



Global Warming 2019 -2020

Abrupt Accelerating Global Surface heating

Peter Carter

25 Feb. 2020

Please share

This presentation addresses only surface heating to 2019, actually recorded



1.5°C
and
ACCELERATING

Peter Carter

25 Feb. 2020

At
1.5°C
and
ACCELERATING

January 2020

**Record monthly global average surface temperature Increase
1.5°C**

2019

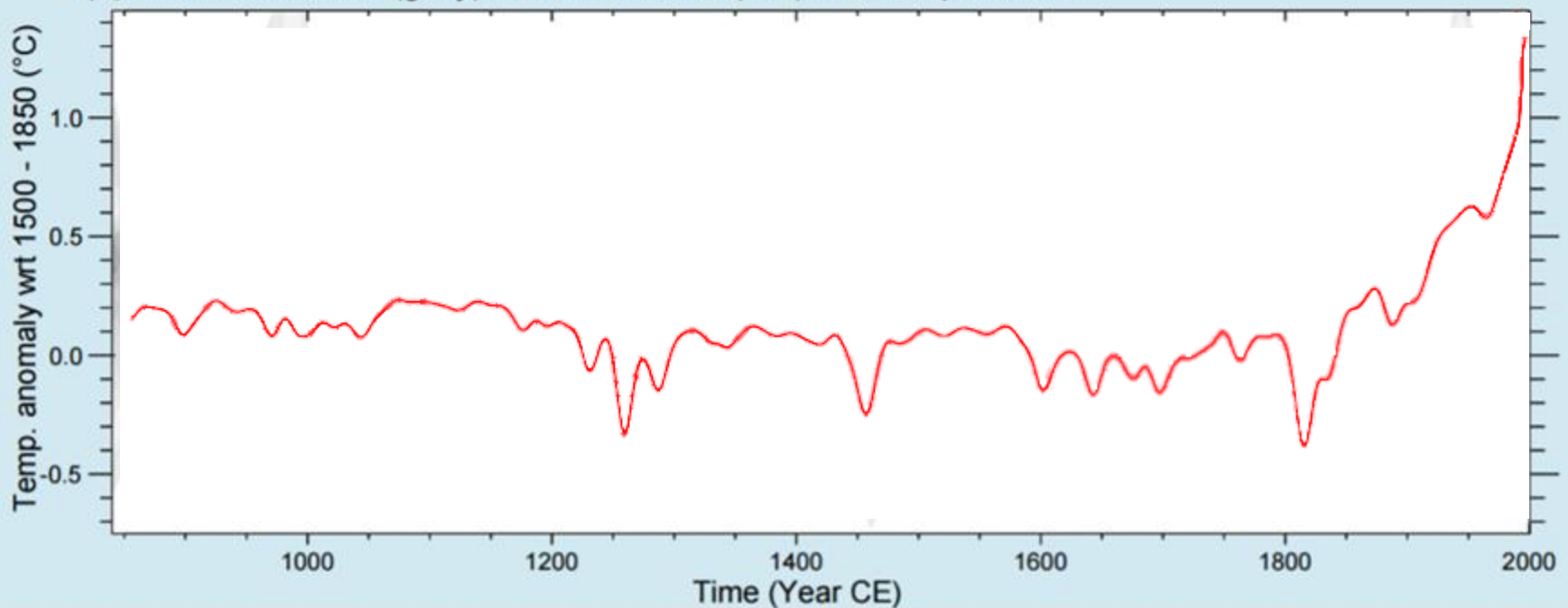
**Global surface heating has accelerated (faster)
over the past decade**

**Global land average temperature increase
1.57°C**

Abrupt Surface Heating

The context of today's accelerating global surface temperature increase

Northern Hemisphere temperature increase over the past 2000 years



IPCC 2014 5th assessment, WG 1, Box TS.5, Figure 1

Monthly Record Surface Heating at 1.5°C

“January 2020 was globally the warmest January in the 141-year of instrumental temperature measurements, just edging 2016, the year with a large El Nino” (which boosts global warming).

“January 2020 was 1.50°C warmer than the 1880-1920 January mean.”

“Parts of Siberia were much warmer than normal, by as much as 14°C.”

Source: Columbia University, Earth Institute,
NASA GISS climate expert team

 Climate Science, Awareness and Solutions

NOTE regarding Siberia :

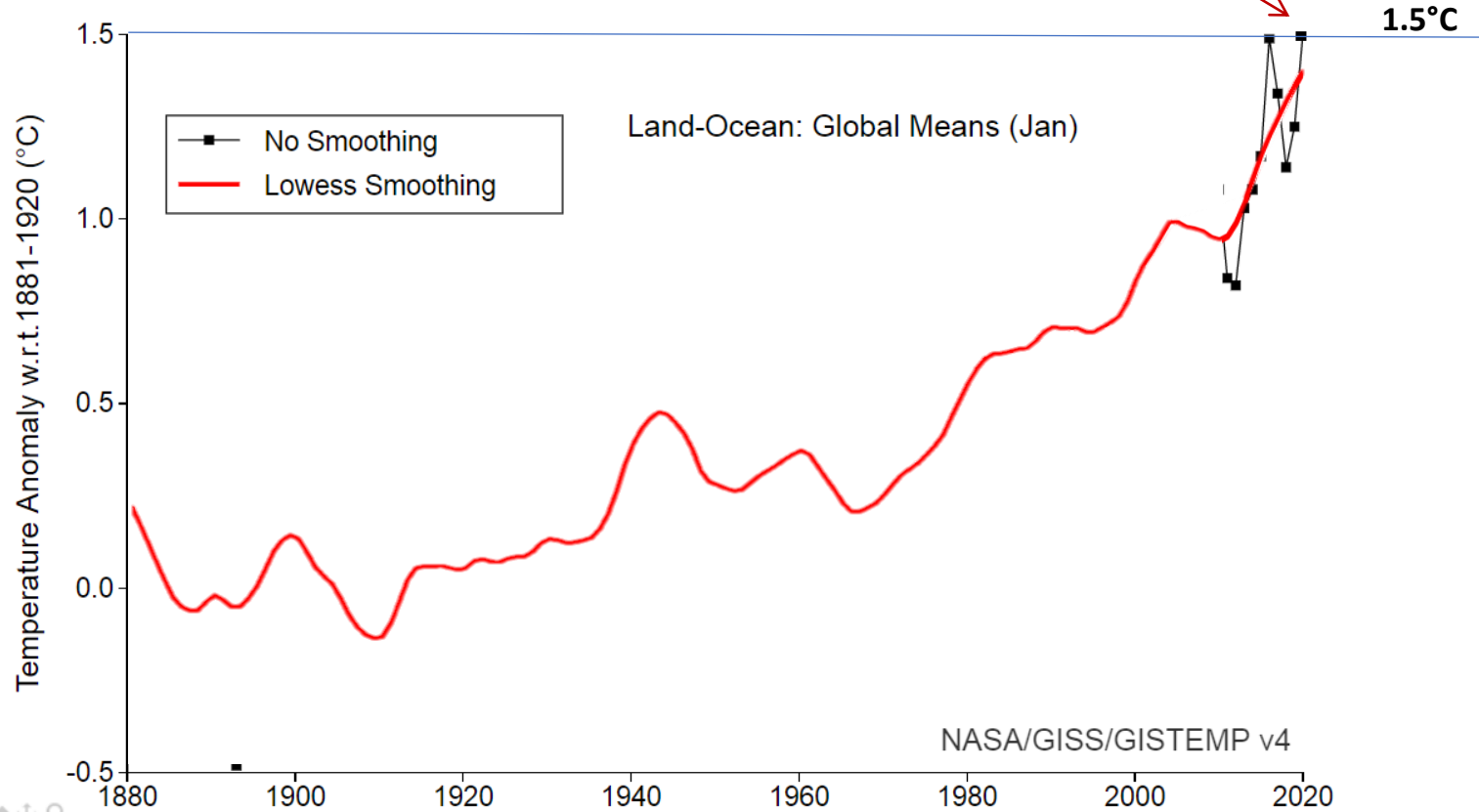
Arctic surface heating is accelerating much faster than anywhere else.

Thawing permafrost is emitting methane, CO₂ and nitrous oxide (global warming feedback emissions).

Due to increasing CO₂ as well as methane emissions from permafrost, the Arctic has now switched from a carbon sink to a carbon source (NOAA 2016, 2019 Arctic Report Cards).

Permafrost is included in this presentation because its amplifying global warming feedbacks (albedo & GHG emissions) constitute the main cause of hothouse Earth and runaway global heating/climate chaos.

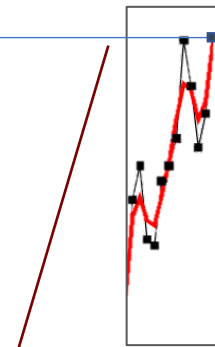
January 2020: at 1.5°C



January 2020

Record January Monthly Surface Heating at **1.5°C**

—■— No Smoothing
2 years



January 2020 Global Temperature Update

“January 2020 was globally the warmest January in the 141-year of instrumental temperature measurements, just edging 2016, the year with a large El Nino” (which boosts global warming).

“January 2020 was **1.50°C** warmer than the 1880-1920 January mean.”

Source: Columbia University, Earth Institute,
NASA GISS climate expert team

🌍 Climate Science, Awareness and Solutions

January 2020: Monthly Record at 1.5°C

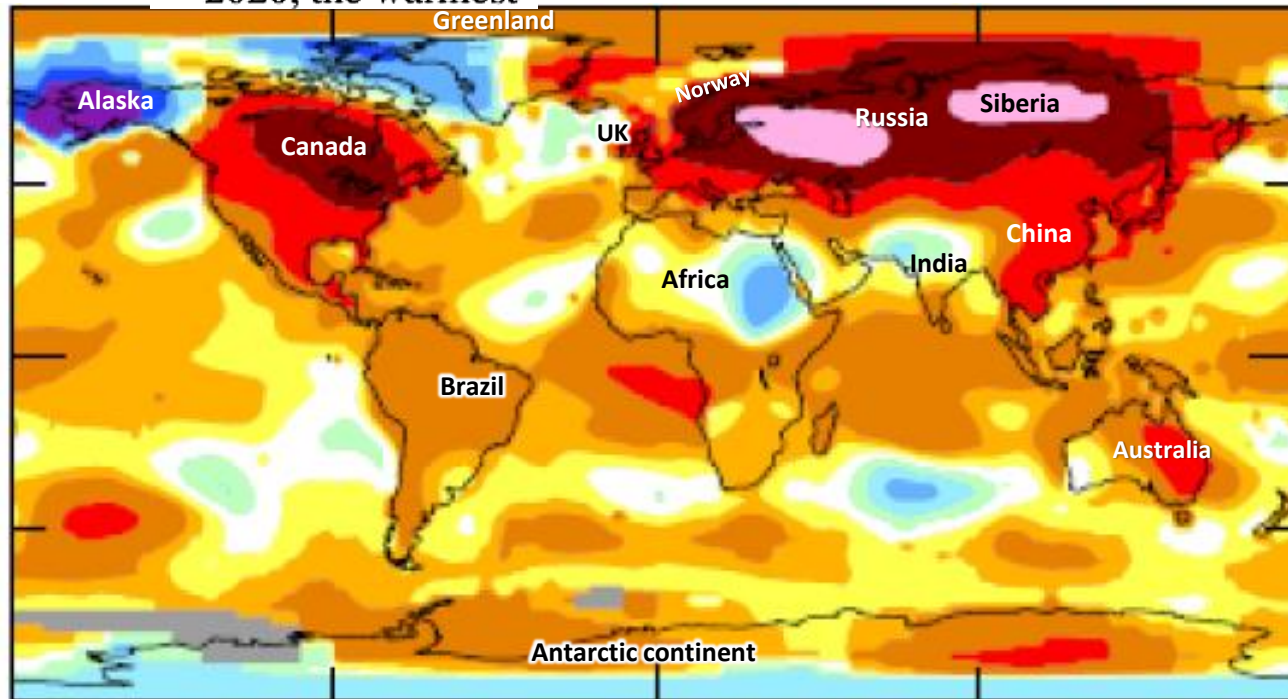
January surface temperature relative to 1951-1980 mean °C

“The northern region, mostly land, has both the greatest warming and greatest variability.”

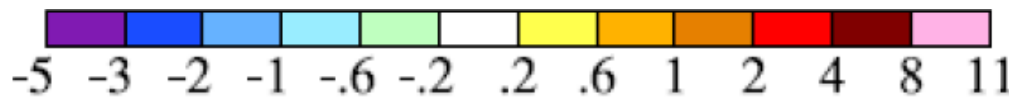
Note: extreme climate chaotic variability of Alaska and Siberia

2020, the warmest

1.18



“Parts of Siberia were much warmer than normal, by as much as 14°C.”



Columbia University, Earth Institute
Temperature updates and figures
by J. Hansen and M. Sato ,
February 2020

Permafrost Distribution (NASA)

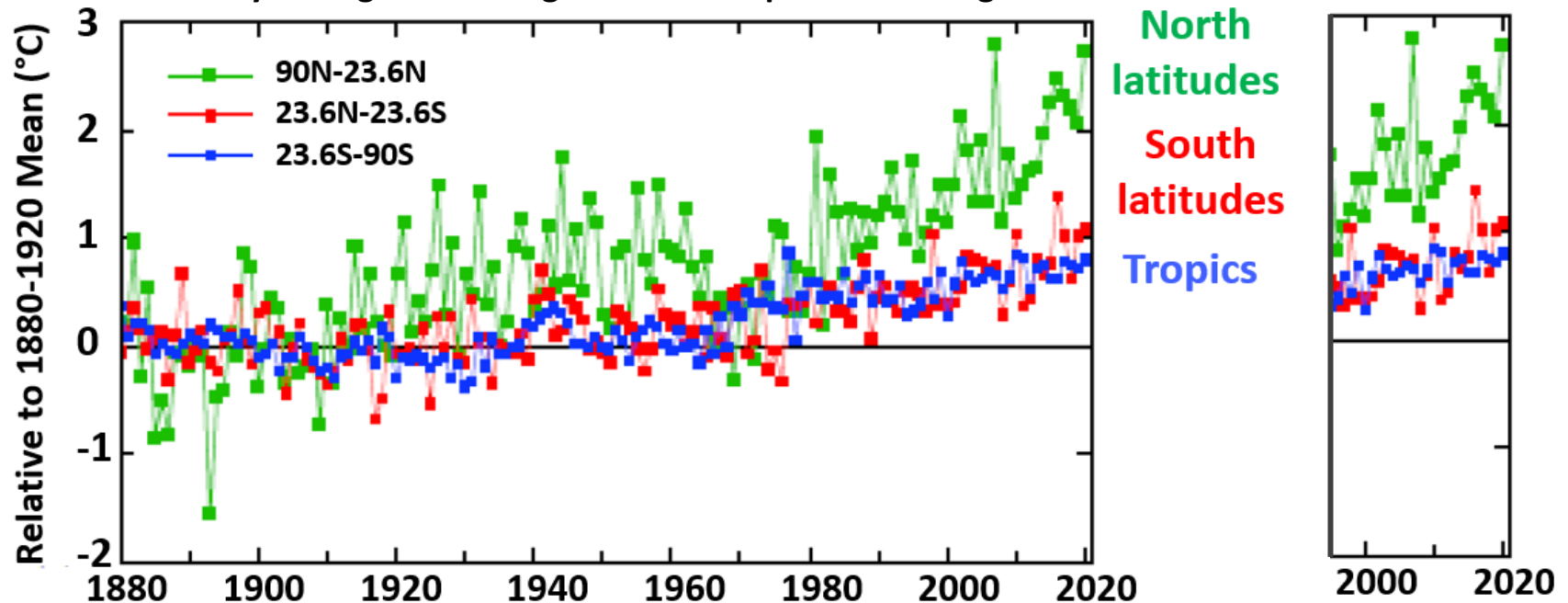


Climate Emergency Institute

January 2020: Accelerating Zonal Surface Temperature Increases Particularly Since 2000

“The northern region, mostly land, has both the greatest warming and greatest variability.”

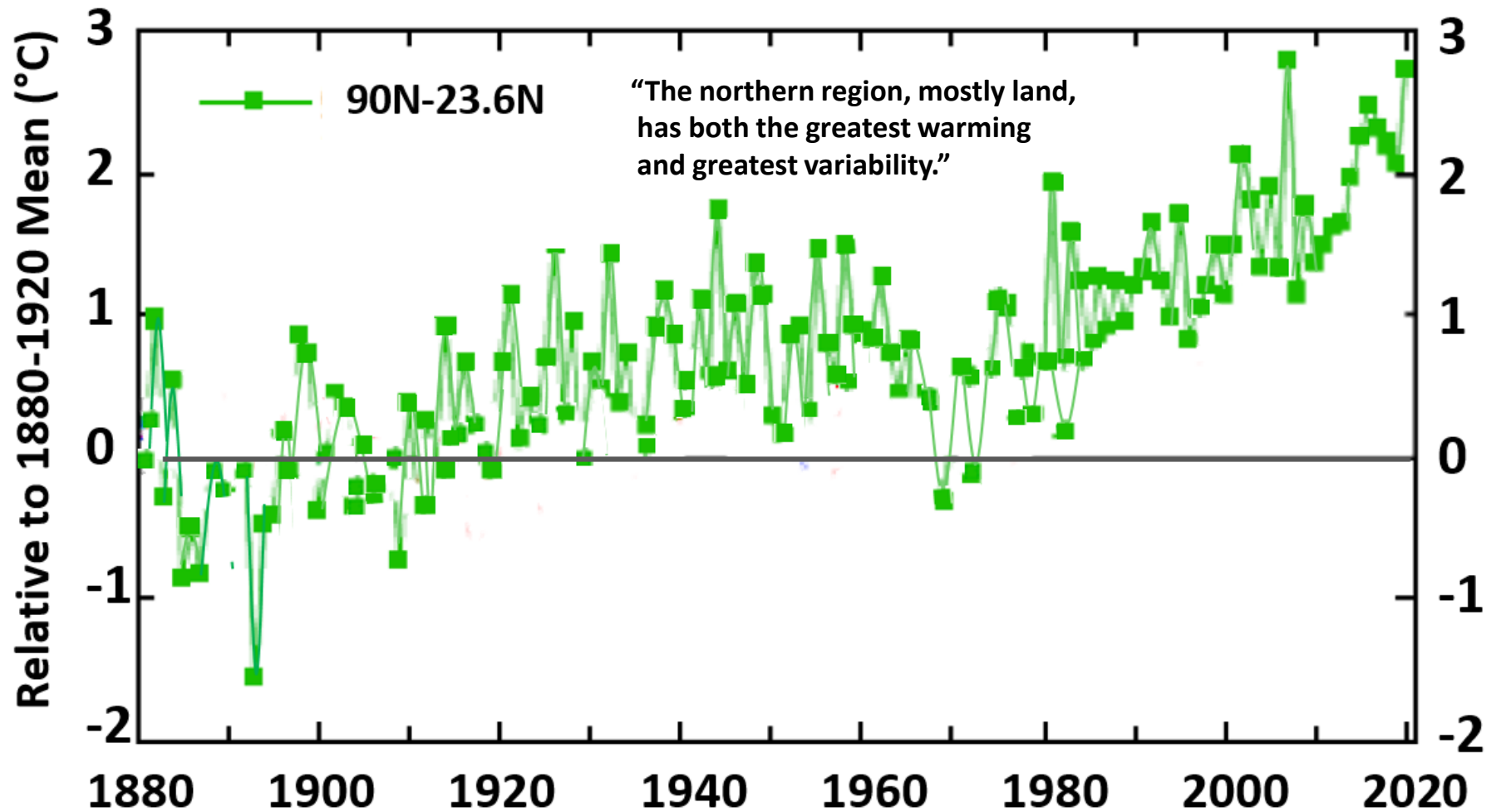
January 2020 global average surface temperature change



Columbia University, Earth Institute
Temperature updates and figures by J. Hansen and M. Sato , February 2020

