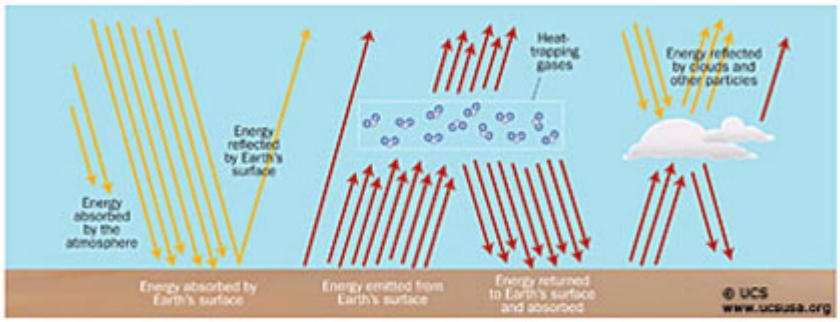
climate science

Frequently Asked Questions about Global Warming

How heat-trapping emissions work



Design: Amanda Wait/Nonprofitdesign.com. Click here for a larger version.

What does the greenhouse effect have to do with global warming?

The "greenhouse effect" refers to the natural phenomenon that keeps the Earth in a temperature range that allows life to flourish. The sun's enormous energy warms the Earth's surface and its atmosphere. As this energy radiates back toward space as heat, a portion is absorbed by a delicate balance of heat-trapping gases in the atmosphere—among them carbon dioxide and methane—which creates an insulating layer. With the temperature control of the greenhouse effect, the Earth has an average surface temperature of 59°F (15°C). Without it, the average surface temperature would be 0°F (-18°C), a temperature so low that the Earth would be frozen and could not sustain life.

"Global warming" refers to the rise in the Earth's temperature resulting from an increase in heat-trapping gases in the atmosphere.

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What is causing global warming?

Scientists have concluded that human activities are contributing to global warming by adding large amounts of heat-trapping gases to the atmosphere. Our fossil fuel use is the main source of these gases. Every time we drive a car, use electricity from coal-fired power plants, or heat our homes with oil or natural gas, we release carbon dioxide and other heat-trapping gases into the air. The second most important source of greenhouse gases is deforestation, mainly in the tropics, and other land-use changes.

offsite
General emissions information
Past emissions trends
Emissions trends in the United States
International emissions trends

Since pre-industrial times, the atmospheric concentration of carbon dioxide has increased by 31 percent. Over the same period, atmospheric methane has risen by 151 percent, mostly from agricultural activities like growing rice and raising cattle.

As the concentration of these gases grows, more heat is trapped by the atmosphere and less escapes back into space. This increase in trapped heat changes the climate, causing altered weather patterns that can bring unusually intense precipitation or dry spells and more severe storms.

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What is the best source of scientific information on global warming?

IPCC Highlights-Climate Science
IPCC Backgrounder

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Intergovernmental Panel on Climate Change

In 1988, the United Nations Environment Programme and the World Meteorological Organization set up the **Intergovernmental Panel on Climate Change (IPCC)** to examine the most current scientific information on global warming and climate change. More than 1,250 authors and 2,500 scientific experts reviewers from more than 130 countries contributed to the panel's most recent report, *Climate Change 2007: The Fourth Assessment Report* (the full report will be released in November 2007). These scientists reviewed all the published and peer-reviewed scientific information produced during the previous few years to assess what is known about the global climate, why and how it changes, what it will mean for people and the environment, and what can be done about it.

The IPCC Fourth Assessment Report is the most comprehensive and up-to-date evaluation of global warming. As the new benchmark, it serves as the basis for international climate negotiations.

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Is global warming already happening?

Yes. The IPCC concluded in its Third Assessment Report, "An increasing body of observations gives a collective picture of a warming world and other changes in the climate system." The kinds of changes already observed that create this consistent picture include the following:

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Observed Climate Variability and Change
Impacts, Adaptation, and Vulnerability to Climate Change

Examples of observed climatic changes

- Increase in global average surface temperature of about 1°F in the 20th century
- Decrease of snow cover and sea ice extent and the retreat of mountain glaciers in the latter half of the 20th century
- Rise in global average sea level and the increase in ocean water temperatures
- Likely increase in average precipitation over the middle and high latitudes of the Northern Hemisphere, and over tropical land areas
- Increase in the frequency of extreme precipitation events in some regions of the world

Examples of observed physical and ecological changes

- Thawing of permafrost
- Lengthening of the growing season in middle and high latitudes
- Poleward and upward shift of plant and animal ranges
- Decline of some plant and animal species
- Earlier flowering of trees
- Earlier emergence of insects
- Earlier egg-laying in birds

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Are humans contributing to global warming?

