Climate change
in the Gulf region

VERSION 2 (Published 2024)

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

How climate change may affect the Gulf region

- higher temperatures
- hotter and more frequent hot days
- variable rainfall
- less frequent but more intense tropical cyclones
- rising sea level
- more frequent sea level extremes
- warmer and more acidic ocean
- increased evapotranspiration

Addressing climate change

It makes good financial, social and environmental sense to take appropriate action to manage the risks from climate change. Well-considered and effective climate risk management and adaptation action can limit the adverse impacts of climate change on individuals, communities, the economy and natural systems.

This publication presents a summary of projected changes to the climate of the Gulf region, and highlights some potential impacts and possible adaptation responses.

For further information on how we can plan for and manage current and future climate impacts across different sectors and regions, refer to the Queensland Government's Climate website and the Queensland Future Climate Dashboard.

For more information on climate change in Queensland, please visit www.energyandclimate.qld.gov.au/climate.

Queensland Government

Looking to the future

The Gulf region is in the wet-dry tropics (savanna) and is generally hot to very hot throughout the year.

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 region's rainfall is highly seasonal, with most rain falling during the wet season (October–March).

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

Average temperatures across the state are already more than 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 Queensland Government produces high-resolution climate projections for Australia using a process called 'dynamical downscaling'. This process refines global models' projections, especially across coastal and mountainous regions, and improves the simulations of climate extremes such as heatwaves and tropical cyclones. This high-resolution information is better suited to exploring the impacts of future climate change at regional and local scales.

Because future emissions of greenhouse gases are unknown, climate scientists consider different but plausible pathways for future greenhouse gas concentrations under different social and economic conditions called 'Shared Socioeconomic Pathways' (SSPs). The Queensland Government provides climate projection data for three of these SSPs, representing successively greater climate change impacts:

SSP1-2.6	Low emissions future with sustainable development
SSP2-4.5	Medium emissions future with socioeconomic trends similar to historical patterns
SSP3-7.0	High emissions future driven by strong regional rivalry.

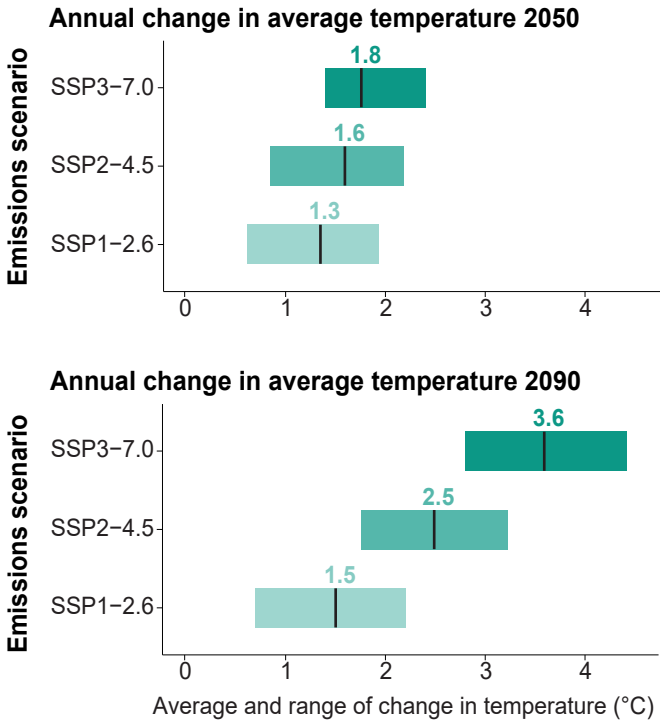
For more information on how the Shared Socioeconomic Pathways are used in climate modelling, please see this explainer by Carbon Brief.

Climate projections for the Gulf region

The following graphs show the projections for a selection of climate variables for two 20-year time periods. One is centred on the year 2050 and the other on 2090. The black vertical line on each bar is the multi-model average value. The shaded bars show the range of projected changes from all 15 climate models. Changes shown in the graphs are relative to a 1981–2010 baseline.

