Future Climate Change in Australia

Greenhouse gas concentrations have increased over the past 200 years due to human activities such as burning coal and oil, land-clearing and agriculture. This has led to global warming and other changes in climate.

Further climate change is likely despite efforts to reduce greenhouse gas emissions. The Intergovernmental Panel on Climate Change (IPCC) has concluded that by the year 2100:

- **the Earth is projected to warm by 1.4 to 5.8°C**
- **the sea-level is projected to rise by 9 to 88 cm**

relative to 1990. The projected rate of warming is much larger than observed warming of 0.6° during the 20th century and is very likely to be without precedent during at least the last 10,000 years, based on palaeoclimatic data (temperatures derived from air bubbles trapped in polar ice cores).

Top End

- Salt-water intrusion into Kakadu wetlands due to sea-level rise
- Less water for cities (e.g. Darwin), agriculture (e.g. mangoes, melons) and natural ecosystems (e.g. national parks)
- More heat stress for livestock and people
- Stronger tropical cyclones will increase coastal inundation and property damage

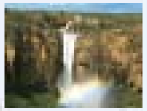
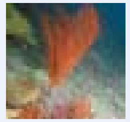


Photo © Greg Miles

Darwin	Now	2030	2070
Annual average max. temperature (ºC)	31.9	33.1 ± 0.8	35.4 ± 2.5
Dec–Feb days above 35ºC	1	7.5 ± 5.5	42 ± 37
Annual rainfall (mm)	1710	1710 ± 70	1710 ± 205
Annual moisture balance (mm)	–918	–1000 ± 50	–1160 ± 155

Northern coastal Queensland

- Warmer ocean temperatures will increase bleaching of coral on the Great Barrier Reef
- Stronger cyclones will increase coastal inundation, coral damage, property damage and beach erosion
- Less water for cities (e.g. Cairns), agriculture (e.g. sugar) and natural ecosystems (e.g. rainforests)
- Reduced biodiversity, e.g. decreased rainforest habitat for frogs, skinks, tree kangaroos and possums



Cairns	Now	2030	2070
Annual average max. temperature (ºC)	28.9	29.9 ± 0.7	31.9 ± 2.2
Dec–Feb days over 35ºC	3	5.5 ± 2.5	41 ± 35
Annual rainfall (mm)	2028	1945 ± 160	1785 ± 485
Annual moisture balance (mm)	–200	–245 ± 30	–340 ± 95

How will this impact on Australia? Increases in carbon dioxide will enhance plant growth and water-use efficiency, but changes in climate may offset these benefits. For example, wheat yield would rise unless rainfall decreases by 20% and the warming exceeds 2ºC. The net effect on agriculture, forestry and ecosystems varies with region and species. More extremely hot days will lead to greater air conditioning demand, more heat stress, fires and deaths. Fewer cold days will make winters more pleasant and reduce heating costs, but reduce snow-cover. Flood damage is likely to increase. Warmer and drier conditions will increase water demand.

Well-planned adaptation will help to minimize the losses and optimize the benefits, e.g. choosing crops and planting/harvest times to suit the new climate, designing energy-smart buildings, allocating water for environmental river flows, and improving water supply systems.

Northwestern Australia

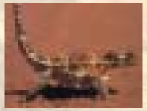
- Stronger tropical cyclones will increase coastal inundation, coral damage, property damage and beach erosion
- Southward spread of mosquito-borne diseases
- Greater energy demand for cooling in summer


Photo © Japan Meteorological Agency

Broome	Now	2030	2070
Annual average max. temperature (ºC)	32.2	33.4 ± 0.8	35.7 ± 2.5
Dec–Feb days above 35ºC	17	36 ± 17	57 ± 30
Annual rainfall (mm)	596	570 ± 95	525 ± 285
Annual moisture balance (mm)	–2178	–2240 ± 40	–2370 ± 125

Central Australia

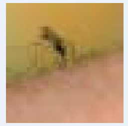
- Greater energy demand for cooling in summer, less energy demand for heating in winter
- Less water for desert communities (e.g. Alice Springs) and desert ecosystems (e.g. spiny devil)
- Southward spread of pests and diseases



