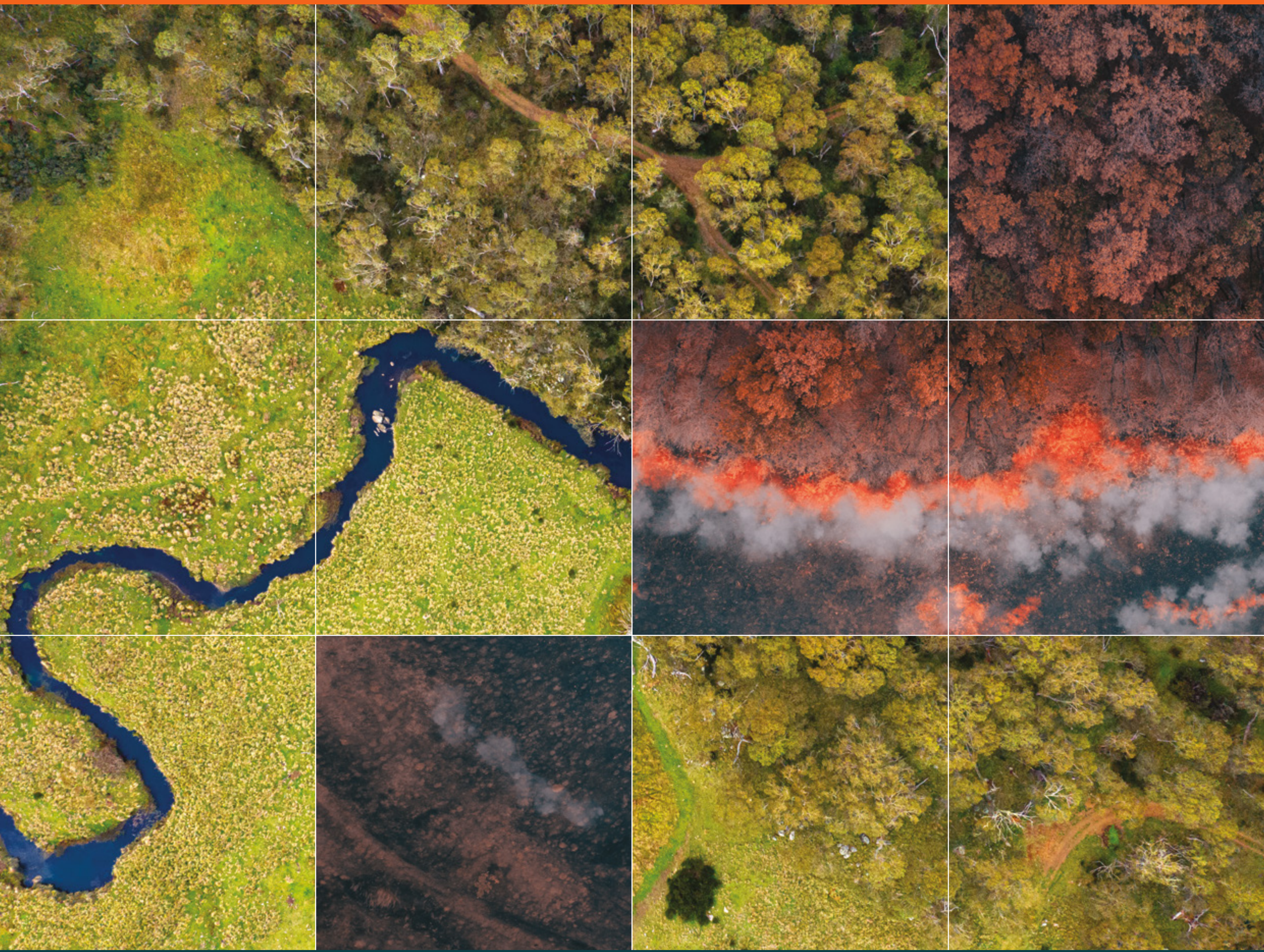
NARCliM

Hunter

Climate Change Snapshot



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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. The NSW Government acknowledges the Guringai, Biripi, Geawgal, Worimi, Wonnarua, Darkinyung and Awabakal Aboriginal people from the Hunter region as having an intrinsic connection with the lands and waters. The landscape and its waters provide the First Nations people with essential links to their history and help them to maintain and practise their traditional culture and lifestyle.

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.

They are the first astronomers and scientists who have been listening to 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 wisdom at this pivotal moment in time.

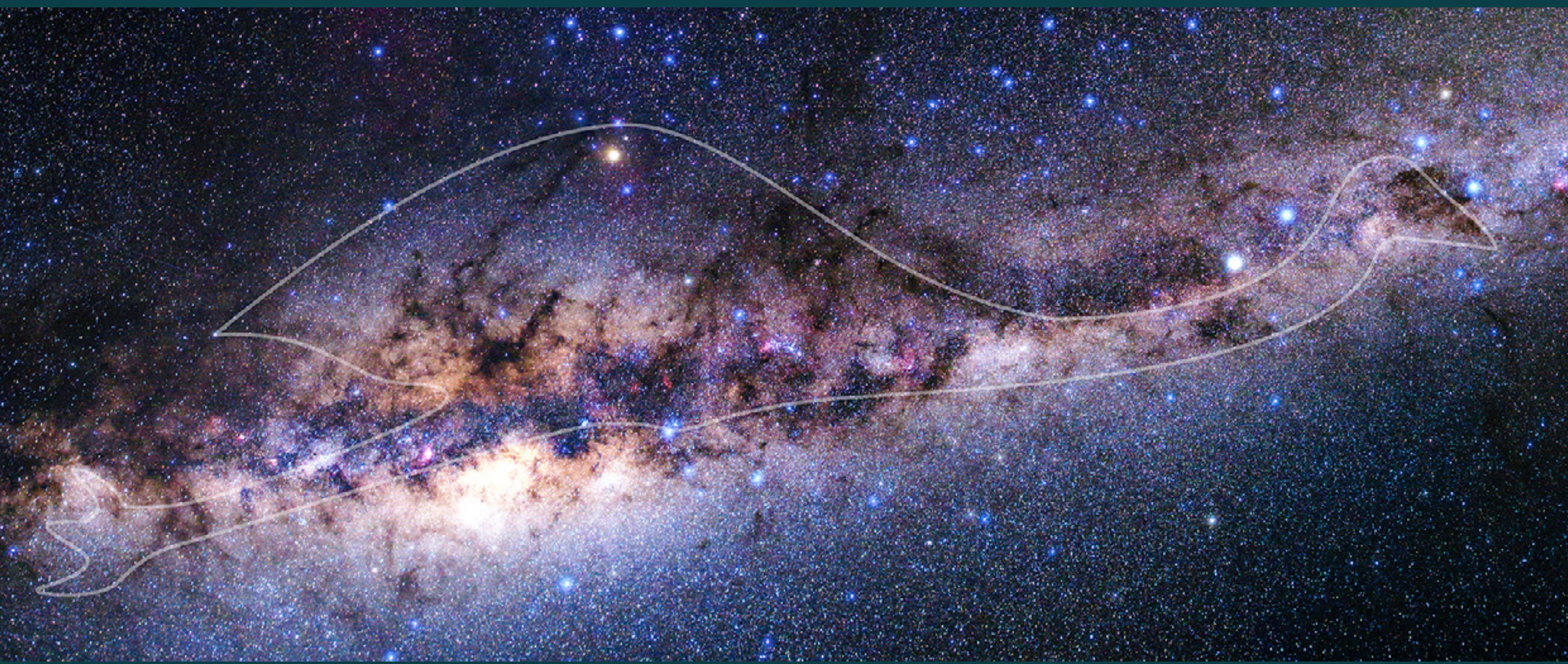

Photo caption:
The Emu in the Sky is an Aboriginal constellation that is made up of the dark clouds of the Milky Way. With the movement of the earth, the position of the Emu in the Sky changes throughout the year. Aboriginal people in some nations across NSW and Australia relate the position of the Emu 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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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 summarises the latest NARCliM2.0 projections for temperature, average rainfall, hot days 35°C and above, cold nights under 2°C and severe fire weather (Forest Fire Danger Index greater than 50) at a 4km resolution for NSW and the Australian Capital Territory (ACT). There is information for both a low-emissions scenario (SSP1-2.6), and a high-emissions scenario (SSP3-7.0) to the year 2100 to show the range of plausible climates that may be experienced, depending on our actions to reduce greenhouse gas emissions. The snapshot also summarises the latest projections for sea-level rise, derived from the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report released in 2021. Detailed climate projection information is available through the AdaptNSW Interactive Map and the Climate Data Portal.

Understanding current warming

NSW and the ACT have already warmed by 1.4°C since national records began in 1910.[1] This local warming figure represents surface air temperature over land in NSW and is not directly comparable to average estimates of global warming which include surface air temperature over both land and ocean. Surface warming occurs faster over land than the ocean. Significant impacts from climate change are already occurring in NSW and are expected to be felt more widely in the future, particularly if concerted global effort is not taken to reduce greenhouse gas emissions and adapt to the expected impacts of climate change.

