Causes, Consequences and Solutions to Climate Change
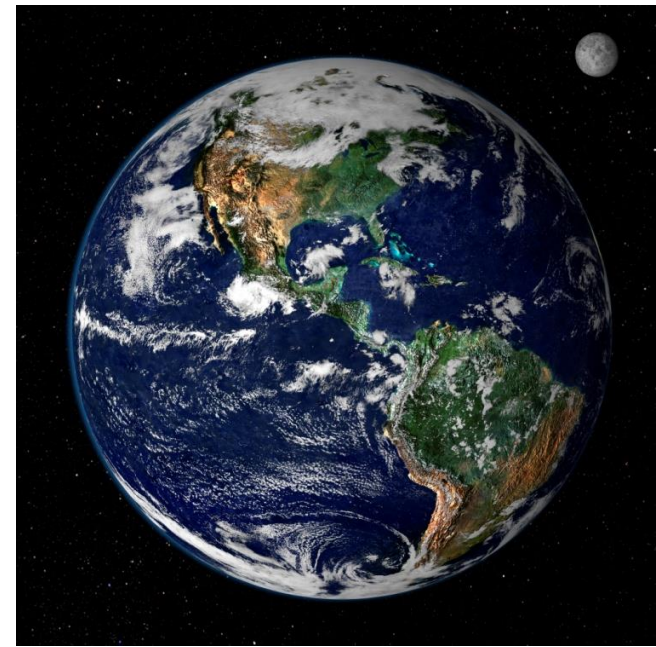
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February 2019

THE UNIVERSITY OF
TOLEDO
1872
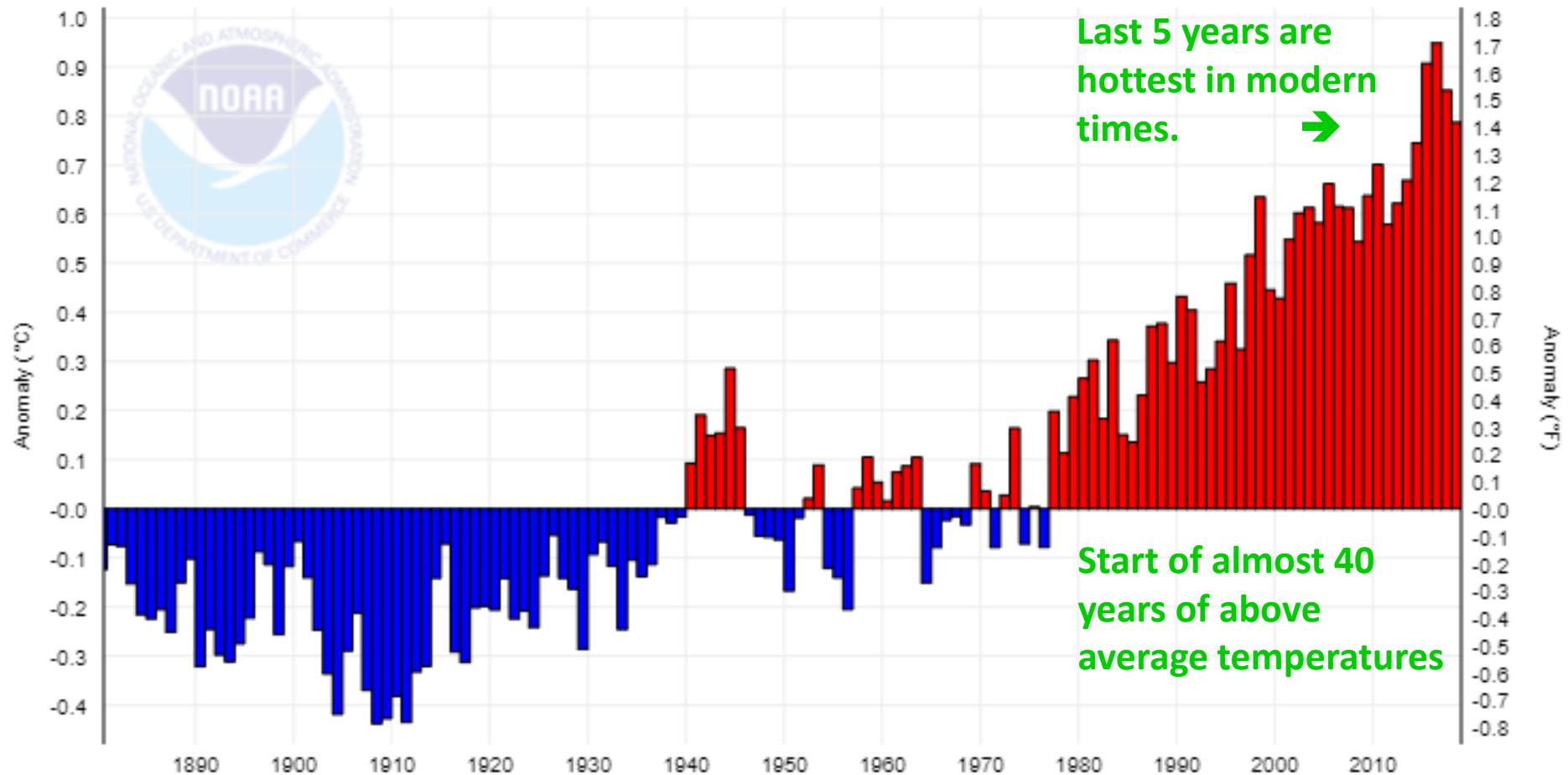
National Council for
Science and the Environment

