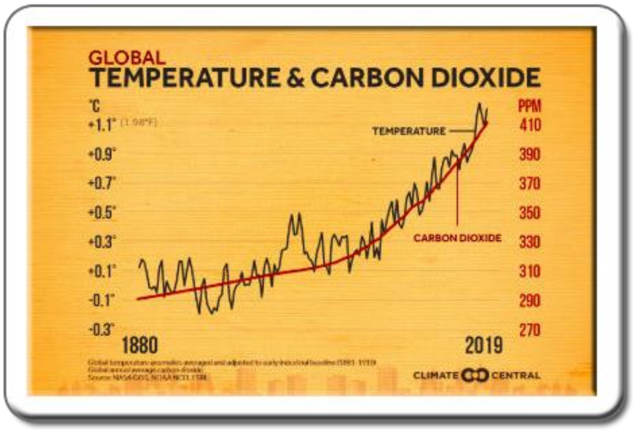


A Serious Look At Climate Change

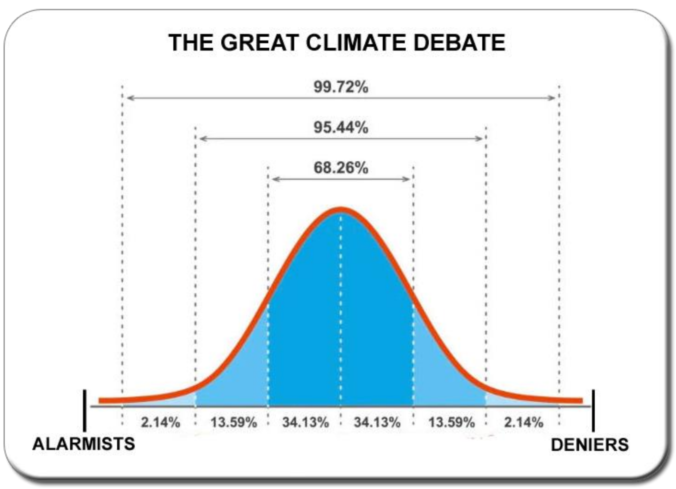
Vortex Energy Group LLC
www.VortexEnergyGroup.com

Our Take On The Divisive Issue Of Climate Change

If anyone knows me personally, they know that I love to debate. Debate… not argue. For years, I have loved to present supporting evidence for my personal views, but I have also loved to take the opposite viewpoint just to keep things interesting. When people are learning to debate in school, they too have to take an opposing view, just to make them more proficient in stating and then supporting facts.

They say it's not good to discuss certain subjects like politics or religion in public. Celebrities have always been quick to take a side and then publicly show the world just how informed they are. A handful of celebrities chose to not openly take a stance on certain issues, in fear of losing half of their fan base. For our company, we are in that same boat.

The following information is part of our efforts to present both sides of the climate change debate. While we acknowledge that gathering supporting data, articles, and documentation for the "climate change is real" side is rather easy. We also acknowledge that gathering that same level of supporting data, articles, and documentation for the "climate change is not real" side is very difficult. Our collection of documents is hopefully going to show some level of balance in terms of information available, regardless of the number of each in our library.



This image shows a typical bell curve graph. A bell curve is a symmetrical, bell-shaped graph that represents a normal distribution, where most data points cluster around the center, and the number of data points decreases as they move further from the center.

This concept is actually very useful when looking at various topics like politics or religion, but not for college sports! I've been at political events where people from the same side actually got heated about a Purdue University versus Indiana University basketball game.

You may be able to tell what the tone and tenor of our climate change information is… We recognize both the emotional side of the issue, as well as the factual evidence side. We encourage everyone to learn more about each viewpoint, and then engage in civil discord, where the truth should prevail. And yes, most times a little bit of both will be evident. Like we've said before: "two things can be true at the same time."

A Serious Look at Climate Change

1. What scientists mean by "climate change" in this context

For most major assessments (IPCC, NASA, NOAA, etc.), "climate change" concerns right now are mostly about:

- **Measured warming of the climate system** (air, ocean, land, ice) since ~1850–1900.
- **Changing statistics of extremes** (heat waves, heavy rain, etc.).
- **Long-lived gases** (especially CO_2) rising to levels not seen in modern human history.
- **Knock-on effects**: sea level, ecosystems, water resources, agriculture, and infrastructure.

