Scientific Community Debates on Causes and Consequences of Global Warming: Review

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Abstract: *Global warming is a most burning topic gained the attention of many social thinkers such as scientists, policy makers, environmentalists, researchers and student worldwide. It is the increase of the average temperature on the Earth. The root cause for the increase of the temperature is global warming. As the Earth is getting warmer, disasters like hurricanes, disease and injury of heat waves, droughts, storms and floods are getting more frequent. Over the last 100 years, the average air temperature near the Earth's surface has risen by a little less than 1^0C. The causes and consequences of global warming on the Earth`s environment have been reviewed in the present study. The controversy between scientists on the causes of global warming may be natural or may be caused by human interference. The natural causes were atmospheric carbon dioxide (CO_2), Volcanic Eruptions, the dynamic system of the Earth, Sun, and Cosmos. Human activities have been emitting extra greenhouse gases, which were mostly resulted from burning of fossil fuels (like coal, oil and gas). Urbanization and associated human activities like industrialization and use of cars, deforestations and land use changes and etc. have been identified as human-induced causes of global warming. About 97% of climate experts believed that human-activities are the major causes of global warming. Generally, global warming is affecting rainfall, shrinking of the ice sheets, increasing average temperature, affecting plants and animals, rising sea level and shifting seasons.*

Keywords: Atmosphere, Carbon dioxide, Fossil fuels, Greenhouse gases, Increase temperature

1. Introduction

Currently, there are growing concerns about global warming and its impacts on people and the ecosystems on which they are depended. Global warming, which is the increment of the average temperature on globe (Smitha, 2011). According to Smitha (2011), the average air temperature near the Earth's surface has risen by a little less than one degree Celsius over the last 100 years where global warming is the cause while climate changes are its immediate effect. Climate change refers to any significant long-term changes in the expected patterns of the average weather of a given region or the whole Earth over a significant period of time. It is about non-normal variation to the climate, and the effects of these variations on other parts of the Earth. The long term changes may take tens, hundreds or perhaps millions of years. The word "weather'' points out to the short term (daily) changes in temperature, wind, and/or precipitation of an arena (Merritts *et al*.,1998). Experts often prefer to speak about climate change rather than global warming, as a result of higher global temperatures doesn't necessarily mean that it will be warmer at any given time at every place on globe (Smitha, 2011). Warming is strongest at the Earth's Poles, the Arctic and the Antarctic, and will continue to be so (Smitha, 2011). Melting ice is the most visible impact of the warming climate. Due to the thermal expansion of the ocean, sea levels are rising; in addition to melting of land ice. Changes in temperature and precipitation patterns increase the frequency, duration, and intensity of other extreme weather events, such as floods, droughts, heat waves, and tornadoes (Trenberth, 2005). Other effects of global warming include lower agricultural yields (Regmi, 2007), further glacial retreat, reduced summer stream flows, species extinctions (Paudel, 2012).

Global warming is one of the current most popular and controversial topics among scientists and other stakeholders. The controversy involved almost every aspects of global warming, including its causes, consequences and even whether the global

warming has really happened. The objective of this paper is therefore to review the causes and consequences of global warming on Earth`s environment which are currently discussed by different scientists and organizations who are working in this respect.

2. Scenario of Global Warming

The continuous rise in temperature of the planet is really upsetting. The root cause for this is global warming. Global warming begins when sunlight reaches the Earth. The clouds, atmospheric particles, reflective ground surfaces and surface of oceans then sends back about 30 % of sunlight back into the space, whilst the remaining is absorbed by oceans, air and land (Shahzad, 2015). This consequently heats up the surface of the planet and atmosphere, making life feasible. As the Earth warms up, this solar energy is radiated by thermal radiation and infrared rays, propagating directly out to space thereby cooling the Earth. However, some of the outgoing radiation is re-absorbed by carbon dioxide, water vapors, ozone ground level, methane and other gases in the atmosphere and is radiated back to the surface of Earth.

