Climate Change

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Human-induced climate change is a real phenomenon that impacts our planet's ecosystem resources, species diversity, weather patterns, oceans, etc. However, some argue that climate change is of natural means, not human-induced. Since the Industrial Revolution, an increase in the human population has been observed. With a rapidly growing human population, increased concentrations of greenhouse gases in the atmosphere, and warming oceans, it is clear that climate change is human induced.

The global climate change trend observed from the 1900s to the present day is attributed to the "greenhouse effect." This effect occurs due to an increase in gases such as methane and carbon dioxide that slow the loss of heat from Earth. Carbon dioxide in Earth's atmosphere has increased by 47% since the start of the Industrial Revolution due to various human activities such as deforestation, burning fossil fuels, and land-use changes. Methane as well has increased in Earth's atmosphere from human activities such as the decomposition of wastes in landfills, agriculture, and rice cultivation. These factors that contribute to the rise of carbon dioxide and methane in the atmosphere can be linked to the explosion of human population growth during the Industrial Revolution.

During the Industrial Revolution, there was a significant increase in the human population which has continued to grow exponentially. Each human has a unique carbon footprint which represents the number of greenhouse gases they produce from their lifestyle and activities. The increase of greenhouse gases in our atmosphere stems from the population of humans as well as each individual's carbon footprint. Figure 1 shows the correlation between a rapidly growing population and the atmospheric CO2 produced as a result of many more carbon footprints. For Earth to sustain the rapidly growing human population, the average carbon footprint for humans must be greatly reduced. Several solutions to minimizing our carbon footprint include using more eco-friendly forms of transportation (biking or walking), conserving water (shorter showers or avoiding unnecessary flushes to dispose of trash), or switching to a sustainable, clean source of energy (installation of solar panels or buying an electric car). The correlation between an increasing world population and rising carbon dioxide levels and undeniable (see Figure 1).

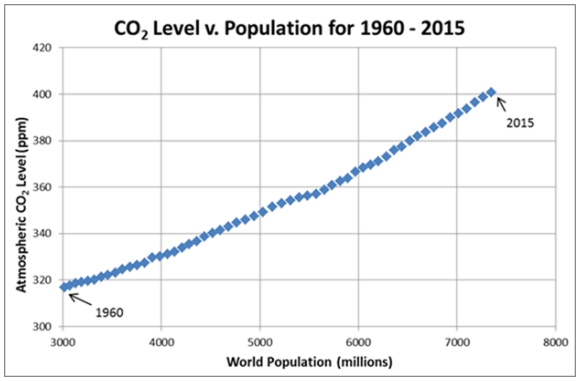

FIGURE 1: CO2 LEVEL V. POPULATION FOR 1960-2015

Climate change has devastated Earth's forests, habitats, ecosystems, and most importantly its oceans. Earth's oceans have endured the most damaging climate change effects including coral bleaching, fish migration, and ocean acidification. Earth utilizes the oceans' ability to absorb heat to minimize the increase of global temperatures from excess greenhouse gases. 90% of Earth's warming occurs in its oceans with an alarming rise of 0.17 degrees Celsius (0.3 degrees Fahrenheit) from 2000 to 2017. The

warming of oceans is prominent in its coral reefs as coral bleaching takes place expelling the algae in its tissue that provide 90% of the coral's energy. As a result, this process causes the shrinkage and starvation of the corals that thousands of marine species rely on. Fish migration is another significant effect of Earth's warming oceans as fish populations and species are drifting toward the poles disrupting fisheries. The most dangerous effect of warming oceans is the distressing increase of ocean acidification at a rate of 30 times the natural variation. When seawater absorbs carbon dioxide, it creates a series of chemical reactions that reduce the amount of carbonate in the oceans. Carbonate is essential for marine life to thrive such as plankton and coral as it helps form their shells and skeleton (without carbonate, their shells could dissolve). Coral and plankton are the building blocks for marine ecosystems making it imperative for a significant reduction of ocean acidification rates. Humans are pushing the limits of the oceans' capability to absorb heat leading to disastrous consequences that impact drastic changes throughout marine ecosystems, fisheries, and extreme weather patterns.

One of the most overlooked consequences of warming oceans is the drastic changes in weather patterns; one such example can be found in the increasing number of significant storms and hurricanes. The upward trend of annual hurricanes for the last 140 years can be attributed to the 0.8 degree Celsius rise in ocean temperatures since 1880 (see Figure 2A). The world has seen a sharp increase in tropical storms over the past century. These storms are fueled by warm, moist air, which is why they are most commonly found over warm ocean waters near the equator. These storms are known by many names, from hurricanes to cyclones, and they are reputably the most violent storms on the planet that can produce winds up to 372 km/h. The correlation between changing ocean temperatures and the frequency of hurricanes is captured in Figure 2.

