# Climate change

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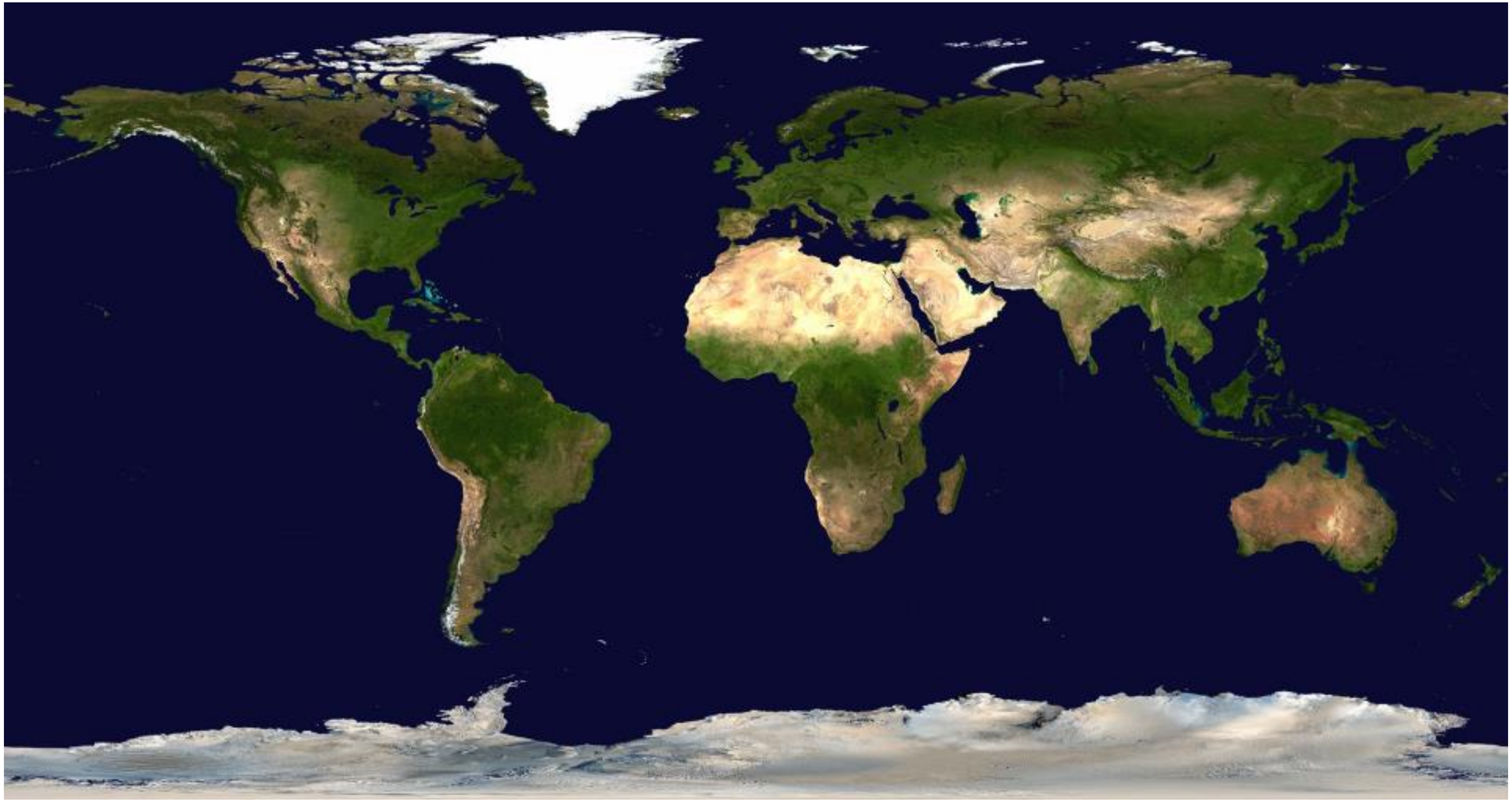
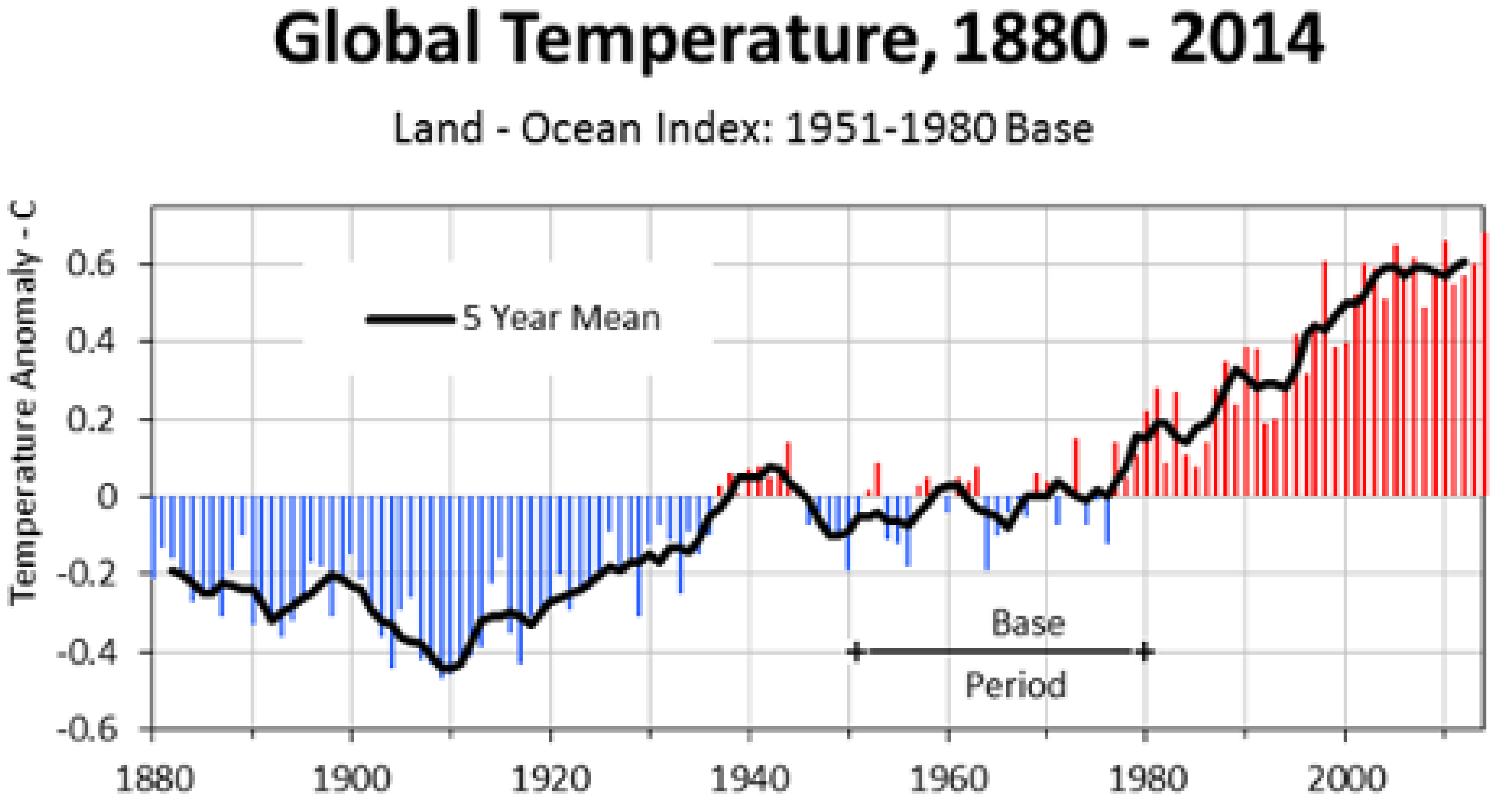
Seminar on Global Change
Universitas Gadjah Mada
Pascasardjana
Yogyakarta October 2019

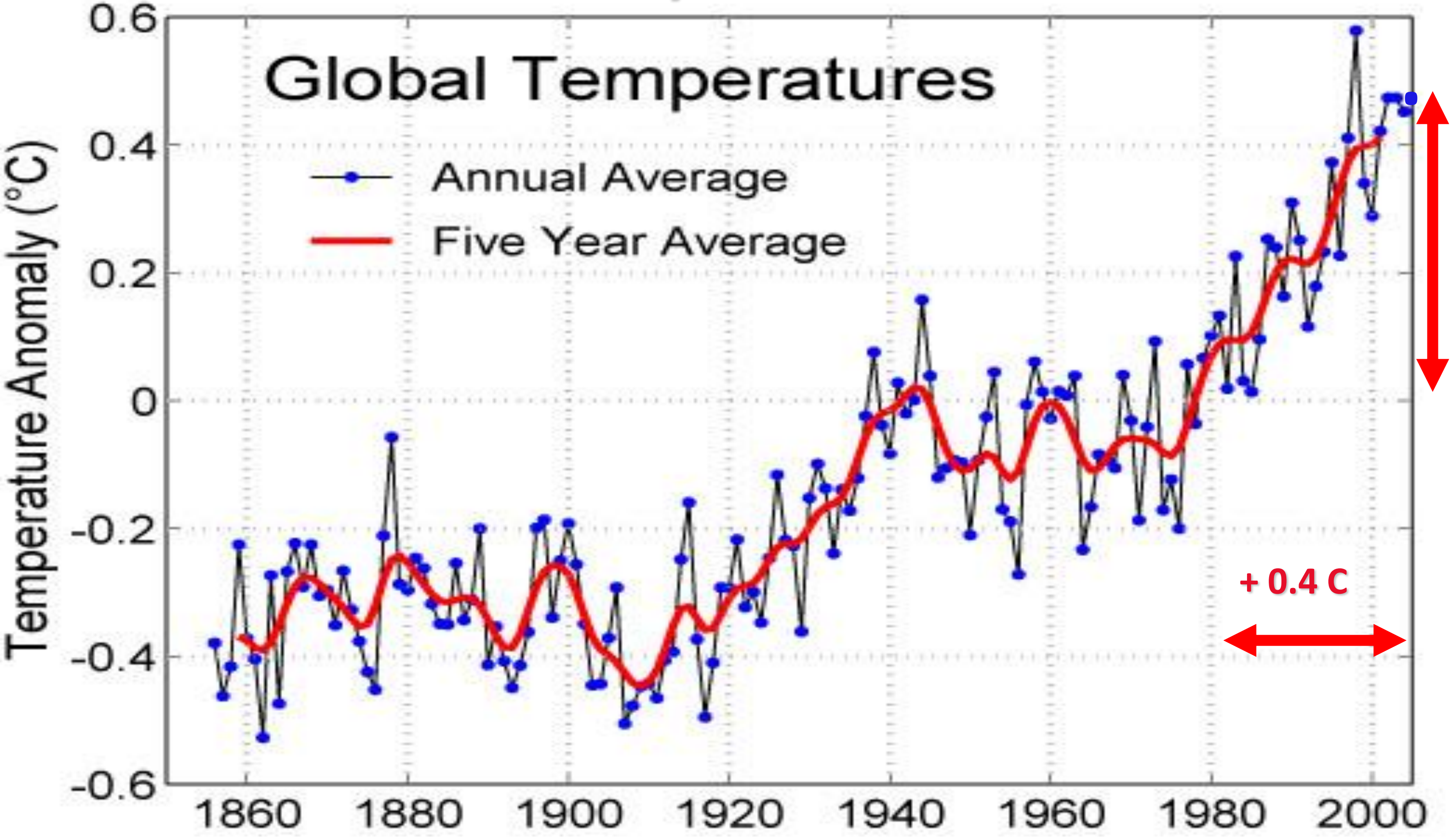





Source: Goddard Institute for Space Studies (GISS) and Climate Research Unit (CRU), prepared by ProcessTrends.com, updated by globalissues.org

