



Department of
Primary Industries

Climate Change, Extremes and Agriculture

National Olive Industry Conference

Albury Entertainment Centre - October 17, 2019

Gary Allan

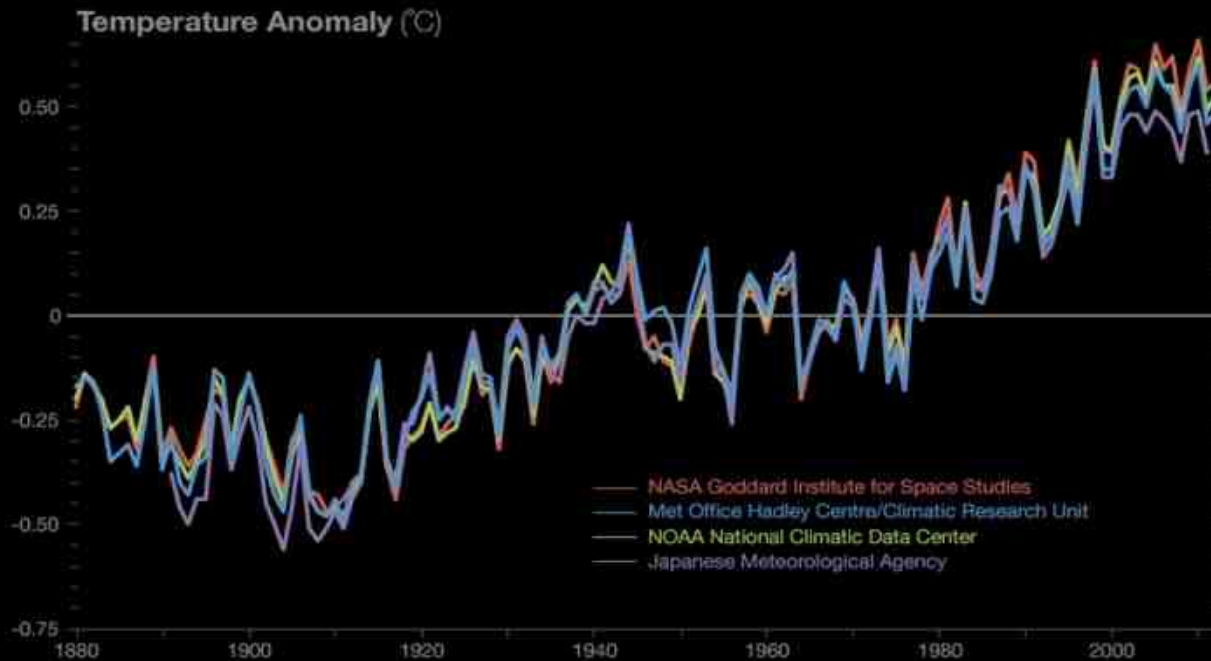
*Engagement Manager, Vulnerability Assessment
NSW DPI - Orange Agricultural Institute*



Olea europaea (F.E.Kohler ca. C 19)

(thanks to my DPI colleagues - Jamie Ayton, Scott Wallace, Steve Falivene)

Some say scientists can't agree on Earth's temperature changes.



Here's what "disagreement" looks like.



CLIMATE 365

climate365.tumblr.com | go.nasa.gov/climate365

Climate Change – the Big Picture



ipcc
INTERGOVERNMENTAL PANEL ON climate change

Climate Change and Land

An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems

Summary for Policymakers



FOR MORE INFORMATION:

Website: <http://ipcc.ch>
IPCC Secretariat: ipcc-sec@wmo.int
IPCC Press Office: ipcc-media@wmo.int

WG I WG II WG III

WMO UNEP

CLIMATE CHANGE AND LAND

An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

2

REPORT COVER IMAGE:
Agricultural landscape between Ankara and Hattusna, Anatolia, Turkey (40°00' N – 33°35' E)
©Yann Arthus-Bertrand | www.yannarthusbertrand.org | www.goodplanet.org

WMO UNEP

ipcc
ON climate change

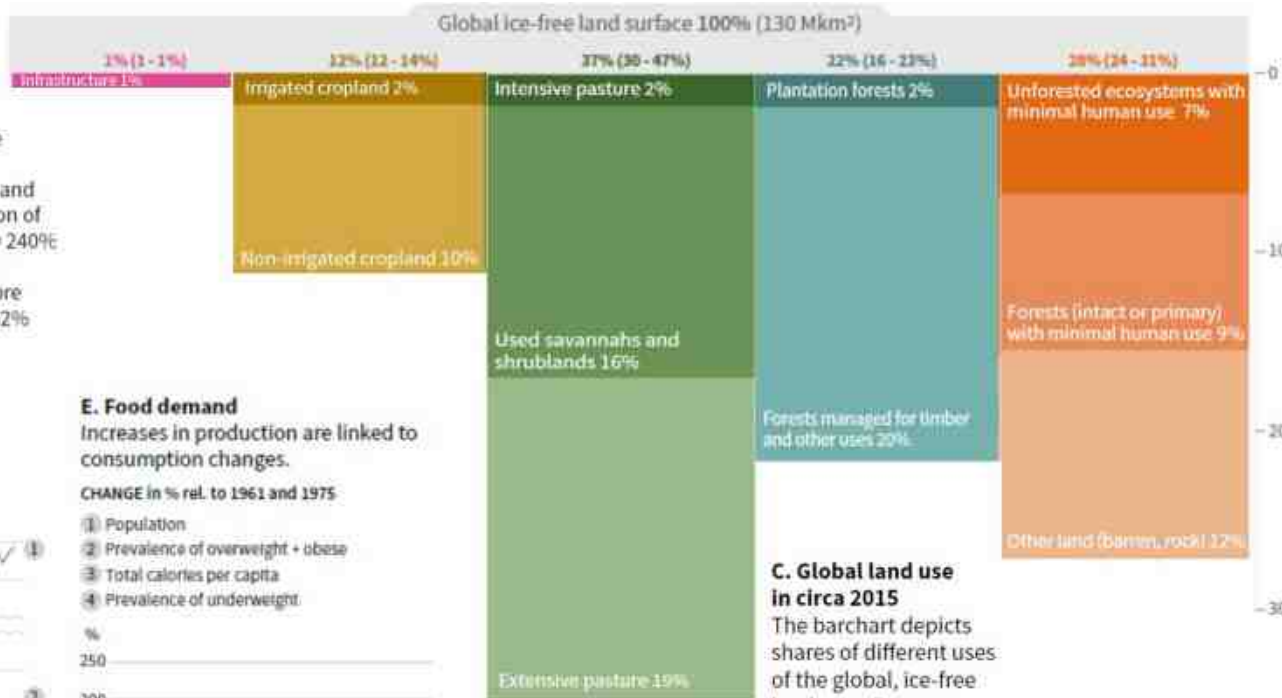
of 1.5°C

Limiting global warming of 1.5°C
the global emission pathways,
the threat of climate change,
and climate poverty



WMO UNEP

Land use (including agriculture)

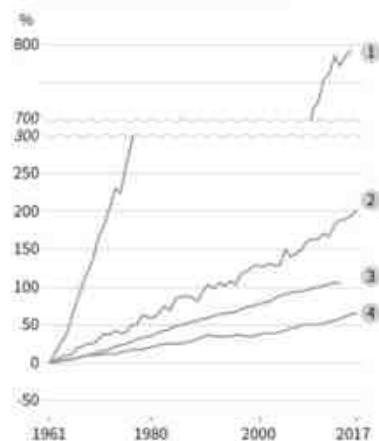


D. Agricultural production

Land use change and rapid land use intensification have supported the increasing production of food, feed and fibre. Since 1961, the total production of food (cereal crops) has increased by 240% (until 2017) because of land area expansion and increasing yields. Fibre production (cotton) increased by 152% (until 2013).

CHANGE in % rel. to 1961

- 1 Inorganic N fertiliser use
- 2 Cereal yields
- 3 Irrigation water volume
- 4 Total number of ruminant livestock

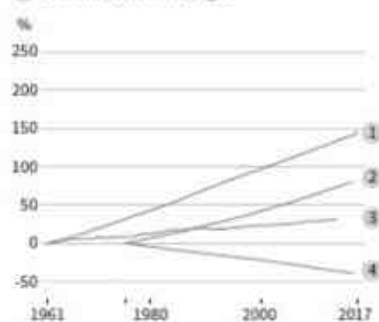


E. Food demand

Increases in production are linked to consumption changes.

CHANGE in % rel. to 1961 and 1975

- 1 Population
- 2 Prevalence of overweight + obese
- 3 Total calories per capita
- 4 Prevalence of underweight



C. Global land use in circa 2015

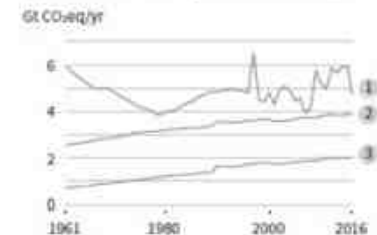
The bar chart depicts shares of different uses of the global, ice-free land area. Bars are ordered along a gradient of decreasing land-use intensity from left to right.

B. GHG emissions

An estimated 23% of total anthropogenic greenhouse gas emissions (2007-2016) derive from Agriculture, Forestry and Other Land Use (AFOLU).

CHANGE in emissions rel. to 1961

- 1 Net CO₂ emissions from FOLU (Gt CO₂/yr)
- 2 CH₄ emissions from Agriculture (Gt CO₂-eq/yr)
- 3 N₂O emissions from Agriculture (Gt CO₂-eq/yr)

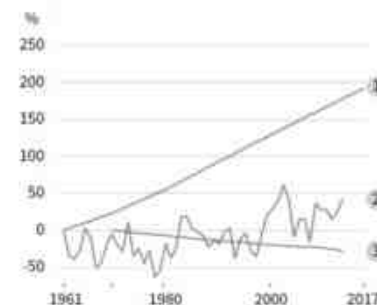


F. Desertification and land degradation

Land-use change, land-use intensification and climate change have contributed to desertification and land degradation.

