climate extremes
ARC centre of excellence

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The ARC Centre of Excellence for Climate Extremes

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Committee Secretary
House of Representatives Standing Committee on Regional Development, Infrastructure and Transport
PO Box 6021
Parliament House
Canberra ACT 2600

Submission to House of Representatives Standing Committee on Regional Development, Infrastructure and Transport Environment and Communications Legislation Committee

Dear Committee Chair,

Inquiry into the implications of severe weather events on the national regional, rural and remote road network

The **ARC Centre of Excellence for Climate Extremes** welcomes the opportunity to make a submission in relation to Inquiry into the implications of severe weather events on the national regional, rural and remote road network. We applaud the committee in highlighting this issue and support the committee in their investigations.

We agree with the committee's desire to improve climate resilience and support Australian communities. The road network is and will be exposed to severe weather and climate hazards for many years to come, with risks associated with both weather and climate growing through time. The impacts to Australian communities will be felt through interruptions to the road supply chains transporting resources like food, water and fuel as well as damage leading to social, environment and economic cost and prolonged isolation of small towns and rural settlements.

Our submission outlines the following aspects:

1. Climate and severe weather events
2. Physical climate risk in relation to Australia's road infrastructure
3. Defining climate resilient corridors

We thank the committee for the opportunity to make a submission on this important issue and offer our expertise on weather and climate extremes. We are happy to provide further information on matters arising from this submission where required.

Yours sincerely,

Professor Andrew Pitman
Centre Director
ARC Centre of Excellence for Climate Extremes

Australian Research Council (ARC) Centre of Excellence for Climate Extremes

The **Australian Research Council (ARC) Centre of Excellence for Climate Extremes** is Australia's leading climate science centre consisting of five partner universities - The University of New South Wales, Monash University, The Australian National University, The University of Melbourne and The University of Tasmania as well as multiple national and international partner organisations. Its research focuses on understanding the underlying processes of climate extremes to reduce Australia's economic, social and environmental vulnerability.

1. Climate and severe weather events

Climate and weather extremes are already affecting many facets of Australian society including infrastructure, human health, soil and water, agriculture, energy security, financial security and our natural environment, posing significant risks to the Australian and global economy. There are likely to be more intense extremes in the future, particularly for heatwaves and rainfall, along with more frequent swings from extreme droughts to flooding rains[1]. It is crucial that climate risk is considered across the infrastructure portfolio.

Current weather events already pose threats to the Australian road network. Our researchers have demonstrated short-duration, high intensity rainfall events, or rapid rain bursts, have increased by 40% over the past 20 years in the Sydney region[2]. The intensification trend found increases in the risk of severe and more frequent flash flooding with impacts to infrastructure, local ecological values, and economic loss from damage. Responses to events like these include design updates for flood control standards, drainage infrastructure as well as town planning and run-off analysis.

Australia's climate is warming slightly faster than the global average temperature and the first two decades of the 21st century were both warmer than any decade in the 20th century. The latest report from the United Nations' Intergovernmental Panel on Climate Change (IPCC)[3] states climate change is causing greater impacts than anticipated, and these impacts are emerging at lower amounts of warming than expected.

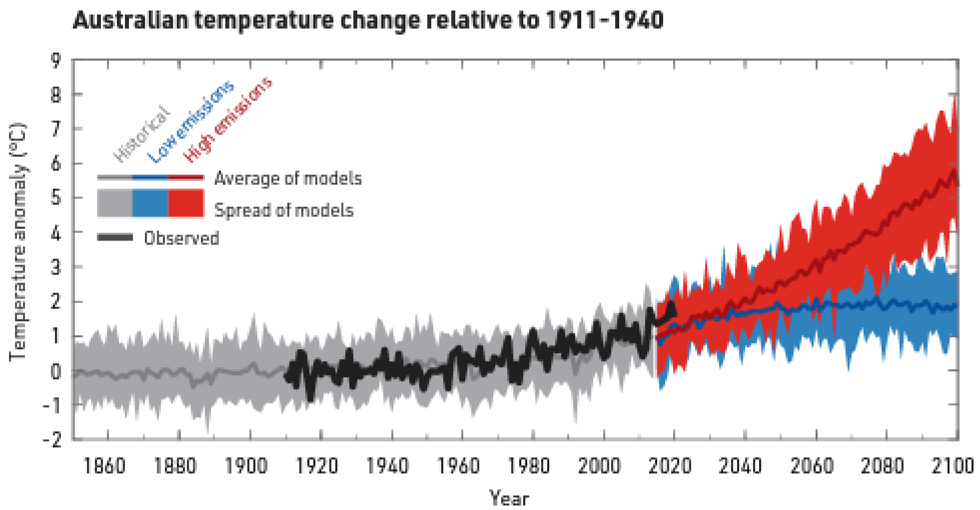
The number of days over 50°C has doubled since the 1980s worldwide, imposing threats to infrastructure as well as human health. The 2021-22 summer was recording breaking in Perth, with 11 days over 40°C, exceeding the previous record of 7 summer days over 40°C in 2015-16. Australia's hottest ever temperature of 50.7°C was recorded on the 13th of January 2022 in the coastal town of Onslow in Western Australia. Heatwave conditions are expected to worsen as the climate warms[4].

Every additional fraction of a degree of warming increases the risk of extreme weather events.

Rainfall variability and rainfall intensity is increasing; however, this is combined with long-term rainfall declines in some regions which will further intensify droughts[5], challenging water resources and bushfire management in some parts of the country impacting roads, towns and the environment.

