



**National Environmental Science
Program
Earth Systems and Climate Change Hub
science and services:
Assessment of current capability and
future directions**

SUMMARY REPORT

Mr Paul Holper, Dr Simon Torok,
Mr Kevin Hennessy and Dr Greg Ayers

January 2018

Summary

This assessment is designed to inform further development of the National Environmental Science Program (NESP) Earth System and Climate Change (ESCC) Hub's long-term strategy related to delivery of Earth Systems and Climate Change science and services for Australia. It examines current research and outreach capability and future directions, with an emphasis on how the Hub's key partners can best respond to target stakeholder gaps, needs and associated national priorities.

Much ESCC Hub science is underpinned by international research; advances in climate change science and services underpin Hub work and thinking, as does Australian government policy on climate change.

The Australian Government has developed and published a set of nine national science and research priorities that it will use to guide a proportion of its research investment to areas of critical need and national importance. One of the priorities is to 'Build Australia's capacity to respond to environmental change and integrate research outcomes from biological, physical, social and economic systems'. The National Environmental Science Program (NESP) is strongly aligned with this priority.

A recent evaluation of the Australian Climate Change Science Program identified some impediments to impact that provide pertinent warnings for the NESP ESCC Hub, including: limited funding through short funding cycles; limited focus on end-users and stakeholder engagement; lack of public profile; and climate science understanding and climate risks not adequately informing funding decisions.

In 2016, the Australian Academy of Science reviewed climate science capability to identify how well Australia's climate science sector is positioned to meet current and future demands for weather and climate knowledge. The review concluded that Australia's climate research capability needs to be significantly larger than it is at present.

Tailored information in the form of customised climate products and services can be used to mitigate the effects of climate change and extreme weather events. The Hub plays a role in this area and there is potential to do much more.

The assessment includes opinions and recommendations from dozens of stakeholders, including researchers, users of climate change science and services and representatives from the Department of the Environment and Energy.

Interview responses

1. *Current level of climate change science capability*

Respondents overwhelmingly agreed that the current level of climate change science capability in Australia is not appropriate for the task of monitoring, analysing and responding to climate change. Many respondents said the climate change research community needs to move from a research-focus to greater applications at the user level. There is a need to downscale data to the regional and local levels that decision makers need: rather than more global climate modelling, Australia needs more regional modelling to clarify impacts of climate change on areas such as cities, agriculture, water, biodiversity, oceans, and Antarctica, otherwise responses to climate change will not be optimal.

2. *Strengths, weaknesses, opportunities and threats*

Strengths: strong science reputation, bringing together CSIRO, BoM and universities

Weaknesses: perceived lack of coherence, coordination, or an overall strategy; lack of funds; A science-driven agenda that lacks engagement with States, Territories and end users; lack of communication of science in a way that is accessible to non-academics

Opportunities: turning climate data into an 'arms race' where organisations having a commercial advantage by accessing climate change data; Hub leadership of conferences and workshops to identify synergies between industry, government and research

Threats: inability to support sufficient staff; lack of political action to address climate change, and difficulty make climate change relevant to parts of the economy; international reputational damage done by the government and CSIRO

3. The main requirements now and in future from climate change science and services

There was a range of climate change requirements and use raised, especially for projections, as well as ongoing monitoring of change, specific areas (such as sea-level data), and advice.

4. Are current NESP ESCC Hub strategies and programs heading in the right direction?

Respondents noted the importance of communication, outreach and knowledge brokering. Noted new or specific areas of science as a priority included downscaling and risk assessment, the interplay between climate change and climate variability, decadal modelling, the impact of climate change on extremes (fire, drought, etc.) and water, research on carbon, and oceans.

5. How could the NESP ESCC Hub science and services be delivered in a way that is more effective and efficient?

Nearly every respondent to this question raised two key areas that would improve delivery: (1) the need for the Hub to be part of (or lead) a national strategy of collaboration across climate research agencies, and (2) the need for the Hub to improve its communication.

