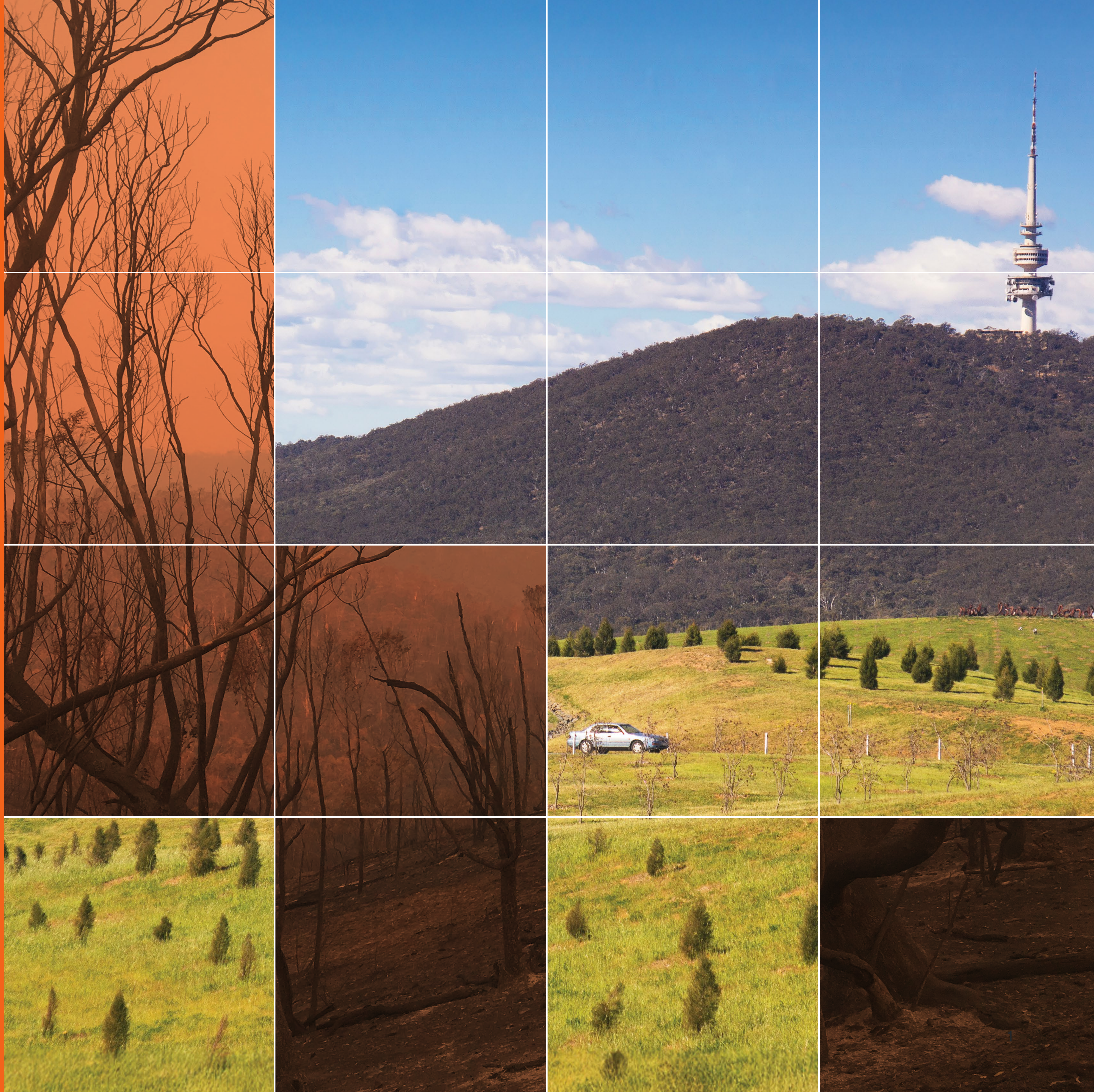
NARCliM

NSW GOVERNMENT

Australian Capital Territory

Climate Change Snapshot



In partnership with

ACT Government

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 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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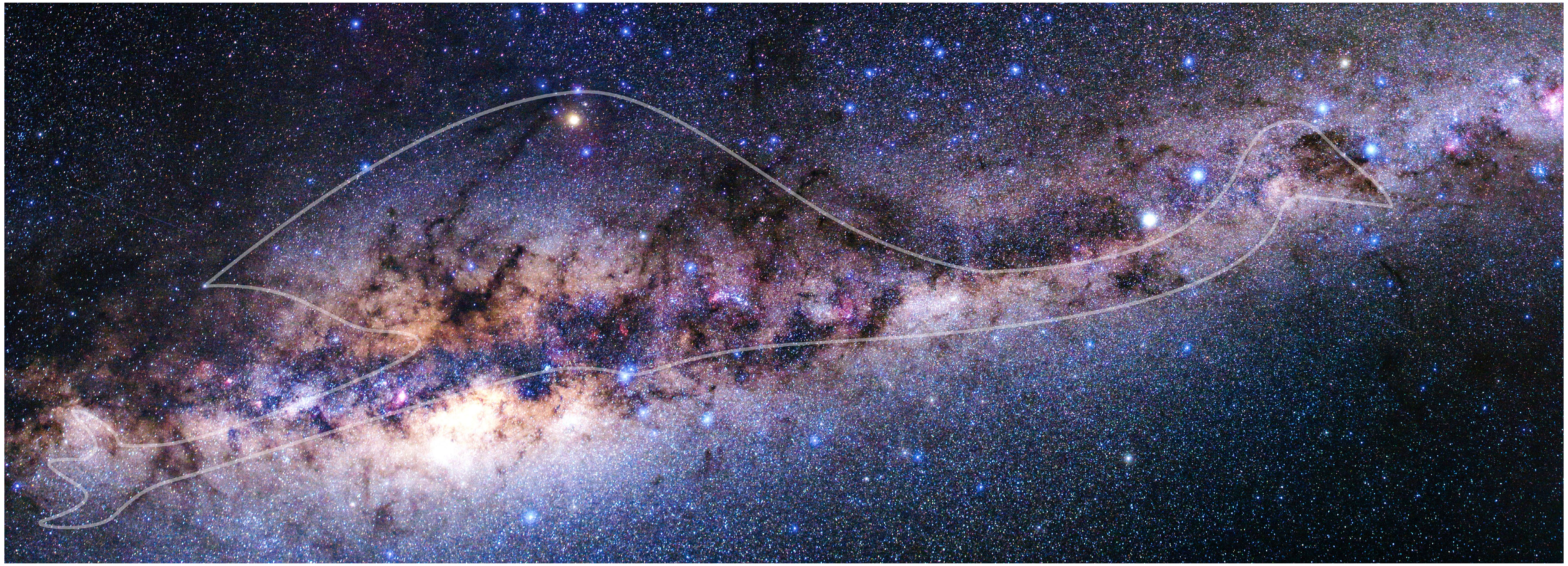


Acknowledgement of Country

The ACT Government acknowledges the Ngunnawal people as traditional custodians of the ACT and recognises any other people or families with connection to the lands of the ACT and region. We acknowledge and respect their continuing culture and the contribution they make to the life of this city and this region.

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 Australian Capital Territory (ACT) 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.

The ACT is already experiencing climate change. This document provides local-scale climate modelling insights to help NSW 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

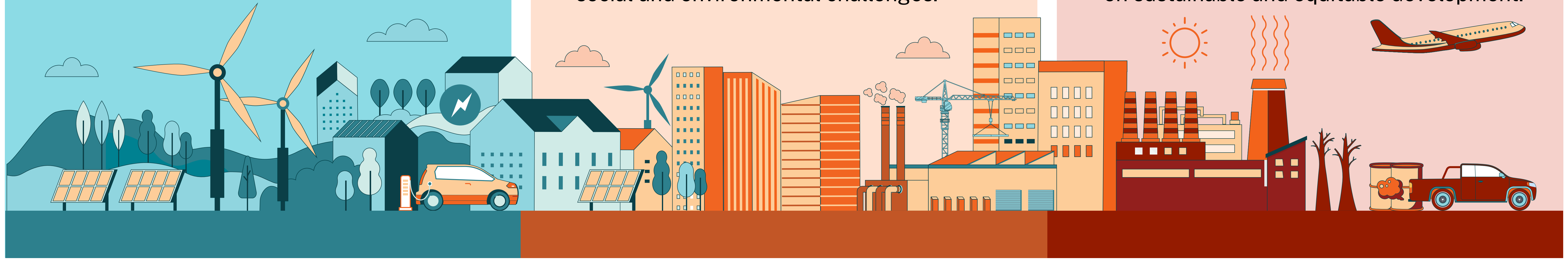
SSP 2–4.5

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 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

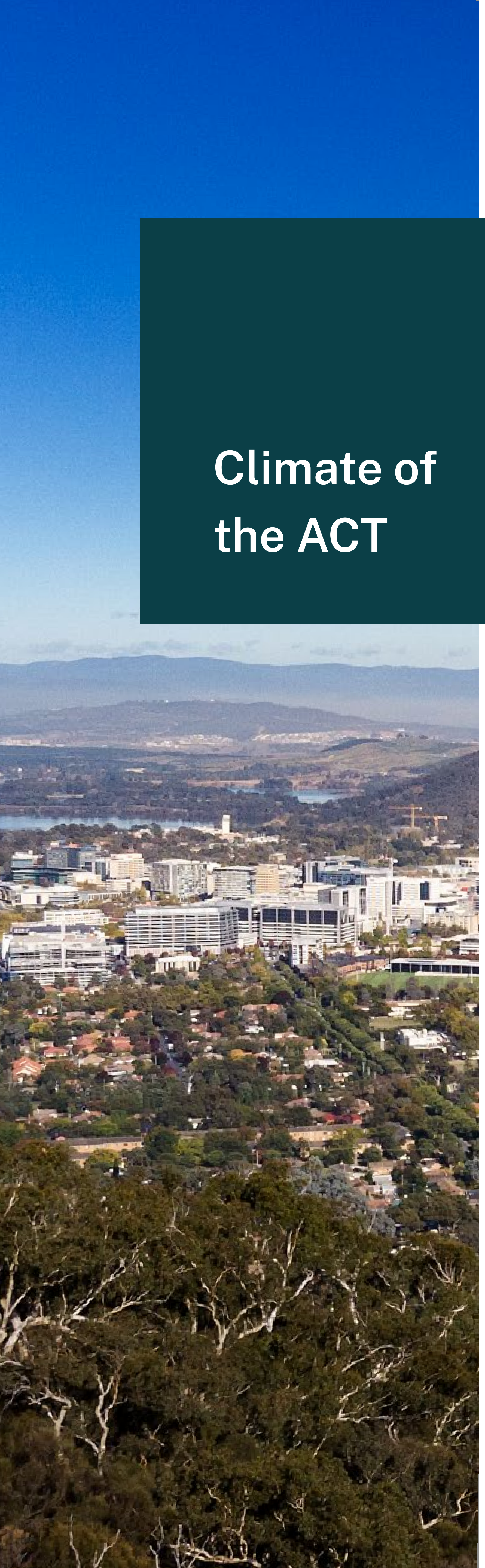
Use the historical model values in Table 1 as the baseline when interpreting both middle of the century and end of the century climate projections in this snapshot.

