T20 Policy Brief

Task Force 6
Accelerating SDGs: Exploring New Pathways to the 2030 Agenda

THE CONSEQUENCES OF ARCTIC AMPLIFICATION IN A WARMING WORLD

INDIA 2023

भारत 2023 INDIA

July 2023

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Abstract

The Arctic plays a crucial role in maintaining global climate, but human activities are causing irreversible damage to this fragile 'great white shield,' risking catastrophic shifts that have direct impacts on the G20 nations. Since 1980, the Arctic has experienced warming four times faster than the global average, in a phenomenon known as Arctic amplification. This has caused the extent of the Arctic's reflective sea ice to shrink and the amount of heat going into the darker ocean to increase, causing more ice to melt in a self-amplifying feedback loop. As the Arctic becomes warmer and less reflective, changes are already evident across the globe through teleconnections, and more changes are expected. To address the challenges of a warming Arctic, the G20 members should conduct a multi-country study to improve the understanding of global risks associated with a warming Arctic and implement immediate efforts to cut short-lived climate pollutants (SLCPs) to slow the rate of warming, protect the Arctic, and keep the 1.5°C-guardrail within reach.

The Challenge

1

a. Arctic amplification accelerates global warming

The loss of Arctic summer sea ice is accelerating climate change by reducing the Arctic's ability to reflect incoming solar radiation safely back to space.[1] In 2007, Arctic sea ice underwent a significant shift which is unlikely to be reversed, becoming thinner, younger, and more vulnerable.[2] The extent of Arctic sea ice in September declined by 43 percent between 1982 and 2020, and the region could be ice free in September within the next 10–15 years.[3,4] Losing Arctic sea ice in the summer months would result in warming equivalent to a trillion tons of CO_2, or 25 years of emissions.[5] Melting land-based snow and ice will cause further warming. [6]

Arctic sea ice thickness and volume reduced by 48 percent and 72 percent, respectively, between 1982 and 2020.[7] The decline in ice older than four years is significant, since older ice is denser and less susceptible to decline than first-year ice. Between 1985 and 2018, multi-year Arctic sea ice declined by 95 percent;[8] young ice now accounts for about 70 percent of the ice pack.[9]

The warming of the Arctic Ocean due to the influx of warmer water from the Atlantic and Pacific oceans significantly contributes to the melting of sea ice and overall Arctic warming.[10] As a result, the Arctic is experiencing unprecedented extreme events; since 2000, the Arctic has experienced heatwaves similar to those in the middle and low latitudes, while cold spells lasting more than 15 days have become nearly non-existent.[11] These extreme events, exacerbated by sea ice loss, have also been observed in adjacent and distant regions.

b. Impact on tipping points and self-amplifying feedbacks

Permafrost thaw

Permafrost thaw is another self-amplifying feedback loop accelerated by Arctic warming, leading to emissions of climate pollutants, increased lightning storms, and wildfires.[12] As permafrost thaws, it releases CO_2, methane, and nitrous oxide, which not only warms the climate but also destroys stratospheric ozone.[13] Without rapid mitigation efforts, permafrost thaw could release climate pollutants equivalent to the remaining carbon budget of the 1.5°C target.[14]

Permafrost thaw could pose a severe risk to 3.3 million people by 2050, including 42 percent of human settlements and 70 percent of current infrastructure within the permafrost domain, including 45 percent of the oil and gas production fields in the Russian Arctic.[15] The projected cost of permafrost thaw-related damage to Russian infrastructure alone could reach US$69 billion by 2050.[16]

Melting Greenland Ice Sheet and weakening Atlantic Meridional Overturning Circulation (AMOC)

Over the past two decades, the Greenland Ice Sheet's melt rate has increased by 250–575 percent.[17] This increase, caused in part by the warming Arctic, pushes the ice sheet towards irreversible collapse, which is likely to occur if warming surpasses 1.5°C.[18] Ice sheet melt by the end of the century will cause at least 27.4–78.2 centimetres of sea-level rise, threatening at least 10 percent of the global population living in low-lying coastal areas and increasing the risk of catastrophic coastal flooding.[19,20]

