

Observation and Temperature Changes : Warming of The Climate System and Future of Global Warming in 21st Century

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ABSTRACT

Global warming is the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century and its projected continuation. Since the early 20th century, Earth's mean surface temperature has increased by about 0.8 °C (1.4 °F), Warming of the climate system is unequivocal, and scientists are more than 90% certain that it is primarily caused by increasing concentrations of greenhouse gases produced by human activities such as the burning of fossil fuels and deforestation. Climate model projections were summarized in 21st Century Fourth Assessment Report (AR4) by the Intergovernmental Panel on Climate Change (IPCC). They indicated that during the 21st century the global surface temperature is likely to rise a further 1.1 to 2.9 °C (2 to 5.2 °F) for their lowest emission scenario and 2.4 to 6.4 °C (4.3 to 11.5 °F) for their highest. The ranges of these estimates arise from the use of models with differing sensitivity to greenhouse gas concentrations. The Earth's average surface temperature rose by $.74 \pm 0.18$ °C over the period 1906–2005. Temperature changes vary over the globe. Since 1979, land temperatures have increased about twice as fast as ocean temperatures (0.25 °C per decade against 0.13 °C per decade).

Proposed policy responses to global warming include mitigation by emissions reduction, adaptation to its effects, and possible future geo engineering. Most countries are parties to the United Nations Framework Convention on Climate Change (UNFCCC), whose ultimate objective is to prevent dangerous anthropogenic climate change. Reports published by the United Nations Environment Programme (UNEP) and the International Energy Agency suggest that efforts as of the early 21st century to reduce emissions may be inadequate to meet the UNFCCC's 2 °C target. Future of climate change and associated impacts will vary from region to region around the globe. The effects of an increase in global temperature include a rise in sea levels and a change in the amount and pattern of precipitation, as well a probable expansion of subtropical deserts. Warming is expected to be strongest in the Arctic and would be associated with the continuing retreat of glaciers, permafrost and sea ice. Effects significant to humans include the threat to food security from decreasing crop yields and the loss of habitat from inundation.

Key words : Environment Programme, Food Security, Climate Change, Global Warming etc.

1. INTRODUCTION

Since 1978, output from the sun has been precisely measured by satellites[1]. These measurements indicate that the Sun's output has not increased since 1978, so the warming during the past 30 years cannot be attributed to an increase in solar energy reaching the Earth. In the three decades since 1978, the combination of solar and volcanic activity probably had a slight cooling influence on the climate [2].

Climate models have been used to examine the role of the sun in recent climate change[3]. Models are unable to reproduce the rapid warming observed in recent decades when they only take into account variations in solar output and volcanic activity. Models are, however, able to simulate the observed 20th century changes in temperature when they include all of the most important external forcings, including human influences and natural forcings.

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Another line of evidence against the sun having caused recent climate change comes from looking at how temperatures at different levels in the Earth's atmosphere have changed [4]. Models and observations show that greenhouse warming results in warming of the lower atmosphere (called the troposphere) but cooling of the upper atmosphere (called the stratosphere) [5]. Depletion of the ozone layer by chemical refrigerants has also resulted in a strong cooling effect in the stratosphere. If the sun were responsible for observed warming, warming of both the troposphere and stratosphere would be expected [6].

2. OBSERVATION AND TEMPERATURE CHANGES CLIMATE MODELS

Calculations of global warming prepared in or before 2001 from a range of climate models under the SRES A2 emissions scenario, which assumes no action is taken to reduce emissions and regionally divided economic development.

Projected change in annual mean surface air temperature from the late 20th century to the middle 21st century, based on a medium emissions scenario (SRES A1B). This scenario assumes that no future policies are adopted to limit greenhouse gas emissions.

A climate model is a computerized representation of the five components of the climate system: Atmosphere, hydrosphere, cryosphere, land surface, and biosphere. Such models are based on physical principles including fluid dynamics, thermodynamics, and radioactive transfer. There can be components which represent air movement, temperature, clouds, and other atmospheric properties; ocean temperature, salt content, and circulation; ice cover on land and sea; the transfer of heat and moisture from soil and vegetation to the atmosphere; chemical and biological processes; and others.

Although researchers attempt to include as many processes as possible, simplifications of the actual climate system are inevitable because of the constraints of available computer power and limitations in knowledge of the climate system. Results from models can also vary due to different greenhouse gas inputs and the model's climate sensitivity. For example, the uncertainty in IPCC's 2007 projections is caused by the use of multiple models with differing sensitivity to greenhouse gas concentrations, the use of differing estimates of humanity's future greenhouse gas emissions, any additional emissions from climate feedbacks that were not included in the models IPCC used to prepare its report, i.e., greenhouse gas releases from permafrost.

