CLIMATE COUNCIL

# FLYING BLIND: NAVIGATING CLIMATE CHANGE WITHOUT THE CSIRO

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# Key Findings

## 1 The cuts to CSIRO's climate science will damage Australia's ability to understand, respond to and plan for a changing climate.

- Governments and business rely on climate science to make billion-dollar decisions. Without it, they will be relying on guesswork. For example, the design of Brisbane Airport's new runway, built on a low-lying coastal fringe, was informed by the latest sea-level science from the CSIRO.
- Climate modelling is the backbone of our ability to predict changes in the climate system, information that is vital to adapting to climate change and to building preparedness for our worsening extreme weather events. Cutting further model development will leave us dangerously exposed to the escalating risks of climate change.
- Farmers and firefighters will be particularly exposed if Australia's climate science capabilities are reduced. CSIRO research is assisting farmers with tools and technologies to manage during more frequent and severe droughts. Climate science also supports bushfire responses by providing the knowledge underpinning high fire danger weather warnings and fire behaviour predictions.

## 2 If the cuts proceed, Australia will have already reneged on a key promise in the Paris climate agreement.

- Australia, along with the rest of the world's nations, agreed to strengthen climate science as a fundamentally important component of meeting the climate change challenge.

## 3 The cuts will leave a gaping hole in the international science community's ability to understand climate change in the Southern Hemisphere.

- Australia has the strongest climate research capability in the Southern Hemisphere. Without it, the ability of the international scientific community to understand the changing atmospheric and oceanic circulation in this hemisphere, and what this means for the risks of climate change in our part of the world, including Australia itself, will be significantly diminished.
- Almost 3000 scientists across 60 countries have written an open letter to highlight how these cuts will significantly limit CSIRO's capacity and diminish the global climate change research effort.

# 1. Introduction

**The federal government's $110 million budget cut to the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (ABC 2015) and a recent decision by CSIRO's CEO to slash the organisation's climate research capacity is a significant blow to Australia's ability to understand, respond to and plan for a changing climate (CSIRO 2016a; SMH 2016a).**

Cuts to CSIRO climate science are at odds with Australia's commitment, signed at the United Nations climate talks in Paris (COP21) in December 2015, to join the rest of the world to limit global warming and the impacts of climate change. Part of the commitment that the world's nations undertook in Paris is to strengthen climate science as a fundamentally important component of meeting the climate change challenge (UNFCCC 2015).

The recently announced cuts to climate science mean that Australia has already reneged on one of its obligations under the Paris commitments. As a result of these cuts, we will greatly reduce our ability to study what will happen to our health and wellbeing, our economy, our water resources, our cities, our farmers, our infrastructure, our ports, our energy security and every other aspect of this country that will change as a result of the already shifting climate. Moreover, we'll lose a world-class capability that has taken decades to build and cannot be easily recovered.

Cuts to CSIRO climate science are at odds with Australia's commitment, signed at the United Nations climate talks in Paris (COP21) in December 2015, to strengthen the global climate research effort.

The CSIRO is a key component of Australia's climate science capability. It provides world-class expertise in many areas of climate science, ranging from climate modelling, climate projections for Australia, the carbon cycle, atmospheric and oceanic circulation, sea-level rise, ocean acidification, land-atmosphere interaction, extreme weather events, regional climate impacts on agriculture and water, greenhouse gas measurements, paleoclimate, and biodiversity and ecosystem services. All of this is essential for understanding how the climate system is changing and the risks for Australia.

These cuts also have important implications for the global climate research community, as Australia has the strongest climate research capability in the Southern Hemisphere.


**Figure 1:** UN Secretary General Ban Ki-Moon celebrates the historic adoption of the 2015 Paris Agreement on climate change with key colleagues and leaders. Australia is a signatory to this agreement and cuts to CSIRO climate science is at odds with Australia's commitment.

## We'll lose a world-class capability that has taken decades to build and cannot be easily recovered.

Thus, the decision to slash CSIRO's climate divisions leaves the world's scientific community with a vastly diminished climate research capability in the Southern Hemisphere. Just as for emission reductions, Australia is expected to do its fair share in the global science effort, and to leave this important task to the developing countries of Africa and South America is unrealistic and will strain their resources and capacity. Additionally, it makes it more difficult for Australia to leverage the research undertaken by other agencies internationally.

