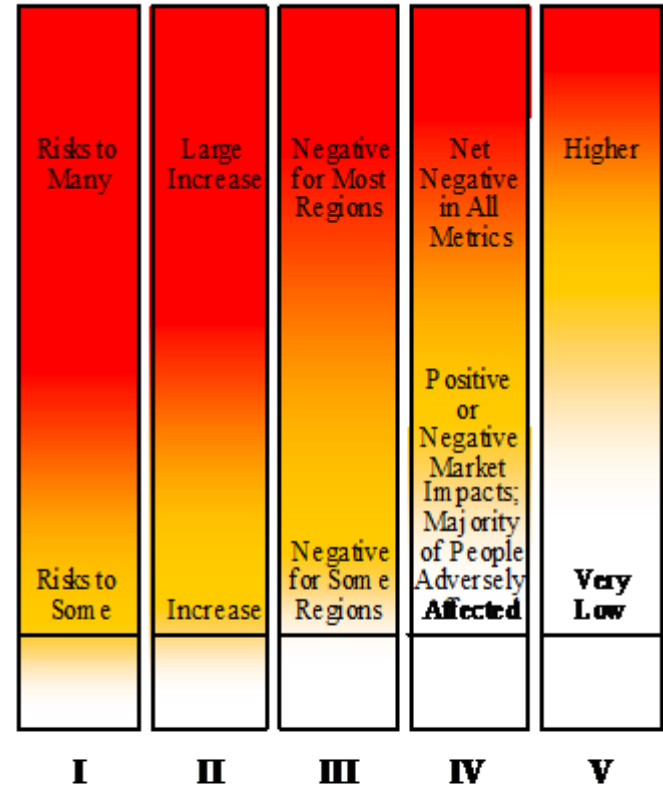
Daily mortality in Paris (summer 2003) (IPCC AR4 Ch 8)



Reasons for Concern



Reasons for Concern



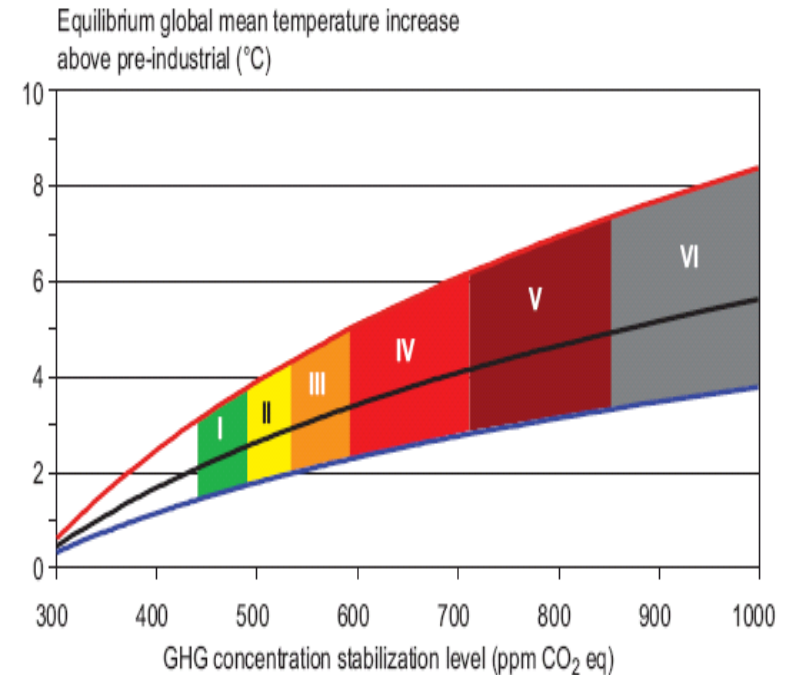
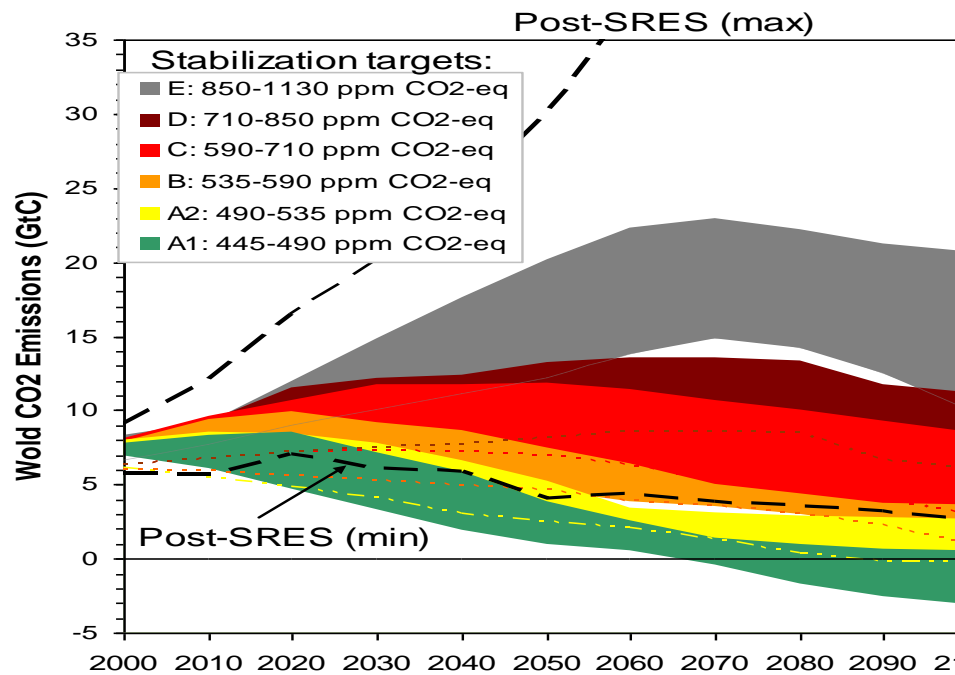
- I Risks to unique and threatened systems
- II Risks from extreme climate events
- III Distribution of Impacts
- IV Aggregate Impacts
- V Risks from large-scale discontinuities

