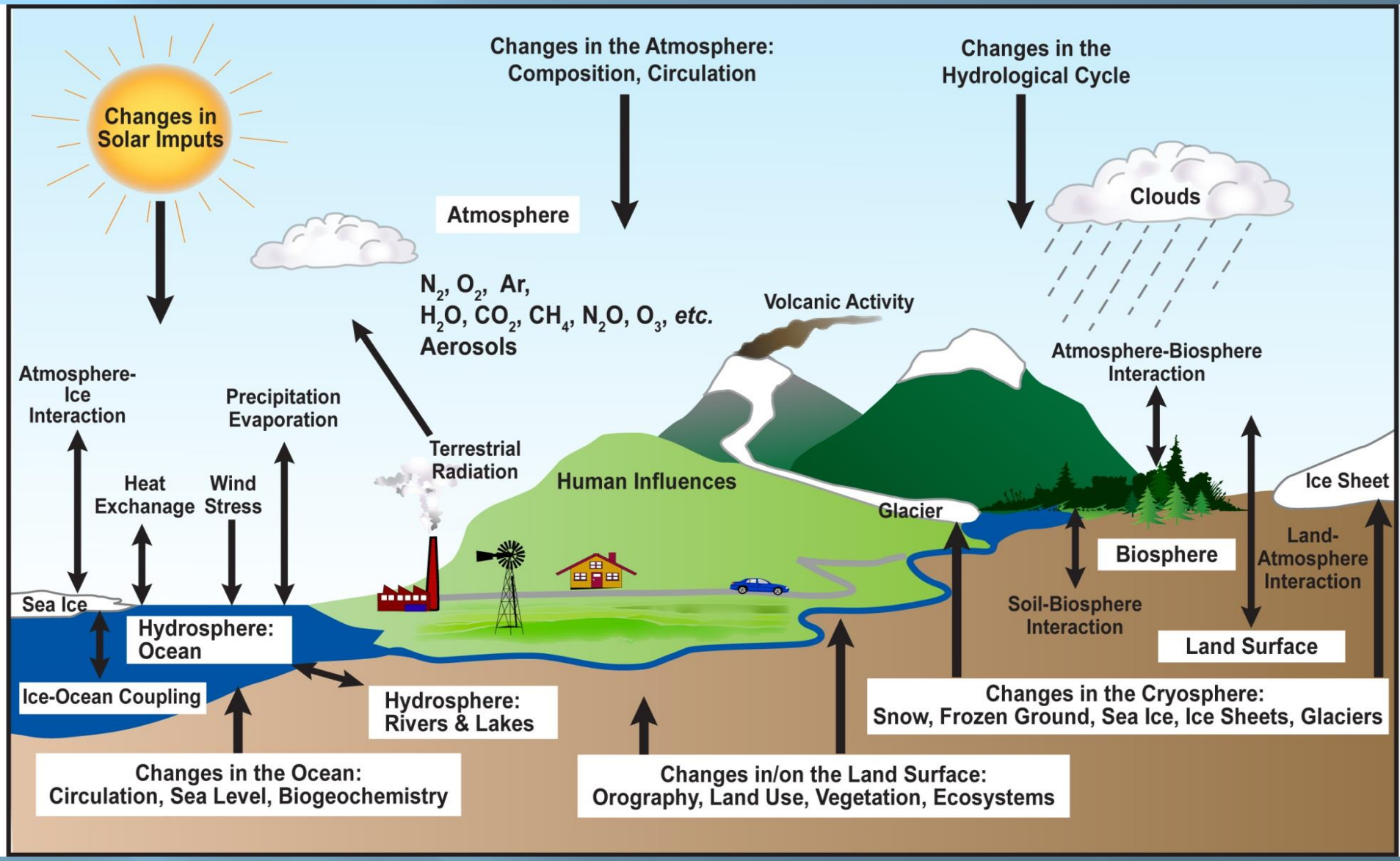
CLIMATE CHANGE: from global to local issues

Hervé Le Treut

Institut Pierre-Simon Laplace

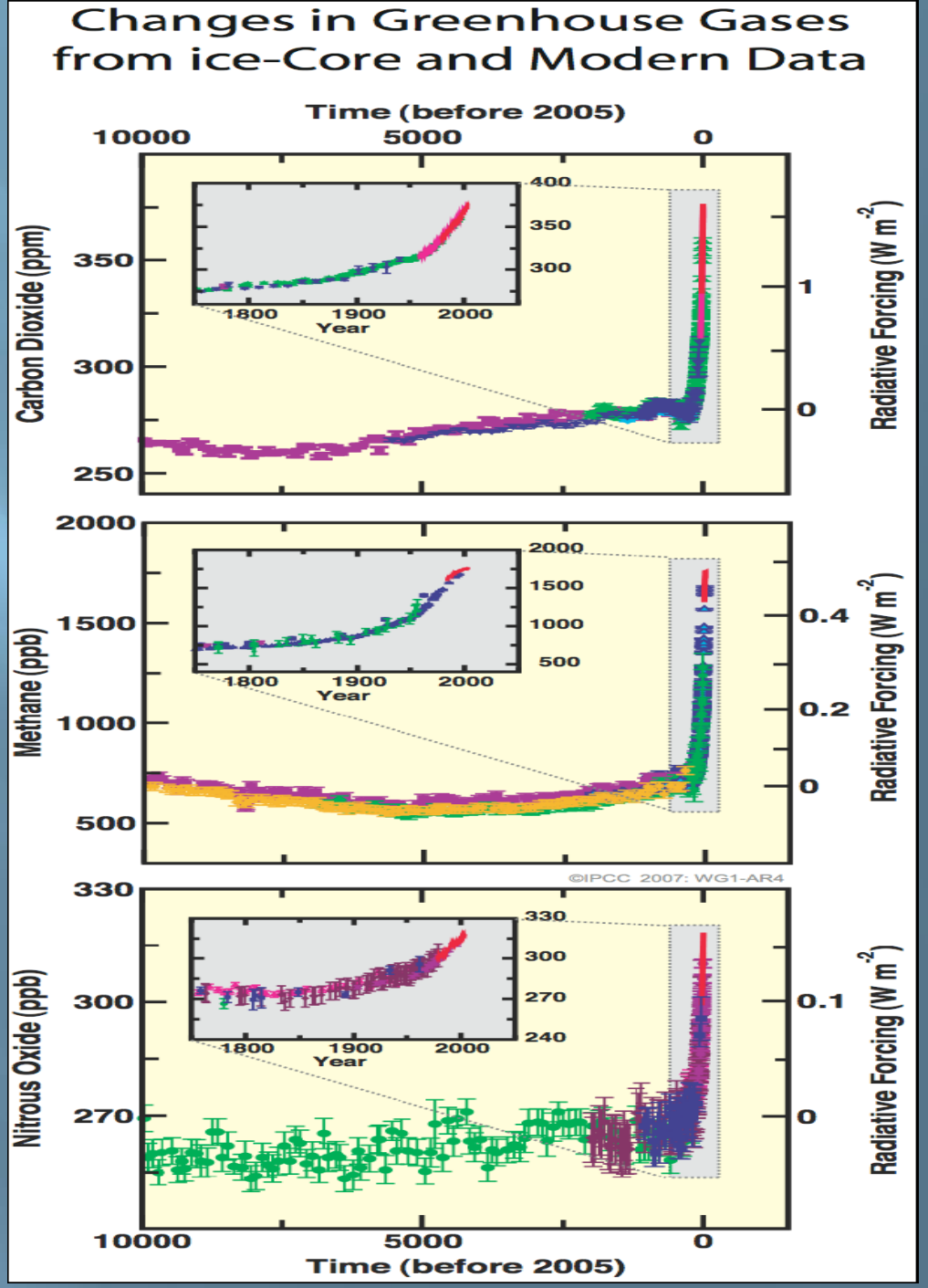
Paris

ClimWine 2016 Symposium: 10-10th of April, 2016. Bordeaux


Changes in Solar Imputs
Changes in the Atmosphere: Composition, Circulation
Changes in the Hydrological Cycle
Atmosphere
Clouds
N_2, O_2, Ar,
H_2O, CO_2, CH_4, N_2O, O_3, *etc.*
Aerosols
Volcanic Activity
Atmosphere-Ice Interaction
Precipitation Evaporation
Heat Exchanage
Wind Stress
Terrestrial Radiation
Human Influences
Atmosphere-Biosphere Interaction
Glacier
Ice Sheet
Biosphere
Land-Atmosphere Interaction
Soil-Biosphere Interaction
Land Surface
Sea Ice
Hydrosphere: Ocean
Ice-Ocean Coupling
Hydrosphere: Rivers & Lakes
Changes in the Cryosphere: Snow, Frozen Ground, Sea Ice, Ice Sheets, Glaciers
Changes in the Ocean: Circulation, Sea Level, Biogeochemistry
Changes in/on the Land Surface: Orography, Land Use, Vegetation, Ecosystems

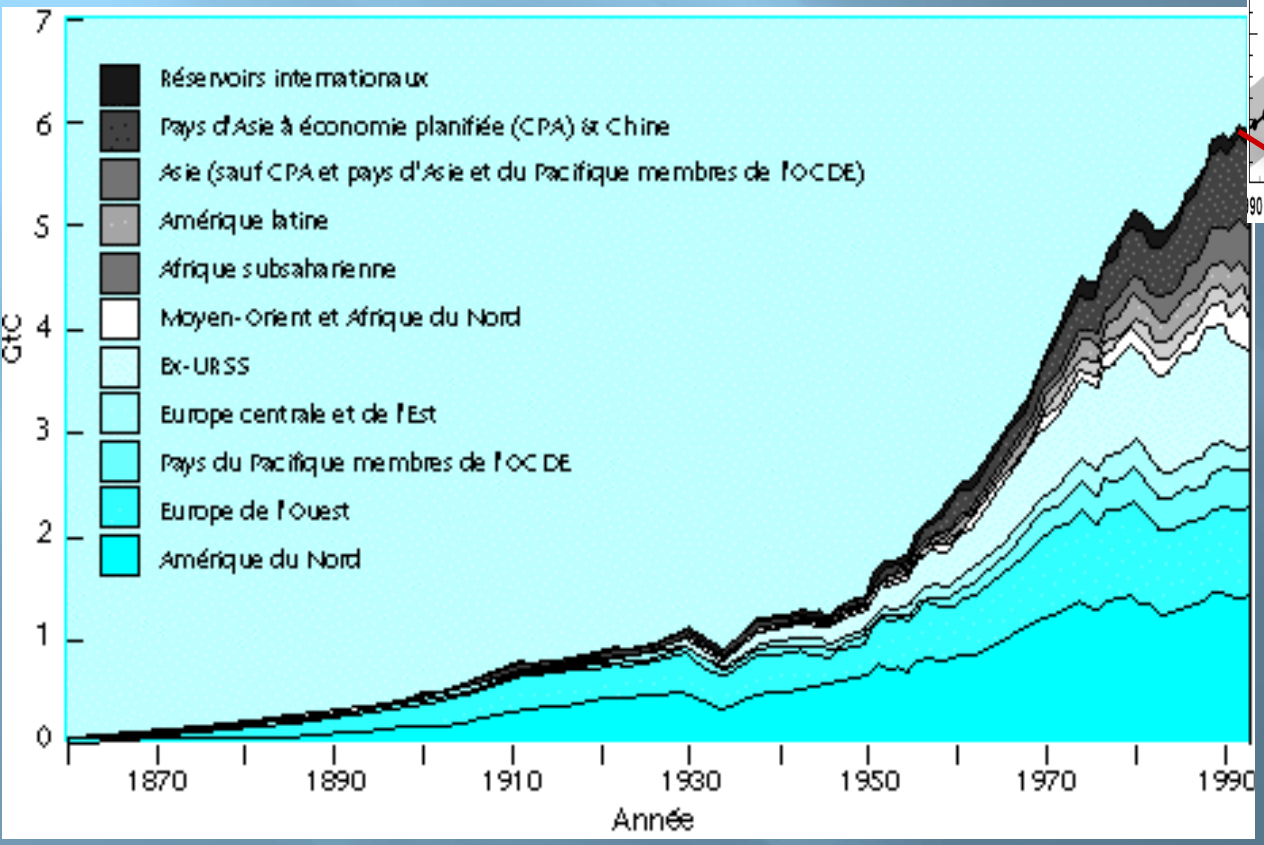
Le climat dans lequel se sont développés nos civilisations: une situation très particulière