Alice Springs	Now	2030	2070
Annual average max. temperature (ºC)	28.6	29.8 ± 0.8	32.1 ± 2.5
Dec–Feb days above 35ºC	55	63 ± 5	73 ± 11
Annual rainfall (mm)	285	295 ± 20	315 ± 65
Annual moisture balance (mm)	–2781	–2905 ± 90	–3025 ± 155

Southeast Queensland

- Southward spread of mosquito-borne diseases, and greater fire risk for forests and urban areas
- Less water for cities (e.g. Brisbane & Gold Coast), agriculture (e.g. irrigated cotton) and natural ecosystems (e.g. Lamington National Park)
- Less frost damage to crops, higher wheat yields but lower wheat quality, increased pest and disease risk
- Annual loss due to Queensland fruit fly may rise from $28.5 million now to $40.4 million for a 2ºC warming



Brisbane	Now	2030	2070
Annual average max. temperature (ºC)	25.5	26.5 ± 0.7	28.5 ± 2.2
Dec–Feb days over 35ºC	2.5	4.5 ± 1.5	20 ± 15
Annual rainfall (mm)	1146	1100 ± 90	1010 ± 275
Annual moisture balance (mm)	–387	–430 ± 30	–525 ± 95

Southwestern Australia

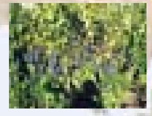
- Reduced deep-drainage of soils, leading to lower salinity risk
- Less water for cities (e.g. Perth)
- Reduced biodiversity (e.g. rivers, frogs, forest)
- Lower crop yields (e.g. wheat, grapes, stone-fruit)


Photo © W.A. Museum

Perth	Now	2030	2070
Annual average max. temperature (ºC)	23.3	24.3 ± 0.7	26.3 ± 2.2
Dec–Feb days above 35ºC	15	19 ± 3	29 ± 10
Annual rainfall (mm)	869	800 ± 105	660 ± 310
Annual moisture balance (mm)	–882	–960 ± 45	–1125 ± 155

Southern South Australia

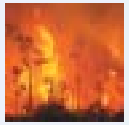
- Reduced dryland crop yields (e.g. wheat) and faster ripening of grapes leading to earlier harvest
- Greater fire risk for forests and urban areas
- Less water for cities (e.g. Adelaide)
- Less frost damage to crops, but inadequate chilling for stone-fruit leading to reduced yield



Adelaide	Now	2030	2070
Annual average max. temperature (ºC)	21.4	22.4 ± 0.7	24.4 ± 2.2
Dec–Feb days above 35ºC	10	13.5 ± 2.5	21 ± 7
Annual rainfall (mm)	454	435 ± 35	400 ± 110
Annual moisture balance (mm)	–1407	–1470 ± 40	–1600 ± 125

Eastern New South Wales

- Greater fire risk for forests and urban areas
- Less water for cities (e.g. Sydney), agriculture (e.g. irrigated cotton) and natural ecosystems (e.g. Macquarie Marshes)
- Less snow for skiing and alpine ecosystems: area with at least 30 days snow-cover may shrink 18–66% by 2030 and 39–96% by 2070
- Less frost damage to crops, but inadequate chilling for apples and stone-fruit leading to reduced yield



Sydney	Now	2030	2070
Annual average max. temperature (ºC)	22.1	23.3 ± 0.8	25.6 ± 2.5
Dec–Feb days over 35ºC	2	3 ± 1	7 ± 4
Annual rainfall (mm)	1102	1070 ± 70	970 ± 265
Annual moisture balance (mm)	–686	–765 ± 45	–930 ± 155

CLIMATE DATA

- Values for **Now** come from the Bureau of Meteorology **www.bom.gov.au/climate/averages**
- Values for **2030** and **2070** come from CSIRO's assessment of nine climate models driven by a range of projected increases in greenhouse gases. **www.dar.csiro.au/publications/projections2001.pdf**

