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Climate science as foundation for global climate negotiations

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Abstract

One of the successes of COP26 (the 26th Conference of the Parties) was the prominence of climate science and its implications. Science was written into the Glasgow Climate Pact, recognizing 'the importance of the best available science for effective climate action and policy making'. This paper discusses the reasons for COP26's success and reflects on subsequent events at COP27. The continued importance of science in global climate negotiations throughout this critical decade for climate is clear.

1. How the profile of science was raised in the lead-up to and at COP26

A priority for the UK COP26 (the 26th Conference of the Parties) Presidency was to 'keep 1.5 °C alive' and to focus on a stronger commitment to the lower end of the Paris Agreement long term temperature goal, moving the emphasis from '*well below 2 °C above pre-industrial levels*' to the more ambitious '*pursuing efforts to limit the temperature increase to 1.5 °C*'. As stated by Alok Sharma, President for COP26, the outcomes were 'driven by the latest science'.

Five factors helped to bring science to the forefront of the COP26 climate negotiations and surrounding conversations in Glasgow.

The first was the release of the first of three IPCC (Intergovernmental Panel on Climate Change) Working Group reports in the IPCC's sixth assessment cycle. The IPCC Working Group I 'Climate Report' [1] on the physical science basis of climate change—the first major assessment since the Paris Agreement—was published in August 2021.

The IPCC Climate Report provides the latest assessment of current global warming and its consequences including, for the first time, the attribution of extreme events to human influence. It also assesses future climate change, including a more accurate estimate of how the climate responds to human influence, the consequences of every increment of global warming, and how slow changes like future sea level rise are committed to depending on greenhouse gas emissions. The role of climate feedbacks and short-lived climate pollutants are also included in the assessment of how emissions reductions can limit future climate change. One third of the report focuses on the regional climate information that is relevant for adaptation and risk assessment.

The science assessed by the IPCC Climate Report is becoming ever more pertinent as the effects of climate change become increasingly apparent and climate conversations permeate an increasingly broad policy arena. It is also becoming increasingly accessible. For example, the report includes an Interactive Atlas that allows the information underpinning the report to be explored over space and time. This resource has had over half a million users in practically all countries of the world since it was released.

Second was the critical timing of the IPCC Climate Report's release ahead of COP26 in August 2021, despite the challenges presented by the COVID-19 pandemic. By the middle of 2021, the world had already

experienced a series of devastating extreme weather events [2], including wildfires [3], heatwaves [4–6] and flooding [7] (some examples are given in the footnotes), some of which were entirely unprecedented in severity. The IPCC Climate Report was thus released at a time when public attention was already focused on the severe consequences of climate change. It also provided a very stark and clear message that human activities are causing and will continue to exacerbate extreme events. The UN Secretary-General called the report a 'code red for humanity' [8] and the IPCC's clear explanation meant that the science could simply not be ignored by politicians, whilst civil society was also demanding action.

Third, the COP26 programme gave heavy prominence to science to ensure critical findings were visible, accessible and understandable to delegates. Events included dedicated science sessions over the first four days of the conference, with a range of international scientific organizations presenting their evidence to Parties (the signatories of the United Nations Framework on Climate Change or UNFCCC). Of these, the IPCC had the most airtime. On 4 November during a Subsidiary Body for Scientific and Technological Advice SBSTA IPCC special event [9], evidence from the IPCC Climate Report was presented to Party delegates and discussed with IPCC authors. Parties were informed of the severity of the consequences of climate change the world faces today and into the future, especially from extreme weather. They heard from the IPCC that global surface temperature will continue to increase, and that global warming levels of 1.5 °C and 2 °C will be exceeded unless there are deep reductions in CO_2 and other greenhouse gas emissions in the coming years and decades. Furthermore, they learned that reaching at least net zero CO_2 emissions can stabilize global warming and prevent many consequences, including extremes, from getting worse.

