

## Response to Ron Armstrong's "Climate Change: An Alternate View"

### INTRODUCTION

On 9 April 2018, Ofcom ruled that the BBC Radio 4 programme *Today* had breached broadcasting rules by "not sufficiently challenging" climate change denier Lord Lawson. In an interview aired on 10 August 2017, the ex-chancellor claimed "official figures" showed average world temperatures had "slightly declined." He also claimed the UN's Intergovernmental Panel on Climate Change had confirmed there had not been an increase in extreme weather events for the last ten years. This view, shown to be false by the Met Office, was not challenged on air by presenter Justin Webb. "Statements made about the science of climate change were not challenged sufficiently during this interview, which meant the programme was not duly accurate," said an Ofcom spokeswoman. (see <http://www.bbc.co.uk/news/entertainment-arts-43699607>)

On 19 April 2018, Ron Armstrong gave a handout and presentation to the North East Humanists (NEH) that made many claims in order to build an argument that the theory of Anthropogenic Global Warming (AGW) is flawed and ought to be reconsidered. While NEH is not bound by the same broadcasting rules as the BBC, in the interest of truth and balance, the following paper recaps Ron Armstrong's arguments (*in italics*) and provides a point-by-point response, which members of the NEH may want to consider. Due to the length of the original argument and the complexity of the science required to answer it, three levels of detail have been provided for those who wish to spend a little or a lot of time on this topic:

1. A short and indirect response can be seen in the five-minute video from the online lecture series, *Denial 101 — Making Sense of Climate Change Denial*: <https://www.youtube.com/watch?v=H5kejSYPD7U>.
2. A two-and-a-half-page "Summary of the Response" has been provided below without any references.
3. The full "Response in Detail" follows this summary and provides roughly eighteen pages of referenced quotations from a number of online resources about climate change. (These references, of course, provide several hundred more pages worth of reading for anyone wishing to follow the links.)

## SUMMARY OF THE RESPONSE

1. *CO2 in the atmosphere has increased slowly since 1740, and dramatically since 1940. This is probably due in part to human activity.*

- CO2 in the atmosphere has increased dramatically and many different “fingerprints” point scientists to being certain that it is a result of human activity.

2. *Global temperature over the land and ocean haven't risen much since 1880 and maybe not at all from 1997 to 2013.*

- 90% of the extra heat in our atmosphere gets absorbed by the oceans, which have warmed considerably, and that is why surface air temperatures have not risen dramatically yet. Global warming has been observed in many different indicators though and has now been found to have continued in recent decades too.

3. *In the 1970's, scientists said we were heading for a global cooling!*

- At the time, the scientists admitted their understanding of climate change was new and poor. Nearly fifty years later, scientists have gained much more understanding and they have the published papers to prove their revised theories.

4. *There have been other periods in history—before humans emitted CO2—when temperature has risen, so why is this any different?*

- Short term weather fluctuations and long term climate changes have occurred in the past due to many different factors: changes in solar output, changes in the Earth's orbit and tilt, changes in ocean activity (e.g. El Nino effects), volcanic eruptions, industrial aerosols, etc. Scientists have measured all of these effects and pinpointed how much of the current temperature rises are due to increases in greenhouse gasses from human activity and they can model what these increases would do in the future.

5. *There was a 'pause' or 'hiatus' in global warming from 1995 to 2015 even though CO2 has risen. How can that be explained? The theory must be wrong!*

- Climate changes are supposed to move slowly over hundreds and thousands of years. Scientists agree that a minimum of 30 years of data must be examined to see any trends. With the proper long-term view, the so-called 'hiatus' did not occur. The Earth is still warming and we have statistically significant proof of this now.

6. *The scientists who are keeping the data and making the theories have fiddled with their data to make their theories seem correct. This is not good science!*

- This accusation against climate scientists is just not true, as has been judged by peer-reviewed papers, independent political commissions, and international government committees. As new methods of gathering data on global temperatures have improved, the interpretation of old data sets has been revised. All of these revisions have been publicly explained and

vetted in peer-reviewed processes. It is unfortunate that the evidence for global warming has gotten stronger and stronger, but those are the facts.

*7. Ice cores going back 450,000 years show CO<sub>2</sub> changes lag temperature changes by 600 to several thousand years. Therefore, changes in global temperatures probably cause changes in CO<sub>2</sub>.*

- The chart that Ron Armstrong shared establishes a very clear link between temperature and CO<sub>2</sub>, even before humans started emitting vast amounts of CO<sub>2</sub>. We know from climate physics and the effects of greenhouse gases that more CO<sub>2</sub> can raise global temperatures (if everything else is equal). The fact that CO<sub>2</sub> responds to temperature changes caused by other global and cosmic activities means there will likely be worse reinforcing effects now that human activity has initiated global warming.

*8. Our models of climate change do not track the observations so the theorists must be wrong.*

- This is not true. The evidence Ron Armstrong cites is a very faulty comparison of apples to oranges. It compares the predictions of models for global surface temperature with actual measurements from satellite data. These are very different things! Upper atmosphere temperatures change mostly due to solar activity, not greenhouse gas effects. A proper comparison of apples to apples shows that climate models have become quite accurate.

*9. Climate change hasn't caused more extreme weather.*

- Two individual data points were presented for this argument—the frequency of tornadoes in America, and Eurasian snow extent—and then a very strong claim was made. This is bad science. It is cherry picking and does not tell the whole story. When looking at data for the whole world, the IPCC says (via a lengthy and transparent peer-reviewed process) that “it is *likely* that since 1951 there have been statistically significant increases in the number of heavy precipitation events (e.g. above the 95<sup>th</sup> percentile) in more regions than there have been statistically significant decreases, but there are strong regional and sub-regional variations in the trends. More recent assessments indicate that it is *unlikely* that annual numbers of tropical storms, hurricanes, and major hurricanes counts have increased over the past 100 years in the North Atlantic basin. Evidence, however, is for a *virtually certain* increase in the frequency and intensity of the strongest tropical cyclones since the 1970's in that region.”

*10. The Paris Agreement is toothless without the US and China who are the biggest emitters of CO<sub>2</sub>. By promising to reduce CO<sub>2</sub>, the UK has increased the cost of electricity, which bears down hardest on poor people.*

- The US and Europe have been the largest cumulative emitters of CO<sub>2</sub> over the years from 1970 to 2013. If the West led the way to pollution of the atmosphere, then the West ought to lead the way towards cleaning it up too. Fossil fuels have received massive government subsidies, they pollute the air with toxic particles, they require immense investments for

extraction, refinement, and transportation, they are largely owned by corrupt countries, and many wars have been fought to ensure access to them. All of this has dramatically affected poor and rich people, but like most social ills, has been hardest on the poor.