How to use this snapshot

This snapshot provides a summary of plausible future climate change in the Hunter region relative to a baseline of average climate from 1990–2009. The projections for 2050 represent averaged data for 2040–2059 and projections for 2090 represent averaged data for 2080–2099. In translating the projections, it is important to consider the previous historical changes that occurred prior to 1990–2009. For example, national temperature records indicate that NSW has warmed by 0.84°C between 1910–1930 and the 1990–2009 baseline.[1]

Modelling climate change at a local level provides detailed insights into how NSW communities, built environments and natural environments will continue to be impacted by climate change. Information in this snapshot can be used in conjunction with detailed information that is available through the AdaptNSW Interactive Map and the Climate Data Portal.

NARCliM climate projections

NARCliM2.0 projections provide nation-leading climate model data that span the range of plausible future changes in climate for south-east Australia at a 4km resolution, and for the broader Australasian region at a 20km resolution. NARCliM2.0 projections are the next generation of NARCliM, building on previous generations delivered in 2014 and 2021. NARCliM is the NSW Government's trusted source of climate information and data for all audiences and sectors. Detailed information on NARCliM can be found 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 selected global climate models and 2 regional climate models, giving 10 model combinations in total. Unless otherwise specified, the presentation of data in this snapshot is averaged across a 20-year period from the NARCliM model ensemble.

Combining multiple models through averaging and other statistical methods produces better projections by providing a comprehensive range 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 modelling project and scientific methods at AdaptNSW.

Shared Socioeconomic Pathways

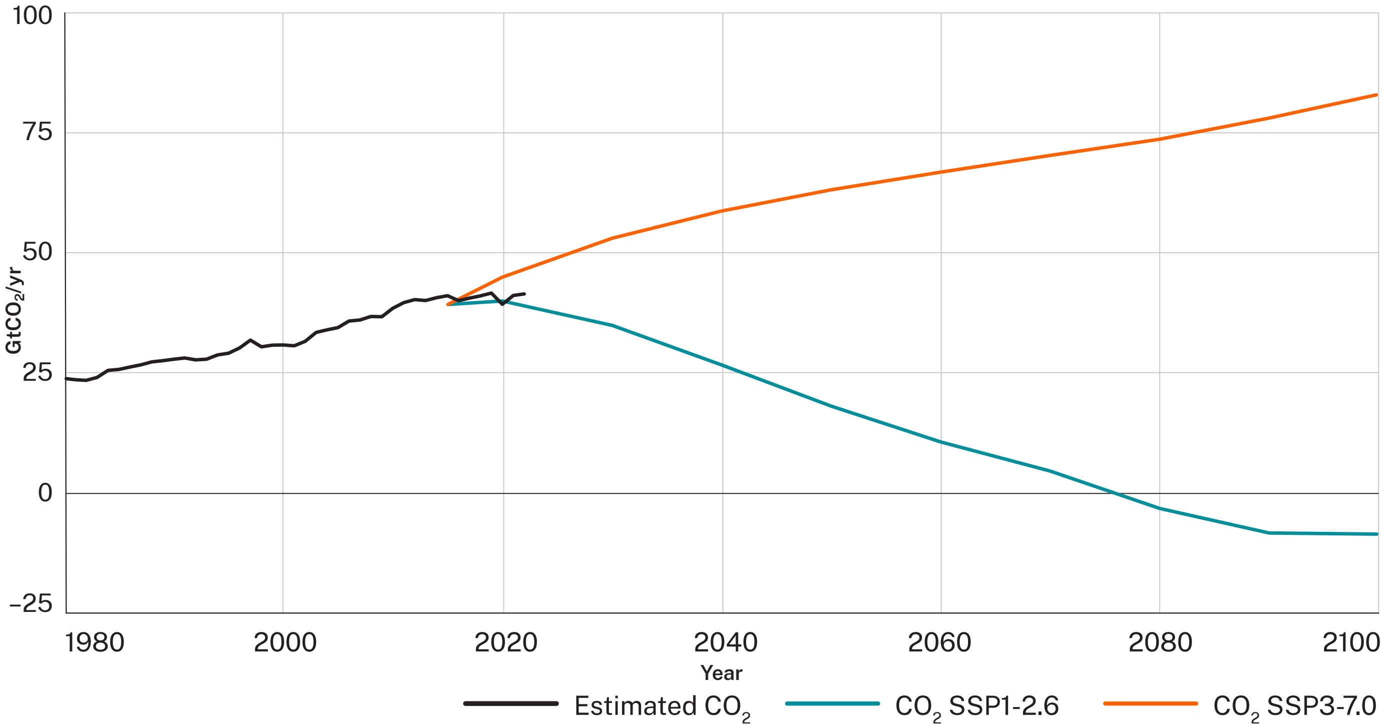
Shared Socioeconomic Pathways (SSPs) are the most recent emissions scenarios adopted in the IPCC's Sixth Assessment Report.

The SSPs describe how greenhouse gas emissions and socioeconomic factors – such as population, economic growth, education, urbanisation and land use – may change in the future. Global carbon dioxide emissions modelled for a low-emissions scenario and a high-emissions scenario are displayed below (Figure 1). For more information on emissions scenarios, visit AdaptNSW.

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

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.

Figure 1. Human-caused global emissions of carbon dioxide – past and projected



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.

Projected changes
Hunter

Low-emissions scenario

Average temperature increase

↑ **1.1°C**
2050

↑ **1.2°C**
2090

Hot days per year will increase by:

7.1 2050 | **7.7** 2090

Sea level will rise by:

19cm 2050 | **39cm** 2090

Severe fire weather days per year will increase by:

0.9 2050 | **0.7** 2090

High-emissions scenario

Average temperature increase

↑ **1.9°C**
2050

↑ **3.6°C**
2090

Hot days per year will increase by:

10.8 2050 | **23.9** 2090

Sea level will rise by:

23cm 2050 | **59cm** 2090

Severe fire weather days per year will increase by:

1.2 2050 | **2.3** 2090

Regional impacts

Coastal wetlands

Inundated by rising sea levels

Bushland

Increased severe fire weather

Changes to rainfall

Hunter valley

Inundated by rising sea levels

Estuarine settlements

Data is based on NARCliM2.0 (2024) projections for SSP1-2.6 (low-emissions) and SSP3-7.0 (high-emissions) and is presented relative to the historical climate baseline of 1990–2009. The projections for 2050 represent averaged data for 2040–2059 and projections for 2090 represent averaged data for 2080–2099. 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. Sea-level rise data is from the IPCC's Sixth Assessment Report is presented relative to a baseline of 1995–2014.

Climate of the Hunter

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

The Hunter region covers 26,100 km^2 around the central NSW coast. The Hunter region includes the city of Newcastle and has a growing population as more people are attracted to the area for the lifestyles, natural spaces and jobs it offers. Other major towns in the region include Maitland, Lake Macquarie, Cessnock, Singleton, Muswellbrook and Scone.

Current climate

The geography of the Hunter region affects local weather conditions, which together have led to a range of unique and important ecosystems. The proximity of the region to the coast and its topography result in a considerable variation in climate. The climate of the Hunter region is subtropical to temperate, creating a convergence zone for ecosystems that are characteristic of the North Coast, Western Slopes and Sydney Basin. The region contains several estuaries and large lake systems including Port Stephens and Lake Macquarie. The Hunter Estuary Wetlands Ramsar site (Kooragang Nature Reserve and Shortland Wetlands) is of international significance and Barrington Tops National Park forms part of the Gondwana Rainforests of Australia World Heritage Area.

Table 1. Baseline climate for the Hunter

	Average temperature	Hot days	Cold nights	Rainfall	Severe fire weather days
Observed	16.6°C	8.7	22.9	917mm	1.1
Historical model	16.5°C	8.1	19.5	855mm	1.8

Table 1 outlines the annual average values for the 1990–2009 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.[1] Observed information and data in graphs come from Australian Gridded Climate Data (AGCD).[2]

Temperature

The Hunter is getting warmer

Temperature is the most reliable indicator of climate change. For NSW, 6 of the 10 warmest years on record since 1910 have occurred since 2013. All 10 warmest years on record have occurred since 2005. The warmest year on record for both mean temperature and maximum temperature in the Hunter region was 2019, when average temperature was 1.4°C above the 1990–2009 average.[2]

Projections

Across the Hunter region, average temperatures will increase throughout this century (Figure 2).

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, a temperature increase of 1.6°C is projected during the same period under a high-emissions scenario. Notably, the temperature projections for 2050 under 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 3) and across all seasons. The ocean's moderating influence results in lower temperature increases along the coast compared to inland areas. The Upper Hunter area of the region, including towns such as Muswellbrook and Singleton, will see the greatest relative increases in temperature. By 2090, Merriwa is likely to experience an increase in temperature of 1.5°C under a low-emissions scenario and 4.1°C under a high-emissions scenario. Comparatively, Newcastle is likely to experience an increase in temperature of 1.2°C under a low-emissions scenario and 3.3°C under a high-emissions scenario.

