

**Senate Standing Committee  
on Environment and Communications**

**Inquiry into Recent Trends in and Preparedness  
for Extreme Events**

Submission from:  
**National Climate Change Adaptation Research Facility (NCCARF)**

Director: Jean Palutikof

## **1. Context**

The bushfires of January 2013, have demonstrated that the emergency services have learnt from earlier catastrophic events such as the Black Saturday fires, and have modified their advice to householders and firefighting techniques.

It is increasingly clear that, as global warming progresses, we will be dealing with many more heatwave events and more catastrophic bushfire events. With less certainty, we may expect more floods and droughts, and more intense tropical cyclones.

It is not only the emergency services that will need to learn to manage more frequent and more severe climate extremes. Agencies in health care, electricity, water, sewerage and transport provision, just to take a few examples, will all have to learn to prepare for, manage and respond to such events.

The mission of the National Climate Change Adaptation Research Facility (NCCARF) is to provide the knowledge needed by decision-makers working in the area of climate change adaptation, and to build capacity in the practitioner and research community. This submission sets out NCCARF activities that directly address these roles.

## **2. Role of NCCARF**

The National Climate Change Adaptation Research Facility was established in 2008 with the aim of leading the research community in a national interdisciplinary effort to generate the biophysical, social and economic information needed by decision-makers in government, and in vulnerable sectors and communities, to manage the risks of climate change impacts.

In this Phase of NCCARF, which concludes in June 2013 (see Section 3 of this submission), we have pursued this role through three main programs:

- (a) research to develop new information;
- (b) networks that coordinate Australia's research community, build capacity and support effective interaction between research and decision-making communities; and
- (c) outreach activities

All of NCCARF's activities focus on delivering information to decision-makers to support climate change adaptation investments and initiatives. The involvement of relevant and interested end users is a key component of all NCCARF activities. In this way NCCARF seeks to enable and support the Australian community to adapt effectively to climate change impacts.

### **2.1 *Research to develop new information***

The National Climate Change Adaptation Research Facility manages two research areas, the Adaptation Research Grants Program (ARGP) and the Synthesis and Integrative Research Program (SIRP). Together, these seek to address short- to medium-term knowledge gaps and deliver practical and pragmatic information, knowledge and tools that decision-makers need for Australia to effectively adapt to climate change.

The ARGP, with a \$36 million budget (including cash leveraging) and 96 projects, addresses knowledge gaps identified in nine thematic National Adaptation Research Plans (NARPs). There are research programs in terrestrial, marine and freshwater biodiversity, primary industries, human health, emergency management, settlements and infrastructure, the social, institutional

and economic dimensions of climate change, and Indigenous communities and adaptation.

The SIRP, with a \$6 million budget and 46 projects, builds on existing research to directly address knowledge needs of decision-makers. The SIRP achieves this by synthesising across thematic topics and integrating NCCARF research outputs with the wider field of adaptation research. This program delivers timely and specific information tailored to the needs of key stakeholder groups. To ensure SIRP research is directly relevant to stakeholders, they are involved in research projects at all stages of development, implementation and delivery.

NCCARF's research portfolio of 142 projects involves 33 Australian universities, 61 Commonwealth, State and Local government entities, and 26 private institutions.

Much of NCCARF's research has focused on adapting to the impacts of extreme events, which are likely to be a key outcome of climate change. Learning from extremes related to climate variability helps to develop approaches, decision support tools, and practices that will support the ability of Australian and global society to adapt to the effects of climate change.

Appendix A provides summaries of NCCARF's research projects which are concerned with extreme events. Some projects have been completed and reports are available on the NCCARF website ([www.nccarf.edu.au](http://www.nccarf.edu.au)), others are undergoing peer review or are nearing completion. Reports for all projects will be available by June 2013. Projects are diverse and include everything from analyzing damage to buildings during the 2010-2011 eastern Australia flood events to adapting aged care facilities to extreme heat to prevent premature death in elderly Australians.

## *2.2 Research networks*

The National Climate Change Adaptation Research Facility's Adaptation Research Networks, hosted by universities across Australia, comprise communities of researchers and practitioners working together to progress climate change adaptation knowledge.