CHANGE in % rel. to 1961 and 1970

- 1 Population in areas experiencing desertification
- 2 Dryland areas in drought annually
- 3 Inland wetland extent

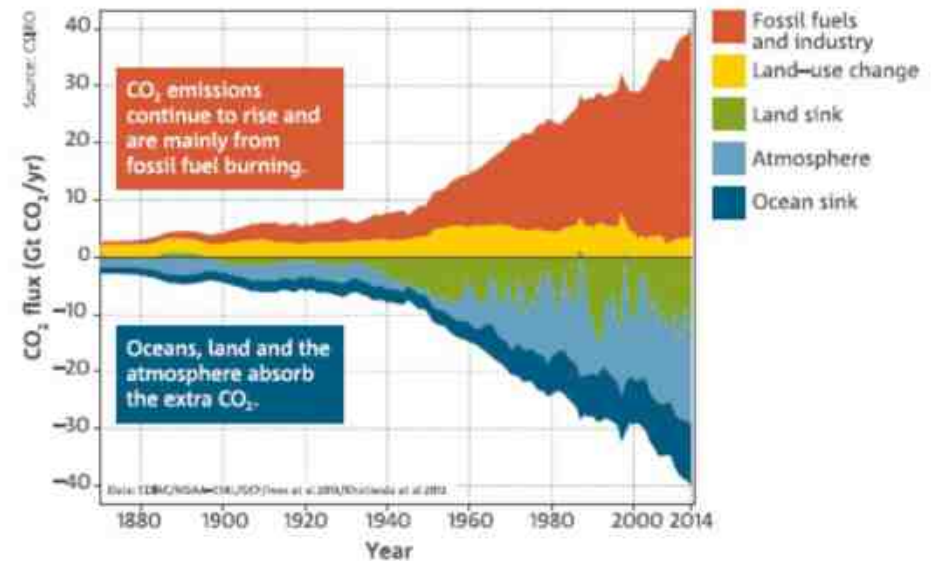
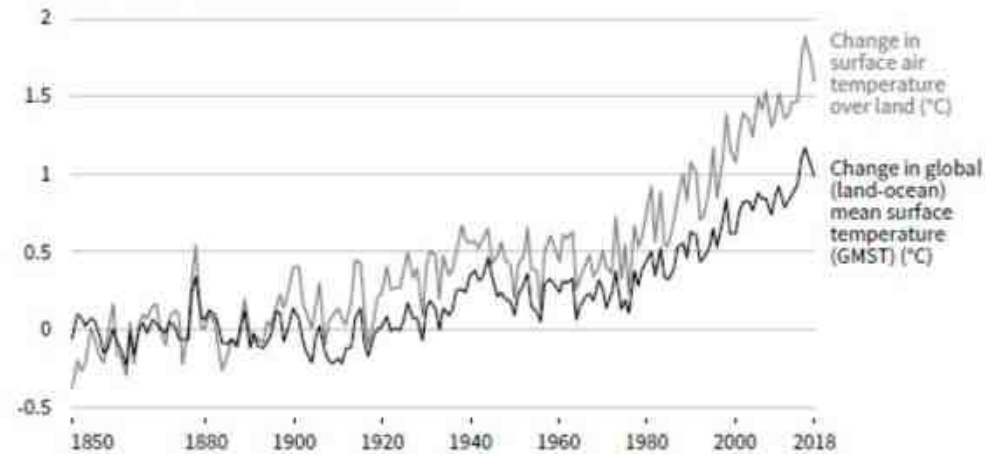


Global temperatures and emission sources

A. Observed temperature change relative to 1850-1900

Since the pre-industrial period (1850-1900) the observed mean land surface air temperature has risen considerably more than the global mean surface (land and ocean) temperature (GMST).

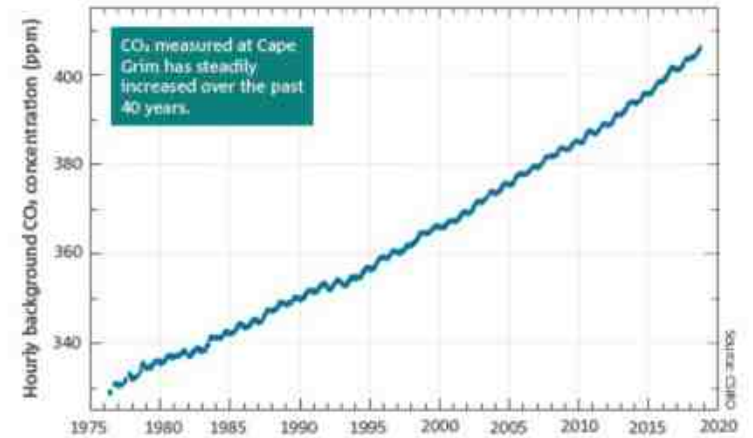
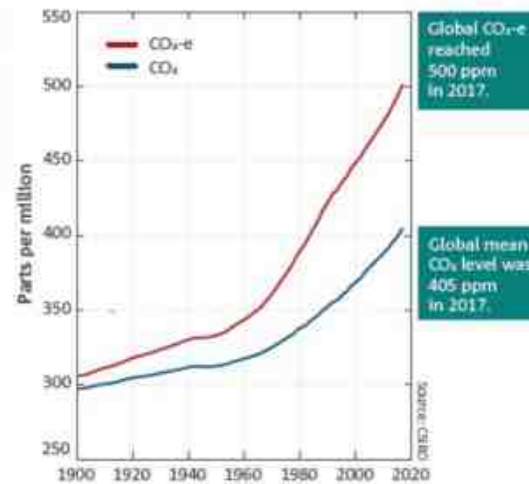
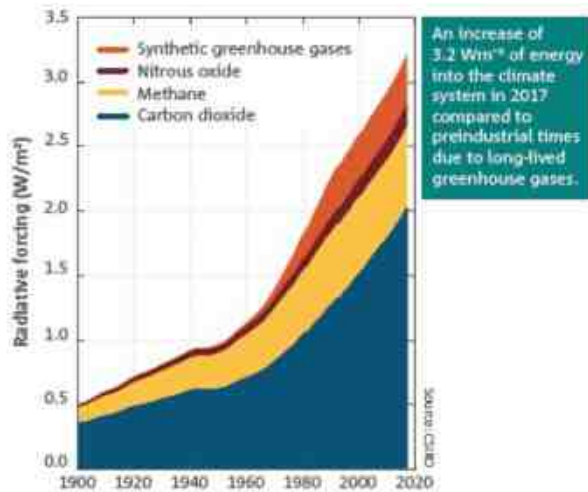
CHANGE in TEMPERATURE rel. to 1850-1900 (°C)



Increases in emissions



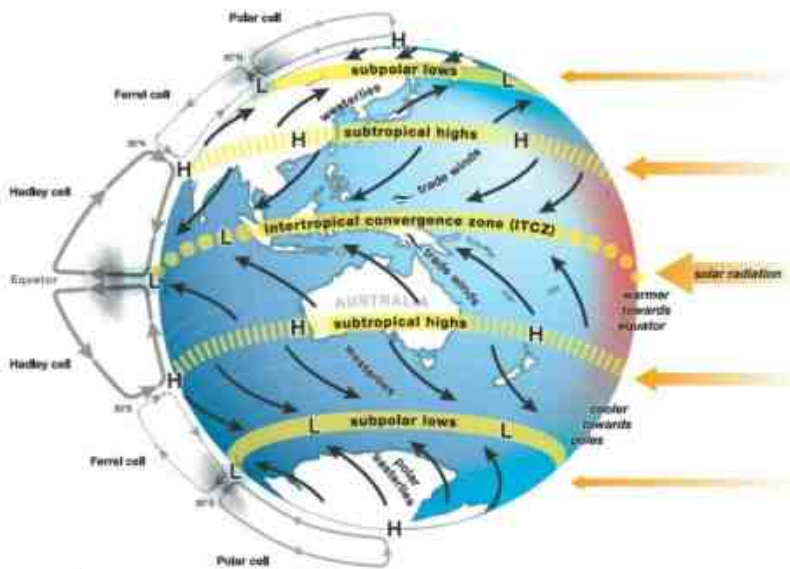
- Global average concentrations of all the major long-lived greenhouse gases continue to rise in the atmosphere, with carbon dioxide concentrations rising above 400 ppm since 2016 and the CO₂ equivalent of all gases reaching 500 ppm in 2017.
- Emissions from burning fossil fuels continue to increase and are the dominant contributor to the observed growth in atmospheric CO₂.



Background hourly clean-air CO₂ as measured at the Cape Grim Baseline Air Pollution Station through to September 2018. The blue hourly data represent thousands of individual measurements. To obtain clean air measurements, the data are filtered to only include times when weather systems come across the Southern Ocean, and thus the air is not influenced by local sources of pollution.

Global Circulations

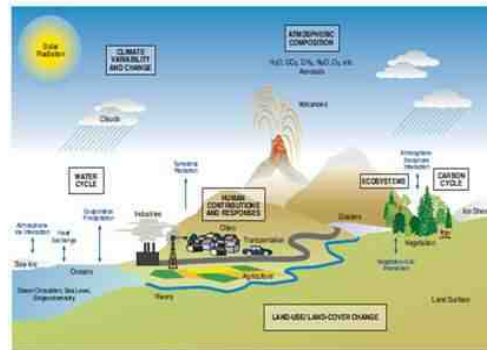
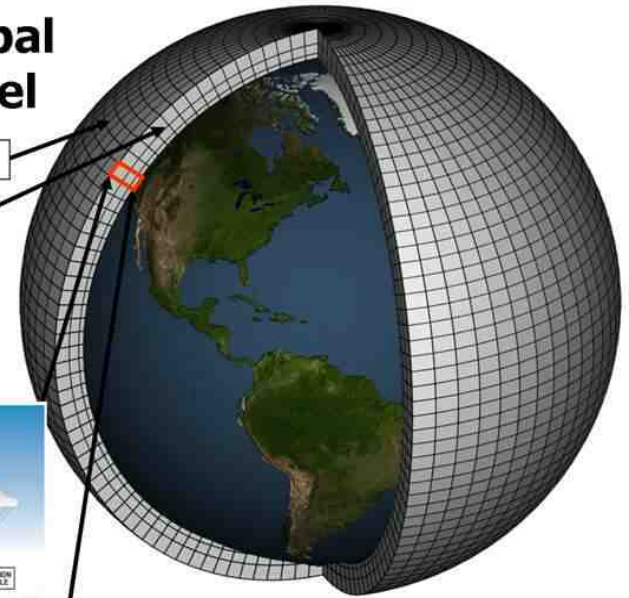
Global circulations



Schematic for Global Atmospheric Model

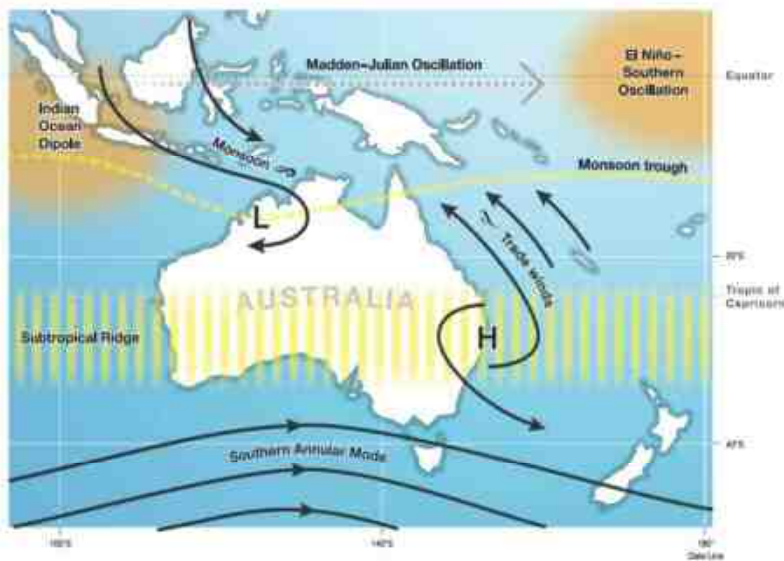
Horizontal Grid (Latitude-Longitude)

Vertical Grid (Height or Pressure)