Both IPCC and United Nations Environment programme (UNEP) gap report authors also provided evidence to the Structured Expert Dialogue (SED) of the Second Periodic Review of the Long-term Global Goal of the UNFCCC, which met over the second and third days of COP26. The Periodic Review is a process that aims to ensure that the long-term global goal is adequate for meeting the ultimate objective of the Convention in light of the most up to date evidence on climate change, and reviews overall progress towards it. The SED provides a space for discussions between Parties and with experts on the latest scientific knowledge and evidence base to inform climate policy formulations during the negotiations, and ensures the scientific integrity of the Periodic Review.

International organisations were also invited to present updates on Earth observation of the climate system and climate change, including for the implementation of the Paris Agreement, at the Earth Information Day on 3 November.

IPCC authors took a range of questions from delegates during all of these sessions. These included queries on future climate, such as how the latest climate projections compare to previous assessments, how scenarios are used, what low likelihood outcomes of future climate change might look like, and how uncertainties in the near-term, including due to climate variability, are addressed. There were also requests for more information on Earth system feedbacks and climate sensitivity. Specific issues were also raised on topics from our current understanding of how ice sheets may be affected by global warming and risks of future sea level rise, to what future changes are expected in storms and cyclones. There were also questions related to current and future emissions such as how remaining carbon budgets are calculated, the role of CO_2, methane and other non-CO_2 emissions in raising global temperatures, and how reaching net zero CO_2 emissions was assessed as part of modelling exercises. Delegates noticeably sought information on where knowledge had progressed, particularly on understanding the consequences of 1.5 °C global warming since publication of the Special Report on Global Warming of 1.5 °C, how regional observations and literature were used in the assessment, and where there were gaps in the data.

The fourth factor is that independent science advice and synthesis products of the latest policy-relevant information are increasingly being sought at a national scale. As a result, national climate advisory committees, or technical bodies, have already been established in over 30 countries around the world. These councils and committees are an effective means to bring science advances much closer to the policy agenda in their home countries. To support this, a new International Climate Council Network was launched on the first day of COP26 at an event hosted by the UK Presidency. The aims are to incentivize other countries to coordinate scientific advice, and to encourage continued development of best practices to support evidence-based decision making on adaptation and mitigation, as well as the assessment of climate action at national and sub-national scales. A joint statement was issued by the newly formed network to urge the success of negotiations at COP26—'we wish for the messages of the IPCC to guide the strengthening of NDCs and for science-based policy advice to spread across the world'.

Fifth, science is now mainstreamed in the media and civil society discourse like never before. The release of the IPCC Climate Report on 9 August 2021 received an unprecedented level of attention in the world media compared to past IPCC reports. Media coverage of the report was recorded in 195 countries and in 72 languages.

Meanwhile, the scientific community, non-governmental organisations and civil society used the science to hold the ambition of the negotiations and country pledges to account, and keep scientific analyses in the spotlight. Civil society movements such as Fridays for Future have used climate science as the basis of their call for urgent action, in particular since the release of the IPCC Special Report on Global Warming of 1.5 °C, strengthening this again after the IPCC Climate Report release. In addition, for the first time during a COP, over 200 climate scientists published a letter as negotiations were underway to 'urge parties at COP26 to fully acknowledge the latest and most comprehensive assessment of climate change science' and 'stress that immediate, strong, rapid, sustained and large-scale actions are necessary'.

2. How the science reached negotiations

Turning to the climate negotiations themselves, what scientific evidence was used and how did it reach the actual negotiations taking place largely behind closed doors? Science does not enter the UNFCCC negotiation process by accident or only during the two intense COP weeks. The preamble to the 1992 UNFCCC convention itself recognized that climate action will be most effective if new scientific findings are considered. The UNFCCC therefore established the Subsidiary Body for Scientific and Technological Advice (SBST to provide scientific and technical advice. Regular processes within the UNFCCC ensure a continuous dialogue between science and policy.

