Guide to climate projections for risk assessment and planning in South Australia | 2022

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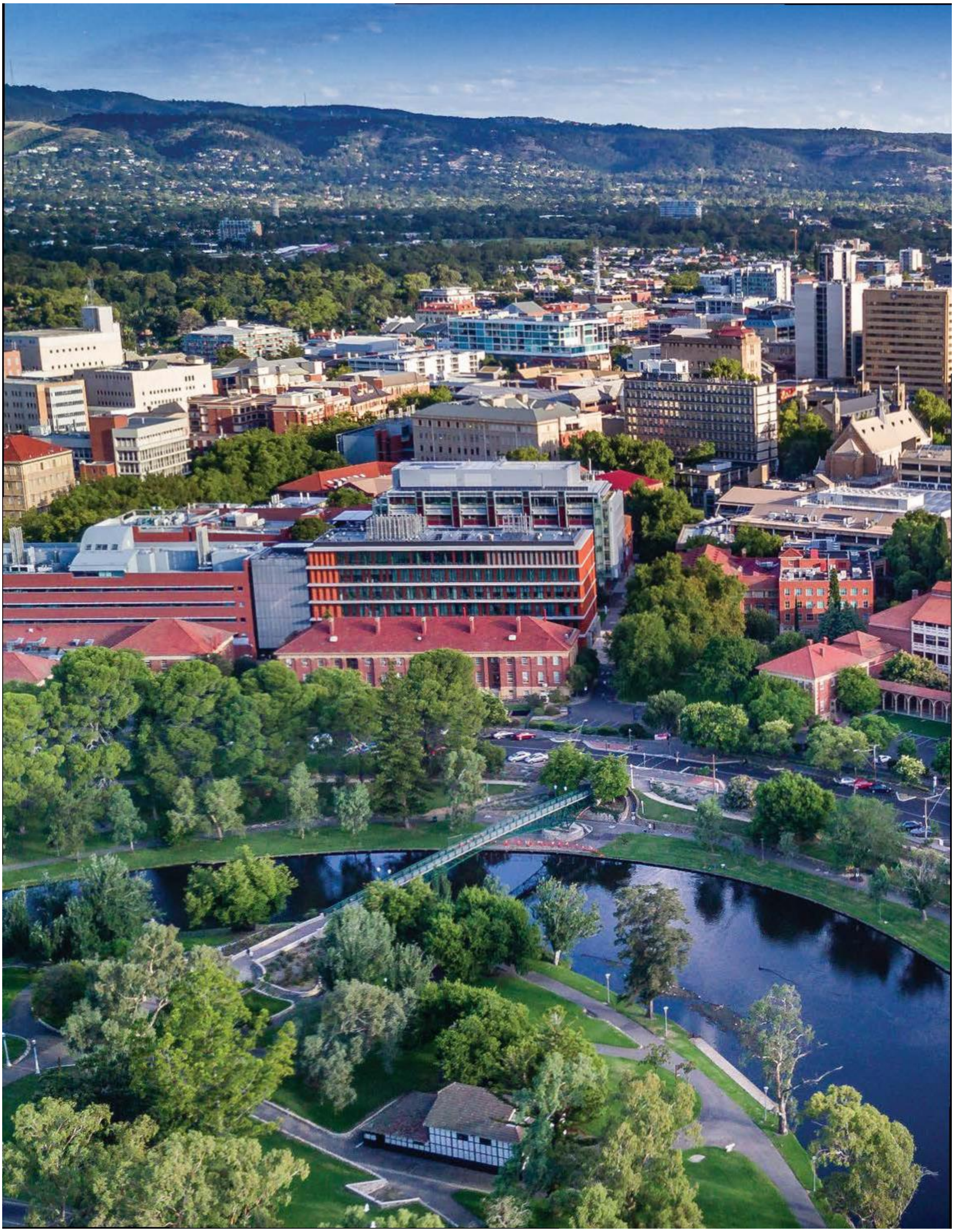
1.0	October 2020	Initial release
1.1	November 2020	Minor data corrections
2.0	November 2022	NARCliM 1.5 projections update



Executive summary

The climate of South Australia is changing. We are already observing increases in average temperatures, a greater frequency of very hot days, declining rainfall and rising sea levels.

New climate projections indicate these changes will continue over coming decades, increasingly affecting communities, industries, infrastructure and the environment in every part of the state and requiring every sector of society to adapt. Planning for South Australia's future requires an understanding of how the climate is likely to change over time. The South Australian Government is committed to helping governments, business and communities prepare for climate change by providing high quality and accessible climate information.

This *Guide to Climate Projections for Risk Assessment and Planning in South Australia 2022* provides a summary of the likely changes to key climate variables, such as temperature, rainfall, evapotranspiration, days of severe fire danger and sea level rise, under different greenhouse gas emissions scenarios. The document draws on the most up-to-date climate change projections for South Australia and can be used for climate change risk assessment, adaptation planning and community engagement.

How to use this document

The **Executive summary** describes statewide climate trends projected to 2050 and beyond for South Australia.

Section 2 describes how climate models generate projections for the future climate; the influence of greenhouse gas emissions scenarios, and the main sources of information on climate change projections in South Australia. Recommended scenarios for use in risk assessment and planning in South Australia are included in this section.

Section 3 provides a description of the projected changes in climate for the state in the short-to-medium-term (2030 and 2050) under a high emissions scenario and provides examples of potential flow-on economic, social and environmental impacts. This section also includes examples of projected changes in climate at a regional scale.

Section 4 provides data on the magnitude of the projected changes in a range of climate variables in the short, medium and long term (2030, 2050 and 2090) for 10 locations, across South Australia.

Section 5 provides statewide maps of projected changes in average daily temperature, average annual rainfall and the frequency of days over 40 °C, based on NARCliM1.5 modelling projections.

Sections 6 to 12 provide projections of changes in annual and seasonal temperature and rainfall, frosts, fire danger index, evapotranspiration, wind speed, sea level rise and sea surface conditions for regions of South Australia for in the short, medium and long term (2030, 2050 and 2090), and for 2 emissions scenarios (RCP4.5 and RCP8.5).

Summary of climate change trends

South Australia has already become hotter and drier with more variable and extreme weather and these trends are projected to continue over this century and beyond. Table 0-1 summarises statewide trends projected to 2050 and beyond.

Table 0-1 Summary of climate trends projected for South Australia to 2050 and beyond

	Higher temperatures	Maximum, minimum and average temperatures will increase.
	Warmer spring temperatures	Warming in spring is likely to be greater than in any other season.
	Hotter and more frequent hot days	The frequency of very hot days will continue to increase, and periods of hot weather will get longer and hotter.
	Fewer frosts	The frequency of frost events will remain comparable until 2030. In the longer-term, frosts are expected to decrease as the climate warms.
	Declining rainfall	Average annual rainfall will decline.
	Lower spring rainfall	Spring rainfall declines will be greater than any other season.
	More drought	Time spent in drought will increase.
	More intense heavy rainfall events	The number and intensity of heavy rainfall events will increase.
	Increased potential evapotranspiration	Potential evapotranspiration is projected to increase across all seasons.
	Wind	Wind speeds will remain comparable until 2030. In the longer-term, a pattern of winter wind speed decrease is likely.
	More dangerous fire weather	Harsher fire weather will be experienced, and fuels will be drier and more ready to burn.
	Rising sea levels	Sea levels will continue to rise.
	Warmer and more acidic ocean waters	Sea surface temperatures will continue to rise, and acidity will continue to increase.

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1. Introduction

The climate of South Australia is changing. Temperatures have been increasing and rainfall has been declining. There have been longer, hotter and more frequent heatwaves, an increase in dangerous fire weather, an increase in the intensity of heavy rain events and rising sea levels along our coast.

Projections of future climate indicate these changes are likely to continue over coming decades, increasingly affecting communities, industries, infrastructure and the environment in every part of the state and requiring every sector of society and the economy to adapt.

Planning, decision-making and resource management need to take into account how the future climate will impact individuals, business, industry and the natural environment, and how to respond to the changes. This requires a clear understanding of how the climate is likely to change in South Australia in the future. Climate projections support this understanding and provide an evidence base for the assessment of the risks and opportunities.

The *Guide to Climate Projections for Risk Assessment and Planning in South Australia 2022* provides a summary of the changes in climate and sea levels likely to occur in South Australia, together with guidance on the use of climate projections for risk assessment and planning.

This updated guide includes dynamically downscaled projections for South Australia from the NARCliM 1.5 regional climate modelling project, and replaces earlier SA Climate Ready projections. The extensive coverage of the NARCliM 1.5 modelling of South Australia enables statewide mapping of projected changes in average temperature, rainfall and extreme heat. In addition, a range of other updates have been made where new information has become available since 2020.

It is important to note that projections are not forecasts. They do not provide a prediction of exactly what might occur by a particular date. Instead, they draw on the best available information to indicate how temperature, rainfall and other climate variables are likely to change in the future under a range of possible emissions scenarios. The information presented in this document is drawn from sources that are underpinned by the scientific rigour and credibility of peak Australian and international scientific organisations such as the Climate Change Research Centre of the University of New South Wales, the Bureau of Meteorology (BoM), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Intergovernmental Panel on Climate Change (IPCC).

This document will be updated in 2024 with new regional-scale model data from the NARCliM 2.0 project.

2. About climate projections

Climate projections are generated by computer models, which simulate the physical processes that drive the global climate, including the influence of greenhouse gas concentrations. Future emissions and concentrations of atmospheric greenhouse gases will depend on population growth, economic growth, fossil fuel use, changes in land use and technology. Internationally agreed future scenarios of emissions are used to ensure models use common inputs. Climate projections are reported for common future time horizons, against a baseline of historic (measured) data.

Climate research and modelling is continuously improving and the information in this document will be updated as new scientific findings, models and climate change projections are released. This 2022 update incorporates climate projections from the NSW Australian Regional Climate Modelling Project stage 1.5 (NARCliM 1.5 – see the NSW Climate Data Portal for more information).

The NARCliM 1.5 regional-scale climate modelling is based on CMIP5 models that informed the IPCC 5th Assessment Report (IPCC, 2014). NARCliM 2.0 regional-scale climate modelling, which is currently in progress, will provide higher-resolution gridded climate projections for South Australia based on the CMIP6 models of the IPCC 6th Assessment Report (IPCC, 2021).

2.1 Timescales

Climate models provide outputs over different time frames. To smooth out variations in model outputs, climate data are commonly presented as an average over a 20-year time period, reported as mean annual values centred on a future marker year, commonly 2030 (2020–2039), 2050 (2040–2059), 2070 (2060–2079) and 2090 (2080–2099).

The projected changes are reported in comparison to the observed climate of a defined historic baseline period. The climate scenarios available for South Australia, and used in this document, refer in most cases to a baseline period spanning 20 years from 1986–2005. This is the standard baseline period adopted in the IPCC 5th Assessment Report. There is an exception for the projections of extreme rainfall (section 7.3), which are drawn from the CSIRO-BoM Climate Change in Australia project and refer to a 30-year baseline period spanning 1981–2010.

Other baseline periods are also used, often referring to a pre-industrial climate. The Paris Agreement global warming targets to hold global temperatures below 1.5 °C – 2.0 °C are expressed with reference to a 'pre-industrial' baseline period of 1850–1900.

2.2 Global emissions scenarios

The rate and extent of changes in future climate will depend on the change in concentrations of atmospheric greenhouse gases, such as carbon dioxide, methane and nitrous oxide as a result of their release or emission to the atmosphere.

Climate change projections presented in this report are based on a range of greenhouse gas scenarios, termed Representative Concentration Pathways (RCPs), developed by the IPCC to represent plausible future trends of greenhouse gas emission rates and the consequent concentrations of greenhouse gas in the atmosphere. The four commonly referenced RCPs range from very low (RCP2.6) through medium (RCP4.5 and RCP6.0) to high (RCP8.5) future concentrations and are based on possible global responses to manage the emissions of greenhouse gases.

Table 2-1 shows the modelled future global mean temperature changes at 2050 and 2090, compared to a 1986–2005 baseline period under the four RCP scenarios. It shows that each scenario leads to a significantly different future climate by 2090.

Table 2-1 RCPs and projected warming relative to 1986 to 2005 (adapted from Collins et al., 2013)

RCP	Global mean temperature increase (°C) relative to 1986–2005	
	2050 (2046–2065)	**2090** (2081–2100)
RCP2.6	1.0 °C (± 0.3)	1.0 °C (± 0.4)
RCP4.5	1.4 °C (± 0.3)	1.8 °C (± 0.5)
RCP6.0	1.3 °C (± 0.3)	2.2 °C (± 0.5)
RCP8.5	2.0 °C (± 0.4)	3.7 °C (± 0.7)

In the above table, the mean temperature increases projected by a range of climate models are listed with (±) standard deviation (in brackets). The standard deviation is a measure of how spread out the projections of different models are. Including the standard deviation with the mean gives a range of temperatures (e.g. 0.7 to 1.3 °C for RCP2.6 at 2050). About two thirds of the models predict temperature changes within this range, while approximately one sixth of models show less warming and another one sixth of models show more warming. Note that these values do not include the approximately 0.6 °C of warming that has already occurred between the pre-industrial baseline period of 1850–1900 and the recent baseline period of 1986–2005.

Future emissions pathways

Projections currently available for South Australia are based on the RCPs of the IPCC Fifth Assessment Report (AR5) and these are the emissions scenarios referred to throughout this document. The guidance on emissions scenarios will be updated in future in line with the IPCC 6th Assessment Report (AR6), which introduces the use of a range of Shared Socioeconomic Pathways (SSPs) to derive greenhouse gas scenarios for climate modelling.

The SSPs describe a range of pathways that examine how global society, demographics and economics might change over the next century. The SSPs consider how global socioeconomic conditions will influence energy generation and use and associated greenhouse gas emissions.

The next generation of climate projections, including the downscaled regional projections of the NARCliM 2.0 project, will be based on these scenarios, specifically SSP1-2.6 and SSP3-7.0.

Table 2-2 SSPs and projected warming relative to 1995 to 2010 (adapted from IPCC, 2021)

SSP	Global mean temperature increase (°C) relative to 1995–2014	
	2050 (2046–2065)	**2090** (2081–2100)
SSP2.6	0.85 °C (-0.4 / +0.5)	0.95 °C (-0.5 / +0.6)
SSP4.5	1.15 °C (-0.4 / +0.5)	1.85 °C (-0.6 / +0.8)
SSP7.0	1.25 °C (-0.4 / +0.5)	2.55 °C (-0.8 / +1.0)
SSP8.5	1.55 °C (-0.5 / +0.6)	3.55 °C (-1.0 / +1.3)

In Table 2-2 (above), projected temperature differences in 2050 and 2090 relative to the average global surface temperature of 1995–2014 are reported for four of the shared socioeconomic pathways used in the climate modelling reported in the IPCC 6th Assessment Report. Notably, the projected temperature changes in Table 2-2 are similar to those presented in the IPCC 5th Assessment Report (Table 2-1), however, because they are referenced to a later baseline period (1995–2014 instead of 1986–2005), they appear a little lower.

2.3 Uncertainty and confidence in climate projections

In the IPCC assessment reports, each climate statement includes a measure of confidence which considers the evidence available (i.e. research type, quality, quantity and consistency) and agreement between the available lines of evidence. Projections with high agreement (numerous across the literature) and robust evidence have higher confidence than those with low agreement and limited evidence. Confidence is expressed at five levels from very high to very low.

Climate Change in Australia projections are reported in the same language as that used by the IPCC. However, the IPCC uses additional lines of evidence, including model reliability in simulating the current climate, evidence for the processes driving the simulated changes and the level of consistency with emerging trends in the observations (CSIRO and Bureau of Meteorology, 2015).

Generally, the confidence in temperature projections is higher than confidence in rainfall projections.

There is a level of uncertainty inherent in the use of climate projections, stemming from: uncertainty in future emissions and atmospheric greenhouse gas concentrations; limitations in our understanding of the climate system; and the natural variability of the climate system. Uncertainty is not related to confidence. There are still uncertainties associated with climate projections that have very high confidence.

This document makes recommendations about which climate projection scenarios to use in risk assessment and planning, as well as associated issues of uncertainty and confidence and how to consider these.

2.4 Recommended scenarios for risk assessment

When selecting which climate projections to use for assessments, decision makers should consider the lifetime of the decision or assessment being undertaken and the level of risk associated with the decision.

What is the decision lifetime?

The decision lifetime has been defined as the sum of the lead time (the time from when the decision is first identified to the execution of the decision) and the consequence time (the time period over which the consequences of the decision emerge) (Stafford Smith et al., 2011).

For example, the decision lifetime of a bridge is the time from when the need for the bridge is first identified through the construction time to the point where the bridge has reached the end of its useful life and needs replacing. For a road bridge, this may be over 70 years.

The range of future emissions represented by the medium (RCP4.5) and high (RCP8.5) scenarios is considered sufficient for planning and risk assessments.

For decisions and assessments *with a lifetime to 2050 or before*, the use of a single future emissions scenario may be sufficient and may simplify the assessment process.

If a single emissions scenario approach is adopted for decisions and assessments with a lifetime to 2050, the Department for Environment and Water recommends that climate change risk assessment and planning is based on a climate future in line with the *RCP8.5 emission scenario* for the following reasons:

- Observed temperature changes in Australia have been tracking towards the upper end of the range of temperature change projected in model simulations that include the currently observed conditions of greenhouse gases (Figure 1). For more information see the Future climate section of the Bureau of Meteorology State of the Climate report 2020 http://www.bom.gov.au/state-of-the-climate/.

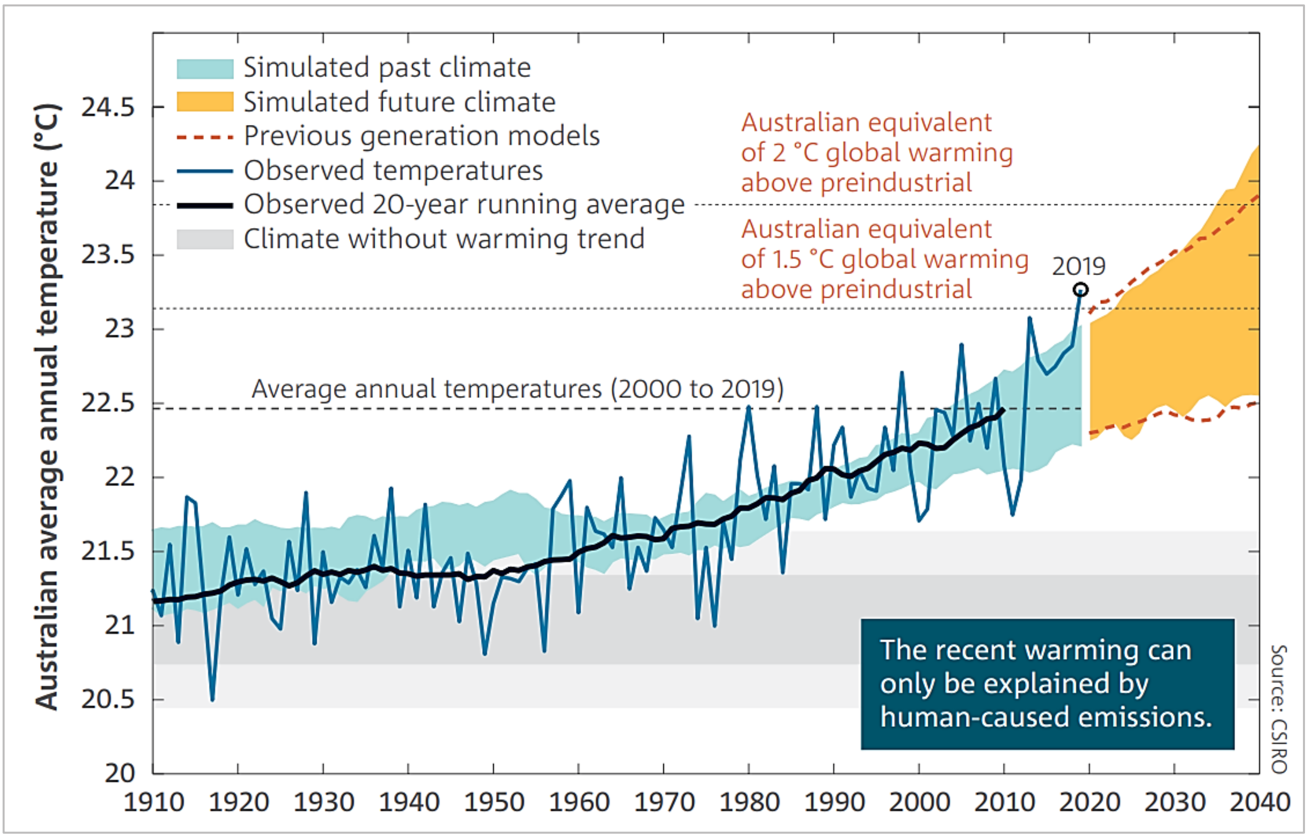
There are relatively minor differences between greenhouse gas scenario concentrations (under the different RCP scenarios) and the resulting projected temperature changes prior to 2050, compared to the much greater range of differences projected beyond 2050 (see Table 2-1).

Considering the uncertainty both in future emissions trajectories and the sensitivity of global temperature to greenhouse gas concentrations, planning according to a high concentration scenario for the near-to-medium term future is a suitably precautionary approach.

Beyond 2050, uncertainties in emissions pathways and resulting temperature changes increase markedly. For risk assessment and planning decisions *with a lifetime that extends beyond 2050*, impacts and risks of a range of emissions scenarios should be considered. It is recommended that as a minimum, *both the medium (RCP4.5) and high (RCP8.5)* emissions scenarios are considered for the following reasons:

- There is higher uncertainty in the longer-term future direction of greenhouse gas emissions, which will be affected by economic and political factors and the rate of development and adoption of new technologies.
- There is significant difference between the future climate associated with emissions scenarios of RCP4.5 and RCP8.5 after 2050. The difference in impact and associated costs under these two scenarios should be evaluated to determine the most acceptable balance between the likely costs of impacts and the costs of risk mitigation.

*Figure 1: Australian average annual temperature observed and simulated from global climate models**



**Adapted from Bureau of Meteorology State of the Climate 2020.*
Figure 1 notes:

- *Past (pale blue) and future (orange) bands show the range of 20-year running average of new generation climate model results that include observed conditions of greenhouse gases, aerosols, solar input and volcanoes. Dashed lines show the equivalent from the previous generation of global climate models.*
- *The pale grey band of the climate without warming trend shows both an inner and an outer band which are one and 2 standard deviations, respectively, from the 1850–1900 average, i.e. prior to the rapid growth in greenhouse gas emissions from human activities.*
- *The black dashed lines show the Australian equivalent of the global warming thresholds 1.5 °C and 2 °C above the pre-industrial baseline period 1850–1900, equating to warming levels of around +2.1 °C and +2.8 °C respectively, based on the observed ratio of Australian to global temperature of around 1.4 °C.*

A lower greenhouse gas scenario – RCP2.6 – is approximately aligned to a global emissions scenario with a greater than 50% probability of meeting the Paris target of no more 2 °C above the pre-industrial baseline period of 1850–1900. Achieving emissions in line with the RCP2.6 scenario would require an immediate, steep and sustained decline in CO_2 emissions globally, in addition to large-scale implementation of atmospheric CO_2 capture and storage to achieve net negative emissions (van Vuuren 2011; IPCC 2018). A growing number of nations and states are committing to a target of net zero emissions by 2050. It is too early to determine whether these commitments will be supported by the development and implementation of policies to achieve the rapid global decline in emissions and stabilisation of greenhouse gas concentrations required to align with the RCP2.6 scenario. This scenario will be modelled as part of the NARCliM 2.0 regional climate modelling project (see below).

2.5 Information sources used for this report

The projections in this document have been collated from 2 sources, which provide climate projections coverage for the whole of South Australia:

1. Climate Change in Australia (CSIRO and Bureau of Meteorology) and
2. The NSW Australian Regional Climate Modelling project stage 1.5 (NARCliM1.5).

2.5.1 NARCliM 1.5

The NARCliM (NSW / ACT Regional Climate Modelling) project has produced regional climate projections for south-eastern Australia (NSW Climate Data Portal), covering an area that includes the eastern half of South Australia. The NARCliM models produce data for more than 100 meteorological variables. The NSW Government released the first set of NARCliM climate projections in 2014, referred to as NARCliM1.0. It then made supplementary climate projections available in 2020, referred to as NARCliM1.5. These new projections offer enhancements to the earlier ones. Notably, they use a later group of global climate models (GCMs) used in the Coupled Model Intercomparison Project-5 (CMIP5). Projections are provided for two Representative Concentration Pathways (RCPs) from CMIP5: RCP4.5 and RCP8.5. The new projections provide continuous data from 1951 to 2100.

