What does the United Nations Paris Climate Agreement mean for Antarctica?

Presenter - Professor Tim Naish, Victoria University of Wellington, New Zealand
on behalf of SCAR

2017 SCAR Science Lecture, Beijing, China

VICTORIA UNIVERSITY OF WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
Antarctic Research Centre
Te Pūtahi Rangahau i te Kōpakatanga ki te Tonga

Paris Climate Change Agreement

- The Paris climate Agreement was signed by 196 member nations of the United Nations Framework Convention on Climate Change (UNFCCC) at the 21st meeting of the Conference of Parties (COP 21) in December 2015.

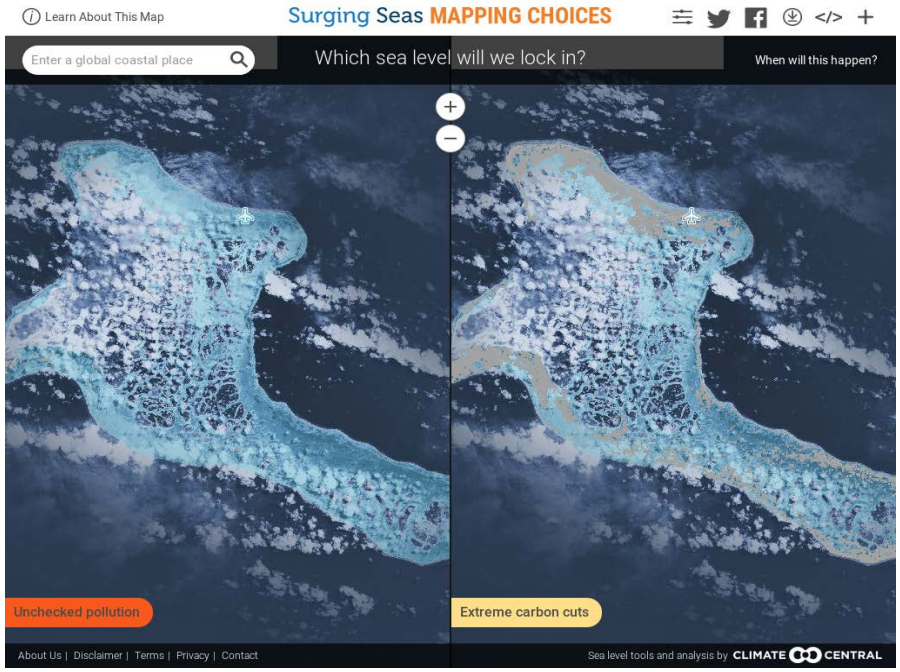
- The UNFCCC is an international environmental treaty negotiated at the Earth Summit in Rio de Janeiro in 1992, with the objective to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

- The Paris Agreement aims to keep global warming below 2°C - “the safe guardrail for dangerous climate change” identified by the Intergovernmental Panel on Climate Change (IPCC)

- This will be achieved through nationally determined commitments (NDCs) aimed to reduce all anthropogenic greenhouse gas emissions to zero before the end of this century.

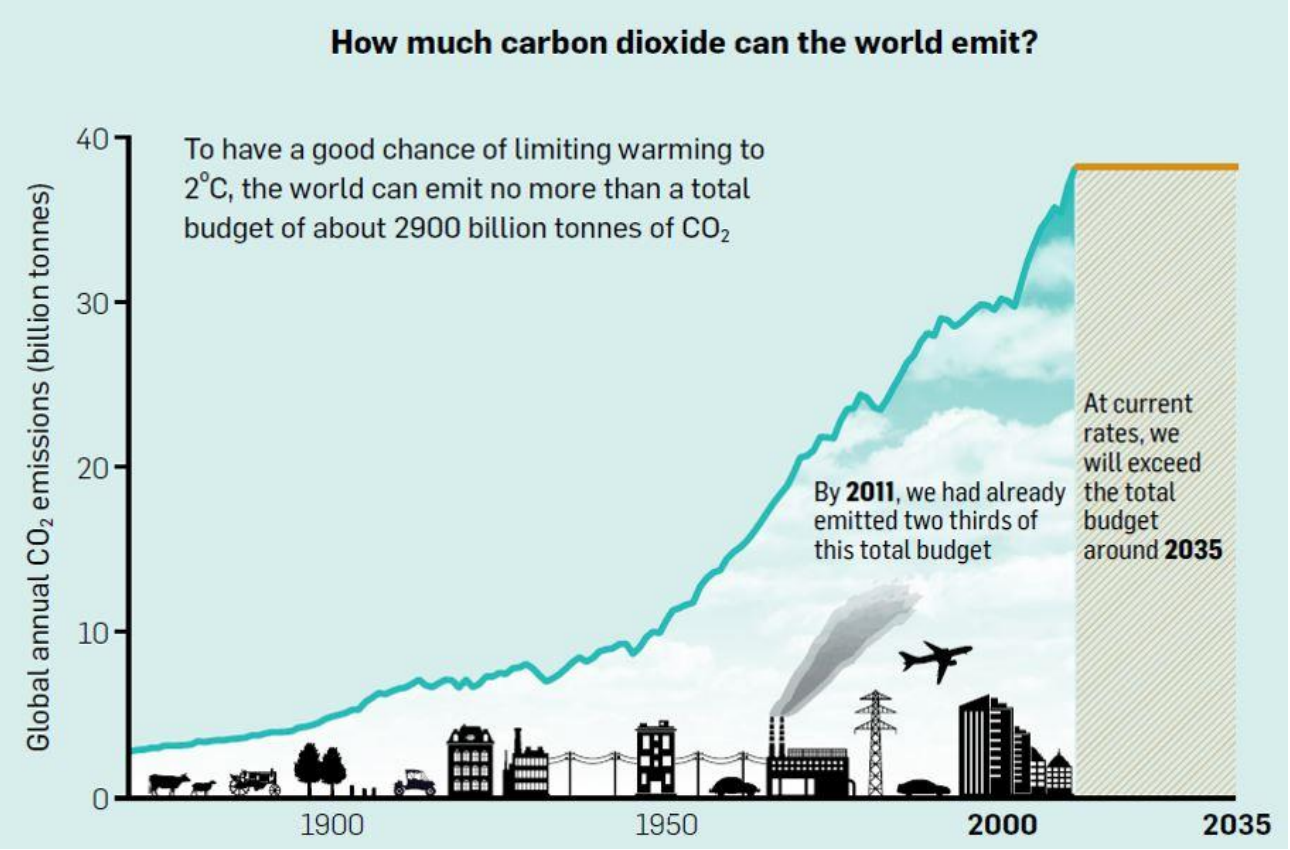
Why the ambition of 1.5°C of global warming?

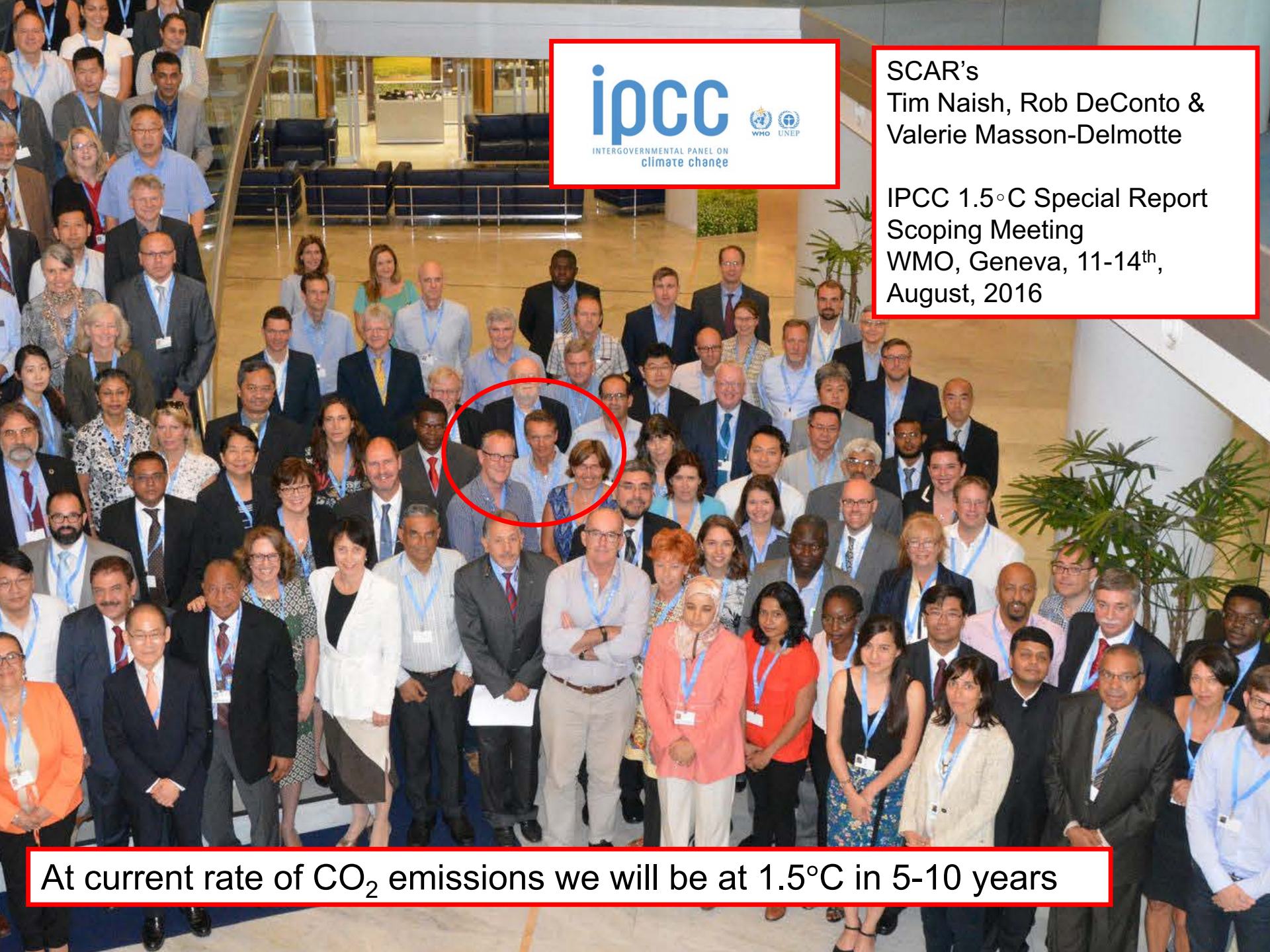
- Following pressure from vulnerable African and low-lying coastal nations, the parties further agreed to “pursue efforts to” limit temperature increase to 1.5°C.



The challenge of the Paris Agreement

- The Paris Climate Agreement was subsequently signed by 194 countries in New York on Earth Day, 22nd April 2016, and the Agreement went into force on 7th November 2016.



