Victoria's Future Climate Tool – case study

Stress testing for the potential impact of heatwave on Ambulance Victoria

vmia

Ambulance Victoria

VICTORIA State Government | Environment, Land, Water and Planning

Victoria’s Future Climate Tool – case study

Did you know that Ambulance Victoria used **Victoria’s Future Climate Tool** to give them insight about the impact of heatwaves?

In this case study, you’ll walk through the process Ambulance Victoria used to better understand the projected increased frequency and severity of heatwaves.

You’ll also see a snapshot of the models and methods they used to better understand the effect of this risk on their strategic objectives.

Step-by-step process

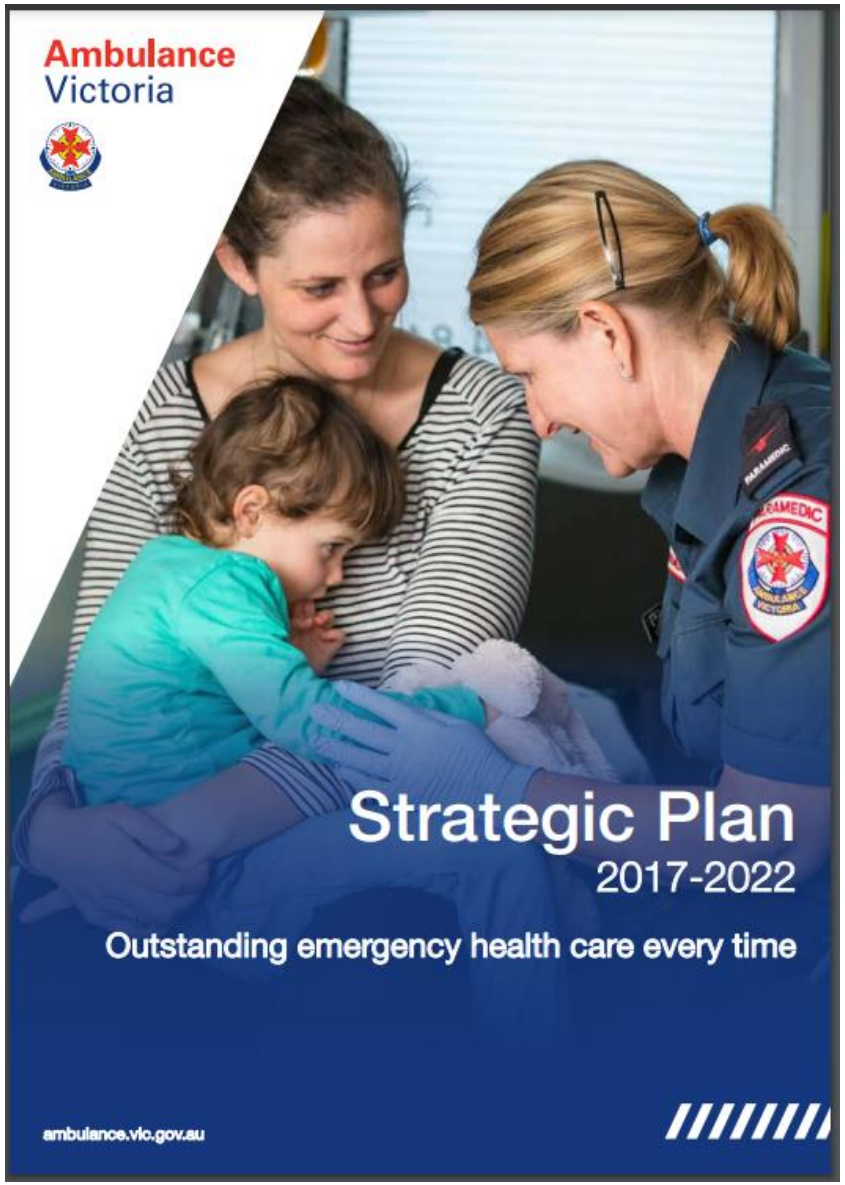
Step 1: We consider the business of our agency, focusing on strategic objectives	• About Ambulance Victoria (AV) • AV's Strategic Plan
Step 2: We select a climate variable or variables of interest	• Exploring the impact of heatwave on AV
Step 3: We consider historical examples of the selected climate variable/s	• Considering the past impact of heatwave on AV
Step 4: We consider a potential worst-case scenario for the future of the climate variable/s	• Using **Victoria's Future Climate Tool** to develop future climate scenarios
Step 5: We consider how the results of the scenario would impact achievement of our agency's strategic objectives	• Stress test scenario results • What does this mean for AV?

About Ambulance Victoria

Step 1: We consider the business of our agency…

- Ambulance Victoria services more than 6 million people, 4.6 million of whom live in greater Melbourne.
- Services are based across 260 different locations to provide response in metropolitan, regional, rural and remote areas, working with local communities and partners right across Victoria.
- AV works at the intersection of health and emergency management. It provides emergency pre-hospital treatment, ambulance and air ambulance transport for people facing medical emergencies, important non-emergency patient transport and critical care adult retrieval services between hospitals.
- AV staff attend average of 1880 emergency cases every day, and travel over 95,000 km on the road.

Start with the strategic plan



… focusing on the strategic objectives of the agency, because risk is the effect of uncertainty on objectives

Step 2: We select a climate variable or variables of interest

Why heatwave?

In Australia, from 1900 to 2010, heatwaves killed more people than all other natural hazards combined (Coats *et al* 2014). The heatwave that preceded the Black Saturday fires resulted in an estimated 374 excess deaths; double the number of deaths caused by the bushfires.

Climate projections suggest that across the state the:

- number of heatwaves experienced across the state could at least double (depending on the future climate scenario)
- duration of heatwaves is likely to increase
- maximum temperate is likely to be higher

This is expected to have significant implications for the Victorian Government and for our communities.

AV looked closely at the heatwaves of both 2009 and 2014.

Consider the past impact of heatwaves

Step 3: We consider historical examples of the selected climate variable/s

Get started by examining past events where the climate hazard has already impacted your agency.

If these events were to become

- more frequent
- more extreme, with higher temperatures
- lasting for longer

Ask yourself: what impact would this have? What additional resources would be required? What mitigation efforts could be considered?

How did the heatwave that preceded Black Saturday affect AV?

The effects of the heatwave were disastrous and affected Victoria's most vulnerable people:

- Between 26 January and 1 February 2009, maximum temperatures were 12–15°C *above normal* for most of Victoria. Melbourne endured three consecutive days of temperatures above 43°C.
- In the metro area the Ambulance Victoria caseload showed:
  - 25% increase in total emergency cases
  - 46% increase over the three hottest days
  - 34 times the number of direct heat-related cases.

It's estimated the heatwave lead to the deaths of 374 people. Most who died were aged 75 or older.

https://www2.health.vic.gov.au/public-health/chief-health-officer/cho-publications/heatwave-in-victoria

The past impact of heatwaves on AV

What did the 2014 heatwave mean for AV?

Victoria experienced the hottest four-day period on record in January 2014. While maximum temperatures were slightly below those observed during earlier heatwaves, mean temperatures were high and the heat lasted for a longer time.

Scientists offer a ‘best guess’ estimate that climate change increased the odds of this event occurring by 89% (Black *et al* 2015).

In the metro area, the heatwave led to:

- Increases in both emergency department presentations and AV responses.
- 621 heat-related presentations during the week, more than five times the expected number (105).
- An estimated 167 excess deaths during the heatwave according to the Chief Health Officer.
- A 25% increase in caseload.

https://www2.health.vic.gov.au/Api/downloadmedia/%7BDC381402-DF8F-42A5-8153-2BDF690F5402%7D

Use Victoria's Future Climate Tool to develop scenarios

Step 4: We consider scenarios for the future of the climate variable/s

Focus on the hottest, driest future to stress test your system/s.

Carry out good scenario planning by considering multiple possible futures taking into account variability and extreme events.

We face a range of plausible futures. For this reason, it's better to look at more than one scenario when you assess climate change risks. A good rule of thumb is to consider:

- a "best guess" future
- a "stress test" future (a possible worst-case scenario)
- the recent past.

The benefit of stress testing is that you use a risk management tool to think about uncertain events with the worst effects. This is a safe way to test your assumptions and your organisation's resilience. In this case study we show how AV:

- used Victoria's Future Climate Tool as **a stress test only**
- selected the pathway and models in the tool that produced the **hottest and driest outcome**
- explored the worst projections available for heatwave to ask what it meant for them.

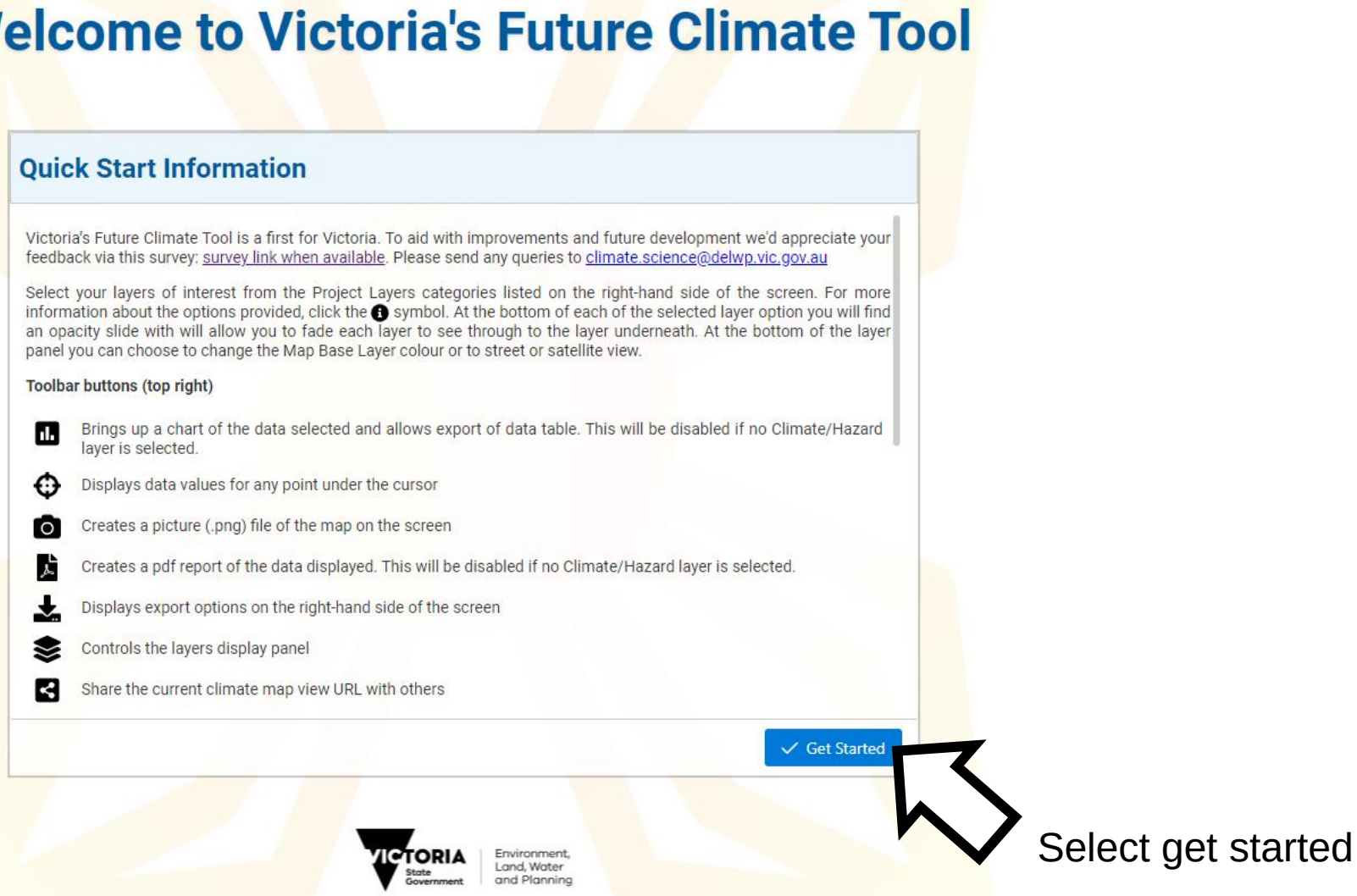
If the stress test indicated the need for significant action, you'd do further analysis to see if the results hold up under multiple possible futures.

