

Increasing of Atmospheric Temperature and Effect on Ice Caps Melting

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ABSTRACT

Global warming is a slow and steady rise in the temperature of the Earth's climate system. Green house gases, especially carbon dioxide, are the main reason for the global warming. There are different consequences due to global warming, such as increasing the temperature of the atmosphere, burning jungles, ice caps melting, etc. This research focuses on the ice caps melting and follows the rate of melting in the ice caps area in the world. The results of ice caps melting are collected from the research institutions and laboratories, such as National Snow and Ice Data Center (NSIDC), Japan, National Oceanic and Atmospheric Administration (NOAA), USA, Mauna Loa Observatory in Hawaii. As estimated, the arctic region is warming faster than any other on the earth. Arctic sea ice disappears steadily due to increasing atmospheric temperatures, approximately 270 two hundred seventy billion tons (270×10^9) melts of Greenland's ice cap annually. As recorded, there are nine hundred km^3 (900 km^3) of summer sea ice has been disappeared from the Arctic ocean in 2012. The variation of Arctic melting is not steady due to different factors such as climate change and melting momentum. It was observed that there was an improvement in the Arctic sea ice area in 2016 and in 2017; this phenomena might be due the decrease in the atmospheric temperature. This gives hope in the future and indicates a decrease in the temperature of the Earth's atmosphere.

Keywords: global warming; Green House Gases; Ice Caps melting; Atmospheric temperature; Arctic melting

INTRODUCTION

The atmospheric temperature has increased due to global warming. The main reason of the global warming is the green house gases, especially, carbon dioxide. The concentration of carbon dioxide has increased up to more than 410 ppm, which leads to increasing of the atmospheric temperature. There was a significant change in the areas of the ice caps because of increasing earth's temperature during the past five years. 90% of the ice caps on the earth are in the South and the thickness of Antarctica ice is about 2.133 kilometers.

This means that "water level of the ocean and seas will increase by 61 meters" when the Antarctica ice melts. It was stated that "The Beaufort Gyre, a key Arctic Ocean current, is acting strangely. Scientists say it may be on the verge of discharging a huge amount of ice and cold freshwater that could kick off a period of lower temperatures in northern Europe" [1]. This means that the lower temperature in northern Europe will move to higher level due

to ice caps melting of Arctic Ocean. Currently, the Arctic plumping system has a vital change; the arctic region is warming faster than any other on the earth. Arctic sea ice disappears steadily due to increasing atmospheric temperatures, Approximately 270 two hundred billion tons (270×10^9) melts of Greenland's ice cap annually. This means that the gyre area of Arctic is no longer functioning as it has predictably done for more than a half century. Also, the Arctic's permafrost thawing is accelerated due to increasing of temperature. As estimated, global permafrost catches twice as much carbon as the atmosphere [2]. This change of the Arctic's permafrost enables the rodents to make residence in the area and to make new digs and build dams.

"The Times Online states, "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]." A research "by Anny Cazenave of the National Centre for Space Studies in France shows that the ice cap melting has been affected by thermal water expansion"[4]. Cazenave's

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researches stated that the Thames River in London could rise by 8 to 35 inches, by 2100. Cazenave's data indicate that sea levels could be raised at 3.4 mm a year; this is in the past 15 years. It could be raised at 1.7 mm, which was recorded by tidal gauges over the past 50 years.

Cazenave said: "This rate, observed since the early 1990s, could reflect acceleration linked to global warming."

In 2006, "Bill Blakemore of ABC News in a report found that both poles of Earth are melting, which could harm coastal towns" [5]. Also, nobody can deny the fact of ice cap melting, said by "the National Academy of Sciences. As confirmed, the Earth's surface temperature rose one-Fahrenheit degree in the 20th century". "In a published research, 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)". As noticed, ice caps melting are accelerated by global warming. The ice volume lost from ice fields of mountains was calculated by scientists for the first time. [6].

"As reported by The Sunday Times, 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" [7].

"As stated by National Aeronautics and Space Administration (NASA), USA, there was an extent of surface melt over Greenland's ice sheet on July 8 and July 12, 2012". On July 8, 2012, as indicated by collected data from 3 satellites, nearly 40 % of the ice sheet had undergone thawing at or near the surface. "The melting had dramatically accelerated and an estimated 97 % of the ice sheet surface had thawed by July 12, within a few days" [8].

"A recent report says the Arctic may be ice-free by 2040" [9]. The Council's Arctic Monitoring and Assessment Program report that melting process of Arctic is going faster than expected, and by the late 2030s, it might be ice-free in summer.

