Title
Surfzone drifters: A new tool for observing nearshore circulation

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Surfzone drifters: a new tool for observing nearshore circulation

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Surfzone circulation, driven primarily by breaking waves, transports sediments, pollutants, and swimmers. Changes in patterns of wave breaking owing to variations in wave height and direction along curving coastlines, over irregular bathymetry, and near man-made structures can cause complex surfzone circulation, including rip currents. Large numbers of fixed, single-point current meters would be required to resolve this spatially complex circulation. Drifting buoys (or 'drifters') often have been used to resolve complex flows in the deep ocean and on the continental shelf (Davis 1985). In this project, a drifter designed to measure surfzone circulation has been developed and field tested (Fig. 1). Drifter positions accurate to within a few meters are estimated in real-time at 0.1 Hz using the Global Positioning System (GPS) and a shore-to-drifter radio link (Fig. 2). More accurate positions are estimated at 1 Hz from post-processed, internally-logged data. Mean alongshore currents estimated from trajectories of the 0.5 m-draft drifters in 1-2 m water depth agree well with measurements obtained with nearby, bottom-mounted, acoustic current meters (ADV) (Fig. 3a). The ADV and drifter mean cross-shore flows are weak (usually less than 5 cm s^{-1}) seaward of the surf zone (Fig. 3b). Within the surf zone, the near-bottom ADV measure primarily offshore-directed mean flows (undertow), whereas the near-surface flows measured by the 0.5m-draft drifters are predominantly onshore (Fig. 3b). These comparisons are consistent with surfzone field observations of weakly vertically-sheared alongshore currents (Garcez-Faria et al 1998) and strongly vertically-sheared cross-shore currents (Garcez-Faria et al 2000). The drifter development and testing is described in Schmidt et al (in press).

A fleet of 10 drifters, built with Sea Grant support, was deployed in July 2002 at Scripps Beach, La Jolla, California. Drifters released in the surfzone were advected seawards by a well-developed bifurcated rip current (Fig. 4). Maximum velocities in both lobes of the rip current occured near the seaward edge of the surfzone (≈ 2 m isobath), and the rip current extended roughly twice the width of the surfzone from the shore. A numerical model (Yu and Slinn, in press), using the observed bathymetry and incident waves, agrees qualitatively well with the observations (Fig. 5). These observations and results were presented by Sea Grant trainee W. E. Schmidt (Schmidt et al. 2002) at the American Geophysical Union 2002 Fall Meeting, and received an Outstanding Student Paper Award. Modeling of other observations is ongoing.

REFERENCES

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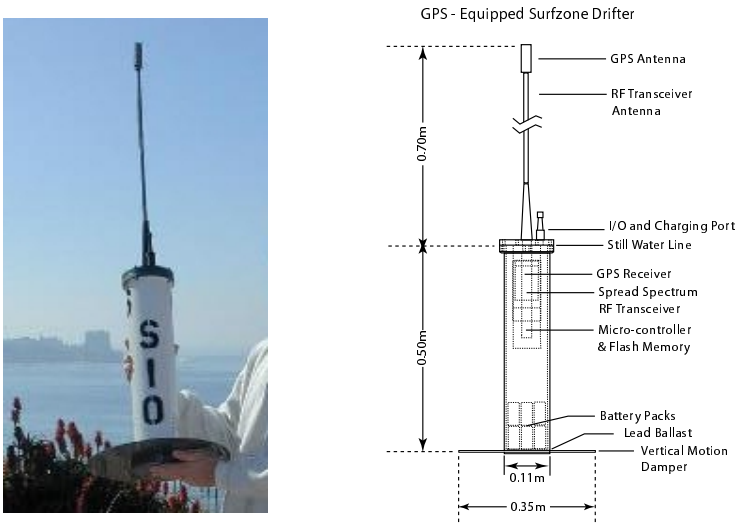

Figure 1: Schematic of the surfzone drifter. Surface piercing antennae for receiving GPS signals and for radio-frequency (RF) communication with shore are molded permanently to the drifter top cap. A 6-pin port, also integral to the top cap, permits programming and data downloading (I/O), and battery charging without opening the drifter package.

