Changement climatique
le constat : la nécessaire transition

Valérie Masson-Delmotte

valmasdel

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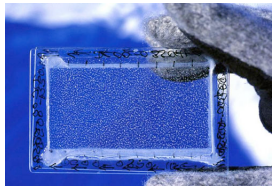
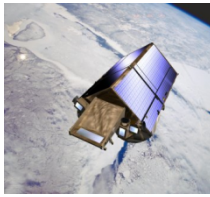
- **Introduction : sciences du climat**
- **Indicateurs de l'état du climat**
- **Scénarios et projections**
- **Prochains rapports du GIEC**

Une formidable aventure scientifique



Physique des fluides
Thermodynamique
Transferts radiatifs

Datations/reconstructions
Super calculateurs
Satellites



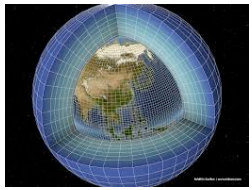
Antiquité

Moyen Age

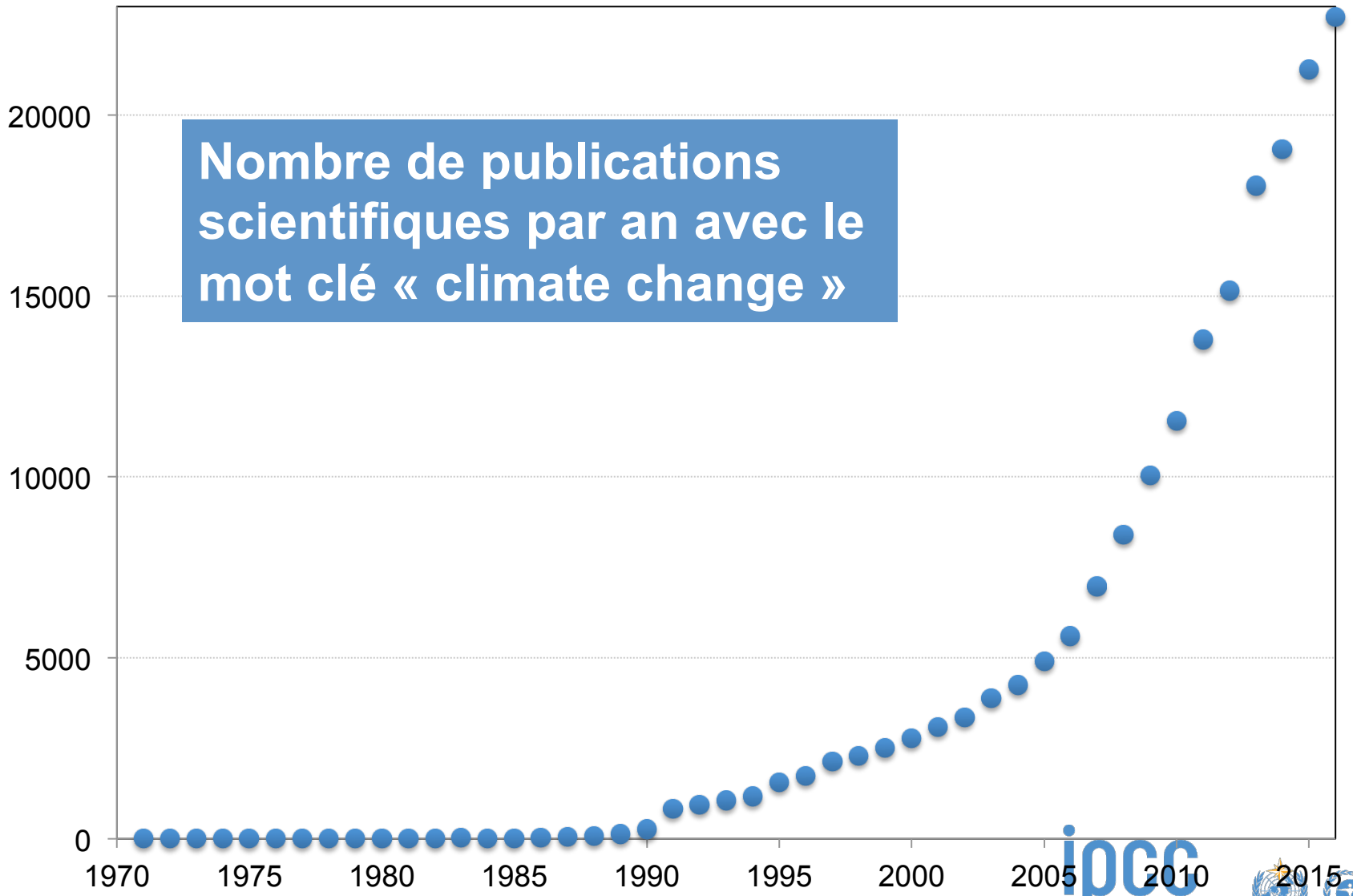
17ème siècle
Instruments météo

19ème siècle
Réseaux
Glaciations
Effet de serre

20ème siècle
Climats passés
Modélisation du climat



De la production de connaissances…



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à l'évaluation de l'état des connaissances

Sur la base de l'information scientifique, technique et socio-économique, le GIEC (Groupe intergouvernemental d'experts sur l'évolution du climat) évalue :

- *les bases scientifiques des risques associées à l'influence des activités humaines sur le climat*
- *les impacts potentiels*
- *les options d'adaptation et d'atténuation*

Les rapports du GIEC doivent être pertinents pour éclairer les choix politiques mais non prescriptifs.

La préparation des rapports du GIEC

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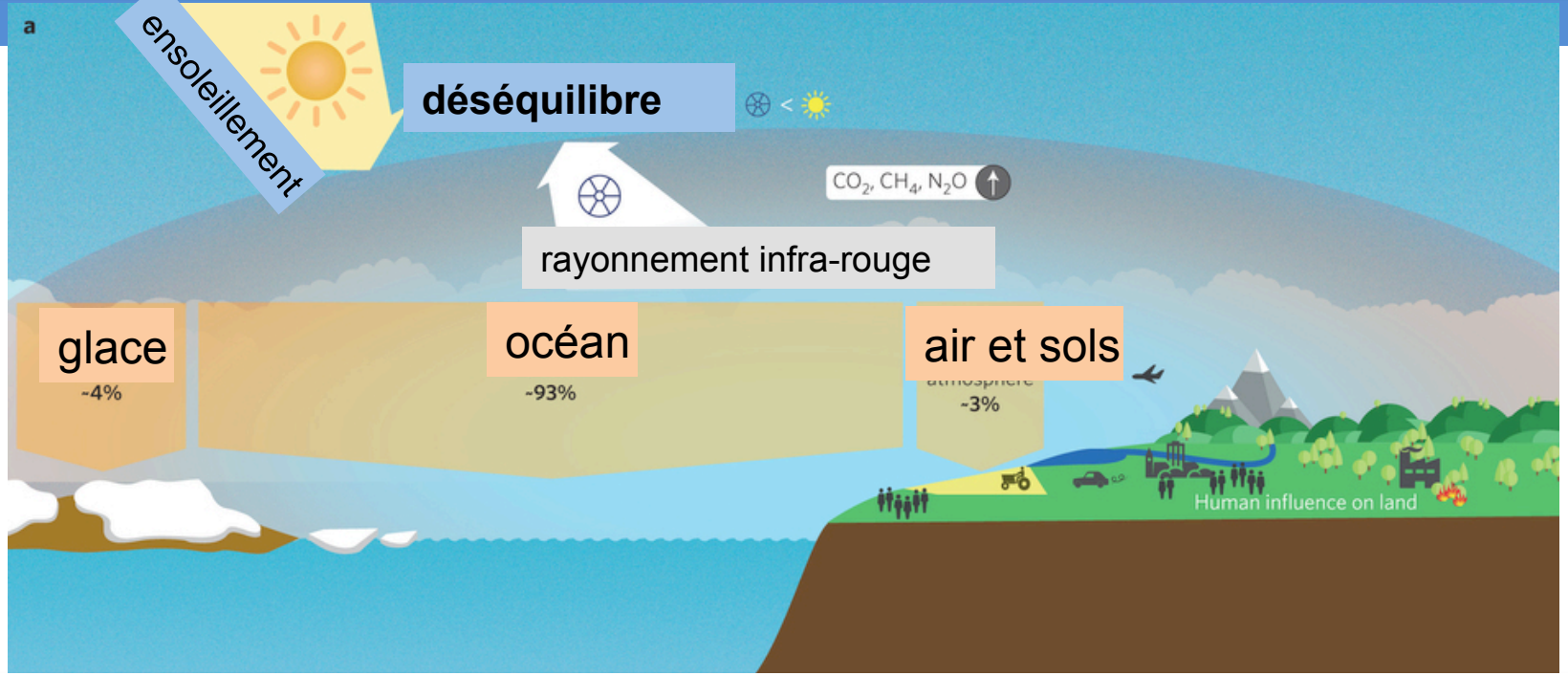
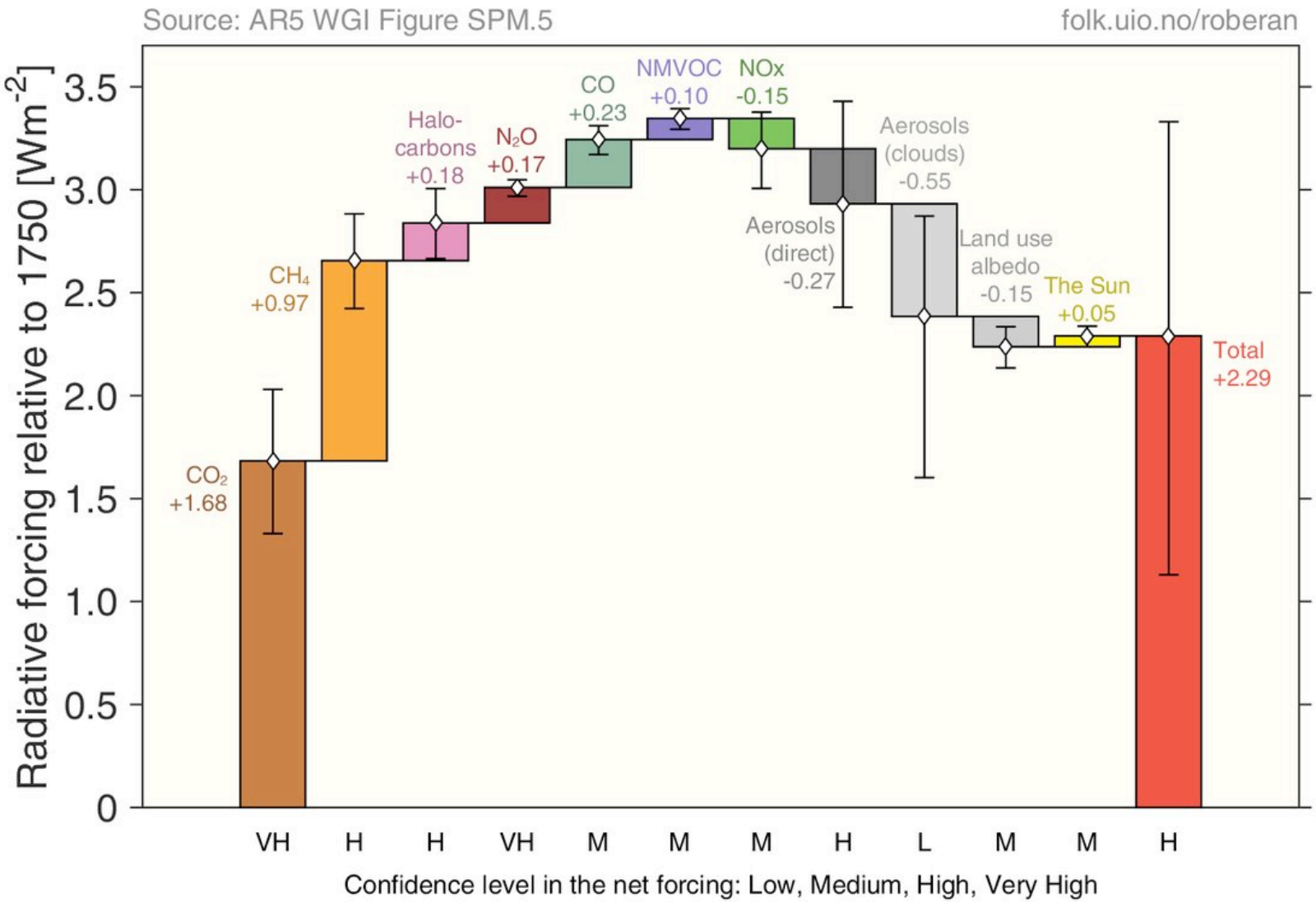
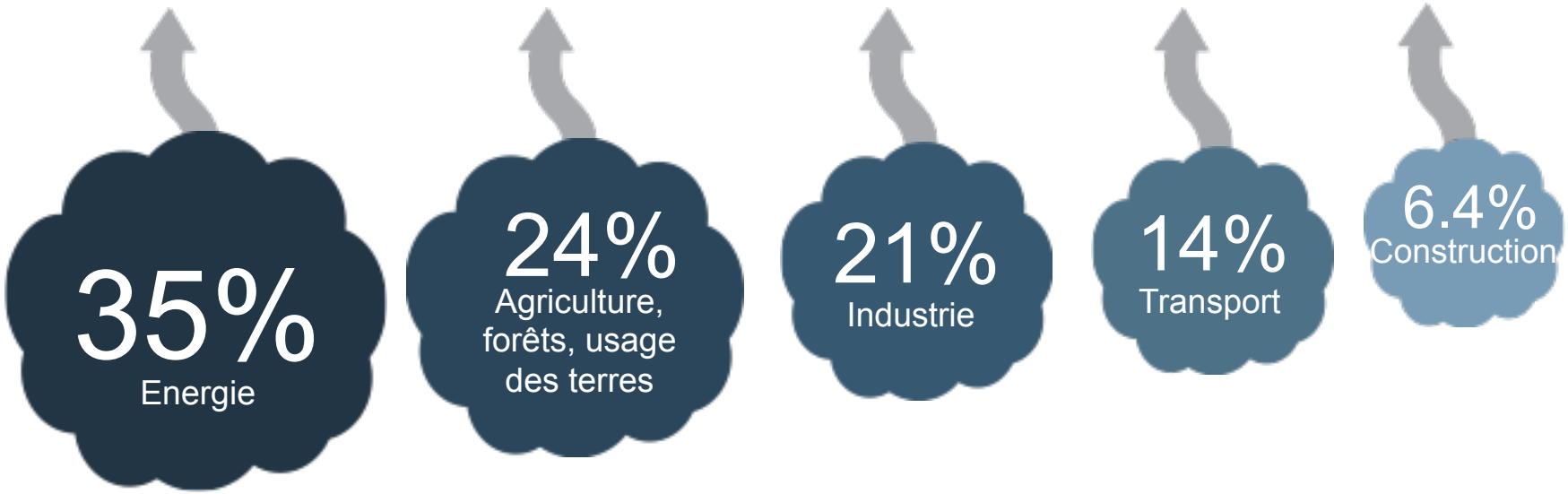

a
ensoleillement
déséquilibre
CO_2, CH_4, N_2O
rayonnement infra-rouge
glace
~4%
océan
~93%
air et sols
~3%
Human influence on land

