



PROJECTIONS
FOR SELECTED AUSTRALIAN CITIES



Australian Government
Department of the Environment
Bureau of Meteorology

-20° -10° 0° 10° 20° 30° 40° 50°

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PREFACE

Climate change represents a significant challenge to individuals, communities, governments, businesses and the environment. The 2013 Intergovernmental Panel on Climate Change (IPCC) assessment report reviewed and assessed the current state and future projections for the global climate system.

The report concluded that

- the globally averaged surface warming is 0.85 °C from 1880 to 2012. It is very likely that the number of cold days and nights has decreased and the number of warm days and nights has increased on the global scale.
- on a global scale, the ocean warming is largest near the surface, and the upper 75 metres warmed by 0.11 °C per decade over the period 1971 to 2010.
- global-average sea level has risen. The rate of increase is 1.7 mm/year between 1901 and 2010, 2.0 mm/year between 1971 and 2010, and 3.2 mm/year between 1993 and 2010.
- greenhouse gas concentrations have markedly increased as a result of human activities.
- human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes.

- it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.
- continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system.

In recognition of the impact of climate change on the management of Australia's natural resources, the Australian Government developed the Regional Natural Resource Management Planning for Climate Change Fund. This fund has enabled significant research into the impact of the future climate on Australia's natural resources, as well as adaptation opportunities for protecting and managing our land, soil, water, plants and animals. The research was aligned to clusters of Australia's 54 natural resource management (NRM) regions, which are defined by catchments and bioregions. These clusters (Figure 1), formed by logical groupings of recent past climatic conditions and biophysical factors, capture broad patterns of projected change.

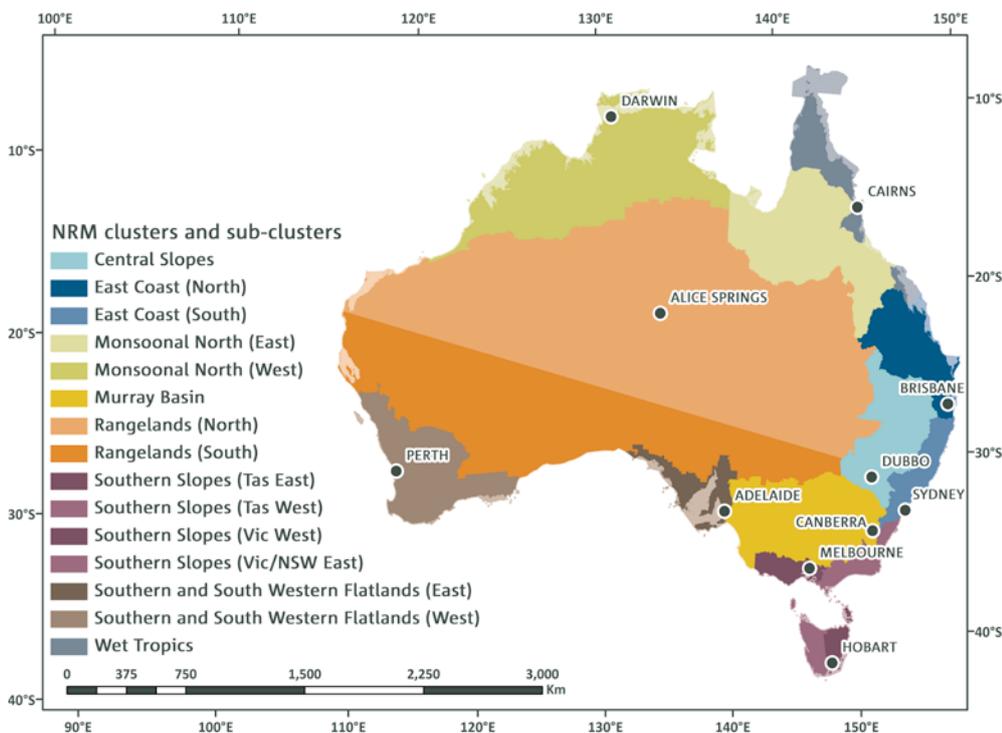


FIGURE 1: SITES AROUND AUSTRALIA FOR WHICH PROJECTIONS ARE SUMMARISED (LIGHTER SHADES DENOTE COASTAL WATERS INCLUDED IN THE CLUSTERS TO ENCOMPASS OFFSHORE ISLANDS).

