

Climate Change and International Security

**“The biggest threat to security modern humans
have ever faced”**

Sir David Attenborough

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Foreword

Conflict resolution analysis in recent years has focused on the economic, political and social aspects of specific conflicts, such as those in Afghanistan, Libya, and Syria. What has been missing is a broader understanding of the potential impact of climate change in the Middle East, North Africa and the Sahel and the new generation of conflict that will emerge in the short to medium term.

This report provides an overview of the impacts of climate change, how it can fuel armed conflict, and the broader implications for the region. It concludes with recommendations for strengthened multilateral cooperation in addressing climate change and the threats posed by changes in the natural world to international peace and security.

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List of Abbreviations

AMOC	Atlantic Meridional Overturning Circulation
COP	Conference of Parties
MENA	Middle East and North Africa
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
SIPRI	Stockholm International Peace Research Institute
UAE	United Arab Emirates
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WFP	World Food Programme

I. Introduction

As scientists have warned for decades, Earth's climate is changing rapidly and dramatically. The global average temperature in the first two decades of the 21st Century was 1.1 degrees Celsius warmer than the average temperatures recorded from 1850 to 1900, according to the Intergovernmental Panel on Climate Change (IPCC).¹ This brings Earth's temperature to within 0.4 degrees of the 2015 Paris Agreement's goal to limit temperature rise to 1.5 degrees Celsius above pre-industrial levels.

The consequences are evident all around the world. Climate change is causing destructive weather events and massive wildfires, glacial melting and rising sea levels, water and food shortages and devastating loss of ecosystems. As societies struggle to assess the extent of the social, economic and environmental shocks that may come, there is growing recognition that climate change will have a direct impact on international peace and security in the years ahead.

Military establishments in several countries have already indicated concern about the complex emergencies that may be triggered by climate-related events in the future. NATO, recognizing that climate change may pose challenges greater than originally envisioned for the organization, is preparing for increased cooperation on situational awareness and information sharing on future climate threats.² In the United States, military leaders have been concerned to see coastal military bases imperiled during increasingly severe Atlantic storm seasons, and are now planning for a world of increased instability and humanitarian disasters as the impacts of climate change take effect.³

At the United Nations, there are increasing calls for the Security Council to take a more active role in anticipating and addressing climate-related risks to international peace and security. In 2020, a group of Security Council members declared climate change to be "the defining issue of our time and a multidimensional challenge,"

which the United Nations system has yet to address comprehensively and systematically. "Millions of people around the world today already experience the effects of climate change which exacerbates, prolongs or contributes to the risk of future conflicts and instability and constitutes a key risk to international peace and security," they stated.⁴

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In February 2021, the United Kingdom convened a Security Council open debate on climate and security and invited the naturalist Sir David Attenborough to address the Council. Calling climate change "the biggest threat to security modern humans have ever faced," he warned that "[we] are now perilously close to tipping points, that once passed, will send global temperatures spiraling catastrophically higher." Xie Zhenhua, Special Envoy for Climate Change of China, stressed that "any role played by the Security Council must fall under its purview." John Kerry, Special Presidential Envoy for Climate of the United States, noted that no one country can solve the climate crisis on its own. "It is exactly the kind of crisis the United Nations was created to address."⁵

¹Intergovernmental Panel on Climate Change, "Climate Change 2021, The Physical Science Basis," Working Group I Contribution to the Sixth Assessment Report.

²Erlanger, Steven, "NATO Needs to Adapt Quickly to Stay Relevant for 2030, Report Urges," New York Times, 30 November 2020.

³Floumoy, Michèle A., "Key player in war on climate change? The Pentagon," CNN, 26 October 2020.

⁴Permanent Mission of the Federal Republic of Germany to the United Nations, Joint Statement on the Open Debate of the Security Council on Climate and Security, 24 July 2020.

⁵United Nations Security Council Open Debate on Climate and Security, 23 February 2021.

II. Accelerating Change of Earth's Climate

1. "A Vast Increase in the Amount of Carbon Dioxide Reaching the Atmosphere"

In 1959, scientists at the National Oceanic and Atmospheric Administration (NOAA) observatory on the Mauna Loa volcano in Hawaii measuring the concentration of carbon dioxide in the earth's atmosphere found that the atmosphere contained about 315 parts per million of carbon dioxide. This measurement showed a dramatic increase above the historic levels of atmospheric concentration of carbon dioxide of less than 300 parts per million that had prevailed throughout human history.⁶ Before the start of the Industrial Revolution in England in the 1700s, the concentration of carbon dioxide in the atmosphere was 280 parts per million.⁷

Three decades later, the science was clear that continued changes in the chemical balance of the atmosphere would affect life on Earth.⁸ In 1988, Dr. James Hansen, director of NASA's Goddard Institute for Space Studies, in testimony before the United States Senate Energy and Natural Resources Committee, told senators that "it was 99 percent certain that the warming trend experienced at the time was not a natural variation but was caused by a buildup of carbon dioxide and other artificial gases in the atmosphere."⁹ His warning that human activity was responsible for a change in Earth's climate came as a shock to many, and was reported around the world.

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The following year, at the United Nations General Assembly, Prime Minister Margaret Thatcher of the United Kingdom spoke of the urgency and importance of the growing threat to the global environment. "We are seeing a vast increase in the amount of carbon dioxide reaching the atmosphere," she said. "The annual increase is three billion tonnes: and half the carbon emitted since



the Industrial Revolution still remains in the atmosphere. At the same time as this is happening, we are seeing the destruction on a vast scale of tropical forests which are uniquely able to remove carbon from the air." The result, she warned, "is that change in future is likely to be more fundamental and more widespread than anything we have known hitherto."¹⁰

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Thatcher called for an international framework convention on climate change and a global convention "to conserve the infinite variety of species – of plants and animal life – which inhabit our planet." Three years later, at the 1992 Earth Summit in Rio de Janeiro,¹¹ world leaders joined together to adopt the United Nations Framework Convention on Climate Change (UNFCCC) with an objective to stabilize the concentration of greenhouse gases in the atmosphere at a level that would prevent dangerous interference with Earth's climate system.

The UNFCCC goals were confirmed in subsequent climate conferences over the years. At the 21st Conference of Parties (COP) of the UNFCCC in Paris in 2015, leaders of 196 nations agreed to strengthen the global response to the threat of climate change by keeping the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase further to 1.5 degrees Celsius.

⁶NOAA Global Monitoring Laboratory, Earth System Research Laboratories.

⁷The Swedish scientist Svante Arrhenius in 1896 published a paper arguing that increased levels of carbon dioxide could raise global temperatures.

⁸In 1967, Dr. Syukuro Manabe of Princeton University developed a computer model that confirmed the connection between carbon dioxide and warming in the atmosphere. In 2021, Dr. Manabe was awarded the Nobel Prize for Physics for his groundbreaking work.

⁹Shabecoff, Philip, "Global Warming Has Begun, Expert Tells Senate," New York Times, 24 June 1988.

¹⁰Margaret Thatcher, Speech to the United Nations General Assembly (Global Environment), 8 November 1989

¹¹United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 3-14 June 1992.

2. One Trillion Tons of CO2 Added to the Atmosphere

By the end of 2020, it was clear that the global commitments since the Rio Earth Conference to avert catastrophic warming of the planet had not been effective. The past decade had been the hottest in human history and ocean heat was found to be at record levels. United Nations Secretary-General Antonio Guterres noted that greenhouse gas emissions were now 62 percent higher than when the international climate negotiations began in 1990.¹² The World Meteorological Organization warned that with the average global temperature hitting record highs in 2020, the Paris Agreement's 1.5 degrees Celsius milestone could be surpassed in as little as four years.¹³

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In May 2021, measurements by the NOAA Mauna Loa Observatory in Hawaii showed that atmospheric carbon dioxide levels had reached an average of 419 parts per million.¹⁴ This means that atmospheric concentrations of carbon dioxide have increased by 50 percent over the 1750 –1800 average.¹⁵ Scientists estimate that carbon levels are now comparable to where it was during the Pliocene era, more than 4 million years ago, when global sea levels were about 23 meters higher than today.¹⁶ According to Scientific American, well above one trillion tons of carbon dioxide had now been emitted by humans through the burning of fossil fuels since the start of the Industrial Revolution.¹⁷

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Worrisome new data also suggests that Earth's climate may be considerably more sensitive to carbon dioxide emissions than had previously been believed. Modeling

results from more than 20 scientific institutions for inclusion in the United Nations Intergovernmental Panel on Climate Change (IPCC)¹⁸ assessment on the scientific basis of the risk of human-induced climate change now indicated that the amount of warming projected from a doubling of atmospheric carbon dioxide concentrations from the pre-industrial level of 280 parts per million could lead to a significantly higher temperature increase than previously projected.¹⁹

3.A Profound Impact on Land and in the Oceans

With the increase in global temperatures already more than 1 degree Celsius above the pre-industrial level, we are seeing a profound impact on the environment, ecosystems and people. Wildfires, droughts, floods and hurricanes have continued to increase in frequency and severity. Oceans are warmer and more acidic, causing stress to ocean ecosystems around the world.²⁰ The abundance of fish in the world's oceans is no more, with fish stocks depleted and many species close to extinction. The Great Barrier Reef, which supports a vast array of marine life off the coast of Australia, has now lost half of its coral populations.²¹

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According to the IPCC, oceans have taken up more than 90 percent of the excess heat in the climate system. This warming, as well as changes in ocean circulation and chemistry, are disrupting species throughout the ocean food chain. Marine heatwaves have doubled in frequency, fueling stronger and more frequent hurricanes.²² Some 30 percent of human-induced carbon dioxide emissions have been absorbed by the oceans, resulting in chemical reactions that cause ocean acidification, which harms shellfish and other marine organisms.²³

¹²Harvey, Fiona, "Humanity is waging war on nature, says UN secretary general," Guardian, 2 December 2020.

¹³"2020 may be the third hottest year on record, world could hit climate change milestone by 2024," UN News, 2 December 2020.

¹⁴"Carbon dioxide peaks near 420 parts per million at Mauna Loa observatory," NOAA Research News, 7 June 2021

¹⁵Betts, Richard, "Met Office: Atmospheric CO2 now hitting 50% higher than pre-industrial levels," Met Office Hadley Centre and University of Exeter, 16 March 2021.

¹⁶"Carbon dioxide peaks near 420 parts per million at Mauna Loa observatory," NOAA Research News, 7 June 2021

¹⁷Scharf, Caleb A., "The Crazy Scale of Human Carbon Emission," Scientific American, 26 April 2017.

¹⁸The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report on the scientific basis of risk of human-induced climate change is to be released in the first half of 2022.

¹⁹Watts, Jonathan, "Climate worst-case scenarios may not go far enough, cloud data shows," Guardian, 13 June 2020.

²⁰Chinese Academy of Sciences, "Upper ocean temperatures hit record high in 2020," Phys.Org, 13 January 2020.

²¹Cramer, Maria, "The Great Barrier Reef Has Lost Half Its Corals," New York Times, 14 October 2020.

²²IPCC Special Report on the Ocean and the Cryosphere in a Changing Climate, 24 September 2019.