3.6°C

rise in average temperature across the Hunter by 2090 under a high-emissions scenario

6 of 10

warmest years on record have occurred since 2013

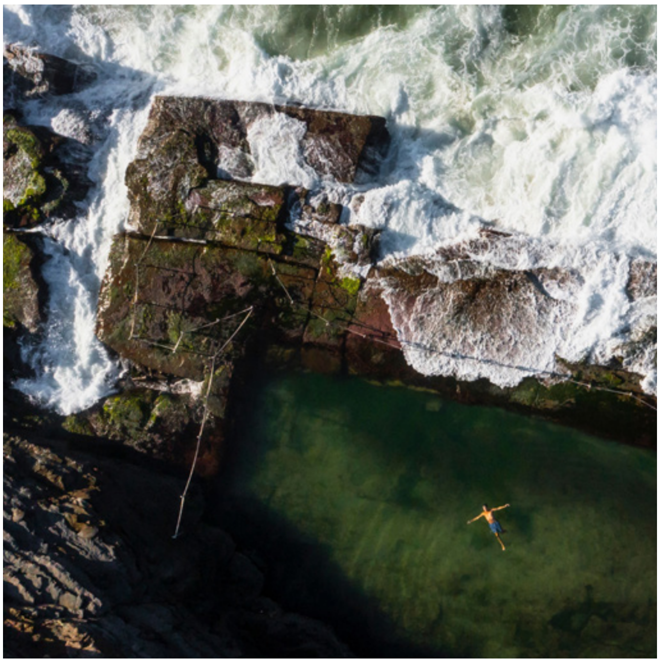
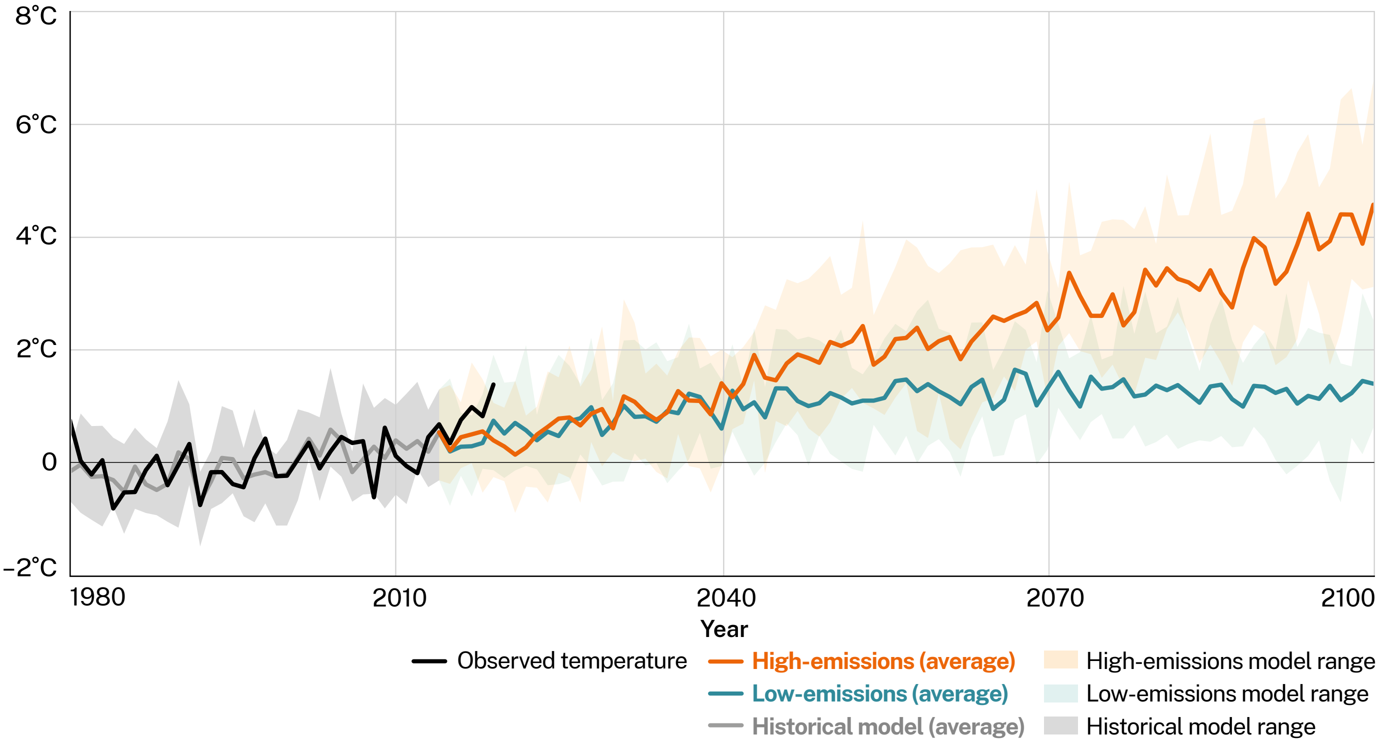


Table 2. Projected annual average temperature increase – Hunter

	2050		2090	
	Low-emissions	High-emissions	Low-emissions	High-emissions
Temperature	**1.1°C** (0.6–1.8°C)	**1.9°C** (1.1–2.9°C)	**1.2°C** (0.5–2.1°C)	**3.6°C** (2.5–5.2°C)
Maximum temperature	**1.2°C** (0.6–2.0°C)	**2.0°C** (1.2–3.2°C)	**1.3°C** (0.4–2.3°C)	**3.7°C** (2.6–5.4°C)
Minimum temperature	**1.1°C** (0.6–1.7°C)	**1.8°C** (1.0–2.7°C)	**1.2°C** (0.6–1.9°C)	**3.6°C** (2.5–5.2°C)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range.

Figure 2. Historical and projected average temperature change – Hunter

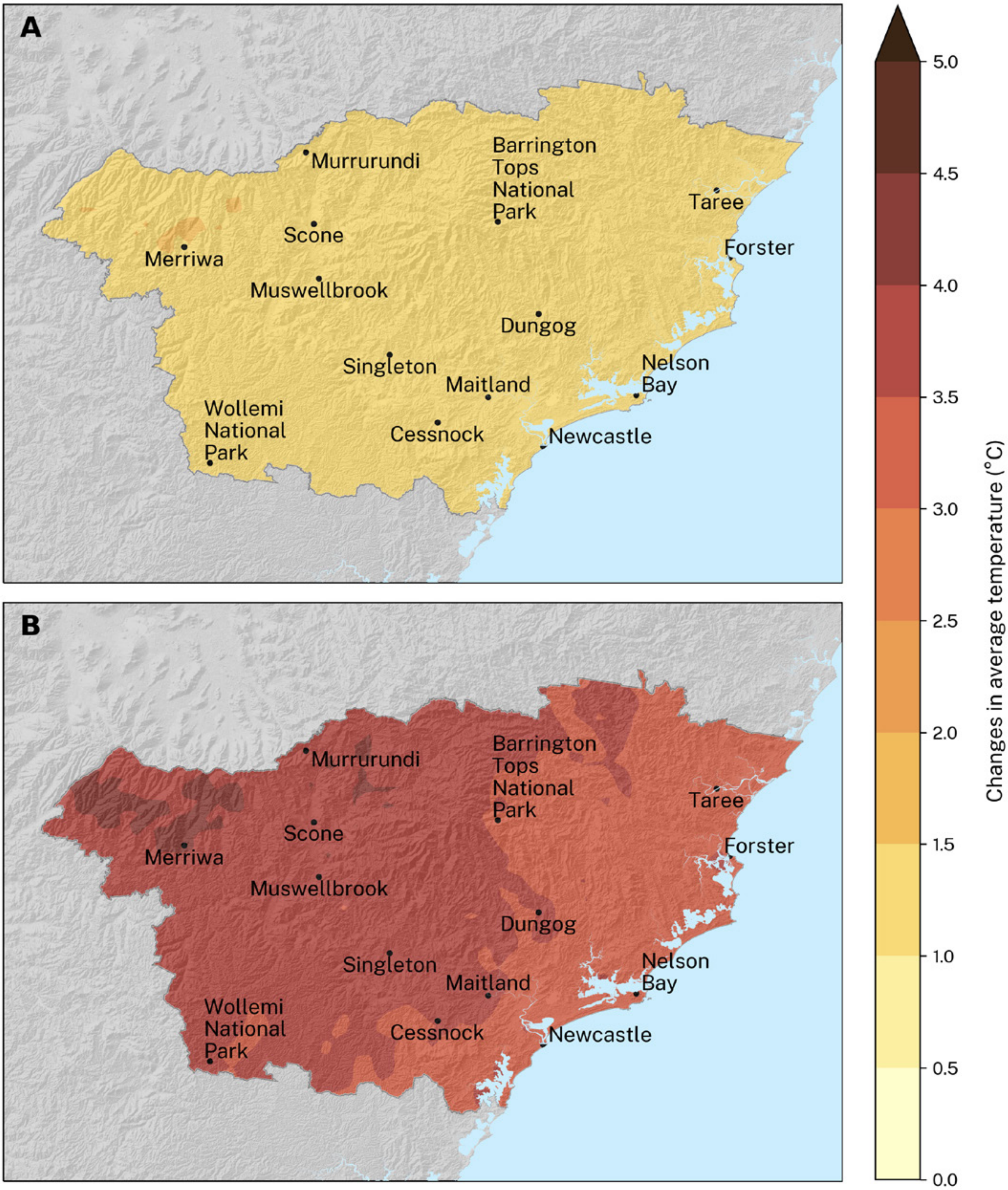


The shading around the graphs

The climate change projections presented in this snapshot are relative to the historical climate baseline of 1990–2009. The graphs provide a projected annual average for the 2 emissions scenarios.

