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Effect of global warming on the ice cap melting of poles

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ABSTRACT

This study invistigates the effect of global warming on the ice caps melting of poles. The research procedures rely on information, reports and data about the polar ice caps melting from the professional organization and institution, such as National Geographic (NG), National Snow and Ice Data Center (NSIDC), and Japan Aerospace Exploration Agency (JAXA). The data shows that melting of the ice caps increases in different areas of the world. The ice glaciers of Arctic decrease by about 10 % in the past 30 years. The ice loss in Antarctica and Greenland together contributes approximately 12 % of the rise in sea levels. Thickness of the ice caps will be decreased and potential energy of the ice cover will be converted into kinetic energy. The coastal and islands areas of the world are vulnerable to the climate change and will be affected by the ice caps melting. Sea levels could rise about 50 cm by year 2100. This level seems that it is not a significant increase but this rise can cause many effects. It could fast the erosion and would increase the evacuation of the coastal areas in the world. Reducing the green house gases is a crucial need to control global warming. Based on the JAXA data, the sea ice extent in the year 2013 is higher than the extents of years 2012, 2007, and 2011. It means that there is an improvement in the world climate by decreasing the green house gases.

KEYWORDS

Ice caps melting;
Earth poles;
Green house gases;
Global warming;
Islands.

INTRODUCTION

We need to save the environment and to decrease environmental pollution. The environmental pollution impacts on the humans, animals, plants, oceans, seas, rivers, ice caps of south and north poles. The pollution increases due to increasing industrial activities. These activities increase the emission of pollutant gases or greenhouse gases, carbon dioxide, chloroflorocarbon (CFC), and other gases[1]. These gases increase the earth temperature. Nowadays, there is an international awareness towards this problem[2]. The United Nation (UN) has an annual summit to chase industrial countries to decrease the greenhouse gases emission. On the other hand, cars emissions, chemicals fumes, and smoke from factories pollute the air. The problem of environmental pollution is also affected by the number of people living in an area. Small population will use low energy, so the pollution will be controlled. In big cities the population is high and pollution is high too. This is due to using large quantities of oil and

natural gas for industry, transportation, and domestic uses. The ice cap of polar is defined as a region planet, which is covered in ice. The formation of ice cap is due to two factors: high elevations of the ice cap and sun radiation are rare. South pole forms the main ice cap on the earth, with about 90 % of the ice in the world. The ice covers Antarctica has average of 2.133 kilometers thick. If we imagine that the whole of the ice of the Antarctic is melted, water level of the ocean and sea will increase about 61 meters. Thousands of years ago, majority of the earth was frozen. More than half of earth's surface was occupied by glaciers or extreme desert. The forests were not as today, but were rare. We are now facing the fact that ice cap is melting. Environmental pollution, mainly greenhouse gases, increases the earth's temperature. The increase of temperature will affect the polar ice cap melting, especially, South Pole. The ice caps melting have melted faster in last twenty years than in the last thousands of years. As confirmed by scientists, the ice caps melting accelerate the rate of rising sea levels. The islands and cities or villages, which locate in or near the sea shores, will be in danger. Times international newspaper reported that "the ice caps are melting so fast that the world's oceans are rising more than twice as fast as they were in the 1970s[3]." As noticed by scientists, there is shrinking in the sea ice skin of the Arctic Ocean. The satellites show this behavior and present important matters within the images, especially, some physical properties of the ice, such as the way of entrance of the marine water into the ice skin[4]. The physical properties of the sea ice have not fully investigated. Therefore, scientists are working to study more about the physical properties of the ice cap. They would like to know more about the fate of the polar ice cap. International research institutes presents that thermal water expansion has an effect on ice cap melting[5]. As stated by Cazenave, by 2100, the Thames River in London could rise by 8 to 35 inches. The data indicate that sea level rose at 0.34 cm within 15 years. In fact, rising of water is faster than the average 0.17 cm recorded over the past 50 years. Cazenave said: "This rate, observed since the early 1990s, could reflect acceleration linked to global warming." In 2006, it was reported that both poles of earth were melting, which could harm coastal towns[6]. As confirmed, temperatures increased 1ºF through twentieth century. Climatologists stated that the ice cap crowning Kilimanjaro's peak shrank in the nearly hundred years between 1912 and 2007. It was stated that 26% of the reduction happened within 8 years (2000 to 2007). It was the first time that the scientists calculated the ice volume lost from mountain's ice fields[7]. As reported by international newspaper, the melting of ice cap is so fast. Scientists said that the oceans are rising more than twice as quick as they were in the 1970s. They have relied on satellites pictures to see how the oceans are reacting as billions of water gallons arrives from melting ice caps of poles[8]. As stated by National Aeronautics and Space Administration (NASA), USA, there was an extent of surface melt over Greenland's ice sheet. Collected data from 3 satellites indicated that on August 2012, about 40 % of the ice caps had thawed at or near the surface. Within a few days, there was a dramatic increase in melting process of the ice caps. About 97 % of the ice sheet had melted by December 2012[9]. Ice caps melting of poles increase over the past 20 years and reach more than 4 trillion tones of ice. This huge amount moved into the oceans, rising up sea levels. According to melting polar ice, sea level has raised to 1.1 cm[10]. Satellites pictures by NASA and ESA show that the most comprehensive melting of ice sheet appears in Antarctica and Greenland to date[11] (Shepherd, 2012). Melting of Antarctic and Greenland ice sheets have added 1.1cm to world sea levels since 1992[12]. There is a change in mass of ice caps of Greenland and east Antarctica and Antarctic Peninsula between 1992 and 2011. Since 1992, there is an increase in the average contribution of polar ice on the rate of world sea level rise[13]. As estimated, there is an annual loss of 344 billion tons of glacial ice. This amount increases sea levels up to 20 percent. In fact, global warming has great effect on the ice cap melting[14]. Greenland's ice cap is the largest in the northern hemisphere and the second largest in the world, after the Antarctic ice cap. As reported by NASA, the velocity of ice sheet increases in summer. This behavior aligns with the ice sheet surface melting intensity and timing. Based