Along with projections for NRM clusters, significant interest has been expressed in climate change at the city-scale. This report provides climate change projections for 11 cities around Australia (Figure 1), based on average results for the cluster or sub-cluster in which the cities are located. This is a subset of the 14 cities listed in Appendix B of the 2007 CSIRO and Bureau of Meteorology Climate Change in Australia report. Projected changes presented here will be applicable to all other cities and sites in the cluster and sub-clusters.

For this report, the range of projections presented is based on historical and future climate simulations from the CMIP5 model archive. Data sourced from this archive and presented here are from up to 40 models and two of the four emission scenarios defined for the Fifth Assessment Report of the IPCC, called Representative Concentration Pathways (RCPs). Projections for RCP4.5 (intermediate emissions) and RCP8.5 (high emissions) are summarised in this document. More information about climate projection methods is available in the Climate Change in Australia Technical Report (2015, Chapter 6; see below).

Projections for annual-average changes in temperature, rainfall, evapotranspiration, wind speed, solar radiation and relative humidity are given for 20-year periods centred on 2030 (2020-2039) and 2090 (2080-2099) relative to a 20-year period centred on 1995 (1986-2005). In addition, rainfall projections are presented for the different seasons (See Table A for each city).

Projections for sea level rise draw on results from the CMIP5 models and other contributing factors. Methods for calculating projected sea level changes are detailed in the Climate Change in Australia Technical Report (2015, Chapter 8). Projections of future sea level changes are shown for selected locations for 20-year periods centred on 2030 (2020-2039) and 2090 (2080-2099) relative a 20-year period centred on 1995 (1986-2005). Note that the ranges of sea level rise should be considered likely (at least 66 % probability), and that if a collapse in the marine based sectors of the Antarctic ice sheet were initiated, these projections could be several tenths of a metre higher by late in the century.

To illustrate what the CMIP5 projected warming implies for changes to the occurrence of hot days and frost days,

a simple example is given for each city. The ‘change factor approach’ is used (see Section 6.3.1. in the 2015 Climate Change in Australia Technical Report), whereby model-simulated changes in monthly-average temperature are applied to an observed daily temperature time series for the city. In the original and modified time series, the frequency of extreme temperature exceedance can be compared. For all cities (where the relevant threshold is currently exceeded), days with maximum temperature above 35 and 40 °C, and frost risk days (minimum temperature less than 2 °C) are provided for a 30-year period centred on 1995 (1981-2010), and for 30-year periods centred on 2030 and 2090 under RCPs 4.5 and 8.5 (see Table B for each city).

Confidence ratings (highlighted using italics in this document) are based on five lines of evidence: (1) evaluation of global climate model ability to simulate current climate, (2) agreement on the magnitude and direction of change amongst global climate model results, (3) agreement between global climate model projections and experiments incorporating downscaling approaches, (4) understanding of physical processes, and (5) consistency between projections and observed trends. For more information about confidence ratings refer to Section 6.4 of the 2015 Technical Report (see below).

It is important to note that people living in large cities can be more susceptible than non-urban dwellers to the effects of heatwaves as a result of the urban heat island (UHI) effect. This is caused by the prevalence in cities of heat-absorbing materials such as dark coloured pavements and roofs, concrete, urban canyons trapping hot air, and a lack of shade and green space in dense urban environments. It can result in substantially higher temperatures (particularly overnight) than surrounding non-urban areas. For more information on the UHI, see the State of Australian Cities (2013) report <http://www.infrastructure.gov.au/infrastructure/pab/soac>.

More information relating to the projections reported here, including access to the Technical Report, is available at www.climatechangeinaustralia.gov.au.

Guidance on how to use climate information in impact assessments is provided in Chapter 9 of the Technical Report.

