TEN STRESSES ON THE PLANET

Global Warming

Australia has its worst drought in history. Denver receives 57 inches of snow in a week. Thirty thousand people die in Europe from heat. Glaciers retreat. The Tundra thaws. Spring arrives two weeks early in eastern Canada.[i] *News of extreme weather comes to us with increasing frequency. While such events may not be individually attributed to global warming, they are consistent with patterns that scientists warn are stressing the planet. Indeed, many scientists prefer the term* global climate change *because the effects of Earth's warming are so varied.*

These climate disruptions can be traced to subtle but far-reaching changes in Earth's atmosphere. Carbon dioxide, methane, and other trace gases in the atmosphere absorb the sun's heat, causing the lower atmosphere and Earth's surface to warm as if wrapped in a blanket. This natural greenhouse effect keeps the earth from becoming an ice ball. But humans are adding greenhouse gases to the atmosphere—in effect adding more blankets. Since records have been kept, the 16 warmest years have occurred since 1983 with the highest in 1998 and 2005. For the US, 2006 was the warmest year on record.

RISING LEVELS OF GREENHOUSE GASES

The primary cause of global warming is the increase of carbon dioxide (CO_2) in the atmosphere. About 410 million years ago, during the Carboniferous Period, the atmospheric level of CO_2 and the temperature of the planet were many times higher than today. Plants, drawing CO_2 out of the air, grew so abundantly that they covered the land and ocean with a dense mat of vegetation—in some places hundreds, or even thousands, of feet deep. As the mats of vegetation were compressed under layers of sediment, they eventually became what we now call fossil fuels (coal, oil, natural gas).[ii]

When humans began digging up coal to fuel the industrial revolution, the level of atmospheric CO_2 began to rise slowly at first, then more rapidly in the late 19th century with the discovery of oil. During the past 250 years, the CO_2 level has increased by 31 percent, reaching a concentration unseen on the planet in 650,000 years.[iii] Since the start of the industrial revolution the atmospheric levels rose from 280 ppm to 381 ppm in 2006.[iv]

Scientists estimate that CO_2 produced by burning fossil fuels, largely for electric power generation and transportation, is responsible for 60 percent of the overall warming effect. About 18 percent is from CO_2 released by deforestation and other land conversion. Fourteen percent is from methane, and eight percent is from nitrous oxide.[v]

Methane and nitrous oxide have much lower atmospheric levels than CO_2, but because they trap heat more effectively per molecule, their warming impacts have become significant. Atmospheric concentrations of methane have doubled since the onset of the industrial revolution, largely because of an increase in the production of beef, rice, and oil.[vi] (Methane emissions from cow digestion quadrupled in the last century; waterlogged rice paddies release methane as submerged vegetation decays; and methane often leaks from poorly managed oil wells.)[vii] Nitrous oxide escapes into the atmosphere when nitrogen fertilizers are applied to farm fields.

The US, with less than five percent of the world's population, produces more than 22 percent of the annual CO_2 emissions resulting from human activity.[viii] Residents in the industrial nations of Europe, North America, and Japan are responsible for 3.5 tons of carbon emissions per person each year whereas the world's poorest citizens are responsible for about 0.1 ton. The richest tenth of Americans account for 11 tons per person.[ix]

Extreme Weather Events

In 1988, when governments first became alarmed about global warming, the World Meteorological Organization and United Nations Environmental Programme established the Intergovernmental Panel on Climate Change (IPCC) to provide independent scientific advice to governments on the complex issue of climate change. This Panel produced reports in 1990, 1995, 2001, and 2007. The reports, the most recent of which included the work of 2,500 scientists from 130 countries, have documented a number of observable changes caused by global warming.

The most obvious result of global warming is an increased number and severity of storms, floods, and droughts worldwide. A rule of thumb is that for every degree the temperature increases, three percent more water vapor is added to the air. More water vapor in the atmosphere leads to a significant increase in the energy available to drive storms. Total winter precipitation in the US has increased ten percent since 1900, and "extreme precipitation events," such as rainstorms that dump more than two inches of water in 24 hours, have increased by 20 percent. Rising ocean temperatures in tropical oceans are also increasing the intensity of hurricanes: category 4 and 5 hurricanes have doubled since 1990.[x] One NASA analyst said, "We seem to be getting these storms of the century every couple of years." NASA data also show increases in incidences of drought. With warmer atmospheric temperatures, there's more evaporation of soil moisture. Those parts of a continent that are normally dry are even drier. Costs associated with extreme weather events in the US increased from an annual average of $4 billion in the 1980s to over $200 billion in 2005.[xi]

El Niño events have become more frequent, persistent, and intense since 1970.[xii] Traditionally every four to seven years a band of water 2-10 degrees warmer than the surrounding ocean bulges toward the Pacific coast of South America, spawning enormous storms, altering currents, changing wind patterns, and causing droughts all around the world. Because it often appears around Christmas, it's called El Niño or "The Child." Oceanographers, in studying accounts by Spanish explorers, concluded that the 1982-83 El Niño was the most powerful in nearly 500 years, and it was followed by an even stronger event only 14 years later—the briefest time ever recorded between very strong El Niños.

