

climate change in
VICTORIA: 2008 SUMMARY



the Victorian
climate change
adaptation program

A Victorian
Government
initiative





INTRODUCTION

Climate change is one of the most important challenges facing us today. Without action to both reduce greenhouse gas emissions and prepare for these changes, the direct and indirect impacts of climate change may have major adverse effects on our society, our economy and the environment.



This is a summary of how the climate of Victoria is expected to change during the 21st century based on a range of future greenhouse gas emissions scenarios.

The climate change projections have been prepared by CSIRO on behalf of the Victorian Government. They are consistent with the national climate change projections released in 2007 (www.climatechangeinaustralia.com), which were based on climate modelling used for the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (2007). Further information from the Bureau of Meteorology and peer-reviewed scientific studies has also been included.

Accompanying this brochure is a series of regional climate change profiles that are available from www.climatechange.vic.gov.au

This brief summary is for general information only and is not intended for impact analysis or developing adaptation responses, which will require more specific information.

Naturally occurring greenhouse gases keep the planet warm enough to sustain life. Without these gases the planet's average temperature would be about 33°C colder, more like the moon. The main greenhouse gases are water vapour, carbon dioxide, methane and nitrous oxide. The Earth's climate is also influenced by natural cycles, such as 100,000 year glacial cycles due to wobbles in the Earth's orbit, 11 year sunspot cycles, and 2–7 year El Niño cycles due to air-sea interactions.

However, there is strong scientific evidence that human activities are now affecting our climate. Since the industrial revolution around 1750, the concentration of carbon dioxide has increased by one-third, methane has risen by 150% and nitrous oxide has grown 18%. **Figure 1** shows concentrations of carbon dioxide and methane over the last 1000 years. The increases in carbon dioxide are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture. This has enhanced the greenhouse effect which is resulting in climate change (**Figure 2**).

Both here in Victoria and throughout other parts of the world, signs of a changing climate are evident. The decade of 1998–2007 was the warmest on record, according to the World Meteorological Organization. In Victoria, 2007 was the warmest year on record with a mean annual temperature 1.2°C above the long-term average. Most of the warming since 1950 is very likely due to increases in greenhouse gases generated by human activities. This warming has been associated with more heatwaves, changes in rain and wind patterns, more extreme weather, rapid melting of Arctic ice and higher global

sea levels. There is also widespread evidence (including some from Victoria) that this warming has already had discernable impacts on many physical and biological systems.

Without effective global action to reduce greenhouse gas emissions, by the end of the 21st century the concentration of carbon dioxide in the atmosphere is expected to be two or three times higher than the pre-industrial level of 280 parts per million (ppm). Because of the inertia in the climate system, past activities that released greenhouse gases are affecting us now. At the same time, today's decisions and actions will have impacts far into the future. We are committed to at least a further 0.6°C of warming by 2030. However, we have a choice – the extent of climate change we experience will depend on the net emissions produced in the next couple of decades and beyond. A global emissions reduction target of 60% by 2050 still commits us to planning for at least a 2°C warming from pre-industrial (1750) levels. Beyond 2°C warming, the risk of dangerous and rapid climate change increases significantly and the costs of adaptation also increase.

Climate change will have significant impacts on human and natural systems. Globally, these impacts will include coastal flooding; more heatwaves, storms and droughts; less frost, snow and ice; more people at risk from food and water shortages; reduced habitat for many plant and animal species; and more people exposed to infectious diseases such as malaria.

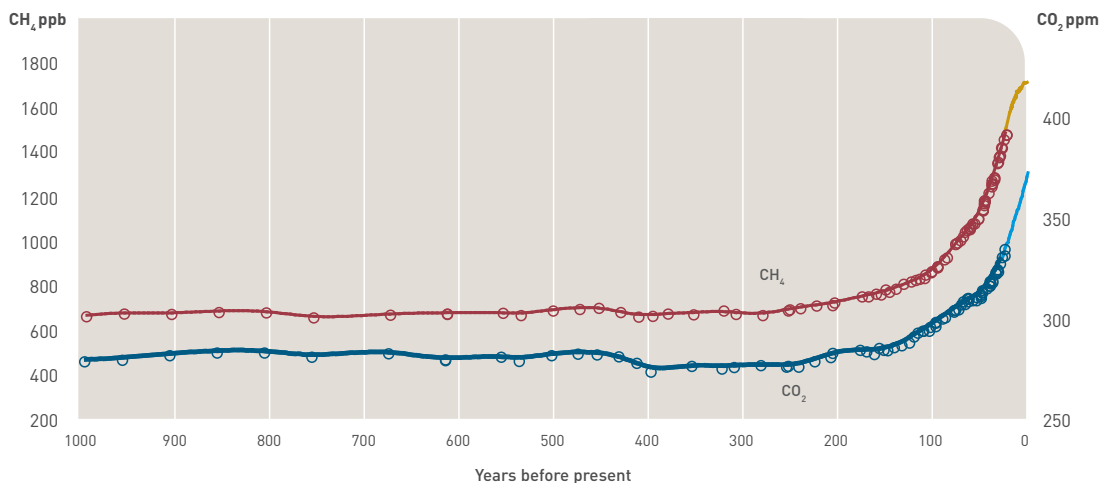
While Victorians have learned to live with a variable climate, we will increasingly need to adapt to climatic conditions beyond this variability and in a more sustainable way.



Figure 1

Atmospheric concentrations of carbon dioxide (CO₂) and methane (CH₄) over the past 1000 years (data from Antarctic ice cores)

ppm Parts per million
ppb Parts per billion



WHAT IS THE ENHANCED GREENHOUSE EFFECT?

About half of the sun's energy reaching the top of our atmosphere penetrates to the Earth's surface. The rest is either reflected back into space by the atmosphere or absorbed by gases and dust particles. The solar energy that does reach the Earth's surface warms the land and oceans. In turn, the land and oceans release heat in the form of infrared radiation.

Greenhouse gases absorb and re-emit some of this radiation, warming the lower atmosphere. This extra heat, which keeps the surface of our planet warm enough to sustain life, is called the greenhouse effect. Without heat-trapping gases in our atmosphere, the Earth's surface temperature would be, on average, -18°C rather than the +15°C we currently experience.

