



Climate science update & impacts for Queensland



Public Seminar
Cobb +Co. Museum, Toowoomba
Renew Toowoomba Branch
17 May 2019

Prof Brendan Mackey, Director
Griffith Climate Change Response Program
Griffith University, Queensland

www.griffith.edu.au/climate-change-response-program

Prime Minister Margaret Thatcher

- Eco Warrior -



<https://www.margaretthatcher.org/document/107817>

Speech to United Nations General Assembly
1989 Nov 8

“...The United Kingdom therefore proposes that we prolong the role of the Inter-governmental Panel on Climate Change after it submits its report next year, so that it can provide an authoritative scientific base for the negotiation of this and other protocols.....We can then agree to targets to reduce the greenhouse gases, and how much individual countries should contribute to their achievement...”

...I believe we should aim to have a convention on global climate change ready by the time the World Conference on Environment and Development meets in 1992. That will be among the most important conferences the United Nations has ever held. I hope that we shall all accept a responsibility to meet this timetable...”



NATIONAL NSW ENVIRONMENTAL ACTIVISM

'The earth has survived many things', Abbott tells children protesting against climate change inaction

By Laura Chung and Jenny Noyes May 4, 2019 — 8.30am

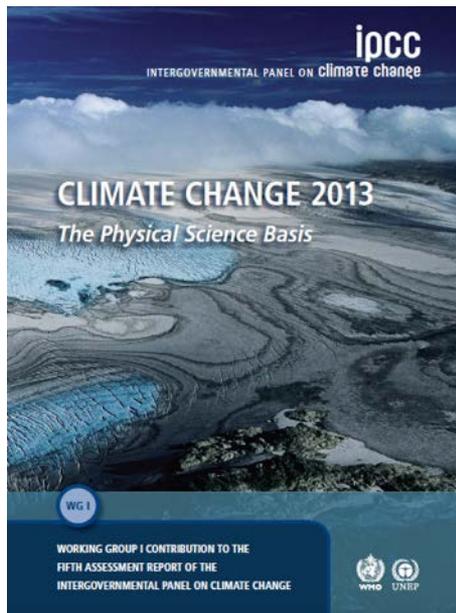
A group of students tracked Mr Abbott down in a local cafe after the protest and voiced their concerns to him.

He responded to the students' questions, telling them "the earth has survived many things".

He also told them he didn't believe the "environmental catastrophe" predicted by scientists would come about.

"I'm not saying that there isn't going to be some time in the future when, for whatever reason, things come to an end, but I don't believe that modest increases of atmospheric carbon dioxide concentrations over the next few decades are bound to bring about the kind of environmental catastrophe that you seem to fear."

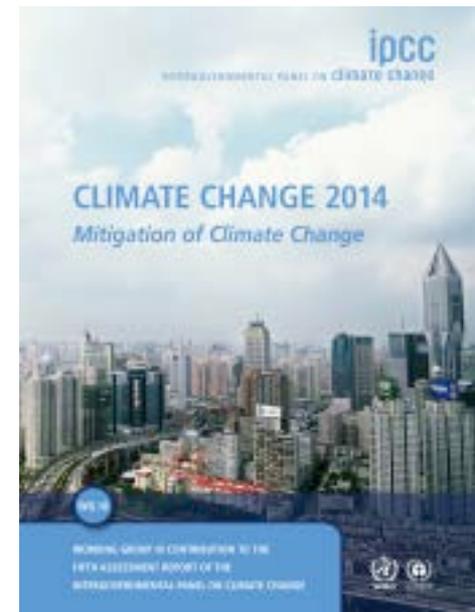
The science is “in” on human forcing of natural processes that drive Earth’s climate system



Current & future climate



Impacts, vulnerability & adaptation



Mitigation

The Carbon Dioxide Theory of Climatic Change

By GILBERT N. PLASS

The Johns Hopkins University, Baltimore, Md.¹

(Manuscript received August 9 1955)

Abstract

The most recent calculations of the infra-red flux in the region of the 15 micron CO_2 band show that the average surface temperature of the earth increases 3.6°C if the CO_2 concentration in the atmosphere is doubled and decreases 3.8°C if the CO_2 amount is halved, provided that no other factors change which influence the radiation balance. Variations in CO_2 amount of this magnitude must have occurred during geological history; the resulting temperature changes were sufficiently large to influence the climate. The CO_2 balance is discussed. The CO_2 equilibrium between atmosphere and oceans is calculated with and without CaCO_3 equilibrium, assuming that the average temperature changes with the CO_2 concentration by the amount predicted by the CO_2 theory. When the total CO_2 is reduced below a critical value, it is found that the climate continuously oscillates between a glacial and an inter-glacial stage with a period of tens of thousands of years; there is no possible stable state for the climate. Simple explanations are provided by the CO_2 theory for the increased precipitation at the onset of a glacial period, the time lag of millions of years between periods of mountain building and the ensuing glaciation, and the severe glaciation at the end of the Carboniferous. The extra CO_2 released into the atmosphere by industrial processes and other human activities may have caused the temperature rise during the present century. In contrast with other theories of climate, the CO_2 theory predicts that this warming trend will continue, at least for several centuries.

NEWS

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UK Parliament declares climate change emergency

 1 May 2019 Share

Ireland's Parliament declares climate emergency in 'historic' decision



Queensland Government

The [Queensland Climate Transition Strategy \(PDF, 2.51MB\)](#) sets a vision of a zero net emissions future for Queensland that supports jobs, industries, communities and our environment.

The Queensland Government has made three key climate change commitments:

1. Powering Queensland with 50% renewable energy by 2030
2. Doing our fair share in the global effort to arrest damaging climate change by achieving zero net emissions by 2050
3. Demonstrating our commitment to reducing carbon pollution by setting an interim emissions reductions target of at least 30% below 2005 levels by 2030.

These targets will guide policy and drive the investment needed to put Queensland on the path to a zero net emissions economy.