In the American West, longer, warmer summers have resulted in more wild fires. Since the 1980s, major wildfires have increased fourfold, and the area of forest burned, sixfold.[xiii]

Melting Sea Ice and Glaciers

In 1995 in Antarctica, a vast section of ice the size of Rhode Island broke off the Larsen ice shelf. The following year scientists discovered that, over the last half century, five of the nine ice shelves attached to the Antarctic Peninsula had disintegrated.[xiv] Polar climate change effects are more pronounced because the Arctic and Antarctic warm at a much faster rate than the Equator. Scientists working in Alaska, 170 miles north of the Arctic Circle, have observed

average summer temperatures rise by about seven degrees in the past two decades.[xv] Around Hudson's Bay, sea ice has been vanishing two weeks earlier than it did in the 1970s. Polar bears are getting thinner and reproducing less successfully as they are forced to swim more often, and for longer distances, in search of floating ice sheets. Global warming could cause the Arctic's summer sea-ice to completely disappear in 40 years.[xvi]

Non-polar glaciers, stable for 800 years, have been melting steadily, decreasing by an average of ten percent since 1960.[xvii] The ice cap on Mt. Kilimanjaro, for example, is predicted to disappear within the next decade. At the current rate of retreat, there will be no glaciers left in Glacier National Park in 2019.[xviii] In the western US, studies suggest a reduction of snow pack by 50 to 70 percent.[xix] The consequences of such reductions could be catastrophic for communities that rely on snow and ice melt for drinking water, irrigation, and hydroelectric power.

Biotic Response

Spring is starting about a week earlier in the northern hemisphere than it did 20 years ago, and the distribution of vegetation and wildlife has begun to shift significantly toward the poles and toward higher elevations. For example, mosquitoes are appearing in the Arctic for the first time.[xx] Outbreaks of dengue fever and malaria, previously limited to tropical areas, are occurring at higher latitudes. Many plants and animals are unable to migrate fast enough to survive, or bodies of water or urban regions block their migration. Some mountainous animals, such as particular species of butterflies and pikas, are threatened with extinction because they can't move any higher. In some cases climate change has upset the delicate balance of plant-animal co-evolution. For example, pied flycatchers in some areas of Europe are now starving because the caterpillars they depend on for food peak before the young birds hatch.

Future Scenarios

The IPCC expects weather-related catastrophes to increase. Its models project a rise in global temperature of 3.1 to 7.2 degrees (above 1980-99 levels) by 2100. Warming is expected to be greatest over land and at high northern latitudes. A 3-degree increase could place 30 percent of all plants and animals at risk of extinction; a 7-degree increase could risk 70 percent. The panel projects a sea-level rise of 7 to 23 inches by 2100, due to melting ice and expansion of water itself as temperatures rise. Sea-level rises could be greater. Predictions are difficult because of uncertainties about ice melt and ocean absorption. Rising seas could displace tens of millions of people in low-lying areas, particularly deltas in China, Bangladesh, and Egypt.

To avoid catastrophic climate impacts, the IPCC recommends a stabilization of CO_2 atmospheric levels at 450 ppm, which should keep temperature increases about 4 degrees above pre-industrial levels.[xxi] Even with a reduction in CO_2 and other greenhouse gas levels, the temperature will continue to rise for decades, and sea levels will continue to rise for several centuries because CO_2 can stay in the atmosphere for 100 years or more.[xxii]

The IPCC goal cannot be reached without massive reductions in the use of fossil fuels. In this century CO_2 emissions have grown at a much faster rate than during the 1990s, and if current trends continue, they will increase by 57 percent by 2030.[xxiii] This is due to worldwide economic growth, powered by coal-intensive China. Researchers on the Panel and from the European Union and California have determined that an 80 percent reduction in emissions by 2050 will be required to meet the goal.

Looking beyond predictions from models, scientists have posited a disturbing scenario of runaway warming from the melting of ice caps. Ice reflects 90 percent of the sun's heat back into space, whereas seawater absorbs 90 percent. A reduction in ice creates a feedback loop whereby ocean temperature increases, promoting greater ice melt.[xxiv] A 5.4 degree increase in temperature above pre-industrial levels could make disintegration of ice caps in Antarctica and Greenland unstoppable.[xxv] Sea levels would rise many feet within a few years and as much as 20 feet within a century or two.[xxvi] Many of the world's cities, industrial areas, and agricultural lands would be flooded.

WHAT IS BEING DONE?

The nations of the world responded to global warming in 1997 with the formation of the Kyoto Protocol. Effective in 2005, the protocol commits the industrialized nations that ratified it to reduce collective emissions of greenhouse gases by an average of five percent below 1990 levels by 2012. Europe acted quickly: France, Netherlands, Denmark, Finland, and Sweden passed taxes on carbon emissions or fossil fuels.[xxvii] The US did not ratify the protocol, but in 2006 California passed the first Kyoto-type law in the US, intending to decrease greenhouse gases to 1990 levels by 2020 and to 80 percent below those levels by 2050. Earlier, seven Northeast states signed an agreement to adopt a cap for power plants. At least 80 corporations, more than half of them Fortune 500 companies, have committed to reductions and are measuring progress toward their goals through the EPA's Climate Leaders program.[xxviii]

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