MORE INFORMATION

CSIRO
www.dar.csiro.au/impacts, www.marine.csiro.au/iawg

- The greenhouse effect
- Observed changes in Australian climate 1900-2000
- CSIRO climate change projections for Australia
- CSIRO climate change impacts for Australia
- OzClim PC software (climate change projections)

Intergovernmental Panel on Climate Change (IPCC)
www.unep.ch/ipcc

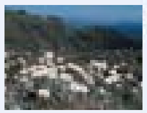
- Third Assessment Report – Climate Change 2001
  – The Scientific Basis
  – Impacts, Adaptation and Vulnerability
  – Mitigation
  – Synthesis Report
- Climate Change and Biodiversity

Australian Greenhouse Office
www.greenhouse.gov.au

- National Greenhouse Strategy (resource efficiency & greenhouse gas abatement)
- Australian Greenhouse Science Program
- Australian Emissions Monitoring
- International activities (Kyoto Protocol)
- Greenhouse Challenge (business activities reducing greenhouse gas emissions)
- Household Greenhouse Action (reducing emissions from households)
- Energy Efficiency
- Natural Resource Management

Tasmania

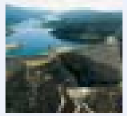
- Greater fire risk for forests and urban areas
- Less water for cities (e.g. Launceston) and agriculture (e.g. irrigated dairy)
- Reduced biodiversity in alpine areas
- Less frost damage to crops, but inadequate chilling for apples and stone-fruit leading to reduced yield



Launceston	Now	2030	2070
Annual average max. temperature (ºC)	16.9	17.8 ± 0.6	19.5 ± 1.8
Jun–Aug days below 0ºC	21	14 ± 4	7 ± 7
Annual rainfall (mm)	684	684 ± 25	684 ± 80
Annual moisture balance (mm)	–630	–675 ± 30	–770 ± 95

Victoria

- Less water for cities (e.g. Melbourne), agriculture (e.g. wheat, dairy) and natural ecosystems (e.g. temperate forests)
- Greater fire risk for forests and urban areas
- Less snow for skiing and alpine ecosystems: area with at least 30 days snow-cover may shrink 18–66% by 2030 and 39–96% by 2070
- Less frost damage to crops, but inadequate chilling for apples and stone-fruit leading to reduced yield



Melbourne	Now	2030	2070
Annual average max. temperature (ºC)	19.8	20.8 ± 0.7	22.8 ± 2.2
Dec–Feb days over 35ºC	8	10.5 ± 1.5	15 ± 5
Annual rainfall (mm)	657	630 ± 50	580 ± 155
Annual moisture balance (mm)	–584	–665 ± 50	–825 ± 155

Changes expected in Australia are shown for ten regions for the years 2030 and 2070. The range of values depicting likely changes is due to an allowance for uncertainty in future emissions of greenhouse gases and the response of the climate system. Most of Australia may warm 0.4 to 2.0ºC by 2030, and 1 to 6ºC by 2070, with slightly less warming near the coast. This would likely result in:

- more evaporation, more hot days and fewer cold days
- rainfall decreasing in the south and east (mainly winter/spring)
- some inland and eastern coastal areas experiencing wetter summers
- some inland areas becoming wetter in autumn
- extreme rainfall and tropical cyclones becoming more intense.

The tendency for less rainfall and more evaporation means less water will be available, as measured by the **annual moisture balance** (rainfall minus potential evaporation). Potential evaporation measures the ability of the atmosphere to remove water from soil, vegetation and water bodies.

The background image of Australia depicts surface reflectance for October 1995 derived from satellite measurements. Data from the AVHRR instrument on board the US NOAA-14 satellite were processed under the auspices of the CSIRO Earth Observation Centre [http://www.eoc.csiro.au].

CSIRO

This poster is printed on "harvest" paper which is chiefly composed of bagasse fibre, a waste product of the sugar industry. It is resource efficient as it utilises a waste product from a farming industry as a substitute for wood fibre. It can also be recycled.