GLOBAL WARMING

GLOBALNO ZAGREVANJE

Autor:

Cekic Aleksandra, ucenica IV razreda Gimnazije "Stevan Jakovljevic", Vlasotince

Mentor:

Pipovic Biljana, professor engleskog jezika

REZIME

Poslednjih 150 godina primeceno je zagrevanje Zamljjine povrsine i atmosphere i neosporna je cinjenica da prosecna globalna temperatura raste. Medjutim, pitanja oko kojih se naucnici ne slazu su moguci uzroci i posledice globalnog zagrevanja, iako mnogi od njih tvrde da je zagrevanje posledica preterane emisije ugljen-dioksida. U svakom slucaju, pretpostavlja se da ce posledice globalnog zagrevanja biti ocigledne i siroko rasprostranjene za par decenija, izazivajuci brojne prirodne i drustvene problem putem promena u vremenu, nivou svetskog mora, poljoprivrednim prinosima, bioloskoj raznovrsnosti i, naravno, uticuci na ljudsko zdravlje. Stoga, jedna od glavnih briga naucnika, strucnjaka za zastitu zivotne sredine i ogromnog broja drugih organizacija je nacin na koji mozemo kontrolisati i uticati na globalno zagrevanje.

Kljucne reci: globalno zagrevanje, efekat staklene baste, ugljen-dioksid, varijacije u Suncevoj radijaciji, uzroci i posledice globalnog zagrevanja, prilagodjavanje

SUMMARY

The Earth's surface and near-surface atmosphere warming has been observed during last 150 years, and it is an undisputable fact that there is the increase in global average temperature. However, the problems which scientists disagree about are possible causes and effects of global warming, although it seems that a lot of scientists assert that global warming is the consequence of an excessive emission of carbon-dioxide. Anyway, consequences of global warming are predicted to be evident and widespread in couple of decades, inducing a number of natural and social problems by weather and sea level changes, changes in agriculture yield and biological diversity, and, of course, affecting human health. Therefore, one of the main concerns of scientists, environmentalists and a great number of other organizations is the way which we can control and affect global warming.

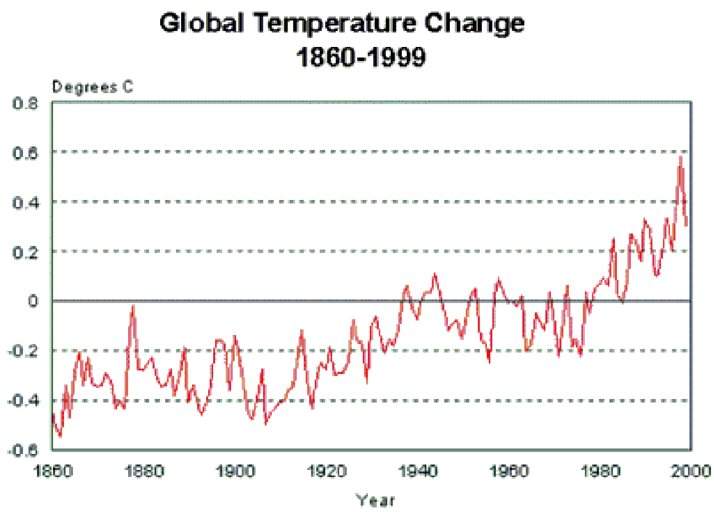
Key words: global warming, greenhouse effect, carbon-dioxide, solar variations, causes and effects of global warming, adaptation

Introduction

The Earth's climate has changed throughout history. From glacial periods (or "ice ages") where ice covered significant portions of the Earth to interglacial periods where ice retreated to the poles or melted entirely - the climate has been continuously changing. Today, one of the most vigorously debated topics on the Earth is the issue of climate change. Regarding its past causes and consequences, a present concern with climate change by so great number of scientists and the existence of a number of different opinions are reasonable.

Anyway, the general consensus of the scientific community is that the Earth's surface is warming. Global warming in recent historical times has been an undisputable fact, and everybody agrees that no one can reasonably deny that.

Global warming is the increase in the average temperature of the Earth's near-surface air, landmass and oceans since the mid-20th century. The average surface temperature of Earth is about 15°C. During the 100 years ending in 2005, global surface temperature increased 0.74 ± 0.18 °C. Scientists predict further warming of 1.4 to 5.8 Celsius degrees by the year 2100.It may seem improbable that a shift of a few degrees in temperature could have a large effect, but even a seemingly small shift in the average temperature of a system as vast as the entire surface of the planet, sustained over a number of years, can cause a dramatic change in the way the oceans, land, and atmosphere transfer heat. This transfer of heat is one of the primary dynamics of the earth's climatic system, and it drives such phenomena as precipitation, ocean currents, and storms. The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the temperature increase since the mid-twentieth century is "very likely" due to the increase in anthropogenic greenhouse gas concentrations. Another mentionable hypothesis says that Earth's current global warming is a direct result of a long, moderate 1,500-year cycle in the Sun's irradiance.



