

Lesson 1

Carbon, tipping points and our simplest solutions.

Key Points

Concepts

- *Human Psychology & Perception* - the climate crisis isn't just a science problem; it's a perception problem too. There are many psychological elements that we need to overcome and help others to overcome.
 - ◆ *Exponential Growth* - we are not wired to intuitively understand how quickly things can change when they're speeding themselves up.
 - ◆ *Responding To Threats* - we cope well when reacting to immediate threats, but we don't take slow moving, long term problems seriously.
 - ◆ *Engrained Normalities* - many of the biggest problems in the world exist, not because we don't know they're damaging, but because we are so used to the way things have always been done.
- *Positive Feedback Loops* - as the world heats up, some of the consequences (like increasing forest fires, melting ice and extra water vapour) cause the heating to accelerate even more. When these positive feedback loops develop enough, they will reach potentially irreversible "tipping points" and accelerate beyond anyone's control.
- *Greenhouse Gases* - carbon dioxide (CO₂), methane, water vapour and other greenhouse gases cause the greenhouse effect, which traps heat on our planet. As the greenhouse effect gets stronger, it causes global warming / heating. We are generally most worried about CO₂ levels increasing, though other gases are also a concern.
- *Speed of The Change* - CO₂ concentrations in the atmosphere have been higher and lower before in the past. It's not the fact that CO₂ concentrations are going up that we're worried about; it's the speed that they're going up, and the inability of life on Earth to keep up with these rapid changes (*covered more in lesson 2*).
- *Fossil Fuels* - these burn to release CO₂, alongside other pollutant gases (*covered more in lesson 3*). Most (70%) of human-produced greenhouse gases come from energy production. We generate most (about 85%) of our energy by burning fossil fuels.



- *Net-Zero* - when any CO₂ emitted is counterbalanced by CO₂ that's absorbed, we say that a system is "net-zero": it doesn't add any extra CO₂ into the atmosphere, overall.
- *Alarmism* - some people say that climate scientists are alarmist, but most of the time, the opposite is true: the models of scientists are usually very conservative.

Solutions / Actions

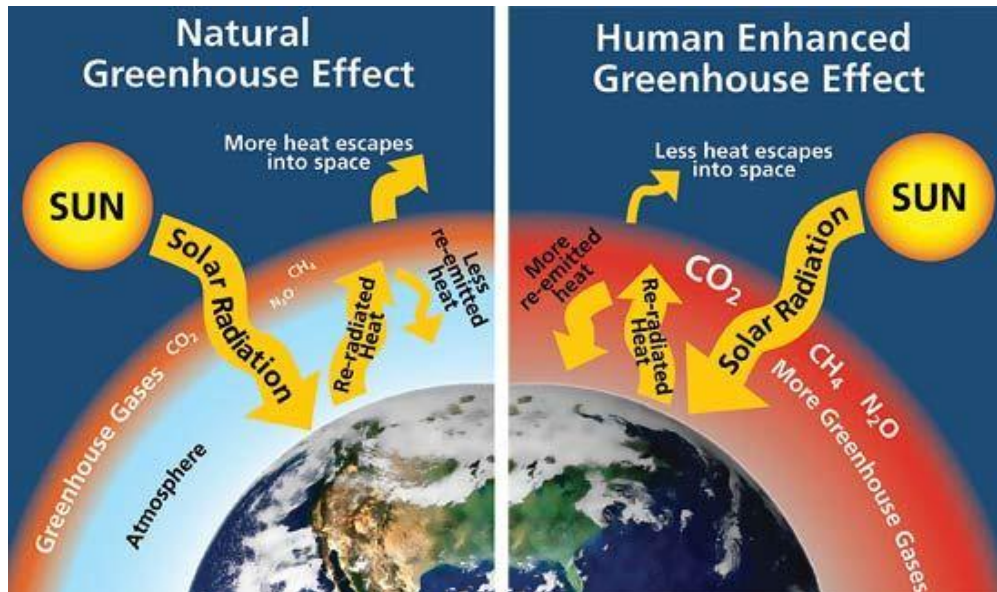
- *Stopping Fossil Fuels* - this is by far the best way for the world to combat the climate crisis. This can be done by reducing energy wastage and inefficiency, and by switching to greener sources of energy production (solar, wind, wave etc.). Despite what is often said, it is true that we can power the world without fossil fuels.
- *Individual Changes* - some of the most effective personal changes we can make to reduce the usage of fossil fuels are...
 - ◆ *Move Our Money* - most banks, pension funds etc. invest in fossil fuels. One of the most powerful things we can do is to move our money to organisations that don't.
 - ◆ *Vote* - if we live in democracies, then by voting for parties with very green policies, we shift the political conversation, even if our party doesn't get elected.
 - ◆ *Get Green Energy* - by finding a way to pay the little bit extra for energy generated from renewable sources, we transform the system.
 - ◆ *Fly Less* - for those of us who fly, one of the most effective things we can do is to stop.
- *System Changes* - Individual changes play a vital role in changing perceptions, and have a much bigger impact than our intuition tells us they do. However, in order to achieve the rapid systemic change required, we need governments to be very proactive. COVID-19 changed the world almost overnight. We need an equally rapid response to the climate crisis.
- *Teaching, Communicating & Empowering* - We are living through a crisis of imagination, held back by engrained normalities. There is so much potential for things to change and perceptions are beginning to shift: it's up to all of us to accelerate this rising tide by teaching, spreading knowledge and becoming the change we need to see. Collectively, we are so much stronger than any seemingly unchangeable inertia.