The next slide shows a summary of almost 140 years worth of global temperatures.

The plot shows the difference between the **average daily temperature over a year** **at locations around the world compared to the** **long term average of that location.**

Note: Sources are found in links at the bottom of most pages

Summary of Global Direct Temperature Measurements

Global Land and Ocean Temperature Anomalies, January-December

Last 5 years are hottest in modern times. →

Start of almost 40 years of above average temperatures

https://www.ncdc.noaa.gov/cag/global/time-series/globe/land_ocean/12/12/1880-2018
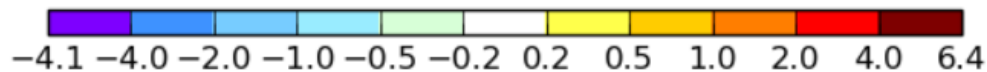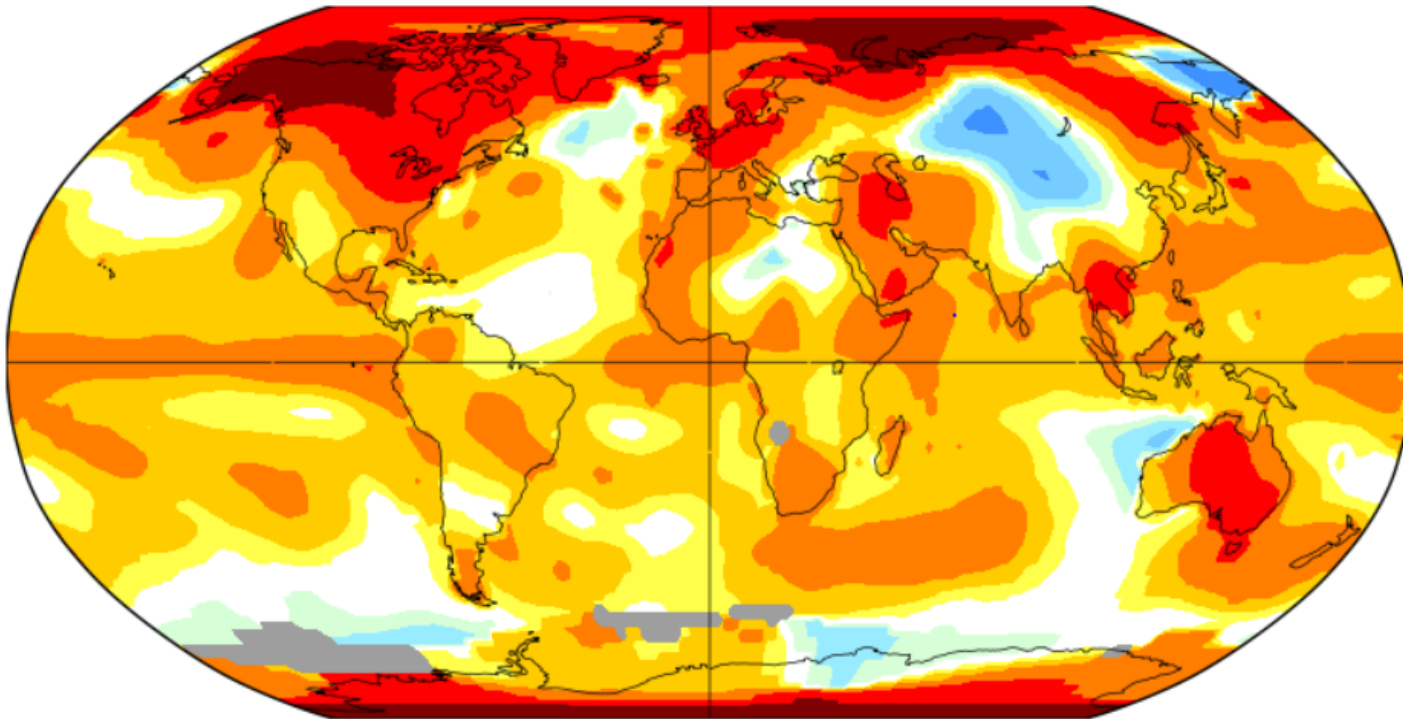
This map shows the difference from average by location around the world. It is very uneven with the greatest degree above average in the Arctic.

