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Impacts du changement climatique : où en sommes-nous depuis les Accords de Paris ?

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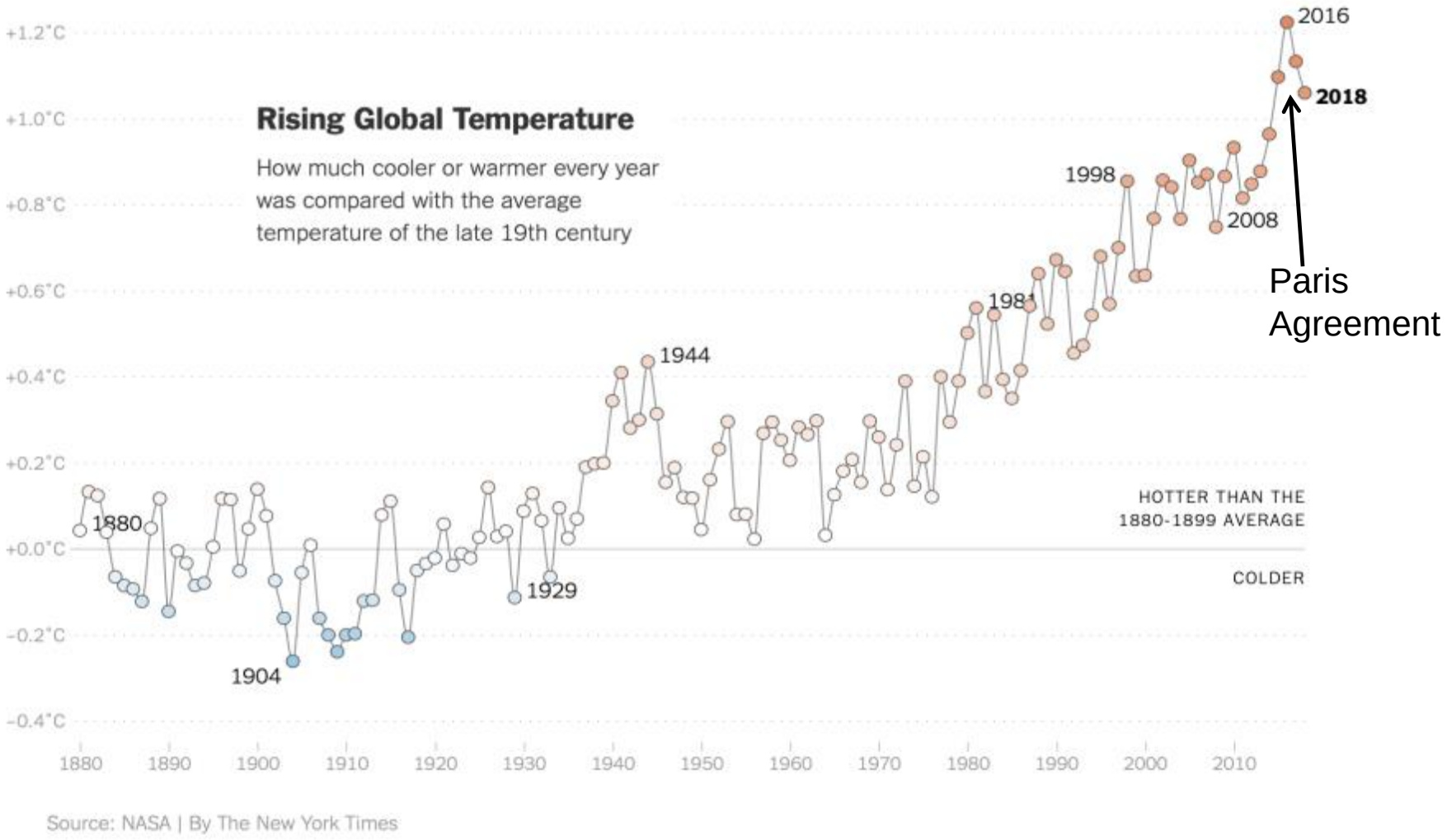
Where are we now (key messages)?

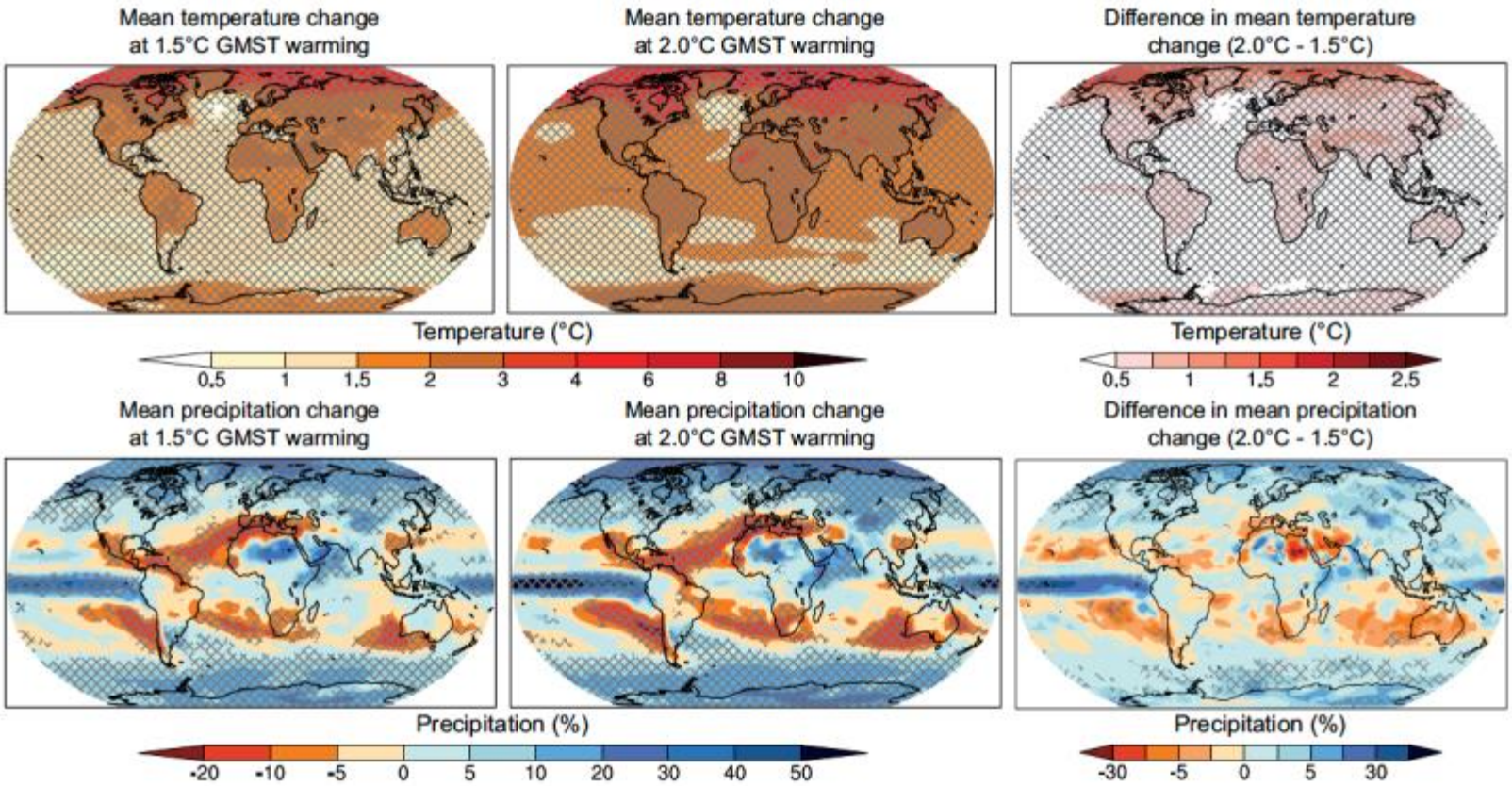
Since pre-industrial times, human activities have caused approximately 1°C of global warming.

