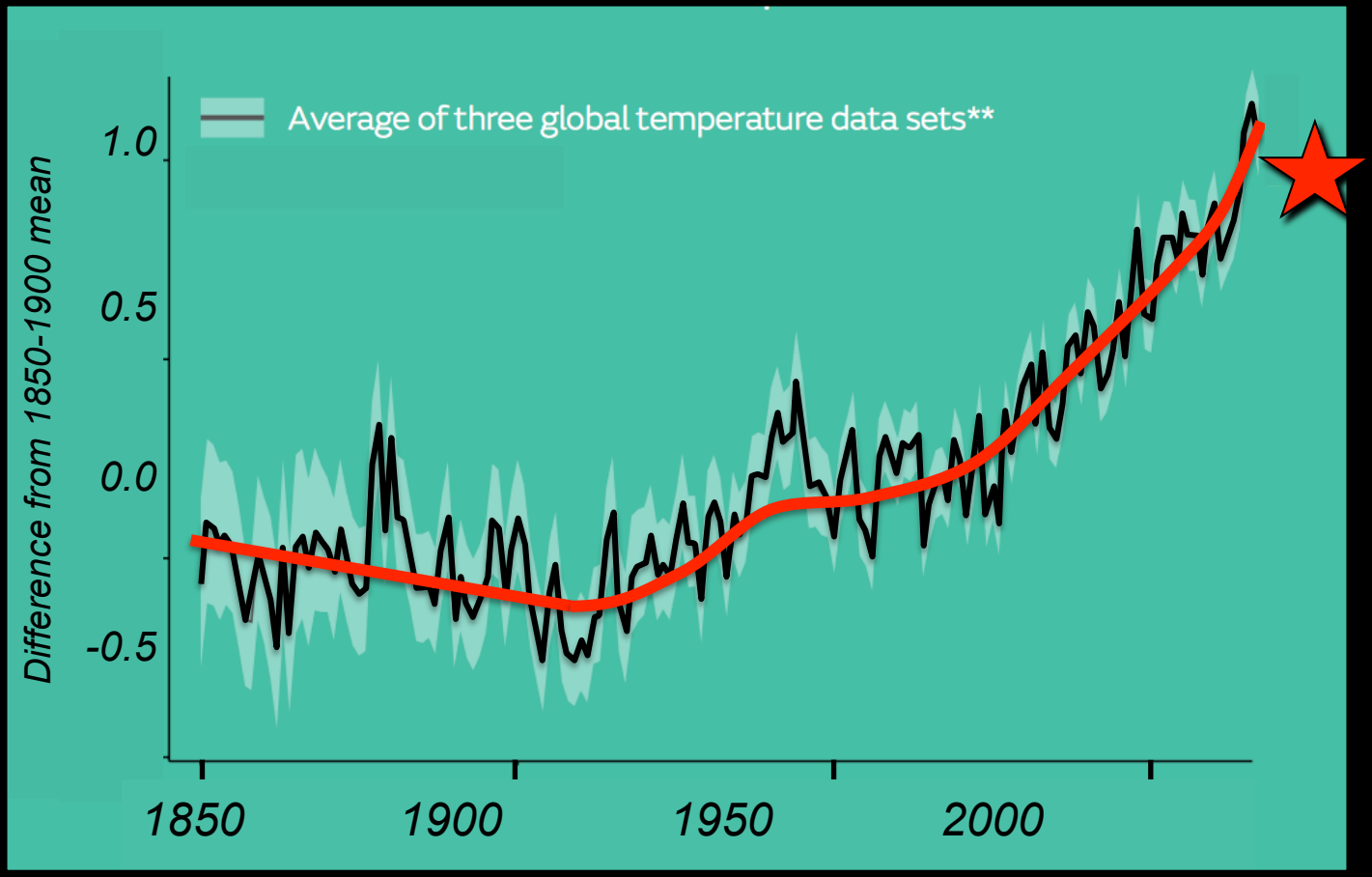
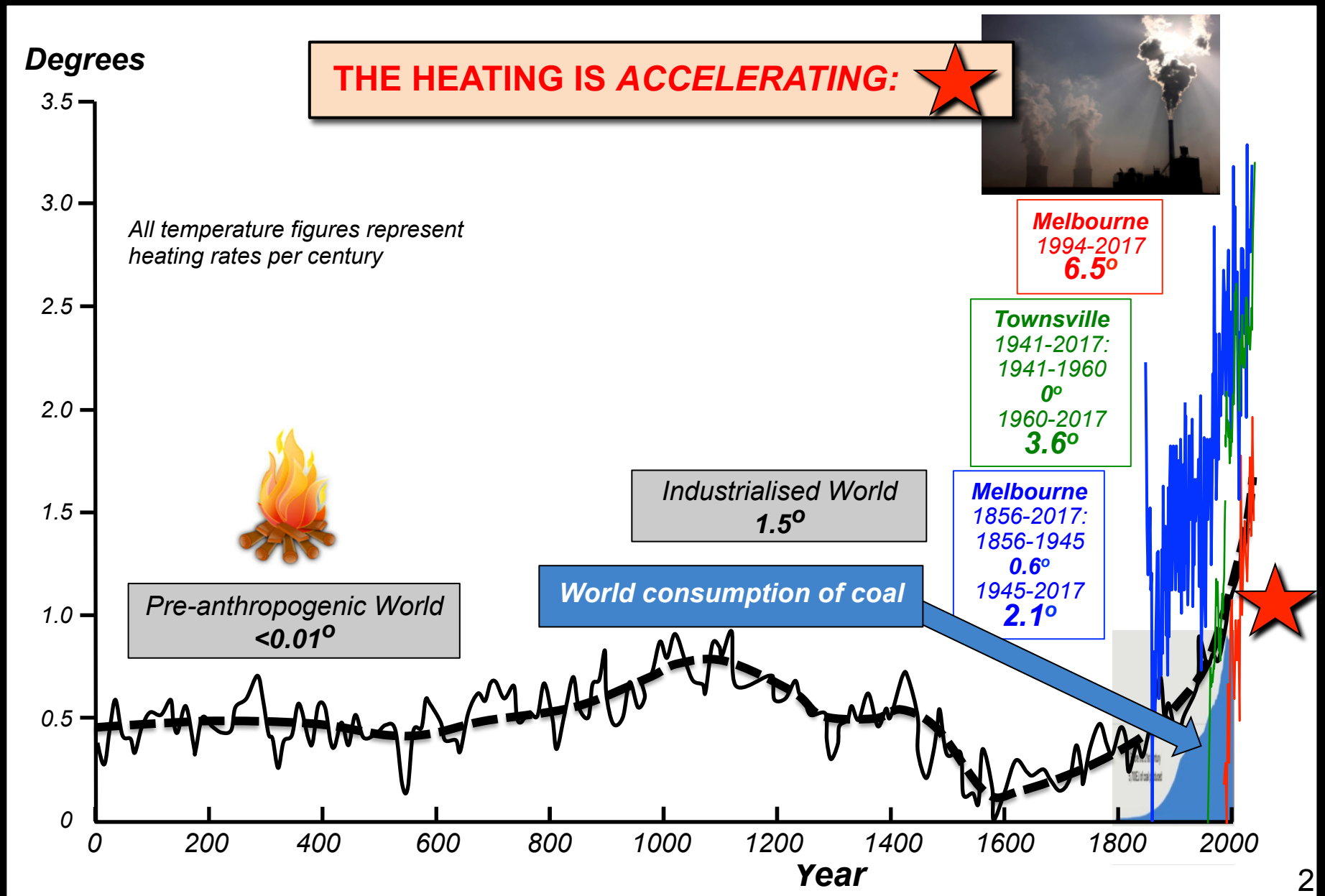
The fundamental world heating graph: Past 170 years