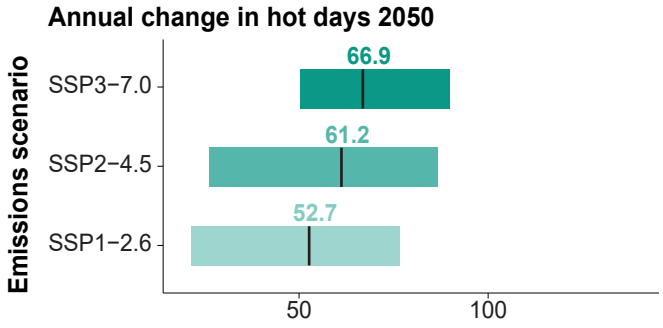
Higher temperatures

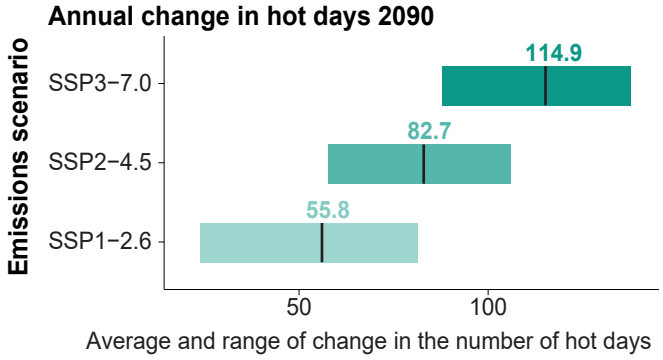
Maximum, minimum and average temperatures are all projected to continue to rise. We can expect annual average temperatures to increase by approximately 1.3 °C under a low emission scenario or about 1.8 °C under a high emissions scenario in 2050. In 2090, we can expect annual average temperatures to increase by about 1.5 °C under a low emission scenario and about 3.6 °C under a high emissions scenario.



More frequent hot days

There is likely to be an increase in the annual number of hot days (over 35 °C), especially later in the century. By 2090, the number of hot days experienced is projected to increase by an average 56 days per year in a low emissions future, compared to an average increase of about 115 days per year in a high emissions future.



