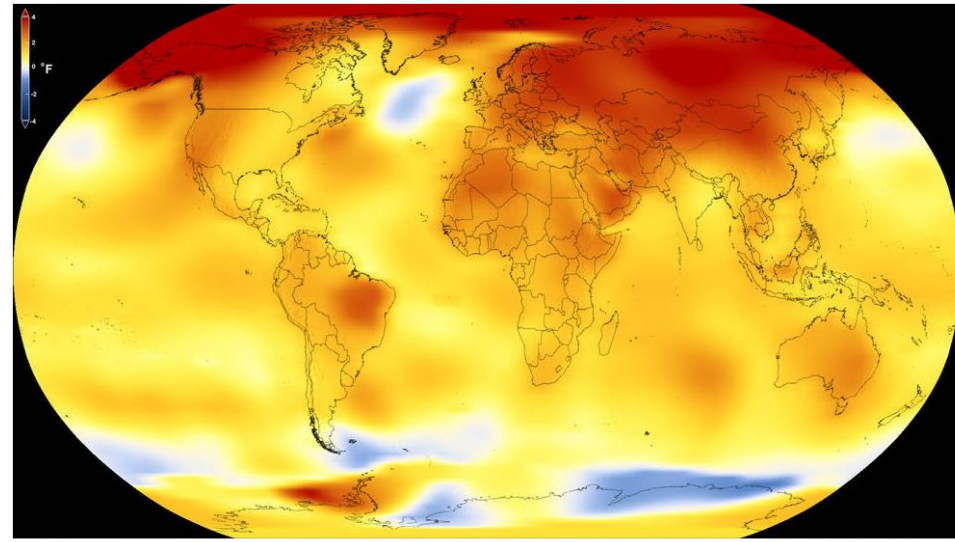


How do you Reply to Those Who are Skeptical about Climate Change?

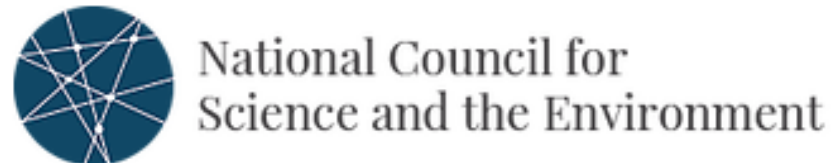


This map shows Earth's average global temperature from 2013 to 2017, as compared to a baseline average from 1951 to 1980, according to an analysis by NASA's Goddard Institute for Space Studies. Yellows, oranges, and reds show regions warmer than the baseline.
Credits: NASA's Scientific Visualization Studio

<https://www.nasa.gov/press-release/long-term-warming-trend-continued-in-2017-nasa-noaa>

Andy Jorgensen, Ph.D.

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Senior Fellow, National Council for Science and the Environment**



Skepticism is
important and
healthy in science....
But the facts must
be examined.



The next slides
are excerpts from
this website.
Much more is
available.

Climate Myth...

Climate's changed before

Climate is always changing. We have had ice ages and warmer periods when alligators were found in Spitzbergen. Ice ages have occurred in a hundred thousand year cycle for the last 700 thousand years, and there have been previous periods that appear to have been warmer than the present despite CO₂ levels being lower than they are now. More recently, we have had the medieval warm period and the little ice age. (Richard Lindzen)

Greenhouse gasses – mainly CO₂, but also methane – were involved in most of the climate changes in Earth's past. When they were reduced, the global climate became colder. When they were increased, the global climate became warmer. When CO₂ levels jumped rapidly, the global warming that resulted was highly disruptive and sometimes caused mass extinctions. Humans today are emitting prodigious quantities of CO₂, at a rate faster than even the most destructive climate changes in earth's past.

Rate is the key.

Life flourished in the Eocene, the Cretaceous and other times of high CO₂ in the atmosphere because the greenhouse gasses were *in balance* with the carbon in the oceans and the weathering of rocks. Life, ocean chemistry, and atmospheric gasses *had millions of years to adjust* to those levels.



Lush life in the Arctic during the Eocene, 50 million years ago (original art - Stephen C. Quinn, The American Museum of Natural History, N.Y.C)

But there have been several times in Earth's past when Earth's temperature jumped abruptly, in much the same way as they are doing today. Those times were caused by large and rapid greenhouse gas emissions, just like humans are causing today.

