



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



All photos courtesy of Malcolm Bowman

Coast Watch...

Relative “Quiet” Broken with March Storm

WEB EXTRA

Stony Brook, NY, March 19, 2010 - A late season nor'easter ripped through Metropolitan New York and Long Island the evening of March 13, 2010. And although the storm's fury fell short of the damaging 1992 nor'easter, the results of last Saturday's storm will still be considered a moderate coastal flooding event that caused roadway and railroad closures. A combination of high winds—some reported up to hurricane force—and saturated soil brought down numerous trees resulting in extensive power outages, especially on Long Island where 263,000 customers lost power.

This storm did not break any records, but did break the relative “quiet” of the past decade. The gauge at the Battery in lower Manhattan recorded a peak surge of 1.28 meters and a storm tide of 2.58 meters. Said Stony Brook University's **Dr. Brian Colle**, “This was the highest surge since the January 1996 nor'easter and the storm tide was within 0.38 meter of the 1992 flooding event.” (Click here to read more about the 1992 flooding event that brought much of NYC's transportation

to a halt.) Other flooding events during the “active” 1990s with storm tide greater than 2.50 meters at the Battery were: October 19, 1996 (2.51 m); March 20, 1996 (2.53 m); March 14, 1993 (2.54 m); December 11, 1992 (2.96 m); and October 31, 1991.

Stony Brook University's **Dr. Malcolm Bowman** was down at the Battery at high tide Saturday evening to check out the conditions, camera in hand. (We thank him for sharing his photos here.) “The seawall had been overtopped and the boat ramp beyond the gate was completely inundated,” said Bowman. “So, too, was the promenade and the area around the Coast Guard's historic Battery tide station. If you were to sit on the park benches, your legs would be in standing water.” Snapping pictures in the gloom and dark, Bowman was surprised at how eerily calm and quiet it was compared to the howling wind and rain experienced further uptown. There were a few other brave souls out there and because of high winds and tides, the Staten Island Ferry service was suspended.

“There's lots of interesting science here to get fired up about,” says Colle. He observed that there were similarities between the 1992 storm and the recent one. “Not the deepest cyclone in both, but the storms were sitting just inland with a huge fetch and strong winds ahead (north) of a west-east front. This March 2010 storm offers more clues on what it takes to get a big flooding event.”

Dr. Bowman also commented on why there was a high storm surge at Port Jefferson (the port closest to Stony Brook University) and other locations around Long Island Sound. “Surges are often highest in western Long Island Sound because of its NE-SW orientation and its funnel shape. Northeast winds drive surges down the Sound and they pile up in western LIS. Also large waves break against the shore, adding additional surge.”

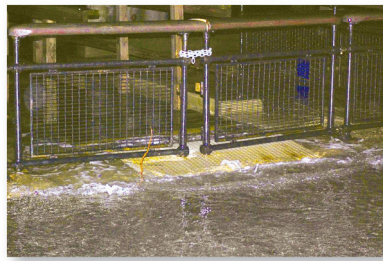
Bowman and Colle are both members of the Stony Brook Storm Surge Group at the School of Marine and Atmospheric Sciences (SoMAS) and recipients of New York Sea Grant funding for various projects. Click here for more on how these researchers are finding ways to improve storm surge forecasts.

Editor's Note: Professor Colle conducts a Friday afternoon weather discussion each week where students and faculty alike share their enthusiasm and meteorological expertise for weather and its forecasting. It was after attending the informative March 12 weather discussion that this writer called her sister traveling from Maryland to New York and said, “Don't come.” She didn't listen and spent several harrowing hours on flooded roads and alternate routes. From the vantage point of the Verrazano Narrows Bridge she could see that the Belt Parkway which hugs the coast of Brooklyn had flooded with seawater.

— Barbara A. Branca



The gauge at The Battery in lower Manhattan (at far back left) recorded high surge and storm tide numbers. So high, in fact, service was suspended for the Staten Island ferry (seen here, in the distance).



At high tide on Saturday evening, The Battery Park seawall had been overtopped and the boat ramp beyond the gate (pictured here) was completely inundated.



The promenade at the Battery was also completely inundated from the flooding event. The seawall is pictured here on the right.

