Facts on Climate Change

A summary of the 2007 Assessment Report of the IPCC

A summary by:

GreenFacts
Facts on Health and the Environment

CLIMATE CHANGE is already having measurable consequences and future impacts are expected to be wide-ranging and costly. How can we adapt to such changes or limit their extent? The latest findings of the IPCC provide some answers.

What makes the climate change?

The Earth's climate is influenced by many factors, mainly by the amount of energy coming from the sun, but also by factors such as the amount of greenhouse gases and aerosols in the atmosphere, and the properties of the Earth's surface, which determine how much of this solar energy is retained or reflected back to space.

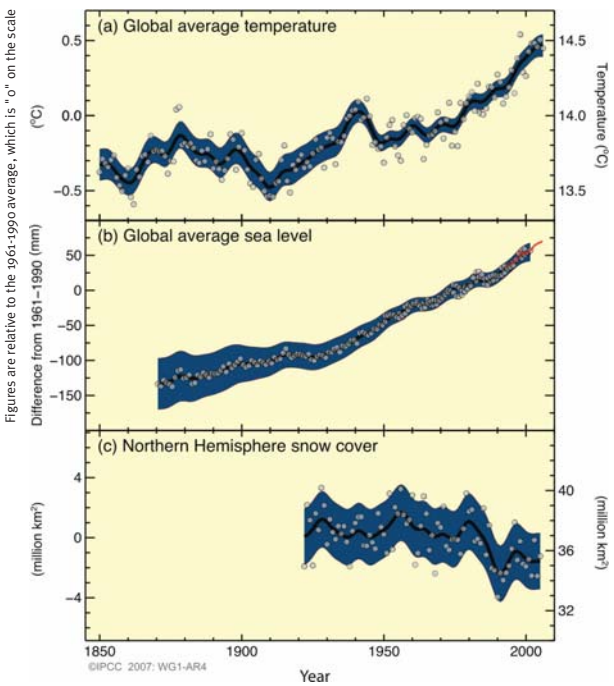
Atmospheric concentrations of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have significantly increased since the beginning of the industrial revolution. This is mainly due to human activities, such as the burning of fossil fuels, land use change, and agriculture. For instance, the atmospheric concentration of carbon dioxide is now far higher than in the last 650 000 years and has been growing faster in the last 10 years than it has been since the beginning of continuous measurements around 1960.

It is very likely that, overall, human activities since 1750 have had a global warming effect on the Earth.

Human emissions of greenhouse gases are likely to be the main cause of global warming

How is climate changing and how has it changed in the past?

Changes in temperature, sea level, and snow cover (1850 - 2005)



The warming of global climate is now unequivocal. There are many observations of increasing air and ocean temperatures, widespread melting of snow and ice, and rising sea levels.

More specifically, 11 of the last 12 years (1995-2006) rank among the 12 warmest years ever recorded since global surface temperatures are measured (1850). Over the last 100 years (1906–2005), global temperature has increased by 0.74°C. Global sea level has risen by 17 cm during the 20th century, in part because of the melting of snow and ice from many mountains and in the polar regions. More regional changes have also been observed, including changes in Arctic temperatures and ice, ocean salinity, wind patterns, droughts, precipitations, frequency of heat waves and intensity of tropical cyclones.

Temperatures of the last half century are unusual in comparison with those of at least the previous 1300 years. The last time that the polar regions remained significantly warmer than now for a very extended period (125 000 years ago), the sea level rose by 4 to 6 meters.

Most of the increase in global temperature observed over the past 50 years is very likely due to human emissions of greenhouse gases.

How is the climate going to change in the future?

The global average temperature is expected to increase by about 0.2°C per decade over the next two decades. Continuing greenhouse gas emissions at or above current rates would further increase global temperatures and cause many other climatic changes during the 21st century.

The best estimates for projected global temperature increases from the 1980s to the end of the 21st century range from 1.8°C (1.1°C - 2.9°C) to 4°C (2.4 - 6.4°C) for the IPCC scenarios that do not consider additional mitigation measures apart from those already in place in 2000.

Global average sea level is expected to rise by 18 to 59 cm by the end of the 21st century. Warming is expected to be greatest over land and at high northern latitudes and smallest over the Southern Ocean and parts of the northern Atlantic Ocean. Other projected changes include acidification of the oceans, reduced snow cover and sea ice, more frequent heat waves and heavy precipitation, more intense tropical cyclones, and slower oceanic currents.

Warming and sea level rise caused by human activity will continue for centuries, even if greenhouse gas concentrations were stabilized. If warming persists over many centuries, it could lead to a complete melting of the Greenland Ice sheet, increasing global sea levels by about 7m.

What impacts of climate change have already been observed?