on GPS measurements, they found that the melt water accumulating in these lakes drains through the 1.2-kilometre-thick ice sheet to the bedrock, lubricating the ice sheet and making it slide faster[15]. This phenomenon returns to the movement of the little mountain glaciers, but as discovered in 2002 that the ice sheets move in large amounts. The increase of temperature affects the thickness of the ice sheets, which lead to fast moving of the ice sheets towards the coast of the Greenland. As stated the rate of melting of ice cap has been accelerated in the last across the entire Canadian Arctic. The current rates of melting surpass the previous rates for Present melt rates exceed the past rates for thousands of centuries[16]. Surface of the earth will be affected by the melting of ice cap. Thawing of ice cap reduces the pressure on the rock below the ice cap sheet. This process will lower the melting point of magma. As stated, from 1880 to 1990 the magma increases by 10 % more than the average of magma per century during the previous nine hundred year[17]. As stated, increasing of the magma pressure will increase the risk of eruptions of volcano[15]. More understanding is required to achieve more development in this area. Therefore, there are a number of studies have been processed to understand the relation between global warming and ice caps melting (Robin, 2006). As revealed, long term study needs to be done to understand such relation. Also, future change in the sea levels must be monitored. The increase of earth temperature leads to global warming[18]. In addition to the effect of global warming on human, animals will be affected too. As stated, polar bears could be influenced by the global warming[1]. The polar animals' habitat, especially, polar bears, is essentially ice caps of the sea. Therefore, melting of the ice caps causes a great danger to the polar animals. The polar bears have been classified by the Department of the Interior in the US as a "threatened" species which is one step below an "endangered" species[1]. Also, islands will be affected by the increasing of the levels. As stated, the ice caps melting and the rises of the ocean's level may lead to disappearance of the islands in Tuvalu. There are nine islands of Tuvalu locate in the Pacific Ocean[19]. Increasing of the ocean and sea levels will affect other islands, such as corals islands. The sea level will expand and will increase due to global warming. This process will affect islands in the sea. The increase of the sea level will lead to fragile sand under its waves. Nowadays, millions of people live on many islands of the worlds and these islands are vulnerable to the rising waves. Accordingly, people and their cultures will be at risk, and they will lose their nations[20]. Researchers try to model variations in the ice sheet to understand the future effect of the climate change on the melting process[21]. Therefore, this study aims at monitoring ice caps melting of poles and the effect on sea and ocean water levels.

