

State of Scientific Understanding of Climate Change

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This brief summary is largely based on the IPCC scientific assessments and summarizes our views of what already is known and what remains uncertain concerning the greenhouse warming issue.

What Scientists Understand Very Well

- * The atmospheric abundances of greenhouse gases (carbon dioxide, methane, nitrous oxide, and halocarbons) are increasing due to human activities.
- * Greenhouse gases absorb infrared radiation, altering the atmospheric radiative balance.
- * Greenhouse gases affect the Earth's climate for centuries because of their very long residence times and the associated time response of the climate system.
- * Changes in other substances partially offset the impact of greenhouse gases (stratospheric ozone depletion and increases in sulfate aerosols and carbonaceous soot).
- * Natural climate variability makes it difficult to detect an enhanced greenhouse warming.
- * Global surface temperatures have increased (0.3 to 0.6°C) over the past century.
- * Global surface temperatures were anomalously high in the late 1980s, 1990 and 1991.
- * No inconsistency is found between surface, radiosonde and satellite observations of temperature trends during the 1980's.
- * Substantial reduction of key uncertainties (detailed quantification of the timing, magnitude and regional patterns of climate change) needs a decade or more.
- * The stratosphere is expected to cool significantly because of increases in carbon dioxide and decreases in stratospheric ozone.

What Scientists Understand Reasonably Well

- * Observed global temperature changes are not inconsistent with model predictions especially if allowance is made for the cooling effect due to anthropogenic aerosols and stratospheric ozone depletion. Natural climate variability could be the cause of the observed temperature increase, alternatively, natural variability could have masked an even larger human-induced increase.
- * Doubled carbon dioxide abundances are predicted to increase temperatures by 1.5 to 4.5 °C.
- * Significant warming is expected by the mid-21st century (1-5 °C), assuming that the global emissions of greenhouse gases continue at the levels of the central IPCC scenarios.
- * Sea level is expected to rise for many centuries (4-12 inches by the middle of the next century)
- * Greater warming is likely in the northern polar winter.
- * Reductions in northern, but not southern, sea ice are expected.
- * Global mean precipitation will increase: changes in regional distribution are less certain.
- * Climate change will impact ecological and socio-economic systems. Changes in temperature, precipitation and soil moisture will affect water availability, agricultural productivity, and will alter the productivity and boundaries of natural terrestrial ecosystems.

What Greenhouse Predictions are Less Certain

- * The prediction of mid-continental summer dryness.
- * The prediction that ocean overturning will diminish.

The Most Serious Uncertainties that Need to be Resolved

- * Future atmospheric abundances of carbon dioxide.
- * Cloud-radiation feedbacks.
- * Regional-scale predictions of climate change.
- * Changes in the frequency and intensity of tropical storms.