

Acclimating to a Warmer World

With some climate change unavoidable, researchers focus on adaptation

By RICHARD MONASTERSKY



In November 1950, a storm sent sea water flooding over dikes at La Guardia Airport in New York City.

Next January, shortly after the Y2K bug comes out of hibernation for its New Year's feast, a group of U.S. researchers will report to Congress and the President on an even less tractable problem: the issue of global climate change. The study will offer up now familiar charts of rising temperatures, swelling seas, and strengthening storms, but it will also present an expansive new strategy for dealing with the threat of greenhouse warming.

For more than a decade, climate scientists have been following essentially one route by investigating the need to limit emissions of carbon dioxide and other heat-trapping gases. Their work on mitigation strategies helped forge the 1997 Kyoto Protocol, an international treaty that would force industrialized countries to cut emissions by 5.2 percent over the next 10 years or so (SN: 12/20&27/97, p. 388). The agreement, however, has garnered little support in Congress, which objects to a treaty that doesn't include limits for developing nations as well.

Amid this political thicket, scientists in the United States and around the world are now taking a different course—recommending that society find ways to adapt to a warmer world. The approach doesn't represent a reversal so much as a broadening of paths. While reducing

emissions is a necessary step, researchers say, the Kyoto accord cannot succeed on its own or reap immediate results. In fact, adapting to warmth may even allow some industries to benefit from novel economic opportunities.

"No matter what happens with these international agreements, we are experiencing climate change now, and we will be experiencing it for many decades," says Michael C. MacCracken, who is helping coordinate the U.S. study, which goes by the unwieldy title of the U.S. National Assessment of the Potential Consequences of Climate Variability and Change for the Nation.

"We really need to focus on adapting and coping with a changing situation," says MacCracken. "Mitigation is aimed at trying to slow or stop climate change out several decades to centuries from now, and that's a very important issue. But in the meantime, society is making a lot of choices that will determine how we are going to be affected by changing climate in the future."

The fatalism now creeping into climate studies grows in part from a simple and disturbing realization.

"It's only when you start to calculate through the numbers that have been pro-

posed for emissions reduction in the Kyoto agreement that you realize it's barely scratching the surface of the problem," says Martin Parry of the University of East Anglia in England. "So, even if you get full implementation now of the Kyoto proposals, you can see from those numbers the relatively small amount by which climate change is drawn down," says Parry, who studies how climate shifts will affect global food supplies.

Computer models, for example, project that with no emissions limits, global temperatures will climb 2.5°F by the year 2050. The Kyoto Protocol would shave only 0.1°F off that amount of warming, according to Parry and his colleagues, who discussed these results in the Oct. 22, 1998 NATURE.

Moreover, the protocol wouldn't seriously ameliorate the suffering due to climate change, they say. According to their calculations, the Kyoto agreement would leave unchanged the population threatened by water shortages in the middle of the next century and would reduce by only 4 percent the number of people facing an added risk of coastal flooding from rising seas.

Water shortages aren't inevitable, however. Countries can significantly reduce their vulnerability by taking steps aimed at adaptation, contend Parry and his

coworkers. If conservation efforts could squeeze a 5 percent reduction in global water consumption, 600 million people would drop from the list of those potentially at risk of water shortages.

While adaptation can have dramatic benefits, scientists have been reluctant to explore this route in the past, says Parry. "If we start thinking about adaptation, there is a tacit admission that climate change cannot fully be mitigated out of the system. In other words, that's sort of an admission of failure, if you like."

At the same time, he says, the complexity of studying adaptation daunted researchers initially. Mitigation, although hard to accomplish, actually poses a much simpler scientific problem than trying to assess how various regions and sectors of society might adapt to global warming.

Climate researchers worldwide are now plunging into the more difficult task as part of an upcoming study by the Intergovernmental Panel on Climate Change (IPCC). The United Nations body that does scientific analyses for international negotiators, the IPCC is currently drafting its third assessment, a decade after the first one captured worldwide attention.

