GLOBAL WARMING

By Frank Cardulla

Global warming is a complex topic, and one filled with emotional and political ramifications. All said, it’s the environmental hot topic of the ‘00s. On one side is a virtual army of scientists and citizens concerned about the environment, arguing that human activities over the past couple of centuries are pushing our environment toward a somewhat unpredictable and potentially devastating series of consequences. Opposing this view is a smaller, equally vocal group of scientists who may doubt that global warming is real, or question the extent to which it is caused by human activities, or may disagree with the dire predictions made by environmentalists.

The vast ecosystem

It’s difficult to envision the dimensions of the ecosystem called Earth, the magnitude of its oceans, the seemingly endless area of its land. Can the activities of man really affect something so vast? Evidence is mounting that the answer is “Yes.”

Literally hundreds of distinct observations provide evidence that global warming is real. Many plants and animals are shifting their ranges toward the earth’s poles and to higher altitudes, where average temperatures are cooler. Glaciers are melting and oceans are rising. And in the northern polar region, Arctic permafrost is melting, gradually increasing the depth at which the soil stays frozen year-round.

Over the past century, climate records confirm an average global surface temperature increase of about 1˚C, with more than half of that increase occurring within the past 25 years. Ocean temperatures also appear to be rising, as the seawater acts to absorb much of the heat that might otherwise be trapped in the atmosphere.

A milestone report issued by the United Nations-sponsored Intergovernmental Panel on Climate Change (IPCC) concluded that the trend toward a warmer world is under way and has been for some time, a view largely supported by a National Research Council report of June 2001. A change of one degree doesn’t sound impressive. Skeptics even argue that this small change may just represent a normal fluctuation in earth’s average temperature. A few scientists even argue that the temperature change is simply due to changes in the sun’s output. Perhaps changes in the sun’s magnetic field have altered the amount of cosmic radiation reaching the earth, which in turn affects cloud formation, which in turn affects the average temperature on earth.

Despite the continuing debate, the emerging consensus is that global warming is real and that human activities are the primary cause. It’s almost impossible to sense global warming on a personal or local level. Global warming, by definition, is global. The fact that you may have sweltered this past summer or froze this past winter doesn’t mean much on a global scale.

If there is mounting evidence that the world is getting warmer, what might be causing it?

Greenhouse gases work in a similar manner. Certain atmospheric gases such as carbon dioxide, water vapor, methane, tropospheric ozone, chlorofluorocarbons, as well as soot (carbon) particles are known to be particularly good at trapping heat energy. Sunlight passes through the atmosphere and warms the earth. Greenhouse gases absorb, then re-emit some...
of this energy, but at longer wavelengths, in the infrared region of the electromagnetic spectrum. Without greenhouse gases in the atmosphere, this radiation would simply escape back into space. But re-emitting some of it back to earth produces a warming effect.

The greenhouse effect isn’t “bad.” Just the opposite is true. Without it, earth would have an average temperature of about –18 °C. Life as we know it would simply not exist. A delicate balance exists between the amount of energy reaching the earth from the sun and the amount escaping back into space. A look at our neighboring planets confirms our good luck. Venus has too much of a greenhouse effect; Mars, almost none.

Now this balance is endangered. Since the start of the Industrial Revolution, roughly 200 years ago, human activities, especially the burning of fossil fuels (coal, oil, and natural gas) have released enormous amounts of carbon dioxide into the atmosphere. For every burned gallon of gas, the atmosphere gained 21 pounds of CO₂! It’s estimated that today’s atmospheric concentration of CO₂ is 30% greater than preindustrial levels. In addition to fuel burning, other human activities, like planting rice and raising herds of cattle, have contributed methane, another greenhouse gas.

The majority of scientists accept the ample evidence that the average temperature on earth is rising. With evidence that the concentration of greenhouse gases has also increased in the atmosphere over the past two centuries, the connection seems obvious. Most scientists agree that the greenhouse effect explains the warming temperatures.

Wouldn’t a warmer earth be a good thing?

A reasonable question is “So what?” What’s so bad about a slightly warmer earth? If you live in Northern Minnesota, and you happen to be reading this in January, global warming probably sounds pretty appealing. Let’s look at some of the global consequences. This is where we enter the realm of speculation. Guessing is easy. Scientific prediction? That’s a bit more complex.