Causes du déséquilibre radiatif



Sources de gaz à effet de serre en 2010, dans le monde



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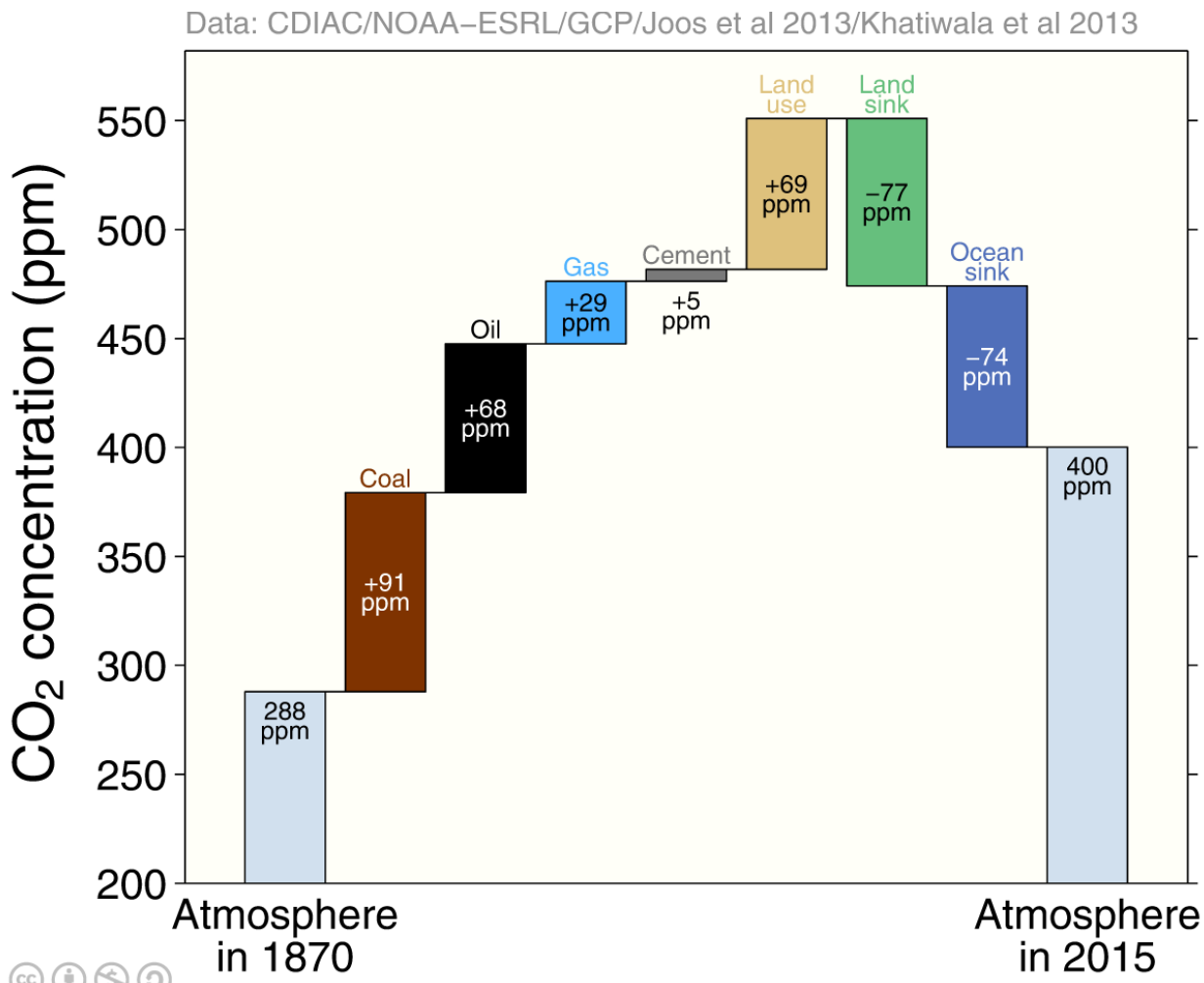
Causes de l'augmentation de la concentration atmosphérique en CO_2 depuis 1750



Global Carbon Project

Global Carbon Project, 2016

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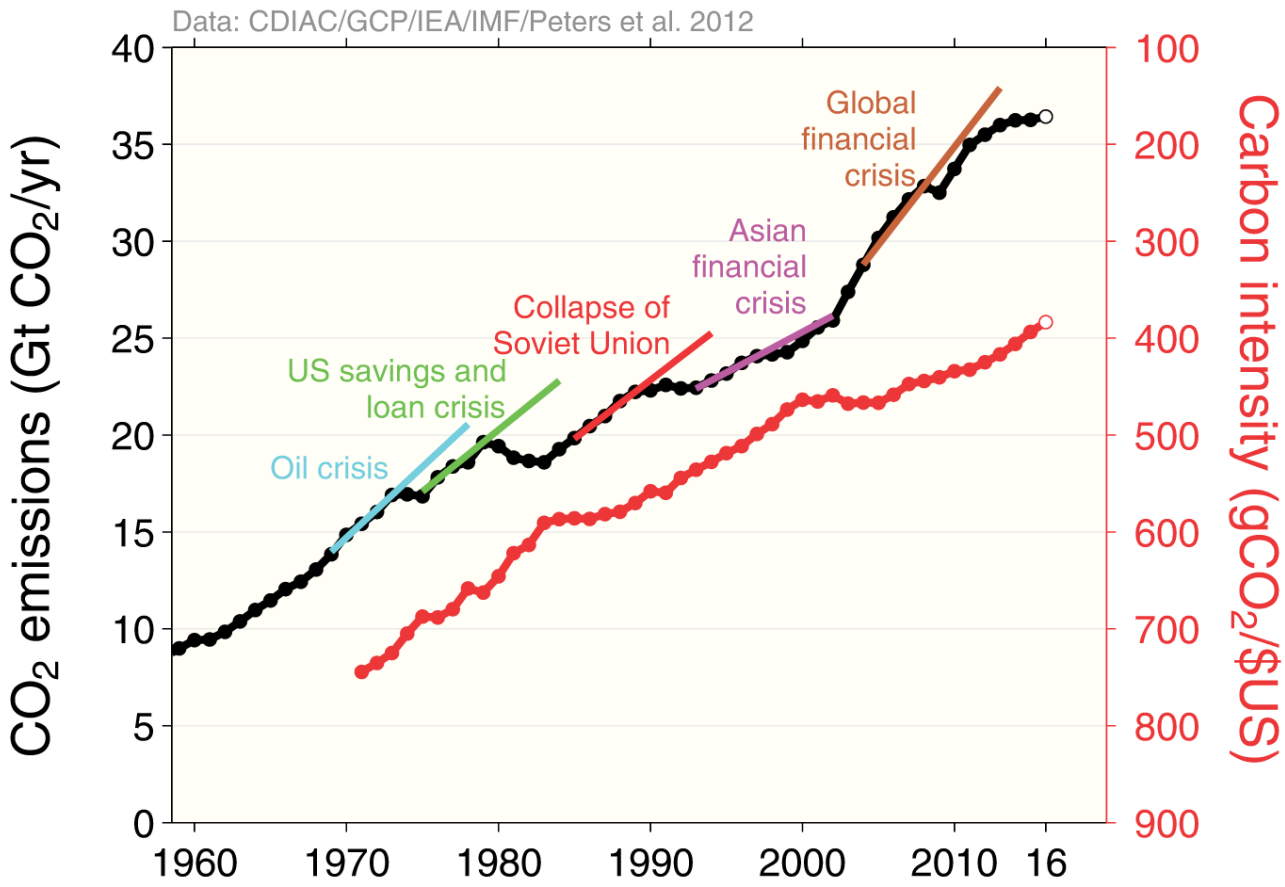
Emissions de CO_2 liées aux énergies fossiles +63% entre 1990 et 2015



Global Carbon Project

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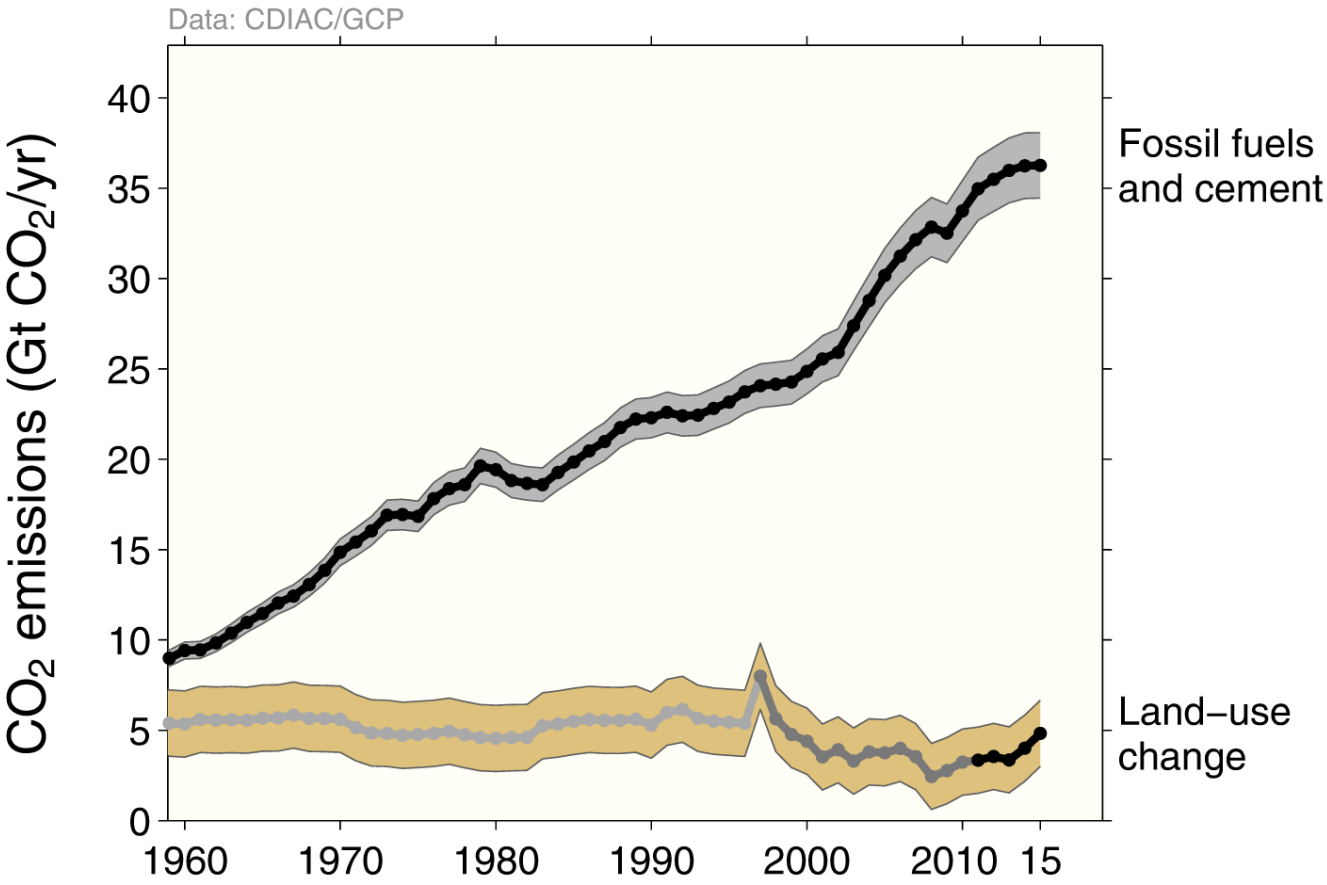
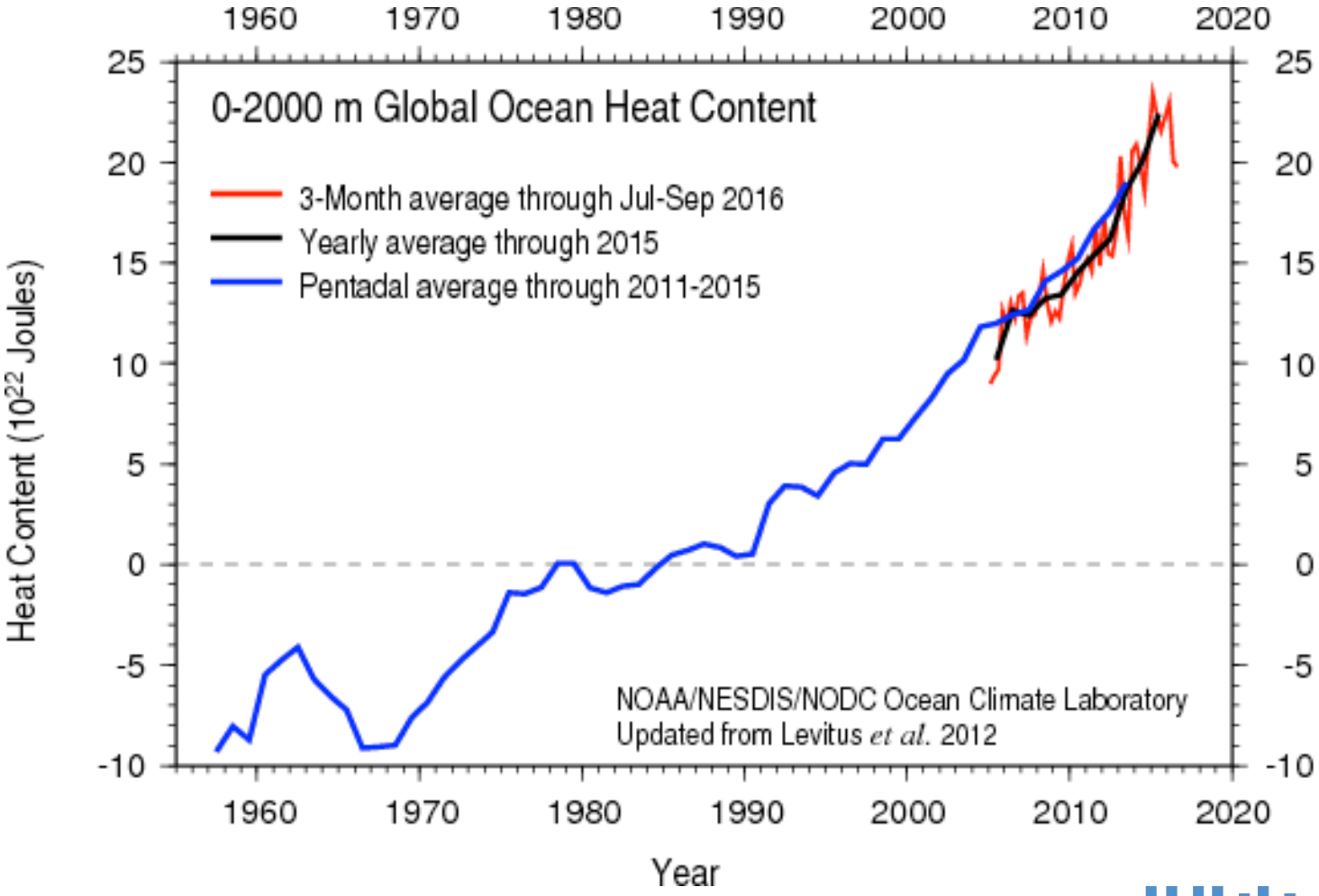
Déforestation : 30% des émissions de CO_2 en 1960, 9% en 2006-2015