UNDERSTAND | ADAPT | TRANSITION

Pathways to a climate resilient Queensland

Queensland Climate Adaptation Strategy
2017–2030



We know the climate is changing abnormally
from observed weather data

And we can scientifically project future climate using models

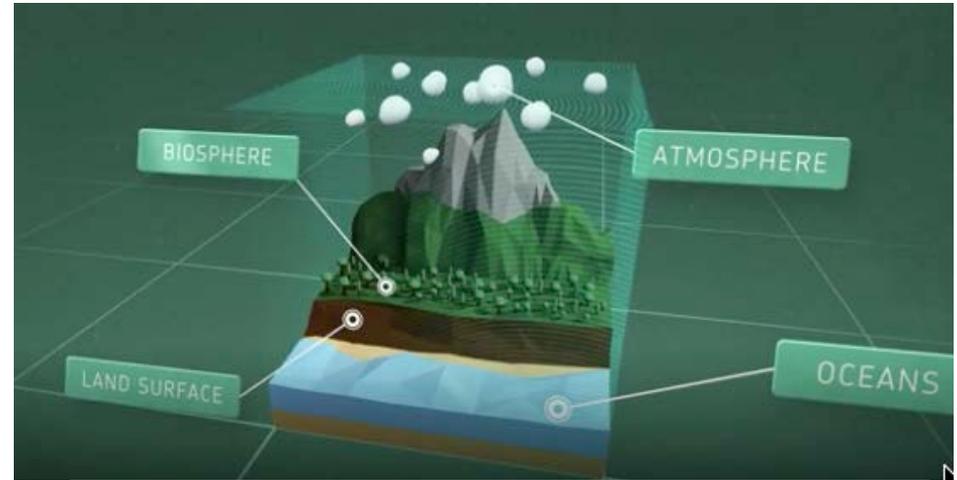
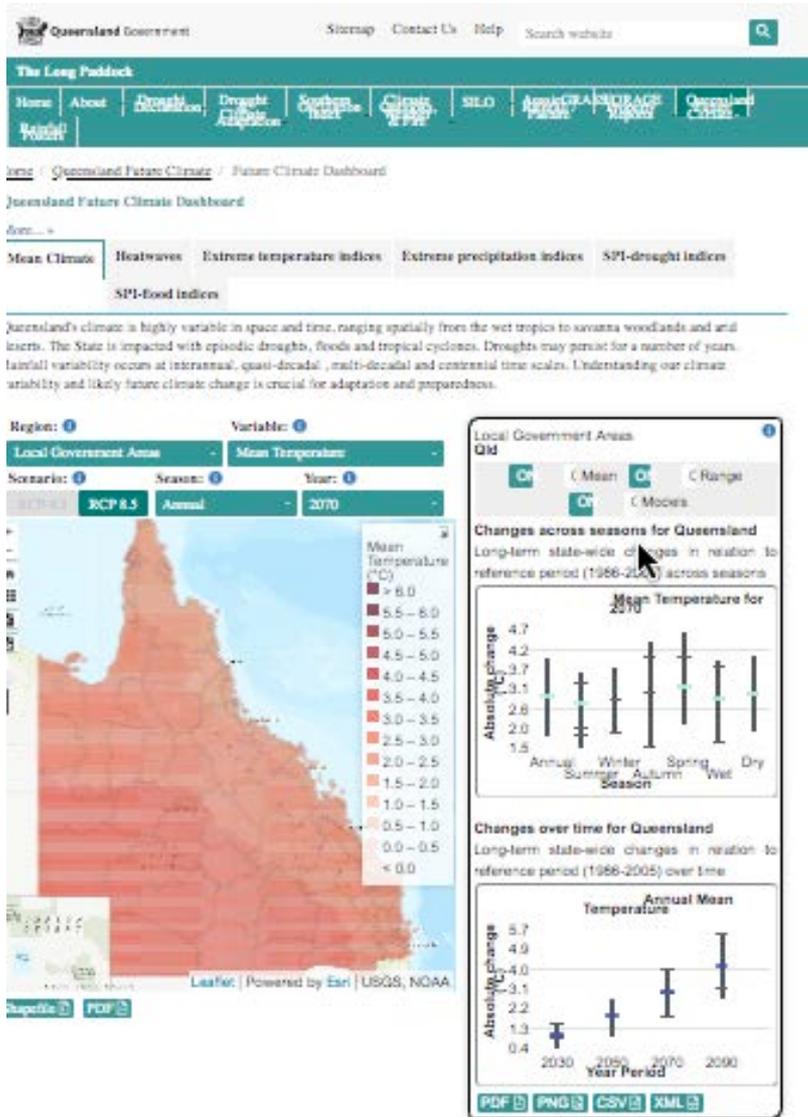
But not toy models, like Lego models



www.stedscathedral.uk



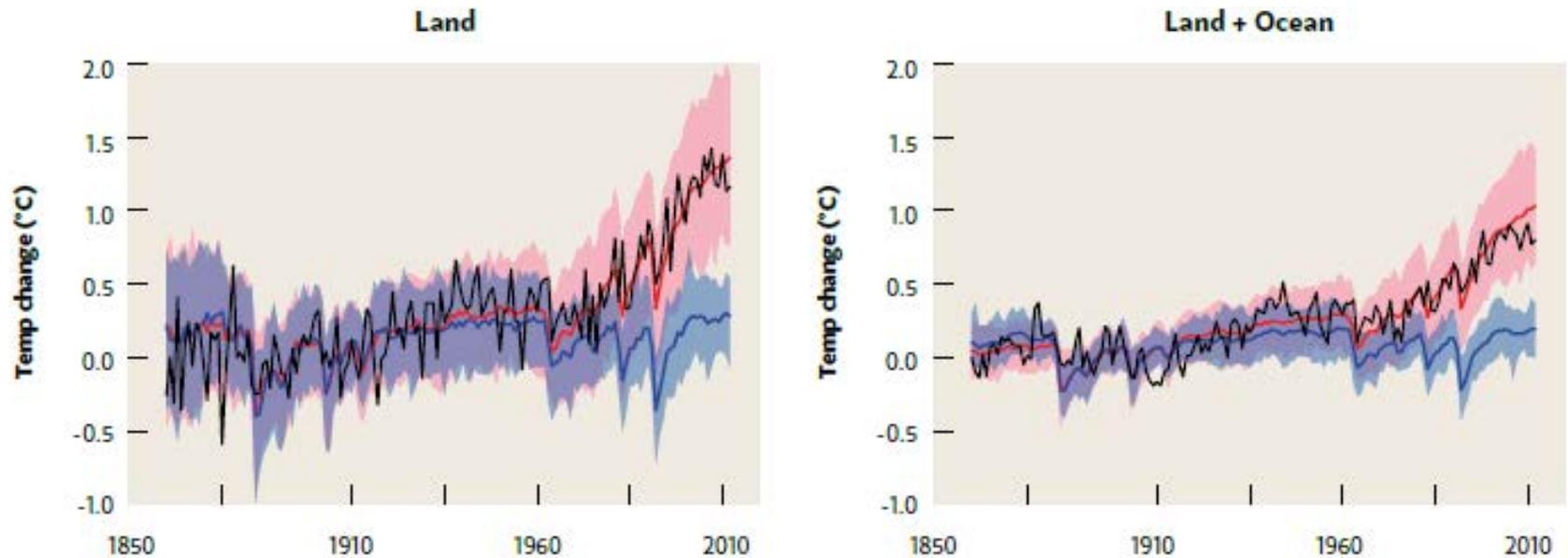
...I mean scientific models



Black = observed

Blue = model natural

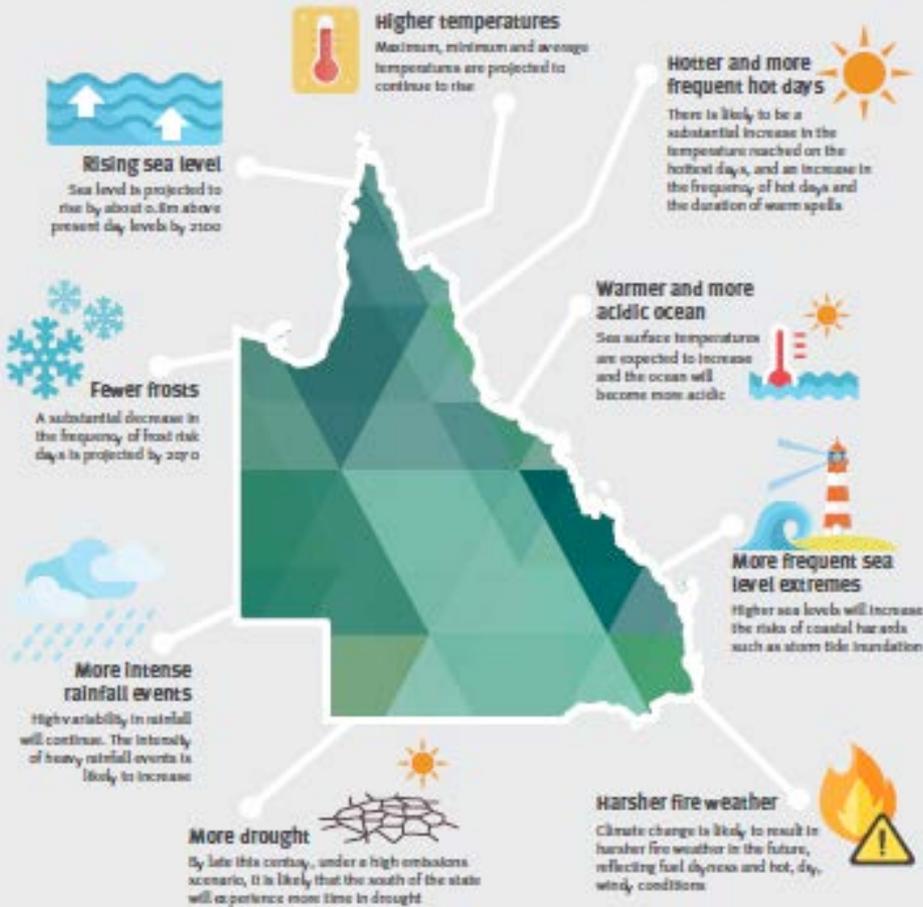
Pink = model natural + human



Climate models can correctly replicate recent warming only if they include human influences

Source: IPCC (2013), Fifth Assessment Report, Working Group 1, Figure 10.21.

