Debunking common climate science myths

JOHN COOK
Why address misinformation?

1. Defensive reason
2. Offensive reason

How to address misinformation
Inoculating the Public against Misinformation about Climate Change

Sander van der Linden,* Anthony Leiserowitz, Seth Rosenthal, and Edward Maibach

Effectively addressing climate change requires significant changes in individual and collective human behavior and decision-making. Yet, in light of the increasing politicization of (climate) science, and the attempts of vested-interest groups to undermine the scientific consensus on climate change through organized “disinformation campaigns,” identifying ways to effectively engage with the public about the issue across the political spectrum has proven difficult. A growing body of research suggests that one promising way to counteract the politicization of science is to convey the high level of normative agreement (“consensus”) among experts about the reality of human-caused climate change. Yet, much prior research examining public opinion dynamics in the context of climate change has done so under condi-

Polarization can be amplified when the inherent uncertainty of science itself is used to cast doubt on the existence of a scientific consensus. For example, ideologically motivated, vested-interest groups known as “Merchants of Doubt” have orchestrated influential “disinformation campaigns” in which they publicly dispute the scientific consensus on various issues, including human-caused climate change. These campaigns have not only successfully undermined public understanding of the degree of scientific consensus regarding climate change, but also created a sense of suspicion and distrust among the public towards scientific information.
Facts vs Misinformation

van der Linden et al. (2017)
The point of modern propaganda isn't only to misinform or push an agenda. It is to exhaust your critical thinking, to annihilate truth.
Educational opportunity

One of the most powerful and engaging ways to teach science is by explaining how science can get distorted.
Test scores

Misconception based learning

Traditional learning

Mean score

Pretest Posttest Delayed posttest

McCuin et al. 2014
Confidence gain

Gain in confidence

Muller et al. 2007

Refutation
Extended exposition
Exposition
How to effectively debunk misinformation
Continued Influence Effect
Continued Influence Effect
The golden rule of debunking

Fight Sticky Myths...

...With Stickier Facts
S.U.C.C.E.S.S.

- Simple
- Unexpected
- Credible
- Concrete
- Emotional
- Story
Is global warming happening?

It’s inappropriate to make inferences from short periods of noisy data. You can only obtain statistically significant trends using time periods greater than 16 years.

- Cooling trend over last decade
- Annual Global Surface Temperature (NASA GISS)
Since 1998, our climate has absorbed 4 Hiroshima bombs worth of heat every second.
Climate change like atom bomb, Sydney summit told

NEDA VANOVAC  AAP  June 22, 2013 6:16PM

THE planet has been building up temperatures at the rate of four Hiroshima bombs of heat every second, and it's all our fault, Australia's Climate Action Summit has been told.

Hurricane Katrina and superstorm Sandy are just two examples of how extreme weather will intensify, Australia's Climate Action Summit has heard.

Humans are emitting more carbon dioxide into the atmosphere than any other time in history, says John Cook, Climate Communication Fellow from the Global Change Institute at the University of Queensland.
Climate change like atom bomb, Sydney summit told

Earth's temperature rise equals four Hiroshima atomic bombs: Climate scientist

Earth's temperature rise 'equal to four Hiroshima atomic bombs every second'

Climate change likened to heat of bomb blasts

Schimbarile climatice, legate de bombele nucleare
Our planet is global warming at 7,409,177,820,267,687 kitten sneezes per second.
Kitten Sneezes Are Worse Than Hiros!

Now the inhumanity has devolved into cat-hating as well.

In the face of intense criticism, John Cook put forth at the AGU meeting a unit for those who prefer a "cuddlier" figure for the amount of heat trapped by global warming -- the "kitten sneeze."

That amount, 4 Hiros/second, is 4*63 Terajoules/s, so one kitten sneeze (KS) is apparently

\[ 1 \text{ KS} = 0.034 \text{ Joules} = 8.1 \text{ millicalories} \]

However.... That's a brutal number of sneezes per kitten, as I will now prove.

There are 95.6 million cats in the United States, which works out to 0.30 cats per American. (Frankly I think it ought to be crime for anyone to own keep just a third of a cat, with a serious punishment for violations, but maybe that's just me.)
cats per American. (Frankly I think it ought to be crime for anyone to even keep just a third of a cat, with a serious punishment for violations, but maybe that's just me.)

While it's unlikely the world-at-large has as many cats per capita as does the U.S., this figure doesn't include feral cats, wild cats, lions or tigers, so let's take it as the world average. With a global population of 7.13 billion people, the number of estimated cats on the planet is 2.15 billion.

