Climate Change: Challenge and Opportunity

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What is the IPCC?

- **IPCC : Intergovernmental Panel on Climate Change (GIEC in French)**
- **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**

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What does IPCC tell us about climate science?

- **WG1: 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 (90%) 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, by 2100**
- **Frequency/intensity of several extreme phenomena due to increase (ex: heat waves, droughts, floods, …)**

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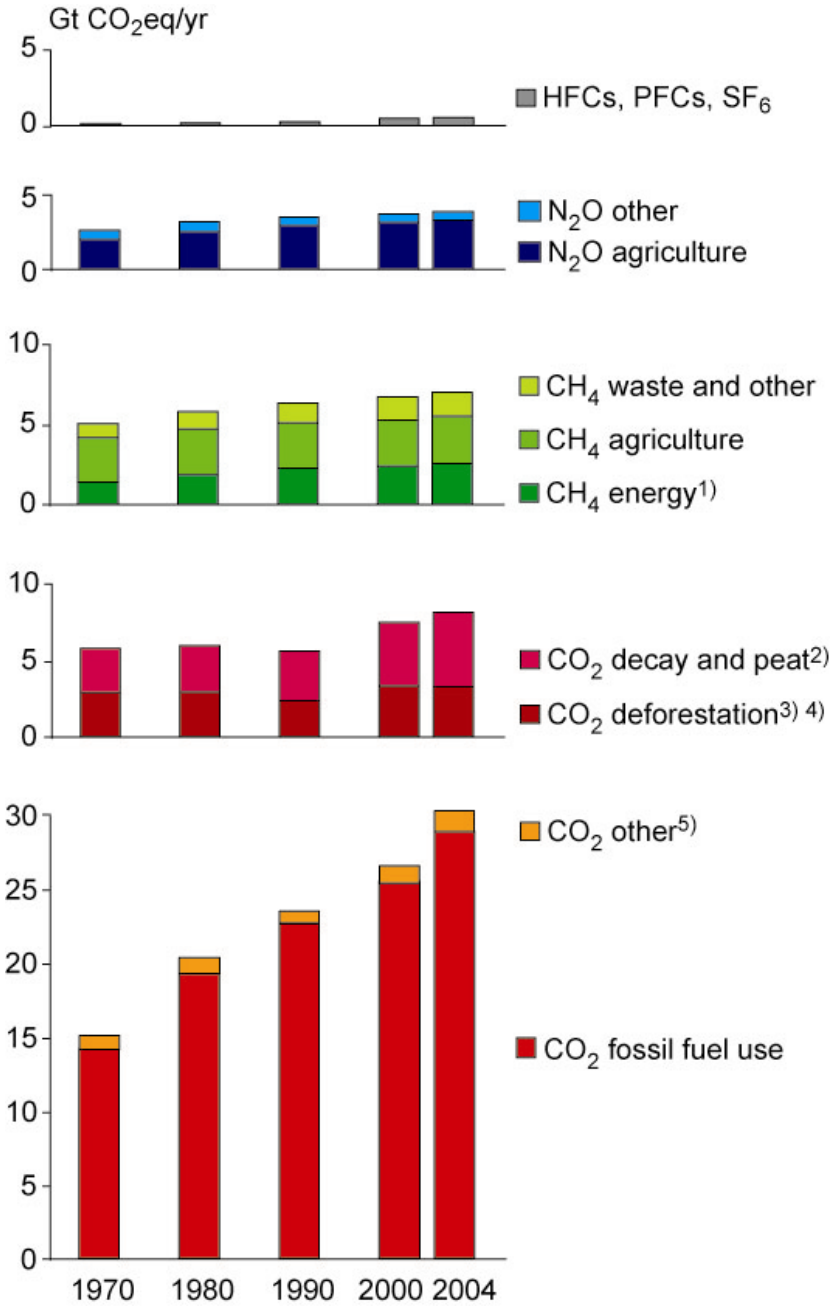
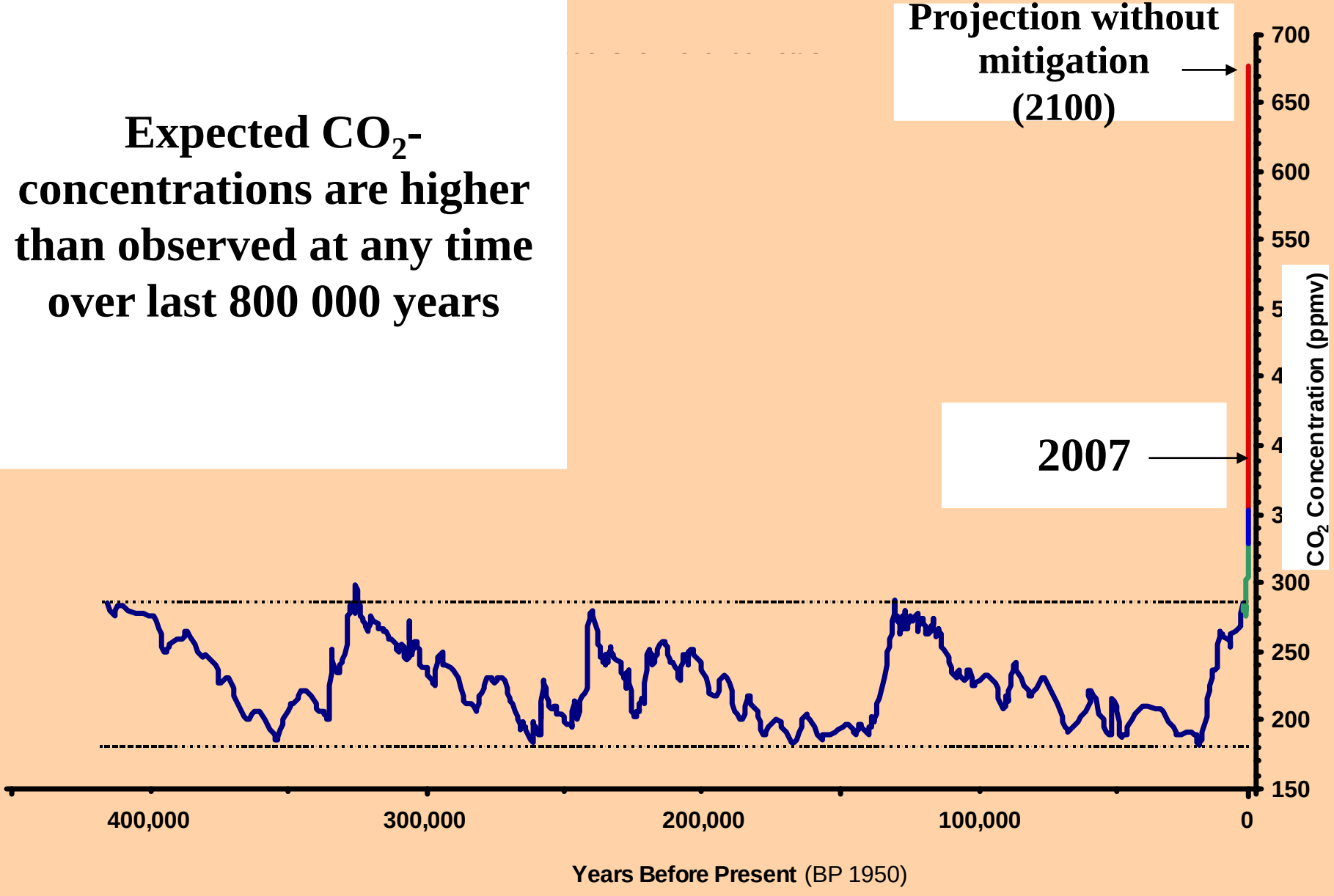
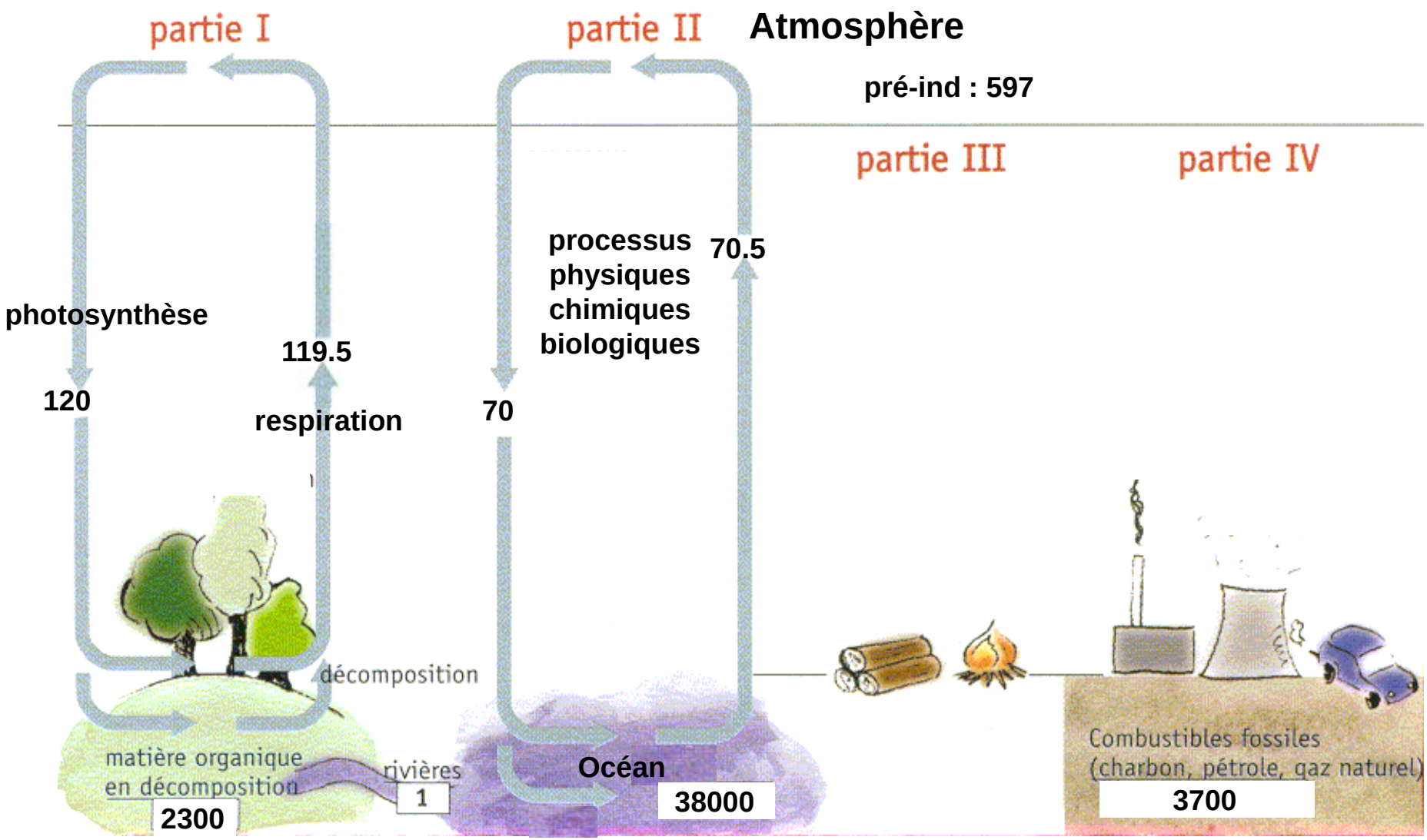
Carbon dioxide is the largest contributor