Those concerns are framed in terms of *risks* and *probabilities*, not certainties that specific extreme scenarios will happen.

2. Basic observed changes that drive concern

2.1 Global temperature

- The IPCC AR6 Synthesis Report estimates **global surface temperature in 2011–2020 was about 1.1°C above 1850–1900** (best estimate 1.09°C, range 0.95–1.20°C). IPCC
- NOAA analysis finds that Earth has warmed by about **0.11°F (0.06°C) per decade since 1850**, roughly **2°F (~1.1°C) total**. Climate.gov

These numbers are averages; land has warmed more than oceans (around 1.6°C over land vs ~0.9°C over ocean). IPCC

2.2 Greenhouse gas concentrations

- Before large-scale fossil fuel use, **CO_2 was ~280 ppm** (parts per million).
- Modern measurements at Mauna Loa show:
  - **May 2025 monthly mean ~430 ppm**. Scripps Institution of Oceanography
  - Weekly average for late November 2025 ~**427 ppm**, about **26 ppm higher than 10 years ago**. NOAA Global Monitoring Laboratory

NASA notes that global mid-troposphere CO_2 has climbed from ~365 ppm in 2002 to **over 420 ppm in 2022**. NASA Science

These levels are a central factual reason many people worry: they are well outside the range of the last several hundred thousand years of ice-core records.

2.3 Ocean heat content

- Roughly **90% of the excess heat** associated with planetary warming has gone into the oceans. NASA Science
- Global ocean heat content in the upper 2,000 m increased by about **1 W/m² (±0.1)** over 2005–2024. marine.copernicus.eu

This matters because warmer oceans:

- Expand (raising sea level),
- Influence storms and rainfall,
- And stress marine ecosystems (coral reefs, fisheries, etc.).

2.4 Sea level rise

The IPCC AR6 assessment:

- **Global mean sea level rose about 0.20 m (20 cm) between 1901 and 2018**. IPCC
- Rise rates:
  - 1901–1971: ~1.3 mm/yr
  - 1971–2006: ~1.9 mm/yr
  - 2006–2018: ~3.7 mm/yr (acceleration). IPCC

A general summary: sea level has risen ~15–25 cm since 1901, with rates around **4–5 mm/yr in the last decade**. Wikipedia

2.5 Sea ice and ice sheets

- Satellite data since 1979 show **September Arctic sea-ice extent shrinking ~12.2% per decade** relative to 1981–2010. NASA Science
- NASA's indicator: minimum Arctic sea ice has declined in all months and almost all regions since the late 1970s. Climate.gov
- In March 2025, Arctic winter sea ice maximum was the **lowest in 47 years of satellite records** (5.53 million sq miles). AP News

For land ice:

- Since the 1990s, Greenland, Antarctica, and mountain glaciers have shifted from roughly balanced to **net mass loss**, contributing significantly to sea-level rise. IPCC

These observations underlie concerns about long-term commitments to sea-level rise, even if emissions were to slow later.

3. Major categories of concern

3.1 Heat extremes and human health

Observed:

- The IPCC concludes it is *virtually certain* that **the number and intensity of hot extremes have increased** since the 1950s in most land regions. IPCC
- NOAA reports that recent decades show more frequent high-temperature records versus cold records globally.

Why this worries people:

- Heat waves are already a leading weather-related killer; high temperatures combined with humidity can push "wet-bulb" values toward levels that the human body cannot tolerate for long without cooling.
- Urban areas with limited air conditioning, older populations, or strained grids are particularly at risk.

Risk-style framing:

- Not every summer is catastrophic, but the *probability distribution* shifts so that dangerous heat events become more likely relative to the historical baseline.

3.2 Water cycle: droughts, heavy rain, and floods

Observed shifts:

- A warmer atmosphere can hold ~7% more water vapor per °C of warming (Clausius–Clapeyron relationship), which tends to:
  - Intensify **heavy rainfall** events.
  - Alter the timing and location of precipitation.

- IPCC AR6 finds that **heavy precipitation events have increased** in intensity and frequency in many regions with high confidence. IPCC

Concerns:

- **Flooding** from intense downpours and stalled weather systems.
- **Drought** in other regions where overall precipitation decreases or becomes more variable.
- Impacts on:
    - Reservoirs and hydropower,
    - Irrigated agriculture,
    - Groundwater recharge.

