

Melbourne, Wednesday, 9 of April 2025

Subject: Strategic Examination of Research and Development

Dear SERD Panel,

The Australian Research Council Centre of Excellence for the Weather of the 21st Century welcomes the opportunity to contribute to the Strategic Examination of Research and Development.

We wholeheartedly agree with the need to assess the state of the national research and development landscape. Our Centre's goal is to understand and predict the changes in our weather linked to climate change. Building on that understanding, we seek to prepare our communities and economy for these changes. This ambition connects us to virtually all sectors of government and business. In this submission, we use climate change research to highlight issues in the R&D system in Australia, which we believe to be pervasive in other fields.

Our main challenge is the lack of national strategy in critical areas that deeply affect climate research and its translation. In particular, climate model development and high-performance computing and data are poorly served and not aligned with strategic research supporting societal needs. We elaborate on all these points in our detailed responses below.

We look forward to contributing to further consultation stages in the review process and are happy to answer any additional questions you may have about our submission. Please feel free to reach out for further clarification or information.

Professor Christian Jakob

Director, ARC Centre of Excellence for the Weather of the 21st Century

The **ARC Centre of Excellence for the Weather of the 21st Century** is a consortium of world-leading climate and weather researchers based across five Australian universities, together with major domestic and international partner organisations, including the Bureau of Meteorology and CSIRO.

21st Century Weather aims to address these challenges by answering a vital question: **How will Australia's weather transform as our climate changes?**

We will advance our understanding of atmospheric circulation and weather systems, and develop ultra-high-resolution climate models to enhance our understanding of Australia's weather and climate.

The foundational knowledge we create will enable policymakers, industry and communities to make better decisions, harness weather resources and help us prepare for high-impact weather.

Climate change will affect all aspects of our lives and we are approaching a crisis point in our ability to provide Australians with the best possible research and information.

Our climate is changing. We are already experiencing this change as a change in the weather. Human actions transforming our entire economy will determine the severity of these changes. Consequently, businesses, governments and communities need to plan ahead, not only to adapt to already inevitable changes but also to implement the actions required to transition to a net-zero economy as efficiently as possible.

Our future economy will be more weather-dependent than our current one, as we source most of our electricity from the weather. No sector of life is unaffected by climate change—finance, health, agriculture and water, to name a few. Our ability to anticipate and deal with emergencies, to plan for an ageing population, regional security, immigration and border control, and all our future critically depends on climate research and its deep integration with decision-making.

Planning ahead requires information about the weather in a future climate. This information is produced by climate models and brought to those who need it through widely accessible collaborative computing and data systems. The data availability of future climate is largely taken for granted, but underpinning it are:

- Fundamental climate research to identify and understand key processes in the climate system, from the circulation of the atmosphere and ocean to the melting of ice sheets and its effects on sea level.
- The translation of knowledge into millions of lines of computer code that represent the physical laws of the climate system for the entire globe.
- The implementation of this computer code on world-class, high-performance computing and data (HPCD) systems.
- The execution of a complex set of model simulations that consider different scenarios for the future economic development of our planet.
- The interpretation and delivery of the simulation results to decision-makers in business, government and communities.

We are in severe danger of losing our sovereign capability to provide Australians with the underpinning research, data and information to make good decisions about our future.

- Our climate modelling capability, including the research underpinning it, is dwindling at an alarming rate. Importing systems from overseas with little to no investment in sovereign capability has replaced it.
- The lack of strategic thought connecting the pieces limits the translation of existing research to actionable information. It leads to slow, wasteful and dispersed processes funded ad-hoc instead of the deep integration of research with operational service delivery.
- Our high-performance computing and data infrastructure is lagging behind the rest of the world without a national strategy to uplift it.

Climate research lacks a national strategy and our sovereign capabilities are dwindling fast.

At the foundation of all climate decision-making lies climate science. Without it, the functions it supports will collapse. Yet, there is no national strategy for climate research in Australia. This gap was recently highlighted in "[A Decadal Plan for Australian Earth System Science 2024–2033](#)" by the Australian Academy of Science. We fully support their observation that while Australia's Earth system science is talented, it is fragmented, operates under often competing priorities and increasingly focuses on short-term outcomes.