Global Carbon Project

Evolution du contenu de chaleur des océans



NOAA

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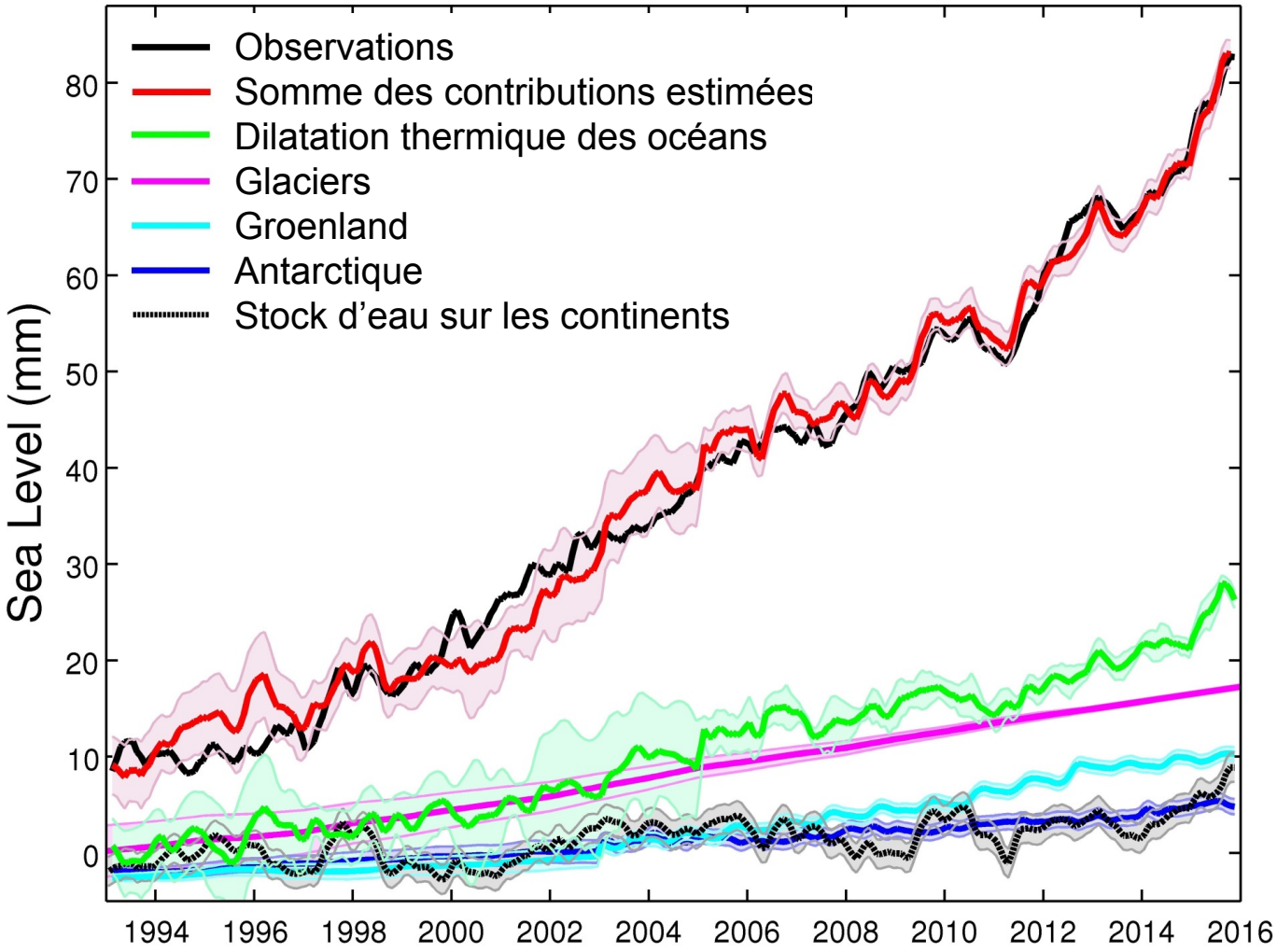
Niveau moyen des mers

1900-1990 : 1,2 à 1,9 mm / an
1993-2016 : 3,1 ± 0.4 mm / an



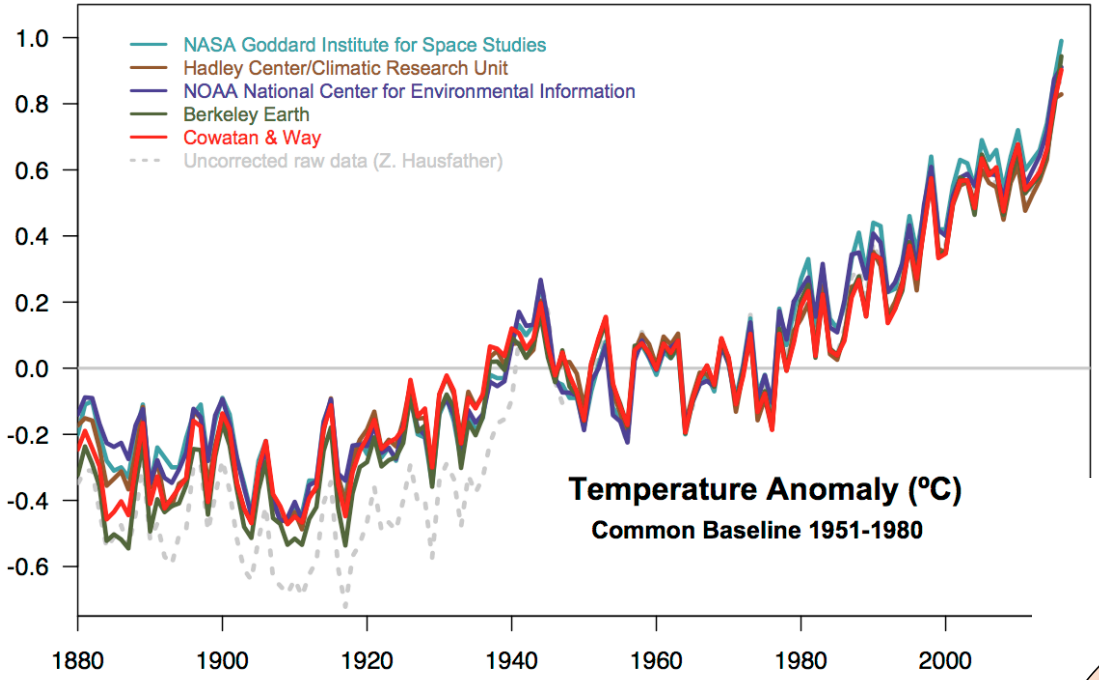
Océans 34%

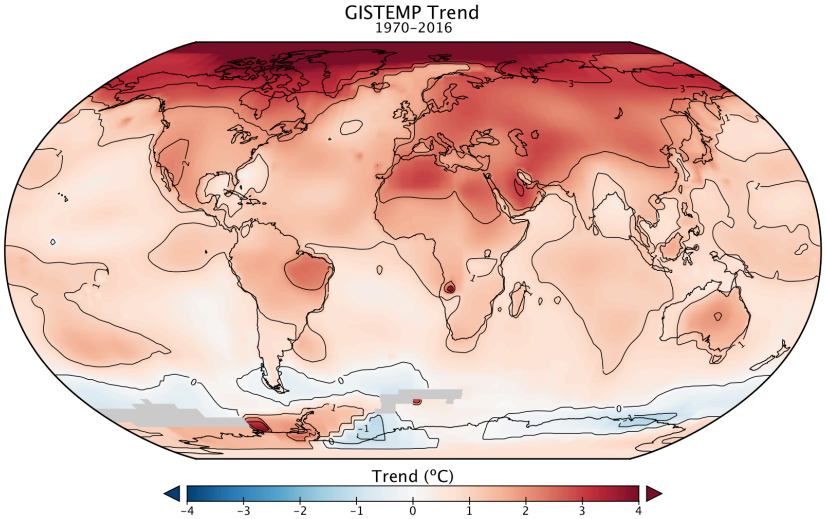
Glaces 56%

Eaux 8%

LEGOS

Evolution de la température de surface



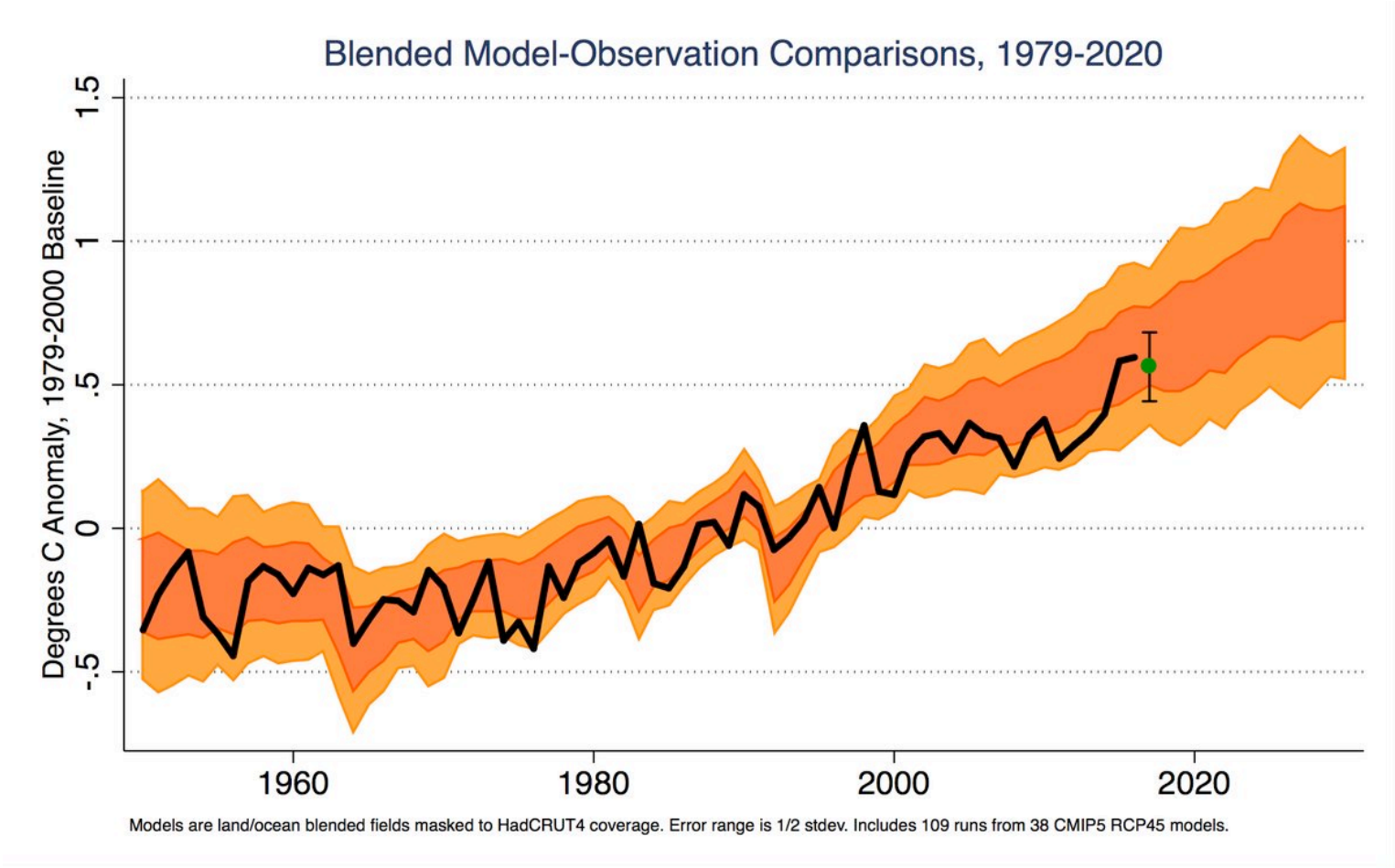


Tendance : + 0,18°C par décennie

2015 et 2016 : >1°C au-dessus du niveau pré-industriel

NASA GISS; Hawkins et al, BAMS, 2017

Comparison entre réchauffement observé et simulations du 5ème rapport du GIEC (2013)



Met Office ; Z. Hausfather

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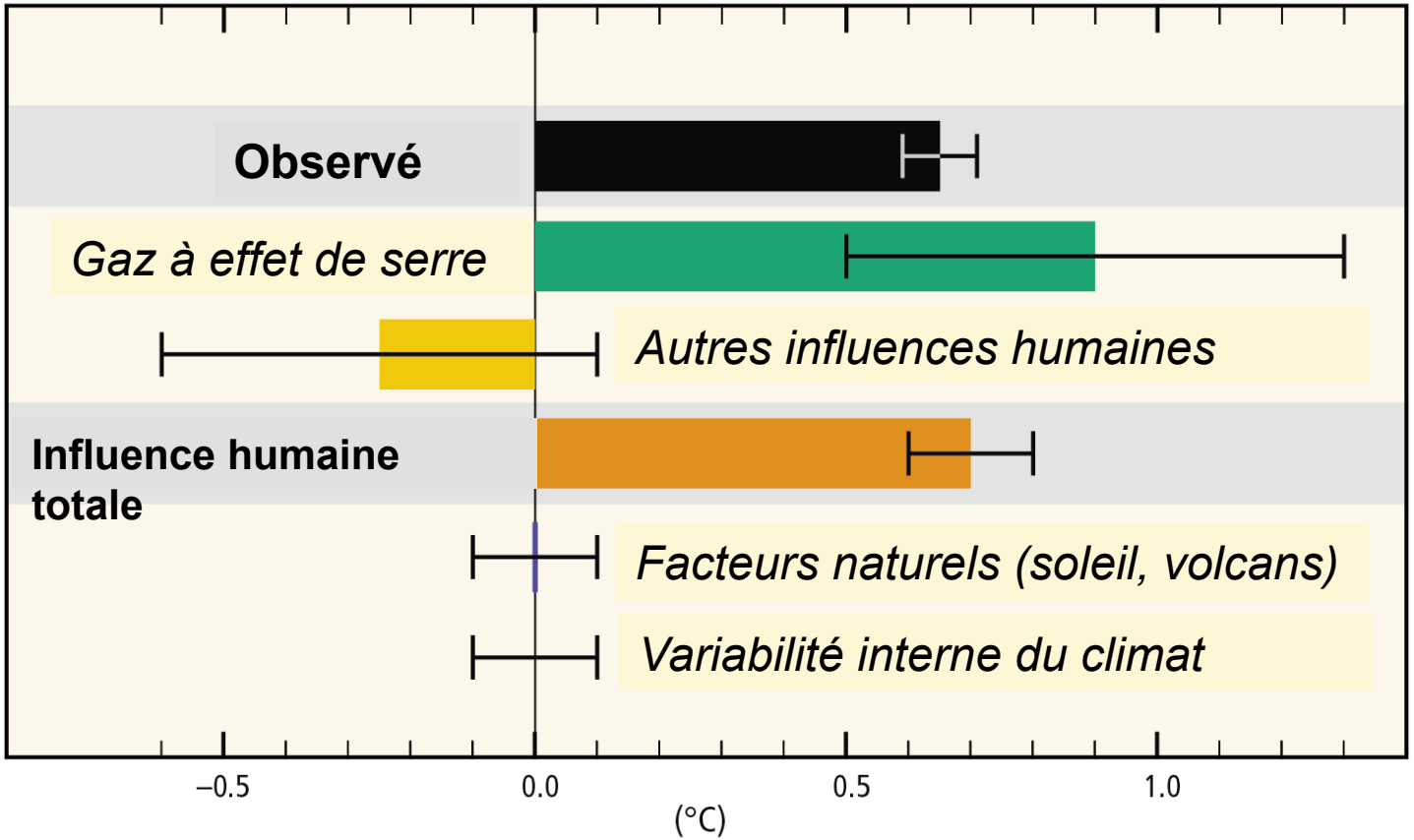
Contributions au réchauffement entre 1951 et 2010