Climate Emergency Institute

January 2020 Accelerating Northern Hemisphere Surface Heating Reached 2.8°C



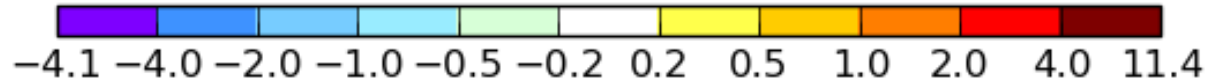
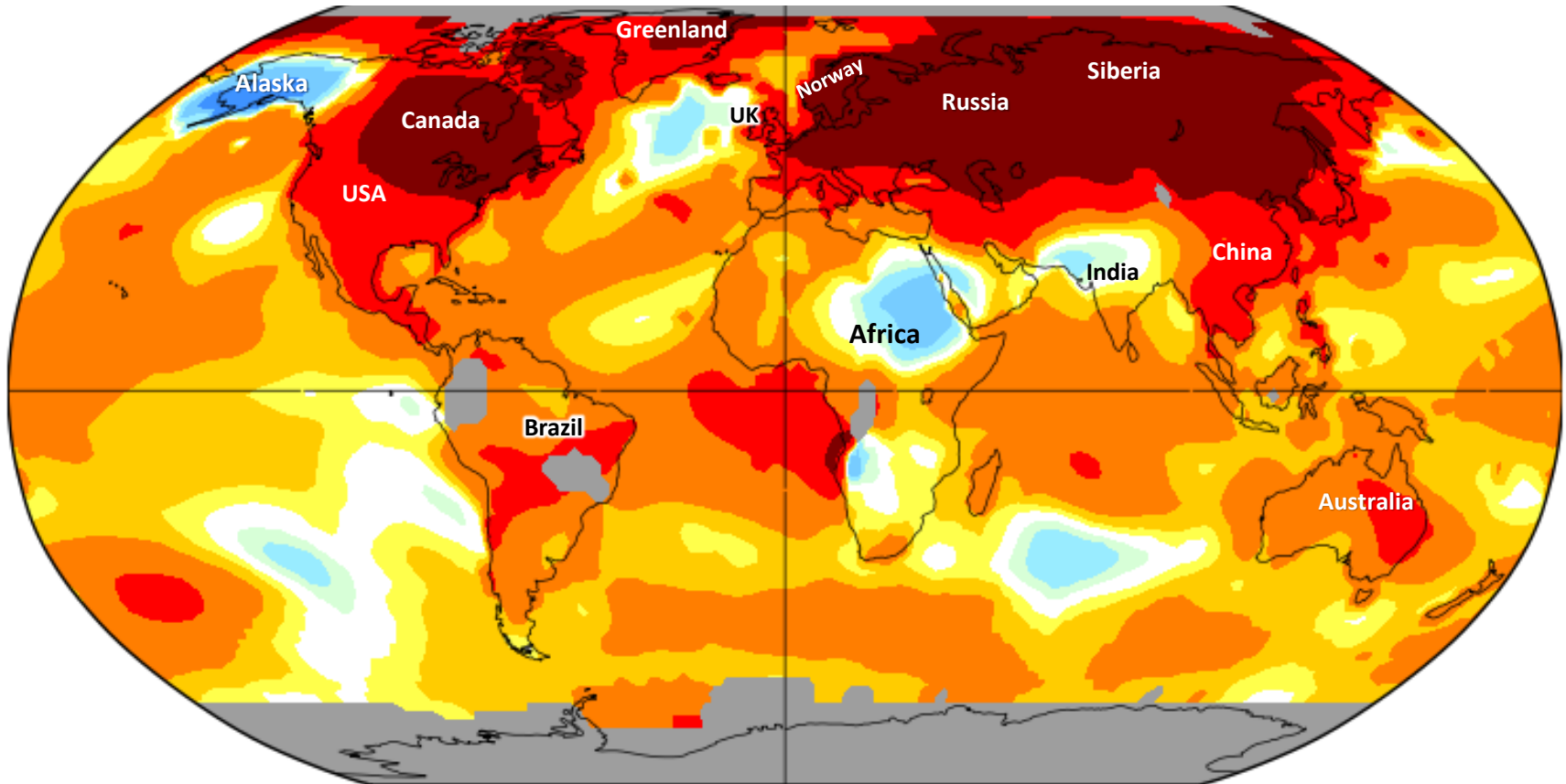
JANUARY 2020

Global Average Surface Temperature Increase 1.51°C

January 2020

L-OTI(°C) Anomaly vs 1881-1920

1.51



JANUARY 2020

Global LAND Surface Temperature Increase

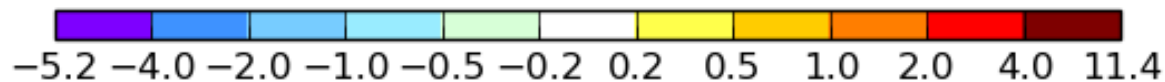
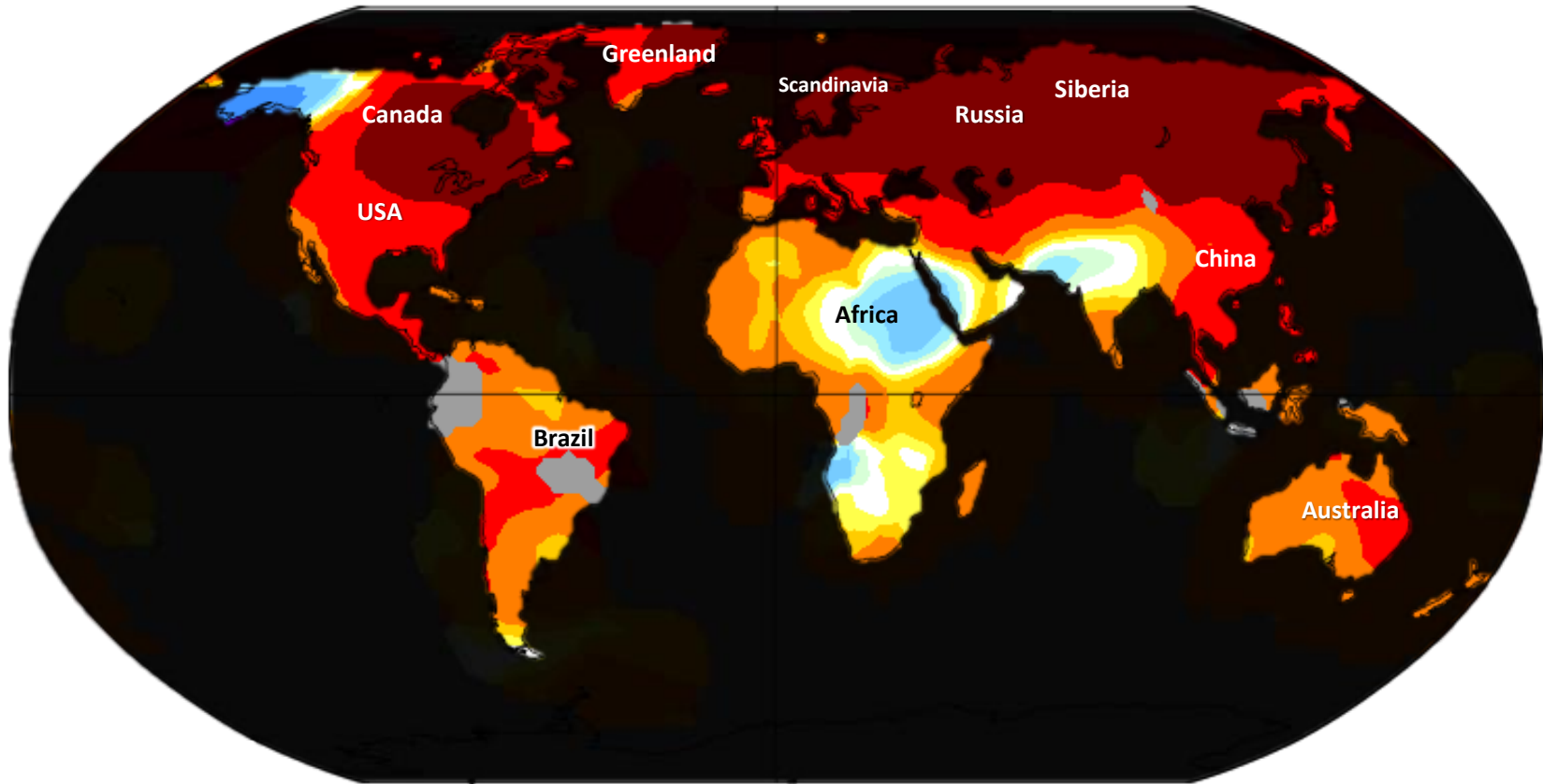
January 2020

1.92°C

Tsurf(°C) Anomaly

vs 1881-1920

Permafrost Distribution (NASA)



JANUARY 2020

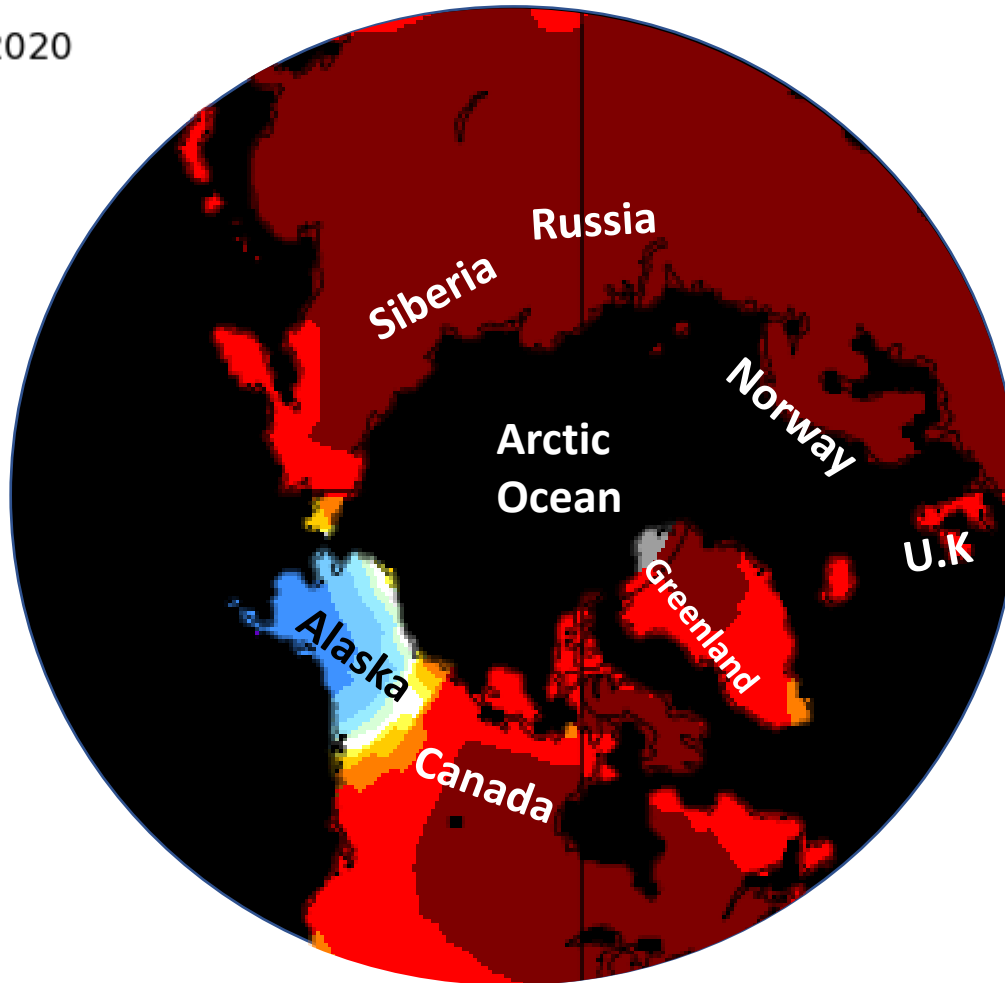
Arctic & N. Hemisphere Land Surface Temperature Increase

Tsurf(°C) Anomaly vs 1881-1920

1.92°C

January 2020

1.92



Permafrost Distribution Arctic Polar View



Permafrost (purple)

NASA

2019

**Global surface temperature increase
from 1880-1920 baseline**

**is at 1.2°C and
ACCELERATING**

(Multiple references)

2019 global surface **temperature** increase from 1880-1920 baseline is at 1.2°C and **accelerating**

Abstract.

“Global surface temperature in 2019 was the 2nd highest in the period of instrumental measurements in the Goddard Institute for Space Studies (GISS) analysis.

The rate of global warming has accelerated in the past decade.

The 2019 global temperature was +1.2°C (~2.2°F) warmer than in the 1880-1920 base period.

The five warmest years in the GISS record all occurred in the past five years.

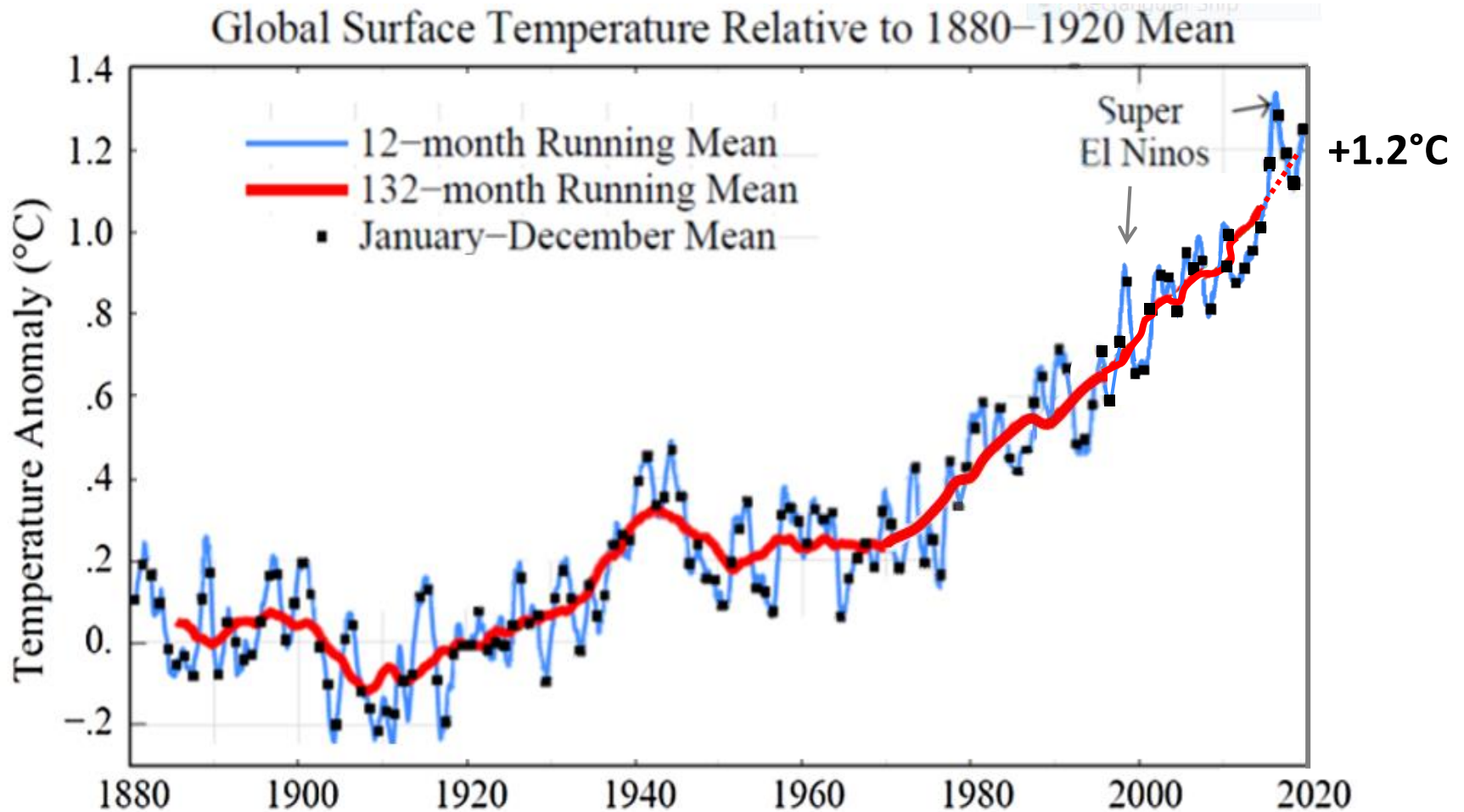
Growth rates of the greenhouse gases driving global warming are increasing, not declining.”

15 January 2020

James Hansen, Makiko Sato, Reto Ruedy, Gavin Schmidt, Ken Lob, Michael Hendrickson

Climate Science, Awareness and Solutions

2019 global surface temperature increase from 1880-1920 baseline is at 1.2°C and **accelerating**



from Global Temperature in 2019
15 January 2020

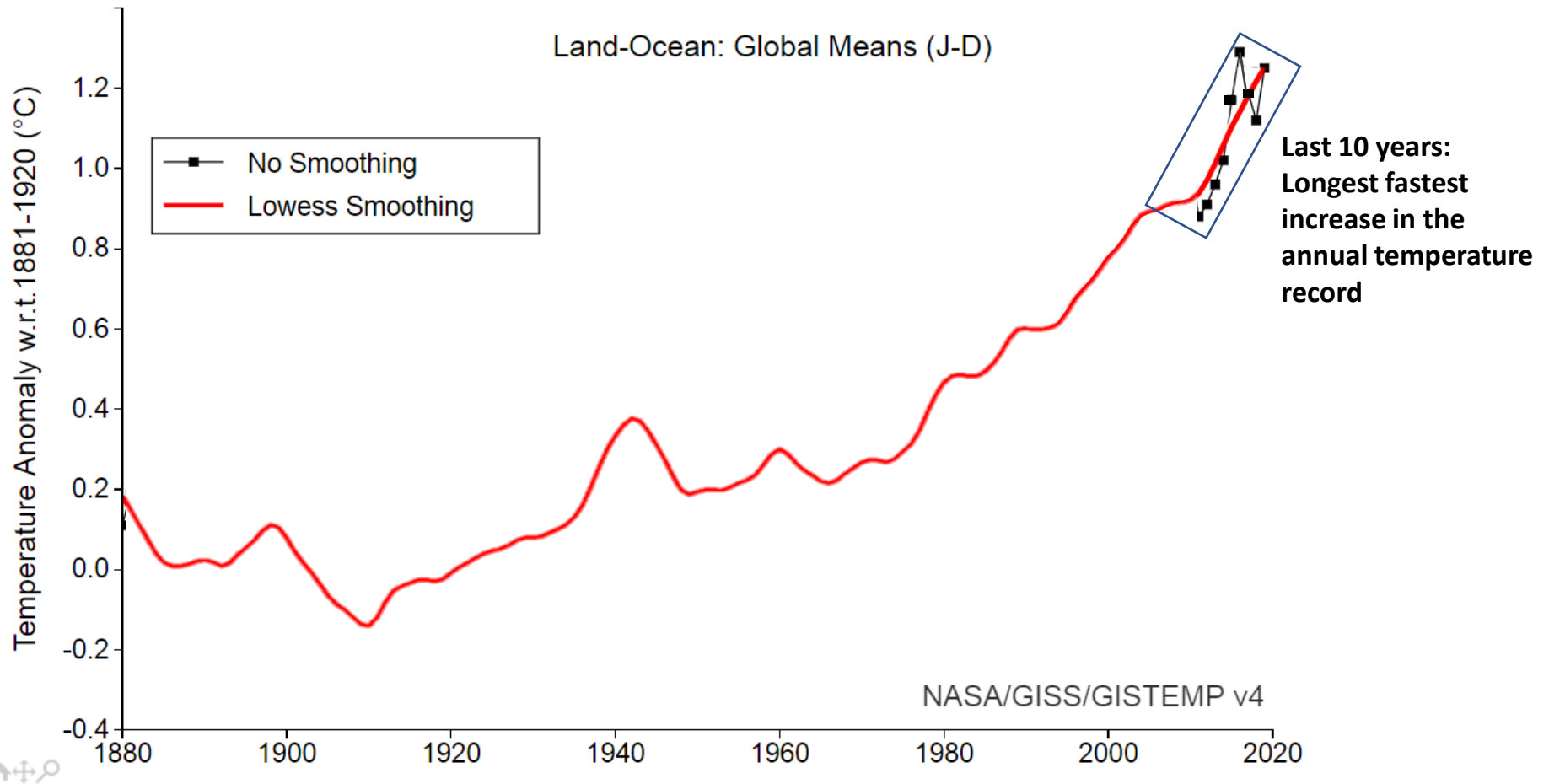
James Hansen, Makiko Sato, Reto Ruedy, Gavin Schmidt, Ken Lob, Michael Hendrickson

