

Remote Sensing in an Era of Global Warming

By

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Abstract

On February 5, 2007 the Intergovernmental Panel on Climate Change (I.P.C. C.), a joint venture of the United Nations Environment Program (U.N.E.P.) and the World Meteorological Organization (W.M.O.) released its Fourth Assessment Report on the state of the climate. Like earlier reports, issued every 4-5 years, the 2007 Report was vetted by over a thousand independent scientists, as well as by national representatives of the W.M.O.s 190 participating countries.

Since the creation of the I.P.C.C in 1998 there have been a number of improvements in satellite and in-situ data acquisition processes. More efficient and extensive means have been developed for the sharing of raw data and analyzed information.

The 2007 Report dealt, among other things, with the rate of sea level rise and surface and atmospheric climate change. Depending on whether the subject had been measured starting in 1960, whether humans contributed to the observed trend, and whether there was a likelihood of future trends based on the

IPCC Special Report on Emission Scenarios (SRES), three conclusions were drawn.

As to post 1960 trends regarding heavy precipitation events it was rated as "Likely;" the rating was "Likely" in some regions since 1970 for intense tropical cyclone activity increases; and "Likely" for the increased incidence of extremely high sea levels (excluding tsunamis). For human contributions to observed trends for each of the above conditions they were rated "Likely," "More likely than not," and "More likely than not." For projections for heavy precipitation the rating was "Very likely," and for the other two rated subjects, namely, intense tropical cyclone activity and the incidence of extremely high sea levels, the ratings were "Likely."

These scientific evaluations have been assessed by insurance companies doing business in coastal areas where hurricanes and accompanying winds and flooding have caused heavy losses in life and in tangible property. The ramifications will be detailed below.

Reference will also be made to the role of specialized international intergovernmental organizations engaged in disseminating weather and climate information and engaged in mitigating the harms resulting from natural or technological disasters.

1. Introduction

Hurricane Dean, a Category 5 storm, in the Western Atlantic in August 2007, served as a reminder of the need to find means for the identification and tracking of such dangerous events. It brought with it winds of up to 100 miles per hour. Substantial damage occurred in Florida and in Mexico

The Intergovernmental Panel on Climate Change in its 2006 Report assessed the three conditions identified in the Abstract. A major finding was that since 1970 hurricanes and cyclones have produced global warming. This was in contrast to the 2002 Report where scientists concluded that they did not have sufficient evidence to such a link. Attention was drawn to the more efficient means for observation (remote-sensing) and modeling techniques. It was noteworthy in its reference to improvements in the means for measuring atmospheric changes through many information gathering procedures

2. Relevant and Supporting Inquiries

Supporting the 2006 findings were several important public and private scientific reports. Among these was the "Review of the Economics of Climate Change," authored by Sir Nicholas Stern, head of Britain's economic service and former chief economist for the World Bank. Regarded

as a landmark in the struggle against climate change, it concluded that "without rapid and substantial spending, global warming will reduce worldwide productivity on the scale of the Great Depression, devastate food sources, cause widespread deaths, and create hundreds of millions of refugees."¹ It was noteworthy in that it appraised the costs of taking action and those of neglect. Bringing carbon emissions under control was found to be mandatory.²

States have engaged in cooperative efforts to reduce greenhouse gas emissions. In December, 2006, the European Union issued an order for member countries to meet commitments under the Kyoto Protocol. The announcement furthered the goal of creating an international market in emission credits.

The Group of 8 (G-8) have also taken strong positions regarding climate change. In its 2007 meeting the German Chancellor, Angela Merkel, called for the world to cut global CO₂ emissions from the 1990 level by one-half by 2050. The proposal was rejected by the United States and Australia. They repeated their opposition in the 2007 session of the Asia-Pacific Economic Cooperation forum. Following the 2006 Report President Chirac called on the United Nations to replace the UN Environmental Program and to replace it with an agency that would be an instrument for evaluating ecological damage and how to remedy it.