²³National Ocean Service, National Oceanic and Atmospheric Administration. <https://oceanservice.noaa.gov/facts/acidification.html>

Temperatures in the Arctic are rising twice as fast as in other regions, leading to rapid melting of glaciers and permafrost. Arctic sea ice has declined by 12 percent per decade since satellite measurements began in the 1970s.²⁴ And for the first time in recorded history, the Arctic's thickest ice is starting to break up, exposing open water north of Greenland, an area normally frozen all year.²⁵ In 2020, the minimum extent of Arctic ice was the second lowest ever recorded.

In Antarctica, temperatures in 2020 rose to 20 degrees Celsius for the first time in recorded history, causing further stress to its vast ice cover. It is estimated that the Antarctic ice sheets have existed in their current form for 34 million years. But studies show that as much as 60 percent of Antarctica's glaciers are now at risk of fracture. A loss of this amount of ice in Antarctica would cause devastating destruction to the Southern Ocean ecosystem.²⁶

In December 2021, the American Geophysical Union warned that the Thwaites glacier in western Antarctica, the largest glacier on Earth, could collapse in just a few years. Warming ocean water is melting the ice from below, and an estimated 900 billion metric tons of ice has been lost since 2000. A collapse of the Thwaites glacier could trigger a cascade of glacial collapse across Antarctica.²⁷

Scientists also warn that the rising temperatures and loss of snow and ice cover may unleash a dangerous climate change feedback effect. The rapid melting of the glaciers in the Arctic, Antarctica and mountain regions around the world could thus bring about an 'ice albedo effect,' whereby the earth's reflectivity is diminished when ice melts and gives way to the darker and less reflective surfaces of the oceans and land.²⁸ The loss of Earth's extensive ice cover could then lead to an even more dramatic increase in global temperatures than currently expected.

A recent study by the Potsdam Institute for Climate Impact Research found that, even if the Paris Agreement

goal of keeping global warming to 2 degrees Celsius is met, melting of the Antarctic ice sheets will cause sea level rise of some two and a half meters around the world. If temperatures should rise four degrees above pre-industrial levels, which is where we are heading with current levels of greenhouse gas emissions, the sea level would rise as much as six meters from Antarctic ice loss alone. If the melting of the Greenland ice sheets and other mountain glaciers around the world are included in the estimates, the sea level rise would be even higher.²⁹

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The consequences would be catastrophic, with coastal communities around the world at risk of flooding and inundation by the rising waters. The IPCC has warned that hundreds of millions of people could be affected. The threat to population centers in Asia is particularly high, with cities like Dhaka, Ho Chi Minh City, Mumbai, Shanghai and Tokyo dangerously exposed to rising waters. Other vulnerable cities include Alexandria, Miami, New York, Rio de Janeiro and Venice.³⁰ Coastal communities in countries such as Benin, Cote D'Ivoire, Nigeria, Senegal and Togo are also highly exposed.^{31 32}

For some small island states, the rising oceans around them could pose a threat to their very existence. Recognizing this threat, the World Bank in 2017 warned that the situation was serious, with low-lying archipelago states such as Tuvalu and Kiribati in the Pacific Ocean acutely vulnerable to climate change. Looking at contingency planning in the Pacific region, the World Bank urged more secure countries like Australia and New Zealand to prepare to open its borders to climate migrants as the situation becomes more dire.³³

In October 2012, the citizens of New York were shocked to see water rising above the city's seawalls when Hurricane Sandy brought a massive storm surge to its shores. In an unprecedented event, water flooded through the city's streets and tunnels, inundating buildings and causing electrical outages. Hurricane Sandy had formed over the Atlantic, first making landfall in Jamaica and Cuba, then continuing through the Caribbean and up the entire eastern seaboard of the United States, from Florida to Maine, before dissipating over Ontario, Canada.

4. Heatwaves and Unusual Weather Events

In July 2020, an unusual 'heat dome' spread across the Middle East. In Bagdad, the temperature soared to 51.8 degrees Celsius, the highest on record for the city. The heat was overwhelming, leading to tensions throughout the city. Two protesters were shot dead by security forces during demonstrations over electricity shortages that had made refrigeration, fans and air conditioning out of reach for many. In Lebanon, which was also suffering from a nationwide electricity crisis, the temperature in Beirut rose to 45 degrees Celsius. In Damascus, Syria, the temperature also broke records, at 46 degrees Celsius.³⁴

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Two weeks later, in California's Death Valley, the temperature rose to 54.4 degrees Celsius (130°F), the world's hottest temperature ever reliably recorded.³⁵ Drought and heatwaves had spread across much of the United States during the summer and, in northern California, the record-breaking temperatures caused an unusual number of intense lightning storms, most without rain. More than 6,000 lightning strikes were recorded in just 24 hours.³⁶ Over the next two weeks, fires incinerated six times as much land as all the destructive wildfires in California in 2019, forcing 100,000 people to flee their homes.³⁷

The rising global temperatures also gave way to more intense storms over the oceans. The 2020 Atlantic Ocean hurricane season was the fifth consecutive year with above-normal activity.³⁸ In early November, Hurricane Eta, a Category 4 hurricane, roared off the Caribbean Sea, making landfall on the coast of Nicaragua. The massive storm lingered for three days over Central America, its rain and winds devastating nations already weakened by the Covid-19 pandemic and the economic crisis that followed. More than 215 people were killed in Guatemala, Honduras, Mexico and Panama.

Two weeks later, Hurricane Iota, another massive storm, made landfall just 15 miles from where Eta had landed. The combined destruction of the two storms was immense, leaving thousands of homes destroyed, infrastructure damaged and vast tracts of farmland inundated by heavy rains. Some 7 million people were affected by the two storms, according to the United Nations.³⁹ "The devastation is beyond compare," said Adm. Craig S. Fuller, the head of the U.S. Southern Command, which had delivered aid to survivors of the storms. "When you think about Covid, plus the double punch of these massive, major hurricanes back-to-back - there are some estimates of up to a decade to recover."⁴⁰

The economic impact of the two hurricanes in Nicaragua alone was estimated at \$738 million – about 6 percent of the country's GDP. In Honduras, the San Pedro Sula Valley, the economic center of the country, was devastated. Months after Eta's and Iota's destruction, thousands had left Honduras in the hope of finding safety elsewhere. "These people have lost everything, even their hope," César Ramos, of the Mennonite Social Action Commission, told the New



²⁴Fountain, Henry, "Shift to a Not-So-Frozen North Is Well Underway, Scientist Warn," New York Times, 8 December 2020.

²⁵Bobbe, Sarah, "An Unprecedented Breakup of Ice in the Arctic," Ocean Conservancy, 27 August 2018.

²⁶Kerry, John, "China's Chance to Save Antarctic Sea Life," New York Times, 26 October 2020.

²⁷Weisberger, Mindy, "Antarctica's 'Doomsday Glacier' could meet its doom within three years," Space, 21 December 2021.

²⁸Arctic Ice Project, 2020.

²⁹Harvey, Fiona, "Melting Antarctic ice will raise sea level by 2.5 metres – even if Paris climate goals are met, study finds," Guardian, 23 September 2020.

³⁰OECD, Southampton University, Risk Management Solutions and CIRED/Meteo-France, Ranking of the World's Cities Most Exposed to Coastal Flooding.

³¹"West Africa at the Precipice: Visualizing Climate Stress and Insecurity," Igarape Institute, February 2021.

³²Princewill, Nimi, "Lagos floods: Africa's most populous city could be unlivable in a few decades, experts warn," CNN, 1 August 2021

³³Doherty, Ben and Roy, Eleanor Ainge, "World Bank: let climate-threatened Pacific islanders migrate to Australia or NZ," Guardian, 8 May 2017.

³⁴Cappucci, Matthew and Salim, Mustafa, "Bagdad soars to 125 degrees, its highest temperature on record. Extreme heat hits the Middle East, with records falling in Iraq, Iran, Saudi Arabia, Lebanon and Syria," Washington Post, 29 July 2020.

³⁵Lustgarten, Abraham, "How Climate Change Will Remap Where Americans Live," ProPublica and The New York Times, 20 September 2020.

³⁶Gorman, Steve, "California's heat wave and lightning storms rooted in same weather patterns," Reuters, 18 August 2020.

³⁷Lustgarten, Abraham, "Climate worst-case scenarios may not go far enough, cloud data shows," Guardian, 13 June 2020.

³⁸U.S. National Oceanic and Atmospheric Administration, "Record-breaking Atlantic hurricane season draws to an end," 24 November 2020.

³⁹"Natural and political disasters in Central America," Economist, 10 December 2020.

⁴⁰Kitroeff, Natalie, "2 Hurricanes Devastated Central America. Will the Ruin Spur a Migration Wave?" New York Times, 4 December 2020.

⁴¹Kitroeff, Natalie, "Stay or Go? Storms Were a Tipping Point for Many Hondurans," New York Times, 7 April 2021.

In the United States, Hurricane Laura, also a category 4 hurricane, caused more than \$13 billion in damage when it struck Lake Charles, Louisiana, in late August 2020. Six weeks later, Hurricane Delta made landfall just 12 miles from where Laura had landed, causing an additional \$4 billion in damages. Munich Re, the global reinsurance company, estimated the damage from hurricanes, wildfires and other disasters in the United States in 2020 at \$95 billion, almost double the amount in 2019.⁴²

The Pacific Ocean storm season had also intensified. In May 2020, Cyclone Amphan displaced five million people in Bangladesh and India.⁴³ In late October, Typhoon Molave hit the Philippines and Indochina, followed shortly thereafter by Super Typhoon Goni, which killed 31 people and caused more than \$1 billion in damage in the Philippines.⁴⁴

In China, torrential rains during the 2020 monsoon season caused extensive flooding along the Yangtze River and other major rivers, displacing more than 2 million people.⁴⁵ President Xi Jinping spoke to officers of the People's Liberation Army and the People's Armed Police who had been involved in the relief work downstream from the Three Gorges Dam, reminding them: "The Chinese nation has fought natural disasters for thousands of years, gaining precious experience." The devastating flooding occurred just as the first wave of the Covid-19 pandemic had been brought under control in China.⁴⁶

5. The Ancient Cedars of Lebanon

The storied cedars of Lebanon have been praised throughout history. Mentioned in one of humanity's oldest tales, the Epic of Gilgamesh, as perfect for the building of temples and fortresses, the cedars survived the Mesopotamians, Phoenicians and ancient Egyptians, the Greek and Roman empires, crusaders and modern wars. Scientist now warn that climate change may wipe out most of Lebanon's cedar forests by the end of the century.⁴⁷

As the climate has warmed, the cedars have been dying at unprecedented rates. In the Shouf Biosphere Reserve, Lebanon's largest protected area, it used to rain or snow 105 days a year. At higher altitudes, snow stayed on the ground for three to four months. In 2018, there were just 40 days of rain and only a month of snow. An insect infestation, unknown before 1997, in the Tannourine Cedars Forest Nature Reserve, led to the loss of more than 7 percent of its trees. "Climate change is a fact here," Nizar Hani, director of the Shouf Biosphere Reserve told a reporter.⁴⁸

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Climate change is also killing the majestic redwoods and sequoias of California. The sequoias are some of the largest and oldest trees on Earth. One fallen tree had been estimated to date back more than 3,200 years. Due to their size, fully grown sequoias used to be safe from fires. Only the younger trees would succumb, leaving the mature trees standing. But since 2015, nearly two-thirds of the 48,000 acres of giant sequoia groves have burned, half in 2020 alone. With the fires bigger, hotter and higher than ever, hundreds of the large sequoias and redwoods may have been wiped out by the wildfires.⁴⁹

