

The future is collaborative

The way in which climate change research funds are managed is shifting dramatically toward investments in large collaborative research networks. This poses significant challenges for researchers, and requires changes from the institutions and funders that support them.

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In January 2019, the United Kingdom Research and Innovation's Global Challenges Research Fund announced \$262 million in funding for 12 Global Research Hubs over five years, involving some 400 partner organisations and covering 85 countries¹. This is just the tip of the iceberg; fundamental changes in climate change research are afoot.

Our analysis of publicly available data (for example, <https://iatistandard.org> and <https://devtracker.dfid.gov.uk>) suggests that, in the past ten years alone, Canada, the United Kingdom and the Netherlands have invested at least 300 million dollars in a specific type of climate change research: large research collaborations that span countries, continents and disciplines. When we factor in knowledge brokering projects, this figure reaches half a billion dollars over the same time period.

These forms of investments fundamentally change the way that research is practiced, who has a place at global research tables, how researchers perceive their role in society, and how they understand their relationships with one another.

The move toward collaboration

The past few decades have witnessed profound changes in the research landscape in all fields. High-impact research has become increasingly dependent on team work^{2,3}, and self-organising social networks of researchers have become a key feature of the research system as a whole⁴.

These changes are particularly evident in the climate change research community, where some specific pressures are at play. The shift toward collaborative research models in this field has been hastened by the wide-spread recognition that action, and therefore research, is needed at multiple scales⁵, and an associated appreciation that effective climate responses require transdisciplinary perspectives, despite the inherent challenges in working across disciplines and knowledge domains^{6,7}.

These have not been the only pressures at play. Research funders face mounting pressure to demonstrate the societal



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value and impact of the research that they support, even while resources become more limited. These pressures have been felt particularly acutely in climate change research, where the urgency of the issues, the accelerating rate of change at which societal impacts are being experienced, and significant public attention have led to a near whole-sale shift toward applied science, and a recognition that scientists must engage in messy and complex processes of policy development⁸. Grants are therefore shifting to coordinated networks of research partners, rather than individual projects, as efforts mount to minimise the administrative burden on funders while responding to the imperative of collaborative and transdisciplinary research.

However there is another trend, and it might be the game-changer. In the field of climate change, researchers from the global South are key to successful research. There are some obvious but often understated

reasons for this. The Intergovernmental Panel on Climate Change (IPCC)'s recent Global Warming of 1.5° (ref. ⁹) report made clear that urgent investments are required to support adaptation in the global South. At the same time, drastic reforms of our food systems are needed in order to remain within planetary boundaries, with implications for agriculture and livestock practices in the global South¹⁰. What this means is that while we might currently see self-selecting elite research networks emerging around the world⁴, those with strong South–North and South–South partnerships are likely to be more successful at achieving impact and securing funding going forward.

Challenges ahead

This new environment poses significant challenges for researchers, host institutions and funders alike. Securing access to research funds will require a significant

culture change for researchers, and therefore the institutions that house them. An individual's ability to forge and maintain social networks is likely to be more important than individual competitiveness, and the measures used to ascertain career advancement and success must shift to accommodate this. For example, academic publications that are co-authored with researchers from different contexts and disciplines should be recognised as evidence of strength, rather than weakness, by research organisations.

To remain relevant, researchers must forge relationships and pursue novel partnerships, sometimes across the global South and North, and sometimes with actors outside of the traditional academic arena altogether. The latter becomes especially important when the goal is to contribute toward changes in policy and practice. To do this successfully, researchers need to pay attention to historical and contemporary power imbalances. No research partnerships are free of history. In some cases, it is important that Northern researchers follow rather than lead in South–North partnerships, and many South–South partnerships are beset by similar tensions linked to historical asymmetries in research investment across the global South. As collaborations develop between researchers and civil society organisations, the politics of whose knowledge is valid, also requires careful attention. Power asymmetries, even just perceived asymmetries, have a major impact on project outcomes in collaborative projects. Such asymmetries can pivot on culture, gender, citizenship and other factors in ways that homogeneous research teams may have never considered in the past. Researchers will therefore need the social skills necessary to participate in culturally, linguistically and contextually diverse teams¹¹, and the ability to lead such teams is likely to impact on career trajectories. This is not business as usual, and university curricula must change to adequately prepare researchers for the type of careers ahead of them.