The range of plausible climate futures across the NARCliM model ensemble is shown by light shading. For historical climate data, both recorded observational data (dark line) and modelling of the past climate in NARCliM2.0 (grey) are presented.

Figure 3. Projected change in average temperature by 2090 for the Hunter under A) a low-emissions scenario and B) a high-emissions scenario



Hot days

Hot days will become more frequent

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

Projections

The number of hot days varies widely across the Hunter region. During the baseline period, areas near the coast had on average fewer than 5 hot days per year. Inland areas, such as the Upper Hunter, had on average 20 hot days per year, while higher elevation areas such as Barrington Tops had on average less than 1 hot day per year.

The number of hot days will increase for the Hunter region by 2050 for both a low-emissions and a high-emissions scenario, with an even greater increase by 2090 under a high-emissions scenario (Table 3). The number of hot days is projected to increase across spring, summer and autumn, with the largest increase in 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 day projected across the region (Table 3). However, a substantial increase of 13.1 additional hot days per year is projected under a high-emissions scenario during the same period.

By 2090, the Hunter could experience nearly four times the number of hot days per year under a high-emissions scenario.

Increases to hot days will occur across all of the region (Figure 5). The Upper Hunter area including Singleton and Scone is projected to experience the greatest increase in the number of hot days. Coastal areas are projected to experience a comparatively lower increase due to the moderating influence of the ocean. By 2090, Singleton is projected to experience 13.3 additional hot days per year under a low-emissions scenario and 37.6 additional hot days per year under a high-emissions scenario. A high-emissions scenario is projected to nearly triple Singleton's baseline period average of 22.6 hot days per year. Comparatively, on the coast of the region, Newcastle's baseline period average is 2.3 hot day per year. By 2090, Newcastle is projected to experience an additional 1.9 hot days per year under a low-emissions scenario and 5.3 additional hot days per year under a high-emissions scenario.

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

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

Hot days

Table 3. Projected increase in average annual number of hot days – Hunter

2050		2090	
Low-emissions	High-emissions	Low-emissions	High-emissions
7.1 days (3.1 to 11.5 days)	**10.8 days** (4.6 to 22.0 days)	**7.7 days** (2.0 to 16.7 days)	**23.9 days** (12.7 to 41.4 days)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range.

Figure 4. Historical and projected change in annual number of hot days – Hunter

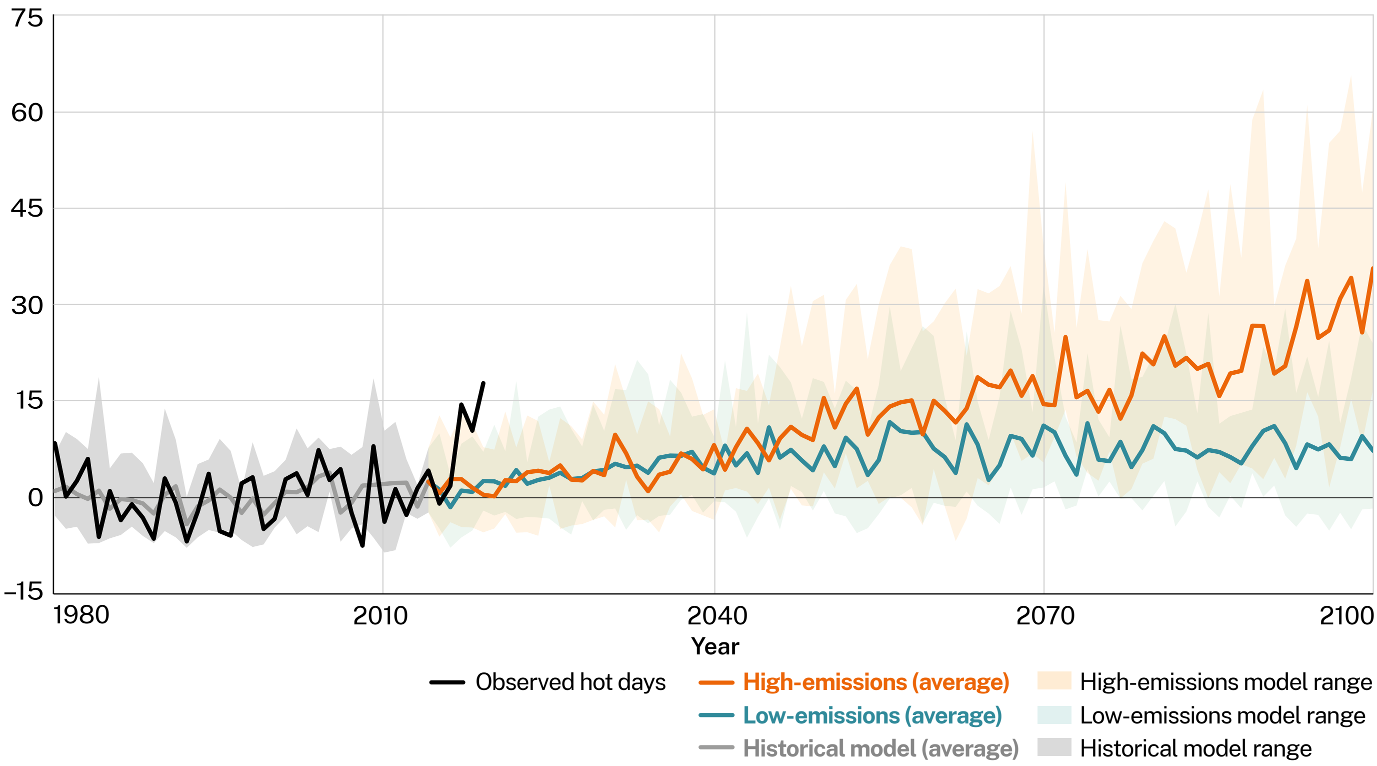
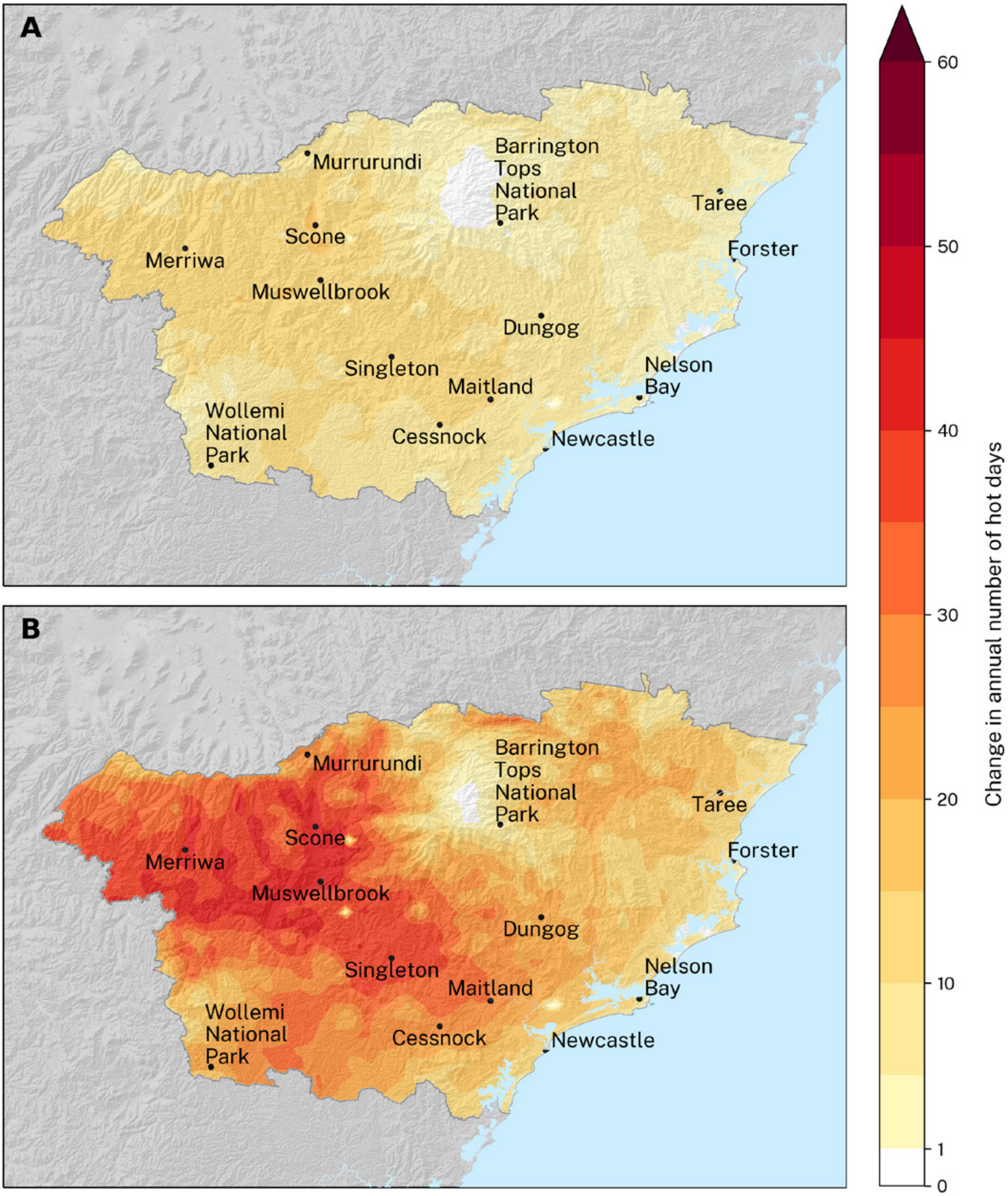