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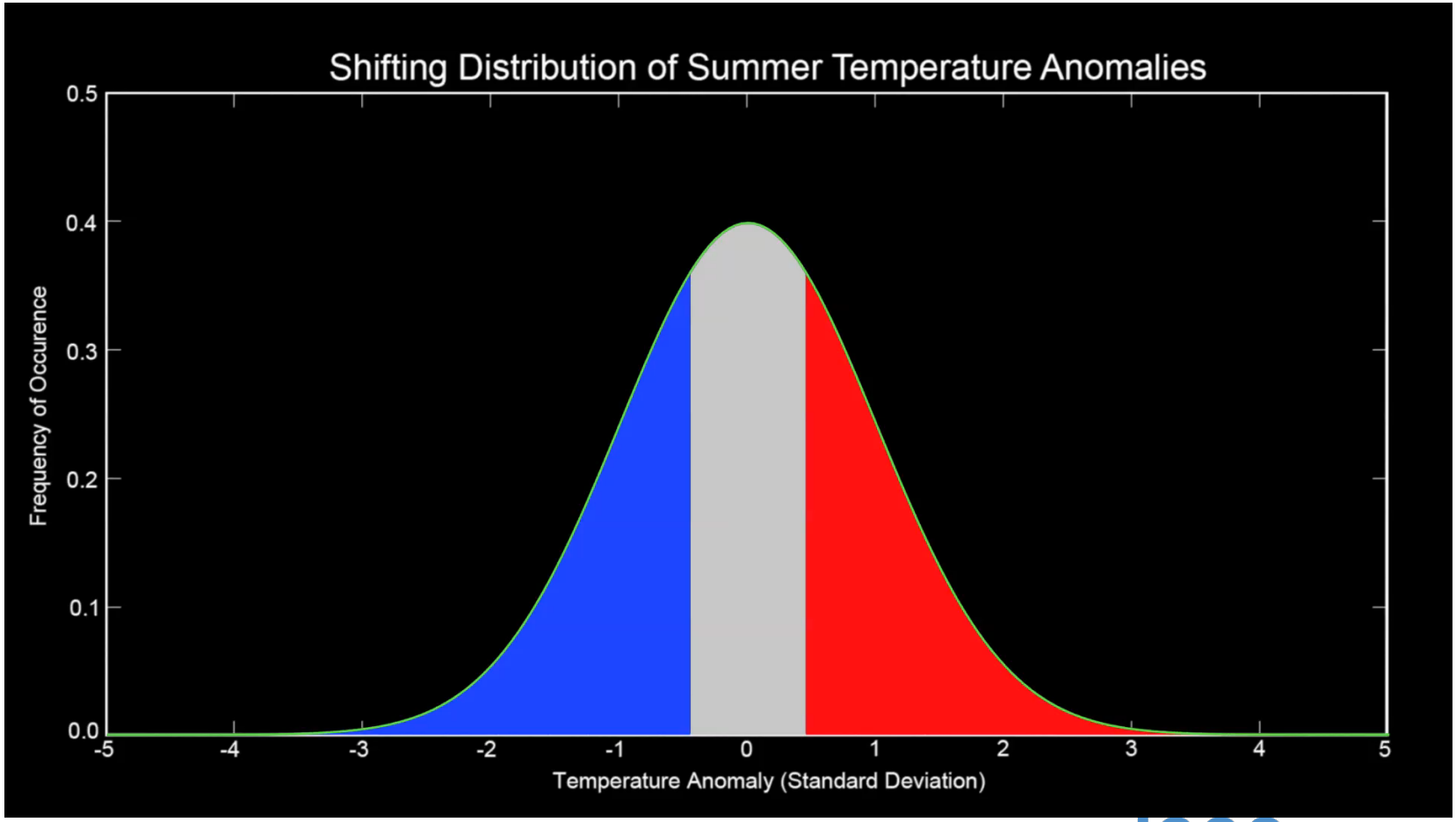
Modification de l'intensité et/ou la fréquence des vagues de chaleur estivales



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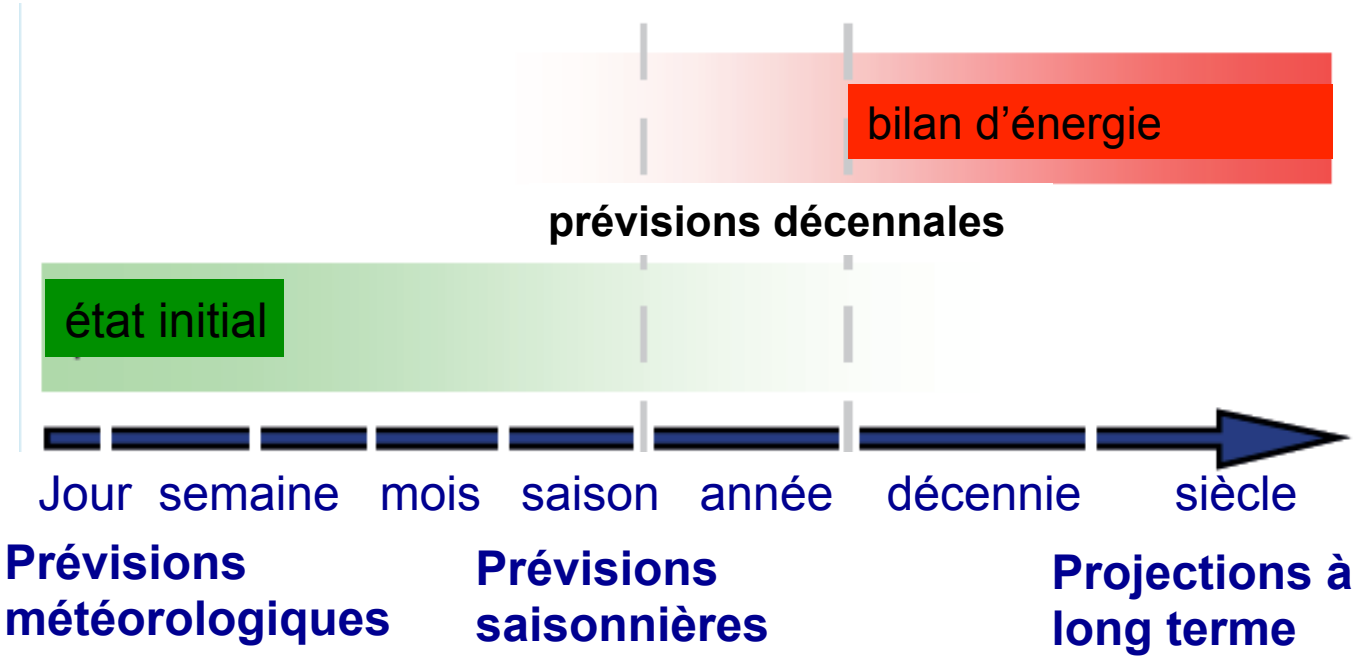
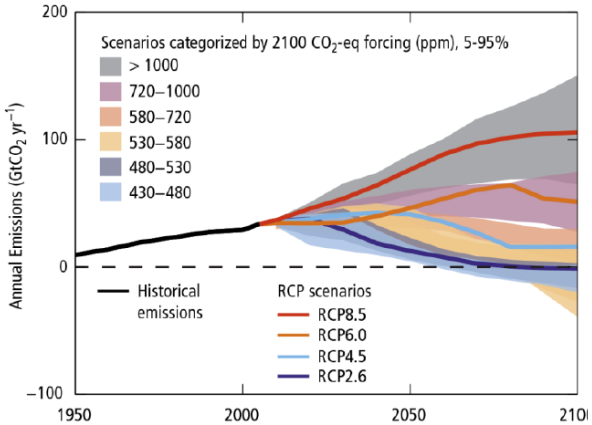
Futur : prévisions - projections

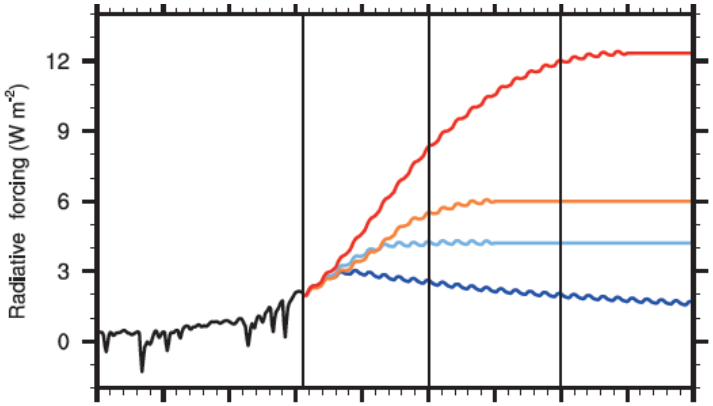


Futur : scénarios et projections

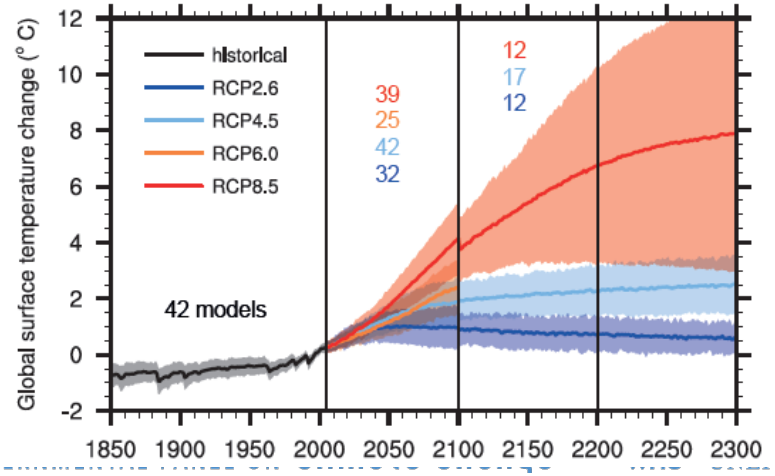
Trajectoire d'émissions de gaz à effet de serre



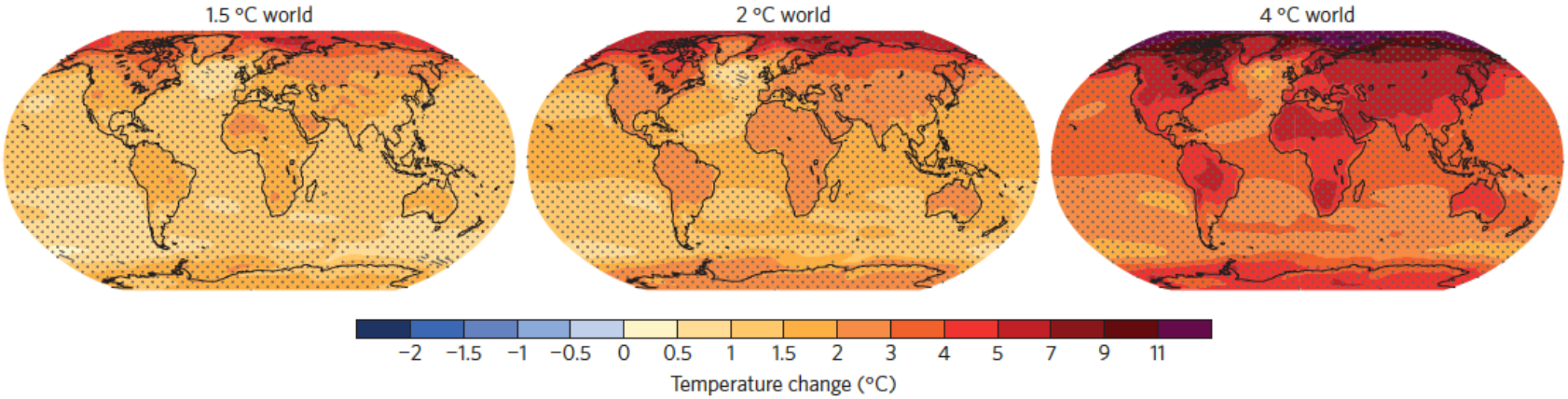
Effet sur le bilan d'énergie (W/m²)

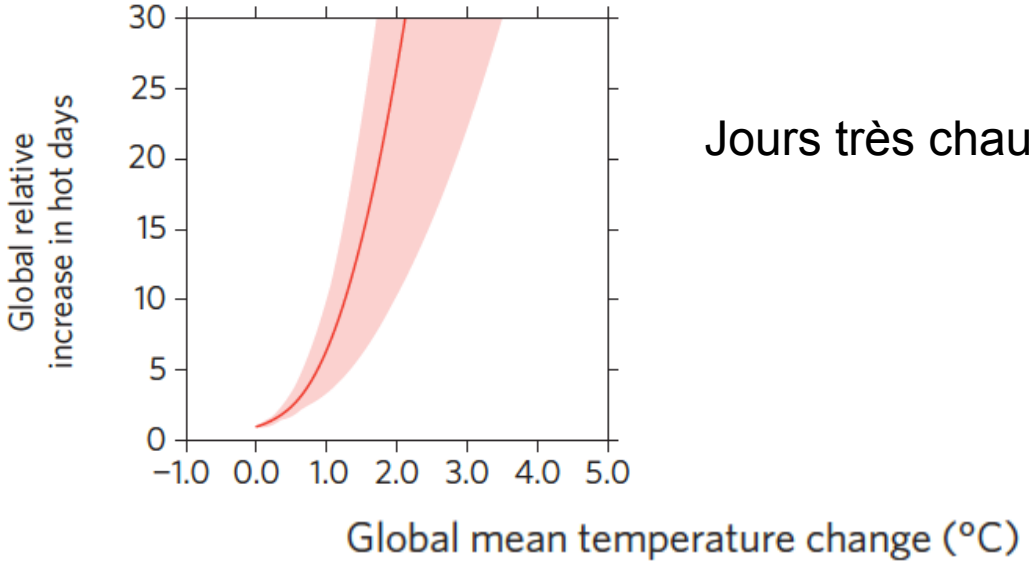


Réponse du climat (°C)



Que représentent 1,5 – 2 ou 4°C de plus?





