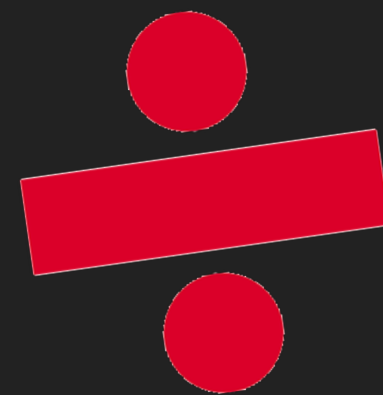
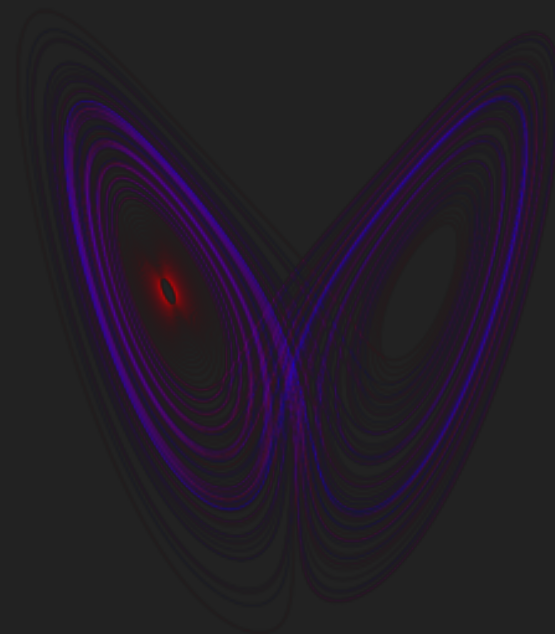




$$(x+3)^2 = 4$$



$$e^{i\pi} + 1 = 0$$



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ICE SHELF DISINTEGRATION

3 INGREDIENTS TO THIS TALK

1. Swell waves

2. Sea ice

3. Ice shelves

OCEAN SWELL

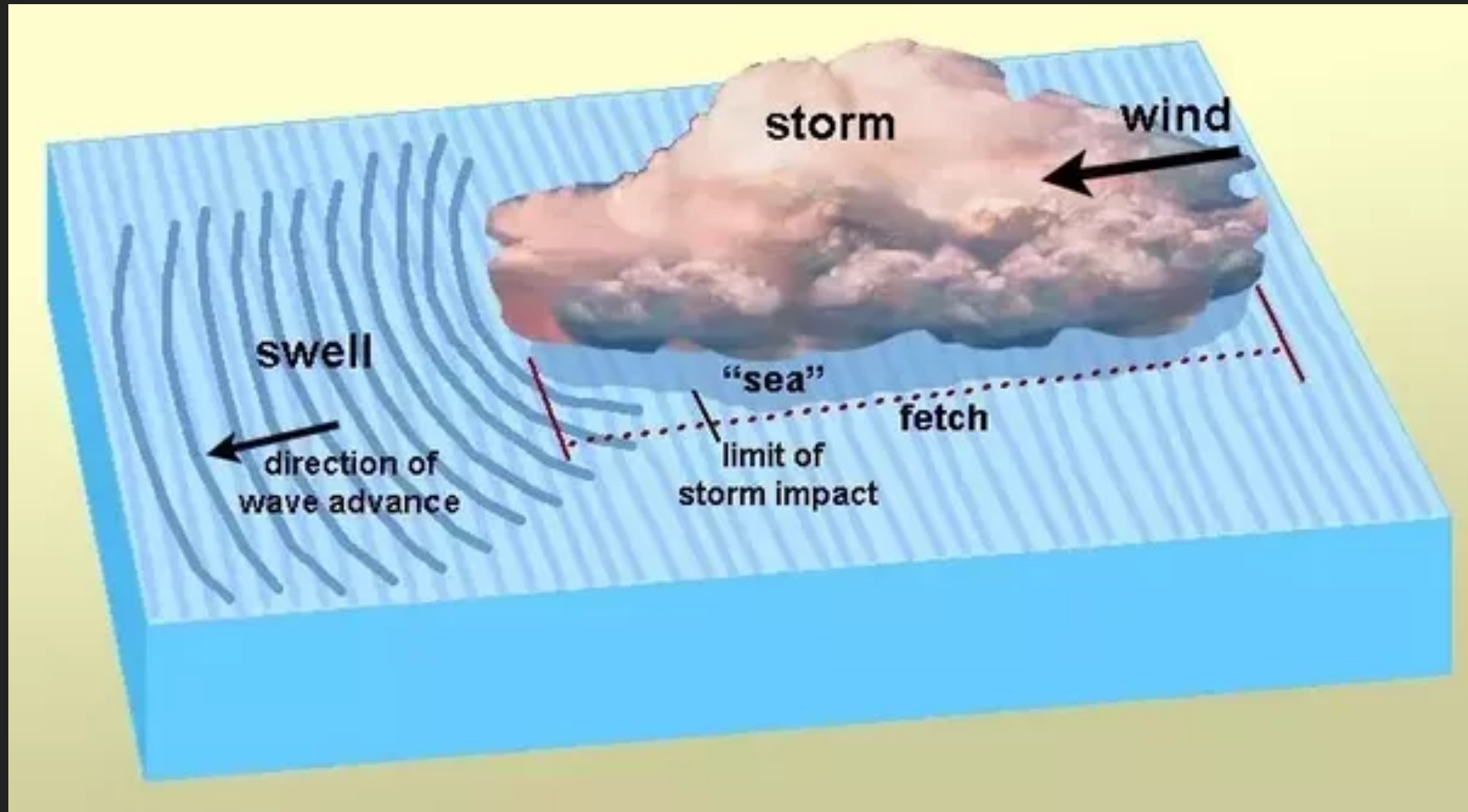
- ▶ Picture an ocean wave...



