Climate change-related heat risks and solutions in urban environments

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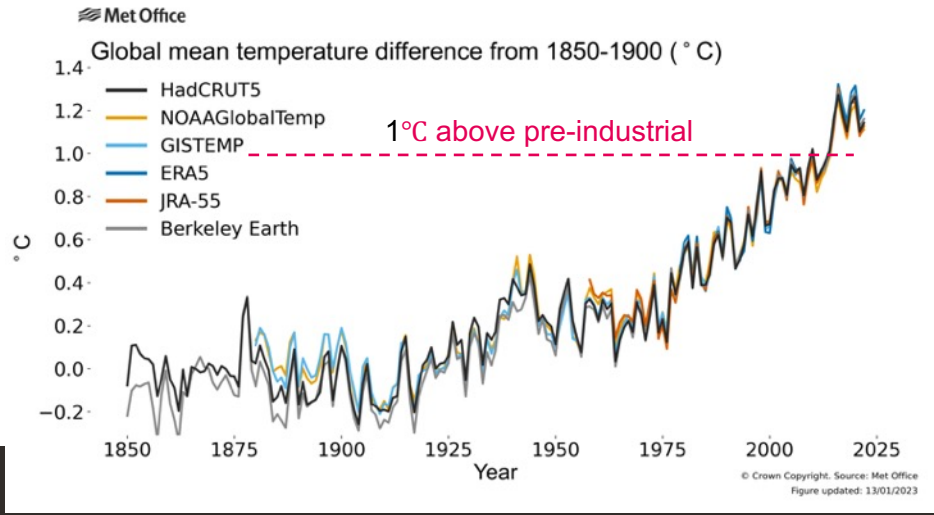
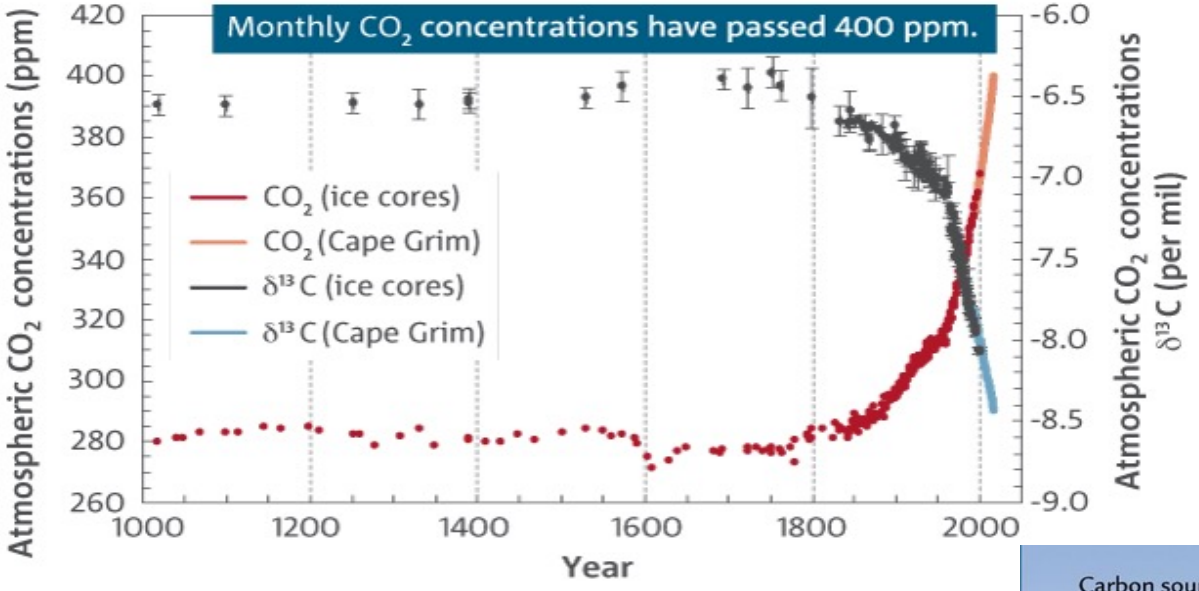
Some views from leaders

Antonio Guterres,
UN Secretary-General, 2021
"The IPCC Report is a code red for humanity"

Andrew Mackenzie, BHP, 2019
"The evidence is abundant: Global warming is indisputable. The planet will survive. Many species may not"



