Climate Change and Global Politics: A scientific introduction

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Twitter: @JPvanYpersele

CERIS (ULB Diplomatic School of Brussels), 28 January 2023

Thanks to the Walloon Government (funding the Walloon Platform for IPCC) and to my team at the Université catholique de Louvain for their support

The Essential Truth About Climate Change in Ten Words

The basic facts of climate change, established over decades of research, can be summarized in five key points:

IT'S REA IT'S US **EXPERTS AGREE** IT'S BAD THERE'S HOPE

Global warming is happening.

Human activity is the main cause.

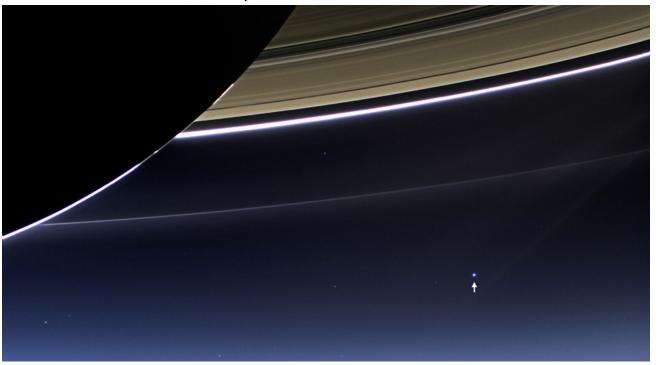
There's scientific consensus on human-caused global warming.

The impacts are serious and affect people.

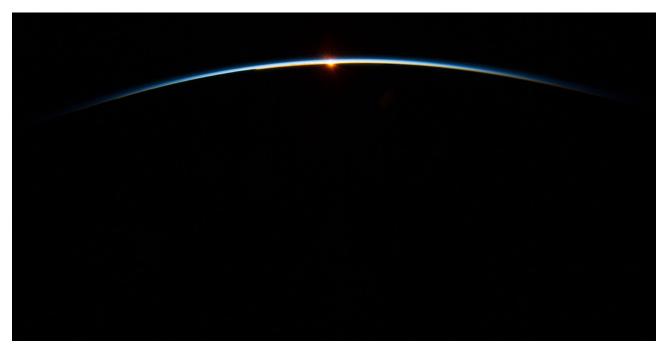
We have the technology needed to avoid the worst climate impacts.

Source: @JohnfoCook

That small blue dot is the Earth, a seen from Cassini, orbiting Saturn, 1.44 billion km from us, on 19-7-2013



Our atmosphere is thin and fragile (as seen by ISS crew on 31 July 2013)



Jean-Pascal van Ypersele (vanyp@climate.be)



Let us think about the future of these children from Machakos in a warming climate

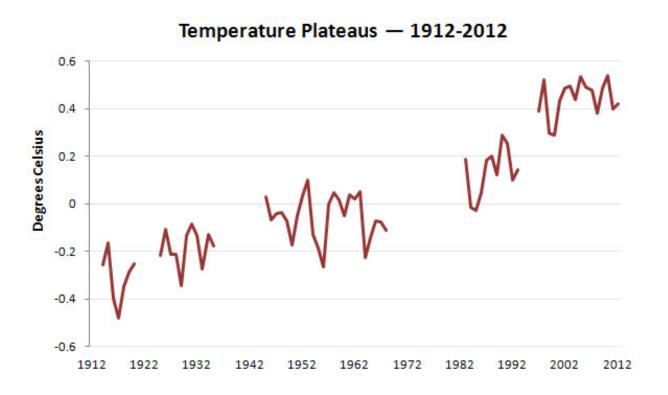


Photo: @JPvanYpersele April 2015

Temperature Change From 1961-1990 Average

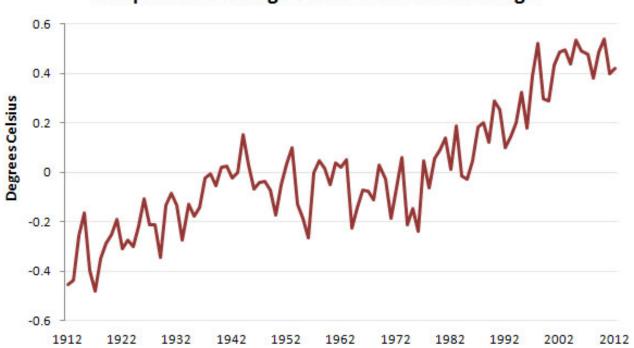


Lying With Statistics, Global Warming Edition



Lying With Statistics, Global Warming Edition

Temperature Change From 1961-1990 Average



In the USA alone, organizations which sow doubt about climate change spend almost a billion dollars/year! (Brulle 2014, average numbers for 2003-2010)

The European Union fares a little better, but many Brussels lobbyists try to dilute the EU environmental efforts (see the car industry...)

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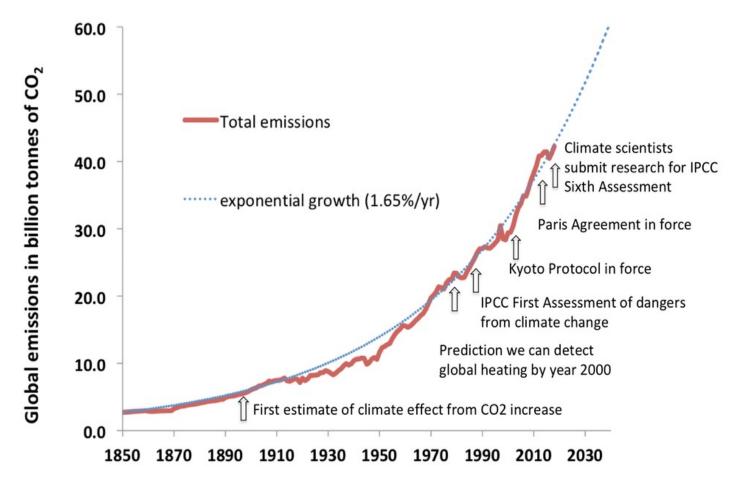
The « merchants of doubt » have evolved in their arguments:

- Existence of global warming
- Human responsability in the warming
- Cost of decarbonization
- Drawbacks from alternatives

(recent example: so-called enormous needs of cobalt for electric mobility reported on CNN; see critical analysis on

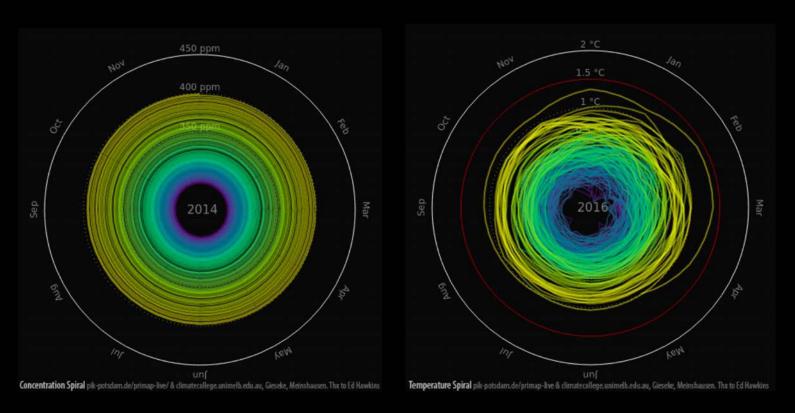
https://www.desmogblog.com/2018/05/02/cnn-wrongly-blames-electric-cars-unethical-cobalt-mining)

@JPvanYpersele



Source: Wolfgang Knorr, in The Conversation (2019)

CO₂ Concentration and Temperature spirals



CO₂ Concentration since 1850 and Global Mean Temperature in °C relative to 1850 – 1900 Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset Animation available on http://openclimatedata.net/climate-spirals/concentration-temperature/

Fact: Extreme weather events are becoming more frequent or intense due to climate change, sealevel rise threatens coastal communities...

