What Global Warming?
A look at the arguments the skeptics make—and how believers respond
By MICHAEL TOTTY

When we recently ran an article about ideas on ways to cool the planet, we were swamped with emails from people who were impassioned in their belief that global warming is a myth. It was striking that so many people held views at odds with what is apparently the consensus among climate scientists, as well as policy makers.

That consensus, simply put, states that the planet is warming, and that most of the temperature rise is very likely due to an increase in greenhouse gases in the atmosphere caused by human activity. Barring a reduction in greenhouse-gas emissions, the 21st century will see more frequent heat waves, intense storms and, in the tropics, declines in rainfall.

So, what do the skeptics say? In a nutshell, they argue that the warming in the past century has been modest and that human activities’ contribution to the warming has been minimal; there is no crisis. Here are some of their major points—and the response by those who believe in global warming.

WHAT THE SKEPTICS SAY: The Earth isn't warming—at least not to any extent that could actually be called a "crisis." And some data even suggest that the Earth is getting colder.

The planet may have grown warmer over the course of the 20th century. But that warming stopped more than 10 years ago, and since 1998 the trend shows less warming or even cooling. Indeed, the period from December 2007 through November 2008 was the coldest 12-month span of the decade. Even if the planet isn't cooling, there's no evidence that warming is accelerating or that temperatures are increasing at an alarming rate.

THE RESPONSE: It's true: By most measures, average temperatures this decade seem to have plateaued.

But this isn't evidence of a cooling planet. Partly, it's a result of picking an exceptionally hot year—1998—as a starting point. That year experienced an unusually strong El Niño, a natural and periodic warming of the Pacific Ocean that can have powerful effects on global climate.
The long-term trend since the mid-1970s shows warming per decade of about 0.18 degree Celsius (about 0.32 degree Fahrenheit). That temperatures this decade have hardly increased demonstrates how natural year-to-year variations in climate can either add to or subtract from the long-term warming trend caused by the increase in greenhouse gases in the atmosphere.

The ’00s still have been exceptionally warm: The 12 years from 1997 through 2008 were among the 15 warmest on record, and the decade itself was hotter than any previous 10-year period. While 2008 was the coolest year since 2000—a result of the cooling counterpart of El Niño—it was still the 11th-warmest year on record. And 2009 is on track to be among the five warmest.

WHAT THE SKEPTICS SAY: Records of surface temperatures are unreliable and exaggerate the amount of warming.

The reason some scientists think the planet is warming drastically is that they're relying on temperature readings from ground weather stations that in many cases have been artificially boosted by an "urban heat island" effect. Most temperature-gathering weather stations are located in cities or towns. Yet cities generally trap more heat—in asphalt, concrete and other structures—and the effect can be significantly greater than any warming effects of greenhouse gases.

THE RESPONSE: It's true there's an urban heat-island effect. But it hasn't skewed the overall trends that indicate global warming.

NASA’s Goddard Institute for Space Studies compares temperature readings from urban weather stations with those from nearby rural stations, and adjusts the urban data so that temperature trends match those of the rural stations. And any trends in the data are based on the rural readings alone. Other scientists have found that apparent differences between urban and rural temperature readings have probably been overstated.

There's also plenty of evidence independent of the urban temperature readings to suggest that the planet is heating up: Oceans are warming, glaciers and permafrost are disappearing, the Arctic ice cap is shrinking, and plants and animals in the Northern Hemisphere are migrating northward out of their historic ranges.

WHAT THE SKEPTICS SAY: Satellite temperature readings are more reliable than those taken from surface weather stations, and satellites show little warming over the past 30 years.

Satellite readings of temperatures of the lower atmosphere compiled by the University of Alabama-Huntsville show a smaller warming trend over the past 30 years than the surface record. This minor temperature increase is well within natural variations. it may even point to a break, around 2002-03, in the 20th century warming trend.

THE RESPONSE: The earliest studies of temperature trends using satellite data did show significant differences with the surface-temperature trend, but much of that stemmed from problems with how the satellite data were put together.
As errors have been corrected, the satellite and weather-balloon measures of the lower atmosphere show warming trends similar to the surface measures.

WHAT THE SKEPTICS SAY: There's nothing especially unusual about today's temperatures.

The Earth's climate is constantly changing, and climate shifts have been far more dramatic in the past. Temperatures rose during the Medieval Warm Period, which extended from about 800 to 1300 A.D., and the period was as warm or warmer than the 20th century. That's long before industrialization caused an increase in CO2 levels, undermining the link between rising atmospheric carbon dioxide and rising temperatures.

It's likely that the warming trend we're experiencing today is merely the expected return to warmer temperatures after the Little Ice Age, a period of extremely cold winters from the 16th to the early 19th century.

THE RESPONSE: Reliable temperature records go back only about 150 years.

To get a picture of the pre-modern world's climate, it's necessary to correlate data from a variety of proxy sources around the globe, such as ice cores, coral growth, tree rings and the like. These temperature reconstructions show a similar pattern: a warmer period during the Middle Ages, a cooler period from about 1600 into the 1800s—and much higher temperatures in the late 20th century.

While the reconstructions suggest that temperatures in the Middle Ages were as high as those in the early 20th century, they were probably lower than the sharp temperature increase over the past 30 years. The warmest temperatures before the 20th century probably occurred between 950 and 1100 and were probably more than 0.1 degree Celsius below the 1961-1990 average (which is used as a benchmark for most current temperature measures).

Still, there is a great deal of uncertainty in the temperature reconstructions, and the uncertainty increases as scientists look further back in time. While there's evidence for warm conditions during the Medieval period, exactly when it was warmer and for how long may have varied from place to place around the world.

WHAT THE SKEPTICS SAY: Natural factors are enough to account for the moderate warming we've seen since 1900.

Changes in solar output in the past have contributed to wide temperature swings across the globe. Other natural phenomena, such as the El Niño Southern Oscillation and its cooling counterpart, La Niña, can cause large but temporary climate shifts.

These normal fluctuations are enough to cause the warming of the planet, while the effects of greenhouse-gas emissions remain relatively small.
THE RESPONSE: There's no question that solar energy and periodic, natural changes affect the world's climate. But these natural factors aren't enough to account for the sharp increase in temperatures since the late 1970s.

Studies of solar output over more than 1,000 years show a strong relationship with temperatures in the Northern Hemisphere; temperatures rise when solar output increases, and they decline when solar radiance, as measured by sunspot and other activity, decreases.

But the studies have also found that solar energy doesn't account for the steep temperature rise since the mid-1970s, a period during which solar output has remained relatively unchanged. The sun's contribution to warming since then has been negligible.

Natural climate changes, like El Niño, also have a definite impact on weather patterns for as much as a decade; El Niño, for instance, accounted for the high temperatures in 1998. But such climate changes occur in recurring cycles and don't show longer-term trends.

WHAT THE SKEPTICS SAY: There's no evidence that rising sea levels are linked to increased carbon-dioxide levels.

Sea levels are certainly rising, and they have been since the last Ice Age 21,000 years ago. But the observed increases in the 20th century are relatively small, and recent studies indicate that sea levels may have risen more quickly in the first half of the century than in the second. There has been no sign of a recent acceleration in the rate of sea-level rise.

The increases we have seen may reflect only periodic, decade-level fluctuations, not a continuing, long-term increase. This suggests the sea-level rises this century will be about the same as last century and could easily be accommodated.

THE RESPONSE: After rising following the last Ice Age, sea levels stabilized about 2,000 years ago and held fairly steady until about 1800, but they have been rising since then—about 1.7 millimeters a year for the 20th century. Contrary to what the skeptics say, however, satellite readings indicate sea levels rose more steeply—about 3.4 millimeters a year, or a little more than one-eighth of an inch—from 1993 to 2008.

Although such a sharp short-term climb is very likely a sign of a long-term acceleration in sea-level increases, it is recent enough that it still could indicate decade-level variability; assessing the long-term trend will require more years of data.

For the rest of the 21st century, ocean levels are projected to rise at a greater rate as the melting of ice sheets in Greenland and West Antarctica accelerates. Accurate projections of the rise are difficult, however, because the mechanics of the melting ice sheets are poorly understood.

The Intergovernmental Panel on Climate Change, a U.N.-affiliated organization, estimated in 2007 that sea levels will rise between 18 centimeters and 59 centimeters by 2095, with another rise of 10 to 20 centimeters possible if the melting of those ice sheets speeds up.
But a recent report predicts that the rise in sea levels this century is likely to be twice as great as the IPCC report projects.

WHAT THE SKEPTICS SAY: Polar ice isn't disappearing.

Warmer temperatures are partly responsible for recent declines in sea ice in the Arctic, but shifting winds are the main factor. What's more, declines in the northern ice cap have been counterbalanced by increases in the Antarctic ice pack, so there's little net loss of polar ice. These opposite trends argue against the existence of man-made global warming.

THE RESPONSE: The two ends of the Earth do seem to behave differently, but that reflects the complexity of the world's climate system and isn't evidence against global warming.

The Arctic is an ocean surrounded by land, which holds in more heat. Also, as the ice cap melts, the darker ocean absorbs more heat and accelerates the rate of warming. The Antarctic, by contrast, is a continent surrounded by ocean, and climate models predict that it will respond differently to global warming.

In the north, satellite measurements show that Arctic sea ice has decreased steadily since the late 1970s; in September, when the ice cap is at its smallest, sea ice has declined about 10% a decade, or about 28,000 square miles through 2007. Though the ice has recovered somewhat, the September 2009 minimum was still 24% below the average from 1979 to 2000. What's more, the sea ice is thinner and probably reached a record low volume in 2008.

In the Antarctic, meanwhile, wintertime ice has extended its range by about 1%, or almost 39,000 square miles, a decade. (Most Antarctic sea ice typically disappears completely in the summer.) The mechanism for this isn't completely understood; scientists theorize that ozone depletion in the region contributes to stronger and colder winds that promote production of sea ice.

It's possible, too, that increased snowfall—a result of a warmer southern ocean and air temperatures—also adds to the amount of sea ice.

WHAT THE SKEPTICS SAY: There is no consensus that human-caused warming is creating a disastrous rise in global temperatures. The causes of 20th-century warming are in sharp dispute among scientists, as is the amount of warming expected in the future.

THE RESPONSE: Science is rarely final, and it always has its skeptics. Hypotheses are tested and retested as more data are collected and examined, and disagreements among researchers play a vital role in moving scientific understanding forward.

But the vast majority of scientists who study the climate agree on the essential points: that the Earth is getting warmer and that most of the warming in recent decades has been caused by carbon-dioxide emissions from human activities. As CO2 concentrations increase, the rate of warming will accelerate.
This view, summarized by the Intergovernmental Panel on Climate Change, is endorsed by the world's leading scientific organizations, including the national academies of science in a score of countries and, in the U.S., the American Association for the Advancement of Science, the American Geophysical Union and the American Meteorological Society.

In a recent survey of more than 3,000 Earth scientists, 82% agreed that human activity is a "significant contributing factor" in changing global temperatures. Specialists were in greater agreement: 75 of the 77 climate scientists who actively publish in the field—about 97%—agreed with the statement.