Using Victoria's Future Climate Tool to develop future scenarios (2)

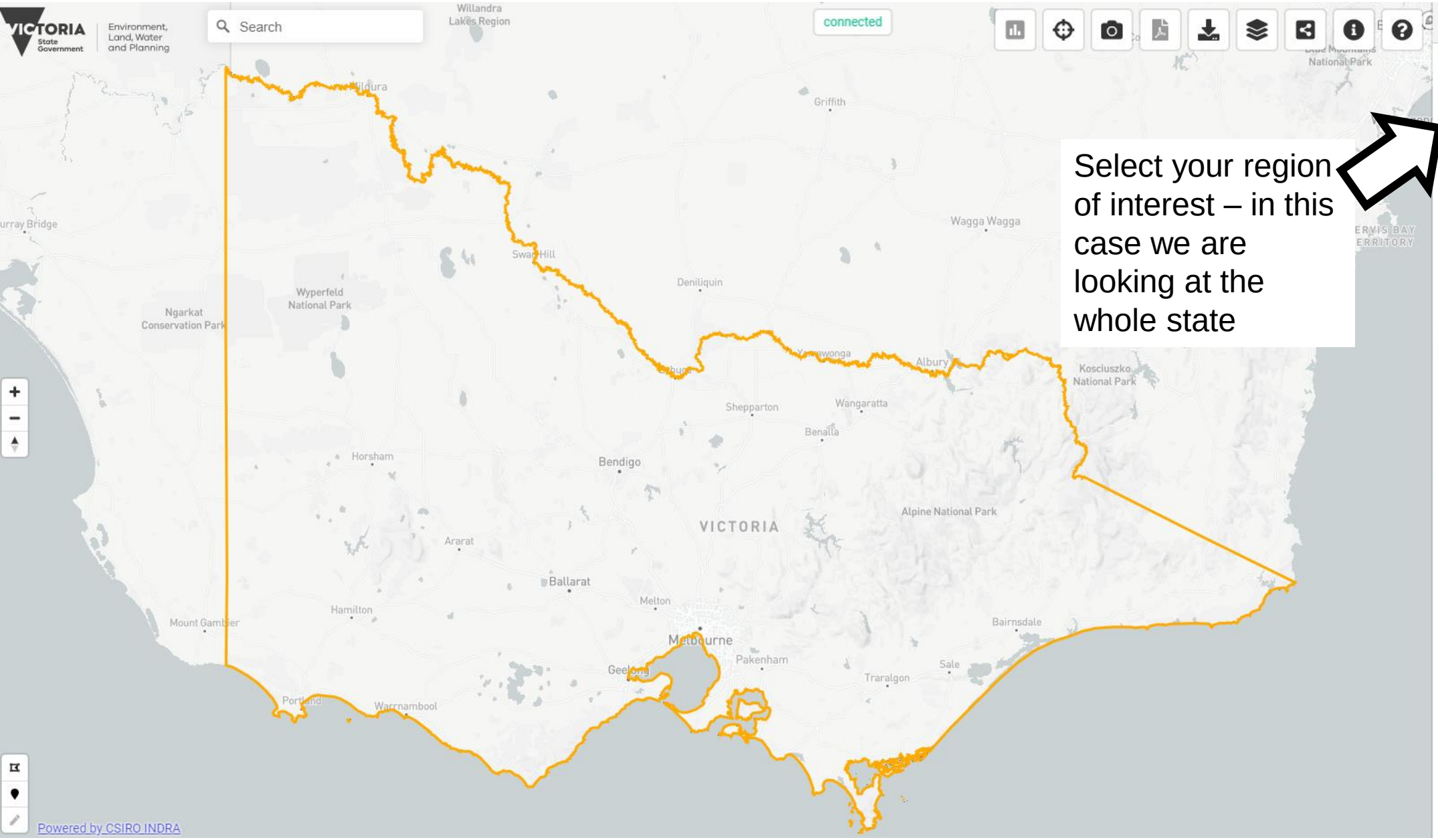
Explore the following slides to find out how to extract relevant data from Victoria's Future Climate Tool.

It's important to note that the numbers shown in these scenarios are annual averages for 20-year periods and as such, actual events may vary greatly from year to year. ***Any individual year may be a lot better or a lot worse.***

Using Victoria's Future climate tool to develop future scenarios – Access the tool at: https://vicfutureclimatetool.indraweb.io/



