NARCliM

Central West and Orana

Climate Change Snapshot

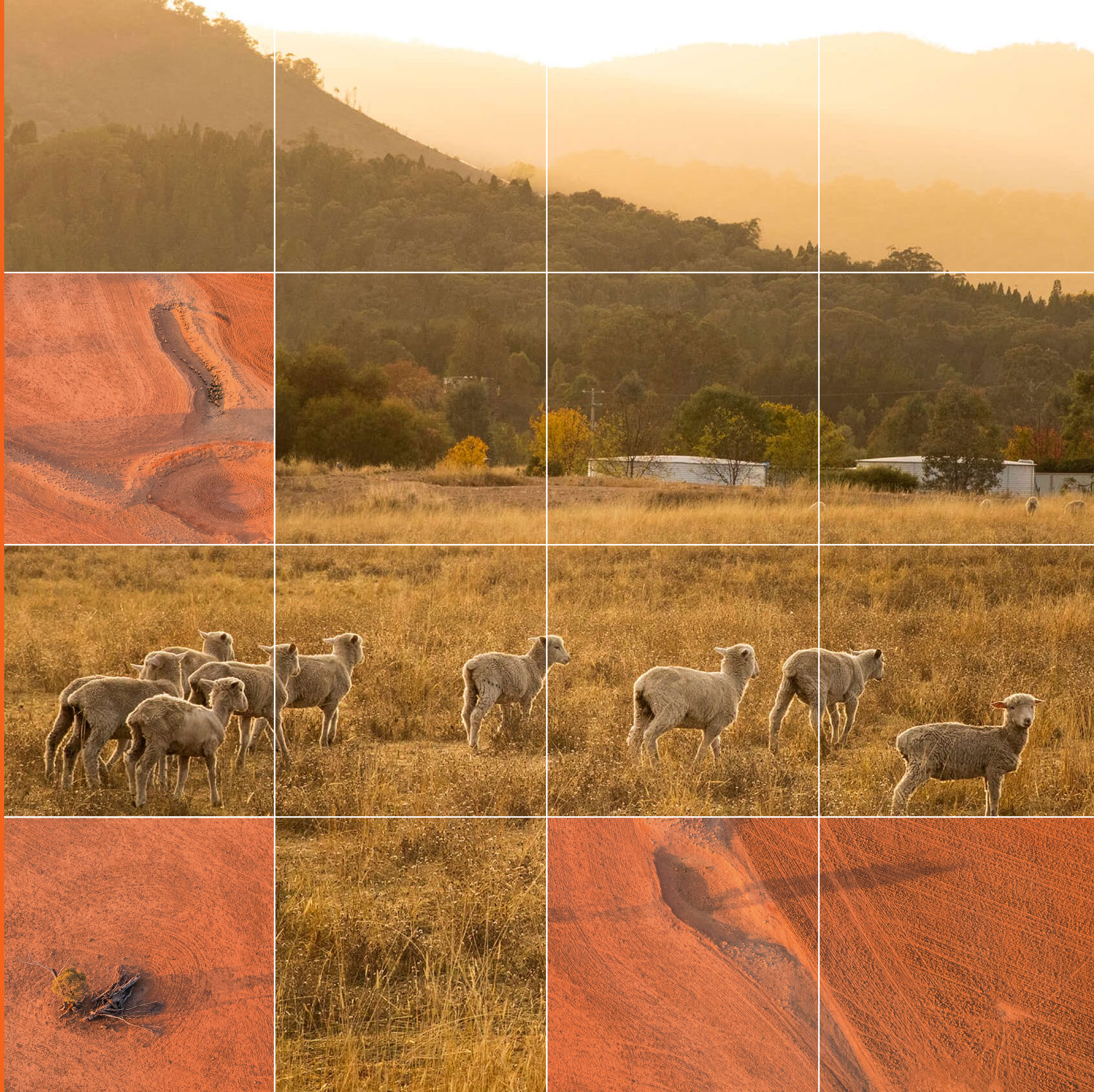

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Photo caption:

The Emu in the Sky is an Aboriginal constellation that is made up of the dark clouds of the Milky Way. With the movement of the Earth, the position of the Emu in the Sky changes throughout the year. Aboriginal people in some nations across NSW and Australia relate the position of the Emu in the Sky to the breeding behaviour of the emu on the land. Cultural astronomy teaches us about the relationship between the sky and land; and that we are all interconnected.

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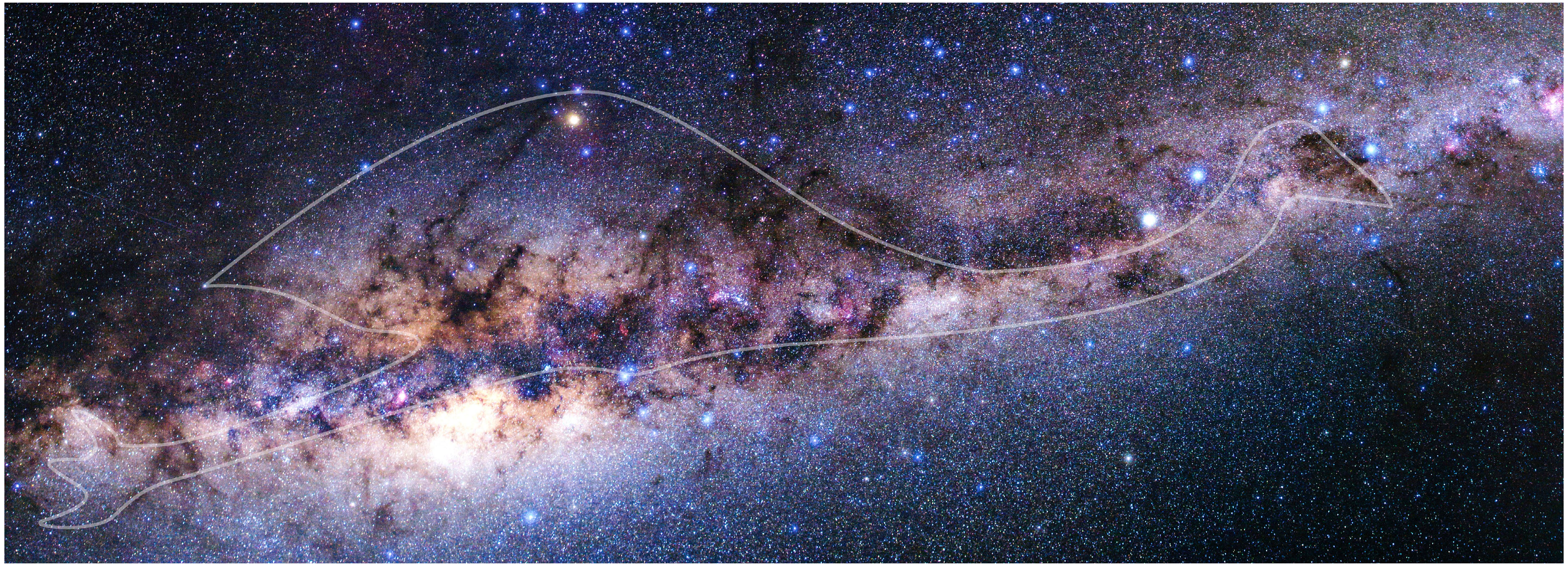


Acknowledgement of Country

The NSW Government acknowledges First Nations people as the first Australian people and the traditional owners and custodians of the country's lands and water. Australia's First Nations people have lived in NSW for over 60,000 years and have significant spiritual, cultural and economic connections with its lands, waters, seas and skies.

The Central West and Orana region encompasses the traditional lands of the Wiradjuri, Wongaibon, Wailwan (also known as Weilwan and Wayilwan), Gamilaroi (also known as Gamilaraay and Kamilaroi) and Ngiyampaa peoples.

They are the first astronomers and scientists who have been listening, reading and understanding natural processes and caring for Country for generations.

We pay respects to Elders past and present and acknowledge the significance of their traditional knowledge in adapting to changes in climate over tens of thousands of years.

We recognise the importance of their cultural knowledge and guidance at this pivotal moment in time.

About this snapshot

The New South Wales (NSW) and Australian Regional Climate Modelling (NARCliM) project delivers high-resolution climate change projections for NSW and south-east Australia.

This snapshot provides the latest NARCliM2.0 climate projections for the Central West and Orana under low, medium and high emissions scenarios for the middle of the century (2050) and end of the century (2090). It includes projections for key climate variables including temperature, average rainfall, hot days (days ≥35°C), cold nights (<2°C), and severe fire weather days (Forest Fire Danger Index >50). The projections help illustrate potential climate changes and their impacts, as well as associated climate risks.

NSW is already experiencing climate change. This document provides local-scale climate modelling insights to help Central West and Orana communities understand and plan for the impacts of climate change on their infrastructure, environment and way of life; and to support informed planning, risk assessment and action.

This snapshot offers a high-level overview, with more detailed data available through the AdaptNSW Interactive Map, Climate Data Portal and AdaptNSW.

How to use this snapshot

While there are several different ways to engage with the information in this snapshot, here are some key things to consider:

- **Explore each climate variable across scenarios –** review projections under low (SSP1–2.6), medium (SSP2–4.5), and high (SSP3–7.0) emissions scenarios to understand how climate risk differs depending on emissions pathways (Shared Socioeconomic Pathways, SSPs).
- **Compare scenario-based changes over time –** examine how each climate variable responds to different emissions scenarios for the middle of the century (2050) and the end of the century (2090) to understand how risks may evolve.
- **Identify where projections of climate variables align or diverge –** look for patterns across emissions scenarios and timeframes to see where risks remain consistent and where they escalate or diverge significantly.

Time periods in this snapshot

The projections for each time period represent averaged data across all climate models used for NARCliM for a 20-year period:

- **Baseline period: baseline** → The modelled average for each climate variable from 1990–2009, used for comparison with future projections.
- **Middle of the century: '2050' projection** → The projected average for each climate variable for 2040–2059.
- **End of the century: '2090' projection** → The projected average for each climate variable for 2080-2099.

About this snapshot

NARCliM climate projections

NARCliM is NSW's regional climate modelling project. NARCliM combines carefully selected global and regional climate models through a process known as dynamical downscaling, to generate detailed, locally relevant climate projections. These simulate a range of plausible future climates, helping to inform climate risk assessments and support planning at local and regional levels.

Launched in 2024, NARCliM2.0 provides nation-leading climate model data that span the range of plausible future changes in climate. It offers:

- climate projections out to the year 2100, and simulations of the past climate from 1951 to 2014
- 4-km scale projections for south-east Australia
- 20-km scale projections for the broader Australasian region
- projections for key climate variables and extremes.

There is more information About NARCliM, as well as specific information on Downscaling in NARCliM and Global and regional climate models used by NARCliM at AdaptNSW.

Methods and uncertainty

To help address future uncertainty, NARCliM2.0 is built on a selection of emissions scenarios, global climate models and regional climate models that, together, capture a range of climates that could occur. This is referred to as the NARCliM model ensemble. The NARCliM2.0 model ensemble is made up of different combinations of 5 global climate models and 2 regional climate models, giving 10 model combinations in total.

The data presented in this snapshot is generally an average for different 20-year time periods (e.g. the 2050 projection is the average for the 2040–2059 time period). Time series data are presented as annual averages. Combining multiple models through averaging and other statistical methods produces better projections by providing a comprehensive representation of possible future climate scenarios.

To ensure that NARCliM models adequately simulate regional climate, scientists use them to simulate the past climate and compare the results with actual observations. Outputs undergo rigorous quality control and scientific technical peer review.

There is more information on The NARCliM modelling methodology and NARCliM data processing, testing and validation at AdaptNSW.

Mental health support

Climate change information can be distressing for some readers, with many Australians of all ages experiencing significant eco-anxiety.
For supporting information, please visit the Black Dog Institute or Australian Psychological Society or speak with your local healthcare provider.

