

Climate change teaching resource – Causes & effects

What Scientists Say: The latest IPCC Report on the causes of climate change

NB: This is an 'extended version' for exploring the greenhouse gases as the major cause of modern-day climate change. See the "Causes Living Graph" activity which can be a suitable starter, flipped work or homework task to this activity.

Minimum time required: 35 minutes

Resources needed

- "[Why the IPCC climate reports are so important](#)" YouTube video by Climate Adam
- *What scientists say is causing modern-day climate change* worksheet

Methodology & teachers notes

It is strongly recommended that you read [The IPCC AR6 WG1 Report: A Teachers' Guide](#) in preparation to deliver this activity. It provides all the background information needed – which won't be duplicated here – including how to interpret some key data visualisations from the IPCC.

1. Show students up to 1:48 of Climate Adam's YouTube video where Adam explains who the IPCC are and the reports that they write. Pause at 1:48 and pose these statements to the class. One of them is false – discuss which one they think it might be.
 - a. Researchers don't get paid to contribute to IPCC reports
 - b. The IPCC conduct research into climate change
 - c. The latest report features 721 authors across 90 different countries
 - d. Governments have 'signed off' on the IPCC reports
 - e. The IPCC reports are full of uncertainty
2. Watch the rest of Climate Adam's video. From this, students should establish that the false statement is 'b' above. The IPCC does not conduct research, it *collects and summarises* existing work. Statement 'e' refers to *scientific uncertainty*, and **not doubt**. Part of the next activity will help demonstrate that.
3. Hand out copies of the ***What scientists say is causing modern-day climate change*** worksheet and display the graph on the board. You can find a high-definition version of it on the [IPCC website here](#).

A good idea may be to reveal the graph bit-by-bit, starting off only showing the left-side ('Observed warming') and discussing that. While students should

be very familiar with a bar graph, the error tails/bars may be new to them. However, they are *exceptionally* important as they demonstrate how to present data uncertainties. The worksheet tasks get less scaffolded. So you could do Q1 together as a class and then challenge the students to complete Q2 and Q3 by themselves with your support. While those questions are more skills-based, the questions on the reverse side of the worksheet lend more to thoughtful informed discussion.

Worksheet answers

As the graph doesn't have fine axis ticks, the answers can be close enough so long as the working is correct!

- Q1.** The world is around 1.1°C warmer than the 1850-1900 average (between +0.85°C and +1.2°C, an uncertainty range of 0.35°C).
- Q2.** Effectively all this warming was due to human influence. Greenhouse gases have warmed the planet by around 1.5°C (between +1.0°C and +2.0°C), while other human drivers, mostly sulphur dioxide have cooled the planet by around 0.4°C (between 0.0°C and -0.8°C).
- Q3.** The two greenhouse gases that contribute most warming are carbon dioxide at +0.75°C (between +1.25°C and +0.5°C) and methane at +0.5°C (between +0.3°C and +0.8°C).
- Q4.** (a) +1.0°C, (b) 0.0°C, (c) +0.1°C, (d) +0.2°C, (e) +1.3°C,

So, even if we only look at the data based on climate modelling which puts more emphasis on natural causes and less on human ones, then the climate would actually have warmed by around +1.3°C, with 1.0°C of that (77%) being from human activity. Therefore, climate scientists can use the word 'unequivocal' in their confidence in attributing climate change to human activity. Natural processes *cannot* explain it. Scientifically, the case is closed.

References, sources & credits

IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

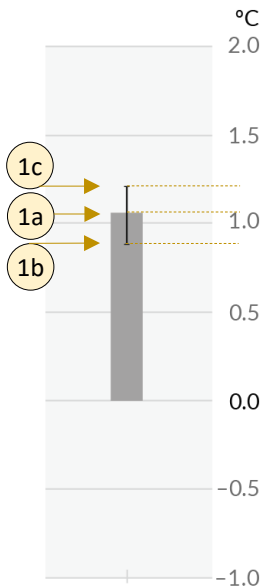
Further reading

Rackley, K. (2021, August 9). [The IPCC AR6 WG1 Report: A Teachers' Guide](#) [Blog post]

Learning materials: Worksheet – What scientists say is causing modern-day climate change (1)