# Measured Surface Temperature the past 150 years

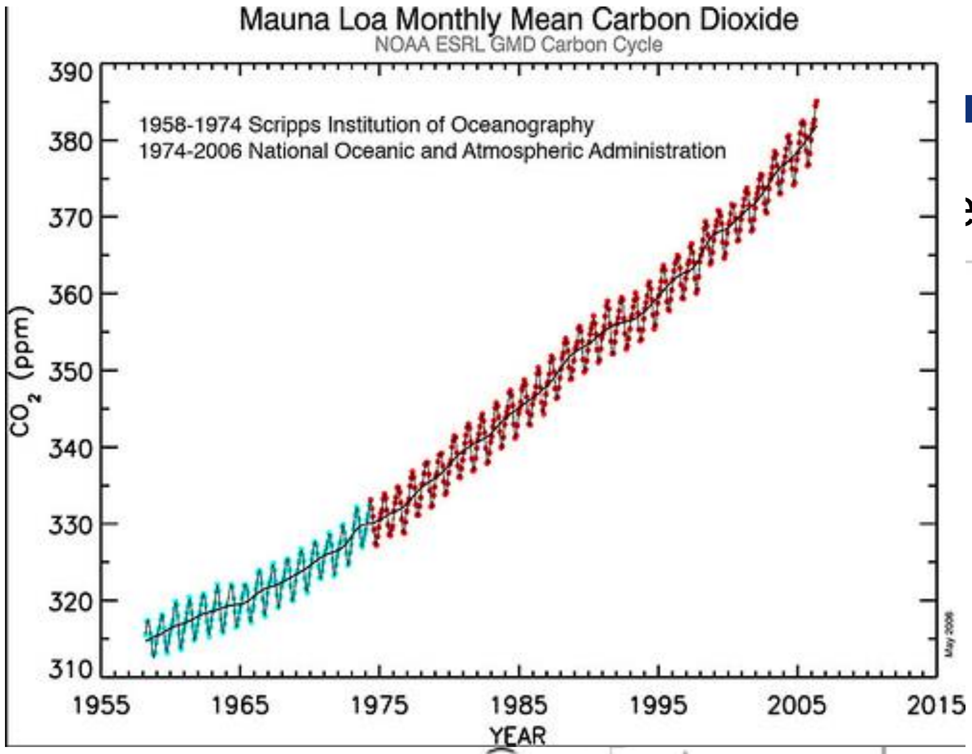
## 13 warmest years: 1997- 2009

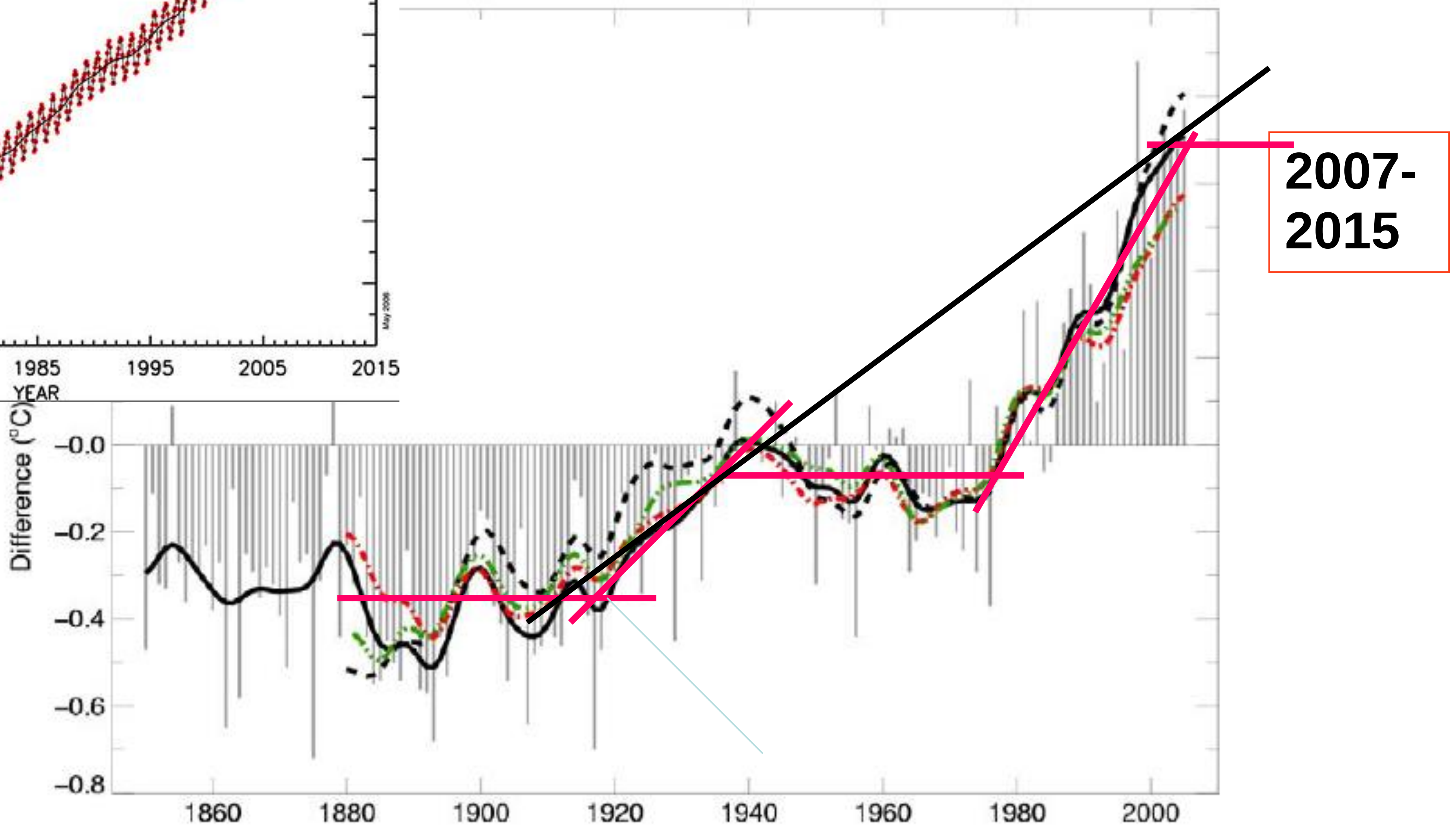


# Global mean temperature

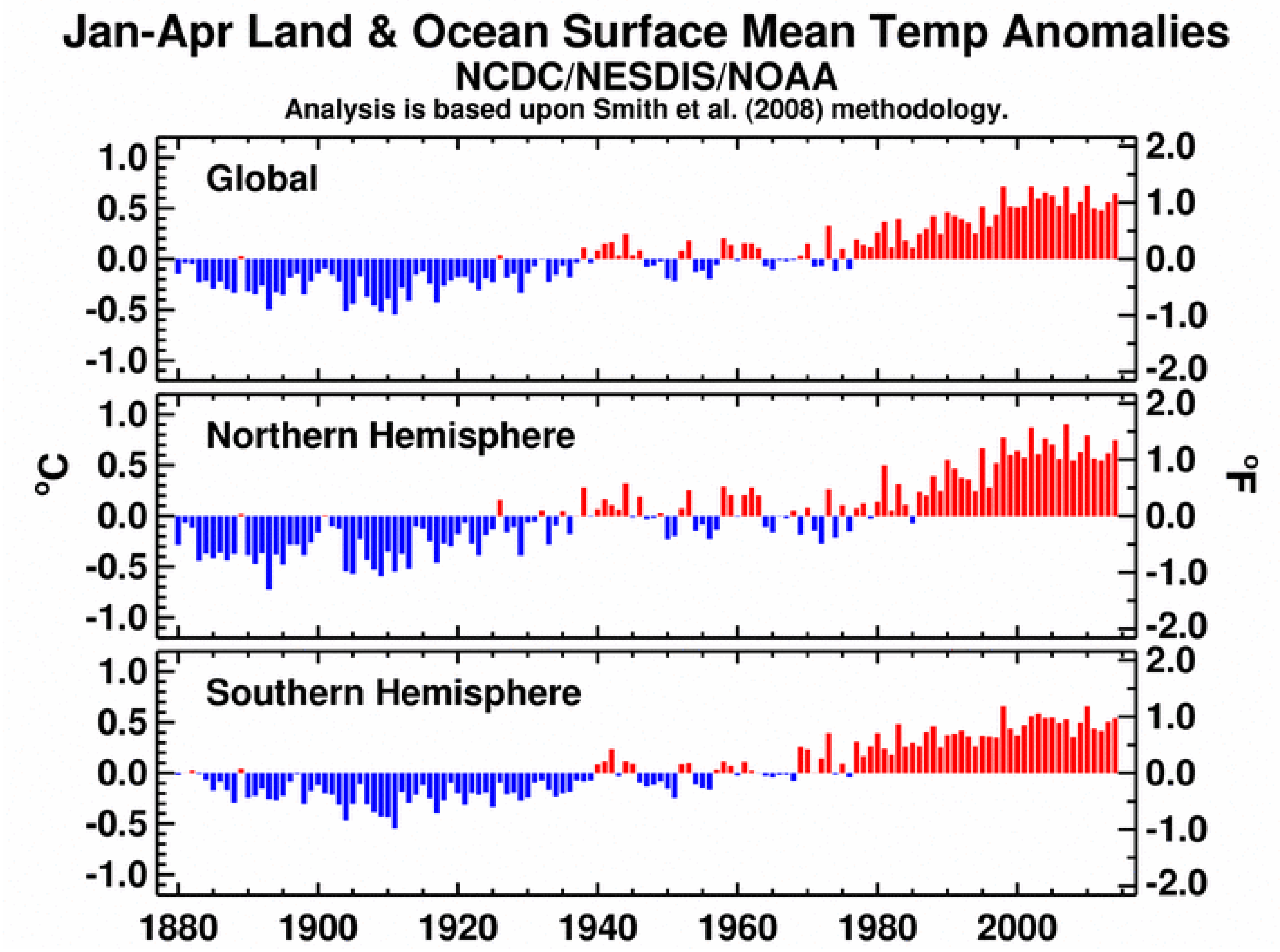


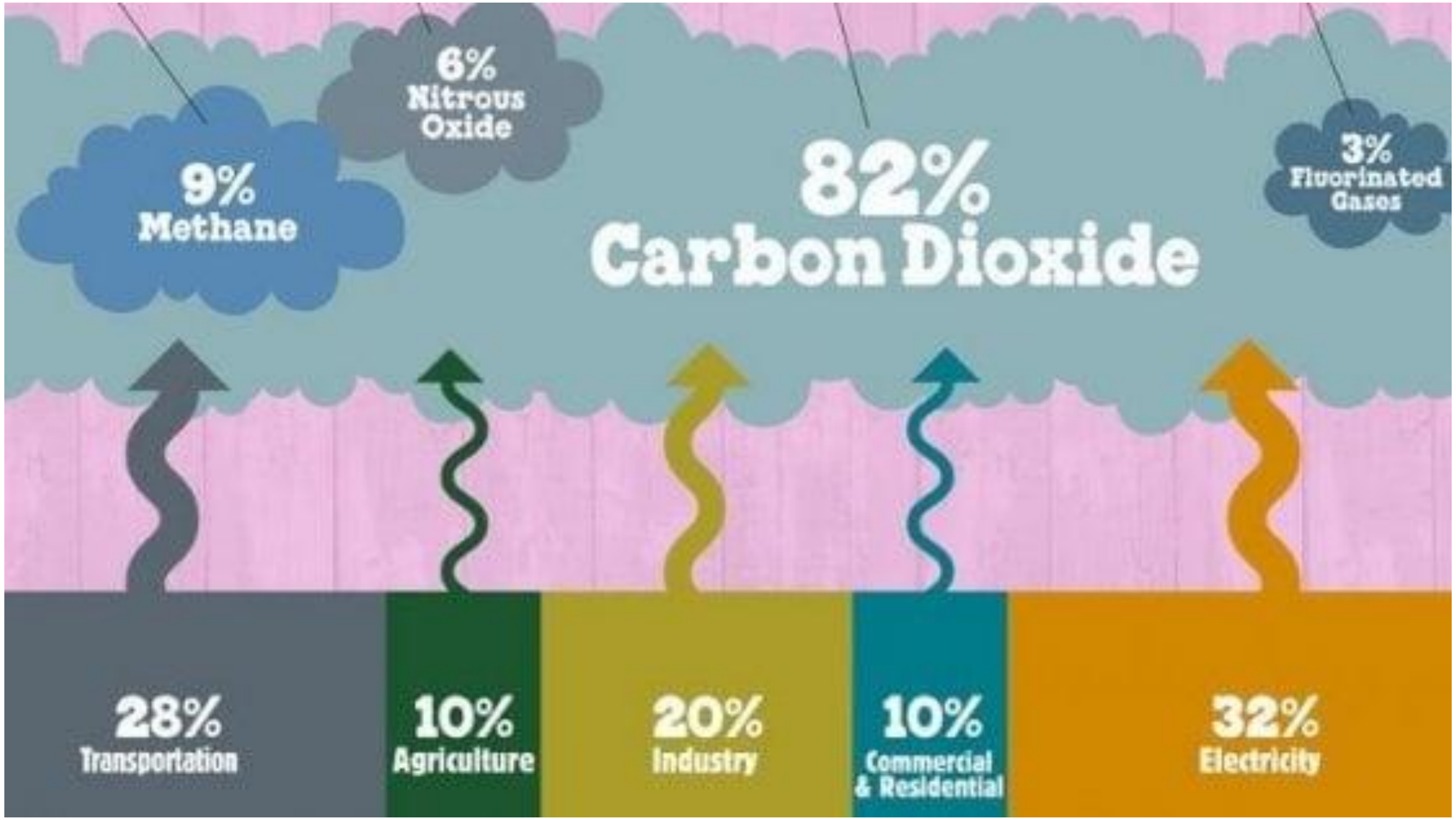
e with the average over the period 1961-90 (°C)

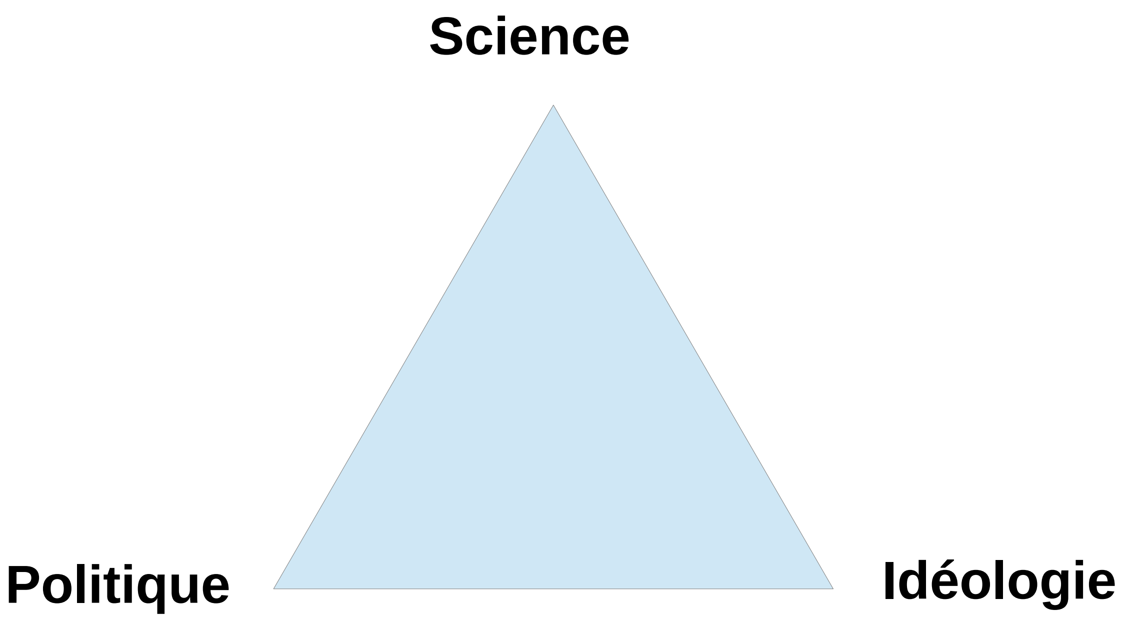


# CLIMATECHANGE and GLOBAL FOOD SECURITY;;;,

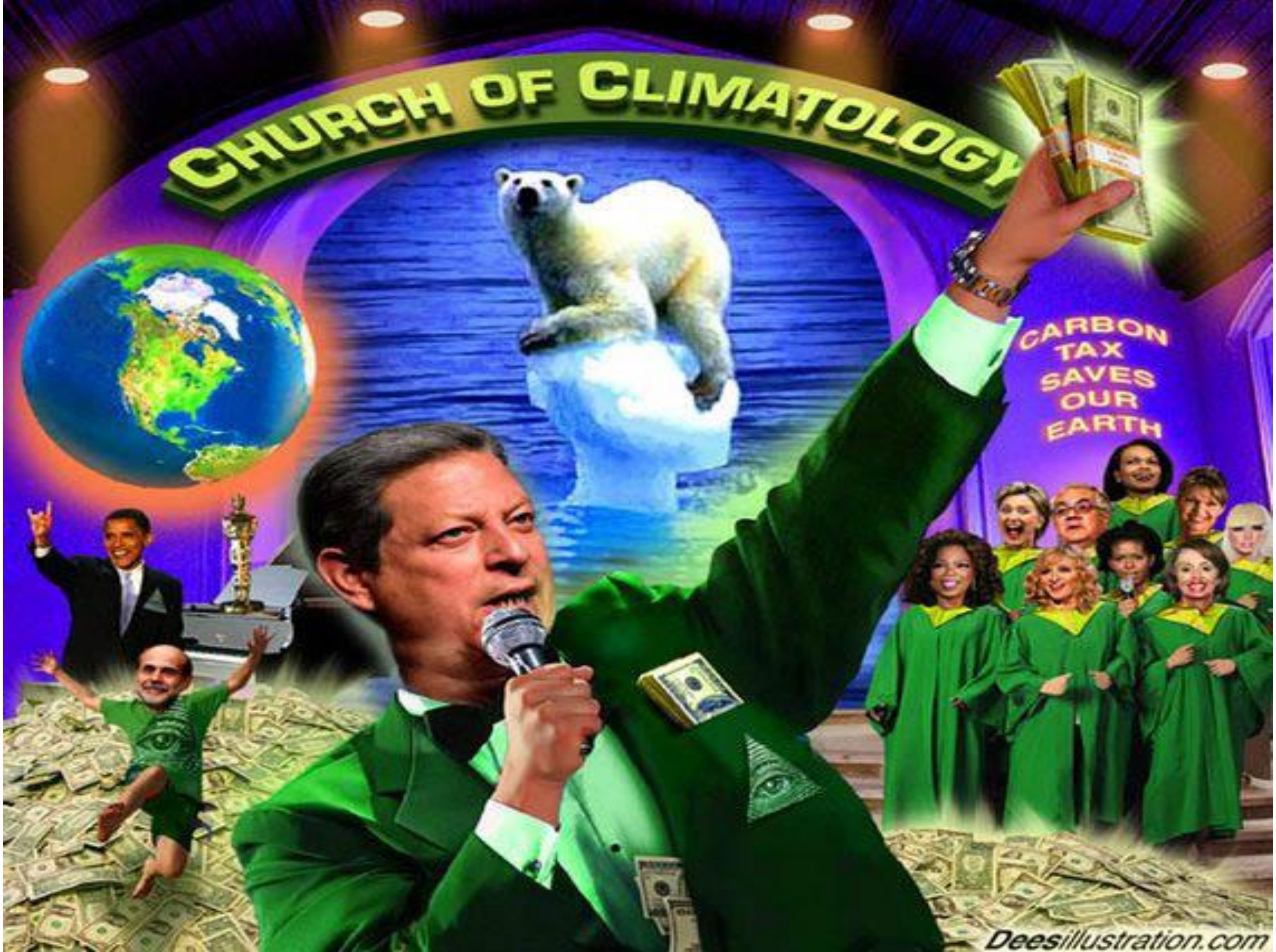



9%
Methane
6%
Nitrous
Oxide
82%
Carbon Dioxide
3%
Fluorinated
Gases
28%
Transportation
10%
Agriculture
20%
Industry
10%
Commercial
& Residential
32%
Electricity




**Among the sustainability parameters**
**« Climate change «  has taken front stage in scientific and political circles.**
**This has led to ideological developments.**

Re. Global warming, the role of greenhouse gases therein and the human contribution to GHG emissions.


CHURCH OF CLIMATOLOGY
CARBON
TAX
SAVES
OUR
EARTH
Deesillustration.com

# Confusion between the scientific and political definitions of climate change:

•

Scientific definition :

Climate change may be due to natural processes or to persistent anthropogenic presssure. Research will **apportion the two effects**.

