

Causes of Climate Change

In the following module, there is a list of activities that can be utilized to have conversations about the causes and misconceptions of climate change. First, students look at climate opinion maps and survey data from their peers at West Virginia University. Second, they look at maps which showcase the causes of observed temperature increase. Third, students have a broader, more open discussion about maps on climate change and attempt to visualize where effects occur.

Activity 2.1 - Visualizing Climate Change via Climate Opinion Maps

Collecting public opinion on global warming and climate change is instrumental in influencing decision-making and policy for the reduction and mitigation of future impacts. Yet, the way public opinion is collected differs across scale, from the national to the local level.

National-level statistics, which are often more easily attainable and cost-effective, can gloss over important differences in opinion at smaller scales such as counties and metropolitan areas. In an effort to combat these inconsistencies, the Yale Program on Climate Change Communication (YPCCC) developed a model that breaks down national public opinion to smaller scales of measurement, allowing for rich data visualization that speaks to the diversity of Americans' beliefs, attitudes and policy support.

Each year, the YPCCC produces public opinion maps based on data collected from the Climate Change in the American Mind Survey. Within the survey, questions are divided into four broad categories: 1) beliefs; 2) risk perceptions; 3) policy support; and 4) behaviors. An example question asks, "What do you think? Do you think global warming is happening?" In the spring 2020 iteration of opinion maps, an estimated 72% of adults nationally believe that global warming is happening. However, this percentage greatly differs across the state- and county-level. In comparison to this national area, an estimated 59% of adults in West Virginia believe that global warming is happening. West Virginia, in fact,

has the lowest estimated percentage of global warming belief in all of Yale's statewide data, prompting a closer evaluation of this stark divide from national opinion.

1. Why do you think that the percentage of belief that global warming is happening is the lowest in West Virginia? What cultural or socioeconomic factors might play into this opinion?

However, Climate Opinion Maps fall short in the sense that they do not survey college students, who might have different perceptions, beliefs, and opinions of climate change than other adults across West Virginia. In an effort to collect more data on college-aged individuals, a survey similar to the Climate Opinion Map questions was utilized in various undergraduate courses at West Virginia University in the spring 2020 semester. Courses included environmental and STEM-related courses in the Davis College and Eberly College. Students were asked to answer approximately 24 survey questions about their opinions on climate change.

Out of roughly 410 respondents, 91% (371 participants) believe that global warming is happening. This percentage is drastically above the 59% of surveyed adults within the same period across the state of West Virginia by the Yale Climate Opinion Maps. Interestingly, 75% (306 participants) were 'somewhat worried' and 'very worried' about global warming, and 78% (317 participants) thought that they would be personally harmed by global warming in some capacity. Again, students surveyed were well-above the statewide average of adults worried about global warming (49%) and who thought they would be personally affected (30%).

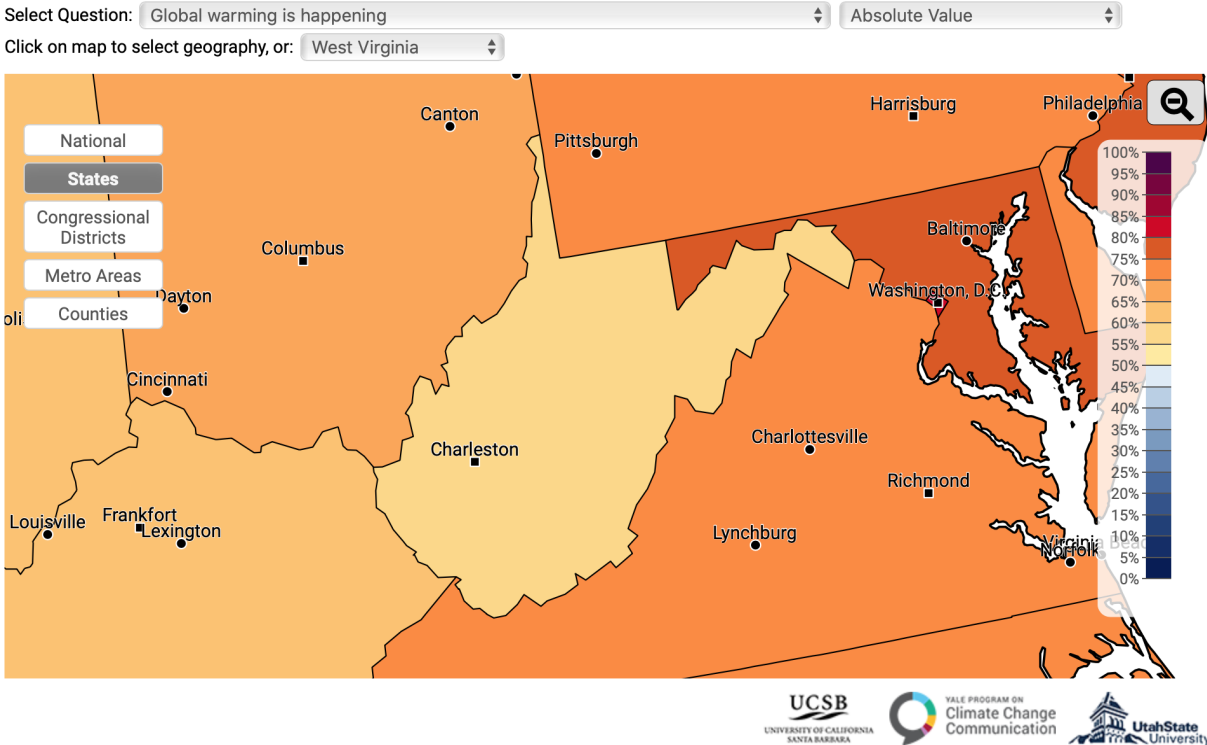
2. Why would the percentages among college students be drastically different than those of adults across West Virginia?
3. Do you believe that the percentages would shift based on what types of students were surveyed (i.e. students in non-STEM or non-environmental focused majors)?