6. How can the ESCC Hub improve the 'path-to-impact'?

Respondents again raised communication and coordination as crucial; many pointed to the need to improve the program design process

The research and extensive interviews lead to the following ten findings:

1. The foundation of any national or international policies and actions in response to climate change must be built on the best possible science.
2. The science must be better coordinated and appropriately funded across all Australian (and international) science providers, with priorities guided by a clear understanding of user needs.
3. Efficient and effective uptake of climate change information and services in Australia requires a step-change enhancement in the strategy, processes and organisation of climate change science and service delivery.
4. There is a need for more communication to ensure science is integrated with decision making, and more communication and translation of research for practical use, as well as more knowledge brokering and Indigenous engagement.
5. There is a need for long-term strategy coupled with long-term funding cycles cemented into long-term partnerships with users.
6. The historical quality of Australia's climate change science community represents a strength to be built on; however, this strength is at risk if staffing remains depleted.
7. There has been a generational shift with senior scientists already ending or near to ending their careers, coinciding with a reduction overall in funding support, leading to capacity difficulties.
8. The reality of climate change is generating increasing needs for evidence-based and science-based assessments of climate change risk and the science-based services needed for optimal response.
9. An improved effort and endeavour involving each of the academic community, the government funded institutions, governments industry and commerce – in fact all end-users – is required to ensure that

balance can be both achieved and optimised in the national interest. The Hub is the appropriate fulcrum nationally for establishment of that balance.

10. For maximum impact and for creation of ‘ambassadors’, the science-based knowledge and services need to be delivered by Hub to a very ‘granular’ level, to small sectors of the economy and even down to the enterprise level where very specific business needs exist.

The Hub does excellent work, and will benefit from increased communication and stakeholder engagement. Provision of tailored information and services to clients, especially downscaled climate change information connected to impacts, represents a fertile area for the future. Additionally, the Hub is well placed to help in much needed coordination of the national climate change science effort. A helpful first step would be enhanced communication that identifies who is doing what and, by implication, the opportunities for improved efficiencies.

Increased communication, outreach and end-user engagement along with greater coordination work require resourcing. To properly implement these activities for the benefit of the Hub and the nation, the Hub will need to allocate additional funds for staffing, travel and materials.

In the climate change science services area, the Hub can identify and focus on a discrete number of products and build trust with clients to get these adopted, paving the pathways to impact. There are myriad sources of evidence that more funding is needed in Australia for the entire pipeline from climate change science through to service delivery and action.

The Hub communicates well, but needs to do more – to help with national decision making, application of research for practical use and the realisation by funders that the Hub represents a genuine *investment* for the nation.

Analysis and findings in detail

A number of themes are evident in the strategic science directions of each of the numerous national (and international) agencies, entities or programs identified in the landscape reviews. These themes are almost completely congruent and consistent between the climate change science providers and climate service-users (community, business and policy-makers), and are equally clearly reflected in the stakeholder feedback sought and received for this assessment (Appendices E and F). These themes are elaborated below.

The narrative expressed by the themes identified in the information gathered for this assessment has a long history that continues to reproduce a consistent set of messages found in each of the steps along that historical path. A few examples over the past decade include the science review by Solomon and Steffen (2007), the policy-oriented review of Wilkins (2008), the National Framework for Climate Change Science (Department of Climate Change 2009), its Implementation Plan (DCCEE 2012), and most recently the Australian Academy of Science’s Climate Science Capability Review (Australian Academy of Science 2017). Numerous other examples could be given. However, the key point is that the formation of the Hub and its purpose in integrating the best climate science into climate services for the benefit of Australia are built on a sound and consistent pedigree of past analysis of Australia’s climate science needs and the required capability to deliver on those needs. The themes that follow flesh out and build on that historical narrative and historical pedigree.

1. The foundation of any national or international policies and actions in response to climate change must be built on the best possible science.

There is the strong recognition that the foundation of any national or international policies and actions in response to climate change must be built on the best possible science. This must be both biophysical and socio-economic science and it requires cross-disciplinary and international collaboration.

2. The science must be better coordinated and appropriately funded across all Australian (and international) science providers, with priorities guided by a clear understanding of user needs.

There continue to be inefficiencies in the way climate science is undertaken in Australia. In future, the science must be better coordinated and appropriately funded across all Australian (and international) science providers, with priorities guided by a clear understanding of user needs. Moreover, the interviews with stakeholders yield information that is consistent with the Australian Academy of Science Climate Science Capability Review in that regard, as well as in the widely held view that resources devoted to climate change science and services in Australia are 'underdone'. The Australian Academy of Science Review suggested a need for an additional 77 full time equivalent staff nationally over the next four years for climate science and services, noting that the AAS review canvassed several groups of next-users, but did not have the time and resources to gather input from the wide range of organisations in the end-user community. It is likely that the unmet need in climate services is larger than was able to be determined.

3. Efficient and effective uptake of climate change information and services in Australia requires a step-change enhancement in the strategy, processes and organisation of climate change science and service delivery.