Political definition

Equates 'climate change' with human-caused climate change and attributes **negative impacts to human activities**

**The heart of scientific and policy debate :**

**Natural climate variability**
**versus**
**Human-caused CC**

# Ecology is a science

**It is not concerned about good or bad.**

# Climatology is a science

**It should not be concerned about good or bad.**

**Per se, climate change is not good or bad.**
**it is only bad or good insofar as it impacts on human life on earth**

**Those changes maybe desired, not desired, accepted, fought agains etc…**

*** science des rapports entre les êtres vivants et leur milieu**
**** branche de la géographie physique qui examine les mécanismes régissant les conditions atmosphériques à lo**

The Anthropocene
is not the end of our world.
It's just the beginning.

Global change > climate change

Pollution is not climate change

We need to start talking about what kind of planet we want to live on

observational evidence…….mounting : T°, sea ice, glaciers,

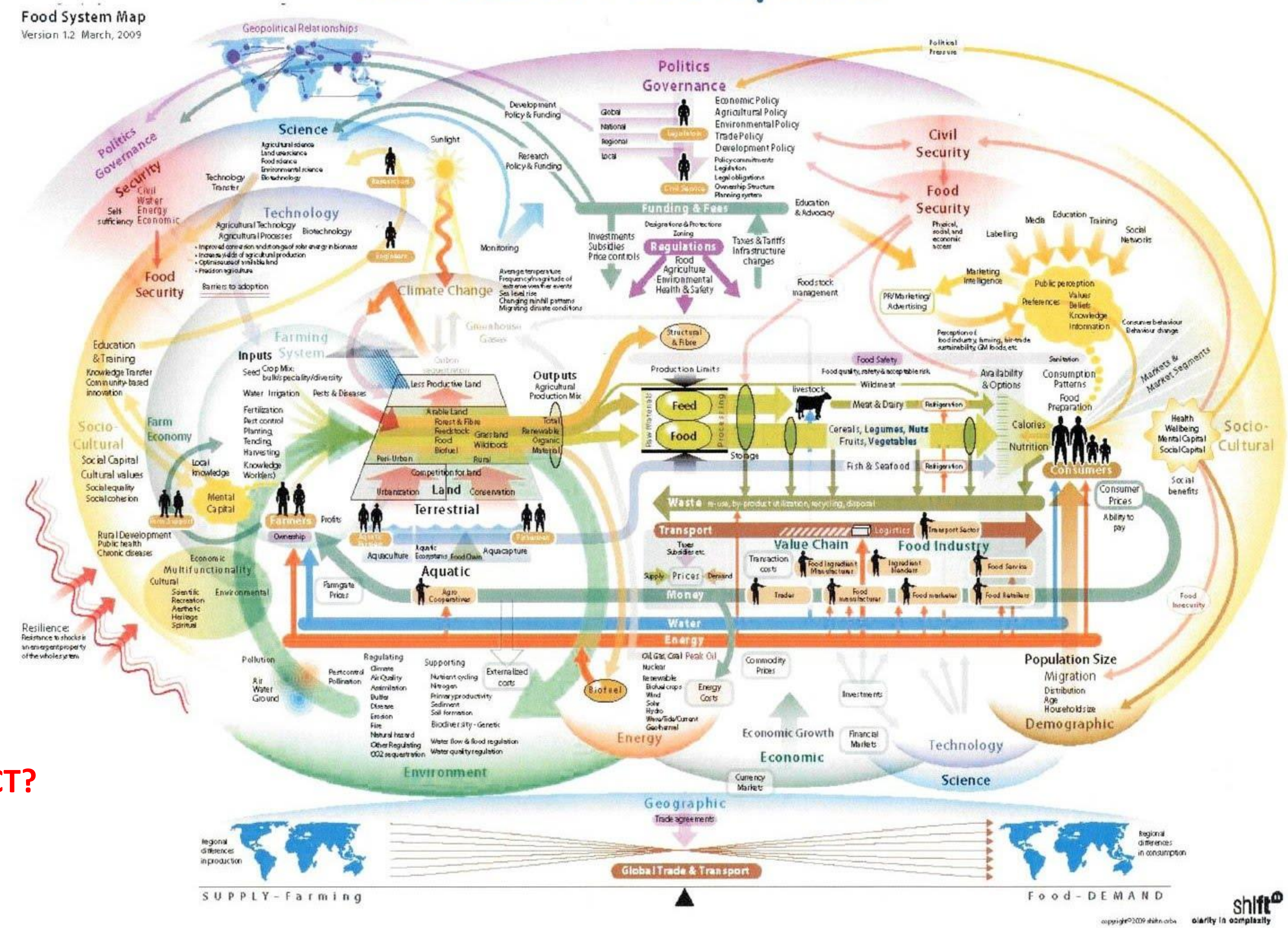
Assessments of areas of ambiguity & ignorance

Belief polarization as a result of politicization
of the science

Recognition of Uncertainty •

Accepting Doubt  and Ignorance

# The Global Food System




**MONITORING ?**
**CLIMATE IMPACT?**

But,

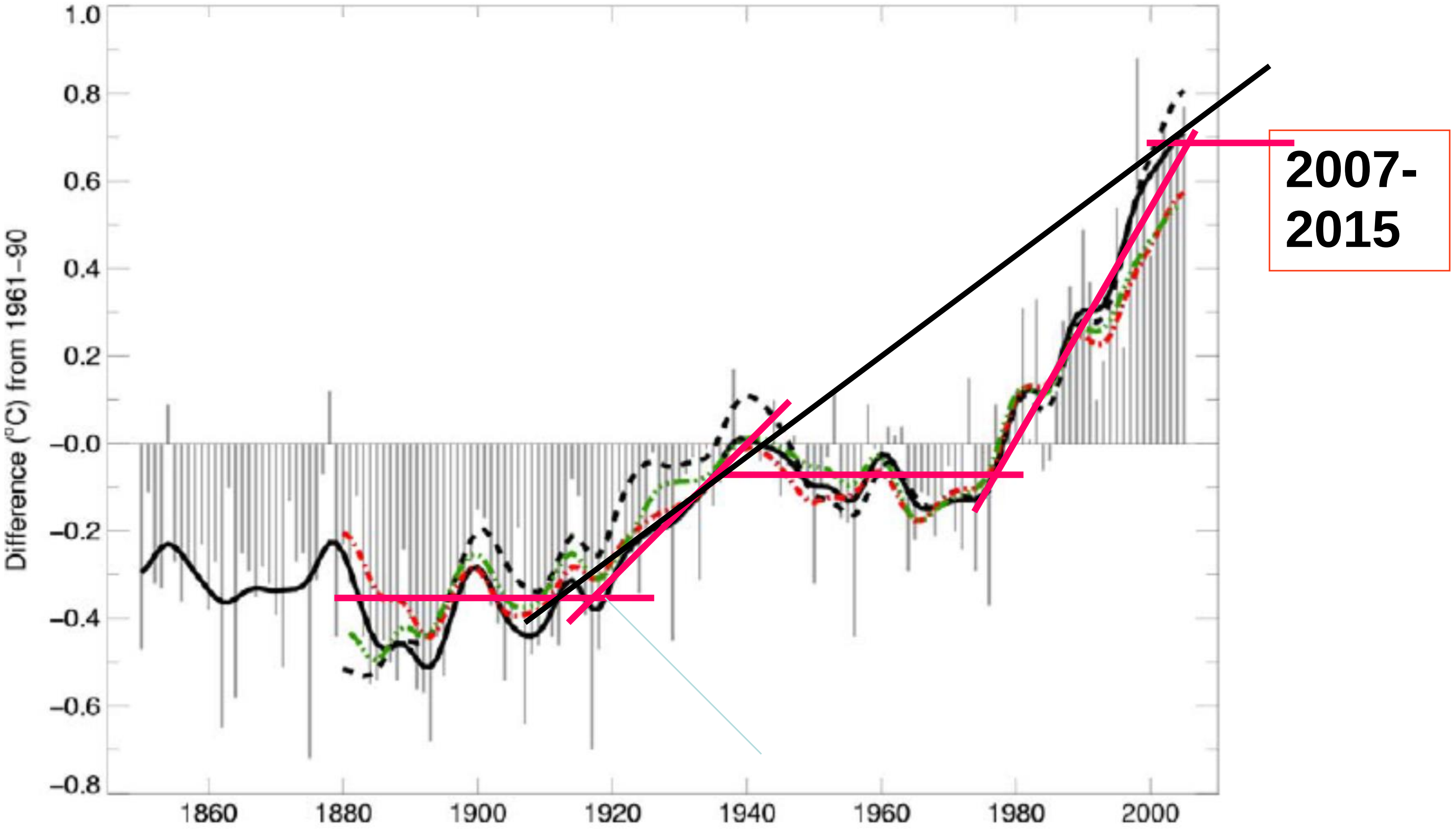
Climate impacts on food production need to be better addressed :

- **Future agriculture will be driven by more important agents of change such as technology and innovation, investments, markets, demand and new diets, etc.**

**Climate is the « changing » context in which those forces will operate.**

# Global mean temperature

T difference with the average over the period 1961-90 (°C)



- Impacts will be on **whole (eco-, agroeco-)systems** and not on individual components (e.g. a single crop) of those systems.