Source: IPCC TAR WG2 (2001)

What does IPCC tell us on mitigation?

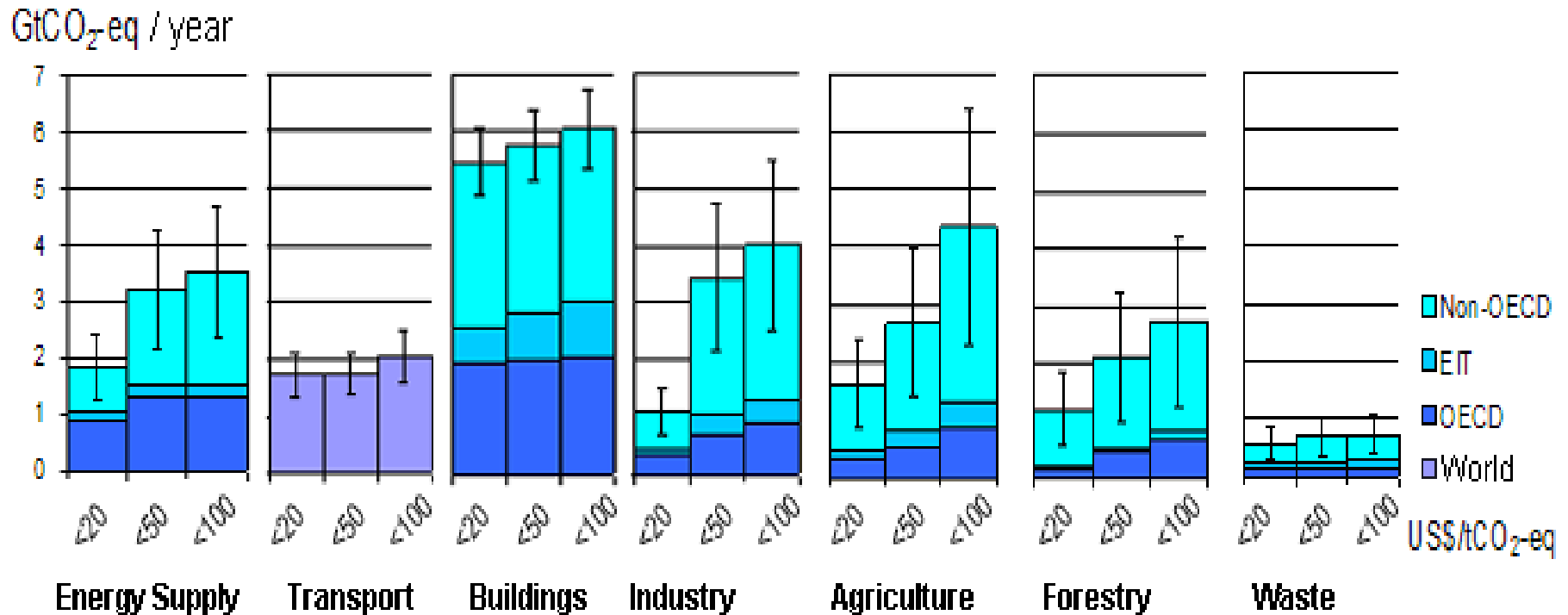
⌘ WG3: Mitigation

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



Multigas and CO₂ only studies combined