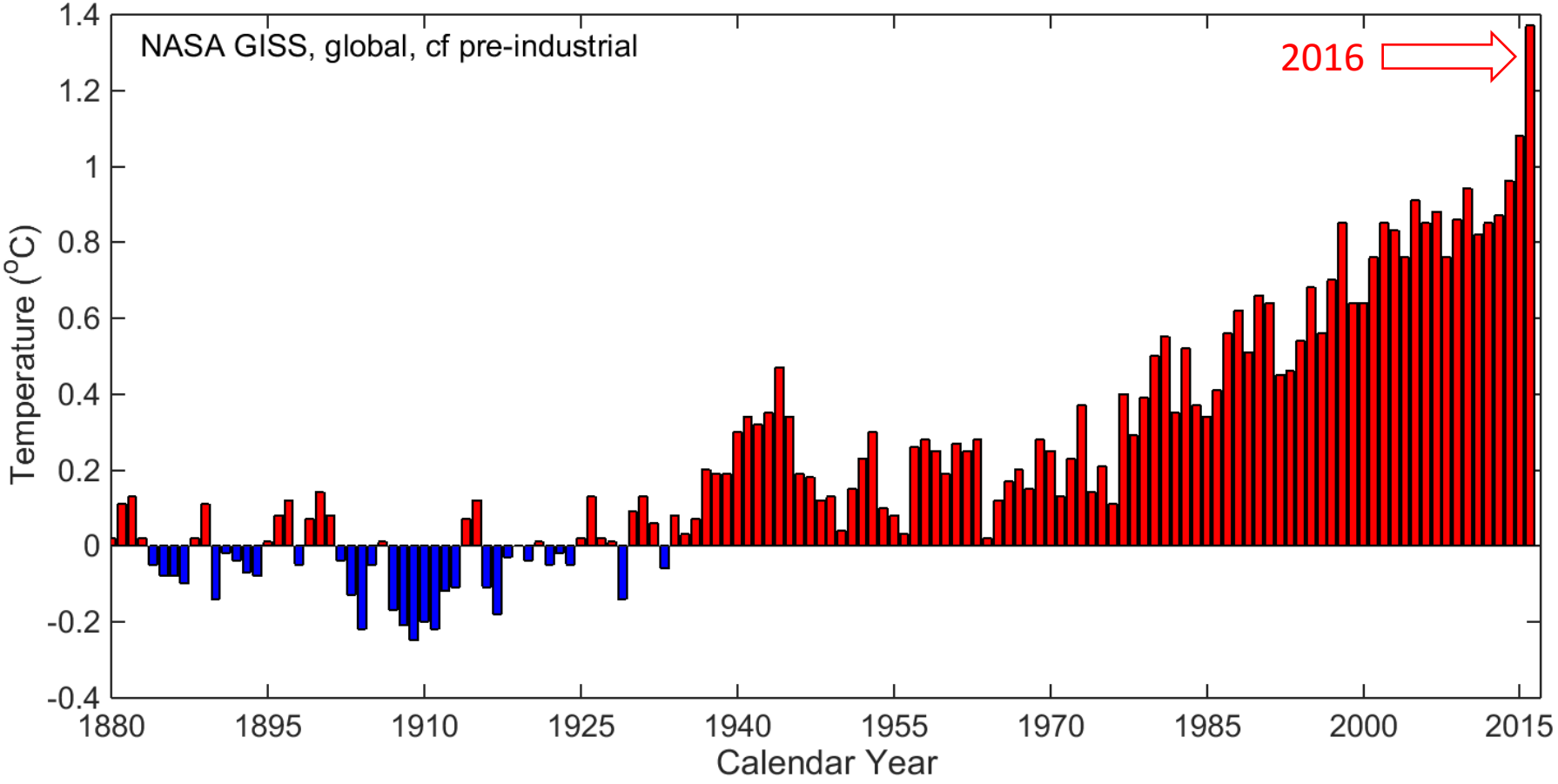


SCAR's
Tim Naish, Rob DeConto &
Valerie Masson-Delmotte

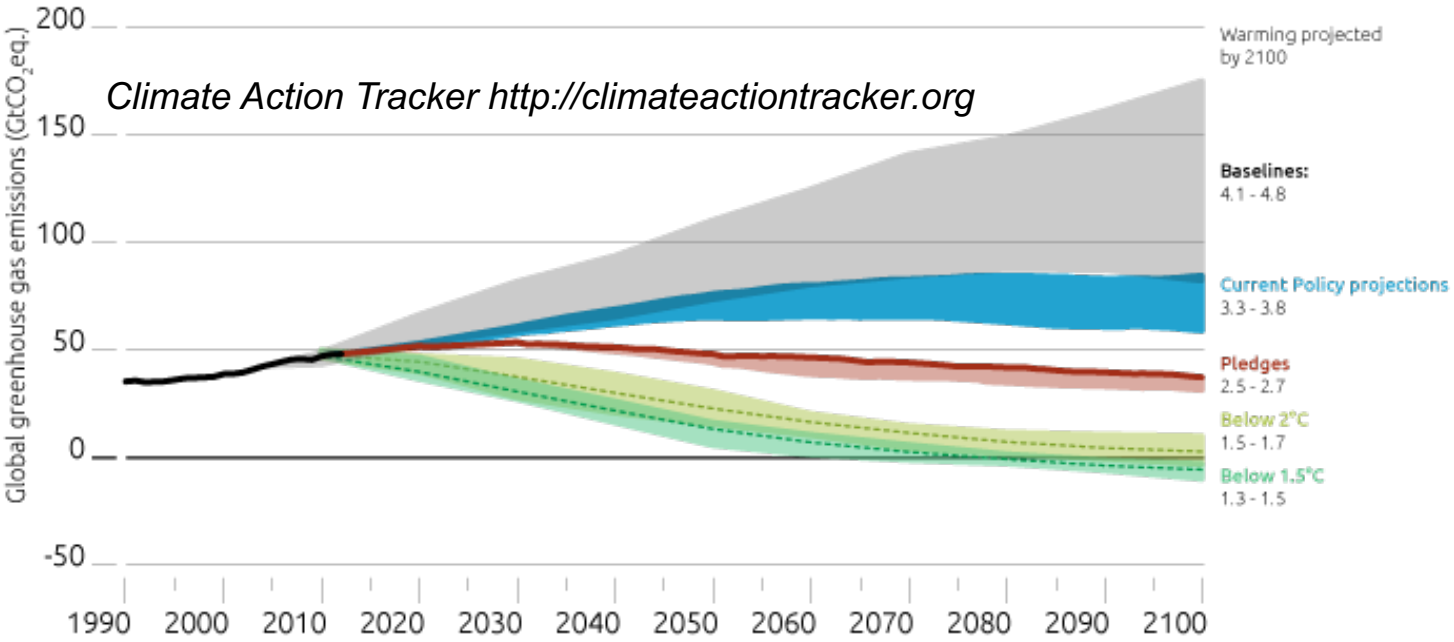
IPCC 1.5◦C Special Report
Scoping Meeting
WMO, Geneva, 11-14th,
August, 2016

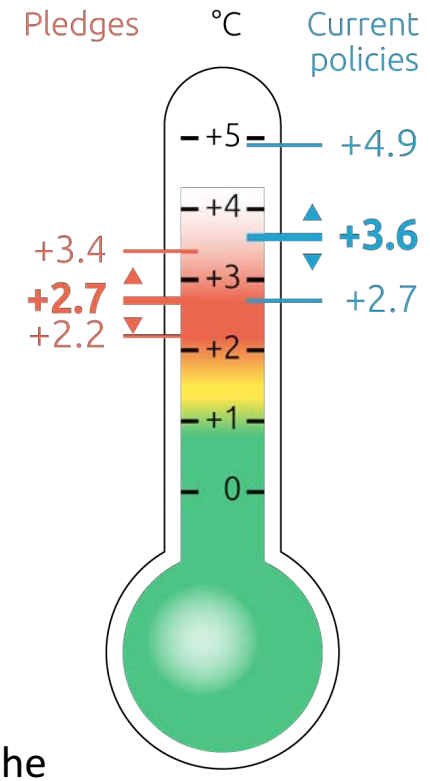
At current rate of CO_2 emissions we will be at 1.5°C in 5-10 years

The challenge of the Paris Agreement



How is the world tracking?





- The NDCs tabled in Paris, if implemented, will restrict global warming to ~2.7°C.
- This is still above the UNFCCC safe guardrail, and well-above the more ambitious goal of 1.5°C.
- Current policy settings sees global temperatures stabilizing closer to 3.5°C.
- In five years-time nations will be asked to increase their ambition for emissions reduction.
- We need to be 40% below 1990 levels by 2030 to be on track

The relationship between UNFCCC and IPCC to the ATS

United Nations
Framework Convention on
Climate Change

No direct pathway for policy

ICSU
International Council for Science

Antarctic climate research

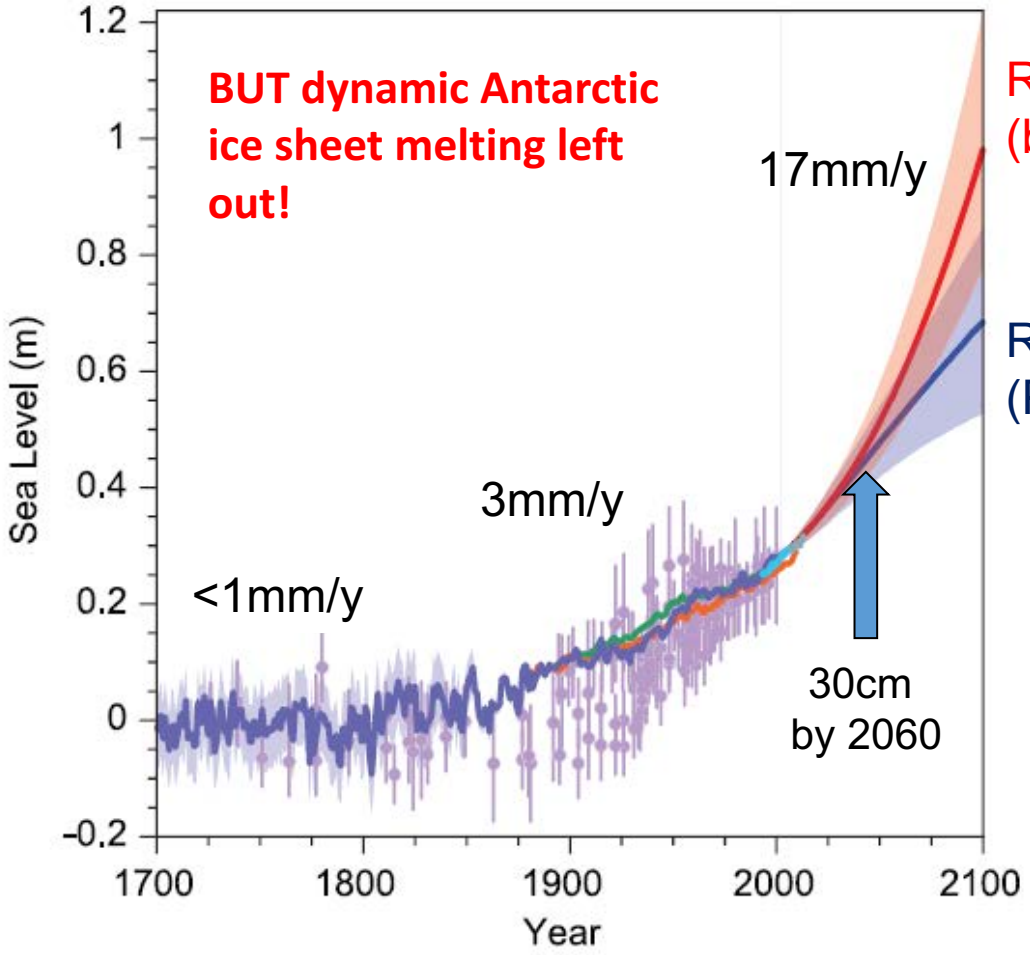
ATS & Agreements

Strategic research programmes

AntarcticClimate21

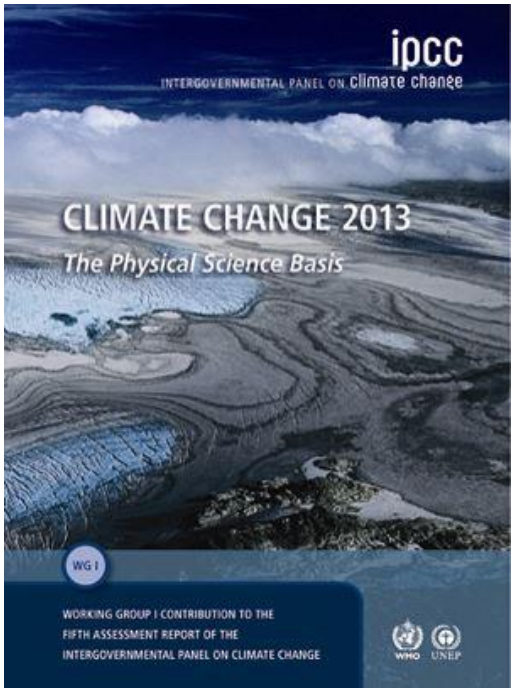
COMNAP
Council of Managers of National Antarctic Programs