Therefore the issue is not whether there is a greenhouse effect, but whether and how human activities cause increases in gases that contribute to the greenhouse effect, and what the potential implications are for human society and life on the Earth.

The conceivable effects of global warming are wide-ranging and possibly severe. Consequences of global warming could include a rise in sea level, due both to the warming and resultant expansion of ocean water and to the melting of polar ice caps; and local changes in temperature and precipitation patterns. These changes, in turn, could cause the flooding of densely populated land in coastal areas worldwide, local droughts or flooding, and major losses of plant and animal species.

Possible Causes of Global Warming

The causes of the recent warming are an active field of research. Locating the causes is difficult because the Earth's climatic system is complex, and some factors that affect climate may vary in cycles over time. Nevertheless I will try to consider two ideas which I have found the most important and accepted by huge number of scientists:

- global warming is caused by anthropogenic greenhouse effect, and
- global warming is a consequence of variations in solar irradiance.

Greenhouse Effect

The greenhouse effect results from the interaction between sunlight and the layer of greenhouse gases in the Earth's atmosphere that extends up to 100 km above Earth's surface. The sunlight is composed of a range of radiant energies known as the solar spectrum, which includes visible light, infrared light, gamma rays, X rays, and ultraviolet light. When the Sun's radiation reaches the Earth's atmosphere, some 25 percent of the energy is reflected back into space by clouds and other atmospheric particles. About 20 percent is absorbed in the atmosphere. For instance, gas molecules in the uppermost layers of the atmosphere absorb the Sun's gamma rays and X rays. The Sun's ultraviolet radiation is absorbed by the ozone layer, located 19 to 48 km above the Earth's surface. About 50 percent of the Sun's energy, largely in the form of visible light, passes through the atmosphere to reach the Earth's surface. Most of this energy is short-wave radiation. Soils, plants, and oceans on the Earth's surface absorb about 85 percent of this heat energy, while the rest is reflected back into the atmosphere—most effectively by reflective surfaces such as snow, ice, and sandy deserts. In addition, some of the Sun's radiation that is absorbed by the Earth's surface becomes heat energy in the form of long-wave infrared radiation, and this energy is released back into the atmosphere.

Certain gases in the atmosphere, including water vapor, carbon dioxide, methane, and nitrous oxide, absorb this infrared radiant heat, temporarily preventing it from dispersing into space. As these atmospheric gases warm, they in turn emit infrared radiation in all directions. Some of this heat returns back to Earth to further warm the surface, what is known as the greenhouse effect, and some of this heat is eventually released to space. This heat transfer creates balance between the total amount of heat that reaches the Earth from the Sun and the amount of heat that the Earth radiates out into space. This energy balance—the exchange of energy between the Earth's surface, atmosphere, and space—is important to maintain a climate that can support a wide variety of life.

The heat-trapping gases in the atmosphere behave like the glass of a greenhouse. They let much of the Sun's rays in, but keep most of that heat from directly escaping. Because of this, they are called greenhouse gases. Without these gases, heat energy absorbed and reflected from the Earth's surface would easily radiate back out to space, leaving the planet with an inhospitable temperature close to –19°C, instead of the present 15°C.

The Earth's atmosphere is primarily composed of nitrogen (78 percent) and oxygen (21 percent). These two most common atmospheric gases have chemical structures that restrict absorption of infrared energy. Thus greenhouse gases make up less than 1 percent of the atmosphere. The major ones are water vapor, carbon-dioxide (CO_2), methane (CH_4), ozone (O_3), and nitrous oxide (NO).