December 2018   L-OTI(°C) Anomaly vs 1951-1980   0.92

−4.1 −4.0 −2.0 −1.0 −0.5 −0.2 0.2 0.5 1.0 2.0 4.0 6.4

Note: Gray areas signify missing data.
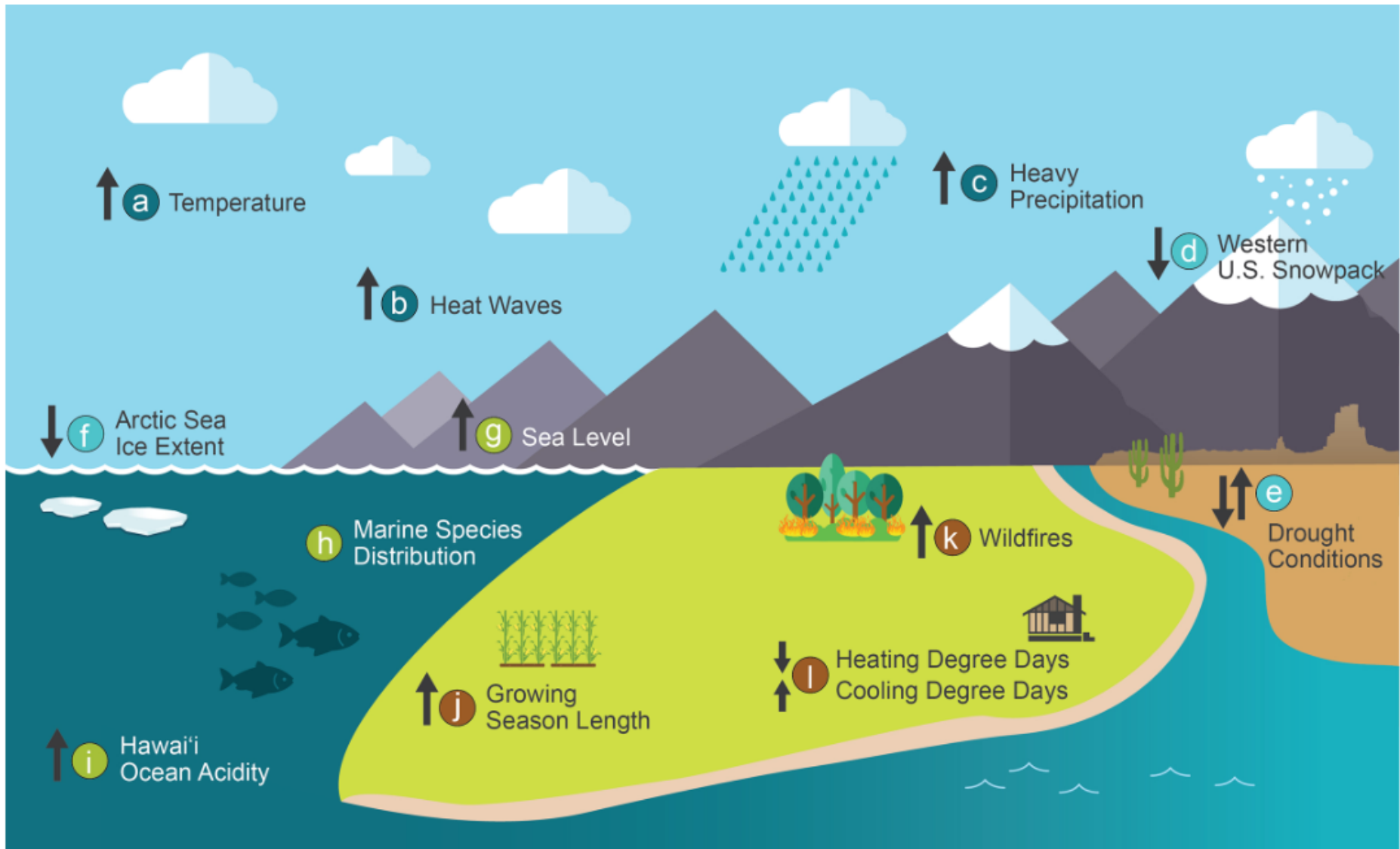*Note:* Ocean data are not used over land nor within 100km of a reporting land station.

Warmer temperatures means less ice. Ice reflects sunlight, so less ice means more sunlight is absorbed causing more heating.