About this snapshot

Shared Socioeconomic Pathways

NARCliM2.0 uses Shared Socioeconomic Pathways (SSPs), which are the most recent emissions scenarios adopted in Coupled Model Intercomparison Project Phase 6 (CMIP6) models and used in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report.

The SSPs are a type of storyline-based emission scenario that estimate the world's future emissions and how these will affect the climate. SSPs outline different global development trajectories based on factors such as population, economic growth, education, urbanisation and land use, and technological advancement.[1] By analysing SSPs, we can better understand the long-term consequences of today's decisions and determine if we are heading toward higher-risk scenarios.[2]

For more information on emissions scenarios visit Emissions scenarios used by NARCliM on AdaptNSW and Summary for policymakers report by the IPCC.

Why do we use 3 SSPs?

The future is uncertain. There are many plausible futures on the horizon, and the one we reach depends on the path we take to get there. NARCliM provides projections for 3 SSPs (low-, medium- and high-emissions), each representing a distinct future with varying levels of climate risk.

Considering a range of SSPs and understanding where these scenarios align or diverge – in both the middle of the century (2050) and the end of the century (2090) – helps inform better planning and decision-making. NARCliM data highlights just how stark the differences between futures can be.

For more information about how to integrate this information into your risk assessments see Climate risk ready guide and Limitations and appropriate use on AdaptNSW.

Low-emissions future

SSP 1–2.6

SSP1–2.6 describes a **low-emissions future** with a global transition towards sustainable and equitable development.

Medium-emissions future

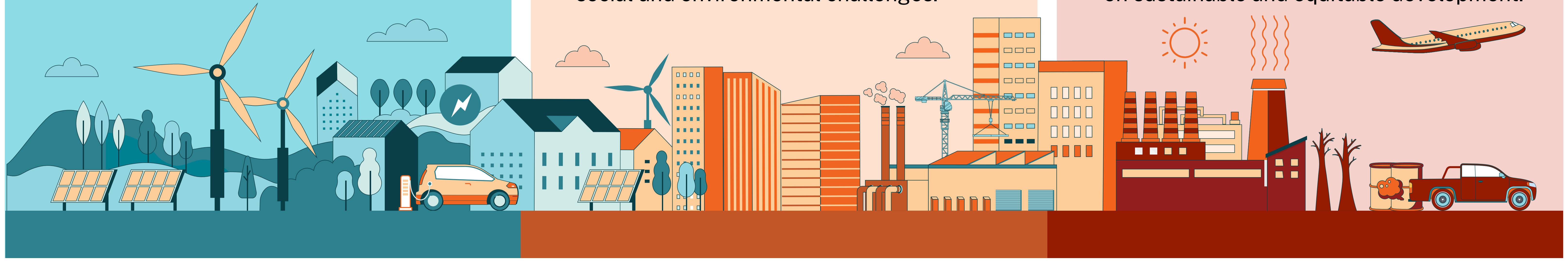
SSP 2–4.5

SSP2–4.5 describes a **medium-emissions future** with uneven economic growth, slow sustainability progress, ongoing environmental degradation, and persistent social and environmental challenges.

High-emissions future

SSP 3–7.0

SSP3–7.0 describes a **high-emissions future** of regional conflict and development where countries do not collaborate on tackling climate change and do not focus on sustainable and equitable development.



About this snapshot

Understanding the baseline period

To assess future climate projections, a climate baseline is used. This is a reference point which future change is relative to. In this snapshot, the baseline is the 20-year period from 1990 to 2009. This period is termed the baseline period to represent the average climate across those 2 decades.

A 20-year baseline averages out natural climate variability and avoids misleading comparisons with unusually hot, cold, wet or dry years. Using a fixed reference point prevents issues that may arise from using shifting reference points to compare future change against.

Climate during the baseline period is described in 2 ways in this snapshot:

- **Historical model:** The NARCliM2.0 simulation of past climate conditions.
- **Observed:** What was actually measured using weather station data during this period.

These 2 values are similar but not the same. Climate models aim to capture long-term patterns and trends, rather than matching observations perfectly. Observed values give context for comparison of the historical model with what it was in reality.

Looking backwards from the baseline

Before the baseline period, +0.84°C of observed warming had already occurred across NSW and the Australian Capital Territory (ACT) since records began. This is the difference between the 20-year average temperature of the 2 periods centred on 1920 (1910–1929) and 2000 (1990–2009). The Bureau of Meteorology's national climate records for temperature begin in 1910, making 1910–1929 the first available 20-year average for comparison with the baseline.

Consider the following when incorporating past warming into future projections:

- Warming before the baseline (+0.84°C) is not included in projections of future change.
- Warming after the baseline period is already included in future projections and should not be added again.

Looking forwards from the baseline

Use the historical model values in Table 1 as the baseline when interpreting both middle of the century and end of the century climate projections in this snapshot.

By comparing future projections to the historical model baseline values, we ensure the projected changes reflect genuine shifts, instead of also including the small differences between the modelled and observed data.

Table 1. Baseline climate for the Central West and Orana

	Average temperature	Average maximum temperature	Average minimum temperature	Hot days	Cold nights	Rainfall	Severe fire weather days
Observed	17.1°C	24.0°C	10.1°C	30.5 days	43.3 days	562 mm	4.9 days
Historical model	17.2°C	23.1°C	11.6°C	29.8 days	42.1 days	467 mm	6.4 days

Table 1 outlines the annual average values for the baseline period in this snapshot. All observed data is calculated from Bureau of Meteorology products. Long-term temperature change data is from the long-term temperature record.[3] Observed information and data in graphs come from Australian Gridded Climate Data (AGCD).[4]

Climate of Central West and Orana

The climate of the Central West and Orana underpins a diverse array of important lifestyles, industries and natural ecosystems. A stable climate is critical to support a range of values in the Central West and Orana, including our unique biodiversity, recreational activities and food systems.

The Central West and Orana region encompasses the traditional lands of the Wiradjuri, Wongaibon, Wailwan (also known as Weilwan and Wayilwan), Gamilaroi (also known as Gamilaraay and Kamilaroi) and Ngiyampaa peoples.

The Central West and Orana region spans an area of approximately 117,098 km^2, including major towns like Dubbo, Bathurst, Orange and Parkes, and boasts a rich cultural heritage. Situated within the Murray–Darling Basin, the region contains iconic natural landscapes including parts of the Greater Blue Mountains World Heritage area and the internationally significant Macquarie Marshes.

The landscape of the Central West and Orana is varied, characterised by vast plains, hills and ranges, rugged mountains and expansive woodlands. It is home to the Blue Mountains, which dominate the eastern edge of the region. In contrast, the western part of the region is characterised by fertile plains and agricultural lands, particularly around towns like Dubbo and Orange. The topography of the Central West and Orana region results in a large range of climatic conditions and there are distinct seasonal variations in the climate of the region. Generally, the region experiences a temperate climate. It is relatively dry on the western plains compared to the Central Tablelands. Summers are warm to hot on the western plains and cooler on the tablelands, which also experience cool to cold winters and snowfall at higher elevations. Temperatures are milder on the slopes, with summer temperatures cooler than the plains and winter conditions warmer than the tablelands.

Children and adolescents (0–14 years old) make up 19.7% of the population (slightly higher than the NSW and ACT average of 18.2%), while people aged 65 and over represent 20.5%, and working-aged people (15–64) represent 59.8% of the region's population.[5]

The Central West and Orana supports a diverse range of industries that are vital for NSW's economy, with the highest number of businesses in agribusiness (agriculture, forestry and fishing), construction as well as specialised services (professional, scientific and technical). The largest industries of employment for the region are health care and social assistance (15.3%), education and training (9.4%), agribusiness (9.0%), retail trade (8.7%) and construction (7.8%).[5]

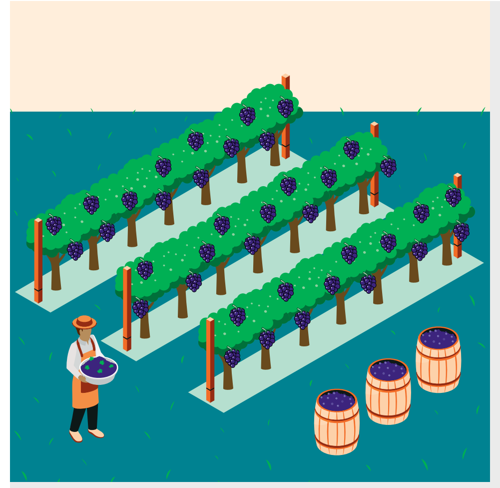
The region's climate has provided the foundation for many of the region's current social, economic and ecological systems. These systems will be impacted by increased temperatures, more hot days, fewer cold nights, greater fire danger and higher rainfall variability.

The following pages outline the projected changes in these key climate variables across the Central West and Orana region.

PROJECTED CHANGES

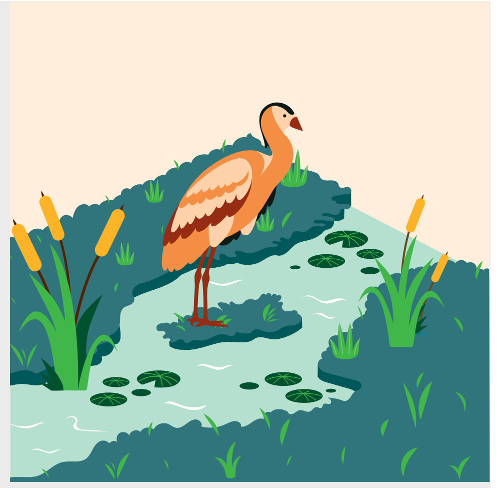
	Low-emissions scenario		Medium-emissions scenario		High-emissions scenario	
	2050	2090	2050	2090	2050	2090
Increase in average temperature	+1.2˚C	+1.4˚C	+1.6˚C	+2.8˚C	+2.1˚C	+4.1˚C
Increase in hot days per year	+15.9	+17.1	+19.4	+34.7	+24.7	+49.4
Decrease in cold nights per year	–11.8	–14.0	–15.6	–26.2	–19.6	–33.5
Increase in severe fire weather days per year	+2.4	+2.7	+2.4	+5.7	+3.8	+7.5

REGIONAL IMPACTS



Viticulture

Changes to rainfall



Inland wetlands

Changes to rainfall

Agriculture

Changes to rainfall

Regional town

Increased extreme heat

Data is based on NARCliM2.0 projections for SSP1–2.6 (low-emissions), SSP2–4.5 (medium-emissions) and SSP3–7.0 (high-emissions) and is presented relative to the baseline period of 1990–2009. Values presented are averages across the NARCliM2.0 model ensemble, and do not represent the full range of plausible climate futures. Regional climate change impacts are used to highlight how the region is likely to be affected by climate change, and impacts are not limited to the examples provided.

Temperature

In NSW, 8 of the 10 warmest years on record since 1910 have occurred since 2013.

4.1°C

rise in average temperature across the Central West and Orana by 2090 under a high-emissions scenario.

Temperatures are projected to be higher by 2050 under a high-emissions scenario than by 2090 under a low-emissions scenario.

The Central West and Orana is getting warmer

Temperature is the most robust indicator of climate change. In NSW, 8 of the 10 warmest years on record since 1910 have occurred since 2013. The warmest year on record for both average temperature and maximum temperature in the Central West and Orana region was 2019, when the average temperature was 1.5°C above the 1990–2009 baseline average.[4]

Projections

Across the Central West and Orana region, average temperatures will increase throughout this century (Figure 1).

Under a low-emissions scenario, the average temperature increase across the region is projected to be 0.2°C between 2050 and 2090 (Table 2). However, major temperature increase of 1.2°C under a medium-emissions scenario and 2.0°C under a high-emissions scenario are expected during the same period. Notably, the temperature projections for 2050 under both a medium-emissions scenario and a high-emissions scenario are expected to exceed the projections for 2090 under a low-emissions scenario.