Jours très chauds

Knutti et al, Nat. Geo., 2015

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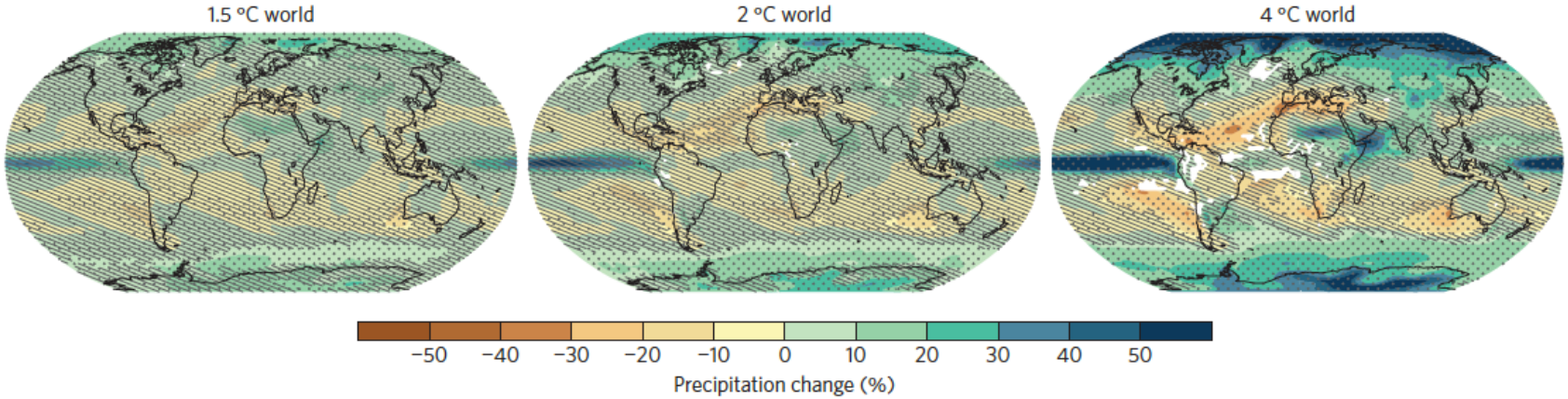
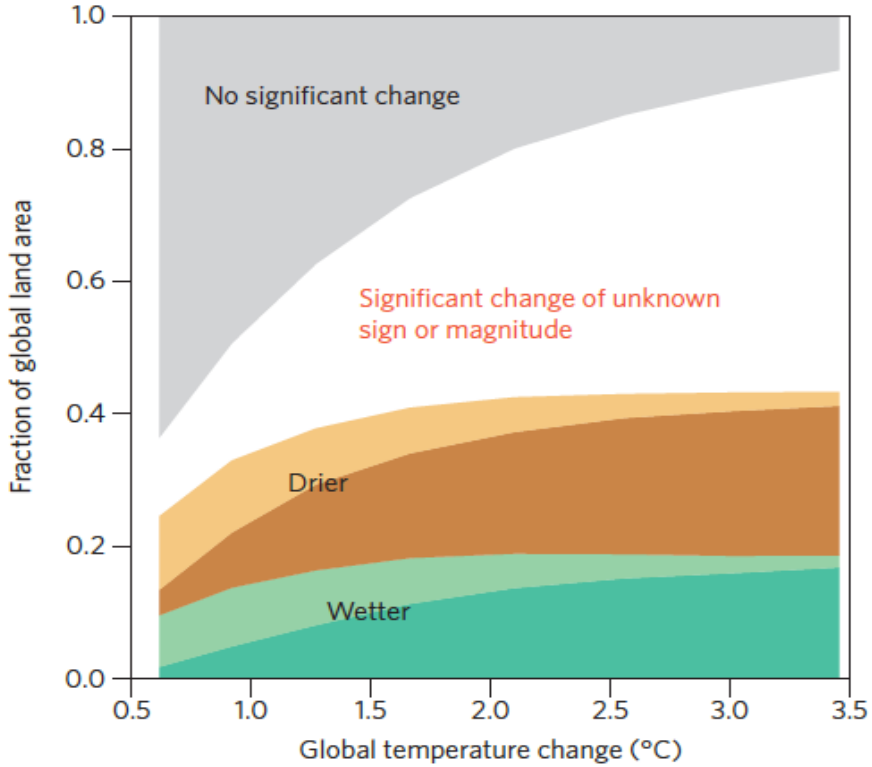
Que représentent 1.5 – 2 ou 4°C de plus?



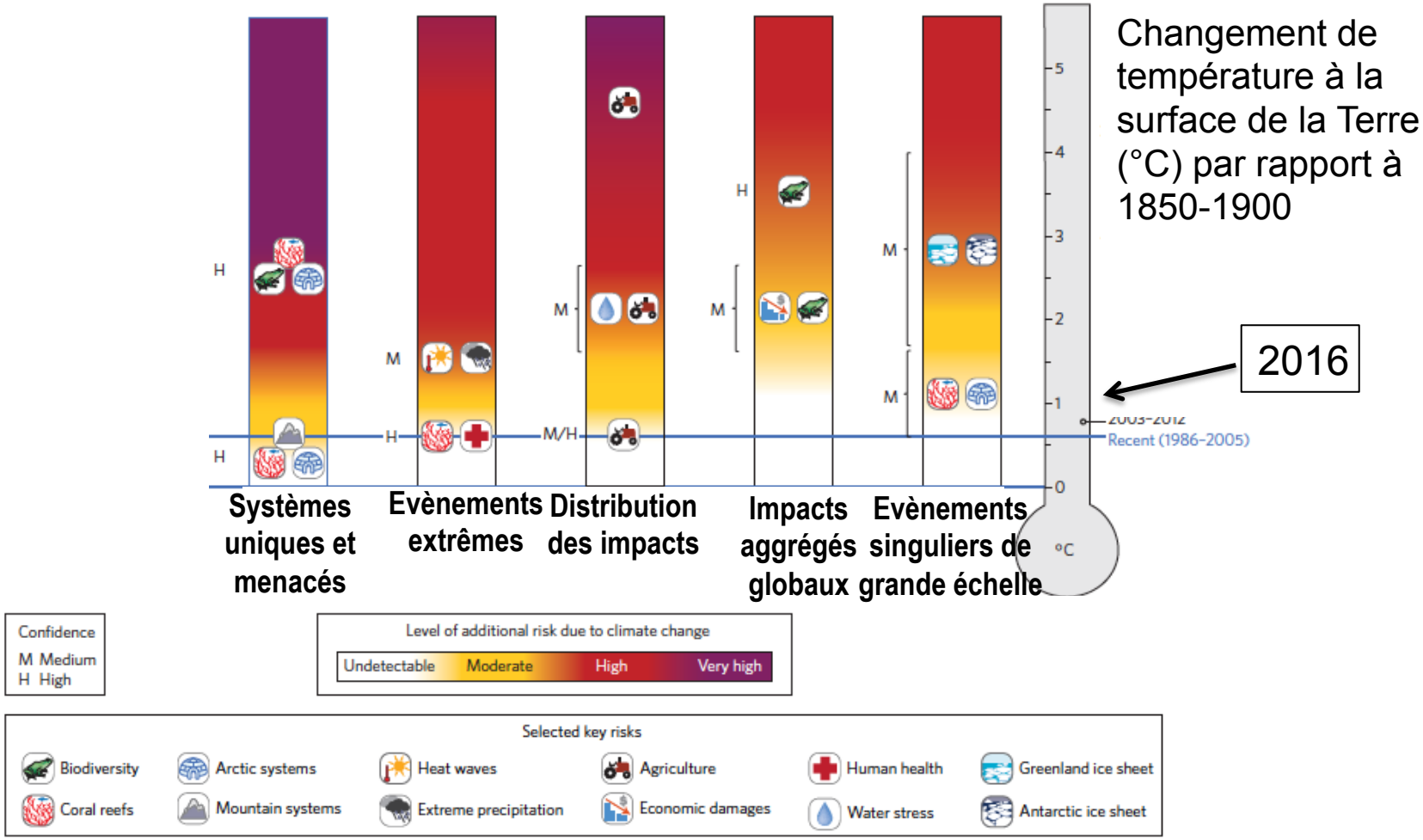
Changements du cycle de l'eau :

- 50% de la population mondiale à +2°C
- 50% de la surface terrestre à +3°C



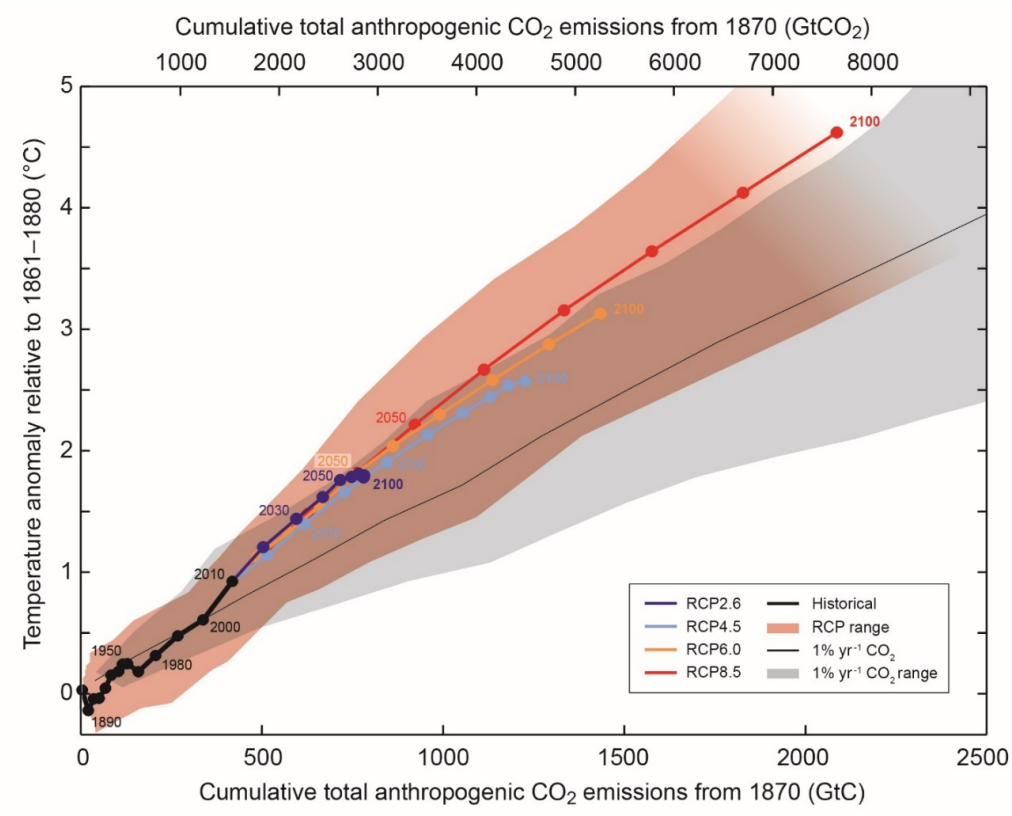
Sedlacek and Knutti, 2014; Knutti et al, Nat. Geo., 2015

Futur : risques supplémentaires



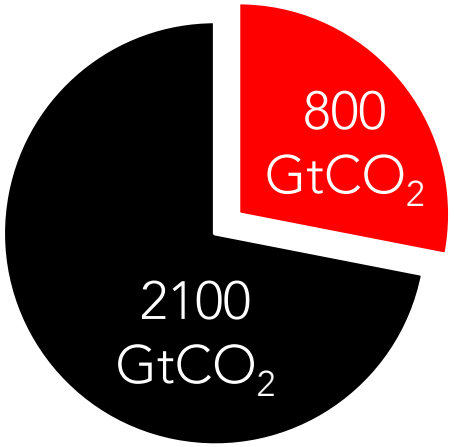
O'Neil et al, NCC, 2017

Concept de « budget carbone » : émissions cumulées de CO_2



<2.0°C, >66%

Indicative range 450-1050$GtCO_2$



IPCC 2013

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Solutions pour réduire les risques

Adaptation, et réduction au long cours des rejets de gaz à effet de serre

Tout retard augmente les défis technologiques, économiques, sociaux et institutionnels pour réduire les rejets de gaz à effet de serre

L'atténuation a un coût mais cela ne prend pas en compte les co-bénéfices (ex: qualité de l'air et santé), ni les coûts des dommages

Options d'atténuation

Efficacité énergétique

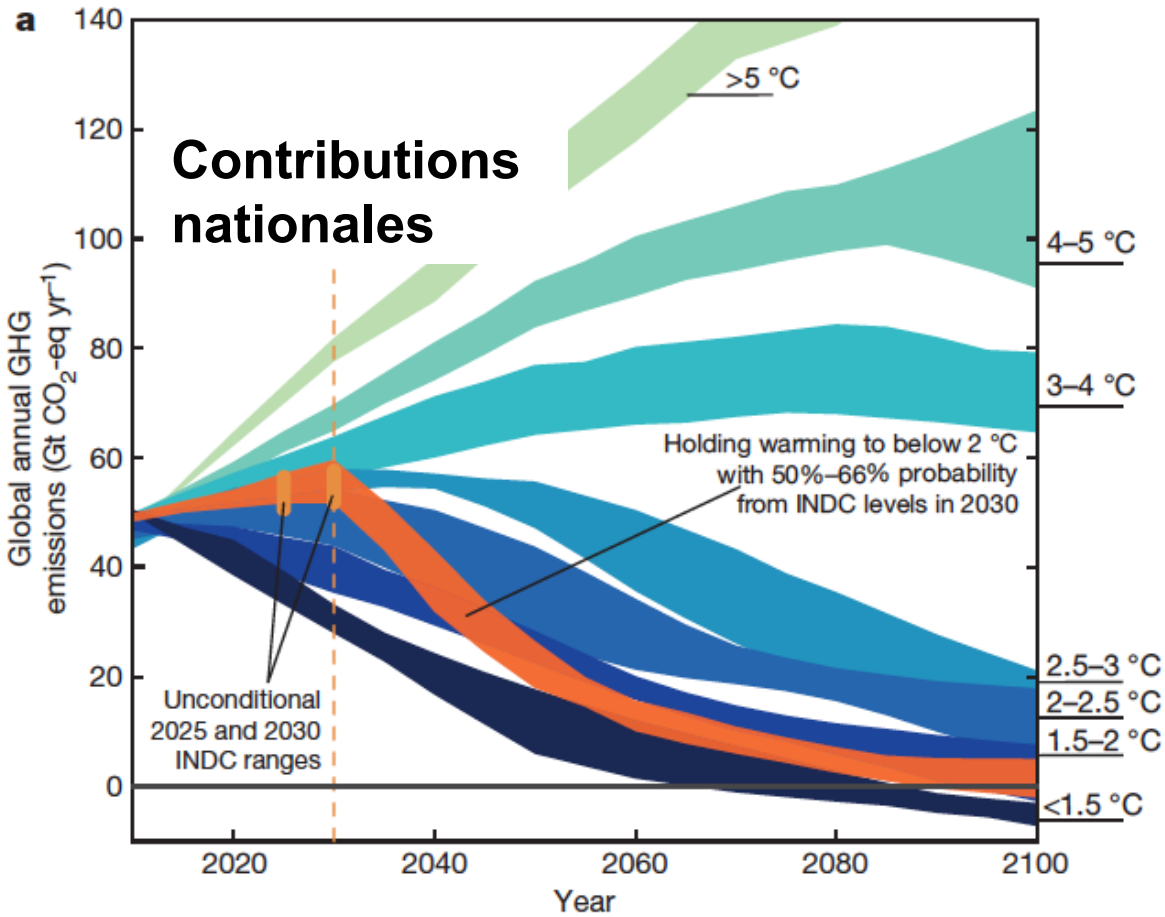
Energie bas carbone et zéro carbone

Renforcement des puis de carbone

- Forêts
- Energie de la biomasse avec captage et stockage

Comportements et modes de vie

Mécanisme de l'accord de Paris



Etape de dialogue 2018

Inventaire global 2023 (adaptation, atténuation)

