Climate in Peril
Current Status and Impact
Arctic and the Antarctica

Lecture 1

Hurtigruten Antarctica – January 2017

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Who am I?

- Civil Engineer
- Private sector/foundations
- Former UN Director
- Former Environmental Ambassador to the City of Arendal
- Climate & Energy communucation

Planets and atmospheres

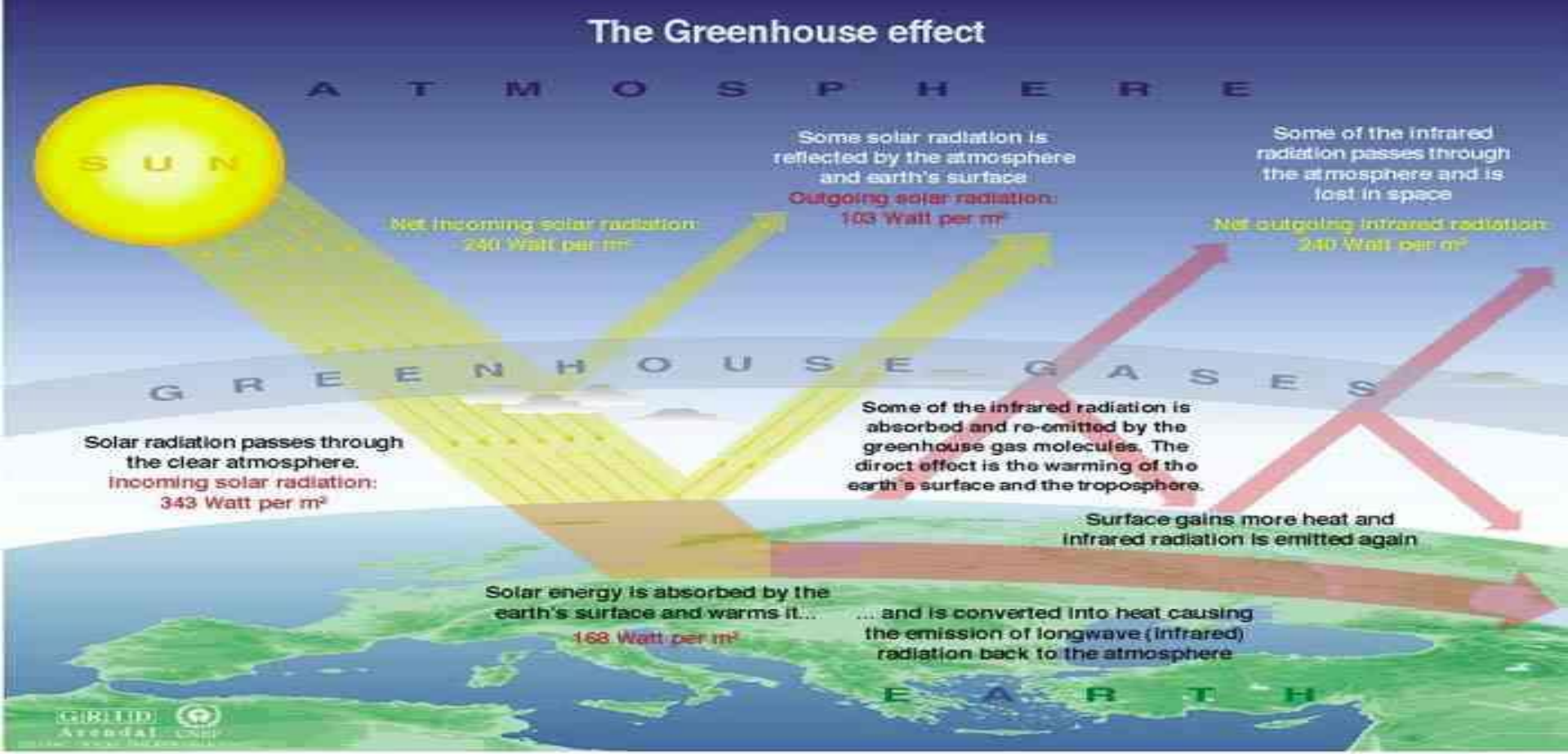
Mars
Thin atmosphere
(All CO_2 in ground)
Average temperature : - 50°C

Earth
0,03% of CO_2 in the atmosphere
Average temperature : + 14°C

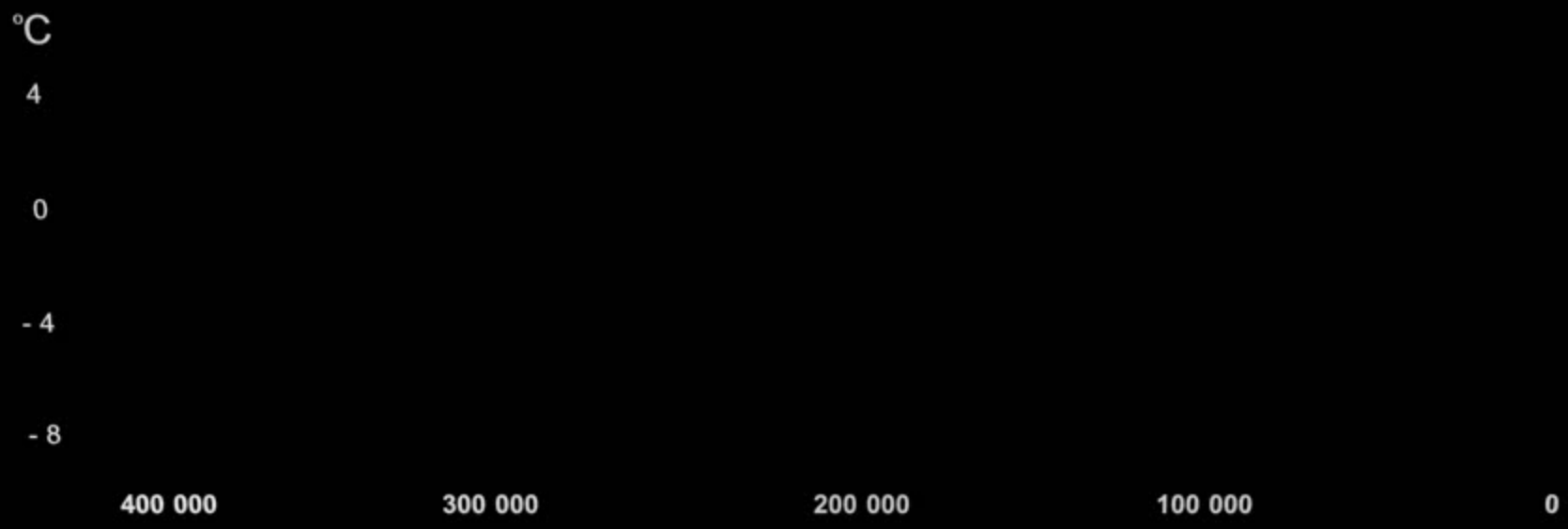
Venus
Thick atmosphere
containing 96% of CO_2
Average temperature : + 420°C

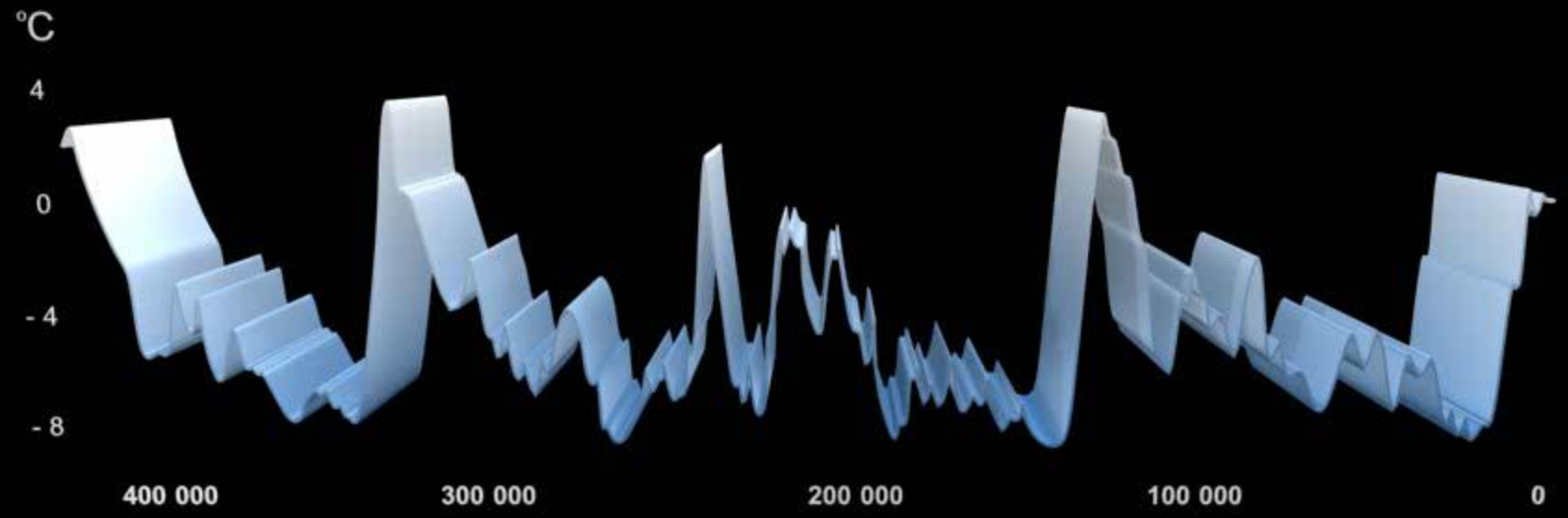
CRIE Arendal UNEP

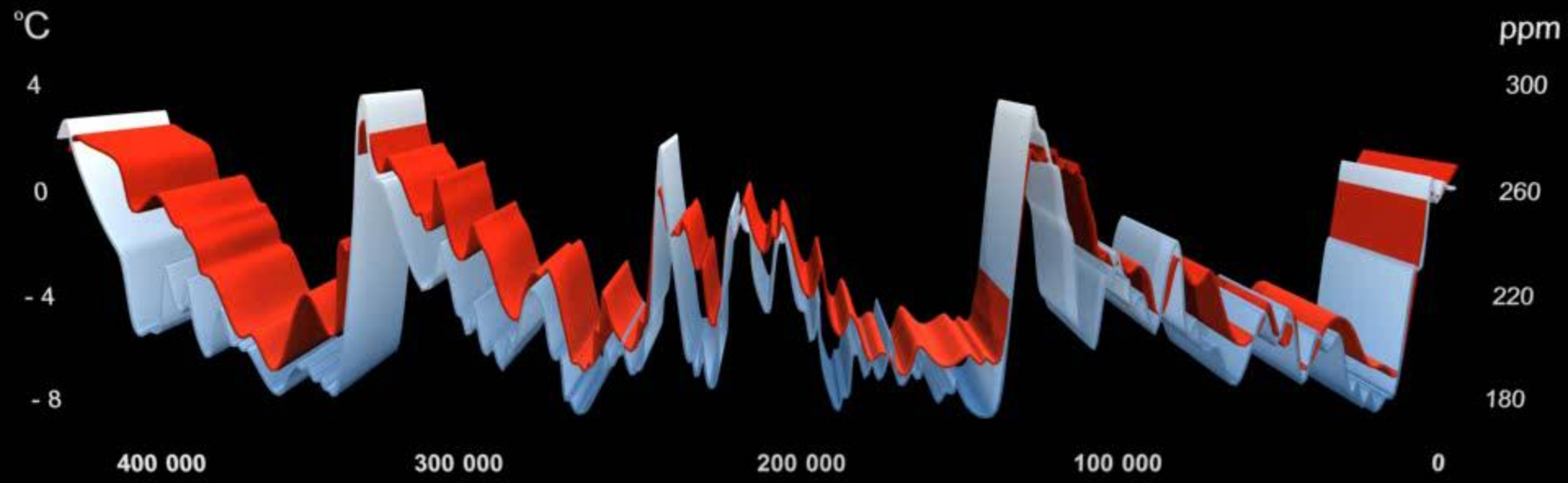
Sources: Calvin J. Hamilton, Views of the solar system, www.planetscapes.com; Bill Arnett , The nine planets, a multimedia tour of the solar system, www.seds.org/billa/tnp/nineplanets.html