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 ACT

	Average temperature	Average maximum temperature	Average minimum temperature	Hot days	Cold nights	Rainfall	Severe fire weather days
Observed	11.5°C	17.7°C	5.2°C	2.8 days	116.2 days	741 mm	0.3 days
Historical model	10.8°C	16.4°C	6.1°C	2.1 days	122.7 days	763 mm	0.4 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 the ACT

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

The ACT is home to Australia's capital city, Canberra, with a population of over 450,000 people. Canberra serves as a regional hub for smaller regional cities, towns and villages in the surrounding areas of NSW.

Regional characteristics

Overall the ACT has a relatively dry, continental climate, experiencing warm to hot summers and cool to cold winters. However, due to the ACT's varied landscape, the ACT does experience a range of climatic conditions over a relatively small area. The average climate gets cooler and wetter the further south you go. In the north of the territory, around Canberra, it is relatively dry and warm compared to the much cooler and wetter south-western area around the northern Australian Alps in Namadgi National Park. Northern parts of the territory experience mild summers, with colder winters experienced in the alpine regions of the Namadgi National Park. More mild conditions are experienced in central part of the ACT with warmer winters than the south, but cooler summers than the north of the territory. The range of climates support a variety of habitats including open grasslands, low open woodlands and tall wet forests. The region also contains important subalpine heathlands and wetlands.

Working-aged people (15–64) make up 68.1% of the population (slightly higher than the NSW and ACT average of 64.3%), while children and adolescents (0–14) represent 18.2% and people aged 65 and over represent 13.7% of the region's population.[5]

The ACT supports a diverse range of industries. The largest industries in the region, by employment, are public administration and safety (31.2%), specialised services (professional, scientific and technical) (11.2%) as well as health care and social assistance (11.1%).[5]

The territory'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 ACT.

PROJECTED CHANGES

	Low-emissions scenario		Medium-emissions scenario		High-emissions scenario	
	2050	2090	2050	2090	2050	2090
Increase in average temperature	+1.1°C	+1.2°C	+1.4°C	+2.5°C	+1.8°C	+3.7°C
Increase in hot days per year	+2.6	+3.2	+3.6	+8.0	+5.3	+12.8
Decrease in cold nights per year	–19.1	–22.3	–26.8	–46.6	–32.4	–67.7
Decrease in average spring rainfall	–9.9%	–16.6%	–12.6%	–22.6%	–16.8%	–21.8%

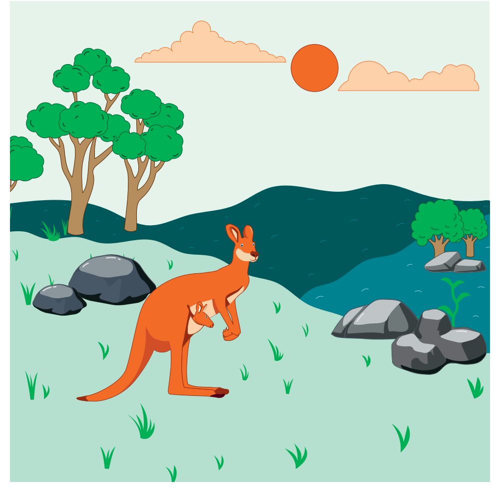
REGIONAL IMPACTS

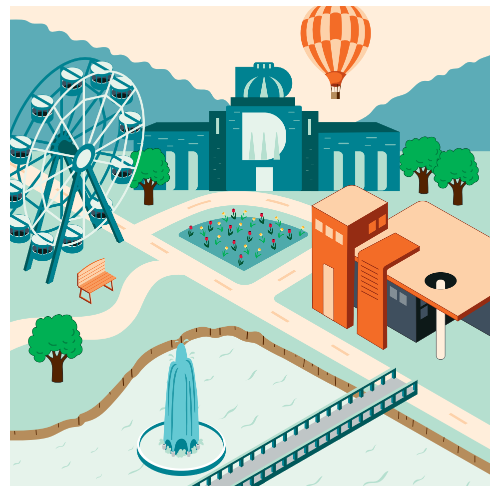
Canberra

Increased extreme heat

Tourism

Increased extreme heat





Increased severe fire weather

Urban fringe

Changes to rainfall

Water supply

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. Climate change impacts are used to highlight how the ACT is likely to be affected by climate change, and impacts are not limited to the examples provided.

Temperature

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

3.7°C

rise in average temperature across the ACT 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 ACT is getting warmer

Temperature is the most robust indicator of climate change. The warmest year on record for both mean temperature and maximum temperature in the ACT was 2019, when the average temperature was 1.0°C above the 1990–2009 baseline average.[4]

Projections

Across the ACT 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 less than 0.1°C between 2050 and 2090 (Table 2). However, major temperature increases of 1.1°C under a medium-emissions scenario and 1.9°C under a high-emissions scenario is expected during the same period. Notably, the temperature projections for 2050 under a medium-emissions scenario and a high-emissions scenario are expected to exceed the projections for 2090 under a low-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 – ACT

2050

	Low-emissions	Medium-emissions	High-emissions
Temperature	**1.1°C** (0.4°C to 1.6°C)	**1.4°C** (0.9°C to 1.9°C)	**1.8°C** (0.9°C to 2.7°C)
Maximum temperature	**1.2°C** (0.4°C to 1.7°C)	**1.6°C** (1.0°C to 1.9°C)	**2.0°C** (1.0°C to 2.9°C)
Minimum temperature	**1.0°C** (0.5°C to 1.4°C)	**1.4°C** (0.8°C to 1.9°C)	**1.7°C** (0.8°C to 2.5°C)

2090

	Low-emissions	Medium-emissions	High-emissions
Temperature	**1.2°C** (0.5°C to 1.9°C)	**2.5°C** (1.8°C to 3.7°C)	**3.7°C** (2.5°C to 5.2°C)
Maximum temperature	**1.3°C** (0.5°C to 2.1°C)	**2.8°C** (1.8°C to 4.0°C)	**3.9°C** (2.7°C to 5.5°C)
Minimum temperature	**1.1°C** (0.6°C to 1.6°C)	**2.4°C** (1.7°C to 3.4°C)	**3.5°C** (2.4°C to 5.0°C)

Temperature increases are additional to the historical model baselines of 10.8℃ for average temperature, 16.4℃ for average maximum temperature and 6.1℃ for average minimum temperature.

Figure 1. Historical and projected average temperature change – ACT

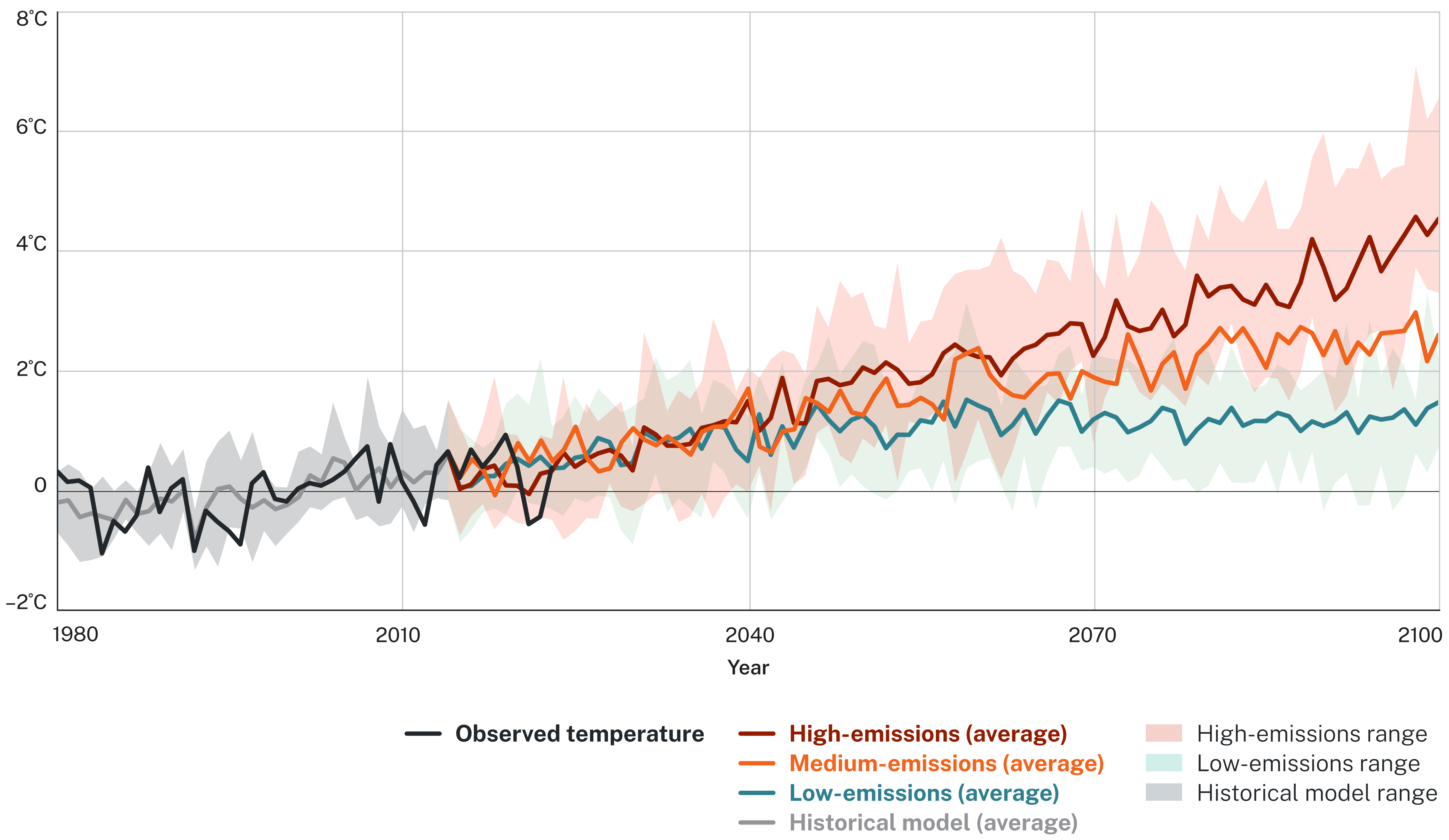
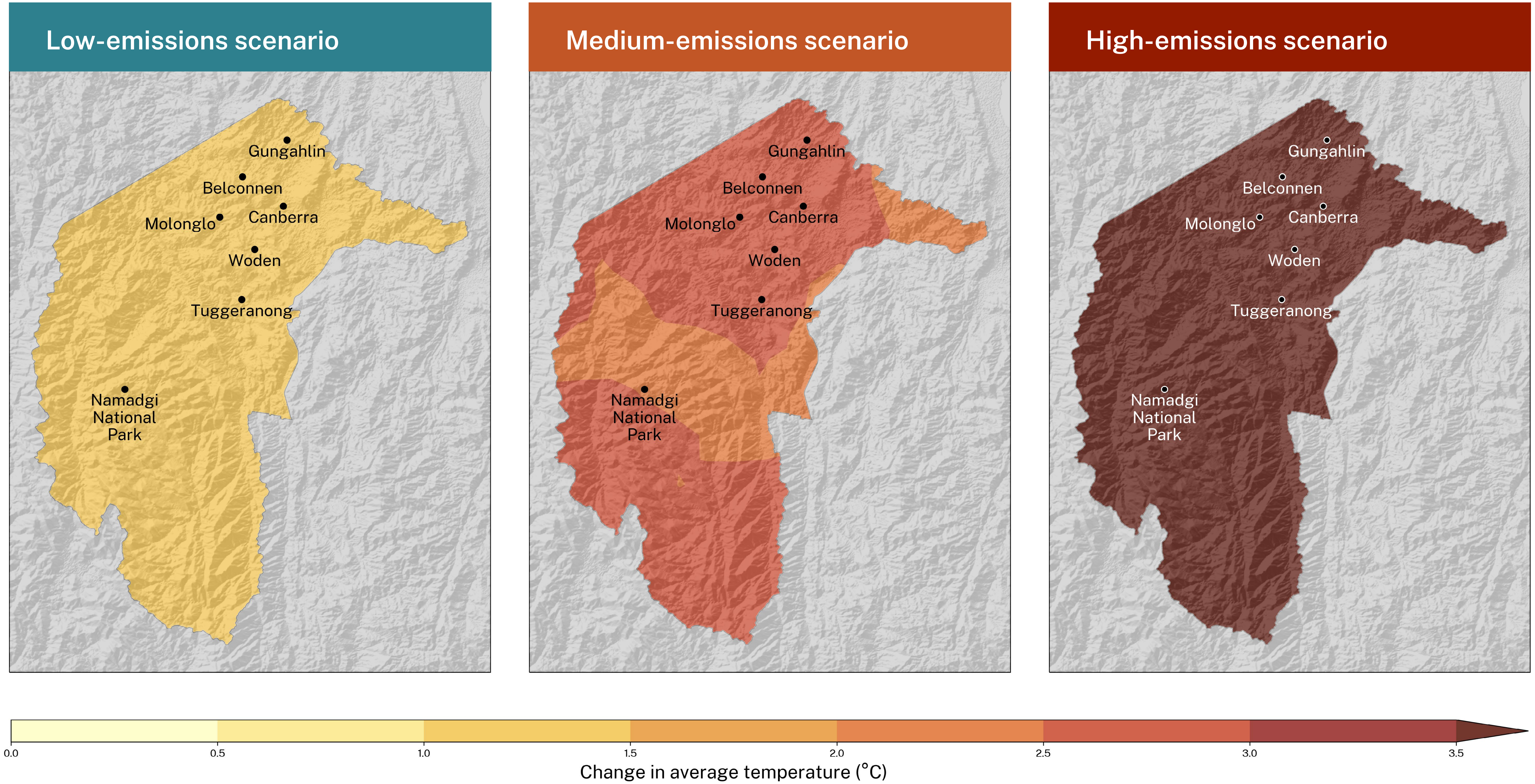