Finally, Australia is on the front line of climate change impacts. Climate change is increasing the frequency and severity of many extreme weather events, including heatwaves, extreme bushfire conditions and coastal flooding. Hot days have doubled in the last 50 years, whilst heatwaves have become hotter, last longer and occur more often. Over the last 30 years extreme fire weather has become more common in the populous southeast region of Australia- including southern NSW, ACT, Victoria, Tasmania and parts of South Australia. Coastal flooding ("extreme sea-level events") has tripled at Sydney and Fremantle over the 20$^{th}$ century and more than $226 billion in commercial, industrial, road, rail and residential assets around Australian coasts are potentially exposed to flooding and erosion hazards at a sea-level rise of 1.1 m (Climate Council 2015). These cuts leave Australia flying blind in turbulent times. Here's a more detailed look at what we'll lose with these CSIRO cuts.

# 2. The Value of CSIRO Climate Science and What We'll Lose

**The report "Climate Change in Australia: Projections for Australia's NRM (Natural Resource Management) Regions", published jointly by CSIRO and the Bureau of Meteorology (BoM) in 2015, is a clear example of why ongoing, world-class climate science is essential for Australia's wellbeing (http://www.climatechangeinaustralia.gov.au/en/).**

This report describes how our climate is changing, why it is changing, and what we need to know to protect our health, make wise investment decisions, and prepare for the worsening extreme weather events that climate change is bringing. Governments, farmers and businesses rely on this information to make countless important decisions. Without such knowledge there is an increased likelihood that more lives will be lost and property damaged, and more funding misspent on ill-informed investments. Critically, in a rapidly changing climate where the nature of risks is constantly changing, ongoing research is required to continually improve our knowledge base. It is essential to understand and monitor how the climate is changing in order to ensure we understand the evolving nature and extent of the challenge facing Australia. Put simply, we can't accurately or effectively mitigate or adapt to climate change without the most up-to-date climate science.

