

Geography 3991
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Assignment 1: Critical Reflections and Essay
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Section A: Critical Reflections

Topic 1: Introduction to the Science of Climate Change

Reviewing the articles on the science of climate change was an excellent opportunity for me to recall material that I had learned in my historical geology course. While the course covered many other aspects of our planet's history, it reminded me of how long our natural resources have existed, and how quickly we are depleting them! I found that the data and facts contained within this first topic provided details to support any questions I had regarding the particulars of anthropogenic global warming and climate change.

Before taking this course, I considered myself reasonably well-informed on the impacts of climate change but thinking more about the socio-economic aspects has prompted me to think more critically about the topic. I agree that the concept of global warming is not new and viewing the data graphs and observing a potential future disaster is most alarming. I am especially concerned about the effects that a rising CO₂ level has on our oceans, which is something that I had not previously researched in detail. I had done an assignment on feedback loops and had been applying this understanding to the concepts in this course, especially the CO₂ content in the oceans as

I read through *Climate Change. Evidence, Impacts, and Choices*, I was especially interested in the facts from the carbon dioxide fingerprint regarding the presence of the carbon-14 isotope, which is proof that human activity is the leading cause of greenhouse gas emissions. Furthermore, I live in 100 Mile House BC, an area where deforestation and agriculture have a particular impact on climate change.

I also took a particular interest in the section that indicates our current warming trend is not solar-induced. When I was a child, the media of the time often reported "the sun is stronger than it used to be" without giving any real explanation. I remember thinking, incorrectly, that the sun was the culprit in climate change. Moreover, the information in this topic has encouraged me to think on more of a global scale, and how local sustainability issues perform on a planet-wide system. I find myself studying the graphs presented in the readings to see how much the climate data had changed, even from when I was in elementary school.

Reflecting on the Topic One overviews of the science of climate change has served as a reminder of how fact is being used to project future changes to our climate. I have studied many of the Geological aspects of our planet, so learning about how humans are impacting these ecosystems stresses the importance to be of preserving our world and sustaining the environment to the best of our ability.

Topic 2: Tipping Points and Abrupt Climate Change

When considering the formation of our Earth and the massive time that is covered by the Geological Time Scale, tipping points and abrupt change are especially interesting. This topic surfaced in my thoughts many times as I researched articles on Climate Science Skeptics. Many of them do not seem to worry about a "tipping point" because they are uncertain about when it may occur. We should still be concerned about an event that may be uncertain. Our global environment depends on our concern.

Watching the video about the Thwaites Glacier and the Western Antarctic Ice Sheet was especially informative. We are in a time of "steady changes" and do not know when an abrupt change may occur. I have observed the marked retreat line of the glacier at the Columbia Ice Field and visited Berg Lake in Mt. Robson Provincial Park. The vastness of these landscapes makes me realize how extreme an effect would be should the West Antarctic Ice sheet collapse into the ocean. Knowing the mechanics of glacial flow helps to understand how human activated global warming can cause such extreme damage. I already realized the composition and formation of glaciers, but now appreciate how monitoring glacial movement and creating simulation models is so valuable to understanding the effects of constant change, abrupt change, and potential tipping points.

Reading about *The Abrupt Change Early Warning System in Abrupt impacts of climate change: Anticipating Surprises* encouraged me to think critically about the fact that

even though some climate changes may be inevitable, anticipating abrupt change is imperative to reducing possible consequences of a global catastrophic event. Studying the details about a geologic structure like a glacier, and how far it has advanced or retreated is one level, but thinking about the potential impact of a glacial collapse like the Western Antarctic Ice Sheet is essential in creating early warning systems for abrupt climate change. Glacial activity is an example of where physical science must interact with stakeholders of social and economic components to address climate change on a global level.

This particular topic alerted me to the importance of how science and social engagement must interact to create environmental sustainability. We can only create a climate change warning system if all stakeholders can collaborate. To do this, we need to study and understand how human and climate systems affect each other. Climate change is not a topic to be ignored by those skeptics who do not think into the future of our local and global environment.