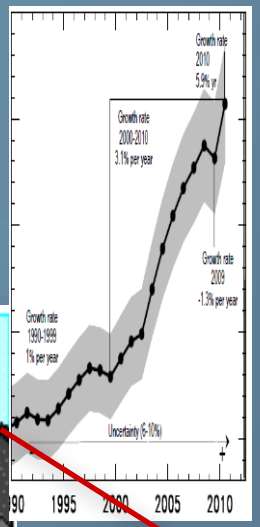
10 000 ans
de « quasi-stabilité »
et quelques décennies de changement



IPCC, 2007

Le contexte : les émissions de CO_2 liées à la combustion des hydrocarbures ont été multipliées par presque 10 depuis la deuxième guerre mondiale (en milliards de tonnes de carbone par an)





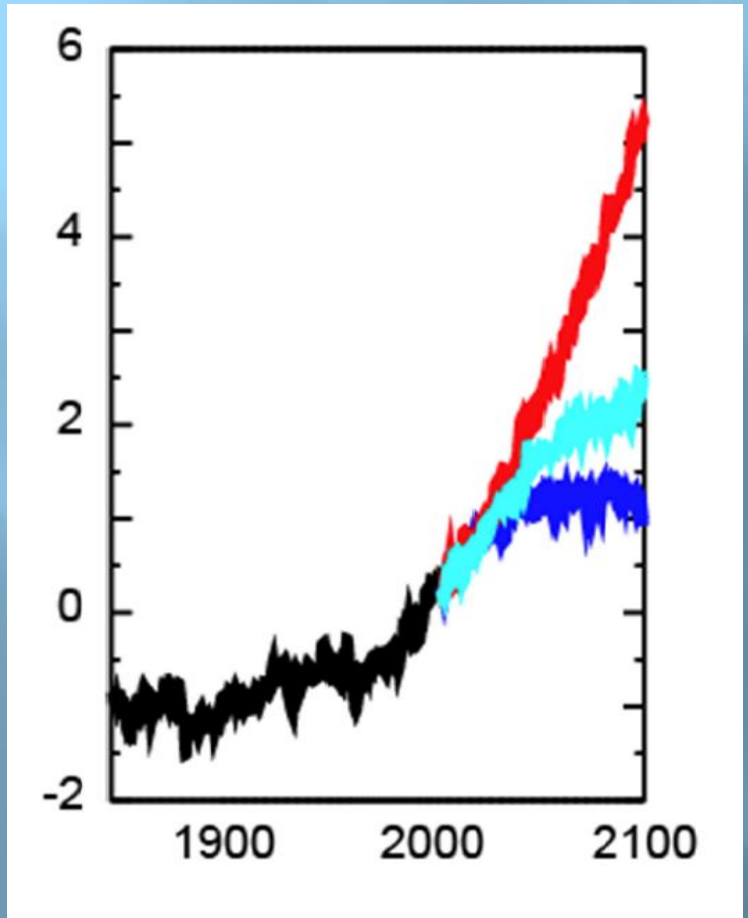
Sommet de la Terre
Rio 1992

International Energy Agency

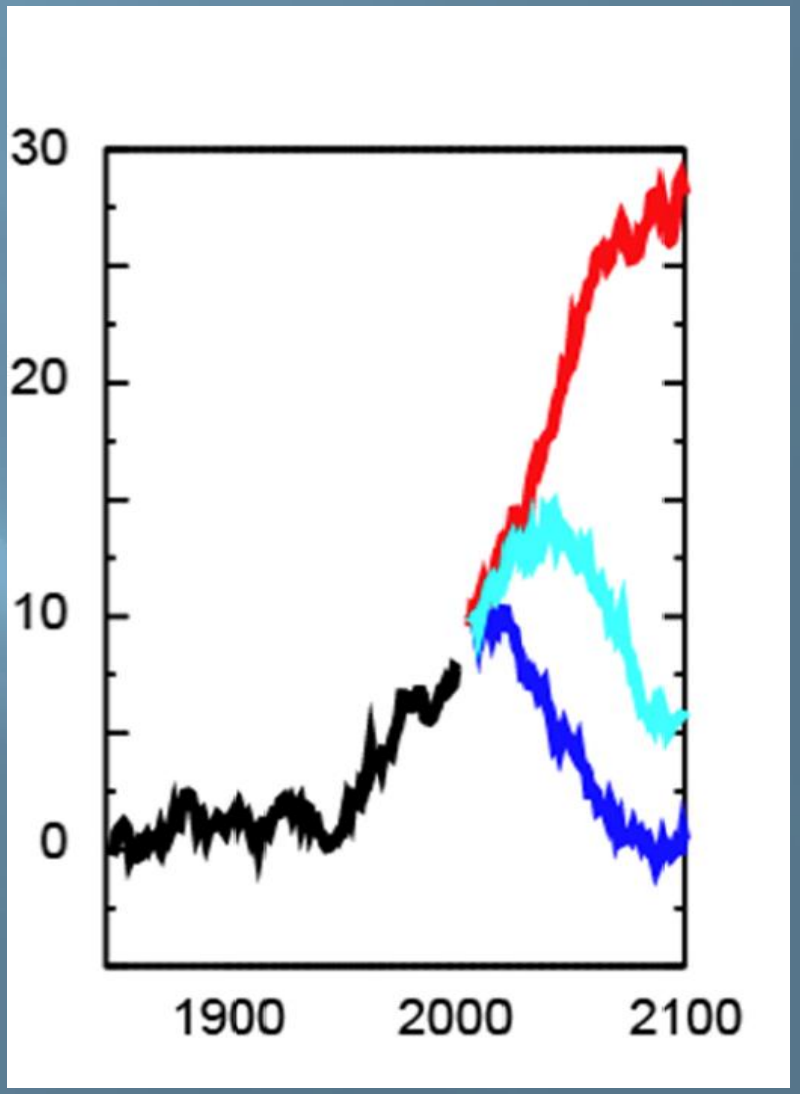
Un vision inverse du problème: quelles émissions pour quel objectif?

IPSL / GIEC 2013

Réchauffement (en °C)



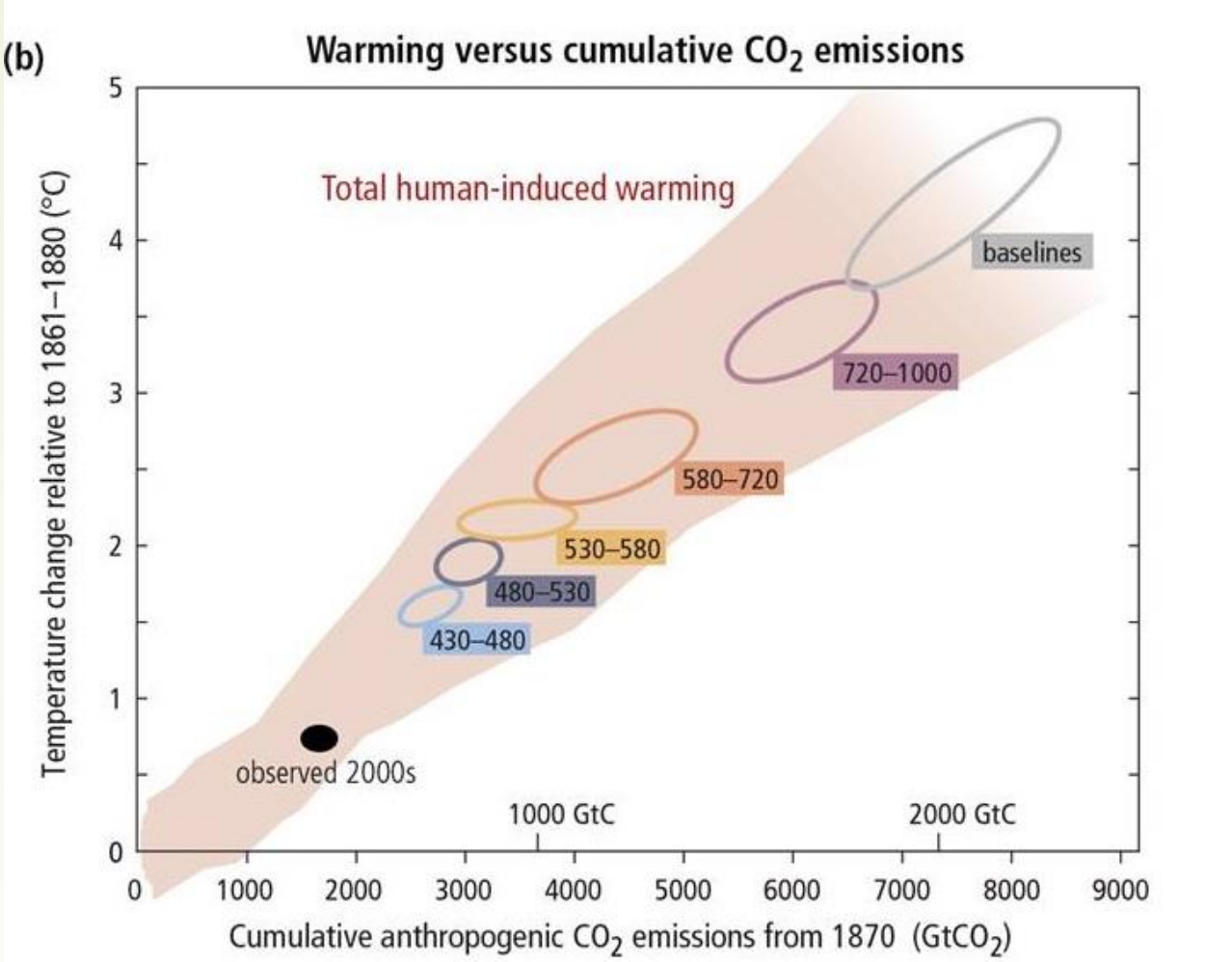
Emissions associée de CO_2
(en GtC / an)



