Climate Science: Debunking Some Prevalent Myths

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For years, oil companies and special interest groups have financed campaigns to make the general public doubt the reality and seriousness of climate change, funneling money into conservative non-profits, think tanks, politicians, and climate-denial front groups. With the support of Big Oil companies and their allies, a small but vocal group of climate deniers has currently become influential, and climbed the political ladder all the way to the executive power (The Climate Reality Project, 2015). A few well-funded voices managed to mislead – or at least confuse – millions and block progress on one of the most important issues of our time. It is important to investigate how deniers have been good at cherry-picking facts and misrepresenting data to tell a story with some of the most important points conveniently left out (The Climate Reality Project, 2015). In this paper, some of their strategies are explained in order to debunk some myths and get back to the main mission of our time: to spread truth and implement climate change solutions.

The facts are clear when considering that 97 percent of climate scientists agree that human-made climate change is real and affecting us now. There is ample evidence to show current climate change is happening, and that it is not part of Earth's regular climate fluctuations. For example, as summer Arctic sea ice coverage is lost due to increasing global temperatures, the ocean around the pole could absorb heat from the sun that normally would have been reflected by sea ice. In the winter, when the ocean around the pole refreezes, this excess heat would be released to the atmosphere, decreasing the temperature difference between the pole and the equator (Pierre-Louis, 2019). The Polar Vortex is now weak and more frequent southward dips of the polar air mass occur. For example, a dip caused colder than average temperatures across much of the US this past winter (Popovich & Pierre-Louis, 2019).

It is hard to believe that anyone could claim otherwise. However some deniers, for example atmospheric scientist Richard Lindzen, state that the increase in global mean temperature by a few degrees is not anthropogenic and can be explained by regular cycles of temperature variability (Lindzen, 2009). The study of Earth's climate variability trends reveal that, although climate change has occurred in the past without the presence of humans, Earth is now warming at a faster rate than ever before (Riebeek, 2010). Looking back at Earth's climate history, NASA discovered that Earth moved out of ice ages over the past million years, but global average temperature increased steadily from 4 to 7 degrees Celsius over 5,000 years. In contrast, over the last 100 years, the global temperature has increased by 0.7 Celsius, which is ten times faster than the average rate of global warming after an ice age. Based on climate models, it is predicted that Earth will warm from 2 to 6 degrees Celsius in the next 100 years, which is at least twenty times faster than the global warming that has happened at different times in the past 2,000,000 years (Riebeek, 2010).

For example, another widespread myth is that there is no correlation between CO2 and mean global temperature (Lindzen, 2009), which then leads to the wrong idea that climate projections greatly overestimate global warming. However, greenhouse gasses-- mainly CO_2, but also methane-- were involved in most of the climate changes in Earth's past (Keeling, 2012). When they were reduced, the global climate became colder. When they were increased, the global climate became warmer. When CO_2 levels jumped rapidly, the global warming that resulted was highly disruptive and sometimes caused mass extinctions (Knoll, Bambach, Payne, Pruss, & Fischer, 2007). Furthermore, humans today are emitting prodigious quantities of CO2, at a rate faster than even the most destructive climate changes in earth's past. Life flourished in the Eocene, the Cretaceous and other periods when the atmosphere had high levels of CO2 because the greenhouse gasses were in balance with the carbon sequestered by the oceans and the removal

of atmospheric carbon by weathering rocks. In these periods, living organisms, ocean chemistry, and atmospheric gasses had millions of years to adjust to those high CO2 concentrations (Hong & Lee, 2012). Earth scientists discovered that those fast shifts in temperature were caused by large and rapid greenhouse gas emissions, in the same way that humans are forcing climate change today (Riebeek, 2010). The abrupt global warming events were almost always highly destructive for life by causing mass extinctions at the end of the Permian, Triassic, and mid-Cambrian periods (Knoll et al., 2007). The symptoms from those events-- a large, rapid jump in global temperatures, rising sea levels, and ocean acidification-- are all happening today.

Some deniers claim that while major greenhouse gas H2O substantially warms the Earth, minor greenhouse gases such as CO2 have little effect. The 6-fold increase in hydrocarbon use since 1940 has had no noticeable effect on atmospheric temperature (Soon, Baliunas, Robinson, & Robinson, 1999), but current evidence supports CO2 is the most important greenhouse gas responsible for global warming. Gases in the atmosphere determine what we actually feel because they absorb the sun's energy and store it as heat, thus increasing global temperature. CO2 traps infrared heat that is trying to bounce back into space ("NASA Earth Obs.," 2013). This is concerning because carbon dioxide levels keep climbing rapidly. For example in 2004, 29 Lake Michigan's worth of emissions went into the atmosphere (NEAA, 2014).

Although natural causes of warming like solar radiation and volcanic eruptions have increased global temperature in the past, data analysis of climate patterns show how these natural emissions where balanced by natural earth processes (Svenson et al., 2004), but the introduction of anthropogenic CO2 is seen as anomalous temperature patterns. Thus, CO2 has a string effect in temperature and it has been observed by many different measurements ("NASA Earth Obs.," 2013). It was discovered that CO2 absorbs and re-emits longwave radiation (Tyndall, 2018). Also, the

theory of greenhouse gases predicts that if we increase the proportion of greenhouse gases, more warming will occur (Arrhenius, 1896). These basic scientific principles enabled scientists to measure the influence of CO2 on both incoming solar energy and outgoing long-wave radiation. Less longwave radiation is escaping to space at the specific wavelengths of greenhouse gases, and increased longwave radiation is measured at the surface of the Earth at the same wavelengths ("NASA Earth Obs.," 2013). Hence, there is an unequivocal correlation between carbon dioxide and global average temperature. Atmospheric composition going back a million years can be determined from bubbles in ice cores. Humans evolved with atmospheric carbon concentrations at 100ppm, and they are now 440ppm (Keeling, 2012).

Furthermore, statistics can be used to misrepresent data. A common climate denier tactic is focusing on a specific year in a data set, usually one that happens to be an outlier. A great example of this is the year 1998. Nineteen-ninety-eight was one of the hottest years on record thanks to an unusually strong El Niño. That means when a subset of climate data is pulled from 1998–2012 (as deniers often do), it is starting at a record high point. And when looking at the years that follow – years that vary naturally in temperature with some falling well below the 1998 peak – the upward trend in temperatures is not as visually obvious (The Climate Reality Project, 2015).

The ocean regulates the climate system the way hearts regulate the flow of blood throughout the human body. As the heart of the climate's circulatory system, the ocean maintains the earth's temperatures. Burning fossil fuels stresses the ocean, and damages its ability to keep the climate stable. As a result of this stress, the ocean pumps an inadequate amount of heat and moisture throughout the system which causes differential effects of climate change in various parts of the world. Also, scientist know sea level is not rising uniformly. The western North Atlantic sea level rises more rapidly because the land mass is sinking as the weight of glaciers in other areas is

removed, this called the Yoga Ball Effect (Yin, Griffies, & Stouffer, 2010). Gravity pulls water toward glacial mass, and as glaciers melt, water moves towards the northern hemisphere, resulting in 25% more sea level rise. Regional changes in circulation can also increase sea level locally. For example, when the gulf stream slows down, the water trapped in the middle of the currents spreads to coasts (Nicholls & Cazenave, 2010). Moreover, one to six feet of sea level rise are predicted to occur before the end of this century because heat causes oceans to expand, and melting ice adds water volume to the oceans.

In conclusion, human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems. Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen. Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years (IPCC, 2014). Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century.

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