Go to the recent Yale Climate Opinion Map here:

<https://climatecommunication.yale.edu/visualizations-data/ycom-us/>

Click on 'Select State' and Select 'West Virginia'. Then, on the left-hand side of the map, select 'States'. The map should look like the one below.

Estimated % of adults who think global warming is happening (72%), 2020



Go to the top dropdown menu and select the question: 'global warming is mostly caused by human activities.'

4. What is the percentage of adults in West Virginia that believe global warming is caused by human activities? Are you surprised by this percentage?
5. How far is the percentage of adults in West Virginia off of the national average?
 - a. How does this percentage differ from other surrounding states, such as Maryland, Virginia, and Kentucky?
 - b. Why might the percentages differ? Think of different hypotheses based on population, jobs / livelihood, etc.

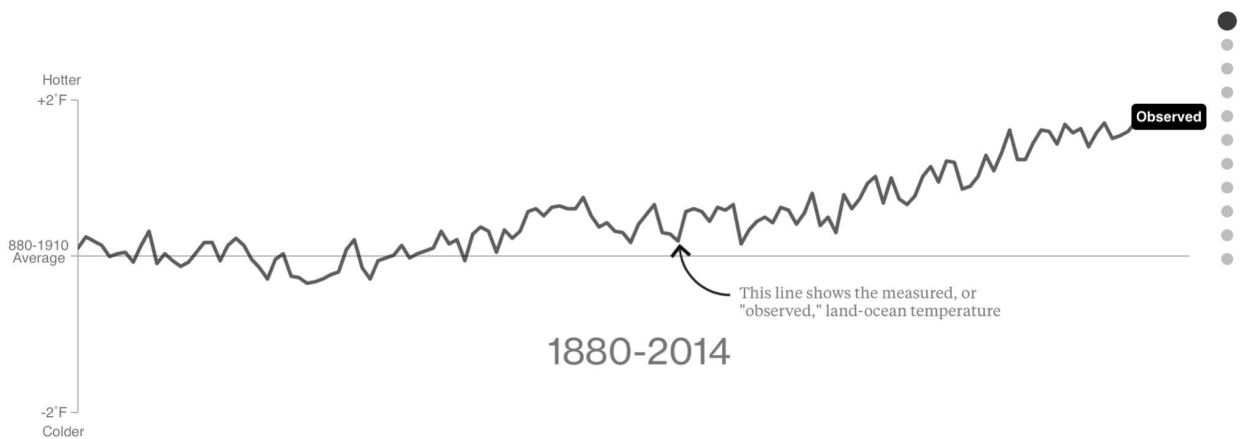
By looking at student survey data from West Virginia University on the same question, only 30% (124 participants) believed that global warming is mostly caused by human activities. 62% (252 participants) believed that global warming is caused by both natural changes in the environment and human activities. In the next section, we will look at

other maps that show that, **in reality, global warming is mostly caused by human activities.**

Activity 2.2 - What's Really Warming the World?