*11. Global temperatures have always been changing. Just look at the data of temperature changes over the last 10,000 years.*

- A chart in the original presentation shows that since the end of the last Ice Age, global temperatures have fluctuated within a small band from 14 to 16 degrees C, but this is actually a short-term view as well as evidence of the narrow range that human society has flourished in! Climate scientists are very aware that climate varies naturally across a range of time scales from centuries to hundreds of thousands of years, but the amount of climate change over the last 100 years is abnormal. The carbon dioxide concentration in the atmosphere is now higher than at any time over the last 800,000 years. The last time CO<sub>2</sub> levels were commonly around 400 ppm was 3 million years ago during the Pliocene period. Ice age cycles still occurred then but the warm inter-glacial periods were maybe 2–3° C warmer than today, and sea level was 10–20 meters higher. If CO<sub>2</sub> levels remain at current levels for long enough, why wouldn't this happen again? During the most extreme warm event of the last 500 million years (the end-Permian Mass Extinction Event of 252 million years ago), upper ocean temperatures may have reached 35–40 °C, while temperatures in the tropics would have been lethal for humans. Seventy-five percent of families of species of plants and animals on land went extinct; 96% in the oceans. Our civilization would not survive on a world like this.

## RESPONSE IN DETAIL

*[April Bulletin] Prior to the meeting, Ron Armstrong provided the following information about his talk: “My opinions are similar to those of William Happer. An interview with him can be found at*

*<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/william-happer-interview/>*

- This single article cited from *The Best Schools* was only one part of a major series there titled “The Most Rigorous Debate on Climate Change and Global Warming.” This series contained many thorough responses to climate change denial. For all of the technical details, which provide most of the information for the rest of this response, see the following links:
- “David Karoly Interview” <https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>
- “Major Statement by David Karoly” <https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>
- “Major Statement by William Happer” <https://thebestschools.org/special/karoly-happer-dialogue-global-warming/happer-major-statement/>
- “Winner of the \$5000 Contest to Continue This Debate” <https://thebestschools.org/blog/2017/05/17/announcing-global-warming-fcd-contest-winner/>
- “Glenn Tamblyn’s Detailed Response to Happer” <https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/>
- “Happer’s Detailed Response to Karoly” <https://thebestschools.org/special/karoly-happer-dialogue-global-warming/happer-detailed-response/>
- “Tamblyn’s Final Reply to Happer” <https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>
- “Happer’s Final Reply to Tamblyn” <https://thebestschools.org/special/karoly-happer-dialogue-global-warming/happer-final-reply/>
- “The Real Truth about Greenhouse Gases and Climate Change: Paragraph-by-Paragraph Comments on an Article by Dr. William Happer” by Michael C. MacCracken, Ph.D., Chief Scientist for Climate Change Programs at the Climate Institute in Washington DC [http://www.climatesciencewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatesciencewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf)

*[Page 1] CO2 has increased since 1958. Some of it is probably due to burning fossil fuel. CO2 has been estimated from ice cores since 1750. During that time CO2 has increased from 275 ppm to over 400 ppm now.*

- This is a good place to start with an area of agreement. However, the quibble about certainty should be removed.
- “The observed concentration of carbon dioxide in the atmosphere is about 400 parts per million. Over the last 800,000 years, during ice ages and warmer interglacial periods, the CO<sub>2</sub> concentration was never above 300 parts per million, as shown by the air extracted from bubbles trapped in ice from Greenland and Antarctica. This shows that the recent large increases in CO<sub>2</sub> can’t be explained by natural variability. ... The increase in atmospheric CO<sub>2</sub> matches estimates of the release of carbon into the atmosphere from burning fossil fuels and from deforestation due to land clearing. It is associated with a decline in the isotopic ratio of carbon-13 to carbon-12 in the CO<sub>2</sub>, as expected for photosynthetically processed carbon and exactly what would result from the burning of fossil fuels and from land clearing. In addition, there has been an observed small decrease in the oxygen concentration in the atmosphere, exactly as expected from burning fossil fuels. Such a change in isotopic ratios in the atmospheric CO<sub>2</sub> and the decline in atmospheric oxygen cannot be explained by carbon dioxide coming from underwater volcanoes or from the oceans. Hence, human activity since the industrial revolution, associated with burning fossil fuels and with land clearing, is the cause of the increase in atmospheric carbon dioxide.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)
- “Over the last 40 years, when we have reliable observations of changes in solar radiation at the top of the atmosphere due to variations in solar activity, the variations in solar radiation are very small and have no correlation with global temperature variations. Over this period, solar radiation has declined slightly, while global temperature has increased significantly.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)
- “A critical point ... is the speed of the current changes. The rate of rise in CO<sub>2</sub> levels today is unprecedented in at least the last 55 million years. If we look at more recent data — the ice core records that span back hundreds of thousands of years — we see CO<sub>2</sub> concentrations varying by around 100 parts per million (ppm) over time scales of tens of thousands of years. The most rapid changes are typically during the great deglaciations, when levels rise by 100 ppm in around 10,000 years: 1 ppm per century. Today, CO<sub>2</sub> levels are rising at 1 ppm every 22 weeks!” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/>)

*[Page 2] Global mean temperature over land and ocean has shown a mild increase since 1880. But the 1940-1975 data have been adjusted and the global temperature was very nearly unchanged from 1997-2013. If CO<sub>2</sub> and temperature both increased, this is just correlation, not causation (e.g. my house has increased in value with my age).*

- Correlation does not equal causation, but we know there is causation here because CO<sub>2</sub> is a greenhouse gas. Even Happer admits that CO<sub>2</sub> “is partially opaque to the thermal, infrared radiation of the earth’s surface,

but transparent to most sunlight. Most of the atmosphere consists of nitrogen (N<sub>2</sub>) and oxygen (O<sub>2</sub>), which are nearly transparent to both sunlight and thermal radiation, and which are therefore not greenhouse gases.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/william-happer-interview/>)