Topic 3: Science and the Climate Change Debate

I have been reading and listening to debates regarding Science and Climate change throughout my life but am now paying closer attention to the potential solutions for “decarbonizing the global economy” (Reusswig 2013). I have always accepted the fact that humans contribute to global warming by burning fossil fuels, but as a youth often pondered if it was as dangerous as the news was announcing. How quickly to we need to deal with a solution? I now fully understand that the answer is: immediately! It

is easy to be deceived by the media. The reading from this topic and the research into climate change skeptics taught me to be extremely mindful of my sources regarding global warming and science.

In the article by Fritz Reusswig, he argues that a scientific agreement on climate change will be less relevant in the future. He states that the issue of climate change is political, yet many climate scientists are apolitical. He thinks that because the question of the existence of climate change has become definitive, the consensus will shift from accepting the fact to agreeing upon action to be taken for a solution. I agree with this! However, I also think that scientists will need to continue with data collection and analysis to remain up to date with any changing statistical facts regarding the status of climate change statistics. Climate change is just that, change. There will be no single final solution, as the circumstances are continually changing! I found that this article made me delve into the concept of an evolving planet, and how great our responsibility is to sustain our environment.

I also became more aware of the skeptic view on climate change, and how an economical, or political motivation can falsely report scientific facts. The previous article by Reusswig states that formerly valuable assets like coal, oil, and natural gas have transformed from “private goods to public bads” (Reusswig 2013). I feel that this statement is point-on as to the reason for climate change skepticism. The public needs to do proper research to make sure that they obtain a realistic and accurate understanding of the science of climate change. We need all sides of the story! This topic has motivated me to become more aware, and to challenge any skeptical views toward anthropogenic climate change.

In conclusion for this topic, I would like to emphasize how important it is to understand articles on climate change and to challenge any views that do not seem to take all considerations into account. We need to study the science of climate change with a critical thought process and not allow uninformed opinions to skew the facts regarding how we need to preserve our global ecosystems.

Section B: Essay

Why do you (or do not) think that climate change caused by anthropogenic sources is occurring?

Anthropogenic Accountability

Climate change due to anthropogenic sources, to me, is indisputable. Scientists have been taking measurements since about 1880 and have proved that the Earth has warmed by more than 0.8 degrees Celsius in the past one hundred years, with most of that change in the last thirty-five years. How can we be sure that these causes are not from natural cycles like the sun? Continued analysis of data has measured the increasing levels of carbon dioxide, methane, nitrous oxide, and water vapour in our atmosphere. They have measured carbon dioxide levels in our oceans. Yes, the greenhouse gases occur naturally in the Earth's atmosphere, but their dramatic increase since humans began burning oil, natural gas, and coal for energy, practicing

deforestation by burning trees, and increased livestock farming, provides evidence that humans are the cause for our current state of climate change.

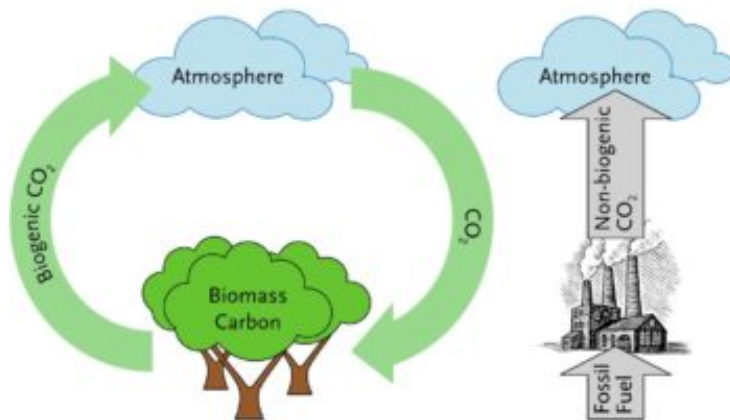
The measurements of atmospheric and oceanic CO₂ are the main focus of proof for anthropogenic global warming. The Industrial Revolution marked the commencement of the rise in CO₂ levels. Scientists have studied the composition of ice-trapped air bubbles from Greenland and Antarctica. Carbon dioxide levels had remained relatively constant before the 1800s and then began to rise quickly. Today, they are approximately 40% higher than before the Industrial Revolution. The ice-core air bubble data also indicates that the levels are the highest they have been in the past 800,000 years! Data shows that the concentration of CO₂ in the atmosphere has risen from "approximately 280 parts per million (ppm) to today's 400 ppm" (UCS, 2017). The information provided by these sources is credible evidence that human interaction is responsible for increased greenhouse gas emissions.

