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Impacts and Risks of "Realistic" Global Warming Projections for the 21st Century

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Abstract

The IPCC AR6 assessment of the impacts and risks associated with projected climate changes for the 21st century is both alarming and ambiguous. According to computer projections, global surface temperature may warm from 1.3 °C to 8.0 °C by 2100, depending on the global climate model (GCM) and the shared socioeconomic pathway (SSP) scenario used for the simulations. Actual climate-change hazards are estimated to be high and very high if the global surface temperature rises, respectively, more than 2.0 °C and 3.0 °C above pre-industrial levels.

Recent studies, however, showed that a substantial number of CMIP6 GCMs run "too hot" because they appear to be too sensitive to radiative forcing, and that the high/extreme emission scenarios SSP3-7.0 and SSP5-8.5 are to be rejected because judged to be unlikely and highly unlikely, respectively. Yet, the IPCC AR6 mostly focused on such alarmistic scenarios for risk assessments.

This paper examines the impacts and risks of "realistic" climate change projections for the 21st century generated by assessing the theoretical models and integrating them with the existing empirical knowledge on global warming and the various natural cycles of climate change that have been recorded by a variety of scientists and historians. This is achieved by combining the SSP2-4.5 scenario (which is the most likely SSP according to the current policies reported by the International Energy Agency) and empirically optimized climate modelling.

According to recent research, the GCM macro-ensemble that best hindcast the global surface warming observed from 1980 to 1990 to 2012–2022 should be made up of models that are characterized by a low equilibrium climate sensitivity (ECS) (1.5 °C < ECS ≤ 3.0 °C), in contrast to the IPCC AR6 likely and very likely ECS ranges at 2.5–4.0 °C and 2.0–5.0 °C, respectively. I show that the low-ECS macro-GCM with the SSP2-4.5 scenario projects a global surface temperature warming of 1.68–3.09 °C by 2080–2100 instead of 1.98–3.82 °C obtained with the GCMs with ECS in the 2.5–4.0 °C range.

However, if the global surface temperature records are affected by significant non-climatic warm biases — as suggested by satellite-based lower troposphere temperature records and current studies on urban heat island effects — the same climate simulations should be scaled down by about 30%, resulting in a warming of about 1.18–2.16 °C by 2080–2100. Furthermore, similar moderate warming estimates (1.15–2.52 °C) are also projected by alternative empirically derived models that aim to recreate the decadal-to-millennial natural climatic oscillations, which the GCMs do not reproduce.

The proposed methodologies aim to simulate hypothetical models supposed to optimally hindcast the actual available data. The obtained climate projections show that the expected global surface warming for the 21st-century will likely be mild, that is, no more than 2.5–3.0 °C and, on average, likely below the 2.0 °C threshold. This should allow for the mitigation and management of the most dangerous climate-change related hazards through appropriate low-cost adaptation policies. In conclusion, enforcing expensive decarbonization and net-zero emission scenarios, such as SSP1-2.6, is not required because the Paris Agreement temperature target of keeping global warming < 2 °C throughout the 21st century should be compatible also with moderate and pragmatic shared socioeconomic pathways such as the SSP2-4.5.

Keywords: Impact of global warming projections; risks of global warming projections

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1. Introduction

My presentation is essentially based on Scafetta (2024) whose abstract is reproduced above. Additional relevant material can be found in Scafetta (2023). Both works are open access. Details can be found there and in the references therein. In the following, I will give a general summary of the presentation and of its relevance for policy makers.

2. Summary of presentation

The European Union continues to pursue the goal of achieving "carbon neutrality", also known as "net zero by 2050". In other words, the aim is to achieve a balance between the climate-changing emissions emitted by EU Member States and the amount of greenhouse gases removed from the atmosphere through their reabsorption by oceans and forests and through the use of some specific technologies. To achieve the target, current greenhouse gas emissions (mainly CO_2 and methane) must be reduced as much and as quickly as possible. The key is to replace energy produced from fossil fuels with energy produced from renewable sources such as geothermal, hydro, solar and wind power, and to replace combustion vehicles with electric vehicles. However, the Green Deal will come at a huge cost to the EU, which is in danger of de-industrialising and impoverishing itself, so policymakers need to carefully assess the wisdom and feasibility of the whole project.

Achieving "net zero" carbon emissions is thought to be essential to prevent global temperatures from rising more than 1.5 °C above pre-industrial levels by mid-century and around 2.0 °C by the end of the century. "Pre-industrial" is defined as the reference period from 1850 to 1900. The aim is to mitigate and slow down climate change sufficiently to prevent potential environmental disasters and to give human societies time to adapt to inevitable future climate changes.

Even if the physical science underlying such claims is correctly understood, the goal in question appears to be ideologically driven and unattainable. This is due to the fact that the 27 EU countries contribute only 6.67 percent of global emissions (official EU data from: https://edgar.jrc.ec.europa.eu/report_2023), and that global emissions continue to increase at a rate of more than 1 percent per year despite decreasing emissions in Europe. Indeed, as evidenced by data from the Global Coal Plant Tracker (https://globalenergymonitor.org/projects/global-coal-plant-tracker/tracker/), hundreds of coal-fired power plants are currently under construction in Asia, particularly in China and India.