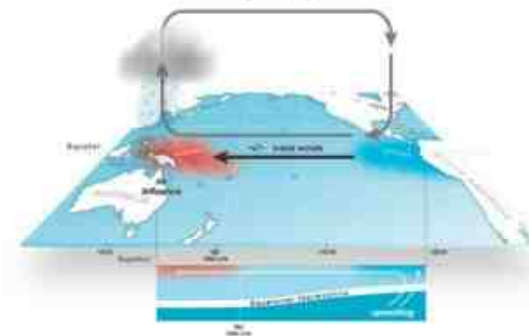
Major drivers of Australia's Climate

Australian climate influences



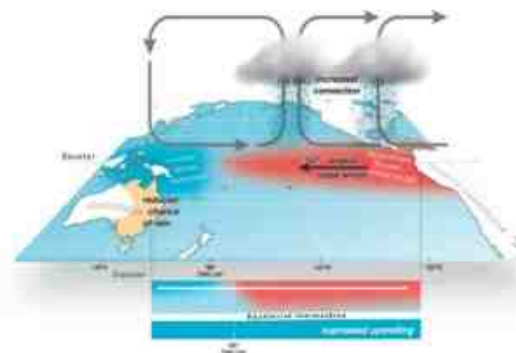
El Niño-Southern Oscillation (ENSO)

Neutral



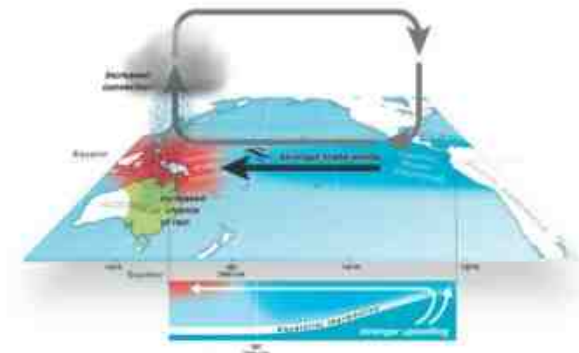
El Niño-Southern Oscillation (ENSO)

El Niño



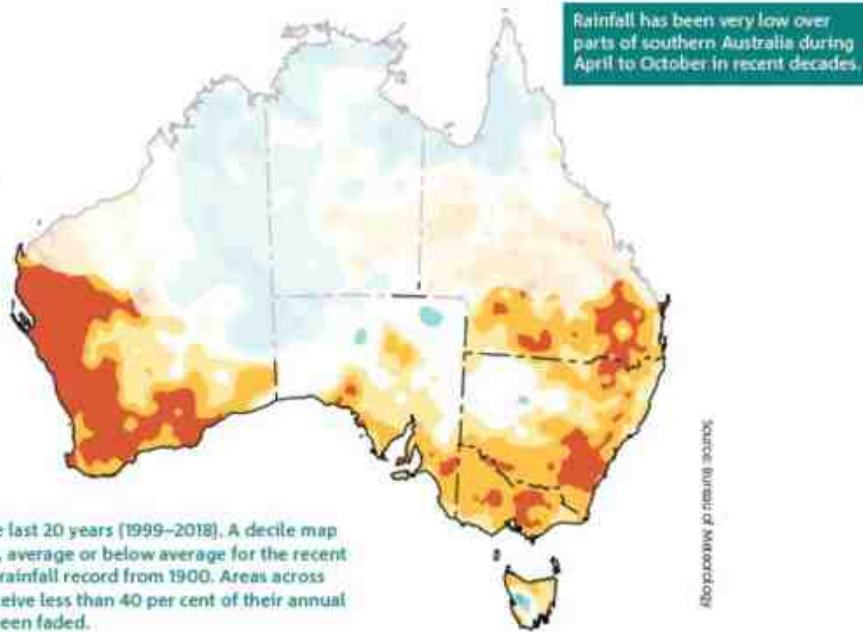
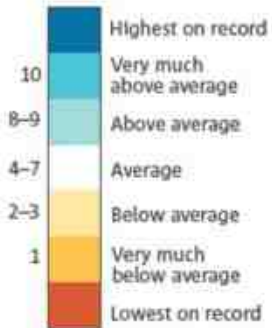
El Niño-Southern Oscillation (ENSO)

La Niña

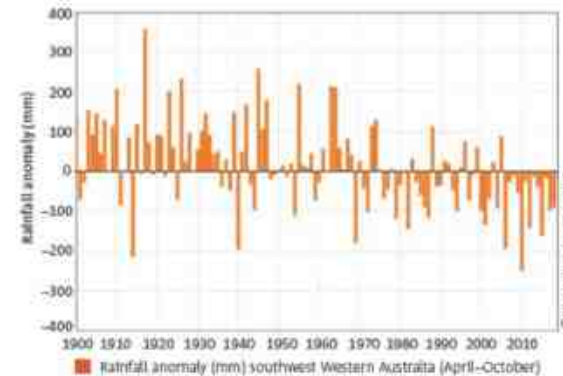
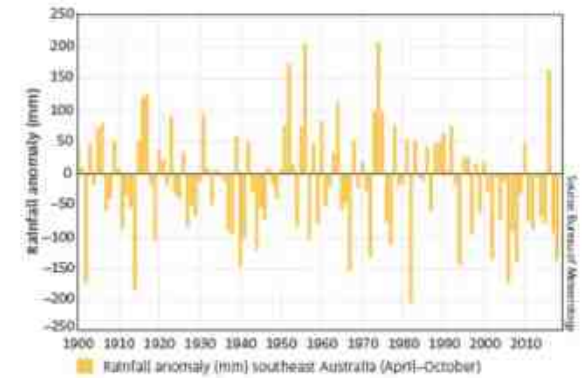


Changes in Australian Rainfall

Rainfall decile ranges

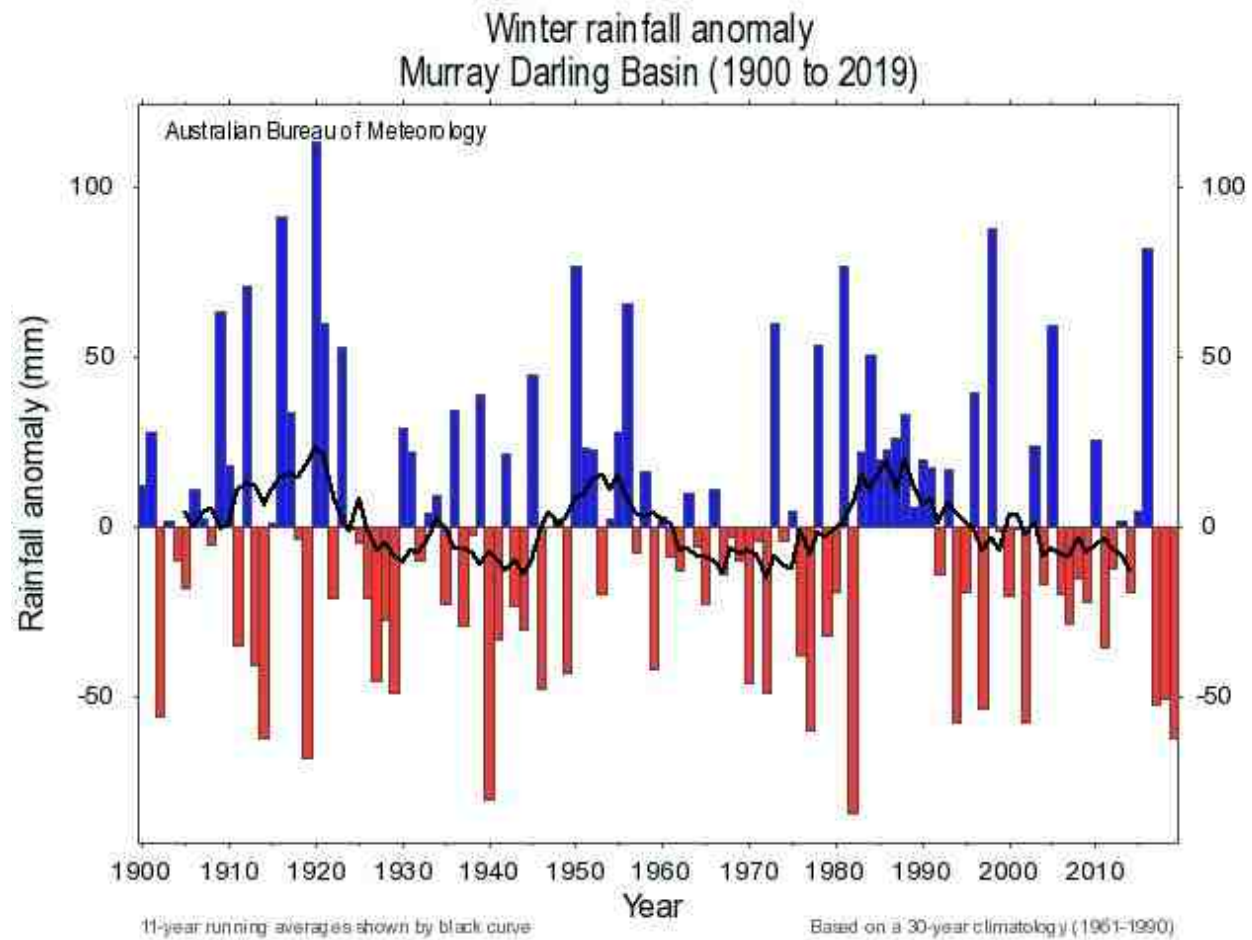


April to October rainfall deciles for the last 20 years (1999–2018). A decile map shows where rainfall is above average, average or below average for the recent period, in comparison with the entire rainfall record from 1900. Areas across northern and central Australia that receive less than 40 per cent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