Useful Diagrams

The Greenhouse Effect

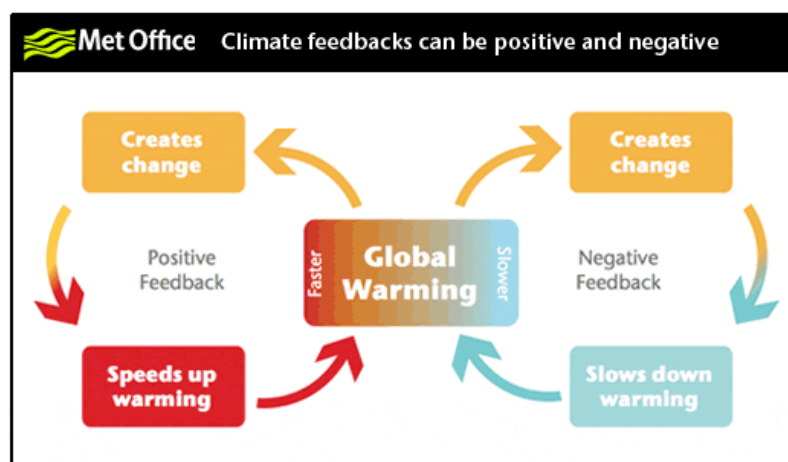
This is a natural process that keeps the world warm enough for life to thrive. However, humans are rapidly enhancing it by releasing a large quantity of CO₂ into the atmosphere.



([National Park Service, USA](#))

Feedback Loops

Some feedback loops speed up warming and others slow it down. The warmer the world gets, the more we risk triggering stronger positive feedback loops, that could dominate the negative feedback loops.

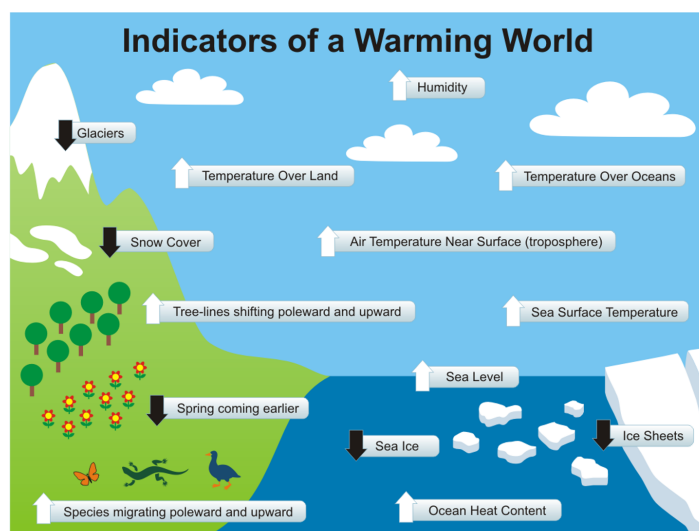


([Met Office](#))