As recognised explicitly in the Plan for Implementing Climate Change Science in Australia (DCCEE 2012) and the climate science capability review (Australian Academy of Science 2017), efficient and effective uptake of climate change information and services in Australia requires a step-change enhancement in the strategy, processes and organisation of climate change science and service delivery. In other words, to reap full effect from burgeoning possibilities in climate change science services, the service delivery *process* requires substantive, parallel, complementary development and investment alongside the science itself. This is core business for the future success and effectiveness of the ESCC Hub.

4. There is a need for more outreach to ensure science is integrated with decision making, and more translation of research for practical use, as well as more knowledge brokering and Indigenous engagement.

An almost universal theme from the interviews was the need for more communication to ensure science is integrated with decision making, and more communication and translation of research for practical use. Respondents frequently mentioned the need to do a better job of demonstrating the value of what climate change capability can deliver, and of articulating the capability that Australia needs, in order to achieve – or at least improve the chances of – a long-term strategy and long-term funding for climate change research. There were also repeated calls for more knowledge brokering and Indigenous engagement to build on initial efforts in this area by the ESCC Hub.

5. There is a need for long-term strategy coupled with long-term funding cycles cemented into long-term partnerships with users.

Climate change is a long-term issue: decadal and longer. But research projects and programs are rarely aligned temporally with investments, collaborations, partnerships and deliverables mostly based on short-term funding cycles. This disconnect between climate change and research timescales affects the research strategy that can be developed and its ability to be delivered into services. There is a need for long-term strategy coupled with long-term funding cycles cemented into long-term partnerships with users. That strategy and its delivery into services must not be subjected, as have been previous national strategies, to the vicissitudes of short-term funding cycles. This identified weakness was clear as far back as 2007 in the Solomon and Steffen review and remains identified by stakeholders today.

6. The historical quality of Australia's climate change science community represents a strength to be built on; however, this strength is at risk if staffing remains depleted.

The historical quality of Australia's climate change science community is superb, with numerous 'stars' who have gained and merit strong international recognition and acclaim. This is a strength to be built on, but as noted in the Australian Academy of Science capability review (2017) it is at risk if the overall FTEs available remain depleted and are not enhanced as that review recommended.

7. There has been a generational shift with senior scientists already ending or near to ending their careers, coinciding with a reduction overall in funding support, leading to capacity difficulties.

A threat is that there has been (1) a generational shift with senior scientists already ending or near to ending their careers, while at the same time (2) there has been a reduction overall in funding support, leading to capacity difficulties. An example of this problem of reduction in capability in both the levels of the experience and levels of effort was identified recently in an international review of the Cape Grim Science Program carried out by CSIRO and the Bureau. It would be problematic if this finding were to become more widespread in the climate change science community. Again, the Solomon and Steffen review (2007) identified this issue, as did subsequent strategic analyses (Department of Climate Change 2009, DCCEE 2012, Australian Academy of Science 2017).

8. The reality of climate change is generating increasing needs for evidence-based and science-based assessments of climate change risk and the science-based services needed for optimal response.

A great opportunity for national benefit is widely identified by almost all stakeholders in the reality of climate change itself, as this reality is generating increasing needs for evidence-based and science-based assessments of climate change risk and the science-based services needed for optimal response. This is evident in the huge variety of needs identified in Appendices D, E and F explicitly covering virtually all sectors of Australian society and the Australian economy.

9. An improved effort and endeavour involving each of the academic community, the government funded institutions, governments industry and commerce – in fact all end-users – is required to ensure that balance can be both achieved and optimised in the national interest. The Hub is the appropriate fulcrum nationally for establishment of that balance.

It is widely recognised on the science side and on the end-user side that within the current institutional and policy arrangements it is difficult to balance the nation's strategic science capability and end-user needs across the spectrum from investigator-led academic research to mission directed institutional research. An improved effort and endeavour involving each of the academic community, the government funded institutions, governments industry and commerce – in fact all end-users – is required to ensure that balance can be both achieved and optimised in the national interest. It is widely viewed by contributors to this assessment that the Hub is the appropriate fulcrum nationally for establishment of that balance. Moreover, such a view expressed by respondents in this assessment is very consistent with conclusion of the Australian Academy of Science Capability Review that there is a need for a new and enduring coordination mechanism for climate change science in Australia (a need also previewed as long ago as in the first recommendation of Solomon and Steffen (2007)). Part of achieving the balance is communicating to potential funders the importance of the science in underpinning adaptation and mitigation. For example, DFAT would be well advised to support the pursuit and application of Hub science for overseas application. CSIRO and the Bureau of Meteorology can offer what universities often cannot – greater security of staffing and funding along with a broad researcher base, which is an important selling point, especially for government clients. Most Australian States support climate change programs. There is potential for the Hub to provide value to the States by application to them of its science along with communication and outreach. Undoubtedly, there is duplication and inefficiency in the States doing their own projections; let alone trying to undertake the associated outreach and support.