## ANNUAL MEAN TEMPERATURE (IN °C) FOR THE PRESENT CLIMATE (A), AND FOR LATE 21ST CENTURY (B).

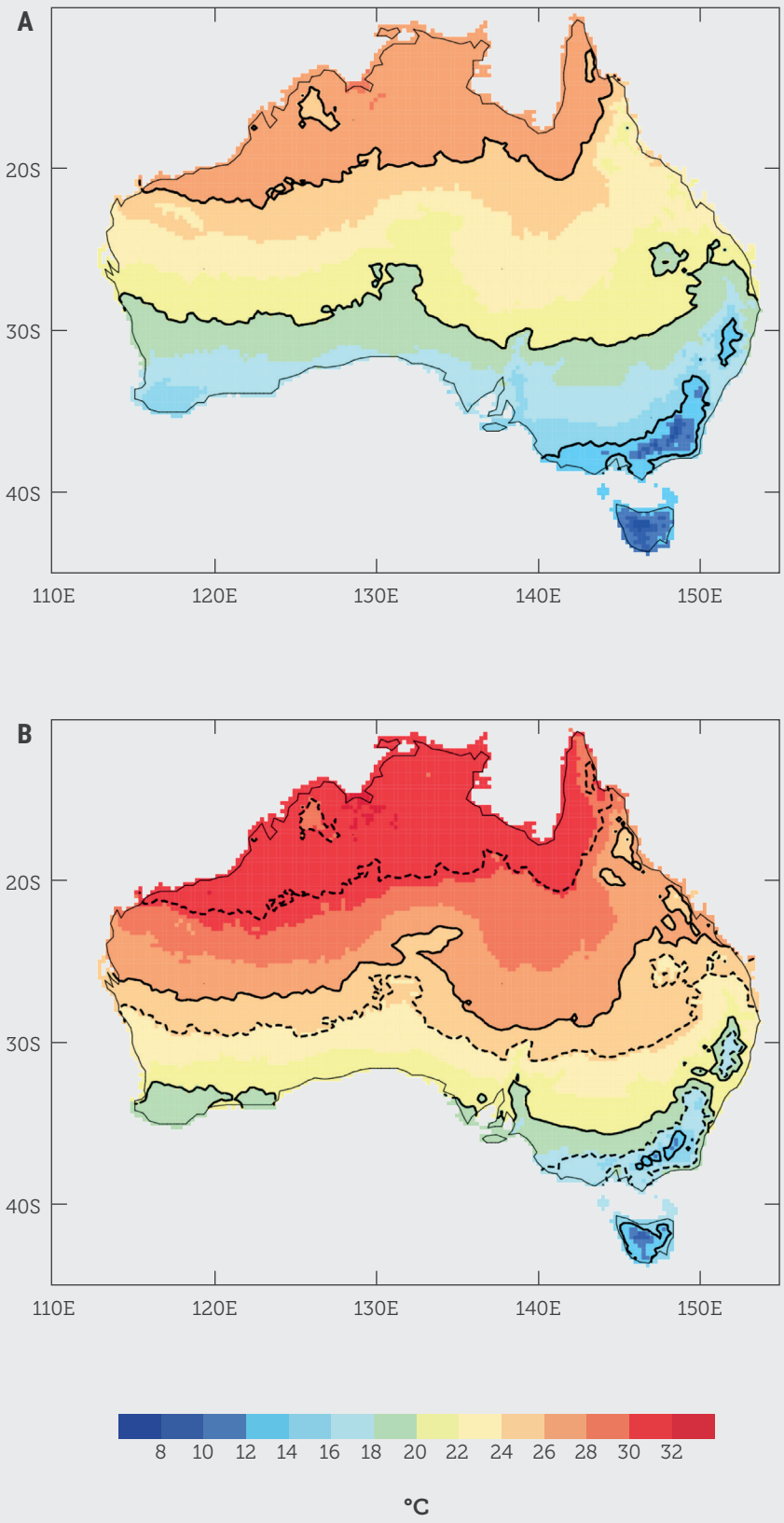



**Figure 2:** Annual mean temperature (in °C) for the present climate (A), and for late 21st century (B). The future case is calculated by adding the median (P50) warming from 1986-2005 to 2080-2099 under RCP8.5 to the mean temperature of the present climate. In each panel the 14°C, 20°C and 26°C contours are shown with solid black lines. In (B) the same contours from the original climate are plotted as dotted lines. To provide the clearest depiction of the shifts in contours, the longer period 1950-2008 BoM dataset issued for the present climate, on a 0.25°C grid. **Source:** CSIRO and BoM 2015.

# CSIRO Climate Science: Protecting Australia from a Changing Climate

**Below are a few of the areas where CSIRO's research capacity needs to be maintained and strengthened to support our wellbeing.**

## 1 CLIMATE MODELLING

Climate modelling represents the backbone of our ability to predict changes in the climate system– temperature, rainfall, drought, bushfire weather and much more (Figure 2). This information is vital to adapting to climate change and to building preparedness for our worsening extreme weather events. Climate models are not static, but are continually improving based on fundamental climate research. Modelling also occurs on many different spatial and temporal scales. Cutting fundamental climate science and further model development will leave us dangerously exposed to the escalating risks of climate change.

In addition, the next generation of climate models will provide detailed risk assessments of how climate extremes will change. This data will play a vital role in helping to calculate risk and determine climate vulnerability; for example, an engineer could use this data to ensure that a significant infrastructure project is resilient to climate change. Without these models and the expertise to translate them for a local context, Australia may struggle to attract investment for major projects over other countries that have more detailed information on climate vulnerability (Pitman 2016).

## 2 SEA LEVEL RISE

Around the world, rising sea levels due to human-induced climate change are already having an impact. CSIRO research helps us understand how sea levels have changed over time, information that is used to improve projections for future sea-level rise (CSIRO 2016b), particularly at the regional level where critical investment decisions must be made. For example, the design of Brisbane Airport's new runway (Figure 3), located on a low-lying coastal fringe, was informed by the latest sea-level science from CSIRO (Colonial First State Global Asset Management 2012; Climate Council 2014).

## 3 CARBON CYCLE

Understanding the carbon cycle (how carbon moves through the biosphere, atmosphere and oceans) allows us to monitor how much carbon is in the atmosphere and therefore the extent that we need to reduce our carbon emissions to tackle climate change effectively. Hence, this understanding plays an essential role in climate mitigation. CSIRO houses the worldwide headquarters for the Global Carbon Project (GCP), the most authoritative research body on

**Figure 3:** A cross-runway at Brisbane Airport, located on a low-lying site near Moreton Bay, with a new runway under construction (top left of photo). The design of Brisbane Airport's new runway, located on a low-lying coastal fringe, was informed by the latest sea-level science from CSIRO.

how the carbon cycle is changing. The GCP releases an annual update of the global carbon budget and trends, as well as detailed information on the human and natural processes that are driving changes in the carbon cycle (GCP 2015). This analysis underpins international climate negotiations and scenario development, and it supports national climate policies and mitigating strategies around the world, including Australia. The GCP is an international asset that CSIRO has supported over the years as an Australian contribution to the global research effort.

