

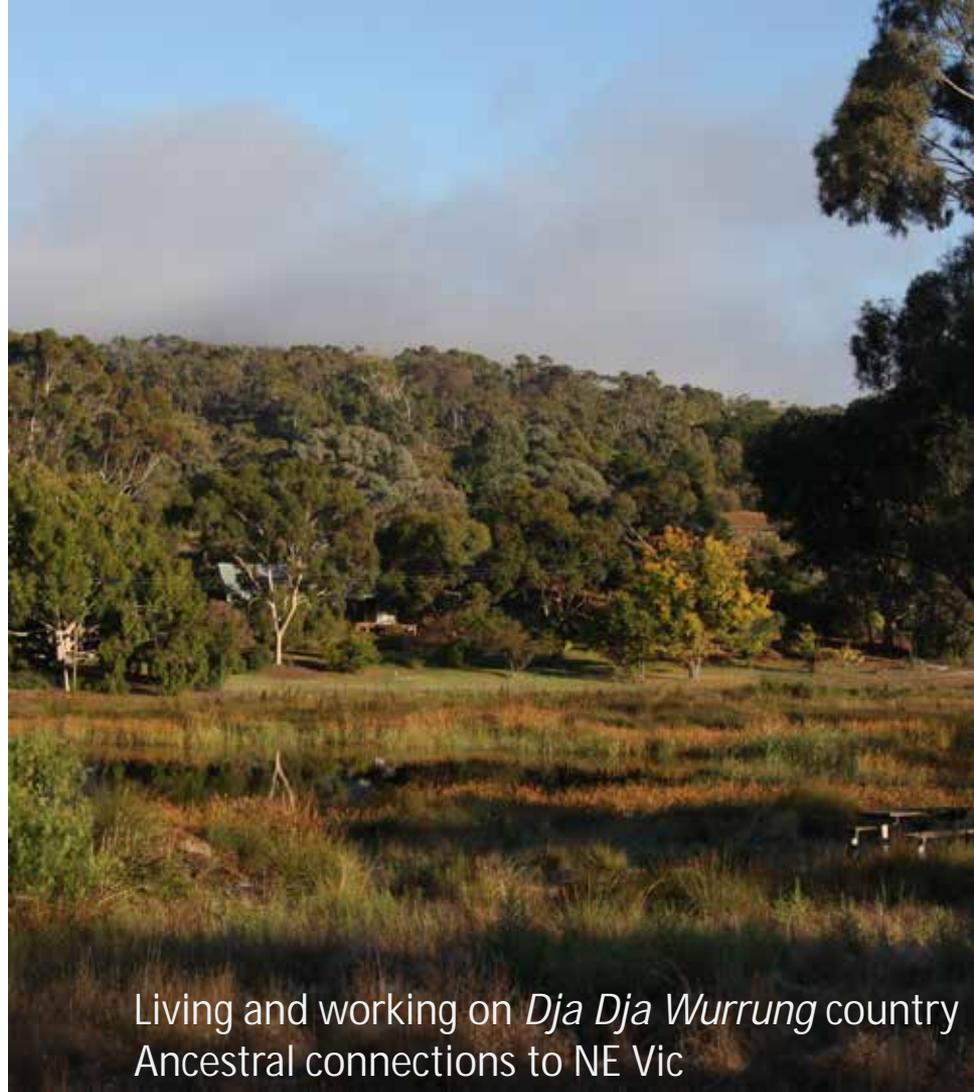


Getting Climate Projections Information to People in NRM

Accessible and fit for purpose?

John Clarke | 27th August 2021
Oceans & Atmosphere - Climate Science Centre

Australia's National Science Agency



Living and working on *Dja Dja Wurrung* country
Ancestral connections to NE Vic



Outline

- Some climate basics and misconceptions
- How are climate projections made?
- How good are climate projections anyway?
- Finding the right information for your needs



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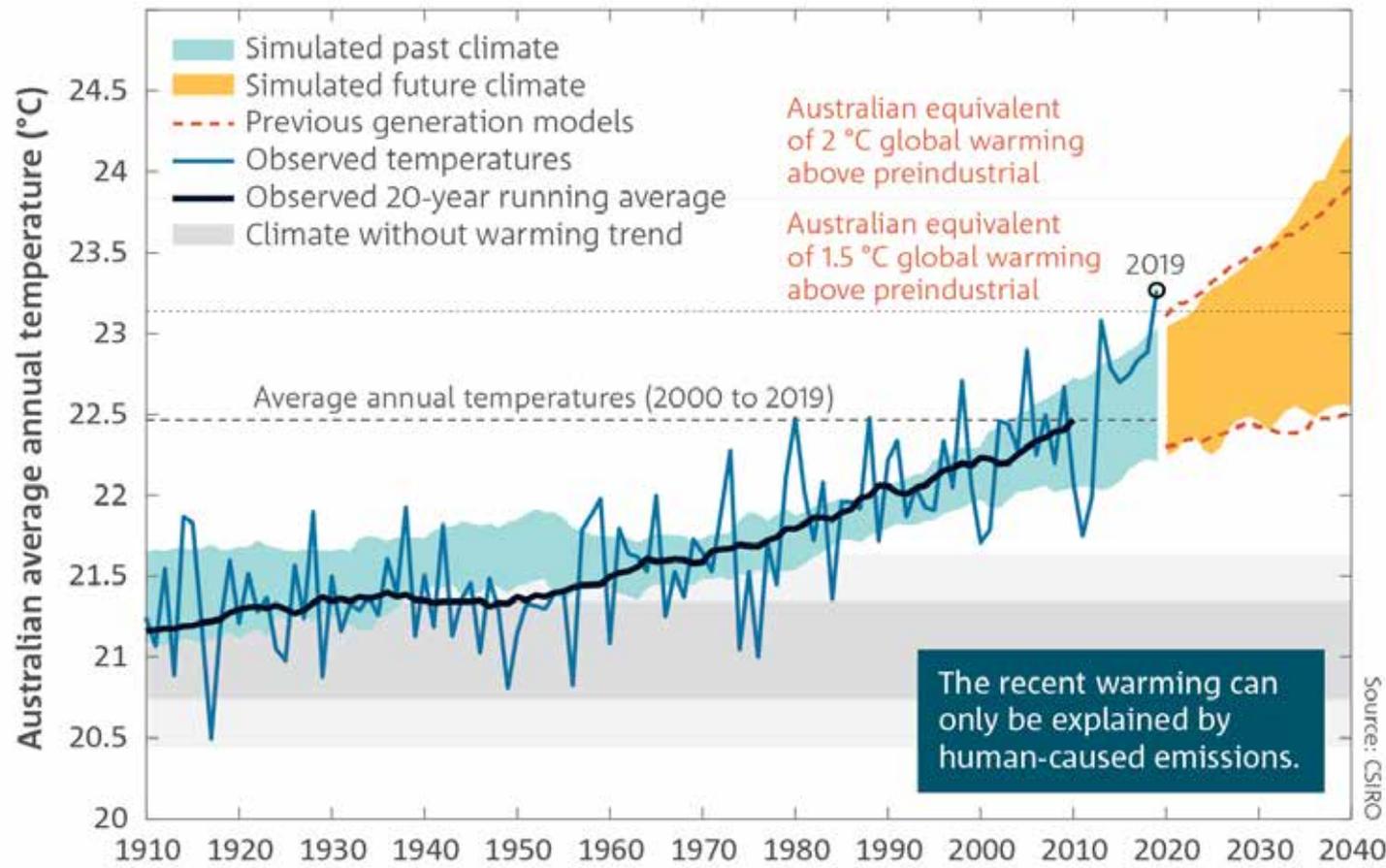
What is weather and what is climate?

Weather	Climate variability	Climate	Climate change
<p>Current atmospheric conditions at a particular place and time – over a few hours to a few days</p>	<p>Natural variation in climate that occurs between months, seasons and years</p>	<p>Average pattern of weather for a particular place over decades (e.g. 30 years)</p>	<p>Long-term trend in climate over decades to centuries</p>