Expected CO_2-concentrations are higher than observed at any time over last 800 000 years



Cycle du carbone



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

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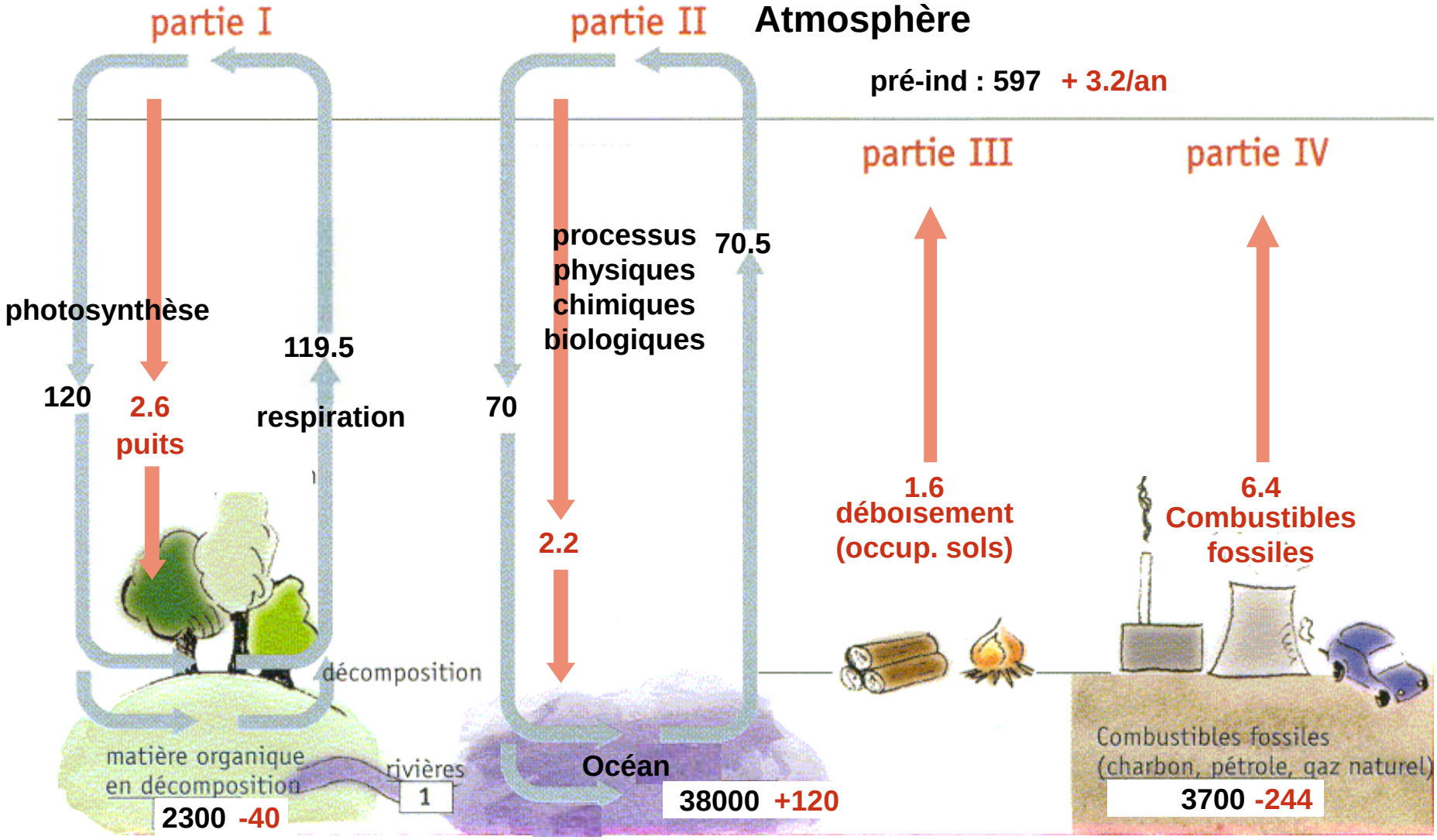
Cycle du carbone



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

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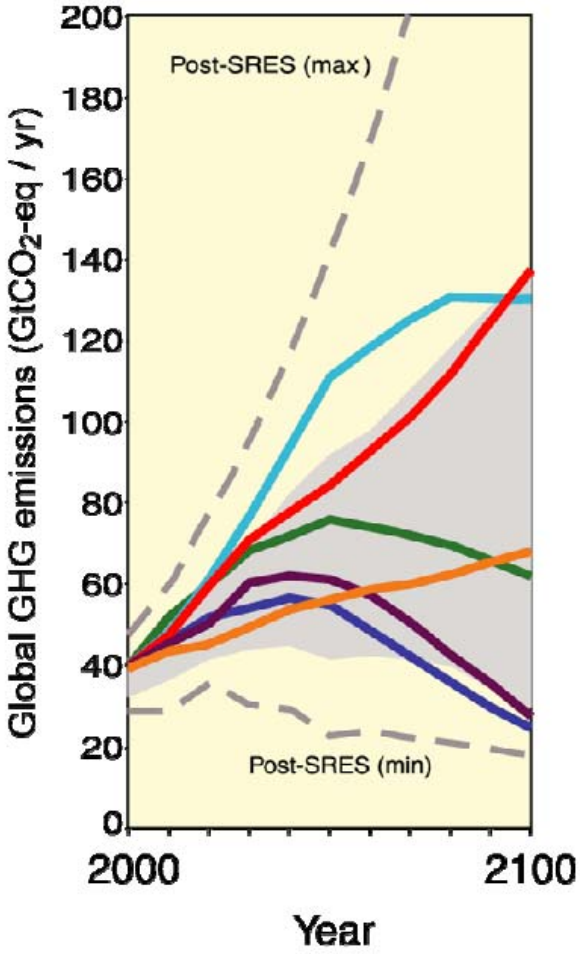
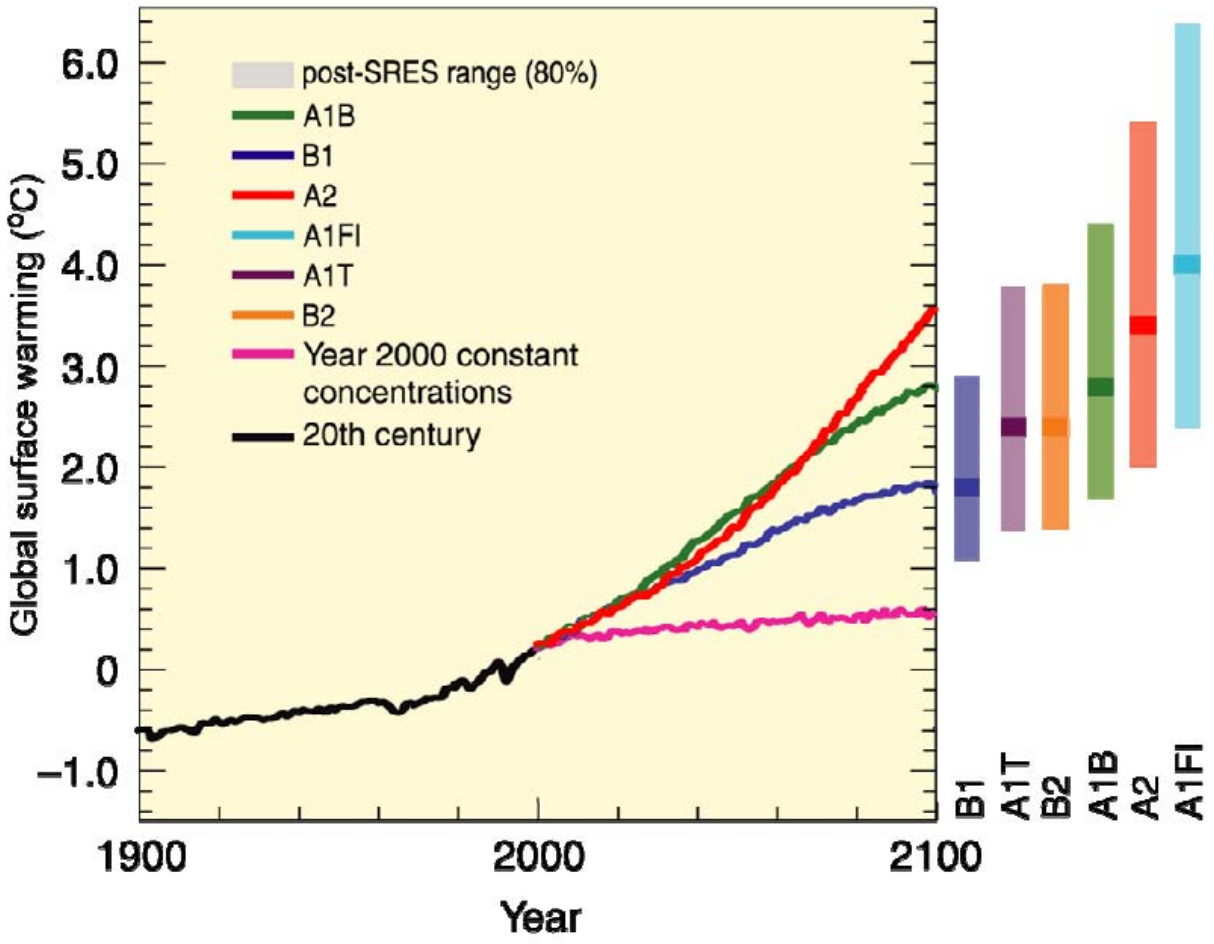
Source: IPCC, AR4 (2007)

