FORUM

Climate Science to Citizen Action: Energizing Nonformal Climate Science Education

PAGES 204–205

Within the United States, public discourse on climate science and society's response to climate change are changing rapidly [*Nisbet and Myers*, 2007]. Awareness of the seriousness and urgency of the problem has been increasing, as has understanding of the complexity and scale of change in human behaviors and technologies that will be required to stabilize greenhouse gas emissions to mitigate climate change (see a Yale University/Gallup/ClearVision Institute poll at http://environment.yale.edu/news/Research/5310/american-opinions-on-global-warming-summary/). A tremendous opportunity exists to build upon this nascent awareness and enhance the degree to which U.S. citizens are informed about, and are ready to take action on, this defining challenge of the 21st century.

Although progress has been made in understanding the degree to which human activity contributes to climate change, disbelief and confusion persist and are frequently coupled with a tepid understanding of, and limited commitment to, changes in policy, technology, lifestyle, or behavior to reduce emissions. The scale of societal action required to stabilize greenhouse gases is enormous; to reach this scale, a deeper and more consistent public understanding of climate science and its implications for society is necessary. The term "climate science" used in this context reflects a multidisciplinary, integrated definition that includes technical, economic, and behavioral/social aspects associated with both the climate change problem and potential solutions.

Existing climate science educational resources are diffuse: Valuable information is dispersed among many different Web sites and organizations, and this information is of variable accuracy, quality, and accessibility. Given the urgency of the need for enhanced climate science understanding, it is critical to reduce redundancy and improve coordination of climate science education in at least three ways: (1) by unifying definitions and content of basic climate literacy, (2) by facilitating stronger and better networked coalitions to connect existing resources, and (3) by gathering and widely disseminating "best practices" in climate science education.

There should be aggressive support for, and expansion of, recent efforts in these three areas, including the collaboratively developed Climate Literacy Framework (spearheaded by the U.S. National Oceanic and Atmospheric Administration (NOAA) and which began to be distributed in March 2008) and the creation in mid-2007 of the multistakeholder Climate Literacy Network (information about both of these efforts is at http://www.climateliteracynow.org/). In addition, developing climate science networks to foster cross linking and sharing of valuable resources—including Web sites such as "Windows to the Universe" (http://www.windows.ucar.edu) and "Encyclopedia of Earth" (http://www.eoearth.org/), sponsored by the University Corporation for Atmospheric Research and the National Council on Science and the Environment, respectively—will enhance accessibility to, and use of, existing resources and will identify gaps and needs for additional resources.

Reaching a Diffuse Audience

While the diffusion of resources for climate change education is a significant, even daunting, challenge, a second area of diffusivity may prove even more difficult to surmount: the highly dispersed nature of the public audience. Approximately 20% of the U.S. population is enrolled in formal educational programs, i.e., classroom education at schools, colleges, and universities (see http://nces.ed.gov/programs/digest/d04/tables/dt04_394.asp). Thus, centralized, formal educational mechanisms, processes, and institutions do not reach 80% of the population, people whose decisions, actions, and attitudes have significant implications for society's response to climate change.

Given the urgency for taking action on climate change, there is not sufficient time to rely solely on the transfer of knowledge and understanding from the formal educational system to the population at large. The vast majority of the population must be reached through forums and mechanisms outside the traditional classroom. There needs to be a coordinated focus on nonformal education (organized education outside the K-16 system, i.e., workshops and other activities sponsored by community groups, nongovernmental organizations (NGOs), museums, and other organizations) and informal education (exposure to information through popular culture, mass media, and interactions with friends, family, and work colleagues).

The diffuse and heterogeneous nature of the audiences that could benefit from climate science education requires a coordinated, systematic, and energetic approach to nonformal climate science education. Different climate science information is compelling to different stakeholders. While learning about drought risk and the potential growing market for biofuels may be of interest to midwestern farmers, the potential for jobs in renewable energy and energy efficiency may be of critical interest to technical and vocational educators and to state and federal labor agencies. Pedagogical strategies that are responsive to diverse target audiences (including the use of localized examples of climate change impacts and the inclusion of specific potential financial implications of both climate change impacts and climate action initiatives) must be compiled and made available to the broad spectrum of individuals and organizations engaged in communicating climate science to different audiences.