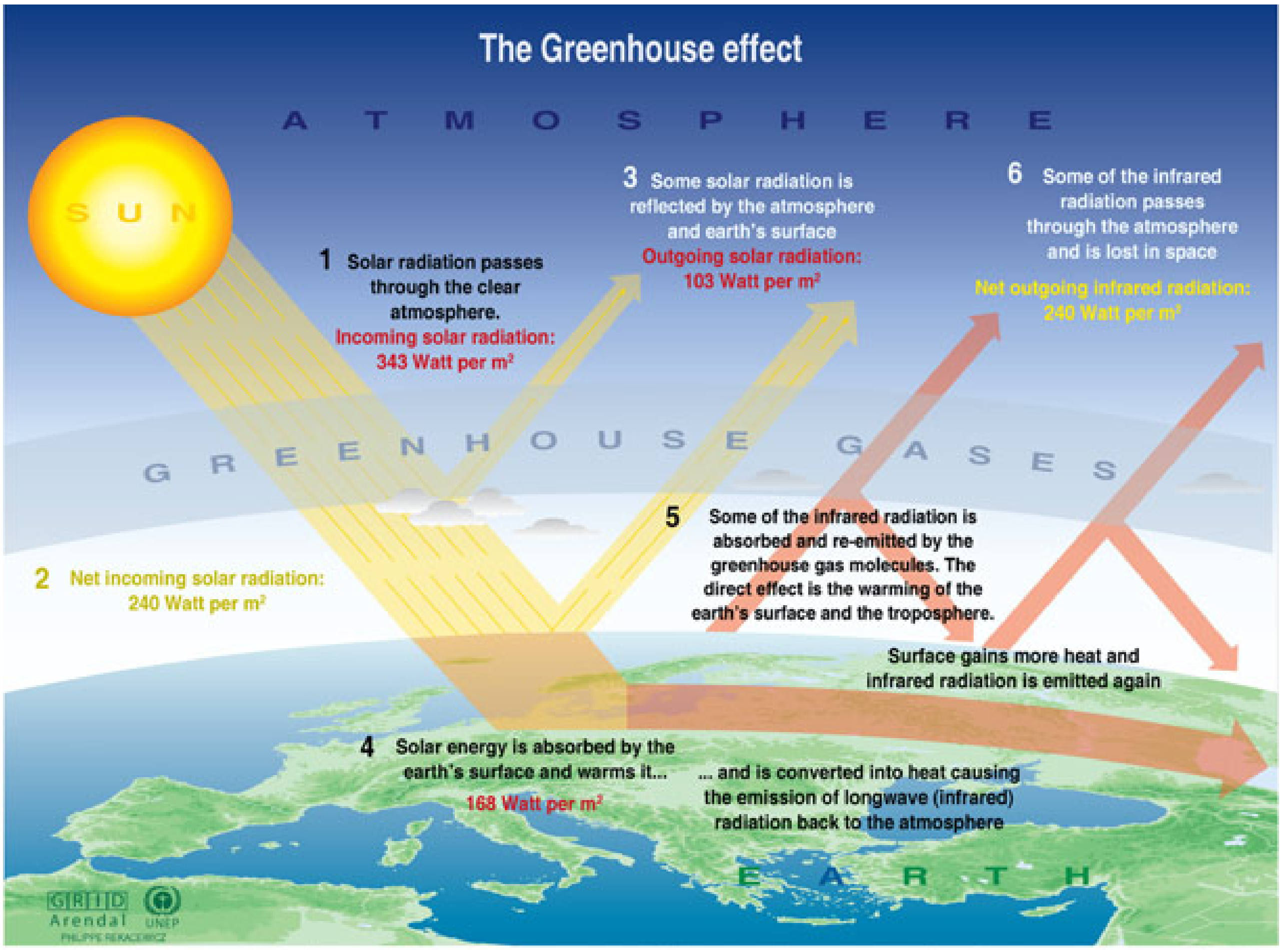
Water vapor is the most common greenhouse gas in the atmosphere, which cause about 60 % to 70 % of the natural greenhouse effect (not including clouds). Humans do not have a significant direct impact on water vapor levels in the atmosphere. However, as human activities increase the concentration of other greenhouse gases in the atmosphere (producing warmer temperatures on Earth), the evaporation of oceans, lakes, and rivers increase and raise the amount of water vapor in the atmosphere which again makes the atmosphere warm further causing it to hold still more water vapor and so on in cycle.

Carbon dioxide constantly circulates in the environment through a variety of natural processes known as the carbon cycle. Volcanic eruptions and the decay of plant and animal matter both release carbon dioxide into the atmosphere. In respiration, animals break down food to release the energy required to build and maintain cellular activity. A byproduct of respiration is the formation of carbon dioxide, which is exhaled from animals into the environment. Oceans, lakes, and rivers absorb carbon dioxide from the atmosphere. Through photosynthesis, plants collect carbon dioxide and use it to make their own food, in the process incorporating carbon into new plant tissue and releasing oxygen to the environment as a byproduct.

In order to provide energy, humans burn objects that contain carbon, such as the fossil fuels: oil, coal, and natural gas; wood or wood products; and some solid wastes. When these products are burned, they release carbon dioxide into the air. In addition, humans cut down huge tracts of trees for lumber or to clear land for farming or building. This process, known as deforestation, can both release the carbon stored in trees and significantly reduce the number of trees available to absorb carbon dioxide.

Human activities are adding a number of other greenhouse gases to the atmosphere. These include **methane** (CH_4) from agricultural sources; **nitrogen dioxide** (N_2O), probably mostly from agricultural activity; and a number of the manufactured **chlorofluorocarbons** (CFCs) and their substitutes, used in refrigeration. CFCs are already being phased out because they damage the earth's ozone layer that screens out some of the ultraviolet radiation from the sun. (It’s known that excessive exposure to ultraviolet radiation can cause cancer.)

Various greenhouse gases remain in the atmosphere for different amounts of time before breaking down. Methane has a “life span” of about a decade; N_2O stays in the air for more than 100 years; and CO_2 remains for up to 200 years.