The next generation of NARCliM data is in development and will use a combination of IPCC's CMIP6 GCMs and regional climate models for 1960-2100 using two greenhouse gas/radiative forcing scenarios: SSP1-2.6 and SSP3-7.0. These NARCliM 2.0 datasets are due for release in 2023.

2.5.2 Climate Change in Australia

Climate Change in Australia (CCIA) provides a suite of products, including reports, a website and datasets, resulting from a 4-year project undertaken by the Bureau of Meteorology and CSIRO from 2012 to 2015. The project developed an extensive range of climate change projections for Australia based on the most recent set of internationally co-ordinated modelling experiments. The final project outputs, including the extensive CCIA web portal, were delivered in 2016. The projections provided by the CCIA project describe likely changes in key variables for Australian regions, including temperature and rainfall averages and extremes, fire weather, cyclones, average and extreme sea level rise and ocean acidification. Other variables reported on include wind, soil moisture, runoff, evapotranspiration, humidity and solar radiation.

Projections for each of the four RCPs are available. The CCIA reports describe projections for two time horizons, a near future 2020–2039 (2030) and late in the century 2080–2099 (2090), noting that additional time periods are provided on the CCIA website. Climate projections are provided for regions identified as 'cluster regions' which each aggregate two or more of the former South Australian Natural Resource Management (NRM) regions. The NRM regions used as the basis for cluster regions of the CCIA project, were as defined by the South Australian *Natural Resources Management Act 2004*. From 1 July 2020, the *Landscape South Australia Act 2019* replaced the 2004 Act as the key framework for managing the state's natural resources, redefining the regional boundaries for management of natural resources as a number of South Australian Landscape Regions. The guidance and projections provided in this report refer to the CCIA cluster regions and the South Australian Landscape Regions (Figure 2). Projections for the landscape regions have been derived from NARCliM 1.5 climate modelling outputs.

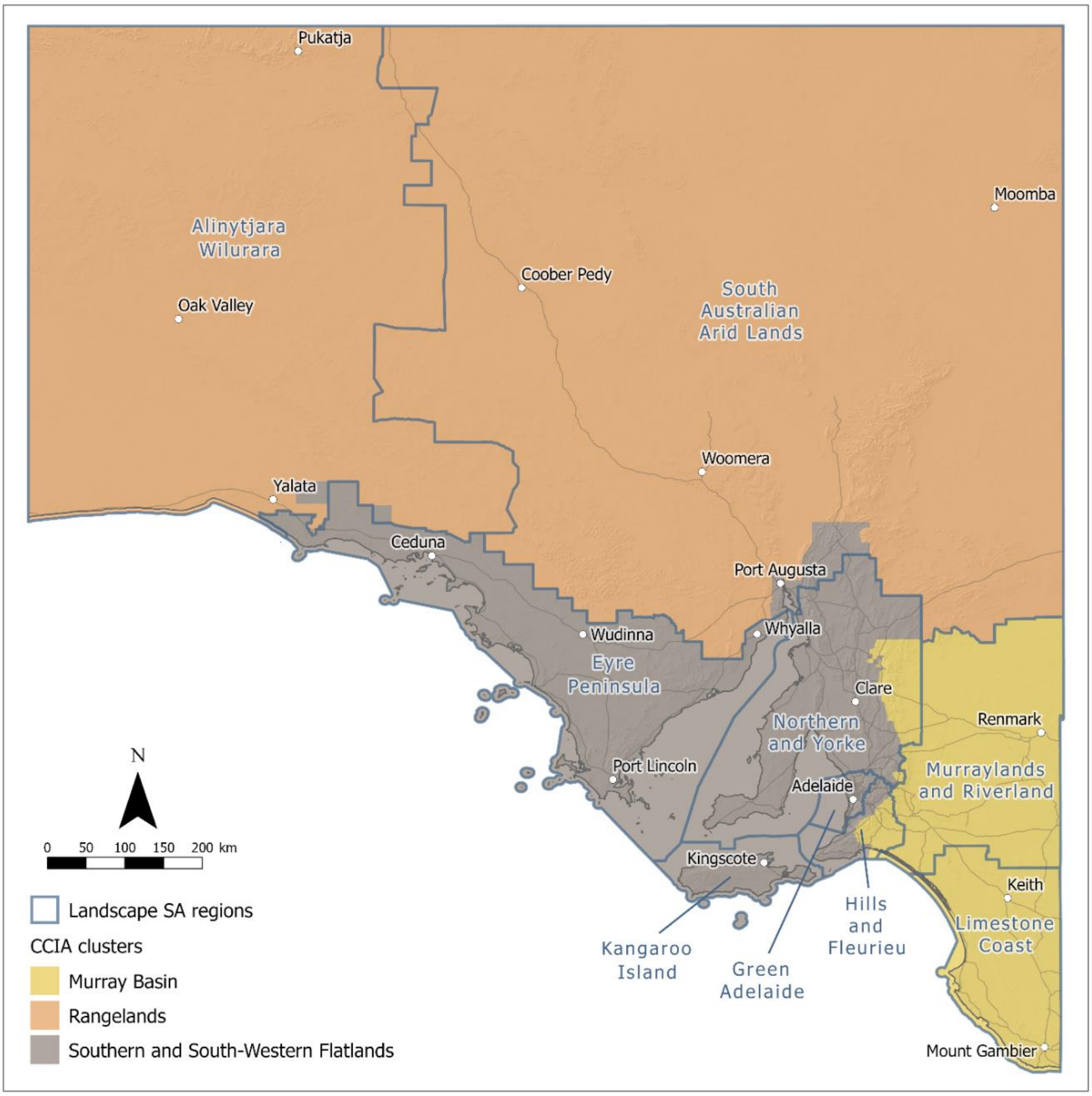


Figure 2: Regional geographical divisions of South Australia as defined by the CSIRO and Bureau of Meteorology Climate Change in Australia project, with overlaid boundaries of the Landscape Regions of South Australia.

The South Australian Landscape Regions fall into three of the CCIA cluster regions:

1. Rangelands (North and South) covers the:
   i. Alinytjara Wilurara region
   ii. SA Arid Lands region
2. Southern and South Western Flatlands (East) covers the:
   i. Green Adelaide region
   ii. Hills and Fleurieu region
   iii. Eyre Peninsula region
   iv. Kangaroo Island region
   v. Northern and Yorke region
3. Murray Basin covers the:
   i. Murraylands and Riverland region
   ii. Limestone Coast region.

2.6 Other information sources

Other sources of climate information are available for parts of the state and other climate impacts including climate projections from the SA Climate Ready datasets, coastal inundation mapping from Coast Adapt and the Cooperative Research Centre (CRC) for Spatial Information. While not summarised in this report, these information sources may be useful depending on the nature of the planning or risk assessment to be undertaken.

2.6.1 SA Climate Ready

The CSIRO prepared downscaled climate projection data for South Australia in 2015 as part of the Goyder Institute for Water Research's SA Climate Ready project. Projections for six climate variables were provided, including rainfall, maximum and minimum temperature, solar radiation, humidity and evapotranspiration. These were downscaled to be representative of specific locations and sub-regions across South Australia. The suite of products from the SA Climate Ready project includes downscaled climate projection datasets, regional climate projection summaries and other documentation. The projection data is reported on for each of the state's former Natural Resources Management (NRM) regions and complements the national-scale projections produced by the CSIRO and the Bureau of Meteorology.

Projections are provided for RCP4.5 and RCP8.5, and regional projection summaries are available for 20-year time periods centred on 2030, 2050, 2070 and 2090 (Charles and Fu, 2015). The data and regional projections summaries can be accessed at https://data.environment.sa.gov.au/Climate/SA-Climate-Ready/SitePages/Home.aspx.

2.6.2 Coastal inundation mapping

The Enviro Data SA Coastal Flood Mapping Viewer is an interactive flood mapping tool has been developed as a result of the partnerships between the Limestone Coast Local Government Association, the Eyre Peninsula Landscape Board, the Eyre Peninsula Local Government Association, the Coast Protection Board and the Department for Environment and Water. The viewer enables exploration of maps to identify areas on Eyre Peninsula and the Limestone Coast that may be vulnerable to coastal flooding due to storm surge and/or sea level rise. Other coastal areas of South Australia will be added to the viewer in 2023.

CoastAdapt and the CRC for Spatial Information provide sources of information that can assist in understanding potential inundation resulting from sea level rise.

The CoastAdapt website www.coastadapt.com.au provides sea level rise and inundation information for all Australian coastal councils. It also provides links to the coastal geomorphology dataset Smartline, which maps shoreline erodibility. The inundation mapping shows model outputs for 2050 and 2100, with four greenhouse gas concentration scenarios: RCP2.6, RCP4.5, RCP6.0 and RCP8.5.

A coastal risk mapping tool www.coastalrisk.com.au has been developed by the CRC for Spatial Information. The tool allows users to investigate projected sea level rise and storm surge scenarios for their locality. This tool enables a range of inundation scenarios for 2100 to be assessed relating to low, medium and high emissions scenarios and can be manually set to provide any height of sea level rise above mean sea level.

2.6.3 Urban heat and tree mapping

The Enviro Data SA Urban Heat and Tree Mapping Viewer enables the exploration of high-resolution surface temperature data for the Adelaide metropolitan area.

In addition to thermal data, LiDAR (Light Detection and Ranging) data acquired over the Adelaide Metropolitan area and covering 18 local government areas is used to create a number of layers that can be used to map urban tree canopy extent and height for all vegetation greater than 3 m in height, including:

- Evaluate how urban infrastructure choices affect the temperature characteristics and extents of urban heat islands,
- Help plan activities to mitigate high temperatures in the urban environment, and
- Improve the resilience of communities and assets to extreme heat and prolonged heat events.

3. Description of climate projections to 2050

This section provides a description of the changes in climate associated with short to medium term (2030 and 2050) projections for South Australia associated with a high emissions scenario (RCP8.5).

A statement on the likely change projected for the state is presented along with some examples at a regional scale (using South Australian Landscape Regions).

The projections described are relative to the baseline period of 1986 to 2005. The information has been drawn from the tables in sections 4 and 6 to 12 of this document, the data for which are sourced from NARCliM 1.5 and Climate Change in Australia projections (see Section 2.5).

Each example refers to a mean value of the range of possible future changes reported in the data source.

Examples of potential flow-on economic, social and environmental impacts as a result of the changes are included for each climate variable.

For more detailed data:

Section 4 provides information on the magnitude of the projected changes in a range of climate variables in the short to medium term (2030 and 2050) for 10 regional locations across South Australia.

Sections 6 to 12 provide a complete set of projections for each South Australian landscape region, each time frame (2030, 2050 and 2090) and 2 emissions scenarios (RCP4.5 and RCP8.5).

3.1 Temperature

3.1.1 Mean and annual temperature

Annual mean daily maximum and minimum temperatures will increase across all South Australian regions.

- By 2030 annual mean daily maximum temperatures are projected to increase by up to 1.3 °C, with a greater increase projected in the north of the state.
- For example, in the Kangaroo Island and Hills and Fleurieu Landscape Regions, mean daily maximum temperatures are projected to increase by 1.0 °C and in the SA Arid Lands and Alinytjara Wilurara Landscape Regions, mean daily maximum temperatures are projected to increase by 1.3 °C.
- By 2030 mean annual minimum temperatures are projected to increase by up to 1.1 °C. A greater increase is projected for the north of the state.
- For example, in the Limestone Coast Landscape Region, annual mean minimum temperatures are projected to increase by 0.8 °C and in the SA Arid Lands Landscape Region, annual mean minimum temperatures are projected to increase by 1.1 °C.
- By 2050 annual mean maximum temperatures are projected to increase by up to 2.2 °C, with a greater increase projected in the north of the state.
- For example, in the Kangaroo Island Landscape Region, mean annual maximum temperatures are projected to increase by 1.5 °C and in the SA Arid Lands and Alinytjara Wilurara Landscape Regions, mean annual maximum temperatures are projected to increase by 2.2 °C.
- By 2050 mean annual minimum temperatures will increase by up to 1.7 °C. A greater increase is projected for the north of the state.

- For example, in the Kangaroo Island Landscape Region, annual mean minimum temperatures are projected to increase by 1.3 °C and in the SA Arid Lands and Alinytjara Wilurara Landscape Regions, annual mean minimum temperatures are projected to increase by 1.7 °C.

3.1.2 Seasonal temperature

Across all South Australian regions, warming in spring is likely to be greater than in any other season.

- By 2030, mean daily maximum spring temperatures are projected to increase by up to 1.6 °C, compared to mean daily maximum winter temperatures increases of up to 1.1 °C.
- For example, in the Kangaroo Island Landscape Region, mean daily spring maximum temperatures are projected to increase by 1.0 °C compared to 0.9 °C for mean daily winter maximums. In the Northern and Yorke and Eyre Peninsula Landscape Regions, mean daily spring maximum temperatures are projected to increase by 1.3 °C compared to 1.0 °C for mean daily winter maximums.
- By 2050, mean maximum spring temperatures are projected to increase by up to 2.7 °C, compared to mean maximum winter temperatures increases of up to 2.0 °C.
- For example, in the Northern and Yorke Landscape Region, mean daily spring maximum temperatures are projected to increase by 2.2 °C compared to 1.7 °C for mean daily winter maximums. In the SA Arid Lands Landscape Region, mean daily spring maximum temperature is projected to increase by 2.6 °C compared to 2.0 °C for mean daily winter maximums.

South Australia faces increasing impacts from warming temperatures including:

- changes to growing seasons and plant growth (for example, warmer winters can reduce the yield of pomme and stone fruits that require winter chill)
- increased potential for algal blooms in waterbodies
- increased population, range and migration of pest plants and animals
- increased range and occurrence of food, water and mosquito borne disease such as *E. coli* and Ross River virus.

3.1.3 Extreme heat and heatwaves

Across all South Australian regions, the frequency of very hot days will continue to increase and heatwaves will get longer and hotter.

- By 2030 the frequency of days per year above 35 °C in most regional centres is projected to increase by more than 30% from the baseline period of 1986–2005
- For example, in Mount Gambier, the number of days over 35 °C is projected to increase to over 9 days per year compared to an average of 7.4 days per year for the baseline period.
- By 2030 the frequency of days per year above 40 °C is projected to increase by more than 50% from the baseline period of 1986–2005.
- For example, in Whyalla, the number of days over 40 °C is projected to increase to over 10 days per year compared to an average of 6.7 days per year during the baseline period. In some regional centres, the frequency of days over 40 °C is projected to double by 2030. For example, in Clare, the number of days over 40 °C is projected to increase to 4.8 days per year compared to an average of 1.2 days per year during the baseline period.
- In Adelaide, the number of days per year over 40 °C is projected to increase from 1.1 days per year in the 1986-2005 baseline period to around 3 days per year.
- By 2050 the number of days per year above 35 °C is projected to increase by more than 40%.
- For example, in Renmark, the number of days over 35 °C is projected to increase to nearly 52 days per year compared to an average of 33 days per year for the baseline period.
- By 2050 the number of days per year over 40 °C is projected to more than double.
- For example, in Woomera, days over 40 °C are projected to increase to an average of 31 days per year compared to 13.9 days per year for the baseline period. In Port Augusta, around 22 days per year over 40 °C are projected,

compared to 11 days for the baseline period. For Adelaide, it is projected that there will be more than 5 days per year, compared to 1.1 days per year for the baseline period.

South Australian faces increasing impacts from extreme heat and heatwaves including increases in:

- risk of heat related illness and death
- energy demand for cooling in summer
- heat stress of livestock
- damage to yield and quality of crop production
- demand for irrigation
- rates of deterioration of exterior surfaces including road surfaces and buildings
- incidents of anti-social and violent behaviour.

Recent observations of extreme heat
Over the last decade (2012–2021) there has been an average of more than 5 days per year over 40 °C in Adelaide, indicating that the rate of increase in very hot days is greater than projected. This has also occurred in many regional areas of South Australia. Further modelling and analysis are required to determine if this higher rate of change will continue. However, it is possible that the frequency of very hot days will continue to change at a faster rate than indicated by the projections.

3.1.4 Frost

Warming conditions will reduce the frequency of frost events after 2030. Locations where frost occurs only a few times a year under current conditions are projected to become nearly frost-free by 2030. Frost event frequencies are likely to remain comparable to current levels until then.

Frost is the ice crystals or frozen dew drops on objects near the ground that occurs when the surface temperature falls below freezing point. Frost is most common when there is no cloud and little or no wind.

Despite continued warming, the number of frost days and length of the frost season has increased in recent decades as a result of changing atmospheric conditions bringing more very cold air from further south, resulting in more frequent clear, dry nights. Research suggests that frost frequencies over the August to November period will remain comparable to current levels until the early 2030s[1]. After this point it is forecast that frequency will decline.

South Australian agriculture, in particular the growing of grains and pulses, horticulture and viticulture may benefit from reduced frost frequency and associated damage after 2030.

3.2 Rainfall

3.2.1 Annual rainfall

Annual rainfall will decline across all South Australian regions.

- By 2030 annual rainfall across the state is projected to decline by 1.7–6.8%, from the baseline period of 1986–2005, with smaller declines in the south.
- The Murraylands and Riverland Landscape Region is projected to have the greatest decline (6.8%), followed by Alinytjara Wilurara, Northern and Yorke and Eyre Peninsula regions projected to have declines of 6.6%, 4.6% and 4.6% respectively. The smallest decline (1.7%) is projected for the Limestone Coast Landscape Region.

[1] http://climate.anu.edu.au/files/Steve-Crimp-Frost.pdf

- By 2050 annual rainfall is projected to decline by 4.0–23.0%.
- The SA Arid Lands Landscape Region is projected to have the greatest decline (23.0%) with Alinytjara Wilurara and Murraylands and Riverland Landscape Regions projected to have declines of 15.7% and 15% respectively. The smallest annual average decline (4.0%) is projected for the Green Adelaide region.

3.2.2 Seasonal rainfall

Across all South Australian regions, rainfall declines in spring are likely to be greater than any other season.

- By 2030, rainfall declines are projected for all regions for spring and autumn. Declines are greater in spring than any other season and range from 8.8% decline in the Limestone Coast region to 13.2% decline in the Kangaroo Island landscape region.
- By 2030, a small decline in summer rainfall is projected for the Kangaroo Island Landscape Region. Increases in summer rainfall are projected for the other regions.
- By 2050 rainfall declines are projected for all regions in all seasons, except Alinytjara Wilurara in summer. Projected declines in spring rainfall are the greatest, ranging from 12.2% in the Green Adelaide region to just over 30% decline for SA Arid Lands Landscape Region.

3.2.3 Drought

The amount of time spent in drought will increase for all South Australian regions.

Drought is generally used to refer to a time of acute water shortage. The Climate Change in Australia projections used the standardised precipitation index that considers monthly rainfall as it has contributed to the previous 12 months rainfall and compares this to the long-term record. Droughts under this definition last for longer than one year (CSIRO and Bureau of Meteorology, 2015).

- By 2030, time spent in drought (over a 20-year period) is projected to nearly double in the Hills and Fleurieu, Eyre Peninsula, Kangaroo Island and Northern and Yorke Landscape Regions. This means that up to 65% of time could be in drought by 2030. By 2030 the frequency of extreme drought will more than double.
- By 2030, time spent in drought (over a 20-year period) is projected to increase slightly for the Alinytjara Wilurara and SA Arid Lands Landscape Regions, with a small additional increase by 2050.
- By 2030, time spent in drought in the Murraylands and Riverland and Limestone Coast Landscape Regions will increase by nearly 40%, meaning that up to 60% of time could be in drought by 2030. Projections for 2050 show a similar proportion of time spent in drought to 2030.
- By 2050, time spend in drought is projected to more than double in the Hills and Fleurieu, Eyre Peninsula, Kangaroo Island and Northern and Yorke Landscape Regions. This means that up to 70% of time could be in drought by 2050.

South Australia faces increasing impacts from declining rainfall including:

- increased stress on water resources and more frequent reduced water availability years
- increased irrigation demand for parks and open space
- loss of biodiversity associated with watercourses, wetlands and natural areas
- increased demand for groundwater
- increased risk of respiratory illness as reduced rainfall and drought conditions lead to more frequent dust storms
- reduced productivity of crops and livestock
- reduced natural regeneration of native plants.

3.2.4 Extreme rainfall events

The amount of rain falling in extreme rainfall events will increase in all South Australian regions and the frequency of extreme rainfall events will increase.

Climate Change in Australia provides regional projections for the change in annual maximum daily rainfall and the change in the 20-year return level for the 1-day maximum rainfall (5% chance of occurrence within any one year) but only for 2090. The Climate Change in Australia Threshold calculator provides projections of the number of days with rainfall above the 99.9th percentile for specific locations at 2030, 2050, 2070 and 2090. The 99.9th percentile represents a 1-in-1000 day rainfall event, that is, the largest event occurring approximately every three years (~1000 days).

- By 2030, the average number of days per year in which rainfall is expected to be above the historic 99.9th percentile (i.e. the 1-in-1000 day rainfall event) will increase to 0.49 days in Woomera, 0.6 days in Adelaide and 0.68 days in Mount Gambier from the baseline (historic) figures of 0.34, 0.38 and 0.66 respectively.
- By 2050, the average number of days per year in which rainfall is expected to be above the historic 99.9th percentile will reduce slightly to 0.41 days in Woomera and 0.59 for Adelaide but increase to 0.82 days in Mount Gambier.

South Australia faces increasing impacts from heavy rainfall events including:

- increase in damage to transport infrastructure, including roads and bridges, with secondary impacts on supply chains, repair and replacement costs
- increased risk of flooding and demand for emergency response and recovery
- increased risk of overflow from wastewater treatment ponds or septic tanks
- increased damage to food crops.

3.3 Fire weather

All of South Australia is projected to experience harsher fire weather. Projected warming and drying across the state will lead to fuels that are drier and more ready-to-burn.

The Forest Fire Danger Index (FFDI) takes measures of fuel dryness, temperature and wind speed to provide a measure of fire danger. Fire weather is considered 'severe' when FFDI exceeds 50 as bushfires have potentially greater human impacts at this level (Blanchi et al., 2010).

- By 2030, the number of days with a severe fire danger rating will increase by 35% in the Rangelands, 28% in the Murray Basin and 12% in the Southern and South Western Flatlands from the baseline.
- Projections are not available for 2050 (2090 only) but projected warming and drying to 2050 means that the trend of increasing days of severe fire danger ratings will continue to 2050 and beyond. By 2090 it is projected that days with a severe fire danger rating will increase by 117% in the Rangelands, 111% in the Murray Basin and 64% in the Southern and South Western Flatlands from the baseline.

South Australia faces increasing impacts from more dangerous fire weather including increases in:

- demand for emergency response and recovery
- bushfire risk and expansion of bushfire-prone areas, increasing risk to public health and safety for residents and visitors
- damage or destruction of assets and infrastructure including energy generation and distribution networks
- health and safety risks associated with bushfire including smoke inhalation, radiant heat exposure and burns.

Note, in September 2022 the Australian Fire Danger Rating (AFDR) system was introduced as the new standard for fire danger ratings in Australia. The AFDR uses a numerical fire behaviour index (FBI) that varies according to fuel types. Data on historic FBI values and any projected future trends of change in FBI values is not available at the time of publishing of this guide.

3.4 Potential evapotranspiration

Potential evapotranspiration is projected to increase across all seasons and regions in South Australia.

Potential evapotranspiration is a standardised estimation of the evaporation and transpiration that would occur given a limitless supply of water. It is the combination of two separate processes; evaporation from water bodies, or the ground surface and transpiration through the leaves of vegetation. Potential evapotranspiration provides an indication of the potential water stress of crops and other vegetation.

- By 2030, increases in annual potential evapotranspiration in South Australia will range from 2.4% for the Kangaroo Island Landscape Region to 3.4% for Northern and Yorke Landscape Region. The Green Adelaide, Hills and Fleurieu and Murraylands and Riverland Landscape Regions are projected to have an increase of 3.1%, and increases of 2.9%, and 2.7% are projected for the South East and Eyre Peninsula Landscape Regions respectively.
- By 2050, increases in annual potential evapotranspiration in South Australia will range from 4.1% for Kangaroo Island and 5.5 % for the Northern and Yorke Landscape Region. The Green Adelaide, Hills and Fleurieu, Murraylands and Riverland, South East and Eyre Peninsula Landscape Regions are projected to have increases of 5.2%, 5.3%, 4.8% and 4.6% respectively.

South Australia faces increasing impacts associated with increasing evapotranspiration including:

- reduced soil moisture and secondary impacts on plant health and crop yield
- increased irrigation demand
- adverse impacts on wetland and water resource condition
- adverse impacts on groundwater recharge.

