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
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
January 2020: 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°F
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).

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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

“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)
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

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January 2020 Accelerating Northern Hemisphere Surface Heating Reached 2.8°C

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

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

Climate Emergency Institute
JANUARY 2020
Global Average Surface Temperature Increase
1.51°C

NASA GISS Surface Temperature Analysis (v4)
Climate Emergency Institute
January 2020

Global LAND Surface Temperature Increase

1.92°C

Permafrost Distribution (NASA)

Climate Emergency Institute

NASA GISS Surface Temperature Analysis (v4)
JANUARY 2020

Arctic & N. Hemisphere Land Surface Temperature Increase

1.92°C

Tsurf(°C) Anomaly vs 1881-1920

January 2020

1.92

Permafrost Distribution Arctic Polar View

Permafrost (purple)

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

**Land-Ocean: Global Means (J-D)**

- No Smoothing
- Lowess Smoothing

**Last 10 years:**
Longest fastest increase in the annual temperature record
2019 global surface temperature increase from 1880-1920 baseline is at 1.2°C and accelerating.

Very Rapid annual increase from 2000, increased again from 2010.
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

- Fastest acceleration from 2000
- Big increase from 2010

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globalwarmingindex.org
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
2019 Global LAND Surface Heating
1.57°C

Data Sources:
- Land: GHCNv4
- Ocean: none
Map Type: Anomalies
Mean Period: Annual (Jan-Dec)
Time Interval: Begin 2019 — End 2019
Base Period: Begin 1881 — End 1920
Smoothing Radius: 1200 km
Map Projection: Robinson

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

Adapted from NASA GISS

NASA permafrost map
Permafrost Distribution Arctic Polar View

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

Adapted from NASA GISS
“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.”
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
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.
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
Zonal Average Temperature Change
1900-2019

Adapted from NASA GISS
Zonal Average Temperature Change
2000-2019

Adapted from NASA GISS
In September 2019, global land heating was 1.43°C. Regions in and close to the Amazon were very hot.
2019 was a Big Record for Amazon Fires

The Wasting of the Amazon (3 Sept 2019)
Australia Heat-Wave 2019: Catastrophic Wildfires
January 3, 2020, NOAA
Map showing fires recorded in Australia in the seven days to 31 December 2019
Graphic: NASA / FIRMS / BBC

Source: NASA/FIRMS
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

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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

Source: NASA

Adapted from NASA GISS
“Since the mid 1990s the Arctic has warmed at more than twice the magnitude of global temperature rise; a phenomenon known as Arctic amplification”

The 2019 Arctic surface temperature increase is more than two and half times the global average.
In November 2019 the Arctic Surface Heating was 4 X the Global Average

Comparative Rates of surface heating

<table>
<thead>
<tr>
<th>Region</th>
<th>Temperature Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>+ 0.6 °C</td>
</tr>
<tr>
<td>NH</td>
<td>+ 0.9 °C</td>
</tr>
<tr>
<td>SH</td>
<td>+ 0.4 °C</td>
</tr>
<tr>
<td>Arctic</td>
<td>+ 2.5 °C</td>
</tr>
<tr>
<td>Antarctic</td>
<td>+ 2.3 °C</td>
</tr>
<tr>
<td>Tropics</td>
<td>+ 0.4 °C</td>
</tr>
</tbody>
</table>

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

2017 NOAA
Arctic Report Card

Continuous permafrost of NW North America and NE of East Siberia (Beaufort-Chukchi region);
Surface Heating of Arctic Seas

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

NOAA 2018 Arctic Report card

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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.
Vast Cold Freshwater Run-off from Greenland Ice Sheet Melting

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

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

C. Gentemann, Geophysical Research Letters, 2017
Increasing severity of Marine Heat-Waves
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

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).

Source: sciemag.org

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

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