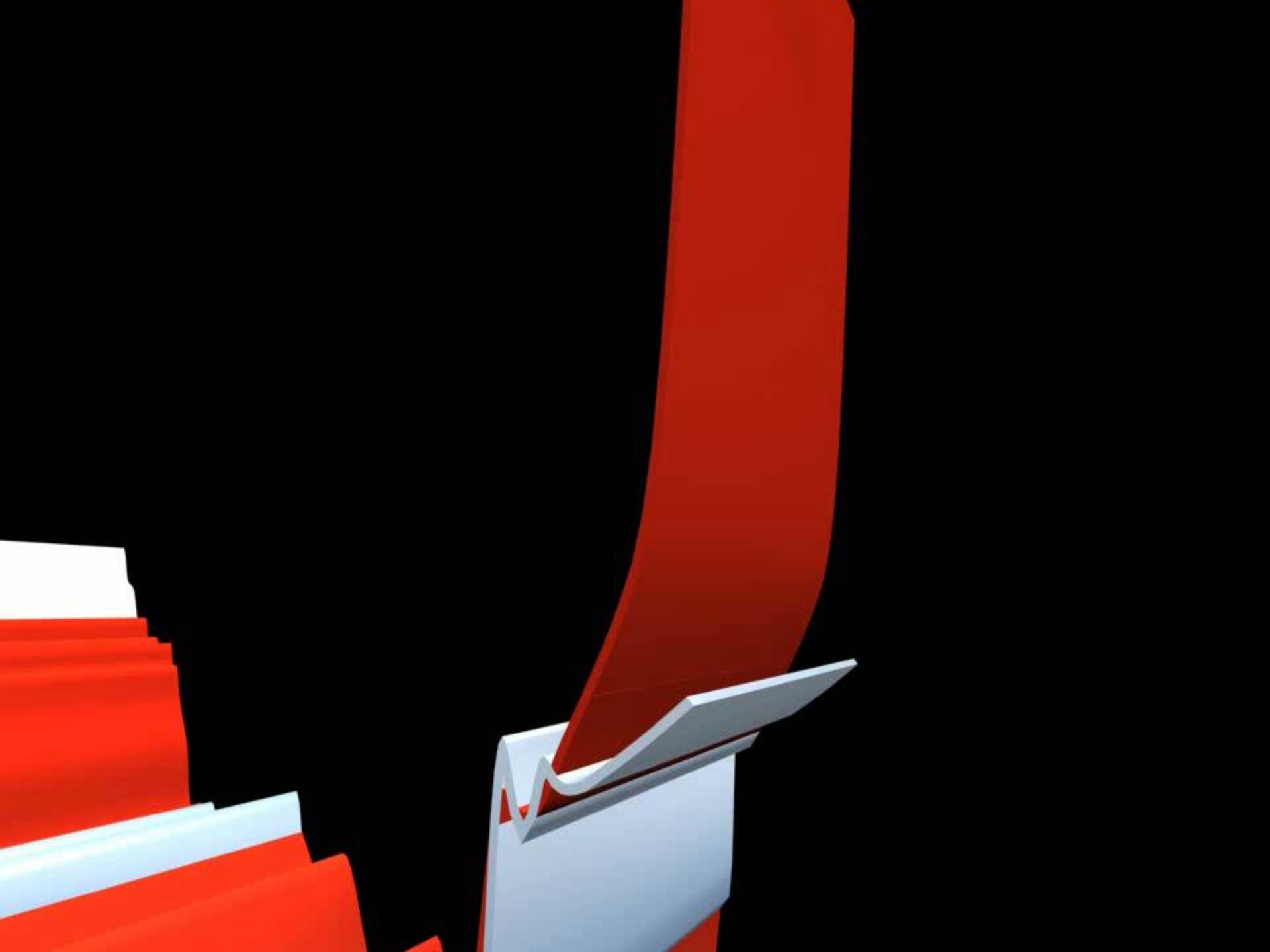


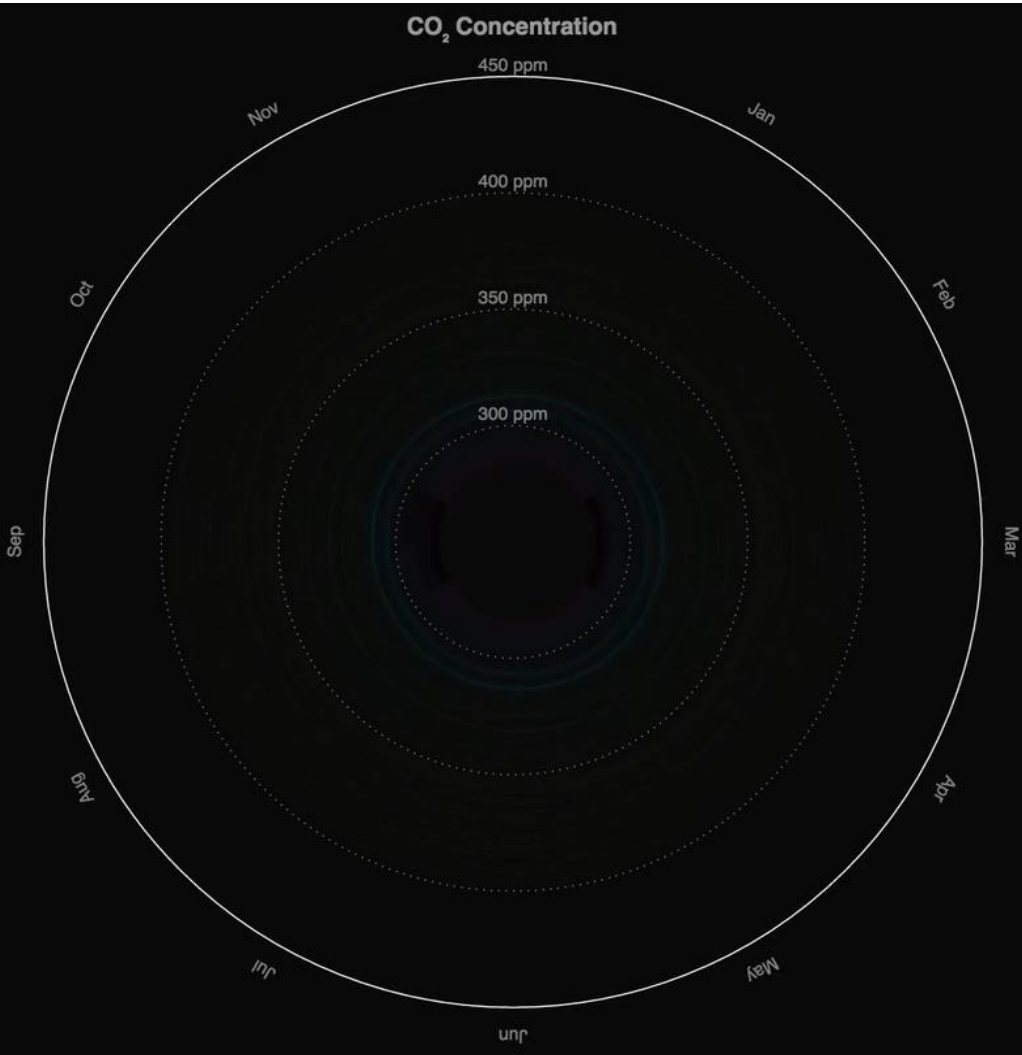
Sources: Okanagan university college in Canada. Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington: Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press. 1996.


°C
4
0
- 4
- 8
400 000
300 000
200 000
100 000
0


°C
4
0
- 4
- 8
400 000
300 000
200 000
100 000
0

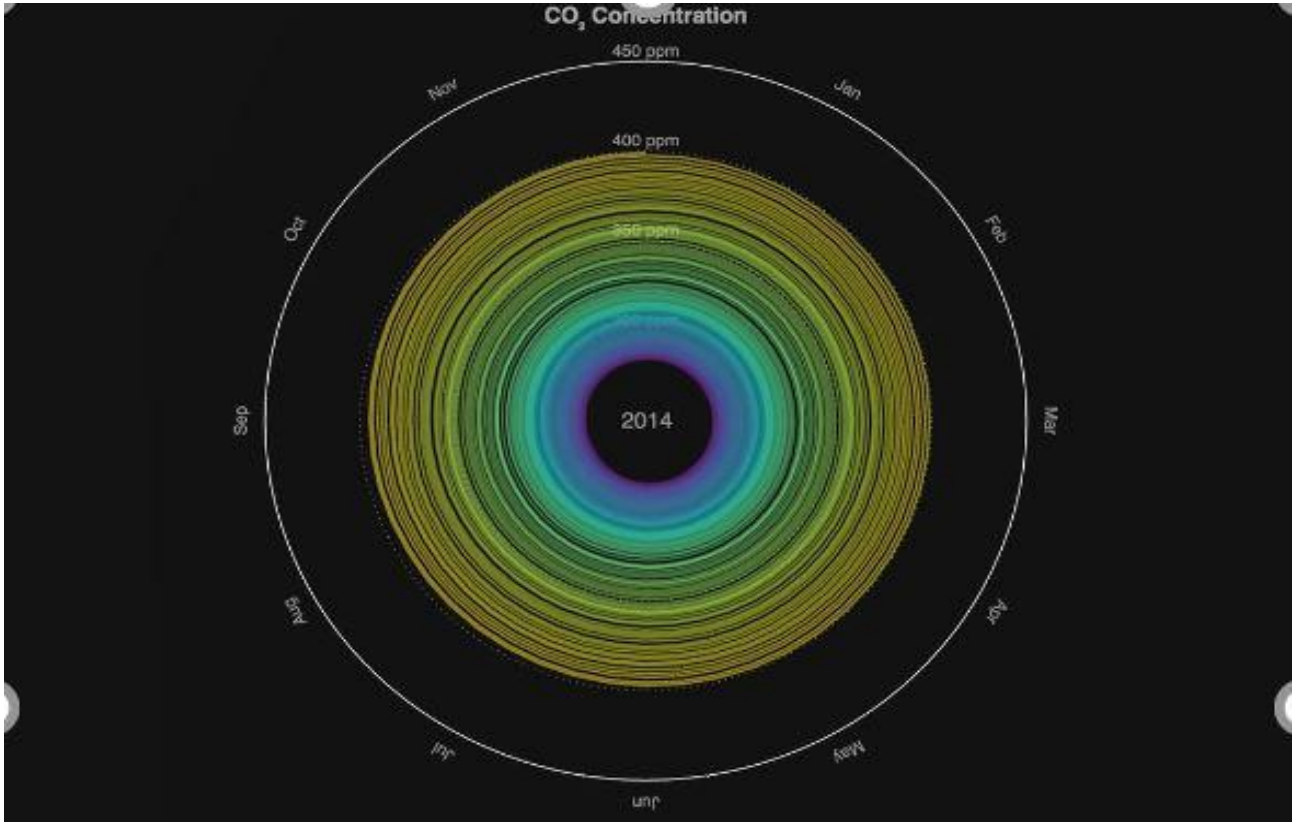

°C
4
0
- 4
- 8
ppm
300
260
220
180
400 000
300 000
200 000
100 000
0



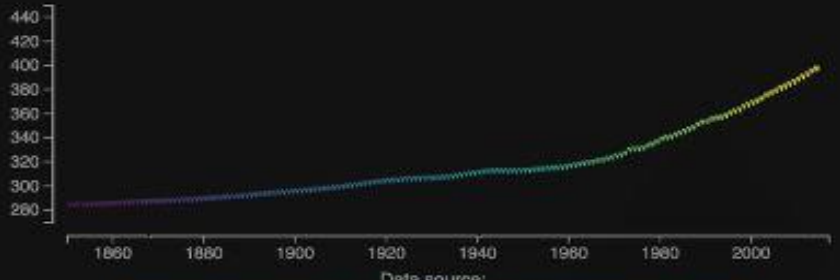


Global Monthly CO_2 concentration in ppm
Data source:
Historical Greenhouse Gas Concentrations for CMIP6 (Version 1 July 2016)