The large Dome Fire in the Mojave Desert to the south tore through the Joshua tree woodland of Cima Dome, an unusual phenomenon in a desert. A total of 43,273 acres burned, and an estimated 1.3 million Joshua trees were killed in the fire. With wildfires raging throughout the state, a request from the local fire department for extra resources to contain the desert fire was denied. In nearby Death Valley, the temperature had just risen to 54 degrees Celsius.⁵⁰

The 2020 California wildfire season was the worst in recorded history. By the end of the year, Cal Fire reported that nearly 10,000 fires had burned over 4.2 million acres, more than 4 percent of California's 100 million acres of land. In Oregon, fires burned approximately 1 million acres of land, almost double the 10-year average of 557,000 acres. At the same time, nearly 700,000 acres burned in Colorado. Smoke from the fires on the West Coast spread across the continent to the East Coast of the United States.⁵¹

Record heat also fueled wildfires in the vast boreal forests of the Northern Hemisphere and accelerated the warming of frozen ground in Alaska, Greenland and Siberia. In June 2020, the temperature in the Siberian town of Verkhoyansk reached a record 37 degrees Celsius. As the permafrost melts in the Arctic region, the landscape itself is warping - twisting riverbanks, roads, buildings and infrastructure. In Siberia, the enormous Batagaika crater is growing at an alarming rate as the tundra around it thaws.⁵²

Half the fires in Russia's Arctic region burned through peatlands, releasing large amounts of carbon dioxide, nitrous oxide and methane, a gas that has more than 80 times the warming power of carbon dioxide.⁵³ According to data collected by NASA and the EU Copernicus Atmosphere Monitoring Service, the Arctic fires in Russia released more carbon dioxide in just June and July 2020 than in any complete fire season in the region since data collection began in 2003.⁵⁴

Northern peatlands contain as much as 1,600 billion tons of carbon, organic matter preserved over millions of years. Should this be released into the atmosphere, it could lead to dramatically accelerated global warming.⁵⁵ A recent study of permafrost at the Stordalen mire by the town of Abisko in northern Sweden found that there may be even more carbon dioxide release associated with thawing Arctic permafrost than scientists previously imagined. Should this finding be confirmed, it would

mean that there could be a large new source of carbon dioxide that is unaccounted for in current climate change modeling by organizations such as the IPCC.⁵⁶

Wildfires were also causing enormous destruction in the Southern Hemisphere. In Australia, bushfires burned more than 46 million acres and destroyed more than 3,500 homes, the worst fire season in Australia's recorded history.⁵⁷

In 2019, concern had spread around the world over the immense environmental destruction taking place as fires burned through the Amazon rainforest in Brazil, home to some three million species of animals and plants. The number of fires in 2019 in the Amazon had increased by 145 percent in just one year, from 2018.⁵⁸ In 2020, the dry season in the Amazon region was even more severe, attributed in part to the warming of the tropical North Atlantic Ocean, which pulled moisture away from South America. By September, there were more than 28,000 fires burning throughout the Amazon, according to the NASA fire monitoring system. As the forest burned, large quantities of carbon dioxide were released into the atmosphere.⁵⁹

Fires also spread through the Pantanal, the world's largest tropical wetland, which stretches over parts of Bolivia, Brazil and Paraguay. With its magnificent wildlife, the Pantanal draws more than one million tourists every year.⁶⁰ But in 2020, drought turned the wetlands into a tinderbox and fires raged out of control. Analysis by the NASA Biosphere Sciences Laboratory found that at least 22 percent of the Pantanal had burned since January. Almost half of the land in the Pantanal controlled by indigenous peoples burned, in a devastating blow to the future of these communities.⁶¹



⁴²Flavelle, Christopher, "U.S. Disaster Costs Double in 2020, Reflecting Costs of Climate Change," New York Times, 7 January 2021.

⁴³Sengupta, Somini, "Even Amid a Pandemic, More Than 40 Million People Fled Their Homes," New York Times, 20 May 2021.

⁴⁴Masters, Jeff, "A look back at the horrific 2020 Atlantic hurricane season," Yale Climate Connections, 21 December 2020.

⁴⁵"Third flood of monsoon season for Yangtze River piles pressure on China's Three Gorges Dam," South China Morning Post, 27 July 2020.

⁴⁶Lee Myers, Steven, "After Covid, China's Leaders Face New Challenges From Flooding," New York Times, 21 August 2020.

⁴⁷Barnard, Anne, "Climate Change Is Killing the Cedars of Lebanon," New York Times, 18 July 2020.

⁴⁸Ibid.

⁴⁹Branch, John, "They're Among the World's Oldest Living Things. The Climate Crisis Is Killing Them," New York Times, 9 December 2020.

⁵⁰Ibid., National Park Service.

⁵¹"2020 North American Wildfire Season," Center for Disaster Philanthropy, 7 December 2020.

⁵²"Siberia's enormous hole in the ground is getting bigger," BBC, 21 July 2020.

⁵³"Methane: A crucial opportunity in the climate fight," Environmental Defense Fund.

⁵⁴"Another Intense Summer of Fires in Siberia," NASA Earth Observatory, 30 July 2020.

⁵⁵"The prophet of permafrost," Economist, 19 December 2020.

⁵⁶"Arctic permafrost releases more CO2 than once believe," University of Copenhagen, 9 February 2021.

⁵⁷Nuccitelli, Dana and Masters, Jeff, "The top 10 weather and climate events in a record-setting year," Yale Climate Connections, 21 December 2020.

⁵⁸"Greenpeace captures images of fires in the Amazon," Greenpeace International, 25 August 2019.

⁵⁹Spring, Jake, "Fires in Brazil's Amazon the worst in a decade, data shows," Reuters in Brasilia, 1 October 2020.

⁶⁰The Pantanal, the world's largest tropical wetland, World Wildlife Fund.

⁶¹Einhorn, Catrin, Arrellaga, Maria Magdalena, Migliozi, Blacki, and Reinhard, Scott, "The World's Largest

6. The Sixth Extinction

In 2016, a study by a German entomological society found that the overall abundance of flying insects in German nature reserves had decreased by 75 percent in just 27 years. Reported around the world, the finding became known as the “Insect Armageddon.” In the United States, scientists found that the monarch butterfly population had fallen by 90 percent, a loss of 900 million butterflies.⁶² Bees, the vital pollinators of food crops and other plants, are disappearing throughout Europe and North America.

The oldest of the great baobab trees of Africa are also dying. Africa’s elephant population has fallen from an estimated 12 million to some 400,000.⁶³ The Australian Koalas, the Egyptian vultures, the striped hyenas of North Africa, the snow leopards of Central Asia, the European bison - all are threatened by habitat loss, pollution and climate change. Since 1970, oceanic sharks and rays have declined by 71 percent, according to a study released in 2021. Seagrass meadows, a vital part of marine ecosystems, have declined in coastal areas around the world. In the waters around the United Kingdom, more than 90 per cent of the seagrass has been lost.⁶⁴

If the pace of extinctions continues to accelerate, the planet will lose vast ecosystems and the necessities they provide – fresh water, pollination, pest and disease control. “We are racing faster and closer toward the point of collapse than scientists previously thought,” concluded a study published in the Proceedings of the National Academy of Sciences.⁶⁵

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in an assessment in 2019 concluded that a million animal and plant species are now threatened with extinction. Sir Robert Watson, IPBES Chair, said: “We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide.”⁶⁶

“We are now in the midst of a sixth mass extinction with nearly a third of all amphibian species, nearly a quarter of all mammals, and an eighth of all birds classified as threatened.”

Elizabeth Kolbert, writing in The New Yorker magazine some years earlier, had presented the mass dying of species in a historical perspective. Over the past half-billion years, there have been at least twenty mass extinctions, when the diversity of life on earth has suddenly and dramatically contracted, Kolbert wrote. Five were so devastating that they are put in their own category. The last of these mass extinctions occurred at the end of the Cretaceous period, sixty-five million years ago, when the dinosaurs were lost. “We are now in the midst of a sixth mass extinction with nearly a third of all amphibian species, nearly a quarter of all mammals, and an eighth of all birds classified as threatened,” Kolbert concluded.⁶⁷

7.A Scarcity of Water

The World Bank has warned that water will become scarce in regions where it is now abundant – such as Central Africa and East Asia – and scarcity will greatly worsen where water is already in short supply – such as the Middle East and the Sahel in Africa.⁶⁸ An assessment on the state of water by the UN Food and Agricultural Organization found that water shortages are now affecting more than 3 billion people around the world. In sub-Saharan Africa, 50 million people live in areas where severe drought has catastrophic effects on cropland and pastureland once every three years, increasing the risk of famine.⁶⁹

In 2015, Sao Paulo almost ran out of water. A record drought between 2015 and 2018 forced the citizens of Cape Town to plan for “Day Zero” when their taps would run dry.⁷⁰ Chennai almost ran out of water in June 2019, following years of low rainfall during the monsoon season. In early 2021,

most of Turkey was experiencing severe drought. If it continued, scientists warned, crop production in Turkey could be threatened.⁷¹

The Middle East and North Africa (MENA) region, which encompasses 70 per cent of the world’s most water-stressed countries, is one of the world’s regions most vulnerable to the impacts of climate change. According to NASA, the Middle East has been subject to an almost continuous drought since 1998. The Dead Sea in Jordan has already shrunk by almost a third in the last two decades, due to lower rainfall, higher temperatures leading to increased evaporation, and water being siphoned off from the Jordan River. North Africa’s Sahel, stretching from Mauritania to the Sudan, is threatened by increased deforestation, desertification and water shortages due to climate change.⁷²

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In August 2021, aid groups warned that more than 12 million people in Syria and Iraq are losing access to water, food and electricity because of rising temperatures, record low levels of rainfall and drought. “The total collapse of water and food production for millions of Syrians and Iraqis is imminent,” warned the Norwegian Refugee Council. The water crisis was compounded by decreasing water flows into the Euphrates River.⁷³

The Global Center on Adaptation reports that the MENA region is projected to experience an average temperature rise of 4.8 degrees Celsius by the end of the century. Extended periods of heat combined with increased sandstorms and longer drought periods, the Center warns, could make parts of the region uninhabitable.⁷⁴ The agricultural sector in the region could be devastated with water availability declining by as much as 45 per cent.⁷⁵

In the Arabian Peninsula, rising temperatures have left Yemen’s beekeepers increasingly exposed to recurrent droughts and volatile rain patterns. A United Nations Development Programme study found that changing weather patterns in the region was disrupting the production of the famed Sidr honey, known for its health benefits and high price on the world market. Unseasonal rains caused the ancient Sidr trees to flower early, and heavy downpours harmed their flowers before the bees can reach the nectar. These changes in weather patterns now threaten the livelihoods of more than 100,000 beekeeping households in war-torn Yemen.⁷⁶

These changes in weather patterns threaten the livelihoods of more than 100,000 beekeeping households in war-torn Yemen.