- ▶ The wave had a long journey to reach that point.

OCEAN SWELL: FROM WIND TO WAVES

- ▶ Great storms rage over the oceans



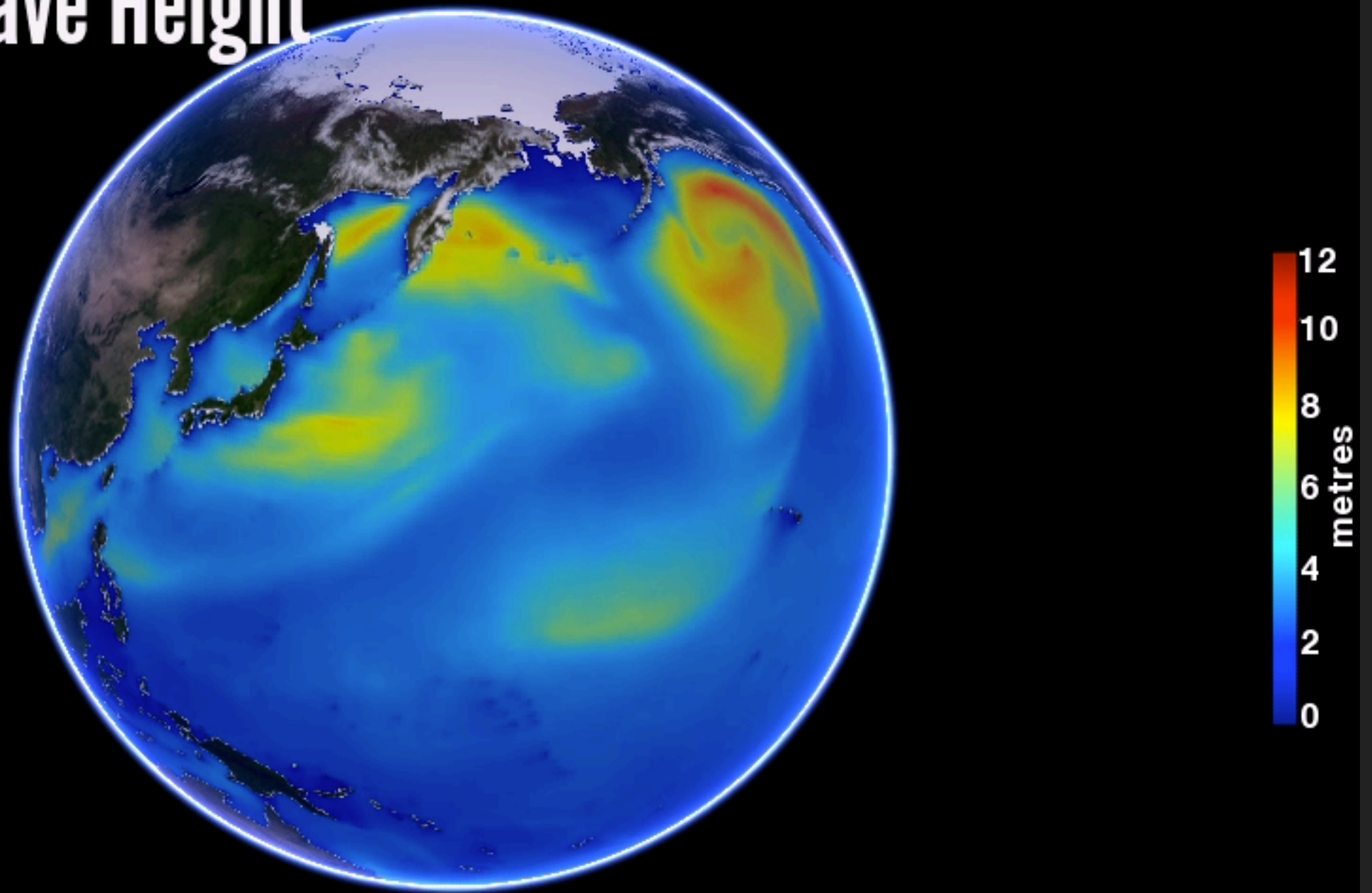
- ▶ Other ocean waves: wind waves; tsunami; etc

OCEAN SWELL: TRANSOCEANIC CONNECTIONS

- ▶ Travel the oceans with very little energy loss

Significant Wave Height

1 January 2008



Source: Bureau of Meteorology

OCEAN SWELL: ARE POWERFUL

- Destroy coastlines, offshore



- Can lift up a ship

Power per km coastline
=
Capacity of power plant



SEA ICE = FROZEN SURFACE OF OCEAN, I.E. IT'S SALTY

- ▶ Obligatory photos of polar bears and penguins:



- ▶ Comes in many different types



SEA ICE: IS IMPORTANT!

