

## *Integrating Science and Management for Storms and Hurricanes: A Panel Discussion*

**Donald F. Boesch**

University of Maryland Center for Environmental Science  
Cambridge, MD 21613

The conference on *Hurricane Isabel in Perspective* was a success on a number of accounts in my view. First, it provided an impetus for scientists to pull together a rich array of information about the physical, ecological, and human responses in the Chesapeake Bay ecosystem to this unusual event. While the effects of Isabel on the estuary itself were not as dramatic as Tropical Storm Agnes with its heavy rains and overwhelming floods, they were certainly felt by waterfront property owners. Also, in the estuary itself the responses were at the same time both reassuringly predictable, for example the propagation of storm surge, and quite surprising, for example, the bio-physical processes associated with the destratification and restratification of the Bay. In either case, Hurricane Isabel provided a remarkable opportunity to learn how the Bay works.

Second, the conference provided a rare opportunity for individuals working at the local government level—those responsible for emergency preparedness and response, planning and zoning, and infrastructure management—to interact with Bay scientists and those at the leading edge of weather and storm forecasting. Much learning took place—in both directions.

Third, energy and enthusiasm was developed among the participants to improve planning, the dissemination of information, and incorporation of a more dynamic view of the Bay in its restoration. In particular, calls echoed throughout the conference to take advantage of the freshness of the experience to improve public understanding and response in order to avoid personal tragedies, economic losses, and unsustainable investments.

The conference closed with a discussion within a panel of six very experienced individuals, which I had the privilege of moderating. I have tried to capture the essence of the panelists' viewpoints here. No doubt, some important points that they made are left out. Also, the reader should remember that these are my summarizations and not a verbatim representation of their comments. Thus, any credit goes to them, but blame stops with me.

Dr. **Hans Paerl**, a highly regarded ecologist from the University of North Carolina, has had unsolicited, first-hand experience regarding the effects of hurricanes on coastal ecosystems. He works at the Institute of Marine Sciences in Morehead City, the epicenter of one of the most hurricane-prone regions of the U.S. coast. Six major hurricanes made landfall on the North Carolina coast between 1996 and 1999, as of course did Isabel in 2003. In 1999 the assault seemed unrelenting, with Dennis and Floyd hitting the North Carolina coast in September and Irene passing just offshore in

October. These storms led to unprecedented rainfall and prolonged floods in the eastern part of the state.

Dr. Paerl observed that we should consider the effects of northeast storms as well as hurricanes because they can have very similar effects. But, he cautioned that storms can be very different in their impacts, largely depending upon where landfall occurs and how that influences wind direction and speed and rainfall patterns. The three successive storms in 1999, for example, had very different impacts.

Dr. Paerl also stressed that both science and management need to consider the context of multiple stressors and management challenges within the coastal ecosystem and associated watershed. Many of these systems are under a high level of anthropogenic pressure to start with, so that a storm represents an additional rather than an isolated pressure. For example in Pamlico Sound there is a very high level of fishing pressure, including shrimp trawling. Storm-induced floods resulted in a dislocation of some fishery resources, causing increased pressure on the stocks because of concentrated harvesting. There is a need for more sophisticated models that can adjust predictions of storm impact as an ecosystem becomes more or less stressed by other factors over time. Paerl commented that, sadly, memory of the effects of storms can fade quickly. Despite the ravages of its floods, Hurricane Floyd is largely forgotten and people are now building in the floodplains again in eastern North Carolina.

Mr. **David Lyons** is Chief of the Enforcement Division in the Water Management Administration of the Maryland Department of the Environment. He noted that a principal lesson from Hurricane Isabel is the need to focus on how to make people better prepared. In addition to individual preparedness, he stressed the need for local government to take storms into account when building, updating and managing infrastructure. For example, sewage treatment plants and sewerage pumping facilities need to be carefully designed and have emergency plans in place. Already we are struggling to reduce overflows from sewerage systems that receive stormwaters; planning for tidal flooding from hurricanes adds yet another requirement. Although Isabel was a relatively dry storm from the standpoint of rainfall, it reminds us nonetheless of the need to limit the proliferation of impervious surfaces and enhance stormwater management capabilities. Mr. Lyons stressed the importance of conserving and protecting natural systems that will buffer against storm damages, including the use of non-structural shoreline erosion controls. He was encouraged by presentations at the conference on improved knowledge of elevations of low-lying lands through LIDAR surveys. These efforts are producing very useful information for planning for both storm-surge and stormwater flooding.