However, science (and IPCC findings in particular) might not have been so prominent in the COP26 decisions without the broad support of civil society, and the leadership by Parties and the COP26 Presidency itself. The COP26 Presidency championed the IPCC, and science was identified as a cornerstone of COP26 ambitions from the very beginning. This priority is evidenced, for example, in speeches by Alok Sharma preceding the publication of the IPCC Climate Report highlighting the vital role of science. The COP26 Presidency also ensured that, during preparatory meetings leading up to COP26, a space was available for the discussion of the latest science and its implications for climate action. During these meetings many Parties were very emphatic that they wanted to see a COP26 outcome that was fully in line with the scientific evidence of what it would take to 'keep 1.5 °C alive'. This support gave the COP26 Presidency a strong mandate to ensure the scientific evidence featured centrally in the COP26 outcome, and to push for the strongest ambition.

COP26 was also the first key milestone for the climate negotiations since the Paris Agreement at COP21 in 2015. Its focus on science was significant, not least because reaching agreement on how to reflect the scientific evidence, or even to acknowledge it, in the UNFCCC has been fraught with difficulties in the past. The most recent high-profile example is the disagreement between Parties on how to recognize the IPCC's SR1.5 [10] in the UNFCCC following its publication in 2018, with Parties unable to agree on whether to 'welcome' the report and its findings or to simply 'note' them—one of the lowest levels of acknowledgment in UN decision text.

COP26 firmly '*welcome[d]*' the latest report and paragraphs in the decision texts [11] can be traced directly to the scientific evidence, as assessed by the IPCC and summarized in figure 1 below.

The Glasgow Climate Pact [12] includes specific decisions on science and urgency, adaptation, loss and damage and mitigation. It '*expresses alarm and utmost concern* that human activities have caused around 1.1 °C of warming to date, that impacts are already being felt in every region, and that carbon budgets consistent with achieving the Paris Agreement temperature goal are now small and being rapidly depleted' and '*recognises* that the impacts of climate change will be much lower at the temperature increase of 1.5 °C compared with 2 °C', and '*resolves* to pursue efforts to limit the temperature increase to 1.5 °C' [13]. It goes on to note with serious concern that 'climate and weather extremes and their adverse impacts on people and nature will continue to increase with every additional increment of rising temperatures' [14]. It '*recognizes* that limiting global warming to 1.5 °C requires rapid, deep and sustained reductions in global greenhouse gas emissions, including reducing global carbon dioxide emissions by 45% by 2030 relative to the 2010 level and to net zero around mid-century, as well as deep reductions in other greenhouse gasses' [15].

The final text for Research and Systematic Observations from COP26 focuses on the science and data needs of the UNFCCC and its Parties, and explicitly recognizes 'the dedication of the IPCC experts in continuing their work during the coronavirus disease 2019 pandemic'. It also requests strengthened 'support for sustained systematic observations of the climate system for monitoring changes in the atmosphere, ocean and cryosphere, and on land, including by improving the density of observations in areas of poor coverage, developing and providing long-term data sets and facilitating free and open access to data' and 'improving the performance, development and application of regional and subregional climate models and other downscaling methods in order to improve understanding of local climate-related risks and inform regional, national and local decision making, including in developing countries with high mountain areas, particularly