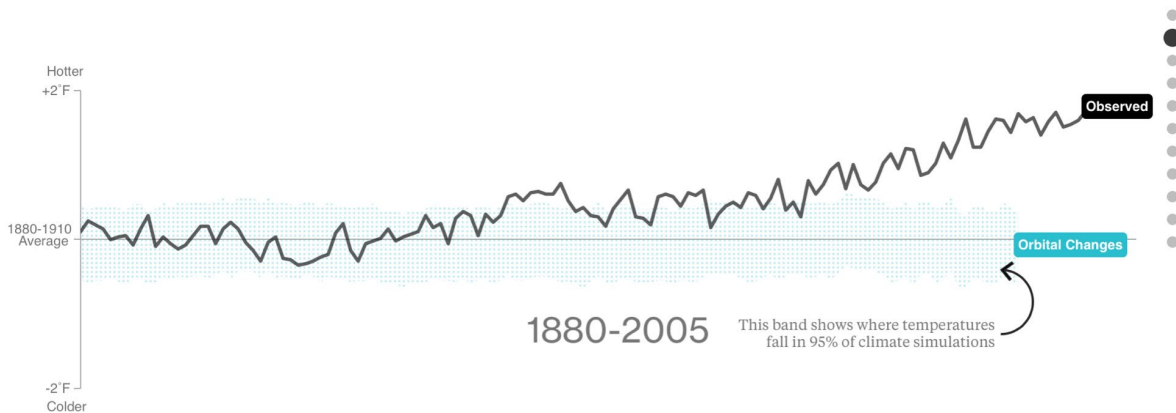
In the following section, various maps put together by [Bloomberg Business](#) show what is really warming the world. They work through different maps of both natural phenomena and human-driven phenomena that contribute to an observed rise in temperature globally.

Below is a map of the observed rise in temperature. Since 1880, global average temperature has increased by 1.4 F.



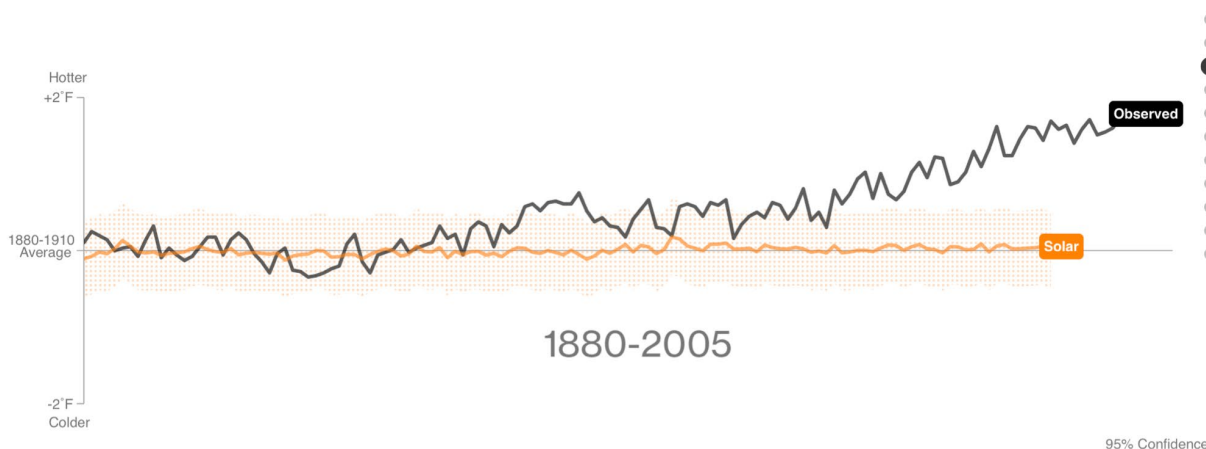
Is it the Earth's Orbit?

The map below shows the influence of the Earth's orbit, tilt, and wobble that change over various time periods. However, over the past 125 years, orbital changes were observed to have minimal impact on the observed rise in temperature.



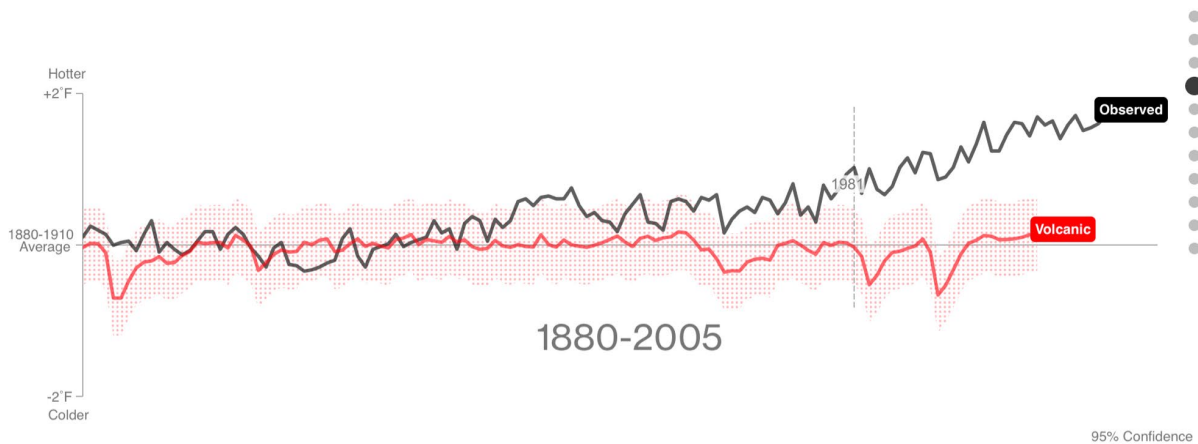
Is it the Sun?

