Climate change in southern South Australia and western Victoria

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February 2009

A report prepared for
Maunsell AECOM

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CONTENTS

EXECUTIVE SUMMARY

Maunsell AECOM is doing an assessment of the likely impacts of climate change on ETSA Utilities, CitiPower Pty and Powercor Australia Ltd's assets and operations over the next regulatory period of 2010-2015. These assets are based in southern South Australia and western Victoria, where climate change is likely to make conditions warmer and drier in future. Consequently, Maunsell asked CSIRO to assess recent trends and projected changes in temperatures, dry days and wind gusts at three sites in southern South Australia (Adelaide, Mt Gambier and Woomera) and four sites in western Victoria (Mildura, Cape Otway, Ballarat and Melbourne). This report includes:

- Background information about observed climate change, climate models, emission scenarios, and assumptions and limitations affecting the projections;
- Annual and seasonal trends in daily minimum and daily maximum temperatures for 1980-2007;
- Extrapolation of minimum and maximum temperature trends for 1980-2007 to 2015 and 2030, and comparison with projections based on four climate models;
- A comparison of present (1981-2000) and projected annual average number of hot days (and 3 to 5-day spells) over 30, 35 and 40°C and hot nights over 25 and 30°C for 20-year periods centred on 2015 and 2030;
- Trends in the intensity of annual and seasonal peak wind gusts during 1980-2007;
- A comparison of present (1981-2000) and projected changes in the frequency of wind gusts over 40, 45, 51, 63, 76, 90, 104, 115, 138 km/hr for 20-year periods centred on 2015 and 2030;
- Trends in annual and seasonal average numbers of dry days (less than 1 mm) during 1980-2007;
- A comparison of present (1981-2000) and projected changes in average numbers of dry days (less than 1 mm) and dry spells (10, 20, 30 and 40 consecutive days with less than 1 mm) for 20-year periods centred on 2015 and 2030.

Observed climate change

Australian-average annual temperatures have increased by 0.9ºC since 1910. Most of this warming has occurred since 1950, with greatest warming in the east and least warming in the north-west. The number of hot days and nights has increased and the number of cold days and nights has declined. Most of eastern and south-western Australia has become drier since 1950, with greater rainfall in the north-west. Wind-speeds have declined over most of Australia since 1975.

Climate models, emission scenarios and limitations of projections

To provide a basis for estimating future climate change, the Intergovernmental Panel on Climate Change (IPCC) prepared greenhouse gas and sulphate aerosol emission scenarios for the 21st century. They were based on a variety of assumptions about demographic, economic and technological factors likely to influence future emissions. The climatic effects of emissions can be simulated using climate models, which are mathematical representations of the Earth's climate system based on well-established laws of physics, such as conservation of mass, energy and momentum. For this report, projections for 20-year periods centred on 2015 and 2030 are generated for the IPCC's A1B emission scenario, which yields mid-range increases in global-average temperature.

The output from 23 climate models is available for research purposes. However, a full set of climate variables is not available for all models. This limits the scope for creating model-specific projections for multiple variables, such as temperature, rainfall and wind-speed. We chose four climate models with different projections of annual-average temperature, wind-speed and rainfall at each site:

- CSIRO Mk3.5: hotter with a large rainfall decrease and a small increase in wind-speed;
- INMCM: hotter with a moderate decrease in rainfall and a tendency for reduced wind-speed;
- MIROC-M: slightly warmer with little change in rainfall and moderate decreases in wind-speed;
- HADGEM1: warmer, with moderate decreases in rainfall and increases in wind-speed.

The CSIRO method for generating model-based projections is designed to extract the underlying multi-decadal trends associated with climate change rather than random yearly-to-decadal climate variability associated with phenomena such as the El Niño Southern Oscillation. This means that projections for 20-year periods centred on 2015 and 2030 describe the average climate, but do not allow for random variability. In reality, changes in average climate will be superimposed on random daily, seasonal and yearly variability that will have significant impacts on extreme events. The extremes in an individual year will be determined by a combination of natural variability and anthropogenic climate change. In this report, when the year 2015 or 2030 is mentioned, this refers to the average climatic conditions for 20 years centred on that year, rather than a single year.

Temperature

Temperatures in southern South Australia and western Victoria have risen over the period 1980-2007. Daily maximum temperatures have risen faster than daily minimum temperatures (except at Cape Otway), with Melbourne having the strongest warming and Mt Gambier and Cape Otway having the weakest warmings.

Based on the four models, projections for 2015 and 2030 are generally consistent with trends over the past 28 years and show an increase in the number of hot days and warm nights (e.g. Adelaide had an average of 18 days over 35°C per year over during 1980-2000, and this average could increase by 1-5 days by 2015, and 3-8 days by 2030). The increases are smallest for the MIROC-M model with low global warming, but they are much larger for the CSIRO Mk3.5 model with high global warming.

Wind gusts

There are mixed trends in wind gust speeds from 1980-2007, with increases in all seasons at Woomera, decreases in all seasons at Mt Gambier, Melbourne and Mildura, and the direction of change varying between seasons at Adelaide. This may be associated with a southward shift in weather systems since the 1970s.

Over the period to 2030, CSIRO Mk3.5, INMCM and MIROC-M collectively suggest a decrease in the frequency of extreme wind-gusts in Adelaide and Mt Gambier, and little change at the other sites. For example, in Adelaide, the present average is 145 days per year with wind gusts over 40 kph, and projections are for 135-145 days by 2015 and 135-146 days by 2030. In contrast, the HADGEM1 model gives increases in the frequency of extreme winds at all sites, e.g. in Adelaide, the average number of days per year with wind gusts over 40 kph is 145-156 days by 2015 and 156-160 days by 2030.

Dry days

The annual number of dry days has increased at all sites from 1980-2007. The trend is 0.18 to 0.79 days per year, with the largest increase at Cape Otway and the smallest at Adelaide and Woomera.

Model based projections show that further increases are likely in future, with an average of 1 to 8 dry more days per year by 2015 at most sites, and an average of 1-13 more dry days per year by 2030. For example, in Adelaide, the present annual average number of dry days increases from 281 at present to 284-286 by 2015, and 284-288 by 2030. The annual average number of 20-day dry-spells also increases slightly at all sites. The MIROC-M model gives smallest increases, while the CSIRO Mk3.5 model gives largest increases.

TECHNICAL SUMMARY

Maunsell AECOM is doing an assessment of the likely impacts of climate change on ETSA Utilities, CitiPower Pty and Powercor Australia Ltd's assets and operations over the next regulatory period of 2010-2015. These assets are based in southern South Australia and western Victoria, where climate change is likely to make conditions warmer and drier in future. Consequently, Maunsell asked CSIRO to assess recent trends and projected changes in temperatures, dry days and wind gusts at three sites in southern South Australia (Adelaide, Mt Gambier and Woomera) and four sites in western Victoria (Mildura, Cape Otway, Ballarat and Melbourne). This report includes:

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- Trends in the intensity of annual and seasonal in peak wind gusts for the period 1980-2007;
- A comparison of present (1981-2000) and projected changes in the frequency of wind gusts over 40, 45, 51, 63, 76, 90, 104, 115, 138 km/hr, for 20-year periods centred on 2015 and 2030;
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Observed climate change

Australian-average annual temperatures have increased by 0.9ºC since 1910. Most of this warming has occurred since 1950, with greatest warming in the east and least warming in the north-west. The number of hot days and nights has increased and the number of cold days and nights has declined. Most of eastern and south-western Australia has become drier since 1950, with greater rainfall in the north-west. Wind-speeds have declined over most of Australia since 1975.

Climate models, emission scenarios and limitations of projections

To provide a basis for estimating future climate change, the IPCC prepared greenhouse gas and sulphate aerosol emission scenarios for the 21st century. They were based on a variety of assumptions about demographic, economic and technological factors likely to influence future emissions. The climatic effects of projected changes in emissions can be simulated using climate models, which are mathematical representations of the Earth’s climate system based on well-established laws of physics, such as conservation of mass, energy and momentum. For this report, projections for 20-year periods centred on 2015 and 2030 are generated for the IPCC’s A1B emission scenario, which yields mid-range increases in global-average temperature.

The output from 23 climate models is available for research purposes. However, a full set of climate variables is not available for all models. This limits the scope for creating model-specific projections for multiple variables such as temperature, rainfall and wind-speed. We chose four climate models with different projections of annual-average temperature, wind-speed and rainfall at each site:

- CSIRO Mk3.5: hotter with a large rainfall decrease and small increases in wind-speed;
- INMCM: warmer with a moderate decrease in rainfall and a tendency for reduced wind-speed;
- MIROC-M: slightly warmer with little change in rainfall and moderate decreases in wind-speed;
- HADGEM1: warmer, with moderate decreases in rainfall and increases in wind-speed.

Compared to the full suite of 23 models with temperature data:

- CSIRO Mk3.5 generally gives exceptionally large increases in temperature;
- HADGEM1 generally gives a response close to the median;
- INMCM generally gives responses well above the median;
- MIROC-M generally gives a response below the median.

Compared to the full suite of 19 models with wind data:

- CSIRO Mk3.5 generally gives increases close to the median;
- HADGEM1 generally gives exceptionally large increases in wind-speed;
- INMCM generally gives decreases close to the median;
- MIROC-M generally gives decreases below the median,

Compared to the full suite of 22 models with rainfall data:

- CSIRO Mk3.5 generally gives exceptionally large decreases in rainfall;
- HADGEM1 generally gives a drying response close to the median;
- INMCM generally gives a drier response further from the median;
- MIROC-M gives a mixture of small decreases and small increases and in general is larger than the median.

Projections for 2015 and 2030 are generated in a 2-stage process. First, for each model, the local change in seasonal average temperature, rainfall and wind-speed is calculated per degree of global warming. Second, these local changes are multiplied by the global warming ranges for the A1B emission scenario in 2015 and 2030, developed by the IPCC. The range of global warming for the A1B scenario is 0.37-0.66^{o}C in 2015 and 0.54 to 1.44^{o}C, relative to 1990. These ranges are factored into low and high projections of climate change for the seven sites in South Australia and Victoria.

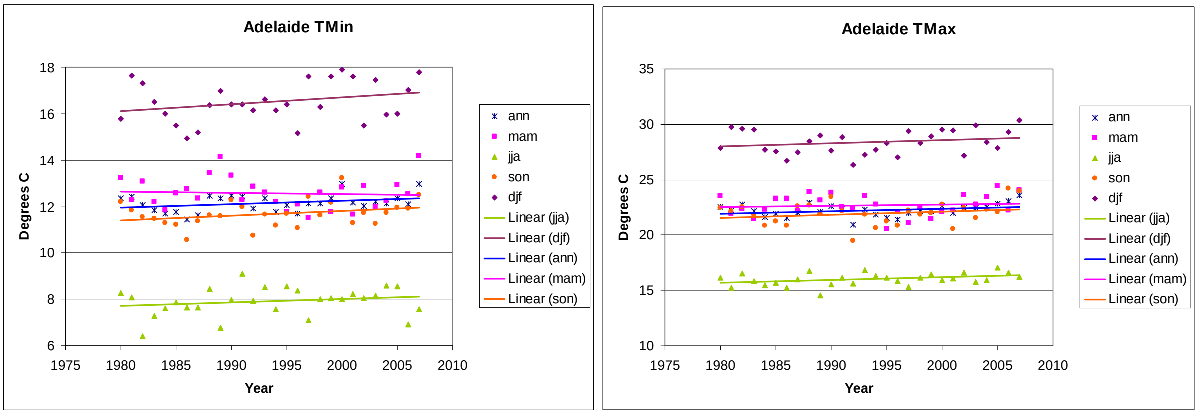
The CSIRO method for generating model-based projections is designed to extract the underlying multi-decadal trends associated with climate change rather than random yearly-to-decadal climate variability associated with phenomena such as the El Niño Southern Oscillation. This means that projections for 20-year periods centred on 2015 and 2030 describe the average climate, but do not allow for random variability. In reality, changes in average climate will be superimposed on random daily, seasonal and yearly variability that will have significant impacts on extreme events. The extremes in an individual year will be determined by a combination of natural variability and anthropogenic climate change. In this report, when the year 2015 or 2030 is mentioned, this refers to the average climatic conditions for 20 years centred on that year, rather than a single year.

Temperature

Observed trends

Temperatures in southern South Australia and western Victoria have risen over the period 1980-2007. Daily maximum temperatures (TMax) have risen faster than daily minimum temperatures (TMin) (except at Cape Otway), with Melbourne having the strongest warming and Mt Gambier and Cape Otway having the weakest warmings. Extrapolation of these trends to 2015 and 2030 are generally consistent with model-based projections.

In Adelaide, the annual mean TMin shows a trend of 0.015^{o}C per year during 1980-2007. TMin shows a positive trend in all seasons except autumn. Largest increases have occurred in spring and summer. Annual TMin was warmest in 2000 and 2007, and coldest in 1986. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent with model projections. Annual mean TMax shows a trend of 0.023^{o}C per year during 1980-2007. TMax shows a positive trend in all seasons, with largest increases in spring and summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of annual the TMax trend to 2015 and 2030 is consistent with model projections.



__Adelaide__ trends in annual (ann) and seasonal (djf, mam, jja, son) TMin and TMax from 1980-2007.

In Mt Gambier, the annual mean TMin shows no trend (-0.001°C per year) during 1980-2007. TMin has a positive trend in summer, negative in autumn and spring, and changes little in winter. Annual TMin was warmest in 1988 and 2007, and coldest in 2006. Extrapolation of the annual TMin trend to 2015 and 2030 is below model projections. Annual mean TMax shows a trend of 0.016°C per year during 1980-2007. TMax shows a positive trend in all seasons, with largest increase in summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is consistent with model projections.

In Woomera, the annual mean TMin shows a trend of 0.014°C per year during 1980-2007, with a positive trend in all seasons except autumn. Largest increases have occurred in summer. Annual TMin was warmest in 2000, and coldest in 1992. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent model projections. Annual mean TMax shows a trend of 0.032°C per year during 1980-2007. TMax shows a positive trend in all seasons, with the largest increases in winter and summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is at the upper end of model projections.

In Ballarat, the annual mean TMin shows a trend of 0.010°C per year during 1980-2007, with a positive trend in all seasons except autumn. The largest increase is in summer (0.045°C per year). Annual TMin was warmest in 2007, and coldest in 1986 and 1994. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent with the low end of model projections (although extrapolation of the autumn trend is below the model projections and extrapolation of the summer trend is above the model projections). Annual mean TMax shows a trend of 0.021°C per year during 1980-2007. TMax shows a positive trend in all seasons, except autumn, with largest increase in summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is consistent with model projections, (although extrapolation of the autumn trend is below the model projections).

In Cape Otway, the annual mean TMin shows a trend of 0.016°C per year during 1980-2007, with a positive trend in all seasons except autumn. The largest increase is in summer. Annual TMin was warmest in 1994, and coldest in 1995. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent with model projections (although extrapolation of the autumn trend is below the model projections and extrapolation of the winter trend is above the model projections). Annual mean TMax shows a trend of -0.005°C per year during 1980-2007. While TMax shows a slight positive trend in winter and summer, this has been offset by a weak negative trend in spring and a stronger one in autumn. Annual TMax was warmest in 1988, and coldest in 1996. Extrapolation of the annual TMax trend to 2015 and 2030 is below model projections.

In Melbourne CBD, the annual mean TMin shows a trend of 0.030°C per year during 1980-2007. TMin has a positive trend in all seasons, with the largest increase is in summer (0.052°C per year). Annual TMin was warmest in 2007, and coldest in 1984. Extrapolation of the annual TMin trend to

2015 is above model projections, but the 2030 extrapolation is consistent with model projections. Annual mean TMax shows a trend of 0.045°C per year during 1980-2007. TMax shows a positive trend in all seasons, with the largest increase in summer. Annual TMax was warmest in 2007, and coldest in 1986. Extrapolation of the annual TMax trend to 2015 and 2030 is above model projections.

In Mildura, the annual mean TMin has a negligible trend during 1980-2007. Decreases in autumn and winter have been offset by increases in spring and summer. Annual TMin was warmest in 1988 and 2007 and coldest in 1984 and 1994. Extrapolation of the annual TMin trend to 2015 and 2030 is below the model projections (although extrapolation of the spring and summer trends are consistent with the model projections). Annual mean TMax shows a trend of 0.029°C per year during 1980-2007. TMax shows a positive trend in all seasons, with largest increases in winter and summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is consistent with model projections.

Projections

Projected increases in TMax and TMin will lead to an increase in the number of hot days and warm nights. This has been quantified for selected threshold temperatures at each site by applying the projected increases in TMax and TMin for 2015 and 2030 to observed daily temperature data for the current climate. The increases appear small for the MIROC-M model with low global warming, but they are much larger for the CSIRO Mk3.5 model with high global warming.

In Adelaide, the annual average number of days over 30°C rises from 53 (at present) to 55-58 by 2015 and 56-64 by 2030. The number of days over 35°C rises from 18 (at present) to 19-23 by 2015 and 21-26 by 2030. The number over 40°C rises from 2.4 (at present) to 2.9-3.6 by 2015 and 3.1-5.0 by 2030. The number of nights over 25°C rises from 5.5 (at present) to 6.0-7.3 by 2015 and 6.5-8.6 by 2030. The number of nights over 30°C rises from 0.2 (at present) to 0.2-0.4 by 2015 and 0.3-0.7 by 2030.

***Adelaide**: Annual average number of days/nights above selected threshold temperatures for present conditions (1981-2000, a 20-year period centred on 1990). Projections for **2015** are given for four climate models: CSIRO Mk3.5, INMCM and MIROC-M. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.*

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	52.9	55.8	58.1	55.6	58.0	54.5	56.0	54.5	56.5
Days > 35°C	17.9	20.4	23.0	20.3	22.9	19.1	20.5	19.1	21.5
Days > 40°C	2.4	3.1	3.6	3.1	3.6	2.9	3.1	2.9	3.2
Nights > 25°C	5.5	6.5	7.3	6.4	7.3	6.0	6.5	6.0	6.7
Nights > 30°C	0.2	0.3	0.4	0.3	0.4	0.2	0.3	0.2	0.3
SDays > 30°C	9.8	10.4	10.9	10.3	10.9	10.1	10.5	10.1	10.6
SDays > 35°C	2.2	2.6	3.0	2.6	3.0	2.4	2.6	2.4	2.9
SDays > 40°C	0.0	0.2	0.3	0.2	0.3	0.1	0.2	0.1	0.2
SNights > 25°C	0.4	0.5	0.6	0.5	0.6	0.4	0.5	0.4	0.5
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

In Mt Gambier, the annual average number of days over 30°C rises from 26 (at present) to 26-28 by 2015 and 27-31 by 2030. The number of days over 35°C rises from 9 (at present) to 9-10 by 2015 and 10-12 by 2030. The number over 40°C rises from 1.3 (at present) to 1.4-1.6 by 2015 and 1.5-2.3 by 2030. The number of nights over 25°C rises from 0.2 (at present) to 0.2-0.3 by 2015 and 0.2-0.4 by 2030. There are no nights over 30°C until at least 2030.

In Woomera, the annual average number of days over 30°C rises from 112 (at present) to 114-125 by 2015 and 117-136 by 2030. The number of days over 35°C rises from 53 (at present) to 55-63 by 2015 and 58-71 by 2030. The number over 40°C rises from 12 (at present) to 13-17 by 2015 and 15-23 by

2030. The number of nights over 25°C rises from 10 (at present) to 10-14 by 2015 and 12-19 by 2030. The number of nights over 30°C rises from 0.3 (at present) to 0.3-0.4 by 2015 and 0.4-1.0 by 2030.

In Ballarat, the annual average number of days over 30°C rises from 22 (at present) to 23-26 by 2015 and 24-32 by 2030. The number of days over 35°C rises from 5 (at present) to 5-7 by 2015 and 6-9 by 2030. The number over 40°C rises from 0.2 (at present) to 0.2-0.3 by 2015 and 0.3-0.7 by 2030. There are no nights over 25°C until at least 2030.

In Cape Otway, the annual average number of days over 30°C rises from 9.3 (at present) to 9.5-10.4 by 2015 and 9.7-12.3 by 2030. The number of days over 35°C rises from 2.5 (at present) to 2.6-2.8 by 2015 and 2.6-3.3 by 2030. The number over 40°C stays around the present average of 0.4. The number of nights over 25°C stays around the present average of 0.3.

In Melbourne, the annual average number of days over 30°C rises from 30 (at present) to 31-35 by 2015 and 33-40 by 2030. The number of days over 35°C rises from 10 (at present) to 10-12 by 2015 and 11-14 by 2030. The number over 40°C rises from 1.5 (at present) to 1.6-2.1 by 2015 and 1.7-3.1 by 2030. The number of nights over 25°C rises from 0.6 (at present) to 0.7-1.0 by 2015 and 0.7-1.4 by 2030. There are no nights over 30°C until at least 2030.

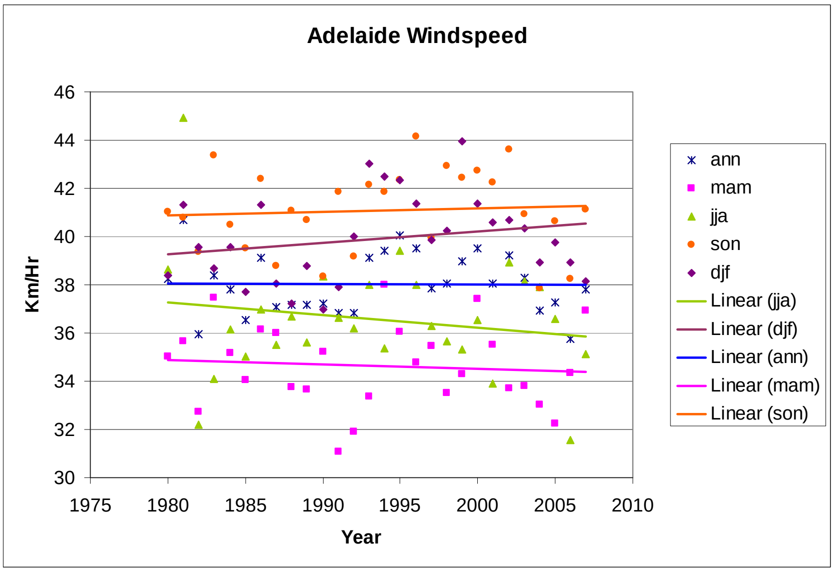
In Mildura, the annual average number of days over 30°C rises from 80 (at present) to 82-92 by 2015 and 86-101 by 2030. The number of days over 35°C rises from 32 (at present) to 33-39 by 2015 and 35-45 by 2030. The number over 40°C rises from 6 (at present) to 7-9 by 2015 and 7-11 by 2030. The number of nights over 25°C rises from 2 (at present) to 2-3 by 2015 and 2-5 by 2030. The number of nights over 30°C stays close to the present average of 0.1 until at least 2030.

Wind gusts

Observed trends

There are mixed trends in wind gust speeds from 1980-2007, with increases in all seasons at Woomera, decreases in all seasons at Mt Gambier, Melbourne and Mildura, and the direction of change varying between seasons at Adelaide. This may be associated with a southward shift in weather systems since the 1970s.

In Adelaide, wind gust speeds have strengthened in spring and summer and decreased in autumn and winter. The trend shows that annual average speed has decreased slightly (-0.003 kph/yr), with largest annual-average gusts in 1981 and smallest in 1982.



***Adelaide** trends in annual (ann) and seasonal (djf, mam, jja, son) wind-gust speed from 1980-2007.*

In Mt Gambier, wind gust speeds have weakened in all seasons. The trend shows that annual average speed has declined by 0.047 kph/yr. The largest gusts occurred in 1981 and smallest in 1985.

In Woomera, wind gust speeds have strengthened in all seasons. The trend shows that annual average has increased by 0.077 kph/yr. The largest gusts occurred in 1986 and smallest in 1980.

In Melbourne, wind gust speeds have weakened in all seasons, except summer (in which negligible change has occurred). The trend shows that annual average speed has declined by 0.058 kph/yr. The largest gusts occurred in 1980 and smallest in 1997.

In Mildura, wind gust speeds have weakened in all seasons. The trend shows that annual average speed has declined by 0.137 kph/yr. The largest gusts occurred in 1985 and smallest in 1993.

Projections

Using wind-speed output from the four climate models, seasonal mean projections for 2015 and 2030 at each site have been applied to daily wind gust data from 1981-2000 in order to estimate the frequency of exceeding specific wind-speed thresholds. At most sites, MIROC-M gives the greatest decreases while HADGEM1 gives the largest increases.

In Adelaide, the present average is 145 days per year with wind gusts over 40 kph, projected to become 135-156 days by 2015, and 135-160 days by 2030. The present average is 3.1 days per year over 76 kph, projected to become 1.8-3.9 days by 2015, and 1.7-4.9 days by 2030.

Adelaide: *Annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on* ***2015****, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming****.***

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
(kph)		Low	High	Low	High	Low	High	Low	High
Days > 40	145.1	140.7	139.6	145.1	135.3	140.7	135.6	145.1	156.3
Days > 45	86.7	94.6	92.6	92.2	97.5	86.7	84.8	101.4	101.4
Days > 51	54.3	53.4	53.3	54.3	53.3	51.9	48.6	57.3	62.3
Days > 63	14.6	12.9	12.7	13.4	13.4	11.9	11.1	14.1	16.5
Days > 76	3.1	2.5	2.4	2.6	2.3	2.3	1.8	3.6	3.9
Days > 90	0.5	0.4	0.4	0.4	0.5	0.4	0.4	0.6	0.6
Days > 104	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Days > 115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Days > 138	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

In Mt Gambier, the present average of 209 days per year over 40 kph is projected to become 205-226 days by 2015, and 197-234 days by 2030. The present average of 12.2 days per year over 76 kph is projected to become 9.9-12.8 days by 2015, and 8.5-17.5 days by 2030.

In Woomera, the present average of 216 days per year over 40 kph is projected to become 207-223 days by 2015, and 196-229 days by 2030. The present average of 12.6 days per year over 76 kph is projected to become 10.6-13.3 days by 2015, and 9.7-14.8 days by 2030.

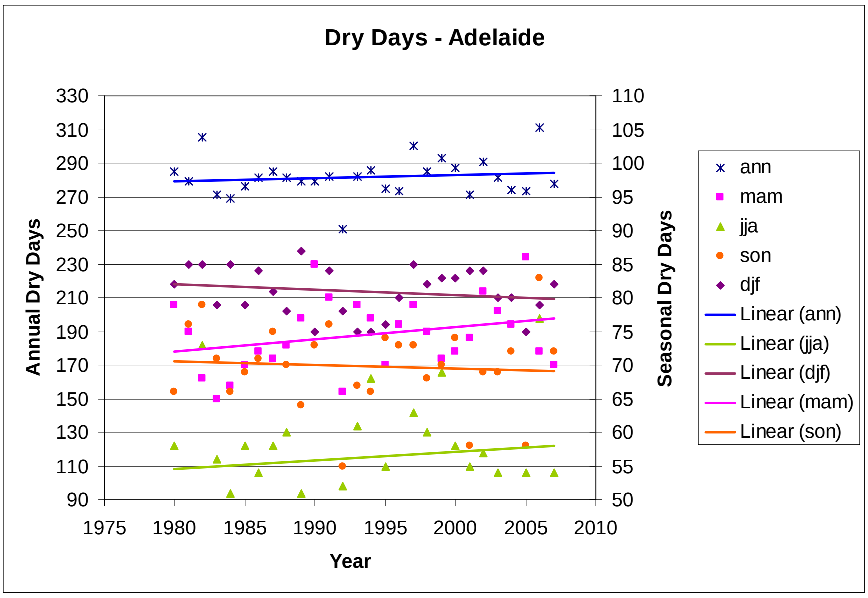
At Melbourne airport, the present average of 222 days per year over 40 kph is projected to become 218-234 days by 2015, and 211-238 days by 2030. The present average of 29 days per year over 76 kph is projected to become 24-33 days by 2015 and 24-38 days 2030.

In Mildura, the present average of 149 days per year over 40 kph is projected to become 139-166 days by 2015, and 135-183 days by 2030. The present average of 6 days per year over 76 kph is projected to become 4.3-8.4 days by 2015 and 3.6-10.3 days by 2030.

Dry days

Observed trends

In Adelaide, the trend in annual number of dry days shows an increase of 0.18 days per year from 1980-2007. The number of dry days has increased in autumn and winter and decreased in spring and summer. Most dry days occurred in 2006 and least in 1992.



***Adelaide** trends in annual (ann) and seasonal (djf, mam, jja, son) dry days from 1980-2007.*

In Mt Gambier, the trend in annual number of dry days shows an increase of 0.36 days per year. The number of dry days has increased in autumn and winter and decreased in spring and summer. Most dry days occurred in 1982 and least in 2004.

In Woomera, the trend in annual number of dry days shows an increase of 0.18 days per year. The number of dry days has increased in autumn and winter and decreased in spring and summer. Most dry days occurred in 2006 and least in 1981.

In Ballarat, the trend in annual number of dry days shows an increase of 0.58 days per year. The number of dry days has increased in all seasons except summer. Most dry days occurred in 2006 and least in 1996.

In Cape Otway, the trend in annual number of dry days shows an increase of 0.79 days per year. The number of dry days has increased in all seasons, especially autumn and winter. Most dry days occurred in 2006 and least in 1992.

In Melbourne, the trend in annual number of dry days shows an increase of 0.51 days per year. The number of dry days has increased in all seasons except summer. Most dry days occurred in 2006 and least in 1992.

In Mildura, the trend in annual number of dry days shows an increase of 0.27 days per year. The number of dry days has increased in autumn and winter with little change in spring and summer. Most dry days occurred in 1994 and least in 1992.

Projections

The annual average number of dry days has been calculated for present (1981-2000) conditions and for 20 years centred on 2015 and 2030, for low and high rates of global warming, for the four climate models at Adelaide, Mt Gambier Woomera, Ballarat, Cape Otway, Melbourne and Mildura. The projection method involves multiplying observed daily rainfall records by the projected percentage changes in seasonal average rainfall simulated by each model. An increase in the number of dry days is likely in future.

According to the projections, in Adelaide, the annual average number of dry days increases from 281 at present to 284-286 by 2015, and 284-288 by 2030. The annual average number of 20-day dry spells changes from 3.5 at present to 3.2-3.5 by 2015, and 3.2-3.7 by 2030.

***Adelaide**: Projected annual-average number of dry days and dry spells for present (1981-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming..*

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	281	286.2	286.2	285.1	285.1	283.9	283.9	286.2	286.2
10 Day Spells	12.6	13.5	13.5	13.2	13.2	12.9	12.9	13.45	13.45
20 Day Spells	3	3.5	3.5	3.5	3.5	3.2	3.2	3.5	3.5
30 Day Spells	1.1	1.4	1.4	1.4	1.4	1.2	1.2	1.4	1.4
40 Day Spells	0.4	0.6	0.6	0.5	0.5	0.4	0.4	0.55	0.55

In Mt Gambier, the annual average number of dry days increases from 248 at present to 254-255 by 2015, and 254-256 by 2030. The annual average number of 20-day dry spells rises from 1.2 at present to 1.3-1.7 by 2015, and 1.3-1.8 by 2030.

In Woomera, the annual average number of dry days increases from 336 at present to 337-339 by 2015, and 337-339 by 2030. The annual average number of 20-day dry spells rises from 8.8 at present to 8.9-9.4 by 2015, and 8.9-9.6 by 2030.

In Ballarat, the annual average number of dry days increases from 254 at present to 259-262 by 2015 and 259-267 by 2030. The annual average number of 20-day dry spells changes from 1.1 at present to 1.2-1.3 by 2015 and 2030.

In Cape Otway, the annual average number of dry days increases from 228 at present to 231-235 by 2015 and 2030. The annual average number of 20-day dry spells changes from 0.4 at present to 0.4-0.5 by 2015 and 2030.

In Melbourne, the annual average number of dry days increases from 268 at present to 272-274 by 2015, and 272-278 by 2030. The annual average number of 20-day dry spells rises from 0.9 at present to 1.1-1.3 by 2015 and 2030.

In Mildura, the annual average number of dry days increases from 323 at present to 323-325 by 2015, and 323-327 by 2030. The annual average number of 20-day dry spells rises from 6.5 at present to 6.5-6.6 by 2015, and 6.5-6.9 by 2030.

1. OBSERVED CLIMATE CHANGE

1.1 Global Climate Change

In 1988, the United Nations Environment Programme and the World Meteorological Organization established the Intergovernmental Panel on Climate Change (IPCC). This comprises many of the world's experts on climate change, and produces authoritative reviews of our knowledge of climate change. The most recent review includes a summary describing observed climate change and its causes (IPCC, 2007).

Our understanding of warming and cooling influences on climate has improved in the past decade, leading to very high confidence that human activities have had a warming effect since the Industrial Revolution, around 1750. The largest human contribution comes from increases in greenhouse gases, such as carbon dioxide, methane and nitrous oxide, whose atmospheric concentrations have increased by 35%, 148% and 18%, respectively. The carbon dioxide increases are due primarily to fossil fuel use and land-use change, while increases in methane and nitrous oxide are primarily due to agriculture.

The Earth's average surface temperature has increased by almost 0.75˚C since the beginning of the 20th Century. Most of the warming since 1950 is very likely due to increases in atmospheric greenhouse gas concentrations associated with human activities. It is extremely unlikely that this warming is due to natural causes alone. The warming has been linked with more heatwaves, changes in precipitation patterns, reductions in sea ice extent and rising sea levels.