Currents



1000 Islands International Tourism Council

Sackets Harbor on Lake Ontario

Great Lakes Small Harbors Initiative

The economic impact of recreational boating in New York is sizable. In 2003, a NYSG-funded study found that NYS-registered boaters spent an estimated \$2.4 billion in the state on gas, food, lodging, launching fees and other boating-related expenses. “The survey gave the boating community an initial understanding of just how large their clout is on New York State’s economy,” said NYSG Recreation and Tourism Specialist **Dave White**.

Data from a January 2009 Great Lakes Recreational Boating Economic Benefit Study published by the U.S. Army Corps of Engineers expanded on this concept, showing recreational boaters in the Great Lakes states – New York, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Michigan and Minnesota – produce \$22 billion in economic value annually. The region has 4.2 million of the 8.4 million boaters nationally.

“The study estimated that boaters in the Great Lakes states spend \$529 million on vessel-related expenditures and another \$665 million on trip-related expenditures,” said Great Lakes Commission Special Projects Manager **David L. Knight**. “That makes the cost-benefit ratio of a funding request to maintain a new Great Lakes Small Harbors Coalition initiative pretty attractive.”

In Fall 2009, **Chuck May**, Chair of the Great Lakes Small Harbors Coalition (GLSHC), worked with NYSG on a grassroots effort to secure federal funding for federally-authorized shallow depth harbors in New York’s Great Lakes region. There are 20 such harbors in the area: three ports along the St. Lawrence River, 10 along Lake Ontario, three along the Niagara River and four along Lake Erie.

“The regional coalition will help New York’s recreational and commercial small harbors address management, dredging and funding needs by recognizing the eight Great Lakes states and hundreds of shoreline communities as all part of the greater Great Lakes system,” said White.

White has reviewed 10 years’ worth of research funded by NYSG and others that shows the NYS-level value of marinas, sportfishing, charter services, and scuba diving. “This research identifies user groups whose interests connect with those of the GLSHC,” White said.

In October 2009, NYSG co-sponsored meetings in Oswego and Albion (near Brockport) to further connect with users. During the meetings, May spoke with nearly 50 representatives of New York’s waterfront interests – harbor masters, elected officials, and representatives of marinas and marine trade associations, yacht clubs, port

authorities and government, environmental, and tourism agencies.

As a direct result of these meetings, at least nine new resolutions have passed with others now pending to become members of the GLSHC. These include ones in Niagara, Orleans, and Oswego counties, the Towns of Wilson, Carleton and Sandy Creek, and the City of Rochester. In addition, Congresswoman **Louise Slaughter** submitted a request with Reps. **Dan Maffei** and **Bill Owens** late last year to the U.S. House of Representatives Subcommittee on Water Resources and Environment’s Transportation and Infrastructure Committee to establish a dedicated fund to dredge federally-authorized harbors on Lake Ontario and the Niagara River. Between their three offices, Slaughter, Maffei and Owens represent all of the Federal harbors on Lake Ontario.

“It’s critical that we maintain adequate funding to protect and leverage New York’s north coast harbors to help create jobs and spur economic development,” said Rep. Slaughter. “Lake Ontario is our region’s largest and most important natural resource. Over the past five years I have been proud to have secured over \$3 million to complete dredging and pier repair work in Rochester Harbor, Oak Orchard Harbor, Olcott Harbor, and Wilson Harbor.”

—Paul C. Focazio and Kara Dunn

Currents

Does winter productivity bring summer hypoxia?

When you think about summertime fisheries on Lake Erie, an image of frigid weather and ice does not come immediately to mind. Yet it's wintertime microbial activity under the ice that influences the development of the summertime hypoxia which has an important impact on the lake's fisheries. Preliminary field studies in 2007 and 2008 documented presence of diatoms and estimated their biomass and production. The importance of this phenomenon relates to the expected degradation of this biomass during the summer months contributing to the low-oxygen condition known as hypoxia.

With NYSG funding for a two-year project, **Dr. Michael R. Twiss** of Clarkson University and **Dr. Steven Wilhelm** of the University of Tennessee-Knoxville set about to further assess winter microbial biomass and metabolism and to test the importance of winter productivity to summer hypoxia in Lake Erie.

With the help of collaborators from Environment Canada and Bowling Green State University, the research team sampled the frigid February waters of Lake Erie in both 2009 and again in 2010. Sampling, experiments and analysis are underway to measure concentrations of plankton, photosyn-

thetic efficiency, rate of photosynthesis, plus bacterial production, growth, grazing, and the balance of production versus consumption of organic carbon during the period of ice cover in Lake Erie to provide much greater detail of microbial activity in the lake in winter. Early findings so far indicate an actively growing cold-loving phytoplankton community is present in the lake in the winter.