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

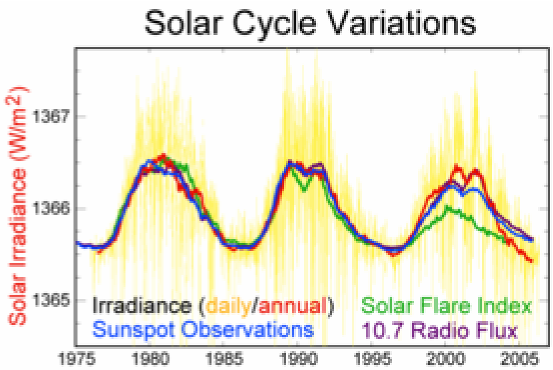
All in all, of all the greenhouse gases, CO_2 is the most important factor in global warming because of its relatively long life span and its prevalence both as a byproduct of the fossil fuel combustion that powers modern industrial systems and as part of a natural cycle that can be pushed out of balance. Despite some use of nuclear energy, geothermal power, and solar energy, the single greatest energy source for human activities is fossil fuel.

Currently the main energy source available for most of the foreseen development in third world countries is fossil fuel. It follows that as industrialization progresses in these large and often densely populated developing areas of the world, it will become increasingly difficult just to keep global carbon dioxide emissions at current levels, let alone to decrease total yearly emissions.

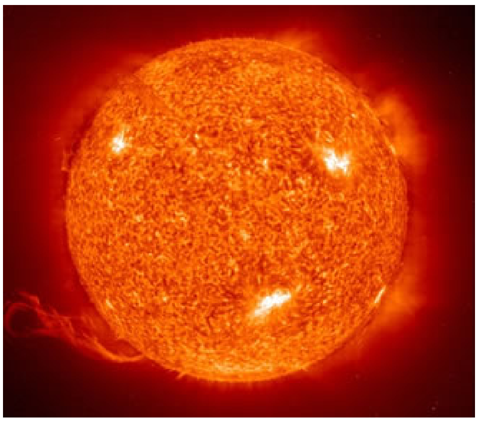
As a result of these human activities, carbon dioxide in the atmosphere is accumulating faster than the Earth's natural processes can absorb the gas. By analyzing air bubbles trapped in glacier ice that is many centuries old, scientists have determined that carbon dioxide levels in the atmosphere have risen by 36 percent since 1750. This level is considerably higher than at any time during the last 650,000 years, the period for which reliable data has been extracted from ice cores. Over the past 20 years, fossil fuel burning has produced approximately three-quarters of the increase in CO_2 from human activity. Most of the rest is due to land-use change, in particular deforestation. . And since carbon dioxide increases can remain in the atmosphere for centuries, scientists expect these concentrations to double or triple in the next century if current trends continue.

Solar Variations

Another hypothesis suggests that warming may be the result of variations in solar activity. Since our entire climate system is fundamentally driven by energy from the Sun, it stands to reason that if the sun's energy output were to change, then so would the climate. Since the measurements started in the late 1970s, solar output has indeed been shown to vary. Proponents of this idea claim that the Sun may have contributed about 45–50 % of the increase in the average global surface temperature over the period 1900–2000, and about 25–35 % between 1980 and 2000.



Orbiting satellites recorded a small increase of 0.07 percent in brightness over the last 30 years. Even though the Sun is brighter now than at any time in the past 8,000 years, the increase in its brightness was not sufficient to cause the past century's modest warming on its own. Scientists explain that as the output of the sun varies, that varies amounts of galactic cosmic rays from deep space which are able to enter our solar system. These cosmic rays enhance cloud formation, which has a cooling effect on the planet. When the Sun is less bright, more cosmic rays are able to get through to Earth's atmosphere, more clouds form and the planet cools. This is precisely what happened from the middle of the 17th century into the early 18th century, when the solar energy input to our atmosphere was at a minimum and the planet was stuck in the Little Ice Age.



Therefore, experts conclude that current global warming is a result of variations in solar irradiance, but not of increased greenhouse effect caused by human activity, which is natural and valuable phenomenon, and without which, the planet would be uninhabitable. Furthermore, data from NASA's Mars Global Surveyor and Odyssey mission in 2005 revealed that the carbon dioxide "ice caps" near Mars' south pole had been shrinking for three consecutive summers, although there's no anthropogenic grreenhouse effect there. This shows that the Earth planet is not the only one suffering warming, fot which the most likely culprit is the Sun.

The Earth's sea, landmass and air near-surface temperature shows certain correlation with both solar irradiance and CO2 concentration. Correlation means that one thing is caused by another, when one increases, another increases and the other way around

Some scientists think that was made a fundamental mistake at the beginning of researching global warming. It was immediately assumed, noticing that CO_2 levels and global temperatures had a pretty good correlation, that CO_2 was the culprit, and was causing global temperatures to rise. In fact, it appears it was just the opposite: rising global temperatures caused increased CO_2 level in the atmosphere. Since CO_2 is by far the heaviest of the major constituents of the atmosphere (nitrogen, oxigen, water vapor), this vary water-soluble gas sinks into the ground and oceans. Because of that, they, especially oceans, are the largest sources of CO2. Thereby, when the Sun heats the earth and oceans, they release CO2, and as far as temperature is higher, CO2 comes out a lot faster. In that way global warming causes the increase in carbon dioxide concentration.