Human-induced emissions of greenhouse gases, such as carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), CFCs and lower-atmospheric ozone, are leading to increased concentrations of these gases in the atmosphere.

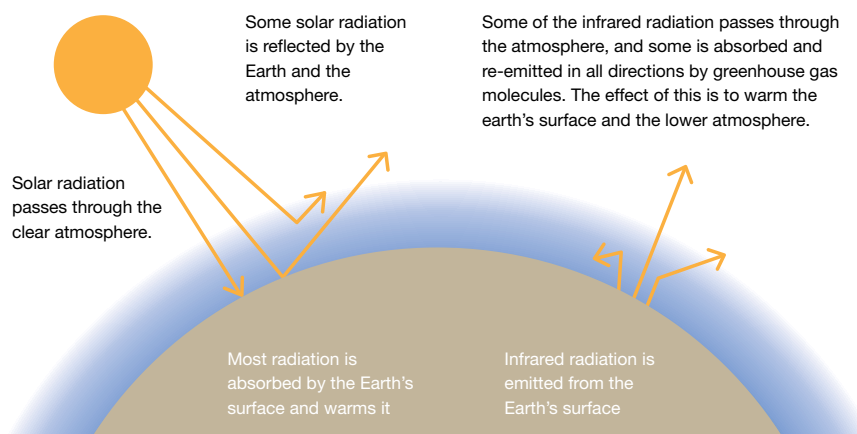
These emissions are causing an enhanced greenhouse effect, an increased trapping of infrared radiation, which is contributing to global warming and climate change. Current concentrations of CO₂ are higher than any time in the past 650,000 years. The CO₂ growth rate in the 1990s was 1.3% per year but from 2000 to 2006 it was 3.3% per year.

→ FACT

Growth in greenhouse gas concentrations in the atmosphere between 1750 and 2005:

- Carbon dioxide: **35%**
- Methane: **148%**
- Nitrous oxide: **18%**

Figure 2
The greenhouse effect





GLOBAL CLIMATE CHANGE

The most widely used indicator of climate change is the global mean, annual average, near-surface air temperature – commonly referred to as the global average temperature.

Global average temperatures have risen by over 0.7°C since the early 20th century, but the rate of warming has increased over the past 50 years, increasing to around 0.13°C per decade. Global sea level has risen about 17 cm since 1900, but has risen about 3 mm per year since 1993.

The Intergovernmental Panel on Climate Change (IPCC) has concluded that warming of the climate system is unequivocal, as is now evident from observations of increasing global average air and ocean temperatures, widespread melting of snow and ice and rising average sea level. The IPCC also concluded that it is very likely that human-generated greenhouse gas emissions have caused most of the observed temperature rise since the mid 20th century (IPCC 2007).

A more detailed description of observed changes to the global climate system can be found in Chapter 3 of the Working Group I report of the IPCC's Fourth Assessment Report available at www.ipcc.ch

→ WHAT IS THE IPCC?

In 1988, the United Nations and the World Meteorological Organization set up the Intergovernmental Panel on Climate Change (IPCC), a body comprising governments and many of the world's experts on climate change. The IPCC was established to provide decision-makers and others interested in climate change with an objective source of information about climate change.

The IPCC does not conduct any research nor does it monitor climate related data or parameters.

Its role is to assess the latest scientific, technological and socio-economic peer-reviewed literature relating to the risk of climate change, its observed and potential impacts and options for adaptation and mitigation.

For more information, visit www.ipcc.ch





ESTIMATING FUTURE CLIMATE CHANGE

The IPCC estimates of global warming are relative to the period 1980 to 1999, but for convenience the baseline is often referred to as 1990. Projections are given for 2030 and 2070 but individual years can vary markedly, so the values can be taken as representative of the decade around the year stated – for example the projections for 2030 are representative of 2026 to 2035. Natural variability (independent of greenhouse gas emissions) can cause decadal means to vary and estimates of this effect are included in estimates of uncertainty.

There is little difference in the effect of different emissions scenarios up to 2030, so results for a mid-range scenario (A1B) are provided. For 2070, the projections are more dependent on the emissions scenario, so results are provided for a lower emissions growth scenario (B1) and a higher emissions growth scenario (A1FI).

The projections in this document update those prepared in 2004 by CSIRO for the Victorian Government. (A summary of the results was published early in 2007: *Climate Change in Victoria: A Summary*.) While these projections are consistent with earlier work, the new projections indicate a narrower range of warming (largely due to improvements in modelling). For rainfall, there is a stronger trend towards precipitation decreases – particularly in autumn and the annual average.

For the first time, projections include a central estimate and range of uncertainty. The central estimate is the median value of the range projected by the models and is referred to as ‘most likely’.

The uncertainty range is based on the two extreme values for the 10th and 90th percentiles.

CONFIDENCE OF CLIMATE CHANGE PROJECTIONS

Climate models are tested against and derived from data from the natural world, providing a major source of confidence in the use of models for climate projection. The other basis for confidence comes from the ability of climate models to represent current and past average climates, as well as observed climate changes. Different aspects of climate change have different levels of uncertainty associated with them. So, while there is high confidence about some projections such as changes in average temperature, there is less confidence in others.

INCREASING LEVELS OF CONFIDENCE OF PROJECTIONS

VERY HIGH

- Higher global and regional temperatures, more hot days, fewer cold days
- Global sea level rise

HIGH

- Decreasing Victorian rainfall in winter and spring
- Increasing Victorian potential evaporation
- Declining Victorian soil moisture
- Increased risk of bushfire in Victoria

MEDIUM TO HIGH

- Increasing storm surge heights in Victoria
- Increasing intensity of extreme rainfall in summer and autumn in Victoria

MODERATE

- Decreasing Victorian rainfall in summer and autumn
- Decreasing annual average stream flow in Victoria
- Increased drought frequency, intensity and duration in Victoria

LOW

- Abrupt changes, such as a step-change in rainfall, rapid melting of polar ice sheets or changes in global ocean currents
- Changes in small-scale storm phenomena, such as tornadoes, hail and wind-gusts