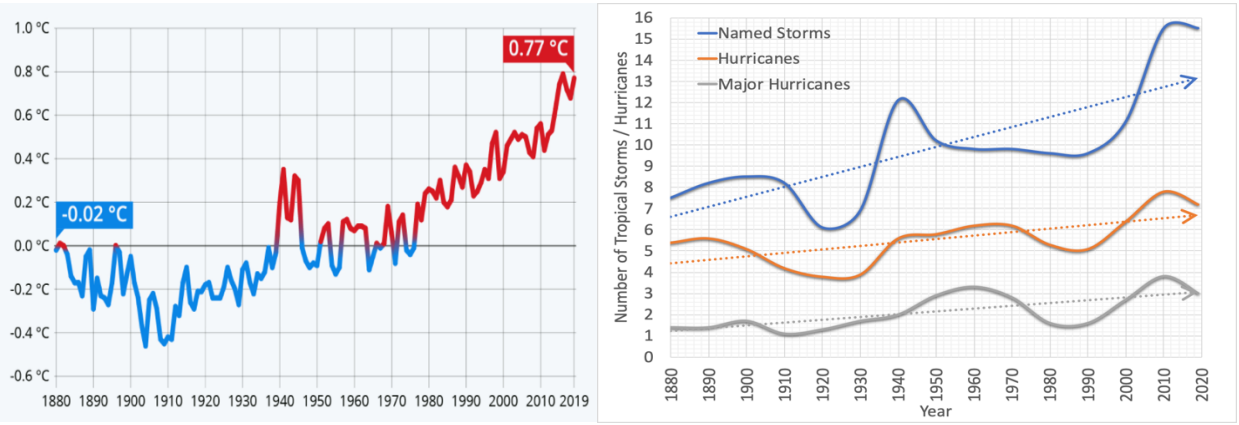

FIGURE 2: A): AVERAGE GLOBAL SEA SURFACE TEMPERATURES, 1880-2015 (LEFT); B): TROPICAL STORMS AND HURRICANE DATA, 1880-2019 (RIGHT)

From 1880-1940, the ocean temperatures decreased by almost half a degree Celsius leading to a decline in hurricanes and tropical storms. From 1940 to the present, the ocean temperature has consistently risen decade after decade leading to over twice as many tropical storms in the last 80 years. This proves that warmer ocean water leads to more significant storms. Figure 3 shows a heatmap of the world's oceans since 1901 as parts of them warmed as much as two and a half degrees Celsius. Most of the Atlantic Ocean has experienced over a one-and-a-half-degree Celsius change explaining North and Central America's largest spike in hurricane activity since the earliest tropical storm data in 1880. The change in sea surface temperatures observed by Figure 3 shows a statistically significant trend that indicates which areas are

more prone to increased hurricane activity. Extreme weather patterns partake in a cause-and-effect relationship with Earth's ocean temperatures and shows how important the protection of our oceans is to maintain a stable planet.

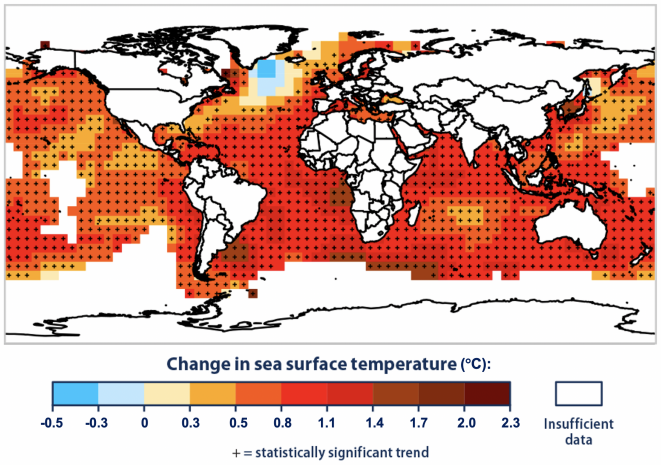

FIGURE 3: CHANGE IN SEA SURFACE TEMPERATURE, 1901-2015

If humans wish to prevent the irreversible effects of rising ocean temperatures and greenhouse gas emissions, they must reduce their climate change impact. Governments can help by investing in science and research to more effectively battle climate change. With investments in science-based companies and grant funded research, new technology can be developed that will better monitor the atmosphere and oceans. These technological advancements will provide more accurate data for appropriate mitigation plans aiming to reduce greenhouse gasses and the upward trend of ocean temperatures.

The Intergovernmental Panel on Climate Change (IPCC) consisting of 1,300 scientists from countries all around the world concluded that there's a 95% chance that humans are responsible for climate change. In the last 150 years, humans raised carbon dioxide levels from 280 to 414 parts per million (reaching the highest atmospheric level for carbon dioxide in the last 800,000 years). When analyzing Figure 4, it is evident that the largest contributor to climate change is the human produced greenhouse gases that impacts our planet's ecosystem resources, species diversity, weather patterns, and oceans.

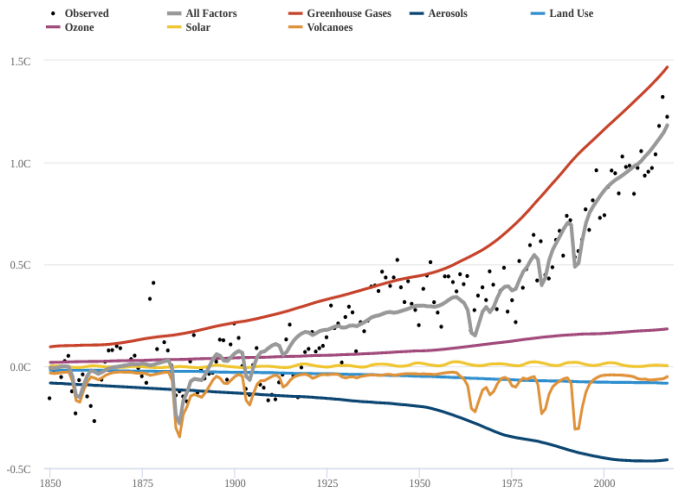

FIGURE 4: FACTORS OF CLIMATE CHANGE, 1850-2019

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