Additionally, the AMOC has weakened since 2008,[21] and climate and ocean models indicate that Arctic changes drive 75 percent of AMOC decline,[22] with depleting Arctic sea ice influencing the AMOC through ocean heat fluxes.[23] A complete collapse of the AMOC would lead to faster sea-level rise along parts of the eastern US and Europe, stronger hurricanes in the southeastern US, and reduced rainfall across the Sahel.[24]

c. Global impact via teleconnections

Indian Summer Monsoons (ISM)

Declines in summer Arctic sea ice correlate with the strength of the ISM, with a proposed teleconnection mechanism linking higher pressure in the high latitudes of the northern hemisphere and lower Eurasian snow cover with an increase in monsoon strength.[25] The ISM provides more than 70 percent of the annual precipitation in India, and its disruption directly impacts the agriculture sector, which supports the livelihood of over half of the country's population, contributes to a fifth of its GDP, and is critical for food security in the country.[26]

From 1951 to 2015, ISM experienced a non-linear trend, with the average precipitation rate declining by 6 percent during the period.[27] From 1901 to 2020, there has also been a 4–10 percent increase in the frequency of extreme rainfall in parts of India.[28] Overall, the frequencies of both dry spells and wet spells have increased.[29]

While most processes influencing the ISM occur in the troposphere and oceans, the interaction between depleting Arctic sea ice and jet streams can also impact the strength of the ISM through upper tropospheric and lower stratospheric teleconnections.[30] Recent observation-based studies show a correlation between Arctic sea ice loss and extreme ISM rainfall events,[31] which contribute to Arctic ice melt through an atmospheric bridge by transporting heat from Asia to the Arctic.[32] Another recent modelling study found that, combined with El Niño, below-normal Greenland sea ice can increase rainfall over central India and reduce rainfall in northern India.[33]

Aridification of California

Between 2000 and 2021, California experienced the driest period in over 1,200 years,[34] and in 2022, lost food production cost the state US$3.5 billion.[35] Drying increases the risk of wildfires, which burned over 362,000 acres of land in 2022.[36] The cost of damages from wildfires has increased from an average of US$61 million in the 1990s to US$400 million in the 2010s.[37]

Decreased wintertime precipitation, which accounts for 75 percent of annual precipitation, has also been linked to changes in Arctic sea ice.[38] Furthermore, Arctic amplification leads to changes in mid-latitude circulation patterns, resulting in decreased storm activity over the north Pacific and north Atlantic oceans.[39]

An equally alarming threat to California is the increasing number and intensity of heatwaves. The loss of Arctic sea ice in the Chukchi Sea has been linked to increased heatwaves in California.[40] Drought conditions can also intensify the duration and severity of heatwaves, with low-income communities and individuals with underlying health conditions being the most vulnerable.[41]

The G20's Role

2

Global warming and its amplification in the Arctic pose a significant threat to global weather patterns and can cause economic and social damage to the G20 countries and the rest of the world. Urgent action to preserve and understand the Arctic should be taken not only by Arctic nations but also by non-Arctic states such as India, China, France, Germany, Italy, Japan, South Korea, and the United Kingdom, all of whom are G20 members and Arctic Council non-Arctic state observers. These countries have national Arctic policies that recognise the importance of the Arctic, the potential risks of a rapidly changing Arctic, and commitments to collaborate in order to conserve the Arctic.

Despite their membership in the Arctic Council, most G20 members actively promote research to explore the feasibility of new shipping routes and oil and gas development in the region. These developments trigger further pollution and warming as more heavy fuel oil is burnt, emitting black carbon, which will fuel the feedback loop.[42] Increased number of Arctic shipping lanes also introduce geopolitical problems and pose other evolving security risks.

The G20 members need to formulate explicit policies aimed at preventing harmful exploitation of the Arctic, and global cooperation is urgently required to protect the Arctic and prevent the catastrophic changes caused by self-amplifying feedback loops that can accelerate climate change.

