

## The Changing Climate



Science

KEYWORDS:

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### ABSTRACT

The term greenhouse effect refers broadly to the partial trapping by the atmosphere of radiation from the Earth's surface, leading to a surface temperature that is larger than would be the case without the atmosphere. Greenhouse gases such as carbon dioxide (CO<sub>2</sub>) absorb heat (infrared radiation) emitted from earth's surface. Some scientists are concerned that the heat in the Earth's atmosphere may be increasing to dangerous levels due to the greenhouse effect. Human activities especially the burning of fossil fuels since the start of the Industrial Revolution have increased atmospheric CO<sub>2</sub> concentrations by about 40%, with more than half the increase occurring since 1971. Since 1905, the global average surface temperature has increased by about 0.8°C. This has been accompanied by warming of the ocean, a rise in sea level, a strong decline in Arctic sea ice, and many other associated climate effects. Much of this warming has occurred in the last four decades. Detailed analyses have shown that the warming during this period is mainly a result of the increased concentrations of CO<sub>2</sub> and other greenhouse gases. Continued emissions of these gases will cause further climate change, including substantial increases in global average surface temperature and important changes in regional climate. The magnitude and timing of these changes will depend on many factors, and slowdowns and accelerations in warming lasting a decade or more will continue to occur.

### Introduction:

The greenhouse effect results from the heat energy of sunlight being absorbed by the Earth and molecules in the Earth's atmosphere. This energy is usually radiated back towards space. However, as we change the gases in the Earth's atmosphere as the results of everyday living, this energy is unable to leave the Earth's atmosphere and is trapped as heat. The heat causes a gradual warming of the air around the Earth. This warming is known as the greenhouse effect. Average global temperatures have been rising since the 1800s: the average temperature of the Earth has risen approximately 0.7°C or 1.2°F. Long-term climate change over many decades will depend mainly on the total amount of CO<sub>2</sub> and other greenhouse gases emitted as a result of human activities[1].

A warmer atmosphere may seem desirable to many people. However, significant warming could have many harmful effects. Lower heating costs could be offset by higher air conditioning costs. Areas that now grow most of the world's food might become too warm or too dry to grow crops. The areas that would become warmer, like Canada, do not have appropriate soil for growing crops. Lower water levels in lakes and streams would concentrate pollutants. Weather patterns may change with hurricanes probably hitting the coast farther north and with greater ferocity. Warmer temperatures would increase the volume of water in the oceans and possibly melt much of the ice in mountain glaciers and the Arctic and Antarctic ice caps. This would cause sea level to rise, causing flooding of the world's coastal cities, where one-third of the world's population lives. Protective barrier islands would disappear underwater, resulting in increased coastal erosion. For these and other related reasons, scientists are very concerned about the greenhouse effect.

### Scientific Analysis

Climate change means not only changes in globally averaged surface temperature, but also changes in atmospheric circulation, in the size and patterns of natural climate variations, and in local weather. La Nina events shift weather patterns so that some regions are made wetter, and wet summers are generally cooler. Stronger winds from Polar Regions can contribute to an occasional colder winter. In a similar way, the persistence of one phase of an atmospheric circulation pattern known as the North Atlantic Oscillation has contributed to several recent cold winters in Europe, eastern North America, and northern Asia. The most important greenhouse gas in the atmosphere is water vapor. Along with clouds, composed of water drops or ice crystals, water vapor plays a key role in trapping outgoing terrestrial radiation. While the atmosphere is relatively transparent to short-

wave radiation (sunlight), it is nearly opaque to infrared radiation, owing to the presence of certain trace gases and of clouds. Much of the infrared radiation passing upward from the Earth's surface is absorbed and reradiated, both upward and downward. Because the surface therefore receives not just solar radiation but also infrared radiation from the atmosphere and clouds, it is much warmer than it would be in the absence of the atmosphere. Next to water in all its phases, the important greenhouse substances in the atmosphere include carbon dioxide, methane, nitrous oxide, ozone, and various chlorofluorocarbons (CFCs). The CFCs are entirely of anthropogenic origin[2].