In addition, there needs to be aggressive support for robust, formal classroom education on climate change science and its social implications, which should be leveraged for, supplemented by, and coordinated with nonformal and informal routes. To illustrate, a parallel may be made to the dual challenges of ensuring that new buildings are energy efficient and that existing buildings are retrofitted. New LEED-qualified (Leadership in Energy and Environmental Design) buildings often attract tremendous attention, but buildings that already exist consume roughly 40% of U.S. total energy use. Similarly, nonformal and informal education mechanisms should be deployed to address the climate literacy of the nonenrolled population, while simultaneously ensuring formal K-16 education for the next generation.

Need for Coordination

Thus, the drive for widespread climate literacy must confront diffusivity on two levels: widely dispersed educational resources, and highly diverse, minimally coordinated audiences. The climate education community cannot rely solely on traditional, centralized, formal channels. A nationally coordinated climate science education campaign is needed to achieve widespread public acknowledgment and understanding of climate change science and to enable society-wide action on this issue. This effort must address both formal and nonformal audiences, and it must develop both short- and long-term approaches in parallel. Strategic planning is critical to ensuring streamlined, efficient efforts in the long term; and the urgency of the climate change problem dictates that where possible, educators need to act now.

At the federal level, partnerships among the U.S. Climate Change Science Program, key federal agencies (National Science Foundation, Environmental Protection Agency, NASA, NOAA, and so forth), and a broad spectrum of nongovernmental partners are crucial for coordination and for ensuring multisectoral and diverse stakeholder input and engagement. A wide range of participants is needed in the development of a national-level strategic plan for climate science education that includes specific mechanisms for working with nongovernmental

partners (the media, educators, corporations, foundations, and NGOs). This coordinated effort and strategic plan should include outreach to, and collaboration with, governmental and nongovernmental funding sources (i.e., private foundations) to initiate and support multidisciplinary research for benchmarking and assessing the effectiveness of existing climate change education programs and for identifying and evaluating promising integrative approaches ("best practices").

The imperative to energize nonformal climate science education has been recognized previously. For example, the proposal in 2006 by the Yale School of Forestry and Environmental Studies for a new consortium that focuses on communicating climate risks and opportunities identifies a similar need for coordinated, society-wide educational efforts to build support for acting on climate risks (see http://www.environment.yale.edu/climate/wp-content/uploads/2007/11/CommunicatingClimateRisk-Draft-1.pdf; see also *Abbasi* [2006]). The recent success of nationally coordinated climate change educational events—such as "Step It Up 2007" (a "day of action" launched by a small group of recent college graduates) and "Focus the Nation" (with more than 1900 colleges, universities, and other organizations sponsoring "teach-ins" on 31 January 2008)—demonstrate the potential of large-scale, nonformal initiatives to activate broad interest in climate issues.

The goal of education is to promote learning, and learning is a lifelong activity that can be fostered in many different forums in many diffuse ways. Energizing nonformal climate science education will expand the learning opportunities available to the U.S. public. Coordinated attention to the deployment of accurate, relevant climate science information in the full spectrum of educational approaches can increase citizens' ability to take the action required to confront the societal challenges of climate change.

Acknowledgments

This essay builds on outcomes from a workshop of climate educators at the National Council on Science and the Environment's 2008 annual meeting in Washington, D. C., in January 2008. Authors Jennie Stephens and Amanda Graham coconvened the workshop, "Diverse Perspectives on Climate Change Education: Integrating Across Boundaries," and they are indebted to participants for insights and resources.