—Lane Smith and Barbara A. Branca

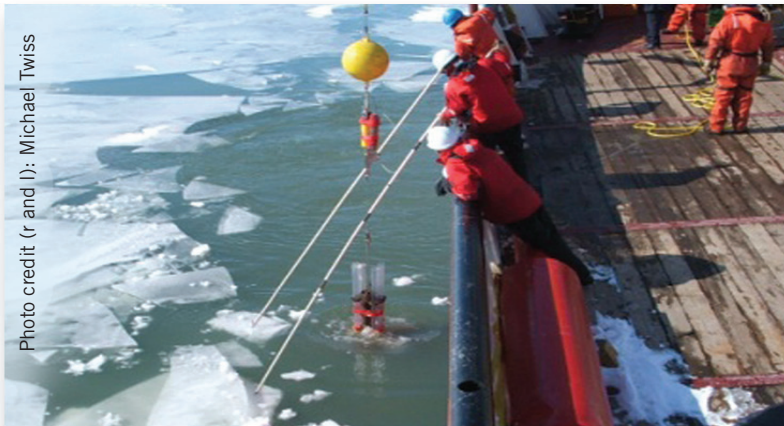


Photo credit (r and l): Michael Twiss



Environment Canada technicians recovering sediment traps through ice on Lake Erie in winter.

Currents

New Web Site Helps Managers Deal with Nor'easters

Hurricanes may get more press and attention, but winter storms known as northeasters (or nor'easters) have a greater impact on New York's coast. They are more frequent, last longer and are usually much larger in size than hurricanes. To help coastal communities better deal with these storms, **Jay Tanski**, New York Sea Grant Coastal Processes specialist has been working with **Dr. Arthur DeGaetano**, Director of the National Oceanic and Atmospheric Administration's Northeast Regional Climate Center (NRCC) and professor at Cornell University, to develop the East Coast Winter Storm Climatological and Forecasting Data Web site <http://nywinterstorm.org>. Funded by NOAA's Climate Program, the site was designed in consultation with local coastal managers and emergency personnel to provide them with the real time and historical data on nor'easters along with tools to help them better use this data.

The site provides seasonal forecasts of storm activity, historical climatological data and a "one stop" compilation of sites providing real time weather and oceanographic data in the region. The 2009-2010 seasonal forecast by the NRCC indicated that storm activity this winter will be higher than normal in both number and strength of storms.

One of the features local managers are finding most useful on the site is the Analogue Storm Track tool. When an East Coast Winter Storm is forecast by the NOAA Global Forecast System (GFS) model, the Web site compares the forecasted storm to a historical data base of over 700 storms from 1950 to 2007 and automatically selects the five most similar storms (analogue storms) based on forecasted positions and pressures. In addition to displaying the tracks and associated pressures for both the analogue and forecast storm, the site allows the user to view actual measurements of storm surge levels associated with

the analogue storms at different tide gauge locations as the storm moves up the coast.

"We were surprised at how well the site worked during the past northeasters. It is being put to good use," said **John Baroni**, emergency manager from the Village of East Rockaway on Long Island's south shore referring to the early 2010 storms that brought record snows to the northeast. Baroni was involved in the development of the web site and is showing others how to use it to better assess the possible impacts of approaching storms.

—Jay Tanski

Last Wave

Ordering Publications

Go to www.nyseagrant.org, click on "Publications" section, fill out our "Publications Request Form" or send requests to Susan M. Hamill:

New York Sea Grant Communications
121 Discovery Hall, Stony Brook University
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Journal Reprints

Aroundry, L.O., and P.L.-F. Liu. 2009. Two-dimensional, two-phase granular sediment transport model with applications to scouring downstream of an apron. *Coastal Engineering* 56(7): 693-702. Pub ID# 3250.

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Rinta-Kanto, J.M., M.A. Saxton, J.M. DeBruyn, J.L. Smith, C.H. Marvin, K.A. Krieger, G.S. Saylor, G.L. Boyer, and S.W. Wilhelm. 2009. The diversity and distribution of toxigenic *Microcystis* spp. in present day and archived pelagic and sediment samples from Lake Erie. *Harmful Algae* 8(3): 385-394. Pub ID# 3213.

