Climate change: What do we know after the new IPCC report?

Jean-Pascal van Ypersele

(Université catholique de Louvain) Former IPCC Vice-Chair (2008 - 2015)

Twitter: @JPvanYpersele

Stakeholders Dialogue, Brussels, 20 October 2021

Thanks to the Walloon Government (funding the Walloon Platform for IPCC) to my team at UCLouvain for their support

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

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

@JPvanYpersele

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 <u>http://openclimatedata.net/climate-spirals/concentration-temperature/</u>

CO₂ Concentration 24 May 2021 (Keeling curve + last 10000 years)



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

The Carbon Bathtub



Source: @CarbonInteractive



Climate Change 2021 The Physical Science Basis

Summary for Policymakers





Working Group I contribution to the Sixth Assessment Report of the ntergovernmental Panel on Climate Chang



IDCC Intergovernmental panel on climate change

BY THE NUMBERS

Author Team

234 authors from 65 countries

28% women, 72% men

30% new to the IPCC

Review Process 14,000 scientific publications assessed

78,000+ review comments

46 countries commented on Final Government Distribution

Key messages from the latest WGI AR6 IPCC Report:

A. The Current State of the Climate

- A.1 It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.
- **A.2** The scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years.
- **A.3** Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since the Fifth Assessment Report (AR5).
- **A.4** Improved knowledge of climate processes, paleoclimate evidence and the response of the climate system to increasing radiative forcing gives a best estimate of equilibrium climate sensitivity of 3°C, with a narrower range compared to AR5.

a) Change in global surface temperature (decadal average) as **reconstructed** (1-2000) and **observed** (1850-2020)

Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years



1000

WMO

INTERGOVERNMENTAL PANEL ON CLIMATE CHANEE

Figure SPM.1

Progression of Understanding: Greater and Greater Certainty in Attribution

IPCC



ÍOCC INTERGOVERNMENTAL PANEL ON CLIMATE CHANEE

Arctic sea ice

area



2 million years

Fastest rates in at least **3000 years**

rise

Lowest level in at least **1000 years**

Glaciers retreat

 $(\mathbf{\hat{O}})$

WMO

Unprecedented in at least 2000 years

SIXTH ASSESSMENT REPORT Working Group I – The Physical Science Basis

Human-induced climate change is already affecting many weather and climate extremes in every region across the globe





Extreme heat More frequent More intense



Increase in some regions

Drought

More frequent

Fire weather

IOCC

INTERGOVERNMENTAL PANEL ON Climate change



Ocean Warming Acidifying Losing oxygen

Photo Credits from left: 1. Luiz Guimaraes 2. Jonathan Ford 3. Peter Burdon 4. Ben Kuo 5. NOAA

Heat waves kill (Ex: 2003 summer in EU: 70000 deaths)





Wallonia Floods, July 2021



Source: VRT Nieuws

Key messages from the latest WGI AR6 IPCC Report:

B. Possible Climate Futures

- B.1 Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in carbon dioxide (CO₂) and other greenhouse gas emissions occur in the coming decades.
- **B.2** Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological droughts in some regions, and proportion of intense tropical cyclones, as well as reductions in Arctic sea ice, snow cover and permafrost.
- **B.3** Continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.
- **B.4** Under scenarios with increasing CO₂ emissions, the ocean and land carbon sinks are projected to be less effective at slowing the accumulation of CO₂ in the atmosphere.
- **B.5** Many changes due to past and future greenhouse gas emissions are irreversible for centuries to millennia, especially changes in the ocean, ice sheets and global sea level.