The past is longer a guide to the future

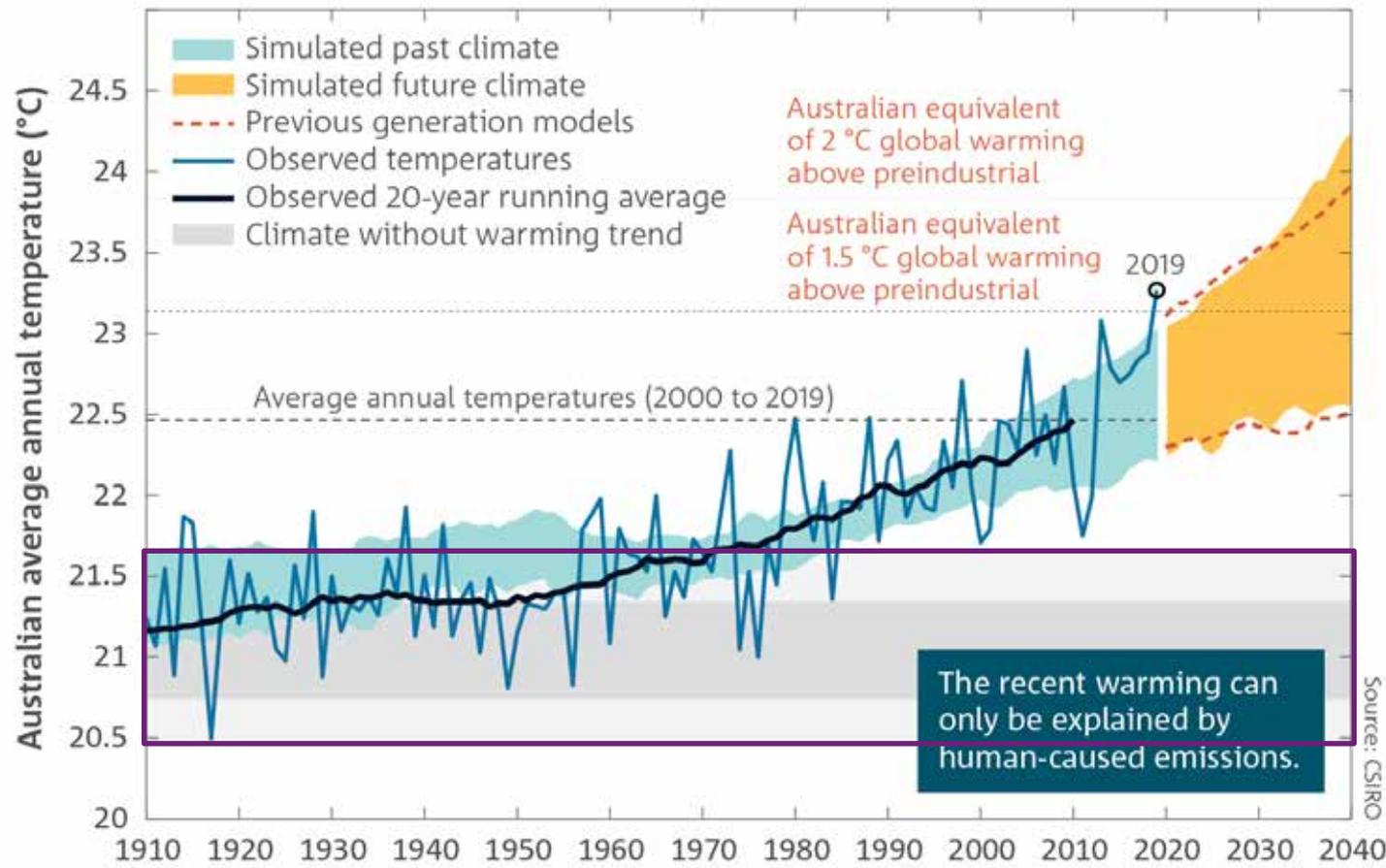
- We now live in a new climate
- Habitats are shifting
- Animals are mating earlier
- Flowering is happening earlier
- Fire season is starting earlier and lasting longer
- Growing season is longer





The past is longer a guide to the future

- We now live in a new climate
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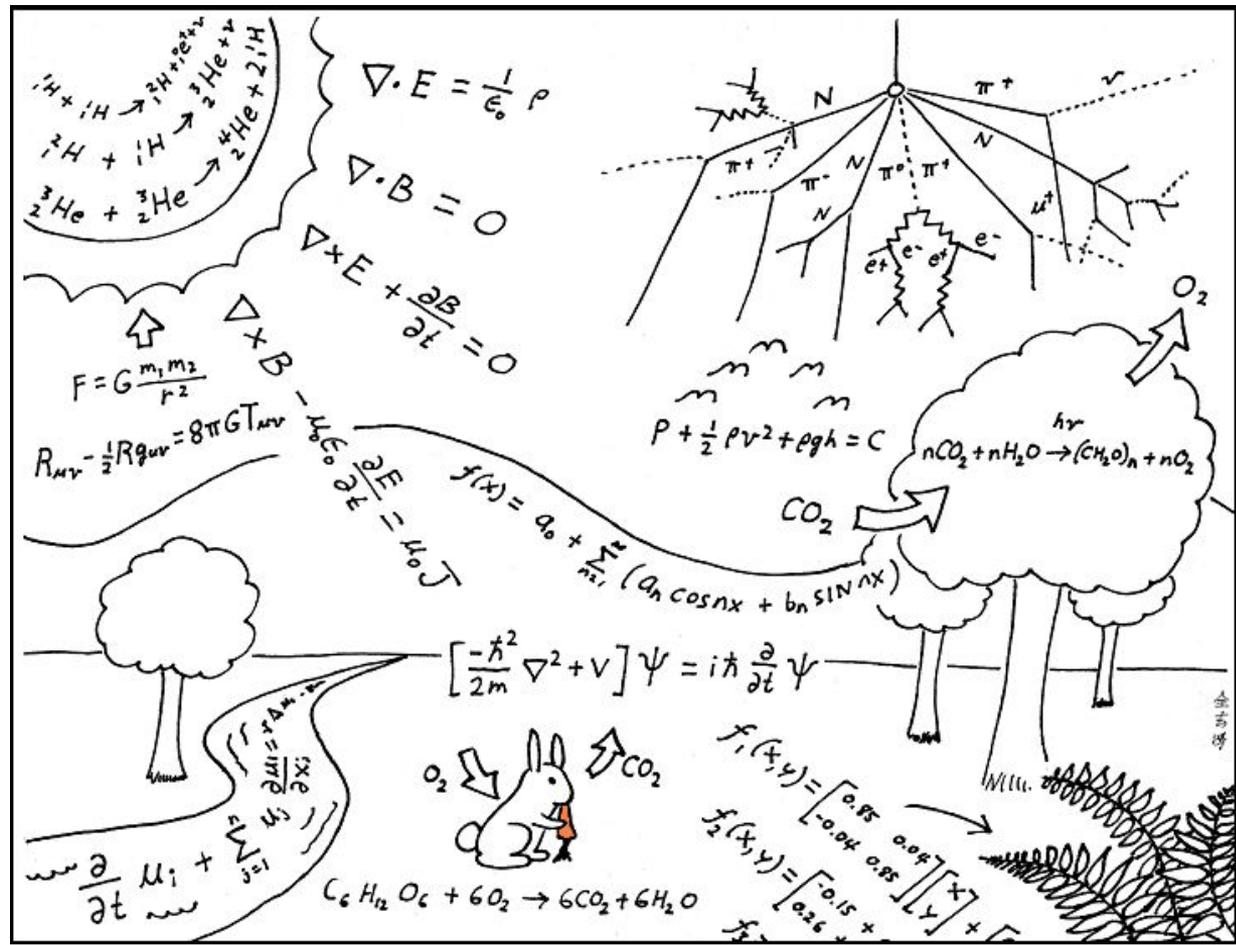


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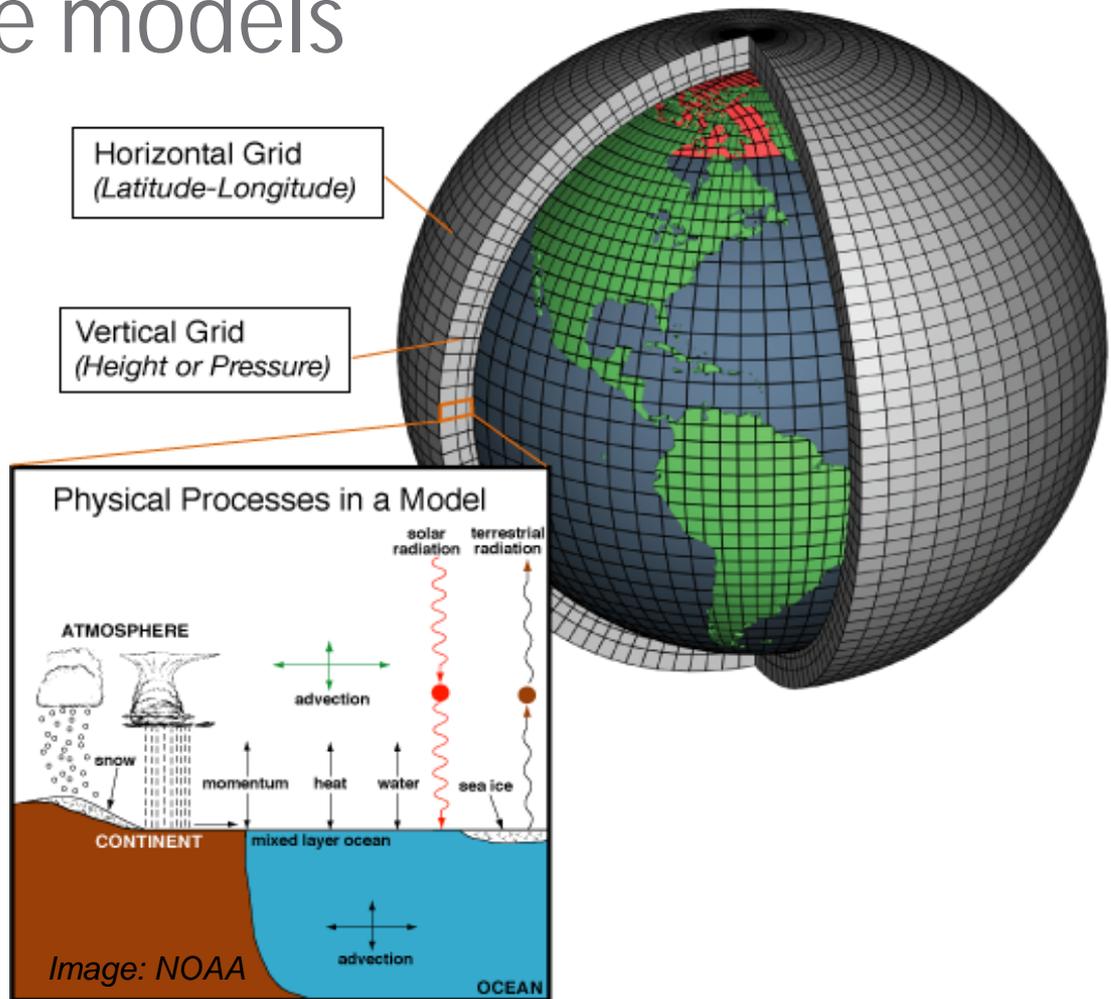