Temperature increases are expected in all parts of the region (Figure 2) and across all seasons. Northern areas of the region, including towns such as Dubbo, Coonabarabran and Nyngan, will see the greatest increases in temperature. By 2090, Dubbo is likely to experience an increase in temperature of 1.4°C under a low-emissions scenario, 2.8°C under a medium-emissions scenario and 4.1°C under a high-emissions scenario. Comparatively, Oberon, in the south of the region, is is likely to experience an increase in temperature of 1.2°C under a low-emissions scenario, 2.4°C under a medium-emissions scenario and 3.6°C under a high-emissions scenario.

Table 2 and Figure 1 provide more information on how the projections differ across the 3 scenarios, and Figure 2 provides information on regional differences by 2090 across the 3 scenarios.

Table 2. Projected annual average temperature increase – Central West and Orana

2050

	Low-emissions	Medium-emissions	High-emissions
Temperature	**1.2°C** (0.6°C to 1.7°C)	**1.6°C** (1.1°C to 2.1°C)	**2.1°C** (1.1°C to 2.9°C)
Maximum temperature	**1.3°C** (0.6°C to 1.8°C)	**1.7°C** (1.0°C to 2.2°C)	**2.1°C** (1.2°C to 3.0°C)
Minimum temperature	**1.2°C** (0.6°C to 1.6°C)	**1.6°C** (1.0°C to 2.1°C)	**2.0°C** (1.0°C to 2.7°C)

2090

	Low-emissions	Medium-emissions	High-emissions
Temperature	**1.4°C** (0.6°C to 2.1°C)	**2.8°C** (2.0°C to 4.0°C)	**4.1°C** (2.9°C to 5.7°C)
Maximum temperature	**1.4°C** (0.6°C to 2.3°C)	**2.9°C** (2.0°C to 4.1°C)	**4.1°C** (3.0°C to 5.8°C)
Minimum temperature	**1.3°C** (0.7°C to 1.9°C)	**2.7°C** (1.9°C to 3.8°C)	**4.0°C** (2.8°C to 5.5°C)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range. Temperature increases are additional to the historical model baselines of 17.2℃ for average temperature, 23.1℃ for average maximum temperature and 11.6℃ for average minimum temperature.

Figure 1. Historical and projected average temperature change – Central West and Orana

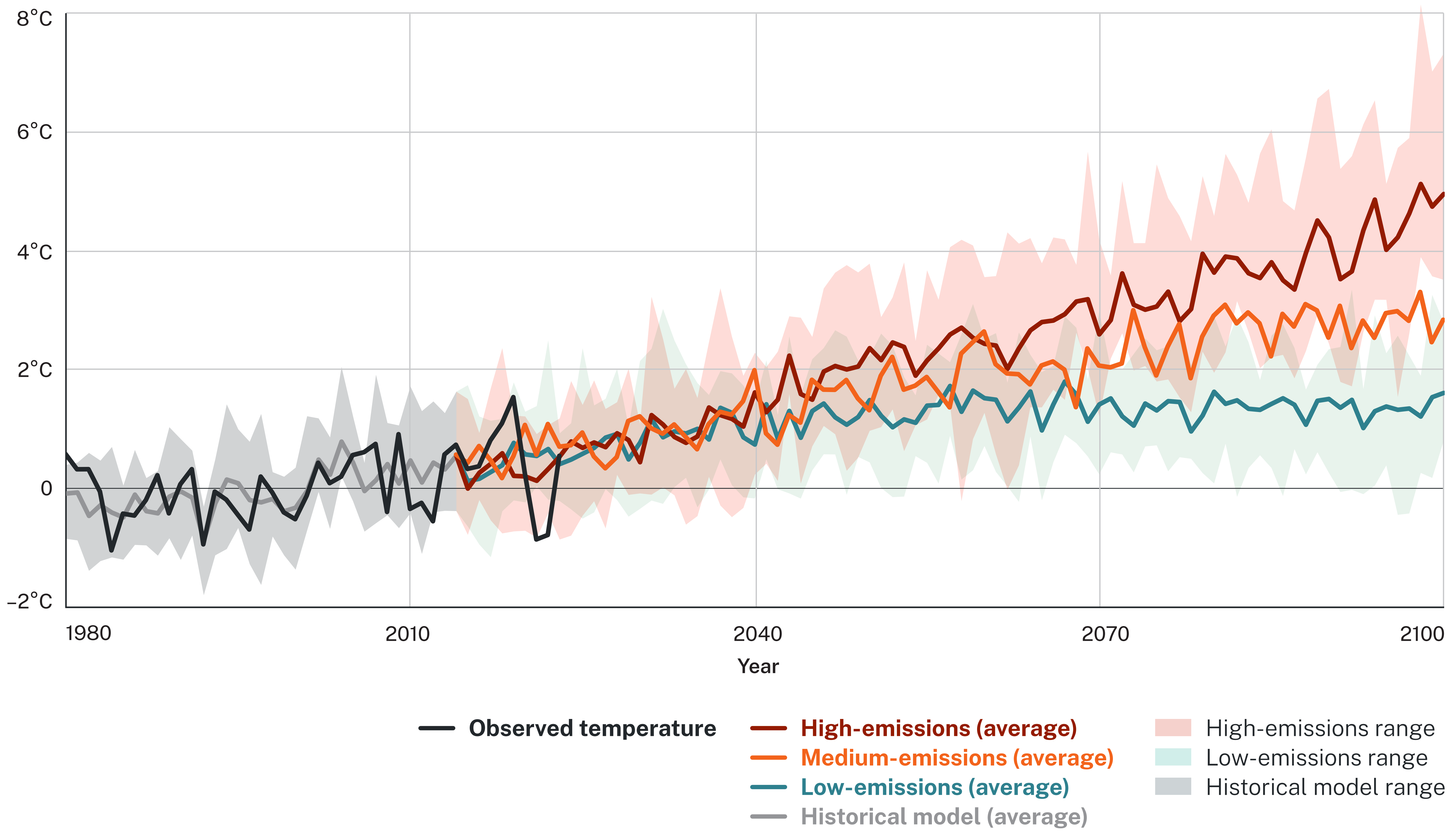
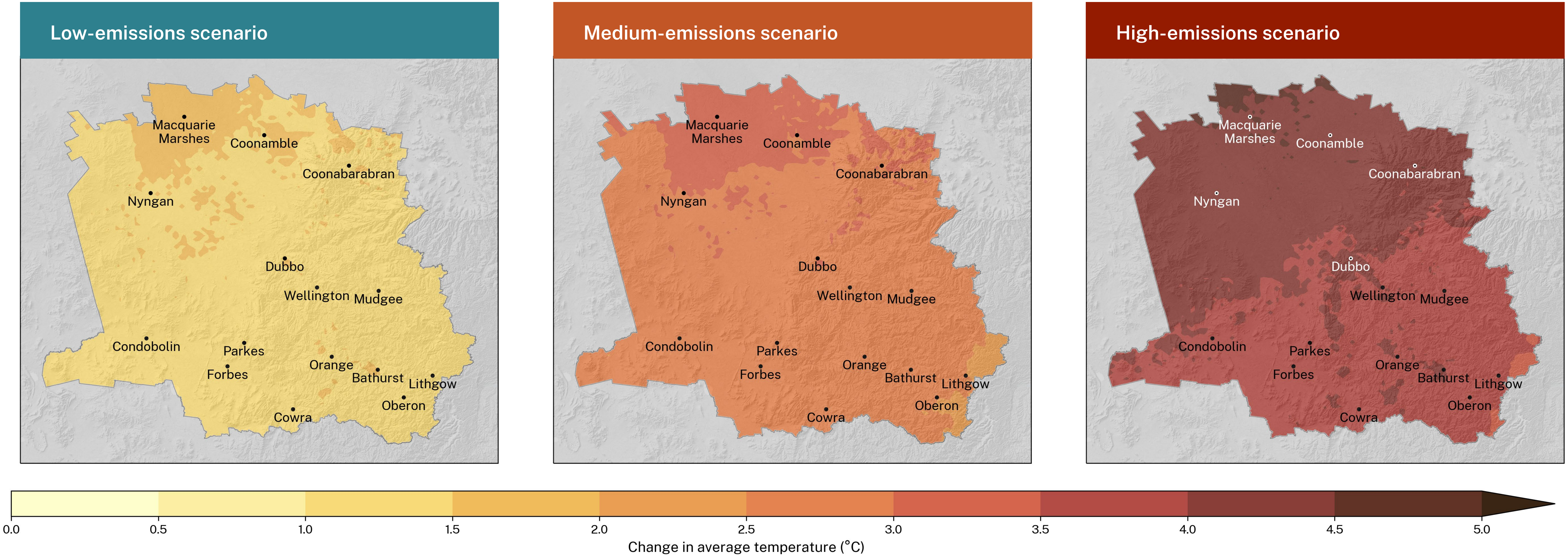


Figure 2. Projected change in average temperature by 2090 for the Central West and Orana



Hot days

Changes to temperature extremes often have more pronounced impacts than changes in average temperatures.

2x

The number of hot days across the Central West and Orana region is projected to more than double by 2090 under a high-emissions scenario.

Higher maximum temperatures affect health through heat stress and exacerbate existing health conditions.

Hot days will become more frequent

Prolonged hot days, where maximum daily temperatures are equal to or above 35°C, increase the incidence of illness and death – particularly among vulnerable people. Seasonal changes in the number of hot days could have significant impacts on bushfire danger, infrastructure and native species.

Generally, the number of hot days in the Central West and Orana region increases from the south-east to the north-west of the region. During the baseline period, areas near Oberon and Lithgow had on average less than 1 hot day per year. Lower elevation areas of the tablelands, such as Forbes, had on average 30 hot days per year, while higher elevation areas such as Mudgee and Parkes had on average 5–10 hot days per year. Areas in the north-west of the region, such as Nyngan, had on average 45–55 hot days per year.

Projections

The number of hot days will increase for the Central West and Orana region by 2050 for all emissions scenarios, with an even greater increase by 2090 under a medium-emissions scenario and a high-emissions scenario (Table 3). The number of hot days is projected to increase during spring, summer and autumn, with the largest increase in summer.

Under a low-emissions scenario, there is a small increase of 1.2 additional hot days per year projected across the region between 2050 and 2090 (Table 3). However, increases of 15.3 additional hot days under a medium-emissions scenario and 24.7 additional hot days under a high-emissions scenario is projected during the same period.

Increases in the number of hot day will occur across all of the region (Figure 4). Northern and western areas of the region, such as Dubbo and Coonamble, are projected to experience larger increases in the number of hot days compared to south-eastern areas of the region. By 2090, Dubbo is projected to experience 19.5 additional hot days per year under a low-emissions scenario, 40.0 under a medium-emissions scenario and 56.7 under a high-emissions scenario. A medium-emissions scenario is projected to more than double Dubbo's baseline period average of 29.8 hot days per year, while a high-emissions scenario is projected to nearly triple Dubbo's baseline average. Comparatively, in the south-east of the region, Bathurst's baseline period average is 3.9 hot days per year. By 2090, Bathurst is projected to experience an additional 6.8 hot days per year under a low-emissions scenario, 15.0 under a medium-emissions scenario and 23.6 under a high-emissions scenario.

Table 3 and Figure 3 provide more information on how the projections differ across the 3 scenarios, and Figure 4 provides information on regional differences by 2090 across the 3 scenarios.

Table 3. Projected increase in average annual number of hot days – Central West and Orana

2050

Low-emissions	Medium-emissions	High-emissions
15.9 days (4.2 to 25.2 days)	**19.4 days** (9.2 to 24.5 days)	**24.7 days** (8.6 to 40.4 days)

2090

Low-emissions	Medium-emissions	High-emissions
17.1 days (6.0 to 32.0 days)	**34.7 days** (19.3 to 52.3 days)	**49.4 days** (30.1 to 76.7 days)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range. Hot day increases are additional to the historical model baseline of 29.8 hot days.