AS QUEENSLAND'S CLIMATE CHANGES, WE CAN EXPECT:



Average temperatures in Queensland have already increased by approximately 1°C over the past 100 years.¹

Between 2011 and 2016, 45 extreme weather events have caused \$13 billion in damage to public assets and infrastructure.²

Insured damage to private assets in declared disaster events is valued at \$8.6 billion in the 10 years to 2016.³

Queensland in 2030

In 2030, under a high greenhouse gas emissions scenario, Brisbane's climate is projected to be more like the current climate of Bundaberg, and the climate of Cairns more like the current climate of Cooktown.⁴

Adapting to manage climate-related risks is no longer optional

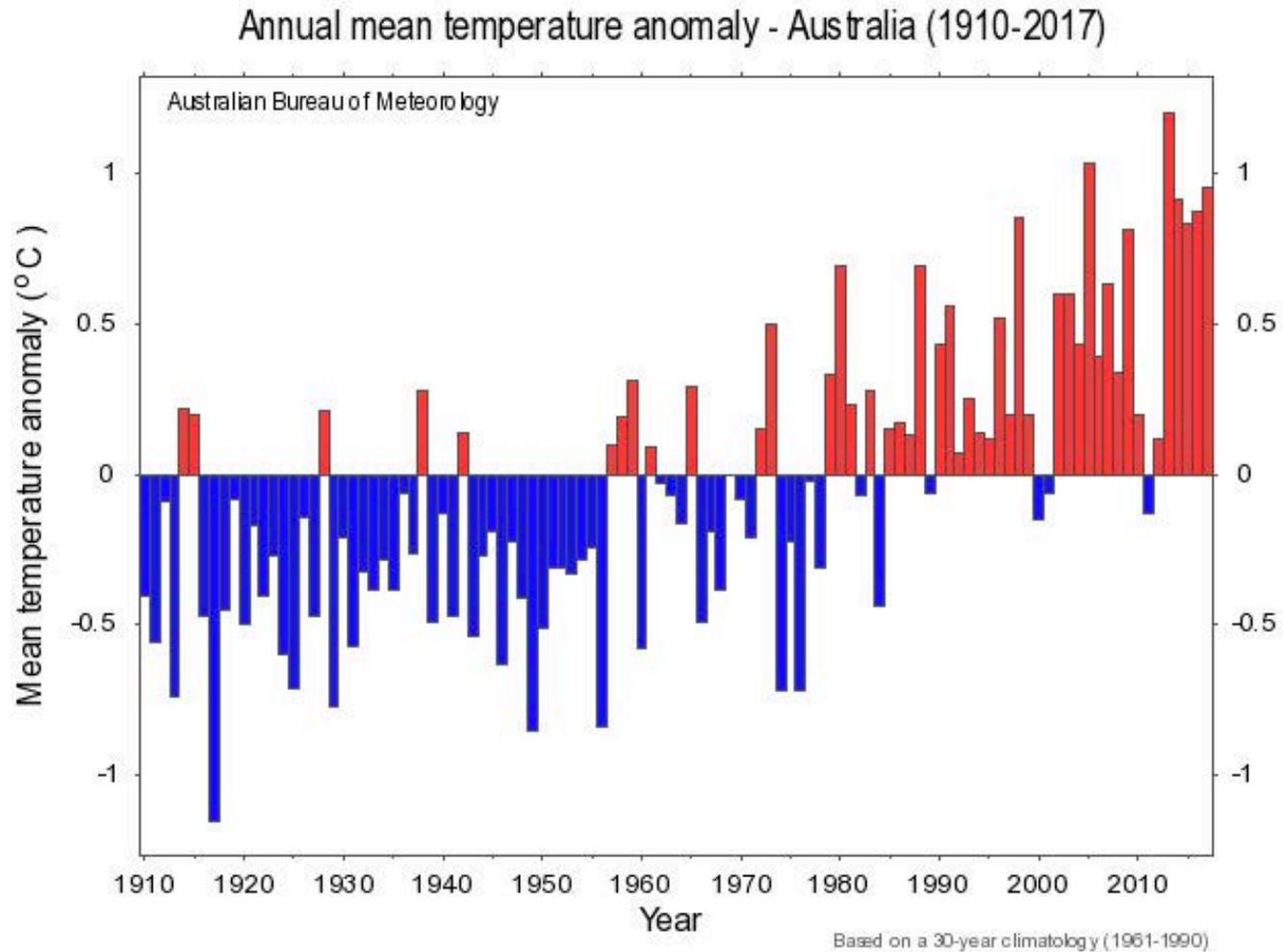
- The climate will continue to change forever
- The new (climatic) norm, is no (climatic) norm
- Climate-risk profiles will continue to change “forever”

Hazards, impacts & risks change for Queensland & Gold Coast from current and future climate

- Heat waves
- Floods
- Coastal erosion
- Great Barrier Reef
- Catastrophic fires
- Dangerous jelly fish
- Financial risks

