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Will Hurricane Katrina Impact Shoreline Management? Here's Why It Should.

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The hurricane hit the Mississippi coast head on. Orrin Pilkey immediately rushed to Waveland to bail out his parents whose house was 4 blocks back from the Gulf of Mexico. Their house had been flooded up to the 5-foot level and a half dozen trees had crashed through the roof. Some neighboring houses were now piles of broken boards and glass. But the houses closer to the beach disappeared completely, leaving behind empty concrete pads as evidence of their former existence. The wood, the sinks, the refrigerators, the cars and all the family treasures from the destroyed houses had piled up in a sort of dike or ridge well inland of the coast. Reopening of roads through the debris dikes resulted in large road cuts stratified with the layers of a human disaster. A railroad embankment on the backside of town halted the storm surge and marked the line between devastated homes and damaged homes. For once, it paid to have lived on the wrong side of the tracks. American flags flew from trees and house fragments and the prevailing attitude among survivors was one of patriotism and confidence that no matter what the odds, we shall return.

The storm described above is not Hurricane Katrina; rather, the passage relates the personal experience of one of us (the old one) following the impact of Hurricane Camille in 1969. Although it took more than a decade, the buildings destroyed by Camille were replaced with larger and costlier structures. High wind building codes were supposedly enforced in the post-Camille reconstruction, but the maximum design wind was only 120 MPH. Even if those buildings had been built to withstand category 4 winds, the waves on the rising storm surge would have caused massive destruction.

Impact of Katrina:

We have examined the coastal impact and property damage from Hurricane Katrina through two aerial surveys. What we saw was stunning, although not unforeseeable. The scene in Waveland today is eerily like the scene in 1969. The same debris dike is present

and white concrete pads are all that remain of the coastal homes (figure 1). The railroad embankment again afforded some protection for the buildings behind it (figure 2). The inland extent of active storm surge processes matches, and possibly surpasses that of Hurricane Camille. Initial estimates indicate storm surge levels of more than 10 m. In a zone stretching from the Mississippi line to western Dauphin Island, AL, most shoreline property in the immediate coastal zone was obliterated. In many areas, the active storm surge and wave impact extended .5 km inland leaving a large, mappable debris line snaking its way across southern Mississippi. The Chandeleur Islands were spread thinly across the Gulf, although the more robust and better-vegetated Mississippi Gulf Islands fared much better. Katrina was a major event, but those of us in the coastal science community know that it has happened before and will happen again.

Dauphin Island, Alabama:

Dauphin Island, in the adjacent state of Alabama, has a more spectacular record of recurring destruction than the Mississippi Coast. This 15-mile long island consists of a low, westward-extending spit derived from the erosion of a Pleistocene headland/island. Katrina destroyed 150 homes on western Dauphin Island even though it was on the periphery of the hurricane, not near the storm's more dangerous center. The western end of Dauphin Island is typical of many of the low-lying barrier islands that line the southeast US coast from New York around to Mexico. The island is migrating landward in response to rising sea level and storm impact. During Katrina, Dauphin Island slid out from underneath many oceanfront homes, as it washed northward during the storm. As part of that process, overwash added width to the back of island leaving boathouses stranded on land (figure 3).

Dauphin Island has been slammed repeatedly by storms, and it has been repeatedly rebuilt: Hurricanes Frederic (1979), Danny (1997), Georges (1998) and Ivan 2004. The clean up from Ivan had not even been completed when Katrina struck. In the 1940's and 1950's, wide inlets were cut across the island by storms. After Hurricane Frederic, brief consideration was given to not rebuilding the destroyed bridge to the island and thereby discouraging intense development. The moment of rationality passed, and a new \$38 million bridge was constructed. Dauphin Island is a classic example of a shoreline that should never have been developed, and later, should never have been rebuilt multiple times.

Is beach replenishment the solution?

American barrier island shorelines are jammed to the hilt with buildings. Every year the average size of the buildings increases as big cottages replace small ones, and as high-rises replace big cottages. Coastal population has soared along with the construction. One might imagine that hurricanes would slow down the building boom. Sadly, the opposite is true. The mayor of Charleston, SC, has indicated that Hurricane Hugo was "good" for his city. With all of the federal and state aid pouring in, hurricanes have become urban renewal for the coast. Post-storm property values increase as destroyed buildings are replaced by bigger and "better" ones. The rush to develop the shore is colliding with an increase in hurricane intensity and duration plus a rising sea level. It is disturbing to us that the coastal science community cannot reach a consensus on how to respond.