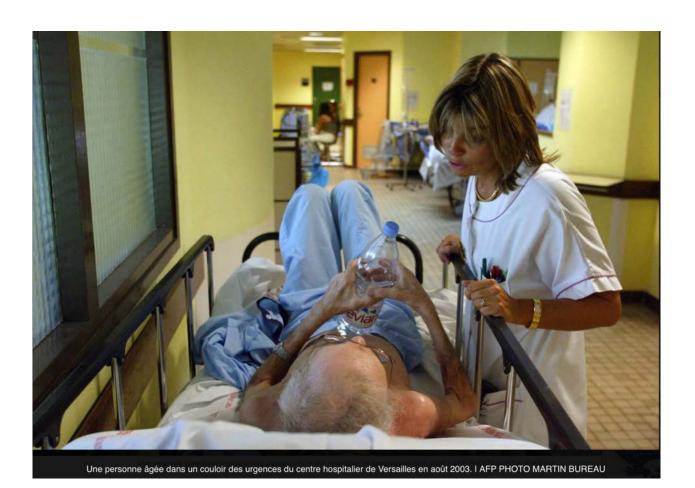
Since 1950, extreme hot days and heavy precipitation have become more common





There is evidence that anthropogenic influences, including increasing atmospheric greenhouse gas concentrations, have changed these extremes

Heat waves kill





MORE EVAPORATION

MORE PRECIPITATION

Available water

1°C increase = 7% more water vapor

- Temperature +

CLIMATE CO CENTRAL

Wallonia Floods, July 2021



Source: VRT Nieuws



Felix Schaad (Tages Anzeiger, Switzerland)

Floods cost

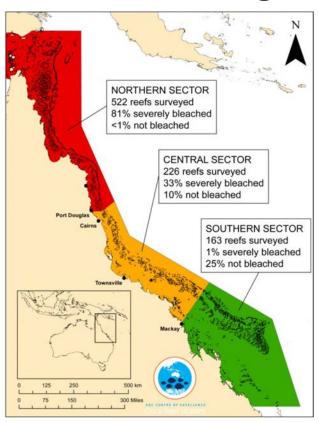


Coral reefs are dying



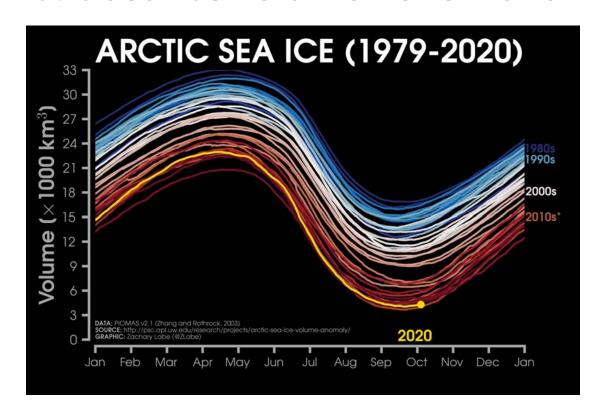
American Samoa (from www.globalcoralbleaching.org)

Only 7% of the Great Barrier Reef has avoided coral bleaching (May 2016)



JCU Australia - ARC Centre of Excellence for Coral Reef Studies / Tom

Arctic sea-ice volume 1979-2020



Plateau Glacier (1961) (Alaska)



http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Plateau Glacier (2003) (Alaska)



http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Les glaciers, d'un siècle à l'autre

La Mer de Glace (massif du Mont-Blanc, France)

1919 2019



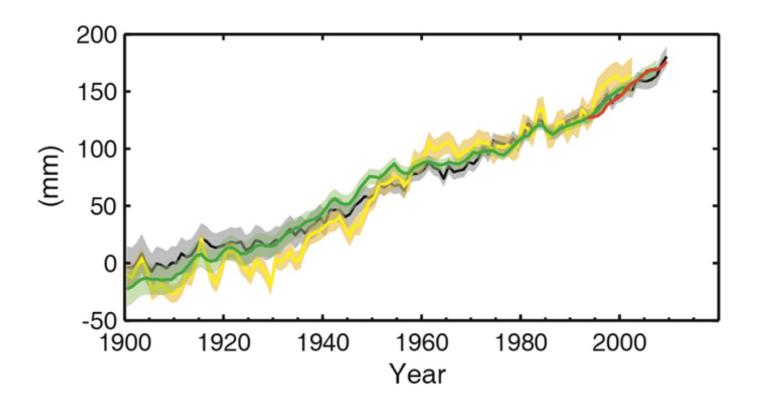
Photo: Walter Mittelholzer, ETH-Bibliothek Zürich

Photo : Dr Kieran Baxter, Université de Dundee



Photo: @RaphvanYpersele (Instagram)

Change in average sea-level change



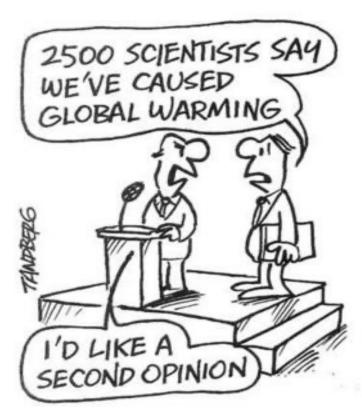
Why the IPCC?

Established by WMO and UNEP in 1988

to provide policy-makers with an objective source of information about

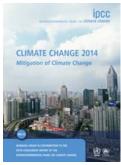
- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options (adaptation & mitigation).

WMO=World Meteorological Organization UNEP= United Nations Environment Programme









What is happening in the climate system?

What are the risks?

What can be done?





Key messages from IPCC AR5

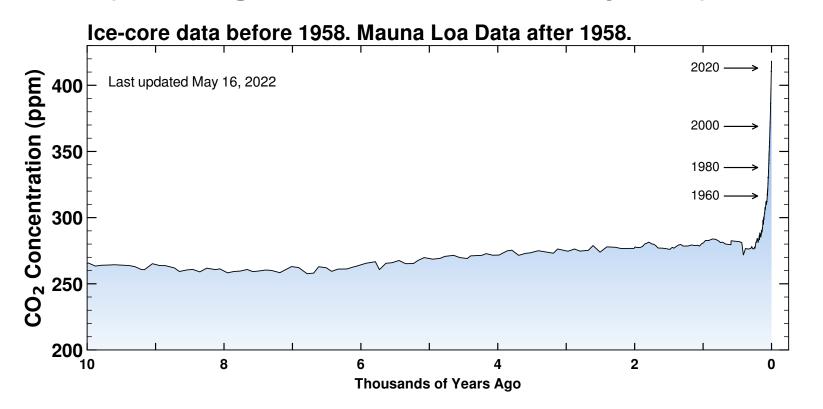
- → Human influence on the climate system is clear
- → Continued emissions of greenhouse gases will increase the likelihood of severe, pervasive and irreversible impacts for people and ecosystems
- → While climate change is a threat to sustainable development, there are many opportunities to integrate mitigation, adaptation, and the pursuit of other societal objectives
- → Humanity has the means to limit climate change and build a more sustainable and resilient future



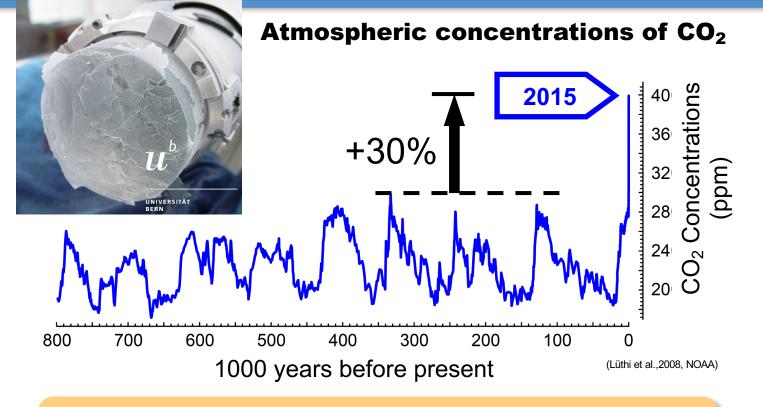




CO₂ Concentration 16 May 2022: 421,36 ppm (Keeling curve + last 10000 years)

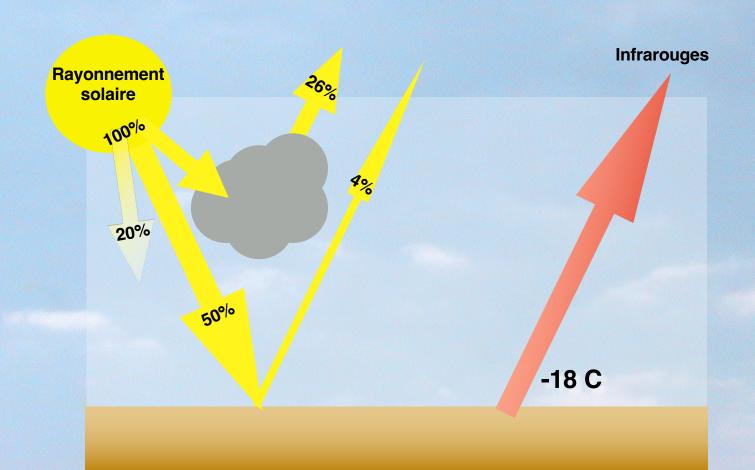


Source: scripps.ucsd.edu/programs/keelingcurve/

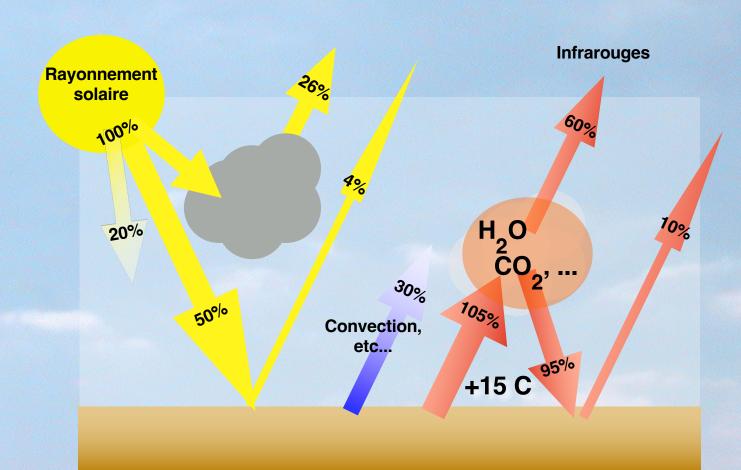


The concentrations of CO₂ have increased to levels unprecedented in at least the last 800,000 years.

