

The urgency of the climate change challenge: Why zero net emissions are needed?

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IPCC Vice-Chair from 2008 to 2015

Twitter: @JPvanYpersele

**« SunRiseAction.eu Stakeholder Workshop »,
Brussels, 18 June 2019**

Thanks to the Walloon government for supporting www.plateforme-wallonne-giec.be & my team at UCLouvain

I want you to panic... and act

“I don’t want your hope. I don’t want you to be hopeful. I want you to panic ... and act as if the house was on fire. ”

Greta Thunberg
Environmental Activist

WORLD
ECONOMIC
FORUM



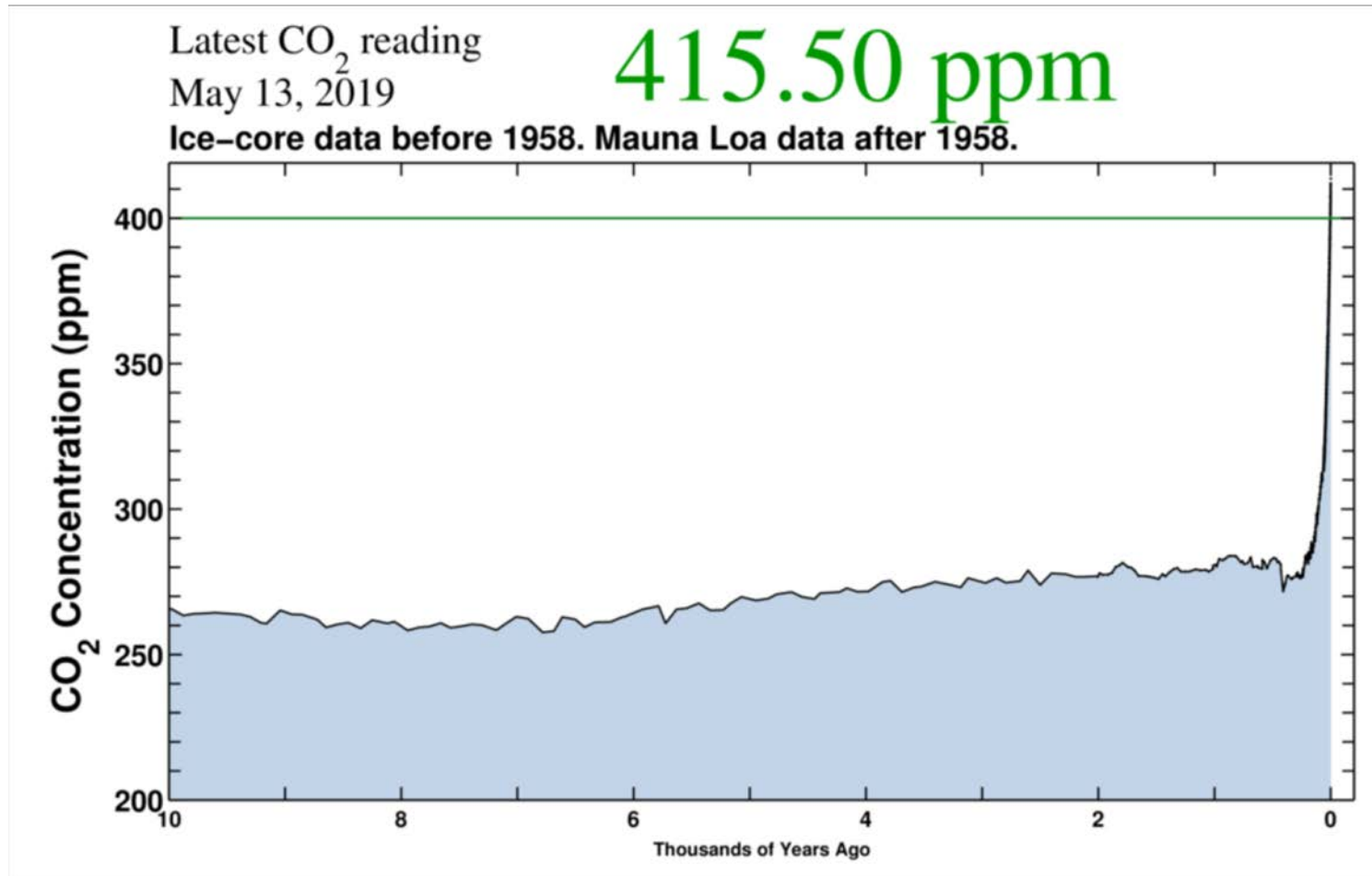
That small blue dot is the Earth, as seen from Cassini, orbiting Saturn, 1.44 billion km from us, on 19-7-2013



Fact n° 1: Because we use the atmosphere as a dustbin for our greenhouse gases, we thicken the insulation layer around the planet

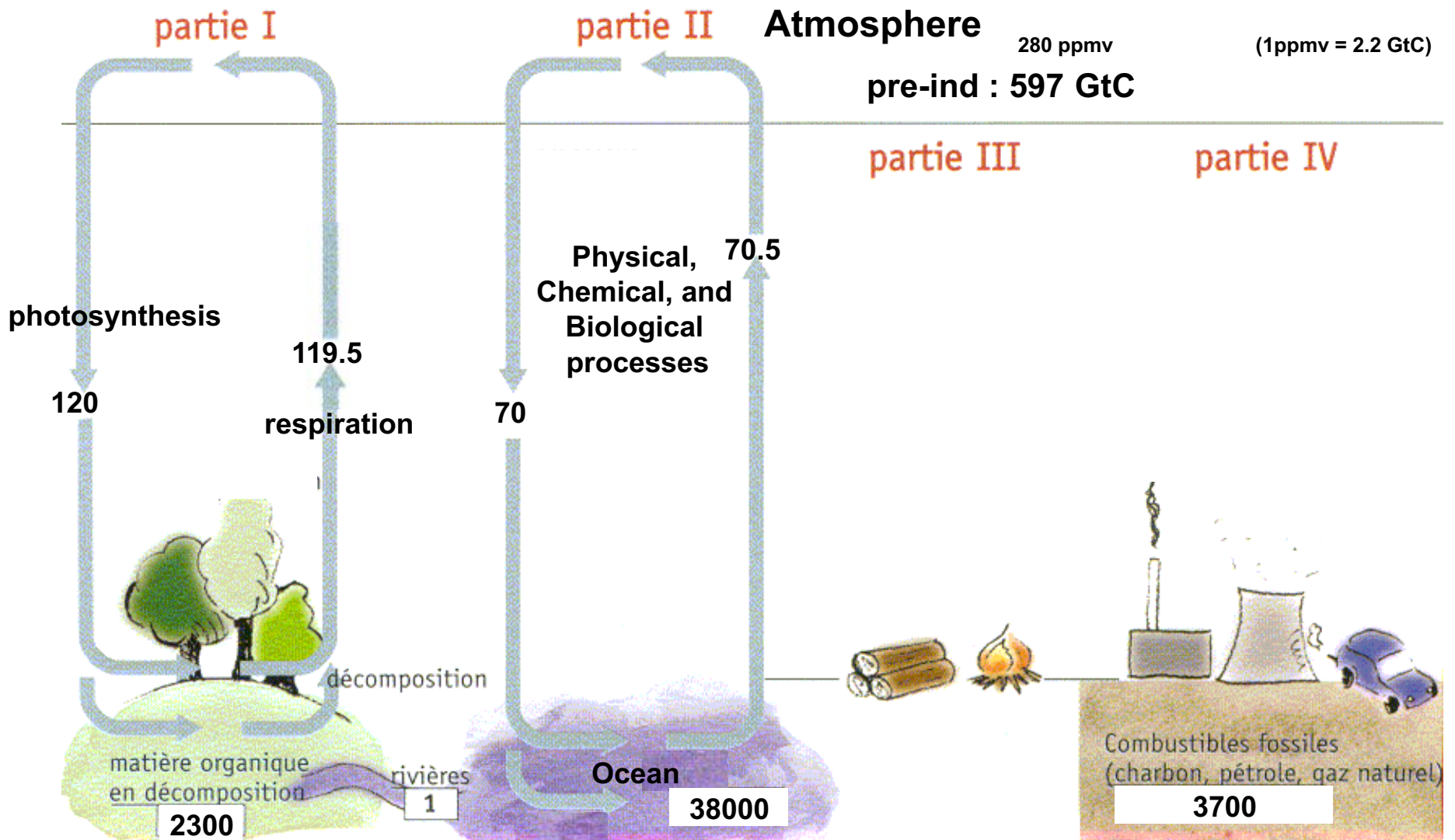
That is why we must cut emissions to ZERO as soon as possible

CO₂ Concentration, 13 May 2019 (Keeling curve)