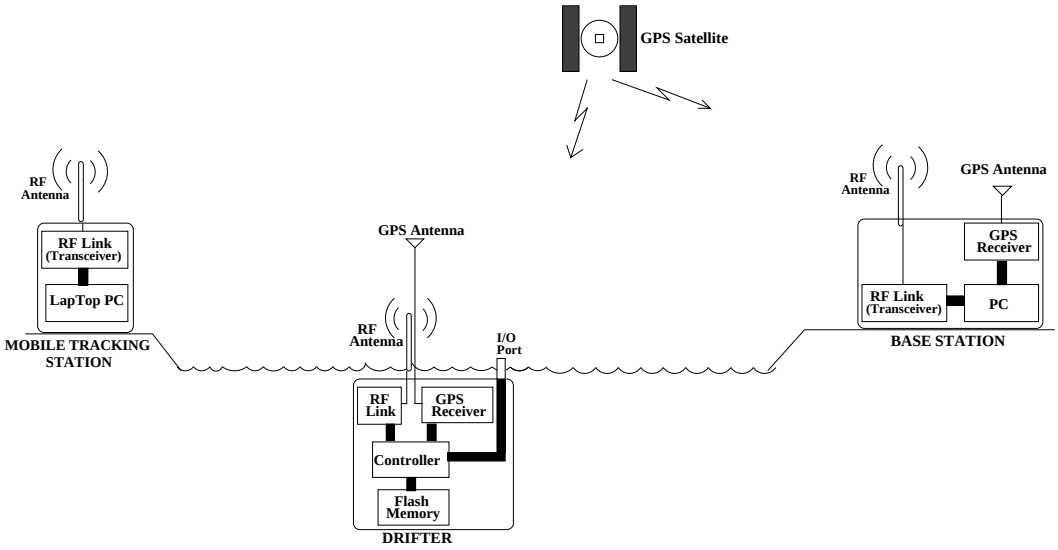

Figure 2: Drifter system schematic. The base station performs DGPS and data logging functions, and can serve a fleet of ten drifters. A mobile tracking station monitors drifter DGPS positions in real-time.

