Past and Future Climate – Present Weather

Week 4

Snowball Earth – an "Outrageous" Idea?

Terry Hart

Dates

26 March	**Climate**
2 April	Geology

Term 2

23 April	**Climate**
30 April	Geology
7 May	**Climate**
14 May	Geology
21 May	**Climate**
28 May	Geology
4 June	**Climate**
11 June	Geology
18 June	**Climate**

https://sonicpathfinder.org/U3A/Weather/Weather_index.html

Understanding Weather

by **Terry Hart**

Nunawading U3A

In 2026 Terry prosemted a course of lectures on Unferstading Climate

(**A short tutorial** - just in case you did not know!
You can look for a specific text string on this (or any other) web page. To find out how, go to **How to jump to a text string**)

A collection of links to pdf versions of Terry Hart's Power Point presentations.
(Links are underlined)

Introduction:

Visiting the Bureau of Meteorology web site

Embedded and related links:

Bureau of Meteorology web page

What is Weather:

Lightning Megaflashes, and What is Weather?

Embedded and related links:

Youtube video **Lightning Tracing, crawling across sky in Northern Australia**

https://sonicpathfinder.org/U3A/U3A_index.html

University of the Third Age
Resources

Go to

Social Philosophy Manningham U3A

Or

Astronomy, Physics and Cosmology Manningham U3A and Nunawading U3A

Or

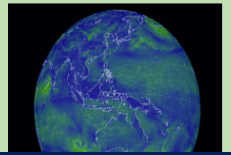
Geology Nunawading U3A

Or

The Pitchforks are Coming

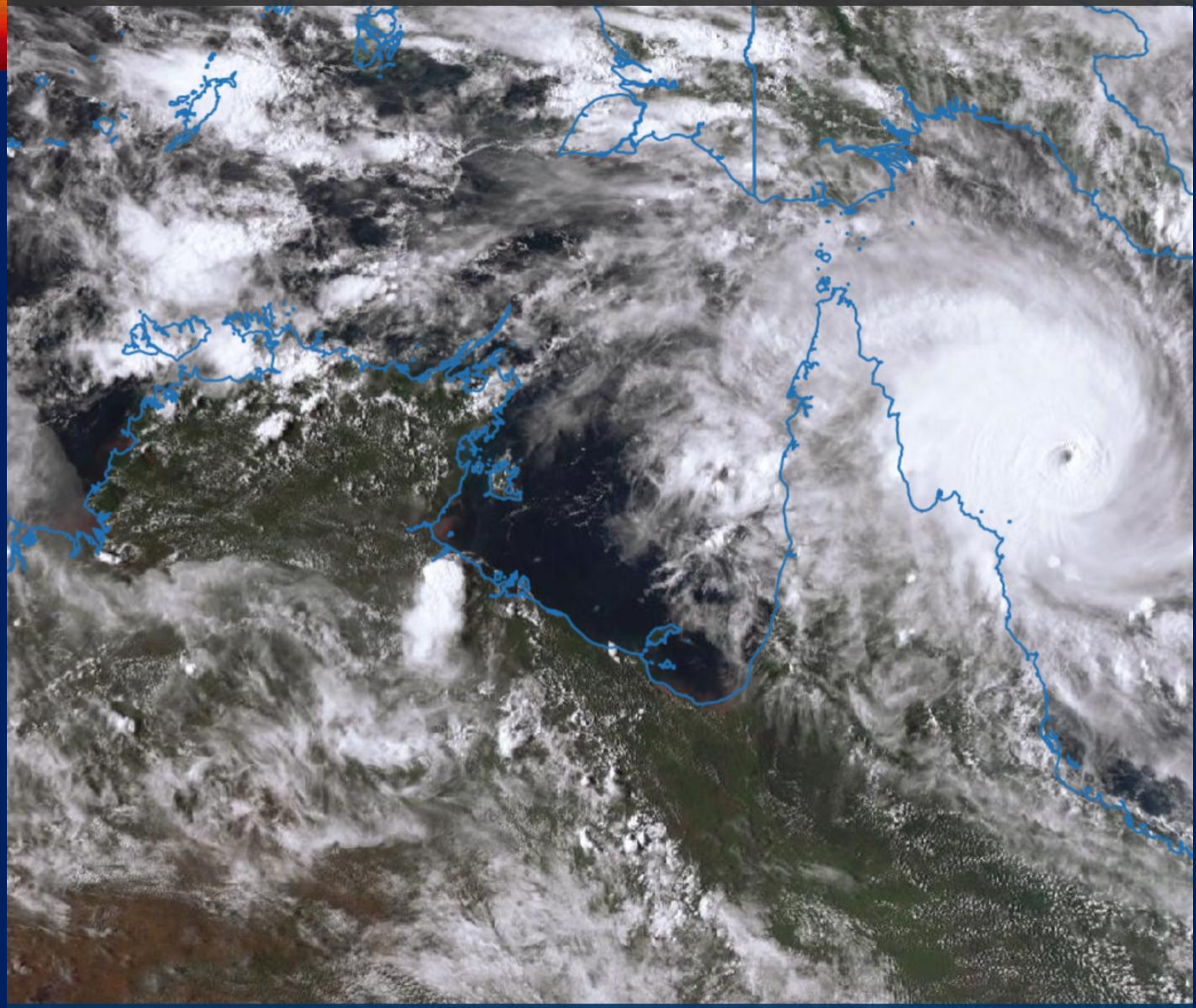
Or

Understanding Weather Nunawading U3A



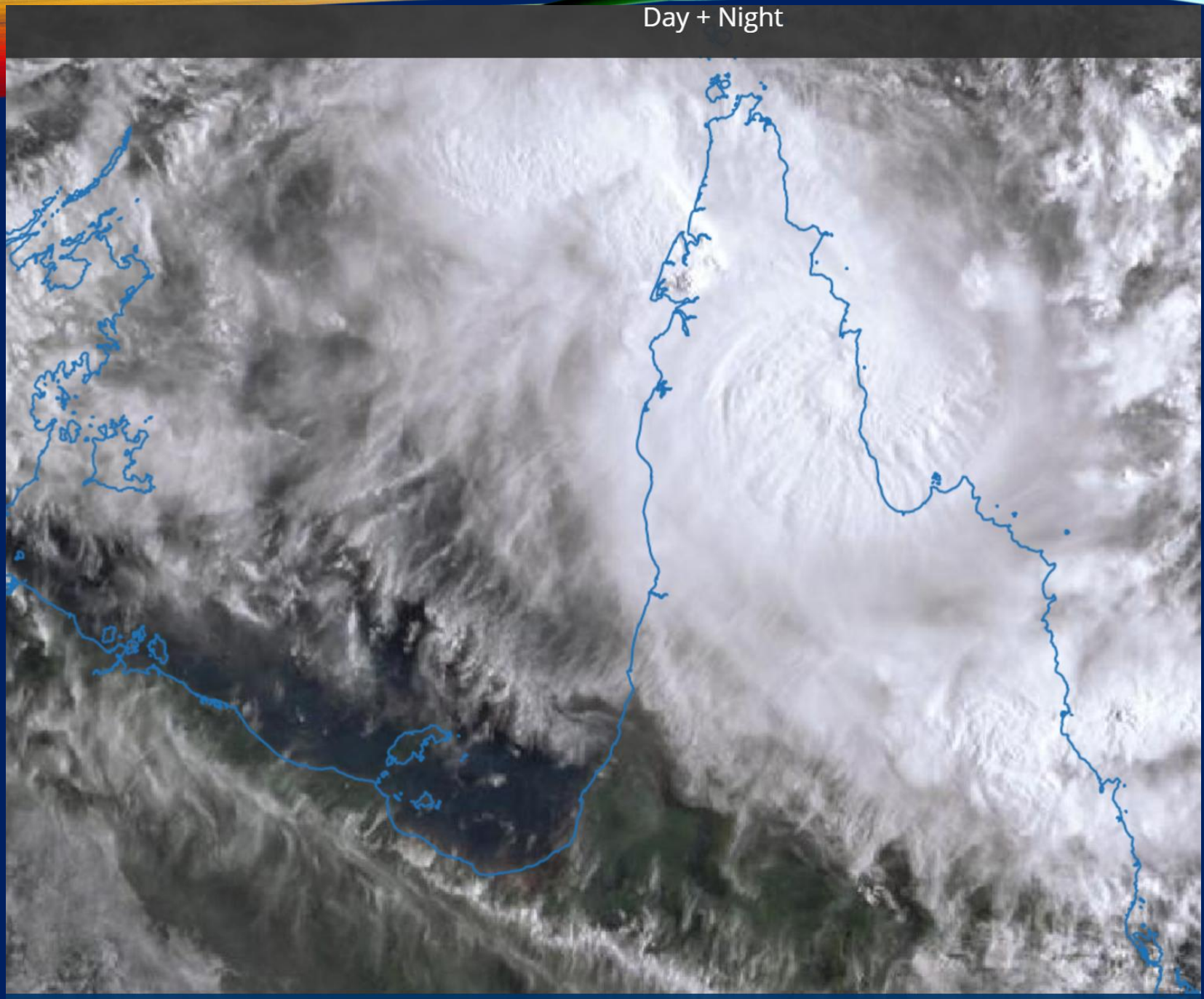
Thanks to the Argo program—a fleet of nearly 4,000 robotic ocean floats—that scientists have been able to measure and track long-term ocean warming. (Photo: Olivier Dugornay/Institut Français de Recherche pour l'Exploitation de la Mer, CC BY 4.0)