Meteorologists and Oceanographers observe data and use models of the Earth's atmosphere and ocean to identify "human fingerprints" connected with CO₂ level changes, which allows them to "attribute the proportion of those changes to human activities" (UCS, 2017). Scientists agree that the extraction and burning of coal, oil, gas, and forests is a major cause of global warming. "In 2013, the Mauna Loa Observatory in Hawaii recorded carbon dioxide levels over 400ppm. In March 2015 global averages reached this threshold, and in September 2016, the world reached a point of no return: CO₂ levels are unlikely to dip below 400ppm again" (UCS 2017).

What about the natural causes of global warming? Do they not contribute to the problem of climate change? It is correct that natural forcing agents or "climate drivers" (UCS 2017) also affect our climate. Some of these include orbital changes explained by the Milankovitch Theory (three cyclical changes in Earth's orbit: eccentricity, obliquity, and tilt), volcanic eruptions emitting aerosols into the atmosphere, variation in solar radiation, and movement of Earth's crustal plates (CSI). However, these natural forcing agents cause minimal warming compared to the anthropogenic forcing agents. For example, solar output readings have been available since the late 1970s. Satellite records indicate that the "Sun's output has not shown a net increase in the past 30 years and thus cannot be responsible for warming during that period" (NAS 2012). Other evidence against solar-induced global warming is weather balloons and satellites. Data from these sources have been analyzed and reports a warming trend in the lower atmosphere (troposphere) and cooling in the stratosphere (upper layer). This pattern is indicative of warming from greenhouse gases because they trap energy near to the Earth's surface. If the Sun were responsible, there would be a more even warming trend among the atmospheric layers (NAS 2012).

The carbon dioxide fingerprint gives further evidence that global warming is human-caused. The most dominant source is the fact that fossil carbon is accumulating in the atmosphere. Scientists know that it is fossil carbon from the burning of fossil fuels because the two types of carbon have different chemical properties. Biocarbon is found in the Earth's biological systems, while fossil carbon exists in fossil fuels. Fossil carbon contains little of the radioisotope carbon-14, and the carbon-14 levels in our

atmosphere are deficient. Therefore, the source of carbon in our atmosphere is from the anthropogenic burning of fossil fuels.



"...burning fossil fuels releases carbon that has been locked up in the ground for millions of years while burning biomass emits carbon that is part of the biogenic carbon cycle" (IEA 2019).

Burning fossil fuels and clearing land upsets the carbon cycle. Deforestation removes plant growth that contained stored carbon in their wood, stems, and leaves, represent biomass carbon. Clearing a forest removes the trees and plants that would extract carbon dioxide from the atmosphere. When forest land exchanges for agricultural farmland like crops and pasture, it stores less biomass carbon. Moreover, carbon releases into the atmosphere from the now exposed soil.

After researching the facts on climate change, and how the data points directly to anthropogenic sources, it is evident to me that humans are the primary cause of current global warming issues. By comparing the sources of biomass carbon and fossil carbon I am confident that the problems with greenhouse gas emissions began with human actions during the time of the Industrial Revolution. Furthermore, global data regarding CO₂ emissions well supports this argument. We are part of the carbon cycle, and decisions regarding controlling our impact will affect this cycle. If the carbon cycle continues to change, it will, in return, impact us. Continuing to study anthropogenic climate change is essential to understanding and monitoring how the carbon cycle will operate into the future.

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