The models do not assume the climate will warm due to increasing levels of greenhouse gases. Instead the models predict how greenhouse gases will interact with radiative transfer and other physical processes. One of the mathematical results of these complex equations is a prediction whether warming or cooling will occur.

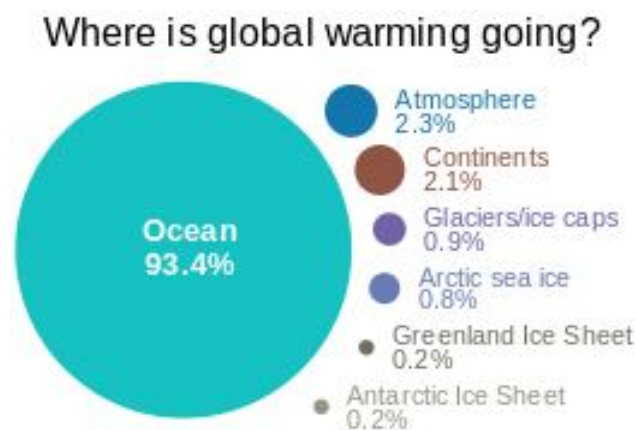


Fig. 1. Observed Temperature Changes

Recent research has called special attention to the need to refine models with respect to the effect of clouds and the carbon cycle.

Models are also used to help investigate the causes of recent climate change by comparing the observed

changes to those that the models project from various natural and human-derived causes. Although these models do not unambiguously attribute the warming that occurred from approximately 1910 to 1945 to either natural variation or human effects, they do indicate that the warming since 1970 is dominated by man-made greenhouse gas emissions.

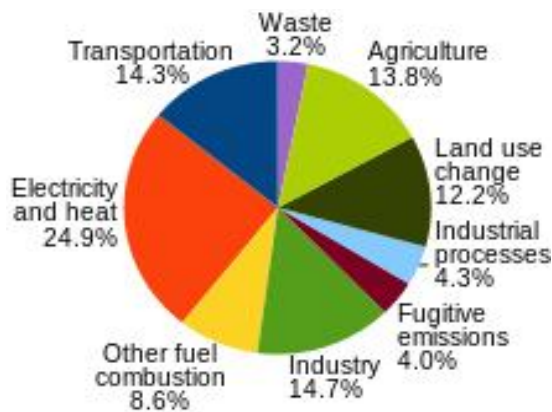


Fig.2. Annual world greenhouse gas emissions, in 2005 by sector

The physical realism of models is tested by examining their ability to simulate contemporary or past climates. Climate models produce a good match to observations of global temperature changes over the last century, but do not simulate all aspects of climate. Not all effects of global warming are accurately predicted by the climate models used by the IPCC. Precipitation increased proportional to atmospheric humidity, and hence significantly faster than global climate models predict.

3. OBSERVED AND EXPECTED ENVIRONMENTAL EFFECTS OF GLOBAL WARMING

Sparse records indicate that glaciers have been retreating since the early 1800s. In the 1950s measurements began that allow the monitoring of glacial mass balance, reported to the World Glacier Monitoring Service (WGMS) and the National Snow and Ice Data Centre (NSIDC) to the projections.

Therefore, none of these projections should be interpreted as a “best estimate” of future sea level rise. Projections of global mean sea level rise by Parris and others Probabilities have not been assigned rise.

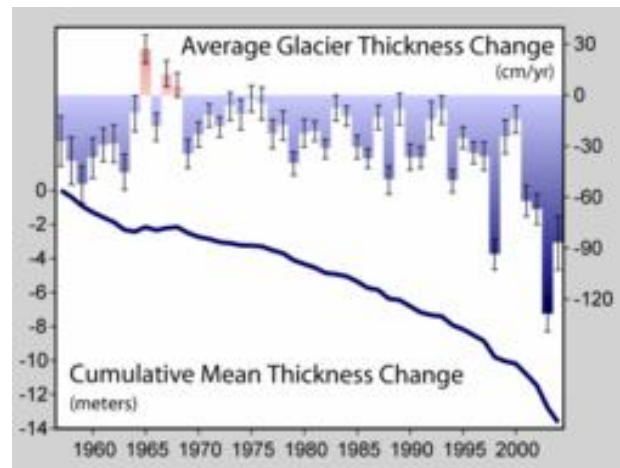


Fig.3. Average Glacier Thickness Changes cm/year

Detection is the process of demonstrating that climate has changed in some defined statistical sense, without providing a reason for that change. Detection does not imply attribution of the detected change to a particular cause. “Attribution” of causes of climate change is the process of establishing the most likely causes for the detected change with some defined level of confidence. Detection and attribution may also be applied to observed changes in physical, ecological and social systems.