3.5 Wind

By 2030, changes in near-surface wind speed will be small compared to natural variability. In the longer-term (2090) small decreases in wind speed are projected for southern parts of South Australia in winter.

- By 2030 projected changes in wind speed relative to the baseline are -0.1% for Rangelands, +0.1% for the Murray Basin; and -0.5% for the Southern and South-Western Flatlands.
- Projections are not available for 2050 (2090 data is available—refer to Section 9)

Research has indicated that the impact of projected changes in wind speeds on South Australian wind energy and energy costs is likely to be negligible (Evans et al., 2018).

3.6 Sea level

Sea levels along the South Australian coasts are projected to continue to rise. The height of extreme sea level events will also increase.

- By 2030, a sea level rise of around 13 cm is projected compared with the average level during 1986–2005.
- By 2050, a sea level rise of 22–25 cm is projected compared with the average level during 1986–2005.

- By the end of the century, a sea level rise of between 39 and 85 cm is projected. However, if Antarctic ice sheet collapse occurs, these projections could be several tenths of a metre higher (Church et al., 2013).

South Australia faces increasing impacts associated with rising sea levels including:

- increase in the extent and frequency of coastal flooding to buildings and infrastructure including homes, roads and businesses
- erosion of beaches and damage to coastal infrastructure, impacting safety, amenity and recreation, and tourism opportunities
- damage to underground assets from rising groundwater or coastal inundation.

3.7 Sea surface temperature, salinity and acidification

Sea surface temperatures are projected to continue to rise and acidity will continue to increase. Ocean salinity is likely to decrease in South Australian waters.

- By 2030, mean sea surface temperatures are projected to increase by 0.5 °C at Port Adelaide, Victor Harbor and Portland (Victoria) and by 0.6 °C at Thevenard. Ocean pH is projected to decrease by 0.08 units (i.e. become more acidic). Salinity is projected to decrease by between 0.02 and 0.07 g/kg compared to baseline concentrations.
- Projections are not available for 2050 (2090 data is available—refer to Section 12).

South Australia faces increasing impacts associated with rising sea surface temperatures and acidity including:

- changes in nutrient cycling in marine waters
- adverse impacts on the condition and extent of suitable habitat for coastal fisheries
- adverse impacts on shell-forming organisms including molluscs, crustaceans and foraminifera
- adverse impacts on fisheries, aquaculture and tourism.

4. Climate projections for South Australian locations to 2030, 2050, and 2090

Information on the magnitude of projected change compared to the baseline is provided here for a range of locations in South Australia: Adelaide, Clare, Coober Pedy, Keith, Mount Gambier, Port Augusta, Renmark, Whyalla, Woomera and Wudinna.

These tables include data associated with the high and medium emissions scenarios RCP8.5 and RCP4.5 compared to a baseline period of 1986–2005. Data has been sourced from the following:

1. Mean estimates of change in annual and seasonal temperatures and rainfall for 2030 (2020–2039), 2050 (2040–2059) and 2090 (2080–2099) are derived from NARCliM 1.5 gridded projection datasets. These are derived from averages of the six NARCliM 1.5 global and regional model combinations for the grid cell closest to the centre of each of the ten locations.
2. The 2050 and 2090 extreme rainfall data is from the Climate Change in Australia Thresholds Calculator.
3. Baseline temperatures and rainfall data are derived from observation data during 1986–2005 from the Bureau of Meteorology Climate Data Online* and the Queensland Government SILO database of Australian climate data. Baseline temperature data from the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) database has been used for locations where these are available.

* Bureau of Meteorology observational data for these stations is provided for a 30-year baseline period of 1981–2010, which differs from the 20-year baseline period of 1986–2005 used by the NARCliM 1.5 projections. The central 20 years of these two baseline periods are the same; however, mean rainfall values may be marginally different between the longer and shorter baseline periods.

Recent observations of extreme temperature days in central Adelaide

The observed frequency of days of above 40 °C over the 10 years from 2012 to the end of 2021 in the Adelaide (ACORN-SAT) weather record was 5.1 days per year, compared to 1.2 days per year during the 1986–2005 baseline period, indicating the rate of increase in very hot days at that station is greater than projected for central Adelaide. There is currently no assessment of whether this higher rate of change will continue; however, it is possible that the frequency of very hot days will continue to change at a faster rate than indicated by the projections.

The observed frequency of days of below 2 °C in the Adelaide (ACORN-SAT) weather record over the 10 years from 2009 to the end of 2018 was 1.3 days per year, compared with 0.5 days per year during the 1986–2005 baseline period, indicating the projected decrease in very cold nights at that station is not yet apparent for the recent record in Adelaide.

Table 4-1 Projected change in climate variables for Adelaide RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 21.8	+1.1	+1.6	+2.0
	Mean daily min: 12.2	+0.9	+1.2	+1.7
Seasonal temperature (°C)	Mean daily max: 27.6	+1.4	+1.8	+2.0
Summer	Mean daily min: 16.0	+1.1	+1.4	+1.7
Autumn	Mean daily max: 22.5	+1.0	+1.3	+1.7
	Mean daily min: 12.7	+0.8	+1.2	+1.6
Winter	Mean daily max: 15.9	+1.0	+1.3	+1.9
	Mean daily min: 8.6	+0.9	+1.1	+1.8
Spring	Mean daily max: 21.3	+1.2	+1.9	+2.4
	Mean daily min: 11.5	+0.8	+1.3	+1.8
Mean annual rainfall	530 mm	-6%	-10%	-7%
Seasonal rainfall Summer	62 mm	-10%	-5%	-12%
Autumn	103 mm	-7%	-5%	-1%
Winter	223 mm	-1%	-8%	-2%
Spring	141 mm	-15%	-20%	-18%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	13.1	+5.6	+8.9	+10.2
Mean number of very hot days (over 40 °C) per year	1.1	+1.6	+3.0	+3.1
Mean number of very hot days (over 45 °C) per year	0.0	+0.1	+0.1	+0.1
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.38	0.40	0.71	0.71

Table 4-2 Projected change in climate variables for Adelaide RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 21.8	+1.1	+1.6	+3.7
	Mean daily min: 12.2	+1.0	+1.5	+3.0
Seasonal temperature (°C)	Mean daily max: 27.6	+1.4	+1.9	+3.6
Summer	Mean daily min: 16.0	+1.1	+1.6	+2.8
Autumn	Mean daily max: 22.5	+1.0	+1.5	+3.5
	Mean daily min: 12.7	+0.9	+1.4	+3.1
Winter	Mean daily max: 15.9	+1.0	+1.6	+3.4
	Mean daily min: 8.6	+1.0	+1.6	+3.1
Spring	Mean daily max: 21.3	+1.2	+1.7	+4.1
	Mean daily min: 11.5	+0.9	+1.4	+3.1
Mean annual rainfall	530 mm	-1%	-3%	-29%
Seasonal rainfall Summer	62 mm	+3%	-13%	-32%
Autumn	103 mm	-7%	-10%	-31%
Winter	223 mm	5%	5%	-22%
Spring	141 mm	-10%	-11%	-36%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	+13.1	+6.5	+9.3	+23.4
Mean number of very hot days (over 40 °C) per year	1.1	+1.9	+4.1	+9.6
Mean number of very hot days (over 45 °C) per year	0.0	+0.2	+0.3	+1.1
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.38	0.60	0.59	0.84

Table 4-3 Projected change in climate variables for Clare RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 21.3 Mean daily min: 8.7	+1.3 +0.9	+1.8 +1.3	+2.3 +1.7
Seasonal temperature (°C) Summer	Mean daily max: 28.7 Mean daily min: 13.4	+1.6 +1.2	+1.9 +1.6	+2.3 +1.8
Autumn	Mean daily max: 22.0 Mean daily min: 9.1	+1.0 +0.8	+1.5 +1.1	+1.8 +1.5
Winter	Mean daily max: 13.7 Mean daily min: 4.6	+1.1 +0.8	+1.4 +1.0	+2.0 +1.7
Spring	Mean daily max: 20.7 Mean daily min: 8.0	+1.5 +0.8	+2.4 +1.4	+3.0 +1.9
Mean annual rainfall	582 mm	-8%	-12%	-11%
Seasonal rainfall Summer	74 mm	+3%	3%	-9%
Autumn	96 mm	-9%	-12%	-11%
Winter	238 mm	-7%	-9%	-6%
Spring	172 mm	-11%	-22%	-19%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	16.7	+9.6	+13.9	+17.8
Mean number of very hot days (over 40 °C) per year	1.2	+3.2	+5.5	+6.7
Mean number of very hot days (over 45 °C) per year	0.0	+0.4	+0.6	+0.7
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.55	0.58	0.79	0.85

Table 4-4 Projected change in climate variables for Clare RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 21.3	+1.2	+1.9	+4.4
	Mean daily min: 8.7	+1.0	+1.5	+3.1
Seasonal temperature (°C)	Mean daily max: 28.7	+1.5	+2.2	+4.1
Summer	Mean daily min: 13.4	+1.3	+1.7	+3.1
Autumn	Mean daily max: 22.0	+1.1	+1.8	+4.0
	Mean daily min: 9.1	+0.9	+1.4	+3.1
Winter	Mean daily max: 13.7	+1.0	+1.6	+3.9
	Mean daily min: 4.6	+0.9	+1.5	+3
Spring	Mean daily max: 20.7	+1.3	+2.1	+5.4
	Mean daily min: 8.0	+0.9	+1.4	+3.2
Mean annual rainfall	582 mm	-2%	-8%	-30%
Seasonal rainfall Summer	74 mm	+6%	-9%	-27%
Autumn	96 mm	-8%	-16%	-33%
Winter	238 mm	4%	4%	-20%
Spring	172 mm	-8%	-15%	-42%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	16.7	+9.6	+14.7	+37.6
Mean number of very hot days (over 40 °C) per year	1.2	+3.6	+7.1	+17.9
Mean number of very hot days (over 45 °C) per year	0.0	+0.4	+0.9	+3.3
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.55	0.71	0.63	0.91

Table 4-5 Projected change in climate variables for Coober Pedy RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 27.7	+1.4	+1.9	+2.5
	Mean daily min: 14.0	+1.0	+1.5	+2.0
Seasonal temperature (°C)	Mean daily max: 35.4	+1.5	+1.8	+2.3
Summer	Mean daily min: 20.6	+1.4	+1.9	+2.2
Autumn	Mean daily max: 27.5	+1.1	+1.5	+2.1
	Mean daily min: 14.3	+0.9	+1.2	+1.8
Winter	Mean daily max: 19.5	+1.3	+1.4	+2.2
	Mean daily min: 7.1	+0.7	+0.9	+1.7
Spring	Mean daily max: 28.7	+1.5	+2.5	+3.1
	Mean daily min: 14.0	+1.1	+1.9	+2.5
Mean annual rainfall	175 mm	-12%	-11%	-17%
Seasonal rainfall Summer	63 mm	+7%	+15%	+2%
Autumn	35 mm	-22%	-23%	-29%
Winter	37 mm	-16%	-8%	-13%
Spring	38 mm	-2%	-17%	-21%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	69.5	+18.4	+28.6	+35.1
Mean number of very hot days (over 40 °C) per year	21.1	+13.0	+19.2	+25.2
Mean number of very hot days (over 45 °C) per year	0.9	+1.8	+3.4	+5.1
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.41	0.38	0.56	0.49

Table 4-6 Projected change in climate variables for Coober Pedy RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 27.7	+1.3	+2.2	+4.8
	Mean daily min: 14.0	+1.1	+1.8	+3.8
Seasonal temperature (°C)	Mean daily max: 35.4	+1.3	+2.3	+4.5
Summer	Mean daily min: 20.6	+1.5	+2.1	+4.1
Autumn	Mean daily max: 27.5	+1.2	+2.0	+4.4
	Mean daily min: 14.3	+1.1	+1.7	+3.7
Winter	Mean daily max: 19.5	+1.2	+2.0	+4.3
	Mean daily min: 7.1	+0.8	+1.4	+3.2
Spring	Mean daily max: 28.7	+1.6	+2.6	+5.8
	Mean daily min: 14.0	+1.2	+1.8	+4.3
Mean annual rainfall	175 mm	-5%	-21%	-37%
Seasonal rainfall Summer	63 mm	+24%	+5%	-9%
Autumn	35 mm	-15%	-30%	-42%
Winter	37 mm	-10%	-23%	-37%
Spring	38 mm	-9%	-25%	-49%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	69.5	+17.7	+29.7	+70
Mean number of very hot days (over 40 °C) per year	21.1	+12.8	+22.3	+53.3
Mean number of very hot days (over 45 °C) per year	0.9	+2.0	+4.9	+18.3
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.41	0.53	0.43	0.53

Table 4-7 Projected change in climate variables for Keith RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 22.1 Mean daily min: 8.8	+1.2 +0.7	+1.6 +1.0	+2.0 +1.4
Seasonal temperature (°C) Summer	Mean daily max: 28.9 Mean daily min: 12.3	+1.5 +1.0	+1.9 +1.4	+2.2 +1.6
Autumn	Mean daily max: 22.7 Mean daily min: 9.0	+1.0 +0.7	+1.4 +1.1	+1.7 +1.4
Winter	Mean daily max: 15.5 Mean daily min: 6.0	+1.0 +0.6	+1.2 +0.8	+1.9 +1.5
Spring	Mean daily max: 21.5 Mean daily min: 8.0	+1.2 +0.4	+1.9 +0.9	+2.3 +1.3
Mean annual rainfall	454 mm	-7%	-8%	-7%
Seasonal rainfall Summer	62 mm	-1%	+4%	-12%
Autumn	83 mm	-6%	-4%	0%
Winter	185 mm	-4%	-6%	0%
Spring	123 mm	-12%	-18%	-20%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	19.0	+7.1	+10.2	+12.5
Mean number of very hot days (over 40 °C) per year	3.5	+2.2	+4.3	+5.1
Mean number of very hot days (over 45 °C) per year	1.0	+0.5	+0.7	+0.6
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.31	0.46	0.68	0.66

Table 4-8 Projected change in climate variables for Keith RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 22.1 Mean daily min: 8.8	+1.1 +0.8	+1.7 +1.3	+3.9 +2.6
Seasonal temperature (°C) Summer	Mean daily max: 28.9 Mean daily min: 12.3	+1.5 +1.2	+2.1 +1.5	+4.1 +2.7
Autumn	Mean daily max: 22.7 Mean daily min: 9.0	+1.1 +0.9	+1.6 +1.3	+3.7 +2.9
Winter	Mean daily max: 15.5 Mean daily min: 6.0	+1.0 +0.8	+1.6 +1.4	+3.5 +2.7
Spring	Mean daily max: 21.5 Mean daily min: 8.0	+1.0 +0.7	+1.6 +1.1	+4.3 +2.3
Mean annual rainfall	454 mm	-2%	-6%	-24%
Seasonal rainfall Summer	62 mm	+8%	-9%	-21%
Autumn	83 mm	-3%	-10%	-27%
Winter	185 mm	4%	4%	-13%
Spring	123 mm	-9%	-15%	-36%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	19.0	+6.9	+10.1	+28.8
Mean number of very hot days (over 40 °C) per year	3.5	+2.6	+5.5	+13.9
Mean number of very hot days (over 45 °C) per year	1.0	+0.5	+0.9	+3.0
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.31	0.56	0.55	0.78

Table 4-9 Projected change in climate variables for Mount Gambier RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 19.2	+1.0	+1.3	+1.7
	Mean daily min: 8.5	+0.7	+1.0	+1.5
Seasonal temperature (°C)	Mean daily max: 24.5	+1.3	+1.6	+1.8
Summer	Mean daily min: 11.3	+0.9	+1.2	+1.5
Autumn	Mean daily max: 20.0	+0.9	+1.2	+1.5
	Mean daily min: 9.1	+0.8	+1.1	+1.5
Winter	Mean daily max: 14.2	+0.9	+1.1	+1.7
	Mean daily min: 6.0	+0.7	+0.9	+1.6
Spring	Mean daily max: 18.4	+0.9	+1.4	+1.8
	Mean daily min: 7.7	+0.5	+0.9	+1.4
Mean annual rainfall	711 mm	-7%	-7%	-7%
Seasonal rainfall Summer	89 mm	-14%	-4%	-14%
Autumn	143 mm	-6%	-3%	0%
Winter	295 mm	-1%	-2%	1%
Spring	182 mm	-11%	-16%	-17%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	7.4	+2.1	+3.3	+3.7
Mean number of very hot days (over 40 °C) per year	1.2	+0.5	+0.8	+0.7
Mean number of very hot days (over 45 °C) per year	0.0	0.0	0.0	0.0
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.66	0.67	0.97	0.90

Table 4-10 Projected change in climate variables for Mount Gambier RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 19.2 Mean daily min: 8.5	+1.0 +0.8	+1.4 +1.3	+3.2 +2.7
Seasonal temperature (°C) Summer	Mean daily max: 24.5 Mean daily min: 11.3	+1.3 +1.0	+1.7 +1.4	+3.2 +2.6
Autumn	Mean daily max: 20.0 Mean daily min: 9.1	+1.0 +0.9	+1.4 +1.4	+3.3 +2.9
Winter	Mean daily max: 14.2 Mean daily min: 6.0	+0.9 +0.8	+1.5 +1.5	+3.1 +2.9
Spring	Mean daily max: 18.4 Mean daily min: 7.7	+0.8 +0.7	+1.3 +1.2	+3.2 +2.4
Mean annual rainfall	711 mm	-1%	-6%	-21%
Seasonal rainfall Summer	89 mm	0%	-14%	-27%
Autumn	143 mm	-7%	-8%	-24%
Winter	295 mm	7%	3%	-7%
Spring	182 mm	-6%	-11%	-30%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	7.4	+1.9	+3.4	+8.6
Mean number of very hot days (over 40 °C) per year	1.2	+0.4	+1.0	+2.5
Mean number of very hot days (over 45 °C) per year	0.0	0.0	0.0	+0.2
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.66	0.68	0.82	1.00

Table 4-11 Projected change in climate variables for Port Augusta RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 25.2 Mean daily min: 12.6	+1.3 +0.9	+1.7 +1.3	+2.3 +1.8
Seasonal temperature (°C) Summer	Mean daily max: 31.9 Mean daily min: 18.3	+1.4 +1.2	+1.7 +1.6	+2.1 +1.8
Autumn	Mean daily max: 25.4 Mean daily min: 13.1	+1.0 +0.9	+1.4 +1.2	+1.9 +1.6
Winter	Mean daily max: 18.0 Mean daily min: 6.7	+1.3 +0.7	+1.4 +1.0	+2.2 +1.7
Spring	Mean daily max: 25.6 Mean daily min: 12.2	+1.4 +0.9	+2.3 +1.6	+2.8 +2.1
Mean annual rainfall	247 mm	-10%	-11%	-17%
Seasonal rainfall Summer	57 mm	+1%	+7%	-15%
Autumn	44 mm	-10%	-16%	-19%
Winter	72 mm	-15%	-10%	-14%
Spring	72 mm	-8%	-17%	-20%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	39.0	+11.6	+17.7	+21.4
Mean number of very hot days (over 40 °C) per year	11.0	+6.4	+10.0	+12.6
Mean number of very hot days (over 45 °C) per year	1.2	+1.2	+2.3	+2.5
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.41	0.46	0.57	0.51

Table 4-12 Projected change in climate variables for Port Augusta RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 25.2	+1.3	+2.0	+4.2
	Mean daily min: 12.6	+1.0	+1.5	+3.2
Seasonal temperature (°C) Summer	Mean daily max: 31.9	+1.3	+2.0	+3.7
	Mean daily min: 18.3	+1.3	+1.7	+3.1
Autumn	Mean daily max: 25.4	+1.1	+1.8	+3.9
	Mean daily min: 13.1	+1.0	+1.5	+3.2
Winter	Mean daily max: 18.0	+1.2	+1.9	+4.1
	Mean daily min: 6.7	+0.8	+1.4	+3.2
Spring	Mean daily max: 25.6	+1.4	+2.2	+5.0
	Mean daily min: 12.2	+1.0	+1.5	+3.5
Mean annual rainfall	247 mm	-7%	-18%	-35%
Seasonal rainfall Summer	57 mm	+7%	-16%	-21%
Autumn	44 mm	-10%	-25%	-37%
Winter	72 mm	-7%	-9%	-29%
Spring	72 mm	-13%	-25%	-48%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	39.0	+12.1	+17.8	+41.9
Mean number of very hot days (over 40 °C) per year	11.0	+6.4	+11.3	+26.7
Mean number of very hot days (over 45 °C) per year	1.2	+1.2	+3.1	+9.9
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.41	0.51	0.49	0.61

Table 4-13 Projected change in climate variables for Renmark RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 24.4 Mean daily min: 9.9	+1.2 +0.9	+1.7 +1.3	+2.2 +1.7
Seasonal temperature (°C) Summer	Mean daily max: 31.8 Mean daily min: 15.2	+1.4 +1.3	+1.8 +1.7	+2.2 +2.0
Autumn	Mean daily max: 24.3 Mean daily min: 9.9	+1.0 +0.8	+1.4 +1.2	+1.8 +1.6
Winter	Mean daily max: 16.9 Mean daily min: 5.0	+1.2 +0.7	+1.3 +0.9	+2.2 +1.6
Spring	Mean daily max: 24.6 Mean daily min: 9.6	+1.3 +0.7	+2.2 +1.4	+2.7 +1.8
Mean annual rainfall	250 mm	-7%	-8%	-11%
Seasonal rainfall Summer	51 mm	+7%	+7%	-12%
Autumn	40 mm	-11%	-13%	-13%
Winter	81 mm	-10%	-9%	-9%
Spring	77 mm	-5%	-13%	-13%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	33.0	+11.0	+16.5	+22.1
Mean number of very hot days (over 40 °C) per year	7.7	+4.4	+7.1	+9.0
Mean number of very hot days (over 45 °C) per year	0.6	+0.5	+1.0	+1.1
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.24	0.41	0.49	0.44

Table 4-14 Projected change in climate variables for Renmark RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 24.4 Mean daily min: 9.9	+1.2 +1.0	+2.0 +1.5	+4.2 +3.1
Seasonal temperature (°C) Summer	Mean daily max: 31.8 Mean daily min: 15.2	+1.4 +1.4	+2.2 +1.9	+4.2 +3.6
Autumn	Mean daily max: 24.3 Mean daily min: 9.9	+1.1 +0.9	+1.8 +1.4	+3.9 +3.2
Winter	Mean daily max: 16.9 Mean daily min: 5.0	+1.1 +0.8	+1.9 +1.5	+3.7 +2.9
Spring	Mean daily max: 24.6 Mean daily min: 9.6	+1.3 +0.9	+2.1 +1.3	+4.8 +3.1
Mean annual rainfall	250 mm	-6%	-17%	-30%
Seasonal rainfall Summer	51 mm	+7%	-8%	-14%
Autumn	40 mm	-9%	-25%	-34%
Winter	81 mm	-4%	-6%	-18%
Spring	77 mm	-9%	-22%	-45%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	33.0	+11.5	+18.9	+44.9
Mean number of very hot days (over 40 °C) per year	7.7	+4.5	+9.2	+22.8
Mean number of very hot days (over 45 °C) per year	0.6	+0.5	+1.5	+4.7
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.24	0.51	0.47	0.65

Table 4-15 Projected change in climate variables for Whyalla RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 23.7	+1.1	+1.6	+2.0
	Mean daily min: 11.7	+0.9	+1.3	+1.7
Seasonal temperature (°C)	Mean daily max: 29.3	+1.2	+1.5	+1.8
Summer	Mean daily min: 17.0	+1.1	+1.4	+1.7
Autumn	Mean daily max: 24.0	+0.9	+1.3	+1.7
	Mean daily min: 12.3	+0.9	+1.2	+1.6
Winter	Mean daily max: 17.7	+1.2	+1.4	+2.1
	Mean daily min: 6.4	+0.7	+1.0	+1.7
Spring	Mean daily max: 23.9	+1.2	+2.0	+2.5
	Mean daily min: 11.1	+0.9	+1.5	+2.0
Mean annual rainfall	275 mm	-11%	-8%	-16%
Seasonal rainfall Summer	59 mm	-4%	-2%	-17%
Autumn	52 mm	-9%	-11%	-15%
Winter	79 mm	-16%	-10%	-15%
Spring	84 mm	-9%	-10%	-18%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	25.6	+6.9	+10.4	+12.5
Mean number of very hot days (over 40 °C) per year	6.7	+3.9	+5.9	+7.2
Mean number of very hot days (over 45 °C) per year	0.6	+1.1	+1.9	+2.1
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.55	0.45	0.61	0.56