Modelling the climate system





Global climate models

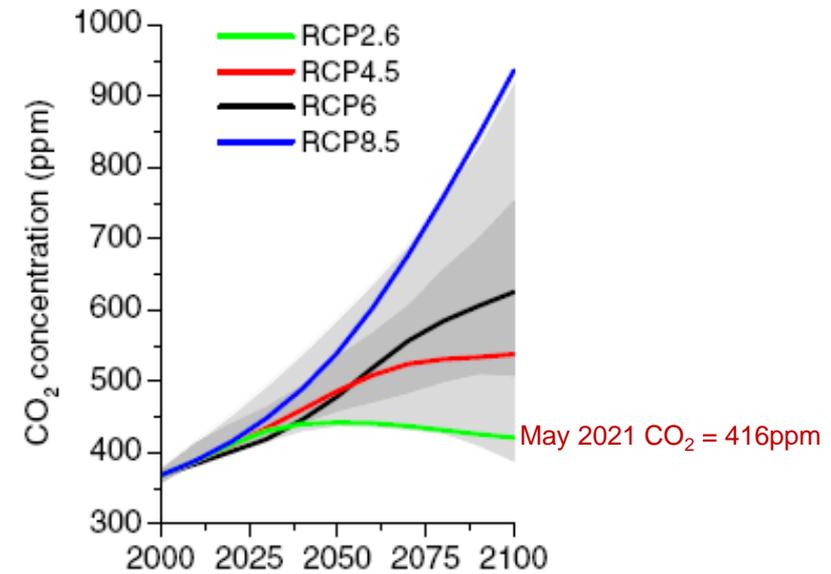
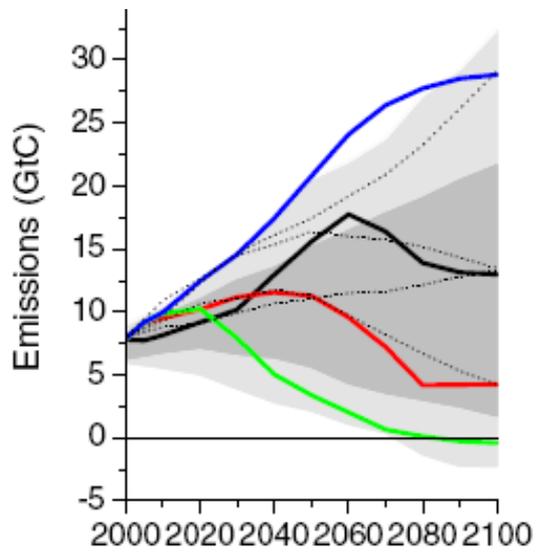




Future scenarios: emissions and concentrations

International scientific community defined a set of plausible future **emissions scenarios**.

Each emissions scenario has an associated greenhouse gas **“concentration pathway”**.
(RCP: Representative Concentration Pathway)

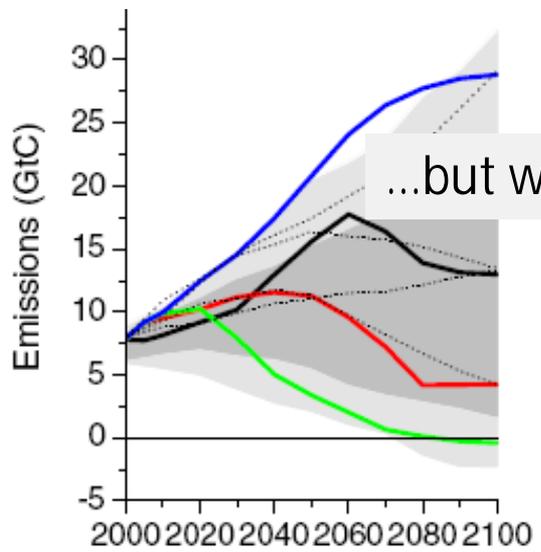




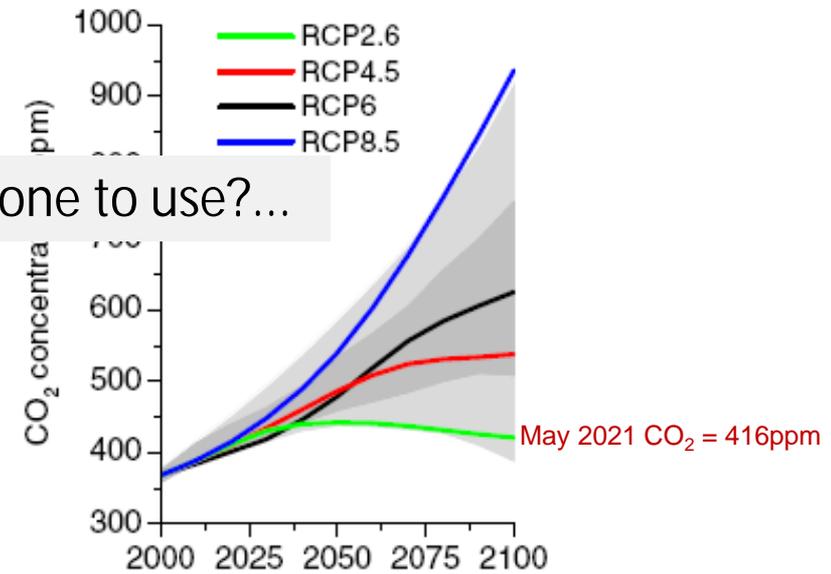
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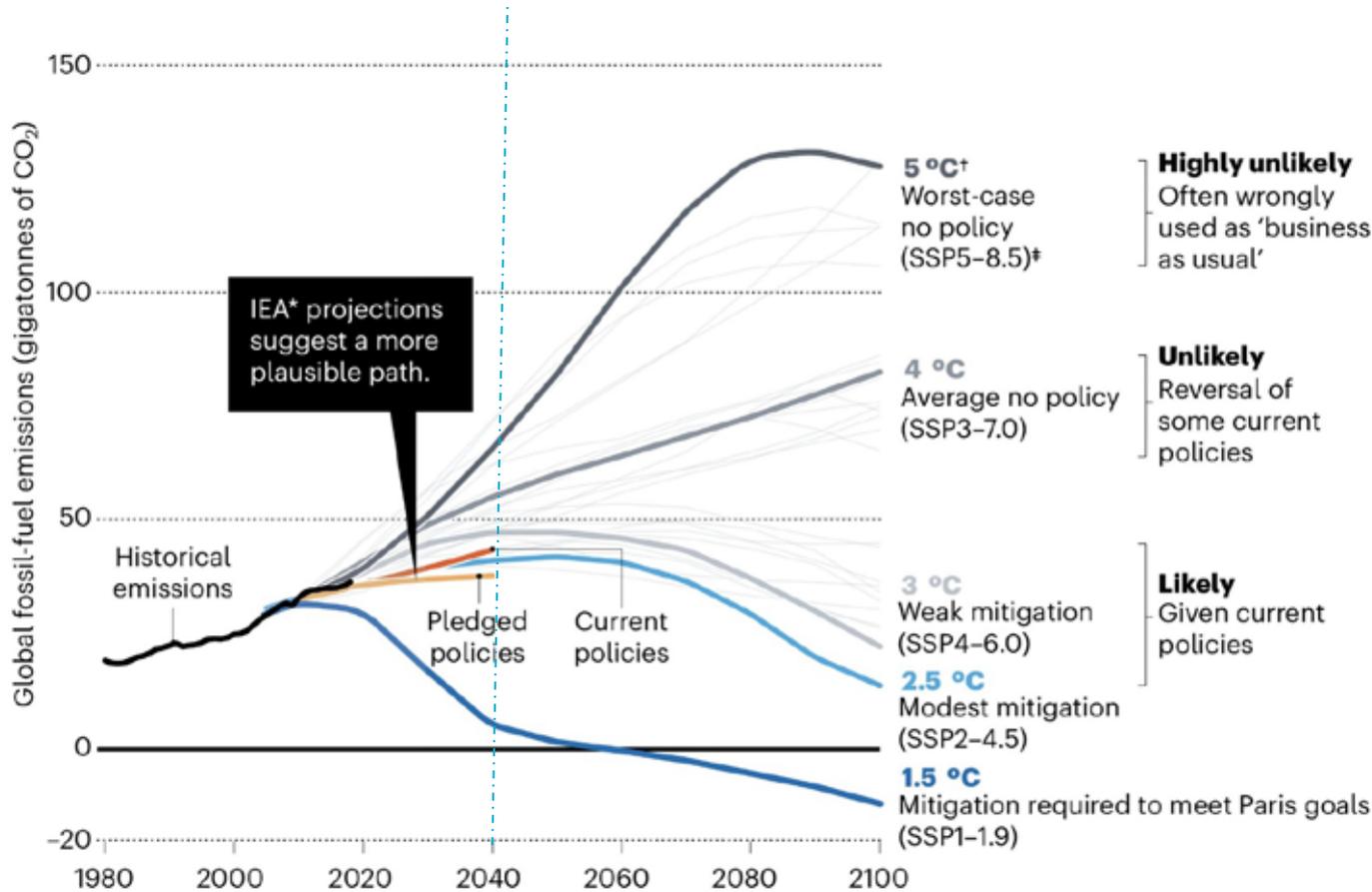


...but which is the right one to use?...