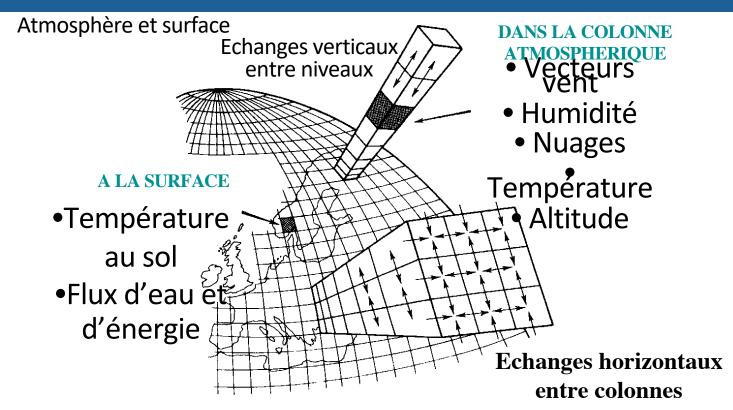
Cycle de l'énergie et effet de serre



Cycle de l'énergie et effet de serre



Modèles climatiques



Résolution typique ~ 2°x 2°(modèle global, atmosphère) Intervalle de temps typique : ≤ 30 minutes Progression of Understanding: Greater and Greater Certainty in **Attribution**

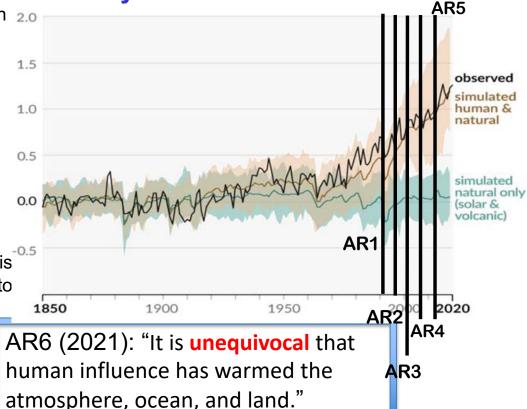
AR1 (1990): "unequivocal detection not likely for a decade"

AR2 (1995): "balance of evidence suggests discernible human influence"

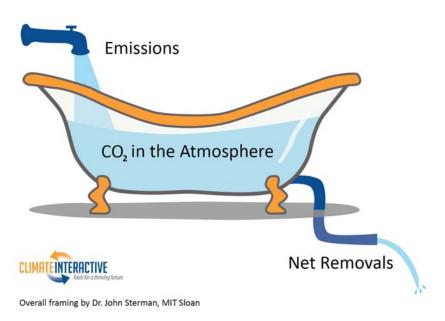
AR3 (2001): "most of the warming of the past 50 years is **likely** (odds 2 out of 3) due to human activities"

AR4 (2007): "most of the warming is very likely (odds 9 out of 10) due to greenhouse gases"

AR5 (2013) «It is **extremely likely** (odds 95 out of 100) that human influence has been the dominant cause... »

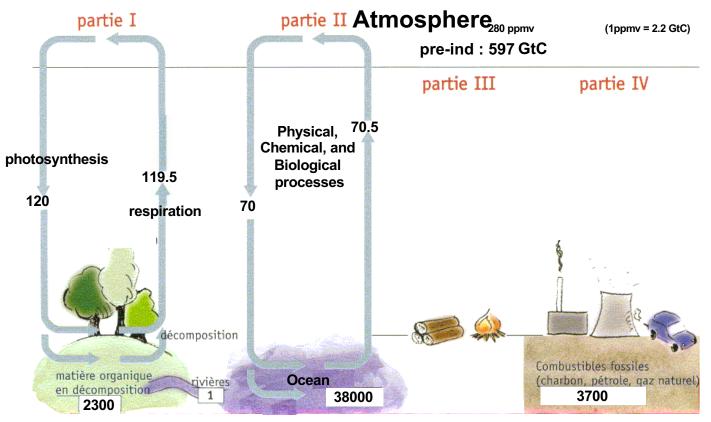


The Carbon Bathtub



Source: @CarbonInteractive

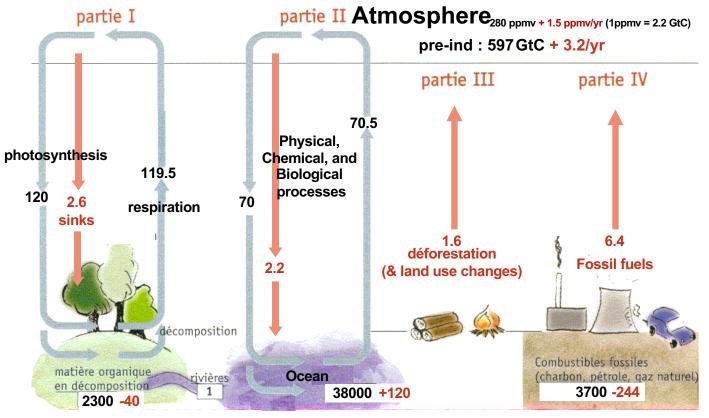
Carbon cycle: unperturbed fluxes



Units: GtC (billions tons of carbon) or GtC/year (multiply by 3.7 to get GtCO₂) vanyp@climate.be

Carbon cycle: perturbed by human activities

(numbers for the decade 1990-1999s, based on IPCC AR4)



Units: GtC (billions tons of carbon) or GtC/year

Stocks!

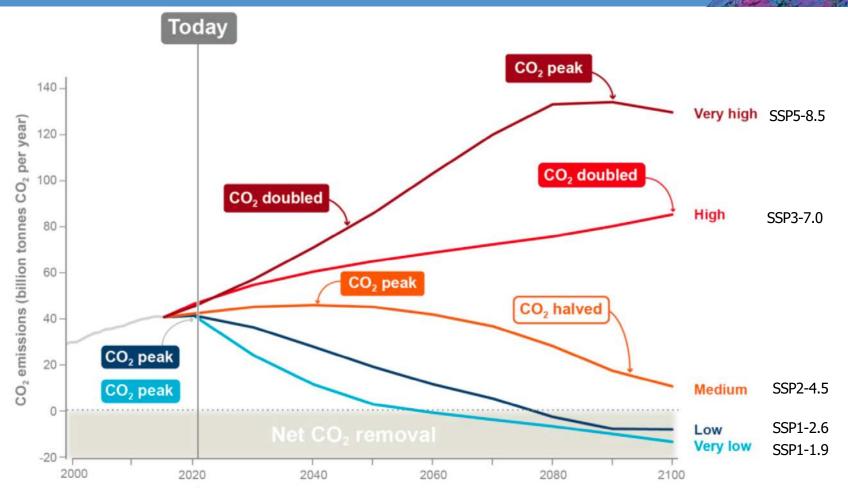
The carbon cycle is policy-relevant

- CO₂ accumulates in the atmosphere as long as human emissions are larger than the natural absorption capacity
- Historical emissions from developed countries therefore matter for a long time
- As warming is function of cumulated emissions, the carbon « space » is narrowing fast (to stay under 1.5 or 2° C warming)

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Working Group I – The Physical Science Basis

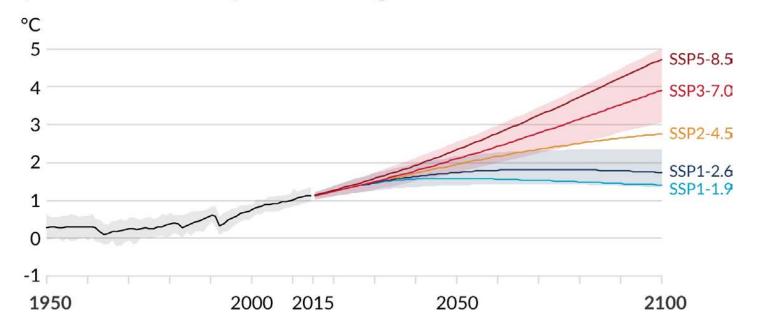






Human activities affect all the major climate system components, Figure SPM.8 with some responding over decades and others over centuries