Average Monthly Arctic Sea Ice Extent
January 1979 - 2019

https://nsidc.org/arcticseaicenews/
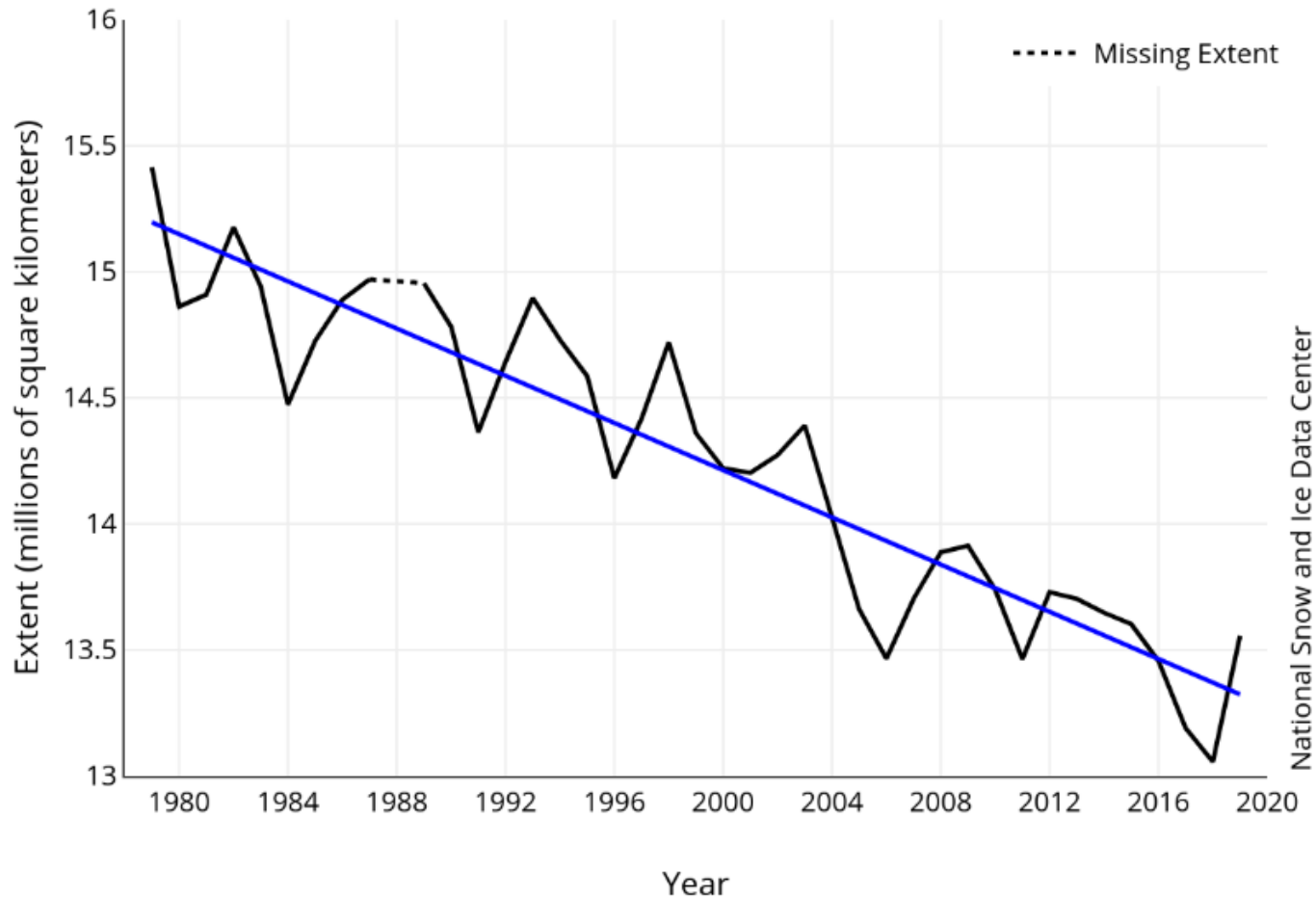
Evidence of Climate Change Indicated By These 11 Measurements

Consequences of Climate Change

- Increased **health problems** such as heat stroke, more disease carrying pests like mosquitoes and ticks.

- Increased intensities of **hurricanes and heavier rains** in many parts of the country.

- Other parts experience **drought** with effects like **reduced crops and more wildfires.**

- **Rising ocean levels** threaten the millions who live on the coasts, like Miami, New York, San Francisco, New Orleans and many places around the world.

- Oceans becoming **more acidic** from carbon dioxide. This **reduces seafood production** which millions around the world depend on.

# 50 Inches of Rain Fell on Houston During Hurricane Harvey

Widespread Impacts from Hurricane Harvey

Figure 1.6: Hurricane Harvey led to widespread flooding and knocked out power to 300,000 customers in Texas in 2017, with cascading effects on critical infrastructure facilities such as hospitals, water and wastewater treatment plants, and refineries. The photo shows Port Arthur, Texas, on August 31, 2017—six days after Hurricane Harvey made landfall along the Gulf Coast. *From Figure 17.2, Ch. 17: Complex Systems (Photo credit: Staff Sgt. Daniel J. Martinez, U.S. Air National Guard).*

https://nca2018.globalchange.gov/chapter/1/

Earth's temperature is changing due to the Greenhouse Effect.