Figure 2. Projected change in average temperature by 2090 for ACT



Hot days

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

5x

The number of hot days across the ACT is projected to increase by more than 5 times 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. The number of hot days observed for the ACT is on average 2.8 hot days per year.[2]

Projections

Across the ACT, the average number of hot days per year will increase throughout this century (Figure 3).

The number of hot days will increase for the ACT 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 across spring, summer and autumn, with the largest increase expected during summer.

Under a low-emissions scenario, there is a minimal increase in the number of hot days between 2050 and 2090, with less than 1 additional hot day per year projected across the region (Table 3). However, increases of 4.4 additional hot days under a medium-emissions scenario and 7.5 additional hot days under a high-emissions scenario are projected between 2050 and 2090.

The changes will occur across most of the region, particularly northern areas (Figure 4). Canberra is projected to experience the greatest increases in the number of hot days, with alpine regions of Namadgi National Park expected to experience smaller increases. By 2090, Canberra will likely experience 6.9 additional hot days under a low-emissions scenario, 16.1 additional hot days under a medium-emissions scenario and 24.5 additional hot days under a high-emissions scenario. A medium-emissions scenario is projected to be nearly quadruple Canberra's baseline period average of 5.6 hot days per year, while a high-emissions scenario is projected to increase it more than 5 times. Comparatively, Namadgi National Park's baseline period average is 0.3 hot days per year. By 2090, the park is projected to experience an additional 0.7 hot days under a low-emissions scenario, 2.4 additional hot days under a medium-emissions scenario and 4.9 additional hot days 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 – ACT

2050

Low-emissions	Medium-emissions	High-emissions
2.6 days (0.4 to 5.4 days)	**3.6 days** (1.1 to 6.6 days)	**5.3 days** (0.5 to 12.6 days)

2090

Low-emissions	Medium-emissions	High-emissions
3.2 days (0.8 to 8.3 days)	**8.0 days** (2.8 to 16.1 days)	**12.8 days** (4.5 to 27.3 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 2.1 hot days.

Figure 3. Historical and projected average annual number of hot days – ACT

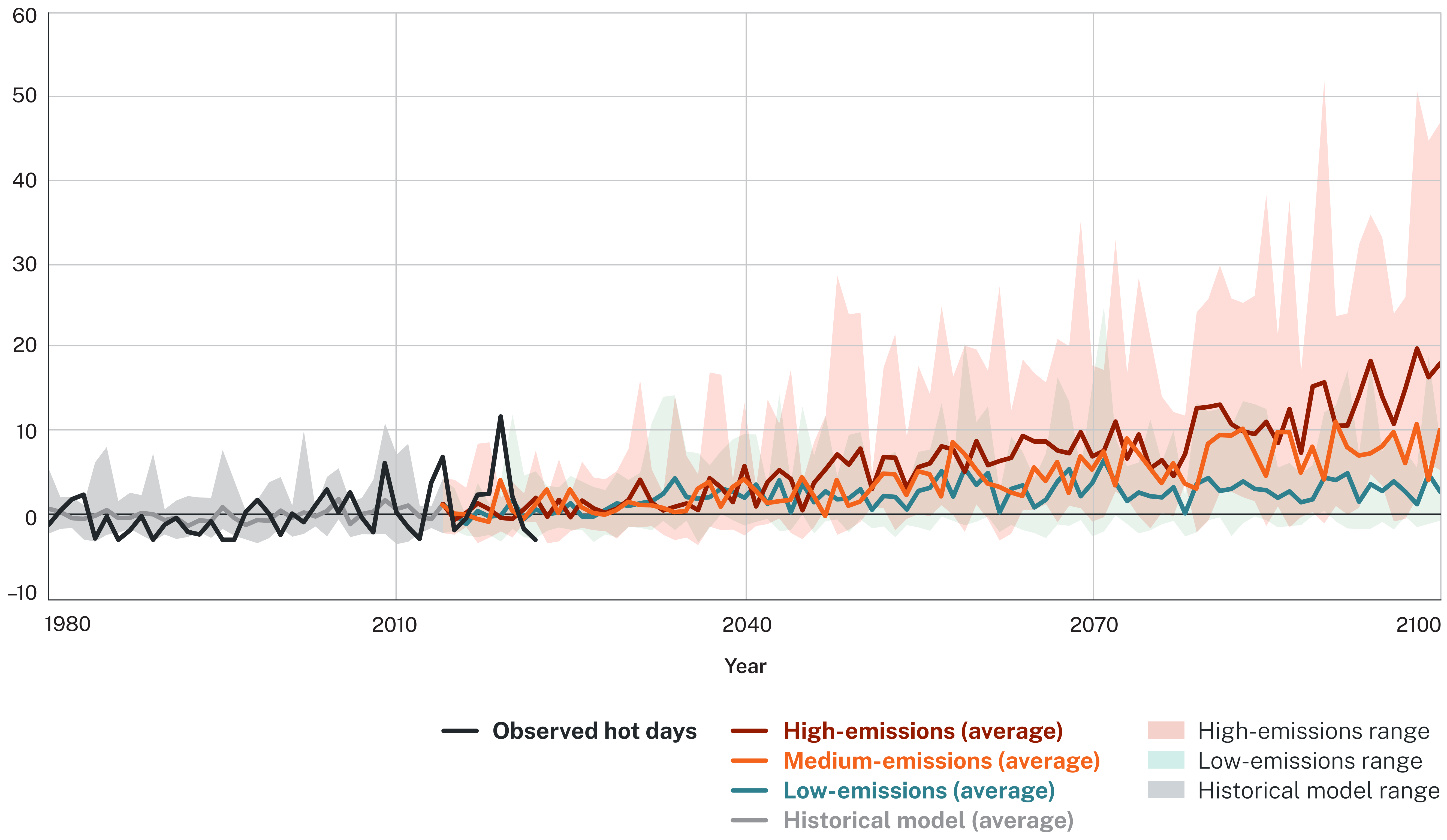
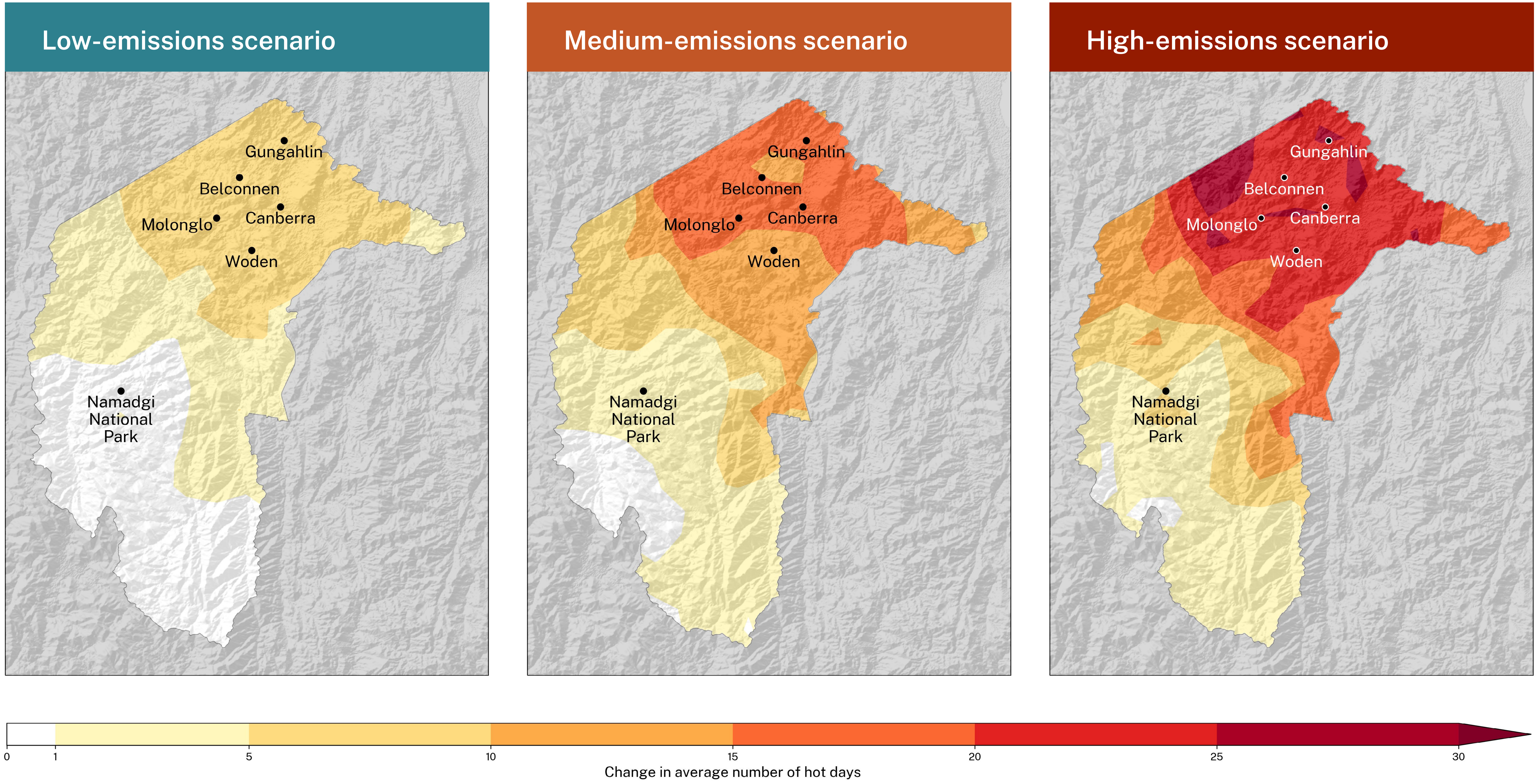


Figure 4. Projected change in annual number of hot days by 2090 for the ACT



Cold nights

Cold nights are important for snow in alpine areas and the viability of important plant species, including some temperate fruits.

