

Earth's Future

COMMENTARY

10.1029/2022EF002876

Key Points:

- The focus of the IPCC has shifted to lower temperatures, beginning with assessment report 5
- Only 14 % of the temperature mentions in assessment report 6 are above 2°C, in contrast to our current trajectory in which temperatures above 2°C seem likely

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Citation:

Jehn, F. U., Kemp, L., Ilin, E., Funk, C., Wang, J. R., & Breuer, L. (2022). Focus of the IPCC assessment reports has shifted to lower temperatures. *Earth's Future*, 10, e2022EF002876. <https://doi.org/10.1029/2022EF002876>

Received 23 APR 2022

Accepted 2 MAY 2022

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Focus of the IPCC Assessment Reports Has Shifted to Lower Temperatures

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Abstract We focus on how different global temperature increases represented in IPCC reports have shifted over time. While the first four assessment reports had a roughly equal focus on temperatures above and below 2°C, the more recent fifth and sixth assessment reports have a considerably stronger focus on warming below 2°C. This is concerning as warming above 2°C is more likely given current emissions trajectories and is more influential on climate risk assessments.

1. Introduction

In an earlier study, we showed that the coverage of the IPCC reports (2013–2019) disproportionately focused on lower temperatures of 1.5–2.0°C above pre-industrial levels (Jehn et al., 2021). This suggests a skew in the literature that others also have observed (Lynas, 2020; Wagner & Weitzman, 2015; Wallace-Wells, 2019). This concentration on lower temperature ranges fits the goals of the 2015 Paris Agreement. However, it does not reflect the most likely trajectories, and misses the importance of knowing the effects of higher temperature for risk assessments. Higher levels of warming have non-linear impacts (Schellnhuber et al., 2016) and significantly influence the costs (Quiggin, 2018), risks (Dietz, 2011), and modeling of climate change (Weitzman, 2009). Welfare estimates strongly depend on low-probability, high-impact risks, which are heightened under higher temperature scenarios (Dietz, 2011). Knowledge of extreme impacts from higher-end warming is also vital for risk management under uncertainty, such as through the use of the minimax principle (ranking options by their plausible worst-case) (Kunreuther et al., 2013).

How has the coverage of different temperature ranges varied over time in IPCC reports, and do the reports of Working Group I, II and III of the Sixth Assessment Report (AR6) continue the previously observed bias? To assess this we text-mine all available IPCC reports that have been published up until 11 April 2022. By counting the mentions of different levels of warming, we examine how the research focus summarized in the IPCC reports has shifted from the first assessment report until today. This is an imperfect but useful proxy for surveying the spread of the broader literature.

2. Materials and Methods

We extracted the text from all IPCC special, supplementary, synthesis, and working group reports that have been published until 11 April 2022 (this includes the report of working group III for AR6). All reports have been published in Portable Document Format. We used the hierarchical VISual LAYout model (Shen et al., 2022) for a structured content extraction of the PDFs. The text was then mined for the mentions of the temperatures in the format ' X°C'. This includes temperature mentions from figures and figure captions. Reports mentioning 10 or fewer temperatures overall were excluded from further analysis. This analysis was repeated for all mentions for reasons for concern.

The approximate true positive rate was determined by looking at a random sample of 60 mentions per temperature. 60 mentions was decided on as a sufficient sample since manually checking all 11,000 mentions was unfeasible, and this size produced consistent results. Those mentions were checked if they were referring to a change

