

# Can Ice and Glacier Melting Poses Global Threats in 21st Century

**Bharat Raj Singh<sup>1</sup> and Onkar Singh<sup>2</sup>**

<sup>1</sup>Director, School of Management Sciences, Lucknow-226501, Uttar Pradesh, India  
email:brsinghlko@yahoo.com; Mob: +91-9415025825

<sup>2</sup>Vice Chancellor, Madan Mohan Malviya University of Technology, Gorakhpur, Uttar Pradesh, India  
email:onkpar@rediffmail.com; Mob: +91-9415114011

## **Abstract**

Globally fast extraction of hydrocarbon and burning of fossil fuels such as coal or petroleum causes huge quantity of release of the carbon dioxide and other heat-trapping "greenhouse gases" into the atmosphere. Though natural amounts of carbon dioxide have varied from 180 to 300 parts per million (ppm), today's carbon dioxide levels are around *400 ppm*, that is 40% more than the highest natural levels over the past 800,000 years. Thus the atmosphere carbon dioxide comes mainly from coal and oil because of its chemical composition and contains a unique fingerprint. Cutting and clearing forests also releases large amounts of carbon dioxide. Worldwide deforestation means that earth now don't have as many trees to absorb the extra carbon dioxide. This means more carbon dioxide stays in the atmosphere, trapping more heat.

Present state of heating of atmosphere raises global warming, changes in environment and poses continuous occurrence of natural disasters, which has made it inevitable for the environmentalist and scientists to extensively study and carry out detailed analysis of the threats faced by civilization across the entire globe. It is estimated that September 2030, sea ice coverage will shrink from about 2.3 million square miles (6 million square kilometers) to 770,000 square miles (2 million square kilometers) in a span of ten years. By 2040 only a small amount of sea ice will remain along the north coasts of Greenland and Canada, while rest of the ocean basin will remain ice free through the summer. Winter ice will thaw from about 12 feet (3.7 meters) to 3 feet (1 meter) thick. It is to be noted that the Arctic sea ice is like a giant mirror. It reflects the sun's energy back into space and prevents much of it from being absorbed by the ocean. But as warmer average temperatures melt the ice, the mirror shrinks. A smaller mirror means that the ocean absorbs more of the sun's energy, which creates further warming. Thus Global warming will alter ocean circulation patterns and drive warmer Atlantic waters into the much chilled water from Arctic sea, poses threats like intense storm, heavy snow fall, and severe reduction in the temperature for livelihood

**Keywords:** Hydrocarbon, Carbon dioxide, Global warming, Deforestation, shrinkage of ice sheets

## 1. Introduction

Globally environmental changes and continuous occurrence of natural disasters has made it inevitable for the environmentalists and scientists to extensively study and carry out detailed analysis of the following threats faced by civilization across the entire globe:

- i). Fast shrinkage of the polar ice and by 2040, there will be no polar ice seen during summer.
- ii). Fast rise in the Sea Level,
- iii). Danger for species like: polar bear etc.
- iv). Ice sheets, where it meets the Atlantic sea, that this area may be affected by cold waves, heavy snow falls and intense storms.
- v). Permafrost may create further warming which cannot be reversed.

It is evident that the entire Arctic tundra region is melting, the frozen layer of soil known as permafrost is the growing concern and is considered as a threat by the scientists. Although the ancient plant matter from which permafrost was formed has been frozen for the past tens of thousands of years, climate change is causing it to thaw and decompose. If this process continues at its current rate, sufficient methane would be released at some point to set off irreversible global warming. In addition to this, some Arctic regions such as Northern Alaska, USA are showing an increase in a phenomenon called Thermo-karsts, in which the melting permafrost layer has caused the ground above it to collapse into hollows. Another newer factor being studied as the region warms is a potential increase in tundra fires. Scientists warn that these combined factors could turn the Arctic from a vast carbon sink into a potentially lethal source of methane in less than a decade.

As our planet is on a dangerous course of passing irreversible tipping points with disastrous consequences, entire community of the scientists involved, in the research and fieldwork is helping us to understand the growing threat of melting permafrost in the crucial Arctic region. The melting of permafrost in turn releases toxic methane gases, resulting into more warming of the atmosphere. Thus, it is essential to act promptly to avoid further catastrophic warming and stabilize the planet on which all lives depend, as permafrost's melt is a potential source of runaway global warming.