ADELAIDE

These projections are based on average results for the sub-cluster in which Adelaide is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected (*very high confidence*) with fewer frosts (*high confidence*).
- A continuation of the trend of decreasing winter rainfall is projected (*high confidence*). Spring rainfall decrease is also expected (*high confidence*). Changes in other seasons are unclear.
- Increased evapotranspiration is projected (*high confidence*).
- Increased intensity of extreme daily rainfall events is projected (*high confidence*).
- Mean sea level will continue to rise and the height of extreme sea-level events will also increase (*very high confidence*).
- A harsher fire-weather climate is projected (with *high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE SUB-CLUSTER IN WHICH ADELAIDE IS LOCATED, RELATIVE TO THE PERIOD 1986-2005. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.7 (0.5 to 0.9)	1.5 (1 to 1.9)	2.9 (2.4 to 3.9)
Rainfall (%)	Annual	-4 (-13 to +4)	-7 (-18 to +3)	-9 (-37 to +6)
	Summer	0 (-24 to +30)	-3 (-20 to +13)	-3 (-26 to +22)
	Autumn	-1 (-22 to +18)	-2 (-26 to +17)	+2 (-33 to +33)
	Winter	-6 (-16 to +6)	-9 (-24 to +2)	-19 (-43 to -3)
	Spring	-5 (-20 to +10)	-14 (-26 to +3)	-19 (-50 to +9)
Evapotranspiration (%)	Annual	2.5 (1.4 to 3.5)	5.1 (3.4 to 7.3)	10.2 (7.4 to 15.7)
Wind speed (%)	Annual	-0.9 (-2.3 to +1.1)	-1.4 (-3.8 to +0.1)	-1.8 (-4.4 to +0)
Solar radiation (%)	Annual	+0.6 (-0.4 to +1.4)	+1.1 (-0.1 to +2.3)	+1.5 (-0.1 to +3.6)
Relative humidity (%) (absolute)	Annual	-0.3 (-1 to +0.4)	-0.8 (-2 to -0.1)	-1.6 (-3.2 to -0.3)
Sea level rise (m)* (Port Adelaide)	Annual	0.12 (0.08 to 0.16)	0.45 (0.28 to 0.63)	0.60 (0.39 to 0.83)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C AND BELOW 2 °C (FROST RISK) FOR ADELAIDE (CBD). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	20	26 (24 to 29)	32 (29 to 38)	47 (38 to 57)
Over 40 °C	3.7	5.9 (4.7 to 7.2)	9.0 (6.8 to 12)	16 (12 to 22)
Below 2 °C	1.1	0.5 (0.8 to 0.4)	0.2 (0.4 to 0.1)	0.0 (0.0 to 0.0)



ALICE SPRINGS

These projections are based on average results for the sub-cluster in which Alice Springs is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected (with *very high confidence*). Fewer frosts are projected with *high confidence*.
- Changes to annual/seasonal-average rainfall are possible but unclear.
- Increased intensity of extreme daily rainfall events is projected (with *high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.
- Increased evapotranspiration is projected (*high confidence*)

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION AND RELATIVE HUMIDITY FOR THE SUB-CLUSTER IN WHICH ALICE SPRINGS IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS.

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	1 (0.6 to 1.5)	2.1 (1.5 to 3.1)	4.4 (3.1 to 5.6)
Rainfall (%)	Annual	-2 (-11 to +7)	-5 (-16 to +9)	-4 (-31 to +19)
	Summer	0 (-12 to +8)	-3 (-17 to +10)	+4 (-21 to +26)
	Autumn	-1 (-24 to +22)	-2 (-22 to +33)	+6 (-40 to +39)
	Winter	-7 (-27 to +19)	-11 (-32 to +7)	-22 (-58 to +35)
	Spring	-1 (-25 to +22)	-9 (-32 to +12)	-14 (-53 to +26)
Evapotranspiration (%)	Annual	2.4 (1.1 to 4.5)	5.1 (3.3 to 8.4)	11.7 (6.7 to 17.7)
Wind speed (%)	Annual	-0.3 (-2.5 to +0.8)	-0.5 (-2.6 to +1.6)	+0.2 (-4.8 to +2.4)
Solar radiation (%)	Annual	0 (-0.9 to +1)	0 (-1.4 to +1.5)	-0.8 (-3.3 to +1.2)
Relative humidity (%) (absolute)	Annual	-0.3 (-2.1 to +0.8)	-1.1 (-4.8 to +0.1)	-1.9 (-7.3 to +1.1)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C AND BELOW 2 °C (FROST RISK) FOR ALICE SPRINGS (AIRPORT). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	94	113 (104 to 122)	133 (115 to 152)	168 (145 to 193)
Over 40 °C	17	31 (24 to 40)	49 (33 to 70)	83 (58 to 114)
Below 2 °C	33	24 (28 to 19)	13 (20 to 8.4)	2.1 (6.0 to 0.8)