Climate projections without mitigation





NB: écart par rapport à la moyenne 1980-1999

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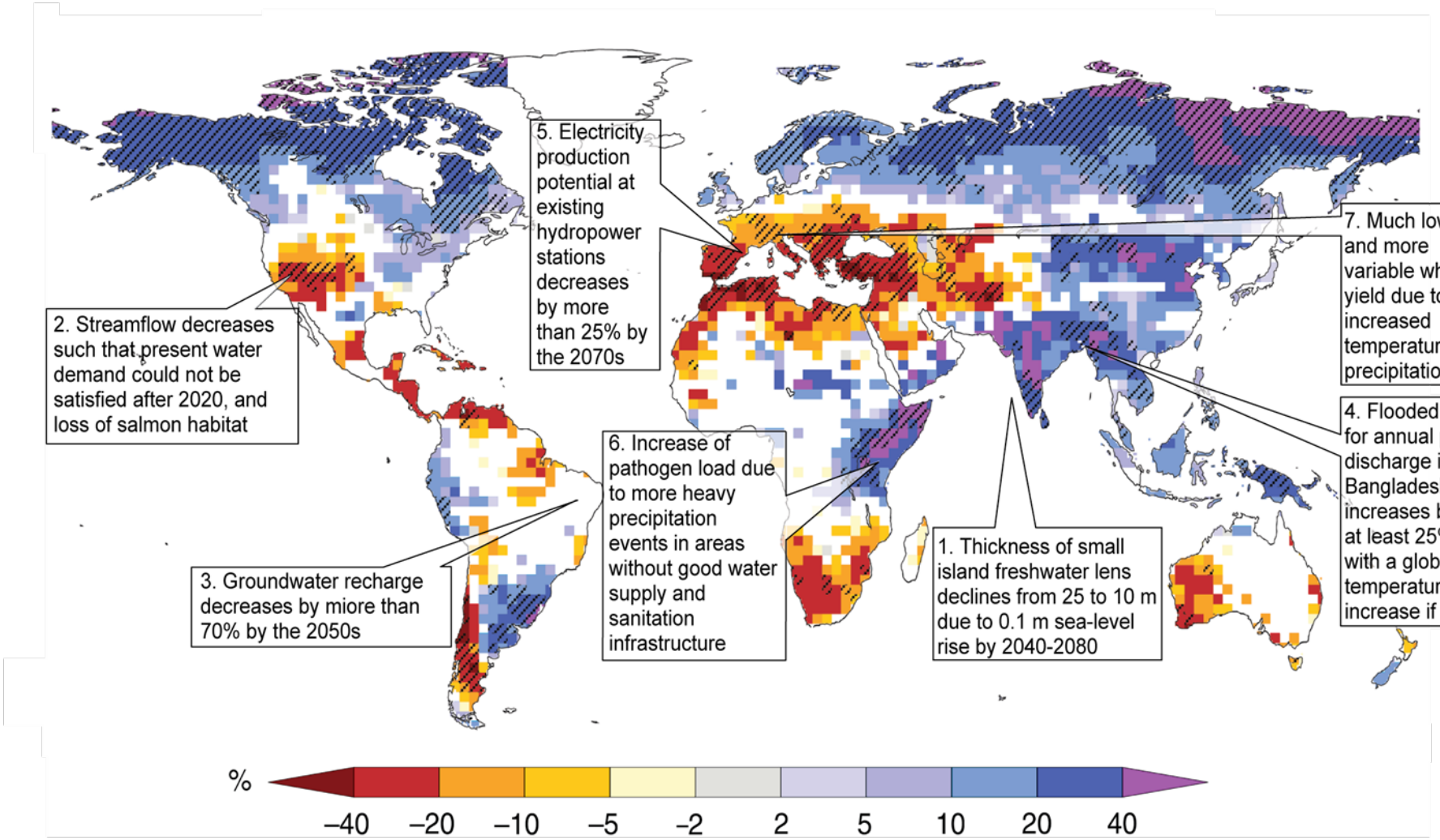
What does IPCC tell us about impacts and adaptation?