However, regardless of how much there is CO2 in the atmosphere, it can absorp up to 8% of the heat irradiated by the Earth. Every gas absorbs infrared radiation (heat) of precisely defined wavelengths, and carbon dioxide absorbs radiation of 3 different wavelengths which make together 8% of total irradiating heat which means that 92% of the "heat" passes right through without being absorbed by CO2. Besides, CO_2 makes up only 380 of each million molecules of air – the rest are a mixture of all the other atmospheric gases and water vapor – i.e. only one in every 2632 molecules is a CO_2 molecule.

In other words, the laws of physics don't seem to allow CO2 it's currently assumed place as a significant greenhouse gas based on present concentrations. The other greenhouse gases such as methane, nitrous oxide, CFC... exist only in extraordinarily smaller amounts and aren't even up for serious discussion by any segment of the scientific community. And, since the other components of the atmosphere (oxygen, nitrogen, and water vapor) aren't materially affected by human activity, „the greenhouse effect is a totally natural phenomenon, unaffected by human activity“, say proponents of this hypothesis.

Climate Models

Before the discussion about expected climate changes starts, a few words about that what the predictions are based on. It's known that atmospheric modeling, which can predict changes in the weather quite reliably more than about a day or two in advance, still doesn't exist. But all estimates of how the climate could change in the future are produced by computer models of the Earth's climate system. These models are known as general circulation models (GCMs). It is important to recognize that computer projections of climate change in specific areas are not forecasts comparable to tomorrow's weather forecast. Rather, they are hypothetical examples of how the climate might change and usually contain a range of possibilities. Models have proven to be extremely important tools for simulating and understanding climate, and there is considerable confidence that they are able to provide credible quantitative estimates of future climate change, particularly at larger scales. These climate models are based on physical principles of different processes, with simplifications being necessary because of limitations in computer power and the complexity of the climate system. All modern climate models include an atmospheric model that is coupled to an ocean model and models for ice cover on land and sea. Some models also include treatments of chemical and biological processes. Great number of these models projects a warmer climate due to increasing levels of greenhouse gases. However, even when the same assumptions of future greenhouse gas levels are used, there still remains a considerable range of climate sensitivity. Although current computer models are now sophisticated enough to be reasonably good at modeling current climate, always there is possibility of surprise factor appearing.

Possible Effects of Global Warming

Regardless whether it is caused by natural variations or human effects, global warming has really occurred and its consequences are expectable and numerous. The increase in global temperatures may cause other changes, including glacial retreat and worldwide sea level rise. Changes in the amount and pattern of precipitation may result in flooding and drought. There may also be changes in the frequency and intensity of extreme weather events. Other effects may include changes in agriculture, species extinctions, and different implications for human health.

Temperature Changes

Temperatures are changing in the lower atmosphere - from the Earth's surface all the way through the stratosphere (14-23 km above the Earth's surface). Scientists are working to document temperature trends and determine their causes.

Records from land stations and ships indicate that the global mean surface temperature has warmed by between 0.6 and 1.0°C since 1850. The eight warmest years on record (since 1850) have all occurred since 1998, with the warmest year being 2005. The Intergovernmental Panel on Climate Change (IPCC) concluded in 2007 that warming of the climate system is now indisputable, based on observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

Additionally:

- The warming trend has been seen in both daily maximum and minimum temperatures, with minimum temperatures increasing at a faster rate than maximum temperatures.
- Land areas have tended to warm faster than ocean areas and the winter months have warmed faster than summer months.
- Average temperatures in the Arctic have increased at almost twice the global rate in the past 100 years.

The IPCC has concluded that most of the observed warming in global average surface temperature that has occurred since the mid-20th century is very likely a result of human activities. During the first half of the last century, there was likely less human impact on the observed warming, and natural variations, such as changes in the amount of radiation received from the Sun, likely played a more significant role. Today, most climate change scenarios project that greenhouse gas concentrations will increase through 2100 with a continued increase in average global temperatures. How much and how quickly the Earth's temperature will increase remains unknown given the uncertainty of future greenhouse gas emissions and the Earth's response to changing conditions. In addition, natural influences, such as changes in the Sun and volcanic activity, may affect future temperature, although the extent is unknown because the timing and intensity of natural influences cannot be predicted.

Advancements in model simulations, combined with more data on observed changes in climate, have increased confidence in projections of future temperature changes. In its 2007 assessment, the Intergovernmental Panel on Climate Change for the first time was able to provide best estimates and likely ranges for global average warming under each of its emissions scenarios.

Future temperature changes will not depend only on the direct effects of natural and human influences. The temperature may also change due to what are known as climate "feedbacks" – the climate system's responses to these direct effects. These feedbacks can increase or decrease the direct effect:

- An example of a **positive feedback** that could arise from warming results from melting ice and is known as the ice-reflectivity feedback. If temperatures warm near the Arctic, sea ice would likely melt. Because seawater is not as reflective as ice, the loss of ice would result in additional warming (since the ocean would absorb more solar radiation than ice).
- An example of a **negative feedback** that could arise from warming is an increase in low clouds from increased evaporation (which warming promotes). The addition of low and/or thick clouds (e.g. stratus, cumulonimbus clouds) would tend to cool the climate (by reflecting sunlight) – decreasing the warming.