Scientists turn to a variety of computer models to predict the probable effects of various increases in earth’s temperature. Computer models are certainly not infallible. They must be constantly revised, and they are only as good as the data on which they are based. Because of the technical challenges involved in constructing these models, some argue that they should play no role in making important decisions. But should a degree of uncertainty be our excuse for doing nothing?

The question is complex, and the actions that we take or do not take are likely to have significant effects on our future lives and the lives of our children.

IPCC scientists fed a number of different estimates of population growth, technological changes, and economic growth into computer programs. First they estimated the annual amount of excess carbon dioxide that might be seeped into the atmosphere over the next century. Their estimates ranged from 6 billion to 35 billion tons. Using these estimates, they ran seven different computer models to predict the resulting temperature increase by the year 2100. Their estimates, posted on their Web site in April 2001, ranged from an average global temperature increase of 1.4 to 5.8 °C. New data and refinements in climate models have resulted in these estimates being about 50% greater than these posted only five years ago.

The behavior of ordinary clouds is particularly difficult to factor into climate change computer models. Cloud origins as a result of evaporation patterns and cloud impacts on surface temperatures are among the research goals of scientists planning NASA’s EOS Aura mission. EOS, an acronym for Earth Observing System, includes a series of satellite missions for providing data on the functioning of earth as a system—and, particularly, how humans affect that system. EOS Aura will study the atmosphere, including greenhouse gases such as methane, tropospheric ozone, and aerosols. The specific effects of global temperature increases are difficult to predict. Some areas of the world might benefit from a moderate amount of warming. Growing seasons in parts of the United States and Canada could lengthen. But crops yields in regions closer to the equator could be drastically reduced. If temperature increases are at the higher ends of the prediction scale, widespread catastrophic droughts might occur. Developing nations, many of which can least afford any disruption to their food supply, may be the most severely affected.

Perhaps 35% of earth’s natural habitat could be fundamentally altered. Although populations of plants and animals are genetically adaptable, natural processes of adaptation and selection take generations. Many species might not adjust to climate changes in time. Already, in the Arctic regions, thinner, later forming Hudson Bay ice is affecting polar bears dependent on ice slabs for hunting seals. The migration routes of the caribou have changed, and grizzly bears, insects, and birds are now found in areas north of their traditional ranges.

Predicting our global future is inexact, frustrating, and complex, but too much is at stake to abandon the effort. NASA’s EOS Aura mission will collect critical data to increase our understanding of the phenomenon of global warming. With this understanding, it will be the responsibility of all of us to decide on a course of action to ensure that earthly life not only survives, but prospers.
Recommended Links on the Web

Ozone
Asthma
Global Warming

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RECOMMENDED LINKS ON THE WEB

Note: These were recommended, active links in August 2001. With the passage of time, many will no longer be accessible, and in others, the content may change. ChemMatters cannot guarantee that all content will remain appropriate and/or relevant.

The number of online resources related to the topics in this special issue of ChemMatters is nearly as vast as the subject matter itself. This Teacher’s Guide will put you in touch with some of the best of them by providing annotated URL links to a wide variety of Websites that are directly or peripherally related to each of the articles appearing in the issue. Teachers interested in obtaining additional or more detailed information on any particular issue or topic should be able to connect directly to the Site by clicking on the listed URL.

A few things should be kept in mind if you choose to visit these sites.

Although we have made every effort to insure that the listed URLs are complete and accurate, sites sometimes change their URL or go “out of business.” Since the Teacher’s Guide material must be prepared well in advance of its on-line posting, it is possible that some of the listed Websites are no longer available or at least not available at the listed URL.

Our goal is to provide a variety of valuable information and support for teachers. Some Websites will simply provide general scientific information relating to the topic, others a much more detailed and thorough discussion of some content addressed in the article.