SIXTH ASSESSMENT REPORT

Working Group I-The Physical Science Basis

INTERGOVERNMENTAL PANEL ON Climate change

ipcc



INTERGOVERNMENTAL PANEL ON Climate change

Ð

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



Changes in global surface temperature for the five illustrative emissions scenarios considered

Near term, 2021-2040 Mid-term, 2041–2060 Long term, 2081–2100 Scenari Best Verv Best Very Best Very estimate likely estimate likely estimate likely 0 (°C) (°C) $(^{\circ}C)$ range range range (°C) (°C) (°C) SSP1-1.5 1.2 to 1.7 1.2 to 2.0 1.4 1.0 to 1.8 1.6 1.9 SSP1-1.5 1.2 to 1.8 1.7 1.3 to 2.2 1.8 1.3 to 2.4 2.6 2.7 2.1 to 3.5 SSP2-1.5 1.2 to 1.8 2.0 1.6 to 2.5 4.5 SSP3-1.5 1.2 to 1.8 2.1 1.7 to 2.6 3.6 2.8 to 4.6 7.0 SSP5-1.6 1.3 to 1.9 2.4 1.9 to 3.0 4.4 3.3 to 5.7 8.5

Table SPM.1



Working Group The Thysical Science Dasis

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



SIXTH ASSESSMENT REPORT

Working Group I-The Physical Science Basis

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

Hot temperature extremes over land 10-year event 50-year event Frequency and increase in intensity of extreme temperature Frequency and increase in intensity of extreme temperature event that occurred once in 10 years on average event that occurred once in 50 years on average in a climate without human influence in a climate without human influence Future global warming levels Future global warming levels 1850-1900 Present 1 °C 2°C 4°C 1850-1900 Present 1 °C 2°C 4°C 1.5 °C 1.5 °C FREQUENCY per 50 years FREQUENCY per 10 years ••• ... will likely will likely Once will likely will likely will likely will likely now likely Once now likely occurs occur occur occur occurs occur occur occur 2.8 times 9.4 times 4.1 times 5.6 times 4.8 times 8.6 times **13.9 times** 39.2 times (8.3 - 9.6) (1.8 - 3.2)(2.8 - 4.7)(3.8 - 6.0)(2.3 - 6.4)(4.3 - 10.7) (6.9 - 16.6)(27.0 - 41.4) INTENSITY increase +6 °C **INTENSITY** increase +6 °C +5 °C +5 °C +4 °C +4 °C. +3 °C +3 °C +2 °C +2 °C +1 °C +1 °C 0°C 0°C +1.2 °C +1.9 °C +2.6 °C +5.1 °C +1.2 °C +2.0 °C +2.7 °C +5.3 °C hotter hotter hotter hotter hotter hotter hotter hotter

Figure SPM.6

INTERGOVERNMENTAL PANEL ON Climate change

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

Figure SPM.5





IPCC AR6 WGI SPM Figure SPM.6



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



SIXTH ASSESSMENT REPORT

Working Group I - The Physical Science Basis

« Sea level rise greater than 15 m

cannot be ruled out with high emissions »



e) Global mean sea level change in 2300 relative to 1900 Sea level rise greater than 15m cannot be ruled out with high emissions

9m

8m

7m

6m

5m

4m

7 m

INTERGOVERNMENTAL PANEL ON Climate change 🛛 🚾 🗤

The proportion of CO₂ emissions taken up by land and ocean carbon sinks is smaller in scenarios with higher cumulative CO₂ emissions

Figure SPM.7



Total cumulative CO_2 emissions taken up by land and oceans (colours) and remaining in the atmosphere (grey) under the five illustrative scenarios from 1850 to 2100

IOCC

Key messages from the latest WGI AR6 IPCC Report:

C. Climate Information for Risk Assessment and Regional Adaptation

- **C.1** Natural drivers and internal variability will modulate human-caused changes, especially at regional scales and in the near term, with little effect on centennial global warming. These modulations are important to consider in planning for the full range of possible changes.
- C.2 With further global warming, every region is projected to increasingly experience concurrent and multiple changes in climatic impact-drivers. Changes in several climatic impact-drivers would be more widespread at 2°C compared to 1.5°C global warming and even more widespread and/or pronounced for higher warming levels.
- **C.3** Low-likelihood outcomes, such as ice sheet collapse, abrupt ocean circulation changes, some compound extreme events and warming substantially larger than the assessed *very likely* range of future warming cannot be ruled out and are part of risk assessment.

