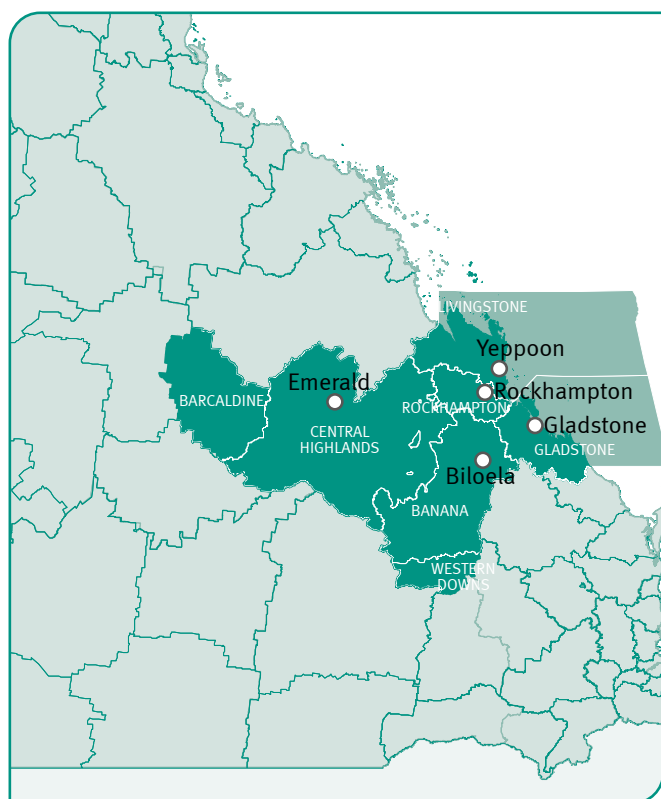


Climate change in the Central Queensland region

VERSION 1



UNDERSTAND | ADAPT



How will climate change affect the Central Queensland region?

In the future, the region can expect:



higher temperatures



rising sea level



hotter and more frequent hot days



more frequent sea-level extremes



fewer frosts



warmer and more acidic seas



more intense downpours

How can we deal with these changes?

Queensland often experiences climate extremes such as floods, droughts, heatwaves and bushfires. Climate change is likely to exacerbate the frequency and severity of these events. We will increasingly be affected by changes in temperature, rainfall, sea level and extreme weather conditions.

It makes sense to take appropriate action to better manage our climate risks. Well-considered and effective adaptation measures can limit the adverse impacts of climate change on communities, the economy and natural systems. We can achieve more if we act together to plan for and manage current and future climate impacts across different sectors and regions.

Central Queensland region snapshot

The Central Queensland region extends from the coast to the central highland regions around Emerald and Alpha, and includes Rockhampton and Gladstone. The region occupies 10% of the area of the state, with 5% of the state's population resident there.

The Queensland Government is working with a range of stakeholders, using the best available science to address the risks climate change presents to our economy, environment, infrastructure and communities. This publication presents details of the expected changes to temperature, rainfall and the sea. It highlights the likely impacts on people, businesses and the environment and presents ways to respond. For more information on climate change in Queensland, visit www.qld.gov.au/environment/climate/climate-change.



Looking to the future

Our current climate

The Central Queensland region has a sub-tropical climate with hot, moist summers and warm, dry winters, with occasional frost in the south. The average annual temperature is 21°C. Summer average temperature is 27°C, autumn is 22°C, winter 15°C and spring is 22°C.

Annual and seasonal average rainfall are variable, affected by local factors such as topography and vegetation, and broader scale weather patterns, such as the El Niño–Southern Oscillation.

The greatest rainfall occurs in summer, averaging 277mm per year.

The region's annual average potential evaporation is more than twice the annual average rainfall, which contributes to the depletion of soil moisture.

However, the climate is changing across Queensland.

Average temperatures across the state are currently 1°C higher than they were 100 years ago. Recent decades have shown a clear warming trend. Our climate is already highly variable but climate change is leading to shifts beyond this natural variability.

