

*News Articles Framing Climate Change Emerging as a Result of Anthropogenic Impacts:*

## **Climate change: How do we know it is happening is caused by humans?**

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Scientists and politicians say we are facing a planetary crisis because of climate change. But what's the evidence for global warming and how do we know it's being caused by humans? How do we know the world is getting warmer?

Our planet has been warming rapidly since the dawn of the Industrial Revolution.

The average temperature at the Earth's surface has risen about 1.1C since 1850. Furthermore, each of the last four decades has been warmer than any that preceded it, since the middle of the 19th Century.

These conclusions come from analyses of millions of measurements gathered in different parts of the world. The temperature readings are collected by weather stations on land, on ships and by satellites.

Multiple independent teams of scientists have reached the same result - a spike in temperatures coinciding with the onset of the industrial era.

Scientists can reconstruct temperature fluctuations even further back in time.

Tree rings, ice cores, lake sediments and corals all record a signature of the past climate.

This provides much-needed context to the current phase of warming. In fact, scientists estimate the Earth hasn't been this hot for about 125,000 years.

How do we know humans are responsible for global warming?

Greenhouse gases - which trap the Sun's heat - are the crucial link between temperature rise and human activities. The most important is carbon dioxide (CO<sub>2</sub>), because of its abundance in the atmosphere.

We can also tell it's CO<sub>2</sub> trapping the Sun's energy. Satellites show less heat from the Earth escaping into space at precisely the wavelengths at which CO<sub>2</sub> absorbs radiated energy.

Burning fossil fuels and chopping down trees lead to the release of this greenhouse gas. Both activities exploded after the 19th Century, so it's unsurprising that atmospheric CO<sub>2</sub> increased over the same period.

There's a way we can show definitively where this extra CO<sub>2</sub> came from. The carbon produced by burning fossil fuels has a distinctive chemical signature.

Tree rings and polar ice both record changes in atmospheric chemistry. When examined they show that carbon - specifically from fossil sources - has risen significantly since 1850.

Analysis shows that for 800,000 years, atmospheric CO<sub>2</sub> did not rise above 300 parts per million (ppm). But since the Industrial Revolution, the CO<sub>2</sub> concentration has soared to its current level of nearly 420 ppm.

Computer simulations, known as climate models, have been used to show what would have happened to temperatures without the massive amounts of greenhouse gases released by humans.

- What does net zero mean?
- Is the UK on track to meet its climate targets?

They reveal there would have been little global warming - and possibly some cooling - over the 20th and 21st Centuries, if only natural factors had been influencing the climate.

Only when human factors are introduced can the models explain increases in temperature.

What impact are humans having on the planet?

The level of heating Earth has experienced already is predicted to cause significant changes to the world around us.

Real-world observations of these changes match patterns scientists expect to see with human-induced warming. They include:

- The Greenland and Antarctic ice sheets melting rapidly
- The number of weather-related disasters has increased by a factor of five over 50 years
- Global sea levels rose 20cm (8ins) in the last century and are still rising
- Since the 1800s, the oceans have become about 40% more acid, affecting marine life

But wasn't it warmer in the past?

There have been several hot periods during the Earth's past.

Around 92 million years ago, for example, temperatures were so high that there were no polar ice caps and crocodile-like creatures lived as far north as the Canadian Arctic.

That should not comfort anyone, however, because humans were not around. At times in the past, sea level was 25m (80ft) higher than the present. A rise of 5-8m (16-26ft) is considered enough to submerge most of the world's coastal cities.

There is abundant evidence for mass extinctions of life during these periods. And climate models suggest that, at times, the tropics could have become "dead zones", too hot for most species to survive.

These fluctuations between hot and cold have been caused by a variety of phenomena, including the way the Earth wobbles as it orbits the Sun over long periods, volcanic eruptions and short-term climate cycles such as El Niño.

For many years, groups of so-called climate "sceptics" have cast doubt on the scientific basis of global warming.

However, virtually all scientists who publish regularly in peer-reviewed journals now agree on the current causes of climate change.

A key UN report released in 2021 said it "is unequivocal that human influence has warmed the atmosphere, oceans and land".

# Climate explained: how much of climate change is natural? How much is man-made?

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As someone who has been working on climate change detection and its causes for over 20 years I was both surprised and not surprised that I was asked to write on this topic by *The Conversation*. For nearly all climate scientists, the case is proven that humans are the overwhelming cause of the long-term changes in the climate that we are observing. And that this case should be closed.

