



UNPACKING THE IPCC FIFTH ASSESSMENT REPORT: IMPACTS, ADAPTATION, AND VULNERABILITY (WORKING GROUP II)

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

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1. What is the IPCC and how does it work?

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). Every five to seven years the IPCC publishes an Assessment Report (AR) providing a comprehensive synthesis of information about human-induced climate change. The Reports focus on three key aspects: the physical science of climate change (Working Group I), impacts, adaptation, and vulnerability (Working Group II), and mitigation strategies (Working Group III). In 2007 the IPCC was awarded the Nobel Peace Prize in recognition of its work to disseminate knowledge about climate change and actions needed to counteract the risks.

The IPCC report process is a global endeavour with hundreds of authors. The draft reports are subject to intense scrutiny by expert reviewers and governments (Figure 1). The final version of the Summary for Policymakers (SPM),

a document that accompanies the report, is approved line-by-line by member countries prior to its release.

Working Group I of the Fifth Assessment Report (AR5), covering the physical science, was released on 27 September 2013. The report found that warming of the climate system was unequivocal, with scientists more certain than ever before that global warming since 1950 has been caused primarily by human activities. It also confirmed that climate change is already influencing the frequency and intensity of many extreme weather events, with substantial reductions in greenhouse gas emissions necessary to stabilise the Earth's climate.

AR5 WGII was released on 31 March 2014, and AR5 WGIII will be launched on 13 April 2014. This Climate Council report summarises the key messages from the Working Group II report on climate change impacts, adaptation, and vulnerability.

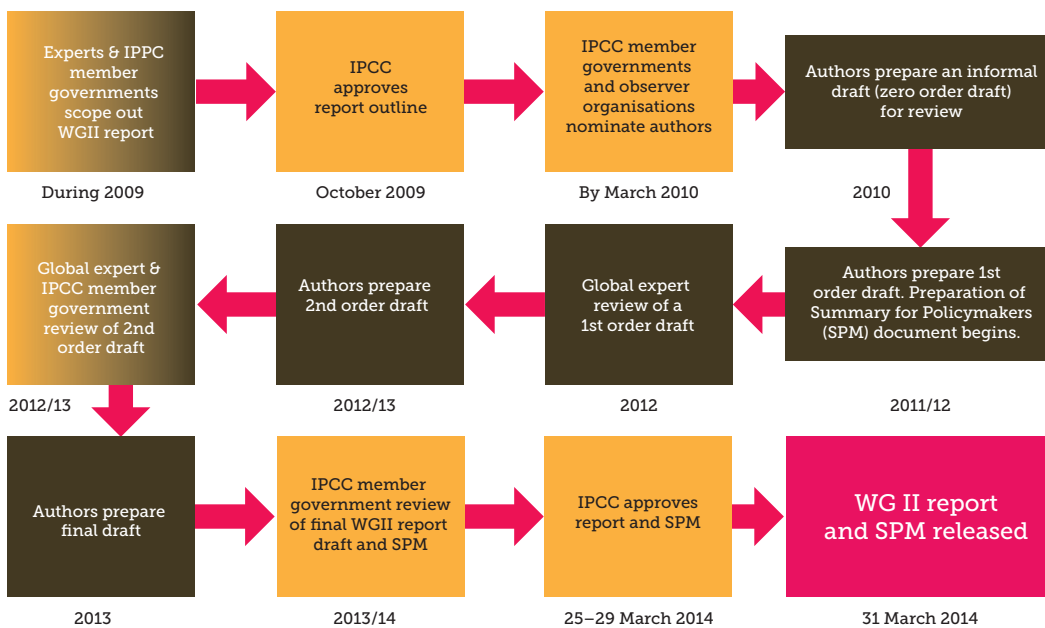
IPCC REPORTS ARE GLOBAL ENDEAVOURS

This latest IPCC report was a global endeavour, involving more than 300 convening lead authors, lead authors, and review editors from 70 countries. There were an additional 436 contributing authors. The report underwent four drafts, each of which was subject to extensive review. The first and second drafts received more than 48,000 comments from more than 1,700 expert and government reviewers. Each comment was responded to in writing. Chapter 25, which focuses on the Australasian region, includes almost 1000 references.

