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Editorial

Rip Current Research at Miami Beach, Florida

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Beaches are the number one recreational destination for Americans, and these sandy playgrounds are the most extensive natural parks in the country. We are naturally drawn to the rhythmic pounding of the waves, but many beachgoers are oblivious to the currents in the surf zone which are generated by breaking waves and are nearly invisible at Miami Beach.

The sighting of a single shark near a swimming beach can generate widespread public alarm and many news reports, while rip current drowning receives scant attention. In actuality, these strong offshore-flowing currents are fairly common at surf beaches; lifeguards in the United States rescue more than 90,000 people each year with rip currents being responsible for 80 percent of the saves (www.usla.org). More than 100 people drown annually in rip currents in the United States, which is greater than hurricanes or tornadoes during an average year (Figure 1).

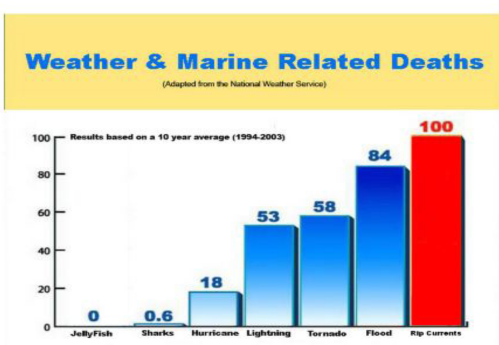

Figure 1: National Weather Service graphic showing the loss of life from various natural hazards in the United States.

Miami Beach, which recently celebrated its 100th anniversary, is world famous; this ten-mile span of white sand is the playground for millions of South Florida residents and attracts tens of millions of visitors annually. The beach is the magnet, and the revenue generated by this tremendous resource amounts to hundreds of millions of dollars per year. Yet there is no concerted research program to understand the waves and currents that are resulting in beach erosion and dangerous rip currents.

Miami Beach is one of the top 10 beaches in the world, but it also has the distinction of ranking as the #3 beach for rip current drowning in the United States. While Miami Beach Ocean Rescue does an outstanding job of warning beachgoers and saving those caught in these offshore-flowing currents, the entire span of beach cannot be patrolled 24/7. Moreover, near shore wave gauges are prerequisite for numerical modeling and accurate rip current prediction. The NOAA offshore, deep-water wave gauge cannot provide the necessary data because the series of close-to-shore reefs greatly affect the incident wave field, and rip currents are generated by the waves breaking directly on the beach. Beachgoers, except for surfers, generally stay out of the water when big waves (e.g., exceeding 1.5 m) are breaking onshore, but most beach drowning occur during sunny days with an onshore wind of 15-20 kts [1], which does not seem dangerous to most people. South Florida is known for its clear water because limestone is the only rock type and there are no rivers or streams bringing silts and clays to the coast that would cause turbidity. These "Clear-Water Rips" are difficult to detect (Figure 2), even for trained lifesavers (Miami Beach Chief Lifeguard Vincent Canosa, personal communication, 2016).

Figure 2: A clear-water rip current at Miami Beach, Florida as delineated by red fluorescent tracer dye.

The long-standing method of rip current prediction is largely based on meteorological conditions (e.g., wind speed, direction and duration), which is used by the National Weather Service to issue warnings of high probability (red flag), medium risk (yellow flag) and low likelihood of occurrence (green flag). There are few observations and no field measurements of near shore breaking wave height, which is the generator of rip currents, to confirm this empirical formulation. Self-funded field measurements are presently underway [1], but there are no instrumented measurements of significant wave height (e.g., highest one-third of waves) in South Florida necessary for use in modeling.

The National Weather Service South Florida Forecast Office on the Florida International University campus in Miami is operating a numerical model for forecasting wave height and hence rip current occurrence, and wave gauge data collected for a period of time (e.g., preferably for five years or longer) is imperative for calibration and verification of this sophisticated model. Therefore, we propose to install wave gauges and monitor wave height and correlate wave height with rip current frequency and flow characteristics.

Wave data are also necessary to better understand beach erosion and proposed methods of maintaining and stabilizing the beach, especially re-nourishment and dewatering projects. Nearly all of the available near shore sand of suitable size for beach nourishment has been exhausted at Miami Beach and elsewhere in South Florida (http://www.sun-sentinel.com/local/broward/fl-sand-management-20151029-story.html) and new sand must be brought from outside areas and/or the available sand resources must be better distributed to nourish eroded areas.

Miami Beach is booming with a billion-dollar rejuvenation of the world-famous Fontainebleau Hotel and new five-star hotels (e.g., Ritz-Carlton, Loews and Four Seasons in nearby Surfside). The city is spending $250 million, which could eventually total $500 million, to raise low-lying roads and install pumps to expel flood waters caused by rising sea level (http://www.miamiherald.com/news/local/community/miami-dade/miami-beach/article41141856.html), yet they have not committed any funds to obtain the necessary wave data to predict rip currents and help maintain their main economic engine-the sandy beach. An observational network needs to be established in order to quantify and understand the local wave field that drives both dangerous rip currents and beach erosion.

Reference

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