In 1995, the world's climate experts in the IPCC concluded for the first time in a cautious consensus, "The balance of evidence suggests that there is a discernible human influence on the global climate."

RELATED LINKS
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Climate Change 2001: The Scientific Basis - Policymaker Summary (pdf)

In its 2001 assessment, the IPCC strengthened that conclusion considerably, saying, "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."

Scientists have found significant evidence that leads to this conclusion:

- The observed warming over the past 100 years is unlikely to be due to natural causes alone; it was unusual even in the context of the last 1,000 years.
- There are better techniques to detect climatic changes and attribute them to different causes.
- Simulations of the climate's response to natural causes (sun, volcanoes, etc.) over the latter half of the 20th century alone cannot explain the observed trends.

- Most simulation models that take into account greenhouse gas emissions and sulphate aerosols (which have a cooling effect) are consistent with observations over the last 50 years.

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How much warmer is the Earth likely to become?

The IPCC's Third Assessment Report projects that the Earth's average surface temperature will increase between 2.5° and 10.4°F (1.4°-5.8°C) between 1990 and 2100 if no major efforts are undertaken to reduce the emissions of greenhouse gases (the "business-as-usual" scenario). This is significantly higher than what the Panel predicted in 1995 (1.8°-6.3°F, or 1.0°-3.5°C), mostly because scientists expect a reduced cooling effect from tiny particles (aerosols) in the atmosphere.

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View past global temperature trends
View U.S. and global climatic trends
Latest IPCC (WG I) projections

Scientists predict that even if we stopped emitting heat-trapping gases immediately, the climate would not stabilize for many decades because the gases we have already released into the atmosphere will stay there for years or even centuries. So while the warming may be lower or increase at a slower rate than predicted if we reduce emissions significantly, global temperatures cannot quickly return to today's averages. And the faster and more the Earth warms, the greater the chances are for some irreversible climate changes.

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Would a temperature rise of a couple degrees really change the global climate?

An increase of a few degrees won't simply make for pleasantly warmer temperatures around the globe. Even a modest rise of 2°- 3°F (1.1°-1.7°C) could have dramatic effects. In the last 10,000 years, the Earth's average temperature hasn't varied by more than 1.8°F (1.0°C). Temperatures only 5°-9°F cooler than those today prevailed at the end of the last Ice Age, in which the Northeast United States was covered by more than 3,000 feet of ice.

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Potential impacts on the U.S.
Worldwide early warning signs

Scientists predict that continued global warming on the order of 2.5°-10.4°F over the next 100 years (as projected in the IPCC's Third Assessment Report) is likely to result in:

- a rise in sea level between 3.5 and 34.6 in. (9-88 cm), leading to more coastal erosion, flooding during storms, and permanent inundation
- severe stress on many forests, wetlands, alpine regions, and other natural ecosystems
- greater threats to human health as mosquitoes and other disease-carrying insects and rodents spread diseases over larger geographical regions
- disruption of agriculture in some parts of the world due to increased temperature, water stress, and sea-level rise in low-lying areas such as Bangladesh or the Mississippi River delta.

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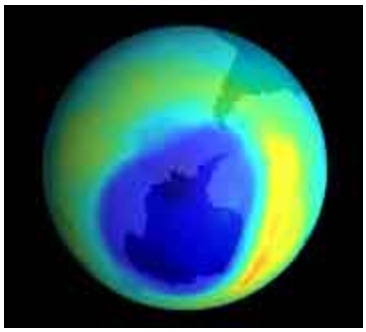
Is global warming connected to the hole in the ozone layer?