Table 4-16 Projected change in climate variables for Whyalla RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 23.7	+1.1	+1.8	+3.7
	Mean daily min: 11.7	+1.0	+1.5	+3.2
Seasonal temperature (°C) Summer	Mean daily max: 29.3	+1.2	+1.7	+3.1
	Mean daily min: 17.0	+1.2	+1.6	+3.0
Autumn	Mean daily max: 24.0	+1.0	+1.6	+3.4
	Mean daily min: 12.3	+1.1	+1.5	+3.2
Winter	Mean daily max: 17.7	+1.1	+1.9	+3.8
	Mean daily min: 6.4	+0.9	+1.5	+3.2
Spring	Mean daily max: 23.9	+1.2	+2.0	+4.4
	Mean daily min: 11.1	+1.0	+1.5	+3.3
Mean annual rainfall	275 mm	-4%	-20%	-31%
Seasonal rainfall Summer	59 mm	+1%	-16%	-20%
Autumn	52 mm	-5%	-22%	-29%
Winter	79 mm	-3%	-14%	-24%
Spring	84 mm	-8%	-25%	-44%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	25.6	+6.6	+9.8	+25.4
Mean number of very hot days (over 40 °C) per year	6.7	+3.5	+6.6	+16.2
Mean number of very hot days (over 45 °C) per year	0.6	+1.1	+2.3	+6.9
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.55	0.57	0.53	0.57

Table 4-17 Projected change in climate variables for Woomera RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 26.1	+1.4	+1.9	+2.5
	Mean daily min: 12.8	+1.0	+1.4	+1.9
Seasonal temperature (°C) Summer	Mean daily max: 33.8	+1.5	+1.8	+2.4
	Mean daily min: 18.8	+1.3	+1.8	+2.0
Autumn	Mean daily max: 26.0	+1.1	+1.5	+2.0
	Mean daily min: 13.2	+0.9	+1.2	+1.7
Winter	Mean daily max: 18.1	+1.4	+1.5	+2.3
	Mean daily min: 6.6	+0.7	+1.0	+1.7
Spring	Mean daily max: 26.6	+1.5	+2.5	+3.1
	Mean daily min: 12.7	+1.0	+1.8	+2.3
Mean annual rainfall	173 mm	-9%	-13%	-19%
Seasonal rainfall Summer	44 mm	+12%	+7%	-13%
Autumn	38 mm	-10%	-18%	-28%
Winter	46 mm	-18%	-16%	-16%
Spring	44 mm	-4%	-16%	-17%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	52.3	+16.8	+24.6	+32.4
Mean number of very hot days (over 40 °C) per year	13.9	+9.0	+13.8	+18.9
Mean number of very hot days (over 45 °C) per year	0.6	+0.9	+2.0	+2.8
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.34	0.41	0.52	0.49

Table 4-18 Projected change in climate variables for Woomera RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 26.1	+1.3	+2.2	+4.7
	Mean daily min: 12.8	+1.1	+1.6	+3.6
Seasonal temperature (°C)	Mean daily max: 33.8	+1.3	+2.3	+4.4
Summer	Mean daily min: 18.8	+1.4	+1.9	+3.6
Autumn	Mean daily max: 26.0	+1.2	+1.9	+4.3
	Mean daily min: 13.2	+1.0	+1.6	+3.5
Winter	Mean daily max: 18.1	+1.2	+2.0	+4.3
	Mean daily min: 6.6	+0.9	+1.5	+3.3
Spring	Mean daily max: 26.6	+1.6	+2.5	+5.6
	Mean daily min: 12.7	+1.1	+1.7	+3.9
Mean annual rainfall	173 mm	-7%	-21%	-35%
Seasonal rainfall Summer	44 mm	+13%	-11%	-13%
Autumn	38 mm	-10%	-26%	-38%
Winter	46 mm	-13%	-18%	-37%
Spring	44 mm	-10%	-24%	-44%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	52.3	+17.2	+26.7	+63.1
Mean number of very hot days (over 40 °C) per year	13.9	+9.3	+17.0	+41.3
Mean number of very hot days (over 45 °C) per year	0.6	+1.0	+2.6	+11.1
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.34	0.49	0.41	0.53

Table 4-19 Projected change in climate variables for Wudinna RCP4.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 24.9 Mean daily min: 10.2	+1.3 +0.8	+1.8 +1.2	+2.3 +1.6
Seasonal temperature (°C) Summer	Mean daily max: 31.7 Mean daily min: 14.6	+1.5 +1.1	+1.9 +1.4	+2.2 +1.6
Autumn	Mean daily max: 25.4 Mean daily min: 10.7	+1.1 +0.8	+1.5 +1.1	+1.9 +1.5
Winter	Mean daily max: 17.6 Mean daily min: 6.1	+1.1 +0.7	+1.4 +0.9	+2.0 +1.6
Spring	Mean daily max: 25.0 Mean daily min: 9.4	+1.5 +0.7	+2.4 +1.3	+2.9 +1.8
Mean annual rainfall	294 mm	-9%	-12%	-14%
Seasonal rainfall Summer	50 mm	-5%	-8%	-20%
Autumn	44 mm	-13%	-18%	-12%
Winter	120 mm	-8%	-8%	-9%
Spring	79 mm	-9%	-14%	-15%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	38.8	+11.4	+17.9	+21.9
Mean number of very hot days (over 40 °C) per year	10.8	+6	+9.5	+12.2
Mean number of very hot days (over 45 °C) per year	0.6	+1.2	+2.3	+2.6
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.38	0.6	0.71	0.68

Table 4-20 Projected change in climate variables for Wudinna RCP8.5

Annual and seasonal temperatures and rainfall	1986–2005 baseline (for location)	Mean projected change 2030	Mean projected change 2050	Mean projected change 2090
Annual mean temperature (°C)	Mean daily max: 24.9	+1.2	+2.0	+4.3
	Mean daily min: 10.2	+0.9	+1.5	+3.0
Seasonal temperature (°C)	Mean daily max: 31.7	+1.4	+2.1	+4.0
Summer	Mean daily min: 14.6	+1.1	+1.6	+2.8
Autumn	Mean daily max: 25.4	+1.1	+1.8	+3.9
	Mean daily min: 10.7	+0.9	+1.4	+3.0
Winter	Mean daily max: 17.6	+1.0	+1.7	+3.8
	Mean daily min: 6.1	+0.8	+1.5	+3.0
Spring	Mean daily max: 25.0	+1.5	+2.3	+5.3
	Mean daily min: 9.4	+0.9	+1.4	+3.0
Mean annual rainfall	294 mm	-5%	-14%	-31%
Seasonal rainfall Summer	50 mm	0%	-19%	-29%
Autumn	44 mm	-11%	-19%	-37%
Winter	120 mm	0%	-2%	-22%
Spring	79 mm	-7%	-19%	-37%
Extreme temperature events	**1986–2005 baseline frequency**	**Mean projected change in frequency 2030**	**Mean projected change in frequency 2050**	**Mean projected change in frequency 2090**
Mean number of very hot days (over 35 °C) per year	38.8	+11.4	+17.4	+43.4
Mean number of very hot days (over 40 °C) per year	10.8	+6.2	+11.0	+26.4
Mean number of very hot days (over 45 °C) per year	0.6	+1.4	+3.1	+9.1
Mean number of very cold nights (minimum less than 2 °C) per year	0.5	-0.1	-0.1	-0.1
Extreme rainfall events	**1981–2010 baseline frequency**	**Mean projected frequency 2030**	**Mean projected frequency 2050**	**Mean projected frequency 2090**
Heavy rainfall (mean days per year above 99.9th percentile)	0.38	0.53	0.56	0.59

5. Maps of projected statewide change to 2030 and 2090

Maps are provided of projected changes to:

- Average annual rainfall
- Average daily maximum temperature
- Average annual number of days of 40 °C or above

For each of these variables there are four maps showing changes compared to the baseline period of 1986–2005 in the:

- near future (2030) with RCP4.5 emissions scenario
- near future (2030) with RCP8.5 emissions scenario
- far future (2090) with RCP4.5 emissions scenario
- far future (2090) with RCP4.5 emissions scenario.

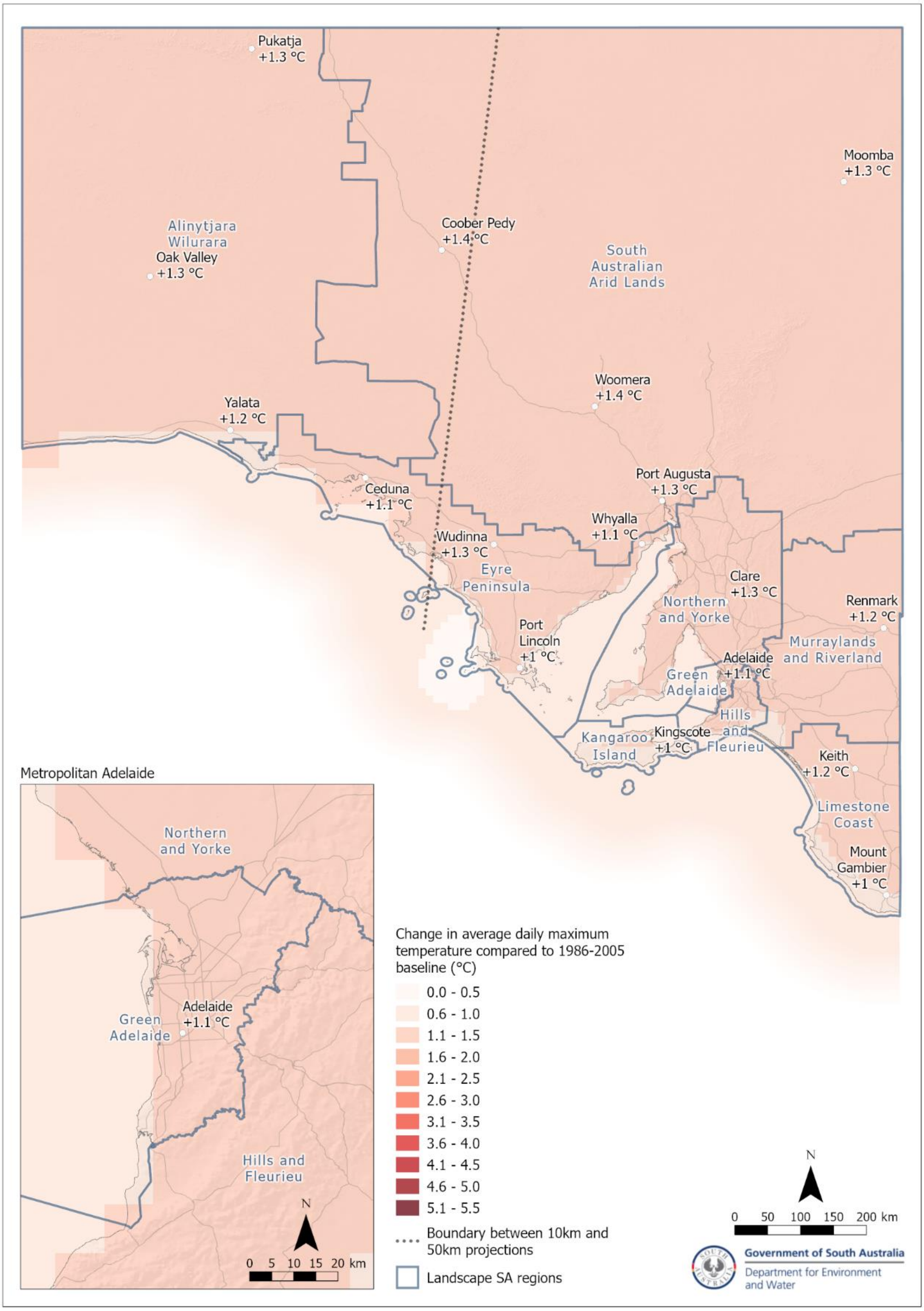
The colour-coded quantities of change shown in these maps are the average of the NARCliM 1.5 projections of the combination of three global and two regional models. The average change projected at a number of regional centres is also shown, drawn from the numerical value of the grid cell closest to the centre of each identified location.

Comparison of projected changes for near future (2030) and far future (2090) and across the two emissions scenarios highlights that:

- there are much greater projected changes in climate in the far future than in the near future
- in the near future, the projected changes relating to the two emission scenarios are not markedly different from each other
- in the far future, there are stark differences between the climate outcomes in the high scenario compared with the mid-range scenario.

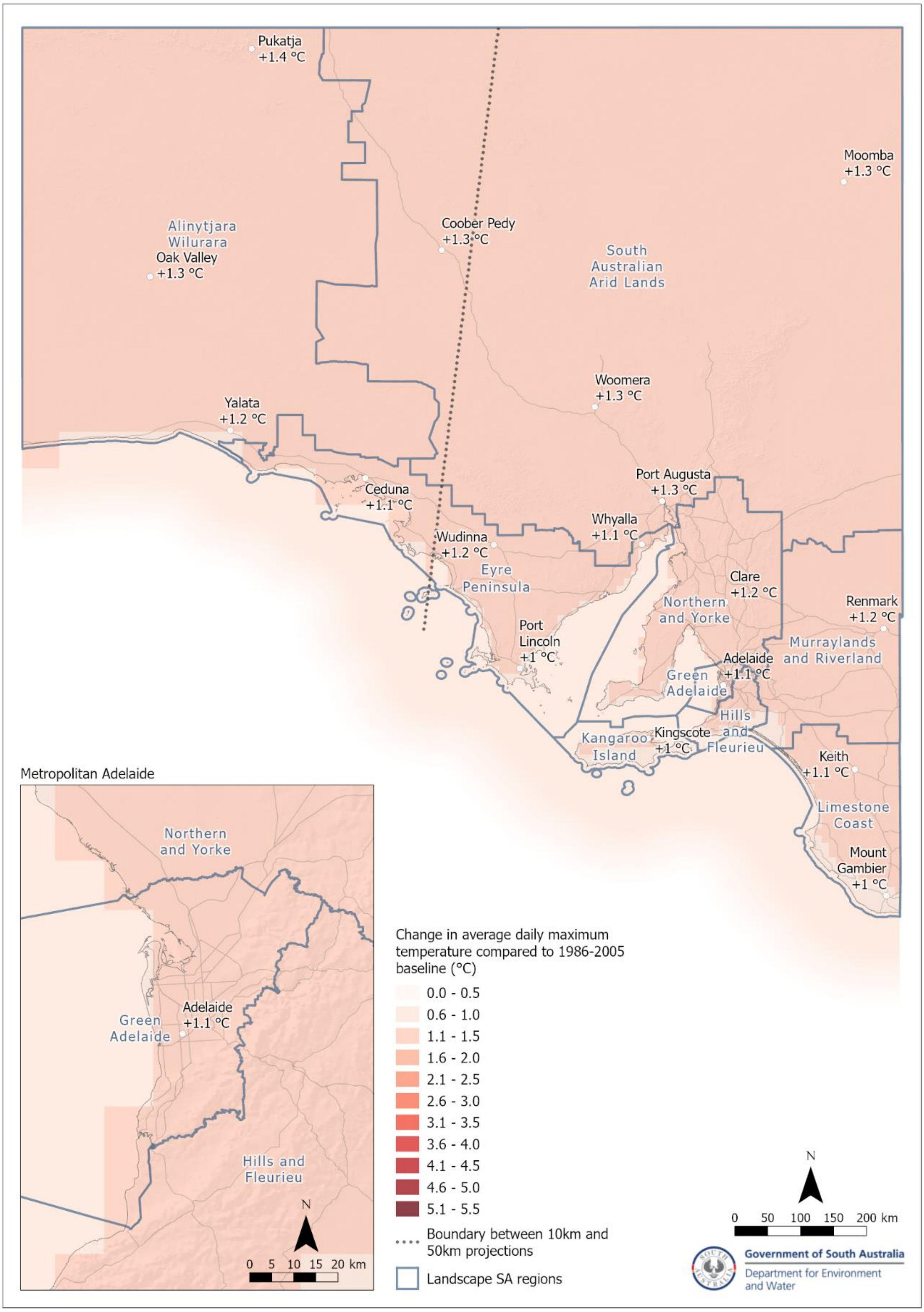
Change in average daily maximum temperature (2020-2039)

Compared to 1986-2005 baseline | Medium emissions scenario (RCP4.5)



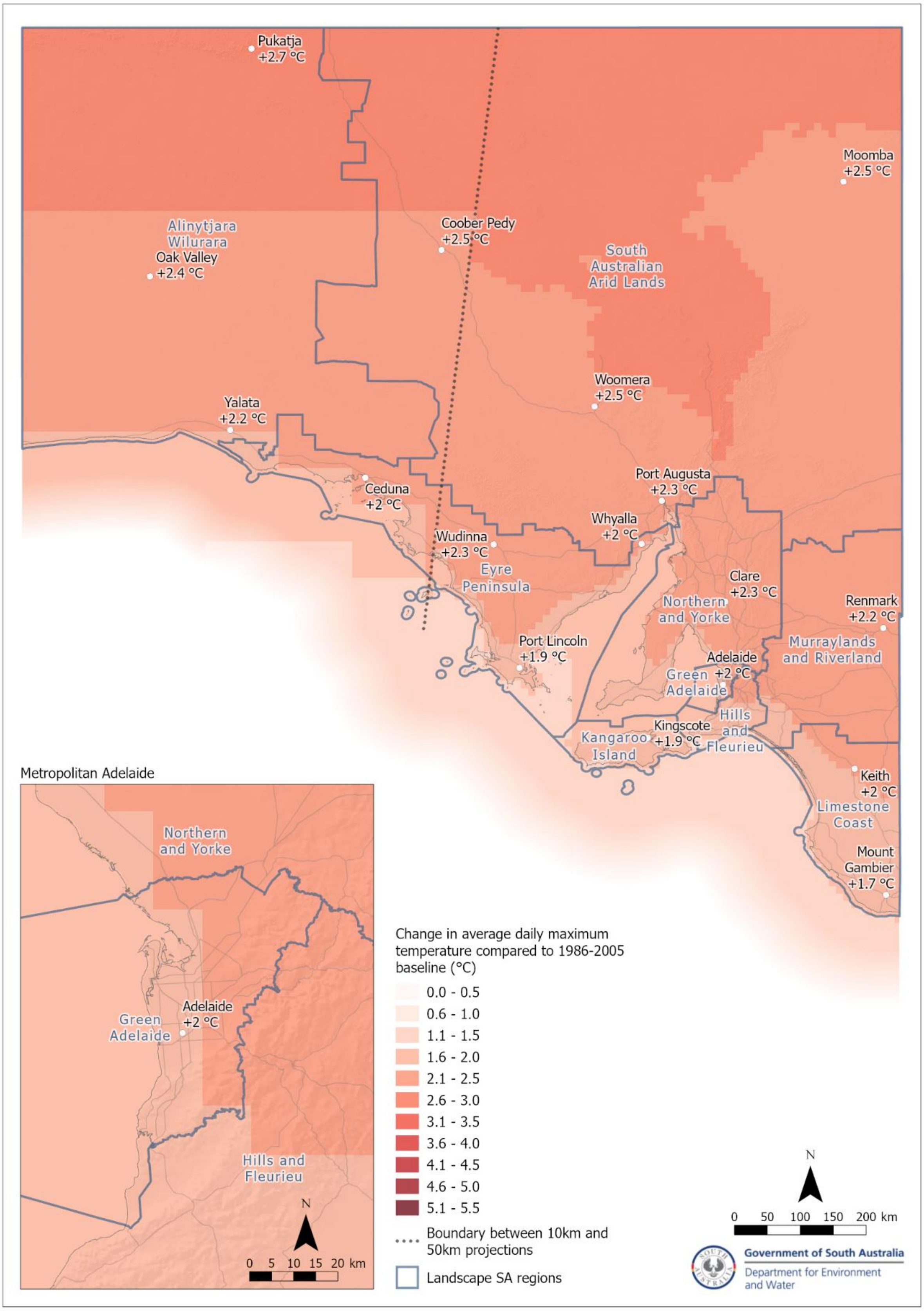
Change in average daily maximum temperature (2020-2039)

Compared to 1986-2005 baseline | High emissions scenario (RCP8.5)



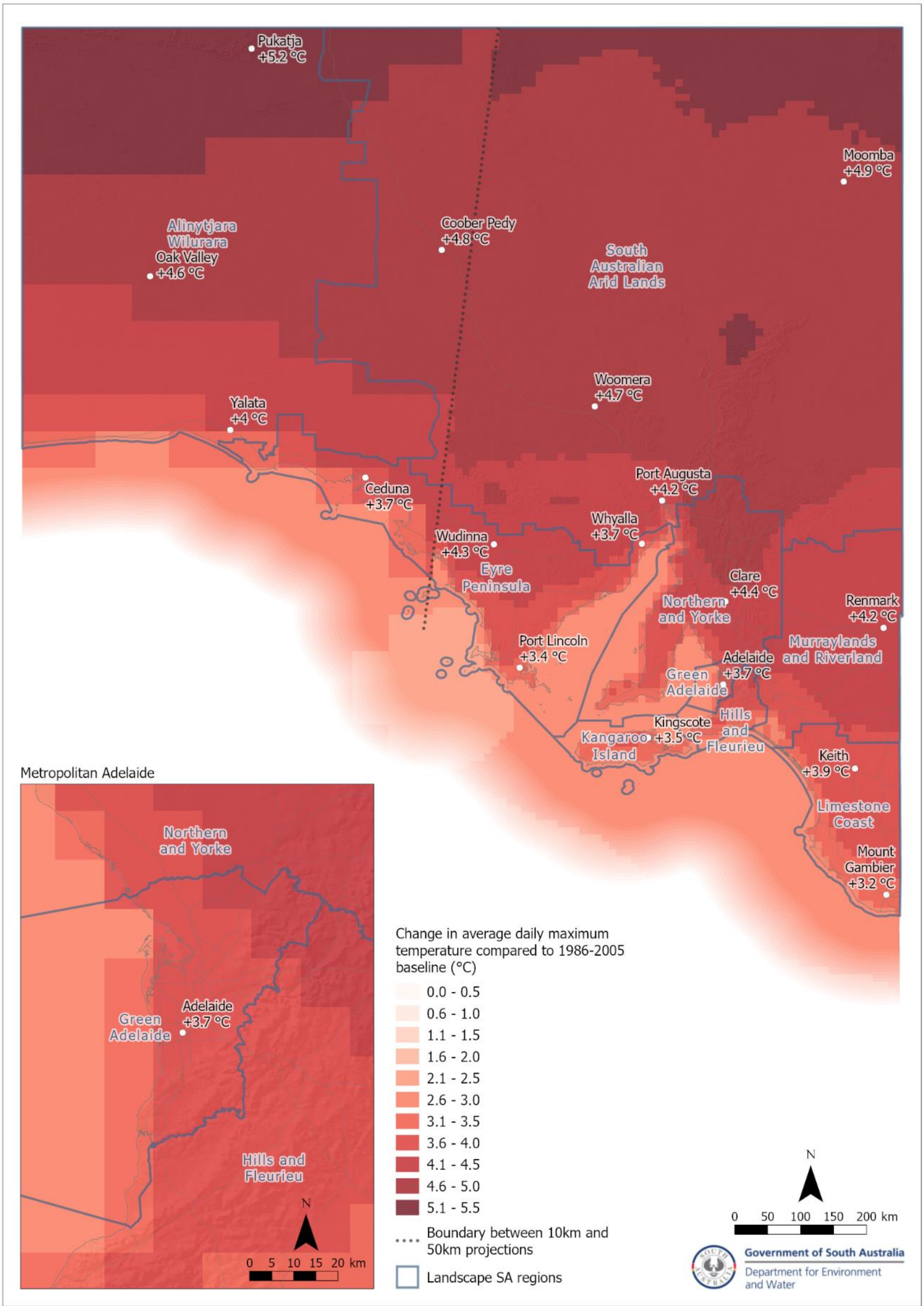
Change in average daily maximum temperature (2080-2099)

Compared to 1986-2005 baseline | Medium emissions scenario (RCP4.5)