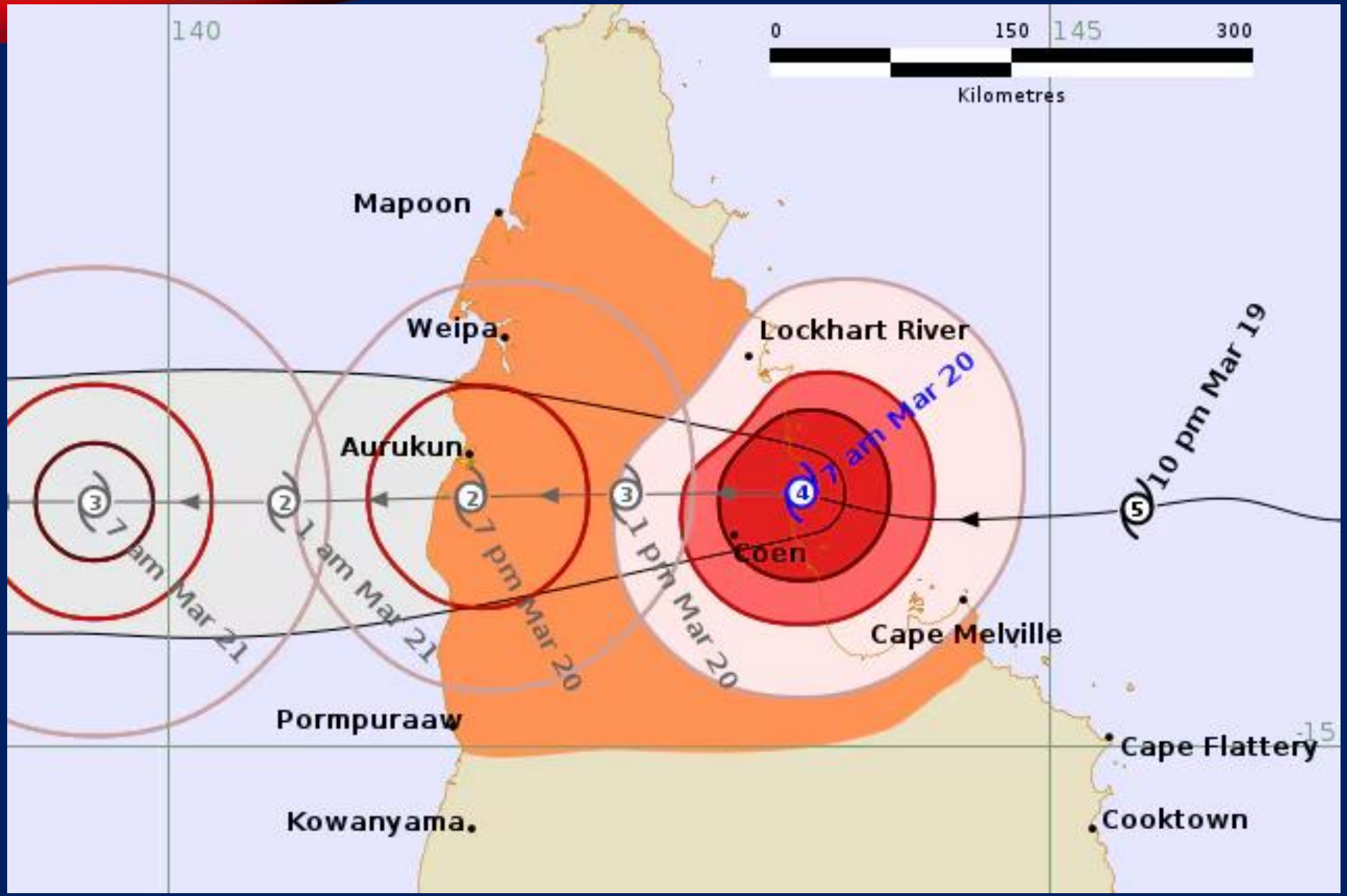
Day + Night



hursday, 19 March 2026 05:10 pm AEDT

Slower — + Faster


Day + Night
Friday, 20 March 2026 09:00 am AEDT
Slower
Faster


140
145
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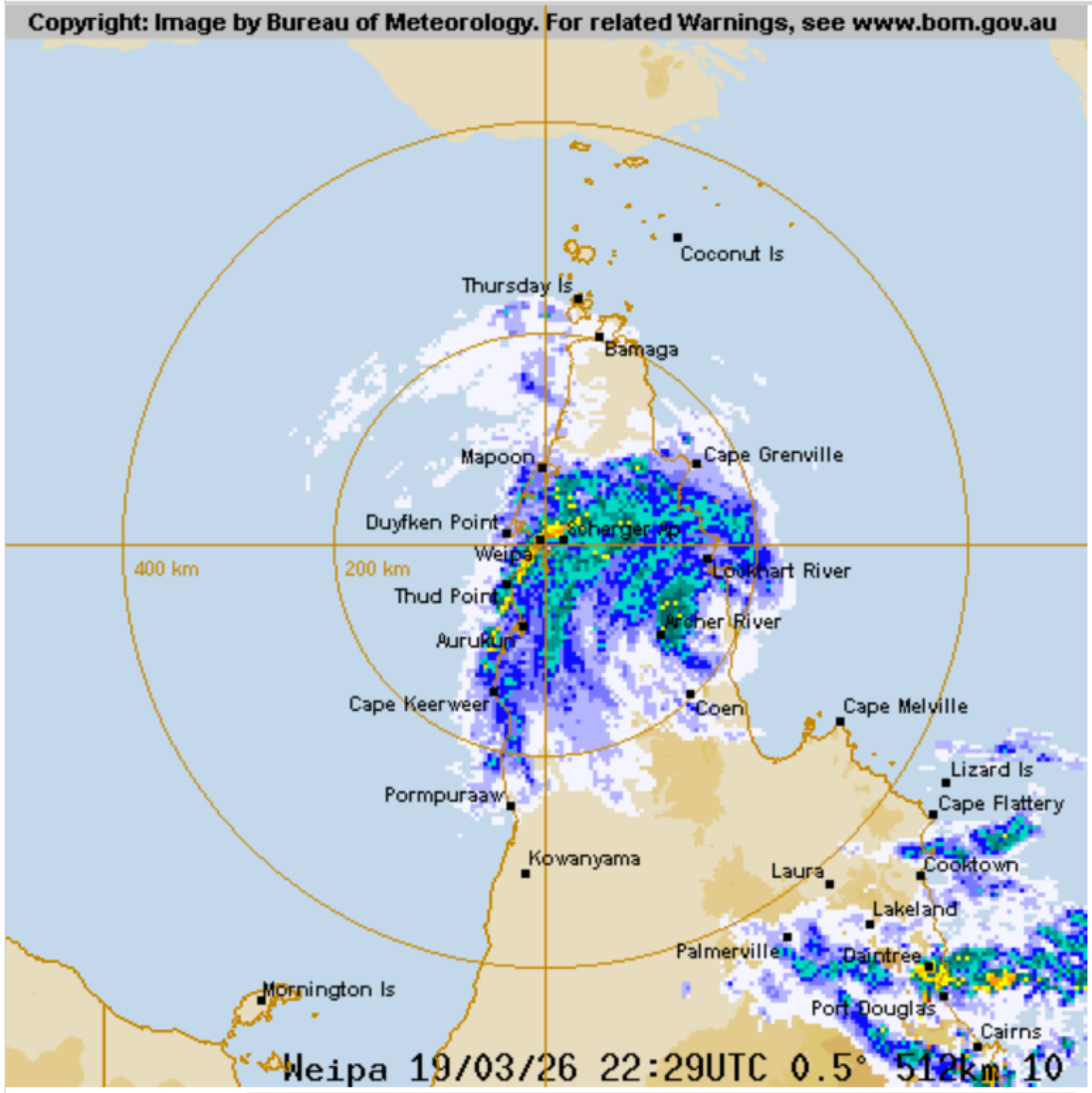
300
Kilometres
Mapoon
Weipa
Lockhart River
Aurukun
Coen
Cape Melville
Pormpuraaw
Cape Flattery
Kowanyama
Cooktown
7 am Mar 21
1 am Mar 21
7 pm Mar 20
1 pm Mar 20
7 am Mar 20
10 pm Mar 19
15

512 km composite Weipa Radar Loop

View the current warnings for Queensland

Loops | Single images | Radar Site Information | Other Rada

Radar | 64 km | 128 km | 256 km | 512 km composit



Nearby radars

Radar controls

Frame: 7
08:31 EST
20/3/2026

Pointer data

Pointer

226 km East
160 km North
277 km Away
55 Degrees

Map Coordinates

11 deg 14 min S
144 deg 0 min E

- (•) Degrees & Minutes
- ( ) Decimal Degrees

Origin

226 km East
160 km North Rst.

MetEye - your eye on the environment™

View the current warnings for Australia

Start typing, then select from list (town, city, postcode or lat/lon) Locate Find me Time zone AEDT

Friday, 20 March 2026 | Sat | Sun | Mon | Tue | Wed | Thu

8:00 | 11:00 | 14:00 | 17:00 | 20:00 | 23:00

LATEST WEATHER

- Current Temp, Rain, Wind ...