Figure 3. Historical and projected average annual number of hot days – Central West and Orana

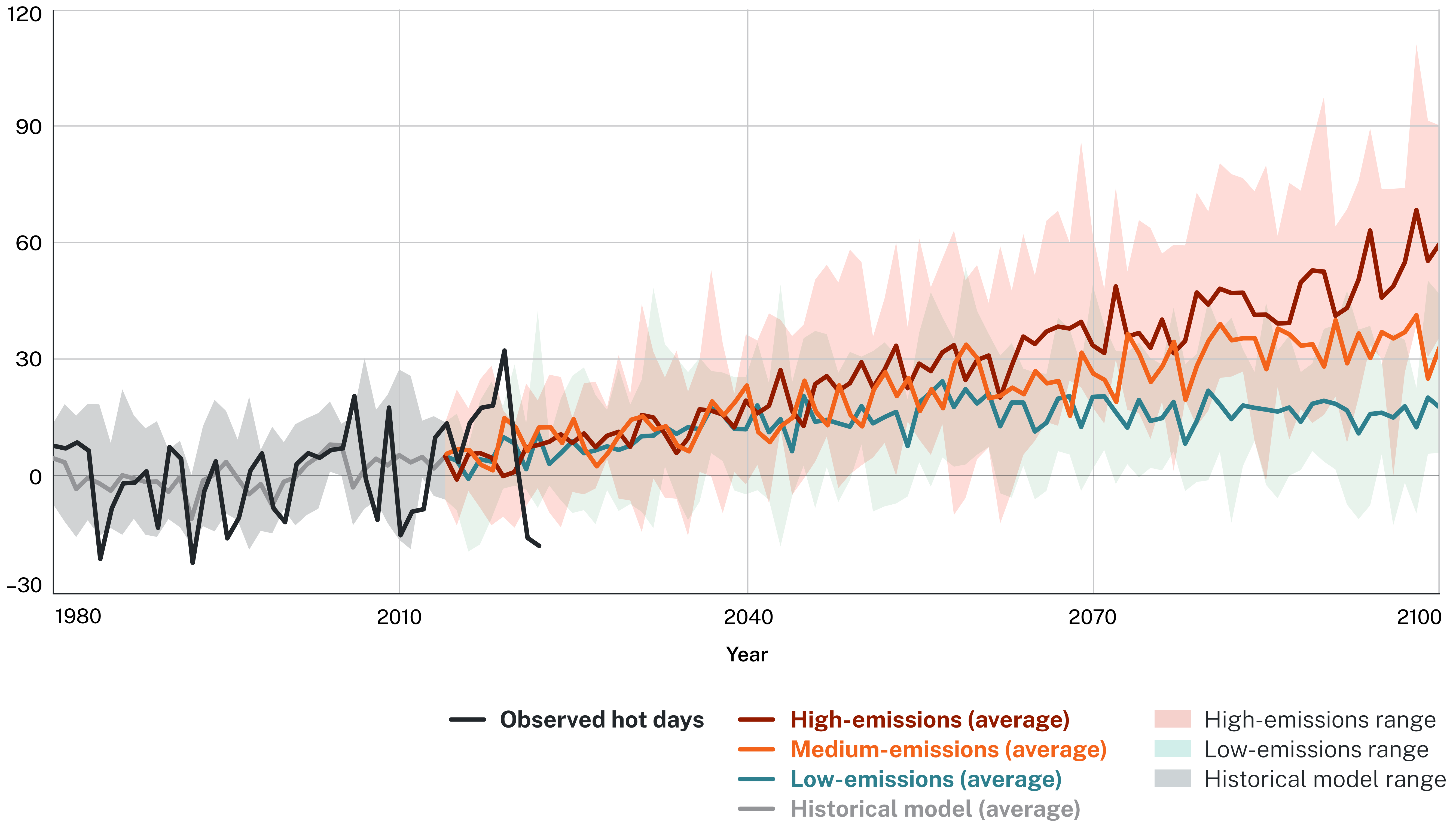
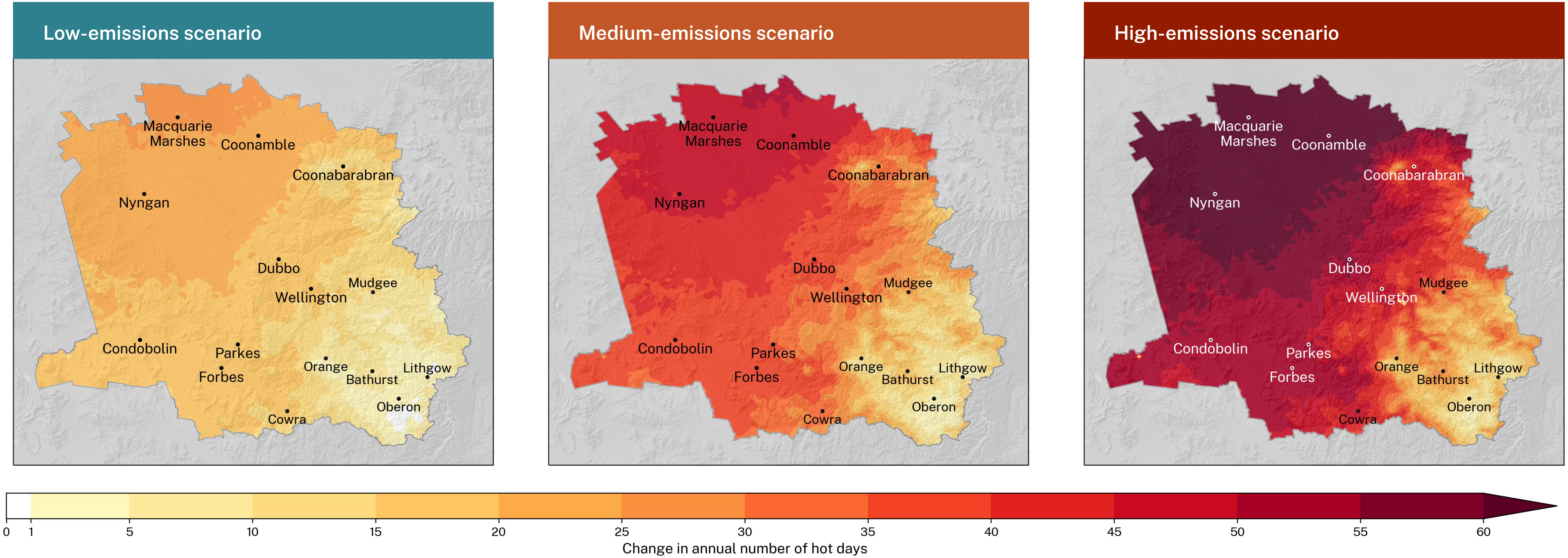


Figure 4. Projected change in annual number of hot days by 2090 for the Central West and Orana



Increased heat stress

Heatwaves have been responsible for more human deaths than any other natural hazard, including bushfires and floods. Heatwaves occur when both maximum and minimum temperatures are unusually hot over 3 days, compared to the previous month and historical weather. Heatwaves in 2011 and 2019 led to a 14% rise in NSW hospital admissions. In 2009, the heatwave in Victoria preceding the 2009 bushfires led to 374 deaths, with the bushfires directly responsible for 173 deaths.

Northern and western areas of the region are projected to experience greater increases in the number of hot days (Figure 4).

Higher-elevation areas in the south-east of the region are projected to experience smaller increases in the number of hot days (Figure 4).

Communities and agricultural producers are expected to be increasingly impacted by more hot days of 35°C and above. This is likely to cause increased heat stress for people and may decrease the suitability of some types of agriculture within the region, such as mixed livestock-cropping.

Cold nights

Cold nights are important for biodiversity in higher-elevation areas and the viability of important plant species, including some temperate fruits.

Under a high-emissions scenario, the number of cold nights across the Central West and Orana could reduce by 80% by 2090.

Under a low-emissions scenario, the number of cold nights across the region could reduce by 35% by 2090.

Cold nights will decrease

Cold nights are those where the minimum temperature drops below 2°C. These are important for the viability of some important plant species. For example, some common temperate fruit species require sufficiently cold winters to produce flower buds.

The number of cold nights varies widely across the Central West and Orana region, but generally decreases from the south-east to the north-west. During the baseline period, areas of higher elevation in the mountainous south-east of the region near Oberon had on average more than 100 cold nights per year. High elevation areas of the tablelands such as Orange and Bathurst had on average 80–100 cold nights per year, while lower elevation areas such as Forbes and Dubbo had 40–50 cold nights per year. North-western areas of the region such as Nyngan had 10–15 cold nights per year.

Projections

Across the Central West and Orana region, the average number of cold nights per year will decrease throughout this century (Figure 5).

The number of cold nights will decrease for the Central West and Orana region by 2050 for all emissions scenarios, with an even greater decrease by 2090 under a medium-emissions scenario and a high-emissions scenario (Table 4). The number of cold nights is projected to decrease across autumn, winter and spring, with the largest decreases in winter.

Under a low-emissions scenario, there is a small decrease of 2.2 fewer cold nights per year projected across the region between 2050 and 2090 (Table 4). However, decreases of 10.6 fewer cold nights per year under a medium-emissions scenario and 13.9 fewer cold nights per year under a high-emissions scenario are projected during the same period.

Cold nights will decrease across all of the region, particularly in higher elevation areas in the south-east of the region (Figure 6). The greatest decreases are projected to occur along the western edge of the Great Dividing Range including Bathurst and Lithgow, as well the area surrounding the Warrumbungle National Park. By 2090, Bathurst is projected to have 25.4 fewer cold nights per year under a low-emissions scenario, 46.6 under a medium-emissions scenario and 64.9 under a high-emissions scenario. A medium-emissions scenario is projected to reduce Bathurst’s 98.3 cold nights per year baseline period average by nearly 50%, while a high-emissions scenario is projected to reduce Bathurst’s baseline average by more than 65%.

Table 4 and Figure 5 provide more information on how the projections differ across the 3 scenarios, and Figure 6 provides information on regional differences by 2090 across the 3 scenarios.

Table 4. Projected decrease in average annual number of cold nights – Central West and Orana

2050

Low-emissions	Medium-emissions	High-emissions
11.8 days (6.5 to 18.8 days)	**15.6 days** (9.0 to 20.7 days)	**19.6 days** (9.7 to 25.1 days)

2090

Low-emissions	Medium-emissions	High-emissions
14.0 days (8.6 to 19.0 days)	**26.2 days** (19.1 to 33.5 days)	**33.5 days** (25.9 to 39.8 days)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range. Cold night decreases are relative to the historical model baseline of 42.1 cold nights.