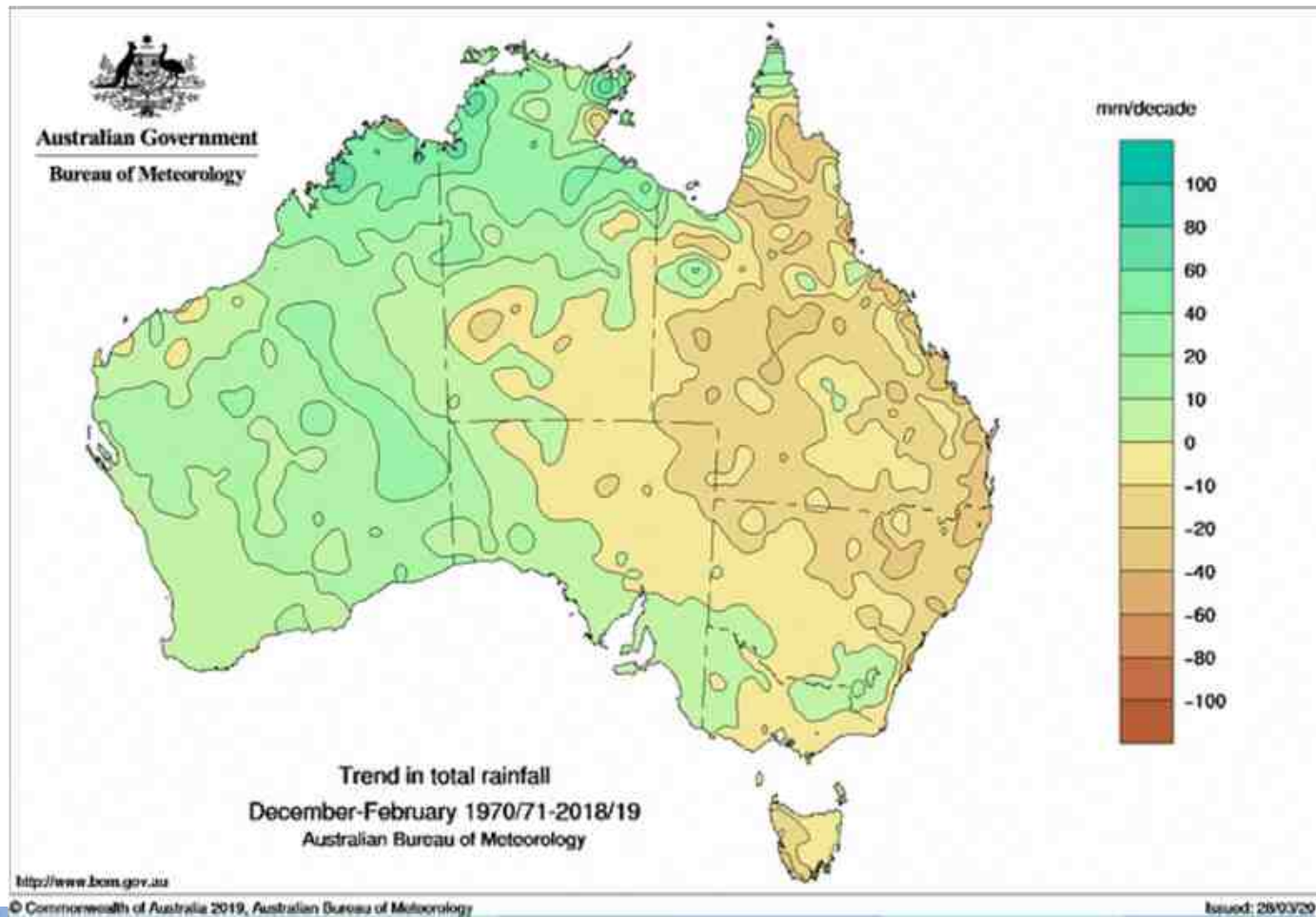


Anomalies of April to October rainfall for southwestern (southwest of the line joining the points 30° S, 115° E and 35° S, 120° E) and southeastern (south of 33° S, east of 135° E inclusive) Australia. Anomalies are calculated with respect to 1961 to 1990 averages.

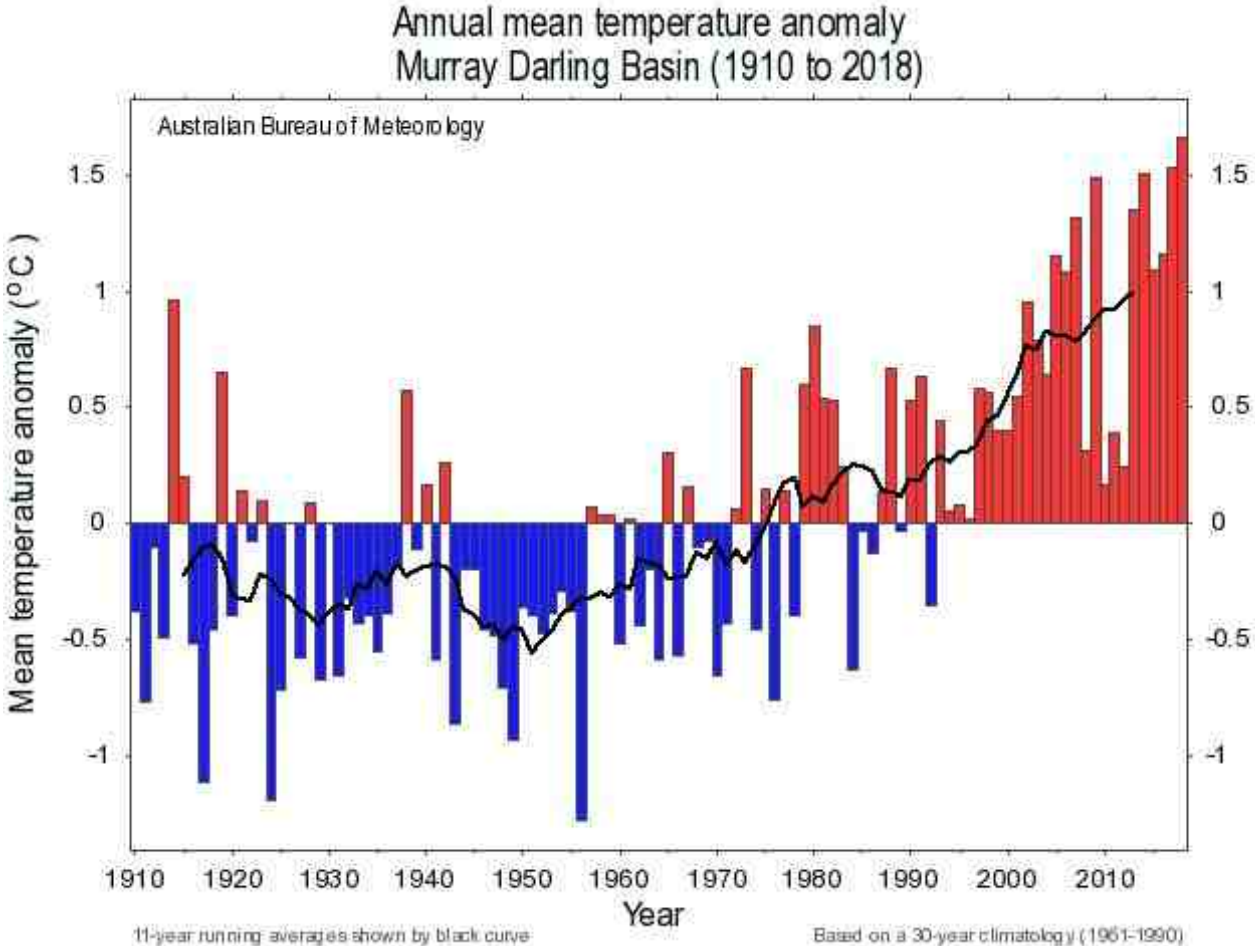
Australian Rainfall Δ (ctd.)



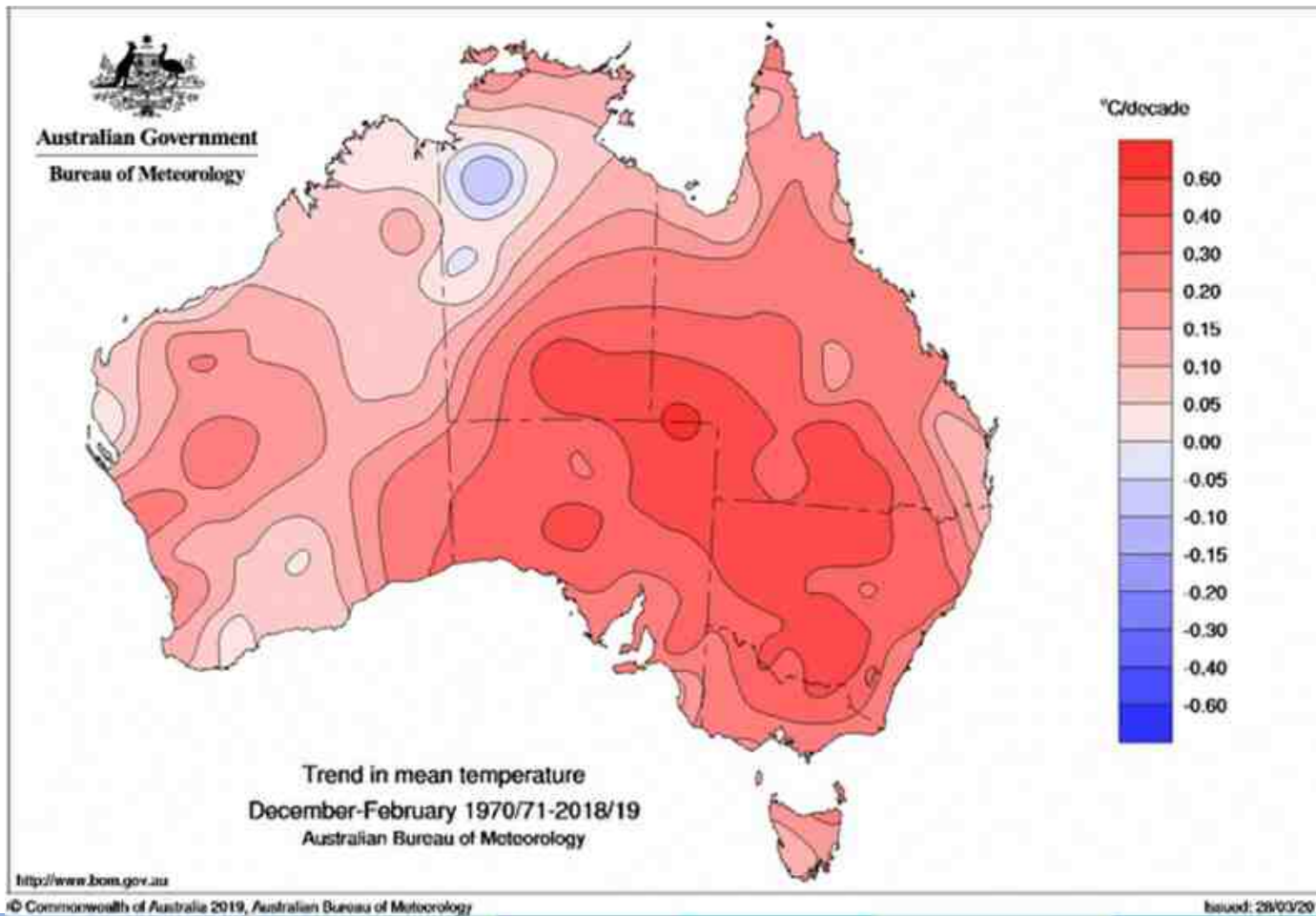
Australian Rainfall Δ (ctd.)



Changes in Australian Temperatures (Mean)



Australian temperature Δ



Temperature - Extremes

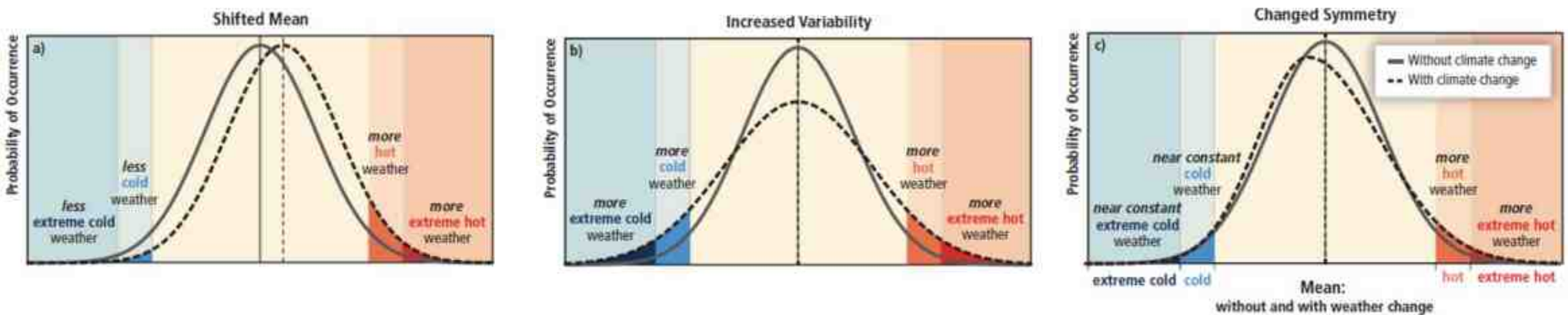
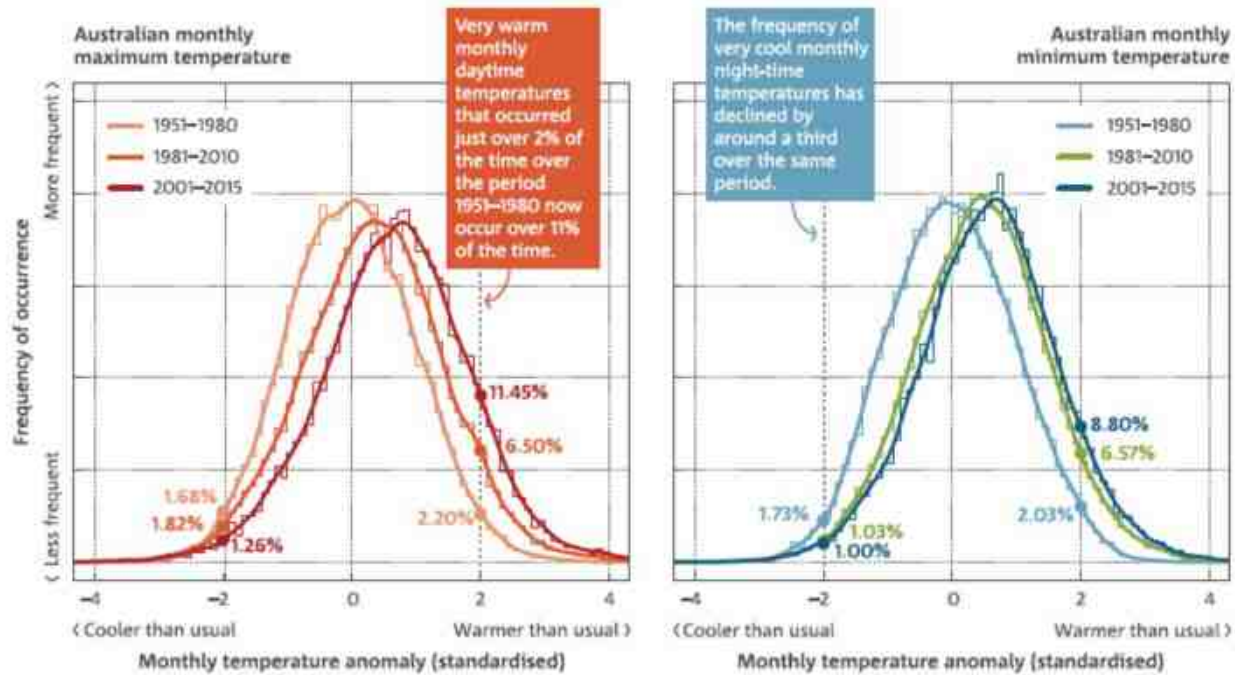


Figure SPM.3 | The effect of changes in temperature distribution on extremes. Different changes in temperature distributions between present and future climate and their effects on extreme values of the distributions: (a) effects of a simple shift of the entire distribution toward a warmer climate; (b) effects of an increase in temperature variability with no shift in the mean; (c) effects of an altered shape of the distribution, in this example a change in asymmetry toward the hotter part of the distribution. [Figure 1-2, 1.2.2]

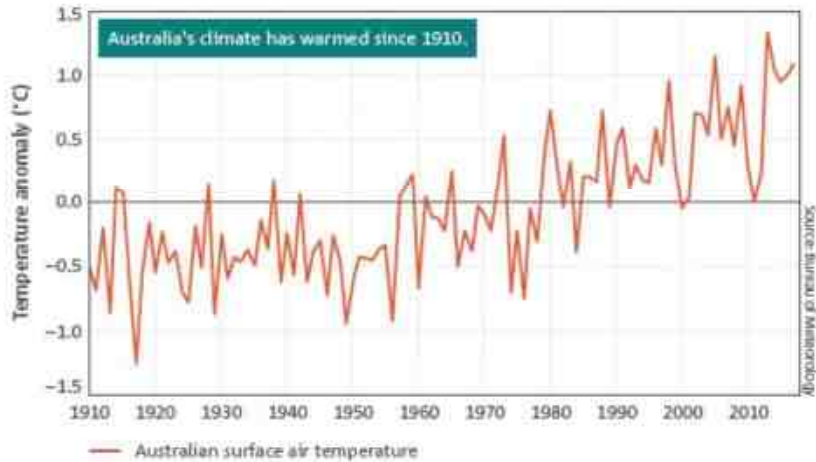
Temperature - extremes



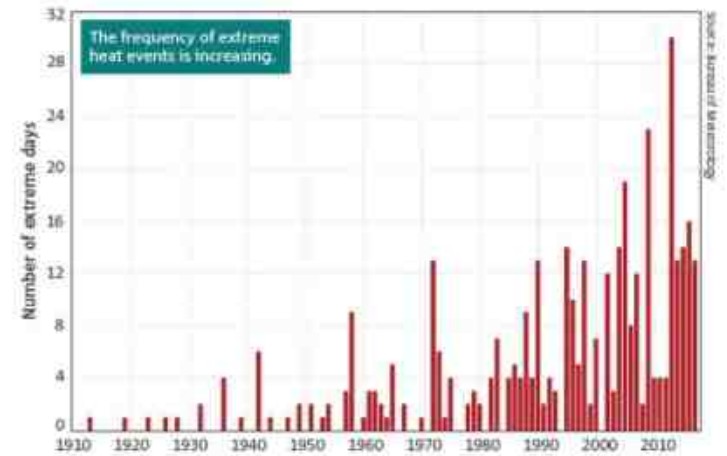
Distribution of monthly day and night-time temperature anomalies (standardised with respect to the 1951-1980 base period) aggregated across 104 locations and all months of the year, for three periods: 1951-1980 (orange, light blue), 1981-2010 (red, green) and 2001-2015 (dark red, dark blue). Very warm months correspond to two standard deviations from the mean. Detection and attribution studies use various methods to understand the significance of these distribution shifts and their cause.



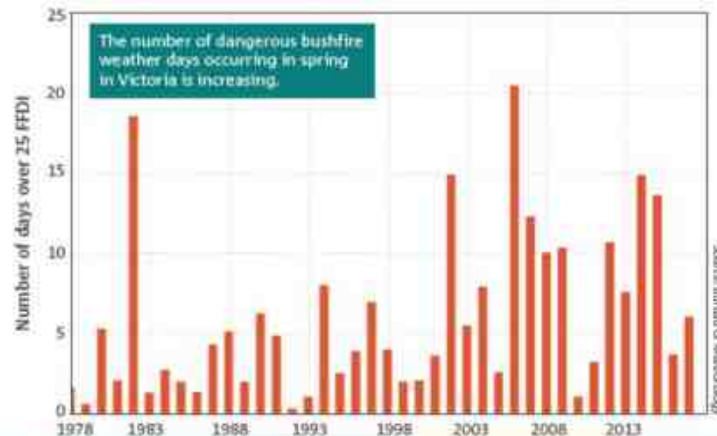
- Australia's climate has warmed by just over 1 °C since 1910, leading to an increase in the frequency of extreme heat events.



Anomalies in annual temperature over land in the Australian region. Anomalies are the departures from the 1961–1990 standard averaging period.



Number of days each year where the Australian area-averaged daily mean temperature is extreme. Extreme days are those above the 99th percentile of each month from the years 1910–2017. These extreme daily events typically occur over a large area, with generally more than 40 per cent of Australia experiencing temperatures in the warmest 10 per cent for that month.

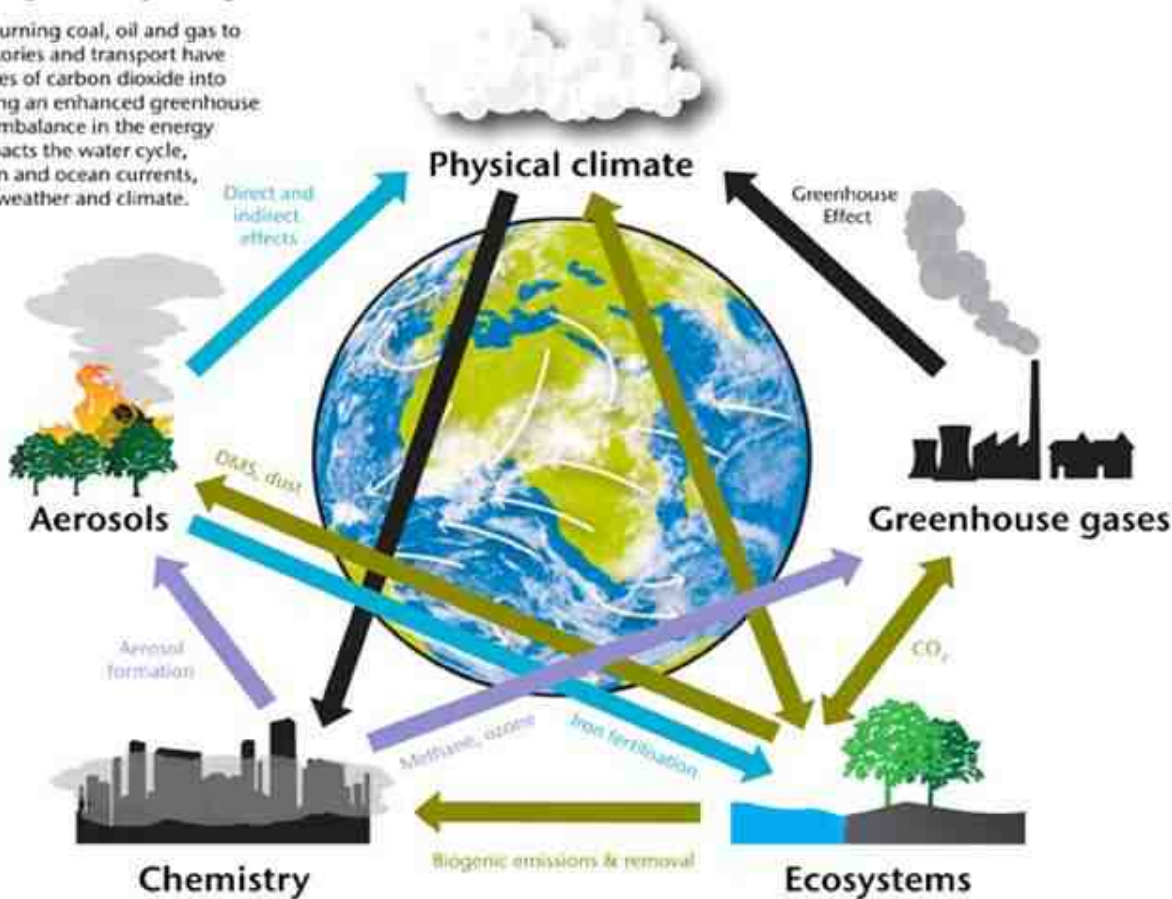


Area average of the number of days with FFDI greater than 25 (very high fire danger) in Victoria in spring for the years starting in July (1978–2017). Although there is considerable interannual variability in the index, there is also a clear trend in more recent decades towards a greater number of very high fire weather days in spring.