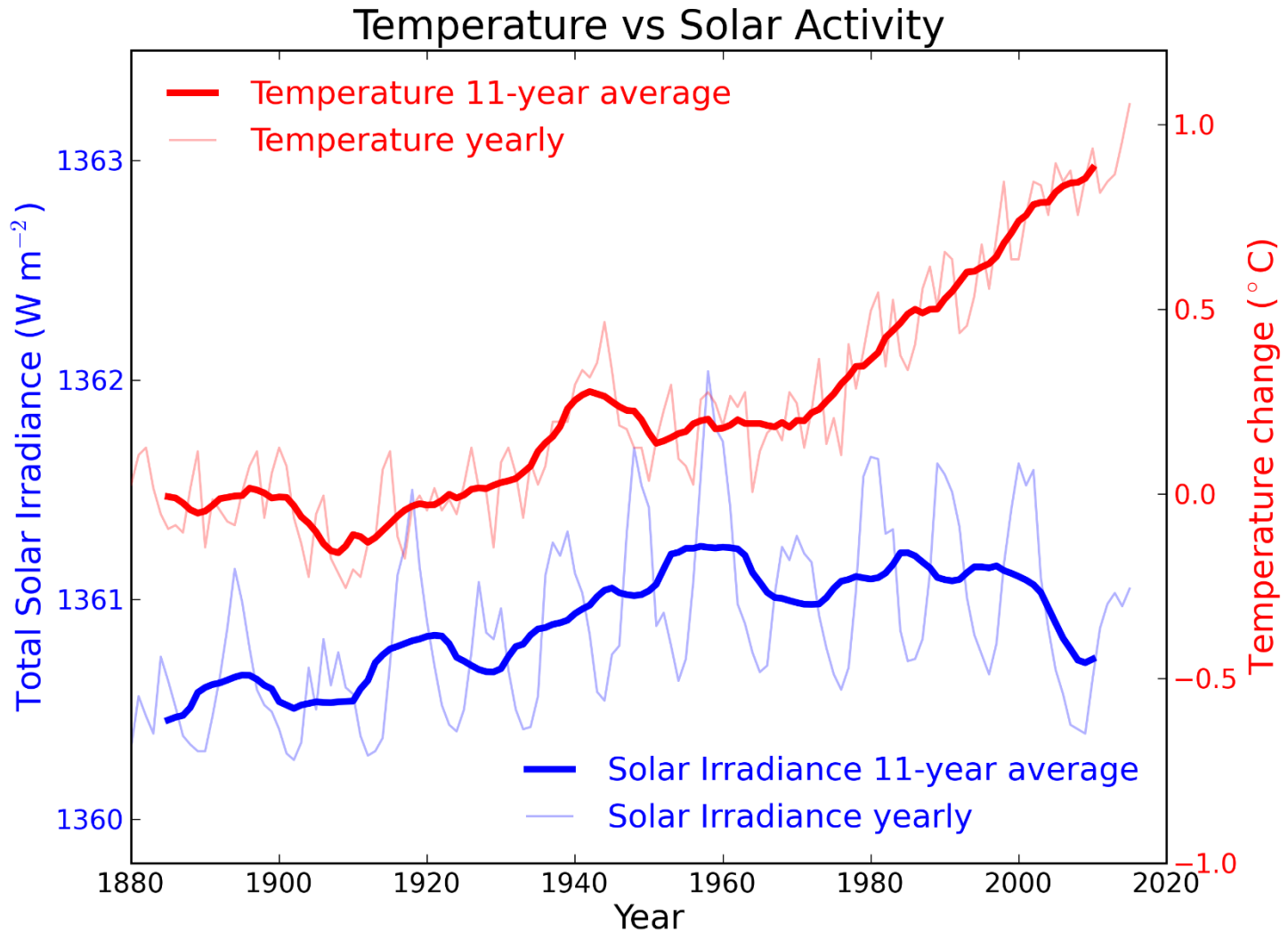
Those abrupt global warming events were almost always highly destructive for life, causing mass extinctions such as at the end of the Permian, Triassic, or even mid-Cambrian periods. The symptoms from those events (a big, rapid jump in global temperatures, rising sea levels, and ocean acidification) are all happening today with human-caused climate change.

Climate Myth...