Regional climate change is already affecting many natural systems. For instance, it is increasingly being observed that snow and ice are melting and frozen ground is thawing, hydrological and biological systems are changing and in some cases being disrupted, migrations are starting earlier, and species' geographic ranges are shifting towards the poles.

Despite remaining gaps in knowledge, it is likely that these effects are linked to human influence on climate. At the regional level, however, responses to natural variability are difficult to separate from the effects of climate change.

Some previously unanticipated impacts of regional climate change are just starting to become apparent. For instance, melting glaciers can threaten mountain settlements and water resources, and damage associated with coastal flooding is increasing.

Glaciers are melting in many places across the world

What impacts are expected in the future?

Over the course of the 21st century, many impacts are expected to occur in natural systems. For instance, changes in precipitation and the melting of ice and snow are expected to increase flood risks in some areas while causing droughts in others. If there is significant warming, the capacity of ecosystems to adapt will be exceeded, with consequences such as an increased risk of extinction of species.

The most vulnerable people are in general the poor, since they have less capacity to adapt, and their livelihoods often depend on resources that are linked to climate.

Africa is particularly vulnerable to climate change, because of existing pressures on its ecosystems and its low capacity to adapt. On all continents, water supply and the threat to coastal areas will be an issue. Overall future impacts are expected to be negative, although some positive effects are also expected initially, such as an increase in agricultural productivity at high latitudes accompanying a moderate warming, or decreased heating needs in cold regions.

Impacts will depend on the magnitude of the temperature increase. For instance, some crops at mid- to high latitudes will have higher productivity if local temperature increases by 1-3° C, but will be negatively affected beyond that. If higher temperatures persist after the 21st century it could result in very large impacts. For instance, the large sea-level rise that would result from the melting of the Greenland and Antarctic ice sheets would have major repercussions on coastal areas. The cost associated with the effects of climate change is projected to increase over time with rising temperatures.

A projected increase in the severity and frequency of droughts, heat waves, and other extreme weather events is expected to cause major impacts over the course of this century.

How can we adapt to climate change?

People need to adapt to the impacts of climate change, for instance through technological solutions such as coastal defences and changes in consumption habits. People are already adapting to climate change, and further adaptation efforts will be necessary during coming decades. However, adaptation alone is not expected to be able to cope with all projected effects since the options diminish and the costs increase with rising temperatures.

Vulnerability of human populations to climate change and its consequences can be affected by other factors, such as pollution, conflicts, or epidemics such as AIDS. An emphasis on sustainable development can help human societies reduce their vulnerability to climate change. However, climate change itself can become an impediment to their development.

Mitigation measures that aim to reduce greenhouse gases emissions can help avoid, reduce or delay impacts, and should be implemented in order to ensure that adaptation capacity is not exceeded.

What are the current trends in greenhouse gas emissions?

Global greenhouse gas emissions have grown markedly since pre-industrial times, with a 70% increase from 1970 to 2004 alone. Over this period, emissions from the transport and energy sectors have more than doubled. Policies put in place in some countries have been effective in reducing emissions in those countries to a certain degree, but not sufficiently to counteract the global growth in emissions.

Without additional measures to mitigate climate change, global greenhouse gas emissions will continue to grow over the coming decades and beyond. Most of this increase would come from developing countries, where *per capita* emissions are still considerably lower than those in developed countries.

This text is a faithful summary, by GreenFacts, of the IPCC Fourth Assessment Report.
A longer, more detailed summary can be found on www.greenfacts.org/en/climate-change-ar4/.

What actions can be taken to reduce greenhouse gas emissions?

Mitigation measures to reduce greenhouse gas emissions have a certain cost. However, they also constitute an economic benefit by reducing the impacts of climate change and the costs associated with them. In addition, they can bring economic benefits by reducing local air pollution and energy resource depletion.

If the benefits of avoided climate change are taken into account and a "carbon price" is established for each unit of greenhouse gas emissions, this could create incentives for producers and consumers to significantly invest in products, technologies and processes that emit less greenhouse gases. The resulting mitigation potential is substantial and could offset the projected growth of global emissions over the coming decades or reduce emissions below current levels.

Mitigation measures could contribute to stabilizing the concentration of greenhouse gases in the atmosphere by 2100 or later. To achieve low stabilization levels, stringent mitigation efforts are needed in the coming decades. This could reduce global GDP by up to a few percent.

Changes in lifestyle and behaviour that favor resource conservation can contribute to climate change mitigation.

Public transport can help reduce greenhouse gas emissions

Renewable energies are one path to emission reduction

Mitigation measures can also have other benefits for society, such as health cost savings resulting from reduced air pollution. However, mitigation in one country or group of countries could lead to higher emissions elsewhere or effects on the global economy.