- ▶ Supports wildlife; Reflects sun; Drives ocean currents; Etc.
- ▶ The fact you're most likely to know about sea ice...

It's disappearing



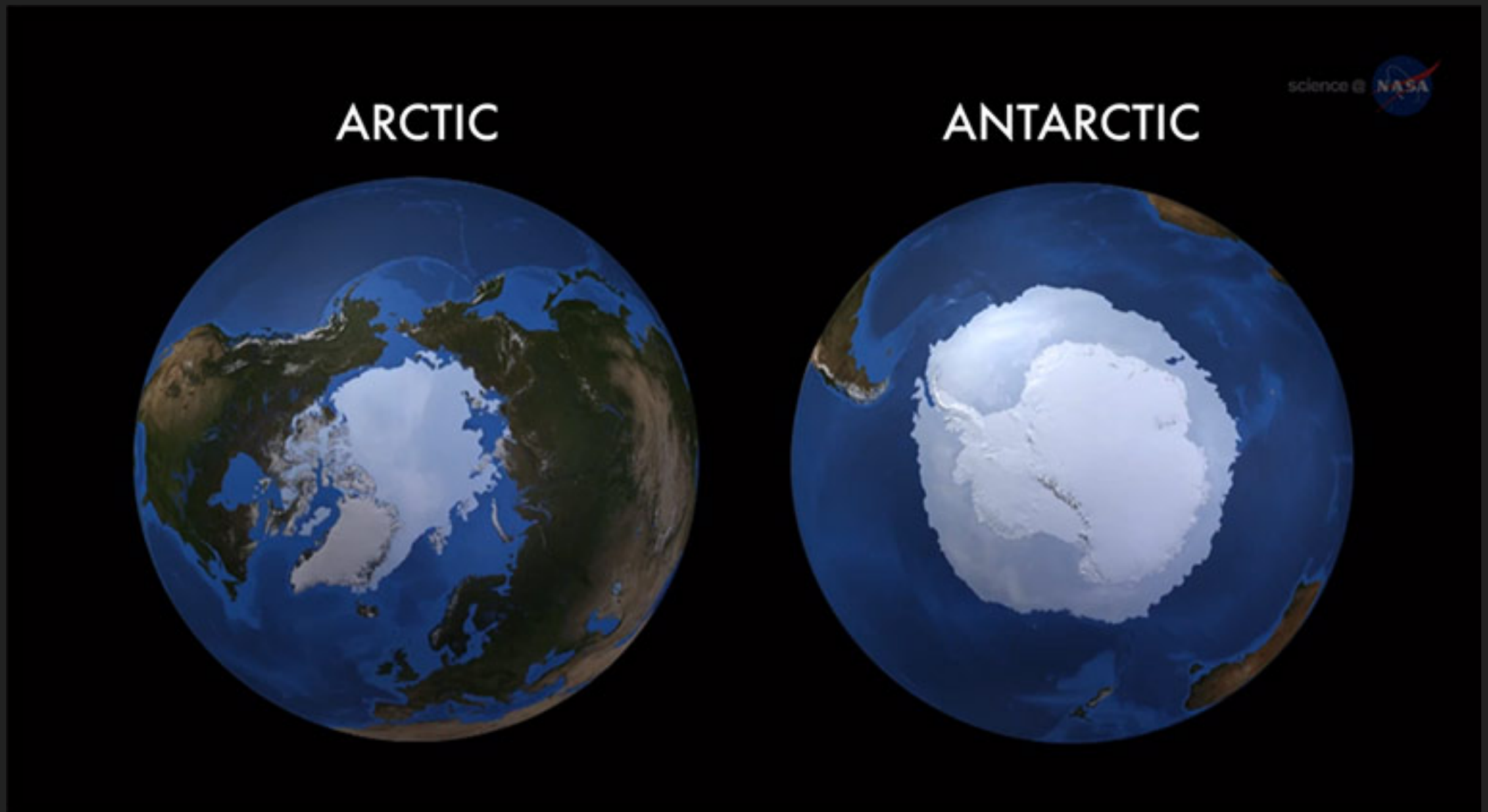
Arctic ice melt 'like adding 20 years of CO2 emissions'