It's the sun

"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)

Over the last 35 years the sun has shown a cooling trend. However global temperatures continue to increase. If the sun's energy is decreasing while the Earth is warming, then the sun can't be the main control of the temperature.



Climate Myth...

It's not bad

"Two thousand years of published human histories say that warm periods were good for people. It was the harsh, unstable Dark Ages and Little Ice Age that brought bigger storms, untimely frost, widespread famine and plagues of disease." (Dennis Avery)

- “(M)ost climate change impacts will confer few or no benefits, but may do great harm at considerable cost.”
 - Negative Agricultural changes, such as distribution of water, crop yield
 - Health effects – heat waves, more disease-carrying insects
 - Reduced reflection in sunlight due to less ice
 - Increased ocean acidification, more low oxygen levels in the oceans
 - Rising sea levels

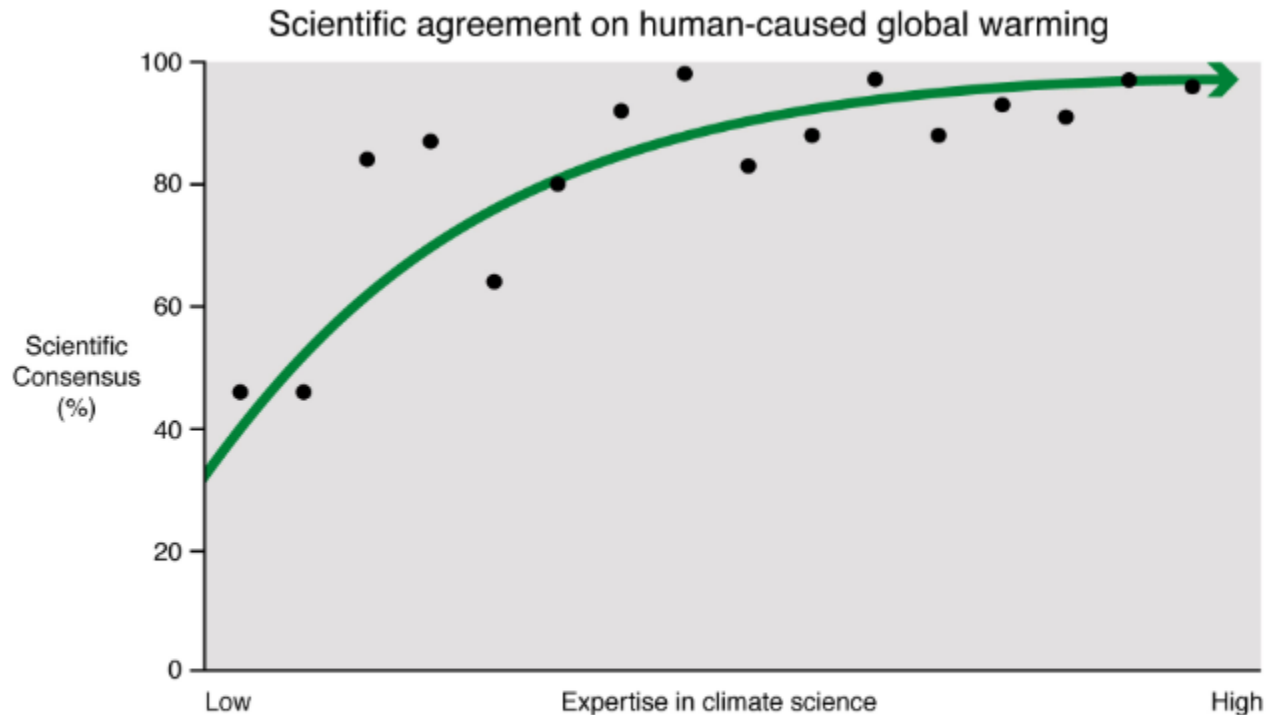
Climate Myth...

There is no consensus

The Petition Project features over 31,000 scientists signing the petition stating "There is no convincing scientific evidence that human release of carbon dioxide will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere ...". (Petition Project)

Authors of seven climate consensus studies — including Naomi Oreskes, Peter Doran, William Anderegg, Bart Verheggen, Ed Maibach, J. Stuart Carlton, and John Cook — co-authored a paper that should settle this question once and for all. The two key conclusions from the paper are:

- 1) Depending on exactly how you measure the expert consensus, it's somewhere between 90% and 100% that agree humans are responsible for climate change, with most of our studies finding 97% consensus among publishing climate scientists.
- 2) The greater the climate expertise among those surveyed, the higher the consensus on human-caused global warming.