At the heart of the problem are the relatively low overall investment in research in Australia, the false assumption that the science is done, and, perhaps most importantly, the disparate funding model applied in Australia. Climate science and its application to societal decision-making are funded by three Federal Government departments supporting different parts of the sector. The Department of Education funds the academic sector and some of the key underpinning computing infrastructure. The Department of Industry, Science and Resources funds climate research in CSIRO, and the Department of Climate Change, Energy, the Environment, and Water funds climate research in the Bureau of Meteorology and the National Environmental Science Program. The coordination between these departmental funding streams is ineffective, and, as a result, research is fragmented and often competitive instead of collaborative.

Further, other government departments for which climate research is essential, like Treasury, Health, Defence, Foreign Affairs and Trade, are unaware of how the information they need is produced but expect it will be available. Australia would benefit from a strategic funding scheme that incentivises collaborative research between Publicly Funded Research Agencies (PFRAs) and the University sector.

Recommendation: Develop an all-of-government approach to deliver a national strategy for long-term climate research to support climate-related decision-making in Australia.

There is no strategy to connect climate research with delivering optimal climate information to decision-makers.

Climate research plays a significant role in providing actionable information to decision-makers in all sectors of the economy and community. Yet, it cannot provide this information by itself. Translating research outcomes into actionable information is a complex task and often requires highly customised methods that vary from sector to sector and even business to business.

The Australian Government has reacted to this challenge by establishing the Australian Climate Service. This new investment is an important step in translating research into service and is most welcome. However, implementing short-term outcomes overrode a strategic approach that fully integrates research, operational data production and the use of this data by an outward-facing service entity. In short, climate research produces systems, like observations and models, to assess past and future climate change. A climate service requires data from such systems to serve its customers. However, the lack of clear roles and responsibilities to produce the data strains the research and service communities. It negatively impacts all involved, most of all the decision-makers who urgently require information.

Recommendation: Develop a high-level, all-of-government strategy to fund, execute and integrate foundational research into a national climate information system.

Our high-performance computing has fallen well behind world standards, with serious consequences to research and the delivery of best-practice climate change information.

There is no national strategy for high-performance computing and data (HPCD) in Australia that aims to foster a fundamentally collaborative computing and data environment. This lack of strategy affects all research areas and their downstream applications to critical societal issues, such as climate change, energy, water, food, environment and regional security. With the rise of machine learning and artificial intelligence in an ever-increasing number of fields, Australia's situation is worsening rapidly.

All the information about the future of our climate used by Australian governments, businesses and communities results from complex climate

models executed and stored on large HPCD systems. Yet, Australia's key HPCD facility, the National Computational Infrastructure, lacks secure and funded maintenance, upgrades, and plans beyond 2025, relying solely on ad-hoc solutions. This uncertainty has lasted for the last two decades, during which individual, bespoke cases for replacement have been made each time existing HPCD infrastructure reaches its end of life after five to six years.

The current technology boom means that leaving the planning and funding of Australia's peak facilities to the end of their lives is no longer a viable way to have a competitive HPCD infrastructure. Further, the investment in high-performance computing infrastructure for research via the National Collaborative Research Infrastructure Strategy is inadequate to meet the evolving research and societal national and international demands for cutting-edge HPCD facilities in the coming decades.

Again, the answer lies in a national, all-of-government, long-term strategic approach, as highlighted in the Australian Academy of Sciences report on "[The Future Computing Needs of the Australian Science Sector](#)". Given the scale of the problem, this approach must consider private-public partnerships, international collaboration and co-funding. Australia is uniquely placed to provide a renewable-powered, world-class, HPCD system for the Indo-Pacific.

Recommendation: Urgently uplift Australia's high-performance computing and data (HPCD) for research capability to world standards, potentially in partnership with our neighbours and private industry as appropriate.

The lack of national strategy and integration is symptomatic of broader issues in the system.

In a time when our planet is undergoing major concurrent transformations in the geopolitical, social, and environmental realms, having the best possible information for decision-makers is vital. Yet, the lack of nationally coordinated approaches to climate research, high-performance computing, and the integration of research and translation means we are on the brink of losing the ability to provide high-quality information to those who need it. The main causes are entrenched processes that prohibit the collaboration of all involved to have an all-of-government and all-of-community approach. Instead, budgets are split across departments and distributed to individual institutions, which then compete for fractions of what is needed with little to no incentive to collaborate. The results are inefficiencies and the ultimate loss of key sovereign capability to address our greatest challenges.