Baisse des émissions vers neutralité carbone

Objectif de long terme

Rogelj et al, Nature, 2016

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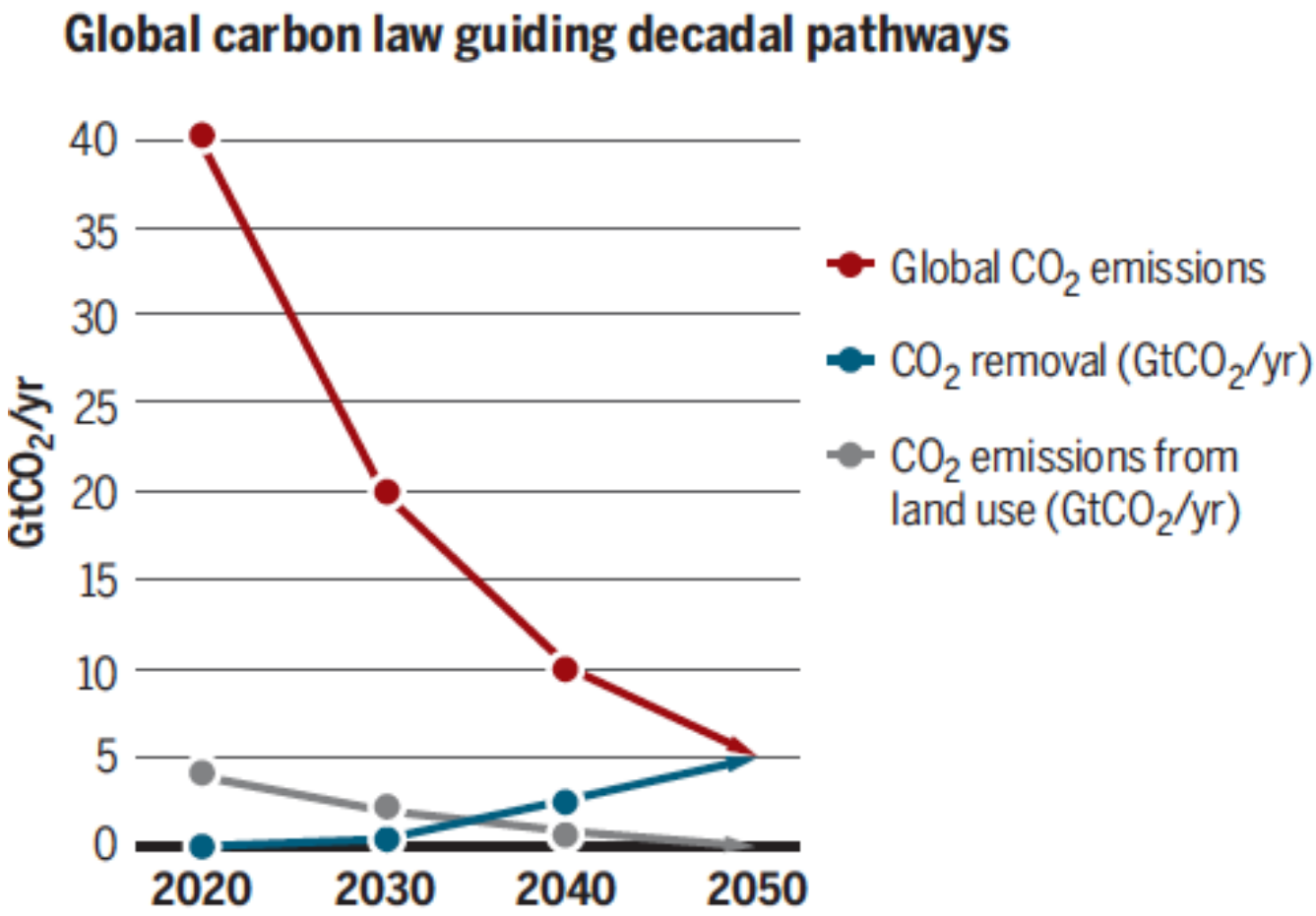
Le défi



Rockström et al, Science, 2017

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Global warming of 1.5°C (SR1.5)

Chapter 1: Framing and context	15
Chapter 2: Mitigation pathways compatible with 1.5°C in the context of sustainable development	40
Chapter 3: Impacts of 1.5°C global warming on natural and human systems	60
Chapter 4: Strengthening and implementing the global response to the threat of climate change	50
Chapter 5: Sustainable development, poverty eradication and reducing inequalities	20

IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC)

Chapter 1: Framing and context	15
Chapter 2: High mountain areas	30
Chapter 3: Polar regions	50
Chapter 4: Sea level rise and implications for low lying islands, coasts and communities	50
Chapter 5: Changing ocean, marine ecosystems, and dependent communities	65
Chapter 6 : Extremes, abrupt changes and managing risks	20
Box : Low lying islands and coasts	<5

IPCC Special Report on Climate Change and Land (SRCCL)

Chapter 1: Framing and context	15
Chapter 2: Land-climate interactions	50
Chapter 3: Desertification	35-40
Chapter 4: Land degradation	40
Chapter 5: Food security	50
Chapter 6 : Interlinkages between desertification, land degradation, food security, and greenhouse gas fluxes : synergies, trade-offs and integrated response options	40
Chapter 7 : Risk management and decision making In relation to sustainable development	40

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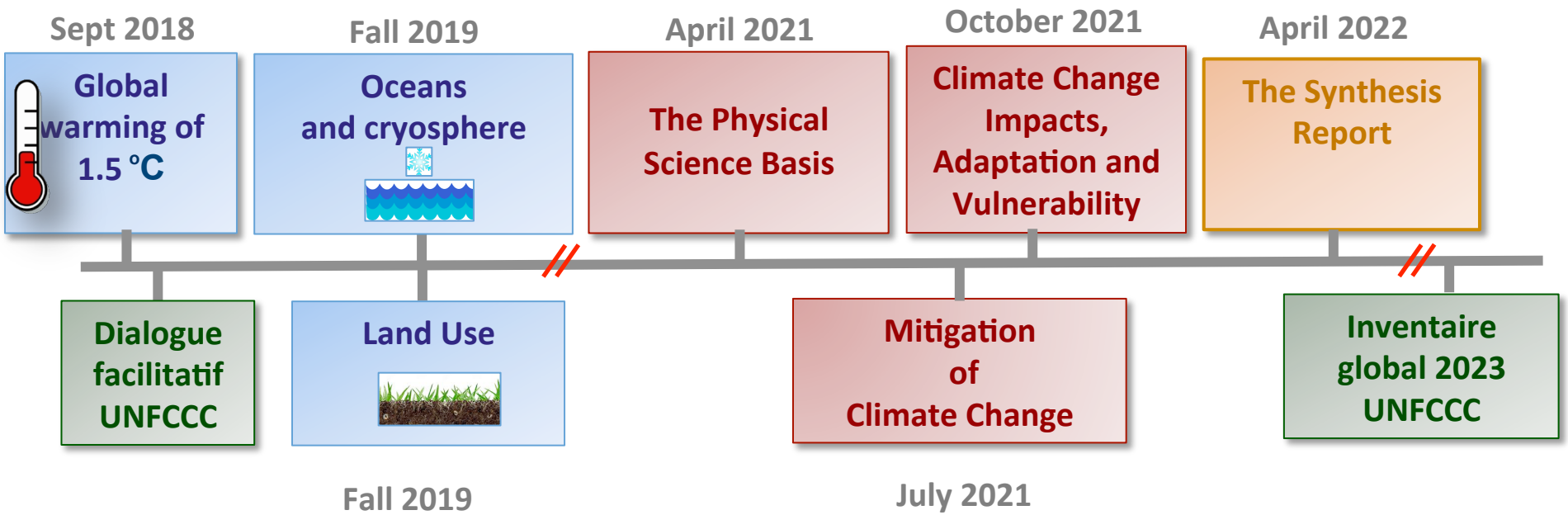
Calendrier



Cities and Climate Change Science Conference (March 2018)

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THANK YOU FOR YOUR ATTENTION!

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IPCC Secretariat: ipcc-sec@wmo.int
IPCC Press Office: ipcc-media@wmo.int

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https://vimeo.com/ipcc

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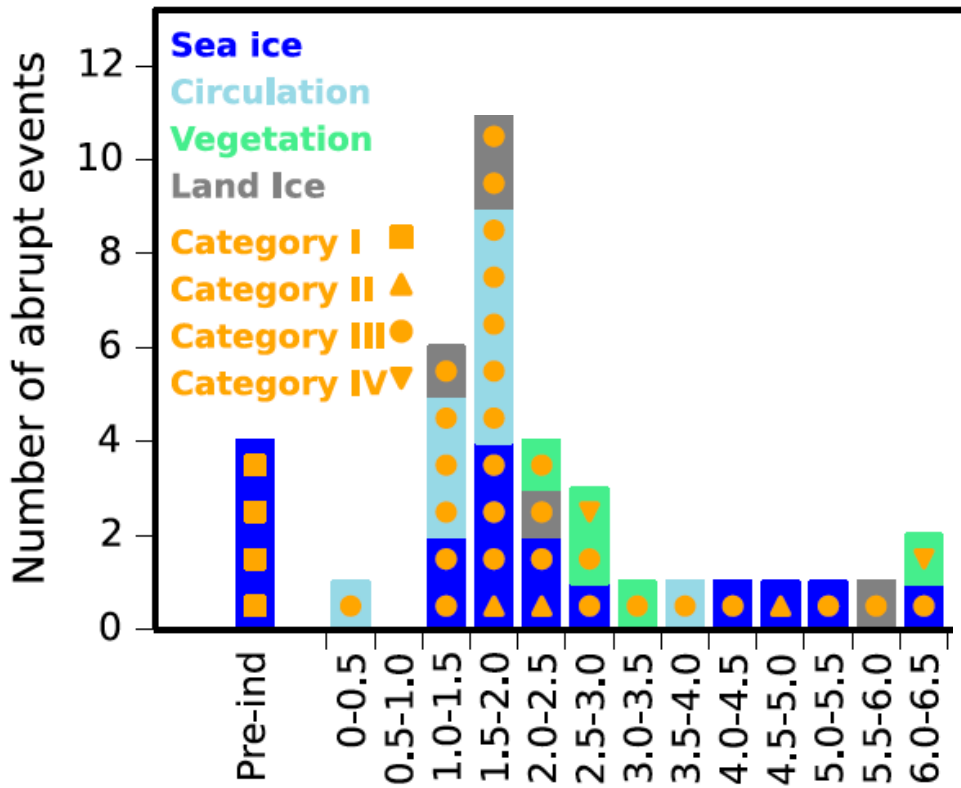
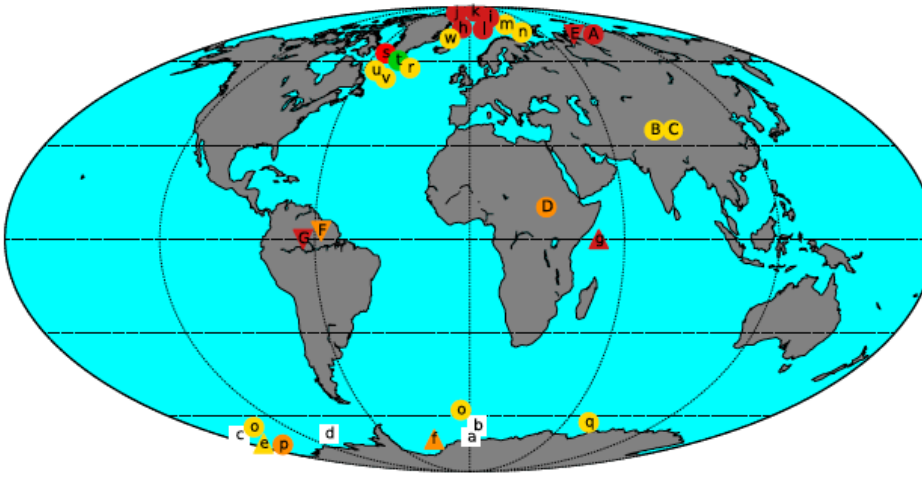
Quels risques de changements abrupts?

Catalogue dans les simulations climatiques **CMIP5**





Intensité du réchauffement global (°C)

Drijfhout et al, PNAS, 2015

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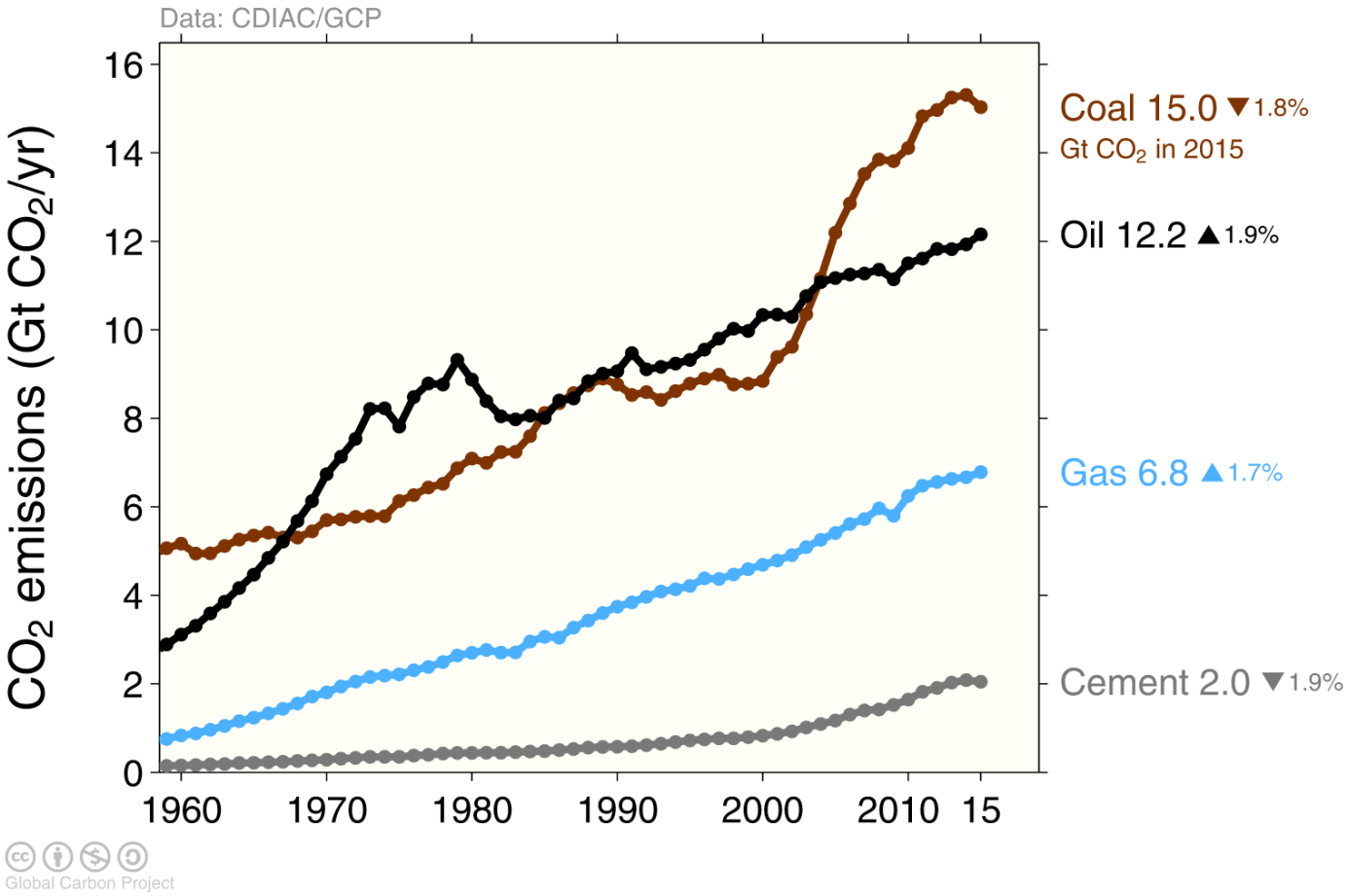
Emissions liées au charbon, pétrole, gaz et ciment