Heat waves

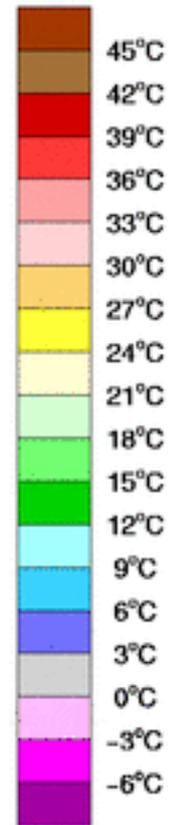
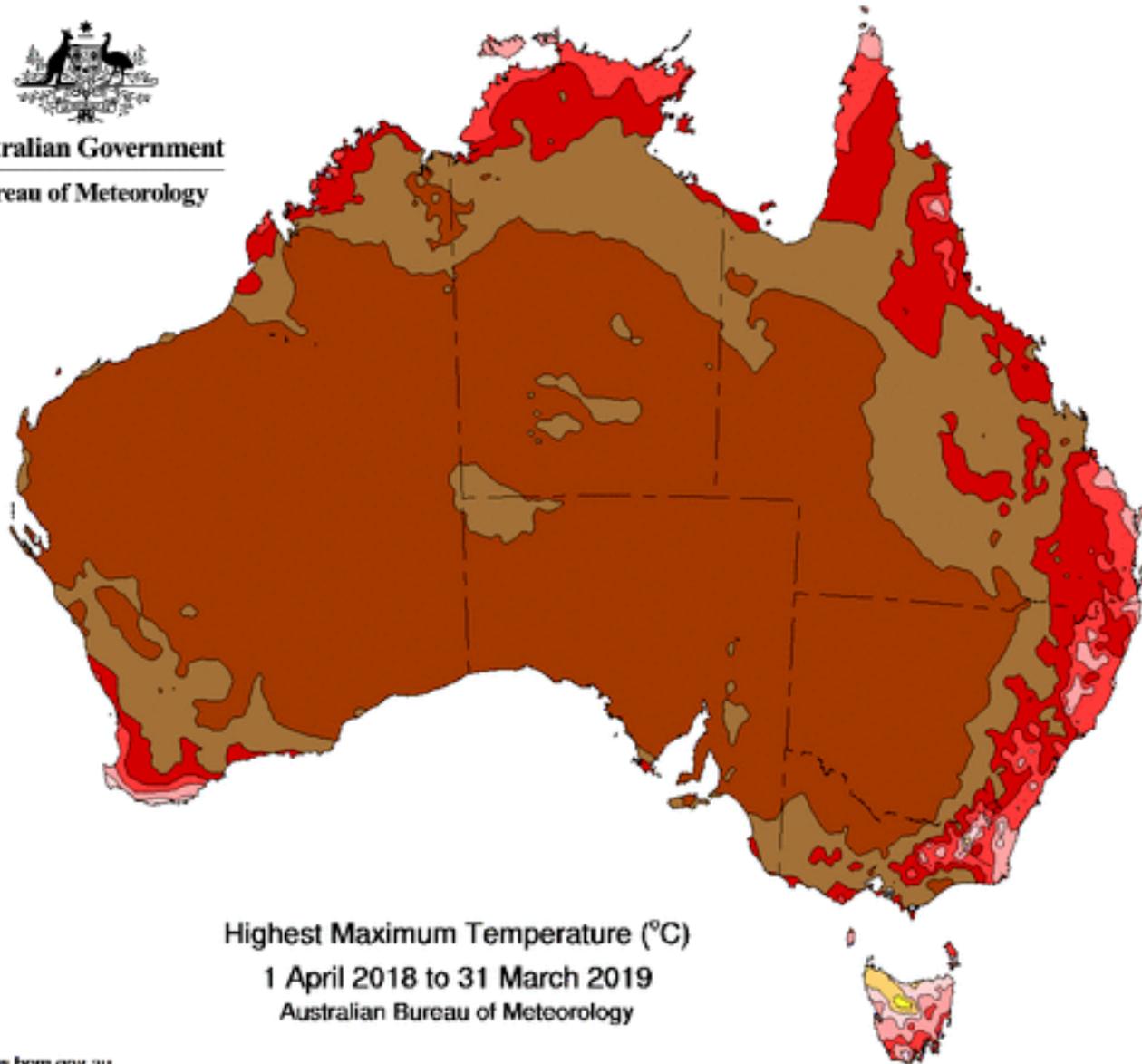
Observed warming





Australian Government

Bureau of Meteorology



Highest Maximum Temperature (°C)

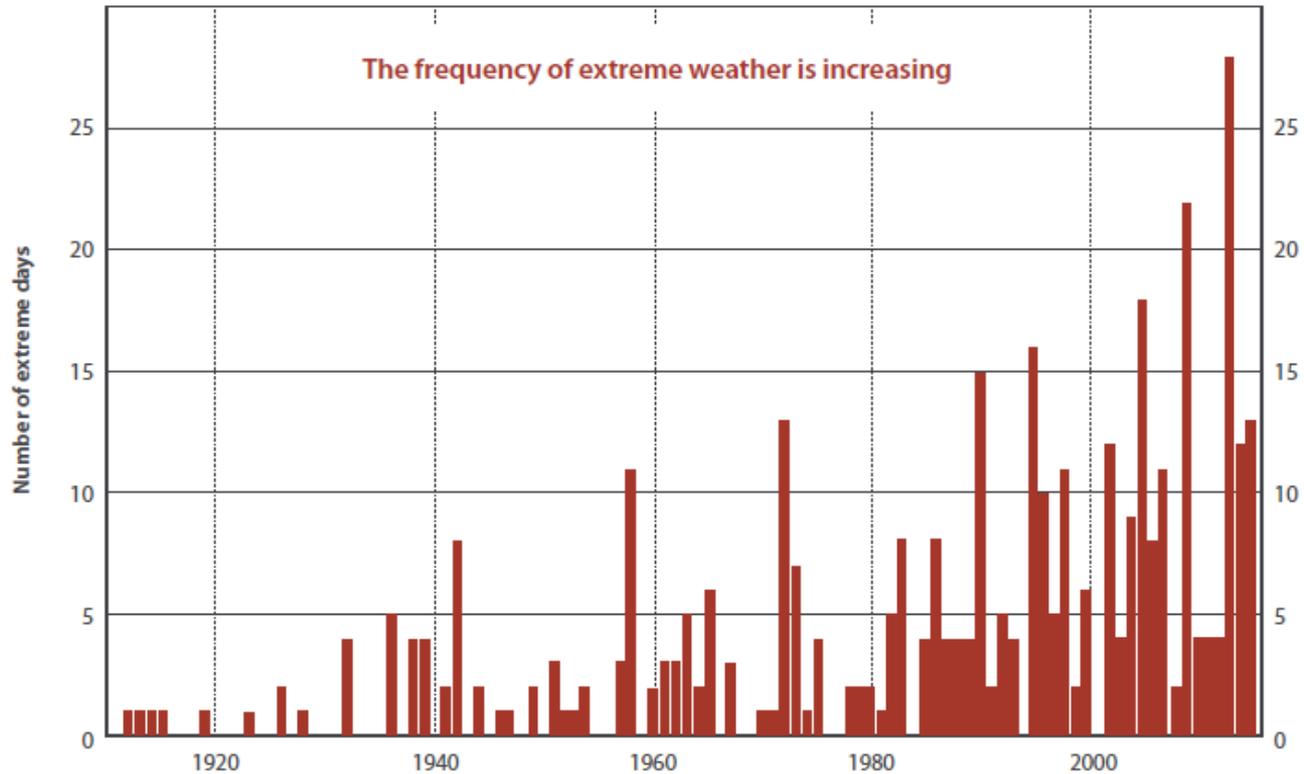
1 April 2018 to 31 March 2019

Australian Bureau of Meteorology

<http://www.bom.gov.au>

Observed change in extreme heat events

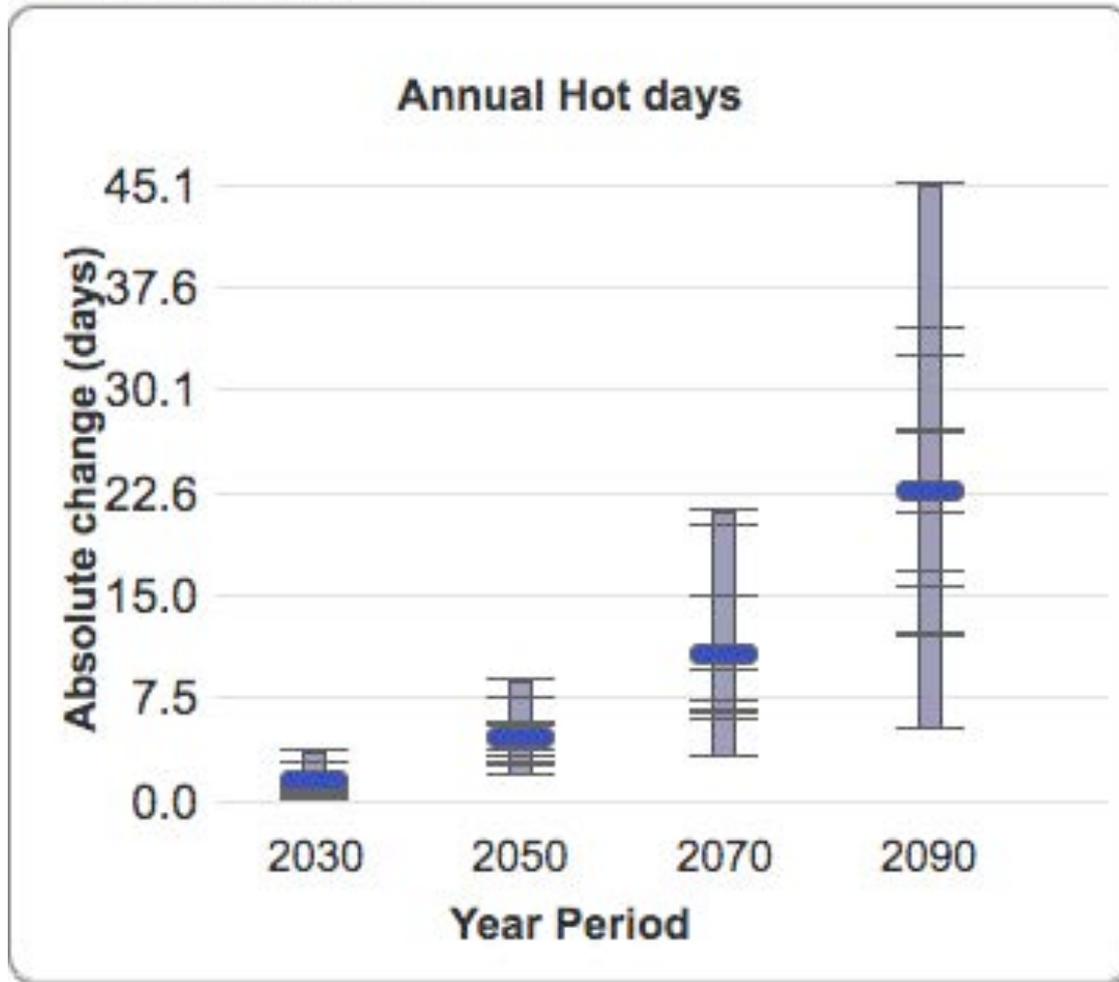
Figure 2.6: Frequency of extreme heat events 1910-2015