1.2 Climate Change in Australia

Australian-average annual temperatures have increased by 0.9ºC since 1910. Most of this warming has occurred since 1950 (Figure 1), with greatest warming in the east and least warming in the north-west (Figure 2). The warmest year on record is 2005, but 2007 was the warmest year for southern Australia (Australian Bureau of Meteorology, 2008b). The number of hot days and nights has increased and the number of cold days and nights has declined (CSIRO and Australian Bureau of Meteorology, 2007).

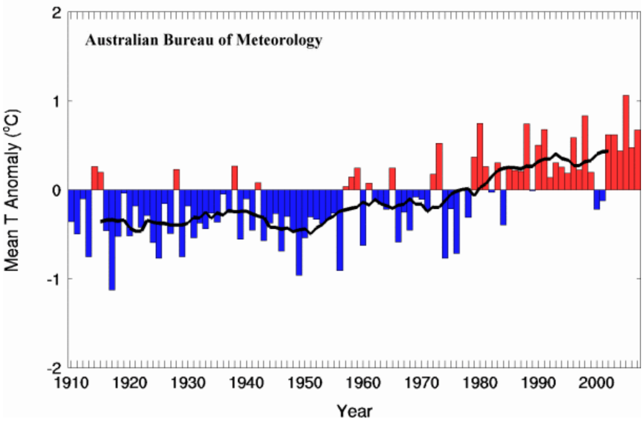


Figure 1: Australian-average annual temperature anomalies relative to the average for the 1961-1990 period. Source: Australian Bureau of Meteorology (2008a).

Since 1950, most of eastern and south-western Australia has become drier (Figure 2). In New South Wales and Queensland rainfall trends partly reflect a very wet period around the 1950s, though recent years have been unusually dry. In contrast, north-western Australia has become wetter over this period, mostly during summer. Since 1950, the frequencies of very heavy rainfall events (over 30 mm/day) and wet days (at least 1 mm/day) have decreased in the south and east but increased in the north (Figure 3) (CSIRO and Australian Bureau of Meteorology, 2007).

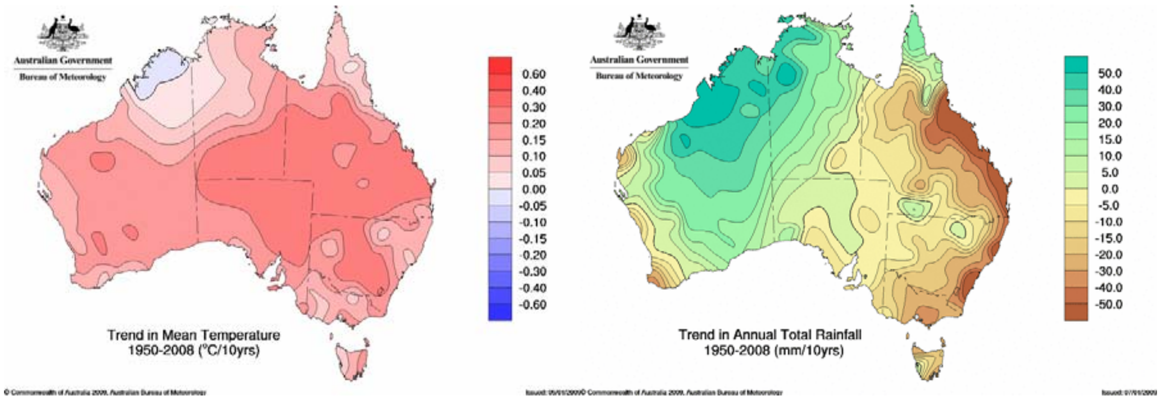


Figure 2: Trends in annual mean temperature and rainfall since 1950. Source: Australian Bureau of Meteorology (2008a).

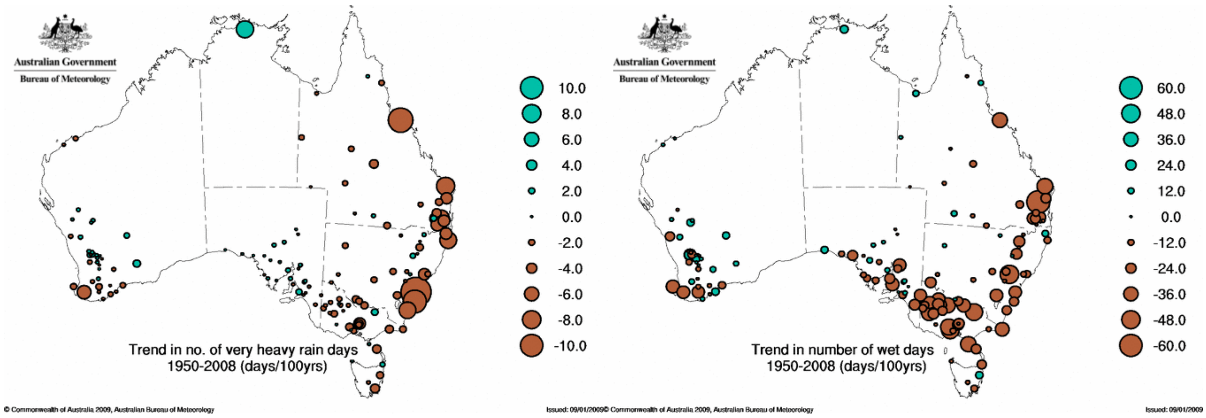


Figure 3: Trends in the frequencies of very heavy rain days (over 30 mm/day) and wet days (at least 1 mm/day) since 1950. Source: Australian Bureau of Meteorology (2008a).

Australian rainfall shows considerable variability from year-to-year, partly due to the El Niño – Southern Oscillation (ENSO). El Niño events tend to be associated with hot and dry years in Australia, and La Niña events tend to be associated with mild and wet years (Power et al. 2006). There has been a marked increase in the frequency of El Niño events and a decrease in La Niña events since the mid-1970s (Power and Smith 2007).

Australian average annual wind-speeds have declined over the period 1975-2006 (McVicar et al., 2008). The majority of Australia (88%) exhibits a reduction in wind-speed, with 57% of the area having statistically significant decreases, e.g. between Adelaide and Cape Otway (Figure 4).

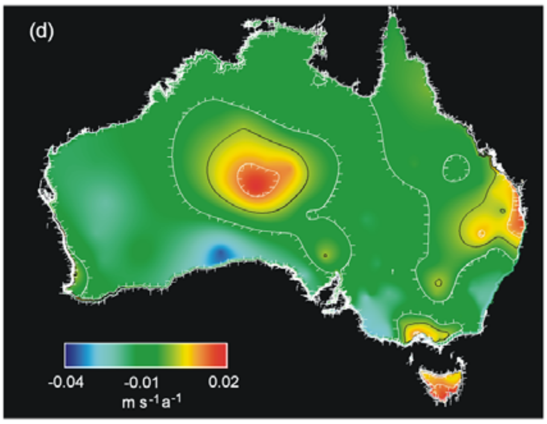


Figure 4: Wind-speed trends from 1975-2006. Black lines show no change and white lines show significant trends with barbs pointing to increased significance. Source: McVicar et al. (2008).

2. MODELS, EMISSIONS, ASSUMPTIONS AND LIMITATIONS

To provide a basis for estimating future climate change, 40 greenhouse gas and sulphate aerosol emission scenarios were prepared for the 21st century by the IPCC (Nakićenović and Swart, 2000), based on a variety of assumptions about demographic, economic and technological factors likely to influence future emissions. The climatic effects of projected changes in emissions can be simulated using climate models, which are mathematical representations of the Earth's climate system based on well-established laws of physics, such as conservation of mass, energy and momentum.

The future climate is strongly influenced by inherently uncertain factors, so it is not possible to make definitive climate predictions for decades ahead. However, projections that account for uncertainties can be made by considering the output of computer models of the Earth's climate system and different scenarios for future greenhouse gas and sulphate aerosol emissions. Uncertainties in projected regional climate to 2030 are mostly due to differences between the results of the climate models rather than the different emissions scenarios. In this report, projections for 2015 and 2030 are given for the IPCC's mid-range A1B emissions scenario (Nakićenović and Swart, 2000) for a selection of climate models.

Projections can be created in a number of ways, depending on the intended purpose. Two common examples are described below.

If projections are needed for general communication, with a focus on quantifying the range of possibilities across all available models for one climate variable at a time, then it is appropriate to combine results from multiple climate models. Recently, this has been done using a method that produces probabilistic distributions for future changes in a range of climate variables for Australia (CSIRO and Bureau of Meteorology, 2007, Ch 5) and Victoria (Vic DSE, 2008).

If projections are needed for a detailed risk assessment, with a focus on internally consistent changes between climate variables, then it is inappropriate to combine multi-model results (CSIRO and Bureau of Meteorology, 2007, Ch 6). Projections should instead be based upon individual model results. Data from up to 23 different models can be downloaded from the CMIP3 database at http://www-pcmdi.llnl.gov/ipcc/about_ipcc.php.

Simulated monthly average temperature and rainfall are available for 23 climate models, wind-speed for 19 models, solar radiation for 20 models and relative humidity and potential evaporation for 14 models. Daily temperature data are available for 8 models, daily rainfall for 16 models and daily wind-speed for 5 models. Hence, a full set of climate variables is not available for all models. This limits the number of models that can be used for creating model-specific projections that include multiple variables.

Some of the monthly temperature and rainfall data for Australia are available from the OzClim website (CSIRO, 2008), which can generate projections for various years and emission scenarios.

The CSIRO method for generating model-based projections is designed to extract the underlying multi-decadal trends associated with climate change rather than random yearly-to-decadal climate variability associated with phenomena such as the El Niño Southern Oscillation. This means that projections for 20-year periods centred on 2015 and 2030 describe the average climate, but do not allow for random variability. In reality, changes in average climate will be superimposed on random daily, seasonal and yearly variability that will have significant impacts on extreme events. The extremes in an individual year will be determined by a combination of natural variability and anthropogenic climate change. In this report, when the year 2015 or 2030 is mentioned, this refers to the average climatic conditions for 20 years centred on that year, rather than a single year.

3. CLIMATE CHANGE ANALYSIS

3.1 Data and methods

Observed trends

Daily maximum temperature, minimum temperature, wind-gust and rainfall data were supplied by the Bureau of Meteorology for 1980-2007 for the following sites (identified by name and Bureau of Meteorology station number):

- Adelaide station number 23090
- Mt Gambier airport station number 26021
- Woomera station number 16001
- Mildura station number 76031
- Ballarat station number 89002
- Cape Otway station number 90015
- Melbourne CBD station number 86071

Wind-gust data represent the daily peak wind-speed. These data were not available for the full period of 1980-2007 at Ballarat (missing 1986-2002) or Cape Otway (missing 1985-1995). Wind data for Melbourne central business district (CBD) were available but unsuitable for trend analysis due to an artificial drop in wind-speed in October 1999 related to moving instrumentation from the top of a building to ground-level. Wind data for Melbourne airport (station number 086282) were used instead – this site is windier than the ground level site at Melbourne CBD (which has average gusts around 25 kph).

Trends in annual and seasonal averages of maximum and minimum daily temperatures, precipitation, and maximum daily wind speed at each site were assessed using linear regression. This involves fitting a line through the sample data, which can be plotted on a graph. Various statistics describe the line, but the most important is the slope, since this quantifies the trend, in units per year[1].

Projections

For this study, projections are required for a detailed impact assessment. Hence, the focus is on internally consistent changes between climate variables, so model-specific projections are needed. There are a number of ways to select models for risk assessment, e.g. use all models with relevant data available, use a subset of models that provides the most extreme changes in selected variables, use a subset that gives distinctly different changes in combined variables such as temperature and rainfall, use those that perform best at simulating particular features of the past climate, etc.

Since temperature and rainfall are key variables in this study, four models are chosen to represent distinctly different projections of annual-average temperature and rainfall over the seven sites in South Australia and Victoria (Tables 1 to 7):

- CSIRO Mk3.5: hotter with a large rainfall decrease and small increases in wind-speed[2];
- INMCM: warmer with a moderate decrease in rainfall and a tendency for reduced wind-speed;
- MIROC-M: slightly warmer with little change in rainfall and moderate decreases in wind-speed;
- HADGEM1: warmer, with moderate decreases in rainfall and increases in wind-speed.

[1] For temperature, these trends were extrapolated to 2015 and 2030 for comparison with projections derived from climate models. Consistency between the extrapolated and model values may indicate that past trends are a good guide to the future. Observed regional trends for 1980-2007 may differ from those simulated by climate models for 1990-2030 for the other variables, which have large decadal variability.

[2] The GISS_ER model gives larger increases in temperature, but it does not have large decreases in rainfall and it has a relatively low skill score according to CSIRO and Bureau of Meteorology (2007).

Compared to the full suite of 23 models with temperature data:

- CSIRO Mk3.5 generally gives exceptionally large increases in temperature;
- HADGEM1 generally gives a response close to the median;
- INMCM generally gives responses well above the median;
- MIROC-M generally gives a response below the median.

Compared to the full suite of 19 models with wind data:

- CSIRO Mk3.5 generally gives increases close to the median;
- HADGEM1 generally gives exceptionally large increases in wind-speed;
- INMCM generally gives decreases close to the median;
- MIROC-M generally gives decreases below the median,

Compared to the full suite of 22 models with rainfall data:

- CSIRO Mk3.5 generally gives exceptionally large decreases in rainfall;
- HADGEM1 generally gives a drying response close to the median;
- INMCM generally gives a drier response further from the median;
- MIROC-M gives a mixture of small decreases and small increases and in general is larger than the median.

Projections for 2015 and 2030 are generated in a 2-stage process. First, for each selected model, the local change in seasonal average temperature, rainfall and wind-speed is calculated per degree of global warming, based on linear regression. Second, these local changes are multiplied by the global warming ranges for the mid-range A1B emission scenario in 2015 and 2030, separately developed by the IPCC (2007). This approach, known as pattern scaling, has been used by CSIRO for many years (Whetton et al., 2005) and it allows the underlying climate change signal to be separated from yearly-decadal variability. The range of global warming for the A1B scenario is 0.37-0.66^{o}C in 2015 and 0.54 to 1.44^{o}C in 2030, relative to 1990. This is factored into low and high projections of climate change for the seven sites in South Australia and Victoria (Appendix 1).

Projected changes in seasonal averages have been applied to observed daily data for 1981-2000 (a 20-year period centred on 1990) to create synthetic daily data for 20 years centred on 2015 and 2030. This simple method assumes no change in daily variability in future.

Table 1: Adelaide changes in annual temperature, rainfall and wind-speed, per degree of global warming, for all available climate models.

Model	Temperature change (°C)	Rainfall change (%)	Wind-speed change (%)
CCCMA_47	1.04	-1.7	-3.84
CCCMA_63	0.94	2.1	-1.84
CNRM	0.7	-3.1	1.55
CSIRO_Mk35	1.02	-13.1	0.45
ECHAM5	0.68	-3.4	1.72
ECHO-G	0.72	-1.9	-0.33
GFDL_20	0.93	-11.8	-1.82
GFDL_21	0.79	-14.2	0.86
GISS_AOM	0.82	-4.9	0.4
GISS_EH	1.03	4.2	-2.42
GISS_ER	1.35	-4.8	1.69
HADCM3	0.82	-7	3.4
HADGEM1	0.71	-6.6	3.74
IAP	0.68	-2.8	0.41
INMCM	0.95	-5.6	-0.38
ISPL_CM4	1.03	-11.3	-3.5
MIROC-H	0.82	-2.8	-1.49
MIROC-M	0.68	1	-2.37
MRI_GCM232	0.84	-3.1	0.33
BCCR	0.8	-13.8	N/A
CSIRO_Mk30	0.81	-3.1	N/A
NCAR_CCSM	0.98	-3.1	N/A
NCAR_PCM1	1.02	N/A	N/A
Median	0.82	-3.25	0.33

Table 2: Mt Gambier changes in annual temperature, rainfall and wind-speed, per degree of global warming, for all available climate models.

Model	Temperature change (^oC)	Rainfall change (%)	Wind-speed change (%)
CCCMA_47	0.9	-4.8	-5.34
CCCMA_63	0.95	-1.3	-1.22
CNRM	0.78	-4.8	5.29
CSIRO_Mk35	0.87	-11.4	-0.06
ECHAM5	0.52	-3.7	1.81
ECHO-G	0.71	-3.4	-3.71
GFDL_20	0.73	-8.4	-1.32
GFDL_21	0.61	-8.4	2.7
GISS_AOM	0.61	-6.1	-0.07
GISS_EH	0.93	0.2	-0.83
GISS_ER	1.15	-5	0.72
HADCM3	0.62	-5.8	4.49
HADGEM1	0.55	-4.9	4.88
IAP	0.61	-4	1.47
INMCM	0.85	-5.2	-0.72
ISPL_CM4	0.86	-7.3	-3.09
MIROC-H	0.74	-4.2	-1.35
MIROC-M	0.6	-1.2	-2.05
MRI_GCM232	0.73	-5.8	0.66
BCCR	0.89	-2.4	N/A
CSIRO_Mk30	0.52	-9.1	N/A
NCAR_CCSM	0.82	-4.8	N/A
NCAR_PCM1	0.9	N/A	N/A
Median	0.74	-4.9	-0.07

Table 3: Woomera changes in annual temperature, rainfall and wind-speed, per degree of global warming, for all available climate models.

Model	Temperature change (^{o}C)	Rainfall change (%)	Wind-speed change (%)
CCCMA_47	1.23	-3.5	2.99
CCCMA_63	1.07	4.3	0.28
CNRM	1.1	-2.7	-0.37
CSIRO_Mk35	1.38	-13.5	0.46
ECHAM5	0.99	-4.5	1.17
ECHO-G	0.93	4	0.81
GFDL_20	1.12	-17.2	-1.52
GFDL_21	1.02	-11.9	1.24
GISS_AOM	1.12	-9.9	5.71
GISS_EH	1.13	7.4	-1.48
GISS_ER	1.49	-1.8	1.32
HADCM3	0.99	-6.9	2.38
HADGEM1	0.96	-7.7	1
IAP	0.86	-4.8	-0.53
INMCM	1.1	-5.4	2.09
ISPL_CM4	1.12	-8.9	0.21
MIROC-H	0.94	1.4	-2.46
MIROC-M	0.71	3.7	-2.2
MRI_GCM232	0.98	-3.6	0.65
BCCR	1.02	-3.4	N/A
CSIRO_Mk30	1.21	-18.5	N/A
NCAR_CCSM	1.2	-1.3	N/A
NCAR_PCM1	1.16	N/A	N/A
Median	1.07	-4.0	0.46

Table 4: Ballarat changes in annual temperature, rainfall and wind-speed, per degree of global warming, for all available climate models.

Model	Temperature change (°C)	Rainfall change (%)	Wind-speed change (%)
CCCMA_47	1.05	-5	-5.9
CCCMA_63	1.05	-1.8	-2.65
CNRM	0.92	-5	6.8
CSIRO_Mk35	1.15	-12.1	0.61
ECHAM5	0.78	-4.1	2.11
ECHO-G	0.81	-0.4	-3.53
GFDL_20	0.87	-7	-1.38
GFDL_21	0.82	-7.2	2.29
GISS_AOM	0.77	-5.4	0.37
GISS_EH	1.02	1.6	-1.75
GISS_ER	1.3	-4	-0.4
HADCM3	0.86	-6.7	6.53
HADGEM1	0.72	-4	5.07
IAP	0.72	-3.1	1.33
INMCM	0.91	-4.9	-1.11
ISPL_CM4	0.94	-7.8	-3.48
MIROC-H	0.87	-2.7	-0.85
MIROC-M	0.62	-0.3	-2.46
MRI_GCM232	0.86	-6.1	0.47
BCCR	0.96	-0.5	N/A
CSIRO_Mk30	0.91	-11.5	N/A
NCAR_CCSM	0.92	-3.4	N/A
NCAR_PCM1	0.99	N/A	N/A
Median	0.91	-4.5	-0.04

Table 5: Cape Otway changes in annual temperature, rainfall and wind-speed, per degree of global warming, for all available climate models.

Model	Temperature change (^oC)	Rainfall change (%)	Wind-speed change (%)
CCCMA_47	0.92	-6.1	-5.65
CCCMA_63	0.94	-2.5	-2.51
CNRM	0.76	-4.6	5.98
CSIRO_Mk35	0.99	-10.7	0.42
ECHAM5	0.63	-3.3	1.66
ECHO-G	0.76	-3.9	-4.93
GFDL_20	0.72	-8.1	-0.75
GFDL_21	0.65	-5.3	3.78
GISS_AOM	0.58	-5.2	0.21
GISS_EH	0.99	0.9	-0.86
GISS_ER	1.18	-4	-0.63
HADCM3	0.69	-4.4	5.96
HADGEM1	0.51	-5	4.14
IAP	0.64	-2.8	1.42
INMCM	0.84	-4.4	-0.17
ISPL_CM4	0.77	-5.7	-2.31
MIROC-H	0.75	-3.3	-1.09
MIROC-M	0.58	-1	-1.27
MRI_GCM232	0.78	-5.1	0.38
BCCR	0.89	0	N/A
CSIRO_Mk30	0.65	-8.9	N/A
NCAR_CCSM	0.81	-4.2	N/A
NCAR_PCM1	0.91	N/A	N/A
Median	0.76	-4.4	-0.17

Table 6: Melbourne CBD changes in annual temperature, rainfall and wind-speed, per degree of global warming, for all available climate models.

Model	Temperature change (°C)	Rainfall change (%)	Wind-speed change (%)
CCCMA_47	1.09	-4.70	-6.20
CCCMA_63	1.06	-1.60	-3.77
CNRM	0.92	-5.70	7.58
CSIRO_Mk35	1.19	-11.40	0.01
ECHAM5	0.81	-4.30	1.51
ECHO-G	0.85	-0.10	-3.92
GFDL_20	0.85	-5.90	-1.49
GFDL_21	0.82	-6.20	2.07
GISS_AOM	0.75	-5.30	0.42
GISS_EH	1.02	1.20	-1.84
GISS_ER	1.26	-3.10	-1.38
HADCM3	0.88	-6.10	6.81
HADGEM1	0.69	-4.00	4.72
IAP	0.71	-2.50	0.87
INMCM	0.92	-4.70	-0.98
ISPL_CM4	0.91	-7.40	-3.41
MIROC-H	0.89	-3.30	0.27
MIROC-M	0.64	-0.20	-2.12
MRI_GCM232	0.88	-5.60	0.16
BCCR	0.91	-3.00	N/A
CSIRO_Mk30	0.95	-0.50	N/A
NCAR_CCSM	0.97	-11.30	N/A
NCAR_PCM1	0.99	N/A	N/A
Median	0.91	-4.5	0.01

Table 7: Mildura changes in annual temperature, rainfall and wind-speed, per degree of global warming, for all available climate models.

Model	Temperature change (°C)	Rainfall change (%)	Wind-speed change (%)
CCCMA_47	1.23	-2.6	-2.85
CCCMA_63	1.04	3.5	-2.54
CNRM	1.02	-3.7	2.95
CSIRO_Mk35	1.31	-13	1
ECHAM5	0.92	-5.5	2.88
ECHO-G	0.88	6	-1.06
GFDL_20	1.04	-11.2	-2.43
GFDL_21	1	-12	-0.13
GISS_AOM	1.01	-8	3.19
GISS_EH	1.13	6.8	-3.35
GISS_ER	1.56	-2	0.96
HADCM3	0.93	-5.8	5.16
HADGEM1	0.79	-6.8	6.28
IAP	0.83	-3.9	-0.42
INMCM	1.06	-5.7	0.17
ISPL_CM4	1.14	-9.9	-3.83
MIROC-H	0.95	-1.9	-1.77
MIROC-M	0.72	3	-3
MRI_GCM232	0.97	-6.3	0.64
BCCR	1.01	-0.2	N/A
CSIRO_Mk30	1.19	-16.1	N/A
NCAR_CCSM	1.04	0.5	N/A
NCAR_PCM1	1.13	N/A	N/A
Median	1.02	-4.7	-0.13

3.2 Temperature

This section describes:

- Trends in annual and seasonal average daily minimum and maximum temperature (TMin and TMax, respectively) for 1980-2007
- The extrapolation of minimum and maximum temperature trends for 1980-2007 to 2015 and 2030, and comparison with projections based on four climate models
- A comparison of present (1981-2000) and projected annual average number of hot days (and 3-5-day spells) over 30, 35 and 40°C and hot nights over 25 and 30°C for 20-year periods centred on 2015 and 2030.

Observed trends

Linear regression was used to assess trends in annual and seasonal average TMin and TMax. Extrapolating these trends to 2015 and 2030 allowed a comparison with model-based projections.

For each site, the tables below show:

1. The regression slope (trend in units per year), intercept (the point on the vertical axis where the trend line crosses) and variance explained (R^2 values: the higher the value, the better the trend line fits the data), and predicted values for 1990, 2015 and 2030.
2. For 2015 and 2030, values projected by the climate models for low and high rates of global warming are compared to the values extrapolated from the regression equation. The value labelled "Present 1990" is the regression value for the year 1990.
3. Time series of annual and seasonal mean values for the period 1980-2007.

In Adelaide, the annual mean TMin shows a trend of 0.015°C per year during 1980-2007. TMin shows a rising trend in all seasons except autumn. Largest increases have occurred in spring and summer. Annual TMin was warmest in 2000 and 2007, and coldest in 1986. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent with model projections. Annual mean TMax shows a trend of 0.023°C per year during 1980-2007. TMax shows rising a trend in all seasons, with largest increases in spring and summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is consistent with model projections.

In Mt Gambier, the annual mean TMin shows no trend (-0.001°C per year) during 1980-2007. TMin shows a positive trend in summer, a negative trend in autumn and spring, and little change in winter. Annual TMin was warmest in 1988 and 2007, and coldest in 2006. Extrapolation of the annual TMin trend to 2015 and 2030 is below model projections. Annual mean TMax shows a trend of 0.016°C per year during 1980-2007. TMax shows a rising trend in all seasons, with largest increase in summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is consistent with model projections.

In Woomera, the annual mean TMin shows a trend of 0.014°C per year during 1980-2007. TMin shows a rising trend in all seasons except autumn. The largest increase is in summer. Annual TMin was warmest in 2000, and coldest in 1992. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent with model projections. Annual mean TMax shows a trend of 0.032°C per year during 1980-2007. TMax shows a positive trend in all seasons, with largest increases in winter and summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is at the upper end of model projections.

In Ballarat, the annual mean TMin shows a trend of 0.010°C per year during 1980-2007. TMin shows a rising trend in all seasons except autumn. The largest increase is in summer (0.045°C per year). Annual TMin was warmest in 2007, and coldest in 1986 and 1994. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent with the low end of model projections (although extrapolation of the autumn trend is below the model projections and extrapolation of the summer trend is above the model projections). Annual mean TMax shows a trend of 0.021°C per year during 1980-2007. TMax shows a rising trend in all seasons, except autumn, with largest increase in summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is consistent with model projections, (although extrapolation of the autumn trend is below the model projections).

In Cape Otway, the annual mean TMin shows a trend of 0.016°C per year during 1980-2007. TMin shows a rising trend in all seasons except autumn. The largest increase is in summer. Annual TMin was warmest in 1994, and coldest in 1995. Extrapolation of the annual TMin trend to 2015 and 2030 is consistent model projections (although extrapolation of the autumn trend is below the model projections and extrapolation of the winter trend is above the model projections). Annual mean TMax shows a trend of -0.005°C per year during 1980-2007. While TMax shows a slight warming trend in winter and summer, this has been offset by a weak decrease in spring and a stronger decrease in autumn. Annual TMax was warmest in 1988, and coldest in 1996. Extrapolation of the annual TMax trend to 2015 and 2030 is below model projections.

In Melbourne CBD, the annual mean TMin shows a trend of 0.030°C per year during 1980-2007. TMin shows a rising trend in all seasons, with the largest increase is in summer (0.052°C per year). Annual TMin was warmest in 2007, and coldest in 1984. Extrapolation of the annual TMin trend to 2015 is above model projections, but the 2030 extrapolation is consistent with model projections. Annual mean TMax shows a trend of 0.045°C per year during 1980-2007. TMax shows a rising trend in all seasons, with largest increase in summer. Annual TMax was warmest in 2007, and coldest in 1986. Extrapolation of the annual TMax trend to 2015 and 2030 is above model projections.

In Mildura, the annual mean TMin has a negligible trend during 1980-2007. Decreases in autumn and winter have been offset by increases in spring and summer. Annual TMin was warmest in 1988 and 2007 and coldest in 1984 and 1994. Extrapolation of the annual TMin trend to 2015 and 2030 is below the model projections (although extrapolation of the spring and summer trends is consistent with the model projections). Annual mean TMax shows a trend of 0.029°C per year during 1980-2007. TMax shows a positive trend in all seasons, with largest increases in winter and summer. Annual TMax was warmest in 2007, and coldest in 1992. Extrapolation of the annual TMax trend to 2015 and 2030 is consistent with model projections.