A Warming World

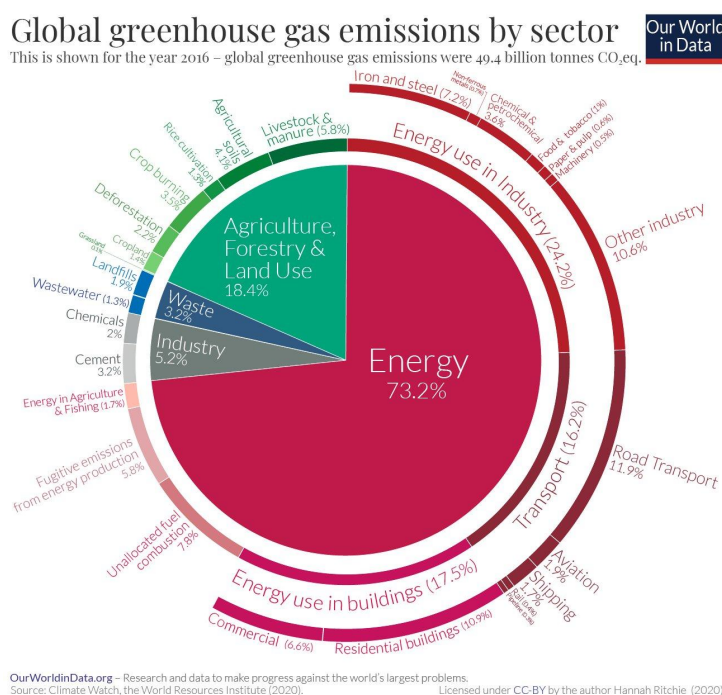
Here are some key indicators of a warming world. You may have seen pictures of glaciers disappearing and felt spring arriving earlier, among others.



([NOAA](#))

Sources of Greenhouse Gases

A large array of human activities result in the release of greenhouse gases. The largest contributor by far is energy production.

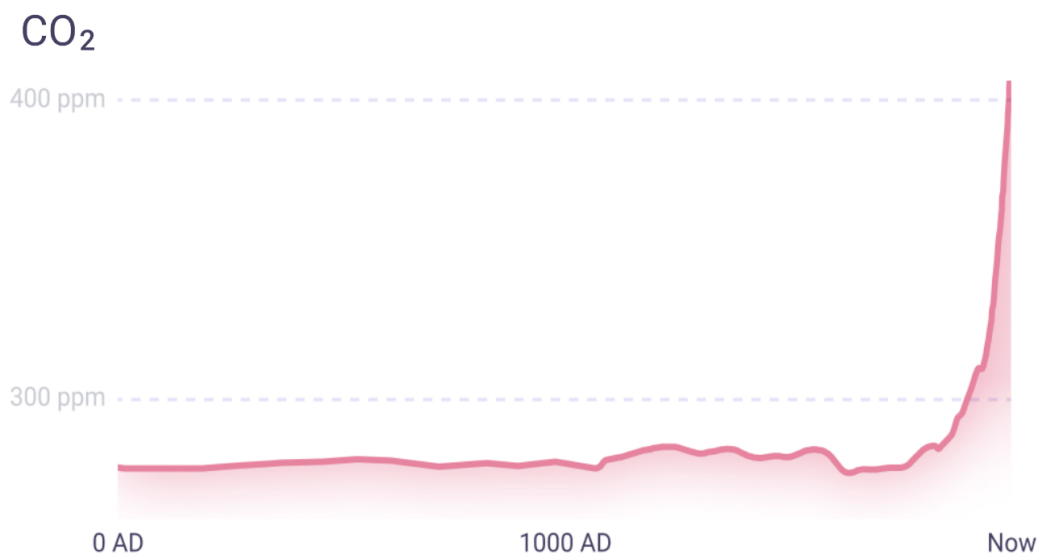


([Our World In Data](#))