- Already seeing consequences for people, nature and livelihoods
- At current rate (0.2°C/decade), would reach 1.5°C between 2030 and 2052
- Human induced global warming has already caused multiple observed changes in the climate system and in the ecosystems (high confidence)

Year 2018 is the 4th warmest year since 1880



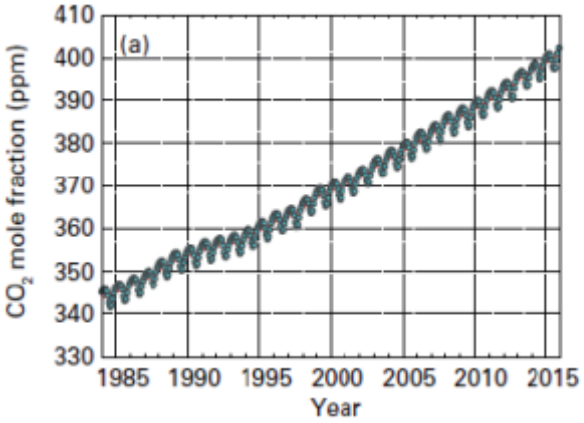
Changes of temperature and precipitation at 1.5°C and 2°C global warming



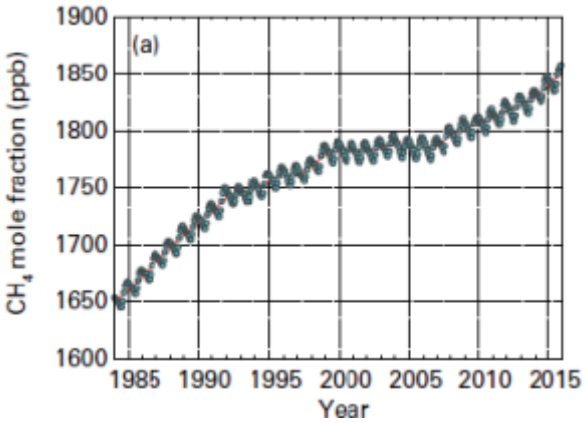
Hotspots : high latitudes, North Siberia

Droughts: Mediterranean, Central America, Chile, South Africa, S. China, Australia

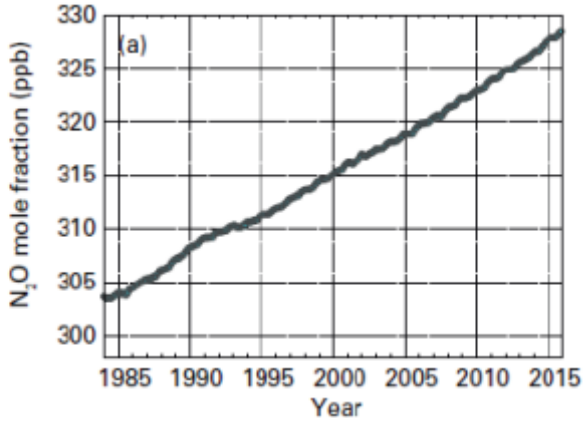
The human activities modify the greenhouse gaz proportion in the atmosphere