### The effects of CO<sub>2</sub>

Let me turn to some of the problems the non-pollutant CO<sub>2</sub> is supposed to cause. CO<sub>2</sub> does indeed cause some warming of our planet, and we should thank Providence for that, because without the greenhouse warming of CO<sub>2</sub> and its more potent partners, water vapor and clouds, the earth would be too cold to sustain its current abundance of life. Other things being equal, more CO<sub>2</sub> will cause more warming. The question is how much warming, and whether the increased CO<sub>2</sub> and the warming it causes will be good or bad for the planet. More CO<sub>2</sub> is supposed to cause cities to flood, parched agriculture, tropical diseases in Alaska, etc., and even an epidemic of kidney stones.

The argument starts something like this. CO<sub>2</sub> levels have increased from about 280 ppm to 410 ppm over the past 150 years or so, and the earth has warmed by about 0.8 C during that time. Therefore the warming is due to CO<sub>2</sub>. **The Changing Climate:**

It is not just rising average global temperatures that concern scientists but also their effects on weather extremes, declining global ice cover and sea level rise. In fact, many of the predictions that scientists have made in the past about the impacts of global warming are already upon us, including disappearing glaciers, loss of sea ice, more extreme heat waves, accelerated sea level rise, and stronger hurricanes. Scientists say these effects are likely to worsen in the decades ahead[3].

### Rising Sea Level:

Among the most serious and potentially catastrophic effects of global warming is sea level rise, caused by a combination of melting glaciers all over the world and the "thermal expansion" of the seas as oceans warm.

Rising sea level will have severe impacts in low-lying coastal communities throughout the world. In Bangladesh, for example, even a one-meter rise would inundate 18 percent of the country.

In the United States, where 53.5 percent of the population lives in close proximity to the ocean, the most vulnerable areas are the Southeast and Mid-Atlantic coasts. Also at risk are low-lying areas and bays such as North Carolina's Outer Banks, the Florida Coast, and much of southern California.

#### **Melting Polar Ice:**

In November 2004 an international team of 300 scientists from 15 countries, including the United States, issued a report on the impacts of climate change in the Arctic. In addition to painting a stark picture of how climate change already is affecting the region, the report of the Arctic Climate Impact Assessment predicted that at least half the summer sea ice in the Arctic will melt by the end of this century, along with a significant portion of the Greenland Ice Sheet [4].

#### **Droughts and Flooding:**

Other weather impacts from climate change include a higher incidence of drought and flooding and changes in precipitation patterns. According to the Intergovernmental Panel on Climate Change, future changes in weather patterns will affect different regions in different ways. In the short term, for instance, farms and forests may be more productive in some regions and less productive at others. Among the reasons; precipitation will increase in high-latitude regions of the world in summer and winter, while southern Africa, Australia and Central America may experience consistent declines in winter rainfall. As a result of these changes, agriculture in developing countries will be especially at risk. Wheat, for example, may virtually disappear as a crop in Africa, while experiencing substantial declines in Asia and South America.

Two reports released by the Pew Center on Global Climate Change in 2004 looked at the likely impact of climate change on the United States. The U.S. areas most at risk, according to the reports, will be the Southeast and southern Great Plains because of the low-lying coasts in the Southeast and the long-term impacts of warmer temperatures on agriculture in both regions. The reports also warned of the potential impacts of climate change on long-lived infrastructure in the United States, especially the nation's water resources [5].

#### **Effects on Human Health:**

A recent United Nations report blamed climate change, along with worsening air and water quality and poor disposal of solid waste, for an increase in malaria, cholera and lower respiratory tract infections in African societies. Africans also are suffering from the effects of reduced crop yields and decreased availability of water. Climate change can affect human health directly (for example, because of extreme temperatures and heat waves) and indirectly (for example, by contributing to the spread of infectious disease or threatening the availability and quality of food and water). The elderly, the infirm and the poor will be especially at risk.

#### **Effects on Ecosystems:**

Climate change holds the potential of inflicting severe damage on the ecosystems that support ails life, from hazards to coral reefs due to warmer and more acidic ocean waters to threats to polar bears because of declines in sea ice. Ecosystems around the world already are reacting to a warming world.