Original Climate Spiral by Ed Hawkins (Climate Lab Book),
extended with Carbon Budget and Concentration Spiral by
Robert Gieseke and Malte Meinshausen
(PRIMAP Group, Potsdam Institute for Climate Impact Research, Germany &
Australian-German Climate & Energy College, The University of Melbourne, Australia)
Data Processing · Source Code



Monthly CO_2 concentration in ppm



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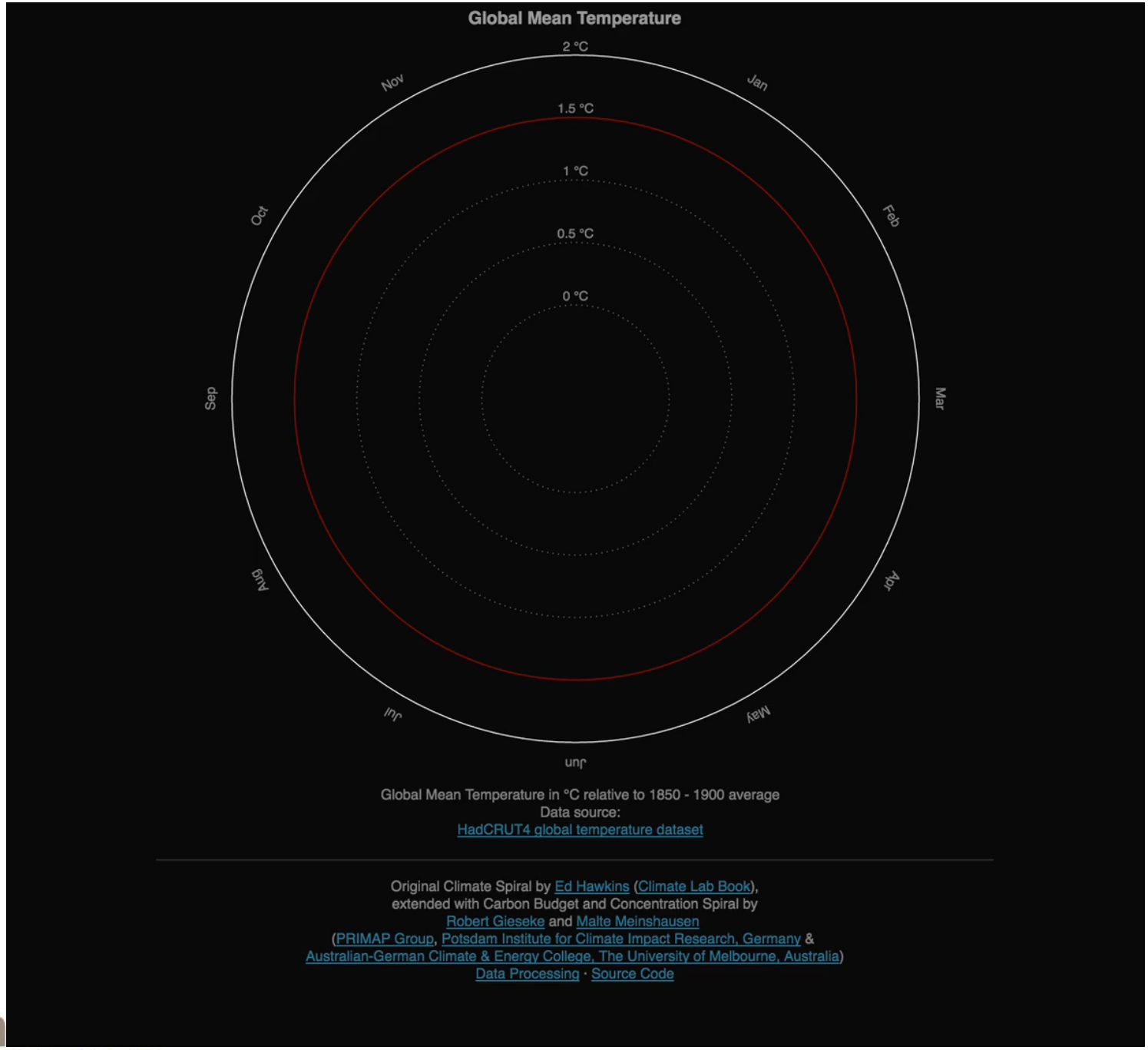
Global Mean Temperature
2 °C
1.5 °C
1 °C
0.5 °C
0 °C
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Global Mean Temperature in °C relative to 1850 - 1900 average
Data source:
HadCRUT4 global temperature dataset
Original Climate Spiral by Ed Hawkins (Climate Lab Book),
extended with Carbon Budget and Concentration Spiral by
Robert Gieseke and Malte Meinshausen
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Data Processing · Source Code

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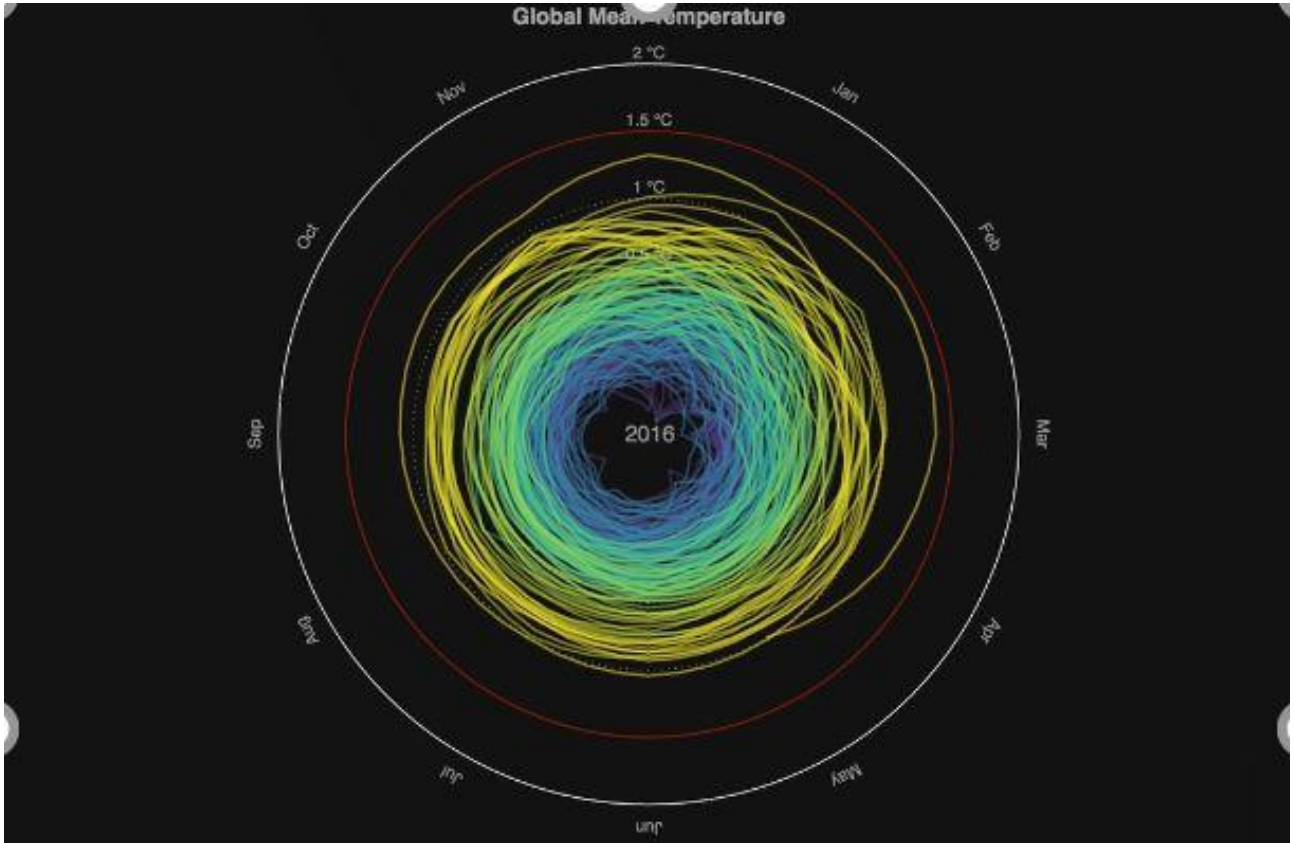
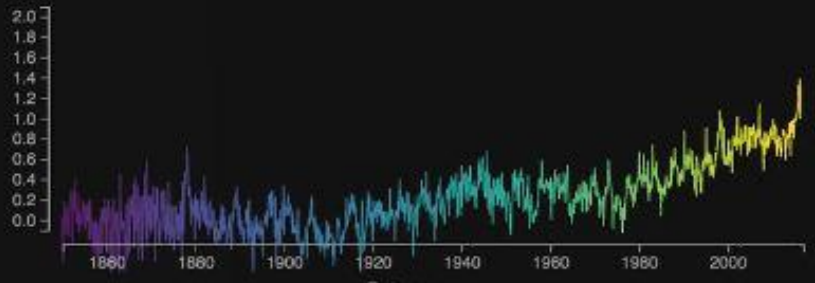


Global Mean Temperature in °C relative to 1850 - 1900 average



Data source:
HadCRUT4 global temperature dataset

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Australian-German Climate & Energy College, The University of Melbourne, Australia)
Data Processing · Source Code

Impact!