Gaz carbonique : CO_2 + 40 %



Méthane : CH_4 * 2,6



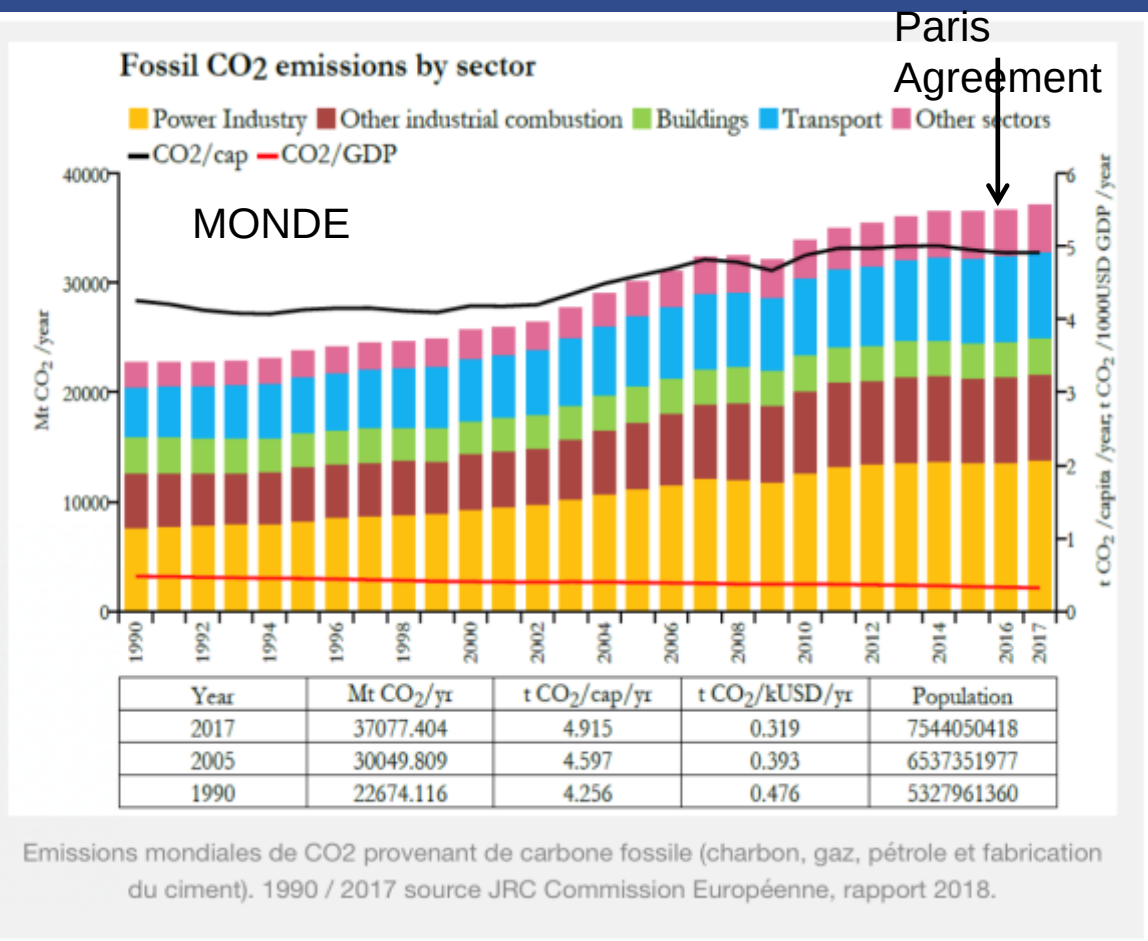
Protoxyde d'azote : N_2O + 20 %

En 2013, près de 75 % des émissions de GES étaient dues au CO_2 (combustibles fossiles pour environ 90 %). Le méthane (CH_4) a contribué pour 14 % (rizières, décharges, ruminants...) et le N_2O pour 8 % (engrais, fumiers, fossiles…).

Depuis le début de l'ère industrielle, la quantité d'énergie disponible pour « chauffer » les composantes du système climatique a augmenté de 1 % (2,3 W/m2). Ce chiffre tient compte de l'augmentation de l'effet de serre (3 W/m2) et de l'effet de refroidissement des aérosols (environ 0,7 W/m2).

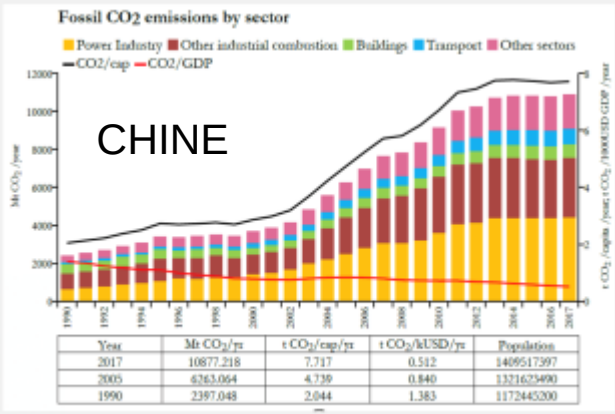
Jean Jouzel

The human activities emit more and more carbone in the atmosphere



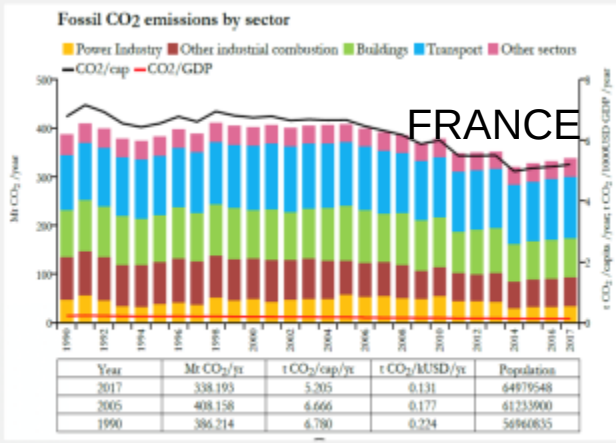
Year	Mt CO_2/yr	t CO_2/cap/yr	t CO_2/kUSD/yr	Population
2017	37077.404	4.915	0.319	7544050418
2005	30049.809	4.597	0.393	6537351977
1990	22674.116	4.256	0.476	5327961360

Emissions mondiales de CO2 provenant de carbone fossile (charbon, gaz, pétrole et fabrication du ciment). 1990 / 2017 source JRC Commission Européenne, rapport 2018.



Year	Mt CO_2/yr	t CO_2/cap/yr	t CO_2/kUSD/yr	Population
2017	10877.218	7.717	0.512	1409517397
2005	6763.064	4.739	0.840	1321623490
1990	2397.048	2.044	1.383	1172445200

