Development of an HF radar derived nearshore wave and current product: Application to rip current probability along the New Jersey coast R/6640-001

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Research Summary

Rip currents are the number one cause of ocean drowning and rescue incidents along the coasts of the United States. According to the United States Lifesaving Association (USLA), 71% of the total surf zone rescues, 12,137 incidents in 2003, were due to rip currents. Rip currents are strong nearshore features with currents directed away from the beach on the order of 1.9 knots (2.2 mph) and along-beach scales of tens to hundreds of feet. Swimmers can be caught in alongshore feeder currents, or the rip itself, and subsequently are swept off the beach and into deeper waters. While the theory for cross-shelf rip currents is not as developed as the longshore currents there are linkages between the two. Longshore currents are driven by a radiation stress generated by wave breaking. Mechanisms for rip formation include interactions with the ocean floor and the surface waves. Different mechanisms can dominate on different beaches at different times and it is certainly possible that more than one mechanism can be at work at a given time. This has led to the development of a daily rip current warning issued by NOAA's National Weather Service (NWS) in areas most often at risk.

Inputs to the rip current warning system typically include estimates of nearshore environmental parameters such as the wave height, period and direction, the wind speed and direction, and the alongshore current. Long term monitoring of local waves and currents in many different locations are needed to get stable statistics on the potential mechanisms to drive these semi-empirical models. CODAR High Frequency (HF) radar remotely measures waves and currents providing the means to monitor surface currents and waves remotely near the coast. These data can be collected continuously over a large range of environmental conditions. At present, over 65 CODAR HF radars are deployed nationally, and the current plan is to expand to a national network of over 200. Most applications have focused on the current measurements the system provides. Systems deployed along the New Jersey coast have supported scientific research, Coast Guard search and rescue, pollution spill response, and fisheries research.

The ability to use this growing network as the drivers for nearshore rip current warning systems depends on the development and testing of refined wave processing algorithms to bring the wave data products to the same level of maturity as the existing current mapping products. This proposed project will enhance processing algorithms to include a robust nearshore current and wave capability. The increased wave and current observations nearshore will help researchers to better understand the conditions favorable for rip current formation, and ultimately provide the necessary statistics and boundary conditions to predict rip currents. The Rutgers HF Radar testbed located at Sandy Hook is chosen for this test, since it is the only facility in the world with co-located HF radars operating simultaneously in the same three frequency bands as those deployed worldwide.

The new products developed here will provide additional near-shore observations that will impact beachgoers, public safety officers, forecasters, and researchers that work and play along the New Jersey coast. Through the existing partnership between Rutgers University and the NWS Weather Forecast Office in Mount Holly NJ, information exchange will improve rip current outlooks with increased knowledge and observations. Near-shore wave and current observations will be available at all 7 HF radar sites in the New Jersey network. The data produced through this project will directly benefit public safety, education, and operational surf zone forecasts.