There is a link between climate change and volcanic eruptions. Also, the volcanic activity is linked to the melting of polar ice caps. As stated the ice caps melting of poles could lead to increased volcanic activity [10]. This study focuses on the global warming effect on melting

of ice caps of poles. As revealed, 100 gigatons of ice per year is lost from Greenland ice sheet. There is a detected change in the mass of the Earth's part directly below by Climate Experiment spacecraft and the Twin Gravity Recovery [11]. The measurements of U.S./German satellites have added evidence that the ice caps of poles are melted by global warming. It seems that July will be the warmest month in 2018 because the colder area has recorded high temperature such as Canada, and some countries of Europe. This means that the global warming is not controlled and emission of green gases increases this year. Accordingly, it is expected that ice caps melting will increase too. Therefore, this research focuses on ice caps melting, which is considered one of the consequences of global warming. There is a significant change in the Arctic Ocean due to increasing of atmospheric temperature. Also, the Arctic's permafrost thawing is accelerated due to increasing of atmospheric temperature.

MATERIALS AND METHODS

This research uses the following tools:

- The recorded data about the atmospheric temperature and ice caps melting will be collected from the research institutions and laboratories, such as National Snow and Ice Data Center (NSIDC), Japan, National Oceanic and Atmospheric Administration (NOAA), USA, Mauna Loa Observatory in Hawaii, etc.
- The reports and researches about the atmospheric temperature, the polar ice caps melting and views about the problem will be discussed.
- Statistical analysis, such as descriptive analysis and correlation analysis will be done.
- The images, which captured by satellites, are important to show the situation of the ice cap melting and effect of increasing atmospheric temperature. In fact, scientists can use these images to estimate future changes of the ice caps melting.

RESULTS AND DISCUSSION

Variation of Atmospheric Temperature

The atmospheric temperature variation has been estimated since 1890 up to 2020, as shown in Figure (1). The temperatures increases through the years, the main reason is the global warming due to green house gas (GHG) emissions,

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especially, high level of carbon dioxide. As presented in the Figure 1, there are five warmest years, the first year is 2016(+0.45°C), second warmest year is 2015(+0.42°C), third warmest year is 2017(+0.38°C), fourth warmest year is 2014(+0.27°C), and the fifth warmest year is 1998(+0.22°C) [12]. As reported by the Guardian International Edition in 2017, the 2016 was the hottest year ever both for ocean and land, the scientists have stated that the mean reason for the hottest record of 2016 is the human activities. The human activities include transportation (flying, cars, trains and ships) industry, household activities, and any human

activity uses fossil fuels energy [13]. Therefore, the solution is clear which is to cut off the usage of nonrenewable energy and to replace it with renewable energy sources. As estimated our climate accumulated about 2,675,000,000 Hiroshima atomic bombs of heat since 1998 and the accumulation of heat is continuous every moment, it will never stop as long as the nonrenewable energy exists. It may be stop one day, but this will not happen unless we reach 100 % usage of renewable energy source in every aspects of our life. It's a dream, but who knows, it may come true in the future.

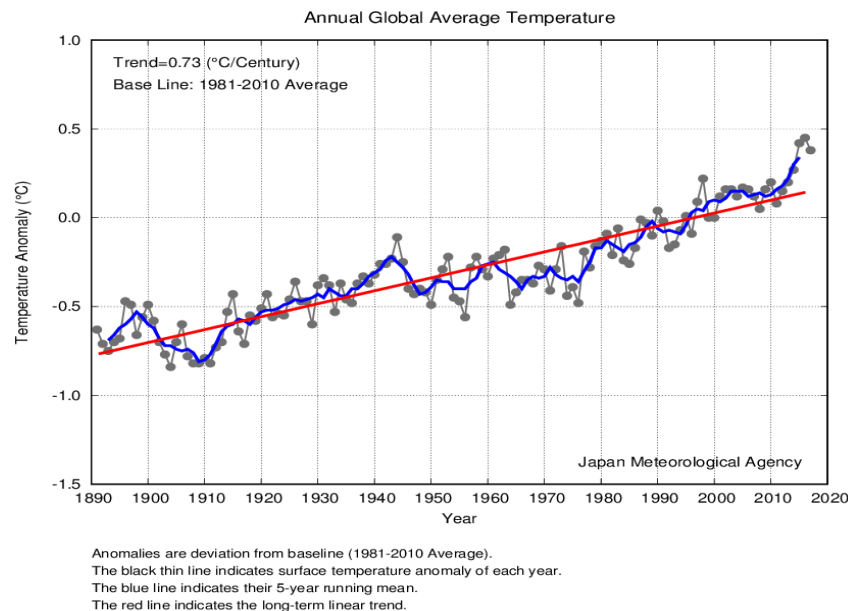


Figure 1. Annual Global Average temperature variation from 1890 to 2020 [12].