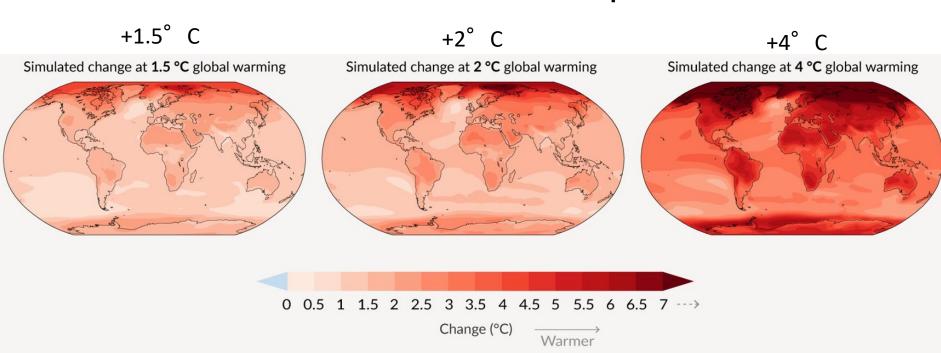
a) Global surface temperature change relative to 1850-1900



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Across warming levels, land areas warm more than oceans, and the Arctic and Antarctica warm more than the tropics



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Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming

Figure SPM.6

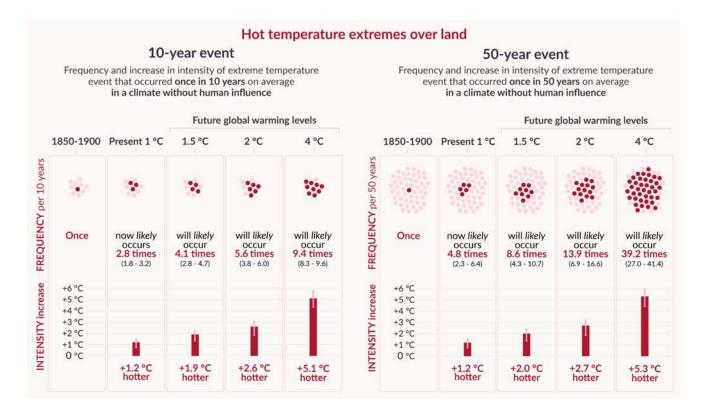
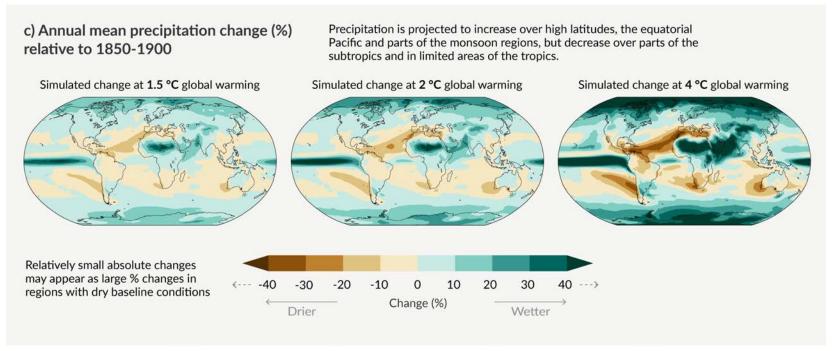




Figure SPM.5

With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

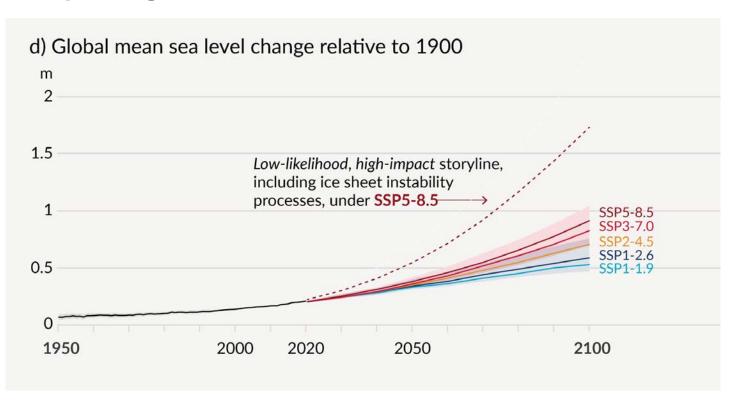




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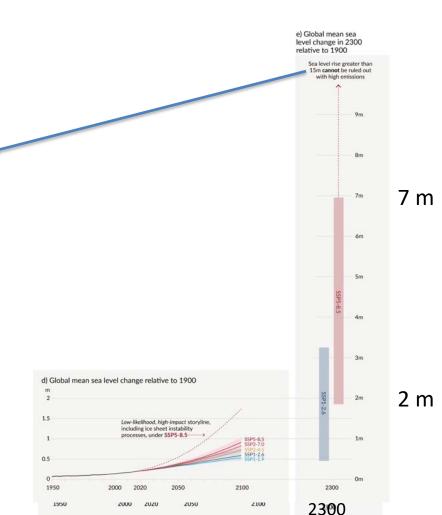
Human activities affect all the major climate system components, Figure SPM.8 with some responding over decades and others over centuries



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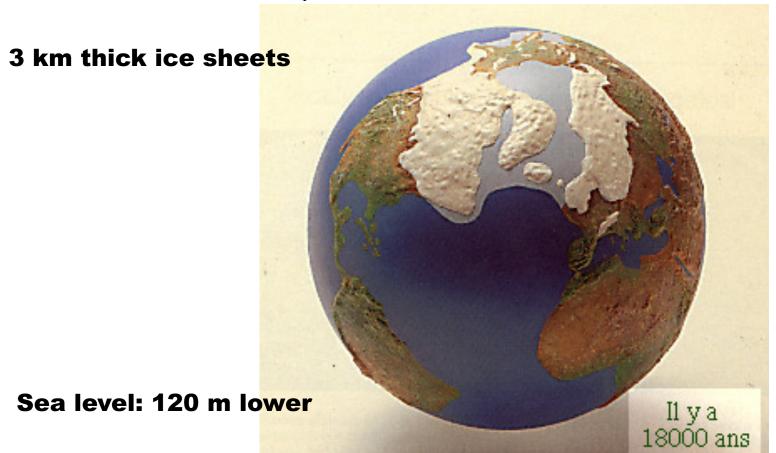
Working Group I — The Physical Science Basis

« Sea level rise **greater than 15 m** cannot be ruled out with high emissions »



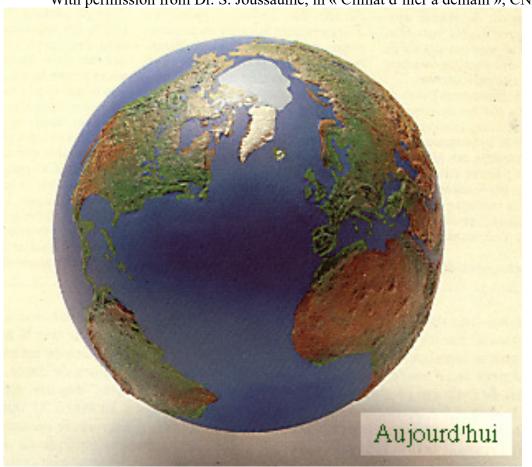
18-20000 years ago (Last Glacial Maximum)

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.



Today, with +4-5° C globally

With permission from Dr. S. Joussaume, in « Climat d'hier à demain », CNRS éditions.

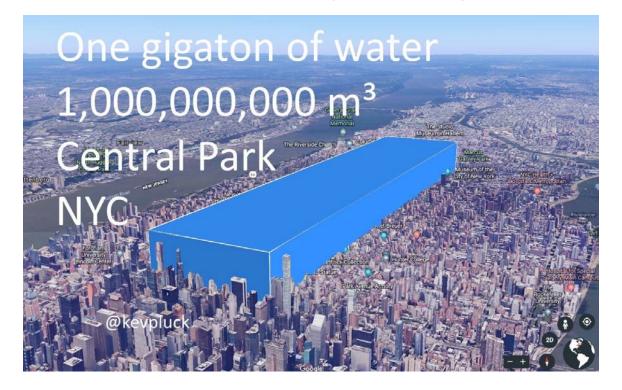


Fact: Average temperature is probably on its way to exceed the « conservation temperature » for the Greenland and (some of the)

Antarctic ice sheet

There is therefore a very high risk that average sea level would increase by several metres over the next century or two

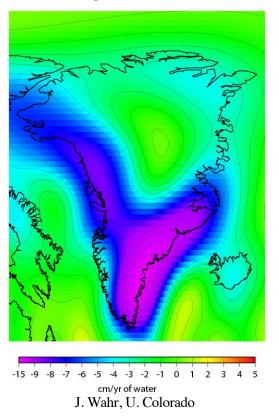
The Antarctic Ice Sheet presently loses 1 Gt of water every 1.5 day



Source: @Kevpluck, June 2018

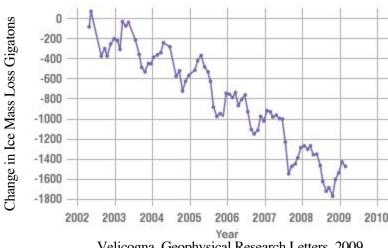
Greenland Ice Mass Loss 2002-2009 Derived From NASA GRACE Gravity Mission

Greenland



GREENLAND MASS VARIATION SINCE 2002

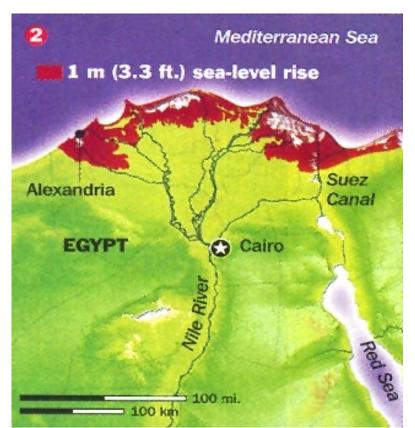
Data source: Ice mass measurement by NASA's Grace satellites.