Due to uncertainties about future emissions and concentrations of greenhouse gases, their clear warming effect in the atmosphere, the response of the climate system, and estimates of future temperature change are uncertain. With these warnings in mind, the IPCC made the following projections of future warming:

- The average surface temperature of the Earth is likely to increase by 1.4 -5.8°C by the end of the 21st century. The average rate of warming over each inhabited continent is very likely to be at least twice as large as that experienced during the 20th century.
- Warming will not be evenly distributed around the globe:
    - Land areas will warm more than oceans in part due to water's ability to store heat.
    - High latitudes will warm more than low latitudes in part due to positive feedback effects from melting ice (as discussed above).
    - Most of North America, all of Africa, Europe, northern and central Asia, and most of Central and South America are likely to warm more than the global average.
    - Projections suggest that the warming will be close to the global average in south Asia, Australia and New Zealand, and southern South America.
- More greenhouse gases are emitted in the Northern than Southern Hemisphere, but this does not contribute to the difference in warming because the major greenhouse gases "live" long enough to mix between hemispheres.
- The warming will differ by season, winter and nighttime temperatures will tend to rise more than summer and daytime ones.

Precipitation and Storm Changes

Increasing temperatures tend to increase evaporation which leads to more precipitation. As average global temperatures have risen, average global precipitation has also increased. According to the IPCC, the following precipitation trends have been observed:

- Precipitation has generally increased over land north of 30°N from 1900-2005, but has mostly declined over the tropics since the 1970s. Globally there has been no statistically significant overall trend in precipitation over the past century, although trends have varied widely by region and over time.
- It has become significantly wetter in eastern parts of North and South America, northern Europe, and northern and central Asia, but drier in the Sahel, the Mediterranean, southern Africa and parts of southern Asia.
- There has been an increase in the number of heavy precipitation events over many areas during the past century, as well as an increase since the 1970s in the prevalence of droughts—especially in the tropics and subtropics.

A following increase in the average global temperature is very likely to lead to additional changes in precipitation and atmospheric moisture because of changes in atmospheric circulation and increases in evaporation and water vapor. Although regional precipitation projections must be considered with caution, climate models suggest:

- An increase in global average annual precipitation during the 21st century, although changes in precipitation will vary from region to region.
- An increase in the intensity of precipitation events, particularly in tropical and high-latitude regions.
- Annual average precipitation increases over most of northern Europe, the Arctic, Canada, the northeastern United States, tropical and eastern Africa, the northern Pacific, and Antarctica, as well as northern Asia and the Tibetan Plateau in winter.

- Annual average precipitation decreases in most of the Mediterranean, northern Africa, northern Sahara, Central America, the American Southwest, the southern Andes, as well as southwestern Australia during winter.
- Reduced rainfall over continental interiors during summer due to increases in evaporation.

The frequency and intensity of mid-latitude and tropical storm systems have varied over the 20th century. For example, in the Atlantic basin, the period from about 1995-2005 was extremely active both in terms of the overall number of tropical storm systems including hurricanes as well as in storm intensity. However, the two to three decades before the mid-1990s were characterized as a relatively inactive period.

That Atlantic hurricane season of 2005, which set a record with 27 named storms, a great deal of attention has focused on the relationship between hurricanes and climate change. Numerous studies have been published on possible linkages, with a range of conclusions. In order to provide an assessment of the impact of global warming on tropical systems, the World Meteorological Organization's hurricane researchers published a consensus statement. Their conclusion includes:

"Though there is evidence both for and against the existence of a detectable anthropogenic signal in the tropical cyclone climate record to date, no firm conclusion can be made on this point.

There is general agreement that no individual events in 2004 and 2005 can be attributed directly to the recent warming of the global oceans but it is possible that global warming may have affected the 2004-2005 group of events as a whole."

Nevertheless mid-latitude storm tracks are projected to shift toward the poles, with increased intensity in some areas but reduced frequency. Tropical storms and hurricanes are likely to become more intense, produce stronger peak winds, and produce increased rainfall over some areas due to warming sea surface temperatures (which can energize these storms). The relationship between sea surface temperatures and the frequency of tropical storms is less clear. There is currently no scientific consensus on how future climate change is likely to affect the frequency of tropical storms in any part of the world where they occur.

Sea Level Changes

Tide gauge measurements suggest that sea level has risen worldwide approximately 12-22 cm during the last century. A significant amount of sea level rise has likely resulted from the observed warming of the atmosphere and the oceans. According to the Intergovernmental Panel on Climate Change, the primary factors driving current sea level rise include:

- the expansion of ocean water caused by warmer ocean temperatures
- melting of mountain glaciers and small ice caps
- (to a lesser extent) melting of the Greenland Ice Sheet and the Antarctic Ice Sheet

While the global average sea level rise of the 20th century was 12-22 cm, the sea level has not risen uniformly from region to region:

- Indonesia, Thailand, and Bangladesh are experiencing above-average sea level rise.
- Northwestern Australia is experiencing below-average sea level rise, a trend that is evident in much of the ocean between Western Australia and East Africa.
- Most of the Pacific and Atlantic basins are experiencing average to above-average sea level rise.