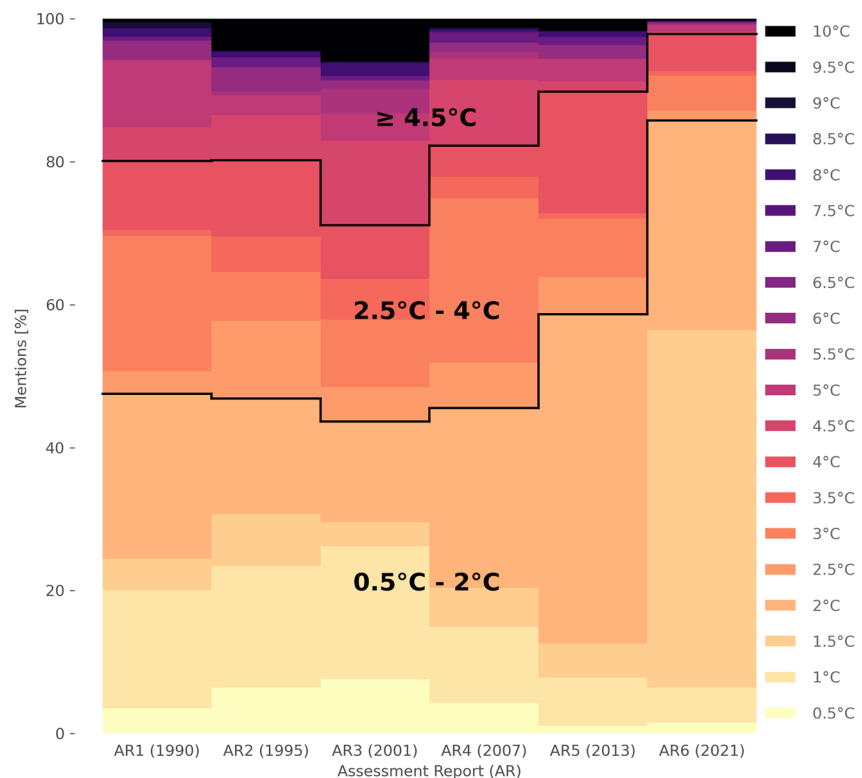


Figure 1. Occurrences of temperatures mentioned in the IPCC assessment reports over time. Includes all working group reports, special reports, and synthesis reports published until 11 April 2022 with more than 10 temperature mentions overall.

in global mean air temperature or something different. Therefore, mentions of for example, climate sensitivity or local temperature changes were counted as false positives.

3. Results and Discussion

Our results show that the focus of the literature, as summarized by the IPCC, has shifted considerably over time (Figure 1). The first four assessment reports had a similar coverage of different temperatures. Over this time there was even a small amount of increased coverage of temperatures above 4°C, this trend reversed with the fifth assessment report. The fifth assessment report had a strong shift toward covering 2°C. There was significantly less coverage of temperatures above 4°C. This pattern continued in the sixth assessment report, which has an even stronger emphasis on 1.5 and 2°C. Cover of higher temperatures above 4°C declined further still. Synthesis reports tend to have the most balanced representation of temperatures compared to other IPCC reports (special, supplementary, and working groups). The shift in AR6 to lower temperatures is partly caused by the Special Report on Global Warming of 1.5°C. However, even if we would remove it from our analysis, the mentions of 1.5°C in AR6 would only drop from 49% to 45%. The reports of working group I, II and III also have a strong focus on 1.5°C.

In the past assessment reports, the working group I reports have usually contained the strongest focus on higher temperatures, as they mainly compare impacts from RCP2.6 and RCP8.5 scenarios. This pattern continues in AR6, where the report of working group I has a stronger focus on higher temperatures than the reports of working group II and III.

Other areas in the IPCC display no such trends? The five reasons for concern (Zommers et al., 2020) do not show such a change over time. However, risk levels for every single one of the reasons for concern at a given temperature have generally increased with each assessment (Zommers et al., 2020). All of the reasons for concern have a high or very high risk at 2–3°C, yet we increasingly focus on lower temperatures.

The trends also appear unlikely to be explained by changes in emissions trajectories. The current trajectory puts the world on track for a temperature rise between 2.1 and 3.9°C by 2100 (Liu & Raftery, 2021). Median estimates assuming full implementation of existing climate policies stand at 2.5–2.9°C and for pledges 2.4°C (for 2030 targets) by 2100 (Climate Action Tracker, 2021). Temperatures might still get higher, due to tipping points (Lenton et al., 2019) and carbon cycle feedbacks (Hausfather, 2021). Hence, even fairly optimistic trajectories incur warming above the range that the literature appears focused on. The worst-case emissions pathway of RCP8.5 (now SSP5-8.5) now seems unlikely due to increased policy action and the associated falling costs of renewable energy (Hausfather & Peters, 2020). However, the IPCC does not attach probabilities to scenarios, and the historical variability in emissions makes a range of global scenarios plausible (Pedersen et al., 2020). Moreover, carbon cycle feedbacks and climate sensitivity can lead to SSP5-8.5 level temperatures being reached with lower anthropogenic emissions.