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

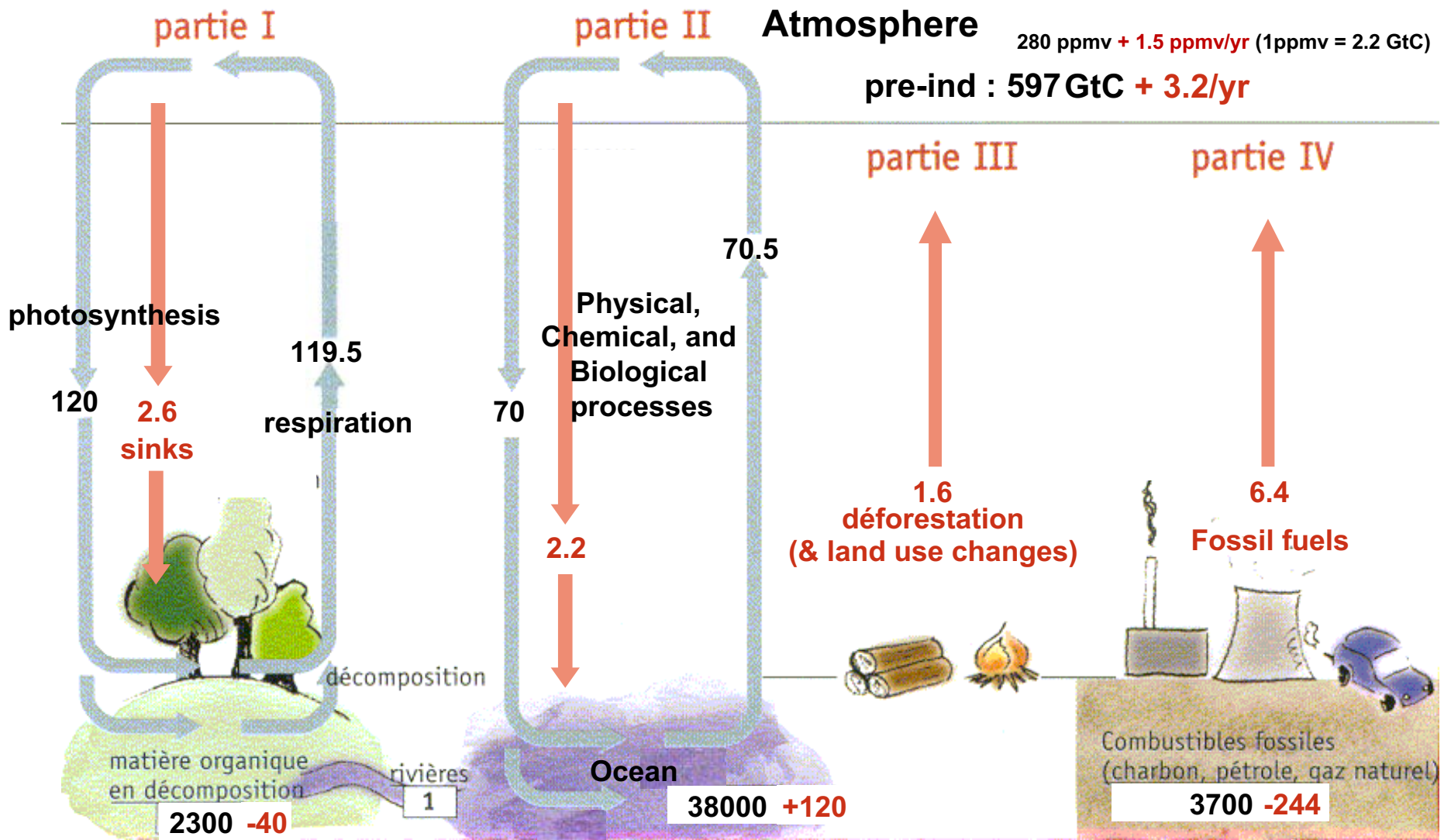
Carbon cycle: unperturbed fluxes



Units: GtC (billions tons of carbon) or GtC/year (multiply by 3.7 to get GtCO₂)

Carbon cycle: perturbed by human activities

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



Stocks!

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

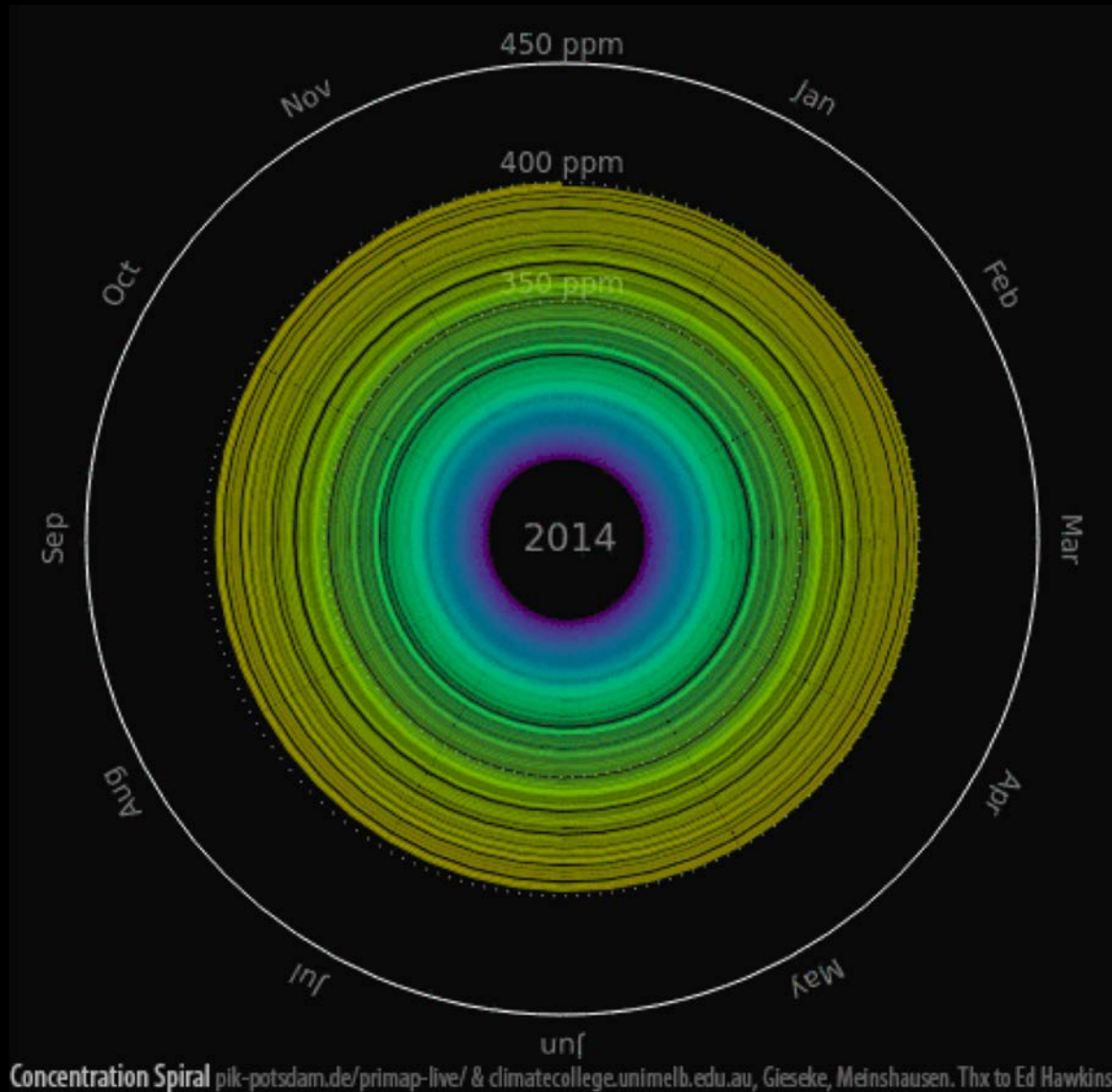
Climatic Change: Are We on the Brink of a Pronounced Global Warming? (Broecker, 1975)

Table 1. Reconstruction and prediction of atmospheric CO₂ contents based on fuel consumption data.

| Year | Chemical fuel CO ₂ ($\times 10^{16}$ g) | Excess atmospheric CO ₂ * ($\times 10^{16}$ g) | Excess atmospheric CO ₂ (%) | Excess atmospheric CO ₂ (ppm) | CO ₂ content of the atmosphere† (ppm) | Global temperature increase‡ (°C) |
|------|---|--|--|--|--|-----------------------------------|
| 1900 | 3.8 | 1.9 | 0.9 | 2 | 295 | 0.02 |
| 1910 | 6.3 | 3.1 | 1.4 | 4 | 297 | .04 |
| 1920 | 9.7 | 4.8 | 2.2 | 6 | 299 | .07 |
| 1930 | 13.6 | 6.8 | 3.1 | 9 | 302 | .09 |
| 1940 | 17.9 | 8.9 | 4.1 | 12 | 305 | .11 |
| 1950 | 23.3 | 11.6 | 5.3 | 16 | 309 | .15 |
| 1960 | 31.2 | 15.6 | 7.2 | 21 | 314§ | .21 |
| 1970 | 44.0 | 22.0 | 10.2 | 29 | 322§ | .29 |
| 1980 | 63 | 31 | 14 | 42 | 335 | .42 |
| 1990 | 88 | 44 | 20 | 58 | 351 | .58 |
| 2000 | 121 | 60 | 28 | 80 | 373 | .80 |
| 2010 | 167 | 83 | 38 | 110 | 403 | 1.10 |

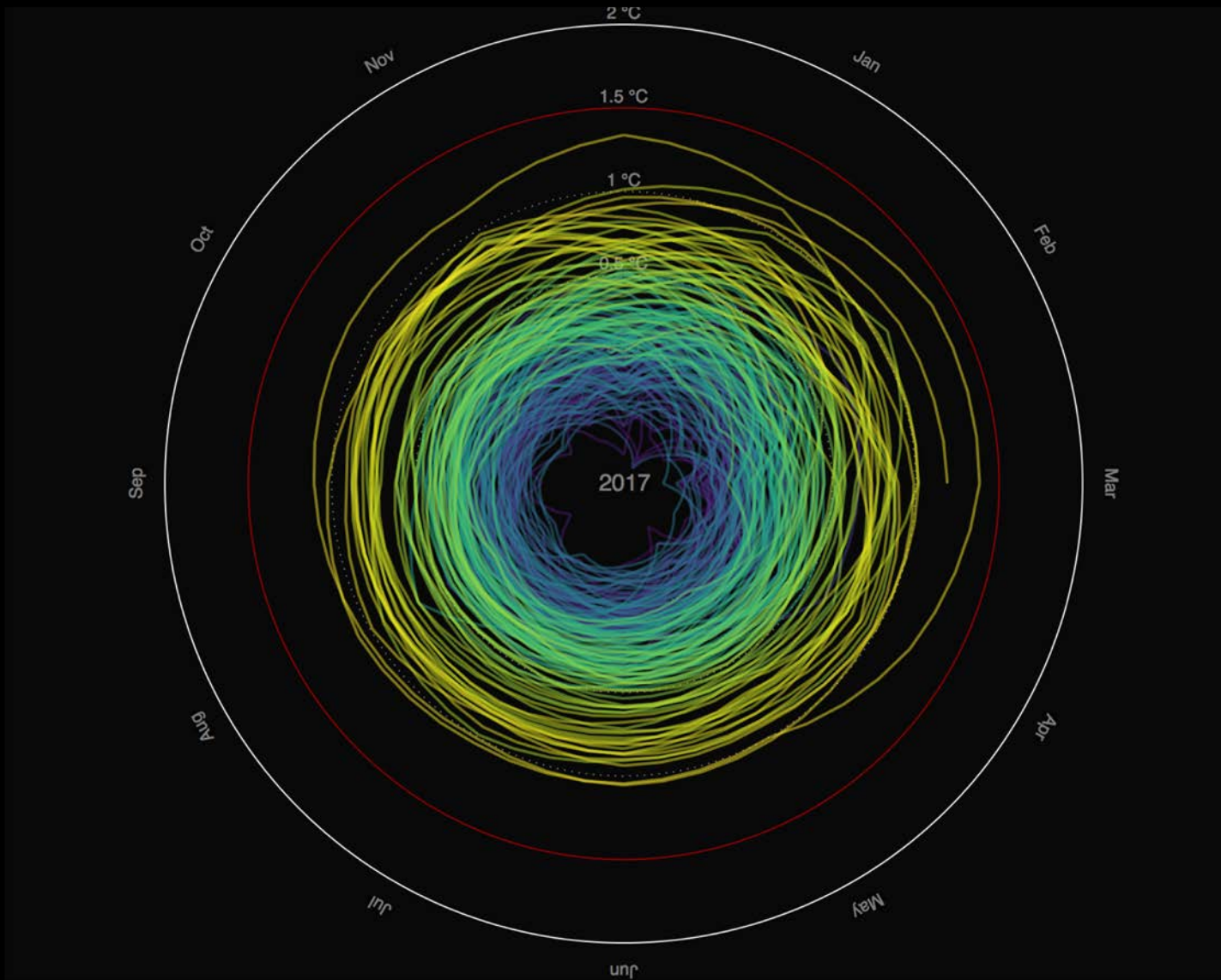
*On the assumption that 50 percent of the CO₂ produced by the burning of fuel remains in the atmosphere.
 †The preindustrial atmospheric partial pressure of CO₂ is assumed to be 293 ppm. ‡Assumes a 0.3°C global temperature increase for each 10 percent rise in the atmospheric CO₂ content. §Value observed on Hawaii for 1960, 314 ppm; value for 1970, 322 ppm (8). ||Post-1972 growth rate taken to be 3 percent per year.