Source: Bureau of Meteorology, State of the Climate 2016, page 7

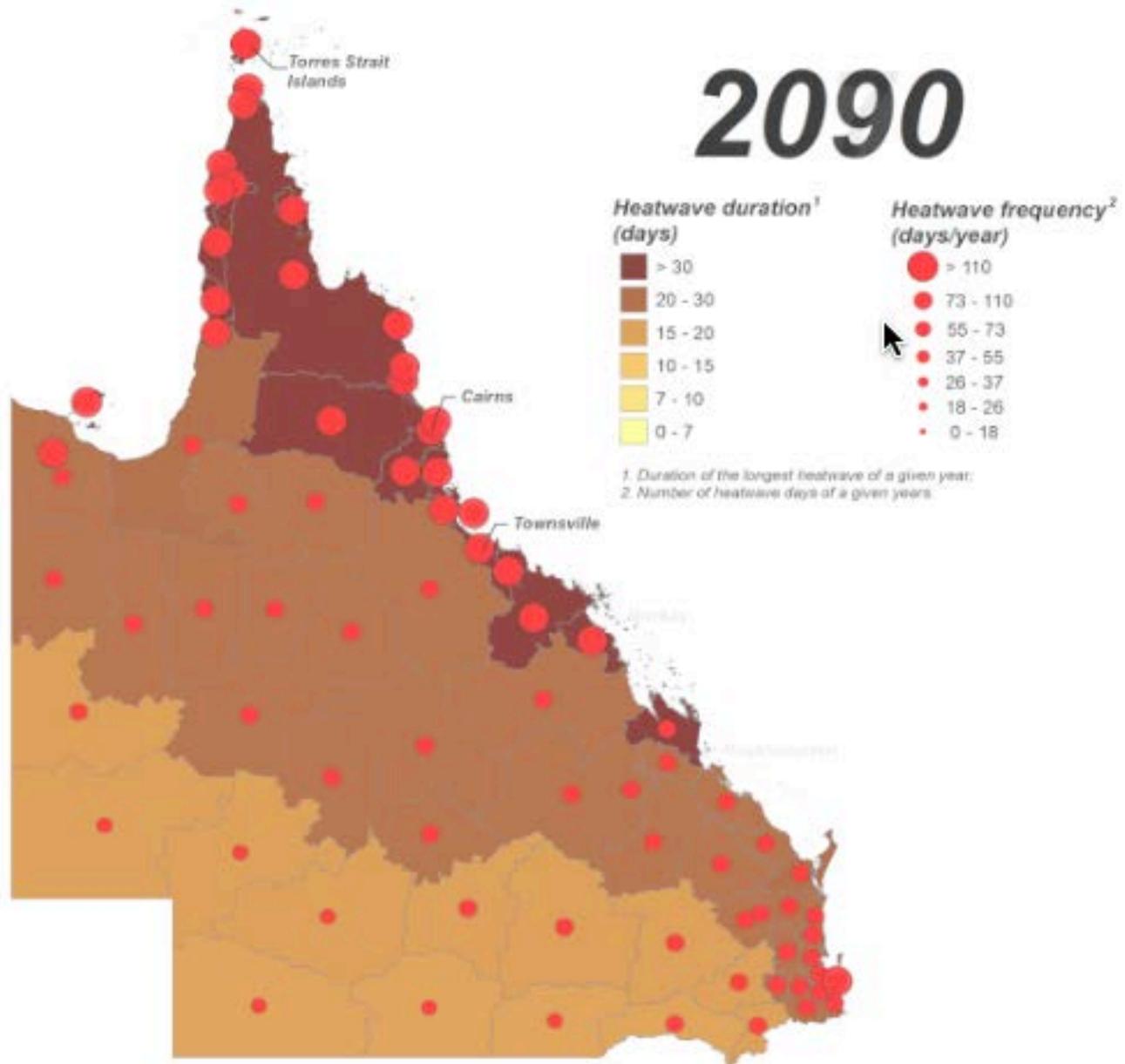
Changes over time for regions

Long-term regional changes in relation to reference period (1986-2005) over time



Heat waves

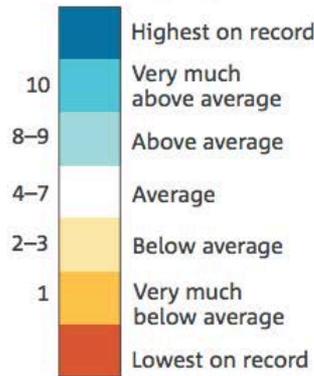
2090



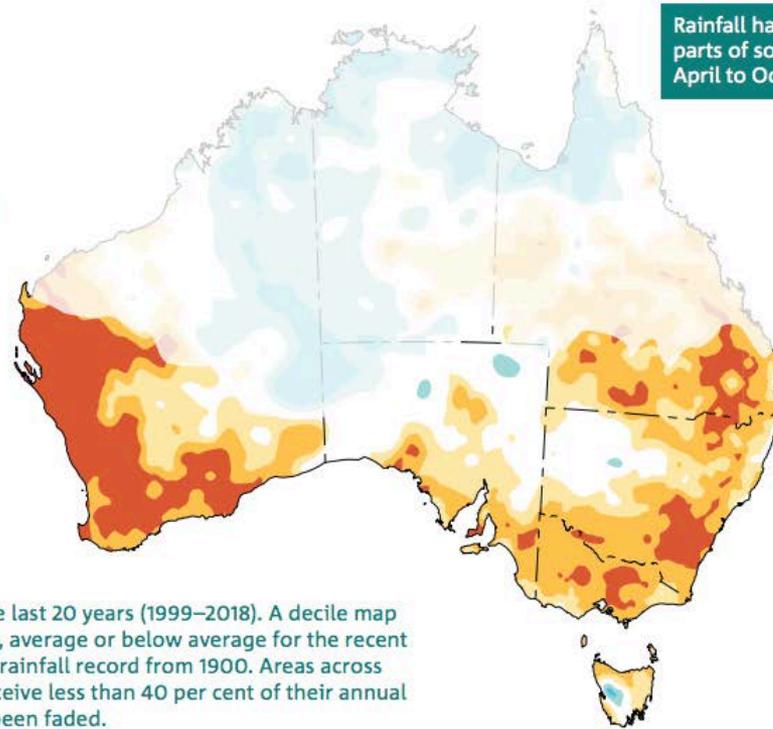
Floods

Observed change in rainfall

Rainfall decile ranges



April to October rainfall deciles for the last 20 years (1999–2018). A decile map shows where rainfall is above average, average or below average for the recent period, in comparison with the entire rainfall record from 1900. Areas across northern and central Australia that receive less than 40 per cent of their annual rainfall during April to October have been faded.