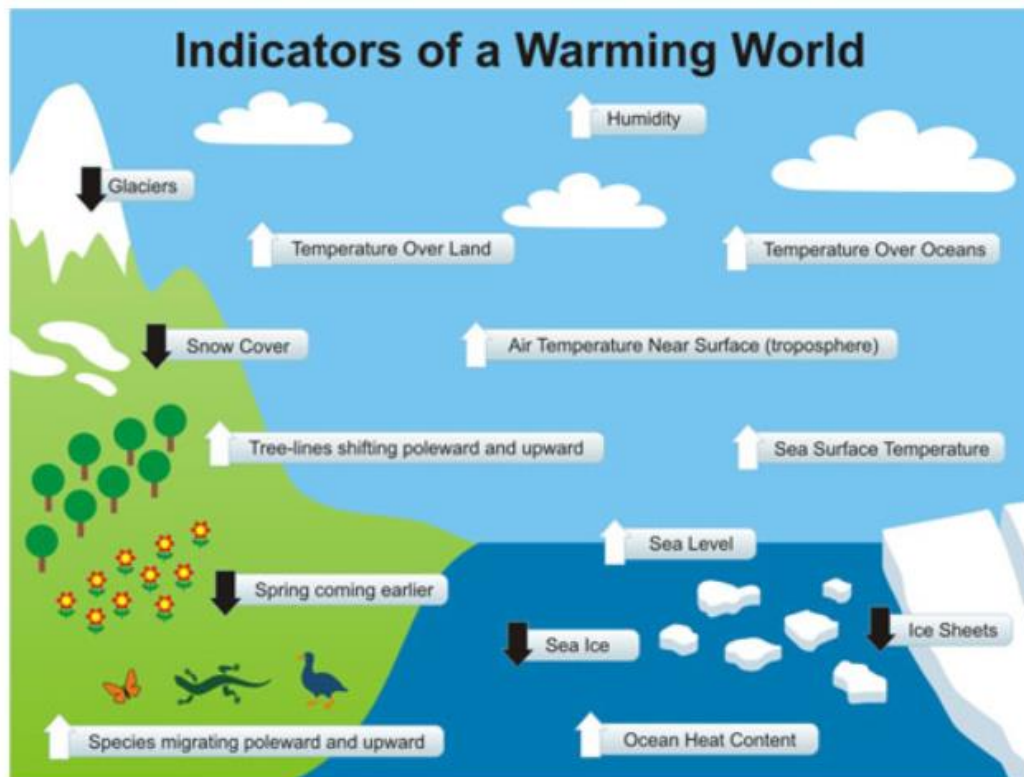


Scientific consensus on human-caused global warming as compared to the expertise of the surveyed sample. There's a strong correlation between consensus and climate science expertise. Illustration: John Cook. Available on the [SkS Graphics page](#)

Climate Myth...

It's cooling

"In fact global warming has stopped and a cooling is beginning. No climate model has predicted a cooling of the Earth – quite the contrary. And this means that the projections of future climate are unreliable." (source: [Henrik Svensmark](#))



Indicators of a warming world based on surface, satellite, and ocean temperature measurements, satellite measurements of energy imbalance (the difference between incoming and outgoing energy at the top of the atmosphere), and of receding glaciers, sea ice, and ice sheets, rising sea level, and shifting seasons.

Climate Myth...

Models are unreliable

"[Models] are full of fudge factors that are fitted to the existing climate, so the models more or less agree with the observed data. But there is no reason to believe that the same fudge factors would give the right behaviour in a world with different chemistry, for example in a world with increased CO₂ in the atmosphere." (Freeman Dyson)