BRISBANE

These projections are based on average results for the sub-cluster in which Brisbane is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected (*very high confidence*). Fewer frosts are projected (*high confidence*).
- Annual/seasonal-average rainfall changes are possible but unclear.
- Increased evapotranspiration is projected (*high confidence*).
- Increased intensity of extreme daily rainfall events is projected, with *high confidence*.
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
- A harsher fire-weather climate is projected (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE SUB-CLUSTER IN WHICH BRISBANE IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.9 (0.6 to 1.2)	1.8 (1.2 to 2.6)	3.7 (2.5 to 4.7)
Rainfall (%)	Annual	-4 (-16 to +4)	-9 (-21 to +7)	-16 (-32 to +17)
	Summer	-5 (-17 to +16)	-5 (-22 to +11)	-6 (-29 to +28)
	Autumn	-5 (-23 to +15)	-6 (-28 to +19)	-12 (-36 to +30)
	Winter	-5 (-27 to +8)	-12 (-35 to +7)	-17 (-49 to +18)
	Spring	-5 (-23 to +16)	-14 (-36 to +5)	-28 (-53 to +3)
Evapotranspiration (%)	Annual	3.5 (2.1 to 4.9)	7.4 (4.3 to 10.6)	14.1 (8.2 to 19)
Wind speed (%)	Annual	0 (-2.1 to +1.4)	+0.5 (-2.5 to +3.6)	+2.2 (-1.2 to +6.5)
Solar radiation (%)	Annual	+0.5 (-0.7 to +1.7)	+1.1 (-0.5 to +2.8)	+0.8 (-2.1 to +3.1)
Relative humidity (%) (absolute)	Annual	-0.5 (-1.8 to +1.3)	-0.9 (-3.7 to +0.7)	-1.2 (-3.5 to +2.5)
Sea level rise (m)* (Brisbane)	Annual	0.13 (0.09 to 0.18)	0.47 (0.31 to 0.65)	0.65 (0.45 to 0.87)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C FOR AMBERLEY (INLAND FROM BRISBANE). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	12	18 (15 to 22)	27 (21 to 42)	55 (37 to 80)
Over 40 °C	0.8	1.2 (1.1 to 1.6)	2.1 (1.5 to 3.9)	6.0 (2.9 to 11)



CAIRNS

These projections are based on average results for the cluster in which Cairns is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with *very high confidence*.
- Changes to annual/seasonal-average rainfall are possible but unclear.
- Increased intensity of extreme daily rainfall events is projected, with *high confidence*.
- Increased evapotranspiration is projected (*high confidence*).
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
- Fewer but more-intense tropical cyclones by the end of the century (*medium confidence*), but with notable decadal variability.
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE CLUSTER IN WHICH CAIRNS IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.7 (0.6 to 1)	1.4 (1 to 2)	2.9 (2.3 to 3.9)
Rainfall (%)	Annual	0 (-11 to +6)	-2 (-12 to +8)	-2 (-26 to +21)
	Wet season (Nov-Apr)	0 (-13 to +9)	0 (-12 to +10)	+1 (-27 to +17)
	Dry Season (May-Oct)	-3 (-21 to +12)	-6 (-29 to +24)	-6 (-46 to +50)
Evapotranspiration (%)	Annual	2.9 (1.1 to 4.4)	5.1 (3 to 9.3)	9.8 (5.9 to 17)
Wind speed (%)	Annual	+0.4 (-0.7 to +3.8)	+1 (-1.6 to +7.1)	+2.2 (-0.6 to +7.7)
Solar radiation (%)	Annual	0 (-0.6 to +1.2)	+0.1 (-1.6 to +2.2)	-0.3 (-4.7 to +2.2)
Relative humidity (%) (absolute)	Annual	-0.1 (-0.9 to +0.6)	0 (-1 to +0.7)	+0.1 (-1.9 to +1.5)
Sea level rise (m)* (Cairns)	Annual	0.13 (0.09 to 0.17)	0.48 (0.31 to 0.65)	0.65 (0.44 to 0.87)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C FOR CAIRNS (AIRPORT). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	3	5.5 (4.4 to 7.9)	11 (7.4 to 22)	48 (24 to 105)
Over 40 °C	0	0.1 (0.1 to 0.2)	0.3 (0.2 to 0.4)	0.7 (0.5 to 2.0)



CANBERRA

These projections are based on average results for the cluster in which Canberra is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence*.
- By late in the century (2090), less rainfall is projected during the winter and spring with *high confidence*.
- There is *medium confidence* that summer and autumn rainfall will remain unchanged.
- Increased evapotranspiration is projected (*high confidence*).
- Extreme daily rainfall intensity is projected to increase, with *high confidence*.
- A harsher fire-weather climate in the future (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION AND RELATIVE HUMIDITY FOR THE CLUSTER IN WHICH CANBERRA IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS.