Figure 5. Projected change in annual number of hot days by 2090 for the Hunter under A) a low-emissions scenario and B) a high-emissions scenario



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Cold nights

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.

Projections

The number of cold nights varies widely across the Hunter region. During the baseline period, locations within the Upper Hunter area varied in number of cold nights. Singelton had on average 5 cold nights per year and Murrurundi had 60 cold nights per year. Towns in the Lower Hunter, such as Maitland and Dungog, had on average 2 cold nights per year. Areas along the coast do not typically experience cold nights.

By 2090, areas of the Hunter that experience cold nights could experience a greater than 85% reduction in the number of cold nights under a high-emissions scenario.

The number of cold nights will decrease for the Hunter region by 2050 for both a low-emissions and a high-emissions scenario, with an even greater decrease by 2090 under 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.

Cold nights will decrease across some of the region, particularly in inland areas in the north-west of the region (Figure 7). Coastal areas will not experience any changes, as they do not experience cold nights. The greatest decreases are projected to occur for the Upper Hunter and the Barrington Tops. By 2090, Barrington Tops National Park is projected to have 9.2 fewer cold nights per year under a low-emissions scenario and 20.3 fewer cold nights per year under a high-emissions scenario. A high-emissions scenario is projected to reduce Barrington Tops National Park's 23.5 cold nights per year base period average by nearly 90%.

Table 4. Projected decrease in average annual number of cold nights – Hunter

2050		2090	
Low-emissions	High-emissions	Low-emissions	High-emissions
6.8 days (4.0 to 9.8 days)	**10.8 days** (6.3 to 13.7 days)	**7.6 days** (4.3 to 10.1 days)	**16.7 days** (13.2 to 19.3 days)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range.

Figure 6. Historical and projected change in annual number of cold nights – Hunter

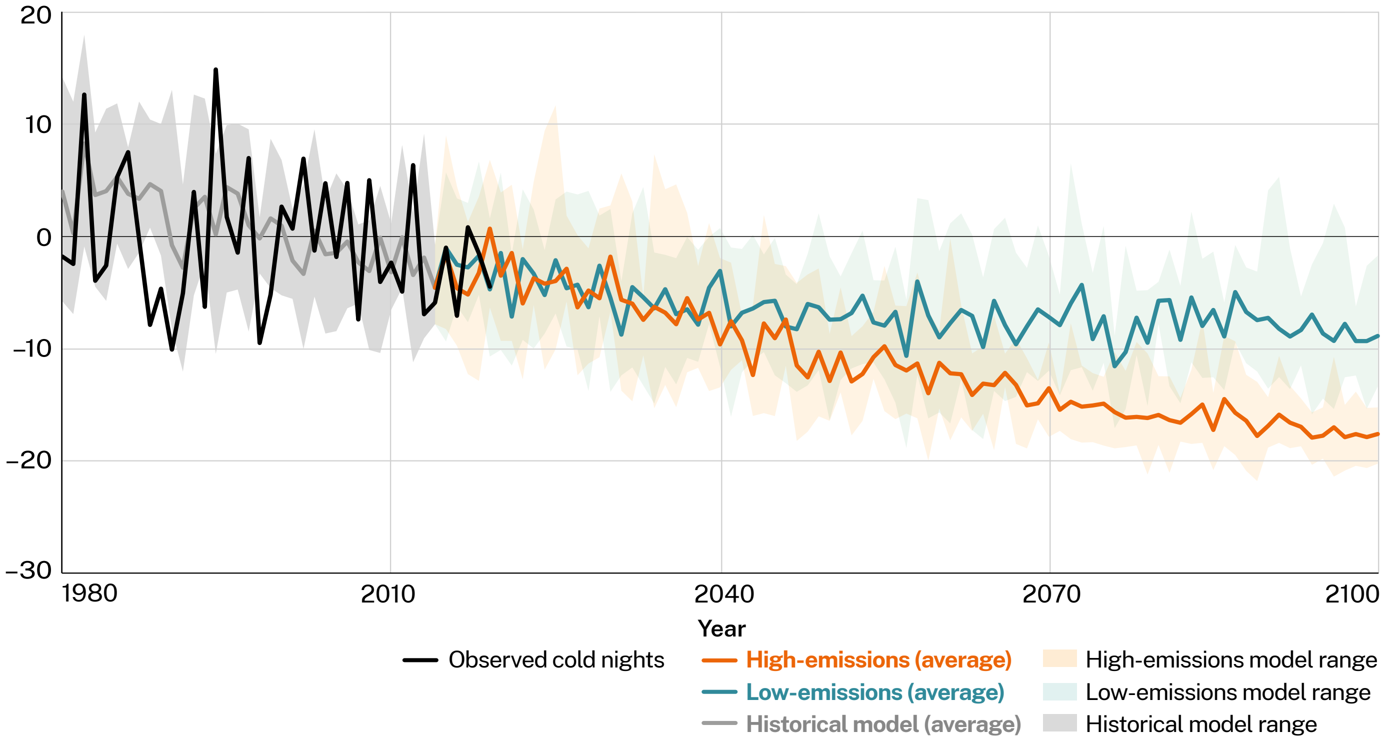
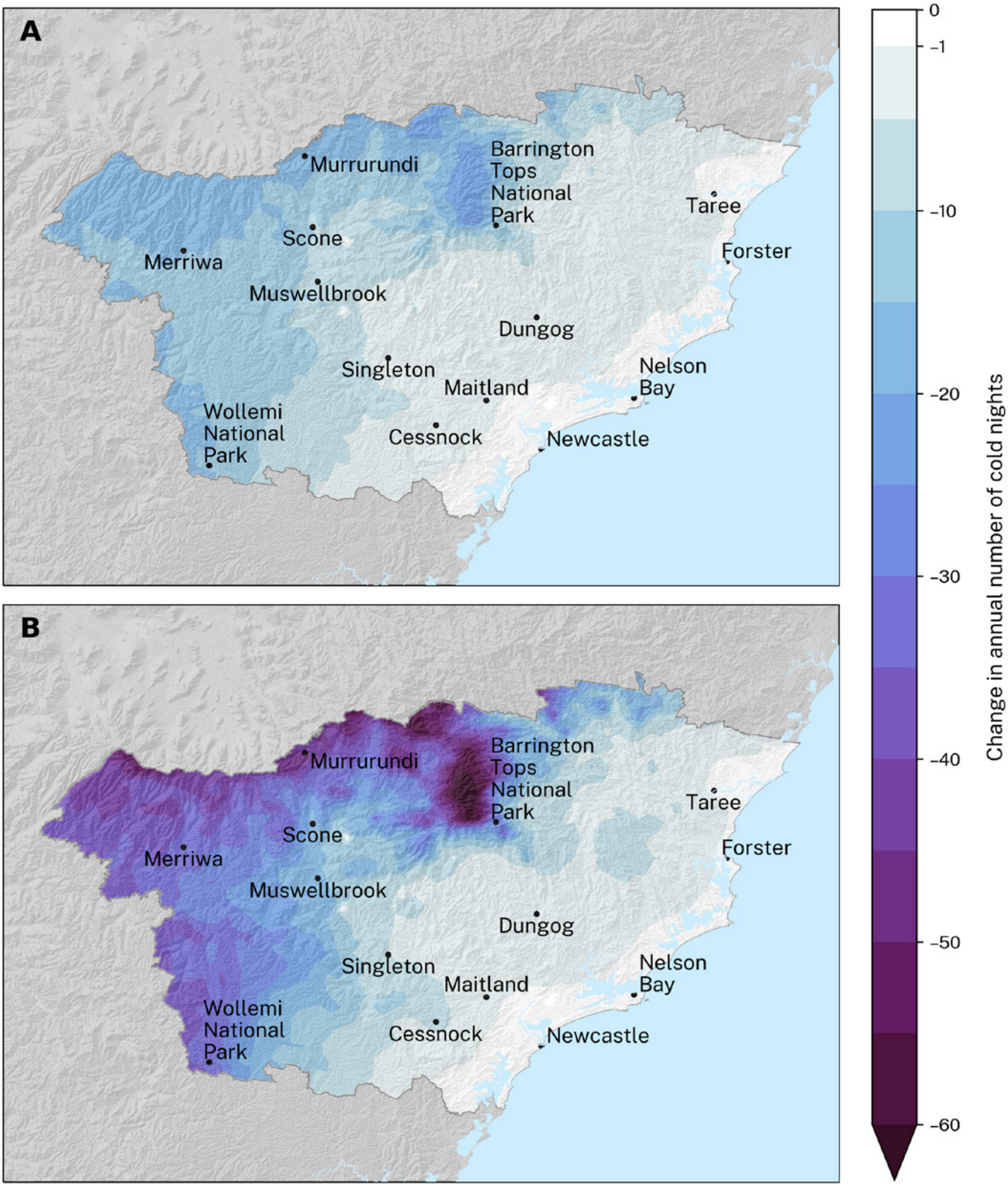