There are two widely disparate views regarding the lessons that Katrina holds for beach communities. At one end of the spectrum is our view; the US should systematically retreat from the oceanfront. The other endpoint is that expressed by the National Shore and Beach Preservation Association (NSBPA) which argues that recent hurricanes like Katrina demand that we redouble our efforts to increase government spending on beach nourishment. NSBPA claims that the primary goal of nourishment is saving lives and property. But even a billion dollar beach would not have protected Mississippi lives and property against the 10 m maximum storm surge of Katrina. In reality, beach replenishment is a desperate attempt to hold off the natural response of this nation's shorelines to a rising sea level. It is an ultimately futile effort to maintain a beach in front of valuable coastal property (figure 4). Replenishment must be sold as storm defense in order to avoid the sad truth that it is the coastal development that has destroyed the beach and created the risk in the first place. Remove the oceanfront development, and the beach will return without the need for replenishment. The public needs to know that there is more than one way to get a beach back. Replenishment is not the only answer.

Beach replenishment also has the following problems:

- 1) The reconstructed, wide beach gives the appearance of a shoreline that is stable and safe, encouraging shoreline development. This deception can actually place more property and lives at risk.
- 2) Despite some suggestions that beach replenishment may provide storm protection, this is certainly untrue when it comes to large storms (like Katrina) or storms of long duration like some nor'easters. No amount of beach replenishment could have saved Mississippi from Katrina. Beach replenishment is not property damage mitigation, and federal funds should not be spent as such.
- 3) In recent years, concern has risen about the environmental impact of pumping sand on a beach. The process essentially kills all organisms and indirectly destroys the entire nearshore ecosystem. This, in turn, impacts shore birds as well as the fish sought by surf fishers. Recovery is assumed to occur in 2 to 4 years, but often a new beach is emplaced before beach faunal recovery is complete.
- 4) More often than not, the cost of the beach replenishment is born by multitudes of federal or state tax payers who will never benefit from the expenditure of their funds. The costs are not born by those who have actually destroyed the beach, the oceanfront developers and property owners.

The bottom line is that beach nourishment cannot be the overall solution to the erosion problem along thousands of miles of shoreline. It costs too much, it does not protect property and lives as sold, and it is actually increasing the amount of property and the number of people in danger. Most importantly, federal disaster relief funds should not be used to rebuild beaches.

Time for the Federal Government to Abandon the Coast:

Irresponsible development of vulnerable coastal areas is costing federal taxpayers hundreds of billions of dollars. Add Katrina to the battering that Florida has absorbed in the last two years, and we have a sobering glimpse into the future of US shorelines during a period of enhanced storm activity. Many researchers believe that increased sea surface temperatures (from global warming) will provide an onslaught of ever more powerful

storms of greater duration. In addition, we have been experiencing an upturn in the number of storms. The future does not look promising for coastal property.

We believe that it is time to cut federal ties with the most vulnerable of our nation's coastal areas. We will restrict our analysis to immediate coastal zone. The issue of what to do with cities like New Orleans is outside the scope of this commentary. The Federal Emergency Management Agency (FEMA), the United States Geological Survey (USGS), the United States Army Corps of Engineers, and numerous researchers — ourselves included — have spent many years mapping and delineating those coastal areas that are particularly vulnerable to hurricane impact. The highly vulnerable shorelines include places like North Topsail Island in our home state of North Carolina, Santa Rosa Island in Florida, and the west end of Dauphin Island in Alabama. Waveland, Mississippi, has been destroyed twice in 35 years. These are all stretches of shoreline that are so unquestionably vulnerable to storm impact that they should never again receive federal tax dollars to rebuild buildings or infrastructure.

Without question, there are many coastal areas destroyed by Hurricane Katrina that should not be rebuilt. There are several obstacles to preventing that rebuilding:

1) *The US is a compassionate nation. We sympathize with and grieve for the victims of the storm as we watch the endless coverage of Katrina's destruction. Those of us who suggest that we may want to reconsider allowing everyone to rebuild are chastised as being insensitive or callous.* We must separate our justified compassion for those who have suffered from a national debate of what happens after the storm. Suggesting that the federal government abandon the subsidizing of coastal infrastructure is not advocating the removal of immediate storm aid (rescue, food, shelter) to those impacted by a storm. We are simply advocating the wise use of federal infrastructure rebuilding dollars, and preservation of the US coastal environment.

