Summary of the Nobel Peace Prize Winning Report on Climate Change

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Imagine what life would be like if our summers were ten degrees Fahrenheit warmer or if our sea levels were two feet higher. Or imagine bizarre storm phenomena such as torrential rainfalls in one city with severe droughts in cities nearby. Such harsh climate conditions are becoming more likely because of atmospheric pollution amplified by human activity.

In December 2008, my Advanced Technical Writing professor, Dr. Reneta Lansiquot, informed me of a climate change research project. I was intrigued with the opportunity so I met with Dr. Reginald Blake, professor of physics and a lead researcher for the climate change project. He informed me that he needed a research assistant for the project and it would last about a year. The project is being worked on by researchers from NASA and Columbia University. Eager to work on a project of this caliber, I accepted the opportunity and attended my first meeting at the Columbia University campus in mid-December. Some of the astonishing facts that were discussed at the meeting include: the eight hottest years ever documented have all occurred since 1998, the average Arctic winter temperature has already increased by eleven degrees Fahrenheit, the northern polar ice cap has decreased in thickness by 6% over the past 40 years, and the world rice crop falls 10% for each degree of warming.

Before I became involved in this research project, I viewed the issue of global climate change very nonchalantly. I am a full-time college student with the benefit of living in America. Like most Americans, I was fooled by the common misconception that we can always attain what we desire. By working on the research project and becoming more informed about climate change, I realized that this problem has serious implications that affect every individual on this planet.

Climate Change: 2007 is a profound body of research that has immensely contributed to my knowledge of the subject. Published in 2007, it is the Fourth Assessment Report published by the Intergovernmental Panel on Climate Change (IPCC). The IPCC is a global committee that has published three previous assessment reports released in 1990, 1995 and 2005, analyzing climate change caused by human activity. Because of this publication, *Climate Change: 2007*, this distinguished panel, the IPCC, shared the 2007 Nobel Peace Prize with former U.S. Vice President Al Gore. The Fourth Assessment Report was a collaborative effort by more than 2,500 scientific expert reviewers and 1,500 authors from over 130 countries worldwide. It consists of four volumes: 1) The Physical Science Basis 2) Impacts, Adaptation and Vulnerability 3) Mitigation of Climate Change

and 4) The Synthesis Report. My paper presents a summary of *Climate Change: 2007,* the IPCC's Fourth Assessment Report, in order for us to examine our planet's previous and current climate changes and attribute their causes to either natural processes or human activity. My summary includes the Report's evaluation of the effect our current climate change has had on physical and biological structures, and its presentation of future climate change projections.

The Problem

Climate change has huge implications and consequences for my generation. As Americans, we have the benefit of going to the supermarket and purchasing virtually anything we want; the term *shortage* has little or no meaning to many of us. However, recent increases in temperature and precipitation as a result of human activity could eventually limit our food supply. Higher temperatures increase soil evaporation rates and the chances of severe droughts. Increased precipitation leads to soil erosion and an increase in soil moisture, both of which are critical for crop yields. Our government would have to allocate funds from the budget to help cope with such agricultural turmoil. Money will have to be spent on technology that will aid crop management from season to season in order to cope with climate change. This aspect of climate change in America would greatly alter our daily lives.

The term *climate change* is often used interchangeably with the term *global warming*. Scientists prefer to use the term *climate change* because it suggests that other factors besides increasing temperatures are associated with our planet's current state. *Climate change* refers to any significant change in measurement of temperature, precipitation, wind, or sea level lasting for an extended period of time. The Earth's climate has changed many times during our planet's history, with events ranging from ice ages to long periods of warmth. Historically, such natural events as volcanic eruptions, changes in the Earth's orbit, and the amount of energy released from the sun have affected the Earth's climate. However, beginning late in the 18th century, human activities associated with the Industrial Revolution have drastically changed the composition of the atmosphere and are largely responsible for the global climate change we are currently experiencing. Advancement in technology during this era yielded machinery and factories that dramatically increased the emissions of harmful pollutants into our atmosphere. Since we have not taken any measures to better the situation, we are, therefore, experiencing a considerable change in our climate.

Causes of Previous Climate Changes

There are many approaches that can be used when analyzing the vast topic of climate change. Perhaps the most logical approach would be to examine the immense amount of information regarding this topic using a chronological structure. This technique will also reveal correlations between climate change and past global events in an effort to identify human contributions to this problem and

the steps that need to be taken in order to improve the situation. During the past 2,000 years, scientists have identified three time periods that exhibited climate changes that were contrary to the norm: the Medieval Climate Anomaly, the Little Ice Age, and the Industrial Era.