Cold nights for alpine areas in Namadgi National Park could more than halve under a high-emissions scenario by 2090.

Under a low-emissions scenario, the number of cold nights across the ACT could reduce by less than 20% by 2090.

Cold nights will decrease

Cold nights are those where the minimum temperature drops below 2°C. These are important for alpine ecosystems, tourism and 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 across the ACT. During the baseline period, alpine regions of Namadgi National Park had on average more than 140 cold nights per year, while Canberra's urban area had on average approximately 76 cold nights per year.

Projections

Across the ACT, the average number of cold nights per year will decrease throughout this century (Figure 5).

The number of cold nights will decrease for the ACT by 2050 for all emissions scenario, 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 3.2 fewer cold nights per year projected across the region between 2050 and 2090. However, decreases of 19.8 fewer cold nights per year under a medium-emissions scenario and 35.3 fewer cold nights per year under a high-emissions scenario are projected during the same period.

Cold nights will decrease across all of the ACT, particularly in alpine regions of Namadgi National Park (Figure 6). By 2090, Canberra is projected to have 20.4 fewer cold nights per year under a low-emissions scenario, 40.5 fewer cold nights per year under a medium-emissions scenario and 55.4 fewer cold nights per year under a high-emissions scenario. A medium-emissions scenario is projected to reduce Canberra's 76.4 cold nights per year baseline period average by more than 50%, while a high-emissions scenario is projected to reduce Canberra's baseline average by more than 70%.

Comparatively, by 2090, Namadgi National Park is projected to have 23.8 fewer cold nights per year under a low-emissions scenario, 50.5 fewer cold nights per year under a medium-emissions scenario and 74.6 fewer cold nights per year under a high-emissions scenario. A medium-emissions scenario is projected to reduce Namadgi National Park's 148.4 cold nights per year baseline period average by more than 30%, while a high-emissions scenario is projected to reduce Namadgi National Park's baseline period average by more than 50%.

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 – ACT

2050

Low-emissions	Medium-emissions	High-emissions
19.1 days (9.7 to 25.4 days))	**26.8 days** (15.9 to 34.3 days)	**32.4 days** (19.3 to 42.4 days)

2090

Low-emissions	Medium-emissions	High-emissions
22.3 days (13.2 to 28.0 days)	**46.6 days** (32.1 to 63.7 days)	**67.7 days** (54.5 to 88.1 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 122.7 cold nights.

Figure 5. Historical and projected change in annual number of cold nights – ACT

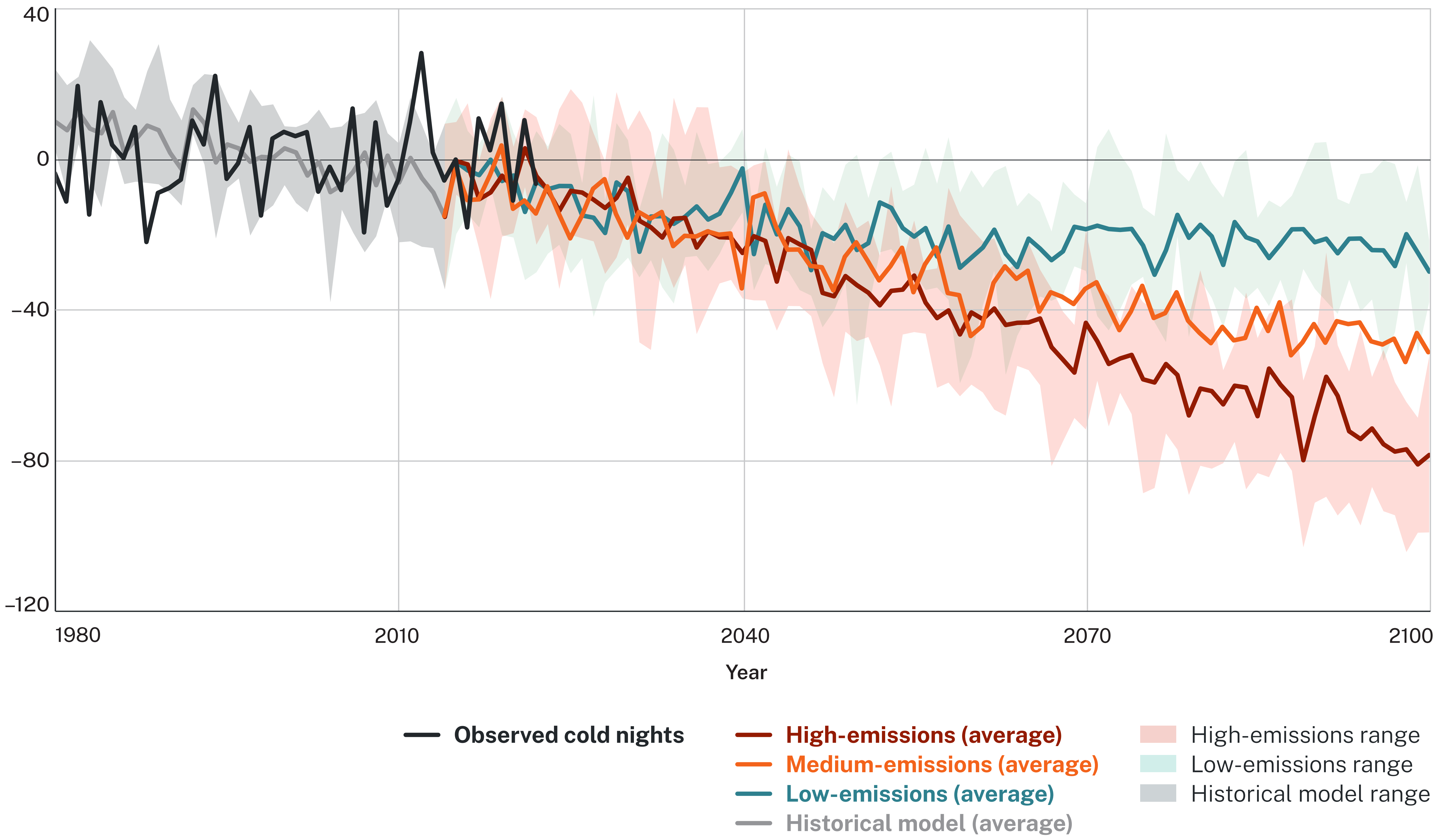
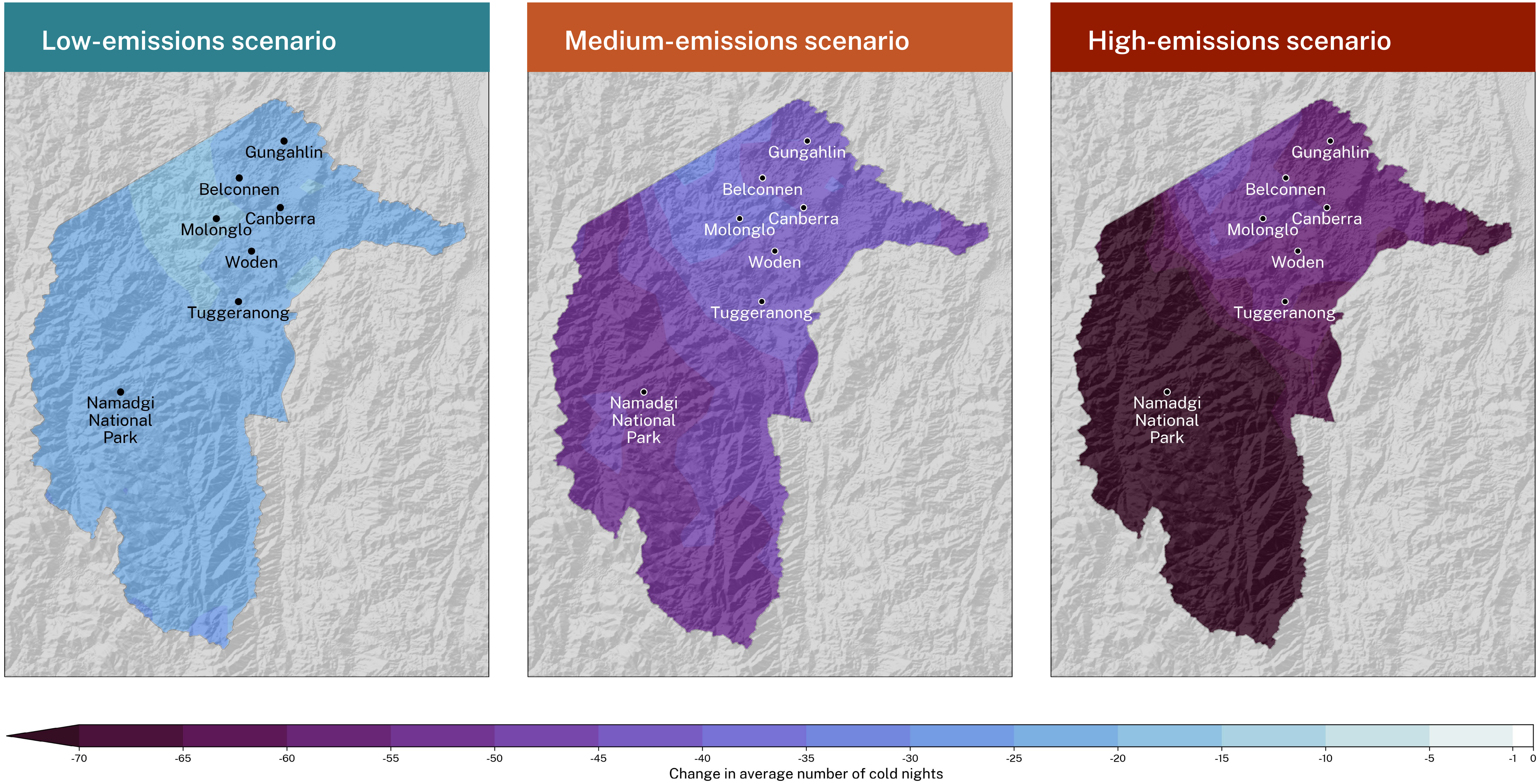
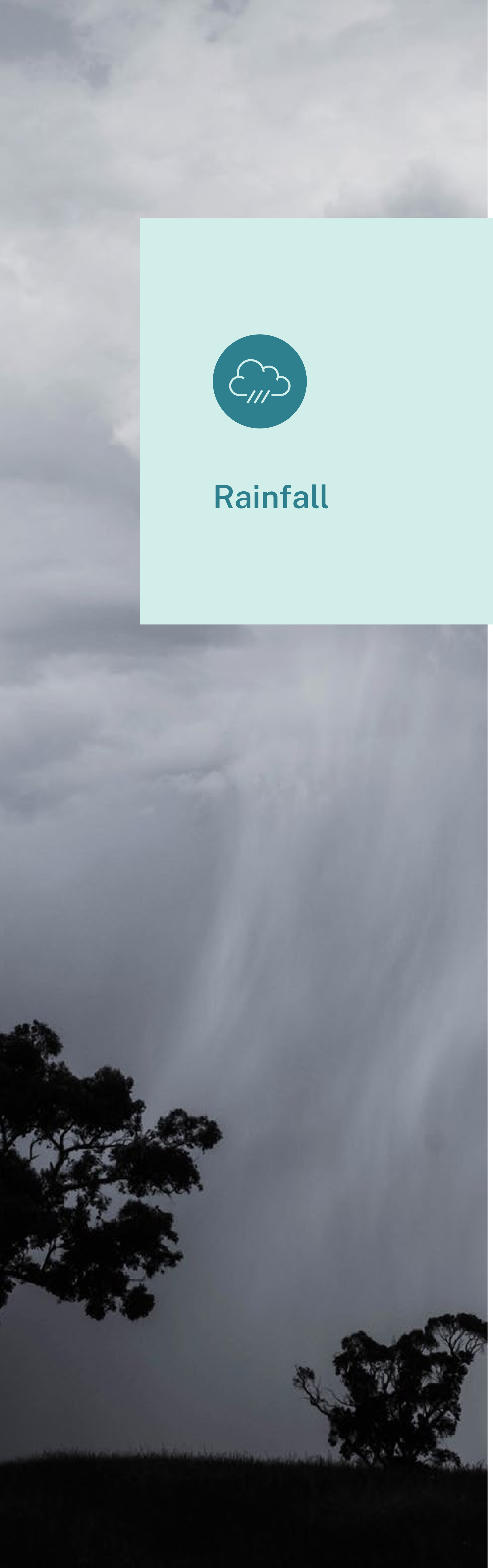