2) *The US is a proud nation. We have a tradition of standing tall in the face of adversity and replanting the flag. Americans often admire the resilient attitude of coastal residents, "I will not be chased from my community. We will rebuild. But we need help," one resident of Grand Isle, Louisiana, told a reporter. Those of us who suggest abandoning high-risk communities are viewed as defeatist or anti-development.* At some point we have to recognize this stoicism for what it is— insanity or hubris. Is rebuilding Waveland, MS, admirable or folly? Dauphin Island, AL, is nothing but a sandbar. Is rebuilding on Dauphin Island a model of American resilience or irresponsible risk taking? The coastal science community knows that in both cases, it is the latter.

3) *The argument is frequently put forward that coastal development is an economic powerhouse driving employment and tax revenues critical to many communities and many states. Therefore, federal aid for rebuilding and federally managed flood insurance is critical to maintaining that economic engine.* This is a false argument. If the economics are so overwhelmingly positive, than federal back up should not be necessary. The US, as a nation, cannot continue to subsidize those who want to live and work on the immediate coast. This is not simply an environmental issue. This is an issue of fiscal conservatism and fairness. If coastal development is so profitable that it is essential to the viability of a locality or a state, then let the free market decide. Remove federal money available for rebuilding infrastructure. No more federally-managed flood

insurance. Let each subdivision, or town, or county, or state develop their own plan for self-insurance of those high-risk coastal areas. If that insurance is too costly, then building there is impractical. The federal government should not be involved in subsidizing the risk. People who live in North Dakota should not be providing coastal welfare for developers in Florida.

4) *We have a strong personal property ethic in this country. Coastal property owners have been very successful at asserting property rights in order to circumvent state laws restricting coastal development (e.g. Lucas vs. South Carolina Coastal Council). We would like to see that matched by a strong personal responsibility ethic. If you want to live in the high risk areas, if your community thinks that the economic benefits are too great to abandon the redevelopment of a storm-impacted oceanfront; great, from now on, you pay. You pay for the infrastructure, the buildings, and the beach replenishment. Ultimately, we believe that coastal retreat is the best option, but for those who insist on occupying the oceanfront we would like to see them accept responsibility for their decisions. Don't look repeatedly for a federal bailout.*

Proposed mechanism for a Federal retreat:

It is difficult, but not impossible, in the middle of a disaster of this magnitude, to decide which communities should be abandoned. The wound is still too tender, and the rush to rebuild still too chaotic. We need to develop a national policy for the future. One that can be implemented with each storm. We need to objectively determine those coastal areas from which we will retreat (pull federal support). We have the knowledge and the data to identify these particularly vulnerable areas. We suggest the formation of a commission similar to the Base Realignment and Closing Commission (BRAC). This Shoreline Retreat Advisory Commission (ShRAC) would be composed of objective scientists and coastal managers. Like the BRAC there should be no politicians or individuals who will focus on turf guarding. The ShRAC would meet every five years to identify vulnerable shorelines that will be removed from all future federal assistance. Some of the federal money saved by switching the rebuilding responsibility to local effort could be used to create public access areas along abandoned oceanfront, rebuilding sand dunes, and aiding communities that choose a planned retreat. In the end, we may be forced into this solution if the coastal impact of more storms like Katrina balloons our federal deficit to the extent that harm is done to the national economy. It is a matter of personal responsibility.

What about Restoring Louisiana's Wetlands and Barrier Islands:

Following Hurricane Katrina, there has been much discussion in the media about a massive plan to restore Louisiana's coastal wetlands and the delta's barrier islands. This effort has been strongly advocated by Louisiana scientists, engineers, land managers, and environmentalists alike. It is well known that Louisiana is suffering the highest rate of land loss in the US. The wetlands in the Mississippi River delta region have been disappearing due to a variety of causes, most of which are human-induced. The price tag associated with the project is often placed at \$14-15 billion. We have the following concerns about the advocacy of the Louisiana coastal restoration:

1) During interviews with national media, many individuals have insinuated that the wetland restoration (had it been in place), would have reduced the impact of Katrina on

New Orleans or coastal Louisiana. This is highly unlikely. Storm waters approached the coast from the east and it is our opinion that any additional wetland would have done little to mitigate storm impact.