Observed carbon dioxide increases

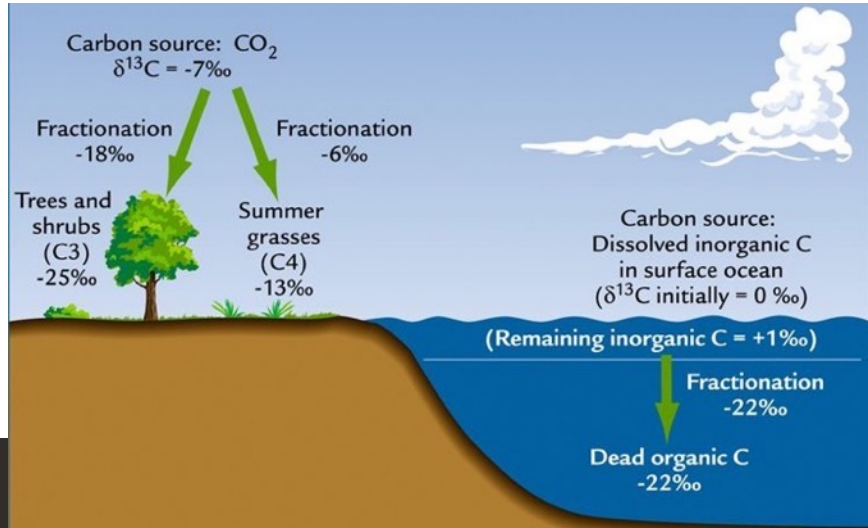


Source: CSIRO

The decrease in the ratio of the carbon-13 isotope ($\delta^{13}C$) that accompanies increasing CO_2 trends show that the sources are fossil fuel and land-use change.