IPCC REPORTS ARE ASSESSMENTS OF PEER-REVIEWED SCIENCE

The IPCC reports are not simply summaries or literature reviews; they are a product of comprehensive judgements made by experts. Each finding is evaluated in terms of the *strength* and *agreement* of the evidence, leading to a statement of *confidence* in the conclusion.

IPCC Assessment report process: WGII AR5



Grey represents Scientific contribution
 Yellow represents IPCC member governments, observer organisation contribution

Figure 1. The IPCC Working Group II Fifth Assessment Report process and timeline.

IPCC AR5 WGII FACTS AND FIGURES

Number of convening and lead authors, expert reviewers: **309**

- > Chapter 25 (Australasia): **8**
- > Number of contributing authors: **37**

Number of countries represented on writing teams: **70**

Total number of expert and government comments received on first and second order drafts: **48,142**

- > Chapter 25: **1,127**

All comments were responded to in writing.

Total government comments received on final draft SPM: **2,350**

Total references in final version Chapter 25: **971**

2. Key messages

- 1. The IPCC reports conclude that climate change is occurring as a result of human activities. This latest report from Working Group II confirms and reinforces the findings of the previous assessment report (AR4) published in 2007.**
 - in Melbourne expected to increase by 20 to 40% by 2030, and by up to 190% by 2070.
 - › The iconic Great Barrier Reef is under threat. Under current rates of ocean warming and acidification, coral reef systems could be eliminated by mid- to late-century. If average global temperatures rise above 2°C it is expected that few coral-dominated systems will survive.
 - › There are risks from increased frequency and intensity of flooding from extreme rainfall events, causing damage to infrastructure.
- 2. There is increased evidence that climate change is already affecting many natural and human systems and poses significant risks to human health, ecosystems, infrastructure, agricultural production and communities.**
- 3. Key findings for Australia include:**
 - › Marked decreases in agricultural production in the Murray-Darling Basin and south western and south eastern Australia could occur if projections of severe dry conditions are realised.
 - › There are significant future risks of increased loss of life, damage to property, and economic loss due to bushfires in southern Australia.
 - › Since 1950 hot extremes have become more frequent and intense, while cold extremes have become rarer. Increased hot weather is expected to hit major population centres, with hot days, for example,
- 4. Reducing the risk in Australia of water shortages, bushfire weather, extreme heatwaves, and decreased agricultural production will depend on how rapidly we are able to reduce carbon emissions locally and globally, and on the how effectively we are able to implement adaptation measures.**
- 5. The IPCC is the most authoritative international body on climate change science and impacts. IPCC assessment reports are subject to an extremely rigorous review process.**

3. What's new in this report?

- › This report emphasises that there is now even more evidence that climate change presents serious risks to the world.
- › Compared to previous assessments, the levels of risk associated with extreme events and the distribution of impacts are similar, but can be assessed with higher confidence.
- › Once temperatures reach 2°C or more than the recent period (1986–2005), the risks to unique and threatened ecosystems and those associated with large-scale events (such as tipping points in the climate system) are now considered to be even higher than previously assessed.

4. Climate change is having serious, diverse effects globally

Climate change is already having significant impacts on species and ecosystems and this is projected to continue in the future (Figure 2). There have been observed changes in the ranges, seasonal behaviours, migration patterns, and populations of both terrestrial and marine species. Many regions of the world are also experiencing changing rainfall patterns, and in some areas, melting ice and snow have affected water resources and water quality. Glaciers, especially in the Himalayas, have also been significantly

affected by rising air temperature and are continuing to shrink rapidly, threatening surrounding ecosystems and communities that rely on them as a water source.

Climate change has had a negative impact on crop and agricultural food production in many regions, including some in Africa and Europe. Climate change has also likely contributed to the global burden of ill-health, particularly through increased deaths due to heat-related events.

