Chapter 1

A Science Story on an Environmental Reporter's Beat

What Is Climate? What Is Weather?

Almost everyone talks about weather and climate, without thinking too much about them: "The weather today will be warmer with a chance of showers ... The climate in Arizona is dry." No big deal, right?

The difference is important to anyone writing about climate change, because the two start to blend together if they are not clearly distinguished. Climate is a complex system involving the sun, oceans, atmosphere, land surfaces, ice, and plant and animal life. Both natural forces and human changes can influence the behavior of this system. Climate and weather are affected by the same things: heat or cold, sun or clouds, rain or drought, snow and ice, wind or calm. Weather is what changes from hour to hour, day to day, or month to month. Climate might be termed "average weather" — how it tends to be in a certain place over the long term — although this is a simplification, too.

We are used to thinking of weather as what changes, and climate as what doesn't, at least not from year to year or decade to decade.

There are problems with that definition. Climate changes, too, but usually on much longer time scales. Weather forecasters often define climate by computing "average" temperatures over a 30-year timespan. The very dailiness of journalism and politics works against long-term thinking. In the U.S. House of Representatives, the world ends every two years; on a daily newspaper every 24 hours.

In May and June 1988, there was a heat wave along America's eastern seaboard. The Senate Committee on Energy and Natural Resources was holding hearings on global warming. NASA scientist James Hansen announced to the committee that he was "99 percent sure" that global warming had arrived. The *Washington Post* and *New York Times* reported it "straight." Whether or not Hansen was right, the headlines kicked off a media frenzy that lasted through the summer and into the fall, subsiding only with the first frost.

Weather — especially extreme or unusual weather — is often a page one story for many daily newspapers and TV news operations. Floods, droughts, wind storms, cold snaps, and heat waves generate not only conversation but ink.

Was that hot summer of 1988 "weather" or "climate*"? Reporting on*

Climate Change may not finally answer that question, but this guide is intended to help sharpen the ways in which reporters ask it.

Why Might Human-induced Climate Change Pose Concerns?

Climate change, during the whole human past, has forced fundamental changes in how people live. It has influenced the beginnings and ends of cultures and civilizations. Global cooling — what we know as "ice ages" — has occurred as regularly as global warming, bringing large-scale benefit and harm to humans and other species. During the mid-1970s, many leading climate scientists were warning of the onset of another ice age and urging the government to take action to avert disaster.

Climate usually changes slowly under "natural" conditions. It took thousands of years for Earth to warm up after the last ice age and it did so with uneven, unpredictable results from region to region. It took decades for Earth to warm up after the "Little Ice Age" (about 1700-1850). The problem, many scientists fear, is that human-induced global warming may occur much faster than natural climate change. It may be especially hard for humans and ecosystems to adapt to the "shock."

Increases in the concentration of greenhouse gases, most scientists of the authoritative Intergovernmental Panel on Climate Change (see p. viii) agree, "will tend to warm the lower atmosphere and surface ... Any change in the radiative balance of Earth, including those resulting from an increase in greenhouse gases or in aerosols, will tend to alter atmospheric and oceanic temperatures and the associated circulation and weather patterns."

Climate and weather affect crops and natural vegetation, and their changes can bring abundance or hunger on regional scales. World food reserves are not large, world distribution systems are far from perfect, and agriculture changes slowly. Food supplies might well be among the first things affected by human-induced climate change. Although there are natural causes for the droughts in sub-Saharan Africa, human activity like overgrazing and devegetation have sped the effects of climate change there. Starving villagers shown on television are an example of what climate change could bring in some parts of the world. But it also could increase food production in other places.

Sea level rise is another likely outcome of human-induced climate change. The sea rose hundreds of feet at the end of the last ice age. Some coastal cities are built on very low-lying land, quite exposed to the sea. These are the cities about which flood disaster stories are written or broadcast every time a hurricane or typhoon blows by. For these cities, sea level rise would mean destruction of property, dislocation of people,

and economic chaos. And worse. Galveston, Texas, and Charleston, South Carolina, are examples of vulnerable areas in the United States. The coastal and delta area of Louisiana is also vulnerable. Where whole nations are established on low-lying areas elsewhere in the world, as in the Netherlands or Bangladesh, some say consequences could be even more grave.