Rainfall has been very low over parts of southern Australia during April to October in recent decades.

Source: Bureau of Meteorology

Source: Bureau of Meteorology, State of the Climate 2016, page 7

How will rainfall change in the future?

- As the climate warms, heavy rainfall is expected to become more intense, based on the physical relationship between temperature and the water-holding capacity of the atmosphere
- For heavy rain days, total rainfall is expected to increase by around 7 per cent per degree of warming
- For short-duration, hourly, extreme rainfall events, observations in Australia generally show a larger than 7 per cent increase
- Short-duration rain extremes are often associated with flash flooding

(Source: Bureau of Meteorology, State of the Climate 2016, page 8)

The Bureau of Meteorology (BOM) has released a special climate review, officially calling the rain in north Queensland "exceptional".

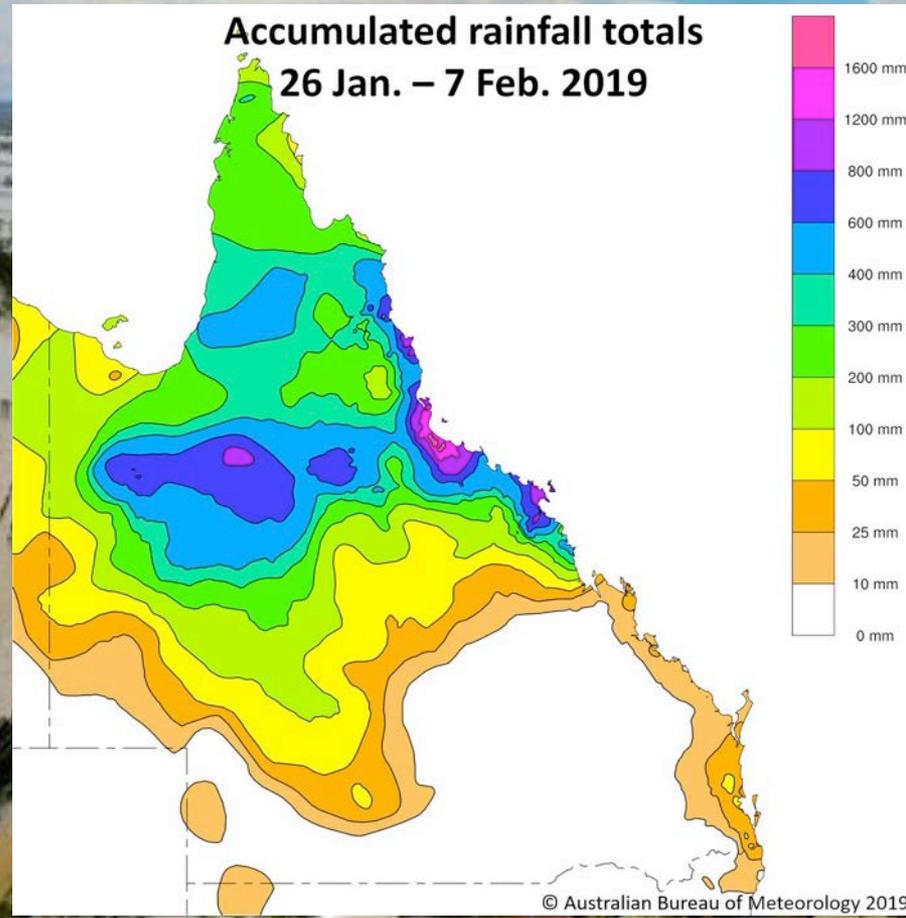
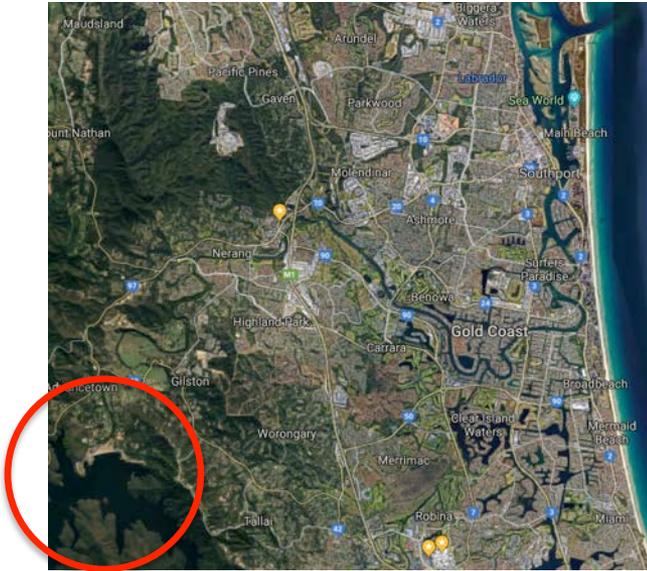


Image: ABC Weather by Kate Doyle 15 February,

Will climate change alter the 1:100 year flood level?



What should be allowed to be built downstream from the Hinze Dam?

Maintaining flood planning levels at Hinze Dam Stage 2 benefits the entire Gold Coast community and no one will be worse off.

...raising Hinze Dam to stage 3 is the last structural flood mitigation opportunity for the City. If the City finds a need to reduce its flood risk in future, there is no viable structural mitigation alternative to generate any substantial reduction in flood risk.



Coastal erosion

Will coastal erosion increase under future climate?



The A-Line is Gold Coast City's main defense against storms under current climate, but will it suffice under future climate?



Cost = \$2,000 per m x 18,000 m = \$436 million

The Netherlands Solution

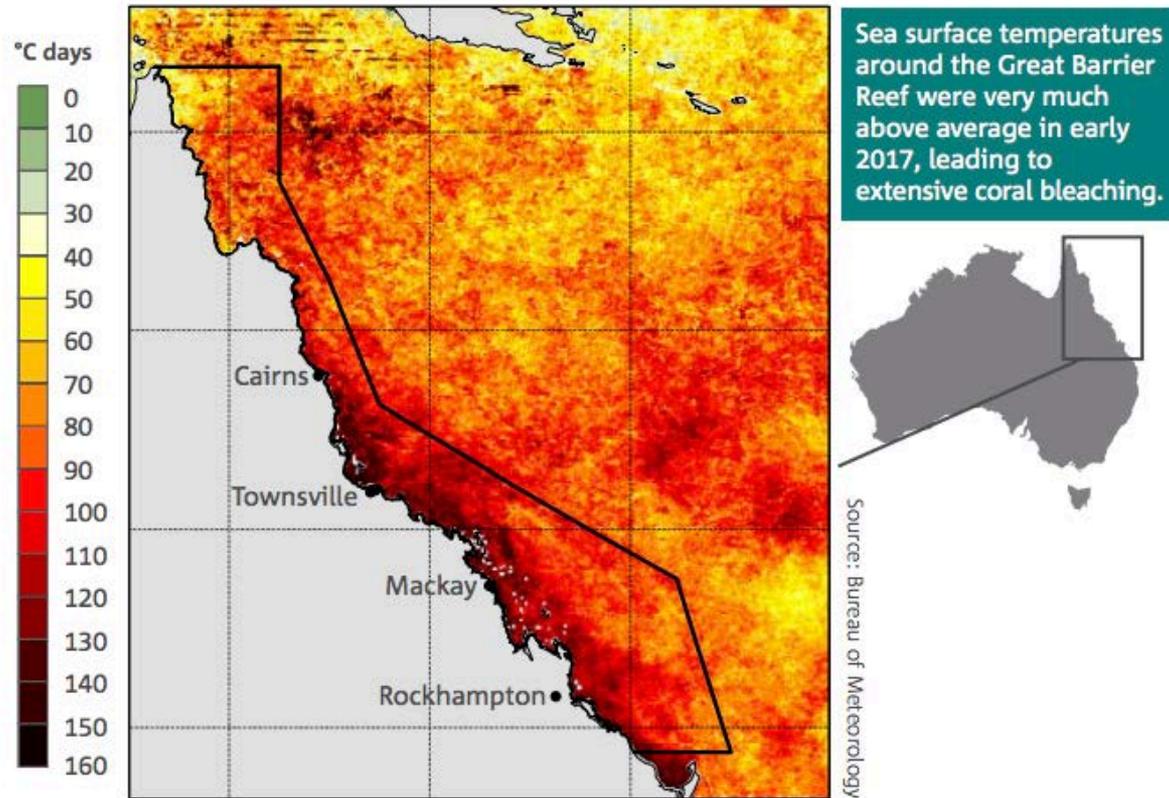
In 1953, a massive North Sea flood disintegrated all the dikes, dams, and sea walls, once again washing away everything that stood in its path. The floods resulted in 1,836 deaths, 200,000 animal casualties, and flooded 200,000 hectares of land. It was realized that a solution had to be found- and quickly