from State of the Climate, 2016

2022 CO_2 of 414 ppm at Cape Grim



Observed global climate change

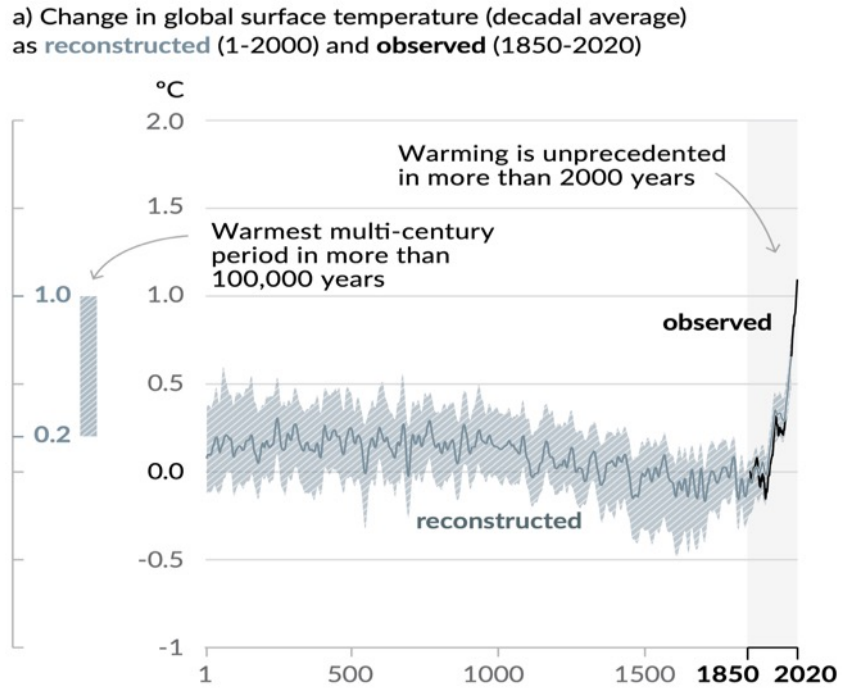


