Earth Gauge
A National Environmental Education Foundation Program

# Commonly Asked Climate Questions and Answers

*Through conversations at the June 2008 AMS Conference on Broadcast Meteorology, and a May 2008 climate change survey conducted by Dr. Kris Wilson of Emory University, we asked meteorologists to tell us which climate questions they received most frequently from their viewers. Based on those responses, we have developed a set of answers to the most common questions.*

*These questions have been carefully researched and answered by Bob Henson, Writer/Editor/Media Relations Associate at the University Corporation for Atmospheric Research and author of The Rough Guide to Climate Change (Penguin, 2006), and Bud Ward, Editor of the Yale Forum on Climate Change and the Media.*

**Available on the web:** www.earthgauge.net/climate-q-a

## What is the difference between "climate change" and "global warming?"

Headline writers and environmental advocates appear to prefer the more evocative term "global warming" over "climate change" in describing the anthropogenic (human-caused) warming of Earth's atmosphere. Many in the climate science community, however, appear to favor "climate change" precisely because it is broader in terms of describing potential impacts—not just warming, but droughts, wildfires, severe storms, sea-level rise, public health, and the like. The term "climate change" can also be used to encompass natural events, such as the onset of ice ages due to variations in Earth's orbit, while "global warming" is typically used to imply that humans are at least partially responsible.

Although the terms often are used synonymously, many experts increasingly recommend "climate change," even though it may lack the attention-getting pizzazz of "global warming."

**More Information:** U.S. EPA Glossary of Climate Change Terms - www.epa.gov/climatechange/glossary.html

## Is climate change natural or human-made?

Both natural and human factors can lead to climate change.

Even if people were burning no fossil fuels, we might be seeing gradual shifts in Earth's climate—including warming or cooling. The main natural process that has led to climate change over the last million years—the ebb and flow of ice ages—is a set of cyclic variations in Earth's orbit around the Sun that have been mapped out for many years.

However, there is no scientifically demonstrated explanation for the warming trend of the last few decades other than human-produced greenhouse gases (see figure 1). There is also no sign of a large natural shift in climate that might be greatly exacerbating or weakening the changes related to human activity.

The existence of large climate changes in the past is no source of comfort. The fact that lightning bolts have produced forest fires for millennia doesn't mean that cigarettes can't cause forest fires today. Similarly, it's true that variations in Earth's orbit, global volcanism, and other factors have produced massive climate change in the past. But this doesn't prohibit humans from having our own impact on climate.

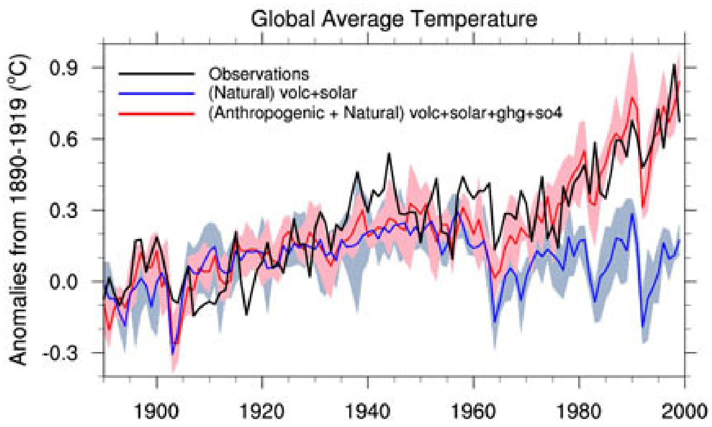


**Figure 1. Comparison of global average temperatures with natural-only (Sun and volcano) vs. natural-plus-human influences.** Experiments using computer models confirm the importance of human-produced emissions in the temperature trends of recent decades. This graphic depicts global average temperature since 1890 as reproduced by the NCAR/DOE Parallel Climate Model. The blue line summarizes simulations performed using only natural influences on climate (volcanoes and solar variations). The red line, from a set of simulations that includes sulfate aerosol pollution and greenhouse gases, is much closer to the observed record (black line). The blue and red shading shows the range of results (the model uncertainty) for each group of simulations, or ensemble. (Illustration courtesy Gerald Meehl, NCAR.)