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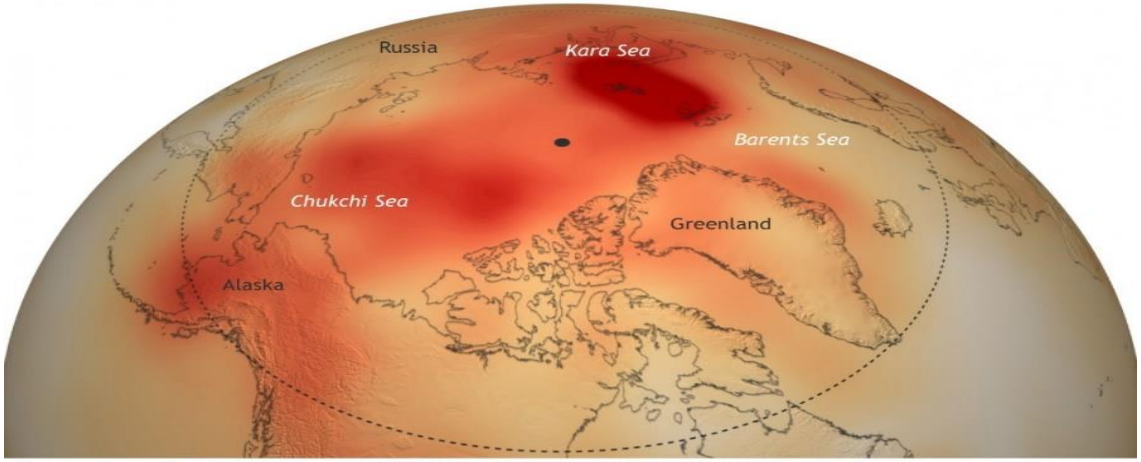
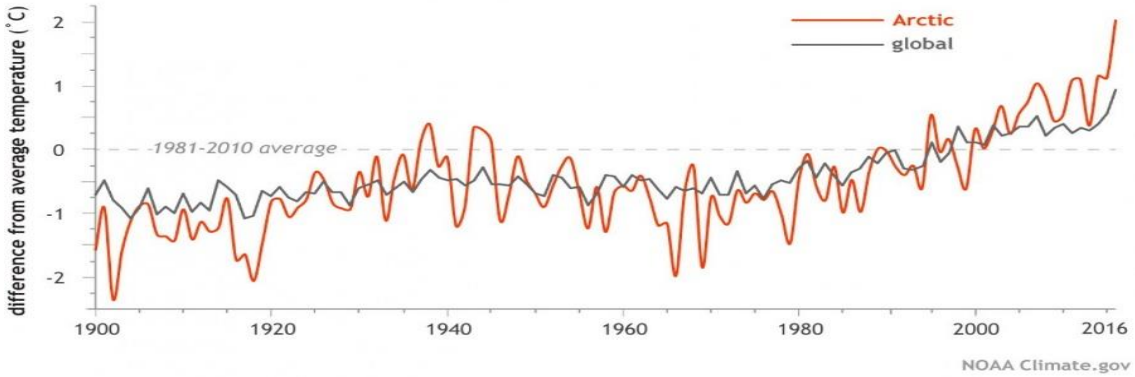
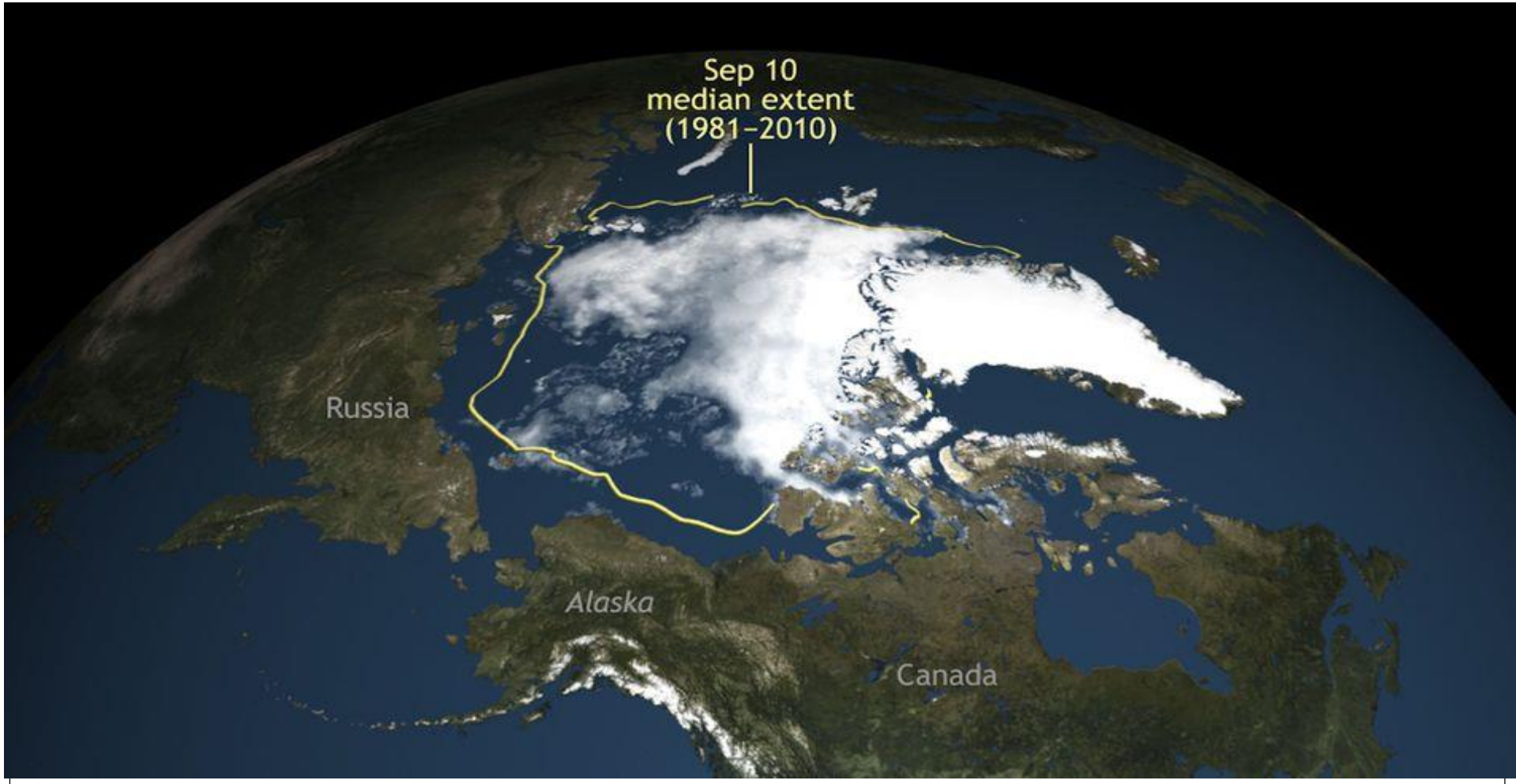
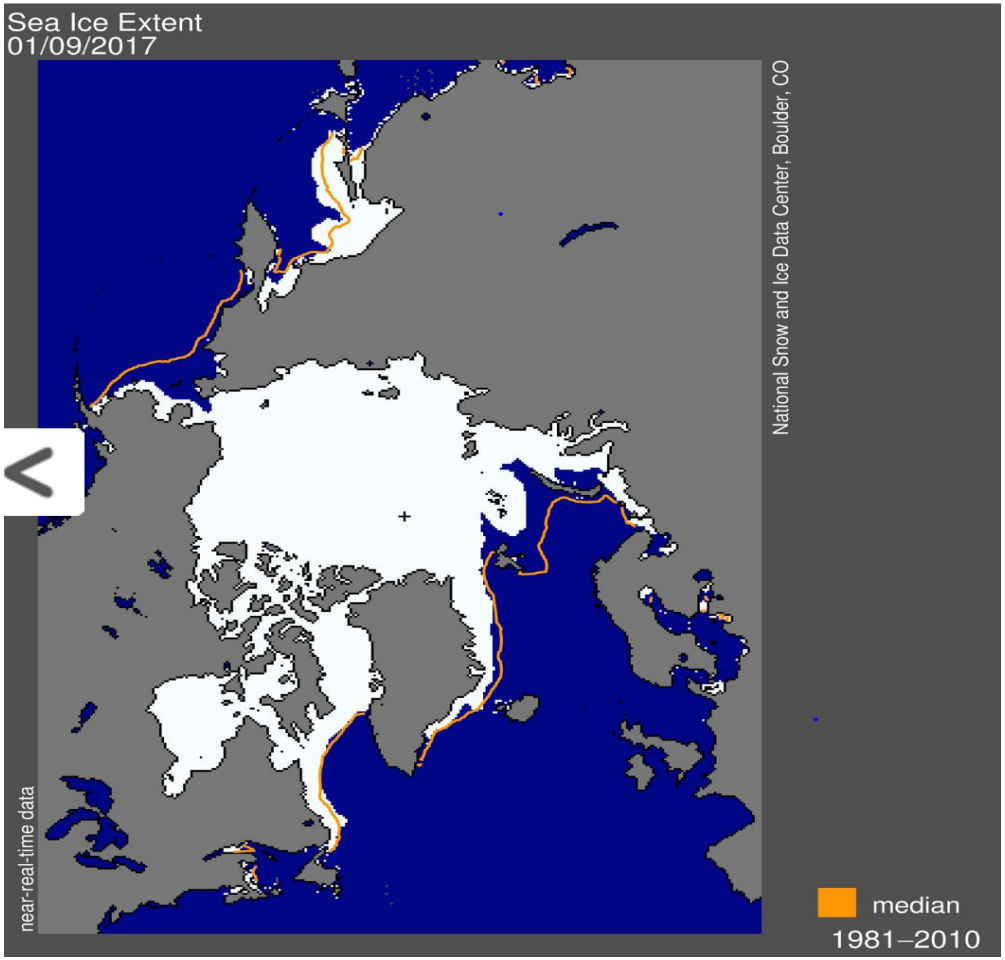
ARCTIC HAD WARMEST YEAR ON RECORD