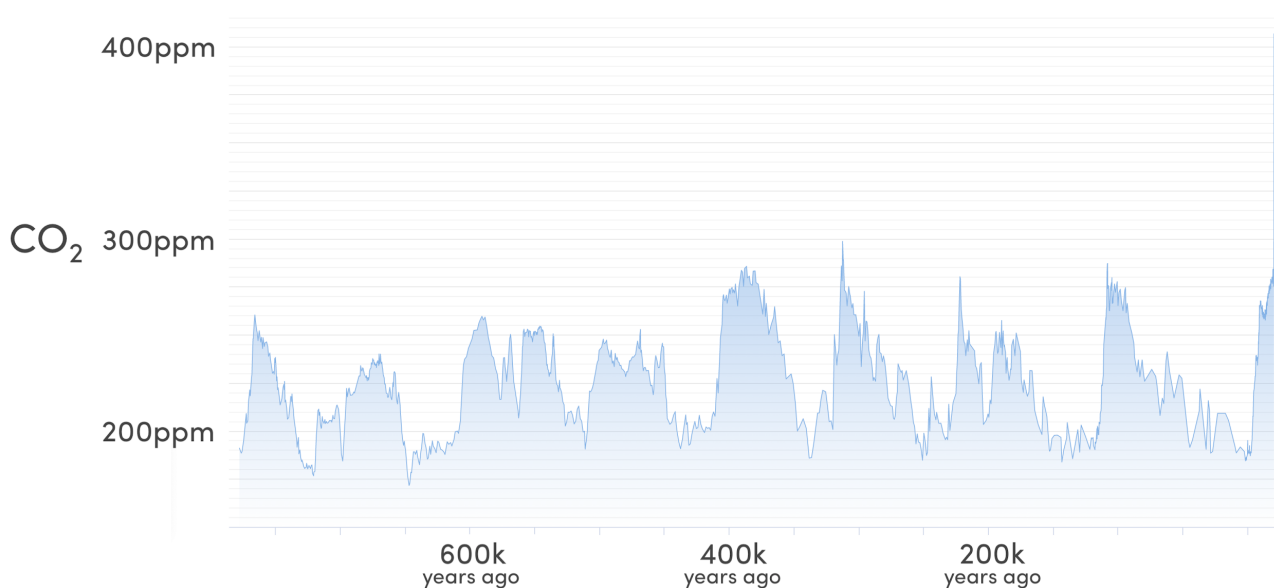
CO₂ Levels

Here is a graph showing the level of CO₂ in the atmosphere over the last 2000 years. “ppm” means parts per million. 400 ppm means there are 400 molecules of CO₂ for every million molecules of air. This might not sound like much, but it has a big effect.



(SCRIPPS & NOAA)

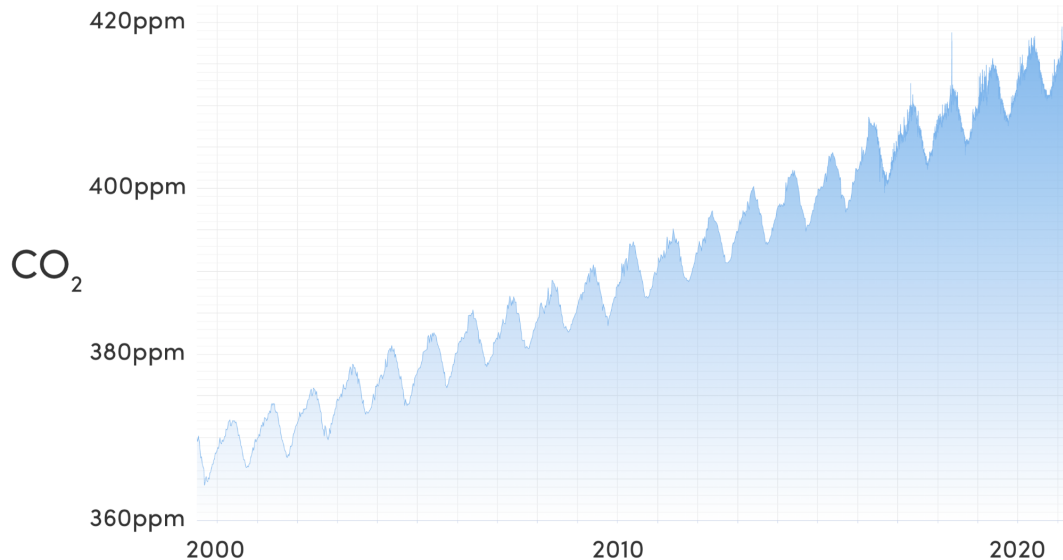
This graph shows the level of CO₂ over the last 800,000 years. This data was gained by studying ancient air, trapped in the Antarctic ice. Notice the very rapid, very recent spike up to levels above 400 ppm on the right hand side.