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Fact Sheets

Fish Habitat 2009 Fact Sheet Series

A series of seven fact sheets produced by NYSG and SUNY College of Environmental Science and Forestry focuses on the preferred habitats, risks to and tips for improving habitats for three species of fish: Northern pike, muskellunge and walleye. Written by NYSG Fisheries Specialist David B. MacNeill and funded by U.S. Fish and Wildlife Service: Fish Enhancement, Mitigation and Research Fund. Other project partners include NYSDEC, NOAA, USGS, USDA, Natural Resources Conservation Service, Save the River and Thousand Islands Land Trust. Available online at <http://www.seagrant.sunysb.edu/glsportfish/article.asp?ArticleID=377> or contact David MacNeill (315) 312.3042 or dbm4@cornell.edu

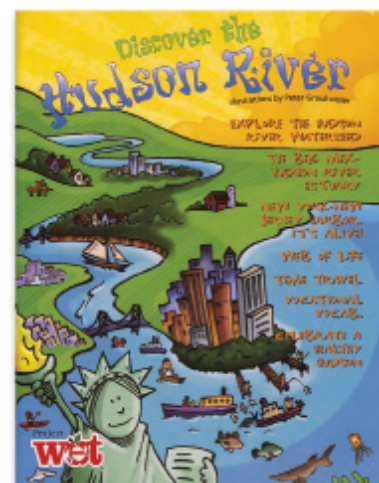
Hudson River Resource for Teachers and Students

Project WET's *Discover the Hudson River*, a 16-page color booklet designed for teachers and students in the upper elementary grades (5-6 grades), uses lively text, games, maps and activities to provide information about the Hudson watershed, its variety of wildlife and the many ways people influence and are influenced by the Hudson River.

"We're offering teachers an add-on to their science curriculum that's educational but not too cumbersome for kids," says NYSG Hudson Estuary Specialist *Nordica Holochuck*, of the visually-driven *Discover*. "The puzzles and games included in the booklet are interesting and fun. It represents another approach to engage young people in environmental education."

For more information, go to www.nyseagrant.org/hriver and click on "Publications." Teachers can request a free copy of *Discover the Hudson River* from Holochuck for a limited time via E-mail, nch8@cornell.edu or phone, (845) 340.3983.

Produced in 2009 to commemorate the 400th anniversary of Henry Hudson's first exploration, the booklet is a joint venture of Project WET (Water Education for Teachers), the New York State Department of Environmental Conservation, New York Sea Grant, the New York-New Jersey Harbor Estuary Program, the National Oceanic and Atmospheric Administration and Central Hudson Gas and Electric Corporation.



From the Director...

Welcome to New York Sea Grant's (NYSG's) first *New York Coastlines* issue of 2010, the first of our new shorter, but more frequent and timely issues! While the search for a new Associate Director for Extension continues, **Chuck O'Neill** (pictured at right) recently replaced **Bob Kent** as our Interim Associate Director. Chuck has been with NYSG since 1981 and is best known for his leadership on invasive species issues in the Great Lakes and elsewhere. I want to thank Bob Kent for his efforts on behalf of NYSG during the past year, and wish him well as he returns to his regular extension duties on a half-time basis. Bob has also been leading the planning for the upcoming meeting of northeast Sea Grant programs in the scenic Hudson Valley in May, hosted by NYSG.

We are currently reviewing research pre-proposals from our latest call for proposals. This call for proposals is focused on two areas of research from our new Strategic Plan that are currently receiving only limited research support: sustainable coastal development and coastal hazard resilience. We hope that this call for proposals will help broaden both our research portfolio

and the community of researchers supported by NYSG.

This issue of *New York Coastlines* focuses on harbors, from New York Harbor in New York City to small harbors upstate. New York Harbor and other exposed coastal areas such as Long Island's south shore are threatened by the storm surge from nor'easters and other storms. The lead article features some of our research and extension efforts to predict storm surges as well as to disseminate timely information in a form useable by emergency managers. A shorter article covers the Great Lakes Small Harbors Initiative to secure Federal support for these important upstate economic engines. Articles on Lake Erie research and a new Hudson River publication round out the issue.



Interim Associate Director
Chuck O'Neill

A handwritten signature in black ink that reads "James W. Ammerman".



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