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Effects of Global Warming on the Glacial Melts in North Polar

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Abstract

Global warming has become familiar to many people as one of the most important environmental issues of our time. This review will describe the effects of global warming on the glacial melt at the North Pole. On the land, glaciers are melting and retreating in places like Antarctica, Greenland, and Alaska. At sea, the area of floating ice, which we call sea-ice Floating ice is formed by the freezing of the sea surface. Is becoming smaller each year. The cold region (north polar) is home to a variety of creatures, which, with the melting of natural glaciers, are under threat. Therefore, these are the clearest threats of the current climate change effects of global warming on the glacial melts in the North Polar, which have effects on mercury (Hg), marine systems, sea level rise, public health, and economies.

Keywords: Global Warming, Glacial Melts, North Polar, Mercury (Hg), Marine systems

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INTRODUCTION

Global warming is one of the most important environmental issues that many people are aware of currently (Davarcioglu, 2017; Moser, 2010; Lorenzoni et al., 2006). The expanding global population, changing climate conditions, and economic activity make it more vital than water (Bagdatli and Belliturk, 2016a). Climate change and global warming are diminishing accessible water resources practically everywhere on the planet (Ucak and Bagdatli, 2017).Increasing or decreasing changes in climatic values affect living things negatively and cause a decrease in productivity, especially in agricultural production (İstanbulluoğlu et al., 2013). As well as being known as global pollution because greenhouse gases such as carbon dioxide (CO_2) have a long life in the atmosphere, their effects impact everyone in the world (Jacobson, 2012; Gibbons et al., 2000; Abbasi and Abbasi, 2012; Solomon et al., 2010; Smith et al., 2009; Shine et al., 2005; Montzka et al., 2011). One of the fundamental ideas behind global warming can be figured out by considering two energies: the surface of the Earth is warmed by solar radiation, and the other is the thermal radiation from the Earth and the atmosphere that is radiated out into space (Hansen, 2004).

Therefore, these two radiation streams must generally be in balance because the atmosphere contains greenhouse gases, which act as a blanket over the Earth's surface by absorbing the thermal radiation they emit, causing the greenhouse effect (Hansen, 2004).

In addition, this effect causes climate change to influence the long-term climate everywhere on our planet. such as drought, rising sea levels, melting glaciers, warming oceans, floods, storms, and heat waves, can directly and indirectly affect plants and have a disastrous impact on people's way of life and communities (Taloor et al., 2022; David and Odenigbo, 2022).

Todays, one of the basic problems that worries people is the melting of natural glaciers. In fact, glaciers are ancient rivers of compressed snow that creep through the landscape, shaping the planet’s surface and forming freshwater reservoirs (Haq et al., 2012; Singh and Dhir, 2014; Adhikari and Huybrechts, 2009). According to the information abstained, over 68 percent of fresh water is stored in the Antarctic and Greenland Ice Sheets (Bamber et al. 2018; Windnagel et al. 2023). Today, around 10 percent of the earth is covered with natural glaciers; 90 percent are located in Antarctica, and the remaining 10 percent are in Greenland. Therefore, approximately 200,000 glaciers are distinct from the ice sheets (Huss and Farinotti, 2012; Windnagel et al., 2023). The world’s largest glaciers by area are found in Antarctica and the North Pole. Since time immemorial, nearly all of the Arctic Ocean has been covered by ice all year (Windnagel et al., 2023). The northernmost point on Earth is the North Pole, which is located in the middle of the Arctic Ocean and is usually blanketed with ice. The ice sheets that cover the North Pole are about two to three meters thick and more than 4,000 meters deep (Nelson, V., 1997). This cold region is home to a wide variety of creatures, including Arctic foxes, polar bears, seals, fish, birds, and even some people. Some plants and animals even depend on the ice to thrive, so they have learned to coexist with it (Osborne & Boyce, 2012). Additionally, ice functions as a shield to preserve the Earth and our oceans. The globe stays colder because of these brilliant white areas, which reflect extra heat into space. Unfortunately, because of the increasing effects of global warming on glacial melt in the North Polar Region, it is possible that the giant ice sheets of Greenland and Antarctica won't remain stable. The extent to which enhanced melting as the climate warms somewhat offsets heavier snowfall during the colder seasons is also unknown. Because of weather change, a combination of rising ocean temperatures and ice sheet melting could systematically inundate the world’s coasts by raising sea levels for centuries. Dramatic environmental shifts are occurring throughout the North Polar Region due to global warming (Karl & Trenberth 2003).