(SCRIPPS & NOAA)



And finally, this graph shows the level of CO₂ over the last 20 years. It wobbles up and down with the seasons, but overall it is continuing to rise rapidly.



([SCRIPPS & NOAA](#))

Notable Quotes

Below are some quotes that represent the scale and urgency of the climate crisis.

"We are in a planetary emergency."

- Prof. James Hansen, Former Director, NASA Goddard Institute for Space Studies

"Based on sober scientific analysis, we are deeply within a climate emergency state but people are not aware of it."

- Prof. Hans Schellnhuber, Founding Director of the Potsdam Institute for Climate Impact Research

"There is sufficient evidence to draw the most fundamental of conclusions: now is the time to declare a state of planetary emergency. The point is not to admit defeat, but to match the risk with the necessary action to protect the global commons for our own future."

- Prof. Johan Rockström, Director of the Potsdam Institute for Climate Impact Research

"This is an emergency and for emergency situations we need emergency action."

- Ban Ki-Moon, Former UN Secretary-General

"The climate emergency is our third world war. Our lives and civilisation as we know it are at stake, just as they were in the Second World War."

- Prof. Joseph Stiglitz, Economist, recipient of the Nobel Memorial Prize in Economic Sciences

([Dr Emily Grossman's "Emergency on Planet Earth"](#))

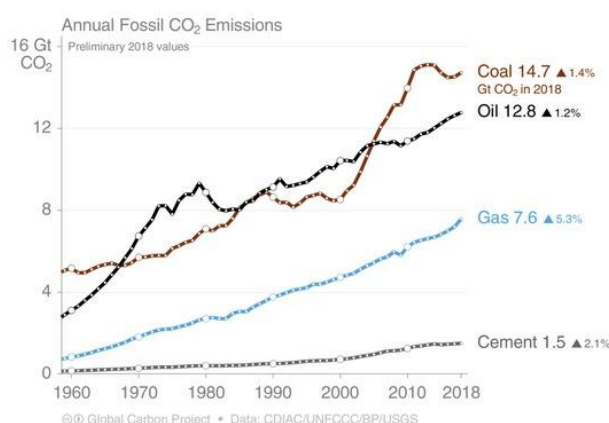


Appendix

Here are some bonus diagrams and images that you might find useful or interesting.

Emission From Different Fossil Fuels

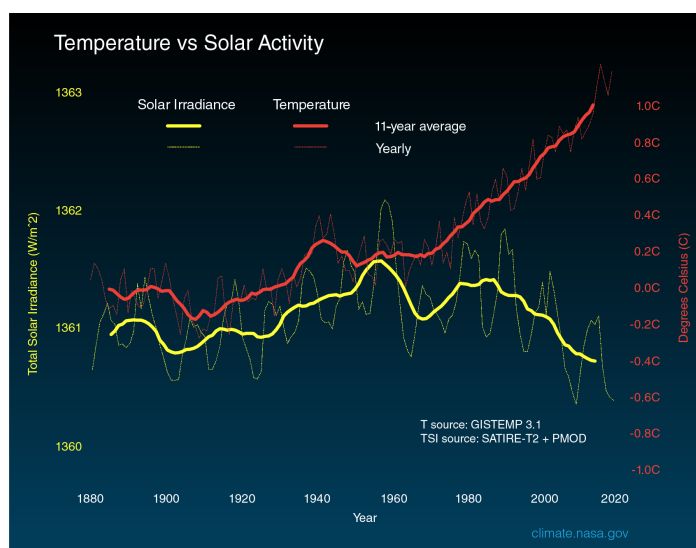
Since the 1960s, emissions have been rising across fossil fuels.