Small island states, including several in the Pacific, are particularly vulnerable to multiple risks posed by climate change, and are expected to feel a heavy economic and health burden. Rising sea levels create a higher risk of erosion and coastal flooding and are a serious threat to freshwater supplies. Local agriculture and fisheries are also likely to feel negative impacts, affecting local food security. In these states, climate change will compound existing issues such as resource degradation.

Increasing ocean temperatures and acidification will continue to threaten the Earth's polar and marine regions. Ocean acidification in Antarctica poses a risk

to the development of zooplankton, with wide-reaching and devastating effects on marine food webs. In the Northern Hemisphere, Arctic sea ice is melting more rapidly than the upper limits of most model projections and similar observations have been made in parts of Antarctica.

People living in poverty are, and will be, hardest hit by the effects of climate change. Vulnerable communities will continue to struggle to cope with additional pressures created by climate change, including impacts on crop yields, infrastructure, communities and livelihoods.

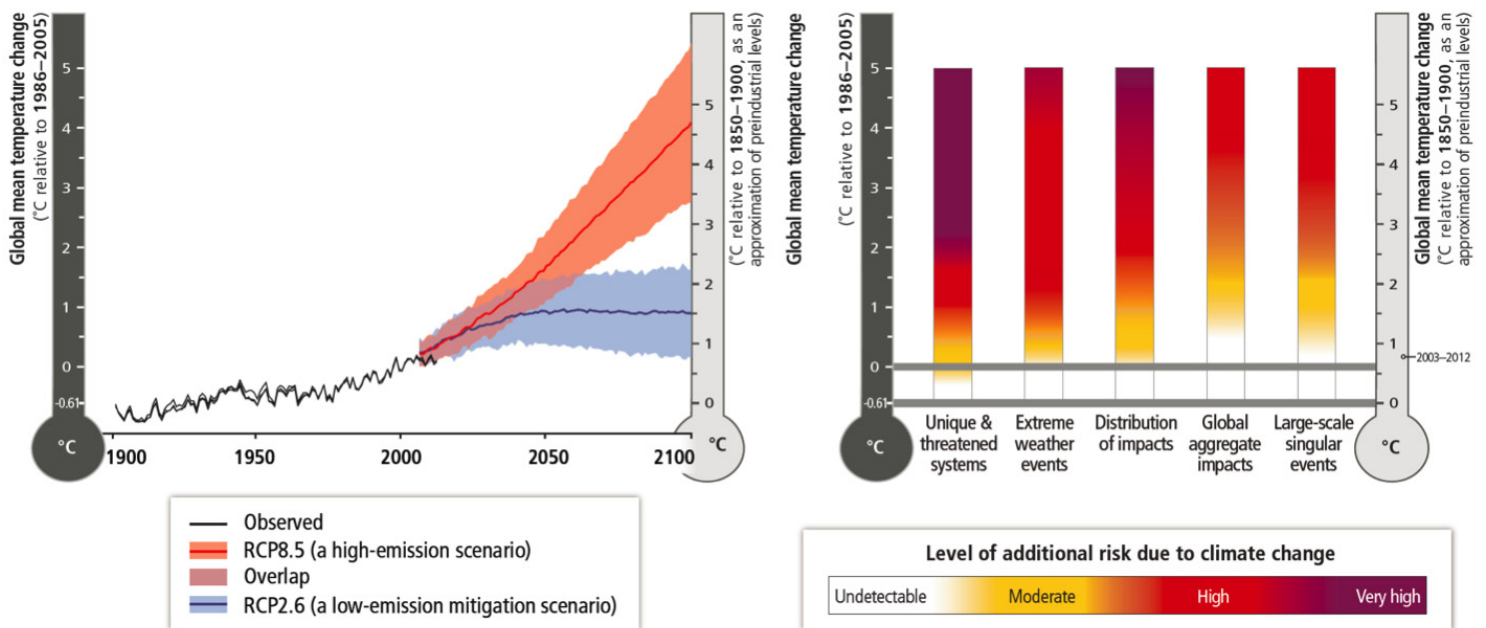


Figure 2. A global perspective on climate-related risks. Risks associated with reasons for concern are shown at right for increasing levels of climate change. The color shading indicates the additional risk due to climate change when a temperature level is reached and then sustained or exceeded. Undetectable risk (white) indicates no associated impacts are detectable and attributable to climate change. Moderate risk (yellow) indicates that associated impacts are both detectable and attributable to climate change with at least *medium confidence*, also accounting for the other specific criteria for key risks. High risk (red) indicates severe and widespread impacts, also accounting for the other specific criteria for key risks. Purple, introduced in this assessment, shows that very high risk is indicated by all specific criteria for key risks. For reference, past and projected global annual average surface temperature is shown at left. Based on the longest global surface temperature dataset available, the observed change between the average of the period 1850–1900 and of the AR5 reference period (1986–2005) is 0.61°C (5–95% confidence interval: 0.55 to 0.67°C), which is used here as an approximation of the change in global mean surface temperature since preindustrial times, referred to as the period before 1750. Source: IPCC 2014a

5. What does this mean for Australia?

Climate change is already affecting Australia. The regional climate is warming, and will continue to do so. While reducing emissions from burning fossil fuels will help to avert even more dangerous climate change, it will be very difficult to avoid some impacts entirely.

The IPCC Working Group II assessment report has identified a number of key risks facing Australia.