As well as everywhere we look, we notice more intense or uncommon weather, such as storms, floods, or droughts. Some places may get colder, while others may get warmer. However, the Arctic and North Polar Glaciers are the places where climate change is occurring the quickest. According to recent estimates and studies, the clearest evidence of current climate change effects of global warming is on the glacial melts in the North Polar, which have effects on mercury (Hg), marine systems, sea level rise, public health, and economies. the purpose of this review is Effects of Global Warming on the Glacial Melts in North Polar

How has climate change affected the physical and biogeochemical characteristics of Arctic (North Polar) environments?

Climate change and mercury (Hg) in the North Pole:

Climate change has affected the physical and biogeochemical characteristics of Arctic environments (Prowse et al., 2006). Probably the largest driver of change for physical and biogeochemical changes in the Arctic ecosystem is warmer air temperatures. In the Arctic, recent temperature increases are more than twice as great as those observed at lower latitudes. Additionally, there are regional variations in the most recent atmospheric climatic patterns seen throughout the Arctic (AMAP, 2017). These wide changes to the meteorological environment may have implications for the long-range transport of mercury (Hg) to the Arctic and exchange with terrestrial and marine environments. According to recent estimations, the Arctic permafrost contains a significant amount of mercury and is subject to damage because of climate change (Chetelat et al., 2022; Dastoor et al., 2022; Chetelat et al., 2022).

Therefore, one of the most obvious signs of present climate change effects is mercury (Hg) movement from terrestrial catchments, where widespread permafrost thaw, glacier melt, and coastal erosion are boosting the export of Hg to downstream ecosystems (Chetelat et al., 2022). According to Goodsite et al.'s 2012 study, mercury is a gaseous element whose reaction kinetics depend on atmospheric temperature. Therefore, climate affects how mercury is distributed between the atmosphere and land surfaces. So, warmer temperatures appear to promote the formation of methylmercury in lake and ocean sediments as well as tundra soils, according to experimental data (Chételat et al. 2015).

Improved geographic coverage of measurements and modeling approaches are needed to better evaluate the net effects of climate change and its long-term implications for Hg contamination in the Arctic. The other critical issue is how climate change is affecting terrestrial and marine systems.

The effect of climate change on the North Polar’s terrestrial and marine systems:

According to research from the past ten years, either increased export owing to a change in circulation or local melting has caused the multi-year ice field in the Arctic to thin out since the 1970s (Macdonald et al., 2003; Smetacek and Nicol, 2005). Sea ice drastically lowers the quantity of sunlight that reaches the ocean. indicates that for the first time in many thousands of years, some oceanic regions are seeing summertime sunlight. As a result, when polar marine habitats warm more due to global warming, sea ice thickness and extent will be affected in a cascading manner. The productivity of species and the relative significance of various energy channels via food webs might be influenced (Meredith et al., 2019; Trebilco et al., 2020; IPCC, 2021; Thorson et al., 2021). Therefore, over the past 50 years, scientists have observed some zooplankton and fish species moving toward the poles as the oceans become warmer (Kortsch et al., 2015).

As mentioned in the article and research, that is why the Arctic has large populations of marine birds and exceptionally large stocks of fish, benthos, and mammals (seals, walrus, and whales) (Smetacek and Nicol 2005). In addition, another reason is that the light increases the productivity of the North Pole by allowing phytoplankton to flourish and photosynthesize in formerly arid regions. It is possible to view the rise in phytoplankton as a positive development because it will enhance marine life and provide more food for zooplankton, benthos, and eventually fish, polar bears, whales, birds, and seals (Darnis et al. 2012).