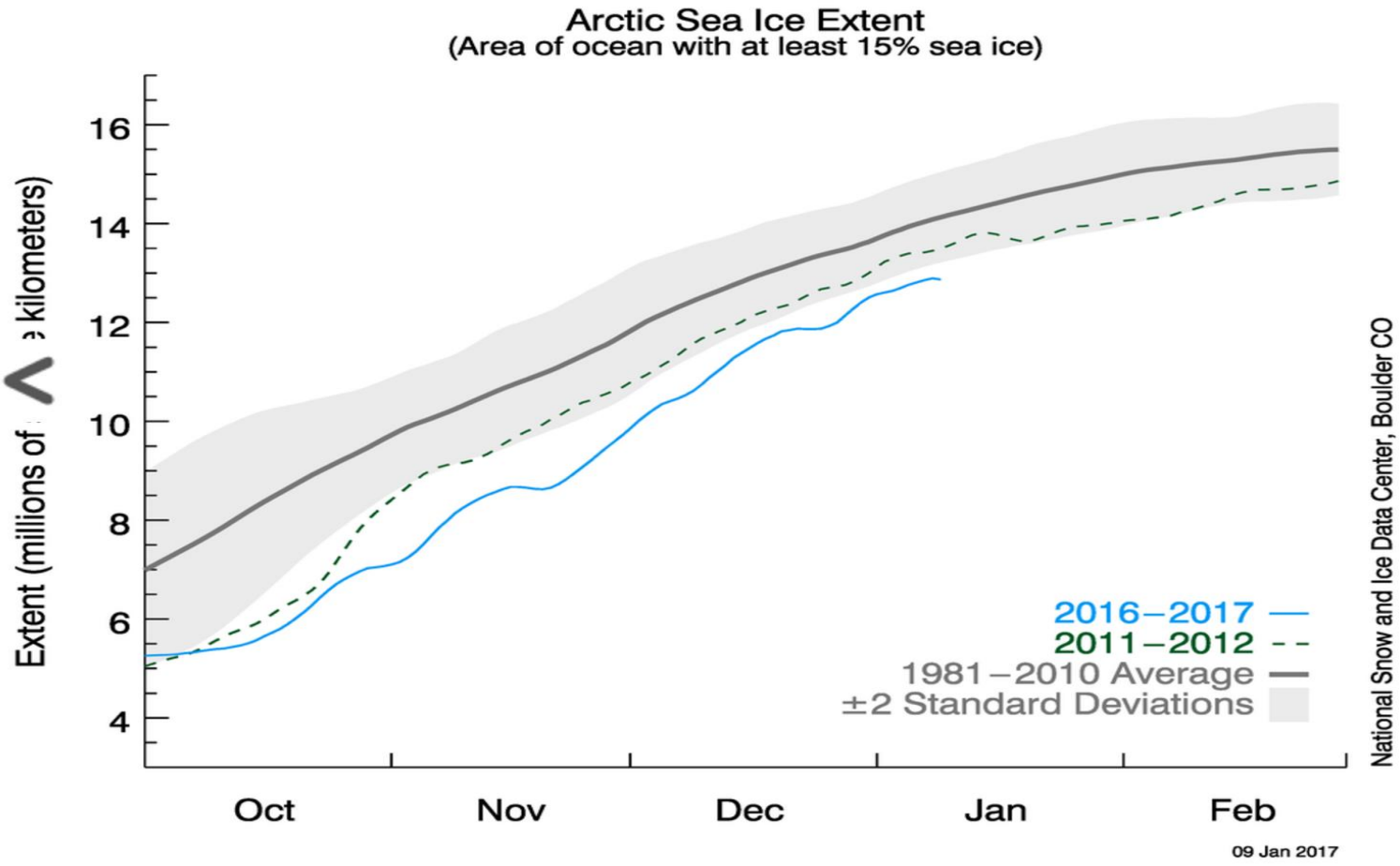


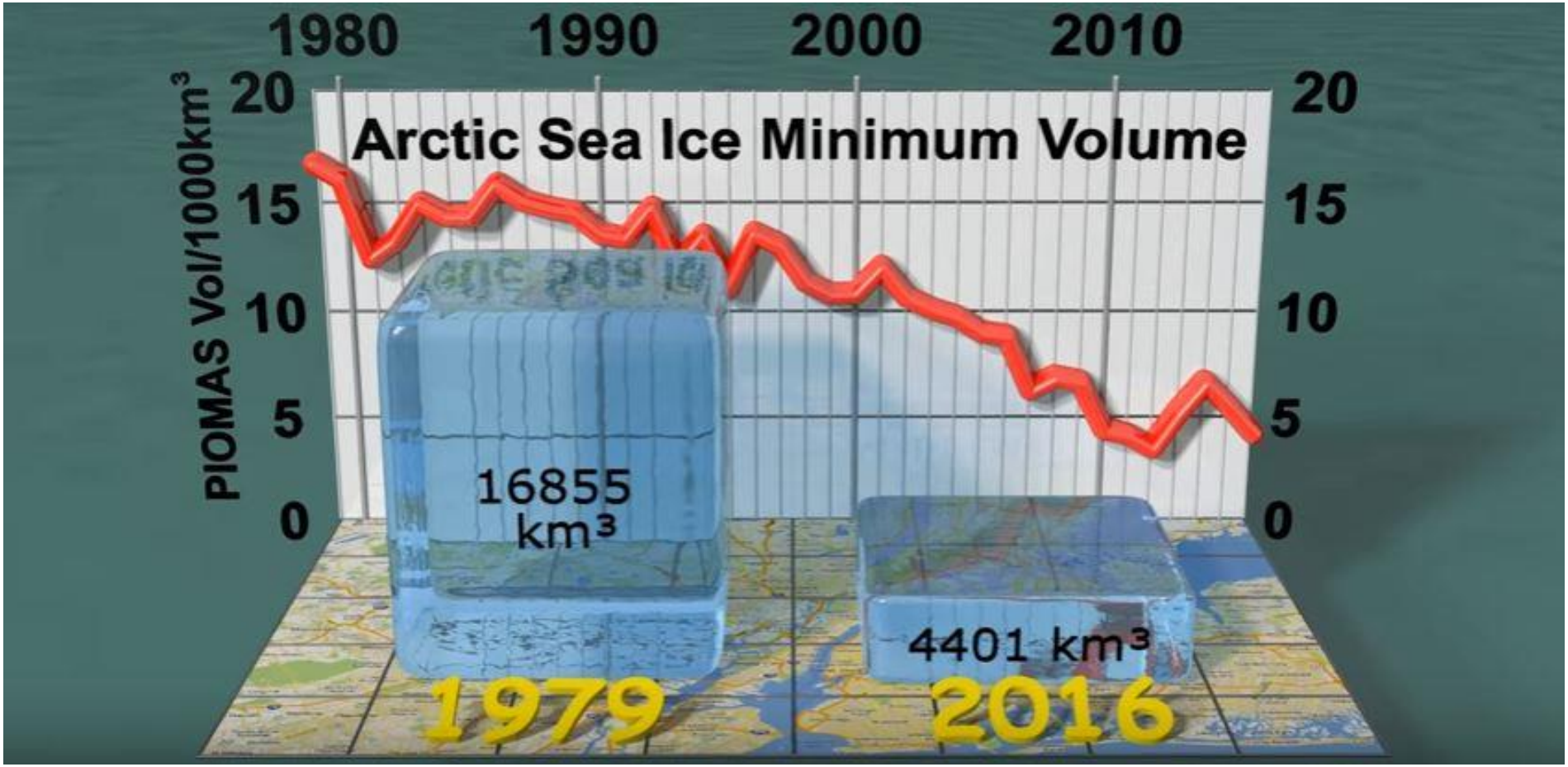
ARCTIC IS WARMING TWICE AS FAST AS THE GLOBAL AVERAGE




Sep 10
median extent
(1981–2010)
Russia
Alaska
Canada

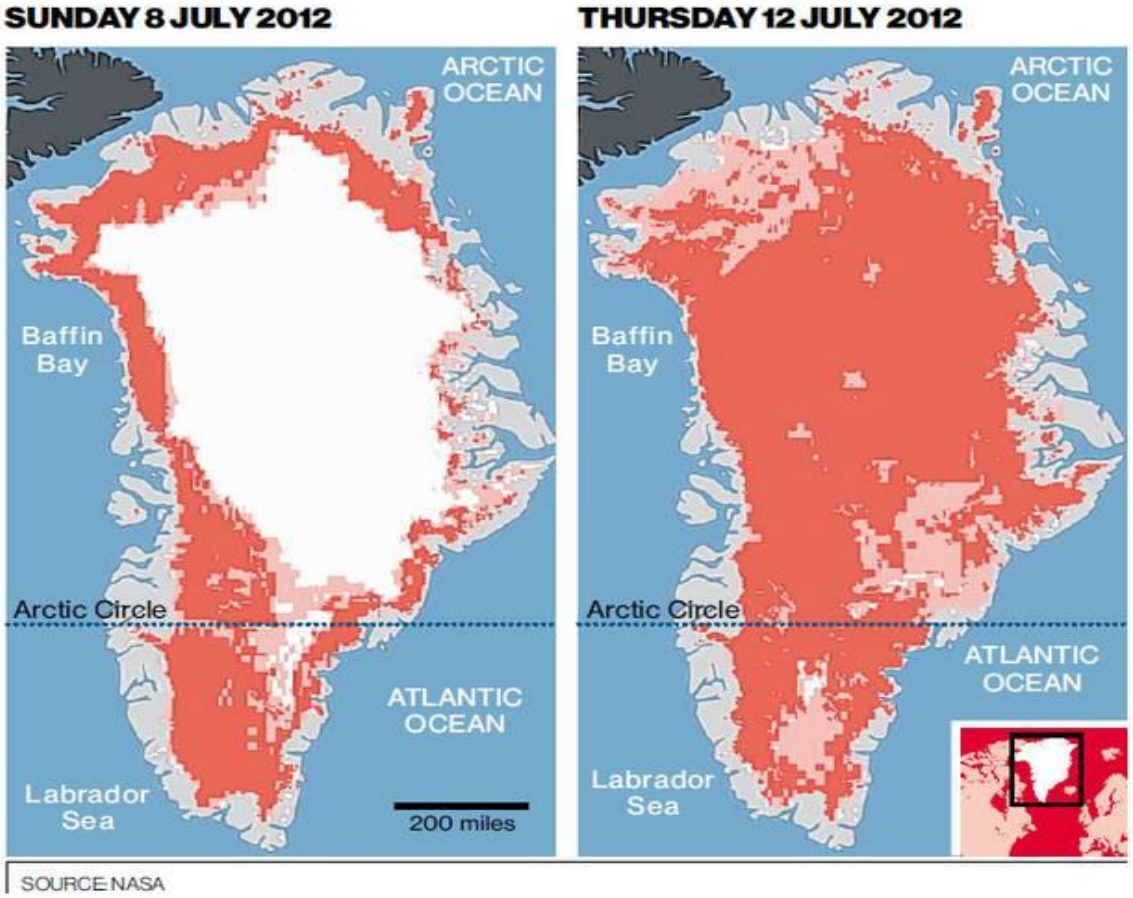

Sea Ice Extent
01/09/2017
National Snow and Ice Data Center, Boulder, CO
near-real-time data
median
1981–2010


Arctic Sea Ice Extent
(Area of ocean with at least 15% sea ice)
Extent (millions of ² kilometers)
16
14
12
10
8
6
4
Oct
Nov
Dec
Jan
Feb
2016–2017
2011–2012
1981–2010 Average
±2 Standard Deviations
National Snow and Ice Data Center, Boulder CO
09 Jan 2017


1980
1990
2000
2010
PIOMAS Vol/1000km³
20
15
10
5
0
Arctic Sea Ice Minimum Volume
16855
km³
4401 km³
1979
2016

MELTING AWAY GREENLAND FROM ABOVE

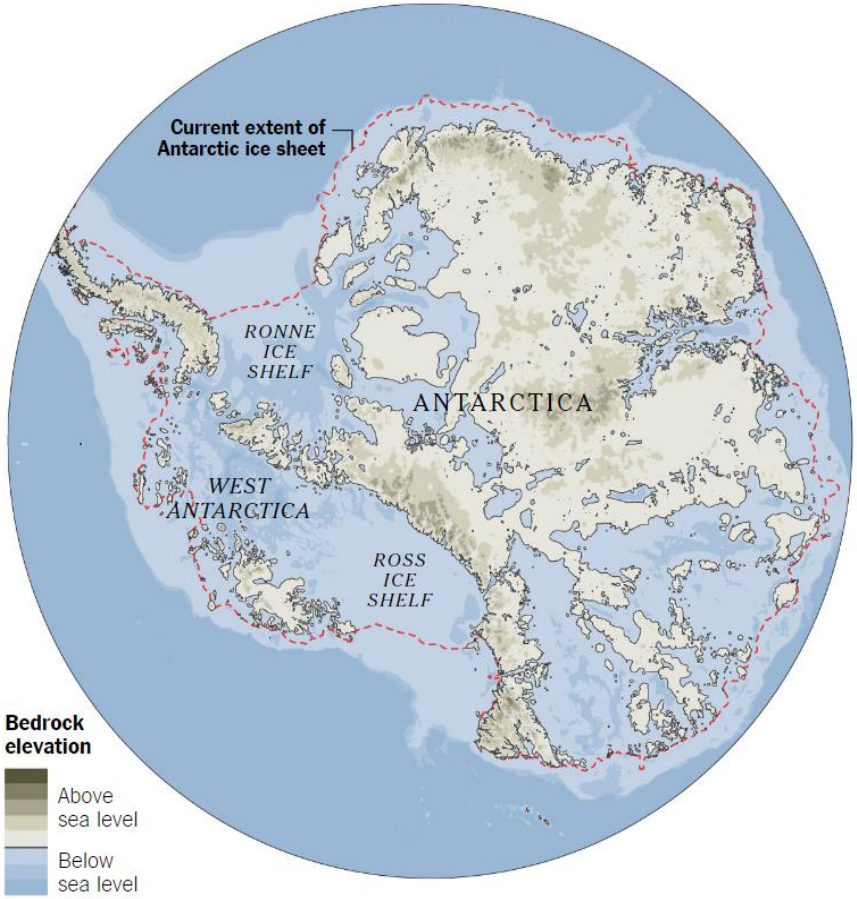
Land mass
No melting
Surface 'melt' (detected by 2 or 3 Satellites)
Surface 'melt' (detected by at least one Satellite)



Source: Roger Braithwaite, University of Manchester (UK)