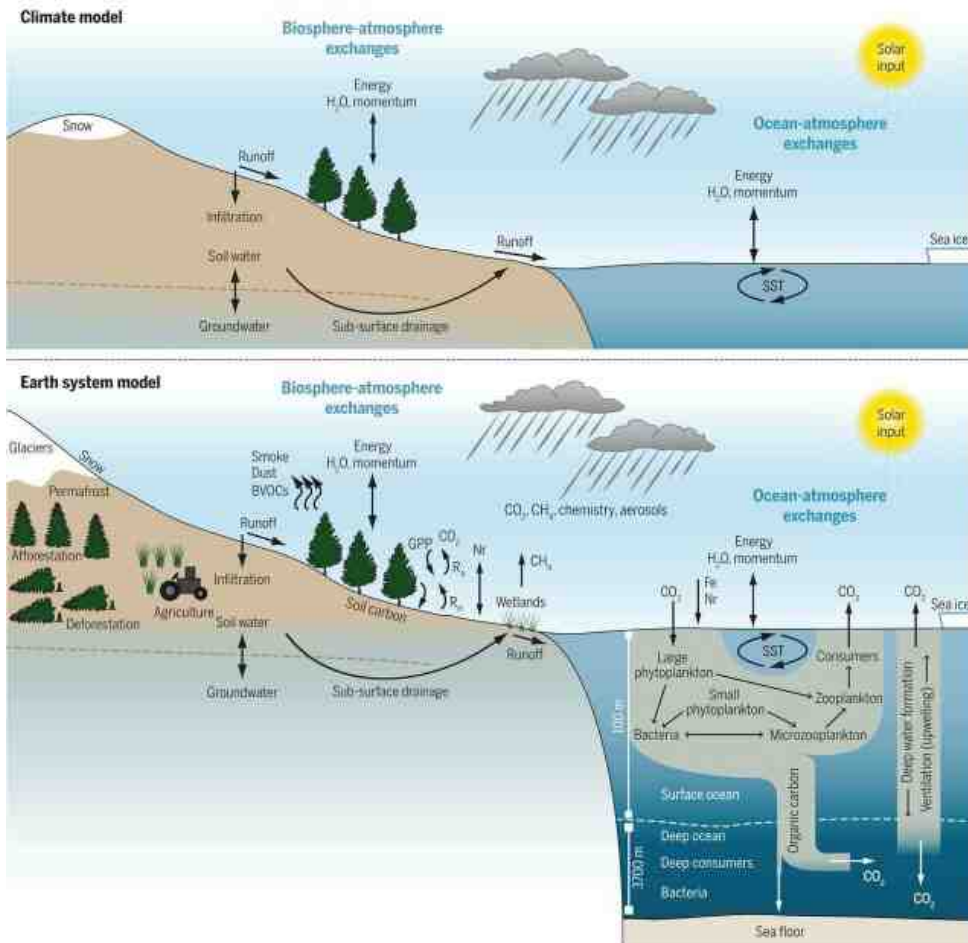
The Earth System

One thing changes everything

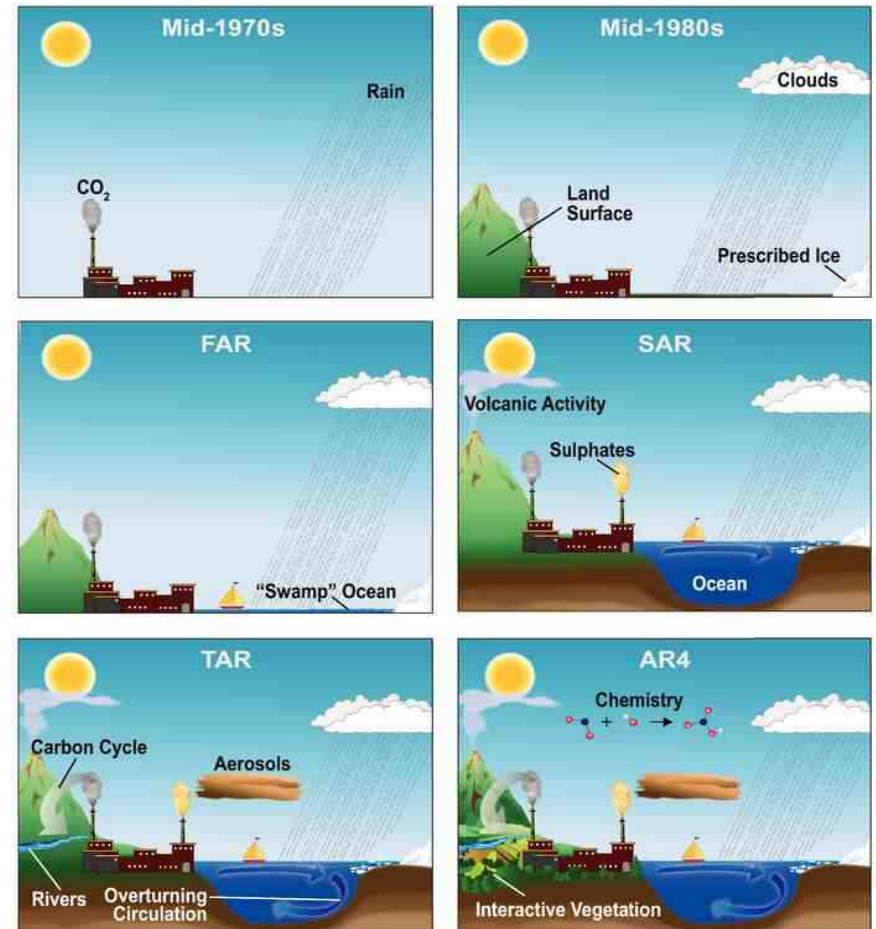
Human activities like burning coal, oil and gas to power our homes, factories and transport have released huge quantities of carbon dioxide into the atmosphere, causing an enhanced greenhouse effect. This causes an imbalance in the energy cycle that, in turn, impacts the water cycle, atmospheric circulation and ocean currents, leading to changes in weather and climate.



Modelling the Earth System (Simulations)



The World in Global Climate Models

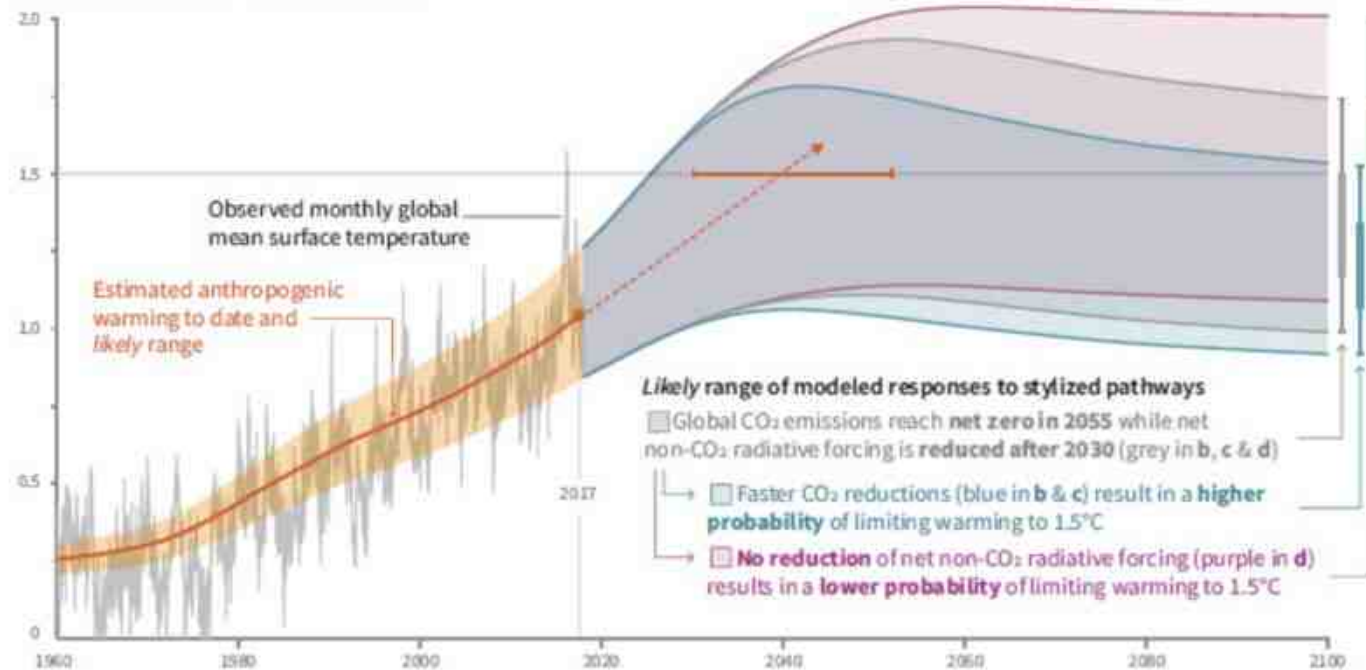


Future Climate - Global projections

Cumulative emissions of CO₂ and future non-CO₂ radiative forcing determine the probability of limiting warming to 1.5°C

a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways

Global warming relative to 1850-1900 (°C)



IPCC 2019
(AR6 - 2022)

Future Climate – Australian projections

NEW REVISION


CLIMATE CHANGE IN AUSTRALIA

GETTING STARTED Support and guidance for use of information and data.	CLIMATE CAMPUS Learn about the underpinning science of climate change, modelling and projections.	PROJECTIONS AND DATA Explore Australia's projected climate and access model data. Register for data access.	IMPACTS AND ADAPTATION Learn about possible regional impacts on natural resources and management responses.
NEWS & UPDATES Keep up to date on datasets, enhancements, and downtime.	HISTORIC CLIMATE CHANGE Learn about observed climate change over Australia.	REGIONAL CLIMATE CHANGE EXPLORER Summary of climate change projections for Australian regions.	PUBLICATIONS LIBRARY Download technical and regional reports and other publications.