The Medieval Climate Anomaly, also referred to as the Medieval Warm Period or the Medieval Climate Optimum, existed between 900 and 1300 A.D. Evidence suggests that Europe, Greenland, and Asia experienced significant increases in temperature. Some 200 years later, the Little Ice Age, occurring between 1500 and 1850 A.D., cooled temperatures a bit. Pack ice, ice that floats on the surface of Arctic waters, began advancing southwards in the North Atlantic. Together, the Medieval Climate Anomaly and the Little Ice Age represent the two most drastic changes in natural climate variability, suggesting that the climate changes that existed within these two periods were caused by the Earth's natural forces, unlike those changes that occurred during the Industrial Era, which was caused by human development.

Scientists have been able to piece together pictures of the Earth's climate during the Medieval Climate Anomaly and the Little Ice Age by analyzing ice cores, boreholes, tree rings, glacier lengths, pollen remains, and ocean sediments, and by studying changes in the Earth's orbital path. They have developed knowledgeable explanations of what may have caused these extreme climate changes during these two time periods. First of all, changes in the shape of the Earth's orbit, or eccentricity, as well as its tilt and precession, the slow torque of the Earth, affect the amount of sunlight that can be received by the Earth's surface. These three important orbital processes of the Earth operate in cycles and are predicted to be the most important factors in causing ice ages. Another explanation for the climate changes during the Medieval Climate Anomaly and the Little Ice Age is the change in the sun's heat intensity. These changes occur inside the sun and can affect the intensity of sunlight that reaches the Earth's surface. The varying sunlight intensity can cause either warming or cooling on the Earth's surface.

Furthermore, volcanic eruptions may have affected climate during these two periods because volcanoes emit aerosols and carbon dioxide into the atmosphere. Aerosols that are emitted from volcanoes block sunlight, thereby allowing the Earth's surface to cool down temporarily. Carbon dioxide (CO_2) is a greenhouse gas that warms the Earth's surface. It is theorized that volcanic eruptions may have elevated CO_2 concentrations in the atmosphere, thus trapping terrestrial radiation and increasing surface temperatures. However, in comparison to the previous volcanic eruptions that released CO_2 into the atmosphere and may have increased temperature, human activities now emit 130 times as much CO_2. Finally, changes in ocean currents may have contributed to the climate changes that occurred during the Medieval Climate Anomaly and the Little Ice Age. The heating or cooling of the Earth's surface can cause changes in ocean currents. Because ocean currents play a significant role in distributing heat around the Earth, changes in these currents can bring about significant changes in climate from region to region. When analyzing the causes of the climate changes during the

Medieval Climate Anomaly and the Little Ice Age, the most significant aspect is that they were all attributed to the Earth's natural functions and not human activity.

The Industrial Revolution began around 1750 and was characterized by major changes in agriculture, manufacturing, production and transportation. Everyday life transitioned from a manual-labor-based economy to machine-based manufacturing. It began with the mechanization of the textile industries, the development of iron-making techniques, and the increased use of refined coal. Steam-powered machines were fueled primarily by coal. In the late 1800s and early 1900s, technology spurred the economy with the development of steam-powered ships, railways, and internal combustion engines. Unfortunately, effortless labor and economic boom came with a price.

Current Climate Change Causes and Consequences

Human activities have substantially added to the amount of heat-trapping greenhouse gases in the atmosphere. The greenhouse gases that most commonly enter the Earth's atmosphere as a result of human activities are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinate gases. Carbon dioxide enters the atmosphere through burning of such fossil fuels as oil, natural gas, and coal, as well as from solid waste and trees. Carbon dioxide can be removed from the atmosphere when it is absorbed by plants. However, this biological process is limited due to deforestation by human population. Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and from the decay of organic waste in municipal solid waste landfills. In addition, nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Finally, fluorinated gases, which are powerful greenhouse gases, are emitted from a variety of industrial processes. Burning fossil fuels has also resulted in emissions of aerosols. The addition of greenhouse gases and aerosols has changed the composition of the atmosphere, and these changes in the atmosphere have significantly influenced temperature, precipitation, and sea level.

Temperature changes have been recorded from the Earth's surface all the way through the stratosphere, which extends from 9 to 14 miles above the Earth's surface. From my current involvement in the climate-change research project, I have learned the best scientific approach for analyzing data is to look for common trends and then proceed to determine their causes. Since about 1850, scientists have been keeping somewhat consistent temperature records reported by land stations and ships. Average temperatures in the Arctic have increased at almost twice the normal rate within the past 100 years. Widespread reductions in the number of days below freezing occurred during the latter half of the 20th century in the U.S. as well as in most land areas of the world. The eight warmest years on record have all occurred since 1998, with the warmest year being 2005. Another alarming fact is that land areas have tended to warm faster than ocean areas and the winter months have warmed faster than summer months.

Increasing temperatures tend to increase evaporation, leading to more precipitation. The common trend observed by scientists is as follows: as average global temperatures have risen, average global precipitation has also increased. The number of heavy precipitation events over various regions has also increased during the past century. Precipitation has become significantly greater in the eastern parts of North and South America, northern Europe, and northern and central Asia. Also, changes in precipitation and evaporation over the oceans are inferred from the freshening of mid- and high-latitude waters.