GREENHOUSE GAS EMISSIONS SCENARIOS

CSIRO and the Australian Bureau of Meteorology have assessed future climate change from the results of 23 global climate models used in the IPCC Fourth Assessment Report (2007) and different IPCC scenarios for greenhouse gas emissions. The emissions scenarios, which project emissions growth from 1990 to the end of the 21st century, consider a range of assumptions about demographic change, economic growth and technological developments which are likely to influence future emissions. National results were published in *Climate Change in Australia* (2007) www.climatechangeinaustralia.gov.au

Long-term temperature increases depend on how much and how quickly heat trapping greenhouse gases accumulate in the atmosphere and how the climate system responds to the increased concentrations. For this report, three different emissions scenarios have been used to calculate climate projections:

- The **B1** scenario is a **lower emissions growth scenario** ↑ and assumes that there is a rapid shift to less fossil-fuel intensive industries. Under this scenario, it is expected that there will be a weak growth in CO₂ emissions until 2040, and then a decline. CO₂ concentrations approximately double, relative to pre-industrial levels, by 2100. A global temperature increase relative to 1990 of 1.8°C (1.1 to 2.9°C) is likely.
- The **A1B** scenario is a **medium emissions growth scenario** ↑ where there is a balanced use of different energy sources – not just fossil fuels. CO₂ emissions increase moderately until 2030, but decline by the middle of the 21st century. By 2100 a global temperature increase of 2.8°C (1.7 to 4.4°C) is likely.
- The **A1FI** is a **higher emissions growth scenario** ↑↑ and assumes a continuation of strong economic growth based on continued dependence on fossil fuels. CO₂ concentrations more than triple, relative to pre-industrial levels, by 2100. A global temperature increase of 4.0°C (2.4 to 6.4°C) is likely. This scenario represents the highest level of late 21st century emissions that were thought to be plausible back in 2000. However, recent evidence indicates that CO₂ emissions have been growing at a more rapid rate.

A fourth emissions scenario is shown in Figure 3: the **450** scenario assumes stabilisation of CO₂ concentrations at 450 ppm (approximately double pre-industrial levels) by 2100, requiring a reduction in global emissions of about 50% by 2050 and 70% by 2100.

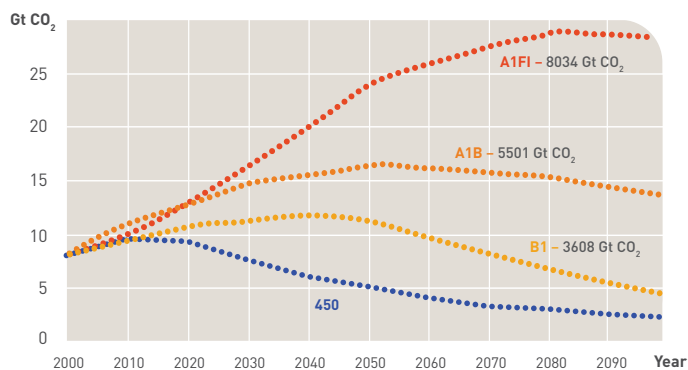


Figure 3
450, B1, A1B and A1FI scenarios showing annual CO₂ emissions out to 2100 in gigatonnes.

→ FACT

Over the past 17 years, observations of CO₂ concentrations, global mean temperatures and sea level rise have been tracking close to the upper limit of IPCC projections (i.e. A1FI scenario).



VICTORIA'S PAST CLIMATE

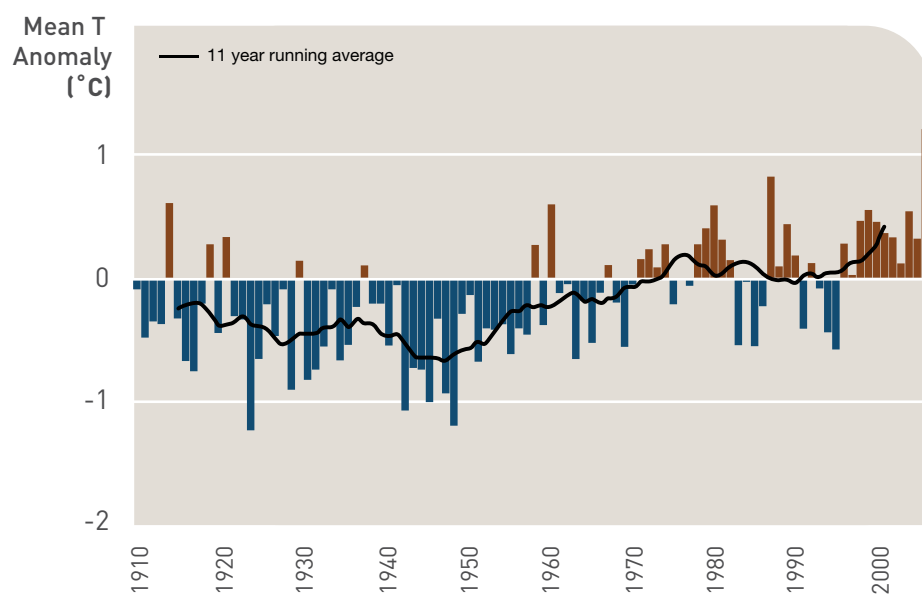
Victoria experiences a wide range of climatic conditions. These range from the hot summers of the Mallee to the winter snow storms of the alpine areas in the north east, and from the relatively dry wheat belt of the Wimmera to the wet elevated areas of Gippsland.

Descriptions of 'average' climate are complicated by annual and decadal variability. The climate that is considered normal today is unlikely to be the same as that of 50 or 100 years ago. Consistent with international convention, the average climate described below is based on the 30 year period from 1961 to 1990.

Annual average temperature in Victoria decreased slightly between 1910 and 1950 but has increased since 1950. Over this period (1950 to 2007), daily maximum temperatures have increased by about 0.8°C while daily minimum temperatures have risen by only half as much (0.4°C). The greatest increase in average and maximum temperatures have occurred in spring while minimum temperatures increased the most in summer.

Victoria experienced an exceptionally hot and dry decade from 1998 to 2007. The average daily maximum over the decade was 0.6°C warmer than the 30 year (1961-1990) average, while the average daily minimum was 0.2°C warmer.