Our future climate

Our climate is changing primarily because increasing amounts of greenhouse gases in the atmosphere are trapping heat, warming the air and oceans.

To determine what our future climate might be, scientists use global climate models to simulate the Earth's climate system. The models use a set of mathematical formulae that describe the physical processes of the atmosphere, ocean, land and ice.

Population, the economy, policy decisions and technology will all affect future emissions of greenhouse gases. We don't know exactly what these effects will be, so to cover a range of possibilities, scientists use emissions scenarios called representative concentration pathways (RCPs) to develop climate projections. These projections describe a lower emissions future, where greenhouse gas emissions are substantially reduced (using a scenario termed RCP4.5), and a high emissions future, where high levels of greenhouse gas emissions are set to continue (using a scenario termed RCP8.5).

The projections in this summary are given for 20-year periods centred on 2030 and 2070. The 2030 high and low emissions scenarios are so similar that only the high emissions scenario has been used in this publication. Projections are represented as a change relative to the average for the period 1986–2005.

For example, in 2070 under a high emissions scenario, temperature in the Central Queensland region is projected to rise by 2.9°C (1.8 to 3.8°C). In this case, the middle temperature rise determined by all the models is 2.9°C. The range is between 1.8°C and 3.8°C, meaning 95% of model results indicated a rise of at least 1.8°C and 95% of the model results indicated a rise of 3.8°C or less.

The Queensland Climate Transition Strategy outlines how we will transition to a zero net emissions future that supports jobs, industries, communities and the environment. Find the strategy at www.qld.gov.au/environment/climate/climate-change/response.

Gladstone 2030

In 2030, under a high emissions scenario, the climate of Gladstone will be more like the current climate of Bowen.

To find out what the future climate will be like where you live, use the climate analogues tool on the Climate Change in Australia website at www.climatechangeinaustralia.gov.au. The tool matches projected rainfall and maximum temperature with the current climate experienced in another location for the years 2030, 2050 and 2090.



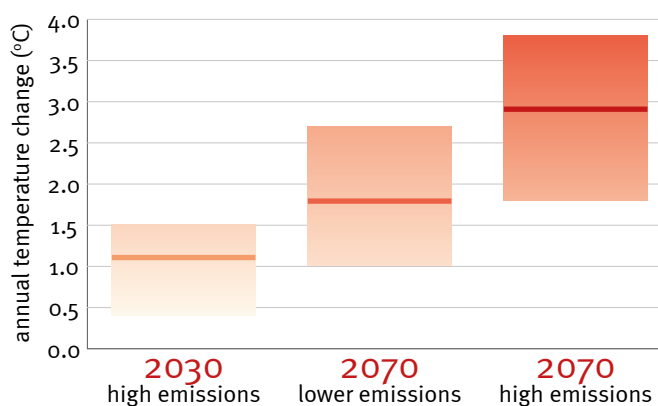
Climate projections for Central Queensland



Higher temperatures

Maximum, minimum and average temperatures are projected to continue to rise. For the near future (2030), the annually averaged warming is projected to be between 0.4 and 1.5°C above the climate of 1986–2005. By 2070, the projected range of warming is 1.0 to 3.8°C, depending on future emissions.

The region's current summer average temperature is 27°C. This could rise to over 28°C by 2030 and to over 30°C by 2070.



Projected annual average temperature changes for the Central Queensland region. The horizontal line on each bar is the middle (median) projected temperature change. The extent of each bar indicates the range of projected changes.



Hotter and more frequent hot days

There is likely to be a substantial increase in the temperature reached on the hottest days, and an increase in the frequency of hot days and the duration of warm spells.



Fewer frosts

A substantial decrease in the frequency of frost risk days is projected by the end of the century.



Harsher fire weather

Fire weather is a measure of fuel dryness and hot, dry, windy conditions. Across the region, when and where fire does occur, there is high confidence that fire behaviour will be more extreme.

