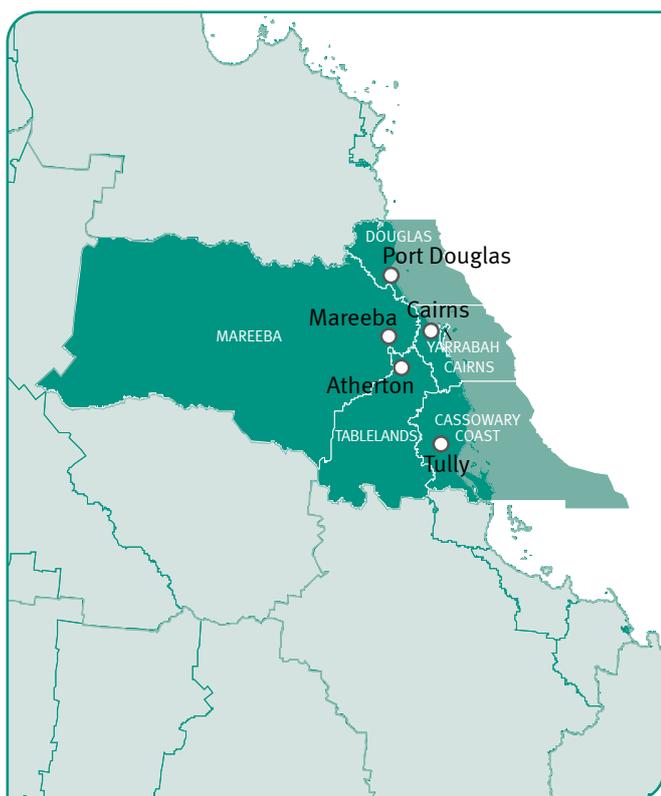


Climate change in the Far North Queensland region

VERSION 1



UNDERSTAND | ADAPT



Far North Queensland region snapshot

The Far North Queensland region is centred on the coastal city of Cairns. The region includes Daintree and Mossman to the north, Innisfail to the south and the Atherton Tablelands to the west. It contains a number of world heritage-listed areas, including the iconic Great Barrier Reef, and the Wet Tropics and Daintree rainforests, which are major world biodiversity hotspots and significant international tourist destinations. The region occupies 4% of the total area of the state, and includes 5% of the state's population.

How will climate change affect the Far North Queensland region?

In the future, the region can expect:

-  higher temperatures
-  hotter and more frequent hot days
-  more intense downpours
-  less frequent but more intense tropical cyclones
-  rising sea level
-  more frequent sea-level extremes
-  warmer and more acidic seas

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.

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/resources/science.



Looking to the future

Our current climate

The Far North Queensland region has a diversity of climates based on distance from the coast and elevation, but is generally hot and humid with a distinct wet season (December–March) and dry season (April–November).

The current average annual temperature is 24°C. The December to February average temperature is 27°C; for July to August, the average is 20°C.

Annual average rainfall is 1085mm, with most falling during the wet season; however, 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. Rainfall is associated with moist onshore south-east trade winds, monsoonal lows or tropical cyclones. Tropical cyclones occur from November to April, although the hazard is greatest between January and March.

The Wet Tropics is extremely wet, in contrast with many other tropical forest regions of the world, where rainfall events are less extreme and more evenly spread throughout the year.

The region's annual average potential evaporation is more than 50% greater than 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 Far North Queensland region is projected to rise by 2.4°C (1.7 to 3.2°C). In this case, the middle temperature rise determined by all the models is 2.4°C. The range is between 1.7°C and 3.2°C, meaning 95% of model results indicated a rise of at least 1.7°C and 95% of the model results indicated a rise of 3.2°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.

Cairns 2030

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

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.