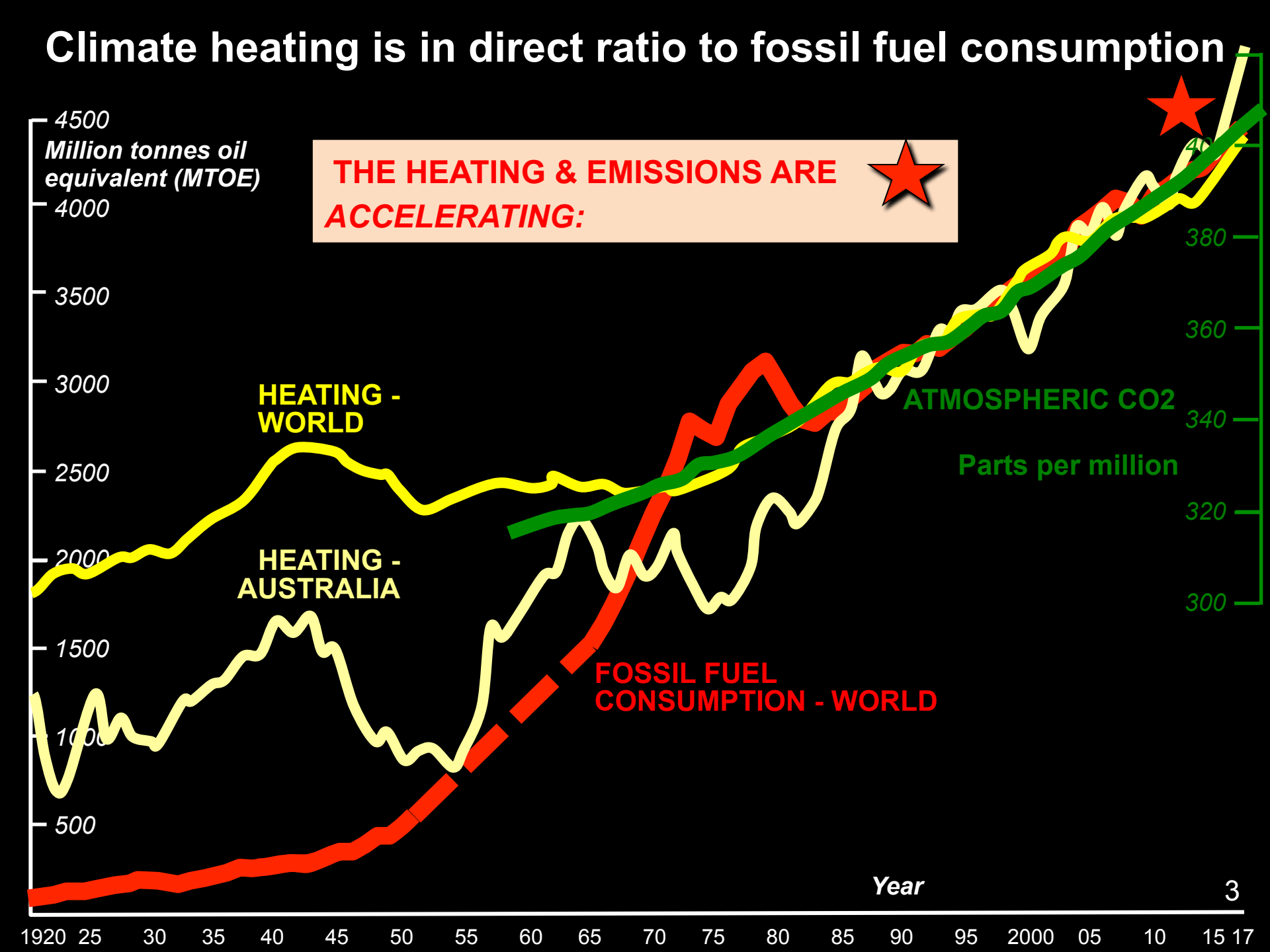
THE HEATING IS *ACCELERATING:*



The fundamental world heating graph: Past millenium

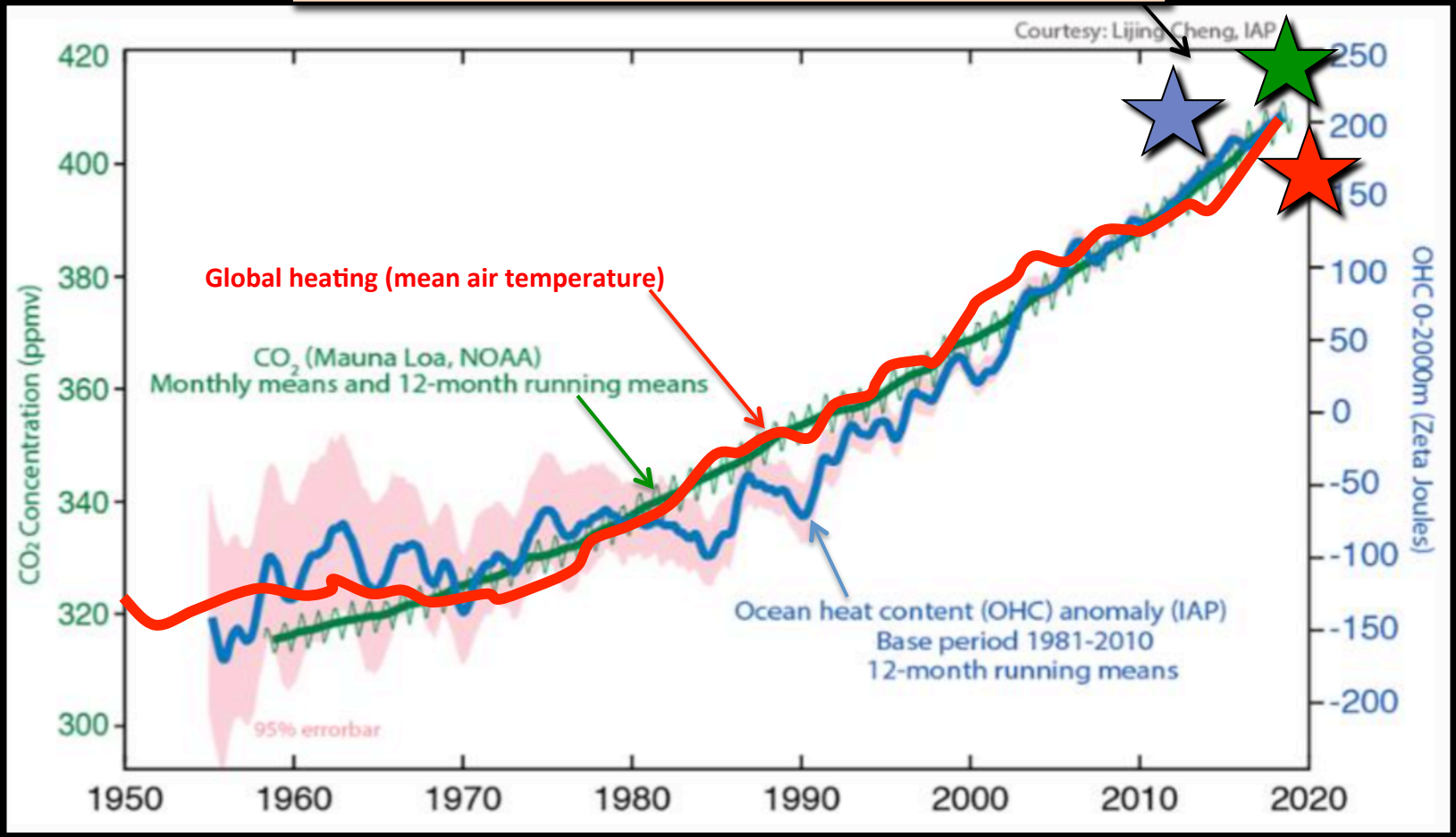


Climate heating is in direct ratio to fossil fuel consumption

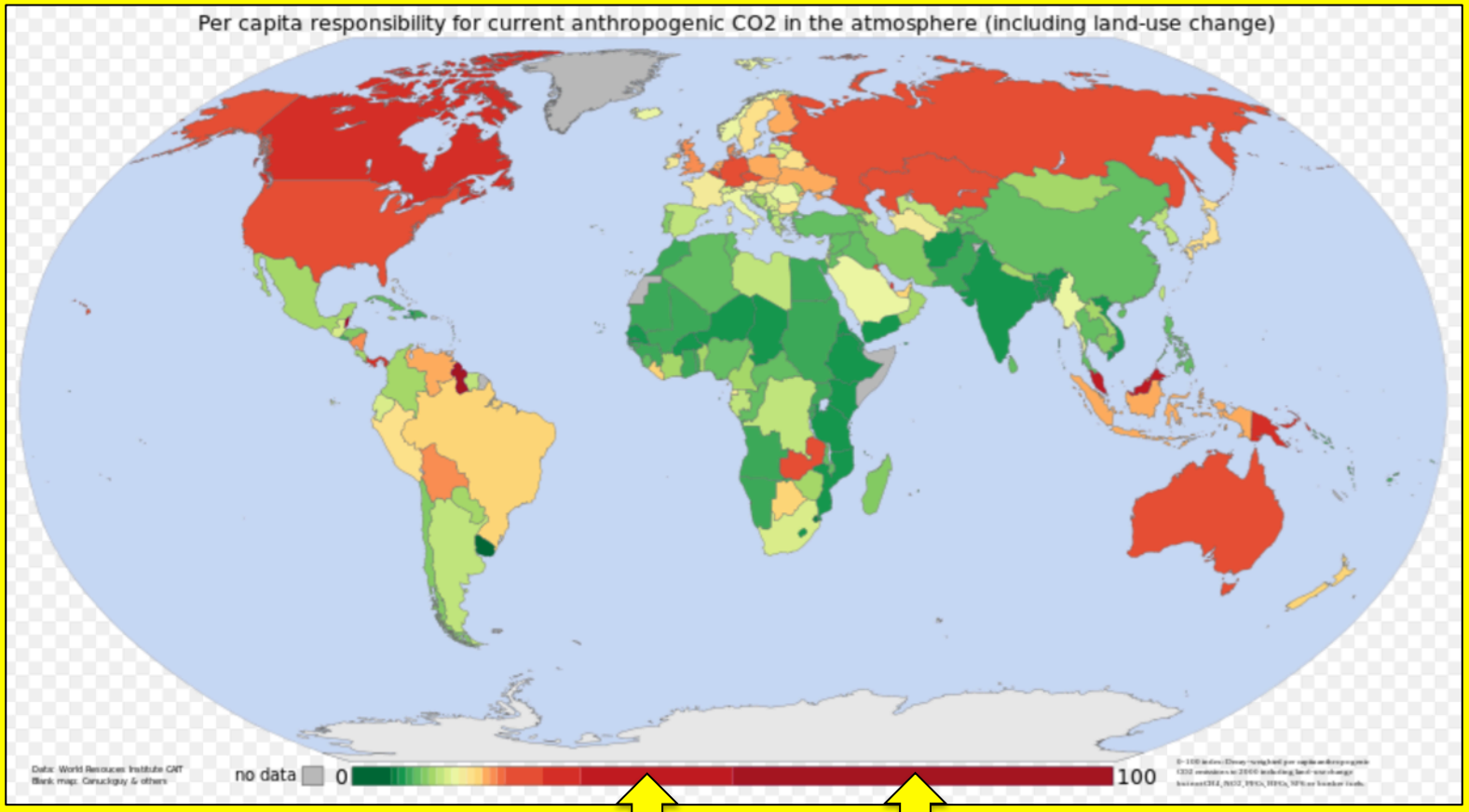


Climate heating (air & ocean) is in direct ratio to CO2

THE HEATING & EMISSIONS ARE *ACCELERATING:*



Global heating: Australia's contribution to carbon emissions

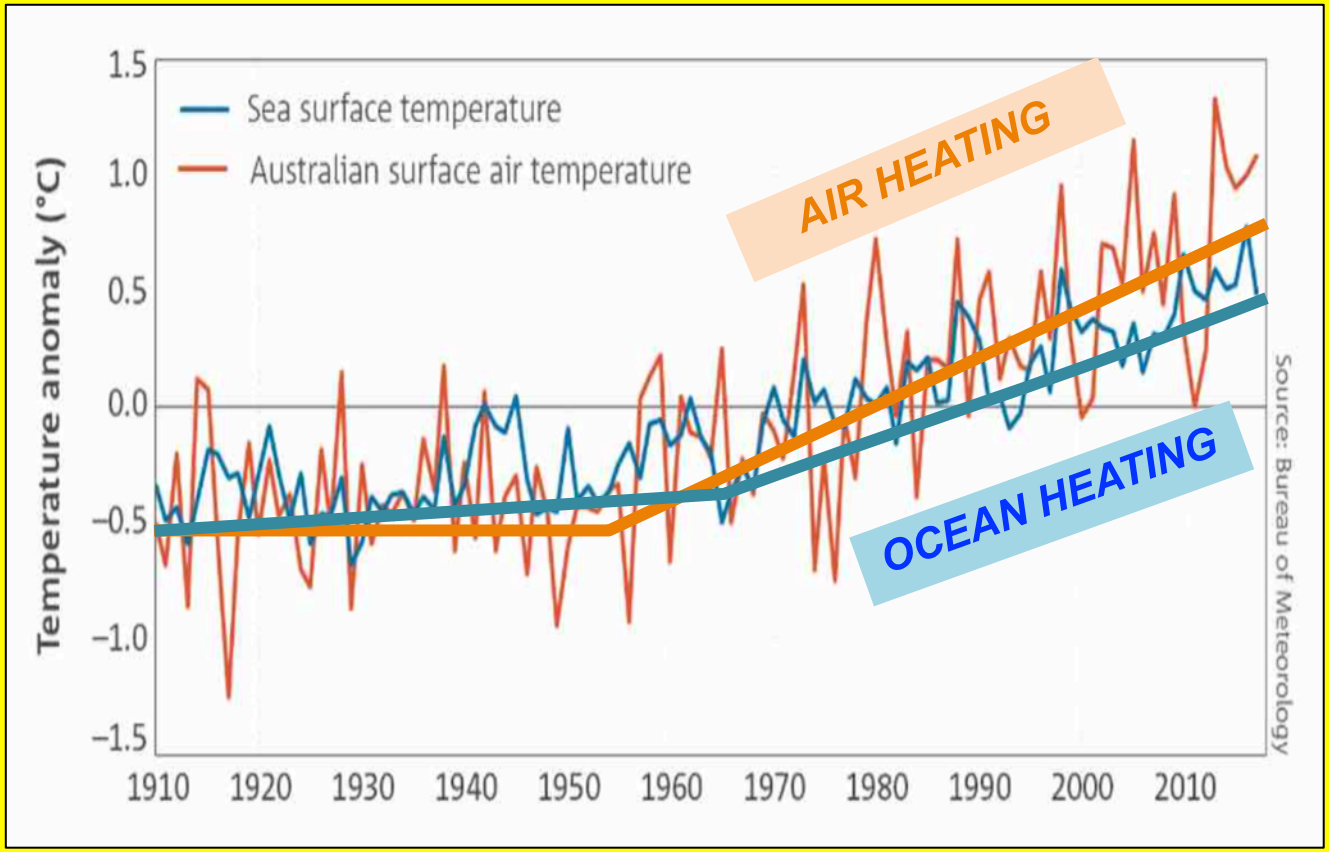


Australia is here

Canada is the only country worse than Australia

Australia & Bowen's heating curves: air & ocean (Coral Sea)

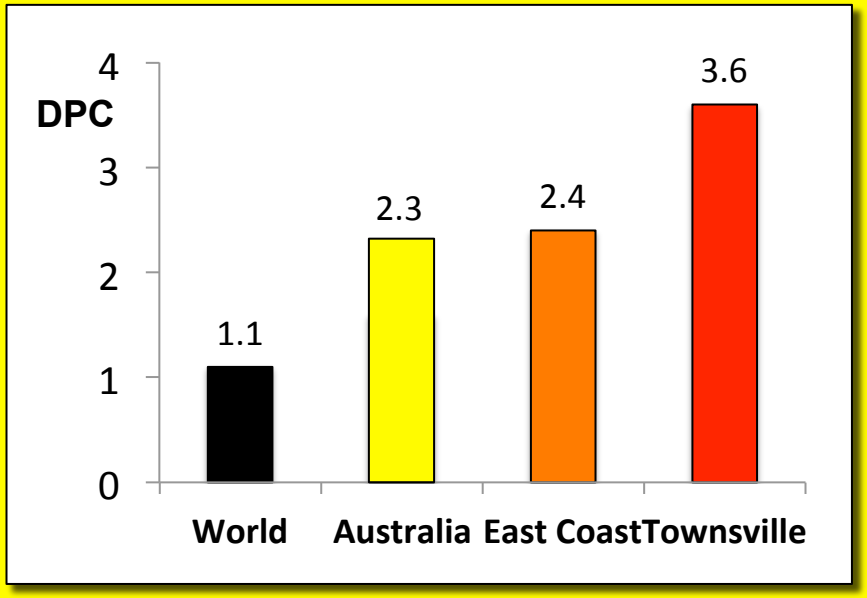
Degrees



Time (years) ⟶

Global heating: How does Australia compare?

THE WORLD	**1.1° per 100y**	
AUSTRALIA	**2.3° per 100y***	**2x** the world
EAST COAST AUSTRALIA	**2.4° per 100y**	**2.2x** the world **1.5x** the rest of Australia
BOWEN	**>3.6° per 100y**	**3x** the world **2x** the rest of Australia
MELBOURNE & SYDNEY accelerating in past 25 yrs	**5.3° per 100y**	**5x** the world **4x** the rest of Australia

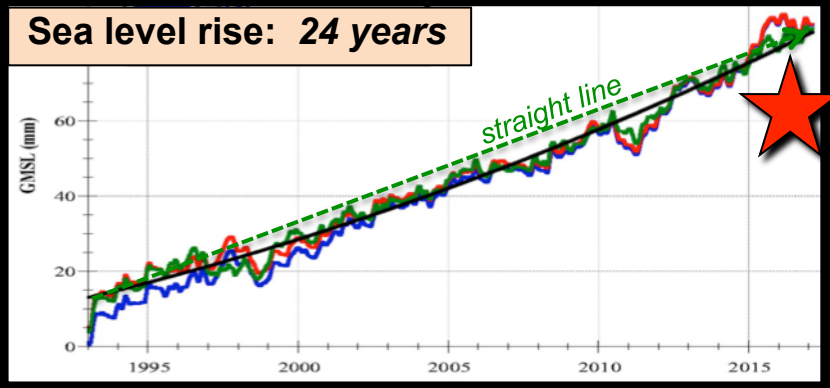


Global heating key indicators

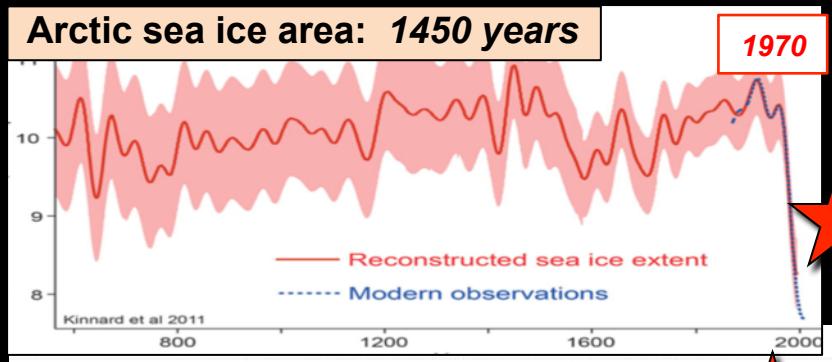
MOST ARE *ACCELERATING:*

SEA LEVEL

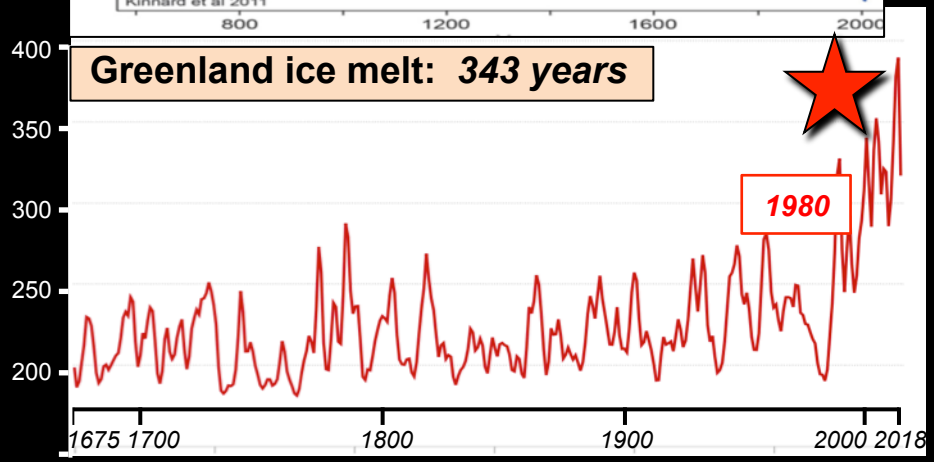
Sea level rise: *24 years*



Arctic sea ice area: *1450 years*

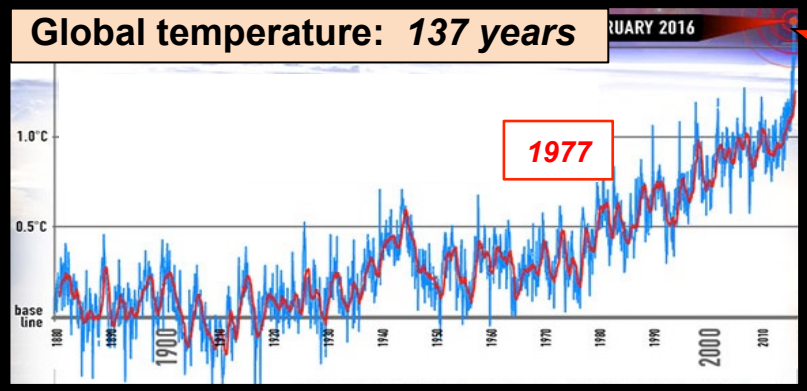


Greenland ice melt: *343 years*

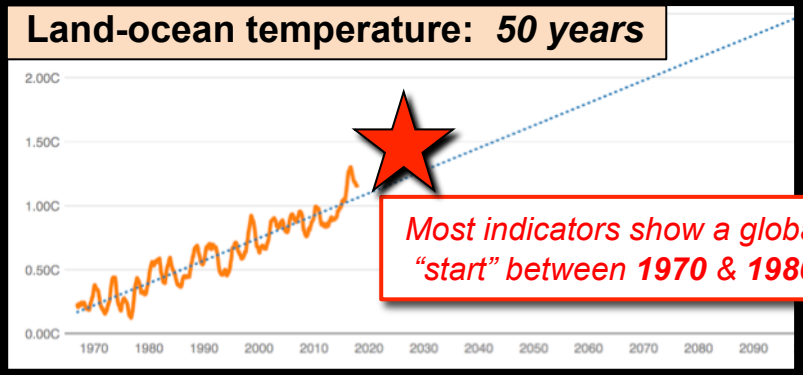


TEMPERATURE

Global temperature: *137 years*

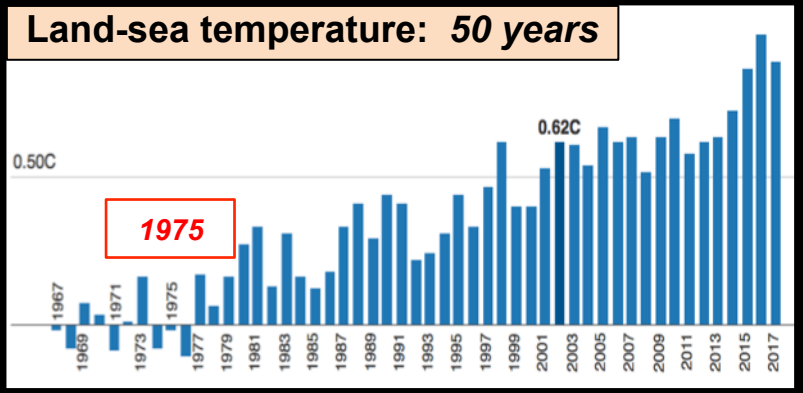


Land-ocean temperature: *50 years*



*Most indicators show a global "start" between **1970** & **1980***

Land-sea temperature: *50 years*



The Arctic icecap will be destroyed in 20 years

US oil firm's bid to drill for oil in Arctic hits a snag: lack of sea ice
Guardian 15 Nov 2018

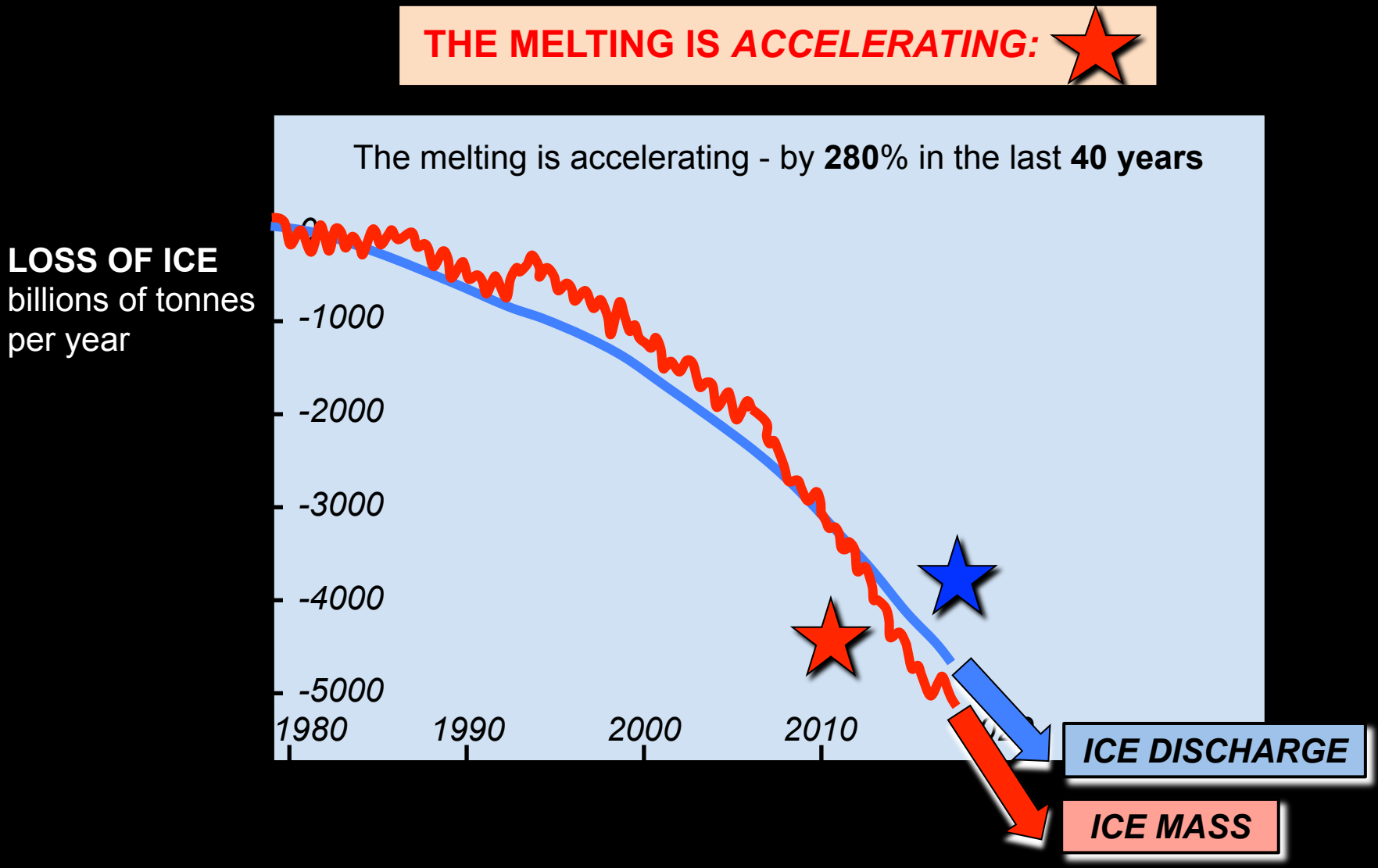
Texas-based Hilcorp Energy's plan to extract 70,000 barrels a day follows Trump's reversal of an Obama-era ban on fossil fuel activity in the region. In October 2018 President Trump approved the go-ahead of the Liberty project to extract oil from beneath the Beaufort Sea, off Alaska's north coast. The drilling would be the first of its kind in US waters in the Arctic. Hilcorp has now added another year to completion of the drilling island. Construction will start in 2020.

Climate change is causing the planet to warm, with the Arctic heating up twice as quickly as the global average. It experienced its warmest winter ever earlier this year. Bureau of Ocean Energy Management said businesses like Hilcorp that rely upon shoreline ice for drilling platforms will likely face "significant challenges as the growing season shortens", with the melting of permafrost and coastal erosion also hampering projects.

Mr Trump has opened up virtually all Federal waters, including the Arctic, for oil & and gas drilling leases, as part of a "US energy dominance" strategy.