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.8 (0.6 to 1.1)	1.8 (1.3 to 2.4)	3.8 (2.7 to 4.5)
Rainfall (%)	Annual	-2 (-9 to +5)	-6 (-16 to +4)	-5 (-27 to +9)
	Summer	0 (-15 to +13)	-2 (-17 to +10)	+6 (-13 to +27)
	Autumn	-1 (-24 to +12)	-3 (-23 to +18)	0 (-29 to +26)
	Winter	-3 (-15 to +8)	-8 (-21 to +7)	-13 (-38 to +4)
	Spring	-3 (-16 to +12)	-11 (-28 to +5)	-12 (-48 to +6)
Evapotranspiration (%)	Annual	2.6 (1 to 4.5)	5.4 (2.9 to 8.5)	12 (7.6 to 18.1)
Wind speed (%)	Annual	-1 (-2.9 to +1.5)	-1.3 (-4.6 to +0.8)	-0.6 (-5 to +2.6)
Solar radiation (%)	Annual	+0.7 (-0.1 to +1.7)	1.5 (0.1 to 3.2)	+2.2 (0 to +4.9)
Relative humidity (%) (absolute)	Annual	-0.7 (-1.6 to +0.5)	-1.6 (-4.1 to -0.3)	-2.7 (-5.8 to -0.8)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C AND BELOW 2 °C (FROST RISK) FOR CANBERRA (AIRPORT). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	7.1	12 (9.4 to 14)	17 (13 to 23)	29 (22 to 39)
Over 40 °C	0.3	0.6 (0.4 to 0.8)	1.4 (0.8 to 2.8)	4.8 (2.3 to 7.5)
Below 2 °C	91	81 (87 to 76)	68 (75 to 61)	43 (52 to 35)



DARWIN

These projections are based on average results for the sub-cluster in which Darwin is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with *very high confidence*.
- Changes to annual/seasonal-average rainfall are possible but unclear.
- Increased intensity of extreme daily rainfall events is projected, with *high confidence*.
- Increased evapotranspiration is projected (*high confidence*).
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
- Fewer but more-intense tropical cyclones by the end of the century (*medium confidence*), but with notable decadal variability.
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE SUB-CLUSTER IN WHICH DARWIN IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.9 (0.6 to 1.3)	1.8 (1.3 to 2.8)	3.7 (2.8 to 5.1)
Rainfall (%)	Annual	0 (-11 to +6)	-1 (-13 to +8)	+4 (-24 to +19)
	Wet season (Nov-Apr)	0 (-8 to +6)	0 (-11 to +8)	+4 (-23 to +19)
	Dry Season (May-Oct)	-5 (-35 to +19)	-6 (-30 to +22)	-4 (-45 to +44)
Evapotranspiration (%)	Annual	3.2 (1.4 to 4)	6.8 (4 to 8.5)	12.2 (7.8 to 16.7)
Wind speed (%)	Annual	-0.4 (-2.5 to +0.5)	-0.9 (-3.5 to +1.7)	+0.2 (-3.3 to +1.8)
Solar radiation (%)	Annual	-0.1 (-1 to +1)	-0.2 (-1.7 to +1.9)	-0.6 (-3.5 to +1.5)
Relative humidity (%) (absolute)	Annual	+0.1 (-1.6 to +0.7)	-0.7 (-3.5 to +0.6)	-0.9 (-6.3 to +1.4)
Sea level rise (m)* (Darwin)	Annual	0.12 (0.08 to 0.16)	0.47 (0.30 to 0.65)	0.62 (0.41 to 0.85)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C FOR DARWIN (AIRPORT). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	11	43 (25 to 74)	111 (54 to 211)	265 (180 to 322)
Over 40 °C	0	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.2)	1.3 (0.2 to 11)



DUBBO

These projections are based on average results for the cluster in which Dubbo is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with very high confidence. Fewer frosts are projected with *high confidence*.
- Average winter rainfall is projected to decrease by late in the century with *high confidence*. There is only

medium confidence in spring decrease. Changes in summer and autumn are possible but unclear.

- Increased intensity of extreme daily rainfall events is projected, with *high confidence*.
- Increased evapotranspiration is projected (*high confidence*).
- A harsher fire-weather climate in the future (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION AND RELATIVE HUMIDITY FOR THE CLUSTER IN WHICH DUBBO IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS.