In this paper, authors are focusing mainly on the shrinkage of the polar ice and its serious effects on humanities, especially in January to March in USA and UK as well as on the entire global lively hoods.

## 2. Global Warming Fast Facts

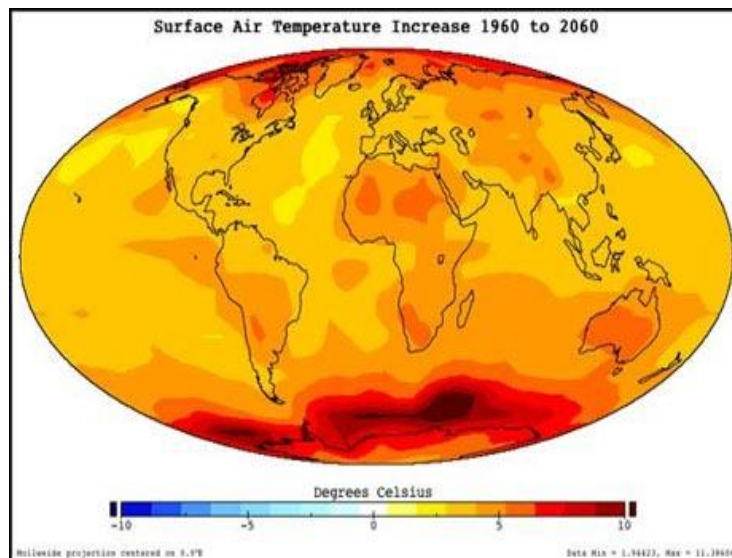
It is a fact that Global warming is human-caused and it will continue for centuries even if greenhouse-gas emissions are stabilized as per the experts of the International Panel of Climate Change (IPCC) report-2007 as shown in **Fig.1**. The human activities not only linked with human activity to Earth's warming temperatures but its continued effect is causing rise in the seas' level, more intense storms, heavy snow fall and a host of many other environmental maladies[1-9].

"Fossil fuel use, agriculture, and land-use change are fundamentally affecting the systems on our planet," Achim Steiner, executive director of the United Nations Environment Programme, said at a press briefing in Paris, France on February 2, 2007.

Still there are many myths that climate change is regular process and there is as such no effect of global warming which is responsible for climate change, intense storms, heavy snow fall or cold waves. People also say that the ice age likely to advance in the near future.

Let us believe this theory for a moment then questions comes:

- i. Whether the earth's solar orbit is shrinking that makes the earth closer to the Sun and causing rise in the temperature? If so, the rotation of the earth around the Sun i.e. 364.256 days should get reduced.
- ii. If the ice age is likely to advance then why intense storm is knocking islands near the coastal areas; why cold waves are advancing towards plane from hilly glaciers and why the Arctic sea is shrinking and causing heavy snow fall experienced in the USA & UK in January 2014?



**Fig. 1.** A world map plots the annual average rise in the surface air temperatures from 1960 to 2060 based on the past measurements and future projections. **Source:** Map courtesy NASA

The truth remains that due to exploitation of the earth's resources and burning of huge quantity of fossil fuel, industrialization etc., global warming is now visible and damaging the climatic conditions, that is mainly caused by humans. This is further justified by global warming fast facts.

### a. Is It Happening?

Yes, the Earth is already showing many signs of worldwide climate change.

- Average temperatures have risen by 1.4 degrees Fahrenheit (0.8 degree Celsius) around the world since 1880, much of this in recent decades, according to NASA's Goddard Institute for Space Studies.
- The rate of warming is increasing. The 20th century's last two decades were the hottest in 400 years and possibly the warmest for several millennia, according to a number of climate studies. And the United Nations' Intergovernmental Panel on Climate Change (IPCC) reports that 11 of the past 12 years are among the dozen warmest since 1850.
- The Arctic region is feeling the effects the most. Average temperatures in Alaska, Western Canada, and Eastern Russia have risen twice the global average temperature, according to the Multinational Arctic Climate Impact Assessment Report compiled between 2000 and 2004.
- Arctic ice is rapidly disappearing, and the region may have its first completely ice-free summer by 2040 or earlier. Polar bears and indigenous creatures are already suffering from the sea-ice loss.
- Glaciers and mountain snows are rapidly melting—for example, Montana's Glacier National Park now has only 27 glaciers, versus 150 in 1910. In the Northern Hemisphere, thaws also come a week earlier in spring and freezes begin a week later.
- Coral reefs, which are highly sensitive to small changes in water temperature, suffered the worst bleaching—or die-off in response to stress—ever recorded in 1998, with some areas seeing bleach rates of 70 percent. Experts expect these sorts of events to increase in frequency and intensity in the next 50 years as sea temperatures rise.
- An upsurge in the amount of extreme weather events, such as wildfires, heat waves, and strong tropical storms, is also attributing in part to climate change by some experts.