- Many coastal areas outside of the U.S., Europe and Japan have too few tide gauges to be sure about long-term trends in regional sea level rise.

Higher temperatures are also likely to increase, beside sea level, the amount of snowfall over central Greenland and Antarctica. The higher snowfall is likely to reduce part of the sea level rise because the additional snow is composed of water that would otherwise be in the ocean.

The IPCC estimates that the global average sea level will raise by18-59 cm by 2100. Note that these estimates assume that ice flow from Greenland and Antarctica will continue at the same rates as observed from 1993-2003. The IPCC warns that these rates could increase or decrease in the future. But current understanding of ice sheet dynamics is too limited to estimate such changes more precisely.

According to the IPCC, current model projections indicate substantial variability in future sea level rise between different locations. Some locations could experience sea level rise higher than the global average projection, while others could have a fall in sea level. The same factors that currently cause sea level to rise more rapidly along the Mid-Atlantic and Gulf Coasts, and less rapidly in parts of the Pacific Northwest, are likely to continue. Changes in winds, atmospheric pressure and ocean currents will also cause regional variations in sea level rise - but those variations cannot be reliably predicted. There are significant uncertainties about the extent and speed of future changes:

- The West Antarctic Ice Sheet contains enough ice to raise sea level by 5-6 meters. Possible instabilities in the ice sheet could allow it to slide into the oceans after a sustained warming, or if other factors raised sea level. There is a small chance the collapse of this ice sheet could occur within a few centuries, but the response of the ice sheet to future climate change is uncertain and a subject of debate.
- The Greenland ice sheet contains enough ice to raise sea level about 7 meters. Although it is already contributing to sea level rise (from melting), it does not contain the same instabilities as Antarctica that could result in a rapid collapse. Most model projections suggest a gradual melting over millennia related to sustained climate warming.

Sea-level changes will complicate life in many coastal regions. Floods, erosion of cliffs, beaches, and dunes will increase. Even a modest rise in sea level will greatly change coastal ecosystems. New marshes will form in many places. Wealthier countries will spend huge amounts of money to protect their shorelines, while poor countries may simply evacuate low-lying coastal regions.

Agriculture

Agriculture is highly sensitive to climate variability and weather extremes, such as droughts, floods and severe storms. The forces that shape our climate are also critical to farm productivity. And while food production may benefit from a warmer climate, the increased potential for droughts, floods and heat waves will pose challenges for farmers if the trends continue.

Several factors directly connect climate change and agricultural productivity:

- Average temperature increase
- Change in rainfall amount and patterns
- Rising atmospheric concentrations of CO_2
- Change in climatic variability and extreme events

Most agricultural impact studies have considered the effects of one or two aspects of climate change on a particular farming activity. Few, however, have considered the full set of anticipated shifts and their impact on agricultural production across the country.

An increase in average temperature can 1) lengthen the growing season in regions with a relatively cool spring and fall; 2) adversely affect crops in regions where summer heat already limits production; 3) increase soil evaporation rates, and 4) increase the chances of severe droughts.

Change in rainfall amount and patterns can affect soil erosion rates and soil moisture, both of which are important for crop yields. While regional precipitation will vary the number of extreme precipitation events is predicted to increase.

Change in climatic variability and extreme events means changes in the frequency and severity of heat waves, drought, floods and hurricanes, which remain a key uncertainty in future climate change. Such changes are anticipated by global climate models, but regional changes and the potential affects on agriculture are more difficult to forecast.

Increasing atmospheric concentrations of CO_2, driven by emissions from human activities, can enhance the growth of some crops such as wheat, rice and soybeans. CO_2 can be one of a number of limiting factors that, when increased, can enhance crop growth. Other limiting factors include water and nutrient availability.

Animals and Plants

Perhaps the greatest of all negative consequences of global warming will be the effect on biological diversity (the variety of plants, animals, and microorganisms with which human beings share the planet). Sometime change has been so abrupt as to cause mass extinctions, and other times, it appears that most species survived by moving to follow favorable conditions.

Today, global warming could cause dramatic change in biological communities. Experiments suggest that increased CO_2 or increased temperature will shift competitive balances between species so that in specific locations some species get the upper hand and others are pushed out. In the past, in landscapes unchanged by human beings, communities of animals, plants, and microorganisms were able to disassemble and disperse to more suitable habitats, and then to reassemble in new combinations. The modified landscapes of today present obstacles to dispersal.

At present, the planet's biological diversity is largely locked up in conservation units such as wildlife reserves, parks, and forests. These units are set within heavily modified landscapes such as urban and agricultural lands, which separate these units and make mass dispersions of animal species difficult or impossible. If animals are unable to move to other habitats in response to global warming, massive extinctions are likely to occur.