Emissions CO2 par secteurs Chine 1990 2017, source Commission Européenne

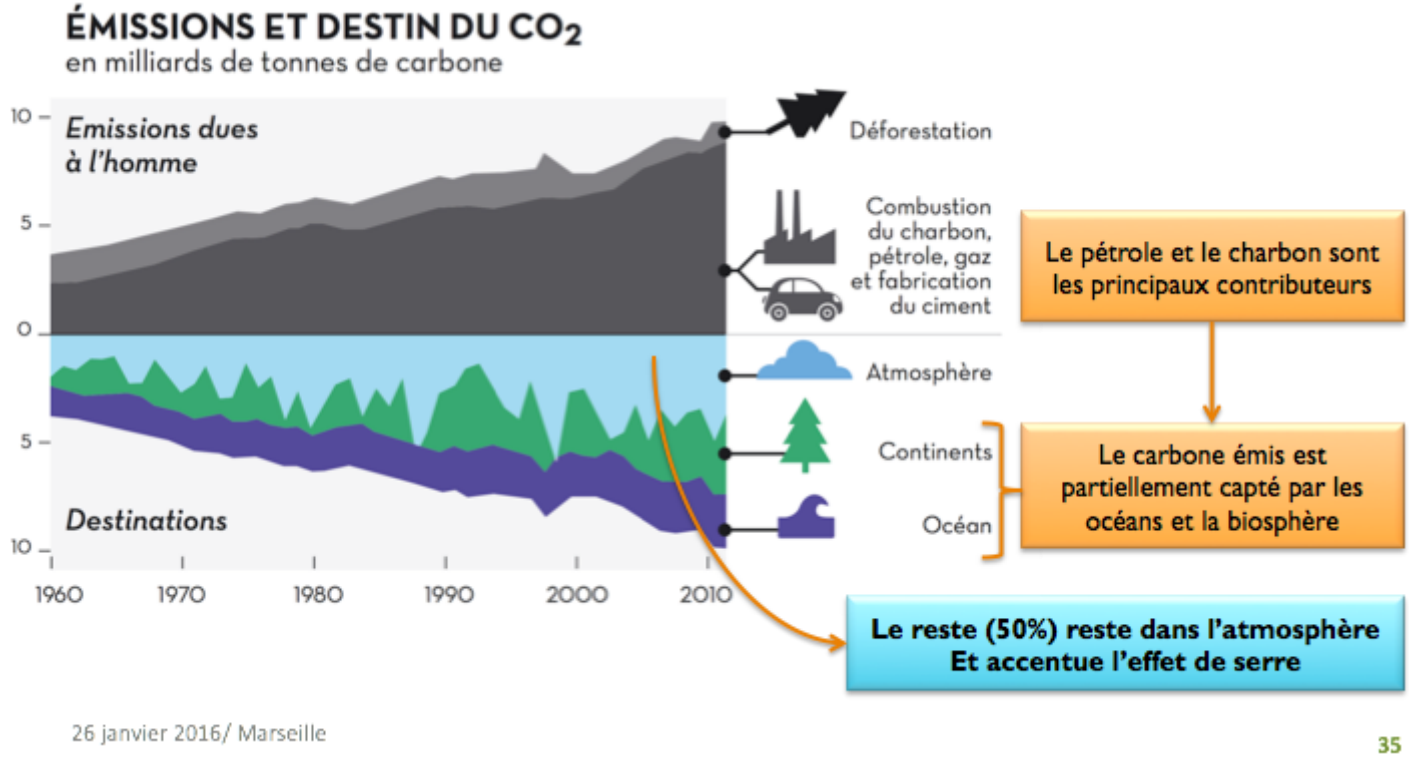


Year	Mt CO_2/yr	t CO_2/cap/yr	t CO_2/kUSD/yr	Population
2017	338.193	5.205	0.131	64979548
2005	408.158	6.666	0.177	61233900
1990	386.214	6.780	0.224	56960835

Emissions CO2 par secteurs France 1990 2017, source Commission Européenne

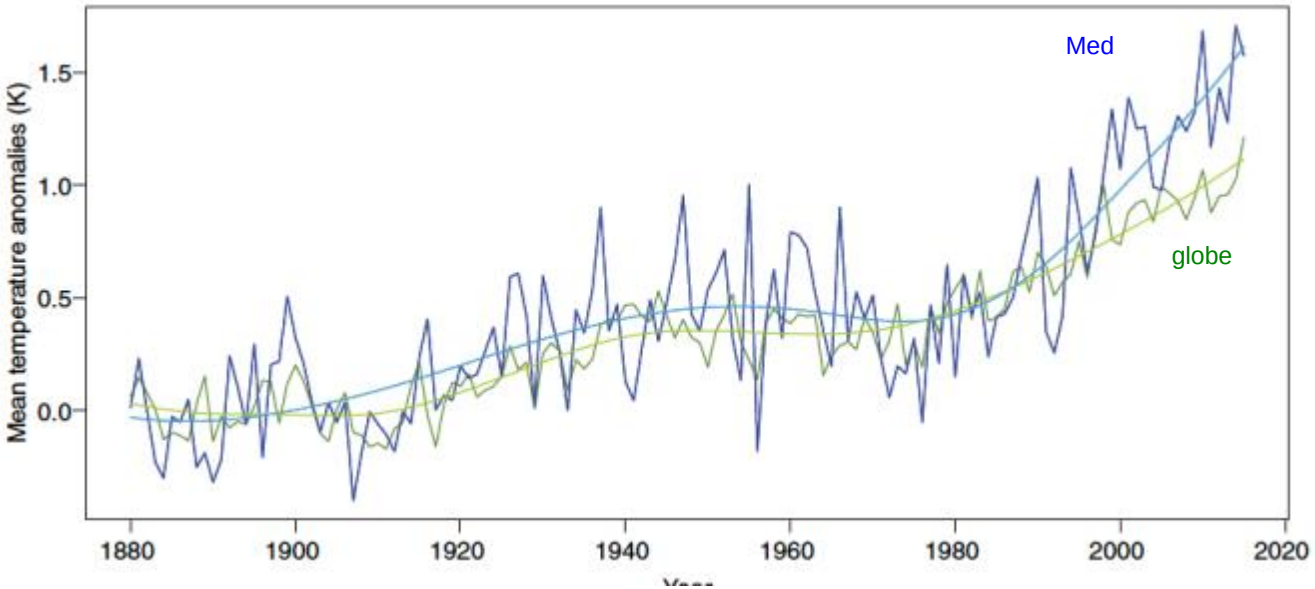
L'industrie est l'émetteur principal (à cause des énergies fossiles). En France c'est plutôt les transports (l'industrie a tendance à diminuer). Les changements d'occupation des sols jouent également un rôle (artificialisation des sols, agriculture, déforestation)

Main sources and sinks of CO_2



Les principales sources de CO_2 sont la consommation d'énergie fossile, la fabrication du ciment et la déforestation. Les principaux puits de CO_2 sont l'océan et la biosphère. La différence (en bleu clair) reste dans l'atmophère

The global warming is already 1°C but the Mediterranean region warming has already reached 1.5°C