In 1995, the panel produced an 878-page volume subtitled "Impacts, Adaptations, and Mitigation of Climate Change." At the time, however, the topic of mitigation dominated over adaptation. "Although the word *adaptation* appears in the title of the report, it was barely evident," says James McCarthy of Harvard University, one of the editors of the upcoming assessment. "It will be a much more serious focus this time around," he told an audience in June at a meeting of the American Geophysical Union in Boston.

The IPCC will look at two kinds of adaptations, says geographer Barry Smit of the University of Guelph in Ontario, who is editing a chapter on this topic. It will be critical, he says, to assess how much natural ecosystems can adapt to climate change, as well as to estimate how society may cope. "Getting a handle on the sorts of adaptations that we can reasonably expect to occur is fundamental to any reasonable estimation of the implications—costs and opportunities—of climate change. The research community has gradually recognized this," says Smit.

The weather that scorched much of the United States in July underscored this new research focus by showing just how ill-prepared the nation is to deal with current conditions, let alone those to come.

Across the eastern half of the country,



Reaping the benefits of adaptation: Despite this year's drought, some corn in this Maryland field remains healthy. Tall stalks in the background are protected by an organic mulch that retains soil moisture. Stunted corn in the foreground was planted in bare soil.

dozens of elderly and low-income people baked to death in shuttered homes. In New York City, overheated wires and an unprecedented demand for air conditioning strained the electric-power grid, blacking out parts of Manhattan. Several eastern states have suffered their worst drought on record as unrelenting sun withered crops and drained reservoirs.

If climate scientists are correct, the weather served up this summer is just an appetizer. In the New York City region, for example, the average temperatures may climb 3°F to 4.5°F by the year 2050, according to computer climate simulations. At the same time, the number of days each year exceeding 90°F would grow from the current average of 13 to somewhere between 31 and 37. These data come from the New York component of the national assessment.

Such numbers are not meant to be exact predictions but rather scenarios to help people think about climate change, says the leader of the New York study, Cynthia Rosenzweig of Columbia University and NASA's Goddard Institute for Space Studies in New York City.

The New York study, which will come out as a separate report next year, seeks to analyze just how these changes will affect the 19.6 million people living in the city's greater metropolitan region. To make such a broad assessment, Rosenzweig and her colleagues have brought in local experts who must deal with whatever changes occur. The list includes representatives of utility companies, municipal governments, federal agencies, business people, and community organizations.

As part of the national assessment, similar campaigns involving thousands of people are going on in 14 other re-

gions around the country. In all these studies, the researchers must first map out the range of problems currently plaguing each area. Then, they can ask how climate change will alter the picture.

Global warming will in many cases pile more stress onto already overloaded sectors of society. The transit and sewer systems in New York City, for example, occasionally flood even in current weather conditions, says Rae Zimmerman, professor of planning and public administration at New York University.

"There is a problem with flooding right now," she says. "As climate change becomes more severe, these frequencies are going to be greater."

The sewer system in New York City channels storm runoff into surrounding waterways, but these outlets close automatically during high tides to prevent salt water from backing up into the system. Sea levels are currently inching upward, however, because increasing global warmth is causing ocean water to expand and is melting many glaciers.

In the next century, the rising water will eventually submerge and close the drainage system even at low tide, causing flooding in the streets during storms. Raising the system, says Zimmerman, "would involve massive construction and huge costs."

During December 1992, a strong nor'easter storm caused extensive flooding in the subway, an underground commuter-train system, airports, and high-