Mr. Lyons also reminded the audience that the public's memory is short and people will rapidly forget about the impacts of Hurricane Isabel. Consequently, we need to communicate to the public now what happened and why the storm surge was so high. He further noted that many of the "best management practices" used for Chesapeake Bay conservation are not currently designed to cope with hurricanes and other extreme storm events. These practices range from agricultural management practices to fisheries

management. For example, how should harvest quotas be adjusted following such storm events?

Dr. **Wilson Shaffer**, a storm-surge modeler with NOAA's National Weather Service, picked up on the theme of the public's short memory. He said that we should recognize that tropical storms are relatively rare events in the Chesapeake Bay region. It was 70 years between the 1933 storm and Hurricane Isabel, which produced similar storm surges. Very few people had thought such flooding possible and most are unaware of the general axiom: "run from the water, hide from the wind." Some people hid when they should have run. Overall, better education of the public is required to ensure that people respond appropriately to warnings. Also, we need to improve public understanding of storms, for example people should be aware that the greatest danger lies in the northwest quadrant of an approaching hurricane. So that appropriate warnings can be provided, perhaps there is a need for an ensemble of models that project the worst and best case scenarios for each storm.

Mr. **Richard Batiuk**, Associate Director for Science of EPA's Chesapeake Bay Program Office, observed that Hurricane Isabel provided an opportunity to assess what worked and what did not. For example, there were many places where significant erosion had occurred from behind bulkhead walls, whereas nearby natural shorelines with no engineered protection were not seriously eroded. We also learned that the physical processes in the Bay are of major consequence, and in ways we did not understand before, thus it is important to continue to improve our understanding of these processes. Hurricanes also magnify dynamics that normally occur within the Bay, making them more obvious and amenable to quantification. That is why that continuing assessment of the observed responses of the estuarine ecosystem to Hurricane Isabel provides a real opportunity to substantially improve knowledge and our ability to predict responses to phenomena, both those that are natural and those caused by humans.

Ms. **Ann Swanson**, Executive Director of the Chesapeake Bay Commission, asked: What have science and management taught us? There is a division in thought between the scientific community, which increasingly recognizes ecosystems such as the Chesapeake Bay as highly dynamic, and most humans, who expect stability. How can we reconcile the ecological tendency for variability with a human desire for predictable structure? While we know a lot, there are large gaps in knowledge, yet management decisions need to be made every day. Should we make management decisions only when we know something well or, in fact, because we don't know as much as we would like? In her experience, three elements are required to effect change: knowledge (among scientists and in the broader community), political interests, and public concerns. She suggested that Hurricane Isabel, then, provides a window of opportunity because it created public concern and, thus, political interest.

Ms. Swanson noted that an environmental agenda can be moved forward driven by quite different interests. For example, impervious surface can be reduced in a development due to both environmental (reducing runoff) and financial (cheaper) requirements. Both arguments can have credence for different audiences, but both have the same result. We

need to consider the responses to Hurricane Isabel in this context, that is when dealing with a socioeconomic concern could result in environmental improvements as well. In that regard we need to consider locations for future development, management of runoff, shoreline stabilization and the use of living shorelines, and abatement of sediment loads to the tidal waters of the Bay. She asked if, based on the lessons of Hurricane Isabel, could the scientific community identify a short list of things that should we be doing differently, from both ecological and social perspectives. Isabel has provided a window of opportunity with the public, but it will close soon.

Dr. **Carl Hershner**, Director of the Center for Coastal Resources Management at the Virginia Institute of Marine Science, observed that Dr. Bill Boicourt mentioned integrated models of the continental shelf, estuary and watershed are the holy grail of physical scientists who study estuaries. He pointed out that, while he doesn't underestimate the importance of physical processes, the behavior of the ecosystem may be much more complex. We are learning more and more that such ecosystems are dynamic over the long term as well as the short term, thus we need to consider the resilience of the system not just in terms of how quickly it returns to "normal" after an extreme event such as a hurricane, but also with regard to the potential that it may shift to another state as a result of the combined pressures of chronic human alteration and acute natural events.

The panel's discussion was lively and seemingly well appreciated by the audience. I think that all came away from the conference and concluding panel discussion committed to remembering the lessons of Isabel as captured in these proceedings and to helping citizens understand better the risks, changes and options confronting them in the world in which we live.