Funders also need to change and take on new responsibilities. We face a real risk that smaller universities, particularly in the global South, will be over-looked and under-funded in this new environment. Entire countries, for example those affected by conflict and unable to ensure the stability required for long-term large research collaborations, may be forgotten altogether. Larger research grants come with a higher level of scrutiny, potentially leading to the consolidation of funds in a limited number of trusted and large institutions that can meet the more demanding financial, project management and reporting requirements.

Research funders must be forthright in their efforts to include a variety of actors in leadership roles in collaborative projects.

Opportunities for success

If well designed, large consortia can act as 'protected environments' that address some of these challenges, allowing smaller organizations and younger researchers to grow, and new research teams to emerge. Consortia can, for example, offer significant opportunities for network building because of the variety of partners involved, and such network building can be particularly critical for early career researchers and individuals and organisations from the global South. If an explicit focus on learning is integrated into their design, exposing participants to the processes of synthesis and collaborative sense making, then consortia offer opportunities for enhancing both technical research skills and the softer social skills required in collaborative research. Importantly, consortia-type research programs should not be confused with large authorship teams². When diverse teams are brought together through consortia, and opportunities for learning and synthesis are created, then these kinds of programs tend to create ideal conditions for small research communities to find one another, explore common interests and create new collaborations that outlive the consortium itself¹².

One such example where South–South–North partnerships have produced evidence of collaboration, Southern leadership and impact, is the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAS). In this program, more than 40 organisations and 450 researchers across 17 countries worked to support resilience to climate change in Africa and South Asia¹². Ninety-six per cent of the 106 peer-reviewed papers produced were collaboratively written. Of these, 56% of co-authors resided in different countries, and 47% of the papers were led by southern scholars. Significant investment in learning and trust-building allowed for fresh partnerships that supported collaboration beyond research, and included civil society organisations. The size of the collaboration offered the opportunity to ask systemic cross-scale research questions and allowed the research teams to pursue policy impact at the most appropriate scales. For example, research teams were able to explore climate-linked migration from multiple spatial and temporal scales, from in-depth life histories that were compared across several countries¹³, to systematic surveys covering some 7,500 households across three deltas in Bangladesh, India and Ghana^{14–16}. Research results such as this, that cover a breadth of

geographical regions, as well as the depth of lived experiences, have made it possible for research teams to engage policy dialogues from local levels all the way to the Global Compact on Migration¹⁷.

Conclusion

This new era of climate change research features transdisciplinary networks of researchers and practitioners, and even a blurring of the lines between these identities. Going forward, strong Southern research leadership must be supported, and intentional efforts made to engage smaller institutions to avoid over-investment in a limited number of better-known organisations.

Even as funders externalize the costs of managing research funds through larger grants, they will need to take on new responsibilities. Funders must commit to an investment in learning on a suite of issues that this collaborative turn creates. While a shift to larger networks transfers costs onto grant recipients, the ultimate success of such grants requires research leaders with new sets of collaborative skills. Researchers need support with how to pursue policy impact at multiple scales and deal with, often invisible, power asymmetries between partners, and with how to lead, manage and participate in diverse and geographically dispersed teams. Post-graduate programs do not teach these skills, as a rule, and so today's graduates are often ill-equipped to successfully participate in the climate change research arena — this needs to change.

Looking ahead, the most effective researchers are likely to be those who embrace diversity in team composition and structure, and that look beyond their disciplines, their home institutions and their national borders to build their research networks. Research funders have a responsibility to ensure that all researchers can do this, and host institutions must recognise effective collaborative behaviour among researchers as an indicator of career success. □

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Published online: 25 March 2019
<https://doi.org/10.1038/s41558-019-0447-3>

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Model-based assessments for long-term climate strategies

Many countries are formulating a long-term climate strategy to be submitted to the United Nations Framework Convention on Climate Change by 2020. Model-based, multi-disciplinary assessments can be a key ingredient for informing policy makers and engaging stakeholders in this process.