The map below shows the variance in the sun's temperature over a 125-year period. Again, we see that the sun's change in temperature had minimal effect on the observed change in temperature, too.



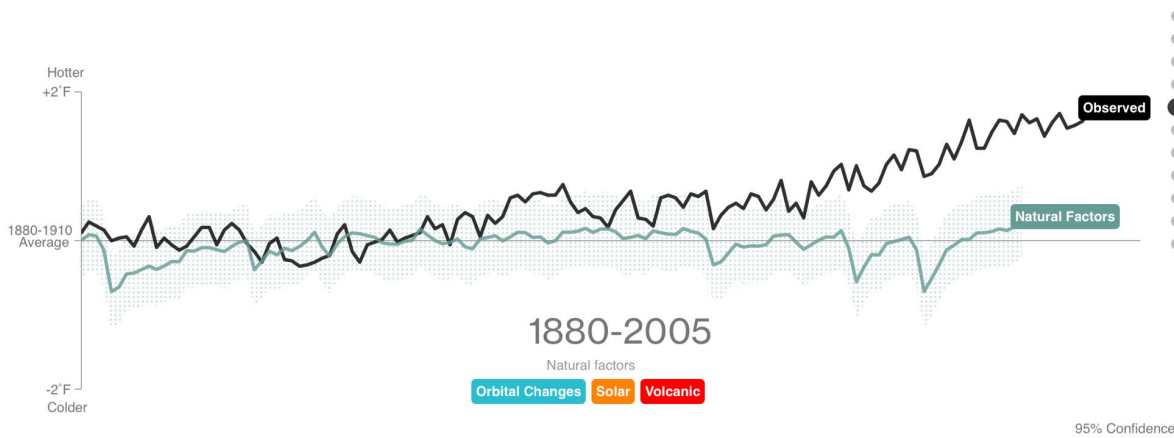
Is it volcanoes?

Volcanic eruptions emit various sulfate chemicals that actually cool the atmosphere. For example, the volcanic eruption in Iceland in 2010 released sulfate chemicals that shifted global temperatures downward for approximately 1-2 years. Even so, the eruptions have limited effect on the observed increase in temperature.



All Three?

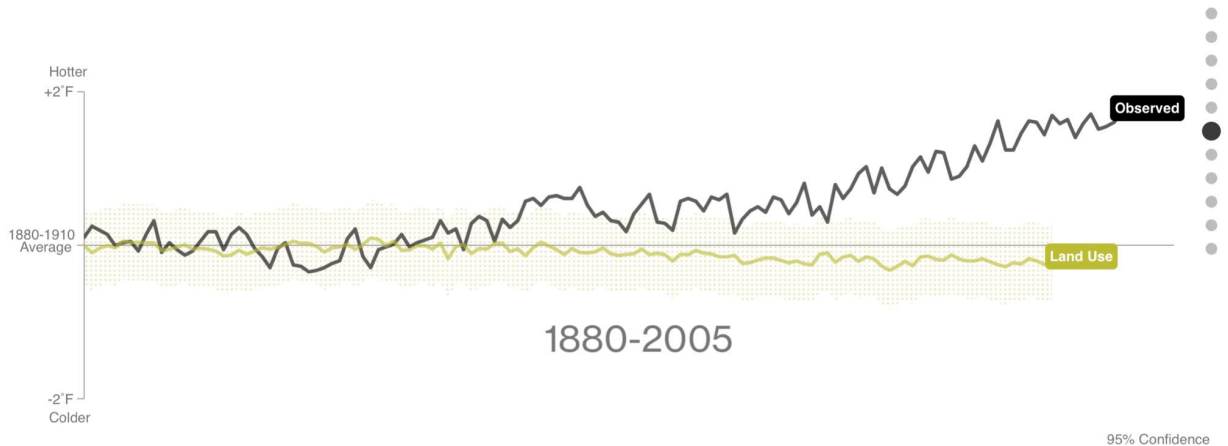
When these above three natural changes are added together, it still does not account for the observed temperature changes.