Climate change projections are based on Climate Change in Australia data from CSIRO and the Bureau of Meteorology. More detailed information on these and other climate variables is available at www.qld.gov.au/environment/climate/climate-change/resources/science.

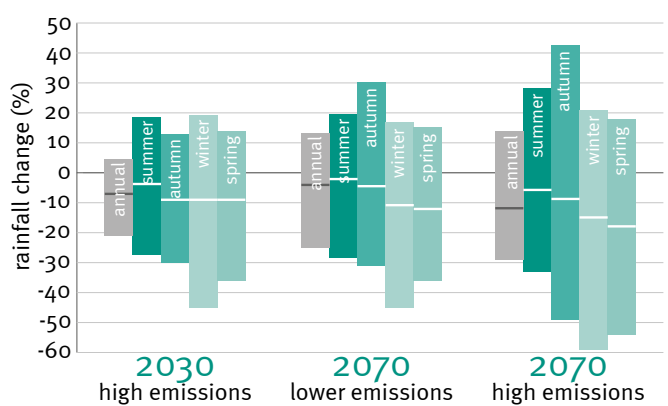


More intense downpours

High climate variability is likely to remain the major factor influencing rainfall changes in the next few decades.

Rainfall projections for 2070 show little change or a decrease, particularly in winter and spring. However, rainfall is naturally highly variable and this will continue to be a major factor in the next decade.

The intensity of heavy rainfall events is likely to increase.



Projected annual and seasonal rainfall changes for the Central Queensland region. The horizontal line on each bar is the middle (median) projected rainfall change. The extent of the bar indicates the range of projected changes.



Changes to drought are less clear

By late this century, under a high emissions scenario, it is likely that eastern parts of the region will experience more time in drought.



Sea level will continue to rise

Sea level is projected to rise by 0.8m above present day levels by 2100.



More frequent sea-level extremes

Higher sea levels will increase the risks of coastal hazards such as storm tide inundation.



Warmer and more acidic ocean

Sea surface temperature has risen significantly across the globe over recent decades and warming is projected to continue.

The ocean will become more acidic due to dissolved carbon dioxide, with acidification proportional to emissions growth.



Climate risks, impacts and responses

The range of likely changes to Queensland's climate in the coming years and decades presents opportunities and risks. Extensive work is being done to identify the likely impacts, sector by sector, and how best to respond to them.