There are eight Networks representing key themes:

- Emergency management
- Settlements and infrastructure
- Human health
- Social, economic and institutional dimensions (including climate change adaptation as it relates to Australia's Indigenous communities).
- Water resources and freshwater biodiversity
- Marine biodiversity and resources
- Terrestrial biodiversity
- Primary industries

The Networks connect over 4,800 people across Australia involved in climate change adaptation including researchers, policy makers, professionals, land and water managers and community leaders. Extreme events are the focus of many Network activities. For example, in May 2013 the Settlements and Infrastructure Network, together with the Emergency Management Network, will host a workshop in Sydney which will focus on the role of government, industry, research and the community in developing shared responsibility for maintenance of key infrastructure services through the practices of preparedness, prevention, response, and recovery. Collaborators will include the NSW Office of Environment and Heritage (OEH), Water

Services Association of Australia (WSAA) Emergency Management Australia (EMA), Ausgrid, Geoscience Australia and Ports Australia. Other recent activities include:

- The *Marine Biodiversity and Resources Network* will host a seminar in Hobart, taking advantage of the presence of international experts in climate change for the Fourth Lead Author Meeting of the IPCC Working Group I Fifth Assessment. Although Working Group I deals with the physical science, which is not directly related to adaptation, two experts were identified who can give presentations suitable for a non-specialist audience. Peter Stott (UK Met Office) will speak on detection and attribution, which is particularly timely given the recent weather events in Australia. Linda Mearns (NCAR, USA) will speak on future scenarios of climate change for adaptation.
- The *Social Economic and Institutional Dimensions Network* hosted the 'Valuing Adaptation Workshop' at Monash University which explored competing ideas and approaches to valuing the benefits of climate change adaptation actions, and examined how values influence how adaptation decisions are made.
- The *Settlements and Infrastructure Network* held the public event 'Coastal community engagement under a changing climate'. This workshop was attended by people from local councils, regional bodies, state government, environmental groups and researchers. It focussed on case studies of adaptation and community engagement challenges.
- The *Terrestrial Biodiversity Network* has published a new fact sheet on wildlife corridors: [www.nccarf.jcu.edu.au/terrestrialbiodiversity/documents/Corridor\\_FINAL.pdf](http://www.nccarf.jcu.edu.au/terrestrialbiodiversity/documents/Corridor_FINAL.pdf)
- The *Primary Industries Network* has been taking a lead role in assisting members to apply for funding through the DAFF Filling the Research Gap funding. They held a public webinar on December 13 to assist members to submit successful applications.

### 2.3 NCCARF Outreach activities

Outreach activities are a major component of NCCARF's activities. It is fundamental to NCCARF's approach that outputs from NCCARF's funded research are communicated to stakeholders. Activities include:

- preparing research summaries clearly identifying key findings from research projects;
- working with research providers to help achieve maximum impact from their work;
- holding workshops with stakeholders and researchers to enable stakeholders to understand how they can apply research findings;
- liaising with decision makers in all levels of government and in priority sectors;
- organizing seminars and events about important topics;
- holding communication activities in all parts of Australia;
- distributing information through newsletters, through our Networks and partners; and,
- holding meetings with relevant experts to develop policy guidance materials to support climate change adaptation.

### 3. In conclusion: the future of NCCARF

In its current phase, NCCARF is funded until 30<sup>th</sup> June 2013. At this time, funding does not exist for a continuation of NCCARF beyond that date. Nevertheless, the roles that NCCARF fulfills, in capacity building, knowledge development and communication for climate change adaptation, remain increasingly important as climate change impacts start to take hold in Australia.

I would be pleased to provide further information about the wide range of programs and initiatives undertaken or supported by NCCARF that would be relevant to your inquiry.

## Climate change adaptation knowledge for extreme weather

### What is NCCARF?

The National Climate Change Adaptation Research Facility is a unique venture established by the Australian Government in 2008 to harness and coordinate the capabilities of Australia's researchers, to generate and communicate the knowledge decision-makers need for successful adaptation to climate change. NCCARF fulfils its mission by:

- Building capacity in research and end user communities, principally through its eight thematic Adaptation Research Networks;
- Generating knowledge for adaptation through its research programs;
- Effectively delivering knowledge through the NCCARF annual conference, workshops and master classes, reports, policy briefs and information sheets, the website and social media.