Since topics such as ozone depletion, global warming and pollution are complex and often controversial, an effort will be made to provide “balance” by providing links for both sides of an issue, even when a prevailing opinion is acknowledged in the article. Neither ACS nor the staff of ChemMatters can be responsible for the accuracy of the information contained in any individual Website. Indeed, that information can change from the time the URL is listed to the time the Teacher’s Guide is posted for use. At the very heart of the scientific enterprise is a lack of dogmatic assertion and an openness to all information. As is true for any information available on the Web, the teacher must assess and evaluate all information and arguments presented.
Frequently Asked Questions about Stratospheric Ozone Depletion

This is a site from the U.S. Global Change Research Information Office. It is a good source for a lot of general and specific questions that teachers may have or students may ask. Some of the questions answered are:

- How do we balance the good and bad effects of sunlight on human health?
- How strong is the evidence that UV-B radiation causes skin cancer in humans?
- Should one have all moles removed to decrease the risk of skin cancer?
- Do sunglasses protect against cataracts?
- Is the UV amount one receives as a child important even in later years?
- Are hair-covered animals at any risk?
- Will penguins be affected by the ozone hole?
- Is UV-B radiation a factor in the decline of frogs and other amphibians?
- Does water effectively shield aquatic organisms from UV exposure?
- What will be the effects of an increased UV-B radiation on crop and forest yields?
- Can plants protect themselves against UV-B?
- In the increase in UV-B radiation caused by ozone depletion equivalent to that incurred by moving several hundred kilometers towards the equator?
- Can organisms adjust to a changed UV environment?
- Does ozone depletion pose any danger in the tropics?
- Do we need to worry about relatively small increases in UV-B due to ozone depletion, when natural variability is so much larger?
- Does one get higher UV exposures at higher elevations?
- Does air pollution protect one from UV-B radiation?
- Can changes in cloudiness cause larger UV changes than ozone depletion?
- Are the risks of ultraviolet exposure at the beach less on a cloudy day?
- Will sunscreens protect one from harmful effects of increased UV-B radiation?
- Will getting a suntan help prevent skin cancer?
- In tanning with UV lamps safer than with sunlight?
- Has the benefit of the Montreal Protocol been worth the cost?

http://www.gcrio.org/ozone/ozoneFAQs.html

Stratospheric Ozone Depletion: Implementation Issues

This site is a link from the Federation of American Scientists. They describe themselves as a privately-funded non-profit policy organization whose Board of Sponsors includes 51 Nobel laureates in the sciences. Their Website states that the Federation "conducts
analysis and advocacy on science, technology and public policy, including national security, nuclear weapons, arms sales, biological hazards, secrecy, and space policy. General information about this organization can be found at:

http://www.fas.org/about.htm

The site itself is fairly extensive, (13 pages), and although somewhat dated, having been posted in Dec., 1996, it does contain a lot of information relating to the historical development of our recognition of the problem of a depleting ozone layer, the role that CFCs are thought to play in the depletion of the ozone layer, some possible alternative mechanics, some environmental effects thought to be connected to stratospheric ozone depletion and some of the regulatory and political activities connected to the problem.

http://www.fas.org/spp/civil/crs/97-003.htm

**Stratospheric ozone levels for Canada and the World, 1957-98**

This site provides both data and a graph of the above. The site comes from what is called the Indicators and Assessment Office of Canada. It is a governmental project that has been in operation for over ten years and whose goal is to gather statistics or parameters that, tracked over time, provide information on trends in the condition of a phenomenon (like ozone depletion) that has a significance extending beyond that associated with the properties of the statistics themselves. The complete site also deals with other environmental issues in addition to ozone depletion.

http://www.ec.gc.ca/Ind/English/Ozone/Tech_Sup/stsup4_e.cfm

**Stratospheric Ozone Depletion: Celebrating Too Soon**

This site is a link from the World Resources Institute. They describe their goals as (1) Reverse the rapid degradation of ecosystems, assuring their capacity to provide the goods and services on which human well being depends, (2) Halt the changes to the Earth’s climate caused by human activity, (3) Catalyze the adoption of policies and practices that expand prosperity while reducing the use of materials and generation of wastes, and (4) Guarantee people’s access to information and decisions regarding natural resources and environment. This site contains a lot of information in regard to the “black market” that exists for banned CFCs as well as data about the level of production of CFCs in developing nations such as Brazil, India, Mexico and China.

http://www.wri.org/trends/ozone1.html

**The National Oceanic and Atmospheric Administration**

NOAA is a federal agency whose mission is “to describe and predict changes in the Earth’s environment, and conserve and wisely manage the Nation’s coastal and marine resources.” It deals with a wide range of environmental, atmospheric and oceanic issues.