Adelaide minimum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-17.1525	0.014696	0.109285	12.1	12.5	12.7
Autumn(mam)	23.95602	-0.00571	0.004787	12.6	12.5	12.4
Winter(jja)	-21.6448	0.01482	0.040036	7.8	8.2	8.4
Spring(son)	-27.6902	0.019749	0.086906	11.6	12.1	12.4
Summer(djf)	-44.2736	0.030487	0.083678	16.4	17.2	17.6

2. Comparison, 2015

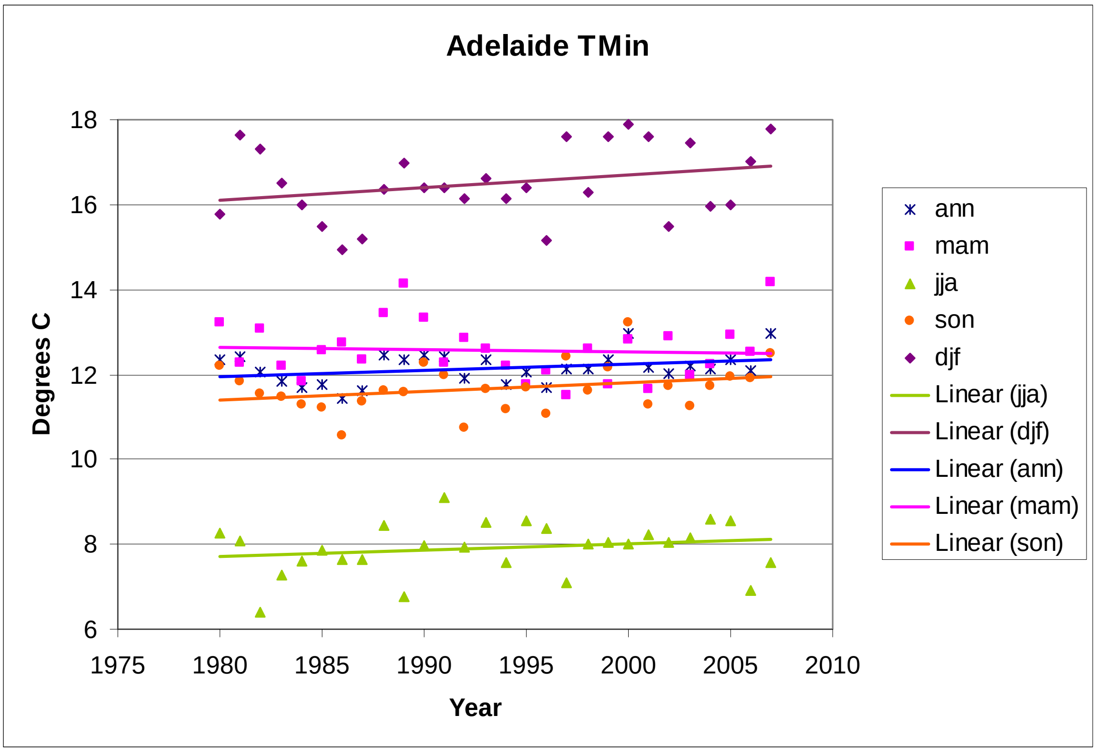
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	**1981-2000**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**2015**
Annual	12.1	12.4	12.7	12.4	12.6	12.3	12.5	12.4	12.6	12.5
Autumn(mam)	12.6	13.0	13.3	13.0	13.3	12.8	13.0	12.8	13.0	12.5
Winter(jja)	7.8	8.2	8.4	8.0	8.2	8.1	8.2	8.1	8.2	8.2
Spring(son)	11.6	12.0	12.2	11.7	11.9	11.9	12.0	11.9	12.1	12.1
Summer(djf)	16.4	16.7	17.0	16.9	17.3	16.6	16.8	16.8	17.0	17.2

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	**1981-2000**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**2030**
Annual	12.1	12.7	13.2	12.6	13.0	12.5	12.8	12.6	12.9	12.7
Autumn(mam)	12.6	13.3	13.8	13.3	13.8	13.0	13.4	13.0	13.4	12.4
Winter(jja)	7.8	8.4	8.8	8.2	8.4	8.2	8.5	8.2	8.5	8.4
Spring(son)	11.6	12.2	12.7	11.9	12.1	12.0	12.4	12.1	12.4	12.4
Summer(djf)	16.4	17.0	17.5	17.3	18.0	16.8	17.2	17.0	17.5	17.6

4. Adelaide TMin time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	12.4	13.2	8.3	12.2	15.8
1981	12.4	12.3	8.1	11.8	17.6
1982	12.1	13.1	6.4	11.6	17.3
1983	11.8	12.2	7.3	11.5	16.5
1984	11.7	11.8	7.6	11.3	16.0
1985	11.8	12.6	7.9	11.2	15.5
1986	11.5	12.7	7.6	10.6	14.9
1987	11.6	12.3	7.7	11.4	15.2
1988	12.4	13.4	8.4	11.6	16.4
1989	12.3	14.1	6.8	11.6	17.0
1990	12.5	13.3	8.0	12.3	16.4
1991	12.4	12.3	9.1	12.0	16.4
1992	11.9	12.8	7.9	10.8	16.1
1993	12.3	12.6	8.5	11.5	16.6
1994	11.8	12.2	7.6	11.2	16.1
1995	12.1	11.8	8.6	11.7	16.4
1996	11.7	12.1	8.4	11.1	15.2
1997	12.1	11.5	7.1	12.4	17.6
1998	12.1	12.6	8.0	11.6	16.3
1999	12.4	11.8	8.0	12.2	17.6
2000	13.0	12.8	8.0	13.2	17.9
2001	12.2	11.7	8.2	11.3	17.6
2002	12.0	12.9	8.1	11.7	15.5
2003	12.2	12.0	8.2	11.3	17.4
2004	12.1	12.2	8.6	11.7	16.0
2005	12.3	12.9	8.5	12.0	16.0
2006	12.1	12.5	6.9	11.9	17.0
2007	13.0	14.2	7.6	12.5	17.8



Adelaide maximum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-24.116	0.023251	0.118026	22.2	22.7	23.1
Autumn(mam)	-0.96617	0.011864	0.010757	22.6	22.9	23.1
Winter(jja)	-33.5286	0.024851	0.138013	15.9	16.5	16.9
Spring(son)	-34.6733	0.028409	0.051682	21.9	22.6	23.0
Summer(djf)	-27.9472	0.028266	0.046395	28.3	29.0	29.4

2. Comparison, 2015

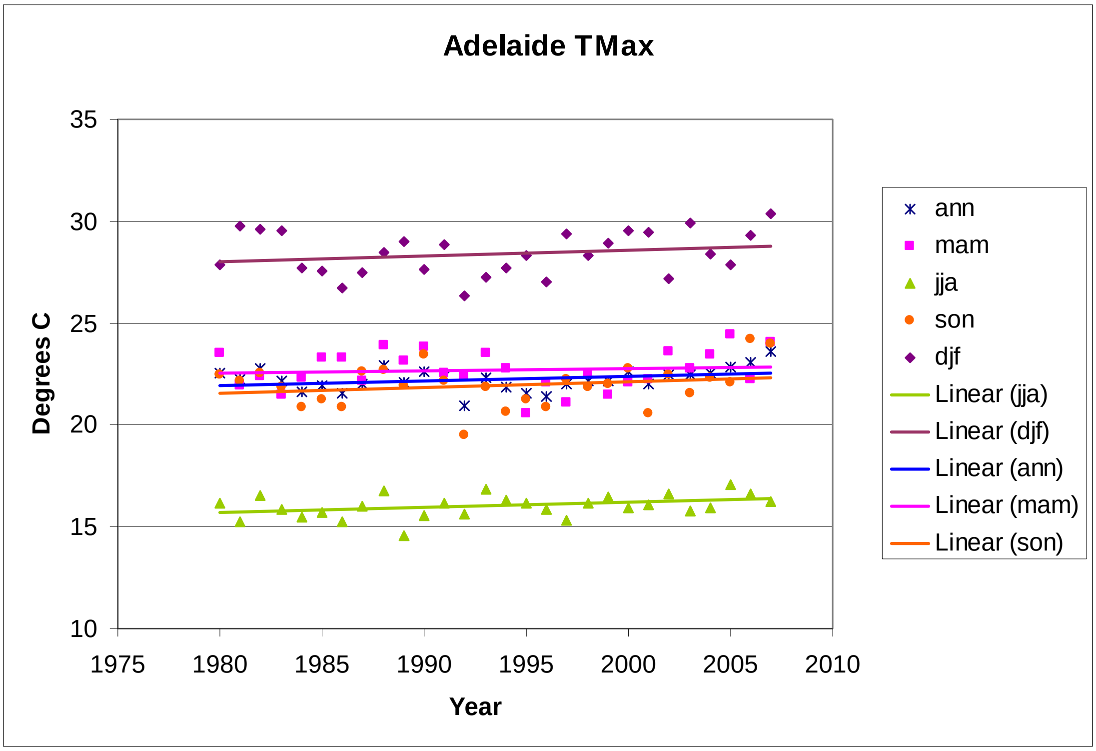
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	22.2	22.6	22.9	22.5	22.8	22.4	22.6	22.5	22.7	22.7
Autumn(mam)	22.6	23.1	23.4	23.0	23.3	22.9	23.1	22.9	23.1	22.9
Winter(jja)	15.9	16.3	16.6	16.3	16.6	16.2	16.4	16.3	16.5	16.5
Spring(son)	21.9	22.3	22.6	22.3	22.6	22.2	22.4	22.3	22.6	22.6
Summer(djf)	28.3	28.7	29.0	28.7	29.0	28.5	28.7	28.7	28.9	29.0

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	22.2	22.9	23.5	22.8	23.4	22.6	23.0	22.7	23.1	23.1
Autumn(mam)	22.6	23.4	24.0	23.3	23.8	23.1	23.4	23.1	23.5	23.1
Winter(jja)	15.9	16.6	17.2	16.6	17.0	16.4	16.8	16.5	16.8	16.9
Spring(son)	21.9	22.6	23.2	22.6	23.2	22.4	22.9	22.6	23.0	23.0
Summer(djf)	28.3	29.0	29.6	29.0	29.6	28.7	29.1	28.9	29.3	29.4

4. Adelaide TMax time series of mean annual and seasonal values (°C).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	22.5	23.5	16.2	22.5	27.9
1981	22.2	21.9	15.3	22.1	29.8
1982	22.7	22.4	16.6	22.6	29.6
1983	22.1	21.5	15.8	21.8	29.5
1984	21.6	22.3	15.5	20.9	27.7
1985	21.9	23.3	15.7	21.2	27.5
1986	21.5	23.3	15.2	20.9	26.7
1987	22.0	22.2	16.0	22.6	27.5
1988	23.0	23.9	16.8	22.7	28.5
1989	22.1	23.1	14.6	21.9	29.0
1990	22.6	23.9	15.6	23.4	27.6
1991	22.4	22.5	16.1	22.2	28.8
1992	21.0	22.4	15.7	19.5	26.3
1993	22.3	23.5	16.8	21.6	27.3
1994	21.8	22.8	16.3	20.6	27.7
1995	21.5	20.6	16.1	21.3	28.3
1996	21.4	22.1	15.8	20.9	27.0
1997	22.0	21.1	15.3	22.2	29.4
1998	22.2	22.5	16.2	21.8	28.3
1999	22.2	21.4	16.4	22.0	28.9
2000	22.6	22.1	16.0	22.8	29.6
2001	22.0	22.2	16.1	20.5	29.5
2002	22.4	23.6	16.6	22.5	27.2
2003	22.5	22.7	15.8	21.6	29.9
2004	22.5	23.5	16.0	22.3	28.4
2005	22.8	24.4	17.1	22.1	27.9
2006	23.0	22.2	16.6	24.2	29.3
2007	23.6	24.0	16.2	24.0	30.4



Mt Gambier minimum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	11.00606	-0.00125	0.000812	8.5	8.5	8.5
Autumn(mam)	62.73391	-0.02683	0.110411	9.3	8.7	8.3
Winter(jja)	4.474028	0.000711	9.76E-05	5.9	5.9	5.9
Spring(son)	13.55419	-0.00295	0.002381	7.7	7.6	7.6
Summer(djf)	-37.9519	0.024696	0.07921	11.2	11.8	12.2

2. Comparison, 2015

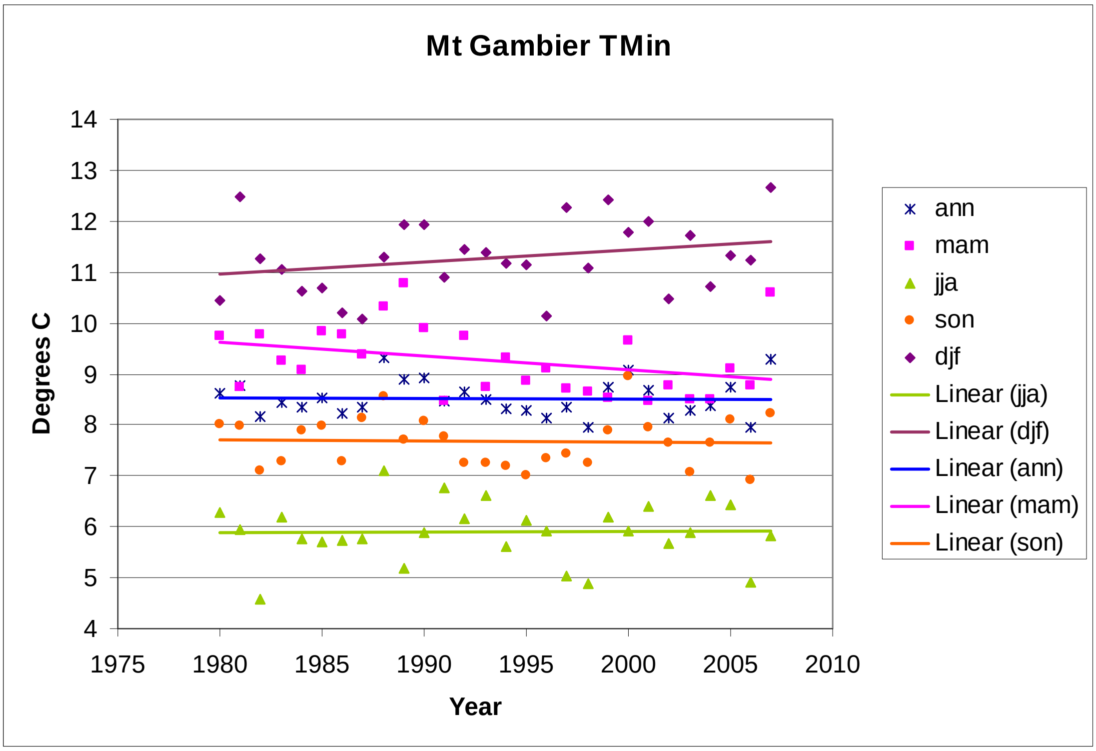
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	8.5	8.8	9.1	8.8	9.0	8.7	8.9	8.7	8.9	8.5
Autumn(mam)	9.3	9.7	9.9	9.6	9.9	9.5	9.7	9.4	9.6	8.7
Winter(jja)	5.9	6.2	6.4	6.1	6.3	6.1	6.2	6.1	6.2	5.9
Spring(son)	7.7	8.0	8.2	7.8	8.0	7.9	8.0	7.9	8.0	7.6
Summer(djf)	11.2	11.5	11.7	11.6	12.0	11.4	11.6	11.5	11.7	11.8

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	8.5	9.1	9.5	9.0	9.4	8.9	9.1	8.9	9.1	8.5
Autumn(mam)	9.3	9.9	10.4	9.9	10.3	9.7	10.0	9.6	9.9	8.3
Winter(jja)	5.9	6.4	6.8	6.3	6.6	6.2	6.5	6.2	6.4	5.9
Spring(son)	7.7	8.2	8.6	8.0	8.2	8.0	8.3	8.0	8.3	7.6
Summer(djf)	11.2	11.7	12.1	12.0	12.6	11.6	11.9	11.7	12.0	12.2

4. Mt Gambier TMin time series of mean annual and seasonal values (°C).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	8.6	9.7	6.3	8.0	10.5
1981	8.8	8.7	5.9	8.0	12.5
1982	8.2	9.8	4.6	7.1	11.3
1983	8.4	9.3	6.2	7.3	11.0
1984	8.3	9.1	5.8	7.9	10.6
1985	8.5	9.8	5.7	8.0	10.7
1986	8.2	9.8	5.7	7.3	10.2
1987	8.3	9.4	5.8	8.1	10.1
1988	9.3	10.3	7.1	8.6	11.3
1989	8.9	10.8	5.2	7.7	11.9
1990	8.9	9.9	5.9	8.1	11.9
1991	8.5	8.5	6.8	7.8	10.9
1992	8.7	9.8	6.2	7.3	11.4
1993	8.5	8.7	6.6	7.3	11.4
1994	8.3	9.3	5.6	7.2	11.2
1995	8.3	8.9	6.1	7.0	11.1
1996	8.1	9.1	5.9	7.3	10.1
1997	8.3	8.7	5.0	7.4	12.3
1998	8.0	8.7	4.9	7.3	11.1
1999	8.7	8.5	6.0	7.9	12.4
2000	9.1	9.6	5.9	8.9	11.8
2001	8.7	8.5	6.4	7.9	12.0
2002	8.1	8.8	5.7	7.7	10.5
2003	8.3	8.5	5.9	7.1	11.7
2004	8.4	8.5	6.6	7.6	10.7
2005	8.7	9.1	6.4	8.1	11.3
2006	7.9	8.8	4.9	6.9	11.2
2007	9.3	10.6	5.8	8.2	12.7



Mt Gambier maximum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-11.8216	0.015567	0.078445	19.2	19.5	19.8
Autumn(mam)	11.38352	0.004299	0.001519	19.9	20.0	20.1
Winter(jja)	-19.809	0.016931	0.106568	13.9	14.3	14.6
Spring(son)	-14.5948	0.016527	0.043255	18.3	18.7	19.0
Summer(djf)	-25.1004	0.024977	0.040576	24.6	25.2	25.6

2. Comparison, 2015

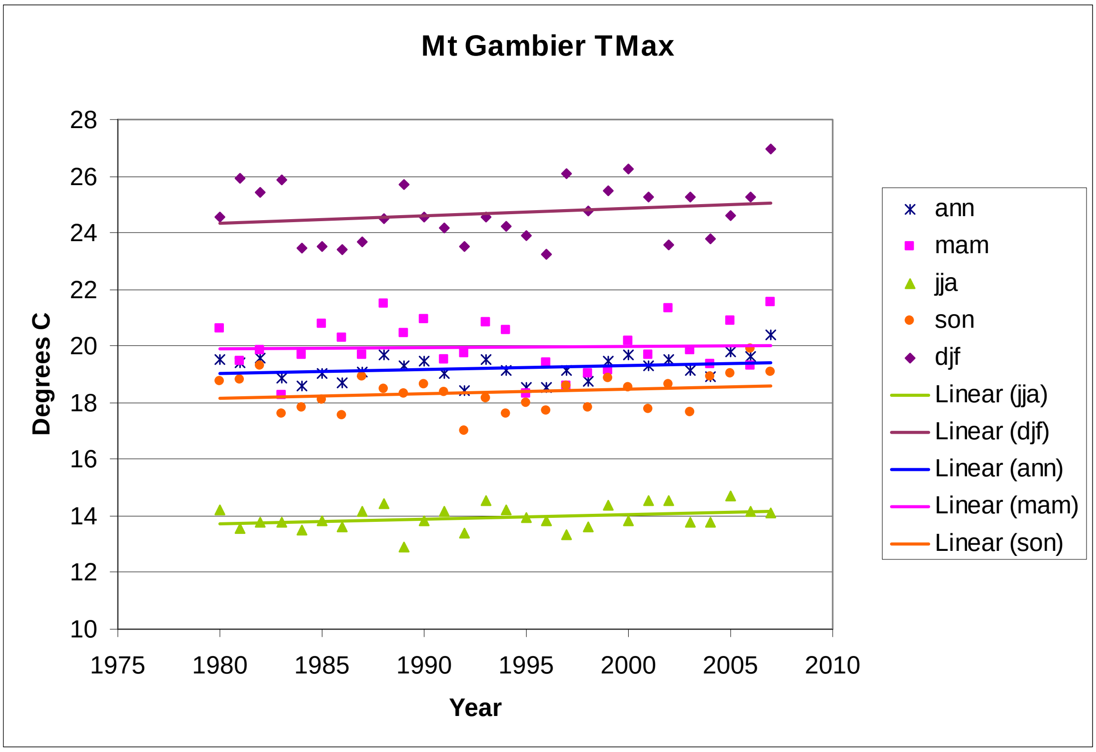
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	19.2	19.5	19.8	19.5	19.8	19.4	19.6	19.4	19.6	19.5
Autumn(mam)	19.9	20.3	20.6	20.3	20.5	20.2	20.4	20.2	20.3	20.0
Winter(jja)	13.9	14.2	14.5	14.2	14.4	14.1	14.3	14.1	14.3	14.3
Spring(son)	18.3	18.6	18.9	18.7	18.9	18.6	18.8	18.6	18.8	18.7
Summer(djf)	24.6	24.9	25.2	25.0	25.3	24.9	25.1	24.9	25.1	25.2

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	19.2	19.8	20.2	19.8	20.2	19.6	20.0	19.6	19.9	19.8
Autumn(mam)	19.9	20.6	21.1	20.5	20.9	20.4	20.7	20.3	20.6	20.1
Winter(jja)	13.9	14.5	14.9	14.4	14.8	14.3	14.7	14.3	14.5	14.6
Spring(son)	18.3	18.9	19.4	18.9	19.4	18.8	19.2	18.8	19.1	19.0
Summer(djf)	24.6	25.2	25.6	25.3	25.8	25.1	25.4	25.1	25.4	25.6

4. Mt Gambier TMax time series of mean annual and seasonal values (^{o}C).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	19.5	20.6	14.2	18.8	24.5
1981	19.4	19.4	13.5	18.8	25.9
1982	19.6	19.9	13.8	19.3	25.5
1983	18.8	18.3	13.8	17.6	25.9
1984	18.6	19.7	13.5	17.8	23.4
1985	19.0	20.8	13.8	18.1	23.5
1986	18.7	20.3	13.6	17.5	23.4
1987	19.1	19.7	14.1	18.9	23.7
1988	19.7	21.5	14.5	18.5	24.5
1989	19.3	20.4	12.9	18.3	25.7
1990	19.5	20.9	13.8	18.6	24.6
1991	19.0	19.5	14.2	18.4	24.2
1992	18.4	19.8	13.4	17.0	23.5
1993	19.5	20.8	14.5	18.1	24.6
1994	19.1	20.5	14.2	17.6	24.2
1995	18.5	18.3	14.0	18.0	23.9
1996	18.5	19.4	13.8	17.7	23.2
1997	19.1	18.6	13.3	18.6	26.1
1998	18.8	19.0	13.6	17.8	24.8
1999	19.4	19.1	14.4	18.9	25.5
2000	19.7	20.2	13.8	18.5	26.2
2001	19.3	19.7	14.5	17.8	25.3
2002	19.5	21.3	14.5	18.7	23.5
2003	19.1	19.9	13.8	17.7	25.3
2004	18.9	19.4	13.8	18.9	23.8
2005	19.8	20.9	14.7	19.0	24.6
2006	19.6	19.3	14.2	19.9	25.3
2007	20.4	21.5	14.1	19.1	26.9



Woomera minimum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-14.2263	0.013605	0.096222	12.8	13.2	13.4
Autumn(mam)	22.99529	-0.00484	0.003725	13.4	13.2	13.2
Winter(jja)	-20.4555	0.01354	0.042907	6.5	6.8	7.0
Spring(son)	-24.5578	0.018703	0.05588	12.7	13.1	13.4
Summer(djf)	-36.0907	0.027682	0.061322	19.0	19.7	20.1

2. Comparison, 2015

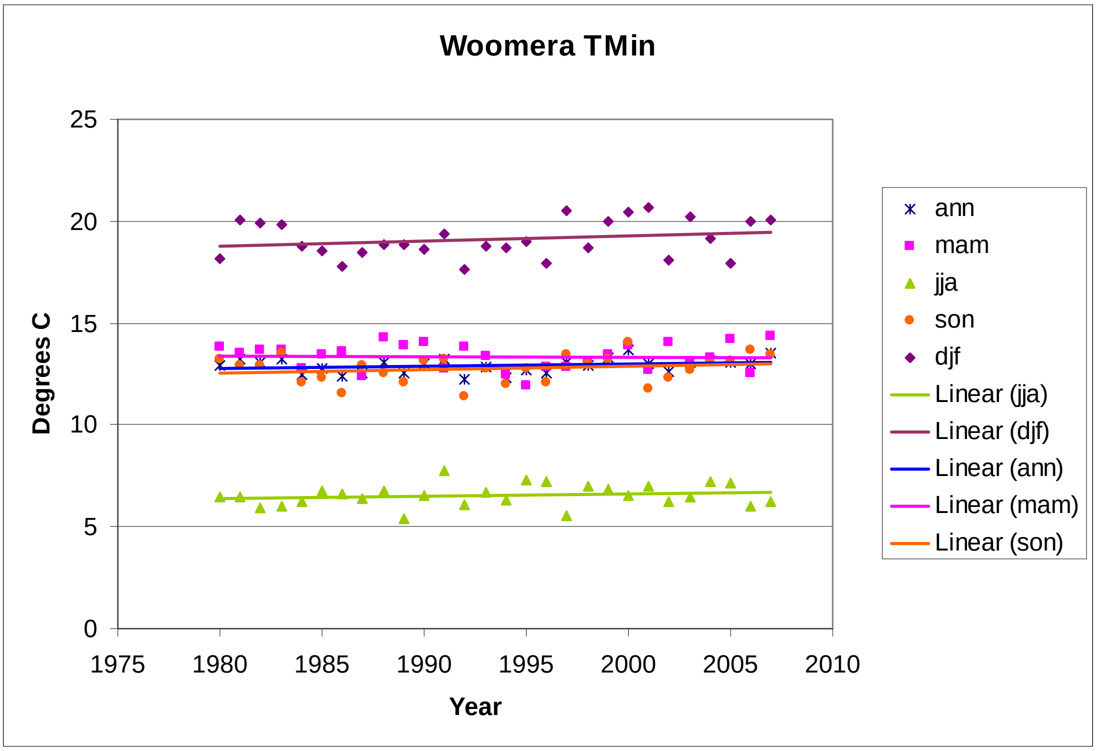
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	12.8	13.3	13.7	13.2	13.4	13.1	13.3	13.2	13.5	13.2
Autumn(mam)	13.4	13.9	14.3	13.9	14.3	13.6	13.9	13.7	14.0	13.2
Winter(jja)	6.5	6.9	7.2	6.6	6.8	6.7	7.0	6.7	6.9	6.8
Spring(son)	12.7	13.2	13.5	12.8	13.0	12.9	13.1	13.1	13.4	13.1
Summer(djf)	19.0	19.4	19.8	19.5	19.8	19.2	19.4	19.5	19.9	19.7

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	12.8	13.5	13.9	13.4	13.8	13.3	13.6	13.5	13.9	13.4
Autumn(mam)	13.4	14.0	14.6	14.0	14.5	13.8	14.1	14.0	14.4	13.2
Winter(jja)	6.5	7.0	7.4	6.8	7.1	6.9	7.2	6.9	7.2	7.0
Spring(son)	12.7	13.3	13.8	12.9	13.1	13.1	13.4	13.4	13.8	13.4
Summer(djf)	19.0	19.6	20.1	19.9	20.6	19.4	19.8	19.9	20.4	20.1

4. Woomera TMin time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	12.9	13.8	6.5	13.3	18.2
1981	13.2	13.5	6.4	12.9	20.1
1982	13.1	13.7	5.9	12.9	19.9
1983	13.2	13.6	6.0	13.5	19.8
1984	12.5	12.8	6.3	12.1	18.8
1985	12.7	13.5	6.8	12.3	18.6
1986	12.4	13.6	6.6	11.6	17.8
1987	12.4	12.4	6.3	12.8	18.5
1988	13.1	14.3	6.7	12.5	18.8
1989	12.5	13.9	5.4	12.1	18.8
1990	13.0	14.1	6.6	13.1	18.2
1991	13.1	12.7	7.7	12.7	19.3
1992	12.2	13.9	6.1	11.4	17.7
1993	12.9	13.4	6.7	12.7	18.8
1994	12.3	12.4	6.3	12.0	18.7
1995	12.7	11.9	7.3	12.7	19.0
1996	12.5	12.9	7.2	12.1	17.9
1997	13.0	12.8	5.5	13.3	20.5
1998	12.9	13.0	7.0	13.0	18.7
1999	13.3	13.4	6.9	13.2	20.0
2000	13.7	13.9	6.5	14.0	20.5
2001	13.0	12.7	7.0	11.8	20.7
2002	12.6	14.1	6.2	12.3	18.1
2003	13.1	13.0	6.5	12.7	20.3
2004	13.2	13.3	7.3	13.1	19.1
2005	13.1	14.2	7.2	13.1	17.9
2006	13.0	12.5	6.0	13.7	20.0
2007	13.5	14.4	6.3	13.5	20.0



Woomera maximum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-38.1426	0.032181	0.154435	25.9	26.7	27.2
Autumn(mam)	-22.7954	0.024395	0.040652	25.7	26.4	26.7
Winter(jja)	-57.3781	0.037784	0.138611	17.8	18.8	19.3
Spring(son)	-36.0988	0.031489	0.042293	26.6	27.4	27.8
Summer(djf)	-37.0706	0.035522	0.100479	33.6	34.5	35.0

2. Comparison, 2015

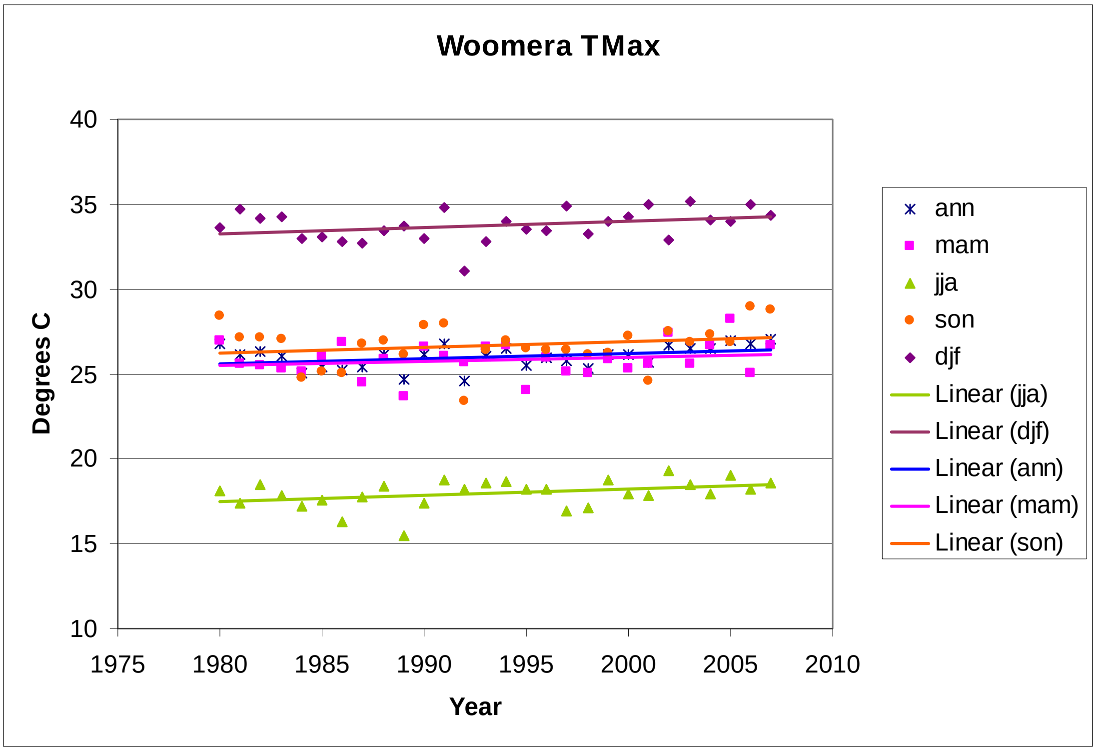
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	25.9	26.4	26.9	26.4	26.7	26.2	26.4	26.4	26.7	26.7
Autumn(mam)	25.7	26.4	26.9	26.2	26.5	26.0	26.2	26.2	26.5	26.4
Winter(jja)	17.8	18.3	18.7	18.3	18.6	18.1	18.3	18.2	18.5	18.8
Spring(son)	26.6	27.1	27.5	27.1	27.5	26.9	27.2	27.1	27.5	27.4
Summer(djf)	33.6	34.1	34.5	34.1	34.4	33.9	34.0	34.2	34.5	34.5

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	25.9	26.9	27.6	26.7	27.3	26.4	26.8	26.7	27.2	27.2
Autumn(mam)	25.7	26.9	27.7	26.5	27.1	26.2	26.5	26.5	26.9	26.7
Winter(jja)	17.8	18.7	19.4	18.6	19.2	18.3	18.7	18.5	18.9	19.3
Spring(son)	26.6	27.5	28.3	27.5	28.2	27.2	27.6	27.5	28.1	27.8
Summer(djf)	33.6	34.5	35.3	34.4	35.0	34.0	34.4	34.5	35.1	35.0

4. Woomera TMax time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	26.8	26.9	18.2	28.4	33.6
1981	26.1	25.6	17.4	27.2	34.7
1982	26.3	25.5	18.5	27.1	34.1
1983	26.1	25.3	17.8	27.1	34.2
1984	25.0	25.1	17.2	24.8	33.0
1985	25.4	26.1	17.5	25.1	33.1
1986	25.2	26.9	16.3	25.0	32.8
1987	25.4	24.5	17.7	26.8	32.7
1988	26.1	25.8	18.4	27.0	33.4
1989	24.7	23.7	15.4	26.1	33.7
1990	26.2	26.6	17.4	27.9	33.0
1991	26.8	26.0	18.8	27.9	34.8
1992	24.6	25.6	18.2	23.4	31.1
1993	26.0	26.6	18.5	26.5	32.8
1994	26.5	26.7	18.7	26.9	34.0
1995	25.5	24.0	18.2	26.5	33.5
1996	26.0	25.9	18.2	26.4	33.4
1997	25.8	25.1	17.0	26.4	34.9
1998	25.3	25.0	17.1	26.2	33.2
1999	26.2	25.9	18.7	26.2	34.0
2000	26.2	25.3	17.9	27.3	34.3
2001	25.7	25.6	17.8	24.6	35.0
2002	26.7	27.4	19.3	27.5	32.9
2003	26.5	25.6	18.4	26.8	35.2
2004	26.5	26.7	17.9	27.3	34.1
2005	27.0	28.2	19.0	26.9	34.0
2006	26.8	25.0	18.2	29.0	35.0
2007	27.0	26.7	18.6	28.8	34.3



Ballarat minimum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-13.3003	0.009976	0.020056	6.6	6.8	7.0
Autumn(mam)	37.98074	-0.01541	0.017962	7.3	6.9	6.7
Winter(jja)	-8.55311	0.005862	0.004791	3.1	3.3	3.3
Spring(son)	-0.33286	0.003069	0.001599	5.8	5.9	5.9
Summer(djf)	-79.9754	0.045261	0.119364	10.1	11.2	11.9

2. Comparison, 2015

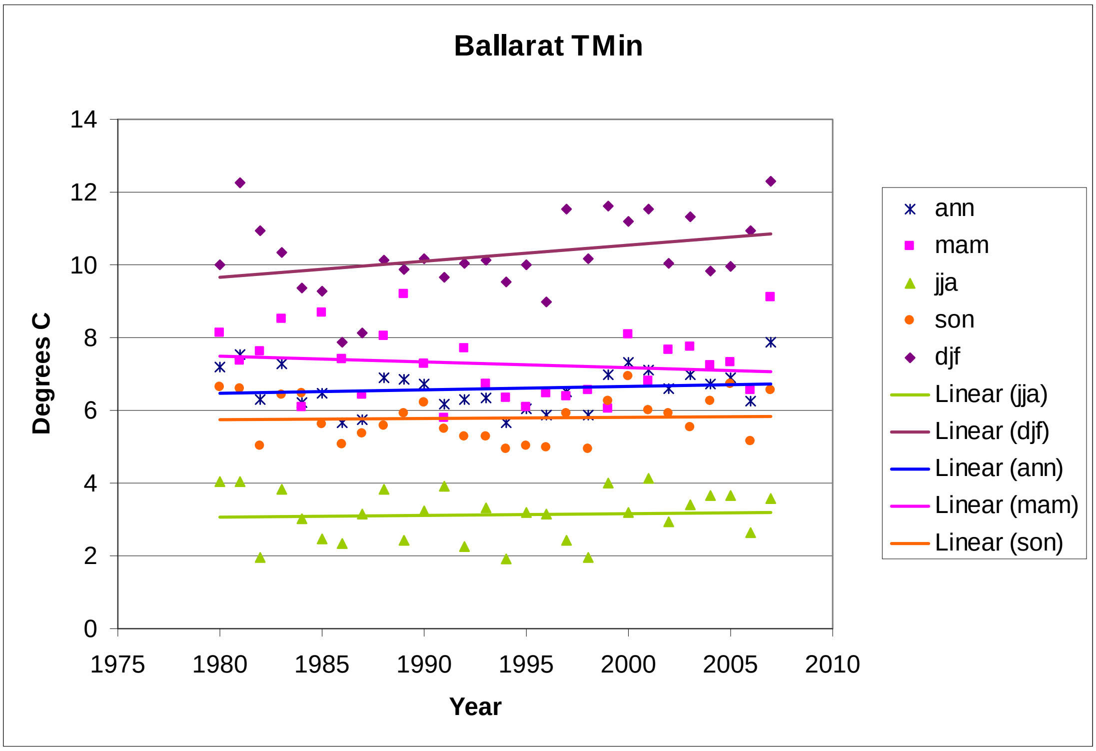
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	6.6	6.9	7.2	6.8	7.1	6.8	6.9	6.8	7.0	6.8
Autumn(mam)	7.3	7.7	8.0	7.6	7.9	7.5	7.7	7.5	7.7	6.9
Winter(jja)	3.1	3.4	3.7	3.3	3.5	3.3	3.4	3.3	3.4	3.3
Spring(son)	5.8	6.2	6.4	5.9	6.0	6.0	6.1	6.0	6.2	5.9
Summer(djf)	10.1	10.5	10.8	10.6	10.9	10.3	10.5	10.5	10.8	11.2