We are still drilling the Arctic - for more oil

Antarctica is melting, and the melting is accelerating



Climate rage is here: Temperature-aggression hypothesis

Temperature-Aggression Hypothesis:
People act more aggressively in extreme heat

Darwin (Australia)	% higher in hot season
Insomnia	110%
Anxiety	111%
Hostility	118%
Physical aggression	127%
Murders (by quarter)	50% in "buildup", 30% in wet: only 20% in winter half
Assault + sexual assault	Increases
Heat exhaustion	Increases
Alcohol consumption	Increases
Fracture hospitalisation	Increases
Property theft	No change

Darwin's "mango madness"

Tshwane (Pretoria, South Africa)	
Violent crimes	150%
Sexual crimes	141%
Property crimes	112%

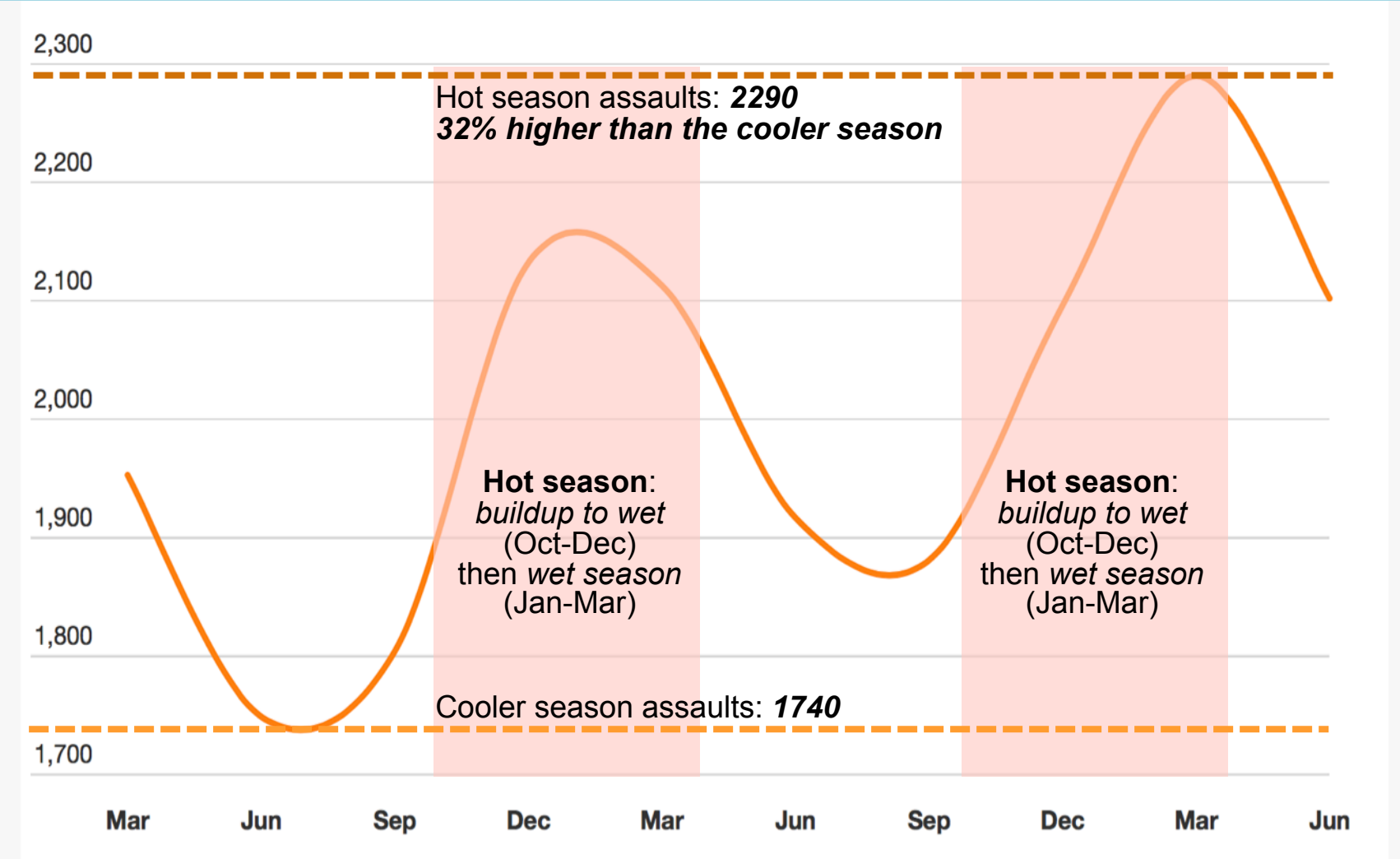
Heat increases crime everywhere

Chicago (USA)

Hotter US cities have significantly higher violent crime. Serious assaults increase by 7% per hundred thousand for every ^{o}C hotter. Chicago (population 2.7 million) has **1900 more assaults on a 35^{o} day than on a 25^{o} day**.

https://www.abc.net.au/news/2014-10-07/mango-madness-mental-illness-tropical-wet-season-build-up/5795852
https://phys.org/news/2018-08-temperatures-crime-evidence-south-africa.html

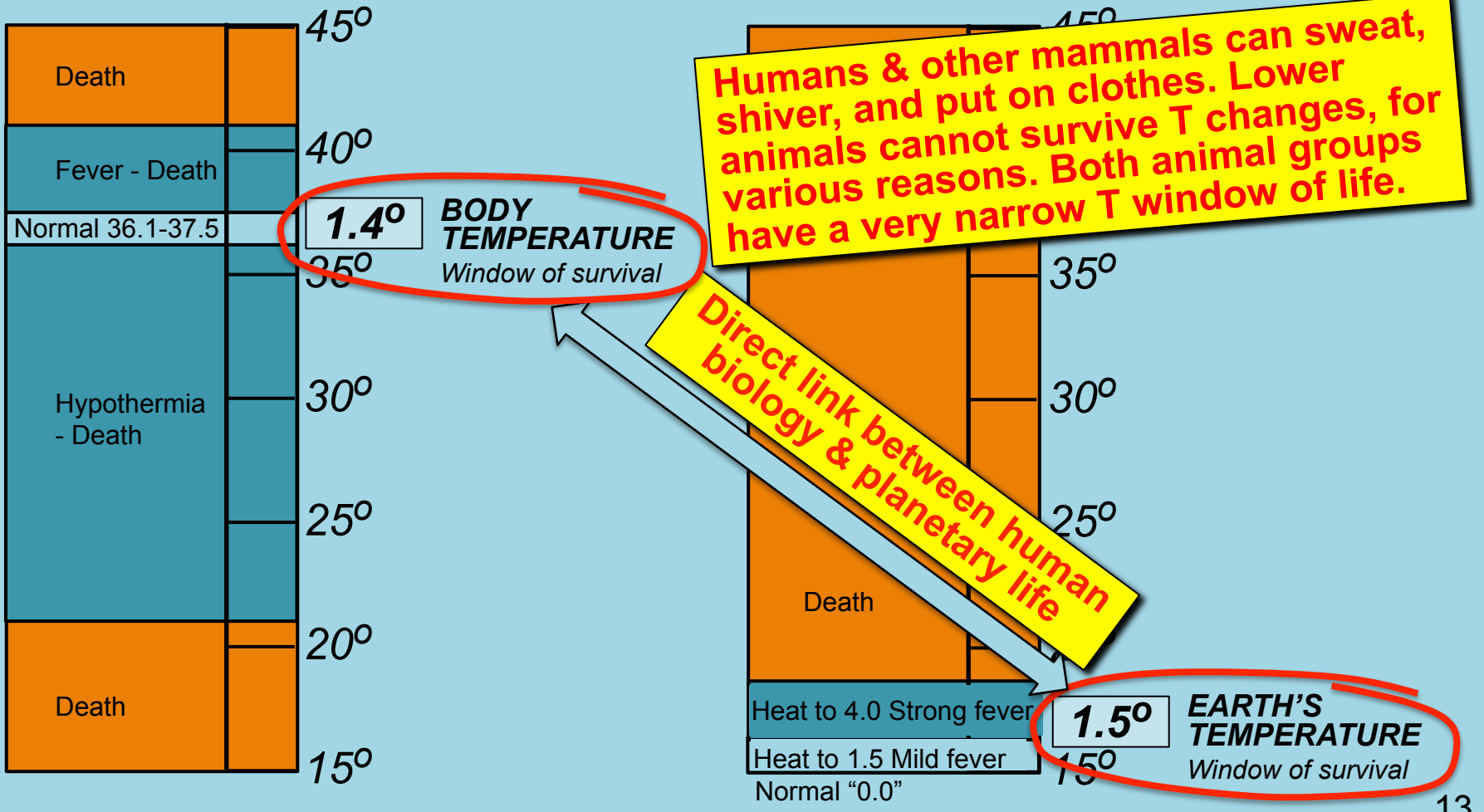
Climate rage is here: Darwin's mango madness



Offences against the person *From Northern Territory Department of Justice, 2011-13*

The damage to life from a world temperature rise over 1.5-2º

The Earth is sensitive to temperature change just like our human body - for a similar reason



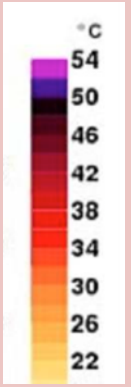
Australia adopts new, more severe climate ratings: heat & fire

NEW RATING FOR TEMPERATURE - ADOPTED IN 2013

Ultra-high temperature
Australia adds new colour to temperature maps as heat soars

"Forecast temperatures are so extreme that the Bureau of Meteorology has had to add new colours to its scale. It is a sign of things to come. Global warming is turning the volume of extreme weather up, to 11. The temperature forecast for next Monday by Australia's Bureau of Meteorology is so unprecedented - over 52C - that it has had to add new colours to the top of its scale, pink and a suitably incandescent purple."

https://www.smh.com.au/environment/weather/temperatures-off-the-charts-as-australia-turns-deep-purple-20130108-2ce33.html



New temperature rating system contains 2 new colour categories:
52-54o Pink
50-52o Purple

NEW RATING FOR FIRE DANGER - ADOPTED IN 2017

Catastrophic fire danger

"In 2017 the Australian bushfire danger rating system was modified to include a new additional 6th danger category of "catastrophic". Previously, the highest risk category was "extreme". This new category was deemed necessary by bushfire experts as the old scheme was not designed to capture the catastrophic type fires now being experienced. This new rating system reflects the established fact that there has been a long-term increase in extreme fire weather, and in the length of the fire season, across large parts of Australia.

The Bureau of Meteorology declared a "catastrophic" fire danger - the highest possible risk rating - in some central areas, while fire fighters battle to contain more than 140 blazes across the state.

Sources: News.com.au, November 29, 2018 12.01 pm"

Witness Statement, Professor Brendan Mackey PhD, 9 May 2019
Email: b.mackey@griffith.edu.au

New bushfire danger rating system contains a new 6th category of "catastrophic"

Emergency vs climate emergency: the same but different

EMERGENCIES - *NATURAL:* THEIR KEY FEATURES

NATURAL EMERGENCIES	Climate change	Flood	Wildfire	Earthquake	Tsunami	Eruption	Famine	Pandemics to date
Uniquely new	√	THESE						
May be covert	√		COMPONENTS					
Extended time	Decades				DIFFERENTIATE		Several years	Several years
Planet-covering	√					CLIMATE		
H. sapiens threat	√						CHANGE	
Uncontrollable	√	√	√	√	√	√		√
Uncertainty	√	√	√	√	√	√	√	√
Permanent harm	√		√	√	√	√	√	√

A tick √ denotes that the emergency may have this characteristic

Related to climate change

Related to weather

Related to geological processes

Related to biological processes

EMERGENCIES - *HUMAN:* THEIR KEY FEATURES

NATURAL EMERGENCIES	Climate change	Traffic accident	Building fire	Plane crash	Communications outage	Government	Civil strife	War
Uniquely new	√	THESE						
Covert	√		COMPONENTS					
Extended time	Decades				DIFFERENTIATE	Months	Year	Several years
Planet-covering	√					CLIMATE		
H. sapiens threat	√						CHANGE	Nuclear
Uncontrollable	√	√	√	√			√	
Uncertainty	√	√	√	√	√	√	√	√
Permanent harm	√						√	√

A tick √ denotes that the emergency may have this characteristic

Related to climate change

Related to human or system error

Related to (inter)national relations

The new arithmetic of emergency: doesn't mean fast or *short*

What is the urgency which defines an emergency?

Lenton et al (2019) analysing climate change developed a parameter called Urgency:

"Urgency (U) is the time it takes to react to an issue (τ) "divided by the intervention time left to avoid a bad outcome (T)" or U = τ/T."

I clarify and restate this as follows:

Urgency = Amount of time I *need* to deal with it, divided by **Amount of time I *have* to deal with it**

This has quite a profound implication. The state of mind of a person facing every emergency is *not* the statement "**I have to act really fast, it's an emergency**". Rather, the state of mind defining every emergency is "**I have lots to do to to deal with this emergency and not much time to do it"**. This equates to, precisely, a simple arithmetic equation: the *equation of emergency - every* emergency:

U = Tneed / Tavailable

How does this improve our perception of the timeframe of an emergency?

The emergency equation is important and informative in a number of areas.

The urgency equation is a ratio of variables (each is a time variable). Because the ratio divides time by time, they cancel each other out, and we are left with *a dimensionless number, not a variable. Time is removed from the urgency.* This means that the urgency of an emergency depends, *not on a fixed amount of time*, but *on what we need to do in the time available, before the emergency reaches its natural climax and maximum harm.* The equation is the foundation of every emergency; it is the paramount thing that defines it as an emergency, no matter how long it is lasting - one minute, one hour, one week, or one century. The equation provides the link between the experience and its arithmetic: a ratio which removes time from the emergency equation, a ratio which links every emergency, in all possible timeframes.

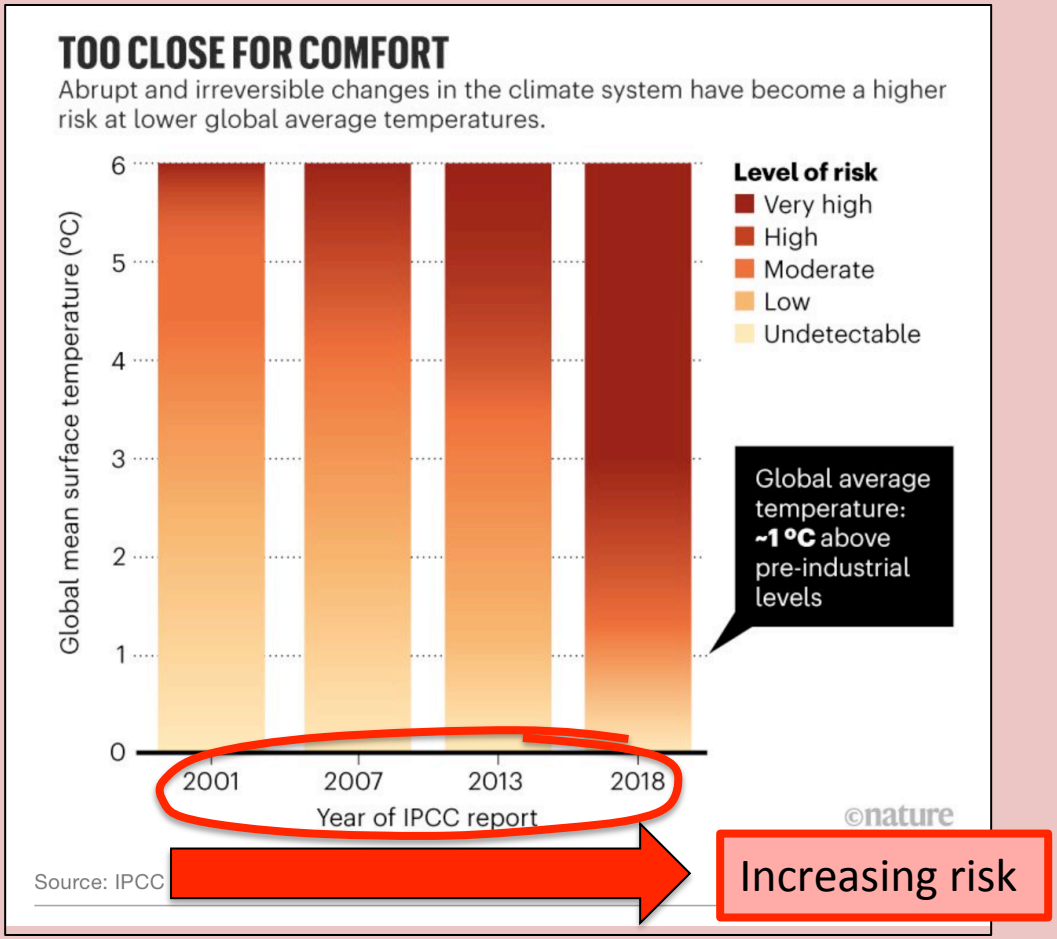
Urgency boils down to a dimensionless number **U = Tneed / Tavailable = the Urgency Index** of any emergency. Urgency consists of a ratio of times, not an absolute time. The value of the emergency equation is as follows:

1 it identifies the real dynamic of an emergency, and this is not speed.

2 It provides an index which allows us to meangingfully compare all categories of emergency, whether small or large, short or prolonged.

3 The index of Urgency allows us to quantify the urgency, hence to rank it against other emergencies; and it requires us to identify the qualitative elements of a solution. It delivers valuable quantitative and qualitative information which directly inform our rational response to the emergency: data acquisition, planning, prioritisation, triaging, and retro-analysis of the emergency response.