› **Extensive and permanent damage to coral reef systems in Australia, including the Great Barrier Reef and the Ningaloo Reef by mid-century**

Coral reef systems are particularly threatened by climate change and permanent damage to these systems may now be unavoidable. At the current rates of ocean warming and acidification, coral reef systems could be eliminated by mid- to late-century. If average global temperatures rise above 2°C it is expected that few coral-dominated systems will survive.

The oceans have absorbed the vast majority of additional heat from the enhanced greenhouse effect –

around 93%. The upper layer of the oceans, where coral reef systems are found, have absorbed most of this heat.

Increasing sea surface temperatures have already been driving significant changes in the species composition and structure of coral reefs around Australia. Increased sea temperatures have resulted in mass coral bleaching and mortality. Since the late 1970s there have been multiple mass coral bleaching events on the Great Barrier Reef and, most recently, on the Ningaloo Reef in Western Australia.

Increasing concentrations of carbon dioxide in the atmosphere means that more carbon dioxide is dissolved in the ocean. The increased ocean acidity that results poses significant risks for corals and many other marine organisms that form shells and skeletons from calcium carbonate.

Climate-related stressors on coral reef systems are exacerbated by non-climate stressors, further reducing their resilience. These include tourism, overfishing, sediment runoff and shipping.

› **The loss of mountain ecosystems and the extinction of some native species in Australia due to increasing temperatures and fire risk**

Montane ecosystems – those at high altitudes – are also very vulnerable to the impacts of climate change. As with coral reef systems, some impacts on montane systems are likely be unavoidable, although reducing emissions will reduce the risks.

These systems are threatened by a combination of rising temperatures and reductions in snow cover, along with increased fire risk and a trend to drier conditions. Native species in these and other environments are likely to be at increasing risk of population reductions, habitat loss, and extinction. Overall, the rate of climate changes we are currently experiencing is likely to be too fast for most species to be able to adapt.

Other key regional risks are likely to be severe, but may be reduced with strong mitigation and adaptation measures.

› **Increased frequency and intensity of intense rainfall causing flooding**

Flooding in Queensland in 2011 caused significant damage to regional infrastructure and housing, and was responsible for 35 deaths. Similar flooding events may become more frequent in the future. The intensity of extreme daily rainfall and short duration extremes in Australia has increased. Projections for the future are varied, but increases in the intensity of extreme daily rainfall will be more likely in areas where average

rainfall is also predicted to increase, such as in the north of the Northern Territory and Western Australia.