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	6.6	7.2	7.7	7.1	7.5	6.9	7.2	7.0	7.3	7.0
Autumn(mam)	7.3	8.0	8.6	7.9	8.3	7.7	8.0	7.7	8.0	6.7
Winter(jja)	3.1	3.7	4.1	3.5	3.8	3.4	3.7	3.4	3.7	3.3
Spring(son)	5.8	6.4	7.0	6.0	6.2	6.1	6.4	6.2	6.6	5.9
Summer(djf)	10.1	10.8	11.4	10.9	11.6	10.5	10.9	10.8	11.2	11.9

4. Ballarat TMin time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	7.2	8.1	4.0	6.6	10.0
1981	7.5	7.3	4.1	6.6	12.3
1982	6.3	7.6	2.0	5.0	10.9
1983	7.3	8.5	3.8	6.4	10.3
1984	6.2	6.1	3.0	6.4	9.4
1985	6.5	8.7	2.5	5.6	9.3
1986	5.7	7.4	2.3	5.1	7.9
1987	5.8	6.4	3.2	5.4	8.1
1988	6.9	8.0	3.8	5.6	10.1
1989	6.8	9.2	2.4	5.9	9.9
1990	6.7	7.3	3.2	6.2	10.2
1991	6.2	5.8	3.9	5.5	9.7
1992	6.3	7.7	2.3	5.3	10.0
1993	6.3	6.7	3.3	5.3	10.1
1994	5.7	6.3	1.9	4.9	9.5
1995	6.1	6.1	3.2	5.0	10.0
1996	5.9	6.5	3.1	5.0	9.0
1997	6.5	6.4	2.4	5.9	11.5
1998	5.9	6.5	2.0	5.0	10.2
1999	7.0	6.1	4.0	6.3	11.6
2000	7.3	8.1	3.2	6.9	11.2
2001	7.1	6.8	4.1	6.0	11.5
2002	6.6	7.6	2.9	5.9	10.1
2003	7.0	7.7	3.4	5.5	11.3
2004	6.7	7.2	3.7	6.2	9.8
2005	6.9	7.3	3.7	6.7	10.0
2006	6.3	6.5	2.6	5.1	10.9
2007	7.9	9.1	3.6	6.5	12.3



Ballarat maximum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-24.2759	0.02107	0.057364	17.6	18.2	18.5
Autumn(mam)	24.78521	-0.00314	0.000752	18.5	18.4	18.4
Winter(jja)	-42.9506	0.02712	0.151094	11.0	11.7	12.1
Spring(son)	-37.8729	0.02745	0.043658	16.8	17.4	17.9
Summer(djf)	-41.7951	0.03327	0.036365	24.4	25.2	25.7

2. Comparison, 2015

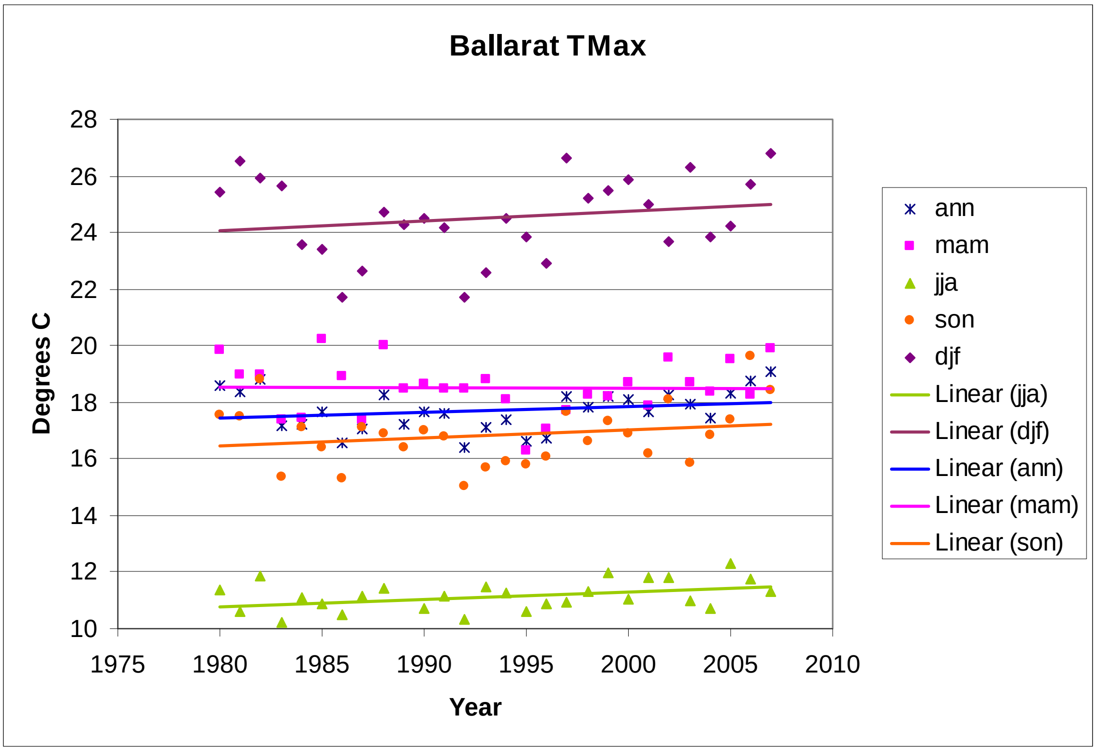
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	17.6	18.1	18.5	18.0	18.3	17.9	18.1	18.0	18.2	18.2
Autumn(mam)	18.5	19.0	19.4	18.9	19.1	18.8	19.0	18.8	19.0	18.4
Winter(jja)	11.0	11.5	11.8	11.4	11.6	11.3	11.5	11.3	11.5	11.7
Spring(son)	16.8	17.3	17.7	17.1	17.5	17.0	17.3	17.2	17.5	17.4
Summer(djf)	24.4	24.9	25.3	24.8	25.1	24.7	24.9	24.9	25.1	25.2

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	17.6	18.5	19.2	18.3	18.8	18.1	18.5	18.2	18.7	18.5
Autumn(mam)	18.5	19.4	20.1	19.1	19.6	19.0	19.3	19.0	19.4	18.4
Winter(jja)	11.0	11.8	12.4	11.6	12.1	11.5	11.8	11.5	11.8	12.1
Spring(son)	16.8	17.7	18.4	17.5	18.0	17.3	17.7	17.5	18.0	17.9
Summer(djf)	24.4	25.3	25.9	25.1	25.7	24.9	25.2	25.1	25.6	25.7

4. Ballarat TMax time series of mean annual and seasonal values (°C).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	18.6	19.9	11.4	17.6	25.4
1981	18.4	19.0	10.6	17.5	26.5
1982	18.8	19.0	11.9	18.8	25.9
1983	17.2	17.4	10.2	15.4	25.6
1984	17.2	17.4	11.1	17.1	23.6
1985	17.7	20.2	10.9	16.4	23.4
1986	16.6	18.9	10.5	15.3	21.7
1987	17.0	17.4	11.2	17.1	22.6
1988	18.3	20.0	11.4	16.9	24.7
1989	17.2	18.5	9.9	16.4	24.3
1990	17.7	18.7	10.7	17.0	24.5
1991	17.6	18.5	11.2	16.8	24.2
1992	16.4	18.5	10.3	15.0	21.7
1993	17.1	18.8	11.5	15.7	22.6
1994	17.4	18.1	11.2	15.9	24.5
1995	16.6	16.3	10.6	15.8	23.8
1996	16.7	17.0	10.9	16.1	22.9
1997	18.2	17.7	11.0	17.7	26.6
1998	17.8	18.3	11.3	16.6	25.2
1999	18.2	18.2	12.0	17.3	25.5
2000	18.1	18.7	11.0	16.9	25.9
2001	17.7	17.9	11.8	16.2	25.0
2002	18.3	19.6	11.8	18.1	23.7
2003	17.9	18.7	11.0	15.8	26.3
2004	17.4	18.4	10.7	16.8	23.8
2005	18.3	19.5	12.3	17.4	24.2
2006	18.8	18.3	11.8	19.6	25.7
2007	19.1	19.9	11.3	18.4	26.8



Cape Otway minimum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-20.053	0.01557	0.062584	10.9	11.3	11.6
Autumn(mam)	13.45976	-0.0007	9.53E-05	12.1	12.0	12.0
Winter(jja)	-41.0195	0.02476	0.154161	8.2	8.9	9.2
Spring(son)	-8.72285	0.00937	0.0278	9.9	10.2	10.3
Summer(djf)	-41.3433	0.02746	0.100469	13.3	14.0	14.4

2. Comparison, 2015

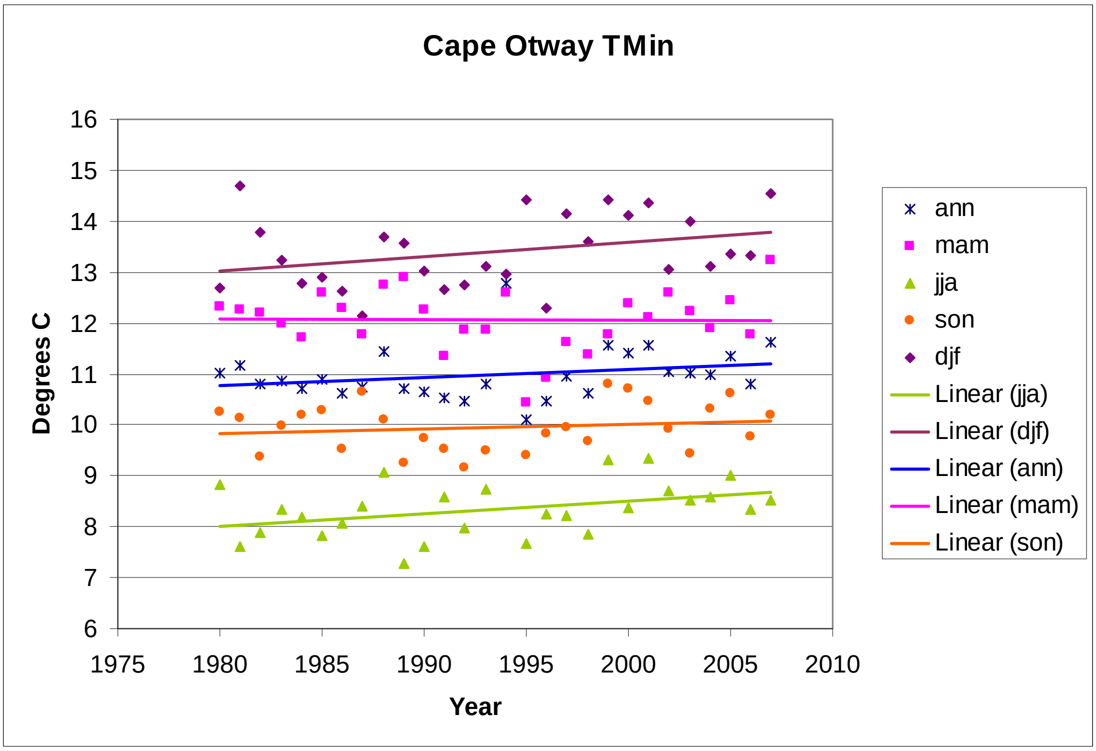
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	10.9	11.3	11.5	11.2	11.4	11.1	11.3	11.2	11.3	11.3
Autumn(mam)	12.1	12.4	12.7	12.4	12.6	12.3	12.4	12.2	12.4	12.0
Winter(jja)	8.2	8.6	8.8	8.5	8.7	8.4	8.6	8.5	8.6	8.9
Spring(son)	9.9	10.2	10.5	10.1	10.3	10.1	10.3	10.1	10.2	10.2
Summer(djf)	13.3	13.7	13.9	13.7	14.0	13.5	13.7	13.6	13.8	14.0

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	
Annual	10.9	11.5	12.0	11.4	11.8	11.3	11.6	11.3	11.5	11.6
Autumn(mam)	12.1	12.7	13.2	12.6	13.0	12.4	12.7	12.4	12.6	12.0
Winter(jja)	8.2	8.8	9.2	8.7	9.0	8.6	8.8	8.6	8.8	9.2
Spring(son)	9.9	10.5	11.0	10.3	10.5	10.3	10.5	10.2	10.4	10.3
Summer(djf)	13.3	13.9	14.4	14.0	14.5	13.7	14.0	13.8	14.0	14.4

4. Cape Otway TMin time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	11.0	12.3	8.8	10.3	12.7
1981	11.2	12.3	7.6	10.1	14.7
1982	10.8	12.2	7.9	9.4	13.8
1983	10.9	12.0	8.4	10.0	13.2
1984	10.7	11.7	8.2	10.2	12.8
1985	10.9	12.6	7.8	10.3	12.9
1986	10.6	12.3	8.1	9.5	12.6
1987	10.7	11.8	8.4	10.7	12.1
1988	11.4	12.7	9.1	10.1	13.7
1989	10.7	12.9	7.3	9.3	13.6
1990	10.6	12.3	7.6	9.7	13.0
1991	10.5	11.3	8.6	9.5	12.7
1992	10.5	11.9	8.0	9.2	12.7
1993	10.8	11.9	8.7	9.5	13.1
1994	12.8	12.6	N/A	N/A	13.0
1995	10.1	10.4	7.7	9.4	14.4
1996	10.5	10.9	8.3	9.8	12.3
1997	11.0	11.6	8.2	9.9	14.1
1998	10.6	11.4	7.9	9.7	13.6
1999	11.6	11.8	9.3	10.8	14.4
2000	11.4	12.4	8.4	10.7	14.1
2001	11.6	12.1	9.3	10.5	14.3
2002	11.1	12.6	8.7	9.9	13.1
2003	11.0	12.2	8.5	9.4	14.0
2004	11.0	11.9	8.6	10.3	13.1
2005	11.3	12.4	9.0	10.6	13.4
2006	10.8	11.8	8.3	9.8	13.3
2007	11.6	13.2	8.5	10.2	14.5



Cape Otway maximum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	27.71762	-0.00542	0.010435	16.9	16.8	16.7
Autumn(mam)	61.14806	-0.02182	0.042649	17.7	17.2	16.9
Winter(jja)	11.93489	0.000683	0.000155	13.3	13.3	13.3
Spring(son)	27.49902	-0.00558	0.006366	16.4	16.3	16.2
Summer(djf)	15.1204	0.002622	0.000572	20.3	20.4	20.4

2. Comparison, 2015

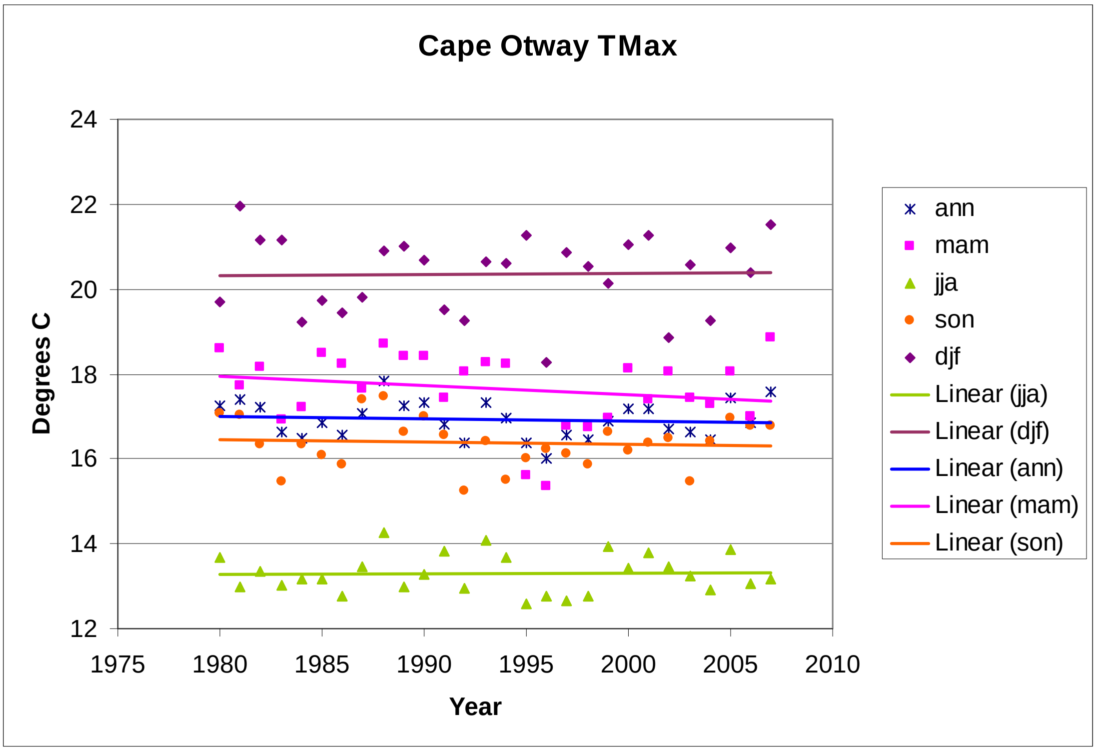
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	16.9	17.3	17.7	17.3	17.5	17.2	17.4	17.1	17.3	16.8
Autumn(mam)	17.7	18.2	18.5	18.0	18.3	17.9	18.1	17.9	18.0	17.2
Winter(jja)	13.3	13.7	14.0	13.6	13.8	13.5	13.7	13.5	13.6	13.3
Spring(son)	16.4	16.8	17.2	16.7	17.0	16.7	16.9	16.6	16.8	16.3
Summer(djf)	20.3	20.7	21.0	20.7	21.0	20.6	20.8	20.6	20.8	20.4

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	
Annual	16.9	17.7	18.2	17.5	18.0	17.4	17.7	17.3	17.6	16.7
Autumn(mam)	17.7	18.5	19.1	18.3	18.7	18.1	18.4	18.0	18.3	16.9
Winter(jja)	13.3	14.0	14.5	13.8	14.3	13.7	14.0	13.6	13.9	13.3
Spring(son)	16.4	17.2	17.8	17.0	17.5	16.9	17.2	16.8	17.1	16.2
Summer(djf)	20.3	21.0	21.6	21.0	21.5	20.8	21.1	20.8	21.1	20.4

4. Cape Otway TMax time series of mean annual and seasonal values (°C).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	17.2	18.6	13.7	17.1	19.7
1981	17.4	17.7	13.0	17.0	22.0
1982	17.2	18.2	13.4	16.3	21.1
1983	16.6	16.9	13.0	15.5	21.2
1984	16.5	17.2	13.2	16.3	19.2
1985	16.9	18.5	13.2	16.1	19.7
1986	16.6	18.2	12.8	15.9	19.5
1987	17.1	17.6	13.5	17.4	19.8
1988	17.8	18.7	14.3	17.5	20.9
1989	17.2	18.4	13.0	16.6	21.0
1990	17.3	18.4	13.3	17.0	20.7
1991	16.8	17.4	13.8	16.6	19.5
1992	16.4	18.1	12.9	15.2	19.3
1993	17.3	18.3	14.1	16.4	20.7
1994	17.0	18.2	13.7	15.5	20.6
1995	16.4	15.6	12.6	16.0	21.3
1996	16.0	15.4	12.8	16.2	18.3
1997	16.6	16.8	12.7	16.1	20.9
1998	16.4	16.8	12.8	15.9	20.5
1999	16.9	16.9	13.9	16.6	20.1
2000	17.2	18.1	13.4	16.2	21.0
2001	17.2	17.4	13.8	16.4	21.3
2002	16.7	18.1	13.5	16.5	18.9
2003	16.6	17.4	13.2	15.5	20.6
2004	16.5	17.3	12.9	16.4	19.3
2005	17.4	18.1	13.9	16.9	21.0
2006	16.8	17.0	13.1	16.8	20.4
2007	17.6	18.9	13.2	16.8	21.5



Melbourne CBD minimum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-47.7858	0.029664	0.275529	11.2	12.0	12.4
Autumn(mam)	-8.87273	0.010481	0.017238	12.0	12.2	12.4
Winter(jja)	-49.9991	0.028886	0.15273	7.5	8.2	8.6
Spring(son)	-45.6026	0.028261	0.16396	10.6	11.3	11.8
Summer(djf)	-87.8761	0.051667	0.218189	14.9	16.2	17.0

2. Comparison, 2015

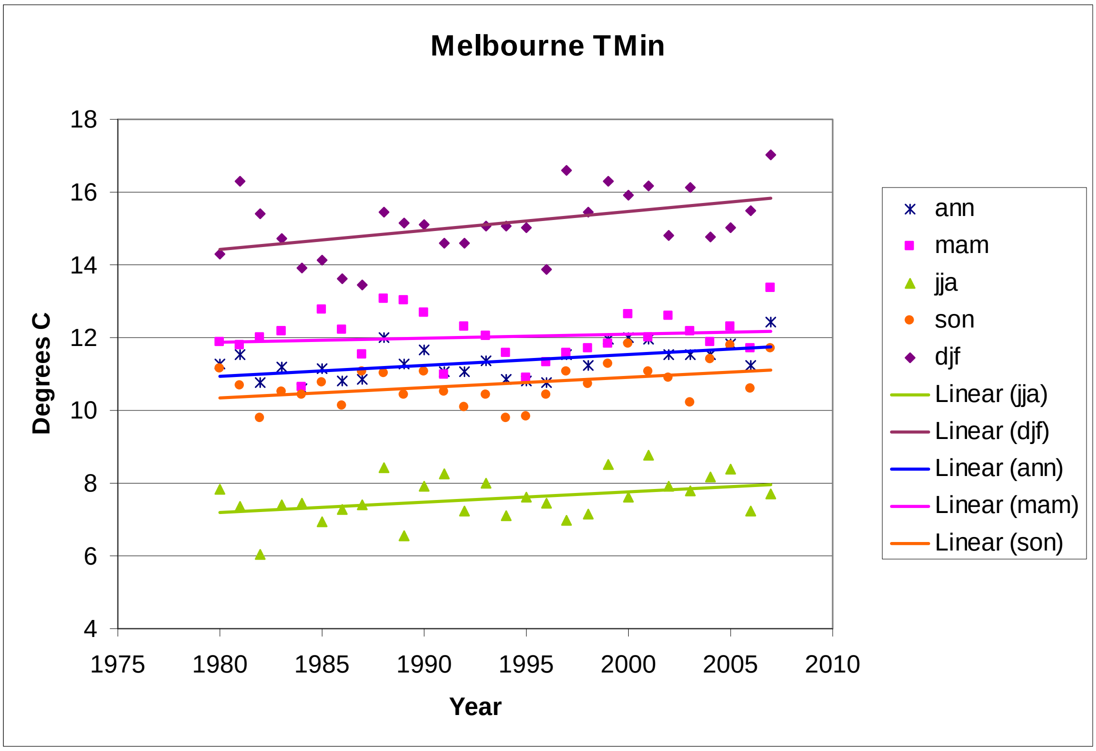
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	11.2	11.6	11.9	11.5	11.8	11.5	11.6	11.6	11.8	12.0
Autumn(mam)	12.0	12.4	12.7	12.3	12.6	12.2	12.4	12.3	12.5	12.2
Winter(jja)	7.5	7.8	8.1	7.7	7.9	7.7	7.8	7.7	7.9	8.2
Spring(son)	10.6	11.0	11.3	10.8	10.9	10.8	11.0	11.0	11.2	11.3
Summer(djf)	14.9	15.4	15.7	15.4	15.8	15.2	15.4	15.4	15.6	16.2

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	11.2	11.9	12.5	11.8	12.2	11.6	11.9	11.8	12.1	12.4
Autumn(mam)	12.0	12.7	13.3	12.6	13.0	12.4	12.7	12.5	12.8	12.4
Winter(jja)	7.5	8.1	8.5	7.9	8.2	7.8	8.1	7.9	8.1	8.6
Spring(son)	10.6	11.3	11.9	10.9	11.1	11.0	11.3	11.2	11.5	11.8
Summer(djf)	14.9	15.7	16.3	15.8	16.4	15.4	15.7	15.6	16.1	17.0

4. Melbourne CBD TMin time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	11.3	11.9	7.8	11.1	14.3
1981	11.5	11.8	7.4	10.7	16.3
1982	10.8	12.0	6.0	9.8	15.4
1983	11.2	12.2	7.4	10.5	14.7
1984	10.6	10.6	7.4	10.4	13.9
1985	11.1	12.8	6.9	10.8	14.1
1986	10.8	12.2	7.3	10.1	13.6
1987	10.9	11.6	7.4	11.1	13.4
1988	12.0	13.1	8.4	11.0	15.5
1989	11.3	13.0	6.6	10.4	15.1
1990	11.7	12.7	7.9	11.1	15.1
1991	11.1	11.0	8.2	10.5	14.6
1992	11.0	12.3	7.2	10.1	14.6
1993	11.4	12.0	8.0	10.4	15.0
1994	10.9	11.6	7.1	9.8	15.1
1995	10.8	10.9	7.6	9.8	15.0
1996	10.8	11.3	7.4	10.4	13.9
1997	11.5	11.6	7.0	11.1	16.6
1998	11.2	11.7	7.1	10.7	15.5
1999	12.0	11.8	8.5	11.3	16.3
2000	12.0	12.6	7.6	11.8	15.9
2001	12.0	12.0	8.8	11.0	16.2
2002	11.5	12.6	7.9	10.9	14.8
2003	11.6	12.2	7.8	10.2	16.1
2004	11.5	11.9	8.2	11.4	14.8
2005	11.8	12.3	8.4	11.8	15.0
2006	11.2	11.7	7.2	10.6	15.5
2007	12.4	13.4	7.7	11.7	17.0



Melbourne CBD maximum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-68.657	0.044642	0.343445	20.2	21.3	22.0
Autumn(mam)	-30.36	0.025715	0.072293	20.8	21.5	21.8
Winter(jja)	-72.5875	0.043855	0.465646	14.7	15.8	16.4
Spring(son)	-71.6144	0.045986	0.197239	19.9	21.0	21.7
Summer(djf)	-101.313	0.063689	0.202856	25.4	27.0	28.0

2. Comparison, 2015

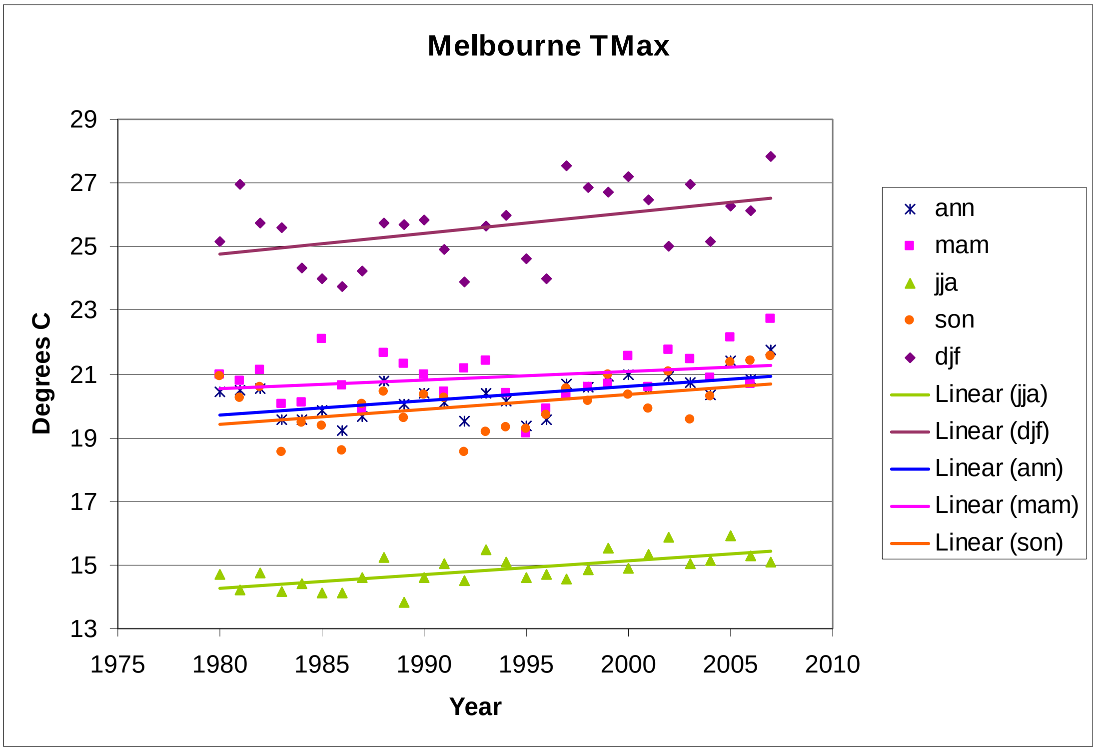
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	20.2	20.7	21.1	20.6	20.8	20.4	20.7	20.6	20.8	21.3
Autumn(mam)	20.8	21.3	21.7	21.2	21.4	21.1	21.2	21.2	21.4	21.5
Winter(jja)	14.7	15.1	15.5	15.0	15.3	14.9	15.1	15.0	15.2	15.8
Spring(son)	19.9	20.4	20.9	20.3	20.6	20.2	20.4	20.4	20.7	21.0
Summer(djf)	25.4	25.9	26.3	25.8	26.1	25.7	25.9	25.9	26.2	27.0

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	20.2	21.1	21.8	20.8	21.4	20.7	21.0	20.8	21.2	22.0
Autumn(mam)	20.8	21.7	22.5	21.4	21.9	21.2	21.6	21.4	21.7	21.8
Winter(jja)	14.7	15.5	16.1	15.3	15.7	15.1	15.5	15.2	15.5	16.4
Spring(son)	19.9	20.9	21.6	20.6	21.2	20.4	20.8	20.7	21.1	21.7
Summer(djf)	25.4	26.3	27.0	26.1	26.7	25.9	26.3	26.2	26.6	28.0

4. Melbourne CBD TMax time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	20.4	21.0	14.7	20.9	25.2
1981	20.5	20.8	14.2	20.2	27.0
1982	20.5	21.1	14.7	20.6	25.7
1983	19.6	20.1	14.1	18.5	25.6
1984	19.6	20.1	14.4	19.5	24.3
1985	19.9	22.1	14.1	19.4	24.0
1986	19.2	20.6	14.1	18.6	23.8
1987	19.7	19.8	14.6	20.1	24.2
1988	20.8	21.6	15.2	20.4	25.8
1989	20.1	21.3	13.8	19.6	25.7
1990	20.4	21.0	14.6	20.3	25.8
1991	20.1	20.4	15.0	20.2	24.9
1992	19.5	21.2	14.5	18.5	23.9
1993	20.4	21.4	15.5	19.2	25.6
1994	20.2	20.4	15.1	19.3	26.0
1995	19.4	19.1	14.6	19.3	24.6
1996	19.6	19.9	14.7	19.7	24.0
1997	20.7	20.3	14.6	20.6	27.5
1998	20.6	20.6	14.8	20.2	26.9
1999	20.9	20.7	15.5	21.0	26.7
2000	21.0	21.6	14.9	20.4	27.2
2001	20.5	20.6	15.3	19.9	26.5
2002	20.9	21.8	15.8	21.1	25.0
2003	20.7	21.4	15.0	19.6	27.0
2004	20.4	20.9	15.2	20.3	25.2
2005	21.4	22.1	15.9	21.4	26.3
2006	20.8	20.7	15.3	21.4	26.1
2007	21.8	22.7	15.1	21.5	27.8



Mildura minimum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	9.392214	0.00044	8.77E-05	10.3	10.3	10.3
Autumn(mam)	85.44899	-0.03766	0.11471	10.5	9.6	9.0
Winter(jja)	18.80528	-0.00699	0.005809	4.9	4.7	4.6
Spring(son)	-10.6658	0.01034	0.028255	9.9	10.2	10.3
Summer(djf)	-54.9383	0.03558	0.102764	15.9	16.8	17.3