Simulated annual global mean surface temperatures

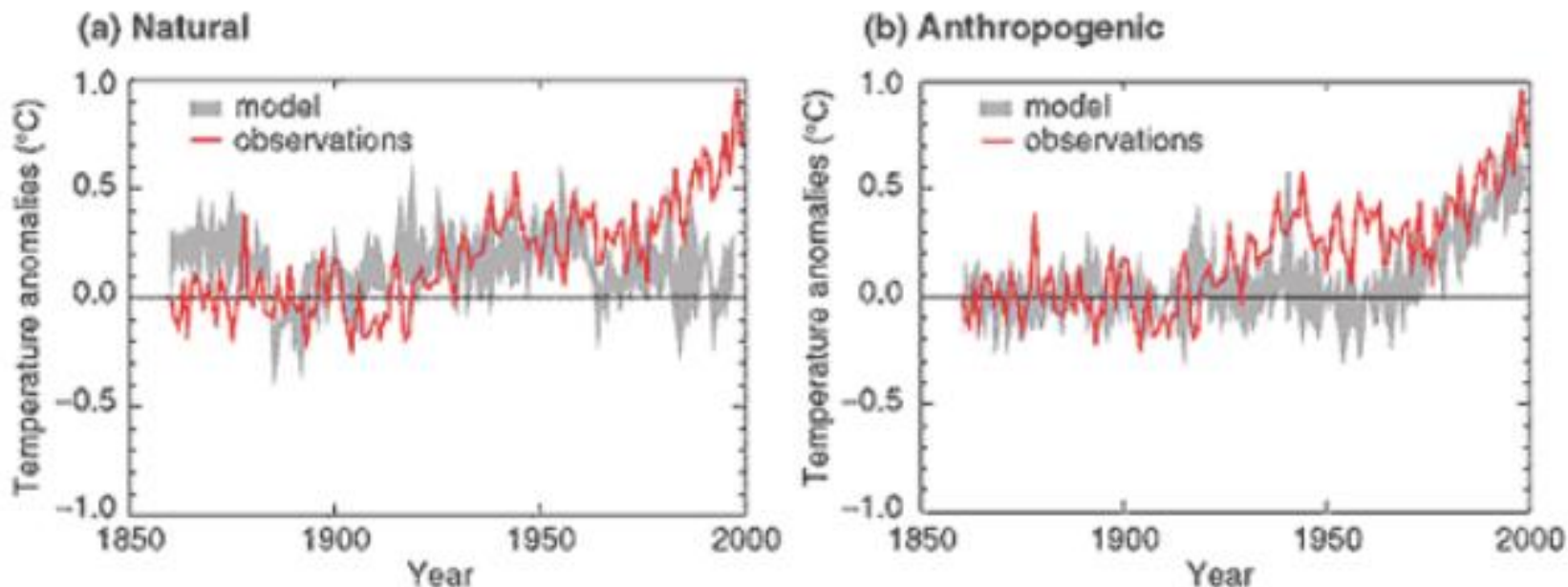


Figure 1: Comparison of climate results with observations. (a) represents simulations done with only natural forcings: solar variation and volcanic activity. (b) represents simulations done with anthropogenic forcings: greenhouse gases and sulphate aerosols. (c) was done with both natural and anthropogenic forcings (IPCC).

Climate Myth...

Temp record is unreliable

"We found [U.S. weather] stations located next to the exhaust fans of air conditioning units, surrounded by asphalt parking lots and roads, on blistering-hot rooftops, and near sidewalks and buildings that absorb and radiate heat. We found 68 stations located at wastewater treatment plants, where the process of waste digestion causes temperatures to be higher than in surrounding areas.

In fact, we found that 89 percent of the stations – nearly 9 of every 10 – fail to meet the National Weather Service's own siting requirements that stations must be 30 meters (about 100 feet) or more away from an artificial heating or radiating/reflecting heat source." (Watts 2009)

Surface temperature measurements are collected from about 30,000 stations around the world (Rennie et al. 2014). About 7000 of these have long, consistent monthly records (Fig. 1). As technology gets better, stations are updated with newer equipment. When equipment is updated or stations are moved, the new data is compared to the old record to be sure measurements are consistent over time.

In 2009 some people worried that weather stations placed in poor locations could make the temperature record unreliable. Scientists at the National Climatic Data Center took those critics seriously and did a careful study of the possible problem. Their article "On the reliability of the U.S. surface temperature record" (Menne et al. 2010) had a surprising conclusion. The temperatures from stations that critics claimed were "poorly sited" actually showed slightly *cooler* maximum daily temperatures compared to the average.