- Happer said: “The argument starts something like this. CO<sub>2</sub> levels have increased from about 280 ppm to 390 ppm over the past 150 years or so, and the Earth has warmed by about 0.8 degree Celsius during that time. Therefore the warming is due to CO<sub>2</sub>. But correlation is not causation. Roosters crow every morning at sunrise, but that does not mean the rooster caused the sun to rise. The sun will still rise on Monday if you decide to have the rooster for Sunday dinner.” In response, MacCracken says: “That a supposedly well-informed scientist would say this is astounding, or perhaps unethical—a student being so ignorant of the very careful analyses that have been done would get a failing grade. Specifically, the results of increasingly detailed ‘fingerprint’ analyses have been described in each of the last three IPCC assessments. These analyses carefully analyze and decompose the temporal, altitudinal, latitudinal, and, increasingly, geographic patterns of change into the most likely contributions from each of the potentially important natural and human-induced causes of change, and then compare observed changes with those that are expected.” ([http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “Changing the quantities of greenhouse gases in the atmosphere can influence the balance (that keeps Earth’s climate steady). And we are doing that: CO<sub>2</sub> levels have risen from burning of fossil fuels, land clearance, and agriculture; methane (CH<sub>4</sub>) levels have risen due to our emissions, land use changes (such as rice production), ruminant animals (such as cows), and changes in wetlands; nitrous oxide (N<sub>2</sub>O) levels have risen because we use nitrogenous fertilizers for our crops; various man-made chemicals such as chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF<sub>6</sub>) have been added to the air. Finally, there is the other key greenhouse gas, water vapor. This the most important of the greenhouse gases, contributing approximately 50% to the greenhouse effect, in contrast to the preceding substances that contribute around 25% (clouds are the remaining 25%). Water vapor is the largest positive feedback in the climate system, multiplying the impact of the preceding gases.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/>)
- “Although the physics of what types of clouds form where and why is quite complex, this basic requirement dominates: globally there will be enough water vapor in the atmosphere to balance the hydrological cycle based on the temperature of the air. If there isn’t, evaporation corrects that in days. Similarly, if there is too much water vapor, increased precipitation restores the hydrological balance. If the atmosphere’s average temperature changes, the water vapor content also changes, adjusting in hours or days — which is just what is observed. On time scales from hours to seasonal cycles, water vapor content responds

strongly to air temperature. When large volcanic eruptions occur, such as Mt. Pinatubo in the Philippines in June 1991, their ash clouds cool the weather system. Water vapor levels fall in consequence till the ash cloud clears. Water vapor is a sensitive feedback.”

[\(https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/\)](https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/)

*[Pages 3 and 4] In the 1970's, Prof. Herbert Lamb predicted we were heading into an ice age due to a fall in global temperature from 1940 to 1970. A National Academy of Sciences report noted the same possibility. A 1975 article in Newsweek talked more about "The Cooling World."*

- This Newsweek article also said: “Just what causes the onset of major and minor ice ages remains a mystery. Our knowledge of the mechanisms of climatic change is at least as fragmentary as our data.” That was 43 years ago. The science has moved on considerably since then, as seen and referenced throughout this response.

*[Pages 5, 6, 7] A chart of air temperature vs. human CO2 emissions shows three periods of temperature growth, only one of which occurred since CO2 emissions increased drastically. The other growths in temperature are unexplained. There has also been “a pause” or “a hiatus” from 1995-2015 where there has been no statistically significant rise in temperature. Climate scientist Phil Jones agreed with this statistical analysis. Monkton has used least mean squares test to show there was no global warming between 1997 and 2015. Any theory can be falsified by showing one prediction that does not agree with subsequent measurements. Therefore the theory of Anthropogenic Global Warming (AGW) is wrong because observations don't match predictions. And the people making the measurements should be independent from the people advocating the theory. This is like cold fusion research where believers act like a religion or cult.*

- No one claims that CO2 is the only means of affecting the climate. Sunspots / cosmic ray intensity, Earth orbit variations, La Nina / El Nino effects, volcanic eruptions, stratospheric ozone depletion, and industrial aerosols in the lower atmosphere all play parts that have caused variations in the climate in the past.
- “Over the last couple of million years, the Earth has cycled between glacial and interglacial conditions with periodicities that quite well match seasonal and geographic shifts in solar radiation reaching the top of the atmosphere as a result of cyclic changes in the Earth's orbit around the Sun. These cycles are caused by the changing ellipticity (circularity) of the Earth's orbit (cycle of about 413,000 years with a major subcycle at about 100,000 years) that shortens some seasons and lengthens others, the tilt of the Earth's axis (cycle of about 41,000 years) that latitudinally redistributes incoming solar radiation and thus alters the intensity of the seasons, and the precession of the Earth's orbit (cycle of about 21,000 years), which affects the time of year when the Earth is closest to the Sun, changes seasonal contrasts and affects the relative amount of energy going to the Northern and Southern Hemispheres.”

[http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))

- “Also ... the 1950s to 1970s were the peak years for air pollution, which has a cooling effect.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)
- “A repeated mistake Professor Happer makes is referring to surface and atmospheric data as ‘the Earth,’ when thermodynamically this is a small part of the system. Most of the changes in heat content — over 90% — are in the oceans and thus are the primary measure of whether the Earth is warming or cooling. Modest changes in the patterns of heat exchange between the oceans and the atmosphere can cause atmospheric climate to vary significantly. This is why atmospheric climate is so variable, and thus why we need 30+ years to distinguish it from weather. The atmosphere is the tail wagged by the dog of the oceans.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)
- “The so-called “hiatus” in global warming was a creation of a small number of commentators who usually considered the period from 1998, a very hot year, to around 2012. 1998 was a very hot year associated with the strongest El Niño event in the last 150 years. The years 2011 and 2012 were colder, being associated with back-to-back La Niña events. It is not surprising that if you select a period starting in a hotter year, like 1998, and finishing in a colder year, like 2012 — both associated with natural variability — that there is a reduction in the warming trend in global average temperature due to natural variability. Does this mean global warming stopped? No — for two reasons. First, global warming is the addition of heat to the climate system, not just the increase in global average temperature. In fact, about 90 percent of the heat added to the climate system due to the increase in greenhouse gases in the atmosphere over the last 100 years has gone into heating up the oceans and only a small fraction has gone into heating the atmosphere and the land surface. The heat content of the ocean, particularly the deep ocean, has increased more rapidly over the last two decades, even while the global average surface temperature showed a reduced rate of warming due to natural variability from 1998 to 2012. Second, if we want to focus on the role of global warming in global average temperatures, we need to consider the longer-term average temperature for at least a decade, and the changes from decade to decade. There is a pronounced warming from the decade of the 1990s to the most recent decade — 2006 to 2015 — even including the colder years associated with the strong La Niña of 2010 and 2011. Hence, global warming did not stop in the early part of the twenty-first century. The slowdown in the rate of increase in global mean temperature only exists if you start in 1998, a very hot year, and is due to natural variability of yearly temperatures. Global warming does not mean that the chaotic variability of global temperature disappears. The year-to-year natural variability is superimposed on longer-term global warming.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)