› **Limited water resources in southern Australia, due to higher temperatures and decreased rainfall**

Southwest Australia has experienced decreases in autumn and winter rainfall since the 1970s, and the southeast has experienced decreased autumn and winter rainfall since the 1990s. Increased drought frequency is expected in southern Australia, with decreases in the amount of rainfall by as much as 10% by 2030, and by up to 30% by 2070. These upper-limit scenarios would have important implications for regional agriculture, rural livelihoods, ecosystems, and urban water supply.

Uncertainty in the scale of projected rainfall changes means that effective adaptation to these risks will be particularly challenging.

› **Increased negative health outcomes (death and morbidity) and infrastructure damage associated with more frequent and intense heatwaves**

An increased number of hot days is one of the most direct consequences of global warming. Air temperature in Australia has increased at a rate of 0.09°C each decade since 1911. Since 1950 there has been significant warming across the continent, particularly over inland areas (Figure 3). Hot days and hot nights have become more frequent.

Similarly, hot extremes have become more frequent and intense, while cold extremes have become rarer. Increased hot weather is expected to have significant impacts in major population centres, with hot days, for example, in Melbourne expected to increase 20 - 40% by 2030, and up to 190% by 2070.

Heatwaves are also projected to increase in frequency and intensity. The 2009 Victorian heatwave was associated with over 300 excess deaths and contributed significantly to increased heat-related morbidity. Vulnerable sections of society, such as the elderly and people with pre-existing medical conditions, will be affected disproportionately.