## 4 OCEANIC AND ATMOSPHERIC CIRCULATION

Fundamental scientific understanding of how oceanic and atmospheric circulation are changing around Australia, the Southern Hemisphere and the globe is essential for understanding how rainfall patterns are changing across Australia and will change in the future (Dowdy et al. 2015; Grose et al. 2015). For example, CSIRO research has highlighted the role of the Southern Ocean as part of the global ocean circulation in influencing our weather, not least its substantial role in producing the rainfall that sustains production in the primary agricultural zones in the southeast and southwest of the continent (CSIRO 2013). Furthermore, the floods of 2011 were more severe than expected, following on the heels of a record-breaking drought. Both events are likely to have been influenced by climate change (Lewis and Karoly 2014; van Dijk et al. 2013; Jones et al. 2016). Leading research from CSIRO has given us a much better idea of how the Pacific and Indian Oceans combine under climate change to influence extreme weather events (Cai et al. 2013; CSIRO and BoM 2015). Much more needs to be known about how climate change is influencing our rainfall and drought patterns, and that can only be done with a strong Australian research effort.

Central to the effort is ongoing Australian contributions to the ocean monitoring and research capacity, focusing on our surrounding seas. Currently Australia contributes 23% and 29% to the Argo float network in the Southern and Indian Oceans, respectively. Just as important as the float network is the system of repeat ocean research transects, which measures temperature, salinity, carbon dioxide content and other ocean characteristics. Through CSIRO, Australia contributes similarly to the research transect system (Durack et al. 2016).

## 5 EXTREME WEATHER

The influence of climate change on many types of extreme weather events is already evident, thanks to recent research in Australia and overseas. Had the research effort been cut in, say, 2010, we would lack this knowledge and would be ill-prepared for the escalating risks that we now face. Without ongoing research, we'll lack the knowledge we need to deal with even more severe risks in the coming decades (CSIRO and BoM 2015).

- **Bushfires**
  Australian bushfires threaten lives and property and cause millions of dollars of damage each year. CSIRO's research is used to respond to bushfires in many ways, from weather warnings to fire-fighter training to predicting fire behaviour (CSIRO 2016c).

- **Drought**
  Australia has a highly variable climate with a naturally occurring cycle of wet and dry periods. Droughts are an expected outcome of this variability, although their severity and frequency may change in the future. CSIRO research is assisting farmers with technologies and tools to manage during periods of drought (CSIRO 2016d). CSIRO and partner organisation are also working to understand the complexities of climate variability, climate change and drought in eastern Australia so that industry and local communities can respond to the challenges and opportunities of a changing climate (SEACI 2012).

- **Extreme rainfall**
  Flooding across Australia can have significant consequences for infrastructure, people and communities. CSIRO conducts research on causes of extreme rainfall, including the role of climate change, the impacts of flooding and how to prepare or respond (CSIRO 2016e).

- **Tropical cyclones**
  Tropical cyclones threaten northern and western Australia every year. CSIRO research seeks to understand causes and likely changes in tropical cyclone intensity, location and frequency (CSIRO 2016f).

- **Heatwaves**
  Heatwaves have significant impacts for health, infrastructure, ecosystems and agriculture, and these are likely to grow in the future. CSIRO and BoM estimate that the long term average (1961-1990) number of days over 35°C may increase from 10 days at present in Melbourne to 12-26 days by 2070. Adelaide will go from 18 days over 35°C to 24-47 days by 2070, while Canberra will go from 5 days to 8-26 days by 2070 (CSIRO and BoM 2007).


## 6 OCEAN ACIDIFICATION

CSIRO research is crucial for understanding the strength of the marine carbon "sink", which removes carbon from the atmosphere but, as a result, increases the acidity of the ocean (CSIRO 2016g). These complex processes are already having impacts on Southern Ocean ecosystems and on coral reefs, such as Australia's iconic Great Barrier Reef (IPCC 2014).