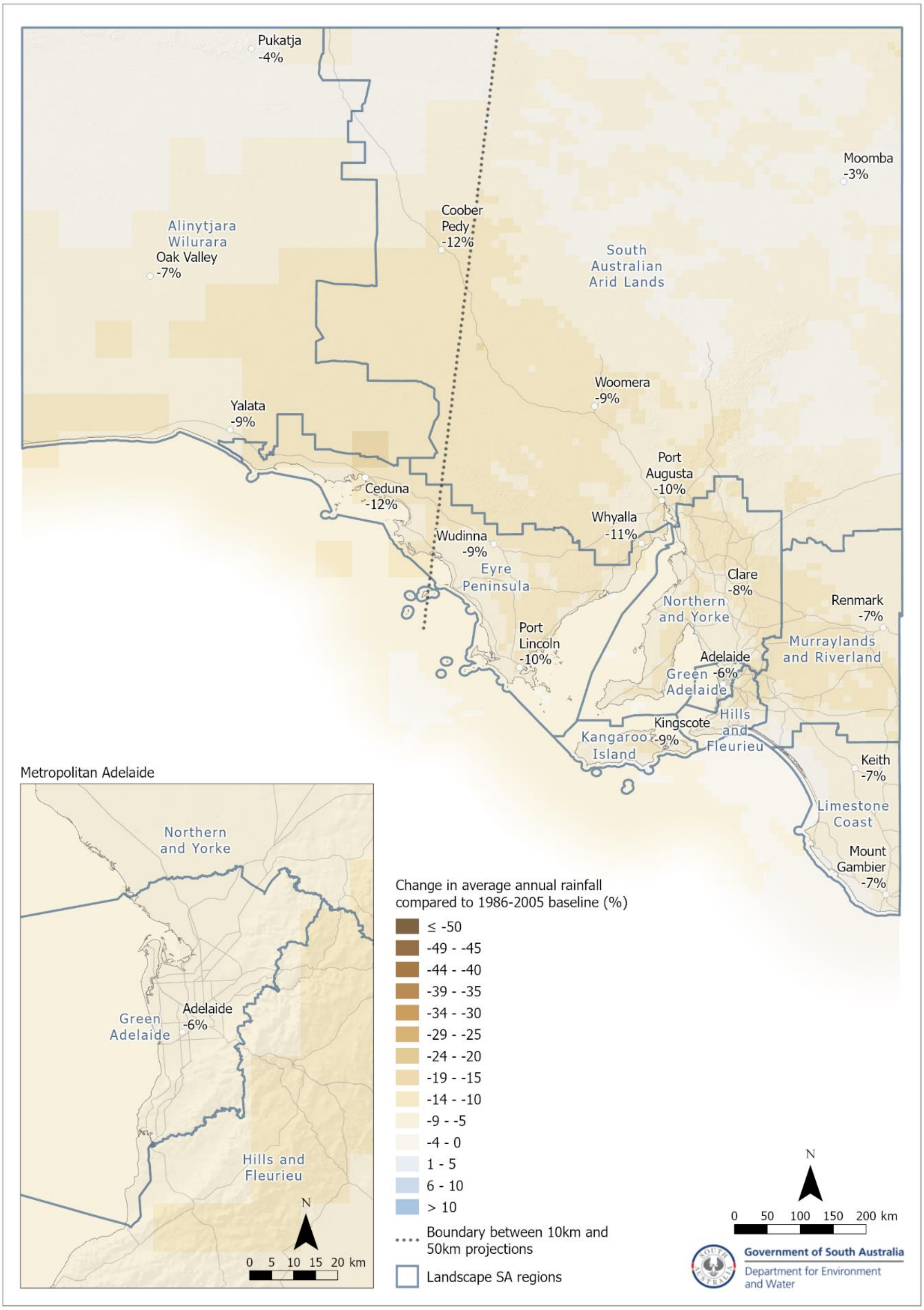
Change in average daily maximum temperature (2080-2099)

Compared to 1986-2005 baseline | High emissions scenario (RCP8.5)



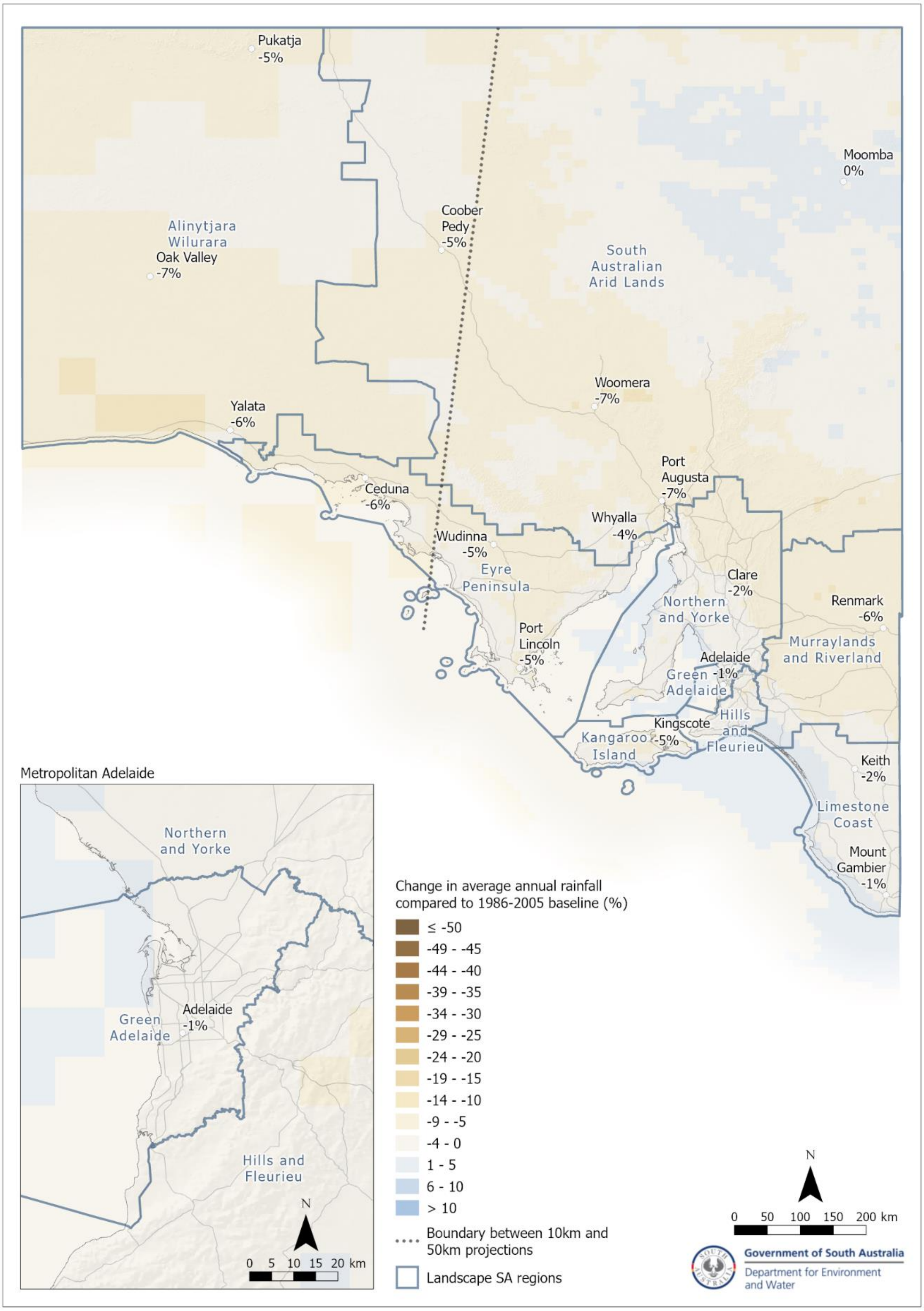
Change in average annual rainfall (2020-2039)

Compared to 1986-2005 baseline | Medium emissions scenario (RCP4.5)



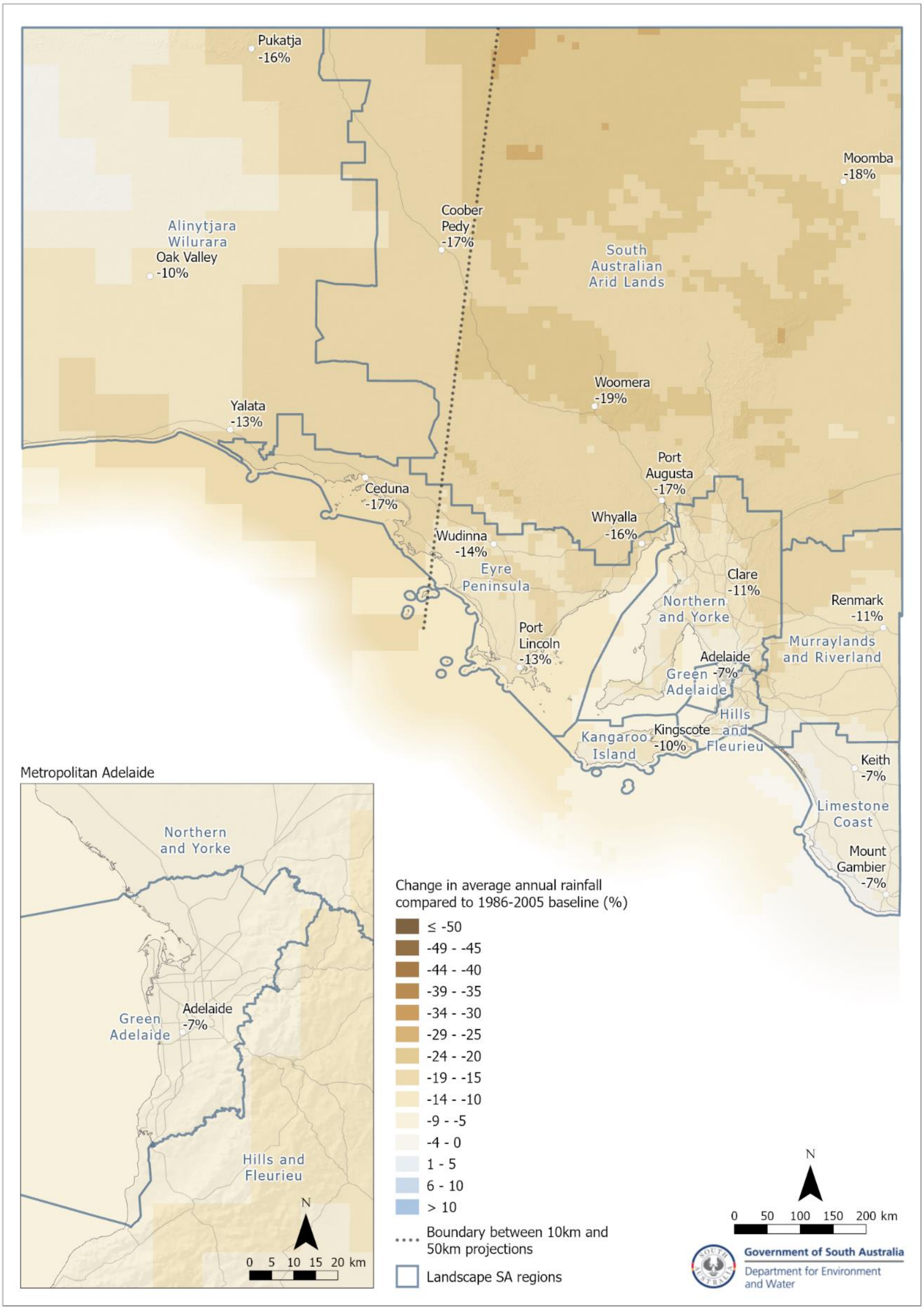
Change in average annual rainfall (2020-2039)

Compared to 1986-2005 baseline | High emissions scenario (RCP8.5)



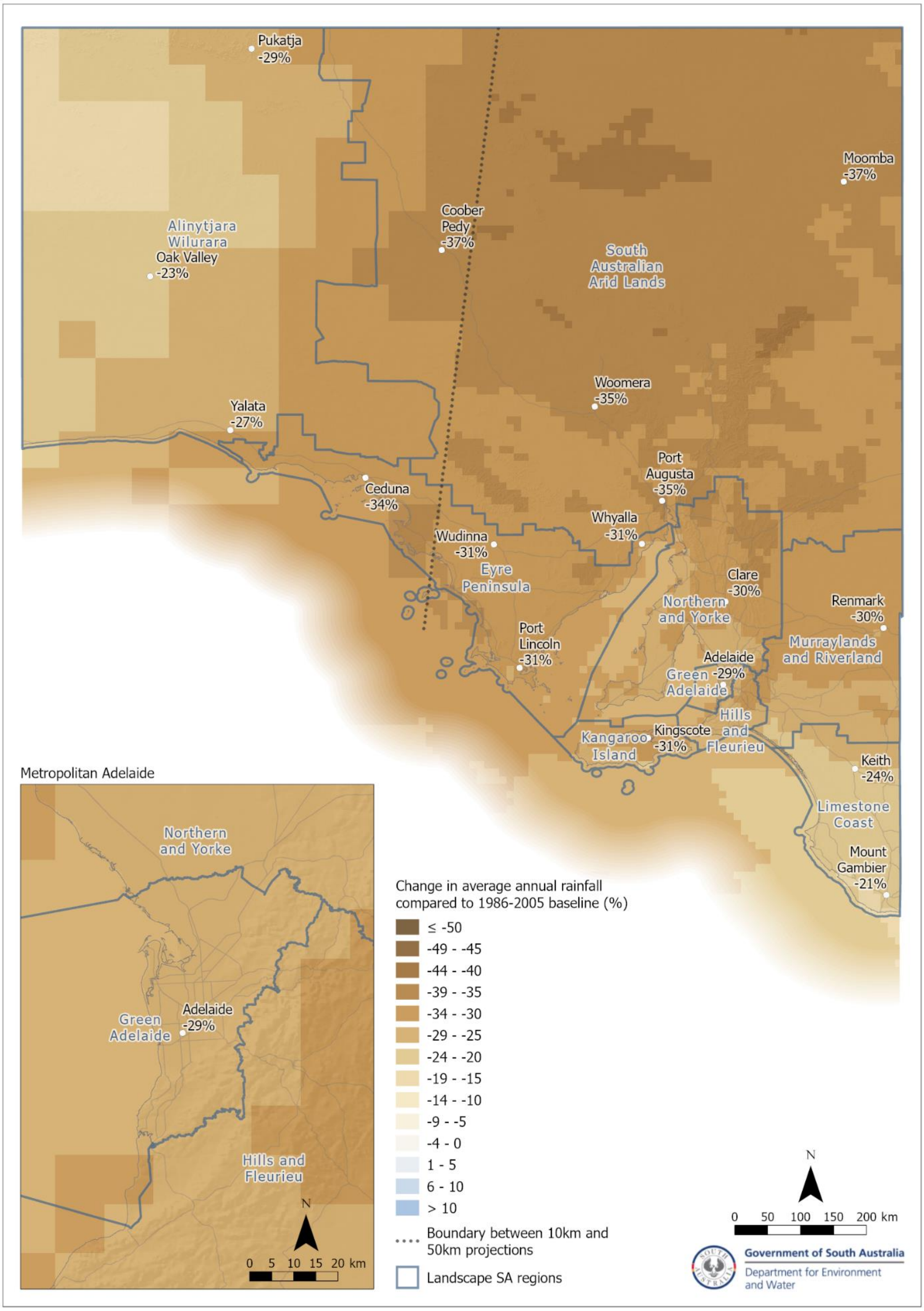
Change in average annual rainfall (2080-2099)

Compared to 1986-2005 baseline | Medium emissions scenario (RCP4.5)



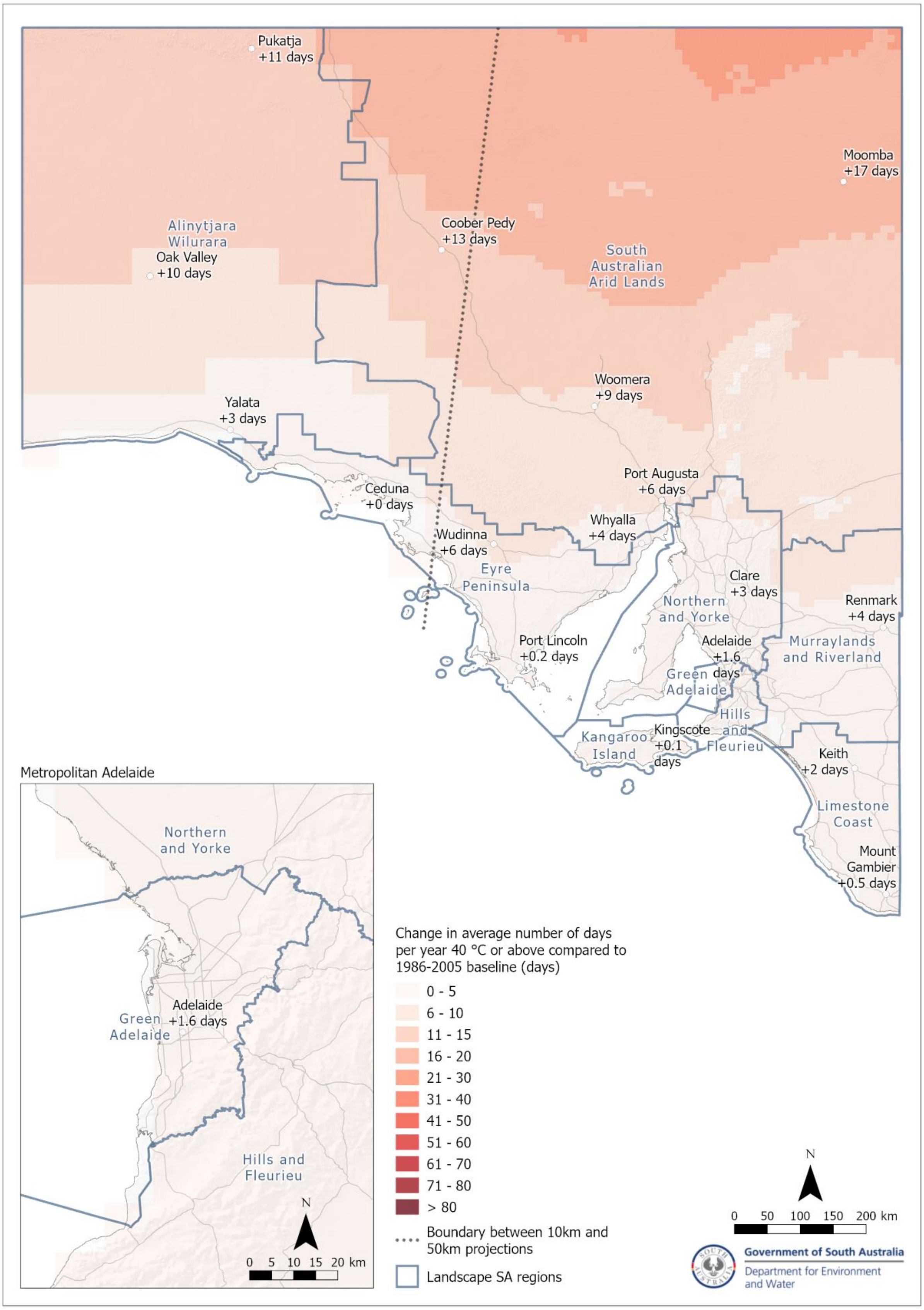
Change in average annual rainfall (2080-2099)

Compared to 1986-2005 baseline | High emissions scenario (RCP8.5)



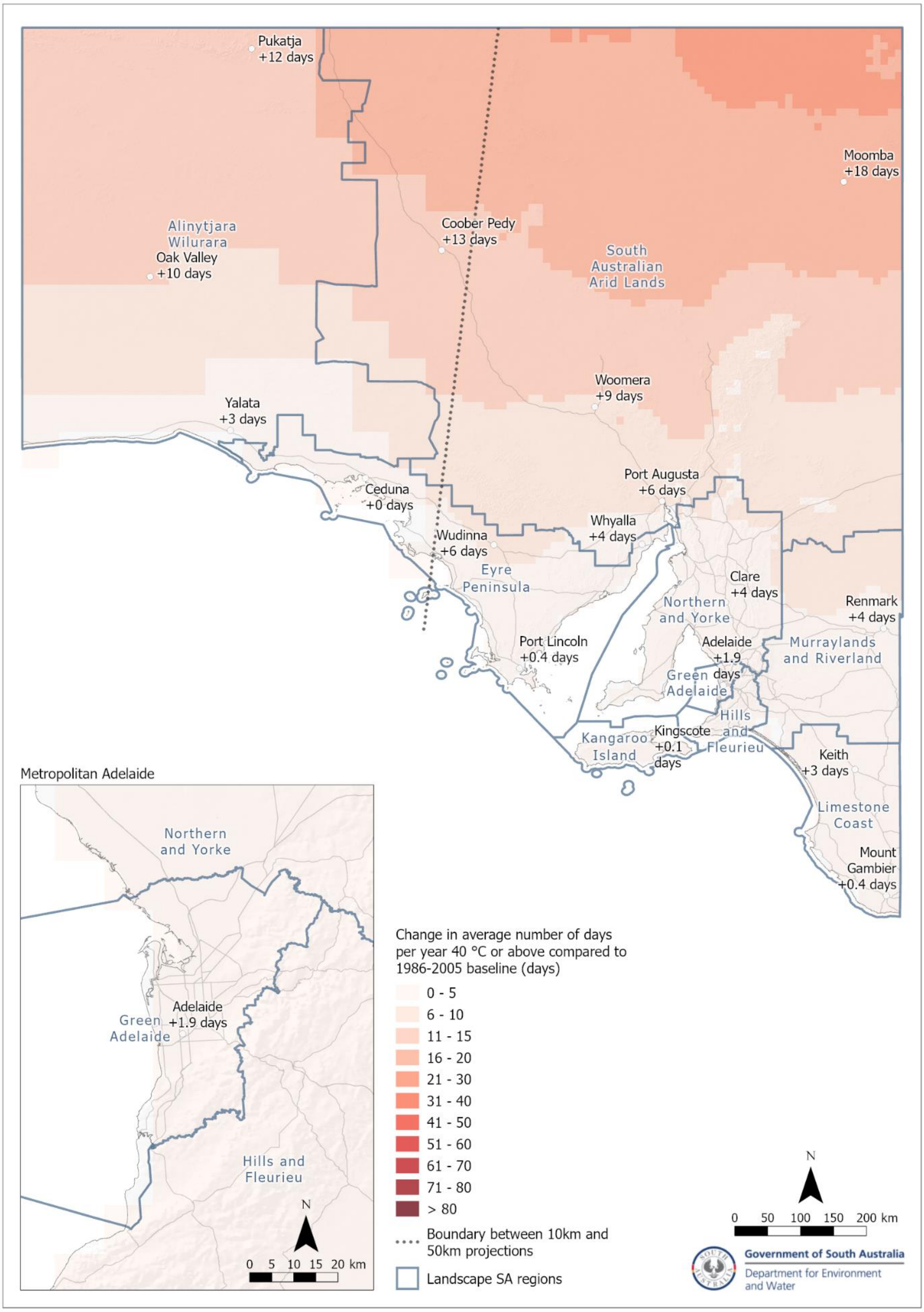
Change in average number of days per year 40 °C or above (2020-2039)

Compared to 1986-2005 baseline | Medium emissions scenario (RCP4.5)



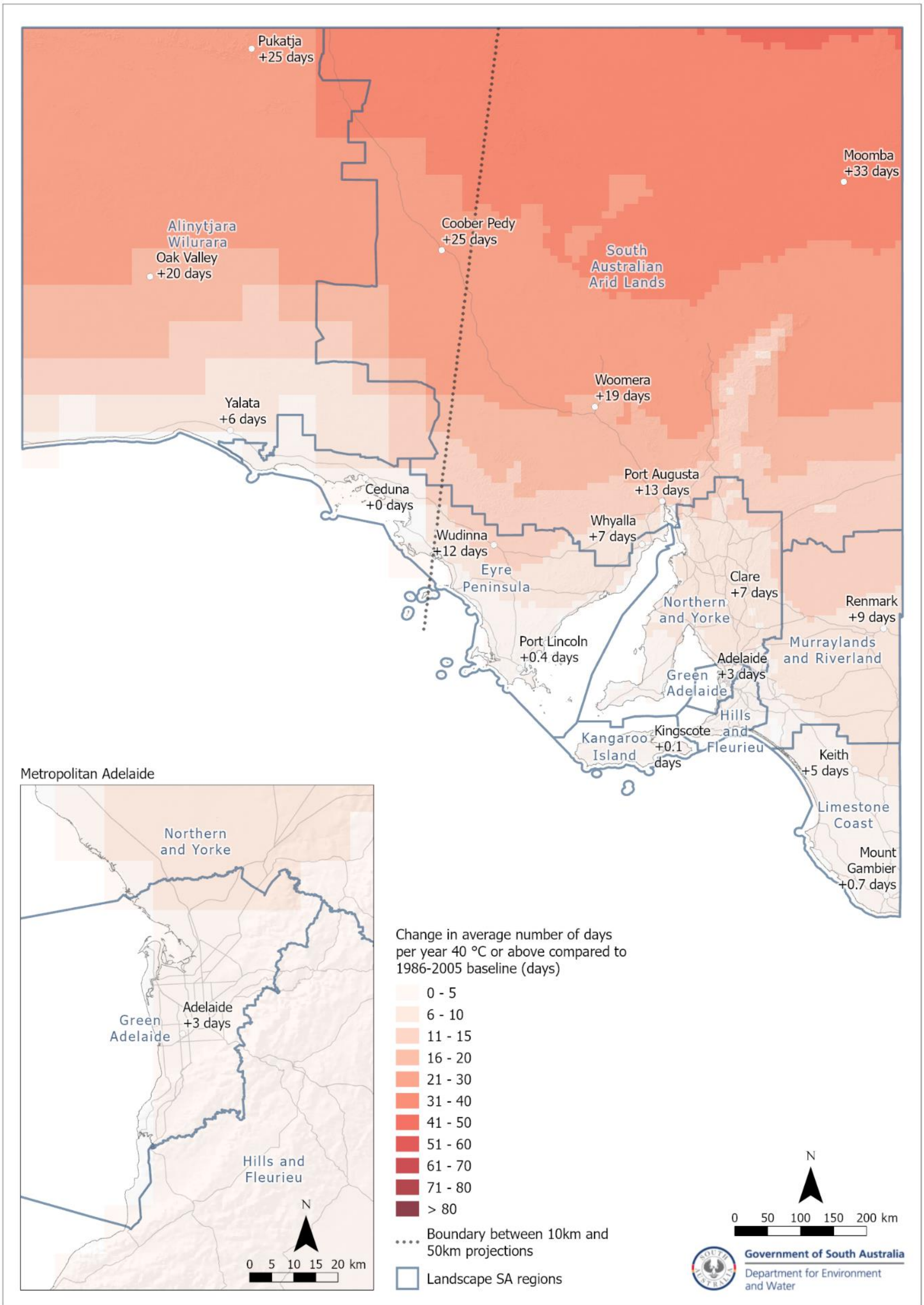
Change in average number of days per year 40 °C or above (2020-2039)