Sea-level rise is the clearest global consequence of anthropogenic climate change



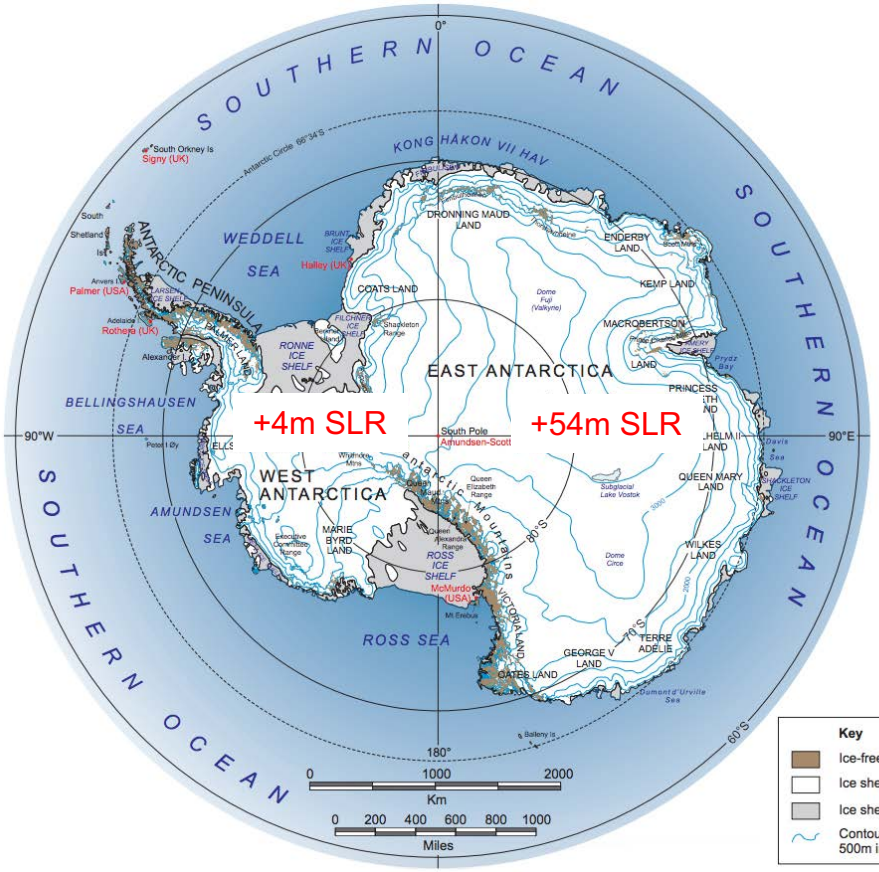
RCP 8.5
(business as usual)

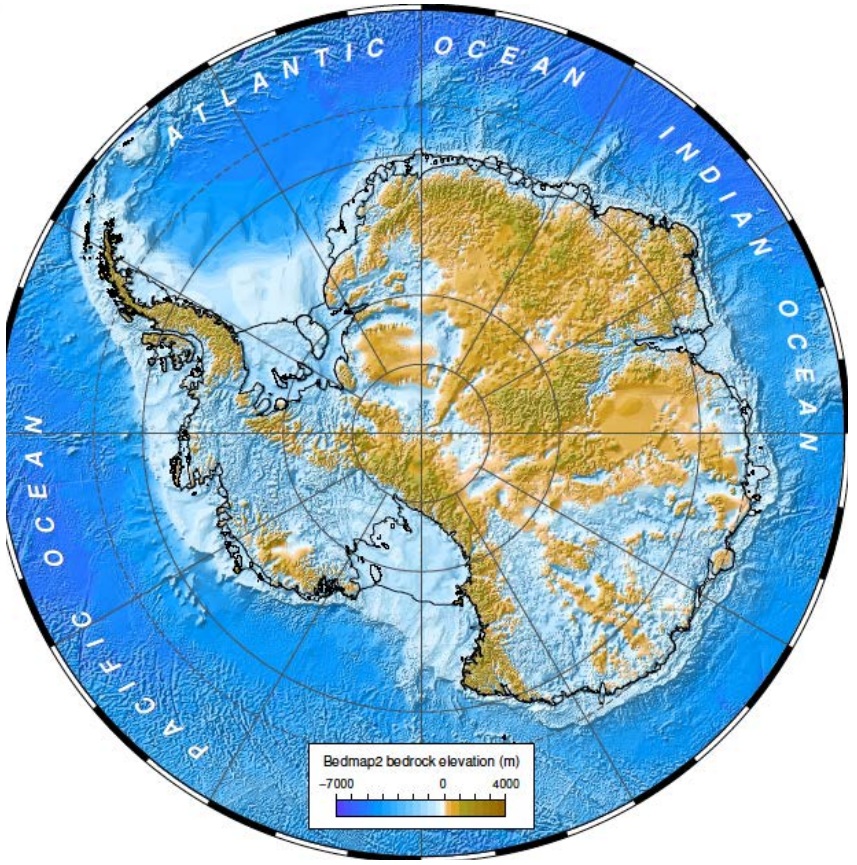
RCP 2.6
(Paris 1.5-2° C)



Sources listed in Church et al. IPCC (2013)

Future fate of Antarctica's ice sheets is one of the largest uncertainties in climate science





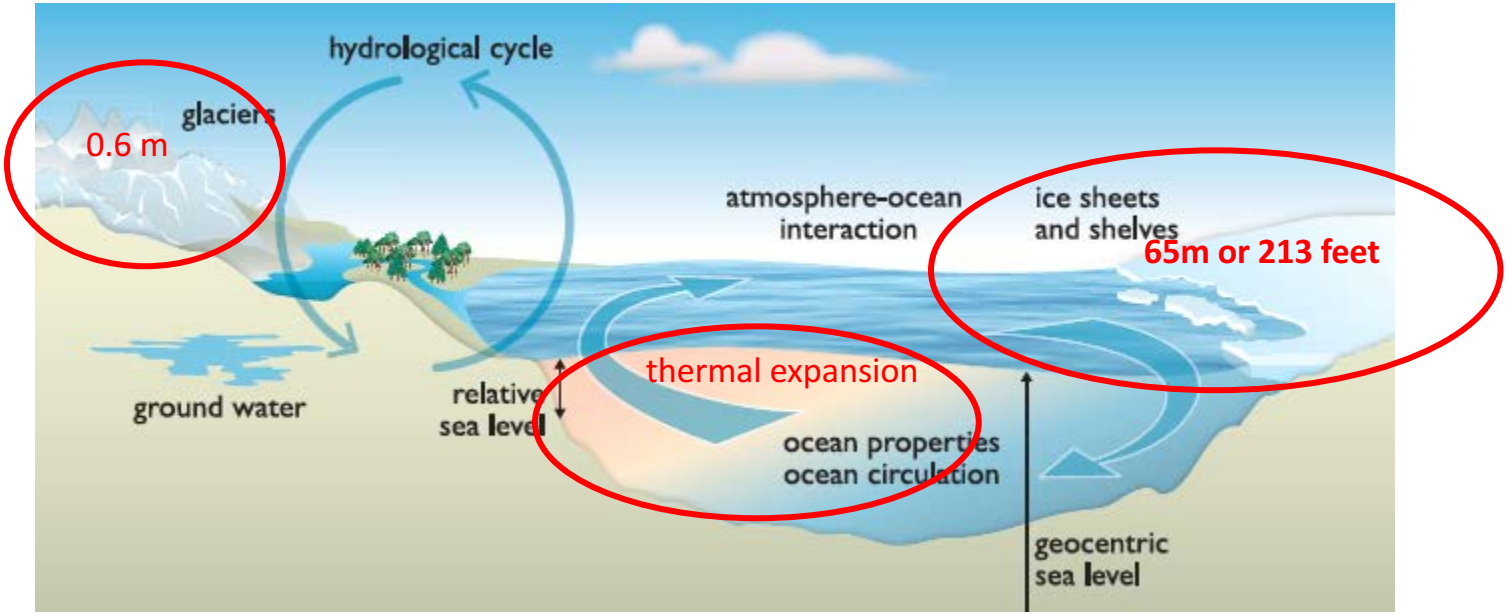
British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

About 20 m of global sea-level rise is locked up in the highly vulnerable parts of he Antarctic ice sheet and is already beginning to melt

XL ANTARCTIC TREATY CONSULTATIVE MEETING · BEIJING · CHINA · 2017

THE INTERNATIONAL COUNCIL FOR SCIENCE · SCAR · SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

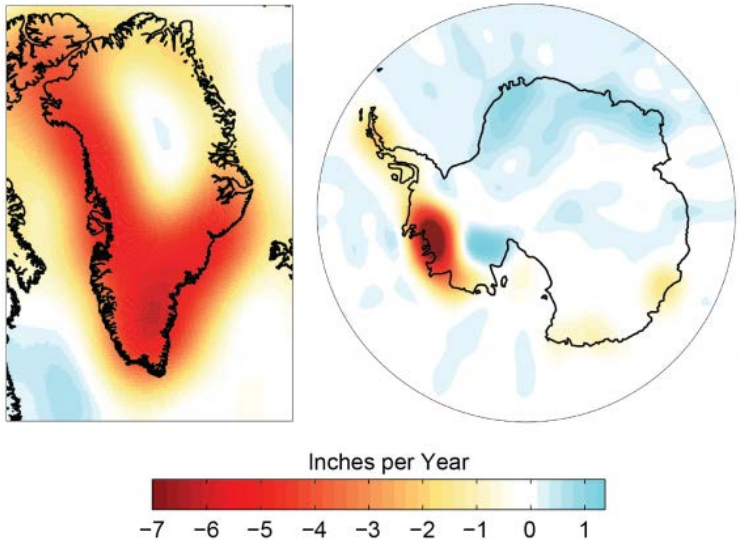
Where has the sea level rise come from so far, & where will future sea-level rise come from?