Climate Science Awareness and Solutions

Climate Emergency Institute

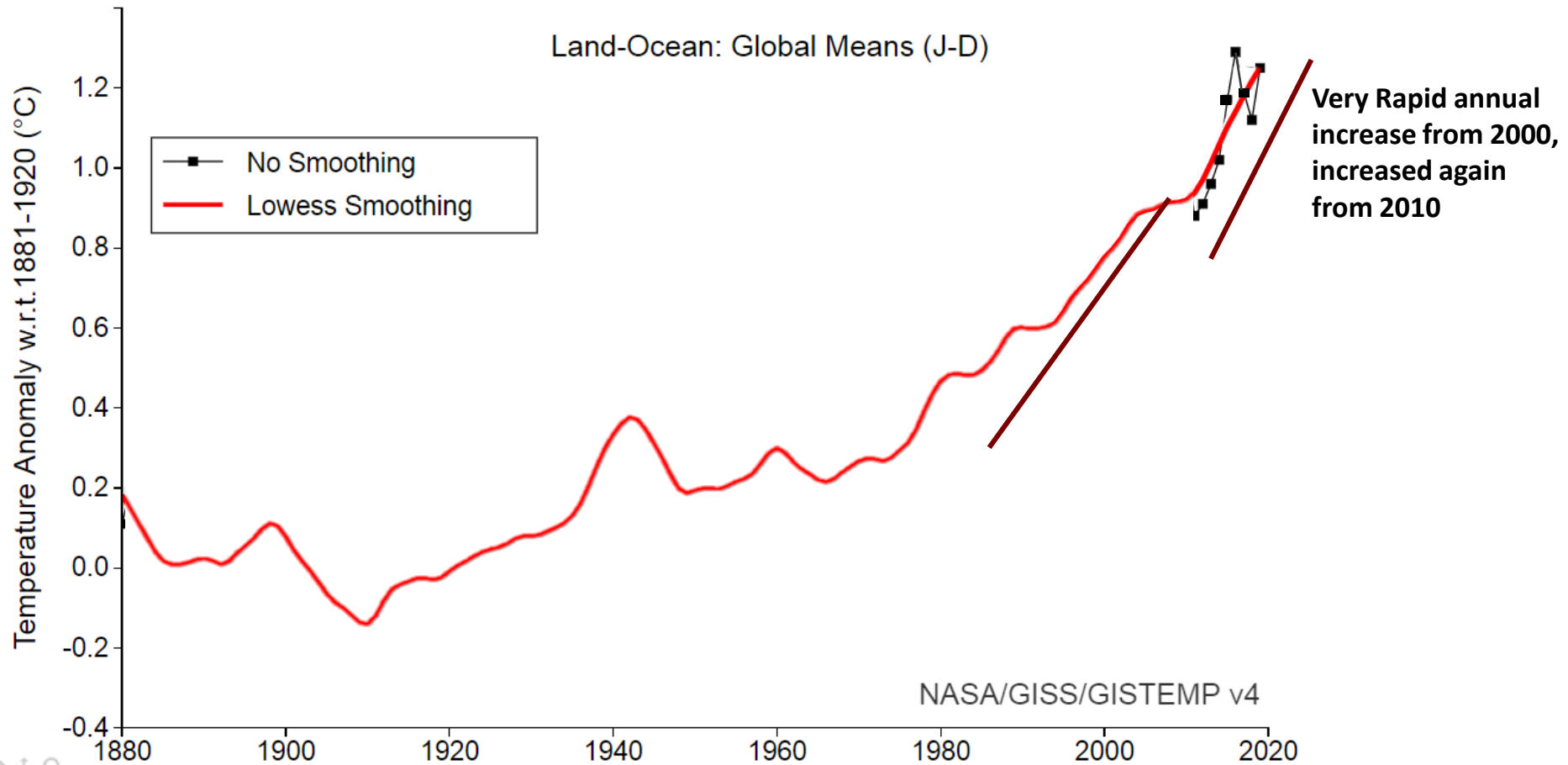
2019 global surface temperature increase
from 1880-1920 baseline
is at 1.2°C and

accelerating



2019 global surface temperature increase
from 1880-1920 baseline
is at 1.2°C and

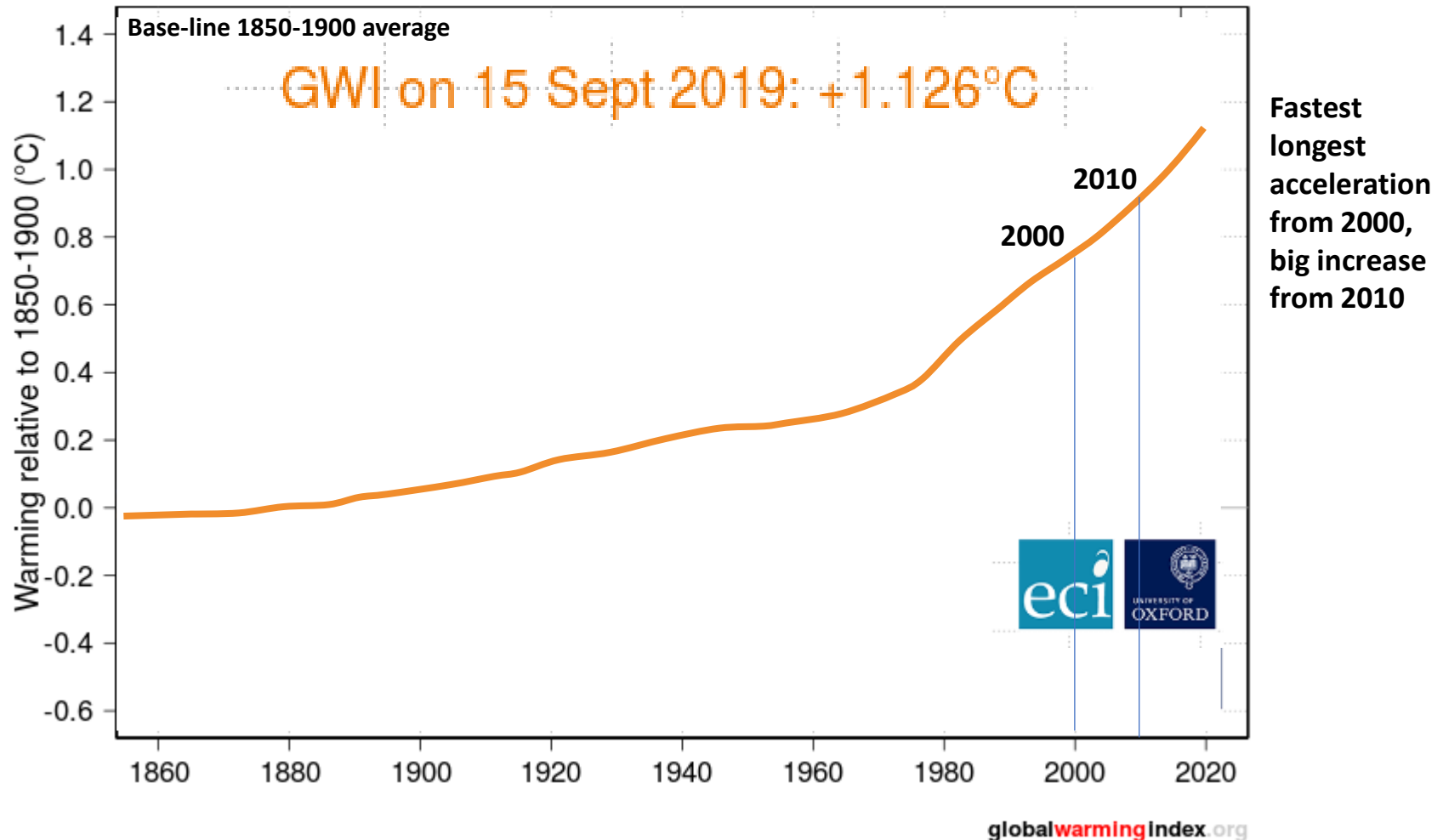
accelerating



Accelerating Global Warming Index to September 2019: 1.26°C

Global average temperature increase caused solely by human GHG emissions

Global Warming Index (aggregate observations) - updated to Sept 2019



2019: WIDESPREAD RECORD HEAT

December: joint record with 2015

November: joint record with 2016)

October: record (just)

September: record

August: 2nd highest

July: record

June: record

Note: 2019 was a weak-El Nino year
unlike the strong El Nino of 2015-16

(Source: Copernicus)

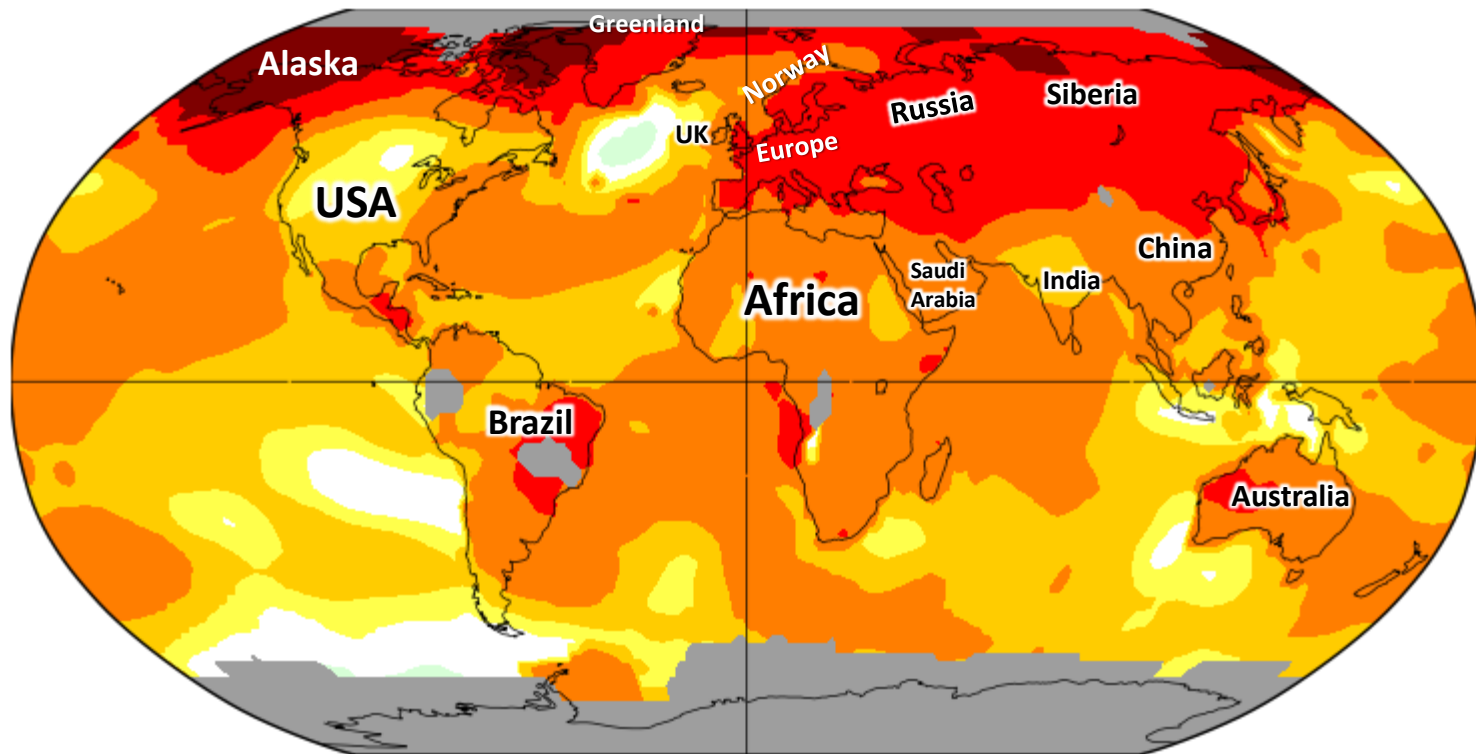
2019 Global Average Surface Heating

1.23°C (from NASA GISS map)

Annual J-D 2019

L-OTI (°C) Anomaly vs 1881-1920

1.23 NASA GISS



Data Sources: Land : Ocean :

Map Type:

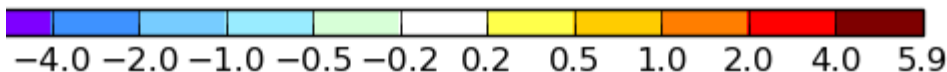
Mean Period:

Time Interval: Begin End

Base Period: Begin End

Smoothing Radius:

Map Projection:



GISS Surface Temperature Analysis (v4)

Global Maps

2019 Global LAND Surface Heating

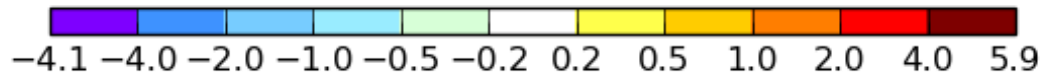
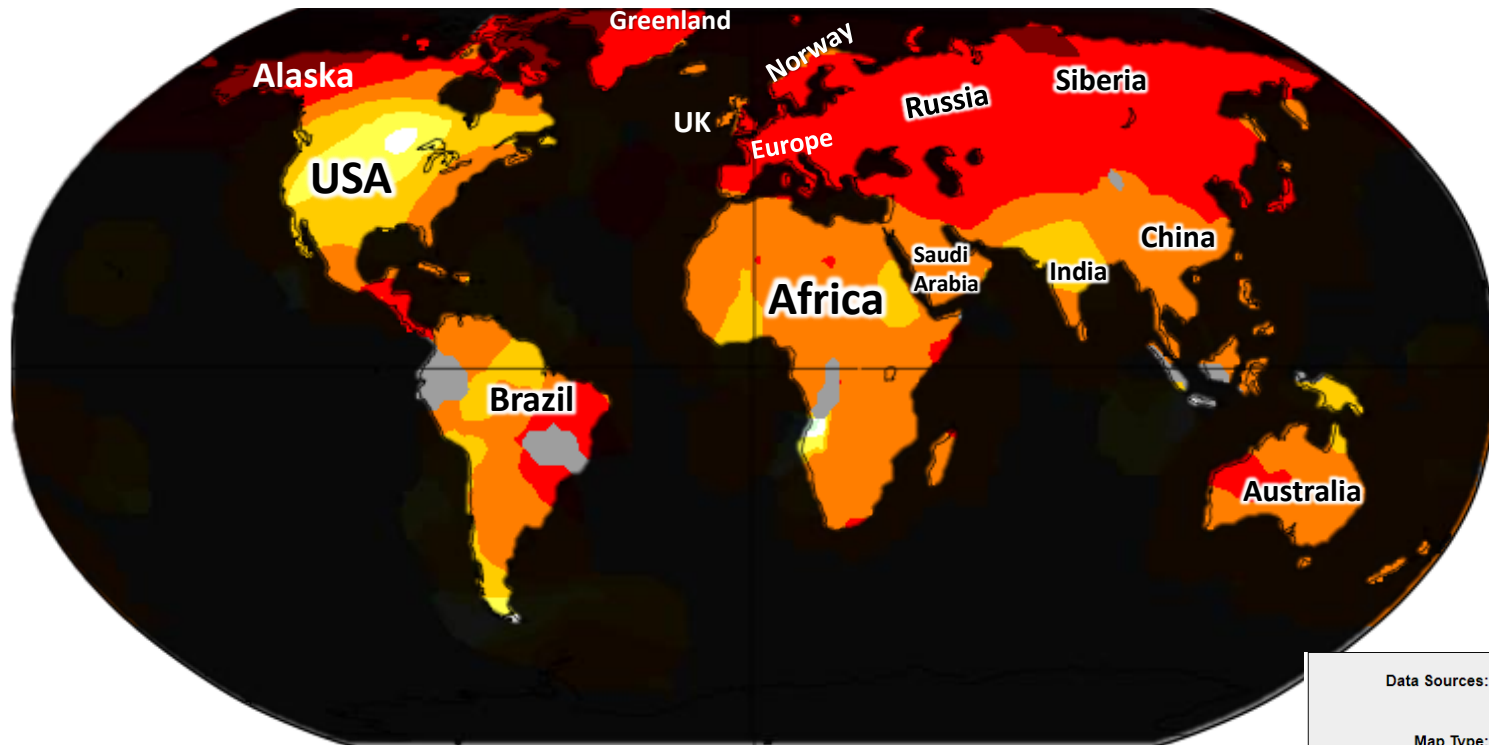
1.57°C

NASA GISS

Annual J-D 2019

Tsurf(°C) Anomaly vs 1881-1920

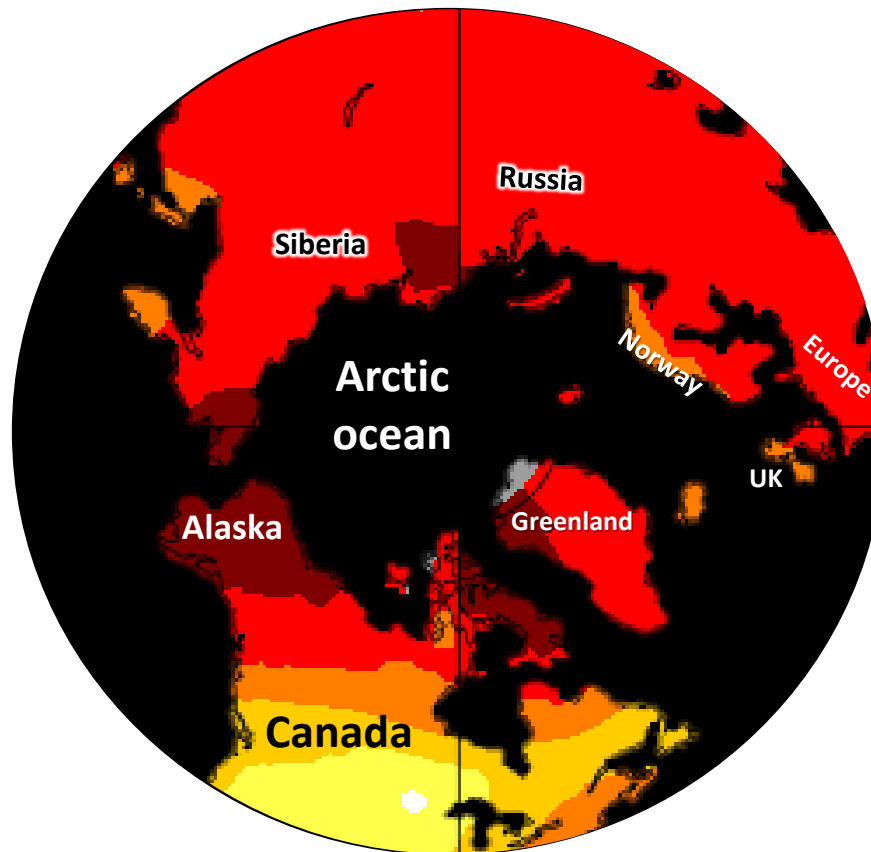
1.57



Data Sources:	Land : <input type="text" value="GHCNv4"/>	Ocean : <input type="text" value="none"/>
Map Type:	<input type="text" value="Anomalies"/>	
Mean Period:	<input type="text" value="Annual (Jan-Dec)"/>	
Time Interval:	Begin <input type="text" value="2019"/>	End <input type="text" value="2019"/>
Base Period:	Begin <input type="text" value="1881"/>	End <input type="text" value="1920"/>
Smoothing Radius:	<input type="text" value="1200 km"/>	
Map Projection:	<input type="text" value="Robinson"/>	
<input type="button" value="Make Map"/>		

2019 Arctic & N. Hemisphere Land Surface Heating (1.57°C global land)

Tsurf(°C) Anomaly vs 1881-1920
Annual J-D 2019



NASA permafrost map
Permafrost Distribution Arctic Polar View

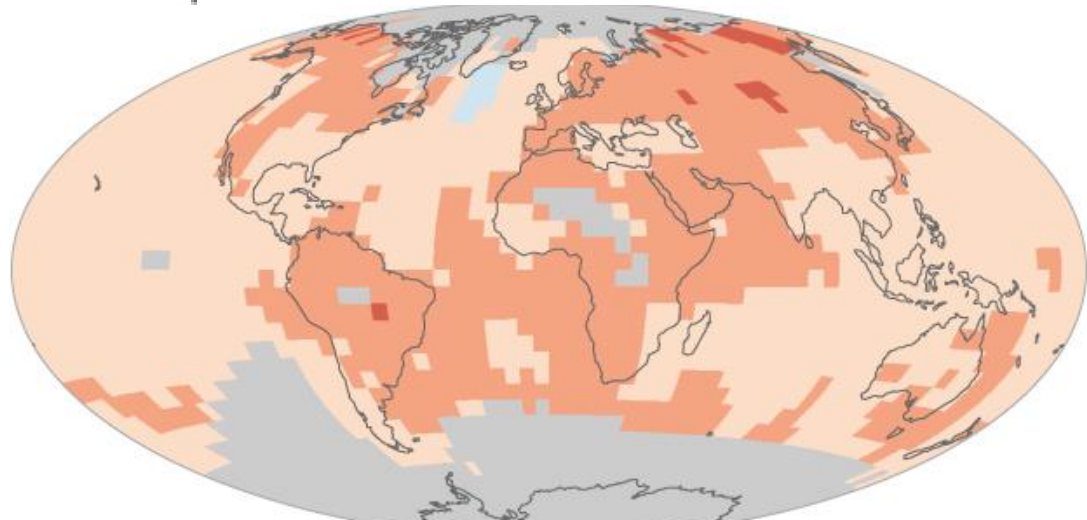


2019 Accelerating Global Surface Heating (from NOAA)

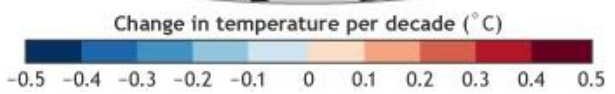
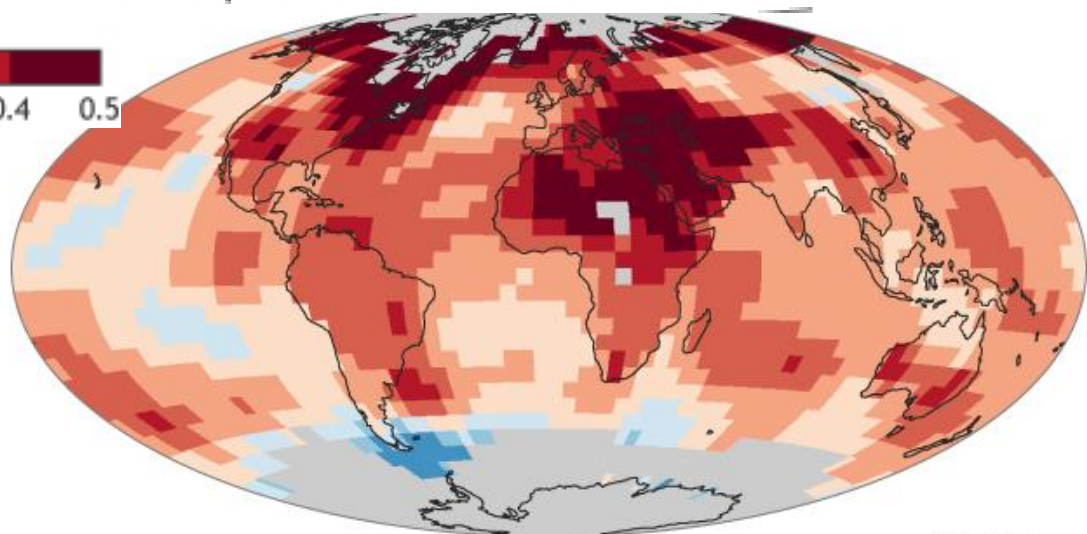
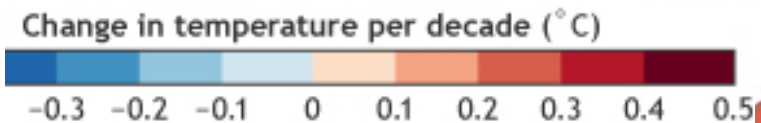
NOAA 16 Jan 2020

“The combined land and ocean temperature has increased at an average rate of 0.07°C per decade since 1880; however, the average rate of increase since 1981 (0.18°C) is more than twice as great.”