2. Comparison, 2015

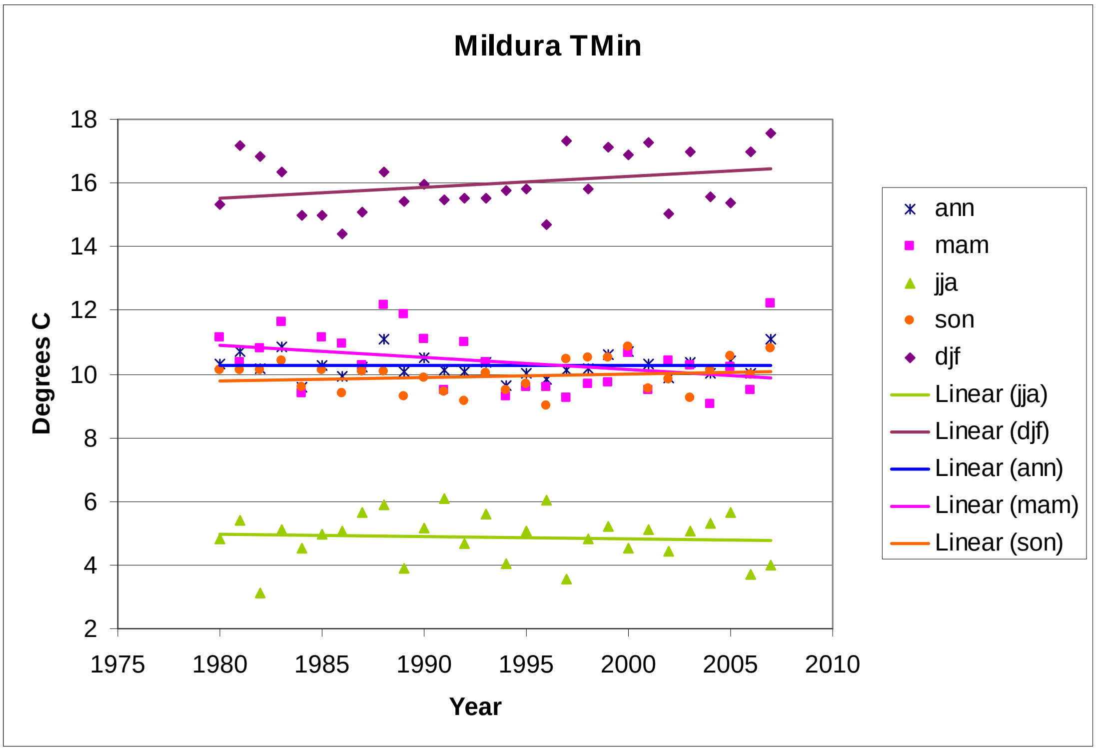
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	**1981-2000**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**2015**
Annual	10.3	10.7	11.1	10.6	10.8	10.5	10.7	10.5	10.8	10.3
Autumn(mam)	10.5	11.0	11.4	10.9	11.3	10.8	11.0	10.7	10.9	9.6
Winter(jja)	4.9	5.2	5.5	5.1	5.3	5.1	5.3	5.1	5.2	4.7
Spring(son)	9.9	10.4	10.7	10.0	10.1	10.2	10.4	10.2	10.4	10.2
Summer(djf)	15.9	16.3	16.7	16.4	16.9	16.1	16.3	16.3	16.6	16.8

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	**1981-2000**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**2030**
Annual	10.3	11.1	11.7	10.8	11.3	10.7	11.1	10.8	11.1	10.3
Autumn(mam)	10.5	11.4	12.1	11.3	11.8	11.0	11.4	10.9	11.3	9.0
Winter(jja)	4.9	5.5	6.0	5.3	5.5	5.3	5.7	5.2	5.5	4.6
Spring(son)	9.9	10.7	11.4	10.1	10.3	10.4	10.7	10.4	10.8	10.3
Summer(djf)	15.9	16.7	17.3	16.9	17.7	16.3	16.7	16.6	17.1	17.3

4. Mildura TMin time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	10.3	11.2	4.8	10.1	15.3
1981	10.7	10.4	5.4	10.1	17.2
1982	10.2	10.8	3.1	10.1	16.8
1983	10.9	11.6	5.1	10.4	16.4
1984	9.6	9.4	4.5	9.6	15.0
1985	10.3	11.1	5.0	10.1	15.0
1986	9.9	10.9	5.1	9.4	14.4
1987	10.2	10.3	5.6	10.1	15.1
1988	11.1	12.2	5.9	10.1	16.3
1989	10.1	11.9	3.9	9.3	15.4
1990	10.5	11.1	5.2	9.9	16.0
1991	10.1	9.5	6.1	9.5	15.5
1992	10.1	11.0	4.7	9.1	15.5
1993	10.4	10.4	5.6	10.0	15.5
1994	9.6	9.3	4.1	9.5	15.8
1995	10.0	9.6	5.1	9.7	15.8
1996	9.8	9.6	6.0	9.0	14.7
1997	10.1	9.2	3.6	10.5	17.3
1998	10.2	9.7	4.8	10.5	15.8
1999	10.6	9.7	5.2	10.5	17.1
2000	10.7	10.6	4.6	10.8	16.9
2001	10.3	9.5	5.1	9.5	17.3
2002	9.9	10.4	4.5	9.8	15.0
2003	10.4	10.3	5.1	9.2	17.0
2004	10.0	9.0	5.3	10.1	15.6
2005	10.4	10.2	5.6	10.6	15.4
2006	10.0	9.5	3.7	10.0	17.0
2007	11.1	12.2	4.0	10.8	17.6



Mildura maximum temperatures

1. Regression

	Intercept	Slope	R^2	1990	2015	2030
Annual	-33.7797	0.02898	0.155532	23.9	24.6	25.0
Autumn(mam)	-6.72704	0.01537	0.021924	23.9	24.3	24.5
Winter(jja)	-57.3504	0.03692	0.191387	16.1	17.0	17.6
Spring(son)	-32.0048	0.02824	0.043226	24.2	24.9	25.3
Summer(djf)	-35.7423	0.03381	0.067447	31.5	32.4	32.9

2. Comparison, 2015

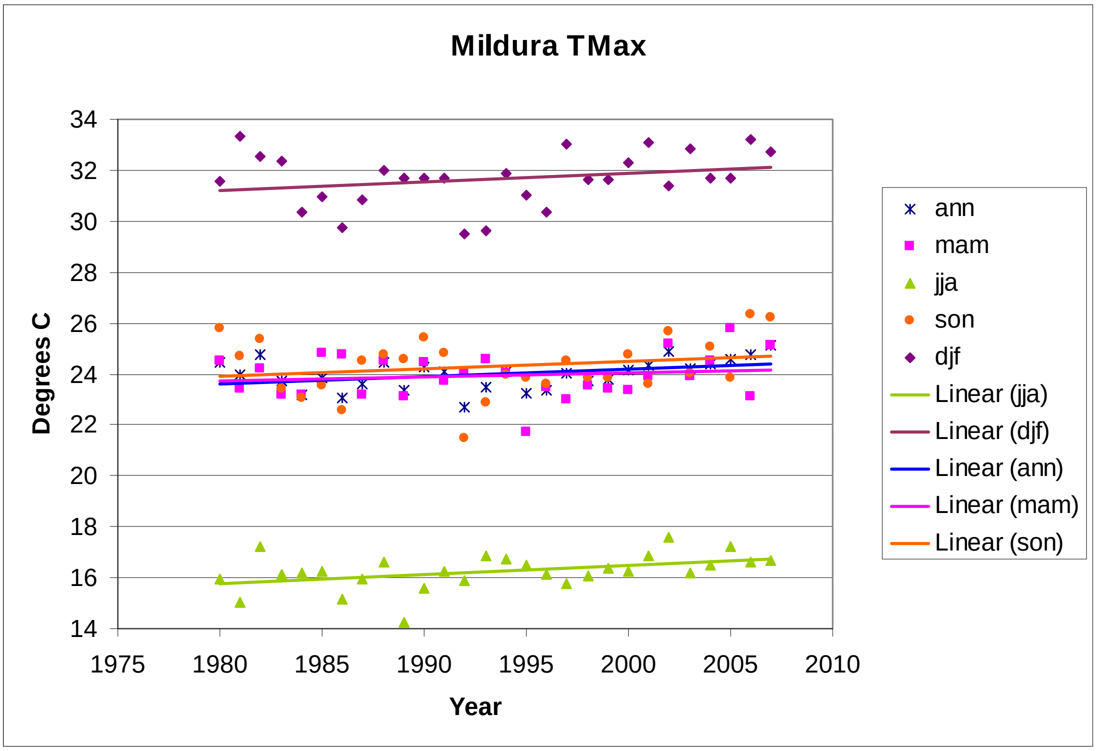
	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2015
Annual	23.9	24.4	24.8	24.3	24.7	24.2	24.4	24.3	24.5	24.6
Autumn(mam)	23.9	24.4	24.9	24.3	24.6	24.1	24.3	24.2	24.4	24.3
Winter(jja)	16.1	16.6	16.9	16.5	16.8	16.4	16.6	16.5	16.7	17.0
Spring(son)	24.2	24.7	25.1	24.7	25.1	24.5	24.8	24.7	24.9	24.9
Summer(djf)	31.5	32.1	32.5	32.0	32.3	31.8	32.0	32.0	32.2	32.4

3. Comparison, 2030

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1		Extrapolation
Season	1981-2000	Low	High	Low	High	Low	High	Low	High	2030
Annual	23.9	24.8	25.5	24.7	25.3	24.4	24.8	24.5	25.0	25.0
Autumn(mam)	23.9	24.9	25.7	24.6	25.1	24.3	24.6	24.4	24.8	24.5
Winter(jja)	16.1	16.9	17.6	16.8	17.4	16.6	17.1	16.7	17.0	17.6
Spring(son)	24.2	25.1	25.9	25.1	25.7	24.8	25.3	24.9	25.5	25.3
Summer(djf)	31.5	32.5	33.2	32.3	32.9	32.0	32.3	32.2	32.7	32.9

4. Mildura TMax time series of mean annual and seasonal values (^oC).

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	24.4	24.5	16.0	25.8	31.6
1981	24.0	23.4	15.0	24.7	33.3
1982	24.8	24.2	17.2	25.4	32.5
1983	23.7	23.2	16.1	23.4	32.4
1984	23.2	23.2	16.2	23.1	30.4
1985	23.9	24.8	16.3	23.6	31.0
1986	23.0	24.8	15.2	22.6	29.7
1987	23.6	23.2	16.0	24.5	30.8
1988	24.5	24.5	16.6	24.8	32.0
1989	23.4	23.1	14.3	24.6	31.7
1990	24.2	24.4	15.6	25.4	31.7
1991	24.1	23.7	16.2	24.8	31.7
1992	22.7	24.0	15.9	21.4	29.5
1993	23.5	24.6	16.9	22.8	29.6
1994	24.1	24.0	16.8	24.0	31.9
1995	23.2	21.7	16.5	23.8	31.0
1996	23.4	23.5	16.1	23.6	30.3
1997	24.0	23.0	15.7	24.5	33.0
1998	23.7	23.5	16.1	23.9	31.6
1999	23.8	23.4	16.4	23.9	31.7
2000	24.1	23.4	16.2	24.8	32.3
2001	24.3	23.9	16.9	23.6	33.1
2002	24.9	25.2	17.6	25.6	31.4
2003	24.2	23.9	16.2	24.0	32.9
2004	24.4	24.5	16.5	25.0	31.7
2005	24.6	25.8	17.2	23.9	31.7
2006	24.8	23.1	16.6	26.3	33.2
2007	25.1	25.1	16.7	26.2	32.7



Projections

The present (1981-2000) annual average number of hot days (and 3-5-day spells) over 30, 35 and 40°C and hot nights (and 3-5-night spells) over 25 and 30°C has been calculated at each site. Projected changes in average minimum temperature have been added to the observed minimum temperature data to create synthetic data for 20-year periods centred on 2015 and 2030. Likewise, projected changes in average maximum temperature have been added to the observed maximum temperature data to create synthetic data for 20-year periods centred on 2015 and 2030. Using the synthetic data, the average numbers of hot days/spells and hot nights/spells have been estimated for 2015 and 2030. The increases are smallest for the MIROC-M model with low global warming, but they are much larger for the CSIRO Mk3.5 model with high global warming, e.g. in 2030, the number of days over 35°C increases by up to 4 days in Mt Gambier, 5 days in Adelaide and 18 days in Woomera.

In Adelaide, the annual average number of days over 30°C rises from 53 (at present) to 55-58 by 2015 and 56-64 by 2030. The number of days over 35°C rises from 18 (at present) to 19-23 by 2015 and 21-26 by 2030. The number of days over 40°C rises from 2.4 (at present) to 2.9-3.6 by 2015 and 3.1-5.0 by 2030. The number of nights over 25°C rises from 5.5 (at present) to 6.0-7.3 by 2015 and 6.5-8.6 by 2030. The number of nights over 30°C rises from 0.2 (at present) to 0.2-0.4 by 2015 and 0.3-0.7 by 2030.

Mt Gambier, the annual average number of days over 30°C rises from 26 (at present) to 26-28 by 2015 and 27-31 by 2030. The number of days over 35°C rises from 9 (at present) to 9-10 by 2015 and 10-12 by 2030. The number of days over 40°C rises from 1.3 (at present) to 1.4-1.6 by 2015 and 1.5-2.3 by 2030. The number of nights over 25°C rises from 0.2 (at present) to 0.2-0.3 by 2015 and 0.2-0.4 by 2030. There are no nights over 30°C until at least 2030.

In Woomera, the annual average number of days over 30°C rises from 112 (at present) to 114-125 by 2015 and 117-136 by 2030. The number of days over 35°C rises from 53 (at present) to 55-63 by 2015 and 58-71 by 2030. The number of days over 40°C rises from 12 (at present) to 13-17 by 2015 and 15-23 by 2030. The number of nights over 25°C rises from 10 (at present) to 10-14 by 2015 and 12-19 by 2030. The number of nights over 30°C rises from 0.3 (at present) to 0.3-0.4 by 2015 and 0.4-1.0 by 2030.

In Ballarat, the annual average number of days over 30°C rises from 22 (at present) to 23-26 by 2015 and 24-32 by 2030. The number of days over 35°C rises from 5 (at present) to 5-7 by 2015 and 6-9 by 2030. The number of days over 40°C rises from 0.2 (at present) to 0.2-0.3 by 2015 and 0.3-0.7 by 2030. There are no nights over 25°C until at least 2030.

In Cape Otway, the annual average number of days over 30°C rises from 9.3 (at present) to 9.5-10.4 by 2015 and 9.7-12.3 by 2030. The number of days over 35°C rises from 2.5 (at present) to 2.6-2.8 by 2015 and 2.6-3.3 by 2030. The number of days over 40°C stays around the present average of 0.4. The number of nights over 25°C stays around the present average of 0.3.

In Melbourne, the annual average number of days over 30°C rises from 30 (at present) to 31-35 by 2015 and 33-40 by 2030. The number of days over 35°C rises from 10 (at present) to 10-12 by 2015 and 11-14 by 2030. The number of days over 40°C rises from 1.5 (at present) to 1.6-2.1 by 2015 and 1.7-3.1 by 2030. The number of nights over 25°C rises from 0.6 (at present) to 0.7-1.0 by 2015 and 0.7-1.4 by 2030. There are no nights over 30°C until at least 2030.

In Mildura, the annual average number of days over 30°C rises from 80 (at present) to 82-92 by 2015 and 86-101 by 2030. The number of days over 35°C rises from 32 (at present) to 33-39 by 2015 and 35-45 by 2030. The number of days over 40°C rises from 6 (at present) to 7-9 by 2015 and 7-11 by 2030. The number of nights over 25°C rises from 2 (at present) to 2-3 by 2015 and 2-5 by 2030. The number of nights over 30°C stays close to 0.1 until at least 2030.

Adelaide: Annual average number of days/nights above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2015**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30^{o}C	52.9	55.8	58.1	55.6	58.0	54.5	56.0	54.5	56.5
Days > 35^{o}C	17.9	20.4	23.0	20.3	22.9	19.1	20.5	19.1	21.5
Days > 40^{o}C	2.4	3.1	3.6	3.1	3.6	2.9	3.1	2.9	3.2
Nights > 25^{o}C	5.5	6.5	7.3	6.4	7.3	6.0	6.5	6.0	6.7
Nights > 30^{o}C	0.2	0.3	0.4	0.3	0.4	0.2	0.3	0.2	0.3
SDays > 30^{o}C	9.8	10.4	10.9	10.3	10.9	10.1	10.5	10.1	10.6
SDays > 35^{o}C	2.2	2.6	3.0	2.6	3.0	2.4	2.6	2.4	2.9
SDays > 40^{o}C	0.0	0.2	0.3	0.2	0.3	0.1	0.2	0.1	0.2
SNights > 25^{o}C	0.4	0.5	0.6	0.5	0.6	0.4	0.5	0.4	0.5
SNights > 30^{o}C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Adelaide: Annual average number of days/nights above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2030**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30^{o}C	52.9	58.1	63.4	58.0	63.5	56.0	59.0	56.5	59.9
Days > 35^{o}C	17.9	23.0	25.8	22.9	26.2	20.5	23.3	21.5	24.0
Days > 40^{o}C	2.4	3.6	5.0	3.6	4.9	3.1	3.6	3.2	3.8
Nights > 25^{o}C	5.5	7.3	8.5	7.3	8.6	6.5	7.4	6.7	7.6
Nights > 30^{o}C	0.2	0.4	0.6	0.4	0.7	0.3	0.4	0.3	0.5
SDays > 30^{o}C	9.8	10.9	12.0	10.9	12.3	10.5	11.1	10.6	11.4
SDays > 35^{o}C	2.2	3.0	3.8	3.0	3.8	2.6	3.0	2.9	3.2
SDays > 40^{o}C	0.0	0.3	0.4	0.3	0.4	0.2	0.3	0.2	0.3
SNights > 25^{o}C	0.4	0.6	0.9	0.6	0.8	0.5	0.7	0.5	0.7
SNights > 30^{o}C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mount Gambier: Annual average number of days/nights above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2015**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	25.5	26.5	27.7	26.5	28.0	26.2	27.0	26.2	26.8
Days > 35°C	8.5	9.4	10.1	9.4	10.2	9.0	9.7	9.0	9.7
Days > 40°C	1.3	1.4	1.6	1.4	1.6	1.4	1.5	1.4	1.5
Nights > 25°C	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Nights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SDays > 30°C	3.0	3.2	3.3	3.2	3.4	3.1	3.3	3.1	3.2
SDays > 35°C	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
SDays > 40°C	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
SNights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mount Gambier: Annual average number of days/nights above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2030**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	25.5	27.7	30.7	28.0	31.0	27.0	28.7	26.8	28.2
Days > 35°C	8.5	10.1	11.4	10.2	11.5	9.7	10.4	9.7	10.4
Days > 40°C	1.3	1.6	2.2	1.6	2.3	1.5	1.8	1.5	1.8
Nights > 25°C	0.2	0.3	0.3	0.2	0.4	0.2	0.3	0.2	0.3
Nights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SDays > 30°C	3.0	3.3	3.7	3.4	3.8	3.3	3.6	3.2	3.5
SDays > 35°C	0.6	0.6	0.7	0.6	0.7	0.6	0.6	0.6	0.6
SDays > 40°C	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.1
SNights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Woomera: Annual average number of days/nights above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2015**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30^{o}C	111.7	118.9	124.5	117.2	121.4	114.4	117.2	116.4	120.8
Days > 35^{o}C	53.1	59.0	62.7	58.2	60.9	55.4	58.2	57.6	60.5
Days > 40^{o}C	12.3	15.0	17.3	14.5	16.1	13.4	14.5	14.3	16.0
Nights > 25^{o}C	9.8	12.0	13.8	11.5	12.8	10.4	11.5	11.4	12.6
Nights > 30^{o}C	0.3	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.4
SDays > 30^{o}C	28.7	31.0	32.8	30.5	31.7	29.6	30.5	30.3	31.5
SDays > 35^{o}C	10.7	12.2	13.2	11.9	12.5	11.3	11.9	11.9	12.4
SDays > 40^{o}C	1.6	1.8	2.3	1.6	2.0	1.6	1.6	1.6	1.9
SNights > 25^{o}C	0.9	1.4	1.5	1.4	1.5	1.1	1.4	1.4	1.5
SNights > 30^{o}C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Woomera: Annual average number of days/nights above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2030**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30^{o}C	111.7	124.5	136.2	121.4	131.2	117.2	122.0	120.8	128.1
Days > 35^{o}C	53.1	62.7	71.2	60.9	67.6	58.2	61.3	60.5	66.5
Days > 40^{o}C	12.3	17.3	22.5	16.1	20.2	14.5	16.2	16.0	19.8
Nights > 25^{o}C	9.8	13.8	18.5	12.8	16.5	11.5	13.0	12.6	15.9
Nights > 30^{o}C	0.3	0.4	1.0	0.4	0.6	0.4	0.4	0.4	0.6
SDays > 30^{o}C	28.7	32.8	36.2	31.7	35.1	30.5	31.9	31.5	34.2
SDays > 35^{o}C	10.7	13.2	15.6	12.5	14.6	11.9	12.7	12.4	14.4
SDays > 40^{o}C	1.6	2.3	3.4	2.0	2.7	1.6	2.0	1.9	2.7
SNights > 25^{o}C	0.9	1.5	2.4	1.5	2.1	1.4	1.5	1.5	2.0
SNights > 30^{o}C	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Ballarat: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2015**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	22.0	24.0	25.8	23.1	25.4	22.6	23.7	23.0	24.3
Days > 35°C	4.9	5.7	6.8	5.3	6.3	5.2	5.7	5.3	5.9
Days > 40°C	0.2	0.3	0.3	0.2	0.3	0.2	0.3	0.2	0.3
Nights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SDays > 30°C	2.9	3.3	3.5	3.2	3.5	3.2	3.3	3.2	3.4
SDays > 35°C	0.3	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4
SDays > 40°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Ballarat: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2030**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	22.0	25.8	31.6	25.4	28.2	23.7	25.7	24.3	27.2
Days > 35°C	4.9	6.8	8.5	6.3	7.8	5.7	6.8	5.9	7.6
Days > 40°C	0.2	0.3	0.7	0.3	0.4	0.3	0.3	0.3	0.4
Nights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SDays > 30°C	2.9	3.5	4.7	3.5	4.2	3.3	3.5	3.4	3.9
SDays > 35°C	0.3	0.5	0.8	0.4	0.7	0.4	0.5	0.4	0.7
SDays > 40°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cape Otway: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2015**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	9.3	9.7	10.4	9.6	10.3	9.5	9.7	9.5	9.6
Days > 35°C	2.5	2.6	2.8	2.6	2.8	2.6	2.6	2.6	2.6
Days > 40°C	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Nights > 25°C	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Nights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SDays > 30°C	0.2	0.3	0.4	0.2	0.3	0.2	0.2	0.2	0.2
SDays > 35°C	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SDays > 40°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cape Otway: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2030**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	9.3	10.4	12.3	10.3	12.1	9.7	10.4	9.6	10.4
Days > 35°C	2.5	2.8	3.3	2.8	3.3	2.6	2.8	2.6	2.8
Days > 40°C	0.4	0.4	0.5	0.4	0.5	0.4	0.4	0.4	0.4
Nights > 25°C	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Nights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SDays > 30°C	0.2	0.4	0.5	0.3	0.5	0.2	0.4	0.2	0.4
SDays > 35°C	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SDays > 40°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Melbourne CBD: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2015**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	30.3	32.6	34.9	31.9	33.9	31.1	32.5	31.4	33.0
Days > 35°C	9.8	10.5	11.8	10.3	11.5	10.0	10.5	10.0	10.8
Days > 40°C	1.5	1.7	2.1	1.7	2.0	1.6	1.7	1.6	1.7
Nights > 25°C	0.6	0.7	1.0	0.7	0.9	0.7	0.7	0.7	0.7
Nights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SDays > 30°C	3.4	3.7	4.3	3.6	4.0	3.5	3.7	3.5	3.9
SDays > 35°C	0.9	0.9	1.1	0.9	1.0	0.9	0.9	0.9	0.9
SDays > 40°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 25°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Melbourne CBD: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2030**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	30.3	34.9	39.8	33.9	37.0	32.5	34.7	33.0	35.2
Days > 35°C	9.8	11.8	14.1	11.5	12.7	10.5	11.7	10.8	11.9
Days > 40°C	1.5	2.1	3.1	2.0	2.5	1.7	2.1	1.7	2.2
Nights > 25°C	0.6	1.0	1.4	0.9	1.4	0.7	1.0	0.7	1.0
Nights > 30°C	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
SDays > 30°C	3.4	4.3	5.2	4.0	4.7	3.7	4.2	3.9	4.4
SDays > 35°C	0.9	1.1	1.4	1.0	1.2	0.9	1.0	0.9	1.1
SDays > 40°C	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
SNights > 25°C	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mildura: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2015**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	80.4	86.4	91.7	84.6	89.1	82.4	85.5	83.3	86.1
Days > 35°C	31.9	35.5	38.6	34.3	37.2	32.9	34.9	33.5	35.5
Days > 40°C	6.1	7.6	8.9	6.9	8.2	6.5	7.0	6.7	7.5
Nights > 25°C	1.9	2.5	3.2	2.4	2.8	2.3	2.4	2.3	2.5
Nights > 30°C	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SDays > 30°C	18.1	19.9	21.3	19.2	20.5	18.6	19.5	18.8	19.7
SDays > 35°C	5.6	6.0	6.5	5.9	6.2	5.7	6.0	5.7	6.0
SDays > 40°C	0.5	0.7	1.2	0.7	0.9	0.6	0.7	0.6	0.7
SNights > 25°C	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.2
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mildura: Annual average number of days/night above selected threshold temperatures for present conditions (1981-2000: a 20-year period centred on 1990). Projections for **2030**, relative to 1990, are given for four climate models: CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1. The low and high projections allow for low and high rates of global warming, respectively. SDays and SNights refer to the annual-average number of spells of 3-5 days/nights above selected threshold temperatures.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 30°C	80.4	91.7	101.0	89.1	97.2	85.5	90.0	86.1	92.8
Days > 35°C	31.9	38.6	45.2	37.2	42.5	34.9	37.5	35.5	39.2
Days > 40°C	6.1	8.9	11.4	8.2	10.5	7.0	8.3	7.5	9.0
Nights > 25°C	1.9	3.2	4.8	2.8	4.1	2.4	2.8	2.5	3.3
Nights > 30°C	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1
SDays > 30°C	18.1	21.3	24.3	20.5	23.0	19.5	20.8	19.7	21.9
SDays > 35°C	5.6	6.5	8.1	6.2	7.4	6.0	6.2	6.0	6.7
SDays > 40°C	0.5	1.2	1.6	0.9	1.5	0.7	0.9	0.7	1.3
SNights > 25°C	0.1	0.2	0.5	0.2	0.5	0.1	0.2	0.2	0.3
SNights > 30°C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

3.3 Wind gusts

Observed trends

Daily wind gusts are recorded by the Bureau of Meteorology and are defined as the maximum wind-speed in a 24-hour period. Annual and seasonal average wind gust speeds were calculated for Adelaide, Woomera Mt Gambier, Melbourne Airport and Mildura for each year in the period 1980-2007. For each site, the trend was calculated using linear regression. There are different trends at each site, with increases in all seasons at Woomera, decreases in all seasons at Mt Gambier, Melbourne and Mildura, and the direction of change varying between seasons at Adelaide. This may be associated with a southward shift in weather systems since the 1970s (CSIRO and BoM, 2007). Results are given in tables below.

In Adelaide, wind gust speeds show a trend towards strengthening in spring/summer and weakening in autumn/winter. The annual average speed has decreased slightly (-0.003 kph/yr), with largest gusts in 1981 and smallest in 1982.

In Mt Gambier, wind gust show a trend towards weakening in all seasons. The annual average speed has declined by 0.047 kph/yr. The largest gusts occurred in 1981 and smallest in 1985.

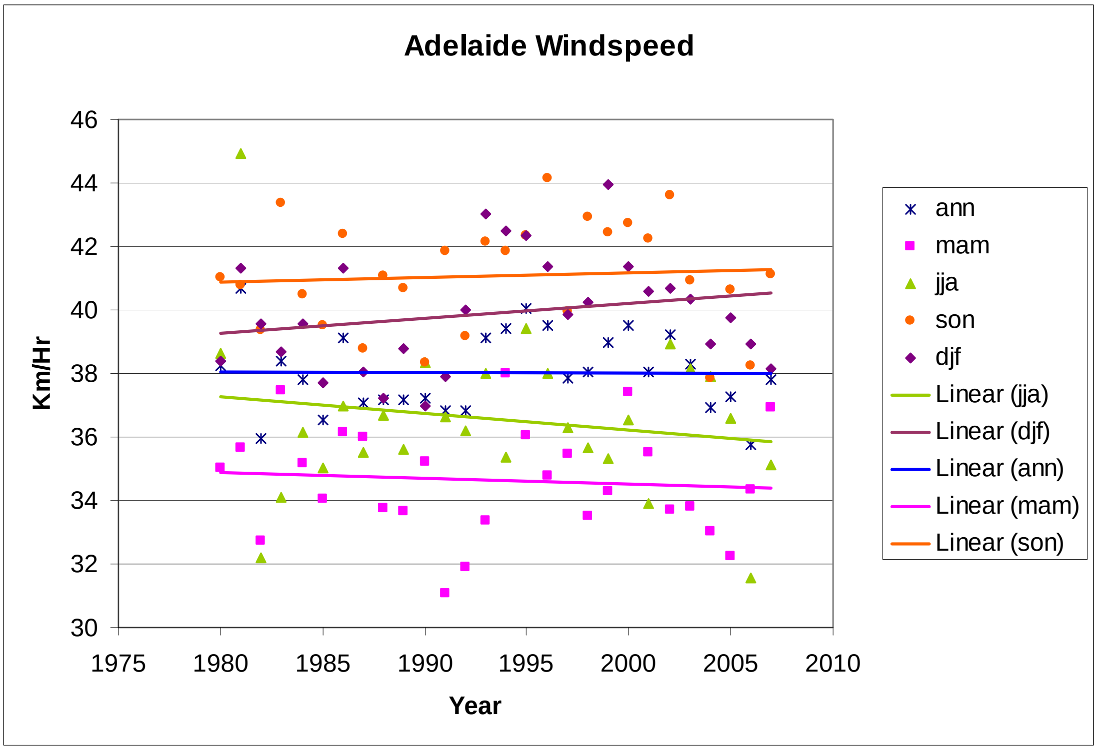
In Woomera, wind gust speeds show a trend towards strengthening in all seasons. The annual average has increased by 0.077 kph/yr. The largest gusts occurred in 1986 and smallest in 1980.

In Melbourne, wind gust speeds show a trend towards weakening in all seasons, except summer (in which negligible change has occurred). The annual average speed has declined by 0.058 kph/yr. The largest gusts occurred in 1980 and smallest in 1997.

In Mildura, wind gust speeds show a trend towards weakening in all seasons. The annual average speed has declined by 0.137 kph/yr. The largest gusts occurred in 1985 and smallest in 1993.