### **b. Are Humans Causing It?**

Yes, Burning fossil fuels and deforestation are its chief culprits. Burning of fossil fuels in transport as shown in **Fig. 2**, industrialization & power plants etc. and cutting of forests, known as deforestation are major contribution.



**Fig. 2.** Burning fossil fuels through Transport Sector

Carbon dioxide is the most dangerous greenhouse gas. Methane also can significantly damage the atmosphere. Methane is the primary component of natural gas, which, when burned, emits less carbon dioxide than coal. But unburned, when it is vented or leaked directly into the atmosphere, methane is far more potent, packing a much bigger punch over the first 20 years after its emitted. In other words, methane has the potential to undo much of the greenhouse gas benefits we stand to gain from switching from coal to natural gas. An aging pipeline infrastructure and a rapid expansion in natural gas development are just two reasons why methane emissions are increasing. But fully addressing methane emissions require us raising the bar on detection, as you can't fix what you don't measure. That's why we're tapping tech innovators to invent the next-generation of low-cost air pollution monitors to help companies identify methane leaks in real-time [10-12]. But lowering methane emissions alone is not enough as it also needs to address the other major causes of climate change: *deforestation and the burning of traditional fossil fuels, like coal.*

### 3. What Sea-Ice Loss Means for Development in the Arctic

Researchers predict that nearly ice-free summers are on the way, although it's not yet clear when this will happen. This shift has implications for climate in particular, it is expected to aggravate global warming and for the animals, such as polar bears and walrus, which depend on the ice for habitat as shown in **Fig. 3**. But the loss of ice over the Arctic Ocean also opens up the possibility for increased shipping, tourism, oil and gas exploration, and fishing. But this potential development raises challenges with which nations will have to grapple, said Anne Siders, a postdoctoral researcher with the Columbia Center for Climate Change Law, to an audience at Columbia University Wednesday, Sept. 19, 2012. Siders was among a panel of researchers who discussed the science behind the declining sea ice, the suite of changes occurring in the Arctic and public perception of it. A predictably open Arctic Ocean creates opportunities and challenges for nations that ring the Arctic region.