## 7 GREENHOUSE GASES

The latest greenhouse gas (GHG) data are updated monthly from Cape Grim on Tasmania's west coast. The CSIRO / BoM facility is one of three key sites identified by the World Meteorological Association for long-term carbon dioxide measurements. Cape Grim is in an important site, as the air sampled arrives at Cape Grim after long trajectories over the Southern Ocean, under conditions described as 'baseline'. This baseline air is representative of a large area of the Southern Hemisphere, unaffected by regional pollution sources (there are no nearby cities or industry that would contaminate the air quality) (CSIRO 2016h). While the Cape Grim station is not under threat from these rounds of cuts, other areas could be, such as paleoclimate research. CSIRO has measured atmospheric carbon dioxide concentration over the past 2000 years in air trapped in Antarctic surface ice - called firn - and deeper ice cores (Fraser 2013).

## 8 CITIES AND CLIMATE CHANGE

Climate change threatens the liveability of cities, further exacerbated by rapidly urbanising coasts where most of the Australian population lives. Climate impacts exacerbate existing coastal challenges such as urban sprawl, ageing infrastructure, population growth, pollution and the loss of biodiversity. CSIRO research is helping Australian cities and coastal communities prepare for the impacts of climate changes, while also reducing our urban greenhouse gas emissions and improving long term sustainability (CSIRO 2016i).

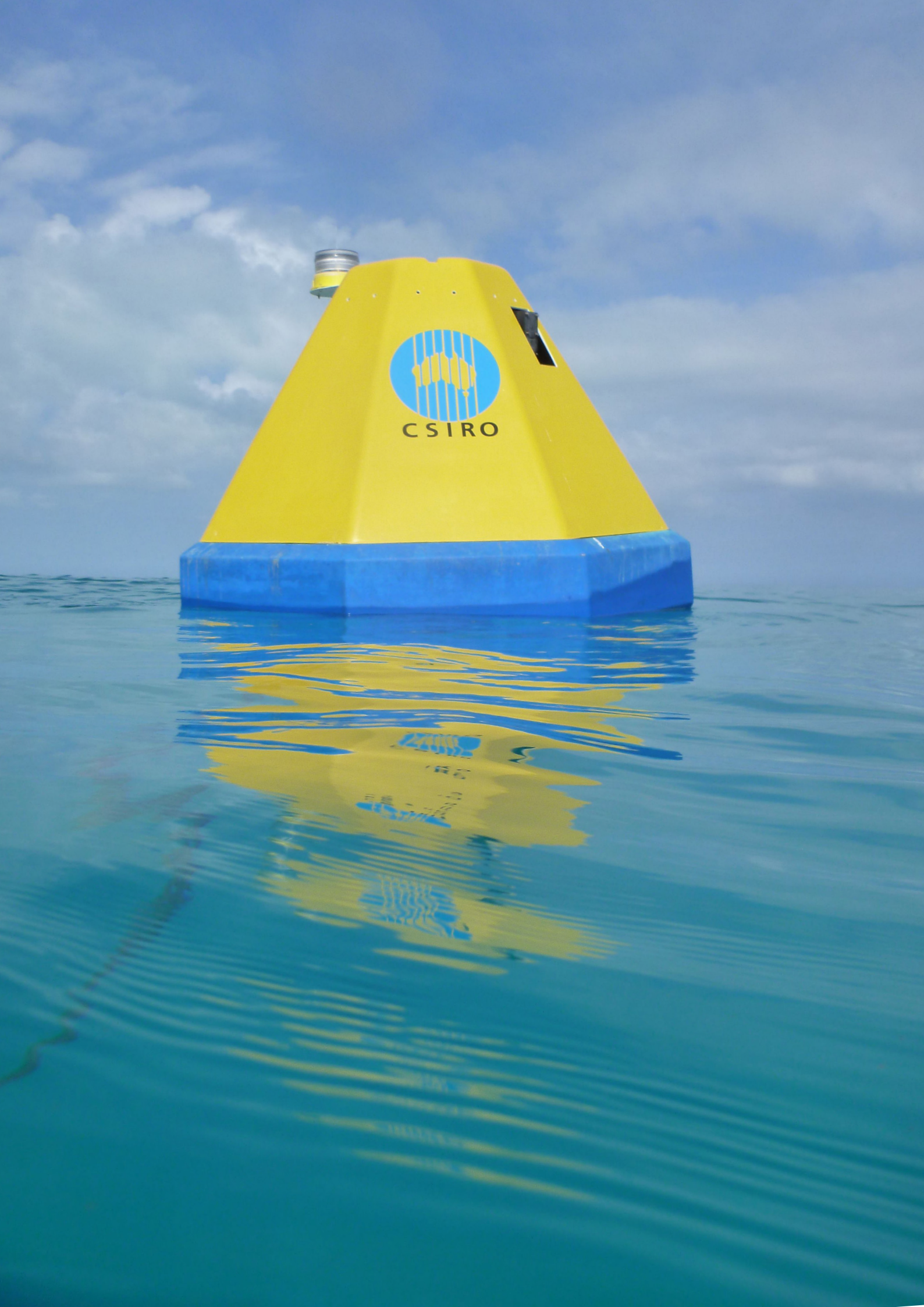
## 9 ADAPTIVE SOCIAL AND ECONOMIC SYSTEMS