The URL for the general site is:

http://www.cmdl.noaa.gov/

If you go to this general site, you can link to a large number of sites that deal with various aspects of the depletion of the ozone layer. One nice link for general information related to the Antarctic Ozone Hole can be found at:
Another linked site that relates to stratospheric ozone depletion (Antarctic, Arctic, and global) is:

http://www.al.noaa.gov/WWWHD/pubdocs/StratO3.html

For some information relating to depletion of ozone over the Arctic region

This site, which comes from the BBC news service, contains an opinion of one of three British scientists who discovered the Arctic ozone hole, that Arctic ozone damage is “likely by 2020.”

http://news.bbc.co.uk/hi/English/sci/tech/newsid_990000/990391.stm

For an article from Natural Science dealing with Stratospheric Ozone Depletion 10 Years after Montreal

http://naturalscience.com/ns/cover/cover4.html

The following site is from the National Council for Science and the Environment, in Washington, DC. It contains a rather lengthy (13 pages) discussion of CFC production and use as well as a number of political actions that were directed at ameliorating the problem of the destruction of the ozone layer:

http://www.cnie.org/nle/strat-5.html

An outstanding source of information relating to all aspects of the environment

This is the general Web site of the NASA Earth Observatory. It has dozens upon dozens of links to a large number and wide range of connected sites that deal with a wide variety of environmental topics. The best way to use this site is to go to the general site and then link to whatever is your current area of interest. Navigation around the site is very easy as is finding links that deal with any particular topic. The URL for the general site is:

http://earthobservatory.nasa.gov/

For information relating specifically to ozone, both “good” and “bad,” go to:

http://earthobservatory.nasa.gov:81/Library/Ozone

The site above is titled “Ozone: What is it, and why do we care about it?,” but at the end of the site there is a link to a site entitled “Ozone Balance in the Stratosphere,” which in turn links to a site titled “Ozone Depletion,” which then links to “Monitoring Ozone from Space.”

Information relating to the health effects of increased UV-B exposure

This site is from the Center for International Earth Science Information Network at Columbia University.

http://www.ciesin.org/TG/HH/ozover.html

Contrary views regarding the “Ozone” problem
One of the most strident objectors to most of the “mainstream” views regarding environmental issues such as global warming or ozone depletion is Dr. S. Fred Singer. Dr. Singer has impressive scientific credentials. He currently heads the Science & Environmental Policy Project, which expresses opinions that are often in sharp contrast to “mainstream” views regarding ozone depletion, its probable causes, and the expected consequences.

Dr. Singer claims expertise on “Global climate change and the greenhouse effect, depletion of the stratospheric ozone layer, acid rain, air pollution, importance and future of the U. S. Space program, energy resources and U. S. energy policy.” His academic and professional credentials and background can be found at:

http://www.sepp.org/bios/singer/biosfs.html

The URL for the general WebSite that deals with environmental issues is:

http://www.sepp.org/

For a discussion of several “key issues,” including ozone depletion:

http://www.sepp.org/keyissue.html

For a reply Dr. Singer made to a an article in Nature:

http://naturalscience.com/ns/letters/ns_let09.html

ASTHMA

The Asthma and Allergy Foundation of America can provide a general site from which you can link to a large number of related sites using their search function. The URL for the general site is:

http://www.aafa.org/

There is a specific linked site that deals with a number of topics related to asthma, and answers a number of common questions. Some specific questions answered at this site include:

What do I need to know about air pollution?
How can air pollution affect my asthma?
Are there special programs for monitoring air pollution?
Should I be concerned about air pollution in my work environment?
Should I be concerned about air pollution in my home?

http://www.aafa.org/asthmaandallergyinformation/aboutasthmaandallergies/asthmaandallergyanswers/air_pollution.cfm

Another linked site that deals with the question of why the incidence of asthma is on the rise is:

http://www.aafa.org/asthmaandallergyinformation/aboutasthmaandallergies/articlesofinterest/why_is.cfm

The “Frequently Asked Questions” link from the Asthma and Allergy Foundation of America can provide answers to many common questions regarding this disease, including:
What is asthma?
Who is at risk of developing asthma?
What causes asthma attacks?
Can a child outgrow asthma?
Can asthma reappear in adults after disappearing years ago?
Can people die from asthma?
Is it possible to build up a tolerance to asthma and allergy medications taken regularly?
What is exercised-induced asthma?
Can I exercise if I have asthma?