Figure 4
Victorian annual average temperature since 1910: variations from the 1961–1990 mean



Rainfall totals decreased over the past decade. While total annual rainfall for the state decreased by 13% compared with the 30 year (1961-1990) average, the greatest decrease occurred in autumn (28%). Summer rainfall showed no trend. Rainfall totals were especially low in central and south west Victoria – in some cases 20% below the 1961 to 1990 average.



One of the major impacts of the rainfall decline and temperature increase in south-eastern Australia has been a reduction in surface water available for storage. This is partly related to the marked reduction in inter-annual variability (the absence of very wet years means that the catchments have not recovered from dry years) and seasonal changes in rainfall. Figure 5 illustrates the reduction in yearly inflows into Melbourne's major water storages - about 30% over the last decade. Inflows to Lake Eildon have reduced by 38%.

It is becoming evident that the climate that we have known in the 20th century is unlikely to be the best guide to the climate of the future. Projections of the changes in climate that we can expect in the future are summarised in the following pages.

→ FACTS

The ten hottest years in Victoria:

- 1 2007
- 2 1988
- 3 1914
- 4 1961
- 5 1981
- 6 2000
- 7 2005
- 8 1999
- 9 2001
- 10 1990

(Ranked according to average mean daily temperature.)

Over the past decade:



2006 had the warmest spring



2001 had the warmest summer



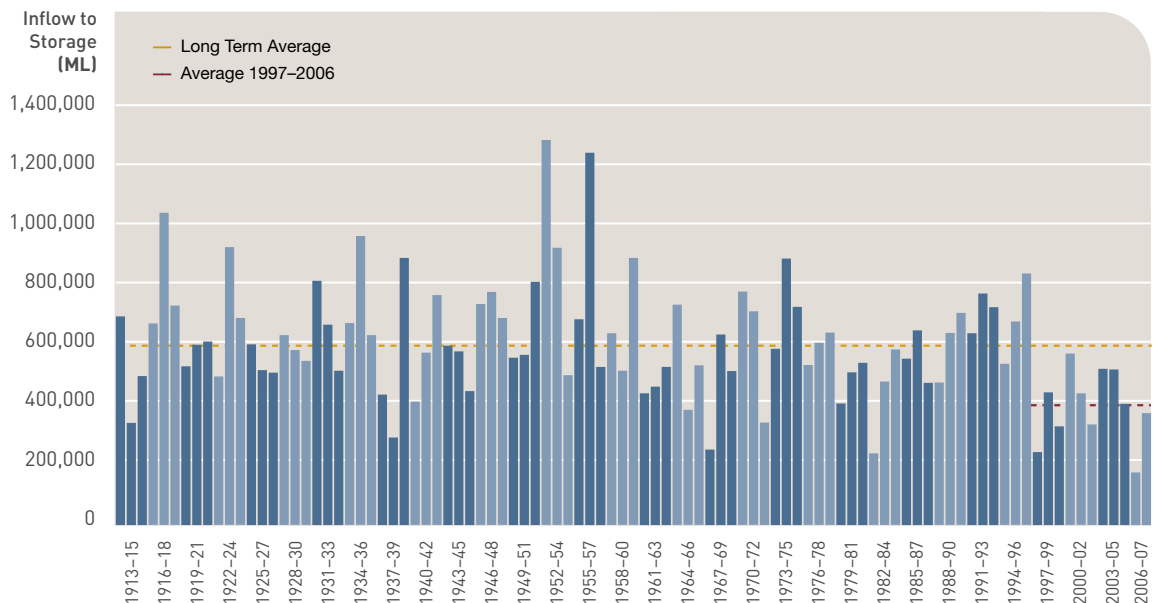
2005 and 2007 had the warmest autumn



2005 had the mildest winter

(Based on average daily maximum temperature.)

Figure 5
Annual inflows to Melbourne's water storages



FUTURE CLIMATE

hot & cold

Victoria is expected to warm at a slightly faster rate than the global average, especially in the north and east of the state. By 2030, annual average temperatures are expected to increase by around 0.8°C (although the range of model results indicates a range of 0.6 to 1.2°C). Warming is likely to be greatest in spring and summer. By 2070, the average annual temperature could increase by 1.4°C under a lower emissions growth scenario (0.9 to 2.0°C) or by as much as 2.7°C under a higher emissions growth scenario (1.8 to 3.8°C). **Figure 6** shows annual average and seasonal temperature projections for 2070 under the lower and higher emissions growth scenarios. Data shown is the 50th percentile (i.e. 'most likely' scenario) based on results from different climate models.

As well as changes in average temperature, the number of hot days will increase in both frequency and intensity. One measure of this is the number of days over 35°C that can be expected each year. The largest increases are expected in inland areas while the smallest changes can be expected in coastal regions. Similarly, changes to the annual average number of frosts (defined as a minimum temperature below 2°C) will also decrease across the state. The largest reductions are likely to occur inland, while changes will be minimal near the coast. Examples of these changes for specific sites can be found in **Figures 7 and 8** on the following page.

Within larger cities, particularly the Melbourne metropolitan area, the 'urban heat island' effect is increasing. This is a result of the growing number of hard surfaces and buildings which lead to additional increases in temperature.

Figure 6
Annual average and seasonal temperature change projections for 2070 under the lower and higher emissions growth scenarios

