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Warming Up to the Truth: The Real Story About Climate Change
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The Climate Action Report, a periodic report to the United Nations, was issued in early June. A media frenzy claimed that this report somehow contained revelatory new science that changed the debate on global warming.

The report has little new science. But since 1992, when America embarked on the Rio Treaty, a great deal of new science has come forward. The United States is a leader in studying the subject. The U.S. has invested some $45 billion in research funding on this question over the past 10 years.

I wanted to update you on the latest science since 1992 and assure you that what is in the Climate Action Report is really nothing revelatory.

The scientific facts on which everyone agrees are that, as a result of using coal, oil, and natural gas, the carbon dioxide content of the air is increasing. The air's concentration of other human-produced greenhouse gases, like methane, has also increased. These greenhouse gases absorb infrared radiation from the sun, and they retain some of that energy close to earth.

All computer simulations of climate change say that, based on how we understand climate to work, the low layer of air for one to five miles up (the low troposphere), where the radiation is trapped, should warm. That low layer of air warming should, in turn, warm the surface.

Scientific facts gathered in the past 10 years do not support the notion of catastrophic human-made warming as a basis for drastic carbon dioxide emission cuts.

You probably know that the Kyoto agreement fails to stop the hypothesized human-made global warming. Kyoto would hurt America's and the world's workers and the struggling poor and the elderly, owing to the severe cuts in energy use that it entails.

MEASURING SURFACE TEMPERATURE

Now for the science. There are two important records that we'll look at. I just told you how we think climate operates in the presence of

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increasing carbon dioxide and greenhouse gases in the air from human activities. The layer of air one to five miles up retains energy and that layer, in turn, heats the surface of the earth. The human-made greenhouse warming component must warm both layers of air, with computer simulations indicating the low troposphere would warm more quickly and to a greater amount than the surface.

Let's start with the surface temperature records. They are made by thermometers, and go back to about the mid-19th century in locations scattered around the world. For some locations the records go back even further.

Two groups have analyzed these surface temperature records: the Climatic Research Unit in Great Britain, and the NASA Goddard Institute for Space Sciences. They broadly say the same thing: The 19th century was cooler than the 20th century. There may be some disagreement on the exact amount of the warming, but certainly the 20th century was warmer than the 19th.

To see if the 20th-century surface warming is from human activity or not, we begin looking in detail at the surface record. In the 20th century, three trends are easily identified. From 1900 to 1940, the surface warms strongly. From 1940 to about the late 1970s, a slight cooling trend is seen. Then from the late 1970s to the present, warming occurs. Briefly, the surface records show early 20th-century warming, mid-20th-century cooling, and late 20th-century warming.

Most of the increase in the air's concentration of greenhouse gases from human activities--over 80 percent--occurred after the 1940s. That means that the strong early 20th century warming must be largely, if not entirely, natural.

The mid-20th-century cooling can't be a warming response owing to the air's added greenhouse gases. The only portion of this record that could be largely human-made is that of the past few decades. The slope of that trend calculated over the past few decades is about one-tenth of a degree Centigrade per decade.

Now, most all the computer models agree that the human-made warming would be almost linear in fashion. So over a century the extrapolated warming trend expected from continued use of fossil fuels would amount to about 1 degree Centigrade per century. That's what the surface temperature says would be the upper limit.

But I gave you a scientific test to do early in my remarks. The question is, What happens in the low layer of air from one to five miles up that must warm in response to the increase in greenhouse gas concentrations? The surface warming can be concluded as owing to human-made greenhouse gas emissions only if the low troposphere warms, if the computer simulations are accurate.

One can have surface warming from a variety of reasons. So the key layer of air to look at is the one-to-five-mile up layer of air.

MEASURING AIR TEMPERATURE

NASA launched satellites starting in 1979 to measure this layer of air. The satellites look down and record these measurements daily. I've plotted the monthly averages. There are lots of jigs and jags in the data, and they are real.

The air temperature varies not only on a daily basis, on a monthly basis, but also from year to year. A very huge warming spike in 1997-1998 is a strong, natural phenomenon called El Niño, a warming of the Pacific that in turn warms the air. Because the Pacific is so pervasive in the global average, it raises the temperature. But it doesn't last very long, and after the El Niño subsided, temperatures fell.