| Sector | Climate risks ↑ = increase, ↓ = decrease | Impacts | Potential responses |
|---|---|---|---|
|  | <ul style="list-style-type: none"> ↑ sea level ↑ fire weather ↑ heatwaves | <ul style="list-style-type: none"> Erosion and infrastructure damage along the coastline Increased maintenance costs Increased disruption to services Increased energy and water usage | <ul style="list-style-type: none"> Consider future climate and sea-level rise when locating and constructing new infrastructure Increase road heights Insure public and private assets Design buildings to accommodate changing climate |
|  | <ul style="list-style-type: none"> ↑ temperature ↑ sea level ↑ fire weather ↑ sea temperature | <ul style="list-style-type: none"> Increased threats to tourism infrastructure Damage to popular environmental sites Risks to tourists unfamiliar with conditions | <ul style="list-style-type: none"> Consider climate risks in emergency planning for tourist sites Adopt appropriate cancellation policies for extreme weather Prepare for changing seasonal demand |
|  | <ul style="list-style-type: none"> ↑ inundation and flooding ↑ fire weather ↑ heatwaves | <ul style="list-style-type: none"> Disruption to supply chains Disruption to workplaces and infrastructure Loss of customers during emergency recovery | <ul style="list-style-type: none"> Business continuity planning Shift critical infrastructure out of hazard zones Enable flexible working arrangements Diversify customer base and products |
|  | <ul style="list-style-type: none"> ↑ temperature ↑ hot days ↑ fire weather ↑ sea temperature ↓ rainfall ↑ drought risk | <ul style="list-style-type: none"> Changed distribution of pests and diseases Heat stress on livestock and crops Farms affected by bushfire Reduced water security Changes in fishery distribution and abundance | <ul style="list-style-type: none"> Consider diversifying outputs or business Consider different crop varieties and sowing times Improve water efficiency |
|  | <ul style="list-style-type: none"> ↑ sea level ↑ fire weather ↑ temperature ↑ ocean acidification ↓ rainfall ↑ drought risk | <ul style="list-style-type: none"> Existing threats to flora and fauna are exacerbated Changes to habitat Altered disturbance regimes Changing dynamics of invasive species | <ul style="list-style-type: none"> Develop strategies to respond to new and emerging diseases and pests Increase green urban infrastructure and urban biodiversity Link habitats to allow species to move Consider moving selected populations to new areas |
|  | <ul style="list-style-type: none"> ↑ heatwaves ↑ fire weather | <ul style="list-style-type: none"> More stress on health and emergency services More heat-related deaths, particularly among the elderly and disadvantaged Mental health effects Changes in disease occurrence | <ul style="list-style-type: none"> Use existing social networks to support vulnerable community members Implement rural mental health care programs Consider climate risks when developing emergency planning for schools, hospitals, services Increase green spaces and cool zones for heat stress |
|  | <ul style="list-style-type: none"> ↑ inundation and flooding ↑ heatwaves ↑ rainfall intensity ↑ fire weather | <ul style="list-style-type: none"> Increased fire season duration and fire intensity will affect urban fringe communities Increased sea level and storm intensity will affect coastal communities and increase inland flooding risk | <ul style="list-style-type: none"> Increased focus on community preparedness and prevention Update risk management standards to account for increased risk from climate change |

Adapting to climate change

Queensland's environment, economy and communities are already experiencing the impacts from a changing climate. The development of a Queensland Climate Adaptation Strategy will assist government, businesses and communities to manage and respond to our changing climate.



Human settlements and infrastructure

The majority of Central Queensland's population of nearly 240,000 resides on or near the coast. The two largest centres, Rockhampton and Gladstone, account for 45% of the region's population while the two largest inland centres, Emerald and Biloela, account for another 9%. The balance of the population is spread across the region. The region is serviced with an extensive road and rail network that links the region internally and to surrounding regions. Regional ports facilitate international export trade.

On the coast, extreme inundation and erosion events could become more frequent, resulting in high clean-up and asset maintenance costs.

Flooding, due to more intense extreme storms, could affect water, sewerage, stormwater, transport and communications infrastructure. Flash flooding and wind damage will exacerbate these impacts closer to the coast. This may increase the cost of insurance.

Inland, increased bushfire risk and the impact of hotter days and extreme heat events will affect infrastructure.

Adaptation measures

- Consider how to adapt existing homes to deal with projected inundation and higher temperatures.
- Plan for new infrastructure to take into account climate impacts and extreme events such as heatwaves, flooding and sea-level rise.
- Ensure insurance is adequate for anticipated climate risks.
- Develop a Coastal Hazard Adaptation Plan.



