**COP26 was a success for climate science, we need to build from this**

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Science has been written into the Glasgow Climate Pact. Four factors helped bring science to the fore: 1) the August 2021 publication of the Intergovernmental Panel on Climate Change (IPCC) Working Group One report; 2) the focus on science within the COP26 programme; 3) targeted synthetic independent advice from a range of national bodies; 4) main streaming of climate science stories by the media. We should capitalize on this success to make our science even more useful going forward.

A priority for the UK COP26 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 have been "driven by the latest science".

## How science raised its profile at COP26

Four factors helped bring science to the forefront of the climate negotiations.

Firstly, the timely publication of the first of three IPCC Working Group reports in the IPCC's sixth assessment cycle, despite the challenges faced because of the COVID-19 pandemic. The IPCC Working Group I "Climate Report" [1] on the physical science basis of climate change - the first major climate science 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 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 included in the assessment of how emissions reductions can limit future climate change. A third of the report is on the assessment of regional climate information that is relevant for adaptation and risk assessment.

[1] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. *In press.*

The science assessed by the IPCC Climate Report is becoming ever more relevant for policy makers and users around the world as the effects of climate change become increasingly apparent, permeating an increasingly broad policy arena. It is also becoming increasingly accessible. For example, the report includes an Interactive Atlas, which allows the information underpinning the report to be explored over space and time, and has been used by over half a million users in practically all countries of the world since it was released this summer.

Secondly, science featured prominently in the COP26 programme, including 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, UNFCCC). Of these, the IPCC had the most air time, including an SBSTA-IPCC special event on the 4th November where evidence from the IPCC Climate Report was presented to Party delegates, including a question and answer session with IPCC authors. Key messages included the severity of the consequences of climate change we face today and into the future, especially from extreme weather. The IPCC also highlighted that global surface temperature will continue to increase in the coming decades, and global warming levels of 1.5°C and 2°C will be exceeded unless there are deep reductions in CO2 and other greenhouse gas emissions in the coming years and decades. Reaching at least net zero CO2 emissions can stabilise global warming and prevent many consequences, including extremes, from getting worse.

Both IPCC and 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 questions from delegates during all of these sessions. The questions ranged from broader 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.

Thirdly, 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 incentivise 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."

Fourthly, science is now mainstreamed in the media and civil society discourse like never before. The release of the IPCC Climate Report this summer on the 9th of 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. 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.

Throughout the COP, 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. 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".

### How the science influenced negotiations

Turning to the climate negotiations themselves, how does this scientific evidence feed into the actual negotiations taking place largely behind closed doors?

COP26 has been the first key milestone for the climate negotiations since the Paris Agreement, originally planned five years since COP21. The scientific evidence has not always been welcomed by all delegates at past COPs. The most recent high-profile example is the disagreement between Parties on how to recognise the IPCC's SR1.5 and its findings in the UNFCCC following its publication in 2018, with Parties unable to agree on whether to "welcome" its findings or to "note" them. Delegates can debate for days on the exact wording of text used in COP decisions: even though the nuances are lost on most observers, they in fact carry real meaning in the final versions of the text.

This time, COP26 firmly "*welcomes*" the latest report and decision texts[2] can be traced directly to the scientific evidence, as assessed by the IPCC, as summarized in Figure 1. The Glasgow Climate Pact 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 global warming to date and that impacts are already being felt in every region" 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".[3] 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".[4] It "r*ecognizes* 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 per cent by 2030 relative to the 2010 level and to net zero around mid-century, as well as deep reductions in other greenhouse gases".[5]

[2]Decisions in Glasgow fall under the three UN climate treaties: the United Nations Framework Convention on Climate Change (the COP), the Kyoto Protocol (the CMP), and the Paris Agreement (the CMA). The Glasgow Climate Pact encompasses the decisions under all three.

[3]IPCC Climate Report Summary for Policymakers headline statements B2, C2, and Figures SPM.5, SPM.6 and SPM.9.

[4]IPCC Special Report on Global Warming of 1.5°C Summary for Policymakers headlines B1-B6 and Figure SPM.2.

[5]IPCC Special Report on Global Warming of 1.5°C Summary for Policymakers headline C1.


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

The final text for Research and Systematic Observations focuses on the science and data needs of the UNFCCC and its Parties, and explicitly recognises "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 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 has meanwhile been 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 also 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 negotiations has been a strengthened ratchet mechanism, through which countries' pledges will be reassessed next year at COP27, brought forwards from 2025. This is 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. Looking forwards, adaptation and resilience will be a priority of the Egyptian presidency for COP27. The publication of the second and third parts, and the synthesis of the IPCC sixth assessment in 2022 will be highly anticipated evidence for the next round of climate negotiations on climate adaptation, Loss and Damage, finance and future pathways to limit climate change.

The science of climate change is at the forefront of political and public discourse like never before. We should capitalize on this success and work hard to make our science and IPCC reports even more useful and relevant going forward. We expect significant progress in understanding and resolving climate system physics, chemistry and biogeochemical processes, a more comprehensive exploration of the uncertainties of the climate response to human activities, and

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. Improved and more accessible data in data-poor and vulnerable regions is a priority. The future for how climate science contributes to policy lies in answering 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 solution options, and how do we implement these solutions (balancing benefits and trade-offs). These will require even further integration of the physical sciences with the 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.