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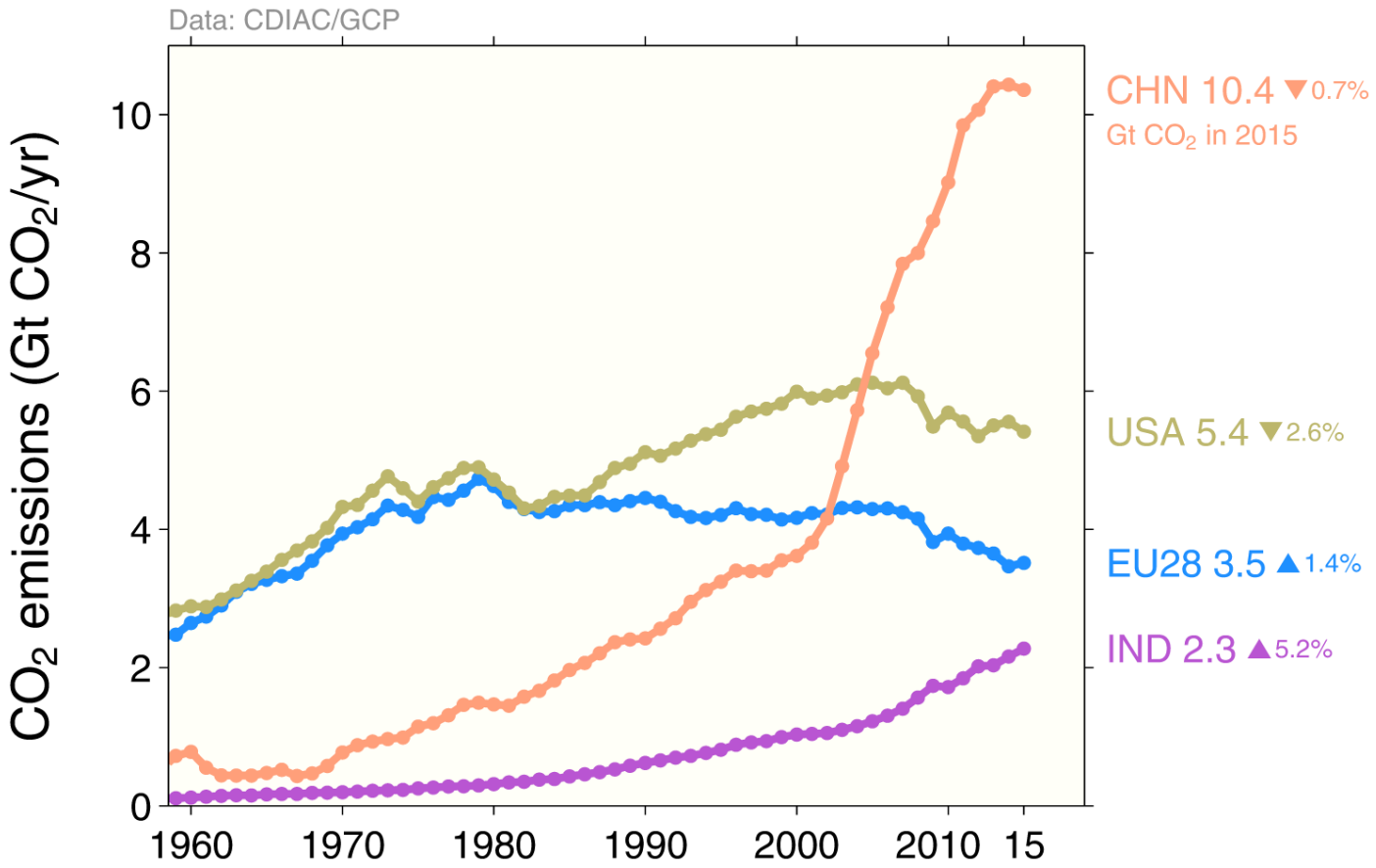
Le top 4 : 59% des émissions mondiales



Global Carbon Project

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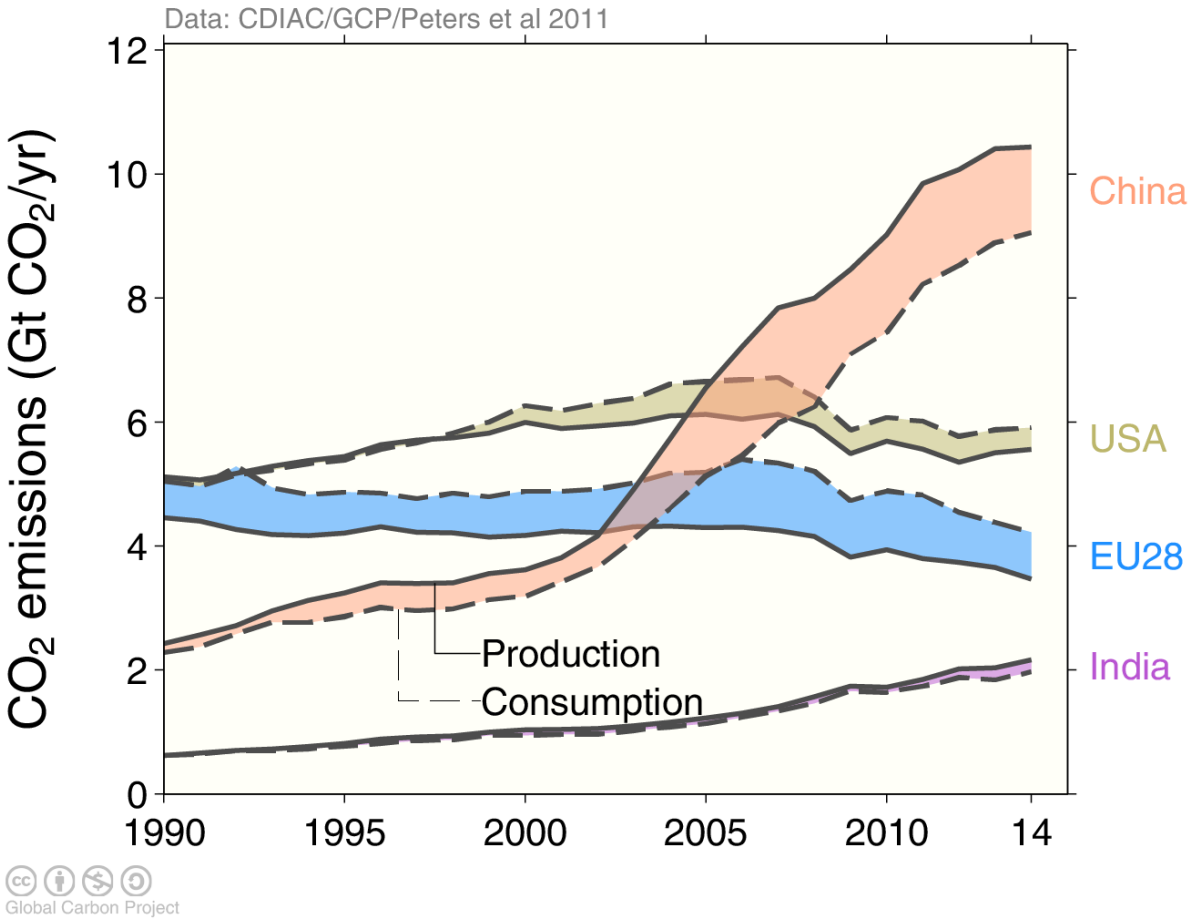
Une autre perspective si l'on considère la consommation et non la production



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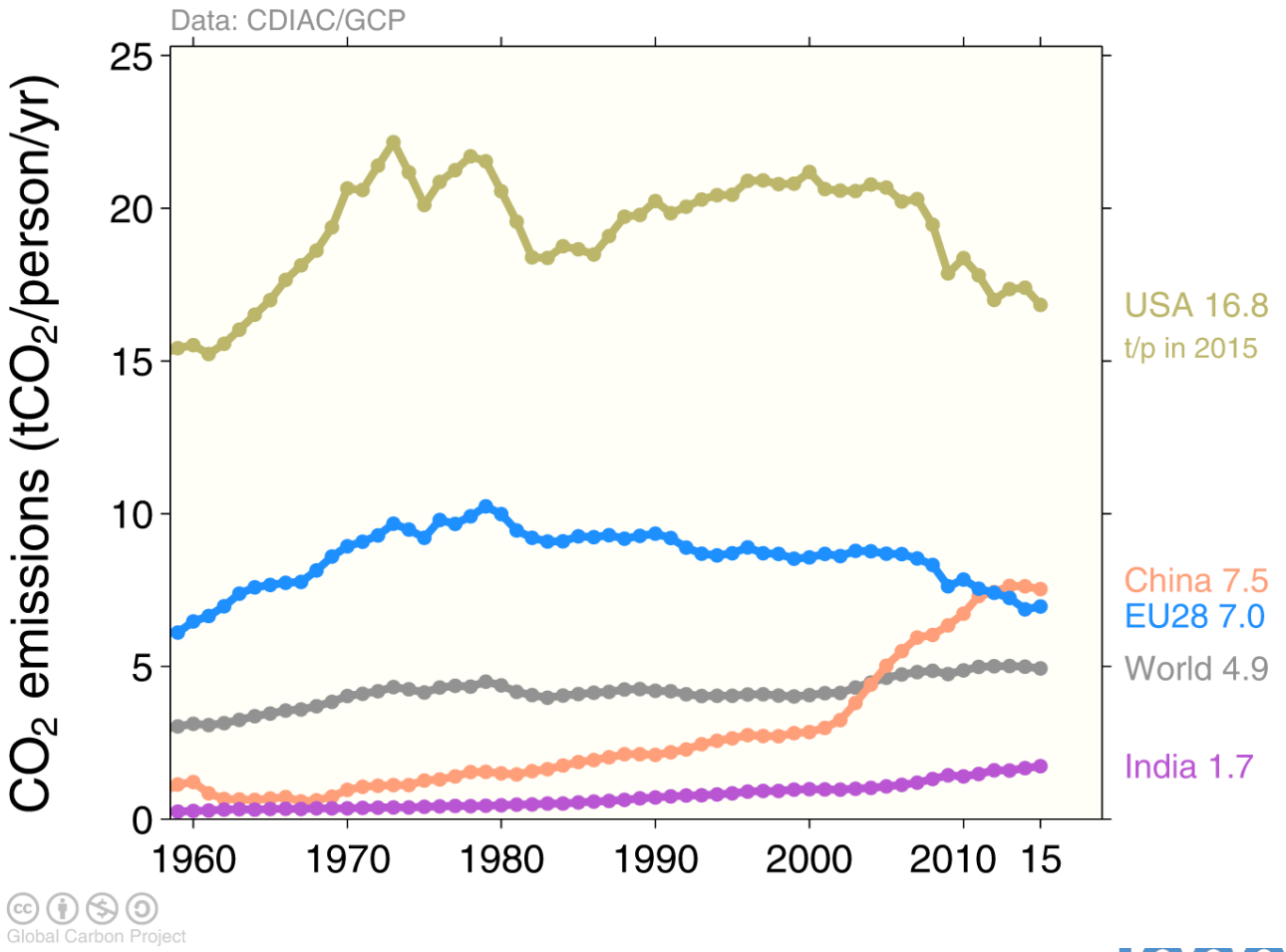
De grands contrastes dans les émissions par personne



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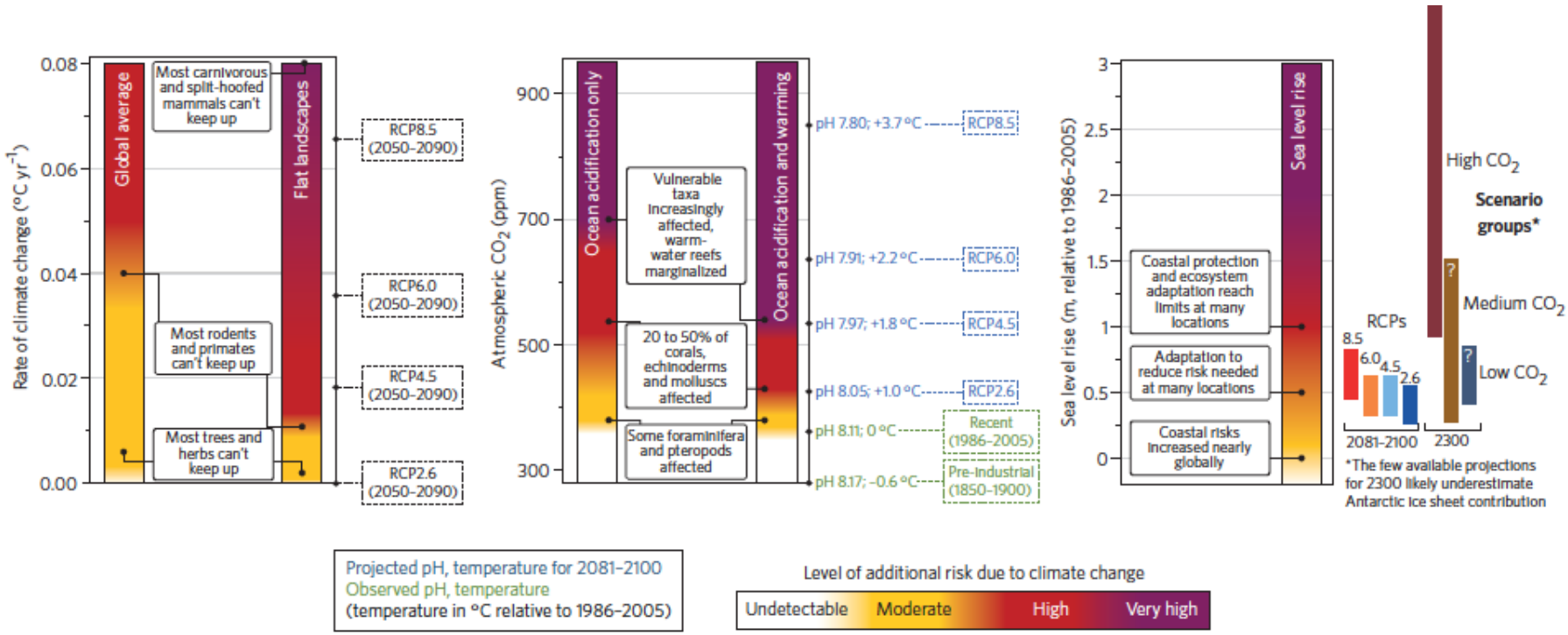
Futur : risques supplémentaires