**Fig. 3.** Threatening for polar bears that depend on the ice for habitat

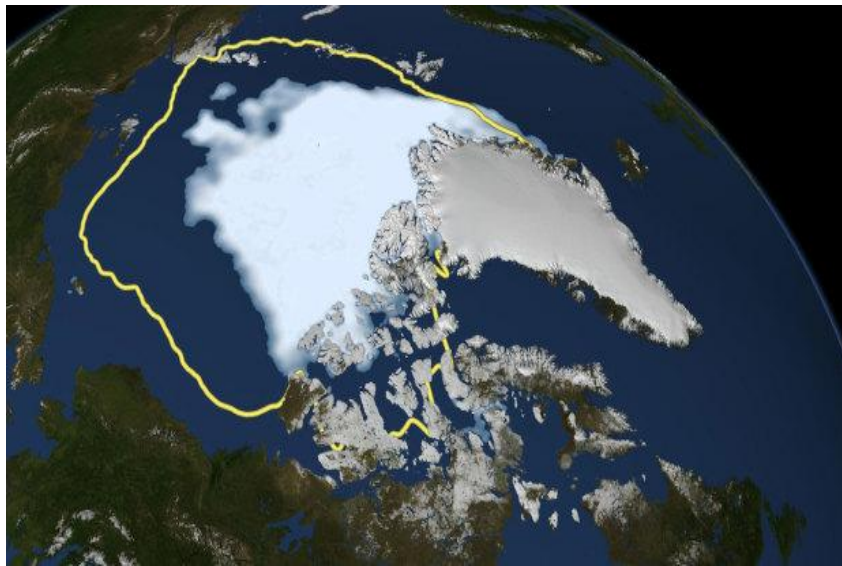
## 4. Arctic Summers Ice Free by 2040,

### 4.1 Study Predicts

Summers in the Arctic Ocean may be ice free by 2040—decades earlier than previously expected, according to a new study of the effects of global warming on sea ice (see Fig.4). The scenario is predicted by computer models that assume greenhouse gas emissions will continue unabated. Gases such as carbon dioxide spewed into the atmosphere by coal-fired power plants and automobiles are considered major drivers of global warming.

According to computer models, if the gases continue to build up in the atmosphere at the current rate, sea ice will steadily decline for decades and then abruptly disappear [13].

There are tipping points in the system, said Bruno Tremblay, an assistant professor of Atmospheric and Ocean Sciences at McGill University in Montreal, Canada and when we reach them, things accelerate in a nonlinear way [14].



**Fig. 4.** Summer sea ice in the Arctic on Sept. 16, 2012, at centre in white, and the 1979 to 2000 average extent for the day shown, with the yellow line.

(Source: NASA satellite- by U.S. National Snow and Ice Data Center)

### 4.2 How Is It Happening?

In the Arctic, the summer melt reduces ice cover to its minimum by September, when the arrival of winter usually refreezes the sea ice.

- In one model simulation, September sea ice coverage will shrink from about 2.3 million square miles (6 million square kilometers) to 770,000 square miles (2 million square kilometers) in a span of ten years.
- By 2040 only a small amount of sea ice will remain along the north coasts of Greenland and Canada, while rest of the ocean basin will remain ice free throughout the summer (North America map).
- Winter ice will thaw from about 12 feet (3.7 meters) to 3 feet (1 meter) thick.
- Tremblay explains that the Arctic sea ice is like a giant mirror. It reflects the Sun's energy back into space and prevents much of it from being absorbed by the ocean.
- But as warmer average temperatures melt the ice, the mirror shrinks. A smaller mirror means that the ocean absorbs more of the Sun's energy, which creates further warming.
- This warming causes more ice to shrink, which causes more heat absorption. "It goes into a positive feedback loop - a very efficient way of getting rid of the ice cover," Tremblay said.
- In addition, climate models suggest that global warming will alter ocean circulation patterns and drive warmer Atlantic waters into the Arctic. "That is a positive feedback as well and it enhances the melting of the ice."

### **4.3 Serious Consequences**

According to Tremblay, as the ice thins due to climate warming, a particularly warm summer or a pulse of warm water from a modified circulation pattern might be the tipping point. "For us to say it could happen by 2020 or 2030 is not unrealistic," he said. "We are already seeing very strong signs in the rate of sea ice change."

Loss of Arctic sea ice would likely take a lethal toll on animals such as polar bears that rely on the ice as a hunting platform [15]. Local indigenous people would also be unable to fish from the ice, forcing them to adapt. "That's going to be a big strain on their mode of living," he said.

What's more, the melting ice could open up new shipping lanes through the Arctic and spark a race to exploit newly exposed resources [16].

### **4.4 North American Cold Wave in the Year 2013-14**

The 2013–14 North American cold waves was an extreme weather event extending from December 2013 to April 2014, and was also part of an unusually cold winter affecting parts of Canada and the Eastern United States [17]. The event consisted of 2 episodes, the first one in December 2013 and the second in early 2014, both caused by southward shifts of the North Polar Vortex. Record cold temperatures also extended well into March.

From December 6–10, 2013, the first wave of record-breaking cold air pushed into the Eastern U.S., before the temperatures returned to a more stable range. On January 2, 2014, an Arctic cold front initially associated with a nor'easter, tracked across Canada and the United States, resulting in heavy snowfall. Temperatures fell to unprecedented levels, and low temperature records were

broken across the United States. Business, school, and road closures were common, as well as mass flight cancellations [18-21]. Altogether, more than 200 million people were affected, in an area ranging from the Rocky Mountains to the Atlantic Ocean and extending south to include roughly 187 million residents of the Continental United States [22].