Domestic cats live about 16 years, and are kittens for roughly 6 months. So right now there are about 67 million kittens on the planet.

Thus, each kitten would have to sneeze 110 million times a second to equal the amount of heat trapped each second by global warming.

I'm sorry, but any kitten that sneezes 110 million times a second is not going to last more than a few microseconds, and that's just cruel.

So instead of the insensitivity and inaccuracy of comparing global warming to the horrific death and destruction of a major world city and its inhabitants, Cook is comparing it to the near-instantaneous vaporization of millions and millions of the cutest beings on the planet, bar none.

This isn't an improvement at all -- a unit that imagines the wanton mass destruction of the world's entire population of innocent kittens is perhaps the only unit that is worse than the Hiro.

Back to the drawing board, please.
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Why does John Cook hate little Oliver?

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van der Linden et al. (2017)
INOCULATION THEORY

Warning of threat + Counter-arguments
Warning Before Misinformation

... several independent investigations have concluded that the “Petition Project” is extremely misleading. For instance, many of the signatures on the petition are fake (for example, past signatories have included the long deceased Charles Darwin, members of the Spice Girls, and fictional characters from Star Wars). Also, although 31,000 may seem like a large number, it actually represents less than 0.3% of all US science graduates (a tiny fraction). Further, nearly all of the legitimate signers have no expertise in climate science at all.
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Petition

We urge the United States government to reject the global warming agreement that was written in Kyoto, Japan in December, 1997, and any other similar proposals. The proposed limits on greenhouse gases would harm the environment, hinder the advance of science and technology, and damage the health and welfare of mankind.

There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth’s atmosphere and disruption of the Earth’s climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.
Response to Misinformation

Change in Perceived Consensus (%)

-20 -10 0 10 20

Liberal  Political Ideology  Conservative

Misinformation
Promoting “fake experts” to manufacture doubt about science

Sometimes, inconvenient scientific facts threaten the interests of industry groups and organisations. For example, the scientific evidence linking smoking with lung cancer threatened the profits of the tobacco industry. Similarly, scientific evidence linking fossil fuel emissions with global warming threatens the profits of the fossil fuel industry.

In these cases, a common tactic for industry groups and organisations is to manufacture doubt about the science through the promotion of “fake experts”. Fake experts are spokespersons who convey the impression of expertise in a given area without possessing actual relevant experience. Groups wishing to cast doubt on science often use fake experts to convince the public that the science isn’t settled.
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Response to Misinformation

- "Fake experts" technique
- Misinformation

Change in Perceived Consensus (%)

Liberal  Political Ideology  Conservative
Since 1998, our climate has absorbed 4 Hiroshima bombs worth of heat every second.
Best practices in debunking
3 ELEMENTS TO AN EFFECTIVE DEBUNKING

**FACT**
Replace the myth with a more compelling and memorable fact

**MYTH/MISCONCEPTION**
Warn people before mentioning the myth so they’re cognitively on guard

**FALLACY**
Explain the technique used by the myth to distort the fact.

- **F**: Fake Experts
- **L**: Logical Fallacies
- **I**: Impossible Expectations
- **C**: Cherry Picking
- **C**: Conspiracy Theories
5 CHARACTERISTICS OF SCIENCE DENIAL

1. Fake Experts
2. Logical Fallacies
3. Impossible Expectations
4. Cherry Picking
5. Conspiracy Theories
The inevitable consequence of a consensus of evidence is a consensus of scientists, manifesting in a multitude of ways. Among actively publishing climate scientists, several studies have found 97% agreement that humans are causing global warming. National Academies of Science from 80 different countries endorse the consensus, as well as leading scientific organizations such as the National Oceanic and Atmospheric Administration, Australian Bureau of Meteorology and Canadian Meteorological and Oceanographic Society.

Most attacks involved misrepresentation of our research

Earlier this year, I was part of a team that published research in the journal Environmental Research Letters, measuring the level of scientific agreement on human-caused global warming across 21 years of peer-reviewed climate papers. We identified over 4,000 papers stating a position on human-caused global warming in their abstract. Among those abstracts, 97.1% endorsed the consensus view.

To independently confirm our results, we went to the foremost experts – the very scientists who authored the papers. We invited scientists to rate the level of endorsement of their own papers. Over 2,000 papers were rated by 1,200 scientists. The result obtained from the scientists was strikingly consistent with both our results and previous studies: 97.2% consensus.

