



# New Jersey State of the Shore Report 2008



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The New Jersey Marine Sciences Consortium (NJMSC) is pleased to present its *2008 State of the Shore Report*, an annual beach assessment and interpretation of New Jersey's coastal resource issues. Much progress has been made in improving water quality and conserving, preserving and

protecting the integrity of New Jersey's 127 miles of coastal beaches and other natural resources, but at the same time, increasing development pressure, port expansion, legacy pollutants and eutrophication continue to present daunting challenges to sustaining the State's \$50 billion coastal economy.

As ever more people migrate to the Jersey coast, new and better coastal policies will be required to *simultaneously* address coastal economic health, public access, resource sustainability issues, and to facilitate cooperation and consensus building among diverse social, cultural, economic and environmental-ecological interests. The wealth of coastal economic and natural resources contained within the nation's most densely populated state creates intense

competition for coastal lands, waters and resources. These pressures are under increasing influence of climate change and sea level rise exacerbating the challenges of effective coastal zone management. New Jersey's coastal communities face enormous pressures to balance growth demand with quality-of-life issues, and because New Jersey's coastline is largely "built," protection of people and property has become an area of increasing importance to New Jersey.

Recognizing the need for *balance* between economic vitality and quality of life, NJMSC's primary mission has focused on sustainable coastal management and the wise use of ecological capital. In its newly legislated role as a Research & Development and "technology transfer" institution for the State, NJMSC's mission and activities are clearly in lockstep with New Jersey's interests in the coastal zone. As we welcome the summer of 2008, NJMSC stands poised to do its part and renew its commitment towards contributing solutions to coastal issues by promoting economic growth balanced by a quality of life that is among the best in the nation.





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## Coastal Storm Activity

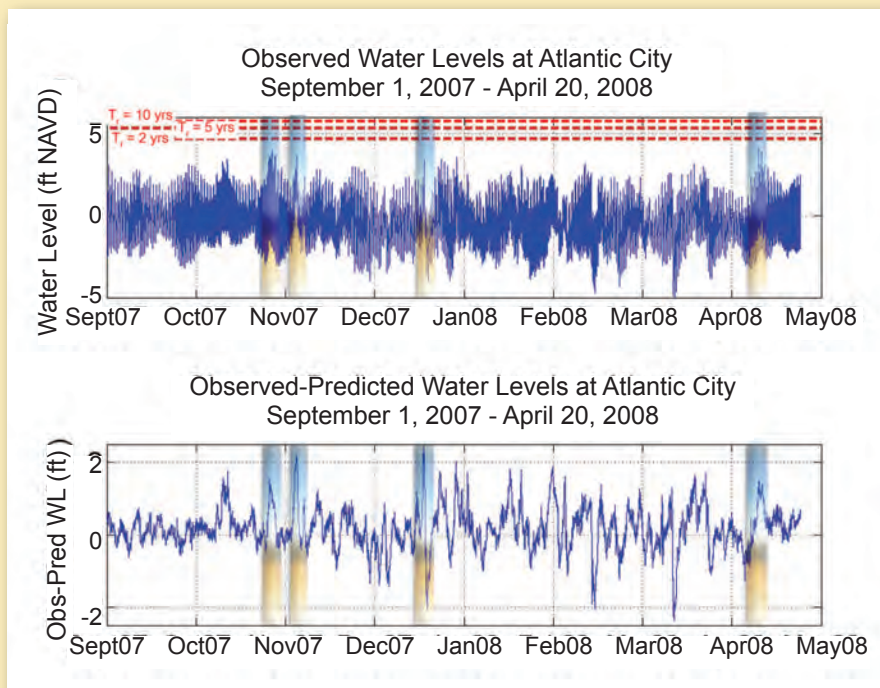
New Jersey's coastal communities once again have reason to celebrate, as this past winter marked the fifth mild winter storm season in a row, and the fifteenth since the back-to-back devastating winter storms experienced in 1991 and 1992. This winter, the majority of the Northeast winter storms tracked to the north and west of New Jersey, sparing the coast from the type of conditions that typically result in significant beach erosion. Similar to last year, a series of storms in mid-April resulted in a short extension of the storm analysis (from April 15 until April 20) section of this report, so that one of the more significant storms of the winter season could be included.

Impacts of coastal storms are typically evaluated in several ways. Traditionally, water levels are used as they correlate well to coastal flooding and inundation, but other factors including storm surge and wave energy can be used as well. In fact, the majority of the damage to New Jersey's beaches occurs when large ocean waves are accompanied by extreme water levels. Timing plays an important factor when it comes to the potential

damage from coastal storms since even a moderate storm occurring during a spring high tide can have significantly more impact than a severe storm which peaks at low tide.

Water levels measured by the NOAA tide gauge at Atlantic City between September 1, 2007 and April 20, 2008 are shown in the upper panel of Figure 1. Also shown in the figure is the storm surge, or difference between the measured values and the astronomical predictions. Water level data from Sandy Hook and Cape May were tabulated as well, but show similar trends and are therefore not presented. The water levels corresponding to the two-, five-, and ten-year return periods ( $T_r$ ) based on an extreme value analysis of the complete Atlantic City data set (1912-2007) are identified. Shaded rectangles are used to identify four major storms which are discussed in more detail below.