These gases are commonly known as greenhouse gases due to their heat-trapping capacity. The concentration of greenhouse gases in the atmosphere was artificially increased by humankind at an alarming rate since the past two centuries (Shahzad, 2015). This is due to burning of fossil fuels which increase the amount of greenhouse gases (carbon dioxide, methane and oxides of nitrogen) present in the atmosphere.

There are many greenhouse gases which are mainly emitted by human activity (Guggenheim, 2006). The first and foremost in the list is carbon dioxide. Excessive burning of fossil fuels like coal and oil is the major factor for producing this gas. Moreover, deforestation i.e. removal of trees for acquiring lands also causes large amount of carbon dioxide in the atmosphere. Living plants store carbon dioxide. When those plants die and decay, carbon dioxide is released back into the atmosphere. As forests and grasslands are cleared for your use, enormous amounts of stored carbon enter the atmosphere. Cement manufacture also contributes carbon dioxide to atmosphere when calcium carbonate is heated generating lime and carbon dioxide.

The second culprit gas is methane, commonly known as natural gas. It is produced as a result of agricultural activities such as livestock digestion, paddy rice farming and use of manure. Methane is also produced due to improper management of waste. Nitrous oxides are generated mainly by fertilizers. Moreover, fluorinated gases such as chlorofluorocarbons (CFCs) are chiefly a result of various industrial processes and refrigeration (Shahzad, 2015)

3. Causes of Global Warming

There are literally thousands of scientists who are working on the causes of global warming around the world. However, no one can really prognoses what will be the climate looks like in the coming 50 or 100 years' time (Goel and Bhatt, 2012). Generally, there are real uncertainties among the scientists that rapid climate change will have dramatic impacts on life on earth. Over the last 10,000 years, the earth has experienced a very stable climate and life has adapted to it (Goel and Bhatt, 2012). Recently, however, the earth has experienced an overall increase in temperature changes and many scientists now believe that there is a direct link between this warming and the causes of the warming.

Although the cause of global warming is the controversial, various scientists summarized in to two main categories which are natural or may be caused by human interference (Goel and Bhatt, 2012).

3.1. Natural causes of climate change

According to Endersbee (2008), climate change is a characteristic feature of the dynamic system of the Earth, Sun, and Cosmos. The major driving forces causing climatic variations on Earth are the variations in the full spectrum of radiation of the Sun, the variations in the orbit of the Earth around the Sun, the varying gravitational influence of the larger planets on the Sun, and the influences of cosmic radiation on both the Sun and the Earth. According to Wang and Chameides (2007), the thermodynamics of warming of the Earth's lower atmosphere must arise from one or more processes that supply excess heat to the lower atmosphere. The greenhouse effect is the results of the increased output from the sun, the increased absorption of heat from the sun due to changes in the Earth's planetary reflectivity or "albedo" and an internal variation in the climate system that transfers heat

from one part of the Earth to the atmosphere (Wang and Chameides, 2007). Direct observations confirm that none of these explains the observed warming over the latter half of the 20th century as indicated in Figure 1 where no appreciable change in solar output over the past two decades has been observed.