Global temperature trends from 1901 to 2017



Global temperature trends from 1988 to 2017

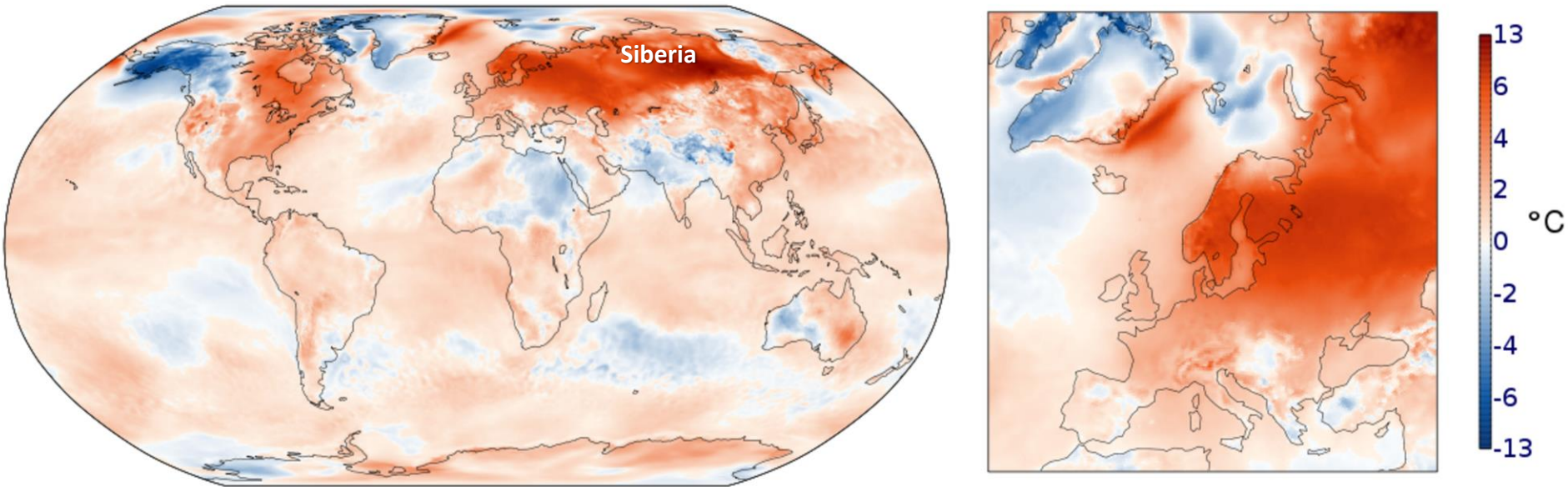


NOAA Climate.gov
Data: NCEI

2019 Record Surface Heating Affected Europe

from Copernicus, European Commissions

Surface air temperature anomaly for January 2020 relative to 1981-2010

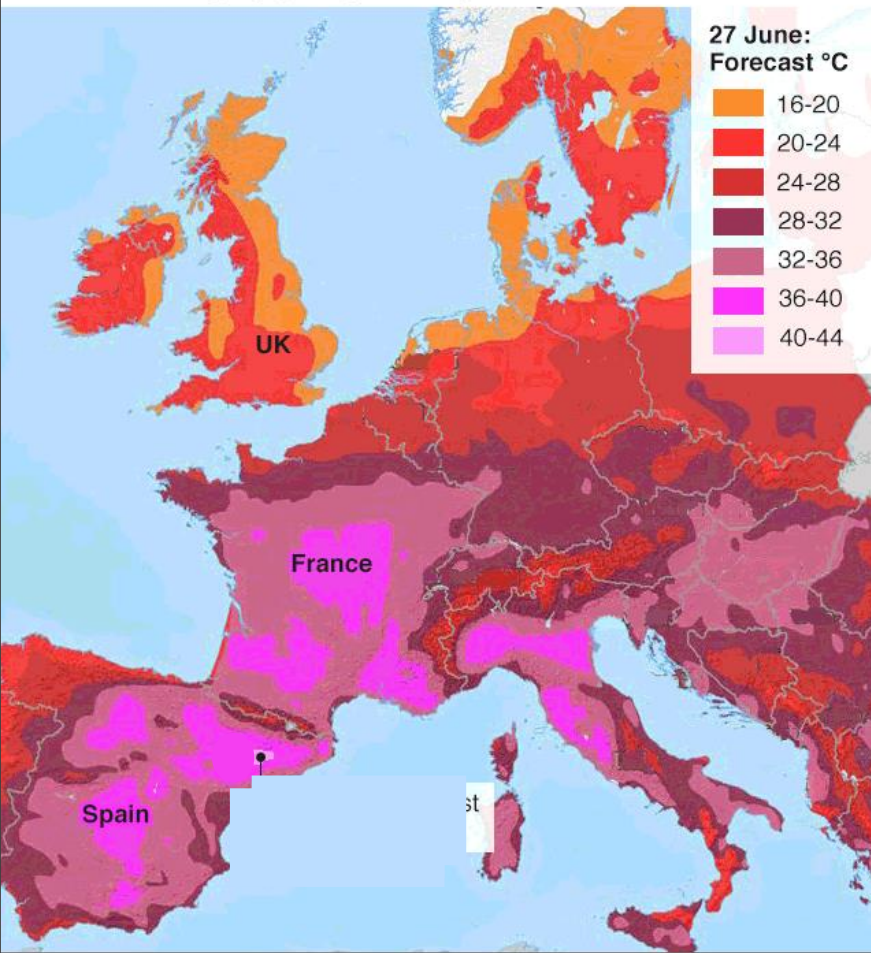


Permafrost Distribution (NASA)

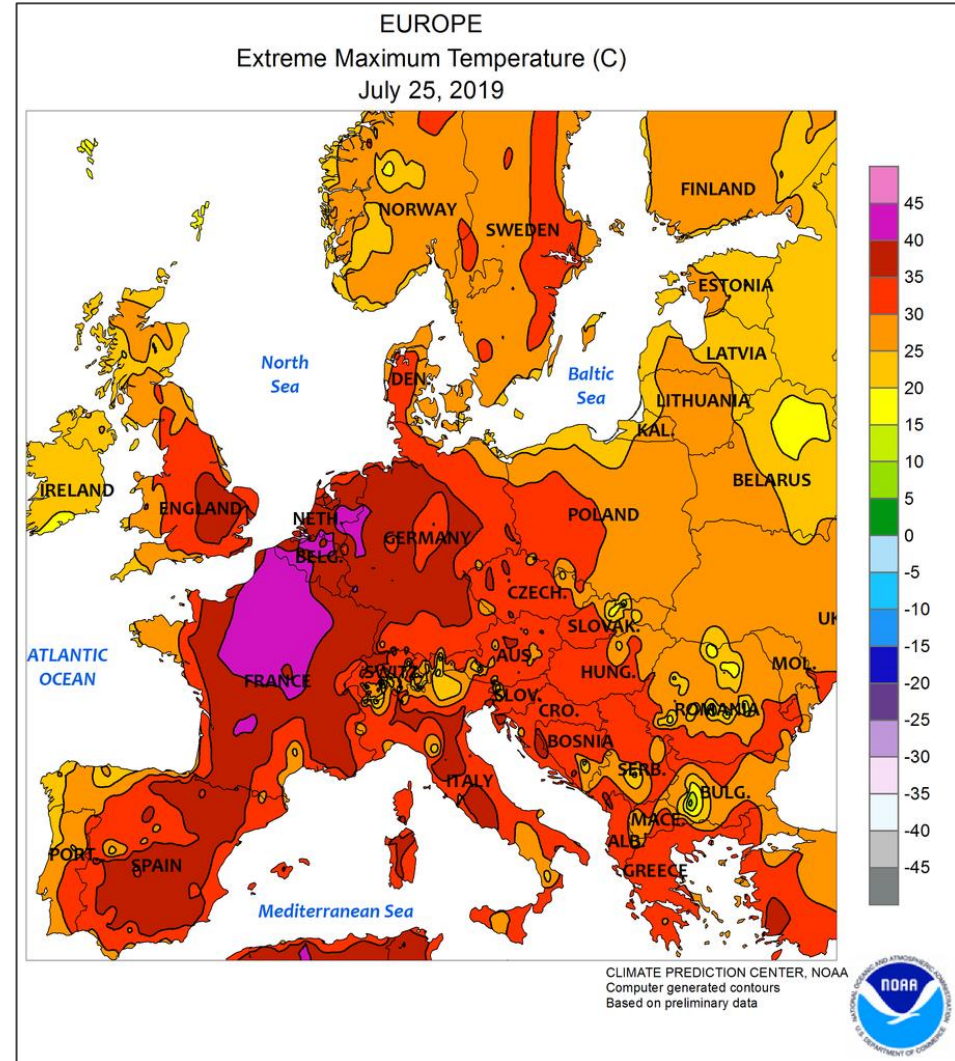


Europe 2019: Back-to-back Extreme Heat Waves with Record Temperatures in June and July

Heatwave gripping Europe



Source: ERCC/WMO



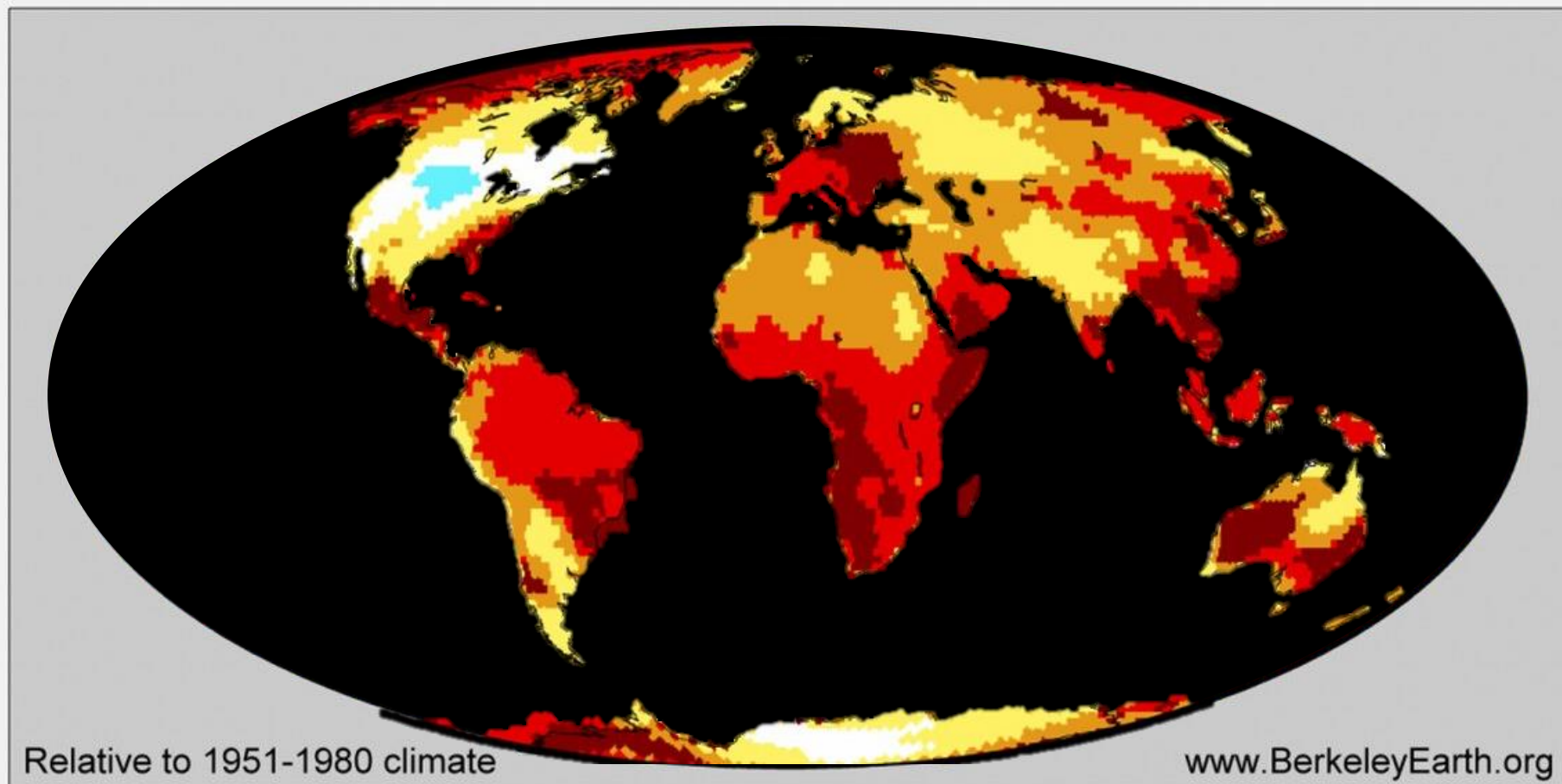
2019: Heat Records and Extremes

36 countries - from Belize to Botswana, from Slovakia to South Africa - experienced their hottest year since instrumental records began




Numerous locations around the globe that already have warmed by at least 2 degrees Celsius over the past century

Berkeley Earth: January to December 2019





 Record Low

 Extreme Low

 Very Low

 Below Average

 Near Average

 Above Average

 Very High

 Extreme High

 Record High

**Disastrous and Catastrophic, Rapidly Increasing
Extreme Heat Waves, Affecting All Regions,
with Unprecedented Severe Impacts on
Populations and Food Crops is Unavoidable**

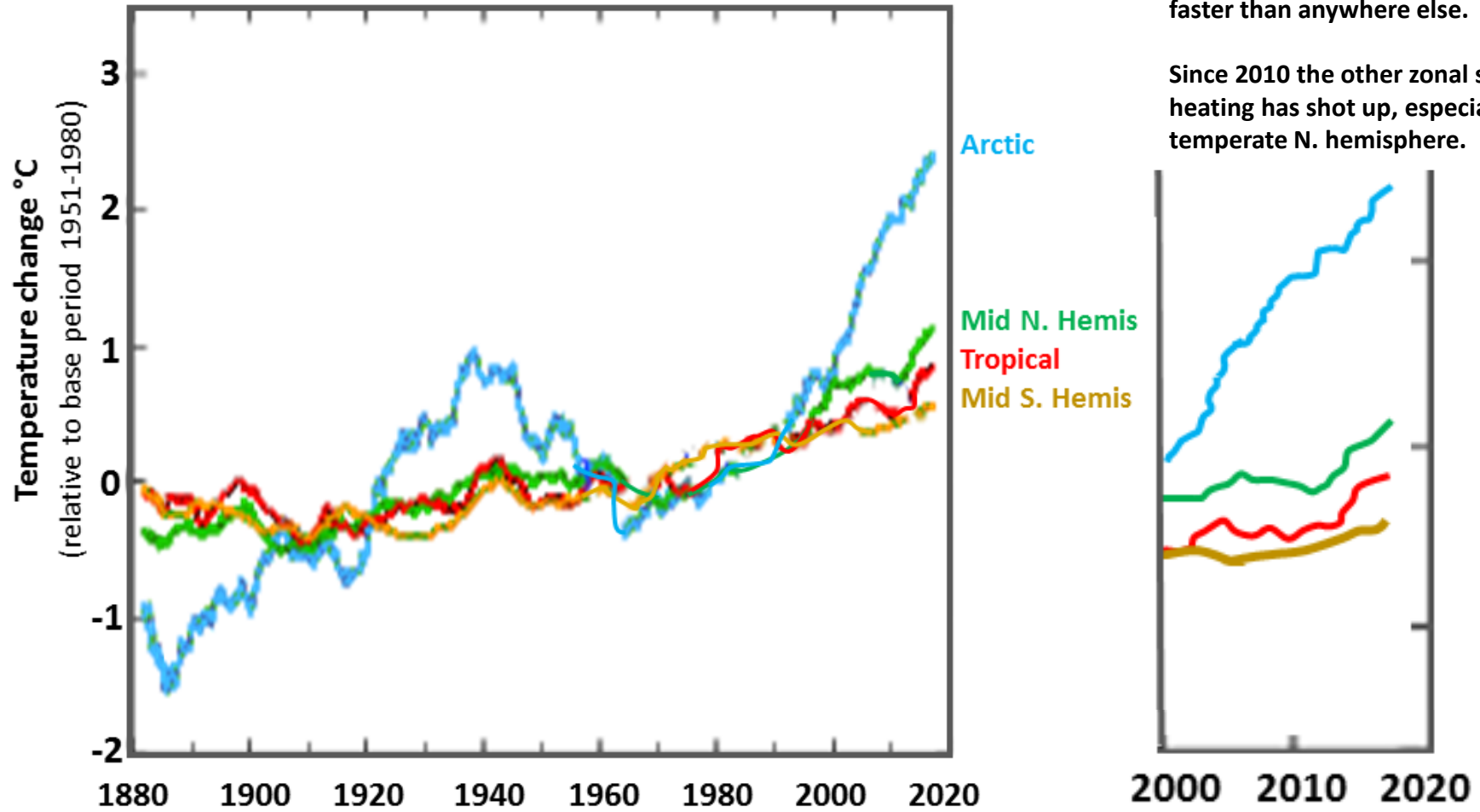
Arctic: Fastest Accelerating Heating since 2000

Recent Decade Rapid Acceleration of Zonal Heating

Zonal average temperature increases 1880-2019

Since 2000 Arctic acceleration (amplification) has soared much faster than anywhere else.

Since 2010 the other zonal surface heating has shot up, especially the temperate N. hemisphere.