RESEARCH METHODOLOGY

The research methodology depends on collecting information and data about the polar ice cap melting from the professional organization and institution, such as National Geographic (NG), NASA, National Snow and Ice Data Center (NSIDC), Japan Aerospace Exploration Agency (JAXA), etc. Reports will be collected about the polar ice cap melting and views about the problem. Analysis and interpretation of the data will be done using scientific logic procedures and descriptive analysis will be done. The satellites pictures can be used to give an idea about the situation of the ice cap melting of the poles. In fact, scientists can use these pictures to predict future changes of the ice caps melting.

RESULTS AND DISCUSSION

Danger of Ice caps melting

The question has been delivered by the scientists; is there a danger of the ice caps melting? In fact, there is no clear answer about this question, but evidences have been noticed by the scientists that the ice caps of poles are in danger and they will melt. They don't know when it will happen. The increase of earth's temperature will accelerate ice caps melting. As stated, The Greenland has a reasonable amount of ice; if it melts it will add about seven meters to the oceans. Scientists from the Universities of London and Edinburgh say that ice loss in Antarctica and Greenland together contributes

TABLE 1 : The extent rate of declining September Arctic sea ice

Decades	Extent Rate	Results
1979-1989	13%	More ice Melting of the Arctic sea ice
1989-1999	13%	More ice Melting of the Arctic sea ice
1999-2009	13%	More ice Melting of the Arctic sea ice

Figure 1 : The ice cap of quelccaya in peru (Adkins, 1983)[25]

approximately 12 percent of the rise in sea levels[22]. It is revealed by the National Snow and Ice Data Center (NSDIC) that North Pole ice is continuing to melt at a dangerous rate. The Arctic Summer ice may disappear over the next few years, much earlier than scientists had previously predicted[23]. The data about the extent of Arctic ice caps indicates that there is a decline to the lowest rate in September 2012. The lowest extent drops to 1.32×10^6 mils^2[23]. The Arctic ice caps declined at the rate of 13% each decade since 1979. It was observed that the lowest ice extent had been seen for the 33 years from summer of 2012 year. The mean reason for the notable change is the global warming due to climate change. Continues emission of green house gases increases the earth temperature. The united nation has a call for the industrial counties to, at least, decrease the emission. As shown in TABLE 1, if the declining rate of September Arctic sea ice continues at the current rate this may lead a great danger for the ice cap melting. Accordingly, the sea level will increase and will cover certain coast cities, villages and islands all over the world.

It was revealed that the Arctic sea ice was decreased. It was three million miles^2 in 2007 and decreased by about 47 % in August 2012 to be 1.58 million miles square. This record was the lowest since NASA starts to record in 1979[24]. The scientists state that the ice cap of Arctic reaches its minimum in summer. This behavior occurs before building the ice cover during winter. This change in the ice cap behavior in recent years indicates that there is a fundamental change in Arctic ice cover. In 2007, the summer weather was very favorable to the melting ice, in 2012; it is the delicacy of the ice cover that has contributed to the record retreat of Arctic sea ice[22].

As said by Mark Serreze, NSDIC director, summer of 2007 was a perfect weather to melt ice caps. This is because the ice was too thin and weak[22]. The reason for this behavior is that layers of ice is becoming more of a seasonal ice cover and large areas are now ready to melting out in summer. Also, it can be said that the multilayer of ice formed within many years will be easily loosed and melted. The first law of thermodynamic stated that energy neither be created or destroyed, but converted from one form to another[25]. Accordingly, the potential energy of the ice cover will be converted into kinetic energy. As shown in Figure 1, the ice cap in Peru will completely melt in 2100 if it continues melting by the current high rate. This will affect thousands of

TABLE 2 : Variation in the glaciers areas in some parts of the world

Names of the ice glaciers in the world	Actual area	Remaining area	Loss of the ice glaciers
Sperry Glacier, USA	3.2 Km^2	1.20 Km^2	37.5 %
Kilimanjaro snows	12 Km^2	1.85 Km^2	About than 85 % Scientists said that the ice caps rapidly melting
Glaciers in the Garhwal Himalaya in India	599.9 ± 15.6 Km^2	~145 Km^2	The ice glaciers are melting fast, more than 80 %. It could virtually disappear by 2035
Arctic sea ice (Figure 3)	4,920,000 Km^3	492,000 Km^3	The ice glaciers declined by about 10 % in the past 30 years. 16,400 Km3 of ice that are lost every year (1979-2010 average)

people who rely on its water for drinking and electricity.

