World climate panel charts path for action

An international panel of scientists and economists has shifted the threat of climate change from the future squarely into the present.

The United Nations–sponsored committee, which carries the authority of over 2,000 investigators, has concluded that humankind is now altering climate in an identifiable way. It also states for the first time that the expected economic disruptions caused by climate change are large enough to warrant taking action to stem the problem, even if such steps cost money.

The reports issued this month by the Intergovernmental Panel on Climate Change (IPCC) differ in critical ways from the tentative statements put out by the same panel 5 years ago.

"In 1990, we said that on the basis of the observable record alone, we cannot claim to have detected the greenhouse effect," says panel member Tom Wigley, a researcher at the National Center for Atmospheric Research in Boulder, Colo. "We can now see the fingerprint of man in the past temperature record. That's a pretty radical change."

Researchers say that a better search pattern has enabled them to detect the human-induced changes in climate. Previously, they combed temperature records looking solely for the warming effect brought about by emissions of carbon dioxide and other greenhouse gases. Recent studies, however, have proved more successful because they have also taken into account the cooling influence of sulfates derived from sulfur pollution.

Computer simulations that include both greenhouse warming and sulfate cooling match more closely the pattern of observed warming over the last century (SN: 6/10/95, p.362).

Including the effects of sulfate pollution has also caused the IPCC to scale back its assessment of how quickly climate will warm. It now projects 1°C to 3.5°C of warming by the year 2100, with a best estimate of 2°C. In its 1990 report, the IPCC estimated a warming of 3°C over the same period because it anticipated greater future emissions of greenhouse gases.

The revised projections of sea level change call for a rise of 15 to 90 centimeters by the year 2100, with a best estimate of 48 cm. In 1990, the IPCC forecast a 65 cm rise in sea level by 2100.

These conclusions have not yet been released officially; they are slated to appear later this month in a report from the IPCC science committee, known as Working Group I. However, details have emerged over the last 3 weeks as Working Group II issued its assessment of the impacts of climate change and Working Group III released its report on the socioeconomic dimensions of the issue.

The three IPCC assessments will inform ongoing international negotiations concerning limits on greenhouse gas emissions.

According to the impacts committee, the rise in sea level expected by 2100 will put 92 million people at risk of flooding each year, a doubling of the current number. Climate change will also threaten human health and cause significant loss of life by fostering the spread of malaria and other vector-borne diseases, according to the panel.

Warming and changes in rainfall will disrupt agriculture in developing countries, reduce Earth's biological diversity, melt one-third to one-half of existing mountain glaciers, and cause one-third of all ecosystems to shift to another type, such as from forest to grassland.

In its assessment of economic studies conducted to date, the IPCC found that the expected benefits of climate change will not balance the anticipated damage. Although various analyses disagree on the extent of future costs, they justify taking action "beyond no regrets" strategies, concludes the IPCC. The term no regrets refers to options that would not only mitigate climate change but also be considered worthwhile for other reasons. Promoting energy efficiency, for example, will save money while reducing greenhouse gas pollution.

"This is the first time an IPCC report has concluded there is good reason to take action on a precautionary basis, beyond those measures that cost nothing," says Florentin Krause, a member of Working Group III and an energy modeler with the International Project for Sustainable Energy Paths in El Cerrito, Calif.

"After all is said and done, the net present value of the damages that we risk incurring is so large that it is rational for precautionary action to be taken, even if it does cost money," he adds.

To deal with the inherent uncertainties of climate change, the IPCC panel advocates pursuing a portfolio of actions aimed at mitigation, adaptation, and improving knowledge. As future findings improve understanding, countries could adjust their portfolios, just as an individual would shift investments to keep up with a changing market.

Gains of 10 to 30 percent in energy efficiency alone could be achieved at little or no net cost over the 20 to 30 years, according to the IPCC. In the long run, some studies suggest, developed countries could reduce their greenhouse gas emissions by 50 percent at little cost. Other analyses, however, conclude that major reductions will cost several percent of a country's gross domestic product. *— R. Monastersky*

Squeezing H_2 and O_2 yields new compound

Water, water, everywhere—and now a new property to think about.

Researchers studying mixtures of oxygen and hydrogen have found that the two gases—which normally combine explosively to form water (H_2O)—appear to combust less readily under extreme pressure than they do under ordinary atmospheric pressure.

This unusual observation, reported in the Nov. 2 NATURE by chemists Paul Loubeyre and René Le Toullec of the University of Paris, shows that even with such a highly combustible mixture as H_2 and O_2, "high pressures can lead to unexpected behavior."

Ordinarily, higher pressures enhance reactivity. Yet Loubeyre and Toullec found that oxygen and hydrogen, carefully pressurized in a diamond anvil container to 76,000 atmospheres at room temperature, resisted explosive condensation into droplets of water.

Instead, the gaseous molecules appeared to cluster quietly into a 14-atom compound containing three molecules of oxygen and four molecules of hydrogen. The researchers call this blend an "O_2/H_2 alloy."

"At this stage, we cannot tell whether this alloy is a disordered solid," they report, or some other type of mixture. Interestingly, they say, the spectroscopic measurements made of the pressurized oxygen-hydrogen mixture "are almost identical" to those of the separate elements in solid form—"which is quite surprising," they add.

Information from this experiment could prove useful in the development of novel energy-storage systems, including better rocket fuels, the two scientists speculate. It might also help explain unusual features of the interiors of the outer planets, such as Jupiter, whose cores contain much pressurized hydrogen, helium, oxygen, and ice.

That pressure caused the reaction rate of oxygen and hydrogen to slow down rather than speed up is "remarkable," writes Russell J. Hemley, a chemist at the Carnegie Institution of Washington, D.C., in NATURE. "Perhaps the greatest implications are for fundamental chemistry." Although this reaction has been "exhaustively studied since the earliest days of chemistry," it continues to reveal new phenomena, he adds.

The atomic details of hydrogen-oxygen bonding, Hemley says, have remained "enigmatic." Yet a deeper understanding of the reaction's subtleties could affect our view of the solar system, given the abundance of these elements and their importance to planetary science. *— R. Lipkin*