  Australian Government
Department of the Environment
Bureau of Meteorology



<https://www.climatechangeinaustralia.gov.au/en/>

TECHNICAL REPORT



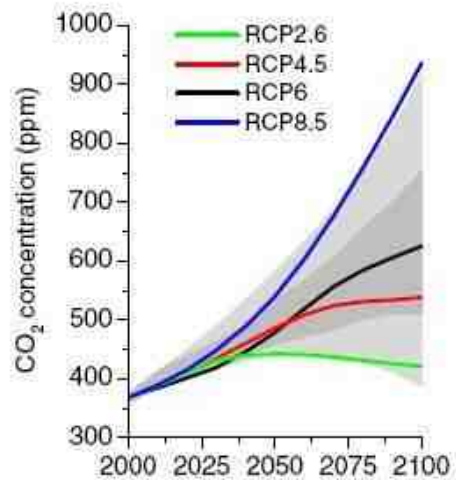
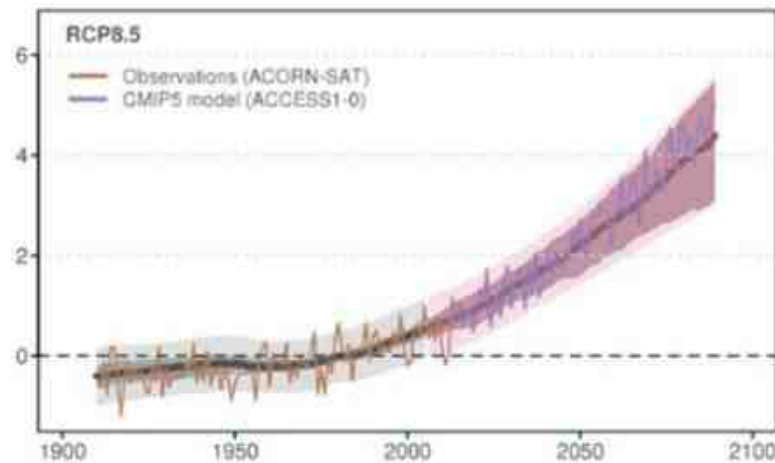
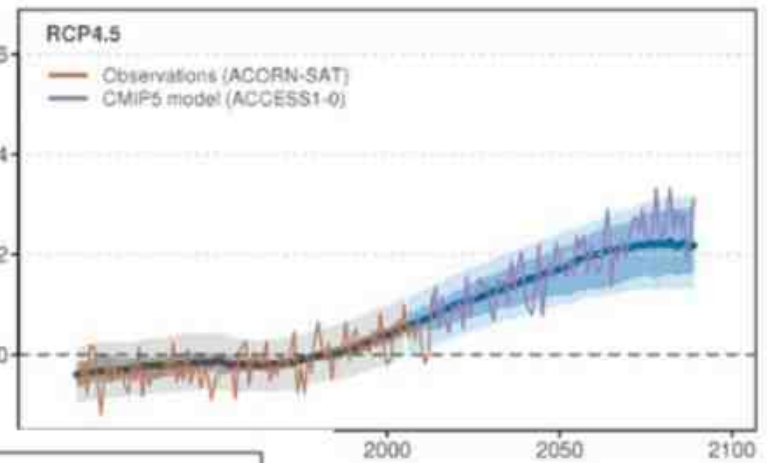
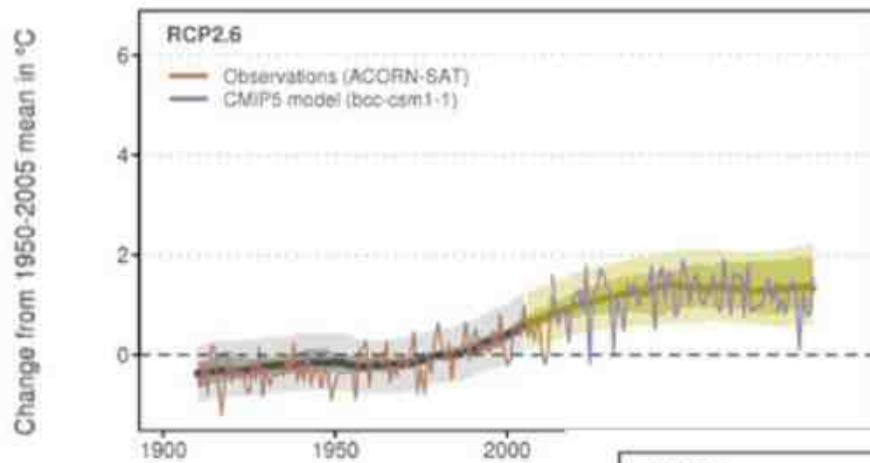
PROJECTIONS
FOR AUSTRALIA'S NRM REGIONS

2015
(222 pp!!)

–10° –5° 0° 5° 10° 15° 20° 25°

Australian projections



Australian climate change projections



Australia's national climate projections at www.climatechangeinaustralia.gov.au indicate that over coming decades Australia will experience:

- Further increase in temperatures, with more extremely hot days and fewer extremely cool days.
- Ongoing sea level rise.
- Further warming and acidification of the oceans around Australia.
- More frequent, extensive, intense and longer-lasting marine heatwaves, suggesting in turn more frequent and severe bleaching events on the Great Barrier Reef, and potentially the loss of many types of coral throughout the tropical reef systems of Australia and globally.
- A decrease in cool-season rainfall across many regions of southern Australia, with more time spent in drought.
- More intense heavy rainfall throughout Australia, particularly for short-duration extreme rainfall events.
- An increase in the number of high fire weather danger days and a longer fire season for southern and eastern Australia.
- Fewer tropical cyclones, but a greater proportion of high-intensity storms, with ongoing large variations from year to year.

A few possible issues to consider for olives....

- ↑ Temperatures are already resulting in observed phenological changes, for a range of horticultural crops.....
- For example, issues with flowering (October/November), which may lead to lower yields or inconsistent optimal harvest times
- Impacts on fruit ripening (and therefore oil accumulation and chemical composition), so as with other horticultural crops, we may see shorter harvest periods to maintain quality
- Temperature during maturation of the fruit has a direct effect on the fatty acid composition of the oil. Generally hotter temperatures lead to decreased oleic acid (C18:1) and increased linoleic acid (C18:2) and/ or palmitic acid (C16:0)
- ↑ Temperatures can reduce total polyphenol contents and some volatile compounds. Oils produced from these conditions are robust, with higher bitterness and pungency and lower fruit note
- Water availability. Olives can survive in warm or arid conditions, however, in order to produce commercial yields either irrigation or well timed rainfall is required. Insufficient rainfall or lack of irrigation water will lower yields and may affect quality parameters such as free fatty acids, if the fruit desiccates prior to harvest.
- *Studies into deficit irrigation and irrigation timing to maintain olive oil quality will be crucial!*



Department of
Primary Industries

<https://www.dpi.nsw.gov.au/climate-and-emergencies/climate-change-research-strategy>

NSW Primary Industries Climate Change Research Strategy



Energy



Carbon
Opportunities



Climate
Resilience

PI CCRS Overview



A research strategy to prepare primary industries for the future

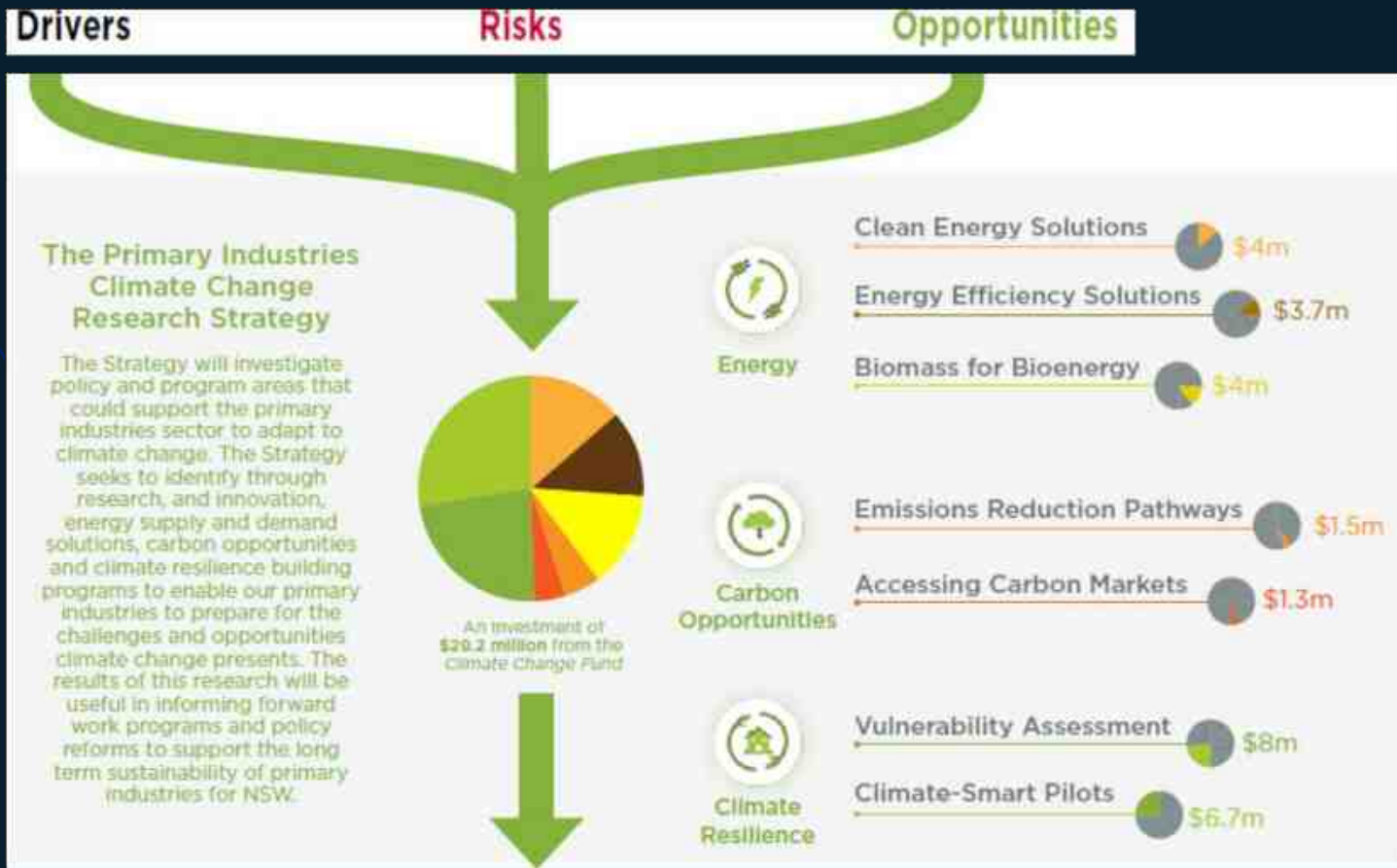
The Strategy has a portfolio of targeted actions aimed at growing the NSW primary industries sector through helping it meet the challenges of a changing climate, whilst enabling primary industries to capitalise on the opportunities.

With support from the Climate Change Fund, the Strategy will help primary industries maintain growth in productivity and profitability, while working with stakeholders to guide future projects and investment.

