

1.2. Observed climate change and future trends

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Extreme events are closely associated with changes in temperature and precipitation, and with the frequency of events. IPCC predicts that the average global temperature at the surface will increase by 1.4-5.8°C between 1990 and 2100. Winter precipitation in central and high northern latitudes will probably increase. Intensive precipitation will most probably become more frequent.

"An increasing body of observations gives a collective picture of a warming world and other changes in the climate system." This conclusion is drawn by the Intergovernmental Panel on Climate Change (IPCC) in its Third Assessment Report (TAR).¹ The report demonstrates that the temperature increase observed over the past 50 years is principally attributable to human activity.

Climate change in the 20th century

The observed changes in the global climate during the 20th century are described in the report of Working Group I of the TAR¹ (see box, p. 18).

Extreme events are closely associated with changes in temperature and precipitation, and with the frequency of events. The average global air temperature at the earth's surface rose in the course of the 20th century by $0.6 \pm 0.2^\circ\text{C}$. Globally, the 1990s probably represented the warmest decade, and 1998 the warmest year, since instrumental measurements began in 1861. The daily minimum values of air temperature over land rose between 1950 and 1993 by an average of 0.8°C . In numerous regions in central and northerly latitudes, frost-free periods have become longer. Since 1950, extremely low temperatures have become rarer and extremely high temperatures somewhat more frequent.

During the 20th century, precipitation over most land areas in central and high latitudes of the northern hemisphere has increased by 0.5-1% per decade. In the second half of the 20th century, the frequency of heavy precipitation events probably increased by 2-4%. Possible reasons for this are changes in the moisture content of the atmosphere, and in large-scale storm and thunderstorm activity. The land area affected by severe drought or floods increased slightly in the course of the 20th century.

The intensity and frequency of tropical and extra-tropical storms show no significant global trends in the 20th century. Predictions of changes in storm activity are not at present possible. No systematic changes in the frequency of tornados, or days with thunder or hail events, are evident in the limited areas analysed.

Climate trends in the 21st century

Future climatic variations may be approximately assessed using complex meteorological models. When applied retrospectively, the models are increasingly able to reproduce climate fluctuations observed in the past, so that increasing trust is now