During a United Nations Security Council mission to the Lake Chad Basin in Northern Central Africa in 2017, members of the Council learned of the devastating economic and social impact of the near disappearance of Lake Chad. Some 90 percent of the surface area of Lake Chad has been lost since the 1960s. President Mahamadou Issoufou of Niger told the Council that the terrorist organization Boko Haram could not have spread its influence in the region had it not been for the environmental devastation and the consequent loss of livelihoods that the disappearance of Lake Chad has caused.⁷⁷

The Darfur region of the Sudan had experienced a similar situation where prolonged periods of drought had forced large population movements and increased competition for land and natural resources, leading to conflict between farmers and herders in the region.⁷⁸ A United Nations Environment Programme (UNEP) report in 2007 warned that drought and environmental degradation could trigger a succession of wars in Africa unless more was done to contain the damage.⁷⁹

⁶²Jarvis, Brooke, “The Insect Apocalypse Is Here,” New York Times, 2 December 2020.

⁶³World Wildlife Fund, 202.

⁶⁴Carrington, Damian, “Catastrophic: UK has lost 90% of seagrass meadows, study finds,” Guardian, 4 March 2021.

⁶⁵Nuwer, Rachel, “Mass Extinctions Are Accelerating, Scientists Report,” New York Times, 1 June 2020.

⁶⁶UN Report: Nature’s Dangerous Decline ‘Unprecedented’ – United Nations Sustainable Development, 6 May 2019.

⁶⁷Kolbert, Elizabeth, “The Sixth Extinction? There have been five great die-offs in history. This time, the cataclysm is us,” New Yorker, 18 May 2009.

⁶⁸Climate-Driven Water Scarcity Could Hit Economic Growth by Up to 6 Percent in Some Regions, Says World Bank,” The World Bank, 3 May 2016.

⁶⁹The State of Food and Agriculture 2020. Overcoming water challenges in agriculture,” FAO, 2020.

⁷⁰Squazzin, Antony, “Fears of Water’s ‘Day Zero’ Spur Cape Town to Consider Rainless Day Fund,” Bloomberg, 25 February 2020

⁷¹NASA Earth Observatory, “Turkey Experiences Intense Drought,” 11 January 2021.

⁷²Lustgarten, Abraham, “Refugees From the Earth,” New York Times, 26 July 2020.

⁷³“Water crisis and drought threaten 12 million in Syria, Iraq,” Al Jazeera, Climate Change News, 8 November 2021

⁷⁴“State and Trends in Adaptation Report 2020,” Global Center on Adaptation.

⁷⁵Bell, Jennifer, “Super and ‘ultra-extreme heatwaves’ predicted in the Middle East: Experts,” Al Arabiya English, 2 June 2021.

⁷⁶Gebeily, Maya, “Yemen’s famed beekeepers feel the sting of climate change,” Reuters, 21 June 2021

⁷⁷“Addressing the impacts of climate-related disasters on international peace and security,” What’s In Blue, 24 January 2019.

⁷⁸Abouyoub, Younes, “Climate: The forgotten Culprit. The Ecological Dimension of the Darfur Conflict,” Race, Gender & Class, New Orleans, Vol. 19, Iss. ½ (2012)

⁷⁹Broder, Julian, “Darfur conflict heralds era of wars triggered by climate change, UN report warns, Guardian, 23 June 2007

A United Nations Environment Programme report in 2007 warned that drought and environmental degradation could trigger a succession of wars in Africa unless more was done to contain the damage.

In Asia, a 2019 assessment of the Hindu Kush Himalaya region found that if global temperatures continue to rise, more than two-thirds of the glaciers in the Hindu Kush and Himalaya mountains will disappear by the end of this century, with serious consequences for almost 2 billion people. The glaciers have already receded by some 15 percent since the 1970s.⁸⁰

The Hindu Kush Himalaya mountains are home to some 240 million people who are dependent on the flow of water from the ice above. The glaciers on these mountains are also the source of 10 major river basins in Asia, including the Brahmaputra, Ganges, Indus, Mekong, and Yangtze rivers, encompassing over 2.4 million km².⁸¹ By the end of the century, the loss of this source of water could force large-scale population displacements in the affected regions, with tensions rising over access to land, water, hydro-power and other resources. The impact of this climate crisis throughout Asia and beyond could be catastrophic, the assessment found.⁸²

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The immediate impact of the melting of glaciers in mountain regions is seen in the rise of flooding, landslides and soil erosion. In February 2021, the warming in the Himalaya mountains was believed to have caused a sudden burst of flooding in the state of Uttarakhand, India. More than 150 people, most of them workers for the Rishiganga hydroelectric power project, were swept away by the sudden avalanche.⁸³

Europe's alpine glaciers are also melting at higher speeds than anticipated. "The days of Bavaria's glaciers are numbered, earlier than we had previously believed," said Thorsten Glauber, Environment Minister of Bavaria. A recent study found that a glacier on Zugspitze, Germany's highest peak, is losing 250 liters of water every 30 seconds.⁸⁴ In the Andes, the water from melting glaciers is pouring into the lakes below. In Peru, Lake Palcacocha in the Cordillera Blanca mountain range has grown 34 times in size since the 1940s, raising fears that its banks may break and release dangerous floods into the Andean city of Huaraz.⁸⁵

In Africa, the melting of the glacier on the Rwenzori mountains, a UNESCO World Heritage site on the border between Uganda and the Democratic Republic of Congo, is also having a direct impact on the people below. In 2012, forest fires reached altitudes above 4,000 meters, devastating the vegetation that controlled the flow of the rivers downstream. The BBC reports that since then, the communities at the foot of the Rwenzori have suffered an increase in destructive flooding, while also experiencing less frequent but heavier rainfall.⁸⁶

In May 2020, heavy rains caused five rivers on the Rwenzori mountain to burst their banks. The waters swept houses and schools off the hills and destroyed the entire town of Kilembe in Uganda. Some 25,000 houses were lost and 173,000 people affected. The Bakonzo community is now engaged in efforts to restore the lands along the Rwenzori mountain, through tree planting and other protective measures. The name Rwenzori means 'place of snow' in the Bakonzo language.⁸⁷

In October 2021, the World Meteorological Organization warned that the last remaining glaciers in eastern Africa – on Mount Kilimanjaro in Tanzania, Mount Kenya in Kenya, and the Rwenzori Mountains – are expected to melt entirely in the near future.⁸⁸

8. Increasing Variability of Polar Jet Streams and Ocean Currents

Scientists warn that the increasing weather variability associated with rising global temperatures will lead not only to more intense heatwaves and destructive storms but also bursts of extreme cold in the Northern Hemisphere.

In February 2021, a weakening of the polar vortex caused a sudden burst of Arctic cold air to descend into the United States, blanketing much of the country in snow and ice. Record-cold temperatures in Texas forced residents to turn up their heating systems. The sudden rise in electricity demand led to power failures throughout the state, leaving millions without heat. As the crisis continued, frozen water pipes burst and flooded homes. Thousands of residents were forced to boil snow for water. Grocery stores ran out of food, and long lines formed at food-distribution centers. Many Texans were just emerging from the year-long Covid-19 crisis. The Insurance Council of Texas estimated the cost of this unusual weather event at \$20 billion.⁸⁹

Across the Atlantic, the same Arctic conditions led to extreme winter weather conditions in Europe. Germany experienced unusually cold temperatures and Spain was covered in deep snow. In April, extreme frost damaged up to 80 percent of the vineyards in France.⁹⁰ Scientists at the Potsdam Institute for Climate Impact Research explained that though unstable polar vortices happen from time to time, data from the last decades show that this is now a more frequent phenomenon, with the likely cause the rapid warming of the Arctic.⁹¹

While the majority of Earth's heat is redistributed by the atmosphere, heat is also moved by the Global Ocean Conveyor Belt, a worldwide system of currents that connect the world's oceans. A recent study published in Nature Geoscience found that the Atlantic part of this system – the Atlantic Meridional Overturning



Circulation (AMOC) – has now slowed by 15 percent, due to the melting of glacial ice in the Arctic and the resulting influx of cold, heavier and less salty water. If warming continues, ocean circulation could slow by as much as 45 percent. This would put us dangerously close to a tipping point of accelerating and irreversible change.⁹²

The deep ocean currents of the AMOC powers the Gulf Stream west from Africa to the Caribbean, and then north up along the east coast of the United States. It passes Cape Hatteras in North Carolina, before turning east toward the British Isles and the North Sea. In the North Atlantic, the Gulf Stream continues north past Iceland and Scandinavia, carrying more water than all the world's rivers combined. The Gulf Stream is estimated to transport heat northward equivalent to 78,000 times of Scandinavia's current use of energy. Scientists believe that without this massive current of warm water, the world would look quite different.⁹³

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Meteorologists have already noted the changing weather patterns affecting both sides of the Atlantic Ocean. As the AMOC slows, it may lead to an increase in storms and heatwaves in Europe, and enhanced sea level rise on the east coast of the United States. If global temperatures rise above 2 degrees Celsius, the AMOC's push of tropical heat from the south to the north may stop, possibly leading to an initial cooling of the Northern Hemisphere. Beyond that, scientists do not know exactly what would happen.⁹⁴

⁸⁰Sharma, Eklabya, Coordinating Lead Author, "Hindu Kush Himalaya Assessment: Climate Change, Sustainability and People," Springer, 2019.

⁸¹Ibid.

⁸²Chugh, Nidhitha, "Why the melting of the Hindu Kush and Himalayan glaciers matter. The entire region is headed for an immense climate crisis by 2100, scientist warn," Diplomat, 8 May 2019.

⁸³Mashal, Mujib and Kumar, Hari, "Glacier Bursts in India, Leaving 150 Missing in Floods," New York Times, 7 February 2021.

⁸⁴Eddy, Melissa, "German High Court Hands Youth a Victory in Climate Change Fight," New York Times, 29 April 2021.

⁸⁵Berwyn, Bob, "For a City Staring Down the Barrel of a Climate-Driven Flood, A New Study Could be the Smoking Gun," Inside Climate News, 4 February 2021.

⁸⁶Uchoa, Pablo, "Uganda climate change: The people under threat from a melting glacier," BBC, 30 March 2021.

⁸⁷Ibid.

⁸⁸Santora, Marc, "A Warning That Africa's Last Glaciers Will Soon Vanish, While African nations contribute less than 4 percent of global greenhouse gas emissions, a UN report underscored the outsize impact that climate change is having on the continent," New York Times, 19 October 2021

⁸⁹Healy, Jack, "'Like We're Being Cursed': First Covid and Now Waterlogged Homes," New York Times, 22 February 2021.

⁹⁰Castrodale, Jelisa, "Up to 80% of French Vineyards Have Been Damaged by Heavy Frost," Food and Wine, 16 April 2021.

⁹¹"Winter weather, a polar front – and areas of drought: PIK's assessment of the current weather situation," Potsdam Institute for Climate Impact Research, 12 February 2021.

⁹²Bjerström, Erika, "Ny forskning: Golfströmmen har mattats av upp emot 20 procent," SVT Nyheter, 21 February 2021, Harvey, Fiona, "Atlantic Ocean circulation at weakest in a millennium, say scientists," Guardian, 25 February 2021.

⁹³Velasquez-Manoff, Moises and White, Jeremy, "In the Atlantic Ocean, Subtle Shifts Hint at Dramatic Dangers," New York Times, 3 March 2021.