CO₂ concentration spiral: the insulation thickens!



CO₂ concentration spiral 1851-2014 (ppm), by Gieseke & Meinshausen,
Available on <http://pik-potsdam.de/primap-live>

Temperature spiral



Global Mean Temperature in °C relative to 1850 – 1900

Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset

Animated version available on <http://openclimatedata.net/climate-spirals/temperature>

Modèles climatiques

Atmosphère et surface

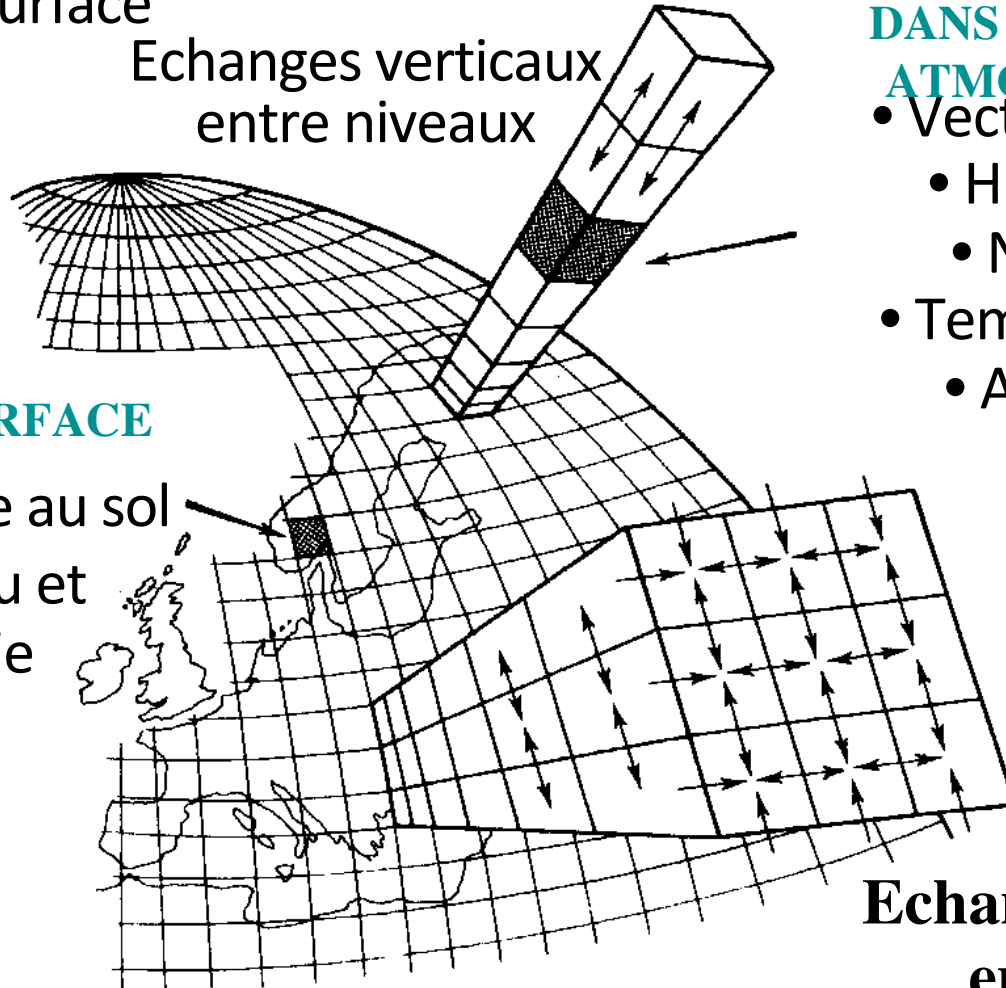
Echanges verticaux
entre niveaux

**DANS LA COLONNE
ATMOSPHERIQUE**

- Vecteurs vent
 - Humidité
 - Nuages
- Température
- Altitude

A LA SURFACE

- Température au sol
- Flux d'eau et d'énergie



**Echanges horizontaux
entre colonnes**

Résolution typique $\sim 2^\circ \times 2^\circ$ (modèle global, atmosphère)

Intervalle de temps typique : ≤ 30 minutes

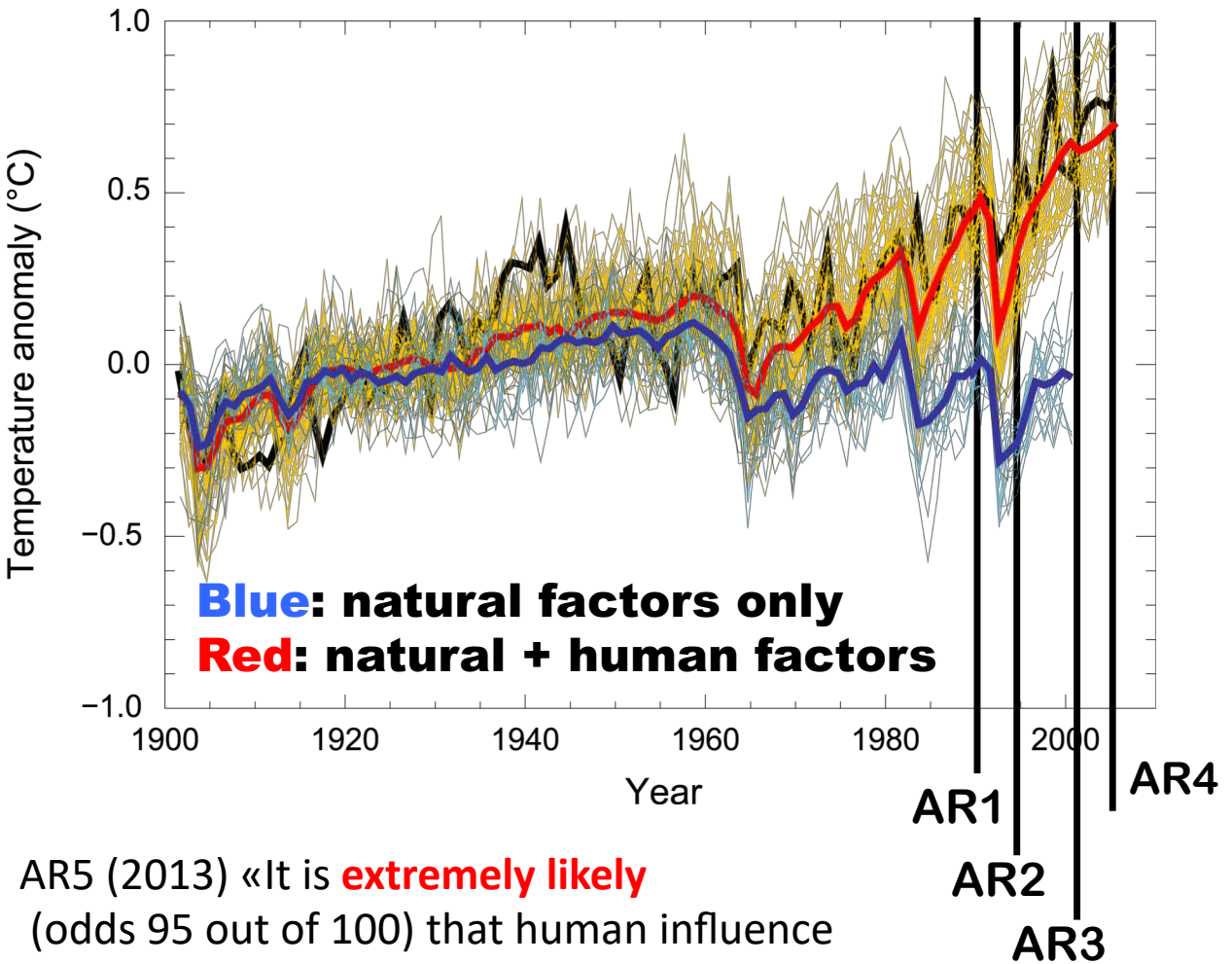
A Progression of Understanding: Greater and Greater Certainty in Attribution

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... »

