Kates, R. W. and R. D. Torrie. 1998. "Global Change in Local Places," Environment, Vol. 40. No. 2, pp. 5, 39-41.

Global Change in Local Places

By Robert W. Kates and Ralph D. Torrie

Policymakers and researchers from numerous disciplines are now engaged in a major effort to link the local with the global. That is, they are looking at the great global changes that are now under way in the environment, society, technology, and culture in terms of their effects on the local places in which individuals actually live and work—and on the ways in which local activities contribute to global change. This trend is clearly evident in recent efforts to prevent global climate change, where bottom-up initiatives are being accompanied by efforts to downscale both science and policy.

While most scientists recognize that global change is broader than environmental or climate change, the bulk of current research deals with one particular aspect of climate change, namely, global warming. This research is usually top-down. It begins with a computer model of the global atmosphere to which features of the oceans, land surface, and vegetation have been added. This model is used to obtain rough estimates of the extent of global warming and the changes in the hydrological cycle (along with crude estimates of their spatial patterns), usually for a benchmark doubling of carbon dioxide and other greenhouse gases. These results are then used to simulate the possible impacts on nature and human activity, which in the latest international assessment included 9 natural ecosystems and 10 managed systems that provide water, food and fiber, human infrastructure, and health services.[1] Inventories of the ways in which society can abate or mitigate greenhouse gas emissions or adapt to climate change are then drawn up, and the socioeconomic costs and benefits of such actions are explored via integrated global models of climate change and societal response.

This enormous analytical effort has been organized by the Intergovernmental Panel on Climate Change (IPCC), which is responsible for conducting scientific assessments of climate change, its impacts, and potential responses to it. These assessments provide needed scientific and technical information to the approximately 160 nations that have signed the United Nations Framework Convention on Climate Change, which aims at stabilizing greenhouse gases at a level that will "prevent dangerous anthropogenic interference with the climate system." (For more details on the latest IPCC assessment of the climate situation, see pages 23-39 of the November 1997 issue of *Environment*.) The signers meet regularly. Their most recent meeting was held in Kyoto, Japan, in December, where the industrialized countries made legally binding commitments to reduce their emissions of greenhouse gases. Thus, the major policy focus is on international agreements that encourage or mandate national actions.

Actions to abate greenhouse gases are never global, however, and despite much of the rhetoric, most are not even carried out at the national level. Rather, they occur when individuals and organizations modify their behavior, change their activities, and employ different technologies—all decisions that are made at the local level.[2] Thus, there has been growing interest in a bottom-up approach to both science and policy, one that would enhance the ability of individual localities to do their own scientific assessments and then to act on them. To revise the well-known slogan, the challenge is to "think locally but act globally" as well as doing the reverse.

One major effort to do science from the bottom up is being sponsored by the Mission to Planet Earth program of the National Aeronautics

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Institutions

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and Space Administration through the Association of American Geographers. In this project, the scientific competence and local knowledge found in many regional colleges and universities is being tapped to determine the linkages between individual localities and global climate change. The project is looking at such key questions as how local places contribute to global change, how their contributions change over time, what forces drive such changes, what control local interests have over such forces, and how likely it is that mitigation and adaptation efforts will be initiated and adopted locally.

A basic assumption of the project is that there is untapped scientific competence in regional and local institutions of higher learning that focus primarily on teaching rather than research. While deeply involved in teaching, training, and research related to local or regional problems, these institutions are poorly linked to the international scientific effort found in such projects as the International Geosphere-Biosphere Programme of the International Council of Scientific Unions and the Human Dimensions Programme of the International Social Science Council (which tend to draw participants from large research universities or specialized institutes). Yet teaching institutions possess two important qualities that research universities do not: extensive local knowledge and a long-term commitment to their area or region. It is precisely that knowledge that is needed to make local assessments and to guide local initiatives for abatement and adaptation. And it is long-term commitment that makes it possible to address an issue such as climate change, where the full impacts may not be felt for many years and where actions taken now will have implications far into the future.

In the first or pilot phase of the project, three study areas in the United States, each about one equatorial degree (13,000 square kilometers) in size, were selected. These areas were small enough to reflect a range of local concerns but large enough to be represented in global models, which characteristically focus on areas 5 to 10 degrees square in size. The three areas also represented diverse sources of and sinks for greenhouse gases. The Blue Ridge-Piedmont region of North Carolina combines rapid growth with a diverse array of rural and urban activities and extensive forests on its western border. The High Plains-Ogallala region of southwestern Kansas is thinly populated but has intensive agriculture (which draws on an ancient but declining aquifer), livestock production, and natural gas extraction. The Great Lakes-Manufacturing region of northern Ohio, characterized by "rust belt" industries closely linked to automobile production, is still in the midst of a major restructuring.