- **WG2: Impacts, Vulnerability, and adaptation**

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

Effects on Nile delta: 10 M people above 1m

(Time 2001)

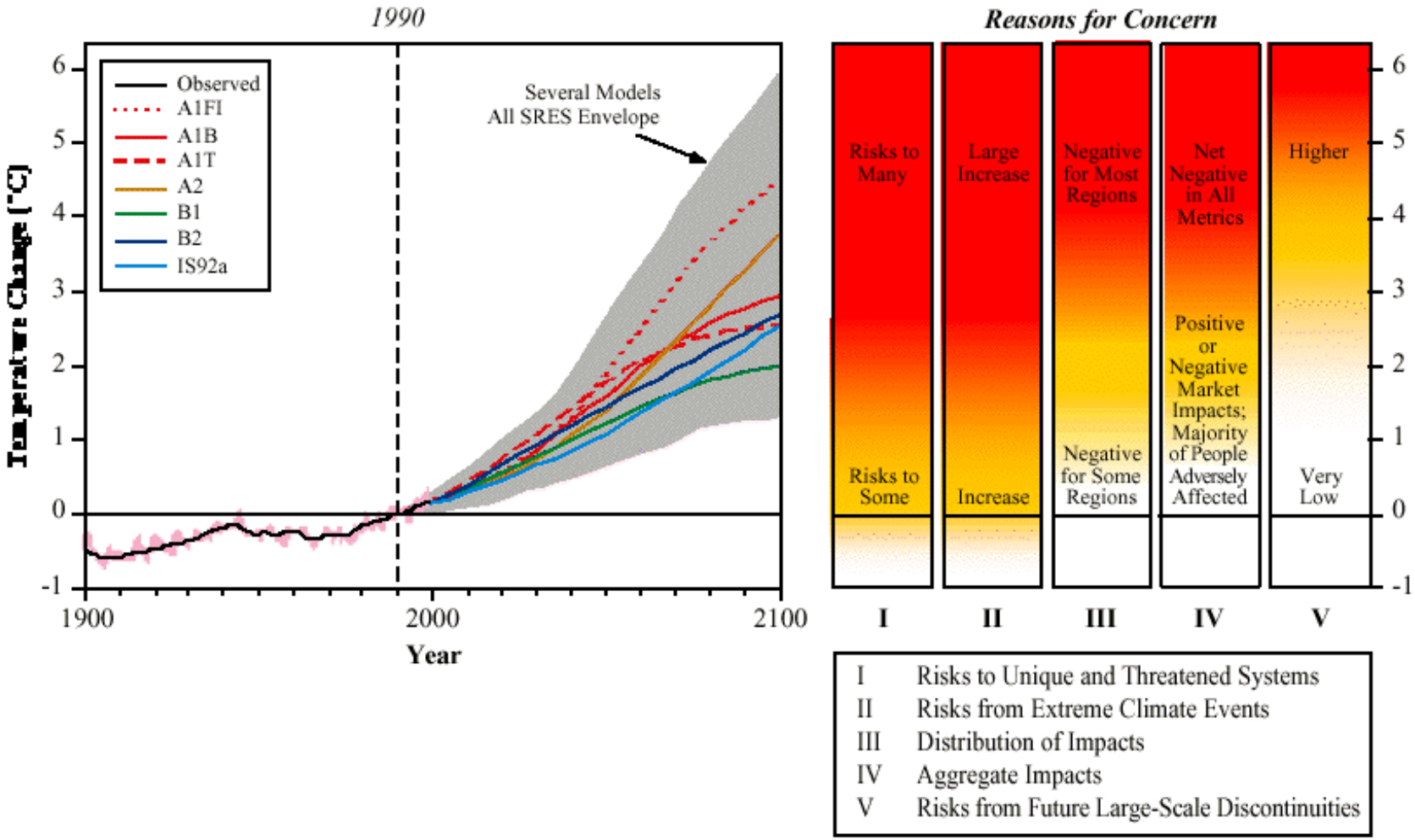
20% - 30% of plants and animals species at increased risk of extinction