Recommendations to the G20

3

a. Improve understanding of Arctic science

Latest scientific research on the global impacts of a warming Arctic emphasises the importance of ensuring that climate models accurately represent relevant physical processes, such as Arctic teleconnections, the weakening of the AMOC, and the melting of the Greenland Ice Sheet. A recent study has highlighted the need for improved monitoring and data collection.[43] Observing and understanding the processes linking the Arctic to global weather and climate patterns is essential given the possible catastrophic impacts.

Current Arctic policies by Arctic and non-Arctic G20 members within the Arctic Council focus on exploring the feasibility of new shipping routes and oil and gas drilling in the Arctic, which introduces further regional risks by shifting emissions from low to high latitudes. Collaboration is required to enhance black carbon emissions inventories through regular reporting and investments in observation sites.

A multi-pronged approach is needed to mitigate the environmental, societal, and economic risks posed by a warming Arctic. International cooperation, institution building, and sustainable management of Arctic resources using local knowledge can strengthen pre-emptive action. More in-depth understanding, modelling, and measurement of Arctic amplification and teleconnections is necessary to inform policy decisions and action. Given the limitations of current observational datasets and climate models, a multi-country study would be an appropriate starting point.

b. Reduce SLCP emissions

To reduce the rate of Arctic warming and respond to the near-term climate emergency, the G20 should implement fast-acting strategies that cut non-CO_2 super pollutants, particularly short-lived climate pollutants (SLCPs), including methane, black carbon, hydrofluorocarbons, and tropospheric ozone, which can slow warming in the near term and slow the loss of Arctic sea ice.[44]

Cutting non-CO_2 super-pollutants, rather than solely targeting CO_2, can slow warming four times faster, avoiding up to 0.6°C of warming by 2050 and up to 1.2°C by 2100.[45] These measures can reduce the rate of warming in the Arctic by two-thirds.[46] The Intergovernmental Panel on Climate Change (IPCC), along with 11,000 scientists, has stressed the importance of cutting non-CO_2 super-pollutants to limit warming to 1.5°C and slow climate feedback loops, potentially reducing the short-term warming trend by more than 50 percent over the next few decades while saving millions of lives, increasing crop yields, and protecting the Arctic.[47]

Moreover, the Arctic is nearly five times more sensitive to black carbon emitted in the Arctic region than from similar emissions in the mid-latitudes.[48] In the Arctic, black carbon warms the atmosphere and darkens the snow and ice, which reduces reflectivity, since the darker surface absorbs extra solar radiation, thus causing further melting.[49]

The Arctic Council has already recognised the importance of addressing the region's black carbon and methane emissions. In 2019, the Council committed to reducing black carbon emissions by at least 25–33 percent below 2013 levels by 2025.[50] These reductions should be prioritised by the G20 members as they will help improve air quality and reduce the number of people exposed to fine particle concentrations from 18 million to 1 million while preventing 40 percent of air pollution related deaths in Arctic Council countries by mid-century.[51]

However, it is crucial to strengthen other commitments, including the International Maritime Organization's (IMO) ban on heavy-fuel oil (HFO) use in the Arctic for some ships from July 2024, with waivers and exemptions for others until 2029.[52] This timeline should be shortened to minimise the rapid rate of warming in the Arctic. The HFO ban could reduce black carbon emissions by up to 30 percent without waivers or exemptions.[53]

Banning investments in Arctic oil and gas development can further help protect the region. All major US banks—Bank of America, Goldman Sachs, JP Morgan Chase, Wells Fargo, Citi, and Morgan Stanley—have committed to stop the funding of oil and gas exploration in the Arctic.[54] Insurance companies, including AXA, Swiss RE, and Zurich Insurance, are also beginning to commit to banning the coverage of Arctic oil projects.[55]

Other implementable solutions to reduce black carbon and methane emissions in the Arctic include developing low-impact shipping corridors, eliminating gas flaring, implementing clean cookstoves, setting higher emission requirements on and phasing out inefficient cookstoves, regulating emissions from on- and off-road transport and stationary engines, and minimising open biomass burning.[56]

Attribution: Durwood Zaelke et al., “The Consequences of Arctic Amplification in a Warming World,” *T20 Policy Brief*, July 2023.

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