JL Dufresne, LMD/IPSL

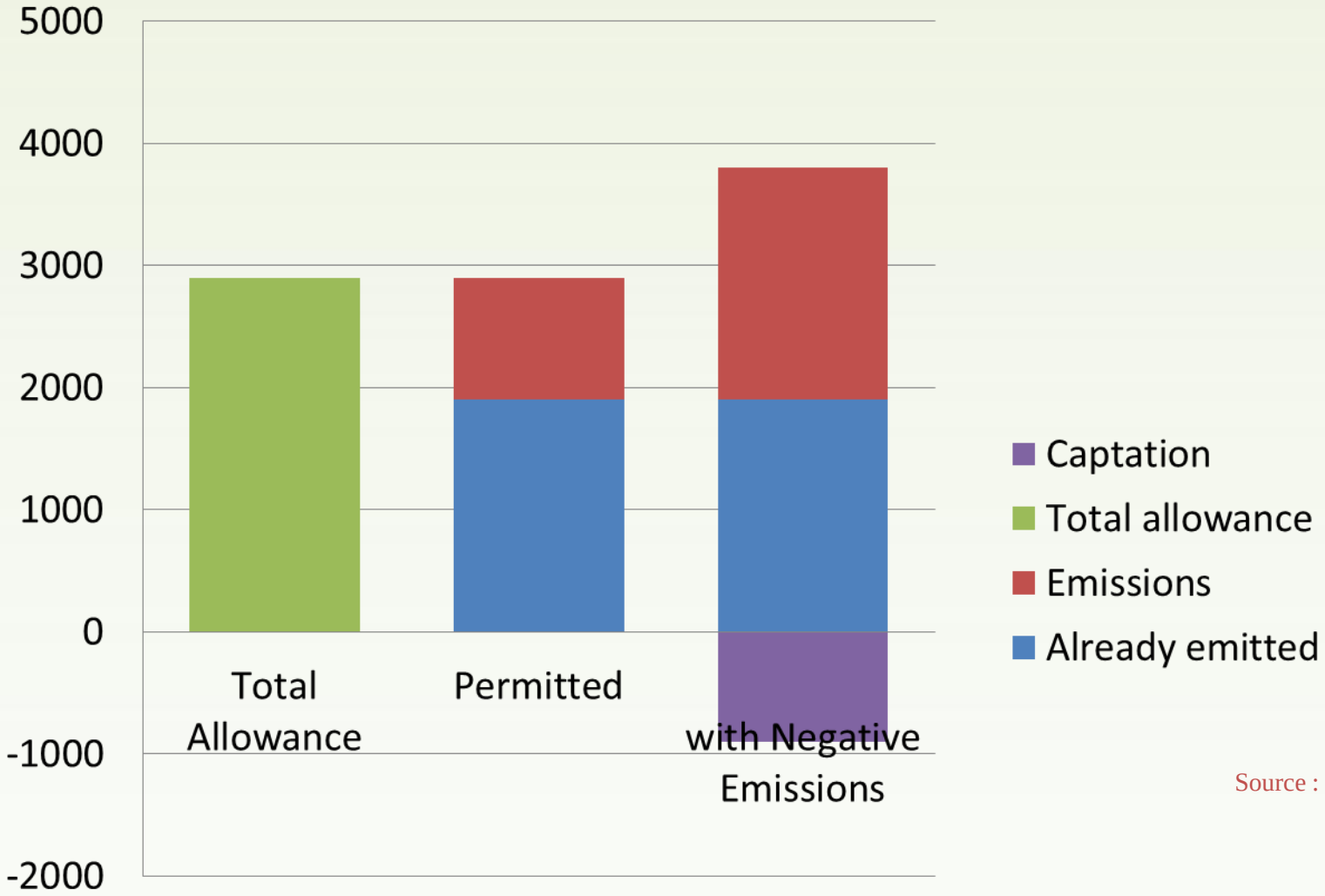
Une contrainte nouvelle: le lien entre les émissions cumulées de CO_2 et l'objectif des 2°C

Source : IPCC, AR5, WG1, 2014



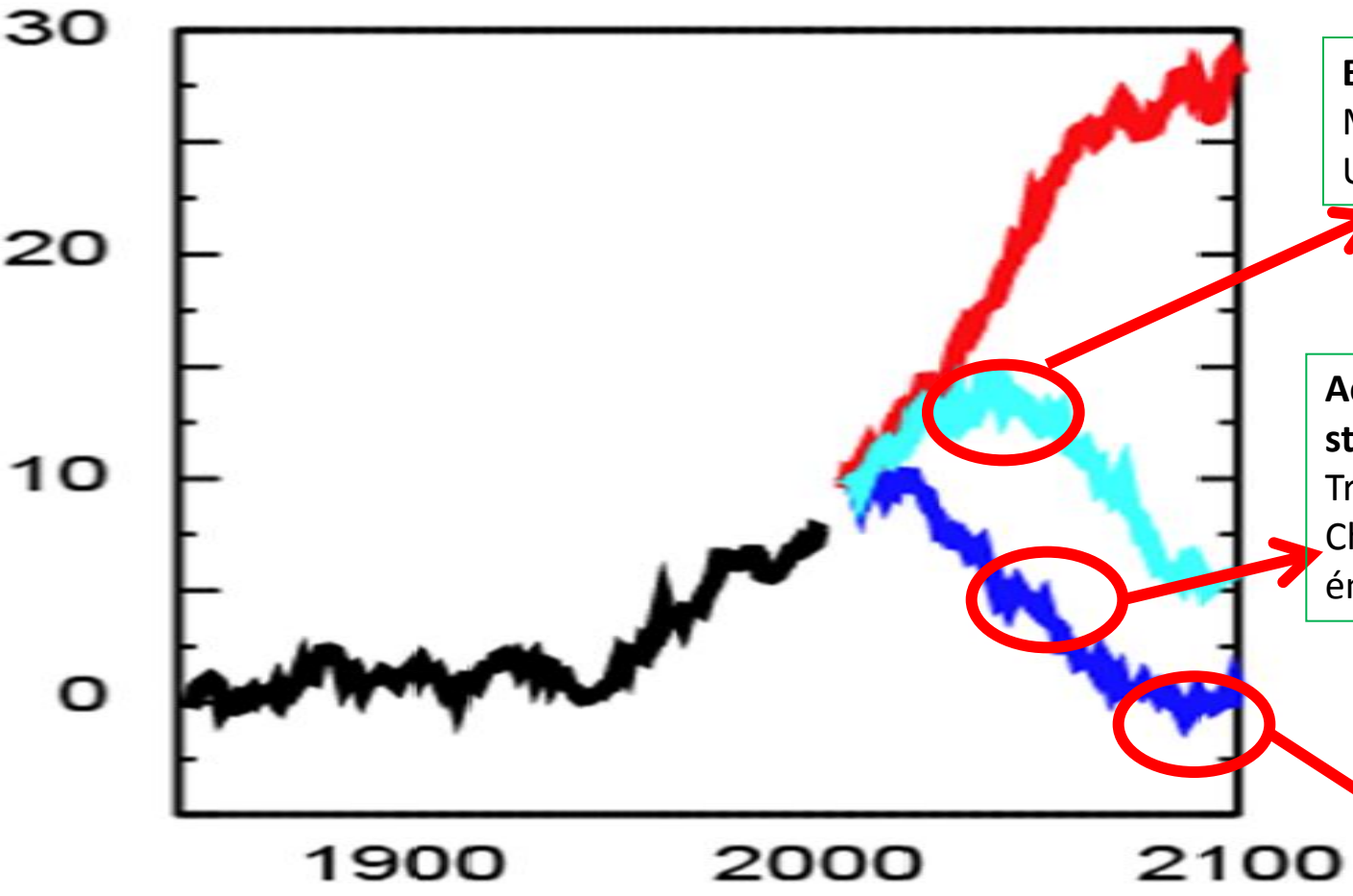
Negative emissions :
it cannot be a last-minute option

Emission budget to get 66% chance of not going over 2°C
Cumulated emissions in tons of CO_2 equivalent



Source : GICN, 2015

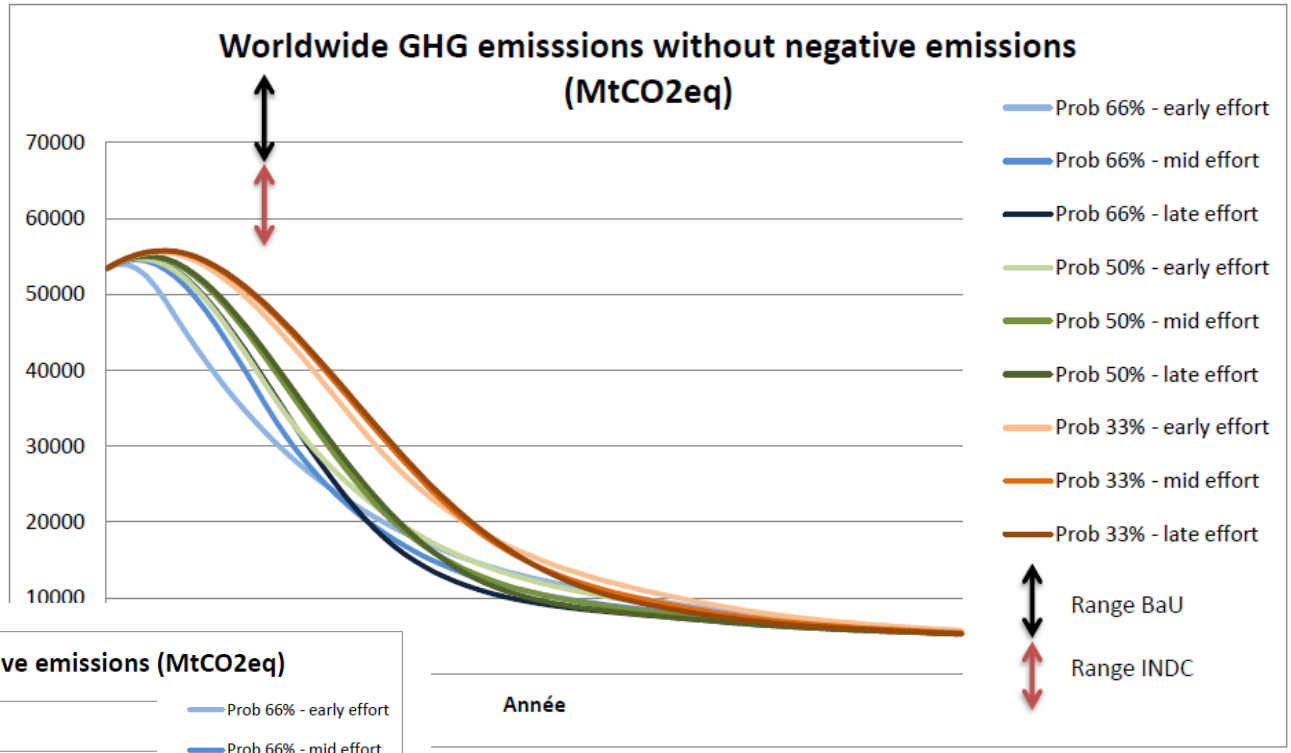
Réduire les émissions de gaz à effet de serre: Une action contrainte tout au long du siècle