- “We also need to understand what timescale the weather is averaged over. As defined by the World Meteorological Organization and actually first used by its predecessor, the International Meteorological Organization, before WWII, climate is the 30-year average of the weather. This isn’t an arbitrary definition, but was calculated from the statistics of weather data. Thus changes over a few years are not climate changes, they are just natural variability, something within the climate.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/>)
- “When we consider climate change or global warming, it is important to consider changes over periods of 30 years or longer. The World Meteorological Organization (WMO) considers a climate normal to be the average conditions of temperature, rainfall, and other weather variables over a period of 30 years. The most recent climate normal is for the period 1981–2010. We consider such an extended period to reduce the effects of natural variability from year to year and decade to decade, much of which is random and associated with exchanges of heat between the ocean and the atmosphere.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)
- “2015 is the hottest year in all three datasets and 2014 is the second-hottest year. Part of this record heat in 2015 is due the occurrence of a strong El Niño in 2015, which was associated with hotter-than-normal sea surface temperatures in the equatorial Pacific Ocean and the release of heat from the ocean into the atmosphere. El Niño is part of the natural variability of the climate system. The previous El Niño was in 1997–98 and was even stronger than the 2015–16 El Niño, but the global average temperature then was about 0.2° C lower than in 2015.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)
- “When you read Phil Jones' actual words, you see he's saying there is a warming trend but it's not statistically significant. He's not talking about whether warming is actually happening. He's discussing our ability to detect that warming trend in a noisy signal over a short period.” (<https://skepticalscience.com/Phil-Jones-says-no-global-warming-since-1995.htm>)
- “Last year (in 2010), Jones told BBC News that post-1995 warming was not significant - a statement still seen on blogs critical of the idea of man-made climate change. But another year of data has pushed the trend past the threshold usually used to assess whether trends are ‘real’. ... Last year's analysis, which went to 2009, did not reach this threshold; but adding data for 2010 takes it over the line. “The trend over the period 1995-2009 was significant at the 90% level, but wasn't significant at the standard 95% level that people use,” Professor Jones told BBC News. ‘Basically what's changed is one more year [of data]. That period 1995-2009 was just 15 years - and because of the uncertainty in estimating trends over short periods, an extra year has made that trend significant at the 95% level, which is the traditional threshold that statisticians have used for many years. ‘It just shows the difficulty of achieving significance with a short time series, and that's why longer series - 20 or 30 years -

would be a much better way of estimating trends and getting significance on a consistent basis.” (<http://www.bbc.co.uk/news/science-environment-13719510>)

*[Pages 8, 9, 10, 11] Data on global temperatures is held in three terrestrial databases. The data has been revised to better fit the theory of AGW. This is a conflict of interest. A hacked email to Phil Jones shows a conspiracy. A graph shows NASA changing data from 1940—1975, which originally showed a drop of 0.4 degrees Celsius but now shows a drop of only 0.1 degrees Celsius. An article from Monckton titled “Fiddling with the Data” claims terrestrial temperature records have been changed so much they are no longer to be trusted, whereas satellite temperature records show no global warming for over 18 years. Two graphs from Tony Heller show corrections to datasets have resulted in recent temperatures appearing much higher, and older temperatures appearing much lower. John Bates, a NOAA Scientist blew the whistle on this and claimed data was changed to influence the 2015 Paris Climate talks. Armstrong stated that there is “no rhyme or reason for these changes. They are just fiddling with the data.”*

- “There have been criticisms of the quality of the long-term record of temperature from weather observing stations on land. Some of these criticisms include the possible warming influence due to the growth of cities and urban areas around weather stations that had originally been in rural locations. Others include the influence of adjustments made to the original observations to seek to produce a high-quality homogeneous data record by removing the influences of site moves and instrument changes. These concerns have been addressed by the scientists who have processed the data and have been shown to have minimal impact on the long-term global warming trend.”  
(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)
- “The Professor commented on the slight cooling in the surface temperature record between the 1940s and 1970s. However, he seems unaware that the surface record has a well-known spurious warm bias due to a marked change in measurement techniques during the war years and, to a lesser extent, the 1960s.”  
(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)
- “This is not to say, however, that there are not still biases in the observations that need to be looked into. For example, ocean surface temperatures from the years during World War II are generally higher than for surrounding periods. So, did World War II warm the oceans or are there some biases or neglected forcings? This is an important question because, in comparing model results and observations over the 20th century, the only large domain for which there is statistically significant disagreement between observations and model simulations seems to be over the oceans during World War II. To date, analyses indicate that a much greater share of the observations during those years were from US Navy ships and the way in which they made the measurements was somewhat different than the techniques used by ships

of other nations, so there is reason to think that this may contribute to the model-observation differences.”

([http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))

- “Stitching together raw data from multiple satellites is very complex. Thus, the satellite datasets are much less accurate than the surface temperature datasets. Professor Happer’s stronger emphasis on satellite temperature measurements does not agree with the experts on the subject.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)
- “It is particularly ironic that Dr. Happer so strongly criticizes the development of the temperature record for the last 500 years, but then does not discuss the much more serious problems with the record of changes in upper tropospheric temperature. This record, which is derived from satellite-based observations taken by the Microwave Sounding Unit (MSU), was touted for over a decade by the Marshall Institute and other global warming skeptics as showing that the upper troposphere was cooling, in contradiction to the warming trend derived from observations of surface temperatures. That there was an apparent contradiction brought extensive scientific attention (just as had been the case for the paleoclimatic record). This time, however, a series of serious problems was found with the data set, including biases due to the decaying altitudes of satellites, to changes in the time of day of measurement as the orbit drifted, to the techniques used for cross-calibration across satellites, to inadequate solar shielding for the sensor used for radiosonde observations needed for cross-calibration, and on and on. Now, with a record finally exceeding three decades long, the record indicates that the tropospheric temperatures are climbing along with surface temperatures.” ([http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “What particularly frustrates climate scientists that I know is that those that Dr. Happer refers to as “Skeptics” (actually all scientists are taught to be skeptical, and, as a result, the IPCC chapters devote a lot of their attention to describing uncertainties, etc.) seem totally one-sided in their presentations, never seeming to have any doubt in their interpretations and the data sets they use. ... Thus, the “Skeptics” are not seen as carrying their weight—all they do is attack, expressing themselves as absolutely sure they are right. And then when their results are looked at closely and found wanting, there is no admission or apology; instead, they are on to the next attack.” ([http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “We can also confidently exclude changes in solar activity as a contributor to recent observed climate change using the fingerprint of the response to increases of solar radiation in the observed pattern of changes in temperature in the stratosphere and in the lower atmosphere. Increases in solar radiation would lead to warming in the stratosphere due to

absorption by oxygen and ozone in the upper atmosphere and warming in the lower atmosphere and at the surface. However, the observed pattern of temperature change over the last 50 years shows cooling in the lower stratosphere and warming in the lower atmosphere and at the surface, exactly as expected from human impacts on the climate.”