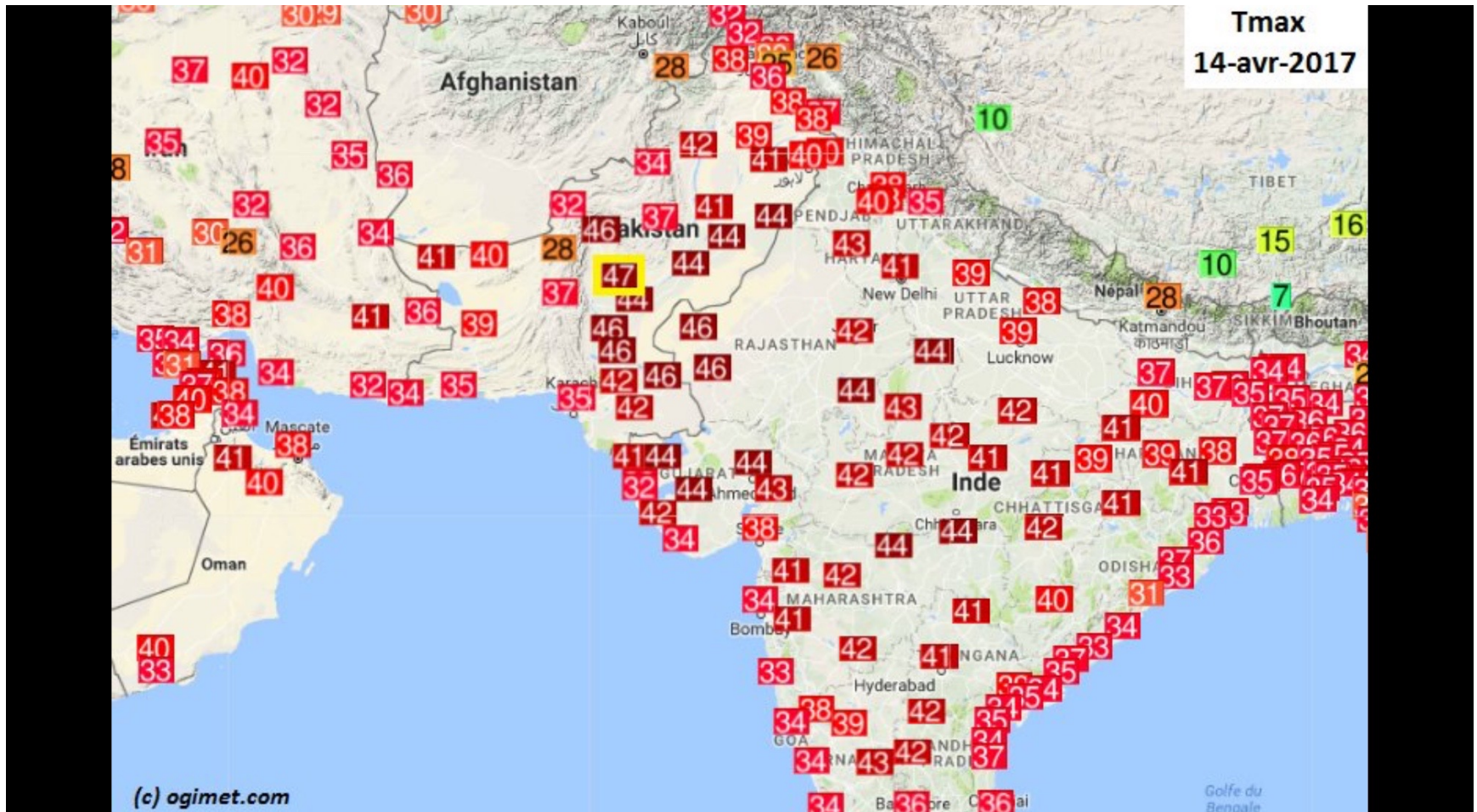
**Fact n° 2: We have changed the
composition of the atmosphere
and disturbed the climate
system**

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





Plateau Glacier (1961) (Alaska)



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

Plateau Glacier (2003) (Alaska)

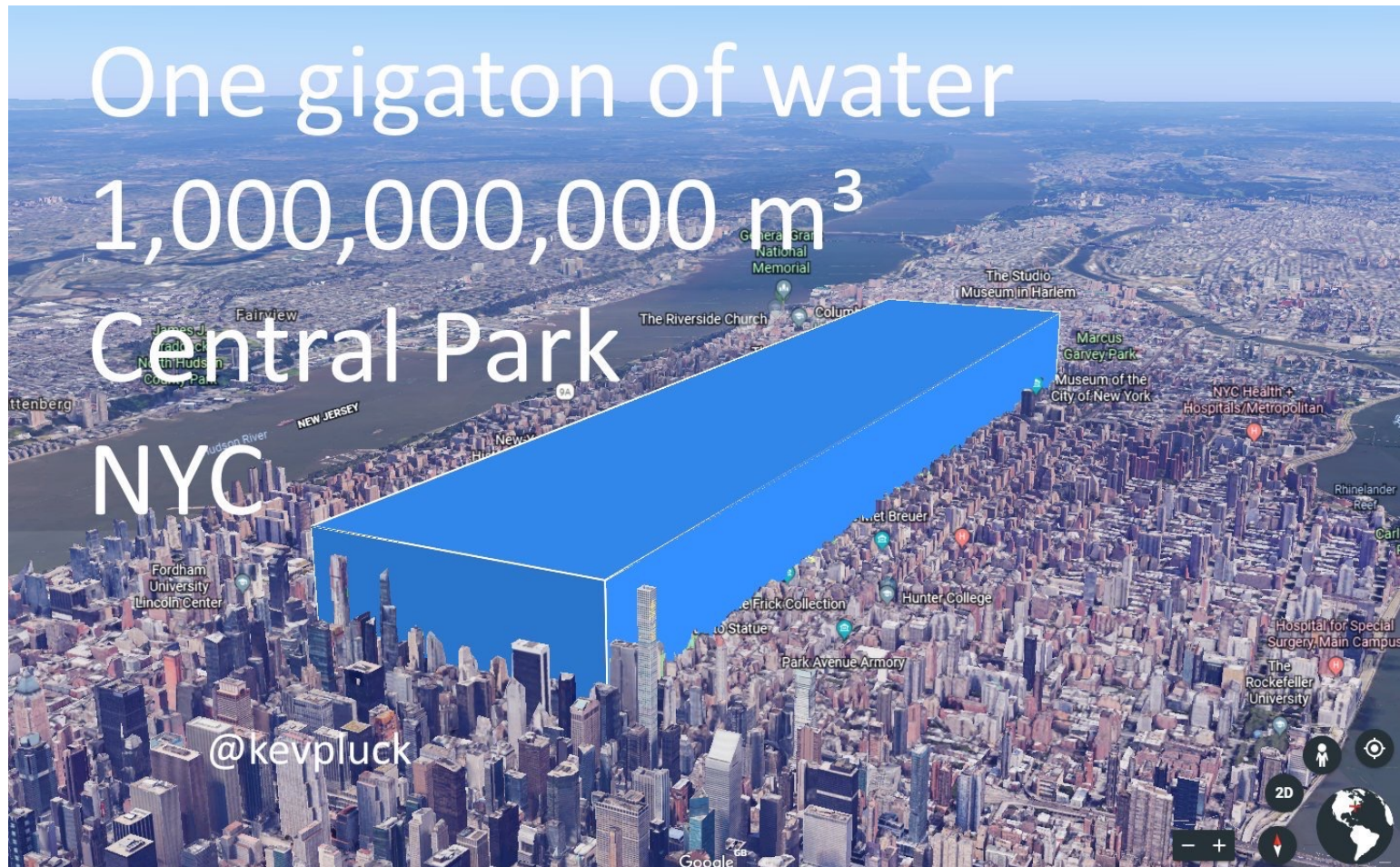


http://www.weather.com/news/science/environment/alaskas-glaciers-capturing-earth-changing-our-eyes-20131125?cm_ven=Email&cm_cat=ENVIRONMENT_us_share

Fact n° 3: Average temperature is probably on its way to exceed the « conservation temperature » for the Greenland and (some of the) Antarctic ice sheet

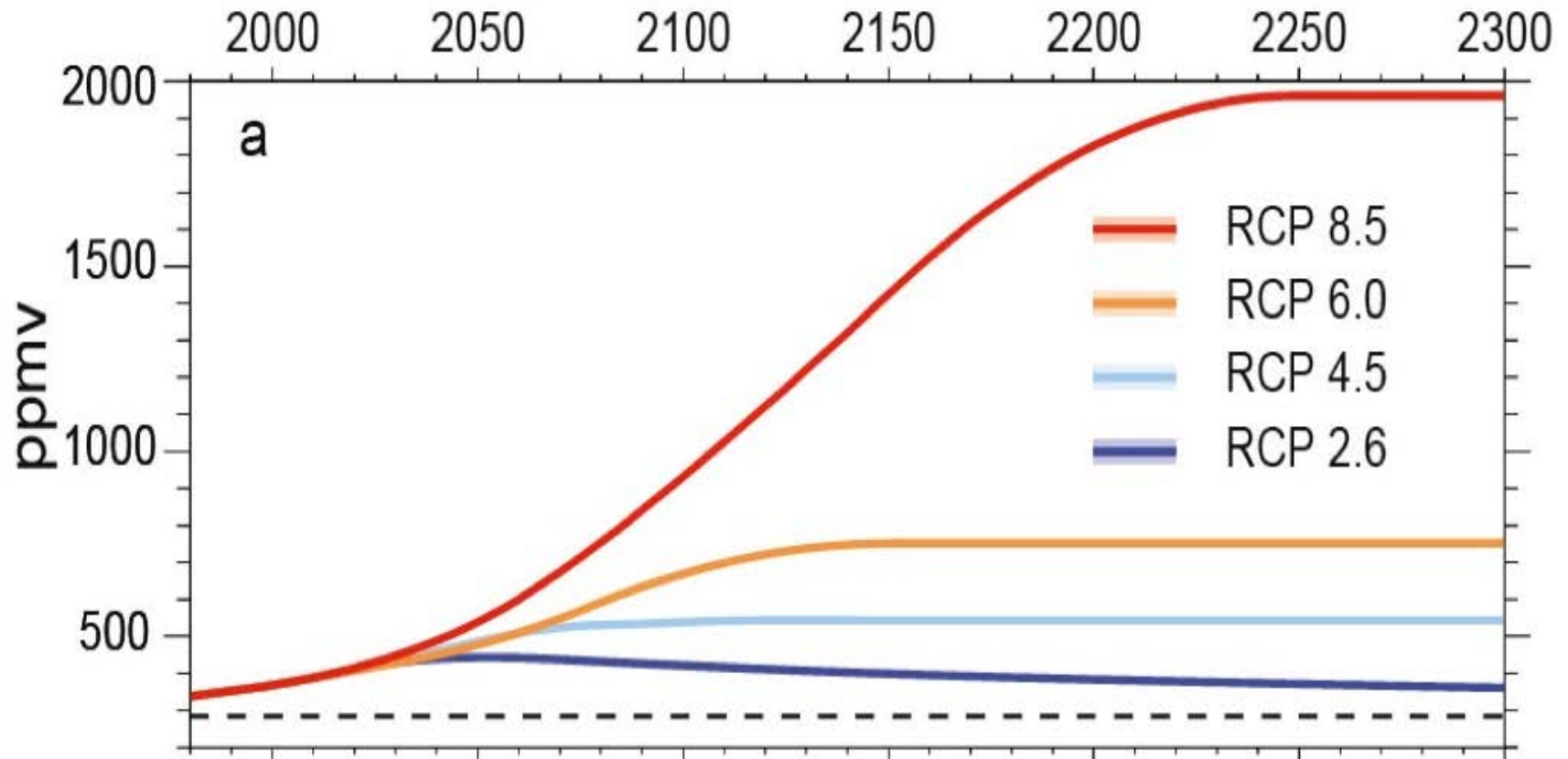
There is therefore a very high risk that average sea level would increase by several metres over the next century or two