Situation of Ice Caps Melting

As estimated in 2016, there was a satellite measurements, which underestimated Greenland ice melting by some 40% [13]. As known, the Arctic sea ice area is nearly 15×10^6 km², which is nearly twice as the Australia size. This seems that huge amount of ice, but because of climate change it is the second lowest area of ice as confirmed by the the National Snow and Ice Data Center in 2017 [14]. In previous research, the highest loss of the Arctic sea ice area was in 2012 [15]. As estimated, there are nine hundred km³ (900 km³) of summer sea ice has been disappeared from the Arctic ocean in 2012, this result is reported by The European Space Agency's Cryosat-2 probe [12]. This is estimated as 50 % higher than the expected by scientists. The mean reason for this melting of the Arctic and such high percentage rate of loss are due to global warming, which is triggered by increasing GHG emissions. The most dangerous

scenario is that the Arctic might be free of ice within few years, especially, in summer. Figure 2 shows the Arctic sea ice extent change and mean volume from 1979 up to 2017, as published by Japan Aerospace Exploration Agency (JAXA) [16]. As presented in the Figure 2, there is a drop of nearly 262×10^3 km² within three days. The Arctic sea ice area is nearly 15×10^6 km², the lowest maximum record of this area was 13.942×10^6 km² in 2015, but in 2016 the area increases to 13.959×10^6 km² and in 2017 the area increases to 13.878×10^6 km². The improvement in the Arctic sea ice area in 2016 and in 2017 might be due the decrease in the atmospheric temperature and improvement in the global warming in general. Also, it can be claimed that the awareness towards the environment is improved all over the world. The international summit about environment and global warming has produced a positive thinking and dealing with environment.

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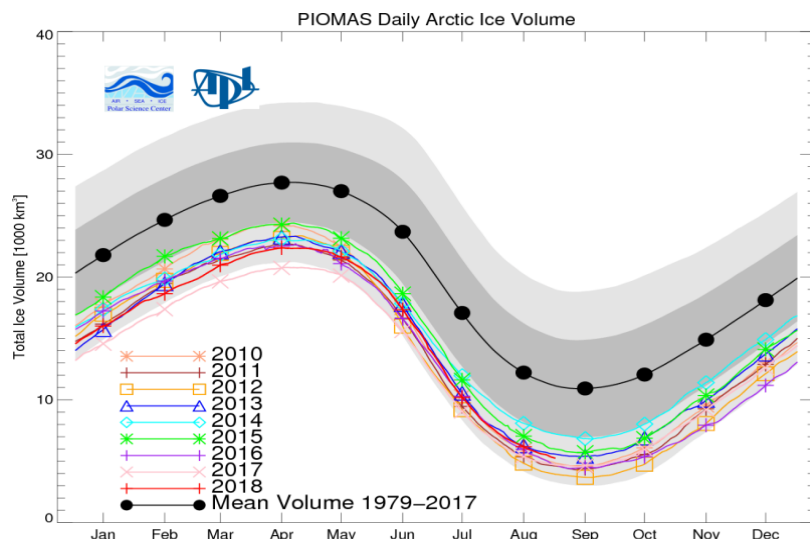


Figure 2. Arctic sea ice extent change and mean volume from 1979 up to 2017, as published by Japan Aerospace Exploration Agency (JAXA) [16].

As noticed from the data in Table 1, the extent of Arctic sea ice melting is not going steady, but there is high extent during July and August of 2008 and 2009, the extent slow down again in the year 2010 to 2012, then it backs again to increase from 2013 to 2015, and it is slow down in 2016 and 2017. This means that the climate change is not only the mean factor affecting the ice caps melting but also there other factors may be affect. As stated the ice can absorb heat and will not melt after absorbing the heat, but it will be stored in the ice. This phenomena has been discussed and it is called melting momentum [16].

Table 1. The extent of Arctic sea ice melting in July and August of different years.