El Niños are natural and occur every several years. In 1982, an equally strong El Niño was developing in the Pacific. But then, a volcano erupted. Material lofted by strong volcanic eruptions can temporary cool temperatures. So those two events occurring at nearly the same time meant there was a net cooling just after 1982, instead of an unmasked strong El Niño-driven pulse of warmth.

El Niño is part of a system of ocean and air changes called the El Niño Southern Oscillation, in which the La Niña phase tends toward cooling. Detailed physical understanding of the El Niño Southern Oscillation is lacking.

Again, these phenomena are naturally occurring. They have existed for many millennia prior to human-added greenhouse gases in the air.

I asked the computer to naively draw a linear trend through the data recorded by satellites. This linear trend probably has a bias, an upward bias because of that strong 1997-1998 El Niño warm pulse. Nonetheless, the fitted trend is: positive four-hundredths of a degree Centigrade per decade.

Now, this is the layer of air sensitive to the human-made warming effect, and the layer that must warm at least as much as the surface according to the computer simulations. Yet, the projected warming from human activities can't be found in the low troposphere in any great degree. The four-hundredths of a degree Centigrade might be entirely due to this El Niño bias. If the small warming trend in the low troposphere were assumed to be entirely human-caused, the trend is much smaller than forecast by any model. Extrapolated over a century, the observed trend indicates a human-made warming trend no greater than four-tenths of a degree Centigrade.

In contrast, the computer models say this very key layer of air must be warming from human activities. The predictions are that the air must be warming at a rate of approximately a quarter of a degree Centigrade per decade.

Comparing what the computer models say should be happening with the actual satellite observations shows a mismatch of around a factor of 6. That is, this layer of air just is not warming the way the computer simulations say it should. There should have been a half a degree Centigrade per decade warming in this layer of air over the period of satellite observations. The human-made warming trend isn't there.

Now, an argument is often made that the measurements made by satellites looking down on this key layer of air are biased, or that the satellites have instrumental problems.

NASA researchers worked very hard to make these measurements the best possible, and to correct for any of the deficiencies seen in them. But it's always useful to have an independent set of data, and we have that from NOAA (the National Oceanic and Atmospheric Administration) scientists and from other groups around the world.

Measurements are also made of this layer of air from weather balloons that carry thermometers. Balloons are launched worldwide every day to make the measurements. The balloon data go back to 1957, and importantly, they overlap with the satellite data which began in 1979 and have continued through the present. During the period of overlap, the correlation coefficient between the two data sets, the technical term for how well do these two independent measurements agree, is well over 99 percent.

In other words, the satellite data and the balloon data both say that the records reflect the actual change in this layer of air. Again, as with the satellite record, one can recognize short-term natural variations--El Niño, La Niña, volcanic eruptions--but one does not see the decades-long human-caused warming trend projected by climate models.

Often, one sees these same data from this key layer of air with a linear trend drawn through them. However, because of bias in the record from a natural phenomenon, it is not appropriate to draw a straight line through the four decades of the temperature record. One must work around the natural phenomenon I'm going to tell you about.

Every 20 to 30 years, the Pacific Ocean changes sharply. The sudden shift is called the Pacific Decadal Oscillation, or PDO, and produces an ocean, air, and wind current shift. Fishermen will notice, for example, migrations of fish species along the West Coast.

In 1976-1977 the Pacific Decadal Oscillation shifted, and is labeled the Great Pacific Climate Shift of 1976-1977. As a result, temperatures changed dramatically from their former average (since around 1946), and returned to warmth seen from around 1923 to 1946. So sharp is the shift that the appropriate thing to do is to look for a secular trend (which might be the human-made trend) before 1976-1977, and then after 1976-1977. But drawing a straight line through that natural event should be avoided.

The PDO is natural, because proxy records--of tree growth, for example--detail the oscillation going back several centuries, which is prior to human activities that significantly increase the content of greenhouse gases in the air.

And also known from computer simulations is that the human-made warming trend is supposed to grow steadily over decades. So, a shift all at once in 1976-1977 is ruled out by those two reasons. One, it's not what the models project; and two, we see this event before the build-up of human-made greenhouse gases, and it is therefore natural.

The satellite data and the balloon data agree when both records coexist, from 1979 to the present. The balloon record reaches back four decades. Neither record sees a meaningful human-made warming trend.

Now, just remember this one thing from this talk, if nothing else: That layer of air cannot be bypassed; that layer of air must warm if computer model projections are accurate in detailing the human-made warming trend from the air's increased greenhouse gases. But that layer of air is not warming. Thus the human-made effect must be quite small.