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	1 (0.6 to 1.3)	2.1 (1.4 to 2.7)	4.2 (3 to 5.4)
Rainfall (%)	Annual	-2 (-11 to +7)	-4 (-16 to +6)	-6 (-23 to +18)
	Summer	+1 (-9 to +16)	0 (-14 to +17)	+10 (-14 to +29)
	Autumn	-5 (-22 to +19)	-4 (-28 to +23)	-4 (-35 to +27)
	Winter	-3 (-20 to +11)	-10 (-24 to +9)	-17 (-39 to +15)
	Spring	-2 (-18 to +12)	-8 (-26 to +12)	-14 (-40 to +11)
Evapotranspiration (%)	Annual	3.3 (1.6 to 4.8)	6.8 (4.2 to 10.8)	12.5 (9.8 to 18.1)
Wind speed (%)	Annual	-1 (-5.3 to +1.5)	-0.7 (-5.3 to +1.7)	+1.4 (-3.5 to +6.8)
Solar radiation (%)	Annual	+0.5 (-0.7 to +1.8)	+1.3 (-0.3 to +2.6)	+0.9 (-1.7 to +3.3)
Relative humidity (%) (absolute)	Annual	-0.6 (-2.5 to +0.9)	-1.6 (-4.1 to -0.3)	-2.4 (-7.4 to +1.1)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C AND BELOW 2 °C (FROST RISK) FOR DUBBO (AIRPORT). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	22	31 (26 to 37)	44 (36 to 54)	65 (49 to 85)
Over 40 °C	2.5	3.9 (3.2 to 5.6)	7.8 (5.1 to 12)	17 (9.9 to 26)
Below 2 °C	39	30 (34 to 27)	21 (26 to 13)	6.0 (10 to 2.4)



HOBART

These projections are based on average results for the sub-cluster in which Hobart is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence*.
- More rainfall in winter is projected with *medium confidence*, with a decrease in spring. Changes to summer and autumn rainfall are possible but less clear.
- Increased evapotranspiration is projected (*high confidence*).
- Increased intensity of extreme daily rainfall events is projected, with *high confidence*.
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
- A harsher fire-weather climate in the future (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE SUB-CLUSTER IN WHICH HOBART IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.6 (0.4 to 1)	1.4 (0.9 to 1.9)	2.9 (2.3 to 4)
Rainfall (%)	Annual	+1 (-6 to +4)	-1 (-8 to +5)	-2 (-18 to +9)
	Summer	-3 (-16 to +9)	-4 (-18 to +11)	-6 (-22 to +10)
	Autumn	0 (-7 to +11)	-2 (-8 to +10)	+1 (-23 to +13)
	Winter	+1 (-6 to +10)	+2 (-6 to +13)	+6 (-11 to +19)
	Spring	-3 (-11 to +5)	-6 (-15 to +3)	-9 (-33 to +3)
Evapotranspiration (%)	Annual	3 (1.3 to 5.2)	6.4 (3.4 to 10.4)	14.1 (7.9 to 23.3)
Wind speed (%)	Annual	+0.9 (-1.5 to +2.5)	+0.2 (-1.8 to +2.6)	+2.1 (-1.5 to +4.3)
Solar radiation (%)	Annual	+0.8 (-0.4 to +1.9)	1.7 (0 to 3.6)	+3.2 (-0.5 to +7.6)
Relative humidity (%) (absolute)	Annual	-0.3 (-0.7 to +0.1)	-0.5 (-1.1 to 0)	-1 (-2.1 to -0.5)
Sea level rise (m)* (Spring Bay)	Annual	0.13 (0.09 to 0.18)	0.48 (0.31 to 0.66)	0.66 (0.45 to 0.89)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 °C AND BELOW 2 °C (FROST RISK) FOR HOBART (BATTERY POINT). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	1.6	2.0 (1.9 to 2.1)	2.6 (2.0 to 3.1)	4.2 (3.2 to 6.3)
Below 2 °C	9.1	5.8 (6.9 to 3.7)	2.1 (4.1 to 1.1)	0.3 (0.6 to 0.1)