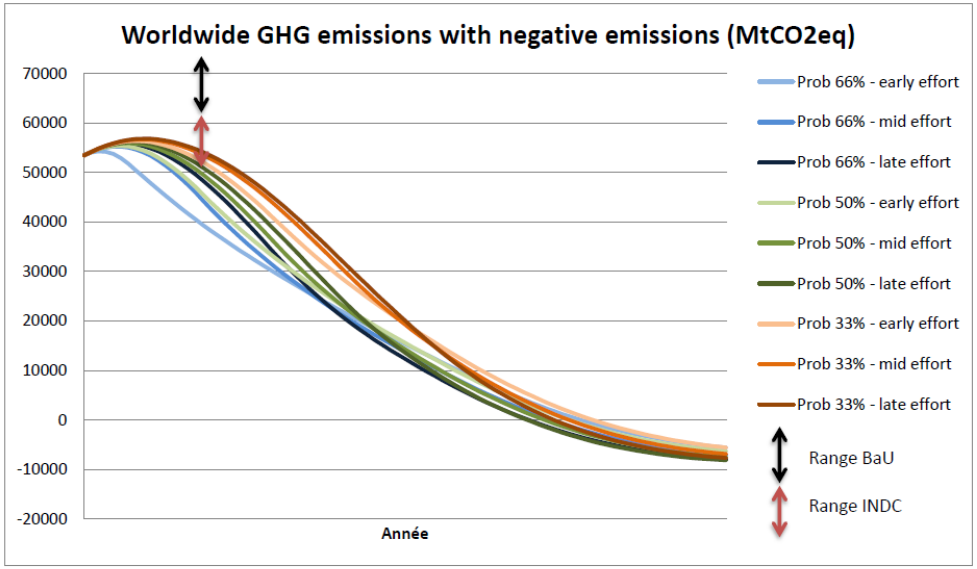


Eviter tout retard
Méthane , Pollution
Usage des sols, …

Actions à caractère structurel
Transports, Urbanisme,
Changement de filières énergétiques

Emissions négatives
CCS, BECCS ??



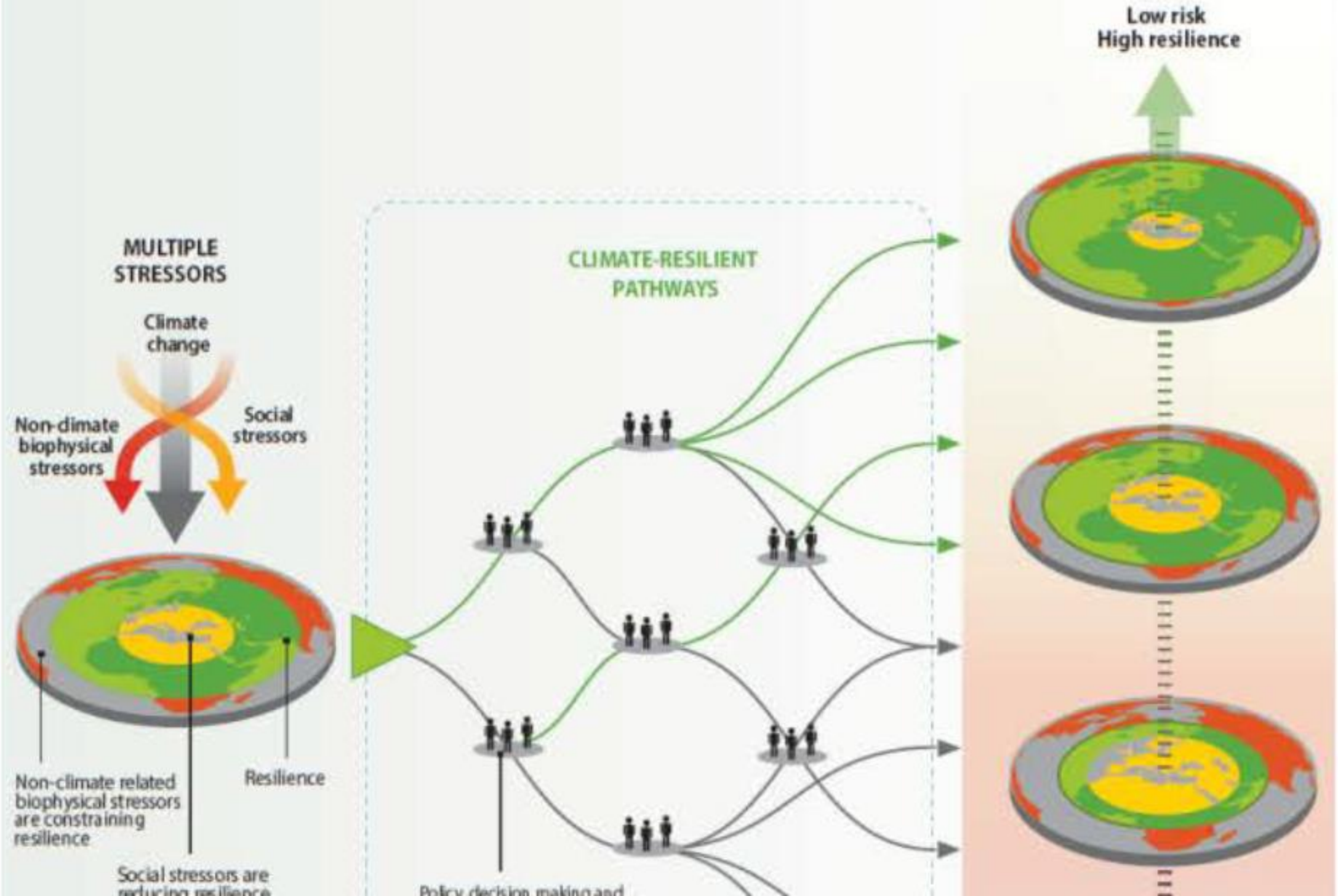


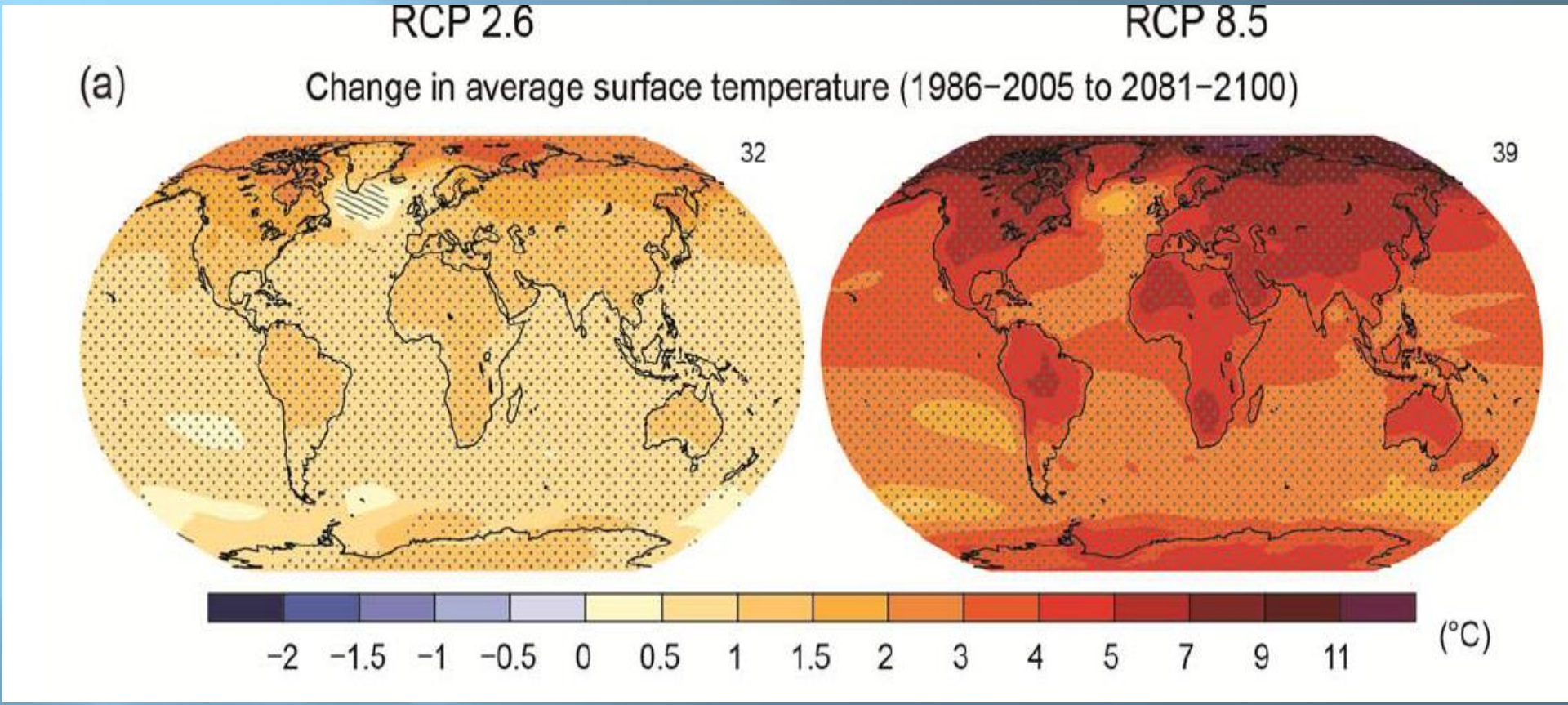
2015

2100

Les contributions des Etats nous mettent-elles sur la « route des 2°C » (travail en cours) ?