⁹⁴Berardelli, Jeff, "Atlantic Ocean circulation is the weakest in at least 1,600 years, study finds," CBS News, 26 February 2021.

9. The Hottest July Ever Recorded

In 2021, as the summer solstice in the Northern Hemisphere neared, meteorologists warned of a future of extreme heatwaves in the Middle East. Another heat dome was descending on the region and Al Arabiya reported temperatures nearing 50 degrees Celsius across Iran, Iraq, Kuwait, Oman, Saudi Arabia and the United Arab Emirates (UAE). Normally, the hottest temperatures are recorded later in the summer. On June 22, the temperature in the Kuwaiti city of Nuwaiseeb rose to 53.2 degrees.⁹⁵

Another heat dome was descending on the region and Al Arabiya reported temperatures nearing 50 degrees Celsius across Iran, Iraq, Kuwait, Oman, Saudi Arabia and the United Arab Emirates.

In the United States, much of the West was suffering from unusually high temperatures. A heat dome over Arizona and Nevada had led to temperatures over 46 degrees Celsius (115°F).⁹⁶ Within weeks, another heat dome was developing, this time in the Pacific Northwest. In Portland, Oregon, temperatures soared to 46 degrees Celsius, the highest temperature recorded in Oregon since record keeping began in 1940.⁹⁷ Soon, wildfires were again burning across the western United States. In California, massive fires burned more than 2.8 million acres across the state. In three months, California spent \$1.1 billion trying to contain the fires.⁹⁸

Further north, the same atmospheric condition enveloped British Columbia, Canada's westernmost province. In the small town of Lytton, outside Vancouver, the temperature rose to 49 degrees Celsius, shattering all records. On June 30, a wildfire consumed Lytton, destroying 90 percent of its buildings. In August, more than 300 wildfires were burning throughout British Columbia.⁹⁹

Hundreds of deaths were linked to the extreme weather conditions across the Pacific Northwest.¹⁰⁰

In Europe, heavy rainfall caused massive flooding in several countries, including England, Austria, Belgium, Germany, the Netherlands, and Switzerland. In Germany and Belgium, 220 people were killed as floodwaters surged through river valleys, causing the worst flooding in memory.¹⁰¹ Photos of the floods showed levels of destruction not seen in Europe since the end of the Second World War.

In India, heavy monsoons set off landslides and forced the evacuation of 300,000 people in the state of Maharashtra.¹⁰² Violent flash floods in Afghanistan killed at least 80 people in the Nuristan Province, adding to the humanitarian crisis in the country. In Bangladesh, monsoon rains caused massive destruction in the Cox's Bazar refugee camp where hundreds of thousands of Rohingya refugees have lived since fleeing persecution in Myanmar.¹⁰³

In China, more than 80,000 people were evacuated in the province of Sichuan as heavy rains caused massive flooding. A week later, the province of Henan experienced the highest recorded rainfall since record keeping started in 1951. Flooding damaged more than 1 million hectares of crops and destroyed more than 35,000 houses. In Zhengzhou, 25 people died as floodwaters inundated the city. More than 12 drowned in the city's subways.¹⁰⁴ The flooding in Henan resulted in a record single-event insurance loss of \$1.7 billion, impacting companies that provide property and casualty insurance, the S&P Global Ratings reported.¹⁰⁵

In Southern Africa, prolonged drought had left several countries facing food shortages. In Madagascar, the UN World Food Programme (WFP) reported that an unrelenting drought had forced hundreds of thousands to the brink of famine at a "scale beyond belief." "People have been living on raw red cactus fruits, wild leaves and locusts for months," David Beasley, the WFP director said.¹⁰⁶

In Russia, massive wildfires were once again raging through the frozen taiga of Siberia, which residents said were the worst in memory. In 2020, forest fires in Russia had burned 4.7 billion trees, according to a Greenpeace study. In 2021, the Siberian fires were estimated to have been larger than all the world's fires burning around the world combined. Aisen Nikolaev, head of Yakutia region, said: "We are living through the hottest, driest summer in the history of meteorological measurements since the end of the 19th century."¹⁰⁷

By the end of June, several countries in the Middle East and North Africa had recorded temperatures higher than 50 degrees Celsius.¹⁰⁸ Intense heat was also enveloping Southern Europe.¹⁰⁹ Soon, a ring of fire was spreading around the Mediterranean Sea, causing massive destruction in Sardinia and Cyprus, Greece and Turkey, Lebanon and into Syria's Homs province, Algeria, Libya and Tunisia.

Soon, a ring of fire was spreading around the Mediterranean Sea, causing massive destruction in Cyprus and Sardinia, Greece and Turkey, Lebanon and into Syria's Homs province, Algeria, Libya and Tunisia.

More than 90 people were killed in Algeria, as more than 50 wildfires burned across the country.¹¹⁰ As the temperature rose to 49 degrees in Tunisia, wildfires spread into the northern Bizerte and Jendouba provinces, destroying 450 hectares of pine and acacia forests.¹¹¹ At least 15 fires burned across the north and northwest of the country.¹¹²

Scientists warn that heatwaves of this kind are expected to increase in frequency, magnitude and duration in the Middle East and North Africa, with direct negative impacts on human health, agriculture, water and energy, causing conflict and migration. In the second half of this century, some 600 million people in the region could be exposed to annually recurring "super and ultra-extreme heatwaves" with temperatures up to 56 degrees Celsius

and higher. In parts of the Middle East, the combined effect of high temperatures and humidity could exceed the threshold for human adaptability.¹¹³

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On August 14, temperatures at the summit of the Greenland Ice Sheet rose above freezing, an unusual event. Then it rained for several hours. There had not been any record of rain there since observations began in the 1980s. On average, Greenland has lost more than 300 billion tons of ice per year over the past two decades.¹¹⁴

The IPCC had just released a draft report on the physical science basis of climate change, which found that the atmospheric concentrations of carbon dioxide were now higher than at any time in at least two million years, and concentrations of methane and nitrous oxide were higher than at any time in the last 800,000 years.¹¹⁵ The report warned that we are now approaching several tipping points in the climate beyond which the impacts of climate change become irreversible. A few days later, scientists at the US National Ocean and Atmospheric Administration confirmed that July was the world's hottest month since record keeping began 142 years ago.¹¹⁶



⁹⁵Haddad, Mohammed, "Mapping the hottest temperatures around the world," Climate New, Al Jazeera, 1 July 2021.

⁹⁶Plummer, Brad, Healy, Jack, Choi-Schagrin, Winston and Fountain, Henry, "Climate Change Batters the West Before Summer Even Begins," New York Times, 17 June 2021.

⁹⁷Vigdor, Neil, "Pacific Northwest Heat Wave Shatters Temperature Records," New York Times, 27 June 2021.

⁹⁸McDonald, Brent, Burroughs, Sashwa, Weingart, Eden, and Felling, Meg, "Inside the Fight Against Dixie Fire," New York Times, 11 October 2021.

⁹⁹Isai, Vjosa, "British Columbia Battles Nearly 300 Wildfires at Once. Here's How," New York Times, 12 August 2021.

¹⁰⁰Taylor, Matthew, and Cecco, Leyland, "Nowhere is safe, say scientists as extreme heat causes chaos in US and Canada," Guardian, 1 July 2021.

¹⁰¹Fountain, Henry, "Climate Change Contributed to Europe's Deadly Floods, Scientists Find," New York Times, 23 August 2021.

¹⁰²Deep Singh, Karan, "Scores Die in India as Monsoon Rains Swap Towns and Send Boulders Tumbling," New York Times, 26 July 2021.

¹⁰³Deep Singh, Karan, and Hasnat, Saif, "They Were Driven From Their Homes. Then Floods Struck Their Camps," New York Times, 29 July 2021.

¹⁰⁴Lee Myers, Steven, "Please Save Us! Grim Scenes in China as Flood Inundates a Subway," New York Times, 20 July 2021.

¹⁰⁵Goel, Shubhangi, "China floods, extreme weather deals a big blow to insurance companies," CNBC, 18 August 2021

¹⁰⁶Lederer, Edith M., "UN: Madagascar drought push 400,000 toward starvation," AP, 26 June 2021

¹⁰⁷Dixon, Robyn, "Siberia's wildfires are bigger than all the world's other blazes combined," Washington Post, 11 August 2021.

¹⁰⁸Haddad, Mohammed, "Mapping the hottest temperatures around the world," Al Jazeera, 1 July 2021.

¹⁰⁹On 11 August, the temperature on the Sicilian town of Syracuse was recorded at 48.8 degrees Celsius, a record in Europe.

¹¹⁰El Sayed, Nadine, "North Africa's wildfires are a grim warning," Nature Middle East, 26 August 2021

¹¹¹Murad Dalaji, "Forests destroy 450 hectares of forest in Tunisia," 11 August 2021.

¹¹²Wildfires bring devastation to Algeria, Tunisia" Africa News, 12 August 2021.

¹¹³Zittis, G., Hadjinicolaou, P., Almazroui, M. et al. "Business-as-usual will lead to super and ultra-extreme heatwaves in the Middle East and North Africa," Nature Climate and Atmospheric Science, 23 March 2021.

¹¹⁴Fountain, Henry, "It Rained at the Summit of Greenland. That's Never happened Before," New York Times, 20 August 2021.

¹¹⁵Kauffman, Marcus, "IPCC Report: 'Code Red' for human driven global heating, warns UN chief," UN News, 9 August 2021.

¹¹⁶Millman, Oliver, "July was world's hottest month ever recorded, US scientists confirm," Guardian, 13 August 2021.

Atmospheric concentrations of carbon dioxide were now higher than at any time in at least two million years, and concentrations of methane and nitrous oxide were higher than at any time in the last 800,000 years.

In March 2022, Australia's Prime Minister, Scott Morrison, declared a national emergency due to climate change. The country had experienced heavy rains and the worst flooding in Australian history. As the Insurance Council of Australia estimated the costs of the flooding at more than \$1 billion, Mr. Morrison acknowledged that climate change was a factor. "We are dealing with a different climate to the one we were dealing with before," he said. "Australia is getting harder to live in because of these disasters."¹¹⁷

Two weeks later, scientists raised alarm over events unfolding in the Arctic and Antarctica, calling them "historic," "unprecedented" and "dramatic."¹¹⁸ Temperatures in eastern Antarctica had been recorded at 40 degrees Celsius above normal levels, and in the Arctic at 30 degrees above normal. Michael Mann, director of the Earth System Science Center at Pennsylvania State University, said that these extreme weather conditions exceeded predictions to a worrying degree. Fiona Harvey, environment correspondent for the Guardian, warned that these heatwaves at both of Earth's poles could trigger further cascading changes that will accelerate climate breakdown.¹¹⁹

10. Global Displacement of Populations

The United Nations has long warned that the consequences of a warming world – extreme heat, water scarcity and failed crops, wildfires, destructive storms, flooding and rising seas – may trigger waves of mass migration crises around the world with millions forced to flee their homes in search of safer territory.