No one sector or technology can address the entire mitigation challenge. All sectors including buildings, industry, energy production, agriculture, transport, forestry, and waste management could contribute to the overall mitigation efforts, for instance through greater energy efficiency. Many technologies and processes that emit less greenhouse gases are already commercially available or will be in the coming decades.

To stabilize the concentration of greenhouse gases in the atmosphere, emissions would have to stop increasing and then decline. The lower the stabilization level aimed for, the more quickly this decline would need to occur. Worldwide investments in mitigation technologies, as well as research into new energy sources, will be necessary to achieve stabilization. Delaying emission reduction measures limits the opportunities to achieve low stabilization levels and increases the risk of severe climate change impacts.

How can governments create incentives for mitigation?

A wide variety of policy tools can be applied by governments to create incentives for mitigation action, such as regulation, taxation, tradable permit schemes, subsidies, and voluntary agreements. Past experience shows that there are advantages and drawbacks for any given policy instrument. For instance, while regulations and standards can provide some certainty about emission levels, they may not encourage innovation and more advanced technologies. Taxes and charges, however, can provide incentives but cannot guarantee a particular level of emissions. It is important to consider the environmental impacts of policies and instruments, their cost-effectiveness, institutional feasibility and how costs and benefits are distributed.

Although the impact of the Kyoto protocol's first commitment period (2008-2012) on global carbon emissions is expected to be limited, it has allowed the establishment of a global response to the climate problem as well as the creation of an international carbon market and other mechanisms that may provide the foundation for future mitigation efforts.

Switching to more sustainable development paths can make a major contribution to climate change mitigation. Policies that contribute to both climate change mitigation and sustainable development include those related to energy efficiency, renewable energies, and conservation of natural habitats.

In general, sustainable development can increase the capacity for adaptation and mitigation and reduce vulnerability to the impacts of climate change.

The Esbjerg power station in Denmark, where carbon dioxide capture is being implemented

Conclusion

Current warming trends are unequivocal. It is very likely that greenhouse gases released by human activities are responsible for most of the warming observed in the past 50 years. The warming is projected to continue and to increase over the course of the 21st century and beyond.

Climate change already has a measurable impact on many natural and human systems. Effects are projected to increase in the future and to be more severe with greater increases in temperature. Adaptation measures are already being implemented and will be essential in order to address the projected consequences. There is, however, a limit to adaptation; mitigation measures will also be needed in order to reduce the severity of impacts.

Mitigation measures that aim to reduce greenhouse gas emissions can help avoid, reduce or delay many impacts of climate change. Policy instruments could create incentives for producers and consumers to significantly invest in products, technologies and processes that emit less greenhouse gases. Without new mitigation policies, global greenhouse gas emissions will continue to grow over the coming decades and beyond. Rapid worldwide investments and deployment of mitigation technologies, as well as research into new energy sources, will be necessary to achieve a stabilization of the concentration of greenhouse gases in the atmosphere.

Additional research addressing gaps in knowledge would further reduce uncertainties and thus facilitate decision-making related to climate change.

GLOSSARY

Adaptation – A change in ecosystems or in human societies that allows them to adjust to the changing conditions of the environment.

Aerosol – An aerosol is a collection of microscopic particles, solid or liquid, suspended in a gas. Natural sources of aerosols include salt particles from sea spray, dust and clay particles from the weathering of rocks. Aerosols can also originate as a result of human activities and are often considered pollutants.

Atmosphere – The mass of air surrounding the Earth. The atmosphere consists of nitrogen (78%), oxygen (21%), and traces of other gases such as argon, helium, carbon dioxide, and ozone. The atmosphere plays an important role in the protection of life on Earth; it absorbs ultraviolet solar radiation and reduces temperature extremes between day and night.

Climate change – Defined by the United Nations Convention on Climate Change as "change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods"

Greenhouse gas – A gas in Earth's atmosphere, be it of natural or human origin, that absorbs heat radiated by the earth and warms the atmosphere, creating what is commonly known as the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere.

Land use – The human use of a piece of land for a certain purpose (such as irrigated agriculture or recreation). Changes in land use may have an impact on the properties of the surface, which can have implication for the climate at a local or a global scale.

Facts on this publication

This publication presents a faithful summary by GreenFacts of the Fourth Assessment Report published in 2007 by the Intergovernmental Panel on Climate Change (IPCC), the leading scientific consensus report on the topic, providing an overview of the current state of knowledge.

The IPCC was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). It has produced over the years a number of reports on various aspects of climate change that have become widely used references. Their publications can be found on the IPCC website: www.ipcc.ch

A more detailed summary can be found on ***www.greenfacts.org/en/climate-change-ar4/***

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