All sectors and regions have the potential to contribute by 2030



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

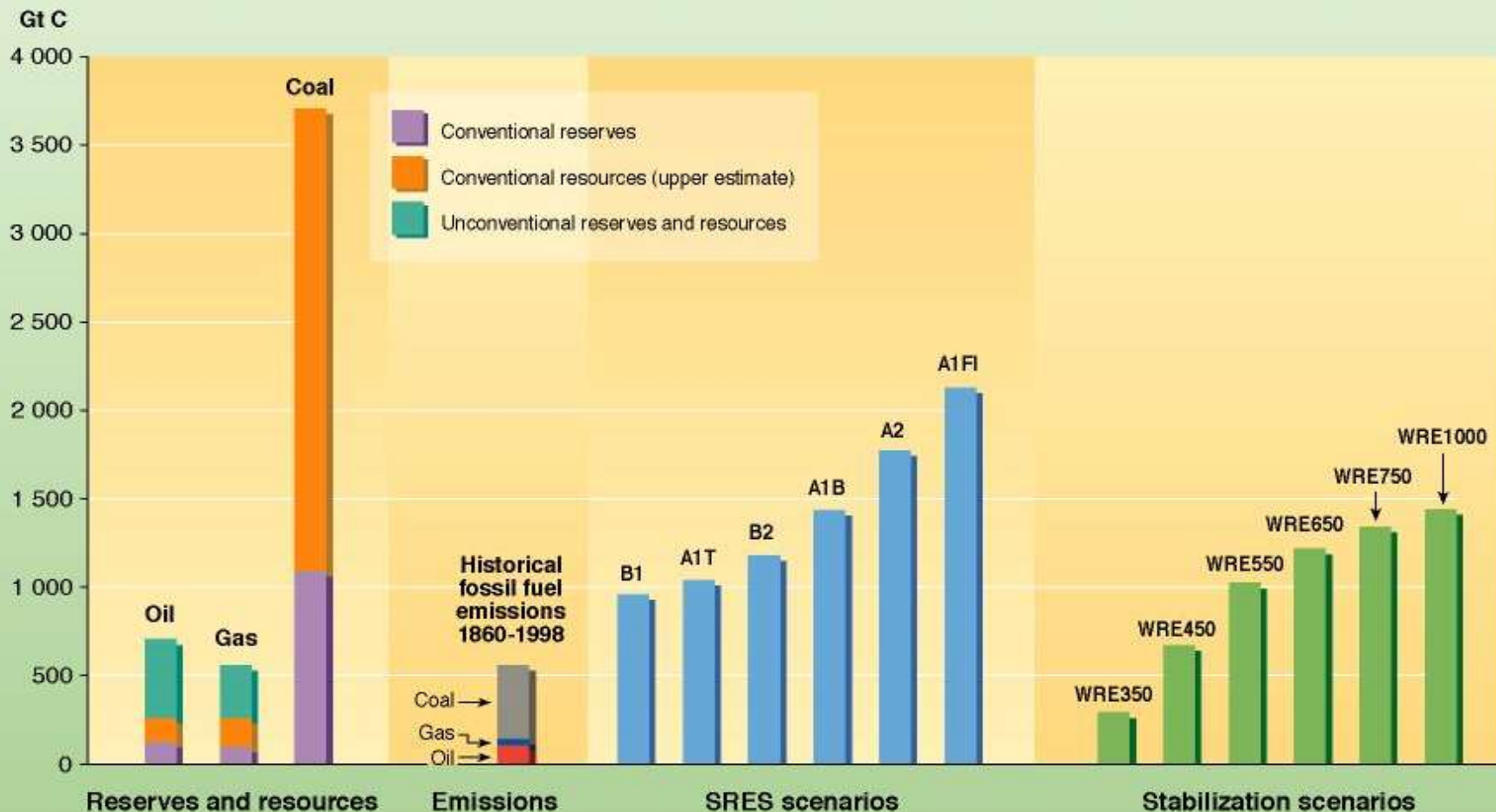
A few Links between Climate Change and Fossil Fuel Depletion