1. Why is it assumed that natural changes, such as the ones outlined above, offer an explanation for the observed temperature change of 1.4 F?
2. How might shifting the narrative of climate change to only focusing on natural changes absolve human-caused effects?

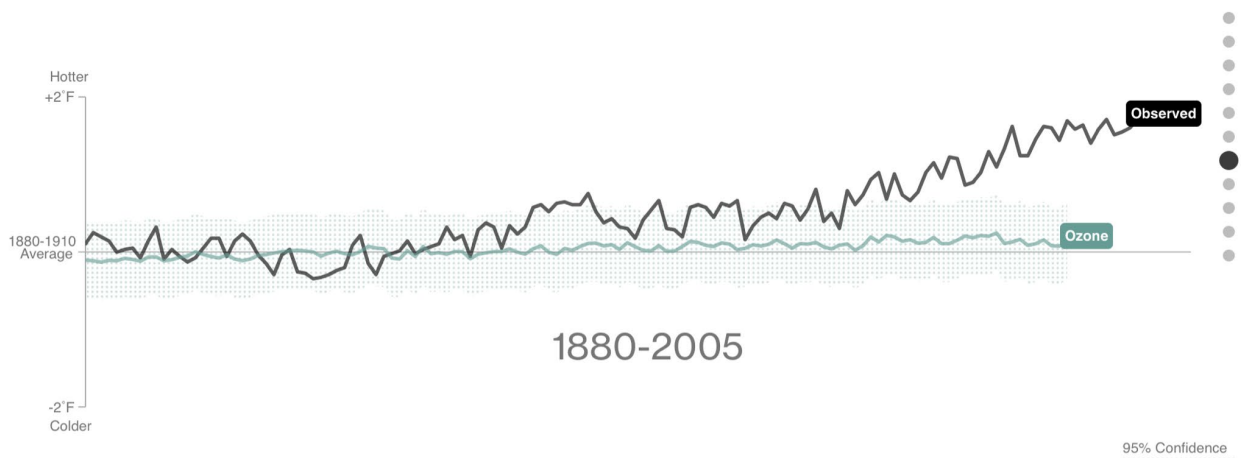
So if it's not nature, is it deforestation?

The map below shows land-use changes over a 125-year period. Humans have altered approximately half of the Earth's surface via plowing, paving, and deforestation. The removal of dense forest vegetation leads to lighter patches which reflect more sunlight. This phenomenon, in turn, produces a cooling effect.



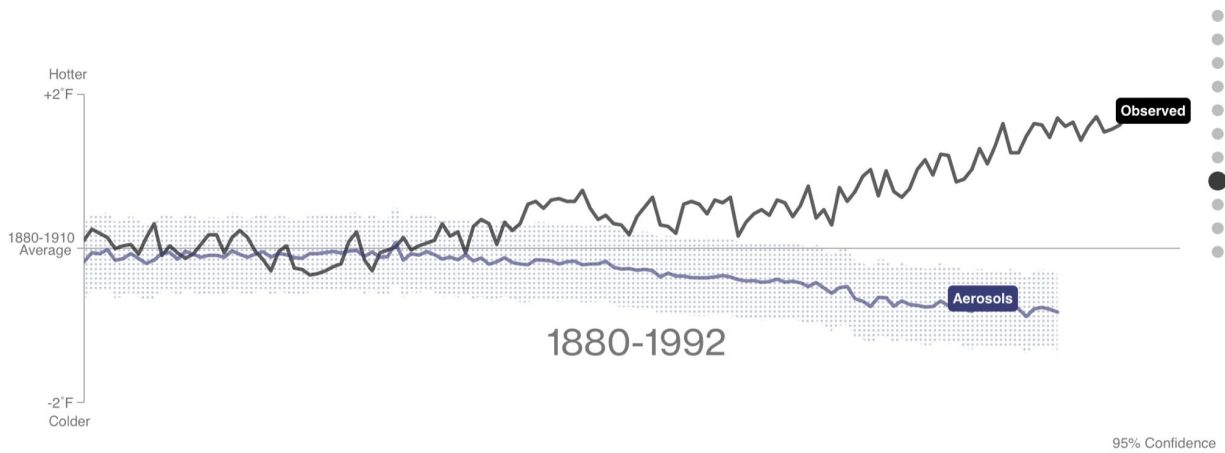
Or ozone pollution?

The map below is of observed ozone pollution. Ozone produced naturally and high in the atmosphere helps to block sunlight and can produce a cooling effect. However, ozone produced by human activity and pollution at the Earth's surface traps heat and increases temperatures. Ozone at the Earth's surface is a greenhouse gas. Yet, ozone has a limited effect on the observed temperature increase.