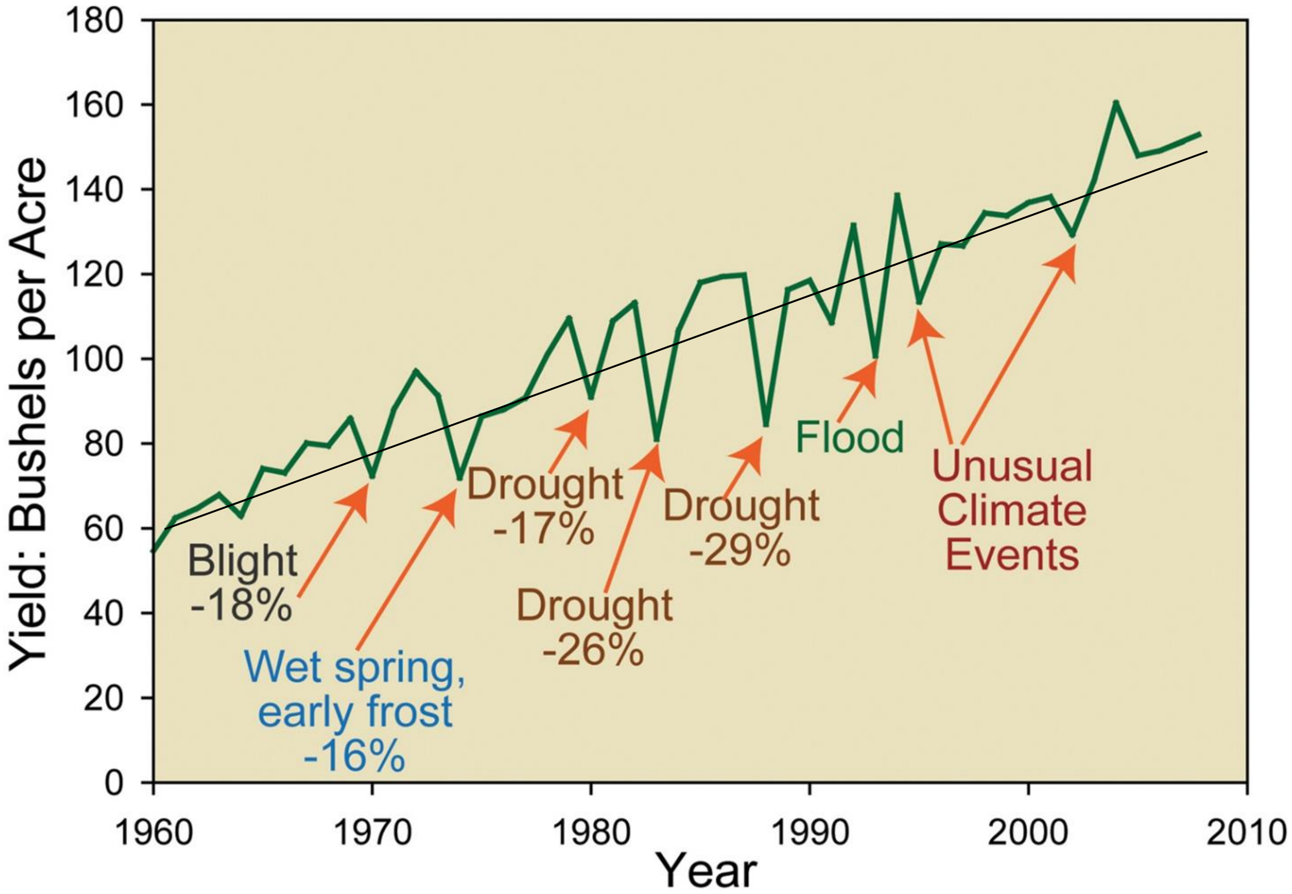
- Slow changes favour **natural adaptation** (rate of change)

- Are we not confusing **climate variability** (a probabilistic rule) with climate change ?

- Negative impacts are more dramatic then identifying new **opportunities** ?

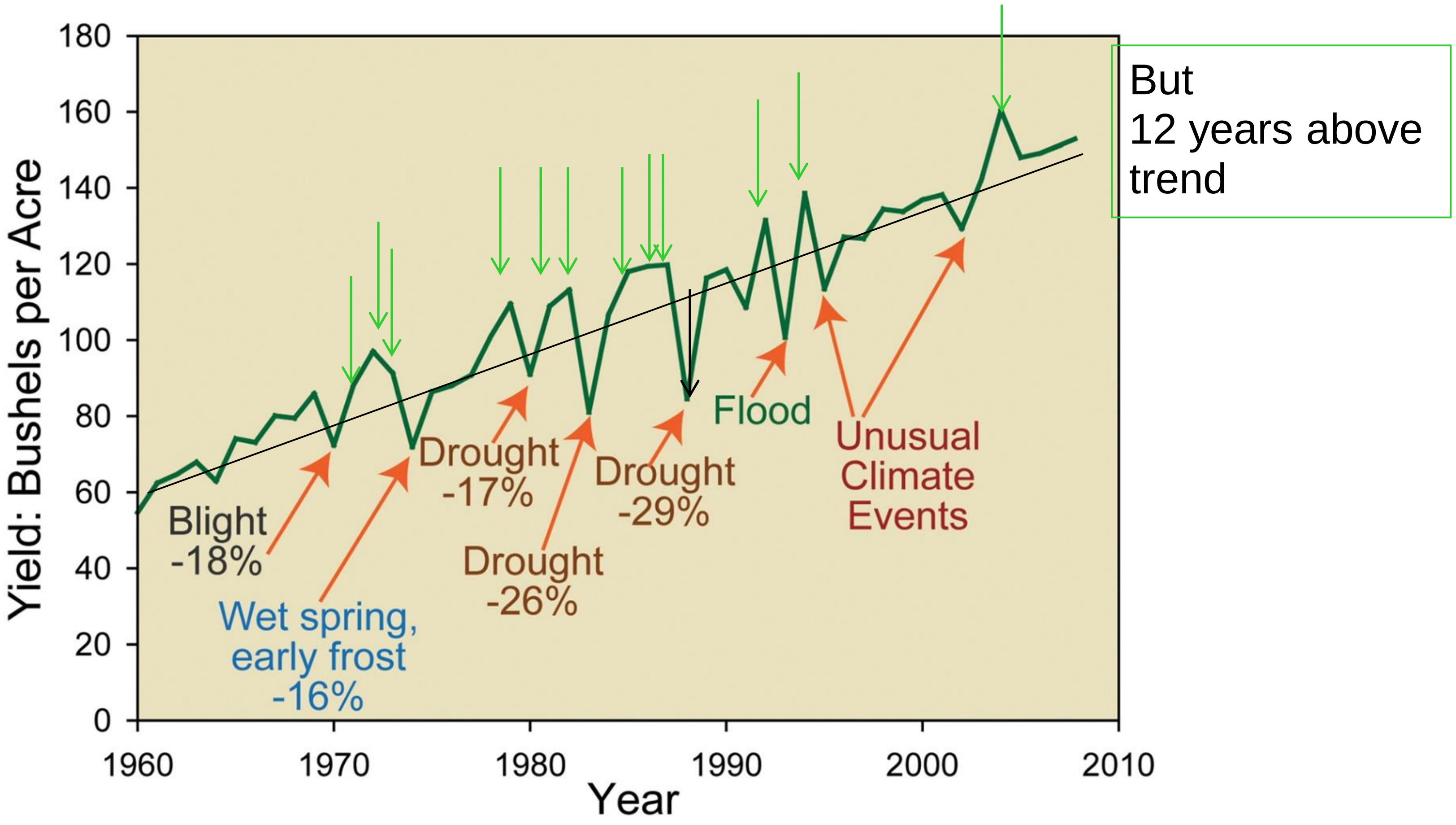
- Plants respond to **combination of T/P/{GHG}?**

- **Spatial patterns** of CC as well as of its potential (+ or -) impacts must be identified at regional to subregional scale.




Updated from NAST[219]

While technological improvements have resulted in a general increase in corn yields, extreme weather events have caused dramatic reductions in yields in particular years. Increased variation in yield is likely to occur as temperatures increase and rainfall becomes more variable during the growing season. Without dramatic technological breakthroughs, yields are unlikely to continue their historical upward trend as temperatures rise above the optimum level for vegetative and reproductive growth.

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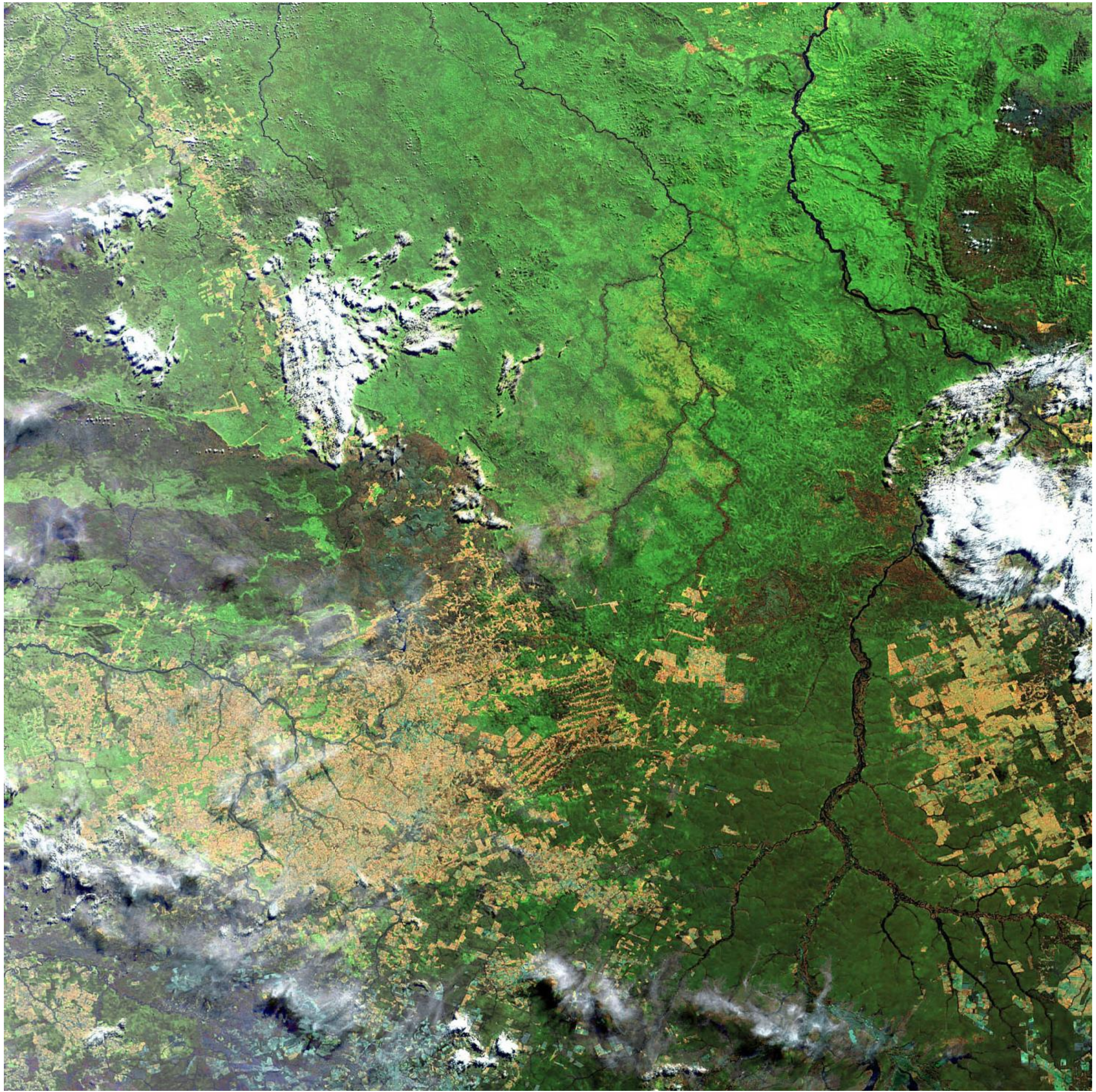

Un FRONT de changement global ?

China, Heilongjian Province - 2010

Août 2008 Brazil, Mato Grosso: le changement global en marche devant nos yeux !!!!