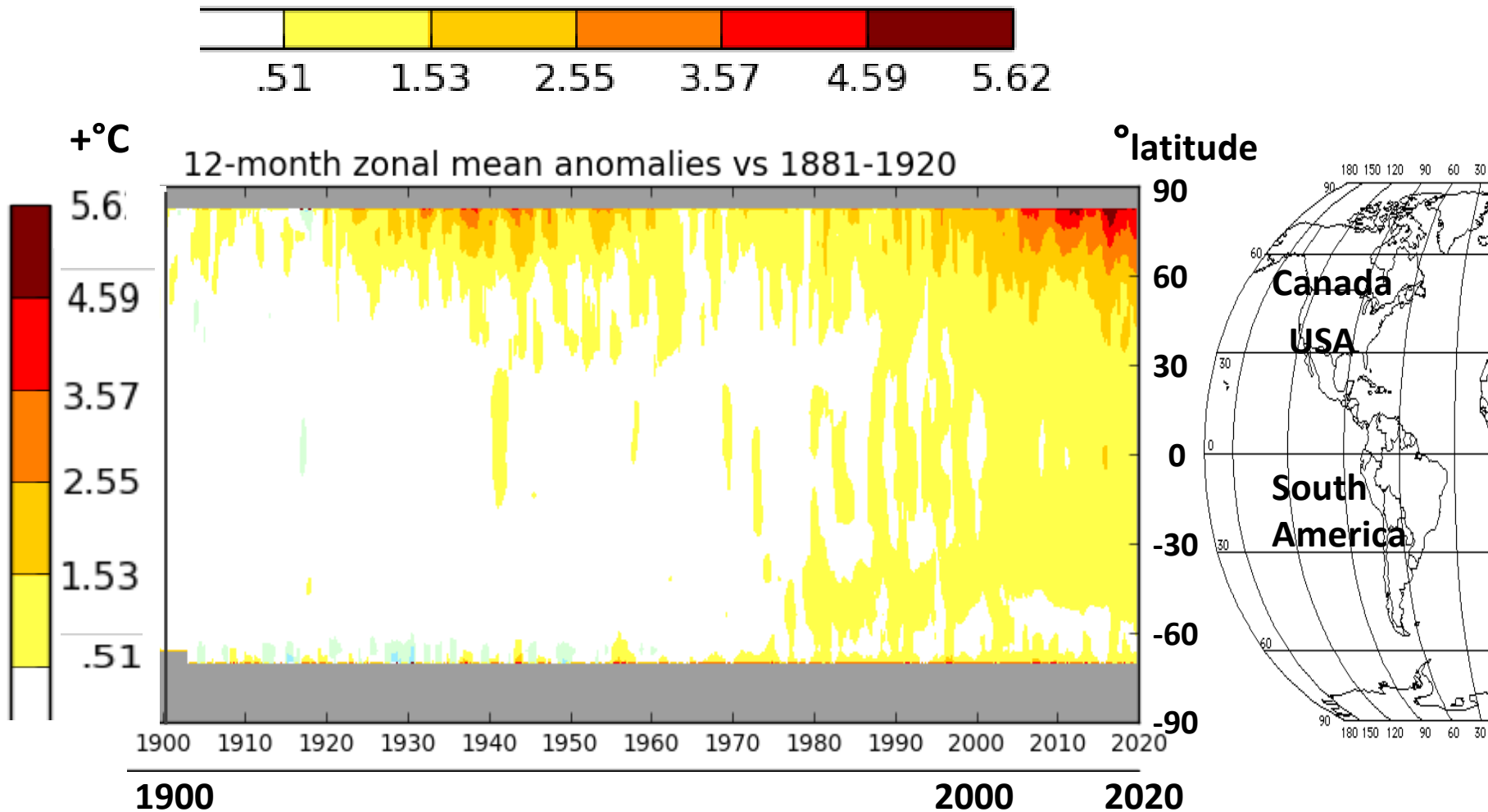
Zonal means, 12-month running mean temperature changes in five zones: Arctic , N. Mid-Latitudes, Tropical, S. Mid-Latitudes, Data through June 2019 used

Source: J. Hansen, Columbia Earth Institute accessed Jan 2020

Climate Emergency Institute

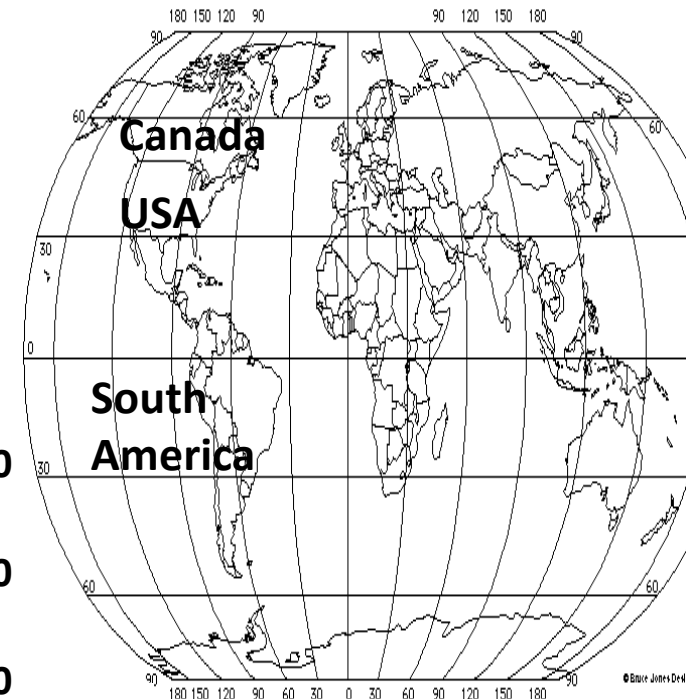
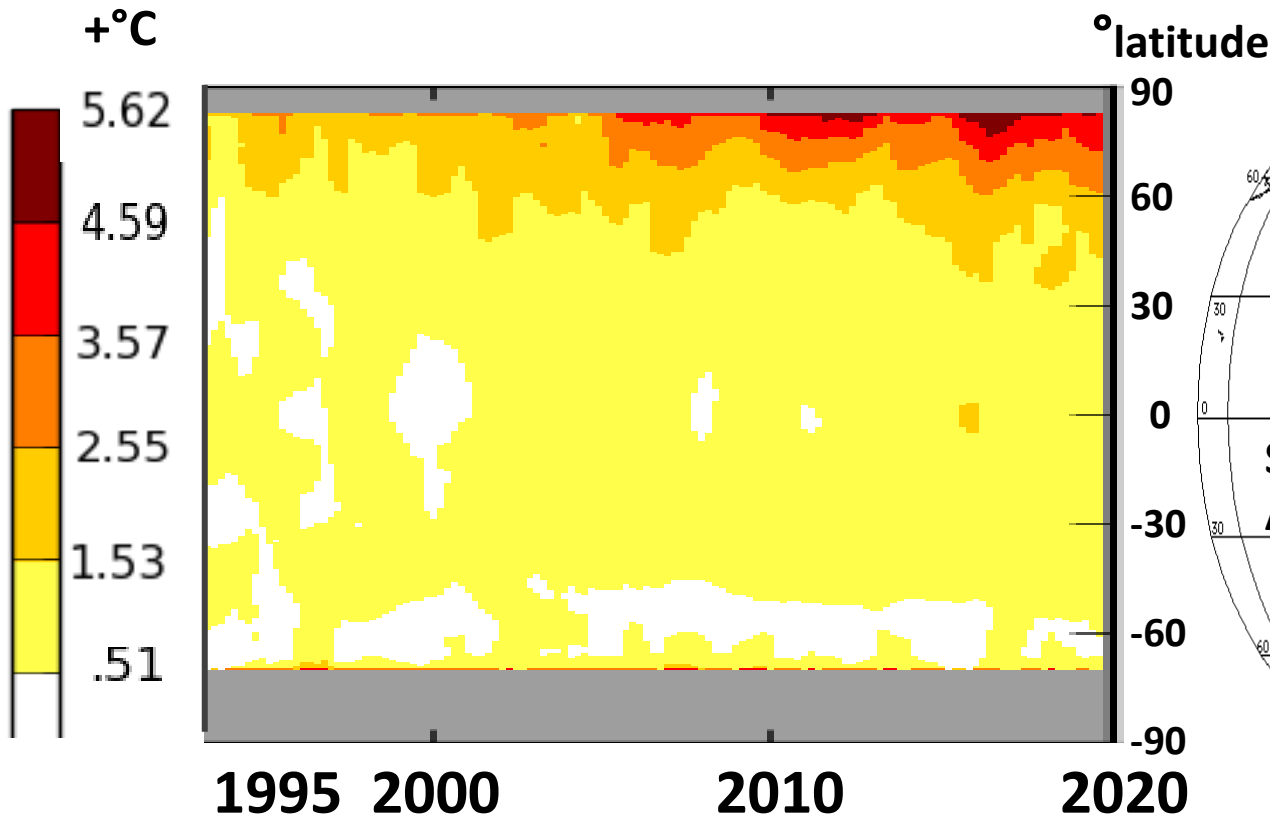
Zonal Average Temperature Change 1900-2019

NASA GISS



Zonal Average Temperature Change 2000-2019

NASA GISS

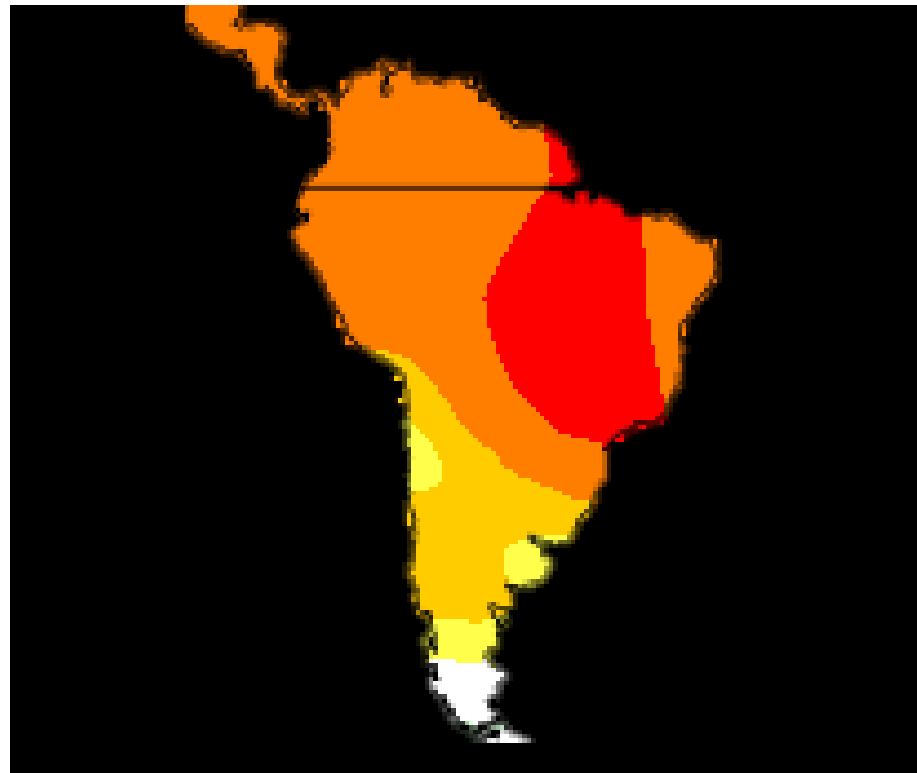


2019 Summer Amazon Heating

In September 2019, global land heating was 1.43°C.
Regions in and close to the Amazon were very hot.

September 2019

Tsurf(°C) Anomaly vs 1951-1980



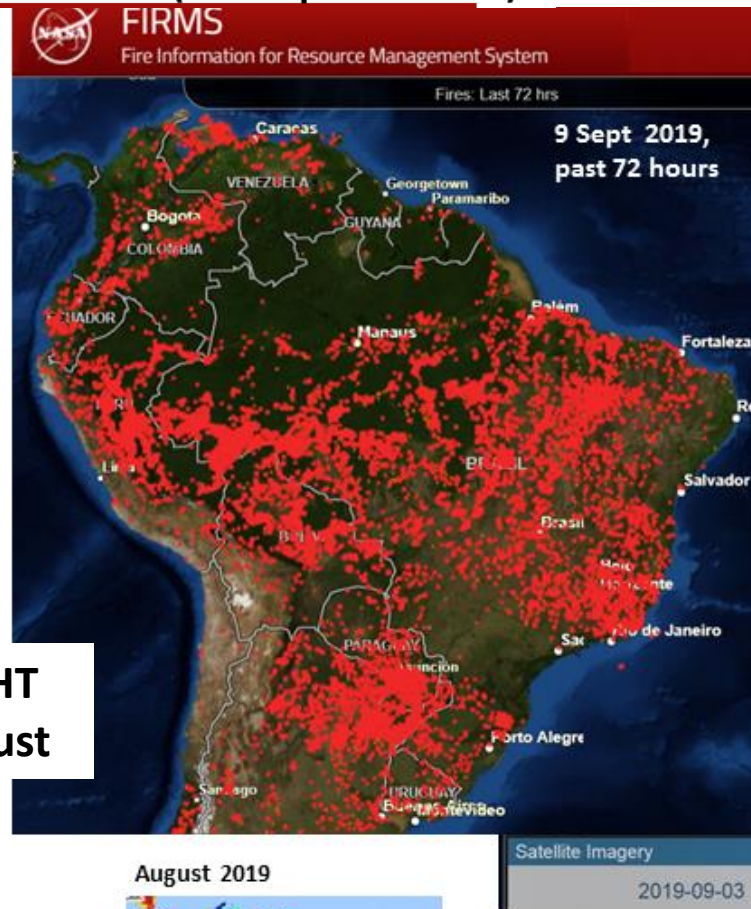
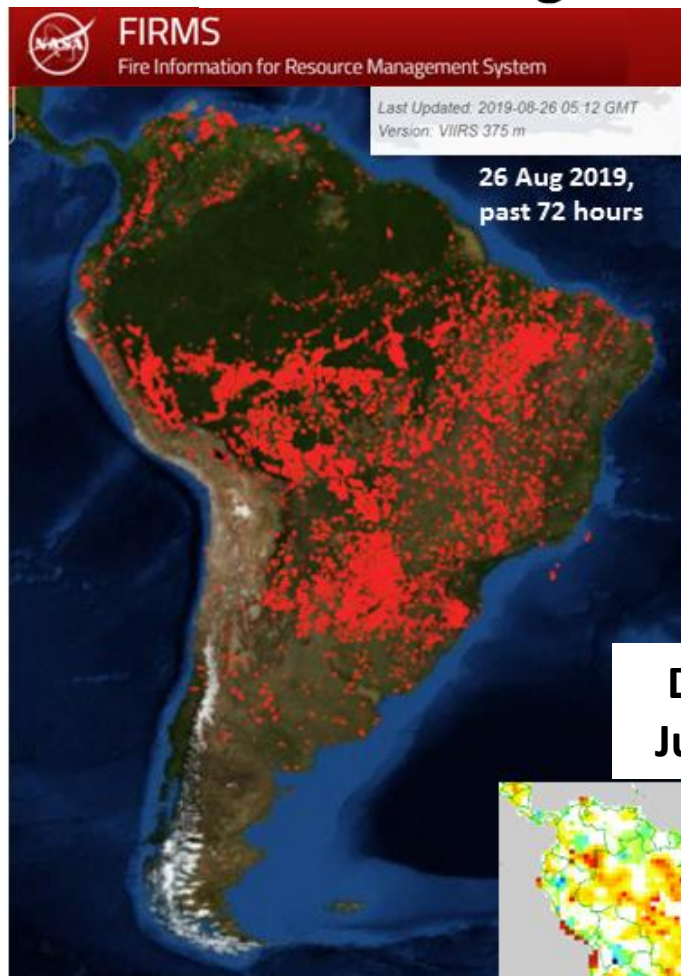
From NASA GISS



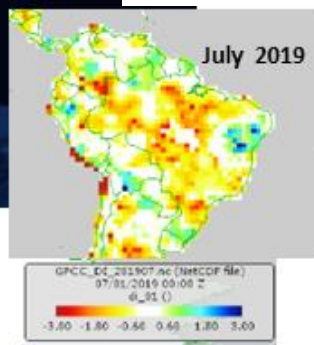
Climate Emergency Institute

2019 was a Big Record for Amazon Fires

The Wasting of the Amazon (3 Sept 2019)

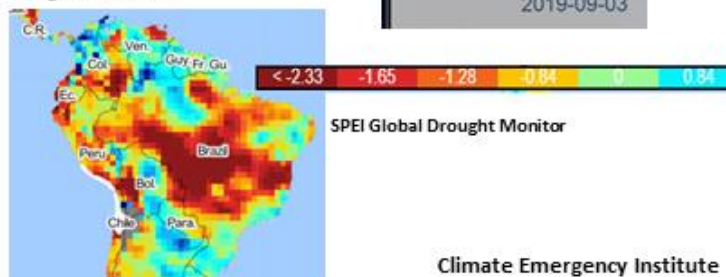


**DROUGHT
July-August**



US Global Drought Information System

August 2019

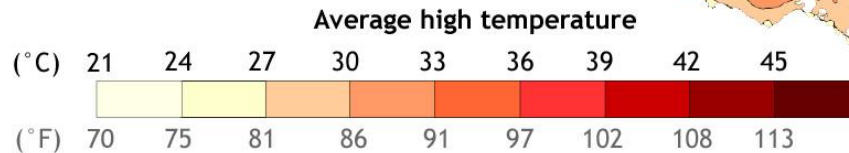
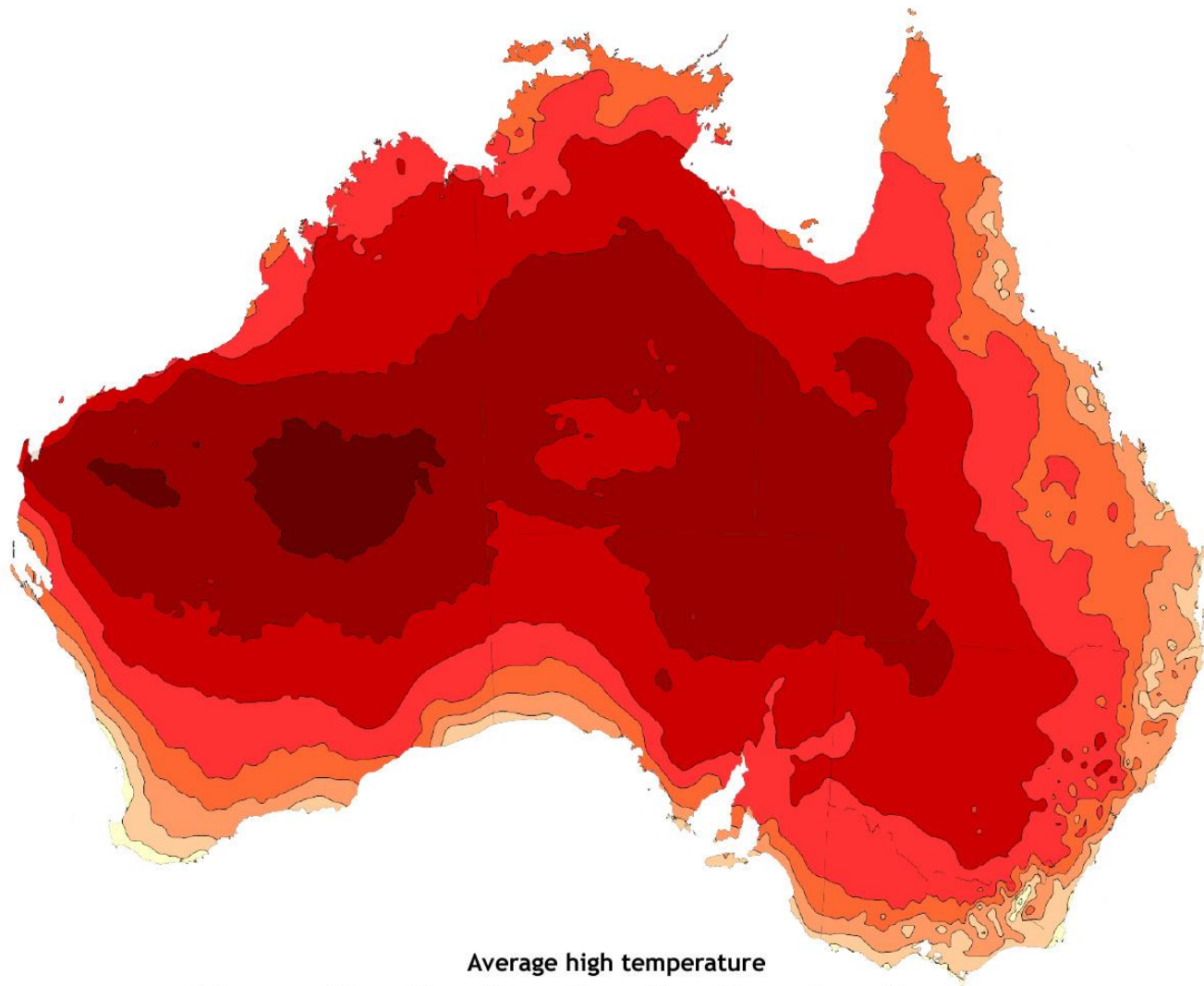