Fig SPM.1, IPCC AR6 WG1

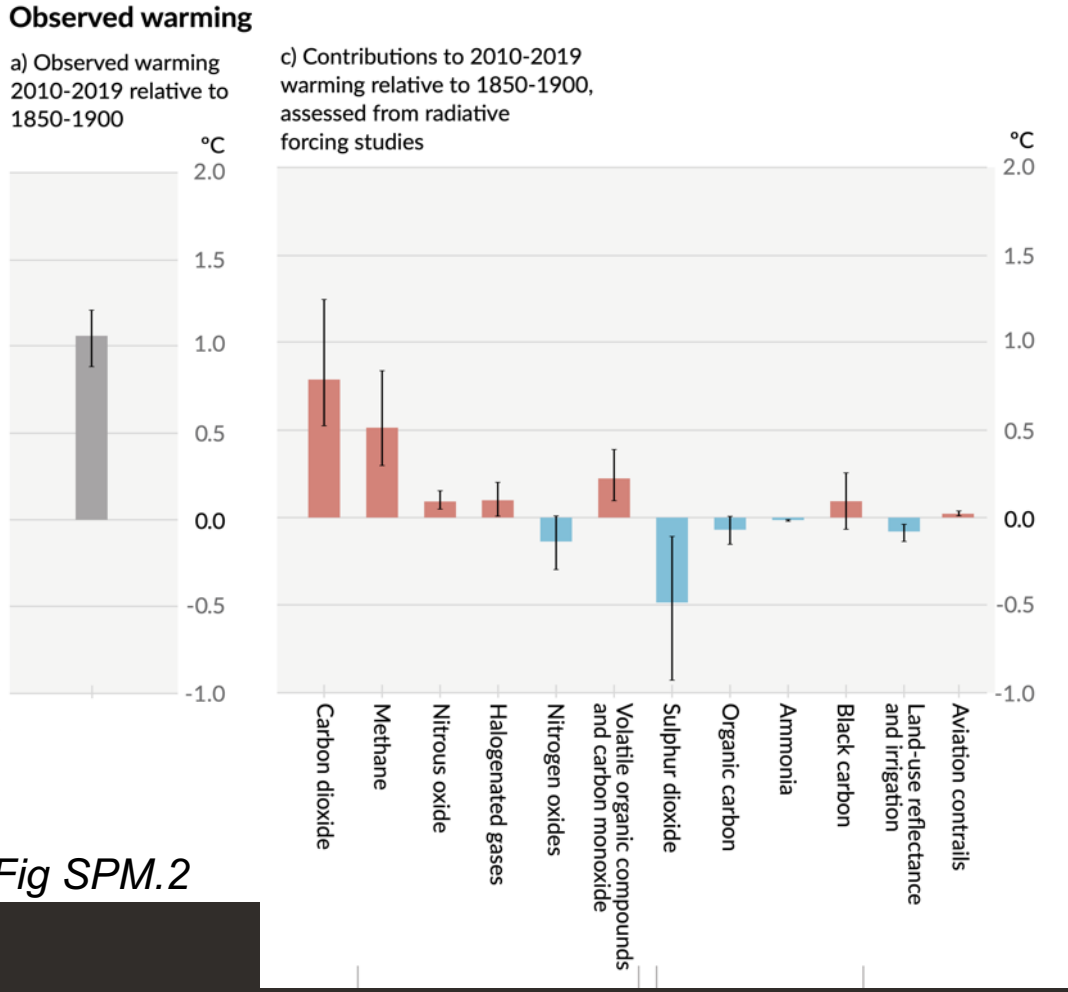
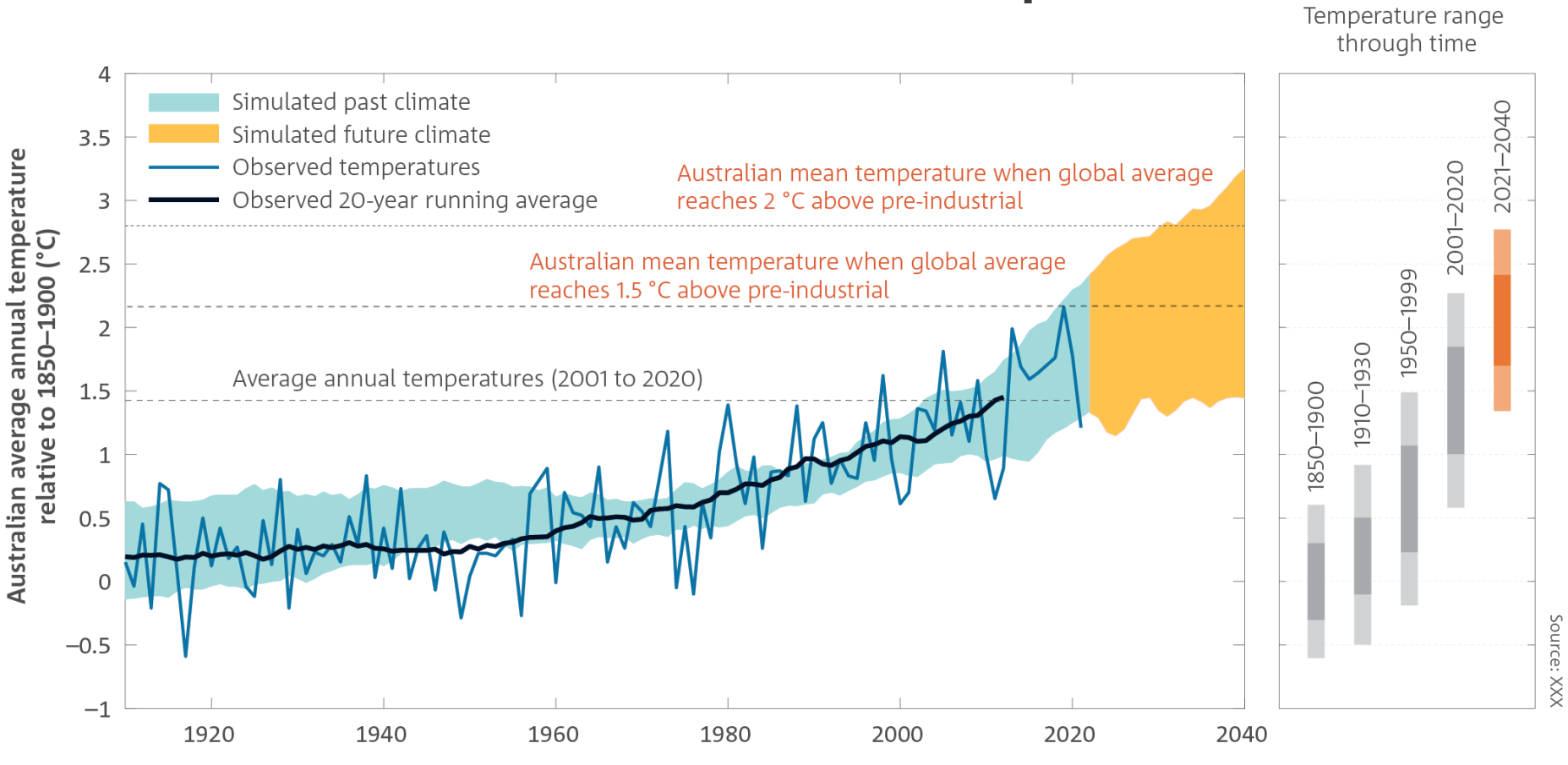
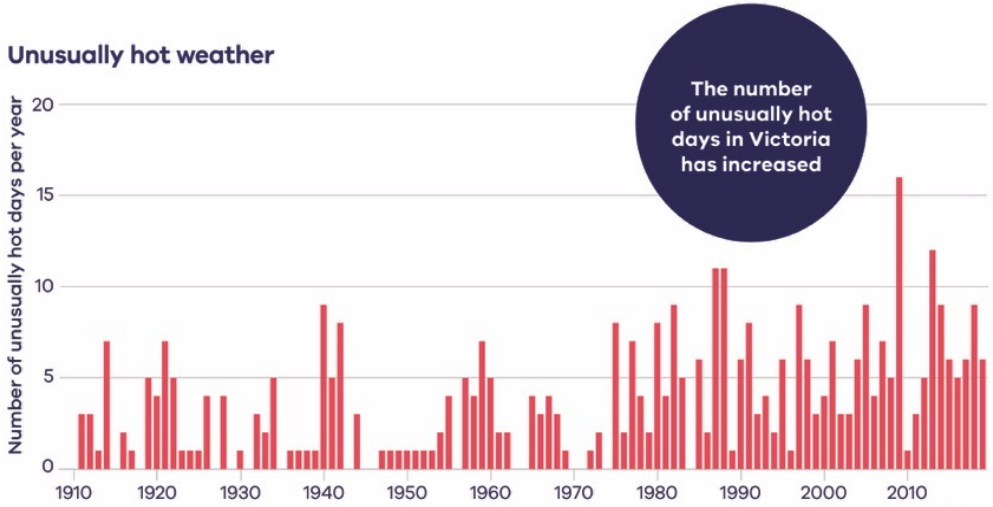