2) It has been suggested that rebuilding and maintaining the offshore barrier islands would provide protection for the wetlands and property in the delta region. Again, we believe that this hypothesis is untested and unlikely to be true. Hurricane Katrina overtopped all of the Mississippi coastal barriers in Gulf Islands National Seashore on its way to devastating the inland shorelines of Mississippi. These islands are far more robust and well vegetated than islands like the Chandeleurs or Isle Deniers. The Chandeleurs were no more than a tiny speed bump to the forces of Katrina.

3) The restoration plan, as we've seen it, does little to address the root causes of wetland loss: sediment deficit in the Mississippi River, water extraction, canals. Rather, it is a massive engineering project designed to fix problems caused by engineering. We find it ironic that some of the same people calling for higher levees are calling for wetlands restoration. The fact of the matter is that maintaining these wetlands in a regime of rising eustatic sea level (at accelerating rates) is probably untenable. We would be creating our own little Holland with need for engineering and maintenance expenditures forever.

4) We are strong advocates of wetland protection and restoration. If the federal Government is going to spend \$14-15 billion on wetland restoration, let's put all US wetlands on the table. North Carolina is rapidly losing coastal wetlands. Isolated wetlands have been removed from federal protection nationwide. Funds of that magnitude should be spent where the highest rate of success is likely. We're not sure that would be the Louisiana delta region.

We believe that there are many concerned and honest advocates for the project to restore coastal Louisiana. We simply argue that the effort shouldn't be mislabeled as storm protection and we shouldn't rush into the expenditure.

Are coastal scientists doing enough?

Have we, as coastal scientists fulfilled our obligations to society by adequately warning of the problem of beachfront development? We think that, more often than not, the voice of the coastal community has been muted on this topic. Of course the number of publications describing and mapping coastal hazards would probably fill a dump truck or two. But, technical and gray literature writings may never make it to the public. A stronger, direct presence of scientists on individual local projects is needed to counter the hugely powerful beachfront lobby. By direct presence we mean participation in public hearings, speeches to civic clubs, comments submitted in response to environmental impact statements (EIS) and design documents published for public comment by the US Army Corps of Engineers. Most of these things are activities not always appreciated by Universities. They certainly aren't the items most favored on tenure applications. But scientific knowledge brings with it societal responsibility. We would like to see more of us engaging that responsibility. Failure to do so means that only those with a direct financial interest will participate in the debate. And, their first priority will not be to fiscal responsibility, environmental preservation, or even human safety.

We think Hurricane Katrina's impact on the Mississippi Coast could be an opportunity to focus US attention on the need to completely rethink our national coastal policy. Above all, it is the time to m

Figure 1. Waveland Mississippi on Sept 2, 2005, four days after Hurricane Katrina came ashore. Note the ridge of debris, 8 rows of (former) houses back from the beach. Photo by Andy Coburn

Figure 2 Another view of devastated Waveland Mississippi. Here the ridge of debris can be seen extending across the entire top of the photo. The dark line behind the debris line is the location of the railroad embankment that helped reduce storm surge in both Hurricanes Camille (1969) and Katrina. Photo by Andy Coburn

Figure 3 Dauphin Island Alabama was strongly impacted by Hurricane Katrina. Here it can be seen that the entire island was overwashed and was significantly widened, as part of the island migration process, by the deposition of sand on the lagoon side of the island. Note the piers and boathouses that now stand over dry sand. Photo by Andy Coburn

Figure 4 A common problem with beach replenishment is mining sand from the wrong location as can be seen on Ocean Isle, North Carolina after the passage of Hurricane Ophelia (sept 17, 2005). The roads obviously have been shortened by long term erosion and pieces of concrete and pavement can be found on the beach. The erosion rate here may have accelerated because sand for a beach nourishment project (200X) was obtained from the adjacent ebb tidal delta of Shallote Inlet. Obtaining sand from inlets provides the cheapest and best sand available for most beaches but as a consequence, the rate of erosion on adjacent beaches is often increased. Photo by Andy Coburn