In 2010 Dr. Richard Muller criticized the "hockey stick" graph and decided to do his own temperature analysis. He organized a group called Berkeley Earth to do an independent study of the temperature record. They specifically wanted to answer the question is "the temperature rise on land improperly affected by the four key biases (station quality, homogenization, urban heat island, and station selection)?" Their conclusion was NO. None of those factors bias the temperature record. The Berkeley conclusions about the urban heat effect were nicely explained by Andy Skuce in an SkS post in 2011. Figure 2 shows that the U.S. network does not show differences between rural and urban sites.

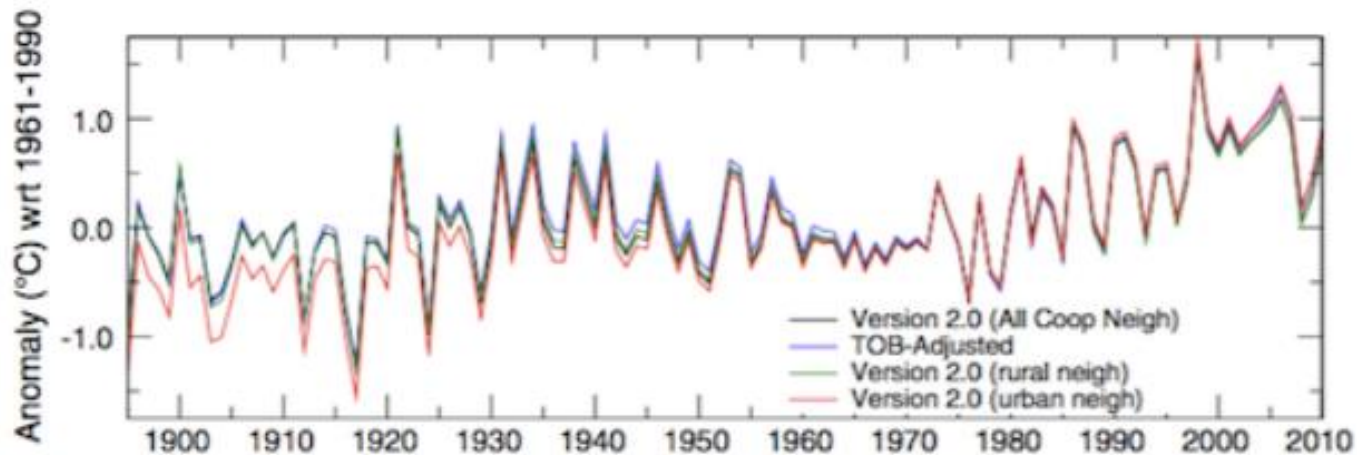


Figure 2. Comparison of spatially gridded minimum temperatures for U.S. Historical Climatology Network (USHCN) data adjusted for time-of-day (TOB) only, and selected for rural or urban neighborhoods after homogenization to remove biases. (Hausfather et al. 2013)

Climate Myth...

Animals and plants can adapt

[C]orals, trees, birds, mammals, and butterflies are adapting well to the routine reality of changing climate." (source: [Hudson Institute](#))

Clearly, this planet-wide domination by human society will have implications for biological diversity. Indeed, a recent review on the topic, the [2005 Millennium Ecosystem Assessment report](#) (an environmental report of similar scale to the [Intergovernmental Panel on Climate Change Assessment Reports](#)), drew some bleak conclusions – 60% of the world's [ecosystems](#) are now degraded and the extinction rate is now 100 to 1000 times higher than the “background” rate of long spans of geological time. For instance, a [study I conducted in 2003](#) showed that up to 42% of species in the Southeast Asian region could be consigned to extinction by the year 2100 due to [deforestation](#) and habitat fragmentation alone.

Climate Myth...

It hasn't warmed since 1998

For the years 1998-2005, temperature did not increase. This period coincides with society's continued pumping of more CO₂ into the atmosphere. (Bob Carter)

From NASA in the first session:

“Global temperatures in 2018 were 1.5 degrees Fahrenheit (0.83 degrees Celsius) warmer than the 1951 to 1980 mean, according to scientists at NASA’s Goddard Institute for Space Studies (GISS) in New York. Globally, 2018's temperatures rank behind those of 2016, 2017 and 2015. **The past five years are, collectively, the warmest years in the modern record....**”

There's also a tendency for some people just to concentrate on atmospheric or surface air temperatures when there are other, more useful, indicators that can give us a better idea how rapidly the world is warming. **More than 90% of global warming heat goes into warming the oceans**, while less than 3% goes into increasing the atmospheric and surface air temperature. Records show that the Earth has been warming at a steady rate before and since 1998 and there is no sign of it slowing any time soon (Figure 1).