Select get started


VICTORIA
State Government
Environment, Land, Water and Planning
Search
connected
Layers
Project Layers
Region/Place Layer
State Land Boundary
Climate/Hazard Layer
None
Coastal Inundation Layer
None
Infrastructure Layer
None
Selected Layer Options
Input polygon/point
State Land Boundary
Map Base Layer
Light
Select your region of interest – in this case we are looking at the whole state
Willandra Lakes Region
Griffith
Wagga Wagga
Deniliquin
Wyperfeld National Park
Ngarkat Conservation Park
Albury
Kosciuszko National Park
Shepparton
Wangaratta
Benalla
Horsham
Bendigo
VICTORIA
Alpine National Park
Ararat
Ballarat
Melton
Hamilton
Mount Gambier
Melbourne
Pakenham
Bairnsdale
Sale
Traralgon
Geelong
Portland
Warrnambool
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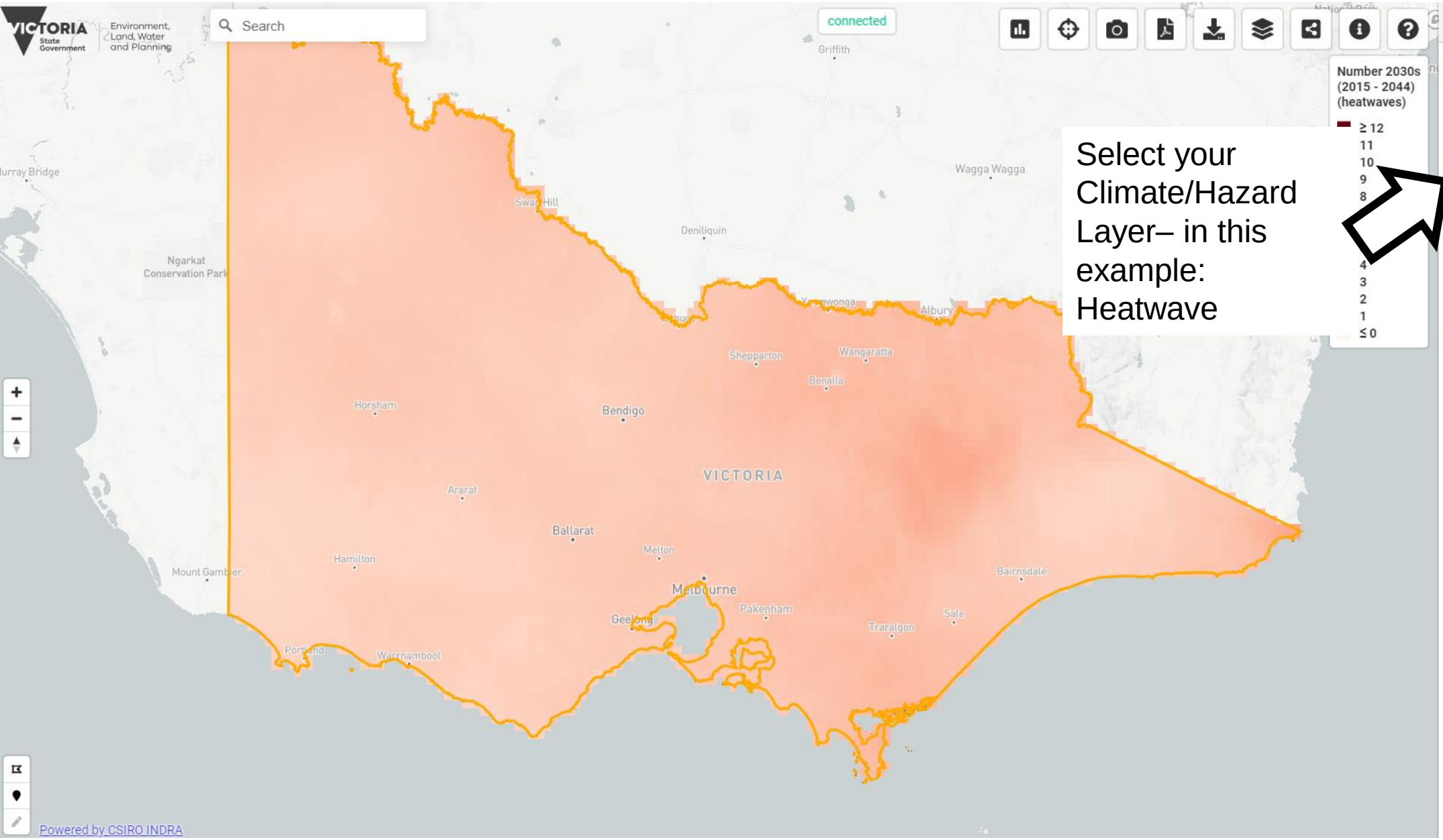
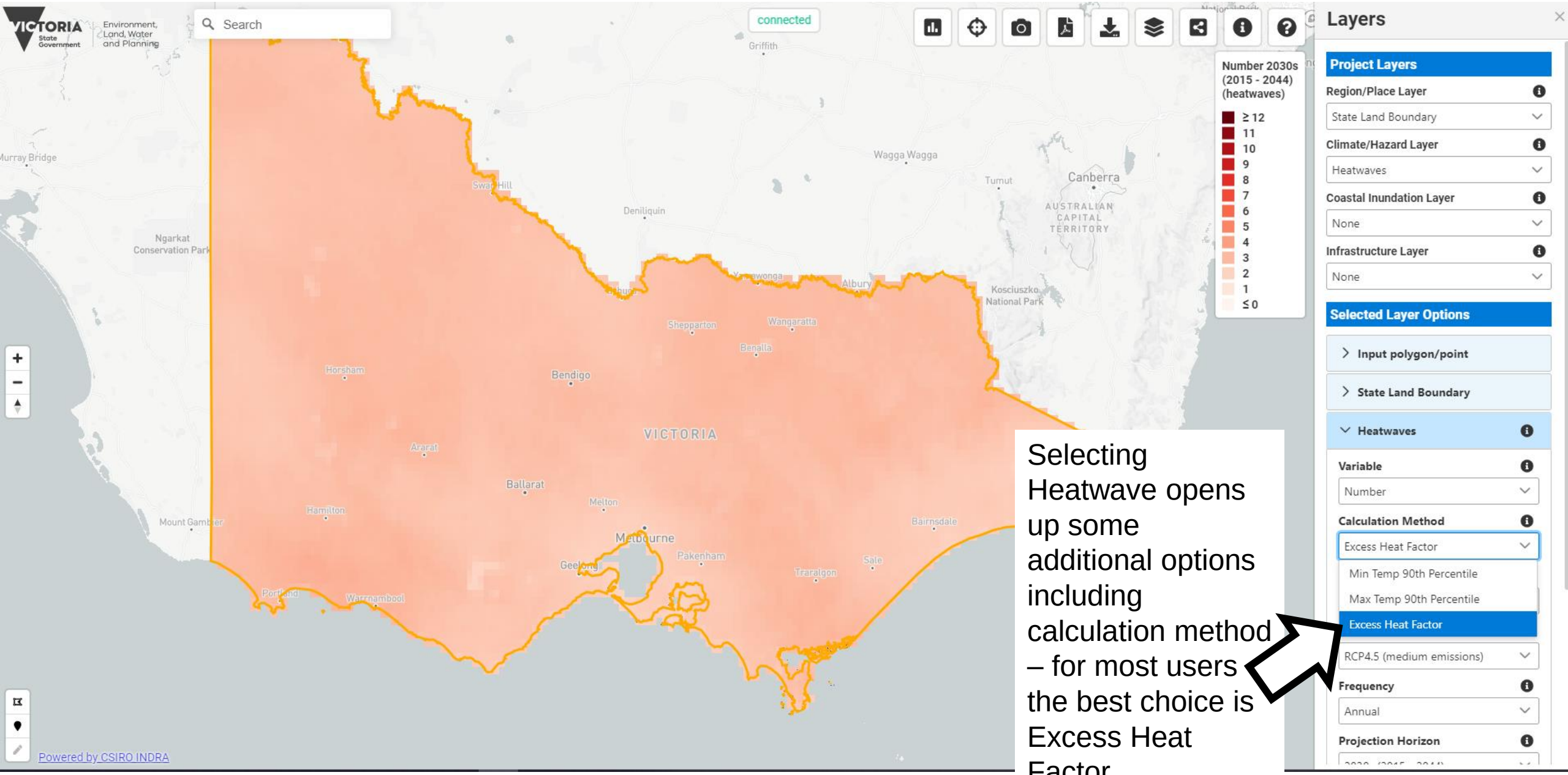
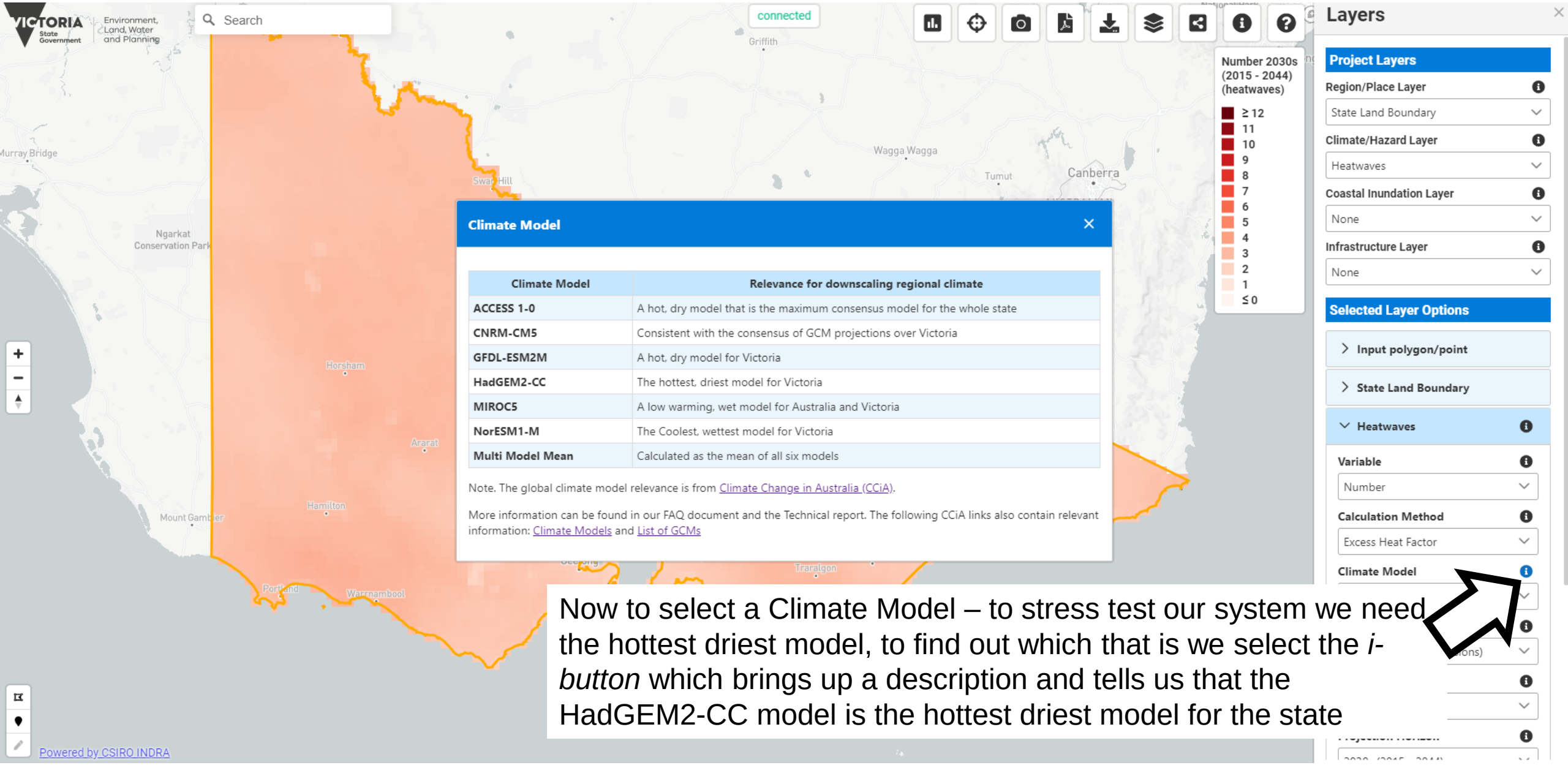
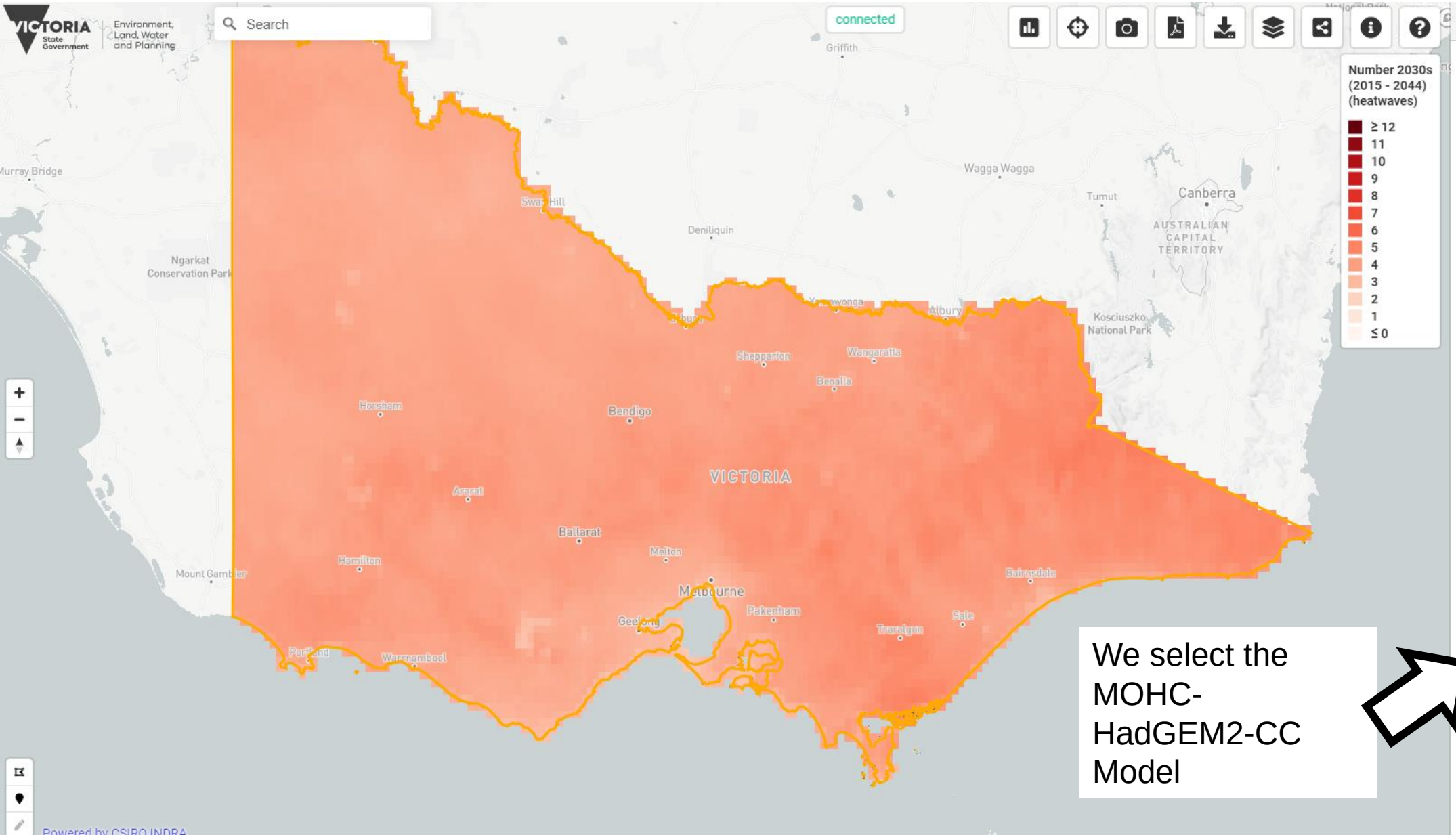

VICTORIA
State Government
Environment, Land, Water and Planning
Search
connected
Number 2030s (2015 - 2044) (heatwaves)
≥ 12
11
10
9
8
4
3
2
1
≤ 0
Select your Climate/Hazard Layer– in this example: Heatwave
Layers
Project Layers
Region/Place Layer
State Land Boundary
Climate/Hazard Layer
Heatwaves
Past Climate Baseline (1986-2005)
Temperature Extremes
Rainfall Extremes
Extreme Value Analysis
Heatwaves
Extreme Dry/Wet (SPI)
Input polygon/point
State Land Boundary
Heatwaves
Variable
Number
Calculation Method
Min Temp 90th Percentile
Climate Model
Multi Model Mean
Emission Scenario
RCP4.5 (medium emissions)
Frequency
Annual
Projection Horizon
Griffith
Wagga Wagga
Swan Hill
Deniliquin
Albury
Shepparton
Wangaratta
Benalla
Bendigo
Horsham
VICTORIA
Ararat
Ballarat
Melton
Hamilton
Mount Gambier
Melbourne
Pakenham
Geelong
Bairnsdale
Sale
Traralgon
Warrnambool
Ngarkat Conservation Park
Powered by CSIRO INDRA



Selecting Heatwave opens up some additional options including calculation method – for most users the best choice is Excess Heat Factor.