Human Health

Throughout the world, the frequency of some diseases and other dangers to human health depend largely on local climate. Extreme temperatures can lead directly to loss of life, while changes in the range of infective parasites can indirectly impact the frequency of serious infectious diseases. Expected warmer temperatures can increase air and water pollution, which in turn harm human health. Although climate change is expected to bring a few benefits to health, like fewer deaths due to exposure to cold, the IPCC has concluded that, globally, negative climate-related health impacts are expected to outweigh positive health impacts during this century.

Climate change may directly affect human health through increases in average temperature. Such increases may lead to more extreme heat waves during the summer and produce less extreme cold spells during the winter. Rising average temperatures are predicted to increase the frequency of heat waves and hot extremes. Particular segments of the population such as those with heart problems, asthma, the elderly, the very young and the homeless can be especially vulnerable to extreme heat. An increase in the frequency of extreme events may result in more event-related deaths, injuries, infectious diseases, and stress-related illnesses. Climate change is expected to contribute to some air quality problems - increases in the frequency of smog events, pollens combine with sunlight and high temperatures – which are especially harmful for those with asthma and other chronic lung diseases.

Climate change may increase the risk of some infectious diseases, particularly those diseases that appear in warm areas and are spread by mosquitoes and other insects. These diseases include malaria, dengue fever, yellow fever, and encephalitis. But the potential for an increase in the spread of diseases will depend not only on climatic but also on non-climatic factors, primarily the effectiveness of the public health system.

Efforts to Control Global Warming and Adaptations

Due to significient scientific evidence and growing political interest, global warming is currently recognized as an important national and international issue. Since 1992 representatives from over 160 countries have met regularly to discuss how to reduce worldwide greenhouse gas emissions. In 1997 representatives met in Kyōto, Japan, and produced an agreement, known as the Kyōto Protocol, which requires industrialized countries to reduce their emissions by 2012 to an average of 5% below 1990 levels. The United States, which currently emits more than 20% of the world's carbon dioxide from fossil fuels, agreed to a 7% cut below 1990 levels, while 15 nations of the EU committed themselves to an 8% reduction. Japan agreed to a 6% cut. Many experts expect that as the scientific evidence about the dangers of global warming continues to mount, these and other nations will be motivated to cooperate more effectively to reduce the risks of climate change.

Some degree of future climate change will occur regardless of future greenhouse gas emissions. Adapting to or coping with climate change will therefore become necessary in certain regions and for certain socioeconomic and environmental systems. The need for adaptation may be increased by growing populations in areas vulnerable to extreme events.

Illustrative examples of potential adaptation measures in different sectors, in short, include the following:

Human Health

- Many diseases and health problems that may be worsen by climate change can be effectively prevented with adequate financial and human public health resources, including training, observation, emergency response, and prevention
- Urban tree planting to moderate temperature increases
- Weather advisories to alert the public about dangerous heat conditions
- Adjusting clothing and activity levels, increasing fluid intake

Coastal Areas and Sea Level Rise

- Developing maps shoving which areas will require shore protection and which areas will be allowed to adapt naturally

- Analyzing the environmental consequences of shore protection
- Promoting shore protection techniques that do not destroy all habitat
- Engaging state and local governments in defining responses to sea level rise
- Improving early warning systems and flood danger mapping for storms
- Protecting water supplies from contamination by saltwater

Agriculture and Wildlife

- Altering the timing of planting dates to adapt to changing growing conditions
- Breeding new plant species and crops that are more tolerant to changed climate condition
- Promoting fire suppression practices because of increased fire risk due to temperature increases
- Altering forest species that are better suited to the changing climatic conditions
- Controlling insect outbreaks
- Protecting and enhancing migration corridors to allow species to migrate as the climate changes

Water Resources

- Improving water use efficiency, planning for alternative water sources (such as treated wastewater or desalinated seawater)
- Conserving soil moisture through forestation and other means
- Protecting coastal freshwater resources from saltwater intrusion

Energy

- Increasing energy efficiency to make up for increases in energy consumption
- Protecting facilities against extreme weather events
- Reducing world's dependence of fossil fuels by using alternative energy sources (such as nuclear, solar or wind energy)

Conclusion

The Earth's climate has changed over the past. Since the last century, a new climate change has been observed, which is responsible for the increase in the global average temperature. Although there is no consensus in scientific opinion about whether it is the consequence of human activities or it is a natural phenomenon caused by natural variability, everybody agrees that global warming is really occuring and producing certain after-effects. Current warming presents a major and growing challenge to the world as a whole. While the present changes are important now, their implications are even greater for the future generations that will bear the consequences of current actions or inactions. The action is needed to begin to adapt to the warming that is predicted to continue. It is expected that as the warming becomes greater and faster, the effects will be more evident and dominant.

Contents

References

http://en.wikipedia.org/wiki/Global_warming?redirect=no

http://www.epa.gov/climatechange/index.html

http://www.nasa.gov/worldbook/global_warming_worldbook.html

http://www.livescience.com/globalwarming

http://www.eoearth.org/article/Greenhouse_effect

http://www.epa.gov/climatechange/science/futuretc.html

http://www.epa.gov/climatechange/science/recenttc.html

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