In any case, at least in theoretical terms, Scafetta (2024) argued that current climate science does not justify the necessity of the EU's "Green Deal". There is considerable uncertainty surrounding the scientific issues regarding climate change attribution and forecast, and recent scientific studies lead to more cautious conclusions for the following reasons:

1) The alarmist climate projections for the 21st century are based exclusively on simulations conducted using computer climate models (referred to as CMIP6 GCMs); these are the global climate models (GCMs) employed by the IPCC. These models posit that anthropogenic emissions are the sole factor responsible for global warming during the 20th century. However, due to the lack of contemporary climate data obtained in the absence of anthropogenic emissions, this GCM prediction is not empirically testable. For example, some empirical studies have attributed a significant role to solar activity and natural climate cycles on long time scales, which the GCMs fail to account for.

2) The limitations of the GCMs are well documented and readily apparent when one considers the discrepancies between the various CMIP6 GCMs with respect to the value of the most crucial climate parameter for evaluating the climate impact of greenhouse climate-altering emissions (such as CO_2). This parameter, known as "equilibrium climate sensitivity", is the subject of considerable debate within the scientific community. This parameter is defined as the global climate warming induced at equilibrium by the doubling of atmospheric CO_2 concentration from 280 ppm (pre-1850 levels) to 560 ppm. The current atmospheric concentration of CO_2 is approximately 430 parts per million (ppm). Indeed, the various models yield a range of equilibrium climate sensitivities, from 1.8 °C (which is not an alarming figure) to approximately 6 °C (which is a cause for significant concern). Therefore, the uncertainty is considerable, and the precise sensitivity of the Earth's climate to radiative forcing remains unknown, making it challenging to predict future climate changes and, therefore, to assess climate change hazards. Additionally, several empirical studies indicate that the true climate sensitivity may lie between 1 and 2 °C, which is relatively low and not alarming.

3) Additionally, studies have indicated that non-climatic factors, such as urban warming, which increased in conjunction with global urbanisation throughout the 20th century, may have exerted a partial influence on the global land surface temperatures utilised for estimating global warming. It can therefore be surmised that the actual global warming since 1900 may be lower than the official value of approximately 1.1-1.2 °C. This is evidenced by climate data collected via satellites from 1980 to the present, which demonstrates that global warming since 1980 is approximately 30 % lower than that obtained from ground-measured data.

4) Finally, in order to assess the potential risks associated with future climate change, it is essential to determine realistic Shared Socioeconomic Pathways (SSPs). These are projected socioeconomic global changes that are used to deduce the future amount of greenhouse emission and, therefore, of the climatic forcing functions needed by the GCMs s to calculate future climate change scenarios, which are then used for hazard's assessments. A number of SSPs exist, ranging from SSP1, which is compatible with the EU's "net zero by 2050" policies, to SSP5, which is the most alarming because assumes an economic development based entirely on fossil fuels. Climate simulations based on SSP3, SSP4 and, in particular, SSP5 are frequently employed to substantiate the notion of climate alarmism. Nevertheless, numerous

studies have indicated that only the SSP2, which represents a moderate pathway, can be perceived as a realistic representation of future socioeconomic development. Consequently, any realistic hazard assessment of future climate changes should be based on climate change simulations assuming SSP2-like pathways.

In light of the aforementioned findings, it is imperative to recognise that the notion of "climate alarmism" is predicated on a foundation of hypothetical climate projections derived from reductionist and theoretical climate models that are not only inconsistent with one another but also in contradiction with a substantial body of empirical evidence. For example, they fail to reproduce the Medieval Warm Period and overestimate the global warming observed in the troposphere since 1980. Conversely, empirical studies, while acknowledging the existence of global warming partially induced by human climate-altering emissions, also indicate that the natural complexity of climate and its change is currently poorly understood and not reproducible with the aforementioned models. When considered collectively, this empirical evidence indicates that the global climate models trusted by the IPCC and currently used to assess the risk of future climate changes significantly overestimate the climate impact of anthropogenic emissions.

It can therefore be posited that future warming will be more gradual and moderate than is currently predicted by these climate models. Figure 1 compares my main produced and realistic climate change simulation for the 21st century with its relative risk assessments. The figure shows that the global temperature will likely remain below 2 °C by 2100 also following the SSP2 moderate scenario.