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



Source: @Kevpluck, June 2018

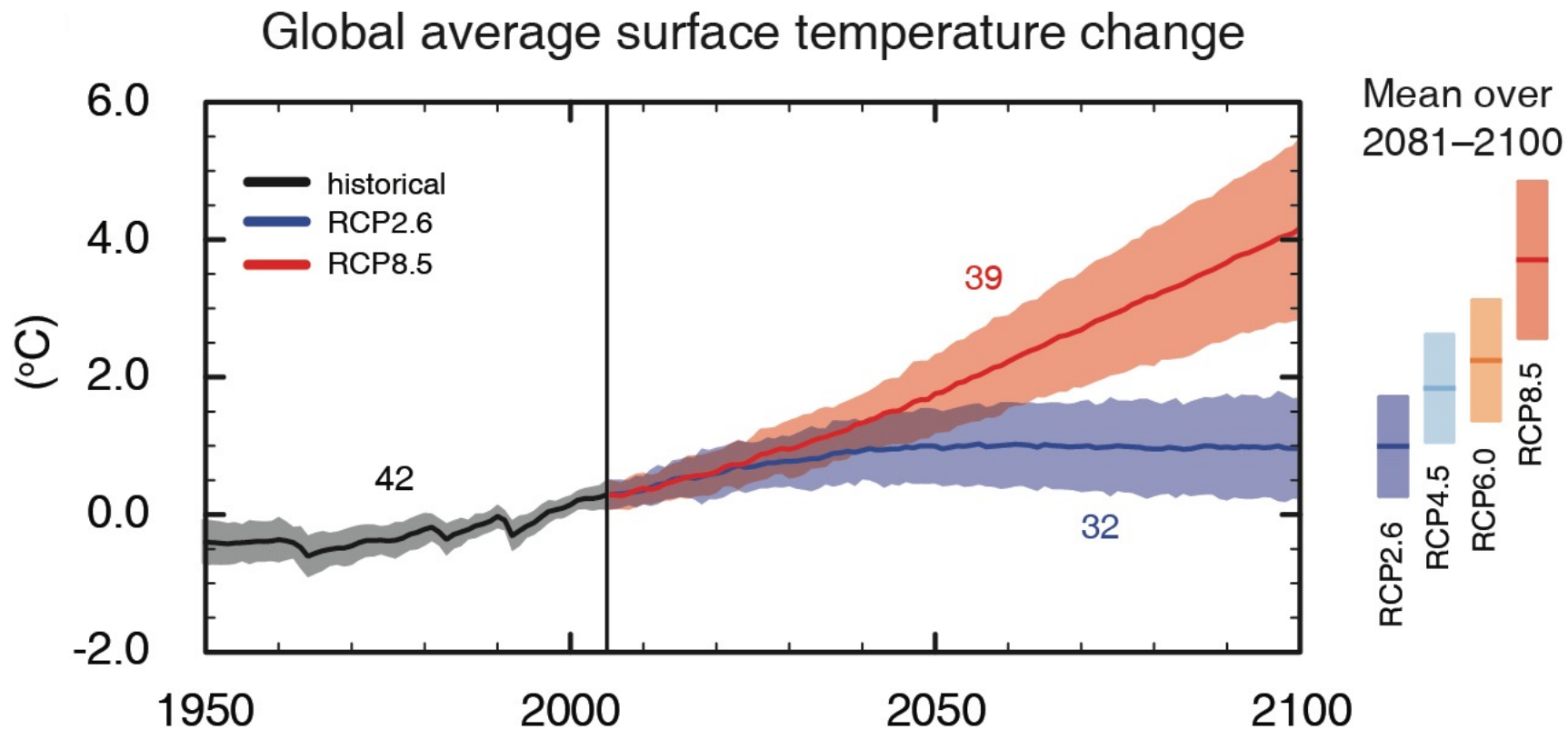
AR5 RCP: Atmospheric CO₂ concentration



Most CMIP5 runs are based on the concentrations, but emissions-driven runs are available for RCP 8.5

Note : « emission-driven » -> knowledge of C-cycle uncertainty

Réchauffement moyen – scén. RCP, 2Is



(IPCC 2013, Fig. SPM.7a)

RCP2.6

RCP8.5

Change in average surface temperature (1986–2005 to 2081–2100)

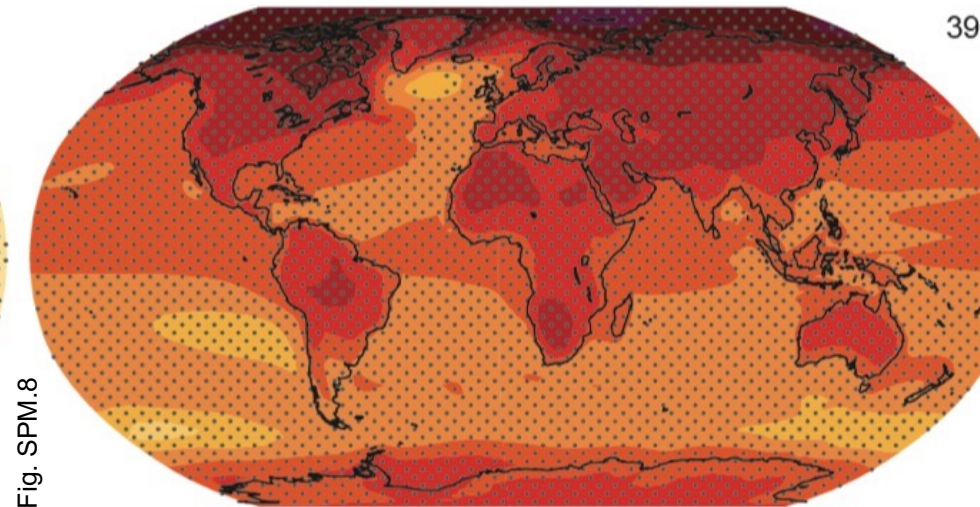
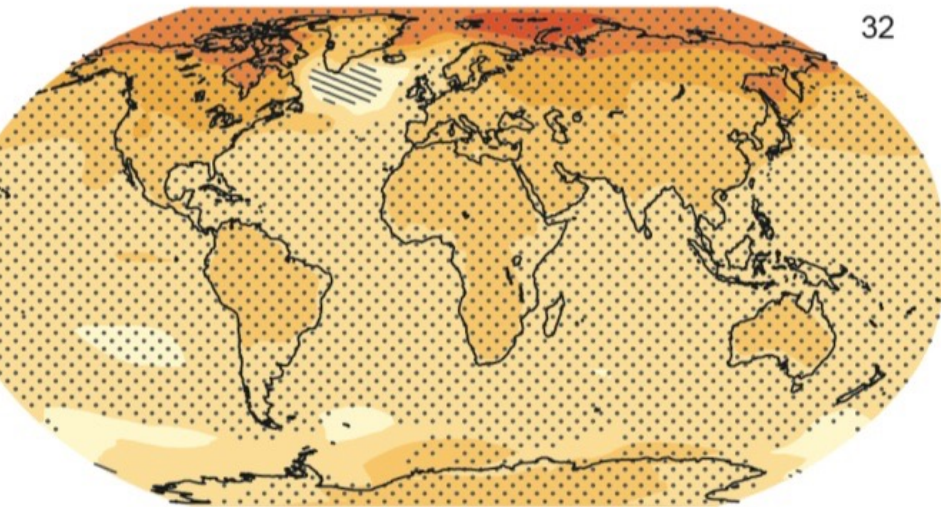
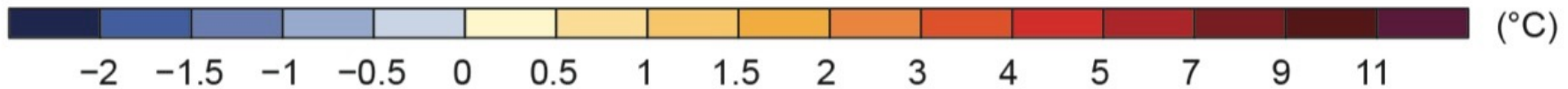


Fig. SPM.8



Hatching [hachures] indicates regions where the multi-model mean is small compared to natural internal variability (i.e., less than one standard deviation of natural internal variability in 20-year means).

Stippling [pointillés] indicates regions where the multi-model mean is large compared to natural internal variability (i.e., greater than two standard deviations of natural internal variability in 20-year means) and where at least 90% of models agree on the sign of change

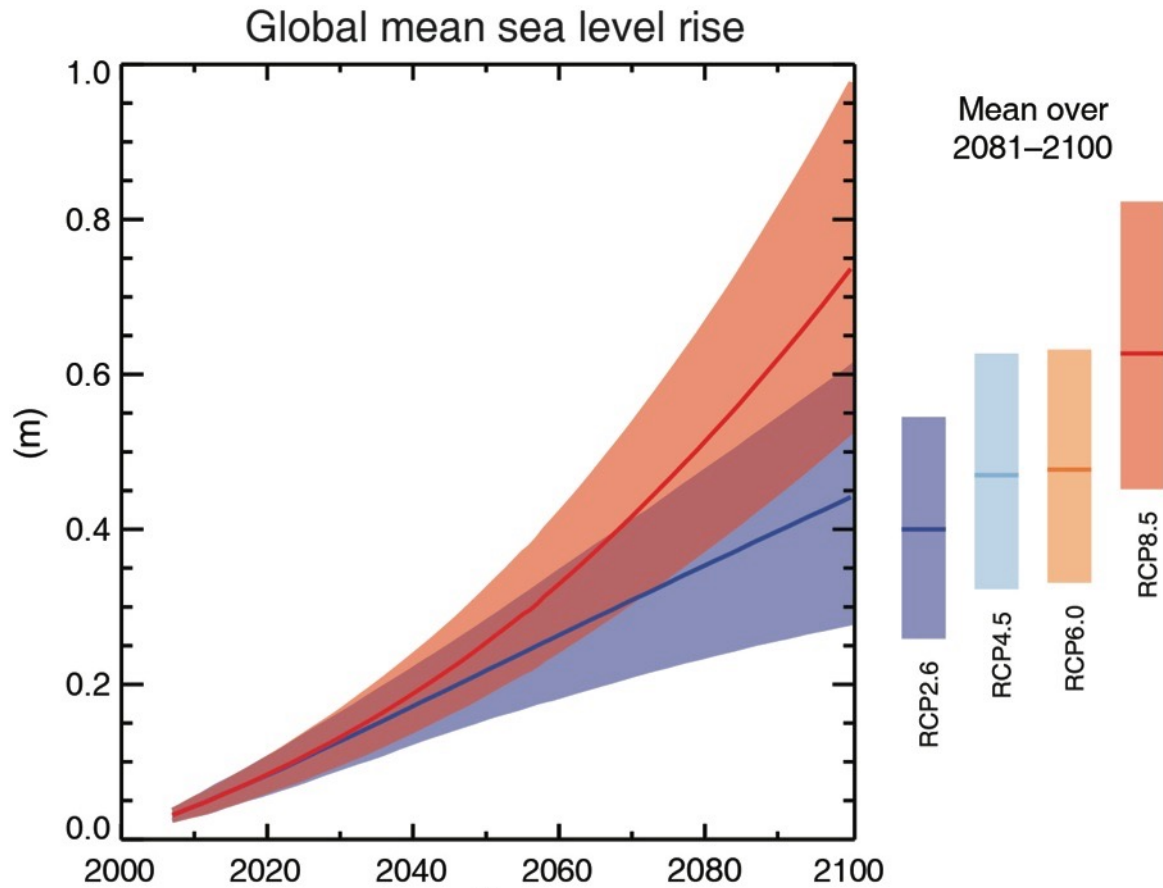


Fig. SPM.9

RCP2.6 (2081-2100), *likely* range:

26 to 55 cm

RCP8.5 (in 2100), *likely* range:

52 to 98 cm

Effects on the Nile Delta, where more than 10 million people live less than 1 m above sea level



NB: + 1 m is possible
in the next 100 years...

