



Coast Watch...

The Quiet Before the Storm?

New York, New York, a wonderful town. The Bronx is up, but the Battery's down.
—“On the Town”

Whether “up” in the Bronx, the most northeastern borough of New York City on the mainland or “down” on the Battery, at the southern tip of Manhattan Island, much of NYC and adjacent coastal Long Island to the east lies less than 15 feet above mean sea level.

Over a quarter of a million people work within walking distance of historic Battery Park, the largest open space in downtown Manhattan. Over four million workers, residents and tourists visit the park annually where the only thing between the park and the breathtaking expanse of New York Harbor is a seawall several feet high.

When water levels at the Battery peaked at 8 feet during the December 1992 nor’easter, water overtopped the seawall and caused major flooding to many of New York City’s subways and commuter trains. For nearly two decades there has been no major flooding event in NYC. Is this the quiet before the storm? What gives in Gotham?

With New York Sea Grant funding, a group of researchers—**Dr. Brian A. Colle** of Stony Brook University’s School of Marine and Atmospheric Sciences (with help from undergraduate **Katherine Rojowsky**, now a graduate student at North Carolina State University) and **Dr. Frank Buonaiuto** of the Department of Geography at City University’s Hunter College—have been looking at storm surges and the climatology of the region. In an article in the January 2010 issue of the *Journal of Applied Meteorology and Climatology*, they zeroed in on NYC, because of its “large population and billions of dollars of infrastructure at risk.” In their published work, the researchers sought to give forecasters and emergency managers a refined conceptual model of what local and regional atmospheric conditions are likely to cause flooding in the New York City area.

To come up with a complete climatological picture, the team described storm surges and actual flooding events at New York Harbor in the 50-year period from 1957 to 2007. By storm surge the team meant the difference between the observed water level during a storm and what would be expected under normal conditions. For flooding events, the team used the thresholds defined by the National Weather Service (NWS): a minor and moderate actual flooding event around New York Harbor was defined as a total water level (storm surge plus the tide) exceeding 6 and 8 feet above the daily average low tide, respectively. They also divided surge events into minor and moderate storm surges. A 2 to 3-foot storm surge is considered a minor surge and for a surge of that size, the NWS issues a coastal flood advisory if it occurs during a high tide. A moderate storm surge exceeds 3 feet and for this the NWS issues a coastal flood warning if this threshold is met during a high tide.

Colle’s team found that in the 50-year period there were 244 minor and 46 moderate surges. Combined with the observed tide, this yielded 174 minor and 16 moderate flooding events. The number of minor and moderate surge events varied dramatically each year as a result of large variations in storm activity and tracks near the coast.

The researchers tracked all the cyclones (low pressure systems) associated with the minor and moderate surge events for NYC. They found that minor surges are associated with a wide variety of storm tracks. But moderate surges are usually associated with nor’easters, damaging winter storms that track northward along the east coast. East coast winter storms can cause millions of dollars in damage over a large area from coastal flooding.

Colle’s team found only one moderate surge during the 2000 to 2007 period suggesting that nor’easters may be tracking differently as compared to the relatively active period of the 1990s for NYC storm surges. “These are interesting results in light of the fact that other studies examining possible effects of climate change suggest that our area may see fewer nor’easters due to changes in storm tracks,” says **Jay Tanski**, NYSG coastal processes specialist. “Given the uncertainty about how climate change may influence these storms, studies like Colle’s are important in that they can help give us an idea how things may be changing.”

The last decade studied, 1997 to 2007, was a relatively “quiet” period in which the number of minor surges decreased. However, the number of minor flooding events increased slightly. This is attributable to the gradual rise in sea level. The research team noted that small annual sea level rise at the Battery has resulted in a water level 10 to 15 centimeters (4 to 6 inches) higher in the 2000s than in the early 1960s.

The Intergovernmental Panel on Climate Change (IPCC 2007) has estimated that sea level will increase between 18 and 59 centimeters during the next century. Says researcher Colle, “If sea level rises 12 to 50 centimeters during the next century, the number of moderate flood events is likely to increase rapidly.” By adding 12.5, 25 and 50 centimeters of sea level rise to observed water levels from the 1997 to 2007 period, Colle noted that the number of moderate flooding events increased to 4, 16, and 136 respectively. The highest number of events equates to having a coastal flood warning issued for NYC nearly twice a week. This illustrates that NYC will become much more vulnerable to storm surge as sea level continues to rise.

The data over the 50-year period showed some other interesting results including a qualitative relationship between the number of minor surges at the Battery and El Niño-South Oscillations events. The researchers found that three of the top four minor surge years at the Battery were associated with years of strong El Niño events. These years coincide with years of a greater number of east coast winter storms that track in a favorable orientation along the east coast.

Fitting together the pieces of storm surge, sea level rise and flooding events together to predict New York City’s climatology may be of great interest to emergency planners. The data analysis suggests that sea level rise over the last few decades may already be enhancing the number of nuisance flooding events—those for which a coastal flood advisory is issued. Says Colle, “New York City will be increasingly more vulnerable to storm surge as sea level continues to rise, thus suggesting the need to take more immediate action to protect the city from more frequent larger flooding events.”

—Barbara A. Branca