For example, one study found that 150 species, including both plants and animals, have responded to earlier spring warming over the last 40 years. These organisms have changed their timing of flowering, migration and other spring activities. The changes occurred regardless of regional difference and were linked directly to enhance greenhouse warming. Researchers also have established that climate change is driving some species to extinction. For instance, in the past 25 years dozens of

species of mountain frogs in Central America have disappeared because of a disease that formerly did not occur where they live. In 2007, a paper in the journal *Nature* revealed that the disease-causing organism, a fungus, has spread to higher elevations as a result of human-induced climate change [6].

#### **Impacts on Ecosystems:**

The resilience of many ecosystems is *likely* to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers (e.g. land-use change, pollution, fragmentation of natural systems, over-exploitation of resources). Over the course of this century, net carbon uptake by terrestrial ecosystems is *likely* to peak before mid-century and then weaken or even reverse, thus amplifying climate change. Approximately 20 to 30% of plant and animal species assessed so far are *likely* to be at increased risk of extinction if increases in global average temperature exceed 1.5 to 2.5°C. For increases in global average temperature exceeding 1.5 to 2.5°C and in concomitant atmospheric CO<sub>2</sub> concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions and shifts in species' geographical ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services, e.g. water and food supply.

#### **Impact on Food:**

Crop productivity is projected to increase slightly at mid- to high latitudes for local mean temperature increases of up to 1 to 3°C depending on the crop, and then decrease beyond that in some regions. At lower latitudes, especially in seasonally dry and tropical regions, crop productivity is projected to decrease for even small local temperature increases (1 to 2°C), which would increase the risk of hunger. Globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1 to 3°C, but above this it is projected to decrease [7].

#### **Impact on Coasts:**

Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas (*very high confidence*). By the 2080s, many millions more people than today are projected to experience floods every year due to sea level rise. The numbers affected will be largest in the densely populated and low-lying mega deltas of Asia and Africa while small islands are especially vulnerable (*very high confidence*).

#### **Impact on Health:**

The health status of millions of people is projected to be affected through, for example, increases in malnutrition; increased deaths, diseases and injury due to extreme weather events; increased burden of diarrheal diseases; increased frequency of cardio-respiratory diseases due to higher concentrations of ground-level ozone in urban areas. Climate change is projected to bring some benefits in temperate areas, such as fewer deaths from cold exposure, and some mixed effects such as changes in range and transmission potential of malaria in Africa. Overall it is expected that benefits will be outweighed by the negative health effects of rising temperatures, especially in developing countries. Critically important will be factors that directly shape the health of populations such as education, health care, public health initiatives, and infrastructure and economic development [8].

Atmospheric and ocean circulation patterns will evolve as Earth warms and will influence storm tracks and many other aspects of the weather. Global warming tilts the odds in favor of more warm days and seasons and fewer cold days and seasons. For example, across the continental United States in the 1960s there

were more daily record low temperatures than record highs, but in the 2000s there were more than twice as many record highs as record lows. Another important example of tilting the odds is that over recent decades heat waves have increased in frequency in large parts of Europe, Asia and Australia.

The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased significantly since the Industrial Revolution began. In the case of carbon dioxide, the average concentration measured at the Mauna Loa Observatory in Hawaii has risen from 316 parts per million (ppm) in 1959 (the first full year of data available) to 396 ppm in 2013. The same rates of increase have since been recorded at numerous other stations worldwide. Since pre-industrial times, the atmospheric concentration of CO<sub>2</sub> has increased by 40%, methane has increased by about 150%, and nitrous oxide has increased by roughly 20%. More than half of the increase in CO<sub>2</sub> has occurred since 1970. Increases in all three gases contribute to warming of Earth, with the increase in CO<sub>2</sub> playing the largest role[9],[10].

Global warming is occurring as a result of the greenhouse effect, most scientists agree that there are steps that we should take to reduce the amount of air pollutants that are thought to cause it. These steps would reduce air pollution and save energy at the very least. Some recommended things that we can do include: reducing the production of CFCs; reducing the use of fossil fuels; increasing the use of air pollution control devices; stopping deforestation; planting more trees; reducing water pollution; and slowing human population growth.