Figure 5. Historical and projected change in annual number of cold nights – Central West and Orana

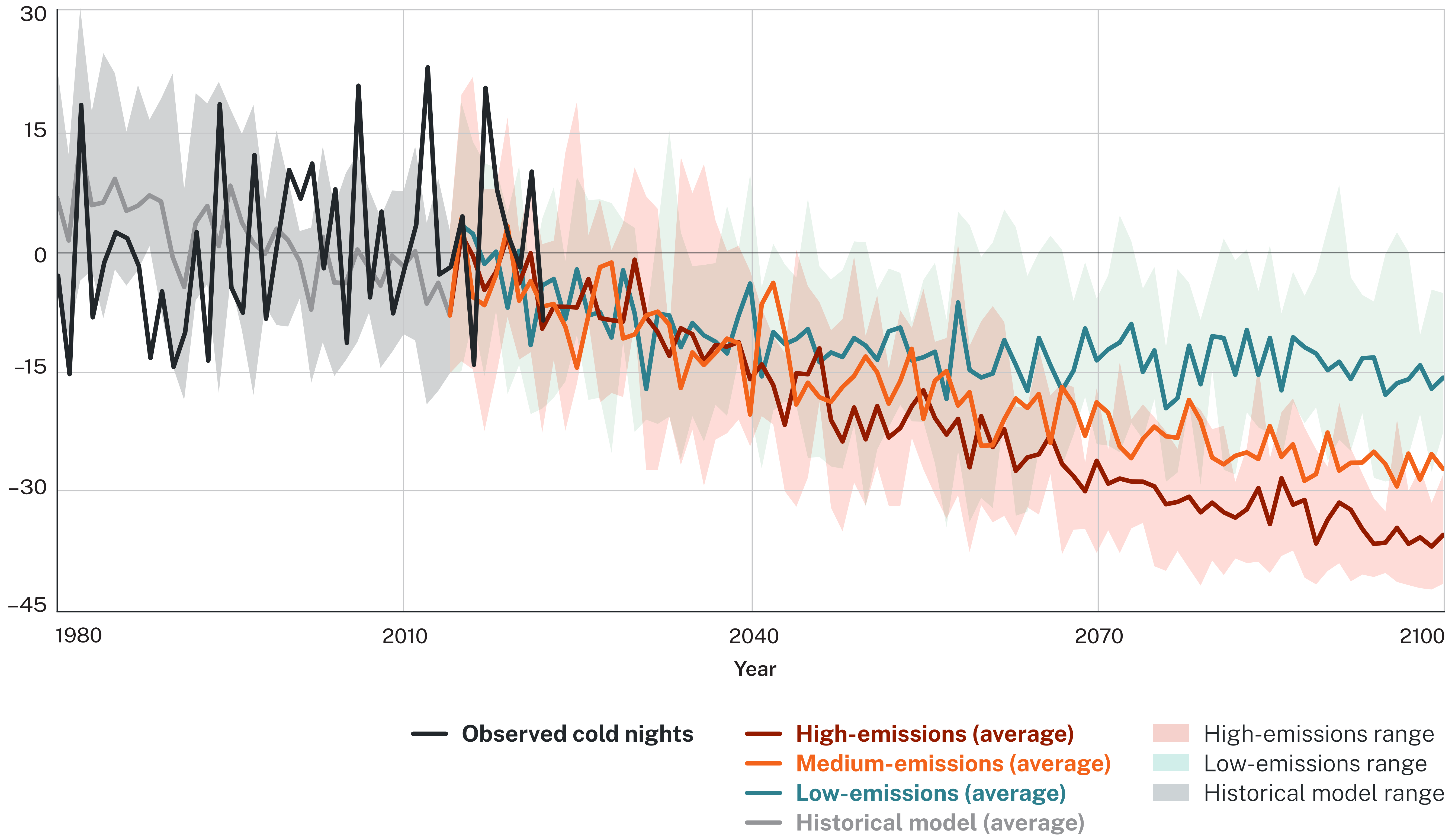
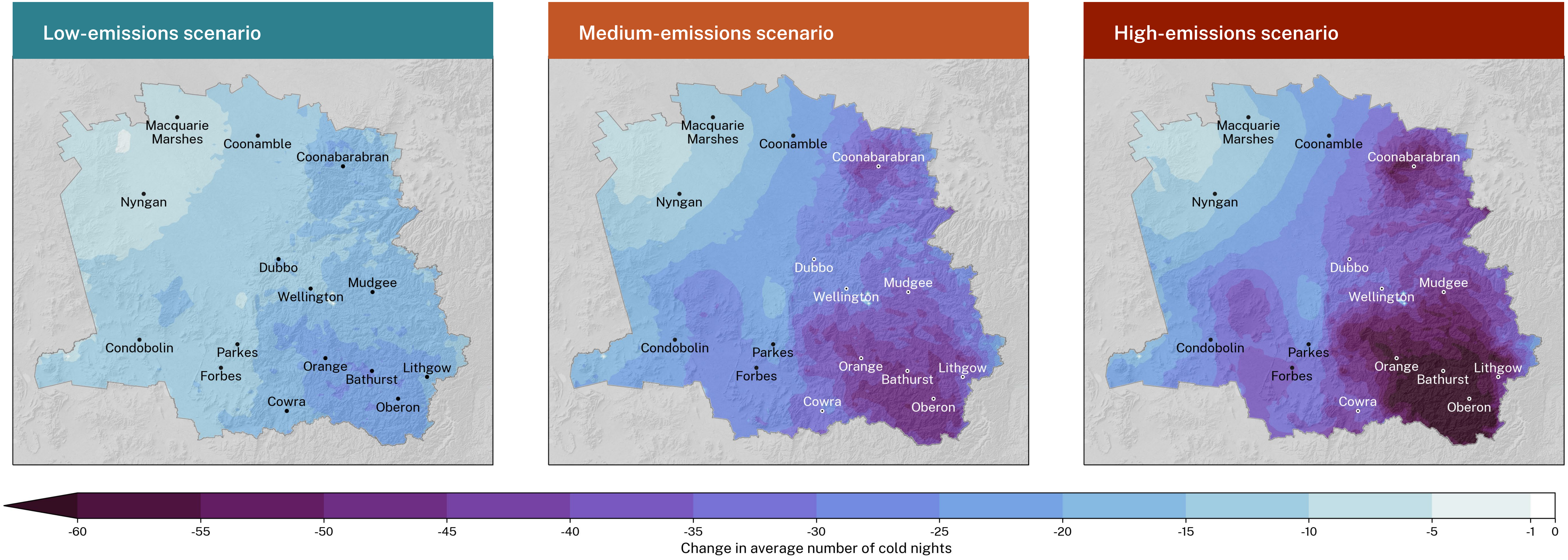
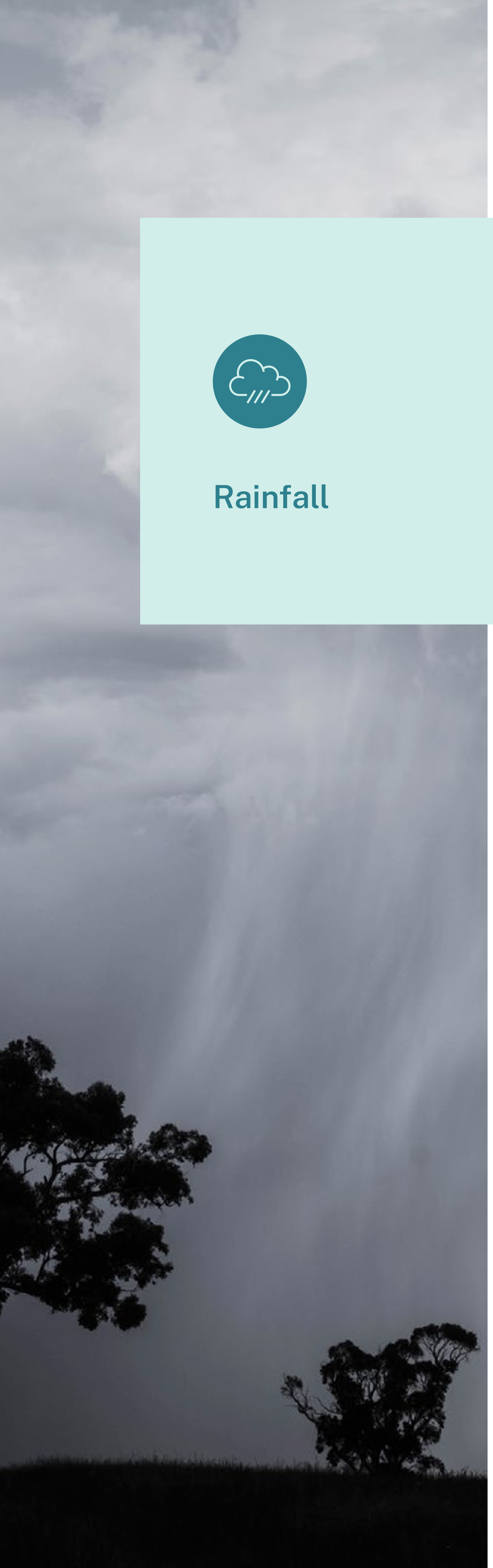


Figure 6. Projected change in annual number of cold nights by 2090 for the Central West and Orana





Rainfall

Rainfall is projected to remain variable

NSW has experienced rainfall extremes in recent decades, with significant impacts on communities, infrastructure and natural ecosystems.

Climate change will influence rainfall patterns and the amount of rainfall that NSW receives. These changes may have widespread impacts on water security, agricultural productivity and native species' reproductive cycles. For example, eucalypt woodlands and riverine plains in the interior west could struggle to cope with drier conditions.

Modelling rainfall is more difficult than modelling temperature due to the complexities of the weather systems that generate rain. NARCliM projections capture a range of plausible climate futures under the 3 emissions scenarios, including wet and dry outcomes. This means that rainfall is inherently more variable in the NARCliM projections than temperature, and the full range of rainfall projections should be taken into account. This can be explored further on the AdaptNSW Interactive Map.

This snapshot provides data on average rainfall change and does not provide data on rainfall extremes or the impacts of climate change on flooding.

Observed annual rainfall across the Central West and Orana region averages about 560 mm.[4] Rainfall generally decreases from the south-east to the north-west of the region, with rainfall highest in the Central Tablelands. Rainfall is generally uniformly distributed throughout the year across the region. The driest year on record was 2019, with an average of only 260 mm across the region.[4]

Projections

Annual average rainfall in the region is projected to remain variable throughout this century (Figure 7). By 2090, on average, annual rainfall is projected to decrease by 10% under a low-emissions scenario, 17% under a medium-emissions scenario and by 11% under a high-emissions scenario (Table 5).

By 2090, on average, summer rainfall is projected to decrease across the region by 13% under a low-emissions scenario, 12% under a medium-emissions scenario and by 1% under a high-emissions scenario (Table 5). A somewhat uniform decrease across the region is projected under a low-emissions scenario and a medium-emissions scenario (Figure 9).

By 2090, on average, autumn rainfall is projected to decrease across the region by 7% under a low-emissions scenario, 12% under a medium-emissions scenario and by 10% under a high-emissions scenario (Table 5).

By 2090, average winter rainfall in the south-east of the region near Lithgow and Oberon is projected to decrease by 5–15% under a low emission scenario and by 25–35% under a medium-emissions scenario and a high-emissions scenario.

By 2090, on average, spring rainfall is projected to decrease across the region by 17% under a low-emissions scenario, 23% under a medium-emissions scenario and by 21% under a high-emissions scenario (Table 5).

Refer to the Interactive Map for further seasonal information.

Table 5 and Figure 7 provide more information on how the projections differ across the 3 scenarios, and Figures 8 to 12 provide information on regional differences by 2090 across the 3 scenarios.