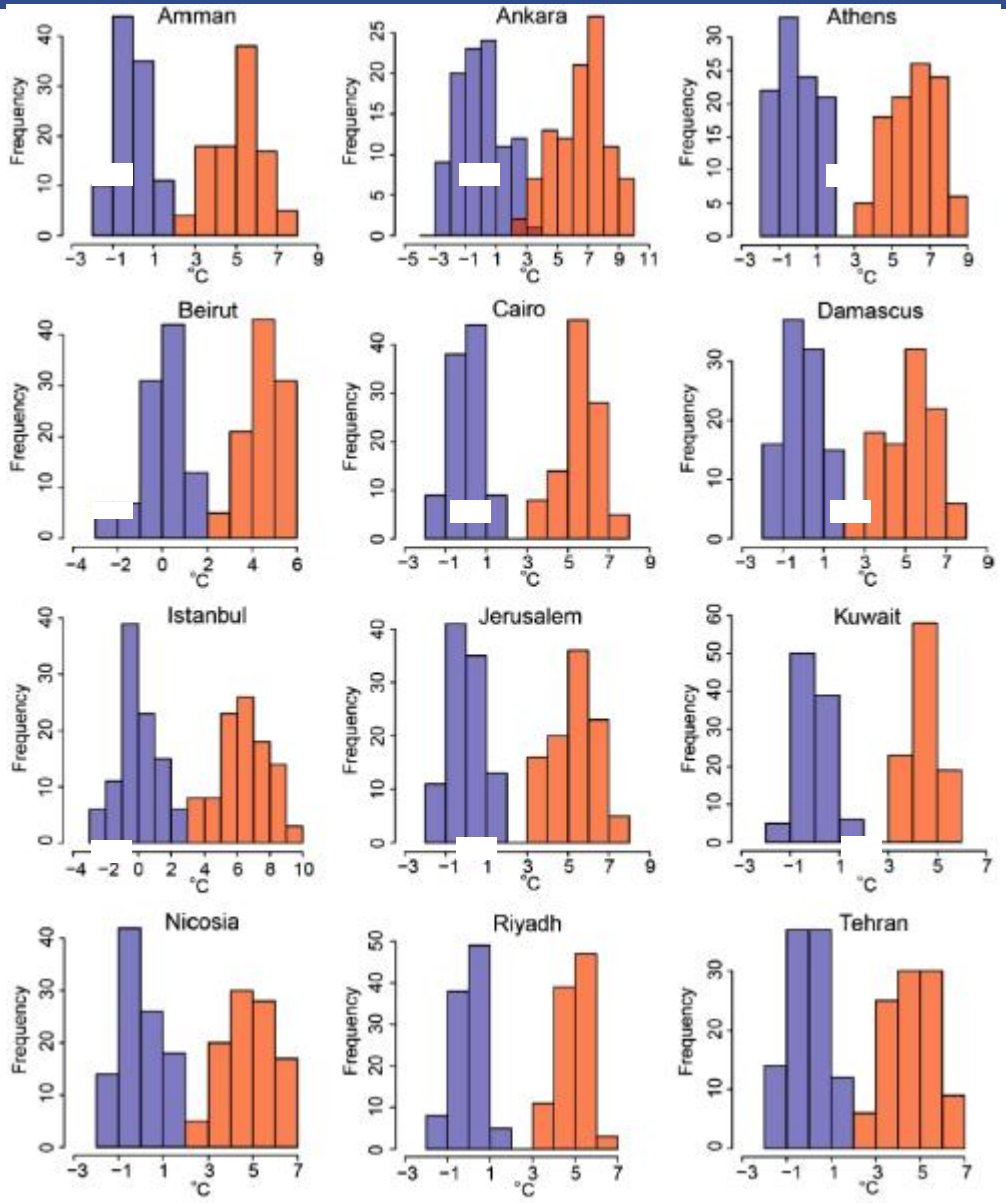
Variation de la temperature annuelle par rapport à la période 1880-1920

20% faster

This illustrates the fact that a global value hidden large spatial variations

In the cities, the situation will be much worse (urban heat islands)

For most of the large cities in the MENA Region ⇨ coldest summer month in the future will be warmer than today's hottest month



Recent and end-of-century temperature anomalies. Model calculated frequency histograms (%) of **summer (JJA) daytime maximum temperature** (TX) anomalies relative to the period 1961-1990, based on the A1B scenario. Blue is for the period 1961-1990 (hence cantered around 0oC) and red for the period 2070-2099

Lelieveld et al. 2014, Regional Environmental Change

Impacts at global warming 1.5°C are significantly lower than at 2°C

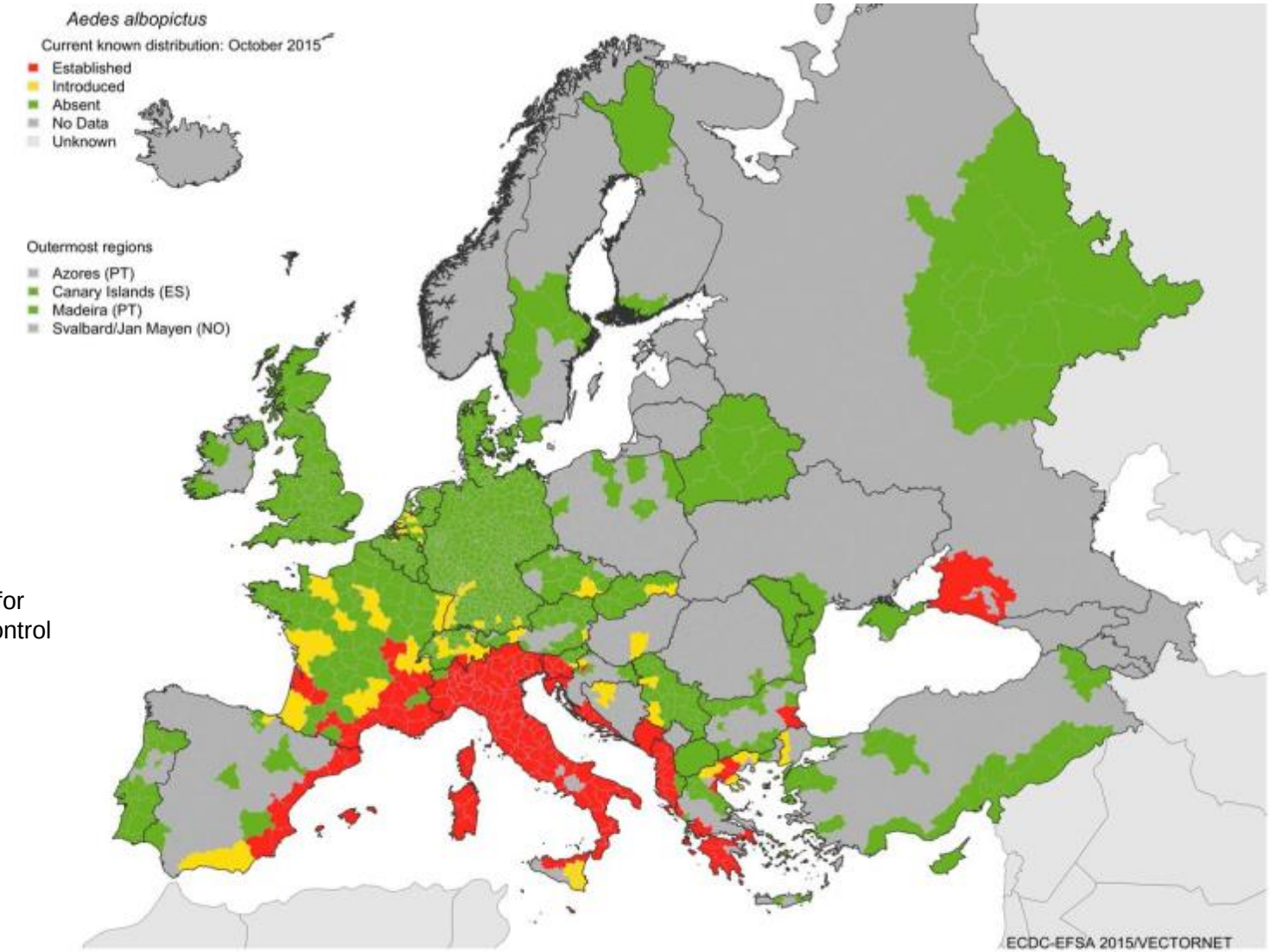
- Less extreme weather where people live, including extreme heat and rainfall
- Global mean sea level rise around 10 cm lower
- 10 million fewer people exposed to risk of rising seas
- Half species saved from extinction
- 2 million km2 permafrost saved
- Coral reefs saved of quasi total decline
- Much less impacts on health