On December 1, 2013, the weakening of the polar vortex led to the beginning of an abnormally cold trend in the Eastern and Central United States. On December 6, the continued deterioration of the polar vortex led to the jet stream pushing southward, bringing record cold temperatures across the Eastern U.S., from December 6 to December 10, when the arctic air retreated from the region.

Beginning on January 2, 2014, sudden stratospheric warming (SSW) led to the breakdown of the regular polar vortex and subsequent southward movement of tropospheric Arctic air [23].

According to the UK Met Office, the jet stream deviated to the south (bringing cold air with it) as a result of unusual contrast between cold air in Canada and mild winter temperatures in the United States. This produced significant wind where the air masses met, leading to bitter wind chills and worsening the impacts of the record cold temperatures.

## 5 Results and Discussion

From the above study, following points noticed that:

- Sea ice coverage shrank from about 2.3 million square miles (6 million square kilometers) to 770,000 square miles (2 million square kilometers) in a span of ten years.
- Arctic ice is rapidly disappearing, and the region may have its first completely ice-free summer by 2040 or earlier. Polar bears and indigenous creatures are already suffering from the sea-ice loss.
- Sea ice will remain along the north coasts of Greenland and Canada, while rest of the ocean basin will remain ice free through the summer (North America map).
- Glaciers and mountain snows are rapidly melting-for example, Montana's Glacier National Park now has only 27 glaciers, versus 150 in 1910.
- Winter ice will thaw from about 12 feet (3.7 meters) to 3 feet (1 meter) thick.
- Cold air in Canada and winter temperatures in the United States lead to bitter wind chills and worsening the impacts of the record cold temperatures on January 02, 2014.
- On January 06, 2014 Babbit, Minnesota was the coldest place in the country at  $(-37^{\circ}\text{F})$  and cold reached to Dallas, experienced low temperature of  $(-16^{\circ}\text{F})$ .
- On January 03, 2014, Boston had a wind chill and over 7 inches snow whereas Boxford, Massachusetts recorded 23.8 inches of snow and schools and government offices were closed.
- Winnipeg was the coldest major city in Canada on January 6, 2014, it reached a low of  $-37^{\circ}\text{C}$  ( $-35^{\circ}\text{F}$ ), while on January 7, the lowest temperature was  $-36^{\circ}\text{C}$  ( $-33^{\circ}\text{F}$ ). On both days, the temperature did not go above  $-25^{\circ}\text{C}$  ( $-13^{\circ}\text{F}$ ).



- Between January 5 and 6, 2014, temperatures fell 50 °F (28 °C) in Middle Tennessee, and during the cold wave, the strain on the power supply left 1,200 customers in Nashville without power, along with around 7,500 customers in Blount County. The Tennessee Emergency Management Agency declared a state of emergency.
- 24,000 residents lost power in Indiana, Illinois, and Missouri, USA.
- In Newfoundland, Canada, late on January 5, 2014, a power failure left 190,000 customers without electricity and Air transportation was delayed out of airports in Montreal and Ottawa, as well as completely cancelled at Toronto Pearson International Airport, due to concerns about de-icing.

## 6 Conclusions

From the study, it is found that Arctic Sea (Polar Ice) is shrinking very fast due to climate warming, particularly in warm summers. It is only on account of manmade effect of global warming. Thus, the following conclusions are listed below to act upon to fight with the dire consequences of fast shrinkage of Arctic sea, glaciers ice melt:

- There are very strong signs already been seen in the rate of sea ice change for the last one decade.
- Happening by 2020 or 2030 is not unrealistic while most of the ocean basin will remain ice free through the summer from the North America map.
- By 2040 only a small amount of sea ice will remain along the north coasts of Greenland, USA and Canada.
- Potential increase in tundra fires due to permafrost warn that the combined factors could turn the Arctic from a vast carbon sink into a potentially lethal source of methane in less than a decade and enhance the shrinkage of Arctic Sea further.
- There are possibilities to grow glacier near north coasts due to heavy ice sheets meeting in the Atlantic sea.
- Ice sheets meeting to Sea-water may not convert quickly into water and create pressure drop, snow fall, extreme temperature drop to minus (-) 60-70 degree centigrade.
- USA & UK northern region may get affected with cold waves, disasters, intense storms, heavy snow falls and living life may not become conducive.
- The cold waves, extreme temperature drop may force lively hood in North American and Europeans to find new places for their living.