Figure 6. Projected change in annual number of cold nights by 2090 for ACT





Rainfall

Rainfall may slightly decrease but will remain variable

Climate change will influence rainfall patterns and the total amount of rainfall that the ACT receives. These changes may have widespread impacts on water security, agricultural productivity and native species' reproductive cycles. For example, eucalypt woodlands 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.

Observed annual rainfall across the ACT averages about 740 mm.[2] Rainfall is highest in the mountainous south-west, which experiences on average more than 1,200 mm per year. Rainfall is lowest for Canberra, which experiences around 600 mm per year.[3] Annual rainfall is generally uniform throughout the year across the ACT, except for alpine regions of Namadgi National Park, which experience slightly more rainfall in winter and spring. The driest year on record was 2019, with an average of only 520 mm across the region.[2]

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

Water availability within the ACT is highly variable from year to year. Compared to the long-term average, river flows in 2019 were more than 80% lower, while flows in 2021 were 3 to 4 times higher.[19]

A decrease in average spring rainfall of 20–25% by 2090 is projected for the ACT under medium-emissions and high-emissions scenarios.

Projections

The ACT is expected to experience a slight drying trend in average rainfall throughout this century (Figure 7). Changes to average rainfall will occur in all seasons, with the most notable changes expected in spring (Table 5).

By 2090, average spring rainfall is projected to decrease by approximately 17% under a low-emissions scenario, 23% under a medium-emissions scenario and by 22% under a high-emissions scenario.

Average autumn and summer rainfall are projected to change by minor amounts. Average winter rainfall is generally projected to change by minor amounts except for a decrease of 23% under a medium-emissions scenario.

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 by season.

Table 5. Projected change to average rainfall – ACT

2050

	Low-emissions	Medium-emissions	High-emissions
Annual	**–8.7%** (–18.9% to +13.0%)	**–7.2%** (–25.1% to +6.8%)	**–13.9%** (–34.7% to +1.3%)
Summer	**–6.9%** (–24.3% to +40.6%)	**–9.5%** (–25.2% to +38.4%)	**–16.5%** (–37.5% to +35.4%)
Autumn	**–11.2%** (–28.4% to +13.4%)	**–0.6%** (–29.0% to +40.0%)	**–10.9%** (–44.8% to +23.6%)
Winter	**–7.5%** (–21.9% to +23.3%)	**–4.5%** (–21.8% to +33.0%)	**–10.6%** (–29.8% to +17.3%)
Spring	**–9.9%** (–26.7% to +17.7%)	**–12.6%** (–37.5% to +22.5%)	**–16.8%** (–28.2% to –4.7%)

2090

	Low-emissions	Medium-emissions	High-emissions
Annual	**–9.9%** (–25.2% to +15.1%)	**–19.0%** (–32.0% to +3.4%)	**–12.9%** (–37.0% to +18.1%)
Summer	**–15.6%** (–37.1% to +57.6%)	**–17.8%** (–33.1% to +50.3%)	**–10.4%** (–46.6% to +57.7%)
Autumn	**–7.8%** (–26.4% to +11.4%)	**–11.5%** (–31.7% to +17.2%)	**–6.8%** (–34.4% to +29.4%)
Winter	**+0.9%** (–26.0% to +41.2%)	**–22.5%** (–35.3% to +19.9%)	**–11.5%** (–28.5% to +46.6%)
Spring	**–16.6%** (–29.6% to +14.0%)	**–22.6%** (–37.3% to +7.9%)	**–21.8%** (–43.1% to +15.9%)

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 763 mm. Average summer rainfall is relative to a baseline of 212 mm, average autumn rainfall is relative to a baseline of 152 mm, average winter rainfall is relative to a baseline of 204 mm and average spring rainfall is relative to a baseline of 195 mm.