Glacier national park and glaciers melting

The Sperry Glacier in Glacier National Park (GNP), Montana, USA, has been investigated by the scientists from the U.S. Geological Survey Global Change Research Program. The results show that the glaciers of the GNP have decreased. The GNP was created in 1910. There were an estimated 150 glaciers in the 1910. Since then the number has declined to less than 30, and most of those remaining have shrunk in area by two-thirds. The scientists expect that most of the park glaciers will disappear within thirty years. They were very pessimistic by expecting that the glaciers may disappear all[26]. If we imagine the disappearing of glaciers in the GNP, this will lead to more water in the sea. Accordingly, more islands and coastal cities will disappear too. This is an alarm to take action and stop melting the ice glaciers. The scientists believe that increasing of the greenhouse gases in the atmosphere due to combustion of nonrenewable energy sources, oil, natural gas and coal, leads to increasing earth's temperature. Scientists record the increase in the average annual surface temperature, which has been considered as signs for some changes in the planet: the ice level, salinity level and oceans temperatures[26]. TABLE 2 represents some changes in area of the ice glaciers in some parts of the world. There is a significant increase in the glaciers loss due to rise of temperatures and high rate of ice melting. Accordingly, more water flows to seas from glaciers and ice caps, and ocean water warms and expands in volume. This combination of effects has played the major role in raising average global sea level between four and eight inches (10 and 20 centimeters) in the past hundred years[27]. It was discovered that the levels of the sea risen and fallen substantially over earth 4.6 billion years ago. Recently, the sea levels change by high rate, which will lead to remarkable changes in the world's coastlines.

As shown in Figures 2 and 3, there is a gradual change in the area of the Arctic over the months of the year. The maximum loss of the area occurs during August, September and October. The area starts to increase again in November and December. The highest loss of the ice area was in 2012. This means that the earth temperature was increased in 2012. The sea ice extent in 2013 is higher than the extents of 2012, 2007, and 2011. This behavior means that there is an improvement in the world climate by decreasing the green house gases. Also, it means that usage of renewable energy increases.

There is an experiment of NASA about the ice sheet of Greenland and other areas of the word. The results present a shrinking in the ice sheet of the Greenland. The shrinking of the ice sheet indicates the crucial effect of the climate change on the ice caps melting. In Northern Hemisphere (NH), spring ice caps breakup 9 days earlier than it happened one hundred fifty year ago. The NH autumn ice caps freeze up 10 days later. In parts of Alaska, the land descends more than 460 centimeters due to thawing permafrost. From the Arctic to Peru, from Switzerland to the equatorial glaciers of Man Jaya in Indonesia, massive ice fields, monstrous glaciers, and sea ice are disappearing. Global warming will increase the earth temperature. This will melt the ice caps, which will increase the water level in the sea

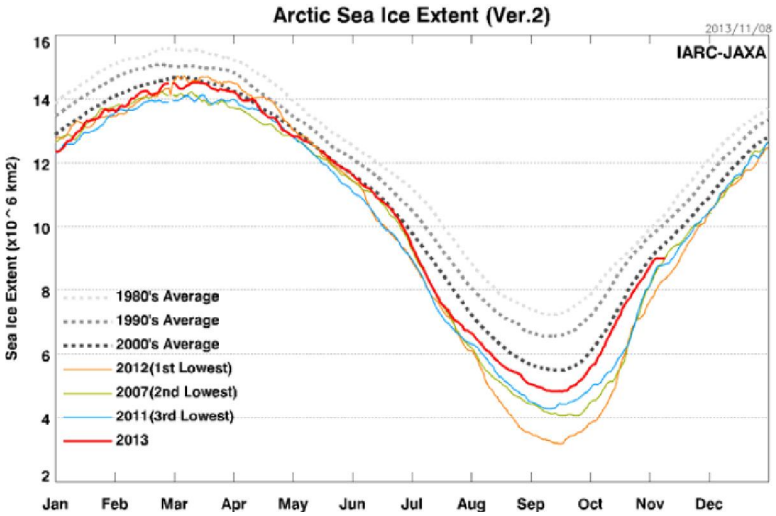

Figure 3 : Arctic sea ice extent-japan aerospace exploration agency (JAXA, 2013)[28]