Climate change presents a major challenge to communities, businesses and all levels of government as they plan for the future. Many of these changes will lead to shifts in natural and human systems, radically altering what they look like and how they function. CSIRO researchers are examining the use of adaptation pathways, a new conceptual and analytical framework for enabling adaptation planning and decision making in response to long-term change (CSIRO 2016j).

## 10 INTERNATIONAL ACTION

Every country needs to contribute its fair share to understanding and responding to climate change. Australia has a proud history and is very well respected for contributing to global science efforts in the World Climate Research Programme, the new Future Earth program and in other international collaborative research efforts. Such contributions are even more important now than they have ever been. In addition to understanding the increasing risks of climate change, we need crucial information on the dangers of very rapid changes in the climate system itself. For example, knowledge on how close we might be to "tipping points" in the climate system (e.g. irreversible melting of polar ice sheets, abrupt shifts in ocean circulation, etc.) is crucial for informing the level of ambition required in the global mitigation effort. CSIRO brings crucial Southern Hemisphere expertise to bear on such important questions.

**Figure 4 (opposite page):** Ocean acidification mooring deployed near Heron Island on the Great Barrier Reef. CSIRO maintains this and other moorings around Australia to monitor $CO_2$ and related ocean acidification parameters in seawater as part of the Integrated Marine Observing System. Photograph by Bronte Tilbrook, copyright. Reproduced with permission.


CSIRO

There is an urgent need for ongoing climate research in Australia. For example, in response to the CSIRO cuts, an open letter of concerned scientists (see SMH 2016b) highlighted further climate changes "questions" not yet resolved:

- Will the El Niño/La Niña variability that drives Australian droughts and floods become more frequent and more intense?
- What should Australia expect, and how should Australia prepare for more extreme weather: heatwaves, bushfires, cyclones, floods and hail?
- Will tropical diseases impact subtropical and temperate Australia as the tropics expand?
- Will Australia's bread basket, the Murray-Darling Basin, remain arable in coming decades, and able to maintain the agricultural productivity that underpins Australian society?
- Where on the land and in the sea will Australia harvest its food from as climate regimes shift?
- Will the Southern Ocean continue to absorb a significant proportion of the human-caused $CO_2$ increases as the planet continues to warm?
- Where and how much sea-level rise and how many extreme sea-level events should Australians expect and prepare for in their coastal communities and coastal infrastructure?
- Will Australia's Great Barrier Reef disappear due to the dual threats of ocean warming and ocean acidification? What will be the impacts for the Australian economy?
- Where and how should Australia invest the billions of current and future dollars in necessary climate change adaptation, and in effective and efficient climate change mitigation?

There is an urgent need for ongoing climate research in Australia.

# 3. Response from the International Science Community

**The cuts to CSIRO have important implications for the global climate research community, as Australia has the strongest climate research capability in the Southern Hemisphere (Australian Academy of Science 2016). Thus, the decision to dismantle CSIRO's climate divisions leaves the world's scientific community with a vastly diminished climate research capability in the Southern Hemisphere – and in Australia itself.**

There has been a significant response from the international science community on the detrimental impact that these cuts will have. A range of organisations and international experts, including almost 3000 scientists across 60 countries, have highlighted how these cuts will significantly limit CSIRO's capacity, with serious impacts for the Australian and global research effort.

Almost 3000 scientists across 60 countries have highlighted how these cuts will significantly limit CSIRO's capacity.

## INTERNATIONAL RESPONSE TO CSIRO CLIMATE SCIENCE CUTS

World Meteorological Organization
Weather • Climate • Water

*"[The CSIRO cuts] have sent shockwaves through the international climate research community...these cuts will sever vital linkages that connect Australia to the UK, the USA, New Zealand, Japan, China and beyond."*

World Climate Research Programme, World Meteorological Organization.

