Earth Systems and Climate Change Hub

National Environmental Science Programme

climate change **science brief**

Reframing climate change projections for global warming levels

Climate change projections currently provide decision makers, industry and researchers with vital information about possible climate futures under a range of emissions scenarios.

There are now more users of climate change information and data than ever before, many with more sophisticated or different needs for future climate risk information. With these new users comes a new need to understand regional climate change impacts and implications under the international Paris Agreement targets of 1.5°C and 2.0°C above the pre-industrial era.

To meet this new need, the Earth Systems and Climate Change Hub has produced new climate change projections information which relate Australia's future climate to a range of future global warming levels. This allows users to visualise and compare Australian climate change impacts under different global warming levels.

Climate change projections

Climate change projections are based on internationally agreed scenarios of plausible future changes in greenhouse gas concentrations in the atmosphere, the most commonly used being the Representative Concentration Pathways (RCPs). Climate change projections that use this framework are useful for understanding climatic changes over time in response to global actions on mitigating greenhouse gas emissions.

Traditionally, climate change projections describe future changes compared to recent historic time periods, such as the period 1986-2005 used as the baseline for the Intergovernmental Panel on Climate Change Fifth Assessment Report. In contrast, the 2015 Paris Agreement describes the agreed global warming targets in terms of the degrees Celsius above the pre-industrial climate, aimed at keeping the global temperature increase below 1.5°C or 2°C.

The world has already warmed by around 1.1°C. A single year of 1.5°C warming could occur within the next few years, and the 10-year average could be at this level by around 2030 to 2050. But what do these global temperature targets mean for Australia?

Reframing regional climate projections

Climate change projections based on 'global warming levels' provide information on the change in a local climate when the global temperature has consistently reached the specified warming level. To produce these projections, estimates need to be produced on how much Australia has already warmed since the early 1850-1900 baseline period, and the global warming levels then need to be translated into Australian impacts.

This global warming level framework for projections is already being used more widely, for example in the guidelines of the Taskforce for Climate-related Financial Disclosures (TCFD), which the private sector uses to disclose and manage climate risk.

Decision makers are increasingly interested in information on what these global warming levels mean for their local climate. This is the case for Australia, where decision makers are already asking questions such as 'If the global average temperature is 2°C hotter than during the pre-industrial period, what will happen to temperature and rainfall in southwest Western Australia compared to today?'.

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Key Australian impacts under a warmer world

Earth Systems and Climate Change (ESCC) Hub researchers have applied the global warming level framework to better understand what key global warming levels (including 1.5, 2 and 3°C) mean for Australia. They found that:

- The Australian land area has warmed by about 1.44 ± 0.24°C since 1910. Since 1850-1900, Australia has warmed by around 1.6°C, which is similar to the global land average but more than overall global warming (estimated at 1.1°C across this period when also including oceans).
- Change to date suggests the Australian land area is warming at a ratio of 1.4 times the global average (including oceans). If this ratio also applies into the future, Australia would warm by 2.1°C when the globe has warmed by 1.5°C, and 2.8°C when the globe reaches the 2°C level. However this ratio may not remain the same through time.
- Climate models also give a range of estimated change for each warming level. For example, at a global value of +3°C, Australia is projected to be between 2.8° and 3.7°C warmer.
- Coastal regions and Tasmania are projected to warm less rapidly than inland regions of Australia.
- 2019 (Australia's hottest year on record) is roughly what we expect the average temperature in Australia to be under a future world that is 1.5°C warmer.
- Rainfall is projected to further decrease in southwest Western Australia for global warming of 1.5°C and above. Multiple lines of evidence suggest that rainfall is also *likely* to decrease in the southeast and east of the country, mainly in winter and spring (although there is low model agreement for annual rainfall change). Projections are more uncertain in summer and autumn.