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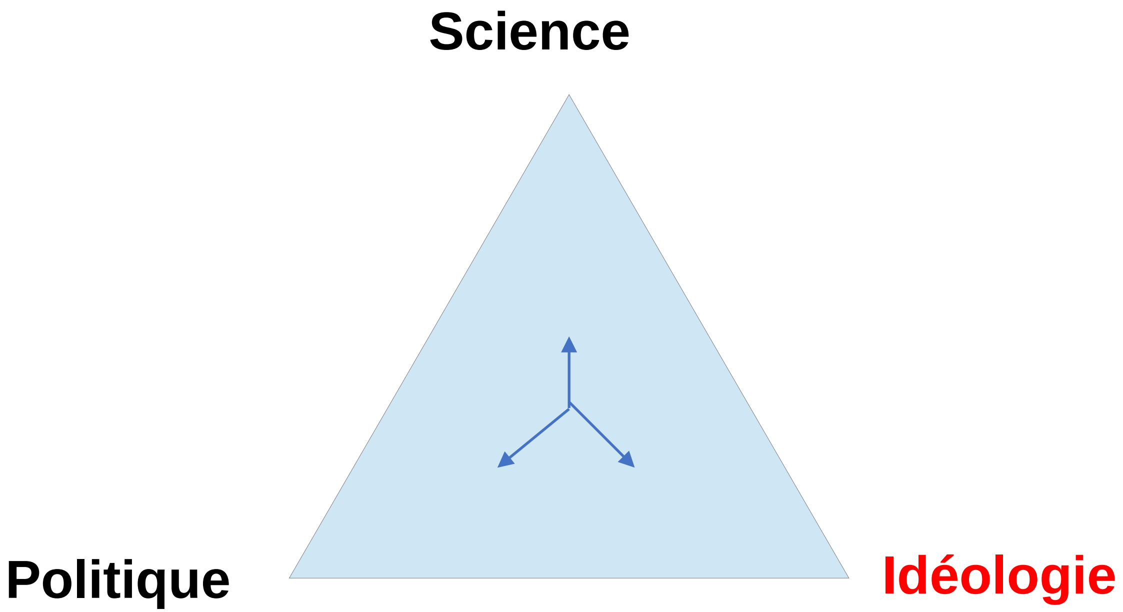


*Mesures, Observations*
*Hypothèses*
*Experimentation*
*Vérification*
*Modelisation*

Example

Climate impacts on food production need to be better addressed :

**! Future agriculture will be driven by more important agents of change such as technology and innovation, investments, markets, demand and new diets, etc.**

**Climate is the « changing » context in which those forces will operate.**

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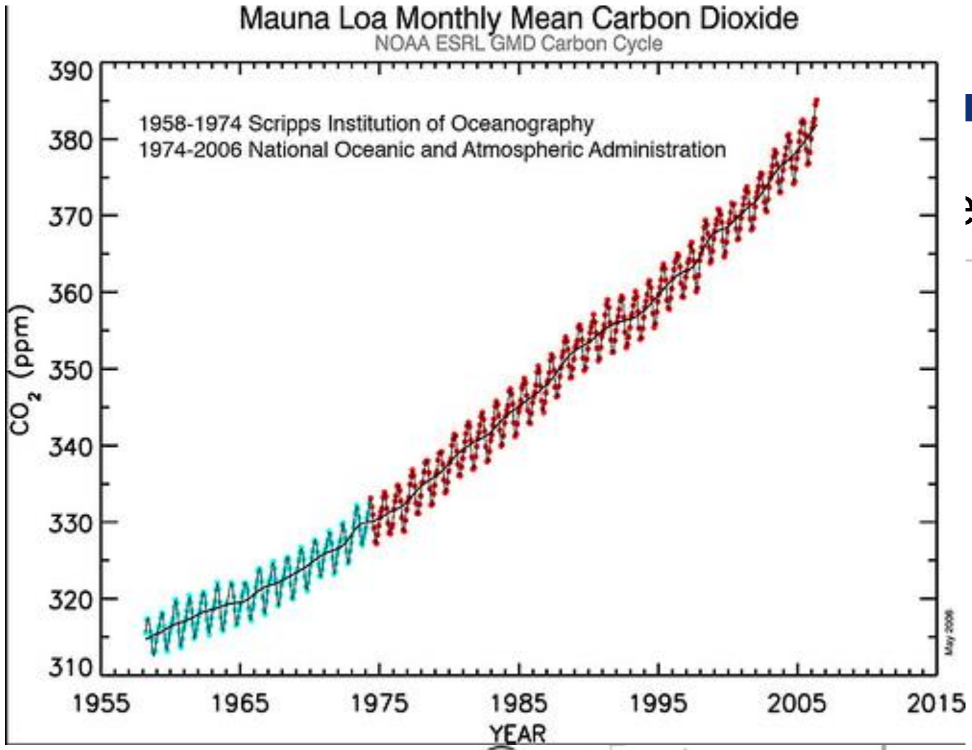
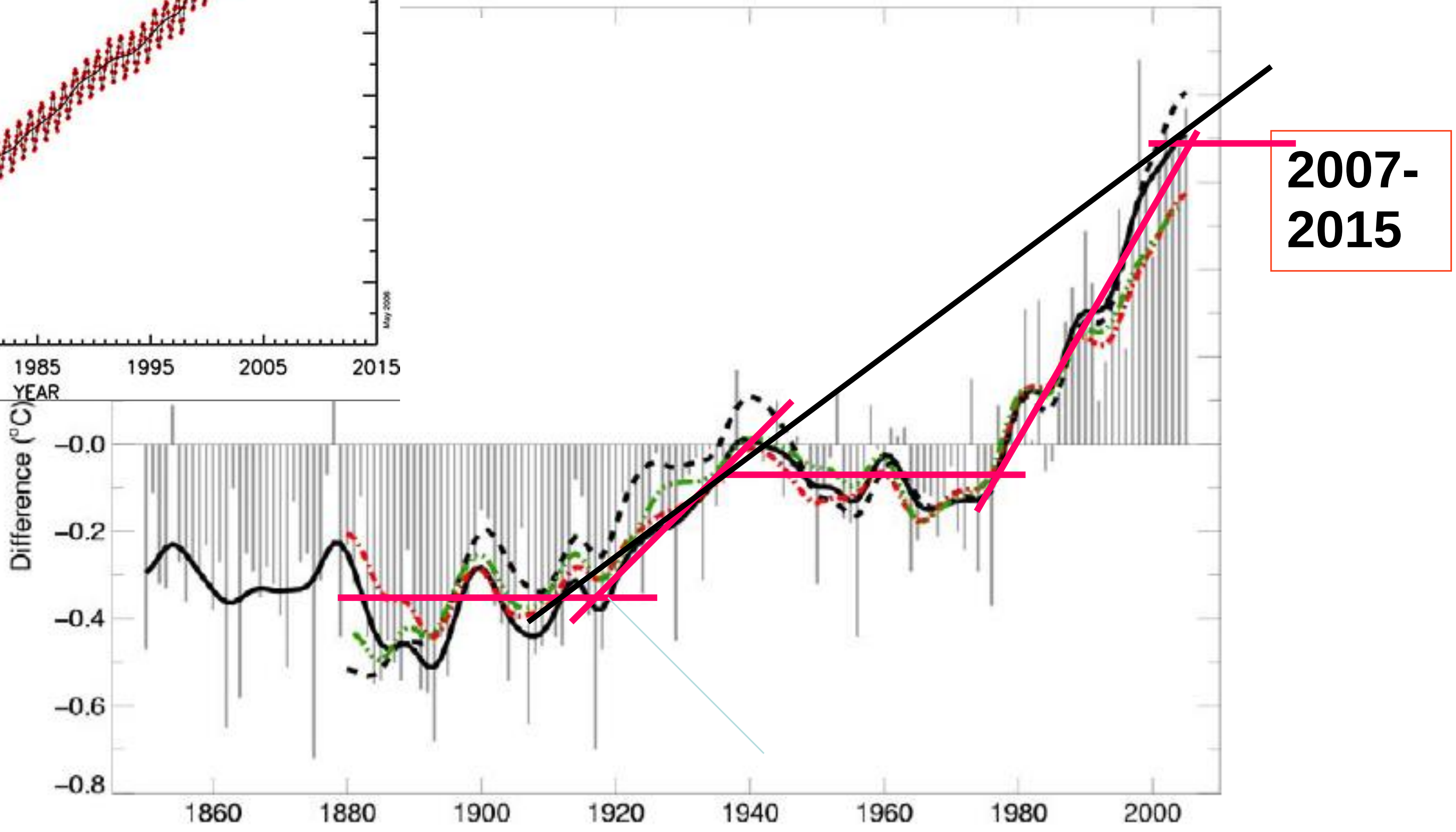


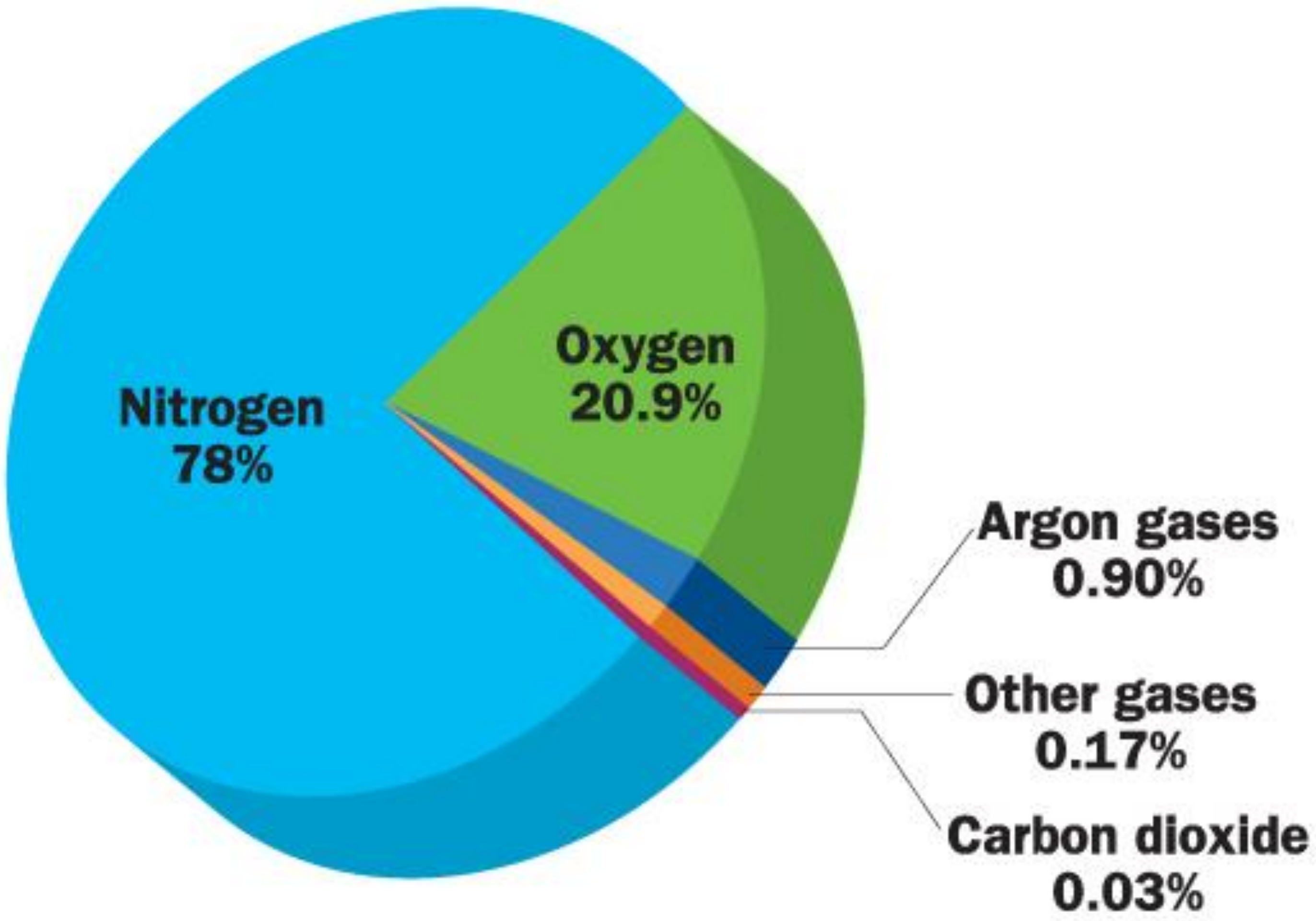



ARTICLE

Recent pause in the growth rate of atmospheric CO2 due to enhanced terrestrial carbon uptake Trevor F. Keenan1,2, I. Colin Prentice2,3, Josep G. Canadell4, Christopher A. Williams5, Han Wang2,6, Michael Raupach4,z & G. James Collatz7