By Susan Watts
Newsnight Science editor, BBC News



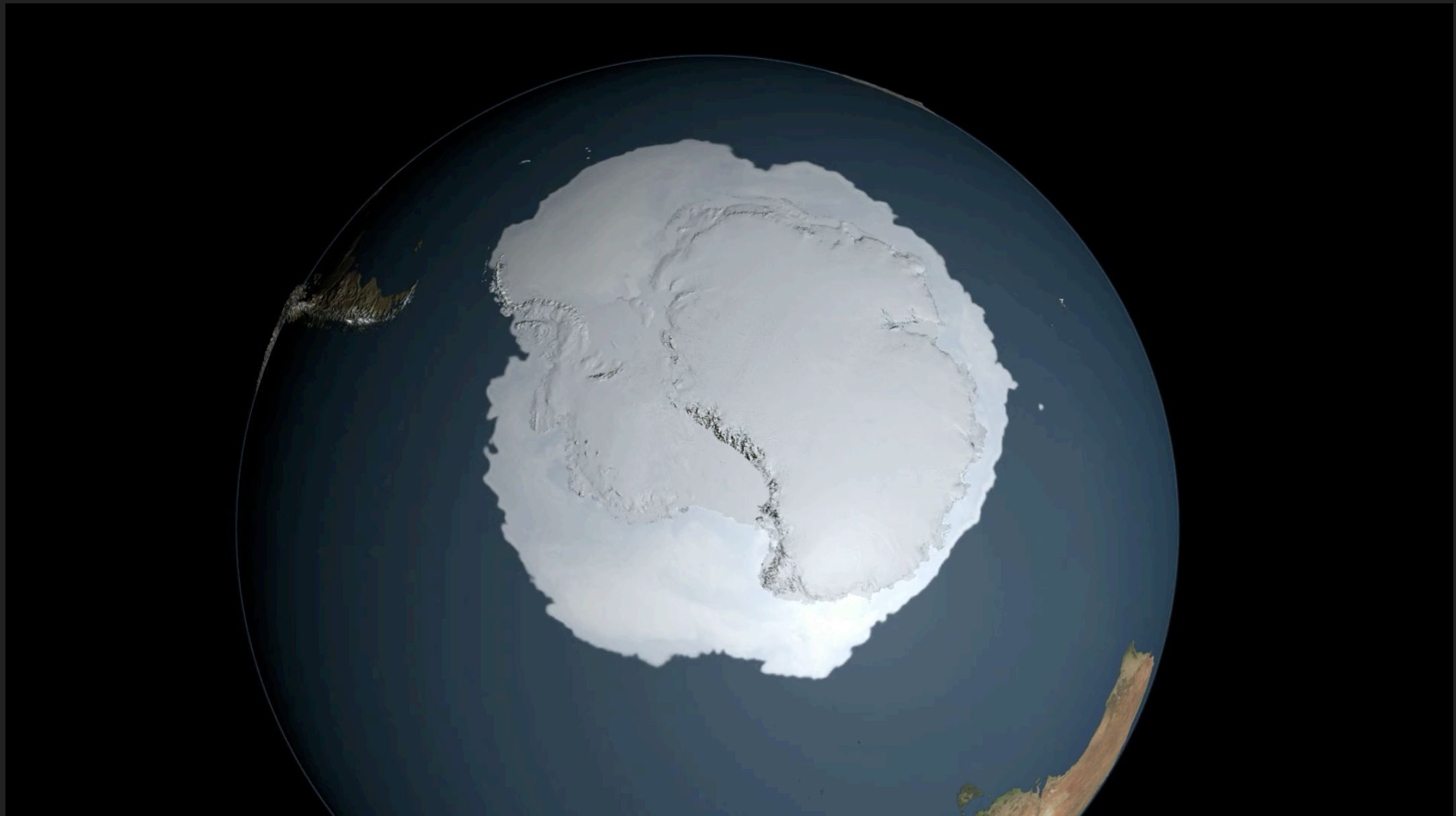
in the Arctic...

SEA ICE: ARCTIC VS ANTARCTIC



- ▶ Arctic sea ice is surrounded by land
- ▶ Antarctic sea ice surrounds land
 - > Strong regional variability & lots of unknowns

SEA ICE: ANTARCTIC



- ▶ Largest seasonal cycle on planet
- ▶ Doubles size of Antarctic at its maximum