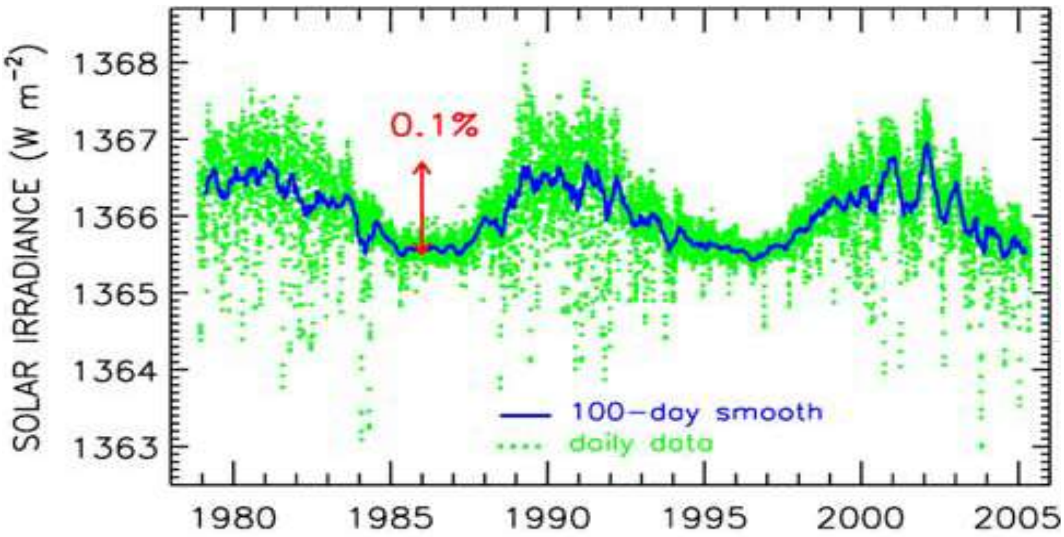

Figure 1. Change in solar output from 1980 to 2005
Source: Lean and Froelich (2006)

According to Wang and Chameides (2007), satellite data reveal that the Earth's reflectivity increased in the '60's, '70s, and early '80s and has decreased modestly since which causes cooling instead of warming. The overall warming from the recent decrease in reflectivity is also small compared to the greenhouse warming. The amount of heat stored in the ocean over recent years matches the amount of heat that the models predicted be trapped on Earth due to an increase in greenhouse gases (Hansen *et al*., 2005).

Volcanic eruptions, one of the natural causes of climate change, may also contributed to global warming as a source of carbon dioxide. In this regard, Chhatwal (2009) claim that Mount Etna, an active but at present a relatively subdued volcano in Sicily, adds about 25 million tons of carbon dioxide to the atmosphere of the entire region around the volcano and concluded that the nature by itself has a great contribution for CO_2 accumulation in the atmosphere not the human activities.

3.2. Global warming caused by human activities

Several studies have surveyed climate scientists who are actively publishing climate research. Each study found the same answer - over 97% of climate experts are convinced humans are changing global temperature (Doran and Zimmerman, 2009; Anderegg *et al*., 2010), which includes dependence on fossil fuels, urbanizations, deforestation, land use change and others.

A survey of all peer-reviewed research on the subject 'global climate change' published between 1993 and 2003 found that among the 928 papers found, not a single paper rejected the consensus position that human activities are causing global warming (Oreskes, 2004), surveying members of the relevant scientific community (Bray and von Storch, 2007; Doran and Zimmerman, 2009; Bray, 2010; Rosenberg *et al*., 2010; Farnsworth and Lichter, 2012; Stenhouse *et al*., 2014; Verheggen *et al*. 2014; Carlton *et al*., 2015), compiling public statements by scientists (Anderegg *et al*., 2010), and mathematical analyses of citation patterns (Shwed and Bearman, 2010).

Burning of fossil fuels is the main source of human-caused greenhouse gas emissions. According to Marland *et al*. (2009), however, carbon dioxide (CO_2) emissions sourced from the human activities are tiny compared to natural emissions. Natural emissions add up to 776 billion

tons of CO_2 per year (IPCC, 2007). On the other hand, nature doesn't just emit CO_2 but also absorbs CO_2. Plants for example breathe in CO_2 and the huge amount of CO_2 is dissolved into the ocean. Generally, nature absorbs about 788 billion tones of CO_2 every year (Lastovicka *et al.,* 2006) which roughly balanced the CO_2 emitted naturally.