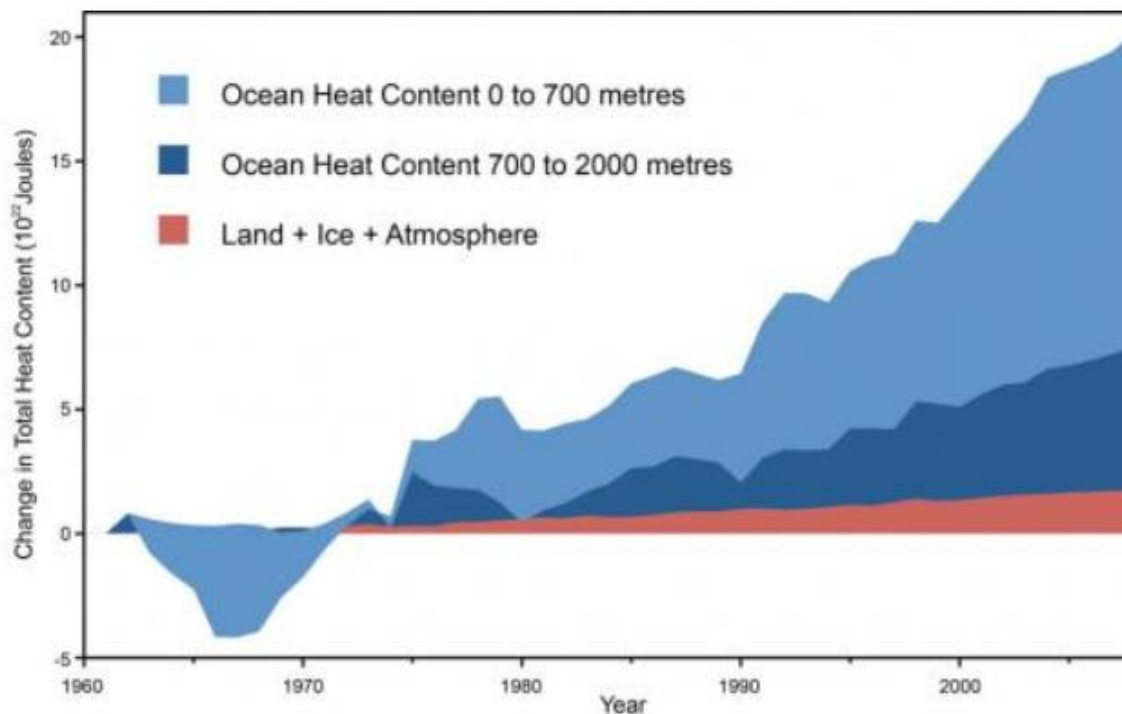


Figure 1: Land, atmosphere, and ice heating (red), 0-700 meter ocean heat content (OHC) increase (light blue), 700-2,000 meter OHC increase (dark blue). From Nuccitelli et al. (2012).

Climate Myth...

Antarctica is gaining ice

"[Ice] is expanding in much of Antarctica, contrary to the widespread public belief that global warming is melting the continental ice cap." (Greg Roberts, *The Australian*)

Satellites measure Antarctica is gaining sea ice but losing land ice at an accelerating rate which has implications for sea level rise.

In Antarctica, sea ice grows quite extensively during winter but nearly completely melts away during the summer (Figure 1). That is where the important difference between Antarctic and Arctic sea ice exists as much of the Arctic's sea ice lasts all the year round. During the winter months it increases and before decreasing during the summer months, but an ice cover does in fact remain in the North which includes quite a bit of ice from previous years (Figure 1). Essentially Arctic sea ice is more important for the earth's energy balance because *when it increasingly melts, more sunlight is absorbed by the oceans* whereas Antarctic sea ice normally melts each summer leaving the earth's energy balance largely unchanged.