The solution as a new plan called Deltaplan which revitalize 3,700 km of dikes and dams including an immense seawall costing \$ 2.5 billion

Great Barrier Reef

Great Barrier Reef Bleaching 2016-2017



Great Barrier Reef coral bleaching risk map, shown as Degree Heating Days: the accumulated (sum) of positive sea surface temperature anomalies with respect to the long-term average of 2002–2011 each day over the reef for December 2016 to March 2017. Green = OK. Yellow = watch. Orange = coral bleaching risk. Red = coral mortality risk.

Source: Bureau of Meteorology, State
of the Climate 2016, page 7

How close are we to 1.5°C?

- Human-induced warming has already reached about 1°C above pre-industrial levels at the time of writing of this Special Report
- By the decade 2006–2015, human activity had warmed the world by 0.87°C compared to pre-industrial times (1850–1900)
- If the current warming rate continues, the world would reach human-induced global warming of 1.5°C around 2040

Why does it matter?

Coral reefs are projected to decline by a further 70–90% at 1.5°C (high confidence) with larger losses (>99%) at 2°C (very high confidence)

GBR Ecm employ 63,000 people, bring \$6.4B to economy and has an asset value of \$56B

Sources:

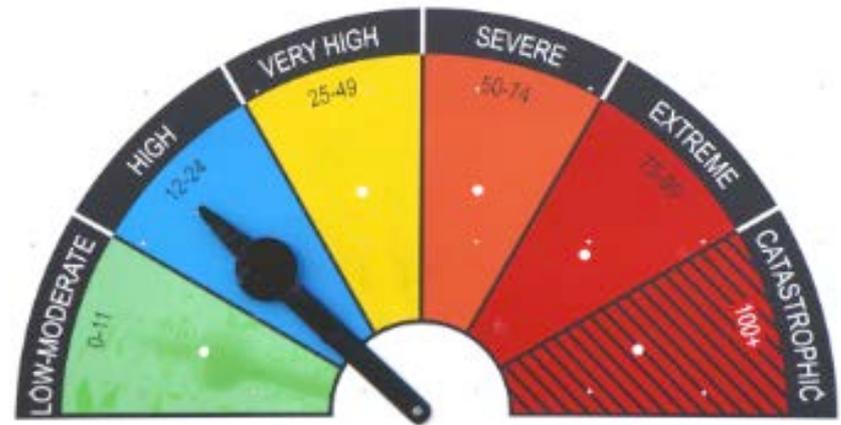
IPCC 1.5 Degree Special Report
Deloitte Access Economics 2017

Image: Great Barrier Reef Foundation

Catastrophic fires



Old fire danger ratings



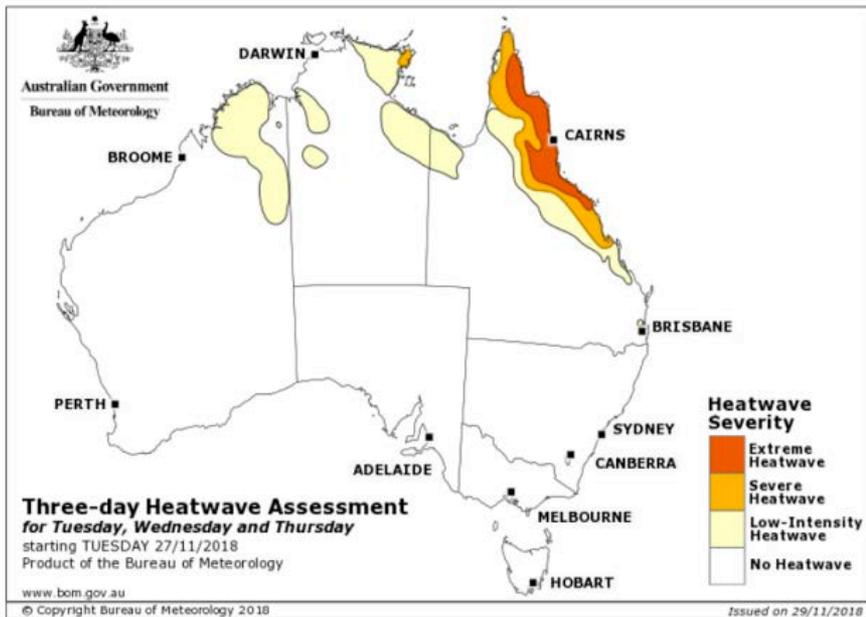
new fire danger ratings

“There needs to be a paradigm shift in the way we look at fire and the way we think about fire”

On Wednesday, Rockhampton Airport recorded catastrophic [fire] conditions for approximately three-and-a-half hours

This was the first time this district has recorded catastrophic conditions and the most prolonged event in Queensland since the implementation of the current Fire Danger Rating System in 2010

“When one looks at the charcoal records with Aboriginal burning, we haven't seen any indicators that show that there had been mass fires or large intense fires like we are seeing today, or 'mega-fires', as I would call them”



Sarah Perkins-Kirkpatrick, future fellow at UNSW's climate change research centre

Queensland's 'abnormal' bushfires linked to climate change [ABC Weather](#)

By [Kate Doyle](#) and [Lucy Murray](#) Updated 1 Dec 2018, 6:51am

Former fire chiefs warn Australia unprepared for escalating climate threat | Australia news | The Guardian

www.theguardian.com 10 April 2019

Two dozen former fire and emergency chiefs from all over Australia want the next prime minister to ensure emergency services have the resources to fight natural disasters caused by climate change.



Source: <https://www.theguardian.com/australia-news/2019/apr/09/former-fire-chiefs-warn-australia-unprepared-for-escalating-climate-threat>

Dangerous jelly fish

Irukandji
jellyfish?