Velicogna, Geophysical Research Letters, 2009

•Contributes to sea level rise

Effets sur le Delta du Nil, où vivent plus de 10 millions de personnes à moins d'1 m d'altitude



(Time 2001)

@JPvanYpersele

On the frontline: The Maldives



@JPvanYpersele

In front of Environment Ministry, Maldives, Aug. 2015



@JPvanYpersele

In front of Ministry of Foreign Affairs, Maldives, Aug. 2015



@JPvanYpersele

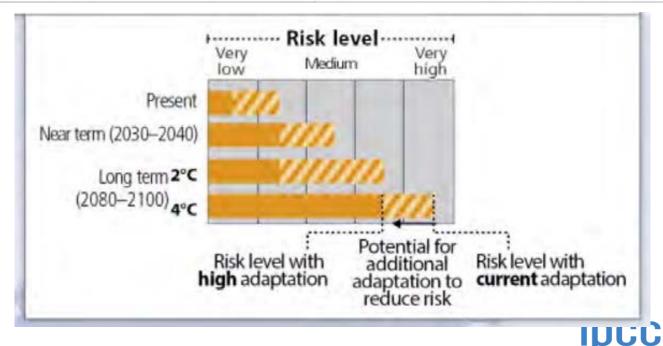


@JPvanYpersele



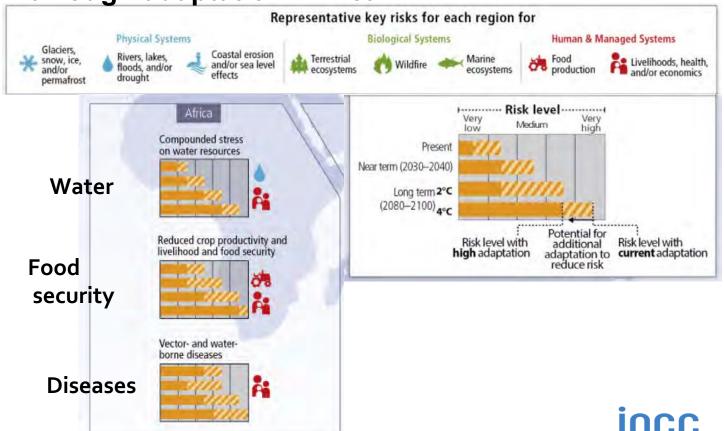
Regional key risks and potential for risk reduction

through adaptation
Representative key risks for each region for Physical Systems **Biological Systems Human & Managed Systems** Glaciers, Coastal erosion Rivers, lakes, Terrestrial Marine snow, ice, Livelihoods, health, and/or sea level floods and/or production drought permafrost





Regional key risks and risk reduction through adaptation: Africa







Selected key risks and potential for adaptation for Africa the present day to the long term

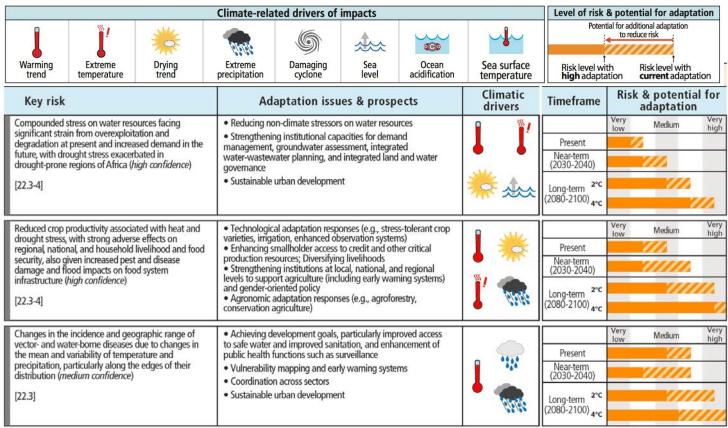
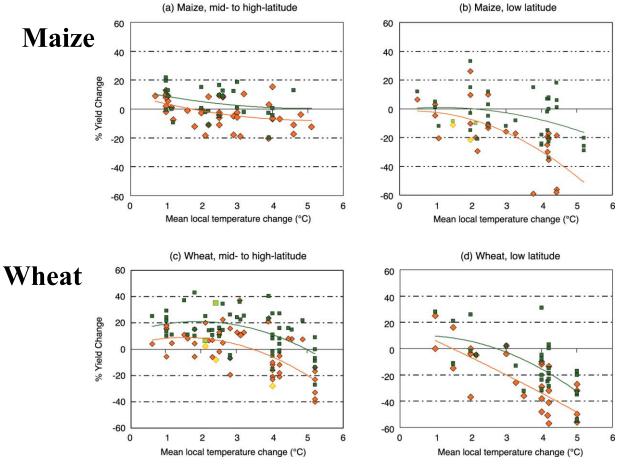




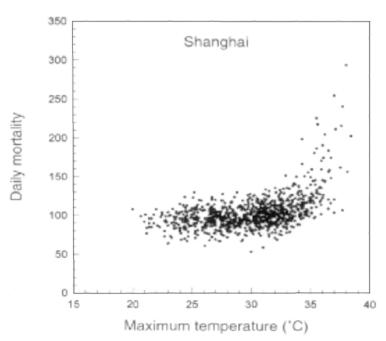


Figure TS.7. Sensitivity of cereal yield to climate change



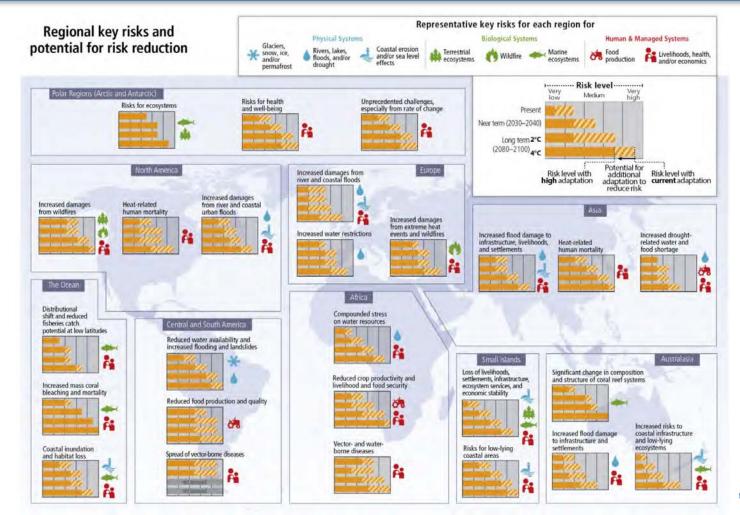
IPCC AR4 WGII

Relationship between maximum temperature and mortality in Shanghai, China, 1980-89



Référence : CILIMATE CHANGE AND HUMAN HEALTH, 1996

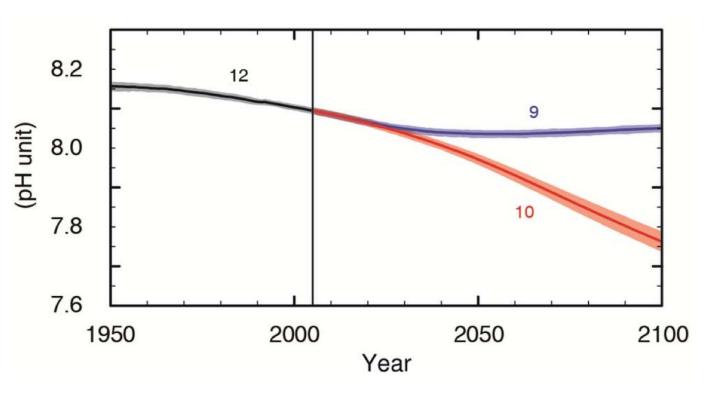
Jean-Pascal van Ypersele
(vanyp@climate.be)





Global ocean surface pH (projections)

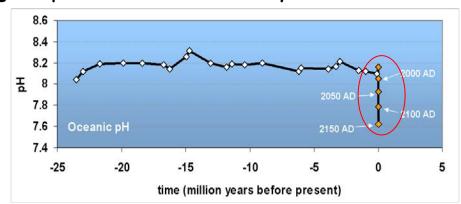
Ocean Acidification, for RCP 8.5 (orange) & RCP2.6 (blue)



IPCC AR5 WGI, Fig SPM 07

Oceans are Acidifying Fast

Changes in pH over the last 25 million years



"Today is a rare event in the history of the World"