Now to select a Climate Model – to stress test our system we need the hottest driest model, to find out which that is we select the *i-button* which brings up a description and tells us that the HadGEM2-CC model is the hottest driest model for the state



Layers

Project Layers

Region/Place Layer: State Land Boundary

Climate/Hazard Layer: Heatwaves

Coastal Inundation Layer: None

Infrastructure Layer: None

Selected Layer Options

Input polygon/point

State Land Boundary

Multi Model Mean
CNRM-CERFACS-CNRM-CM5
CSIRO-BOM-ACCESS1-0
MIROC-MIROC5
MOHC-HadGEM2-CC
NCC-NorESM1-M

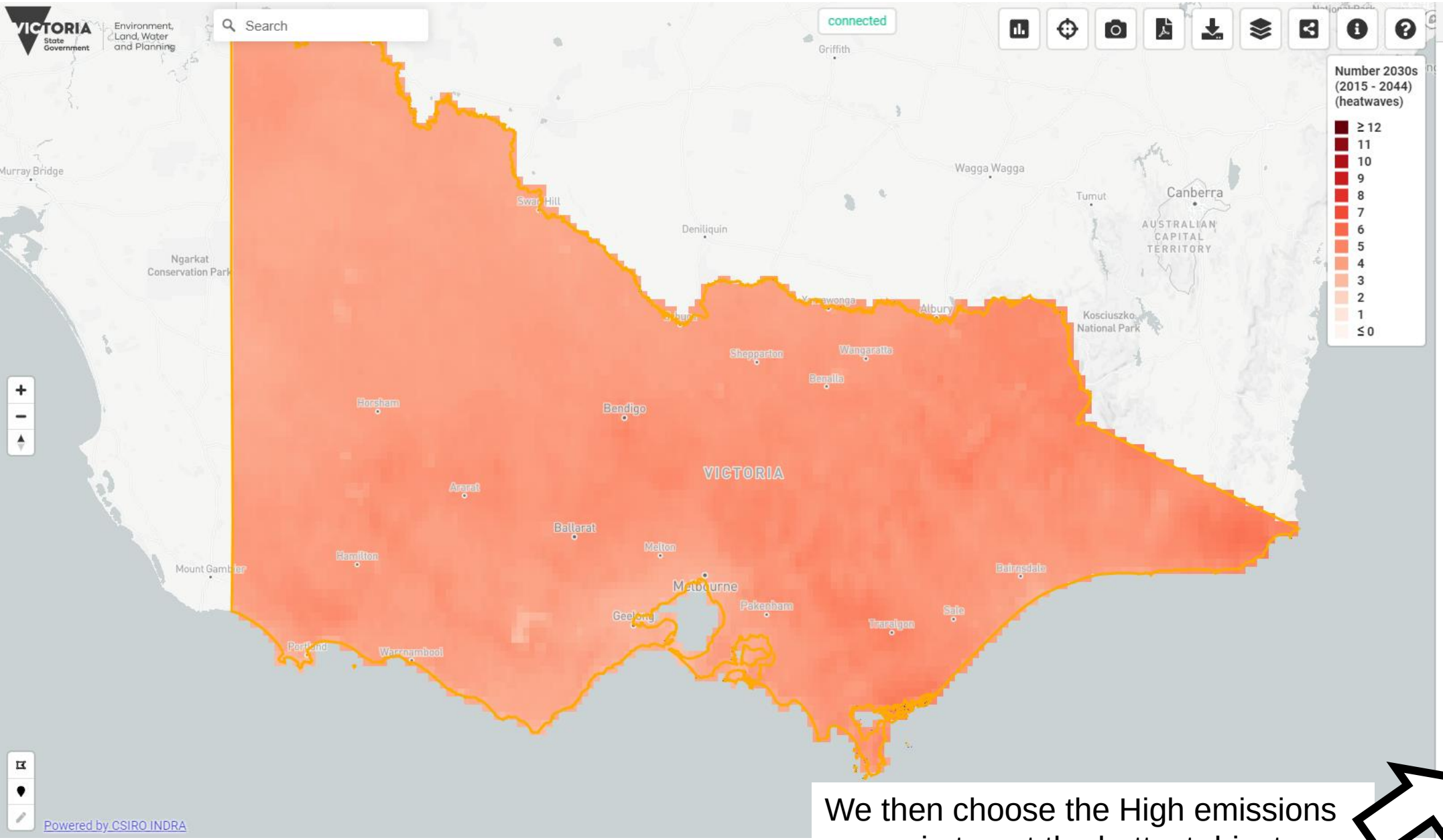
MOHC-HadGEM2-CC

Emission Scenario: RCP4.5 (medium emissions)

Frequency: Annual

Projection Horizon

We select the MOHC-HadGEM2-CC Model



Layers

Project Layers

Region/Place Layer: State Land Boundary

Climate/Hazard Layer: Heatwaves

Coastal Inundation Layer: None

Infrastructure Layer: None

Selected Layer Options

- Input polygon/point
- State Land Boundary
- Heatwaves

Variable: Number

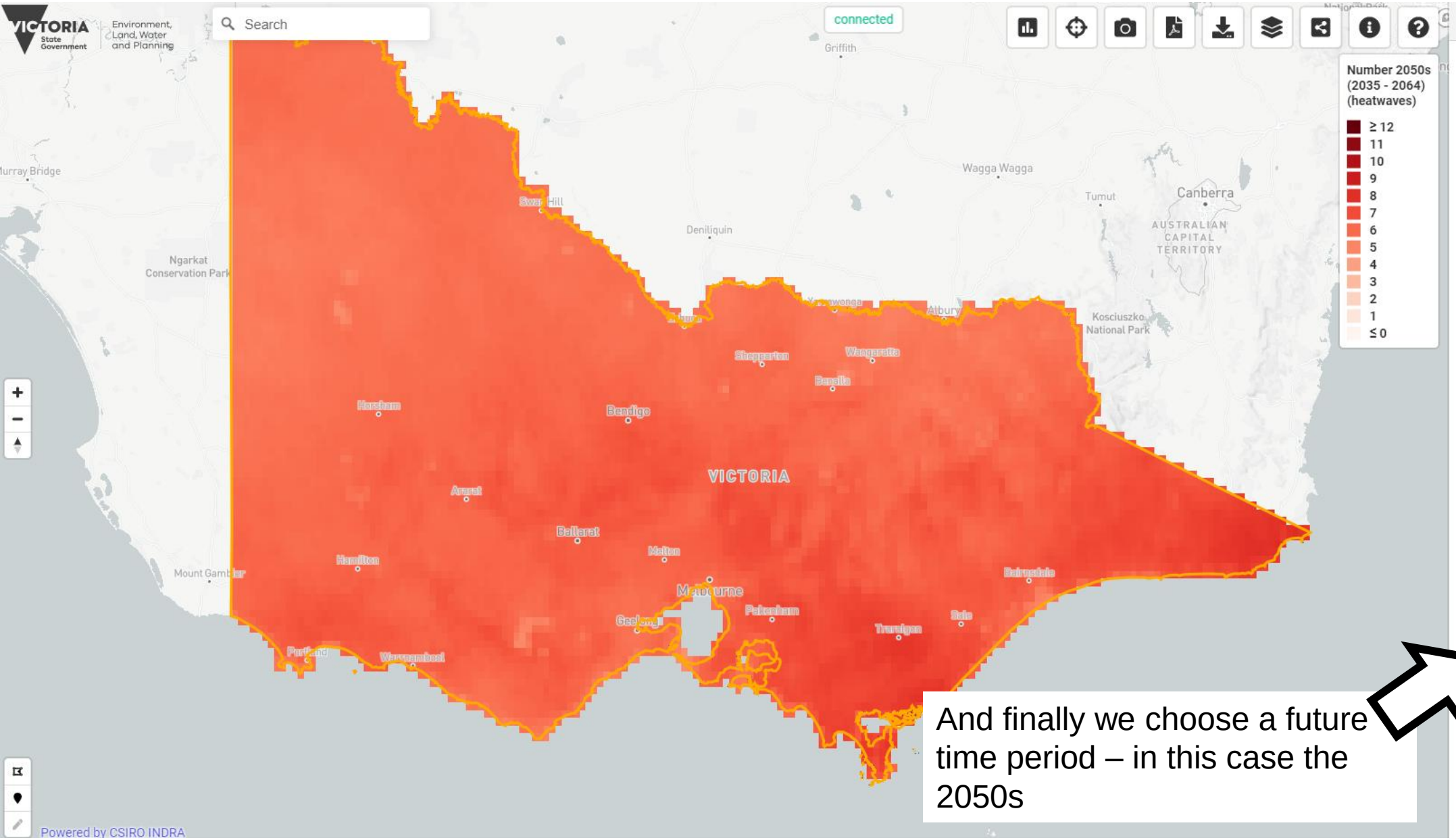
Calculation Method: Excess Heat Factor

Climate Model: MOHC-HadGEM2-CC

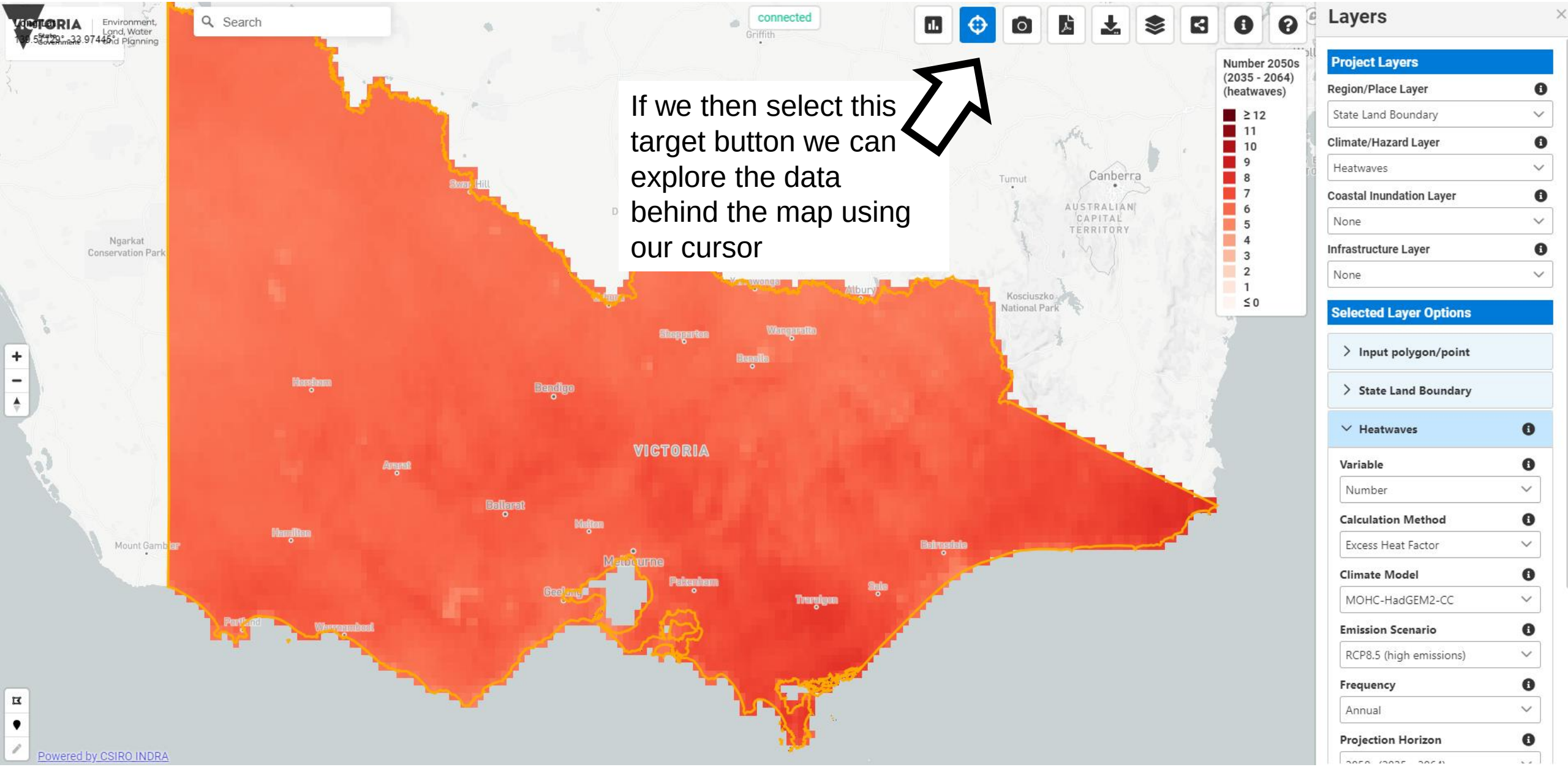
Emission Scenario: RCP8.5 (high emissions)