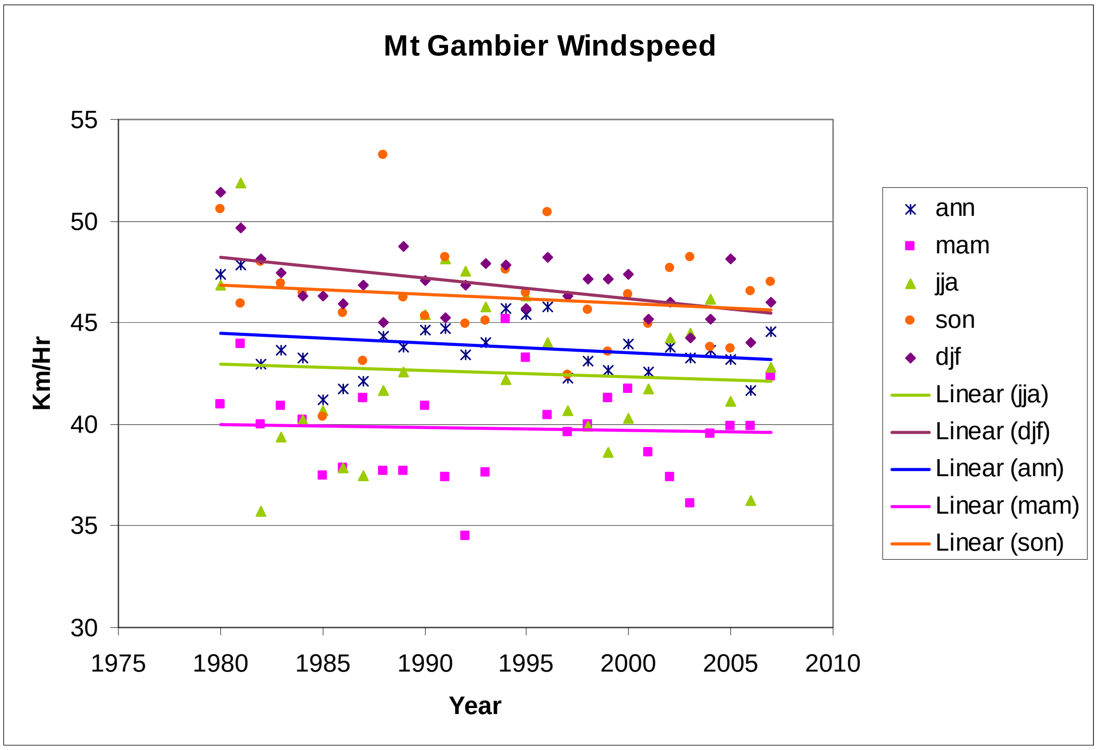
Adelaide annual and seasonal average wind gusts (kph) from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	38.2	35.0	38.6	41.0	38.4
1981	40.7	35.7	44.9	40.8	41.3
1982	35.9	32.7	32.2	39.4	39.6
1983	38.4	37.5	34.1	43.4	38.7
1984	37.8	35.1	36.2	40.5	39.6
1985	36.6	34.0	35.0	39.5	37.7
1986	39.1	36.1	37.0	42.4	41.3
1987	37.1	36.0	35.5	38.8	38.0
1988	37.2	33.7	36.7	41.1	37.2
1989	37.2	33.6	35.6	40.7	38.8
1990	37.2	35.2	38.4	38.3	37.0
1991	36.8	31.1	36.6	41.8	37.9
1992	36.8	31.9	36.2	39.2	40.0
1993	39.1	33.4	38.0	42.2	43.0
1994	39.4	38.0	35.4	41.9	42.5
1995	40.0	36.1	39.4	42.3	42.4
1996	39.5	34.8	38.0	44.1	41.4
1997	37.9	35.4	36.3	39.9	39.8
1998	38.1	33.5	35.7	42.9	40.2
1999	39.0	34.3	35.3	42.4	43.9
2000	39.5	37.4	36.6	42.8	41.4
2001	38.0	35.5	33.9	42.3	40.6
2002	39.2	33.7	38.9	43.6	40.7
2003	38.3	33.8	38.1	40.9	40.3
2004	36.9	33.0	37.9	37.9	38.9
2005	37.3	32.3	36.6	40.6	39.7
2006	35.7	34.3	31.6	38.3	38.9
2007	37.8	36.9	35.1	41.1	38.1



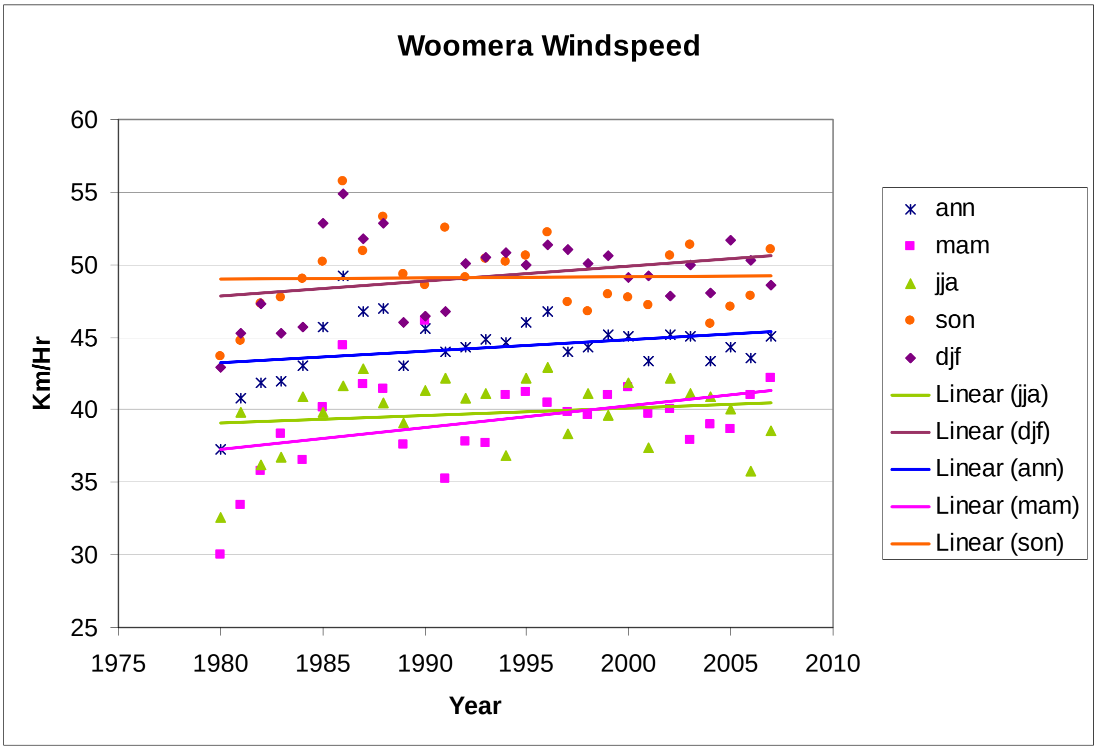
Mt Gambier annual and seasonal average wind gusts (kph) from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	47.4	41.0	46.8	50.6	51.4
1981	47.8	43.9	51.9	45.9	49.6
1982	42.9	40.0	35.7	48.0	48.1
1983	43.7	40.9	39.4	46.9	47.5
1984	43.3	40.2	40.2	46.5	46.3
1985	41.2	37.5	40.7	40.4	46.3
1986	41.7	37.9	37.8	45.4	46.0
1987	42.2	41.3	37.5	43.1	46.8
1988	44.4	37.7	41.6	53.2	45.0
1989	43.8	37.7	42.6	46.2	48.7
1990	44.7	40.9	45.4	45.3	47.1
1991	44.7	37.4	48.2	48.2	45.2
1992	43.5	34.5	47.6	45.0	46.9
1993	44.0	37.6	45.7	45.1	47.9
1994	45.7	45.2	42.2	47.6	47.9
1995	45.4	43.2	46.3	46.5	45.7
1996	45.8	40.5	44.0	50.4	48.2
1997	42.3	39.6	40.7	42.4	46.3
1998	43.1	40.0	39.9	45.6	47.2
1999	42.6	41.3	38.6	43.6	47.2
2000	43.9	41.7	40.3	46.4	47.4
2001	42.6	38.6	41.7	45.0	45.2
2002	43.8	37.4	44.3	47.7	46.0
2003	43.3	36.1	44.5	48.3	44.2
2004	43.7	39.5	46.2	43.8	45.2
2005	43.2	39.9	41.1	43.7	48.1
2006	41.7	39.9	36.2	46.6	44.0
2007	44.6	42.4	42.8	47.0	46.0



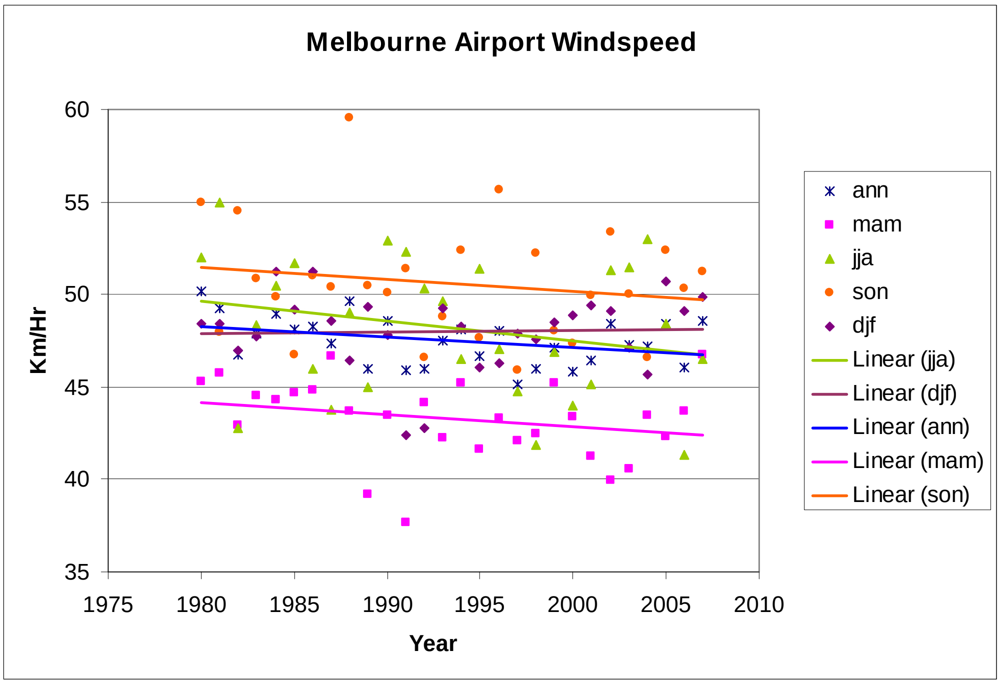
Woomera annual and seasonal average wind gusts (kph) from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	37.3	30.1	32.6	43.7	42.9
1981	40.8	33.5	39.9	44.7	45.3
1982	41.9	35.8	36.2	47.3	47.3
1983	42.0	38.3	36.7	47.7	45.3
1984	43.0	36.5	40.9	49.0	45.7
1985	45.7	40.1	39.8	50.2	52.9
1986	49.2	44.4	41.7	55.7	54.9
1987	46.8	41.8	42.8	50.9	51.8
1988	47.0	41.4	40.5	53.3	52.9
1989	43.1	37.6	39.1	49.4	46.0
1990	45.6	46.1	41.3	48.5	46.4
1991	44.0	35.3	42.2	52.5	46.7
1992	44.4	37.8	40.8	49.1	50.0
1993	44.9	37.7	41.1	50.4	50.5
1994	44.7	41.0	36.8	50.2	50.8
1995	46.0	41.2	42.2	50.6	49.9
1996	46.7	40.4	42.9	52.2	51.4
1997	44.0	39.8	38.3	47.4	51.0
1998	44.3	39.6	41.1	46.7	50.1
1999	45.2	41.0	39.6	48.0	50.6
2000	45.0	41.6	41.8	47.7	49.2
2001	43.4	39.7	37.4	47.2	49.3
2002	45.2	40.0	42.2	50.6	47.9
2003	45.0	37.9	41.1	51.3	50.0
2004	43.4	39.0	40.9	45.9	48.0
2005	44.3	38.7	40.0	47.1	51.7
2006	43.6	41.0	35.7	47.9	50.3
2007	45.1	42.2	38.5	51.0	48.6



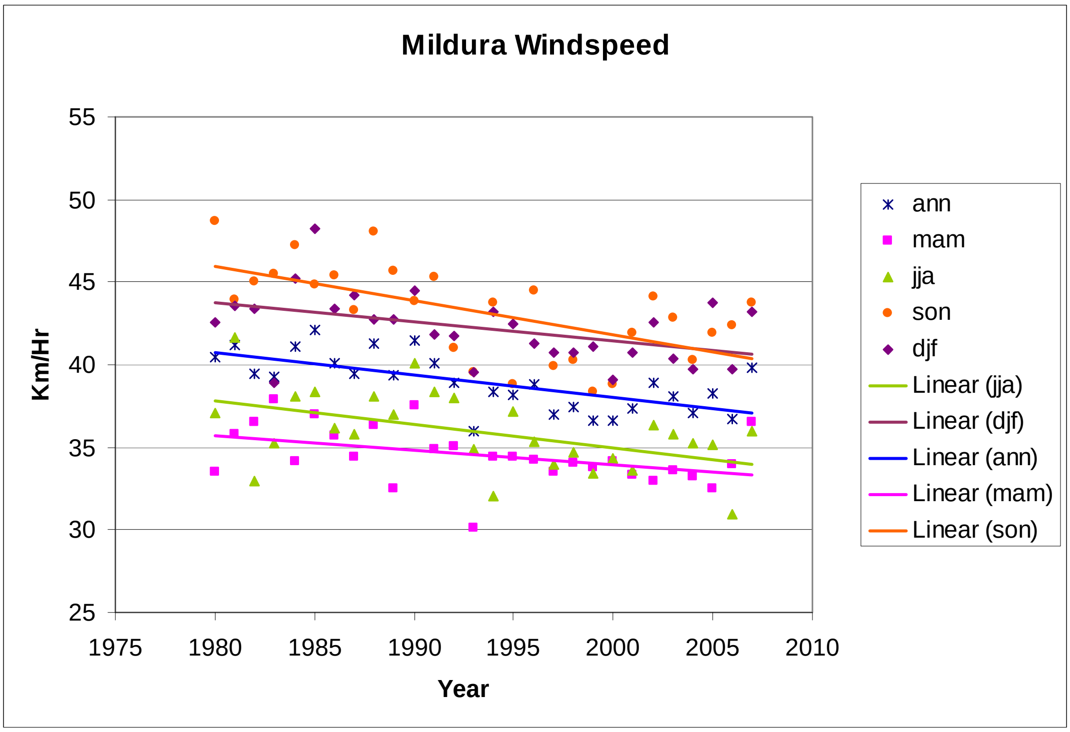
Melbourne airport annual and seasonal average wind gusts (kph) from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	50.2	45.3	52.0	55.0	48.4
1981	49.3	45.7	55.0	48.0	48.4
1982	46.8	43.0	42.8	54.5	47.0
1983	47.9	44.5	48.4	50.9	47.7
1984	49.0	44.3	50.4	49.9	51.2
1985	48.1	44.7	51.7	46.8	49.2
1986	48.2	44.9	46.0	51.0	51.2
1987	47.3	46.7	43.7	50.4	48.6
1988	49.6	43.7	49.0	59.5	46.4
1989	46.0	39.2	45.0	50.5	49.3
1990	48.6	43.5	52.9	50.1	47.8
1991	45.9	37.6	52.3	51.4	42.4
1992	46.0	44.1	50.3	46.6	42.8
1993	47.5	42.3	49.6	48.8	49.3
1994	48.1	45.2	46.5	52.3	48.3
1995	46.7	41.6	51.4	47.6	46.0
1996	48.0	43.3	47.0	55.7	46.3
1997	45.1	42.1	44.7	45.9	47.8
1998	46.0	42.4	41.9	52.2	47.6
1999	47.2	45.2	46.9	48.0	48.5
2000	45.8	43.4	44.0	47.3	48.8
2001	46.4	41.3	45.2	49.9	49.4
2002	48.4	40.0	51.3	53.3	49.1
2003	47.3	40.6	51.4	50.0	47.1
2004	47.2	43.4	53.0	46.6	45.7
2005	48.4	42.3	48.4	52.4	50.7
2006	46.1	43.7	41.3	50.3	49.1
2007	48.6	46.8	46.5	51.2	49.9



Mildura annual and seasonal average wind gusts (kph) from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	40.4	33.5	37.1	48.7	42.6
1981	41.2	35.8	41.7	43.9	43.6
1982	39.5	36.5	32.9	45.0	43.4
1983	39.3	37.9	35.2	45.5	38.9
1984	41.1	34.1	38.1	47.2	45.2
1985	42.1	37.0	38.3	44.9	48.3
1986	40.1	35.7	36.1	45.4	43.4
1987	39.4	34.4	35.8	43.3	44.2
1988	41.3	36.4	38.0	48.0	42.8
1989	39.3	32.5	37.0	45.6	42.8
1990	41.5	37.6	40.1	43.8	44.5
1991	40.1	34.9	38.3	45.3	41.8
1992	38.9	35.0	38.0	41.0	41.7
1993	36.0	30.1	34.9	39.6	39.6
1994	38.3	34.4	32.1	43.7	43.2
1995	38.2	34.4	37.1	38.8	42.5
1996	38.8	34.3	35.3	44.5	41.3
1997	37.0	33.5	33.9	39.9	40.7
1998	37.4	34.1	34.7	40.2	40.7
1999	36.6	33.8	33.4	38.4	41.1
2000	36.6	34.2	34.3	38.8	39.1
2001	37.4	33.3	33.6	42.0	40.7
2002	38.9	32.9	36.3	44.1	42.6
2003	38.1	33.6	35.8	42.9	40.3
2004	37.1	33.2	35.2	40.3	39.7
2005	38.2	32.5	35.1	41.9	43.7
2006	36.7	33.9	30.9	42.4	39.7
2007	39.8	36.5	36.0	43.7	43.2



Wind-speed Regression Coefficients

Adelaide	Intercept	Slope	R^2
Annual	43.31633	-0.00265	0.00031
Autumn(mam)	70.94647	-0.01821	0.007523
Winter(jja)	141.6324	-0.05271	0.030384
Spring(son)	15.2301	0.012963	0.003921
Summer(djf)	-53.5507	0.046882	0.04658

Mt Gambier	Intercept	Slope	R^2
Annual	137.9867	-0.04724	0.060471
Autumn(mam)	68.70054	-0.01451	0.002484
Winter(jja)	104.2176	-0.03096	0.004325
Spring(son)	136.8629	-0.04547	0.020311
Summer(djf)	249.0323	-0.10143	0.263409

Woomera	Intercept	Slope	R^2
Annual	-109.361	0.077099	0.082643
Autumn(mam)	-263.826	0.152043	0.151197
Winter(jja)	-64.1165	0.052125	0.030137
Spring(son)	34.07598	0.00756	0.000554
Summer(djf)	-159.094	0.104484	0.098123

Melbourne AP	Intercept	Slope	R^2
Annual	162.4675	-0.05768	0.13409
Autumn(mam)	173.1193	-0.06515	0.06101
Winter(jja)	264.2094	-0.10837	0.05694
Spring(son)	178.1967	-0.06402	0.02834
Summer(djf)	31.08289	0.00849	0.00111

Mildura	Intercept	Slope	R^2
Annual	311.7871	-0.13689	0.442422
Autumn(mam)	208.705	-0.08738	0.175618
Winter(jja)	320.2512	-0.14264	0.246214
Spring(son)	451.3905	-0.20478	0.361365
Summer(djf)	267.2147	-0.11288	0.198227

Projections

As indicated above, annual average observed trends for 1980-2007 indicate weakening of wind-speeds at Ballarat, Cape Otway and Melbourne, and strengthening of wind-speeds at Woomera. The seasonal mean projections for wind-speed changes from four models in 2015 and 2030 at each site have been applied to daily wind gust data from 1981-2000 (a 20-year period centred on 1990) in order to estimate the frequency of exceeding specific wind-speed thresholds. The thresholds are 40, 45, 51, 63, 76, 90, 104, 115 and 138 kph. HADGEM1 gives the largest increases, while MIROC-M gives the largest decreases. Results are shown in the tables below.

In most cases, the change in frequency between present and future for a given model is in the same direction for low and high global warming, with a slightly greater change for high global warming. However, at Mt Gambier, the low and high global warming projections for the CSIRO Mk3.5 model are the same for some wind gust thresholds – this is because the underlying seasonal mean wind-speed changes are not large enough to affect daily threshold exceedances in those cases. At Woomera, there are similar examples, plus a small number of cases where the high scenario represents a change in the opposite direction to the low scenario, e.g. for days over 40 kph, the present frequency is 215.8 days, the low CSIRO Mk3.5 scenario is 212.1 and the high CSIRO Mk3.5 scenario is 223.1. Closer investigation reveals that this can occur when a model has decreases in average wind-speed in some seasons and increases in others. Depending on the amount of global warming, this can result in different seasons dominating the contribution to the annual average.

In Adelaide, the present average of 145 days per year with wind gusts over 40 kph is projected to become 135-156 days by 2015, and 135-160 days by 2030. The present average of 3.1 days per year over 76 kph is projected to become 1.8-3.9 days by 2015, and 1.7-4.9 days by 2030.

In Mt Gambier, the present average of 209 days per year over 40 kph is projected to become 205-226 days by 2015, and 197-234 days by 2030. The present average of 12.2 days per year over 76 kph is projected to become 9.9-12.8 days by 2015, and 8.5-17.5 days by 2030.

In Woomera, the present average of 216 days per year over 40 kph is projected to become 207-223 days by 2015, and 196-229 days by 2030. The present average of 12.6 days per year over 76 kph is projected to become 10.6-13.3 days by 2015, and 9.7-14.8 days by 2030.

At Melbourne airport, the present average of 222 days per year over 40 kph is projected to become 218-234 days by 2015, and 211-238 days by 2030. The present average of 29 days per year over 76 kph is projected to become 24-33 days by 2015 and 24-38 days 2030.

In Mildura, the present average of 149 days per year over 40 kph is projected to become 139-166 days by 2015, and 135-183 days by 2030. The present average of 6 days per year over 76 kph is projected to become 4.3-8.4 days by 2015 and 3.6-10.3 days by 2030.

Adelaide: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2015**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming**.**

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	145.1	140.7	139.6	145.1	135.3	140.7	135.6	145.1	156.3
Days > 45	86.7	94.6	92.6	92.2	97.5	86.7	84.8	101.4	101.4
Days > 51	54.3	53.4	53.3	54.3	53.3	51.9	48.6	57.3	62.3
Days > 63	14.6	12.9	12.7	13.4	13.4	11.9	11.1	14.1	16.5
Days > 76	3.1	2.5	2.4	2.6	2.3	2.3	1.8	3.6	3.9
Days > 90	0.5	0.4	0.4	0.4	0.5	0.4	0.4	0.6	0.6
Days > 104	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Days > 115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Days > 138	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Adelaide: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2030**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming**.**

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	145.1	139.6	145.6	135.3	140.5	135.6	135.6	156.3	160.0
Days > 45	86.7	92.6	94.9	97.5	93.7	84.8	82.3	101.4	106.1
Days > 51	54.3	53.3	53.6	53.3	56.5	48.6	46.4	62.3	70.9
Days > 63	14.6	12.7	13.5	13.4	13.7	11.1	10.2	16.5	19.8
Days > 76	3.1	2.4	2.2	2.3	2.7	1.8	1.7	3.9	4.9
Days > 90	0.5	0.4	0.4	0.5	0.5	0.4	0.3	0.6	0.7
Days > 104	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2
Days > 115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Days > 138	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mt Gambier: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2015**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming**.**

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	209.4	209.4	208.5	204.8	204.8	209.4	205.7	209.4	226.2
Days > 45	148.7	154.6	154.6	153.0	150.0	148.7	148.7	162.8	162.8
Days > 51	99.9	99.9	100.3	98.1	102.8	96.4	94.4	114.5	114.5
Days > 63	38.3	34.9	36.8	36.3	35.3	34.4	34.4	37.7	44.5
Days > 76	12.2	11.0	11.4	10.9	11.4	10.4	9.9	12.4	12.8
Days > 90	2.2	1.9	1.9	2.2	2.1	1.9	1.8	2.4	2.9
Days > 104	0.3	0.3	0.2	0.4	0.4	0.3	0.2	0.5	0.6
Days > 115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Days > 138	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mt Gambier: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2030**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	209.4	208.5	208.5	204.8	203.9	205.7	197.0	226.2	234.3
Days > 45	148.7	154.6	147.9	150.0	146.9	148.7	145.0	162.8	180.8
Days > 51	99.9	100.3	100.3	102.8	99.9	94.4	88.9	114.5	126.5
Days > 63	38.3	36.8	33.1	35.3	37.1	34.4	32.4	44.5	51.5
Days > 76	12.2	11.4	11.0	11.4	10.9	9.9	8.5	12.8	17.5
Days > 90	2.2	1.9	2.0	2.1	2.2	1.8	1.7	2.9	4.6
Days > 104	0.3	0.2	0.2	0.4	0.4	0.2	0.1	0.6	1.0
Days > 115	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2
Days > 138	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Woomera: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2015**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	215.8	212.1	223.1	218.1	218.1	212.1	207.1	215.8	216.9
Days > 45	156.7	167.1	164.8	165.6	163.3	156.7	154.4	161.2	167.2
Days > 51	109.2	110.1	113.9	110.1	114.0	106.5	101.8	113.0	110.3
Days > 63	41.9	38.8	38.4	41.6	40.3	36.9	35.5	40.1	43.2
Days > 76	12.6	11.2	11.9	12.5	12.7	10.8	10.6	12.1	13.3
Days > 90	2.8	2.9	2.7	3.0	3.0	2.6	2.3	3.0	3.6
Days > 104	0.4	0.5	0.6	0.5	0.6	0.4	0.4	0.6	0.6
Days > 115	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2
Days > 138	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Woomera: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2030**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	215.8	223.1	218.4	218.1	228.9	207.1	196.0	216.9	216.9
Days > 45	156.7	164.8	166.8	163.3	174.3	154.4	155.5	167.2	169.9
Days > 51	109.2	113.9	110.6	114.0	117.8	101.8	94.4	110.3	121.8
Days > 63	41.9	38.4	41.0	40.3	45.8	35.5	32.9	43.2	44.3
Days > 76	12.6	11.9	13.3	12.7	13.8	10.6	9.7	13.3	14.8
Days > 90	2.8	2.7	2.6	3.0	3.7	2.3	2.0	3.6	4.0
Days > 104	0.4	0.6	0.6	0.6	0.6	0.4	0.3	0.6	0.9
Days > 115	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2
Days > 138	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Woomera: annual and seasonal average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2015**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high global warming.

Threshold	Season	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
		1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	**ann**	**215.76**	**212.11**	**223.08**	**218.05**	**218.05**	**212.11**	**207.12**	**215.76**	**216.88**
	djf	71.11	71.11	76.14	71.11	71.11	71.11	71.11	285.79	285.79
	jja	40.71	37.05	37.05	37.05	37.05	37.05	37.05	162.27	147.68
	mam	39.44	39.44	45.39	45.39	45.39	39.44	39.44	157.73	157.73
	son	64.5	64.5	64.5	64.5	64.5	64.5	59.52	257.79	276.88
Days > 45	**ann**	**156.65**	**167.07**	**164.78**	**165.6**	**163.31**	**156.65**	**154.36**	**161.18**	**167.17**
	djf	52.86	58.86	58.86	52.86	52.86	52.86	52.86	212.45	236.55
	jja	28.62	28.62	26.33	28.62	26.33	28.62	26.33	114.05	114.05
	mam	25.16	29.58	29.58	29.58	29.58	25.16	25.16	100.61	100.61
	son	50.01	50.01	50.01	54.54	54.54	50.01	50.01	217.97	217.97
Days > 51	**ann**	**109.18**	**110.09**	**113.91**	**110.09**	**113.96**	**106.48**	**101.76**	**113.04**	**110.35**
	djf	36.04	36.04	42.39	36.04	36.04	36.04	36.04	144.83	144.83
	jja	20.18	17.48	14.94	17.48	17.48	17.48	17.48	80.42	69.69
	mam	15.2	18.81	18.81	18.81	18.81	15.2	15.2	60.77	60.77
	son	37.77	37.77	37.77	37.77	41.63	37.77	33.04	166.37	166.37
Days > 63	**ann**	**41.93**	**38.83**	**38.38**	**41.63**	**40.26**	**36.85**	**35.48**	**40.05**	**43.15**
	djf	12.86	12.86	12.86	12.86	12.86	10.88	10.88	51.68	51.68
	jja	7.93	6.71	5.34	6.71	5.34	6.71	5.34	26.74	26.74
	mam	4.22	4.22	5.13	5.13	5.13	4.22	4.22	14.23	14.23
	son	16.93	15.05	15.05	16.93	16.93	15.05	15.05	67.65	80.04
Days > 76	**ann**	**12.61**	**11.18**	**11.94**	**12.5**	**12.71**	**10.78**	**10.57**	**12.10**	**13.27**
	djf	3.25	3.25	3.96	3.25	3.25	2.64	2.64	13.07	13.07
	jja	1.93	1.27	0.97	1.47	1.27	1.47	1.27	5.87	5.87
	mam	0.86	0.86	1.22	1.22	1.63	0.86	0.86	3.25	3.25
	son	6.56	5.79	5.79	6.56	6.56	5.79	5.79	26.21	30.88
Days > 90	**ann**	**2.85**	**2.9**	**2.69**	**3.05**	**3**	**2.59**	**2.34**	**3.05**	**3.61**
	djf	0.81	0.97	0.97	0.81	0.81	0.81	0.66	3.27	3.88
	jja	0.36	0.25	0.25	0.36	0.25	0.36	0.25	1.42	1.42
	mam	0.2	0.2	0.25	0.2	0.25	0.2	0.2	0.81	0.81
	son	1.47	1.47	1.22	1.68	1.68	1.22	1.22	6.70	8.33
Days > 104	**ann**	**0.41**	**0.51**	**0.56**	**0.51**	**0.61**	**0.41**	**0.36**	**0.61**	**0.56**
	djf	0.1	0.2	0.25	0.2	0.2	0.1	0.1	0.82	0.82
	jja	0.05	0	0	0	0	0	0	0.20	0.00
	mam	0	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00
	son	0.25	0.25	0.25	0.25	0.36	0.25	0.2	1.42	1.42
Days > 115	**ann**	**0.1**	**0.1**	**0.1**	**0.15**	**0.2**	**0.1**	**0.1**	**0.20**	**0.20**
	djf	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.41	0.41
	jja	0	0	0	0	0	0	0	0.00	0.00
	mam	0	0	0	0	0	0	0	0.00	0.00
	son	0	0	0	0.05	0.1	0	0	0.41	0.41
Days > 138	**ann**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**
	djf	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.20	0.20
	jja	0	0	0	0	0	0	0	0.00	0.00
	mam	0	0	0	0	0	0	0	0.00	0.00
	son	0	0	0	0	0	0	0	0.00	0.00

Melbourne Airport: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2015**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	221.92	221.92	219.85	221.92	218.19	221.92	218.30	221.9	234.3
Days > 45	176.06	180.84	180.84	176.06	179.58	176.06	176.06	187.5	187.5
Days > 51	134.39	138.46	133.33	134.39	132.02	134.39	131.82	145.0	145.0
Days > 63	74.71	68.88	71.19	74.71	69.38	67.17	67.17	73.2	80.6
Days > 76	28.96	25.64	25.64	28.96	26.04	24.23	23.53	29.2	33.1
Days > 90	6.99	5.98	6.18	6.99	6.99	6.44	5.33	8.3	10.3
Days > 104	1.31	1.36	1.26	1.31	1.36	1.31	1.21	1.9	2.1
Days > 115	0.30	0.35	0.30	0.30	0.45	0.20	0.20	0.6	0.7
Days > 138	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.1	0.1

Melbourne Airport: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2030**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	221.92	219.85	223.62	221.92	218.19	218.30	211.41	234.3	237.5
Days > 45	176.06	180.84	178.23	176.06	176.37	176.06	172.54	187.5	199.1
Days > 51	134.39	133.33	137.25	134.39	131.97	131.82	123.78	145.0	155.0
Days > 63	74.71	71.19	68.88	74.71	69.38	67.17	64.91	80.6	87.6
Days > 76	28.96	25.64	26.75	28.96	25.04	23.53	23.53	33.1	37.7
Days > 90	6.99	6.18	6.23	6.99	6.84	5.33	4.98	10.3	12.5
Days > 104	1.31	1.26	1.46	1.31	1.56	1.21	1.11	2.1	2.8
Days > 115	0.30	0.30	0.30	0.30	0.55	0.20	0.20	0.7	0.9
Days > 138	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.1	0.2

Mildura: annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2015**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	149.2	150.5	150.6	149.2	145.2	145.2	139.1	154.8	166.3
Days > 45	95.8	104.1	102.9	100.1	105.9	95.8	92.8	111.4	115.8
Days > 51	65.2	68.9	65.1	65.2	66.6	59.1	59.1	73.1	78.0
Days > 63	21.6	19.2	20.7	20.3	20.3	17.8	16.1	23.1	27.1
Days > 76	5.8	4.9	5.6	5.5	6.0	4.8	4.3	7.0	8.4
Days > 90	1.1	1.0	1.1	1.0	1.0	0.9	0.7	1.3	1.6
Days > 104	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Days > 115	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.3
Days > 138	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Mildura annual average number of days when threshold wind gusts (kph) are exceeded for present (1980-2007) and 20 years centred on **2030**, for four climate models (CSIRO Mk3.5, INMCM, MIROC-M and HADGEM1) for low and high rates of global warming.

Threshold	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Days > 40	149.2	150.6	153.5	145.2	146.6	139.1	135.0	166.3	183.3
Days > 45	95.8	102.9	108.1	105.9	104.7	92.8	92.8	115.8	131.8
Days > 51	65.2	65.1	69.8	66.6	69.1	59.1	54.4	78.0	88.4
Days > 63	21.6	20.7	21.6	20.3	21.0	16.1	15.8	27.1	32.7
Days > 76	5.8	5.6	5.8	6.0	6.0	4.3	3.6	8.4	10.3
Days > 90	1.1	1.1	1.1	1.0	1.1	0.7	0.5	1.6	2.7
Days > 104	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.6
Days > 115	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.3	0.3
Days > 138	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

3.4 Dry days

Observed trends

The annual average number of dry days (less than 1 mm of rain) has been calculated for the period 1980-2007 at Adelaide, Woomera, Mt Gambier, Ballarat, Cape Otway, Melbourne CBD and Mildura. Trends have been estimated using linear regression. Results are tabulated and plotted below. At each site, the annual-average number of dry days has increased.

In Adelaide, the trend in annual number of dry days shows an increase of 0.18 days per year. The number of dry days has increased in autumn and winter and decreased in spring and summer. Most dry days occurred in 2006 and least in 1992.

In Mt Gambier, the trend in annual number of dry days shows an increase of 0.36 days per year. The number of dry days has increased in autumn and winter and decreased in spring and summer. Most dry days occurred in 1982 and least in 2004.

In Woomera, the trend in annual number of dry days shows an increase of 0.18 days per year. The number of dry days has increased in autumn and winter and decreased in spring and summer. Most dry days occurred in 2006 and least in 1981.

In Ballarat, the trend in annual number of dry days shows an increase of 0.58 days per year. The number of dry days has increased in all seasons except summer. Most dry days occurred in 2006 and least in 1996.