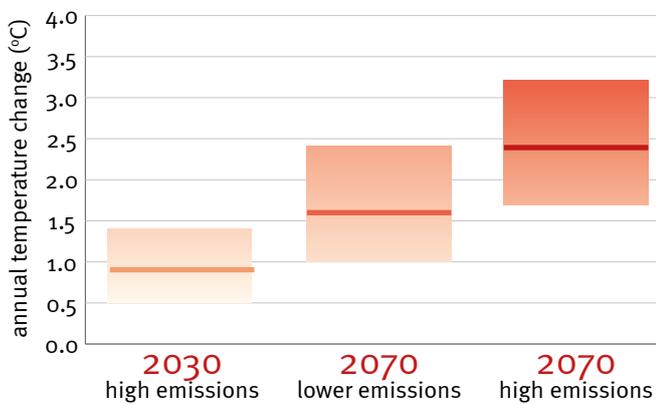


Climate projections for

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 0.5 and 1.4°C above the climate of 1986–2005. By 2070, the projected range of warming is 1.0 to 3.2°C, depending on future emissions.

The region’s 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 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.

Uncertain changes to fire frequency

Change to fire frequency depends on the spatial variability of future rainfall. However, when and where fire does occur, its behaviour is likely to be more extreme.

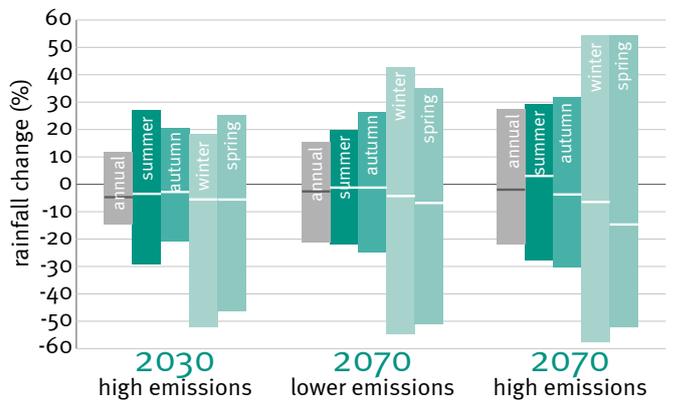
Climate change projections are based on Climate Change in Australia data from CSIRO and the Bureau of Meteorology. More detailed information on these and other climate variables is available at www.qld.gov.au/environment/climate/climate-change/resources/science.

More intense downpours

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

Rainfall changes for 2070 continue to show a large amount of variability. However, there may be slight declines in spring rainfall by the end of the century.

The intensity of heavy rainfall events is likely to increase.



Projected annual and seasonal rainfall changes for the 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.

Less frequent but more intense tropical cyclones

Tropical cyclones are projected to become less frequent, but with increases in the proportion of the most intense storms.

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 ↑ tropical cyclone intensity ↑ inundation and flooding 	<ul style="list-style-type: none"> Erosion and infrastructure damage along the coastline Increased maintenance costs Increased disruption to services 	<ul style="list-style-type: none"> Consider future climate and sea-level rise when locating and constructing new infrastructure Increase road heights Insure public assets
	<ul style="list-style-type: none"> ↑ temperature ↑ sea level ↑ heatwaves ↑ tropical cyclone intensity 	<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"> ↑ sea level ↑ rainfall intensity ↑ sea temperature ↑ tropical cyclone intensity 	<ul style="list-style-type: none"> Increased flood damage Increased maintenance costs Increased disruption to water supplies 	<ul style="list-style-type: none"> Consider future climate and sea-level rise when locating and constructing new infrastructure Insure critical assets Implement water management planning
	<ul style="list-style-type: none"> ↑ heatwaves ↑ flooding ↑ fire weather ↑ sea level 	<ul style="list-style-type: none"> Damage to cultural sites Loss of significant ecosystems 	<ul style="list-style-type: none"> Identify cultural sites at risk and mitigate impacts Review and document cultural practices Increase cultural activities and ceremonies to transfer knowledge
	<ul style="list-style-type: none"> ↑ temperature ↑ heatwaves ↑ fire weather ↑ tropical cyclone intensity 	<ul style="list-style-type: none"> Increased pest and diseases Crops destroyed by cyclones Increased thermal stress 	<ul style="list-style-type: none"> Consider diversifying outputs or business Establish shelter belts to increase shade, e.g. for cattle Consider different crop varieties and sowing times Improve water efficiency
	<ul style="list-style-type: none"> ↑ fire weather ↑ hot days ↑ sea level ↑ tropical cyclone intensity ↑ sea temperature 	<ul style="list-style-type: none"> Cyclone and storm surge damage to landscapes and natural systems Coral bleaching Existing threats to flora and fauna are exacerbated 	<ul style="list-style-type: none"> Develop strategies to respond to new and emerging diseases and pests Link habitats to allow species to move Consider moving selected populations to new areas
	<ul style="list-style-type: none"> ↑ heatwaves ↑ fire weather ↑ tropical cyclone intensity 	<ul style="list-style-type: none"> More stress on health 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
	<ul style="list-style-type: none"> ↑ inundation and flooding ↑ fire weather ↑ heatwaves ↑ rainfall intensity ↑ tropical cyclone intensity 	<ul style="list-style-type: none"> Sea-level rise and increased storm intensity will affect coastal communities and increase inland flooding risk 	<ul style="list-style-type: none"> Improve bushfire safety standards for urban development 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 population of the region is about 250,000, with two-thirds based in and around Cairns and Port Douglas. The region has three major ports and an international airport. There is significant boat construction and maintenance infrastructure servicing fishing, tourism and recreational boats.