Figure 7. Projected change in annual number of cold nights by 2090 for the Hunter under A) a low-emissions scenario and B) a high-emissions scenario



Rainfall

Rainfall is projected to remain variable

Climate change will influence rainfall patterns and total amount of rainfall that NSW receives. These changes may have widespread impacts on water security, agricultural productivity and native species' reproductive cycles. For example, subtropical rainforest communities in the north may contract due to more variable rainfall and changes to humidity and evapotranspiration.

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

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 2 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.

Annual rainfall across the Hunter region averages about 920mm.[2] Rainfall varies as you move from the coast inland, ranging from more than 1300 mm per year on the coast and on the Barrington Tops, down to less than 600mm per year around Merriwa.[3] Rainfall is greatest in summer and autumn, with a higher proportion of winter rainfall on the coast than inland. The driest year on record was 2019, with an average of only 480mm across the region.[2]

Projections

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

Annual average rainfall in the region is projected to remain variable throughout this century (Figure 8). By 2090, on average, annual rainfall is projected to decrease by 8% under a low-emissions scenario and by 9% under a high-emissions scenario (Table 5). Changes to average rainfall will occur in all seasons, with the largest changes expected in winter.

By 2090, on average, winter rainfall is projected to decrease by 12% under a low-emissions scenario and by 26% under a high-emissions scenario (Table 5). The Barrington Tops and southern hinterland areas of the region including Wollemi National Park are projected to experience the greatest changes. By 2090, on average, winter rainfall is projected to decrease for Wollemi National Park by 20% under a low-emissions scenario and by 35% under a high-emissions scenario.

Under a high-emissions scenario, average winter rainfall could decrease by 25–30% across the Hunter.

On average, summer, autumn and spring rainfall is projected to change by less than 12% across the region by 2090 under both a low-emissions scenario and a high-emissions scenario. Refer to the Interactive Map for further seasonal information.

Table 5. Projected change to average rainfall – Hunter

	2050		2090	
	Low-emissions	High-emissions	Low-emissions	High-emissions
Annual	**–8.1%** (–18.2% to +7.0%)	**–15.0%** (–26.0% to +6.2%)	**–8.0%** (–18.9% to +7.2%)	**–8.8%** (–32.3% to +22.9%)
Summer	**–10.8%** (–27.8% to +4.7%)	**–16.5%** (–36.6% to +5.3%)	**–10.7%** (–29.2% to +17.2%)	**–0.8%** (–22.5% to +20.1%)
Autumn	**–4.4%** (–24.0% to +11.1%)	**–10.2%** (–26.1% to +12.8%)	**–2.2%** (–19.0% to +16.7%)	**–6.2%** (–24.8% to +34.4%)
Winter	**–10.7%** (–27.7% to +21.8%)	**–27.0%** (–46.4% to +1.8%)	**–12.4%** (–25.3% to –1.7%)	**–26.2%** (–59.8% to +24.4%)
Spring	**–6.2%** (–15.3% to +25.4%)	**–7.6%** (–28.6% to +16.5%)	**–7.2%** (–22.1% to +13.3%)	**–9.4%** (–32.9% to +22.3%)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range.

Figure 8. Historical and projected change to average rainfall – Hunter

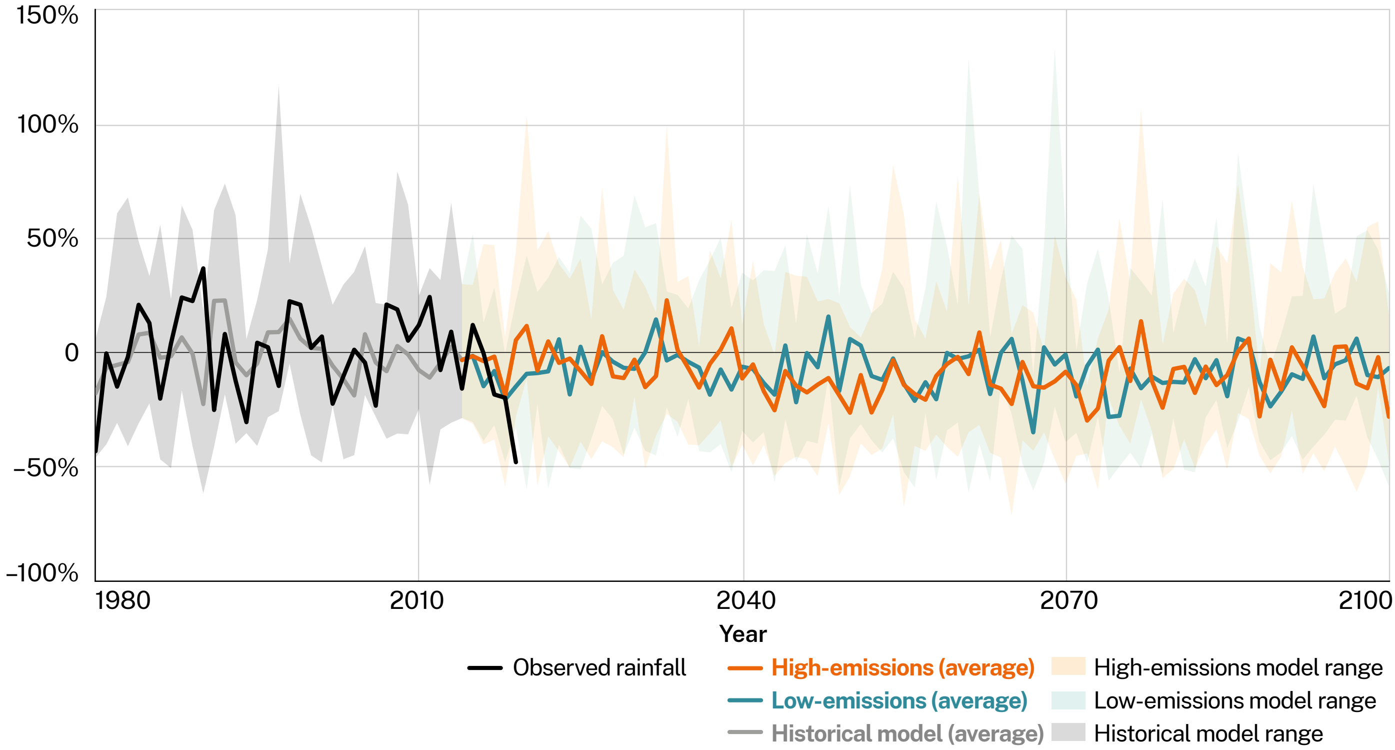
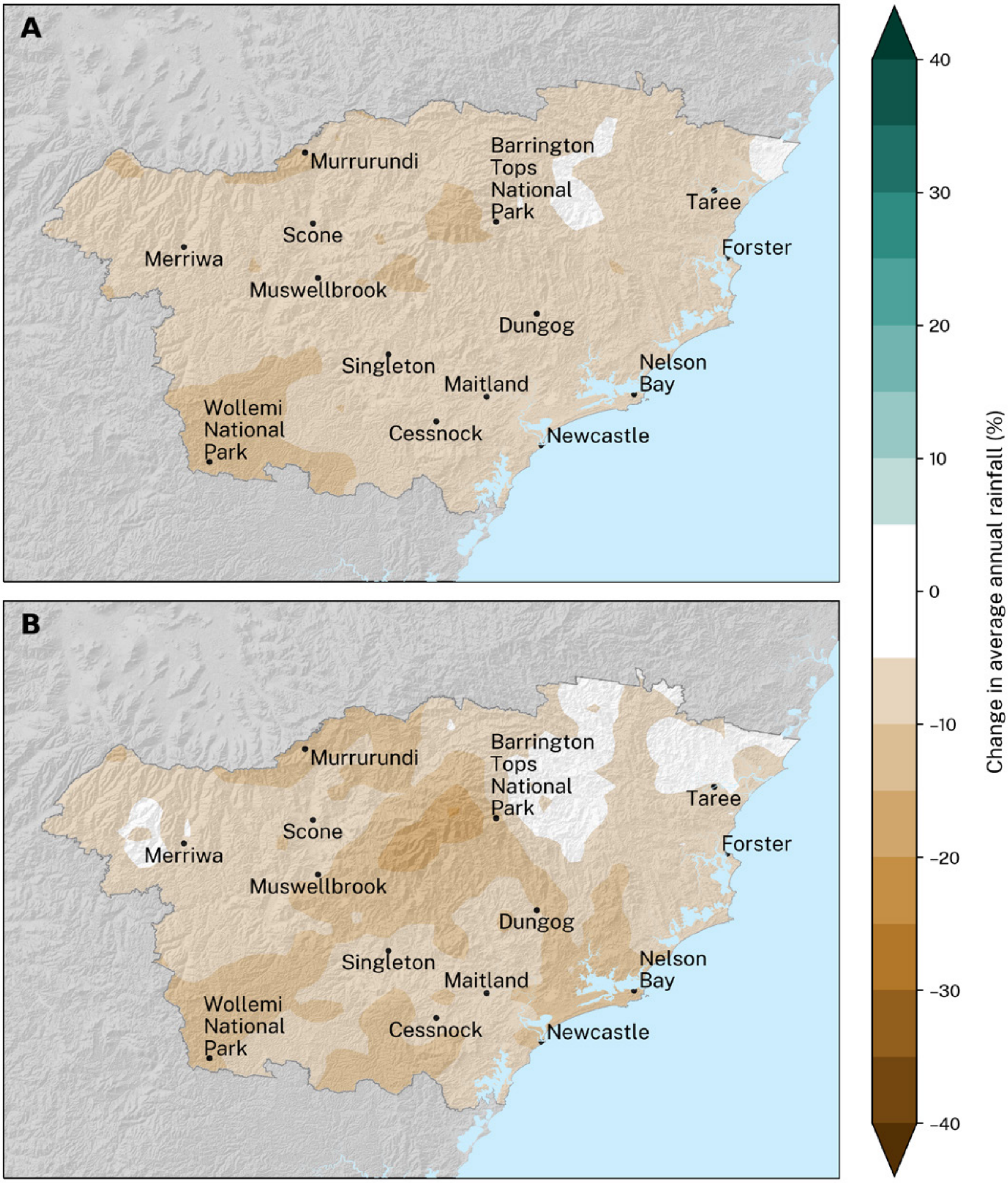