SPEI Global Drought Monitor

Climate Emergency Institute

Australia Heat-Wave 2019: Catastrophic Wildfires

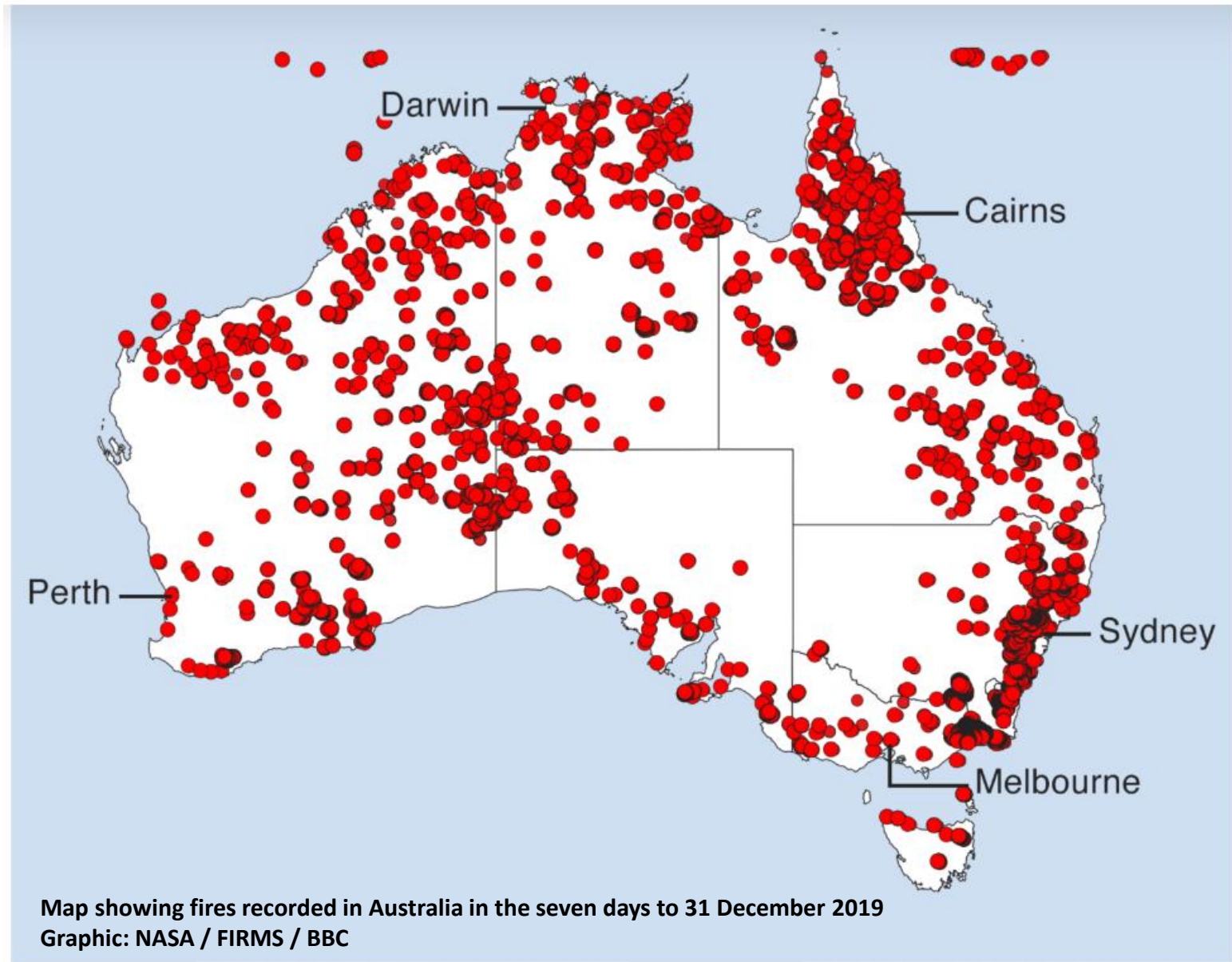
January 3, 2020, NOAA



Mean maximum temperature
week ending Jan 1, 2020

NOAA Climate.gov, adapted from
Australia Bureau of Meteorology

Australia Burning 2019



Australia Burning 2019



One woman shared this picture of her young son wearing a mask and life jacket as the family fled on to a boat to escape the bushfires at Mallacoota, Victoria, Australia on 30 December 2019. Photo: ABC News (Australia)

Global Climate in 2015-2019:

“Climate change **accelerates”**

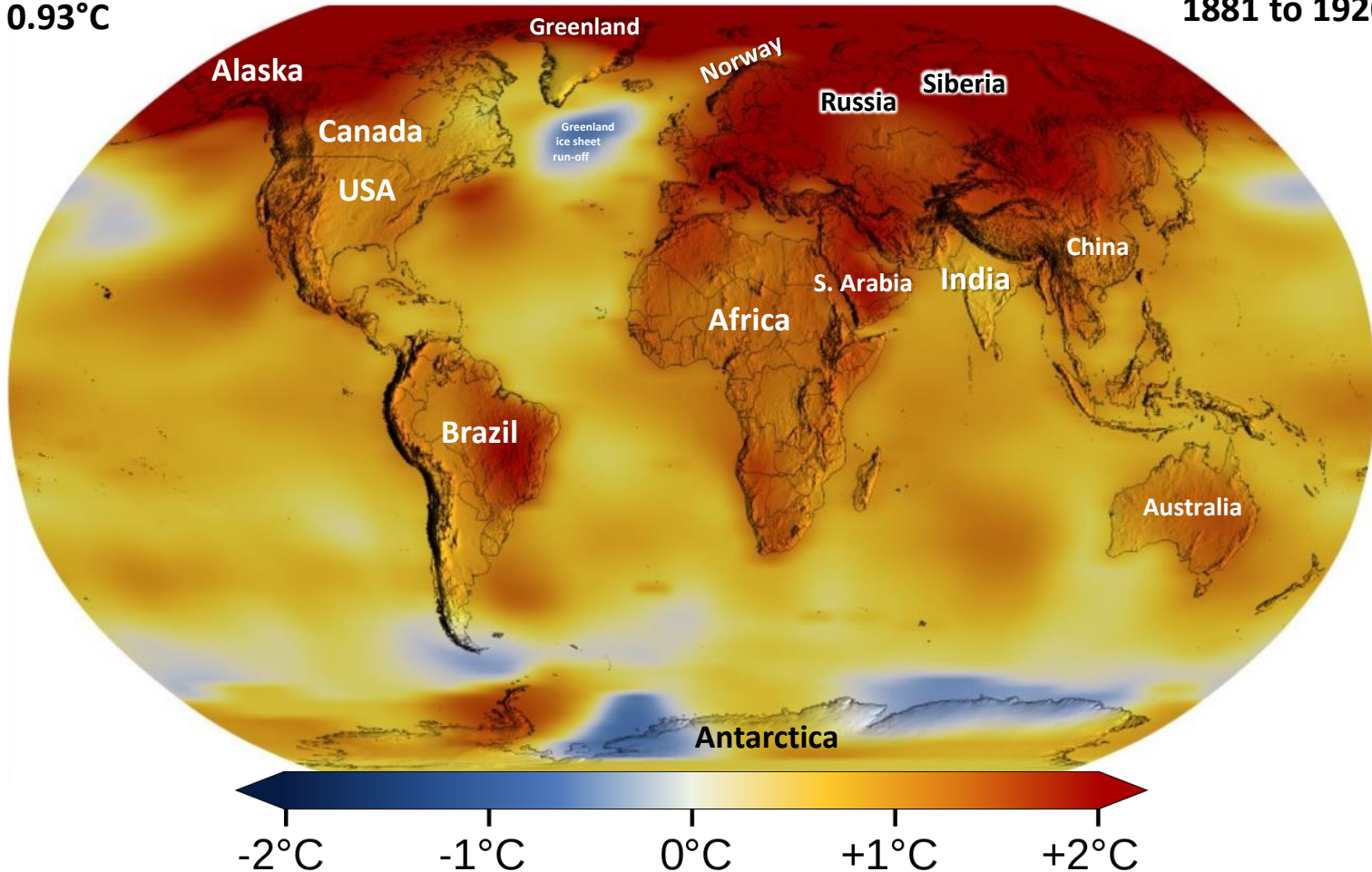
(WMO 2019)

Global Climate in 2015-2019: “Climate change accelerates” (WMO 2019)

Global Surface Heating over the Past 50 years

Increase from
1881 to 1920: 1.2°C

Anomaly from
1951-1980: 0.93°C



Average global temperatures from 2015 to 2019 relative to baseline 1951-1980, NASA GISS

WMO Sept. 2019 *Global Climate Change in 2015-2019*

Rapidly Accelerating Arctic Surface Temperature

Faster than any other region

Global Climate in 2015-2019

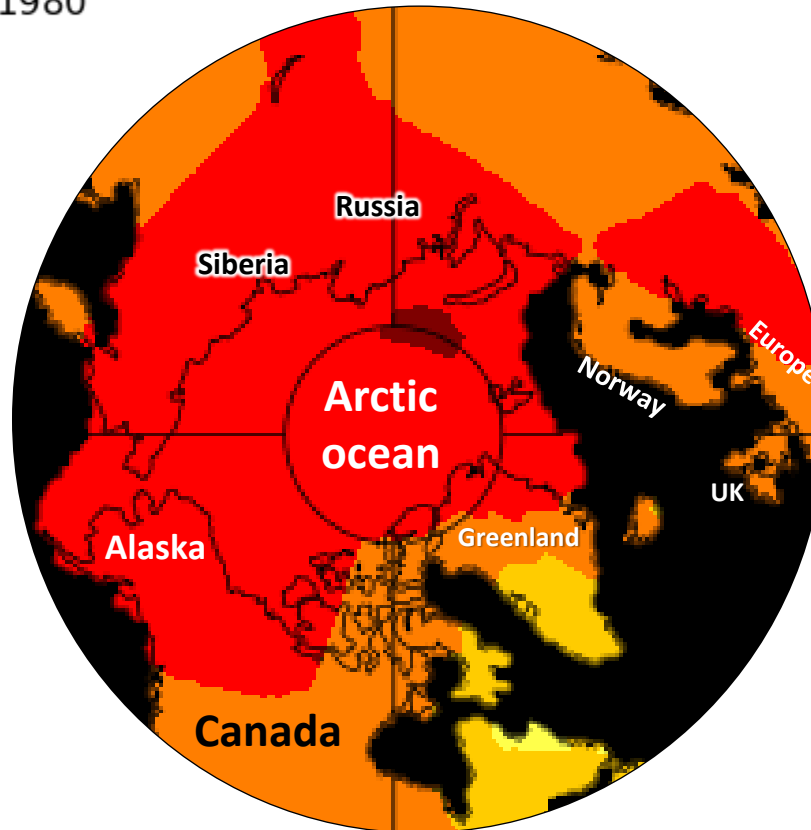
The Arctic

Annual J-D 2015-2019

L-OTI(°C) Anomaly vs 1951-1980

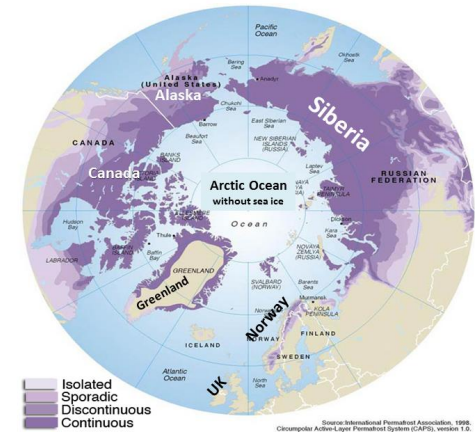
0.93

Global increase relative to
1881 to 1920: 1.2°C



Adapted from NASA GISS

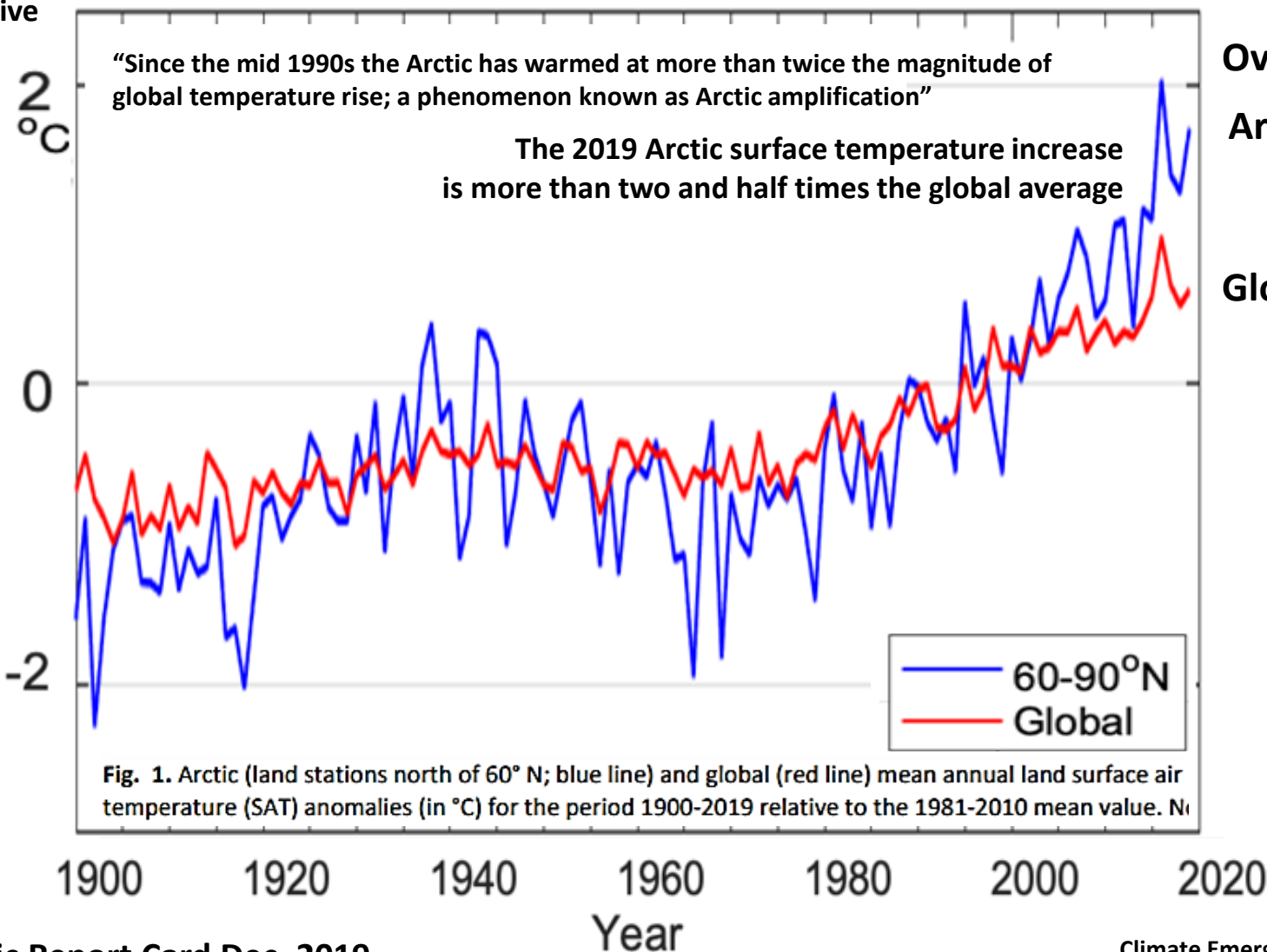
Permafrost Distribution Arctic Polar View



Source: NASA

Rapidly Accelerating Arctic Surface Heating

Arctic surface
temperature
increase relative
to 1981-2010



In November 2019 the Arctic Surface Heating was 4 X the Global Average

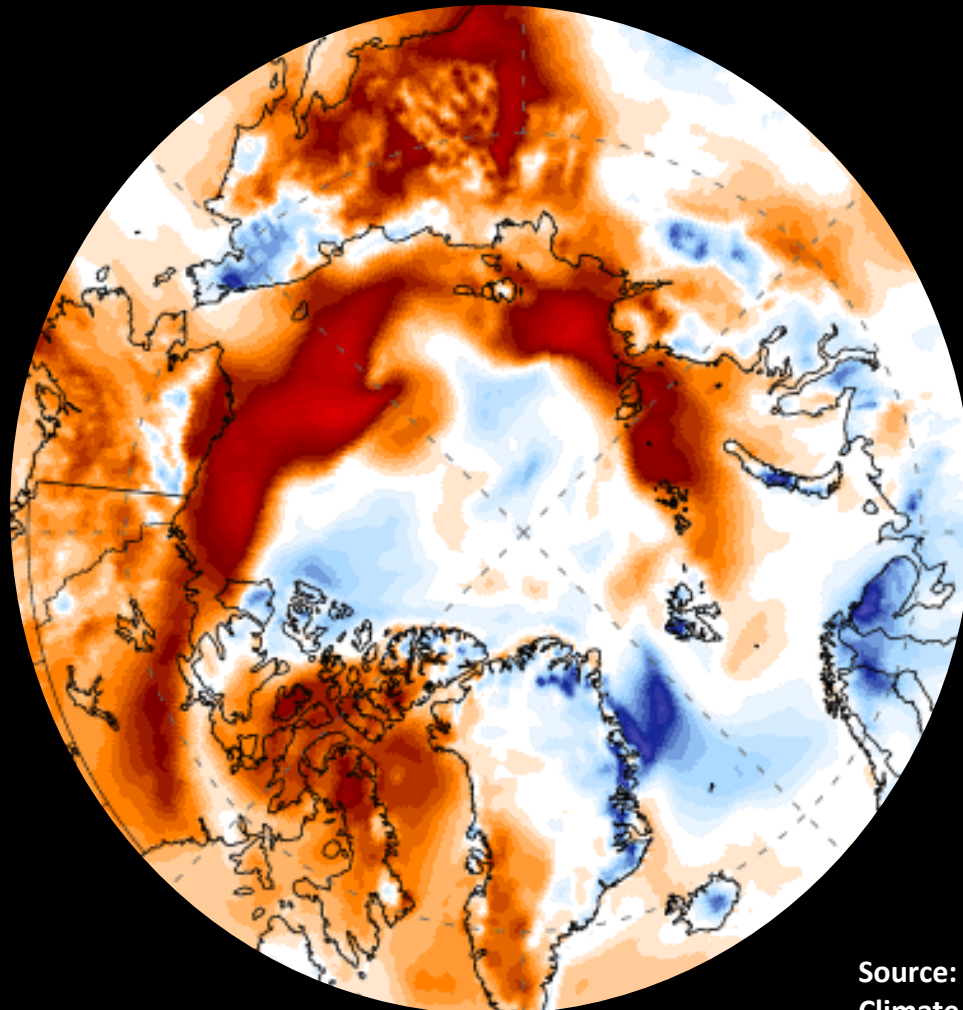
CFSV2 2m T Anomaly (°C) [1979-2000 base]

Fri, Nov 01, 2019

ClimateReanalyzer.org

Climate Change Institute | University of Maine

Relative to 1979-2000 baseline



World	+ 0.6 °C
NH	+ 0.9 °C
SH	+ 0.4 °C
Arctic	+ 2.5 °C
Antarctic	+ 2.3 °C
Tropics	+ 0.4 °C