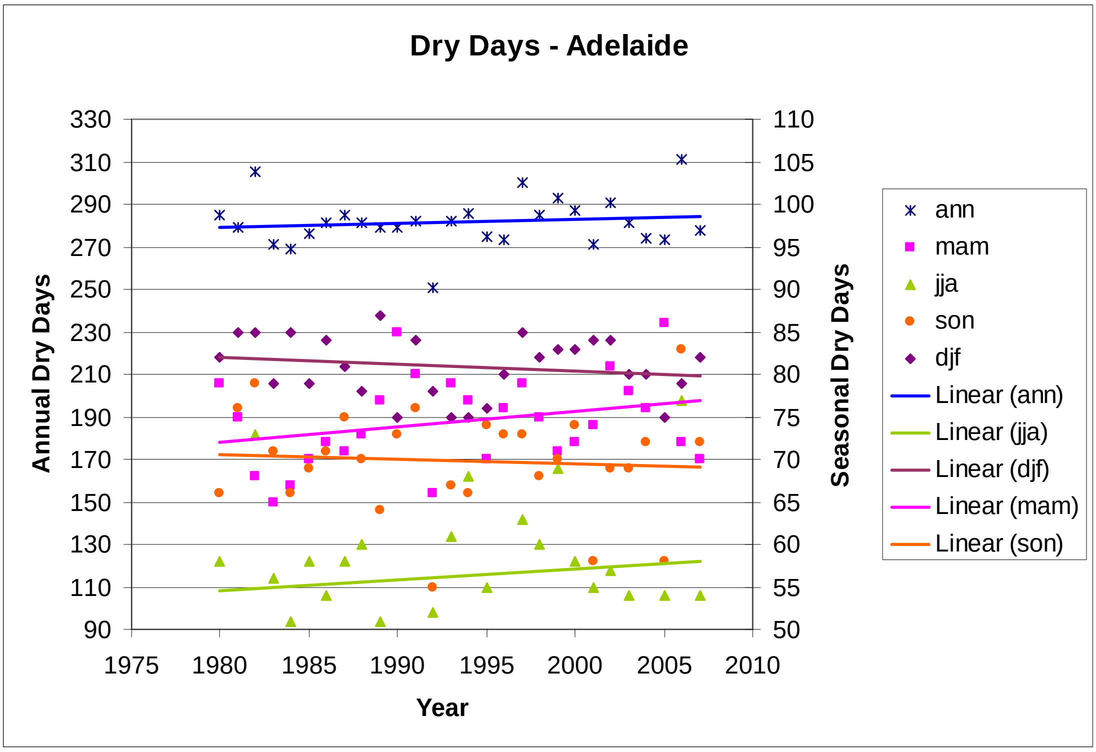
In Cape Otway, the trend in annual number of dry days shows an increase of 0.79 days per year. The number of dry days has increased in all seasons, especially autumn and winter. Most dry days occurred in 2006 and least in 1992.

In Melbourne, the trend in annual number of dry days shows an increase of 0.51 days per year. The number of dry days has increased in all seasons except summer. Most dry days occurred in 2006 and least in 1992.

In Mildura, the trend in annual number of dry days shows an increase of 0.27 days per year. The number of dry days has increased in autumn and winter with little change in spring and summer. Most dry days occurred in 1994 and least in 1992.

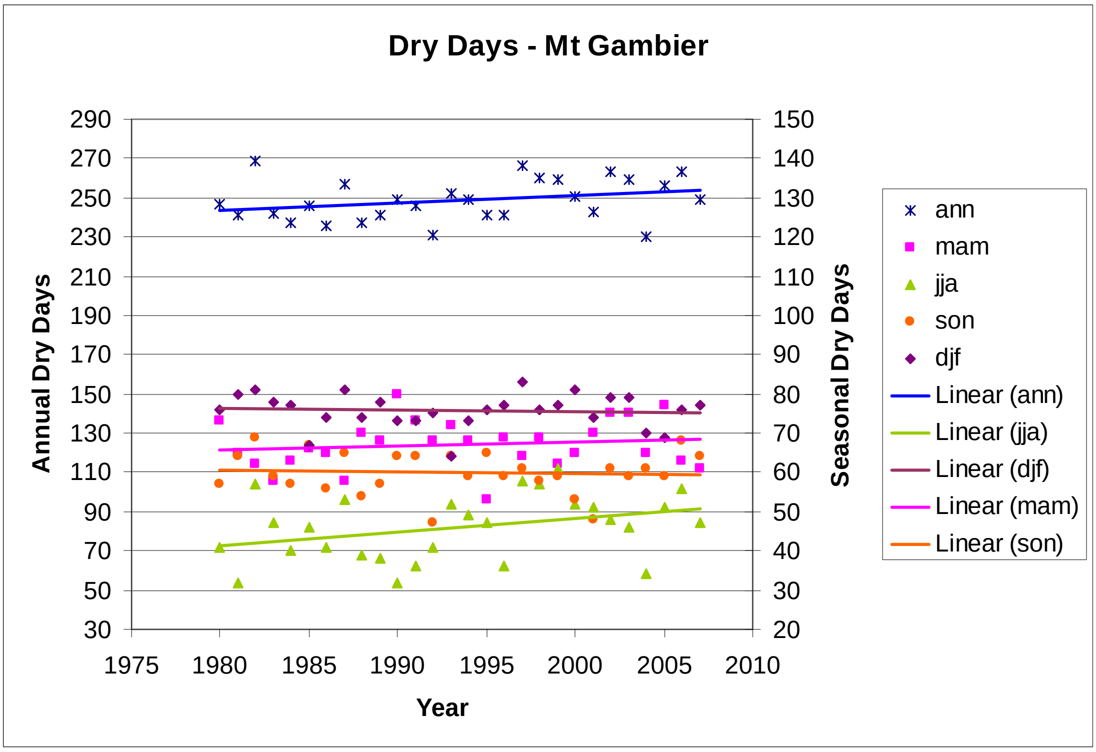
Adelaide annual number of dry days from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	285.0	79.0	58.0	66.0	82.0
1981	279.0	75.0	43.0	76.0	85.0
1982	305.0	68.0	73.0	79.0	85.0
1983	271.0	65.0	56.0	71.0	79.0
1984	269.0	67.0	51.0	66.0	85.0
1985	276.0	70.0	58.0	69.0	79.0
1986	281.0	72.0	54.0	71.0	84.0
1987	285.0	71.0	58.0	75.0	81.0
1988	281.0	73.0	60.0	70.0	78.0
1989	279.0	77.0	51.0	64.0	87.0
1990	279.0	85.0	46.0	73.0	75.0
1991	282.0	80.0	42.0	76.0	84.0
1992	251.0	66.0	52.0	55.0	78.0
1993	282.0	79.0	61.0	67.0	75.0
1994	286.0	77.0	68.0	66.0	75.0
1995	275.0	70.0	55.0	74.0	76.0
1996	273.0	76.0	44.0	73.0	80.0
1997	300.0	79.0	63.0	73.0	85.0
1998	285.0	75.0	60.0	68.0	82.0
1999	293.0	71.0	69.0	70.0	83.0
2000	287.0	72.0	58.0	74.0	83.0
2001	271.0	74.0	55.0	58.0	84.0
2002	291.0	81.0	57.0	69.0	84.0
2003	281.0	78.0	54.0	69.0	80.0
2004	274.0	76.0	46.0	72.0	80.0
2005	273.0	86.0	54.0	58.0	75.0
2006	311.0	72.0	77.0	83.0	79.0
2007	278.0	70.0	54.0	72.0	82.0



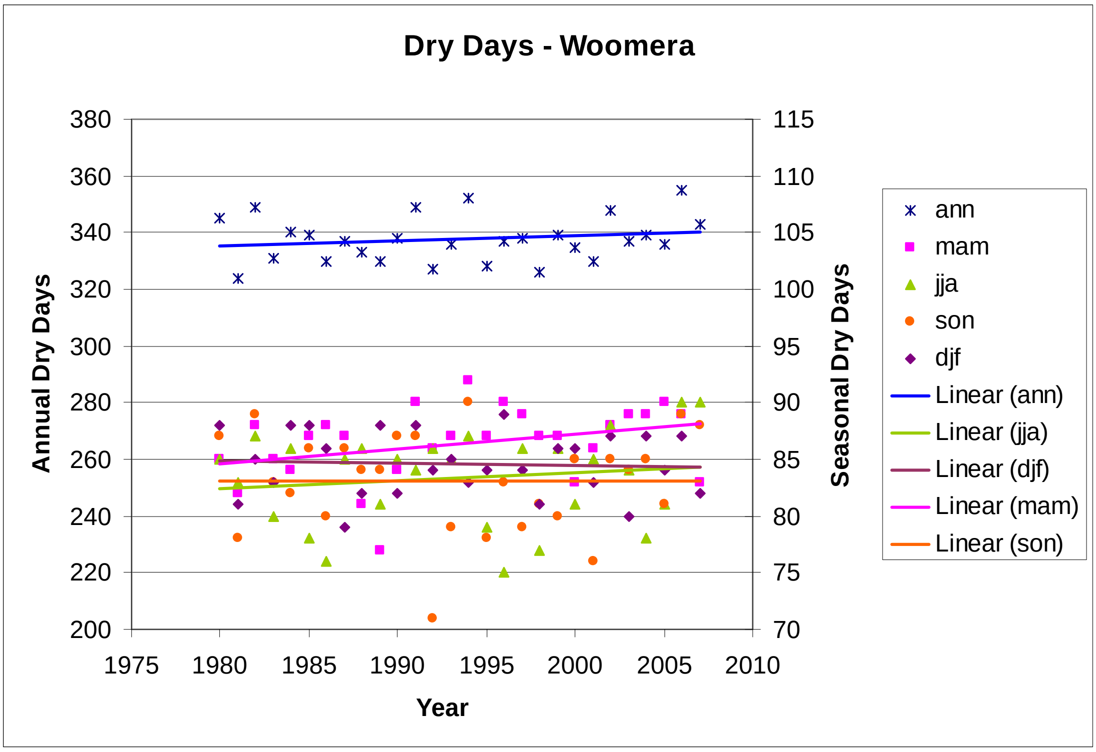
Mt Gambier annual number of dry days from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	247.0	73.0	41.0	57.0	76.0
1981	241.0	65.0	32.0	64.0	80.0
1982	269.0	62.0	57.0	69.0	81.0
1983	242.0	58.0	47.0	59.0	78.0
1984	237.0	63.0	40.0	57.0	77.0
1985	246.0	66.0	46.0	67.0	67.0
1986	236.0	65.0	41.0	56.0	74.0
1987	257.0	58.0	53.0	65.0	81.0
1988	237.0	70.0	39.0	54.0	74.0
1989	241.0	68.0	38.0	57.0	78.0
1990	249.0	80.0	32.0	64.0	73.0
1991	246.0	73.0	36.0	64.0	73.0
1992	231.0	68.0	41.0	47.0	75.0
1993	252.0	72.0	52.0	64.0	64.0
1994	249.0	68.0	49.0	59.0	73.0
1995	241.0	53.0	47.0	65.0	76.0
1996	241.0	69.0	36.0	59.0	77.0
1997	266.0	64.0	58.0	61.0	83.0
1998	260.0	69.0	57.0	58.0	76.0
1999	259.0	62.0	61.0	59.0	77.0
2000	251.0	65.0	52.0	53.0	81.0
2001	243.0	70.0	51.0	48.0	74.0
2002	263.0	75.0	48.0	61.0	79.0
2003	259.0	75.0	46.0	59.0	79.0
2004	230.0	65.0	34.0	61.0	70.0
2005	256.0	77.0	51.0	59.0	69.0
2006	263.0	63.0	56.0	68.0	76.0
2007	249.0	61.0	47.0	64.0	77.0



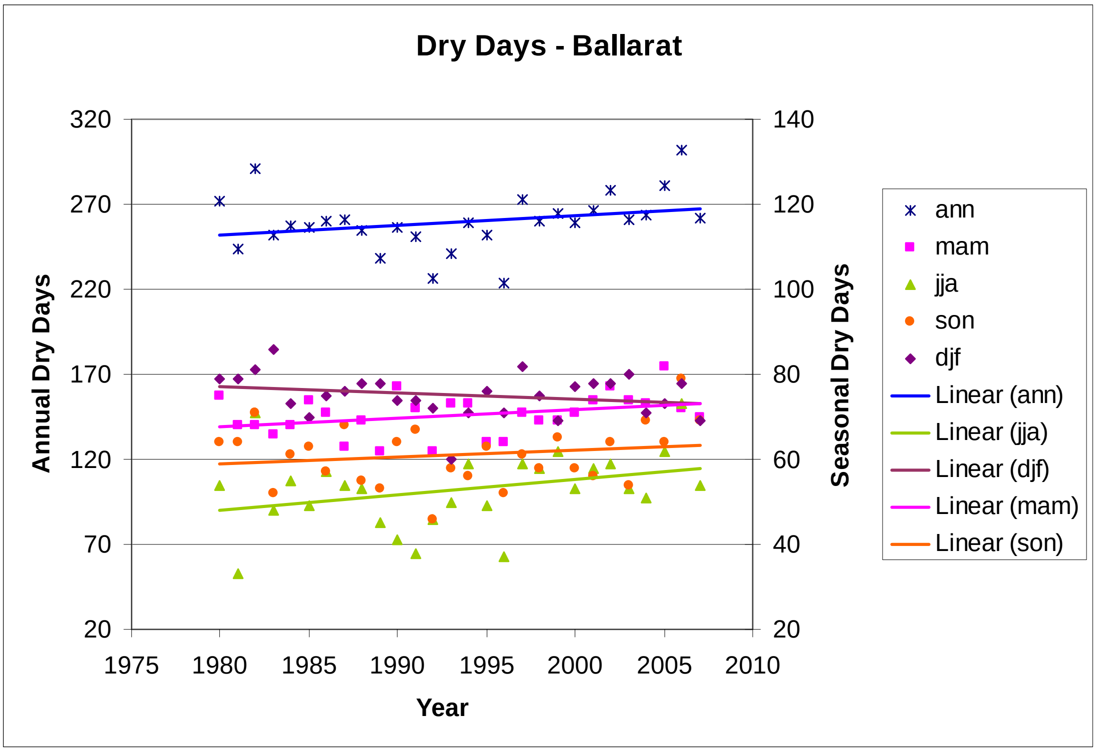
Woomera annual number of dry days from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	345.0	85.0	85.0	87.0	88.0
1981	324.0	82.0	83.0	78.0	81.0
1982	349.0	88.0	87.0	89.0	85.0
1983	331.0	85.0	80.0	83.0	83.0
1984	340.0	84.0	86.0	82.0	88.0
1985	339.0	87.0	78.0	86.0	88.0
1986	330.0	88.0	76.0	80.0	86.0
1987	337.0	87.0	85.0	86.0	79.0
1988	333.0	81.0	86.0	84.0	82.0
1989	330.0	77.0	81.0	84.0	88.0
1990	338.0	84.0	85.0	87.0	82.0
1991	349.0	90.0	84.0	87.0	88.0
1992	327.0	86.0	86.0	71.0	84.0
1993	336.0	87.0	85.0	79.0	85.0
1994	352.0	92.0	87.0	90.0	83.0
1995	328.0	87.0	79.0	78.0	84.0
1996	337.0	90.0	75.0	83.0	89.0
1997	338.0	89.0	86.0	79.0	84.0
1998	326.0	87.0	77.0	81.0	81.0
1999	339.0	87.0	86.0	80.0	86.0
2000	335.0	83.0	81.0	85.0	86.0
2001	330.0	86.0	85.0	76.0	83.0
2002	348.0	88.0	88.0	85.0	87.0
2003	337.0	89.0	84.0	84.0	80.0
2004	339.0	89.0	78.0	85.0	87.0
2005	336.0	90.0	81.0	81.0	84.0
2006	355.0	89.0	90.0	89.0	87.0
2007	343.0	83.0	90.0	88.0	82.0



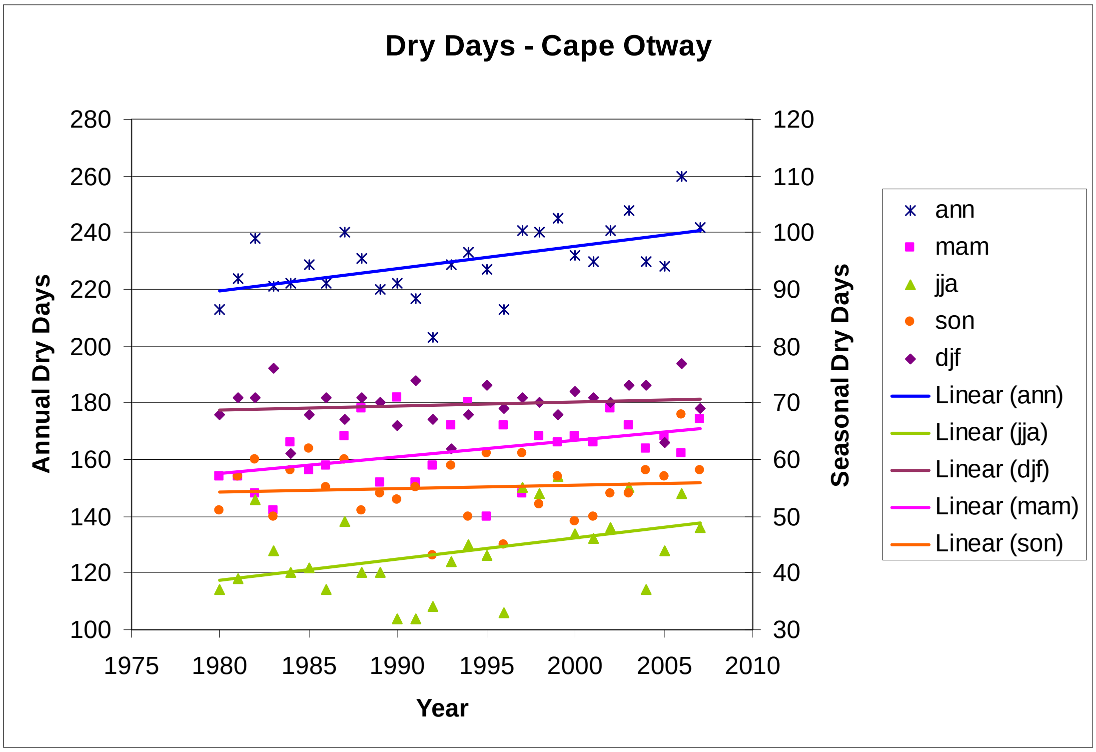
Ballarat annual number of dry days from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	272.0	75.0	54.0	64.0	79.0
1981	244.0	68.0	33.0	64.0	79.0
1982	291.0	68.0	71.0	71.0	81.0
1983	252.0	66.0	48.0	52.0	86.0
1984	257.0	68.0	55.0	61.0	73.0
1985	256.0	74.0	49.0	63.0	70.0
1986	260.0	71.0	57.0	57.0	75.0
1987	261.0	63.0	54.0	68.0	76.0
1988	255.0	69.0	53.0	55.0	78.0
1989	238.0	62.0	45.0	53.0	78.0
1990	256.0	77.0	41.0	64.0	74.0
1991	251.0	72.0	38.0	67.0	74.0
1992	226.0	62.0	46.0	46.0	72.0
1993	241.0	73.0	50.0	58.0	60.0
1994	259.0	73.0	59.0	56.0	71.0
1995	252.0	64.0	49.0	63.0	76.0
1996	224.0	64.0	37.0	52.0	71.0
1997	273.0	71.0	59.0	61.0	82.0
1998	260.0	69.0	58.0	58.0	75.0
1999	265.0	69.0	62.0	65.0	69.0
2000	259.0	71.0	53.0	58.0	77.0
2001	266.0	74.0	58.0	56.0	78.0
2002	278.0	77.0	59.0	64.0	78.0
2003	261.0	74.0	53.0	54.0	80.0
2004	264.0	73.0	51.0	69.0	71.0
2005	281.0	82.0	62.0	64.0	73.0
2006	302.0	72.0	73.0	79.0	78.0
2007	262.0	70.0	54.0	69.0	69.0



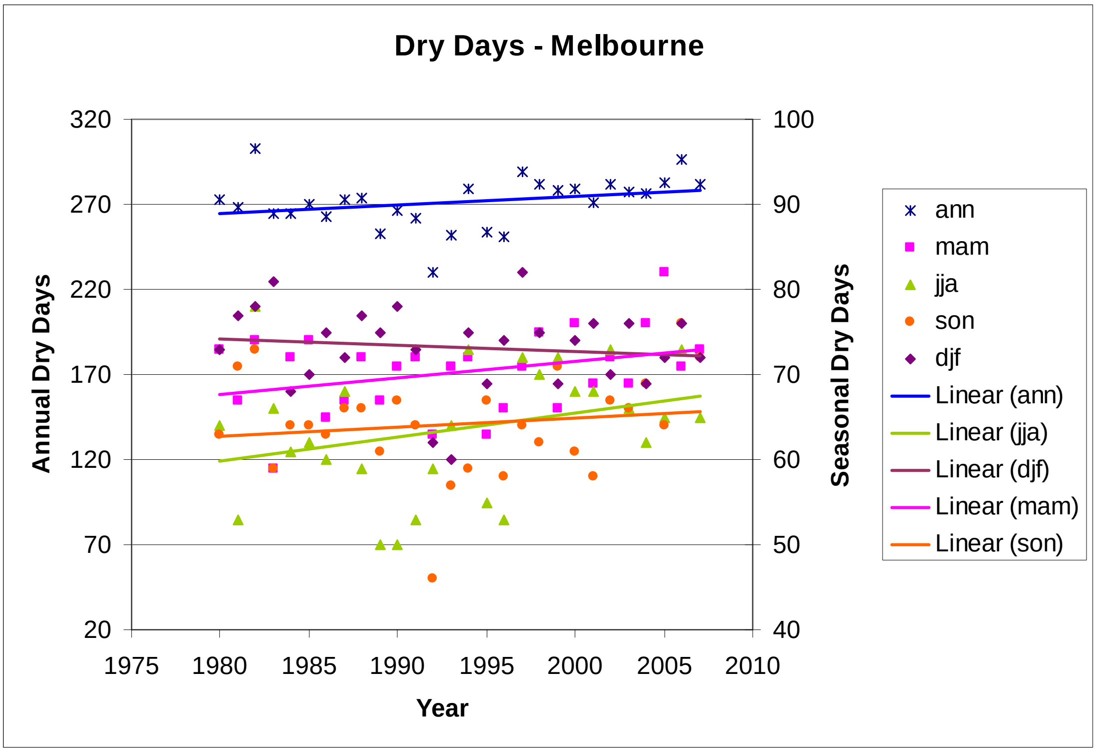
Cape Otway annual number of dry days from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	213.0	57.0	37.0	51.0	68.0
1981	224.0	57.0	39.0	57.0	71.0
1982	238.0	54.0	53.0	60.0	71.0
1983	221.0	51.0	44.0	50.0	76.0
1984	222.0	63.0	40.0	58.0	61.0
1985	229.0	58.0	41.0	62.0	68.0
1986	222.0	59.0	37.0	55.0	71.0
1987	240.0	64.0	49.0	60.0	67.0
1988	231.0	69.0	40.0	51.0	71.0
1989	220.0	56.0	40.0	54.0	70.0
1990	222.0	71.0	32.0	53.0	66.0
1991	217.0	56.0	32.0	55.0	74.0
1992	203.0	59.0	34.0	43.0	67.0
1993	229.0	66.0	42.0	59.0	62.0
1994	233.0	70.0	45.0	50.0	68.0
1995	227.0	50.0	43.0	61.0	73.0
1996	213.0	66.0	33.0	45.0	69.0
1997	241.0	54.0	55.0	61.0	71.0
1998	240.0	64.0	54.0	52.0	70.0
1999	245.0	63.0	57.0	57.0	68.0
2000	232.0	64.0	47.0	49.0	72.0
2001	230.0	63.0	46.0	50.0	71.0
2002	241.0	69.0	48.0	54.0	70.0
2003	248.0	66.0	55.0	54.0	73.0
2004	230.0	62.0	37.0	58.0	73.0
2005	228.0	64.0	44.0	57.0	63.0
2006	260.0	61.0	54.0	68.0	77.0
2007	242.0	67.0	48.0	58.0	69.0



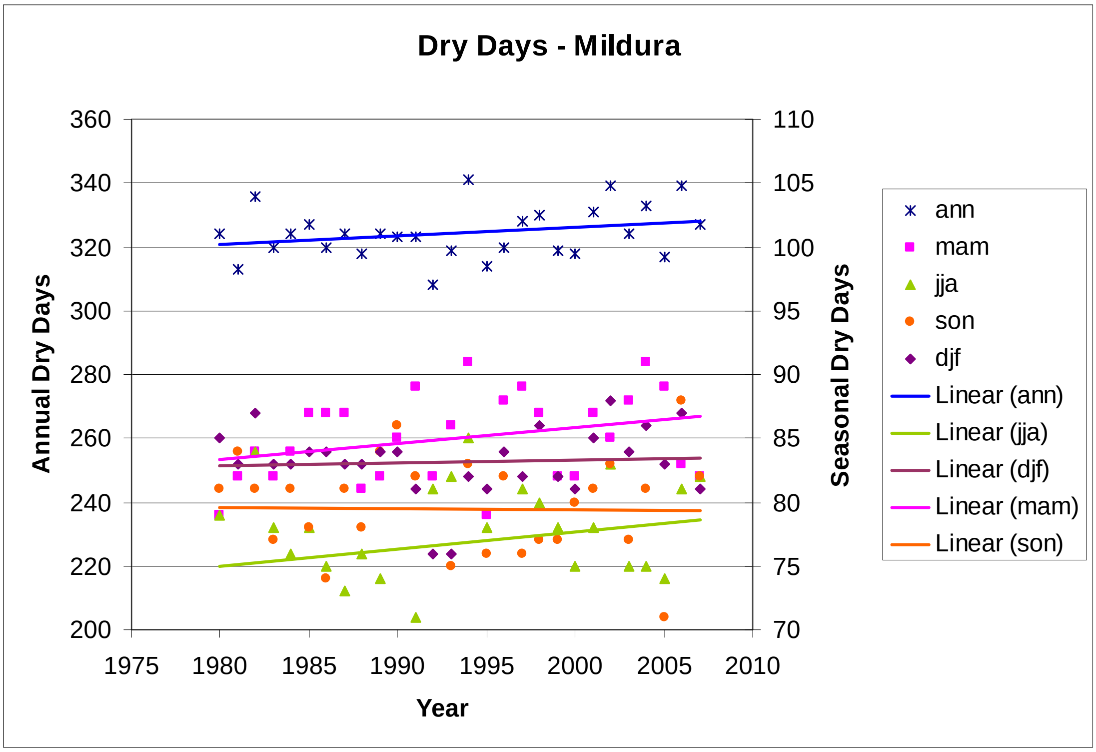
Melbourne CBD annual number of dry days from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	273.0	73.0	64.0	63.0	73.0
1981	268.0	67.0	53.0	71.0	77.0
1982	303.0	74.0	78.0	73.0	78.0
1983	265.0	59.0	66.0	59.0	81.0
1984	265.0	72.0	61.0	64.0	68.0
1985	270.0	74.0	62.0	64.0	70.0
1986	263.0	65.0	60.0	63.0	75.0
1987	273.0	67.0	68.0	66.0	72.0
1988	274.0	72.0	59.0	66.0	77.0
1989	253.0	67.0	50.0	61.0	75.0
1990	266.0	71.0	50.0	67.0	78.0
1991	262.0	72.0	53.0	64.0	73.0
1992	230.0	63.0	59.0	46.0	62.0
1993	252.0	71.0	64.0	57.0	60.0
1994	279.0	72.0	73.0	59.0	75.0
1995	254.0	63.0	55.0	67.0	69.0
1996	251.0	66.0	53.0	58.0	74.0
1997	289.0	71.0	72.0	64.0	82.0
1998	282.0	75.0	70.0	62.0	75.0
1999	278.0	66.0	72.0	71.0	69.0
2000	279.0	76.0	68.0	61.0	74.0
2001	271.0	69.0	68.0	58.0	76.0
2002	282.0	72.0	73.0	67.0	70.0
2003	277.0	69.0	66.0	66.0	76.0
2004	276.0	76.0	62.0	69.0	69.0
2005	283.0	82.0	65.0	64.0	72.0
2006	296.0	71.0	73.0	76.0	76.0
2007	282.0	73.0	65.0	72.0	72.0



Mildura annual number of dry days from 1980-2007

Year	Annual	Autumn(mam)	Winter(jja)	Spring(son)	Summer(djf)
1980	324.0	79.0	79.0	81.0	85.0
1981	313.0	82.0	64.0	84.0	83.0
1982	336.0	84.0	84.0	81.0	87.0
1983	320.0	82.0	78.0	77.0	83.0
1984	324.0	84.0	76.0	81.0	83.0
1985	327.0	87.0	78.0	78.0	84.0
1986	320.0	87.0	75.0	74.0	84.0
1987	324.0	87.0	73.0	81.0	83.0
1988	318.0	81.0	76.0	78.0	83.0
1989	324.0	82.0	74.0	84.0	84.0
1990	323.0	85.0	68.0	86.0	84.0
1991	323.0	89.0	71.0	82.0	81.0
1992	308.0	82.0	81.0	69.0	76.0
1993	319.0	86.0	82.0	75.0	76.0
1994	341.0	91.0	85.0	83.0	82.0
1995	314.0	79.0	78.0	76.0	81.0
1996	320.0	88.0	66.0	82.0	84.0
1997	328.0	89.0	81.0	76.0	82.0
1998	330.0	87.0	80.0	77.0	86.0
1999	319.0	82.0	78.0	77.0	82.0
2000	318.0	82.0	75.0	80.0	81.0
2001	331.0	87.0	78.0	81.0	85.0
2002	339.0	85.0	83.0	83.0	88.0
2003	324.0	88.0	75.0	77.0	84.0
2004	333.0	91.0	75.0	81.0	86.0
2005	317.0	89.0	74.0	71.0	83.0
2006	339.0	83.0	81.0	88.0	87.0
2007	327.0	82.0	82.0	82.0	81.0



Regression Statistics

Adelaide	Intercept	Slope	R^2
Annual	-79.0837	0.180898	0.016216
Autumn(mam)	-293.283	0.184455	0.080431
Winter(jja)	-202.823	0.129995	0.015783
Spring(son)	178.4606	-0.05446	0.005268
Summer(djf)	238.5616	-0.07909	0.032777

Mt Gambier	Intercept	Slope	R^2
Annual	-472.086	0.361522	0.078841
Autumn(mam)	-153.919	0.110837	0.021898
Winter(jja)	-633.776	0.340996	0.114338
Spring(son)	153.766	-0.04707	0.005204
Summer(djf)	161.8424	-0.04324	0.006615

Woomera	Intercept	Slope	R^2
Annual	-16.5369	0.177614	0.032954
Autumn(mam)	-175.443	0.131363	0.111459
Winter(jja)	-54.1256	0.068966	0.019122
Spring(son)	86.92611	-0.00192	1.27E-05
Summer(djf)	126.1059	-0.0208	0.003792

Ballarat	Intercept	Slope	R^2
Annual	-888.372	0.575807	0.078577
Autumn(mam)	-330.599	0.201149	0.117584
Winter(jja)	-680.894	0.36809	0.108824
Spring(son)	-240.591	0.151341	0.031353
Summer(djf)	363.7118	-0.14477	0.05449

Cape Otway	Intercept	Slope	R^2
Annual	-1340.65	0.787904	0.282631
Autumn(mam)	-510.764	0.287083	0.171309
Winter(jja)	-687.273	0.366721	0.163289
Spring(son)	-71.5	0.063492	0.009231
Summer(djf)	-71.1133	0.070608	0.023942

Melbourne	Intercept	Slope	R^2
Annual	-740.195	0.507389	0.07788
Autumn(mam)	-313.793	0.192666	0.109789
Winter(jja)	-492.835	0.279146	0.090308
Spring(son)	-152.921	0.108922	0.022375
Summer(djf)	219.3547	-0.07334	0.014995

Mildura	Intercept	Slope	R^2
Annual	-211.899	0.26902	0.074421
Autumn(mam)	-167.052	0.126437	0.092427
Winter(jja)	-188.36	0.133005	0.044721
Spring(son)	97.46798	-0.00903	0.000299
Summer(djf)	46.04433	0.01861	0.003080

Projections

The annual average number of dry days has been calculated for present (1981-2000) conditions and for 20 years centred on 2015 and 2030, for low and high rates of global warming, for the four climate models at Adelaide, Mt Gambier Woomera, Ballarat, Cape Otway, Melbourne CBD and Mildura. Results are tabulated below. Also shown are annual average numbers of dry spells of 10 dry days, 20 dry days, 30 dry days and 40 dry days.

The projection method involves multiplying observed daily rainfall records by the projected percentage changes in seasonal average rainfall simulated by each model. This assumes no changes in daily rainfall variability. Note that daily rainfall is measured in increments of 0.2 mm. Since a dry day is defined here as less than 1 mm, any projected decrease in mean rainfall applied to records of 1 mm will increase the number of dry days. Further increases in dry days would occur if observed records of 1.2 mm were decreased by more than 20%. A decrease in dry days would require a 25% increase in events with 0.8 mm. Greenhouse-gas related increases and decreases in mean rainfall of 20-25% are highly unlikely before 2030.

In Adelaide, the annual average number of dry days increases from 281 at present (1981-2000) to 284-286 by 2015, and 284-288 by 2030. The annual average number of 20-day dry spells changes from 3.5 at present to 3.2-3.5 by 2015, and 3.2-3.7 by 2030.

In Mt Gambier, the annual average number of dry days increases from 248 at present (1981-2000) to 254-255 by 2015, and 254-256 by 2030. The annual average number of 20-day dry spells rises from 1.2 at present to 1.3-1.7 by 2015, and 1.3-1.8 by 2030.

In Woomera, the annual average number of dry days increases from 336 at present (1981-2000) to 337-339 by 2015, and 337-339 by 2030. The annual average number of 20-day dry spells rises from 8.8 at present to 8.9-9.4 by 2015, and 8.9-9.6 by 2030.

In Ballarat, the annual average number of dry days increases from 254 at present (1981-2000) to 259-262 by 2015 and 259-267 by 2030. The annual average number of 20-day dry spells changes from 1.1 at present to 1.2-1.3 by both 2015 and 2030.

In Cape Otway, the annual average number of dry days increases from 228 at present (1981-2000) to 231-235 by both 2015 and 2030. The annual average number of 20-day dry spells from changes 0.4 at present to 0.4-0.5 by both 2015 and 2030.

