

Understanding global warming's many effects and causes

By Joy Huang / Special To The Tab
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Global warming is not new. Temperatures have been rising worldwide since 1867, when global temperature data was first available. Not everyone is convinced global warming is a serious concern. Skeptics argue that climate change is a normal part of climate cycles, and that Earth has been in a warm period for the past 10,000 years. Those worried about global warming point out that growth at an exponential rate would be catastrophic for the environment. They argue that while the increase in Earth's temperature may be "natural," human industrialization and intervention has drastically accelerated the process.

Everyone agrees that during the 20th century at least, global temperatures increased steadily, and that the rise in temperature impacts Earth's environment and humans in numerous ways. As global temperatures rise, the environment is disturbed and humans are put at risk. Glaciers retreat, sea levels rise, weather patterns change, bleached coral reefs die, and disease spreads.

The melting of glaciers has become a major focus of concern about global warming. As temperatures increase, these ancient ice behemoths thaw more rapidly. In Antarctica, entire sheets of ice sometimes slide off into the ocean. The European Alps and the Caucasus mountains have lost half of their glacial ice in this century, and glaciers in the Andes are retreating at seven times the rate they were just 30 years ago. The most dramatic effects are in the Himalayas, where glaciers feed the Ganges and Indus Rivers of northern India. The 500 million people who depend on those glaciers as a source of water have already experienced erratic flooding and serious mud slides. Glaciologist Keith Echelmeyer surveyed 90 glaciers in Alaska for eight years and discovered that most of them were thinning by 5 feet (1.5 meters) each year and some even up to 10 feet (3 meters) each year. The rate of thinning is exponential, and the thawing speeds up as glaciers get thinner because the melted water lubricates the glacier. In 2002, when the Larsen B ice shelf slid off the Antarctic peninsula, the glaciers behind it started disappearing at up to eight times their previous rate.

Retreating glaciers lead to disastrous flooding and a shortage of water. When glaciers melt, sometimes rocky debris piled at the edge of glaciers impedes the flow of melted water, trapping large lakes behind them. When these moraines give way, the glacial lakes suddenly pour into the valleys below much as lava flows in a volcanic eruption. Eventually, the lakes and rivers they form each summer begin to shrink, leading to a scarcity of water for people dependent on those "summer river flows."

Melting glaciers also affect the oceans. Warm water expands and takes up more space, so sea levels rise in response to the warming of the planet. With the added melted ice from retreating glaciers, the rise in sea level will increase further. Sea levels

rose four to 10 inches (10.16 to 25.4 cm) in the last century. Estimates vary, but the U.S. Environmental Protection Agency predicts a rise of 12 inches (30 cm) along the Gulf and Atlantic coasts by 2025, and most scientists agree that a rise of 28 inches (72 cm) over the next century is possible. These numbers may not seem shocking, but rising sea levels are destructive to coastlines and potentially disastrous to island nations and delta farmlands. Higher sea levels lead to more coastal erosion and destroy farmlands near the coast, replacing them with rocky sediments. Wetlands and adjacent low-lying terrain become prone to flooding. As seawater flows onto land, it contaminates freshwater, increasing river and groundwater salinity. Bangladesh has already experienced so many floods and storms that 10 percent of the country could be submerged as sea levels rise.

Earth's climate is shifting towards extremes. As the planet heats up, evaporation increases, adding more moisture to the atmosphere and causing more violent downpours. Thomas Karl of the National Climatic Data Center reported in the late 1990s that recent decades the US has experienced a 20 percent increase in blizzards and heavy rainstorms. Rising temperatures also strengthen hurricanes, which gather energy over warm water. The warmer the water, the greater the energy, which means more intense storms. Last year in the Gulf of Mexico, there were so many tropical storms that for the very first time forecasters ran out of names."