Compared to 1986-2005 baseline | High emissions scenario (RCP8.5)



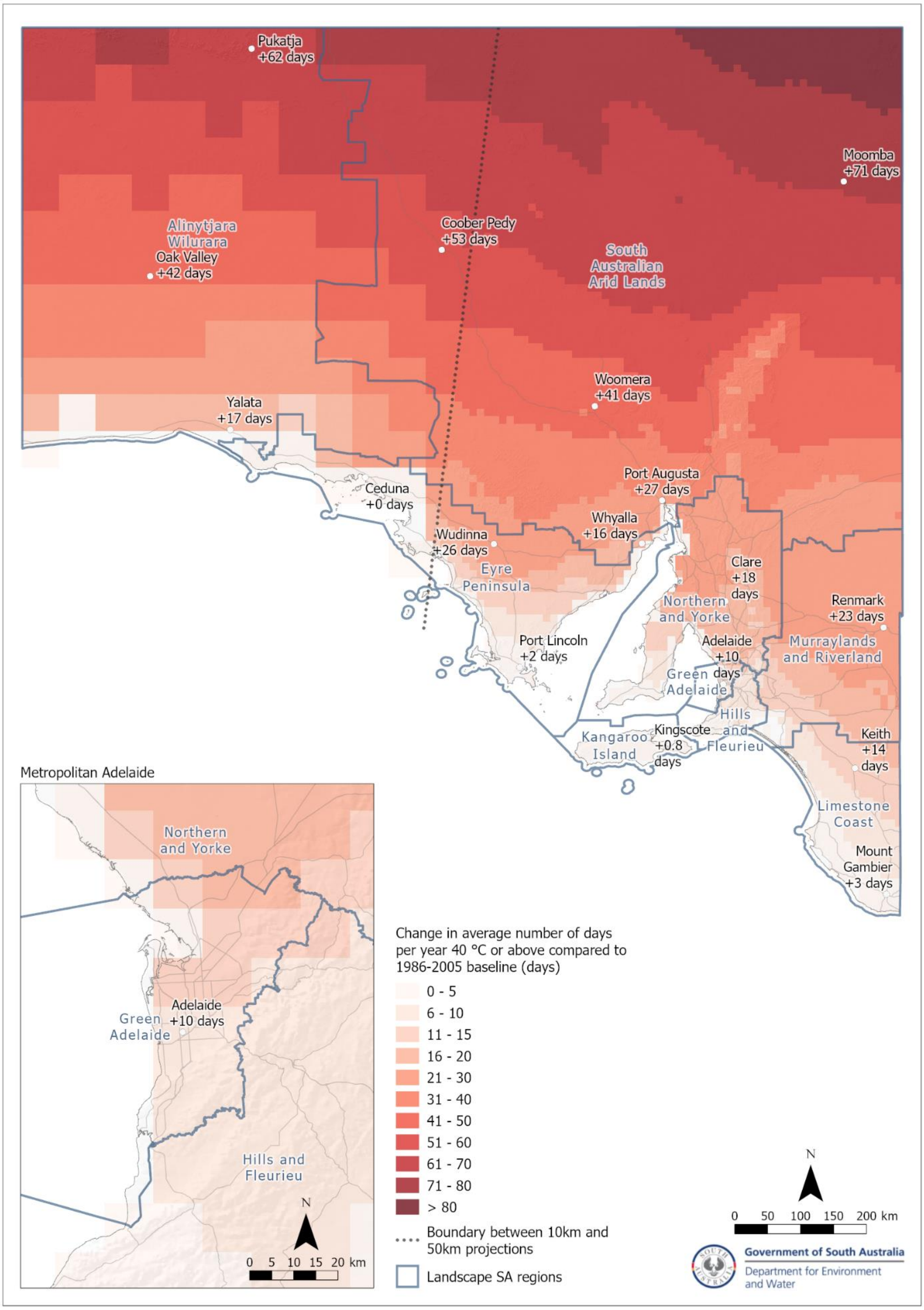
Change in average number of days per year 40 °C or above (2080-2099)

Compared to 1986-2005 baseline | Medium emissions scenario (RCP4.5)



Change in average number of days per year 40 °C or above (2080-2099)

Compared to 1986-2005 baseline | High emissions scenario (RCP8.5)



6. Regional temperature projections to 2030, 2050 and 2090

Sections 6 to 12 provide projections of changes in annual and seasonal temperatures, rainfall, frosts, and fire danger index, evapotranspiration, wind, sea level rise and sea surface conditions for each South Australian Landscape Region, for 2030, 2050 and 2090, and for two emissions scenarios (RCP4.5 and RCP8.5).

Table 6-0 summarises the source of the information presented in these sections.

Table 6-0 Climate projection data sources

Climate variable	Climate projection source
Annual and seasonal temperatures	NARCliM 1.5 – NSW and Department of Planning, Industry and Environment (2020)
Extreme heat	NARCliM 1.5 – NSW and Department of Planning, Industry and Environment (2020)
Frost	Climate Change in Australia – CSIRO and BoM (2015)
Annual and seasonal rainfall	NARCliM 1.5 – NSW and Department of Planning, Industry and Environment (2020)
Heavy rainfall events	Climate Change in Australia – CSIRO and BoM (2015)
Evapotranspiration	SA Climate Ready – Charles and Fu (2015)
Wind and storm	Climate Change in Australia – CSIRO and BoM (2015)
Fire weather	Climate Change in Australia – CSIRO and BoM (2015)
Sea level rise	Climate Change in Australia – CSIRO and BoM (2015)
Sea surface temperature, acidity and salinity	Climate Change in Australia – CSIRO and BoM (2015)

Where NARCliM 1.5 projections are provided, regional data is provided for each South Australia Landscape Region.

Climate Change in Australia data is provided for three regional areas (cluster regions) (see Section 2.5).

Where data is sourced from Climate Change in Australia, the summary statements for each cluster region have been included. For marine projections (sea level rise, sea surface temperature, acidity and salinity) data available for three South Australian locations are included as well as for Portland (Victoria) which is indicative of the south-east coast of South Australia.

Outputs (simulations) from a number of global climate models that best fit the historic Australian climate are used by the data sources. Each climate model provides a different output and the range of outputs from each model is reported.

For SA Climate Ready projections of evapotranspiration, regional data is provided for each of the former NRM regions.

6.1 Average annual maximum and minimum temperatures

For each of the South Australian Landscape Regions, annual average daily maximum and minimum temperatures are projected to increase at each of the future time horizons (2030, 2050 and 2090). The values shown in Table 6-1 and Table 6-2 are the average of the projected temperature change across the six NARCliM 1.5 combinations of global and regional climate models, and the range of the projected change amongst those GCMs, compared with the 1986–2005 baseline.

Table 6-1 Projected increase in annual daily maximum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090

Landscape Region	Increase in daily maximum temperatures (°C)					
	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	1.2 (0.9-1.4)	1.1 (0.8-1.4)	1.6 (1.3-2.1)	1.7 (1.5-1.9)	2.0 (1.5-3.0)	3.8 (3.5-4.5)
Hills & Fleurieu	1.1 (0.9 to 1.3)	1.0 (0.8 to 1.3)	1.5 (1.2 to 2.0)	1.6 (1.5 to 1.8)	1.9 (1.5 to 2.8)	3.5 (3.3 to 4.1)
Eyre Peninsula	1.2 (1.0 to 1.5)	1.1 (0.7 to 1.5)	1.7 (1.3 to 2.2)	1.8 (1.6 to 2.1)	2.1 (1.6 to 3.0)	3.9 (3.5 to 4.6)
Kangaroo Island	1.0 (0.7 to 1.1)	1.0 (0.8 to 1.1)	1.4 (1.1 to 1.8)	1.5 (1.3 to 1.6)	1.8 (1.4 to 2.5)	3.3 (3.0 to 3.7)
Northern & Yorke	1.2 (1.0 to 1.6)	1.2 (0.8 to 1.7)	1.8 (1.3 to 2.3)	1.9 (1.7 to 2.2)	2.2 (1.7 to 3.3)	4.2 (3.8 to 5.0)
SA Arid Lands	1.3 (1.1 to 1.9)	1.3 (0.8 to 1.9)	1.8 (1.5 to 2.3)	2.2 (2.0 to 2.7)	2.5 (2.0 to 3.2)	4.8 (4.2 to 5.4)
Murraylands & Riverland	1.2 (1.1 to 1.5)	1.2 (0.9 to 1.6)	1.7 (1.4 to 2.1)	1.9 (1.8 to 2.1)	2.2 (1.7 to 3.0)	4.1 (3.8 to 4.6)
Limestone Coast	1.1 (0.8 to 1.3)	1.1 (0.7 to 1.3)	1.5 (1.2 to 2.0)	1.6 (1.5 to 1.8)	1.9 (1.4 to 2.8)	3.6 (3.3 to 4.1)
Alinitjara Wilurara	1.3 (1.1 to 2.0)	1.3 (0.9 to 1.9)	1.8 (1.4 to 2.3)	2.2 (1.8 to 2.8)	2.5 (2.0 to 3.1)	4.7 (4.2 to 5.4)

Table 6-2 Projected increase in annual daily minimum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090

Landscape Region	Increase in daily minimum temperatures (°C)					
	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	0.8 (0.6 to 1.2)	0.9 (0.9 to 1.0)	1.2 1.1 to 1.3)	1.5 (1.3 to 1.6)	1.7 (1.4 to 2.0)	2.9 (2.7 to 3.3)
Hills & Fleurieu	0.8 (0.6 to 1.2)	0.9 (0.81 to 1.0)	1.1 (1.0 to 1.3)	1.4 (1.2 to 1.6)	1.6 (1.4 to 1.9)	2.8 (2.6 to 3.2)
Eyre Peninsula	0.8 (0.6 to 1.1)	0.9 (0.9 to 1.0)	1.2 (1.1 to 1.2)	1.5 (1.3 to 1.6)	1.6 (1.4 to 1.8)	2.9 (2.6 to 3.4)
Kangaroo Island	0.7 (0.5 to 1.1)	0.9 (0.7 to 1.0)	1.1 (1.0 to 1.2)	1.3 (1.1 to 1.5)	1.5 (1.3 to 1.7)	2.7 (2.4 to 3.1)
Northern & Yorke	0.9 (0.7 to 1.2)	1.0 (0.9 to 1.1)	1.3 (1.1 to 1.4)	1.5 (1.3 to 1.7)	1.7 (1.5 to 2.0)	3.1 (2.8 to 3.5)
SA Arid Lands	1.0 (0.8 to 1.3)	1.1 (0.7 to 1.3)	1.5 (1.2 to 1.5)	1.7 (1.4 to 2.1)	2.0 (1.7 to 2.2)	3.7 (3.3 to 4.4)
Murraylands & Riverland	0.8 (0.6 to 1.1)	0.9 (0.8 to 1.0)	1.2 (1.1 to 1.2)	1.4 (1.2 to 1.8)	1.6 (1.5 to 1.8)	3.0 (2.6 to 3.6)
Limestone Coast	0.7 (0.4 to 1.0)	0.8 (0.8 to 1.0)	1.0 (1.0 to 1.1)	1.4 (1.1 to 1.5)	1.5 (1.4 to 1.5)	2.6 (2.3 to 3.2)
Alinitjara Wilurara	0.9 (0.8 to 1.1)	1.0 (0.7 to 1.2)	1.4 (1.2 to 1.5)	1.7 (1.3 to 2.1)	2.0 (1.6 to 2.2)	3.7 (3.1 to 4.5)

6.2 Seasonal temperature

Across all of South Australia, warming in spring is projected to be greater than any other season.

The values shown in Table 6-3 to Table 6-10 are the average of the projected seasonal average temperature change across the six NARCliM 1.5 combinations of global and regional climate models, and the range of the projected change amongst those GCMs, compared with the 1986–2005 baseline.

*Table 6-3 Projected increase in mean daily **summer** maximum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily summer maximum temperatures (°C)					
	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	1.5 (1.0 to 1.9)	1.4 (0.8 to 2.0)	1.8 (1.2 to 2.4)	2.0 (1.5 to 2.5)	2.1 (1.4 to 3.0)	3.8 (3.1 to 4.5)
Hills & Fleurieu	1.3 (0.9 to 1.6)	1.2 (0.8 to 1.6)	1.6 (1.1 to 2.0)	1.8 (1.4 to 2.2)	1.8 (1.2 to 2.5)	3.2 (2.7 to 3.6)
Eyre Peninsula	1.4 (0.9 to 1.8)	1.3 (0.8 to 1.7)	1.7 (1.0 to 2.2)	1.9 (1.5 to 2.5)	2.0 (1.4 to 2.8)	3.5 (2.8 to 4.2)
Kangaroo Island	1.2 (0.9 to 1.5)	1.1 (0.7 to 1.5)	1.4 (1.1 to 1.8)	1.6 (1.3 to 2.0)	1.7 (1.3 to 2.3)	2.9 (2.4 to 3.3)
Northern & Yorke	1.5 (1.1 to 1.9)	1.4 (1.0 to 1.8)	1.8 (1.0 to 2.5)	2.1 (1.8 to 2.6)	2.2 (1.5 to 3.1)	4.0 (3.3 to 4.8)
SA Arid Lands	1.5 (1.2 to 2.0)	1.4 (0.9 to 1.8)	1.9 (1.0 to 2.5)	2.4 (2.1 to 3.0)	2.4 (1.6 to 3.1)	4.7 (3.8 to 5.5)
Murraylands & Riverland	1.5 (1.1 to 1.8)	1.4 (1.0 to 1.8)	1.8 (1.1 to 2.4)	2.2 (1.9 to 2.5)	2.2 (1.6 to 3.0)	4.1 (3.3 to 4.7)
Limestone Coast	1.5 (0.9 to 1.9)	1.4 (0.9 to 1.9)	1.8 (1.3 to 2.3)	2.0 (1.5 to 2.4)	2.0 (1.5 to 2.9)	3.8 (3.1 to 4.3)
Alinitjara Wilurara	1.4 (1.1 to 1.9)	1.3 (1.0 to 1.8)	1.8 (1.0 to 2.5)	2.3 (1.8 to 2.9)	2.3 (1.6 to 2.8)	4.3 (3.4 to 5.4)

*Table 6-4 Projected increase in mean daily **summer** minimum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily summer minimum temperatures (°C)					
	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	1.1 (0.7 to 1.5)	1.2 (0.8 to 1.5)	1.4 (1.2 to 1.7)	1.6 (1.2 to 2.0)	1.7 (1.3 to 2.1)	2.8 (2.6 to 3.4)
Hills & Fleurieu	1.0 (0.6 to 1.3)	1.1 (0.9 to 1.3)	1.3 (1.2 to 1.5)	1.5 (1.2 to 1.8)	1.5 (1.3 to 2.0)	2.6 (2.3 to 3.2)
Eyre Peninsula	1.0 (0.7 to 1.4)	1.1 (0.7 to 1.5)	1.4 (1.1 to 1.5)	1.6 (1.2 to 1.9)	1.6 (1.4 to 2.0)	2.8 (2.5 to 3.2)
Kangaroo Island	0.9 (0.6 to 1.1)	1.0 (0.8 to 1.2)	1.2 (1.1 to 1.3)	1.4 (1.2 to 1.6)	1.5 (1.3 to 1.8)	2.5 (2.2 to 3.1)
Northern & Yorke	1.2 (0.8 to 1.6)	1.3 (0.9 to 1.7)	1.6 (1.2 to 1.9)	1.8 (1.3 to 2.2)	1.8 (1.4 to 2.3)	3.2 (2.8 to 3.7)
SA Arid Lands	1.5 (0.8 to 1.9)	1.5 (0.9 to 2.0)	1.9 (1.3 to 2.5)	2.2 (1.7 to 2.8)	2.2 (1.7 to 2.7)	4.2 (3.6 to 4.6)
Murraylands & Riverland	1.2 (0.7 to 1.6)	1.3 (0.9 to 1.8)	1.6 (1.4 to 1.9)	1.8 (1.2 to 2.3)	1.8 (1.4 to 2.4)	3.2 (2.9 to 3.9)
Limestone Coast	1.0 (0.6 to 1.3)	1.1 (0.9 to 1.3)	1.3 (1.2 to 1.5)	1.5 (1.1 to 1.7)	1.5 (1.3 to 2.1)	2.6 (2.2 to 3.2)
Alinitjara Wilurara	1.3 (0.7 to 1.8)	1.2 (0.8 to 1.7)	1.7 (1.0 to 2.3)	2.0 (1.6 to 2.5)	2.0 (1.5 to 2.5)	3.7 (3.2 to 4.1)

*Table 6-5 Projected increase in mean daily **autumn** maximum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily autumn maximum temperatures (°C)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	1.0 (0.7 to 1.3)	1.1 (0.5 to 1.8)	1.4 (1.1 to 1.6)	1.6 (1.1 to 2.0)	1.7 (1.3 to 2.3)	3.6 (3.2 to 4.0)
Hills & Fleurieu	1.0 (0.8 to 1.1)	1.0 (0.5 to 1.6)	1.3 (1.1 to 1.5)	1.5 (1.1 to 1.9)	1.7 (1.3 to 2.1)	3.4 (3.1 to 3.8)
Eyre Peninsula	1.0 (0.7 to 1.4)	1.0 (0.5 to 1.8)	1.4 (1.1 to 1.7)	1.6 (1.2 to 2.1)	1.8 (1.4 to 2.1)	3.6 (3.2 to 4.1)
Kangaroo Island	0.9 (0.6 to 1.0)	1.0 (0.5 to 1.4)	1.2 (0.9 to 1.4)	1.5 (1.0 to 1.7)	1.6 (1.2 to 2.0)	3.2 (2.8 to 3.7)
Northern & Yorke	1.0 (0.7 to 1.5)	1.1 (0.6 to 1.8)	1.4 (1.1 to 1.7)	1.8 (1.4 to 2.1)	1.8 (1.6 to 2.2)	3.9 (3.5 to 4.2)
SA Arid Lands	1.1 (0.6 to 2.0)	1.2 (0.5 to 1.8)	1.5 (0.9 to 2.0)	2.0 (1.5 to 2.5)	2.1 (1.6 to 2.6)	4.3 (3.7 to 4.6)
Murraylands & Riverland	1.1 (0.8 to 1.4)	1.1 (0.7 to 1.7)	1.4 (1.1 to 1.6)	1.8 (1.5 to 2.1)	1.8 (1.7 to 2.2)	3.8 (3.5 to 4.2)
Limestone Coast	1.0 (0.8 to 1.2)	1.1 (0.6 to 1.6)	1.3 (1.0 to 1.5)	1.5 (1.1 to 1.9)	1.7 (1.3 to 2.2)	3.5 (3.2 to 4.0)
Alinitjara Wilurara	1.1 (0.5 to 2.0)	1.1 (0.3 to 1.8)	1.5 (1.0 to 2.1)	2.0 (1.5 to 2.6)	2.1 (1.6 to 2.6)	4.3 (3.6 to 4.6)

Table 6-6 Projected increase in mean daily ***autumn*** *minimum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily autumn minimum temperatures (°C)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	0.8 (0.6 to 1.1)	0.9 (0.5 to 1.3)	1.2 (1.0 to 1.4)	1.4 (0.9 to 1.8)	1.6 (1.3 to 1.8)	3.0 (2.7 to 3.7)
Hills & Fleurieu	0.8 (0.5 to 1.2)	1.0 (0.5 to 1.2)	1.2 (0.9 to 1.3)	1.4 (0.9 to 1.7)	1.6 (1.3 to 1.8)	2.9 (2.5 to 3.5)
Eyre Peninsula	0.8 (0.5 to 1.0)	0.9 (0.4 to 1.3)	1.1 (1.0 to 1.4)	1.4 (0.9 to 1.8)	1.6 (1.3 to 1.7)	3.0 (2.6 to 3.6)
Kangaroo Island	0.8 (0.4 to 1.2)	0.9 (0.5 to 1.2)	1.1 (0.8 to 1.3)	1.3 (0.8 to 1.7)	1.5 (1.2 to 1.8)	2.8 (2.4 to 3.3)
Northern & Yorke	0.8 (0.5 to 1.1)	1.0 (0.6 to 1.4)	1.2 (1.0 to 1.5)	1.5 (1.0 to 1.9)	1.6 (1.4 to 1.7)	3.1 (2.7 to 3.8)
SA Arid Lands	0.9 (0.6 to 1.3)	1.1 (0.5 to 1.8)	1.3 (0.8 to 1.9)	1.7 (1.1 to 2.5)	1.7 (1.5 to 1.9)	3.6 (3.0 to 4.7)
Murraylands & Riverland	0.8 (0.4 to 1.1)	1.0 (0.4 to 1.4)	1.2 (0.9 to 1.6)	1.4 (0.8 to 2.0)	1.5 (1.3 to 1.7)	3.1 (2.6 to 4.0)
Limestone Coast	0.8 (0.4 to 1.1)	0.9 (0.5 to 1.2)	1.1 (0.8 to 1.4)	1.4 (0.8 to 1.7)	1.5 (1.3 to 1.6)	2.8 (2.4 to 3.7)
Alinitjara Wilurara	0.9 (0.5 to 1.1)	1.0 (0.6 to 1.6)	1.2 (0.8 to 1.8)	1.7 (1.3 to 2.4)	1.8 (1.3 to 2.2)	3.5 (2.8 to 4.6)

*Table 6-7 Projected increase in mean daily **winter** maximum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily winter maximum temperatures (°C)					
	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	1.0 (0.6 to 1.5)	1.0 (0.7 to 1.3)	1.3 (0.8 to 1.9)	1.6 (1.2 to 2.1)	1.8 (1.2 to 2.7)	3.4 (3.0 to 3.9)
Hills & Fleurieu	1.0 (0.6 to 1.5)	0.9 (0.7 to 1.3)	1.2 (0.8 to 1.8)	1.6 (1.2 to 2.1)	1.8 (1.2 to 2.7)	3.4 (3.0 to 3.9)
Eyre Peninsula	1.0 (0.7 to 1.5)	1.0 (0.7 to 1.2)	1.4 (0.9 to 2.0)	1.7 (1.4 to 2.1)	2.0 (1.4 to 2.9)	3.6 (3.2 to 4.2)
Kangaroo Island	0.9 (0.5 to 1.4)	0.9 (0.6 to 1.3)	1.2 (0.7 to 1.7)	1.5 (1.1 to 2.0)	1.7 (1.2 to 2.4)	3.2 (2.8 to 3.6)
Northern & Yorke	1.1 (0.7 to 1.4)	1.0 (0.8 to 1.3)	1.4 (0.9 to 2.0)	1.7 (1.4 to 2.1)	2.0 (1.5 to 3.0)	3.8 (3.4 to 4.4)
SA Arid Lands	1.2 (0.7 to 1.7)	1.1 (0.7 to 1.6)	1.5 (1.1 to 2.1)	2.0 (1.7 to 2.3)	2.3 (1.8 to 3.0)	4.3 (3.8 to 4.7)
Murraylands & Riverland	1.1 (0.6 to 1.4)	1.0 (0.6 to 1.5)	1.3 (0.9 to 1.8)	1.8 (1.5 to 2.3)	2.1 (1.7 to 2.8)	3.7 (3.5 to 3.9)
Limestone Coast	0.9 (0.5 to 1.3)	0.9 (0.6 to 1.2)	1.2 (0.9 to 1.6)	1.5 (1.3 to 2.0)	1.8 (1.3 to 2.4)	3.2 (3.0 to 3.6)
Alinitjara Wilurara	1.2 (0.7 to 1.7)	1.1 (0.8 to 1.6)	1.5 (1.0 to 2.0)	1.9 (1.5 to 2.3)	2.2 (1.5 to 3.1)	4.3 (3.8 to 4.8)