The URL for this specific site is:

http://www.aafa.org/asthmaandallergyinformation/aboutasthmaandallergies/faq

A publication called “Doctor’s Guide” has an article entitled “Air Pollution Directly Linked to Asthma in Children.” It can be found at:

http://www.pslgroup.com/dg/ebe92.htm

Another site that comes from the British Dept. of Health Committee on the Medical Aspect of Air Pollutants can provide a number of relevant facts relating to the incidence of asthma and causes, including air pollution. It is found at:

http://www.doh.gov.uk/comeap/airpol2.htm

The publication Science Daily has an article entitled “Air Pollution Hits Children With Asthma Hardest, USC Study Finds.” It can be found at:


A publication called Pulmonology World has a small piece about the relationship of various air pollutants such as nitrogen dioxide, sulfur dioxide and ozone and the incidence of asthma in French children. It is located at:

http://www.pulmonologychannel.com/PulmonologyWorld/12262000_role.shtml

the GlaxoSmithKline pharmaceutical company maintains a WebSite with links to a significant amount of information regarding asthma. Some relevant ones are:

Asthma Statistics: Statistics related to the incidence and consequences of asthma:

http://www.asthmainamerica.com/statistics.htm

and for a related site with links to statistics from several individual cities and states, go to:

http://www.asthmainamerica.com/mm_toc.htm

GLOBAL WARMING

Although there are numerous sites related to global warming that more or less present “factual” data related to things such as global temperatures, carbon dioxide levels in the atmosphere, carbon dioxide emission data, etc., many sites connected to the topic of global warming express a definite and sometimes strong opinion regarding the extent of the problem and its possible
consequences. To the extent possible, the general “bias” of a site will be stated, but each person visiting a site must of necessity read enough to ascertain the viewpoint of the individuals or organizations posting the information and to what extent they want to accept both the information posted and the opinions expressed.

There is a site maintained by the Green House Network. The Green House Network describes itself as a Portland, Oregon-based non-profit organization dedicated to “public education about the economics, politics and peer-reviewed science of global warming”. They maintain a National Volunteer Network of speakers in more than twenty states that are available without charge. Their URL is:

http://www.greenhousenet.org/

The Green House Network has a link to FAQs. Some of the questions answered include:

- What’s the difference between global warming and the greenhouse effect?
- What is causing global warming?
- Is global warming already evident, or is it something that will happen in the future?
- How do we know that recent warming is caused by human activity, rather than part of the natural variability of the climate?
- But don’t scientists disagree on this?
- If the planet is warming, why was it so cold this summer?
- What is the best source of scientific information on global warming?
- How much warming is the earth likely to become?
- Would a temperature increase of a couple degrees really change global climate?
- Are there any benefits to global warming?
- Is global warming connected to the hole in the ozone layer?
- Are there things we do to deal with warming that worsen the problem?
- What can we do about global warming?
- But won’t cutting greenhouse gas emissions destroy the US economy?
- But won’t cutting greenhouse emissions reduce the US standard of living?
- Can we really hope to solve a problem of this magnitude?

The URL for answers to the above questions is:

http://www.greenhousenet.org/resources/faqsglobalwarming.html

For a site presenting data relating to actual carbon dioxide emissions from 1990-1997, as well, as links to supplemental and related data on methane emissions, nitrous oxide emissions, halocarbons and other gases:

http://www.eia.doe.gov/oiaf/1605/gg98rpt/carbon.html

And another related site:

http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html
The site above is actually a link from the Energy Information Administration of the Dept. of Energy, whose general site (from which there are links to a great number of environmental topics) is:

http://www.eia.doe.gov/

Another site that deals with the extent of carbon dioxide emissions is:

http://www.epa.gov/globalwarming/emissions/national/co2.html

A very extensive site (15 pages) containing data on U.S. and global emissions of several greenhouse gases:

http://www.eia.doe.gov/oiaf/1605/gg97rpt/chap1.html

There is a site that argues that the IPCC carbon dioxide predictions are erroneous.