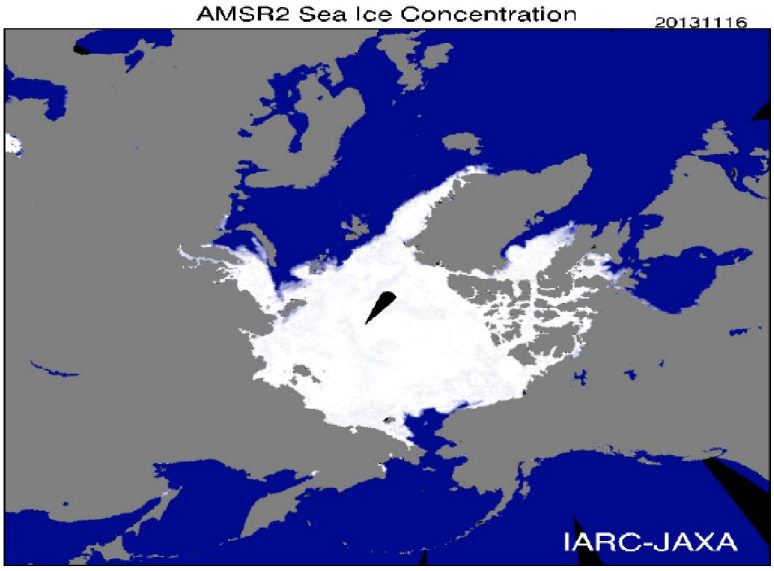

Figure 4 : Arctic sea ice monitor-JAXA (JAXA, 2013)[28]

and ocean. The volume of the sea and ocean will expand. These groups of effects played the major role in increasing the average sea level between 0.1 and 0.2 meters within the past 100 years. This estimation was done by Panel on Climate Change (IPCC). As stated, the scientists discovered that the level of the sea rises and falls ultimately over 4.6 billion year of the earth's history. In fact, the sea level in the recent years is rising rapidly about one tenth inch per year. Therefore, islands and coastal areas will change due to rapid increasing of the sea level.

Greenhouse gases and ice caps melting

The greenhouse gases are responsible for the global warming. They form a shield around the earth and prevent the excessive sun rays to be escaped from the earth surface. Sun rays increase the temperature of the earth and the phenomena called Greenhouse. There are a number of the greenhouse gases. The great effect arises from carbon dioxide (CO_2). The main sources of the CO_2 production are cars and industry. The UN has forced the industrial nations to control the emission of the greenhouse gases. In fact, the economic consequences may affect controlling of the greenhouse gases emission. The economists expect a conflict between global warming and growth of the economy[29]. As stated, it is one theory that rising temperatures cause more ice to break off from these glaciers and fall into the ocean displacing water, which could cause sea lev-

els to rise[29]. The Environmental Protection Agency (EPA) states that the global warming increases the ice caps melting. Researchers confirm that Pacific Island states will be greatly affected due to global warming[30]. As reported, stabilization of greenhouse gas levels is important and it needs continues monitoring to follow any change in the climate[2]. The monitoring process for reducing greenhouse gas emission should be applied to control the global warming and climate change.

Ice melting and sea levels

There is a great impact of the ice cap melting on the sea levels. The scientists expect that the sea levels will increase within the next decades. As estimated, the sea levels could rise as much as half meter by 2100. This level of the half meter seems that it is not a significant increase but this rise would cause many effects. It could fast the erosion and would increase the evacuation of the coastal areas in the world[2]. It can be discussed that ice cap melting has a great effect on the world coastal areas. One of the most important effects is the erosion. The process of coastal erosion is a natural process along the world's coastlines that occurs through the actions of currents and waves and results in the loss of sediment in some places and accretion in others[31]. The erosion will decrease the habitat for many organisms. Aquatic ecosystem will be affected. Some island will be covered by water.

CONCLUSIONS

It could be concluded that:

1. Green house gases increase the temperature of the earth, which enhance global warming.
2. The global warming has a great effect on the climate change all over the world.
3. The global warming leads to ice caps melting of the poles.
4. As noticed from the study, there is a significant increase in the melting of the ice cap areas in the world.
5. The melting will lead to increase the ocean and sea water levels.
6. There are many coastal areas and islands in the world, which will be submerged by the water.
7. Accordingly, the study has a number of recommendations:
8. The emission of the green house gases (GHG) is a crucial matter.
9. The reduction of the GHG will be verified by replacing nonrenewable energy sources by renewable energy sources.
10. Arrangement with international organizations is important to monitor the oceans and seas water levels through following the ice cap melting.

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