Multiple climatic impact-drivers are projected to change in all regions of the world

Figure SPM.9

Number of land & coastal regions (a) and open-ocean regions (b) where each climatic impact-driver (CID) is projected to increase or decrease with high confidence (dark shade) or medium confidence (light shade)



ASSESSED FUTURE CHANGES Changes refer to a 20–30

Changes refer to a 20–30 year period centred around 2050 and/or consistent with 2°C global warming compared to a similar period within 1960-2014 or 1850-1900.

BAR CHART LEGEND

Regions with high confidence increase Regions with medium confidence increase Regions with high confidence decrease Regions with medium confidence decrease

LIGHTER-SHADED 'ENVELOPE' LEGEND

The height of the lighter shaded 'envelope' behind each bar represents the maximum number of regions for which each CID is relevant. The envelope is symmetrical about the x-axis

(**†**)

WMO LINE

CID is relevant. The envelope is symmetrical about the x-axis showing the maximum possible number of relevant regions for CID increase (upper part) or decrease (lower part).

Key messages from the latest WGI AR6 IPCC Report:

D. Limiting Future Climate Change

- D.1 From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO₂ emissions, reaching at least net zero CO₂ emissions, along with strong reductions in other greenhouse gas emissions. Strong, rapid and sustained reductions in CH₄ emissions would also limit the warming effect resulting from declining aerosol pollution and would improve air quality.
- D.2 Scenarios with low or very low greenhouse gas (GHG) emissions (SSP1-1.9 and SSP1-2.6) lead within years to discernible effects on greenhouse gas and aerosol concentrations, and air quality, relative to high and very high GHG emissions scenarios (SSP3-7.0 or SSP5-8.5). Under these contrasting scenarios, discernible differences in trends of global surface temperature would begin to emerge from natural variability within around 20 years, and over longer time periods for many other climatic impact-drivers (*high confidence*).

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE who une

incc

 (\mathbf{f})

Every tonne of CO₂ emissions adds to global warming

Figure SPM.10

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO₂ emissions (GtCO₂)



Emission pathways compatible with below 1.5° C warming:

Global total net CO2 emissions



Non-CO₂ emissions relative to 2010

Emissions of non-CO₂ forcers are also reduced



Source: Wolfgang Knorr, in The Conversation (2019)

2016 Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the intended nationally determined contributions



http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf

Update (July 2021) :Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the nationally determined contributions (NDCs)

Projected range and progression of emission levels



UNFCCC, Aggregate effect of the nationally determined contributions: an update (2021) https://unfccc.int/sites/default/files/resource/cma2021_08_adv_1.pdf

RCP2.6





Humanity has the choice





Conclusions (1/2)

The IPCC AR6 WGI report confirmed that the inhabitability of the Earth is at stake due to climate change

Stabilizing the temperature as close as possible to no more than 1.5°C above the pre-industrial is essential, and requires to move away quickly from fossil fuels, to stop deforestation, and to store more carbon in soils and biomass (while protecting biodiversity)

Conclusions (2/2)

The challenge is huge: transform the world in a few decades so that the whole world activities are decarbonized, while the other Sustainable Development Goals are achieved (eliminating poverty and hunger, providing decent jobs, protecting nature, ...)