### Projects in NCCARF's research programs delivering useful results on extreme weather

The National Climate Change Adaptation Research Facility manages two research areas, the Adaptation Research Grants Program (ARGP) and the Synthesis and Integrative Research Program (SIRP). Together, these seek to address knowledge gaps and deliver the information decision-makers need to successfully adapt Australia to climate change.

The thematic ARGP, with a \$36 million budget (including cash leveraging) and 96 projects, addresses knowledge gaps identified in National Adaptation Research Plans (NARPs). There are programs in terrestrial, marine and freshwater biodiversity, primary industries, human health, emergency management, settlements and infrastructure, the social, institutional and economic dimensions of climate change, and Indigenous communities and adaptation.

The SIRP, with a \$6 million budget and 40 projects, builds on existing research to directly address knowledge needs of practitioners. The SIRP synthesises across thematic topics and integrates NCCARF learnings with the wider field of adaptation research to deliver timely and specific information tailored to the needs of practitioners. These practitioners are engaged in projects at all stages of development, implementation and delivery.

Research projects in the ARGP and SIRP can be clustered to address the needs of particular locations and critical adaptation challenges. NCCARF is producing a series of fact sheets to show where information can be found in NCCARF's research programs to support decision-making and policy development to address critical adaptation challenges.

This fact sheet addresses the challenge of adaptation for Australia's extreme weather.



Projects relevant to extreme weather in NCCARF's research portfolio	Principal Investigator	Institution	Final report availability <sup>1,2</sup>
<b>EXTREMES, BUSINESS AND INDUSTRY</b>			
Harnessing private sector logistics for emergency food and water supplies in flood prone areas	Leo Dobes	Australian National University	31-Aug-2012
Extractive resource development in a changing climate: Learning the lessons from recent weather events in Queensland, Australia	Vigya Sharma	University of Queensland	31-Oct-2012
Changing heat: Direct impacts of temperature on health and productivity - Current risks and climate change projections	Keith Dear	Australian National University	Contact NHMRC <sup>3</sup>
Climate change impacts on workplace heat extremes: Health risk estimates and adaptive options	Elizabeth Hanna	Australian National University	Contact NHMRC <sup>3</sup>
<b>IMPACTS OF DISASTERS ON DISADVANTAGED GROUPS</b>			
Displaced twice? Investigating the impact of Queensland floods on the wellbeing and settlement of a cohort of men from refugee backgrounds living in Brisbane and Toowoomba	Ignacio Correa-Velez	La Trobe University	Contact NHMRC <sup>3</sup>
Climate change and the welfare sector – Risk and adaptation of Australia's vulnerable and marginalised	Karl Mallon	Australian Council of Social Services	31-Mar-2013
Heat-ready: Adapting aged care facilities to prevent premature death in elderly Australians.	Deborah Black	University of Sydney	31-Mar-2013
Extreme heat and climate change: adaptation in culturally and linguistically diverse (CALD) communities	Peng Bi	University of Adelaide	31-Mar-2013
<b>BUILDINGS, INFRASTRUCTURE AND EXTREMES</b>			
Impacts and adaptation response of infrastructure and communities to heatwaves: The southern Australian experience of 2009	Jim Reeves	Queensland University of Technology	30-Jun-2010
Adaptation of the built environment to climate change induced increased intensity of natural hazards	David King	James Cook University	31-Aug-2012
Damage to buildings during the 2010-2011 Eastern Australia flooding events	Matthew Mason	Macquarie University	30-Sep-2012
Rental housing, climate change and adaptive capacity: A case study of Newcastle, NSW	Lesley Instone	University of Newcastle	31-Mar-2013
<b>INTERSECTIONS OF EXTREMES, RESILIENCE AND ADAPTIVE CAPACITY</b>			
Agent based simulation framework for improved understanding and enhancement of community and organisational resilience to extreme events	Lin Padgham	RMIT University	30-Sep-2012
Analysis of institutional adaptability to redress electricity infrastructure vulnerability due to climate change	John Foster and Deepak Sharma	University of Queensland & University of Tech, Sydney	28-Mar-2013
Recovery from disaster experience: Its effect on perceptions of climate change risk and on adaptive behaviours to prevent, prepare, and respond to future climate contingencies	Helen Boon	James Cook University	31-Oct-2012
Exploring the adaptive capacity of emergency management using agent-based modelling	Lin Padgham	RMIT University	31-Mar-2013
Robust optimization of urban drought security for an uncertain climate	George Kuczera	University of Newcastle	31-Mar-2013
Understanding the Pacific's adaptive capacity to emergencies in the context of climate change	Juliet Willetts	University of Tech, Sydney	31-Mar-2013
Aboriginal responses to climate change in arid zone Australia – Regional understandings and capacity building for adaptation	Paul Memmott	University of Queensland	31-May-2013
<b>LIVING WITH EXTREMES</b>			
Investigating factors that inhibit and enable adaptation strategies following the 2010/11 floods	David King	James Cook University	01-Jun-2012
A spatial vulnerability analysis of urban populations to extreme heat events in Australian capital cities	Margaret Loughnan	Monash University	31-Jul-2012
Living with floods: Key lessons from Australia and abroad	Karen Hussey	Australian National University	30-Nov-2012
A framework for adaptation of Australian households to heat waves	Wasim Saman	University of South Australia	31-Mar-2013
Social networks analysis – Bridging degrees of separation to enhance climate change adaptation	Susan Kinnear	Central Queensland University	31-Mar-2013
The right tool for the job – Achieving climate change adaptation outcomes through improved disaster management policies, planning and risk management strategies	Michael Howes	Griffith University	31-Mar-2013
<b>CASE STUDIES OF EXTREMES</b>			
Adaptation lessons from Cyclone Tracy	John McAneney	Macquarie University	31-Jan-2010
East coast lows and the Newcastle-Central Coast Pasha Bulker Storm	Garry Willgoose	University of Newcastle	1-Mar-2010
The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity	Armando Apan	University of Southern Queensland	15-Mar-2010
Storm tides, coastal erosion and inundation	Rodger Tomlinson	Griffith University	30-Apr-2010