(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)

- “When heat is added to the climate system for any reason, most of that heat (about 90%) goes into warming the oceans, some goes into melting ice sheets and glaciers, some goes into warming the land, and a small fraction warms the atmosphere.”  
(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)
- “There are many other indicators of warming of the climate system, apart from increases in global mean temperature, or average temperature, on land. These include long-term increases in both sea surface temperatures and air temperatures observed from ships since the mid-nineteenth century. ... Long-term observations of the length of glaciers show marked reductions from the late nineteenth century to the present for all glaciers that have changed in length, as expected in a warming climate. ... Long-term observations of sea level from tide gauges at many coastal and island sites show a significant increase in sea level of about 20 cm from the late nineteenth century to the present. This sea level rise is an indicator of warming of the ocean waters and melting of ice on land, both due to global warming. ... Other indicators of global warming have shorter observational records and are only available since the mid-twentieth century or the onset of satellite observations. These include reductions in snow cover over land in the Northern Hemisphere, particularly in spring, increases in the average heat content in the deeper ocean, increases in global average air temperature throughout the lower atmosphere, and increases in the water vapor content of the lower atmosphere, all of which are expected due to global warming.”  
(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)
- “Professor Phil Jones, the climate scientist at the centre of the scandal over the leak of sensitive emails from a university computer, has been largely exonerated by a powerful cross-party committee of MPs who said his scientific reputation remains intact. There was no evidence that Professor Jones, head of the Climatic Research Unit at the University of East Anglia (UEA), deliberately withheld or manipulated data in order to support the idea that global warming was real and that it was influenced by human activities, according to a report by the Commons Science and Technology Committee. ... Some of the leaked emails written by Professor Jones talked of using a ‘trick’ to ‘hide the decline’, which some climate sceptics have taken as proof of an attempt to hide data contradicting the idea that global warming was real. But the select committee said these phrases were references to established scientific procedures and there was no case to answer in terms of accusations of dishonesty on behalf of Professor Jones and his unit.”

<https://www.independent.co.uk/environment/climate-change/climate-change-scandal-mps-exonerate-professor-1931631.html>

- “Climate Misinformer: Christopher Monckton: Christopher Monckton is a British consultant, policy adviser, writer, columnist, and hereditary peer. While not formally trained in science, Monckton is one of the most cited and widely published climate skeptics. ... Favourite climate myths by Christopher Monckton: ‘It hasn't warmed since 1998’. What the science says: ‘Every part of the Earth's climate system has continued warming since 1998, with 2015 shattering temperature records.’”  
([https://www.skepticalscience.com/Monckton\\_Myths\\_arg.htm](https://www.skepticalscience.com/Monckton_Myths_arg.htm))
- “In June 2014, Goddard (aka Tony Heller) attracted considerable media attention for his claims that NASA had manipulated temperature data to make it appear that 1998 was the hottest year in United States history. ... The claim was dismissed by Politifact.com, which rated it as ‘pants on fire’—its lowest possible rating. Politifact contacted Berkeley Earth energy systems analyst and environmental economist Zeke Hausfather, who told them that the problem with Goddard's analysis was that it ignored the changes the network of U.S. weather stations had undergone over the last eighty years.”  
([https://en.wikipedia.org/wiki/Steven\\_Goddard](https://en.wikipedia.org/wiki/Steven_Goddard))
- “Unlike the AGW ‘skeptics’, who focus on the facts of the changes without regard to the reasons, actual climate scientists focus on the reasons, which they detail in peer reviewed publications, and in the case of GISS, on site as well. One main contributor to the change in trend from for the meteorological stations index has been the increase in the number of stations. The first version of GISS (1981) relied on just 1000 stations. That increased to 2200 in 1987, and to 7200 in 1999 (between the 1998 and 2000 versions). In 2005, a small number of stations in Antarctica were introduced, which was not a major increase in number, but very significant in improved coverage. Finally, in 2016 the number of stations jumped to 26000. There have also been significant improvements in techniques, as detailed by GISS. ... The merits of these changes in method can be argued, although they all seem like eminently reasonable improvements to me. But if you object to them, you have to make that argument. You cannot simply say that you do not like the result and therefore the methods are wrong - still less that they are fraudulent. The later, however, is the method employed by charlatans like Tony Heller.”  
(<https://skepticalscience.com/search.php?t=c&Search=Steve+Goddard>)
- On Snopes.com, *NOAA Scientists Falsely Accused of Manipulating Climate Change Data: A tabloid used testimony from a single scientist to paint an excruciatingly technical matter as a worldwide conspiracy.* “The Daily Mail article cited a ‘whistleblower’ (retired NOAA scientist John Bates) who came forward to reveal what he described as ethical lapses in the way that study's data were selected and archived by its authors. ... In reality, the entire methodology was spelled out in the paper, and the ship data correction Karl et al selected had previously been published. This correction, far from ignoring the differences between boat and buoy data, actually took into account the generally superior buoy data in its calculation. ... In a paper published last month in the journal Science

Advances, we compared the old NOAA record and the new NOAA record to independent instrumentally homogenous records created from buoys, satellite radiometers, and Argo floats. Our results, as you can see in the chart below, show that the new NOAA record agrees quite well with all of these, while the old NOAA record shows much less warming. This was due to two factors: the old NOAA record spliced together warmer ship data with colder buoy data without accounting for the offset between the two; and the new NOAA record puts more weight on higher-quality buoy records and less weight on ship records (versus the old NOAA record which treated ships and buoys equally) ... The fact that the new NOAA record [Karl et al 2015] is effectively identical with records constructed only from higher quality instruments (buoys, satellite radiometers, and Argo floats) strongly suggests that NOAA got it right and that we have been underestimating ocean warming in recent years. ... In a 7 February 2016 interview with EE News, Bates explicitly stated that he did **not** mean to suggest that Karl et al had manipulated data. ... While Karl et al might reasonably be criticized for having been less than rigorous in their data documentation, their findings have been independently verified, contrary to allegations that the authors manipulated data to reach a desired conclusion. What David Rose fails to mention is that the new NOAA results have been validated by independent data from satellites, buoys, and Argo floats and that many other independent groups, including Berkeley Earth and the UK's Met Office Hadley Centre, get effectively the same results." (<https://www.snopes.com/news/2017/02/08/noaa-scientists-climate-change-data/>)

- "Scientists may work for many years to assemble data sets on which their careers and jobs are based, and just giving the data sets away can be like asking Coca-Cola to just give out its recipe. In addition, not all countries subscribe to open data exchange; for example, countries having invested in the taking of the observations might not want scientists in some big, well-funded country to take and use their observations before their own scientists can do so, so some records may be provided on a do-not-further-release basis. Or there might be concerns that the observations might reveal information of national economic importance or about national security (e.g., it took quite a while for the US Navy to release its records of the depth of sea ice, for if one knew when and where observations were taken, deciphering sonic records might make it possible to figure out how to detect the locations of US submarines in the future)." ([http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))