References

Abbasi, D. R. (2006), *Americans and Climate Change: Closing the Gap Between Science and Action*, Yale Sch. of For. and Environ. Stud., New Haven, Ct. (Available at http://environment.yale.edu/climate/americans_and_climate_change.pdf)

Nisbet, M. C., and T. Myers (2007), Twenty years of public opinion about global warming, *Public Opin. Q., 71*(3), 444–470.

—JENNIE C. STEPHENS, Department of International Development, Community, and Environment, Clark University, Worcester, Mass., and Energy Technology Innovation Policy Group, Kennedy School of Government, Harvard University, Cambridge, Mass.; E-mail: jstephens@clarku.edu; and AMANDA C. GRAHAM, Education Office, MIT Energy Initiative, Massachusetts Institute of Technology, Cambridge

MEETINGS

Glacier and Permafrost Problems in High South Asia

International Workshop on Cryosphere and Hazards for Hindu Kush, Himalayas and Tibetan Plateau; Kathmandu, Nepal, 31 March to 2 April 2008

PAGE 205

An outgrowth of prior conferences that had to be held separately for political reasons [*Bagla,* 2006a, 2006b], a 3-day workshop to discuss the impact of climate change on the glaciers and permafrost of high Asia hosted some 70 geoscientists from China, India, Nepal, Pakistan, and the United States and a few from Europe and Canada. The scientists concluded that a major need exists for better long-term monitoring of glaciers in the region using satellite imagery coupled with direct observations in the field. Also emphasized was the lack of cooperation or lack of sharing of essential hydrological information between the commonly militarily opposed countries in the area. Even within each country, agencies do not necessarily share data with other agencies or with university scientists. For example, a ludicrous situation was noted wherein it is easier to obtain high-resolution imagery and digital elevation models from scientists in opposing countries rather than domestically, where such data can be restricted or illegal to use. Such data hoarding potentially increases a population's risk because people who are trying to forecast hazardous droughts, floods, and landslides commonly cannot get appropriate information.

The workshop established six main conclusions, urging the governments of the Himalayan countries to facilitate data generation and sharing, and to identify at least one benchmark glacier in each country for long-term field-based study. Standardized methods should be developed and used for monitoring and assessing glaciers across the region to facilitate cross-border comparative analysis. Development of basin-wide water scenarios also should be encouraged for all the major water basins in the region as a series of transect studies from east to west.

The workshop brought together the best geoscientists for the region to brainstorm new ideas and procedures for obtaining information about the status and trends of snow and ice resources in high Asia. Additional analytical procedures and a volume of refereed papers from the conference are scheduled to be published in early 2009 in Elsevier's book series called *Developments in Earth Surface Processes*. Further follow-up collaborative projects are being defined, and people are being enlisted in research-proposal development through a structured e-mail consultation being run by Frans Neuman of the Mountain Forum (fneuman@mtnforum) and Greg Greenwood of the Mountain Research Initiative (MRI) (green@guib.unibe.ch).

The workshop, held at, and sponsored by, the International Centre for Integrated Mountain Development (ICIMOD) in Nepal, was also jointly organized by the University of Nebraska at Omaha with their Global Land Ice Measurements From Space Regional Center for Southwest Asia (Afghanistan and Pakistan), as well as the Monsoon Asia Integrated Regional Study (MAIRS) from China, the Institute for Development and Innovation (IDI) from Nepal, and the MRI in Switzerland. Workshop funding came from the U.S. National Science Foundation, the Lounsbery Foundation, and the Smithsonian Institution through its Indian Science and Technology Partnership.

References

Bagla, P. (2006a), Pakistan gives geology conference the cold shoulder, *Science*, *312*, 1117.

Bagla, P. (2006b), Science for peace: Across a political divide, researchers converge on Himalayan plan, *Science, 313,* 30–31.

—JOHN F. SHRODER, MICHAEL P. BISHOP, and UMESH HARITASHY, Department of Geography and Geology, University of Nebraska at Omaha; E-mail: jshroder@mail.unomaha.edu