American support for the basic recommendations of the IPCC were voiced in an editorial published in *Aerospace*, the official publication of the

AIAA.³ Officials of the numerous departments and agencies concerned with the causes and effects of global warming voiced support for the Panel's conclusions. Among those who endorsed the Panel's reference to scientific findings was James Hansen, Director of NASA's Goddard Institute for Space Studies. Speaking in his private capacity as a citizen he called for a moratorium "on the building of new coal-fired power plants." Support for the Panel's findings also came from major investors who called for mandatory national caps on emissions linked to global warming. A spokesman for the National Mining Association, taking note of the needs of the economy for energy, suggested that the Hansen proposal was not a reasonable one.

Among the other U. S. governmental agencies interested in the problem is the National Center for Atmospheric Research (NCAR), which is engaged in storm-forecasting research. In August, 2007, it emphasized the difficulty of measuring the intensity of hurricanes. This was in spite of the fact that the National Hurricane Center had access to new hurricane-forecasting software as well as information from satellites, hurricane-hunter aircraft, and other sensing programs, including ocean buoys. NCAR employs models designed to reproduce realistic storm structures. They have been improved but are still regarded as unreliable in measuring the intensity of hurricanes and other storms.

3. Commercial Perspectives

To the extent that global warming has contributed to the increasing number of hurricanes, and the

gravity of the resulting damages, calls have been voiced for a substantial increase in the detection of the sources of atmospheric change. These have focused on the kinds of fuel used or potentially available. A major factor is the burning of coal to create energy. Major sources of carbon dioxide have been China, India, and the United States, with countries of the European Union being not far behind. Major alternatives are nuclear energy and wind turbine power. The economic and environmental costs of providing ethanol for motor fuels reportedly is greater than the environmental benefits.

Despite safety concerns resulting from the malfunctioning of nuclear power plants, with none having been constructed recently, although several are in planning stages, nuclear fuel has been regarded in some quarters as the preferred source of energy. Automobiles could be powered by hydrogen, natural gas, and electricity. To avoid the entry into the atmosphere of carbon dioxide, it has been suggested that since it can be absorbed in coal beds, that it can be captured and used. When the beds are at shallow depths this would facilitate the gathering of methane gas.

The insurance industry has called for aggressive governmental policies providing more timely storm warnings and more accurate reports on the early formation of hurricanes. Contemplated are more successful defensive preparations and activities. Premiums for storm insurance are on the rise, and this has had a harmful effect on many areas prone to natural disasters. Hurricane Katrina serves as a constant reminder of the overall economic costs. Much of New Orleans was destroyed.

Populations in large numbers left the area and have not returned. The non-use of former commercial and residential areas has imposed serious constraints on the city's tax base, and this has impeded additional recovery. As a result the economy of the area, despite many serious undertakings, has been very critically affected. Concerns exist that the old New Orleans will never again reach its earlier importance.

Several economic costs, which have been passed on to consumers, have resulted from efforts to reduce atmospheric changes. One has been the increased costs to motorists to operate motor vehicles, especially as reflected in gasoline costs. A second has been an increase to consumers of the prices of cereal-based foods. This has been based on the increase in ocean temperatures along the western coast of South America, the home of El Nino. The higher temperatures have reduced the production and harvesting of anchovies, which is a substantial source of food for livestock. High costs have driven up grain prices, and these costs have been passed on to consumers.

Another economic response to global warming has been the creation of the Chicago Climate Exchange. It is a world-wide commercial center allowing for the purchase and sale of emission credits. A similar exchange is located in London.

The legal profession has not been inattentive to environmental harms resulting from greenhouse gases. Lawyers have been called on by polluters to provide advice on existing legislation and international agreements. Others have filed "class actions" on

behalf of individuals, principally those alleging impairments to their health. Included as defendants were banks, the energy sector, insurance companies, and retailers. While at first glance it might appear that that a bank was not engaged in such activities, the suits have alleged that lending institutions make loans to coal-fired power companies and that the banks thereby play a role in the dissemination of emissions. Law suits have also been filed in the United States by consumers charging that the Federal Environmental Protection Agency has failed to enforce statutory provisions requiring the reduction of climate changing ingredients. Lawyers, joined by scientists, have asked Congress to hold aggressive oversight hearings on the EPA's greenhouse gases emissions programs. A part of the strategy on this subject is to require political figures to be more attentive to the facts presented by informed scientists. In California in 2006 the Attorney General filed actions against automobile manufactures for environmental damages allegedly caused by emissions.