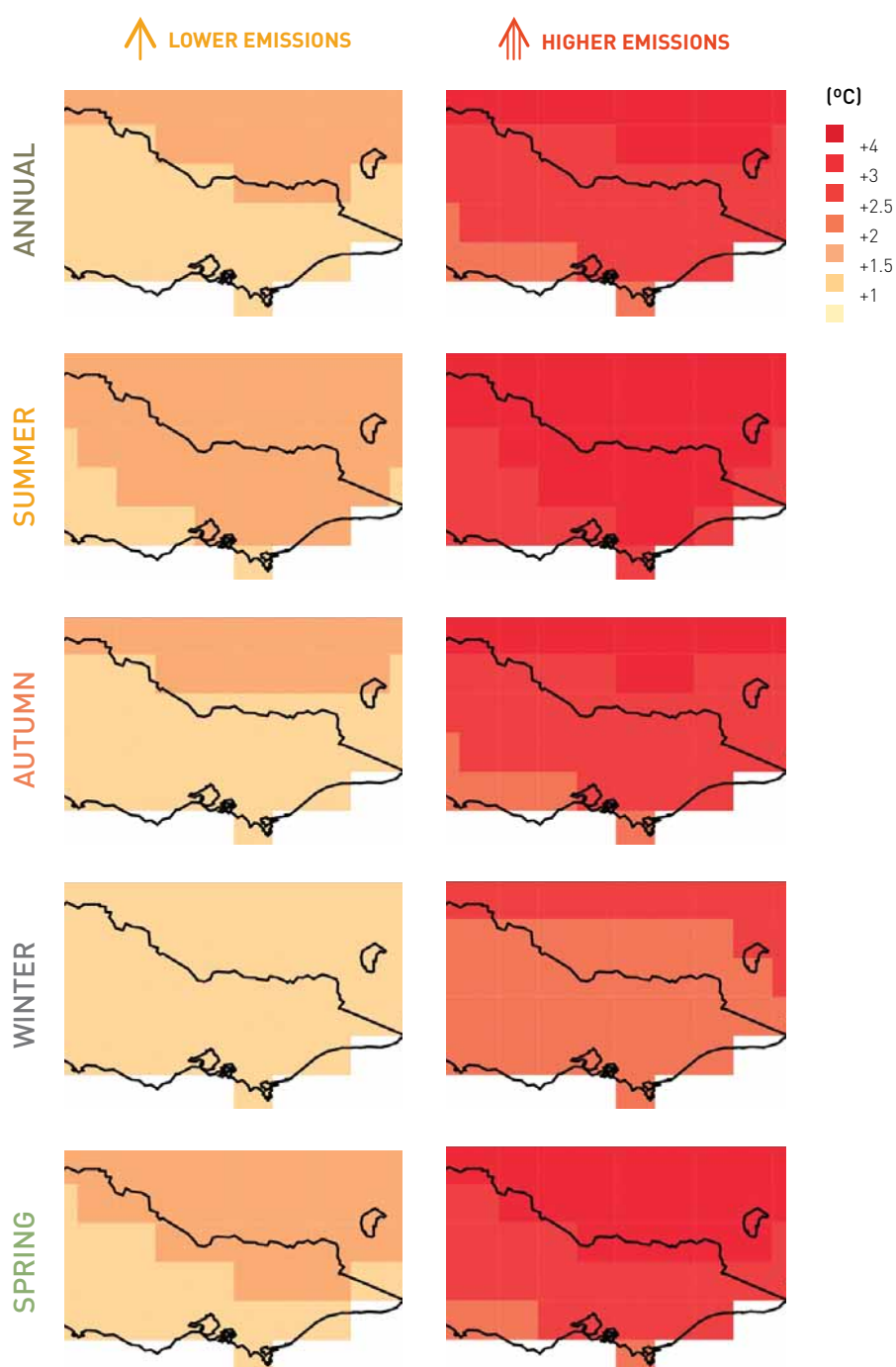




Figure 7

Current and projected average annual number of days over 35°C each year

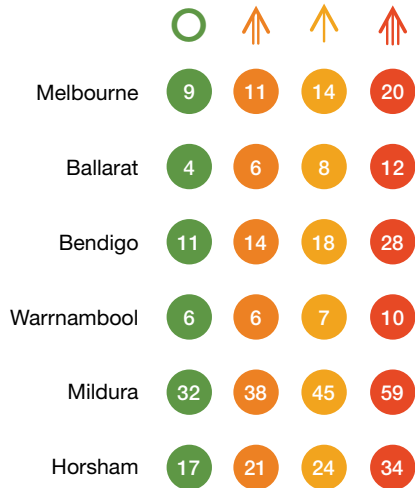





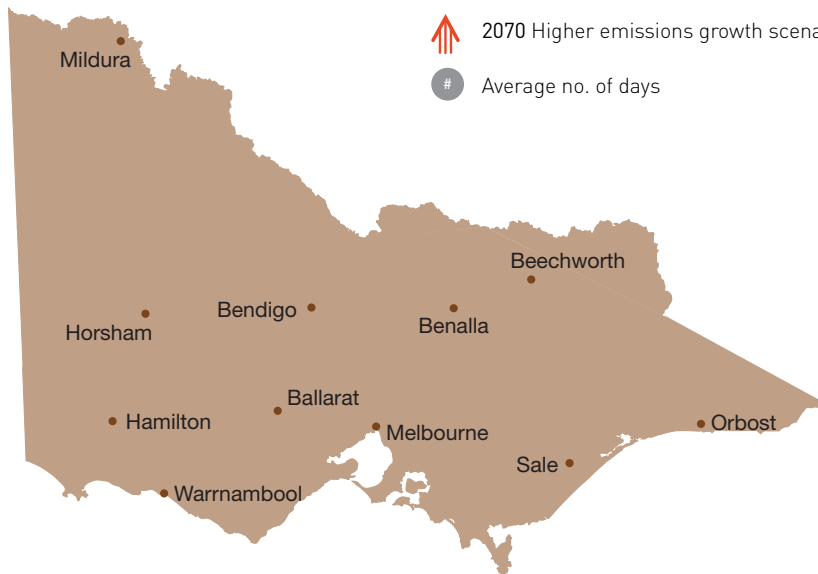


Figure 8

Current and projected average annual number of frosts (days below 2°C) each year



-  Current
-  2030 Medium emissions growth scenario
-  2070 Lower emissions growth scenario
-  2070 Higher emissions growth scenario
-  Average no. of days