Terrestrial ecosystems play a significant role in the global carbon cycle and offset a large fraction of anthropogenic CO2 emissions. The terrestrial carbon sink is increasing, yet the mechanisms responsible for its enhancement, and implications for the growth rate of atmospheric CO2, remain unclear. Here using global carbon budget estimates, ground, atmospheric and satellite observations, and multiple global vegetation models, we report a recent pause in the growth rate of atmospheric CO2, and a decline in the fraction of anthropogenic emissions that remain in the atmosphere, despite increasing anthropogenic emissions. We attribute the observed decline to increases in the terrestrial sink during the past decade, associated with the effects of rising atmospheric CO2 on vegetation and the slowdown in the rate of warming on global respiration. The pause in the atmospheric CO2 growth rate provides further evidence of the roles of CO2 fertilization and warming-induced respiration, and highlights the need to protect both existing carbon stocks and regions, where the sink is growing rapidly.

In a similar way the Anthropocene shifts our world on its axis. This single word encapsulates the fact that human activity now affects Earth's life support system. It conveys the notions of deep time – the past and future – and the uniqueness of today. Beyond geology and Earth system science, it captures the profound responsibility we now must shoulder. It provides a new lens to see our human footprint and it communicates the urgency with which we must now act. The dominant worldview of infinite natural resources, of externalities and exponential growth, is at an end. We are no longer a small world on a big planet. We are now a big world on a small planet, where we have reached a saturation point. Unsustainability at all scales, from localized deforestation to air pollution from cars, hits the planetary ceiling, putting our future at risk. Fifty years of exponential growth has accumulated to such an extent that we have reached Planetary Boundaries – and crashed through them


Nitrogen
78%
Oxygen
20.9%
Argon gases
0.90%
Other gases
0.17%
Carbon dioxide
0.03%

- Impacts will be on **whole (eco-, agroeco-)systems** and not on individual components (e.g. a single crop) of those systems.

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- Are we not confusing **climate variability** (a probabilistic rule) with climate change ?

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- Plants respond to **combination of T/P and to |CO2|**

- **Spatial patterns** of CC as well as of its potential (+ or -) impacts must be identified at regional to subregional scale.

**impact=**

**event severity**

**x**

**exposure**

**x**

**vulnerability**

(impact= event severity x exposure x vulnerability)

The more vulnerable ecosystems and society become,

the more likely « normal » climate impacts will intensify

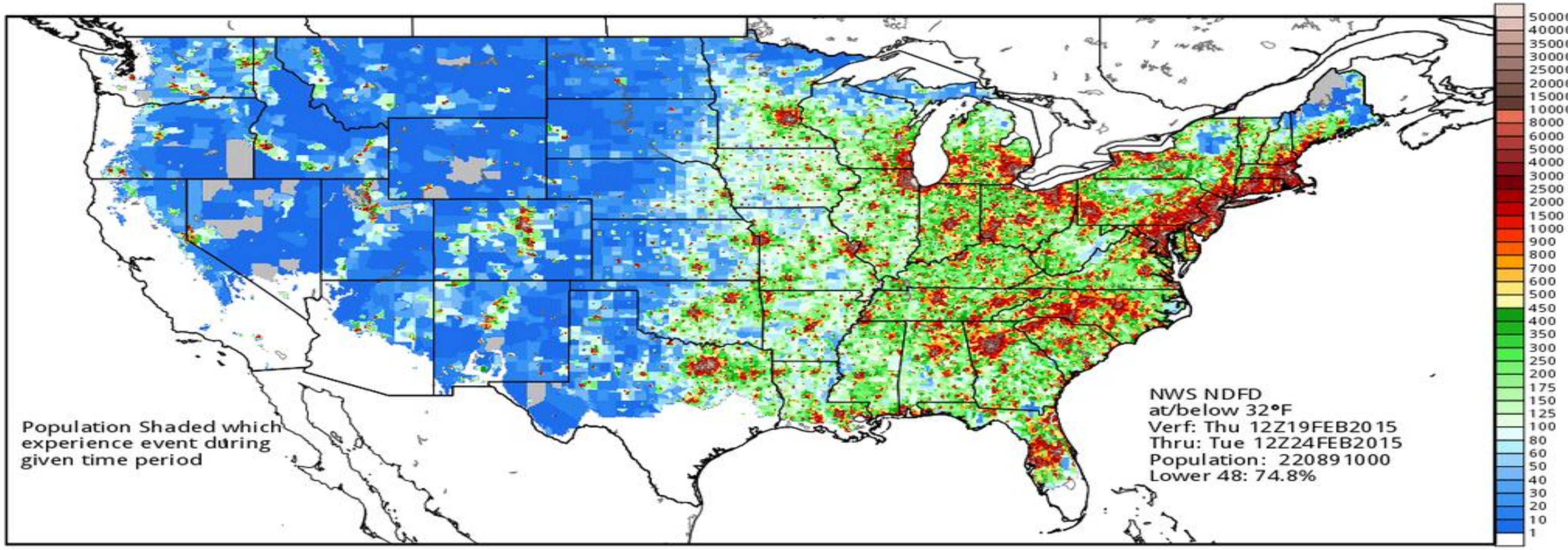
Extreme temperatures

Changes in growing season length timing

Changes in rainfall patterns

Changes in extreme rainfall events

Wind patterns



Population Shaded which
experience event during
given time period
NWS NDFD
at/below 32°F
Verf: Thu 12Z19FEB2015
Thru: Tue 12Z24FEB2015
Population: 220891000
Lower 48: 74.8%
50000
40000
35000
30000
25000
20000
15000
10000
8000
6000
5000
4000
3000
2500
2000
1500
1000
900
800
700
600
500
450
400
350
300
250
200
175
150
125
100
80
60
50
40
30
20
10
1


22-10-19

***0.75 x 1 x 0***

**(impact= event x exposure x vulnerability)**

**Event : prolonged high temperature for period x (ex> 34 ° C for july – sept)**

**Exposure : plants in field (yes)**

**Vulnerability : phenological stage (ripening = vulnerability = 0**

**Impact = 0**

***Impact = 0.5 x 1 x 0.1 = 0.05***

**Ex: floods**

**(impact= event x exposure x vulnerability)**

**- Event : 30 centimeter high - 10 days**

**- Exposure : 300 000 people**

**- Vulnerability : low because houses on stilts**

***Impact = 1 x 1x 0.1 = 0.1***

**Ex: climate variability**

**(impact= event x exposure x vulnerability)**

- **Event : < 50% rainfall for 3 years**
- **Exposure : 200 000 people**
- **Vulnerability : low because irrigation and large reservoir**

MITIGATION IS ABOUT REDUCING THE IMPACT VIA REDUCING SEVERITY OF EVENT

ADAPTATION IS ABOUT REDUCING IMPACT VIS REDUCING EXPOSURE AND OR VULNERABILITIES

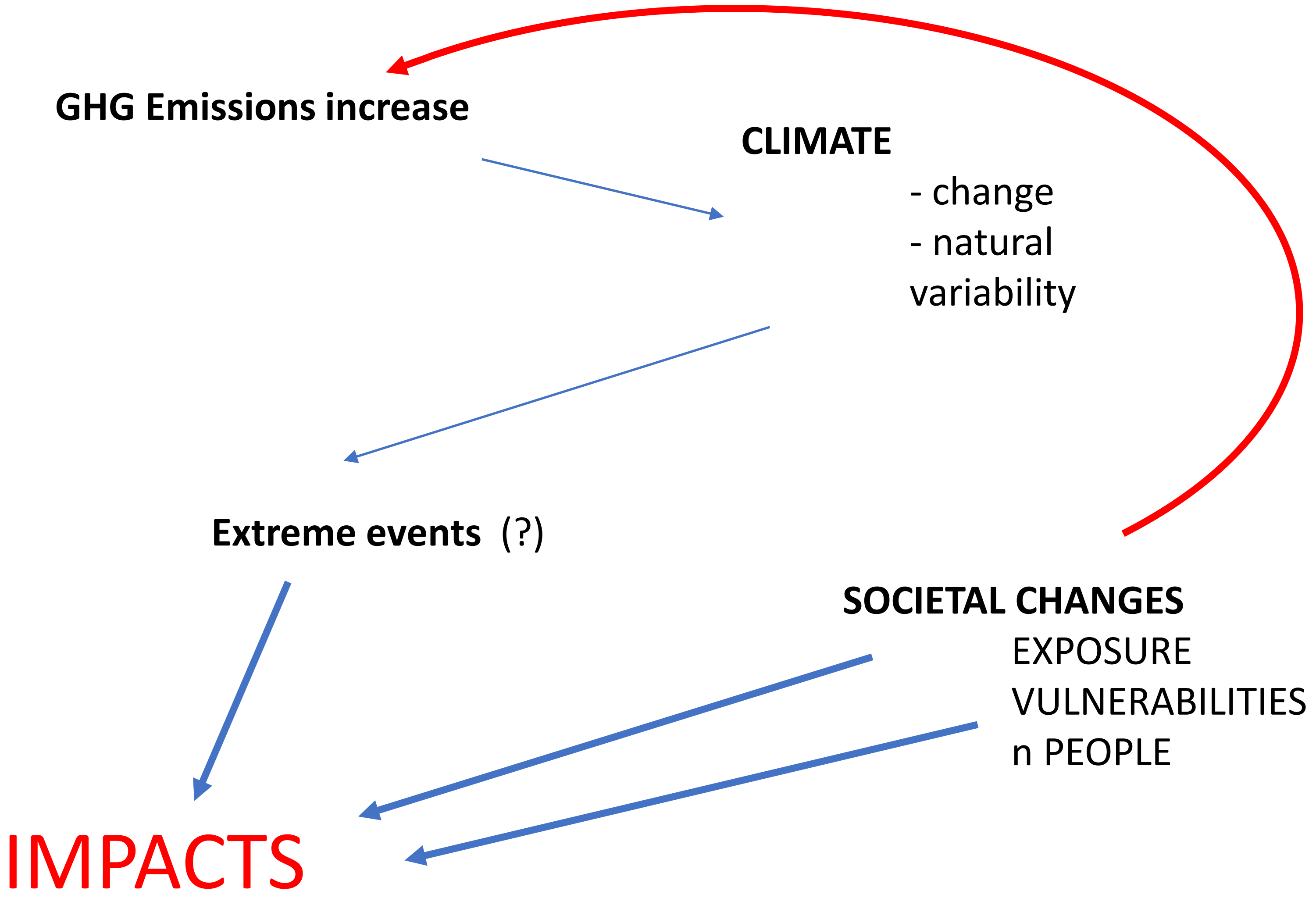
---

EX/ FLOOD IMPACTS

_ MITIGATION = REDUCING GHG TO REDUCE p(EXTREME EVENTS) _

- ADAPTATION =
  - REDUCING EXPOSURE /
    - AVOIDING POTENTIALLY FLOODED AREAS
  - REDUCING VUNERABILITIES
    - BUILDING LEVEES