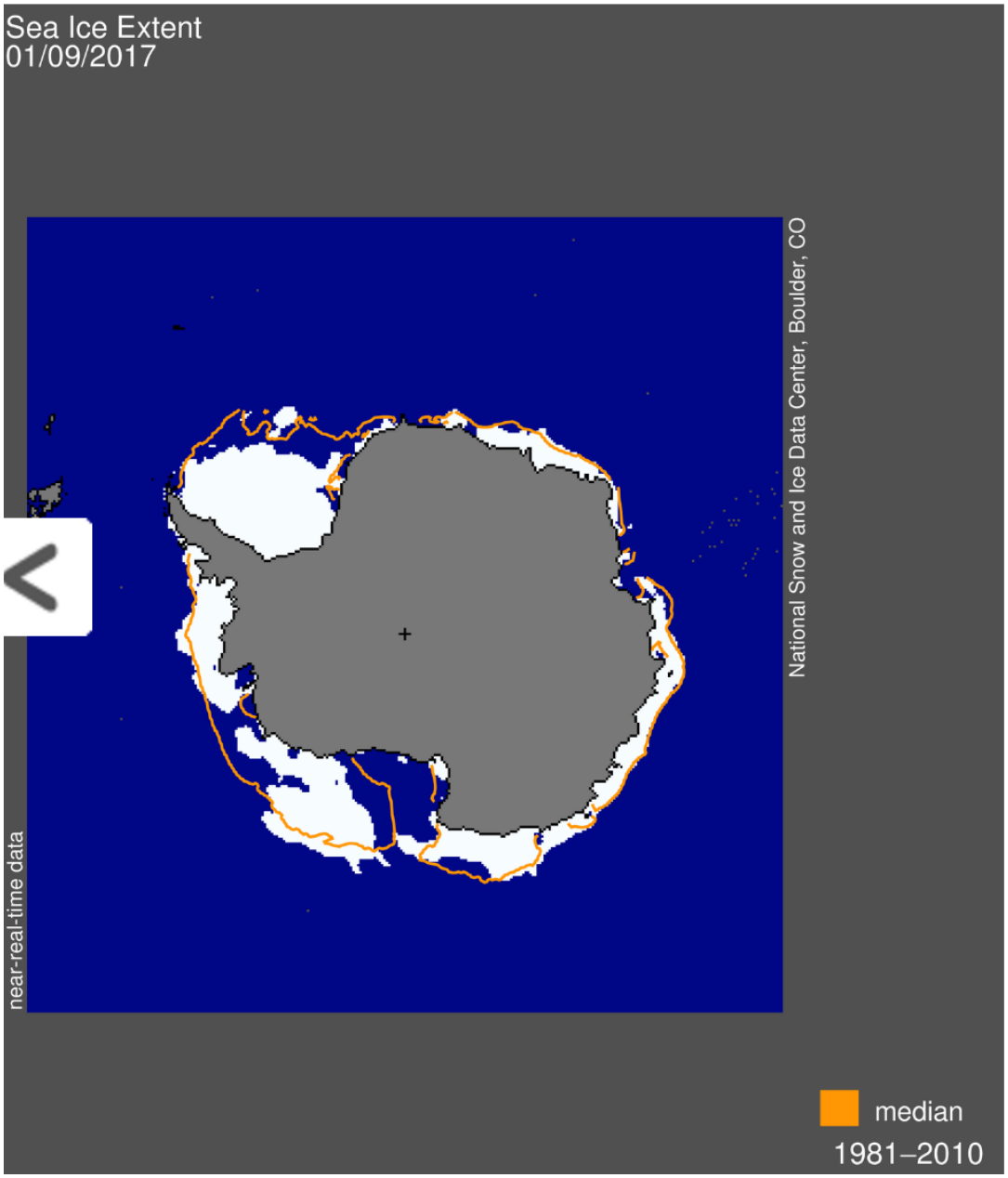
Under the Ice Sheet

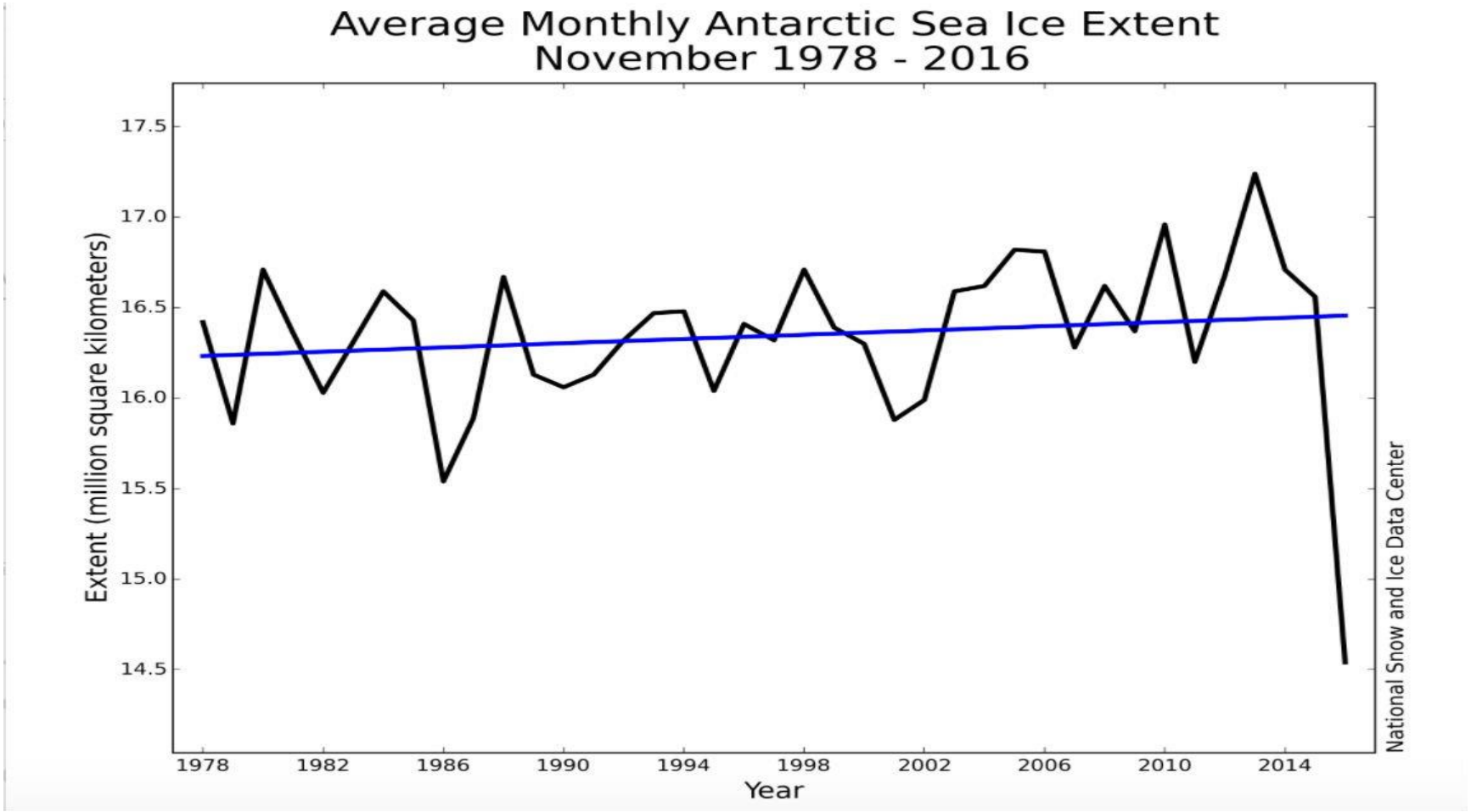
The vast West Antarctic ice sheet sits on bedrock that dips thousands of feet below sea level. New computer simulations suggest that the warming atmosphere and ocean could attack the ice sheet from above and below, causing sea levels to rise much faster than previously thought.

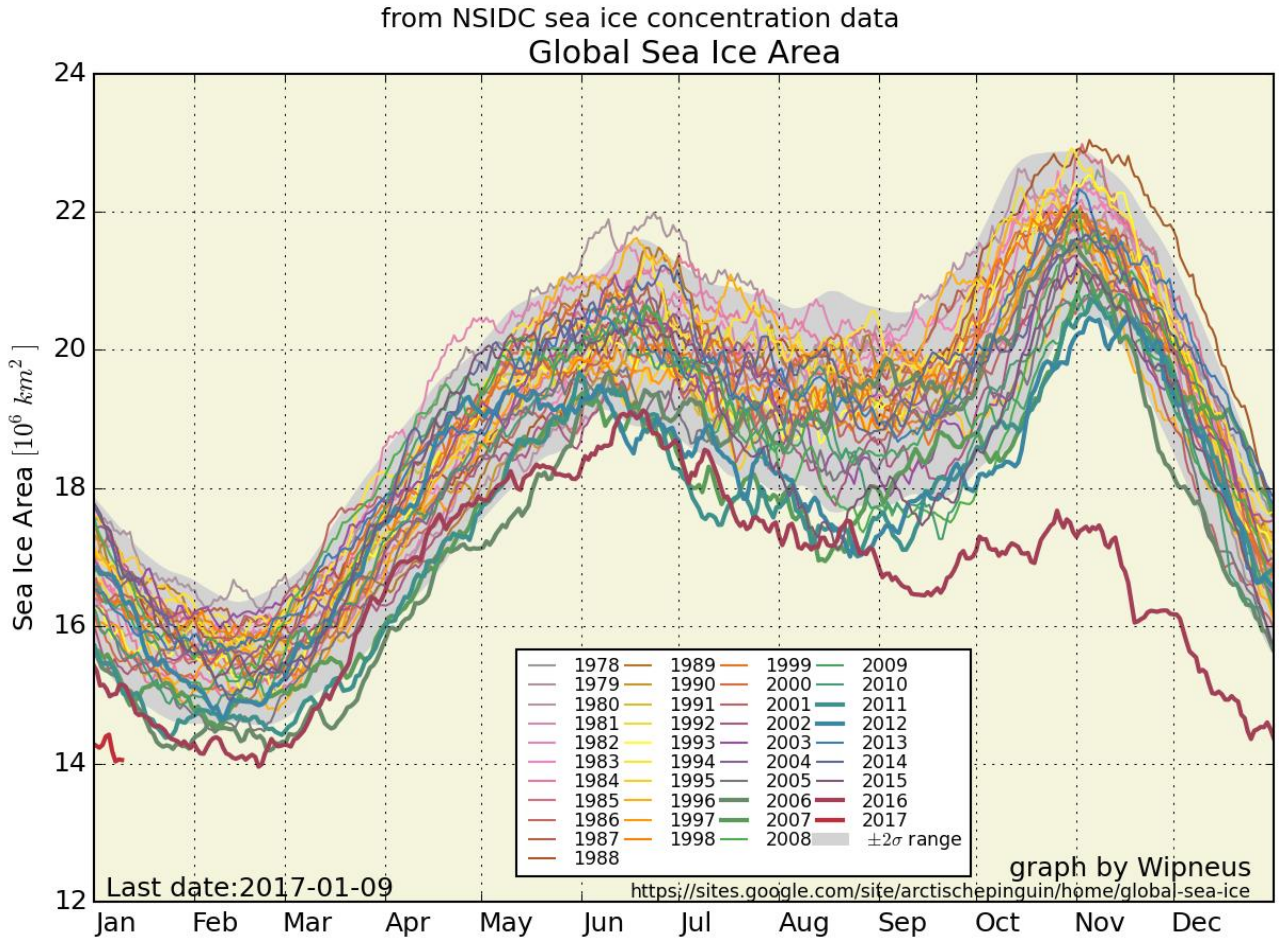


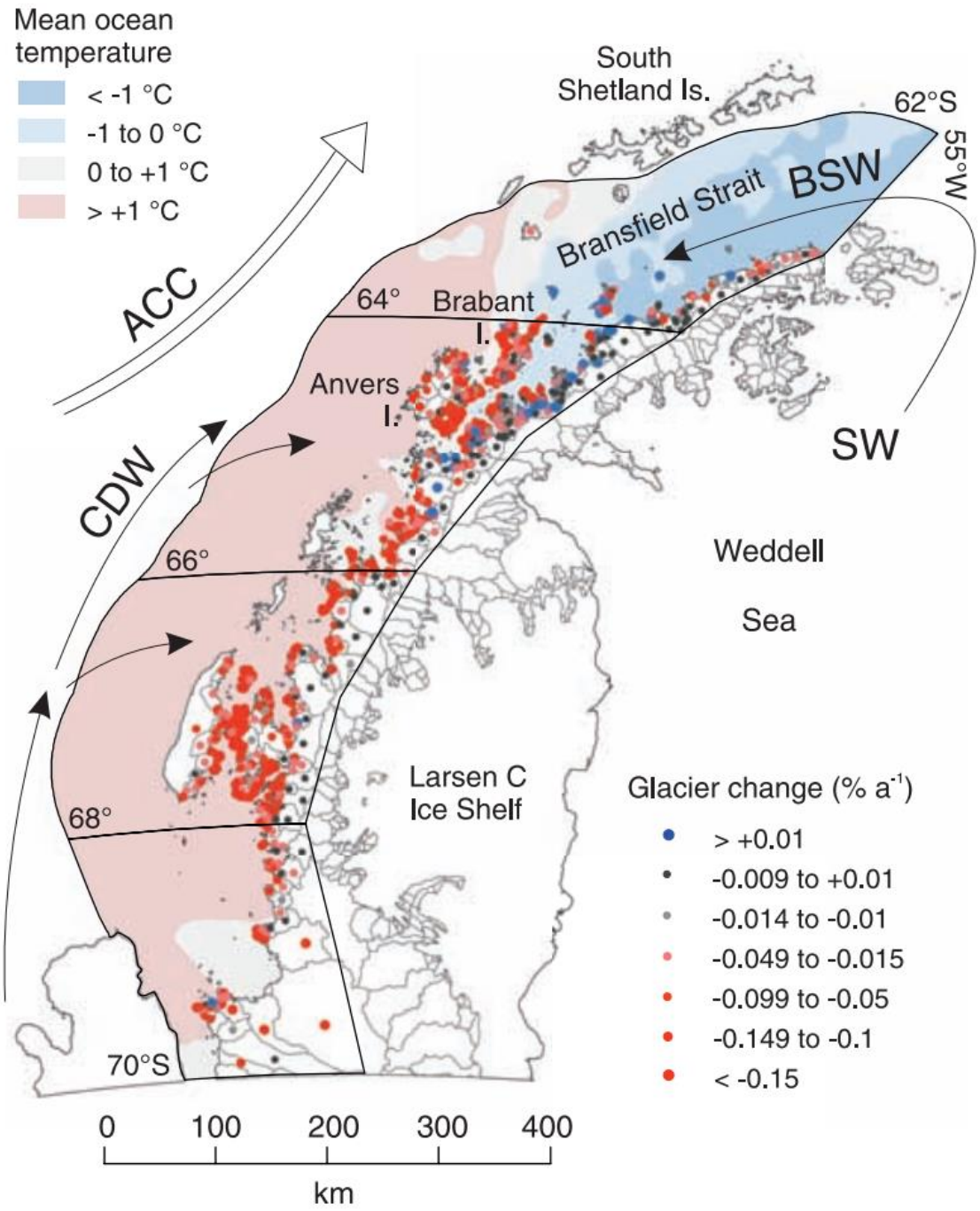
Sources: Nature; Annual Review of Earth and Planetary Sciences; British Antarctic Survey; Bedmap2