#### Awareness:

Citizens and governments can choose among several options in response to this information. They can change their pattern of energy production and usage in order to limit emissions of greenhouse gases and hence the magnitude of climate changes; they can wait for changes to occur and accept the losses, damage and suffering that arise; they can adapt to actual and expected changes as much as possible; or they can seek as yet unproven 'reengineering' solutions to counteract some of the climate changes that would otherwise occur. Each of these options has risks, attractions and costs, and what is actually done may be a mixture of these different options. Different nations and

communities will vary in their vulnerability and their capacity to adapt[11],[12].

#### Conclusion:

This paper explains that there are well-understood physical mechanisms by which changes in the amounts of greenhouse gases cause climate changes. It discusses the evidence that the concentrations of these gases in the atmosphere have increased and are still increasing rapidly, that climate change is occurring, and that most of the recent change is almost certainly due to emissions of greenhouse gases caused by human activities. Further climate change is inevitable; if emissions of greenhouse gases continue unabated, future changes will substantially exceed those that have occurred so far. There remains a range of estimates of the magnitude and regional expression of future change, but increases in the extremes of climate that can adversely affect natural ecosystems and human activities and infrastructure are expected.

## REFERENCE

- Held IM, et al. (2010) probing the fast and slow components of global warming by returning abruptly to pre-industrial forcing. *J Climate* 2. | 2. Hasen J, et al. (2005) Earth's energy imbalance: Confirmation and implications.. | 3. Knutti R, Stocker (2002) Limited predictability of the future thermohaline circulation close to an instability threshold. *J Climate* 15: 179-186. | 4. EPA 2006. Global mitigation of non-CO<sub>2</sub>green-house gases. EPA 430-R-06-0905, Washington, DC, USA. | 5. FAO. 2011b. Global livestock production systems, by T.P.Robinson, P.K.Thornton, G.Franceschini, R.L.Kruska, F.Chiozza, A.Notenbaert, G.Cecchi, M.Herrero, M.Epprecht, S.Fritz, L.You, G.Cochedda&L.See. Rome. | 6. Saha, A.K. (Jan-Feb, 1997). Environment, Social Forestry and Community Awareness.Kurukshetra (Journal on Rural Development, Ministry of I&B, Govt. of India), pp.17-19. | 7. Spencer, R.W., and W.D.Braswell. "How Dry is the Tropical Free Troposphere? Implications for Global Warming Theory,"*Bulletin of the American Meteorological Society* 78 (1997), 1097-1106. | 8. Thompkins, A.M. and K.A.Emanuel. "Simulated Equilibrium Tropical Temperature and Water Vapor Profiles and their Sensitivity to Vertical Resolution." *Quarterly Journal of the Royal Meteorological Society* (2000), in press. | 9. Economic Commission for Africa. 2001. State of the Environment in Africa. 10. Lemke, P., Ren, J., Alley, R.B., Allison, I., Carrasco, J., Flato, G., Fujii, Y., Kaser, G., Mote, P., Thomas, R.H., and Zhang, T. (2007) Observations: changes in snow, ice and frozen ground, *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., and Miller, H.L., Eds.), Cambridge University Press, Cambridge. | 10. Turner, J., Comiso, J.C., Marshall, G.J., Lachlan—Cope, T.A., Beracegirde, T., Maksym, T., Meredith, M.P., Wang, Z.M<, and Orr, A. (2009) Non annular atmospheric circulation change induced by stratospheric ozone depletion and its role in the recent increase of Antarctic sea ice extenr, *Geophysical Research Letters* 36, L08502. | 11. Lucas, C., Henessy, K., Mills, G., and Bathols, J. (2007) Bushfire weather in the southeast Australia : Recent trends and project climate change impacts. | 12. Timbal, B., Arblaster, J.M., and Power, S. (2006) Attribution of the laten twentieth century rainfall decline in southwest Australia, *Journal of Climate* 19, 2046-2062. |