http://www.epa.gov/climatechange/science/stateofknowledge.html
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Climate Change - Science

State of Knowledge

What's Known | What's Very Likely | What's Not Certain

As with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate science. Some aspects of the science are known with virtual certainty[1], because they are based on well-known physical laws and documented trends. Current understanding of many other aspects of climate change ranges from "very likely" to "uncertain."

Related Links

CCSP

- Product 5.2 - Best practice approaches for characterizing, communicating, and incorporating scientific uncertainty in decisionmaking
- Vision for the Program and Highlights of the Scientific Strategic Plan

What's Known

Scientists know with virtual certainty that:

- Human activities are changing the composition of Earth's atmosphere. Increasing levels of greenhouse gases like carbon dioxide (CO_2) in the atmosphere since pre-industrial times are well-documented and understood.
- The atmospheric buildup of CO_2 and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels.
- An "unequivocal" warming trend of about 1.0 to 1.7°F occurred from 1906-2005. Warming occurred in both the Northern and Southern Hemispheres, and over the oceans (IPCC, 2007).
- The major greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries. It is therefore virtually certain that atmospheric concentrations of greenhouse gases will continue to rise over the next few decades.
- Increasing greenhouse gas concentrations tend to warm the planet.

What's Very Likely?

The Intergovernmental Panel on Climate Change (IPCC) has stated "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations" (IPCC, 2007). In short, a growing number of scientific analyses indicate, but cannot prove, that rising levels of greenhouse gases in the atmosphere are contributing to climate change (as theory predicts). In the coming decades, scientists anticipate that as atmospheric concentrations of greenhouse gases continue to rise, average global temperatures and sea levels will continue to rise as a result and precipitation patterns will change.

What's Not Certain?

Important scientific questions remain about how much warming will occur, how fast it will occur, and how the warming will affect the rest of the climate system including precipitation patterns and storms. Answering these questions will require advances in scientific knowledge in a number of areas:

- Improving understanding of natural climatic variations, changes in the sun's energy, land-use changes, the warming or cooling effects of pollutant aerosols, and the impacts of changing humidity

and cloud cover.
- Determining the relative contribution to climate change of human activities and natural causes.
- Projecting future greenhouse emissions and how the climate system will respond within a narrow range.
- Improving understanding of the potential for rapid or abrupt climate change.

Addressing these and other areas of scientific uncertainty is a major priority of the U.S. Climate Change Science Program (CCSP). The CCSP is developing twenty-one Synthesis and Assessment products to advance scientific understanding of these uncertainty areas by the end of 2008. More information.

References

- IPCC, 2007: Climate Change 2007: The Physical Science Basis. EXIT Disclaimer Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning (eds.)].

[1] Throughout the science section of this Web site, use of "virtual certainty" (or virtually certain) conveys a greater than 99% chance that a result is true. Other terms used to communicate confidence include "extremely likely" (greater than 95% chance the result is true), "very likely" (greater than 90% chance the result is true), "likely" (greater than 66% chance the result is true), "more likely than not" (greater than 50% chance the result is true), "unlikely" (less than 33% chance the result is true), "very unlikely" (less than 10% chance the result is true), and "extremely unlikely" (less than 5% chance the result is true). These judgmental estimates originate from the Intergovernmental Panel on Climate Change (IPCC, 2007).