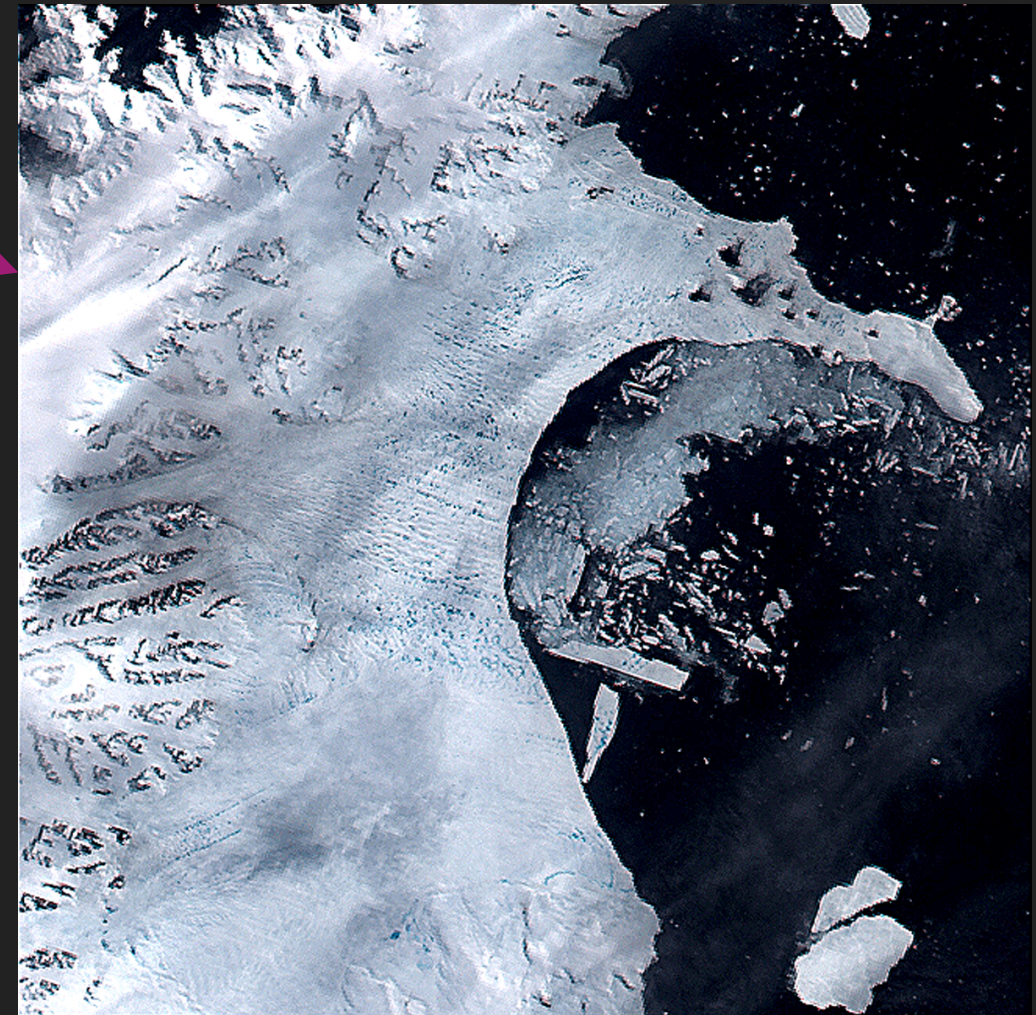
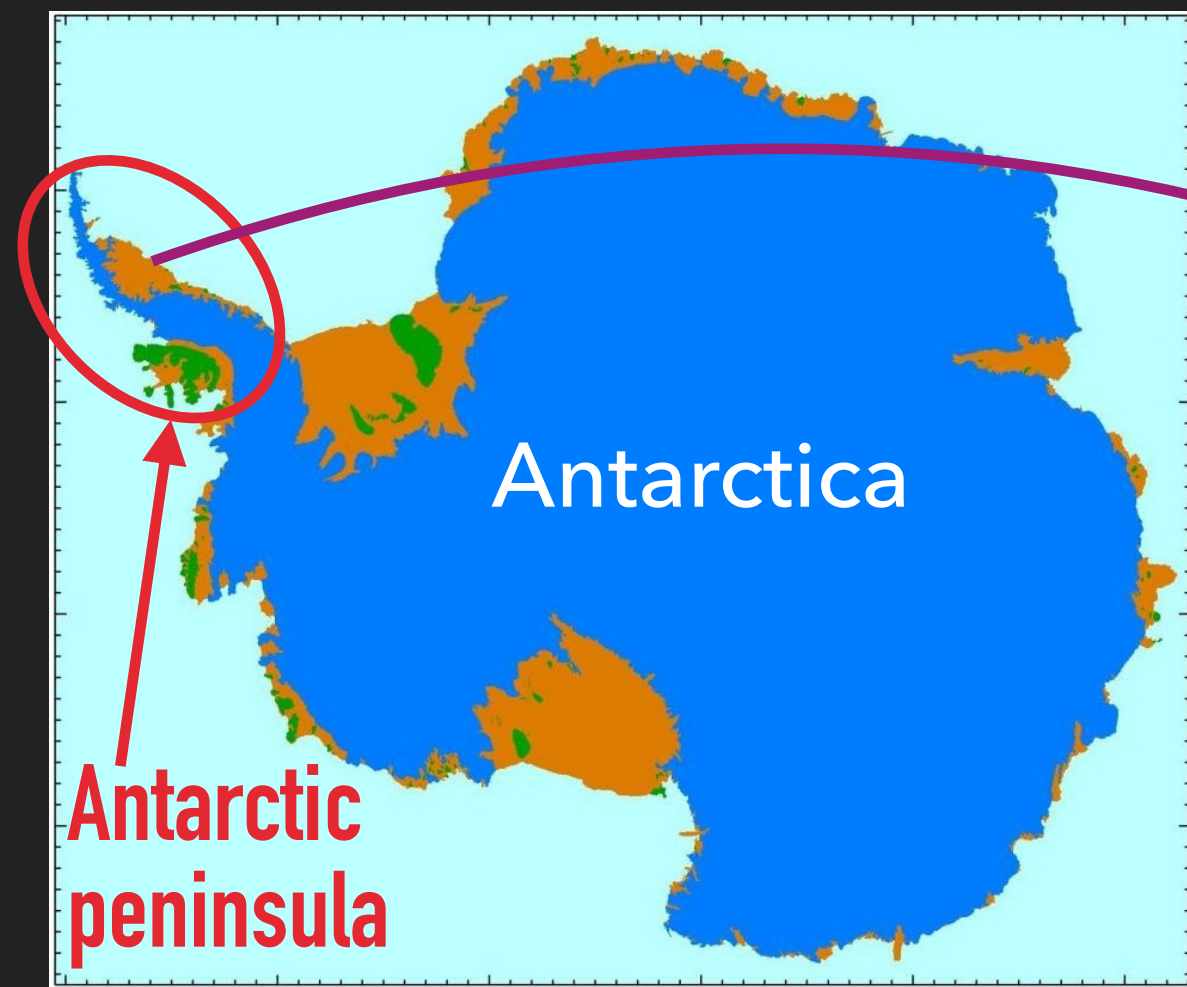
ANTARCTIC ICE SHELVES