Multiple stressors and Climate-resilient development pathways




RCP 2.6
RCP 8.5
(a)
Change in average surface temperature (1986–2005 to 2081–2100)
32
39
−2 −1.5 −1 −0.5 0 0.5 1 1.5 2 3 4 5 7 9 11
(°C)

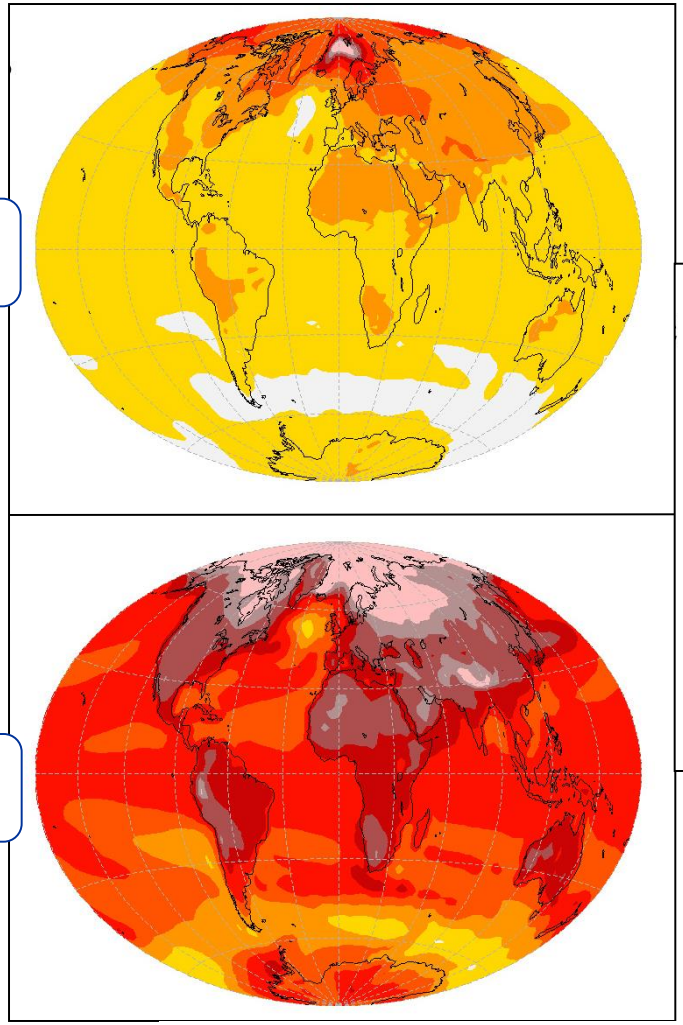
Changement de température de surface

Différence entre **2100** et **1990**

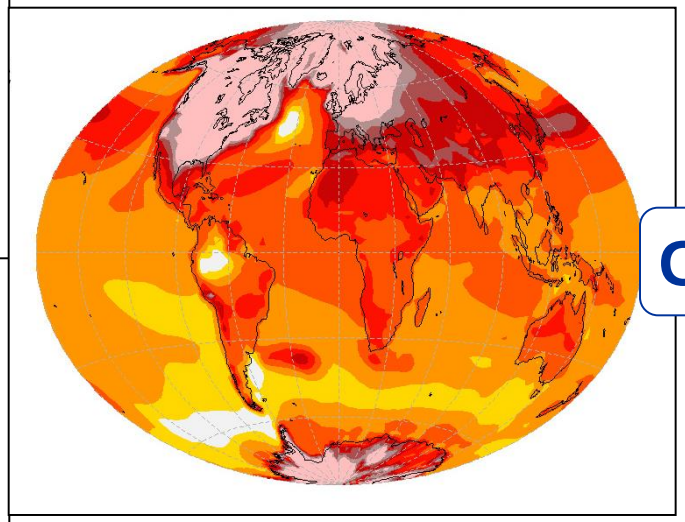
IPSL-CM5A-LR

RCP2.6

RCP8.5



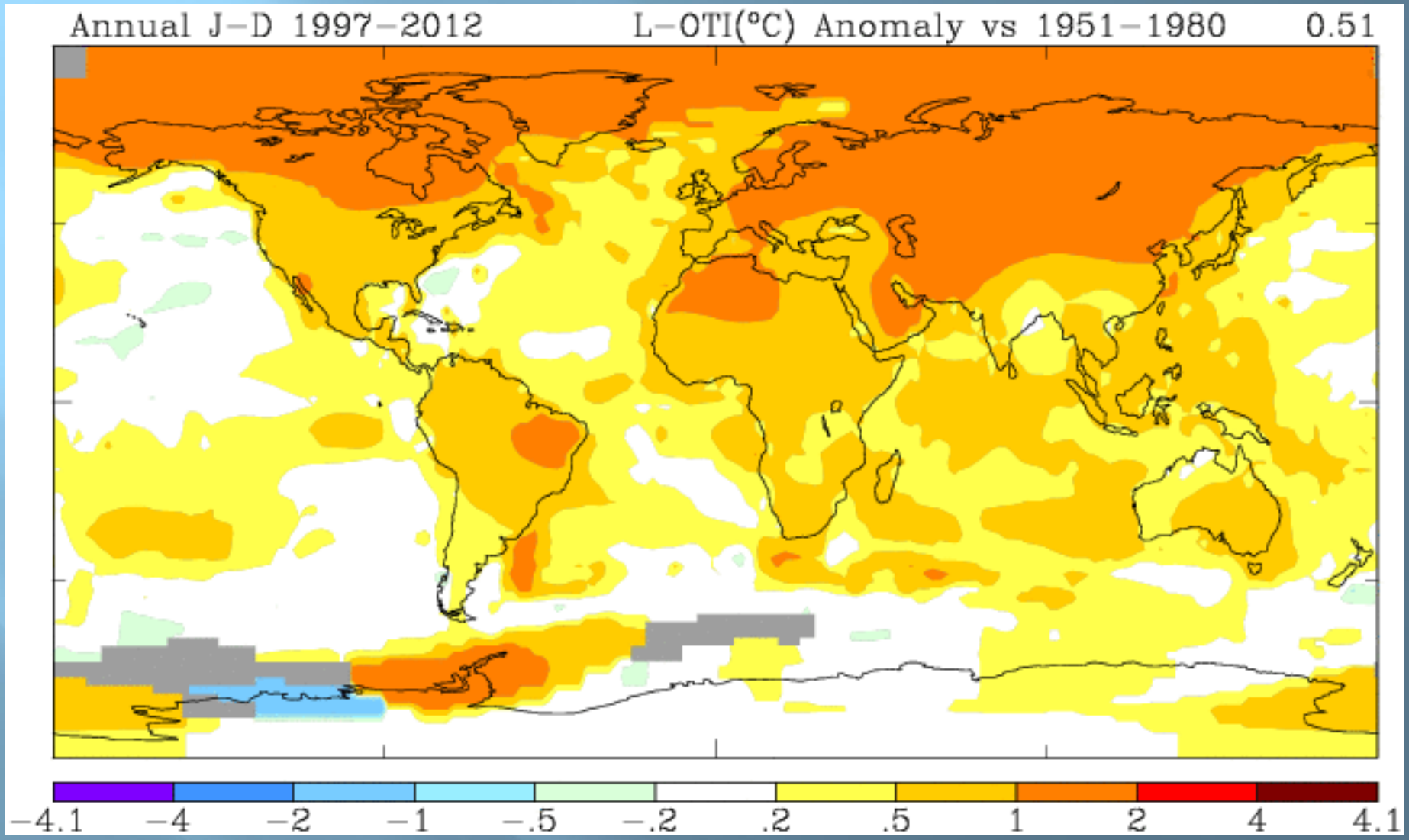
Entre **préindustriel** et **glaciaire**



Glaciaire

- - - - 0 2 4 6 8 (°C)