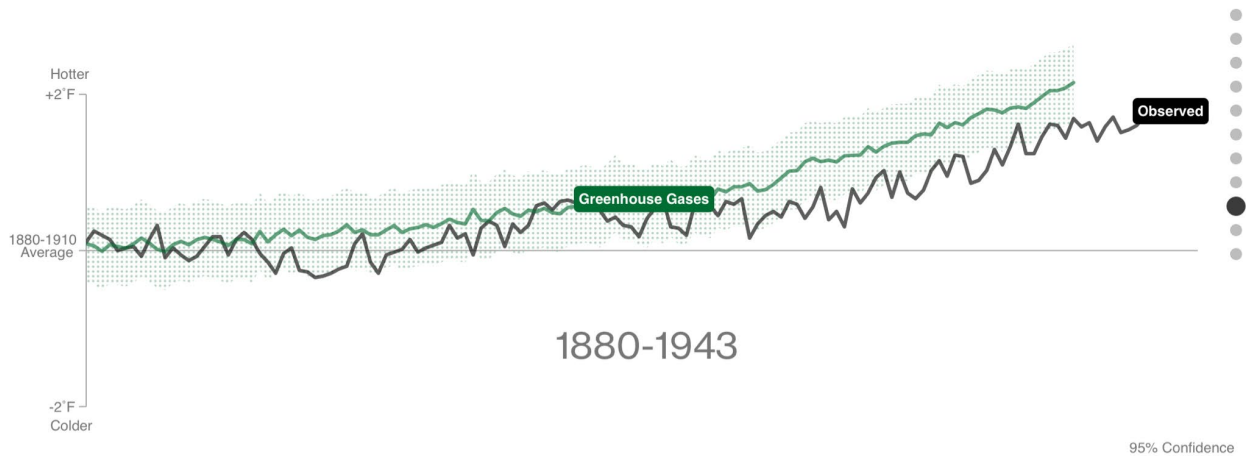
Is it aerosol pollution?

Aerosols are pollutants that have a cooling effect. Sulfate aerosols emitted from coal-burning power plants, for example, can help offset temperature increases. However, these aerosols can damage the environment by causing acid rain and other forms of pollution.

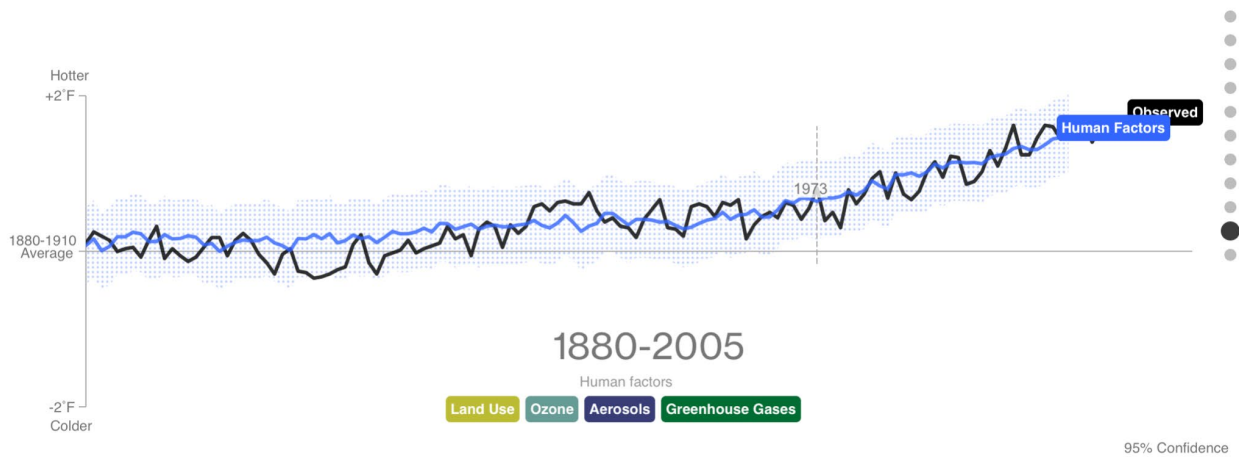


It's Greenhouse Gases!