(Time 2001)

The SR15

ipcc
INTERGOVERNMENTAL PANEL ON climate change















Global Warming of 1.5°C

An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.



HALF A DEGREE OF WARMING MAKES A BIG DIFFERENCE:

EXPLAINING IPCC'S 1.5°C SPECIAL REPORT

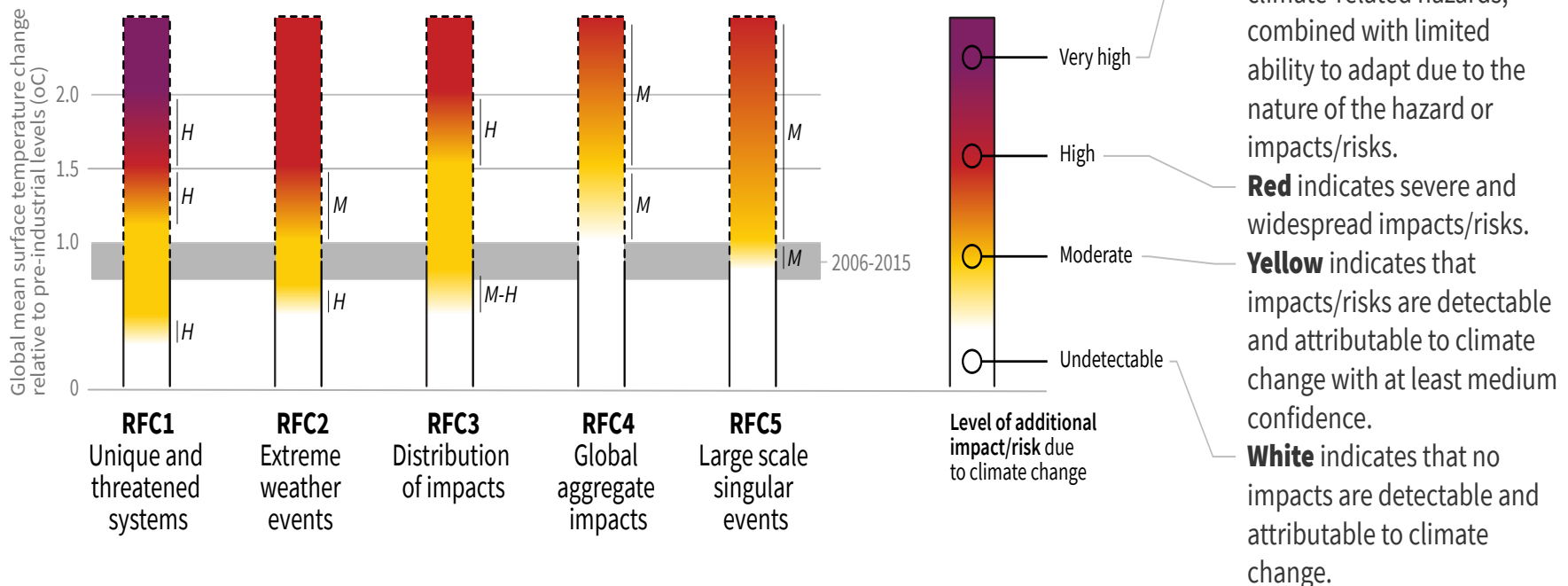
| | 1.5°C | 2°C | 2°C IMPACTS |
|--|--|--|----------------------|
| EXTREME HEAT Global population exposed to severe heat at least once every five years |  <p>14%</p> |  <p>37%</p> | 2.6x WORSE |
| SEA-ICE-FREE ARCTIC Number of ice-free summers |  <p>AT LEAST 1 EVERY 100 YEARS</p> |  <p>AT LEAST 1 EVERY 10 YEARS</p> | 10x WORSE |
| SEA LEVEL RISE Amount of sea level rise by 2100 |  <p>0.40 METERS</p> |  <p>0.46 METERS</p> | .06M MORE |
| SPECIES LOSS: VERTEBRATES Vertebrates that lose at least half of their range |  <p>4%</p> |  <p>8%</p> | 2x WORSE |
| SPECIES LOSS: PLANTS Plants that lose at least half of their range |  <p>8%</p> |  <p>16%</p> | 2x WORSE |
| SPECIES LOSS: INSECTS Insects that lose at least half of their range |  <p>6%</p> |  <p>18%</p> | 3x WORSE |

Responsibility for content: WRI

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.

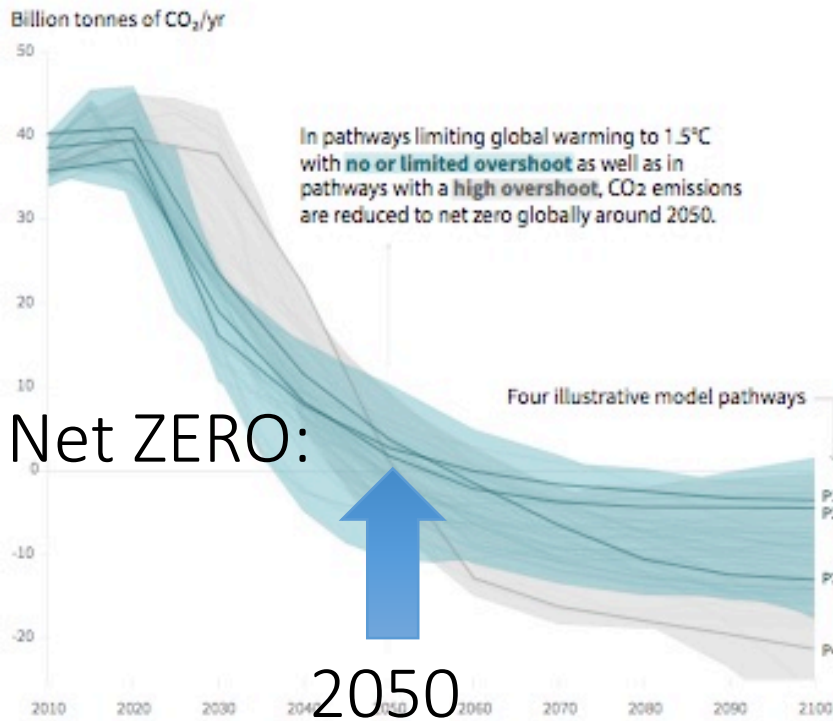
Impacts and risks associated with the Reasons for Concern (RFCs)



Global emissions pathway characteristics

General characteristics of the evolution of anthropogenic net emissions of CO₂, and total emissions of methane, black carbon, and nitrous oxide in model pathways that limit global warming to 1.5°C with no or limited overshoot. Net emissions are defined as anthropogenic emissions reduced by anthropogenic removals. Reductions in net emissions can be achieved through different portfolios of mitigation measures illustrated in Figure SPM3B.

Global total net CO₂ emissions



Timing of net zero CO₂

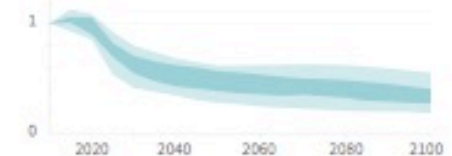
Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios



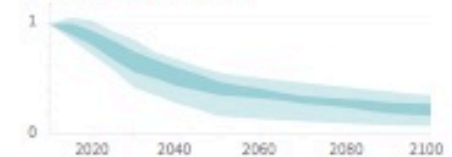
Non-CO₂ emissions relative to 2010

Emissions of non-CO₂ forcers are also reduced or limited in pathways limiting global warming to 1.5°C with **no or limited overshoot**, but they do not reach zero globally.

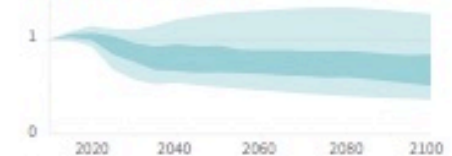
Methane emissions



Black carbon emissions



Nitrous oxide emissions



Remaining carbon budget in 2018

(Source: IPCC SR15)

- The remaining carbon budget of 580 GtCO₂ for a 50% probability of limiting warming to 1.5°C, and 420 GtCO₂ for a 66% probability (medium confidence)
- The remaining budget is being depleted by current emissions of 42 ± 3 GtCO₂ per year

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

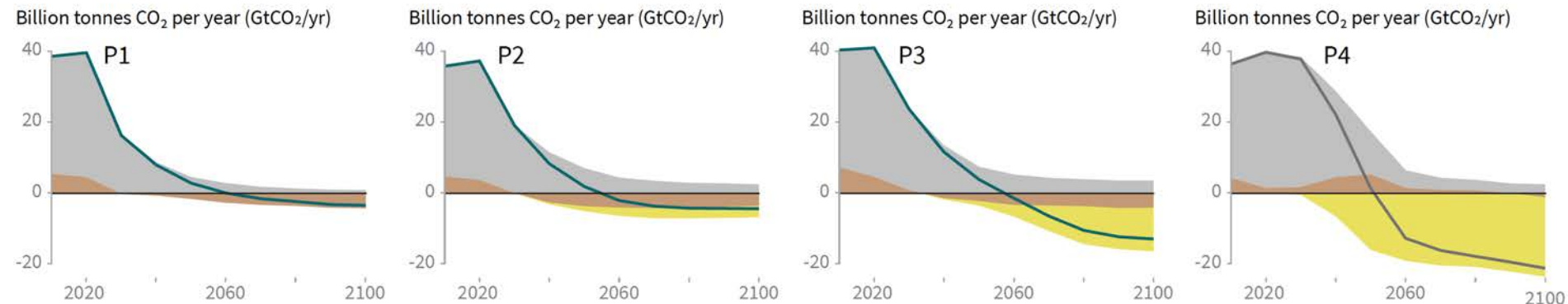
Greenhouse gas emissions pathways

- Progress in renewables would need to mirrored in other sectors
- We would need to start taking carbon dioxide out of the atmosphere (Afforestation or other techniques)
- Implications for food security, ecosystems and biodiversity

Four illustrative model pathways in the IPCC SR15:

Breakdown of contributions to global net CO₂ emissions in four illustrative model pathways

● Fossil fuel and industry ● AFOLU ● BECCS



P1: A scenario in which social, business, and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South. A down-sized energy system enables rapid decarbonisation of energy supply. Afforestation is the only CDR option considered; neither fossil fuels with CCS nor BECCS are used.