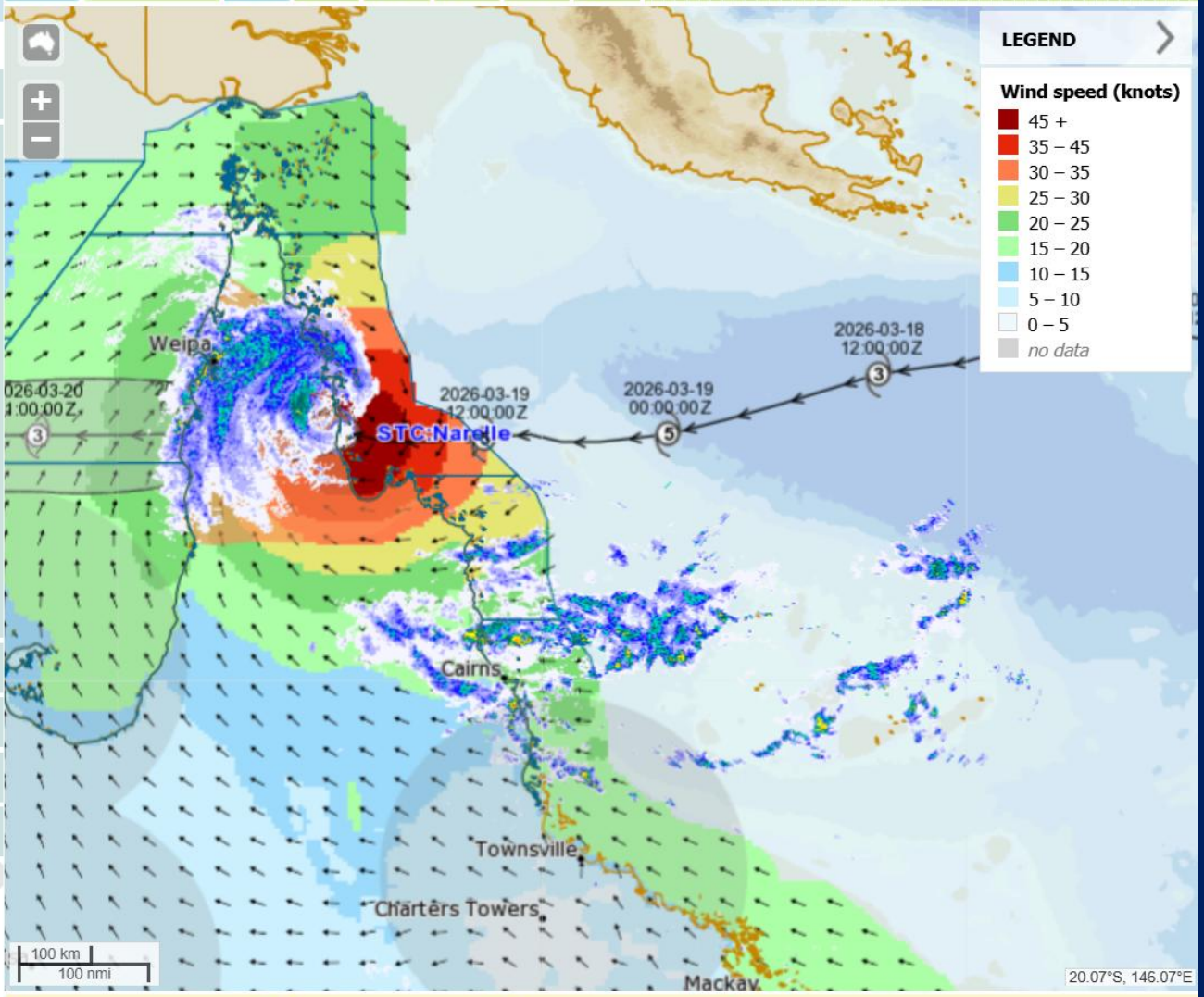
FORECASTS

- Rainfall Forecasts
- Wind Forecasts
  - ○ Wind speed and direction (km/h)
  - ◉ Wind speed and direction (knots)
    Updated 20 Mar 2026, 5:56 AM AEDT
  - ○ Mixing height

  Clear | Info

  Overlay

  - ☑ Latest rain radar
    Updated 20 Mar 2026, 9:31 AM AEDT
  - ☑ Current tropical cyclones Show legend
    Updated 20 Mar 2026, 8:47 AM AEDT
  - ☐ Mean Sea Level Pressure (hPa)
- Waves Forecasts
- Temperature Forecasts
- Storms, Snow, Fog, Frost ...
- Humidity Forecasts
- UV Index Forecasts



☑ Place names ☐ Search marker ☐ Saved locations ☐ Forecast locations

☐ Forecast districts ☑ Marine zones ☐ Roads & railways ☐ Rivers & lakes ☐ Catchments

Latest Weather Observations for Coen Airport

IDQ60801

Issued at 9:13 pm EST Friday 20 March

About weather observations | Map of

Station Details ID: 027073 Name: CC

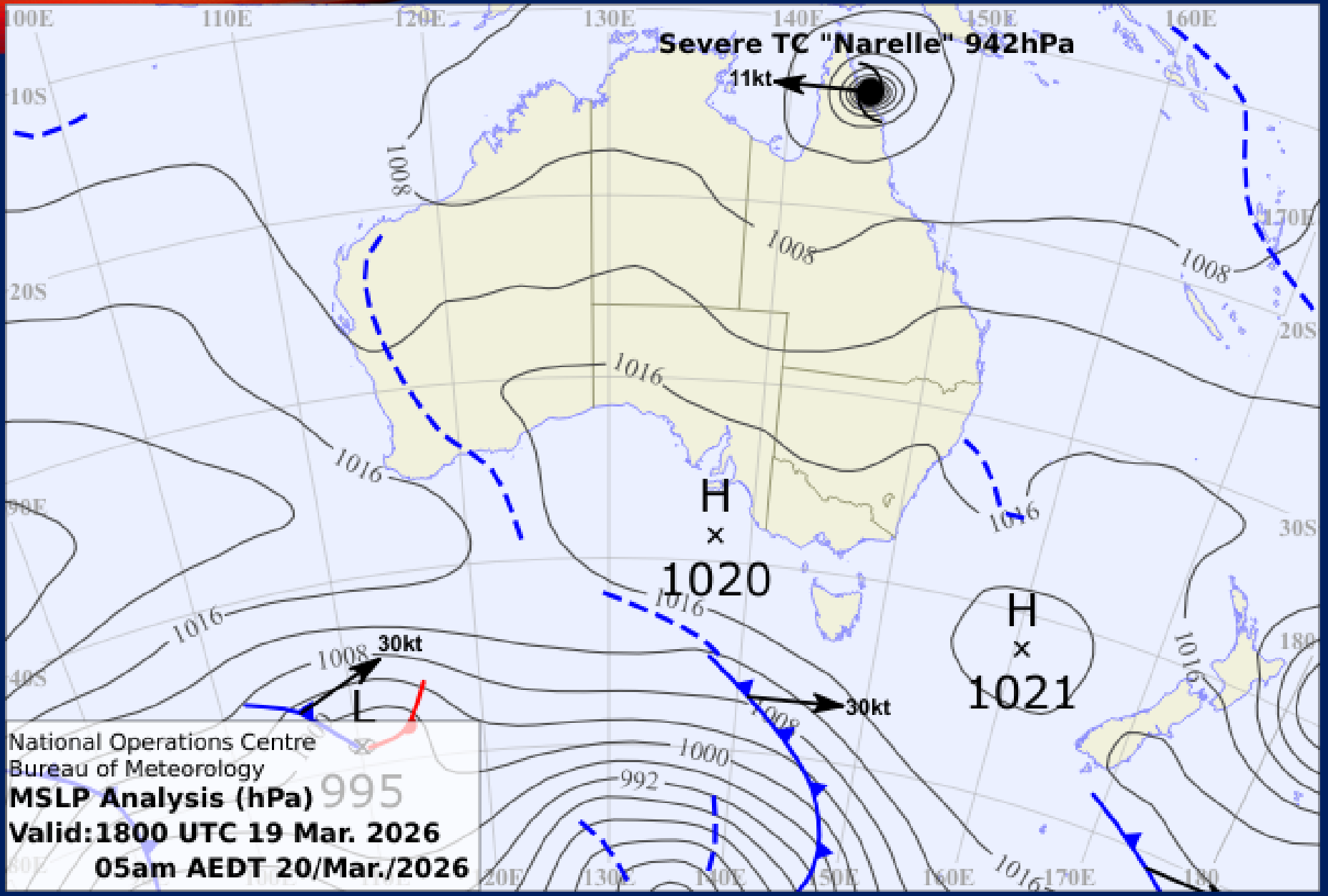
Data from the previous 72 hours. | See a

Date/Time EST	Temp °C	App Temp °C	
20/07:00pm	-	-	-
20/06:30pm	25.1	24.3	20
20/06:04pm	25.4	24.0	20
20/06:00pm	25.2	24.2	20
20/05:37pm	25.3	24.1	20
20/05:30pm	25.4	23.7	20
20/05:00pm	24.7	23.7	21
20/04:47pm	24.4	23.4	21
20/04:30pm	23.5	23.2	21
20/04:06pm	25.2	24.6	21
20/04:05pm	25.3	24.6	21
20/04:00pm	25.4	25.1	21
20/03:30pm	25.4	24.8	22
20/03:24pm	25.4	25.3	22
20/03:05pm	26.1	26.1	23
20/03:00pm	26.2	26.2	23
20/02:30pm	25.9	25.8	23
20/02:03pm	25.8	26.0	23
20/02:00pm	25.9	26.6	23
20/01:30pm	24.9	24.6	23
20/01:00pm	25.4	25.3	23
20/12:34pm	26.1	25.1	23
20/10:00am	-	-	-
20/09:30am	-	-	-
20/09:00am	-	-	-
20/08:30am	-	-	-
20/08:00am	-	-	-
20/07:30am	-	-	-
20/07:00am	-	-	-
20/06:30am	-	-	-
20/06:00am	-	-	-
20/03:00am	-	-	-
20/02:35am	25.0	25.6	24
20/02:30am	25.1	26.6	24
20/02:07am	25.1	27.0	24
20/02:00am	25.1	27.4	24
20/01:30am	25.0	27.2	24
20/01:24am	25.0	27.5	24

Station Details ID: 028008 Name: LOCKHART RIVER AIRPORT Lat: -12.79 Lon: 143.30 Height: 18.5 m

Data from the previous 72 hours. | See also: Recent months at Lockhart River

Date/Time EST	Temp °C	App Temp °C	Dew Point °C	Rel Hum %	Delta-T °C	Wind					Press QNH hPa	Press MSL hPa	Rain since 9am mm
						Dir	Spd km/h	Gust km/h	Spd kts	Gust kts			
20/09:00pm	26.0	28.9	23.1	84	2.0	N	13	20	7	11	1004.2	1004.1	46.4
20/08:30pm	26.1	28.6	23.2	84	2.0	NNW	15	24	8	13	1003.6	1003.5	46.4
20/08:00pm	26.3	29.6	23.2	83	2.1	N	11	22	6	12	1003.2	1003.1	46.4
20/07:30pm	26.1	30.3	23.2	84	2.0	N	6	9	3	5	1002.7	1002.6	46.4
20/07:00pm	26.5	29.2	22.8	80	2.5	N	13	20	7	11	1001.7	1001.6	46.4
20/06:30pm	26.4	28.2	22.5	79	2.6	N	17	28	9	15	1001.0	1000.9	46.4
20/06:00pm	26.7	27.1	21.7	74	3.4	NNW	22	41	12	22	1000.2	1000.1	46.4
20/05:30pm	27.0	27.5	22.0	74	3.4	N	22	43	12	23	999.7	999.6	46.4
20/05:00pm	27.0	27.3	22.2	75	3.2	NNW	24	43	13	23	999.1	999.0	46.4
20/04:31pm	27.1	26.2	21.4	71	3.8	NNW	28	50	15	27	998.3	998.2	46.4
20/04:30pm	27.1	26.6	21.4	71	3.8	NNW	26	50	14	27	998.4	998.3	46.4
20/04:02pm	26.7	25.2	21.0	71	3.8	N	30	48	16	26	997.6	997.5	46.4
20/04:00pm	26.6	24.9	21.4	73	3.5	N	32	50	17	27	997.7	997.6	46.4
20/03:30pm	26.6	22.7	21.1	72	3.6	N	43	61	23	33	997.6	997.5	46.4
20/03:00pm	25.9	23.5	21.1	75	3.2	NNW	35	61	19	33	996.9	996.8	46.4
20/02:30pm	25.5	23.0	21.6	79	2.6	NNW	37	63	20	34	996.2	996.1	46.4
20/02:00pm	25.5	22.3	21.8	80	2.5	NNW	41	69	22	37	995.5	995.4	46.4
20/01:30pm	25.3	22.7	22.8	86	1.7	N	41	69	22	37	995.1	995.0	46.4
20/01:00pm	24.5	22.3	22.8	90	1.2	N	39	67	21	36	994.0	993.9	46.0
20/12:30pm	24.7	22.4	23.3	92	1.0	N	41	76	22	41	993.6	993.5	44.6
20/12:00pm	24.9	23.2	23.7	93	0.8	N	39	63	21	34	993.1	993.0	43.0
20/11:30am	24.3	21.1	23.4	95	0.6	NNW	46	74	25	40	992.6	992.5	40.6
20/11:00am	24.0	19.8	23.0	94	0.7	NNW	50	85	27	46	991.6	991.5	29.2
20/10:30am	24.6	20.9	23.9	96	0.5	NNW	50	78	27	42	990.5	990.4	23.0
20/10:00am	25.1	20.3	23.3	90	1.2	NNW	54	93	29	50	988.4	988.3	10.8
20/09:30am	24.3	19.1	23.3	94	0.7	NNW	56	93	30	50	987.9	987.8	5.2
20/09:26am	24.6	19.5	23.4	93	0.8	NNW	56	93	30	50	987.5	987.4	4.2
20/09:25am	24.5	19.0	23.1	92	0.9	NNW	57	98	31	53	987.6	987.5	4.0
20/09:23am	24.6	18.4	23.2	92	0.9	NW	61	104	33	56	987.8	987.7	3.4
20/09:00am	24.9	17.3	23.7	93	0.8	NW	70	115	38	62	987.0	986.9	108.0
20/08:52am	25.1	17.5	23.7	92	1.0	NW	70	115	38	62	986.3	986.2	106.2
20/08:30am	25.0	18.1	24.0	94	0.7	NW	67	95	36	51	987.3	987.2	101.8
20/08:19am	25.0	18.5	24.0	94	0.7	NW	65	93	35	50	987.7	987.6	99.4
20/08:04am	24.8	18.9	23.8	94	0.7	NW	61	82	33	44	988.1	988.0	96.6
20/08:00am	25.0	19.5	23.8	93	0.8	NW	59	82	32	44	988.1	988.0	96.2
20/07:32am	25.0	20.2	24.0	94	0.7	NW	56	80	30	43	989.6	989.5	91.8
20/07:30am	24.9	20.4	23.9	94	0.7	NW	54	70	29	38	989.9	989.8	91.4
20/07:07am	25.0	20.9	23.8	93	0.8	WNW	52	78	28	42	991.0	990.9	89.0
20/07:00am	25.1	20.8	23.5	91	1.1	NW	52	106	28	57	991.6	991.5	88.4
20/06:56am	25.2	20.6	23.6	91	1.1	WNW	54	106	29	57	991.7	991.6	88.2
20/06:54am	25.5	21.4	23.9	91	1.1	WNW	52	106	28	57	991.6	991.5	88.0
20/06:30am	25.0	22.7	24.0	94	0.7	WNW	43	69	23	37	992.9	992.8	86.0


Severe TC "Narelle" 942hPa
11kt
H
1020
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1021
30kt
30kt
L
995
1008
1016
1000
992
National Operations Centre
Bureau of Meteorology
MSLP Analysis (hPa)
Valid:1800 UTC 19 Mar. 2026
05am AEDT 20/Mar./2026

Katherine River could hit major flood level again as BOM warns of lingering ex-TC Narelle impacts

By Gemma Ferguson | By Grace Atta | Floods

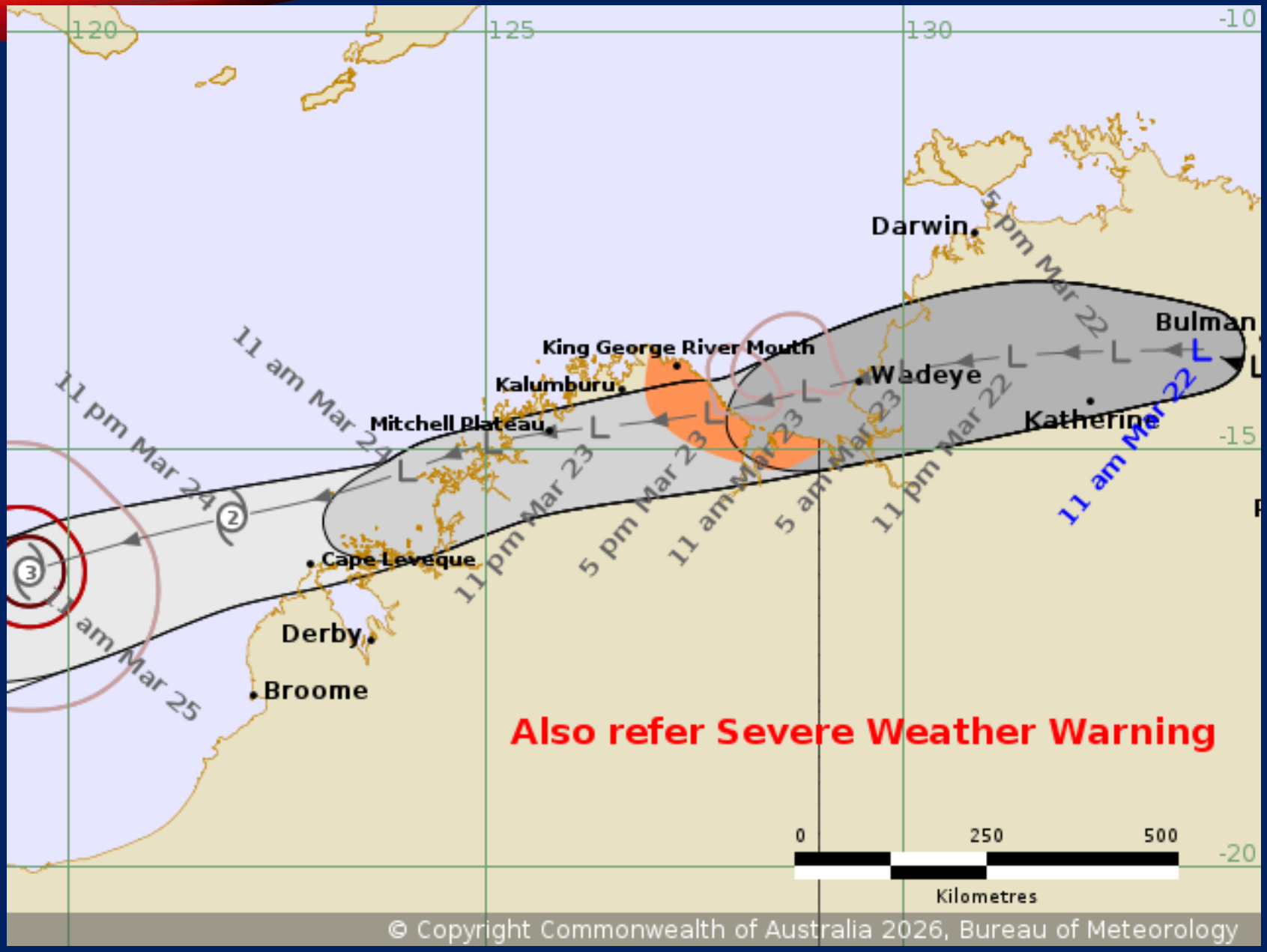
8h ago

Riverine flooding in remote NT communities

Adelaide River was hit with flooding on Monday, but waters have since receded. *(Supplied: Andrew Roberts)*

Could Cyclone Narelle come as far south as Perth?

By Tyne Logan | Weather


120
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-20
Darwin
Bulman
King George River Mouth
Kalumburu
Wadeye
Mitchell Plateau
Katherine
Cape Leveque
Derby
Broome
11 pm Mar 24
11 am Mar 24
5 pm Mar 22
11 pm Mar 23
5 pm Mar 23
11 am Mar 23
5 am Mar 23
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Also refer Severe Weather Warning
0
250
500
Kilometres
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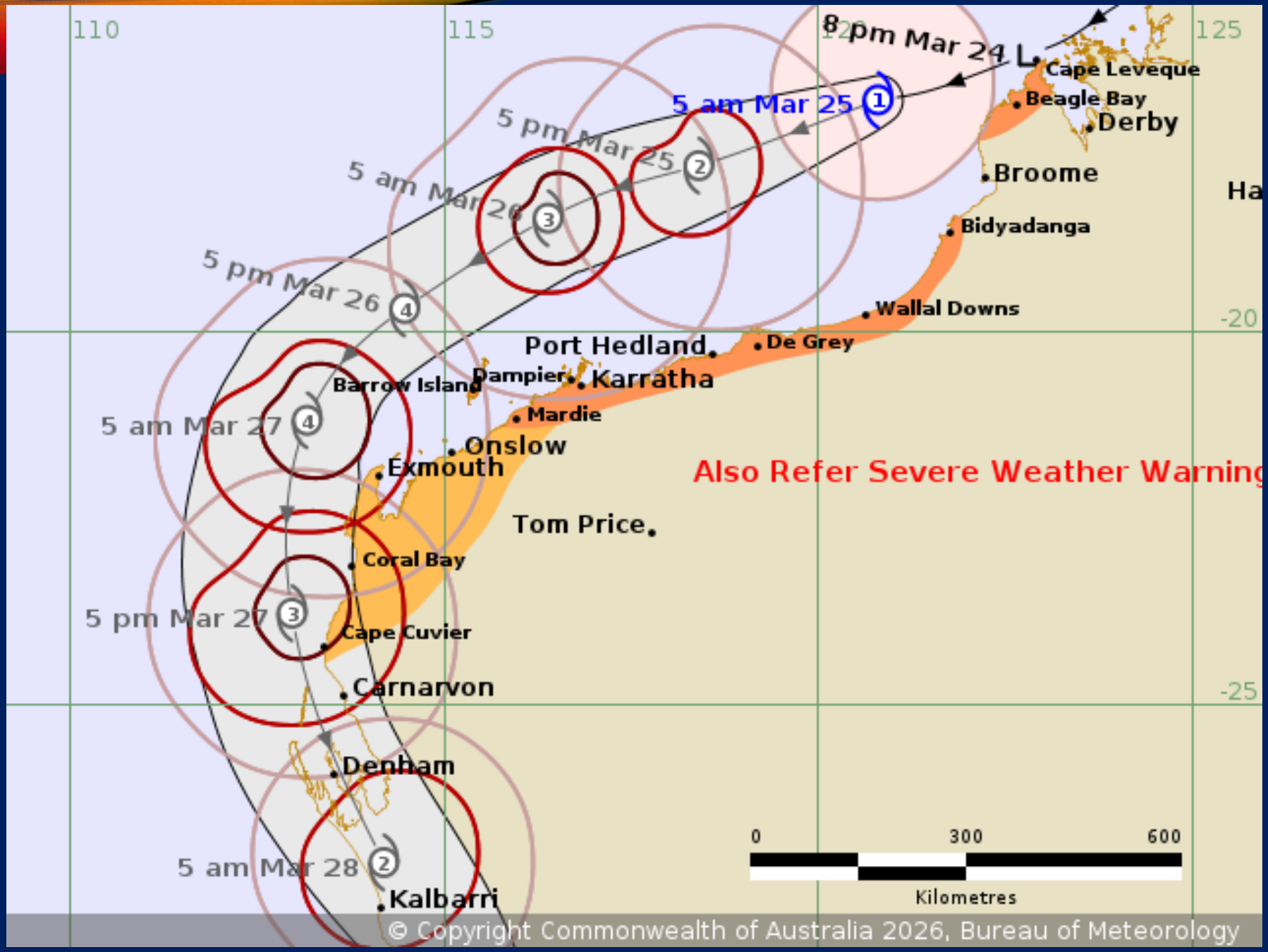
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5 am Mar 27
5 pm Mar 27
5 am Mar 28
Cape Leveque
Beagle Bay
Derby
Broome
Bidyadanga
Wallal Downs
De Grey
Port Hedland
Dampier
Karratha
Barrow Island
Mardie
Onslow
Exmouth
Tom Price
Coral Bay
Cape Cuvier
Carnarvon
Denham
Kalbarri
Also Refer Severe Weather Warning
0
300
600
Kilometres
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Peter Jackson Lecture on Snowball Earth

U3A Nunawading web site (Courtesy of Tony Heyes)
https://sonicpathfinder.org/U3A/Geology/PowerPoints/Snowball%20Earth.pdf

Frozen Earth – The Once and Future Story of Ice Ages
Doug Macdougall (Uni. Of California Press)

Snowballearth.org
https://snowballearth.org/slides.html

Fundamental differences in Geological theories

Uniformitarianism – the same natural laws and processes that operate now have always operated and apply everywhere with no tendency to increase or decrease in general intensity. (Hutton, Lyell)

Catastrophism – geological history shows evidence of catastrophic events (e.g. layers in the fossil records) (Cuvier)

Evidence that parts of Europe had been covered in ice seemed to confirm the catastrophic view

However, it seems that both are true.

"While most of this change has come about slowly – at what might be thought of as a uniformitarian pace – the role of catastrophe cannot be dismissed as it was by Lyell." (Al Fischer, 1984)

"The history of any one part of the earth, like the life of a soldier, consists of long periods of boredom and short periods of terror." (Derek Ager in 1993 adapting a saying of Napoleon.)

A very nice summary of the aims of palaeoclimatology.

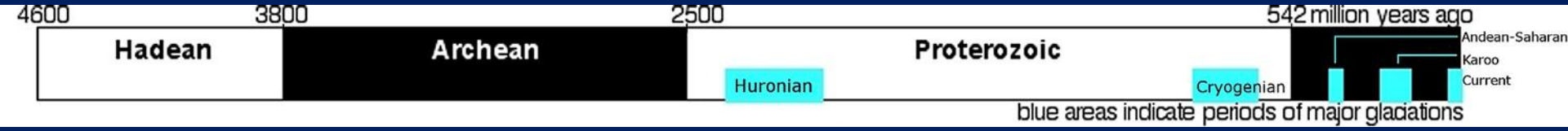
"We may now view earth history as a matter of evolution in which some changes are unidirectional (at least, in net effect), others are oscillatory or cyclic, and still others are random fluctuations, while the whole is punctuated by smaller or greater catastrophes.

"The prime tasks of modern historical geology are to separate the local signals from the global ones, to plot the relationships of global patterns both to time and to each other, and to search for the forces that drive these varied processes."

A.G. Fischer (1984) in *"Catastrophes and Earth History: the new Uniformitarianism".* Princeton Uni. Press

Periodic fluctuations of the earth's climate have been nick-named Icehouse and Greenhouse (with a few excursions to Hothouse). In Greenhouse conditions there are no continental glaciers anywhere on the planet.

"For the most part (85%) over the past 550 million years the climate was warm, resting in a greenhouse state, with occasional falls to glacial conditions and occasional rises to hothouse conditions. The limits of the natural envelope of the earth's climate system ranged from 180 ppm CO_2 and an average global temperature of around 11°C in peak glacial conditions at the low end, to somewhere between 4500 and 8500 ppm CO_2 and between 30 and 32 °C in peak hothouse conditions at the high end." Page 252. Summerhayes *Paleoclimatology*.



Timeline of the five known great icehouse periods, shown in blue. The periods in between depict greenhouse conditions. Icehouse periods:

- the Huronian
- Cryogenian
- Andean-Saharan (also known as Early Paleozoic)
- Late Paleozoic
- Late Cenozoic (**including now**).

Within icehouse states are "glacial" and "interglacial" periods, where ice sheets build up or retreat.

Greenhouse and icehouse periods have played key roles in the evolution of life on Earth by directly and indirectly forcing biotic adaptation and turnover. Life expands – and new lifeforms in the greenhouse periods?

The main factors:

- concentration of atmospheric greenhouse gases
- changes in Earth's orbit
- long-term changes in the solar constant
- oceanic and orogenic changes from tectonic plate dynamics.

The Snowball Earth is a hypothesis proposing that during one or more of Earth's icehouse climates, the planet's surface was nearly entirely frozen, with little or no liquid water exposed. Slushball ?

During the Great Oxygenation Event there was planetary cooling and a series of ice ages known as the Huronian glaciation (2.45–2.22 billion years ago).

Was this the first Snowball Earth?
Not enough geological evidence left to be able to tell but this video thinks so:
https://www.youtube.com/watch?v=YKuoPBbh58Y

The Snowball Earth hypothesis is most commonly associated with the Cryogenian Period with two major glacial episodes:

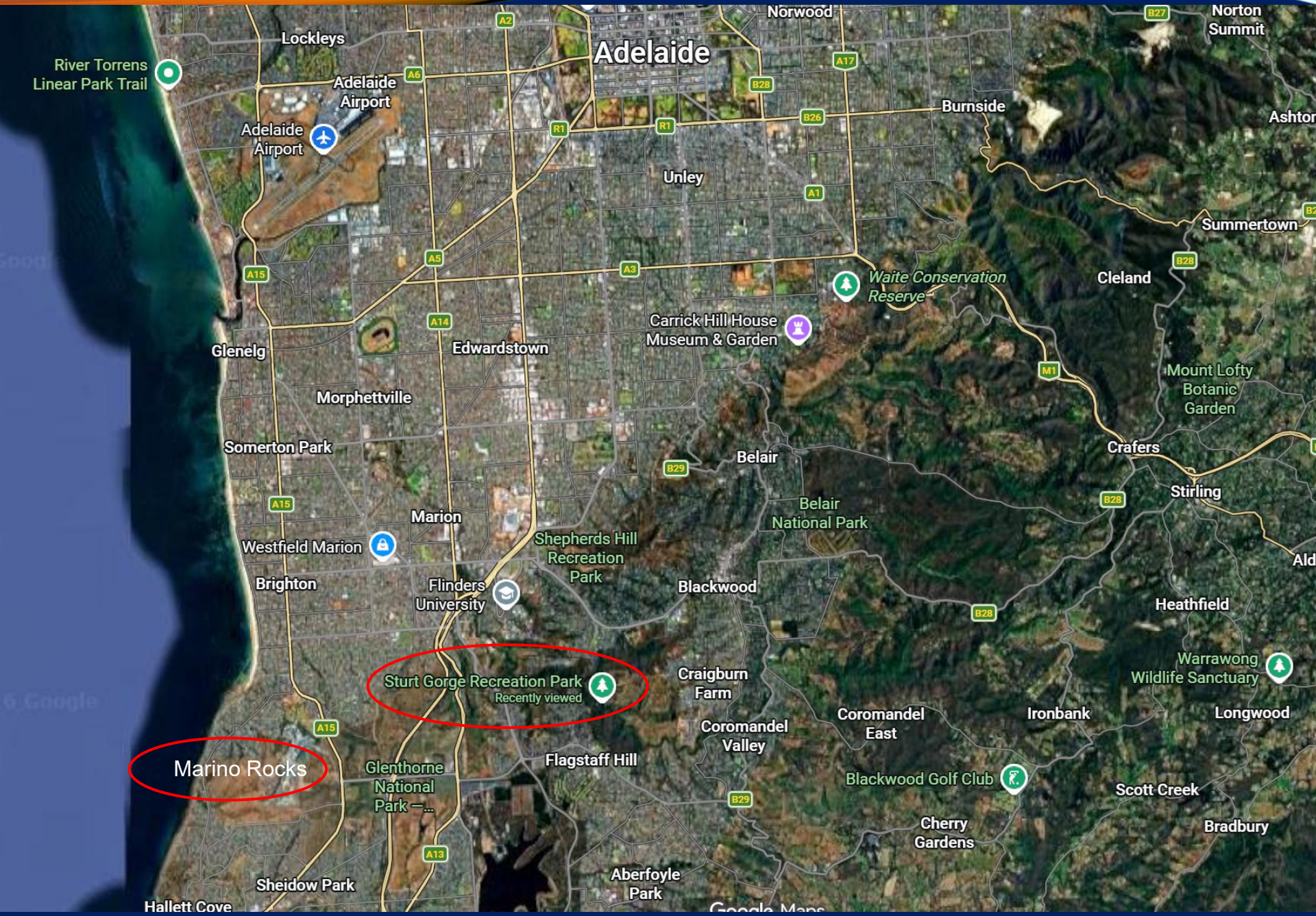
- Sturtian (c. 717–659 Ma)
- Marinoan (c. 645–635 Ma)

A third – Gaskiers (about 580 Ma) – Newfoundland but this was not claimed to be a Snowball event.

Where do these names come from?

Douglas Mawson (1882-1958) found thick and extensive glacial sediments and speculated about the possibility of global glaciation.

His evidence came from Sturt Gorge and the Marino Rocks near Adelaide.

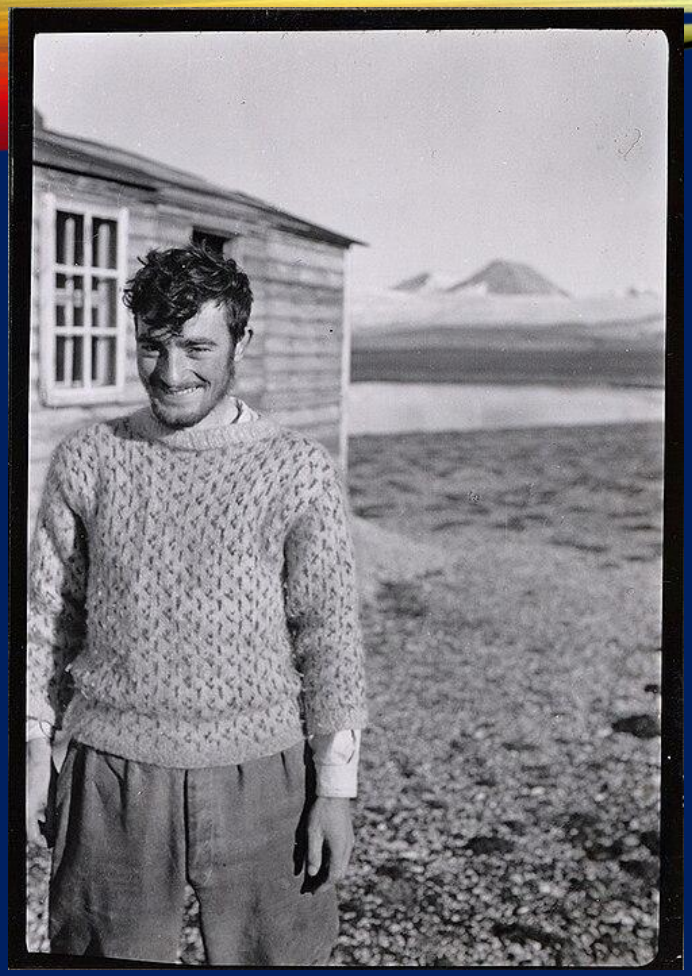

Norwood
Norton Summit
Lockleys
Adelaide
River Torrens Linear Park Trail
Adelaide Airport
Adelaide Airport
Burnside
Ashton
Unley
Summertown
Waite Conservation Reserve
Cleland
Carrick Hill House Museum & Garden
Glenelg
Edwardstown
Mount Lofty Botanic Garden
Morphettville
Somerton Park
Belair
Crafers
Stirling
Belair National Park
Marion
Westfield Marion
Shepherds Hill Recreation Park
Brighton
Flinders University
Blackwood
Heathfield
Warrawong Wildlife Sanctuary
Sturt Gorge Recreation Park
Recently viewed
Craigburn Farm
Coromandel East
Ironbank
Longwood
Coromandel Valley
Marino Rocks
Glenthorne National Park —...
Flagstaff Hill
Blackwood Golf Club
Scott Creek
Cherry Gardens
Bradbury
Sheidow Park
Aberfoyle Park
Hallett Cove
Google Maps

Geological Indicators

Geologists have identified several types of sedimentary deposits that indicate glaciation:

- **Striations**: Scratches on bedrock caused by moving glaciers.
- **Tillites**: Poorly sorted sedimentary rocks formed from glacial deposits.
- **Dropstones**: Large rocks that have been transported by ice and deposited in marine sediments.

These features are found in various locations, including tropical regions, suggesting that glaciers extended to low latitudes.



1964: W. Brian Harland (1917-2003) Palaeomagnetic data showed that glacial tillites in Svalbard and Greenland were deposited at tropical latitudes.

He also found glacial sediments interrupting successions of rocks commonly associated with tropical to temperate latitudes.

He argued that an ice age occurred that was so extreme that it resulted in marine glacial rocks being deposited in the tropics.

In 1969 two scientists, Mikhail I. Budyko at the Main Geophysical Observatory in Leningrad and William D. Sellers at the University of Arizona published simple climate models based on the energy budget of the Earth. The two articles, widely known collectively as “Budyko and Sellers”, indicated that rapid and dramatic changes—either warming or cooling—of the global climate were possible consequences of relatively minor perturbations, including those attributable to human activity.

Using this model, Budyko found that if ice sheets advanced far enough out of the polar regions, a runaway effect could take place, where the increased reflectiveness (albedo) of the ice led to further cooling and the formation of more ice, until the entire Earth was covered in ice and stabilized in a new ice-covered equilibrium.

While Budyko's model showed that this ice-albedo stability could happen, he concluded that it had, in fact, never happened, as his model offered no way to escape from such a feedback loop.

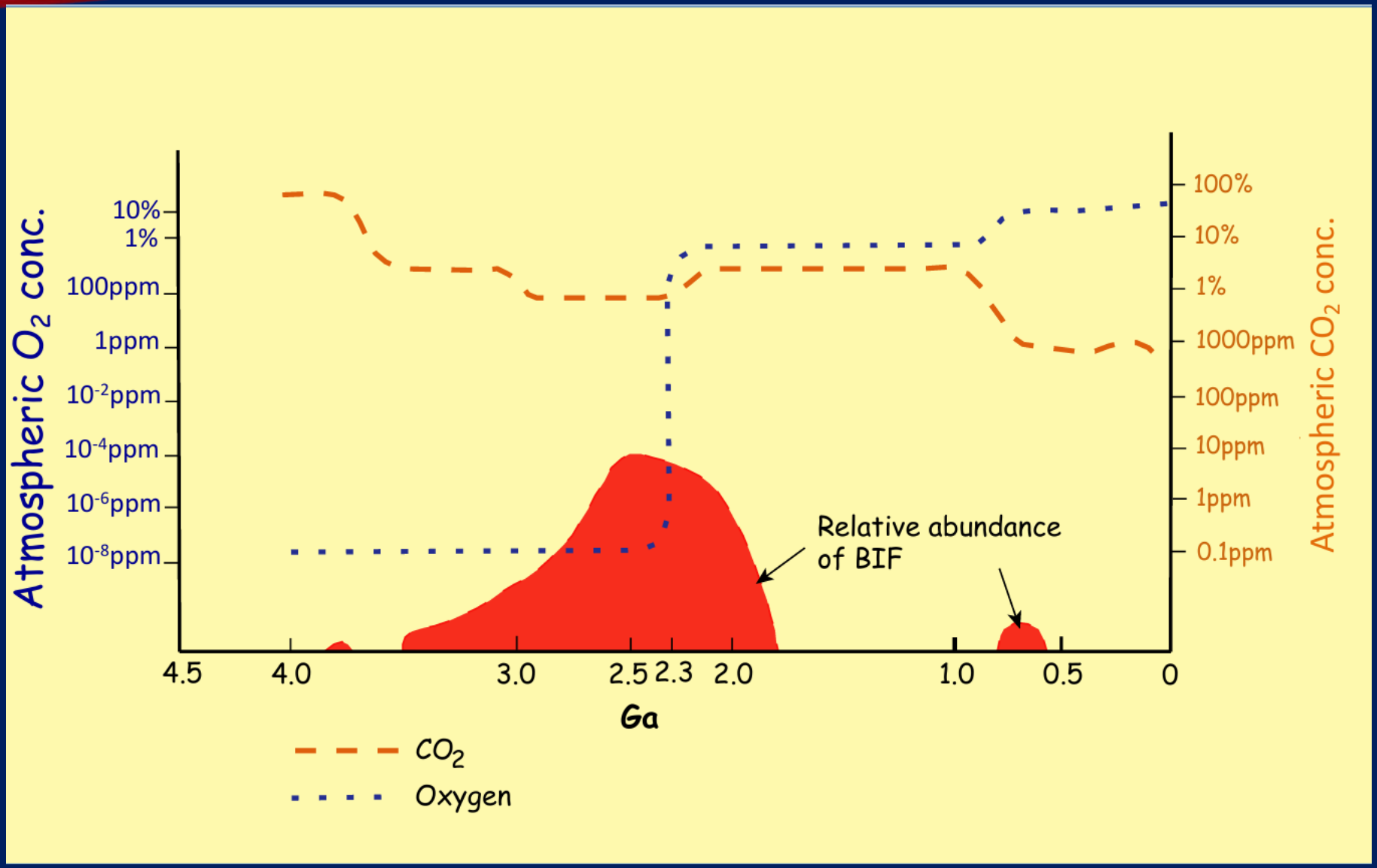
The term “Snowball Earth" was coined by Joe Kirschvink in 1992 based on:

- the recognition that the presence of banded iron formations is consistent with such a global glacial episode (*),
- the introduction of a mechanism by which to escape from a completely ice-covered Earth—specifically, the accumulation of CO_2 from volcanic outgassing leading to an ultra-greenhouse effect. (Most processes removing carbon dioxide – rainfall, photosynthesis, silicate weathering – were suppressed.)
- Carbon 12/13 ratios in the water – life preferentially absorbs carbon-12 so sea water is enriched in Carbon 13. In the glacial period there is no indication of carbon 13 enrichment – indicating that photosynthesis had ceased.

(*) With the ocean cut off from the air by ice

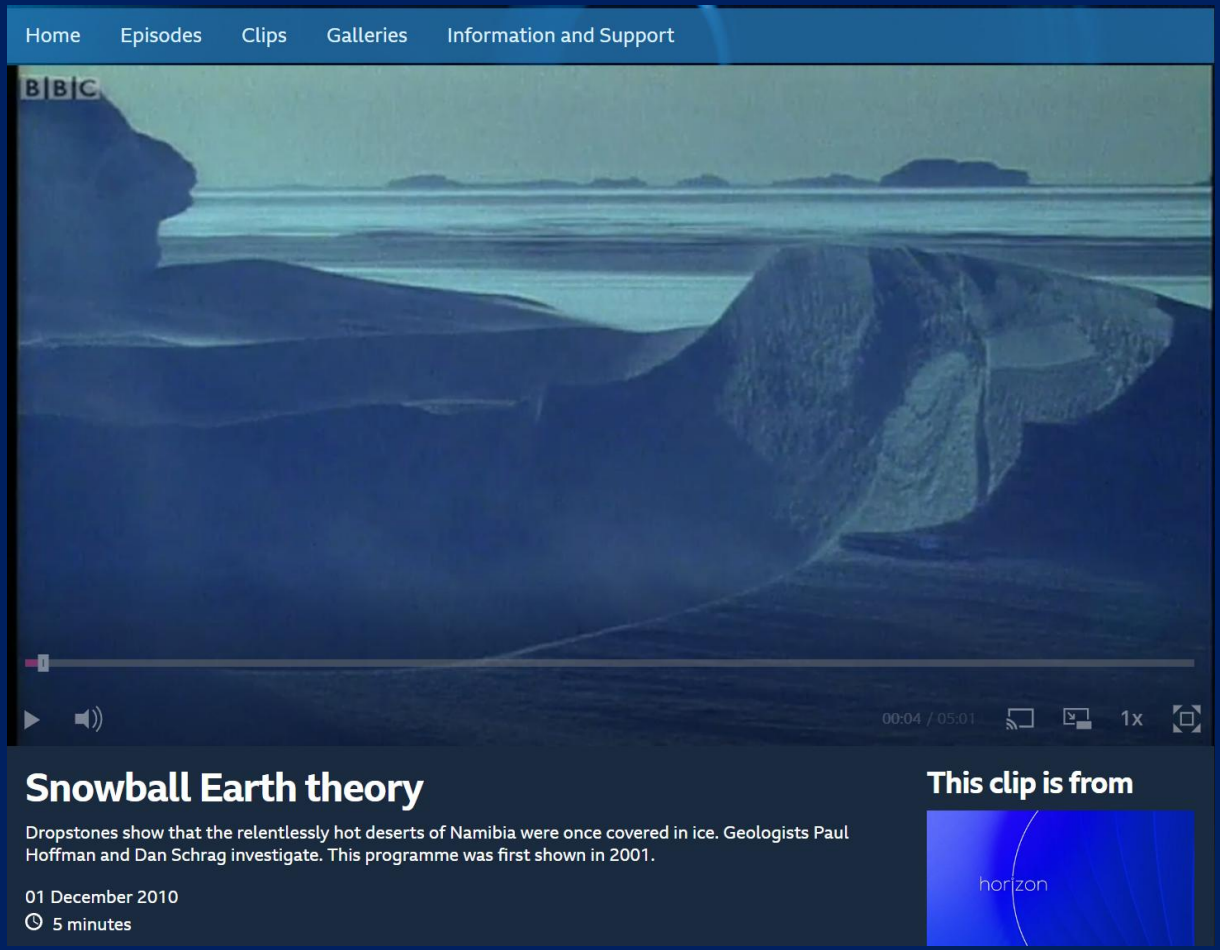
- oxygen would have been consumed by the primitive life in the ocean.
- ferrous iron can dissolve in the ocean.

When oxygen returns the BIFs form as the iron is oxidized (into “rust”).

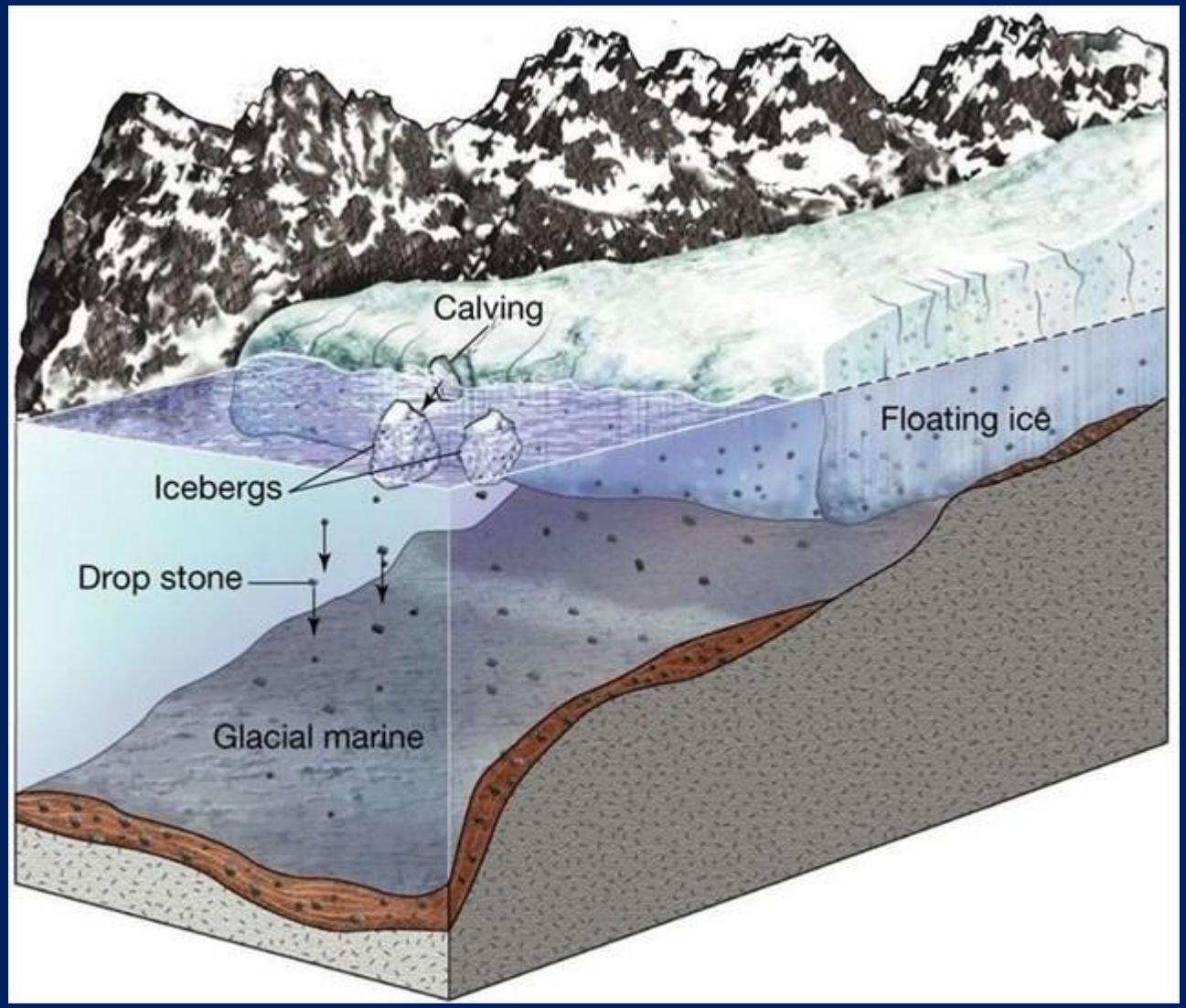

Atmospheric O_2 conc.
10%
1%
100ppm
1ppm
10^{-2}ppm
10^{-4}ppm
10^{-6}ppm
10^{-8}ppm
100%
10%
1%
1000ppm
100ppm
10ppm
1ppm
0.1ppm
Atmospheric CO_2 conc.
Relative abundance of BIF
4.5
4.0
3.0
2.5
2.3
2.0
1.0
0.5
0
Ga
CO_2
Oxygen

Interest in the notion of a snowball Earth increased dramatically after Paul F. Hoffman and his co-workers applied Kirschvink's ideas to sedimentary rocks in Namibia.

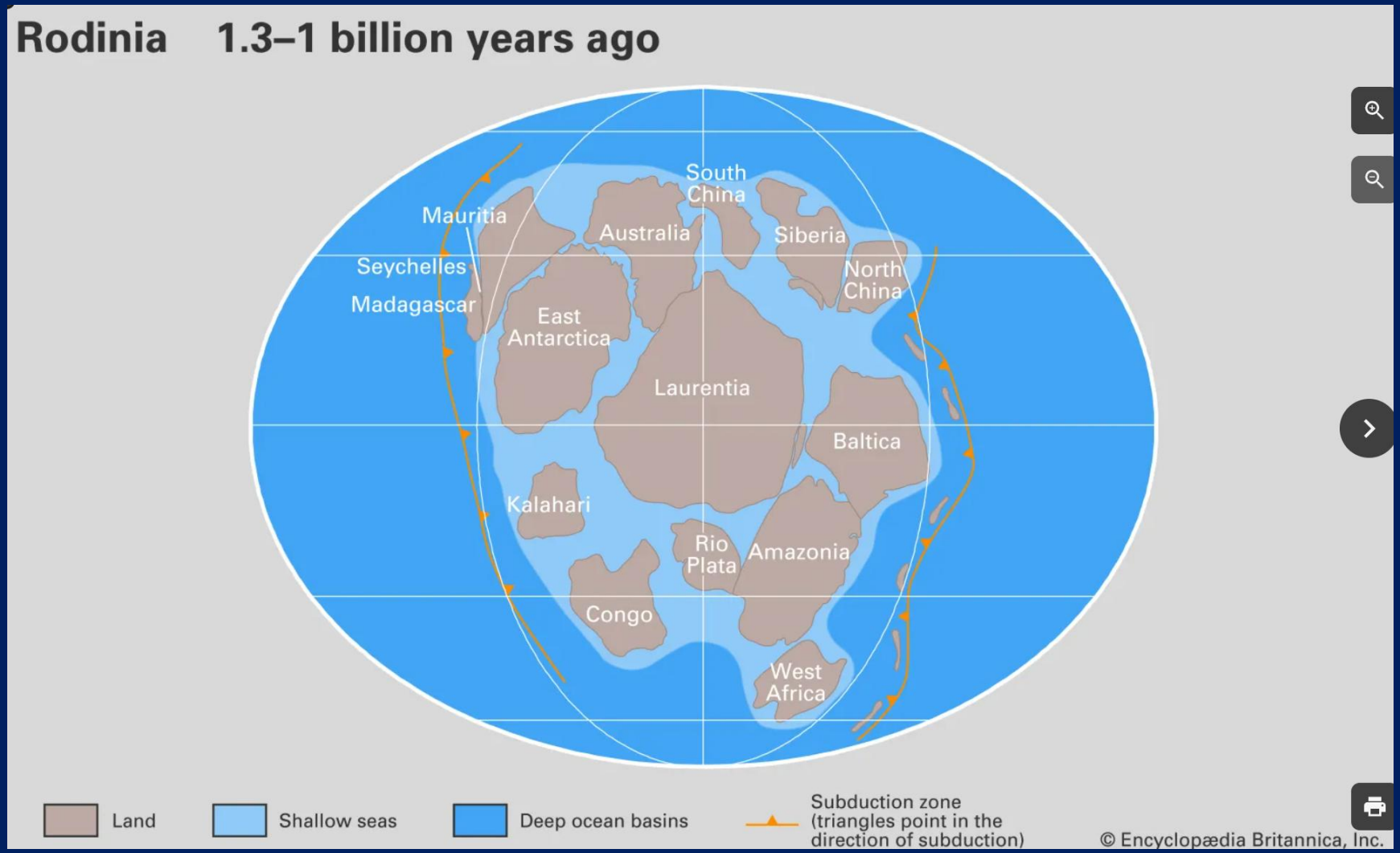
BBC Two - Horizon, 2000-2001, Snowball Earth, Snowball Earth theory
https://www.bbc.co.uk/programmes/p00cgy7m



Dropstones



In 2010, Francis A. Macdonald, assistant professor at Harvard in the Department of Earth and Planetary Sciences, and others, reported evidence that Rodinia was at equatorial latitude during the Cryogenian period with glacial ice at or below sea level, and that the associated Sturtian glaciation was global.



Proponents of the Snowball hypothesis argue that it best explains sedimentary deposits that are generally believed to be of glacial origin at tropical latitudes and other enigmatic features in the geological record.

e.g. Formation of “cap carbonates” over traces of glaciers. (these are not typical limestones formed from dead marine life) but a different type of chemical reaction usually found in warm tropical waters.

The Snowball Earth conditions lasted for millions of years. Surface temperatures, even in the tropics, have been estimated to have been below -20 °C except where open ocean conditions might have prevailed (a variant of the Snowball Earth state referred to as a “Slushball”).

These relatively warm (near 0 °C) surface waters may have served as refugia for life.

Note that complex animal life had yet to evolve on Earth during these Snowball events.

Causes (p 253 Summerhayes)

- Weaker sun (6-7%)
- Volcanoes – emissions shading the earth
- No vegetation on land so the break-up of Rodinia (around 700 mA) could lead to more rain over land and hence weathering
- Life in the ocean producing dimethyl sulphide (DMS) that acts as condensation nuclei for rainfall

Follow-on

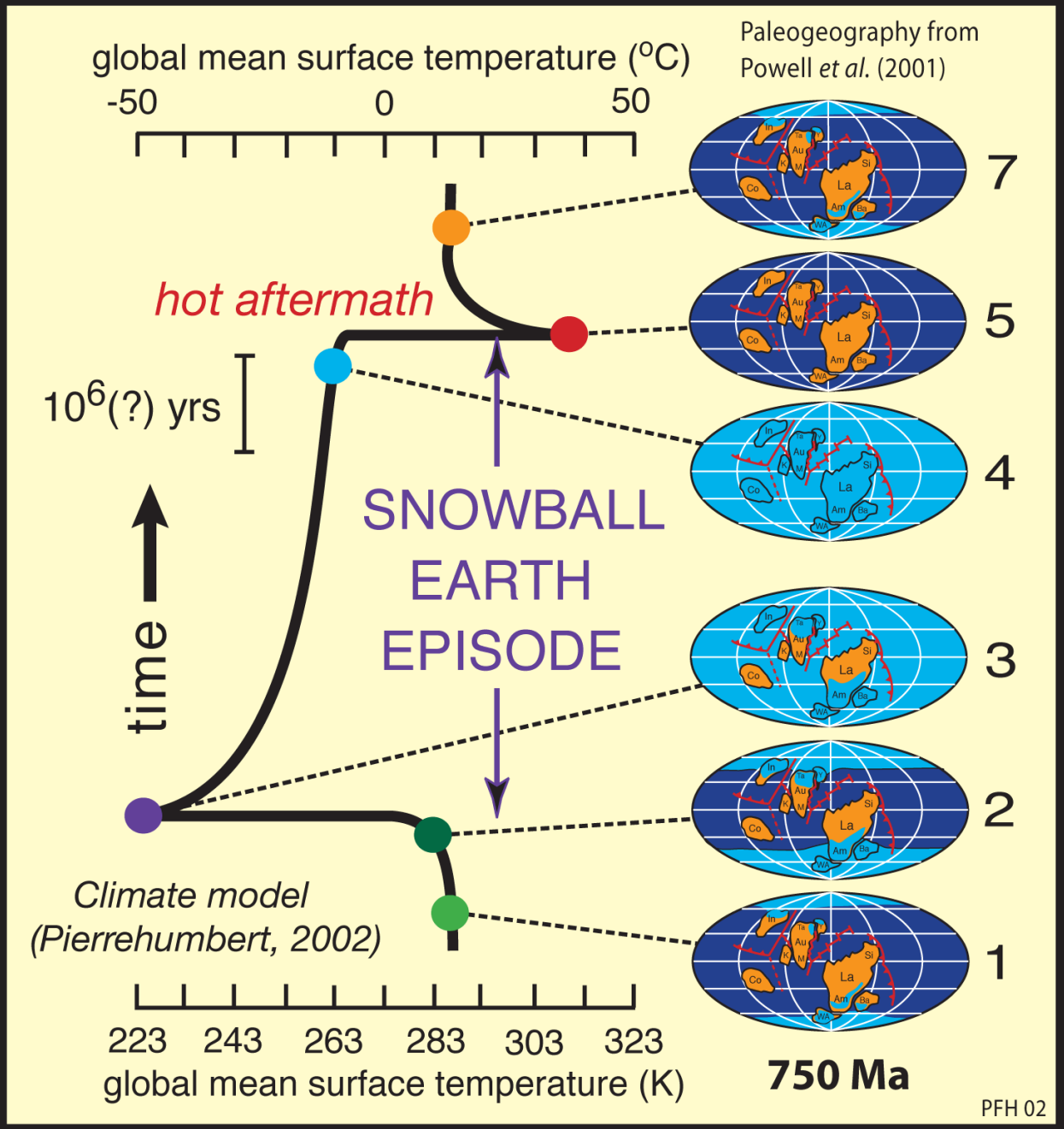
There was an abrupt rebound to hothouse conditions within a few millennia.

It had to be hot to melt the ice and once the ice melted there was a positive feedback loop.

CO_2 concentrations may have reached 10,000 ppm !

There seems to have been rapid evolutionary diversification following these events, as Earth returned to more hospitable conditions.

Snowball Earth: How Our Planet Became a Frozen World and Sparked New Life
https://youtu.be/ppZfLHxhRpU


global mean surface temperature (°C)
-50
0
50
Paleogeography from
Powell et al. (2001)
hot aftermath
10^6(?) yrs
time
SNOWBALL
EARTH
EPISODE
7
5
4
3
2
1
Climate model
(Pierrehumbert, 2002)
223
243
263
283
303
323
global mean surface temperature (K)
750 Ma
PFH 02

Origin of cap carbonates

- Post "Snowball Earth", Earth's surface heated due to high atmospheric CO_2 increased humidity
- elevated sea temperatures → increased evaporation → torrential rain flushes CO_2 from atmosphere → carbonic acid

$$H_2O + CO_2 \leftarrow \rightarrow H_2CO_3$$

Carbonic acid

- carbonic acid active in weathering rocks → releasing calcium

$$H_2CO_3 + CaSiO_3 \leftrightarrow CaCO_3 + H_2O + SiO_2$$

calcite

- carbonates form layers atop glacial sediments → cap carbonates
- recent theories involving methane release have proposed alternate origins

Recovery

Our findings suggest that methane released from low-latitude permafrost clathrates therefore acted as a trigger and/or strong positive feedback for deglaciation and warming.

Also based on research in the same area of Adelaide that Mawson studied.

LETTERS

Snowball Earth termination by destabilization of equatorial permafrost methane clathrate

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PALAEOCLIMATE

Marinoan meltdown

The termination of the Marinoan glaciation 635 million years ago is one of the most spectacular climate change events ever recorded. Methane release from equatorial permafrost might have triggered this global meltdown.

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Imagine that the planet Earth fell into a seemingly perpetual deep freeze. As thick ice caps formed, sea levels would drop by hundreds of metres, turning huge tracts of previously submerged continental shelf into Arctic wasteland. Imagine now, after millions of years, how such an icescape might begin to thaw. This is exactly what geologists have been trying to do for decades, as they have been struggling to piece together the puzzle of what happened at the end of a glaciation that may have covered the entire planet in ice. Several hypotheses have sprung up, one of which suggests that a massive expulsion of methane from previously frozen ground set in motion runaway global warming and sea-level rise due to the melting of glaciers. In their article in *Nature*, Kennedy *et al.*[1] mount support for this 'methane release hypothesis' by identifying evidence for a mix of methane and glacial meltwater directly below the recognized global marker for the end of this glaciation.

Over the past decade, evidence has been building to suggest that the Earth experienced up to 100 million years

Long Video

https://www.youtube.com/watch?v=xhVFZFm44SQ