wet & dry

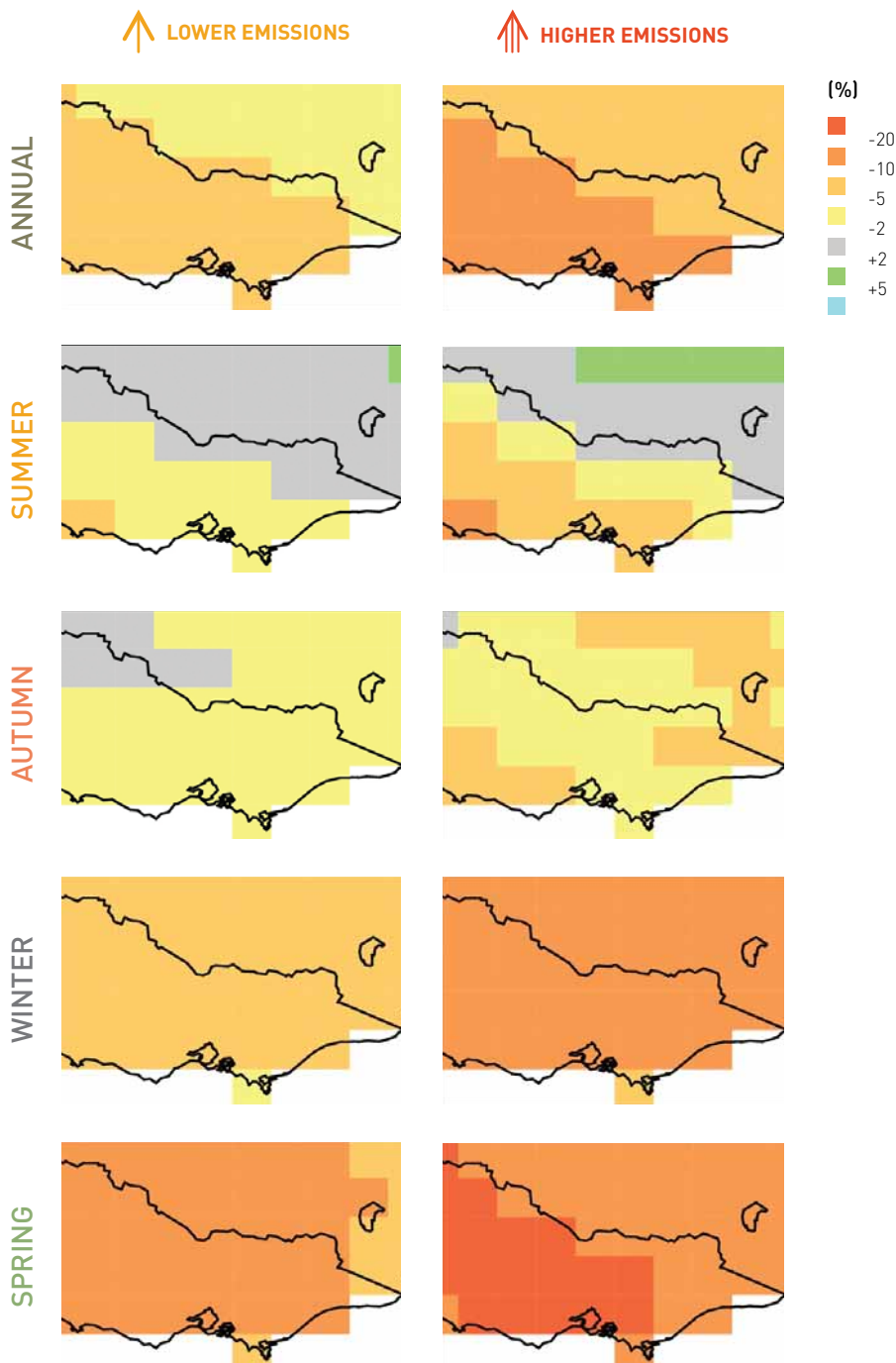
Annual average rainfall is expected to decrease by around 4% by 2030, however the full range of model uncertainty ranges from -9% to +1%. The greatest decreases in rainfall are likely to occur in winter and spring, while heavy rainfall intensity is most likely to increase in summer and autumn. By 2070, annual average rainfall is likely to decrease by 6% (-14% to +2%) under a lower emissions growth scenario or by 11% (-25% to +3%) under a higher emissions growth scenario. **Figure 9** shows annual average and seasonal rainfall projections for 2070 under the low and high emissions scenarios. Data shown is the 50th percentile (i.e. 'most likely' scenario) based on results from different climate models. **Tables 1 and 2** on page 12 give examples of projected changes in annual average rainfall and number of rainy days for several locations in Victoria.

Since the early 1970s, Australian droughts have become more intense as a result of the warmer than average temperatures. The projections for warmer temperatures and reduced annual rainfall are likely to increase the risk of drought. The frequency of drought (defined as having soil moisture in the lowest 10% on record between 1974 and 2003) is likely to increase by between 10% and 80% in the southern half of the state and by between 10% and 60% in the northern half by 2070.

As well as decreases in total rainfall, evaporation is expected to increase, enhancing the overall drying trend. The annual average potential evaporation by 2030 is likely to increase by around 3% (1% to 5%), with the largest changes expected in winter. By 2070 evaporation could increase by 4% (1% to 8%) under a lower emissions growth scenario, or by 8% (2% to 16%) under a higher emissions growth scenario.

Figure 9

Annual average and seasonal rainfall change projections for 2070 under the lower and higher emissions growth scenarios





EMISSIONS GROWTH SCENARIOS

2030

2070



MEDIUM EMISSIONS



LOWER EMISSIONS



HIGHER EMISSIONS

Table 1

Projected percentage change in heavy rainfall intensity (80% confidence range)

	0.9% (-7.7 to +15%)	3.0% (-13 to +25%)	5.9% (-25 to +49%)
Melbourne	0.9% (-7.7 to +15%)	3.0% (-13 to +25%)	5.9% (-25 to +49%)
Lakes Entrance	1.5% (-7.7 to +18%)	4.9% (-13 to +30%)	9.5% (-25 to +59%)
Omeo	2.1% (-8.6 to +18%)	7.0% (-14 to +29%)	13.6% (-28 to +56%)
Warrnambool	1.1% (-6.8 to +16%)	3.6% (-11 to +26%)	6.9% (-22 to +51%)
Tatura	0.8% (-7.1 to +15%)	2.8% (-12 to +24%)	5.3% (-23 to +47%)
Swan Hill	0.6% (-8.5 to +15%)	1.9% (-14 to +26%)	3.6% (-27 to +49%)

Table 2

Projected percentage change in number of rainy days (>1 mm) each year (80% confidence range)