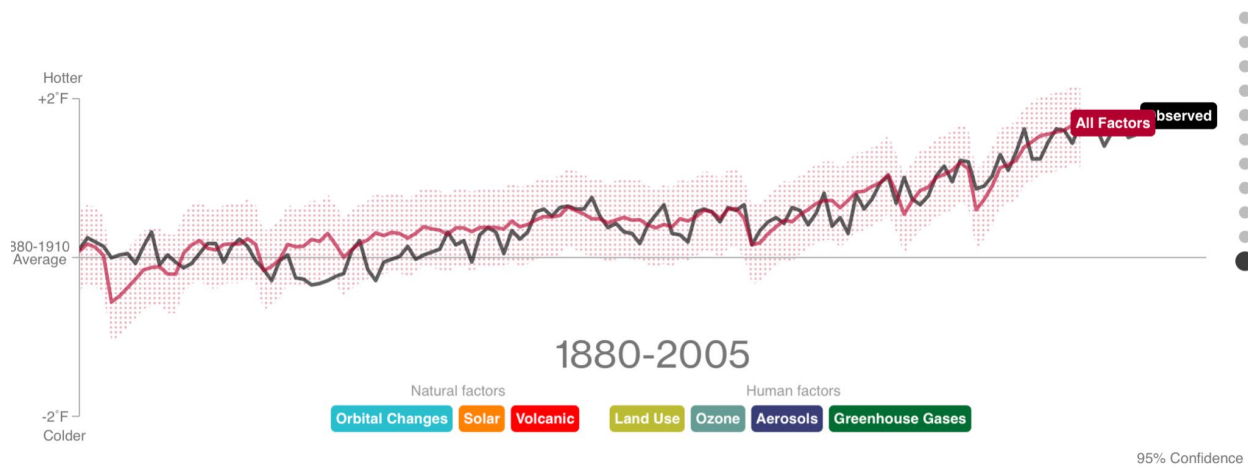
Atmospheric CO₂ levels are 40% higher than they were in 1750. The emission of greenhouse gases such as carbon dioxide from the burning of fossil fuels is the direct contributor to global warming.



The combination of greenhouse gases, aerosols, ozone, and land-use change create a broader umbrella of human activity. This umbrella models the observed temperature change quite well.



When all factors are combined [both human and natural], it is evident that human factors have an overwhelming impact on temperature change.



3. How can data maps such as the ones shown here help teach about climate change and global warming to someone who is a skeptic?
4. Were you surprised by any of the maps shown? Why or why not?
5. What can we do to lower emissions associated with human activity?

Activity 2.2 - Further Discussions of Climate Change

In the following graphs from the [New York Times](#), students are asked open-ended questions to facilitate discussion around climate change impacts.

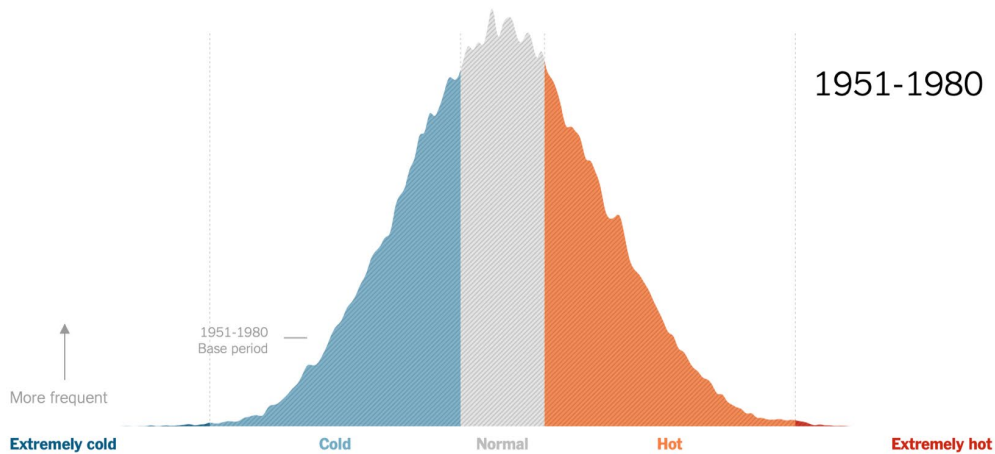
Using the 4 maps below, answer the following questions:

1. What do you notice?
2. What do you wonder?

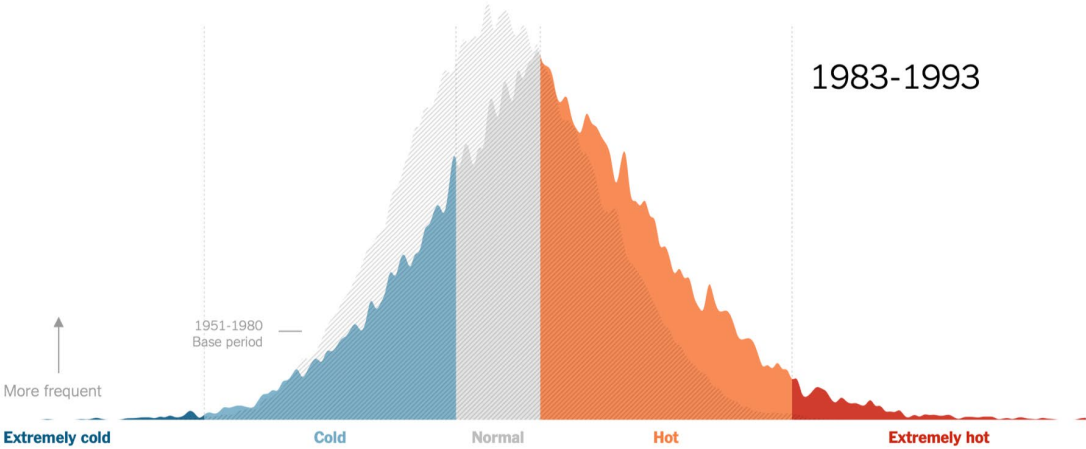
Then, in small groups or pairs:

3. What is going on?
4. Why do you think the graph was produced? What story does it tell?
5. Write a catchy headline for what you see.

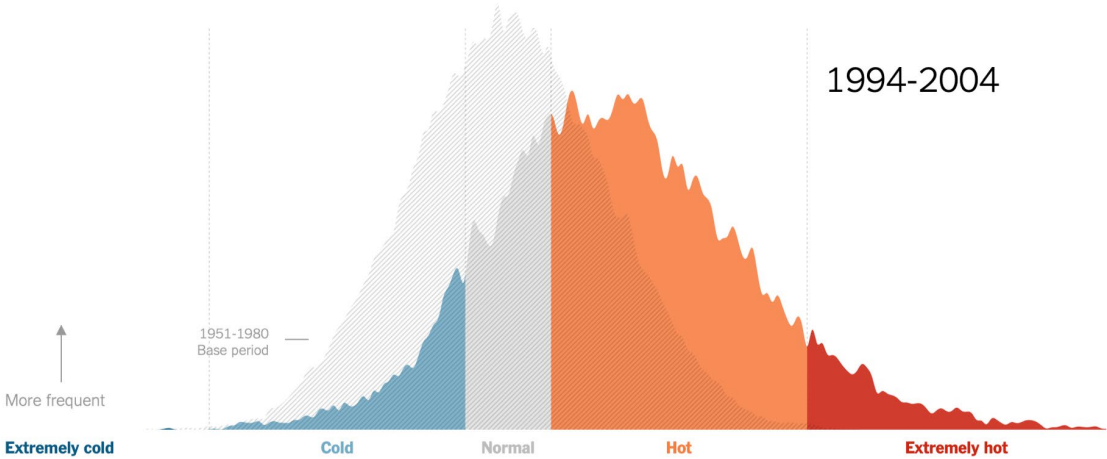
Summer temperatures
in the Northern Hemisphere



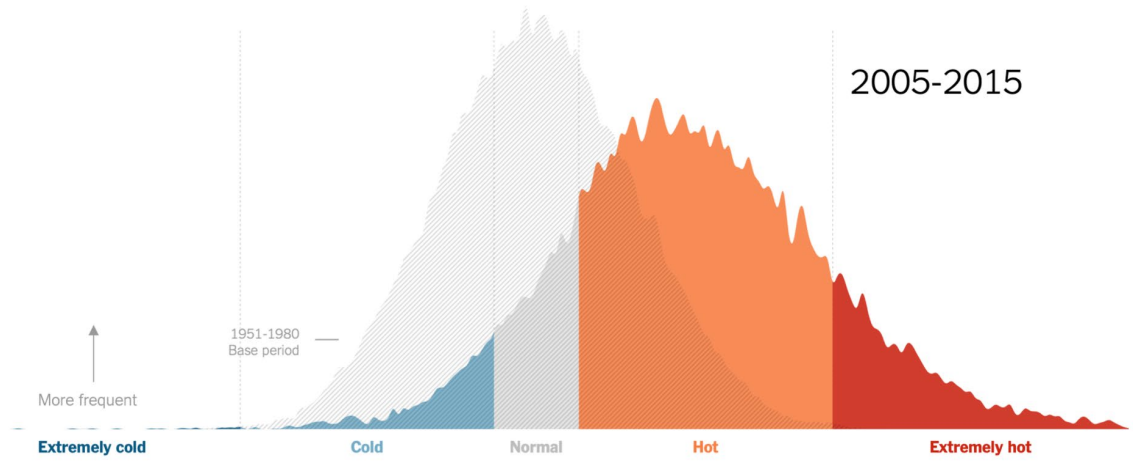
Summer temperatures
in the Northern Hemisphere



Summer temperatures
in the Northern Hemisphere



Summer temperatures
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6. What implications might the data on these graphs have?