Figure 9. Projected change to average rainfall by 2090 for the Hunter under A) a low-emissions scenario and B) a high-emissions scenario



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 a number 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.[4] The number of severe fire danger days observed for the Hunter region is 1.1 days per year on average.[2] The number of severe fire danger days is generally low across coastal areas of the region, with relatively more severe fire danger days in lower elevation inland areas such as Muswellbrook. The record number of severe fire danger days in a year was 2019 with approximately 6 days on average across the region, including 3 days recorded at the Taree station and 24 days recorded at the Merriwa station.[3]

Fire weather was the strongest determining factor of house loss during the Black Summer bushfires.[4]

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 cannot. FFDI also provides a long history of data and gives context to the NARCliM projections.

Projections

The number of severe fire weather days will increase for the Hunter region by 2050 for both a low-emissions 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 spring.

Under a high-emissions scenario, the number of annual severe fire weather days across the Hunter could more than double by 2090.

Increases to severe fire weather days are projected to occur across most of the region (Figure 11). The greatest increases are projected to occur for the Upper Hunter including towns such as Merriwa, with only small increases projected in some coastal areas such as Forster. By 2090, Merriwa is projected to experience 1.9 additional severe fire weather days per year under a low-emissions scenario and 5.8 additional severe fire weather days per year under a high-emissions scenario. A high-emissions scenario is projected to nearly double Merriwa's baseline period average of 5.9 severe fire weather days per year. Comparatively, in the north-east of the region, Foster's baseline period average is 1 severe fire weather day per year. By 2090, Foster is projected to experience 0.1 additional severe fire weather days per year under a low-emissions scenario and 0.4 additional severe fire weather days per year under a high-emissions scenario.

Table 6. Projected increase in average annual number of severe fire weather days – Hunter

2050		2090	
Low-emissions	High-emissions	Low-emissions	High-emissions
0.9 days (0.2 to 2.2 days)	**1.2 days** (0.1 to 3.5 days)	**0.7 days** (–0.8 to 2.2 days)	**2.3 days** (0.1 to 6.1 days)

The bold number is the ensemble average for the period. Underneath the average is the ensemble range.

Figure 10. Historical and projected change to annual number of severe fire weather days – Hunter

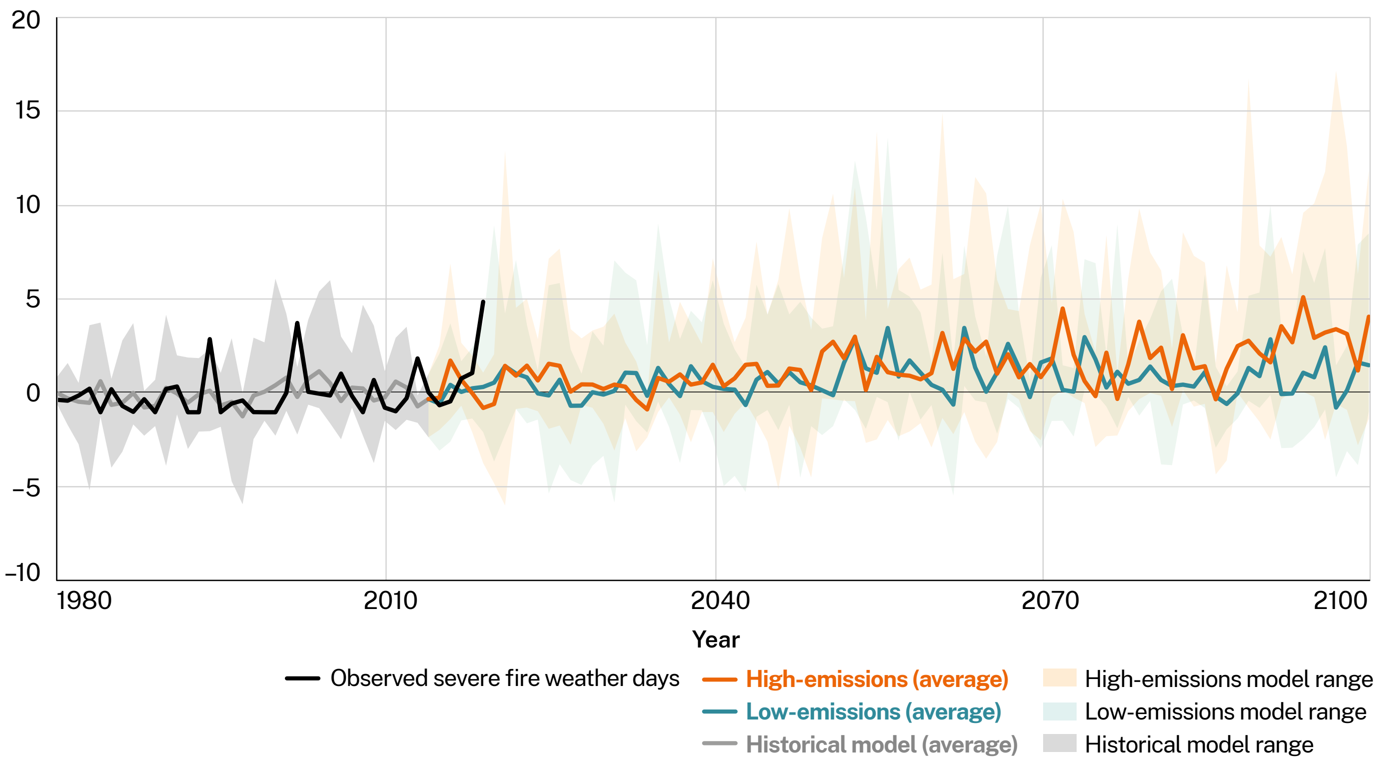
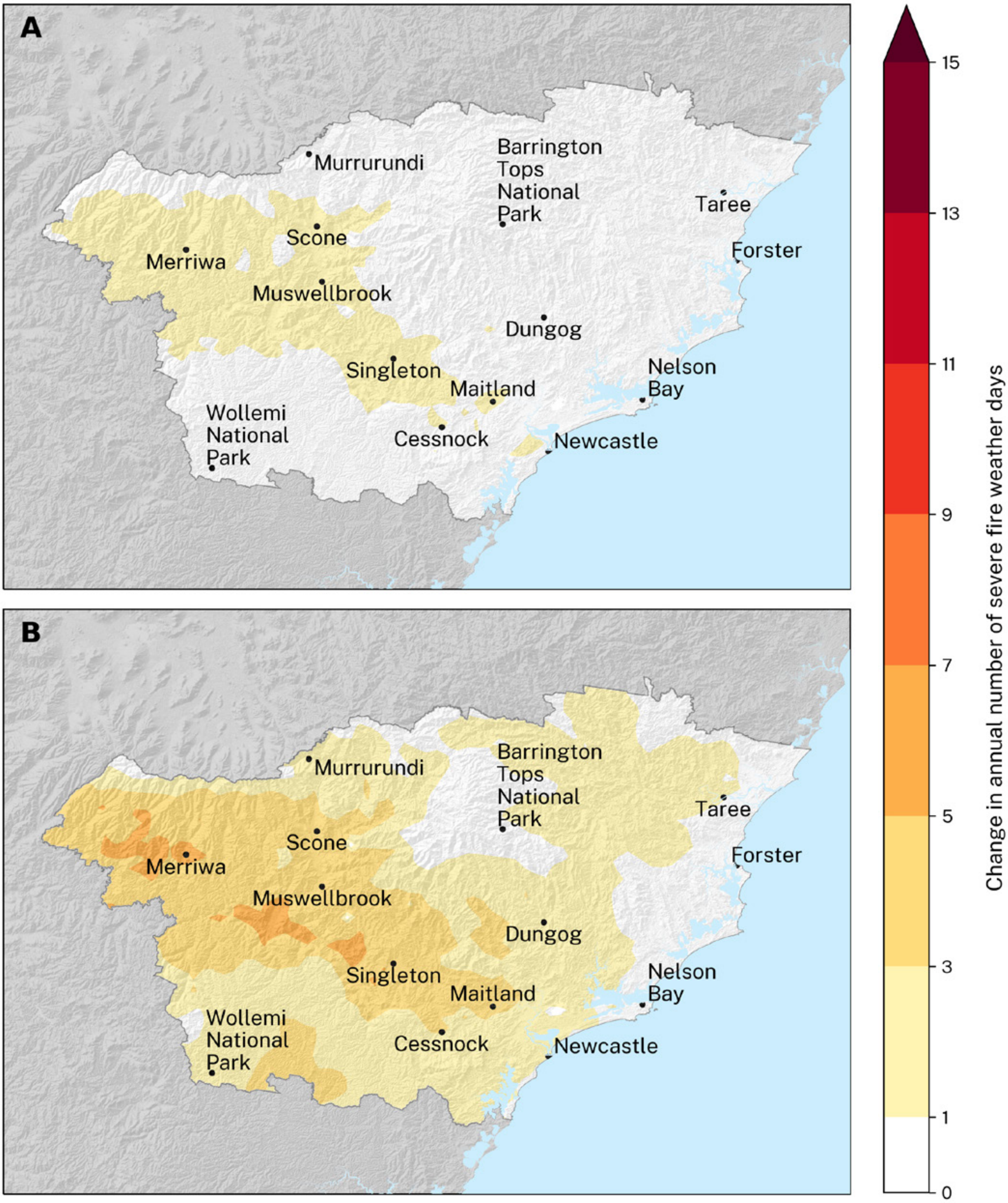