By 2007 political leaders in the United States have been forced to give more attention to environmental concerns. The 2007 Report has been taken seriously. Those with longer memories have recalled Vice-President Gore's 2002 book entitled "Earth in the Balance," and his striking and influential documentary 2006 film entitled "An Inconvenient Truth." Public opinion on the subject turned more in the direction of the environmentalists.

All of these factors point forcibly to the need to take corrective action before it is too late. Remote sensing can play a major role in weather forecasting.

This is an early and critical aspect of the successful remedying of all of the difficulties that have been identified.

The 2007 Report described global warming as a “run-away train.” Notice was taken of the serious impact on the ice areas of the Arctic. One result has been the merging or consolidation of the sea. This has produced major challenges to the well-being of man, animals, and plants living in the area. Given the progressive deterioration produced by climate change, the conditions so readily observable in the Arctic will become even wider and larger in the years ahead.

4. Conclusion

The Remote Sensing principles were designed to contribute to a higher degree of transparency so that mankind might improve its understanding of the universe including outer space and the earth. In the years since 1986 opportunities have existed for the sharing of the newly acquired raw data and to a large extent the knowledge contained in analyzed information. As time has passed a higher degree of certainty has resulted regarding the relationship between the warming of the earth’s atmosphere and general weather conditions including the lifespan of hurricanes. The February, 2007, IIPC Report, based on scientific findings, demonstrated that such findings were entitled to increasing certainty and reliability. Of particular importance to scholars and to the general public, regarding the formation of hurricanes and an understanding of the devastation caused by them, were the Sections on “Surface and Atmospheric Climate

Change” and on “Oceanic Climate Change and the Sea Level.”

Even before the United Nations Conference on the Human Environment was convened in Stockholm in 1973 informed persons were calling attention to the forces that were producing greenhouse effects. Although States continued to monitor the situation, it was not until agreement was reached in the Kyoto Protocol in 1997 that positive steps were taken to establish international standards. The failure of that effort can be attributed primarily to the United States and to China, where economic interests were allowed to prevail over the needs of the general public for a healthful living environment. The success of the automotive industry was linked to a viable economy.

On the other hand, global warming, with its substantial causative effect on the formation of hurricanes and the resultant devastating economic consequences has resulted in another approach to actual economic detriment. To be measured and balanced against the activities of manufacturers are hurricane consequences, and failures to make realistic plans to avert their consequences. The example of Hurricane Katrina in and around New Orleans has raised questions respecting losses to the public economy resulting from a substantially reduced population, fewer businesses, and a much smaller tax base for the municipality. For those who survived and now live in pollutant-prone areas the general problems of public health assistance remain a distinct challenge to the areas’ economic wellbeing.

The effective sharing of remote sensed raw data and analyzed information, which has been acquired in most instances only by governmental action, on an international basis, can allow for the preparation and implementation of suitable defensive responses, including the evacuation of persons and the safeguarding of real and personal property. The cost of acquiring and sharing data and information on hurricanes is tiny when compared with general governmental costs, including the more immediate costs involved in “picking up the pieces” following the abatement of such storms.

¹. Los Angeles Times, A4, October 31, 2006.

². Christian Science Monitor, 13-14, February 22, 2007.

³. Vol. 45, No. 3, 3, March 2007. Michel Jarraud, Secretary-General of the W.M.O. has said: “This report by the IPCC represents the most rigorous and comprehensive assessment possible of the current state of climate science and has considerably narrowed the uncertainties of the 2000 Report.” He described the Report as the product of progressive “observations and measurements of the weather and climate.” He added: “Decision-makers are now armed with the latest facts and will be better able to respond to these realities.”

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