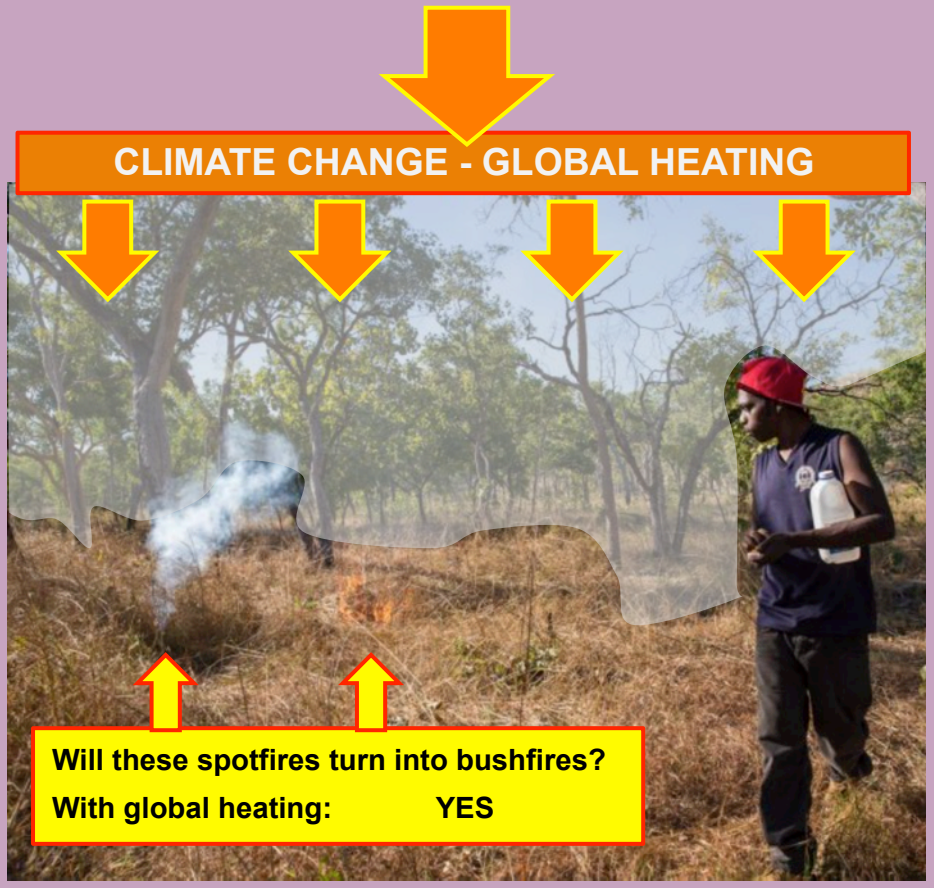
The new arithmetic shows the *urgency* of the emergency



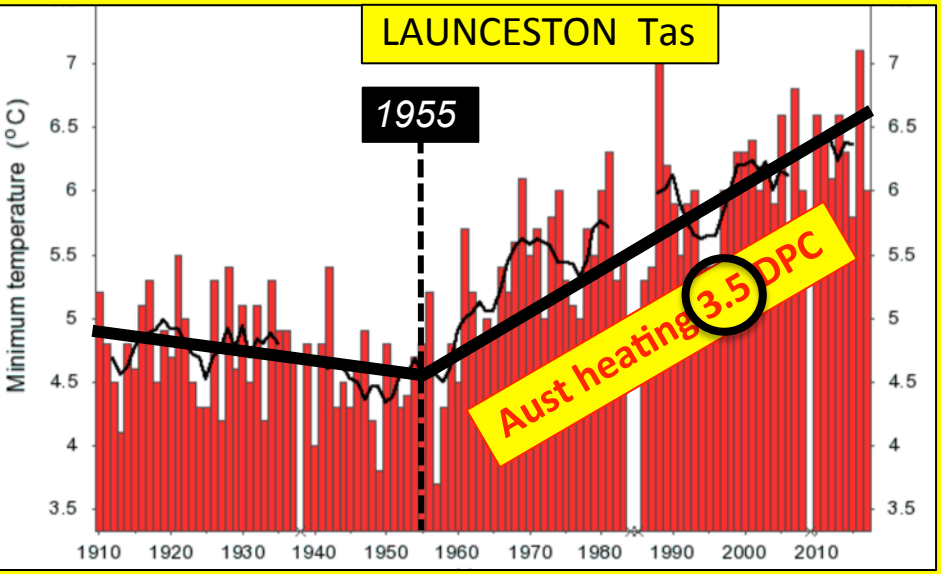
https://www.theguardian.com/environment/2019/dec/01/scientists-theory-of-climates-titanic-moment-the-tip-of-a-mathematical-iceberg?utm_term=RWRpdG9yaWFsX0d1YXJkaWFuVG9kYXlBVVMtMTkxMjAy&utm_source=esp&utm_medium=Email&utm_campaign=GuardianTodayAUS&CMP=GTAU_email

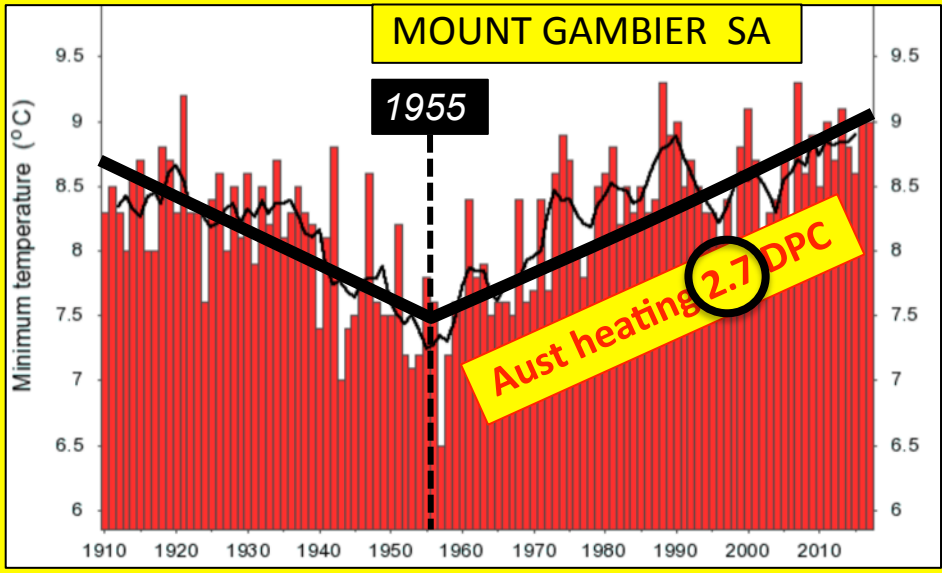
(Most) extreme weather is caused by climate change

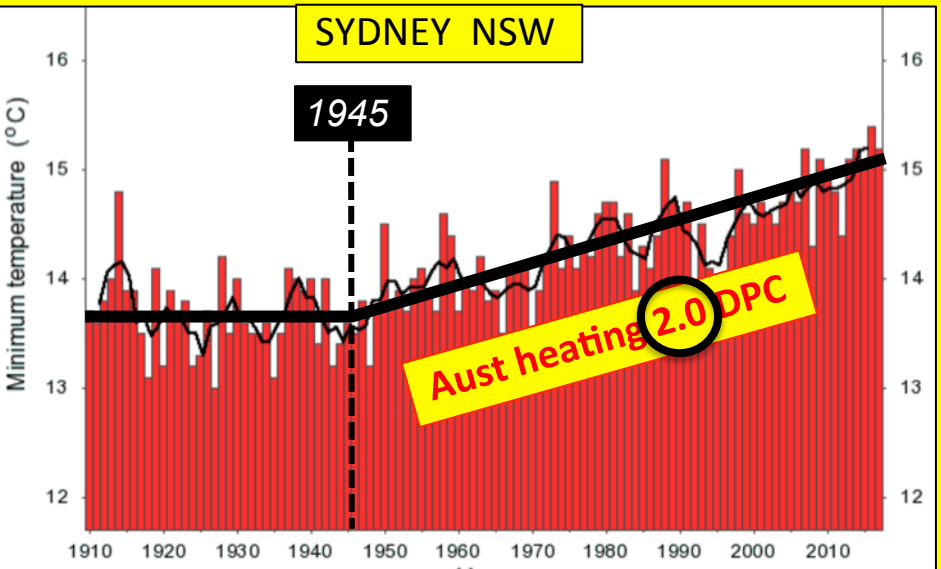
Addition of ENERGY

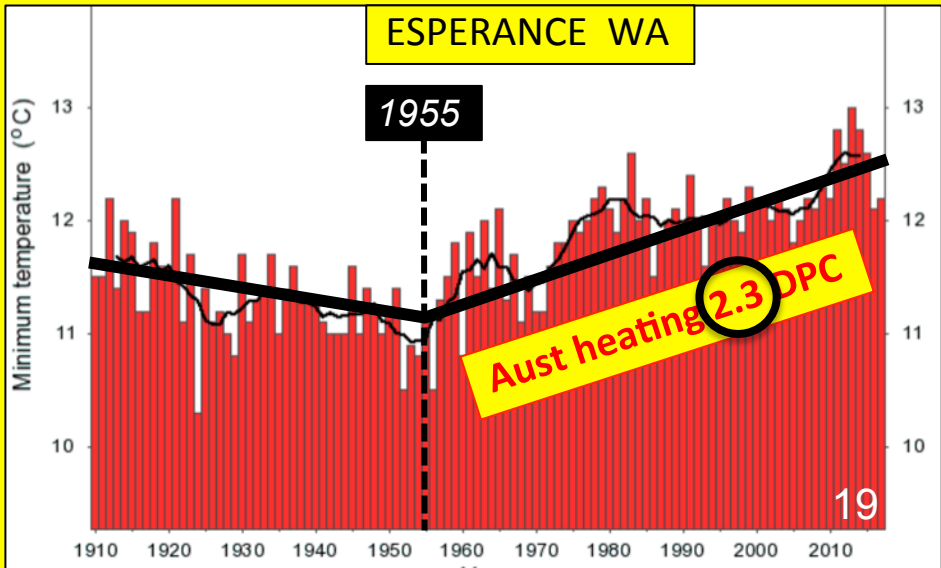


Australia's climate heating in all cities & towns: examples



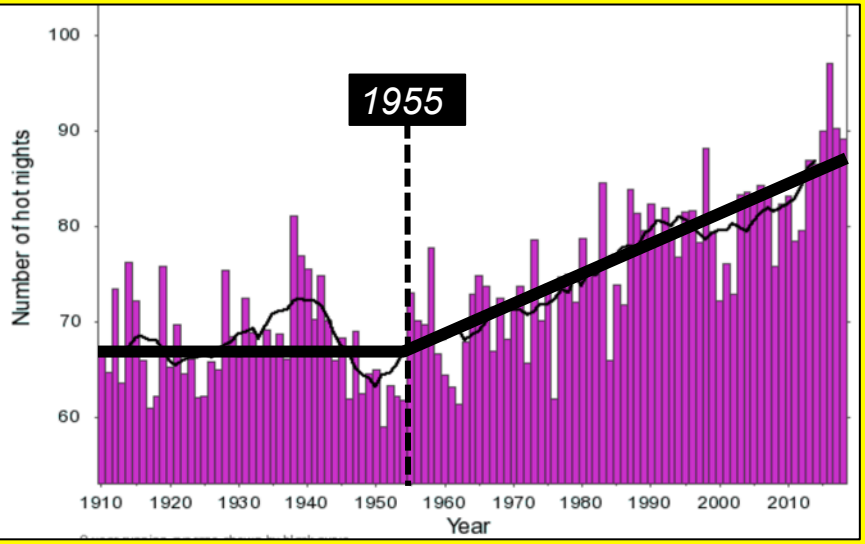




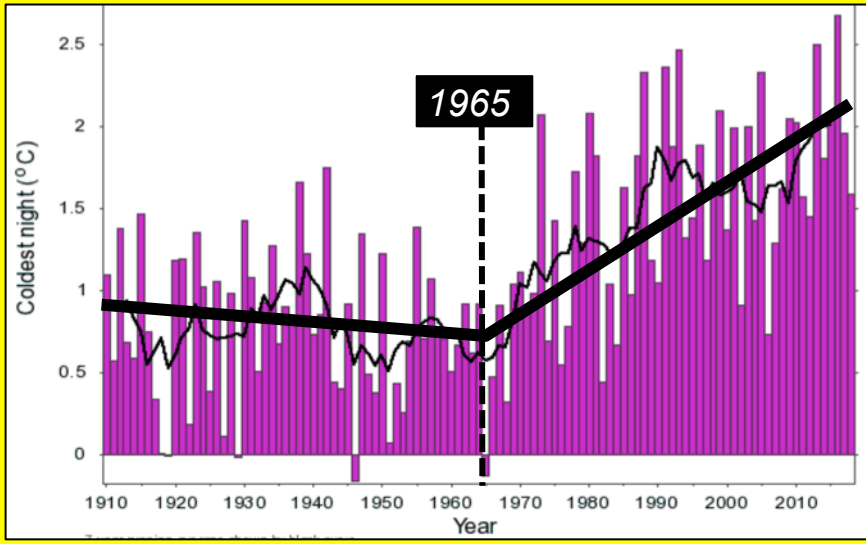


(Most) extreme weather is caused by climate change

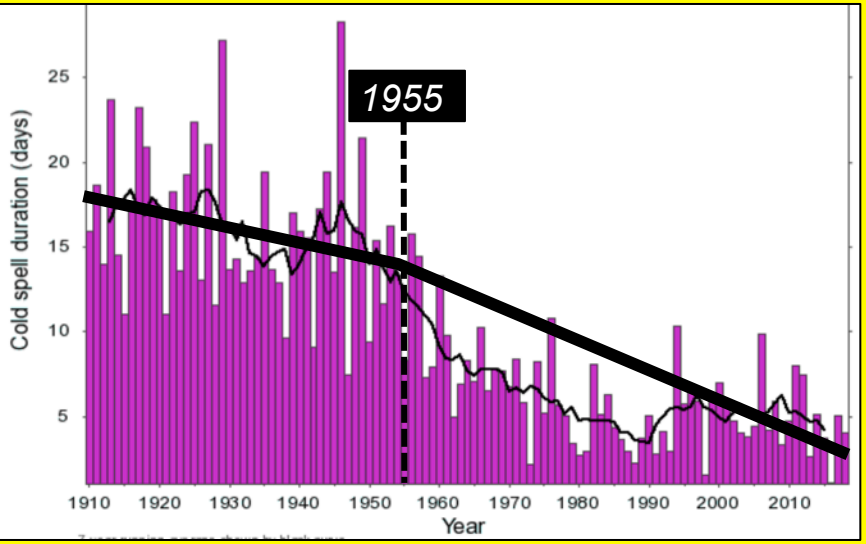
Number of hot nights *INCREASING 130%*



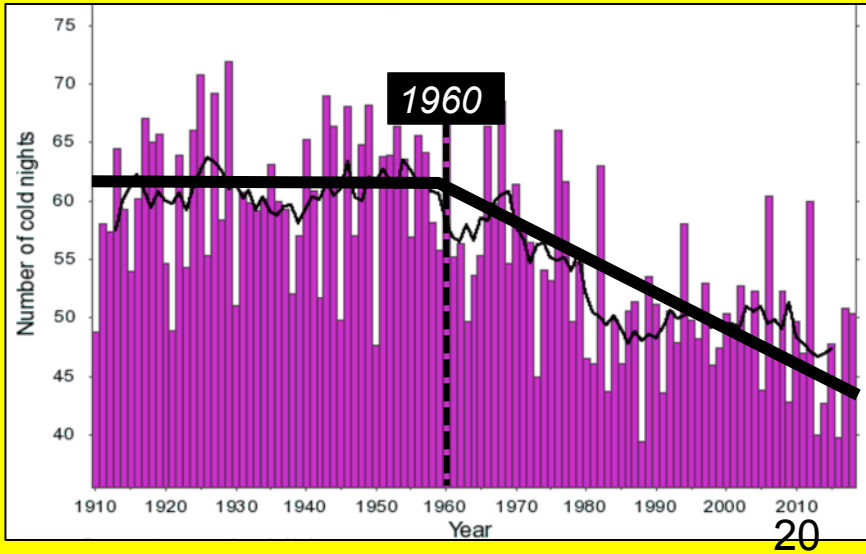
Coldest night temperature *INCREASING 1.5 degrees*



Duration of cold spells *DECREASING to 33%*



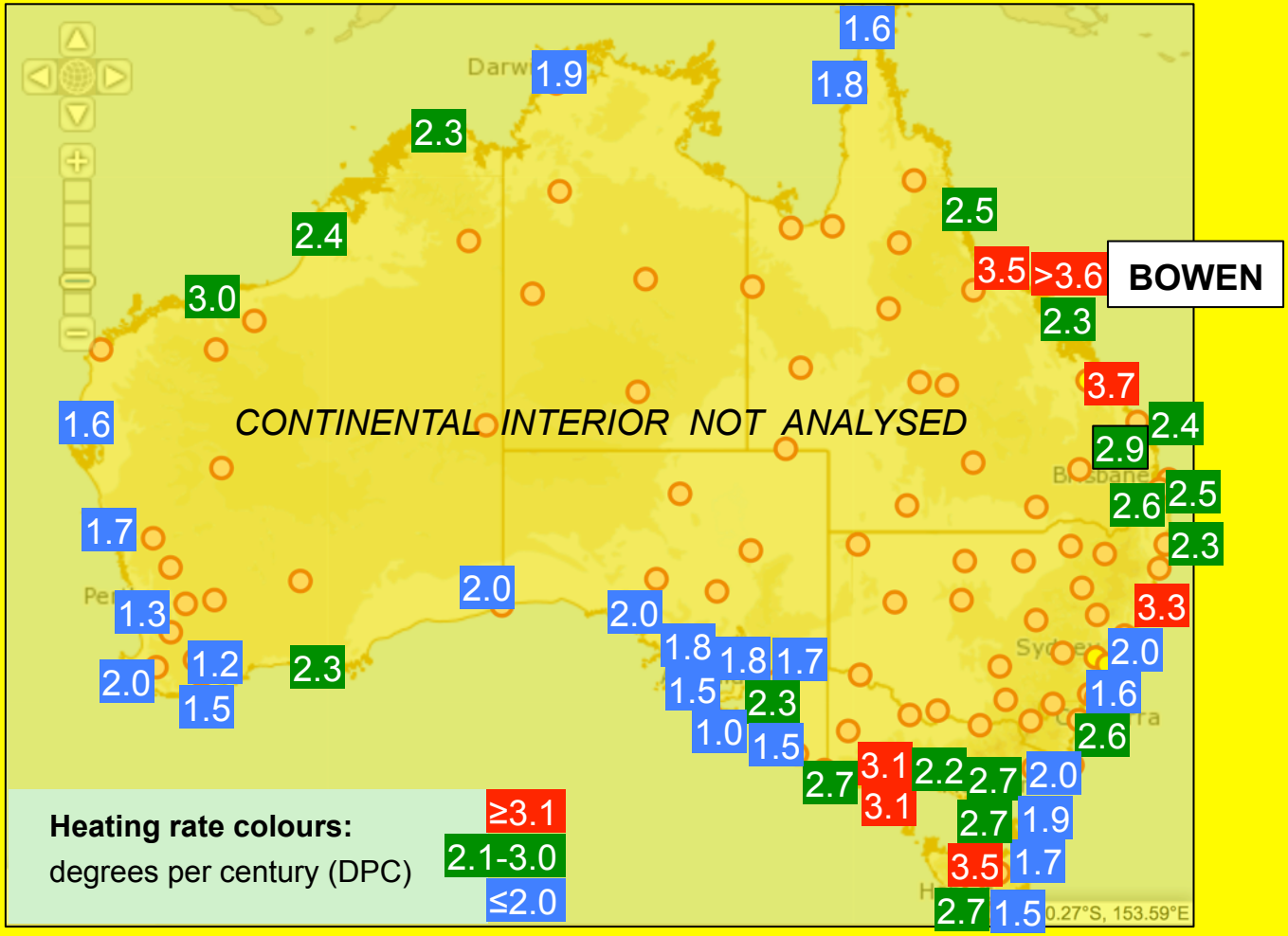
Number of cold nights *DECREASING to 71%*



