



The Intergovernmental Panel on Climate Change was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988. The IPCC is the international scientific body that assesses the potential impacts of climate change and is a highly respected authority on the topic. The views expressed in the following paragraphs are based principally on a presentation given by the chairman of the IPCC, Dr. R. Watson, at a Conference of Parties of the Framework Convention on Climate Change. For more details, please see www.ipcc.ch.

Greenhouse Gases and Global Warming

Carbon dioxide plays a powerful role in enhancing the greenhouse effect - it accounts for half of the enhanced greenhouse effect. On the other hand, carbon dioxide can enhance plant growth.

Lively debated topics for several years, greenhouse gases and climate change are important environmental concerns worldwide. The level of carbon dioxide and other greenhouse gases in the atmosphere is rising, which is considered to be one of the world's greatest environmental threats.

The Intergovernmental Panel on Climate Change (IPCC) recently published a report on the current state of understanding of the Earth's climate system and the influence of human activities. This Third Assessment Report builds upon five years of research on climate change, with hundreds of scientists from many countries participating in its preparation and review. The report discusses the vulnerability of ecological systems and socio-economic sectors to climate change and also suggests several approaches to mitigate climate change by reducing emissions and enhancing coal sinks. The IPCC Report was approved at a series of plenary meetings between January and March 2001. Additionally, a special Synthesis Report, which will address a series of policy-relevant questions, will be ready in September 2001.

Increasing changes in global climate

The Earth's climate has been relatively stable since the last ice age. During this time modern society has evolved, and, in many cases, successfully adapted to the prevailing local climate and its natural variability. However, the Earth's climate is now changing. The Earth's surface temperature this century is clearly warmer than in any other century during the last thousand years. In addition, there is evidence that precipitation patterns are changing, the



Raino Heino, Ph.D.
Research Manager
Finnish Meteorological
Institute
Helsinki
Finland

sea level is rising, glaciers are retreating worldwide, the Arctic sea ice is thinning, and the incidence of extreme weather events is increasing in some parts of the world.

The atmospheric concentrations of greenhouse gases have increased because of human activities, primarily due to the combustion of fossil fuels (coal, oil and gas), deforestation and agricultural practices since the beginning of the pre-industrial era around 1750. The concentration of carbon dioxide in the atmosphere has increased by nearly 30 %, of methane by more than a factor of two and of nitrous oxide by about 15 %. Their concentrations are now higher than at any time in the last 420,000 years, the period for which reliable ice-core data exists. In addition, the combustion of fossil fuels has caused the atmospheric concentrations of sulphate aerosols to increase. Greenhouse gases tend to warm the atmosphere and aerosols tend to cool the atmosphere in some regions, primarily in the Northern Hemisphere.

Weighty scientific evidence suggests that the observed changes in the Earth's climate are, at least in part, due to human activities. Climate models that take into account the observed increases in the atmospheric concentrations of greenhouse gases, sulphate aerosols and the observed decrease in ozone in the lower stratosphere, in conjunction with natural changes in volcanic activity and in solar activ-

ity, simulate the observed changes in annual mean global surface temperature quite well. This, and our basic scientific understanding of the greenhouse effect, suggests that human activities are implicated in the observed changes in the Earth's climate. Basically, the greenhouse effect is a natural process that is essential to maintaining the planet's climate. The term refers to the insulating effect produced by several important gases in the earth's atmosphere – carbon dioxide, methane, nitric oxide, ozone, other trace gases and water vapor. Surrounding the Earth like a giant greenhouse, these gases allow short-wave solar radiation to pass through to the Earth's surface, where it is absorbed.

Future emissions of greenhouse gases and sulphur dioxide will reflect the evolution of governance structures worldwide and changes in population and economic growth. Additionally, emissions will develop according to the rate of diffusion of new technologies into the market place and land-use practices. Energy production and consumption patterns, energy intensity, and the price and availability of energy also play an important role in emission development trends. While different development paths can result in quite different greenhouse gas emissions, most projections suggest that greenhouse gas concentrations will increase significantly during the next century in the absence of policies specifically designed to address the issue of climate change. The IPCC Special Report on Emission Scenarios (SRES) reported that carbon dioxide emissions from the combustion of fossil fuels are projected to range from about 5 to 35 GtC per year in the year 2100 compared to current emissions of about 6.3 GtC per year. Such a range of emissions would mean that the atmospheric concentration of carbon dioxide would increase from today's level of about 365 ppmv (parts per million by volume) to between about 550 and 1000 ppmv by 2100.

Based on the range of climate sensitivities and the plausible ranges of greenhouse gas and sulphur dioxide emissions reported in the SRES, a number of climate models project that the global mean surface temperature could



Climate change may lead to more frequent, harsh regional weather, such as intense rainfall, frequent tornadoes and severe storms.

increase by about 1.5 to 6.0 °C by 2100. The revised high estimates of projected warming arise because the lower projected emission of sulphur dioxide results in less offset of the warming effect of the greenhouse gases. These projected global-average temperature changes would be greater than recent natural fluctuations and would also occur at a rate significantly faster than observed changes over the last 10,000 years. Temperature changes are expected to differ by region: high latitudes are predicted to warm more than the global average. Moreover, in the next century, land areas are projected to warm more than the oceans, and the Northern Hemisphere is projected to warm more than the Southern Hemisphere. However, the reliability of regional scale predictions is still low.

The majority of scientific experts believe that human-induced climate change is inevitable. The question is not whether climate will change in response to human activities, but rather how much, how fast and where. The global climate change is expected to alter regional climate systems across the planet: some areas will likely become wetter, some drier, some hotter and some cooler. It

is also clear that climate change will, in many parts of the world, adversely affect socio-economic sectors, with developing countries being the most vulnerable.

Decision-makers should realize that once carbon dioxide, the major anthropogenic (human-induced) greenhouse gas, is emitted into the atmosphere, it remains there for more than a century. This means that if policy formulation is postponed until all scientific uncertainties are resolved, and carbon dioxide and other greenhouse gases are responsible for changing the Earth's climate as projected by all climate models, the time to reverse the human-induced changes in climate and the resulting environmental damage, would not be years or decades, but centuries to millennia. This would be the case, even if all emissions of greenhouse gases were terminated, which is clearly not feasible.

If actions are not taken to reduce the projected increase in greenhouse gas emissions, the Earth's climate is projected to change at a rate unprecedented in the last 10,000 years with adverse consequences for society, undermining the very foundation of sustainable development. ■