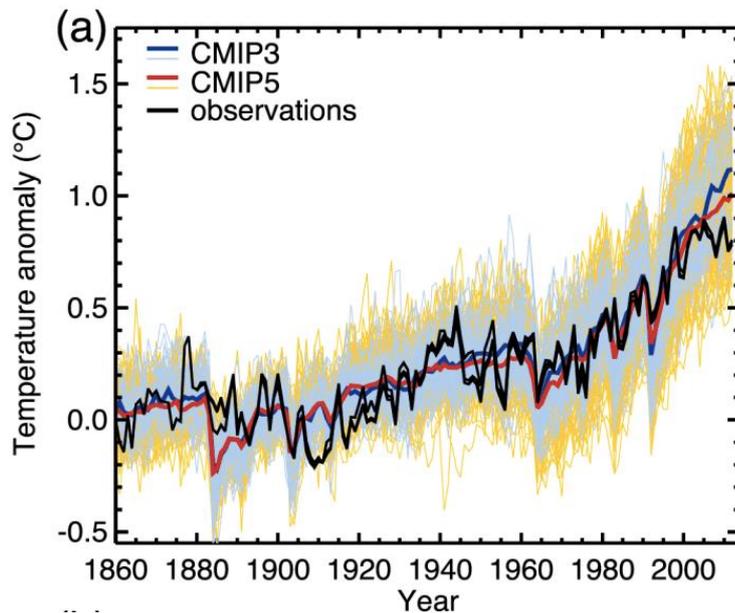
*[Page 11] Ice cores can estimate CO2 and temperature for the last 450,000 years. These estimates show CO2 and temperature are highly correlated, but measurements show CO2 changes lag temperature changes by 600 to several thousand years. Therefore, changes in global temperatures probably cause changes in CO2.*

- “It is true that during the cycles from ice ages to warmer interglacial periods, the warming is initiated by changes in the Earth’s orbit around the Sun leading to increases in sunlight at higher latitudes. The rise in CO<sub>2</sub> follows as it is less soluble in warmer water and the oceans release some of the dissolved CO<sub>2</sub> into the atmosphere. However, that does not mean that CO<sub>2</sub> cannot drive climate change or that the current increase in CO<sub>2</sub> is due to the observed warming. Simple radiation physics as well as geological evidence, such as from the Paleocene-Eocene Thermal Maximum, show that increases in CO<sub>2</sub> in the atmosphere have a warming influence on the climate.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)
- “That the changes in the concentrations of these gases lag the changes in solar radiation (driven by orbital element cycling) suggests that, on these time scales, the changes in atmospheric composition are serving as amplifying (or positive) feedbacks. That colder oceans hold more CO<sub>2</sub> than warmer is very likely one contributor to the positive feedback; changes in the rates of ocean overturning, biological activity on land and in the ocean, capping of polar seas by sea ice, and other processes are also likely contributing, although much remains to be worked out. ... With respect to the situation that we face at present, these lessons are both confirmatory and disturbing. The confirmatory lesson is that an increase in the CO<sub>2</sub> concentration contributes to warming—that the present increase occurs due to injection of fossil fuel CO<sub>2</sub> rather than outgassing from the ocean makes no difference in the climatic influence, and the responsiveness of the climate system would be expected to be (and is calculated to be) about the same for the glacial-interglacial transition and the present warming. The disturbing aspect about the ice cores showing the strong CO<sub>2</sub> variations is that this makes clear that there is a quite strong, natural, amplifying (positive) CO<sub>2</sub> feedback and that we can expect that it will kick in as the world warms; indeed, there are early signs that this is starting to occur. So, rather than contradict current understanding and models, the paleo-evidence not only confirms the level of concern, but also the existence of a strong natural, positive CO<sub>2</sub> feedback that will further amplify the climate change risk the world faces.” ([http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “How does projecting into the future based on a past period when large ‘players’ weren’t involved constitute a sensible projection? If you build a bonfire from some paper, then kindling, then larger timbers, then finally large logs, would you predict how big the fire will become just from what the paper and kindling alone have done initially? [Humans have now thrown large logs onto the bonfire.]” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/>)

*[Page 12] A chart by J.R. Christy shows 32 groups of models have all wildly over-predicted temperature rises since 1995 that do not match the data observed in*

*satellite and balloon datasets. Therefore the theories behind these models must be wrong because they are not predicting the data correctly.*

- Christy is comparing apples to oranges here! The CMIP models are intended to map to Global Mean Surface Temperatures, which merge land and sea temperatures. They are NOT predicting just satellite and balloon temperatures. As discussed above, temperatures in the higher atmosphere are not expected to be influenced by man-made global warming. When comparing apples to apples, the CMIP models track observations very well. Here is the correct chart showing model predictions vs. observations:



- 
- “The observed significant cooling for one to two years after major volcanic eruptions —Santa Maria (1903), Agung (1963), El Chicon (1982), and Pinatubo (1991) —is simulated very well. ... There is very good agreement between the observed long-term global warming since the late nineteenth century and the average global warming across all the model simulations for combined natural and anthropogenic forcing.”  
[\(https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/\)](https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/)

*[Page 12] Two charts show no discernable increase in “strong U.S. tornadoes” or “Eurasian snow” over the last 40-50 years. Therefore climate change does not cause more extreme weather.*

- “Quite cherry-picked data, surely. ... Rutgers University Snow Lab shows a slight increase in snow cover across the Northern Hemisphere in winter. Rutgers also produces graphs for fall and spring. 1.5 million km<sup>2</sup> more snow in fall, 0.8 more in winter, but 3.0 less in spring. So, more snow falling in fall and winter, but progressively less and less snow remaining going into summer, and less snow overall. What does this tell us? The variation in snow cover over the course of a year is increasing. Greater melt-water volumes, larger river flows, potentially more flooding. Also

less snow being held back as snow pack for as long, reducing the natural dam that Mother Nature provides to release water more slowly.”

(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/>)

- “Regarding more extreme weather events, rather than presenting cherry-picked data from small regions or single types of events — which isn’t very informative — the IPCC has assessed the whole world: ‘there is *medium confidence* that globally the length and frequency of warm spells, including heat waves, has increased since the middle of the 20<sup>th</sup> century although it is *likely* that heatwave frequency has increased during this period in large parts of Europe, Asia, and Australia. In summary, further analyses continue to support the AR4 and SREX conclusions that it is *likely* that since 1951 there have been statistically significant increases in the number of heavy precipitation events (e.g. above the 95<sup>th</sup> percentile) in more regions than there have been statistically significant decreases, but there are strong regional and sub-regional variations in the trends. More recent assessments indicate that it is *unlikely* that annual numbers of tropical storms, hurricanes, and major hurricanes counts have increased over the past 100 years in the North Atlantic basin. Evidence, however, is for a *virtually certain* increase in the frequency and intensity of the strongest tropical cyclones since the 1970’s in that region.’ Or we can use data from reinsurance companies, such as Munich Re, who “insure the insurers.” They collect global data on insurable natural disaster events. They find that climate-related events are rising, while geological events such as earthquakes are steady. Importantly, their data consist of number of events, not cost of damages, so confounding factors such as economic and population growth are not an issue.”