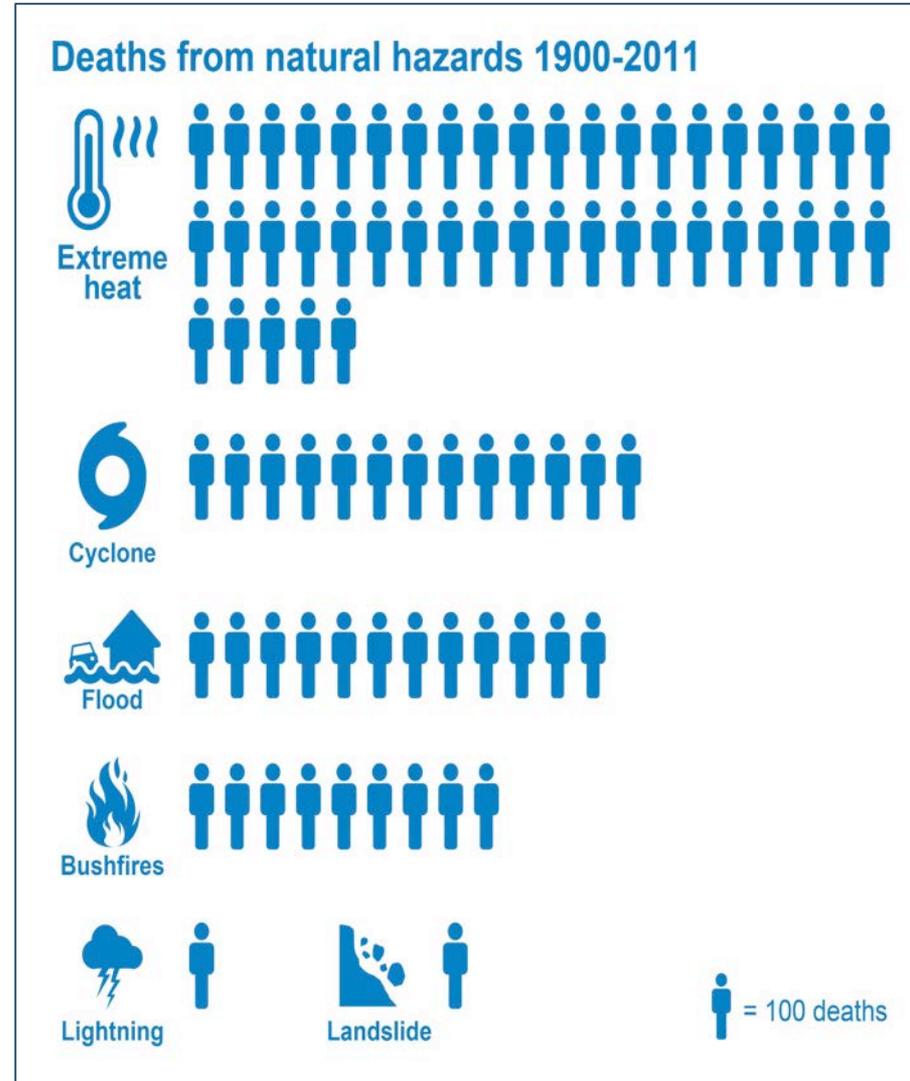
Financial risks

Counting the costs

Between 2011 and 2016, 45 extreme weather events caused \$13 billion damage to public assets and infrastructure. Insured damage to private assets in declared disaster events is valued at \$8.6 billion in the 10 years to 2016 [Qld CRP]

The property market is expected to lose \$571 billion in value by 2030 due to climate change and extreme weather, and will continue to lose value in the coming decades if emissions remain high [Climate Council]

By 2050, climate change is projected to halve the irrigated agricultural output of the Murray-Darling Basin region, which currently accounts for 50% of Australia's irrigated agricultural output by value (about \$7.2 billion per year) [Climate Council]



Mark Carney tells global banks they cannot ignore climate change dangers

Financial sector warned it risks losses from extreme weather and its stakes in polluting firms



▲ Mark Carney arriving for IMF and World Bank meetings in Washington earlier this month. Photograph: James Lawler Duggan/Reuters

The global financial system faces an existential threat from climate change and must take urgent steps to reform, the governors of the [Bank of England](#) and France's central bank have warned, writing in the Guardian.

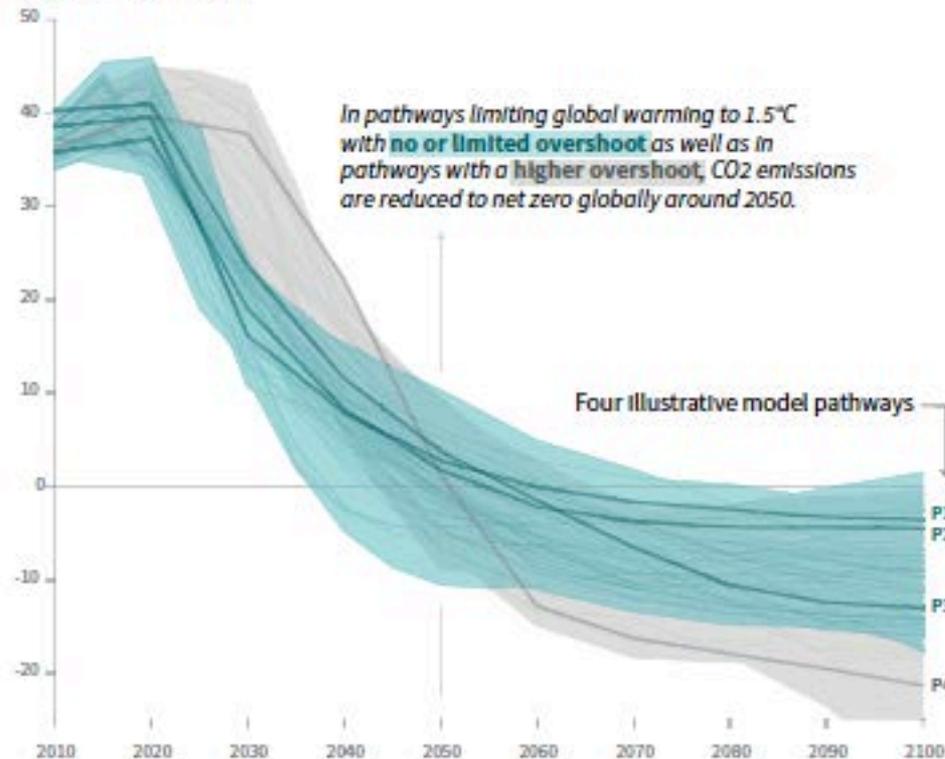
In an [article](#) published in the Guardian on Wednesday aimed at the international financial community, Mark Carney, the Bank's governor, and Villeroy de Galhau, the governor of the Banque de [France](#), said financial regulators, banks and insurers around the world had to "raise the bar" to avoid catastrophe.

[www.theguardian.com/
3/apr/17/mark-carney-tells-
cannot-ignore-climate-](https://www.theguardian.com/3/apr/17/mark-carney-tells-cannot-ignore-climate-)

There is time to limit global warming to below 1.5 degree threshold

Global total net CO₂ emissions

Billion tonnes of CO₂/yr



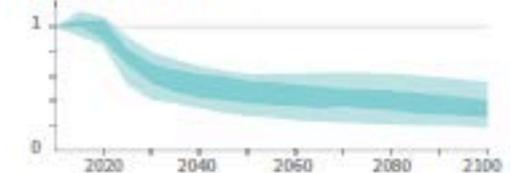
Timing of net zero CO₂
Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios



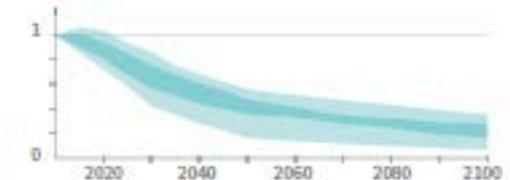
Non-CO₂ emissions relative to 2010

Emissions of non-CO₂ forcers are also reduced or limited in pathways limiting global warming to 1.5°C with no or limited overshoot, but they do not reach zero globally.

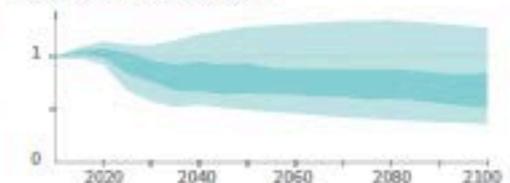
Methane emissions



Black carbon emissions



Nitrous oxide emissions



Source: IPCC 1.5 Degree Special Report