	-6% (-17 to -1%)	-10% (-28 to -2%)	-19% (-54 to -4%)
Melbourne	-6% (-17 to -1%)	-10% (-28 to -2%)	-19% (-54 to -4%)
Lakes Entrance	-5% (-16 to -1%)	-8% (-26 to -1%)	-15% (-51 to -3%)
Omeo	-5% (-17 to -1%)	-8% (-28 to -2%)	-15% (-54 to -3%)
Warrnambool	-6% (-13 to -1%)	-10% (-22 to -2%)	-18% (-43 to -5%)
Tatura	-5% (-17 to -1%)	-9% (-29 to -2%)	-17% (-56 to -3%)
Swan Hill	-6% (-20 to -1%)	-10% (-34 to -1%)	-18% (-66 to -2%)

COMPARING CURRENT AND FUTURE CLIMATES

The changes in average temperature and rainfall that we can expect as a result of climate change can also be characterised by comparing the future climate with the current climate of surrounding areas. As a rough guide, Victorian annual average temperatures increase by about 1°C for every 100 kilometres moving from south to north. A warming of 1.4°C could be thought of as equivalent to making the temperatures roughly equal to those currently located 140 km to the north. Similarly, a 2.7°C increase in temperature would correspond to a distance of roughly 270 km northwards.

Table 3

Examples of how the climates of Victorian towns might change by around 2070 under a higher emissions growth scenario.

	By 2070, the annual average temperature may be similar to that of current day...	By 2070, the annual average rainfall may be similar to that of current day...
Melbourne	Echuca	Seymour
Warrnambool	Horsham	Hamilton
Hamilton	Horsham	Ararat
Horsham	Wentworth (NSW)	Nhill
Bendigo	Ouyen	Charlton
Beechworth	Bonegilla	Charlton
Orbost	Nowra (NSW)	Bairnsdale
Wonthaggi	Seymour	Tooradin
Benalla	Hay	Rutherglen
Mildura	Wilcannia (NSW)	Wilcannia (NSW)



OTHER CHANGES IN CLIMATE

As well as changes in temperature and rainfall, we can expect other climate variations as a result of climate change.

There is likely to be a small increase in the annual amount of solar radiation (see Table 4 below) reaching the ground over most of Victoria due to reductions in cloud cover. Increases will be greatest in inland areas, particularly in winter and spring.

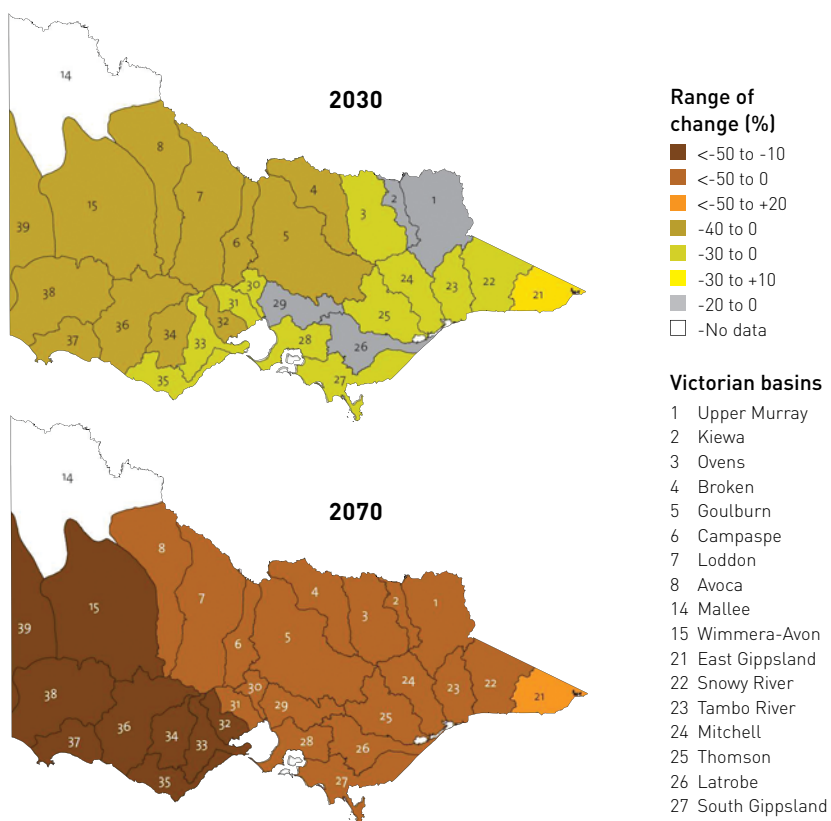
A slight decrease in the annual average humidity is expected by 2030 and this is likely to be greatest in spring while there may be only a slight increase in autumn. In general, coastal areas are more likely to experience increases in humidity than areas further inland.

There is no clear trend for changes in average wind speed as a result of climate change, however any decreases are most likely to occur in autumn in most regions.

runoff

Projected changes in rainfall and higher rates of evaporation will result in less water for our dams and catchments. CSIRO has estimated future changes in runoff to Victoria's 29 catchments (Figure 10).

Figure 10
Projected changes in average annual runoff by 2030 and 2070



These results indicated that by 2030, catchments located in the north east and south east may experience up to 30% reductions in runoff, those in the north west can expect decreases ranging from 5% to 45% while the south-west can expect 5% to 40%. By 2070, runoff into catchments in East Gippsland may increase by 20% or decrease by 50% depending on changes in rainfall. The rest of the state can expect declines of at least 5% or up to 50%.

Table 4
Projected changes in annual average solar radiation, wind speed and relative humidity for Victoria

	EMISSIONS GROWTH SCENARIOS		
	2030	2070	
	↑ MEDIUM EMISSIONS	↑ LOWER EMISSIONS	↑ HIGHER EMISSIONS
Solar radiation (%)	No change to +2%	No change to +3%	No change to +5%
Wind speed (%)	-5 to +4%	-8 to +7%	-16 to +13%
Relative humidity (%)	-1% to no change	-2% to no change	-4% to no change



sea level rise

Global sea levels are projected to rise by between 0.18 m and 0.59 m by 2095, with a possible additional contribution from ice sheet melts of 0.1 m to 0.2 m. Larger contributions to global sea levels from more rapid melting of polar ice sheets is possible, although scientists are unable to estimate these increases until they have a better understanding of the processes involved. Since 1990, sea levels have risen faster than expected, close to the upper limits of projections.

