

# Climate Change: The Scientific Basis

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## Introduction

According to the Intergovernmental Panel on Climate Change (IPCC), Climate Change can be defined as: A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. The most recent IPCC scientific assessment of climate change stated that the best estimate of global temperature increase for the next century for the low scenario is 1.8 °C (likely range is 1.1 °C -2.9 °C) , and the best estimate for the high scenario is 4.0 °C (likely range 2.4 °C to 6.4 °C). These changes may lead to a number of potentially serious consequences. Developing countries will be more vulnerable than industrialized countries, with the poorest of the poor being the most at risk from the increased variability and volatility in weather patterns. Human-induced climate change is expected to decrease agricultural productivity throughout the tropics and sub-tropics, decrease water quantity and quality in most arid and semi-arid regions, increase the incidence of malaria, dengue and other vector-borne diseases in the tropics and sub-tropics, and harm ecological systems and their biodiversity. This will weaken the very foundation of sustainable development. In addition, the sea level rise associated with expected increases in temperature could displace tens of millions of people living in low-lying areas, such as the Ganges and the Nile deltas, and could threaten the very existence of small island states.

## 1. What is the greenhouse effect?

The Sun powers Earth's climate, radiating energy at very short wavelengths, predominately in the visible or near-visible (e.g., ultraviolet) part of the spectrum. Roughly one-third of the solar energy that reaches the top of Earth's atmosphere is reflected directly back to space. The

remaining two-thirds is absorbed by the surface and, to a lesser extent, by the atmosphere. To balance the absorbed incoming energy, the Earth must, on average, radiate the same amount of energy back to space. Because the Earth is much colder than the Sun, it radiates at much longer wavelengths, primarily in the infrared part of the spectrum. Much of this thermal radiation emitted by the land and ocean is absorbed by the atmosphere, including clouds, and reradiated back to Earth. This is called the greenhouse effect. The glass walls in a greenhouse reduce airflow and increase the temperature of the air inside. Analogously, but through a different physical process, the Earth's greenhouse effect warms the surface of the planet. Without the natural greenhouse effect, the average temperature at Earth's surface would be below the freezing point of water. Thus, Earth's natural greenhouse effect makes life as we know it possible. However, human activities, primarily the burning of fossil fuels and clearing of forests, have greatly intensified the natural greenhouse effect, causing global warming.

## 2. What are the greenhouse gases?

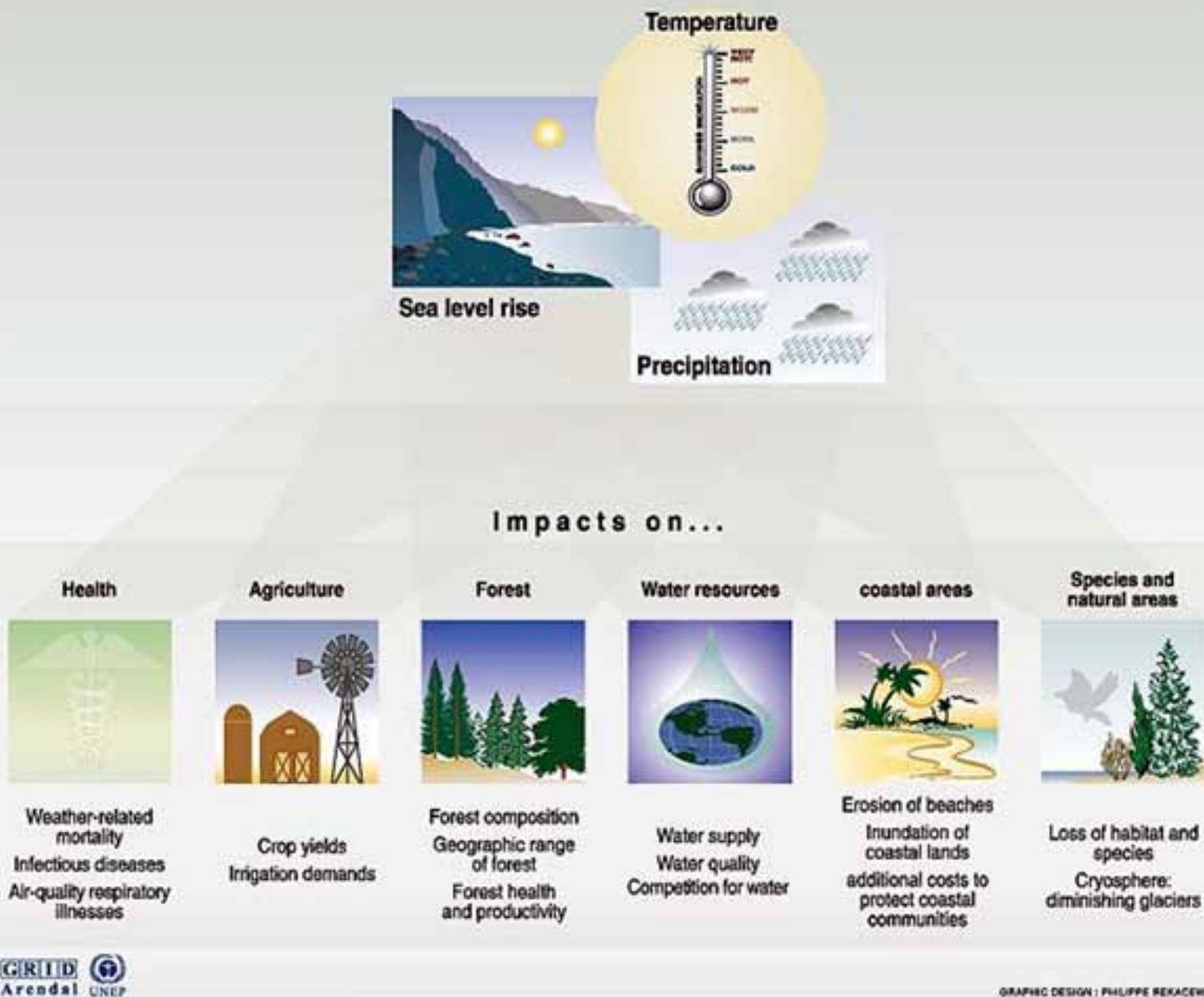
Greenhouse gases are those that can absorb and emit infrared radiation. In order, the most abundant greenhouse gases in Earth's atmosphere are:

- water vapor (H<sub>2</sub>O)
- carbon dioxide (CO<sub>2</sub>)
- methane (CH<sub>4</sub>)
- nitrous oxide (N<sub>2</sub>O)
- ozone (O<sub>3</sub>)

## 3. The potential impacts of climate change

Generally the potential impacts can be summarized in the following figure:

## Potential climate changes impact



### 4. What is climate change mitigation?

Climate change mitigation is defined as a human intervention to decrease the intensity of radiative forcing in order to reduce the potential effects of global warming. Most often, climate change mitigation scenarios involve reductions in the concentrations of greenhouse gases, either by reducing their sources or by increasing their sinks. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to renewable energy (solar energy or wind power), improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere and nuclear power.

### 5. Adaptation to climate change?

Adaptation to climate change is a response to climate change that seeks to reduce the vulnerability of biological systems to climate change effects. Even if emissions are stabilized relatively soon, climate change and its effects will last many years, and adaptation will be necessary. Climate change adaptation is especially important in developing countries since those countries are predicted to bear the brunt of the effects of climate change. That is, the capacity and potential for humans to adapt (called adaptive capacity) is unevenly distributed across different regions and populations, and developing countries generally have less capacity to adapt. Adaptive capacity is closely linked to social and economic development (IPCC, 2007).



There are three basic reasons why can't the ecosystems adapt naturally?

- First, the rate of global climate change is projected to be more rapid than any to have occurred in the last 10,000 years,
- Second, humans have altered the structure of many of the world's ecosystems,
- Third, pollution, as well as other indirect effects of the utilization of natural resources, has also increased since the beginning of the industrial revolution

References and links for further reading:

- Global Environment Facility GEF: <http://www.gefweb.org/>
- United Nations Framework Convention on Climate Change UNFCCC Home Page: <http://unfccc.int>
- The Intergovernmental Panel on Climate Change IPCC Home Page: <http://www.ipcc.ch/>
- United Nations Environment Programme - UNEP : <http://www.unep.org/>
- Wikipedia, the free encyclopedia: Greenhouse gas inventory: [http://en.wikipedia.org/wiki/Greenhouse\\_gas\\_inventory](http://en.wikipedia.org/wiki/Greenhouse_gas_inventory)
- United States Environmental Protection Agency: Climate Change, Kids Site: <http://epa.gov/climatechange/kids/climateweather.html>
- Global Change Master Directory, Earth Science FAQ: Where can I learn more about Global Warming and the Greenhouse Effect?: [http://gcmd.nasa.gov/Resources/FAQs/glob\\_warmfaq.html](http://gcmd.nasa.gov/Resources/FAQs/glob_warmfaq.html)
- The Intergovernmental Panel on Climate Change - Working Group I : Fourth Assessment Report: The Physical Science Basis for Climate Change: Frequently Asked Questions: <http://ipcc-wg1.ucar.edu/wg1/wg1-report.html>
- World Bank: FAQs Climate Change: <http://web.worldbank.org/WBSITE/EXTERNAL/EXTSITETOOLS/0,,contentMDK:20205607~menuPK:435332~pagePK:98400~piPK:98424~theSitePK:95474,00.html>
- The United Nations Environment Programme - World Meteorological Organization Common Questions about Climate Change: <http://www.gcrio.org/ipcc/qa/11.html>
- An Inconvenient Truth authored by Al-Gore published by Butler and Tanner ltd, 2006.