Weather patterns will change erratically. Some places will experience more precipitation and more severe weather, while others will experience an overall decrease in evaporation and rainfall. An average decrease in water vapor concentration reduces the moisture of the soil and can cause desertification. Drought conditions are intensifying in Africa and Asia for this reason. In 2000, Central Mongolia experienced its worst drought in 60 years followed by its harshest winter in 30 years, and 1.8 million domestic animals froze to death.

With higher temperatures, lakes and springs thaw earlier in the spring. In Alaska, four out of the five earliest record thaws occurred in the 1990s. In 1993 German scientists reported that spring was starting six days earlier and autumn five days later than in 1959, extending the growing season by 11 days. This can benefit farmers but it has detrimental effects on freshwater ecosystems. Recent studies document a connection between global warming and eutrophication. One Canadian scientist who collected samples from six lakes in the Canadian Arctic and found that algal growth began 150 years ago and is now increasing exponentially, has said: "These are pristine lakes that mankind hasn't directly affected. But there has definitely been an indirect effect."

Although there are disputes about the magnitude of global warming, the Intergovernmental Panel on Climate Change, consisting of 2,500 top scientists from 60 countries, has compiled a comprehensive study of the impacts of climate change and proposed ways to respond to it. They have published a climate change report every five years since 1988.

The IPCC warned in its most recent report (2001) that global warming is occurring more rapidly than previously believed, mostly due to human activities. They concluded that the average global temperature is projected to rise between 2.5 and 10.4 degrees Fahrenheit (1.4 and 5.8 degrees Celsius) by the year 2100; in North America the temperature is projected to increase by 7.2 to 8.9 degrees Fahrenheit by 2100; the

1990s was the warmest decade and 1998 the warmest year since the beginning of global temperature observations; global sea levels have risen 10 times faster in the last 3,000 years than ever before and are projected to rise about 3 to 28 inches (8 to 72 cm) between 1990 and 2100; and snow cover and the northern sea ice will further decrease.

The IPCC concluded that "The balance of evidence suggest a discernible human influence on global climate." Carbon dioxide is one of the "greenhouse gases," a group of atmospheric gases named for their role in the "greenhouse effect," a natural process that maintains global temperature but which also contributes to global warming. Other greenhouse gases include water vapor, methane, nitrous oxides, and chlorofluorocarbons.

Visible radiation from the sun travels to Earth and is absorbed by the atmosphere. Some of that radiation is absorbed by the Earth, which warms up and radiates back to space as infrared radiation. As greenhouse gases and clouds in Earth's atmosphere absorb and reflect this infrared radiation, this slows the loss of heat from the atmosphere. Carbon dioxide, although it has a lower global warming potential than the other greenhouse gases, is the most important one because of its high atmospheric concentration. Before 1750, its concentration in the atmosphere was around 280 parts per million (ppm), and for 420,000 years, following the natural carbon cycle, it never increased past 325 ppm, but today it has risen to over 360 ppm. Human industrialization was the main trigger for this unprecedented jump in CO₂ atmospheric concentration. CO₂ began increasing in the atmosphere in the late 1700s due to the use of fossil fuels as an energy source. Coal, oil, and natural gas consist of carbon compounds created millions of years ago. When burned, they release water vapor and carbon, which combines with oxygen to form carbon dioxide. The burning of fossil fuels creates three-fourths of the Earth's carbon dioxide.

Cement-making and deforestation also add CO₂ to the atmosphere. Cement-making releases CO₂ from carbonate rocks. Deforestation produces CO₂ emissions through the burning of forests and also through the burning of firewood. Decaying wood results in slow CO₂ emission, whereas burning wood results in rapid CO₂ emission. Since 1992 cement-making and fossil fuel burning together have added more than 6 billion tons of carbon dioxide to the atmosphere each year. Reducing carbon dioxide emissions is no easy task, because we rely on fossil fuels to power industries and homes, cars and planes, and for nearly everything else we do. Practicing conservation measures will reduce the amount of carbon dioxide in the atmosphere, but we must reduce our dependence on fossil fuels to address the problem adequately.

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