Figure 7. Historical and projected change in average rainfall – ACT

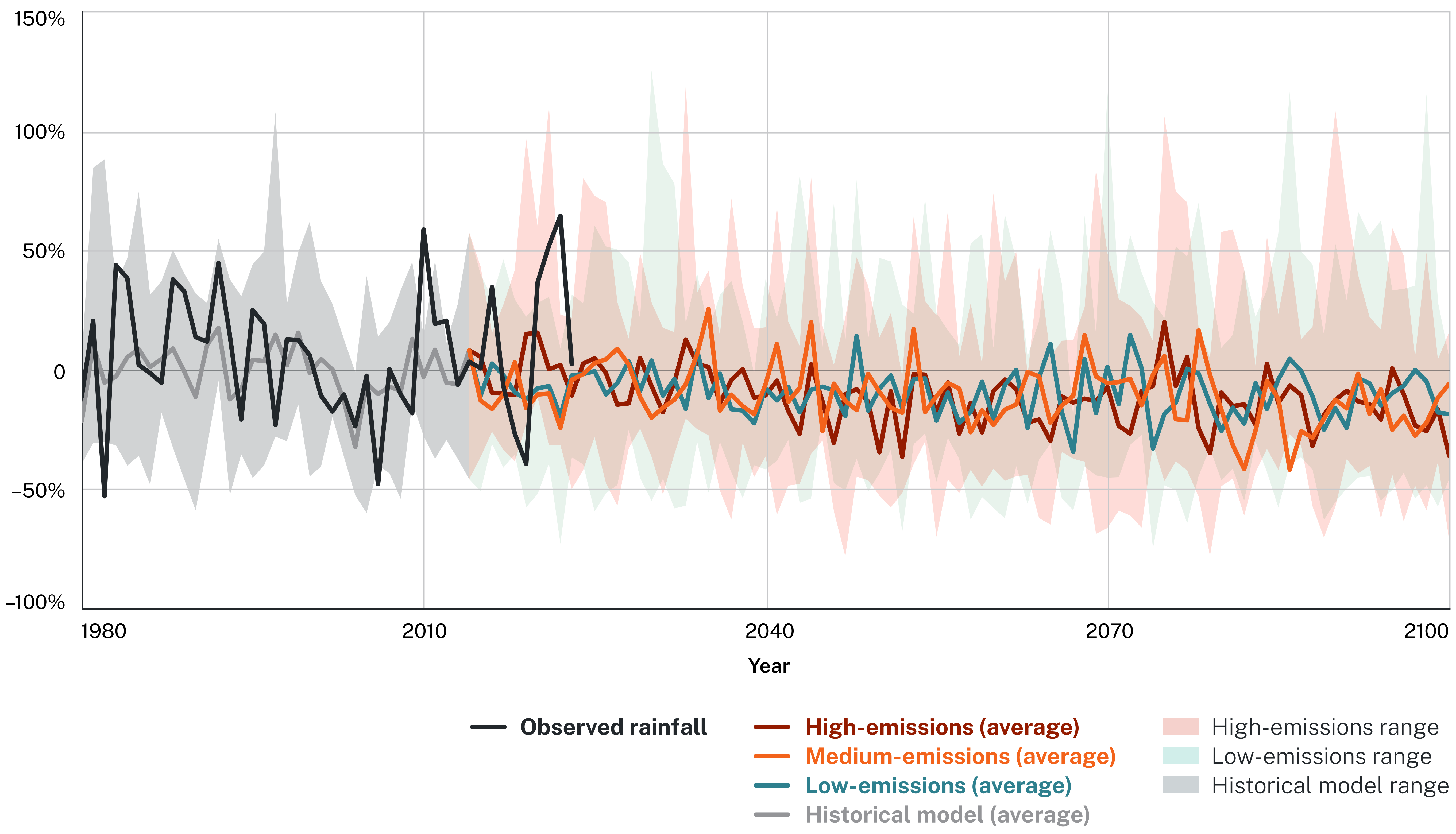


Figure 8. Projected change to average annual rainfall by 2090 for ACT

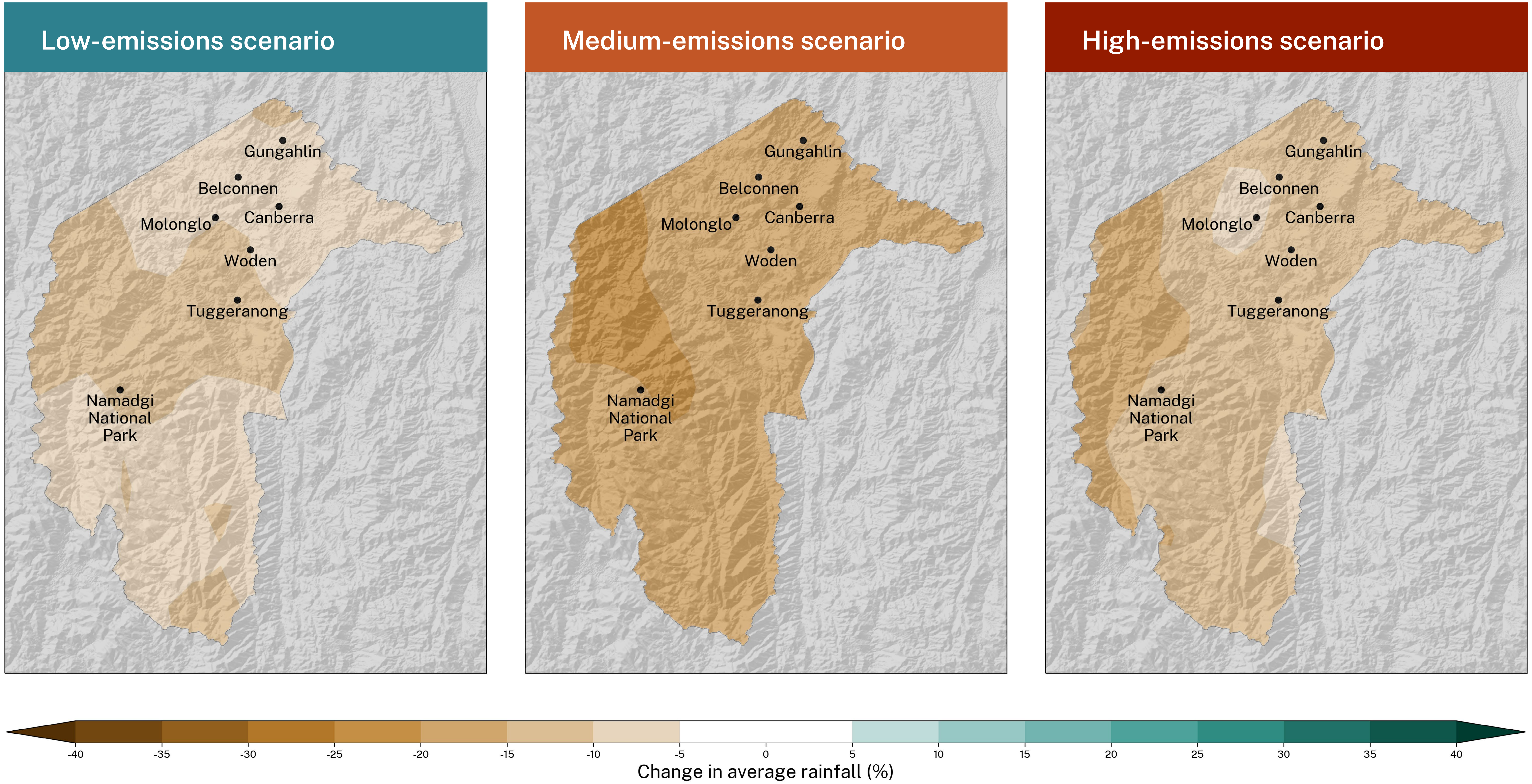


Figure 9. Projected change to average summer rainfall by 2090 for ACT

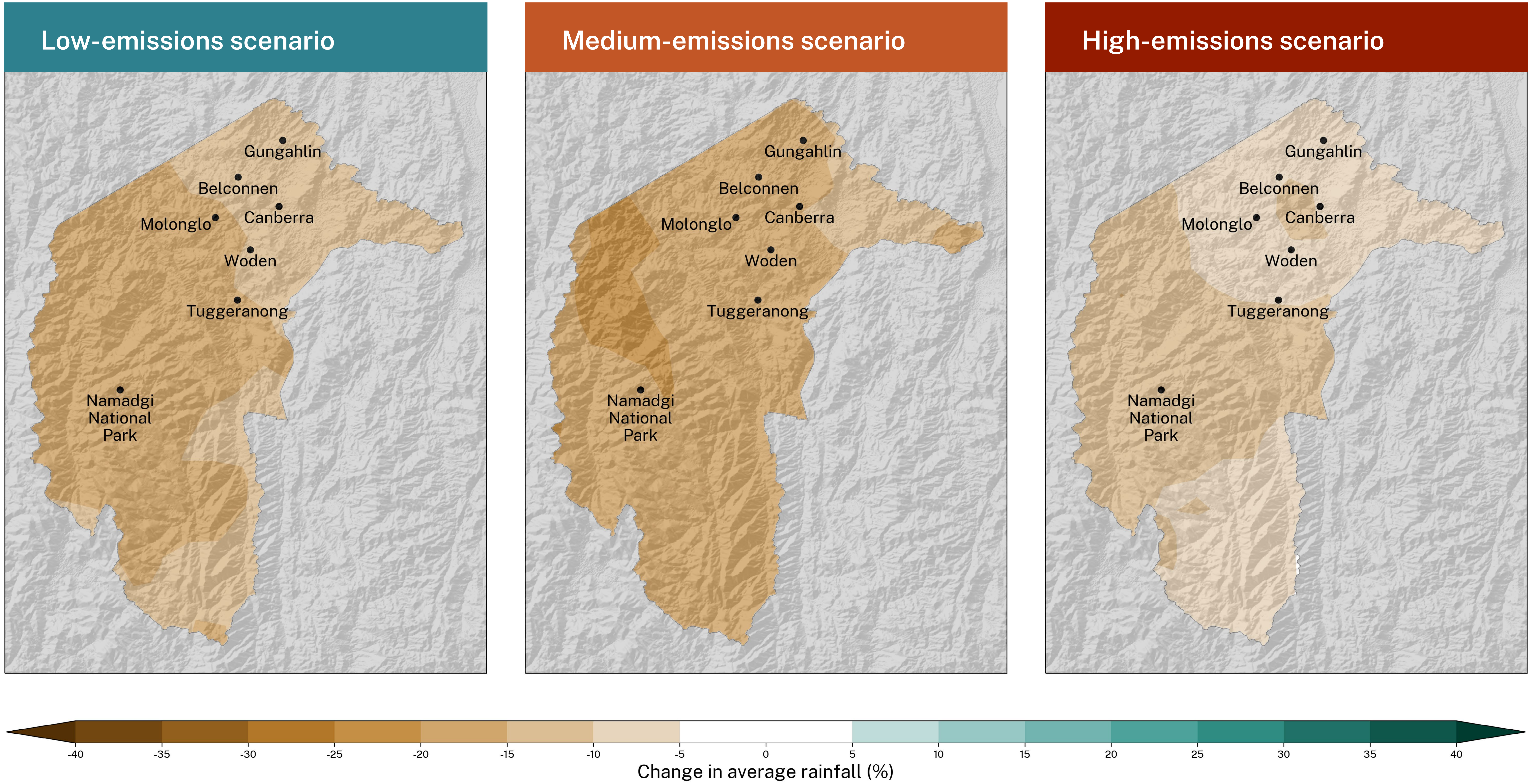


Figure 10. Projected change to average autumn rainfall by 2090 for ACT

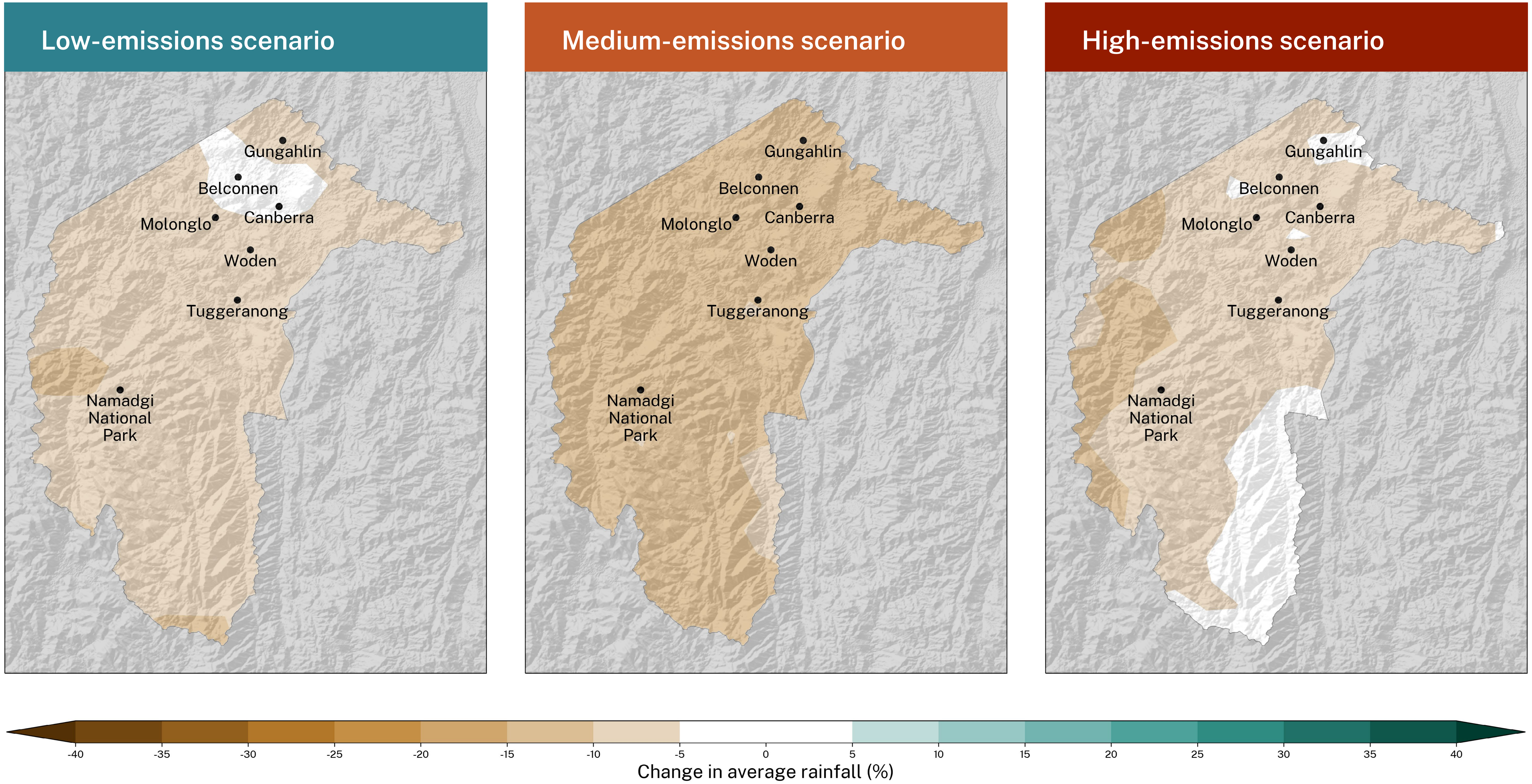


Figure 11. Projected change to average winter rainfall by 2090 for ACT

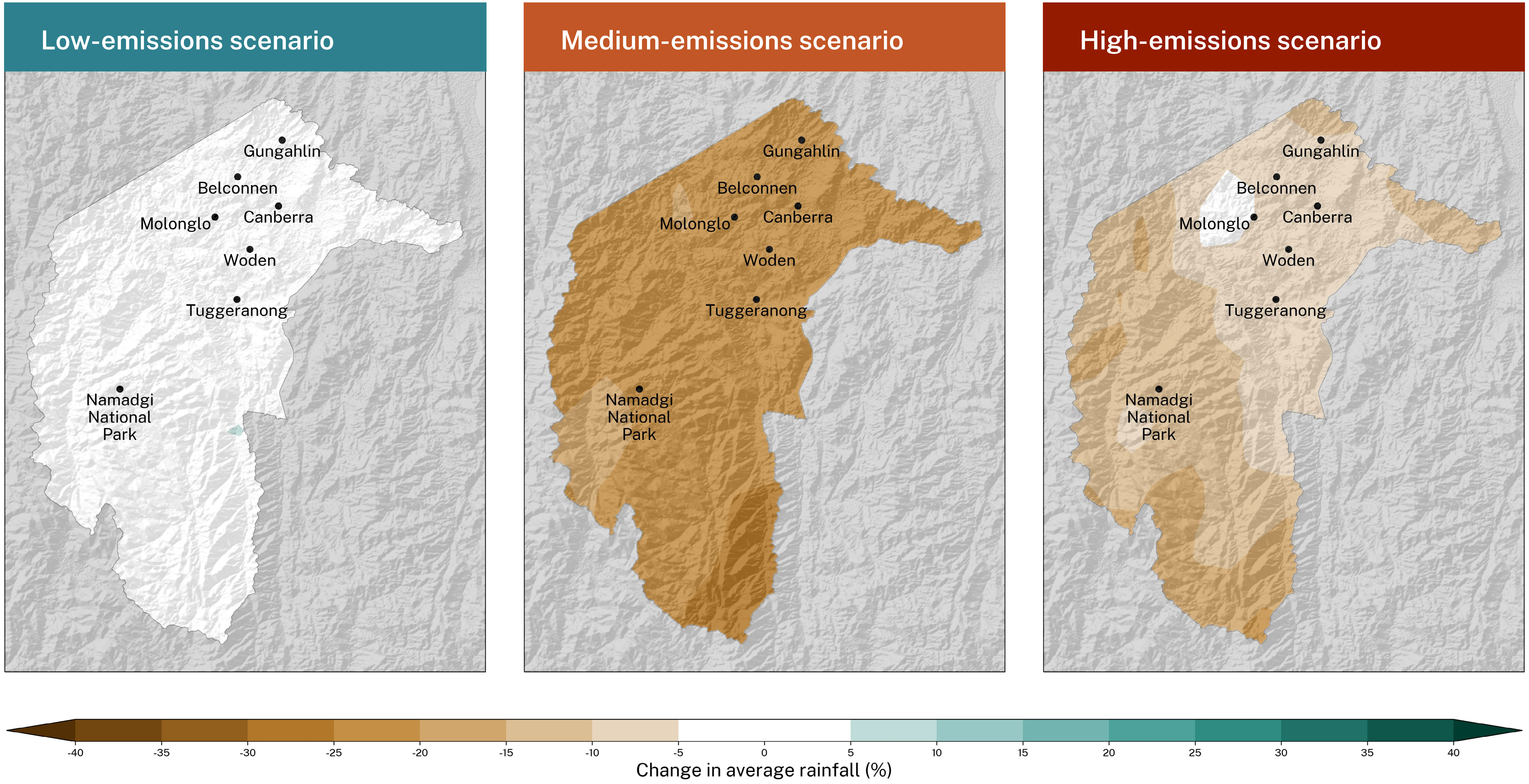
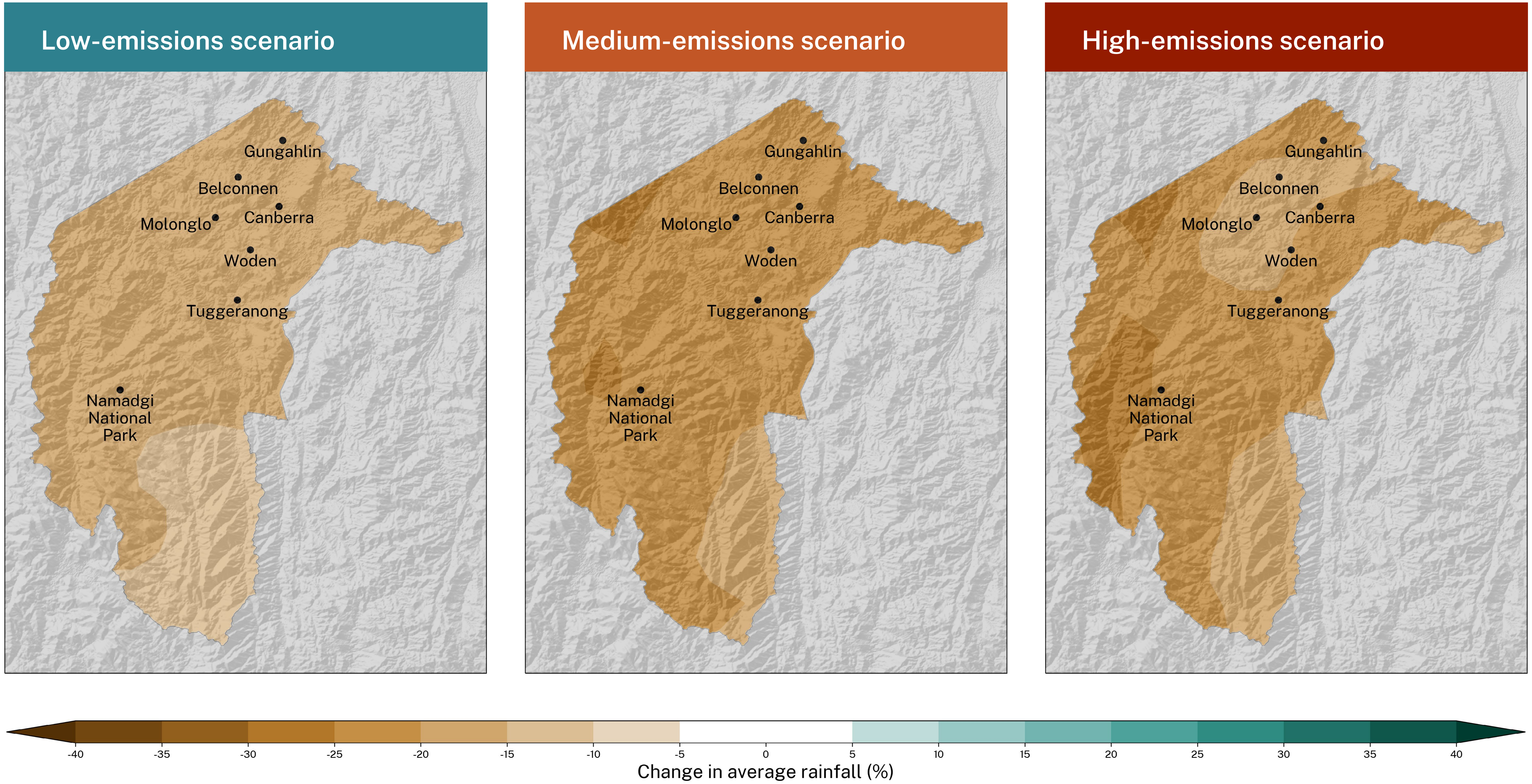


Figure 12. Projected change to average spring rainfall by 2090 for ACT



Changes to rainfall

Increased rainfall variability from climate change is predicted to have significant impacts on the ACT, particularly under a medium-emissions scenario and a high-emissions scenario. While 2021–2023 provided above average water resources to the ACT, the projected long-term trend is for reduced and more variable water resources. 2019 was a particularly dry year with river flows more than 80% lower than the long-term average. In February 2020, total water storage dropped below 50% for the first time since 2013 when the enlarged Cotter Dam was constructed.[6]

While Australia's rainfall is naturally variable–driven by systems like El Niño, La Niña, the Indian Ocean Dipole, and the Southern Annular Mode–climate change is expected to increase this variability, bringing longer dry spells and heavier rainfall in larger wet-dry swings.[7,11] This could negatively impact important biodiversity values of the ACT. For example, the distribution of sphagnum bogs in the internationally significant Ginini Flats Ramsar site may contract, as they exist at the hottest and driest margins of their range in Australia.[8]

Across southern Australia, long-term declines in rainfall have already led to reduced streamflow.[8] Reduced water flows can increase the risk of toxic algal blooms, which are more likely to occur and last longer in warmer, low-flow conditions.[9,10] These changes put water quality and supply at risk, making it harder to deliver safe and reliable water to communities.[9] Increased rainfall variability may further impact water security of the ACT.

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.[12]