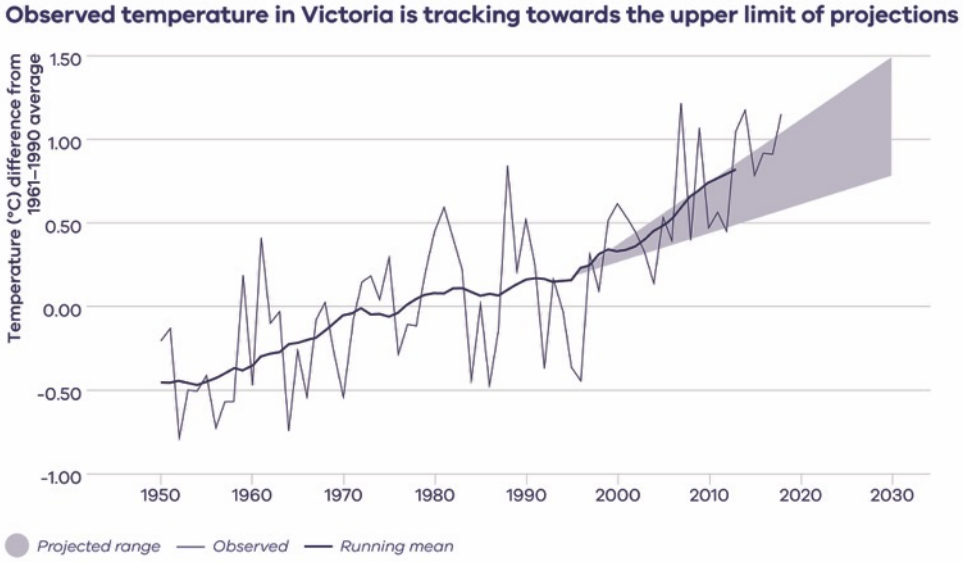
Fig SPM.2

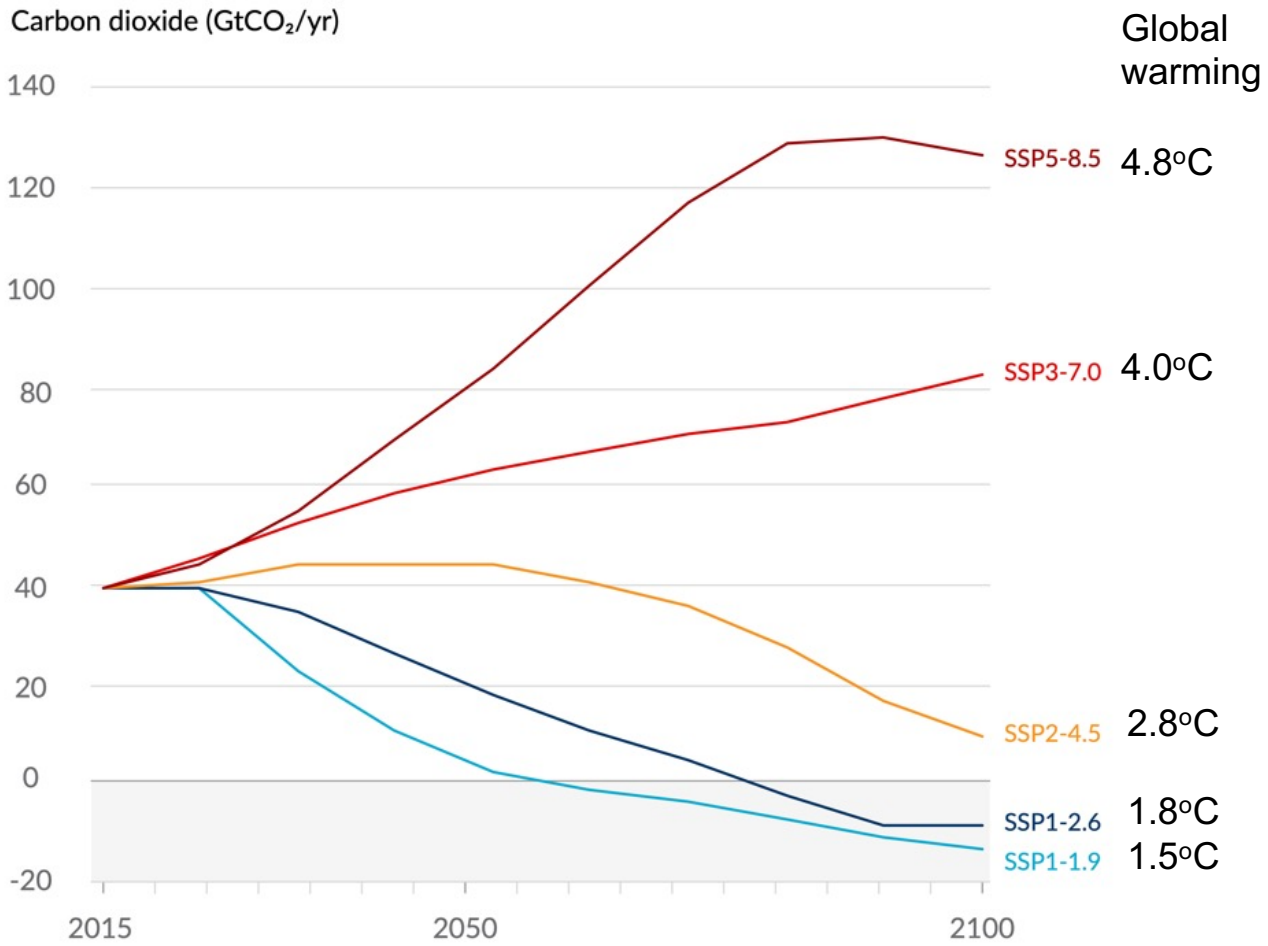
Observed and simulated Australian temperature