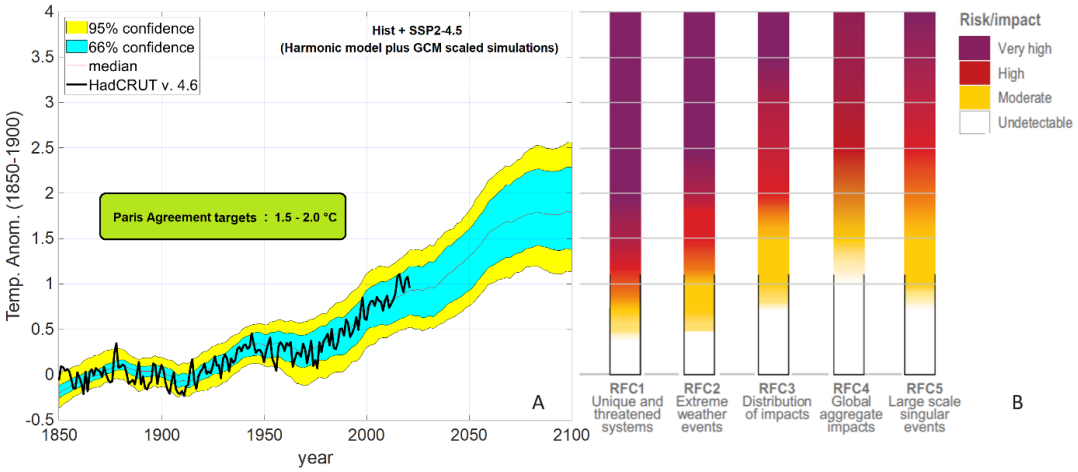

Figure 1: The harmonic empirical global 1635 climate model with the SSP2-4.5 scenario, against the HadCRUT4.6 record (1850–2021). (B) Burning ember diagrams (in function of the global temperature warming) of the main five global reason for concern (RFC) assuming low to no adaptation reported by the IPCC AR6.

The overall results are illustrated in Figure 2 (overleaf), which compares the warming ranges projected for 2080-2100 in the IPCC Sixth Assessment Report on climate change (2021) with the relative risk, with the simulation produced by the author based on the most realistic outcomes, taking into account all the uncertainty associated with climate change and using the realistic SSP2 anthropogenic forcings.

3. Conclusion

Contrary to what is today publicly claimed, it is likely that by 2100, global climate temperature will remain below 2.0 °C compared to the 1850-1900 period, even in the absence of "net zero by 2050" policies. Therefore, the latest scientific results do not appear to justify the energy transition policies proposed in the EU's "Green Deal". Instead, multiple evidences seem to support more moderate and feasible solutions, which include climate adaptation or environmental policies compatible with economic growth. Thus, the Paris climatic targets can be easily achieved without inducing excessive economical stress in the societies.

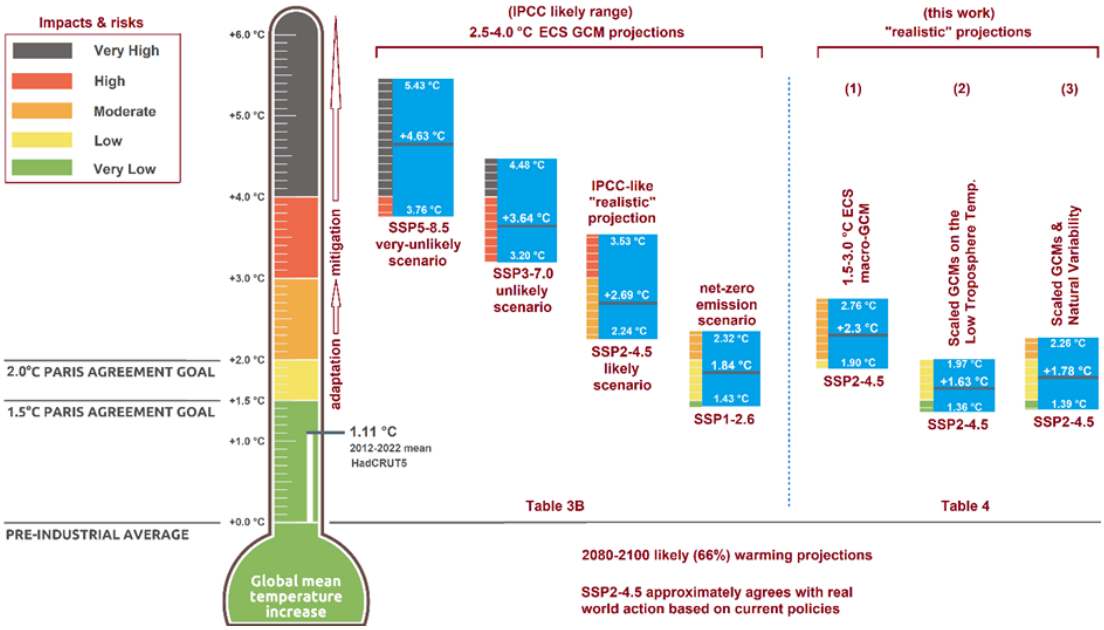

Figure 2. Summary and comparison of the impacts and risks of global warming projections for the 2080–2100 period herein obtained (Tables 3B and 4) versus the climate "thermometer" proposed by the Climate Action Tracker (Text on previous page.)

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