Despite this, climate denialists continue to receive prominence in some media which can lead people into thinking that man-made climate change is still in question. So it's worth going back over the science to remind ourselves just how much has already been established.

Successive reports by the Intergovernmental Panel on Climate Change – mandated by the United Nations to assess scientific evidence on climate change – have evaluated the causes of climate change. The most recent special report on global warming of 1.5 degrees confirms that the observed changes in global and regional climate over the last 50 or so years are almost entirely due to human influence on the climate system and not due to natural causes.

## What is climate change?

First, we should perhaps ask what we mean by climate change. The Intergovernmental Panel on Climate Change defines climate change as:

*a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.*

The causes of climate change can be any combination of:

- Internal variability in the climate system, various components of the climate system – like the atmosphere and ocean – vary on their own to cause fluctuations in climatic conditions, such as temperature or rainfall. These internally driven changes generally happen over decades or longer; shorter variations such as those related to El Niño fall in the bracket of climate variability, not climate change.
- Natural external causes such as increases or decreases in volcanic activity or solar radiation. For example, every 11 years or so, the Sun's magnetic field completely flips and this can cause small fluctuations in global temperature, up to about 0.2 degrees. On longer time scales – tens to hundreds of millions of years – geological processes can drive changes in the climate, due to shifting continents and mountain building.
- Human influence through greenhouse gases (gases that trap heat in the atmosphere such as carbon dioxide and methane), other particles released into the air (which absorb or reflect sunlight such as soot and aerosols) and land-use change (which affects how much

sunlight is absorbed on land surfaces and also how much carbon dioxide and methane is absorbed and released by vegetation and soils).

### **What changes have been detected?**

The Intergovernmental Panel on Climate Change's report showed that, on average, the global surface air temperature has risen by 1°C since the beginning of significant industrialisation (which roughly started in the 1850s). And it is increasing at ever faster rates, currently 0.2°C per decade, because the concentrations of greenhouse gases in the atmosphere have themselves been increasing ever faster.

The oceans are warming as well. In fact, about 90% of the extra heat trapped in the atmosphere by greenhouse gases is being absorbed by the oceans.

A warmer atmosphere and oceans are causing dramatic changes, including steep decreases in Arctic summer sea ice which is profoundly impacting arctic marine ecosystems, increasing sea level rise which is inundating low lying coastal areas such as Pacific island atolls, and an increasing frequency of many climate extremes such as drought and heavy rain, as well as disasters where climate is an important driver, such as wildfire, flooding and landslides.

Multiple lines of evidence, using different methods, show that human influence is the only plausible explanation for the patterns and magnitude of changes that have been detected.

This human influence is largely due to our activities that release greenhouse gases, such as carbon dioxide and methane, as well sunlight absorbing soot. The main sources of these warming gases and particles are fossil fuel burning, cement production, land cover change (especially deforestation) and agriculture.

### **Weather attribution**

Most of us will struggle to pick up slow changes in the climate. We feel climate change largely through how it affects weather from day-to-day, season-to-season and year-to-year.

The weather we experience arises from dynamic processes in the atmosphere, and interactions between the atmosphere, the oceans and the land surface. Human influence on the broader climate system acts on these processes so that the weather today is different in many ways from how it would have been.

One way we can more clearly see climate change is by looking at severe weather events. A branch of climate science, called extreme event or weather attribution, looks at memorable weather events and estimates the extent of human influence on the severity of these events. It uses weather models run with and without measured greenhouse gases to estimate how individual weather events would have been different in a world without climate change.

As of early 2019, nearly 70% of weather events that have been assessed in this way were shown to have had their likelihood and/or magnitude increased by human influence on climate. In a world without global warming, these events would have been less severe. Some 10% of the

studies showed a reduction in likelihood, while for the remaining 20% global warming has not had a discernible effect. For example, one study showed that human influence on climate had increased the likelihood of the 2015-2018 drought that afflicted Cape Town in South Africa by a factor of three.

### **Adapting to a changing climate**

Weather extremes underlie many of the hazards that damage society and the natural environment we depend upon. As global warming has progressed, so have the frequency and intensity of these hazards, and the damage they cause.

Minimising the impacts of these hazards, and having mechanisms in place to recover quickly from the impacts, is the aim of climate adaptation, as recently reported by the Global Commission on Adaptation.

As the Commission explains, investing in adaptation makes sense from economic, social and ethical perspectives. And as we know that climate change is caused by humans, society cannot use “lack of evidence” on its cause as an excuse for inaction any more.