- It is happening now, at a speed and to a level not experienced by marine organisms for about 60 million years
 Mass extinctions linked to previous ocean acidification events
- Takes 10,000's of years to recover

Impacts are already underway

- **Tropics to the poles**
- On all continents and in the ocean
- Affecting rich and poor countries (but the poor are more vulnerable everywhere)



AR5 WGII SPM







Potential Impacts of Climate Change









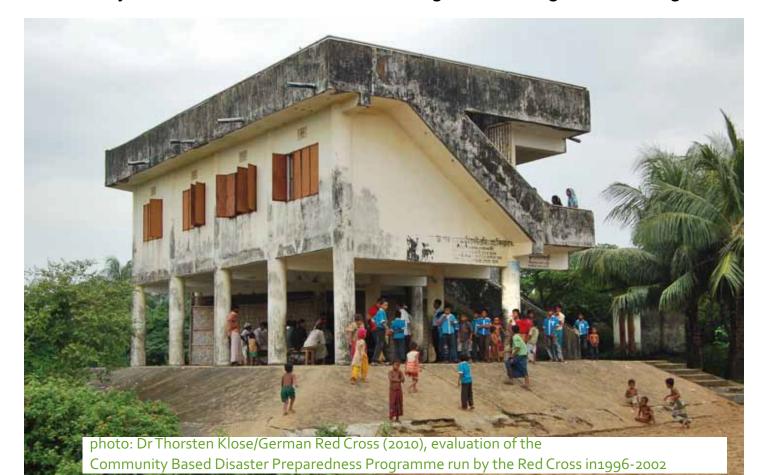
Risk = Hazard x Vulnerability x Exposure (Katrina flood victim, New Orleans, 2005)



AP Photo - Lisa Krantz (http://lisakrantz.com/hurricane-katrina/zspbn1k4cn17phidupe4f9x5t1mzdr)



Flood risk adaptation in Bangladesh (example): cyclone shelters, awareness raising, forecasting and warning

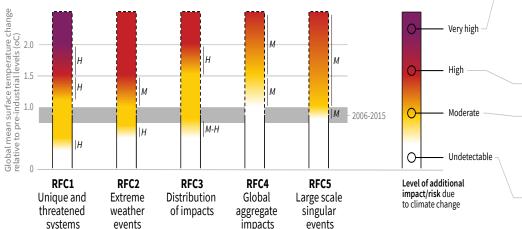




How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

Impacts and risks associated with the Reasons for Concern (RFCs)

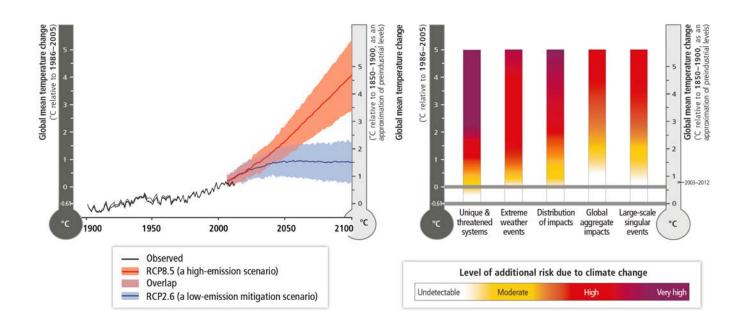


Purple indicates very high risks of severe impacts/risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.

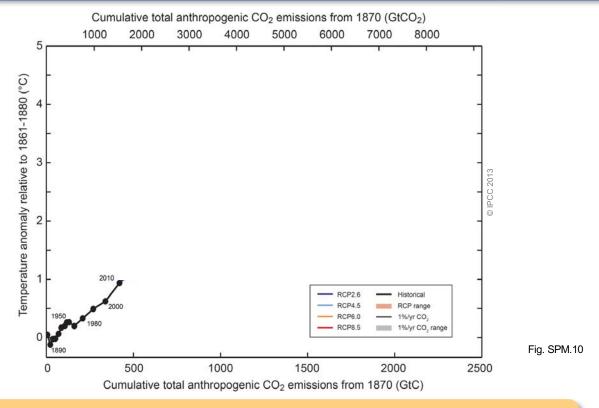
Red indicates severe and

widespread impacts/risks. **Yellow** indicates that impacts/risks are detectable and attributable to climate change with at least medium confidence.

 White indicates that no impacts are detectable and attributable to climate change.

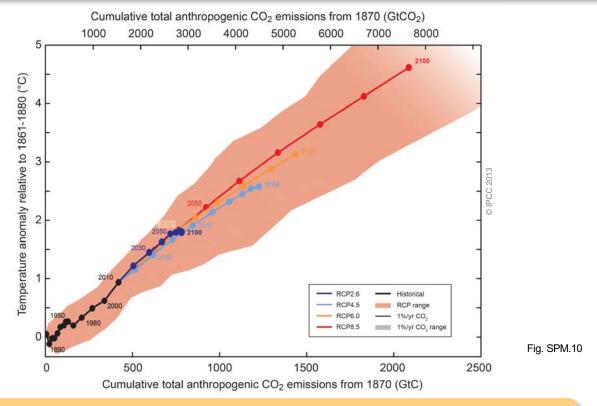


Why net zero emissions are needed as soon as possiblee



Cumulative emissions of CO₂ largely determine global mean surface warming by the late 21st century and beyond.





Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.

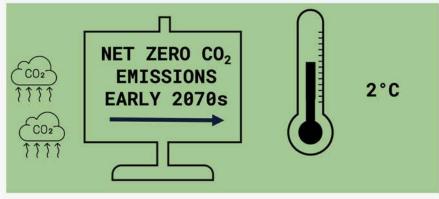




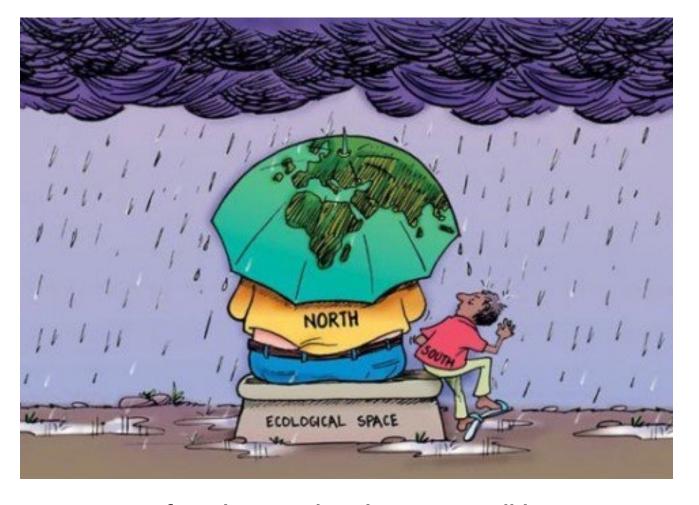


The temperature will stabilise when we reach net zero carbon dioxide emissions

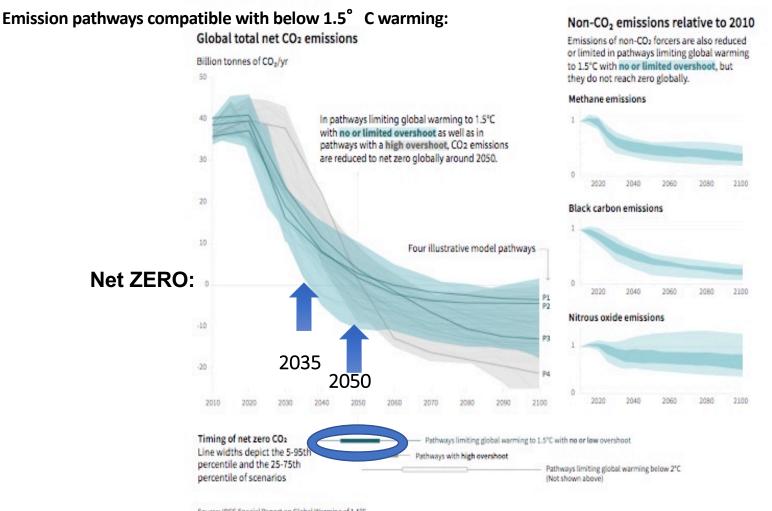




(based on IPCC-assessed scenarios)



Source: Centre for Science and Environment, Delhi



Source: IPCC SR15 Special Report on Global Warming of 1.5°C

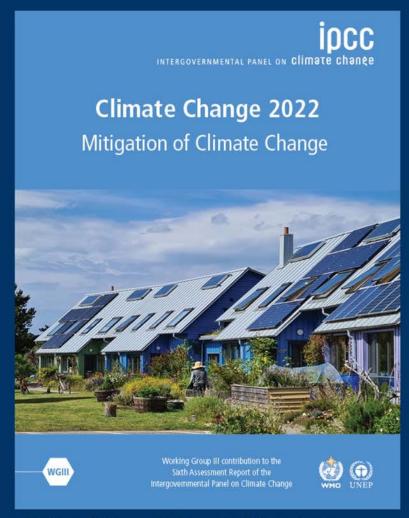
Greenhouse gas emissions pathways

- Limiting warming to 1.5° C would require changes on an unprecedented scale
 - Deep emissions cuts in all sectors
 - A range of technologies
 - Behavioural changes
 - Increase investment in low carbon options









2010-2019: Average annual greenhouse gas emissions at highest levels in human history



Unless there are immediate and deep emissions reductions across all sectors, 1.5°C is beyond reach.