(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)

*[Page 13] The Paris Agreement is a toothless accord with the biggest emitters of CO2 (e.g. China, USA, India) either withdrawing or not committing to anything concrete. Meanwhile, the UK has reduced greenhouse gas emissions by 42% since 1990 and is halfway to their 2050 commitment to reduce those emissions by 80%. This action has resulted in an increasing cost of electricity which hurts poor people most of all. And jobs have been lost, like when Alcan was forced to close.*

- The United States and the European Union were the top two cumulative emitters of CO2 from 1970 to 2013.  
([https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_carbon\\_dioxide\\_emissions](https://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions)) If the West led the way to pollution of the atmosphere, the West ought to lead the way towards cleaning it up too.
- “For those defending the use of coal, oil, and natural gas through tax breaks and overwhelming contributions to political candidates to [then turn around and charge] that moving to use of distributed renewable energy sources will enrich the favored few seems a criticism beyond the pale. Renewable energy systems, with their great variety, have the potential to provide jobs in countries around the world, ending the dependence on importing fuel from the few countries blessed with oil

reserves. While there is a higher initial cost for at least some types of renewable energy systems, that cost is coming down, and then the cost of energy becomes much less, if not quite free.”

([http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))

- Renewable energy costs have plummeted and are now set to be cheaper than fossil fuels by 2020, according to a new report released in 2018. (<https://www.independent.co.uk/environment/renewable-energy-cheaper-fossil-fuels-2020-uk-green-climate-change-global-warming-report-irea-a8160051.html>)
- Fossil fuels have received massive government subsidies, they pollute the air with toxic particles, they require immense investments for extraction, they are largely owned by corrupt countries, and many wars have been fought to ensure access to them.

*[Page 13] In conclusion, a chart shows how temperature has changed over the last 10,000 years since the end of the Ice Age. Any current changes must be seen in this long-term context.*

- “Dr. Happer seems to advocate interpreting the fact that the Earth’s climate has changed over the last four billion years to justify totally ignoring any effect that humans are having on the climate, no matter how large or how rapid.” ([http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “Climate scientists are very aware that climate varies naturally across a range of time scales from centuries to hundreds of thousands of years. The climate change over the last 100 years is abnormal because the change in global average temperature is larger than at any time over the last millennium, the change is driven by human-caused increases in carbon dioxide and other long-lived greenhouse gases, and the carbon dioxide concentration in the atmosphere is now higher than at any time over the last 800,000 years, through multiple ice ages and interglacial periods.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)
- “The last time CO<sub>2</sub> levels were commonly around 400 ppm was 3 million years ago during the Pliocene period. Ice age cycles still occurred, but the warm inter-glacial periods were maybe 2–3° C warmer than today, and sea level was 10–20 meters higher. If CO<sub>2</sub> levels remain at current levels for long enough, why wouldn’t this happen again? ... The list of what we can lose with that much rise includes: Venice; the Nile, Mekong and Ganges deltas — all major farming regions (the Nile delta is two thirds of Egypt’s farmland); Miami and southern Florida. Miami is already installing pumping systems and raising road levels to cope with flooding during peak tides; the storm-water, sewer, and underground rail systems of many coastal cities; much of Denmark; Lower Manhattan; the Netherlands.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-detailed-response/>)

- “While the change is small compared to seasonal variations to which systems are accustomed, the reasonably well-defined boundaries in vegetation and fisheries make clear that small differences matter. Just because humans can survive in a wide range of conditions (with help like clothing and shelter) does not mean that flora and fauna will not be impacted.” ([http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “During the most extreme warm event of the last 500 million years, the end-Permian Mass Extinction Event of 252 million years ago, upper ocean temperatures may have reached 35–40 °C, while temperatures in the tropics would have been lethal for humans. Seventy-five percent of families of species of plants and animals on land went extinct, 96% in the oceans. Our civilization would not survive on a world like this.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)

[Q&A] *Isn't the oil industry fiddling with the data too? No. They aren't in control of it.*

- “Earlier this year (in 2016) our organization, the Rockefeller Family Fund (RFF), announced that it would divest its holdings in fossil fuel companies. We mean to do this gradually, but in a public statement we singled out ExxonMobil for immediate divestment because of its ‘morally reprehensible conduct.’ For over a quarter-century the company tried to deceive policymakers and the public about the realities of climate change, protecting its profits at the cost of immense damage to life on this planet.” (<http://www.nybooks.com/articles/2016/12/08/the-rockefeller-family-fund-vs-exxon/>)  
(<http://www.nybooks.com/articles/2016/12/22/rockefeller-family-fund-takes-on-exxon-mobil/>)
- “For a person wanting the debate to be about the science, this type of comment questioning the motives of virtually the entire scientific community and many in industry is just what generates the type of reaction Dr. Happer then complains about. And to say this without similarly examining the funding and motives of those criticizing climate change science (e.g., much of the fossil fuel industry) is the type of one sidedness that really takes away from Dr. Happer’s credibility.” ([http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “Naomi Oreskes and Eric M. Conway, in their book *Merchants of Doubt* (Bloomsbury Press, 2010), describe multiple lines of evidence for the coordinated promulgation of scientific misinformation to spread doubt and to slow action to reduce greenhouse gas emissions. These efforts seem to be politically or ideologically motivated.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)

- “Where in his list, for example, does he place the Intergovernmental Panel on Climate Change with its hundreds of leading scientists and thousands of expert reviewers, the 190+ governments that participate and have unanimously endorsed its findings through four rounds of international science assessments, the national academies of science of all the leading nations, the many dozens of leading professional societies, and more? Are all of these entities somehow more opportunistic, cynical, money-hungry, and manipulative than the leaders of the fossil fuel companies that had a hidden strategy to sow uncertainties, than the supposedly independent individuals and organizations that get major support from the fossil fuel companies and have as a major purpose the critiquing climate change science, than the non-scientific believers that climate change cannot be man-made, and than the coal companies funding curricula and the teaching of the benefits of coal to elementary school children.”  
([http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))

*[Q&A] Air pollution is a killer. Isn't that reason enough to stop burning fossil fuels? That matters, but wind power requires exactly the same amount of infrastructure to be built for gas-fired electrical plants because the wind doesn't always blow and you need to meet demand.*