On average, the ACT experiences 0.3 days per year of severe fire danger days.[4] The number of severe fire danger days is generally low across the region, though the southern part of urban Canberra is at greater risk of bushfires due to its proximity to Namadgi National Park. The record annual number of severe fire danger days occurred in 2019 with approximately 3.4 days on average across the region, including 3 days recorded at Tuggeranong weather station and 10 days at the Canberra Airport station.

FFDI was monitored by weather stations across NSW and the ACT 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 ACT, 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 in the ACT by 2050 under a medium-emissions scenario and a high-emissions scenario, with an even greater increase projected by 2090 under 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.

5x

By 2090, areas of Canberra's urban fringe could experience more than 5 times the number of severe fire weather days under a high-emissions scenario.

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

Increases in the number of severe fire weather days are projected to occur across some areas of the ACT (Figure 14). The greatest increases are projected to occur for areas on Canberra's urban fringe, with only small increases projected for higher elevation areas of bushland, such as Namadgi National Park. By 2090, Gungahlin is projected to experience 1.3 additional severe fire weather days per year under a low-emissions scenario, 3.4 additional severe fire weather days under a medium-emissions scenario and 4.9 additional severe fire weather days per year under a high-emissions scenario. A high-emissions scenario is projected to be more than 5 times Gungahlin's baseline period average of 1.2 severe fire weather days per year, while a medium-emissions scenario is projected to be more than triple Gungahlin's baseline period average. Similarly, the number of severe fire weather days for Molonglo on Canberra's western urban fringe could nearly triple under a medium-emissions scenario and quadruple under a high-emissions scenario.

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 – ACT

2050

Low-emissions	Medium-emissions	High-emissions
0.2 days (−0.4 to 0.7 days)	**0.3 days** (0.0 to 0.9 days)	**0.6 days** (0.1 to 1.2 days)

2090

Low-emissions	Medium-emissions	High-emissions
0.3 days (−0.3 to 1.0 days)	**0.8 days** (0.1 to 2.1 days)	**1.3 days** (0.1 to 2.9 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 0.4 severe fire weather days.