There are options available **now** in every sector that can at least **halve** emissions by 2030

Demand and services







Land use



Industry



Urban



Buildings



Transport

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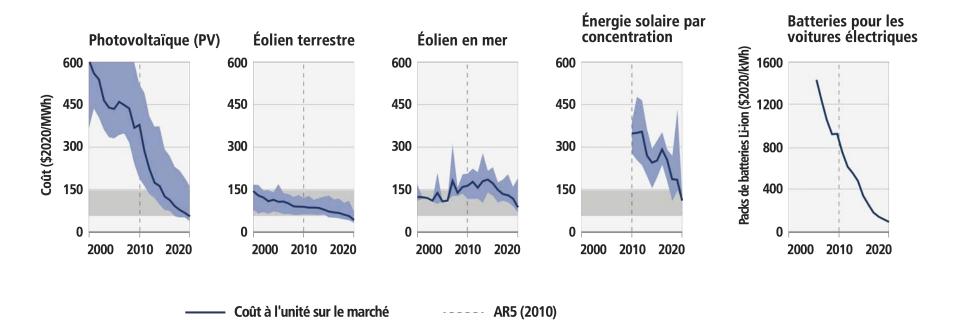
Energy

- major transitions are required to limit global warming
- reduction in fossil fuel use and use of carbon capture and storage
- low- or no-carbon energy systems
- widespread electrification and improved energy efficiency
- alternative fuels: e.g. hydrogen and sustainable biofuels





[Portland General Electric CC BY-ND 2.0, Harry Cunningham/Unsplash, Stéphane Bellerose/UNDP in Mauritius and Seychelles CC BY-NC 2.0, IMF Photo/Lisa Marie David, Tamara Merino CC BY-NC-ND 2.0] Les coûts unitaires de certaines formes d'énergie renouvelable et des batteries pour les voitures électriques ont baissé, et leur utilisation continue d'augmenter (figure SPM.3)



Coût des combustibles fossiles (2020)







Demand and services

- potential to bring down global emissions by 40-70% by 2050
- walking and cycling, electrified transport, reducing air travel, and adapting houses make large contributions
- lifestyle changes require systemic changes across all of society
- some people require additional housing, energy and resources for human wellbeing

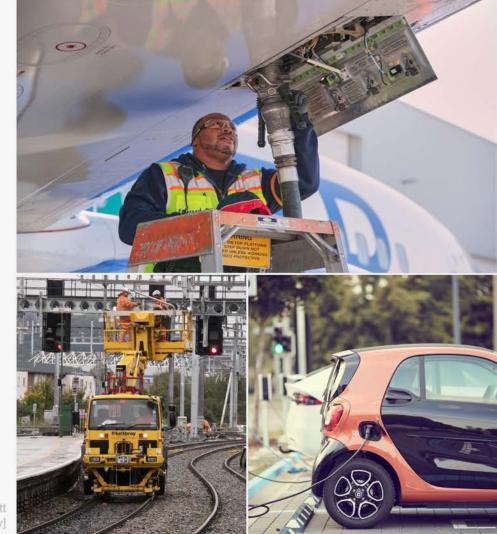


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Transport

- reducing demand and low-carbon technologies are key to reducing emissions
- electric vehicles: greatest potential
- battery technology: advances could assist electric rail, trucks
- aviation and shipping: alternative fuels (low-emission hydrogen and biofuels) needed
- Overall, substantial potential but depends on decarbonising the power sector.





- better urban planning, as well as:
- sustainable production and consumption of goods and services,
- electrification (low-emission energy),
- enhancing carbon uptake and storage (e.g. green spaces, ponds, trees)

There are options for existing, rapidly growing and new cities.









- buildings: possible to reach net zero emissions in 2050
- action in this decade is critical to fully capture this potential
- involves retrofitting existing buildings and effective mitigation techniques in new buildings
- requires ambitious policy packages
- zero energy and zero-carbon buildings exist in new builds and retrofits





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Industry

- using materials more efficiently, reusing, recycling, minimising waste; currently under-used in policies and practice
- basic materials: low- to zero-greenhouse gas production processes at pilot to nearcommercial stage
- achieving net zero is challenging















- can provide large-scale emissions reductions and remove and store CO₂ at scale
- protecting and restoring natural ecosystems to remove carbon: forests, peatlands, coastal wetlands, savannas and grasslands
- competing demands have to be carefully managed
- cannot compensate for delayed emission reductions in other sectors







Technology and Innovation

- investment and policies push forward low emissions technological innovation
- effective decision making requires assessing potential benefits, barriers and risks
- some options are technically viable, rapidly becoming cost-effective, and have relatively high public support. Other options face barriers

Adoption of low-emission technologies is slower in most developing countries, particularly the least developed ones.















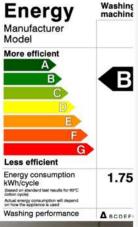














Policies, regulatory and economic instruments

- regulatory and economic instruments have already proven effective in reducing emissions
- policy packages and economy-wide packages are able to achieve systemic change
- ambitious and effective mitigation requires coordination across government and society

BY-NC-ND 2.0, Trent Reeves/MTA Construction &

Sixth Assessment Report

WORKING GROUP III - MITIGATION OF CLIMATE CHANGE

Closing investment gaps

- financial flows: 3-6x lower than levels needed by 2030 to limit warming to below 1.5°C or 2°C
- there is sufficient global capital and liquidity to close investment gaps
- challenge of closing gaps is widest for developing countries





The priorities I suggest

(Element) of solution n° 1: The survival of humanity and ecosystems must become a much higher political priority

... as if we were all running for our life.

Nations Unies

onférence sur les Changements Climatiques

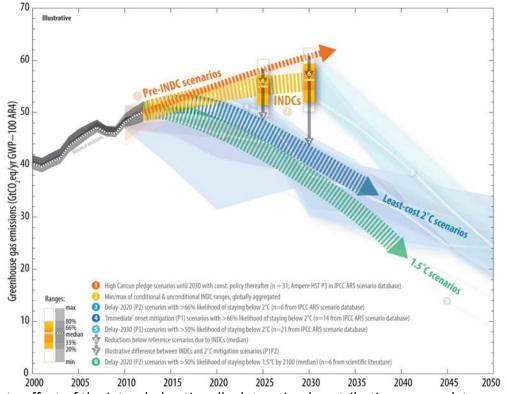
COP21/CMP11



Paris Agreement

- Article 2:
 - (...) to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
 - Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above preindustrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
 - Increasing the ability to adapt (...) and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
 - Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development

Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the intended nationally determined contributions



UNFCCC, Aggregate effect of the intended nationally determined contributions: an update http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf

Solution n° 2: Economic actors must be confronted much more clearly with their responsibilities

Degrowth of climate-unfriendly activities must be accepted, while growth of activities helping climate protection and poverty eradication must be encouraged

Yes, the planet got destroyed. But for a beautiful moment in time we created value for shareholders



"Yes, the planet got destroyed. But for a beautiful moment in time we created a lot of value for shareholders."

Solution n° 3: The best understood language is the price. Destroying the environment must become more and more expensive. Collected funds must be used to help the decarbonization, and avoid impacting the poor disproportionately

EU Emission Trading System, CO₂ taxes, fines, internal CO₂ price (firms do « as if » CO₂ emission was expensive). NB: Price must match the effect desired!

Solution n° 4: Transition towards a clean and sustainable economy and energy system must be « just », and other synergies with the SDGs must be seeked

Ex: The Polish energy system cannot be transformed without facilitating the coal miners reconversion

@JPvanYpersele

SUSTAINABLE GALS







































Joel Pett, USA Today

Solution n° 5: Before looking at how to produce energy cleanly, much more attention must be given to reducing energy demand and efficiency, in all sectors

All production and consumption patterns must be reconsidered, helped by energy audits, etc.

• Substantial reductions in emissions to stay under 2° C would require large changes in investment patterns e.g., from 2010 to 2029, in billions US dollars/year: (mean numbers rounded, IPCC AR5 WGIII Fig SPM 9)

+330

+ 90

+ 40

+ 40

- 120

60

energy efficiency:

power plants w/ CCS:

power plants w/o CCS:

fossil fuel extraction:

renewables:

· nuclear:

Solution n° 6: Building sector: offers many opportunities in energy saving, economic activity, improving wellbeing...

Solution n° 7: Mobility: much more space and priority to pedestrians, bicycles, and public transport; reduce priority given too long to individual transport in urban planning

Electrify remaining vehicles (with clean electricity). Fly less, only if essential.

Solution n° 8: Food and agriculture. A possible change with big positive impact: eat less (red) meat and cheese, of better quality! Eat more plant-based food (produced cleanly)

...It is good for health as well!