<sup>1</sup>Completed final reports are available for download at [www.nccarf.edu.au](http://www.nccarf.edu.au)

<sup>2</sup>Availability dates are estimated using draft report due dates and time for the review process

<sup>3</sup>These projects are being managed by NHMRC who can advise on availability of outputs - [www.nhmrc.gov.au](http://www.nhmrc.gov.au)



# Summaries of projects relevant to extreme weather in NCCARF's research portfolio

## EXTREMES, BUSINESS AND INDUSTRY

### ***Harnessing private sector logistics for emergency food and water supplies in flood prone areas***

Leo Dobes, Australian National University

Climate change is expected to increase the frequency and/or intensity of cyclones, which will affect the availability of food and water supplies in times of emergency. This project will use the Cairns community as a model for a nationally-applicable scoping study to estimate the costs of supplying water and food using conventional public sector emergency services and of harnessing private sector logistics as an alternative. It will compare the relative efficiency of public and private sector arrangements, and estimate any additional government subsidies that may be justified by a cost-benefit analysis.

### ***Extractive resource development in a changing climate: Learning the lessons from recent weather events in Queensland, Australia***

Vigya Sharma, University of Queensland

Researchers will examine the devastating impacts of extreme weather events on mining operations, including the 2010-2011 floods that cost Queensland more than \$2 billion in export earnings. By applying the lens of the recent floods, the project aims to understand the impact on mining operations and the flow-on socio-economic and ecological impacts on the wider region. It will identify measures needed to get operations back on line after a disaster, and strategies to limit impacts from such events in the future across other Australian mining operations.

### ***Changing heat: Direct impacts of temperature on health and productivity - Current risks and climate change projections***

Keith Dear, Australian National University

We know that heat waves kill people. Some 50,000 died in the 2003 European heatwave, but little is known of the details. This project will discover three important dimensions of those details: who is at risk and where do they live; how are people at risk, for example from kidney failure; and just what is it about heat that is most dangerous? Mathematical models will be developed of the future risks, and explore what public health measures will best protect Australians in a warming climate.