The second figure contains wave heights measured by the Stevens Coastal Monitoring Network (CMN) gauge at Avalon over the same period. The gauge has been operational since 1998 and provides real-time meteorological and hydrodynamic data through the web at [cmn.dl.stevens-tech.edu/](http://cmn.dl.stevens-tech.edu/). The length of the wave record is insufficient to estimate return periods; however, the average and maximum significant wave heights are plotted for reference. The average significant wave height over the past winter (2.5 ft.) was noticeably higher than in previous years (2.3 ft. last year and 2.38 ft. the year before) and larger than the long term (1999-2008) winter average of 2.2 ft. in spite of the fact that the maximum recorded wave height was lower (8.9 ft.) than that recorded in either of the two previous seasons (9.36 ft. and 9.86 ft.). This is largely due to an active mid-December to April period during which a series of small to moderate storms raised the yearly average.



**Figure 1: Measured water levels and water level differences at Atlantic City between September 1, 2007 and April 20, 2008.**

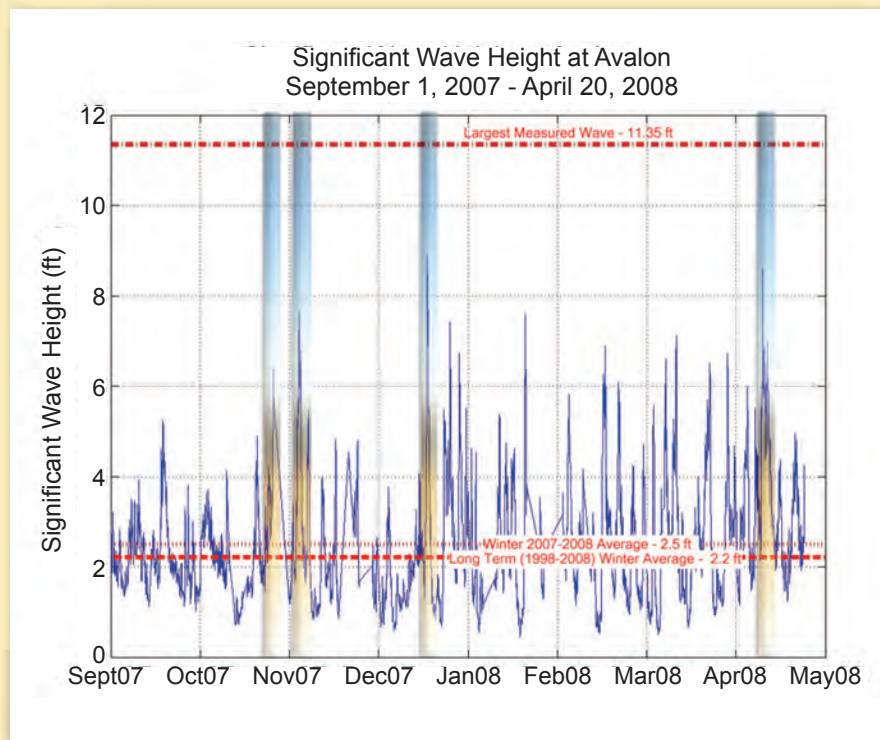


Overall, the winter storm season got off to a slow start, with only a handful of minor events impacting the coast in September and early October. The first significant storm of the season occurred in late October as strong onshore circulation associated with a high-pressure system over New England combined with high spring tides to produce widespread minor coastal flooding. Fortunately, the storm did not generate large waves or a significant surge, and the majority of the flooding was simply related to the timing of the storm during a period of higher than normal astronomical tides.

Following close on the heels of the first storm of the season were the remnants of Hurricane Noel. A small Category 1 storm at its peak, Noel had weakened significantly by the time it approached New Jersey; however, it retained enough energy to generate wind gusts up to 45 mph along the coast. High surf conditions and the second largest storm surge of the season also accompanied the storm, but timing was once again the key as Noel struck during a period of neap or lower than normal tides. As a result, the maximum water level reached during the storm was nearly half a foot lower than that achieved during the October storm.

After an extremely calm late November and early December period, the next significant storm occurred on December 16. Once again the timing of the storm was extremely fortunate as the largest waves and storm surge of the season occurred during a neap tide. The storm was one of only two during this past winter that generated waves in excess of 8 ft. The storm surge was a 0.3 ft above that generated by Noel and nearly a full foot larger than that generated by the October storm. Interestingly, as the storm moved offshore, and the winds shifted around to the west, the storm was also responsible for generating one of the largest setdown events of the winter

The period from mid-December through the end of March was remarkable not for any individual event, but for the frequency with which a number of smaller storms occurred. As happened last year, a series of storms in early to mid-April punctuated the end of the winter storm



**Figure 2: Significant wave height measured at Avalon between September 1, 2007 and April 20, 2008.**

season. The largest of these storms on April 6 generated the highest water level and the second largest wave event of the winter season. Fortunately the surge associated with the storm was less than might have been expected given the energetic wave conditions. The impacts of the storm could have been much worse as the peak of the storm coincided with higher than normal spring tides. The maximum water level of 4.1 ft. NAVD achieved during the April storm represents a storm with a return period ( $T_r$ ) of 1.21 years, or an estimated annual probability of occurrence of 83%.