*Table 6-8 Projected increase in mean daily **winter** minimum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily winter minimum temperatures (°C)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	0.8 (0.5 to 1.4)	0.9 (0.5 to 1.4)	1.0 (0.9 to 1.2)	1.6 (1.1 to 2.1)	1.7 (1.3 to 1.8)	3.0 (2.7 to 3.5)
Hills & Fleurieu	0.8 (0.5 to 1.3)	0.9 (0.5 to 1.4)	1.0 (0.8 to 1.3)	1.6 (1.1 to 2.1)	1.7 (1.3 to 1.9)	3.0 (2.7 to 3.4)
Eyre Peninsula	0.7 (0.5 to 1.2)	0.8 (0.5 to 1.3)	1.0 (0.8 to 1.1)	1.5 (1.0 to 2.0)	1.6 (1.3 to 1.9)	3.0 (2.6 to 3.6)
Kangaroo Island	0.7 (0.4 to 1.2)	0.8 (0.5 to 1.3)	1.0 (0.8 to 1.3)	1.4 (1.0 to 2.0)	1.6 (1.2 to 1.9)	2.8 (2.5 to 3.2)
Northern & Yorke	0.8 (0.5 to 1.3)	0.8 (0.5 to 1.3)	1.0 (0.8 to 1.2)	1.5 (1.0 to 2.0)	1.7 (1.3 to 1.8)	3.0 (2.7 to 3.6)
SA Arid Lands	0.7 (0.6 to 1.0)	0.8 (0.6 to 1.0)	1.0 (0.7 to 1.3)	1.4 (0.9 to 1.9)	1.7 (1.3 to 2.2)	3.2 (2.3 to 4.4)
Murraylands & Riverland	0.7 (0.5 to 1.2)	0.8 (0.5 to 1.3)	0.9 (0.8 to 1.0)	1.5 (0.9 to 1.9)	1.6 (1.3 to 1.8)	2.9 (2.3 to 3.7)
Limestone Coast	0.7 (0.4 to 1.1)	0.8 (0.4 to 1.3)	0.9 (0.7 to 0.9)	1.5 (1.0 to 1.9)	1.5 (1.3 to 1.7)	2.8 (2.3 to 3.4)
Alinitjara Wilurara	0.6 (0.4 to 0.9)	0.7 (0.5 to 0.9)	0.9 (0.5 to 1.4)	1.5 (0.9 to 2.0)	1.7 (1.1 to 2.6)	3.3 (2.2 to 4.8)

Table 6-9 Projected increase in mean daily ***spring*** *maximum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily spring maximum temperatures (°C)					
	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	1.2 (0.9 to 1.6)	1.1 (0.4 to 2.0)	2.0 (1.4 to 2.9)	1.8 (1.6 to 2.4)	2.5 (1.5 to 4.1)	4.3 (3.3 to 5.6)
Hills & Fleurieu	1.1 (0.8 to 1.5)	1.0 (0.4 to 1.8)	1.9 (1.3 to 2.6)	1.7 (1.6 to 2.2)	2.3 (1.5 to 3.8)	4.1 (3.2 to 5.3)
Eyre Peninsula	1.3 (1.1 to 1.7)	1.3 (0.5 to 2.2)	2.2 (1.6 to 3.0)	2.1 (1.8 to 2.7)	2.7 (1.8 to 4.3)	4.7 (3.8 to 6.0)
Kangaroo Island	1.0 (0.7 to 1.2)	1.0 (0.5 to 1.5)	1.7 (1.2 to 2.3)	1.6 (1.4 to 2.0)	2.1 (1.5 to 3.3)	3.7 (3.0 to 4.8)
Northern & Yorke	1.4 (1.1 to 1.8)	1.3 (0.5 to 2.4)	2.4 (1.6 to 3.4)	2.2 (1.9 to 2.8)	2.9 (1.8 to 4.7)	5.1 (3.9 to 6.7)
SA Arid Lands	1.5 (1.1 to 2.0)	1.5 (0.8 to 2.6)	2.5 (1.9 to 3.2)	2.6 (2.3 to 3.3)	3.1 (2.5 to 4.3)	5.8 (5.1 to 6.6)
Murraylands & Riverland	1.3 (1.0 to 1.6)	1.2 (0.5 to 2.2)	2.2 (1.6 to 3.0)	2.1 (1.9 to 2.5)	2.7 (1.8 to 4.2)	4.8 (3.9 to 6.0)
Limestone Coast	1.1 (0.7 to 1.5)	0.9 (0.3 to 1.6)	1.8 (1.2 to 2.6)	1.5 (1.4 to 2.0)	2.1 (1.3 to 3.7)	3.8 (2.8 to 5.2)
Alinitjara Wilurara	1.5 (1.2 to 2.0)	1.6 (1.0 to 2.6)	2.4 (1.9 to 3.1)	2.7 (2.3 to 3.4)	3.1 (2.6 to 4.2)	5.8 (5.3 to 6.5)

*Table 6-10 Projected increase in mean daily **spring** minimum temperatures (°C) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Increase in daily spring minimum temperatures (°C)					
	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	0.7 (0.5 to 1.1)	0.9 (0.7 to 1.3)	1.3 (1.1 to 1.6)	1.4 (1.2 to 1.5)	1.7 (1.4 to 2.4)	2.9 (2.8 to 3.1)
Hills & Fleurieu	0.7 (0.4 to 1.1)	0.8 (0.6 to 1.1)	1.2 (1.0 to 1.5)	1.3 (1.2 to 1.5)	1.6 (1.3 to 2.1)	2.7 (2.6 to 2.9)
Eyre Peninsula	0.7 (0.6 to 1.1)	0.9 (0.7 to 1.3)	1.3 (1.1 to 1.5)	1.4 (1.3 to 1.6)	1.8 (1.5 to 2.2)	3.0 (2.8 to 3.2)
Kangaroo Island	0.6 (0.4 to 1.0)	0.8 (0.6 to 0.9)	1.1 (0.9 to 1.2)	1.2 (1.1 to 1.4)	1.5 (1.3 to 1.8)	2.6 (2.4 to 2.7)
Northern & Yorke	0.8 (0.6 to 1.2)	0.9 (0.6 to 1.4)	1.4 (1.2 to 1.7)	1.4 (1.3 to 1.6)	1.9 (1.5 to 2.5)	3.2 (3.0 to 3.4)
SA Arid Lands	1.0 (0.8 to 1.4)	1.1 (0.5 to 1.9)	1.8 (1.3 to 2.2)	1.7 (1.3 to 2.2)	2.3 (1.9 to 3.1)	4.1 (3.9 to 4.3)
Murraylands & Riverland	0.7 (0.5 to 1.0)	0.8 (0.4 to 1.3)	1.3 (1.1 to 1.5)	1.3 (1.1 to 1.5)	1.7 (1.4 to 2.2)	2.9 (2.6 to 3.1)
Limestone Coast	0.5 (0.2 to 0.8)	0.7 (0.5 to 0.9)	0.9 (0.8 to 1.0)	1.2 (1.0 to 1.3)	1.3 (1.2 to 1.6)	2.3 (2.0 to 2.7)
Alinitjara Wilurara	1.0 (0.6 to 1.4)	1.1 (0.6 to 2.0)	1.7 (1.4 to 2.1)	1.9 (1.3 to 2.4)	2.4 (2.1 to 2.8)	4.1 (3.8 to 4.5)

6.3 Extreme heat

Across all of South Australia the frequency of very hot days is projected to continue to increase.

Table 6-11 Climate Change in Australia cluster projection statements for extreme heat.

<table>
<tr><th>Sub-cluster</th><th>Extreme heat</th><th>Confidence</th></tr>
<tr><td>Southern and South Western Flatlands East</td><td rowspan="3">More hot days and warm spells are projected with very high confidence.
Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells (very high confidence).</td><td rowspan="3">Very high</td></tr>
<tr><td>Rangelands South</td></tr>
<tr><td>Murray Basin</td></tr>
</table>

6.4 Frost

Frost is the ice crystals or frozen dew drops on objects near the ground that occurs when the surface temperature falls below freezing point. Frost is most common when there is no cloud and little or no wind.

Despite recent warming, the number of frost days and length of the frost season has increased in the last few decades as a result of changing atmospheric conditions bringing more very cold air from further south, and more clear, dry nights. Locations where frost occurs only a few times a year under current conditions are projected to become nearly frost-free by 2030. Frost frequencies are likely to remain comparable to current levels until then.

Projected warming will then result in more frequent and hotter hot days and warmer cold extremes (*very high confidence*) and reduced frost (*high confidence*). Climate Change in Australia projects that warming conditions will reduce the incidences of frost after 2030. Table 6-15 provides the Climate Change in Australia projections for each cluster.

Table 6-12 Climate Change in Australia cluster projection statements for frost.

Sub-cluster	Frost days	Confidence
Southern and South Western Flatlands East	A decrease in the frequency of frost days is projected with high confidence. Results show that for 2030 under RCP4.5 there is a projected reduction in the number of days with the potential for frost. By 2090 the number is further reduced, with zero days with the potential for frost in Adelaide under RCP8.5.	High
Rangelands South	A substantial decrease in the frequency of frost is projected with high confidence. Results show that for Alice Springs by 2030 under RCP2.6, there is only a minor reduction in frost days. For 2090, however, substantial reductions occur in frost days under RCP4.5 and RCP8.5.	High
Murray Basin	A substantial decrease in the frequency of frost is projected with high confidence.	High

7. Regional rainfall projections for 2030, 2050 and 2090

7.1 Annual rainfall

Average annual rainfall across all South Australian regions is projected to decline to 2030, 2050 and 2090.

The values shown in Table 7-1 are the average percentage change in average annual rainfall according to the six NARCliM 1.5 combinations of global and regional climate models, and the range of the projected change amongst those GCMs, compared with the 1986–2005 baseline.

*Table 7-1 Projected change in **annual** rainfall (%) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Average change in annual rainfall from 1986–2005 baseline period (%)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	-7.5 (+2.6 to -23.0)	-2.4 (+22.6 to -21.2)	-11.7 (-4.6 to -19.8)	-4.0 (+9.5 to -21.5)	-8.5 (+3.0 to -27.4)	-28.3 (-10.5 to -47.9)
Hills & Fleurieu	-9.0 (-1.3 to -23.0)	-3.3 (+11.3 to -19.0)	-12.5 (- 4.3 to -21.6)	-7.7 (-2.0 to -21.2)	-10.9 (+0.7 to -30.9)	-29.0 (-9.5 to -49.8)
Eyre Peninsula	-9.8 (+7.3 to -29.4)	-4.6 (+8.4 to -22.6)	-13.5 (-3.4 to -28.1)	-12.5 (-4.9 to -28.2)	-14.4 (-5.3 to -29.7)	-32.4 (-15.1 to -52.7)
Kangaroo Island	-8.0 (+2.9 to -25.2)	-3.5 (+13.3 to -19.3)	-12.6 (-4.1 to -23.2)	-9.2 (-2.8 to -25.3)	-11.3 (-0.3 to -28.9)	-29.3 (-12.6 to -48.9)
Northern & Yorke	-9.6 (-1.8 to -25.4)	-4.6 (+5.6 to -19.9)	-12.4 (-4.1 to -22.2)	-11.4 (-1.9 to -22.2)	-13.2 (-3.3 to -30.2)	-31.2 (-13.5 to -51.4)
SA Arid Lands	-7.8 (+11.9 to -32.4)	-4.3 (+8.5 to -25.7)	-10.0 (+2.0 to -26.2)	-23.0 (-4.4 to -33.3)	-19.8 (-9.4 to -33.0)	-36.7 (-20.0 to -53.2)
Murraylands & Riverland	-9.3 (+1.3 to -24.4)	-6.8 (-2.0 to -20.4)	-10.2 (-3.3 to -18.3)	-15.0 (-4.2 to -22.1)	-13.7 (-4.1 to -25.8)	-30.6 (-14.3 to -51.6)
Limestone Coast	-6.6 (-0.2 to -18.5)	-1.7 (+14.4 to -14.9)	-9.4 (-4.1 to -17.5)	-4.7 (+1.9 to -17.6)	-7.3 (+3.1 to -25.6)	-23.0 (-4.8 to -42.4)
Alinitjara Wilurara	-8.1 (+10.3 to -22.9)	-6.6 (+4.3 to -16.9)	-6.9 (+1.9 to -19.3)	-15.7 (+5.9 to -34.1)	-12.5 (-6.6 to -20.3)	-25.8 (-9.7 to -45.7)

7.2 Seasonal rainfall

Across all South Australian regions, average reductions in spring are projected to be greater than any other season.

The values shown in Table 7-2 to Table 7-5 are the average percentage change in average seasonal rainfall according to the six NARCliM 1.5 combinations of global and regional climate models, and the range of the projected change amongst those GCMs, compared with the 1986–2005 baseline.

*Table 7-2 Projected change in **summer** rainfall (%) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Average change in summer rainfall from 1986–2005 baseline period (%)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	-7.7 (+11.0 to -25.5)	4.6 (+40.7 to -21.5)	-1.4 (+22.6 to -17.1)	-8.3 (+1.8 to -15.3)	-13.4 (+24.6 to -36.2)	-33.2 (-4.1 to -43.5)
Hills & Fleurieu	-6.3 (+11.5 to -24.9)	3.7 (+22.4 to -14.5)	-4.1 (+10.9 to -19.5)	-9.4 (-2.7 to -16.9)	-15.3 (+11.6 to -40.1)	-30.9 (-8.2 to -43.5)
Eyre Peninsula	-3.4 (+53.2 to -27.0)	4.1 (+31.5 to -13.5)	-3.0 (+12.2 to -20.7)	-10.0 (+23.4 to -30.2)	-15.8 (+15.9 to -41.5)	-26.7 (-6.2 to -44.0)
Kangaroo Island	-9.3 (+9.4 to -28.1)	-1.0 (+18.5 to -17.3)	-5.8 (+7.5 to -18.8)	-7.1 (+0.8 to -25.0)	-14.3 (+20.2 to -40.6)	-29.4 (-7.9 to -46.3)
Northern & Yorke	3.5 (+54.9 to -13.0)	8.5 (+18.7 to 0.6)	6.7 (+24.5 to -5.9)	-6.1 (+3.6 to -26.4)	-11.6 (+9.1 to -33.6)	-22.9 (+1.0 to -42.9)
SA Arid Lands	6.2 (+69.5 to -12.9)	15.9 (+31.1 to 5.7)	8.4 (+24.4 to -10.1)	-2.8 (+25.1 to -24.7)	-6.2 (+20.4 to -46.4)	-13.4 (+5.1 to -34.6)
Murraylands & Riverland	5.1 (+42.8 to -12.1)	10.5 (+32.5 to 0.5)	7.8 (+33.8 to -10.4)	-5.9 (+9.0 to -25.0)	-12.0 (+16.1 to -37.7)	-18.6 (+9.8 to -37.8)
Limestone Coast	-4.8 (+2.0 to -18.8)	5.4 (+21.1 to -9.1)	2.3 (+20.6 to -10.2)	-6.8 (-0.3 to -13.1)	-12.1 (+15.2 to -31.2)	-25.6 (0.0 to -35.8)
Alinitjara Wilurara	13.3 (+66.5 to -16.3)	10.2 (+25.7 to -3.3)	9.7 (+25.0 to -3.5)	4.4 (+28.8 to -3.2)	0.9 (+32.0 to -38.5)	-2.7 (+13.0 to -19.2)

*Table 7-3 Projected change in **autumn** rainfall (%) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Average change in autumn rainfall from 1986–2005 baseline period (%)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	-8.3 (+15.1 to -27.4)	-8.4 (+16.0 to -28.4)	-6.6 (+16.1 to -24.5)	-11.6 (+2.7 to -32.4)	-2.6 (+5.4 to -14.9)	-29.9 (-12.6 to -43.9)
Hills & Fleurieu	-8.7 (+12.8 to -28.5)	-6.9 (+10.3 to -24.6)	-8.1 (+8.9 to -23.9)	-13.9 (-4.7 to -34.1)	-5.4 (+2.9 to -21.4)	-30.9 (-13.8 to -44.0)
Eyre Peninsula	-13.1 (+17.9 to -47.2)	-8.8 (+11.1 to -34.1)	-15.3 (+7.0 to -42.0)	-19.1 (-8.9 to -48.2)	-11.2 (+7.8 to -31.3)	-35.0 (-21.9 to -46.2)
Kangaroo Island	-5.2 (+18.9 to -33.3)	-3.4 (+11.0 to -22.4)	-8.2 (+6.1 to -28.5)	-12.5 (-0.1 to -37.3)	-4.7 (+8.7 to -24.7)	-29.9 (-17.4 to -42.3)
Northern & Yorke	-12.0 (+8.4 to -39.9)	-9.2 (+9.3 to -34.9)	-12.6 (+15.5 to -34.3)	-19.9 (-9.2 to -44.4)	-13.2 (-5.3 to -25.9)	-34.4 (-16.7 to -45.7)
SA Arid Lands	-10.2 (+25.3 to -56.2)	-5.6 (+24.2 to -42.8)	-13.7 (+12.5 to -34.9)	-25.6 (-0.6 to -55.0)	-27.7 (-5.6 to -41.3)	-40.1 (-15.8 to -58.8)
Murraylands & Riverland	-12.1 (+11.2 to -39.5)	-10.5 (+2.3 to -36.5)	-11.2 (+17.1 to -34.0)	-22.4 (-6.5 to -42.1)	-13.4 (+0.3 to -25.5)	-32.9 (-16.6 to -47.5)
Limestone Coast	-5.9 (+10.4 to -24.0)	-5.6 (+11.0 to -22.5)	-5.0 (+12.1 to -21.1)	-9.8 (+2.3 to -29.6)	-1.0 (+9.0 to -14.4)	-24.2 (-11.3 to -36.8)
Alinitjara Wilurara	-14.2 (+10.2 to -48.8)	-7.7 (+12.2 to -34.9)	-12.9 (+4.4 to -43.8)	-19.5 (-3.0 to -53.8)	-22.9 (-10.7 to -37.1)	-32.0 (-15.5 to -45.7)

*Table 7-4 Projected change in **winter** rainfall (%) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Average change in winter rainfall from 1986–2005 baseline period (%)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	-1.9 (+17.1 to -15.2)	5.0 (+35.5 to -17.1)	-10.1 (+1.0 to -20.8)	6.2 (+28.3 to -8.8)	-3.8 (+16.9 to -25.9)	-20.9 (-1.3 to -41.0)
Hills & Fleurieu	-6.0 (+5.3 to -18.6)	2.4 (+24.0 to -12.8)	-11.0 (+4.2 to -25.4)	1.0 (+11.7 to -9.6)	-4.9 (+12.2 to -30.7)	-20.4 (+2.2 to -44.5)
Eyre Peninsula	-7.3 (+9.8 to -23.3)	1.3 (+23.4 to -18.3)	-11.7 (+1.0 to -23.5)	-1.9 (+11.5 to -14.7)	-11.1 (+0.9 to -31.9)	-24.9 (-0.6 to -50.3)
Kangaroo Island	-5.7 (+7.7 to -22.6)	2.6 (+29.3 to -15.3)	-9.9 (0.0 to -19.8)	-1.4 (+11.4 to -17.3)	-5.9 (+5.0 to -24.7)	-20.8 (-3.8 to -41.1)
Northern & Yorke	-9.6 (+7.8 to -21.4)	-0.1 (+21.6 to -14.8)	-13.7 (-1.0 to -28.2)	-0.9 (+11.4 to -10.2)	-9.7 (+9.7 to -32.7)	-23.1 (+3.6 to -50.5)
SA Arid Lands	-13.2 (+0.1 to -36.3)	-13.4 (+11.9 to -36.5)	-14.4 (+0.4 to -31.7)	-24.7 (+7.2 to -51.2)	-18.9 (-4.6 to -30.2)	-37.0 (-11.9 to -71.4)
Murraylands & Riverland	-9.8 (-2.3 to -23.9)	-4.3 (+7.6 to -18.7)	-11.8 (+3.0 to -28.5)	-5.4 (+3.9 to -11.2)	-10.3 (+6.9 to -30.0)	-19.7 (+10.2 -50.4)
Limestone Coast	-0.5 (+11.2 to -6.7)	6.3 (+28.5 to -10.5)	-6.8 (+3.4 to -18.3)	7.1 (+15.2 to 0.1)	1.4 (+17.4 to -23.7)	-10.7 (+9.2 to -34.3)
Alinitjara Wilurara	-15.7 (-7.2 to -27.3)	-10.6 (+17.8 to -30.3)	-9.7 (+23.6 to -35.2)	-12.5 (+38.8 to -49.3)	-10.9 (+36.0 to -43.1)	-21.6 (+23.5 to -72.7)

*Table 7-5 Projected change in **spring** rainfall (%) in the regions of South Australia by 2030, 2050 and 2090*

Landscape Region	Average change in spring rainfall from 1986–2005 baseline period (%)					
	2030 (RCP4.5)	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Green Adelaide	-15.2 (-7.7 to -33.8)	-9.6 (+6.2 to -26.0)	-21.9 (-2.4 to -40.0)	-12.2 (+6.6 to -31.3)	-20.2 (-1.7 to -41.7)	-37.1 (-8.5 to -65.8)
Hills & Fleurieu	-14.4 (-8.6 to -27.6)	-10.1 (-3.9 to -23.7)	-22.3 (-7.4 to -39.8)	-14.7 (+4.9 to -30.9)	-23.7 (-6.1 to -45.9)	-38.9 (-12.5 to -66.2)
Eyre Peninsula	-12.3 (-0.6 to -24.1)	-11.5 (-5.8 to -20.4)	-18.8 (0.0 to -36.2)	-20.0 (-0.2 to -37.8)	-21.3 (-1.5 to -44.7)	-41.5 (-17.4 to -65.3)
Kangaroo Island	-13.6 (-8.3 to -22.4)	-13.2 (-6.3 to -22.8)	-24.1 (-9.3 to -42.8)	-17.0 (+2.9 to -33.7)	-24.7 (-7.9 to -50.2)	-40.0 (-15.0 to -67.8)
Northern & Yorke	-10.5 (-2.6 to -26.9)	-10.2 (+0.4 to -23.4)	-19.5 (-3.1 to -37.2)	-17.6 (+1.8 to -39.2)	-20.0 (+4.6 to -38.3)	-42.9 (-20.0 to -66.2)
SA Arid Lands	-6.1 (+16.6 to -16.3)	-11.0 (+4.3 to -21.2)	-14.9 (-8.5 to -19.7)	-30.8 (-7.6 to -52.1)	-23.8 (+0.6 to -44.1)	-51.7 (-39.3 to -60.6)
Murraylands & Riverland	-10.2 (-2.1 to -23.9)	-11.8 (+3.1 to -25.8)	-17.0 (-6.4 to -28.8)	-21.0 (-4.0 to -42.8)	-19.5 (+3.8 to -29.7)	-45.4 (-30.4 to -65.5)
Limestone Coast	-14.0 (-5.3 to -29.3)	-8.8 (+0.4 to -23.3)	-20.3 (-5.8 to -34.5)	-13.8 (+3.7 to -32.5)	-20.5 (-5.3 to -38.4)	-35.1 (-7.1 to -60.3)
Alinitjara Wilurara	-5.4 (+13.3 to -21.4)	-11.1 (+19.2 to -34.5)	-7.9 (+12.1 to -17.9)	-25.1 (+12.5 to -66.9)	-14.1 (+11.2 to -28.2)	-40.3 (-27.0 to -58.4)

7.3 Extreme rainfall events

Climate Change in Australia provides regional projections for the change in annual maximum daily rainfall and the change in the 20-year return level for the 1-day maximum rainfall (5% chance of occurrence within any one year) but only for 2090. The Climate Change in Australia Threshold calculator provides projections of the number of days with rainfall above the 99.9th percentile for specific locations at 2030, 2050, 2070 and 2090. The 99.9th percentile represents a 1-in-1000 day rainfall event, that is, the largest event occurring approximately every three years (~1000 days).

Table 7-6 Climate Change in Australia cluster projection statements for extreme rainfall.