How likely is each pathway given current policy?



Considerations

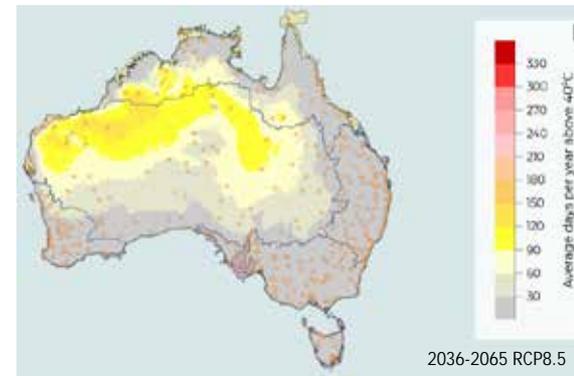
- Decision lifetime
- Impossible to know with certainty
- Keeping options open

*Analysis of International Energy Agency report by Zeke Hausfather, *Carbon Brief*



Historical weather data vs projections data

- Historical: one number
- Future: a range – ALWAYS
- Historical: absolute (?)
- Future: NOT a forecast



Annual days greater than 40°C	
1981-2010	2040-2059
2.2 (BoM)	Medium Emissions 4.8 to 7.8 High Emissions 6.4 to 10.9

Annual 'nights' less than 2°C	
1981-2010	2040-2059
81.1 (BoM)	Medium Emissions 34.3 to 48.5 High Emissions 32.5 to 41.7

Months/yr† much below average rainfall (decile 1)	
1981-2010	2040-2059
1.1	Medium Emissions 1.1 to 1.4 High Emissions 1.1 to 1.9

Rutherglen*: Hot & Cold Days / Dry years
2050s Medium & High Emissions

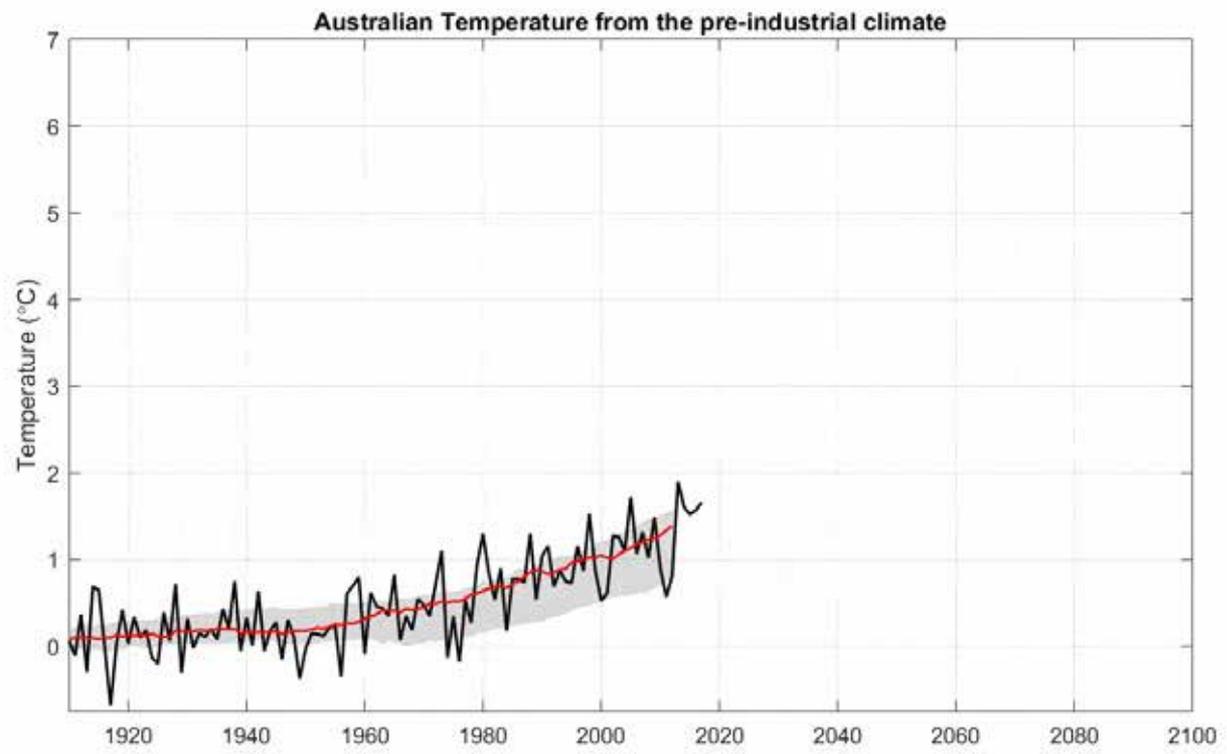
These numbers all represent long-term averages

* -36.10, 146.51

† May-Apr



That pesky range!