### ***Climate change impacts on workplace heat extremes: Health risk estimates and adaptive options***

Elizabeth Hanna, Australian National University

Despite its hot climate, Australia has no national guidelines to protect people who work in the heat. This represents an existing health challenge that will be significantly exacerbated as Australia warms within the projected range of 2-4°C by 2070. A policy vacuum exists as we have

little understanding about the thermal working environment for Australians. Evidence is lacking about direct heat exposures, worker tolerance levels, early symptoms, the adoption of personal and industry strategies, and which of these are effective in averting heat stress. This innovative project aims to fill that knowledge gap by studying the current effects on health and productivity of heat-exposed workers, and modelling future trends in likely impacts under climate change in eight urban and rural regions, with and without adaptive health protection strategies.

## IMPACTS ON DISADVANTAGED GROUPS

### ***Displaced twice? Investigating the impact of Queensland floods on the wellbeing and settlement of a cohort of men from refugee backgrounds living in Brisbane and Toowoomba***

Ignacio Correa-Velez, La Trobe University

In December 2010, a longitudinal study of health and settlement among 233 refugee men living in urban and regional southeast Queensland (SettleMEN project) was completed. Findings revealed significant improvements over time in their subjective health status. At least 40% of the SettleMEN participants, however, live in areas subsequently affected by the devastating southeast Queensland floods in January 2011. This project will compare the recent pre-disaster measures of health and settlement and offer a rare opportunity to investigate the impact of an environmental disaster on a resettled refugee population. The study will generate new knowledge of elements and resources that best support resettled refugee men and their families to adapt successfully to environmental disasters.

### ***Climate change and the welfare sector – Risk and adaptation of Australia's vulnerable and marginalised***

Karl Mallon, Australian Council of Social Services (ACOSS)

Services provided to disadvantaged individuals by community welfare service organisations and communities comprise a critical component of social infrastructure. These are the people who are least resilient to adverse changes in circumstance, and will be affected first and worst by climate change impacts to infrastructure and the built environment. This project will research the sectors in society most vulnerable and least able to adapt to climate change in urban, regional and remote settlements, the nature of these vulnerabilities, the underlying causes of vulnerability and the measures that can be taken to increase adaptive capacity and manage climate change related risks of infrastructure failure.

### ***Heat-ready: Adapting aged care facilities to prevent premature death in elderly Australians***

Deborah Black, University of Sydney

The project will investigate the capacity of aged care facilities to adapt to increasing periods of extreme heat. It will examine policies, procedures, knowledge and environmental factors such as building design and cooling equipment used in aged care facilities in three Australian states and recommend ways they can adapt to prevent premature death from extreme heat in elderly residents.

### ***Extreme heat and climate change: adaptation in culturally and linguistically diverse (CALD) communities***

Peng Bi, University of Adelaide

Do cultural, socio-economic and language factors affect a person's vulnerability to climate change? This project will study culturally diverse communities in three Australian cities: Adelaide, Melbourne and Sydney to identify factors that may affect people's vulnerability to climate change, and particularly hot weather. It will identify groups of people that may be more vulnerable, explore the behaviour they use to adapt to extreme heat, and their perceptions of climate change and recommend ways to increase their capacity to adapt, such as cross-cultural information materials.



## BUILDINGS INFRASTRUCTURE AND EXTREMES

### ***Impacts and adaptation response of infrastructure and communities to heat waves - the southern Australian experience of 2009***

Jim Reeves, Queensland University of Technology

This study details the impact, vulnerability and adaptation responses, at state and local government level, to the unprecedented heatwave that struck Victoria and South Australia in early 2009. It focused on the failures in utilities and related infrastructure, and on emergency management and human health impacts. It analyses institutional responses and identifies lessons learnt for sectors, regions and communities.

### ***Adaptation of the built environment to climate change-induced increased intensity of natural hazards***

David King, James Cook University

This project will examine the likely impacts on the built environment of increased intensities in weather-related natural hazard events, and identify possibilities for the adaptation of regulatory mechanisms in building construction, housing and planning. It will analyse climate change impacts on the built environment, and review existing regulatory mechanisms and their effectiveness. It will then model policy recommendations that provide for improved emergency management preparations and response capabilities across a wide range of agencies and organisations.