93% of the heat from human global warming has gone into the ocean!

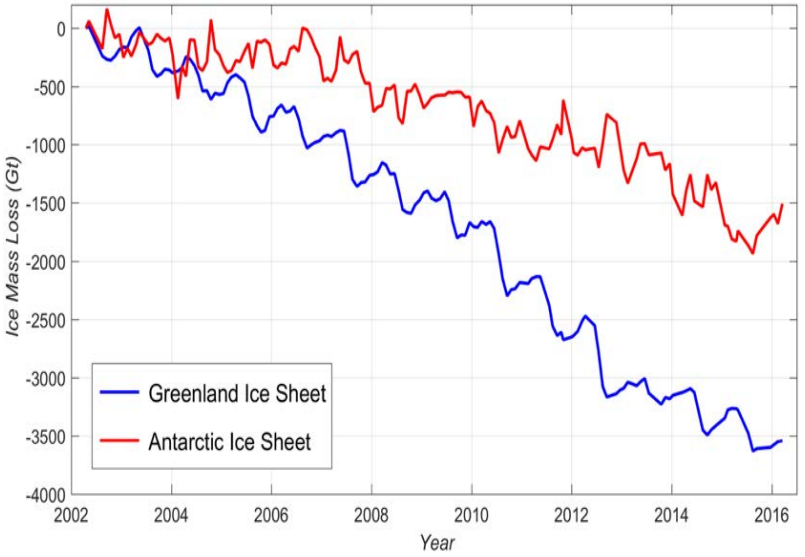
IPCC AR5 2013

Polar ice sheet loss is accelerating
&
sea-level rise is accelerating



Leulliet and Nerem., 2016

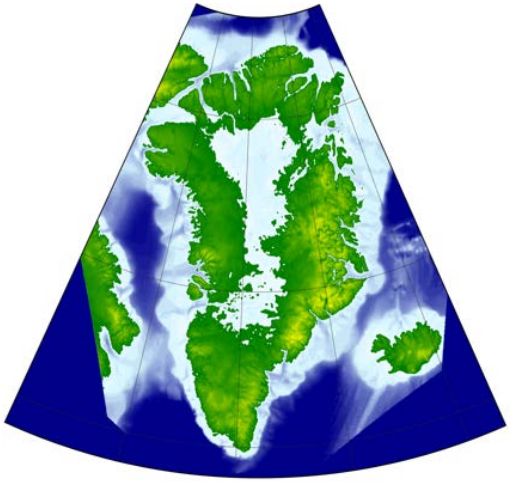
Water equivalent ice loss between 2003 and 2013 measured by the GRACE satellites



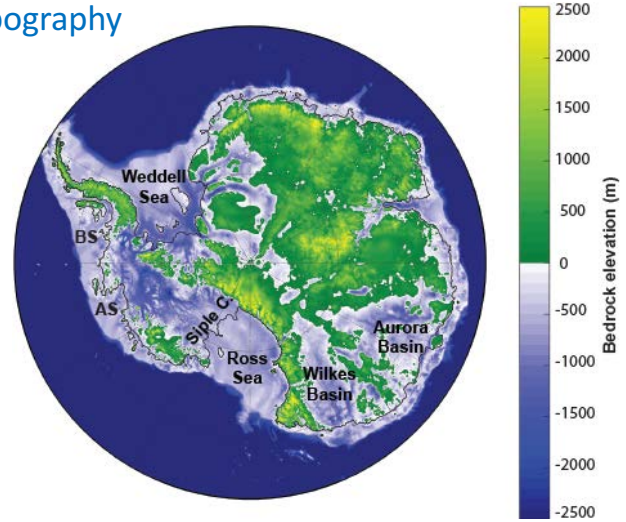
Data source: NASA.

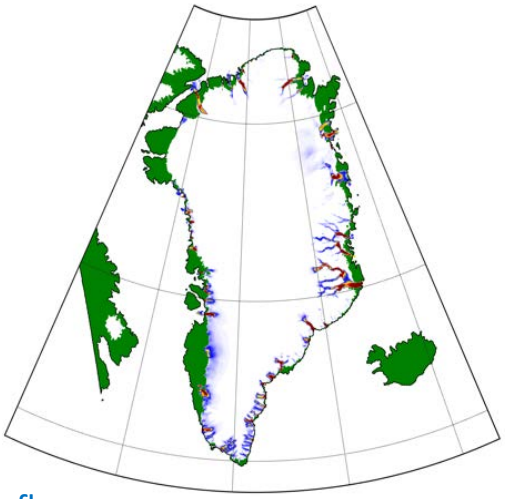
Cumulative mass loss from the Greenland and Antarctic Ice sheets. Note the general acceleration of mass loss. Today, Greenland is contributing more to sea level rise than Antarctica, but that situation could change.

Antarctica and Greenland are very different

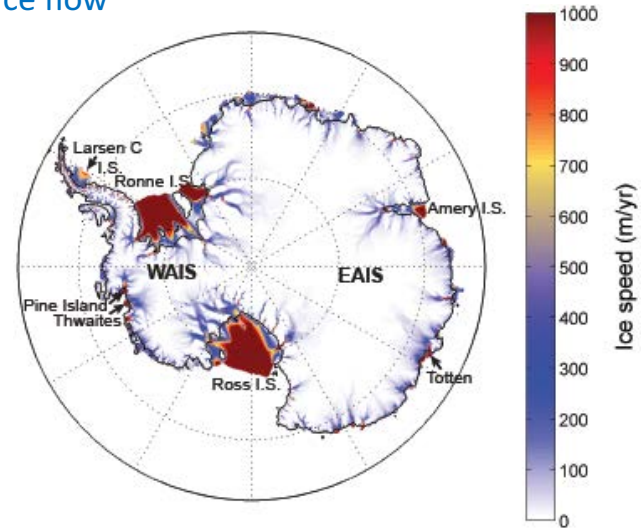


Bed topography

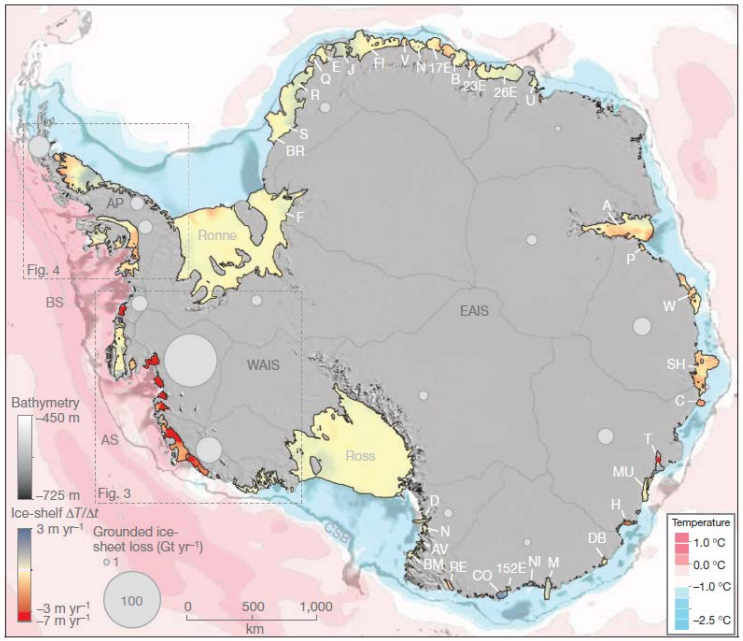




Ice flow

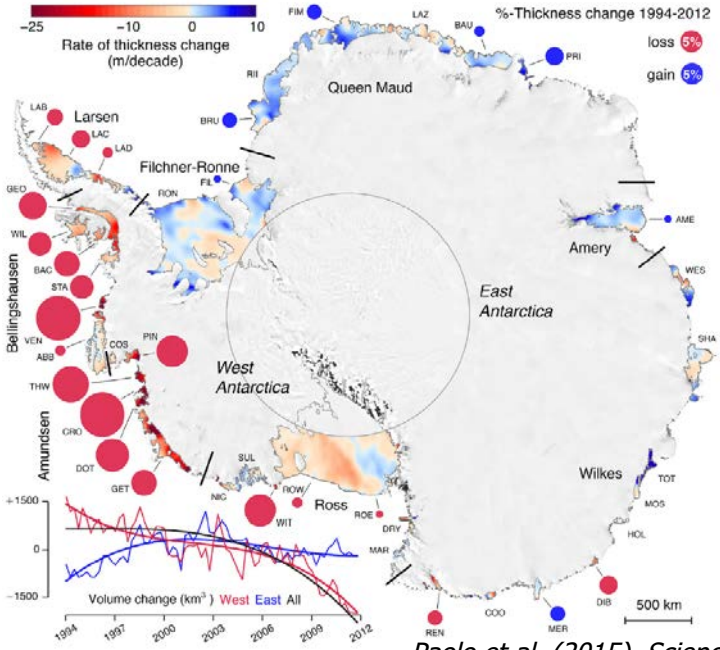


Southern Ocean is warming

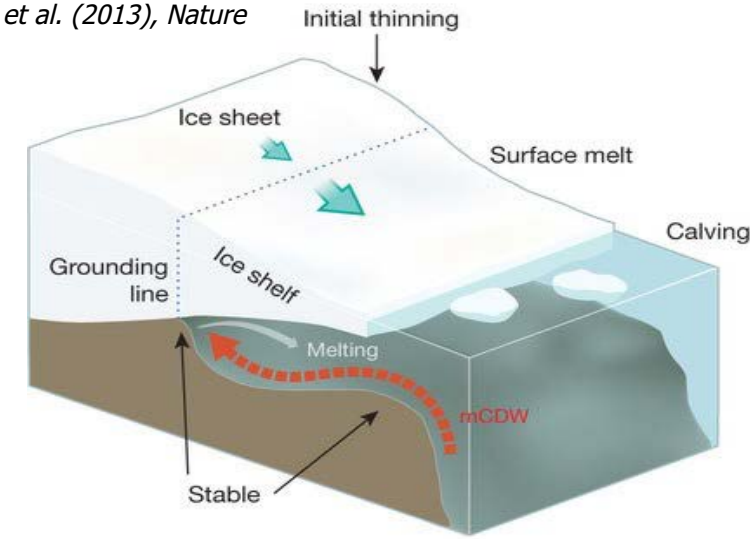


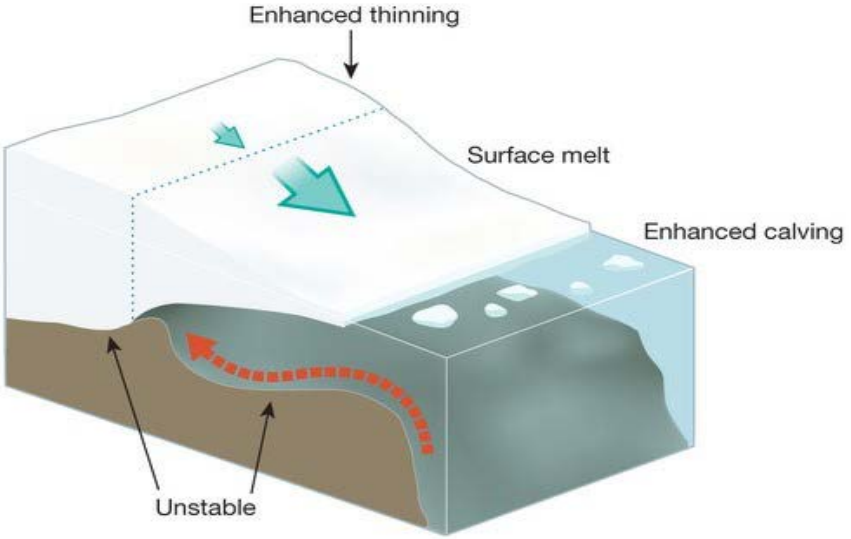
Pritchard et al. (2013), Nature

Ice shelves are melting

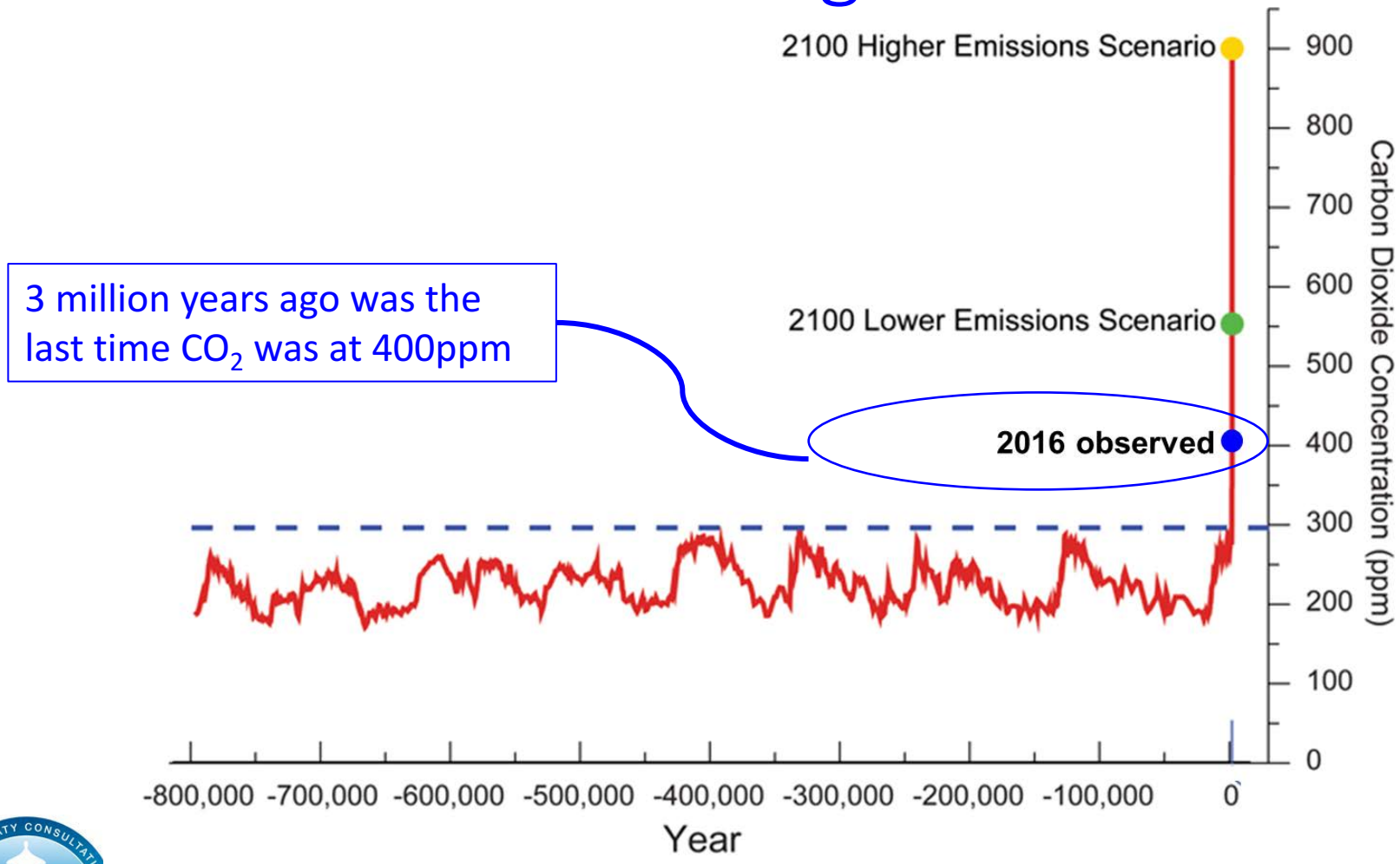


Paolo et al. (2015), Science

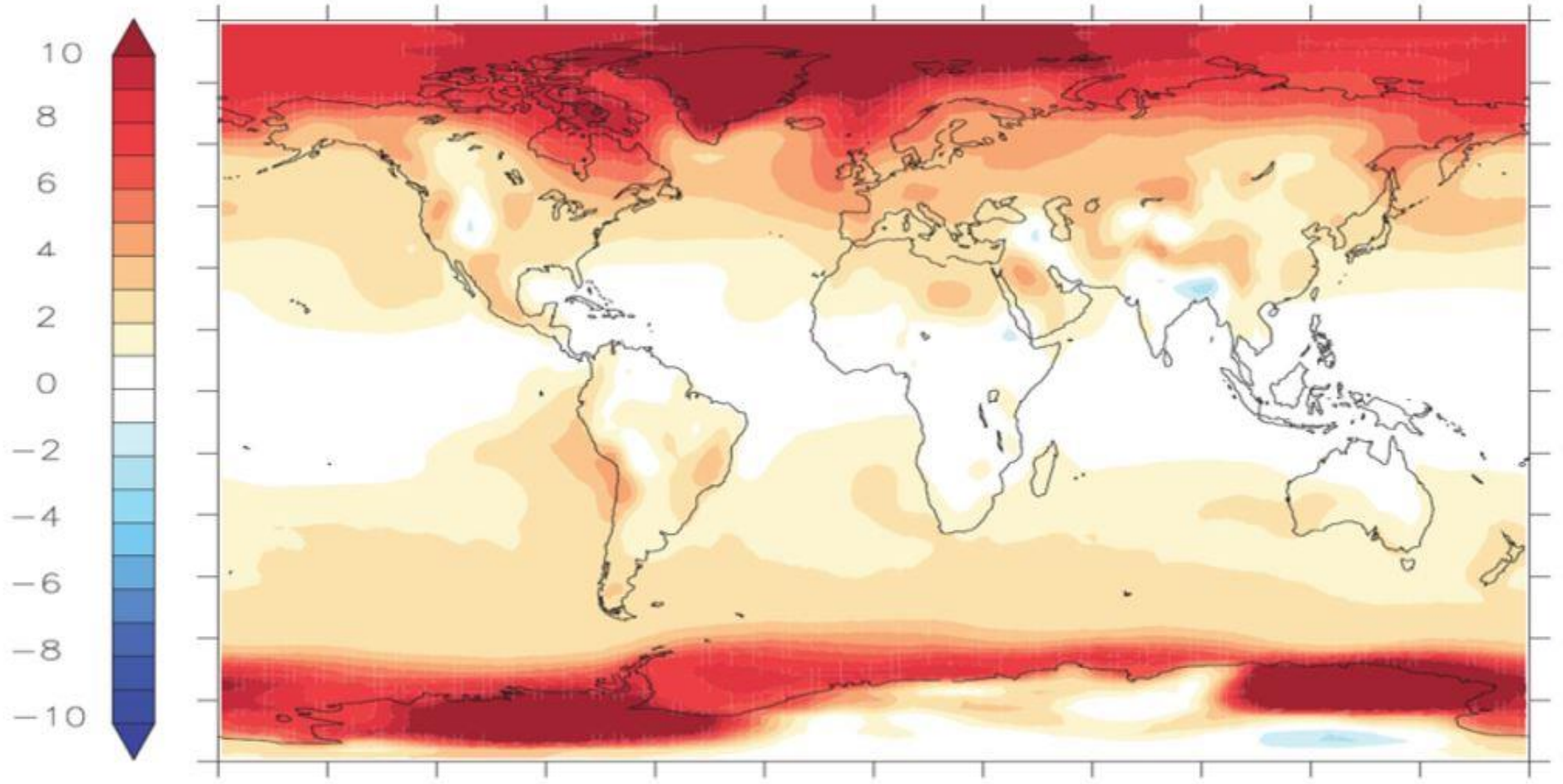




Atmospheric carbon dioxide concentration through time



Earth's surface temperature 3 million years ago



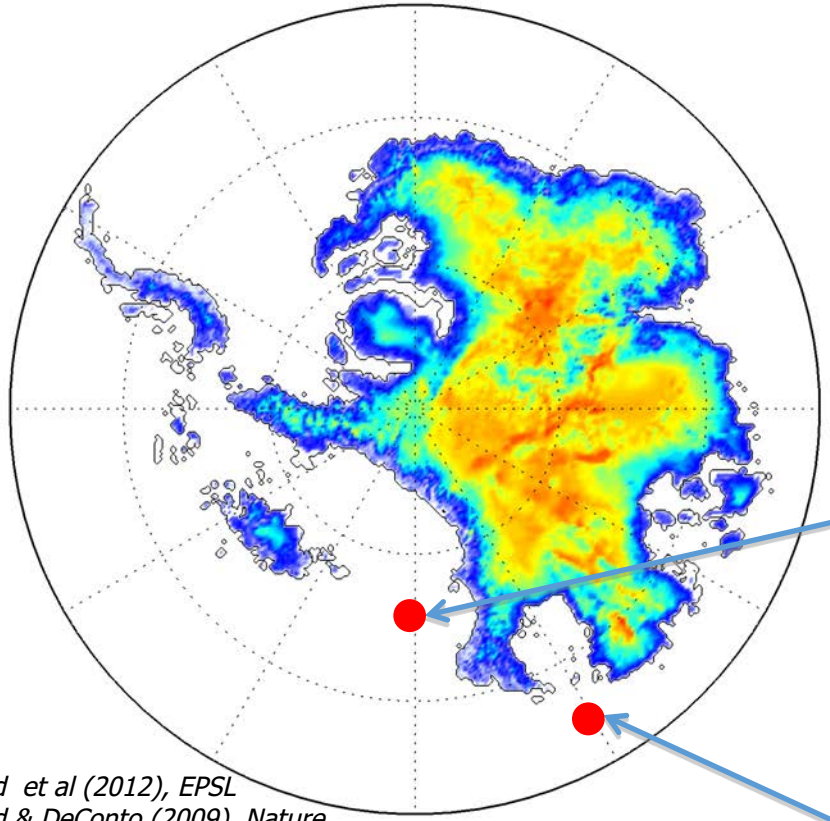
Haywood et al (2012), Climates of the Past

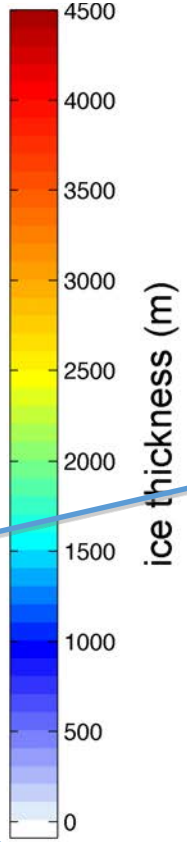
Polar temperature amplification not good news for the ice sheets

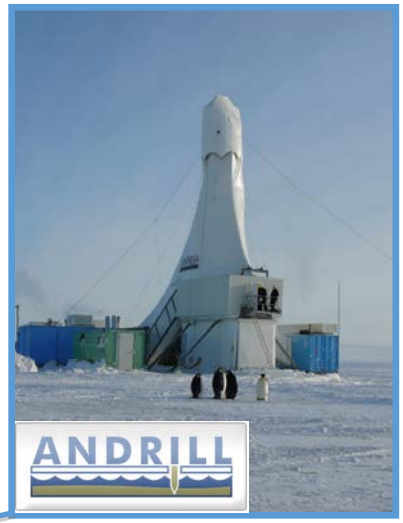
Global = +3℃, Polar regions = +7℃

3 million years ago - the last time Earth had 400ppm carbon dioxide

Antarctica melted contributing +13-15m to global sea-level rise







Naish et al. (2009) - Nature

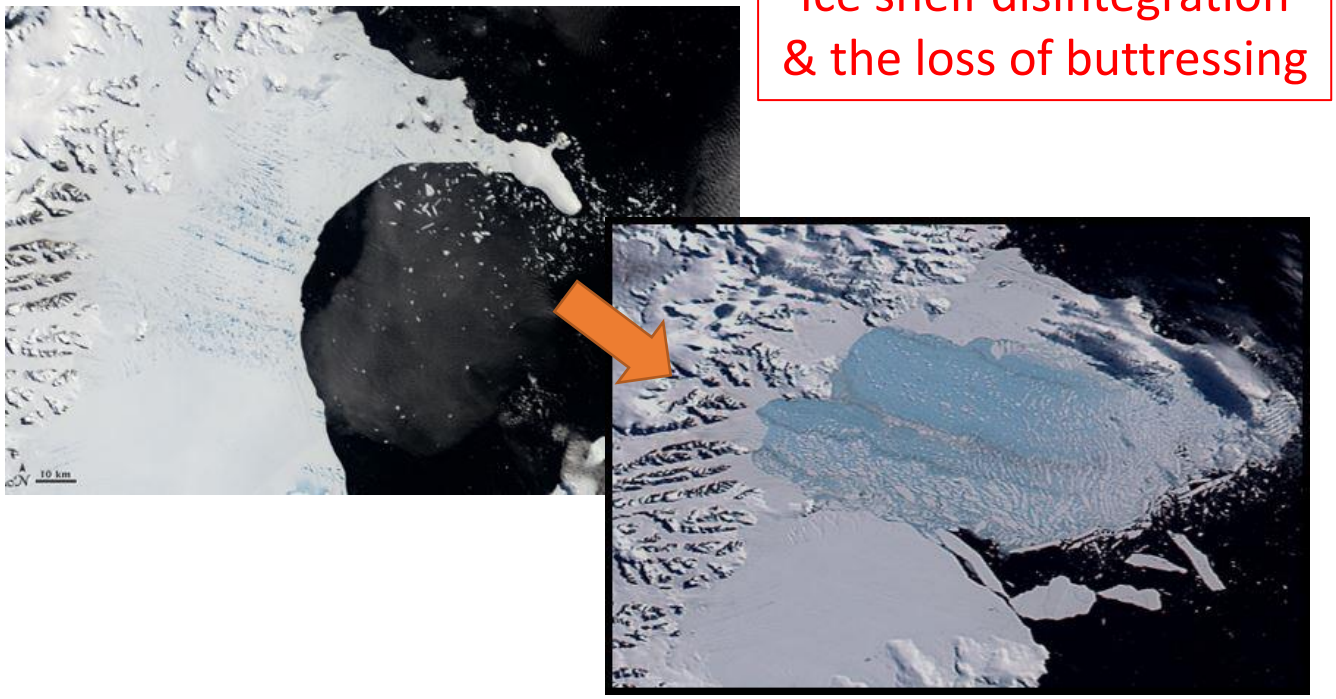
Pollard et al (2012), EPSL
Pollard & DeConto (2009), Nature

Cook et al. (2013) – Nature Geo,
Patterson et al. (2014) – Nature Geo

A new generation of Antarctic ice sheet computer models

- calibrated on past climate
- incorporating the rapid removal of ice shelves
- result in higher predictions of sea-level rise

Ice shelf disintegration
& the loss of buttressing

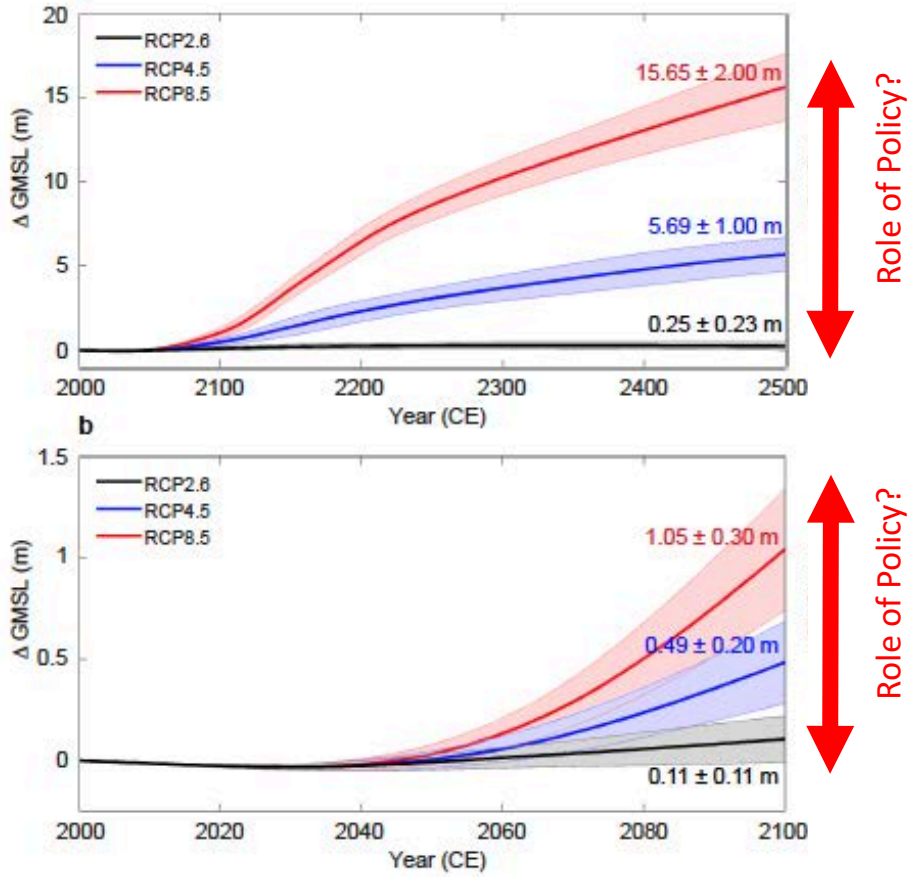


Sudden break up of the Larsen B ice shelf in 2002. Once unbuttressed, the outlet glaciers flowing into the shelf (left), sped up by a factor of 8 in some instances.

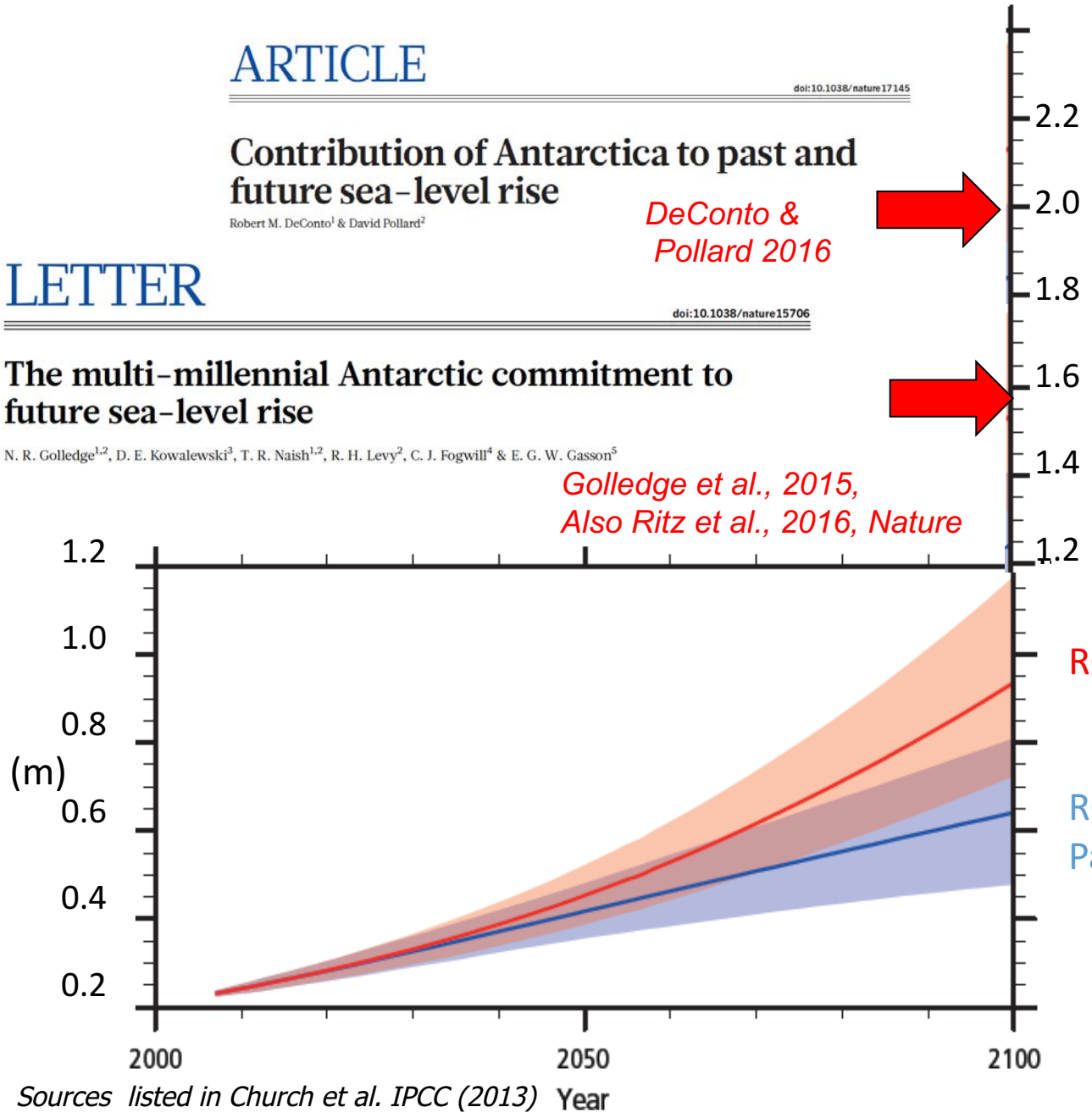
Future Antarctic ice sheet projections with paleo-calibrated model physics

NOTE THE MAJOR REDUCTION IN RISK IN THE RCP2.6 SCENARIO WHICH IS BETWEEN 1.5-2°C

De Conto & Pollard (2016)



Revised estimates for year 2100 global sea-level rise



RCP 8.5 high-emissions pathway, based on new paleo-calibrated ice sheet model simulations compared with the "likely" (66%) range from the IPCC 5th Assessment Report.

RCP 8.5

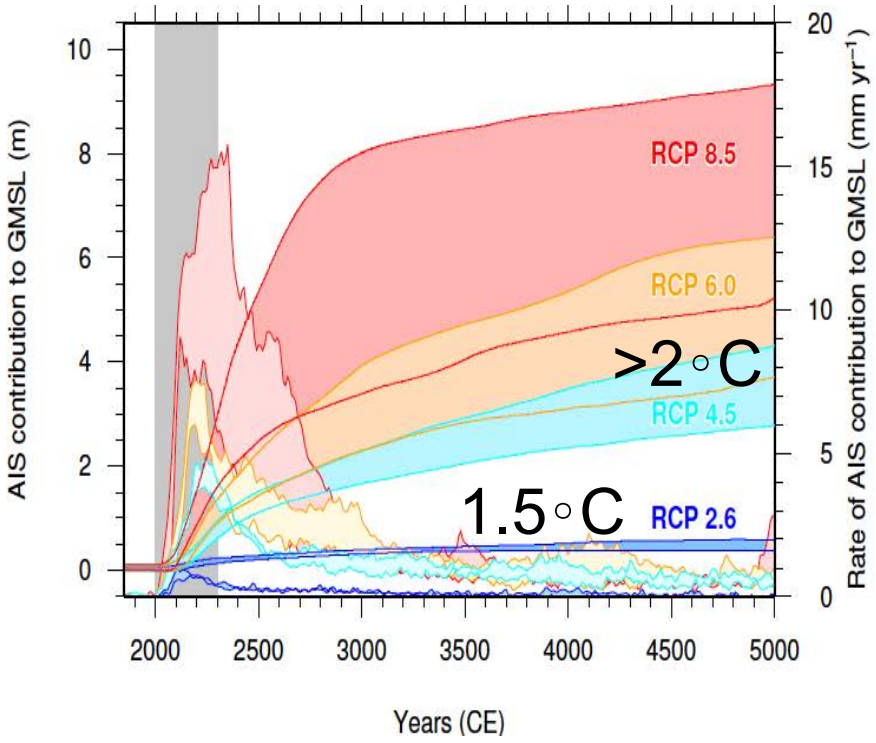
RCP 2.6
Paris target

Sources listed in Church et al. IPCC (2013)

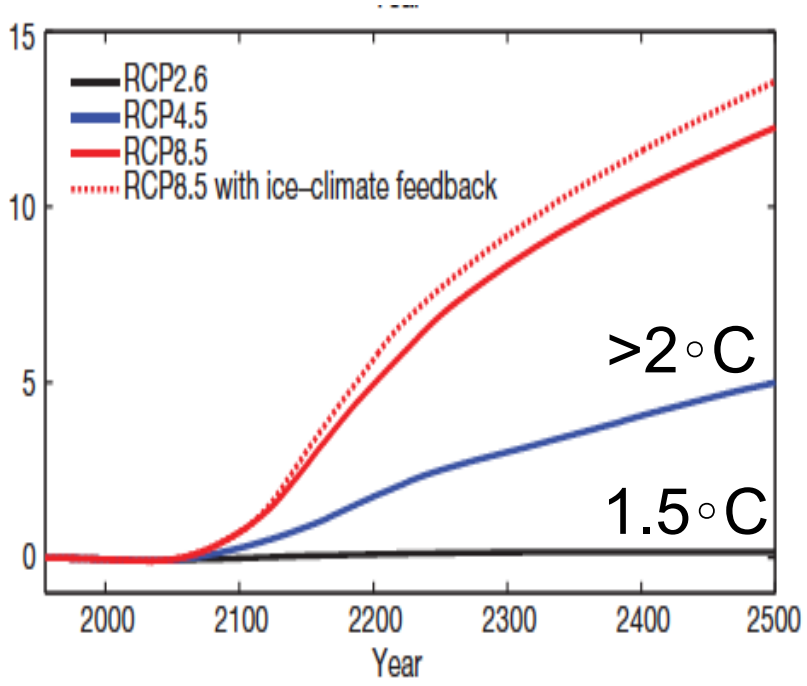
Why the Paris Agreement matters

1.5-2°C appears to be a threshold for big loss of Antarctic ice

Golledge et al. (2015), Nature



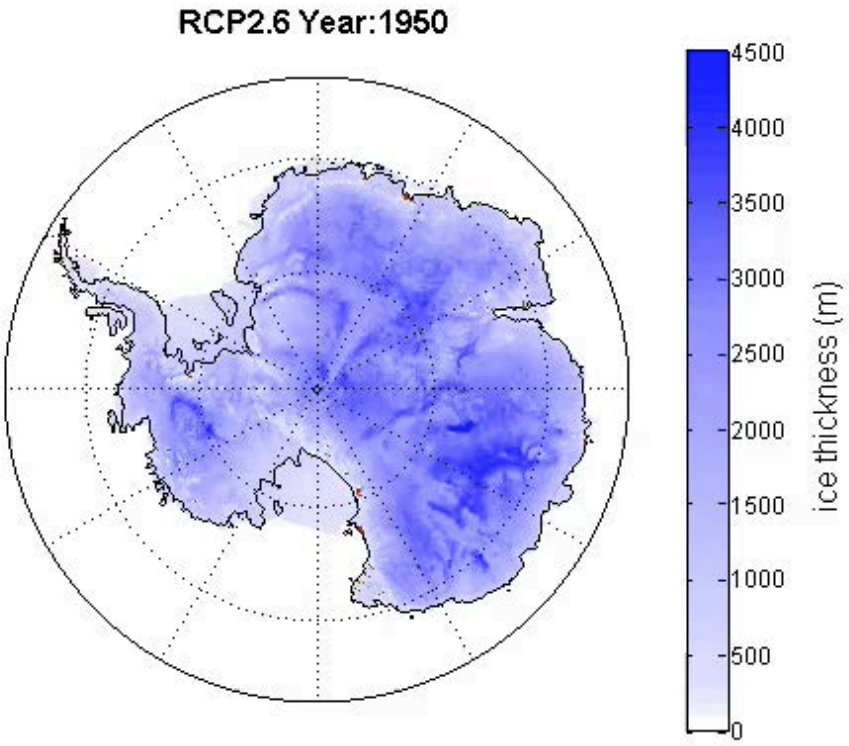
DeConto & Pollard et al. (2016), Nature

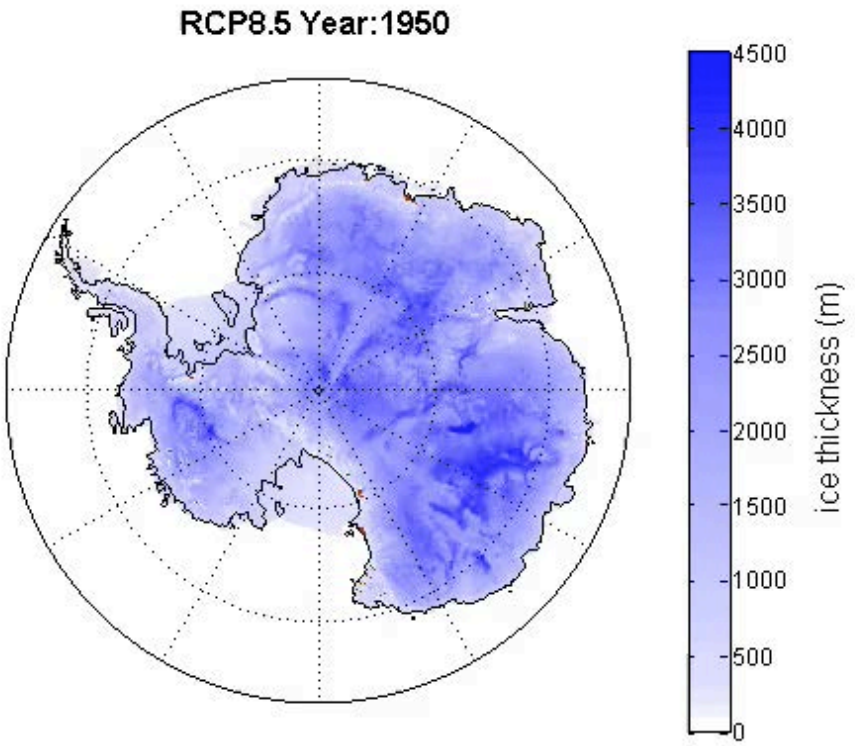


>2◦C = >4m SLR

1.5◦C = <1m SLR

Low emission & high emission scenarios for the future of the Antarctic ice sheet from computer models



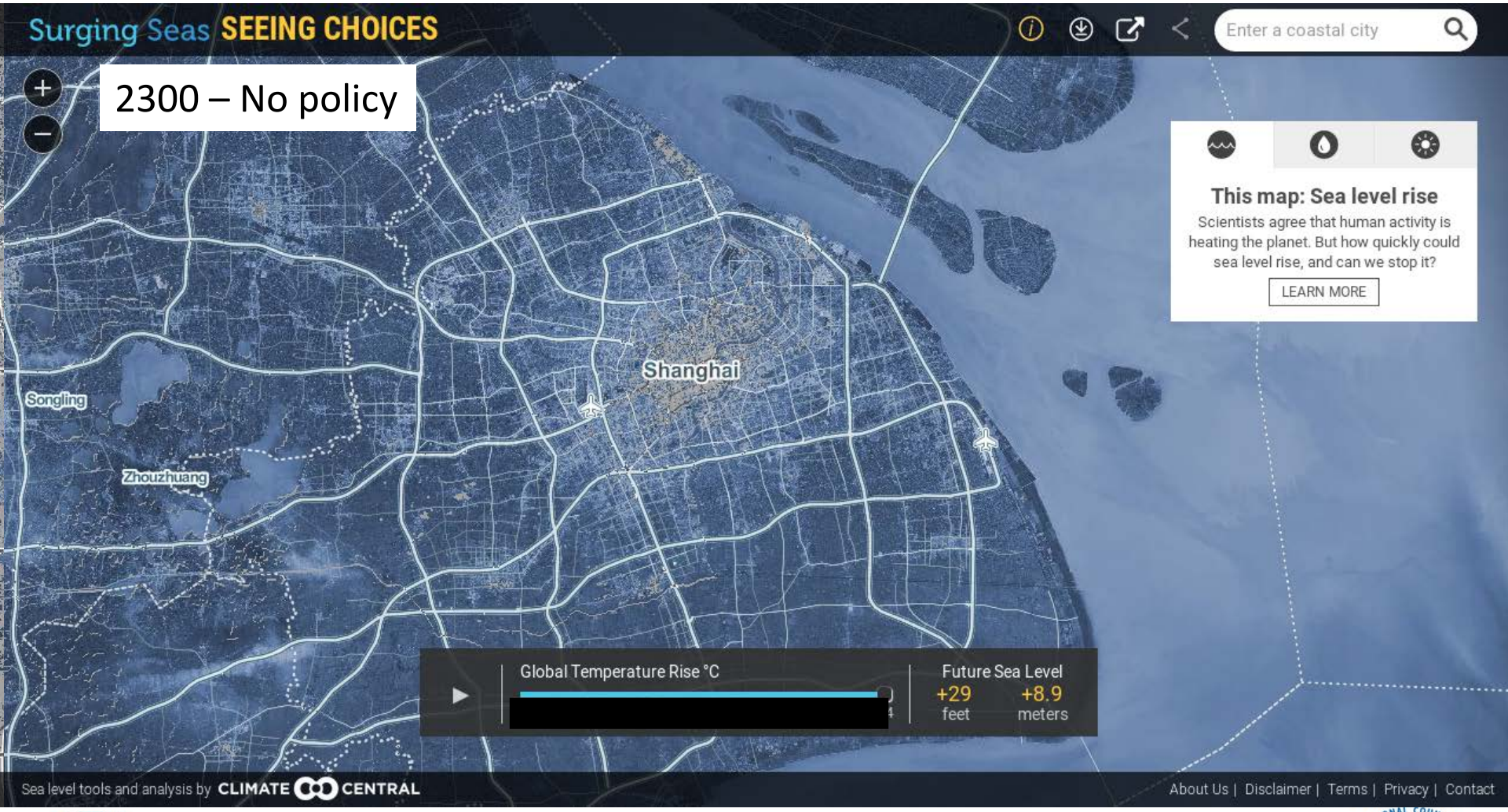


Low emissions <1m SLR

High emissions = 15m SLR

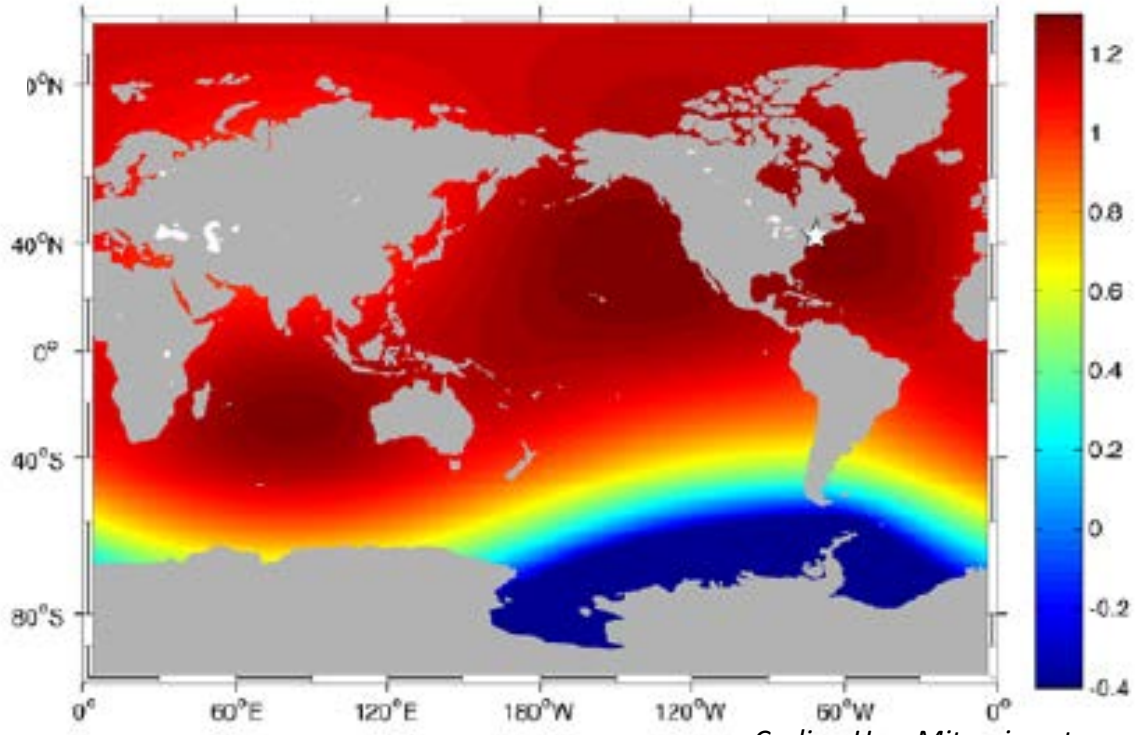
DeConto & Pollard et al. (2016), Nature

Why the Paris Agreement matters: Avoided impacts for Shanghai



Impacts on Antarctic operations:

Antarctica could experience a 2.5 m sea-level fall for 1m average global sea-level rise



Carling Hay, Mitrovica et al. 2011

- Coastal station access issues
- Air fields
- Infrastructure – water pipes, roads, piers, wharves etc.

COMNAP Council of Managers of National Antarctic Programs

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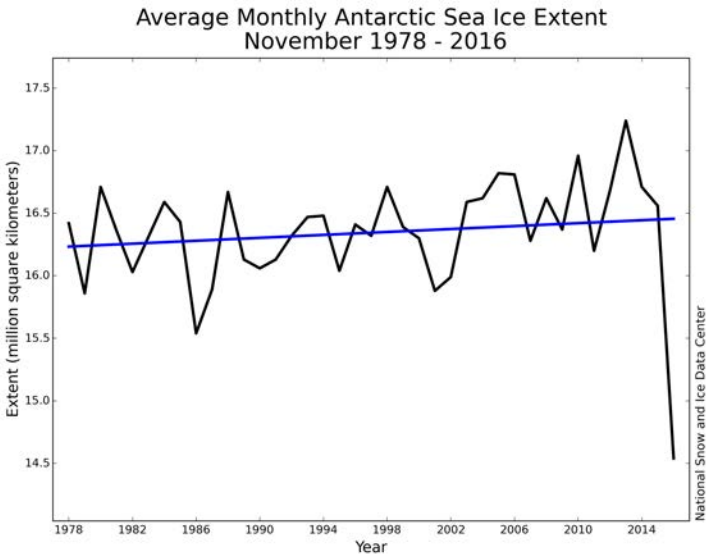
Impacts on Antarctic operations:

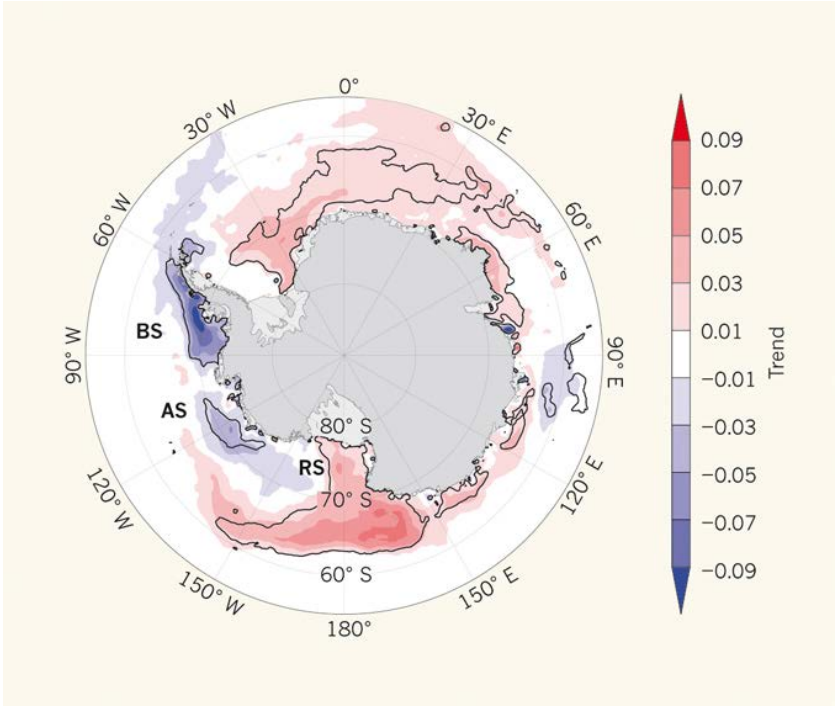
Rapid collapse of ice shelves and increased rates of calving

- Ice shelf collapse
- Ice berg melange
- Hazardous for coastal ships
- Station access issues

Ice bergs off eastern NZ, 2006

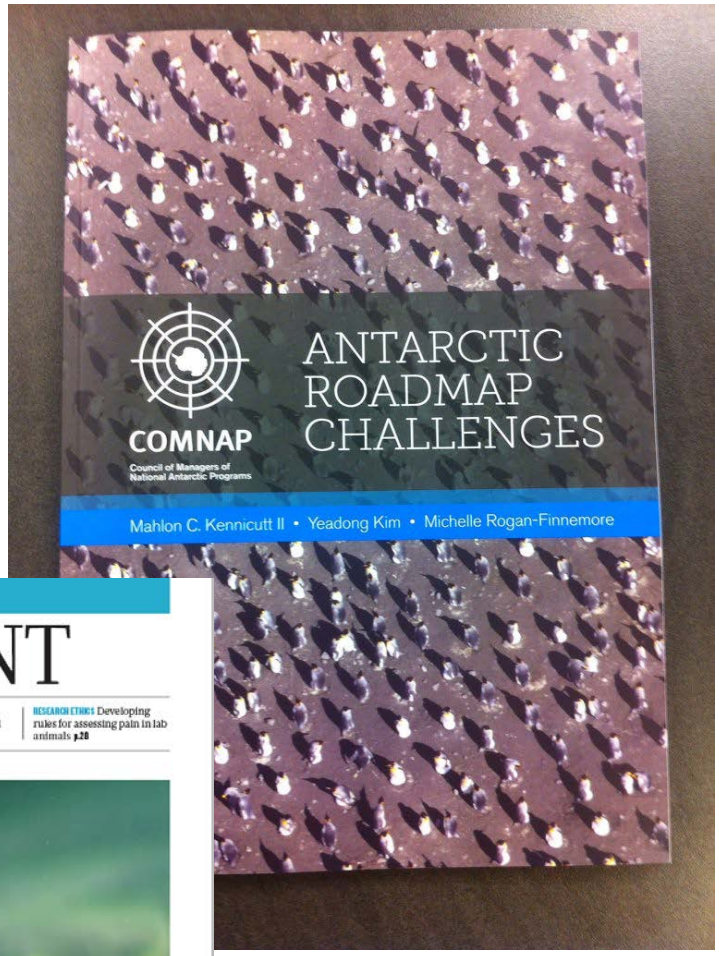
Impacts on Antarctic operations:
Changing patterns of Antarctic sea-ice cover





- Implications for ice breaker design
- Some areas more difficult to access
- New areas will be accessible for both operations and research

Future research focus: Climate change on Antarctica a high priority



Understanding the impacts and avoided impacts on Antarctica of Paris Climate Agreement, is a key *Future Science Challenge* identified by SCAR. See ACTM XL Working Group 2 agenda item 15a (see Background Paper 20).


COMMENT

ART A Dürer's 16th century depiction of melancholy p.26 | MENTAL HEALTH Back evidence-based therapies for treating depression p.27 | EDUCATION University admissions policies should champion diversity p.28 | RESEARCH ETHICS Developing rules for assessing pain in lab animals p.28

The aurora australis over the German Antarctic research base, Neumayer-Station III.

Six priorities for Antarctic science

Mahlon C. Kennicutt II, Steven L. Chown and colleagues outline the most pressing questions in southern polar research, and call for greater collaboration and environmental protection in the region.