Australia's heating rate is 1.5x world rate: Bowen is 3x world

Queensland & Bowen are heating faster than the rest of Australia

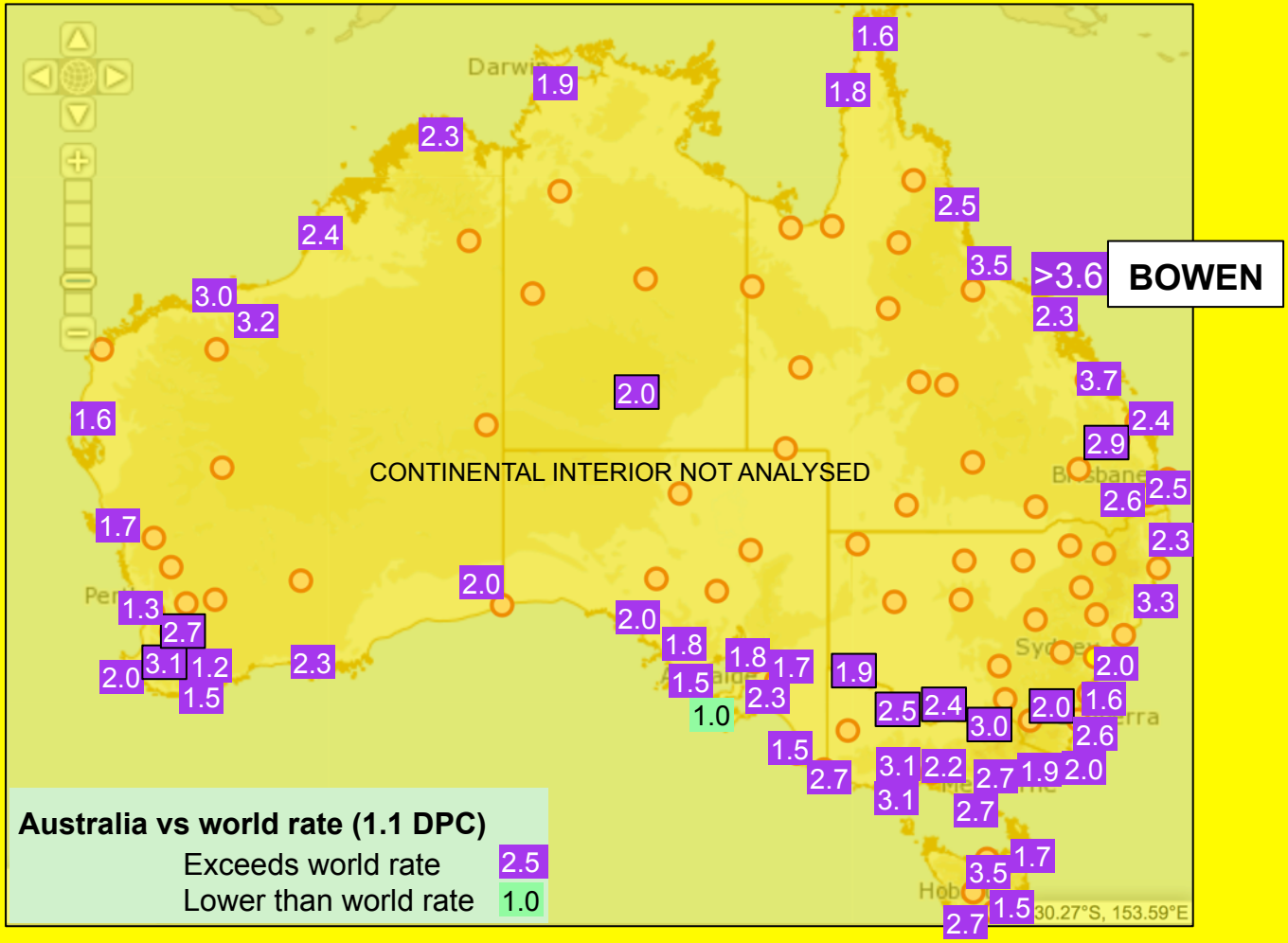
Heating rate - World 1.1



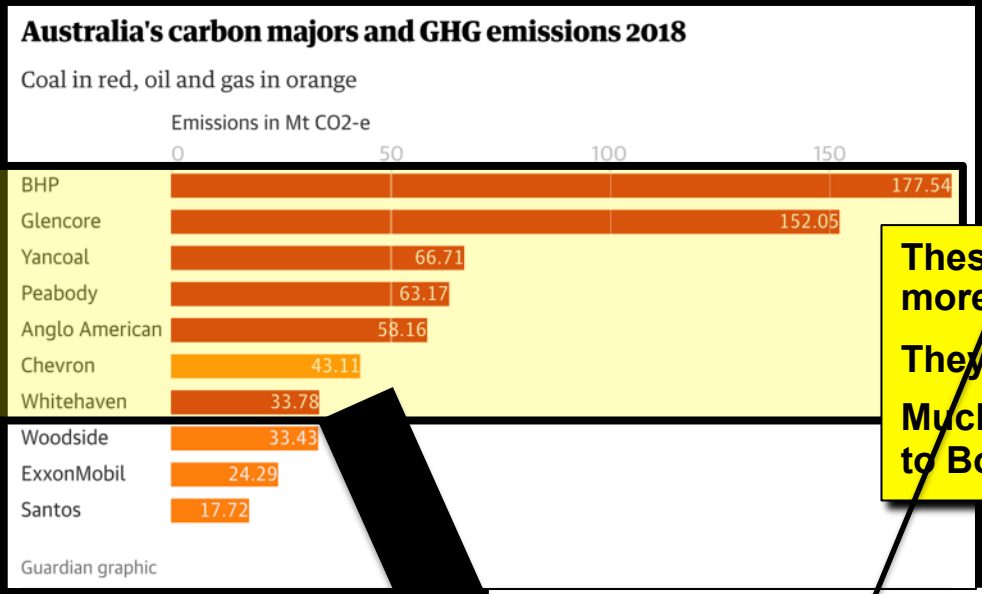
Australia's heating rate is 1.5x world rate (the whole country)

Every location in Australia is heating faster than the world rate

Heating rate - World 1.1



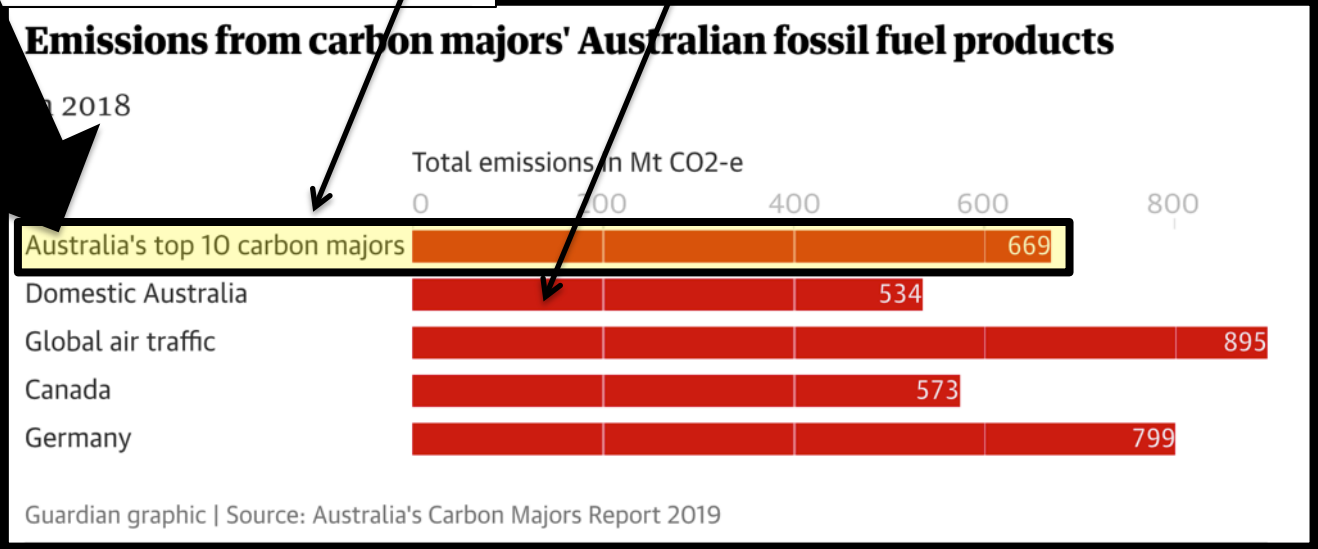
Bowen Basin companies emit more carbon than our economy



These "<u>Australia's top 6 coal producers</u>" emit more carbon than <u>the entire Australian economy</u>.

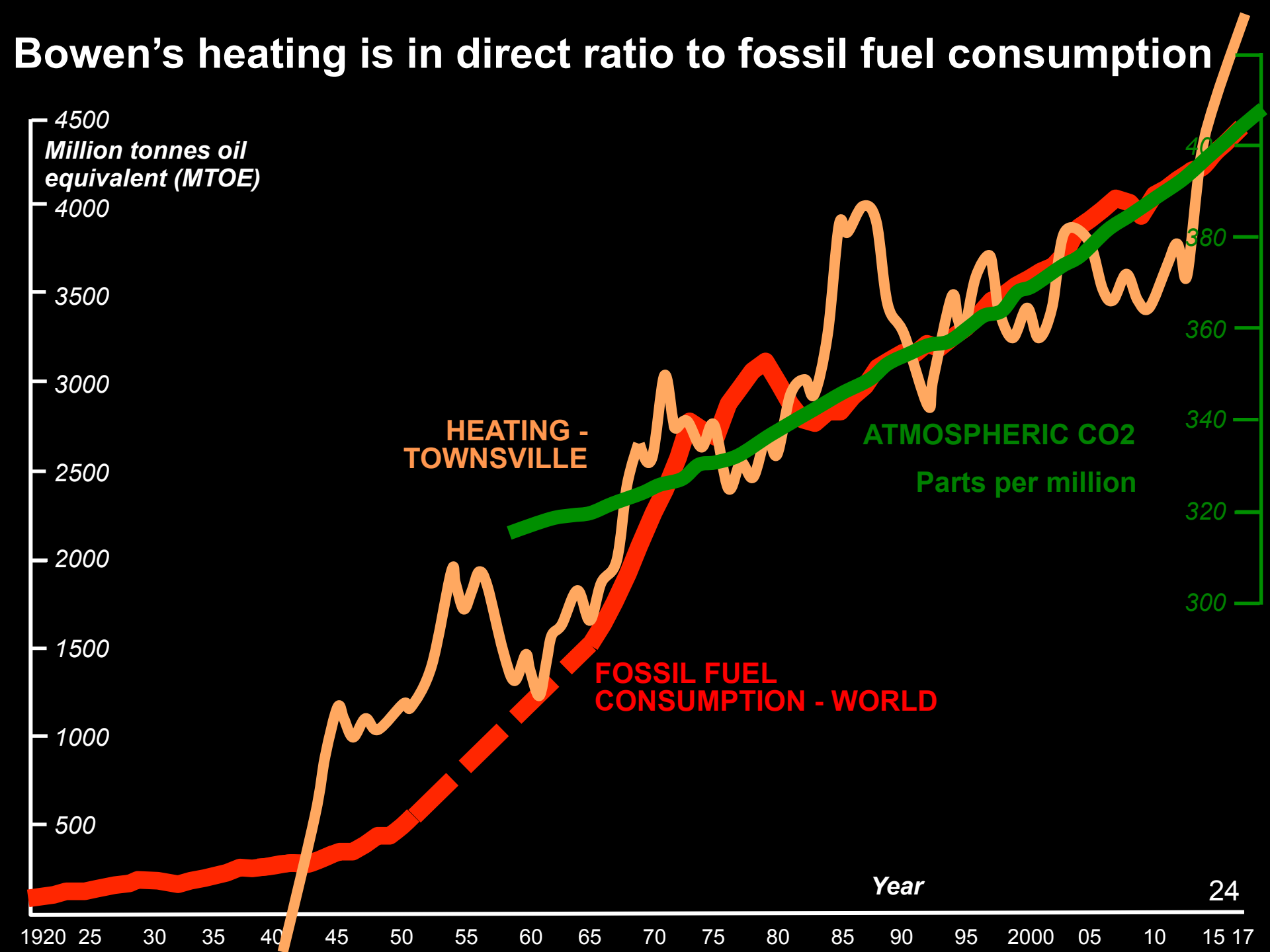
They are all Bowen Basin coalminers.

Much of their coal is transported via the rail line to Bowen which is the subject of the action.

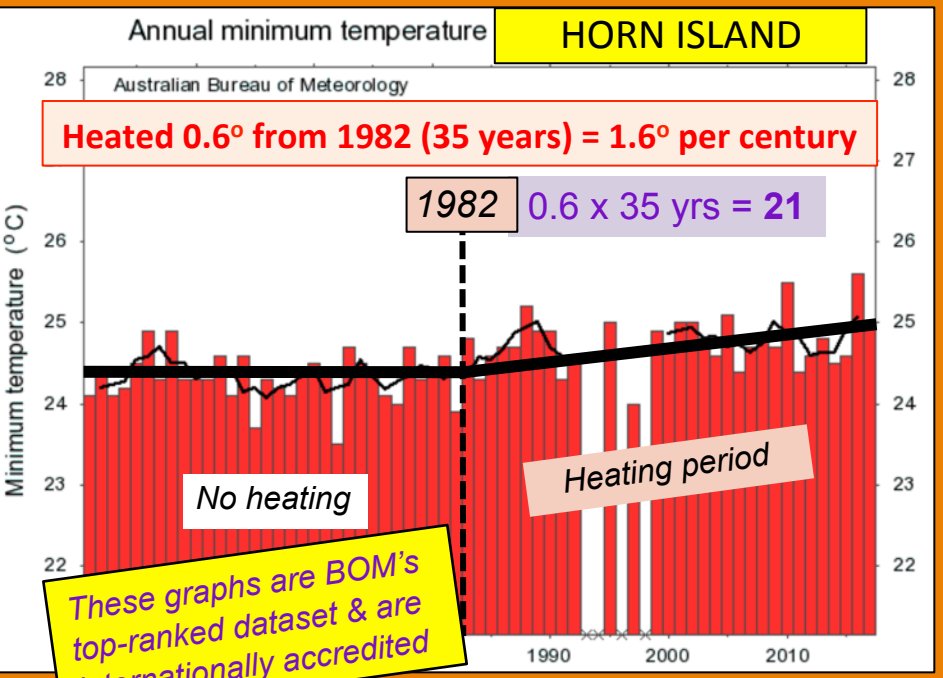


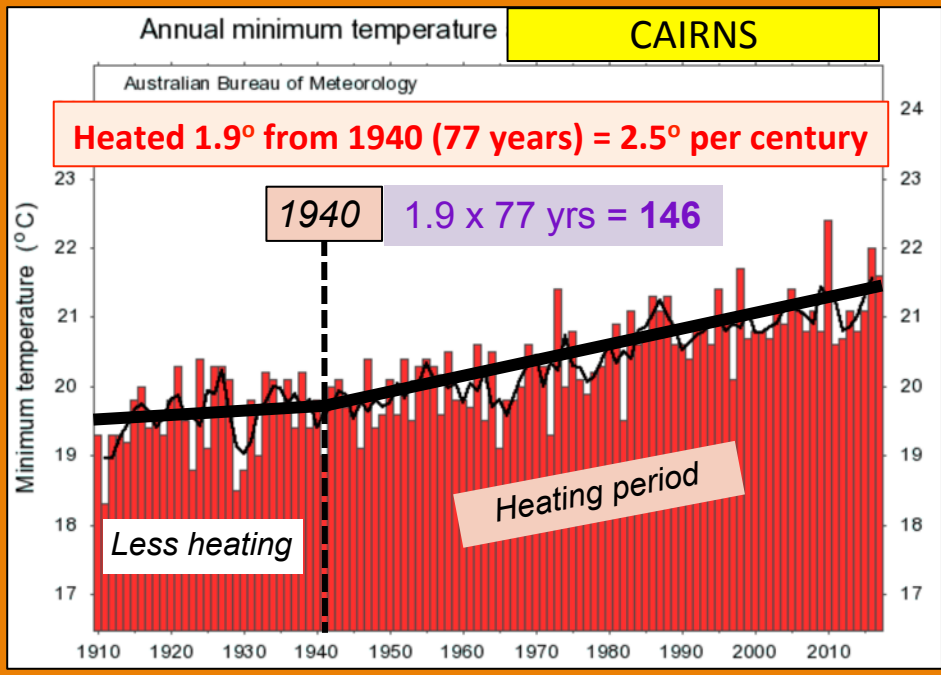
https://www.theguardian.com/australia-news/2019/nov/01/six-biggest-coalminers-in-australia-produce-more-emissions-than-entire-economy

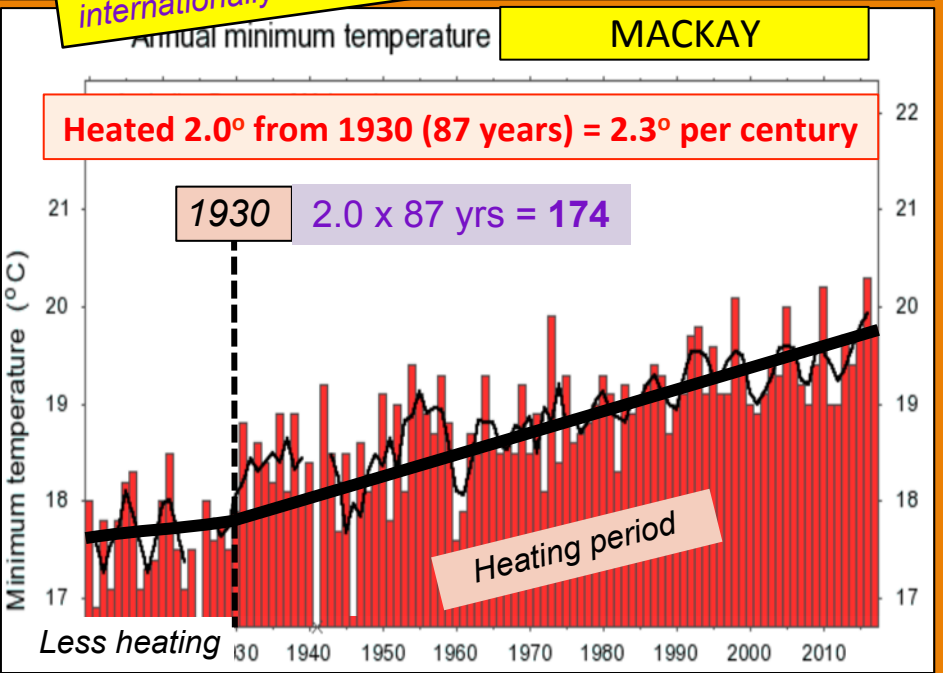
Bowen's heating is in direct ratio to fossil fuel consumption