This is framed as an increased risk of both **too much water at once** (floods, landslides) and **too little** (drought, wildfires), depending on region.

3.3 Sea level rise, coasts, and low-lying communities

From the numbers above (20 cm rise and accelerating rates), concerns focus on:

- **Coastal flooding and storm surge**: Even modest sea-level rise raises the "baseline," so a storm of a given strength can reach further inland.
- **Low-lying deltas and islands**: Densely populated deltas (e.g., in Bangladesh, Nile, Mekong) and many small islands are only a few meters above current sea level.
- **Saltwater intrusion** into coastal aquifers and farmlands.

Long-range IPCC estimates (not predictions of exactly what *will* happen, but ranges under certain warming limits):

- If warming is limited to **1.5°C**, global mean sea level is expected to rise about **2–3 m over the next 2,000 years**.
- For **2°C**, roughly **2–6 m over 2,000 years**. IPCC

Those very long timescales are part of why people talk about "commitment": ice sheets and oceans respond slowly, so even stable temperatures can lock in gradual change.

Some risk analyses also consider low-probability, high-impact possibilities (e.g., **>2 m by 2100** under very high emissions and strong ice-sheet responses), though these are described as unlikely but not ruled out. PreventionWeb

3.4 Storms and extreme events

The data here are more mixed and region-dependent, so assessments are careful:

- **Tropical cyclones (hurricanes/typhoons):**
    - There is *medium confidence* that **the proportion of the most intense storms (Category 3–5) has increased**, and that heavy rainfall associated with these storms has increased in some regions. IPCC
- **Extratrophical storms and jet stream behavior**: Evidence suggests shifts in storm tracks and more intense rainfall, but with substantial natural variability.

Concern is not that every year will bring record storms, but that:

- Warm oceans provide more energy and moisture.
- When big storms do occur, they are more likely to carry intense rain and higher storm surges.

3.5 Ecosystems and biodiversity

Several well-documented stressors:

1. **Coral bleaching**
   - Episodes of **marine heat waves** have caused repeated bleaching on major reef systems (e.g., Great Barrier Reef) over the last few decades.
   - Corals are sensitive to prolonged temperature anomalies of even 1–2°C above typical summer maxima.
2. **Range shifts and timing changes**
   - Many species have shifted their ranges poleward or upslope, and seasonal events (flowering, migration) have changed timing in response to warming and changing seasons (phenology).
3. **Wildfires**
   - In some regions, warmer, drier conditions have lengthened fire seasons and increased the potential for high-severity fires, although land management also plays a major role.

The concern here is less about global averages and more about local thresholds: species and ecosystems that evolved under certain temperature and rainfall patterns can be pushed beyond their tolerance windows.

3.6 Food systems and agriculture

The picture is mixed and depends on crop, region, and adaptation:

- **Positive factors sometimes cited:**
  - CO_2 fertilization can boost photosynthesis and water-use efficiency for many plants.
  - Longer growing seasons at higher latitudes may benefit some crops.
- **Negative factors:**
  - Increased **heat stress** during critical growth periods (e.g., flowering) can reduce yields.
  - **Droughts or intense rainfall** can damage crops and soils.
  - Shifts in pests, diseases, and invasive species.

Major assessments typically summarize this as:

- Moderate global warming (around 1–2°C) might have mixed effects, with both winners and losers.
- Increasing warming raises the chance of **yield declines, crop failures, and price volatility**, especially in already hot regions and for rain-fed agriculture. IPCC

Again, this is framed as **risk**: more ways for things to go wrong in some regions, even if other regions benefit or adapt.

3.7 Human systems: infrastructure, migration, and economics

People who worry about climate change often focus on **compound impacts**, not just temperature itself:

- **Infrastructure**
  - Roads, bridges, power plants, ports, and pipelines were built for certain climate conditions (e.g., flood heights, design temperatures).
  - More intense heat and floods can shorten lifetimes and raise maintenance or replacement costs.
- **Health and labor productivity**
  - High heat and humidity can reduce outdoor work capacity (agriculture, construction) and increase health burdens, especially in low-income settings.

- **Migration and security**
    - Sea-level rise, drought, and extreme weather can put pressure on livelihoods, potentially contributing (along with many non-climate factors) to migration and conflict risks.