fire

The warmer, drier weather for Victoria expected as a result of climate change is likely to increase the frequency and intensity of bushfires. Fire-weather risk measures how a combination of weather variables influence the risk of a fire starting, its rate of spread, its intensity and the difficulty in suppressing it. Relative to the climate of 1974 to 2003, by 2020 it is expected the number of 'extreme' fire danger days will generally increase by between 5% and 40%. By 2050, under a lower emissions growth scenario, the number of 'extreme' fire days is likely to increase by between 15% and 25%, while under a higher emissions growth scenario, the number of days is likely to increase by between 120% and 230%.

snow

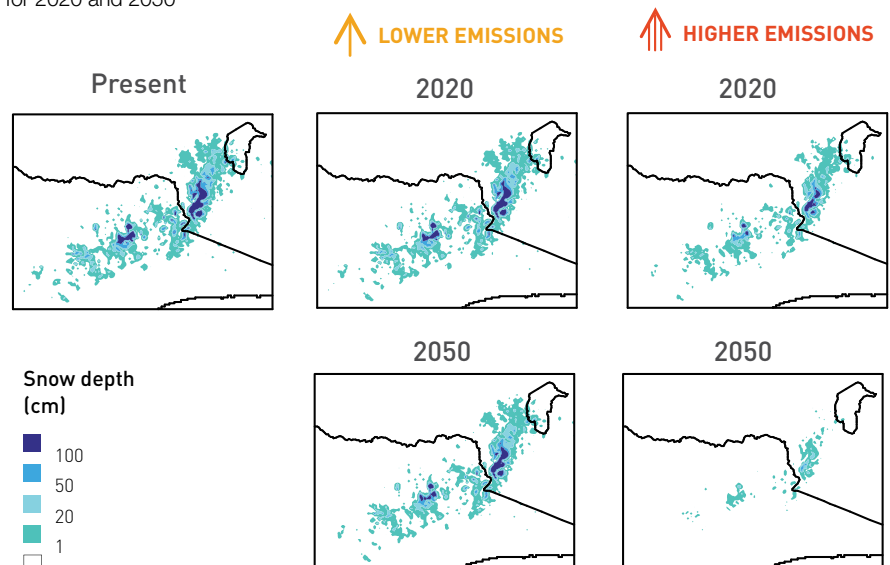
Changes in temperature and precipitation in the alpine regions (above 1000 metres) are expected to have a significant impact on snow conditions in the future. Refer to **Figure 11**. Previous research by CSIRO in 2003 indicated that compared to the climate of 1979 to 1998:

- The area with an annual average of at least 60 days snow cover may decrease by between 18% and 60% by around 2020 and by 38% to 96% by 2050.
- The area with an annual average of at least 30 days snow cover may decrease by between 14% and 54% by around 2020 and 30% to 93% by 2050.
- The area with an annual average of at least one day of snow cover may decrease by between 10% and 39% by around 2020 and 22% to 85% by 2050.

A low impact scenario (a slow rate of warming and a small increase in precipitation) would have only a minor impact on snow conditions by 2020, reducing the average snow-season length by about 5 days. Reductions in peak snow depths are expected to be around 10%, but greater at lower elevations (see **Figure 11**). In comparison, a high impact scenario (fast warming and decreased precipitation) is likely to result in the average snow season shortening by 30 to 40 days by 2020. At higher elevations, such as Mount Hotham, this can represent a reduction in the snow season duration by about 25%. At lower elevations such as Mount Baw Baw, more significant reductions are likely (up to 60%). Impacts on peak snow depth are expected to follow a similar pattern with more moderate impacts expected at higher elevations. There is also a likelihood that maximum snow depth will occur earlier in the season under warmer conditions.

CSIRO's research indicates that with sufficient investment in snow making, the Australian ski industry will be able to manage the projected impact of climate change until at least 2020.

Figure 11
Projected maximum snow depths for present, low and high impact climate change scenarios for 2020 and 2050





PREPARING FOR CLIMATE CHANGE

The uncertainty over the precise scale and timing of climate change impacts should not be an excuse for postponing action. A precautionary approach is needed. Many of the decisions we make today will affect our vulnerability to climate change. We must start preparing for and adapting to these changes now.

In the context of climate change, adaptation refers to any action, either intentional or otherwise, taken to minimise the adverse effects of climate change or to take advantage of any beneficial effects. Adaptation is the primary means of dealing with the unavoidable impacts of climate change. It includes activities to manage risks, adjust economic activity to reduce vulnerability and to improve business certainty. The Victorian Government is driving adaptation planning that recognises Victoria's specific regional vulnerabilities to climate change, and focuses on early planning to manage risks, avoid future costs and maximise potential benefits. The uncertainty about the nature and magnitude of climate change impacts means that ongoing investment in research will be critical in guiding appropriate and efficient responses. Also, applying policies and principles that help society to become more resilient to the range of future conditions will be increasingly important.

Some examples of current adaptation actions in Victoria include:

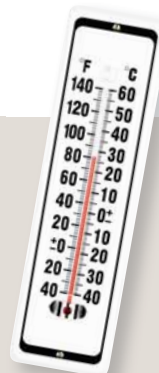
- supporting a program of research to better understand impacts of climate change, particularly for agriculture and biodiversity;
- incorporating climate change projections into sustainable water planning;
- improving water use efficiency;
- developing a heat wave response plan for Victoria;
- detailed mapping and assessment of potential climate change vulnerabilities along the coast, including the impacts of sea level rise, storm surge, erosion and flooding; and
- reviewing flood and bushfire management plans.

Adapting to climate change will never be a sufficient response on its own. At higher concentrations of greenhouse gases, adaptation becomes more difficult and more expensive. Therefore we will need to continue efforts to achieve deep cuts in greenhouse gas emissions.

The Victorian Government is committed to the challenge of climate change and its responsibility to lead Victorian efforts to reduce our greenhouse emissions by 60% by 2050 compared to 2000 levels.

→ FACT

During the last ice age (20,000 – 100,000 years ago) the global average temperature was only 5°C cooler than the current global average of 15°C.



→ INFO

Want to know more about climate change?

Contact the Department of Sustainability and Environment Customer Service Centre on **136 186** or visit our website at www.climatechange.vic.gov.au

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