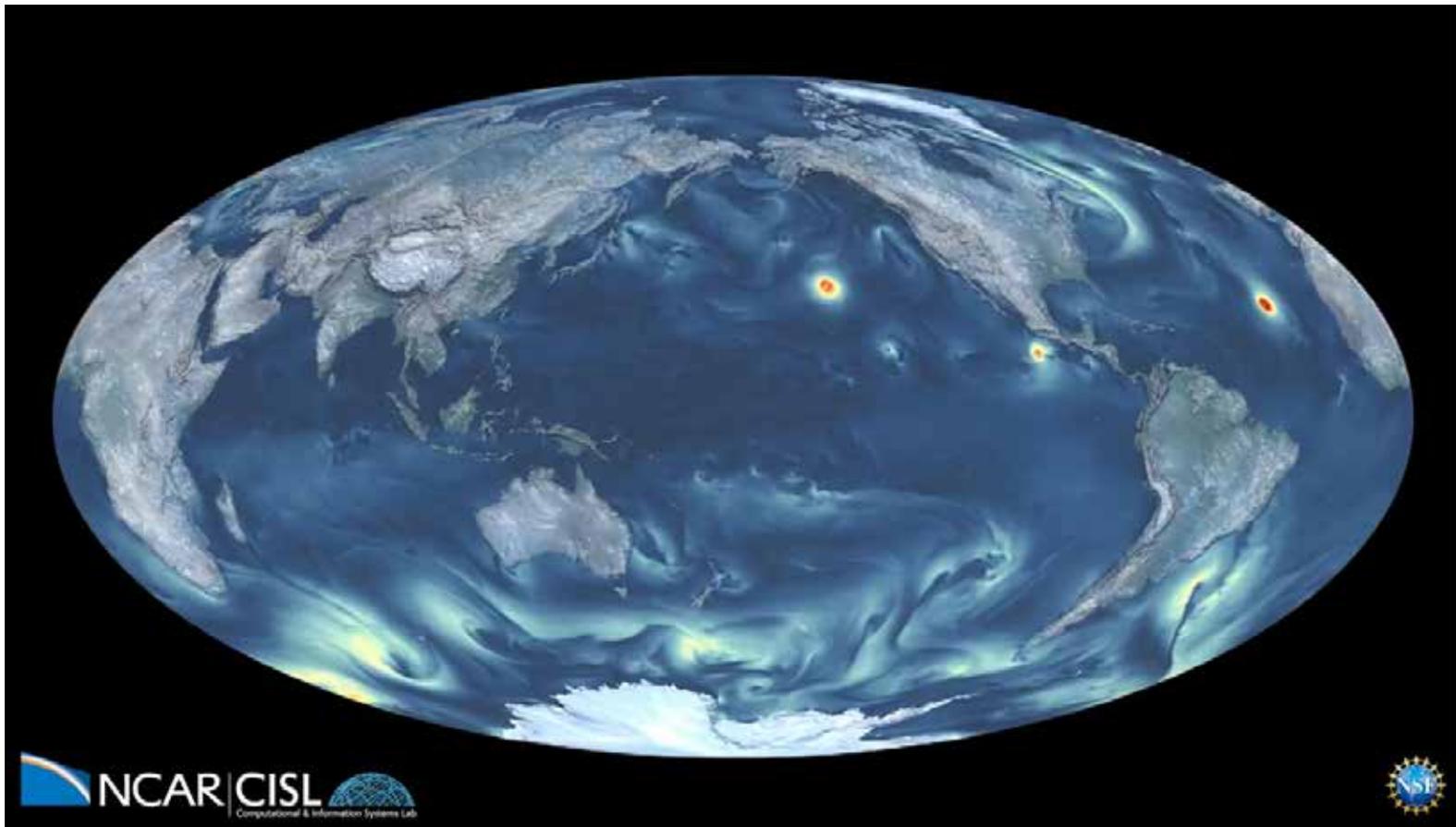


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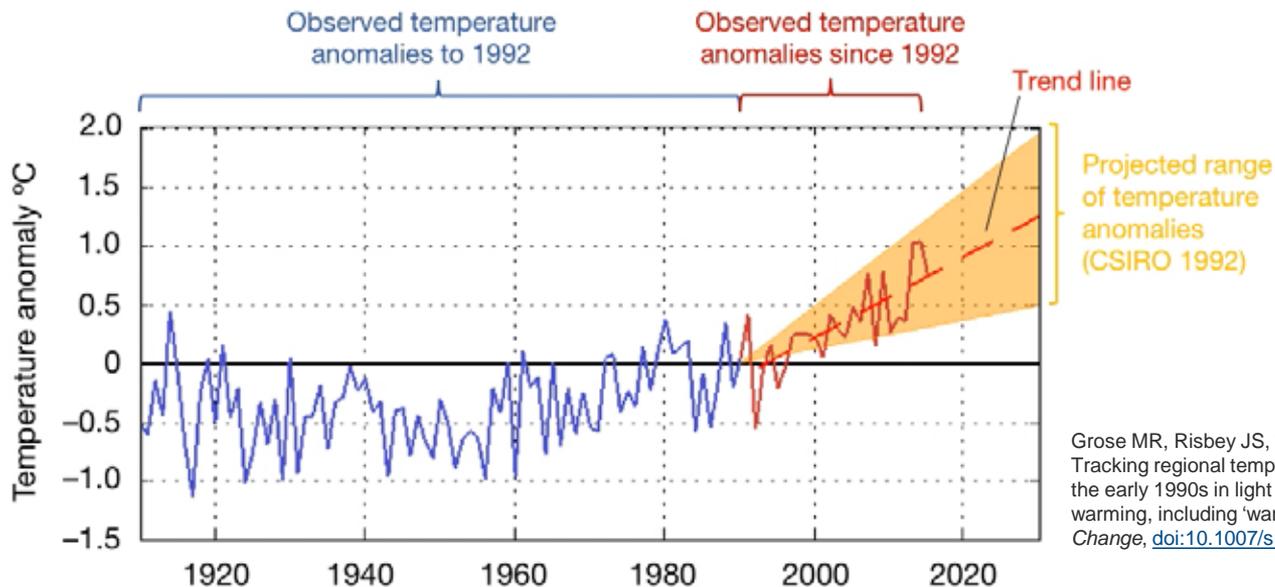
How good are climate models & projections?





How good are climate projections?

- It's almost 30 years since CSIRO released the 1992 projections



Grose MR, Risbey JS, Whetton PH. 2016. Tracking regional temperature projections from the early 1990s in light of variations in regional warming, including 'warming holes'. *Climatic Change*, [doi:10.1007/s10584-016-1840-9](https://doi.org/10.1007/s10584-016-1840-9)



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Fit for purpose?

The information you need depends on why you need it

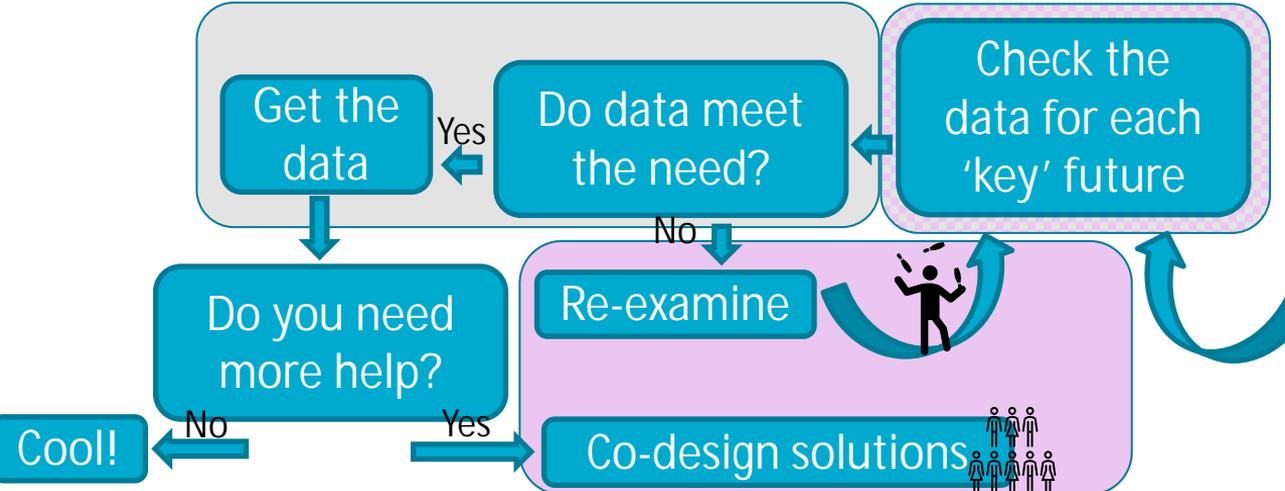
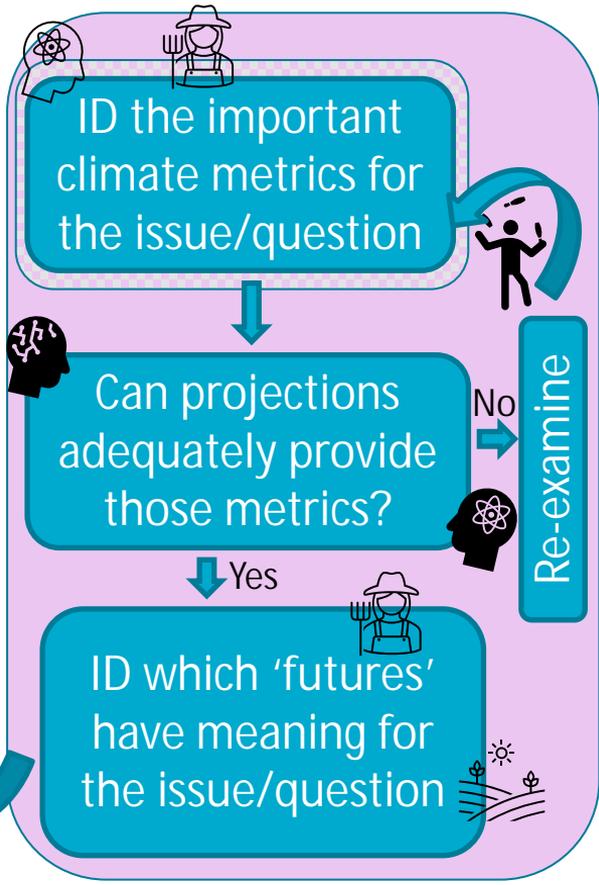
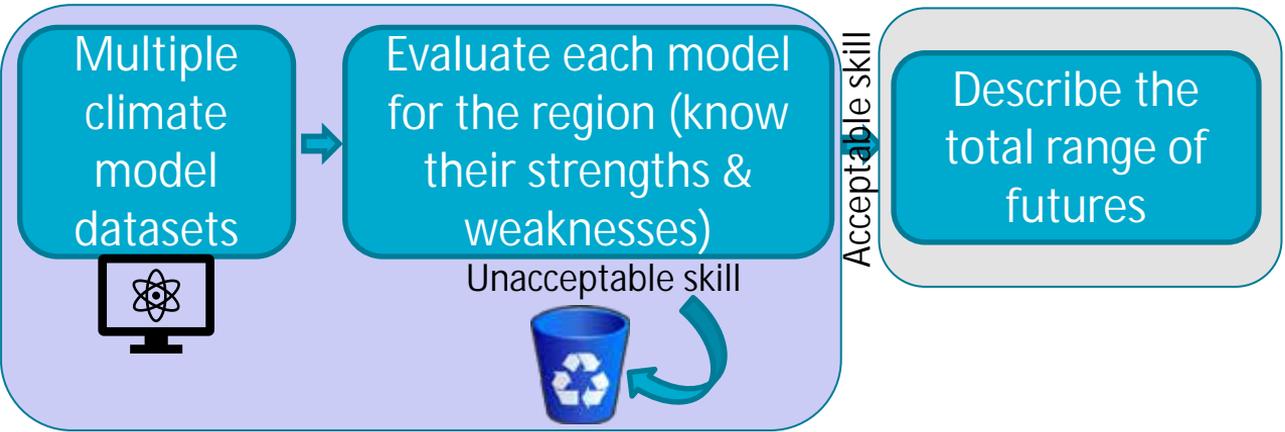
I need information about climate change, in general, to increase my own understanding and/or to raise awareness of climate change and/or to provide context for more specific information.