([Global Carbon Project](#))

Global Temperature vs. Solar Activity

On the internet, a common claim is that the warming of the Earth is due to natural solar cycles. However, since the middle of the last century, the heating effects of the sun have been reducing, whilst the temperature of the planet has actually been increasing.

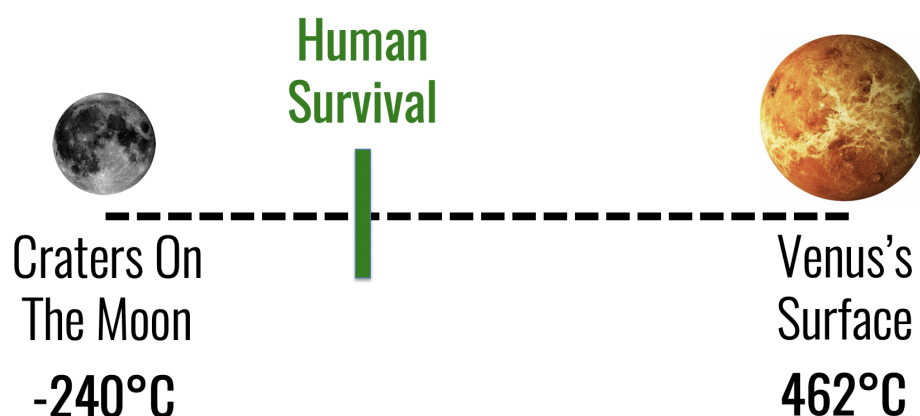


([NASA](#))



The Range of Human Survival

This is a simple diagram created by AimHi's Matthew Shribman to show the temperature range of human survival relative to two of our nearest neighbours in space, to illustrate how precarious our position could be.

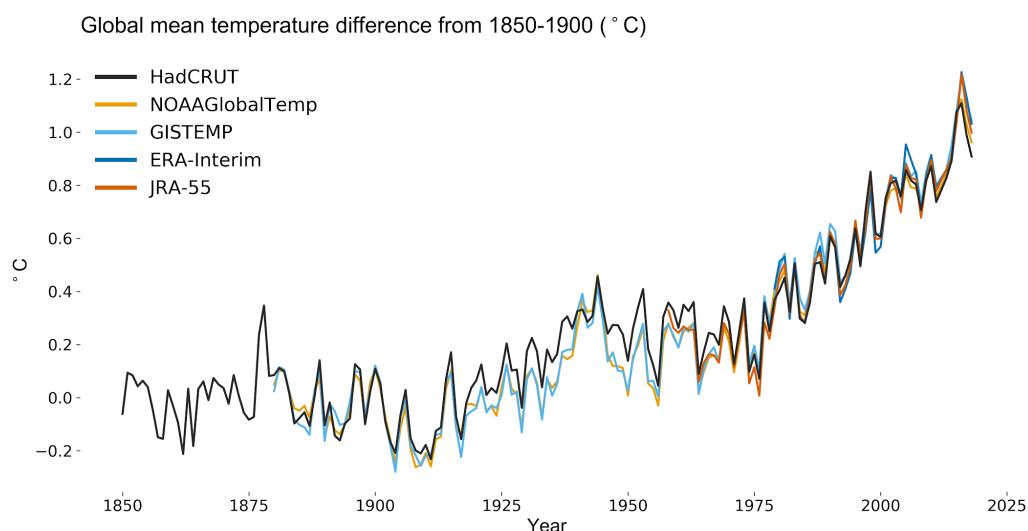


([Matthew Shribman](#))

Scientists Agree On Temperature

This graph shows how closely the world's scientists agree on how the global temperature has changed since 1850.