On the coast, extreme inundation and erosion events could become more frequent, resulting in high clean-up and asset maintenance costs. Some low-lying communities, including Cairns, may face extensive inundation under the projected sea-level rise.

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

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

Adaptation measures

- Consider how to adapt existing homes and communities to deal with projected inundation.
- Plan for new developments and infrastructure to take into account climate impacts and extreme events such as flooding, tropical cyclones and sea-level rise.
- Develop a Coastal Hazard Adaptation Plan.

Tourism

Far North Queensland is famous for its marine- and land-based tourism with areas such as the Great Barrier Reef and the Daintree Rainforest. Typically, around 20% of the region's population are visitors. Most stay in Cairns and Port Douglas. Around one third of international tourists to Queensland visit Cairns.

The tourism industry relies on healthy reef and rainforest environments. These environments are particularly vulnerable to the impacts of climate change. The degradation of the reef will not only be a loss of great intrinsic value; it will also come at a great cost to the tourism industry.

Increased bushfire and flooding risk 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.

Tourism operators in the far north are providing opportunities for visitors to protect the **Great Barrier Reef** while diving. By including activities such as coral surveys, removal of invasive seaweed, monitoring and data collection, tourists have been able to increase the resilience of the reef and play an essential role in maintaining reef water quality.





Business and industry

The region is a hub for the fishing industry and there are a diverse range of line, trawling and net fisheries.

Degradation of reef habitats may lead to a decrease in small reef fish. This could affect higher trophic level species, which may be important for recreational and commercial fisheries.

Ocean acidification may have impacts on the senses of some tropical fish species, including their ability to smell, which they rely on for mating and migration.

Changes in sea temperature may encourage key fishery species to migrate away from commercial catch zones, and may alter reproduction and the ratio of male to female fish of target species. Increasing intensity of cyclones and flooding events will damage fish nurseries, and cause increased outflow of fresh water and sediment.

Adaptation measures

- Incorporate climate change risk management into ecosystem-based fishery management including further developments in bycatch reduction and improved targeting practices.
- Make seasonal changes to home port to minimise economic costs associated with transport.
- Develop programs to restore and protect fish habitats, breeding grounds, nursery habitats and fish refugia.
- Increase environmental flow allocation and water aeration.
- Implement operational changes including fleet restructuring, optimising catch per unit effort and diversifying income streams.
- Develop a new business model that enables fewer fishing days to increase responsiveness to good weather.



Indigenous communities and culture

Around 21,500 of the region's population is of Aboriginal or Torres Strait Islander descent. This is almost three times the state average and four times the national average. While many are based in Cairns, there are many remote Indigenous communities across the region.

Significant Indigenous cultural values are attached to the natural environments of the region and strong links have been maintained by the Indigenous community to country and wildlife, with access to land and its resources crucial for cultural value maintenance. Changes in natural systems resulting from climate change will compromise these values.

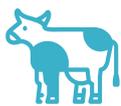
Malaria and other mosquito-borne diseases are likely to be affected by changing temperatures, humidity and rainfall.

Adaptation measures

- Identify cultural sites at risk and mitigate impacts.
- Review and document cultural practices.
- Increase cultural activities and ceremonies to transfer knowledge.