Humans have always moved, in search of food and safety. And in the past decade there has been a surge in

international migration. In 2019, there were an estimated 272 million international migrants in the world, according to the International Organization for Migration.¹²⁰ Most moved in search of work and economic opportunity. Others have been forcibly displaced, fleeing persecution and conflict, violations of human rights and terrorism. In 2020, the UN High Commissioner for Refugees recorded 80 million displaced people worldwide. In 2021, the number of displaced people had risen to 84 million, with 48 million people internally displaced and 26.6 million classified as refugees. More than two-thirds of the displaced came from just five countries – Syria, Venezuela, Afghanistan, South Sudan and Myanmar.¹²¹

The United Nations has long warned that the consequences of a warming world – extreme heat, water scarcity and failed crops, wildfires, destructive storms, flooding and rising seas – may trigger waves of mass migration crises around the world.

The extent of future migration due to the impacts of climate change is still uncertain. According to reporting by ProPublica and the New York Times, new research suggests that climate change will cause humans to move across the planet at an unprecedented, destabilizing scale. One estimate finds that already, 16 million people are displaced by weather-related disasters each year.¹²² The Internal Displacement Monitoring Center found that in the first six months of 2020, throughout 127 countries and territories, climate disasters had caused 9.8 million displacements.¹²⁴ The fear is that these numbers will increase dramatically as the climate crisis worsens in the years ahead. The UN International Organization for Migration has warned that there could be anywhere between 25 million and 1 billion forced environmental migrants by 2050.¹²⁵

¹¹⁷Frost, Natasha, "Australia Is Getting Harder to Live In: Unending Rai, Growing Floods," New York Times, 9 March 2022.

¹¹⁸Fiona Harvey, Heatwaves at both Earth's poles alarm climate scientists, Guardian, 20 March 2022

¹¹⁹Ibid.

¹²⁰The World Migration Report 2020, International Organization for Migration.

¹²¹UNHCR Refugee Data Finder 2021.

¹²²Lustgarten, Abraham, "Refugees From the Earth," New York Times, 26 July 2020.

¹²³Boris Johnson, UN Security Council Open Debate on Climate and Security, 23 February 2021.

¹²⁴Santora, Marc, "A Warning That Africa's Last Glaciers Will Soon Vanish," New York Times, 19 October 2021.

¹²⁵Basseti, Francesco, "Environmental Migrants: Up to 1 Billion by 2050," Climate Foresight, 22 May 2019.

III. Climate Change and International Security

1. 'A Strategically Significant Security Risk'

Security establishments are increasingly concerned about the complex emergencies that may be triggered by the impacts of climate change in the future. NATO, recognizing that climate change may pose challenges greater than envisioned for the organization at its founding in 1949, is aiming to strengthen cooperation among members on situational awareness and information sharing on future climate threats.¹²⁶

A recent review by the Clingendael Institute of the Netherlands found that an increasing number of military institutions are aware of the scale of the social and environmental impacts that climate change will have in the decades ahead. "Climate change is a risk multiplier of an existential nature, affecting every society around the world, generating new conflicts and potentially affecting our global security," the study concluded. "This makes climate change an issue for national and international security – and thus the military."¹²⁷

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The Center for Climate and Security, a Washington, D.C. based institution, has found that climate change, in both scale and potential impact, is a strategically significant security risk that threatens the very systems that support modern life, from food, water and energy to governance and security. According to John Conger, the Center's director emeritus, "climate change is already shaping national security, and its impact will only worsen."¹²⁸

A recent risk assessment on the heightened security risks in the Arctic due to loss of Arctic Sea ice, conducted jointly by the Center for Climate and Security and the Norwegian Institute of International Affairs, found that the risks include the potential for new conflicts,

the breakdown of multilateral cooperation and rising great power tensions. To address this growing threat to peace and security, the report called for greater action to curb climate change and the building of international institutions to manage climate risks.¹²⁹

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In May 2021, foreign ministers of eight Arctic States met at an Arctic Council meeting in Reykjavik, Iceland, to address some of these concerns. The resulting Reykjavik Declaration reaffirmed the Council's commitment to maintaining peace, stability and constructive cooperation in the Arctic region. Foreign Minister of the Russian Federation Sergey Lavrov welcomed the declaration, stating: "Meeting the challenges we face in high altitudes today requires approaches that are truly collective."¹³⁰

Another Center for Climate and Security report - The Security Threat That Binds Us - identified ecological disruption as an underappreciated security threat. "Ongoing stresses to critical Earth systems, including to water, food, wildlife, forests and fisheries, heightens the risks of future pandemics, conflict, political instability, loss of social cohesion and economic harm," the report found. "The fraying of the ecological networks on which humanity depends, which is both interconnected with and distinct from climate change, poses a commensurate security threat," said Dr. Rod Schoonover, lead author of the report. "Ecological disruption clearly is underway worldwide and is a threat to both national and natural security," said retired US Army Brigadier General Gerald Galloway.¹³¹

"Ongoing stresses to critical Earth systems, including to water, food, wildlife, forests and fisheries, heightens the risks of future pandemics, conflict, political instability, loss of social cohesion and economic harm."

¹²⁶Erlanger, Steven, "NATO Needs to Adapt Quickly to Stay Relevant for 2030, Report Urges," New York Times, 30 November 2020.

¹²⁷"Military Response to Climate Change, Netherlands Institute of International Relations," Clingendael, 17 March 2020.

¹²⁸Center for Climate and Security.

¹²⁹"Climate Change and Security in the Arctic," Center for Climate and Security and the Norwegian Institute of International Affairs, 27 January 2021.

¹³⁰Arctic Council Foreign Ministers Sign the Reykjavik Declaration, Adopt the Council's First Strategic Plan and Pass the Chairmanship from Iceland to the Russian Federation," Arctic Council, 20 May 2021.

¹³¹"The Security Threat That Binds Us," Center for Climate and Security, 9 February 2021.

With the warming climate adding stress to water resources, security analysts also warn of an increase in the risk of intrastate and interstate conflict over water rights. Community conflicts are already rising along rivers where changes in water levels are causing economic strain. And somewhat paradoxically, the building of hydropower dams for electricity generation, a clean alternative to fossil fuel power generation, is heightening political tensions in some areas, including along the Nile and the Euphrates and Tigris rivers.¹³²

The building of hydropower dams for electricity generation, a clean alternative to fossil fuel power generation, is heightening political tensions in some areas, including along the Nile and the Euphrates and Tigris rivers.

A recent SIPRI Insights on Peace and Security review on climate change and violent conflict in West Africa found “growing evidence that the adverse effects of climate change increase both the risk and severity of violent conflict.” Changes in temperature and precipitation in the Sahel is worsening livelihood conditions, forcing increased migration and changes in pastoral mobility patterns. In Burkina Faso and Niger, drought has forced livestock herders to rely less on migration and more on crop cultivation. It has also forced farming communities to diversify into herding. These adaptation efforts have led to increased competition for scarce resources, and an increase in the risk of conflict. The review found a similar situation in Nigeria, where climate change has also led to a rise in vulnerability and farmer-herder conflicts.¹³³

The review found that large-scale displacements can also lead to intensified use of natural resources, causing further environmental stress. This was the case in the Lake Chad Basin as migrants who had been displaced by conflict arrived in the basin, leading to increased pressure on local land and water resources.¹³⁴ Increasingly, climate change is recognized as a key driver of instability in West Africa, fueling a rise in interstate and intrastate conflict

throughout the region.

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In the United States, the security threats posed by climate change became a topic of concern when Hurricane Sandy caused massive destruction along the East Coast in 2012. Six years later, Hurricane Michael struck the Tyndall Air Force Base in Panama City, Florida, with devastating impact. Some 95 percent of the buildings on the base were severely damaged or destroyed. Several of the Air Force’s most valuable aircraft were damaged.¹³⁵

A recent Pentagon study concluded that 79 United States military bases will be affected by rising sea levels and frequent flooding in the coming years. It also found that climate-related events could inflict massive damage to infrastructure in the United States, and that the military may be required to commit resources to disaster relief missions unprecedented in their scale. The Pentagon also recognized its role in contributing to climate change as its military institution is the largest emitter of greenhouse gases in the world. It noted that it can take a lead on climate change mitigation by reducing its carbon footprint and thus help avert a continued rise in security threats.¹³⁶

In January 2021, President Joseph Biden announced that the United States would re-join the Paris Climate Agreement and that it would dramatically change its approach to the global climate crisis. He declared that the United States would henceforth adopt a ‘whole-of-government’ approach to confronting the existential threat of climate change to the planet. “In my view,” he said, “we have waited too long to deal with this climate crisis.”¹³⁷

President Biden’s Secretary of Defense, Lloyd Austin, voiced his full commitment to this approach. “We know

first-hand the risk that climate change poses to national security because it affects the work we do every day,” he said. We will “take appropriate actions to prioritize climate change considerations in our activities and risk assessments, to mitigate this driver of insecurity.”¹³⁸

2. Climate Change and the Maintenance of International Peace and Security

“Climate change is the biggest threat modern humans have ever faced,” the naturalist Sir David Attenborough told the United Nations Security Council in February 2021.¹³⁹

“Today there are threats to security of a new and unprecedented kind,” Attenborough said. These are “rising global temperatures, the despoiling of the ocean upon which people everywhere depend for their food, and changes in the weather pattern worldwide that pay no regard to national boundaries, but that can turn forests into deserts, drown great cities and lead to the extermination of huge numbers of other creatures with which we share this planet.”

“We are today perilously close to tipping points, that once passed, will send global temperatures spiraling catastrophically higher,” he warned. “If we recognize climate change and the loss of nature as worldwide security threats, as indeed they are, then we may yet act proportionally, and in time. The task is immense and can only be dealt with by unparalleled levels of global cooperation.”¹⁴⁰

Calling climate change “a geopolitical issue every bit as much as an environmental one,” Boris Johnson, Prime Minister of the United Kingdom, said that it is absolutely clear that climate change is a threat to our collective security and the security of our nations. “If this Council is to succeed in maintaining peace and security worldwide, then it’s got to galvanize the whole range of UN agencies and organizations into a swift and effective response.”



“Let’s do what the Security Council was created to do,” he urged.

“It is absolutely clear that climate change is a threat to our collective security and the security of our nations. If this Council is to succeed in maintaining peace and security worldwide, then it’s got to galvanize the whole range of UN agencies and organizations into a swift and effective response.”

Other Security Council members joined in the call for stronger action by the United Nations. Kais Saïed, President of Tunisia, called on the Council to adopt a new and more comprehensive approach related to climate change, and underlined the need for better prevention strategies.

Uhuru Kenyatta, President of Kenya, noted that the climate-security nexus is already impacting Africa. The implementation of the Council’s mandate to maintain global peace and security will only get more difficult with time if climate change remains on its present course, he said. “We must redouble our efforts to direct all the resources and multilateral frameworks of our rule-based international order to mitigate the effects of climate change.”

¹³²Schwartzstein, Peter, “Why Water Conflict is Rising, Especially on the Lower Level,” Center for Climate and Security, 26 February 2021.

¹³³Tarif, Kheira, “Climate Change and Violent Conflict in West Africa: Assessing the Evidence,” SIPRI Insights on Peace and Security, February 2022.

¹³⁴Ibid.

¹³⁵Roblin, Sébastien, “The U.S. military is terrified of climate change,” NBC News, 20 September 2020.

¹³⁶Ibid., Floumey, Michèle, “Key Player in the War on Climate Change? The Pentagon,” CNN, 26 October 2020.

¹³⁷“Existential threat: Biden takes action to address climate crisis,” Al Jazeera, 27 January 2021.

