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Surf-Zone Drifters: A New Tool for Observing Nearshore Circulation

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A Drifter for the Nearshore

With Sea Grant funding, coastal oceanographers have built a satellite-tracked drifter capable of withstanding the pounding-force of breaking waves. The surf-zone drifter, the first of its kind, offers a new tool for studying the physics of coastal ocean circulation.

Unlike current meters, which measure water velocities at fixed points, this drifter moves with ocean currents, tracing out a trajectory that represents the space-time evolution of a water parcel. These trajectories make it possible to unravel aspects of coastal circulation that would go undetected by more traditional instruments.

A Description of the Drifter

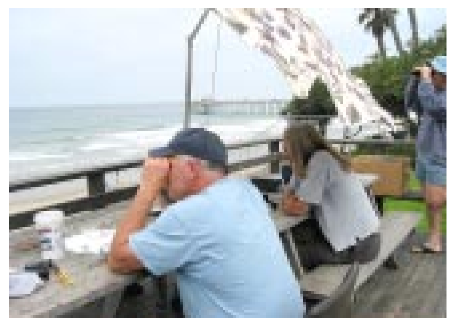
The drifter was designed by coastal oceanography professor Robert Guza, Sea Grant trainee Wilford Schmidt, and engineers Brian Woodward and Kimball Millikan, all at Scripps Institution of Oceanography. It stands just over a meter in height and looks like a long white can with an antenna sticking out the top. Its exterior hull is made of 11-centimeter diameter white polyvinyl chloride (PVC) piping. Sealed inside, there is a Global Positioning System receiver, a data logger and a radio transmitter. There are also batteries and an internal lead weight for ballasting.

Each drifter receives its position from earth-orbiting satellites and transmits its position to a shore-based tracking system, making it possible for researchers to monitor the movements of many drifters on a single plot in real-time.

By design, the drifter floats in a vertical, upright position. Only its antenna actually protrudes above the waterline. A thin PVC disk at the base of the drifter is designed to dampen vertical excursions—cork-like bobbing—of the drifter.

Drifters, such as the one displayed above, are made of PVC piping and are about 1.2 meters tall.

Drifters being deployed in the surf.



Dr. Robert Guza and Sea Grant trainee, Wilford Schmidt, tracking drifters from a platform close to the beach. Photos: Georgia Ratcliffe, California Sea Grant

Testing the Drifter

Laboratory tests in wave tanks at Scripps have confirmed that the drifter essentially moves with water parcels and only to a much lesser extent is pushed by breaking waves and winds. Wind tunnel tests indicated a 1-centimeter-per-second slippage for every meter-per-second wind. Subjected to nonbreaking waves, the drifter moved only slightly, as predicted by linear wave theory. In breaking waves, the drifter moved slightly in the horizontal direction but not vertically, relative to the seafloor. This vertical stability prevents the drifter from being tossed ashore like a lost beach ball.

Applications

One immediate application has been in studying rip currents, seaward jets that often sweep swimmers out beyond their comfort zone. In the summer of 2001 and again in the fall of 2002, scientists and technicians successfully deployed a fleet of the drifters at the base of a rip current located just south of the Scripps pier in La Jolla.

The drifters' paths revealed a never before measured feature of the surf-zone, large eddies (circular currents) at either side of a rip. Swirling waters have been reported anecdotally, predicted by theoreticians and suggested in some numerical simulations, but this was the first time researchers actually measured them.

Another finding: rip currents accelerate as they flow out to sea, reaching a maximum speed at the edge of the surf zone. Maximum speeds were two and three times faster than average.

Looking Forward

As the drifter instrumentation continues to evolve, uses will expand in scope. Potential applications include using the drifters to calculate exchange rates between coastal and open-ocean waters. This information is essential to quantifying the dispersion and fate of coastal pollution.

The drifters could potentially help coastal engineers evaluate the effects of jetties, groins, artificial reefs or seawalls on nearshore circulation, sand loss and coastal erosion.

Trainee Publication

Schmidt, W.E., B.T. Woodward, K.S. Millikan, R.T. Guza, B. Raubenehimer, and S. Elgar. A GPS-tracked surfzone drifter. *J. Atmos. Oceanic Technol*. In Press.

Trainee Presentation

Schmidt, W., D. Slinn, and R.T. Guza. 2002. Surfzone currents over irregular bathymetry: Drifter observations and model results. Proceedings, American Geophysical Union 2002 Fall Meeting, San Francisco, California.

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