

Know the facts

A skeptic's
guide to
climate
change



Are you a climate change skeptic?

You should be. With so many people ignoring the science, it's important to distinguish facts from alarmist statements.

Public exaggeration of the harms from global warming have made many of us skeptical of all reported climate science. And rightly so. Despite this, there are scientific facts about global warming that are not in dispute:



Human emissions are responsible for the increase in CO₂



CO₂ is a greenhouse gas, and more of it in the atmosphere leads to a warmer planet

Be an *informed* skeptic...

These scientific facts have been known for at least five decades.

Is the extreme weather we see today really caused by global warming?

These days, climate change is being blamed for everything, from Hurricane Sandy to tornadoes in Missouri. Claims are made that push beyond what science can tell us. Attributing cause-and-effect to individual weather events is fiendishly difficult.

This chart provides a quick assessment of which extreme weather events are not likely linked to global warming, which events might be linked, and which events have demonstrated (though often exaggerated) links.

Extreme weather event	No global warming link	May change with global warming but amount not established	Evidence of some global warming link
Hurricanes		X	
Tornadoes	X		
Droughts		X	
Forest fires		X	
Heatwaves			X
Coastal floods			X
Earthquakes	X		
Floods		X	

Is global warming real?

As with any issue in science, there are some things that we know, and some things that are uncertain. While global warming is real and grounded in physics, unknowns remain as to how much warming will occur in the future and what impacts this will have on society.

There are facts that nearly all scientists agree on, even those skeptical about the severity of future warming. These are:



Carbon dioxide (CO₂) is a greenhouse gas that warms the earth

The effects of CO₂ in the atmosphere were first established in 1850. Radiative physics shows us that a doubling of CO₂ would raise global temperatures by at least 1.8° Celsius. More warming than this is possible but how much is uncertain.



Humans are responsible for increasing CO₂

We know that additional CO₂ in the atmosphere is human caused. Levels of carbon dioxide in the atmosphere stayed in a narrow range over the last million years. In the last hundred they have risen from 280 ppm to 400 ppm.

Changes in CO₂ concentrations closely match human emissions from burning coal, oil, and gas.



Is the temperature record reliable?

Informed skeptics have rightly raised several common sense concerns about the historical temperature compiled by climate scientists. Those issues were investigated by an independent group of scientists* who were concerned about the accuracy of previous work. This is what they found:

Data selection bias

Using only a small sample of available data was a problem. When the independent study used essentially all the data, they extended the record and improved it substantially.

Poor station quality

Surveys of temperature stations in the U.S. indicated that many stations may be inaccurate. The independent study compared good and poor quality stations, and determined that although absolute temperatures were sometimes biased, the poor stations gave accurate estimates of temperature changes.

Data adjustments

In some cases, the historical records have undergone adjustments to account for changes in observation practices. Critics were rightly suspicious of these adjustments.

The independent study took a hands-off approach and put all their programs and data online for others to try.

Urban heat island effect

Urban areas can be substantially warmer than adjacent rural areas. Critics were concerned that the record might be biased and that the warming recorded was actually due to increased urbanization rather than climate change. The independent study excluded all urban areas and even rural areas near urban ones, resulting in a data set unbiased by the “urban heat island effect.”

When the independent study corrected for all of these issues, it confirmed that the world has warmed 1.5°C, or 2.8°F, over the past 250 years.

Couldn't the Sun have caused the warming?

The Sun is a nuclear fusion reactor a million times larger than Earth; it is responsible for almost all the energy reaching our planet.

However, the amount of energy coming from the Sun doesn't change much, at least over a period as short as a few centuries.

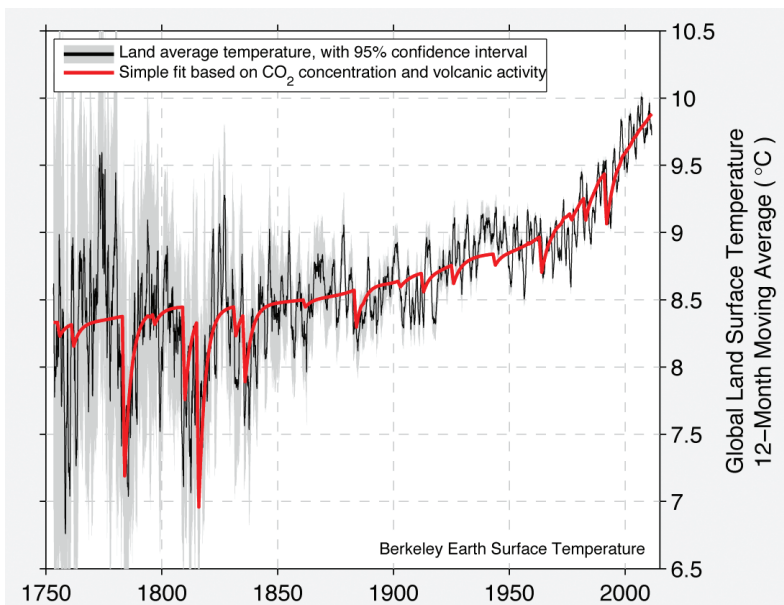
Even the Intergovernmental Panel on Climate Change (IPCC) didn't rule out the sun for warming from 1750 to 1950. But the independent study* demonstrated that there is no correlation between solar activity and global warming.

*Berkeley Earth, www.BerkeleyEarth.org

Hasn't climate changed before in the past?

Yes, natural variability exists, and the Earth's temperature has changed in the past. However, for the past century we know that CO₂ is coming from human burning of fossil fuels. While climate has changed in the past, possibly even as quickly and dramatically as it is changing today, we nevertheless can tell from the unique carbon fingerprint that today's warming is human caused.

The Human Effect - The smooth, significant rise in temperature over the past 250 years, as well as the brief and sporadic (but sometimes intense) cold spells, can be explained by a combination of volcanoes and human greenhouse gas emissions. Volcanoes are important; they are the one natural factor that can sway temperature. But their effect is **temporary**.



How confident are we in future warming?



While informed critics of global warming agree that more CO₂ leads to a warmer planet, there is wide disagreement about how much warming will occur in the future, and if it may have some positive aspects.

What am I supposed to do about it?

The science is clear: global warming is real, and caused by human greenhouse gas emissions. But much of what you hear about “climate change” is exaggerated and/or highly uncertain.

Despite the polarized nature of the current debate, we can move forward if we:



Stay skeptical:
statements should be backed up by data and published research



Practice and promote **energy efficiency**



Recognize that most **future emissions** will come from **China and the developing world**



Demand **sustainable and cost-effective solutions** in the US and around the world



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About Berkeley Earth

Berkeley Earth was founded in 2010 with the goal of addressing the major concerns of climate change skeptics regarding global warming and the land surface temperature record. At Berkeley Earth, we strive to do work that is independent, transparent, and complete. We continue to lower the barriers to entry into climate science by posting all our raw data and our analysis code online to provide an open platform for further analysis. We took a data-driven approach to temperature analysis (using five times more data than other groups), and we are now taking a data-driven approach to other areas of energy and climate science. For more information on Berkeley Earth, please visit www.BerkeleyEarth.org.



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