

## Why are so many citizens reluctant to accept that the Earth's climate appears to be changing? Should scientists be worried by this?

I argue that hesitancy to accept climate change is rooted in the belief that past climate change has been natural – a flaw in inductive reasoning – and because scientific methods of peer-review create a false impression of disagreement. Scientists ought to be worried about this because climate change will result in economic costs and mass extinction. Widespread climate skepticism makes global action – the only way to avoid these consequences – infeasible because of personal skepticism on behalf of leaders and a lack of pressure from citizens on them.

It is worth considering whether scientific methods are truly infallible. Karl Popper argues that any scientific theory must be falsifiable and thus should not be believed with certainty. This belief extends to scientific 'fact'. Scientific theories are characterized by the ability to be overturned or reviewed by future observations. If theories are not deductively based, then all science is proved inductively. For example, someone claiming that the Sun will rise tomorrow simply because it has risen every day before makes an inductive claim – this creates a theory with no strong basis for the reasoning. This inaccuracy comes from the reasoning behind this logic (simply because it occurred before), whereas deductive reasoning follows logically. The consequence of the problem of induction is that we commit to potentially false theories.

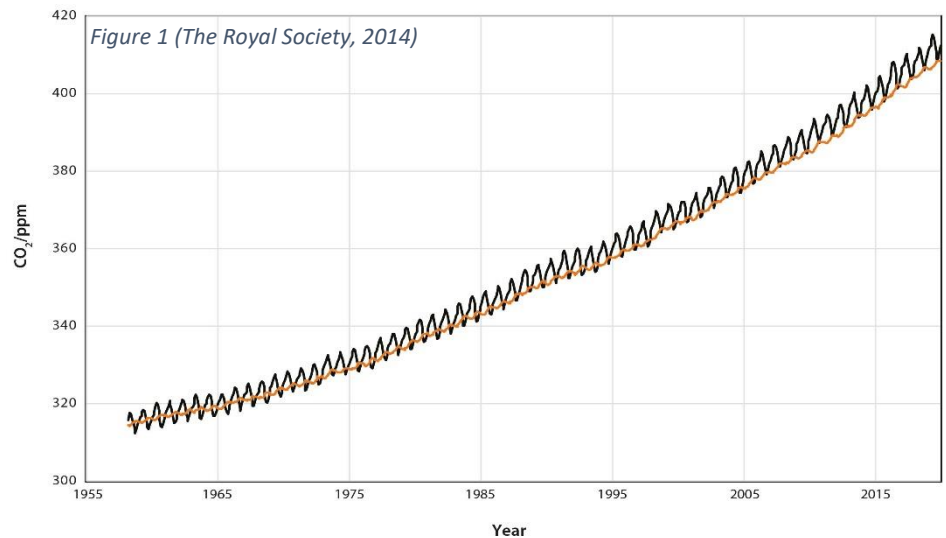
If our evidence for climate change is inductive in nature then we cannot definitively say that global temperatures will correlate with greenhouse gas emissions in the future, only that these figures have risen rapidly since the Industrial Revolution. The need for criticism and peer review in science is necessary to develop our understanding. But this process of review and critique creates the appearance of conflicting viewpoints on topics which the scientific community is in near total agreement. This confuses many citizens trying to ascertain the most accurate theories.

The geological record shows evidence for many climatic variations in the Earth's history – Khairullina et al assert that these variations cannot be manmade and are thus caused by external trends. Factors such as the Earth's position within the Milky Way, sea levels, ocean currents and volcanic activity can all influence the global climate (Khairullina, et al., 2019). The Ordovician-Silurian extinction events were due to global warming and anoxia because of high levels of volcanism (Bond & Grasby, 2020) – both natural trends. That climate change is a natural process encourages doubt and climate skepticism: the belief that as natural causes have caused climate-related extinction events, so is modern climate variation also non-man-made.

However, closer examination of data reveals modern global warming is caused (at least partially) by the greenhouse effect. The Earth's average temperature of  $\sim 14^{\circ}\text{C}$  differs hugely from the expected effective temperature from the Sun's radiation of  $\sim -19^{\circ}\text{C}$  (Kweku, et al., 2018) due to the greenhouse effect. Investigating other planetary atmospheric compositions such as Venus we can find even more evidence. At the surface of Venus temperatures can reach up to  $\sim 750\text{K}$  (despite being a similar size and in a similar position in the solar system to Earth) where  $\text{CO}_2$  concentrations are high. However, in the cloud tops, where  $\text{CO}_2$

concentrations are lower, the effective temperature that the planet radiates to space is only 244K due to a diminished greenhouse effect (Walker, 1975 ).

The greenhouse effect has a massive effect on atmospheric temperature, and it depends on greenhouse gas concentrations – the most abundant of which is CO<sub>2</sub>. Fig 1 reveals that the global concentration of CO<sub>2</sub> has increased rapidly since 1955 (although CO<sub>2</sub> has been released from manmade sources since the industrial revolution, the rate of increase has been highest in recent years). This has contributed massively to rising global temperatures. The concentration of CO<sub>2</sub> had stayed within 260-280ppm for the previous 10000 years but in the last one hundred years it has increased to above 400ppm. Ice core records from previous “ice ages” place the concentration at 170-300ppm, demonstrating how abnormal a rapid increase to 400ppm is (The Royal Society, 2014).



The evidence for global warming is overwhelming and there is assent in the scientific world on both the effects and the causes but, as discussed earlier, the climate is affected by a network of factors and no scientific theory developed soon will be able to predict the climate with 100% accuracy. The evidence demonstrates the consensus is that climate change is almost definitely manmade, and this conclusion is what scientists attempt to communicate to the public.

A study in *Environmental Research Letters* suggests that the economic impact of climate change could be up to \$3000 per tonne of CO<sub>2</sub> released into the atmosphere (University College London, 2021), which would have far-reaching effects across the globe as the changing climate impacts health, savings, and productivity. There will also be great costs to both human life and biodiversity – the fraction of remaining species is estimated to fall by 14% if global temperatures increase between 1-2°C (Nunez, et al., 2019).

The lack of a desire to reduce fossil fuel consumption is because capitalism acts as a mechanism for efficiently allocating scarce resources for consumers, and pollution is a direct consequence of consumerism (Park, 2015). Any viable solutions to climate change will require a global requirement to inhibit the consumption of fossil fuels and other climate pollutants. This has been done before under the Montreal Protocol agreement in 1987, where CFCs (Chlorofluorocarbons) were banned due to their harmful effect on the ozone layer. However, we were less reliant on CFCs, which had readily available alternatives in a way that is not the case for fossil fuels in the energy industry.

In conclusion, the hesitance of global leaders to act upon climate change – whether due to economic incentives or scepticism in their voting base – makes it far less likely that the devastating ecological or economic effects of climate change will be mitigated before it is too late. If scientists care about significant manmade climate change, then climate skepticism should worry them due to the potential threat to the quality of life of future generations.

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