### ***Damage to buildings during the 2010-2011 Eastern Australia flooding events***

Matthew Mason, Macquarie University

Insured losses from the 2010-11 floods approached \$3 billion. When accounting for damage to essential infrastructure, lost productivity and the under- or non-insured, the true cost is several times this value. Many affected properties have a history of flood damage, which shows there are clear deficiencies in our ability to adapt to or mitigate the impact of this hazard. This research will detail the extent of damage to buildings during the recent Eastern Australia flooding and explore the role planning and design/construction regulations played in these failures. It will highlight weaknesses in the current systems and propose effective solutions to mitigate future damage and financial loss under current or future climates.

### ***Rental housing, climate change and adaptive capacity: A case study of Newcastle, NSW***

Lesley Instone, University of Newcastle

This project will produce best-practice guides for landlords and tenants to enhance the capacity of the 27% of Australians who live in rental accommodation to adapt to climate change. Research indicates that there is a low take-up of retrofitting rental properties for climate change, as there are disincentives for landlords to install modifications that primarily financially benefit tenants. Low-income renters are particularly vulnerable to climate change, and already face significant housing and utility stress. This project will work with both renters and housing managers/landlords to develop more effective ways of facilitating adaptation to climate change in the rental sector.

## EXTREMES, RESILIENCE AND ADAPTIVE CAPACITY

### ***Agent based simulation framework for improved understanding and enhancement of community and organisational resilience to extreme events***

Lin Padgham, RMIT University

Agent-based modelling is a means of analysing systems by simulating the actions and interactions of the individual elements or 'agents' they comprise. This project aims to develop an agent-based simulation platform that allows emergency management stakeholders to explore complex multi-scale, multi-actor, emergency management interactions under uncertain future conditions in order to promote more effective governance arrangements. The platform is also intended to be a long-

term decision support tool suitable for the development of agent-based simulations that address a range of extreme events, such as coastal flooding and heat stress.

### ***Analysis of institutional adaptability to redress electricity infrastructure vulnerability due to climate change***

John Foster, University of Queensland & Deepak Sharma, University of Tech, Sydney

This project will examine the capacity of Australia's National Electricity Market (NEM) to adapt to existing and predicted climate change conditions. It will identify potential issues and analyse climate change impacts on reliability in the Market under different climate change scenarios to 2030, particularly what adaptation strategies the power generation and supply network infrastructure will need.

### ***Recovery from disaster experience: Its effect on perceptions of climate change risk and on adaptive behaviours to prevent, prepare, and respond to future climate contingencies***

Helen Boon, James Cook University

This project aims to identify private and public sector groups' beliefs, behaviours and policies that have supported community resilience to a disaster event and construct a model with findings to help implement appropriate and equitable emergency management policies and mitigation strategies for climate change events.

### ***Exploring the adaptive capacity of emergency management using agent-based modelling***

Lin Padgham, RMIT University

Little is known about how societies, organisations and individuals are responding or might respond to the challenges of climate changes. This project uses agent-based modelling that combines social science research and technical computing to explore a range of potential future scenarios at a scale that is not possible without computer support. It provides the opportunity for a wide variety of stakeholders to work together with the community using a practical tool to determine solutions to evolving changing climate impacts.

### ***Robust optimization of urban drought security for an uncertain climate***

George Kuczsera, University of Newcastle

Recent experience with drought and a shifting climate has highlighted the vulnerability of urban water supplies to "running out of water" in Perth, southeast Queensland, Sydney, Melbourne and Adelaide. This has triggered major investment in water infrastructure. With the prospect of rapid population growth in cities, drought security will become more pressing particularly in the face of climate uncertainty. This project will develop and illustrate an urban drought security method that identifies solutions that are both optimal in a triple-bottom-line sense and robust against uncertain knowledge about future climate change.

### ***Understanding the Pacific's adaptive capacity to emergencies in the context of climate change***

Juliet Willetts, University of Technology, Sydney

This project will assess Australia's current emergency response systems, the Pacific Islands' current systems, and their future needs in order to enable better preparedness in the event of disaster. This project aims to gather in-depth information from experts in the Pacific across four sectors: healthcare; food and nutrition; water and sanitation and the psychosocial needs of populations.