NASA image -- Ozone layer hole

Global warming and ozone depletion are two separate but related threats. Global warming and the greenhouse effect refer to the warming of the lower part of the atmosphere (also known as the troposphere) due to increasing concentrations of heat-trapping gases. By contrast, the ozone hole refers to the loss of ozone in the upper part of the atmosphere, called the stratosphere. This is of serious concern because stratospheric ozone blocks incoming ultraviolet radiation from the sun, some of which is harmful to plants, animals, and humans.

The two problems are related in a number of ways, including:

- Some human-made gases, called chlorofluorocarbons, trap heat *and* destroy the ozone layer. Currently, these gases are responsible for less than 10 percent of total atmospheric warming, far less than the contribution from the main greenhouse gas, carbon dioxide.
- The ozone layer traps heat, so if it gets destroyed, the upper atmosphere actually cools, thereby offsetting part of the warming effect of other heat-trapping gases. But that's no reason to rejoice: the cooling of the upper layers of the atmosphere can produce changes in the climate that affect weather patterns in the higher latitudes.
- Trapping heat in the lower part of the atmosphere allows less heat to escape into space and leads to cooling of the upper part of the atmosphere. The colder it gets, the greater the destruction of the protective ozone layer.

Reducing ozone-depleting gases is crucial to preventing further destruction of the ozone layer, but eliminating these gases alone will not solve the global warming problem. On the other hand, efforts to reduce all types of emissions to limit global warming will also be good for the recovery of the ozone layer.

RELATED LINKS

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Kyoto Protocol (greenhouse gases)

Montreal Protocol (ozone)

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Is there anything we can do about global warming?

RELATED LINKS

in global environment

Personal global warming solutions

The role of forests in protecting climate

on UCS website

Clean vehicles program

Clean energy program

offsite

Yes! The most important action we can take to slow global warming is to reduce emissions of heat-trapping gases. Governments, individuals, and businesses can all help.

Fuel-efficient cars

Energy-efficient products

Green-e Renewable Energy Program

Governments can adopt a range of options for reducing greenhouse gas emissions, including

- increasing energy efficiency standards
- encouraging the use of renewable energy sources (such as wind and solar power)
- eliminating subsidies that encourage the use of coal and oil by making them artificially cheap
- protecting and restoring forests, which serve as important storehouses of carbon

Individuals can reduce the need for fossil fuels and often save money by

- driving less and driving more fuel-efficient and less-polluting cars
- using energy-efficient appliances
- insulating homes
- using less electricity in general

Businesses can increase efficiency and save substantial sums by doing the same things on a larger scale. And utilities can avoid building expensive new power plants by encouraging and helping customers to adopt efficiency measures.

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Will responding to global warming be harmful to our economy?

Reducing our impact on the global climate ***does not have to hurt*** the world's economies. The answer depends much on the "how" and "when."

in publications

Clean Energy Blueprint
Drilling in Detroit
Common Sense on Climate Change

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Economics of climate change

The challenge is to strike a balance between responding early enough to avoid major negative (costly) impacts, and responding some time later in order to avoid taking big, expensive steps now which then may turn out to be unnecessary or inappropriate. This type of challenge is typical in business and industry; decision-making under uncertainty is the daily bread of most managers.

Clearly, global warming still involves many unknowns, but the remaining uncertainties in our scientific understanding no longer warrant a "wait and see" stance. Science tells us with increasing certainty that we are in for a serious long-term problem that will affect all of us.

And there is much we can do now that makes sense in terms of the economic bottom line while helping to reduce our impact on the global climate and on our local environment and health. The United States and other developed countries should seize the opportunity to take the lead in developing new, clean, energy-efficient technologies, and help developing countries take a greener path to economic prosperity. All of this can be done in a cost-effective manner, while creating jobs and new business opportunities.

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More questions?

If you have other questions about global warming, check out our briefings, updates, recommendations, analyses, guides, and links.

In addition, there are many web sites that answer frequently asked questions. We recommend the following:

The U.S. Environmental Protection Agency
http://yosemite.epa.gov/oar/globalwarming.nsf/content/ClimateScienceFAQ.html

The Carbon Dioxide Information Analysis Center
http://cdiac.esd.ornl.gov/pns/faq.html

The United Nations Environment Programme/World Meteorological Organization (on the U.S. Global Change Research Information Office website):
http://www.gcrio.org/ipcc/qa/cover.html