GH Effect happens in a car. Sunlight comes through the windows, heats the interior, but the heat cannot escape because it is trapped by the glass. Heat is trapped in the atmosphere by greenhouse gases.

https://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-1-3.html
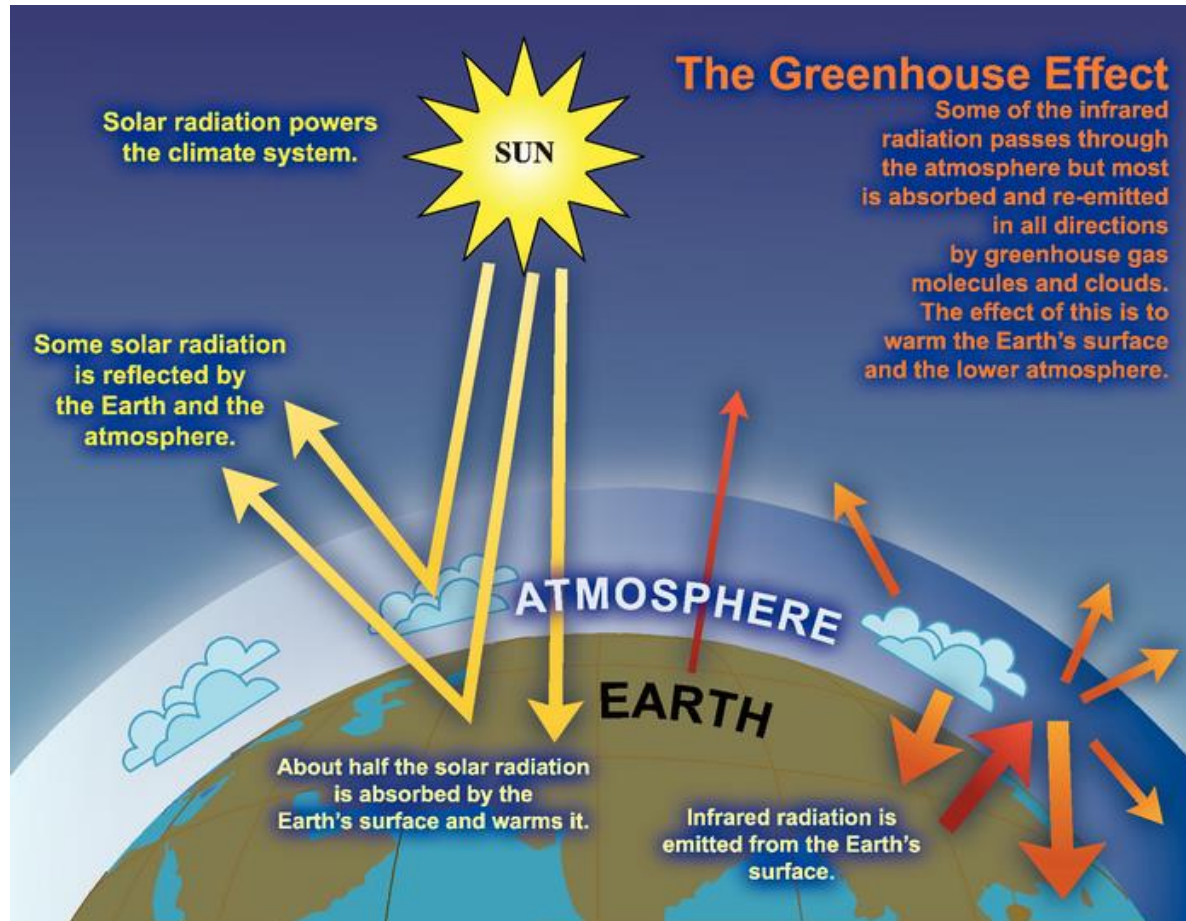
The primary cause of the warming is increased greenhouse gases in the atmosphere which come mostly from burning coal, oil and natural gas.

The important greenhouse gas is carbon dioxide: CO_2

Carbon Dioxide Concentrations in the Atmosphere Have Increased Significantly In Recent Years

Atmospheric CO_2 at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Earth System Research Laboratory