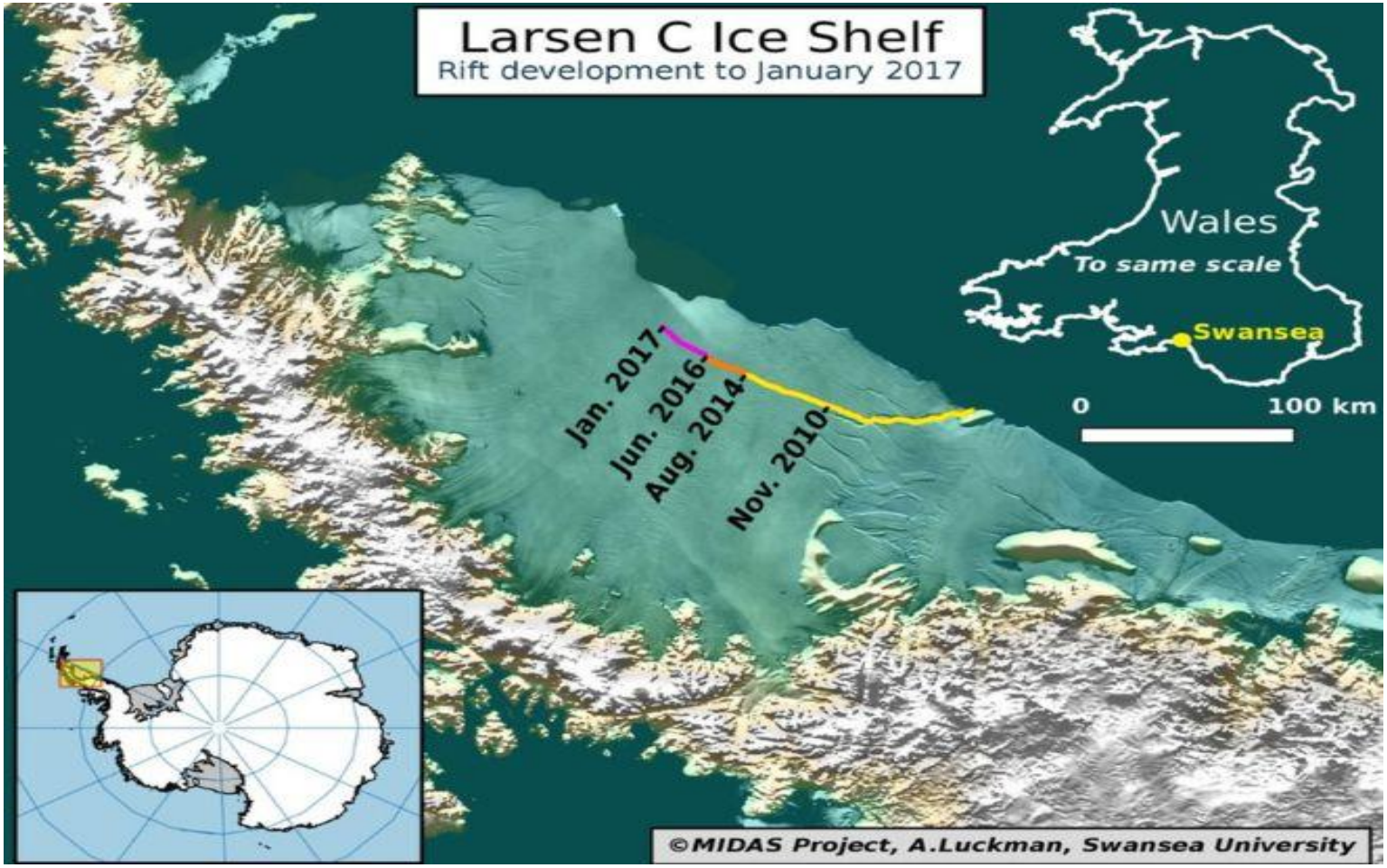
By The New York Times


Sea Ice Extent
01/09/2017
National Snow and Ice Data Center, Boulder, CO
near-real-time data
median
1981–2010


Average Monthly Antarctic Sea Ice Extent
November 1978 - 2016
Extent (million square kilometers)
17.5
17.0
16.5
16.0
15.5
15.0
14.5
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
Year
National Snow and Ice Data Center

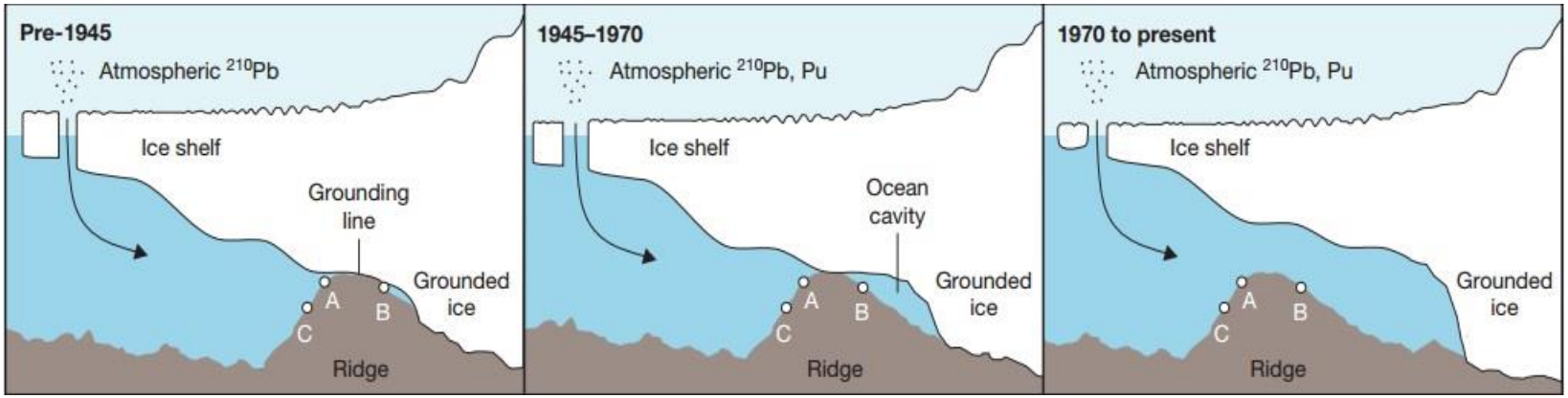

from NSIDC sea ice concentration data
Global Sea Ice Area
Sea Ice Area [10^6 km^2]
24
22
20
18
16
14
12
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
±2σ range
Last date:2017-01-09
graph by Wipneus
https://sites.google.com/site/arctischepinguin/home/global-sea-ice


Mean ocean temperature
< -1 °C
-1 to 0 °C
0 to +1 °C
> +1 °C
South Shetland Is.
62°S
55°W
Bransfield Strait
BSW
ACC
64°
Brabant I.
Anvers I.
CDW
SW
66°
Weddell Sea
68°
Larsen C Ice Shelf
70°S
Glacier change (% a-1)
> +0.01
-0.009 to +0.01
-0.014 to -0.01
-0.049 to -0.015
-0.099 to -0.05
-0.149 to -0.1
< -0.15
0
100
200
300
400
km


Larsen C Ice Shelf
Rift development to January 2017
Wales
To same scale
Swansea
0
100 km
Jan. 2017
Jun. 2016
Aug. 2014
Nov. 2010
©MIDAS Project, A.Luckman, Swansea University

Pine Island: Ice retreat and thinning since a warm pulse kicked off an irreversible melting in 1945.