P2: A scenario with a broad focus on sustainability including energy intensity, human development, economic convergence and international cooperation, as well as shifts towards sustainable and healthy consumption patterns, low-carbon technology innovation, and well-managed land systems with limited societal acceptability for BECCS.

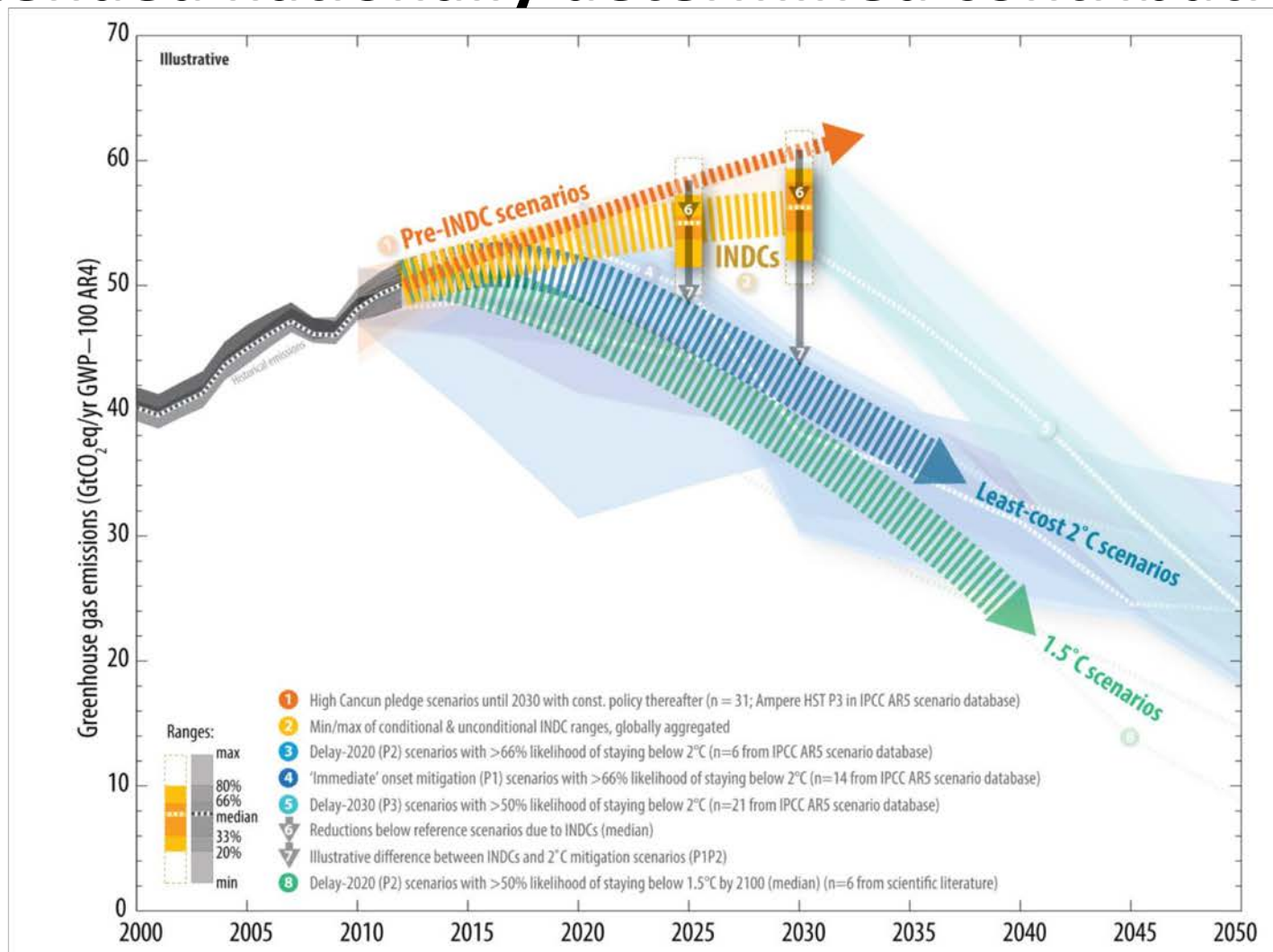
P3: A middle-of-the-road scenario in which societal as well as technological development follows historical patterns. Emissions reductions are mainly achieved by changing the way in which energy and products are produced, and to a lesser degree by reductions in demand.

P4: A resource and energy-intensive scenario in which economic growth and globalization lead to widespread adoption of greenhouse-gas intensive lifestyles, including high demand for transportation fuels and livestock products. Emissions reductions are mainly achieved through technological means, making strong use of CDR through the deployment of BECCS.

Fact n° 10: The present national plans (NDCs) introduced ahead of the Paris Agreement are far from what is needed to respect the 1.5° C objective, and even to stay below 2° C warming

Please note that the Paris Agreement speaks about 1.5° C and « *well below 2° C* » warming, not 2° C

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>

**(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.

The Paris Agreement (COP21, December 2015)

Vision

« ...strengthen the **global response to the threat of climate change**, in the context of **sustainable development** and efforts to **eradicate poverty** »

Objectives

a) Holding the increase in the global average temperature:

- « *to well below 2°C above pre-industrial levels* »
- « *pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change* »

b) Adaptation and Mitigation

- « *Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and*
- *low greenhouse gas emissions development, in a manner that does not threaten food production*»

c) Finances

- « *Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.* »

- **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)

- **energy efficiency: +330**
- **renewables: + 90**
- **power plants w/ CCS: + 40**
- **nuclear: + 40**
- **power plants w/o CCS: - 60**
- **fossil fuel extraction: - 120**

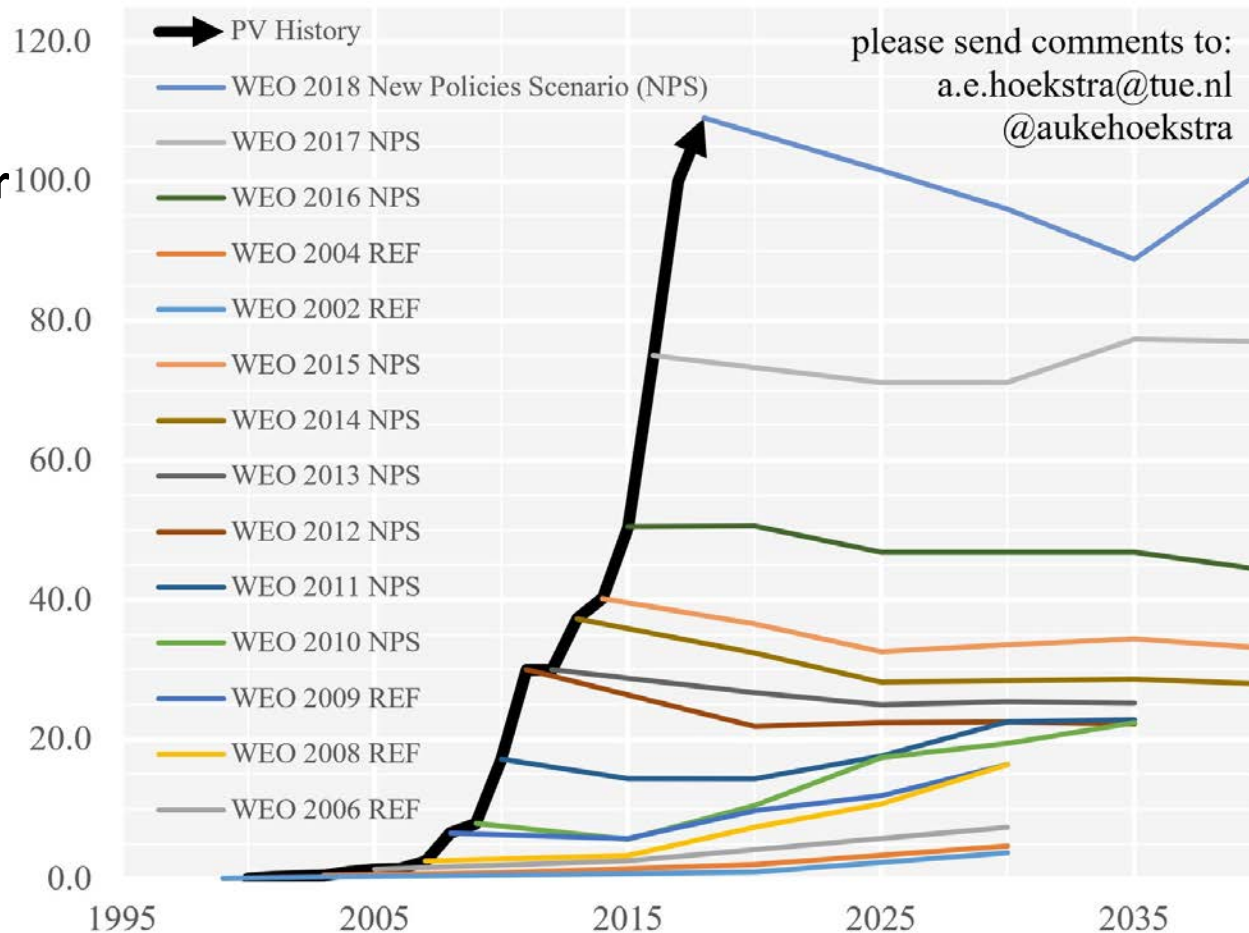
**Solution n° 9: The Sun gives us
in two hours about as much
energy as the world uses in *one*
year, all forms of energy
considered**

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

The International Energy Agency has missed that point...