*"Australia will find itself isolated from the community of nations and researchers devoting serious attention to climate change."*

World Climate Research Programme, World Meteorological Organization.

*"Without this basic information we are not going to understand how rapidly the climate is changing and in fact Australian scientists are world leading and doing some world leading research in this area."*

Dr. Peter Stott, the head of the climate monitoring at the UK's Met Office.


*"The capacity of Australia to assess future risks and plan for climate change adaptation crucially depends on maintaining and augmenting [CSIRO's] research capacity."*

Open letter from 2800 climate scientists around the world.

*"Without committing to the continued development of next generation climate monitoring and climate modelling, billions of public investment dollars for long term infrastructure will be based on guesswork rather than on strategic and informed science-driven policy."*

Open letter from 2800 climate scientists around the world.


*"The impacts across Australia due to evolving patterns of weather and climate are immense. Recall the impacts of recent El Niño events (Ash Wednesday bushfires in 1983, Black Saturday in 2009) and the "Big Dry" – a decade-long drought affecting most of the nation. CSIRO researchers have contributed fundamental insights into all of these events."*

Dr. Jenni Evans, Pennsylvania State University, Professor in the Department of Meteorology and Earth Science.

# 4. Conclusion

**To protect our environment, economy and health, make wise investment decisions, and prepare for worsening extreme weather events, we need to know how our climate is changing, why it is changing, and the nature of the future climate. To meet these challenges, ongoing research is required to continually improve our knowledge base and ensure that we understand the evolving nature and extent of the challenge facing Australia.**

Late in 2015 at the COP21 climate change talks in Paris, Australia committed to strengthening our climate science capability. Dismantling almost all of CSIRO's climate team contradicts this international agreement and severely diminishes the climate science capacity of the Southern Hemisphere. Over decades Australia has built a world-class climate research capability and an enviable reputation as an important and reliable contributor to international science. It is vital for the wellbeing of Australia, now and into the future, that we keep and strengthen this capability. CSIRO's climate research capacity and reputation should not be placed in jeopardy by short-sighted decisions, decisions from which Australia may never recover.

To protect our environment, economy and health, make wise investment decisions, and prepare for worsening extreme weather events, we need to know how our climate is changing, why it is changing, and the nature of the future climate.

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Page 2: Figure 1 "UN Secretary General Ban Ki-Moon celebrates the historic adoption of the 2015 Paris Agreement on climate change" by Flickr user United Nations Photo licensed under CC by -NC-ND 2.0.

Page 6: Figure 3 "Brisbane airport runway" by Brisbane Airport Corporation.

Page 9: Figure 4 Ocean acidification mooring deployed near Heron Island on the Great Barrier Reef. CSIRO maintains this and other moorings around Australia to monitor CO2 and related ocean acidification parameters in seawater as part of the Integrated Marine Observing System. Photograph by Bronte Tilbrook, copyright. Reproduced with permission.

# HOW CSIRO'S CLIMATE RESEARCH HELPS PROTECT AUSTRALIA

## 1 CLIMATE MODELLING

Climate modelling is key to projecting future changes in temperature, rainfall, drought, bushfire weather and much more.

## 2 SEA LEVEL RISE

CSIRO research helps our cities and regions adapt to sea-level rise, particularly where critical investment decisions must be made.

## 3 CARBON CYCLE

CSIRO houses the HQ of the most authoritative international research body on the changing carbon cycle - critical to informing national climate policies around the world.

## 4 OCEANIC & ATMOSPHERIC CIRCULATION

Understanding how oceanic and atmospheric circulation is changing is essential for understanding how patterns of rainfall and drought are changing across Australia.

## 5 EXTREME WEATHER

CSIRO's ongoing research provides us with critical knowledge for dealing with increasingly severe risks from bushfires, heatwaves, floods and tropical cyclones.

## 6 OCEAN ACIDIFICATION

CSIRO research is crucial for understanding what increasing ocean acidity means for coral reefs, such as Australia's iconic Great Barrier Reef, and other marine ecosystems.

## 7 INTERNATIONAL ACTION

Australia has a proud history of contributing to global science efforts in the World Climate Research Programme and other international organisations.

# Thank you for supporting the Climate Council.

The Climate Council is an independent, crowd-funded organisation providing quality information on climate change to the Australian public.


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