An intensifying low pressure system formed off the Delmarva Peninsula on May 11 and tracked east-northeast off the coast of New Jersey on May 12. The intense low pressure system generated sustained easterly winds of 23 mph or greater for a duration of 24 hours. A peak sustained wind of 46 mph with peak gusts of 57.5 mph was measured along the New Jersey coast during the early morning hours of May 12. The strong winds and long duration generated significant breaking wave heights of 10 to 12 ft. along the coast, with extreme waves as high as 18 to 20 ft. The storm surge generated by the coastal low ran up to 3 ft. above the predicted tide levels and persisted over 3 high tides. A maximum water elevation of 4.8 ft NAVD 88 was recorded at Atlantic City





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during the morning tide of May 12. Water elevations of this magnitude should occur about once every five years, however, this was the highest water elevation recorded since 2000. The timing of the storm's peak intensity, coinciding with high tide as well as its long duration made this the most significant storm event to impact the NJ coast since February 1998.

## *Summer Storm Outlook*

The most recent (April 9, 2008) extended range forecast released by the Colorado State University Tropical Meteorology Project calls for an active 2008 hurricane season, with a total of 15 named storms (9.6 is the long term average), 8 hurricanes (5.9 is the long term average) and 4 intense (Category 3 or higher) hurricanes. These numbers are above the long term averages from 1950-2000 of 9.6 named storms, 5.9 hurricanes, and 2.3 intense hurricanes. This year's forecast utilizes a new prediction scheme which in hindcast trials has shown a marked improvement over previous April forecasts. Key factors influencing the most recent forecast include weakening La Niña conditions in the Pacific, warm sea surface temperatures in the north and tropical Atlantic related to the Atlantic Multidecadal Oscillation, and a weak Azores High likely to promote weaker than normal tradewinds and enhanced warm sea surface temperature anomalies in the tropical and subtropical Atlantic. Perhaps more relevant than the actual number of hurricanes is the likelihood of a major hurricane making landfall along the U.S. East Coast, which according to the latest forecast is 69%. While a direct impact from a major hurricane remains fairly unlikely along the New Jersey coast, there is a relatively high probability that New Jersey will be impacted by tropical storm force winds (40-75 mph). Based on the latest forecast, the probability of tropical storm force winds affecting the southern New Jersey counties of Cape May, Atlantic, and Cumberland is 6.9%, down from 7.9% last year and 11.1% in 2006, while the northern New Jersey counties of Ocean, Monmouth, and Burlington again have a slightly higher probability of being impacted (8.8% compared to 10.1% last year and 14.1% in 2006).

## *Coastal Assessment*

Over the past several years New Jersey's beaches have benefited from a series of relatively calm winter storm seasons, and this past winter was no different. Although the average wave height recorded at Avalon was above the long-term mean, the timing of the largest storms was such that the largest waves rarely coincided with extreme

water levels. Without a major storm event, the beaches in most communities should be in relatively good condition heading into the summer months. Furthermore, given the nature of this past winter's storms, it is expected that most of the sand eroded from the dry beach remains within the littoral system, temporarily stored in offshore bars, and will eventually be carried back to shore. Given an extended period of calm late spring/early summer weather, this sand should eventually work its way back on shore.

The New Jersey coast has been in equilibrium with the smaller, more frequent storm events that have impacted the coast over the past 10 years. The duration and intensity of the May 12 storm generated minor to moderate erosion along the entire Atlantic Ocean shoreline. Tracking closer to the southern and central portions of the coast, the storm generated shoreline erosion of between 50 to 75 ft. In many places, the large waves superimposed on the storm surge reached the seaward toe of coastal dunes, widened by the relatively calm conditions over the past decade. Dune recession of up to 8 ft. was reported along the coast. In Monmouth County, the beaches buoyed by the wider width and higher berm elevation due to the federal beach nourishment project experienced 25 to 50 ft. of recession and no dune erosion. Although this was the most significant erosion event in some time, the occurrence of the storm in the later spring will lessen its long-term impacts as sand eroded from the beach will start to move back toward the coast during the calmer wave conditions of the early summer.

## *Future Outlook*

Coastal hazards remain a persistent threat to those of us living, working and recreating along the coast. In the context of climate change, the threat of these hazards is likely to increase rather than decrease; therefore, we must remain vigilant in our efforts to create sustainable coastal communities which balance the needs of all stakeholders. We cannot allow the current statistically anomalous period of mild weather conditions to create a false sense of security. The trend now seems to be placing the responsibility for finding funding and implementing solutions for large-scale federal projects and for providing and implementing solutions increasingly on state and local governments. In the face of ever-tightening fiscal constraints, resources need to be pooled to find innovative and practical means of sustaining one of New Jersey's most valuable natural resources.