It is certain that human influence has already warmed the atmosphere, ocean and land by 1.1°C above pre-industrial levels[6]. Australian surface temperatures will continue to rise until at least 2050 under all emission scenarios and further increases in climate extremes are inevitable[7]. Figure 1 demonstrates this dependency for Australia. The last report by the Intergovernmental Panel on Climate Change[8] underlined the urgent need for emissions reductions to limit warming to below 2°C in order to avoid dangerous climate change, as stated in the ambition of the Paris Agreement.

The impacts from climate extremes are likely to increase with the warming that is already locked in.



Adapted from article in *The Conversation* written by the ARC Centre of Excellence for Climate Extremes: https://theconversation.com/yes-a-few-climate-models-give-unexpected-predictions-but-the-technology-remains-a-powerful-tool-165611

Figure 1 – Australian mean annual temperature changes 1850-2100 from climate model simulations (models that are thought to simulate warming above or below that expected based on multiple lines of evidence have been removed – see "Climate models" box). The observations are sourced from the Australian Bureau of Meteorology (ACORN-SAT v2).

Figure 1

Future changes to Australia's climate depend on the cumulative total of greenhouse gases emitted over time. The more we emit now, the worse climate change will be in the future.

As a climate research centre, we have experience in understanding the causes of weather and extremes. We would like to highlight two aspects of climate research: uncertainty and compound events, which are important when considering severe events.

Uncertainty

Uncertainty is a fundamental component of physical climate risk. Uncertainty may arise from the current limitations of climate projections, natural variability of the climate system and our on-going increasing understanding of the climate system. This is coupled with the complexity of the climate's effect on society, in areas such as population, economics and political developments. This leads to uncertainty about quantifying specific climate variables and whether they will increase or decrease across Australia. For example: it is difficult to robustly predict if fire might impact a specific suburb despite knowing, on average, fire risk will increase.

Uncertainty frames how we consider physical climate risks.

Specific estimates of physical climate risks must consider uncertainty. Trying to provide certainty may be misleading or economically costly for road users and investors. Uncertainty is an important aspect when assessing risk. Ultimately, this has impacts on climate resilience measures and policy. Responding to risk may require bespoke solutions noting that this does lead to considerable time and effort to be implemented.

Compound events

Compound events involve multiple elements of weather and climate occurring simultaneously and causing an impact on a socioeconomic or ecological system[9,10]. They may arise from multiple hazards or drivers or may be a succession of hazards, or are hazards in multiple connected locations, or simply a more severe event as the result of preconditioning. For example: an increase in rainfall or in wind gusts of 10% in isolation are unlikely to be significant. However, if they both occur simultaneously the impact can be considerable. An East Coast Low affecting the Sydney Basin can increase water storages. Three East Coast Lows affecting the Sydney Basin within a few weeks could be catastrophic.

Australia has experienced a variety of compound events that have led to loss of life and negatively impacted the Australian economy over the past decades. Future climate change will lead to an increase in prolonged hot and dry compound events over all of Australia which is likely to increase wet and windy compound events in the northern parts of Australia dominated by tropical cyclones and thunderstorms, and a decrease in events in the south where fronts and frontal systems are the dominant drivers of extreme wind and rain.

Compound events should be considered in risk assessments when exploring future climate risk.

Our understanding of many compound events is insufficient to reliably assess the risk they pose. Current observational records are not sufficiently long and/or are too sparse to perform reliable statistical analyses. This means that we cannot be certain how well our climate models reproduce the interactions at play. The ARC Centre of Excellence for Climate Extremes continues to incorporate compound event research into its program of research.

2. Physical climate risk in relation to Australia's road infrastructure

The impact of severe weather on Australia's road network can and has often been destructive resulting from floods, extreme temperatures and inundation as well as human induced causes. As weather related disruptions become more significant with climate change, the extent to which this translates into risks for road infrastructure depends upon exposure to the hazard. Road infrastructure is exposed to multiple risks depending on location and the vulnerability of the road network.

Multiple hazard exposure makes assessing risk for road infrastructure hard.

A review of current hazards including climate exposure can provide assurance for policy decisions and actions. However, it is important to provide a rationale for decisions before any investment. Any analysis or interpretation of climate hazard data to inform climate resilience decisions should performed cautiously and with expert help under a robust governance framework. Technical expertise can provide advice and produce information and guidance and should be undertaken with the help or through the climate science community. It is important to convey information in a useful way, for example, describing hazard exposure through ranges such as: severity, likelihood, duration, and frequency, confidence. This helps to convey uncertainty and is not quantitative.

Assessing physical climate risk through an initial assessment of current exposure of the road infrastructure using historical observed severe weather events can provide a useful starting framework for a risk assessment. A storyline approach to future climate scenarios can provide an extension to this assessment and include multiple lines of evidence for a qualitative defensible approach focussing on future risk. These strategies are necessarily customised unfortunately.

A potential governance framework should record and provide assurance around climate data including methodology, assumptions, sources of data, what was used, where it came from, how it was generated and how uncertainty is communicated.

3. Climate resilient corridors

As outlined above, climate data can inform standards and design requirements in the context of uncertainties around different possible futures. However, climate data for projections is unable to provide robust quantitative data around such defined concepts as 'climate resilient corridors' in most circumstances. Using climate projections can provide very helpful guidance around future risk, but not reliably enough to identify corridors. These might be defined using information such as topographic data, or soils data. Once defined, aspects of climate risk could be added in useful ways. The converse – using climate projections to suggest a 'climate resilient corridors' will, in general, not be possible. I note exceptions here – one suspects 'climate resilient corridors' will not for example exist close to the ocean or along some flood plains, but these would commonly be identified as vulnerable in the current climate.

Submitted to:
Committee Secretary
Senate Standing Committees on Environment and Communications
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For further information on this submission, please contact:
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