Les changements observés confirment les prévisions



Le relèvement du niveau de la mer

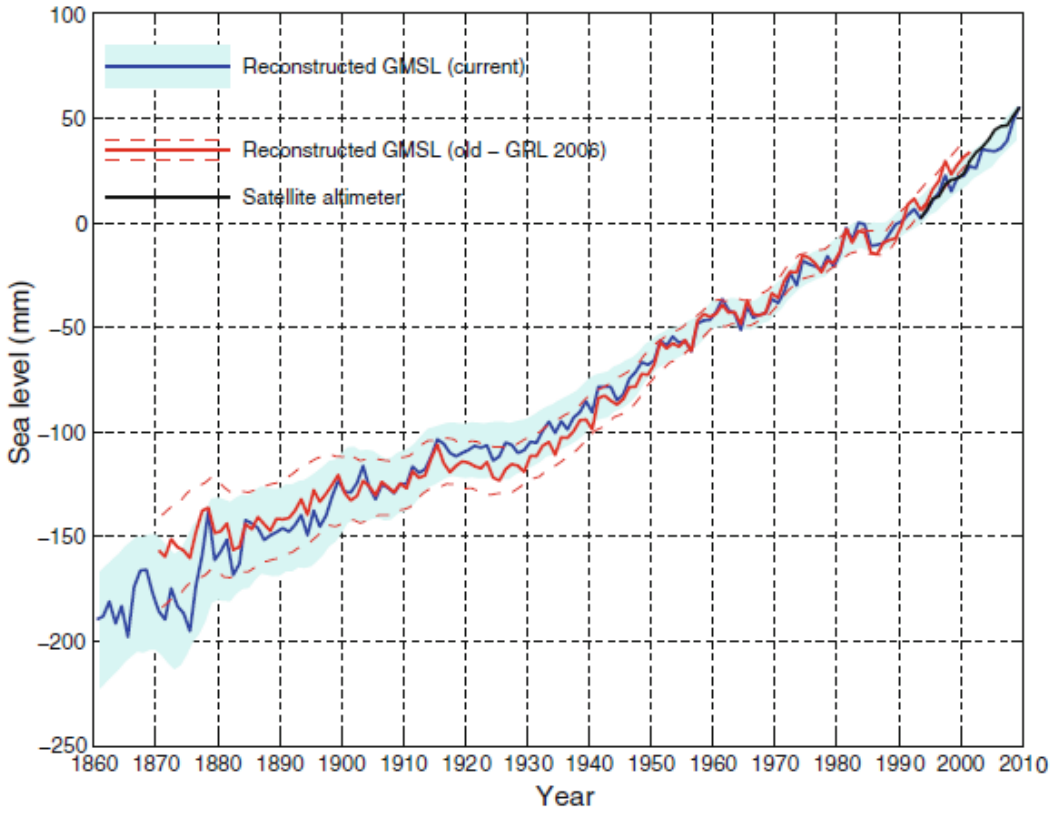
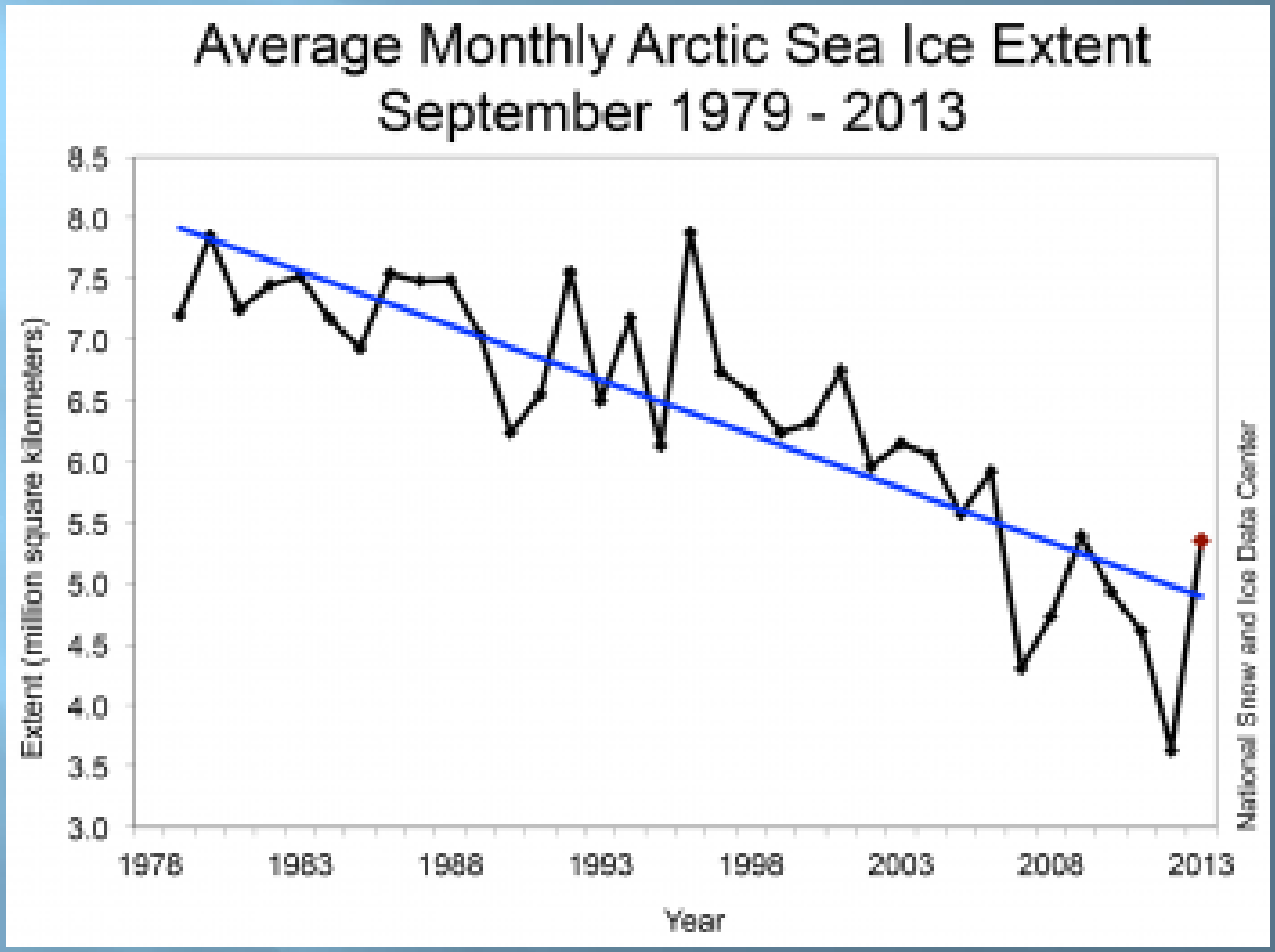
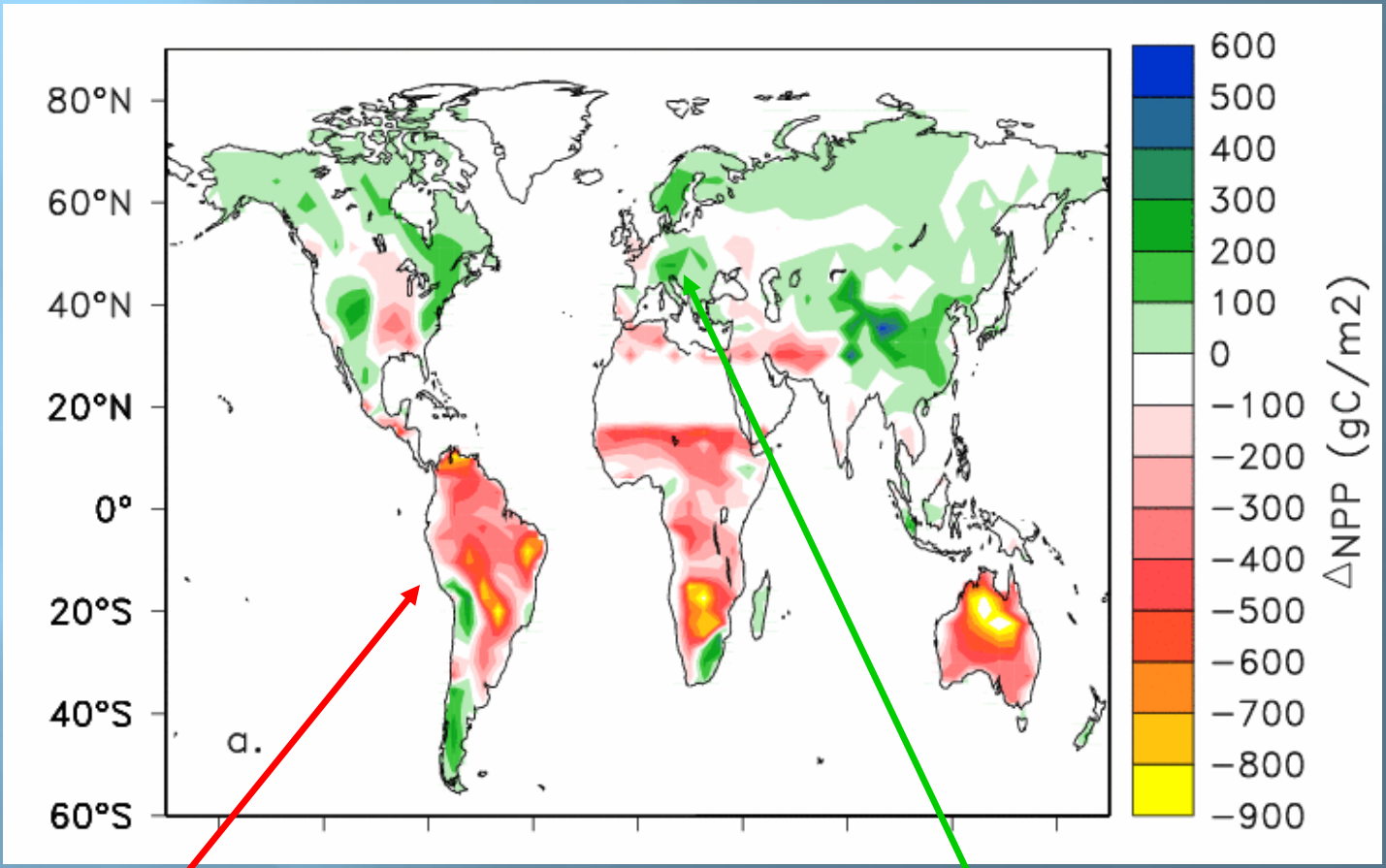


Fig. 5 Global average sea level from 1860 to 2009 as estimated from the coastal and island sea-level data (*blue*). The one standard deviation uncertainty estimates plotted about the low passed sea level are indicated by the *shading*. The Church and White (2006) estimates for 1870–2001 are shown by the *red solid line* and *dashed magenta lines* for the 1 standard deviation errors. The series are set to have the same average value over 1960–1990 and the new reconstruction is set to zero in 1990. The satellite altimeter data since 1993 is also shown in *black*


Average Monthly Arctic Sea Ice Extent
September 1979 - 2013
Extent (million square kilometers)
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
1978
1983
1988
1993
1998
2003
2008
2013
Year
National Snow and Ice Data Center

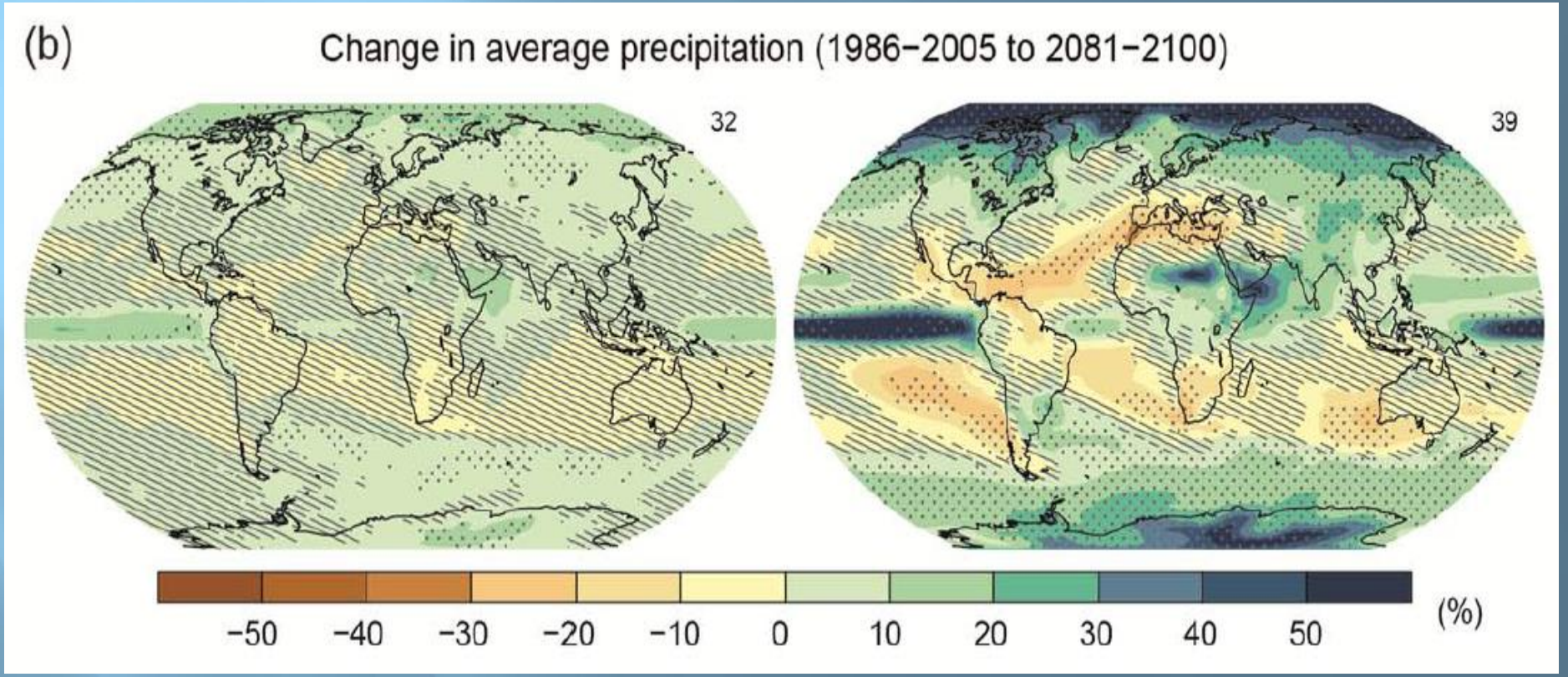
La production primaire nette: dépendance au climat