## *What are greenhouses gases? The greenhouse effect? How is the greenhouse effect different from global warming?*

Nitrogen and oxygen comprise about 99 percent of Earth's atmosphere, but these gases are not part of the greenhouse effect because they neither reflect nor absorb heat radiated from Earth back out into space. "Trace" gases, which make up the remaining 1 percent of the atmosphere, include greenhouse gases. More than 100 years ago, scientists discovered that these gases trapped heat within the troposphere, somewhat like the window panes of a greenhouse. In fact, without $CO_2$, Earth's average temperature would be close to zero Fahrenheit. Since the Industrial Revolution in the mid-1800s, we have been enhancing the natural greenhouse effect by burning fossil fuels. It's this additional heat that's known as global warming.

The greenhouse gases – known as "radiatively active" because they absorb or reflect infrared radiation – include water vapor, carbon dioxide, nitrous oxide, methane, chlorofluorocarbons (CFCs), and ozone. Some of these gases last longer in the atmosphere than others, and some absorb more radiation than others, but all can be important in regulating climate. $CO_2$ is especially important because human activities generate so much of it, from so many diverse activities and because these artificial increases in $CO_2$ concentrations persist for so long. In fact, Earth will still be adjusting for decades to come to the $CO_2$ we've already added to the atmosphere.

There is a strikingly close correlation between the amount, or concentration, of $CO_2$ in the atmosphere and estimated global mean temperature throughout Earth's history, with relatively low $CO_2$ concentrations during colder periods and higher concentrations during warmer periods. Because changes in either can reinforce the other, the $CO_2$ concentrations can either lead or lag global temperature.

Naturally driven changes in climate are believed to have raised or lowered $CO_2$ concentrations for millennia, which in turn reinforced the warming or cooling trends. For example, the eccentricity of Earth's orbit varies on a 100,000-year cycle, which is in sync with the onset and retreat of ice ages. As an ice age begins, oceans cool and absorb more $CO_2$, which supports even more cooling and $CO_2$ absorption. As an ice age ends and the oceans warm, they absorb less $CO_2$, allowing more of the greenhouse gas to build up in the atmosphere.

Similar reinforcements, or positive feedbacks, are occurring now. However, in this case, it appears to be human-driven changes in the carbon cycle, rather than orbital changes, that are driving the feedback loop and leading to rise in global temperature and other changes in climate, according to the Intergovernmental Panel on Climate Change (IPCC).

**More information:**
"The Carbon Dioxide Greenhouse Effect." From: The Discovery of Global Warming, by Spencer Weart. The American Institute of Physics - **www.aip.org/history/climate/co2.htm**

IPCC Fourth Assessment Report - Working Group 1: The Physical Science Basis - **www.ipcc.ch/ipccreports/ar4-wg1.htm**

UCAR News Release: Climate Change Inevitable in the 21st Century - **www.ucar.edu/news/releases/2005/change.shtml**

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### *Isn't carbon dioxide a natural part of the atmosphere? If $CO_2$ takes up such a small percentage of the atmosphere, why does it have such a big effect?*

Through most of human history, carbon dioxide made up about 280 out of every million molecules (parts per million) in a given volume of air in Earth's troposphere. This concentration remained quite steady for thousands of years, with some $CO_2$ being added by volcanic processes (plus a relatively small amount breathed out by animals) and some $CO_2$ being absorbed by oceans, plants, and soil. This natural balance was thrown out of sync by the Industrial Revolution. Even though Earth is now absorbing almost half of the $CO_2$ we emit through fossil fuels, the atmospheric concentration continues to rise year after year. It's now close to 390 parts per million and still climbing by around 1.5 to 2.5 ppm per year. Even if we stopped burning all fossil fuels tomorrow, it would take more than 100 years for the $CO_2$ we've already added to the atmosphere to be drawn back out of it by the oceans, vegetation, and soil.

Just as a tiny amount of hot pepper can transform a recipe, a little extra $CO_2$ has a huge effect on our atmosphere. Ninety-nine (99) percent of the atmosphere, including nitrogen and oxygen, doesn't interfere with radiation reflected from Earth back out to space. But greenhouse gases—all of which have three or more atoms—are able to intercept large amounts of that outgoing radiation. As noted in question 2, without $CO_2$, Earth's average temperature would be close to zero Fahrenheit. If we had several times our current concentration of $CO_2$, then temperatures would skyrocket, as they did more than once during prehistoric periods.

**More information:**
"The Carbon Dioxide Greenhouse Effect." From: The Discovery of Global Warming, by Spencer Weart. American Institute of Physics - **www.aip.org/history/climate/co2.htm**

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### *How are weather observations used to predict climate? What else goes into observing climate? Are there errors in the observational data?*

The global observing system was designed to monitor daily weather, not long-term climate, so it has well-known deficiencies that climate researchers carefully account for. For example, weather stations in large cities are excluded from global climate analyses in order to separate the urban heat-island effect from worldwide warming. Surface air temperatures over the ocean are inferred from sea-surface temperature data collected by ship; these readings track closely with the overtopping air temperatures over periods of a few weeks or more. Although some biases in the ship-based readings have recently been found and corrected, these biases were having virtually no effect on the long-term global trend.

Several groups of scientists (at NOAA, NASA, and the University of East Anglia in Britain) have independently developed methods that take data from around the world and average it to calculate trends in global temperature. There are small differences from year to year between these analyses, which means that, for instance, a given year might rank #5 for warmth in one group's analysis and #6 in another. However, the long-term warming trend is clear and consistent across all three analyses.

Above the surface, temperatures in the tropopause are measured by radiosondes as well as satellite-based sounders. Major discrepancies between these data sets have now been largely resolved, and both sets show overall warming since the 1980s, as noted by a National Research Council study, several recent scientific papers, the Intergovernmental Panel on Climate Change, and the U.S. Climate Change Science Program.

**More information:**
Earth Observations from Space: The First 50 Years of Scientific Achievements. Committee on Scientific Accomplishments of Earth Observations from Space, National Research Council. National Academies Press - **www.nap.edu/catalog.php?record_id=11991**

Reconciling Observations of Global Temperature Change. Panel on Reconciling Temperature Observations, Climate Research Committee, Commission on Geosciences, Environment, and Resources, National Research Council. National Academies Press - **www.nap.edu/catalog.php?record_id=9755**

Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences. Thomas R. Karl, Susan J. Hassol, Christopher D. Miller, and William L. Murray, editors, 2006. A Report by the Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC - **www.climatescience.gov/Library/sap/sap1-1/finalreport/default.htm**

GISS Surface Temperature Analysis: NASA Goddard Institute for Space Studies - **http://data.giss.nasa.gov/gistemp/**

National Climatic Data Center Climate Modeling: State of the Climate Reports - **www.ncdc.noaa.gov/oa/climate/research/monitoring.html**

Temperature Data. Climate Research Unit, University of East Anglia - **www.cru.uea.ac.uk/cru/data/temperature/**

## *If we can't predict the weather a week out, why should we believe what climate models say about the next 100 years?*

Weather and climate are not the same thing. Weather and climate models both call on the laws of physics to predict atmospheric phenomena by combining weather observations with mathematical formulas called algorithms. But they have different resolutions and time scales, and climate models add other features, such as solar variation and ocean circulation, that affect long-term climate but not day-to-day weather.

Weather models project day-to-day weather features forward; eventually, small-scale chaotic features grow to dominate the weather model, making it impossible to predict local weather features beyond about 8 to 10 days. In contrast, climate models look at the next century by using what we know about Earth's orbit, the patterns of incoming sunlight and how it is absorbed by gases in the atmosphere, and other large-scale, long-term processes.

The chaotic features that make short-term forecasts impossible beyond a few days aren't an issue with climate models, because they are not focusing on day-to-day weather but instead on the ebb and flow of seasonal, annual, and interannual features. These are driven by the climate variables above, which can be extrapolated for many decades based on what we know about Earth's orbit and how greenhouse gases are increasing.

If it's January 1 in Fairbanks, Alaska, we can't predict the daily high on February 1, because weather patterns are too chaotic to predict a month ahead. However, we can say with confidence that July 1 will be warmer than January 1, because the factors that shape seasonal climate are well known. Similarly, we can say that Fairbanks in July is likely to run warmer in 2050 than it does now, due to the continued growth of greenhouse gases and their effects on global and regional climate.

Climate models have been tested and proven in simulations of 20th-century conditions, which they reproduce quite well. These "hindcasts" have even helped researchers identify anomalies in the observational record, such as overestimates of Northern Hemisphere cooling in the 1940s due to changes in ocean observing methods. The success of the 20th-century simulations strengthens the case for using climate models to project 21$^{st}$-century climate.

**More information:** "General Circulation Models of Climate." From: The Discovery of Global Warming, by Spencer Weart. The American Institute of Physics - **www.aip.org/history/climate/GCM.htm**

## *If global warming is occurring, why was winter 2007-2008 so cold and snowy?*

It wasn't all that cold a winter globally. While it was the coolest since 2000, temperatures were still above normal for the last 30-year period and warmer than any winter on record before 1974.

The relative coolness was likely shaped by La Niña, which tends to lower global temperature by several tenths of a degree Fahrenheit, just as El Niño tends to raise it. The United Kingdom's Met Office predicted in 2007 that 2008 might be cooler than other years this decade, based on La Niña and other existing ocean patterns. The same 10-year prediction suggests that global temperatures will head upwards again, beginning in 2009, with more global records likely in store afterward.

There were several areas of very heavy snowfall in China and North America through the winter of 2007–08, with all-time records set in Madison, Wisconsin, and in Québec City. These areas of heavy snow are also broadly consistent with La Niña, and they may have been accentuated by the global increase in atmospheric moisture associated with climate change.

These events remind us that cold snaps, or even unusually cold seasons, will continue to occur, even on a warming planet. Global warming does not mean it is always warm everywhere, or that temperature is the only change occurring. A changing climate also involves changes in precipitation and a shakeup in what we've come to think of as familiar weather and climate patterns.

**More Information:** National Climatic Data Center. "Climate of 2008: February in Historical Perspective." - **www.ncdc.noaa.gov/oa/climate/research/2008/feb/feb08.html**

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## *Isn't the climate always changing to some degree?*

Earth's history is full of changes in climate in all magnitudes and time scales, but important aspects of the current warming are unusual. Current global temperatures are the highest they have been in at least the past 500 years, and perhaps the warmest in more than a millennium. Current concentrations of $CO_2$ in our atmosphere are higher than at any other time in at least the past 500,000 years.

While past climate changes resulted from natural causes, people have been burning more and more fossil fuels over the last 150 years, and the resulting accumulation of greenhouse gases is increasingly affecting our climate. Most of the warming over the past half-century is attributable to human activities, according to the IPCC.

Another important difference: past climate changes typically unfolded over thousands or millions of years, in stark contrast to the current changes on scales of decades to a century. Thus, the rate of change, and not simply the fact of change, is important. Continued warming at current rates would be extremely unusual in geological terms. There is no scientific evidence that anything comparable to the rate of change projected in global temperature for the next century has occurred over the past 50 million years. That faster rate of change is an important factor in considering potential adaptation options for humans, plants, animals, and other species.

**More information:**
National Climatic Data Center. "A Paleo Perspective on Global Warming" **- www.ncdc.noaa.gov/paleo/globalwarming/home.html**

"Surface Temperature Reconstructions for the Last 2,000 Years." Committee on Surface Temperature Reconstructions for the Last 2,000 Years, National Research Council. National Academies Press. - **www.nap.edu/catalog.php?record_id=11676**

IPCC Fourth Assessment Report: Working Group 1 Report, "The Physical Science Basis" - **www.ipcc.ch/ipccreports/ar4-wg1.htm**

### *Should we really attribute every extreme event (heat wave, heavy snow, hurricane, cold winter weather, etc.) to climate change?*

This problem highlights the nature of attribution. No weather event is completely caused by climate change, but likewise, no weather event can be completely disassociated from the overarching climate. Some events, such as more intense rainfall and warmer winter nights, have strong links to climate change. For some others, such as strong tornadoes, there may be little or no evidence of a connection to climate change thus far. In still other cases, as with hurricanes, there is legitimate debate about the extent of the links to climate change, and research is ongoing.

It's also important to distinguish between different types of weather records. Records are set in many locations every day, but some are more important or more distinctive than others (e.g., record highs for a given date and place are less significant than *all-time* record highs for the same place). When using records as a pointer toward longer-term climate change, it's vital to look at the magnitude and significance of a given record.

**More Information:** National Climatic Data Center. "U.S. Records" - **www.ncdc.noaa.gov/oa/climate/research/records/**

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### *What role does the Sun play in climate change?*

As a massive nuclear fusion reactor a million times larger than Earth, the Sun is responsible for almost all the energy reaching our planet. Prior to the late 1950s, solar variations were the single largest influence on warming, explaining much of the global temperature increase since the start of the century. Over the past 30 years, however, the solar influence appears to be minimal, compared to the continued buildup of greenhouse gases. As noted in the IPCC's 2007 assessment, virtually all scientific studies indicate that anthropogenic forcings[1] (human-produced emissions) have overwhelmed any natural forcings, such as solar radiation.

If the Sun were responsible for the current warming trend, the troposphere and the stratosphere would both be warming. The stratosphere, however, has actually cooled over the past few decades, as predicted by climate scientists. This is because more of the energy moving from the Earth's surface back into space is being held by greenhouse gases in the troposphere, leaving less heat for the stratosphere to absorb.

Some scientists have hypothesized that cosmic rays inhibit cloud formation and thus are at the root of increasing global temperatures. This hypothesis is based in part on the fact that fewer cosmic rays reach Earth when solar activity is high. However, any such connection would not explain the last 30 years of warming, because cosmic rays are not well correlated with global temperature over this period.

For all of these reasons, it is highly unlikely that the Sun is responsible for the observed modern warming since the 1970s.

[1]A climate forcing is anything that can change the climate. Natural forcings include changes in solar output, orbital changes, and emissions from volcanoes. Anthropogenic (or human-produced) forcings include carbon and other greenhouse gas emissions, particulate emissions, and land-cover changes.

**More information:**

Meehl, et al. 2004. Combinations of Natural and Anthropogenic Forcings in Twentieth-Century Climate. Journal of Climate. Volume 17:3721-3727 - **www.cgd.ucar.edu/ccr/publications/meehl_additivity.pdf**

Lean, J. 2004. Solar Irradiance Reconstruction. IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series # 2004-035. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA. - **ftp://ftp.ncdc.noaa.gov/pub/data/paleo/climate_forcing/solar_variability/lean2000_irradiance.txt**

Lockwood and Frohlich. 2007. Recent oppositely directed trends in solar climate forcings and the global mean surface air temperature. Proceedings of the Royal Society - **http://publishing.royalsociety.org/media/proceedings_a/rspa20071880.pdf**

### *What are some positive effects of climate change?*

Some investors make money even during a recession; likewise, some societies and some areas may benefit from climate change. Farming at high northern latitudes, such as in parts of Canada and Russia, could become more productive. An Arctic that is ice-free in summer would allow for new shipping lanes and open the possibility of oil and gas extraction. Deaths from influenza and other cold-weather ailments might go down.

Even though climate change will bring some winners, the net effect is likely to be costly and damaging to our planet and its people. For example, the deaths caused by periodic heat waves, as well as those from the increased range of disease-carrying insects and other factors, are expected to match or outnumber the lives saved through fewer cold-related health problems. Some changes, such as species die-offs, will be irreversible. And some places near or below sea level—including cities such as New Orleans and countries such as the Netherlands and Bangladesh—may be disproportionately hurt by climate change.

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### *Can scientists predict changes on a regional level? What will happen in my part of the country? How accurate are local predictions?*

Regional predictions of climate change are still a challenge. Most global climate models track temperature, precipitation, and several other variables for multiple layers of the atmosphere on a three-dimensional grid with horizontal points separated by roughly 60–120 miles (as opposed to 10-20 miles or less for typical weather models). Several research groups are focusing on improving regional modeling.

Meanwhile, some general conclusions can be drawn from the global models. For example:

- *Drier to the south.* The 2007 IPCC report noted a strengthening consensus among models for decreased precipitation this century across the subtropics, including the southern tier of the contiguous United States. When combined with warmer temperatures, this decrease is expected to have dramatic impacts on water supply, agriculture, wildfire, and drought-sensitive ecosystems.

- *Wetter to the north.* The northern tier of U.S. states could receive more precipitation overall. In higher latitudes and at higher elevations, the length of time with snow cover in winter is expected to drop, with impacts felt in water management as well as skiing, snowmobiling, and other snow-dependent activities. The global and national trends toward rain and snow falling in heavier bursts when it does fall is also expected to continue.

In 2000 the United States released the National Assessment of Climate Change (see link below). Since then, no comparable study of regional U.S. climate change has been published. The U.S. Climate Change Science Program is preparing a unified synthesis report, *Global Climate Change Impacts in the United States,* which will update many of the topics covered in the 2000 assessment. Other CCSP reports also include some regional-scale detail. The IPCC's 2007 assessment from Working Group II includes a summary of recent and future climate-change impacts across North America.

**More information:**
US Climate Change Science Program. Unified Synthesis Product: Global Climate Change in the United States **-** **www.climatescience.gov/Library/sap/usp/**

IPCC Working Group 2: Climate Change Impacts, Adaptation, and Vulnerability. Chapter 14: North America - **www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter14.pdf**

Highlights from the IPCC Working Group II Summary for Policymakers of "Climate Change 2007: Impacts, Adaptation and Vulnerability." **-** **www.ucar.edu/news/features/climatechange/faqs-wg2-spm.jsp**

The Complexity of Climate Modeling: Components of the NCAR-based Community Climate System Model (CCSM) - **www.ucar.edu/news/features/climatechange/ccsm-illus.jsp**

## *What is the Intergovernmental Panel on Climate Change?*

The Intergovernmental Panel on Climate Change (IPCC) emerged following the success of international diplomatic efforts to curb ozone depletion. Scientific discoveries in the mid-1980s quickly led to the Montreal Protocol, the global agreement that banned several ozone-depleting chemicals. The agreement showed that the United States and other nations worldwide were capable of responding together to meet an emerging global environmental threat.

In 1988, The World Meteorological Organization (WMO) and the United Nations Environmental Programme (UNEP) established the IPCC. It assesses available knowledge on climate change, including the physical science, environmental and societal impacts, and options for mitigation and adaptation. The IPCC also serves as a source of information guiding the U.N.'s Framework Convention on Climate Change. The U.N. framework has been signed by 192 nations, including the United States, in Rio de Janeiro in 1992. The Kyoto Protocol was the first effort to implement the framework. Another global agreement is slated for discussion in December 2009.

IPCC participants include researchers and government representatives. The IPCC does not conduct its own research; instead, it enlists hundreds of scientists around the world to review thousands of studies and synthesize the most important findings. This lengthy process includes meetings among the expert authors on each topic to reach scientific consensus on which findings can be reported with confidence. Each resulting report chapter is then given a peer review by yet more topic experts who were not involved in writing the chapter.

The resulting IPCC assessment reports have been issued in 1990, 1996, 2001, and 2007. The assessments are also reviewed by additional scientists on behalf of governments around the world and then formally accepted by those governments. The diplomats themselves review the brief Summaries for Policymakers that accompany each major section of the final report. It's important to note that the diplomats have a say in *how* each Summary for Policymakers is worded, but the scientists have the last word on *what* is said.

The number of scientists involved, the extensive review process, and the participation of nearly all governments around the world means that IPCC findings carry great weight as benchmark statements of the state of climate science.
Because so many scientists and governments are involved, IPCC conclusions are often quite conservative, focusing on the most solidly accepted aspects of climate research. For example, the 2007 IPCC report estimates that global average sea level will rise by 7.2–23.6 inches (18–59 cm) by 2100 compared to the 1980-1999 average. In settling on this range, the IPCC excluded the contribution from dynamic melting of the Greenland and Antarctic ice sheets because this added effect cannot yet be accurately projected, even though many scientists believe it could be substantial.

**More Information:**
IPCC Assessment reports - **www.ipcc.ch**

Principles Governing IPCC Work - **www.ipcc.ch/pdf/ipcc-principles/ipcc-principles.pdf**

United Nations Framework Convention on Climate Change - **http://unfccc.int/2860.php**

## *How did the IPCC form a consensus that evidence of global warming is "unequivocal?"*

Each IPCC report explains the basis of its conclusions in great detail. For example, the 2007 statement that "warming of the climate system is unequivocal" is explained on page x of the Summary for Policymakers from Working Group I and in further detail in the full report on page 5.The full statement is: "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." The supporting observations (of which there are many) include global temperature trends at the surface and aloft, increased atmospheric water vapor, declines in mountain glaciers and snow cover in both hemispheres, and documented increases in ocean temperature since the 1960s to depths of at least 10,000 feet.

**More Information:**
IPCC Assessment reports - **www.ipcc.ch**

Principles Governing IPCC Work - **www.ipcc.ch/pdf/ipcc-principles/ipcc-principles.pdf**

United Nations Framework Convention on Climate Change - **http://unfccc.int/2860.php**

### *How can I help my audiences understand climate change issues?*

Among climate and meteorology professionals, it may be so obvious as to sometimes be taken for granted, but it's important to communicate that climate science and meteorology are in fact separate and distinct disciplines. Here's an everyday analogy: Climate informs us on what wardrobe to buy, weather on what clothes to wear on a particular day.

Short-term weather events likely have little or no direct bearing on long-term climate trends, which becomes more clear at larger time and space scales. One way to convey this distinction would be to take a few seconds at the start of each month to report the previous month's climate trends (departures in monthly temperature and precipitation). Many U.S. cities have experienced a year or more of above-average monthly readings despite the passage of cold fronts and warm fronts. This would help convey to viewers that climate evolves even as day-to-day weather trends come and go.

Staying abreast of new research via one's professional organizations and widely respected scientific sources on climate change also can be key. Following are a few links to agencies and professional organizations respected for their scientific expertise on climate change issues:

Intergovernmental Panel on Climate Change (IPCC) **– www.ipcc.ch**

IPCC responses to "Frequently Asked Questions" **–**
**http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_FAQs.pdf**

American Meteorological Society Statement on Climate Change -
**http://ametsoc.org/policy/2007climatechange.html**

Home page of the National Academy of Sciences, with links to climate change publications and reports -
**http://nas.edu/**

American Geophysical Union Statement on Climate Change - **http://agu.org/**

"Understanding Climate Change: From Global Warming to Regional Effects." University Corporation for Atmospheric Research (UCAR) - **www.ucar.edu/news/features/climatechange/**