In Melbourne CBD, the annual average number of dry days increases from 268 at present (1981-2000) to 272-274 by 2015, and 272-278 by 2030. The annual average number of 20-day dry spells rises from 0.9 at present to 1.1-1.3 by both 2015 and 2030.

In Mildura, the annual average number of dry days increases from 323 at present (1981-2000) to 323-325 by 2015, and 323-327 by 2030. The annual average number of 20-day dry spells rises from 6.5 at present to 6.5-6.6 by 2015, and 6.5-6.9 by 2030.

Adelaide: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	281	286.2	286.2	285.1	285.1	283.9	283.9	286.2	286.2
10 Day Spells	12.6	13.5	13.5	13.2	13.2	12.9	12.9	13.45	13.45
20 Day Spells	3	3.5	3.5	3.5	3.5	3.2	3.2	3.5	3.5
30 Day Spells	1.1	1.4	1.4	1.4	1.4	1.2	1.2	1.4	1.4
40 Day Spells	0.4	0.6	0.6	0.5	0.5	0.4	0.4	0.55	0.55

Adelaide: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2030, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	281	286.2	288.1	285.1	285.1	283.9	283.9	286.2	286.2
10 Day Spells	12.6	13.5	13.9	13.2	13.2	12.9	12.9	13.5	13.5
20 Day Spells	3	3.5	3.7	3.5	3.5	3.2	3.2	3.5	3.5
30 Day Spells	1.1	1.4	1.5	1.4	1.4	1.2	1.2	1.4	1.4
40 Day Spells	0.4	0.6	0.7	0.5	0.5	0.4	0.4	0.6	0.6

Mt Gambier: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	247.6	255.4	255.4	255.4	255.4	253.9	253.9	255.4	255.4
10 Day Spells	8.0	9.0	9.0	9.0	9.0	8.6	8.6	9.0	9.0
20 Day Spells	1.2	1.7	1.7	1.7	1.7	1.3	1.3	1.7	1.7
30 Day Spells	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
40 Day Spells	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1

Mt Gambier: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2030, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	247.6	255.4	256.1	255.4	255.4	253.9	253.9	255.4	255.4
10 Day Spells	8.0	9.0	9.2	9.0	9.0	8.6	8.6	9.0	9.0
20 Day Spells	1.2	1.7	1.8	1.7	1.7	1.3	1.3	1.7	1.7
30 Day Spells	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4
40 Day Spells	0.0	0.1	0.2	0.1	0.1	0.0	0.0	0.1	0.1

Woomera: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	335.9	338.6	338.6	338.0	338.0	336.8	336.8	338.6	338.6
10 Day Spells	24.7	25.5	25.5	25.2	25.2	24.9	24.9	25.5	25.5
20 Day Spells	8.8	9.4	9.4	9.1	9.1	8.9	8.9	9.4	9.4
30 Day Spells	4.5	5.0	5.0	4.8	4.8	4.7	4.7	5.0	5.0
40 Day Spells	2.4	2.7	2.7	2.6	2.6	2.5	2.5	2.7	2.7

Woomera: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2030, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	335.9	338.6	339.3	338.0	338.0	336.8	336.8	338.6	338.6
10 Day Spells	24.7	25.5	25.6	25.2	25.2	24.9	24.9	25.5	25.5
20 Day Spells	8.8	9.4	9.6	9.1	9.1	8.9	8.9	9.4	9.4
30 Day Spells	4.5	5.0	5.0	4.8	4.8	4.7	4.7	5.0	5.0
40 Day Spells	2.4	2.7	2.7	2.6	2.6	2.5	2.5	2.7	2.7

Ballarat: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	254.2	262.0	262.2	262.0	262.0	259.4	259.4	262.0	262.0
10 Day Spells	7.9	8.8	8.8	8.8	8.8	8.2	8.2	8.8	8.8
20 Day Spells	1.1	1.3	1.3	1.3	1.3	1.2	1.2	1.3	1.3
30 Day Spells	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
40 Day Spells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Ballarat: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2030, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	254.2	262.2	267.2	262.0	262.1	259.4	259.4	262.0	262.1
10 Day Spells	7.9	8.8	9.1	8.8	8.8	8.2	8.2	8.8	8.8
20 Day Spells	1.1	1.3	1.3	1.3	1.3	1.2	1.2	1.3	1.3
30 Day Spells	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
40 Day Spells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Cape Otway: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	227.5	235.4	235.4	235.4	235.4	231.3	231.3	235.4	235.4
10 Day Spells	5.0	5.7	5.7	5.7	5.7	5.1	5.1	5.7	5.7
20 Day Spells	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.5	0.5
30 Day Spells	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
40 Day Spells	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Cape Otway: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2030, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	227.5	235.4	235.4	235.4	235.4	231.3	231.3	235.4	235.4
10 Day Spells	5.0	5.7	5.7	5.7	5.7	5.1	5.1	5.7	5.7
20 Day Spells	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.5	0.5
30 Day Spells	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
40 Day Spells	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Melbourne CBD: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	267.8	274.1	274.1	273.1	273.1	272.2	272.2	274.1	274.1
10 Day Spells	7.8	8.8	8.8	8.7	8.7	8.5	8.5	8.8	8.8
20 Day Spells	0.9	1.3	1.3	1.2	1.2	1.1	1.1	1.3	1.3
30 Day Spells	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
40 Day Spells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Melbourne CBD: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2030, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	267.8	274.1	277.8	273.1	273.1	272.2	272.2	274.1	274.1
10 Day Spells	7.8	8.8	9.2	8.7	8.7	8.5	8.5	8.8	8.8
20 Day Spells	0.9	1.3	1.3	1.2	1.2	1.1	1.1	1.3	1.3
30 Day Spells	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
40 Day Spells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Mildura: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2015, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	322.5	325.4	325.4	325.0	325.0	323.2	323.2	325.4	325.4
10 Day Spells	20.8	21.7	21.7	21.6	21.6	21.1	21.1	21.7	21.7
20 Day Spells	6.5	6.6	6.6	6.6	6.6	6.5	6.5	6.6	6.6
30 Day Spells	2.9	3.1	3.1	3.0	3.0	2.9	2.9	3.1	3.1
40 Day Spells	1.2	1.3	1.3	1.3	1.3	1.2	1.2	1.3	1.3

Mildura: Projected annual-average number of dry days and dry spells for present (1980-2000) and 20 years centred on 2030, for four climate models, for low and high rates of global warming.

	Present	CSIRO Mk3.5		INMCM		MIROC-M		HADGEM1	
	1981-2000	Low	High	Low	High	Low	High	Low	High
Dry Days	322.5	325.4	326.9	325.0	325.0	323.2	323.2	325.4	325.4
10 Day Spells	20.8	21.7	22.1	21.6	21.6	21.1	21.1	21.7	21.7
20 Day Spells	6.5	6.6	6.9	6.6	6.6	6.5	6.5	6.6	6.6
30 Day Spells	2.9	3.1	3.1	3.0	3.0	2.9	2.9	3.1	3.1
40 Day Spells	1.2	1.3	1.4	1.3	1.3	1.2	1.2	1.3	1.3

4. RESEARCH PRIORITIES

There is a need for more research on projections of extreme daily temperature, extreme daily wind gusts and dry days. The simple method used in this report estimates future changes in these variables by applying seasonal-average projections to observed daily data. This assumes that there will be no changes in day-to-day variability. A research priority for CSIRO is to acquire simulated daily temperature, rainfall and wind-speed data from as many global climate models as possible, then calculate projected changes in various measures of extreme frequency and intensity, including changes in daily variability.

However, it is recognised that some characteristics of daily rainfall and wind-speeds are likely to be governed by small scale weather systems (e.g. storms) and features of the land surface (e.g. mountainous areas and coastlines) that are not adequately captured by the coarse resolution of global climate models (CSIRO and Bureau of Meteorology, 2007). Overcoming these issues may require information from finer resolution models over particular regions of interest.

ACKNOWLEDGMENTS

We acknowledge the modelling groups, the Program for Climate Model Diagnosis and Intercomparison (PCMDI) and the WCRP's Working Group on Coupled Modelling for their roles in making available the WCRP CMIP3 multi-model dataset. Support of this dataset is provided by the Office of Science, US Government Department of Energy.

The work of the authors also draws upon research findings of many colleagues within CSIRO Marine and Atmospheric Research and overseas research institutions. CSIRO climate models were developed by members of CSIRO Marine and Atmospheric Research.

Comments from Ian Macadam (CSIRO) were very useful.

APPENDIX 1: CLIMATE CHANGE SCENARIOS

Annual and seasonal average changes in **mean temperature** (^{o}C) for 20 years centred on **2015**, relative to present (1981-2000), for four climate models (CSIRO Mk3.5, INMCM, HADGEM1 and MIROC-M) for low and high rates of global warming.

Site	Season	CSIRO Mk3.5	CSIRO Mk3.5	HADGEM1	HADGEM1	INMCM	INMCM	MIROC-M	MIROC-M
		Low	High	Low	High	Low	High	Low	High
Adelaide	**ann**	**0.38**	**0.67**	**0.26**	**0.47**	**0.35**	**0.63**	**0.25**	**0.45**
	djf	0.37	0.67	0.30	0.53	0.45	0.80	0.25	0.44
	jja	0.34	0.61	0.21	0.38	0.29	0.51	0.24	0.43
	mam	0.41	0.73	0.25	0.44	0.36	0.65	0.24	0.44
	son	0.39	0.69	0.29	0.52	0.31	0.55	0.28	0.50
Ballarat	**ann**	**0.43**	**0.76**	**0.27**	**0.48**	**0.34**	**0.60**	**0.23**	**0.41**
	djf	0.44	0.79	0.31	0.56	0.43	0.76	0.25	0.45
	jja	0.37	0.65	0.19	0.33	0.29	0.52	0.21	0.38
	mam	0.45	0.81	0.26	0.46	0.33	0.59	0.23	0.40
	son	0.44	0.79	0.31	0.55	0.30	0.53	0.24	0.42
Cape Otway	**ann**	**0.37**	**0.65**	**0.19**	**0.34**	**0.31**	**0.55**	**0.21**	**0.38**
	djf	0.37	0.66	0.21	0.38	0.37	0.66	0.24	0.42
	jja	0.33	0.59	0.16	0.29	0.28	0.50	0.20	0.36
	mam	0.38	0.69	0.19	0.34	0.31	0.55	0.21	0.38
	son	0.38	0.67	0.19	0.33	0.28	0.50	0.21	0.38
Melbourne	**ann**	**0.44**	**0.79**	**0.26**	**0.46**	**0.34**	**0.61**	**0.24**	**0.42**
	djf	0.46	0.82	0.30	0.53	0.42	0.75	0.26	0.47
	jja	0.37	0.67	0.18	0.32	0.30	0.53	0.21	0.38
	mam	0.46	0.83	0.25	0.45	0.34	0.60	0.23	0.41
	son	0.46	0.83	0.30	0.53	0.30	0.53	0.24	0.43
Mildura	**ann**	**0.48**	**0.86**	**0.29**	**0.52**	**0.39**	**0.70**	**0.27**	**0.48**
	djf	0.48	0.86	0.34	0.61	0.50	0.88	0.26	0.46
	jja	0.41	0.73	0.22	0.39	0.32	0.57	0.26	0.47
	mam	0.55	0.98	0.28	0.50	0.41	0.73	0.26	0.46
	son	0.49	0.88	0.33	0.59	0.34	0.61	0.30	0.53
Mt Gambier	**ann**	**0.32**	**0.57**	**0.20**	**0.36**	**0.31**	**0.56**	**0.22**	**0.40**
	djf	0.31	0.55	0.23	0.41	0.40	0.72	0.24	0.42
	jja	0.31	0.55	0.18	0.32	0.27	0.49	0.20	0.36
	mam	0.35	0.63	0.20	0.35	0.30	0.54	0.21	0.38
	son	0.32	0.57	0.21	0.37	0.28	0.50	0.23	0.41
Woomera	**ann**	**0.51**	**0.91**	**0.36**	**0.63**	**0.41**	**0.73**	**0.26**	**0.47**
	djf	0.47	0.84	0.41	0.73	0.46	0.82	0.24	0.44
	jja	0.45	0.81	0.25	0.45	0.32	0.57	0.27	0.48
	mam	0.59	1.06	0.34	0.61	0.48	0.86	0.26	0.46
	son	0.52	0.92	0.41	0.73	0.37	0.65	0.29	0.52

Annual and seasonal average changes in **mean rainfall** (%) for 20 years centred on **2015**, relative to present (1981-2000), for four climate models (CSIRO Mk3.5, INMCM, HADGEM1 and MIROC-M) for low and high rates of global warming.

Site	Season	CSIRO Mk3.5	CSIRO Mk3.5	HADGEM1	HADGEM1	INMCM	INMCM	MIROC-M	MIROC-M
		Low	High	Low	High	Low	High	Low	High
Adelaide	**ann**	**-4.85**	**-8.65**	**-2.44**	**-4.36**	**-2.07**	**-3.70**	**0.37**	**0.66**
	djf	-7.07	-12.61	-1.33	-2.38	-1.48	-2.64	2.04	3.63
	jja	-5.66	-10.10	-2.55	-4.55	-4.44	-7.92	-0.48	-0.86
	mam	-3.37	-6.01	-2.26	-4.03	0.26	0.46	0.96	1.72
	son	-3.29	-5.87	-3.66	-6.53	-2.55	-4.55	-0.96	-1.72
Ballarat	**ann**	**-4.48**	**-7.99**	**-1.48**	**-2.64**	**-1.81**	**-3.23**	**-0.11**	**-0.20**
	djf	-3.66	-6.53	-0.81	-1.45	-0.11	-0.20	1.63	2.90
	jja	-5.62	-10.03	-1.11	-1.98	-2.78	-4.95	-0.70	-1.25
	mam	-3.11	-5.54	-1.04	-1.85	-1.15	-2.05	0.56	0.99
	son	-5.51	-9.83	-2.92	-5.21	-3.22	-5.74	-1.92	-3.43
Cape Otway	**ann**	**-3.96**	**-7.06**	**-1.85**	**-3.30**	**-1.63**	**-2.90**	**-0.37**	**-0.66**
	djf	-4.48	-7.99	-1.70	-3.04	-1.48	-2.64	1.52	2.71
	jja	-3.92	-7.00	-1.04	-1.85	-1.92	-3.43	-1.04	-1.85
	mam	-2.81	-5.02	-1.74	-3.10	-0.85	-1.52	0.00	0.00
	son	-4.70	-8.38	-2.92	-5.21	-2.26	-4.03	-1.92	-3.43
Melbourne	**ann**	**-4.22**	**-7.52**	**-1.48**	**-2.64**	**-1.74**	**-3.10**	**-0.07**	**-0.13**
	djf	-2.89	-5.15	-0.81	-1.45	0.37	0.66	1.44	2.57
	jja	-5.33	-9.50	-1.22	-2.18	-2.52	-4.49	-0.56	-0.99
	mam	-2.85	-5.08	-1.33	-2.38	-1.30	-2.31	0.67	1.19
	son	-5.81	-10.36	-2.55	-4.55	-3.44	-6.14	-1.89	-3.37
Mildura	**ann**	**-4.81**	**-8.58**	**-2.52**	**-4.49**	**-2.11**	**-3.76**	**1.11**	**1.98**
	djf	-1.15	-2.05	-0.85	-1.52	0.81	1.45	2.96	5.28
	jja	-8.99	-16.04	-3.44	-6.14	-4.33	-7.72	0.11	0.20
	mam	-2.44	-4.36	-3.11	-5.54	-1.04	-1.85	2.59	4.62
	son	-6.62	-11.81	-2.74	-4.88	-3.81	-6.80	-1.11	-1.98
Mt Gambier	**ann**	**-4.22**	**-7.52**	**-1.81**	**-3.23**	**-1.92**	**-3.43**	**-0.44**	**-0.79**
	djf	-5.66	-10.10	-1.85	-3.30	-2.26	-4.03	1.74	3.10
	jja	-3.66	-6.53	-0.70	-1.25	-2.92	-5.21	-1.15	-2.05
	mam	-3.33	-5.94	-1.96	-3.50	-0.59	-1.06	-0.37	-0.66
	son	-4.22	-7.52	-2.78	-4.95	-2.00	-3.56	-1.96	-3.50
Woomera	**ann**	**-5.00**	**-8.91**	**-2.85**	**-5.08**	**-2.00**	**-3.56**	**1.37**	**2.44**
	djf	-1.92	-3.43	-2.07	-3.70	-1.26	-2.24	2.26	4.03
	jja	-8.36	-14.92	-4.07	-7.26	-4.88	-8.71	-0.07	-0.13
	mam	-5.11	-9.11	-2.55	-4.55	1.48	2.64	3.26	5.81
	son	-4.63	-8.25	-2.78	-4.95	-3.33	-5.94	0.07	0.13

Annual and seasonal average changes in **mean wind-speed** (%) for 20 years centred on **2015**, relative to present (1981-2000), for four climate models (CSIRO Mk3.5, INMCM, HADGEM1 and MIROC-M) for low and high rates of global warming.

Site	Season	CSIRO Mk3.5	CSIRO Mk3.5	HADGEM1	HADGEM1	INMCM	INMCM	MIROC-M	MIROC-M
		Low	High	Low	High	Low	High	Low	High
Adelaide	**ann**	**0.17**	**0.30**	**1.38**	**2.47**	**-0.14**	**-0.25**	**-0.88**	**-1.56**
	djf	1.48	2.65	1.84	3.28	0.65	1.16	-0.20	-0.35
	jja	-1.78	-3.18	1.46	2.61	-1.36	-2.42	-1.72	-3.08
	mam	2.20	3.92	-0.23	-0.40	-1.08	-1.93	-0.13	-0.24
	son	-1.23	-2.20	2.46	4.39	1.22	2.18	-1.46	-2.61
Ballarat	**ann**	**0.23**	**0.40**	**1.88**	**3.35**	**-0.41**	**-0.73**	**-0.91**	**-1.62**
	djf	2.68	4.79	2.83	5.06	0.22	0.39	-0.41	-0.73
	jja	-1.24	-2.22	2.16	3.86	-0.24	-0.43	-0.85	-1.52
	mam	0.53	0.94	-0.31	-0.56	-2.93	-5.23	-0.85	-1.52
	son	-1.06	-1.89	2.82	5.03	1.31	2.34	-1.52	-2.72
Cape Otway	**ann**	**0.16**	**0.28**	**1.53**	**2.73**	**-0.06**	**-0.11**	**-0.47**	**-0.84**
	djf	2.28	4.06	1.91	3.41	0.00	0.01	-0.16	-0.28
	jja	-0.87	-1.54	2.21	3.93	0.26	0.47	-0.21	-0.38
	mam	0.05	0.09	-0.46	-0.81	-2.01	-3.59	-0.51	-0.92
	son	-0.84	-1.50	2.46	4.39	1.49	2.67	-0.99	-1.77
Melbourne	**ann**	**0.00**	**0.01**	**1.75**	**3.12**	**-0.36**	**-0.65**	**-0.78**	**-1.40**
	djf	2.53	4.51	2.37	4.22	0.17	0.30	-0.50	-0.90
	jja	-1.13	-2.01	2.12	3.78	-0.11	-0.20	-0.64	-1.14
	mam	-0.20	-0.36	-0.30	-0.54	-2.85	-5.08	-0.63	-1.12
	son	-1.18	-2.11	2.80	4.99	1.34	2.39	-1.38	-2.46
Mildura	**ann**	**0.37**	**0.66**	**2.32**	**4.14**	**0.06**	**0.11**	**-1.11**	**-1.98**
	djf	2.25	4.01	2.82	5.03	0.71	1.27	-0.38	-0.68
	jja	-2.42	-4.32	2.00	3.56	-1.41	-2.51	-1.91	-3.40
	mam	2.85	5.09	1.00	1.78	-0.57	-1.02	-0.46	-0.83
	son	-1.20	-2.15	3.49	6.22	1.52	2.72	-1.70	-3.03
Mt Gambier	**ann**	**-0.02**	**-0.04**	**1.81**	**3.22**	**-0.27**	**-0.48**	**-0.76**	**-1.35**
	djf	1.75	3.12	2.59	4.61	0.21	0.38	0.08	0.14
	jja	-1.03	-1.84	2.20	3.92	-0.20	-0.35	-0.87	-1.55
	mam	0.20	0.35	-0.25	-0.44	-2.46	-4.39	-0.69	-1.23
	son	-1.00	-1.78	2.68	4.79	1.37	2.44	-1.55	-2.77
Woomera	**ann**	**0.17**	**0.30**	**0.37**	**0.66**	**0.77**	**1.38**	**-0.81**	**-1.45**
	djf	1.65	2.94	0.70	1.24	0.42	0.75	-0.60	-1.06
	jja	-2.75	-4.90	-1.00	-1.78	-1.73	-3.09	-1.94	-3.45
	mam	2.28	4.07	-0.35	-0.63	3.17	5.66	0.41	0.73
	son	-0.49	-0.88	2.13	3.80	1.24	2.21	-1.14	-2.04

Annual and seasonal average changes in **mean temperature** (^{o}C) for 20 years centred on **2030**, relative to present (1981-2000), for four climate models (CSIRO Mk3.5, INMCM, HADGEM1 and MIROC-M) for low and high rates of global warming.

Site	Season	CSIRO Mk3.5	CSIRO Mk3.5	HADGEM1	HADGEM1	INMCM	INMCM	MIROC-M	MIROC-M
		Low	High	Low	High	Low	High	Low	High
Adelaide	**ann**	**0.67**	**1.19**	**0.47**	**0.83**	**0.63**	**1.11**	**0.45**	**0.80**
	djf	0.67	1.18	0.53	0.94	0.80	1.42	0.44	0.78
	jja	0.61	1.08	0.38	0.68	0.51	0.91	0.43	0.76
	mam	0.73	1.30	0.44	0.78	0.65	1.15	0.44	0.77
	son	0.69	1.23	0.52	0.92	0.55	0.97	0.50	0.89
Ballarat	**ann**	**0.76**	**1.35**	**0.48**	**0.84**	**0.60**	**1.06**	**0.41**	**0.73**
	djf	0.79	1.39	0.56	0.99	0.76	1.35	0.45	0.80
	jja	0.65	1.16	0.33	0.59	0.52	0.92	0.38	0.67
	mam	0.81	1.43	0.46	0.81	0.59	1.05	0.40	0.71
	son	0.79	1.40	0.55	0.97	0.53	0.95	0.42	0.75
Cape Otway	**ann**	**0.65**	**1.16**	**0.34**	**0.60**	**0.55**	**0.98**	**0.38**	**0.68**
	djf	0.66	1.17	0.38	0.68	0.66	1.17	0.42	0.75
	jja	0.59	1.05	0.29	0.51	0.50	0.89	0.36	0.63
	mam	0.69	1.22	0.34	0.60	0.55	0.97	0.38	0.67
	son	0.67	1.19	0.33	0.59	0.50	0.89	0.38	0.68
Melbourne	**ann**	**0.79**	**1.39**	**0.46**	**0.81**	**0.61**	**1.08**	**0.42**	**0.75**
	djf	0.82	1.45	0.53	0.94	0.75	1.32	0.47	0.83
	jja	0.67	1.18	0.32	0.57	0.53	0.95	0.38	0.68
	mam	0.83	1.46	0.45	0.80	0.60	1.06	0.41	0.73
	son	0.83	1.46	0.53	0.95	0.53	0.95	0.43	0.76
Mildura	**ann**	**0.86**	**1.53**	**0.52**	**0.92**	**0.70**	**1.24**	**0.48**	**0.84**
	djf	0.86	1.53	0.61	1.08	0.88	1.57	0.46	0.81
	jja	0.73	1.29	0.39	0.69	0.57	1.01	0.47	0.83
	mam	0.98	1.73	0.50	0.89	0.73	1.30	0.46	0.81
	son	0.88	1.56	0.59	1.04	0.61	1.08	0.53	0.94
Mt Gambier	**ann**	**0.57**	**1.02**	**0.36**	**0.64**	**0.56**	**0.99**	**0.40**	**0.70**
	djf	0.55	0.98	0.41	0.73	0.72	1.28	0.42	0.75
	jja	0.55	0.97	0.32	0.57	0.49	0.87	0.36	0.64
	mam	0.63	1.11	0.35	0.62	0.54	0.96	0.38	0.68
	son	0.57	1.02	0.37	0.66	0.50	0.89	0.41	0.73
Woomera	**ann**	**0.91**	**1.61**	**0.63**	**1.12**	**0.73**	**1.29**	**0.47**	**0.83**
	djf	0.84	1.50	0.73	1.30	0.82	1.45	0.44	0.77
	jja	0.81	1.43	0.45	0.80	0.57	1.02	0.48	0.84
	mam	1.06	1.87	0.61	1.09	0.86	1.53	0.46	0.81
	son	0.92	1.64	0.73	1.29	0.65	1.16	0.52	0.92

Annual and seasonal average changes in **mean rainfall** (%) for 20 years centred on **2030**, relative to present (1981-2000), for four climate models (CSIRO Mk3.5, INMCM, HADGEM1 and MIROC-M) for low and high rates of global warming.

Site	Season	CSIRO Mk3.5	CSIRO Mk3.5	HADGEM1	HADGEM1	INMCM	INMCM	MIROC-M	MIROC-M
		Low	High	Low	High	Low	High	Low	High
Adelaide	**ann**	**-8.65**	**-15.33**	**-4.36**	**-7.72**	**-3.70**	**-6.55**	**0.66**	**1.17**
	djf	-12.61	-22.35	-2.38	-4.21	-2.64	-4.68	3.63	6.44
	jja	-10.10	-17.90	-4.55	-8.07	-7.92	-14.04	-0.86	-1.52
	mam	-6.01	-10.65	-4.03	-7.14	0.46	0.82	1.72	3.04
	son	-5.87	-10.41	-6.53	-11.58	-4.55	-8.07	-1.72	-3.04
Ballarat	**ann**	**-7.99**	**-14.16**	**-2.64**	**-4.68**	**-3.23**	**-5.73**	**-0.20**	**-0.35**
	djf	-6.53	-11.58	-1.45	-2.57	-0.20	-0.35	2.90	5.15
	jja	-10.03	-17.78	-1.98	-3.51	-4.95	-8.78	-1.25	-2.22
	mam	-5.54	-9.83	-1.85	-3.28	-2.05	-3.63	0.99	1.76
	son	-9.83	-17.43	-5.21	-9.24	-5.74	-10.18	-3.43	-6.08
Cape Otway	**ann**	**-7.06**	**-12.52**	**-3.30**	**-5.85**	**-2.90**	**-5.15**	**-0.66**	**-1.17**
	djf	-7.99	-14.16	-3.04	-5.38	-2.64	-4.68	2.71	4.80
	jja	-7.00	-12.40	-1.85	-3.28	-3.43	-6.08	-1.85	-3.28
	mam	-5.02	-8.89	-3.10	-5.50	-1.52	-2.69	0.00	0.00
	son	-8.38	-14.86	-5.21	-9.24	-4.03	-7.14	-3.43	-6.08
Melbourne	**ann**	**-7.52**	**-13.34**	**-2.64**	**-4.68**	**-3.10**	**-5.50**	**-0.13**	**-0.23**
	djf	-5.15	-9.13	-1.45	-2.57	0.66	1.17	2.57	4.56
	jja	-9.50	-16.85	-2.18	-3.86	-4.49	-7.96	-0.99	-1.76
	mam	-5.08	-9.01	-2.38	-4.21	-2.31	-4.10	1.19	2.11
	son	-10.36	-18.37	-4.55	-8.07	-6.14	-10.88	-3.37	-5.97
Mildura	**ann**	**-8.58**	**-15.21**	**-4.49**	**-7.96**	**-3.76**	**-6.67**	**1.98**	**3.51**
	djf	-2.05	-3.63	-1.52	-2.69	1.45	2.57	5.28	9.36
	jja	-16.04	-28.43	-6.14	-10.88	-7.72	-13.69	0.20	0.35
	mam	-4.36	-7.72	-5.54	-9.83	-1.85	-3.28	4.62	8.19
	son	-11.81	-20.94	-4.88	-8.66	-6.80	-12.05	-1.98	-3.51
Mt Gambier	**ann**	**-7.52**	**-13.34**	**-3.23**	**-5.73**	**-3.43**	**-6.08**	**-0.79**	**-1.40**
	djf	-10.10	-17.90	-3.30	-5.85	-4.03	-7.14	3.10	5.50
	jja	-6.53	-11.58	-1.25	-2.22	-5.21	-9.24	-2.05	-3.63
	mam	-5.94	-10.53	-3.50	-6.20	-1.06	-1.87	-0.66	-1.17
	son	-7.52	-13.34	-4.95	-8.78	-3.56	-6.32	-3.50	-6.20
Woomera	**ann**	**-8.91**	**-15.80**	**-5.08**	**-9.01**	**-3.56**	**-6.32**	**2.44**	**4.33**
	djf	-3.43	-6.08	-3.70	-6.55	-2.24	-3.98	4.03	7.14
	jja	-14.92	-26.44	-7.26	-12.87	-8.71	-15.44	-0.13	-0.23
	mam	-9.11	-16.15	-4.55	-8.07	2.64	4.68	5.81	10.30
	son	-8.25	-14.63	-4.95	-8.78	-5.94	-10.53	0.13	0.23

Annual and seasonal average changes in **mean wind-speed (%)** for 20 years centred on **2030**, relative to present (1981-2000), for four climate models (CSIRO Mk3.5, INMCM, HADGEM1 and MIROC-M) for low and high rates of global warming.

Site	Season	CSIRO Mk3.5 Low	CSIRO Mk3.5 High	HADGEM1 Low	HADGEM1 High	INMCM Low	INMCM High	MIROC-M Low	MIROC-M High
Adelaide	**ann**	**0.30**	**0.53**	**2.47**	**4.38**	**-0.25**	**-0.44**	**-1.56**	**-2.77**
	djf	2.65	4.69	3.28	5.81	1.16	2.06	-0.35	-0.62
	jja	-3.18	-5.64	2.61	4.62	-2.42	-4.29	-3.08	-5.45
	mam	3.92	6.95	-0.40	-0.71	-1.93	-3.43	-0.24	-0.42
	son	-2.20	-3.90	4.39	7.78	2.18	3.87	-2.61	-4.62
Ballarat	**ann**	**0.40**	**0.71**	**3.35**	**5.93**	**-0.73**	**-1.30**	**-1.62**	**-2.88**
	djf	4.79	8.48	5.06	8.96	0.39	0.69	-0.73	-1.30
	jja	-2.22	-3.93	3.86	6.84	-0.43	-0.76	-1.52	-2.70
	mam	0.94	1.66	-0.56	-0.99	-5.23	-9.27	-1.52	-2.70
	son	-1.89	-3.35	5.03	8.92	2.34	4.14	-2.72	-4.82
Cape Otway	**ann**	**0.28**	**0.49**	**2.73**	**4.84**	**-0.11**	**-0.20**	**-0.84**	**-1.49**
	djf	4.06	7.20	3.41	6.04	0.01	0.01	-0.28	-0.50
	jja	-1.54	-2.74	3.93	6.97	0.47	0.83	-0.38	-0.67
	mam	0.09	0.15	-0.81	-1.44	-3.59	-6.36	-0.92	-1.63
	son	-1.50	-2.66	4.39	7.78	2.67	4.73	-1.77	-3.14
Melbourne	**ann**	**0.01**	**0.01**	**3.12**	**5.52**	**-0.65**	**-1.15**	**-1.40**	**-2.48**
	djf	4.51	7.99	4.22	7.49	0.30	0.53	-0.90	-1.59
	jja	-2.01	-3.57	3.78	6.69	-0.20	-0.35	-1.14	-2.02
	mam	-0.36	-0.63	-0.54	-0.96	-5.08	-9.00	-1.12	-1.98
	son	-2.11	-3.74	4.99	8.85	2.39	4.24	-2.46	-4.35
Mildura	**ann**	**0.66**	**1.17**	**4.14**	**7.35**	**0.11**	**0.20**	**-1.98**	**-3.51**
	djf	4.01	7.11	5.03	8.92	1.27	2.25	-0.68	-1.21
	jja	-4.32	-7.66	3.56	6.32	-2.51	-4.46	-3.40	-6.03
	mam	5.09	9.02	1.78	3.16	-1.02	-1.81	-0.83	-1.46
	son	-2.15	-3.80	6.22	11.02	2.72	4.82	-3.03	-5.37
Mt Gambier	**ann**	**-0.04**	**-0.07**	**3.22**	**5.71**	**-0.48**	**-0.84**	**-1.35**	**-2.40**
	djf	3.12	5.53	4.61	8.18	0.38	0.68	0.14	0.25
	jja	-1.84	-3.26	3.92	6.95	-0.35	-0.62	-1.55	-2.75
	mam	0.35	0.62	-0.44	-0.78	-4.39	-7.78	-1.23	-2.18
	son	-1.78	-3.16	4.79	8.48	2.44	4.33	-2.77	-4.91
Woomera	**ann**	**0.30**	**0.54**	**0.66**	**1.17**	**1.38**	**2.45**	**-1.45**	**-2.57**
	djf	2.94	5.21	1.24	2.20	0.75	1.32	-1.06	-1.88
	jja	-4.90	-8.69	-1.78	-3.16	-3.09	-5.48	-3.45	-6.12
	mam	4.07	7.21	-0.63	-1.11	5.66	10.03	0.73	1.29
	son	-0.88	-1.56	3.80	6.74	2.21	3.92	-2.04	-3.62

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