As different papers expressed endorsement of consensus in different ways, we adopted three precisely defined expressions of consensus. A paper either explicitly quantified how much humans had contributed to warming, explicitly endorsed human-caused global warming without quantification or implied the consensus without an explicit endorsement. No matter which definition was used, or if all three were included together, the same result was obtained: overwhelming consensus.

For example, one definition of consensus specified that humans are causing more than half of global warming, with rejection of consensus specifying that humans are causing less than half. Looking at the scientists’ ratings of their own papers with this definition, we found 96.2% consensus.

For over two decades, opponents of climate action have sought to manufacture doubt about the scientific consensus. As far back as 1991, Western Fuels Association spent over half a million dollars on a campaign to “reposition global warming as theory (not fact)”. The infamous “Luntz memo,” leaked in 2002, revealed the strategy of reducing support for climate mitigation policies by not proposing alternative policies but by attacking scientific consensus. It came as no surprise when our research, finding an overwhelming and strengthening scientific consensus, came under intense attack.

Most attacks involved misrepresentation of our research. For example, Andrew Montford argued in The Financial Post that apart from papers quantifying the human contribution towards global warming, only “a few” climate papers gave a qualitative endorsement. In Montford’s opinion, over 3,800 papers equals “a few,” an extraordinary example of cognitive bias. Montford argues that a “vast majority” of papers claim no position on human-caused warming, ignoring the fact that according to the scientists who wrote the papers, the majority of climate papers accept human-caused global warming.

In fact, Montford gives the consensus found by the scientists who authored the papers a wider berth. This is because independent confirmation from the actual authors of the climate papers falsifies all of his criticisms in one fell swoop. The consensus is robust. It’s found in the abstracts of the papers. It’s found in the full papers as rated by the papers’ actual authors. It’s found using a number of definitions of consensus.

Why does the 97% consensus keep reappearing, in our results and in previous studies? The answer is simply that the proportion of climate scientists dissenting from the consensus is vanishingly small. Out of the 29,896 scientists we found publishing climate papers over the 21-year period, less than half a percent (0.4%) published papers rejecting the consensus.

Whether you look at it front-on, sideways or upside-down, you’ll find overwhelming agreement among climate scientists that humans are causing global warming. This consensus of scientists is the result of the overwhelming consensus of evidence.

John Cook is the Climate Communication Research Fellow at the Global Change Institute, University of Queensland.
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Q18. WHICH PRODUCES MORE CARBON DIOXIDE: VOLCANOES, OR BURNING FOSSIL FUELS?

**Answer:** Multiple independent lines of evidence find that human burning of fossil fuels adds almost 140 times more carbon dioxide than volcanoes do. Human use of fossil fuels is, in effect, a constantly burning megavolcano.

**The Facts:** In the 1990s, a scientist named Ralph Keeling, working with various colleagues, found a telling change in the chemistry of the atmosphere. His measurements showed that, year after year, the amount of oxygen was very gradually, but clearly, going down. Ongoing measurements show that this pattern continues to the present day. Nobody needs to worry about running out of oxygen, as the annual rate of change is tiny, about 19 per meg, meaning that each year, out of every million oxygen molecules, 19 are lost (Scripps Institution of Oceanography, 2015; see Figure 2.7). The finding is nevertheless important because of what it reveals about the cause of another significant change in the atmosphere: the buildup of carbon dioxide.
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Nevertheless, there is a persistent myth that volcanoes produce more carbon dioxide than humans do. Ian Plimer’s (2009) book, *Heaven and Earth*, and his subsequent writings online have done much to popularize this misconception. Plimer has made several statements that are at odds with the available data, for example: “Volcanoes produce more CO₂ than the world’s cars and industries combined” (p. 413). In a 2009 online column for The Drum, a companion site to the Australian Broadcasting Corporation’s television show of the same name, he dismissed human emissions of carbon dioxide over the past 250 years as insignificant, writing: “One volcanic cough can do this in a day.”

Numbers provided by the USGS suggest otherwise. In addition to the annual total emissions of carbon dioxide for all volcanic sources (0.26 Gt, as mentioned earlier), estimates are available for the contributions of individual volcanoes. Take, for example, two of the largest volcanic eruptions over the past few decades. The 1980 eruption of Mount St. Helens in the United States produced an estimated 0.01 Gt of carbon dioxide, and the 1991 eruption of Mount Pinatubo in the Philippines produced around 0.05 Gt of carbon dioxide. Recall that burning fossil fuels released an estimated 36 Gt in 2013. There’s no doubt that standing near an erupting volcano is a truly awe-inspiring experience and that individual eruptions can, for people living nearby, result in tragedy. But compared to human civilization’s capacity to pump out carbon dioxide, they really are just firecrackers. Ian Plimer’s claims that volcanoes produce more carbon dioxide than humans are not supported by the facts. (Terry Gerlach, the USGS volcano expert, wrote a comprehensive review of Ian Plimer’s book at *Earth* magazine in 2010, see Further Reading.)
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GMU Survey of weathercasters

- 40% present an “opposing viewpoint” sometimes when reporting on climate change
- 54% requested information on refuting common misperceptions regarding climate change

Making Sense of Climate Science Denial

Climate change is real, so why the controversy and debate? Learn to make sense of the science and to respond to climate change denial.