¹³⁸Femia, Francesco and Werrell, Caitlin, “The Biden Administration & Climate Security,” Center for Climate and Security, 29 January 2021.

¹³⁹Sir David Attenborough, United Nations Security Council open debate, “Maintenance of international peace and security: climate change,” 23 February 2021.

¹⁴⁰Ibid.

Kaïs Saïed, President of Tunisia, called on the Council to adopt a new and more comprehensive approach related to climate change, and underlined the need for better prevention strategies.

Brigi Rafini, Prime Minister of Niger, said that climate change has increased competition for diminished land and water resources, ramping up tensions between livestock owners and others. He underscored the collective responsibility to tackle this existential challenge, stressing that “climate change and land degradation are no longer purely environmental matters.” He was joined in this call by Ralph Gonsalves, Prime Minister of Saint Vincent and the Grenadines, who said that the Council has a responsibility to address the consequences of climate change. “A failure to do so would be an abdication of the Council’s duty,” he said.¹⁴¹

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Erna Solberg, Prime Minister of Norway, noting that climate change is already redefining the global security landscape, said: “The United Nations must be at the front of preventive diplomacy.” “By shouldering a common responsibility to address the consequences of climate change, the Council will be better prepared to maintain international peace and security.”

Emmanuel Macron, President of France, called for the rebuilding of effective multilateralism to address the challenge of climate change. Of the 20 countries most affected by conflict in the world, 12 are also severely impacted by climate change, he said. “We see the fallout of an unaddressed climate agenda in Boka Haram.” Noting the interconnectedness between the climate

change, environmental destruction and security agendas, he pledged France’s commitment to accelerating the preservation of biodiversity and the Great Green Wall initiative aimed at restoring 250 million hectares of land in Africa. To combat the scourges of the 21st Century, we must join the agendas for peace and security and climate action, Macron told the Council. “We are in a race against time.”

“To combat the scourges of the 21st Century, we must join the agendas for peace and security and climate action. We are in a race against time.”

John Kerry, Special Presidential Envoy for Climate of the United States, thanked other countries for their leadership on climate change and pledged that the United States will work with other Member States to begin treating climate change as the security crisis that it is. “No one country can solve the climate crisis on its own,” he said. “It is exactly the kind of crisis the United Nations was created to address.”

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Xie Zhenhua, Special Envoy for Climate Change of China, noted that global climate governance remains a long and arduous task. Its centerpiece is the full and effective implementation of the Paris Agreement, he said. Any role of the Security Council on climate change must fall under its purview, he stressed.

Heiko Maas, Federal Minister for Foreign Affairs of Germany, speaking for the Group of Friends of Climate and Security, said that the group’s members are united in a common understanding that “climate change is the fundamental challenge of our time.” He called for “concerted efforts by the United Nations in making climate change its top priority.”¹⁴²

3. A Growing Movement to Protect and Restore Earth’s Atmosphere, Land and Oceans

There is now a consensus emerging that to effectively address the climate crisis, we must not only protect nature from further harm, but also start the long process of repairing the damage done to our planet over the past century.

Since the Earth Summit in Rio de Janeiro in 1992, nations have worked through the UNFCCC to find agreement on action to stabilize the concentration of greenhouse gases in the atmosphere at a level that would prevent dangerous interference with Earth’s climate system. Progress has been made over the years, but not enough to forestall the existential crisis we now face.

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The agreement at the UNFCCC COP21 in Paris in 2015 for nations to aim to limit the global temperature rise to 1.5 degrees Celsius above pre-industrial levels was important. Six years later, at the COP26 in Glasgow, Scotland, parties to the convention once again agreed on the urgency of the climate crisis and committed to strengthening their efforts to curb greenhouse gas emissions in the years ahead.¹⁴³ More than 100 countries also pledged to end deforestation and committed to reducing methane emissions by 30 percent by 2030.¹⁴⁴ By some estimates, the amount of methane in the atmosphere is now two and a half times higher than before the Industrial Revolution.¹⁴⁵

Also in Glasgow, the Glasgow Financial Alliance for Net Zero, a group of financial institutions, committed to directing their combined capital, estimated at \$130 trillion, toward investments that would help accelerate

a transition to a net neutral global economy by 2050.¹⁴⁶

Already, countries are raising their ambitions for climate action in the next few decades. In 2020, President Xi Jinping declared that China aims to achieve carbon neutrality by 2060, meaning that China’s net carbon emissions will then be zero.¹⁴⁷ In 2021, Russia joined this commitment, with a declaration that it would stop adding carbon dioxide to the atmosphere by 2060.¹⁴⁸ The regional government of Sakhalin Island in Russia, with vast forests of spruce and fir absorbing millions of tons of carbon, pledged carbon neutrality as early as 2025.¹⁴⁹

Other countries have committed to reaching carbon neutrality by 2050. These include Denmark, France, Germany, Hungary, Japan, South Korea, the United Kingdom and the United States. Sweden took an early lead in 2017, pledging to achieve carbon neutrality by 2045.¹⁵⁰

According to the IPCC, carbon neutrality, also known as net zero carbon dioxide emissions, is achieved when human-induced carbon dioxide emissions are balanced by human-induced carbon dioxide removals over a specified period of time.

While carbon neutrality was long the desired goal, and it is still an important milestone, there is now concern that the climate crisis is so dire that the objective must be carbon negativity. This means that in addition to reducing greenhouse gas emissions to zero in the years ahead, the legacy of more than a century’s burning of fossil fuels must be reversed and the carbon dioxide already in the atmosphere reduced.

While carbon neutrality was long the desired goal, and it is still an important milestone, there is now concern that the climate crisis is so dire that the objective must be carbon negativity.

¹⁴¹Climate Change ‘Biggest Threat Modern Humans Have Ever Faced,’ Security Council Press Release, 23 February 2021.

¹⁴²Ibid.

¹⁴³The Glasgow Climate Pact – Key Outcomes from COP26, UNFCCC

¹⁴⁴Tankersley, Jim, Rogers, Katie and Friedman, Lisa, “With Methane and Forest Deals, Climate Summit Offers Hope After Gloomy Start,” New York Times, 2 November 2021.

¹⁴⁵Zhong, Raymond, “Methane Emissions Soared to a Record in 2021, Scientists Say,” New York Times, 7 April 2022.

¹⁴⁶Alderman, Liz and Nelson, Eshé, “Global finance industry says it has \$130 trillion to invest to tackle climate change,” New York Times, 3 November 2021.

¹⁴⁷Lee Myers, Steven, “China’s Pledge to Be Carbon Neutral by 2060: What It Means,” New York Times, 23 September.

¹⁴⁸Voltaggio, Nicholas, “Russia Joins Pledge to End Deforestation by 2030,” The Caravel, 4 December 2021.

¹⁴⁹Troianovski, Anton, “On a Pacific Island, Russia Tests Its Battle Plan for Climate Change,” New York Times, 19 October 2021.

¹⁵⁰Murray, James, “Which countries have legally-binding net-zero emissions targets?” NS Energy, 5 November 2020.

So far, the carbon negativity movement has been most pronounced in the private sector. Currently, Bhutan and Suriname are believed to be the only countries that absorb more greenhouse gases than they emit.¹⁵¹

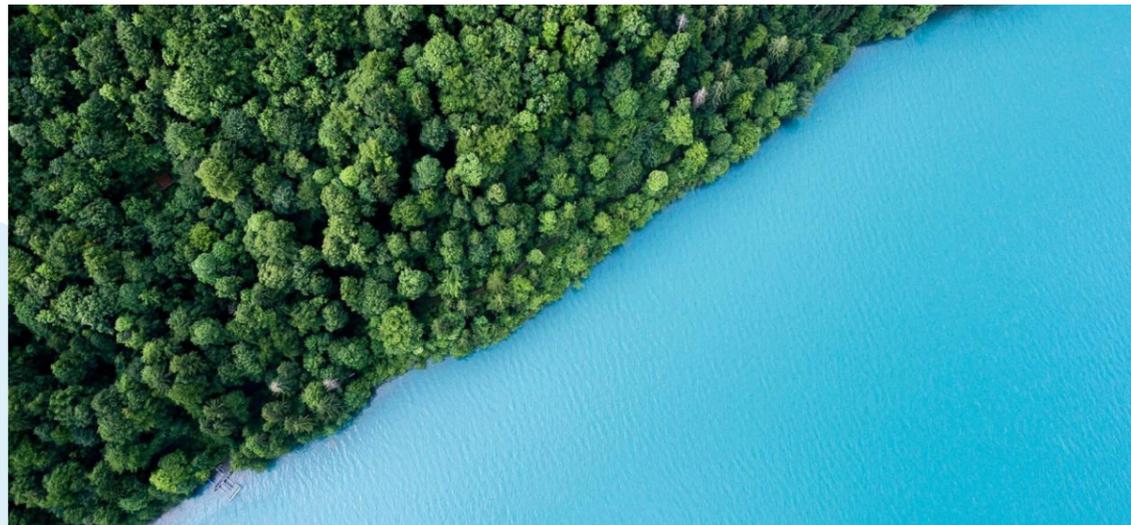
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A growing number of companies and institutions are now researching and developing processes that can help remove carbon from the atmosphere. One is Climeworks, a Swiss direct air capture technology company that has developed the world's biggest air capture and storage plant in the Geothermal Park in Hellisheidi, Iceland. Their new Orca plant will use geothermal energy to pull thousands of metric tons of carbon dioxide out of the atmosphere and pump it underground.¹⁵² Another is Running Tide Technologies, a startup company in Maine, United States, that is studying the capacity of seaweed to capture carbon dioxide via photosynthesis, and then sequester the carbon as the

seaweed sinks to the bottom of the ocean.¹⁵³ Others are looking at solutions that may lead to carbon negative cement,¹⁵⁴ and the spreading of rock dust on farmland to capture carbon dioxide, a process known as enhanced rock weathering.¹⁵⁵

In January 2020, Microsoft surprised the world when it announced that it will be carbon negative by 2030. Brad Smith, Microsoft's president, went further and declared that by 2050, Microsoft will also remove from the environment all the carbon the company has emitted either directly or by electrical consumption since it was founded in 1975.¹⁵⁶

In February 2021, Elon Musk, the CEO of Tesla, offered a \$100 million award to technologies that can remove one ton of carbon dioxide out of the atmosphere per day, with a goal to inspire innovation of technology that can be scaled up to collectively remove 10 gigatons of carbon dioxide per year by 2050.¹⁵⁷ Musk said: "We want to make a truly meaningful impact – carbon negativity, not neutrality."



¹⁵¹Ibid.

¹⁵²Climeworks.com, 1 March 2021. Ben Panko, "World's Largest Carbon Capture Plant Opens in Iceland," Smithsonian Magazine, 9 September 2021

¹⁵³Bever, Fred, "Maine startup aims to pull carbon out of the atmosphere by growing and – then sinking – kelp farms," Bangor Daily News, 9 February 2021.

¹⁵⁴Stashwick, Sasha, "With Carbon Capture, Concrete Could One Day Be A Carbon Sink," NDRC, 13 May 2021.

¹⁵⁵Ahl, Jonathan, "Changing the Rock Dust Applied to Farm Fields Could Help Reduce Carbon Emissions," Harvest Public Media, 2 September 2021.