At these sites, teams of researchers from Appalachian State University in Boone, North Carolina, Kansas State University in Manhattan, and the University of Toledo in Toledo, Ohio, have been estimating the local contributions to those changes in land use and atmospheric conditions that affect the radiation balance, namely, emissions of greenhouse gases and aerosols and the reflective surface of land cover. To do this, they have had to develop new methods for estimating greenhouse gas emissions because the methods used in international assessment efforts are too complicated and data-intensive for most local studies and do not provide the information local areas need. Even in the data-rich United States, many of the data sets needed are not available at local or county levels. For example, fossil fuel consumption—the single most important variable in carbon emissions—is not measured locally. Similarly, electricity generation and consumption data rarely correspond to local areas of concern, and releases of ozone-depleting chemicals (which also have a major greenhouse effect) are estimated only by means of national production data.

The current data categories also focus on the emissions themselves rather than on the people and organizations that produce them (and who could conceivably control or mitigate those emissions). Under the current system, for example, households in a given area cannot determine the portion of overall emissions for which they are responsible. That is because many emissions logically attributable to households are reported in other categories. Emissions stemming from household consumption of electricity, for instance, appear in the utility category, while those related to household travel appear in the transportation category. In the same vein, methane gas originating in household waste is recorded as coming from municipal landfills, and household use of ozone-depleting chemicals is estimated simply as a per capita percentage of national production. To obtain more useful data, the research teams had to develop new estimation methods. Although this was incidental to the study effort, it

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EDITOR'S NOTE

For about a dozen years, *Environment* has published profiles of organizations in a semi-regular Institutions column. While this column highlighted worthy groups, we felt it appropriate to look at the broader concept of institution as needed social inventions: organizations and their procedures of adjudication, rules of conduct, and agreed upon methods of conducting discourse. We introduce this expanded definition with this article, which examines new efforts to work on global change from the bottom up rather than from the traditional top-down approach.

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was a necessary prerequisite to ascertaining emitters' perceptions of global warming and their willingness to take remedial action.

The results to date for the three study areas clearly demonstrate the many ways in which local emissions (and their evolution over time) differ from those of states, provinces, and nations, and thus argue for incorporating local knowledge in global change research. The importance of local knowledge and local contacts should become even greater when the opportunities for abatement are addressed during the project's next stages. Because all three research teams are based in geography and planning departments whose members include many former students, their views enjoy considerable credibility in their respective localities. Well-known and respected experts from local universities are much more likely to convince local people that they have a stake in environmental change and the efforts to mitigate it than are unfamiliar experts from beyond the area. Academic research teams with local expertise but little or no previous experience in global change research can thus be of service to both the global change research community and the institutions of which they are a part.

One of the earliest local initiatives was the Toronto-based International Council for Local Environmental Initiatives (ICLEI), which has focused on policy issues in larger cities or metropolitan areas. In 1990, ICLEI launched its Urban CO_2 Reduction Project to foster local government commitments to reduce greenhouse gas emissions. Beginning with a group of 12 North American and European cities that had pledged to reduce their emissions, a collaborative research effort was undertaken to identify the issues and develop and test methods that local governments could incorporate in their emissions reduction strategies.[3]

In 1995, ICLEI established the Cities for Climate Protection Campaign to accommodate the growing number of local governments committed to reducing greenhouse gas emissions. By late 1997, this rapidly growing program had 203 members worldwide, including 50 in the United States. Together, these cities account for 5 percent of global carbon dioxide emissions. Cities that participate in the campaign have to complete five key tasks or milestones, namely, conducting an energy and emissions inventory; preparing a forecast of future emissions; setting an emissions reduction target; formulating a local action plan to achieve the target; and implementing policy measures to reduce emissions of carbon dioxide and methane. To assist participating cities, ICLEI has developed a set of analytical tools that enable them to readily track their own emissions, forecast changes over time, and assess the potential impacts of a variety of technical and policy measures.[4]

In preparation for the Kyoto conference, ICLEI surveyed participants in the Cities for Climate Protection Campaign about their progress. Of the 97 that responded, 64 have completed their emissions inventories, 48 have formally adopted emissions reduction targets, and 62 are currently implementing measures to reduce carbon dioxide and methane. Indeed, most cities begin to implement emissions reduction measures upon joining the campaign, both to build public support and to gain experience with energy-efficiency retrofits. Because the Cities for Climate Protection Campaign stresses a quantitative and analytical approach, it typically takes members two or three years to complete the emissions inventory, forecast, setting of targets, and action plan.[5]

Most of the cities that have adopted a target have committed themselves to a 20 percent reduction in emissions (from their level in 1990) by 2010, although 18 cities have adopted more stringent targets. How stringent these targets are can be gauged by comparing them with those adopted in Kyoto, namely, 6 to 8 percent for the major industrialized countries. But the experience of three participants who completed the five milestones four years ago (Portland, Oregon, Saarbrücken, Germany, and Toronto) is both encouraging and cautionary.