(key messages)

Impacts on the health

- **Heat-related mortality**
  - Europe: 2035-64: 31-46K more death/yrs (1.5°C), 47-117K more deaths (2°C)
  - South Europe: mortality x 1.8-2.6 in 2050
- **Air pollution PM2.5**
  - Global: 1.3-2.1 M deaths/yr (today), 2.4-2.6 M deaths/yr (1.5C)
- **Vector borne disease**
  - Maladia Sub-Saharan Africa: not clear pattern
  - Chikungunya: South Europe : increased risk W Europe 2040, Central Europe 2041-2070
  - West Nile virus: increased prob 2050 Europe

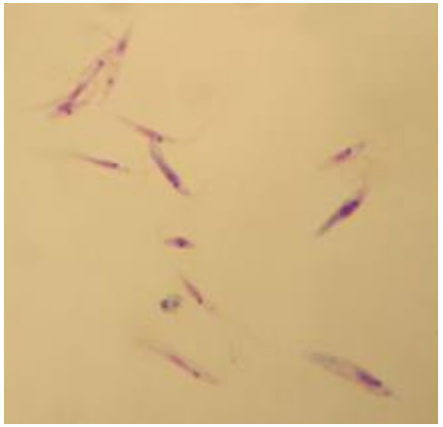
Invasion of mosquitos Aedes albopictus in Europe (octobre 2015)

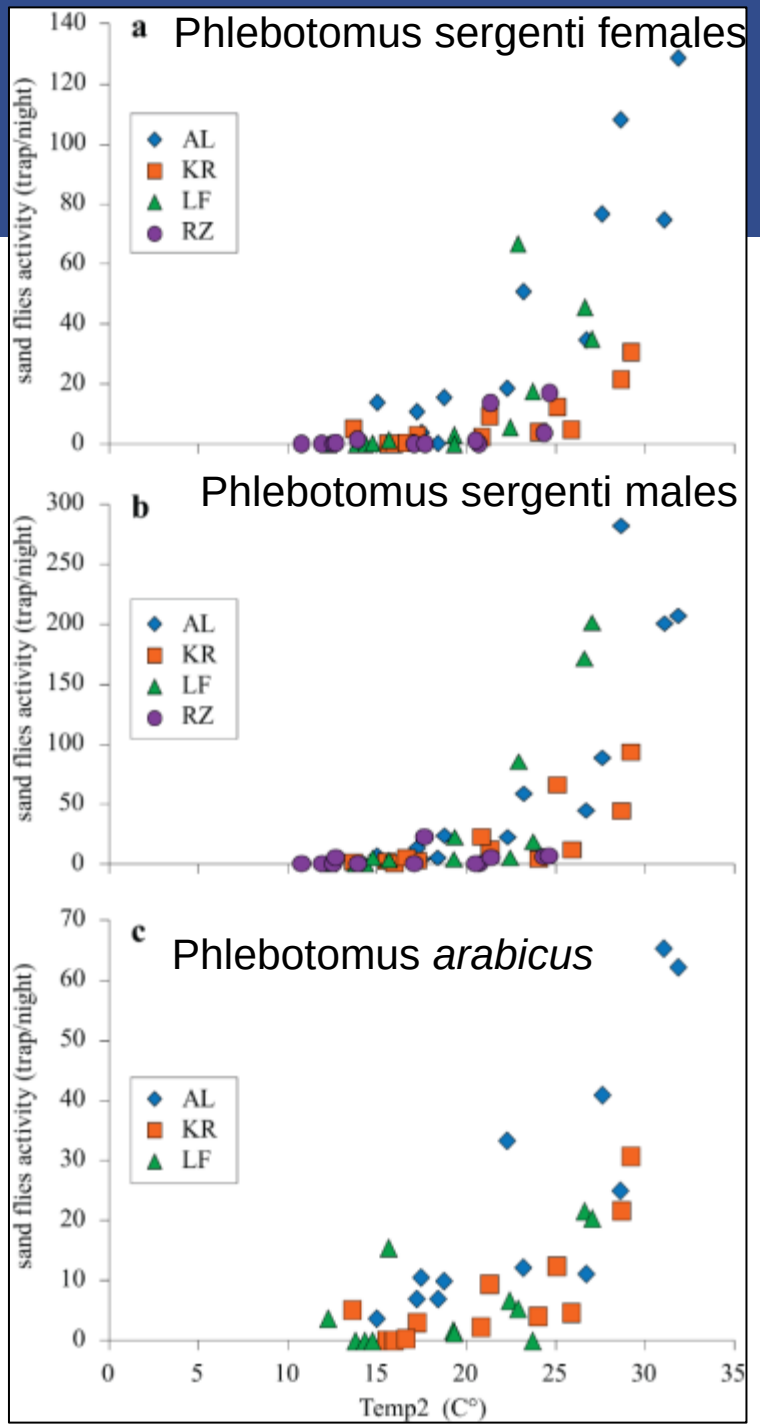


ECDC (European Center for disease prevention and control

Temperature effects on the activity of vectors for *Leishmania tropica* along rocky habitats gradient in the Eastern Mediterranean