Table 5. Projected change to average rainfall – Central West and Orana

2050

	Low-emissions	Medium-emissions	High-emissions
Annual	**–9.3%** (–23.2% to +17.5%)	**–8.1%** (–27.5% to +25.0%)	**–15.7%** (–36.1% to +7.2%)
Summer	**–8.4%** (–28.3% to +32.1%)	**–6.5%** (–25.7% to +63.4%)	**–19.4%** (–41.0% to +35.5%)
Autumn	**–12.3%** (–27.8% to +21.4%)	**–0.5** (–20.1% to +26.1%)	**–11.8%** (–38.3% to +30.3%)
Winter	**–7.0%** (–19.7% to +26.0%)	**–12.8%** (–30.9% to +24.8%)	**–15.5%** (–43.7% to +26.0%)
Spring	**–10.0%** (–37.5% to +31.7%)	**–13.3%** (–43.9% to +37.3%)	**–14.7%** (–46.5% to +19.7%)

2090

	Low-emissions	Medium-emissions	High-emissions
Annual	**–10.1%** (–22.3% to +23.9%)	**–16.9%** (–31.0% to +23.5%)	**–10.9%** (–40.6% to +58.7%)
Summer	**–13.1%** (–36.1% to +59.3%)	**–12.3%** (–38.3% to +75.2%)	**–0.8%** (–33.8% to +53.9%)
Autumn	**–6.9%** (–26.2% to +30.0%)	**–12.1%** (–28.9% to +27.6%)	**–9.8%** (–33.3% to +65.6%)
Winter	**–1.8%** (–29.7% to +40.3%)	**–21.9%** (–42.9% to +55.6%)	**–15.5%** (–52.7% to +76.0%)
Spring	**–17.4%** (–34.9% to +27.2%)	**–22.9%** (–41.4% to +29.7%)	**–21.2%** (–52.3% to +45.6%)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range. Percentages changes in annual average rainfall are relative to the historical model baseline of 467 mm. Average summer rainfall is relative to a baseline of 147 mm, average autumn rainfall is relative to a baseline of 106 mm, average winter rainfall is relative to a baseline of 106 mm and average spring rainfall is relative to a baseline of 108 mm.

Figure 7. Historical and projected change in average rainfall – Central West and Orana

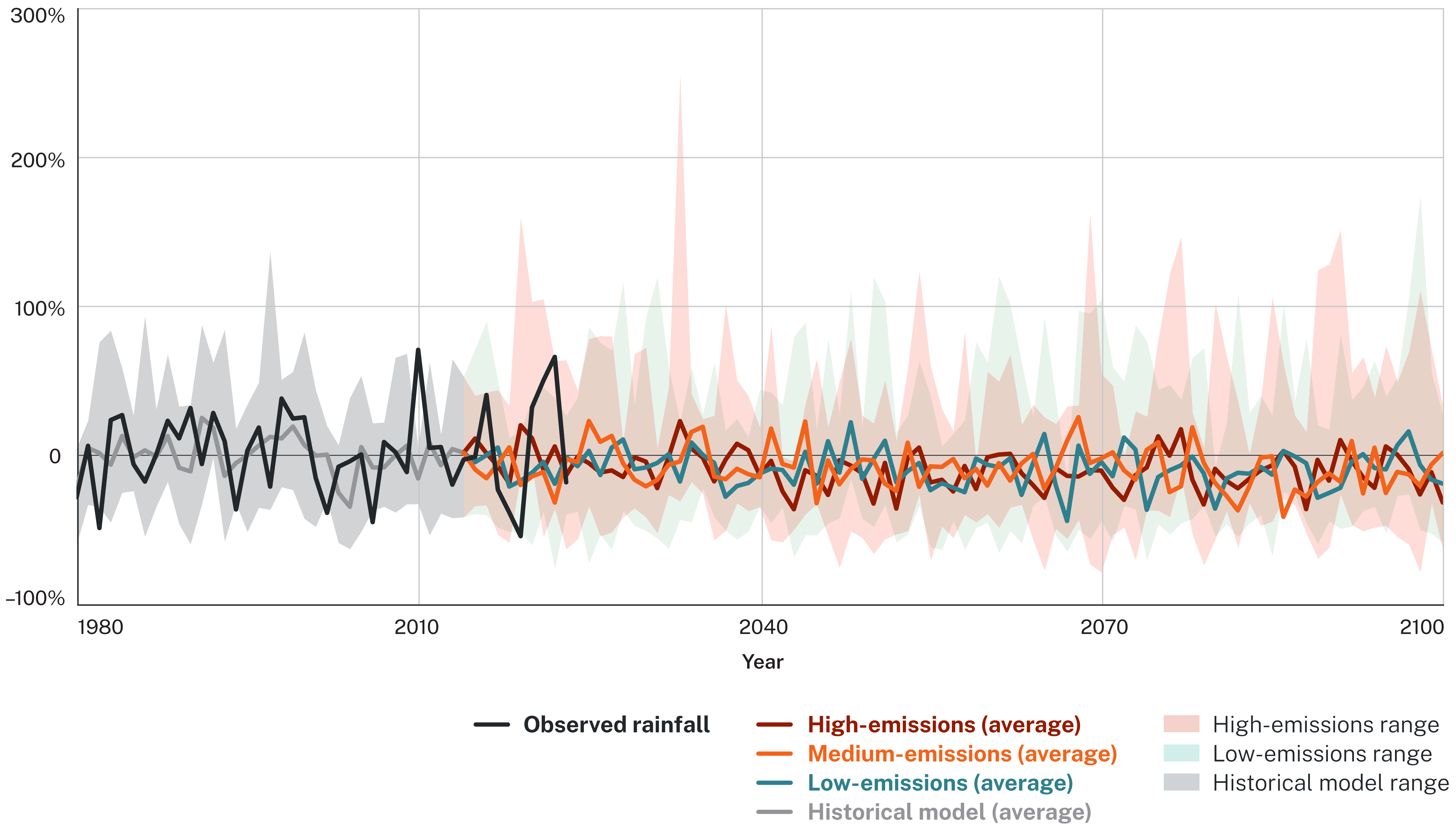


Figure 8. Projected change to average annual rainfall by 2090 for the Central West and Orana

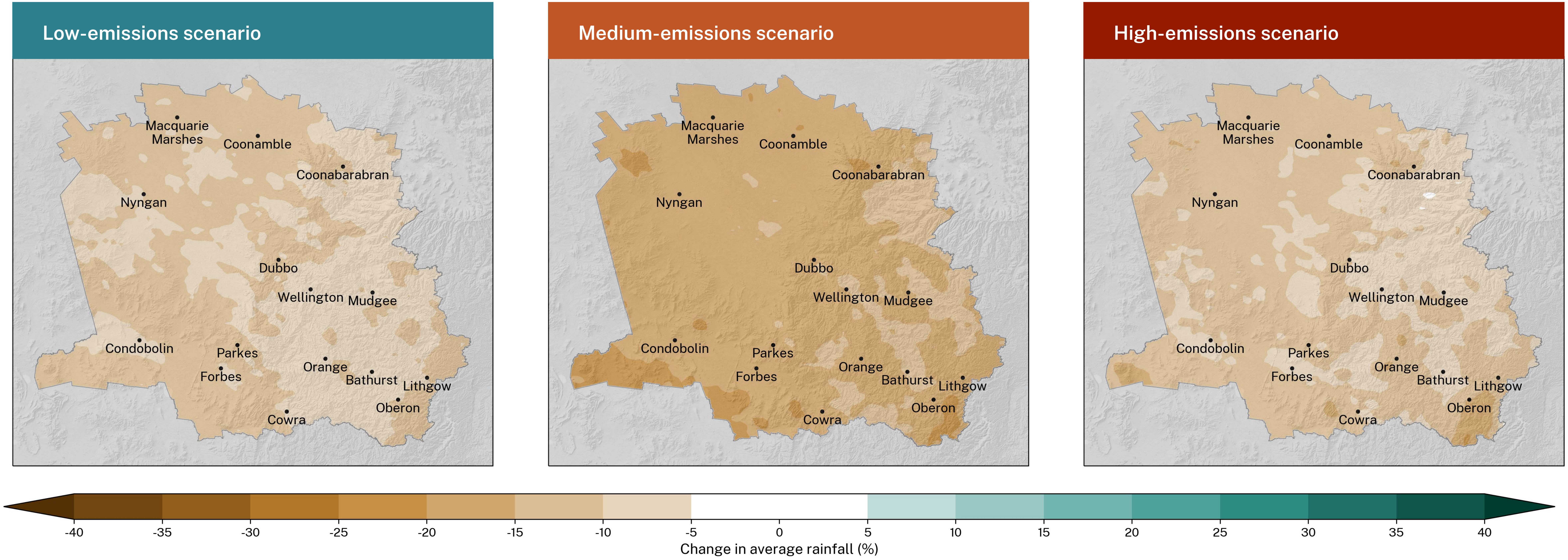


Figure 9. Projected change to average summer rainfall by 2090 for the Central West and Orana

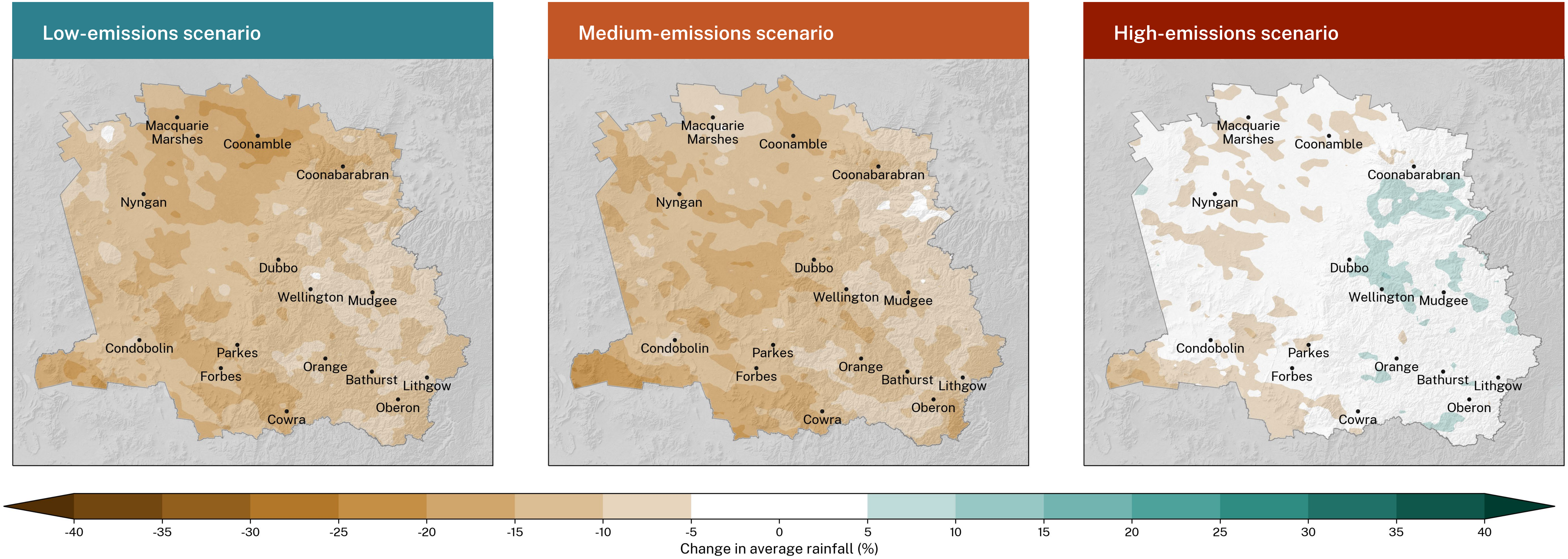
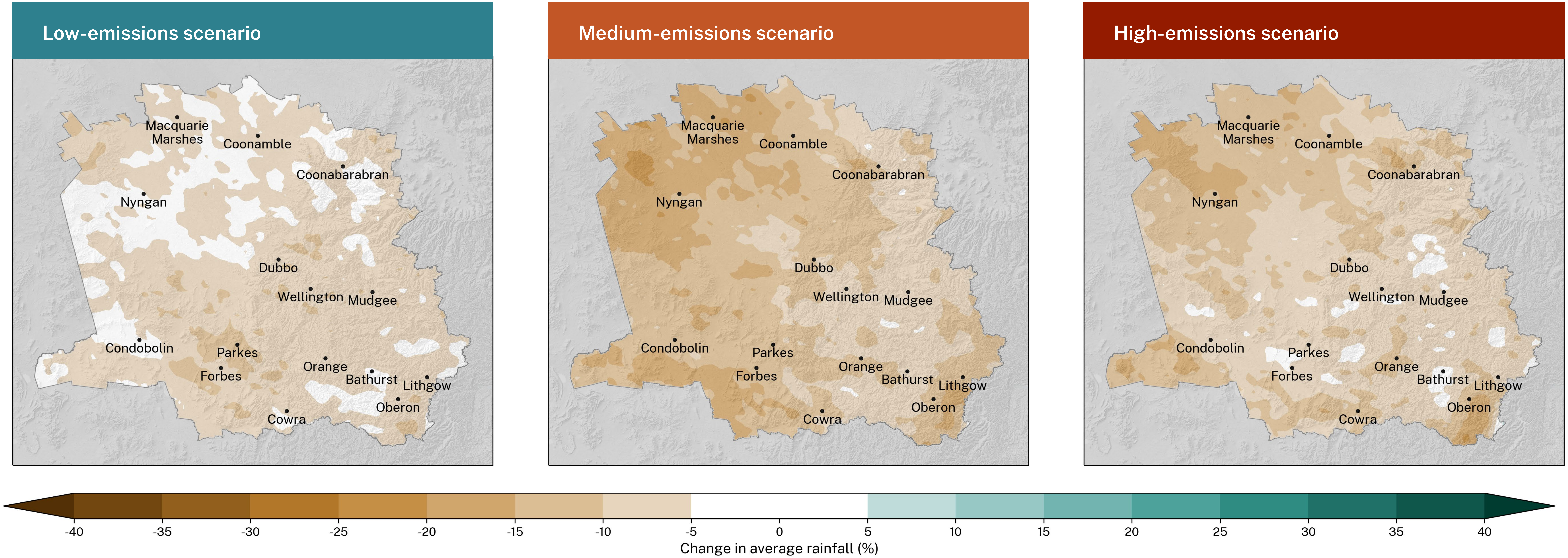