Sub-cluster	***Extreme rainfall***	***Confidence***
Southern and South Western Flatlands	Increased intensity of extreme rainfall events is projected, with high confidence. However, the magnitude of the increases cannot be confidently projected.	High
Rangeland South	Increased intensity of extreme rainfall events is projected, with high confidence, although the magnitude of the increases cannot be confidently projected.	High
Murray Basin	Even though mean annual rainfall is projected to decline, heavy rainfall intensity is projected to increase. The magnitude of the change cannot be confidently projected.	High

Table 7-7 Days per year rainfall above historic 99.9th percentile

Location	**1981–2010 (Historic)**	**2030 (RCP4.5)**	**2030 (RCP8.5)**	**2050 (RCP4.5)**	**2050 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Adelaide	0.38	0.40	0.60	0.71	0.59	0.71	0.84
Ceduna	0.52	0.62	0.65	0.70	0.65	0.72	0.67
Clare	0.55	0.58	0.71	0.79	0.63	0.85	0.91
Coober Pedy	0.41	0.38	0.53	0.56	0.43	0.49	0.53
Keith	0.31	0.46	0.56	0.68	0.55	0.66	0.78
Mount Gambier	0.66	0.67	0.68	0.97	0.82	0.90	1.00
Port Augusta	0.41	0.46	0.51	0.57	0.49	0.51	0.61
Renmark	0.24	0.41	0.51	0.49	0.47	0.44	0.65
Whyalla	0.55	0.45	0.57	0.61	0.53	0.56	0.57
Woomera	0.34	0.41	0.49	0.52	0.41	0.49	0.53
Wudinna	0.38	0.60	0.53	0.71	0.56	0.68	0.59

8. Potential evapotranspiration projections for 2030, 2050 and 2090

Potential evapotranspiration is a standardised estimation of the evaporation and transpiration that would occur from given a limitless supply of water. It is the combination of two separate processes: evaporation from water bodies or the ground surface, and transpiration through the leaves of vegetation. Temperature and wind speed amongst other factors are important for estimating the potential evapotranspiration, which are related to the potential water stress of crops and other vegetation.

The values shown below are the mean percentage change in annual potential evapotranspiration from the 1986–2005 baseline from six GCMs selected for South Australia (adapted from Charles and Fu, 2015).

Potential evapotranspiration is projected to increase in all seasons as temperatures increase.

Table 8-1 Change in annual potential evapotranspiration

Landscape Region	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Green Adelaide	+2.7	+3.1	+3.8	+5.2	+5.1	+9.9
Hills and Fleurieu	+2.7	+3.1	+3.8	+5.2	+5.1	+9.9
Eyre Peninsula	+2.5	+2.7	+3.5	+4.6	+4.6	+9.0
Kangaroo Island	+2.2	+2.4	+3.1	+4.1	+4.2	+8.4
Northern & Yorke	+3.0	+3.4	+4.1	+5.5	+5.4	+10.5
SA Arid Lands	+2.7	+3.2	+3.8	+5.2	+5.2	+10.2
Murraylands and Riverland	+2.8	+3.1	+3.9	+5.3	+5.2	+10.2
Limestone Coast	+2.5	+2.9	+3.6	+4.8	+4.8	+9.7

9. Regional wind projections for 2030 and 2090

By 2030, changes in near-surface wind speeds are projected to be small compared to natural variability. By 2090, wind speed projections show a decrease in southern mainland Australia in winter and south-eastern mainland Australia in both autumn and spring. Projected changes in extreme wind speeds are generally similar to those for average wind.

Table 9-1 provides a summary of the Climate Change in Australia projection statements and Table 9-2 describes the percent change in annual wind speed relative to the 1986–2005 baseline.

Table 9-1 Climate Change in Australia cluster projection statements for wind.

Sub-cluster	Wind speeds	Confidence
Southern and South Western Flatlands East	Small changes (less than ±2 %) are projected with high confidence for mean surface wind speeds by 2030. Decreases in wind speed in winter are projected for 2090 under RCP4.5 and RCP8.5 with high confidence based on model results and the projection of a reduction in storminess. Changes in other seasons are small compared to natural variability.	High
Rangelands	Changes in wind speed averaged over Rangelands North and South indicate mostly small changes, in relative terms. However, larger changes (both increases and decreases) occur in some models. By 2090 under RCP8.5, the more consistent changes include increases in the South (i.e. in South Australia) in spring. Taking into consideration the low model agreement, there is generally *low confidence* on direction of change for much of Rangelands, and generally *medium confidence* in change being small. Along the far west coast of South Australia, there is *medium confidence* in a decrease in winter. Due to limited understanding of physical mechanisms, we have *low confidence* in the increase in wind speeds in spring despite strong model agreement. There is *low confidence* in the projection of small change in extreme winds over Rangelands.	Low
Murray Basin	For 2030, changes in wind speed are projected with high confidence to be small under all RCPs (± 5%). By 2090 under RCP4.5 and RCP8.5, there is an indication in the model results of decreased wind speed in winter. This aligns with changes in atmospheric circulation already discussed and is of medium confidence. Small or inconsistent changes are present in the other seasons. Overall, no large changes in surface wind are expected across the Murray Basin cluster, except in winter.	High

Table 9-2 Percent change in annual wind speed relative to 1986–2005 baseline

Sub-Cluster	2030 (RCP4.5)	2030 (RCP8.5)	2090 (RCP8.5)	2090 (RCP4.5)
Southern and South Western Flatlands East	-0.9 (-2.3 to 1.1)	-0.5 (-3.1 to 0.7)	-1.4 (-3.8 to 0.1)	-1.8 (-4.4 to 0.0)
Rangeland	-0.3 (-2.5 to 0.8)	-0.1 (-1.2 to 1.0)	+0.7 (-2.4 to 2.0)	-0.4 (-2.0 to 0.8)
Murray Basin	-1.0 (-2.9 to 1.5)	+0.1 (-2.6 to 2.4)	-1.3 (-4.6 to 0.8)	-0.6 (-5.0 to 2.6)

10. Regional fire weather projections for 2030 and 2090

There is high confidence that climate change will result in a harsher fire weather climate in the future. However, there is low confidence in the magnitude of the change as this is strongly dependent on the rainfall projection. Southern and Eastern Australia are projected to experience harsher fire weather while changes elsewhere are less certain.

The Forest Fire Danger Index (FFDI) takes measures of fuel dryness, temperature and wind speed to provide a measure of fire danger. Fire weather is considered 'severe' when FFDI exceeds 50 as bushfires have potentially greater human impacts at this level (Blanchi et al., 2010).

Table 10-1 provides a summary of the Climate Change in Australia projection statements and Table 10-2 describes the projected change in the occurrence of days of severe fire weather.

Table 10-1 Climate Change in Australia cluster projection statements for fire weather.

Sub-cluster	Fire weather	Confidence
Southern and South Western Flatlands East	There is high confidence that climate change will result in a harsher fire-weather climate in the future. However, there is low confidence in the magnitude of the change as this is strongly dependent on the summer rainfall projection.	High (but low confidence in magnitude)
Rangelands	Bushfire in the Rangelands depends highly on fuel availability, which mainly depends on rainfall. For most of this cluster, extensive bushfire activity occurs after extended wet periods. These lead to vegetation growth that burns after the wet period ends. There is high confidence that climate change will result in a harsher fire weather climate in the future, due to higher temperature and lower rainfall. But there is low confidence in the magnitude of fire weather projections. When bushfires occur, more extreme fire behaviour can be expected.	High (but low confidence in magnitude)
Murray Basin	There is high confidence that climate change will result in a harsher fire-weather climate in the future. However, there is only low confidence in the magnitude of the projected change to fire weather, as this depends on the rainfall projection and its seasonal variation. The enhanced summer rainfall projected in some scenarios could moderate the number of severe fire weather days	High (but low confidence in magnitude)

Table 10-2 Number of severe fire danger days (FFDI > 50)

Sub-cluster	Baseline	2030 (RCP4.5)	2030 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Southern and South Western Flatlands	4.2	5.0	4.7	5.3	6.9
Rangeland	12.7	18.6	17.1	18.8	27.6
Murray Basin	3.6	4.9	4.6	5.3	5.9

Note, in September 2022 the Australian Fire Danger Rating (AFDR) system was introduced as the new standard for fire danger ratings in Australia. The AFDR uses a numerical fire behaviour index (FBI) that varies according to fuel types. Data on historic FBI values and any projected future trends of change in FBI values is not available at the time of publishing of this guide.

11. Sea level rise for 2030, 2050 and 2090

Mean sea level will continue to rise and the height of extreme sea level storm events will increase. By 2030 the projected range of sea level rise for the South Australian coastline is 0.08 to 0.17 m above the 1986–2005 baseline. By 2050, under the RCP8.5 emissions case, a sea level rise of 22–25 cm is projected compared with the average level during 1986–2005.

In line with global mean sea levels, Australian sea levels are projected to rise through the 21st century, and are very likely to rise at a faster rate during the 21st century than over the past four decades for the range of RCPs considered. Table 11-1 describes the Climate Change in Australia projection statements for sea level rise for each of the three clusters in South Australia.

Table 11-1 Climate Change in Australia cluster projection statements for sea level rise.

Sub-cluster	Sea level rise	Confidence
Southern and South Western Flatlands East	Mean sea level will continue to rise and height of extreme sea-level events will also increase.	Very high
Rangeland South		
Murray Basin		

Sea level projections for the Australian coastline by 2090 are comparable to the global mean sea level projections of 45–82 cm under RCP8.5 (medium confidence). These ranges of sea level rise are considered likely (at least 66% probability). However, if a collapse in the marine based sectors of the Antarctic ice sheet were initiated, the projections could be up to several tenths of a metre higher by late in the century. For all scenarios, global mean sea level is projected to continue to rise after 2100, most likely at much greater rates (DeConto and Pollard, 2016). Table 11-2 describes projected changes in sea level rise from the Climate Change in Australia Marine Explorer tool.

Table 11-2 Projected change in sea level rise relative to 1986–2005 (m)

Port	2030 (RCP4.5)	2030 (RCP8.5)	2050 (RCP4.5)	2050 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Thevenard	+0.12 (+0.07 to +0.16)	+0.12 (+0.08 to +0.17)	Not available	Not available	+0.45 (+0.28 to +0.63)	+0.59 (+0.39 to +0.82)
Port Adelaide	+0.12 (+0.08 to +0.16)	+0.13 (+0.08 to +0.17)	+0.22 (+0.14 to +0.30)	+0.25 (+0.16 to +0.33)	+0.46 (+0.29 to +0.63)	+0.61 (+0.40 to +0.84)
Victor Harbor	+0.12 (+0.08 to +0.16)	+0.13 (+0.08 to +0.17)	+0.22 (+0.14 to +0.30)	+0.24 (+0.16 to +0.33)	+0.45 (+0.28 to +0.63)	+0.60 (+0.39 to +0.83)
Portland (Victoria)	+0.12 (+0.08 to +0.16)	+0.12 (+0.08 to +0.17)	Not available	Not available	+0.46 (+0.29 to +0.64)	+0.61 (+0.39 to +0.84)

12. Sea surface temperature, salinity and acidification for 2030, 2050 and 2090

Sea surface temperature has increased significantly across the globe over recent decades and warming is projected to continue. Around Australia it is very likely that the ocean will become more acidic. Projections for ocean salinity are varied and include increases and decreases

Tables 12-1 to 12-6 describe the Climate Change in Australia projection statements and projected changes in sea level rise, salinity and acidity reported from the Climate Change in Australia Marine Explorer tool.

Table 12-1 Climate Change in Australia cluster projection statements for sea surface temperature.

Sub-cluster	Sea surface temperature	Confidence
Southern and South Western Flatlands East	Sea surface temperature (SST) has increased significantly across the globe over recent decades and warming is projected to continue with very high confidence.	Very high
Rangelands		
Murray Basin		

Table 12-2 Projected change in sea surface temperature relative to 1986–2005 baseline (°C)

Port	2030 (RCP4.5)	2030 (RCP8.5)	2090 (RCP4.5)	2090 (RCP8.5)
Thevenard	+0.5 (+0.3 to +0.7)	+0.6 (+0.3 to +0.9)	+1.2 (+0.9 to +1.8)	+2.2 (+1.7 to +3.4)
Port Adelaide	+0.5 (+0.3 to +0.7)	+0.5 (+0.4 to +0.9)	+1.2 (+0.7 to +1.7)	+2.2 (+1.5 to +3.5)
Victor Harbor	+0.5 (+0.3 to +0.6)	+0.5 (+0.3 to +0.8)	+1.2 (+0.8 to +1.7)	+2.2 (+1.6 to +3.4)
Portland (Victoria)	+0.5 (+0.3 to +0.7)	+0.5 (+0.3 to +0.8)	+1.2 (+0.7 to +1.6)	+2.2 (+1.6 to +3.4)

Table 12-3 Climate Change in Australia cluster projection statements for sea surface salinity.

Sub-cluster	Sea surface salinity	Confidence
Southern and South Western Flatlands East	Ocean salinity in coastal waters will be affected by changes to rainfall and evaporation and this in turn can affect stratification and mixing, and potentially nutrient supply. Changes to salinity across the coastal waters of the three clusters span a large range that includes possible increase and decrease, particularly over the longer term and higher emission scenarios. Locally, salinity can also be affected by riverine input.	Not reported
Rangelands		
Murray Basin		

Table 12-4 Projected change in sea surface salinity relative to 1986–2005 baseline (g/kg)

Port	**2030 (RCP4.5)**	**2030 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Thevenard	+0.01 (-0.18 to +0.09)	-0.02 (-0.23 to +0.11)	-0.03 (-0.22 to +0.23)	-0.13 (-0.46 to +0.43)
Port Adelaide	-0.06 (-0.12 to +0.18)	-0.07 (-0.19 to +0.14)	-0.00 (-0.14 to +0.22)	-0.09 (-0.71 to +0.39)
Victor Harbor	-0.06 (-0.12 to +0.15)	-0.06 (-0.12 to +0.10)	-0.04 (-0.19 to +0.21)	-0.09 (-1.12 to +0.37)
Portland (Victoria)	-0.03 (-0.09 to +0.13)	-0.04 (-0.11 to +0.08)	-0.05 (-0.16 to +0.18)	0.00 (-0.03 to +0.40)

Table 12-5 Climate Change in Australia cluster projection statements for ocean pH.

Sub-cluster	**Ocean pH**	**Confidence**
Southern and South Western Flatlands East	There is very high confidence that around Australia the ocean will become more acidic and also high confidence that the rate of ocean acidification will be proportional to carbon dioxide emissions.	Very high
Rangelands		
Murray Basin		

Table 12-6 Projected change in ocean pH relative to 1986–2005 baseline

Port	**2030 (RCP4.5)**	**2030 (RCP8.5)**	**2090 (RCP4.5)**	**2090 (RCP8.5)**
Thevenard	-0.07 (-0.07 to -0.06)	-0.08 (-0.08 to -0.07)	-0.15 (-0.15 to -0.14)	-0.32 (-0.32 to -0.31)
Port Adelaide	-0.07 (-0.07 to -0.07)	-0.08 (-0.08 to -0.08)	-0.15 (-0.15 to -0.14)	-0.32 (-0.33 to -0.32)
Victor Harbor	-0.07 (-0.07 to -0.07)	-0.08 (-0.08 to -0.08)	-0.15 (-0.15 to -0.15)	-0.32 (-0.33 to -0.32)
Portland (Victoria)	-0.07 (-0.08 to -0.07)	-0.08 (-0.09 to -0.09)	-0.15 (-0.15 to -0.14)	-0.30 (-0.30 to -0.30)

13. Data source references

Technical report

NSW Department of Planning, Industry & Environment and the Climate Change Research Centre, University of New South Wales, 2020, The NSW and ACT Regional Climate Modelling Project: Climate Projections Version 1.5 - Technical Methods Report. NARCliM1.5 Technical Methods Report (nsw.gov.au) (viewed October 2022).

CSIRO & Bureau of Meteorology 2015, Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report, CSIRO and Bureau of Meteorology, Australia https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/168/CCIA_2015_NRM_TechnicalReport_WEB.pdf (viewed May 2020).

Website

Climate Change in Australia, 2015, http://www.climatechangeinaustralia.gov.au, (viewed June 2020).

SA Climate Ready regional summaries, 2015, https://data.environment.sa.gov.au/Climate/SA-Climate-Ready/Pages/default.aspx, (viewed May 2020).

Charles S.P. and Fu G., 2015, *Statistically Downscaled Projections for South Australia*, Goyder Institute for Water Research Technical Report Series No. 15/1, Adelaide, South Australia. http://www.goyderinstitute.org/_r91/media/system/attrib/file/82/CC%20Task%203%20CSIRO%20Final%20Report_web.pdf (viewed June 2020).

Climate Change in Australia Cluster reports

1. Murray Basin

Timbal, B et al., 2015, Murray Basin Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports, (M. Ekström et al. (eds), CSIRO and Bureau of Meteorology, Australia. https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/MURRAY_BASIN_CLUSTER_REPORT_1.pdf (viewed May 2020).

2. Rangelands

Watterson, I et al., 2015, Rangelands Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports, (M. Ekström et al. (eds), CSIRO and Bureau of Meteorology, Australia. https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/RANGELANDS_CLUSTER_REPORT_1.pdf (viewed May 2020).

3. Southern and South-Western Flatlands

Hope, P et al., 2015, Southern and South-Western Flatlands Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports, (M. Ekström et al. (eds), CSIRO and Bureau of Meteorology, Australia. https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/RANGELANDS_CLUSTER_REPORT_1.pdf (viewed May 2020).

14. Glossary

Climate variables — variables that define or describe the long-term average weather or environmental metrics, e.g. rainfall, air temperature, potential evaporation, wind speed, sea level.

Climate projection — a scenario of future climate, generally resulting from running a global climate model (GCM) with a specified greenhouse gas concentration scenario (or RCP). A projection differs from a prediction in that it is conditional on the representation of a particular GCM and the uncertain assumptions of the model inputs (primarily the greenhouse gas concentration scenario, or RCP).

Emissions scenario — description of a possible future scenario of the change in rates of greenhouse gas emissions resulting from human activity. Greenhouse gas emissions scenarios are represented as representative concentration pathways (RCPs).

Downscaling — the process of deriving localised climate changes from large-scale global climate models.

GCM — global climate model, sometimes also referred to as a generalised circulation model or earth systems model. These are mathematical models that integrate systems of differential equations describing the dynamic processes and interaction between the atmosphere, land and ocean. GCMs typically have a grid resolution in the order of 150 x 250 km and require downscaling for local-scale applications.

Greenhouse gas — greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit thermal infrared radiation. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere.

IPCC — Intergovernmental Panel on Climate Change. The IPCC is an organization of governments that are members of the United Nations or the World Meteorological Organisation. The objective of the IPCC is to provide governments at all levels with scientific information that they can use to develop climate policies.

RCP — representative concentration pathway, a scenario of possible future global atmospheric greenhouse gas and aerosol concentrations, applied in GCMs when projecting future climate change. The number of the RCP (e.g. RCP4.5, RCP8.5) represents the radiative forcing (in watts per square metre of the Earth's surface) that is caused by the additional atmospheric greenhouse gas concentrations, in 2100, under the respective scenario.

Statistical downscaling — a process of inferring high-resolution information from low-resolution information (e.g. developing local-scale weather information from regional-scale generalised circulation model outputs that are statistically consistent with historical observed data).

15. References

Blanchi, R., Lucas, C., Leonard, J. & Finkele, K., 2010, Meteorological conditions and wildfire-related house loss in Australia. *International Journal of Wildland Fire*, 19, 914–926.

Bureau of Meteorology & CSIRO, 2018, *State of the Climate 2018*, Bureau of Meteorology www.bom.gov.au/state-of-the-climate and CSIRO: www.csiro.au/state-of-the-climate (viewed June 2015).

Charles S.P. and Fu G., 2015, *Statistically Downscaled Projections for South Australia*, Goyder Institute for Water Research Technical Report Series No. 15/1, Adelaide, South Australia. http://www.goyderinstitute.org/_r91/media/system/attrib/file/82/CC%20Task%203%20CSIRO%20Final%20Report_web.pdf (viewed June 2020).

Church, J.A., Clark, P.U., Cazenave, A., Gregory, J.M., Jevrejeva, S., Levermann, A., Merrifield, M.A., Milne, G.A., Nerem, R.S., Nunn, P.D., Payne, A.J., Pfeffer, W.T., Stammer, D. & Unnikrishnan, A.S., 2013, Sea Level Change, In: T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex & P. M. Midgley (eds) *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK.

Climate Change in Australia, 2015, http://www.climatechangeinaustralia.gov.au/ (viewed October 2022).

Collins, M., Knutti, R., Arblaster, J., Dufresne, J.-L., Fichefet, T., Friedlingstein, P., Gao, X., Gutowski, W.J., Johns, T., Krinner, G., Shongwe, M., Tebaldi, C., Weaver, A..J. & Wehner, M., 2013, Long-term Climate Change: Projections, Commitments and Irreversibility, In: T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex & P. M. Midgley (eds) *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter12_FINAL.pdf (viewed May 2020)

CSIRO & Bureau of Meteorology, 2015, *Climate Change in Australia Information for Australia's Natural Resource Management Regions:* Technical Report, CSIRO and Bureau of Meteorology, Australia.

DeConto, R.M. & Pollard, D., 2016, Contribution of Antarctica to past and future sea-level rise*, Nature,* 531. DOI: 10.1038/nature17145.

Evans, J.P, Kay, M., Prasad, A. and Pitman, A., 2018, The resilience of Australian wind energy to climate change, *Environmental Research Letters* 13 024014, https://iopscience.iop.org/article/10.1088/1748-9326/aaa632/pdf (viewed March 2020).

Food and Agriculture Organization (FAO) of the United Nations, 1998, *Crop evapotranspiration – Guidelines for computing crop water requirements,* FAO Irrigation and drainage paper 56, FAO, Rome.

Hope, P., Abbs, D., Bhend, J., Chiew, F., Church, J., Ekstrom, M., Kirono, D., Lenton, A., Lucas, C., McInnes, K., Moise, A., Didier, M., Mpelasoka, F., Timbal, B., Webb, L. and Whetton, P., 2015, *Southern and South-Western Flatlands Cluster Report*, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports, M. Ekström, et al. (eds), CSIRO and Bureau of Meteorology, Australia, https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/SSWFLATLANDS_CLUSTER_REPORT.pdf (viewed February 2020).

IPCC, 2014, *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team: R.K. Pachauri & L.A. Meyer (eds)]. IPCC, Geneva, Switzerland.

IPCC, 2018, Summary for Policymakers, In: V. Masson-Delmotte, P. Zhai, H.-O.Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, Maycock, M. Tignor, & T. Waterfield (eds.), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways*, World Meteorological Organization, Geneva, Switzerland.

IPCC, 2021: Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.). Cambridge University Press, Cambridge, United Kingdom.

Le Quéré, C., Andrew, R., Friedlingstein, P., Sitch, S., Hauke, J., Pongratz, J. et al., 2018, Global Carbon Budget 2018, *Earth System Science Data*, 10, 2141-2194, https://doi.org/10.5194/essd-10-2141-2018 (viewed June 2020).

NSW Department of Planning, Industry & Environment and the Climate Change Research Centre, University of New South Wales, 2020, The NSW and ACT Regional Climate Modelling Project: Climate Projections Version 1.5 - Technical Methods Report. NARCliM1.5 Technical Methods Report (nsw.gov.au) (viewed October 2022).

Stafford Smith, M., Horrocks, L., Harvey, A., & Hamilton, C., 2011, Rethinking adaptation for a 4°C world, *Phil. Trans. R. Soc.* A.369196–216, http://doi.org/10.1098/rsta.2010.0277 (viewed April 2020).

Timbal, B., Abbs, D., Bhend, J., Chiew, F., Church, J., Ekstrom, M., Kirono, D., Lenton, A., Lucas, C., McInnes, K., Moise, A., Monselasan, D., Mpelasoka, F., Webb, L., Whetton, P., 2015, *Murray Basin Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*, M. Ekström et al. (eds.), CSIRO and Bureau of Meteorology, Australia https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/MURRAY_BASIN_CLUSTER_REPORT_1.pdf (viewed December 2019).

van Vuuren, D.P., Stehfest, E., den Elzen, M.G.J., Kram, T., van Vliet, J., Deetman, S. et al., 2011, RCP2.6: exploring the possibility to keep global mean temperature increase below 2°C, *Climatic Change* 109: 95.

Watterson, I., Abbs, D., Bhend, J., Chiew, F., Church, J., Ekstrom, M., Kirono, D., Lenton, A., Lucas, C., McInnes, K., Moise, A., Didier, M., Mpelasoka, F., Timbal, B., Webb, L. and Whetton, P., 2015, *Rangelands Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*, M. Ekström et al. (eds.), CSIRO and Bureau of Meteorology, Australia https://www.climatechangeinaustralia.gov.au/media/ccia/2.1.6/cms_page_media/172/RANGELANDS_CLUSTER_REPORT_1.pdf (viewed February 2020).

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