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

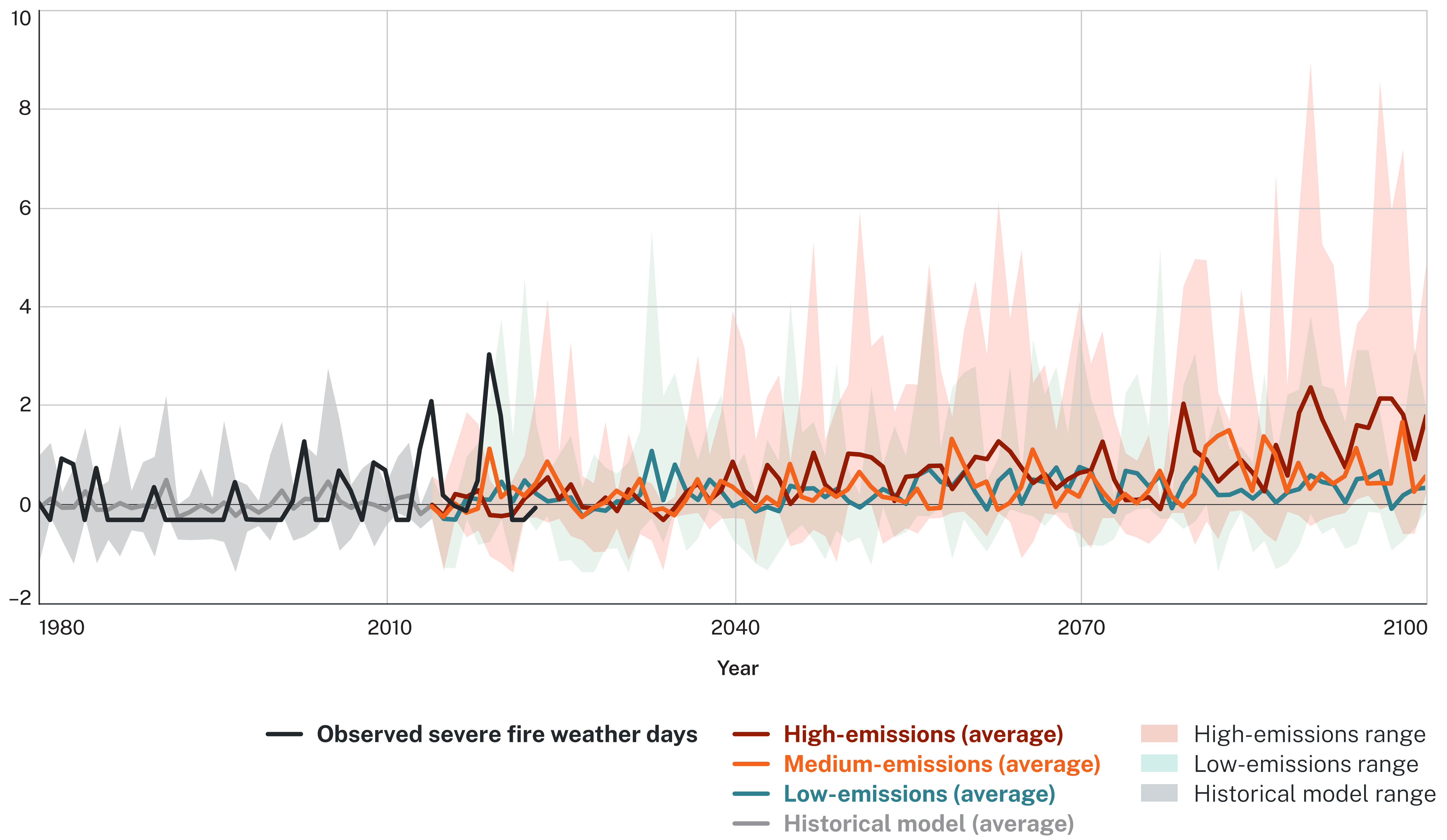
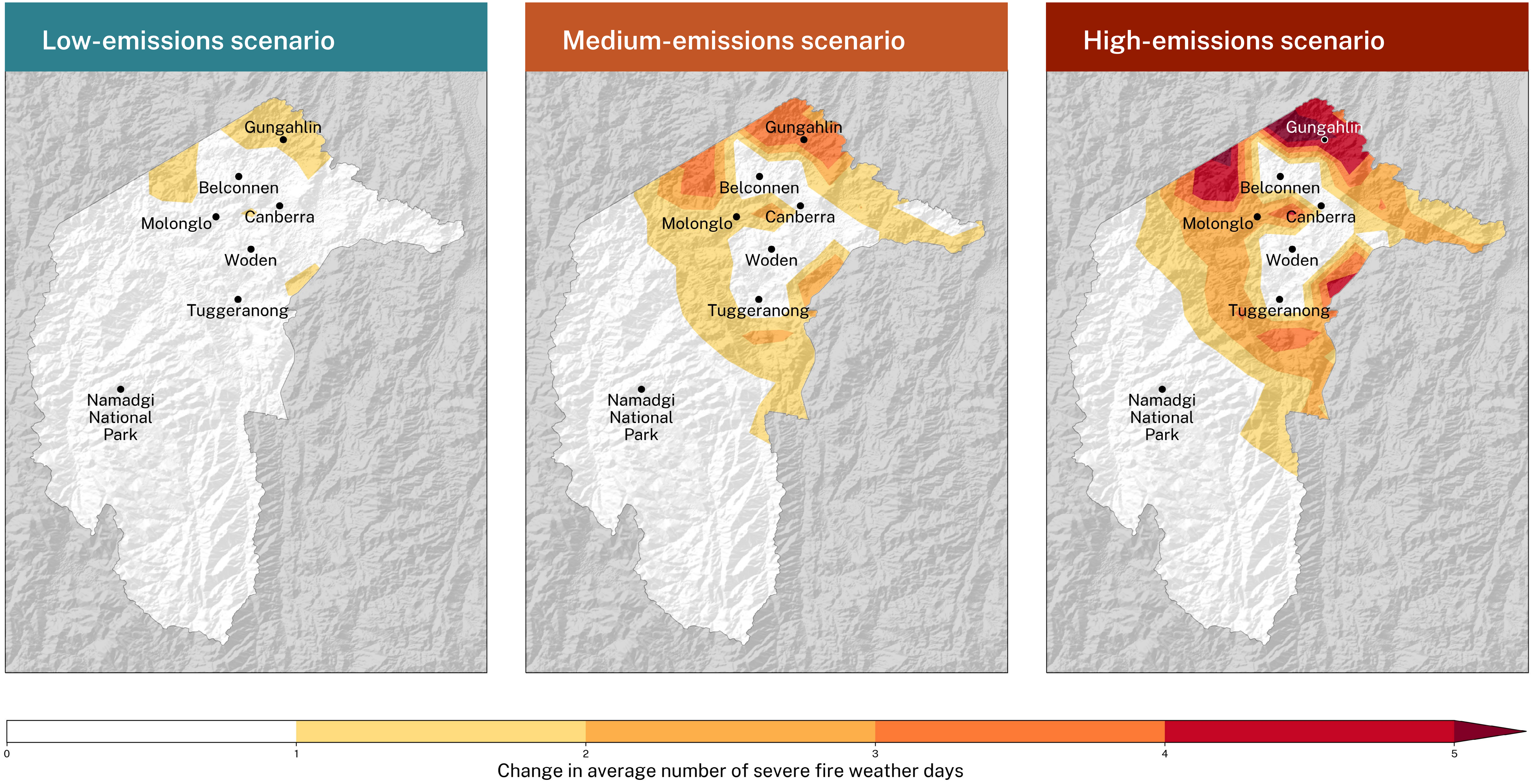


Figure 14. Projected change to average annual number of severe fire weather days by 2090 for ACT



Bushfires

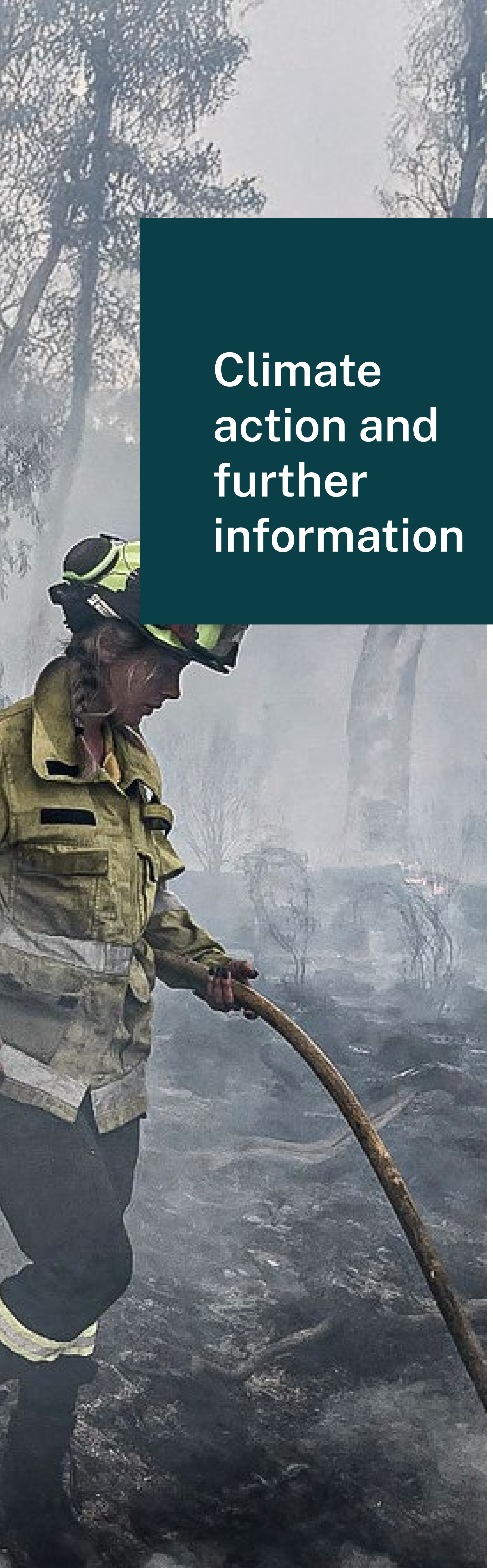
The ACT experienced significant impacts during the 2019–20 bushfire season. The 2019–20 bushfire season caused extensive damage to communities, infrastructure and natural ecosystems in the ACT. The Orroral Valley fire burned around 86,562 hectares of land, including approximately 40% of the entire ACT, 80% of Namadgi National Park and 22% of Tidbinbilla Nature Reserve.[13] The fires directly impacted cultural heritage sites, public access to roads, threatened species and erosion risk across both national parks, and affected infrastructure assets in adjacent rural land.[14]

The ACT, with its extensive areas of urban fringe near bushland is highly vulnerable to the impacts of increasing number of days of severe fire weather. Climate change is expected to reduce the interval between fires, increase fire intensity, and shorten the window for safe fire management activities.[10] For communities on the bushland-urban interface, the increased fire occurrence heightens risks to people, homes and infrastructure.[16]

Areas on Canberra's urban fringe such as Gungahlin are projected to experience greater increases in the number of severe fire weather days.

Canberra experienced severe bushfires during 2003. Suburbs along the urban fringe were most affected with more than 450 homes destroyed and many more damaged.[18]

Severe fire danger days, which create the underlying conditions for large-scale bushfires, are expected to become more common in the future for the ACT, particularly under a high-emissions scenario.



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 the importance of the ACT playing its part through meeting the ACT Government's ambitious, legislated target of net zero emissions by 2045. 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. Find out more about what the ACT Government is doing to mitigate and adapt to climate change here.

Additional resources

- ACT Government's Everyday Climate Choices
- Generate detailed climate information based on your Local Government Area using SEED
- Climate Data Portal
- AdaptNSW
- NARCliM case studies
- Climate Risk Ready NSW Guide

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 2021, Census of Population and Housing, TableBuilder
6. Icon Water Limited 2023, Icon water annual report 2022-23, Canberra.
7. BOM 2024, State of the Climate 2024 - webpage
8. EPSDD 2017, 'Ginini Flats Wetland Complex Ramsar site management plan', Environment, Planning and Sustainable Development Directorate, Canberra
9. Pittock et al. 2003, Climate change: an Australian guide to the science and potential impacts. Australian Greenhouse Office.
10. Hennessy et al. 2007, Australia and New Zealand. In *Climate Change 2007: impacts, adaptation and vulnerability.* Cambridge University Press (CUP), 2007, 507-540.
11. Zhang et al 2024 Anthropogenic amplification of precipitation variability over the past century. *Science*, 385(6707), 427-432.
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
13. Black Summer bushfires, ACT, 2020 – webpage
14. Orroral Valley bushfire impact report – webpage
15. Skiba 2020, Usage of cool burning as a contributor to bushfire mitigation. *Natural Resources*, 11, 307-316.
16. IPCC 1997, The regional impacts of climate change: an assessment of vulnerability. Cambridge University Press, UK.
17. Roberts et al. 2021, Ember risk modelling for improved wildfire risk management in the peri-urban fringes. *Environmental Modelling & Software*, 138, 104956.
18. Australian Disaster Resilience Knowledge Hub, 2023, Canberra Bushfire 2003 - webpage
19. Office of the Commissioner for Sustainability and the Environment, 2023, ACT State of the Environment Report, Canberra

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