Tomorrow never knows

Science should focus more on understanding the present and less on predicting the future, argues **Daniel Sarewitz**.

On humid summer mornings weather forecasters will often predict an afternoon thunderstorm, but sensible people know they probably won't have to cancel plans for a picnic. The forecast may be accurate, but people's understanding of how to interpret and contextualize the information is what makes it valuable to them.

Indeed, weather predictions are uniquely useful and useable. The US National Weather Service issues millions of them annually, affording continual opportunity for assessing and improving performance. Organizations that communicate forecasts have learned to tune information to diverse users, be they average citizens, ship captains or the airline industry. The predicted events are discrete and familiar, and they occur soon after the prediction, so that response options — to delay the flight, or not — are unambiguous, and disagreements have little time to emerge.

When these qualities are lacking, however, big challenges to decision-making ensue. In February 1997, the weather service predicted that the Red River would reach a record flood crest of 15 metres in Grand Forks, North Dakota. The town prepared for that height, but in April the crest passed 16 metres, and the result was US$1.5 billion in flood damage. The prediction was within the historical range of forecast accuracy (R. A. Pielke Jr *Appl. Behav. Sci. Rev.* **7**, 83–101; 1999), but information providers, communicators and users lacked the experience and judgement to respond appropriately to the prediction.

In the wake of the disaster, residents were willing to abandon low-lying areas of town as part of a new $409-million flood-control system for floods of up to 19 metres. What had they learned from their experience? Not to depend on predictions. And when high floods struck again last March, the town stayed dry.

False belief

Predictions are not instructions that people simply follow to make better decisions. They are pieces of an intricate puzzle that may sometimes contribute to improved decisions. For complex, long-term problems such as climate change or nuclear-waste disposal, the accuracy of predictions is often unknowable, uncertainties are difficult to characterize and people commonly disagree about the outcomes they desire and the means to achieve them. For such problems, the belief that improved scientific predictions will compel appropriate behaviour and lead to desired outcomes is false.

This conclusion flies in the face of the instincts and interests of scientists and decision-makers. Scientists are attracted to the intellectual challenge of making predictions, and recognize that promising to provide predictions appeals to the interests of the policy-makers who fund them. And decision-makers would prefer to hand over responsibility for the future to scientists — who would also take the blame when wrong.

For example, regional climate predictions are now being offered by scientists as a next logical step in applying science to the global-warming problem. As explained on the website of the Climate Variability and Predictability project of the World Climate Research Programme: "The increased confidence in attribution of global scale climate change to human induced greenhouse emissions, and the expectation that such changes will increase in future, has led to an increased demand in predictions of regional climate change to guide adaptation." The seductive but dangerous logic is driven by the confluence of the "increased demand" of decision-makers, and the high-prestige science of climate modellers who believe that society needs more of what they've been doing anyway (see *Nature* **453**, 268–269; 2008). But this logic confuses the distinct tasks of bringing a problem to public attention and figuring out how to address the societal conditions that determine the consequences of the problem.

"The right lessons for the future of climate science come from the failure to predict earthquakes."

Hurricane Katrina in 2005 provides cautionary insight. The likelihood of such a storm had been appreciated for decades and, in the days leading up to the disaster, the storm's path was accurately predicted. But New Orleans's fate had long been sealed by a lethal combination of socioeconomic and racial inequity, regional environmental degradation, unwise development patterns and engineering failure. Science had delivered ever more knowledge about regional climate behaviour and ever more accurate hurricane-track predictions, but this was not what the city needed to avoid catastrophe.

In contrast, from a societal perspective, perhaps the best thing that ever happened in the field of earthquake research was the recognition that earthquake prediction was likely to be impossible. In recent decades, the priorities of the US Geological Survey's earthquake-hazard programme have moved away from prediction and towards the assessment, communication and reduction of vulnerabilities. This evolution has demanded closer collaboration between scientists and diverse regional and state decision-makers, to provide information that can help improve construction practices, land-use decisions, disaster-response plans and public awareness.

If wise decisions depended on accurate predictions, then in most areas of human endeavour wise decisions would be impossible. Indeed, predictions may even be an impediment to wisdom. They can narrow the view of the future, drawing attention to some conditions, events and timescales at the expense of others, thereby narrowing response options and flexibility as well.

This difficulty is on spectacular yet unacknowledged display in the climate-change arena. The recently concluded United Nations climate-change conference shows that the world's attention is focused on global warming, but also that clear progress towards addressing the problem is incredibly difficult to achieve. A central obstacle is that predictions of long-term doom have created a politics that demands immense costs to be borne in the near term, in return for highly uncertain benefits that accrue only in a dimly seen future.

Science could help untangle this politically impossible dilemma by moving away from its obsession with predicting the long-term future of the climate to focus instead on the many opportunities for reducing present vulnerabilities to a broad range of today's — and tomorrow's — climate impacts. Such a change in focus would promise benefits to society in the short term and thus help transform climate politics. Strange as it may seem, the right lessons for the future of climate science come not from the success in predicting thunderstorms, floods and hurricanes, but from the failure to predict earthquakes. ■

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