Year	July 31	August 31
2007	-1589	-1416
2008	-3672	-2587
2009	-2230	-1999
2010	178	398
2011	604	629
2012	907	1304
2013	-212	-338
2014	-1994	-1981
2015	-1037	-753
2016	-17	545
2017	870	547

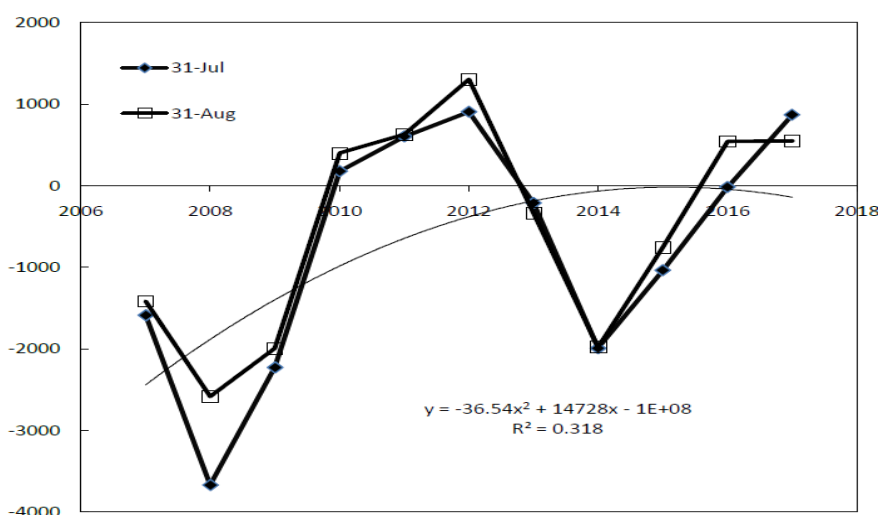


Figure 3. The extent of Arctic sea ice melting in July and August of different years and polynomial trendline of the data.

As shown in the Figure 3, extent of Arctic sea ice melting fluctuates where there is loss and gain of the Arctic sea ice within the range of years; therefore a polynomial trendline is a best-fit curved line for data fluctuates. The

calculation of R^2 is about 0.318, which means that the relation between the data is not strong. This may reflect the variation of atmospheric temperature, which is not steady through the years, and it shows the variation of carbon

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dioxide concentration in the atmosphere. This variation affects the melting processes. The polynomial trendline is an order 3 because it has one hills and two valleys [17].

The Antarctic sea ice extent is shown in Figure 3, as presented by JAXA in 2018 [16]. As observed from the Figure, the first highest

extent change of ice melting of Antarctic sea is in 2014, the second highest is in 2013, and the third highest is in 2012, especially in summer months. Normally, in summer the temperature will be higher than other season, but it seems that the temperature was the highest in 2014, so the extent of melting was the highest in 2014.

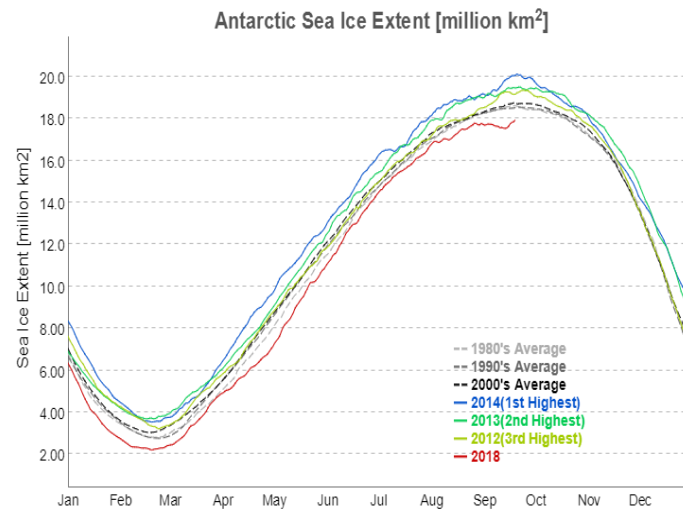


Figure3. Antarctic sea ice extent change each year since 2000, as published by Japan Aerospace Exploration Agency (JAXA) [16].

CONCLUSIONS

- Year 2016 was the hottest year ever both for ocean and land. The main reason for this phenomenon is the human activities.
- Human activities, such as transportation, industry, etc, can be controlled by replacing the fossil fuels and using renewable energy sources.
- It is estimated that Greenland ice melting by some 40%.
- As reported, the highest loss of the Arctic sea ice area was in 2012. There are 900 km³ of summer sea ice has been disappeared from the Arctic ocean in 2012.
- The improvement in the Arctic sea ice area in 2016 and in 2017 might be due the decrease in the atmospheric temperature.
- Year 2014 was the highest extent change of ice melting of Antarctic sea.

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