Additionally, the majority of fish species are now more frequently hunted due to climate change and the melting of pole glaciers. Some Arctic animals, though, have changed over time to rely on the existence of ice. Seals and walruses can exit the ocean thanks to the sea ice, which they need to relax, reproduce, and avoid other marine predators like killer whales (Heath et al., 2021). On the other side, in order to hunt for seals, other species, including polar bears, depend on their ability to cross the frozen sea. So with weather changes and melting ice getting more common, travel is made more challenging by melting ice since bear weight cannot be supported by thin ice. On the other hand, ice presents a challenge to whale species since they need access to the atmosphere to breathe. Overall, it is unclear which predators in the food chain will benefit from melting sea ice and which ones will suffer from it. (Heath et al., 2021). Growing Population is also an important reason for climate variation will raise several issues for worldwide food supply due to which numerous nutritional complications could arise in the upcoming future. Production of food is a major concern that could be effected by climatic variations (Bagdatliet al., 2023), like an upsurge in sea-level due to climate change, leads to the devastation of forests which are key source of food in many regions (Afreen et al., 2022).

Arctic glaciers as important contributors to global sea level rise (Lakes):

Rapid glacial melt in the North Pole influences ocean currents and enormous amounts of cold. Extremely cold glacial melt water entering warmer oceans means ocean currents are being slowed by cold water. These changes in nature caused by glaciers will cause sea levels to rise as land-based ice continues to melt. According to Lindsey (2021), Rahmstorf (2010), and Walsh et al. (2012) studies, rising sea levels are a result of melted glaciers, which increase coastal erosion and raise the storm surge because coastal storms like hurricanes and typhoons become more common and severe as air and ocean temperatures warm. As previously mentioned, the ice sheets in Antarctica and Greenland (North Polar) are the main causes of sea level rise on a worldwide scale (Hock et al., 2009; Radić, & Hock, 2011).

As Vasskog et al. (2015) mentioned, the Greenland ice sheet is already melting four times faster than it did in 2003, and it is already responsible for 20% of the current rise in sea level. The extent to which ocean levels rise in the future will be greatly influenced by how quickly and how much these Greenland and Antarctic ice sheets melt. By the end of the century, the Greenland ice sheet's current pace of melting is predicted to have doubled if emissions keep rising. Alarmingly, if all of Greenland's ice disappeared, sea levels would rise by 20 feet.

The effect of climate change on Arctic public health, and economies:

According to the theories and research of researchers, the possible impact on human health will vary from location to location depending on regional climate variances, variations in health conditions, and the capacity of various populations to adapt (Séguin et al., 2008; Parkinson and Evengård, 2009). In particular, the most vulnerable people may be those living in isolated villages in the Arctic with weak support systems, scant infrastructure, and weak or nonexistent public health systems (Parkinson & Berner, 2009). Therefore, people who rely on subsistence fishing and hunting will be more susceptible to changes that influence the targeted species. As well as certain infectious diseases that may transmit from animals to people because of climate stress and shifting animal populations (Parkinson and Berner, J. 2009).

According to Revich et al. (2022), changes in the climate cause significant issues. Beyond the Polar Circle, in West Siberia, there have been more than 70 significant outbreaks of Siberian anthrax since 1760. One of the other reasons to show climatic change's impact on animals in this part of West Siberia According to literature sources (Revich et al., 2022), an extensive outbreak of Siberian anthrax among deer, followed by a 2 meter deep seasonal thawing of permafrost and possible Siberian anthrax bacterial vegetation, and movement from the active permafrost layer to the top soil, were all triggered by a very hot summer of 2016. There are also signs that global warming causes permafrost to thaw, which could facilitate the release of diseases and other germs. In permafrost soils that are between a few thousand and two million years old, prokaryote and eukaryote microorganisms may be able to survive the year-round negative temperatures. These bacteria may migrate to the surface with groundwater due to permafrost deterioration. This discovery supported the idea that infectious disease vectors that had been dormant in permafrost for a very long time could become active again and be discharged into the ecosystem because of climate change (Streletskiy et al., 2019).

Increasing patient wait times, the inaccessibility of healthcare services, and the emergence of contagious diseases mean that while some risks and direct economic losses may be identified, forecasted, and assessed, many indirect effects and the ensuing economic costs are much harder to predict. There are reasons to think that indirect economic costs brought on by permafrost degradation may far outweigh direct losses.

Future projections of climate change in the North Polar:

There is massive research and study about future expectations of climate change in the northern Arctic or the Atlantic Ocean. In this part, we review a small part of these studies, which reflect the most important risks expected in the future. The researchers and experts focused on projected changes in North Polar temperature, precipitation, sea ice, and glacier melt. Precipitation increases in the North Polar are predicted to vary from 5 to 10% in the Atlantic sector to as much as 35% in some high North Polar areas by the late 21st century (Kattsov et al. 2005).