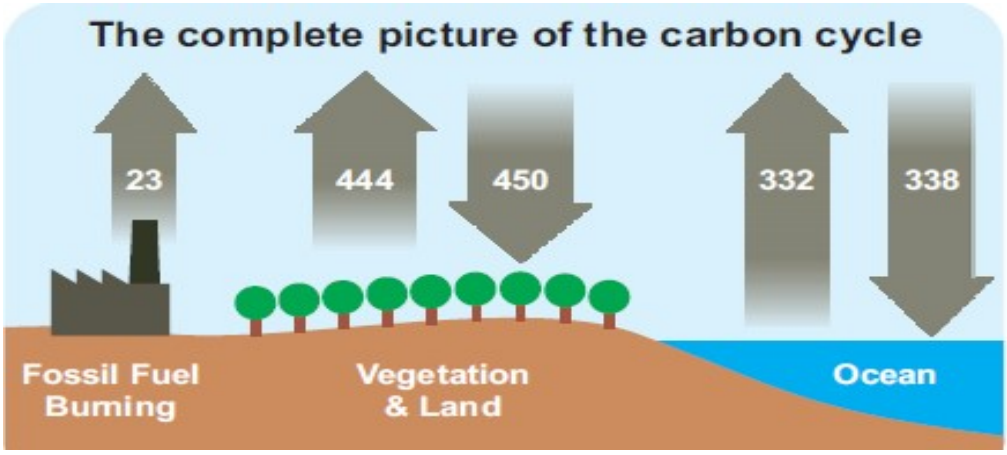

Figure 2. Carbon Cycle for the 1990s

Source: Lastovicka *et al*. (2006): Numbers are in billions tones of CO_2

The activity of the human being like fossil fuel burning on the other hand upsets the balance between emission and absorption of CO_2. While some of the CO_2 emitted from human activities is being absorbed by the ocean and land plants, around half of the emitted CO_2 remain in the air which disturbs the balance between emission and absorption. In this regard, Tripati (2009) expressed that because of burning of fossil fuels, atmospheric CO_2 is currently at its highest level in the last 2 million years which will increase in the future.

Continuation of human-induced CO_2 emissions may cause devastating rise in temperature in the future. According to Luterbacher *et al*. (2004), human-caused global warming may have already doubled the chance of "killer" heat waves like the one that scorched Europe in July–August 2003 which was the hottest summer in Europe in the past 500 years.

Urbanization and associated human activities in the cities are also the other sources of global warming which affect the urban environments worldwide. Heat released from various industries, households and cars contributed to artificial warming of the earth's environment (Goel and Bhatt, 2012). Moreover, the release of greenhouse gases from industries and cars in the cities have significant influences on our environment and contributed to global warming.

The magnitude of urban warming is highly variable over both time and space. On average, urban temperatures may be 1–3°C warmer, but under appropriate meteorological conditions (calm, cloudless nights in winter) air temperatures can be more than 10°C warmer than surrounding rural environments (Oke, 1981). However, in some regional settings, for example in arid environments, cities with large amounts of irrigated greenspace (parks, suburban vegetation) may actually be cooler than the surrounding dry areas (Grimmond *et al.,* 1993).

Deforestation and land use change are the other human activities that contribute to global warming worldwide. The fact that forests store massive amounts of carbon destroying such forests for farming and other purposes facilitate the release of carbon into the atmosphere which accelerates climate change. According to Bennett (2017), about 25% the world greenhouse gas production is contributed from deforestation alone. About 24% of the human-induced greenhouse gases are CFCs (Chloro-Fluoro-Carbons) as indicated by Goel and Bhatt (2012) which deplete the ozone in the stratosphere. Land-use changes are among the primary forcing of climate change, both at regional and global scales (Avissar and Werth, 2005), among others. Similarly, climate changes can impact the current global vegetation distribution and will further modify it in the future (Salazar *et al*., 2007).

4. Consequences of Global Warming

4.1. Fertilizer effect of carbon dioxide

The fact that plants require CO_2 to prepare their food, some argue that emission of CO_2 is a good thing. However, they ignore the fact that plants rely on more than CO_2 to survive. According to Challinor *et al.* (2010) the fertilizer effect of CO_2 is limited and will be quickly overwhelmed by the negative effects of heat stress and drought, which are expected to increase in the future. Over the past century, drought severity has increased globally and is predicted to intensify in the future (IPCC, 2007). Plants cannot take advantage of extra CO_2 supply if they are dying of thirst from drought and other stressing factors (Zhao and Running, 2010).