Economic models attempt to quantify these, but the range of estimates is wide and depends heavily on assumptions. The IPCC generally presents multiple models and stresses uncertainties rather than a single "true" cost. IPCC

4. Where the uncertainties and debates are

Even among scientists who accept the basic warming and CO_2 story, several major questions are still debated:

1. **Climate sensitivity**
    - "Equilibrium climate sensitivity" (how much the planet warms if CO_2 doubles and then the system equilibrates) is estimated in AR6 as **likely 2.5–4°C**, with a best estimate of 3°C. IPCC
    - That range leaves room for disagreement on how serious future warming will be for a given emissions path.
2. **Regional precipitation and extremes**
    - Global patterns (e.g., more heavy rain events overall) are clearer than local details.
    - Some regions have strong model agreement; others have large spread, making planning difficult.
3. **Ice-sheet behavior and "tipping points"**
    - The exact thresholds and timing for potential rapid changes (e.g., West Antarctic Ice Sheet retreat) are not well pinned down.
    - Assessments often label these as *low-likelihood but high-impact* possibilities. News.com.au
4. **Socioeconomic responses**
    - How much societies will adapt (infrastructure upgrades, crop changes, cooling, etc.) and how fast technology improves (energy systems, carbon capture, etc.) are uncertain.
    - These human factors dominate many long-term impact estimates.

This is where the "other side" material on overblown or failed predictions can pair up nicely: the same dataset can be used to argue for caution about worst-case narratives, *and* to illustrate why reasonable people see real risk.

5. How large institutions frame the risk

Large assessments (IPCC, U.S. National Climate Assessment, etc.) generally:

- Present **historical data** (temperatures, sea level, CO_2) with confidence ranges.
- Explore **scenarios**, not forecasts. For example, "If emissions follow pathway A, warming is likely between X–Y°C by year Z." IPCC Browser
- Use **risk language**:
    - "likely," "very likely," "high confidence," "low confidence," etc.
    - Emphasize probabilities and uncertainty instead of absolute guarantees.

The presence of risk is the core *concern*—even if specific extreme timelines or catastrophic narratives are uncertain or disputed.

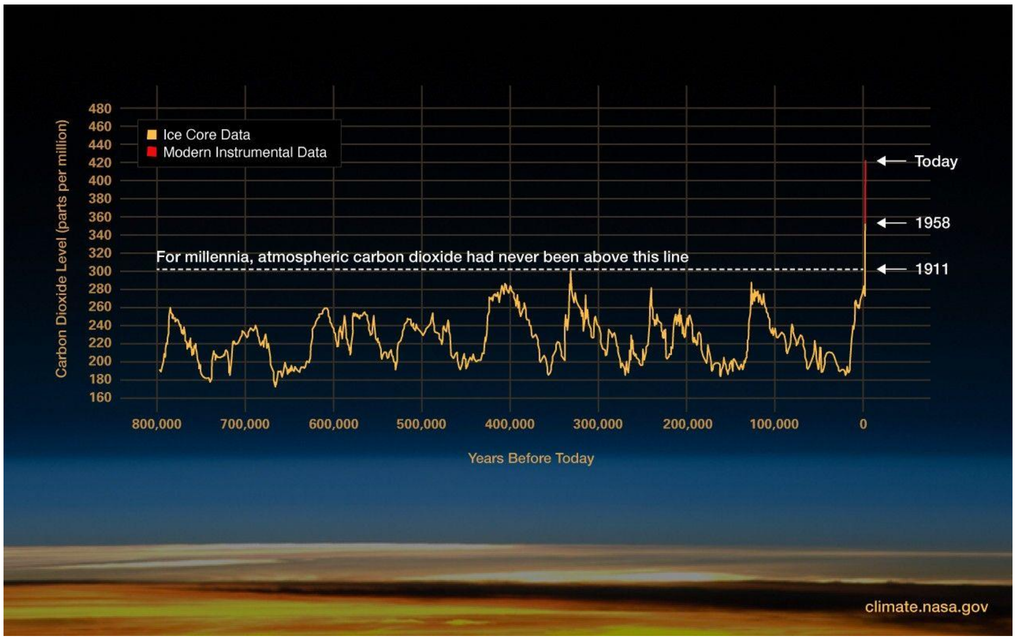
6. Neutral "take-home" points to reuse

This can be summarized for this side of the discussion in a few non-advocacy bullets:

1. **Measured changes**
    - The planet has warmed by about **1.1°C** since pre-industrial times. IPCC
    - **CO_2 levels are around 430 ppm** in 2025, up from ~280 ppm in the 1800s. Scripps Institution of Oceanography
    - **Sea level has risen ~20 cm since 1901**, with rates increasing in recent decades. IPCC
    - **Oceans have stored most of the extra heat**, and Arctic sea ice extent has declined markedly since the late 1970s. NASA Science
2. **Main reasons for concern**
    - Higher odds of **dangerous heat waves**, changing **water availability** (droughts/floods), and **stress on coasts and ecosystems**. IPCC
    - Long-lived changes in **sea level** and potential for **non-linear ice-sheet responses**.
    - Economic and social risks tied to infrastructure, health, and agriculture.
3. **Uncertainties are central, not a side note**
    - Exact future outcomes depend on emissions, technology, adaptation, and natural variability.
    - Much of the debate is about *how large* the risks are, *which regions are most affected*, and *how best to respond*, not about whether basic warming and CO_2 increases have occurred.

The Rate Of Change Since The Mid-20th Century Is Unprecedented Over Millennia

Earth's climate has changed throughout history. Just in the last 800,000 years, there have been eight cycles of ice ages and warmer periods, with the end of the last ice age about 11,700 years ago marking the beginning of the modern climate era — and of human civilization. Most of these climate changes are attributed to very small variations in Earth's orbit that change the amount of solar energy our planet receives.



This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO2 has increased since the Industrial Revolution.

Luthi, D., et al.. 2008; Etheridge, D.M., et al. 2010; Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO2 record.

The current warming trend is different because it is clearly the result of human activities since the mid-1800s, and is proceeding at a rate not seen over many recent millennia.[1] It is undeniable that human activities have produced the atmospheric gases that have trapped more of the Sun's energy in the Earth system. This extra energy has warmed the atmosphere, ocean, and land, and widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred.

Do scientists agree on climate change?

Earth-orbiting satellites and new technologies have helped scientists see the big picture, collecting many different types of information about our planet and its climate all over the world. These data, collected over many years, reveal the signs and patterns of a changing climate.

Scientists demonstrated the heat-trapping nature of carbon dioxide and other gases in the mid-19th century.[2] Many of the science instruments NASA uses to study our climate focus on how these gases affect the movement of infrared radiation through the atmosphere. From the measured impacts of increases in these gases, there is no question that increased greenhouse gas levels warm Earth in response.

Scientific evidence for warming of the climate system is unequivocal.

Intergovernmental Panel on Climate Change

Ice cores drawn from Greenland, Antarctica, and tropical mountain glaciers show that Earth's climate responds to changes in greenhouse gas levels. Ancient evidence can also be found in tree rings, ocean sediments, coral reefs, and layers of sedimentary rocks. This ancient, or paleoclimate, evidence reveals that current warming is occurring roughly 10 times faster than the average rate of warming after an ice age. Carbon dioxide from human activities is increasing about 250 times faster than it did from natural sources after the last Ice Age.[3]

The Evidence for Rapid Climate Change Is Compelling:

- **Global Temperature Is Rising**

The planet's average surface temperature has risen about 2 degrees Fahrenheit (1 degrees Celsius) since the late 19th century, a change driven largely by increased carbon dioxide emissions into the atmosphere and other human activities.[4] Most of the warming occurred in the past 40 years, with the seven most recent years being the warmest. The years 2016 and 2020 are tied for the warmest year on record.[5]

Image credit: Ashwin Kumar, Creative Commons Attribution-Share Alike 2.0 Generic.

- **The Ocean Is Getting Warmer**

The ocean has absorbed much of this increased heat, with the top 100 meters (about 328 feet) of ocean showing warming of 0.67 degrees Fahrenheit (0.33 degrees Celsius) since 1969.[6] Earth stores 90% of the extra energy in the ocean.

