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Climate Change 2021: The physical science basis

Intergovernmental Panel on Climate Change's Sixth Assessment Report

The Intergovernmental Panel on Climate Change (IPCC) has begun to release its Sixth Assessment Report (AR6) on the drivers and potential impacts of climate change and the ways in which human societies may respond.



Climate Change 2021: The physical science basis (the report) is the key output of IPCC's Working Group I (WGI). It provides a contemporary understanding of the current state of the climate, how it is changing, how it may continue to change over shorter and longer timescales, and the influence of human activity in driving that change. It is the first main report of the AR6 cycle and will be followed during 2021 and 2022 by contributions from Working Group II on impacts, adaptations and vulnerabilities related to climate change and Working Group III on options to mitigate greenhouse gas emissions and climate change.

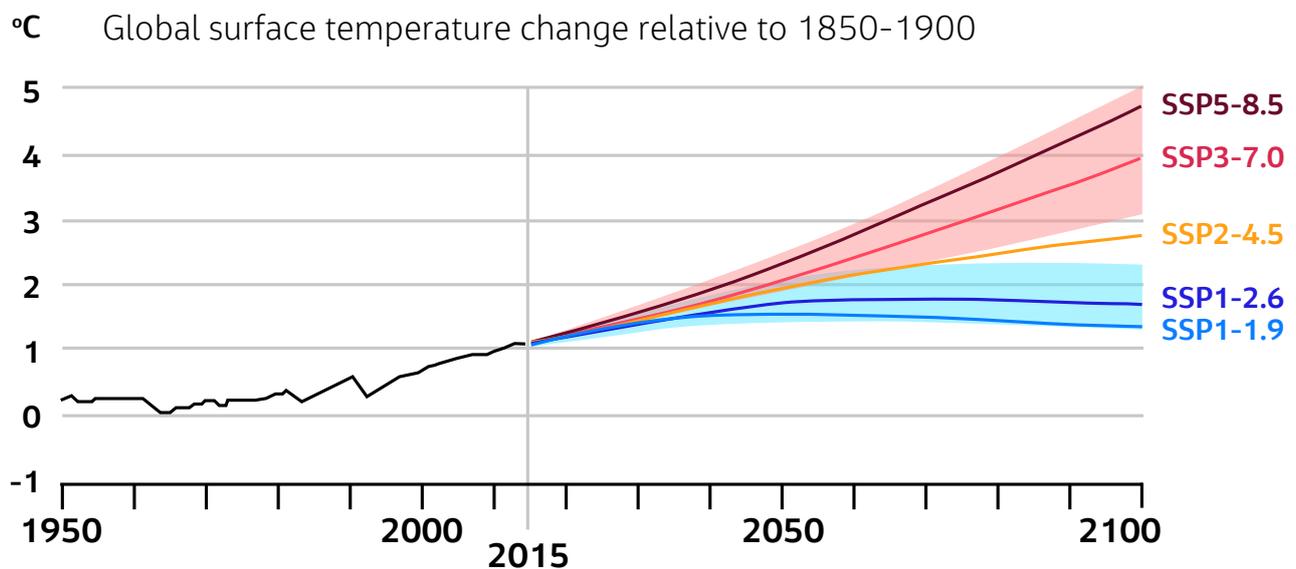
Human influence on the climate system

The report builds on the contributions of WGI to the IPCC's Fifth Assessment Report (AR5), published in 2013 and several IPCC Special Reports published in 2018-19. Its findings are broadly consistent with AR5. Notably, it affirms that the increase of carbon dioxide, methane, and nitrous oxide in the atmosphere over the industrial era is the result of human activities. It concludes that human influence is the principal driver of a global mean surface temperature rise of almost 1.1°C since the start of the industrial era and many other observed changes across the atmosphere, ocean, cryosphere, and biosphere.

The future

Climate modelling is based on five shared socio-economic pathway (SSP) scenarios which describe five alternative trajectories for future greenhouse gas emissions. Two of these scenarios - SSP1-1.9 and SSP1-2.6 - anticipate rapid decarbonization, leading to net removals of greenhouse gases from the atmosphere during the second half of the 21st Century. These contrast with SSP3-7.0 and SSP5-8.5 which anticipate continued growth in emissions until at least until the latter part of this century.

What is clear in the report is that our chance of limiting the increase in global mean temperature to 1.5°C above pre-industrial levels (the more ambitious target of the Paris Agreement by parties to the UN Framework Convention on Climate Change) now appears small. Under all SSP scenarios, the best estimate is that the 1.5°C threshold will be breached some time during the next 20 years. Only under the two most aggressive decarbonization scenarios is it likely that global warming will remain under the 2°C threshold for dangerous human interference in the global climate system. Under the two high emissions growth scenarios, global temperatures could increase by over 4°C above pre-industrial levels by the end of this century.



The projected effects of this warming of the global climate system are far reaching:

- Frequency and intensity of hot extremes and marine heatwaves will increase
- Heavy precipitation events will intensify, with further increases in precipitation in most monsoonal regions and at high latitudes in the northern hemisphere
- Agricultural and ecological droughts will be more severe
- Proportion of intense tropical cyclones will continue to increase
- Reductions in Arctic sea ice, snow cover and permafrost will accelerate.

These climatic changes will be in direct proportion to the extent of global warming and greenhouse gas emissions. The warming itself will be much more rapid in some regions, particularly at high latitudes in the northern hemisphere.

While some changes in the climate system can be reversed if greenhouse gas emissions are reduced at scale across the globe, other changes to oceans, ice sheets, and sea level are effectively locked in. Mountain and polar glaciers will continue melting for decades or centuries. Permafrost thaw appears to be irreversible at centennial timescales. Ice loss from Greenland and Antarctic Ice Sheets will continue, at least over this century.

These combined with continued warming of oceans, mean sea levels will continue to rise for centuries to millennia. This could be by up to 1m by 2100 but sea level increases approaching 2m by 2100 and 5m by 2150 cannot be ruled out (although they are considered unlikely).

The implication of these changes for human society, food production, water resources, and natural systems will be discussed in the forthcoming report of IPCC's WGII.



So, what now?

Limiting human-induced warming to the 1.5°C goal of the Paris agreement requires that cumulative emissions of carbon dioxide are limited quickly and that emissions of carbon dioxide are reduced to at least net zero. Large reductions in emissions of other greenhouse gases are also required.

The WGI report included two important notes on removal of carbon from the atmosphere. The first is that carbon dioxide emissions are more effective at raising temperature than carbon removals from the atmosphere are at lowering it. The second is the carbon dioxide removal methods may have wide-ranging and potentially unintended adverse effects on biogeochemical cycles and climate. The implications of both findings are that urgent emissions reductions, in line with and perhaps even more ambitious than what nations have already committed to under the Paris Agreement, are needed for efficiency and to reduce impacts of human interference in the global climate system.

How can Jacobs help?

The WGI report of the IPCC's AR6 highlights the need for urgent action on two fronts: first, the need for human society and economies to decarbonize rapidly, and second, the need to build increased resilience into all manner of human and natural systems. As a global team of specialists, we can help cities, infrastructure providers, utilities, and communities respond to the challenge posed by greenhouse gas emissions and climate change on both fronts.

Explore the full report here:

<https://www.ipcc.ch/assessment-report/ar6/>

Meet the authors

Craig Clifton

Global Technology Leader, Resilience and Climate Change

Craig.Clifton@jacobs.com

+61 418 381 259

Tapash Das

Senior Technologist, Water Resources and Resilience

Tapash.Das@jacobs.com

+1 858 869 4350

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