Moreover, tide gauge measurements and satellite altimetry suggest that the sea level has risen worldwide by approximately 4.8 to 8.8 inches during the last century, and a significant amount of that sea level increase is probably attributable to the observed warming of the atmosphere and the oceans. The primary factors contributing to the worldwide sea level rise include the expansion of ocean water caused by warmer ocean temperatures and the melting of mountain glaciers and small ice caps. Human activities that may contribute to a rise in sea level include pumping ground water for commercial use, impoundment in reservoirs, wetland drainage, and deforestation.

Projections for the Future

This information regarding the Earth's recent temperature increase and precipitation and sea level changes may seem disturbing. However, conditions may become even more disastrous when we consider the future scientific projections of the Earth. Greenhouse gases that are released into the atmosphere will increase dramatically if we continue at our current pace. These increases will cause further severe changes in our planet's temperature, precipitation, and sea level. In order to develop accurate models of the Earth's future in terms of these factors, scientists take into account such issues as global population, living standards, energy use, and technological advancements.

According to future projections, emissions of global greenhouse gases, excluding CO_2, are expected to increase by 44% by the year 2020. Global emissions of CO_2 are projected to increase about 74% by 2030 and 158% by 2100 as a direct cause of human activity. When developing future temperature projections, scientists consider the reactivity between the Earth's atmosphere and greenhouse gas emissions. Every action produces a reaction. For example, increasing greenhouse gas emissions will lead to an increase in temperature. Increasing temperature will cause melting of ice caps, which, in turn, will cause a rise in sea level. Unfortunately, this cycle continues and expands exponentially. One possible repercussion of melting ice caps is a further increase in temperature. This phenomenon occurs because ice caps reflect sunlight, thereby helping to decrease the surface temperature of the Earth. If ice caps are melted away, then the temperature on the Earth's surface will increase dramatically.

As a result of future projected temperature increases, precipitation around the globe will also continue to increase due to changes in atmospheric circulation and increases in evaporation and water vapor. Projected future models of the Earth

suggest an increase in the intensity of precipitation events, especially in tropical and high-latitude regions. Events such as the Atlantic hurricane season of 2005, which set a record with twenty-seven named storms, may occur more frequently in the future. The annual average precipitation is projected to increase over most of northern Europe, the Arctic, Canada, the northeastern United States, tropical and eastern Africa, the northern Pacific, and Antarctica, as well as in northern Asia and the Tibetan Plateau. Due to the projected steady increase in precipitation over these regions, the earth's atmosphere would be forced to evaporate more moisture from the surface than usual. This increased evaporation will cause annual average precipitation to decrease in such regions as the Mediterranean, northern Africa, Central America, the American Southwest, and the southern Andes, as well as southwestern Australia.

Future projections regarding a rise in sea level can be directly attributed to increasing global temperatures. Mountain glaciers and ice caps will continue to melt, increasing sea level. The coastal regions of Greenland and Antarctic will gradually be melted or slide into the ocean. As the snow melts, it will increase the sea level. If temperatures continue to increase at the current rate, it is estimated that the global average sea level will rise by 7.2 to 23.6 inches by 2100. Other factors that contribute to a rise in sea level are changes in wind patterns, atmospheric pressure, and ocean currents.

Significant changes in temperature, precipitation, and sea level have been observed since the beginning of the Industrial Era. As a result of evaluating possible causes of two other climate changes within the past 2,000 years (Medieval Climate Anomaly and the Little Ice Age), the conclusion is evident that human activity is largely responsible for climate changes that have occurred since the Industrial Era. After analyzing these recent climate changes, scientists have developed various models to project the Earth's future state if we continue to damage our planet at the rate at which we are going. These future projections are quite alarming, considering the intensity of the changes and the short time span in which they will occur. Because we have contributed a great deal to the Earth's recent climate change, it is in our best interest to start altering our daily living routines now in order to protect ourselves and future generations.

Simple steps performed routinely can make a huge difference for the future. Frankly, we cannot afford to continue our pattern of emitting greenhouse gas while expecting no consequences. Stemming climate change is a global issue, and it will only succeed if everyone is on board. Although the rates of climate change since the beginning of the Industrial Era may be alarming, it is even more horrific to consider the future projections if the concentration of greenhouse gas emissions continues to increase at its current rate. Future generations deserve a planet on which they can exist comfortably without having to worry about unexpected climate disasters caused by the reckless lifestyle of their ancestors.

Reference

IPCC. (2007). *Climate Change 2007*: The Fourth Assessment Report. http://www.ipcc.ch/

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Cite as: Jaipaul, R. (2009). Summary of the Nobel Peace Prize winning report on climate change. *City Tech Writer, 4,* 20-26. Online at https://openlab.citytech.cuny.edu/city-tech-writer-sampler/