Image credit: Kelsey Roberts/USGS

- **The Ice Sheets Are Shrinking**

The Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost an average of 279 billion tons of ice per year between 1993 and 2019, while Antarctica lost about 148 billion tons of ice per year.[7]

Image: The Antarctic Peninsula, Credit: NASA

- **Glaciers Are Retreating**

Glaciers are retreating almost everywhere around the world — including in the Alps, Himalayas, Andes, Rockies, Alaska, and Africa.[8]

Image: Miles Glacier, Alaska Image credit: NASA

- **Snow Cover Is Decreasing**

Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and the snow is melting earlier.[9]

Image credit: NASA/JPL-Caltech

- **Sea Level Is Rising**

Global sea level rose about 8 inches (20 centimeters) in the last century. The rate in the last two decades, however, is nearly double that of the last century and accelerating slightly every year.[10]

Image credit: U.S. Army Corps of Engineers Norfolk District

TANGIER, Va. -- A resident of Tangier, Virginia, walks along a road covered by tidal flood waters here September 16, 2016. The small Chesapeake Bay island community of roughly 470 residents are experiencing the impacts of sea level rise, erosion and land subsidence. Scientist estimate the island may become uninhabitable over the next 25 to 50 years if something is not done to help keep the island above water. (U.S. Army photo/Patrick Bloodgood)

- **Arctic Sea Ice Is Declining**

Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades.[11]

Credit: NASA's Scientific Visualization Studio

- **Extreme Events Are Increasing in Frequency**

The number of record high temperature events in the United States has been increasing, while the number of record low temperature events has been decreasing, since 1950. The U.S. has also witnessed increasing numbers of intense rainfall events.[12]

Image credit: Régine Fabri, CC BY-SA 4.0, via Wikimedia Commons

- **Ocean Acidification Is Increasing**

Since the beginning of the Industrial Revolution, the acidity of surface ocean waters has increased by about 30%.[13, 14] This increase is due to humans emitting more carbon dioxide into the atmosphere and hence more being absorbed into the ocean. The ocean has absorbed between 20% and 30% of total anthropogenic carbon dioxide emissions in recent decades (7.2 to 10.8 billion metric tons per year).[15, 16]

Image credit: NOAA

KX NEWS
PUTTING NORTH DAKOTA FIRST

Study claims direct evidence of human-caused climate change

by: David Yeomans, Nexstar Media Wire
Posted: Apr 6, 2021 / 10:54 AM CDT

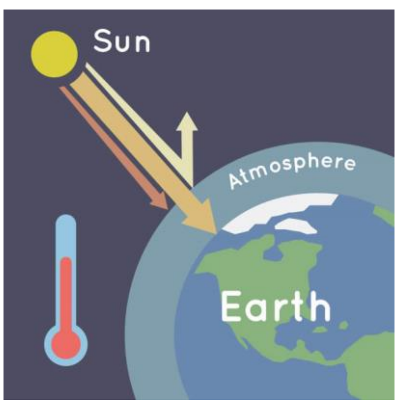
AUSTIN (KXAN) — While it's now common knowledge that man-made greenhouse gas emissions trap more heat at the Earth's surface and cause global temperatures to rise, it's never been proven 100% by conclusive, direct, and observational data.

But that's now changed.

In a first-of-its-kind study, academic researchers along with NASA scientists are quantifying the direct impact that human activity is having on our climate system — and proving human activity is to blame for recent warming trends.

Before the Industrial Revolution, the Earth's climate was, for a large amount of time, in a relatively stable, harmonious stasis where heat energy coming into the atmosphere was equivalent to energy going out. Note that the sun brings incoming heat energy, and the Earth itself gives off outgoing energy to maintain balance.

There is a natural greenhouse effect caused by the aerosols and clouds in our atmosphere, where some of the outgoing energy trying to get back out to space is reflected back to the surface, or trapped. This is the reason Earth's climate is relatively warm and livable.



The greenhouse effect (NASA)

But beginning in the Industrial Revolution in the 1800s, humans began putting massive amounts of additional greenhouse gases into the atmosphere, "thickening the blanket" around the Earth and trapping more of that heat energy at the surface instead of allowing it to radiate out to space. This is causing the planet to warm unnaturally.

While there are well-established observations of greenhouse gases and surface temperatures increasing in tandem, there has never been a global measure of this "energy balance" referred to above that was able to isolate human-caused changes from the natural climate system.

The study used a special method to isolate human climate forcing, and found that it has increased from 2003-2018. In other words, human activity made the blanket around Earth thicker, and better at trapping heat.

Furthermore, the authors were able to show that the increase in heat-trapping gases from human activity were responsible for nearly all of the long-term growth in the energy in/out imbalance during that period, and thus responsible for nearly all of the rising temperatures.

This serves as the first direct, observational evidence that human activity has affected the Earth's energy budget and led to global warming.