### ***Aboriginal responses to climate change in arid zone Australia - Regional understandings and capacity building for adaptation***

Paul Memmott, University of Queensland

Using the Upper Georgina River Basin as a case study, this project will document Aboriginal perceptions and knowledge of climate change, and the capacity of regional communities to respond and adapt to climate change at a number of levels. Based on these findings, a set of regional climate adaptation planning goals, principles and strategies will be generated, which will be able to be extrapolated for other arid zone regions.



## LIVING WITH EXTREMES

### ***Investigating factors that inhibit and enable adaptation strategies following the 2010/11 floods***

David King, James Cook University

This project will identify the factors that inhibit and enable adaptation strategies within communities by exploring issues of underlying vulnerability and constraints to recovery as well as adaptation and risk reduction strategies. It will focus on case study sites in Emerald, Qld, suburbs of Brisbane, and Donald in Victoria, all of which suffered severe loss from flooding in the summer of 2010/11.

### ***A spatial vulnerability analysis of urban populations to extreme heat events in Australian capital cities***

Margaret Loughnan, Monash University

This study will identify threshold weather conditions for mortality in Australian capital cities, describe spatial distribution of human vulnerability to extreme heat, and provide information to target emergency responses during heat waves. Baseline risk assessments will be used to predict changes in vulnerability in relation to predicted changes in climate extremes associated with climate change.



### ***Living with floods: Key lessons from Australia and abroad***

Karen Hussey, Australian National University

The project will compare findings from current flood inquiries underway in Queensland, Victoria and New South Wales with studies from the US, China and the Netherlands. It aims to identify key lessons that could help local and state governments, emergency services and resource managers prepare for future floods.

### ***A framework for adaptation of Australian households to heat waves***

Wasim Saman, University of South Australia

What is the likely impact of heat waves on Australian homes and on the electricity infrastructure in Australia's various climate regions? This project will plan for a national framework that would: develop new summer design conditions for 2030 and 2050 for up to 100 Australian climate zones; establish new thermal comfort criteria for buildings; evaluate the impact of climate change on annual household cooling energy use and peak power demand; examine householder behaviour during heat waves; develop design options to ensure safety and comfort during heat waves, and develop affordable new design options for buildings to avoid heat stress.

### ***Social networks analysis – Bridging degrees of separation to enhance climate change adaptation***

Susan Kinnear, Central Queensland University

This project aims to maximise climate change adaptation in the water sector, particularly through more effective infrastructure management. It will collaborate with local and state government and industry bodies to collect qualitative and quantitative data on adaptive responses to increased climatic variability, through examples of responses to flooding caused by extreme rainfall events and managing supply/demand pressures on municipal water supplies due to changes in flows. It will analyse the transmission of this information within and between organisations and use the findings to inform regional, state and national policy development, stakeholder interactions, and institutional/governance structures in water supply, infrastructure, disaster response and land use planning.

### ***The right tool for the job – Achieving climate change adaptation outcomes through improved disaster management policies, planning and risk management strategies***

Michael Howes, Griffith University

Australia is highly susceptible to climate change impacts such

as more frequent and/or intense floods and bushfires. There is considerable uncertainty about when and how disaster management organisations should address climate change adaptation and the priority that should be granted compared to other problems. This project will create a nationally consistent approach with a supporting set of risk assessment tools to identify potential conflict, improve stakeholder engagement, and integrate climate change adaptation into disaster management. The tools are derived from a comparison of case studies including the 2010–11 Queensland floods; the 2009 Victorian bushfires; the 2011 Perth hills bushfires and statewide risk profiles. The research will improve policymaking, planning and emergency risk management by decision makers at all levels of government.

## CASE STUDIES OF EXTREMES

### ***Adaptation lessons from Cyclone Tracy***

John McAneney, Macquarie University

This case study reviews the impact of the December 1974 Tropical Cyclone Tracy on the city infrastructure and people of Darwin, and examines the engineering, institutional and regulatory responses that it invoked and the relevance of these lessons for future events.