¹⁵⁶Brad Smith, "Microsoft will be carbon negative by 2030," Microsoft Blog, 16 January 2020.

¹⁵⁷Jamasmie, Cecilia, "Elon Musk offers \$100 for best carbon capture innovation," Mining.com, 8 February 2021.

¹⁵⁸At Yale, new FedEx-supported center to focus on climate change solutions," Yale News, 3 March 2021.

"We want to make a truly meaningful impact – carbon negativity, not neutrality."

Shortly thereafter, Yale University announced a \$100 million gift from FedEx for the establishment of a new research center focused on developing natural systems for reducing atmospheric carbon. The Center for Natural Carbon Capture will develop interventions that enhance Earth's abilities to store carbon, through ecosystem carbon sequestration or enhancement of the geological carbon cycle, such as mineral weathering.¹⁵⁸ In the United Kingdom, studies are under way to assess the effectiveness of carbon capture initiatives, such as enhanced rock weathering, biochar, peatland restoration and large-scale tree planting.¹⁵⁹

In 2019, a group of scientists proposed a Global Deal for Nature that would formally protect 30 percent of the earth, with an additional 20 percent designated as climate stabilization areas. Pairing the Global Deal for Nature with the Paris Climate Agreement, the scientists said, was necessary to avoid catastrophic climate change, conserve species and secure essential ecosystem services.¹⁶⁰ At the One Planet Summit convened by France in January 2021, President Macron announced that 50 countries had now joined the High Ambition Coalition for Nature and People, which endorsed the Global Deal for Nature proposal to protect at least 30 percent of Earth's land and oceans by 2030.¹⁶¹

Pairing the Global Deal for Nature with the Paris Climate Agreement, the scientists said, was necessary to avoid catastrophic climate change, conserve species and secure essential ecosystem services.

A few weeks later, President Biden declared that his climate change agenda would include the protection of 30 percent of United States land and ocean territories. The Yale Climate Connections noted that this 30-30 initiative would be critical to moving towards a carbon-

free future. "Natural landscapes and seascapes are carbon sinks, pulling CO2 from the atmosphere and storing carbon in soil, grasses, shrubs, and trees, coral reefs, sea grasses, and ocean floor sediments," it said.¹⁶²

Other initiatives are seeking to restore already degraded lands. The Great Green Wall in the Sahel and Sahara Initiative, led by the African Union, aims to plant a 7,000 kilometers arc of trees along the southern part of the Sahara Desert from Senegal to Djibouti on the Gulf of Eden. Another ambitious restoration program is the Bonn Challenge, which has a goal to restore 350 million hectares of degraded or deforested land by 2030.

In Abu Dhabi, UAE, efforts are under way to protect and restore mangrove forests along its coastline, to build resilience against storms and rising seas and to create a stronger carbon sink. According to an Abu Dhabi study, one hectare of mangrove forest can store 3,754 tons of carbon.¹⁶³ Similar efforts are also ongoing in Nigeria, where environmentalists are establishing mangrove nurseries to help replenish the damaged mangrove ecosystems in the Niger Delta.¹⁶⁴

With the rapid melting of the polar ice caps recognized as a dangerous climate change tipping point, leading to accelerated and irreversible impact, scientists are also looking at means to slow the melting of the ice. Researchers with the Arctic Ice Project are testing methods to protect and restore the Arctic Sea ice, which reflects much of the sun's energy back into space and stabilizes global weather patterns.¹⁶⁵

With the rapid melting of the polar ice caps recognized as a dangerous tipping point, leading to accelerated and irreversible impact, scientists are also looking at means to protect the ice.

¹⁵⁹Carrington, Damian, "Trials to suck carbon dioxide from the air start across the UK," Guardian, 24 May 2021.

¹⁶⁰A Global Deal for Nature: Guiding principles, milestones, and targets, Science Advances.

¹⁶¹Corbet, Sylvie, "50 countries vow to protect 30% of land and sea by 2030," AP News, 11 January 2021.

¹⁶²Lieberman, Bruce, "Details behind Biden's '30 by 30' U.S. lands and ocean climate goal," Yale Climate Connections, 11 March 2021.

¹⁶³Sophie Tremblay, "Abu Dhabi is replanting mangroves in the fight against climate change," CNN, 15 July 2019.

¹⁶⁴Ruth Maclean, "The Nigerian Activist Trying to Sell Plants to the Oil Company That Destroyed Them," New York Times, 3 September 2021

¹⁶⁵The Arctic Ice Project

4. A United Nations Priority Approach to Climate Change and International Security

In 2011, the Security Council met to consider the impact of climate change as part of its primary responsibility under the United Nations Charter for the maintenance of international peace and security. In a presidential statement, the Council expressed “its concern that possible adverse effects of climate change may, in the long run, aggravate certain existing threats to international peace and security.” The possible security implications of loss of territory of some States caused by sea-level-rise, particularly in small low-lying island States, was of particular concern, the statement said.¹⁶⁶

The Security Council also noted that in matters relating to the maintenance of international peace and security under its consideration, conflict analysis and contextual information on possible security implications of climate change is important, when such issues are drivers of conflict, and requested the Secretary-General to ensure that his reporting to the Council contains such contextual information.¹⁶⁷

[The possible security implications of loss of territory of some States caused by sea-level-rise, particularly in small low-lying island States, was of particular concern.](#)

The Security Council recognized the responsibility for sustainable development, including climate change, conferred upon the General Assembly, with the UNFCCC the key instrument in addressing climate change, and the Economic and Social Council, and noted the 2010 General Assembly resolution entitled “Protection of climate for present and future generations of humankind.”¹⁶⁸

Should the Security Council now agree to take a lead role in mobilizing the United Nations system in a comprehensive response to the security threats posed

by climate change and environmental degradation, as urged by an increasing number of world leaders, it may consider working in concert with other principal organs of the United Nations, including the General Assembly, the Economic and Social Council and the Trusteeship Council.

The General Assembly occupies the central position as the chief deliberative and representative organ of the United Nations. Under the United Nations Charter, the General Assembly considers current issues of critical importance to the international community. It may consider reports from the Security Council and other United Nations organs and make recommendations on questions relating to international peace and security.

Under Article 22 of the Charter, Rule 96 of its rules of procedure, the General Assembly may establish such subsidiary organs and committees as it deems necessary for the performance of its function.

The General Assembly currently organizes its work through six main committees: The Disarmament and International Security Committee (First Committee), Economic and Financial Committee (Second Committee), Social, Humanitarian and Cultural Committee (Third Committee), Special Political and Decolonization Committee (Fourth Committee), Administrative and Budgetary Committee (Fifth Committee) and the Legal Committee (Sixth Committee).

Should the General Assembly find that the impacts of climate change are of such consequence to the principles and purposes of the United Nations that it calls for the widest possible cooperation by all countries, as an issue of highest priority, it should consider establishing a seventh committee to allow for a more direct and comprehensive United Nations approach to the threats posed by climate change.

[The General Assembly should consider establishing a seventh committee to allow for a more direct and comprehensive United Nations approach to the threats posed by climate change.](#)

The Economic and Social Council, as well, may consider adding to its eight functional commissions¹⁶⁹ a new commission to support the Council’s deliberations on the social and economic impacts of climate change, and in accordance with Article 65 of the UN Charter, furnish information and assist the Security Council, at its request, with regard to climate change and the maintenance of peace and security.

The Charter established an international trusteeship system for the administration of trust territories inherited from the League of Nations.¹⁷⁰ In 1994, the Trusteeship Council, one of the principal organs of the United Nations, suspended its operations for the administration of trust territories, following the independence of Palau, the last remaining trust territory. The Trusteeship Council is made up of the five permanent members of the Security Council – China, France, the Russian Federation, the United Kingdom and the United States.

In 1997, Secretary-General Kofi Annan presented to the General Assembly a United Nations reform program that proposed a new concept of trusteeship. The Trusteeship Council, he proposed, would “be reconstituted as the forum through which Member States exercise their collective trusteeship for the integrity of the global environment and common areas such as oceans, atmosphere and outer space. At the same time, it should serve to link the United Nations and civil society in addressing these areas of global concern, which require the active contribution of public, private and voluntary sectors.”¹⁷¹

[A reconstituted Trusteeship Council could serve as a clearing house for information on carbon sequestration](#)

[and environmental protection and restoration efforts around the world.](#)

Should Member States agree to a proposal for a reconstituted Trusteeship Council, the Council could serve as a clearing house for information on carbon sequestration and environmental protection and restoration efforts around the world. Voluntary reporting of this kind could include progress made by the African Union’s Great Green Wall initiative, the Global Deal for Nature, the Bonn Challenge support for the restoration of millions of hectares of degraded land, and the carbon capture and sequestration work taking place in Iceland and elsewhere. The Trusteeship Council, mandated to report to the Security Council in “strategic areas”, and to the General Assembly on all other matters, would then be able to provide an overview of public and private sector efforts to protect and restore the balance of the natural world.



¹⁶⁶Statement by the President of the Security Council, “Maintenance of international peace and security”, 20 July 2011, S/PRST/2011/15

¹⁶⁷Ibid.

¹⁶⁸General Assembly resolution 65/159, 20 December 2010.

¹⁶⁹Current ECOSOC functional commissions work on narcotic drugs, population and development, science and technology for development, the status of women, statistics, social development, crime prevention and criminal justice, and forests.

¹⁷⁰League of Nations mandate system established in 1919. Paul Kennedy, *The Parliament of Man. The Past, Present and Future of the United Nations*, Random House, 2006, p. 41.

¹⁷¹Renewing the United Nations: A Programme of Reform, Report of the Secretary-General, 14 July 1997, A/51/950.

IV. Conclusion

In 1945, as the Second World War was coming to an end, representatives of the founding nations of the United Nations assembled in San Francisco with an aim to establish a system of international security that would succeed where the League of Nations before it had failed.

The resulting Charter of the United Nations inspired a world broken by war and immense suffering. Its ambition was high and set out to establish an organization with a mission to save succeeding generations from the scourge of war, to reaffirm faith in fundamental human rights, to establish conditions under which justice and respect for the obligations arising under international law can be maintained, and to promote social progress and better standards of life in greater freedom.

The climate and environmental crisis now before us may test the United Nations as no other crisis has since its founding. To succeed in its mission, the United Nations will need to concentrate its organization and resources to meet this challenge in the years ahead. It must once again inspire the world with its ambition and ability to confront the greatest threat modern humans have ever faced.

V. Recommendations

1. The Security Council should include the impact of climate change on international security as part of its primary responsibility for the maintenance of peace and security.

2. The General Assembly should consider establishing a seventh committee to allow for a more direct and comprehensive United Nations approach to the threats posed by climate change. The Assembly should also appoint a Special Envoy to lead the United Nations system response to climate change and advise the Security Council on the impact of climate change on international peace and security.

3. The Economic and Social Council should consider establishing a Commission on Climate Change to furnish information and assist the Security Council with regard to climate change and international security.

4. Member States should consider reconstituting the Trusteeship Council, whereby the Council would serve as a clearing house for information on carbon sequestration and environmental protection and restoration efforts around the world, thus enabling it to provide an overview of public and private sector efforts to restore the balance of the natural world, in trust for future generations.

5. The Arab League and the African Union should explore the development of mechanisms for monitoring the impact of climate change on peace and security in their regions.



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