MELBOURNE

These projections are based on average results for the sub-cluster in which Melbourne is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence*.
- Generally less rainfall in winter and spring is projected with *high confidence*. Changes to summer and autumn rainfall are possible but less clear.
- Increased evapotranspiration is projected (*high confidence*).
- Increased intensity of extreme daily rainfall events is projected, with *high confidence*.
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
- A harsher fire-weather climate is projected (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE SUB-CLUSTER IN WHICH MELBOURNE IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.6 (0.5 to 0.9)	1.5 (1.1 to 1.9)	3 (2.4 to 3.8)
Rainfall (%)	Annual	-2 (-8 to +3)	-7 (-15 to +3)	-9 (-27 to +4)
	Summer	-2 (-20 to +16)	-3 (-24 to +10)	-5 (-28 to +17)
	Autumn	0 (-20 to +14)	-4 (-17 to +14)	-5 (-30 to +15)
	Winter	-3 (-10 to +7)	-4 (-14 to +7)	-10 (-25 to +6)
	Spring	-5 (-14 to +6)	-10 (-24 to -3)	-19 (-43 to -5)
Evapotranspiration (%)	Annual	2.7 (1.8 to 4.8)	6.5 (3.7 to 9.9)	12.5 (9.2 to 21.4)
Wind speed (%)	Annual	-0.2 (-3.3 to +1)	-1.1 (-5.2 to +0.9)	-1.7 (-5.9 to +1.7)
Solar radiation (%)	Annual	0.8 (0.1 to 2.3)	2 (0.2 to 3.6)	3.1 (0.9 to 7)
Relative humidity (%) (absolute)	Annual	-0.4 (-1.1 to +0.5)	-0.9 (-2.2 to +0.1)	-1.8 (-3.8 to -0.6)
Sea level rise (m)* (Stony Point)	Annual	0.11 (0.07 to 0.16)	0.44 (0.27 to 0.62)	0.59 (0.38 to 0.81)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 °C AND BELOW 2 °C (FROST RISK) FOR MELBOURNE (CBD). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	11	13 (12 to 15)	16 (15 to 20)	24 (19 to 32)
Over 40 °C	1.6	2.4 (2.1 to 3.0)	3.6 (2.8 to 4.9)	6.8 (4.6 to 11)
Below 2 °C	0.9	0.6 (0.8 to 0.4)	0.2 (0.3 to 0.1)	0.0 (0.0 to 0.0)



PERTH

These projections are based on average results for the sub-cluster in which Perth is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence*.
- A continuation of the trend of decreasing winter rainfall is projected with *high confidence*. Spring rainfall decreases are also projected with *high confidence*. Changes in other seasons are unclear.
- Increased evapotranspiration is projected (*high confidence*).
- Increased intensity of extreme daily rainfall events is projected, with *medium confidence*.
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
- A harsher fire-weather climate in the future (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE SUB-CLUSTER IN WHICH PERTH IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.8 (0.6 to 1)	1.7 (1.1 to 2.1)	3.5 (2.6 to 4.2)
Rainfall (%)	Annual	-6 (-15 to -1)	-12 (-22 to -1)	-18 (-37 to -5)
	Summer	-8 (-31 to +17)	-4 (-29 to +28)	-5 (-31 to +36)
	Autumn	-4 (-20 to +10)	-4 (-26 to +12)	-6 (-32 to +13)
	Winter	-7 (-18 to +4)	-14 (-28 to -4)	-29 (-44 to -15)
	Spring	-11 (-23 to +4)	-19 (-36 to +1)	-36 (-59 to -14)
Evapotranspiration (%)	Annual	2.5 (1.2 to 3.5)	5.4 (3.4 to 7.2)	10.3 (7.1 to 15.2)
Wind speed (%)	Annual	-0.1 (-1.7 to +1.1)	-0.3 (-2.6 to +1.4)	+0.3 (-2.7 to +3.3)
Solar radiation (%)	Annual	+0.6 (-0.4 to +1.6)	1 (0 to 2.1)	+1 (-0.6 to +3)
Relative humidity (%) (absolute)	Annual	-0.6 (-1.5 to +0.1)	-1.2 (-2.3 to 0)	-2.2 (-3.8 to -1)
Sea level rise (m)* (Fremantle)	Annual	0.12 (0.07 to 0.16)	0.46 (0.28 to 0.65)	0.61 (0.39 to 0.84)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C AND BELOW 2 °C (FROST RISK) FOR PERTH (AIRPORT). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH AND 90TH PERCENTILE PROJECTIONS TO OBSERVED DAILY TEMPERATURE DATA FOR 1981-2010 (ACORN-SAT).

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	28	36 (33 to 39)	43 (37 to 52)	63 (50 to 72)
Over 40 °C	4	6.7 (5.4 to 7.5)	9.7 (6.9 to 13)	20 (12 to 25)
Below 2 °C	3.4	2.1 (2.5 to 1.4)	0.9 (1.3 to 0.7)	0.1 (0.4 to 0.0)



SYDNEY

These projections are based on average results for the sub-cluster in which Sydney is located (See Figure 1). Projected changes presented here will be applicable to all other cities and sites in the sub-cluster.