Solution n° 9: The Sun gives us in two hours about as much energy as the world uses in *one year*, all forms of energy considered

The cost of solar kWh is crashing, wind power, heat and electricity storage, and smart grids are moving forward

If well designed, measures to prevent climate change could offer so many opportunities:

- Co-benefits in reduced pollution, health improvement, employment, gender equality, food security, reduced poverty, energy independence...
- Opportunities to shift the tax burden away from labour and implement sustainable development
- Opportunities to integrate research results in a useful, policy-relevant way, accross disciplines (including social sciences)

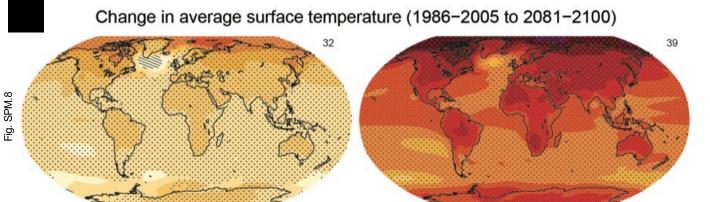


Joel Pett, USA Today

RCP2.6

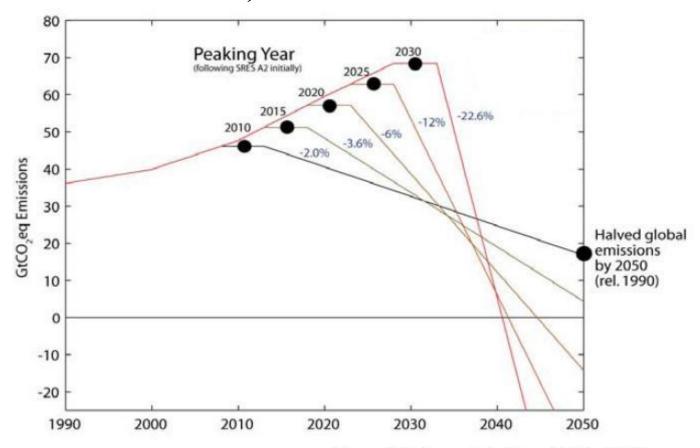
RCP8.5

(°C)



Humanity has the choice

The more we wait, the more difficult it will be



Source: Meinshausen et al. - Nature, 30th April 2009

Walking the talk...

- Energy audit of our home
- Strong external insulation (wood fibre)
- Ultra-efficient windows
- Airtightness inspecting + heat-recovery mechanical ventilation
- Oil furnace replaced by geothermal heat pump principally fed with PV pannels
- Non-tropical wood
- Small, used electric car
- Electric bicycles

Trying to be coherent (wood-based external insulation)



Trying to be coherent...



Key aspects of my IPCC Chair candidacy

The IPCC must be the most scientifically solid
 Voice of Climate » at the international level

2. The IPCC must become even more useful for policy- and decision-makers, while staying policy-neutral

Key aspects of my IPCC Chair candidacy

3. The IPCC must be inclusive (gender balance, developing countries participation...), respectful of all people and cultures, open to more disciplines and more interdisciplinarity, and help train more young scientists into the IPCC process

4. IPCC procedures & products need to be updated to respond better to the new needs of UNFCCC and others

A request:

Please send me your suggestions, wishes, dreams ... about how the IPCC could better serve the needs of the international community in the future :

My email: vanyp@climate.be

Please start the subject line with: IPCC suggestions

Conclusions

The challenge is huge: transform the world in a few decades so that the whole world activities are decarbonized, while poverty and hunger are eliminated in a few decades

Addressing it open so many opportunities, for research in all disciplines and accross disciplines and for integrating results of this research in meaningful actions by all: governments, cities, businesses, NGOs, and citizens.

It opens also economic opportunities, and opportunities to address in a synergistic manner other societal goals, such as the 17 Sustainable Development Goals.

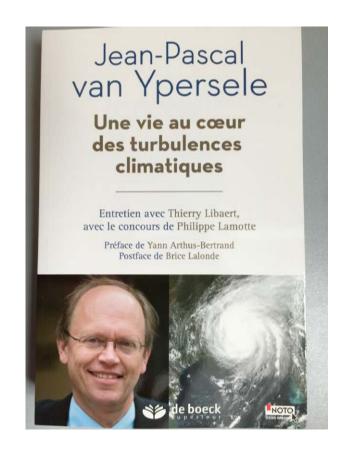
Pour en savoir plus:

Lisez mon livre, où j'aborde tous ces sujets

Publié chez De Boeck supérieur

Préface:Yann Arthus- Bertrand

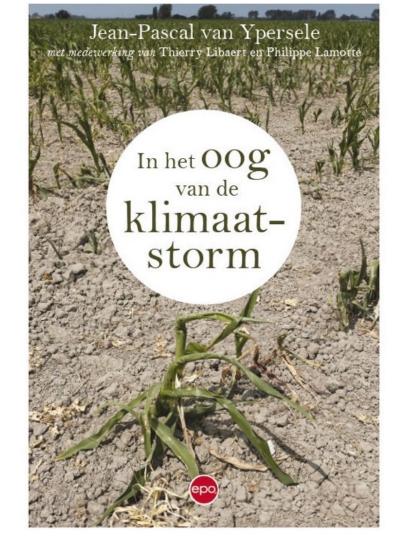
Postface: Brice Lalonde



Om meer te weten:

Bij EPO (2018)

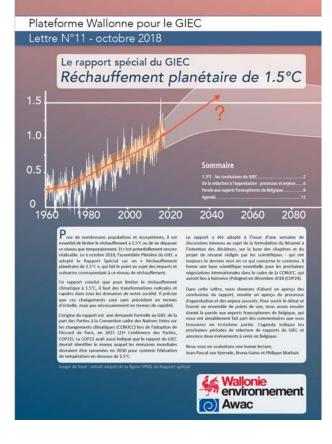
Voorwoord: Jill Peeters



jeunes (et moins jeunes), avec des liens vers des ressources utiles



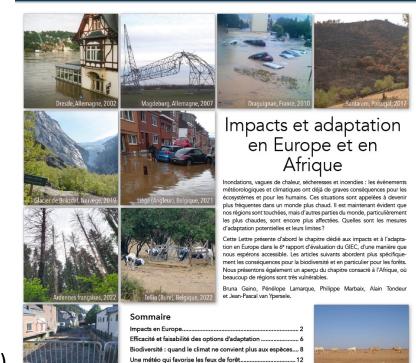
Disponible gratuitement, 6X/an: www.plateforme-wallonne-giec.be



Disponible gratuitement, 6X/an: www.plateforme-wallonne-giec.be

Plateforme wallonne pour le GIEC

Lettre N°27 - Novembre 2022



En Afrique, des risques et impacts élevés16

Lettre PwG n° 27 (novembre 2022) Disponible sur :

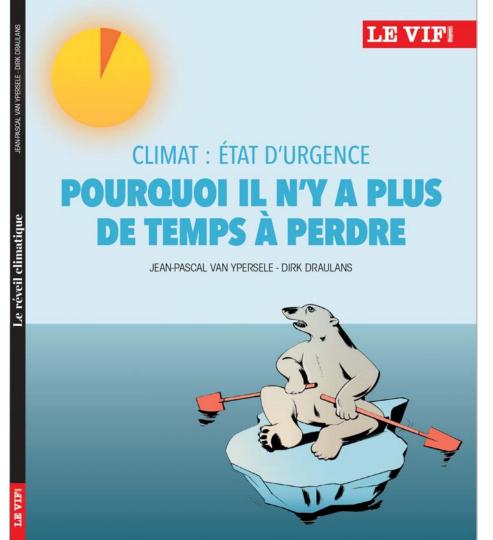
www.plateforme-wallonne-giec.be











Gratuit sur www.levif.be/reveil-climatique Gratis op www.knack.be/klimaatalarm



DIRK DRAULANS (1956) is bioloog, doctor in de wetenschappen en was gastonderzoeker aan de University of Oxford. Sinds 1987 is hij journalist bij Knack.



JEAN-PASCAL VAN YPERSELE (1957) is fysicus en klimatologe. Hij is hoogleraar klimatologie en milieuwetenschappen aan de UCLouvain en was ondervoorzitter van het Intergovernmental Panel on Climate Change (IPCC).

BIJLAGE BIJ KNACK VAN 16 SEPTEMBER 2020. MAG NIET LOS VERKOCHT WORDEN.

HET KLIMAAT ALARM Dirk Draulans en Jean-Pascal van Ypc



Knack

To go further:

- www.ipcc.ch : IPCC
- <u>www.realclimate.org</u>: answers to the merchants of doubt arguments
- <u>www.skepticalscience.com</u>: same
- www.plateforme-wallonne-giec.be: IPCC-related in French, Newsletter, latest on climate, basic climate science
- **Twitter: @JPvanYpersele & @IPCC_CH**

Jean-Pascal van Ypersele (vanyp@climate.be)