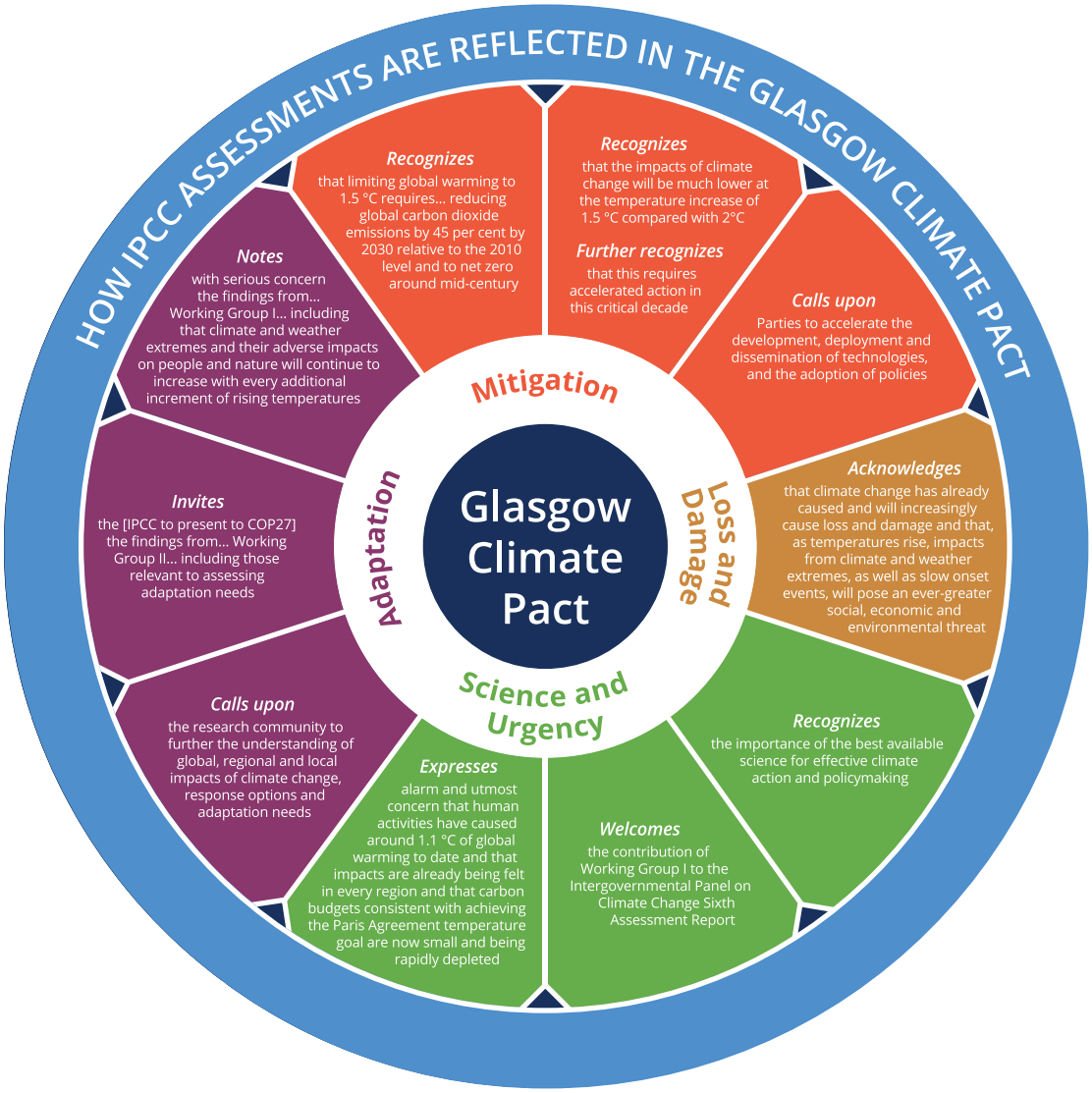

Figure 1. A graphical representation of how IPCC assessments are reflected in the Glasgow Climate Pact.

the Least Developed Countries and Small Island Developing States'. The text includes a more explicit reference to science needs of the Least Developed Countries and Small Island Developing States than before, the need to build capacity in these regions, recognition that indigenous and local knowledge has a role, and also the importance of the research community and user communities working together to ensure users have the kind of information and tools they need.

One of the most important outcomes of COP26 was meanwhile an agreed transparency framework. This is the method by which countries report and track progress towards NDCs, including their greenhouse gas emissions following methods documented in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and its 2019 Refinement. This will help to ensure that collective progress towards limiting temperature rise can be monitored more effectively, and encourage further action and ambition where it is needed.