Figure 11. Projected change to annual number of severe fire weather days by 2090 for the Hunter under A) a low-emissions scenario and B) a high-emissions scenario



Sea-level rise

Sea-level rise will accelerate

Sea levels are rising and are projected to have a major impact on coastal communities in NSW over coming decades. At the NSW baseline sea-level monitoring gauge at Newcastle, average sea level has been rising at a rate of approximately 3.7mm/year since 1991.

Sea-level rise of 3.7mm/year has already led to increases in inundation of streets in some NSW coastal communities.[5,6]

The 'likely' range of sea-level rise is presented here by the low (SSP1-2.6) and high (SSP3-7.0) emissions scenarios, to correspond with the NARCliM climate projections. This likely range was assessed by the IPCC as data within an uncertainty interval of 66%. A broader range of projections and uncertainty is available in the 2021 IPCC Sixth Assessment Report.

Sea level for the Hunter is projected to continue rising under all emissions scenarios. At Newcastle, sea level is projected to rise by 14–27cm under a low-emissions scenario and by 18–31cm under a high-emissions scenario by 2050 relative to a baseline period of 1995–2014.

Later in the century, sea-level rise is projected to accelerate under both emissions scenarios, with significantly faster acceleration under a high-emissions scenario. Sea-level rise by 2100 is projected to be 30–62cm under a low-emissions scenario and 55–96cm under a high-emissions scenario. Even greater sea-level rise will occur by 2150, with a projected rise of 43–102cm under a low-emissions scenario and 90–174cm under a high-emissions scenario.

These projections do not factor in contributions from ice-sheet instability, which have high uncertainty. The IPCC addresses this uncertainty by providing modelling explained in a low-likelihood, high-impact storyline assessed as 'low-confidence'. At Port Kembla, this low-confidence modelling indicates a potential upper limit of sea-level rise of 43cm by 2050, 1.7m by 2100 and 4.9m by 2150.

Sea-level rise will continue for centuries to millennia due to the longer-term response of the oceans and ice sheets to climate change.

In the longer term, the IPCC indicates sea level will rise for centuries to millennia due to continuing deep ocean warming and ice-sheet melt remaining elevated for thousands of years. If global warming is limited to 1.5°C, average sea level will rise by about 2–3m worldwide. For 2°C warming, sea-level rise of 2–6m is expected, and for 5°C warming, 19–22m is expected.

Climate change impacts on the Hunter

Climate change is already impacting the Hunter region, particularly through increased temperatures and sea-level rise. Climate change will continue impacting a variety of important economic, cultural and environmental values across the region.

Sea-level rise

The inundation of low-lying streets around Lake Macquarie has increased in recent decades due to sea-level rise and is Australia's most exposed estuary to sea-level rise.[5] Infrastructure and assets are expected to be increasingly vulnerable to the impacts of sea-level rise in the future, particularly under a high-emissions scenario. Sea-level rise and other climate change stressors such as increased extreme weather events have also been identified as threats to important coastal wetlands in the Hunter, including the Myall Lakes and the Hunter Estuary Wetlands.[7,8]

Bushfires

The region also experienced significant impacts during the 2019–2020 bushfire season with extensive impacts on communities, infrastructure and natural ecosystems. Over 227,000 hectares of the region were burnt and 15,663 buildings were impacted, including 147 homes which were destroyed.[9] There were 25 premature deaths, 38 cardiovascular disease and 129 respiratory disease hospitalisations across the region from poor air quality caused by the bushfires.[10]

Large areas of bushland experienced extreme fire severity, including the Wollemi National Park. The Wollemi National Park was affected by the Kerry Ridge fire, which burnt more than 320,000 hectares across regions and combined with the Gospers Mountain fire to form the largest bushfire ever recorded in NSW. Over 4000 hectares of the Barrington Tops National Park, which forms part of the Gondwana Rainforests World Heritage Area, was also burnt.[11] Severe fire danger days, which create the underlying conditions for large-scale bushfires, are expected to become more common in the future, particularly under a higher-emissions scenario.

References

[1] Long-term temperature record – webpage

[2] About Australian Gridded Climate Data maps and grids – webpage

[3] Bureau of Meteorology Station Data – webpage

[4] 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

[5] Hanslow et al. 2023, 'Sea level rise and the increasing frequency of inundation in Australia's most exposed estuary', *Regional Environmental Change*, 23:146

[6] Hague et al. 2020, 'Sea level rise driving increasingly predictable coastal inundation in Sydney, Australia', *Earth's Future*, 8:9

[7] OEH 2011, 'Myall Lakes Ramsar site ecological character description', *Office of Environment and Heritage*, Sydney

[8] HEAL 2023, 'Hunter Estuary Coastal Management Program Scoping Study', *Hunter Estuary Alliance*, Newcastle

[9] Owens & O'Kane 2020, 'Final report of the NSW Bushfire Inquiry', *Department of Premier and Cabinet*, Sydney

[10] Nguyen et al. 2021, 'The Summer 2019–2020 Wildfires in East Coast Australia and Their Impacts on Air Quality and Health in New South Wales, Australia', *International Journal of Environmental Research and Public Health*, 18:7

[11] DPIE 2020, 'NSW Fire and the environment 2019–20 summary', *Department of Planning, Industry and Environment*, Sydney

Climate action and information

Climate action

The NARCliM projections for the low-emissions scenario and the high-emissions scenario 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.

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.

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