⌘ ... as seen by a climate scientist

There is too much fossil to heat the climate above 2°C

Carbon in fossil fuel reserves and resources compared with historical fossil fuel carbon emissions, and with cumulative carbon emissions from a range of SRES scenario and TAR stabilization scenarios up until 2100



**Adaptation will be
necessary to address
unavoidable impacts
(valid for both CC &
FFD)**



WMO

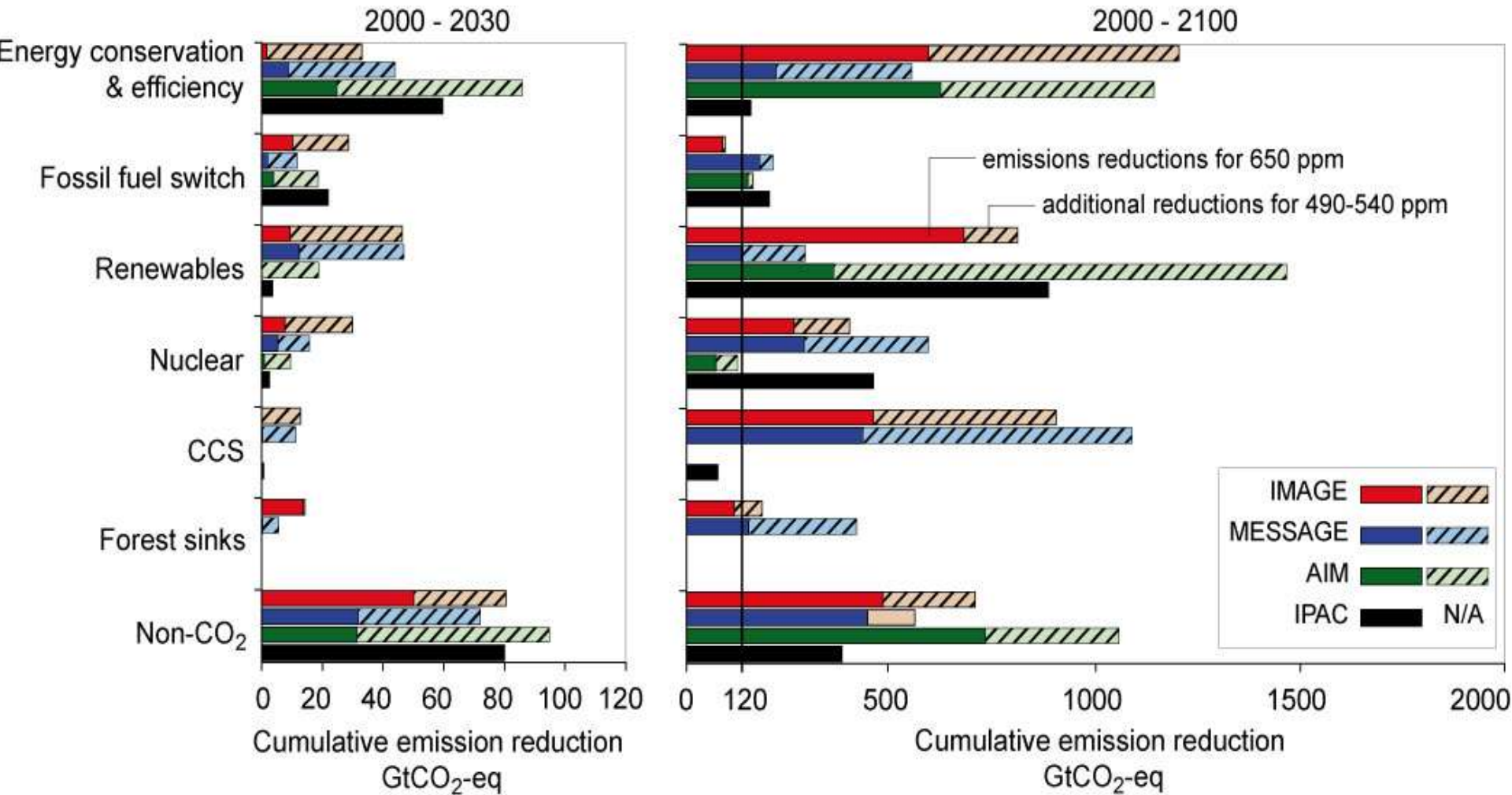


UNEP

What is good for climate is good to delay peak oil & fossil fuel depletion

We need to anticipate, look beyond borders (of any kind), think in an open & integrated manner, with interdisciplinarity, in dialogue with stakeholders, conscious of the effects of our decisions on inter- and intra-generational equity