About this Course
In public discussions, climate change is a highly controversial topic. However, in the scientific community, there’s little appetite, with 97% of climate scientists crediting human activity as global warming.
## FACT
- Our planet has continued to build up heat since 1998 - global warming is still happening.
- Global warming is like rigging the weather dice, making it more likely to get hot days.
- Overall, glaciers across the globe are shrinking at an accelerating rate, threatening water supplies for millions of people.
- Greenland on the whole is losing ice, at a rate of over 2

## MYTH
- "Global warming stopped in 1998."
- "It's cold outside, so global warming must have stopped."
- "Glaciers around the world are increasing, disproving global warming."
- "Greenland Ice sheet is thickening in the middle so it must be gaining ice."

## FALLACY
- Cherry picking: looking at one region or a short period ignores the full picture.
- Impossible Expectations: global warming doesn't mean no more cold weather, just fewer cold days compared to hot days.
- Cherry picking: picking a handful of growing glaciers ignores the vast majority of glaciers that are shrinking.
- Cherry picking: looking at the whole ice sheet shows it's losing ice.
Explaining climate change science & rebutting global warming misinformation

Scientific skepticism is healthy. Scientists should always challenge themselves to improve their understanding. Yet this isn’t what happens with climate change denial. Skeptics vigorously criticise any evidence that supports man-made global warming and yet embrace any argument, op-ed, blog or study that purports to refute global warming. This website gets skeptical about global warming skepticism. Do their arguments have any scientific basis? What does the peer reviewed scientific literature say?

2014 SkS Weekly Digest #37
Posted on 14 September 2014 by John Hartz

SkS Highlights
Results From Argument Headings

- It's the sun
- Solar Cycle Length proves it's the sun
- The sun is getting hotter
- Water levels correlate with sunspots

Results From Argument Content

- Other planets are warming
- It cooled mid-century
- CO2 lags temperature
- It's cosmic rays
- Scientists can't even predict weather
"It's the sun"

The skeptic argument...
"Over the past few hundred years, there has been a steady increase in the numbers of sunspots, at the time when the Earth has been getting warmer. The data suggests solar activity is influencing the global climate causing the world to get warmer." (BBC)

The science says...
The sun’s output has barely changed since 1970 and is irrelevant to recent global warming.

As supplier of almost all the energy in Earth's climate, the sun has a strong influence on climate. A comparison of sun and climate over the past 1150 years found temperatures closely match solar activity (Usoskin 2005). However, after 1975, temperatures rose while solar...
Case studies in inoculation
Humans have died naturally in the past...

...so this death must be natural!
97% of climate scientists agree on global warming.
99.9% of Global Warming Petition Project are NOT climate scientists
John Cook

Email: jcook20@gmu.edu
Web: http://www.skepticalscience.com
Podcast: http://evidencesquared.com
MOC http://sks.to/denial101x
MYTH  “31,000 dissenting scientists prove there’s no expert agreement on human-caused global warming.”

PREMISE #1
A large proportion of scientists dissent against human-caused global warming.

PREMISE #2
Scientists are experts on climate change.

CONCLUSION
There is no expert agreement on human-caused global warming
MYTH
“31,000 dissenting scientists prove there’s no expert agreement on human-caused global warming.”

PREMISE #1
A large proportion of scientists dissent against human-caused global warming.

PREMISE #2
Scientists are experts on climate change.

CONCLUSION
There is no expert agreement on human-caused global warming

MAGNIFIED MINORITY
31,000 is only 0.3% of over 10 million people with science degrees in USA.

FAKE EXPERTS
99.9% of the 31,000 signatories are not climate scientists.
5 CHARACTERISTICS OF SCIENCE DENIAL

F - Fake Experts
L - Logical Fallacies
I - Impossible Expectations
C - Cherry Picking
C - Conspiracy Theories

Magnified Minority
Red Herring
Misrepresentation
Jumping to Conclusions
False Dichotomy