Many other effects can be anticipated. Some could be ecological, such as the destruction of coastal wetlands, loss of species, or disruption of forest communities. Others could be economic, bringing — or relieving — flooding or drought.

The bleakest doomsday scenarios, often given voice by the media, imply that global warming could bring death for billions or the end of the human race. Such scenarios make great entertainment, but have no scientific basis. The warming anticipated over the next century, 4.5°F or so, is much less than people tolerate well in the course of a normal day. The major obvious dangers to life come from things like possible warming-caused flooding or food shortages. Millions of people die from floods or famine already; global warming could make it worse.

In recent years concern has emerged about other harms to human health which might be caused by global warming. A 1995 heat wave, for example, was blamed for the deaths of hundreds of people in Chicago. A number of serious diseases are transmitted by insects and other "vectors" which warmer climate could allow to spread beyond their current range. Examples are malaria, dengue fever, yellow fever, and encephalitis. Hotter temperatures actually worsen smog, which has serious health effects. Some of these health effects are still speculative, and many could be mitigated by basic public health measures such as clean drinking water.

When Might Climate Change Be Manifested? How?

Even when climate change is happening, it is hard to know it for sure. Global average temperatures can vary greatly naturally from year to year, and even from decade to decade. The problem is in knowing what the average is and when it has really changed.

A series of warm years occurred in the late 1980s and 1990s, prompting concern that human-induced global warming already was under way. The National Oceanic and Atmospheric Administration pronounced 1998 the warmest in the previous 119 years — the period since reliable instrument records began. The previous record high global surface temperature had been set the year before, in 1997. Some scientists thought that the intense 1997-1998 El Niño contributed to the warming, but 1998 was the 20th consecutive year of above-average global temperatures. Scientists

agree that the global mean surface air temperature has risen by 0.3° to 0.6° Celsius (C) over the last 100 years, but they are less certain about what might be causing that warming. It has been difficult to say for sure, either that it has begun or that it hasn't, because the rise in global temperature has still scarcely exceeded the range of natural variability. Time (and good data) will tell.

"Denial" is a common human response (as anyone who has watched a tobacco-smoking friend die of lung cancer can tell you). The problem with the uncertainties about global warming is that those very uncertainties make it easy to deny the threat. Given the lag between the time humans emit greenhouse gases and the warming of Earth in response, denial is easier still. Humans could be deeply and irreversibly committed to global warming by the time it is detected with real confidence. In this regard, it also resembles lung cancer, which may show up 30 or 40 years after a person starts smoking.

Climate scientists have devised computer models to estimate when climate change might be manifested. The models can be no better than our imperfect understanding of Earth, and their answers vary. Still, scientists understand most basics of the climate system, and the models show "skill" in many predictions.

Today, the "best guess" of computer models is that global temperature will rise by about 2ºC (or 3.6ºF) from 1990 levels by the year 2100, given "business as usual" emissions. Increased global temperatures of this magnitude are expected to raise global average precipitation and evaporation by a few percentage points and to diminish areas of ice and snow.

Who Contributes to Change? Who Is Affected? How?

If human activities may be changing global climate, who is doing it, and who is affected? Practically everyone:

- anyone who uses electricity made by burning coal, oil, gas, or biomass
- anyone whose home furnace burns gas or oil
- anyone who burns wood or charcoal to cook or keep warm
- anyone who air-conditions their house or car or has a refrigerator with CFCs
- anyone who drives a car
- anyone who raises or eats farm animals, anyone who grows or eats rice, or anyone who uses synthetic fertilizers to grow crops.

It ultimately includes anyone who has a child. Human-induced global warming effects tend to increase in some proportion to the number of people on Earth, because the effects come from common activities that

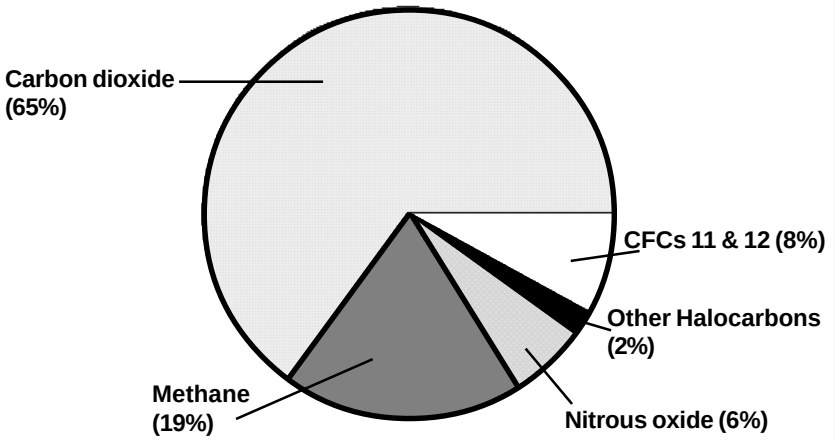
support human life.

Some societies, though, produce more greenhouse gases than others. Historically, the richer and more abundant the lifestyle and the more energy, wood, and food that is used or consumed, the more carbon dioxide (CO_2), chlorofluorocarbons (CFCs), and other greenhouse gases generally are emitted into the air. The link is likely to grow weaker as cleaner and more efficient technologies emerge.

Developed nations, for example, produced more than 60% percent of the carbon dioxide going into the atmosphere in 1995, with developing nations emitting less than 40%, according to the World Resources Institute (WRI). But WRI researchers add that developed nations are responsible for more than 80% of the CO_2 in the atmosphere, on a cumulative basis. As the poorer countries develop, they are expected to increase their share of total emissions, although estimates vary as to how quickly. In 1985, industrialized countries were emitting nearly 10 times as much carbon dioxide per person as developing countries. This kind of information prompted developing nations to argue during climate treaty negotiations that the economic burden of emissions control, from the standpoint of equity, should fall more heavily on the shoulders of industrialized nations.

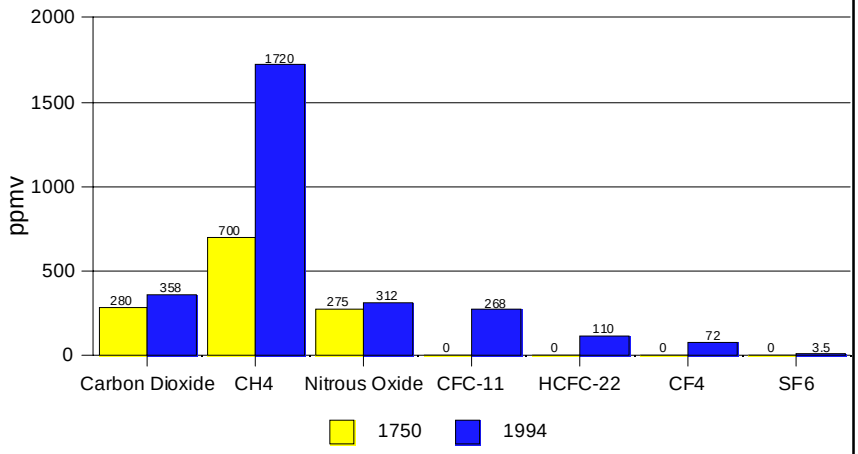
Energy use contributed 46 percent of the human-induced increase in the greenhouse effect during the 1980s, and forestry about 18 percent. CFCs contributed 24 percent of the extra warming, but stiff controls on them came into effect during the decade. Agriculture contributed an

Figure 1. Contribution of Human-induced Greenhouse Gases



Source: 1995 IPCC Assessment

Figure 2. Increase in Concentration of Greenhouse Gases (1750 to 1994)



Source: United Nations Environment Programme, http://www.unep.ch/iuc/submenu/press/climate/cop5kit.htm

estimated 9 percent, while all other sources amounted to only 3 percent of the total.

Figure 1 shows the relative contributions of human-induced greenhouse gases to the increase in radiative forcing from 1980 to 1990.

How Might Societies Respond?

Because energy use contributes roughly half of all the possible human-induced global warming, one solution involves a set of basic changes in human energy use. To have a decisive impact on potential global warming, according to the U.S. Environmental Protection Agency, the changes would have to be substantial and worldwide. If the worst warming fears are correct, failing to act could prove more expensive than acting. (In the meantime, however, the agency also says that there are many easy and cost-effective remedies either under way or ready to start at once.)