> *In the future, Australia could warm by 2.8°C when the globe reaches the 2°C warming level.*

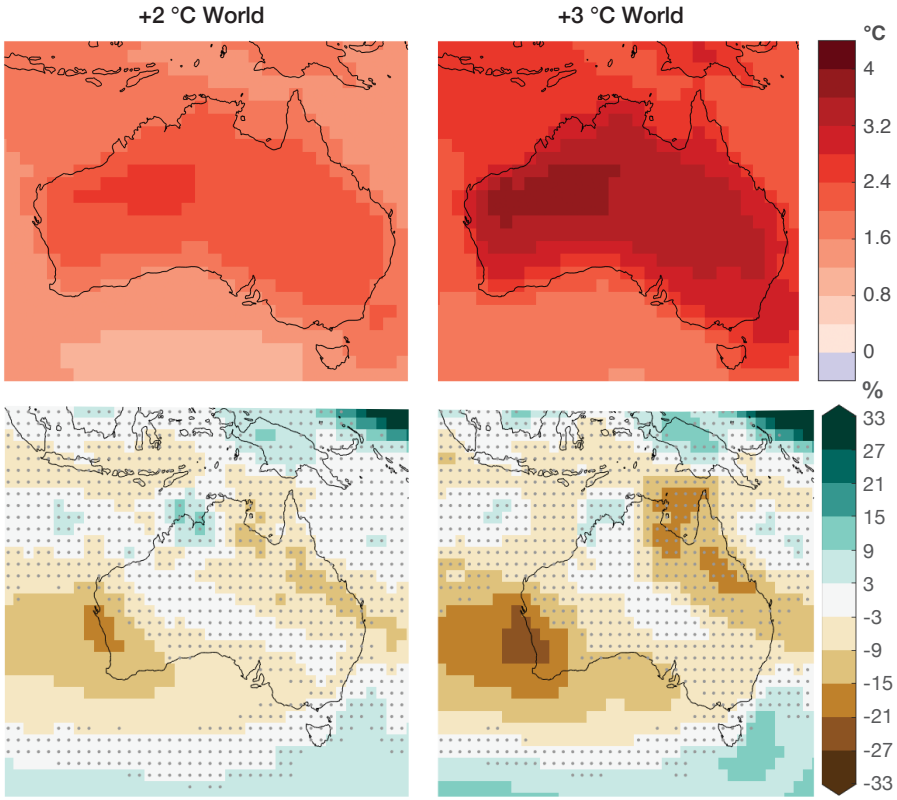

FIGURE 1 **Projected change in Australian average annual temperature (top) and cool season (May-October) rainfall (bottom) at 2°C and 3°C global warming levels, based on CMIP5 models.** Top: Temperature change is presented as °C change relative to 1850-1900. Bottom: Cool season rainfall change is shown as the percentage change relative to 1986-2005. Dots show where the model agreement is less than 80%. Change is quantified by 'time sampling' model simulations when their global temperature is near the warming level. Results are provided for a high emissions scenario (RCP8.5), but are similar under all RCPs that reach the warming levels shown. Annual and warm season rainfall maps can be accessed via the *Climate Change in Australia* website.

Communicating accessible and useful future climate change information

To communicate this new framing of Australian climate change projections, ESCC Hub researchers have updated Australia's national climate change projections website, *Climate Change in Australia*. The new web content provides information and guidance on the broader context around global warming level projections, including the current level of warming, when each level could be reached, how much each state and territory has warmed since the 1850–1900 baseline and much more.

Projections of global warming levels in use

Use of global warming levels for climate-related risk assessment is a relatively new field of work and there is still much to learn. ESCC Hub researchers have worked with business decision makers, through collaborative efforts such as the Climate Measurement Standards Initiative (CMSI), to develop practical ways to put the global warming level projections into practice, including for standard stress tests for the financial sector.

This research was led by ESCC Hub **Project 5.3: Regional climate change projections science and delivery**

National climate change projections for Australia can be found at:
www.climatechangeinaustralia.gov.au

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