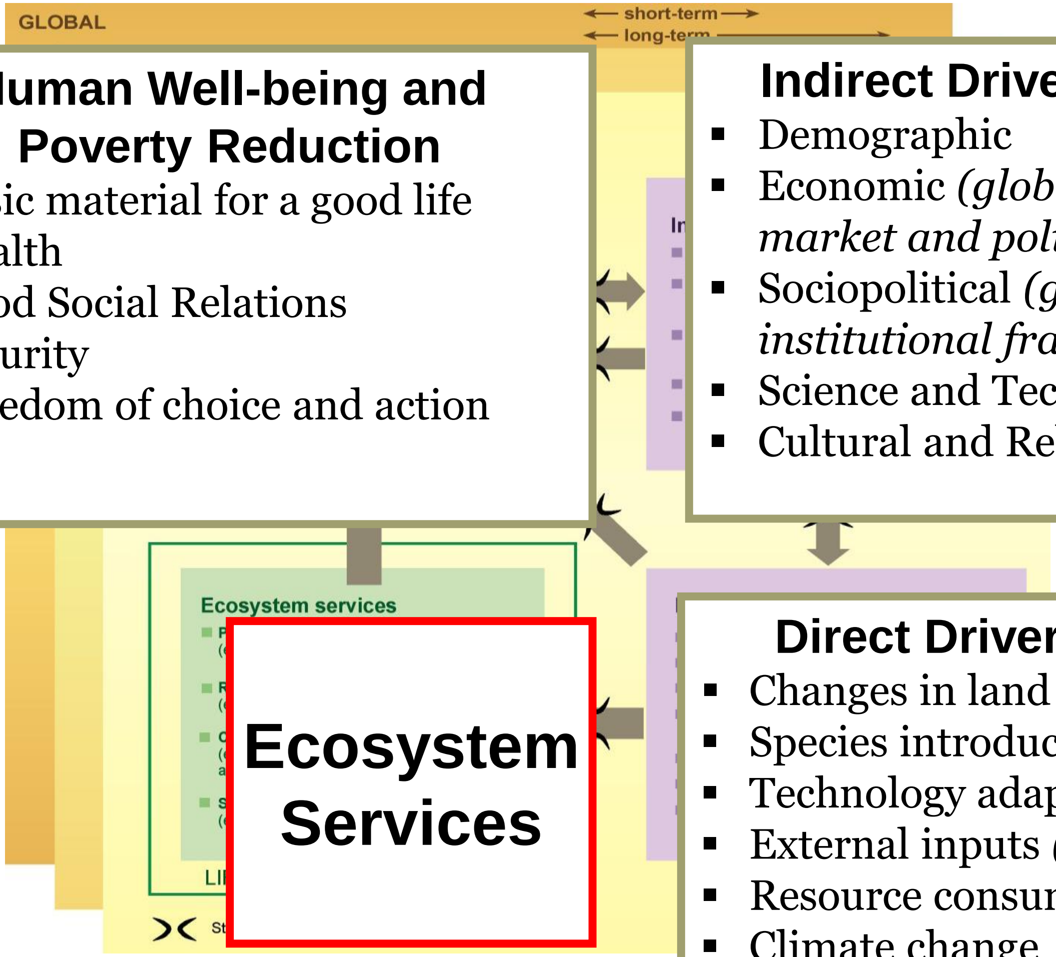
_


GHG Emissions increase
CLIMATE
- change
- natural
variability
Extreme events (?)
SOCIETAL CHANGES
EXPOSURE
VULNERABILITIES
n PEOPLE
IMPACTS

Developping a formal framework for the

**science of impacts**

# MA Framework




**Human Well-being and Poverty Reduction**

- Basic material for a good life
- Health
- Good Social Relations
- Security
- Freedom of choice and action

**Indirect Drivers of Change**

- Demographic
- Economic *(globalization, trade, market and policy framework)*
- Sociopolitical *(governance and institutional framework)*
- Science and Technology
- Cultural and Religious

**Ecosystem Services**

**Direct Drivers of Change**

- Changes in land use
- Species introduction or removal
- Technology adaptation and use
- External inputs *(e.g., irrigation)*
- Resource consumption
- Climate change
- Natural physical and biological drivers *(e.g., volcanoes)*

## The Millennium Assessment Project 2002

Ecosystem services

### •Provisioning

•C ... ed

### •Regulating

•Ben
from

### •Cultural

•N
be

Photo credits (left to right, top to bottom): Purdue University, WomenAid.org, LSUP, NASA, unknown, CEH Wallingford, unknown, W. Reid, Staffan Widstrand

Les services fournis par les écosystèmes sont de différents types

- Fourniture d'aliments, d'eau propre, de bois, de produits biochimiques, de gènes

- Régulateurs du climat, de régime hydrique, composition gazeuse de l'atmosphère, maladies, pollinisation

- Soutien à long terme comme dans les cycles de nutrients, formation des sols, production primaire, etc...

- Bénéfices non-matériels tels que récréation, esthétiques culturels, spirituels, inspirationnels etc...

# Degradation and unsustainable use of ecosystem services

- Approximately 60% (15 out of 24) of the ecosystem services evaluated in this assessment are being degraded or used unsustainably
- The degradation of ecosystem services often causes significant harm to human well-being and represents a loss of a natural asset or wealth of a country

**sustainability science**, an emerging field of research dealing with the interactions between natural and social systems, and with how those interactions affect the challenge of sustainability: meeting the needs of present and future generations while substantially reducing poverty and conserving the planet's life support systems.

La "durabilité" est aujourd'hui le mot clé des politiques locales, nationales et globales. Le mot est chargé de valeurs ancrées dans un **sens de responsabilité collective et d'attention bienveillante** (caring). Sa mise en oeuvre suppose une application harmonieuse des **trois piliers du développement** : croissance économique, protection de la qualité environnementale et équité sociale dans le partage du bien-être. Techniquement le développement durable requiert **l'optimisation d'une série de paramètres disparates**; certains d'entre eux se réfèrent à des faits mesurables, parfois permanents mais souvent changeants.. Dans certains cas, ces faits sont soumis à des jugements liés à des **systèmes de valeurs** ou même à des croyances peu rationnelles. Le DD est aussi **«scale dependent** ».Clairement, le développement durable n'a pas encore trouvé sa théorie.

GOVERNANCE

Is there an **imperative need for global management** of natural resources ?

What are the **advantages** linked to it?

At **what level** – subnational, national, regional, continental, global?*

What **form** could it take (see following slides)?

Are national « self-sufficiency » objectives justified?  If yes, in which domain?

** Or towards a changing landscape of regional arrangements, bilateral deals, geographical specalisation, cultural links etc...*

# PLANETARY MANAGEMENT ?

mondialisation

reactivity

proactivity

regionalisation

## Global Orchestration

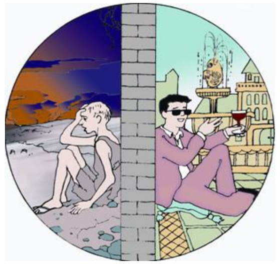
## TechnoGarden

## Order from Strength

## Adapting Mosaic

# Scenario Storylines

– **Global Orchestration** Globally connected society that focuses on global trade and economic liberalization and takes a reactive approach to ecosystem problems but that also takes strong steps to reduce poverty and inequality and to invest in public goods such as infrastructure and education.



– **Order from Strength** Regionalized and fragmented world, concerned with security and protection, emphasizing primarily regional markets, paying little attention to public goods, and taking a reactive approach to ecosystem problems.

# Scenario Storylines

– **Adapting Mosaic** Regional watershed-scale ecosystems are the focus of political and economic activity. Local institutions are strengthened and local ecosystem management strategies are common; societies develop a strongly proactive approach to the management of ecosystems.

– **TechnoGarden** Globally connected world relying strongly on environmentally sound technology, using highly managed, often engineered, ecosystems to deliver ecosystem services, and taking a proactive approach to the management of ecosystems in an effort to avoid problems.

For visualisation and download :

http://maps.elie.ucl.ac.be/CCI/viewer/index.php

The ESA CCI Land Cover team led by the Université catholique de Louvain (BE) includes Brockmann-Consult (DE), Gamma RS (CH), Wageningen University (NL), University of Jena (DE), University of Pavia (IT), Public Research Centre - Gabriel Lippmann (LU), Joint Research Centre (EU), and as climate modelers, the Laboratoire des sciences du climat et l'environnement (FR), the Met Office Hadley Centre (UK), and the Max Planck Institute for Meteorology (DE).

The problem is,

what works for me will very likely not work for you.

So by focusing on environmental limits instead of on the **social strategies** that enable better environmental and social outcomes, we fail to engage the only force of nature that can help us: human aspirations for a better future.

, **it is people, and their institutions — not science — that will decide the future**.
Or is it the “market”….?

talking **more about the better future we want**, and **less about the future we don’t**. It’s about articulating **values**, and about **sharing**, fairly, the only planet we have with one another and the rest of life on earth.

“a direct statistical link between anthropogenic climate change and trends in the magnitude/frequency of floods has not been established...

There is such a furore of concern about the linkage between greenhouse forcing and floods that it causes society to lose focus on the things we already know for certain about floods and how to mitigate and adapt to them.”

Zbigniew et al. 2014 Hydrological Sciences Journal

“Recent long-term droughts in western North America cannot definitively be shown to lie outside the very large envelope of natural precipitation variability in this region