- RCP4.5 (medium emissions)
- RCP8.5 (high emissions)
- Historical (1986 - 2005)

We then choose the High emissions scenario to get the hottest driest results



And finally we choose a future time period – in this case the 2050s


Search
connected
Griffith
Swan Hill
Tumut
Canberra
AUSTRALIAN CAPITAL TERRITORY
Ngarkat Conservation Park
Kosciuszko National Park
Albury
Shepparton
Wangaratta
Benalla
Horsham
Bendigo
VICTORIA
Ararat
Ballarat
Melton
Hamilton
Mount Gambier
Melbourne
Geelong
Pakenham
Traralgon
Sale
Bairnsdale
Portland
Warrnambool
Number 2050s (2035 - 2064) (heatwaves)
≥ 12
11
10
9
8
7
6
5
4
3
2
1
≤ 0
If we then select this target button we can explore the data behind the map using our cursor
Layers
Project Layers
Region/Place Layer
State Land Boundary
Climate/Hazard Layer
Heatwaves
Coastal Inundation Layer
None
Infrastructure Layer
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Number
Calculation Method
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon
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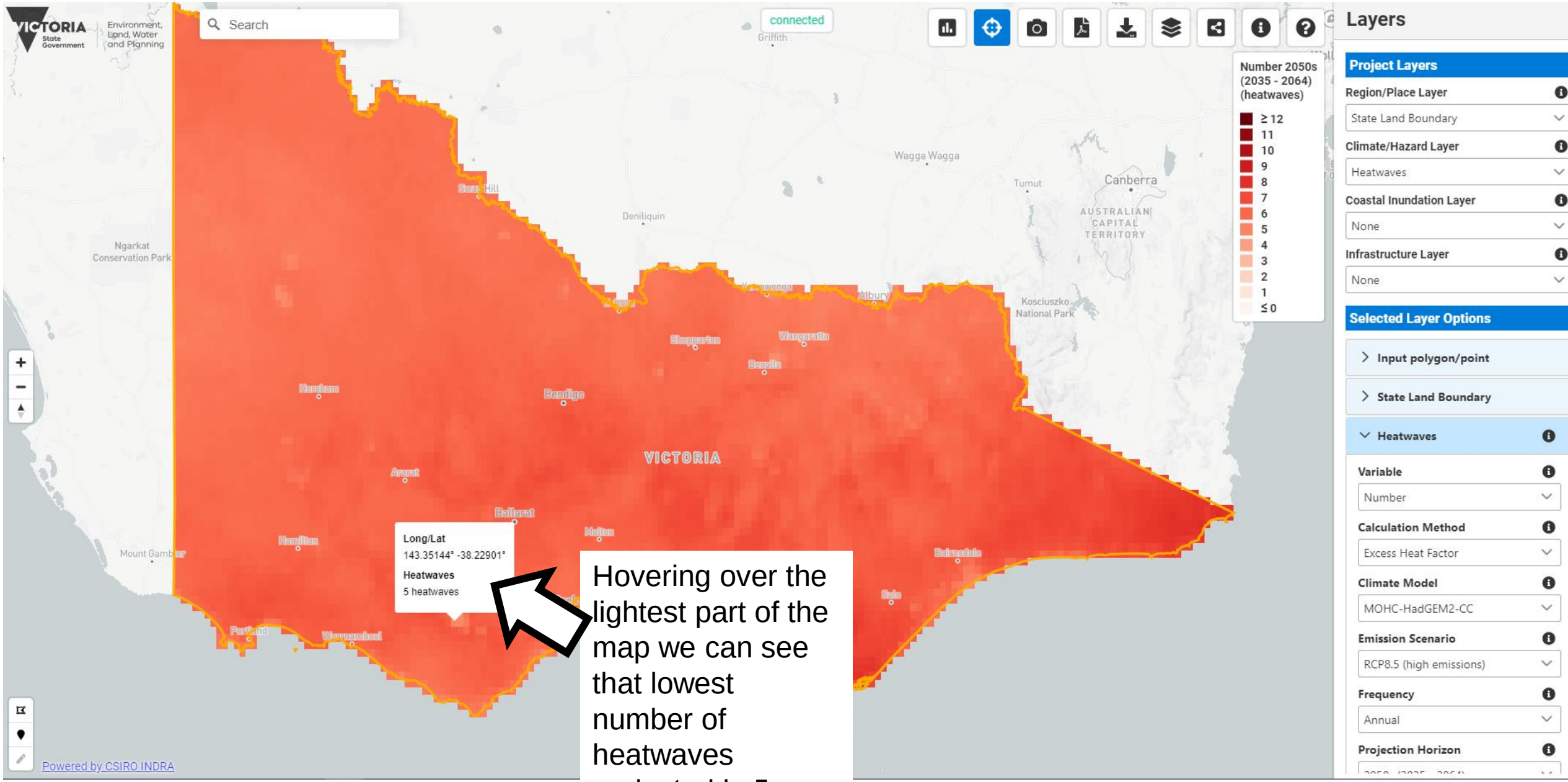
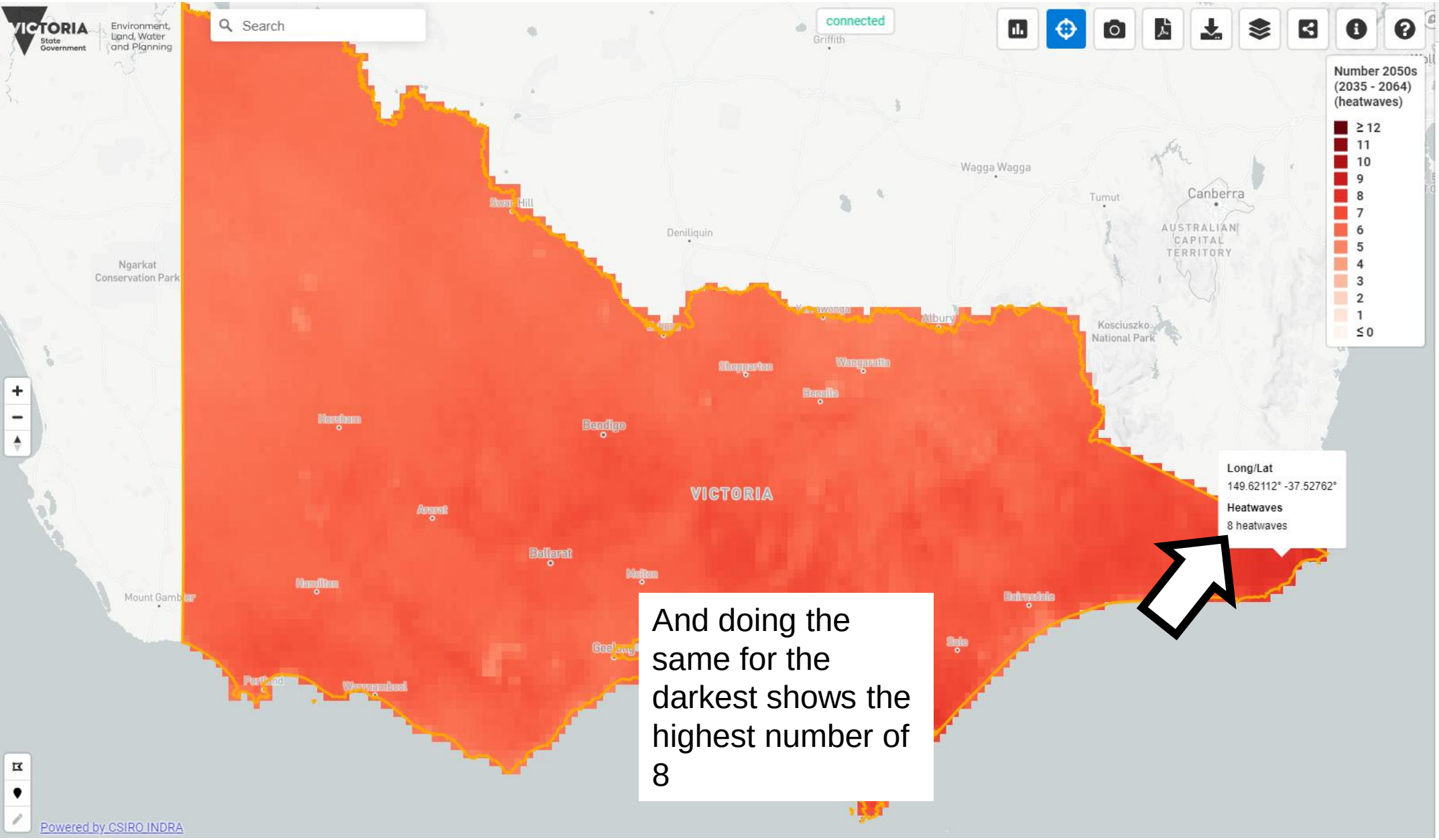


Hovering over the lightest part of the map we can see that lowest number of heatwaves projected is 5….