Tourism

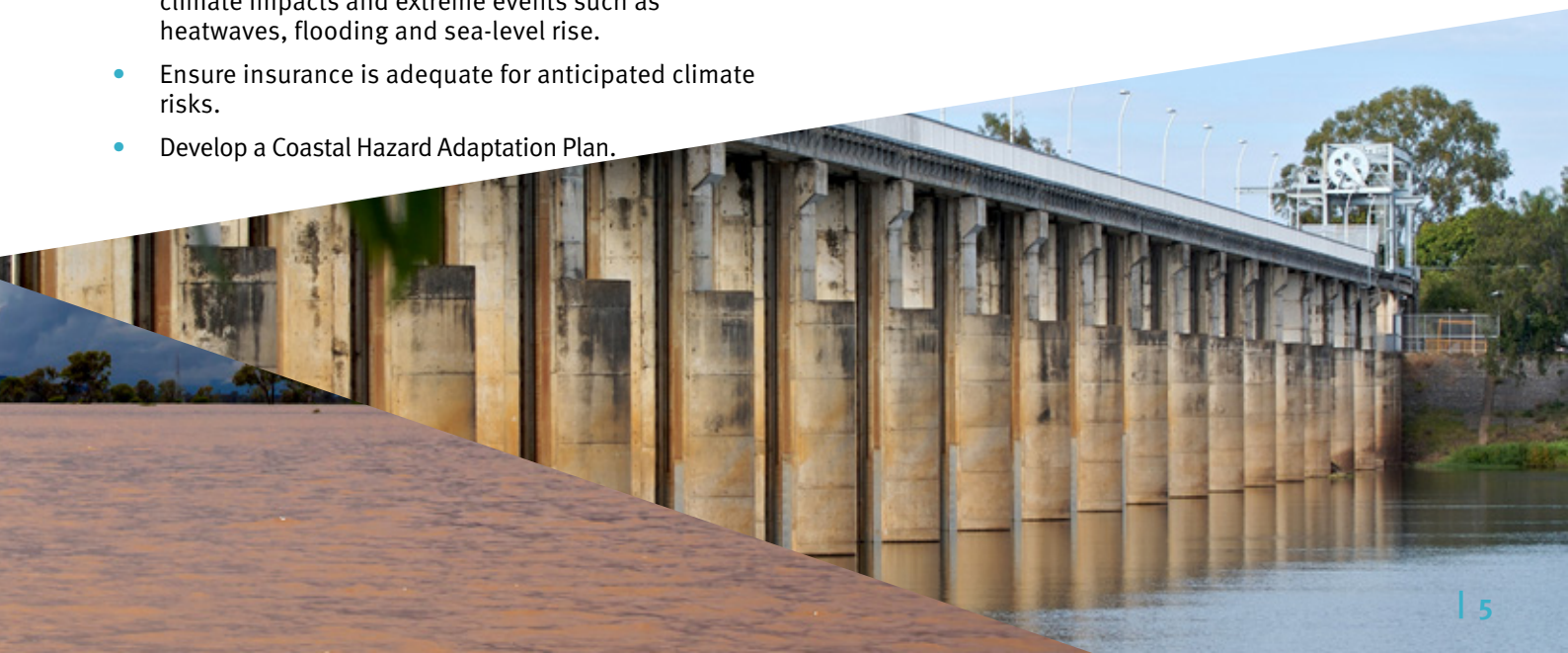
The region boasts a variety of natural tourism attractions. Tourism in the region is a growing part of the larger regional economy with over 3.3 million international and domestic visitors.

Increases in temperature may extend the season when the region is attractive to visitors. This will need to be balanced against increased bushfire and flooding risk, which may threaten tourism infrastructure and damage popular environmental sites. The increased risks to tourists unfamiliar with these conditions will need to be managed.

Adaptation measures

- Consider climate risks in emergency planning for tourist sites.
- Adopt appropriate cancellation policies for extreme weather.
- Prepare for changing seasonal demand.

'Ready Set Go' is a smartphone app designed to assist tourism operators prepare for the impacts of extreme weather events, such as floods and cyclones. The app has been developed by the Queensland Tourism Industry Council, EC3 Global and National Centre for Studies in Travel and Tourism. For more information visit www.apple.com/au/itunes and <http://play.google.com>.





Business and industry

The Central Queensland region is one of the most prosperous mining and agricultural regions in the state. The areas of high resource activity are located in the central, western and southern parts of the region, near the towns of Emerald, Blackwater, Biloela and Moura.

Climate change could cause increased disruption to this important industry. Increased frequency of flooding and inundation, bushfires and heatwaves may disrupt supply chains, make it difficult for staff to get to work and prevent customers from accessing services and products. Extreme events may damage workplaces, equipment and facilities, especially if the businesses are unprepared.