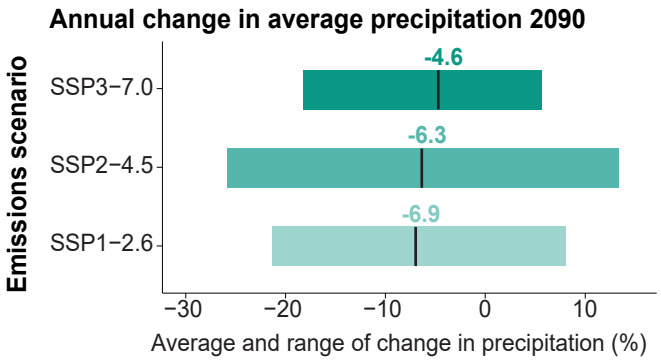


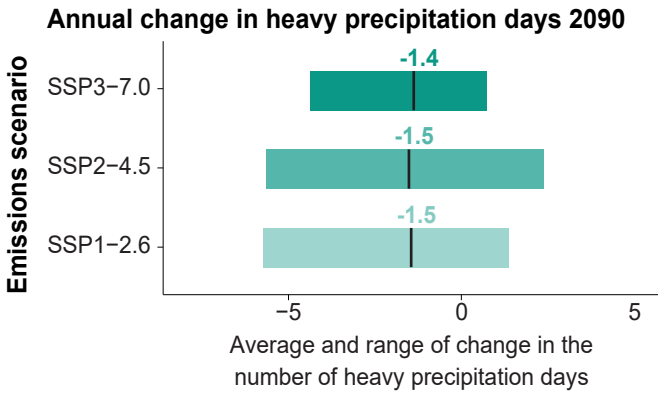
Uncertain changes to fire frequency

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

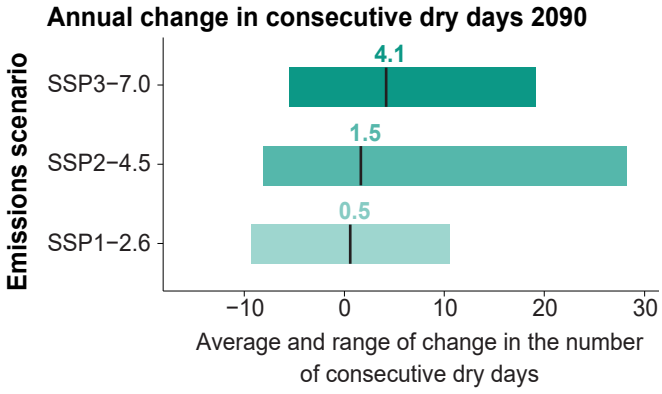
Rainfall variability to continue

There is large uncertainty in the magnitude of projected changes in rainfall. Most climate models indicate small average reductions in annual rainfall by 2050, with slightly greater reductions by 2090. There is likely to be a small decline in future in the number of days with heavy precipitation (days with more than 10 mm of precipitation).





The are small projected changes to consecutive dry days (days with less than 1 mm of precipitation) by both 2050 and 2090. There's no clear trend direction by 2050 and a slight increase by 2090 under the higher emissions scenarios.

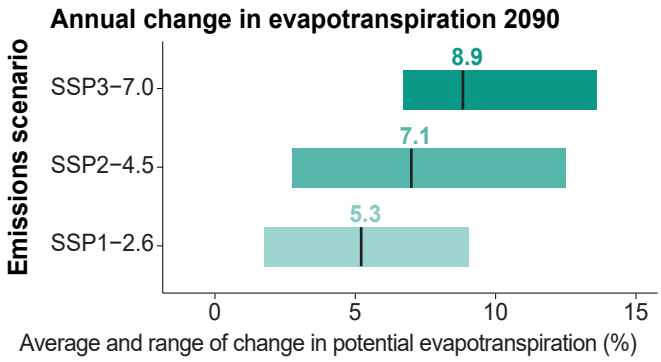


Evapotranspiration to increase

Evapotranspiration is an estimate of the loss of water from both plants and the soil. Evapotranspiration is projected to increase, with greater increases under higher emissions scenarios.

These increases in evapotranspiration are expected to affect drought and fire conditions.

By 2050, there are small projected increases to evapotranspiration and slightly greater increases by 2090.



Less frequent but more intense tropical cyclones

Tropical cyclones are expected to become less frequent but more intense.

Sea level will continue to rise

Global sea levels are likely to rise by between 55 and 90 cm by 2100 under a high emissions scenario (SSP3-7.0) relative to 1995-2014. Even higher rises are possible, particularly if very high greenhouse gas emissions continue.

More frequent sea level extremes

Higher sea levels will increase the risks of coastal hazards such as storm tide inundation and add to the impacts of tropical cyclones.

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 higher concentrations of dissolved carbon dioxide, with acidification proportional to emissions growth. Ocean acidity can make it difficult for coral and some plankton to form shells and skeletons, and shells become more vulnerable.

Climate action in Queensland

The Queensland Government's Climate Action Plan includes commitments to reduce emissions and adapt to our changing climate, and resources to support climate action.

There is extensive climate risk information for rural Queensland at the LongPaddock website.

High resolution climate projections can be accessed from the Queensland Future Climate Dashboard.

Climate risks and potential impacts

The range of likely changes to Queensland's climate in the coming years presents risks and opportunities. The following pages identify some possible impacts and adaptation responses for different sectors within the Gulf region. For decision-making purposes, we encourage readers to undertake a more detailed climate risk assessment to suit their particular interests and needs.