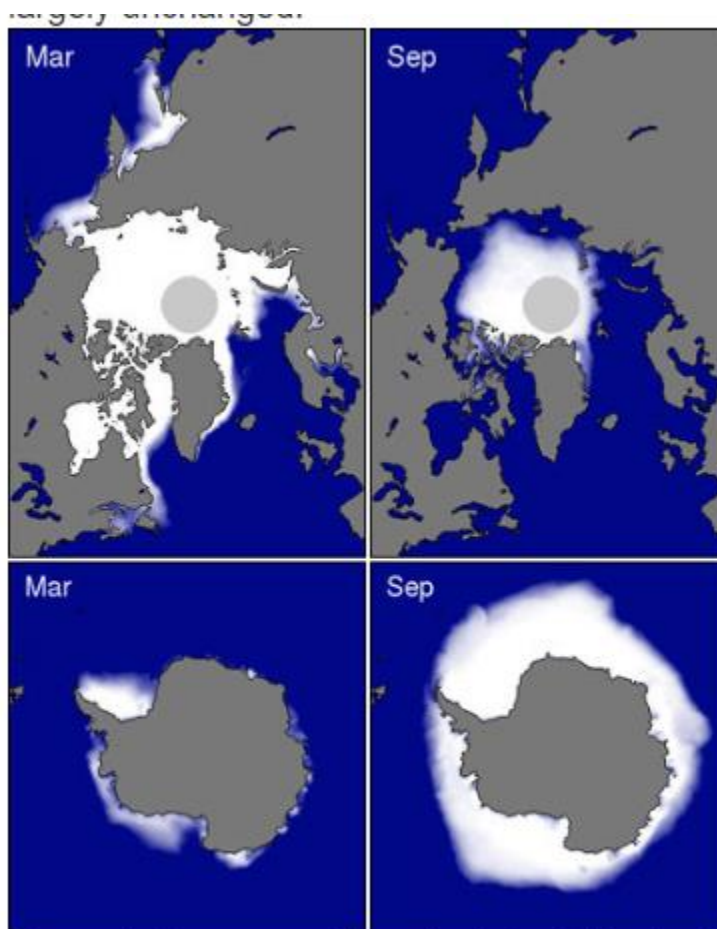


Figure 1: Coverage of sea ice in both the Arctic (Top) and Antarctica (Bottom) for both summer minimums and winter maximums

Source: [National Snow and Ice Data Center](http://www.nsidc.org/)

This page gives answers to 197 questions posed by skeptics.

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Getting skeptical about global warming skepticism

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MOST USED Climate Myths
and what the science really says...

- 1 Climate's changed before
- 2 It's the sun
- 3 It's not bad
- 4 There is no consensus
- 5 It's cooling
- 6 Models are unreliable
- 7 Temp record is unreliable
- 8 Animals and plants can adapt
- 9 It hasn't warmed since 1998
- 10 Antarctica is gaining ice

[View All Arguments...](#)

Global Warming & Climate Change Myths

Here is a summary of global warming and climate change myths, sorted by recent popularity vs what science says. Click the response for a more detailed response. You can also view them sorted by taxonomy, by popularity, in a print-friendly version, with short URLs or with fixed numbers you can use for permanent references.

Climate Myth	vs	What the Science Says
1 "Climate's changed before"		Climate reacts to whatever forces it to change at the time, humans are now the dominant forcing.
2 "It's the sun"		In the last 35 years of global warming, sun and climate have been going in opposite directions
3 "It's not bad"		Negative impacts of global warming on agriculture, health & environment far outweigh any positives.
4 "There is no consensus"		97% of climate experts agree humans are causing global warming.
5 "It's cooling"		The last decade 2000-2009 was the hottest on record.
6 "Models are unreliable"		Models successfully reproduce temperatures since 1900 globally, by land, in the air and the ocean.
7 "Temp record is unreliable"		The warming trend is the same in rural and urban areas, measured by thermometers and satellites.
8 "Animals and plants can adapt"		Global warming will cause mass extinctions of species that cannot adapt on short time scales.
9 "It hasn't warmed since 1998"		Every part of the Earth's climate system has continued warming since 1998, with 2015 shattering temperature records.
10 "Antarctica is gaining ice"		Satellites measure Antarctica losing land ice at an accelerating rate.
11 "Ice age predicted in the 70s"		The vast majority of climate papers in the 1970s predicted warming.
12 "CO2 lags temperature"		CO2 didn't initiate warming from past ice ages but it did amplify the warming.
13 "Climate sensitivity is low"		Net positive feedback is confirmed by many different lines of evidence.

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Advancement of climate change knowledge

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