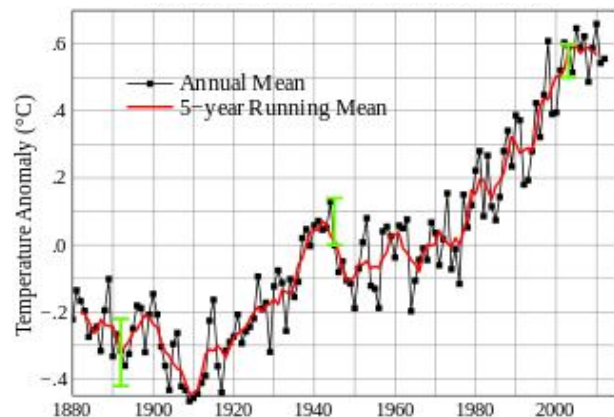


Fig.4. Global mean land-ocean temperature change from 1880-2012

3.1 Natural systems

Global warming has been detected in a number of natural systems. Some of these changes are described in the section on observed temperature changes, e.g., sea level rise and widespread decreases in snow and ice extent. Anthropogenic forcing has likely contributed to some of the observed changes, including sea level rise, changes in climate extremes (such as the number of warm and cold days), declines in Arctic sea ice extent, and to glacier retreat.

Over the 21st century the IPCC projects that global mean sea level could rise by 0.18-0.59 m. The IPCC do not provide a best estimate of global mean sea level rise, and their upper estimate of 59 cm is not an upper-bound, i.e., global mean sea level could rise by more than 59 cm by 2100. The IPCC's projections are conservative, and may underestimate future sea level rise. Over the 21st century, Parris and others suggest that global mean sea level could rise by 0.2 to 2.0 m (0.7-6.6 ft), relative to mean sea level in 1992.

Widespread coastal flooding would be expected if several degrees of warming is sustained for millennia. For example, sustained global warming of more than 2 °C (relative to pre-industrial levels) could lead to eventual sea level rise of around 1 to 4 m due to thermal expansion of sea water and the melting of glaciers and small ice caps. Melting of the Greenland ice sheet could contribute an additional 4 to 7.5 m over many thousands of years.

Changes in regional climate are expected to include greater warming over land, with most warming at high northern latitudes, and least warming over the Southern Ocean and parts of the North Atlantic Ocean. During the 21st century, glaciers and snow cover are projected to continue their widespread retreat. Projections of declines in Arctic sea ice vary.

Future changes in precipitation are expected to follow existing trends, with reduced precipitation over subtropical land areas, and increased precipitation at subpolar latitudes and some equatorial regions.

3.2 Ecological systems

In terrestrial ecosystems, the earlier timing of spring events, and poleward and upward shifts in plant and animal ranges, have been linked with high confidence to recent warming. Future climate change is expected to particularly affect certain ecosystems, including tundra, mangroves, and coral reefs. It is expected that most ecosystems will be affected by higher atmospheric CO₂ levels, combined with higher global temperatures. Overall, it is expected that climate change will result in the extinction of many species and reduced diversity of ecosystems.

Dissolved CO₂ increases ocean acidity. This process is known as ocean acidification and has been called the "equally evil twin" of global climate change. Increased ocean acidity decreases the amount of carbonate ions, which organisms at the base of the marine food chain, such as foraminifera, use to make structures they need to survive. The current rate of ocean acidification is many times faster than at least the past 300 million years, which included four mass extinctions that involved rising ocean acidity, such as the Permian mass extinction, which killed 95% of marine species.

4. CONCLUSION

Reports published by the United Nations Environment Programme (UNEP) and the International Energy Agency suggest that efforts as of the early 21st century to reduce emissions may be inadequate to meet the UNFCCC's 2 °C target. Future of climate change and associated impacts will vary from region to region around the globe. The effects of an increase in global temperature include a rise in

sea levels and a change in the amount and pattern of precipitation, as well a probable expansion of subtropical deserts.

Most countries are Parties to the United Nations Framework Convention on Climate Change (UNFCCC). The ultimate objective of the Convention is to prevent dangerous human interference of the climate system. As is stated in the Convention, this requires that GHG concentrations are stabilized in the atmosphere at a level where ecosystems can adapt naturally to climate change, food production is not threatened, and economic development can proceed in a sustainable fashion. The Framework Convention was agreed in 1992, but since then, global emissions have risen. During negotiations, the G77 (a lobbying group in the United Nations representing 133 developing nations) pushed for a mandate requiring developed countries to take the lead in reducing their emissions. This was justified on the basis that: the developed world's emissions had contributed most to the stock of GHGs in the atmosphere; per – capita emissions per (i.e., emissions per head of population) were still relatively low in developing countries; and the emissions of developing countries would grow to meet their development needs.

In ratifying the Kyoto Protocol, most developed countries accepted legally binding commitments to limit their emissions. These first-round commitments expire in 2012. US President George W. Bush rejected the treaty on the basis that “It exempts 80% of the world, including major population centers such as China and India, from compliance, and would cause serious harm to the US economy.”

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