For a “contrary” view on the issue of global warming and its possible consequences:

One of the most strident objectors to most of the “mainstream” views regarding environmental issues such as global warming or ozone depletion is Dr. S. Fred Singer. Dr. Singer has impressive scientific credentials. He currently heads the Science & Environmental Policy Project, which expresses opinions that are often in sharp contrast to “mainstream” views regarding global warming, its probable causes, and the expected consequences.

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http://www.sepp.org/bios/singer/biosfs.html

The URL for the general WebSite that deals with environmental issues is:

http://www.sepp.org/

For a discussion of several “key issues,” including global warming:

http://www.sepp.org/keyissue.html

For a specific article by Dr. Singer entitled “Trick or Treaty: An Energy Tax in Disguise”, go to:

http://www.independent.org/tii/content/op_ed/o_singer-wt.html

An advocacy group with a strong environmental bias is the Union of Concerned Scientists. They describe their mission in the following words.

“Our vision points the way to a cleaner environment and safer world. Our five programs are the pressure points translating vision into action. Through them, we connect the best scientific
insights with the knowledge and support of an astute citizenry and apply them to the machinery of government at all levels--with results that have set a standard for effective advocacy for decades.”

They often post information which stands in opposition to many of the opinions expressed by individuals with opinions more in line with those expressed by S. Fred Singer.

The general URL for the Union of Concerned Scientists is:

http://www.ucsusa.org/

There is a link to what is described as a seven page “fact sheet.” It deals with the report of the Intergovernmental Panel on Climate Change, the Kyoto Protocol and several other topics related to global warming.

http://www.ucsusa.org/environment/gw.policy.html

The article mentions Dr. James Hansen of the Goddard Institute for Space Studies in New York. Dr. Hansen has expressed the opinion that global warming may not, in fact, be primarily caused by carbon dioxide emissions, but may instead be more closely related to other atmospheric pollutants.

As might be expected, Dr. Hansen’s view, which was published in a National Academy of Sciences paper (August 29, 2000), raised a storm of controversy. Many groups and individuals opposed to the “mainstream” view that global warming is a problem and is caused by human activities jumped on his paper as evidence in support of their positions.

Dr. Hansen feels that the opinions he expressed in his paper have been widely misrepresented, especially in the popular media. He subsequently drafted an “open letter” to try and clarify his actually viewpoints. His clarification can be found at:

http://www.ems.org/climate/zz.ems.00.11.20.html

A brief biographical sketch of Dr. Hansen can be found at:

http://www.ldeo.columbia.edu/dees/faculty/hansen.html

There are a number of additional links connected to the Union of Concerned Scientists that might be of interest. One include a number of FAQs, including

- What does the greenhouse effect have to do with global warming?
- What is causing global warming?
- What is the best source of scientific information on global warming?
- How much warmer is the earth likely to become?
- Would a temperature increase of a couple degrees really change global climate?
- Is global warming connected to a hole in the ozone layer?
- What can we do about global warming?

The URL for this site is:

http://www.ucsusa.org/environment/gw.faq.html
Another is described as a “fact sheet” connected to global warming.

http://www.ucsusa.org/environment/gw.science.html

And another on the General Impacts of Global Warming

http://www.ucsusa.org/environment/gw.impacts.html

And one devoted to “Myths about Global Warming:”

http://www.ucsusa.org/environment/gw.myths.html

If you care to read a brief expression of what might be termed a typical corporate position on the issue of global warming, you can go to:


There is a WebSite from the Washington Post that contains links to a large number of articles related to global warming. The general URL from which links can be assessed is:


Some articles that can be accessed by linking from this site include:

- Global Warming and a Toad Species’ Decline
- U.S. Rebuffs Europeans Urging Change of Mind on Kyoto Treaty
- “Greenhouse Gases” Curbs Revised
- The Warming Debate
- U.N. Report Forecasts Crises Brought on by Global Warming
- U.S. Had Unusually Warm Year, NOAA Says
- Firms Become “Green” Advocates
- The Next Round on Warming
- Sun Studies May Shed Light on Global Warming
- Historical Records Provide a Growing Sense of Global Warmth
- U.S. Seeking a Way Around Greenhouse Reduction Rules
- Waters Near Equator Show “Alarming” Warming Trend
- Drastic Climate Changes Forecast
- A Global Warming Affirmation
- Ocean Temperature Rise May Mean Warmer times Ahead
- Unraveling Two Riddles of Global Warming
- U.S. may Be Entering New Weather Era
- Global Warming is “Real,” Report Finds
- Study: Arctic Sea ice is Rapidly Dwindling
- Global Warming Estimates Rise Slightly
• Frog Decline Linked to Climate Shift
• Hot Year was Killer for Coral
• Global Warming Gets a 2nd Look