Additionally, the recent warming trend in the surface record must not owe to the human-made effect. The surface temperature is warming for some other reason, likely natural influences. The argument here, from NASA and NOAA data, is that this layer of air from one to five miles in altitude is not warming the way computer simulations say it must warm in the presence of human activity. Therefore, the human-made effect is small. The surface data must be warming from natural effects, because the human-made warming trend must appear both in the low troposphere and at the surface. All models are in agreement on that.

SOLAR ACTIVITY

Now, if the surface data are warming for a natural reason, what might that be? Our research team studies changes in the energy output of the sun and its influence on life and the environment of earth.

Records of sunspot activity reach back to the days of Galileo, some 400 years ago. Scientists then could project an image of the sun and draw these dark sunspots that were seen through early telescopes. We know sunspots to be areas of intense magnetic activity, and from NASA satellite measurements in the last 20 years, we know that over time periods of decades, when the magnetism of the sun is strong, the energy output of the sun is also more intense. That is, the sun is a little bit brighter when magnetism is high, and the sun is a bit fainter when magnetism is weaker.

The sharp ups and downs in the sunspot record define the familiar 11-year cycle, or sunspot cycle. The period is not exactly 11 years. It varies between eight and 15 years, and there is no good explanation for the cause of the cycle. But I'm not going to look at the short term, but rather the changing sun over decades to centuries.

Over the past half-century, the sun has become very active, and the sun is more active than it has been for 400 years. Therefore, the sun is likely at its brightest in 400 years.

Also noteworthy is a feature called the Maunder Minimum. In the 17th century, the observations of sunspots show extraordinarily low levels of magnetism on the sun, with little or no 11-year cycle. That phase of low solar activity has not been encountered in modern times (although radiocarbon records indicate that a Maunder-minimum episode occurs for a century every several centuries). The 17th-century Maunder Minimum corresponds with the coldest century of the last millennium.

That may not be a coincidence. If the sun's energy output had faded, the earth may have cooled in response to that decrease in the sun's total energy output.

The next step is to look closer at the temperature records on earth, and see if they link to the decadal-to-century changes in the sun's energy output. Climate scientists believe they can reliably reconstruct Northern Hemisphere land temperature data back to, say, the year 1700.

If changes in the energy output of the sun, drawn from the envelope of that activity of changes in the sun's magnetism, are superposed on the reconstructed temperature record, then the two records show a good correlation.

The ups and downs of each record match fairly well. The coincident changes in the sun's changing energy output and temperature records on earth tend to argue that the sun has driven a major portion of the 20th century temperature change. For example, a strong warming in the late 19th century, continuing in the early 20th century, up to the 1940s, seems to follow the sun's energy output changes fairly well.

The mid-20th century cooling, and some of the latter 20th century warming also seem matched to changes in the sun.

To review: The surface warming that should be occurring from human-made actions, which is predicted to be accompanied by low troposphere warming, cannot be found in modern records from balloon and satellite platforms.

Thus, the recent surface warming trend may owe largely to changes in the sun's energy output.

ECONOMIC CONSEQUENCES OF THE POLICY DEBATE

Science is the primary tool to understand human-caused global warming. But economic consequences of policies meant to cut greenhouse gas emissions also enter the policy debate.

Kyoto-type greenhouse gas emission cuts are expected to make little impact on the forecast rise in temperature, according to the computer simulations (which seem to give exaggerated warming trends, as discussed). One forecast, from the UK Meteorological Office, underscores the point. Without Kyoto, that model predicts a rise in globally averaged temperature of just about 1 degree Centigrade by the year 2050. Implementing Kyoto, according to that model, would result in a slightly but insignificantly lower temperature trend. The temperature rise avoided by the year 2050--the difference between the two trends--is six-hundredths of a degree. That is insignificant in the course of natural variability of the climate. Another way to look at the averted warming is that the temperature rise expected to occur by 2050 is projected to occur by 2053 if the emission cuts are enacted.

The conclusion is that one Kyoto-type cut in greenhouse gas emissions averts no meaningful temperature rise, as projected by the models. In order to avoid entirely the projected warming, British researchers estimate that 40 Kyoto-type cuts in greenhouse gas emission would be required.