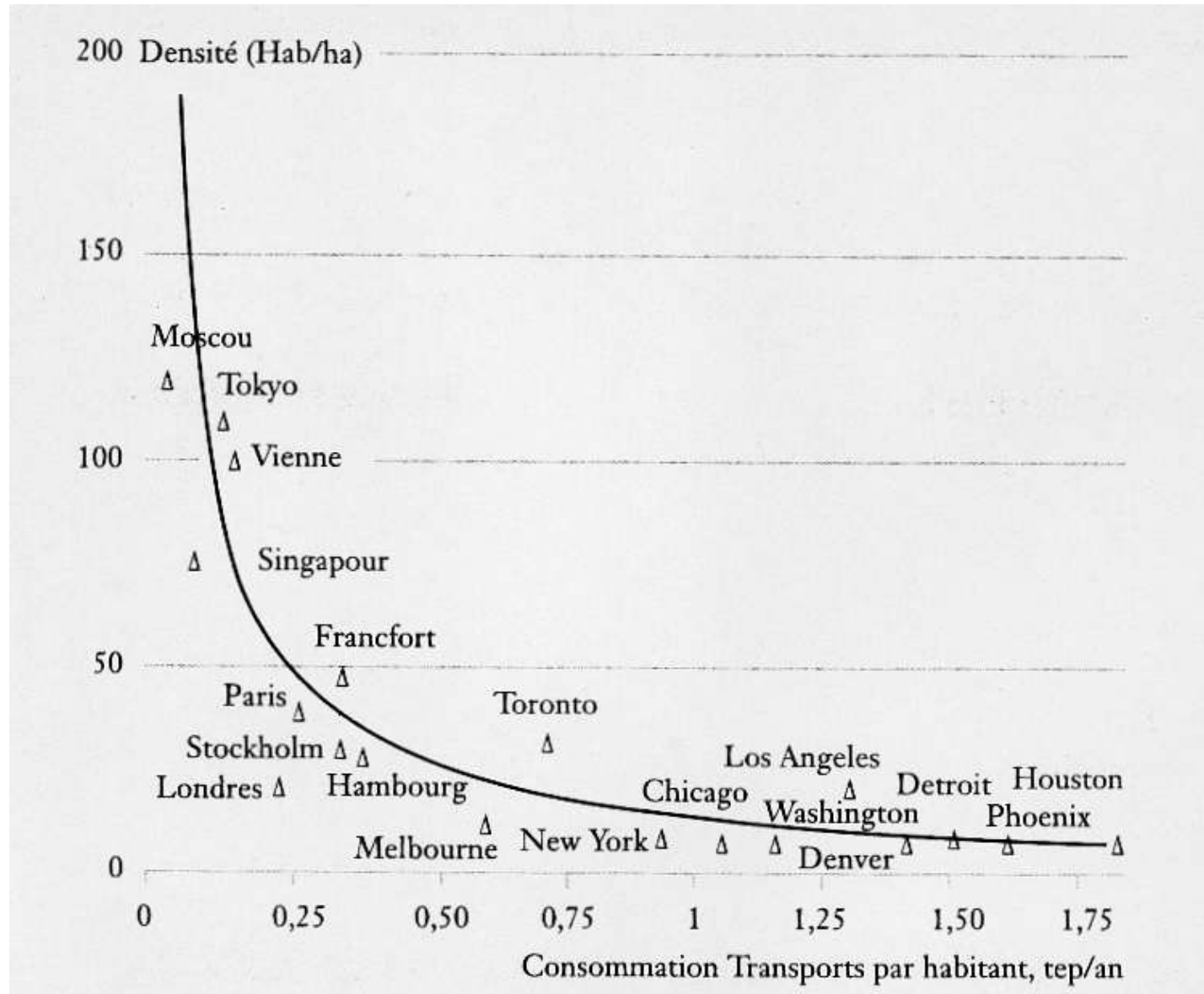
Role of Technology, following IPCC AR4



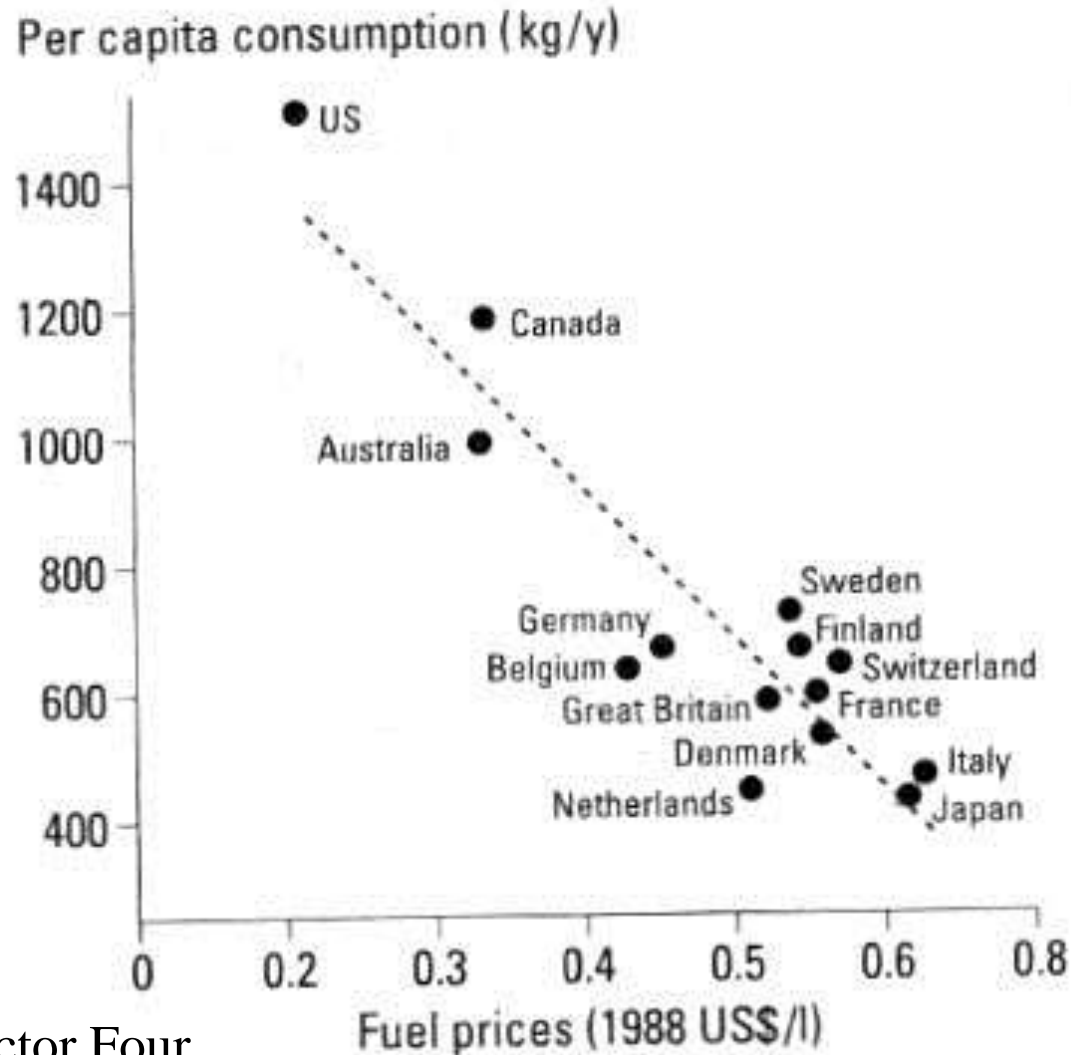
Changes in lifestyle and behaviour patterns can contribute to climate change mitigation