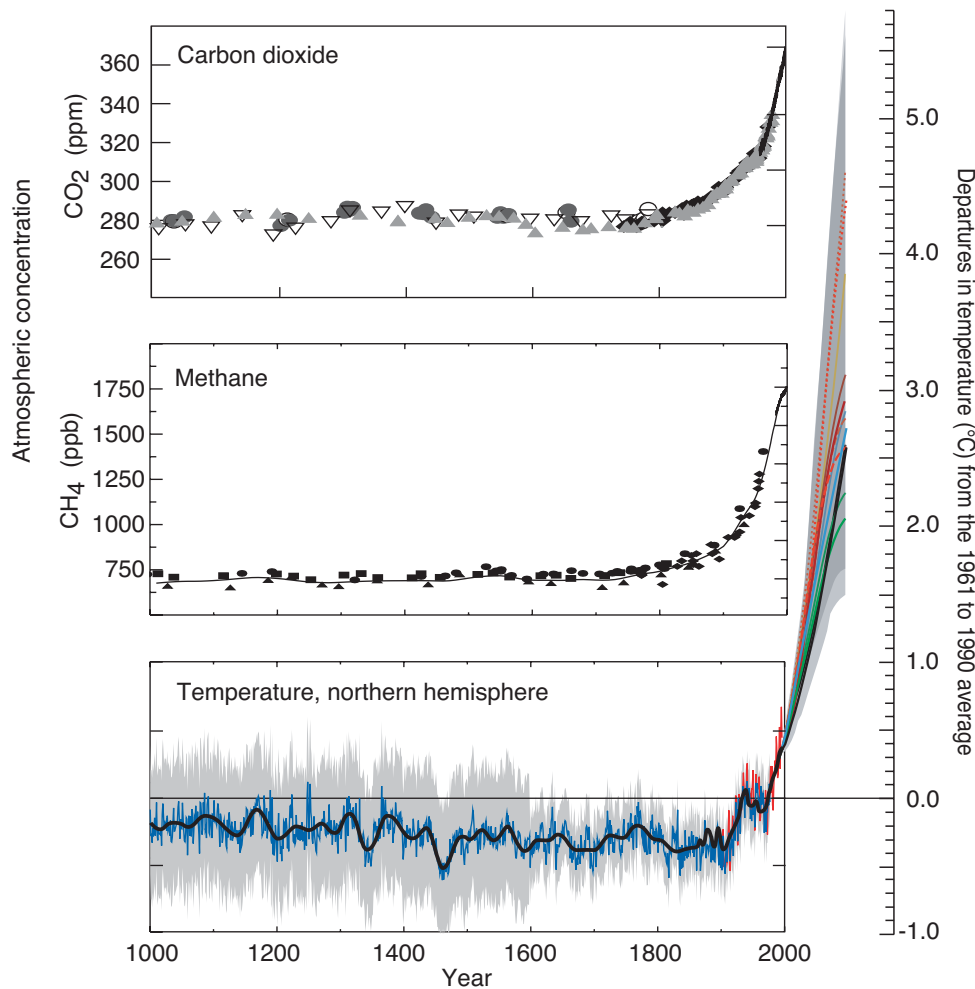


Fig. 2 The concentrations of the greenhouse gases carbon dioxide and methane have heavily increased since the beginning of the 20th century, and depart markedly from the values in the pre-industrial era. At the same time, the surface air temperatures in the northern hemisphere have increased. Climate simulations for the 21st century predict a temperature increase of 1.4°C to 5.8°C (grey area). The temperature increase will be much steeper than was observed over the past 1000 years.¹

placed in them. In order to assess future developments, so-called emission scenarios⁵ are used that specify the emission of the principal greenhouse gases and aerosols in relation to hypothetical changes in population, technology and the economy. Future trends in climate elaborated in the TAR are based on a large number of simulations and studies comparing the different analytical models.

In the period 1990-2100, the simulations show a rise in the average global surface temperature of 1.4-5.8°C. The increase in temperature will proceed significantly faster than in the 20th century (see Fig. 2), and will be above the average particularly over the continents and in high northern latitudes in winter. In general, a tendency towards higher temperature maxima, an increasing number of very hot days, higher temperature minima, less very cold days and those with frost, and lower daily temperature fluctuations above most land masses, are expected.

Furthermore, the average global concentration of water vapour in the atmosphere will increase during the 21st century. Winter precipitation will probably increase in the northern hemisphere in central and northerly latitudes, and in Antarctica. In addition, larger fluctuations in precipitation are expected from year to year, and intensive precipitation events may become more frequent. The dry summer periods over the continents are expected to extend, and in central latitudes, the likelihood of drought in most inner continental areas is expected to increase.

Meteorological models are not yet sufficiently fine-meshed to assess small-scale phenomena potentially having a substantial influence on the environment and society. Thus, for example, geographically confined phenomena such as thunderstorms, tornados, hail and lightning strikes are not simulated in the models.

IPCC reports

The Intergovernmental Panel on Climate Change (IPCC) brings together the available scientific and socio-economic information on climate change, and on methods for its mitigation and for adaptation to its consequences. It was appointed in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP). Since 1990, the IPCC prepared a series of reports that are now standard works of reference frequently consulted by political decision makers, researchers and other experts (www.ipcc.ch).

The Third Assessment Report (TAR) comprises the reports of the three working groups of the IPCC (Working Group I: The Scientific Basis¹; Working Group II: Impacts, Adaptation and Vulnerability²; Working Group III: Mitigation³) and the Synthesis Report⁴. Some 2500 scientists collaborated in preparing the TAR. The reports do not claim to represent the truth as such, but rather aim to present the present status of knowledge in the form of a consensus among the scientists involved. Attention is expressly drawn to any controversy existing on particular issues.

- 1 IPCC, Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K., 881 p., 2001.
- 2 IPCC, Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K., 1032 p., 2001.
- 3 IPCC, Climate Change 2001: Mitigation. Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K., 752 p., 2001.
- 4 IPCC, Climate Change 2001: Synthesis Report. Cambridge University Press, Cambridge, U.K., 397 p., 2002.
- 5 IPCC, Special Report on Emissions Scenarios. Cambridge University Press, Cambridge, U.K., 514 p., 2000.