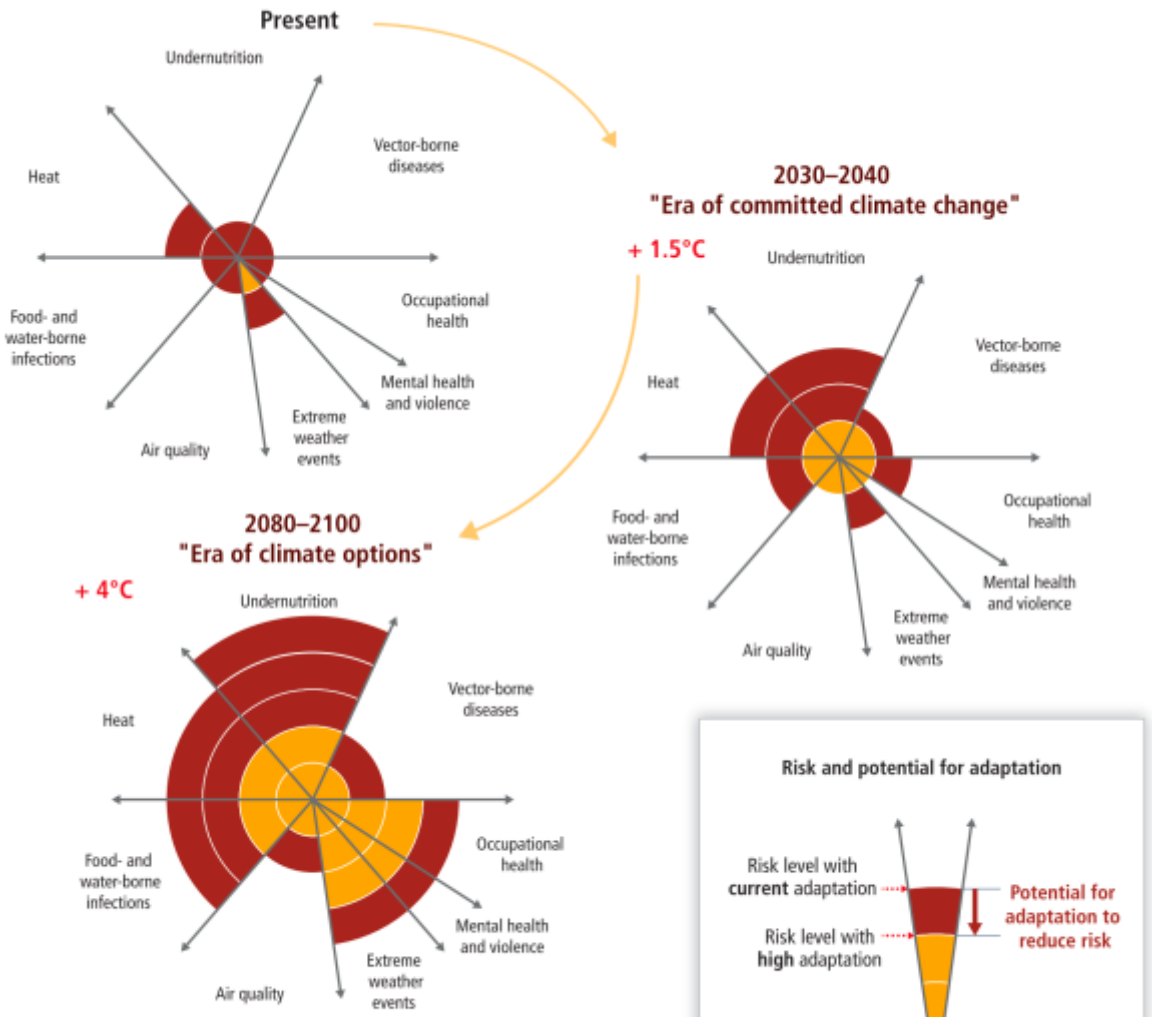
Sandfly activity (number of traps/night) responses to temperature.
Each color represents different study site location in the lower Galilee region.





Waitz Y, Paz S, Meir D, Malkinson D 2018 Temperature effects on the activity of vectors for *Leishmania tropica* along rocky habitats gradient in the Eastern Mediterranean. *Journal of Vector Ecology*

Summary for various heath impacts (IPCC 2014)



Trajectoires d'émissions compatibles avec 1,5°C de réchauffement global

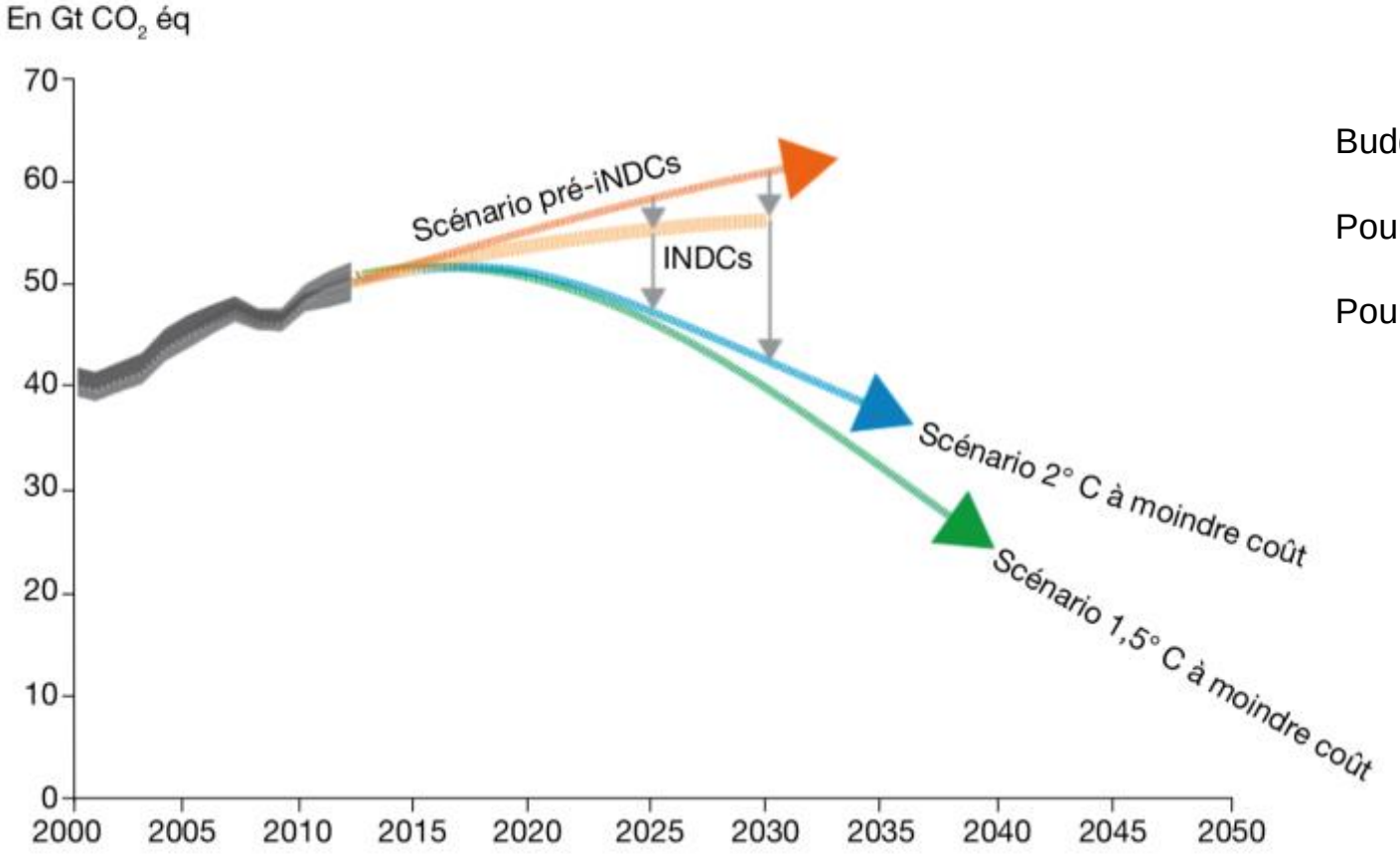
Greenhouse gas emissions pathways

- To limit warming to 1.5°C, CO_2 emissions fall by about 45% by 2030 (from 2010 levels) [20% for 2°C] and a net zero' around 2050 [2075 for 2C]
- Immediate co-benefits for health
- Limiting warming to 1.5°C would require changes on an unprecedented scale, incl. increased investment in low carbon options
- To start taking carbon dioxide out of the atmosphere
- Implications for food security, ecosystems and biodiversity
- National pledges are not enough to limit warming to 1.5°C, rather 3°C