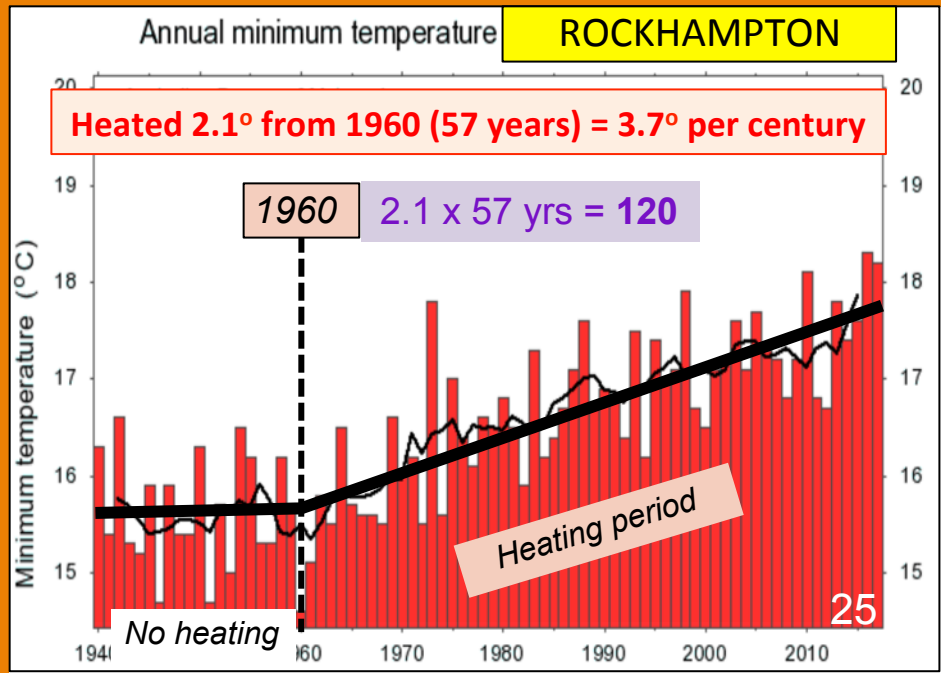


Climate heating: The slow-roasting of the Bowen area

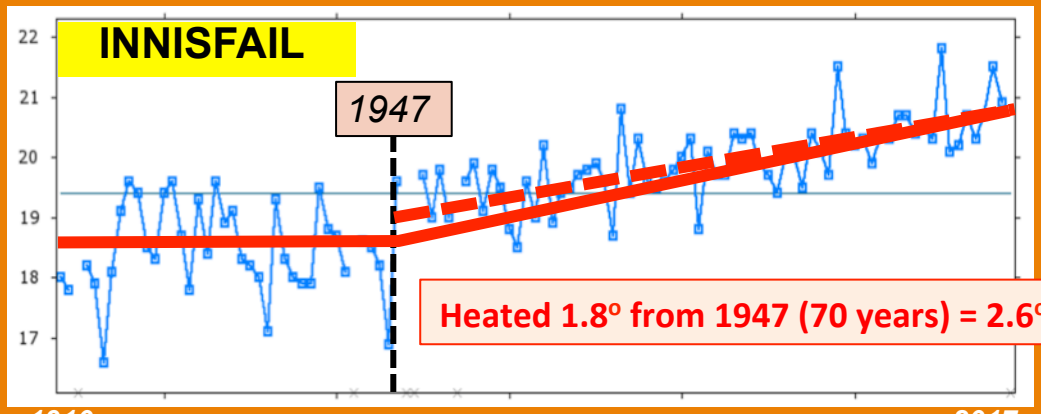








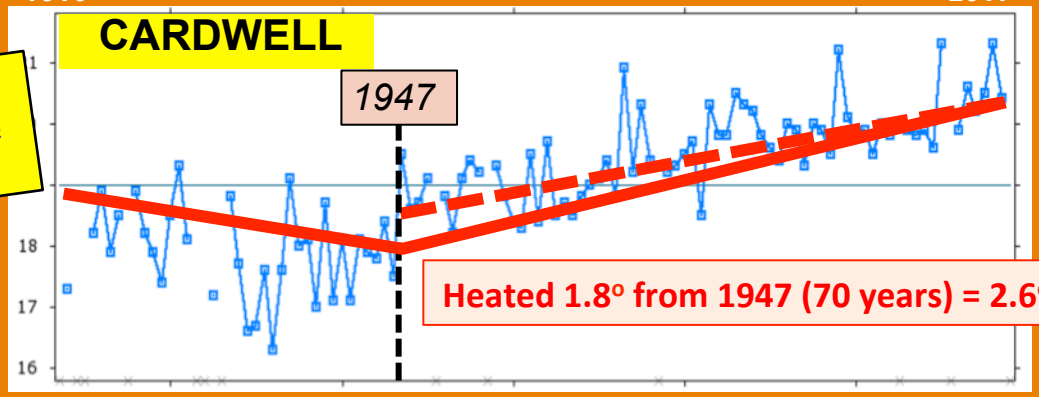
Climate heating: The slow-roasting of the Bowen area



2.6 DPC

1.8° x 70 yrs = **126**

Heated 1.8° from 1947 (70 years) = 2.6° per century

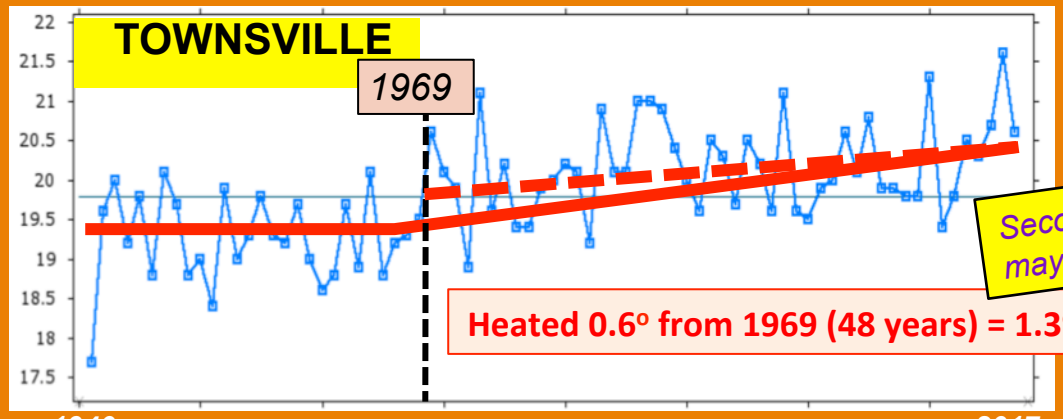


These graphs are BOM's second-ranked dataset & they may contain errors

2.6 DPC

1.8° x 70 yrs = **126**

Heated 1.8° from 1947 (70 years) = 2.6° per century



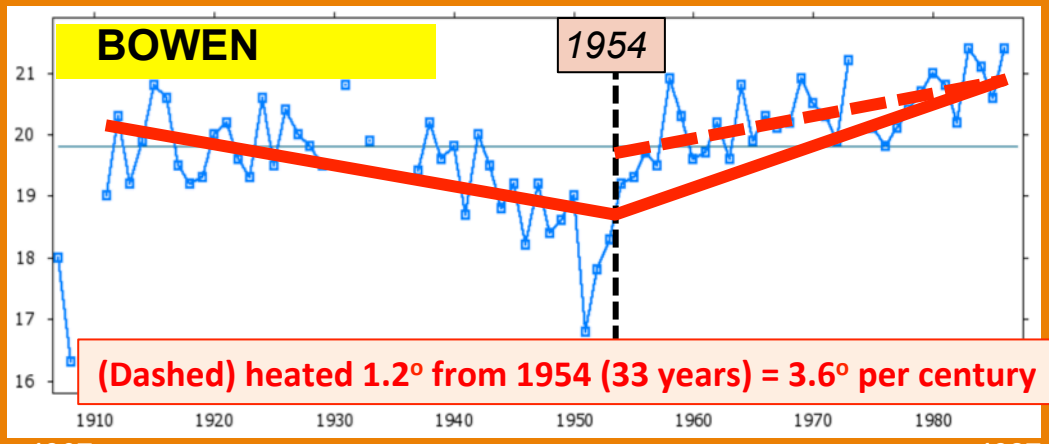
1.3 DPC (?)

0.6° x 48 yrs = **29**

Second-ranked dataset may contain errors

Heated 0.6° from 1969 (48 years) = 1.3° per century

Climate heating: The slow-roasting of the Bowen area

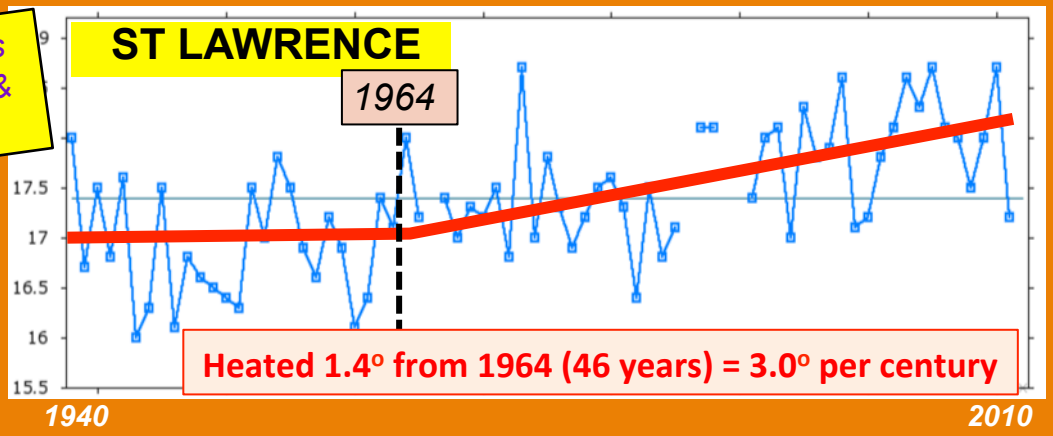


≥3.6 DPC

Dashed 1.2° = **3.6 DPC**

Solid 2.2° = **6.6 DPC**

3.6° DPC over 63 yrs = **143**



These graphs are BOM's second-ranked dataset & they may contain errors

3.0 DPC

3.0 DPC over 53 yrs = **84**

MASTER CALCULATION where record is not up to present

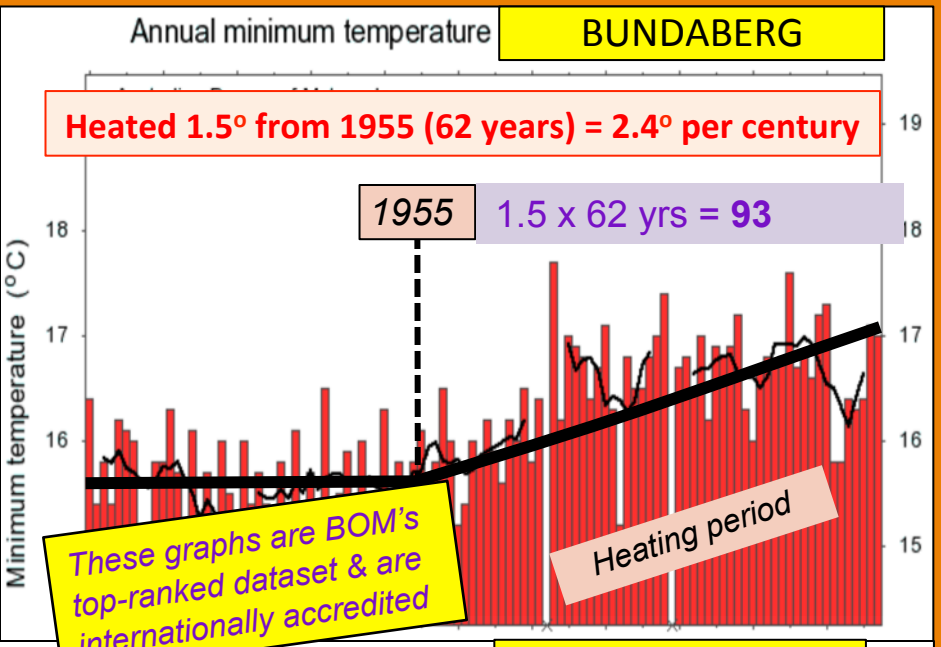
Rate = Rise x 100 / period

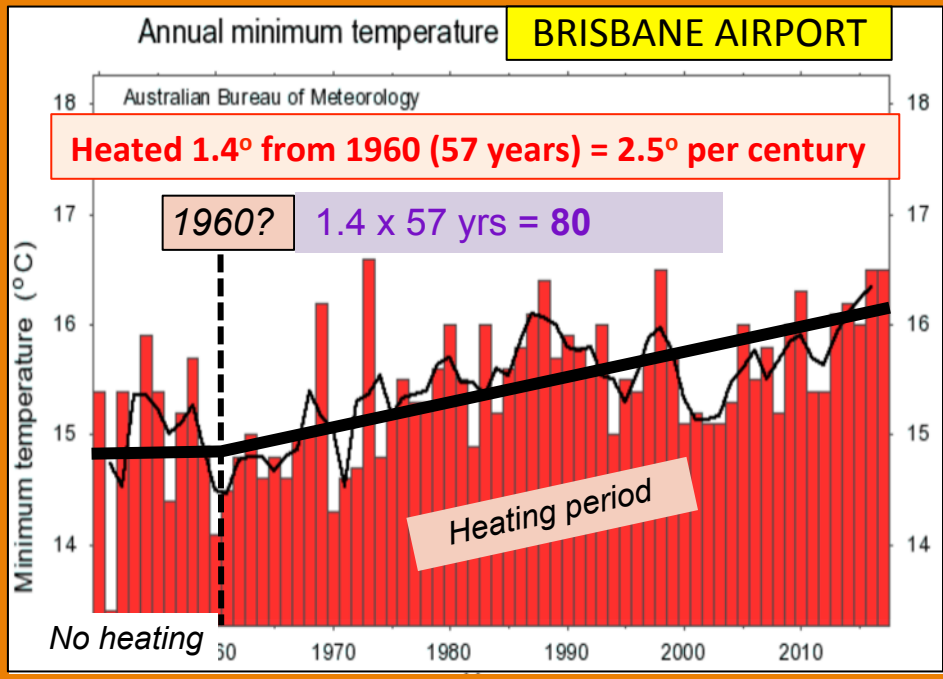
Rise = Rate x period / 100

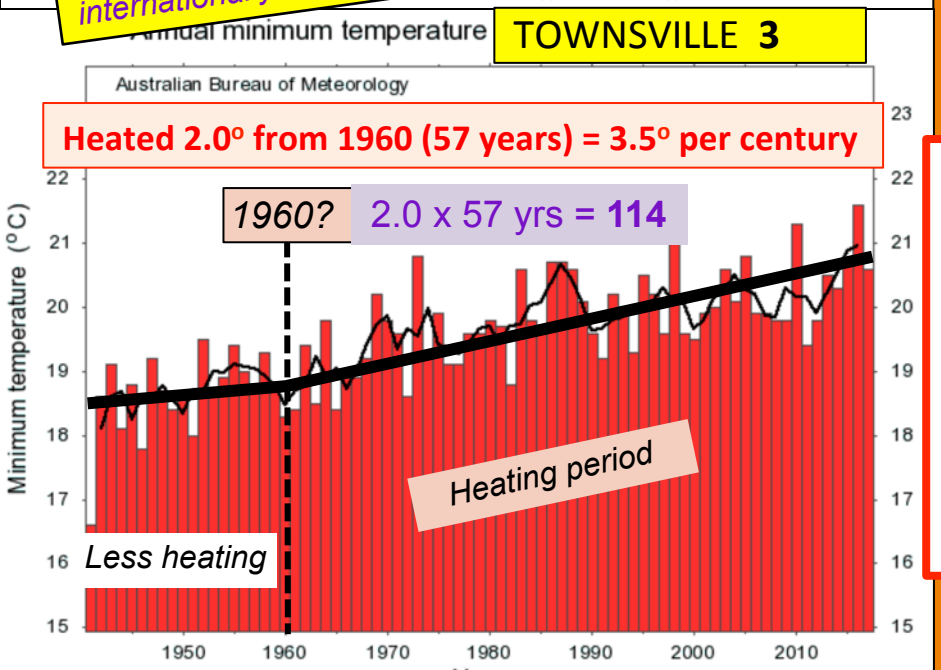
***ΔHeat** = Rise x period*

*= **Rate x period² / 100***

Climate heating: The slow-roasting of the Bowen area







Startdate (year)	
Horn Island	1982
Cairns	1940
Innisfail	1947
Cardwell	1947
Townsville	1969
Bowen	1954
Mackay	1930
St Lawrence	1964
Rockhampton	1960
Bundaberg	1955
Brisbane	?1960

Heating rate (DPC)	
Horn Island	1.6
Cairns	2.5
Innisfail	2.6
Cardwell	2.6
Townsville	3.5
Bowen	>3.6
Mackay	2.3
St Lawrence	3.0
Rockhampton	3.7
Bundaberg	2.4
Brisbane	2.5

ΔHeat (degree-years)	
Horn Island	21
Cairns	146
Innisfail	126
Cardwell	126
Townsville	114
Bowen	143
Mackay	174
St Lawrence	84
Rockhampton	120
Bundaberg	93
Brisbane	80

Climate change & night temperatures in the Bowen area

Night temperatures 14-16 February 2020 Bowen area, Queensland

Townsville

Range:
7.2°
Minimum:
29.2°

16/09:00am	32.5
16/08:30am	32.2
16/08:00am	31.6
16/07:30am	30.3
16/07:00am	30.0
16/06:30am	29.3
16/06:00am	29.6
16/05:30am	29.3
16/05:00am	29.2
16/04:30am	29.5
16/04:00am	29.2
16/03:30am	29.7
16/03:07am	29.6
16/03:00am	29.8
16/02:48am	30.0
16/02:30am	30.2
16/02:25am	30.3
16/02:00am	30.4
16/01:30am	30.0
16/01:00am	29.9
16/12:47am	30.0
16/12:30am	30.0
16/12:29am	30.1
16/12:03am	30.3
16/12:00am	30.3
15/11:30pm	30.7
15/11:00pm	31.0
15/10:30pm	31.3
15/10:00pm	31.6
15/09:30pm	31.5
15/09:00pm	32.0
15/08:30pm	32.1
15/08:00pm	32.2
15/07:30pm	32.2
15/07:00pm	32.5
15/06:30pm	33.7
15/06:00pm	34.4
15/05:30pm	35.4
15/05:00pm	35.5
15/04:30pm	35.2
15/04:00pm	36.0
15/03:30pm	36.4
15/03:00pm	35.5
15/02:30pm	36.0
15/02:00pm	37.1
15/01:30pm	36.3
15/01:00pm	35.7
15/12:30pm	34.1
15/12:00pm	34.0
15/11:30am	35.6
15/11:00am	34.3
15/10:30am	35.8
15/10:00am	36.0
15/09:30am	34.3
15/09:00am	33.5

Alva Beach

5.0°

27.6°

16/09:00am	32.0
16/08:30am	31.6
16/08:00am	31.0
16/07:30am	30.6
16/07:00am	28.4
16/06:30am	27.6
16/06:00am	28.6
16/05:30am	29.1
16/05:00am	29.4
16/04:30am	29.4
16/04:00am	29.4
16/03:30am	29.4
16/03:00am	29.6
16/02:30am	29.7
16/02:00am	29.7
16/01:30am	29.8
16/01:00am	29.8
16/12:30am	29.8
16/12:00am	29.8
15/11:30pm	29.8
15/11:00pm	29.7
15/10:30pm	29.7
15/10:00pm	30.0
15/09:30pm	30.0
15/09:00pm	30.1
15/08:30pm	30.2
15/08:00pm	30.3
15/07:30pm	30.2
15/07:00pm	30.3
15/06:30pm	30.8
15/06:00pm	31.1
15/05:30pm	31.5
15/05:00pm	31.6
15/04:30pm	31.6
15/04:00pm	32.1
15/03:30pm	31.8
15/03:00pm	32.4
15/02:30pm	32.1
15/02:00pm	31.6
15/01:30pm	31.9
15/01:00pm	32.1
15/12:30pm	32.1
15/12:00pm	32.6
15/11:30am	31.6
15/11:00am	31.3
15/10:30am	31.4
15/10:00am	32.0
15/09:30am	31.5
15/09:00am	31.5

Bowen

6.5°

26.3°

15/09:00am	31.0
15/08:30am	30.0
15/08:00am	30.1
15/07:30am	29.0
15/07:00am	28.6
15/06:30am	27.2
15/06:00am	26.4
15/05:30am	26.3
15/05:00am	26.6
15/04:30am	27.0
15/04:00am	27.1
15/03:30am	27.3
15/03:00am	27.9
15/02:30am	27.8
15/02:00am	27.9
15/01:30am	28.2
15/01:00am	28.4
15/12:30am	28.9
15/12:00am	29.1
14/11:30pm	29.1
14/11:00pm	29.0
14/10:30pm	29.5
14/10:00pm	29.6
14/09:30pm	29.8
14/09:00pm	29.5
14/08:30pm	29.3
14/08:00pm	29.1
14/07:30pm	29.3
14/07:00pm	29.7
14/06:30pm	30.3
14/06:00pm	31.0
14/05:30pm	31.4
14/05:00pm	31.6
14/04:30pm	32.0
14/04:00pm	32.0
14/03:30pm	30.3
14/03:00pm	31.1
14/02:30pm	32.8
14/02:00pm	32.8
14/01:30pm	32.4
14/01:00pm	32.5
14/12:30pm	32.6
14/12:00pm	32.2
14/11:30am	32.2
14/11:00am	31.7
14/10:30am	31.4
14/10:00am	31.8
14/09:30am	31.3
14/09:00am	30.5

At any location, its *nightly* temperatures - the *minimum daily temperature* - are the temperature most formally diagnostic of climate change.

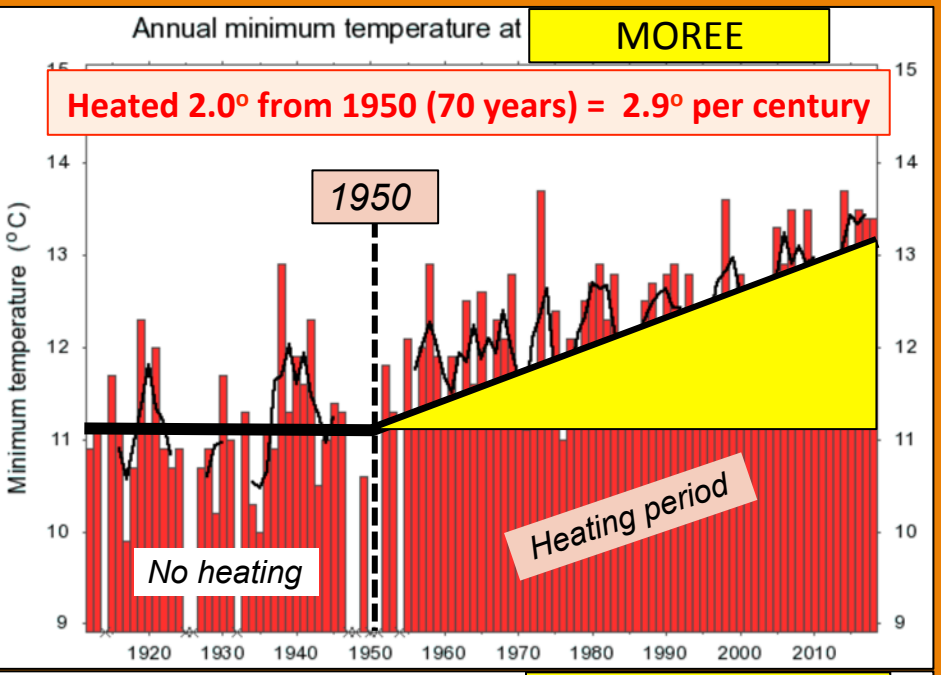
The minimum temperature datasets for these 3 locations show climate heating for the past few decades (see graphs elsewhere).

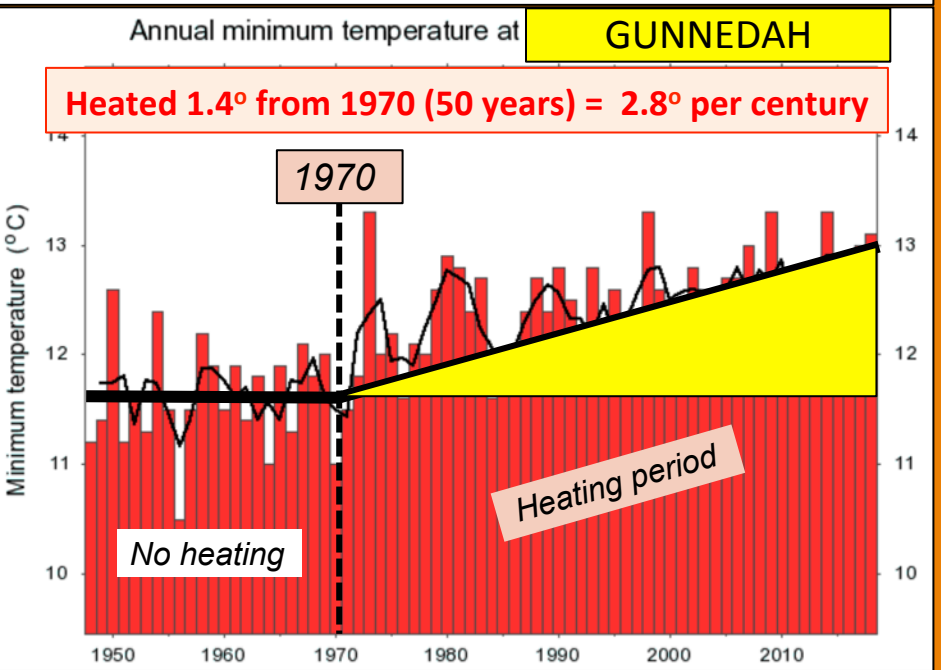
This formal source is reified in anecdotal daily experiences, such as the past week in Townsville in mid-February 2020 which has delivered unusually hot and humid nights, mostly all night - see 24 hour tables on left. The minima are very high; Townsville is above 30° for almost the full 24 hour cycle.

In my and fellow Townsville citizens' experience, plus media articles over the past several years, **Townsville's nightly temperatures are higher than in living memory**.

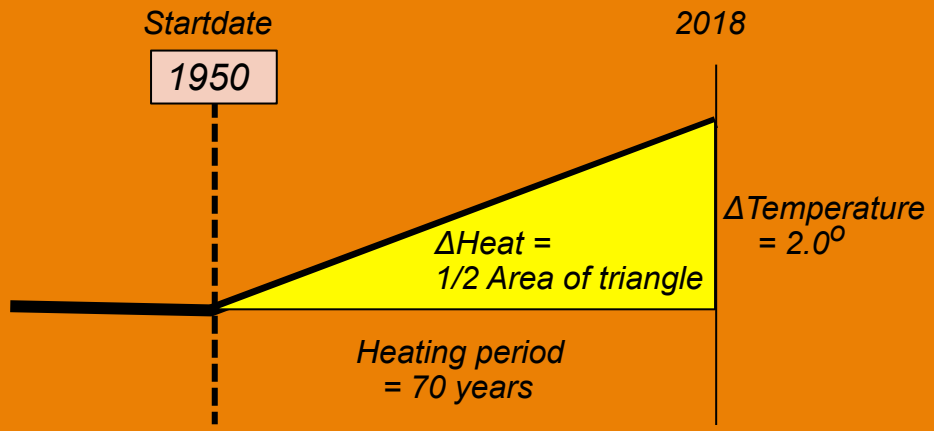
Weather data, BOM, 2020
http://www.bom.gov.au/products/IDQ60801/IDQ60801.94294.shtml

ΔHeat: its factors, definition and calculation

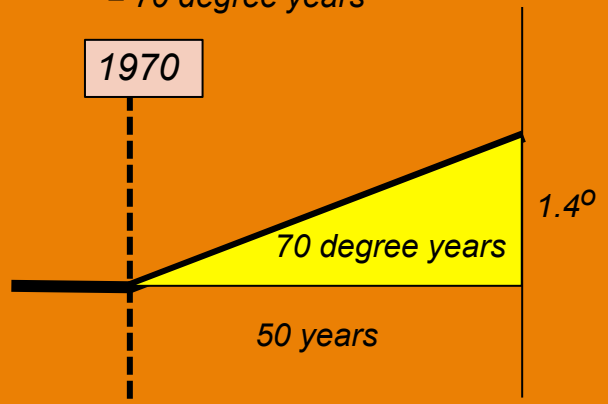




ΔHeat = ΔTemperature x Heating period
= 2.0 x 70
= 140 degree years



ΔHeat = ΔTemperature x Heating period
= 1.4 x 50
= 70 degree years



Climate heating: The slow-roasting of the Bowen area

HEATING RATE | **STARTDATE** | **HEATING PERIOD** | **ΔHEAT**

Heating rate (DPC)	
Horn Island	1.6
Cairns	2.5
Innisfail	2.6
Cardwell	2.6
Townsville	3.5
Bowen	>3.6
Mackay	2.3
St Lawrence	3.0
Rockhampton	3.7
Bundaberg	2.4
Brisbane	2.5

Startdate (yr)	
Horn Island	1982
Cairns	1940
Innisfail	1947
Cardwell	1947
Townsville	1969
Bowen	1954
Mackay	1930
St Lawrence	1964
Rockhampton	1960
Bundaberg	1955
Brisbane	?1960

Heating period (yrs)	
Horn Island	35
Cairns	77
Innisfail	70
Cardwell	70
Townsville	48
Bowen	63
Mackay	87
St Lawrence	53
Rockhampton	57
Bundaberg	62
Brisbane	?57

ΔHeat (degree-yrs)	
Horn Island	21
Cairns	146
Innisfail	126
Cardwell	126
Townsville	114
Bowen	143
Mackay	174
St Lawrence	84
Rockhampton	120
Bundaberg	93
Brisbane	80

Stage 2 heating rate

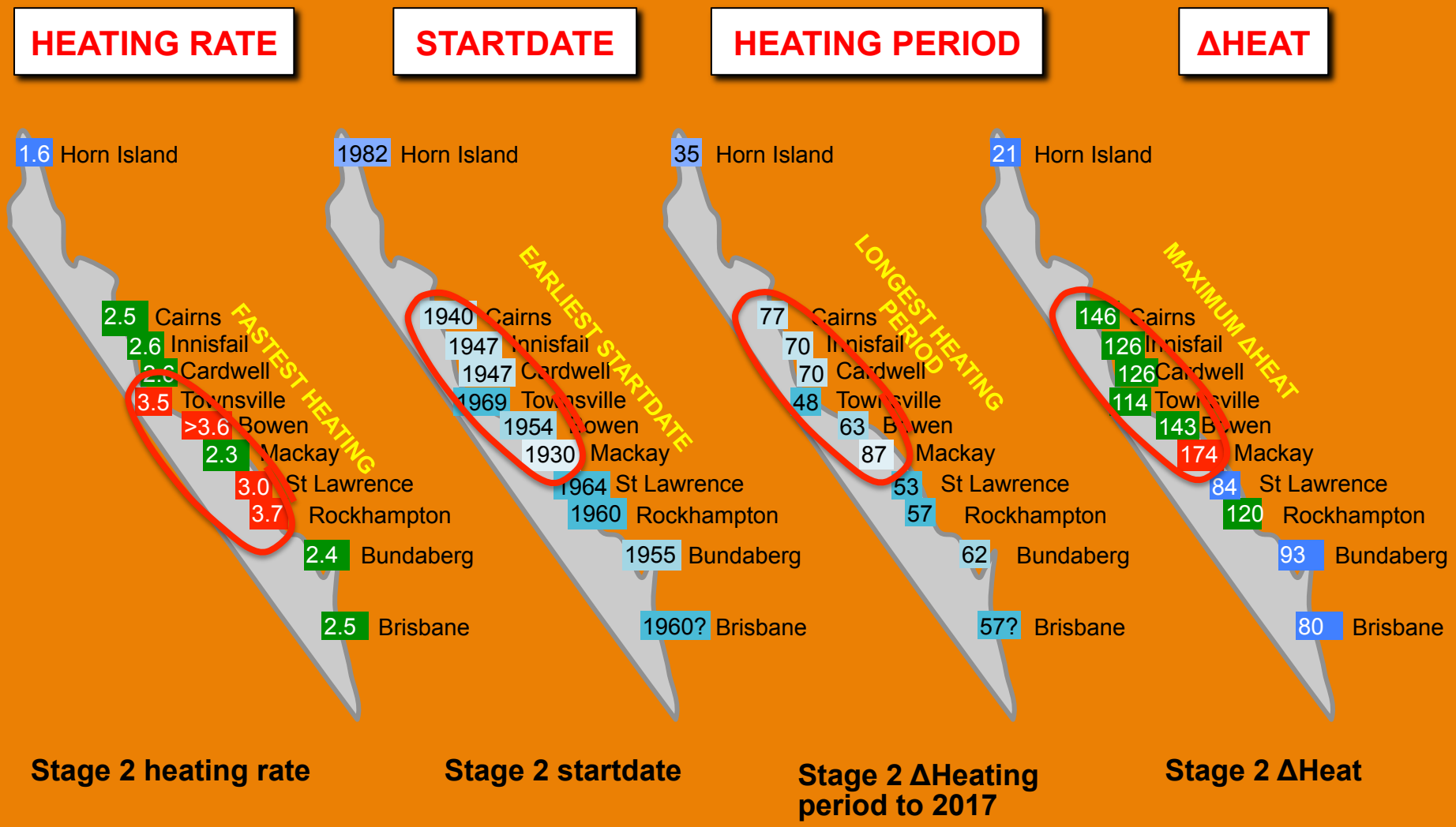
Stage 2 startdate

Stage 2 ΔHeating period to 2017

Stage 2 ΔHeat

1000 km

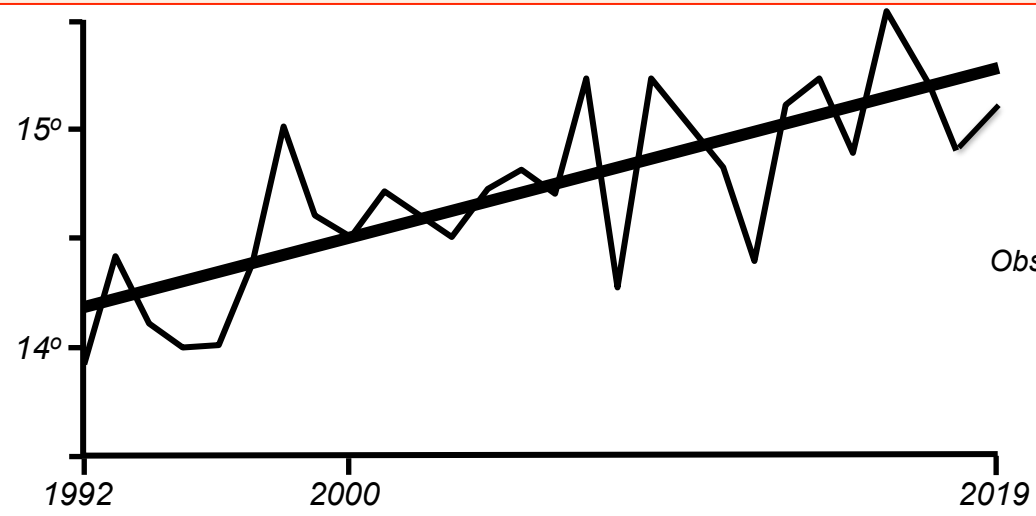
Climate heating: The slow-roasting of the Bowen area



Accelerated heating in Sydney & Melbourne

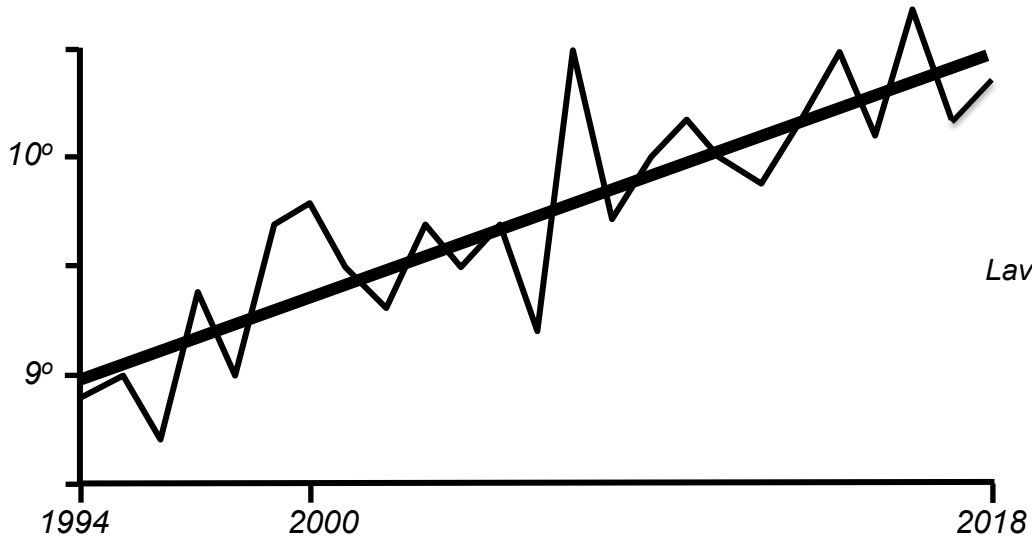
SYDNEY

Heated 1.1° from 1992 to 2019 (27 years) = 4.1° per century = 1° every 24 years



MELBOURNE

Heated 1.5° from 1994 to 2018 (24 years) = 6.3° per century = 1° every 16 years



From BOM ACORN-SAT dataset.

Some Australian locations have sufficiently dense data to show accelerated heating in the past 25 years (this precludes many stations, because proof of accelerated change requires denser data than linear change).

These graphs show minimum daily temperatures for Sydney and Melbourne over the past quarter century, with a calculated linear regression line.

Their heating rates are respectively 4.1 and 6.3 degrees per century (DPC).

These are respectively 205% and 290% greater than each city's heating rate since heating began (respectively 2.0 and 2.2 DPC, each starting ca 1945).