Similarly, equilibrium climate sensitivity (the amount of warming caused by a doubling of CO₂ concentrations once the climate system has come to equilibrium) does not appear to explain the trend. In AR6, the IPCC reported a narrowed “very likely” ECS range (90%–100% likelihood) of 2–5°C. This is down from 1 to 6°C in AR5. While the recent narrowing of climate sensitivity makes higher temperatures unlikely, it also rules out a high likelihood of ending up at 2°C or lower (Sherwood et al., 2020). Indeed, a climate sensitivity of 1.5°C has also been ruled out, while there is only medium confidence of sensitivity being below 5°C. High-end warming seems less likely, but the probability of lower-end warming is even lower. Hence, changes to climate sensitivity do not match the increased focus on the low-temperature rise over time. Our results also show variation between the different kinds of reports (special, supplementary, synthesis, working group). We find that synthesis reports are usually those with the most balanced representation of temperatures, which might imply that policymakers are better informed by the IPCC as one might think after studying Figure 1.

The shorter-term measurement of transient climate sensitivity (TCR) is a more compelling explanatory factor. The likely range for TCR has narrowed from 1.1–3.1°C in AR1 to 1.4–2.2°C in AR6. Yet this seems unlikely to account for the full extent of the observed pattern, and does not explain the shift toward lower temperature scenarios since it is a narrowing of a range, not just a loss of high-end sensitivity. Moreover, it seems unlikely (and imprudent) that the wider literature is only focused on shorter-term temperature changes.

One partial explanation could be a shift toward mid-21st century timeframes after the 2015 Paris Agreement on Climate Change. This would lead to more mentions of lower temperatures. However, if we count the years mentioned in the assessment report the pattern is that AR4, 5 and 6 show a relatively similar distribution. They only differ in their mentions of the years 2000, 2010 and 2020. The main shift happened from AR3 to AR4. Therefore, it is not a compelling explanation for the pattern detected in our analysis of the temperature mentioned.

Our analysis is based on all temperature mentions found in the IPCC. However, higher temperatures are often referring not to changes in global mean air temperature, but to other phenomena like local air temperature change or possible values for ECS. This means the approximate true positive rate of temperature mentions relating to a change in global mean air temperature decreases with rising temperatures. Temperatures $\leq 4^\circ\text{C}$ have approximate true positive rates of around 70%–90%, while temperatures $>4^\circ\text{C}$ have an approximate true positive rate of 10%–40%. Therefore, there is an even larger gap when it comes to our understanding of higher temperatures than previously assumed. Especially, as those true positive temperatures $>4^\circ\text{C}$ often refer to past changes in global mean temperature and not to modeling results.

4. Conclusions

Overall, our results show that the scientific literature covered in the IPCC has increasingly shifted to 1.5 and 2°C. This is likely due to the goals of the Paris Agreement, as all reports published after 2015 skew heavily toward 1.5 and 2°C. This is understandable when it comes to scientific incentives, but not from the perspective of probability and risk assessment. Recent updates on climate sensitivity and emission trajectories are, in some regards, more optimistic than past assessments, but not optimistic enough to justify ignoring higher-end warming scenarios. There is still a gap in climate research, and we are still “betting on the best case.” We need to shift our gaze further up the global thermostat.

Data Availability Statement

All code, data (including the raw strings of the IPCC reports), and supplementary figures can be found in the repository of this paper (Jehn, 2022). Direct link: <https://github.com/florianjehn/IPCC-Reports-Focus-Overview>, last access: 23 April 2022.

Acknowledgments

L. Breuer and C. Funk acknowledge support from the SDG Nexus Network (Grant No. 57526248) funded by the German Academic Exchange Service (DAAD) from funds of Federal Ministry for Economic Cooperation (BMZ) in the frame of the program "exceed—Hochschulexzellenz in der Entwicklungszusammenarbeit." L. Kemp acknowledges funding from the Templeton World Charity Foundation.

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