*News Articles Framing Climate Change as Caused by the Natural Greenhouse Effect:*

## **Greenpeace co-founder: No scientific proof humans are dominant cause of warming climate**

This article was retrieved from: <https://www.foxnews.com/science/greenpeace-co-founder-no-scientific-proof-humans-are-dominant-cause-of-warming-climate>  
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A co-founder of Greenpeace told lawmakers there is no evidence man is contributing to climate change, and said he left the group when it became more interested in politics than the environment.

Patrick Moore, a Canadian ecologist and business consultant who was a member of Greenpeace from 1971-86, told members of the Senate Environment and Public Works Committee environmental groups like the one he helped establish use faulty computer models and scare tactics in promoting claims man-made gases are heating up the planet.

“There is no scientific proof that human emissions of carbon dioxide (CO<sub>2</sub>) are the dominant cause of the minor warming of the Earth’s atmosphere over the past 100 years,” he said.

Even if the planet is warming up, Moore claimed it would not be calamitous for men, which he described as a “subtropical species.”

Skeptics of manmade climate change say there is no evidence the Earth is warming. A UN report on the scientific data behind global warming released in September indicated that global surface temperatures have not increased for the past 15 years, but scientists who believe climate change due to man is occurring say it has merely paused because of several factors and will soon resume.

## **The climate is changing, but not just because of humans. Here's why that matters.**

This article was retrieved from <https://www.nbcnews.com/think/opinion/climate-changing-not-just-because-humans-here-s-why-matters-ncna824271>  
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The climate is changing — the thing is, it isn't *just* due to humans.

Natural forces beyond human control are also gradually affecting our climate. These geophysical forces are vital to understanding global warming. Man is indeed responsible for a large portion — possibly even a majority — of global warming. But also in play are complex gravitational interactions, including changes in the Earth's orbit, axial tilt and torque.

This fact needs to be included in the public debate. Because these gravitational shifts, occurring over millennia, can influence climate patterns and ultimately lead to noticeable variations in seasons. Interestingly, research suggests climate change can alter the tilt of the Earth, but an unrelated change in tilt can also further change the climate. It is a balance-counterbalance relationship.

Changes in the Earth's path around the Sun, or eccentricity, involve shifts in the orbit around the Sun from a roughly circular journey to more of an elliptical one. When the Earth gradually adopts a more elliptical orbit, there are more pronounced temperatures during the summer and winter months. This alteration is exacerbated when the Earth's axial tilt is inclined to a sharper degree than usual. As this happens, it causes the North and South Poles to be positioned more directly toward the Sun.

Haven't you noticed the recent rise in irregular weather patterns? This is not just a man-made problem. Gradual slight variations in the Earth's orbit around the Sun can strongly influence temperature extremes. This is important because the conversation around climate change has become so politicized, we've totally lost sight of the science — and with it, any room for bipartisanship.

Tropical storms, for example, have been forming later in what we know as hurricane season. Based on my own analysis, over the past three decades, the majority of Category 3 or stronger storms to hit the United States appear from late August to early October. Earlier in the 20th century, storms usually occurred in June, July and early August.

It doesn't stop there. Changes in seasons can also affect other types of storms, including severe winter snowstorms and tornadoes. Recall the Storm of the Century in 1993 on the heels of Hurricane Andrew, the year prior. Or what about the recent string of snowstorms (with names like Snowpocalypse, Snowmageddon and Snowzilla) dovetailing with warm-weather superstorms. Climate extremes are evident, and not just with hurricanes.

The variations in the Earth's orbit are known as the Milankovitch cycles — after the Serbian geophysicist Milutin Milanković, who hypothesized this phenomenon in the 1920s. He

discovered that variations in the Earth's path around the Sun, axial tilt and torque could together affect our climate.

Even a slight change or orientation in the precession of the Earth's rotating body can cause a wobbling effect shifting torque in different areas since the planet is not a perfect sphere to some people's surprise.

Now would seem a particularly apt time to act. The 2017 Atlantic hurricane season was an intense, record-setting period. With several landfall hurricanes — Harvey, Irma, Jose and Maria — barreling their way through the Caribbean and Gulf of Mexico, devastating parts of the Leeward Islands and United States.

Still, even President Donald J. Trump has implied the whole of idea climate change may just be a hoax. Most Republicans seem to agree that it is not a serious problem.

Meanwhile, while some Democrats have tried to use the frequency and intensity of storms in the hopes of highlighting the climate change conversation, even this effort has seemed muted.