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

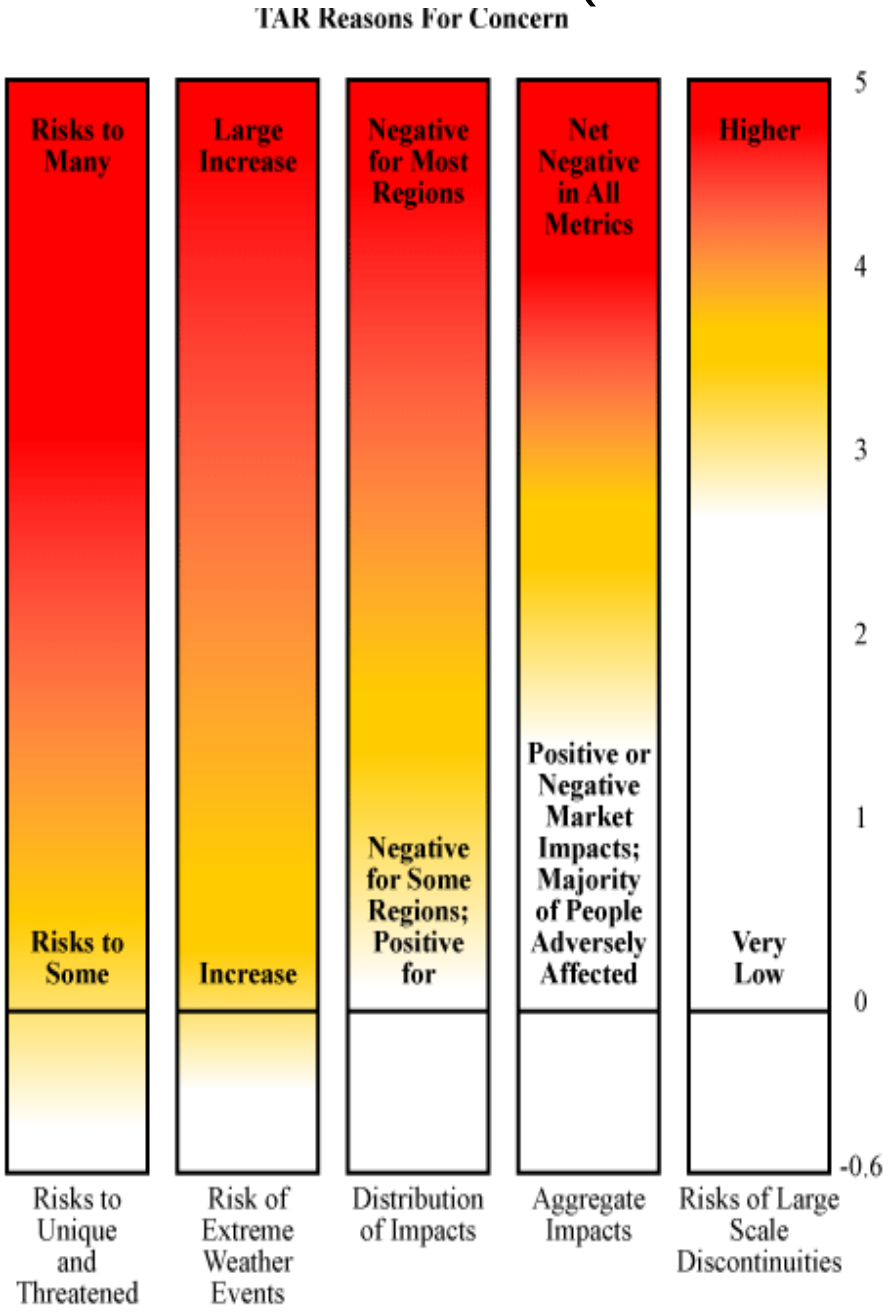
WMO

UNEP

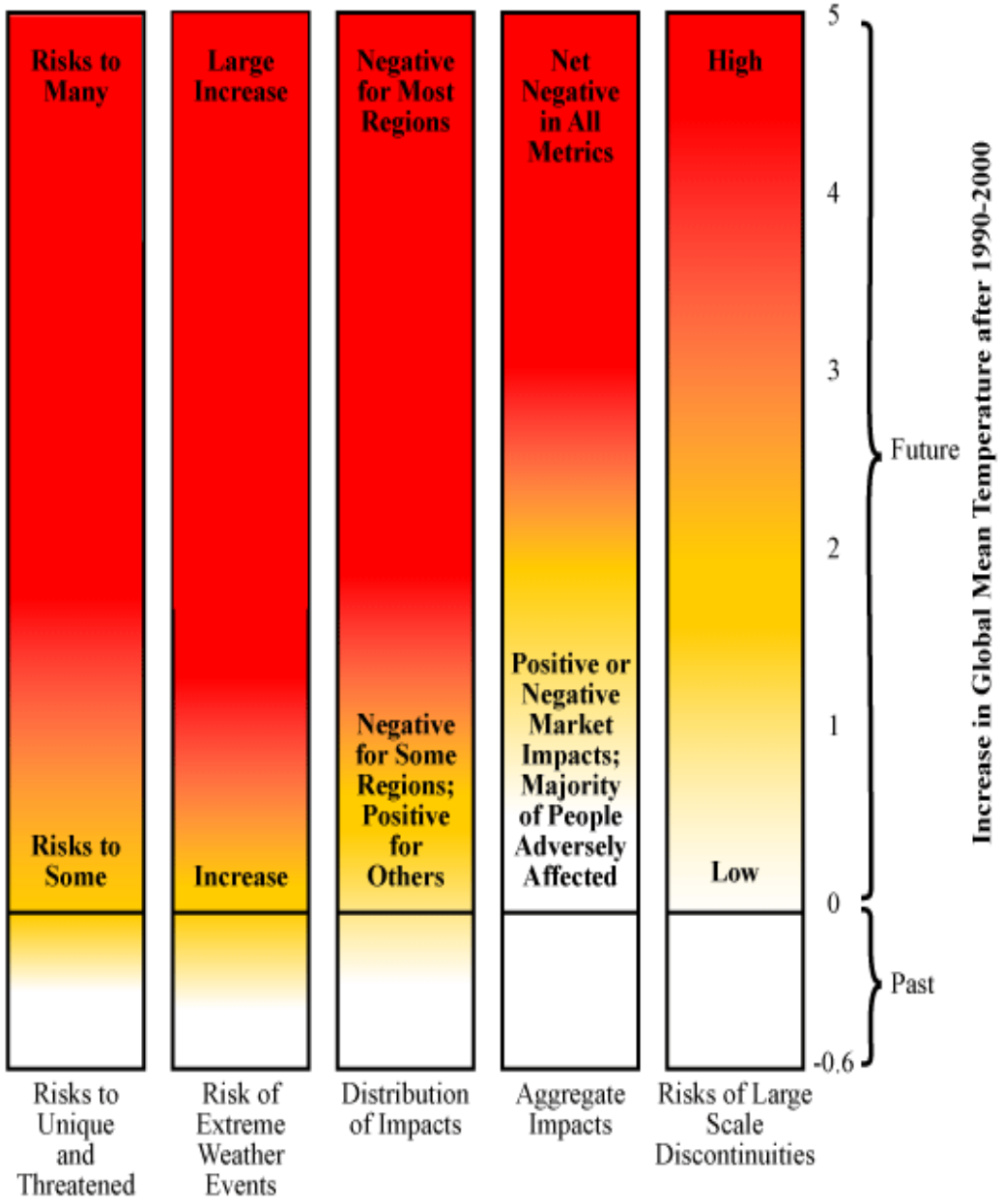
IPCC 2001:


1990
Observed
A1FI
A1B
A1T
A2
B1
B2
IS92a
Several Models
All SRES Envelope
Temperature Change (°C)
6
5
4
3
2
1
0
-1
1900
2000
2100
Year
Reasons for Concern
Risks to Many
Risks to Some
Large Increase
Increase
Negative for Most Regions
Negative for Some Regions
Net Negative in All Metrics
Positive or Negative Market Impacts; Majority of People Adversely Affected
Higher
Very Low
I
II
III
IV
V
I Risks to Unique and Threatened Systems
II Risks from Extreme Climate Events
III Distribution of Impacts
IV Aggregate Impacts
V Risks from Future Large-Scale Discontinuities

Reasons for concern (TAR-2001)