Annual PV additions: historic data vs IEA WEO predictions
In GW of added capacity per year - source International Energy Agency - World Energy Outlook

**GW capacity
added per year**



Technology

Technology alone cannot solve climate crisis, warns ING



Michael Holder

07 December 2018



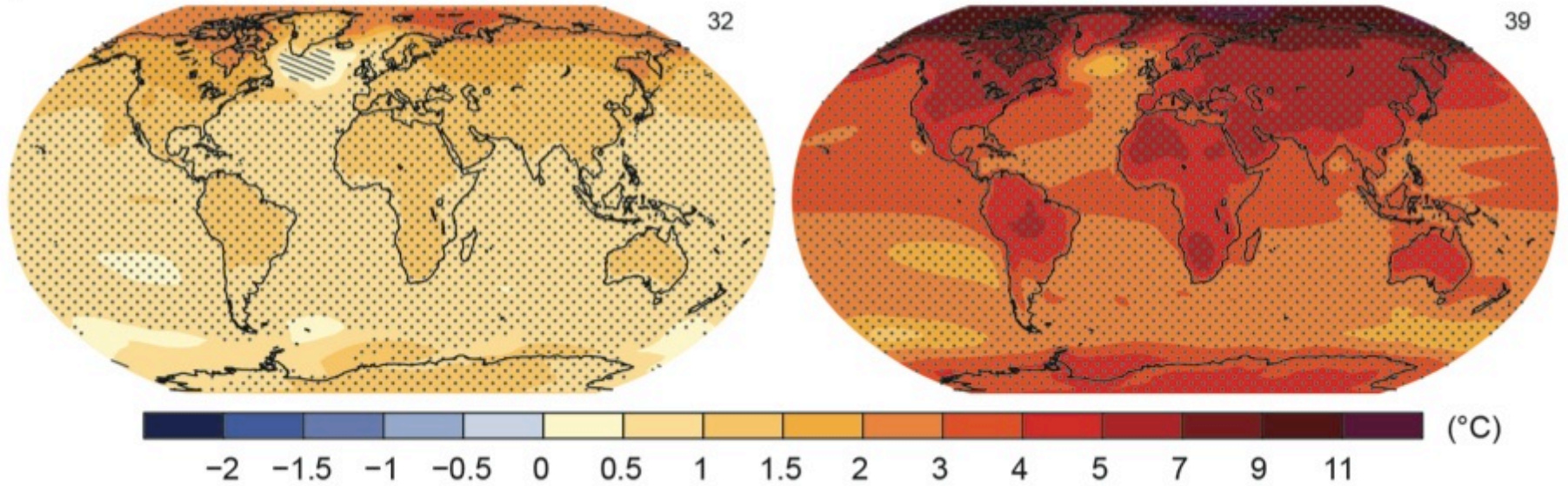
World set to miss 2030 climate targets as new clean technologies take time to scale, warns ING

Technology could reduce today's global energy-related CO2 emissions by 64 per cent by 2050, but effective policies are urgently needed to ensure unintended climate impacts are avoided, new research by...

RCP2.6

RCP8.5

Change in average surface temperature (1986–2005 to 2081–2100)



Humanity has the choice

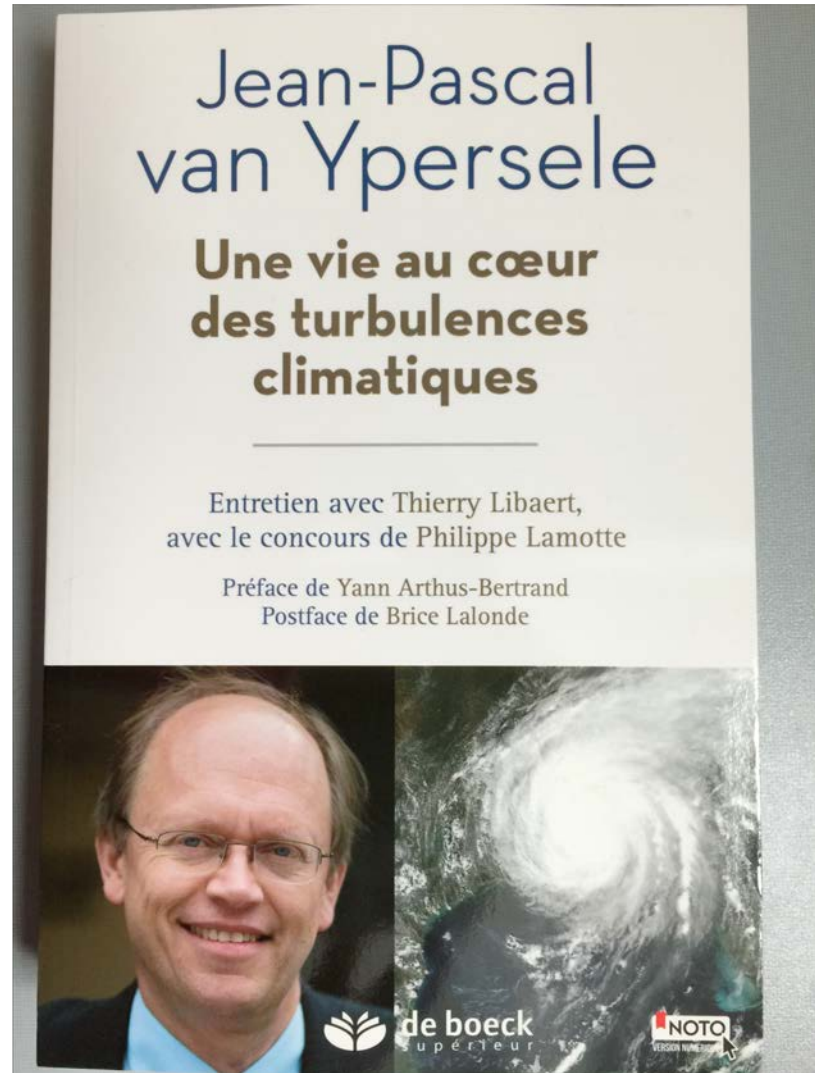
Pour en savoir plus:

**Lisez mon livre, où
j'aborde tous ces sujets**

**Publié chez De Boeck
supérieur**

**Préface: Yann Arthus-
Bertrand**

Postface: Brice Lalonde

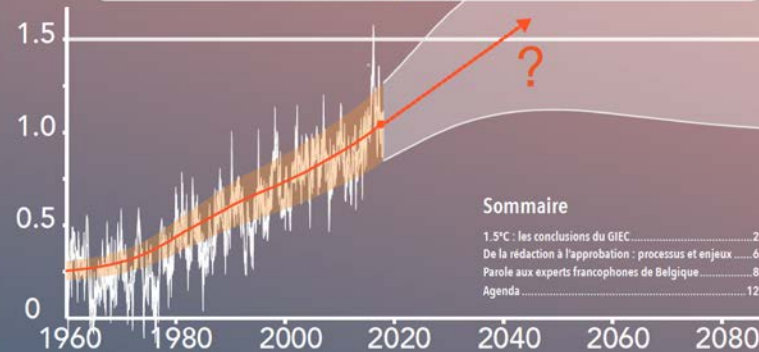


Bij EPO (2018)

**Voorwoord:
Jill Peeters**



Le rapport spécial du GIEC Réchauffement planétaire de 1.5°C



Pour de nombreuses populations et écosystèmes, il est essentiel de limiter le réchauffement à 1.5°C ou de ne dépasser ce niveau que temporairement. Et c'est potentiellement encore réalisable. Le 6 octobre 2018, l'Assemblée Plénière du GIEC a adopté le Rapport Spécial sur un « Réchauffement planétaire de 1.5°C », qui fait le point au sujet des impacts et scénarios correspondant à ce niveau de réchauffement.

Ce rapport conclut que pour limiter le réchauffement climatique à 1.5°C, il faut des transformations radicales et rapides dans tous les domaines de notre société. Il précise que ces changements sont sans précédent en termes d'échelle, mais pas nécessairement en termes de rapidité.

L'origine du rapport est une demande formelle au GIEC de la part des Parties à la Convention cadre des Nations Unies sur les changements climatiques (CNUCC) lors de l'adoption de l'Accord de Paris, en 2015 (21^e Conférence des Parties, COP21). La COP21 avait aussi indiqué que le rapport du GIEC devrait identifier le niveau auquel les émissions mondiales devraient être ramenées en 2030 pour contenir l'élévation de température en-dessous de 1.5°C.

Le rapport a été adopté à l'issue d'une semaine de discussions intenses au sujet de la formulation du Résumé à l'intention des décideurs, sur la base des chapitres et du projet de résumé rédigés par les scientifiques - qui ont toujours le dernier mot en ce qui concerne le contenu. Il forme une base scientifique essentielle pour les prochaines négociations internationales dans le cadre de la CNUCC, qui auront lieu à Katowice (Pologne) en décembre 2018 (COP24).

Dans cette Lettre, nous donnons d'abord un aperçu des conclusions du rapport, ensuite un aperçu du processus d'approbation et des enjeux associés. Pour ouvrir le débat et fournir un ensemble de points de vue, nous avons ensuite donné la parole aux experts francophones de Belgique, qui nous ont aimablement fait part des commentaires que vous trouverez en troisième partie. L'agenda indique les prochaines périodes de relecture de rapports du GIEC et annonce deux événements à venir en Belgique.

Nous vous en souhaitons une bonne lecture,
Jean-Pascal van Ypersele, Bruna Gaino et Philippe Marbaix

Image de fond : extrait adapté de la figure SPM1 du Rapport spécial



'Sauver le climat' : les bases

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



Suite à l'intense mobilisation des jeunes, les changements climatiques ont fait l'objet de beaucoup d'attention au cours des derniers mois. Éléves du secondaire, étudiants, professeurs, parents et grand-parents sont descendus dans la rue pour montrer leur désarroi face à la lenteur de l'action vis-à-vis des changements climatiques.

Nous nous réjouissons de cette mobilisation, car notre rôle nous met encore plus fréquemment que l'ensemble de la population en position de témoin des risques que font courir les changements climatiques, ainsi que de l'ampleur des efforts nécessaires pour mettre en œuvre les objectifs qui se sont fixés les membres des Nations Unies à Paris en 2015 (COP21).

Une démarche essentielle en faveur de ces jeunes est de les aider à se former, à appréhender les principaux éléments de la problématique du climat, et plus largement, de l'influence de nos activités sur notre environnement et sur le futur de l'humanité. L'éducation est un des instruments essentiels pour évoluer vers une société plus durable et plus juste.

Pour y contribuer, nous présentons ici une brève synthèse de la problématique et une sélection de références commentées. Nous espérons que cette Lettre aidera enseignants et élèves à disposer d'une base d'information solide et ainsi à prendre leur part dans la solution à ce problème planétaire : agir à leur niveau et favoriser l'action dans leur entourage et au niveau sociétal.

Plusieurs témoignages d'élèves ou de professeurs sont également présentés.

Nous vous souhaitons une bonne lecture !

Jean-Pascal van Ypersele, Philippe Marbaix et Bruna Gaino

Sommaire

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This gives me
hope:

Well-
informed
young people
speaking
truth to
power



With @GretaThunberg at COP24

To go further :

- www.climate.be/vanyp : my slides (under « conferences)
- www.ipcc.ch : IPCC
- www.realclimate.org : answers to the merchants of doubt arguments
- www.skepticalscience.com : same
- www.plateforme-wallonne-giec.be : IPCC-related in French, Newsletter, latest on SR15
- www.wechangeforlife.org : 250 experts speak
- **Twitter: @JPvanYpersele & @IPCC_CH**