4.2. Effects on plants and animals survival

Each plant and animal species have specific temperature ranges for their survival and development. As the results of warming temperature, many species of plants and animals are already moving their range northward or to higher altitudes. They are in most cases migrating from the equator toward the poles following the ranges of comfortable temperatures as the global average temperature warms. This becomes a problem when the rate of climate change velocity is faster than the rate that many organisms can migrate. Warmer temperatures will also expand the range of many disease-causing pathogens that were once confined to tropical and sub-tropical areas, killing off plant and animal species that formerly were protected from disease (Alina and Stephanie, 2017). These and other effects of global warming, if left unchecked, will likely contribute to the disappearance of up to one-half of Earth's plants and one-third of animals from their current range by 2080 (Warren *et al*., 2013).

Oceans are absorbing much of the CO_2 in the air, which leads to ocean acidification (Hoegh-Guldberg *et al*., 2007). This is predicted to have severe destabilizing effects on the entire oceanic food-chain, on top of the negative effects of coral bleaching from warming waters (Hoegh-Guldberg *et al*., 2010). An estimated one billion people depend on the ocean for a substantial portion (>30%) of their animal protein (Tibbets, 2004).

4.3. Melting of ice

Increasing atmospheric temperatures in the last years caused melting of ices in the North Pole which in turn increases the sea level and storm activity that affected millions of people in the world (Goel and Bhatt, 2012). As glaciers and snowfields dwindle, so does the water supply for millions of people who are deeply reliant on those freshwater supplies, especially for irrigated agriculture (Immerzeel *et al*., 2010). Moreover, rice paddies are inundated with salt water, rivers are contaminated with seawater, aquifers become polluted and populations are displaced. This will force many millions of people to move inland that may increase the risk of conflict (Dasgupta, 2007).

Some studies have even suggested the possibility that warming over the next several centuries would lead to the complete, irreversible dis-appearance of the Greenland ice sheet, which would raise sea level by an extra 7 m, there is also a slight chance that the West Antarctic Ice Sheet could collapse, further raising sea level by 4–6 m (Gregory *et al*., 2004).

4.4. Increase in average temperatures and temperature extremes

One of the most immediate and obvious effects of global warming is the increase in temperature around the world. According to the National Oceanic and Atmospheric Administration (NOAA, 2017), the average global temperature has increased by about 1.4 degrees Fahrenheit over the past 100 years. However, the impacts of the increased temperature differed with the developmental stages of the country. According to Goel and Bhatt (2012), the developing countries are twice at risk to climate change compared to industrialized countries, while small Island states are thrice at risk. In 2007, IPCC drew estimates from projects reports, the increase of average global temperatures that will range from 1.4^0C to 5.8^0C by the 2100. Global warming may also lead to extreme weather other than cold or heat extremes. In the United States, Chicago experienced one of the worst weather-related disasters in Illinois history when a heat wave resulted in 525 deaths during a 5-day period in July of 1995 (Kunkel *et al*., 1996). Another example, hurricane formations will change. Though this is still a subject of active scientific research, current computer models of the atmosphere indicate that hurricanes are more likely to become less frequent on a global basis, though the hurricanes that do form may be more intense **(**Alina and Stephanie, 2017).

5. Conclusions

Global warming is currently one of the most popular and controversial topics among scientists where most of the scientists are argued about its happening the globe. Over 97% of the climate experts are convinced that human activities are changing the global temperature. There is consensus of evidence that human activities are the main causes of increased carbon dioxide level in the atmosphere which causes warming of the atmospheric temperature. Moreover, burning of fossil fuels is the main source of carbon. Measurements from satellites indicated that less heat is escaping to space while more heat returns to Earth surface that causes warming. Global warming is affecting shrinking ice sheet, rising sea level, as well as causes extinction of plants and animals. The human causes and its consequences of global warming are not just a consensus of scientist; there is also a harmony of confirmation. People throughout the world must collaborate and work together to mitigate global warming and seek an appropriate adaptation strategies to fight global warming.

Conflicts of Interests

The authors declared that there is no conflict of interests.

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