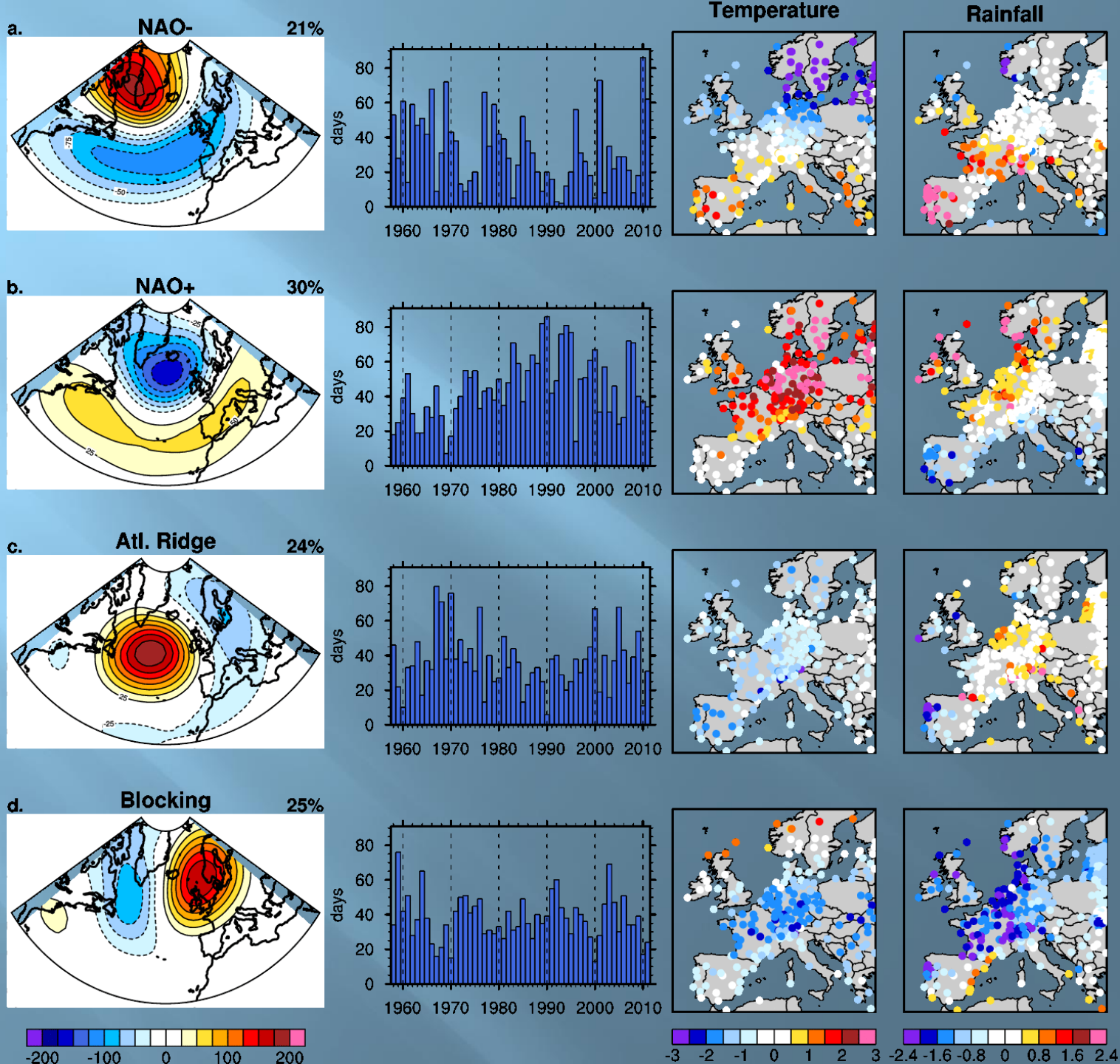


Increase in soil aridity

Extension of the growing season

Berthelot et al., 2002


(b)
Change in average precipitation (1986–2005 to 2081–2100)
32
39
−50
−40
−30
−20
−10
0
10
20
30
40
50
(%)


a.
NAO-
21%
b.
NAO+
30%
c.
Atl. Ridge
24%
d.
Blocking
25%
Temperature
Rainfall
days
0
20
40
60
80
1960
1970
1980
1990
2000
2010
-200
-100
0
100
200
-3
-2
-1
0
1
2
3
-2.4
-1.6
-0.8
0
0.8
1.6
2.4

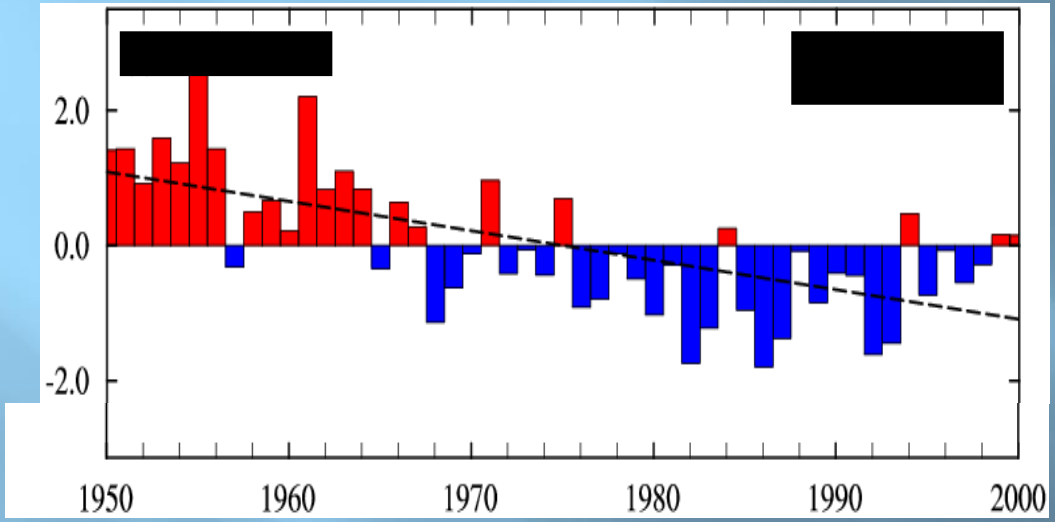
Des enjeux vitaux

Continent	Besoins alimentaires à l'horizon 2050
Afrique	**5**
Asie	2.5
Europe	1
Amérique Latine	2
Amérique du Nord	1.5
Océanie	1.5

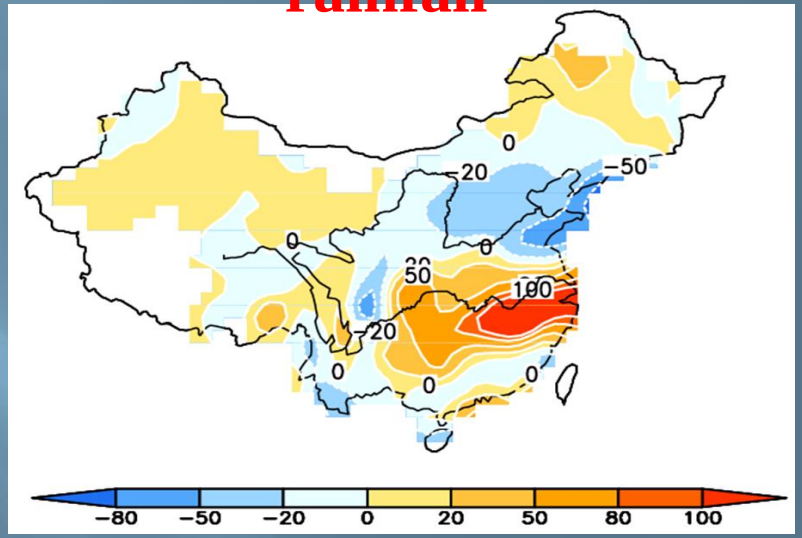
Besoins alimentaires à l'horizon 2050 (base 1 en 2000) sous l'effet combiné de la croissance de la population, de la modification de sa composition (age, sexe) et du régime alimentaire (Collomb 1999, FAO, résultats arrondis)

Variation of the East Asian Summer Monsoon during the second half of the 20th century