All three of these cities have commitments to environmental quality and reductions in energy use that predate the program (Saarbrücken's dates back to the energy crisis of the early 1970s). Thus, their efforts to deal with global climate change are connected to other issues on their agendas, such as job creation and improving air quality and overall urban livability. In addressing these joint problems, these cities have developed new energy technologies, lowered traffic congestion and air pollution, increased recycling to reduce the need for landfills, and adopted land-use planning that discourages sprawl, reduces travel time, and makes energy efficiencies possible. To date, they have seen a marked reduction in per capita emissions of greenhouse gases. This has required considerable investment (about $50 per capita), and the cities have developed novel ways to raise funds with help from private industries or federal and state governments. The gains from these investments have been multiple: new jobs, economic development, and increased competitiveness; less air pollution and waste; more comfortable housing and workplaces; more livable neighborhoods; and, of course, reduced emissions.

While per capita emissions have declined in all three of these cities, increases in population, the number of households, and average miles traveled, along with externally caused shifts in the types of fuel used to generate electricity and the mix of local industries, have led to variable results in overall emissions reduction. Between 1990 and 1995, Portland experienced an 8 percent increase in emissions of carbon dioxide, while Toronto experienced a 7 percent decrease and Saarbrücken a 15 percent decrease. There is also some concern about the pace of future reductions. Some of the measures being imple-

mented promise long-term sustained reductions. But countering these are the negative trends: energy deregulation and consolidation that will lessen municipal influence over utilities; the continued decline in the prices of fuels, which make investments in energy efficiency harder to justify; the failure of national governments to adopt or maintain regulations that encourage efficiency investments; and metropolitan expansion that increases both the size and the problems of these cities. Thus, while the record to date is encouraging, emerging problems argue for caution.

As the bottom-up initiatives in global change science and policy are taking root in local areas and communities, the top-down efforts are undergoing a vigorous downscaling. The latter include efforts to estimate greenhouse gas emissions for nations and subregions within nations, to apply the scientific information from the models to subcontinental regions, to improve forecasts of regional (if not local) impacts, and to make integrated assessments more useful to individual localities.

There is still quite a large gap between science and policy at the global and national levels and their counterparts at the municipal or even the 1-degree grid levels. For some time to come, however, the new "asphalt and grass roots" science and policy institutions will provide scientific direction that will make downscaling efforts more useful, that is, that will enable them to serve as laboratories of action for reducing greenhouse gas emissions and to identify those technologies and policies that can maintain the livability of both the global climate and our local places.

NOTES

1. See J. T. Houghton et al., eds., *Climate Change 1995: The Science of Climate Change*, Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change (New York: Cambridge University Press, 1996); R. T. Watson, M. C. Zinyowera, and R. H. Moss, eds., *Climate Change 1995: Impacts, Adaptations, and Mitigation of Climate Change—Scientific-Technical Analyses*, Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change (New York: Cambridge University Press, 1996); and J. P. Bruce, H. Lee, and E. F. Haites, eds., *Climate Change 1995: Economic and Social Dimensions of Climate Change*, Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change (New York: Cambridge University Press, 1996).

2. Of course, global agreements and nationally imposed regulations may be required to initiate such actions.

3. See R. D. Torrie, *Cities and CO_2: Research Results and Policy Implications from the Urban CO_2 Reduction Project* (Toronto: International Council for Local Environmental Initiatives, 1993) (available from the International Council for Local Environmental Initiatives, 100 Queen Street, Toronto, Ontario, Canada M5H 2N2, or at http://www.iclei.org); and L. D. Danny Harvey, "Tackling Urban CO_2 Emissions in Toronto," *Environment*, September 1993, 16.

4. The resources available to participants in the campaign include case studies, handbooks, and specialized software for quantifying emissions and emissions reductions. In addition, the U.S. Environmental Protection Agency has sponsored a series of workshops in which participants shared their experiences and received training in the development and implementation of local action plans. A standardized approach has emerged and been embodied in the software. This is described in R. D. Torrie, *Urban Greenhouse Gas Inventories and Emission Reduction Assessment: Toward a Standardized Quantification Framework*, rev. ed. (Toronto: International Council for Local Environmental Initiatives, 1996). See also Torrie Smith Associates and International Council for Local Environmental Initiatives, *Protocols and Guidelines for Reporting in the Cities for Climate Protection Campaign* (Toronto: International Council for Local Environmental Initiatives, 1997); and R. D. Torrie and P. Jessup, *Saving the Climate, Saving the Cities: A Briefing Book for Local Governments*, 3rd ed. (Toronto: International Council for Local Environmental Initiatives, 1995).

5. For details on the campaign's results to date, see International Council for Local Environmental Initiatives, *Local Government Implementation of Climate Protection: Report to the United Nations* (Toronto, 1997); and International Council for Local Environmental Initiatives, *U.S. Communities Acting to Protect the Climate: A Report on the Achievements of ICLEI's Cities for Climate Protection—U.S.* (Toronto, 1997). Both reports are available from the International Council for Local Environmental Initiatives at the address given in note 3 above.