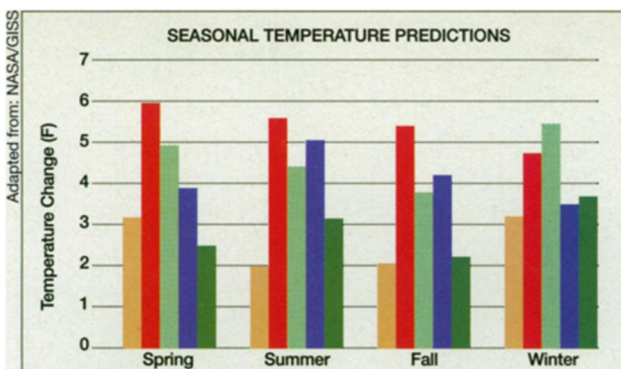
Future floods will strike areas marked in blue, which is land within 10 feet of sea-level in the metropolitan New York City area. Historically, these spots have flooded about once a century. By 2100, water could inundate them every year, according to the worst-case climate models.

ways around the city, says Janine Bloomfield, an ecologist with the Environmental Defense Fund in New York City. Throughout its history, the city has suffered this degree of inundation about once every 40 to 50 years.

With higher sea levels, however, smaller storms should spur similar amounts of flooding. Projections suggest that the type of inundation seen in 1992 could happen every 13 years by 2100. In the most worrisome projections from a set of four climate simulations, such events would recur every year, according to a report issued by Bloomfield and her colleagues in June. In that study, the Environmental Defense Fund borrowed climate scenarios from Rosenzweig and the ongoing New York assessment.

Rosenzweig says the New York study will help in planning for the future. The city's water supply, for instance, comes mostly from upstate river systems, but it draws from the Hudson in cases of drought. As salt water from rising seas moves farther up the Hudson, it will reach the site of the current pumping station, forcing managers to move the intake, she says.

Part of the success of the study, she says, will come from bringing together climate experts and a diverse set of so-



Adapted from: NASA/GISS
What degree of warming? Scientists used two computer models to estimate the temperature rise in New York City by 2050. Red and aqua bars indicate numbers from a Canadian model, blue and green come from a British model. The aqua and green bars depict less warming because they include the cooling effect of sulfur pollution. Tan bars represent what would happen if historical temperature trends continued.

called stakeholders, people who will be affected by coming changes. "The institutional constraints to adaptation are so complicated. By working this through, we'll be improving the potential for adaptation," she says.

In some cases, the researchers envision windfalls from future weather. "It's very easy to fall into the assumption that it's all going to be negative," says William Solecki, a coleader of the New York study and a researcher at Montclair State University in New Jersey. "We're trying to al-

so look at what might be opportunities. With more moderate winter temperatures, maybe retirement communities might be more willing to locate to the region rather than going further south."

A world away from Manhattan, residents of the Great Plains are also straining to see what lies decades ahead. To do that, researchers have looked back to see what kinds of climate shifts have happened before.

"One of the things that seems to be emerging in our analysis is that various management systems have evolved in the last 30 years, when temperature and precipitation have been more stable," says Dennis Ojima, an ecosystem scientist at Colorado State University in Fort Collins who heads the central Great Plains assessment. This region typically experiences much larger climate shifts than occurred over the past 3 decades, he says, and projections suggest that the swings will intensify with climate warming.

"We have to be more agile and flexible in dealing with that year-to-year variability in climate," says Ojima.

The agricultural industry, he says, can respond by maintaining a diverse selection of crop varieties and breeds of livestock. Water managers have suggested storing water in underground aquifers, instead of in open reservoirs that lose much of their moisture to evaporation.

While the assessment process has helped identify opportunities for adaptation, says Ojima, it has also served as a way to bridge the gap between climate researchers and the public. "As a researcher, I've learned a lot in discussions with people in terms of understanding what information is most useful to them." Equally important, he has dispelled many myths about climate change and has started getting more people to consider the potential impacts of global warming on their lives.

Indeed, many scientists involved in making the national assessment view the process as just as important as the reports they will eventually produce. "One of my personal hopes for the legacies of the assessment activity is that we'll have built some networks of people who can think about these issues," says one of the study's coleaders, Jerry Melillo of the Marine Biological Laboratory in Woods Hole, Mass.

This arrangement leads to a more comprehensive approach that links climate threats together with all the other civic and resource problems affecting each region. Only by considering these together, say the scientists, can society hope to cope with some of the inevitable challenges just over the horizon. □

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