Two basic energy strategies are generally favored by environmental groups: energy efficiency and conversion to non-fossil fuel energy sources. Although the world has come a long way in improving energy efficiency since the oil embargo of 1973, it still has a long way to go in these areas.

The big emitters of carbon dioxide in industrialized countries include power plants, jet aircraft, factories, home furnaces, and motor vehicles. Re-fitting or replacing all this equipment on a worldwide scale would be an enormous capital expense. But neither power plants nor cars last forever, and it might make sense, when they are replaced, to convert to alternative energy sources that emit less CO_2. Significant amounts of energy are being produced today by hydroelectric, nuclear, wind, geothermal, and solar thermal technologies. Photoelectric technology may improve to the point where it is also an important source.

Some, particularly certain electric utilities, say nuclear power is the best middle-term answer to the energy riddle. Nuclear plants emit almost no CO_2 and could meet most of the world's power needs with available technology. Proponents of nuclear energy emphasize this point when the subject turns to averting greenhouse warming. Critics of nuclear power routinely counter that the environmental risks posed by possible radiation leaks and nuclear waste disposal make nuclear power unworkable. They point also to the high costs associated with nuclear power production and to fears of nuclear terrorism. Reporters can expect to hear proponents of nuclear energy emphasize that the problems may be more political than technical. Even so, that may not necessarily make solving them any more likely.

While properly associated primarily with stratospheric ozone reduction, CFCs and their chemical relatives contribute also to the greenhouse effect. As it turns out, the increase in greenhouse warming that CFCs cause may be offset to a considerable extent by the cooling effect of the ozone losses they cause. Worldwide CFC reduction efforts initiated by the 1987 Montreal Protocol twice have been strengthened, and the global phase-down of CFC use is credited with helping to slow or reverse continued ozone depletion (see Chapter 5). Some CFC substitutes are also greenhouse gases (HCFCs, HFCs, and PFCs), although less harmful than ones they replace.

Emissions of nitrous oxide and methane, two other greenhouse gases, may be harder to control. They come from a variety of sources resulting from natural and human activities. Combustion energy-efficiency may help reduce nitrous oxide. Both gases have agricultural sources, so changes in farming practices, while not easy, may help.

Since plant life is constantly taking carbon dioxide out of the atmosphere, another warming-reduction strategy would be to increase reforestation efforts. Trees are the biggest CO_2-breathers, but worldwide, deforestation is heightening concerns over greenhouse warming.

Ultimately, societies may have to confront head-on the volatile issue of human population on Earth over the long term. Greenhouse gases from

almost every anthropogenic or unnatural source increase directly with human population. More people will use more energy, more farmland, more trees, more farm animals, and so forth.

Controlling human population through public policy is of course a moral, economic, and political minefield, as the September 1994 Cairo conference demonstrated. Politicians interested in short-term political survival often want to avoid the population issue entirely. It is seldom discussed when policy-makers are addressing potential global warming resulting from human activities. But it may be up to journalists to keep them from avoiding it.

It is true that the rise in CO_2 means we are probably already committed to some greenhouse warming. But this does not mean that it is too late to do anything about it. People in many parts of the globe have demonstrated that they can improve energy efficiency, develop new agricultural and energy technologies, and limit population growth.

There are few simple, small, or easy fixes to the global warming challenge. Of course, energy efficiency makes sense. But even if Americans suddenly cut back 25 percent in their use of electricity, that would not make a very large dent in global greenhouse emissions. In the 1980s, CO_2 made up about 49 percent of the anthropogenic greenhouse forcing. Of the total worldwide CO_2 emissions, the United States contributed about 24 percent. Electric utilities account for only about 36 percent of U.S. CO_2 emissions from energy alone. And carbon fuels only make up 69 percent of the fuels used to generate electricity in the United States. So, very roughly, a 25 percent cut in U.S. electricity use would translate into a cut of only about 0.7 percent in worldwide greenhouse emissions.

This doesn't mean the situation is hopeless. It does mean that the problem will not be solved simply by U.S. citizens' using high-efficiency light bulbs. The implication is that the only way to cut greenhouse emissions significantly is on a worldwide basis, across almost all energy modes, and beyond the energy sector itself.