- ▶ Antarctica covered by vast Ice Sheet – 90% world's ice!
- ▶ Ice shelves are floating ocean extensions of Ice Sheet
- ▶ 100s m thick and 10s-100s kms long
- ▶ Buttress flow of Ice Sheet into ocean

Global warming = ice shelf retreat = sea level rise

ANTARCTIC ICE SHELVES: DISINTEGRATION



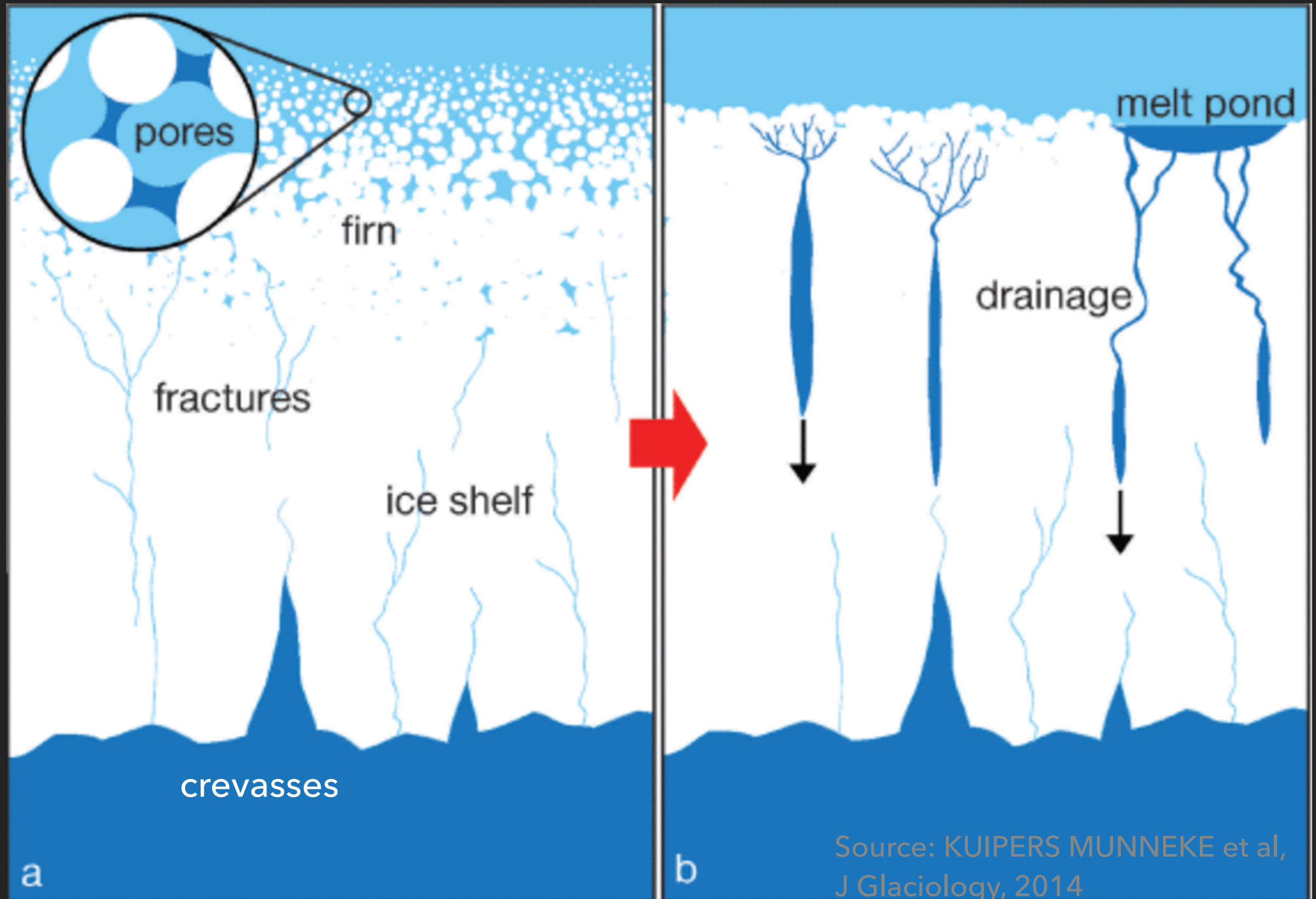
- ▶ Antarctic Peninsula most northerly reach on Antarctica
- ▶ Experienced warming since late 1940s
- ▶ 5 catastrophic disintegration events: Began 1995
- ▶ Stunning in rapidity and scale.