Vitesse de réchauffement et biodiversité

En mer : stress thermique et acidification

Niveau des mers et zones côtières



O'Neil et al, NCC, 2017

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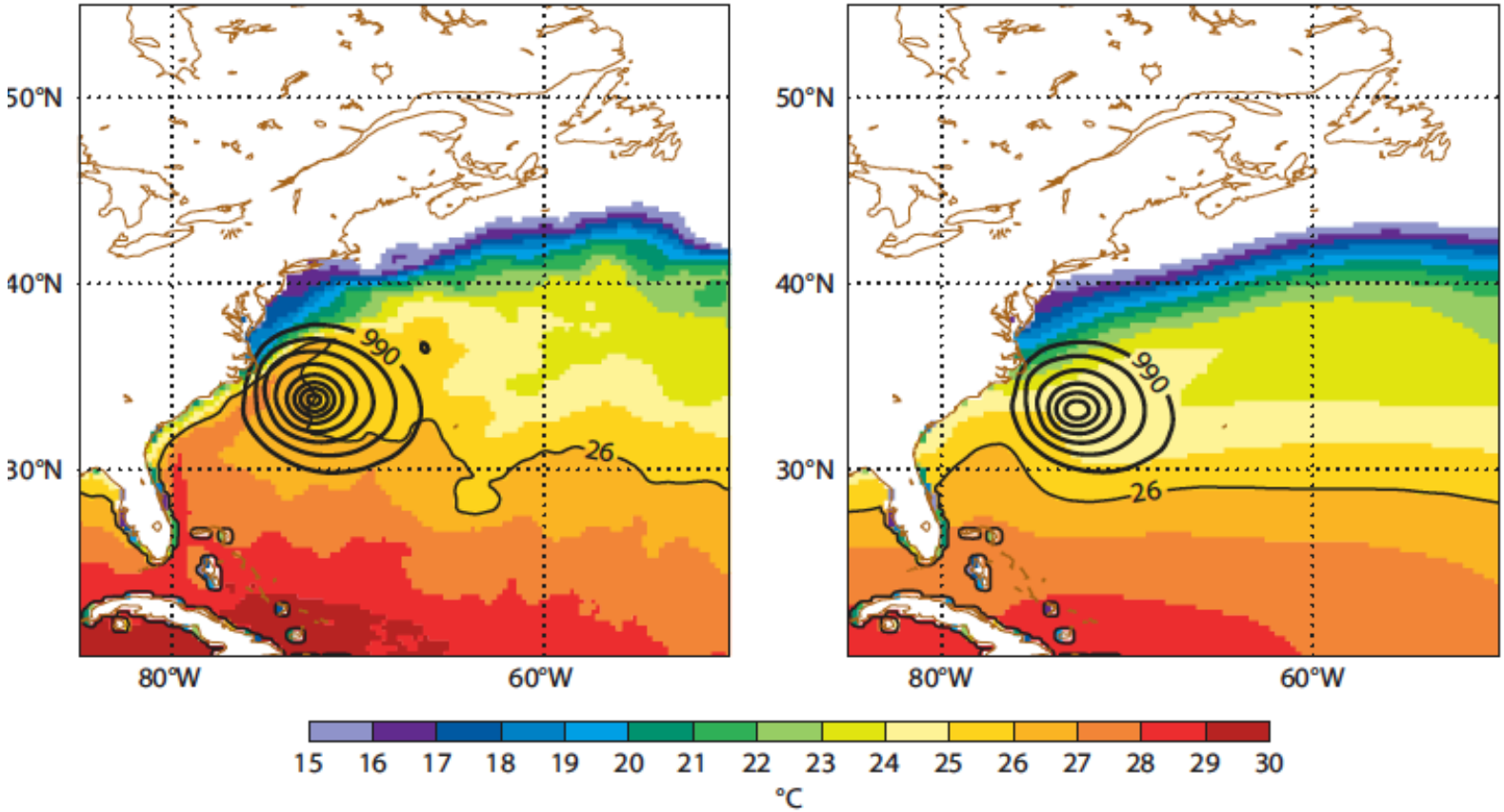
Intensité de l'ouragan Sandy (30 oct. 2013)

70 milliards de $ de dégâts autour de New York : vents, pluies et submersion

Prévision (avec température mer réelle) **Prévision (température mer «normale »)**



Magnusson et al 2013 WMR

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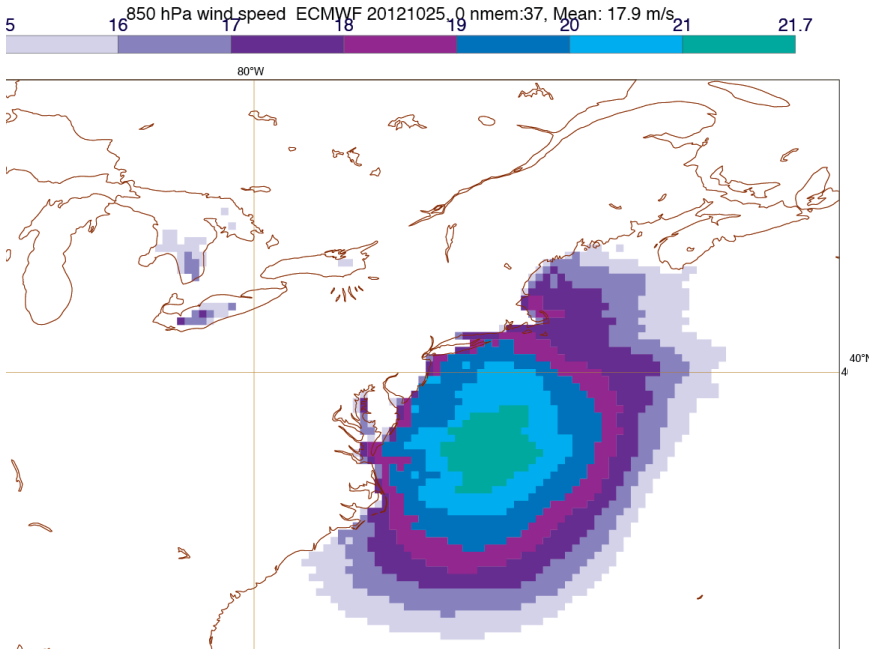
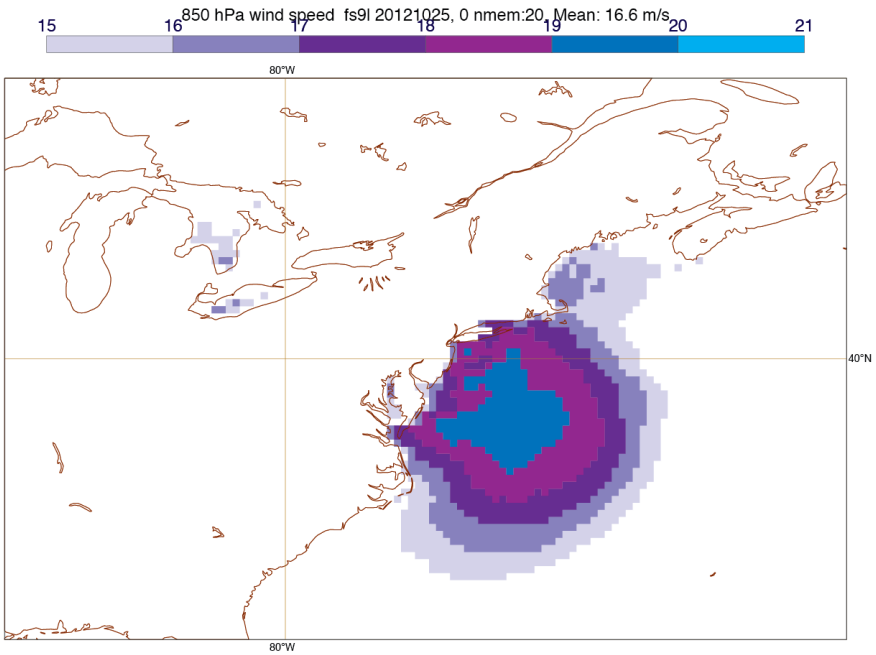
Intensité de l'ouragan Sandy : rôle du réchauffement océanique

Vents (avec température mer réelle)



Vents (température mer «normale »)



Température mer plus élevée: vents +3.6 m/s, pluies +35%
Niveau mer +19 cm

Magnusson et al 2013 WMR

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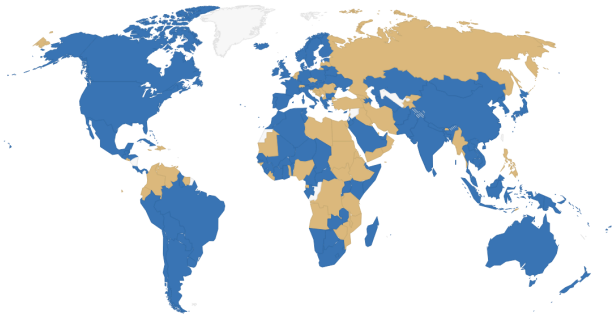
Agenda 2030

- Accord de Sendai pour réduire le risque de catastrophe

- Accord de Paris sur le climat

signé par 194 parties

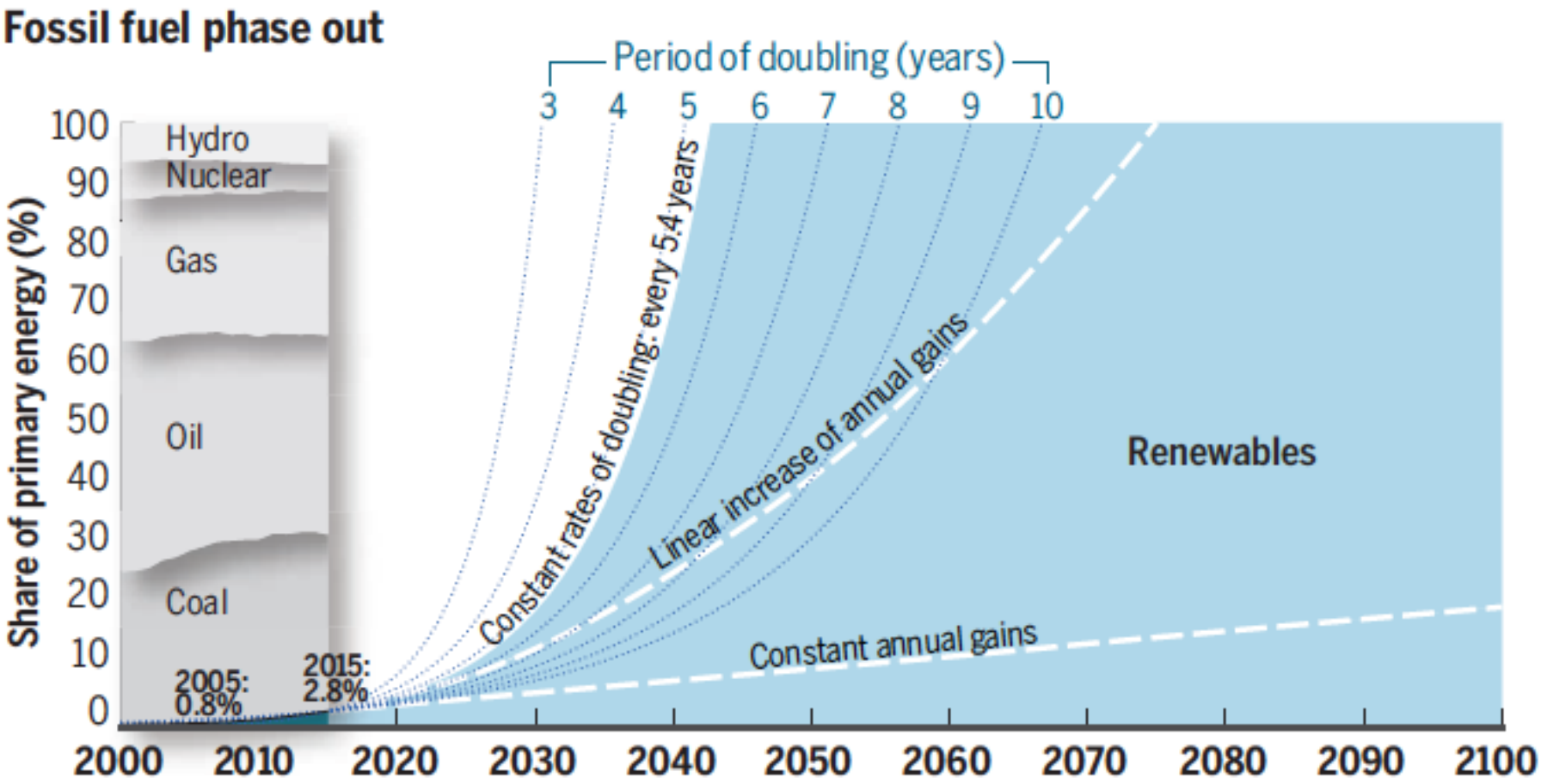
ratifié par 143 parties (82% des émissions mondiales)



- Objectifs du développement durable

- Nouvel agenda urbain

Nécessaire transition énergétique



Rockström et al, Science, 2017

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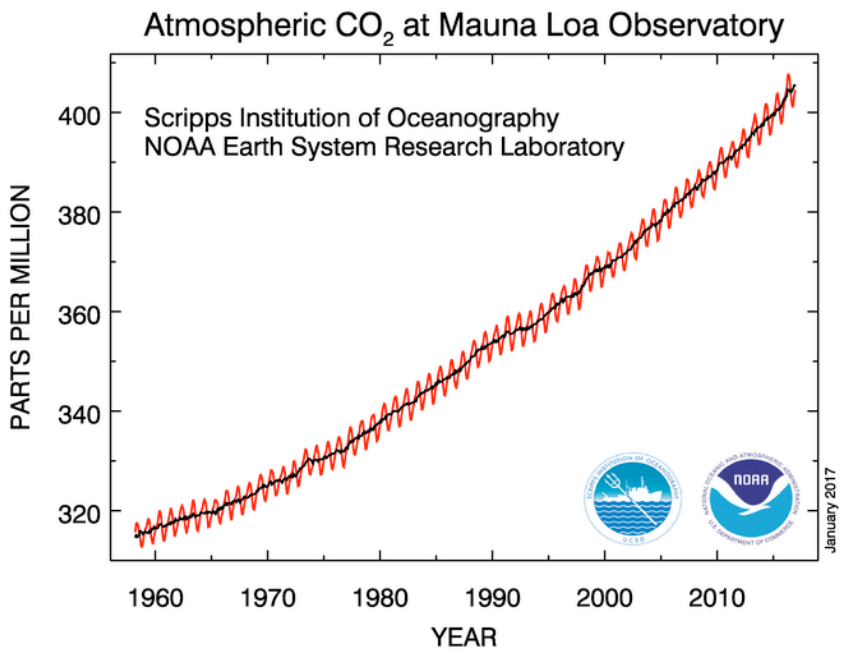
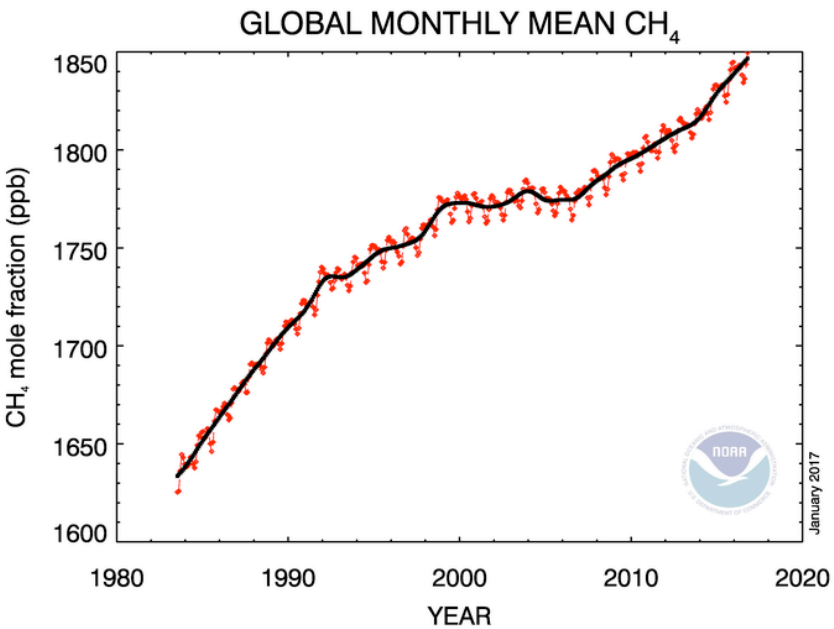
Concentration en gaz à effet de serre dans l'atmosphère





NOAA

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