PARTS PER MILLION

400
380
360
340
320

1960   1970   1980   1990   2000   2010   2020
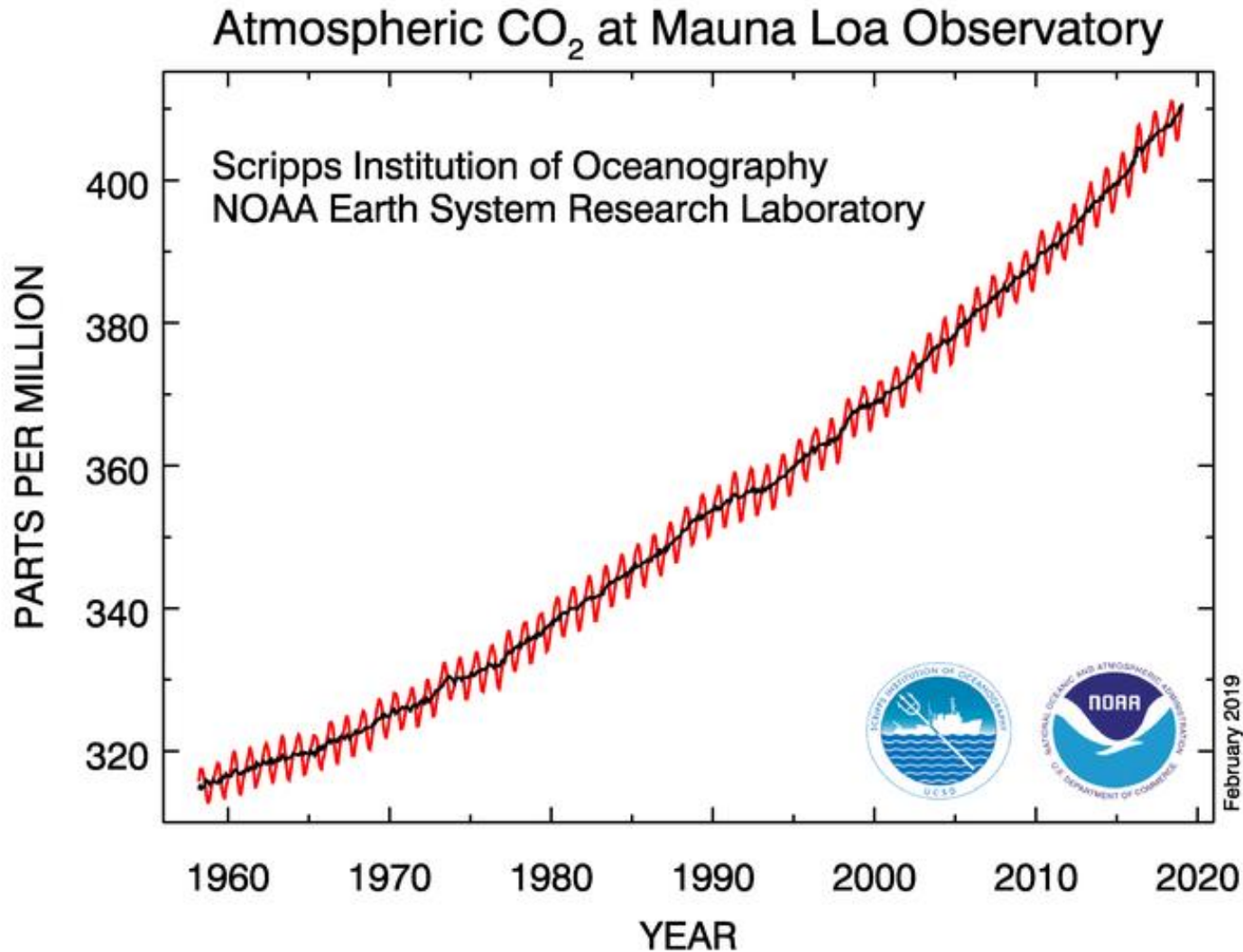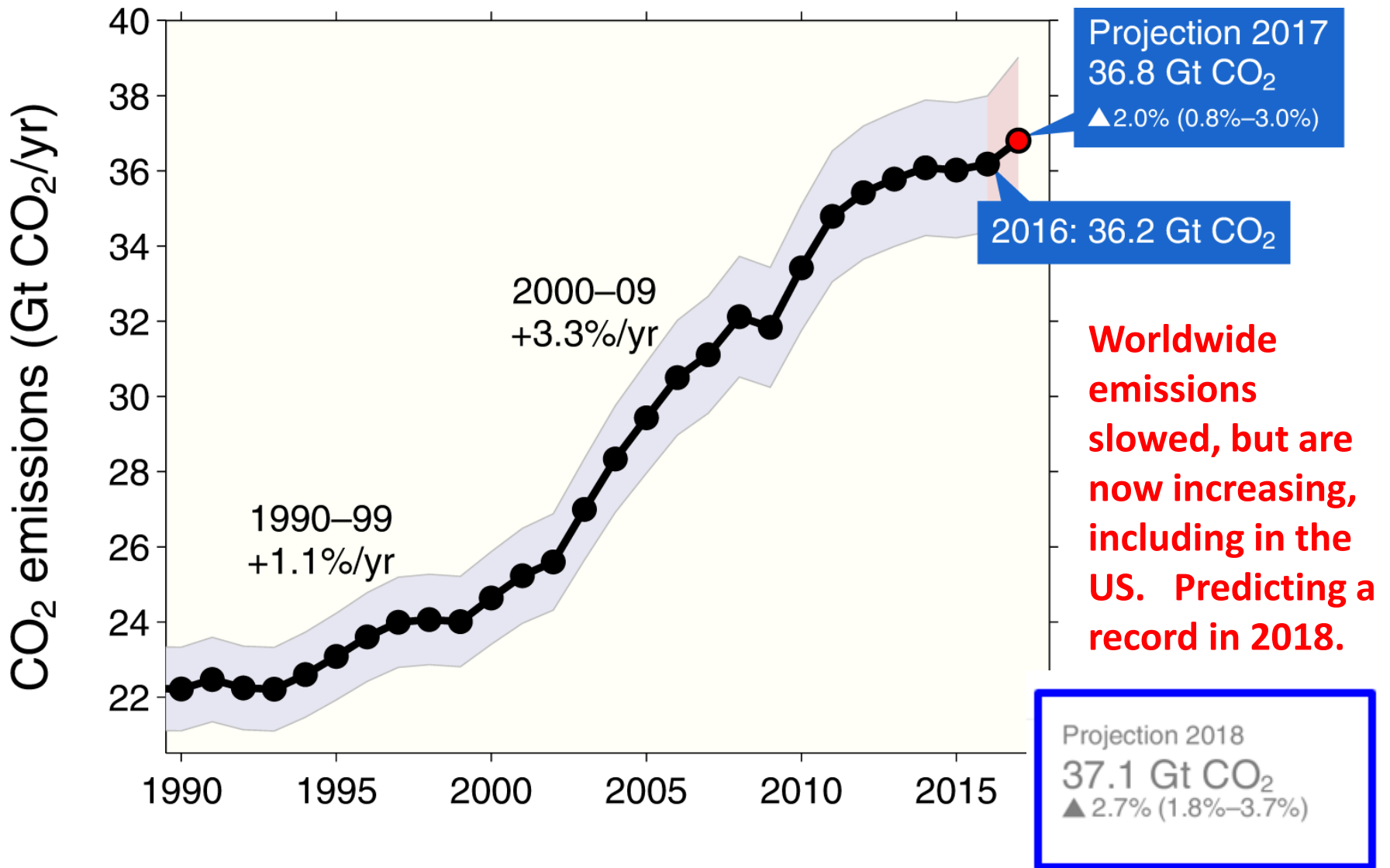
YEAR