Figure 10. Projected change to average autumn rainfall by 2090 for the Central West and Orana



Rainfall

Figure 11. Projected change to average winter rainfall by 2090 for the Central West and Orana

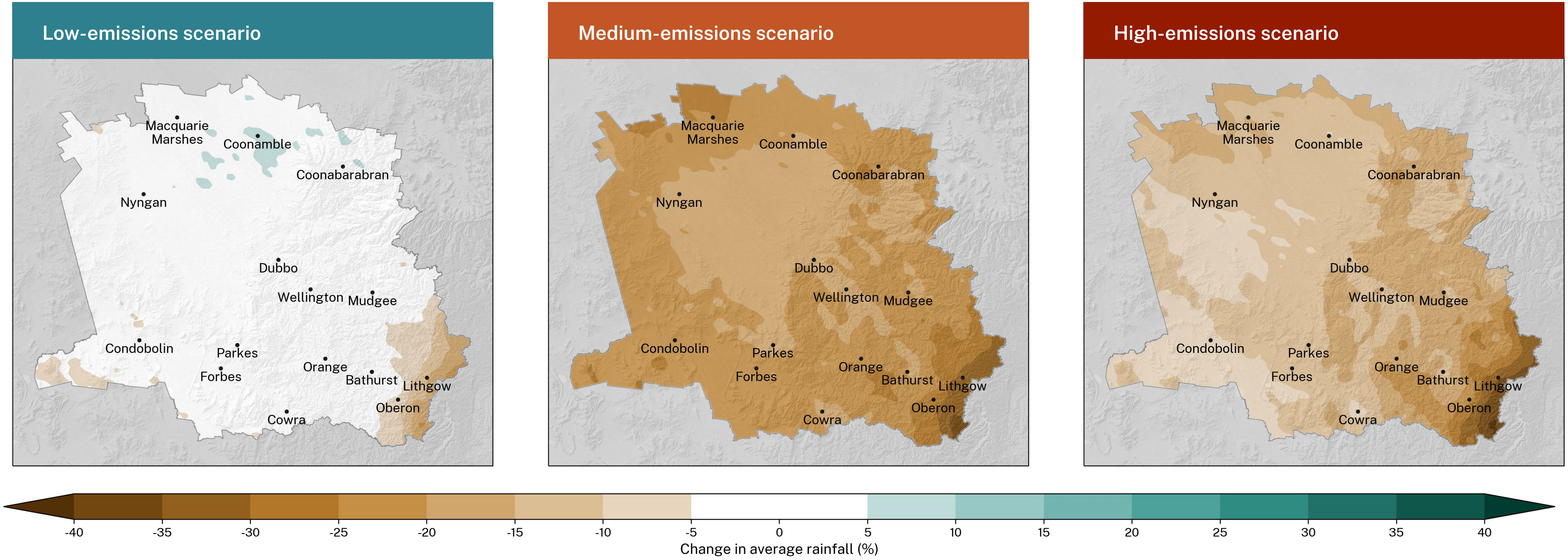
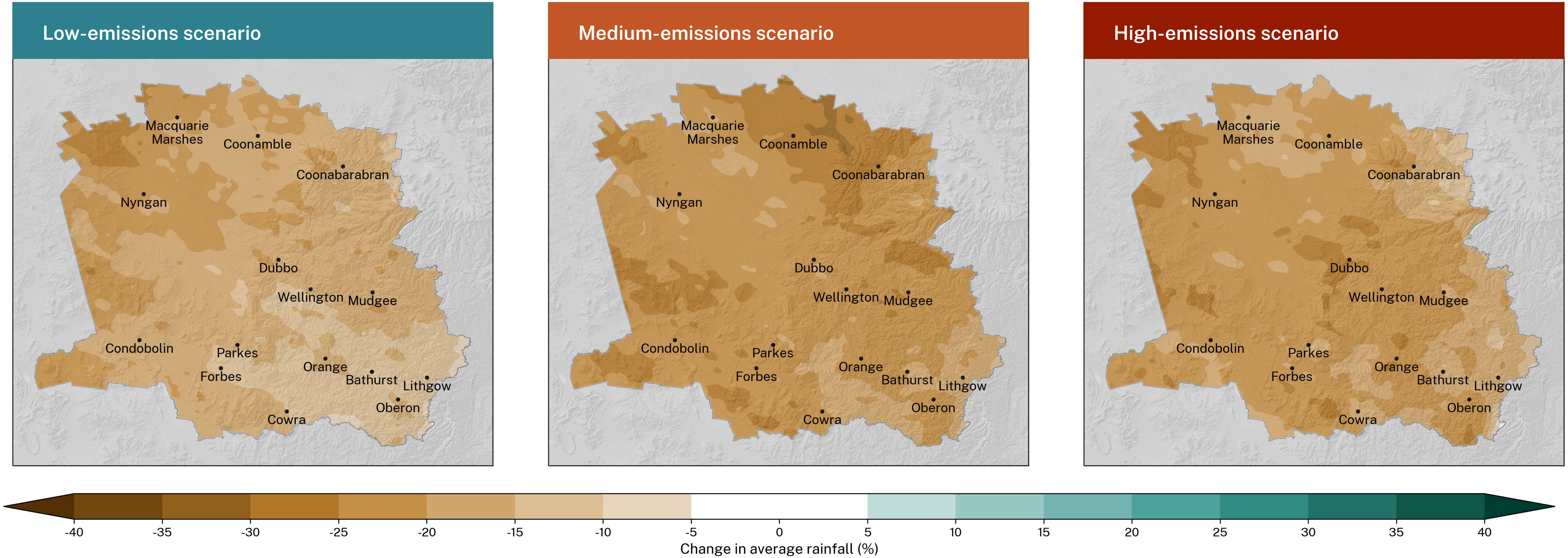


Figure 12. Projected change to average spring rainfall by 2090 for the Central West and Orana



Changes to rainfall

The region's reliance on agriculture makes it particularly susceptible to changes in rainfall patterns, increased temperatures and extreme events. The drought of 2017–2020 was the driest 36-month period on record for the region. In contrast, the 2022 floods resulted in 18 of the region's 19 local government areas being subject to a natural disaster declaration. The internationally significant Macquarie Marshes could be impacted by changes to rainfall and increased temperatures. These changes could cause enhanced evaporation, reductions in available water to plant communities and a reduction in waterbird breeding.[6]

The Central West and Orana region, known for its wine production, faces growing challenges from more variable and extreme rainfall patterns. Soil moisture strongly influences canopy growth and fruit traits.[7] Severe dryness of the soil can be problematic and if prolonged over the growing season may reduce grapevine growth, limit sugar development and lower yields.[8,9] While irrigation may help buffer yield losses in dry years, it is limited by declining rainfall and infrastructure demands, and can negatively affect fruit quality.[7,10]

Changes to rainfall and increased temperatures could have significant impacts on water supplies and internationally significant wetlands throughout the region. There is the potential for an increased risk of significantly lower inflows in key river catchments such as the Macquarie and Castlereagh rivers. A drought of the same severity and length as the 2017–2020 drought could go from a 1 in 1,000-year event to a 1 in 50-year event.[11]

Severe fire weather

Severe fire weather will increase

The Forest Fire Danger Index (FFDI) represents an estimate of fire weather risk. The FFDI is calculated from temperature, relative humidity and wind speed, as well as an index representing fuel dryness.

Severe fire weather (FFDI greater than 50) is most likely in summer and spring. Fire weather was the strongest determining factor of house loss during the Black Summer bushfires.[11] FFDI was monitored by weather stations across NSW until the introduction in 2022 of the Australian Fire Danger Rating System. FFDI is used in this snapshot as it can be simulated using the NARCliM projections, whereas data used by the Australian Fire Danger Rating System currently cannot. FFDI also provides a long history of data and gives context to the NARCliM projections.

Projections

Across the Central West and Orana region, the average number of severe fire weather days per year will increase throughout this century (Figure 13).

The number of severe fire weather days will increase for the region by 2050 for all emissions scenarios, with an even greater increase projected by 2090 under a medium-emissions scenario and a high-emissions scenario (Table 6). The number of severe fire weather days is projected to increase during spring and summer, with the largest increase in summer.

Increases to severe fire weather days are projected to occur across most of the region (Figure 14). The greatest increases are projected to occur in the central and western areas of the region, including Dubbo and Nyngan. By 2090, Dubbo is projected to experience 1.5 additional severe fire weather days under a low-emissions scenario, 2.8 additional days under a medium-emissions scenario and 4.5 additional days under a high-emissions scenario. A high-emissions scenario is projected to more than double Dubbo's baseline period average of 3.2 severe fire weather days per year. In the south-east of the region, Bathurst's baseline period average is 2.4 severe fire weather days. By 2090, Bathurst is projected to experience 1.5 additional severe fire weather days under a low-emissions scenario, 3.3 additional days under a medium-emissions scenario and 4.8 additional days under a high-emissions scenario.

2x

Under a high-emissions scenario, the number of severe fire weather days per year could more than double across the Central West and Orana by 2090.

Fire weather was the strongest determining factor of house loss during the Black Summer bushfires.[12]

Table 6 and Figure 13 provide more information on how the projections differ across the 3 scenarios, and Figure 14 provides information on regional differences by 2090 across the 3 scenarios.

Table 6. Projected increase in average annual number of severe fire weather days – Central West and Orana

2050

Low-emissions	Medium-emissions	High-emissions
2.4 days (−0.4 to 5.8 days)	**2.4 days** (−0.5 to 5.8 days)	**3.8 days** (1.0 to 9.6 days)

2090

Low-emissions	Medium-emissions	High-emissions
2.7 days (−0.4 to 6.8 days)	**5.7 days** (2.4 to 11.4 days)	**7.5 days** (1.9 to 16.6 days)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range. Severe fire weather increases are additional to the historical model baseline of 6.4 severe fire weather days.