The seven targeted actions within the Strategy focus on three key theme areas:



PI CCRS Overview



NSW DPI – State Seasonal Conditions Monitoring

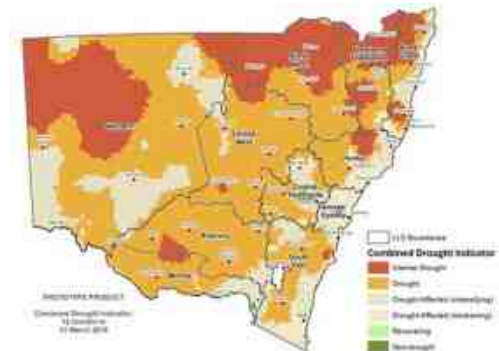
Enhanced Drought Information System (EDIS) & Combined Drought Indicator (CDI)

(1). Enhanced Drought Information System (EDIS)

- System that processes the input of meteorological, hydrological and agronomic data.

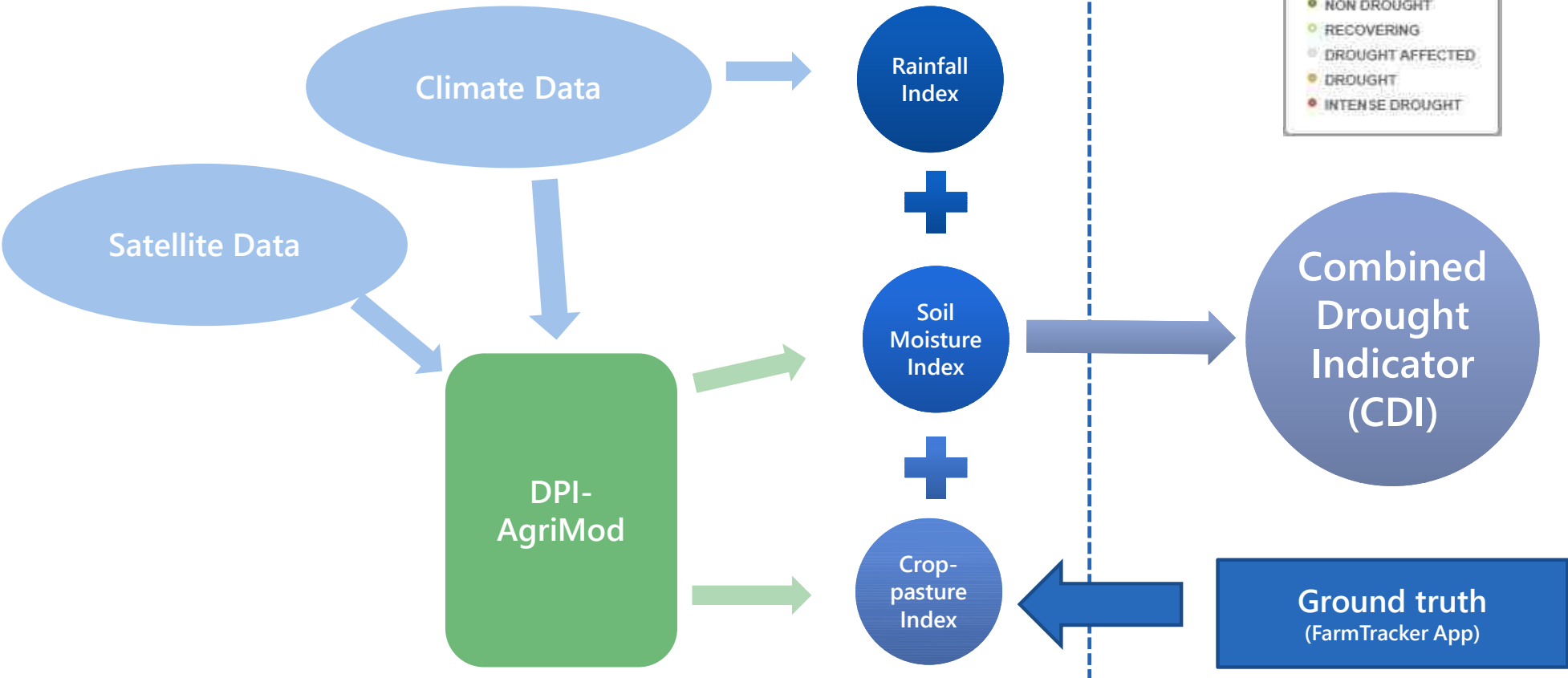
(2). Combined Drought Indicator (CDI)

- The visual output of the EDIS processing & modelling.
- Aggregates the combined effect of rainfall, soil water and plant growth to indicate conditions.
- Indicator of rainfall effectiveness, rather than relying on rainfall alone as the indicator of conditions.
- Aimed to provide the regionalised awareness of conditions and earlier drought detection.
- Accessible by the public:
<https://edis.dpi.nsw.gov.au/>



Enhanced Drought Information System (EDIS)

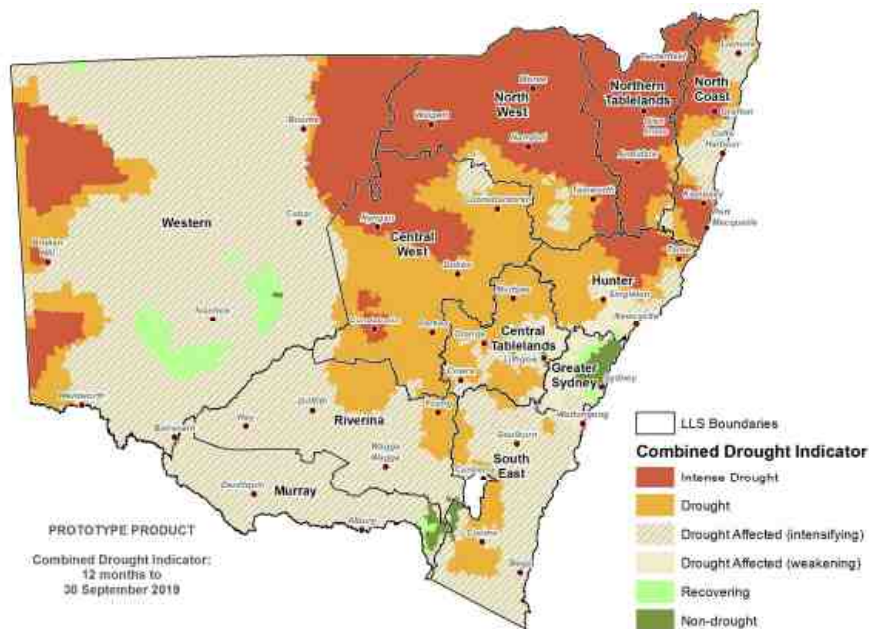
Combined Drought Indicator (CDI)



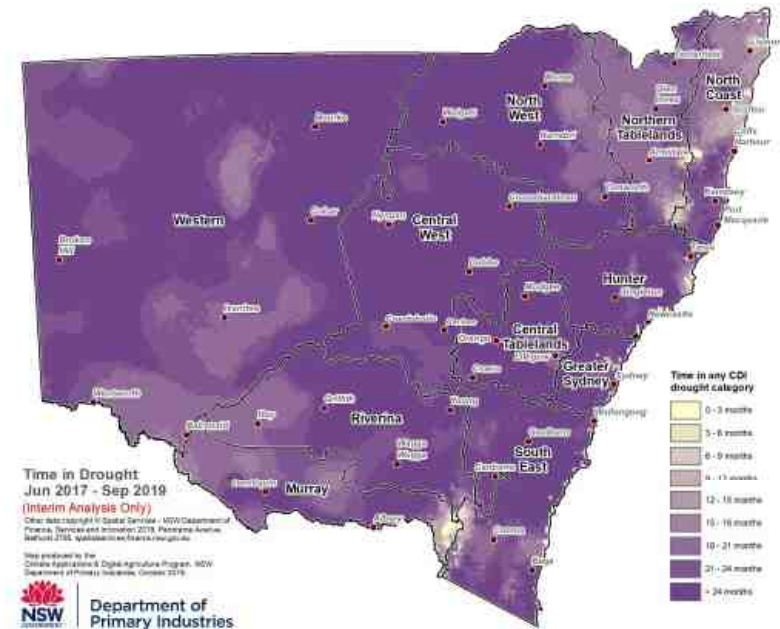
Combined Drought Indicator (CDI)

Regionalised Overview of Current and Accumulated Conditions

Snapshot Overview
30 Sep 2019

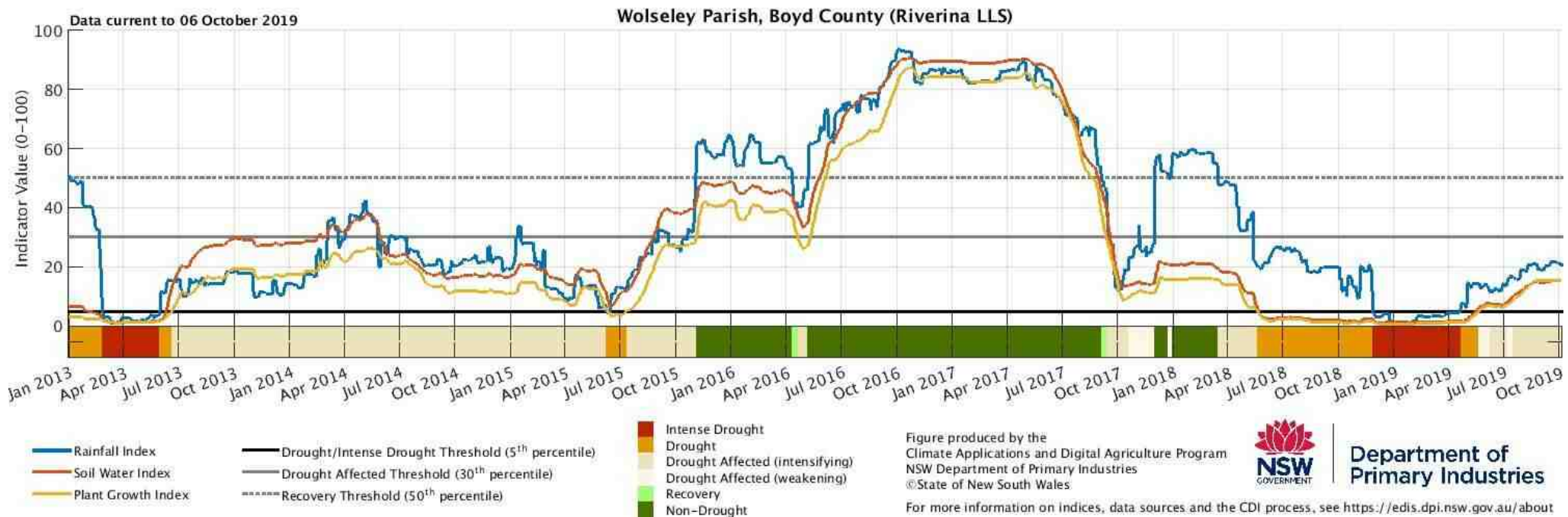


Accumulated Time in Any CDI Drought Category
1 June 2017 – 30 September 2019



Combined Drought Indicator (CDI)

Individual Parish Time Series Tracking of Indices



Seasonal Condition Information Portal (SCIP) – EDIS Website <https://edis.dpi.nsw.gov.au/statistics>

- Overview of Drought Indices, example and SCIP Instructions.
- Parish Search Map - for the purpose of obtaining Parish Name.
- Supporting links.

Thankyou

SUNSET, OUTBACK AUSTRALIA, ISTOCK