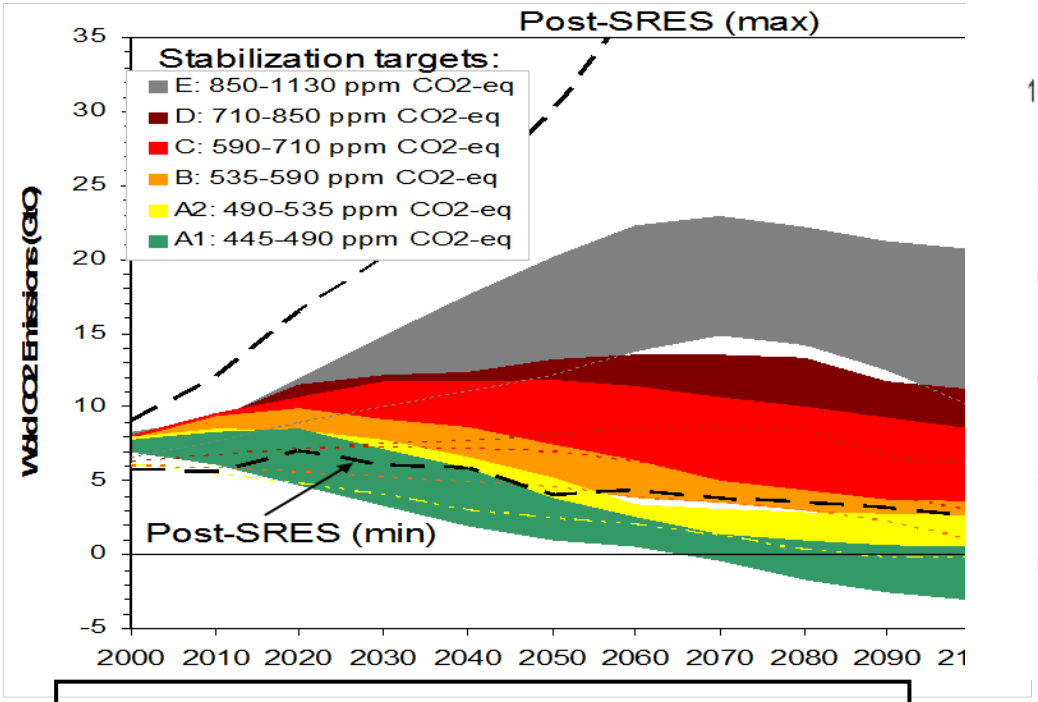
Reasons for concern (Smith et al, 2009, PNAS, based on AR4-2007)



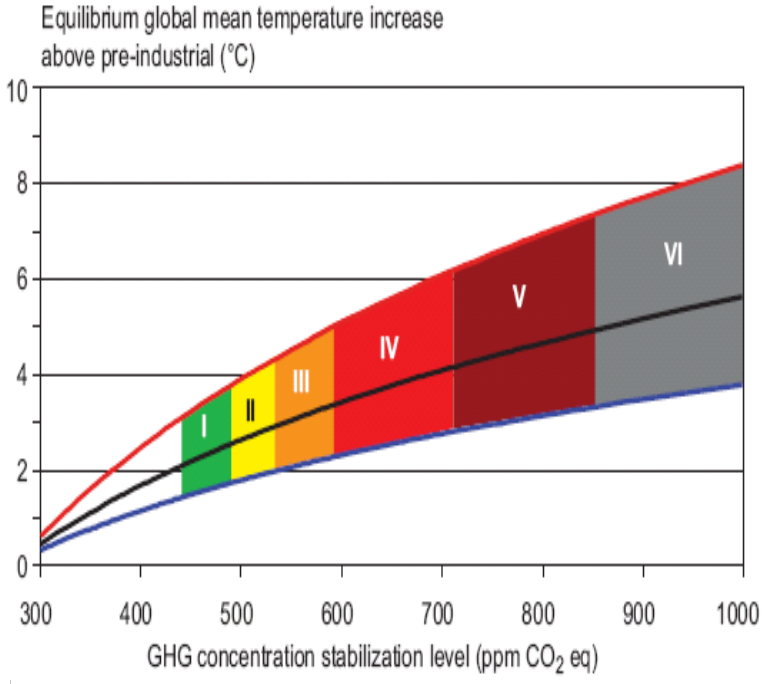
What does IPCC tell us on mitigation?

- **WG3: Mitigation**

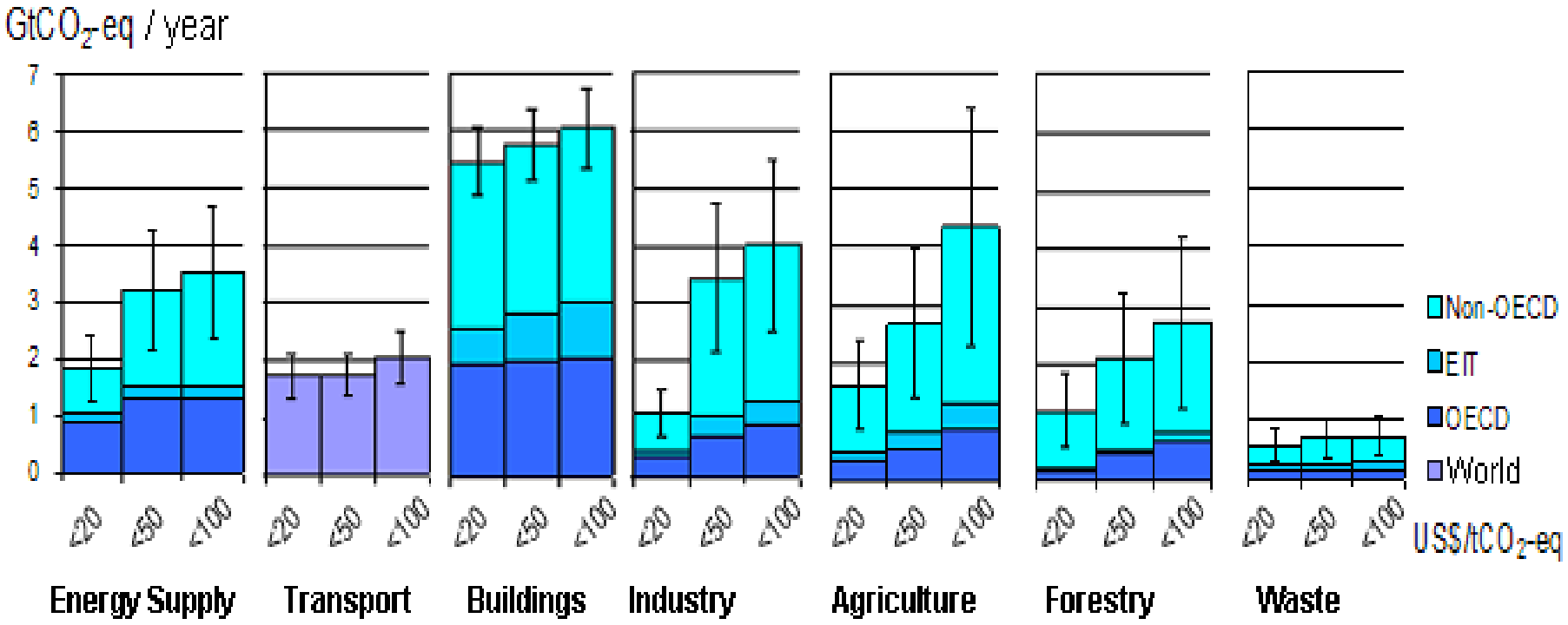
The lower the stabilisation level the earlier global emissions have to go down



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.