Figure 13. Historical and projected change in annual number of severe fire weather days – Central West and Orana

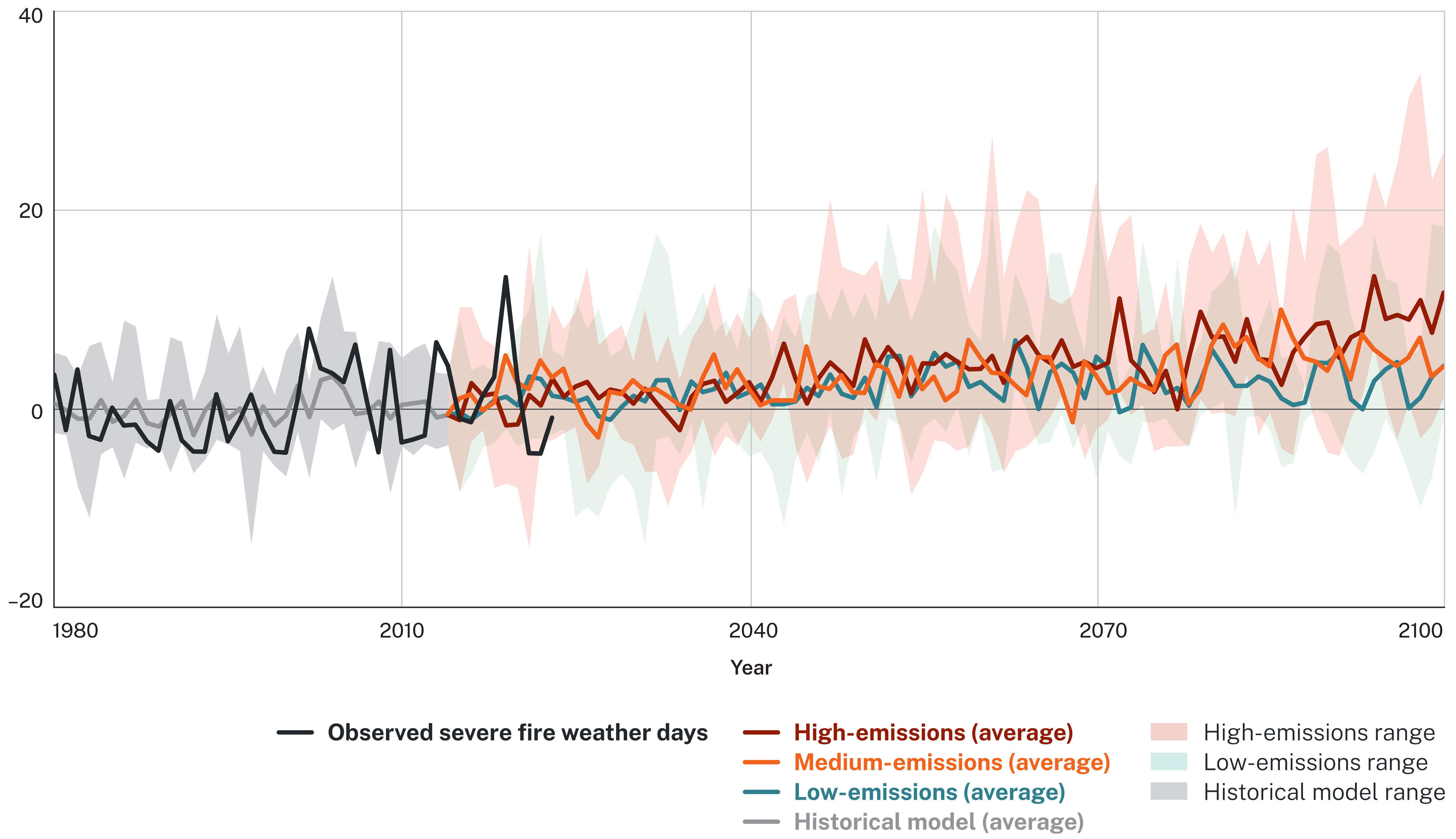
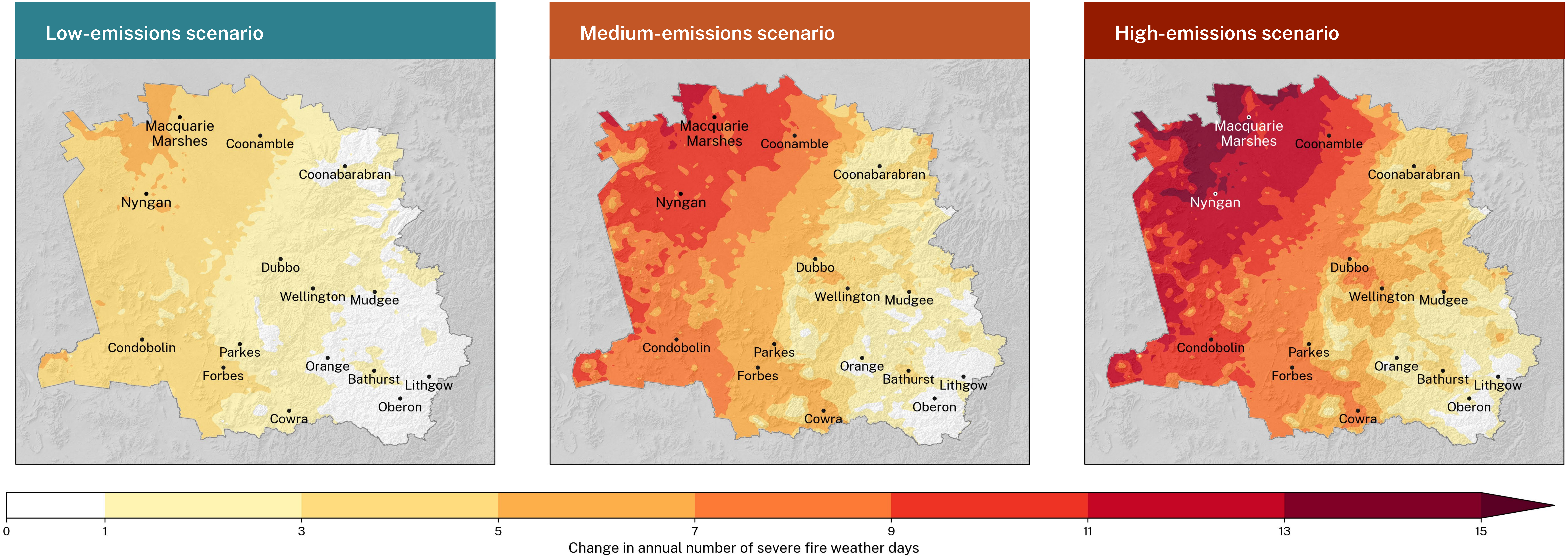
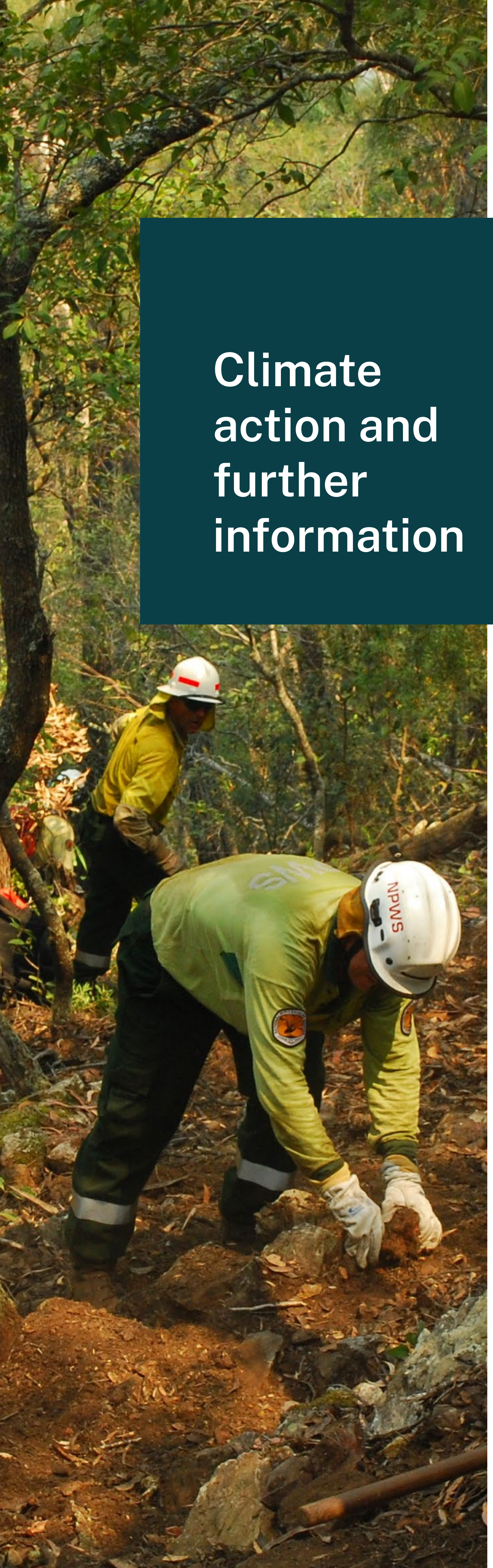


Figure 14. Projected change to average annual number of severe fire weather days by 2090 for the Central West and Orana





Climate action and further information

Climate action

The NARCliM projections for the low-, medium- and high-emissions scenarios highlight the stark difference in climate change impacts that will be experienced under each scenario. The differences provide a reminder of the required action across the world to reduce emissions, and specifically within NSW to meet our legislated Net Zero by 2050 emissions reduction targets. This is our best chance at ensuring the future projections under the high-emissions scenario are avoided. The NARCliM projections highlight the importance of taking action to adapt to the impacts of climate change. For more resources on reducing emissions and adapting to the impacts of climate change, visit AdaptNSW.

Additional resources

- For information on other climate change impacts, including sea level rise, visit AdaptNSW
- Climate change resources for local government on AdaptNSW
- Generate detailed climate information based on your local government area using SEED
- Climate Data Portal
- NARCliM case studies
- Climate risk ready NSW guide
- Local government climate change action in NSW: a guide to leadership

Further information

NARCliM projections are delivered with support from: the ACT, South Australian, Victorian and Western Australian governments; National Computational Infrastructure; Murdoch University; and the University of New South Wales. Detailed information on the methodology and application of the projections can be found on the AdaptNSW website. Climate change information in this snapshot is delivered as part of the NSW Government's commitment to 'Publish regularly updated and improved local level climate change projections' under Action 3 of the NSW climate change adaptation strategy.

References

1. O'Neill et al. 2017, The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. *Global Environmental Change, 42*, 169–180.
2. Riahi et al. 2017, The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change, 42*, 153–168.
3. Long-term temperature record – webpage.
4. About Australian Gridded Climate Data maps and grids – webpage.
5. ABS 2016, Census of Population and Housing, TableBuilder.
6. OEH 2013, 'Macquarie Marshes Ramsar site Article 3.2 response strategy', Office of Environment and Heritage, Sydney
7. Bonada et al. 2021, Soil water availability during spring modulates canopy growth and impacts the chemical and sensory composition of Shiraz fruit and wine. *Australian Journal of Grape and Wine Research*, 27(4), 491-507.
8. Jones et al. 2022, Climate change and its consequences for viticulture. *Managing wine quality*, Woodhead Publishing, 2022, 727-778.
9. Keller 2023, climate change impacts on vineyards in warm and dry areas: challenges and opportunities: From the ASEV Climate Change Symposium Part 1–Viticulture. *American journal of enology and viticulture*, 74(2).
10. Bonada et al. 2020, Impact of low rainfall during dormancy on vine productivity and development. *Australian Journal of Grape and Wine Research*, 26(4), 325-342.
11. DPE (Department of Planning and Environment) 2023, Regional Water Strategy – Macquarie-Castlereagh, Department of Planning and Environment, Sydney.
12. Price et al. 2020, Probability of house destruction. Theme 3A. People and Property Impacts, Bushfire Risk Management Research Hub for the NSW Bushfire Inquiry 2020 – webpage.

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