The **Aboriginal and Torres Strait Islander Resilience Project** collaborates with Aboriginal and Torres Strait Islander communities and organisations, emergency services, disaster management agencies, emergency volunteers, local councils and elders, to share traditional knowledge about disaster resilience through culturally appropriate, localised engagement built on trust and respect. See www.emergencyvolunteering.com.au.





Agriculture

The largest agricultural industry by area is cattle grazing. The region is a major producer of sugarcane, and a number of important or niche horticulture crops including bananas, mangoes, avocados, papaya, lychees, coffee and vegetables.

Overall conditions may become more favourable for an increase in plant diseases, weeds and pests. Increasing evaporation will also result in more frequent depletion of soil moisture, reduced ground cover and lower livestock stock carrying capacity.

Increased animal heat stress is likely, particularly away from the coastline. This can reduce animal production, reproductive performance and increase mortality.

Increased extreme weather events will damage crops, particularly those grown close to the coast. Seasonal changes in climate, coupled with drier periods, may alter the productivity of popular tropical fruit and sugarcane cultivars.

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.
- Provide more cooling mechanisms for livestock, such as shade and sprays.
- Select plant varieties and production systems that are more adaptable to a changing and variable climate.

Queensland Farmers' Federation has prepared a series of short videos with resilience tips for farmers in preparing for, and recovering from, natural disasters. These videos were prepared following Cyclone Yasi in 2011, but much of the core information remains relevant for farmers preparing for natural disasters.

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.



Biodiversity and iconic ecosystems

The Far North is one of the most diverse bioregions on the planet, with an abundance of unique and rare plants and animals. The region also contains an impressive variety of ecosystems, ranging from the tropical rainforests and eucalypt woodlands, to open savanna and coastal dunes.

Portions of the Gulf Plains, Wet Tropics and Einasleigh Uplands bioregions are located within the Far North Queensland region. The Gulf Plains is an important bioregion for waterbirds and is vulnerable to increased flooding over large areas. Biodiversity losses in the Einasleigh Uplands bioregion are likely to be less than the rest of the state due to its high, rocky vegetation.

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

Increased sea temperatures are likely to cause more regular coral bleaching in the Great Barrier Reef. These bleaching events are 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 an event.

Warming seas and increased storm surges 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.
- Continue to manage the impact of agriculture on nutrient runoff into the reef environment.
- Maintain links between habitat patches to enable species to move.

Green turtles on Raine Island have recently experienced tidal inundation and beach erosion from rising sea levels, affecting the viability of turtle nests and causing hazardous conditions for adult females. A partnership between the **Queensland Government, BHP Billiton, Traditional owners and the Great Barrier Reef Foundation** has been established to protect their habitat and restore the island through beach engineering, sand replenishment and turtle monitoring. For more information see www.des.qld.gov.au.



Human health

Tropical diseases such as Ross River fever and Dengue fever are expected to increase in prevalence and range under climate change. Changes in rainfall, high tides and maximum temperatures are key determinants of Ross River virus transmission.

Extremes of weather can cause injury and death, such as during floods and tropical cyclones. Higher temperatures and more hot days can result in heat exhaustion and increased mortality among vulnerable people, including the very young and old.

Increases in extreme events can lead to increased pressure on health services, including an increased demand for health professionals, ambulance and hospital workers. Many parts of the country already find it difficult to recruit dedicated health care and social service professionals.

The emotional and psychological toll of disasters can linger for months, even years, affecting whole families, the capacity for people to work and the wellbeing of the community.

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.

The **Queensland Government** addresses the impact of hotter days on school children by providing guidelines on managing excessive heat in schools. There are clear indicators of when children need to be protected from excessive heat, and strategies to ensure their safety, such as limiting physical activity and sporting events during the hottest part of the day. There is more information at www.education.qld.gov.au/schools/healthy/wellbeing-guidelines/heat.

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 are available from the Queensland Future Climate Dashboard at www.qld.gov.au/FutureClimateDashboard.



Emergency services

While the region is highly desirable for tourism and lifestyle, it is also subject to extreme weather events. Over the past few decades there has been significant increase in bushfires and flooding events, and some severe cyclones.

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

Increases in cyclone and storm intensity and sea-level rise will lead to 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.

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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.

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