Comparative Rates of surface heating

N. Hemisphere over 2X S. Hemisphere

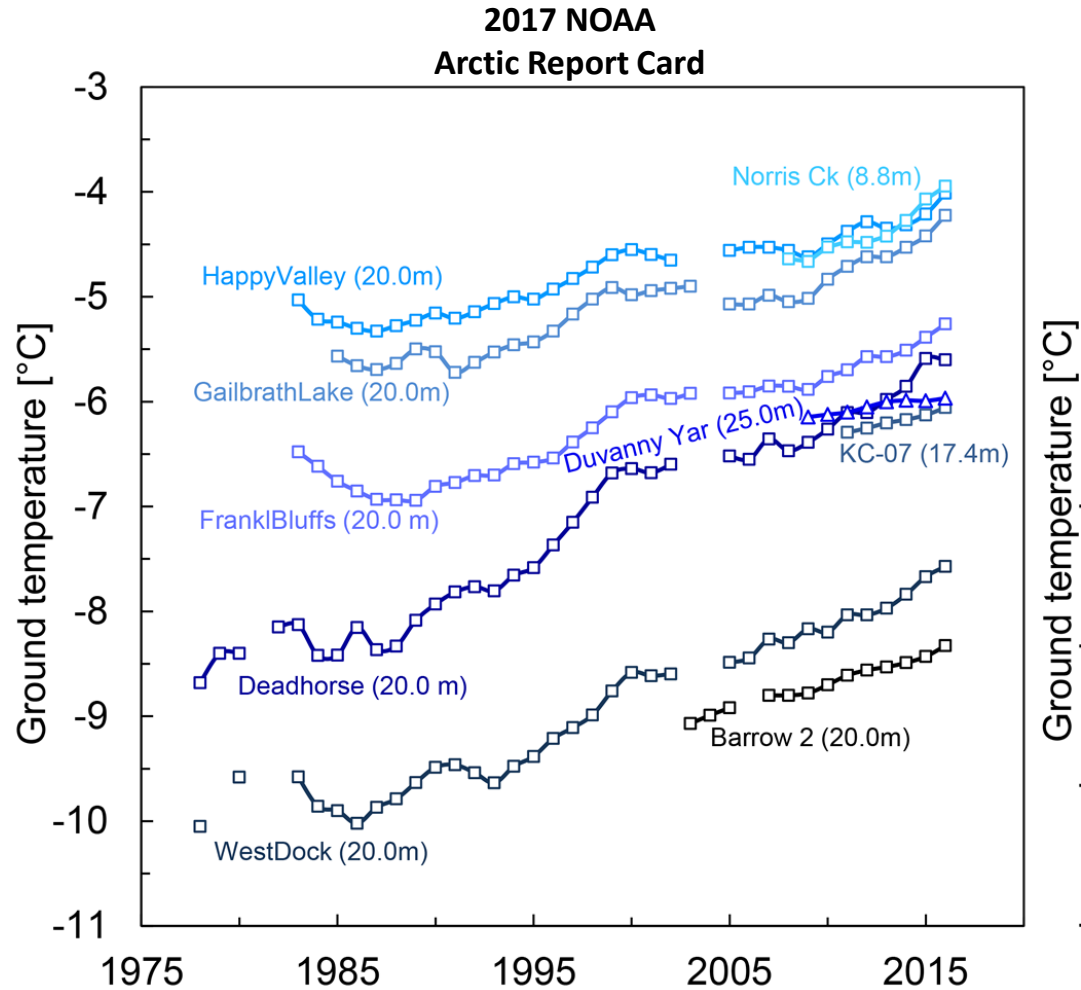
Arctic over 4X global average

Antarctic almost 4X global average

Source: latest data
Climate Reanalyzer

Climate Emergency Institute

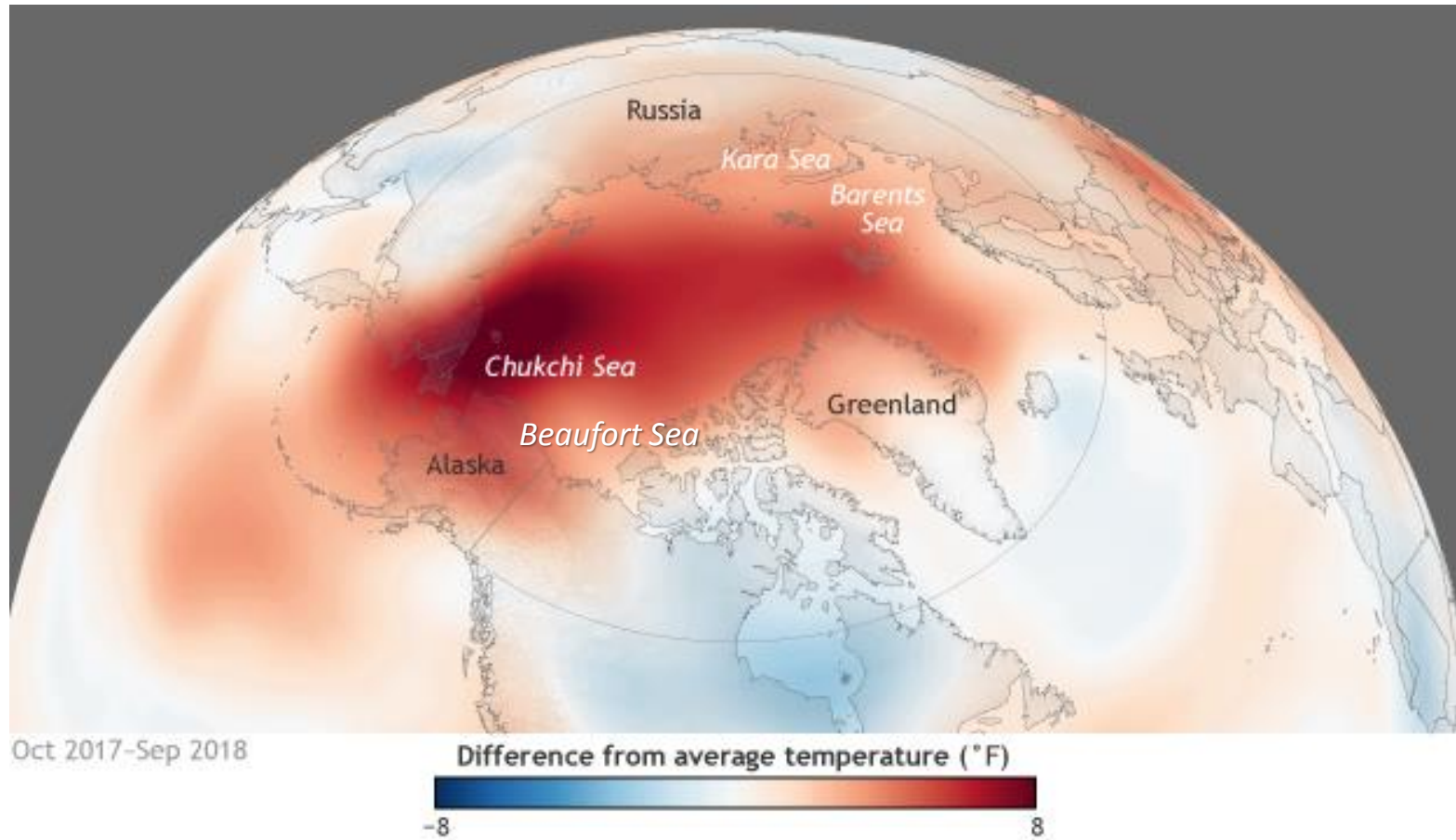
Accelerating Arctic Permafrost Temperatures



Surface Heating of Arctic Seas

Beaufort-Chukchi region

(same region as the permafrost temperature record of previous slide)

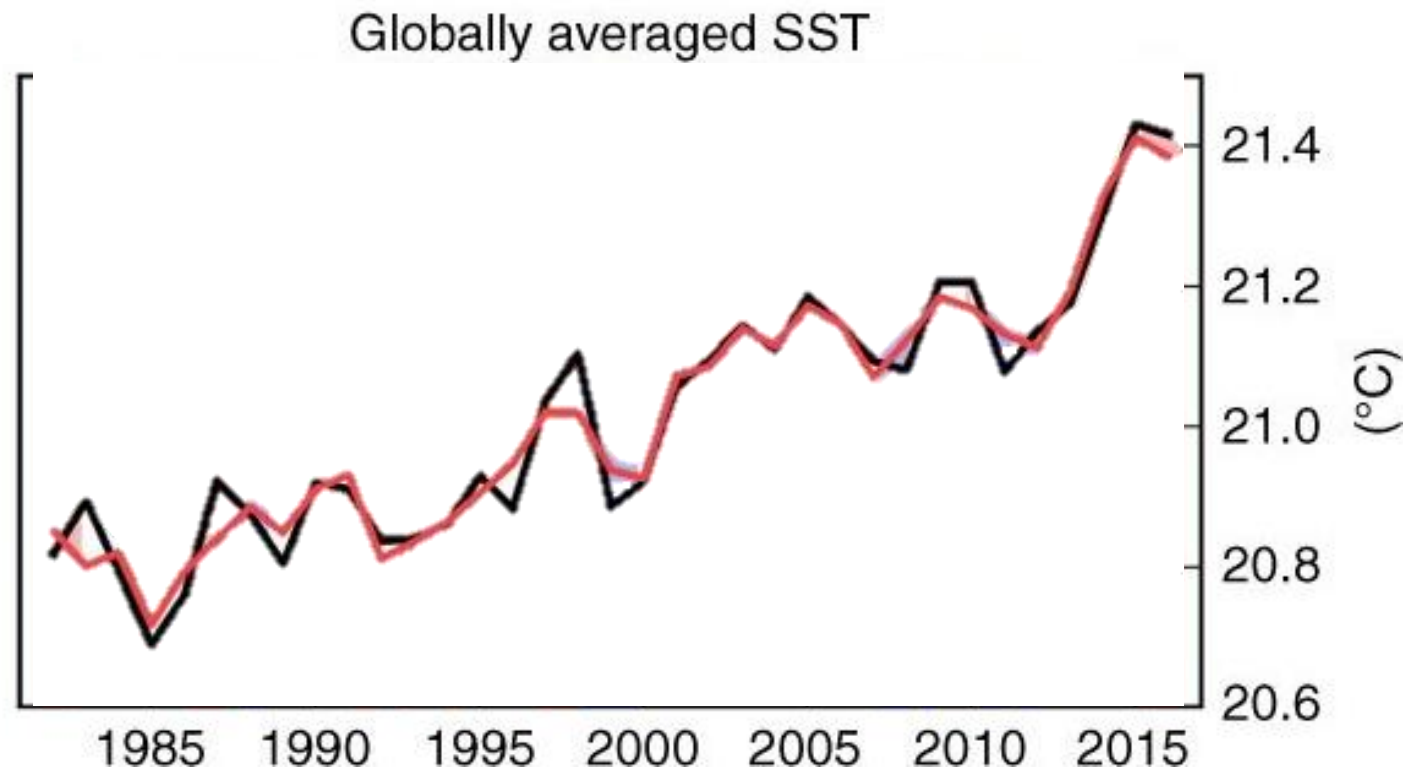


NOAA 2018 Arctic Report card

Climate Emergency Institute

Increasing Global Sea Surface Temperature and Marine Heat-Waves

Accelerating Sea Surface Temperature (SST) Increase



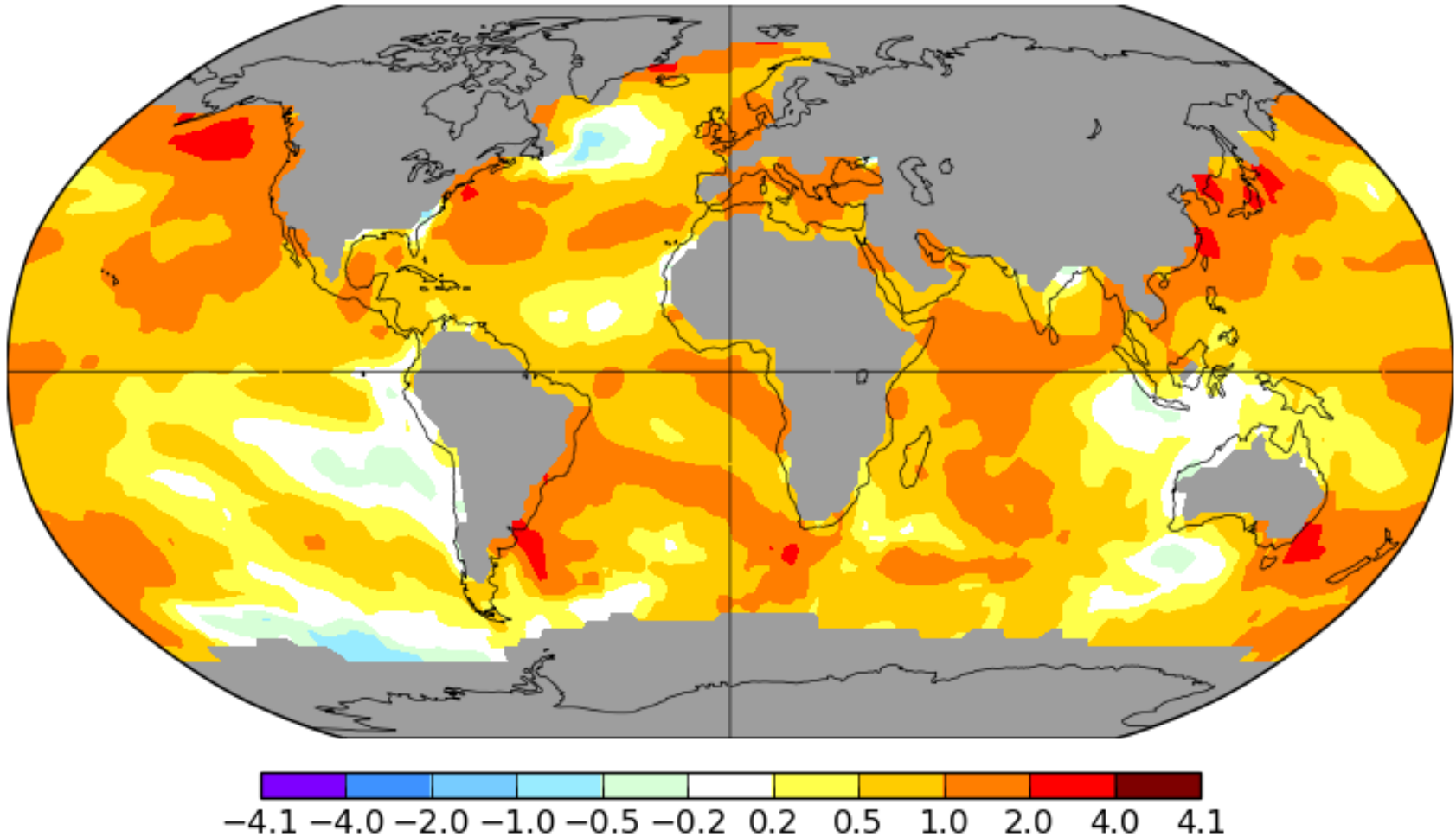
Black lines show the globally averaged time series and red lines show a global average after removing the signature of ENSO.

Global Sea Surface Change 2019

Annual D-N 2019

Tocn(°C) Anomaly vs 1881-1920

0.79

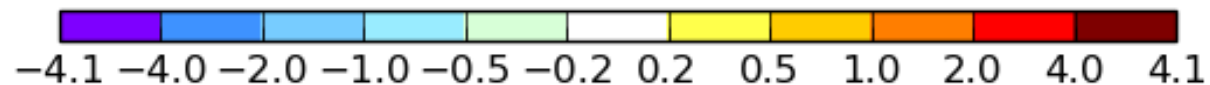
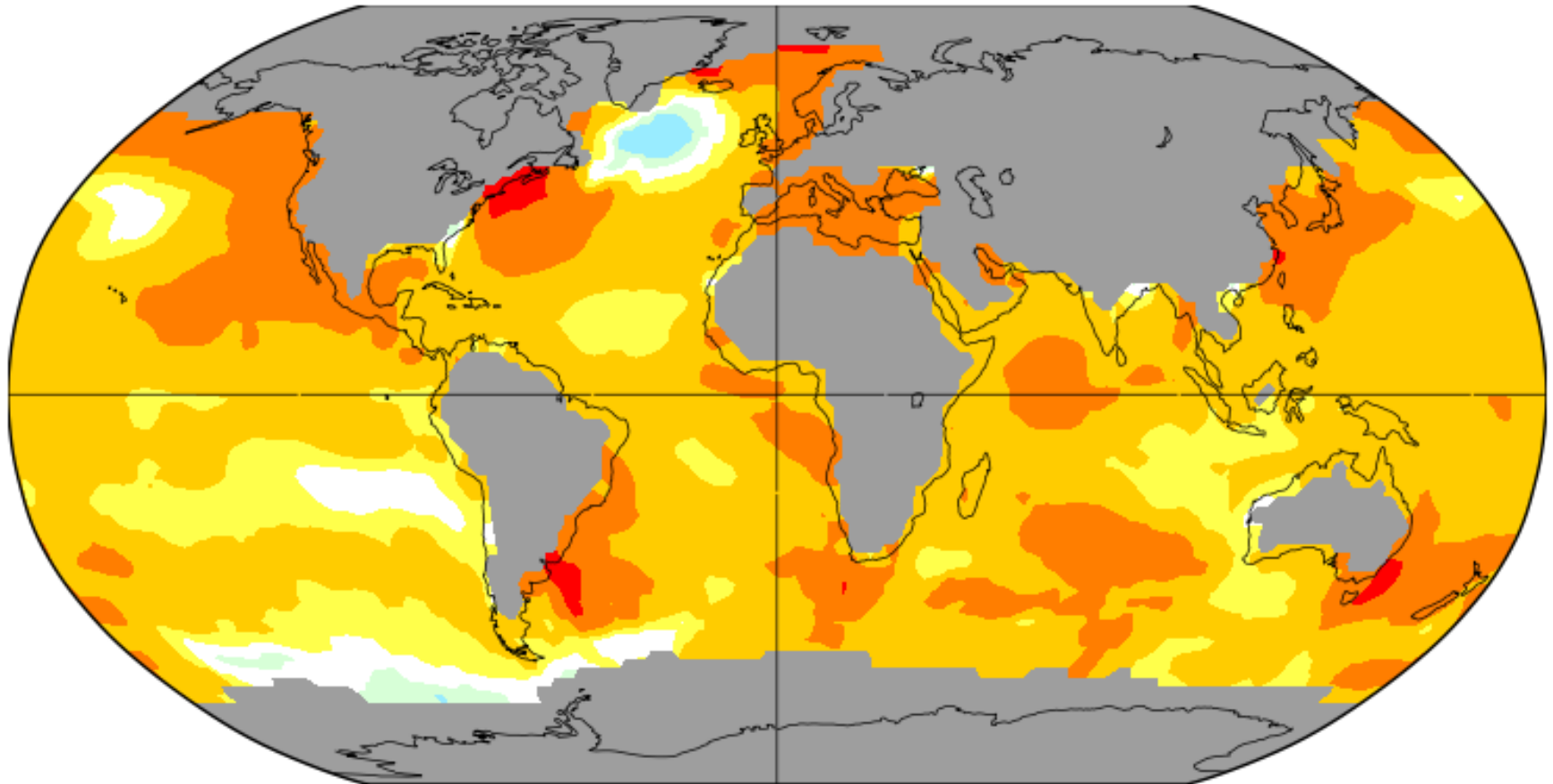


Global Sea Surface Change 2015-2019

Annual D-N 2015-2019

Tocn(°C) Anomaly vs 1881-1920

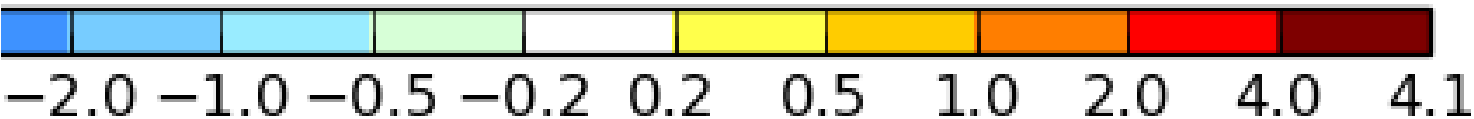
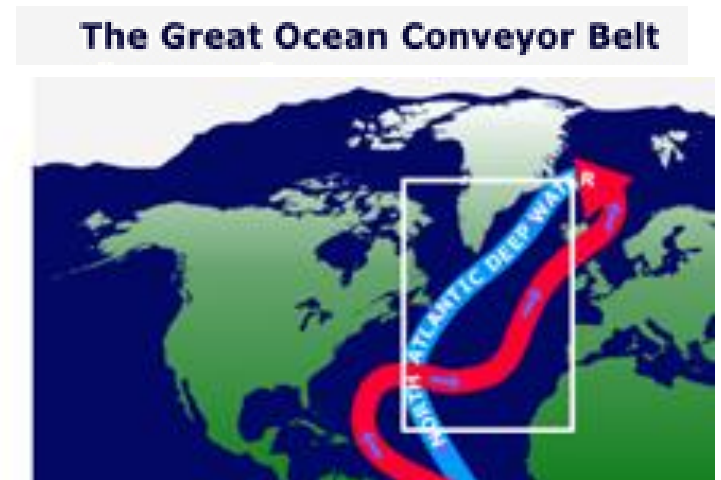
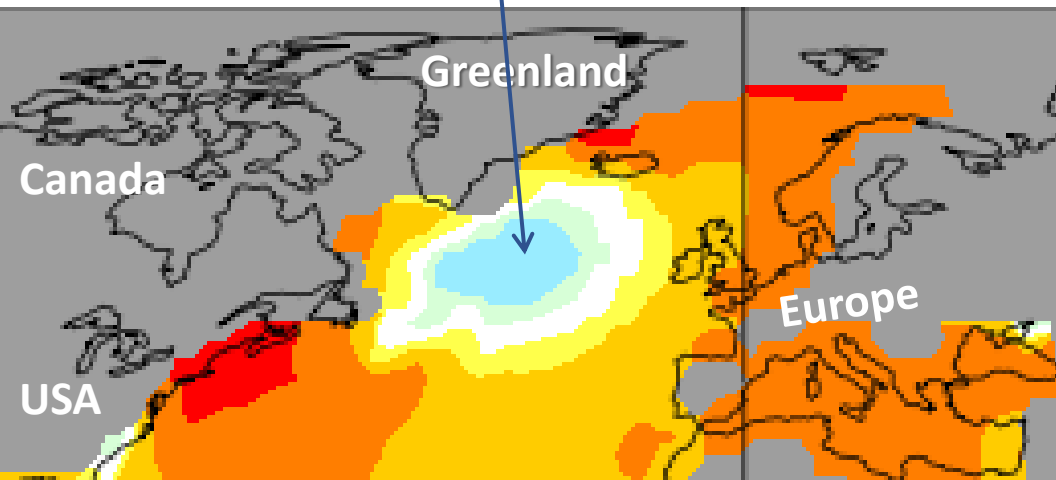
0.79