Their accelerations in the past quarter century, 205% and 290%, show a mean 250% acceleration.

http://www.bom.gov.au/climate/change/index.shtml#tabs=Tracker&tracker=site-networks

North Queensland's Wet Tropics are in accelerating decline

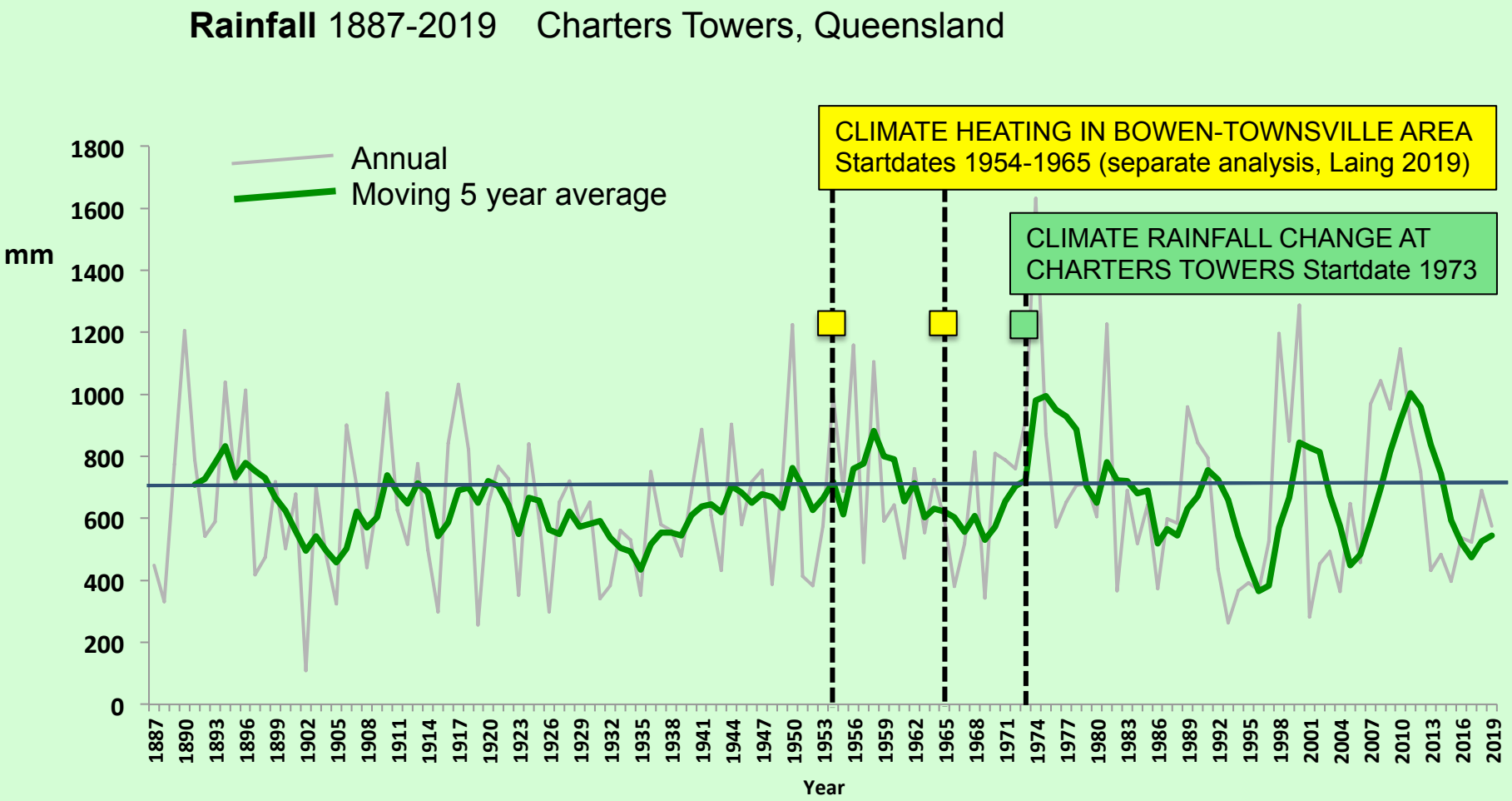
The Wet Tropics World Heritage Area Management Authority *29 April 2019*

- The Wet Tropics World Heritage Area has been damaged by climate change extreme heat ***equivalent to coral bleaching of the Great Barrier Reef***
- The tropical rainforest is in "***accelerating decline"***
- Last summer 2018-19 was the ***hottest on record***
- Mount Bartle Frere recorded an ***unprecedented 39ºC on 6 days that summer***
- Some unique species are at ***imminent risk of extinction***
- Mountain species like the lemuroid ringtail possum are ***unable to survive even one day above 29C***
- This is occurring ***now, not in the future***, and requires an ***immediate response***

https://www.theguardian.com/environment/2019/apr/30/climate-change-damage-to-queenslands-world-heritage-rainforest-as-bad-as-great-barrier-reef utm_term=RWRpdG9yaWFsX0d1YXJkaWFuVG9kYXlBVVMtMTkwNDMw&utm_source=esp&utm_medium=Email&utm_campaign=GuardianTodayAUS&CMP=GTAU_email

Eungella rainforest near Bowen, incinerated for the first time in thousands of years, November 2018

Climate change and its impact on rainfall in the Bowen area



Greater rainfall amplitude, longer and deeper droughts, and more extreme wet periods, have pushed the long term annual average rainfall up in the past 50 years. in the 1980s the CSIRO modelling (based on long term rainfall and coral core data) predicted this pattern, within an overall long term drying trend for that region. The prediction has been realised. Similar rainfall patterns exist in Eastern Indonesia and coastal Vietnam.

ECOGRAZE project, J. Corfield & others, CSIRO, 2001, updated with rainfall data to 2019

Global heating impacts Townsville: Letter to St Pats' students

Cynics of sea level rise engulfed by ignorance

(Editor's headline)

KEL Ackland's "thoughts and opinions" (Letters, November 10) include "I would like to assure Michael and many others that the climate in tropical Townsville has not changed in any way shape or form. It has always been that way. I was born in Townsville in 1942 and lived in this city all of my life". And he cites "the melodies from the Greens songbook ... mistakes and exaggerations".

Kel represents a sizeable proportion of Townsville in disbelieving climate change.

Unfortunately for them, for Townsville, and for the world, the climate sceptics are profoundly wrong.

Graphs show the Bureau of Meteorology data for Townsville (airport) and other North Queensland towns which most of us know.

All show a heating climate, every one with the same diagnostic pattern: a flat line until heating commences in the middle of the 20th century, and with the same rate of heating: averaging 2.7 degrees per 100 years.

This evidence is incontrovertible. Townsville is heating up via man-made global warming, and our rate is 2.5 times the overall global rate of 1.1 degrees per 100 years.

Townsville is in for a beating, and nothing will change unless we do something about it, starting right now.

We had better start telling our grandkids to buckle up and get used to big cyclones like Yasi, more heatwaves in summer, heatwaves in winter, hot nights, and a rising sea along Pallarenda and the Strand (the Coral Sea has already risen around 7cm).

Kel Ackland, in your 76-year life in Townsville you have experienced its full period of heating to date.

Kel, in primary school did you hear about King Canute, who sat by his own Strand in Denmark and told the tide to stop coming in?

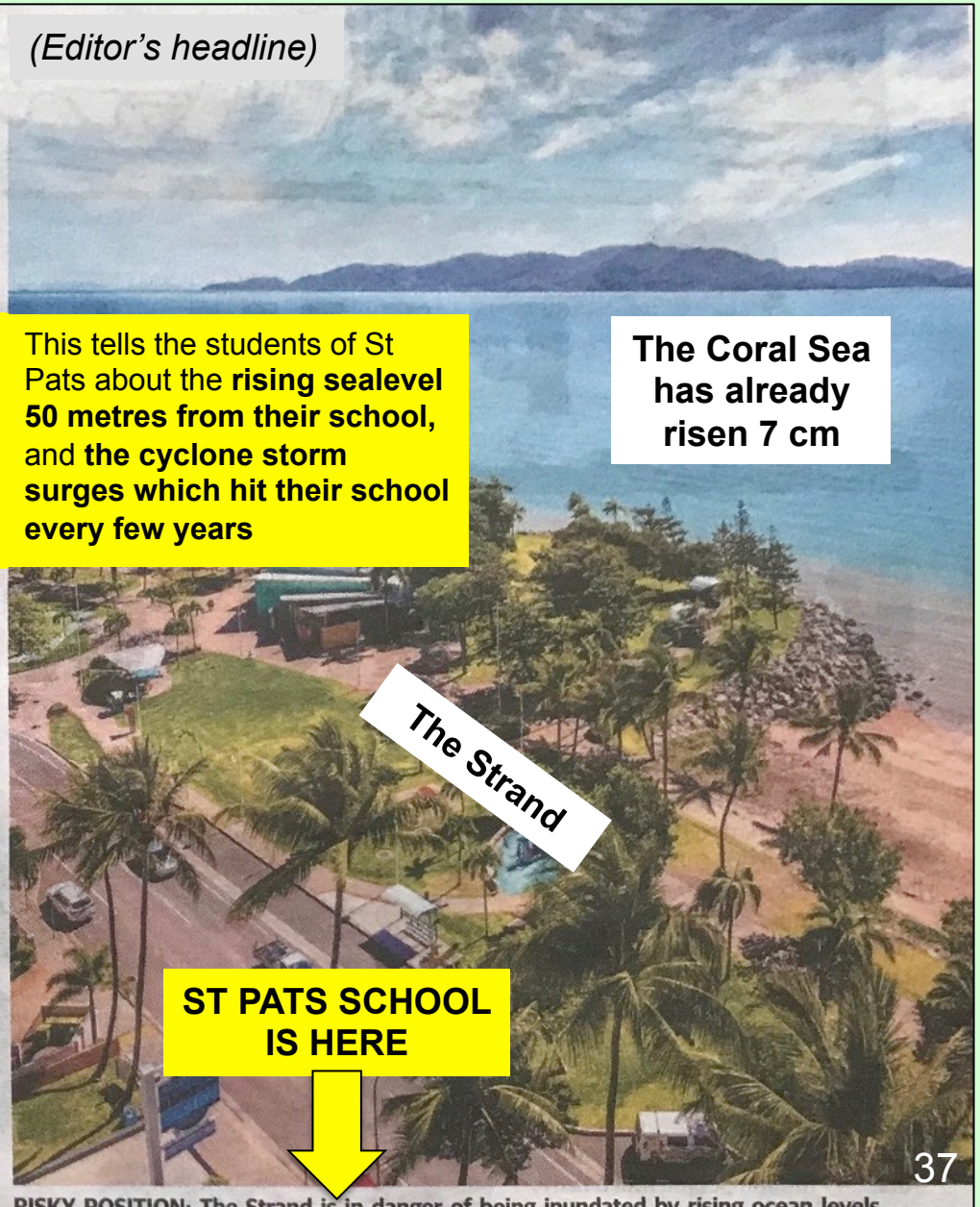
Facts are facts, and no amount of sticking your head in the sand will stop the sea already rising along our Strand.

Are climate sceptics going to be part of the problem or part of the solution?

Will you take responsibility for acknowledging the global warming data, and getting your grandkids ready for a different and difficult future?

DR BILL LAING,
Mining & Renewable Energy Analyst.

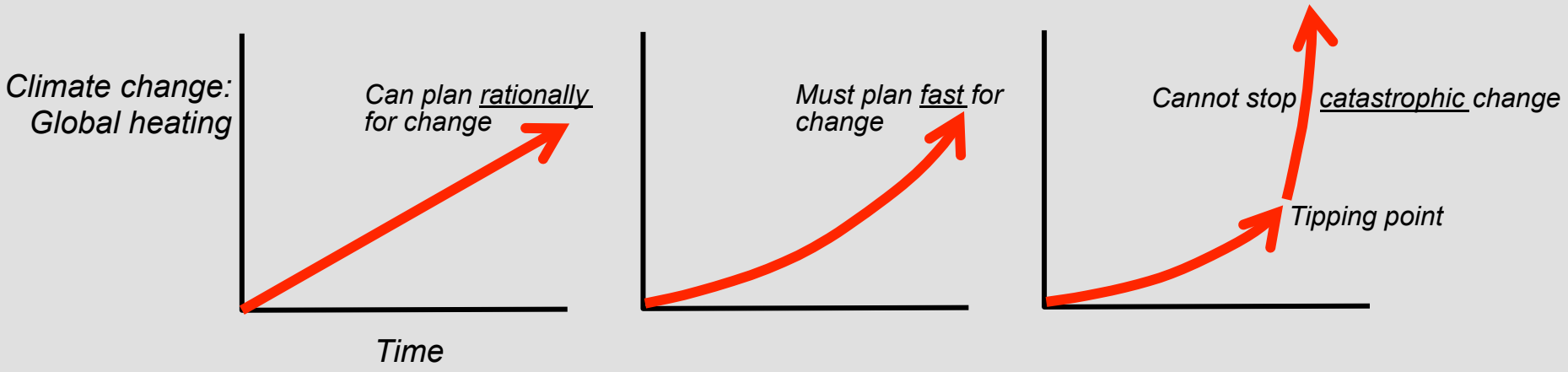
This tells the students of St Pats about the **rising sealevel 50 metres from their school,** and **the cyclone storm surges which hit their school every few years**



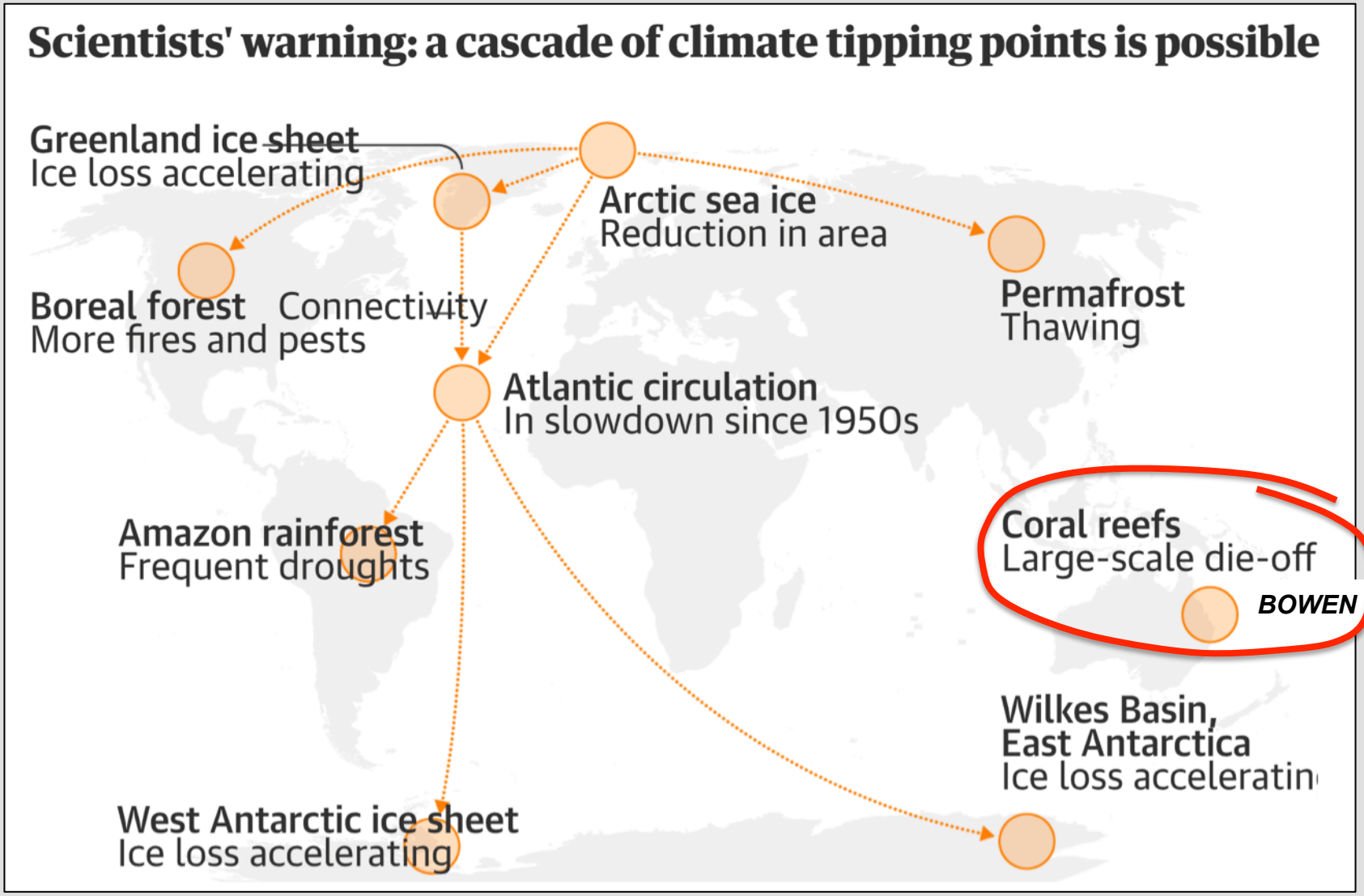
RISKY POSITION: The Strand is in danger of being inundated by rising ocean levels.

Global heating scenarios: Linear - accelerating - tipping

1 LINEAR	*2 ACCELERATING*	*3 TIPPING POINT*
We think Earth is here	***Earth is here***	***Is Earth here?***
Heating rate constant:	**Heating rate increasing**:	**Heating creates unstable equilibrium**:
• Straight line	• Curved line	• Broken line
• Predictable	• Hard to predict	• Impossible to predict
• Less dangerous	• More dangerous	• Catastrophic



Climate change: acceleration and tipping points



The Guardian, Lenton et al, Nature, November 2019

ANNEXURE OF TABLES AND FIGURES

Figure 1	**The fundamental world heating graph: Past 170 years**
Figure 2	**The fundamental world heating graph: Past millenium**
Figure 3	**Climate heating is in direct ratio to fossil fuel consumption**
Figure 4	**Climate heating (air & ocean) is in direct ratio to CO2**
Figure 5	**Global heating: Australia's contribution to carbon emissions**
Figure 6	**Australia & Bowen's heating curves: air & ocean (Coral Sea)**
Figure 7	**Global heating: How does Australia compare?**
Figure 8	**Global heating key indicators**
Figure 9	**The Arctic icecap will be destroyed in 20 years**
Figure 10	**Antarctica is melting, and the melting is accelerating**
Figure 11	**Climate rage is here: Temperature-aggression hypothesis**
Figure 12	**Climate rage is here: Darwin's mango madness**
Figure 13	**The damage to life of a world temperature rise over 1.5-2°**
Figure 14	**Australia adopts new, more severe climate ratings: heat & fire**
Figure 15	**Emergency vs climate emergency: the same but different**
Figure 16	**The new arithmetic of emergency: doesn't mean fast or *short***
Figure 17	**The new arithmetic shows the *urgency* of the emergency**
Figure 18	**(Most) extreme weather is caused by climate change**
Figure 19	**Australia's climate heating in all cities & towns: examples**
Figure 20	**(Most) extreme weather is caused by climate change**
Figure 21	**Australia's heating rate is 1.5x world rate: Bowen is 3x world**
Figure 22	**Australia's heating rate is 1.5x world rate (the whole country)**
Figure 23	**Bowen Basin companies emit more carbon than our economy**
Figure 24	**Bowen's heating is in direct ratio to fossil fuel consumption**

Figure 25	**Climate heating: The slow-roasting of the Bowen area**
Figure 26	**Climate heating: The slow-roasting of the Bowen area**
Figure 27	**Climate heating: The slow-roasting of the Bowen area**
Figure 28	**Climate heating: The slow-roasting of the Bowen area**
Figure 29	**Climate change & night temperatures in the Bowen area**
Figure 30	**ΔHeat: its factors, definition and calculation**
Figure 31	**Climate heating: The slow-roasting of the Bowen area**
Figure 32	**Climate heating: The slow-roasting of the Bowen area**
Figure 33	**Accelerated heating in Sydney and Melbourne**
Figure 34	**North Queensland's Wet Tropics are in accelerating decline**
Figure 35	**Eungella rainforest near Bowen, incinerated for the first time in thousands of years, November 2018**
Figure 36	**Climate change and its impact on rainfall in the Bowen area**
Figure 37	**Global heating impacts Townsville: Letter to St Pats' students**
Figure 38	**Global heating scenarios: Linear - accelerating - tipping**
Figure 39	**Climate change: acceleration and tipping points**