East Asian Summer Monsoon Index

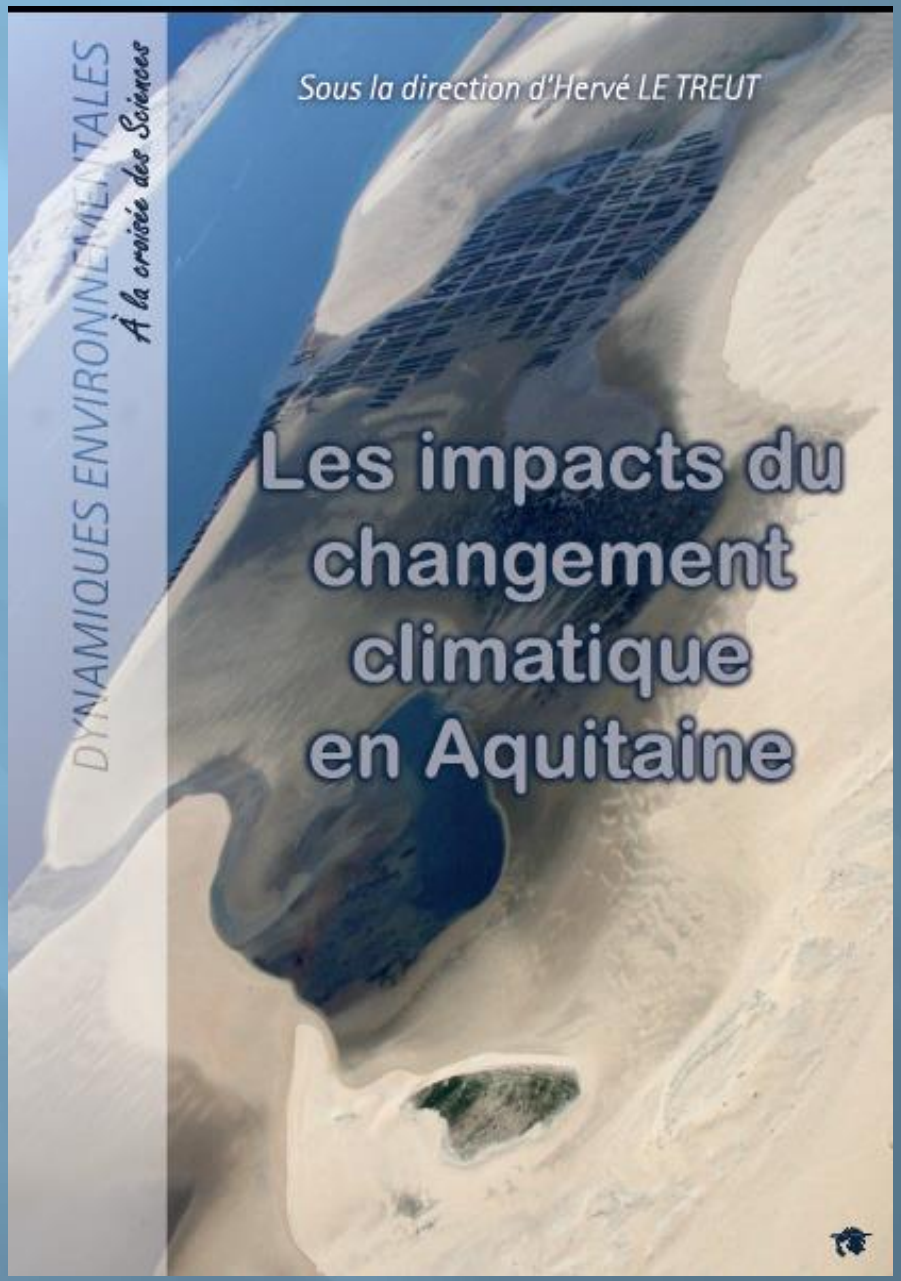


Decadal variation of rainfall



East Asian Summer Monsoon has strong variabilities at interannual and decadal scales. Since the 1980s, the monsoon diminished in intensity, creating precipitation anomalies (above-normal in the south and below-normal in the north).

Courtesy Dr. T. Zhou


DYNAMIQUES ENVIRONNEMENTALES
À la croisée des Sciences
Sous la direction d'Hervé LE TREUT
Les impacts du changement climatique en Aquitaine

A collective work:
F. Grousset, A. Kremer, D. Salles, E. Villenave, E. Bourdenx

Les auteurs

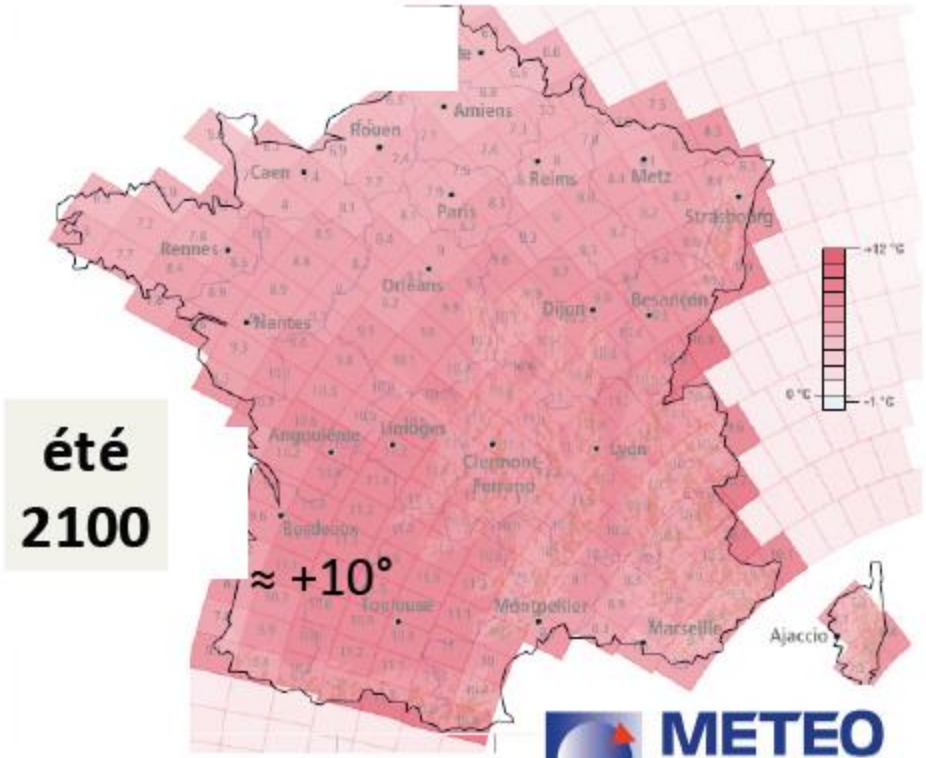
(cf. p. 363)

S. Abadie, G. Abril, D. Amouroux, X. Arnauld De Sartre, I. Auby, L. Augusto, G. Bachelet, I. Baldi, V. Banos, A. Bardonnet, J. Baron, M. Baudrimont, M.L. Begout, Y. Bérard, V. Bernard, C. Bernard, M. Berroneau, P. Bertran, G. Biais, G. Blanc, P. Boet, P. Bonneton, A. Borja, C. Boschet, C. Bouisset, D. Breysse, N. Brisson†, Y. Brunet, H. Budzinski, N. Caill-Milly, C. Cassou, I. Castège, B. Castelle, A. Chaalali, G. Chust, S. Clarimont, B. Clavé-Papion, A. Colin, D. Compagnon, E. Corcket, B. Coupry, G. Coureau, A. Coynel, F.X. Cuende, F. D'Amico, J. D'Elbée, J.C. Dauvin, V. David, B. De Grissac, X. De Montaudouin, M.N. De Casamajor, J. Dehez, Y. Del Amo, S. Delzon, B. Denoyes, M.L. Desprez-Loustau, P. Deuffic, M.H. Devier, L. Doyen, J.C. Duplessy, A. Dupuy, H. Etcheber, J. Favennec, I. Garcia de Cortazar-Atauri, E. Garnier, G. Gault, D. Genty, E. George-Marcepoil, O. Girardclos, N. Goñi, P. Gonzalez, J.P. Goutouly, P.Y. Guernion, F. Grousset, V. Hanquiez, F. Hissel, F. Huneau, D. Idier, G. Irichabeau, H. Jactel, M. Jarry, R. Kantin, M. Kleinhentz, A. Kremer, V. Laborie, E. Lamaud, G. Largier, M. Launay, S. Lavaud, S. Lavorel, Y. Le Bagousse Pinguet, G. Le Cozannet, H. Le Treut, M. Leandri, N. Lenôtre, M. Lepage, T. Leurent, F. Levrault, M. Lissardy, L. Londeix, D. Loustau, C. Lucas, J.P. Maalouf, J.J. Malfait, C. Mallet, D. Malvy, P. Marchet, P. Maron, J.C. Martin, S. Mathoulin-Pelissier, J. Maugein, D. Maurer, N. Mazella, P. Mazellier, C. Meredieu, R. Michalet, O. Mora, G. Morandeau, V. Moreaux, S. Morin, T. Oblet, N. Ollat, J.-C. Péreau, E. Perraudin, P. Pieri, D. Piou, S. Planton, P. Point, P. Prouzet, J.C. Quéro, C. Raherison, T. Rambonilaza, J.P. Rebillard, P. Régnacq, M. Regolini, T. Renault, A. Ribes, E. Rochard, N. Rocle, P. Rolland, R. Salamon, D. Salles, F. Sanchez, M.F. Sanchez-Goñi, E. Sauquet, B. Sautour, J. Schäfer, B. Seguin, G Simonet, A. Sota, A. Sottolichio, J.P. Tastet, J.P. Terreaux, B. Touzard, P. Trichet, J.P. Urcun, C. Van Leeuwen, S. Vaucelle, F. Verdin, E. Villenave, V. Vles, S. Zaragosi.

I. CONTEXTE ET ENJEUX DU CLIMAT POUR L'AQUITAINE

Chap. 1 Du climat global au climat régional

Hervé LE TREUT



II. DEFIS POUR LES RESSOURCES, LES ACTIVITES, LA QUALITE DE VIE EN AQUITAINE

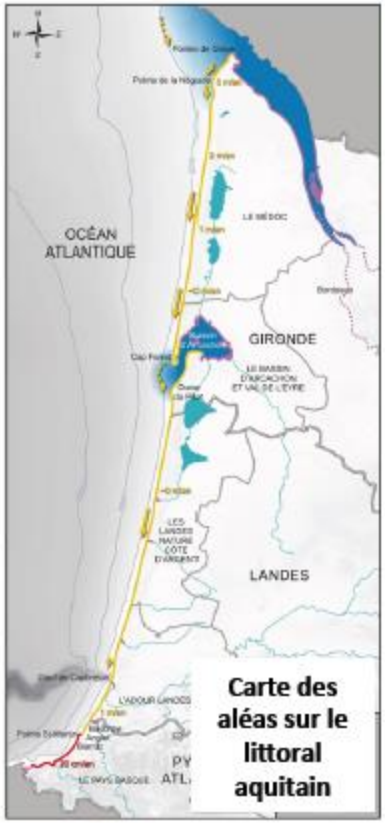
Chap. 6 MODIFICATIONS DU LITTORAL

Philippe BONNETON

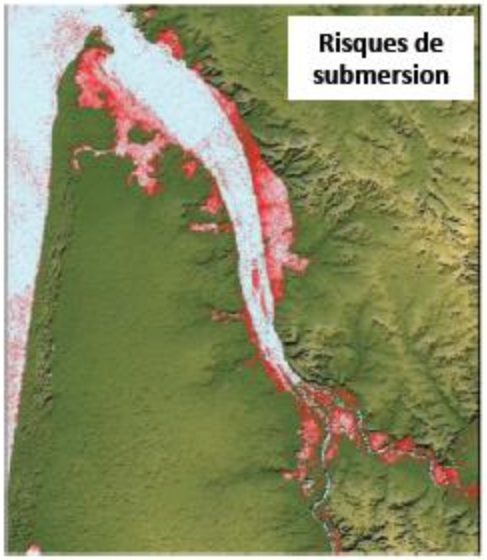
érosion

érosion/ accumulation

inondations



Carte des aléas sur le littoral aquitain



Quels objectifs?

- Appréhender scientifiquement le fonctionnement d'un système complexe, le système climatique
- Comprendre et utiliser les outils de la mécanique des fluides géophysiques