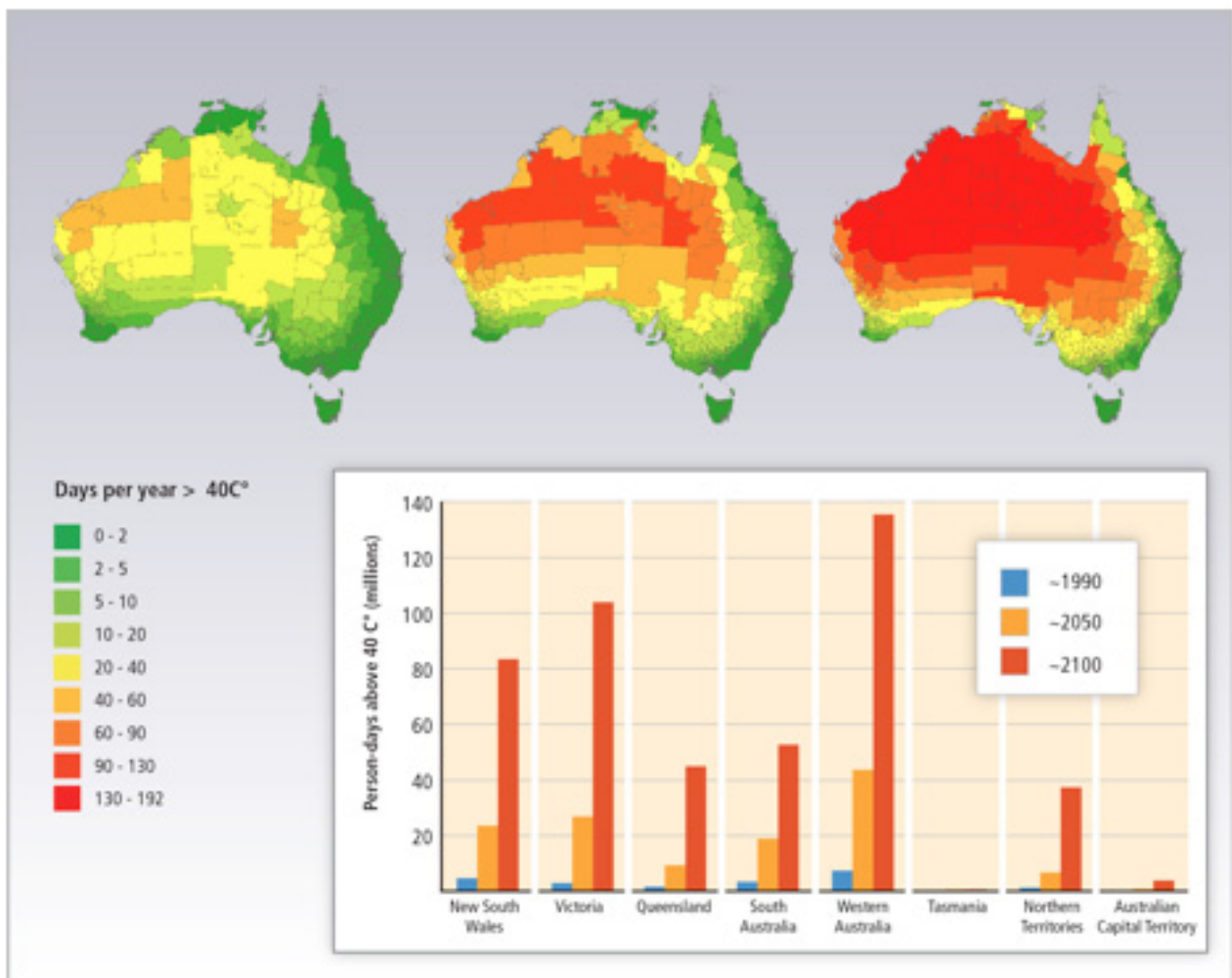


Figure 3. Projected changes in exposure to heat under a high emissions scenario (A1FI). Maps show the average number of days with peak temperatures >40°C, for ~1990 (based on available meteorological station data for the period 1975-2004), ~2050 and ~2100. Bar charts show the change in population heat exposure, expressed as person-days exposed to peak temperatures >40°C, aggregated by State/Territory and including projected population growth for a default scenario. Future temperatures are based on simulations by the GFDL-CM2 global climate model (Meehl et al., 2007), re-scaled to the A1FI scenario; simulations based on other climate models could give higher or lower results. Data from Baynes et al. (2012). Source: IPCC 2014b

› **Increased loss of life, damage to property, and economic loss due to bushfires in southern Australia**

The intense 2009 Victorian bushfires caused 173 deaths and destroyed over 2,000 buildings. Similar bushfire events may become more frequent. Australian fire danger weather has increased in some areas around Australia since the 1970s. Hotter and drier conditions in southern Australia mean that fire danger weather is projected to increase in this region. Under certain scenarios, Australia is likely to see an increase in days of very high and extreme fire danger. For example, Canberra currently experiences an average of 17 days per year of very high and extreme fire danger index. This is expected to increase to 18-23 days by 2020, and to 20-33 days by 2050.

The severity of some key regional risks is dependent on a large range of climate variables, even for a particular global average temperature increase. However, if the most extreme scenarios occur, these risks would be severe.

› **Damage to coastal infrastructure and low-lying ecosystems from sea level rise under high-end scenarios**

Sea level around Australia has been rising at an average rate of 1.4mm per year. Sea-level rise is projected to increase erosion and inundation of low-lying ecosystems, and to damage infrastructure and housing. Sea level rise around Australia in the future is very likely to be greater

than the historical rate. There is very high confidence that over the next few centuries average sea level will continue to rise.

› **Marked decreases in agricultural production in the Murray-Darling Basin and south western and south eastern Australia, due to severe dry conditions under high-end scenarios**

Widespread drought in southeast Australia (1997-2009), including the southern Murray Darling Basin was associated with a decrease in southern Murray Darling Basin GDP by nearly 6% in 2007/2008. Dry conditions and resulting economic downturn can have substantial impacts on local industry, the national economy, and the health (particularly mental health) of rural communities.

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Written by Professor Lesley Hughes. Professor Hughes was a lead author for the Australia and New Zealand chapter in the Working Group II contribution to the IPCC Fifth Assessment Report.

The full report can be accessed at www.ipcc.ch/report/ar5/