Observed and projected Victorian temperature changes







Future emission scenarios

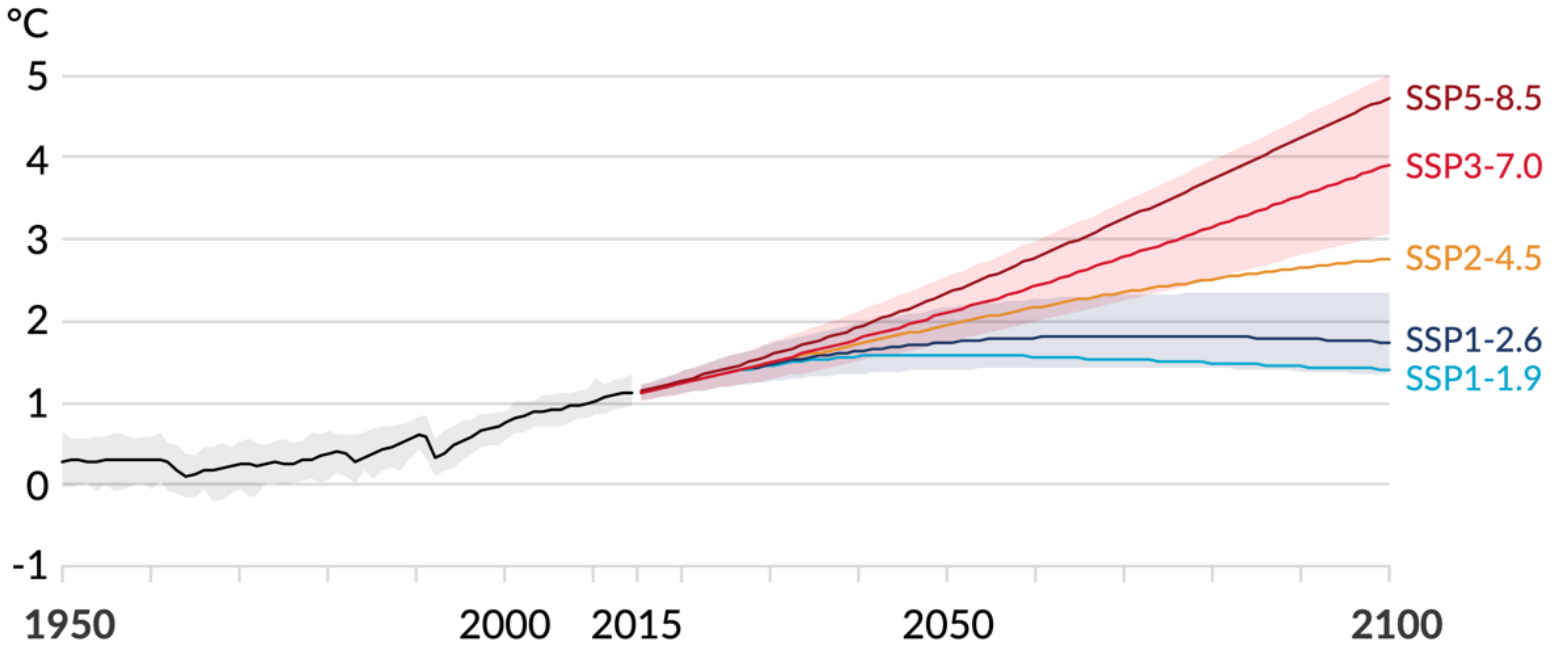
'*Every tonne of CO_2 emissions adds to global warming*'