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To limit global warming, countries around the world are working towards the implementation of international climate policy following the rulebook established during the twenty-fourth Conference of the Parties (COP24) in Katowice, Poland in December 2018. At the same time, governments are formulating a long-term vision, due by the end of 2020 and in line with Article 4.19 of the Paris Agreement, to answer the second question of the Talanoa Dialogue: Where do we want to go? Together with the Nationally Determined Contributions (NDCs), these long-term strategies will be instrumental in mapping out the road to limit global temperature increase to well below 2°C and to pursue efforts to keep warming below 1.5°C.

To date, 11 Parties have formally submitted their long-term strategies to the United Nations Framework Convention on Climate Change (UNFCCC). Ahead of COP24, the European Commission (EC) proposed a strategic long-term vision for greenhouse gas reduction¹. This proposal is an important step in a process towards developing a long-term strategy for climate policy in the European Union (EU). Like some of the long-term strategies that have already been submitted, the in-depth analysis that complements the EC proposal² has a strong quantitative basis and relies extensively on multidisciplinary modelling. Here, we offer insights into the type of model-based assessments that were used in the context of the proposal by the EC. What we present here may be relevant for many countries that are expected to come forward with a long-term strategy over the course of 2019 and 2020.

From long-term targets to a roadmap

In drafting climate policy plans, governments face the challenge of translating the long-term Paris Agreement temperature targets into pathways that can be implemented from today onwards, and that deliver on the required ambition. The Paris Agreement has set the destination, but there are many possible pathways to get there; Fig. 1a shows multiple scenarios in line with 2°C and 1.5°C up to the year 2100. The NDCs, with time horizons up to 2025 or 2030, could serve as an intermediate checkpoint, but ambition levels will need to increase to reach the agreed long-term targets on a global level^{3,4}. Long-term pathways can inform near-term climate policy on the need for speed and ambition by 2030 and beyond. Supporting this process with modelling covering all greenhouse gases and sectors enables a translation of long-term objectives into roadmaps for emission reductions⁵. Figure 1b illustrates — for three scenarios in line with 2°C and two scenarios consistent with 1.5°C, corresponding to the bold lines in Fig. 1a — how emission pathways can be disaggregated into intermediate five-year (sectoral) milestones.

Developing a ‘glocal’ perspective

A second challenge for policymakers is to convert global temperature targets into local greenhouse gas emission targets. Global model results can help narrow down the scenario space for national analyses, and can foster a dialogue that enhances capacity and transfers knowledge between the global and the local level. Furthermore, global models with national detail can provide a consistent check to validate under which

conditions a global scenario can match a particular country-specific emissions profile. Importantly, relevant assessments should be tailored to the local context, taking into account national, institutional and sectoral characteristics.

The EC proposal uses EU-focused models analysing emission reductions of 80%, relative to 1990 levels, and up to climate neutrality by 2050, consistent with EU pathways in global 2°C and 1.5°C scenarios, respectively. To capture EU-specific energy, land use, agricultural and economic aspects, an integrated modelling toolbox that covers all sectors and greenhouse gases provides a quantitative background for the EC proposal (Fig. 2).

Conversely, because climate change is a problem on a planetary scale, bottom-up feedback — from the national to global level — should be given careful consideration, too. Aggregating the NDCs reveals insufficient reduction of greenhouse gases on the global scale³, indicating an ambition gap. The long-term strategies provide an opportunity to close that gap with the pathways presented by the International Panel on Climate Change (IPCC)⁸, while failing to do so by mid-century would result in major challenges in the second half of the century. Models can be useful tools to support planned periodic stocktaking exercises, both for revised NDCs and long-term strategies.

Getting a grip on uncertainties

When considering a time period that spans several decades, uncertainties abound. Thinking ahead without a formalized framework is a daunting task, but putting forward quantified scenarios can guide the thought process by making (the