COMMENTARY

Policy needs robust climate science

The path between climate science and policy is not always linear, argue **Aristides Patrinos** and **Anjuli Bamzai**.

Changes in global and regional climates have always played an important role in civilizations. Migrations from Africa to other continents occurred only when the climate was mild enough to permit them, and cautionary tales are told of entire civilizations collapsing after prolonged periods of drought. The recent catastrophic hurricanes in the United States should be a wake-up call to those concerned with minimizing the impact of such disasters. Societies need robust infrastructures — buildings constructed to withstand high-speed winds, reinforced levees and early warning systems — to deal with extreme weather conditions. Such measures will rely on scientific understanding and accurate predictions of regional climate change, whether it be a result of natural variability or change caused by greenhouse-gas emissions.

In the United States, the Climate Change Science Program (CCSP)[1] is responsible for providing stakeholders and policy makers with the scientific knowledge they need to manage the risks and opportunities of climate change. The CCSP is calling for the delivery of 21 reports to explicitly address the needs of decision makers in sectors such as energy and transport. One such report will focus on understanding regional climate extremes through improved observations and modelling. During 14–16 November, the CCSP held a public workshop on climate science (www.climatescience.gov/workshop2005) to facilitate interactions between researchers and those who rely on the CCSP's products.

Not straightforward

Two papers[2,3] in this issue highlight the potential impacts of regional climate changes caused by anthropogenic greenhouse-gas emissions. In one Barnett *et al.*[2] address the effects of regional climate changes on water availability, including in the western United States. The findings reported in both papers are intended to inform policy and decision making. However, there is often controversy about the mechanisms by which scientific research and development (R&D) should do this, especially when it comes to environmental issues.

One model of the interplay between scientific research and policy making describes an almost linear path whereby an environmental problem is identified and R&D is used to investigate the causes, effects and potential solutions. Information is then fed back to policy makers who may make changes to legislation or technology.

There are instances where problems have been tackled by this linear route; for example, when the discovery of stratospheric ozone depletion led to the Montreal Protocol, which banned substances that harm the ozone layer. But the usual mechanism is less well defined, with repeated interactions occurring between R&D and policy making. We believe that this is the case for regional climate variability. Below we give two examples of multi-level R&D that should eventually give robust solutions for regional climate problems.

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The first describes federal R&D priorities for water availability and usage. The ability to measure, monitor and forecast the state of US and global fresh-water supplies is a problem of national importance. Several federal agencies are developing a research strategy[4] to understand the processes that control water availability and quality, and to collect baseline information and develop monitoring systems needed to ensure adequate future supplies. Untapped water 'resources' could come from water conservation, water re-use, desalination and aquifer storage. These are generally not considered a resource, but should be.

In addition, recent R&D policy directives[5] to federal agencies include the development of pilot integrated observing systems for natural-hazards assessment and disaster warnings. Federal agencies will continue to provide strong US leadership for the Global Earth Observing System of Systems (GEOSS)[6]. The US contribution to GEOSS is the planned Integrated Earth Observations System, which is aimed at reducing loss of life and property caused by disasters, and protecting and monitoring our ocean resources.

Our second example of multi-level R&D is the crucial steps taken in response to recent widespread droughts in the western United States. The droughts led governors in these states to unanimously endorse a drought early-warning system[7]. This system will provide water users across the board — farmers, tribes, business owners, wildlife managers and decision makers at all levels of government — with information that will help them to assess risks in real time, and allow informed decisions to be made ahead of a drought. A national drought policy is being called for that would build upon and enlarge this system.

Vulnerable populations

When developing policy responses to regional climate change, it is essential to consider the vulnerability of the communities affected. For example, extreme poverty and limited development in Africa, coupled with the fragility of ecosystems there, has devastating consequences when combined with natural disasters. The Sahel experienced severe droughts during the 1970s and 1980s, leading to widespread famine and the loss of more than one million human lives. But, paradoxically, excessive development can itself lead to increased vulnerability. Over the past 30 years, US coastal development has quadrupled, and more than 45 million people are now permanent residents of hurricane-prone coastlines. Precarious building in such regions leads to rising economic and human costs associated with natural disasters, as seen with hurricanes Katrina and Rita.

We stand at a crossroads where the risks to humans and property can be minimized by developing robust infrastructures, reliable early warning forecasts and effective response strategies. Maintaining a basic research programme will be critical for success, and the interplay between science and policy will be crucial to how society handles the conflicting dynamics of development and environmental protection. ■

Aristides Patrinos and Anjuli Bamzai are at the Office of Science, US Department of Energy, Washington, DC 20585, USA.

See Editorial, page 257; News Feature, page 275.

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3. Patz, J. A., Campbell-Lendrum, D., Holloway, T. & Foley, J. A. *Nature* **438,** 310–317 (2005).
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5. www.ostp.gov/html/budget/2007/ostp_omb_guidancememo_FY07.pdf
6. www.epa.gov/geoss/index.html
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