Sector	Climate hazards	Potential impacts
Human settlements and infrastructure	• Sea level rise • Increased extreme fire weather • More heatwaves and extreme heat events • Increased tropical cyclone intensity • Flooding	• Inundation, erosion and infrastructure damage along the coastline • Increased maintenance and recovery costs • Increased disruption to services • Increased energy usage
Business and industry	• Sea level rise • Increased fire weather • Inundation and flooding • More heatwaves • Increased tropical cyclone intensity	• Increased damage from extreme climate events • Increased maintenance costs • Increased disruption to services
Indigenous communities and culture	• More heatwaves • More flooding • Increased fire weather • Sea level rise	• Damage to cultural sites • Loss of significant ecosystems
Biodiversity and ecosystems	• Increased fire weather • Higher temperatures • Sea level rise • Increased tropical cyclone intensity • Rising sea temperatures	• Damage to landscapes and natural systems • Coral bleaching • Increased threats to flora and fauna • Changes in the distributions of flora and fauna
Human health	• More heatwaves and heat extremes • Increased fire weather • Increased tropical cyclone intensity • Increased flooding	• More demand for health and emergency services • More heat-related deaths, particularly among the elderly and vulnerable • Mental health effects • Changes in disease occurrence
Tourism	• Rising temperatures • Sea level rise • Increased fire weather • More heatwaves • Increased tropical cyclone intensity	• Increased threats to tourism infrastructure • Damage to popular environmental sites • Risks to tourists unfamiliar with conditions
Agriculture	• Higher temperatures • More heatwaves • Increased evaporation • Changing rainfall patterns • Increased extreme fire weather • Increased tropical cyclone intensity • Rising sea temperatures	• Changes in pest and diseases • Changes in agriculture productivity in shifting climate zones • Changes in water availability and security • Crops destroyed by cyclones • Increased thermal stress for livestock

Adapting to climate change

Queensland's environment, economy and communities are already experiencing the impacts from climate change. The Queensland Climate Adaptation Strategy provides a framework for government, businesses and communities to manage and respond to our changing climate.

Human settlements and infrastructure

- Consider climate change for the location and design of new developments
- Increase road heights
- Appropriate insurance cover
- Climate-sensitive building design

For more information on relevant climate impacts and appropriate adaptation measures please refer to the *Built Environment and Infrastructure Sector Adaptation Plan*.

Tourism

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

See the *Queensland Tourism Climate Change Response Plan*.

Business and industry

- Incorporate climate risks into planning and development of infrastructure and industrial sites
- Undertake supply chain analysis to identify critical areas that are sensitive to climate change
- Insure critical assets
- Upgrade buildings to make them more climate resilient

See the *Small and Medium Enterprise Sector Adaptation Plan*.

Indigenous communities and culture

- Work with First Nations peoples to incorporate their priorities and perspectives in decision-making and operations
- Identify cultural sites at risk and mitigate impacts
- Review and document cultural practices
- Increase cultural activities and ceremonies to transfer knowledge

Agriculture

- Consider climate change projections in long-term business planning
- Consider climate risks in monitoring programs for pests, weeds and disease
- Provide more cooling mechanisms for livestock, such as shade and sprays
- Consider diversification into new commodities or regions
- Improve water use efficiency

See the *Agriculture Sector Adaptation Plan*.

Human health

- Emergency planning
- Develop agreements with workers on how to manage extreme heat
- Clearly identify public cool zones and shaded areas for the community
- Develop social support networks
- Use social networks to support vulnerable people
- Rural mental health care programs
- Increase green spaces and cool zones

See the *Human Health and Wellbeing Climate Change Adaptation Plan*.

Emergency services

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

See the *Emergency Management Sector Adaptation Plan*.

Biodiversity and ecosystems

- Improve connectivity between habitats
- Consider translocation for species threatened by climate change
- Develop strategies to respond to new and emerging diseases and pests
- Undertake weed management and rehabilitation of native plant species
- Reduce vegetation clearing in critical habitats, and maintain intact ecosystems

See the *Biodiversity and Ecosystems Climate Adaptation Plan*.

Acknowledgements
The information on future climates produced in this summary is based on climate simulations performed by the Queensland Future Climate Science Program, delivered through a partnership between the Queensland Government and The University of Queensland.

The Queensland Government acknowledges the World Climate Research Programme's Working Group on Coupled Modelling, which coordinated the Coupled Model Intercomparison Project Phase 6 (CMIP6), and thanks the climate modelling groups for producing and making available their model output.

Photo credits: Queensland Rail Limited, Corporate and External Affairs, Marketing, Promotions and Events