These evidence-led statements across the Glasgow Climate Pact are a strong reflection of climate science feeding into policy via the IPCC process. The science also helped frame other aspects of the negotiations. For example, the US–China declaration starts with the IPCC evidence, highlighting that both countries are 'alarmed by reports including the [IPCC Climate Report]… and further recognize the seriousness and urgency of the climate crisis'.

Another key outcome of the COP26 negotiations was a strengthened ratchet mechanism, through which countries' pledges would be reassessed at COP27, brought forwards from 2025. This was an opportunity for heightened scrutiny by the scientific community, alongside the stated intention of the UK Presidency to 'follow through' on the achievements made at COP26 for the coming year to COP27.

3. From COP26 to COP27

Climate financing, adaptation and Loss and Damage were priorities of the Egyptian presidency for COP27. The publication of the Working Group II [16] and Working Group III [17] reports of the IPCC sixth assessment during 2022 were highly anticipated and crucial aspects of the evidence base for this next round of climate negotiations, informing discussions on the Presidency's priorities as well as on future pathways to limit climate change.

At the start of the summit, the IPCC Chair reiterated the support of the climate science community for the negotiations, highlighting the evidence set out in the Sixth Assessment Reports and stressing the urgent need for action if the world is to avoid the most dangerous climate impacts. Throughout the summit, the IPCC presented findings of the reports including the assessment of mitigation scenarios, sectoral findings, sustainable development, adaptation; and gender-related aspects of climate change. During Earth Information Day, IPCC authors provided contributions on how Earth observations can enhance understanding of the climate system and support adaptation to extreme events plus the development of early warning systems. A High-Level Ministerial Roundtable on pre-2030 Ambition at COP27 also provided insights from the IPCC on cost-effective mitigation options and their potential to close the implementation gap.

The final COP27 outcome, the Sharm-El-Sheikh Implementation Plan, *reaffirms* the Paris Agreement temperature goal; *reiterates* that the impacts of climate change will be much lower at the temperature increase of 1.5 °C compared with 2 °C; and *resolves* to pursue further efforts to limit the temperature increase to 1.5 °C. It also makes several other references to science and urgency: for example, it *welcomes* the contributions of the IPCC Working Group II and III reports; *recognizes* the importance of the best available science for effective climate action and policymaking; and *takes note of* the 2022 UNEP adaptation gap and emissions gap reports, alongside those of the World Meteorological Organization on the state of the climate. Crucially, it *notes with grave concern*, according to the Working Group II and III reports, the growing gravity, scope and frequency of loss and damage associated with the adverse effects of climate change. However, the outcomes of COP27 failed to include new targets or strengthened commitments in line with the 1.5 °C ambition.

4. Climate science and policy going forwards

The science of climate change is at the forefront of political and public discourse like never before and IPCC assessment reports are directly informing UNFCCC global climate negotiations. The science is clear and there is no knowledge deficit for action. Work should continue to make climate science and IPCC reports ever more useful and relevant going forward. Significant progress in understanding and resolving climate system physics, chemistry and biogeochemical processes can be expected, as well as a more comprehensive exploration of the uncertainties of the climate response to human activities. Interdisciplinary approaches on emerging risks that couple the climate system to human and natural systems, across intergenerational and climate timescales, in terms of where we live, as well as for the climate system as a whole will also help prepare adequately for a future resilient to the changes we have already committed to and those that we might still avoid. Improved and more accessible data in data-poor and vulnerable regions is a further priority.

The future for how climate science contributes to policy lies in its ability to answer policy-relevant questions: what risks do we face in the future and what do they mean at different levels (regional, national, local, individual); how do we manage these risks and impacts through mitigation and adaptation; what are the options for resilient solutions that provide multiple desirable benefits; and how do we implement these solutions ensuring a just transition locally and globally. These will require even further integration of the physical and other sciences. In coming years, climate science will continue to work alongside practitioners and decision-makers in the development of policy options, building on the Paris Agreement and the Glasgow Climate Pact not least through increased engagement at future COPs, but also with regular engagement throughout and alongside COP cycles.

Data availability statement

No new data were created or analysed in this study.

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