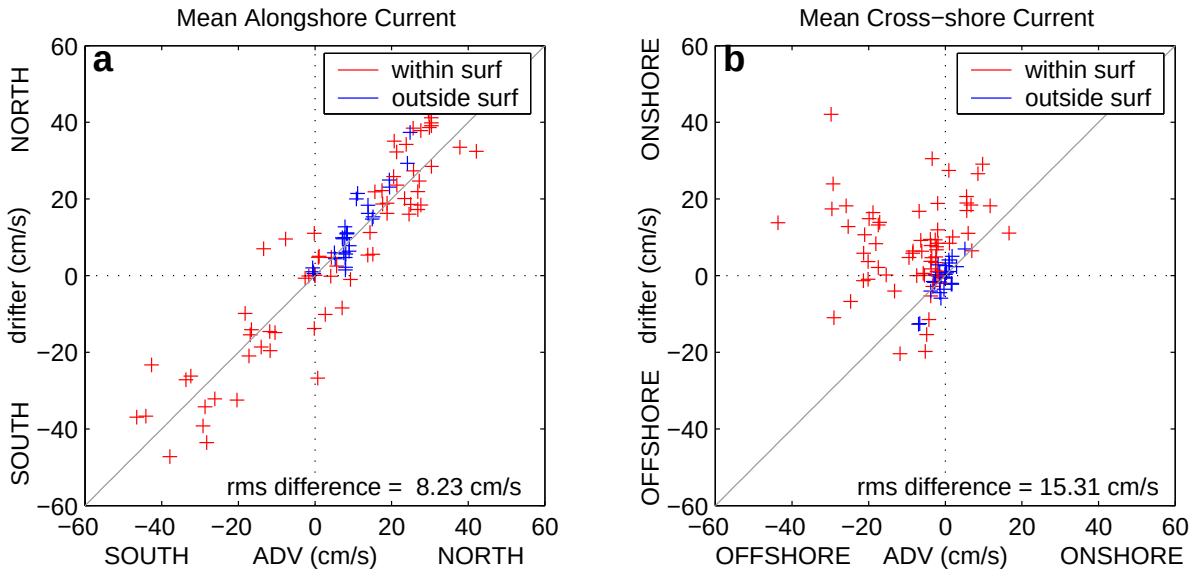

Figure 3: Mean currents observed with drifters versus mean currents observed with fixed current meters (ADV): (a) alongshore (north is positive) and (b) cross-shore (onshore is positive). The sloped solid lines correspond to perfect agreement. Surfzone location was determined from video images. Pairs of drifters were released repeatedly in 1 to 2 m water depth up-current of the ADV, and retrieved down-current of the ADV over roughly 2.5 hours on each of 5 days during the period 4-11 October 2000. Wind speeds were moderate during the deployments, ranging from 0 to 800 cm s^{-1}. Significant wave heights, estimated using data from pressure sensors colocated with the ADV, ranged from 0.3 to 1.2 m. Breaking wave heights (estimated from video) reached 1.5 m. Drifters were released both within and seawards of the surf zone, depending on tide level and wave height.

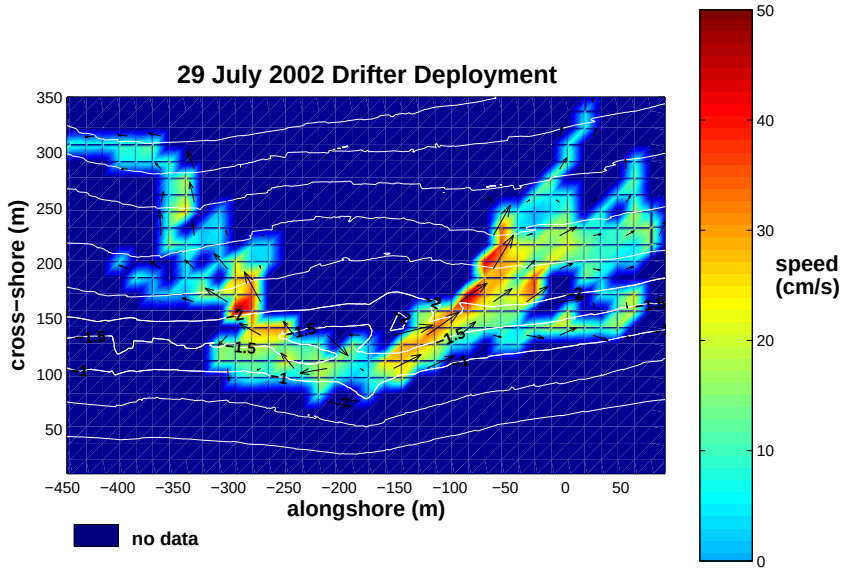

Figure 4: Spatially (10m by 10m squares) and temporally (30 s) mean drifter velocities for a 90 min period on 29 July, 2003. There were about 30 drifter trajectories

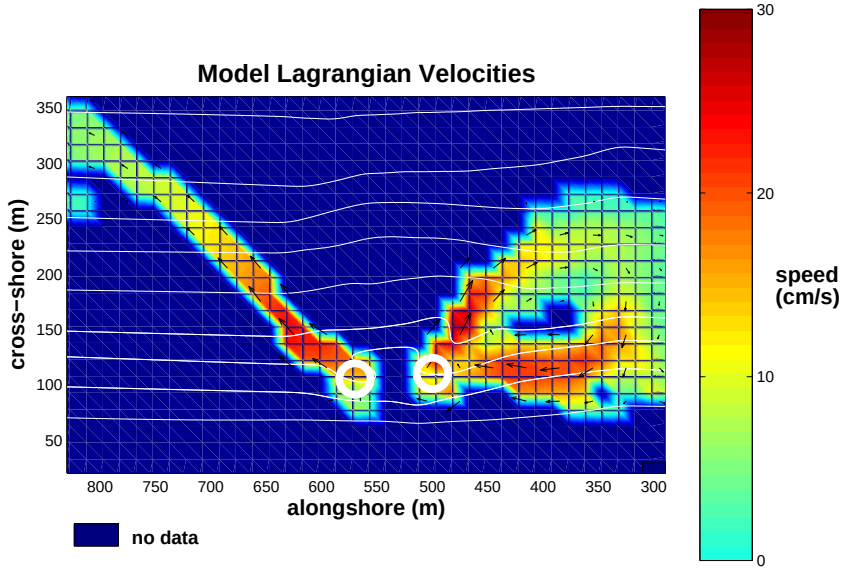

Figure 5: Numerical model drifter velocities for 29 July, 2003. Compare with Fig. 4.

ADDITION to Guza R/CZ-166 Project Questionnaire filed September, 2002

PUBLICATIONS

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