February 2019

Level was under 300 ppm for thousands of years. In February, 2019 it reached 411 ppm.

Sources of Greenhouse Gas Emissions

- Production of heat and electricity (25%)
- Cutting forests and carrying out agriculture (24%)
- Industrial uses (21%)
- Transportation: cars, trucks and planes (14%)
- Buildings (6%)

**To reduce concentrations in the atmosphere,
we must reduce in all these areas.**

https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf, p. 63

Emissions of greenhouse gases from fossil fuel use & industry

GLOBAL CARBON PROJECT

Projection 2017
36.8 Gt CO_2
▲2.0% (0.8%–3.0%)

2016: 36.2 Gt CO_2

2000–09
+3.3%/yr

1990–99
+1.1%/yr

Worldwide emissions slowed, but are now increasing, including in the US. Predicting a record in 2018.

Projection 2018
37.1 Gt CO_2
▲ 2.7% (1.8%–3.7%)

Source: Global Climate Budget https://www.icos-cp.eu/GCP/2017   https://www.icos-cp.eu/GCP/2018   November, 2017

Greenhouse Gas Emissions in Tons CO_2 Per Person Per Year

Of the major countries, the US has the largest emissions per person.

Source: Global Climate Budget https://www.icos-cp.eu/GCP/2017
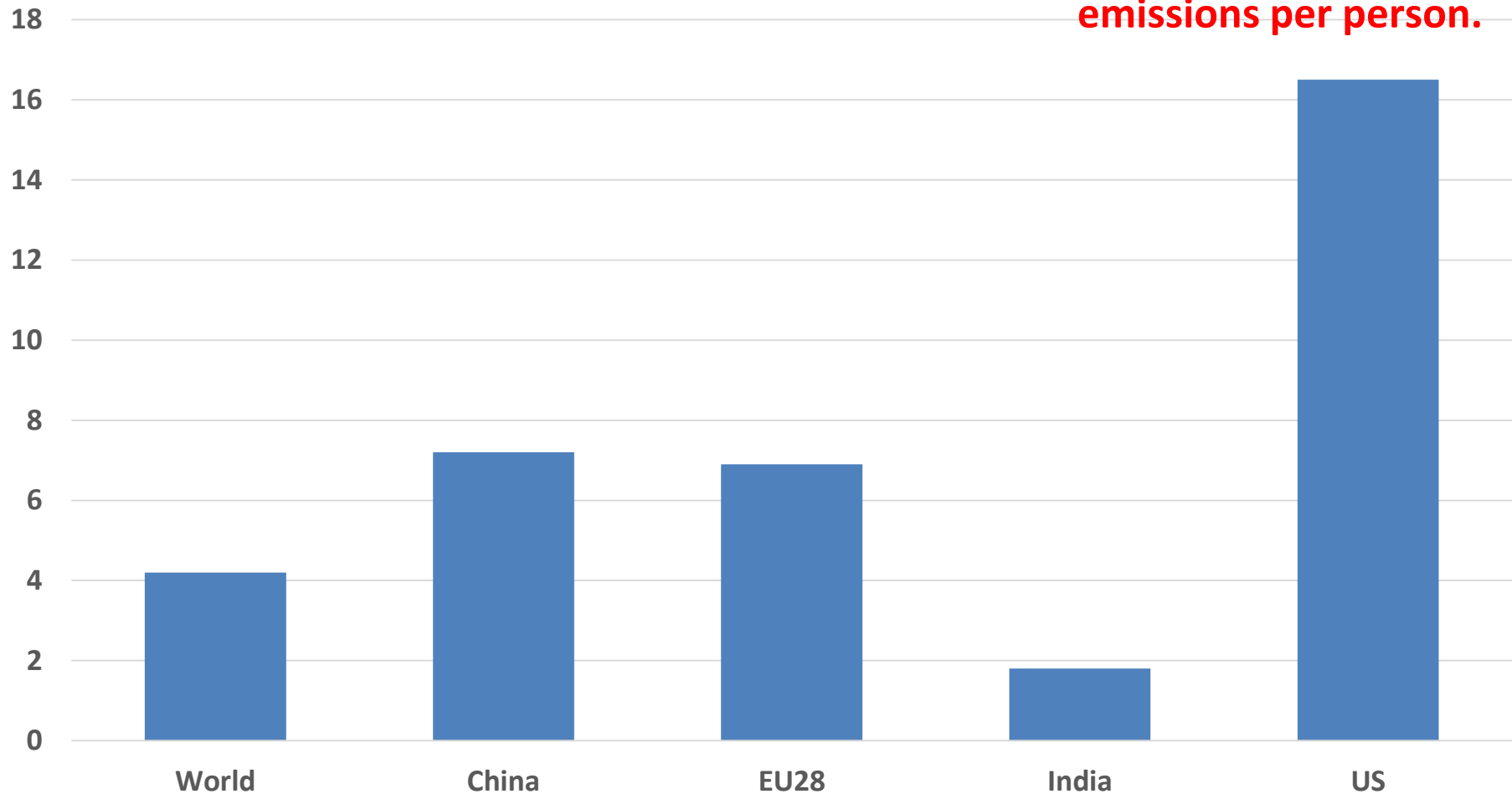
What Can We Do?

- **Change your thermostat** – cooler in winter and warmer in summer. Use an electric blanket at night.

- **Drive less** – be efficient in driving – don't speed, use cruise control - and next time buy a more efficient car

- **Eat less meat**. Producing meat is a major source of greenhouse gases – beef is much worse than chicken – <u>skip the burger</u>!

- **Encourage policies of conservation** with your legislators. **The problem is real and the time to avoid serious consequences is short.**

What Else Can You Do?

Tell your friends and family members!

The next generations need us to respond.

My grandchildren

Web Resource on Climate Change

CAMEL Climate Change Education
A free, comprehensive, interdisciplinary, multimedia resource for educators

Climate
Adaptation
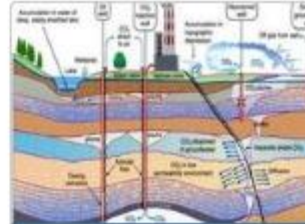Mitigation
E-Learning

Featured Resources

Role Playing: NYC Case Study
Students will apply a role–playing activity to explore the challenges facing climate change planning in New York City....

Unit: Geoengineering
Students will apply a role–playing activity to explore the challenges facing climate change planning in New York City....
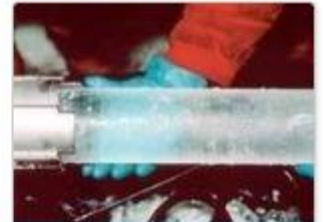
Module: Carbon Capture and Sequestration
Students will learn the basics of carbon capture and sequestration (CCS). Spiraling from the carbon cycle activity.....

Game: ClimateEnergyFusi Game
Climate and Carbon Science Mission – developed by Lawrence Livermore National Laboratory.....

Lab Exercise: Vostok Ice Core: The Cold Hard Truth
n this lab, students learn how to use data from the Vostok ice core to measure...

*http://camelclimatechange.org/index.html

Acknowledgments

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"Creating a Learning Community for Solutions to Climate Change"

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