- Average temperatures will continue to increase in all seasons (*very high confidence*).
- More hot days and warm spells are projected with *very high confidence*. Fewer frosts are projected with *high confidence*.
- Decreases in winter rainfall are projected with *medium confidence*. Changes in other seasons are possible but unclear.
- Increased evapotranspiration is projected (*high confidence*).
- Increased intensity of extreme daily rainfall events is projected, with *high confidence*.
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (*very high confidence*).
- A harsher fire-weather climate is projected (*high confidence*).
- On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

TABLE A: PROJECTED CHANGES FOR 2030 AND 2090 FOR AVERAGE TEMPERATURE, RAINFALL, EVAPOTRANSPIRATION, WIND SPEED, SOLAR RADIATION, RELATIVE HUMIDITY AND SEA LEVEL RISE FOR THE SUB-CLUSTER IN WHICH SYDNEY IS LOCATED, RELATIVE TO THE 1986-2005 AVERAGE. THE PROJECTIONS HAVE BEEN DERIVED FROM THE AVAILABLE GLOBAL CLIMATE MODEL SIMULATIONS IN THE CMIP5 ARCHIVE (UP TO 40 MODELS) DRIVEN BY RCP4.5 AND RCP8.5 (INTERMEDIATE AND HIGH EMISSION SCENARIOS FOR GREENHOUSE GASES AND AEROSOLS). FOR 2030, RESULTS FOR ALL RCP'S ARE SIMILAR SO ONLY RCP4.5 VALUES ARE SHOWN. THE MEDIAN PROJECTION IS SHOWN WITH THE 10TH TO 90TH PERCENTILE RANGE IN BRACKETS (*5TH TO 95TH FOR SEA LEVEL RISE PROJECTIONS).

VARIABLE	SEASON	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.9 (0.6 to 1.1)	1.8 (1.3 to 2.5)	3.7 (2.9 to 4.6)
Rainfall (%)	Annual	-3 (-10 to +6)	-2 (-16 to +9)	-3 (-20 to +16)
	Summer	+1 (-10 to +15)	0 (-15 to +19)	+11 (-12 to +27)
	Autumn	-3 (-22 to +15)	-1 (-22 to +18)	-2 (-28 to +20)
	Winter	-5 (-18 to +14)	-8 (-24 to +7)	-17 (-31 to +1)
	Spring	-1 (-19 to +12)	-6 (-23 to +9)	-8 (-30 to +14)
Evapotranspiration (%)	Annual	3.4 (2.3 to 4.4)	7.8 (5.3 to 9.5)	14.3 (10.1 to 18.1)
Wind speed (%)	Annual	-1.1 (-2.9 to +0.5)	-1 (-4.2 to +0.2)	-1.1 (-6.9 to +4.2)
Solar radiation (%)	Annual	+0.5 (-0.5 to +1.9)	+1.5 (-0.3 to +3.7)	+1.3 (-1.2 to +3.4)
Relative humidity (%) (absolute)	Annual	-0.5 (-1.6 to +0.8)	-1 (-3.1 to +0.3)	-1.5 (-3.8 to +1.3)
Sea level rise (m)* (Sydney)	Annual	0.13 (0.09 to 0.18)	0.47 (0.30 to 0.65)	0.66 (0.45 to 0.88)

TABLE B: CURRENT AVERAGE (1981–2010) ANNUAL NUMBER OF DAYS ABOVE 35 AND 40 °C FOR SYDNEY (OBSERVATORY HILL). ESTIMATES FOR 30-YEAR PERIODS CENTRED ON 2030 (RCP4.5) AND 2090 (RCP4.5 AND RCP8.5) ARE DERIVED BY APPLYING THE MEDIAN, 10TH PERCENTILE AND 90TH PERCENTILE PROJECTIONS TO ACORN-SAT DAILY TEMPERATURE DATA FOR 1981-2010.

THRESHOLD	CURRENT	2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Over 35 °C	3.1	4.3 (4.0 to 5.0)	6.0 (4.9 to 8.2)	11 (8.2 to 15)
Over 40 °C	0.3	0.5 (0.5 to 0.8)	0.9 (0.8 to 1.3)	2.0 (1.3 to 3.3)





-20° -10° 0° 10° 20° 30° 40° 50°