I need information about what the future holds for a particular area so I can provide information to stakeholders and/or include it in strategic planning and/or raise awareness of climate change.

I need data and/or detailed technical information for modelling and/or detailed impact, vulnerability and/or risk assessments.

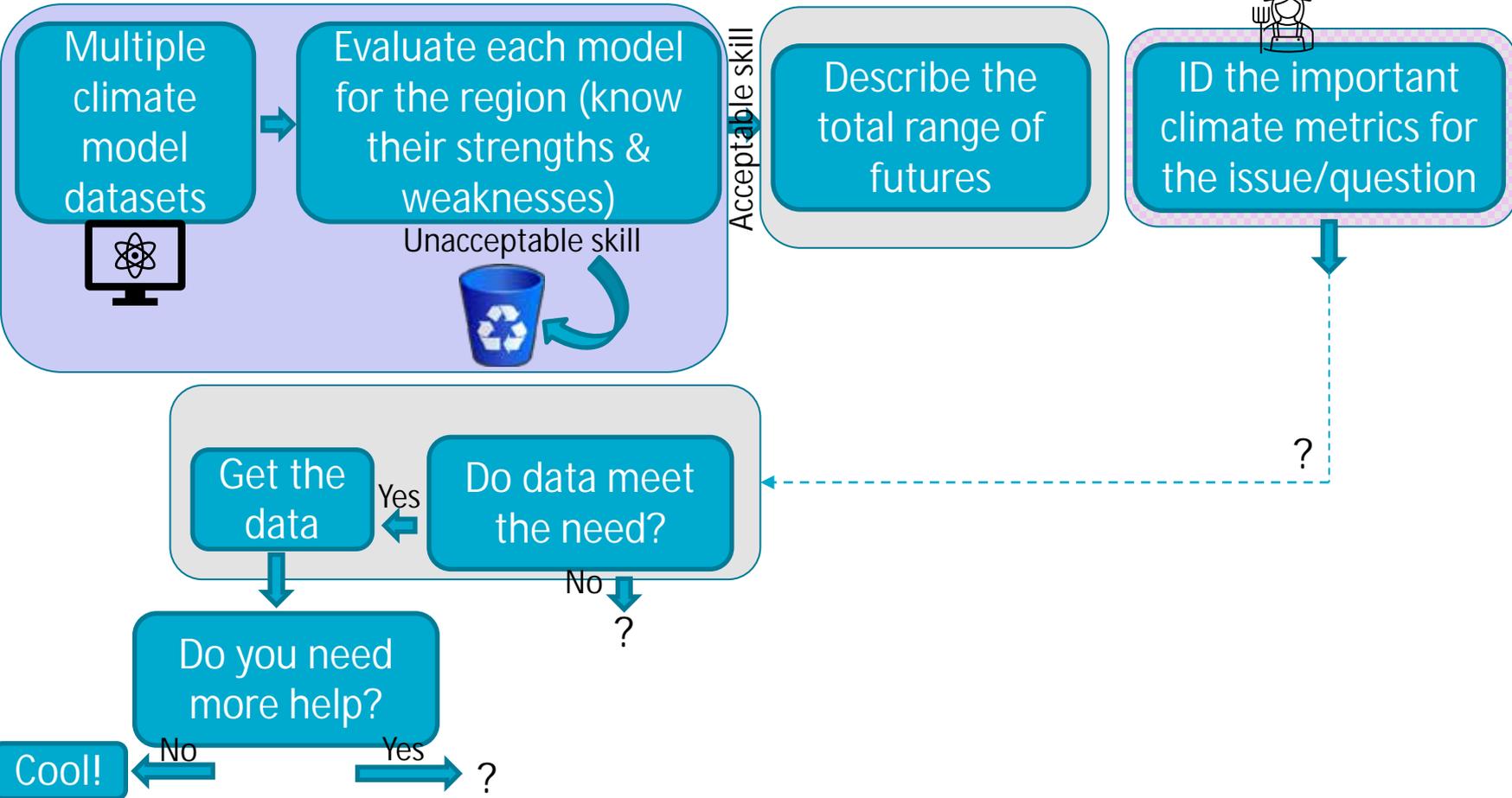


Robust projections for use





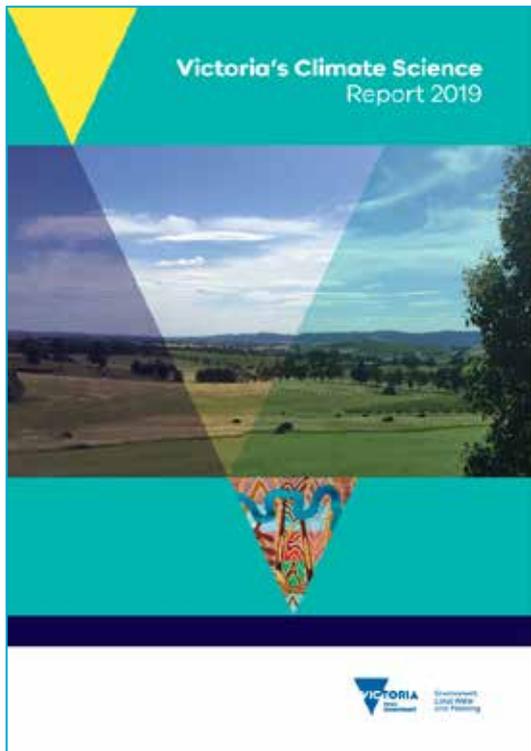
Without co-design...



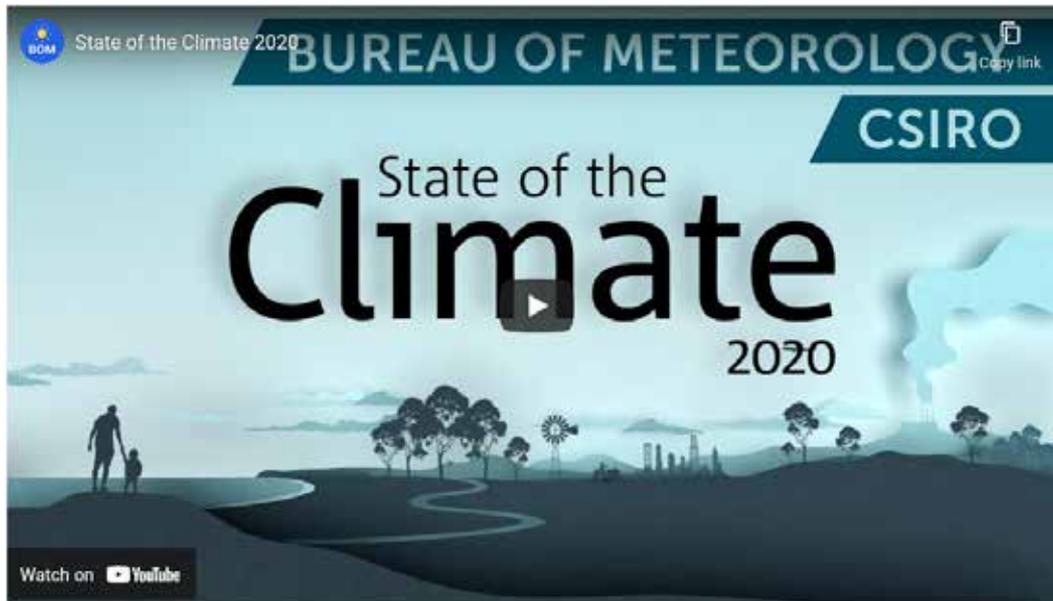


Getting the information - General

- Scientifically robust statements and figures
- Easy to understand
- Multiple formats



<https://www.climatechange.vic.gov.au/victorias-changing-climate>



<https://www.csiro.au/en/research/environmental-impacts/climate-change/State-of-the-Climite>



Temperature change

Compared to 1986-2005)



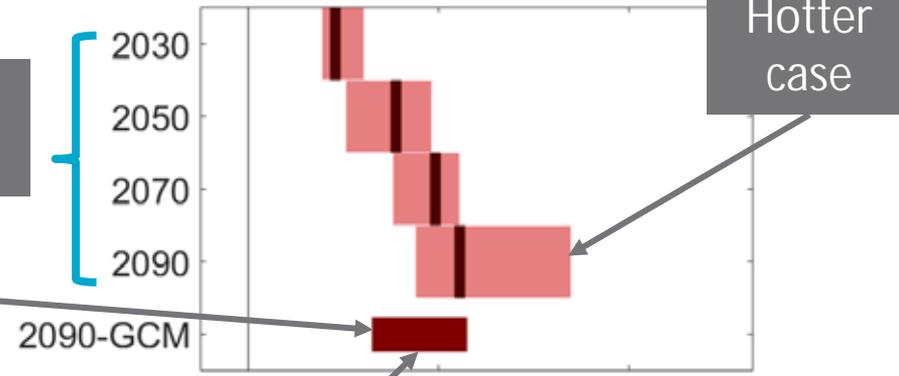
Range of change from VCP19 hi-res models

Cooler case

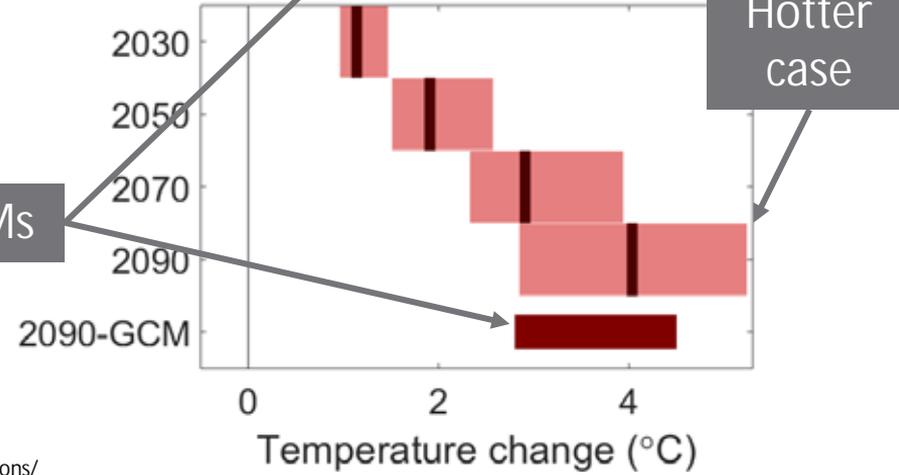
More detail in downloadable spreadsheets

Variable	Unit	Season	Scenario	2030	2050	2070	2090
Maximum daily temperature	°C	Annual	1.13	1.89	2.64	3.42	4.28
Maximum daily temperature	°C	Summer	1.57	2.33	3.08	3.86	4.72
Maximum daily temperature	°C	Autumn	1.28	2.04	2.79	3.56	4.42
Maximum daily temperature	°C	Winter	0.97	1.73	2.48	3.25	4.11
Maximum daily temperature	°C	Spring	1.04	1.80	2.55	3.32	4.18
Minimum daily temperature	°C	Annual	-0.79	-1.55	-2.30	-3.06	-3.82
Minimum daily temperature	°C	Summer	-0.52	-1.28	-2.03	-2.79	-3.55
Minimum daily temperature	°C	Autumn	-0.78	-1.54	-2.29	-3.05	-3.81
Minimum daily temperature	°C	Winter	-1.38	-2.14	-2.89	-3.65	-4.41
Minimum daily temperature	°C	Spring	-1.08	-1.84	-2.59	-3.35	-4.11

Medium emissions



High emissions



Range from GCMs



Rainfall changes

Compared to 1986-2005)



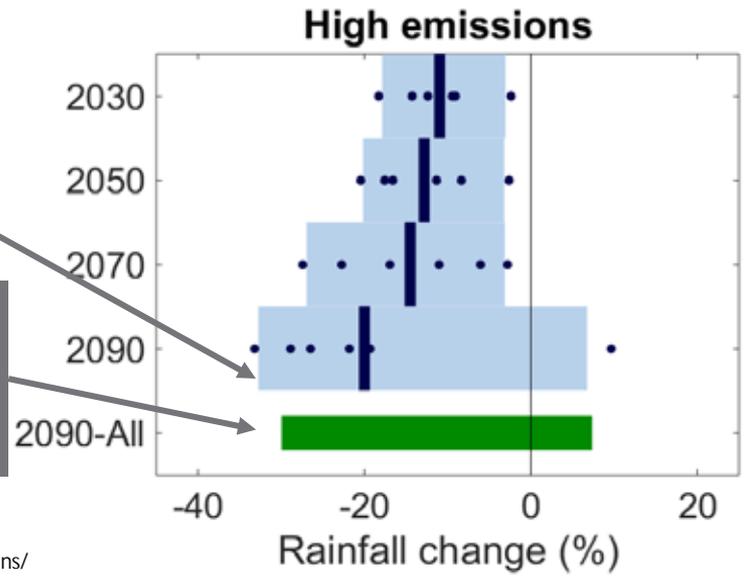
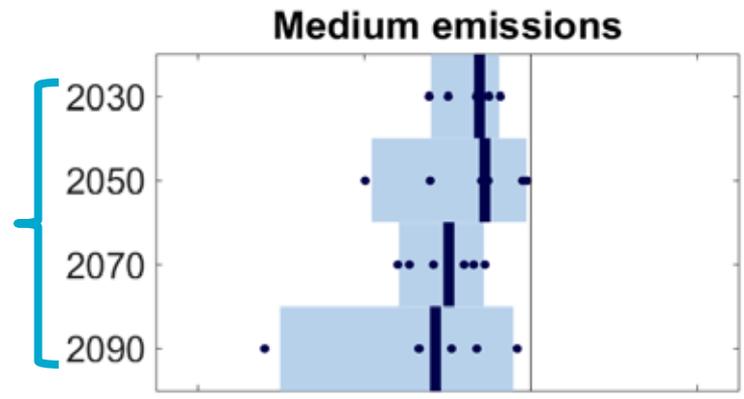
Range of change from VCP19 hi-res models

More detail in downloadable spreadsheets

Variable	Units	Units	Season	2030 RCP4.5	2050 RCP4.5	2070 RCP4.5	2090 RCP4.5
1) Mean temperature	°C	°C	Spring	1.39	2.91	5.54	7.28
2) Annual precipitation	mm	mm	Annual	-4.08	-10.49	-21.21	-33.09
3) Maximum temperature	°C	°C	Summer	0.94	2.03	3.89	5.42
4) Minimum temperature	°C	°C	Autumn	0.35	1.02	1.73	2.44
5) Wind speed	m/s	m/s	Winter	-0.22	-0.46	-0.69	-0.93
6) Humidity	%	%	Spring	0.75	0.51	0.27	0.02
7) Relative humidity	%	%	Annual	-1.29	-2.47	-3.66	-4.85
8) Relative humidity	%	%	Summer	-1.95	-3.25	-4.55	-5.85
9) Relative humidity	%	%	Autumn	-1.50	-2.81	-4.12	-5.43
10) Relative humidity	%	%	Winter	-1.18	-2.50	-3.81	-5.12
11) Relative humidity	%	%	Spring	-0.88	-2.21	-3.52	-4.83
12) Evapotranspiration	mm	mm	Annual	7.96	15.82	23.67	31.53

Slightly drier case

Range from all sources (e.g. VicCI, GCMs)





Hot & Cold Days

2050s Medium & High Emissions



Town	Days/year above 35°C	
	1981-2010	2040-2059
Wodonga	20.6	RCP4.5 34.7 (25.3 to 48.0)
		RCP8.5 44.4 (30.4 to 53.1)
Mansfield	7.4	RCP4.5 18.3 (9.3 to 20.8)
		RCP8.5 19.8 (13.6 to 29.0)

Town	Days/year below 0°C	
	1981-2010	2040-2059
Wodonga	13.4	RCP4.5 6.9 (5.3 to 10.7)
		RCP8.5 5.8 (4.4 to 7.9)
Mansfield	12.4	RCP4.5 8.2 (6.2 to 11.4)
		RCP8.5 6.9 (6.6 to 7.9)





VCP19 on CCiA

- Guidance for users
- Access detailed datasets



Climate Services for Agriculture - prototype

Climate Overview for Whorouly

Select your commodity:

Whorouly, Victoria, Australia



Climate Variables

Historical Climate

Averages for period 1961 - 1990

Current Climate

Averages for period 1991 - 2020

Future Climate

30-year projections for the selected emissions scenario, centred around the selected year

Medium Emissions

2050

Rainfall (mm)

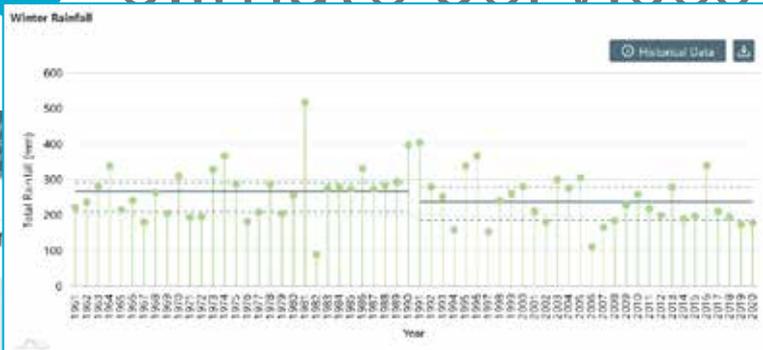
Annual Jan to Dec	Autumn Mar to May	Winter Jun to Aug	Spring Sep to Nov	Summer Dec to Feb
820	196	268	212	144
▼	▼	▼	▼	▲
759	155	239	198	168
≈	▼	≈	≈	≈
764 (480 - 1066)	152 (71 - 265)	247 (138 - 408)	197 (100 - 335)	153 (59 - 306)

Temperature (days)

Annual Heat Risk Days ≥ 35°C	Annual Frost Risk Days ≤ 2°C
13	51
▲	▲
18	55
▲	▼
28 (11 - 44)	36 (20 - 56)



Climate Services for Agriculture - prototype



This analysis looks at winter rainfall over the months of June, July and August. From 1961-1990 average winter rain was 250 mm with a variability of 82 mm, from 1991-2020 average winter rain was 239 mm with a variability of 95 mm. In each 30-year period you can see the range of years to fall between the two dashed lines, 25% above and 25% below. The variability shown for each 30-year period is between the 25th and 75th percentiles.

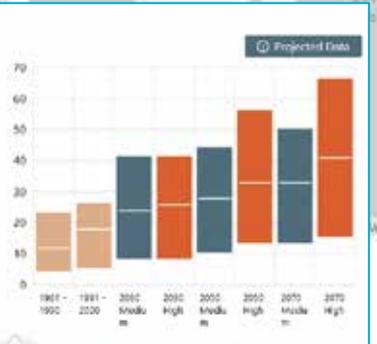
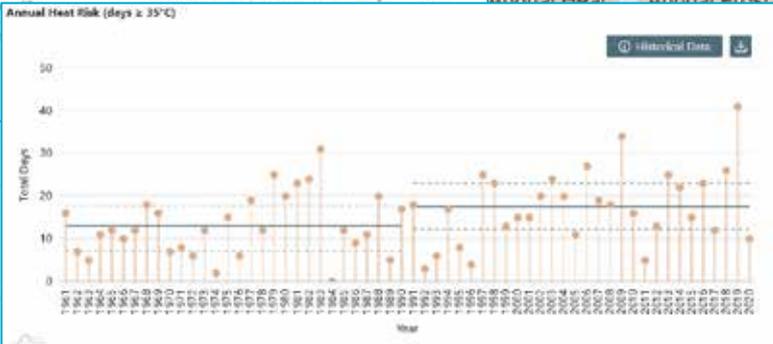
Dashboard Rainfall Temperature Evapotranspiration Prototype

City: Generic

Whorouly, Victoria, Australia

Temperature (days)

Annual Heat Annual Frost



The graph shows the annual totals of Heat Risk days where the maximum temperature was $\geq 35^{\circ}\text{C}$. The solid lines show the average values for each of the thirty year periods, the dashed lines give an indication of the variability over the period. With weather records it is really difficult to separate out trends from the very variable records. One way to do this is to split the history into periods or epochs and then compare the epochs. In climate science a standard epoch is 33 years as this is most likely to contain a bit of everything, a bit of dry, a bit of wet, a bit of hot, a bit of cold. We have split temperature records into two thirty year periods: 1961-1990 and 1991-2020. Over the most recent 30 year period the average annual number of heat risk days has been 15. The highest annual number of heat risk days was 41 in 2019, whilst 1992 had the lowest with 3 days.

How is the likelihood of heat risk changing? To find out we look at the differences between the two periods. Between 1961-1990 and 1991-2020 the number of heat risk days has increased by 5. The average number of days is only part of the story, another thing to look at is how variable the number of heat risk days is in each period. One measure of this to look at is the range around the average value which contains half the records. Over the period 1961-1990 the range around the average that contained half the number of annual records was 11 days, whereas in the later period it was 13 days. The variability of the number of heat risk days per year has increased.

Historical Climate
Averages for period 1961 - 1990

Current Climate
Averages for period 1991 - 2020

Future Climate
30-year projections for the selected emissions scenario, centred around the selected year

Medium Emissions

2050

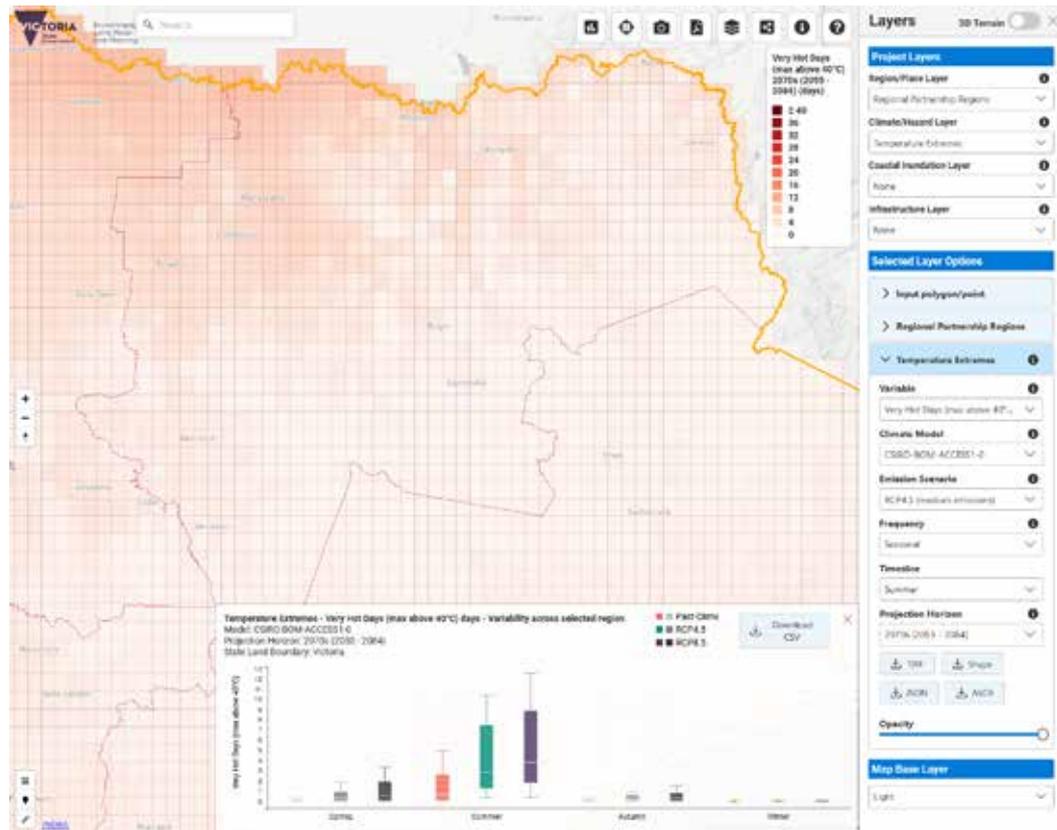
820	196
▼	▼
759	155
≈	▼
764 (490 - 1056)	152 (71 - 265)



Victoria's Future Climate Tool

Temperature extremes

- Interactive
- Suits technical users
- Data & map downloads

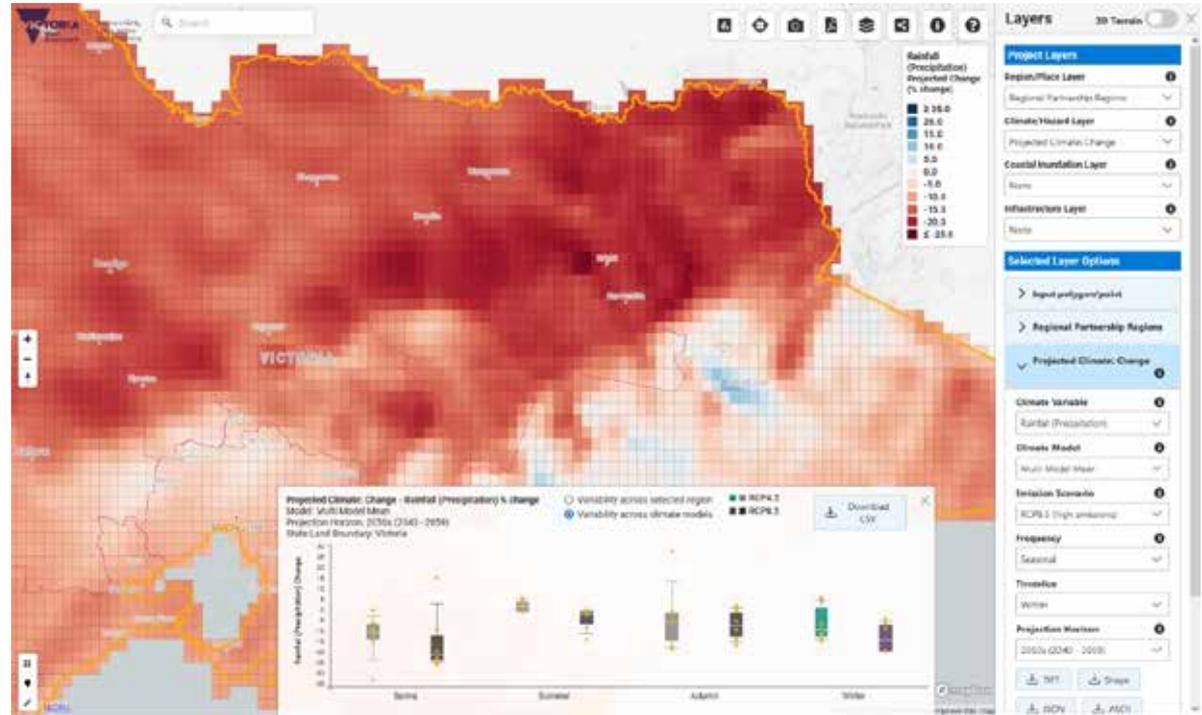




Victoria's Future Climate Tool

Rainfall change

- Enhanced drying on NW slopes of high country





Summary

- Climate models do a good job of projecting plausible future climates
- Climate projections are not forecasts
- A range of future climates are possible and this will always be so
- Find the right type of information to suit your needs
- It can be really complicated – please seek help if you need it



Thank you

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