The Australian Academy of Science Review concluded that the required characteristics of an improved coordination endeavour are: national focus - mission driven; strategic outlook; continuity of function; effective coordinator; end-user engagement. As pointed out by that review in its Section 2.5, this is also a logical follow-on from the historical National Framework for Climate Change Science and its

implementation Plan which it characterised as follows, 'These plans remain valid, but implementation has effectively ceased. These documents could easily form the basis of a renewed strategic planning exercise'.

10. For maximum impact and for creation of 'ambassadors', the science-based knowledge and services need to be delivered by Hub to a very 'granular' level, to small sectors of the economy and even down to the enterprise level where very specific business needs exist.

Finally, a subset of respondents expressed the strong view that for maximum impact and for creation of 'ambassadors', the science-based knowledge and services need to be delivered by the Hub to a very 'granular' level, to small sectors of the economy and even down to the enterprise level where very specific business needs exist. Service provision does need to be well resourced and coordinated. Clients need help in interpreting and applying information products, such as through a Help Desk, guidance material, training, presentations and videos. It is not sufficient to generate tailored data, reports or websites, then assume the client is 'good to go'. While anecdotal in nature and qualitative in its argument, one illustrative example of how value is perceived and ambassadors can be created at the enterprise level is given in a recent ABC news story entitled, 'Want a better forecast? Leading climatologist encourages farmers to largely 'do it yourself'' (<http://www.abc.net.au/news/rural/2017-12-08/climatologist-encourages-farmers-to-learn-how-to-forecast/9240148>).

A comparison of Australian climate science and services with a few international programs indicates that Australia is not at the cutting edge. Climate research programs in the US and Europe are well ahead of Australia in terms of funding, involvement of multiple government agencies, cross-disciplinary research, and integration of climate research/services with impact assessment and adaptation/mitigation decisions.

Implications for the Hub

It is clear from research and interviews that the Hub does – and is seen to do – excellent work, and will benefit from increased communication and end-user engagement. Provision of tailored information and services to clients, especially downscaled climate change information relevant to socio-economic, biological, environmental, human and other impacts, represents a fertile area for the future. Additionally, the Hub is well-placed to help – or possibly lead – in much needed coordination of the national climate change science effort. A helpful first step would be enhanced communication that identifies successful use of climate change science and capability, as well as who is doing what and, by implication, the opportunities for improved efficiencies.

Increased communication, outreach and end-user engagement along with greater coordination work require resourcing. To properly implement these activities for the benefit of the Hub and the nation, the Hub will need to allocate additional funds for staffing, travel and materials.

The hub can look to the Australian Academy of Science (2017) review for a rationale to advocate for additional resources in research areas deemed to be 'moderately or critically under-resourced'. The AAS review noted that, 'the Australian team developing the Australian Community Climate and Earth System Simulator (ACCESS) ... is a small fraction of the size of groups building equivalent models for their regions in other countries. The current level of resourcing of Australia's climate modelling activity will not allow Australia to keep pace with world's best practice.' Similar sentiment was raised by some stakeholders interviewed for this assessment.

Prime scientific roles for the Hub are better downscaling of information, including for shorter (decadal) time-scales. The engagement has been good to date, but there needs to be far more, including more resources for communication, collaboration and Indigenous engagement. Improved outreach offers prospects for additional funding, including from DFAT and the states.

In the climate change science services area, the Hub can identify and focus on a discrete number of products and build trust with clients to get these adopted, paving the pathways to impact. Again, effective knowledge-brokering processes and networks will be critical. Service provision needs to be well-resourced, coordinated, and integrated with core business, rather than an add-on. Clients need extensive, trusted help in interpreting and applying information products, and the ESCC Hub is well-placed to provide this.

There are myriad sources of evidence that more funding is needed in Australia for the entire climate change research pipeline – from climate change science through to service delivery and action. This assessment, especially the stakeholder interviews, adds to this long line of evidence. A prime candidate for any future enhanced funding would be the service delivery process, which as stated earlier, represents core business for the future success and effectiveness of the Hub.

The Hub communicates well, but needs to do more – to help with national decision-making, application of research for practical use, community understanding and support, and the realisation by a range of current and potential funders that the Hub represents a genuine *investment* for the nation.