Met Office



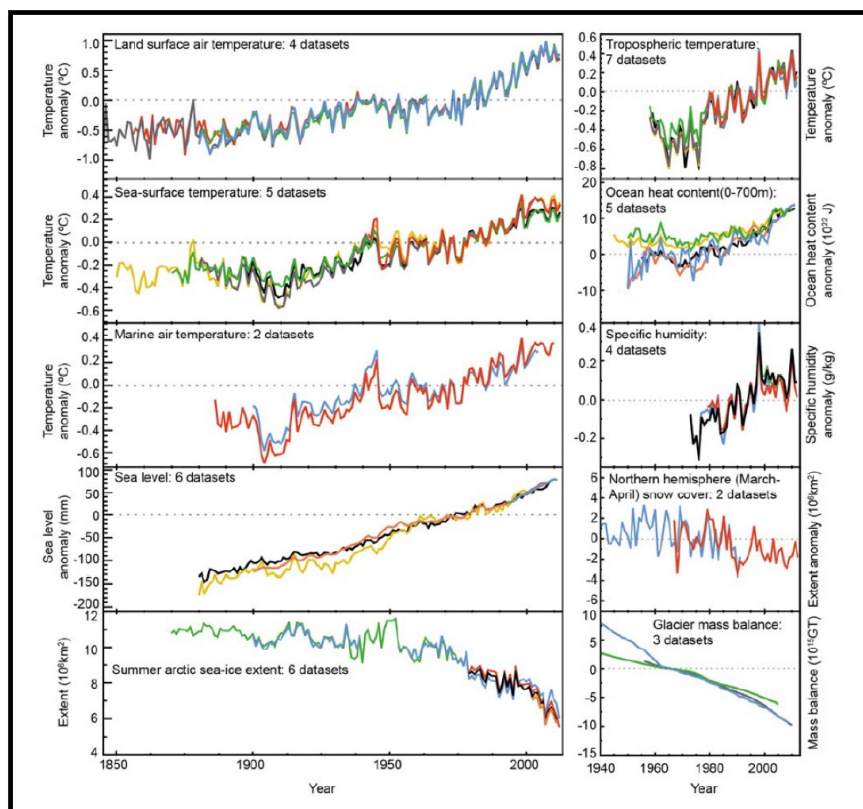
© Crown Copyright. Source: Met Office

([World Meteorological Society](#))



Various Metrics

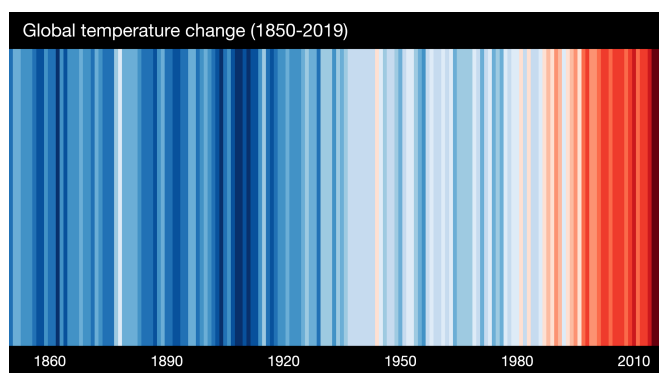
If you'd like to look more into the data, this collection of graphs shows how various things in the world have been changing, from sea temperatures to the extent of Arctic sea ice.



[\(Intergovernmental Panel on Climate Change\)](#)

Climate Stripes

Prof. Ed Hawkins at the University of Reading created this graphic to illustrate the rise in global temperatures since the mid 1800s. Bluer means colder than average, and redder means hotter than average. We also recommend checking out his [Climate Spiral graphic](#).



[\(Prof. Ed Hawkins, University of Reading\)](#)



1.5 To Stay Alive

Finally, here is an artwork, for which we don't know the source, showing a child, presumably living in one of many low-lying areas of the world. We think it's really beautiful.