(key messages)

IMPACT DES INDCs SUR LES ÉMISSIONS DE GES MONDIALES

Comparaison des niveaux d'émissions en 2025 et 2030 résultant de la mise en place des INDCs avec d'autres scénarios



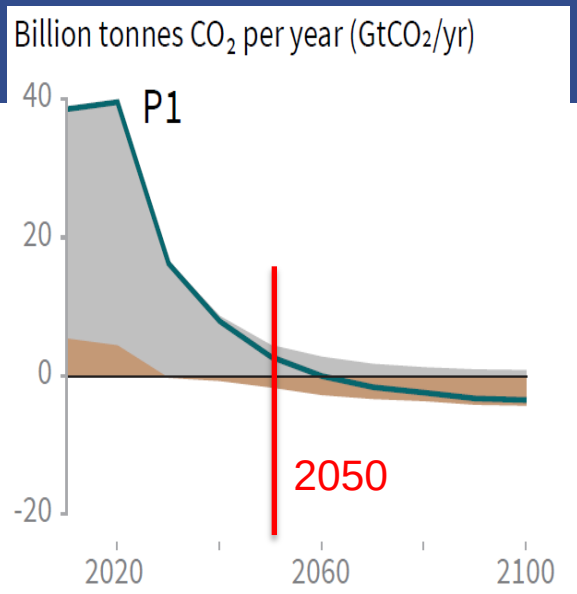
Note : ces scénarios représentent une moyenne des fourchettes d'incertitude estimées, prenant en compte les incertitudes des impacts du changement climatique et la mise en œuvre des contributions nationales ; le scénario 2 °C correspond à un scénario à moindre coût avec 66 % de chance de rester en dessous des 2 °C ; le scénario 1,5 °C correspond à un scénario à moindre coût avec 50 % de chance de rester en dessous de 1,5 °C.
Source : *rapport de synthèse de la CCNUCC, mai 2016*

Budget restant :

Pour 1,5° C : ~ 420 $GtCO_{2\ eq}$

Pour 2° C : ~ 1500 $GtCO_{2\ eq}$

Four possible scenarios

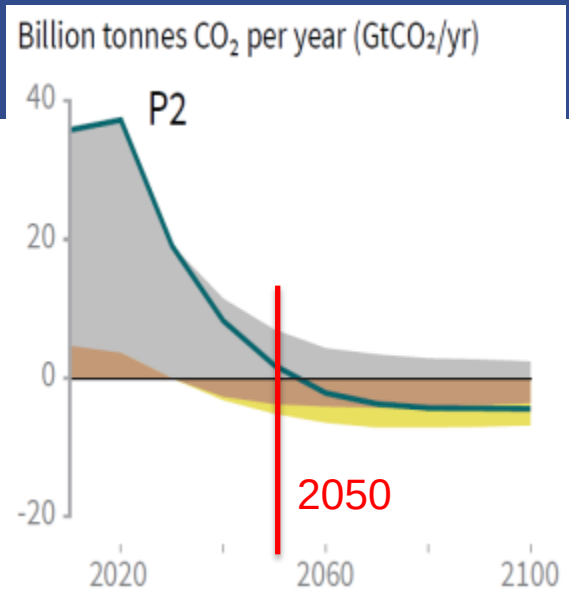


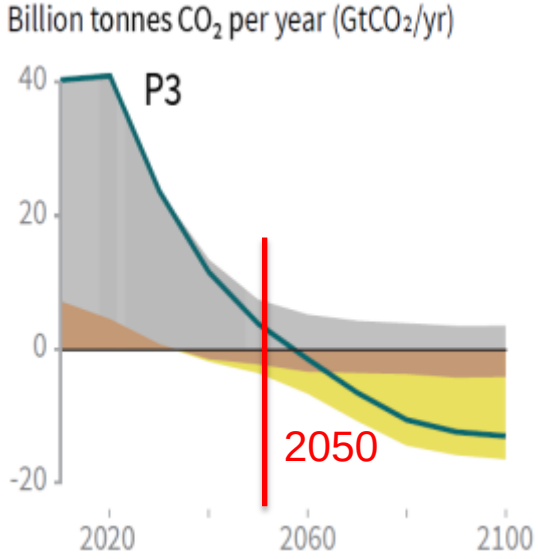
Maîtrise de l'énergie ++

Puits carbone : seulement (re)boisement

Transition diversifiée (ODD)

Puits carbone : forêt + CCS du bois-énergie (limité)





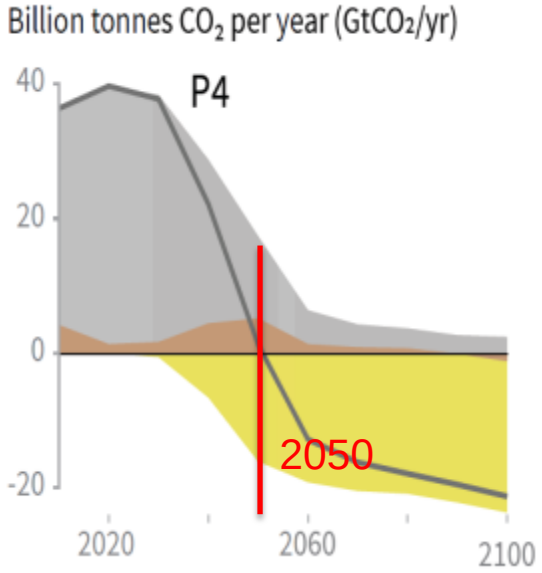
Efficacité énergétique ++

Forte transition de l'appareil productif, forte utilisation du BECCD

(ADEME)

Scénario intensif (fossile)

Usage important de CCS et géoingénierie (sols, océans)



Summary : the key messages of the IPCC special report 1.5°C

The climate change already impacts the ecosystems, people and livelihoods

It is not physically impossible to stay below 1.5°C but it implies unprecedented changes in all the aspects of the society. Each lost month will make the future efforts more difficult.

There is clear benefits to stay below 1.5°C as regards as 2°C or more. Each tenth of degree is important.

Limit the global warming to 1.5°C may and must be done together with the sustainable development goals (ex. reduction of the inequalities, eradication of the poverty)