### ***East coast lows and the Newcastle-Central Coast Pasha Bulker Storm***

Garry Willgoose, University of Newcastle

The storm that hit Australia's east coast in June 2007 was one of the most significant weather events in Australian history, causing the fourth largest recorded insurance loss. Impacts included flash flooding in Newcastle city, general flooding of the Hunter River, high winds and waves, the loss of electricity to 300,000 people for 4 days, a halt to coal export chain for two weeks and the loss of five lives. This project provides a whole-of-government, business and community perspective on adaptation measures being put in place as a result of knowledge gained from the experience during and immediately after the storm, and adaptation measures being put in place following subsequent reflection on ways of better preparing for such storms.

### ***The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity***

Armando Apan, University of Southern Queensland

A warmer climate, with its increased climate variability, will increase the risk of floods, and the accompanying damage to people, property, and the environment. Focusing on two flood events in Mackay and Charleville in 2008, this study aims to enhance understanding of the vulnerability, resilience and adaptive capacity of people and communities to flooding, and to assess the extent to which flood mitigation measures have been implemented. It will explore how societies that are regularly flooded operate and the characteristics of their resilience or non-resilience, as well as the characteristics of communities that are 'on the edge', where flooding might push them into nonviability. The findings will provide information, knowledge and insights on how various stakeholders can better respond and adapt to flood events.



### ***Storm tides, coastal erosion and inundation***

Rodger Tomlinson, Griffith University

This case study examines the socio-economic vulnerability and adaptation responses to extreme coastal storms that result in severe erosion and coastal inundation. It reviews past technical, planning and regulatory responses to extreme tide events, erosion and flooding and their effectiveness for future events. It seeks to identify additional alternative strategies to improve management of future events.

## NCCARF Adaptation Research Networks

NCCARF's Adaptation Research Networks are a community of researchers and practitioners working together to progress climate change adaptation knowledge. Established in 2008, there are eight Networks representing various themes. Each Network is convened at an Australian research institution, chosen through a competitive bidding process. In under four years, they have made a significant and growing contribution towards the advancement of climate change adaptation knowledge across the nation. With over 5000 members, the Networks effectively connect and rapidly communicate with researchers and research end users in government and vulnerable sectors and communities.

## Emergency Management Adaptation Research Network

**The Emergency Management Network, convened by Professor John Handmer, is hosted by RMIT University.**

In order to run activities nationally, Networks have partners across Australia. Network partners provide in-kind support for Network activities and often receive support from the Network hub to run regional events and activities.

### Emergency Management Network partners include:

- Australian National University
- Australian Fire and Emergency Services Authority Council
- Climate Centre, Monash University
- Fire and Emergency Service Authority (WA-FESA)
- James Cook University
- Macquarie University
- NSW Rural Fire Service
- NSW State Emergency Service
- Planning Institute of Australia
- RMIT University
- University of Western Australia
- University of Western Sydney

**Collectively, the Networks have also provided over \$1,000,000 in travel and research grants for students and early career researchers. Extreme weather projects include:**

- Daniel Welsh: Heat stress in rainforest trees
- Michelle Ho: Factors controlling floods and droughts in the Murray-Darling Basin
- Keziah Nunn: Understanding the impact of increasing drought on vulnerable systems
- James Camac: The interactive effects of fire and climate change on vegetation in the Australian Alps
- Gabriele Caccamo: Cross-scale analysis of the relationship between moisture and fire behaviour in the Sydney basin

## Recent NCCARF events related to extreme weather

### Seminars:

- Adapting agriculture management to cope with high-intensity rainfall
- Challenges of fire management: Perspectives from a developing country, Botswana
- Climate change and emergency management - Can we plan to adapt?
- Climate change and extreme events: Understanding and managing the risks
- Climate change, natural disasters and property losses
- Flood, famine and dangerous weather: What can the past tell us about adapting for future climate change?
- Flood recovery in the UK
- Managing the unavoidable - Natural catastrophes
- Learning and change for reducing disasters and increasing adaptation: schools and organisations
- Principles and guidelines for assessing and reducing vulnerability to climate change
- Surveillance strategies for improved emergency management - an international perspective
- Un-natural disasters: the fractured science and politics of climate change
- Visions of sharing responsibility for disaster resilience

### Workshops:

- Forum on climate change and adaptation - Cities
- Urban systems and climate change adaptation
- Legal and policy aspects of adaptation to extreme events



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