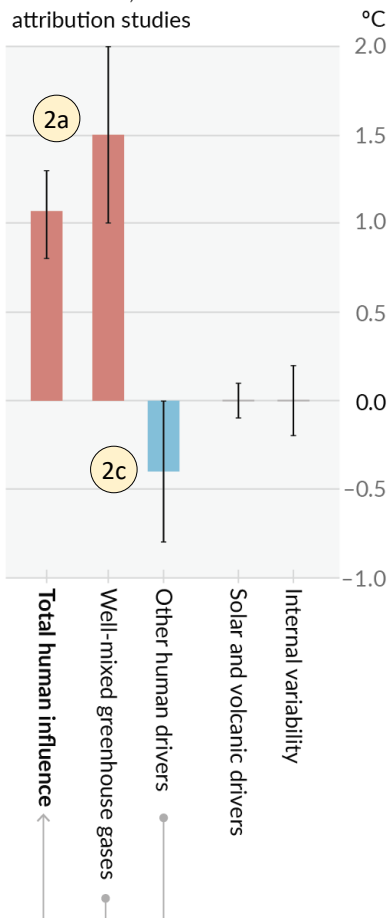
Observed warming

(a) Observed warming 2010–2019 relative to 1850–1900

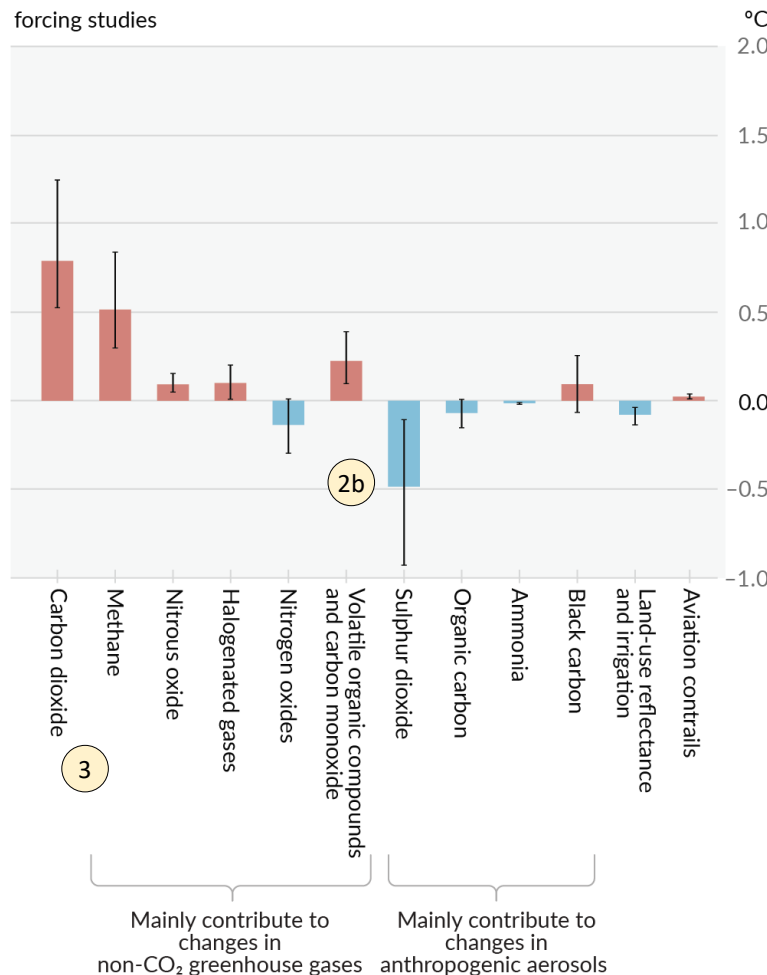


Contributions to warming based on two complementary approaches

(b) Aggregated contributions to 2010–2019 warming relative to 1850–1900, assessed from attribution studies



(c) Contributions to 2010–2019 warming relative to 1850–1900, assessed from radiative forcing studies



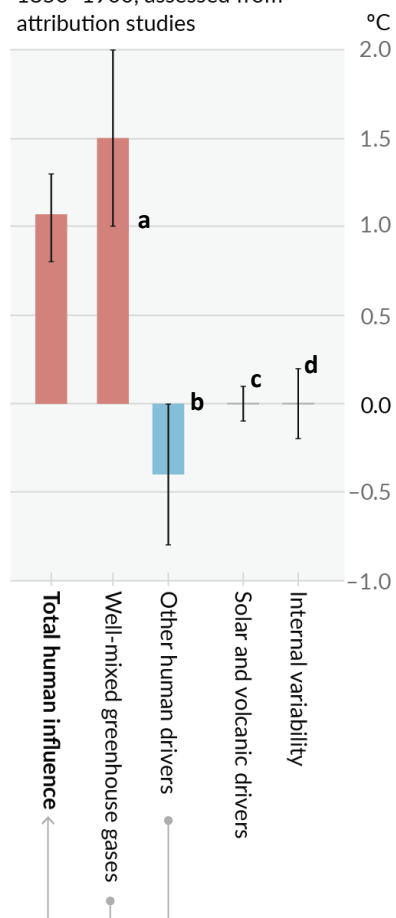
2 Effectively all this warming was due to human influence. Greenhouse gases have warmed the planet by around ____°C (between +____°C and +____°C), while other human drivers, mostly _____ have cooled the planet by around ____°C (between ____°C and -____°C).

3 The two greenhouse gases that contribute most warming are _____ at +____°C (between +____°C and +____°C) and _____ at +____°C (between +____°C and +____°C).

1 The world is around ____°C warmer than the 1850-1900 average (between +____°C and +____°C, an uncertainty range of ____°C).

Learning materials: Worksheet – What scientists say is causing modern-day climate change (2)

(b) Aggregated contributions to 2010–2019 warming relative to 1850–1900, assessed from attribution studies



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Let's look at a hypothetical situation where we assume all the data that has come from climate models is putting too much blame on human activity.

- What is the *least* amount of warming we are sure human greenhouses are causing?
- What is the *least* amount of cooling that other human drivers are causing?
- What is the *most* amount of warming that solar and volcanic activity is causing?
- What is the *most* amount of warming that 'internal variability' (e.g. El Niño)
- Put those together and we get a warming of...**
...with most of that still due to greenhouse gases!

+	°C
	°C
+	°C
+	°C
+	°C

5

The IPCC has therefore concluded it is **unequivocal** that humans are to blame for modern-day climate change. Discuss what you think this means.

Combine what you have learnt today about the IPCC, how they work, and the data you have seen. How much do you trust the scientific conclusions made? Comment on what you think and why.