The article also mentions that there are some who think that electromagnetic changes in the sun may be at least in part responsible for global warming. A site that discusses this view can be found at: (Note: You will need to “copy-paste” the following URL into your browser.)


An article from the Earth Observatory dealing with the possible effects of climate change on human health can be found at:

http://earthobservatory.nasa.gov/Newsroom/MediaAlerts/2001/200104024618.html

A link to an article discussing how the melting arctic permafrost may actually accelerate global warming:

http://ens.lycos.com/ens/feb2001/2001L-02-07-06.html

Another source for links to a large number of sites related to global warming is:

http://www.brightsurf.com/e_global_warming.html

Some of the links connected to this site include:

• Intergovernmental Panel on Climate Change--technical papers and working group information from the United States Environment Program

• EPA Global Warming Site—with information on climate, emissions, uncertainties and EPA reports

• Global Climate Coalition—organization of trade associations established in 1989 to coordinate business participation in the international policy debate on the issue of global climate change and global warming.

• globalchange.gov—federal multi-agency site for Global Change-related data, policy, research, and news.

• Greening Earth Society

• NOAA: Greenhouse Warming—information from the National Oceanic & Atmospheric Administration

• U.S. Global Change Research Information Office (GCRIO)—serves as an information resource service for access to information and data concerning the prevention, mitigation, and adaptation to the effects of global change.

• WWF Climate Change Campaign—dedicated to raising public concern about the need to cut emissions, pressing policymakers to introduce effective measures, and forming innovative partnerships with progressive businesses.
• Center for the Study of Carbon Dioxide and Global Change-uses data such as world and U.S. temperatures, and plant growth data, to produce position papers that find no correlation between increased carbon dioxide emissions and global warming.

• Climate Justice on Corporate Watch-argues that global companies play a role in local pollution and global warming, and that social justice is central to any solution to climate change. Site has news, background information, and more.

• Global Warming: Focus on the Future-interactive explanations of the phenomenon; from EnviroLink

• Greenpeace: Climate Crisis-impact, solutions, politics, and effects on Arctic and Antarctic.

• Are People Really Causing Climate Change?-from Sovereignty International.

• Climate Change-a special feature from the Washington Post

• Global Climate Change and Human Health-a position paper of The American Council on Science and Health. Complete text available for download.

• National Geographic: Riddles of a Changing Climate

• Union of Concerned Scientists: Global Warming-discussing the causes, impacts, and future of global warming issues.

• Warnings from the Ice-explore how Antarctica's ice has preserved the past going back hundreds of thousands of years, and then see how the world's coastlines would recede if some or all of this ice were to melt.

• Shrinking Polar Bears-a look at how global warming, shrinking the arctic ice cap, has drastically affected the chances of survival of polar bears.

One of the sites mentioned as a possible link above is the Greening Earth Society. Although its name may suggest a pro-environmental group, their Web Site describes their mission as follows: "Greening Earth Society promotes the optimistic scientific view that carbon dioxide is beneficial to humankind and all of nature. We provide resources for those seeking sound information on the interdependent relationship between industrial growth, carbon dioxide and the future well-being of our planet."

The site contains links to a number of articles offering views and opinions in contrast to what might be called the "mainstream" view (as offered by the IPCC) that global warming is a potentially serious problem and is primarily caused by carbon dioxide emissions. It is a site that you might want to visit to read opposing points of view. The URL is:

http://www.greeningearthsociety.org/

Another Site called the Global Climate Coalition is an organization of trade associations established in 1989 to coordinate business participation in the international policy debate on the issue of climate change and global warming. Its URL is:

http://www.globalclimate.org/

An interesting article entitled, “The Rise and Fall of the Global Climate Coalition” can be found at: