CSIRO

Australian Government
Bureau of Meteorology

State of the Climate

This snapshot provides observations and analysis of Australia's climate and the factors that influence it. Two organisations, CSIRO and the Australian Bureau of Meteorology have combined to present this current picture of Australia's climate.

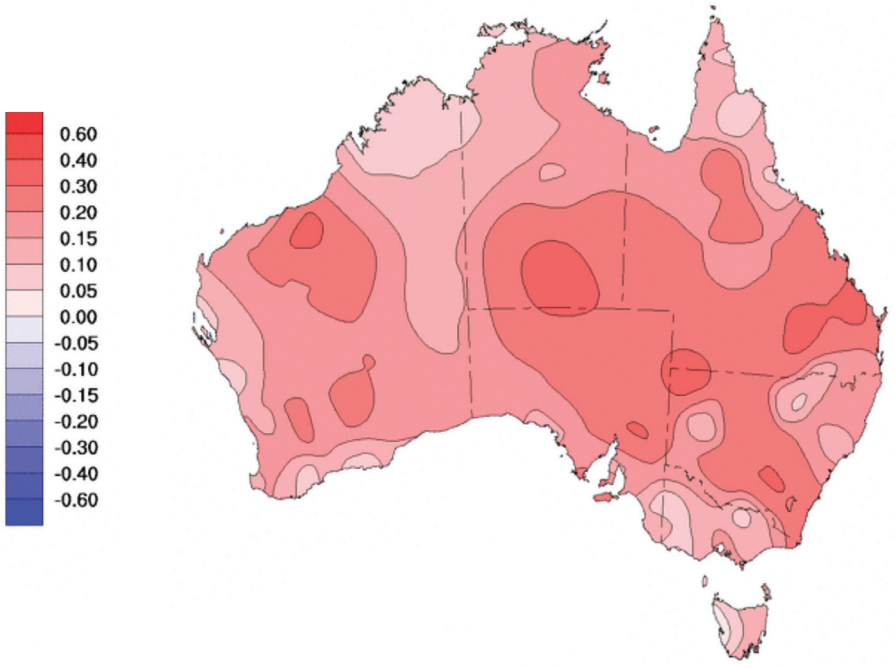
The Bureau of Meteorology has been observing and reporting on weather in Australia for over 100 years, and CSIRO has been conducting atmospheric and marine research for over 60 years.

The snapshot is sourced from peer reviewed data on temperature, rainfall, sea level, ocean acidification, and carbon dioxide and methane levels in the atmosphere.

1. Temperature

Since 1960 the mean temperature in Australia has increased by about 0.7 °C . The long term trend in temperature is clear, but there is still substantial year to year variability of about plus/minus 0.5 °C. Some areas have experienced a warming of 1.5 to 2 °C over the last 50 years. Warming has occurred in all seasons, however the strongest warming has occurred in spring (about 0.9 °C) and the weakest in summer (about 0.4 °C).

Trend in mean temperature 1960-2009 (°C/decade)

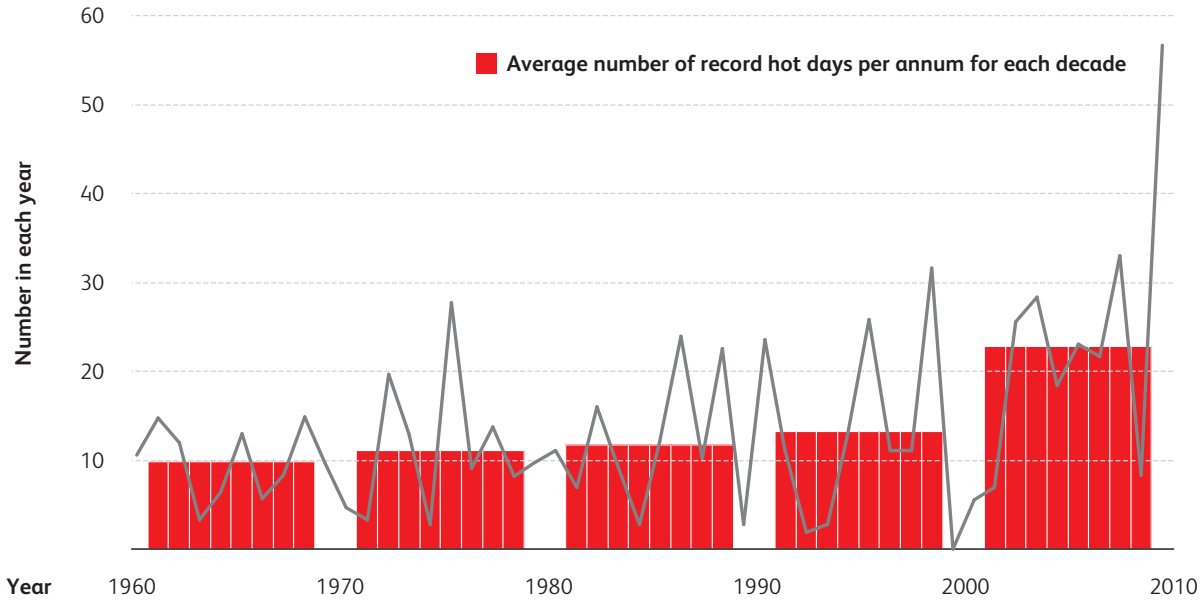


Key Points

- All of Australia has experienced warming over the past 50 years.
- Some areas have experienced warming since 1960 of up to 0.4 °C per decade (see map) resulting in total warming over the five decades of 1.5 to 2 °C

Source: Bureau of Meteorology 2010

Number of record hot day maximums at Australian climate reference stations

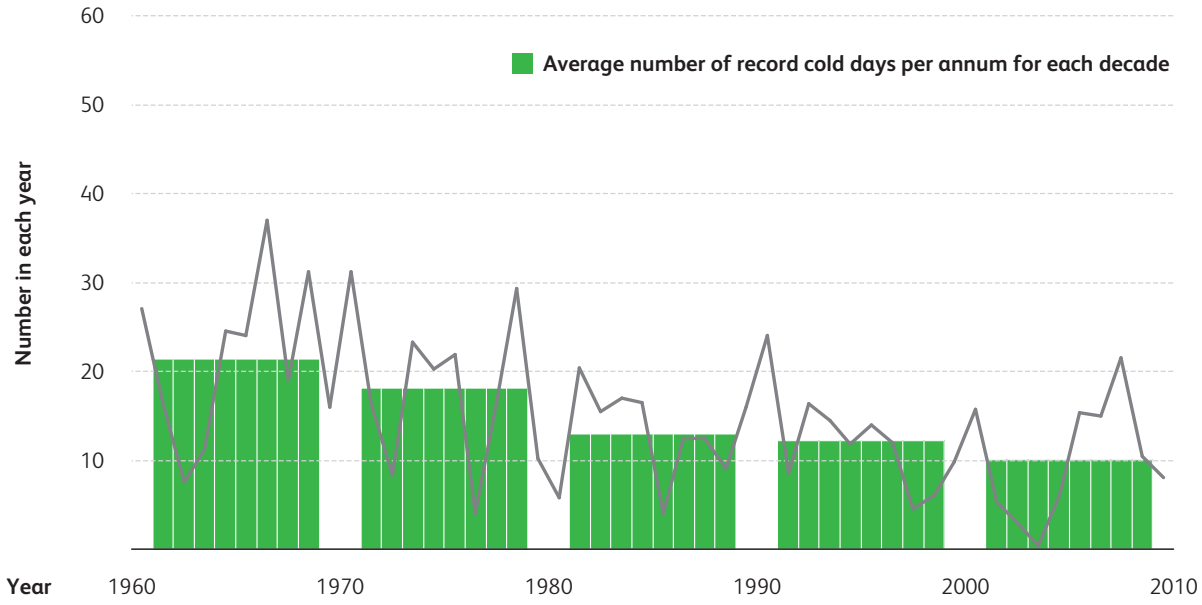


Source: Bureau of Meteorology

Key Points

- The number of days with record hot temperatures has increased each decade over the past 50 years
- There have been fewer record cold days each decade
- 2000 to 2009 was Australia's warmest decade on record

Number of record cold day maximums at Australian climate reference stations

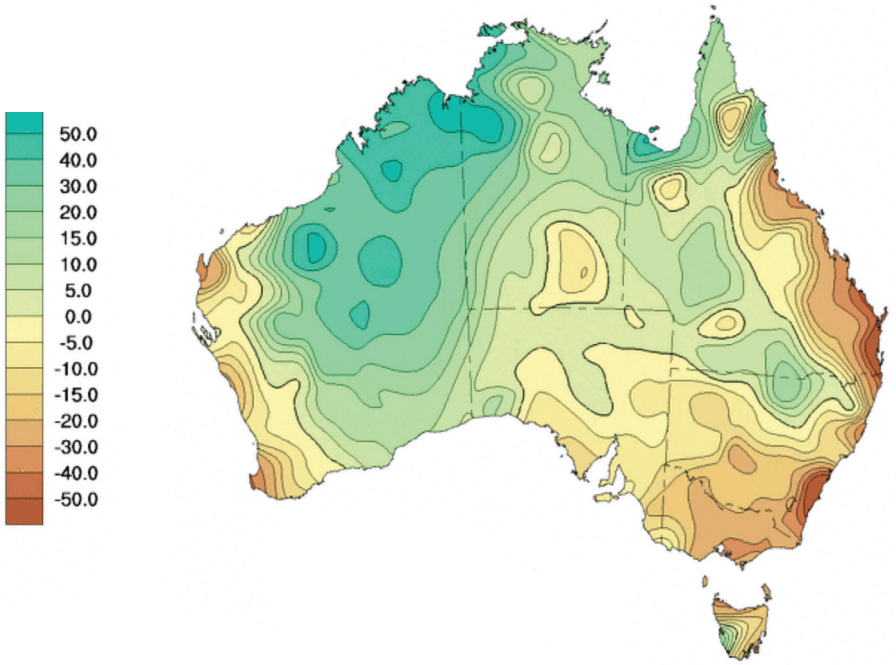


Source: Bureau of Meteorology

2. Rainfall

While total rainfall on the Australian continent has been relatively stable, the geographic distribution of rainfall has changed significantly over the past 50 years. Rainfall decreased in south-west and south-east Australia, including all the major population centres, during the same period.

Trend in annual rainfall 1960-2009 (mm per decade)



Key Points

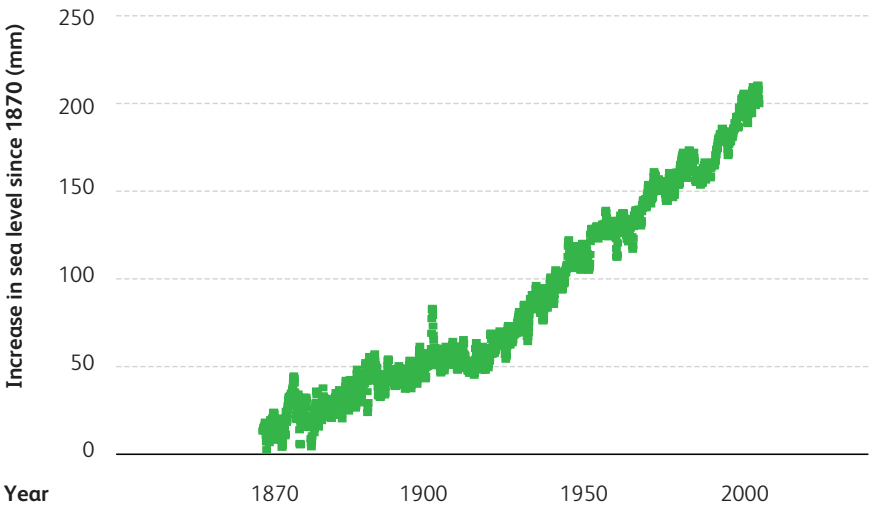
- Trend over five decades of increasing rainfall in many parts of northern and central Australia (see map)
- Trend over five decades of rainfall decreasing across much of southern and eastern Australia (see map)

Source: Bureau of Meteorology

3. Our Oceans

From 1870 to 2007, the global average sea level rose by close to 200mm. Sea levels rose at an average of 1.7mm per year during the 20th century and about 3.0mm per year from 1993-2009. These levels are global averages and because of the differing movements of ocean currents around the globe, results vary from place to place. This is true for Australia where since 1993 levels have risen 7-10mm per year in the north and west, and 1.5-3mm in the south and east.

Rising global mean sea level

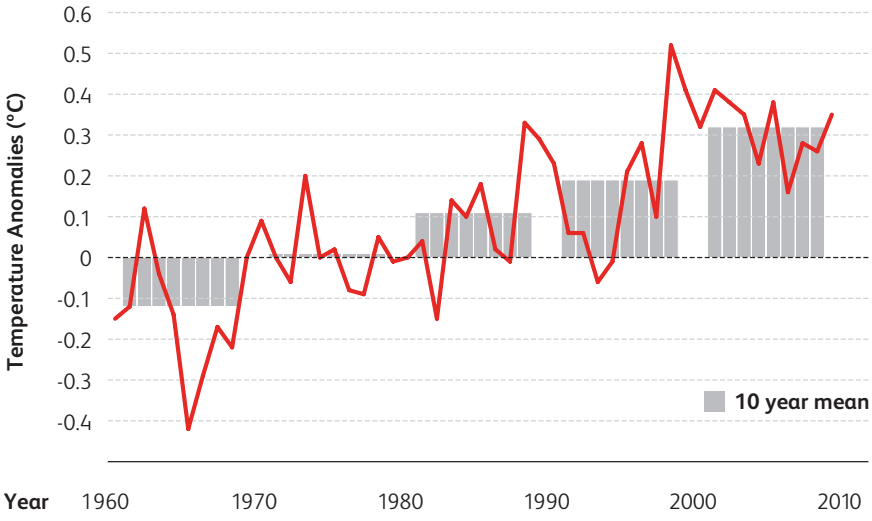


Key Points

- The rate of sea level rise increased during the 20th century
- During 1993 to 2009 sea level rise has been 1.5 to 3mm per year in the south and east of Australia and 7 to 10mm per year in the north and west

Source: CSIRO 2010

Annual and 10 year mean sea surface temperature for the Australian region



Key Point

- Sea surface temperatures around Australia have increased by about 0.4°C in the past 50 years

Source: Bureau of Meteorology 2010

Ocean Acidification

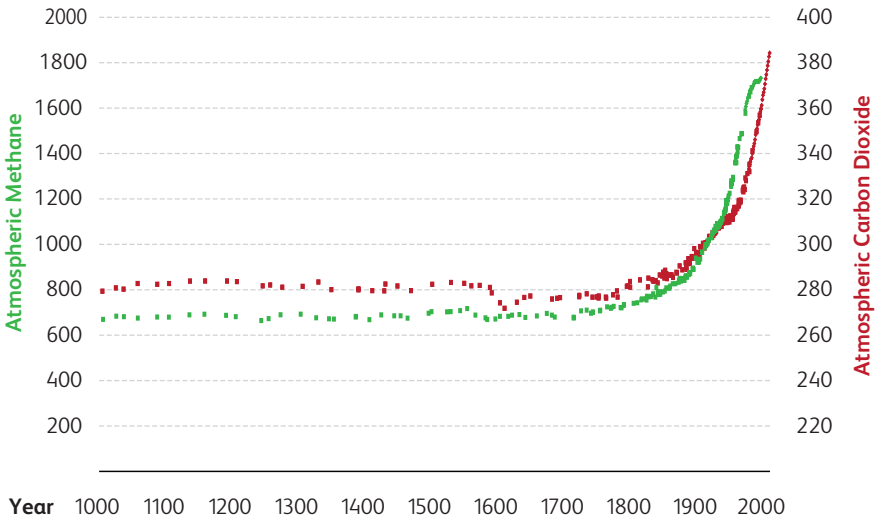
The world's oceans currently absorb about 25 per cent of the carbon dioxide (CO_2) generated by humans – about 40 per cent of this is absorbed in the Southern Ocean. The CO_2 absorbed by the ocean makes the ocean become more acidic. Recent research shows that ocean acidification decreases the ability of marine plants and animals to form shells. Such effects are now being observed at the base of the food chain in the Southern Ocean. This has far-reaching implications for the health of ocean ecosystems around the world.

4. Our Atmosphere

Global CO_2 concentrations have risen rapidly over the last century. Methane, which is another greenhouse gas, has shown similar increases.

The carbon dioxide concentration in 2009 of 386 parts per million (ppm) is much higher than the natural range of 170 to 300 ppm that has existed in the atmosphere for at least the past 800,000 years and possibly the past 20 million years.

Atmospheric Carbon Dioxide (parts per million) and Methane (parts per billion)

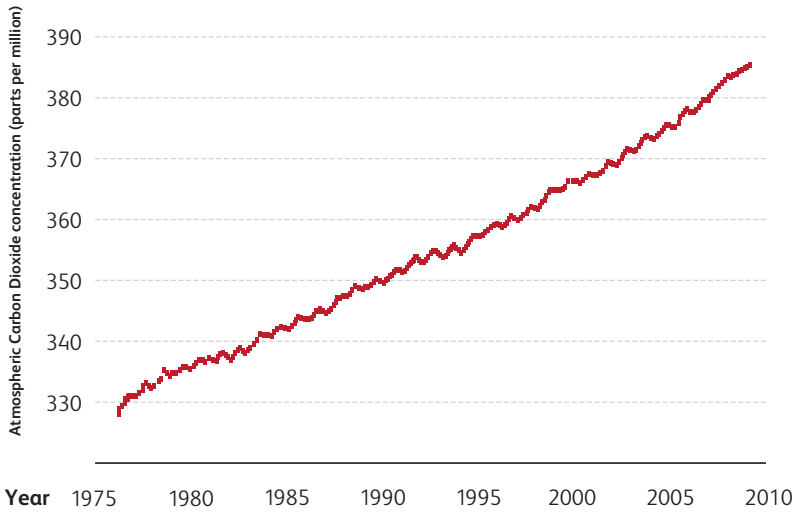


Key Point

- Global greenhouse gases, such as carbon dioxide and methane, in the atmosphere have risen rapidly over the last century

Source: CSIRO 2007

Carbon Dioxide concentrations measured at Cape Grim, Tasmania



Key Point

- The Cape Grim baseline air pollution station, operated jointly by CSIRO and the Bureau of Meteorology in north-western Tasmania, provides vital information about changes to the atmosphere in the Southern Hemisphere. This chart shows the increase in CO_2 concentrations measured at Cape Grim over the past 35 years

Source: CSIRO and Bureau of Meteorology

5. What this means.

Australia will be hotter in coming decades

Australian average temperatures are projected to rise by 0.6 to 1.5 °C by 2030. If global greenhouse gas emissions continue at current levels, warming is projected to be in the range of 2.2 to 5.0 °C by 2070. Warming is projected to be lower near the coast and in Tasmania and higher in central and north-western Australia. These changes will be felt through an increase in the number of hot days.

Much of Australia will be drier in coming decades

In Australia compared to the period 1981-2000, decreases in rainfall are likely in the decades to come in southern areas of Australia during winter, in southern and eastern areas during spring, and in south-west Western Australia during autumn. An increase in the number of dry days is expected across the country, but it is likely that there will be an increase in intense rainfall events in many areas.

It is very likely that human activities have caused most of the global warming observed since 1950

There is greater than 90 % certainty that increases in greenhouse gas emissions have caused most of the global warming since the mid-20th century. International research shows that it is extremely unlikely that the observed warming could be explained by natural causes alone. Evidence of human influence has been detected in ocean warming, sea-level rise, continental-average temperatures, temperature extremes and wind patterns. CSIRO research has shown that higher greenhouse gas levels are likely to have caused about half of the winter rainfall reduction in south-west Western Australia.

Climate change is real

Our observations clearly demonstrate that climate change is real. CSIRO and the Bureau of Meteorology will continue to provide observations and research so that Australia's responses are underpinned by science of the highest quality.

Further information

The Bureau of Meteorology produces an extensive range of regular climate products and reports. Some, such as rainfall, temperature and solar exposure maps, are produced daily for every state. Climate statements and weather reviews are produced monthly for every state. Special climate statements are released when required such as during the extensive flooding in the Northern Territory and Queensland during March 2010.
All of these reports, and many others, can be found through the Bureau's climate pages on its website at **www.bom.gov.au/climate**

Go to **www.csiro.au** for the brochure "The Science of Climate Change" and our web page "Climate Questions, Climate Answers" and other information about adaptation and mitigation. Telephone **1300 363 400** or email **enquiries@csiro.au**

CSIRO and Bureau of Meteorology use scientific modelling based on the laws of physics and thoroughly tested against recorded observations. Models make assumptions about future events such as CO_2 emissions, and are designed to paint a picture of a series of possible future states based on known facts. Because models are representations of the future based on a range of emission scenarios, they tend to produce a range of results, as opposed to observations which are accurate measures of an event that has already occurred. Models are based on an understanding of fundamental science and increased computer capacity allows us to make projections with increased accuracy.