Future vision for remaining ice shelves???

ICE SHELF DISINTEGRATION: CAUSES

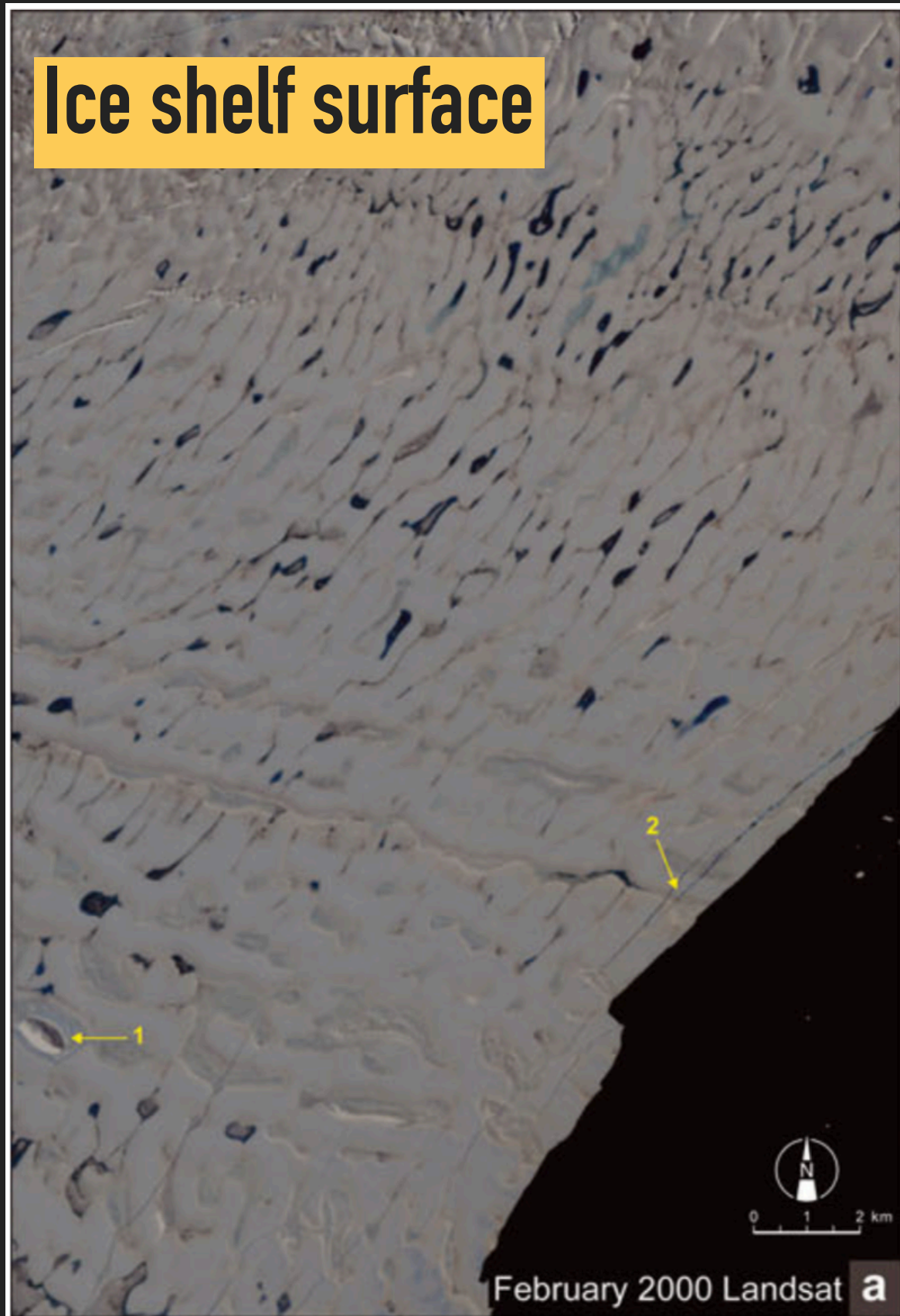
Healthy

Unhealthy



ICE SHELF DISINTEGRATION: CAUSES

Ice shelf surface



- ▶ Ponds and flooding
- ▶ Hydrofracture
- ▶ Thinning
- ▶ Mechanical weakening
- ▶ Fracturing

Source: Glasser & Scambos, J Glaciology, 2008

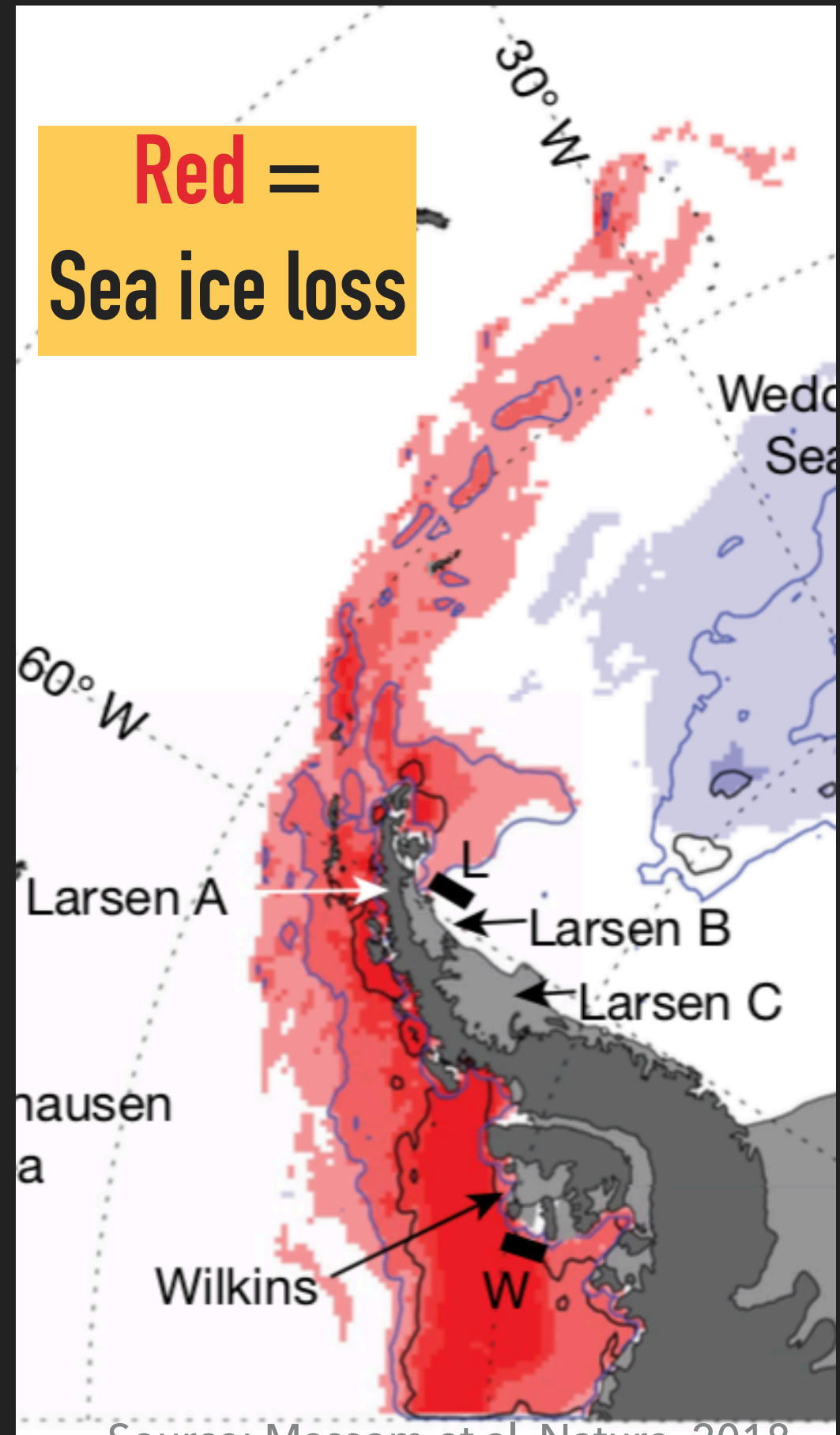
ICE SHELF DISINTEGRATION: OUR FINDINGS

- ▶ Sea ice acts as **barrier** to ice shelves from ocean waves.
- ▶ Climate warming = sea ice loss around Antarctic peninsula.
- ▶ Allowed waves to impact weakened ice shelves.
- ▶ Triggered disintegrations.

Satellite data

GCM models

Mathematical models



Source: Massom et al, Nature, 2018

SOME TAKE HOME MESSAGES

Sorry to end on bad news, but...

- ▶ Sea levels are rising at an accelerating rate.
- ▶ They will continue to rise.
- ▶ To see effects where you live: <http://coastalrisk.com.au>
- ▶ Antarctic Ice Sheet could raise sea levels by 57m.

Scientists...

- ▶ Are not engineers (don't fix things) ... and are not gods!!!
- ▶ Can help understand and predict.
- ▶ Benefit = ability to adapt and mitigate.



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ONE MORE SLIDE TO LIGHTEN THE MOOD