Addressing this challenge offers many opportunities, especially if it is made in a synergistic manner (SDG framework)

COP26 will of course be very important

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



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

Plateforme wallonne pour le GIEC

Lettre n°21 - Édition spéciale - Août 2021

6^e rapport d'évaluation du GIEC Changements climatiques 2021 :

Les éléments scientifiques

[Aspects physiques du climat : en anglais The Physical Science Basis]

Aperçu du Résumé pour les décideurs

Après les terribles inondations qui ont frappé la Wallonie et l'Allemagne, et alors que des incendies détruisent des millers d'hectares de farêt dans le Sud de l'Europe, en Sibérie et en Amérique du Nord, il nous a semblé utile de publier cette éditoin spéciale dès la parution du nouveau rapport du GIEC. Elle donne un aperçu du Nésumé pour les décideurs du rapport, sous la forme de ses 14 messages clés. Cet automne, une lettre plus substantielle sera consocrée à ce nouveau rapport de près de 4000 pages, mais vous disposez ainsi déjà de l'essentiel, en françois (la traduction afficielle partitra dans publieurs mois).

Le texte intégral est bien entendu disponible sur le site du GIEC : jocc.ch/ar6. Vous pourrez aussi y expérimenter un des éléments les plus novateurs de ce raport: l'Atlas interactif, qui permet d'obtenir pour chaque région du monde des informations sur l'évolution de nombreux paramètres climatiques au cours du 21° sécle, et ce pour differents sciencios d'émission de gas à élet de serre.

Les autres parties du 6[°] rapport d'évaluation seront toutes publiées en 2022. En février, le GIEC adoptera la deuxième partie du rapport, qui sera consocrée aux impacts des changements climatiques, à la vulnérabilité et aux mesures d'adoptation. En mars, ce sera la troisième, consacrée aux mesures d'atténuation (réductions d'émissions de gaz à effet de serre). Le rapport de synthèse, transversal, sera publié en septembre^{1°}.

Bonne lecture I

Jean-Pascal van Ypersele, Philippe Marbaix, Pénélope Lamarque et Elisabeth Rondiat. "La 17" Lettre donne un aperçu de l'ensemble du rapport, et le plan du rapport de synthèse est disponible sur plateforme-wallonne-giec.be.

> Le rapport et son approbation

Le 6 août 2021, l'assemblée Plénière du GIEC a adopté la première partie du 6' rapport d'évaluation du GIEC (RE6). Cette partie du rapport concerne principalement l'observation du climat, la compréhension des processus qui influencent le climat, l'évaluation des modèles, et les projections pour le futur.

Les délégués des 195 États membres du GIEC ont également approuvé le Résumé pour les décideurs de ce rapport, après l'avoir discuté phrase par phrase pendant une réunion qui s'est tenue du 26 juillet au 6 août. La délégation bélge état placée sous la responsabilité du Priean-Pascal fun Y reservel. por cessus permet aux représentants des gouvernements de demander de reformuler des phrases pour les rendre plus claires et pertinentes selon leuxs rithers, mais une phrase n'est approuvé que moyennant la confirmation de sa validité scientifique par les auteurs du rapport. Les chapitres du rapport détaillé sont entièrement sous la responsabilité des auteurs scientifiques, supervisés par les co-présidents et vice-présidents du groupe de travail concerné (ici de T1) et du GIC.

Trois scientifiques de nationalité belge ont participé à la rédaction de ce rapport du GIEC en tant qu'auteurs principaux d'un chapitre : le Dr Rafiq Hamdi (IRM), le Pr Philippe Huybrechts (VUB), et le Dr. Joeri Roge) (Imperial College London).





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



Gratuit sur www.levif.be/reveil-climatique



CLIMAT : ÉTAT D'URGENCE **POURQUOI IL N'Y A PLUS DE TEMPS À PERDRE**

JEAN-PASCAL VAN YPERSELE - DIRK DRAULANS



Gratis op www.knack.be/klimaatalarm



 \mathbf{T}

Н

JAN

WIS

DATY



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 klimatoloog. 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.





Knack

To go further :

- www.climate.be/vanyp : my slides (under «conferences»)
- www.ipcc.ch : IPCC
- www.skepticalscience.com : answers to the merchants of doubt arguments
- 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)