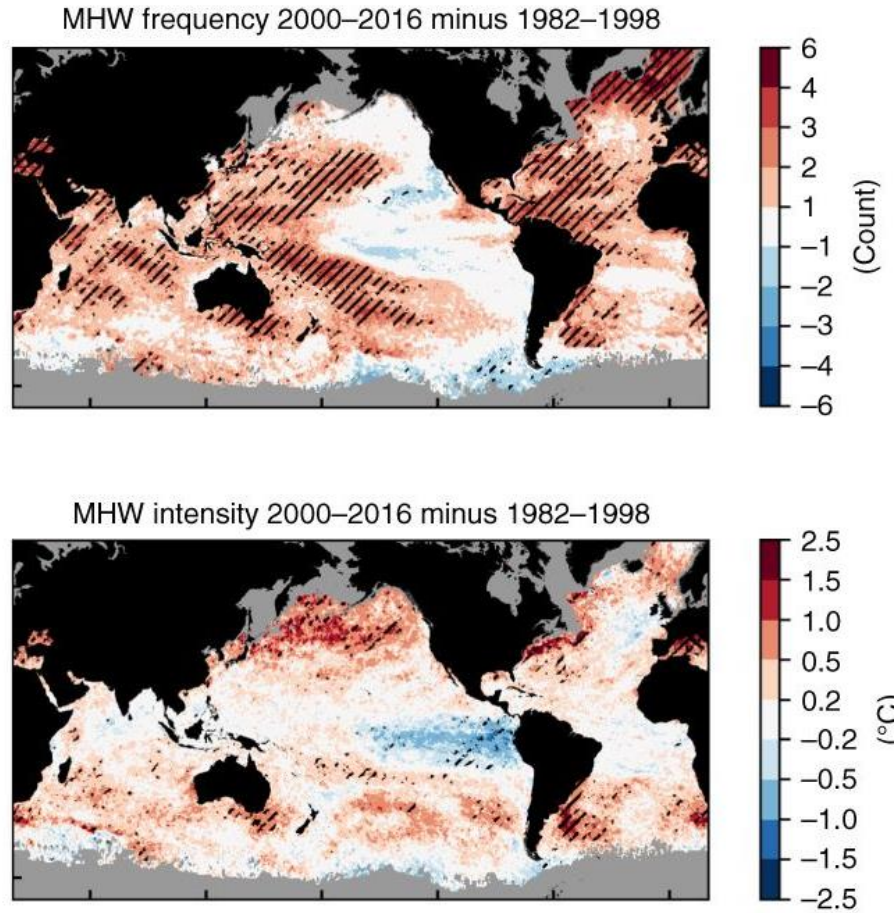
Vast Cold Freshwater Run-off from Greenland Ice Sheet Melting

**This is slowing the Great Ocean Conveyor Deep-Ocean Circulation
which will add to Northern Hemisphere climate chaos**

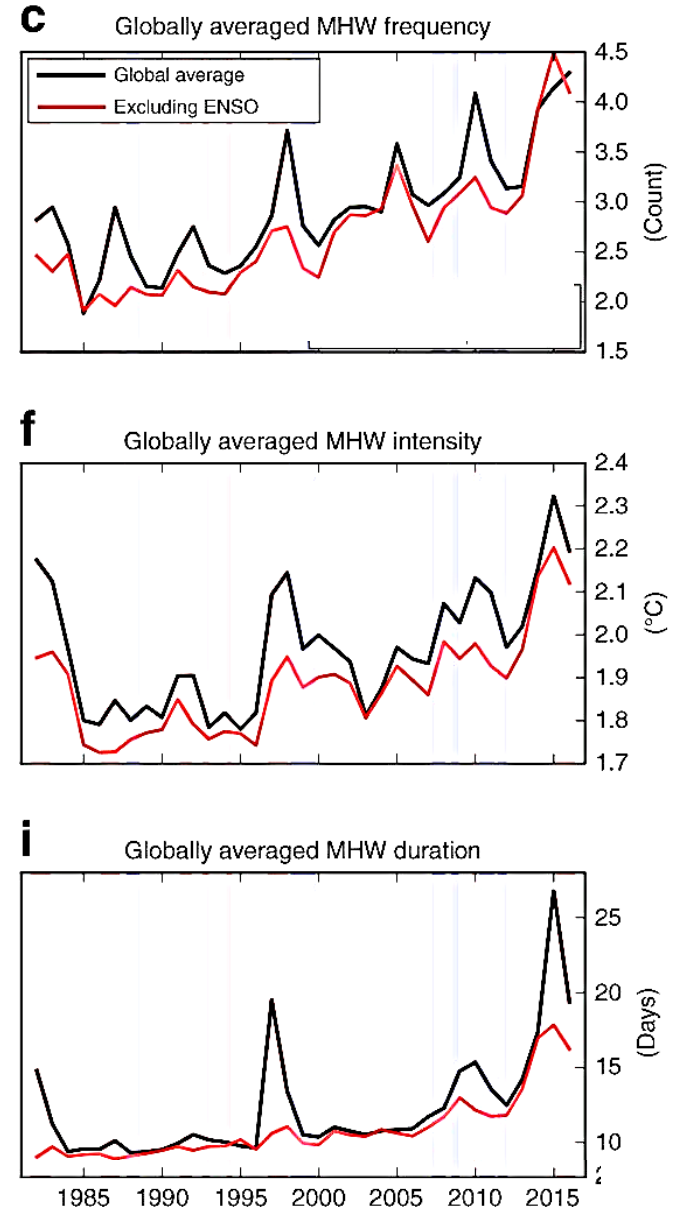
Global Environmental consequences of 21st century ice sheet melt , N.R. Golledge, 2019



Accelerating Marine Heat-Waves

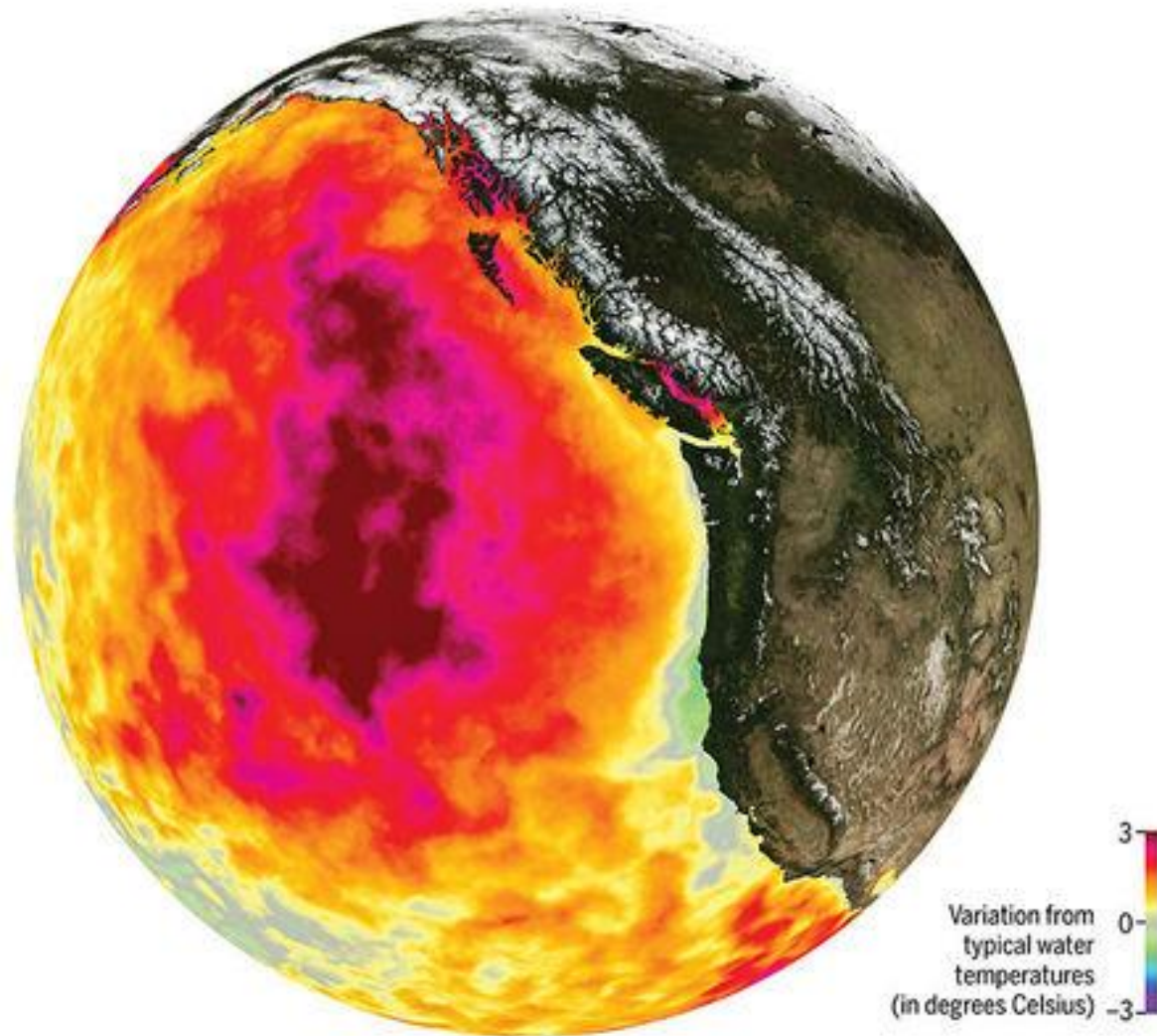


Black lines show the globally averaged time series and red lines show a global average after removing the signature of ENSO.

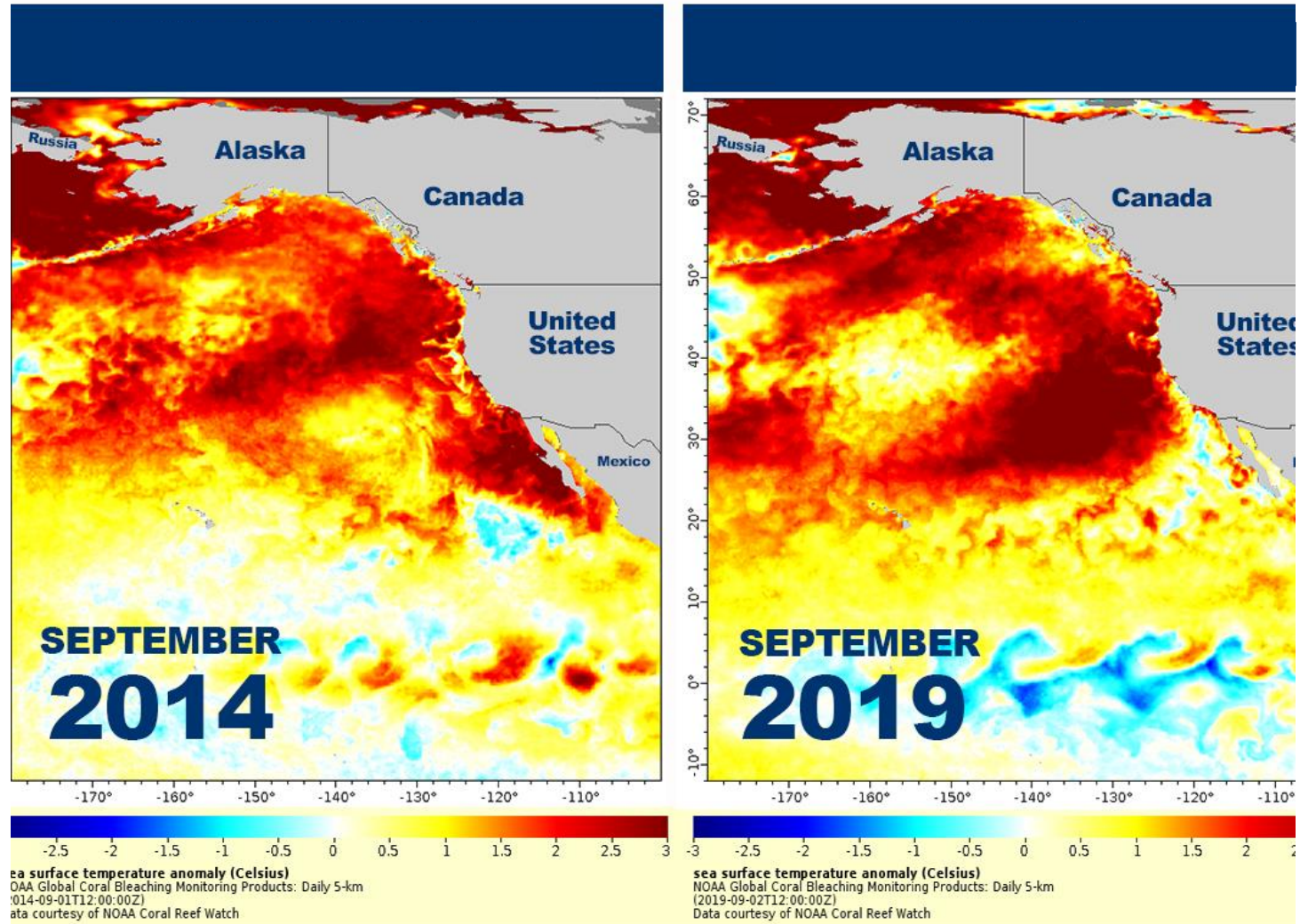


Source: Longer and more frequent marine heatwaves over the past century, Eric C. J. Olive, 2018

Massive Region of North American West Coast Marine Heat Wave (2015)

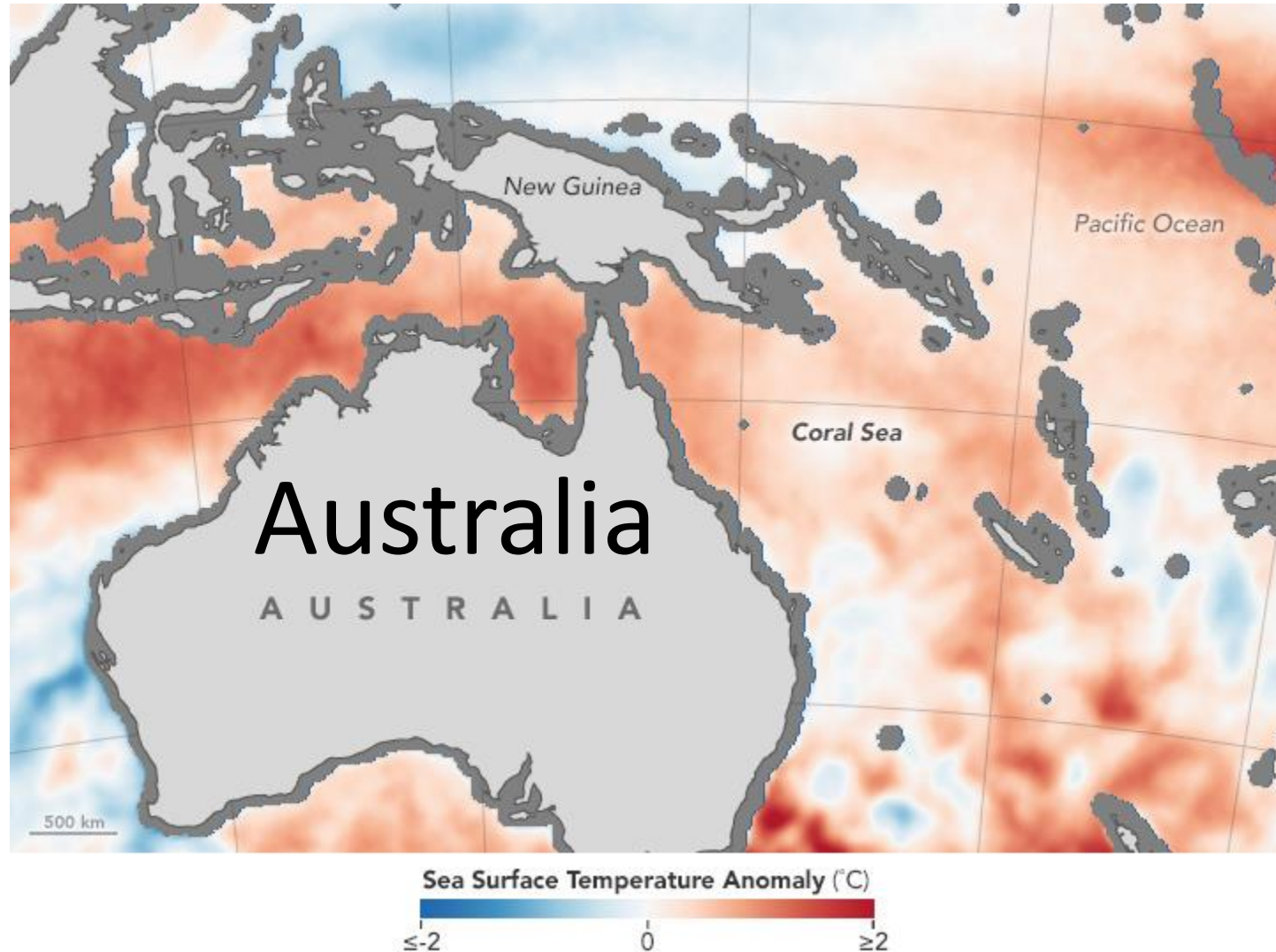


Increasing severity of Marine Heat-Waves



Warm Seas Lead to Extensive Coral Bleaching

NASA Earth Observatory, 2016

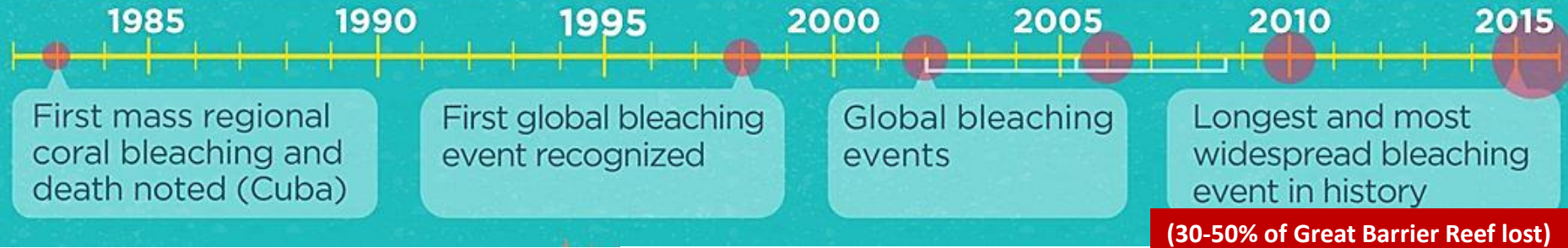


Two years of record global temperatures and a potent El Niño have led to extensive damage to coral reefs around the world, including the Great Barrier Reef.

NASA, May 19, 2016

Sea Surface Heating is Causing Increasing Coral Bleaching and Death

TIMELINE OF INCREASING CORAL BLEACHING EVENTS



(30-50% of Great Barrier Reef lost)

Try though we must by immediate rapid decline of global emissions, the science says it is too late to save the world's tropical reefs. If global emissions are declined immediately 2020 (for a 1.5°C limit by 2100), over 70% of coral reefs will be lost. As warming continues to 2°C all reefs (99%) will be lost. (IPCC 2018 1.5°C Report).

Recent coral bleaching

The global extent of mass bleaching of 100 reefs observed in 2015 and 2016

● Moderate (<30%) ● Severe (>30% coral) affected



Spatial and temporal patterns of mass bleaching of corals in the Anthropocene, Terry P. Hughes, 2018

2019 Global Surface Heating Conclusion

Conclusion

**The Climate is in a New State
of Abrupt Accelerating Global Heating**

**IMMEDIATE RAPID DECLINE IN GLOBAL EMISSIONS
(as in 2018 IPCC 1.5°C Report)
EMERGENCY INTERVENTION IMPERATIVE TO AVOID
END OF WORLD
RUNAWAY GLOBAL HEATING & CLIMATE CHAOS**

What the climate experts say:

The month of January 2020

“January 2020 was 1.50°C warmer than the 1880-1920 January mean.”

“Parts of Siberia were much warmer than normal, by as much as 14°C.”

The year of 2019

The rate of global warming has accelerated in the past decade.

The five warmest years in the GISS record all occurred in the past five years.

Growth rates of the greenhouse gases driving global warming are increasing, not declining.”



Conclusion

**Imperative the world immediately prepare for survival-
against unavoidable, unprecedented, increasing, multiple,
disastrous & catastrophic global surface heating impacts**

What the climate experts say:

The month of January 2020

“January 2020 was 1.50°C warmer than the 1880-1920 January mean.”

“Parts of Siberia were much warmer than normal, by as much as 14°C.”

The year of 2019

The rate of global warming has accelerated in the past decade.

The five warmest years in the GISS record all occurred in the past five years.

Growth rates of the greenhouse gases driving global warming are increasing, not declining.”