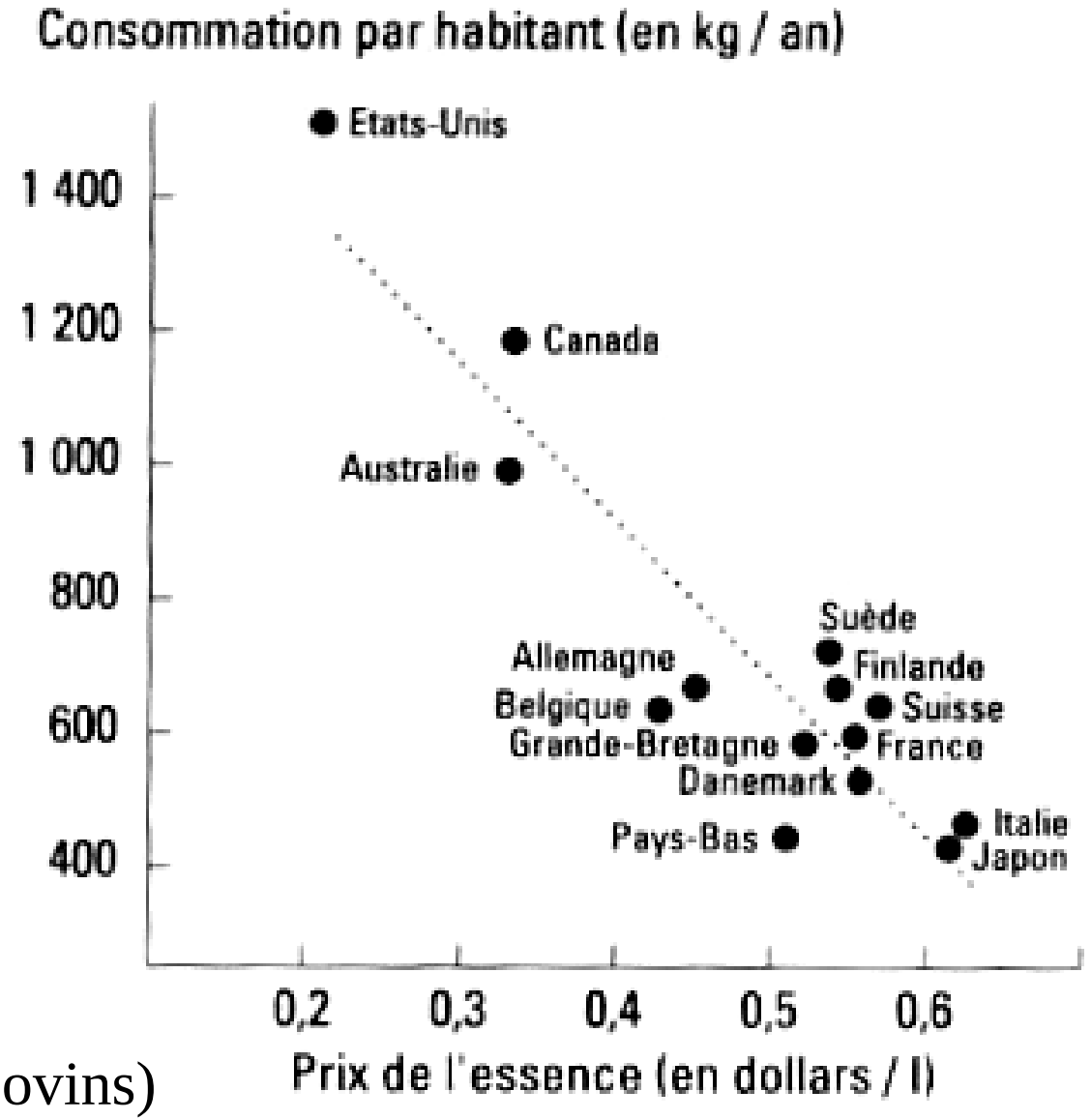
The importance of a “price of carbon”

- 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 CO_{2eq} carbon prices should reach 20-80 US$/t$CO_{2eq}$ by 2030 (5-65 if “induced technological change” happens)
- At these carbon prices large shifts of investments into low carbon technologies can be expected
- For stabilisation at around 450 ppm CO_{2eq} carbon prices should reach 100-200 US$/t$CO_{2eq}$ by 2030 (multiply by 25 for a tonne of CH_4)

What does US$ 100/ tCO2eq mean?

- Crude oil: ~US$ 50/ barrel
- Gasoline: ~24 ct/ litre (1 US$/gallon)
- Electricity:
  - from coal fired plant: ~10 ct/kWh
  - from gas fired plant: ~3 ct/kWh

Correlation fuel price/consumption



(Source: Lovins)

How can emissions be reduced?

Sector	(Selected) Key mitigation technologies and practices currently commercially available.	**Key mitigation technologies and practices projected to be commercialized before 2030. (Selected)**
Industry	More efficient electrical equipment; heat and power recovery; material recycling; control of non-CO_2 gas emissions	Advanced energy efficiency; CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture
Buildings	Efficient lighting; efficient appliances and airconditioners; improved insulation ; solar heating and cooling; alternatives for fluorinated gases in insulation and appliances	Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings

Conclusion: the Challenge

- **The Earth is heading towards a climate no human has ever known (+2-3°C = return 2-3 Myrs in past)**
- **Significant risks are assessed to be occurring for a lower temperature increase than assessed earlier**
- **Time to revise the (old: 1996!) EU 2°C target in the light of AR4: a lower value would be much safer**
- **Developed countries reductions of 25-40% (1990-2020), and global emissions becoming NEGATIVE around 2070 deliver a low probability of staying below a 2°C increase**

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Conclusion: the Opportunities

- **Climate protection needs an agreement as international as possible to cap emissions.**
- **Allow trading of quotas between countries so that carbon price signals that it is not so free to pollute with CO_2 (and CH4, N2O, HFCs….)**
- **Historical responsibility is real: developing countries will only act if developed countries reduce recognize their responsibilities and take the lead**
- **Reduce energy wastage is a priority, and remembering the Sun provides in one HOUR the total energy humanity uses in one YEAR offers many opportunities**
- **Chemistry is certainly part of the solution (reduce emissions, capture CO_2…)**

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Finally, a question

- **How old will our children be in 2050?**
- **My guess: about our age today**
- **Isn't it time to try to leave them a home in good shape?**

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Useful links:

- www.ipcc.ch : IPCC
- www.climate.be/JCM: interactive climate model
- www.climate.be/vanyp : many of my slides

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