CLIMATE COUNCIL

Fig SPM.4 IPCC AR6 WG1

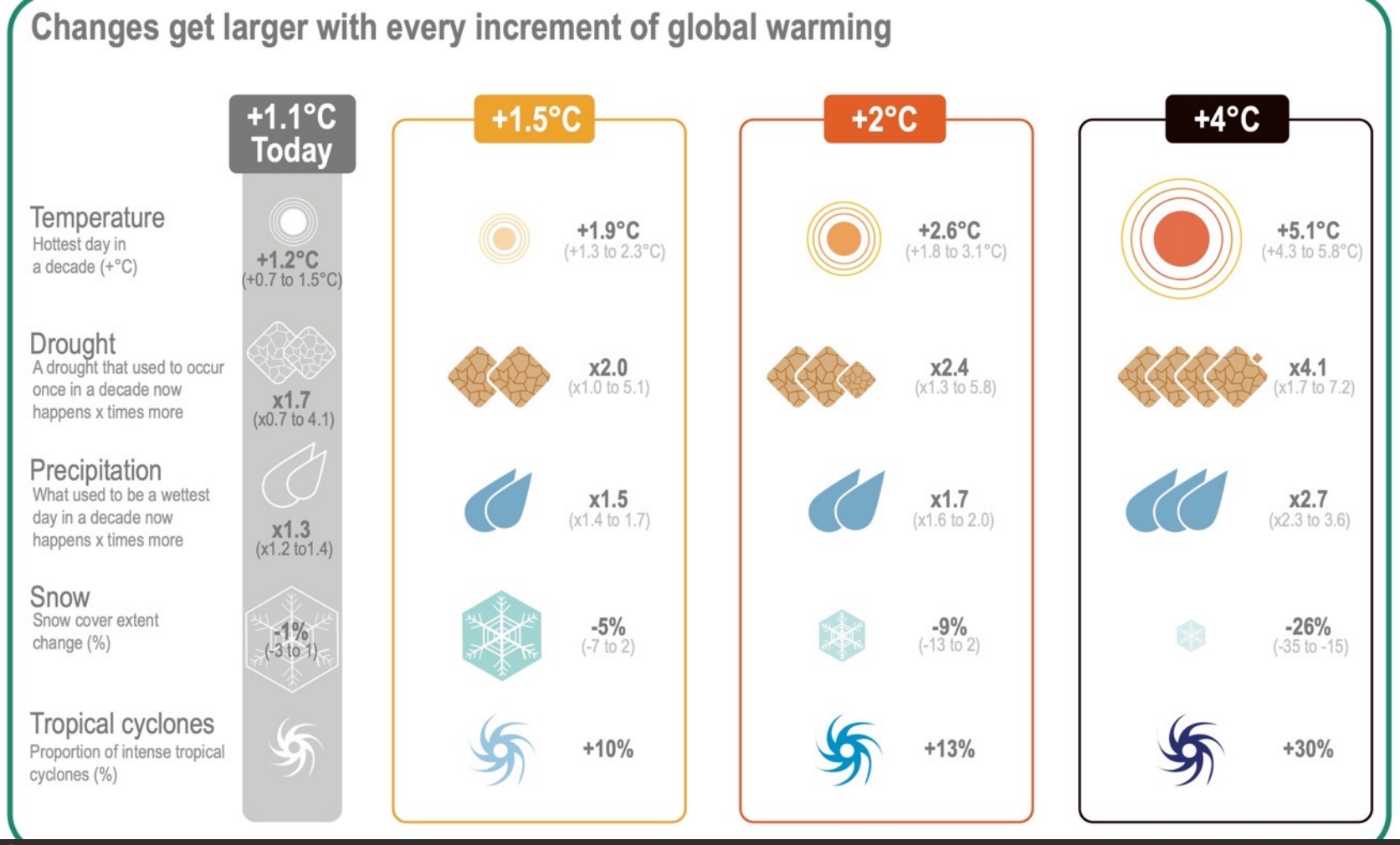
Projected climate change

a) Global surface temperature change relative to 1850-1900



Very low emissions gives >50% chance of warming less than 2°C

Fig SPM.8, IPCC AR6 WG1


Changes get larger with every increment of global warming
+1.1°C Today
+1.5°C
+2°C
+4°C
Temperature
Hottest day in a decade (+°C)
+1.2°C (+0.7 to 1.5°C)
+1.9°C (+1.3 to 2.3°C)
+2.6°C (+1.8 to 3.1°C)
+5.1°C (+4.3 to 5.8°C)
Drought
A drought that used to occur once in a decade now happens x times more
x1.7 (x0.7 to 4.1)
x2.0 (x1.0 to 5.1)
x2.4 (x1.3 to 5.8)
x4.1 (x1.7 to 7.2)
Precipitation
What used to be a wettest day in a decade now happens x times more
x1.3 (x1.2 to1.4)
x1.5 (x1.4 to 1.7)
x1.7 (x1.6 to 2.0)
x2.7 (x2.3 to 3.6)
Snow
Snow cover extent change (%)
-1% (-3 to 1)
-5% (-7 to 2)
-9% (-13 to 2)
-26% (-35 to -15)
Tropical cyclones
Proportion of intense tropical cyclones (%)
+10%
+13%
+30%

Future climate change in Melbourne

	Baseline 1986-2005 1981-2010	Present 2011-2020	2030 (2015-44) medium emissions
Ann mean max temp	20.4°C	+0.8±0.3 **	+0.9°C (0.8 to 1.3°C)
Annual rainfall	631 mm	-7%±9%	-4% (-13% to +2%)
Days/year over 35°C	8.9	9.3±1.8	13 (12 to 15)
Days/year over 40°C	1.2	2.0±0.3 **	2.4 (2.1 to 3.0)

* Significant change at the 90% level; ** Significant change at the 99% level

From ACORN-SAT v2.2 (BoM) and Melbourne's future climate projections

Negative UHI in Melbourne, Sydney in summer heatwaves

	Feb mean Tmax, Tmin	Record Tmax	Days Tx > 35	Days Tx > 40
Melbourne Reg Off	26.9, 16.4	46.4, 7 Feb 2009	10.9	1.9
Melbourne Airport	26.7, 14.4	46.8, "	11.4	2.1
Laverton RAAF	25.9, 14.7	47.5, "	10.8	2.5

	Jan mean Tmax, Tmin	Record Tmax	Days Tx > 35	Days Tx > 40
Sydney Observ Hill	27.0, 20.0	45.8, 18 Jan 2013	4.0	0.5
Parramatta	29.1, 17.9	47.0, 4 Jan 2020	13.1	1.9
Richmond RAAF	30.4,17.9	47.4, "	18.9	3.1

From Bureau of Met station data 1991-2020

IPCC AR6 Climate change impacts

Some high confidence key risks for Australia