It is expected that the situation may go bad to burst every year and will continue in next 2-3 decades. During winter, New York, Britain and Canada i.e., northern belt, may suffer with extreme weather conditions such as: intense storm, heavy snow fall and power disruption. Since the permafrost melt also confirms as a potential source of runaway global warming due to heavy methane availability, thus it is need of the hour to act very fast to help in stopping Climate Change due to Global Warming by adopting means to Save Earth and Save Life for happy living.

## Acknowledgement

Authors are indebted to extend their thanks to the School of Management Sciences, Technical Campus, Lucknow and Madan Mohan Malviya Technology University, Gorakhpur for providing the support of their Libraries.

## References

- [1] Archer, David. 2006. *Global Warming: Understanding the Forecast*. Hoboken, NJ: Wiley-Blackwell.
- [2] Environmental Defence Fund, "Global Warming Myths and Facts," Accessed: January 17, 2009.
- [3] Global Warming, Union of Concerned Scientists: Citizens and Scientists for Environmental Solutions. 2008. Accessed: November 27, 2008.
- [4] IPCC Fourth Assessment Report: Climate Change 2007. Intergovernmental Panel on Climate Change. Accessed: November 21, 2008.
- [5] Montague, Fred. 2006, Environmental Notebook: Observations, Principles, Trends, and Ideas about Life on Earth, Wanship, UT: Mountain Bear Ink.
- [6] National Geographic News. "Global Warming Fast Facts." Accessed: January 14, 2009.
- [7] Walker, Gabrielle and Sir David King. 2008. *The Hot Topic: What We Can Do about Global Warming*. Orlando, FL: Harcourt, Inc.
- [8] Weart, Spencer R. 2003. *The Discovery of Global Warming*. Cambridge, MA: Harvard University Press.
- [9] H. MacMillan, *Winds of change, 1914-1939* (London: 1966), 575; quoted in Michael Sherry, *The Rise of American Air Power: The Creation of Armageddon* (New Haven: 1987), 74.
- [10] Methane studies fact sheet (Website: [http://www.edf.org/sites/default/files/methane\\_studies\\_fact\\_sheet.pdf](http://www.edf.org/sites/default/files/methane_studies_fact_sheet.pdf))
- [11] Methane Study at University of Texas, FAQ page (web: <http://www.edf.org/climate/methane-studies/faq>).
- [12] Methane Research Studies, Roster of Scientists (web: <http://www.edf.org/climate/methane-studies/partners>).
- [13] Arctic Ice Levels at Record Low, May Keep Melting, Study Warns" October 3, 2005.
- [14] Tremblay, Journal *Geophysical Research Letters* -presented at the fall meeting of the American Geophysical Union in San Francisco, California.
- [15] "Polar Bears Suffering as Arctic Summers Come Earlier, Study Finds", September 21, 2006.
- [16] John Roach, National Geographic News, December 12, 2006, Codie Awards.
- [17] Gutro, Rob. "Polar Vortex Enters Northern U.S.". Retrieved January 8, 2014.
- [18] "N America weather: Polar vortex brings record temperatures". *BBC News – US & Canada* (BBC News Online). January 6, 2014. Retrieved January 6, 2014.

- [19] Calamur, Krishnadev (January 5, 2014). "'Polar Vortex' Brings Bitter Cold, Heavy Snow To U.S.". *The Two Way*. National Public Radio. Retrieved January 6, 2014.
- [20] Preston, Jennifer (January 6, 2014). "'Polar Vortex' Brings Coldest Temperatures in Decades". *The Lede* (The New York Times). Retrieved January 6, 2014.
- [21] "Arctic Monday for 140 million as 'POLAR VORTEX' barrels across the US: 4,400 flights canceled, schools closed as far south as ATLANTA and the coldest temperatures recorded in 20 years". *Daily Mail* (London). January 6, 2014. Retrieved January 7, 2014.
- [22] Associated, The. "5 Things To Know About The Record-Breaking Freeze". NPR. Retrieved January 8, 2014.
- [23] Spotts, Pete (January 6, 2014). "How frigid 'polar vortex' could be result of global warming (+video)". *The Christian Science Monitor*. Retrieved January 9, 2014.