- Changes in occupant behaviour, cultural patterns and consumer choice in buildings.
- Reduction of car usage and efficient driving style, in relation to **urban planning and availability of public transport**
- Staff training, reward systems, regular feedback and documentation of existing practices in industrial organizations

Relationship between urban sprawl and energy use per capita in transport (t oil-equivalent/year)





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



Source: Factor Four

Examples of side-effects of climate mitigation

<i>OPTIONS</i>	<i>SYNERGIES</i>	<i>TRADEOFFS</i>
<p><i>Energy:</i> efficiency, renewables, fuel-switching</p> 	<ul style="list-style-type: none">• air quality• supply security• employment• costs (efficiency)	<ul style="list-style-type: none">• particulate emissions (diesel)• biodiversity (biofuels)• costs (renewables)
<p><i>waste:</i> landfill gas capture, incineration</p> 	<ul style="list-style-type: none">• health & safety• employment• energy advantages	<ul style="list-style-type: none">• ground water pollution• costs

A last argument to save fossil fuels:



Keep them for when humanity will need them to counter the next glaciation (due to astronomical factors), in 30-50 thousand years from now...

A quote from a geologist



« This century was that of science; but its last years can be called the era of the wasting; and the thirst to enjoy, without delay and moderation, too often brought the dilapidation of the resources whose progress of our knowledge had brought the discovery; all the more guilty dilapidation, that one knew better and better to which point this provision is limited, and which it is forbidden to hope for its prompt reconstitution »... (Ce siècle a été celui de la science; mais ses dernières années peuvent s'appeler l'ère du gaspillage; et la soif de jouir, sans retard et sans mesure, a trop souvent amené la dilapidation des ressources dont le progrès de nos connaissances avait amené la découverte; dilapidation d'autant plus coupable, qu'on savait de mieux en mieux à quel point cette provision est limitée, et qu'il est interdit d'en espérer la prompte

reconstitution.) **A. de Lapparent (1899), quoted by Juhel (2011)**

"Histoire du pétrole"

A quote from a geologist



« Also it would be necessary to have (...) a severe judgment against intelligences which, having known to see so many things, so completely failed to exert a salutary direction on the wills »

(Aussi faudrait-il (...) une condamnation sévère contre des intelligences qui, ayant su voir tant de choses, ont si complètement failli à exercer une direction salubre sur les volontés)

**A. de Lapparent (1899), quoted by Juhel (2011)
“Histoire du pétrole”**

Useful links:



⌘ www.ipcc.ch : IPCC

⌘ www.unfccc.int : Climate Convention

⌘ www.skepticalscience.com: answers to
« skeptics »

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