As well, Overland et al. (2014) found a significant difference in Arctic surface air temperatures at the end of the 21st century based on two radiative forcing scenarios (mitigation and business-as-usual) in the CMIP5 (Coupled Model Intercomparison Project Phase 5) collection of GCMs (General Circulation Models), which strongly supports starting greenhouse gas mitigation operations. According to Chen et al.'s 2021 climate projections, by 2100, arctic surface air temperatures could increase by 7 degrees Celsius because of an increase in atmospheric carbon dioxide. Therefore, sea ice cover varies significantly throughout the year. As Arthun et al. (2021) mentioned, around 2050, the Arctic will lose its ice cover in late summer. Therefore, the rise in temperature at the North Pole will cause more rainfall in the region and the beginning of the melting of the natural glaciers. According to Bintanja's 2018 research, local, seasonal, and temporal variability in precipitation is larger than local temperature. Increases in Arctic rainfall could lead to impacts from projected strong increases in Arctic rainfall (such as permafrost thawing, ecosystem shifts, sea ice retreat, and glacier melt).

CONCLUSION

Numerous detrimental effects on agricultural crop productivity are caused by the increase in greenhouse gas emissions into the atmosphere, global warming, changes in temperature and precipitation patterns, and other factors (Bağdatlı et al., 2015). Precipitation carries greenhouse gasses and carbon dioxide from the atmosphere down to Earth. We refer to this phenomenon as acid rain. Acid showers alter the water's pH and have an impact on aquatic life. Plants lose their natural structure as a result of it (Bagdatli and Can, 2019). The life of living organisms is badly impacted by extreme temperature changes. In the future, finding clean water will be challenging since rising temperatures would cause more evaporation (Bağdatlı and Can, 2020). Global efforts should be directed at expanding the required research and implementing carbon emission reduction strategies, as reducing greenhouse gas emissions will be a major factor in mitigating the effects of global warming (Bagdatlı and Arıkan, 2020). Conferring to scientists, climate change is a condition where atmospheric air have been changed and retain for centuries. Climate change known as collection of several atmospheric changes which can be happened by human activities or could be natural (Elsheikh et al., 2022b).

The reduction in the surface changes of the water reservoir over time is noticeable. This manifests itself as the result of disorder in the evaporation and current precipitation regime in water sources that are affected by global climate change (Albut at al., 2018). Water, is an important element, for existence of living lives. Precipitation and Rainfall both are sources of water and various activities of living beings depends on both these aspects like life survival, Agricultural productivity, migration of living beings and urbanization (Bagdatli and Arslan, 2019; Elsheikh et al., 2022a). Global climate change, the industrial revolution of the then-human atmosphere to release CO_2 , CH_4, O_3, and NO_2 as gases are very quickly heat the earth by the greenhouse effect that occurred as a result of an increase above normal (Bagdatli and Belliturk, 2016b). The influence of the global climate will have an effect on the changing of seasons, particularly in the observation of substantial fluctuations in temperature and precipitation (Bagdatli and Arslan, 2020).

According to scientific theory and empirical data, the Earth's climate has been warming, and greenhouse gases produced by human activity are mostly to blame for these changes. On the other hand, human activity is largely responsible for climate warming. Climate change affects the long-term climate, causing the melting of natural glaciers in the North Polar Region. In fact, these natural glaciers are freshwater reservoirs. As well, these cold regions are home to a wide variety of creatures, including Arctic foxes, polar bears, seals, fish, birds, and people. Some plants and animals even depend on the ice to thrive, so they have learned to coexist with it. Therefore, this is a vital issue for the survival of the planet because it provides the clearest evidence of the current climate change effects of global warming on the glacial melts in the North Polar, where wide changes in meteorology lead to mercury transport to the Arctic. The other critical issue is the effects of climate change on terrestrial and marine systems. Rapid glacial melt in the north polar will cause sea levels to rise as land-based ice continues to melt. As well as these meteorological chances effects on animals and plants, in particular, people living in isolated villages in the Arctic with weak support systems, scant infrastructure, and no public health systems are most vulnerable to climate change and infectious diseases. People relying on subsistence, fishing, and hunting are more vulnerable to species changes.

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