- Loss … of coral reefs … due to marine heatwaves
- Increase in heat-related mortality … for people and wildlife due to heatwaves
- Cascading impacts on cities, settlements, infrastructure and services due to wildfires, floods, droughts, heatwaves, storms and sea-level rise
- Inability of institutions and governance systems to manage climate risks

Adapting to a changing climate in urban environments

- Reduce impacts of increased heat stress
  - Improved building design, better insulation, more shade
  - Improved urban design, more trees
- Adaptation and mitigation co-benefits
  - Greening cities: more parks and more trees to increase shade and capture carbon dioxide
- Improve water use efficiency
  - Increased water recycling
  - Increased local water capture

Mitigation Measures

More efficient use of energy

Greater use of low-carbon and no-carbon energy

- Many of these technologies exist today (solar and wind)

Improved carbon sinks

- Reduced deforestation and improved forest management and planting of new forests
- Bio-energy with carbon capture and storage

Lifestyle and behavioral changes

AR5 WGIII SPM

Summary

- **We all need to manage climate risks associated with**
  - **physical risks due to the impacts of climate change**
  - **transition to a zero carbon-emission economy across all sectors**
- Climate change has already led to significant increases in climate risks and will continue to do so for the next 30-100 years or more
- Most confident projected changes are for increases in heat waves, extreme fire weather, coastal flooding and extreme short-term rainfall
- Recent observed increases in temperature extremes in many Australian cities are tracking at the worst case projected for 2030
- Adapting to urban heat extremes requires better building design - insulation and shade, urban greening and urban design
- Much stronger emission reductions to limit global warming to 1.5℃

References

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