- “In Bangladesh, sea level rise is expected to cause several million internal refugees to move to the cities. In Syria, 1.5 million people moved to the cities due to prolonged drought, a factor in the current terrible strife there, which then turned into a refugee crisis in Europe and triggered political discord on that continent. In other words, climate change is not just about the climate: it has economic, political, and potentially military consequences, as well.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)
- “The range of possible climate sensitivities, while centering around 3, does include lower and higher possibilities. While lower outcomes obviously would be preferable, good risk management requires that we give a weighting to lower-probability but high-severity possibilities.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)
- “The precautionary principle is part of our legal system. Once the possibility of a risk has been identified, we are required to demonstrate that a course of action is safe. For example, it is part of U.S. Department of Labor Occupational Health & Safety Administration law. To continue with an action, we must demonstrate safety, not risk. So, by the standard of “beyond a reasonable doubt,” is continuing to release greenhouse gases safe? I believe I have shown that it is not safe. Professor Happer, on the other hand, has failed to demonstrate that such a course of action is safe; he seemingly only presumes it is. That is hardly sufficient grounds for risking much human suffering.”  
(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/tamblyn-final-reply/>)

*[Q&A] Do you accept that CO2 is a greenhouse gas? Yes, but it's complex. CO2 is not pollution. We need CO2 to grow plants. This fear of CO2 is like a religion or a cult. When Galileo said the Earth goes around the sun, he was right even though the church said otherwise.*

- “I am confused, however, how it is that Dr. Happer is fully supportive of the science for all of these other problems, but the science for climate change is globally corrupted—seems rather selective to me.”  
([http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climatewatch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- When Galileo argued for the sun being the centre of our universe, he was arguing against religious leaders. When climate change deniers argue against the consensus view, they are arguing against scientists. There is a big difference in these situations.
- “There is an overwhelming consensus of climate scientists who agree that human-caused climate change is happening and that global warming will continue throughout the current century, with many adverse impacts on human and natural systems. This consensus is based on a vast body of scientific evidence and many thousands of peer-reviewed scientific publications. It is the consensus of the evidence and the peer-reviewed publications that is important, which leads to the consensus of climate scientists. The US National Academy of Science has carried out independent assessments of the science of climate change under both Republican and Democrat Presidents and supported the consensus scientific conclusions on greenhouse climate change. All major national scientific Academies in different countries around the world support the consensus view, based on their own independent assessments. Governments of all countries around the world have accepted the science at meetings of the IPCC, despite the fact that any individual country could have vetoed the acceptance of the IPCC Assessment Reports. ... Any scientist or group of scientists who could reliably and convincingly prove that increasing greenhouse gases in the atmosphere have not caused global warming over the last 100 years and will not cause further global warming would be a strong candidate to win a Nobel Prize in Physics. There is no scientific evidence to support this at present.”  
(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/david-karoly-interview/>)
- “For each of the IPCC’s four assessment reports (issued in 1990, 1995, 2001, 2007), the assembly of the involved nations, now exceeding 190, has unanimously endorsed the reports that have emerged from the IPCC’s very careful development and review process. To suggest that the IPCC findings are somehow not mainstream and their process is leading to far-out conclusions bespeaks a very paranoid view of the international community of nations; if anything, the IPCC’s findings have been too cautious, as indicated by each IPCC assessment strengthening the overall findings, bringing them into accord with what were at the time the cutting edge findings of leading scientists.”

[http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))

- “Our society, our agricultural systems, our cities, and our natural ecosystems have all developed in a period with a relatively stable climate over the last 2,000 years. However, the rate of global warming is so rapid that our society and the systems on which we depend are becoming stressed.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)
- “In making the point that humans exhale CO<sub>2</sub> to justify that it is not a pollutant, he fails to add that this occurs because humans can die from their blood carrying too much CO<sub>2</sub>. As for many other substances, too little is a problem (in this case, not enough for plants to grow), too much is a problem (in this case, humans and animals die from too much), and we are dependent on the atmospheric CO<sub>2</sub> concentration being within a safe range.” ([http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change\\_1.pdf](http://www.climate-science-watch.org/wp-content/uploads/2011/09/The-Real-Truth-About-Greenhouse-Gases-and-Climate-Change_1.pdf))
- “Plants grown in an atmosphere with higher carbon dioxide have faster growth rates and lower water use, assuming there are no other limits on growth. However, often plant growth is limited by other factors, including lack of nutrients or lack of water or temperature extremes, including heat waves, so that increases in carbon dioxide don’t provide unlimited benefits to plant growth. In addition, higher carbon dioxide levels have been shown to lead to lower levels of protein production even when plant growth increases.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)
- In “The great nutrient collapse” in Politico, there was a report about Irakli Loladze's research. “Every leaf and every grass blade on earth makes more and more sugars as CO<sub>2</sub> levels keep rising,” Loladze said. “We are witnessing the greatest injection of carbohydrates into the biosphere in human history—[an] injection that dilutes other nutrients in our food supply.” Within the category of plants known as ‘C3’—which includes approximately 95 percent of plant species on earth, including ones we eat like wheat, rice, barley and potatoes—elevated CO<sub>2</sub> has been shown to drive down important minerals like calcium, potassium, zinc and iron.” (<https://www.politico.com/agenda/story/2017/09/13/food-nutrients-carbon-dioxide-000511>)
- “One of the other major impacts of climate change due to increasing carbon dioxide concentrations is the increase in carbon dioxide dissolved in the oceans. As shown below, the dissolved carbon dioxide in the upper waters of the ocean has increased in parallel with the increase in atmospheric concentration. As the oceans absorb more carbon dioxide, they become less basic (or more acidic), with a higher concentration of carbonic acid. This can be seen in the decrease in pH of ocean water by about 0.1 units over the last 30 years. While 0.1 units sounds small, it corresponds to about a 30% increase in the hydrogen ion availability in ocean water.” (<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)

- In the Guardian, there was a recent report titled, “The terrifying phenomenon that is pushing species towards extinction.” “According to some scientists, mass mortality events (MMEs) are on the rise and likely to become more common because of climate change. What can be said with confidence is that the sorts of extreme weather events linked to MMEs – such as the temperature and humidity rise that nearly wiped out the saiga [deer] – will become more frequent. ‘Evolution takes millions of years and if we have a shift in environmental conditions, everything that’s evolved in that particular environment is under different pressures. Microbes adapt and can respond to changes quickly, but mammals take hundreds of thousands of years or millions of years to adapt. That’s the real worry.’”  
(<https://www.theguardian.com/environment/2018/feb/25/mass-mortality-events-animal-conservation-climate-change>)
- “The key points presented above are just a small fraction of the vast body of evidence that support the scientific conclusions on global warming accepted by all the scientific Academies and by all the governments around the world. Science has established that it is virtually certain that increases of atmospheric CO<sub>2</sub> due to burning of fossil fuels will cause climate change that will have substantial adverse impacts on humanity and on natural systems. Therefore, immediate stringent measures to suppress the burning of fossil fuels are both justified and necessary.”  
(<https://thebestschools.org/special/karoly-happer-dialogue-global-warming/karoly-major-statement/>)