GLOBAL CHANGE

# Greenhouse Report Foresees Growing Global Stress

Advocates of controls on greenhouse gas emissions received some potent ammunition last week when the United Nations–sponsored Intergovernmental Panel on Climate Change (IPCC) released a major report in Washington. The panel concluded that global warming could affect everything from ocean fisheries to human health, generally for the worse. And it declared that the warming and its effects could begin to be mitigated at a surprisingly low cost.

"Our first major conclusion is that climate change is an important new additional stress" on global systems both natural and human, said Robert Watson, associate director for environment in the White House's Office of Science and Technology Policy and co-chair of the study group. "Nearly every system we looked at is vulnerable. Climate change will affect all countries in one way or another—some beneficial effects and many adverse effects," among them the spread of tropical diseases including malaria (*Science*, 17 February, p. 957). And because of the cost and technological challenge of coping with these changes, he said, "the developing world in general is more vulnerable than the developed countries."

But in a second, more controversial conclusion, the group found, as Watson put it, that "significant decreases in greenhouse gas emissions are technically and economically feasible." Now it's up to the policy-makers, he said: "The challenge [they] have is to take our best estimates [of impacts and alternatives] and make decisions about how they want to deal with climate change."

The new assessment of impacts and alternatives is part of a massive international effort by the IPCC to sum up the current status of climate change science. Organized under the United Nations Environment Program and the U.N.'s World Meteorological Organization, IPCC is issuing its first full, three-part assessment in 5 years. The 1800-page report on impacts, mitigation, and adaptation has been 2 years in the making, involving about 500 scientist authors and another 500 reviewers from more than 70 countries.

The group, known as Working Group II, took as its starting point the conclusions of another IPCC group, Working Group I, on the likely magnitude of climate change. Its report, due out at the end of November, concludes that the world could warm between 1°C and 3.5°C by the year 2100. The exact figure will depend on how much carbon dioxide and other greenhouse gases humankind pumps into the atmosphere and how sensitive climate is to the added greenhouse gases.

The new upper limit of warming is lower than the 5°C the IPCC had forecast 3 years ago in an interim report, largely because of the newly appreciated cooling effect of pollutant aerosols (*Science*, 16 June, p. 1567). But a warming near the upper limit of the new range could still have dramatic impacts, Working Group II concluded. Midlatitude climate zones, for example, would shift northward by a hefty 550 kilometers over the next century. At that rate, some species of trees might not be able to keep up and might simply die out. In eastern North America, the panel says, a high-end warming would wipe out much of the eastern hardwood forest, opening the way for grassland and scrubland.

For human health, too, the effects at the high end of the temperature scale look disturbing—all the more so, perhaps, because the experts assessing health effects considered only a 3° to 5°C warming in their preliminary analysis. The expansion of the tropical and subtropical areas that favor malaria-transmitting mosquitoes would lead to an additional 50 million to 80 million cases of malaria each year late in the next century, said the report—a 10% to 15% increase. Dengue, yellow fever, and viral encephalitis would presumably increase as well at the high end of warming, the group found.

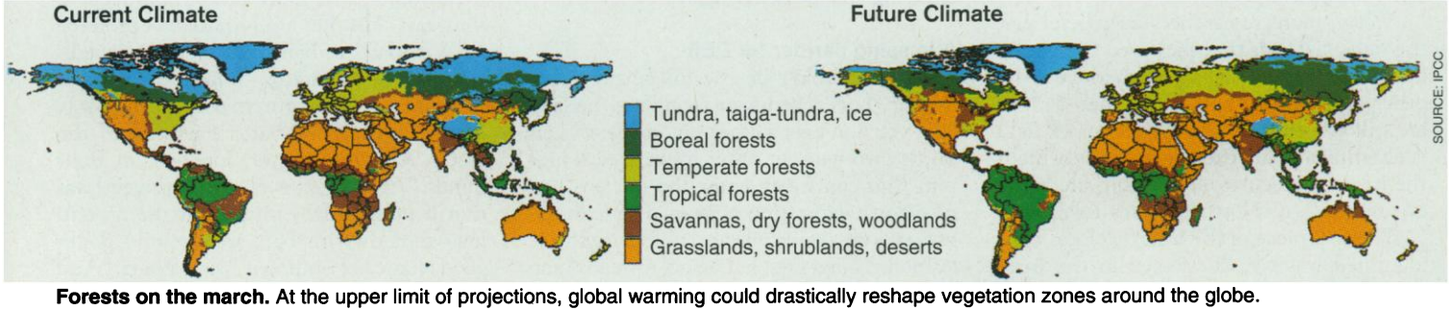
All of these effects and a litany of others—increased coastal flooding due to sea-level rise, loss of mountain glaciers, shifting agricultural areas, land losses on low-lying coasts—could be mitigated with the right technology, according to the report. "There is a 10 to 30% greater-than-present level of efficiency [in energy consumption] that could be attained at little or no additional cost" over 3 decades, said James Edmonds of Battelle Pacific Northwest Laboratories' office in Washington, D.C., who contributed to the report. The savings could come from everything from more efficient heating and lighting to superlightweight motor vehicles.

Not everyone agrees with the technologically upbeat tone of the report. John Shlaes, executive director of the Washington-based industry lobby group Global Climate Coalition, calls many of the proposed mitigation options "speculative technologies and wishful thinking." He also disputed the working group's optimistic view of how much mitigation would cost, arguing that the group overlooked macroeconomic factors. In the long run, for example, an energy-efficient light bulb might more than pay back its high initial cost, but, macroeconomists might ask, will consumers buy it without a costly incentive? Michael Oppenheimer of the Environmental Defense Fund in New York believes "the truth is probably somewhere in between" the technological optimism of the report and the pessimism of macroeconomists.

But there seems to be little debate over another point made in the report: Developing countries will suffer the most from any effects of global warming. "At the low end [of the projected warming], a country like the United States faces costly adaptation ... but I don't think it will wreck the country," says Oppenheimer. "But some developing countries, even at the low end of warming, are facing a grim future." As the report notes, countries lacking large social and economic resources—especially those in semiarid, tropical to subtropical regions where agriculture is already marginal—will be hard-pressed to adapt to warming by changing crops, say, or improving irrigation systems.

On the other hand, says Oppenheimer, "at the high end of projected warming, all societies face substantial disarray." Adds Watson: "The message of this report is that we all must be concerned about climate."

**–Richard A. Kerr**




**Forests on the march.** At the upper limit of projections, global warming could drastically reshape vegetation zones around the globe.