The cost of implementing one Kyoto-type cut is enormous. Fossil fuels supply approximately 85 percent of energy needs in the United States; worldwide the fraction is about 80 percent. International policy discussions propose expensive solutions centered on sharp fossil fuel use cuts and a massive increase in solar and wind power. A cost-effective solution that does not stunt energy use and energy growth is to shut down coal plants, extend the licenses of the 100 nuclear power plants in the United States, and build about 800 more. However, that is not under serious discussion as a solution to what is often described as the most pressing crisis facing the earth.

Renewable energy sources like solar and wind are not only expensive but also environmentally damaging in their vast land coverage. Those renewable energy sources are not foreseen as seriously meeting projected energy and economic growth. For economic growth, fossil fuels will be relied on for the next decade or two.

The cost of engaging in one Kyoto-type greenhouse gas emission cut ranges between $100 billion and $400 billion of lost GDP annually in the United States. For comparison, consider that the Social Security Trustees estimated $407 billion was transferred to retirees in 2001. The $400 billion annual loss in GDP is approximately numerically equal to the total amount of public and private primary and secondary education spending in the United States.

A recent study from Yale University says that over the next 10 years, Kyoto-type cuts would cost about $2.7 trillion in lost GDP in the U.S.

Those costs must be increased if the target of greenhouse gas emission cuts is not one Kyoto-type agreement but 40.

Another possible target for emission cuts is the benchmark of stabilizing the atmosphere at a level of 550 parts per million of equivalent carbon dioxide concentration. That target probably will be discussed at the World Summit on sustainability in Johannesburg. Current discussions imply that developed countries like the United States would be forced to go to zero net carbon emissions by the year 2050. Beyond 2050, the United States would produce net negative carbon emissions, i.e., the United States would not only continue to emit zero net carbon, but also to begin removing carbon from the atmosphere.

In summary, little evidence supports the idea of catastrophic human-made global warming effects. Undertaking a Kyoto-type program would produce little abatement of the forecast risk, while the cost of such a program would divert resources and attention from major environmental, health, and welfare challenges.

In that regard, forecasts are made of the hypothesized impacts of projected human-made global warming effects. For example, one scenario is that hurricanes may increase because more carbon dioxide has been added to the air. This would be a serious economic impact because hurricanes are the costliest natural disaster in the U.S. But hurricanes have not increased in number or severity in the past 50 years. The cost of property damage has increased, because the cost of property has risen along with the rise in U.S. wealth--not because carbon dioxide has been added to the air.

Another scenario is that human-made global warming will see sweeping epidemics of infectious diseases like malaria in the United States. But malaria is endemic to the United States. Malaria strikes were quelled not by controlling the weather, or by controlling the amount of carbon dioxide in the air, but through increased wealth. That the United States became wealthier from fossil fuel use meant people could be protected from malaria by living inside screened or climate-controlled structures, by reducing the disease vector, mosquitoes, and by advancing medical knowledge and care. In contrast, nearly one million people die from malaria each year; many of its victims are children in Africa and other developing nations.

Diminishing the impact of natural disasters is an immediate worldwide need that rests on keeping the U.S. and world economy vibrant. Energy use, that is, fossil fuel use, helped achieve stunning progress for humankind and the environment in the 20th century. For example, life expectancy in the U.S. in the 20th century nearly doubled.

Agricultural experts estimate that technology has improved crop output. But some increase in crop growth, namely about 10 percent, may owe to the added carbon dioxide in the air, that is, the aerial fertilization effect from carbon dioxide. Carbon dioxide is not a toxic pollutant. It is essential to life on earth.

The latest scientific results are good news: The human influence on global climate change is small and will be slow to develop. The conclusion comes from the lack of meaningful warming trends of the low layer of air, in contradiction to the computer simulations that project a strong human effect should already be present. Those results present an opportunity to improve climate theory, computer simulations of climate, and obtain crucial measurements.

The economic consequences of not relying on science but instead on the anti-scientific Precautionary Principle, are considerable, and are not so speculative. The economic impact of significantly cutting fossil fuel use will be hard-felt, and they will be devastating to those on fixed incomes, those in developing countries, and those on the margins of the economy.

For the next several decades, fossil fuel use is key to improving the human condition. Freed from their geologic repositories, fossil fuels have been used for many economic, health, and environmental benefits. But the environmental catastrophes that have been forecast from their use have yet to be demonstrated by their critics.

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