Credit: Smith et al., 2016/Nature. Pine Island



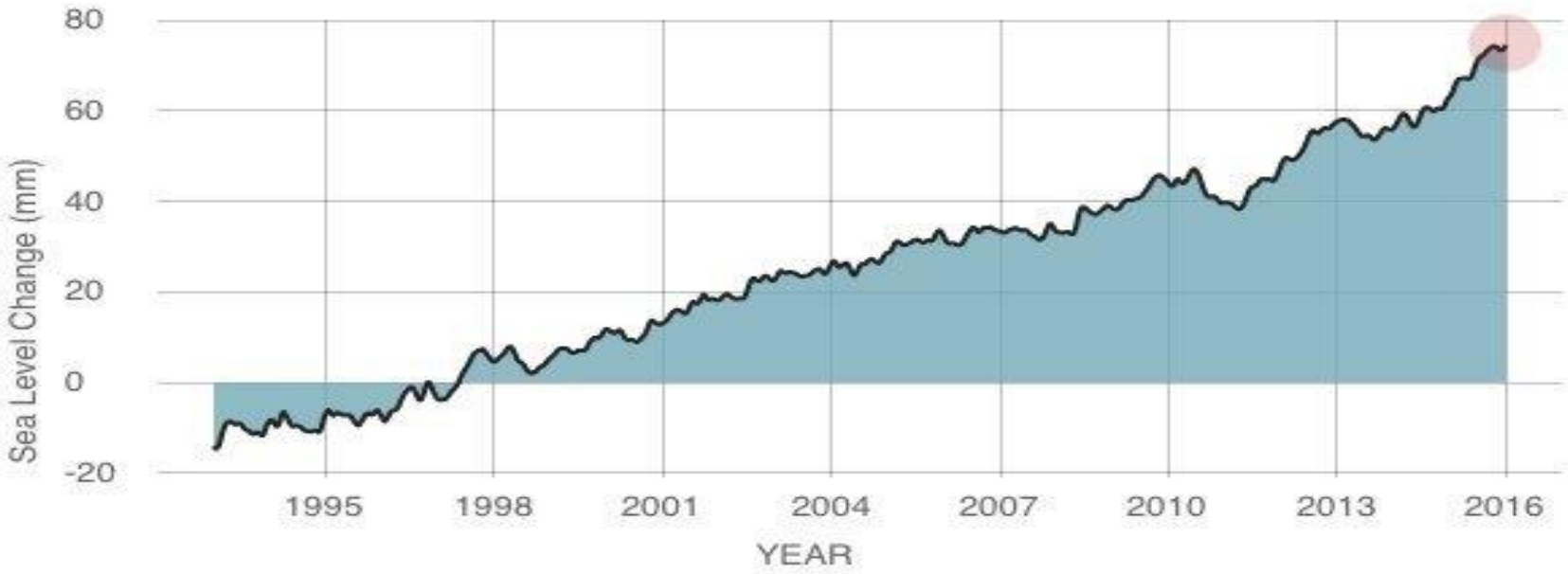
SATELLITE DATA: 1993-PRESENT

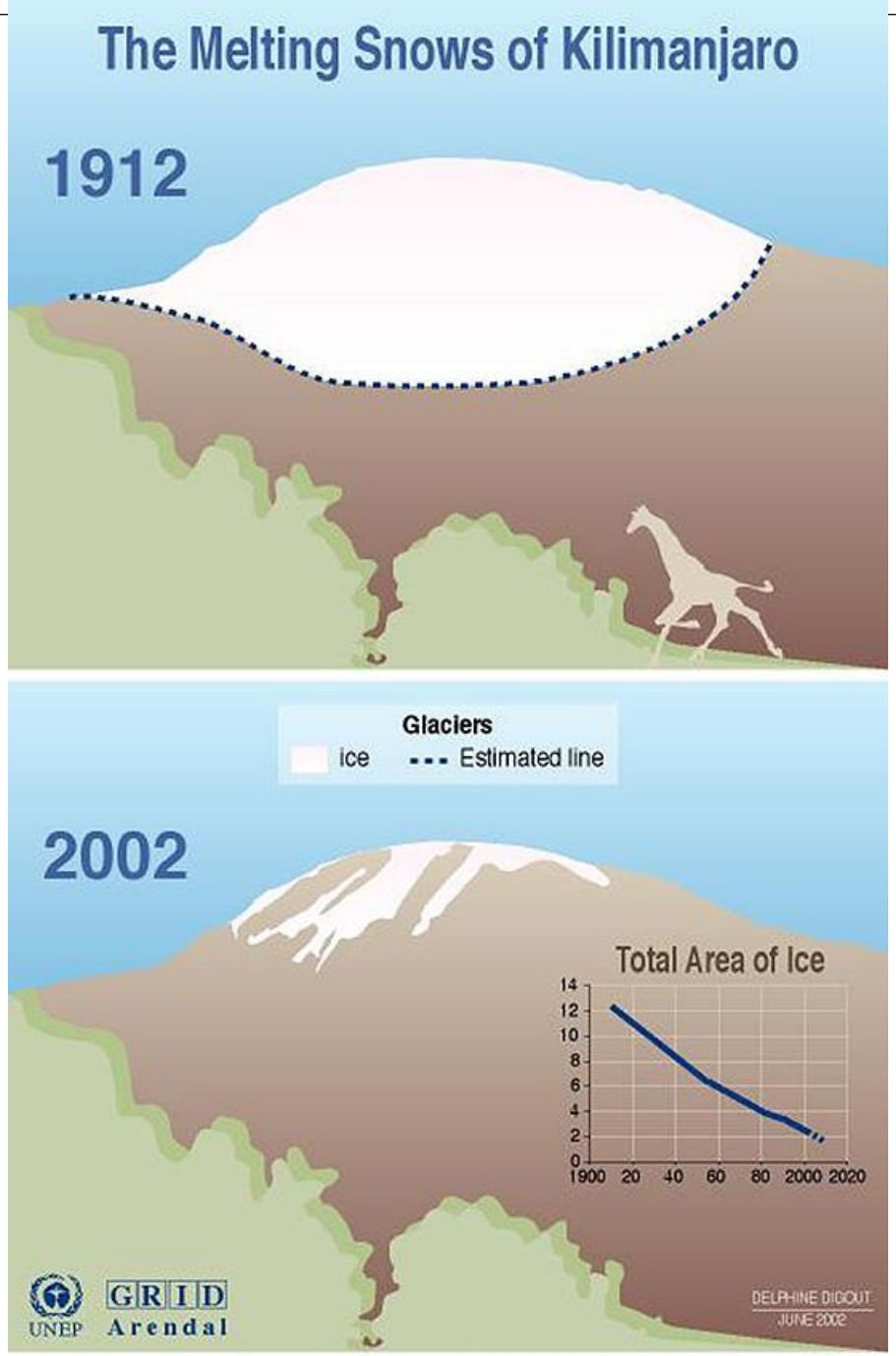
Data source: Satellite sea level observations.
Credit: NASA Goddard Space Flight Center

RATE OF CHANGE

↑ 3.42

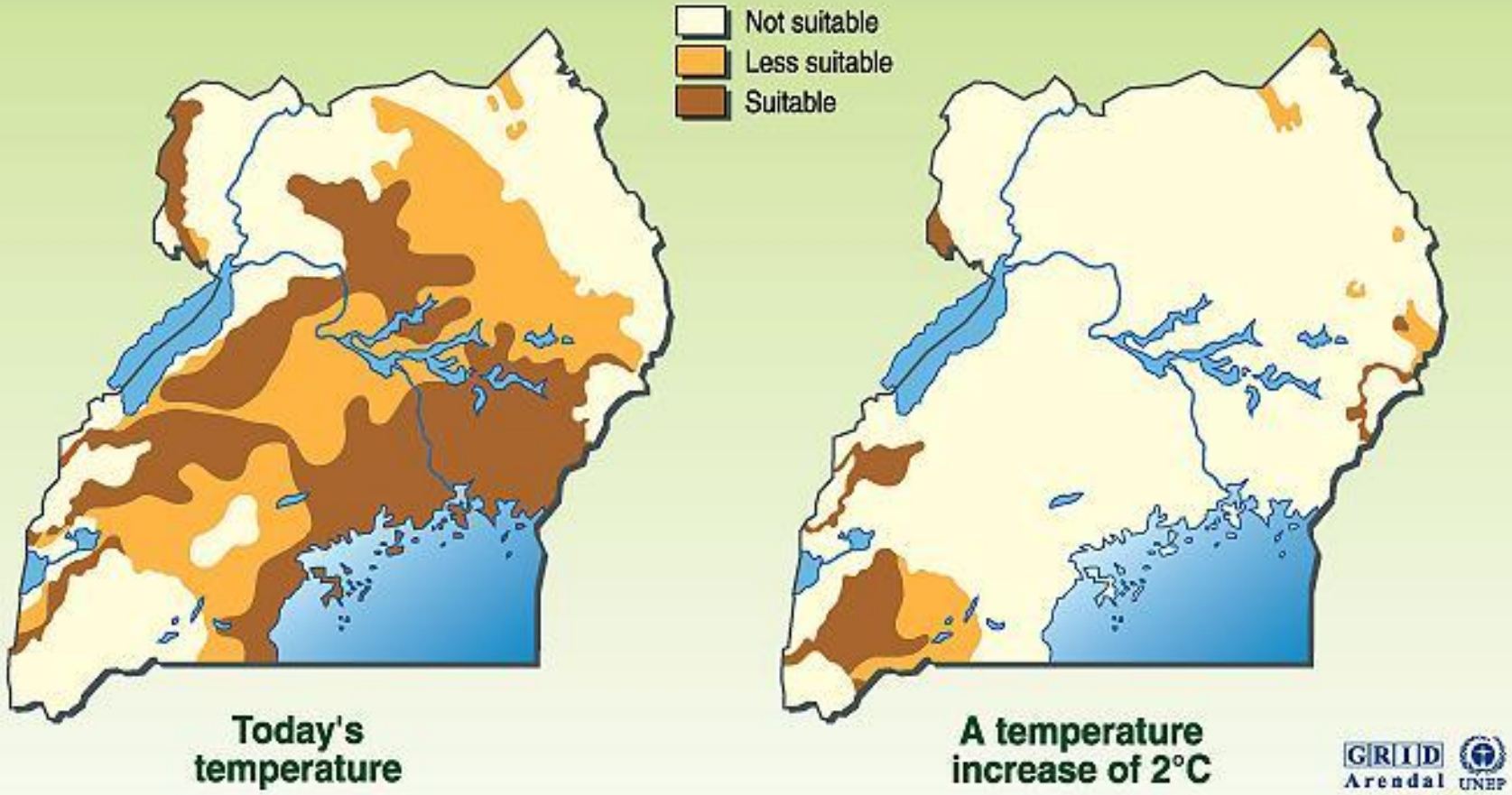
mm per year



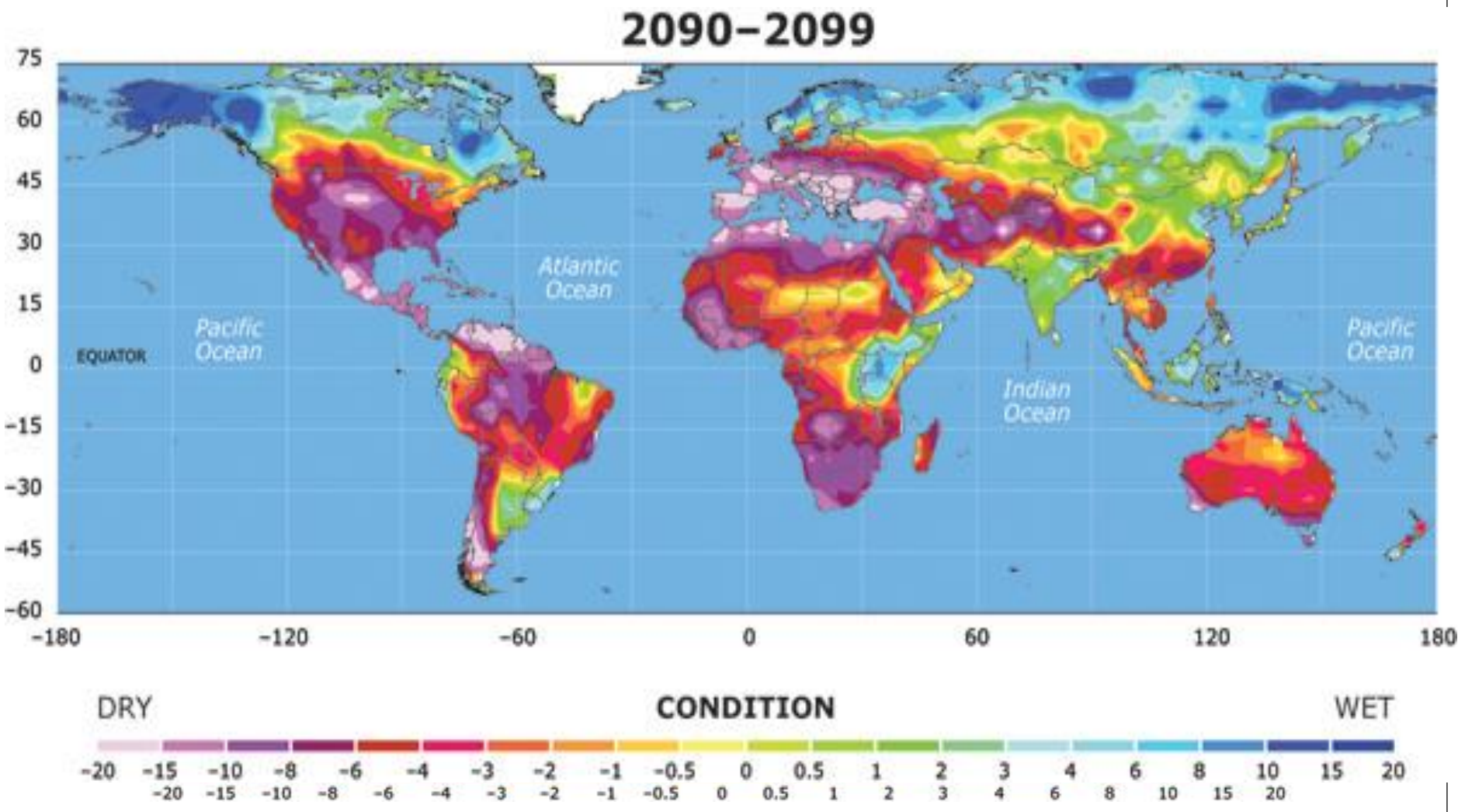


Sources: Meeting of the American Association for the Advancement of Science (AAAS), February 2001 ; Earthobservatory.nasa.gov.

Impact of temperature rise on robusta coffee in Uganda



Source: Otto Simonett, Potential impacts of global warming, GRID-Geneva, case studies on climatic change. Geneva, 1989.


2090–2099
75
60
45
30
15
0
−15
−30
−45
−60
−180
−120
−60
0
60
120
180
EQUATOR
Pacific Ocean
Atlantic Ocean
Indian Ocean
Pacific Ocean
DRY
CONDITION
WET
−20 −15 −10 −8 −6 −4 −3 −2 −1 −0.5 0 0.5 1 2 3 4 6 8 10 15 20

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