Businesses who are prepared will be able to ensure continuity of supply to their clients during/following a disruptive event. Investment in infrastructure, insurance and risk planning will increase as businesses prepare for the impacts.

Adaptation measures

- Undertake business continuity planning accounting for likely increases in extreme weather and events.
- Shift critical infrastructure out of hazard zones.
- Enable flexible working arrangements.
- Diversify customer base and products.



Agriculture

Beef production represents 80% of land use in the region. Other key land uses include dryland cropping of wheat, sorghum and pulses, and irrigated cropping of cotton, grains, fruit trees and grapes around Emerald. The region also hosts a large fishing industry based in Yeppoon and Gladstone, and produces around 30% of Queensland's hardwood and 5–10% of its softwood.

Higher temperatures and increased drought frequency may increase heat and water stress for livestock and crops. Increased carbon dioxide concentrations could increase the productivity of cereal crops, which may offset some of these impacts. There is increased risk of storm damage and erosion, leading to greater nutrient runoff and loss of soil cover.

There may be increased abundance and catch rates of some target prawn and bug species due to possible growth increases with rising temperatures. Degradation of reef habitats may lead to a decrease in small reef fish, which may affect higher trophic level species that are important for recreational and commercial fisheries.

Warmer conditions would allow some pest species to move southwards into areas where they are currently excluded.

Adaptation measures

- Manage climate variability and change by using forecasts of rainfall (and temperature) in decision-making about crops and planting times.
- Monitor the spread of pests, weeds and disease.
- Develop programs to restore and protect fish habitats, breeding grounds, nursery habitats and refugia.
- Make seasonal changes to fishing home port to minimise economic losses associated with transport.

The Queensland Government's **LongPaddock** website provides climate information, seasonal forecasts and a range of decision support tools to assist producers to improve their climate risk management. Visit www.longpaddock.qld.gov.au.



Biodiversity and iconic ecosystems

The region's natural assets are diverse, including Ramsar-listed wetlands and the Great Barrier Reef. Ecosystems range from tropical coastal rainforests to semi-arid inland communities. The region is dominated by the Fitzroy River Basin, and contains the Brigalow Belt and Desert Uplands bioregions.

For further information on Queensland's bioregions see www.qld.gov.au/environment/plants-animals/plants/ecosystems/framework/.

Increased warming and extended drought periods will significantly threaten species in the Brigalow Belt with small ranges and limited ability to migrate. The Desert Uplands has few species with vulnerability to climate change.

Increased sea surface temperatures are likely to cause more regular coral bleaching in the Great Barrier Reef. These bleaching events are very likely to become more severe as temperatures increase and such events could occur annually by 2050. Maintaining the health of reef water quality is paramount for coral recovery after a bleaching event.

Warming seas and increased storm tide inundation may harm coastal ecosystems, which have important recreation and biodiversity values.

Adaptation measures

- Undertake weed management and rehabilitation of native plant species, including community education.
- Reduce vegetation clearing in critical habitats and maintain intact ecosystems.

Project Catalyst is a partnership between more than 70 innovative Queensland cane growers, focused on improving the quality of water that flows from agricultural catchments into the Great Barrier Reef. It promotes practical solutions to increase water use efficiency, prevention of runoff, reduced application of nutrients and pesticides, and better management of soils. See www.reefcatchments.com.au/land/project-catalyst.



Human health

Higher temperatures and more hot days could cause heat exhaustion and increased mortality among vulnerable people, including the very young and old. People in locations that have not regularly experienced such high temperatures may struggle to adapt to these conditions.

Rural, regional and remote communities are particularly sensitive to a changing climate, compounding existing difficulties and inequities. A changing climate will also increase the demand for social support and mental health services.

Adaptation measures

- Develop agreements with workers on how to manage extreme hot days.
- Clearly identify public cool zones or shaded areas for the community.
- Develop social support networks.
- Use existing social networks to support vulnerable community members.
- Implement rural mental health care programs.
- Consider climate risks when developing emergency planning for schools, hospitals, services.
- Increase green spaces and cool zones for heat stress.