VICTORIA
State Government
Environment, Land, Water and Planning
Search
connected
Griffith
Number 2050s (2035 - 2064) (heatwaves)
≥ 12
11
10
9
8
7
6
5
4
3
2
1
≤ 0
Wagga Wagga
Tumut
Canberra
AUSTRALIAN CAPITAL TERRITORY
Deniliquin
Swan Hill
Ngarkat Conservation Park
Kosciuszko National Park
Albury
Shepparton
Wangaratta
Benalla
Horsham
Bendigo
VICTORIA
Ararat
Ballarat
Melton
Hamilton
Mount Gambier
Portland
Warrnambool
Geelong
Bairnsdale
Orbost
Long/Lat
149.62112° -37.52762°
Heatwaves
8 heatwaves
And doing the same for the darkest shows the highest number of 8
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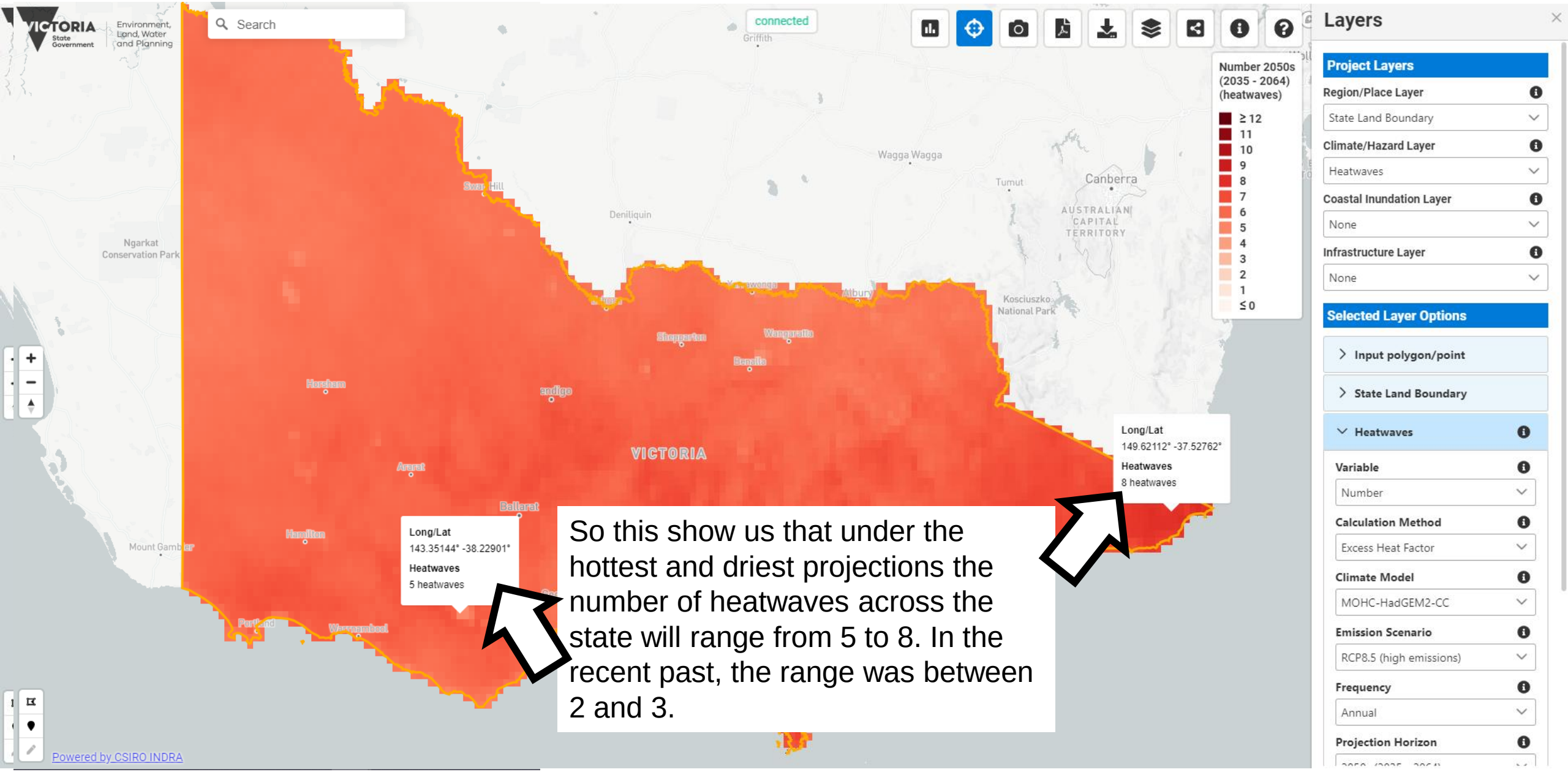
Layers
Project Layers
Region/Place Layer
State Land Boundary
Climate/Hazard Layer
Heatwaves
Coastal Inundation Layer
None
Infrastructure Layer
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Number
Calculation Method
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon


VICTORIA
State Government
Environment, Land, Water and Planning
Search
connected
Griffith
Wagga Wagga
Tumut
Canberra
AUSTRALIAN CAPITAL TERRITORY
Deniliquin
Swan Hill
Ngarkat Conservation Park
Kosciuszko National Park
Shepparton
Wangaratta
Benalla
Horsham
Bendigo
Ararat
Ballarat
Hamilton
Mount Gambier
Warrnambool
Portland
VICTORIA
Number 2050s (2035 - 2064) (heatwaves)
≥ 12
11
10
9
8
7
6
5
4
3
2
1
≤ 0
Long/Lat
149.62112° -37.52762°
Heatwaves
8 heatwaves
Long/Lat
143.35144° -38.22901°
Heatwaves
5 heatwaves
So this show us that under the hottest and driest projections the number of heatwaves across the state will range from 5 to 8. In the recent past, the range was between 2 and 3.
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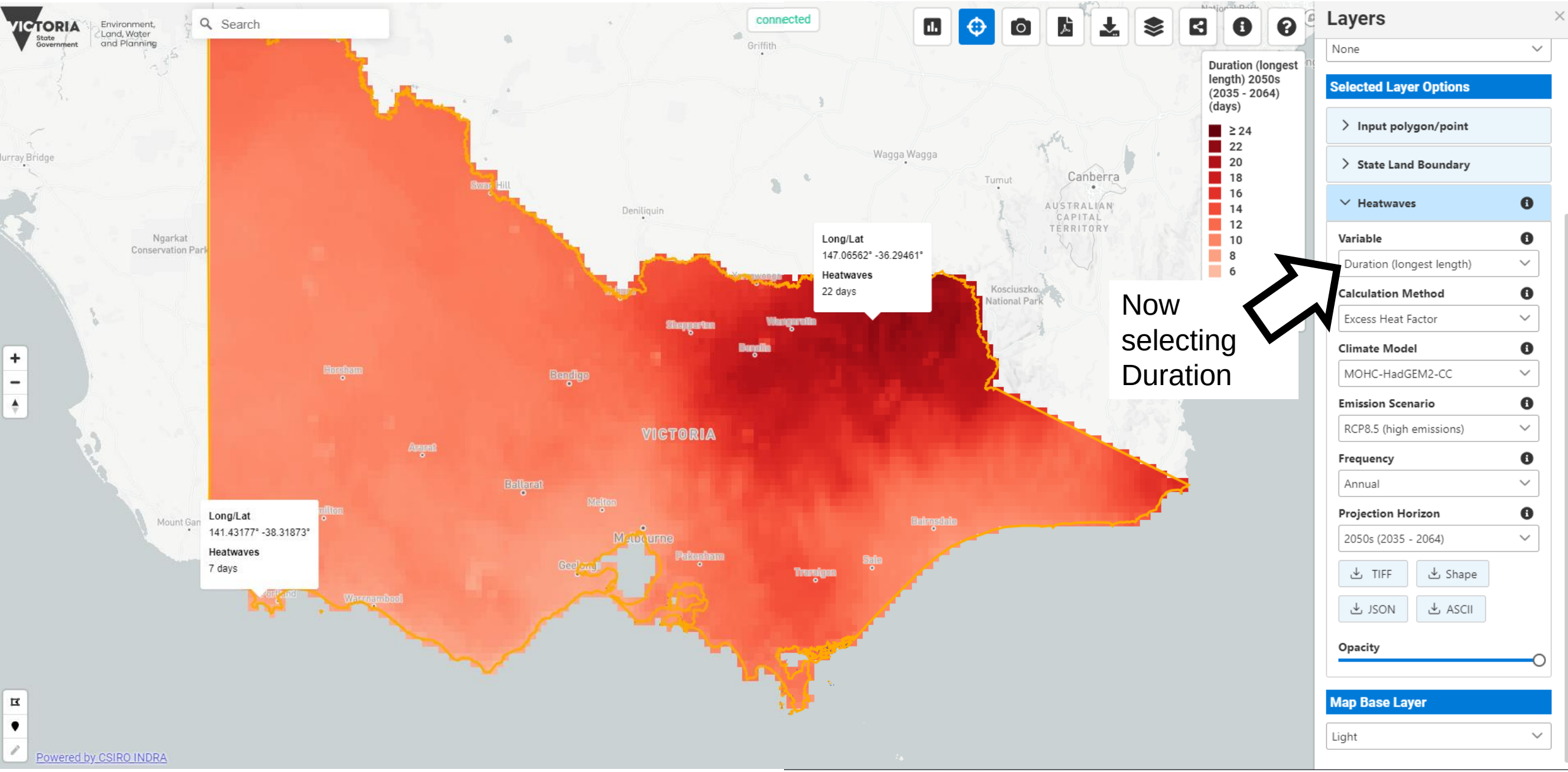
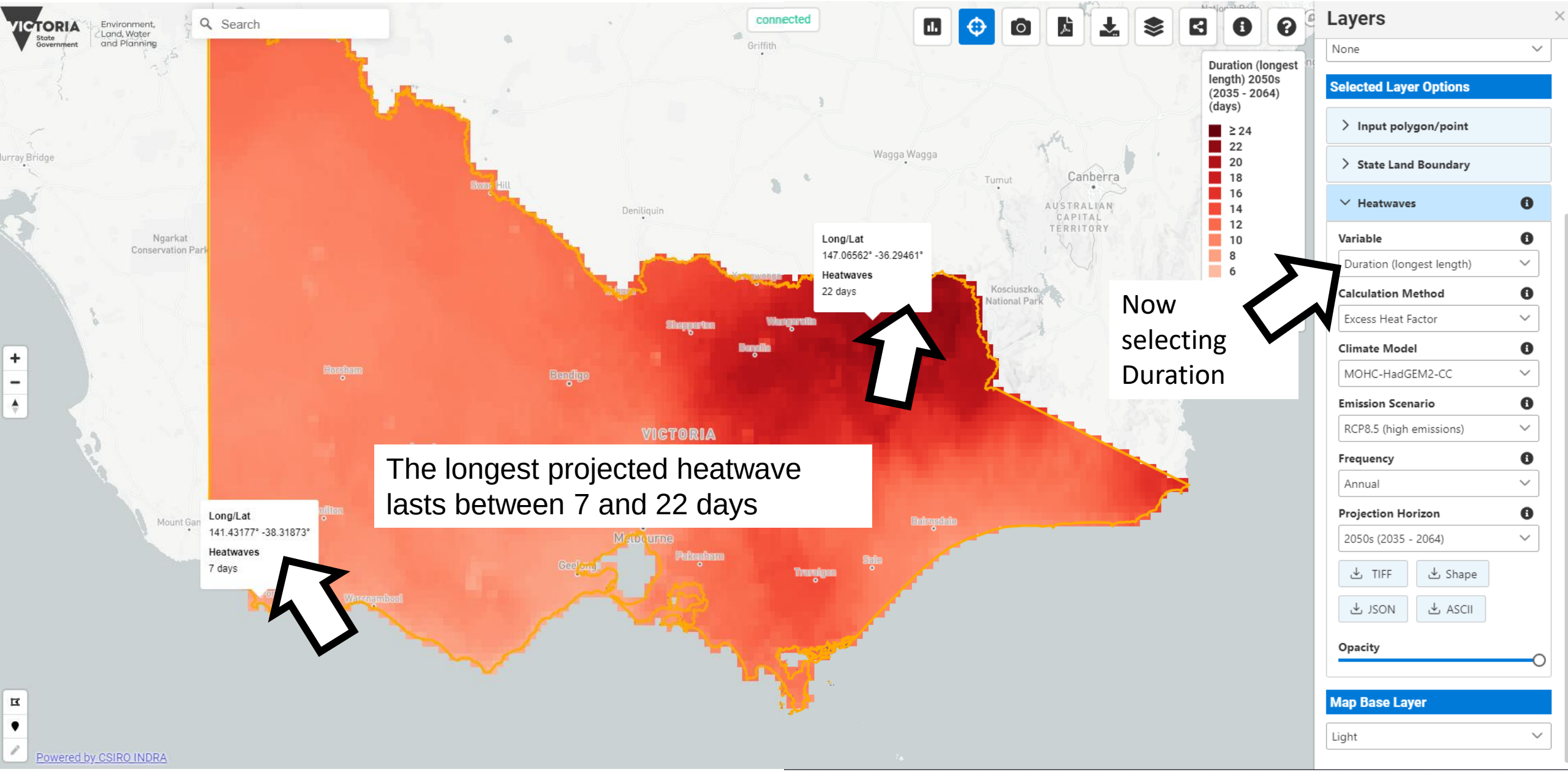
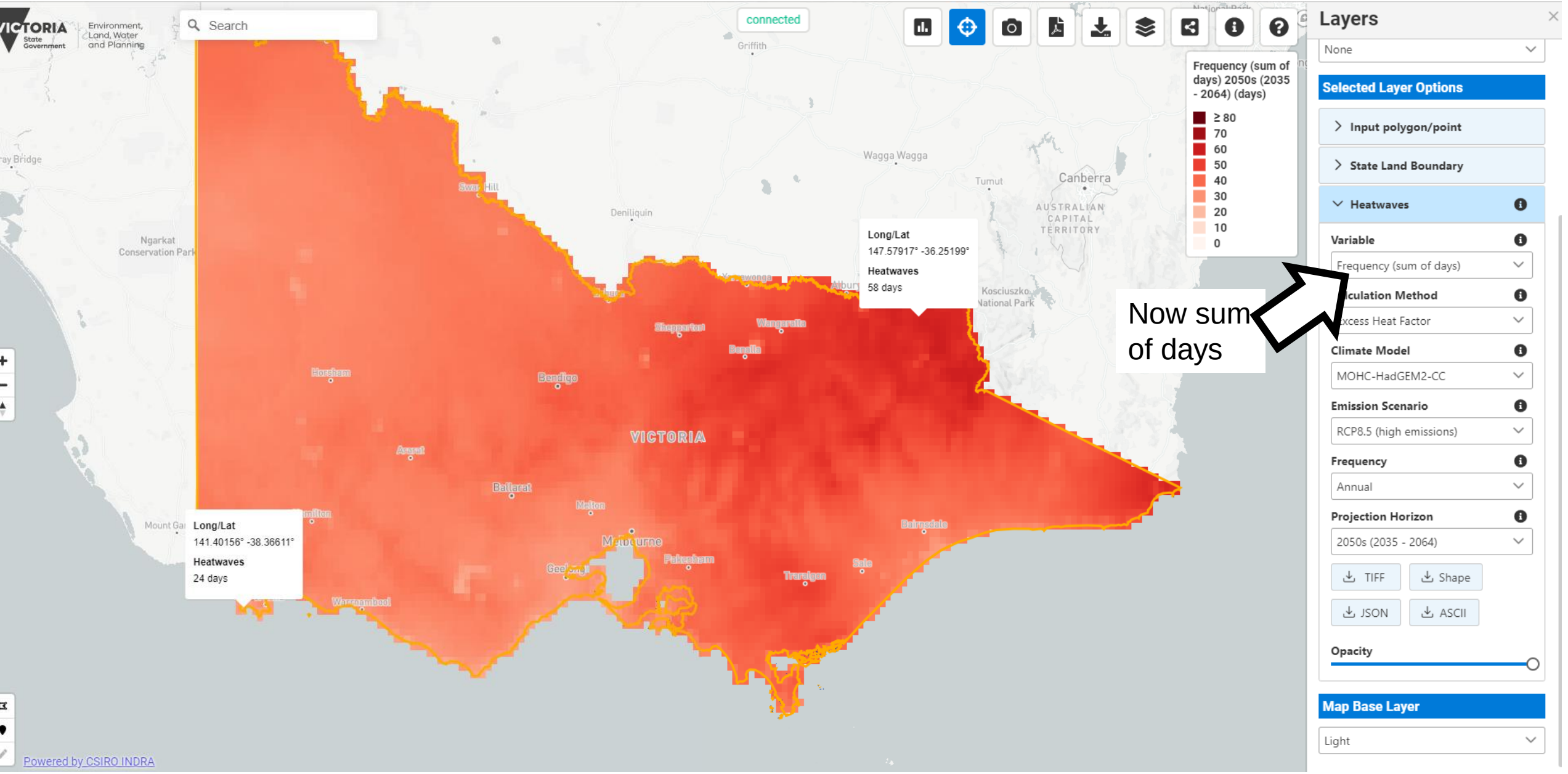
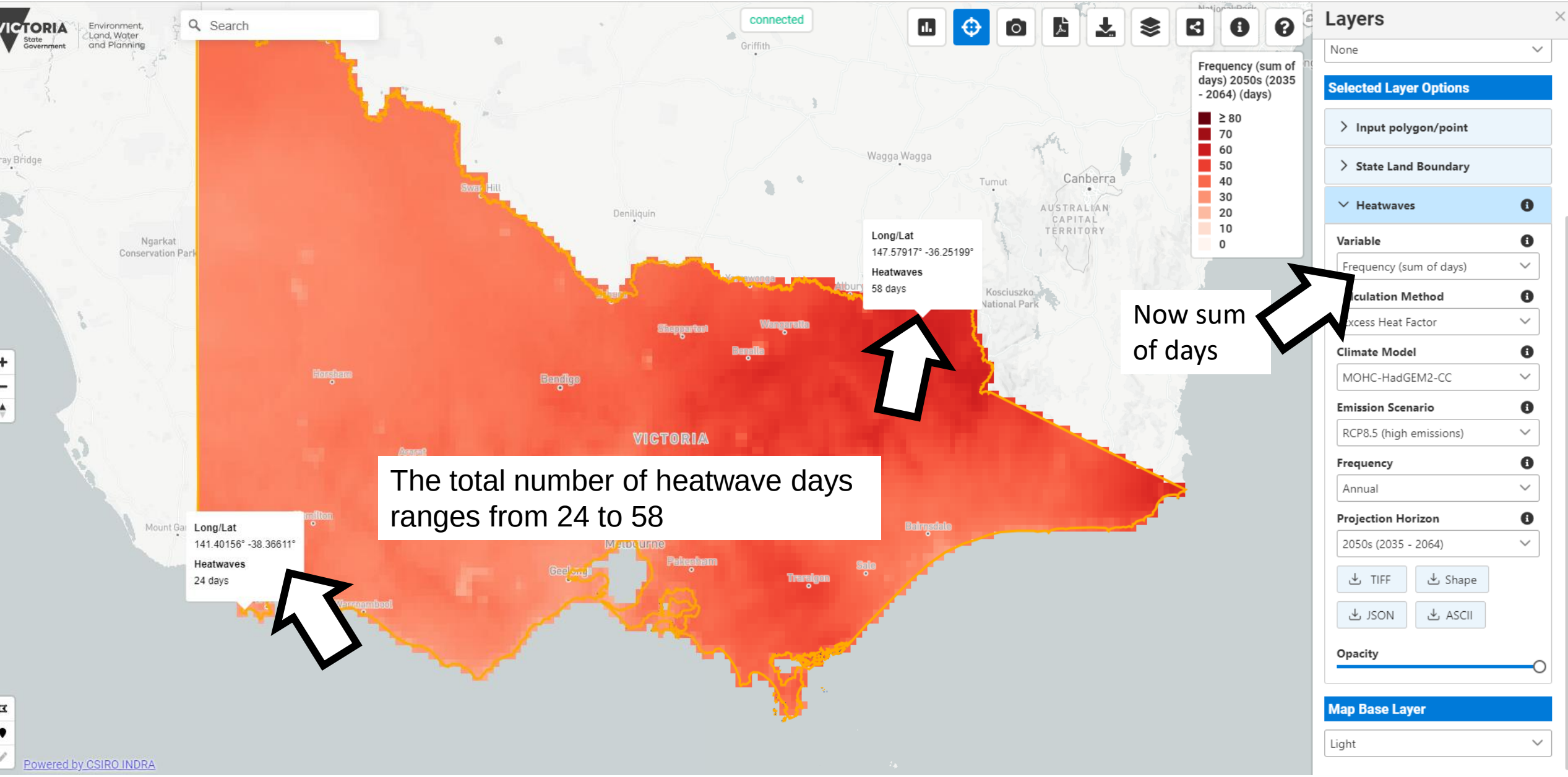
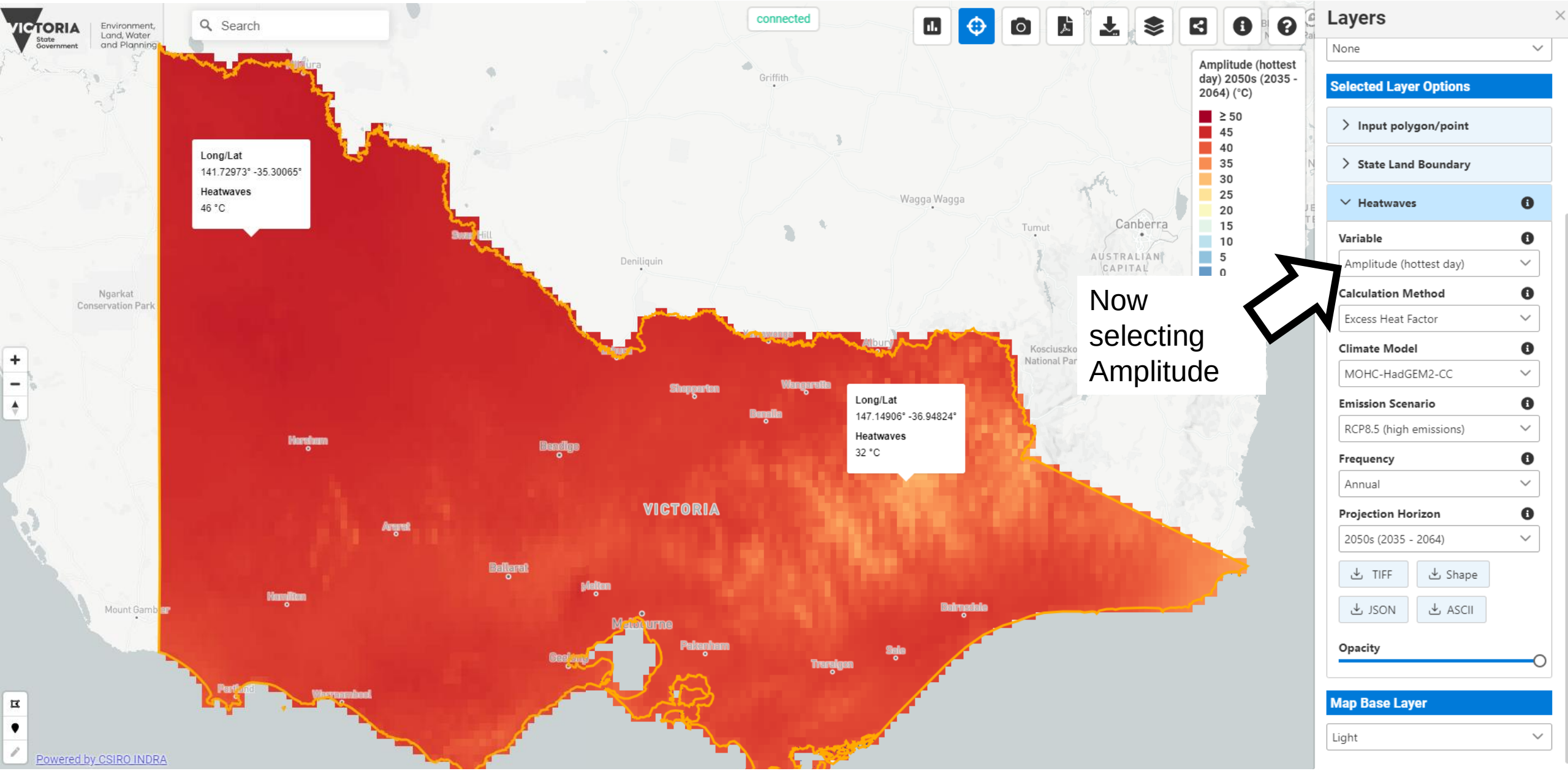
Layers
Project Layers
Region/Place Layer
State Land Boundary
Climate/Hazard Layer
Heatwaves
Coastal Inundation Layer
None
Infrastructure Layer
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Number
Calculation Method
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon

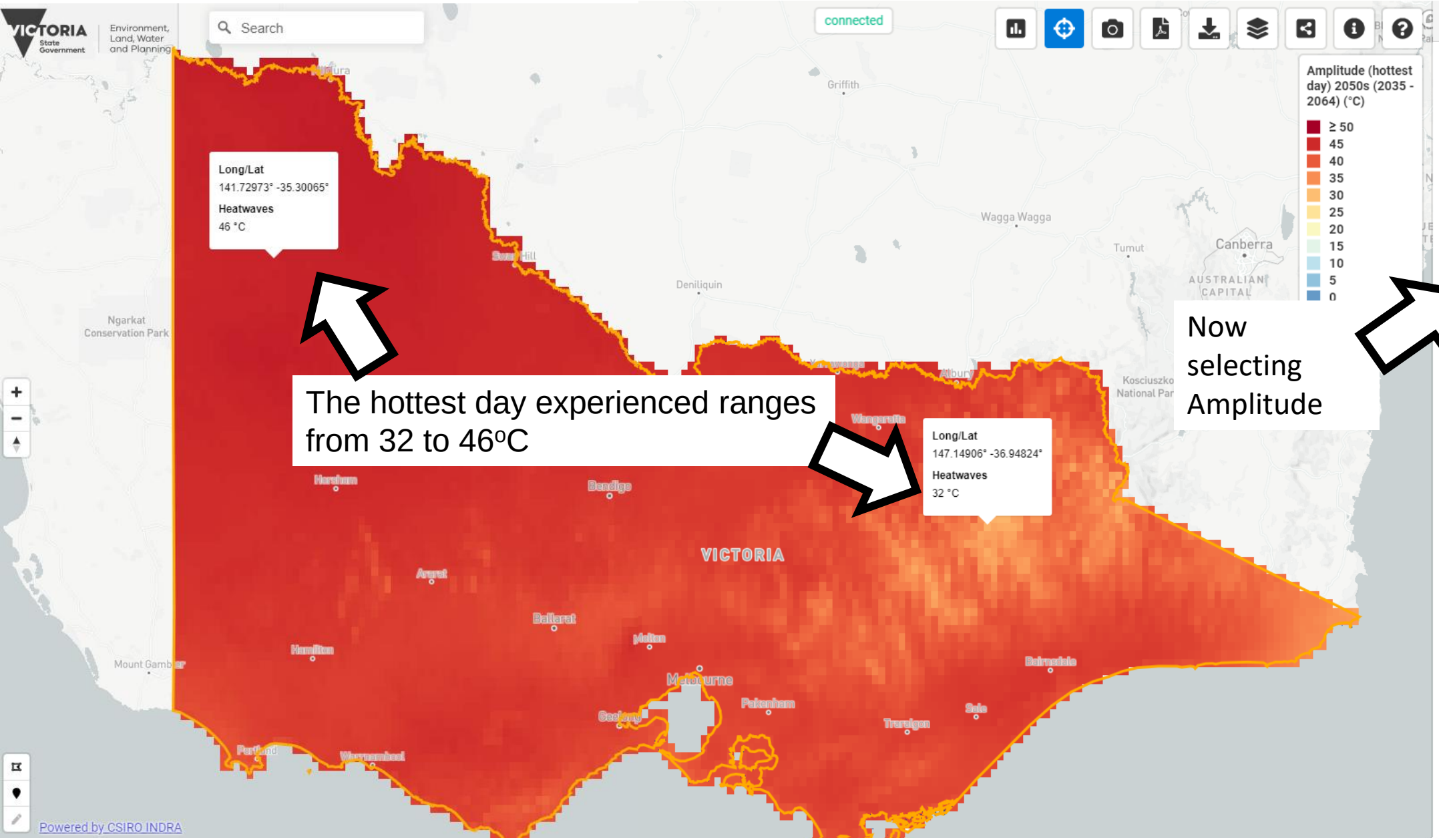

VICTORIA
State Government
Environment, Land, Water and Planning
Search
connected
Duration (longest length) 2050s (2035 - 2064) (days)
≥ 24
22
20
18
16
14
12
10
8
6
Long/Lat
147.06562° -36.29461°
Heatwaves
22 days
Long/Lat
141.43177° -38.31873°
Heatwaves
7 days
Now selecting Duration
Layers
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Duration (longest length)
Calculation Method
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon
2050s (2035 - 2064)
TIFF
Shape
JSON
ASCII
Opacity
Map Base Layer
Light
Powered by CSIRO INDRA


VICTORIA
State Government
Environment, Land, Water and Planning
Search
connected
Duration (longest length) 2050s (2035 - 2064) (days)
≥ 24
22
20
18
16
14
12
10
8
6
Long/Lat
147.06562° -36.29461°
Heatwaves
22 days
Long/Lat
141.43177° -38.31873°
Heatwaves
7 days
The longest projected heatwave lasts between 7 and 22 days
Now selecting Duration
Layers
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Duration (longest length)
Calculation Method
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon
2050s (2035 - 2064)
TIFF
Shape
JSON
ASCII
Opacity
Map Base Layer
Light
Powered by CSIRO INDRA


Search
connected
Layers
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Frequency (sum of days)
Calculation Method
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon
2050s (2035 - 2064)
TIFF
Shape
JSON
ASCII
Opacity
Map Base Layer
Light
Frequency (sum of days) 2050s (2035 - 2064) (days)
≥ 80
70
60
50
40
30
20
10
0
Long/Lat
147.57917° -36.25199°
Heatwaves
58 days
Long/Lat
141.40156° -38.36611°
Heatwaves
24 days
Now sum of days
VICTORIA
Melbourne
Bendigo
Ballarat
Geelong
Wagga Wagga
Canberra
Griffith
Deniliquin
Swan Hill
Sheppartton
Wangaratta
Benalla
Horsham
Ararat
Melton
Pakenham
Traralgon
Sale
Bairnsdale
Albury
Tumut
Kosciuszko National Park
AUSTRALIAN CAPITAL TERRITORY
Ngarkat Conservation Park
Mount Gambier
Warrnambool
Powered by CSIRO INDRA


VICTORIA
State Government
Environment, Land, Water and Planning
Search
connected
Frequency (sum of days) 2050s (2035 - 2064) (days)
≥ 80
70
60
50
40
30
20
10
0
Long/Lat
147.57917° -36.25199°
Heatwaves
58 days
Long/Lat
141.40156° -38.36611°
Heatwaves
24 days
Now sum of days
The total number of heatwave days ranges from 24 to 58
Layers
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Frequency (sum of days)
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon
2050s (2035 - 2064)
TIFF
Shape
JSON
ASCII
Opacity
Map Base Layer
Light
Powered by CSIRO INDRA


VICTORIA
Environment, Land, Water and Planning
Search
connected
Amplitude (hottest day) 2050s (2035 - 2064) (°C)
≥ 50
45
40
35
30
25
20
15
10
5
0
Long/Lat
141.72973° -35.30065°
Heatwaves
46 °C
Long/Lat
147.14906° -36.94824°
Heatwaves
32 °C
Now selecting Amplitude
Layers
None
Selected Layer Options
Input polygon/point
State Land Boundary
Heatwaves
Variable
Amplitude (hottest day)
Calculation Method
Excess Heat Factor
Climate Model
MOHC-HadGEM2-CC
Emission Scenario
RCP8.5 (high emissions)
Frequency
Annual
Projection Horizon
2050s (2035 - 2064)
TIFF
Shape
JSON
ASCII
Opacity
Map Base Layer
Light
Griffith
Wagga Wagga
Canberra
Tumut
Deniliquin
Swan Hill
Albury
Shepparton
Wangaratta
Bendigo
Horsham
Ararat
Ballarat
Melton
Hamilton
Mount Gambier
Melbourne
Pakenham
Traralgon
Sale
Bairnsdale
Geelong
Portland
Warrnambool
Ngarkat Conservation Park
Kosciuszko National Park
AUSTRALIAN CAPITAL
Powered by CSIRO INDRA



Layers

None

Selected Layer Options

- Input polygon/point
- State Land Boundary
- Heatwaves

Variable: Amplitude (hottest day)

Calculation Method: Excess Heat Factor

Climate Model: MOHC-HadGEM2-CC

Emission Scenario: RCP8.5 (high emissions)

Frequency: Annual

Projection Horizon: 2050s (2035 - 2064)

TIFF | Shape | JSON | ASCII

Opacity

Map Base Layer

Light

What did this 2050s scenario tell AV?

Events similar to those that occurred in the 2009 heatwave might occur more frequently, possibly multiple times in a year, and last much longer.

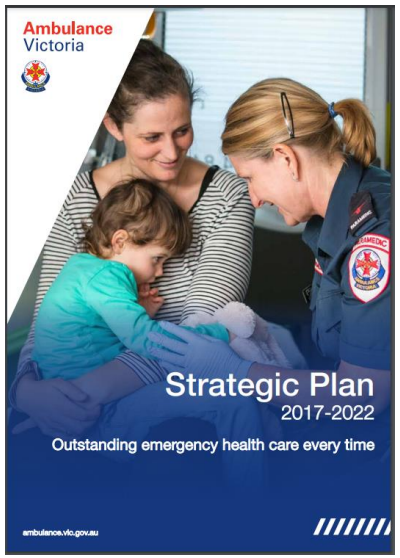
The selected output from the tool indicated:

- an average of between five and eight heatwaves may occur each year across the state
- the longest event could last between seven and 22 days
- the hottest day could reach a maximum of 46^{o}C.

By choosing different criteria, you can analyse more specific regions of the state.

What does this mean for Ambulance Victoria?

Step 5: We consider how the results of the scenarios would impact achievement of our agency's strategic objectives



AV strategic objectives likely to be affected by heatwave	Summary of likely stress test impact?
Providing safe, high quality, timely and expert patient care every time *(Outcome 1 Patient Experience)*	Multiple similar events in the same year and/or event lasting twice as long - likely to cause increased pressure on ambulance services
Planning for and responding to major events and emergencies *(Outcome 2 Partnerships)*	More intense and frequent events likely to place pressure on emergency response
Keeping our people safe, and physically and psychologically well *(Outcome 3 Great place to work & volunteer)*	More pressure on AV's people could result in increased stress-related issues and concerns

Quote from Ambulance Victoria Director Sustainability, Sally Mangan

“With Victoria’s Climate Future Tool, we are able to start to quantify and analyse potential climate futures’ impacts on our service.

“We know heat is a major impact on people’s health, and are focused on planning for different climate futures to support our ability to continue to provide service to community in the face of rising temperatures.

“ This stress testing helps inform our climate strategy overall and supports us to better forecast and plan, in our ongoing efforts to apply a climate change lens to business as usual systems and processes. It also helps us have conversations with our teams at AV about climate change and what it may mean for us in the future.”

How to assess risk using a stress test scenario - what questions to ask?

- Explore changes in risk and values:
  - How would your level of risk change? Increased likelihood? Increased consequences?
  - How would the things your organisation values change under this scenario?
- Analyse current decisions and approaches:
  - Are current approaches sufficient to mitigate the impacts of this future scenario?
  - What actions could help prepare us for these projected changes?
- Explore ‘what if’ questions and explore major system change:
  - What if we experienced multiple events similar to the 2009 heatwave in a single year?
  - What if the conditions experienced during the 2014 heatwave became the average conditions?
- Reveal assumptions:
  - What are the big assumptions we are making about the future in our current planning and management?

Apply future scenarios to existing planning and risk processes

Using scenarios to apply future context to existing risk procedures – what questions to ask?

- Explore how climate change can be taking into account current risk?
- What impact does climate change have on likelihood and consequences?
- Do different scenarios change levels of risk?

What are the potential operational implications?

- In this particular example an increased in heatwaves and heatwave intensity is likely to impact future fleet requirements, staffing, equipment, OHS and staff support.
- It may also result in a need for additional investment in programs to support mitigation actions i.e. increased heatwave community awareness programs and community heatwave planning.