Queensland Health is aware of the impact that drought and disasters have on people and communities. The Tackling Adversity in Regional Drought and Disaster communities through integrating Health Services (TARDDiHS) grants program provides assistance to build community networks that foster social connectedness, improve help-seeking behaviour, build capacity for learning to live with change and uncertainty, and promote positive adaptability in response to adversity. More information is available at www.health.qld.gov.au/clinical-practice/guidelines-procedures/clinical-staff/mental-health/grants/rural-remote-community.



Emergency services

While the region is highly desirable for tourism and lifestyle, it is no stranger to extreme weather events. Over the past few decades there has been a significant increase in bushfires and flooding events, and some severe cyclones.

Higher temperatures and longer dry seasons will increase bushfire risk, particularly for urban fringe communities where natural ecosystems abut houses and businesses.

Sea-level rise and increases in cyclone and storm intensity will see a higher risk of flooding and inundation throughout the region, particularly for coastal communities.

Adaptation measures

- Improve bushfire safety standards for urban development.
- Increased focus on community preparedness.
- Update risk management standards to account for increased risk from climate change.

Local Emergency Alert is a national telephone warning system used by emergency services, such as Queensland Fire and Emergency Services, to alert communities about a likely or actual emergency in your area. Local Emergency Alert sends a voice message to landlines and a text message to mobile phones, to increase community preparedness for extreme weather events and other emergencies.

What's happening in your region?

The Queensland Government is interested to know what innovative climate adaptation initiatives are happening in your region. You can share this information by emailing adaptation@des.qld.gov.au.

Queensland climate change resources

To find out more about the Queensland Government's policy response to climate change, including commitments to reduce emissions and adapt to our changing climate, visit www.qld.gov.au/environment/climate/about-climate-change.

The Bureau of Meteorology website provides access to weather forecasts, severe weather warnings, observations, flood information, marine and high seas forecasts and climate information at www.bom.gov.au.

Climate outlooks are available from the LongPaddock website at www.longpaddock.qld.gov.au.

Information about the projected future climate and its impacts is available from the Queensland Future Climate Dashboard at <https://app.longpaddock.qld.gov.au/dashboard>.

© State of Queensland, 2019.

Published by the Department of Environment and Science.

The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons Attribution 3.0 Australia (CC BY) licence.



Under this licence you are free, without having to seek our permission, to use this publication in accordance with the licence terms. You must keep intact the copyright notice and attribute the State of Queensland as the source of the publication. For more information on this licence, visit <http://creativecommons.org/licenses/by/3.0/au/deed.en>.

Acknowledgements

The Queensland Government acknowledges the use of data from the CSIRO and Bureau of Meteorology Climate Change in Australia website (www.climatechangeinaustralia.gov.au). It also acknowledges the World Climate Research Programme's Working Group on Coupled Modelling, which is responsible for Coupled Model Intercomparison Project (CMIP), and thanks the climate modelling groups for producing and making available their model output. For CMIP the U.S. Department of Energy's Program for Climate Model Diagnosis and Intercomparison provides coordinating support and led development of software infrastructure in partnership with the Global Organization for Earth System Science Portals.

Disclaimer

The climate change data is sourced from existing Australian Government data and is distributed by the Queensland Government as an information source only. The regional climate change impact summary is published by the Queensland Government which also owns the copyright in it.

To the maximum extent permitted by law, the State of Queensland makes no statement, representation, or warranty about the quality, accuracy, context, completeness, availability or suitability for any purpose of, the data or the publication. Users of the data or the publication do so entirely at their own risk.

The Queensland Government disclaims, to the maximum extent permitted by law, all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you or any other person might incur for any reason in relation to the data or the publication.

Photo credits: Kerry Raymond, Department of the Premier and Cabinet, Department of Tourism, Major Events, Small Business and the Commonwealth Games